INNOMOTICS

Operating Instructions | Edition 10/2025

Innomotics Moves!

Motor Drive Systems MD

Motor Mounted Line Permanent Magnet IE5 1UZ
Shaft height 71, 90, 132

innomotics.com/low-voltage-motors

Contents

1. General information

If you have any technical questions or require additional information,
please contact technical support:
https://www.innomotics.com/service

1.1 Information about documentation

The following information explains how to navigate through the documentation.

Read this manual carefully in its entirety. It contains important information for operating the Motor Mounted Line Permanent Magnet IE5 1UZ.

We assume no liability for any damage resulting from non-observance of this manual.

This manual is an integral part of the product and applies exclusively to the Motor Mounted Line Permanent Magnet IE5 1UZ

Provide the operator of the system with this manual so it is available when needed.

1.1.1 Other applicable documents

The Product Configurator supports you when configuring the optimum drive technology products for a number of applications – starting with gearboxes, motors, converters as well
as the associated options and components all the way through to controls, software licenses and connection systems.
The Product Configurator can be used on the internet without requiring any installation.
The Product Configurator can be found at the following address: configurator.innomotics.com

1.2 Notes in this manual

1.2.1 Warnings

The warnings refer to life-threatening dangers. Serious injuries possibly resulting in death may occur.

Each warning consists of the following elements:

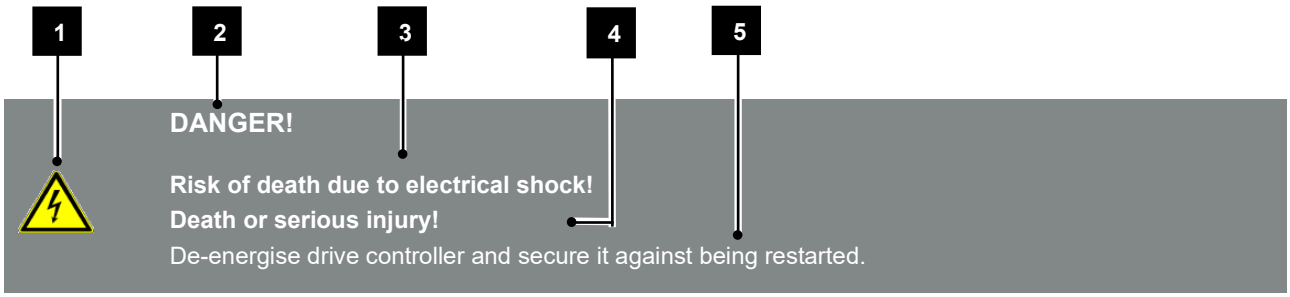


Fig. 1: Structure of the warnings

1 Warning symbol

2 Signal word

3 Type of danger and its source

4 Possible consequence(s) of failure to comply

5 Corrective actions

1.2.2 Warning symbols used

Symbol	Meaning
	Danger
	Danger due to electrical shock and discharge
	Danger due to electromagnetic fields

1.2.3 Signal words

Signal words are used to identify the severity of the danger.

DANGER

Indicates a direct hazard with a high level of risk, which, if not avoided, will result in death or serious injury.

WARNING

Indicates a hazard with a moderate level of risk, which, if not avoided, will result in death or serious injury.

CAUTION

Indicates a hazard with a low level of risk, which, if not avoided, may result in minor or slight injury or property damage.

1.2.4 Information notes

Information notes contain important instructions for the installation and problem-free operation of the drive controller. These must be followed at all times. The information notes also point out that failure to observe the instructions may result in damage to property or financial damages.

IMPORTANT INFORMATION

The drive controller may only be assembled, operated, maintained and installed by trained and qualified staff.

Fig. 2: Example of an information note

Symbols within the information notes

Symbol	Meaning
	Important information
	Damage to property possible

Other notes

Symbol	Meaning
	INFORMATION
	Enlarged view

1.3 Symbols used in this manual

Symbol	Meaning
1., 1., 3. …	Consecutive steps in a handling instruction
	Effect of a handling instruction
✓	Final result of a handling instruction
■	List

Fig. 3: Symbols and icons used

Abbreviations used

Abbreviation	Explanation
Tab.	Table
Fig.	Figure
It.	Item
Ch.	Chapter

1.4 Label on the drive system

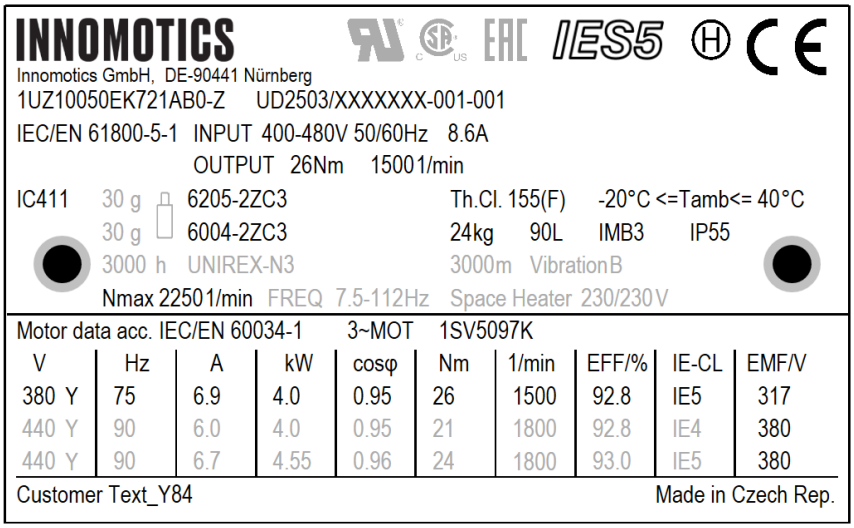


Fig. 4: Label of the MOTOR DRIVE SYSTEMS MD

The label is divided into two sections:

1. Upper part: Drive System information
2. Lower part: Permanent magnet information

1.5 Labels on the drive controller

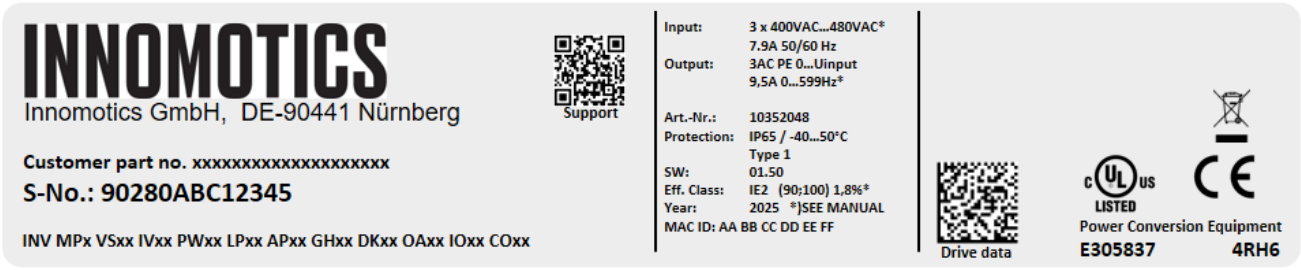


Fig. 4: Label on the drive controller

Input: See chapter *Technical data*
Output: Max. frequency of the drive controller is 599Hz. Software of the MOTOR DRIVE SYSTEMS MD limit it to the max. possible value of the whole the drive system visible on the drive system rating plate
Eff. Class: See chapter *Table of power loss*

Signs and labels are affixed to the drive controller. These may not be altered or removed.

Symbol	Meaning	Symbol	Meaning
	Danger due to electrical shock and discharge		Additional earth connection
	Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down		Observe and read operating manual
	Device may not be disposed of with household waste. Observe the local application of disposal requirements		

1.6 Qualified staff

All work at the motor drive system must be carried out by qualified personnel only. For the purpose of this documentation, qualified personnel is taken to mean people who fulfill the following requirements:
– Through appropriate training and experience, they are able to recognize and avoid risks and potential dangers in their particular field of activity.
– They have been instructed to carry out work on the machine by the appropriate person responsible.

1.7 Important product information

This drive system may not be operated in areas where there is a danger of explosion!

Repairs may only be performed by authorised repair bodies.
Independent and unauthorised intervention may result in death, injury or property damage.
The warranty provided by INNOMOTICS will be invalidated in such cases.

IMPORTANT INFORMATION

- External mechanical loads on the housing are not permitted!
- Using drive controllers in equipment that is not fixed is considered as an exceptional environmental condition and is only permitted if allowed by the standards and guidelines applicable on site.

1.8 Electromagnetic compatibility

This machine is designed in accordance with IEC/EN 60034, and when used as specified it satisfies the re-quirements of European Directive 2014/30/EU on Electromagnetic Compatibility.

1.9 Safe handling

Workplace safety depends on the attentiveness, care, and common sense of the personnel who install, operate, and maintain the machine. In addition to the safety measures listed, caution is always required when you are near the machine. Always pay attention to your safety.

Also observe the following to prevent accidents:
– General safety regulations applicable in the country where the machine is deployed.
– Manufacturer-specific and application-specific regulations
– Special agreements made with the operator
– Separate safety instructions supplied with the machine
– Safety symbols and instructions on the machine

1.10 Responsibility

As a basic principle, electronic devices are not fail-safe. The operator and/or the contractor setting up the machine or system is responsible for ensuring that the drive switches to a safe state if the device fails.

The “Electrical equipment of machines” section in DIN EN 60204-1; VDE 0113-1, “Safety of machinery” describes the safety requirements for electrical control units. These are provided for the safety of people and machines and must be observed in order to retain the functional capability of the machine or system.

An emergency stop feature does not necessarily result in the voltage supply to the drive being switched off. To avoid dangerous situations, it may be useful for individual drives to remain operational or for specific safety procedures to be initiated.
The effectiveness of emergency stop measures is evaluated by means of a risk assessment for the machine or system and its electrical equipment, and is determined by selecting a circuit category according to DIN EN 13849 “Safety of machinery – Safety-related parts of control systems”.

1.11 CE marking

The drive system fulfil the basic requirements of the EU Declaration of Conformity

1.12 Safety instructions

The following warnings, precautionary measures and information are provided for your safety and serve to prevent damage to the drive system and the components connected to it.
This chapter contains warnings and information that are universally applicable when handling the drive system. They are split into General information, Transport & storage and Disassembly & disposal.

Specific warnings and comments that apply to specific activities can be found at the start of the appropriate chapters and are repeated or added to at various critical points in these chapters.

Please read this information carefully as it is provided for your personal safety and will also prolong the life of the drive controller and connected devices.

1.12.1 General information

IMPORTANT INFORMATION

- Carefully read this operating manual and the warning signs affixed to the drive controller before installation and commissioning. Make sure that all warning signs on the drive controller are legible; replace any missing or damaged signs.

  They contain important information on the installation and operation of the drive controller.

  INNOMOTICS GmbH assumes no liability for damages arising from the non-observance of this operating manual.

  This operating manual is an integral part of the product.

  Keep the operating manual close to the drive controller so it is easily accessible to all users.
- The drive controller can only be operated safely if the required environmental conditions listed in the “Suitable environmental conditions” chapter are met.

1.12.2 5 safety rules

To ensure your own personal safety as well as to avoid material damage, always comply with the safety-rel-

evant instructions when carrying out any work. Also carefully comply with the 5 safety rules according to EN 50110-1 "Working in a no-voltage state" in the specified sequence.
1. Disconnect the system.
Also disconnect the auxiliary circuits, for example, anti-condensation heating.
2. Secure against reconnection.
3. Verify absence of operating voltage.
4. Ground and short-circuit.
5. Provide protection against adjacent live parts.
To energize the system, apply the measures in reverse order

1.12.3 Danger as a result of stationary parts under voltage (live parts)

Live parts represent a hazard. Touch protection against active (live) parts is no longer guaranteed if covers are removed. The minimum clearance and creepage distances may be violated when coming close to live parts. Touching or coming close to them can result in death, serious injury or material damage.
– Ensure that all live parts are suitably covered.
– Switch off and disconnect the machine first if you want to remove covers.

1.12.4 Risk of injury due to rotating parts

Rotating parts are dangerous. Touch protection against rotating parts is no longer guaranteed if covers are removed. Touching rotating parts can result in death, serious injury or material damage.
– Ensure that all rotating parts are reliably covered.
– Switch off and disconnect the machine first if you want to remove covers.
– Only remove covers when the rotating parts have come to a complete standstill.

1.12.5 Health hazard due to chemical substances

Chemical substances required for the setup, operation and maintenance of machines can present a health risk.
– Observe the product information provided by the manufacturer.

1.12.6 Flammable substances hazard

Chemical substances required for the setup, operation and maintenance
These substances can ignite if handled incorrectly. They can cause burns
– Observe the product information provided by the manufacturer.

1.12.7 Noise emissions

During operation, the machine's noise emission levels can exceed those permitted at the workplace, which can cause hearing damage.
– Ensure that nobody is in the area of increased noise emissions during machine operation.
– Take steps to reduce noise so that the machine can be operated safely within your system. The following measures may help to reduce noise.
▪Covers
▪Noise insulation
▪Hearing protection measures

1.12.8 Prevention of hearing damage

If the permissible sound pressure level is exceeded phase motors at their rated power.
The permissible sound pressure level is 70 dB (A).

1.12.9 Danger due to magnetic fields for permanent magnet machines

On machines with permanent magnets, the magnetic field is guided in an assembled state in the magnetic circuit of the machine. This means that no magnetic fields, which may be to your health, are detectable outside the machine.

DANGER!
Strong magnetic field when the machine is open

A strong magnetic field is always present inside the machine. If the housing is open, e.g. when maintenance openings are open or when working inside the machine, magnetic objects can be suddenly attracted by this magnetic field. This can result in death, serious injury or material damage.
– Working in the vicinity of the rotor is only permitted in exceptional circumstances. Establish clear and unambiguous access rules in accordance with the magnetic fields prevailing in the workplace. Clearly mark the boundaries of the areas where standing is permitted.
– People who need to use electronic or magnetic medical aids such as pacemakers, hearing aids, implants or similar devices are at particularly high risk. Such persons must undergo an industrial medicine assessment.
– Comply with the following measures.
Personal protective measures
Ensure that under no circumstances you wear or carry any of the following objects, and that you keep these away from the machine:
▪All kinds of magnetic metal parts such as, keys, glasses, tools, knives, scissors, tape measures or similar
▪Magnetic jewelry such as rings, chains, needles, watches, etc.
▪Electronic devices and data carriers such as service cards, check cards, credit cards, calculators, cell phones, etc.
▪Wallets or other iron-containing objects
▪Electrically conductive foreign bodies
– Do not use any magnetic tools or lifting devices.
– Wear only occupational safety items without magnetic metal parts, e.g. occupational safety shoes with non-magnetic protective caps and soles.
– Keep your shoes and clothing free from chips and waste containing iron.
– Exercise caution when installing accessories. Ensure that no parts fall into the inside of the machine.
– Do not perform any cutting at the machine, e.g. manufacturing threaded holes. Any exceptions require written approval from the manufacturer.

1.12.10 Electromagnetic fields when operating electrical power equipment

Electrical power equipment generate electromagnetic fields during operation. Potentially lethal malfunctions can occur in medical implants, e.g. pacemakers, in the vicinity of electrical power equipment. Data may be lost on magnetic or electronic data carriers.
– Protect the personnel working in the plant by taking appropriate measures, such as erecting identifying markings, safety barriers and warning signs and giving safety talks.
– Comply with all of the national health and safety regulations.
– It is forbidden for people with pacemakers to be close to the machine.
– Do not carry any magnetic or electronic data media.

1.12.11 Cybersecurity information

Innomotics provides products and solutions with industrial cybersecurity functions that support the secure operation of plants, systems, machines and networks.
In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial cybersecurity concept. Innomotics' products and solutions constitute one element of such a concept.
Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.
For additional information on industrial cybersecurity measures that may be implemented, please visit:

→ https://innomotics.com/cybersecurity (https://www.innomotics.com/cybersecurity)
Innomotics' products and solutions undergo continuous development to make them more secure. Innomotics strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply latest updates may increase customer's exposure to cyber threats.

IMPORTANT INFORMATION

- Unsafe operating states resulting from software manipulation Software manipulations, e.g. viruses, Trojans, or worms, can cause unsafe operating states in your system that may lead to death, serious injury, and property damage. • Keep the software up to date. • Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine. • Make sure that you include all installed products into the holistic industrial security concept. • Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners. • On completion of commissioning, check all security-related settings.

1.12.12 Residual risks of motor drive systems

When assessing the machine- or system-related risk in accordance with the respective local regulations (e.g., EC Machinery Directive), the machine manufacturer or system installer must take into account the following residual risks emanating from the control and drive components of a drive system:
1. Unintentional movements of driven machine or system components during commissioning, operation, maintenance, and repairs caused by, for example, – Hardware and/or software errors in the sensors, control system, actuators, and cables and connections – Response times of the control system and of the drive – Operation and/or environmental conditions outside the specification – Condensation/conductive contamination – Parameterization, programming, cabling, and installation errors – Use of wireless devices/mobile phones in the immediate vicinity of electronic components – External influences/damage – X-ray, ionizing radiation and cosmic radiation

2. Unusually high temperatures, including open flames, as well as emissions of light, noise, particles, gases, etc., can occur inside and outside the components under fault conditions caused by, for example: – Component failure – Software errors – Operation and/or environmental conditions outside the specification – External influences/damage

3. Hazardous shock voltages caused by, for example: – Component failure – Influence during electrostatic charging – Induction of voltages in moving motors – Operation and/or environmental conditions outside the specification – Condensation/conductive contamination – External influences/damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc., if they are too close

5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly

6. Influence of network-connected communication systems, e.g. ripple-control transmitters or data communication via the network For more information about the residual risks of the drive system components, see the relevant sections in the technical user documentation.

1.12.13 Restriction for flying restart function

The flying restart function is used to restart the drive after it is shut off (e.g. due to a fault or loss of infeed power) and spinning down in torque-free operation before coming to a standstill. It works by detecting the current actual frequency the motor is spinning at and synchronizing the output frequency to this current actual frequency.
In the current firmware version 01.50 there is a restriction, which limits this function to only work when the drive has spun down to 50% of the nominal speed of the drive. Trying to restart the drive above the 50% of nominal speed leads to an overvoltage fault on the DC-Bus. This will not damage the drive but leads to a fault and requires an additional acknowledgement of the DC-Bus fault.
Due to this behaviour it is required to wait to restart the drive until it has drifted below 50% of nominal speed after an fault switch off. This wait time has to be determined by the operator, as it dependent on the moment of inertia of the mass connected to the drive system.

DANGER!

Risk of death due to electrical shock!
Death or serious injury!
De-energise drive controller and secure it against being restarted.

DANGER!

Risk of death due to electrical shock!
Death or serious injury!
Always ground the device in accordance with DIN EN 61140; VDE 0140, NEC and other relevant standards.
The drive controller must be grounded with the motor according to relevant regulations. Non-compliance may result in death or serious injury.
If spring elements are not used when assembling the adapter plate, there must be an extra connection between the motor and drive controller to produce a correct protective conductor connection.

DANGER!

Risk of death due to fire or electrical shock!
Death or serious injury!
Always use the drive controller as intended.
Do not modify the drive controller.
Only use spare parts and accessories sold or recommended by the manufacturer.
During assembly, ensure a sufficient distance from neighbouring parts.

DANGER!

Risk of death due to fire or electrical shock!
Death or serious injury!
Defects such as damage to components, overvoltages, or loose parts, as well as exceptional operating statuses, can cause a failure within the enclosure. This can result in an internal electric arc. If an electric arc occurs and people are nearby, this could lead to death, serious physical injury, and damage to property.

- Ensure that only qualified personnel perform work on the drive.
- Observe the safety and operating instructions in this documentation and on labels at the drive for all work on the drive.

CAUTION!

Risk of burns from hot surfaces!
Serious burns to the skin from hot surfaces!
Allow the drive system cooling elements to cool sufficiently.

1.12.14 Transport & storage

DAMAGE TO PROPERTY POSSIBLE

- Risk of damage to drive system!
- Risk of damage to drive system from improper transport, storage, installation and assembly!
- In general, transport the drive system correctly in its original packaging on a pallet.
- Always store the drive controller properly.
- Only allow qualified staff to undertake installation and assembly.

DAMAGE TO PROPERTY POSSIBLE

The drive system can be damaged if you use it or store it unprotected outdoors.

- Protect the motor against intensive solar radiation, rain, snow, ice and dust. Use a superstructure or additional cover, for example.
- If required, contact the Service center and/or technically coordinate outdoor use.

1.12.15 Information about commissioning

DANGER!

Risk of death due to electrical shock!
Death or serious injury!
De-energise drive controller and secure it against being restarted.
The following terminals may lead to dangerous currents even when the motor is not running:

- Supply terminals X1: L1, L2, L3
- Motor connection terminals X2: U, V, W
- Connecting terminals X6, X7: Relay contacts for relays 1 and 2

IMPORTANT INFORMATION

- If different voltages are used (e.g. +24 V/230 V), crossing cable runs are not permitted under any circumstances. The operator must also ensure compliance with the applicable regulations (e.g. double or reinforced insulation acc. to DIN EN 61800-5-1).
- The drive controller contains components susceptible to electrical discharge.
  These may be destroyed through improper handling. Therefore, precautionary measures against electrostatic charges must be taken when work is performed on these components.

IMPORTANT INFORMATION

- Only use mains connections with hardwiring.
- Ground the drive controller in accordance with DIN EN 61140; VDE 0140-1.
- The MOTOR DRIVE SYSTEMS MD may have touch currents of > 3.5 mA.
  In accordance with DIN EN 61800-5-1, an extra protective grounding conductor of the same cross-section as the original protective grounding conductor should therefore be fitted. A second protective grounding conductor can be connected under the mains supply (position marked with a ground symbol) on the outside of the device.
  A M6 x 12 screw (4.0 Nm torque)
  suitable for this connection is provided with the adapter plate.
- If three-phase frequency converters are used, the use of conventional type A FI protection switches RCDs (residual current-operated protective devices) are not permissible as protection against direct or indirect contact.
  According to DIN VDE 0160 and EN 50178, the FI protection switch must be universal current sensitive (RCD type B).

  Wir empfehlen aufgrund der Auslösecharakteristik einen RCD Typ B SK einzusetzen!

1.12.16 Instructions concerning operation

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

De-energise the drive controller, determine that it is voltage-free and secure it against being restarted.

DANGER!

Risk of death due to revolving mechanical parts!

Death or serious injury!

De-energise drive controller and secure it against being restarted.

IMPORTANT INFORMATION

Observe the following instructions during operation:

- The drive controller runs at high voltages.
- When electrical devices are operated, some of their parts are always subject to dangerous voltage.
- Emergency stop equipment according to DIN EN 60204-1; VDE 0113-1:2007-06 must function in all the control device's operating modes. Resetting the emergency stop equipment may not result in uncontrolled or undefined restarting.
- In order to ensure safe disconnection from the mains, the mains cable has to be fully disconnected from the drive controller in a synchronous manner.

■ Für BG C und BG D (5,5 kW bis 30 kW) gilt es, zwischen aufeinander folgenden Netzzuschaltungen mindestens 1 bis 2 min Pause einzuhalen!

- A pause of at least 3 sec. must be observed between consecutive connections to the grid for devices with three-phase feed-in in sizes A - B (0.55 to 5.5 kW).
- Certain parameter settings may result in the drive controller restarting automatically after the supply voltage has failed.

DAMAGE TO PROPERTY POSSIBLE

If the information is not observed, the drive controller could be damaged and destroyed during subsequent commissioning.

Observe the following instructions during operation:

- The motor parameters, especially the I^2t settings, have to be configured properly to provide proper motor overload protection.
- The drive controller has internal motor overload protection. See parameters 33.010 and 33.011.
  I^2t is ON by default. Motor overload protection can also be ensured via an external PTC.
- The drive controller must not be used as "Emergency stop equipment"
  (see DIN EN 60204-1; VDE 0113-1:2007-06).

1.12.17 Maintenance and inspection

The drive controllers may only be maintained and inspected by electricians with recognised training. Unless explicitly described in this operating manual, changes to hardware and software may only be undertaken by INNOMOTICS experts or persons authorised by INNOMOTICS.

Cleaning the drive controllers

Drive controllers are maintenance-free if operated as intended. If the air is dusty, the cooling ribs of the motor and drive controller have to be cleaned regularly. If devices are fitted with integrated fans, we would recommend cleaning with compressed air.

Measurement of insulation resistanceon control part

An insulation test on the control card's input terminals is not permitted.

Measurement of insulation resistance on power stack

The power stack of an MOTOR DRIVE SYSTEMS MD is tested with 2.2 kV in the course of series testing.

Should the insulation resistance have to be measured during a system test, this can be done under the following conditions:

- an insulation test can be undertaken for the power stack alone,
- to avoid excessively high voltages, all the MOTOR DRIVE SYSTEMS MD's connection cables must be disconnected before testing.
- a 500 V DC insulation tester should be used.

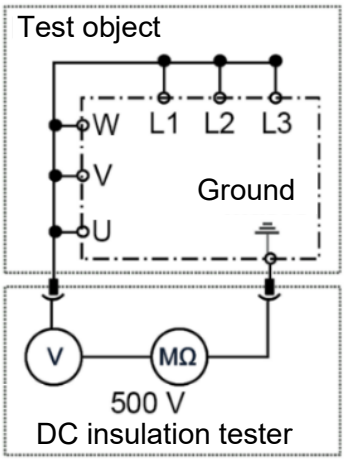


Fig. 5: Insulation measurement on the power stack

Pressure test on an motor drive system

IMPORTANT INFORMATION

A pressure test is not permitted on a standard MOTOR DRIVE SYSTEMS MD.

1.12.18 Repairs

DAMAGE TO PROPERTY POSSIBLE

If the information is not observed, the drive controller could be damaged and destroyed during subsequent commissioning.

- Repairs to the drive controller may only be performed by the INNOMOTICS Service department.

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

De-energise the drive controller, determine that it is voltage-free and secure it against being restarted.

2 min

Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down.

1.12.19 ITsecurity

Important Information

- The rotating electrical drive system of this series are used as industrial drives. The drive system is designed to be installed in an industrial area with access control to avoid maturity use.
- Access to the MOTOR DRIVE SYSTEMS MD, device configuration, including firmware update and parameterization must be restricted to authorized personnel only.
- Service devices (e.g., laptops) may only be used by authorized personnel and must be checked for malware.
- Laptop access to the MOTOR DRIVE SYSTEMS MD uses a point-to-point Ethernet connection. Therefore, the laptop should not be connected to any network.
- Machines or systems should be disconnected from higher-level networks unless absolutely necessary.

2. Overview of the drive system

2.1 Drive controller model description

Sizes A - B

	MOTOR DRIVE SYSTEMS MD type	A	B
INV MP	Inverter, motor-integrated, MP	x	x

	Size	A	B
A	Size A	x	
B	Size B		x

Features:

Model / sector (new feature to differentiate between the sub-variants)		A	B
VS01	Performance	x	x

	Supply voltage	A	B
IV01	400 V	x	x

	Power rating drive controller	A	B
PW03		x	
PW04		x	
PW05		x	
PW06		x	
PW07			x
PW08			x
PW09			x

	Power-conducting plate	A	B
LP01	Without brake chopper	x	x
LP02	With brake chopper	x	x

	Application PCB	A	B
AP01	Default	x	x
AP03	Basic	x	x
AP05	Standard + CANopen	x	x
AP06	Standard + EtherCAT	x	x
AP09	Standard + Profinet	x	x
AP14	Standard + Sercos III	x	x
AP16	Standard + Profibus COMX	x	x

	Housing type	A	B
GH01	Passive cooling, potentiometer	x	x
GH02	Passive cooling	x	x
GH40	Passive cooling, HARTING, potentiometer	x	x
GH41	Passive cooling, HARTING	x	x
GH42	Passive cooling, QUICKON, potentiometer	x	x
GH43	Passive cooling, QUICKON	x	x

	Cover type	A	B
DK01	Without foil keypad	x	x
DK02	Foil keypad, potentiometer	x	x
DK05	MMI option	x	x
DK11	Main switch	x	x
DK12	Main switch, foil + potentiometer	x	x
DK15	Main switch, MMI option	x	x

	Optional module	A	B
OA00	No option module	x	x
OA10	Main switch	x	x

	Type	A	B
CO23	INNOMOTICS drive controller		

INV MP	x	V S01	IVxx	PWxx	LPxx	APxx	GHxx	DKxx	OAxx	COxx

Fehler! Ver-

Sizes C - D

													C	D
	INNOMOTICS MD drive controller type												C	D
INV MP	Inverter, motor-integrated, MP												x	x
		Size											C	D
	C	Size C											x	
	D	Size D												x
Features:														
		Model / sector (new feature to differentiate between the sub-variants)											C	D
		VS01	Performance										x	x
				Supply voltage									C	D
			IV01	400 V									x	x
					Power rating drive controller								C	D
				PW10									x	
				PW12										x
				PW13										x
				PW14										x
						Power-conducting plate							C	D
					LP01	Without brake chopper							x	x
							Application PCB						C	D
						AP01	Default						x	x
						AP05	Standard + CANopen						x	x
						AP06	Standard + EtherCAT						x	x
						AP09	Standard + Profinet						x	x
						AP16	Standard + Profibus COMX						x	x
						AP17	Standard + Profinet + Sercos						x	x
								Housing type					C	D
							GH01	Passive cooling, potentiometer					x	
							GH02	Passive cooling					x	
							GH06	Active cooling, potentiometer					x	x
							GH09	Active cooling					x	x
							GH42	Passive cooling, QUICKON, potentiometer					x	
							GH43	Passive cooling, QUICKON					x	
									Cover type				C	D
								DK01	Without foil keypad				x	x
								DK05	MMI option				x	x
								DK11	Main switch				x	x
								DK15	Main switch, MMI option				x	x
										Optional module			C	D
									OA00	No option module			x	x
									OA10	Main switch			x	x
										Type			C	D
										CO23	INNOMOTICS drive controller		x	x
INV MP	x	V S01	IVxx	PWxx	LPxx	APxx	GHxx	DKxx	OAxx	COxx				

3. Installation and assembly

3.1 Safety instructions for installation

DANGER!

Risk of Injury and material damage caused by inappropriate fastening material!

Serious injury!

If screws of an incorrect property class have been selected or if they have been fastened to an incorrect tightening torque, they may break or become loose. This will cause the machine to move, which could damage the bearings. The rotor could smash into the machine enclosure and machine parts could be flung

out of place. This can result in death, serious injury or material damage.

- Comply with the required property classes for screwed connections.
- Tighten the screwed connections to the specified tightening torques.

DANGER!

Risk of Injury and material damage caused by incorrect machine alignment!

Serious injury!

If the machine has not been properly aligned, this will mean the fastening parts are subjected to stress/distortion.

Screws may become loose or break, the machine will move, machine parts could be flung out of place. This can result in death, serious injury or material damage.

- Carefully align the machine to the driven machine.

DANGER!

Risk of death due to revolving mechanical parts!

Death or serious injury!

De-energise the drive controller, determine that it is voltage-free and secure it against being restarted.

Only allow appropriately qualified staff to install the drive controller.

Only use staff who are trained in mounting, installation, commissioning and handling.

Always ground the device in accordance with DIN EN 61140; VDE 0140, NEC and other relevant standards.

The drive controller must be grounded with the motor according to relevant regulations.
Non-compliance may result in death or serious injury.

If spring elements are not used when assembling the adapter plate, there must be an extra connection between the motor and drive controller to produce a correct protective conductor connection

Unused open cable ends in the motor connection box must be insulated.

Use suitable line circuit breakers with the prescribed nominal current between the mains and drive controller.

Mains connections must be hardwired.

DAMAGE TO PROPERTY POSSIBLE

Mounting parts such as temperature sensors or speed sensors are attached to the machine and could be ripped off or destroyed because of improper handling. This could lead to machine malfunctions, extending even to total loss of the machine.

- Use suitable steps when carrying out installation work on the machine.

Do not stand on cables or attachments during installation. Do not use attachments as steps.

3.2 Recommended preliminary fuses / line protection

MOTOR DRIVE SYSTEMS MD	Size A 3 x 400 V AC		Size B 3 x 400 V AC	
Rated motor speed	up to 1.5 kW	2.2 kW LD	up to 4 kW	5.5 kW LD
Line current	3.3 A	3.9 A	7.9 A	9.3 A
Line current (overload 60 s)	4.95 A	4.3 A	11.85 A	10.2 A
Line current (overload 3 s)	6.6 A	5.85 A	15.8 A	14 A
Line circuit breaker - recommendation	C 10		C 16	
	Characteristics C = line circuit breaker tripping between 6 – 10 times In			
	The cross-section of the supply line must be designed according to the transfer category and maximum permitted current. The contractor commissioning the device must ensure protection for the power line.			

MOTOR DRIVE SYSTEMS MD	Size C 3 x 400 V AC		Size D 3 x 400 V AC	
Rated motor speed	up to 7.5 kW	11 kW LD	up to 22 kW	30 kW LD
Line current	13.8 A	18.3 A	38.2 A	49.8 A
Line current (overload 60 s)	20.7 A	20.13 A	57.3 A	54.8 A
Line current (overload 3 s)	27.6 A	27.5 A	76.4 A	74.7 A
Line circuit breaker - recommendation	C 32		C 80	
	Characteristics C = line circuit breaker tripping between 6 – 10 times In			
	The cross-section of the supply line must be designed according to the transfer category and maximum permitted current. The contractor commissioning the device must ensure protection for the power line.			

3.3 Installation requirements

3.3.1 Suitable ambient conditions

Conditions	Values
Altitude of the installation location:	up to 1000 m above sea level / over 1000 m with reduced performance
Ambient temperature:	- 20 °C to + 40 °C (different ambient temperatures may be possible in individual cases),
Relative air humidity	≤ 55 %, condensation not permitted.
Resistance to vibration and shock:	DIN EN 60721-3-3 SH71, SH90 3M3 (5 – 200 Hz, 0,5g) SH132 3M2 (5 – 200 Hz, 0,5g)
Electromagnetic compatibility:	Immune to interference acc. to DIN EN 61800-3

Tab. 1: Ambient conditions

- Ensure that the housing type (protection class) is suitable for the operating environment:

DAMAGE TO PROPERTY POSSIBLE

Failure to comply with the information may result in damage to the drive controller!

When attaching a cover with integrated foil keypad, be absolutely sure that the flat ribbon cable is not pinched.

Although the drive controller can, in principle, be painted later on, the user must nevertheless check the material compatibility of the intended paint.

DAMAGE TO PROPERTY POSSIBLE

To avoid material damage, before commissioning, check whether the correct direction of rotation of the machine has been set on the customer side, e.g. by de-coupling from the driven load.

DAMAGE TO PROPERTY POSSIBLE

The motor components get very hot during operation. High temperatures can damage parts mounted by customers, such as cables manufactured out of materials that are not heat resistant.

- Temperature-sensitive parts must not come into contact with or be attached to components mounted on the machine.
- Only use heat-resistant mounting parts. The connecting cables and cable entries must be suitable for the particular application.

DAMAGE TO PROPERTY POSSIBLE

Failure to comply with this requirement may eventually result in the loss of the protection class (particularly in respect to seals and fibre-optic elements).

The drive controller of the MOTOR DRIVE SYSTEMS MD is supplied in RAL 9005 (black), the motor in RAL 7030 as standard.

Disassembling the circuit boards (even for the purpose of painting the housing sections) renders the warranty void!

Mounting points and sealing surfaces must be kept free of paint for purposes of EMC and grounding!

3.3.2 Suitable installation location for the motor-integrated drive controller

Make sure that the motor with motor-integrated drive controller is mounted and operated indoors and only in the orientations shown in the following image.

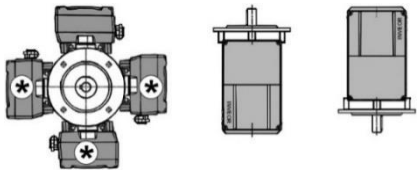
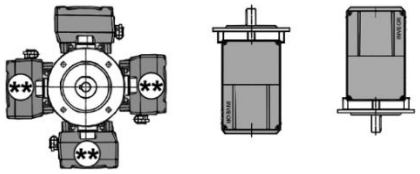
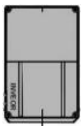
Size, A, B, C Motor installation		**Vibration and shock resistance, standard variants:** See technical data chapter **8.1.1**. Release with standard adapter plate, material number: see order catalog. ***A separate evaluation is necessary for applications with high vibrations, such as piston, screw, claw pumps, and compressors. Resonant frequencies caused by installation or application conditions may lead to damage to the devices when mounted laterally or beneath the motor.***
Size D Motor installation		**Vibration and shock resistance, standard variants:** See technical data chapter **8.1.1**. Release with standard adapter plate, material number: see order catalog ****Release only with HD adapter plate (material number: 10145362).** ***Only after approval of the present vibration profile of the application.*** ***A separate evaluation is necessary for applications with high vibrations, such as piston, screw, claw pumps, and compressors.*** ***Resonant frequencies caused by installation or application conditions may lead to damage to the devices when mounted laterally or beneath the motor.***
Size, A, B, C, D Wall installation		**Vibration and shock resistance, standard variants:** See technical data chapter **8.1.1**. Release with standard adapter plate, material number: see order catalog.

Fig. 6: Motor installation location/permitted alignments

IMPORTANT INFORMATION

Ensure that no condensate from the motor can enter the drive controller during and after installation.

3.3.3 Outdoor area

IMPORTANT INFORMATION

In the event of a deviation from 3.3.2 by installing the drive controller outdoors, the following must be observed to ensure compliance with the IP protection class and humidity/condensation limits specified in the data sheet.
The drive controller must be protected from direct sunlight and condensation. Suitable protection (e.g. enclosure) must be installed.

3.3.4 Distances

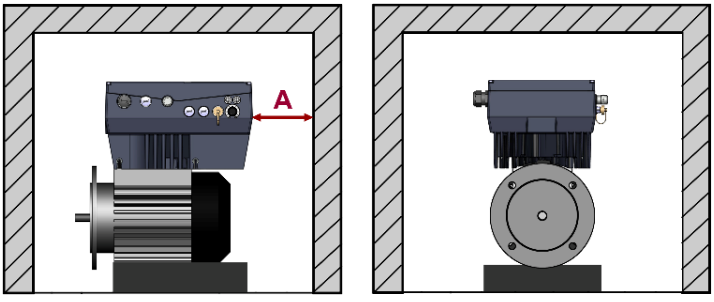


Abb. 7: Distances during assembly

In general, it is important to ensure that there is sufficient convection/cooling air flow around the device.
The maximum ambient temperature indicated in the technical data sheet must not be exceeded, a minimum distance of around the drive system must be respected.

Motor shaft height	Drive controller size	Distance A [mm]
71/90	A/B	20
132	C/D	50

3.3.5 Rotor

This series of machines involves low-voltage synchronous motors with permanent magnet rotors.

3.4 Installation of the drive system

Comply with the following when carrying out any work on the machine:

- Comply with the general safety instructions.
- Comply with the applicable national and sector-specific regulations.
- When using the motor within the European Union, comply with the specifications laid down in EN 50110-1 regarding safe operation of electrical equipment.

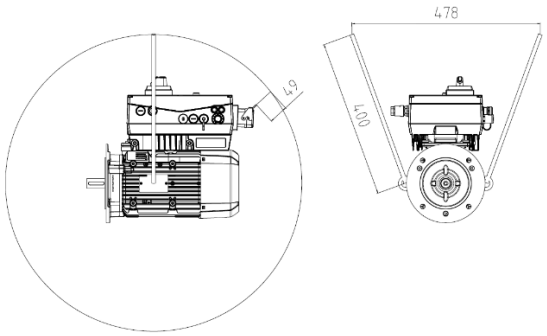
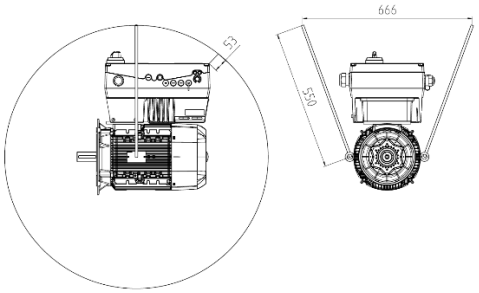
3.4.1 Installing the machine

Preparing the assembly area

1. Prepare a suitable assembly area (e.g. assembly stands). Make sure that the assembly area has sufficient clearance from the floor for the DE shaft end. The necessary data is provided in the machine dimension drawing.
2. Refer to the shipping documents to check that all motor components are available for assembly.

Lift the machine to where it will be mounted and position it

- Consider the mass on the drive system for correct lifting:
  - Below 25 kg, no crane is needed,
  - above 25 kg a crane is recommended
- Use all the eyebolts provided and hoisting straps according to EN 1492-1 and/or lashing straps according to EN 12195-2 to stabilize the position:

SH90	SH132
	

IMPORTANT INFORMATION

For drive systems > 25kg the system rating plate is located on the drive controller instead of the motor housing.

- Prevent foreign bodies from falling into the fan cover. For vertical machine installation with the shaft end facing downwards, attach a protective canopy.
- If the shaft extension is facing upwards, the user must prevent liquid from moving along the shaft and entering the motor.
- Clean bare metal surfaces with anti-corrosion agent using mineral spirits to ensure proper installation and/or machine mounting.
- Do not obstruct the ventilation. Do not draw in the hot discharged air directly – also from adjacent equipment. Avoid exposing them to direct, intense solar radiation, rain, snow, ice, or also dust for extended periods.
- Attach a covering structure or an additional cover when using or storing outdoors.
- Do not exceed the permissible axial and radial forces.
- When clouds or layers of dust are present, strictly maintain the temperature limits according to EN/IEC 60079-14.

Machines with type of construction IM B15, IM B9, IM V8 and IM V9

Types of construction without bearings on the drive side

These machines do not have their own bearing system for the machine shaft at the drive end (DE). The machine shaft is accepted by the (hollow) shaft or coupling of the system or driven machine.

- Using the centering edge, the machine is aligned with respect to enclosures, flanges or driven machines.
- Note that the temperature of the motor and motor shaft increases during operation. The thermal expansion of the machine shaft must be compensated by the customer by applying suitable measures. Use the spring washers provided to locate the NDE bearing without any play.

DAMAGE TO PROPERTY POSSIBLE

Material damage can occur if the following notes are not carefully observed:

- The IM B3 bearing shield with integrated distance ring mounted at the drive end (DE) is only used transport lock. A warning label is attached to this bearing shield.
- The spacer ring is not a roller bearing.
- Remove the bearing shield and the spacer ring.
- Remove the transport lock before commissioning.

Foot mounting

IMPORTANT INFORMATION

Only authorized retrofit partners must be employed to relocate the bolted-on mounting feet at the machine enclosure.

After attaching the mounting feet, you must note the following in order to avoid stressing and deforming the machine.

- Ensure that the foot mounting surfaces are aligned in one plane and are parallel to the machine shaft.
- Post-machine the foot mounting surfaces or use thin shims, for example.
- Professionally touch up damaged painted surfaces.

3.4.2 Aligning and fixing the machine

Observe the following when aligning and mounting:

- Ensure a flat and uniform contact surface for foot and flange mounting.
- When mounting on the wall, support the machine from below, e.g. using a bracket, or bolt it.
- Precisely align the machine when couplings are used.
- Ensure that the mounting surfaces are clean and free of any dirt.
- Remove any anti-corrosion protection using white spirit.
- Avoid installation-related resonances with the rotating frequency and twice the line frequency.
- Note any unusual noise when the rotor is manually turned.
- Check the direction of rotation with the motor uncoupled.
- Avoid rigid couplings.
- Repair any damage to the paint, this must be done immediately and correctly.

Measures for alignment and mounting

The following measures are required to compensate any radial offset at the coupling and to horizontally adjust the electrical machine with respect to the driven load:

- **Vertical positioning**
  For vertical mounting positions, avoid deforming the machines by placing shims under the mounting feet. Keep the number of shims low; only use a few stacked shims.
- **Horizontal positioning**
  To position the machine horizontally, shift it laterally on the foundation and ensure that the axial alignment is maintained (angularity error).
- **When positioning the motor, ensure that a uniform axial gap is maintained around the coupling.**
- **Smooth running**
  Preconditions for smooth, vibration-free operation:
  - Stable foundation design free of any shock or vibration.
  - A precisely aligned coupling.
  - A well-balanced drive output element (coupling, belt pulleys, fans, ...)

  Maintain the maximum permissible vibration values in operation according to ISO 20816-3.
  Avoid inadmissible vibration caused by imbalance, for example (drive output element), external vibration or any resonance over the complete speed range.
  It may be necessary to completely balance the machine with the drive output element or the system resonance frequency must be shifted.
- **Foot mounting/flange mounting**

- Use the specified thread size laid down in EN 50347 when flanging the machine to a foundation or a machine flange.
- Mount the machine at all the foot or flanged holes provided. The choice of fixing elements depends on the foundation and is the plant operator's responsibility. Comply with the required property classes for screwed connections and materials for fixing elements.
- Select the correct screw length for IM B14 flanges.
- Ensure that the screw heads are in full contact with the flange surface. Use additional flat washers (ISO 7093), especially for elongated foot mounting holes.

Flatness of the supporting surfaces for conventional motors

Shaft height	Flatness [mm]
≤ 132	0.10

3.4.3 Fixation of the machine

Preconditions for smooth, vibration-free operation

Preconditions for smooth, vibration-free operation:
- Stable foundation design
- Precise alignment of the machine
- Correct balancing of parts to be fitted to the shaft end.
- Vibration values in compliance with ISO 20816-3

Aligning the machine to the driven machine and mounting

Selecting bolts
- Unless specified otherwise, use fixing screws with at least strength class 8.8 to ISO 898-1 to ensure that themachine is securely mounted and to transmit the torque-generated forces.
- When selecting the bolts and the design of the foundation, take into account the maximum forces occurring in the case of a fault such as short circuit or system transfers in phase opposition, etc.
- Request the foundation force values from the Service Center if required.

See also
– Chapter Tightening torques for screw and bolt connections

Horizontal types of construction with mounting feet

1. Refer to any instructions for aligning the driven machine and those of the coupling manufacturer.
2. Align the machines with coupling output to the driven machine in such a manner that the center lines of the shafts are parallel with no offset. This ensures that no additional forces affect their bearings during operation.
3. For the vertical positioning (x→0) place thin shims under the machine feet. The number of shims should be kept as low as possible, i.e. stack as few as possible. This also prevents the machine being subjected to any stress/distortion. If available, use the existing tapped holes for the forcing-off bolts to somewhat raise the machine.
4. When positioning the machine, ensure that a uniform axial gap (y→0) is maintained around the coupling.
5. Fix the machine to the foundation. The choice of fixing elements depends on the foundation and is the plant operator's responsibility.

IMPORTANT INFORMATION

When aligning, make allowance for the thermal expansion of the machine when the temperature increases..

Horizontal types of construction with flange

The standard flange is provided with a centering. The choice of fit for the mating flange on the driven machine is the system manufacturer's or the plant operator's responsibility.

If the machine is not fitted with a standard flange, align the machine to suit the driven machine.

Procedure

The machine axis must be horizontal when it is lifted and the flange must be parallel to the mating flange, so as to avoid seizing and stressing. Otherwise damage to the centering will result.

1. Grease the centering flange with assembly paste to make the process easier.
2. Screw three studs into tapped holes spaced about 120° apart around the driven machine flange. The studs act as positioning aids.
3. Position the machine so that its axis is aligned with that of the driven machine, but not yet quite touching.
4. Advance the machine slowly towards the driven machine; advancing too quickly risks damaging the centering.
5. 4. If necessary, rotate the machine into the right position so that the clearance holes in the flange are central to the tapped holes.

6. Move the machine fully up against the mating flange so that it is fully in contact.
7. Fix the machine using the flange fixing bolts, finishing by replacing the studs.

See also
– Chapter Tightening torques for screw and bolt connections

Vertical types of construction with flange

The standard flange is provided with a centering. The choice of fit for the mating flange on the driven machine is the system manufacturer's or the plant operator's responsibility.

If the machine is not fitted with a standard flange, align the machine to suit the driven machine.

Procedure

The machine axis must be vertical when it is lifted and the flange must be parallel to the mating flange, so as to avoid seizing and stressing. Otherwise damage to the centering will result.

1. Grease the centering flange with assembly paste to make the process easier.
2. Screw in two studs into tapped holes on opposite sides of the driven machine flange. The studs act as positioning aids.
3. Lower the machine slowly toward the driven machine and into the centering, so that the flanges do not quite touch. Lowering too quickly risks damaging the centering.
4. If necessary, rotate the machine into the right position so that the clearance holes in the flange are central to the tapped holes.
5. Lower the machine completely onto the mating flange so that it is fully in contact; then remove the studs.
6. Fix the machine using the flange fixing bolts.

Removing the rotor shipping brace

If a rotor shipping brace is attached to the machine, remove it at the last possible moment, for example, when you are ready to push on the output or drive element

Storing the rotor locking device
Store the rotor locking device in a safe place. It must be remounted if the machine is removed and shipped on further.

Recommended alignment accuracy

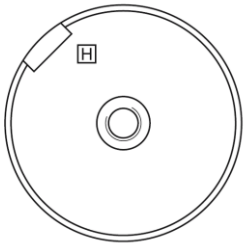
The alignment accuracy required depends essentially on the configuration of the overall machine drive train. Observe the required alignment accuracy of the coupling manufacturer in all cases when aligning the machine.

Speed rpm	Parallel offset mm	Angular misalignment mm per 100 mm coupling diameter
0…900	0.09	0.09
900…1800	0.06	0.05
1800…4500	0.03	0.025

Mounting the drive output elements

The rotor is dynamically balanced. For shaft extensions with feather keys, the type of balancing is specified using the following coding on the face of the drive end of the shaft extension and on the rating plate:

- "H" means balancing with a half feather key (standard)
- "F" means balancing with a whole feather key
- "N" means balancing without a featherkey.



DANGER!

Risk of injury due to Incorrect installation or removal!

Serious injury!

The feather key may be flung out if the motor is operated without drive output elements, such as coupling, etc. Carefully comply with the required measures.

This can result in death, serious injury or material damage.

- The general touch protection measures for drive output elements must be observed.
- Only operate the machine with the drive output element mounted.
- Drive output elements may only be pulled on or pulled off with the correct equipment.
- The feather keys are only locked against falling out during shipping. For test operation or when commissioning without drive output element, carefully secure the feather key using a suitable locking element. When doing this, take into account the type of machine balancing.

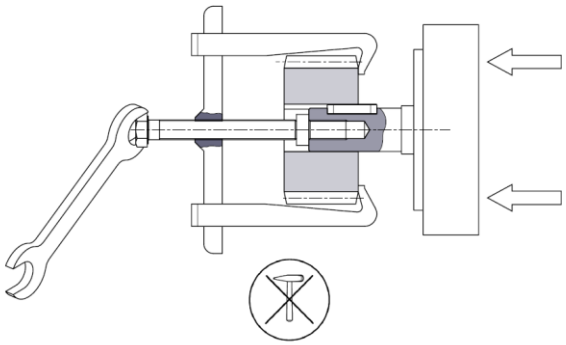
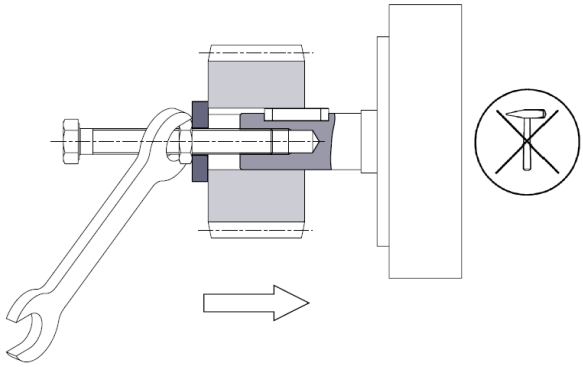
Pulling on drive output elements

Requirements:

- The coupling and/or the drive output element must be appropriately dimensioned for the operating case at hand.
- Observe the coupling manufacturer's instructions.
- Make sure that the balancing type of the drive output element correctly matches the type of balance of the rotor.
- Use only ready drilled and balanced drive output elements. Check the hole diameters and the balancing status before pulling them on. Thoroughly clean the shaft extension

Pulling on:

- Heat up the drive output elements to expand them before pulling them on. Select the temperature difference for the heating process to suit the coupling diameter, fit and material. Observe the coupling manufacturer's instructions.
- Drive output elements may only be pulled on or pulled off with the correct equipment. The drive output element must be pulled on in one continuous operation via the front thread holes in the shaft or pushed on by hand.
- Do not use a hammer, as this will damage the bearings.

Withdrawing drive output elements	Mounting drive output elements
	

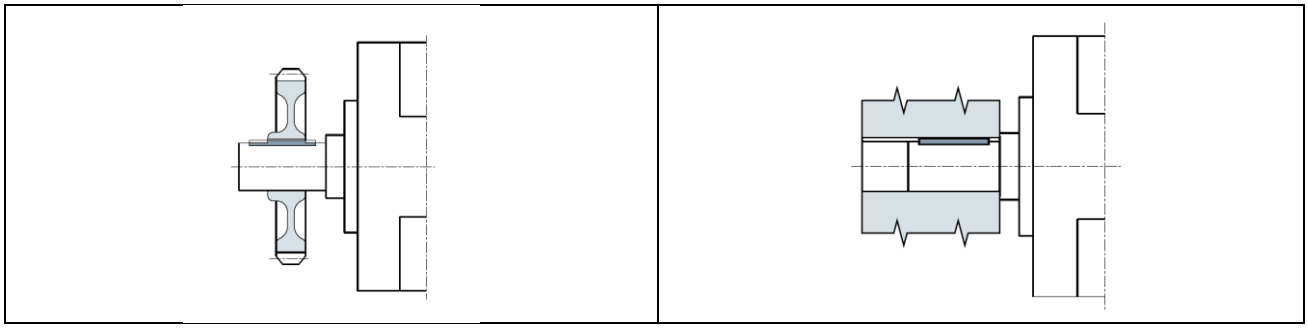
Only transfer radial or axial forces specified in the catalog to the machine bearings via the shaft extension. You can obtain the permissible values for axial and radial forces by contacting the Service Center or by referring to the machine catalog.

Shaft extensions with feather key

The feather key data for the shaft and drive output element must match and indicate the correct type of balancing. The drive output element must be correctly mounted. The balance quality corresponds to vibration severity grade "A" for the complete machine; vibration severity grade "B" is possible as an option. To ensure the required balance quality, it must be ensured that the feather key data on the hub and machine shaft match in the case of a shorter or longer drive output element.

- If the drive output element is shorter than the feather key with balancing type "H", then you must machine off the section of feather key protruding from the shaft contour and drive output element in order to maintain the balance quality.
- If the drive output element is longer than the feather key, when balancing the coupling, take into account that the feather key does not take up all of the coupling slot. The following applies to all four-pole machines with a frequency ≥ 60 Hz:
  - The feather key must be shortened if the coupling hub is shorter than the feather key.
  - The center of gravity of the coupling half should be within the length of the shaft end.
  - The coupling used must be prepared for system balancing.

Withdrawing drive output elements	Mounting drive output elements



Align the offset at the coupling between electrical machines and the driven machines so that the maximum permissible vibration values according to ISO 20816-3 are not exceeded.

3.4.4 Tightening torques for screw and bolt connections

Bolt locking devices

When assembling, refit nuts or bolts that are mounted together with locking, resilient, and/or force-distributing elements with identical, fully-functional elements. Always renew keyed elements.

- When screwing together threads secured with a liquid adhesive, use a suitable medium such as Loctite 243.
- Always use suitable securing devices or removable adhesives (e.g., Loctite 243) when installing fixing bolts with a clamping length of less than 25 mm. The clamping length is taken as the distance between the head of the bolt and the point at which the bolt is screwed in.

Tightening torques

The bolted connections with metal contact surfaces, such as end shields, bearing cartridge parts, terminal box parts bolted onto the stator frame, should be tightened to the following torques, depending on the thread size

Thread	**M5**	**M6**	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Nm	5	8	20	40	70	170	340	600

Table 1: Tightening torques for bolted connections with a tolerance of ±10 %.

The tightening torques stated above apply to screws with property class 8.8, A4-70 or A4-80 according to ISO 898-1, however only to bolts screwed into components made from materials with the same or higher property class, e.g. cast iron, steel or cast steel.

Non-standard tightening torques

Different tightening torques for electrical connections and bolted connections for parts with flat seals or in- sulating parts are specified in the relevant sections and drawings.

3.4.5 End shields, grounding conductors, sheet metal fan covers

If no other tightening torques are specified, then the values in the following table apply.

Thread		**M3,5**	**M4**	**M5**	**M6**	**M8**	**M10**	**M12**	**M16**	**M20**
Nm	min.	0.8	2	3.5	6	16	28	46	110	225
	max.	1,2	3	5	9	24	42	70	165	340

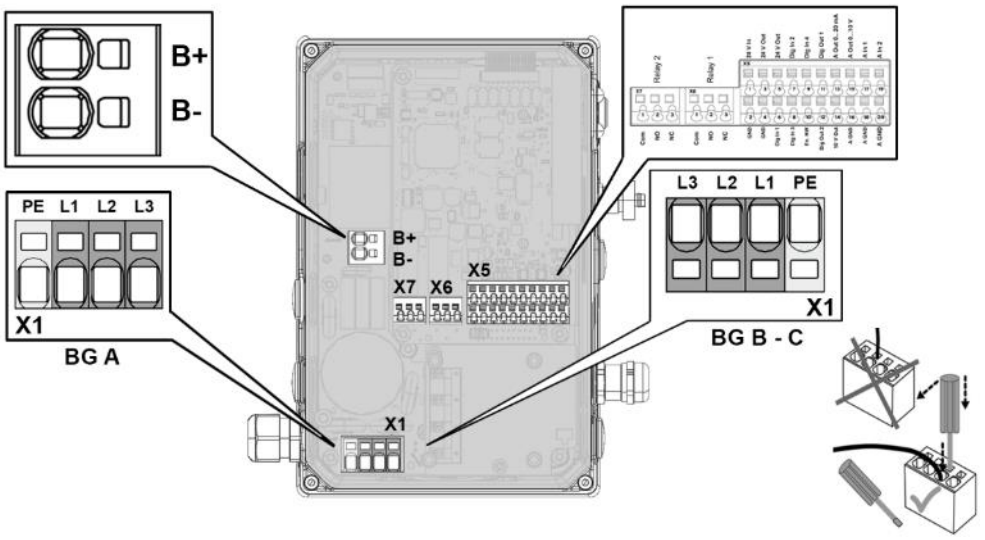
Table 2: Tightening torques for screws on end shields, screw-type grounding conductor connections

Thread		**M4**	**M5**	**M6**
Nm	min.	4	7.5	12.5
	max.	5	9.5	15.5

Table 3: Tightening torques for self-tapping screws on the terminal box, end shields, screw-type grounding conductor connections, sheet metal fan covers

3.4.6 Wiring instructions

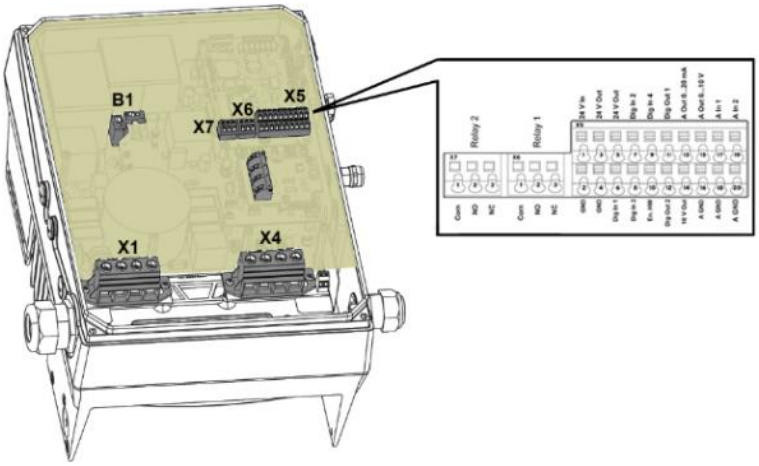
Connection overview (sizes A - C)



Sizes A - C		
X5 – X7	The control connections of the application card are located inside the drive control. Depending on the variant, the assignment and position of the terminals may differ.	
	Terminals:	Plug terminal clamp with activation button (slot screwdriver, max. width 2.5 mm)
	Connection cross-section:	0.5 to 1.5 mm², single-wire, AWG 20 to AWG 14
	Connection cross-section:	0.75 to 1.5 mm², fine-wired, AWG 18 to AWG 14
	Connection cross-section:	0.5 to 1.0 mm², fine-wired (core end sleeves with and without plastic collars)
	Length of stripped insulation:	9 to 10 mm

Sizes A - C			
X1 mains	The terminals for the mains cable are located inside the drive controller. The drive controller also has the option of being equipped with terminals for connecting a brake resistor. Depending on the variant, the assignment and position of the terminals may differ.		
	Core end sleeves with plastic collars and lugs are recommended.		
	Terminals:	Spring force connection (slot screwdriver, max. width 2.5 mm)	
		min.	max.
	Conductor cross-section, rigid	0.2 mm²	10 mm²
	Conductor cross-section, flexible	0.2 mm²	6 mm²
	Conductor cross-section, flexible with core end sleeve without plastic sleeve	0.25 mm²	6 mm²
	Conductor cross-section, flexible with core end sleeve with plastic sleeve	0.25 mm²	4 mm²
	2 conductors of the same cross-section, flexible with TWIN-AEH with plastic sleeve	0.25 mm²	1.5 mm²
	AWG/kcmil conductor cross-section according to UL/CUL	24	8
	Length of stripped insulation:	15 mm	
	Mounting temperature:	-5°C to +100°C	

Connection overview (size D)



Size D		
X5 – X7	The control connections of the application card are located inside the drive control. Depending on the variant, the assignment and position of the terminals may differ.	
	Terminals:	Plug terminal clamp with activation button (slot screwdriver, max. width 2.5 mm)
	Connection cross-section:	0.5 to 1.5 mm², single-wire, AWG 20 to AWG 14
	Connection cross-section:	0.75 to 1.5 mm², fine-wired, AWG 18 to AWG 14
	Connection cross-section:	0.5 to 1.0 mm², fine-wired (core end sleeves with and without plastic collars)
	Length of stripped insulation:	9 to 10 mm

Size D		
X1 mains / X4 motor + B - brake resistor	The terminals for the mains cable are located inside the drive controller. The drive controller also has the option of being equipped with terminals for connecting a brake resistor. The configuration may vary depending on the version.	
	Core end sleeves with plastic collars and lugs are recommended.	
	Torque: < 25 mm² = 2.5 Nm / ≥ 25 mm² = 4.5 Nm	
	Conductor cross-section:	rigid min. 0.5 mm² / rigid max. 35 mm²
	Conductor cross-section, flexible:	min. 0.5 mm² / max. 25 mm²
	Conductor cross-section, flexible with core end sleeve without plastic collar	min. 1 mm² max. 25 mm²
	Conductor cross-section, flexible with core end sleeves with plastic sleeve	min. 1.5 mm² max. 25 mm²
	AWG / kcmil conductor cross-section according to UL/CUL	min 20 max. 2
	2 conductors of the same cross-section, rigid	min. 0.5 mm² max. 6 mm²
	2 conductors of the same cross-section, flexible	min. 0.5 mm² max. 6 mm²
	2 conductors of the same cross-section, flexible with AEH without plastic sleeve	min. 0.5 mm² max. 4 mm²
	2 conductors of the same cross-section, flexible with TWIN-AEH with plastic sleeve	min. 0.5 mm² max. 6 mm²
	AWG according to UL/CUL	min. 20 max. 2

3.4.7 Preventing electromagnetic interferences

To ensure immunity to interference, be sure that control lines run separately from grid and motor cables. Where possible use shielded lines for analogue control circuits. At the line end, the shielding should be fitted with great care. The use of EMC cable screw connections is recommended for this purpose. These are not part of the scope of delivery.

Ensure that no parasitic currents (compensating currents etc.) can flow via an analogue control cable's shielding.

Route the control lines as far away as possible from the power lines. Under certain circumstances, separate power ducts should be used.

If lines do cross, an angle of 90° should be observed as far as possible.

Upstream switch elements, such as protector switches and brake coils or circuit elements that are operated via the outputs of the drive controller have to be interference-suppressed.

RC circuits are suitable as AC voltage protector switches, while free-wheeling diodes or varistors are usually used as DC voltage protector switches. These interference suppression devices are attached directly to the protector switch coils.

IMPORTANT INFORMATION

Where possible, the power for a mechanical brake should be supplied in a separate cable.

Power connections between the drive controller and motor should always be shielded or reinforced, and the shielding must have large-scale grounding at both ends! The use of EMC cable screw connections is recommended. These are not part of the scope of delivery.

Wiring suitable for EMC must be ensured.

3.4.8 Measures to reduce bearing currents

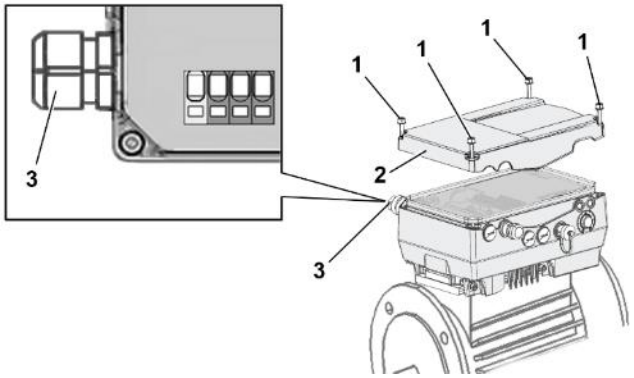
Due to topology, bearing currents can occur when operating with frequency converters. Continuous operating points at low frequencies (e.g. < 10 Hz) can lead to increased bearing wear. This effect can be amplified by high switching frequencies.

The following measures can help reduce bearing currents:

- Reduce the switching frequency. Adjust the switching point between modulation types
- Provide a large-area, low-impedance grounding between motor and inverter
- Use ceramic bearings
- Use dU/dt filters
- Ensure good grounding of the motor shaft (e.g. grounding brushes)

3.4.9 Power connection

Power connection for sizes A - C



IMPORTANT INFORMATION

When connecting a brake resistor to an optional brake chopper, cables with shielding and double insulation must be used!

DANGER!

Risk of death due to electrical shock!

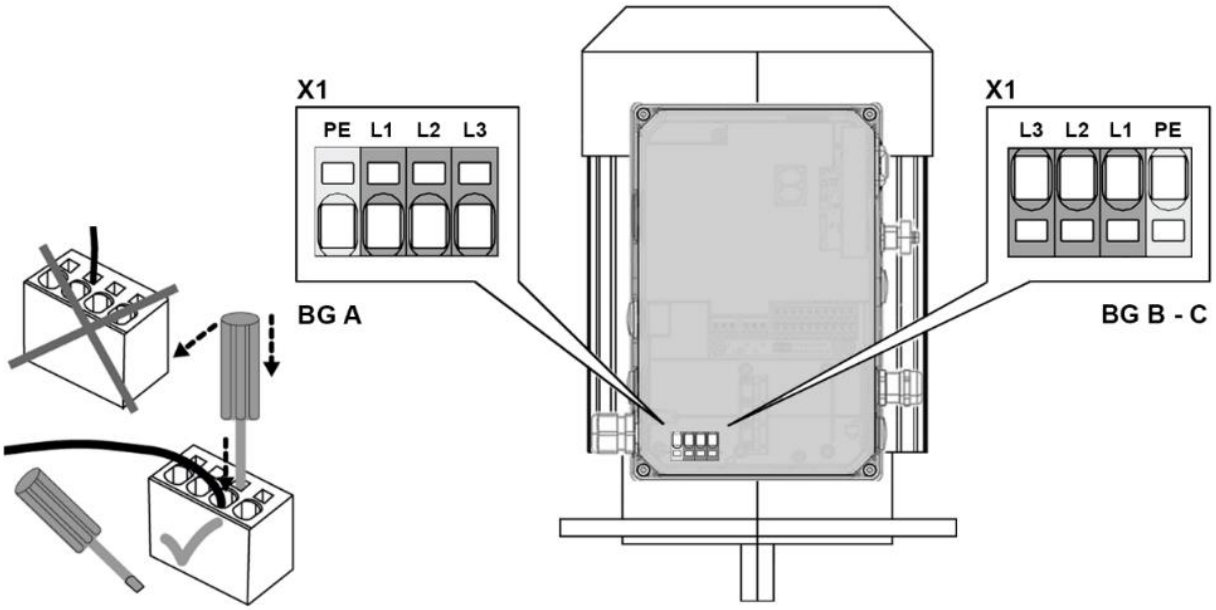
Death or serious injury!

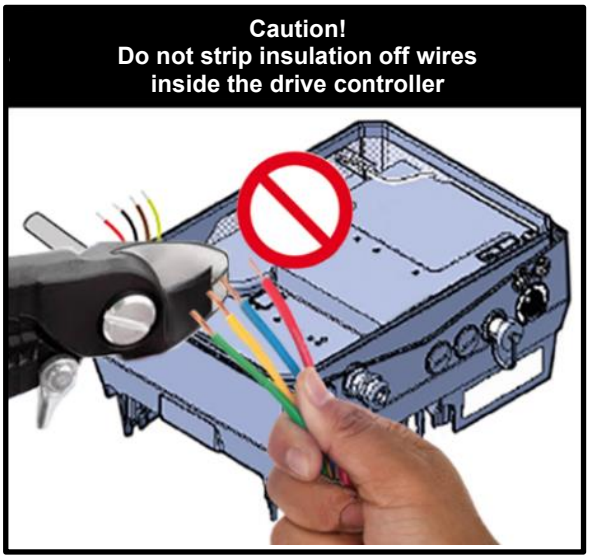
De-energise the drive controller, wait until the motor has come to a standstill, determine that it is voltage-free and secure it against being restarted.

2 min

Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down.

1. Unscrew the four screws (1) from the drive controller's housing cover (2) and then take it off.
2. Guide mains connection cable through cable screw connection (3) into housing of drive controller.





3. Connect the cables with the terminals as follows:

Size	400 V connection			
A	PE	L1	L2	L3
B-C	L3	L2	L1	PE

Terminal no.	Designation	Assignment
1	L1	Mains phase 1
2	L2	Mains phase 2
3	L3	Mains phase 3
4	PE	Protective conductor

Tab. 2: AC feed-in X1

Terminal no.	Designation	Assignment
1	L1	DC mains (+)
2	L2	Not assigned
3	L3	DC mains (-)
4	PE	Protective conductor

Tab. 3: DC input X1

Power connection for sizes D

IMPORTANT INFORMATION

When connecting a brake resistor to an optional brake chopper, cables with shielding and double insulation must be used!

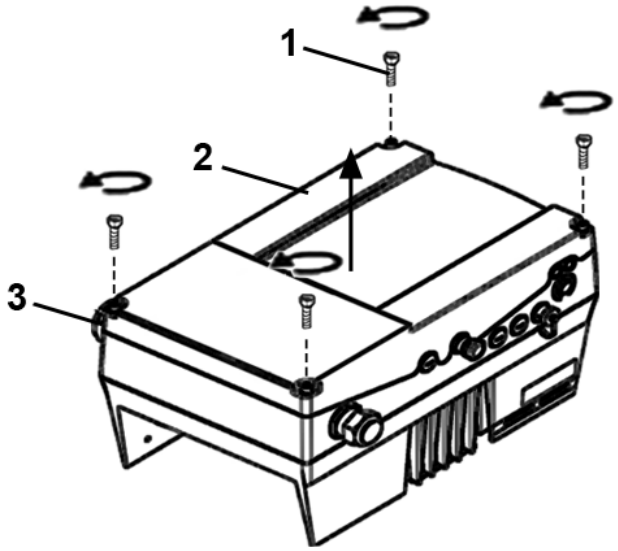
DANGER!

Risk of death due to electrical shock!

Death or serious injury!

De-energise the drive controller, wait until the motor has come to a standstill, determine that it is voltage-free and secure it against being restarted.

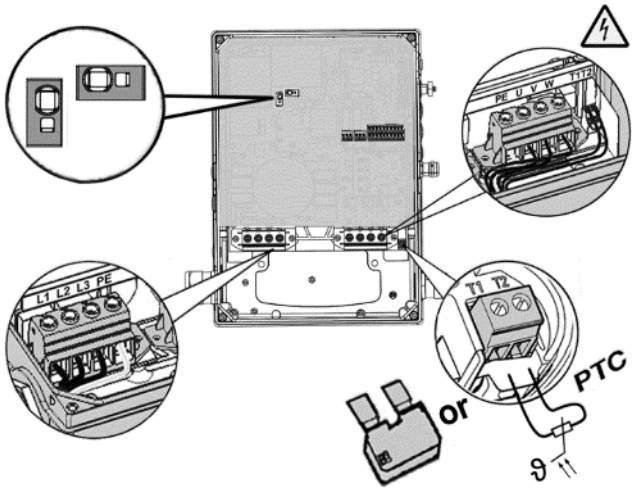
Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down.



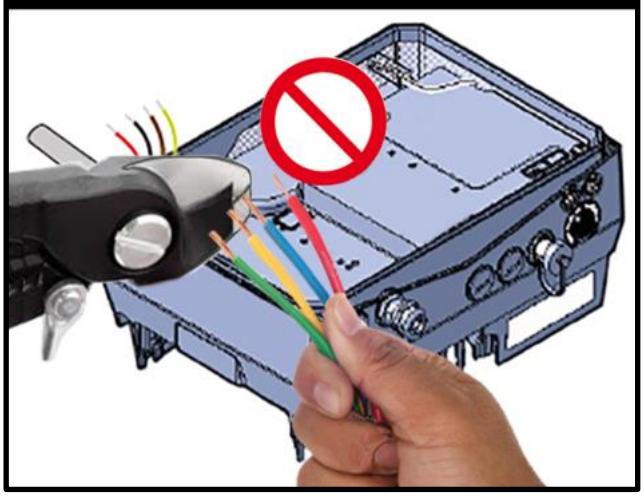
1. Unscrew the four screws (1) from the drive controller's housing cover (2) and then take it off.
2. Guide mains connection cable through cable screw connection (3) into housing of drive controller.

IMPORTANT INFORMATION

The cable screw connection provides strain relief, and the PE connection cable must be connected in a leading fashion (considerably longer).



Caution!
Do not strip insulation off wires inside the drive controller



3. Connect the cables with the terminals as follows:

Terminal no.	Designation	Assignment
1	L1	Mains phase 1
2	L2	Mains phase 2
3	L3	Mains phase 3
4	PE	Protective conductor

Tab. 4: 3 x 400 V AC terminal assignment X1

The protective conductor must be connected to the "PE" contacts.

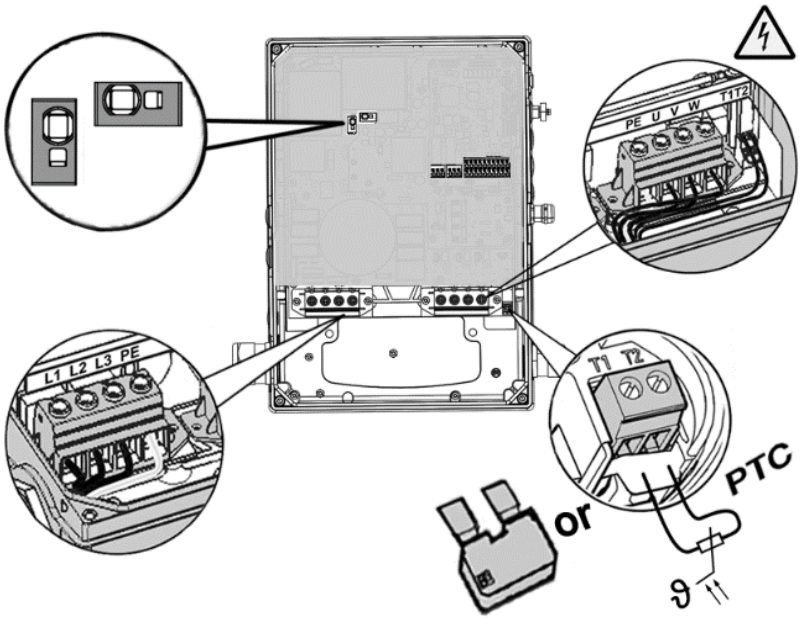


Fig. 8: Size D

Terminal no.	Designation	Assignment
1	L1	DC mains (+)
2	L2	Not assigned
3	L3	DC mains (-)
4	PE	Protective conductor

Tab. 5: DC feed 565 V terminal assignment X1

3.4.10 Control connections X5, X6, X7 (sizes A - D)

Control connections of the standard application board

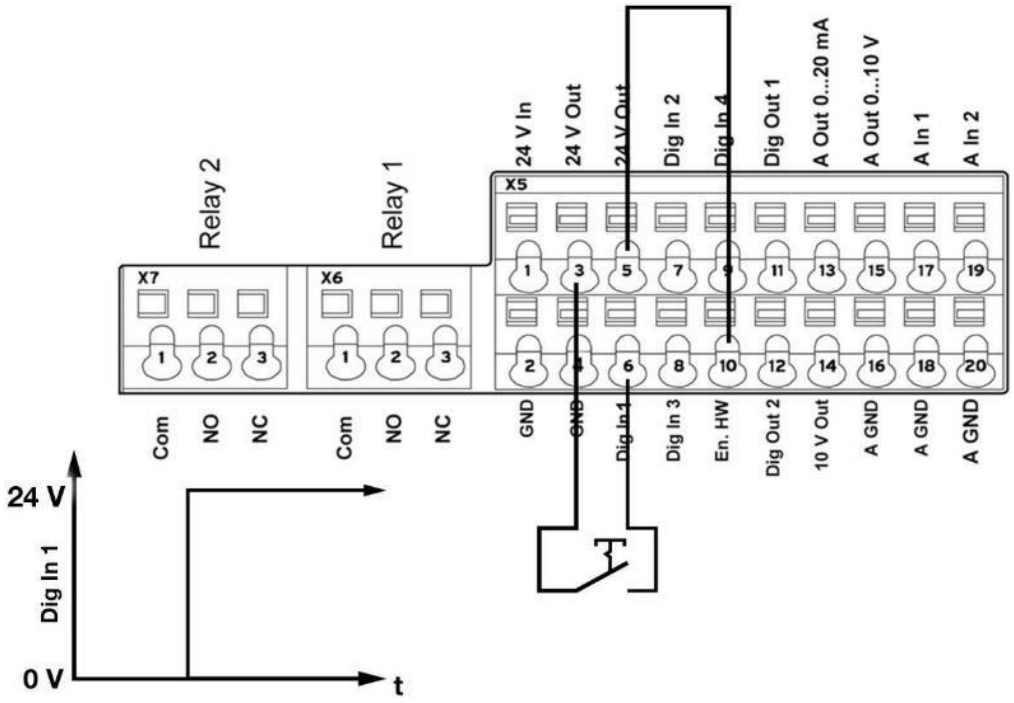
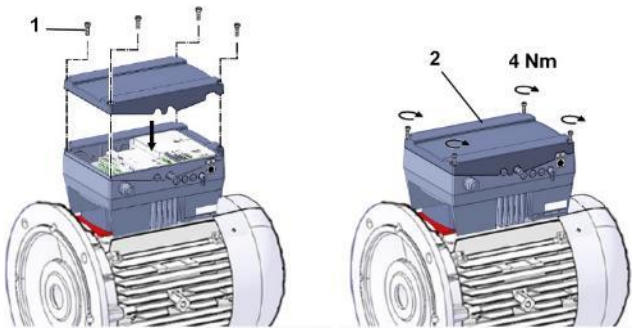


Fig. 9: Control connections of the standard application board

IMPORTANT INFORMATION
Danger of external signals being coupled in.
Use only shielded control lines.

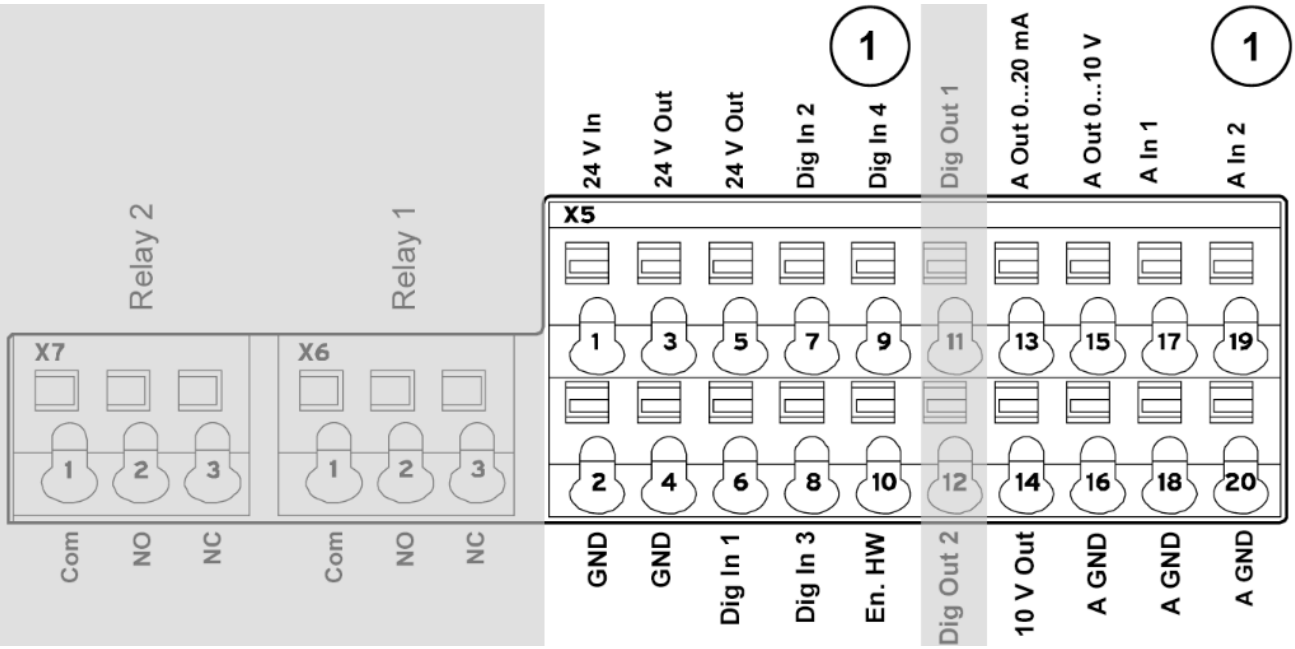
1. Guide the required control line through the cable gland into the housing.
2. Connect the control cables according to the figure and/or table.
   Use shielded control cables.



3. Place the housing cover (2) on the drive controller and screw down with the four screws (1). (Torque 4 Nm)

Size.	Torque
A - C	2 Nm (4 x M4 x 28)
D	4 Nm (4 x M6 x 28)

Terminal assignment for control connection X5 (sizes A - D)

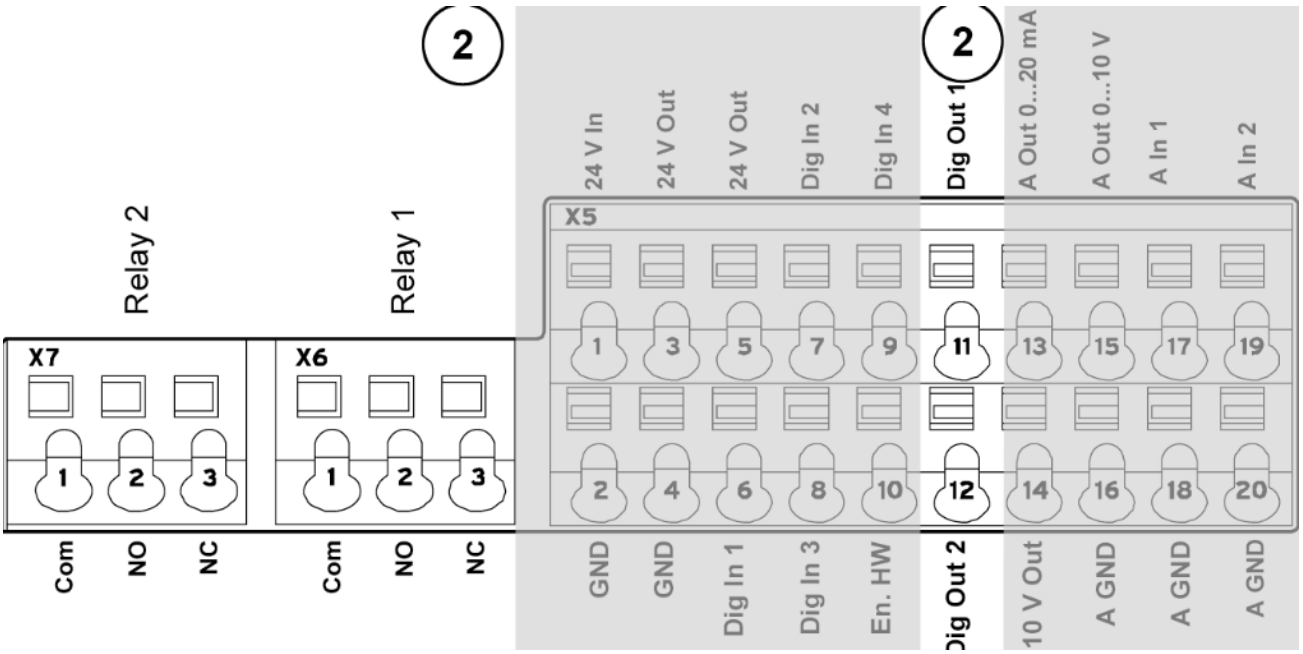


(see also Chapter 3.4.10)

Terminal no.	Designation	Assignment	Parameter
1	24 V In	Ext. power supply	
2	GND (ground)	Ground	
3	24 V Out	Int. power supply	
4	GND (ground)	Ground	
5	24 V Out	Int. power supply	
6	Dig. In 1	Target value enable	1.131
7	Dig. In 2	Free (not assigned)	
8	Dig. In 3	Free (not assigned)	
9	Dig. In 4	Error reset	1.180
10	En HW (enable)	Enable hardware	
13	A. Out 0 … 20 mA	Actual frequency value	4.100
14	10 V Out	For ext. voltage divider	
15	A. Out 0 … 10 V	Actual frequency value	4.100
16	A GND (ground 10 V)	Ground	
17	A. In 1	PID actual value	3.060
18	A GND (Ground 10 V)	Ground	
19	A. In 2	Free (not assigned)	
20	A GND (ground 10 V)	Ground	

Tab. 6: Terminal assignment X5 of the standard application board

Terminal assignment for control connection X6 (sizes A - D)



(see also Chapter 3.4.10)

Terminal no.	Designation	Assignment	Parameter
11	Dig. Out 1	Error message	4150
12	Dig. Out 2	Free (not assigned)	

X6 relay 1

Terminal no.	Designation	Assignment
1	COM	Centre contact relay 1
2	NO	Normally open relay 1
3	NC	Normally closed relay 1

Tab. 7: Terminal assignment X6 (relay 1)

INFORMATION

In the factory setting, relay 1 is programmed as “relay error” (parameter 4.190).

Terminal assignment for control connection X7 (sizes A - D)

X7 relay

Terminal no.	Designation	Assignment
1	COM	Centre contact relay 2
2	NO	Normally open relay 2
3	NC	Normally closed relay 2

Tab. 8: Terminal assignment X7 (relay 2)

INFORMATION

In the factory setting, “no function” is assigned to relay 2 (parameter 4.210).

Control connections of the basic application board

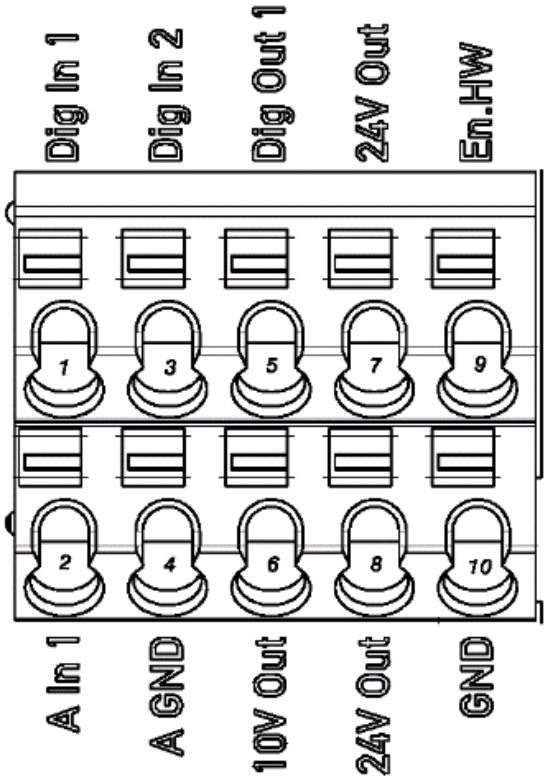


Fig. 10: Control connections of the basic application board

Terminal no.	Designation	Assignment	Parameter
1	Dig. In 1	Target value enable	1.131
2	A. In 1	Free (not assigned)	
3	Dig. In 2	Free (not assigned)	
4	A GND (ground 10 V)	Ground	
5	Dig. Out	Error message	4.150
6	10 V Out	For ext. voltage divider	
7	24 V Out	Int. power supply	
8	24 V Out	Int. power supply	
9	En HW (enable)	Enable hardware	
10	GND (ground)	Ground	

3.4.11 Connection diagram

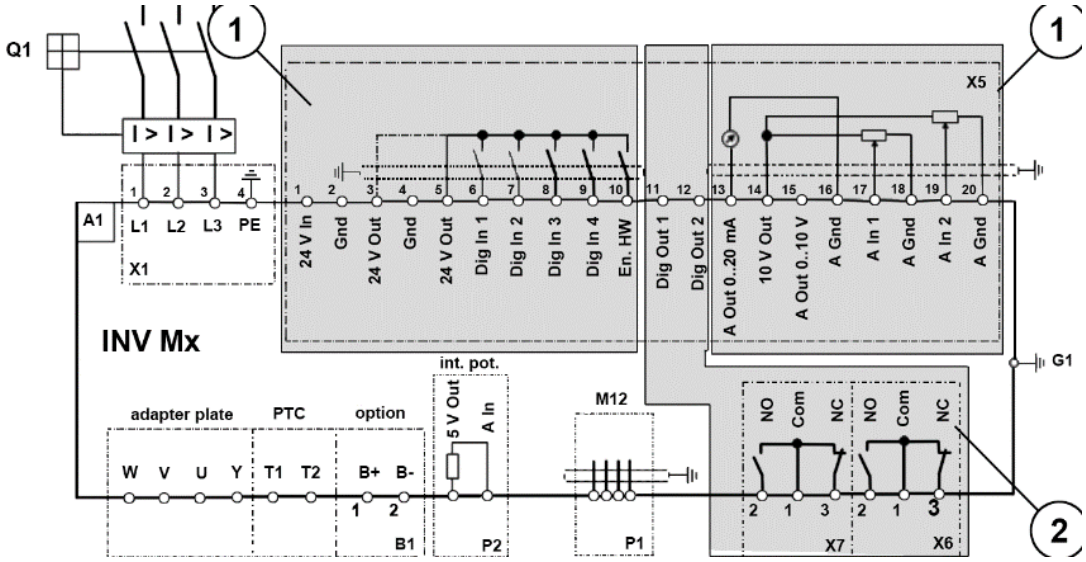


Fig. 11: Connection diagram

Characters	Explanation
A1	Drive controller
B1	Connection for external brake resistor (option)
G1	M6 grounding screw (connection for residual currents > 3.5 mA)
P1	RS485 programming interface (M12 plug)
P2	Internal potentiometer
Q1	Motor protection switch or load break switch (optional)
X1	Mains terminals
X5 – X7	Digital/analogue inputs and outputs

The drive controller is ready once a 3 x 400 V AC mains supply has been activated (on terminals L1 to L3) or a DC mains supply has been activated (on terminals L1 and L3).

The drive controller can also be started up by connecting an external 24 V voltage.

3.4.12 Connection variant using Harting plug

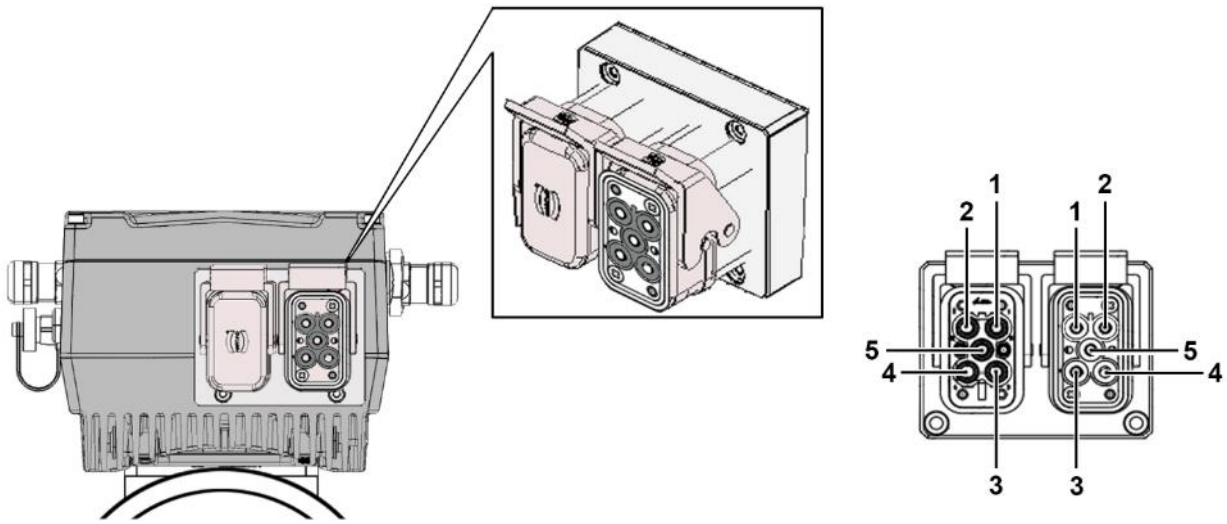


Fig. 12: Harting plug Han Q 4/2

Pin male connector	Pin female connector	Assignment
1	1	L1
2	2	L2
3	3	L3
4	4	-
5	5	PE

3.4.13 PHOENIX Quickon connection variant

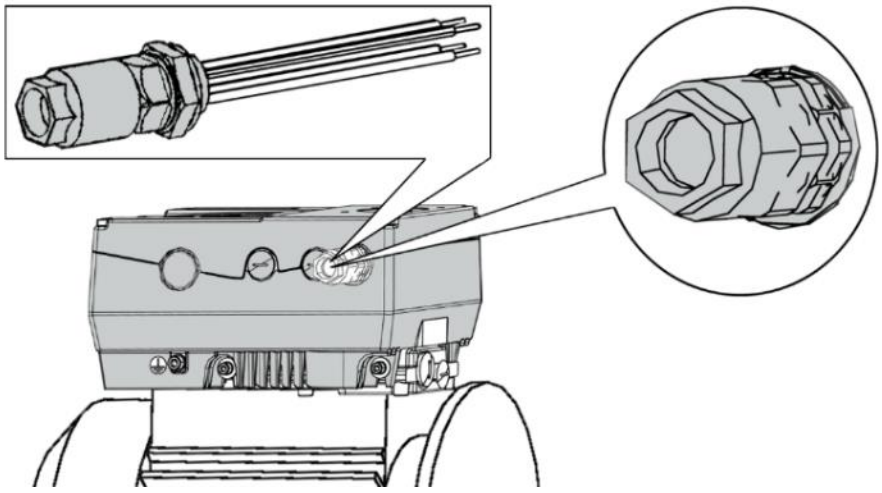


Fig. 13: PHOENIX Quickon

Pin	Colour	Assignment
1	Sw / BK	L1
2	br / BN	L2
3	gr / GY	L3
4	ge / YE	PE

3.4.14 Connection variant using main switch

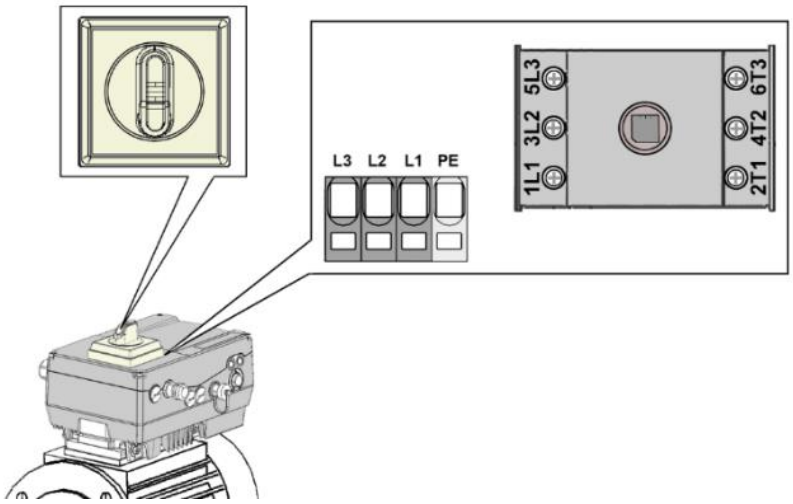
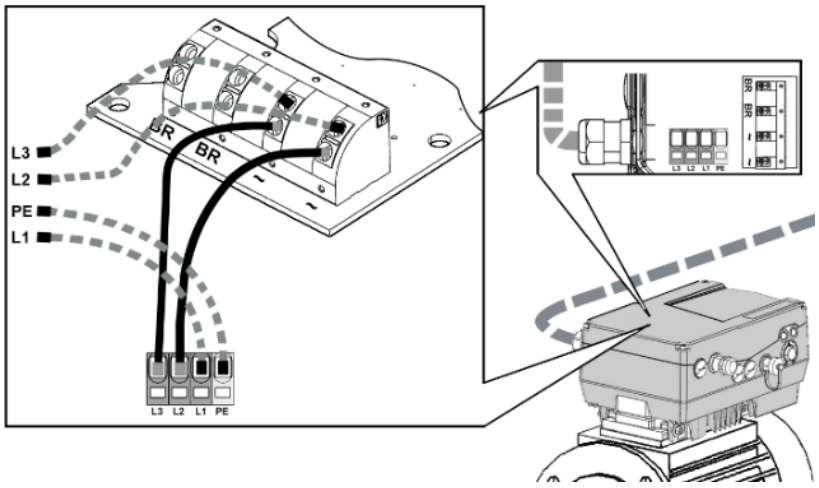


Fig. 14: Main switch

Pin	Assignment
1L1	L1
3L2	L2
5L3	L3
PE	PE

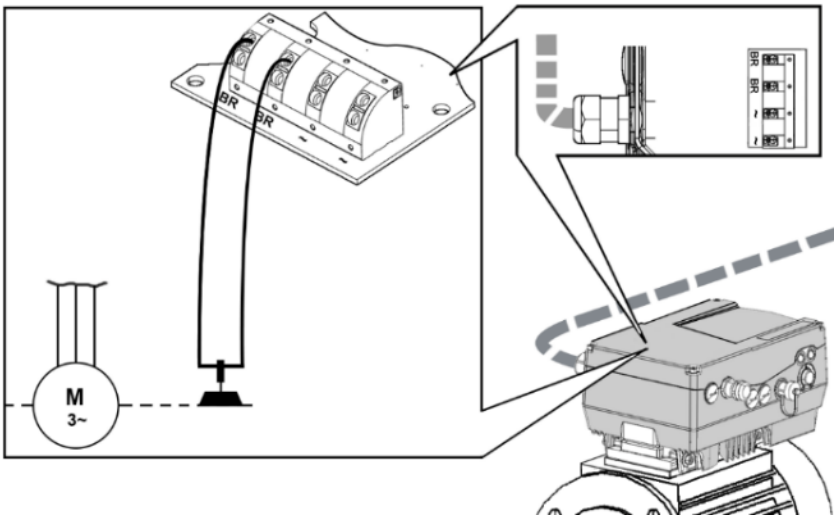
3.4.15 Mains supply connection variant with brake module, size A



IMPORTANT INFORMATION

The brake module's mains supply is wired ex-factory with sizes B - D!

3.4.16 Connection of mechanical brake to brake module



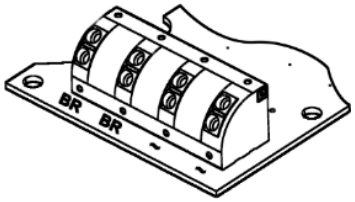
DAMAGE TO PROPERTY POSSIBLE

Make sure that the supply voltage of the brake matches the mains voltage used!

When the supply is 400 V AC, a brake with 180 V DC must **always** be used!

Technical data for brake module

Property	Value
Type	Half-wave rectifier
Output voltage	Vgrid * 0.445 Example: Grid at 230 V~ ≈ 102 V DC Grid at 400 V~ ≈ 180 V DC
Switching the brake voltage	At DC end
Maximum DC output current	0.9 A
Current limitation	none
Voltage limit	none
Short-circuit proof	Yes, via PCB fuses, module must be replaced
Response time	< 10 ms
Switching frequency	< 5 Hz



Connection data for brake module	min.	max.
Conductor cross-section, rigid	0.2 mm²	2.5 mm²
Conductor cross-section, flexible	0.2 mm²	2.5 mm²
Conductor cross-section, flexible with core end sleeve without plastic sleeve	0.5 mm²	2.5 mm²
Conductor cross-section, flexible with core end sleeve with plastic sleeve	0.5 mm²	1 mm²
Conductor cross-section AWG	24	14
2 conductors of the same cross-section, rigid	0.2 mm²	2.5 mm²
2 conductors of the same cross-section, flexible	0.2 mm²	2.5 mm²
2 conductors of the same cross-section, flexible with AEH without plastic sleeve	0.5 mm²	2.5 mm²
2 conductors of the same cross-section, flexible with TWIN-AEH with plastic sleeve	0.5 mm²	1 mm²

3.5 Installation of main switch, size D (optional)

IMPORTANT INFORMATION

The main switch may only be installed by a trained and qualified electrician.

DANGER!

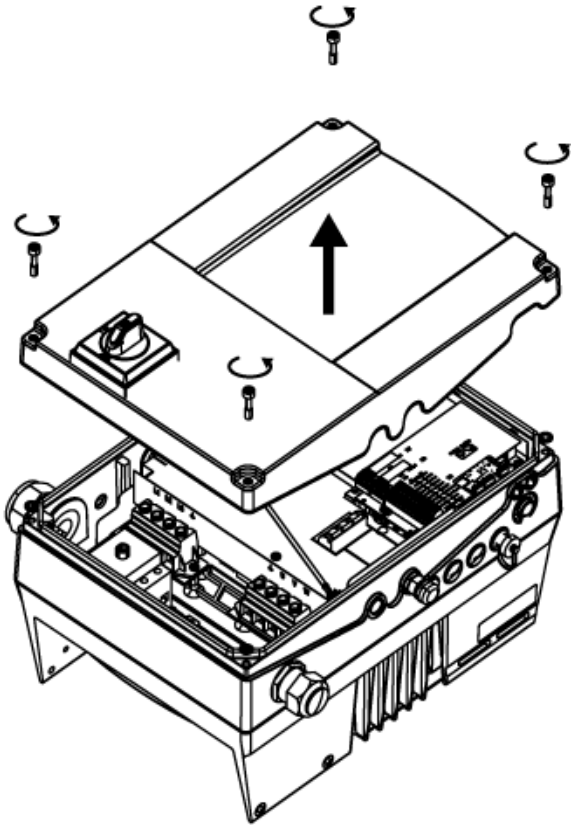
Risk of death due to electrical shock!

Death or serious injury!

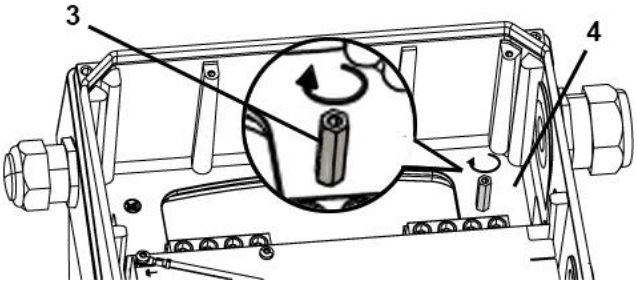
De-energise the drive controller, wait until the motor has come to a standstill, determine that it is voltage-free and secure it against being restarted.

2 min

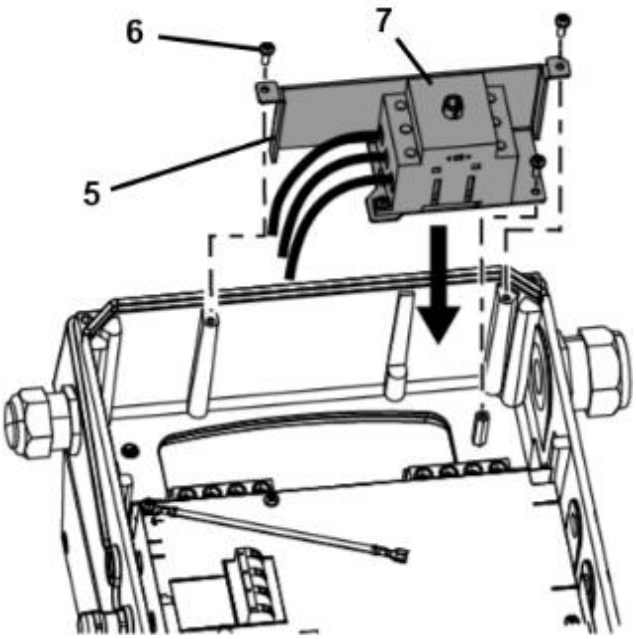
Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down.



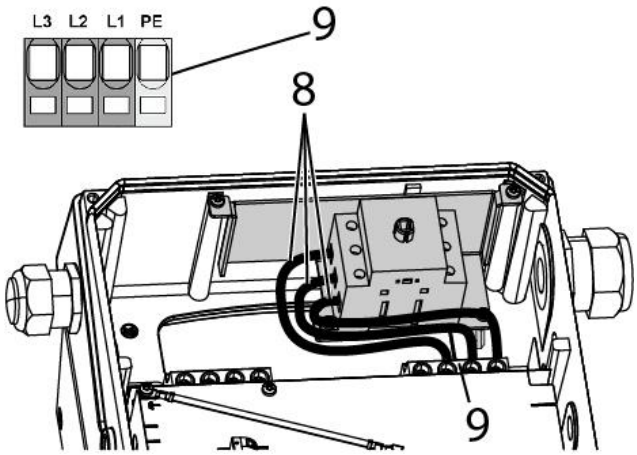
1. Unscrew the four screws (1) from the drive controller's housing cover (2) and then take it off.



2. Screw bolt (3) into base (4) of MOTOR DRIVE SYSTEMS MD (torque 2 Nm).

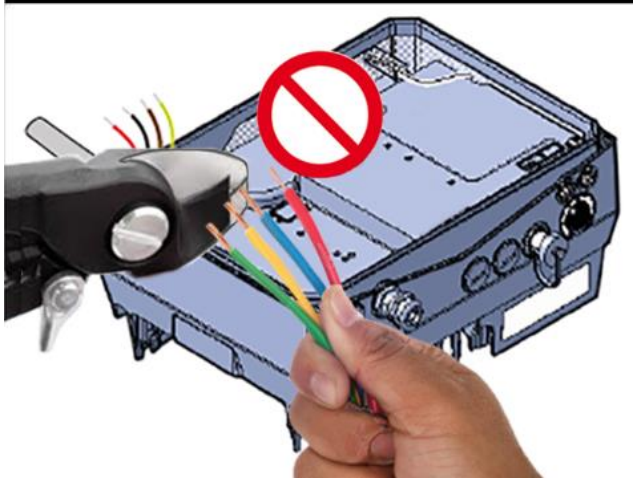


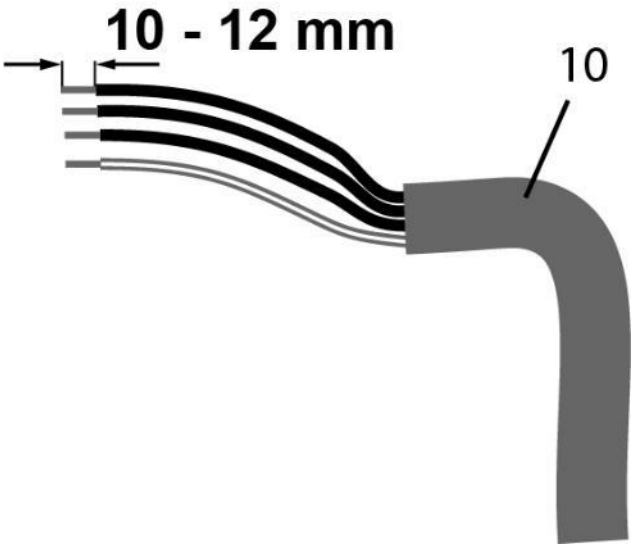
3. Insert the unit, comprising retaining plate (5) and main switch (7), into the MOTOR DRIVE SYSTEMS MD housing.
4. Use the three screws (6) to screw unit and housing together (torque 2 Nm).



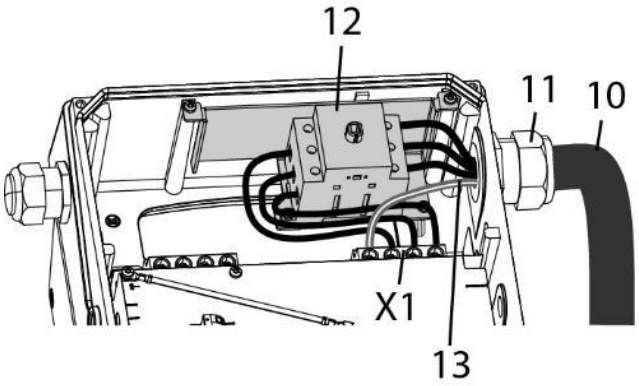
5. Connect cables (8) to mains terminal
[X1] (9)
(torque of mains terminal screws 2 Nm)

Caution!
Do not strip insulation off wires inside the drive controller





6. Strip 10 - 12 mm of insulation off individual cables of mains cable feed (10).



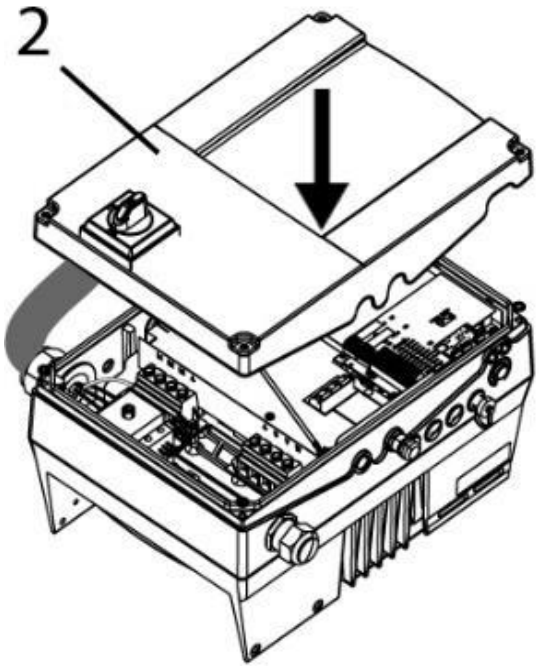
7. Guide mains cable feed (10) through cable gland (11) and into housing of MOTOR DRIVE SYSTEMS MD.
8. Connect individual cables to terminals of main switch (12).
(Torque of main switch screws 2 Nm).
9. Connect PE cable (13) of mains feed (10) to “PE” of mains terminal [X1] (9).
(Torque of mains terminal screw “PE” 2 Nm).

DANGER!

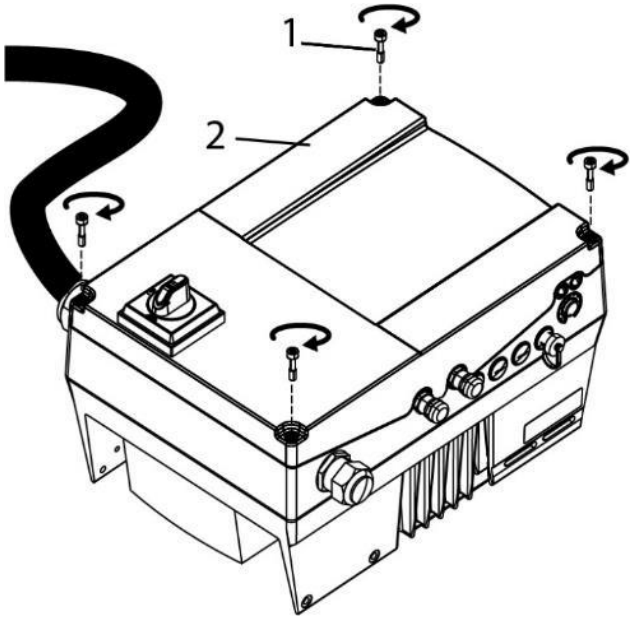
Risk of death due to electrical shock!

Death or serious injury!

De-energise the drive controller, wait until the motor has come to a standstill, determine that it is voltage-free and secure it against being restarted.



10. Carefully place housing cover (2) onto housing of MOTOR DRIVE SYSTEMS MD.



11. Insert the four screws (1) into the cover (2) and screw both components together.
(Torque of screws (1) 4 Nm)

4. Commissioning

4.1 Safety instructions for commissioning

DAMAGE TO PROPERTY POSSIBLE

If the information is not observed, the drive controller could be damaged and destroyed during subsequent commissioning.
Commissioning may only be performed by qualified staff. Safety precautions and warnings must always be observed.

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

Be sure that the power supply provides the correct voltage and is designed for the required current.

Use suitable circuit breakers with the prescribed nominal current between the mains and drive controller.

Use suitable fuses with appropriate current values between the mains and drive controller (see technical data).

The drive controller must be grounded with the motor according to relevant regulations. Non-compliance may result in serious injury.

IMPORTANT INFORMATION

The use of a mains choke or operation on the transformer may impact the control!
This impact may result in the "overcurrent" or "DC link overvoltage" error messages!

4.2 Communication

The drive controller can be commissioned in the following ways:

- using the INNOMOTICS MD connect PC software

Fig. 15: PC software – start screen

- using the MMI* in the cover (MMI option)

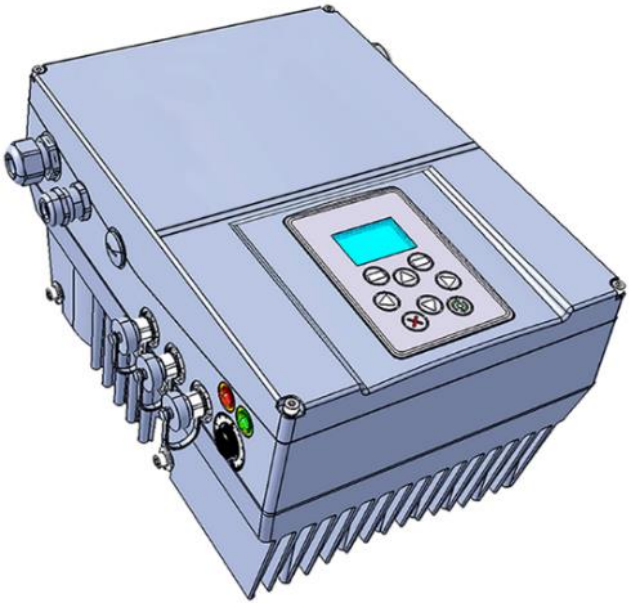


Fig. 16: MMI option

*** Man-machine interface**

4.3 Block diagram

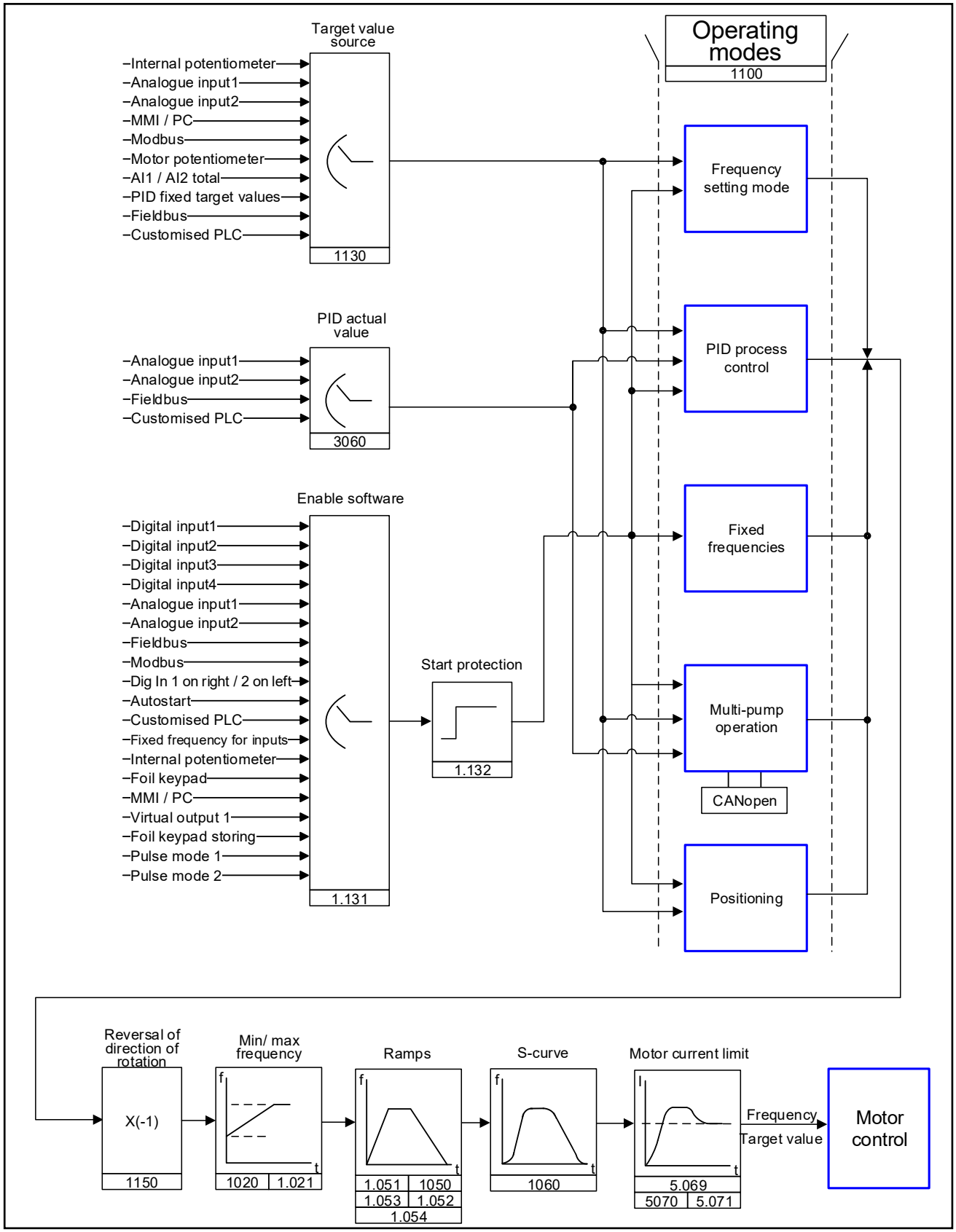


Fig. 17: General structure of target value generation

4.4 Commissioning steps

INFORMATION

Parameterisation is possible prior to device installation!

Parameterisation can be performed before the drive controller is installed in the motor.

The drive control has a 24 V low-voltage input for this purpose, which can supply the electric system without requiring mains power.

The commissioning can be performed using a USB PC communication cable to M12 plug with integrated interface converter RS485/RS232.

4.4.1 Commissioning using the PC:

IMPORTANT INFORMATION

For functions with software version 1.50, you need the pc software version >3.60!
(see https://www.innomotics.com/downloadcenter)

1. Install the INNOMOTICS MD connect software (you can obtain programming software from INNOMOTICS free of charge.
   Required operating system: Windows 7 or later [32 / 64 bit]).
   We recommend undertaking the installation process as an administrator.
2. Connect the PC to the M12 plug M1 with the optional connection cable.
3. Load the motor data record (these will be downloadable for your specific 1UZ1 system from INNOMOTICS free of charge). This download should only be performed, if a factory reset of the system was necessary before that, as it will reset the entire drive configuration to the initial state out of the factory, so any adjustments you have made will be lost.
4. It may be necessary to optimise the speed control (parameters 34.090 to 34.091). The base settings for the speed controller of the 1UZ1 systems are as follows:
   Dependent on power = 34.090 n-controller kp
   a. 1,1 – 1,5 kW = 150
   b. 2,2 – 4 kW = 200
   c. 5,5 – 7,5kW = 300
   d. 15 kW = 400
   e. 22 kW = 500
   34.091: n-controller tn = 0,2
5. Perform the application settings (ramps, inputs, outputs, target values etc.). The factory setting for the maximum frequency monitoring is set to: 5.085 = 2s; depending on your application you may need to adjust this to an appropriate monitoring time.
6. Optional: Define an access level
   (1 - MMI, 2 - user, 3 - manufacturer).

See Fig. of block diagram in chapter **Fehler! Verweisquelle konnte nicht gefunden werden.Fehler! Verweisquelle konnte nicht gefunden werden.**

In order to ensure an ideal operating structure for the PC software, the parameters are classified into different access levels.

The following levels exist:

1. handheld controller: – the drive controller is programmed using the handheld controller.
2. user: – the basic parameters can be programmed into the drive controller using the PC software.
3. Manufacturer: - an extended selection of parameters can be programmed into the drive controller using the PC software.

4.4.2 Commissioning using PC, combined with MMI option

IMPORTANT INFORMATION

For functions with software version 1.50, you need the INNOMOTICS MD connect software version >3.60!
(see https://www.innomotics.com/downloadcenter)

1. Install the INNOMOTICS MD connect software (you can obtain programming software from INNOMOTICS free of charge.
   Required operating system: Windows 7 or later [32 / 64 bit]).
   We recommend undertaking the installation process as an administrator.
2. Connect the PC to the M12 plug M1 with the optional connection cable.

IMPORTANT INFORMATION

After the power on the drive controller has been switched on, the diagnosis interface (M12 PC/MMI) is initially inactive.

To activate this interface, the "MMI option" has to be put into standby mode.

To do this, simultaneously press buttons (1) and (2) for approx. 1.5 sec.

"Standby" appears in the MMI display and internal communication is interrupted for 25 sec.

If communication for the INNOMOTICS MD connect tool is established within 25 sec., the "MMI option" remains in standby mode.

Data can now be exchanged with the PC and/or an external MMI.
If communication is aborted or cannot be established within 25 sec., the "MMI option" switches from standby mode to normal mode.

Turning the display 180°

Depending on how the drive controller is installed within the system, the display may have to be turned 180°.

You can turn the display 180° using parameter 5.200

by setting the parameter value to "1"

Alternatively, the display can also be turned 180° in "normal mode".

To do this, simultaneously press buttons (3) and (4) for approx. 1.5 sec.
The display and functional button assignment are turned 180°.

INFORMATION

The display is only turned 180 ° once the "Disconnect" button has been pressed in the " INNOMOTICS MD connect tool".

5. Parameter

This chapter contains the following:

- an introduction to the parameters
- an overview of the most important commissioning and operation parameters

5.1 Safety instructions for working with parameters

DANGER!

Risk of death due to restarting motors!

Death or serious injury!

Non-observance may result in death, serious injury or damage.

Certain parameter settings and changing parameter settings during operation may result in the INNOMTICS MD drive controller restarting automatically after the supply voltage has failed, or in undesirable changes in the operating behaviour.

INFORMATION

If parameters are changed while the device is in operation, it may take a few seconds for the effect to become noticeable.

5.2 General information on parameters

5.2.1 Explanation of operating modes

The operating mode is the instance in which the target value is generated.
In the case of frequency setting mode, this is a simple conversion of the raw input target value into a rotation speed target value. In the case of PID process control, the target value and actual value are compared and the system then regulates to a specific process variable.

Frequency setting mode:

The target values from the "target value source" (1.130) are rescaled into target frequency values.

0 % is the "minimum frequency" (1.020).

100 % is the "maximum frequency" (1.021).

The target value's plus or minus sign is the decisive factor in rescaling.

PID process control:

The target value for the PID process controller is imported in percentage steps as in the "PID process control" operating mode. 100 % corresponds to the working range of the connected sensor, which is read in via the actual value input (selected by the “PID actual value”).

Depending on the control difference, a rotation speed value is output to the control output with the help of the amplification factors for the proportional gain (3.050), integral gain (3.051) and derivative gain (3.052).

In order to prevent the integral share from increasing infinitely in the case of uncontrollable control differences, this value is limited to a specific set value (corresponding to the "maximum frequency" (1.021)).

PID inverted:

The PID actual value can be inverted using parameter 3.061. The actual value is imported inversely, i.e. 0 V…10 V correspond internally to 100%…0%.

Please note that the target value must also be defined inversely.

An example:

A sensor with an analogue output signal (0 V…10 V) is to operate as the source of the actual value (at AIx). At an output variable of 7 V (70 %), this is to be regulated inversely. The internal actual value then corresponds to 100 % – 70 % = 30 %.

In other words, the target value to be specified is 30 %.

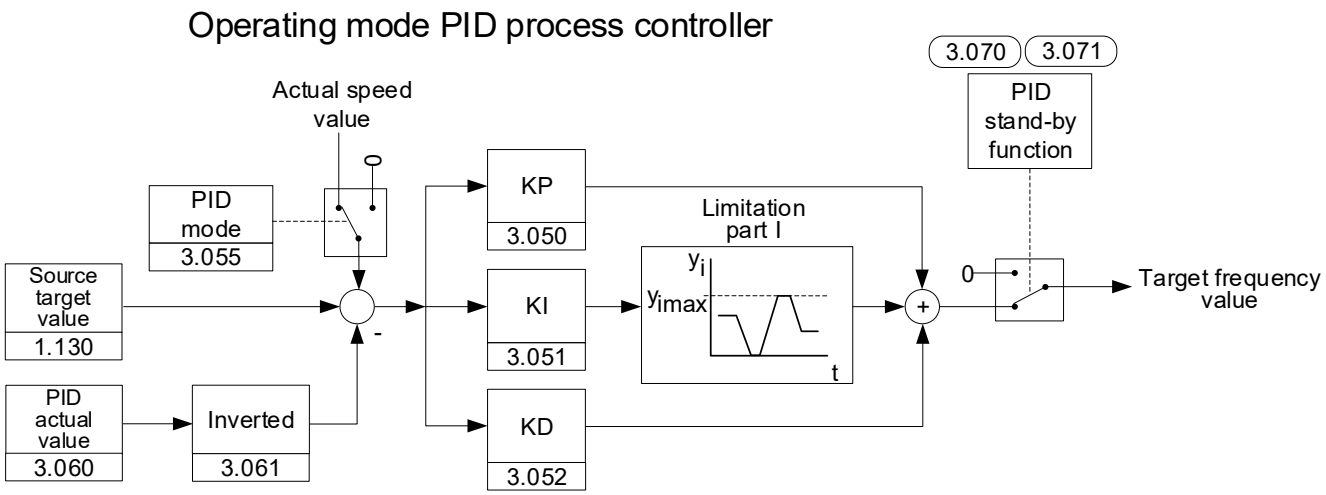


Fig. 18: PID process control

Stand-by function in PID process control

This function can provide energy savings in applications such as booster stations where PID process control is used to control to a specific process value and the pump has to run at a "minimum frequency" (1.020).
As the drive controller can reduce the rotation speed of the pump in normal operation when the process variable is reducing, but it can never fall below the “minimum frequency” (1.020), this provides an opportunity for stopping the motor if it is running during a waiting time, the “PID stand-by time” (3.070) with the “minimum frequency” (1.020).

Once the actual value deviates from the target value by the set % value, the “PID stand-by hysteresis” (3.071), the control (the motor) is started again.

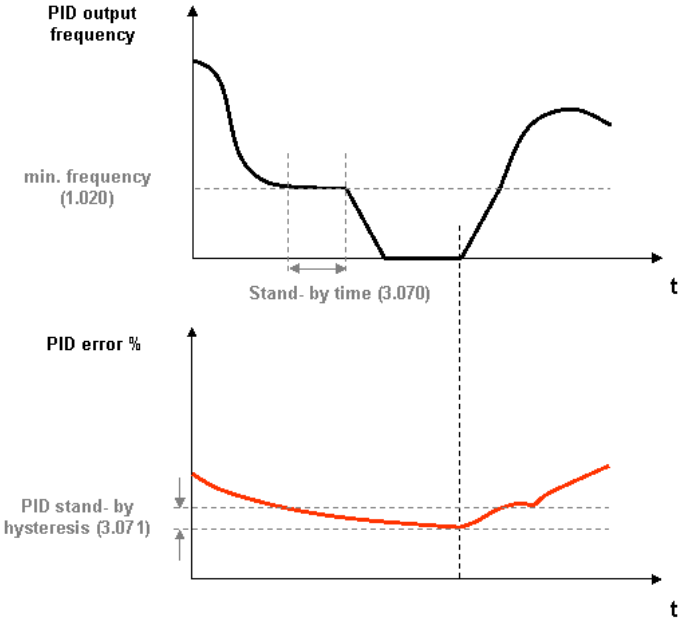


Fig. 19: Stand-by function in PID process control

Fixed frequency

This operating mode controls the drive controller with up to 7 fixed target values.
These are selected under parameter 2.050, where you can select how many fixed frequencies are to be used.

Parameter	Name	Selection options	Function	Number of digital inputs needed
2.050	Fixed frequency/mode	0	1 fixed frequency	1
		1	3 fixed frequencies	2
		2	7 fixed frequencies	3
	Foil keypad (option)	3	2 fixed frequencies	-
	Foil keypad (option)	4	4 fixed frequencies	-

Depending on the number of fixed frequencies required, up to 3 digital inputs are permanently assigned in the table.

Parameter	Name	Presetting	DI 3	DI2	DI1
1.020	Min. frequency	0 Hz	0	0	0
2.051 to 2.057	Fixed frequency 1	10 Hz	0	0	1
2.051 to 2.057	Fixed frequency 2	20 Hz	0	1	0
2.051 to 2.057	Fixed frequency 3	30 Hz	0	1	1
2.051 to 2.057	Fixed frequency 4	35 Hz	1	0	0
2.051 to 2.057	Fixed frequency 5	40 Hz	1	0	1
2.051 to 2.057	Fixed frequency 6	45 Hz	1	1	0
2.051 to 2.057	Fixed frequency 7	50 Hz	1	1	1

Tab. 9: Logic table for fixed frequencies

5.2.2 Motor identification

Various parameters are required for regulated operation of the motor.
For the majority of the parameters, please refer to the motor's type plate. Depending on the selected drive type, additional parameters may be required. These are automatically determined in the associated motor identification.

IMPORTANT INFORMATION

For the procedure for commissioning a drive, including automatic motor identification, please refer to chapter **Fehler! Verweisquelle konnte nicht gefunden werden. "Fehler! Verweisquelle konnte nicht gefunden werden."**

INFORMATION

After a motor is successfully commissioned, the determined data sets can be transferred to additional INNOMOTICS MD drive controller with the same motor without repeated motor identification.

5.2.3 Drive type

IMPORTANT INFORMATION

Please note that a new motor identification must be carried out each time the drive type is changed!

The drive type determines the control process used. This has broad consequences on parameters and performance.

The control process always fits for Synchronous motor with permanent magnets (PMSM).

The following table provides an overview of the characteristics of the drive types and the associated motor identification.

Drive type	Required motor type	Operating characteristics	Motor identification
110: PMSM Efficiency	Synchronous motor with permanent magnets	Regulated, encoderless overload capable, down to zero speed, highest efficiency	Rotating, < 5 min (stationary possible, rotating recommended)

Continues on next page

Continuation

COMMENT:

If you are unsure which motor type is present, the following test procedure will help you to differentiate between them:

The rated frequency and rated speed are indicated on the motor's type plate.

Calculate $\frac{60\ x\ rated\ frequency}{rated\ speed}$

The result is not a whole number but has decimal places

a) This statement is correct: Then it is an asynchronous motor (ASM)

b) This statement is incorrect: Then it is a synchronous motor and it needs to be ascertained whether it contains permanent magnets.
To do this, bridge the motor terminals and then turn the motor shaft by hand.
Is a speed-proportionate resistance torque felt?

b1) Yes: Then it is a synchronous motor **with** permanent magnets (PMSM)

b2) No: Then it is a synchronous motor **without** permanent magnets (SynRM)

DANGER!

Danger to life due to rotating or moving mechanical parts!

Death or serious injury!

Before starting work, block off the entire danger zone of the machine in such a way that uninvolved persons cannot come to harm!

IMPORTANT INFORMATION

In the detailed motor identification for the drive types "110: PMSM efficiency" and "200: SynRM efficiency", current pulses are applied to the motor up to the set "Motor current limit fixed" (5.069).

This will result in corresponding torques for a few milliseconds.

The resulting jolting movements of the motor shaft and the noises produced are normal!

5.2.4 Multiple-pump control

Application

The multiple-pump control function is intended for applications where several pumps, fans or compressors control a common process. With this solution, all process control is stored in the INNOMOTICS MD drive controllers. A total of up to 6 INNOMOTICS MD drive controllers can be connected together.
In such cases, the parameters for one pump are set as master and this pump assumes control of the process.
To increase system redundancy, the parameters for another pump can be set as auxiliary master. Should the master fail, this would then assume control and monitoring of the system.
The remaining INNOMOTICS MD drive controllers can be set as slaves.

Functionality

The process control needed for this functionality is provided via the integrated PID process controller of the master active at that time.

The process controller itself requires an actual value signal sent via a sensor connected to the process.

If an auxiliary master has been activated, this also needs a sensor signal. Here there are options to either use a sensor with a voltage output, which can then be connected in parallel to the analogue inputs of the master and auxiliary master or two separate sensors can be used for the two masters.

The target speed value calculated by the process controller is stipulated for all active pumps in parallel.

Should one pump not reach the target value, a second pump automatically activates.

If this also fails to reach the target value, more pumps are successively activated as required.

Vice versa, if too high a process value is reached, the speed of the active pumps is reduced to a minimum frequency and successive pumps are shut down if necessary.

The CANopen fieldbus is needed for communication.

There are no fixed assignments for the base load pump or auxiliary pumps. Each pump can act as a base load or auxiliary pump depending on operating hours.

Auxiliary master

In order to ensure continued operation in the event of a defective master, one of the pumps can be activated as auxiliary master.

To do this, the multiple-pump mode parameter 8.010 must be set to a value of 1 and the fieldbus address to 2.

For as long as the master is fully functional, the auxiliary master behaves like a slave drive.

But should the master fail (application electronics or fieldbus connection defective), the auxiliary master assumes control.

For this to happen, the auxiliary master also has to receive a sensor signal. There are options to either use a sensor with a voltage output, which can then be connected in parallel to the analogue inputs of the master and auxiliary master or two separate sensors can be used for the two masters.

Emergency operation if there is master and auxiliary master failure

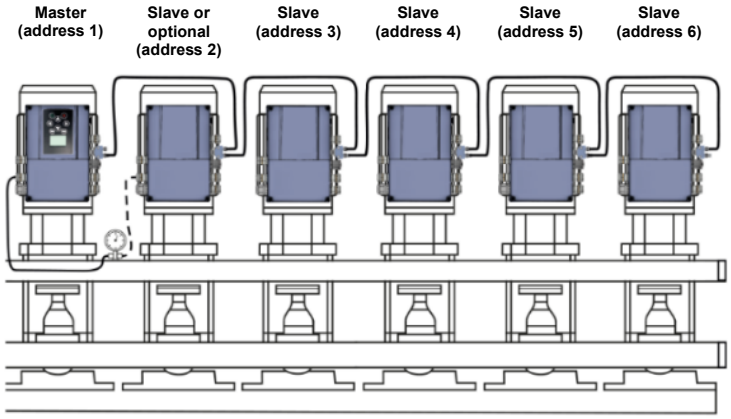
If there is a master and auxiliary master failure, the emergency mode can be activated. This emergency mode can be used with or without an auxiliary master. In emergency mode, all available slave drives run with the frequency parametrised under fixed frequency 1 (2.051).

Automatic pump changes

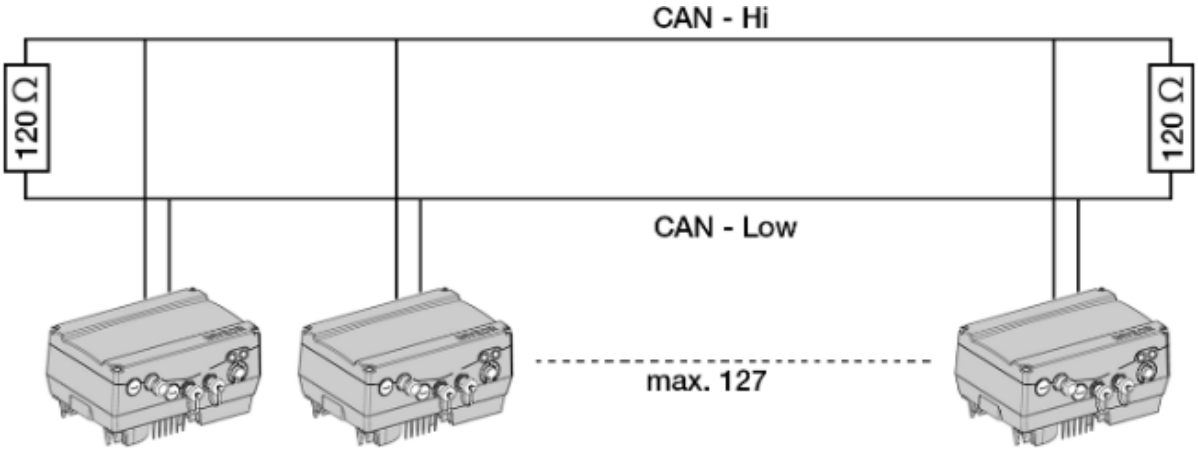
To ensure even wear on the pumps, the "Pump change time 8.050" parameter can be set to a value in hours.

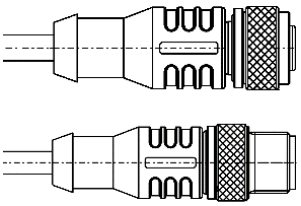
Once this time has lapsed, the system always changes over to the pump with the lowest operating hours.

Communication via CANopen fieldbus (example)



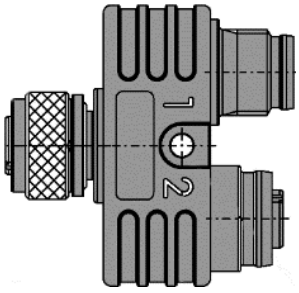
General setup and connection





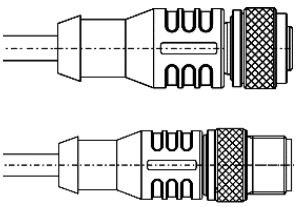
M12 connecting cable
(2 m)

(Article no.:10138812)



M12 Y-splitter

(Article no.:10138799)



M12 connecting cable
(5 m)

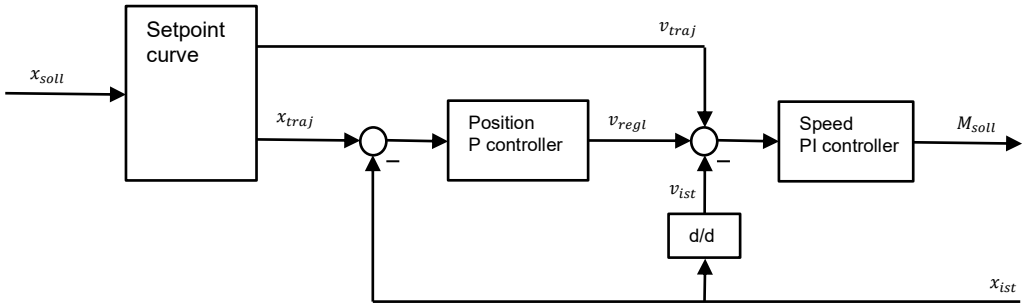
(Article no.:10138813)

M12 terminating resistor

(Article no.:10138793)

5.2.5 Positioning

The structure of the position control consists of a cascaded controller structure with setpoint curve.



The position target values $X_{setpoint}$ can be specified via bus (Profinet, Ethercat, Modbus, CAN, etc.), while physical loads may counteract the target torque $M_{setpoint}$ in addition to inertia.

The special design of the controller structure enables the guidance and disturbance behaviour to be set independently. It is therefore possible to react differently to target value changes than to changes in the load.

Guidance behaviour setting

The mostly abrupt changes of $X_{setpoint}$ are transformed by the setpoint curve into a smooth progression X_{traj}, whose rise and curvature adhere to the following limits:

Limitation		as per parameter	Number
Max. speed	dx/dt	Target frequency value	-
Max. acceleration	d^2x/dt^2	Run up time 1	1.051
Max. delay	d^2x/dt^2	Deceleration time 1	1.050
Max. jolt	d^3x/dt^3	S-curve	1.060

Within these limits, X_{traj} is always the shortest possible (time-optimal) course to the target $X_{setpoint}$.
These parameters determine the guidance behaviour of the positioning, i.e. the response to a target value change.

Interference behaviour tuning/setting

An additional P controller is now superimposed on the PI speed controller in positioning mode from the frequency setting mode. The I component of the speed controller also ensures that no stationary position control deviation remains under load.

The disturbance behaviour of the position control is thus determined by the following parameters:

Parameter name	Number	Affects
Pos. control boost	9.100	P component of the position controller
Speed controller Kp	34.090	P component of the speed controller
Speed controller Tn	34.091	I component of the speed controller

A stability requirement of cascaded control structures is for a subordinate control loop to be at least 2 to 4 times faster than the next one out. In position control, the bandwidth of the position controller (= P- Pos. control boost.) should therefore be correspondingly lower than the bandwidth of the speed controller (= speed controller Kp / rotor inertia * number of pool pairs).

Empirical parameter tuning should be done from the inside out:

1. Change in frequency setting mode (parameter 1.100)
2. Set fast run up time/deceleration time (e.g. 0.1 s) and S-curve (0.001 s)
3. Deactivate I component of speed controller (speed controller Tn >> 1 s)
4. Observe guide step response while slowly increasing speed controller Kp until undesired effects occur (oscillation, scratching, other individual criteria)
5. Starting from this, halve speed controller Kp and save.
6. Slowly lower the speed controller Tn until unwanted effects occur (multiple overshoots)
7. Starting from this, double speed controller Tn (increase further if necessary, multiple overshoots must be omitted) and save.
8. Change to positioning mode (parameter 1.100)
9. Observe guidance step response and thereby slowly increase or lower Pos. control boost (9.100) until the (subjectively) desired controller hardness is achieved. There should be no overshooting.

5.2.6 Structure of the parameter tables

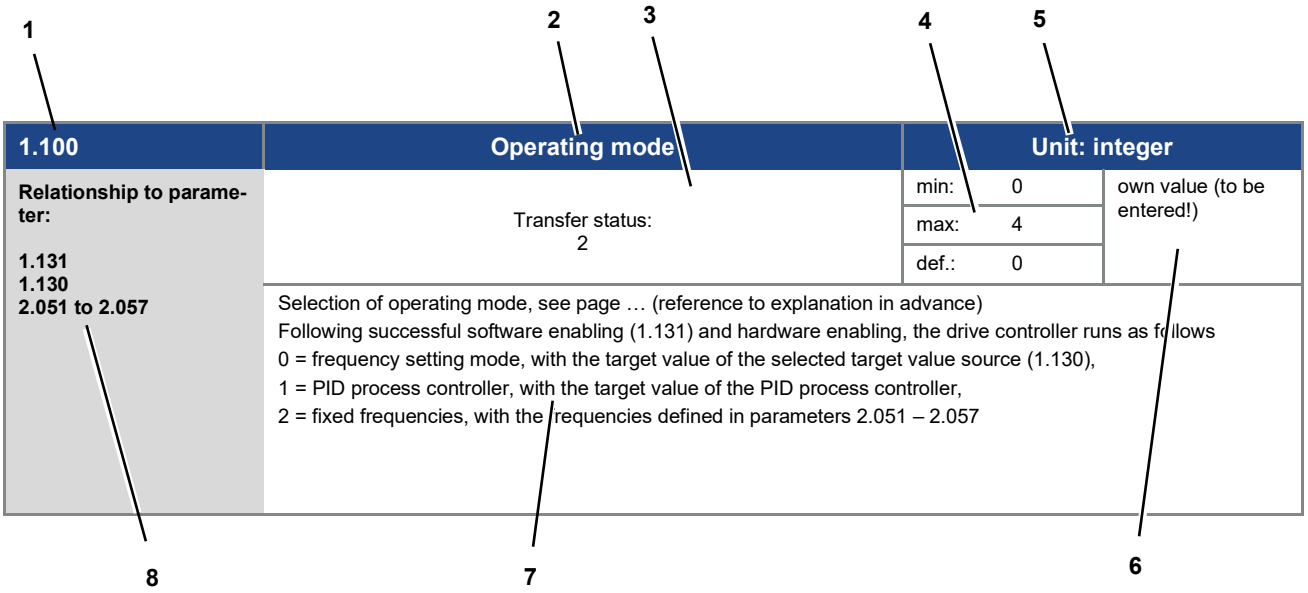


Fig. 20 Example of a parameter table

Key			
1	Parameter number	**5**	Unit
2	Parameter name	**6**	Field for entering an own value
3	Transfer status 0 = switch drive controller off and on for transfer 1 = at speed of 0 2 = during operation	**7**	Explanation of the parameter
4	Value range (from – to – factory setting)	**8**	Other parameters related to this parameter.

5.3 Application parameters

5.3.1 Basic parameter

1.020	Minimum frequency	Unit: Hz		
Relationship to parameter: 1.150 3.070 3.080 5.085	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	599	
		def.:	0	
	The minimum frequency is the frequency which is supplied by the drive controller as soon as it is enabled and there is no additional target value. The frequency falls below this level if: a) the drive accelerates from stationary b) the frequency converter is blocked. The frequency then falls to 0 Hz before it is blocked. c) the frequency converter reverses (1.150). The field of rotation reverses at 0 Hz. d) the standby function (3.070) is active. e) when the current limit is reached f) when the torque limit is reached			

1.021	Maximum frequency	Unit: Hz		
Relationship to parameter: 1.050 1.051	Transfer status: 2	min.:	5	Own value (to be entered!)
		max.:	599	
		def.:	50	
	The maximum frequency is the highest frequency produced by the inverter depending on the target value.			

1.050	Deceleration time 1	Unit: s		
Relationship to parameter: 1.021 1.054	Transfer status: 2	min.:	0.001	Own value (to be entered!)
		max.:	1000	
		def.:	5	
	Deceleration time 1 is the time that the drive controller needs to brake to 0 Hz from the max. frequency (1.021). If the set deceleration time cannot be reached, the fastest possible deceleration time is implemented.			

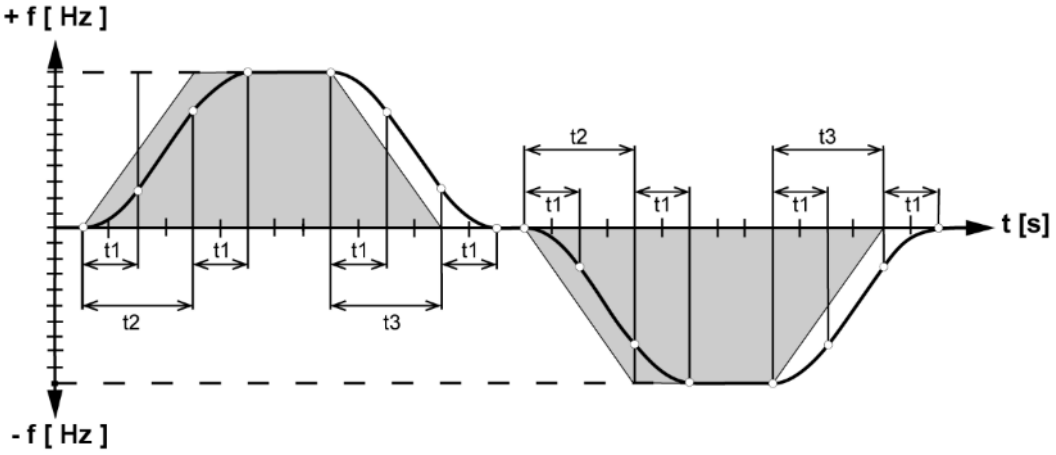
1.051	Run up time 1	Unit: s		
Relationship to parameter: 1.021 1.050 1.054	Transfer status: 2	min.:	0.001	Own value (to be entered!)
		max.:	1000	
		def.:	5	
	Run up time 1 is the time that the drive controller needs to accelerate from 0 Hz to the max. frequency. The run up time can be increased as a result of certain circumstances, e.g. if the drive controller is overloaded.			

1.052	Deceleration time 2	Unit: s		
Relationship to parameter: 1.021 1.050 1.054	Transfer status: 2	min.:	0.001	Own value (to be entered!)
		max.:	1000	
		def.:	10	
	Deceleration time 2 is the time that the drive controller needs to brake to 0 Hz from the max. frequency (1.021). If the set deceleration time cannot be reached, the fastest possible deceleration time is implemented.			

1.053	Run up time 2	Unit: s		
Relationship to parameter: 1.021 1.050 1.054	Transfer status: 2	min.:	0.001	Own value (to be entered!)
		max.:	1000	
		def.:	10	
	Run up time 2 is the time that the drive controller needs to accelerate from 0 Hz to the max. frequency. The acceleration time can be increased as a result of certain circumstances, e.g. if the drive controller is overloaded.			

1.054	Ramp selection	Unit: integer		
Relationship to parameter: 1.050 - 1.053	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	9	
		def.:	0	
	Selection of used ramp pair 0 = deceleration time 1 (1.050) / run up time 1 (1.051) 1 = deceleration time 2 (1.052) / run up time 2 (1.053) 2 = digital input 1 (false = ramp pair 1 / true = ramp pair 2) 3 = digital input 2 (false = ramp pair 1 / true = ramp pair 2) 4 = digital input 3 (false = ramp pair 1 / true = ramp pair 2) 5 = digital input 4 (false = ramp pair 1 / true = ramp pair 2) 6 = customer PLC 7 = analogue input 1 (must be selected in parameter 4.030) 8 = analogue input 2 (must be selected in parameter 4.060) 9 = virtual output (4.230)			

1.060	S-curve	Unit: s		
Relationship to parameter: 1.050 1.051	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	100	
		def.:	0.001	
	Given the application, it is good if the drive starts and stops smoothly. This can be achieved by smoothing the acceleration and delay time. t1 S-curve time (1.060) t2 Run up time (1.051) t3 Deceleration time (1.050)			



1.088	Rapid stop	Unit: s		
Relationship to parameter:	Transfer status: 2	min.:	0.1	Own value (to be entered!)
		max.:	1000	
		def.:	10	
	Only for variant with functional safety The rapid stop parameter prescribes the time that the inverter requires to brake to 0 Hz from the max. speed (1.021). If the set rapid stop time cannot be achieved, the fastest possible deceleration time is implemented.			

1.100	Operating mode	Unit: integer		
Relationship to parameter: **1.130** **1.131** **2.051 to 2.057** **3.050 to 3.071** **8.010 - 8.050**	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	4	
		def.:	0	
	Selecting the operating mode Following software enabling (1.131) and hardware enabling, the drive controller runs as follows: 0 = frequency setting mode, with the target value of the selected target value source (1.130) 1 = PID process controller, with the target value of the PID process controller (3.050 – 3.071), 2 = fixed frequencies, with the frequencies defined in parameters 2.051 – 2.057 3 = selection via INNOMOTICS MD drive controller soft PLC 4 = multiple-pump control (parameters 8.010 - 8.050) 5 = positioning (parameters 9.010 – 9.100)			

1.130	Target value source	Unit: integer		
Relationship to parameter: **3.062 to 3.069**	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	10	
		def.:	0	
	Determines the source from which the target value is to be read. 0 = internal potentiometer 1 = analogue input 1 2 = analogue input 2 3 = MMI/PC 4 = Modbus 6 = motor potentiometer 7 = sum of analogue inputs 1 and 2 8 = PID fixed target values (3.062 to 3.069) 9 = field bus 10 = INNOMOTICS MD drive controller soft PLC			

1.131	Enable software	Unit: integer		
Relationship to parameter: 1.132 1.150 2.050 4.030 4.030 / 4.060	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	16	
		def.:	0	

⚠ DANGER!

The motor may start immediately, depending on the change made.

Selection of the source for the control release.

0 = digital input 1
1 = digital input 2
2 = digital input 3
3 = digital input 4
4 = analogue input 1 (must be selected in parameter 4.030)
5 = analogue input 2 (must be selected in parameter 4.060)
6 = field bus
7 = Modbus
8 = digital input 1 on right / digital input 2 on left
1.150 must be set to "0"
9 = autostart
The motor may start immediately if hardware is enabled and a target value has been provided.
This cannot be prevented even with parameter 1.132.
10 = INNOMOTICS MD drive controller soft PLC
11 = fixed frequency inputs
(all inputs which were selected in parameter 2.050)
12 = internal potentiometer
13 = foil keypad (Start & Stop keys)
14 = MMI/PC
15 = virtual output (4.230)
16 = foil keypad storing
17 = edge for Dig In 1 start / Dig In 2 stop
18 = edge for Dig In 1 start on right /
edge for Dig In 2 start on left /
Dig In 3 stop (1.150 must be set to "0")

1.132	Start-up protection	Unit: integer		
Relationship to parameter: 1.131	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	8	
		def.:	1	

Selection of behaviour in response to enabling software (parameter 1.131).

No effect if autostart was selected.

0 = immediate start with high signal at input of control enable
1 = start only with rising edge at input of control enable
2 = digital input 1 (function active with high signal)
3 = digital input 2 (function active with high signal)
4 = digital input 3 (function active with high signal)
5 = digital input 4 (function active with high signal)
6 = INNOMOTICS MD drive controller soft PLC
7 = analogue input 1 (must be selected in parameter 4.030)

8 = analogue input 2 (must be selected in parameter 4.060)

1.150	Rotation direction	Unit: integer		
Relationship to parameter: 1.131 4.030 4.030 / 4.060	Transfer status: 2	min.: 0 max.: 16 def.: 0	Own value (to be entered!)	
Selection of direction of rotation specification 0 = dependent on target value (depending on the plus or minus sign of the target value: positive: forwards; negative: backwards) 1 = forwards only (no change in direction of rotation possible) 2 = backwards only (no change in direction of rotation possible) 3 = digital input 1 (0 V = forwards, 24 V = backwards) 4 = digital input 2 (0 V = forwards, 24 V = backwards) 5 = digital input 3 (0 V = forwards, 24 V = backwards) 6 = digital input 4 (0 V = forwards, 24 V = backwards) 7 = INNOMOTICS MD drive controller soft PLC 8 = analogue input 1 (must be selected in parameter 4.030) 9 = analogue input 2 (must be selected in parameter 4.060) 10 = foil keypad key for reversing direction of rotation (only when motor is running) 11 = foil keypad key I forwards / 2 backwards (reversal always possible) 12 = foil keypad key I forwards / 2 backwards (reversal only possible when motor stationary) 13 = virtual output (4.230) 14 = foil keypad key for reversing direction of rotation (only in operational status) storing 15 = foil keypad key I + II storing 16 = foil keypad key I + II (only if motor is stationary) stores the last active rotation direction				

1.180	Acknowledge function	Unit: integer		
Relationship to parameter: 1.181 1.182	Transfer status: 2	min.: 0 max.: 7 def.: 4	Own value (to be entered!)	
Selection of the source for error acknowledgement. Errors can only be acknowledged once the error is no longer present. Auto acknowledgement via parameter 1.181. 0 = manual acknowledgement not possible 1 = rising flank at digital input 1 2 = rising flank at digital input 2 3 = rising flank at digital input 3 4 = rising flank at digital input 4 5 = foil keypad (Ackn key) 6 = analogue input 1 (must be selected in parameter 4.030) 7 = analogue input 2 (must be selected in parameter 4.060)				

1.181	Automatic acknowledge function	Unit: s		
Relationship to parameter: 1.180 1.182	Transfer status: 2	min.: 0 max.: 1000 def.: 0	Own value (to be entered!)	
In addition to the acknowledge function (1.180), an automatic fault acknowledgement can be selected. 0 = no automatic acknowledgement > 0 = time for automatic resetting of error in seconds				

1.182	Number of automatic acknowledgements	Unit:	
Relationship to parameter: 1.180 1.181	Transfer status: 2	min.: 0 max.: 500 def.: 5	Own value (to be entered!)
	In addition to the automatic acknowledge function (1.181), it is possible to limit the maximum number of automatic acknowledgements here. 0 = no restriction on automatic acknowledgements > 0 = maximum number of automatic acknowledgements		

INFORMATION

INFORMATION

The internal counter for automatic acknowledgements already undertaken is reset if the motor is operated for the "maximum number of acknowledgements x auto acknowledgement time" period without any errors occurring (motor current > 0.2 A).

Example of resetting the auto acknowledgement counter

max. number of acknowledgements = 8
auto acknowledgement time = 20 sec. } 8 x 20 sec. = 160 sec.

After 160 sec. of motor operation without errors, the internal counter for "auto acknowledgements" undertaken is reset to "0".

In this example, 8 "auto acknowledgements" were accepted.

If an error occurs within the 160 sec., "error 22" is triggered on the 9th acknowledgement attempt.

This error has to be acknowledged manually by switching off the mains.

5.3.2 Fixed frequency

This mode has to be selected in parameter 1.100, see also the section on selecting the operating mode.

2.050	Fixed frequency mode	Unit: integer	
Relationship to parameter: 1.100 2.051 to 2.057	Transfer status: 2	min.: 0 max.: 4 def.: 2	Own value (to be entered!)
	Selection of the digital inputs used for fixed frequencies 0 = Digital In 1 (Fixed frequency 1) (2.051) 1 = Digital In 1, 2 (Fixed frequencies 1 - 3) (2.051 to 2.053) 2 = Digital In 1, 2, 3 (Fixed frequencies 1 - 7) (2.051 to 2.057) 3 = foil keypad (key I = fixed frequency 1 / key II = fixed frequency 2) 4 = fixed frequency (key I = fixed frequency 1 / key II = fixed frequency 2) storing		

2.051 to 2.057	Fixed frequency	Unit: Hz	
Relationship to parameter: 1.020 1.021 1.100 1.150 2.050	Transfer status: 2	min.: - 599 max.: + 599 def.:	Own value (to be entered!)
	The frequencies that are to be output at the digital inputs 1 - 3 specified in parameter 2.050 depending on the switching patterns. See chapter 5.2.1 Explanation of operating modes / fixed frequency.		

5.3.3 Motor potentiometer

This mode must be selected in parameter 1.130.
The function can be used as a target value source for frequency mode and for the PID process controller.

The motor potentiometer can be used to gradually increase / decrease the target value (PID/frequency). Use parameters 2.150 to 2.154 for this purpose.

2.150	MOP digital Input	Unit: integer	
Relationship to parameter: **1.130** **4.030** **4.050**	Transfer status: 2	min.: 0 max.: 8 def.: 3	Own value (to be entered!)
Selection of the source for increasing and reducing the target value 0 = digital input 1 + / digital input 2 – 1 = digital input 1 + / digital input 3 – 2 = digital input 1 + / digital input 4 – 3 = digital input 2 + / digital input 3 – 4 = digital input 2 + / digital input 4 – 5 = digital input 3 + / digital input 4 – 6 = analogue input 1 + / analogue input 2 – (must be selected in parameters 4.030 / 4.050) 7 = INNOMOTICS MD drive controller soft PLC 8 = foil keypad (key 1 - / key 2 +)			

2.151	MOP step range	Unit: %	
Relationship to parameter: **1.020** **1.021**	Transfer status: 2	min.: 0 max.: 100 def.: 1	Own value (to be entered!)
Increments at which the target value changes per keystroke.			

2.152	MOP step time	Unit: s	
Relationship to parameter:	Transfer status: 2	min.: 0.02 max.: 1000 def.: 0.04	Own value (to be entered!)
Indicates the time during which the target value is totalled with a permanent signal.			

2.153	MOP response time	Unit: s	
Relationship to parameter:	Transfer status: 2	min.: 0.02 max.: 1000 def.: 0.3	Own value (to be entered!)
Indicates the time for which the signal is considered permanent.			

2.154	MOP reference memory	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
Defines whether the target value of the motor potentiometer is retained even after power outage. 0 = disable 1 = enable			

5.3.4 PID process controller

This mode must be selected in parameter 1.100,
the target value source must be selected in parameter 1.130,
see also chapter 5.2.1 Explanation of operating modes / fixed frequency.

3.050	PID-P amplification factor	Unit:		
Relationship to parameter: 1.100 1.130	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	100	
		def.:	1	
	Proportional share of PID controller amplification factor			

3.051	PID-I amplification factor	Unit: 1/s		
Relationship to parameter: 1.100 1.130	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	100	
		def.:	1	
	Integral share of PID controller amplification factor			

3.052	PID-D amplification factor	Unit: s		
Relationship to parameter: 1.100 1.130	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	100	
		def.:	0	
	Differential share of PID controller amplification factor			

3.055	PID mode	Unit: integer		
Relationship to parameter:	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	1	
		def.:	0	
	Switches can be made between PID modes here: 0: Standard (no consideration of actual frequency) 1: with consideration of actual frequency			

3.060	PID actual value	Unit: integer		
Relationship to parameter: 1.100 1.130 3.061	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	3	
		def.:	0	
	Selection of the input source from which the actual value for the PID process controller is imported: 0 = analogue input 1 1 = analogue input 2 2 = INNOMOTICS MD drive controller soft PLC 3 = fieldbus (fixed customer-specific input variable 2)			

3.061	PID inverted	Unit: integer		
Relationship to parameter: 3.060	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	1	
		def.:	0	
	The actual value source (parameter 3.060) is inverted 0 = disable 1 = enable			

3.062 to 3.068	PID fixed target values	Unit: %		
Relationship to parameter: 1.130 3.069	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	100	
		def.:	0	
	The PID fixed target values which are to be issued depending on the switching patterns at the digital inputs 1 – 3 specified in parameter 3.069 (has to be selected in parameter 1.130).			

3.069	PID fixed target mode	Unit: integer		
Relationship to parameter: 1.100 3.062 to 3.068	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	2	
		def.:	0	
	Selection of the digital inputs used for fixed frequencies			
	0 = Digital In 1 (PID fixed target value 1) (3.064) 1 = Digital In 1, 2 (PID fixed target values 1 – 3) (3.062 to 3.064) 2 = Digital In 1, 2, 3 (PID fixed target values 1 – 7) (3.062 to 3.068)			

3.070	PID standby time	Unit: s		
Relationship to parameter: 1.020	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	10000	
		def.:	0	
	If the drive controller runs for the set time at its minimum frequency (parameter 1.020), the motor is stopped (0 Hz), see also Chapter 5.2.1 Explanation of operating modes / fixed frequency. 0 = disable > 0 = waiting time until stand-by function is enabled			

3.071	PID stand-by hysteresis	Unit: %		
Relationship to parameter: 3.060	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	50	
		def.:	0	
	Condition for waking up the PID controller from stand-by. Once the control difference exceeds the set value as %, the control begins again, see also PID controller operating modes.			

3.072	PID dry run time	Unit: s		
Relationship to parameter:	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	32767	
		def.:	0	
	After this set time, if the PID actual value has not reached at least 5 % and the controller is running at the max. limit, the INNOMOTICS MD drive controller switches off with error no. 16 PID dry run.			

3.073	PID nominal value min	Unit: %		
Relationship to parameter: 3.074	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	100	
		def.:	0	
	The PID nominal value can be limited using 2 parameters. Example: 0 -10 V target value potentiometer Read Min PID nominal value = 20 % Read Max PID nominal value = 80 % (3.074) Target value at < 2 V = 20 % Target value at 2 V – 8 V = 20 % - 80 % Target value at > 8 V = 80 %			

3.074	PID nominal value max	Unit: %		
Relationship to parameter: 3.073	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	100	
		def.:	100	
	The PID nominal value can be limited using 2 parameters. Example: 0 -10 V target value potentiometer Read Min PID nominal value = 20 % Read Max PID nominal value = 80 % (3.073) Target value at < 2 V = 20 % Target value at 2 V – 8 V = 20 % - 80 % Target value at > 8 V = 80 %			

3.080	PID minimum frequency 2	Unit: Hz		
Relationship to parameter: 1.020	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	400	
		def.:	0	
	The minimum frequency is calculated depending on the PID target value Example: 1.020 minimum frequency = 10 Hz 3.080 PID minimum frequency 2 = 20 Hz Minimum frequency when PID target value is 0 % = 10 Hz Minimum frequency when PID target value is 50 % = 15 Hz Minimum frequency when PID target value is 100 % = 20 Hz			

5.3.5 Analogue inputs

For analogue inputs 1 and 2 (AIx display AI1/AI2)

4.020 / 4.050	Aix input type	Unit: integer		
Relationship to parameter:	Transfer status: 2	min.:	1	Own value (to be entered!)
		max.:	2	
		def.:	1	
	Function of analogue inputs 1 / 2. 1 = voltage input 2 = current input			

4.021 / 4.051	Aix standard Low	Unit: %		
Relationship to parameter:	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	100	
		def.:	0	
	Specifies the minimum value of the analogue inputs as a percentage of the range Example: 0 to 10 V and/or 0 to 20 mA = 0 % to 100 % 2…10 V or 4…20 mA = 20 %...100 %			

4.022 / 4.052	Aix standard High	Unit: %		
Relationship to parameter:	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	100	
		def.:	100	
	Specifies the maximum value of the analogue inputs as a percentage of the range. Example: 0 to 10 V and/or 0 to 20 mA = 0 % to 100 % 2…10 V or 4…20 mA = 20 %...100 %			

4.023 / 4.053	Aix dead time	Unit: %		
Relationship to parameter:	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	100	
		def.:	0	
	Dead time as percentage of the range of the analogue inputs.			

4.024 / 4.054	Aix filter time	Unit: s		
Relationship to parameter:	Transfer status: 2	min.:	0.02	Own value (to be entered!)
		max.:	1.00	
		def.:	0	
	Filter time of analogue inputs in seconds.			

4.030 / 4.060	Aix function	Unit: integer		
Relationship to parameter:	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	1	
		def.:	0	
	Function of analogue inputs 1/2 0 = analogue input 1 = digital input			

4.033 / 4.063	Aix physical unit	Unit:	
Relationship to parameter: 4.034 / 4.064 4.035 / 4.065	Transfer status: 2	min.: 0 max.: 15 def.: 0	Own value (to be entered!)
	Selection of different physical values to be displayed. 0 = % 1 = bar 2 = mbar 3 = psi 4 = Pa 5 = m³/h 6 = l/min 7 = ° C 8 = ° F 9 = m 10 = mm		

4.034 / 4.064	Aix physical minimum	Unit:	
Relationship to parameter: 4.033 / 4.063 4.035 / 4.065	Transfer status: 2	min.: - 10000 max.: + 10000 def.: 0	Own value (to be entered!)
	Selection of the lower limit of a physical value to be displayed.		

4.035 / 4.065	Aix physical maximum	Unit:	
Relationship to parameter: 4.033 / 4.063 4.034 / 4.064	Transfer status: 2	min.: - 10000 max.:+ 10000 def.: 100	Own value (to be entered!)
	Selection of the upper limit of a physical value to be displayed.		

4.036 / 4.066	Aix wire break time	Unit:	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 32767 def.: 0.5	Own value (to be entered!)
	Once the mains is activated, wire break detection is only activated after this set time		

4.037 / 4.067	Aix inverted	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	The signal of the analogue input can be inverted here. 0 = disable (example: 0 V = 0 % 10 V = 100 %) 1 = enable (example: 0 V = 100 % 10 V = 0 %)		

5.3.6 Digital inputs

4.110 to 4.113	DIx inverted	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	This parameter can be used to invert the digital input. 0 = disable 1 = enable		

5.3.7 Analogue output

4.100	AO1 function	Unit: integer	
Relationship to parameter: 4.101 4.102	Transfer status: 2	min.: 0 max.: 40 def.: 0	Own value (to be entered!)
	Selection of the process value that is output at the analogue output. Depending on the process value selected, the standardisation (4.101 / 4.102) must be adapted. 0 = Not assigned / INNOMOTICS MD drive controller soft PLC 1 = Intermediate circuit voltage 2 = Supply voltage 3 = Motor voltage 4 = Motor current 5 = Actual frequency 6 = Speed measured externally by speed sensor (if available) 7 = Current angle or position (if available) 8 = IGBT temperature 9 = Inner temperature 10 = Analogue input 1 11 = Analogue input 2 12 = Target frequency 13 = Motor rating 14 = Torque 15 = Fieldbus 16 = PID target value 17 = PID actual value 18 = Target frequency value after ramp 19 = Actual speed value 20 = Actual frequency value sum 21 = Torque sum 22 = Target frequency value after ramp sum 23 = Target frequency value sum 24 = Actual speed value sum		

4.101	AO1 standard Low	Unit:	
Relationship to parameter: 4.100	Transfer status: 2	min.: - 10000 max.:+ 10000 def.: 0	Own value (to be entered!)
	Describes which area is to be broken down into the 0-10 V output voltage or the 0-20 mA output current.		

4.102	AO1 standard High	Unit:	
Relationship to parameter: 4.100	Transfer status: 2	min.: - 10000 max.:+ 10000 def.: 0	Own value (to be entered!)
	Describes which area is to be broken down into the 0-10 V output voltage or the 0-20 mA output current.		

5.3.8 Digital outputs

For digital outputs 1 and 2 (Dox display DO1 / DO2)

4.150 / 4.170	Dox function	Unit: integer	
Relationship to parameter: 4.151 / 4.171 4.152 / 4.172	Transfer status: 2	min.: 0 max.: 51 def.: 0	Own value (to be entered!)

Selection of the process variable to which the output should switch.

0	=	Not assigned / INNOMOTICS MD drive controller soft PLC
1	=	Intermediate circuit voltage
2	=	Supply voltage
3	=	Motor voltage
4	=	Motor current
5	=	Actual frequency value
6	=	-
7	=	-
8	=	IGBT temperature
9	=	Inner temperature
10	=	Error (NO)
11	=	Error inverted (NC)
12	=	Limit steps enable
13	=	Digital input 1
14	=	Digital input 2
15	=	Digital input 3
16	=	Digital input 4
17	=	Ready for operation (mains supply on, no HW enable, motor stationary)
18	=	Ready (mains supply on, HW enable set, motor stationary)
19	=	Operation (mains supply on, HW enable set, motor running)
20	=	Ready for operation + Ready
21	=	Ready for operation + Ready + Operation
22	=	Ready + Operation
23	=	Motor rating
24	=	Torque
25	=	Fieldbus
26	=	Analogue input 1
27	=	Analogue input 2
28	=	PID target value
29	=	PID actual value
30	=	STO channel 1

Table continues on next page

4.150 / 4.170	Dox function	Unit: integer	
Relationship to parameter: 4.151 / 4.171 4.152 / 4.172	Transfer status: 2	min.: 0 max.: 51 def.: 0	Own value (to be entered!)
	Selection of the process variable to which the output should switch. **Continuation of table** 31 = STO channel 2 32 = Target frequency value after ramp 33 = Target frequency value 34 = Actual speed value 35 = Actual frequency value sum 36 = Torque sum 37 = Target frequency value after ramp sum 38 = Target frequency value sum 39 = Actual speed value sum 40 = Virtual output 50 = Motor current limit enabled 51 = Nominal-actual comparison (para. 6.070 – 6.071)		

4.151 / 4.171	Dox on	Unit:	
Relationship to parameter: 4.150 / 4.170	Transfer status: 2	min.: - 32767 max.: 32767 def.: 0	Own value (to be entered!)
	If the set process variable exceeds the switch-on limit, the output is set to 1.		

4.152 / 4.172	Dox off	Unit:	
Relationship to parameter: 4.150 / 4.170	Transfer status: 2	min.: - 32767 max.: 32767 def.: 0	Own value (to be entered!)
	If the set process variable exceeds the switch-off limit, the output is again set to 0.		

5.3.9 Relay

For relays 1 and 2 (rel. X – display rel. 1/ rel. 2)

4.190 / 4.210	Rel.x function	Unit: integer	
Relationship to parameter: 4.191 / 4.211 4.192 / 4.212	Transfer status: 2	min.: 0 max.: 51 def.: 0	Own value (to be entered!)
	Selection of the process variable to which the output should switch. 0 = Not assigned / INNOMOTICS MD drive controller soft PLC 1 = Intermediate circuit voltage 2 = Supply voltage 3 = Motor voltage 4 = Motor current 5 = Actual frequency value 6 = - 7 = - 8 = IGBT temperature 9 = Inner temperature 10 = Error (NO) 11 = Error inverted (NC) 12 = Limit steps enable **Table continues on next page**		

4.190 / 4.210	Rel.x function	Unit: integer	
Relationship to parameter: 4.191 / 4.211 4.192 / 4.212	Transfer status: 2	min.: 0 max.: 51 def.: 0	Own value (to be entered!)
	Selection of the process variable to which the output should switch. **Continuation of table** 13 = Digital input 1 14 = Digital input 2 15 = Digital input 3 16 = Digital input 4 17 = Ready for operation (mains supply on, no HW enable, motor stationary) 18 = Ready (mains supply on, HW enable set, motor stationary) 19 = Operation (mains supply on, HW enable set, motor running) 20 = Ready for operation + Ready 21 = Ready for operation + Ready + Operation 22 = Ready + Operation 23 = Motor rating 24 = Torque 25 = Fieldbus 26 = Analogue input 1 27 = Analogue input 2 28 = PID target value 29 = PID actual value 30 = STO channel 1 31 = STO channel 2 32 = Target frequency value after ramp 33 = Target frequency value 34 = Actual speed value 35 = Actual frequency value sum 36 = Torque sum 37 = Target frequency value after ramp sum 38 = Target frequency value sum 39 = Actual speed value sum 40 = Virtual output 50 = Motor current limit enabled 51 = Nominal-actual comparison (para. 6.070 – 6.071)		

4.191 / 4.211	Rel.x on	Unit:	
Relationship to parameter: 4.190 / 4.210	Transfer status: 2	min.: - 32767 max.: 32767 def.: 0	Own value (to be entered!)
	If the set process variable exceeds the switch-on limit, the output is set to 1.		

4.192 / 4.212	Rel.x off	Unit:	
Relationship to parameter: 4.190 / 4.210	Transfer status: 2	min: - 32767 max: 32767 def.: 0	Own value (to be entered!)
	If the set process variable exceeds the switch-off limit, the output is again set to 0.		

4.193 / 4.213	Rel.x on delay	Unit: s		
Relationship to parameter: **4.194 / 4.214**	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	10000	
		def.:	0	
	Specifies the length of the switch-on delay.			

4.194 / 4.214	Rel.x off delay	Unit:		
Relationship to parameter: **4.193 / 4.213**	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	10000	
		def.:	0	
	Specifies the length of the switch-off delay.			

5.3.10 Virtual output

The virtual output can be parameterised like a relay and is available as an option with the following parameters:
1.131 Software enable / 1.150 Direction of rotation / 1.054 Ramp selection /
5.090 Parameter set change / 5.010 + 5.011 External error 1 + 2

4.230	VO function	Unit: integer		
Relationship to parameter: **1.054** **1.131** **1.150** **4.231** **4.232** **5.010 / 5.011** **5.010 / 5.011** **5.090**	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	51	
		def.:	0	
	Selection of the process variable to which the output should switch. 0 = Not assigned / INNOMOTICS MD drive controller soft PLC 1 = Intermediate circuit voltage 2 = Supply voltage 3 = Motor voltage 4 = Motor current 5 = Actual frequency value 6 = - 7 = - 8 = IGBT temperature 9 = Inner temperature 10 = Error (NO) 11 = Error inverted (NC) 12 = Limit steps enable 13 = Digital input 1 14 = Digital input 2 15 = Digital input 3 16 = Digital input 4 17 = Ready for operation (mains supply on, no HW enable, motor stationary) 18 = Ready (mains supply on, HW enable set, motor stationary) 19 = Operation (mains supply on, HW enable set, motor running) 20 = Ready for operation + Ready **Table continues on next page**			

4.230	VO function	Unit: integer	
Relationship to parameter: 1.054 1.131 1.150 4.231 4.232 5.010 / 5.011 5.010 / 5.011 5.090	Transfer status: 2	min.: 0 max.: 51 def.: 0	Own value (to be entered!)
Selection of the process variable to which the output should switch. **Continuation of table** 21 = Ready for operation + Ready + Operation 22 = Ready + Operation 23 = Motor rating 24 = Torque 25 = Fieldbus 26 = Analogue input 1 27 = Analogue input 2 28 = PID target value 29 = PID actual value 30 = STO channel 1 31 = STO channel 2 32 = Target frequency value after ramp 33 = Target frequency value 34 = Actual speed value 35 = Actual frequency value sum 36 = Torque sum 37 = Target frequency value after ramp sum 38 = Target frequency value sum 39 = Actual speed value sum 50 = Motor current limit enabled 51 = Nominal-actual comparison (para. 6.070 – 6.071)			

4.231	VO-On	Unit:	
Relationship to parameter: 4.230	Transfer status: 2	min.: - 32767 max.: 32767 def.: 0	Own value (to be entered!)
If the set process variable exceeds the switch-on limit, the output is set to 1.			

4.232	VO-Off	Unit:	
Relationship to parameter: 4.230	Transfer status: 2	min.: - 32767 max.: 32767 def.: 0	Own value (to be entered!)
If the set process variable exceeds the switch-off limit, the output is again set to 0.			

4.233	VO-On delay	Unit: s		
Relationship to parameter: 4.234	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	10000	
		def.:	0	
	Specifies the length of the switch-on delay.			

4.234	VO-Off delay	Unit:		
Relationship to parameter: 4.233	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	10000	
		def.:	0	
	Specifies the length of the switch-off delay.			

4.235	VO inverted	Unit: integer		
Relationship to parameter: 4.230	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	1	
		def.:	0	
	This parameter can be used to invert the virtual output. 0 = disable 1 = enable			

5.3.11 External error

5.010 / 5.011	External error 1/2	Unit: integer		
Relationship to parameter: 4.110 / 4.113 4.230	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	7	
		def.:	0	
	Selection of source via which an external error can be reported. 0 = Not assigned / INNOMOTICS MD drive controller soft PLC 1 = Digital input 1 2 = Digital input 2 3 = Digital input 3 4 = Digital input 4 5 = Virtual output (parameter 4.230) 6 = Analogue input 1 (must be selected in parameter 4.030) 7 = Analogue input 2 (must be selected in parameter 4.060) If there is a high signal at the selected digital input, the drive controller with error no. 23 / 24, switches external error ½. Parameters 4.110 to 4.113 Dix inverse can be used to invert the logic of the digital input.			

5.3.12 Motor current limit

The maximum permissible motor current can be set via parameter "Motor current limit fixed" (5.069) as a percentage of the rated motor current as per parameter "Motor current" (33.031).

In addition, the motor current can be limited to a parametrised maximum value after reaching a parametrised current-time zone.

This function limits the motor current to a parameterised maximum value after a parameterised current-time zone has been reached.

This motor current limit is monitored at application level and thereby limits with relatively low dynamics.
This has to be taken into consideration when selecting this function.

The maximum value is determined using the “motor current limit as %” parameter (5.070).
This is stated as a percentage and relates to the nominal motor current specified in the “motor current” type plate data (33.031).

The maximum current-time zone is calculated from the product of the “motor current limit in s” parameter (5.071) and the fixed overcurrent of 50% of the required motor current limit.

As soon as this current-time zone is exceeded, the motor current is restricted to the limit value by reducing the speed. If the output current of the drive controller exceeds the motor current (parameter 33.031) multiplied by the set limit as % (parameter 5.070) for the set time (parameter 5.071), the output current of the drive controller is limited permanently to the parametrised value.

The entire function can be deactivated by setting the “motor current limit as %” parameter (5.070) to zero.

5.069	Motor current limit fixed	Unit: %		
Relationship to parameter: 33.031	Transfer status: 2	min.:	500	Own value (to be entered!)
		max.:	500	
		def.:	200	
	(see description in chapter 5.3.12)			

5.070	Motor current limit as %	Unit: %		
Relationship to parameter: 5.071 33.031	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	250	
		def.:	0	
	0 = disable **(see description in chapter 5.3.12)**			

5.071	Motor current limit S	Unit: s		
Relationship to parameter: 5.070 33.031	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	100	
		def.:	1	
	See description 5.3.12			

5.3.13 Gearbox factor

5.075	Gearbox factor	Unit:		
Relationship to parameter: 33.034	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	1000	
		def.:	1	
	A gearbox factor can be set here. The mechanical speed display can be adjusted using the gearbox factor.			

5.3.14 Blocking detection

5.080	Blocking detection	Unit: integer		
Relationship to parameter: 5.081 34.110	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	1	
		def.:	0	
	This parameter can be used to activate blocking detection. 0 = disable 1 = enable This function only works reliably if the motor data has been entered correctly and the slip compensation has not been deactivated.			

5.081	Blocking time	Unit: s		
Relationship to parameter: 5.080	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	50	
		def.:	2	
	Indicates the time after which a blockage is detected.			

5.3.15 Additional functions

5.082	Start-up error active	Unit: integer		
Relationship to parameter:	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	1	
		def.:	1	
	Start-up error is defined as follows: Actual value does not reach 10 % of the rated motor frequency after 30 seconds (if target frequency < 10 %, the error is not generated). If the acceleration time is parametrised as > 60 seconds, half the acceleration time is used in place of the 30 seconds. 0 = Function disabled 1 = Function enabled			

5.083	Deactivation error log 11	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 10 def.: 0	Own value (to be entered!)
	If supplied with external 24 V, the logging of error no. 11 "Time out power" can be suppressed here. The error counter is not affected. 0 = Function disabled 1 = Function enabled		

5.085	F. min monitoring	Unit: s	
Relationship to parameter: 1.020	Transfer status: 2	min.: 0 max.: 10000 def.: 0	Own value (to be entered!)
	The delay for monitoring the minimum frequency can be set here. If the minimum frequency for the set time is not reached, error 28 is generated. 0s = function disabled > 0s = function enabled The time must be long enough for the motor to be able to reliably start.		

5.086	F. max monitoring	Unit: s	
Relationship to parameter: 1.021	Transfer status: 2	min.: 0 max.: 10000 def.: 0	Own value (to be entered!)
	The delay for monitoring the maximum frequency can be set here. If the maximum frequency for the set time is exceeded, error 28 is generated. 0s = function disabled > 0s = function enabled		

5.090	Parameter set change	Unit: integer	
Relationship to parameter: 4.030 / 4.060 4.230	Transfer status: 2	min.: 0 max.: 12 def.: 0	Own value (to be entered!)
	Selection of the active data set. 0 = Not used 1 = Data record 1 active 2 = Data record 2 active 3 = Digital input 1 4 = Digital input 2 5 = Digital input 3 6 = Digital input 4 7 = INNOMOTICS MD drive controller soft PLC 8 = Virtual output (parameter 4.230) 9 = Analogue input 1 (must be selected in parameter 4.030) 10 = Analogue input 2 (must be selected in parameter 4.060) 11 = Foil keypad key I for data set 1, key II for data set 2 12 = Foil keypad key I for data set 1, key II for data set 2 storing		
	The 2nd data record is only displayed in the PC software if this parameter is <> 0. The values of the data set currently selected are always displayed in the MMI.		

5.3.16 MMI parameter

5.200	Turning MMI* display	Unit: integer		
Relationship to parameter:	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	1	
		def.:	0	
	Only for MMI in cover. Here the user can define whether the screen / key assignment is turned 180°. 0 = Function disabled 1 = Function enabled			

5.201	Save MMI* display	Unit: integer		
Relationship to parameter:	Transfer status: 2	min.:	1	Own value (to be entered!)
		max.:	5	
		def.:	1	
	The status screen displayed in the MMI * can be selected here. 1 = status 01: Target / actual frequency / motor current 2 = status 02: Speed / motor current / process value 1 3 = status 03: Speed / motor current / process value 2 4 = status 04: Speed / PID target value / PID actual value 5 = status 05: Customer PLC output variable 1 / 2 / 3			

5.202	MMI* password	Unit: integer		
Relationship to parameter:	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	9999	
		def.:	0	
	A password can be allocated here, which is requested when expert mode is selected in the MMI * or the app is queried. 0: Password request deactivated The password can be individually set in both data sets.			

5.210	MMI* option language	Unit: integer		
Relationship to parameter:	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	1	
		def.:	0	
	This parameter can be used to select the language which the MMI * option displays. 0 = local language (factory setting is German) 1 = English This setting does not affect the language choice for the MMI handheld controller.			

*** Man-machine interface**

5.3.17 Fieldbus

6.010	Ethernet fieldbus	Unit: integer	
Relationship to parameter:	Transfer status: 0	min.: 0 max.: 2 def.: 0	Own value (to be entered!)

ONLY FOR DEVICE VARIANTS WITH ETHERNET FIELDBUS MODULES (e.g. AP17 / AP26 / AP47 / AP56)

This parameter can be used to select the Ethernet fieldbus cycle:
0 = Profinet
1 = Sercos III
2 = EtherCat
3 = Ethernet/IP

IMPORTANT INFORMATION

May result in destruction of the device.

The INNOMOTICS MD drive controller **must** be de-energised once after the parameter has been changed! Once the voltage is activated, the selected fieldbus cycle is loaded, this process may take one to two minutes.

The INNOMOTICS MD drive controller **must not be switched off** during this time!

Once successfully loaded, the INNOMOTICS MD drive controller restarts!

6.060	Fieldbus address	Unit: integer	
Relationship to parameter:	Transfer status: 0	min.: 0 max.: 127 def.: 0	Own value (to be entered!)

For this address to be used, the address coding switches in the device must be set to 00.
A change to the fieldbus address is only undertaken once INNOMOTICS MD drive controller is restarted

Profibus devices are automatically set to the "Default 125" address with address coding setting "00" and parameter "0".

6.061	Fieldbus baud rate	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 8 def.: 2	Own value (to be entered!)

Only for CanOpen:
0 = 1 Mbit,
2 = 500 kBit,
3 = 250 kBit,
4 = 125 kBit,
6 = 50 kBit,
7 = 20 kBit,
8 = 10 kBit

*** Man-machine interface**

6.062	Bus time-out	Unit in s	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 100 def.: 5	Own value (to be entered!)
	Bus timeout, if no fieldbus telegram is received after the set time has expired, the INNOMOTICS MD drive controller shuts down with the "Bus timeout" error. The function is only activated once a telegram has been successfully received. 0 = Monitoring disabled		

IMPORTANT INFORMATION

Changing a parameter value via the fieldbus includes direct EEPROM write access.

6.067	IP-address	Unit:	
Relationship to parameter:	Transfer status: 0	min.: 0.0.0.0 max.: 255.255.255.255 def.: 192.168.0.31	Own value (to be entered!)
	The IP address of the Ethernet-based fieldbus can be entered into this parameter if the default address set at the factory is to be changed. If the IP address is set automatically by the fieldbus master, the parameter can be set to 0.0.0.0 or another value.		

6.070 / 6.071	Target / actual value deviation	Unit: %	
Relationship to parameter: **4.150 / 4.170** **4.190 / 4.210** **4.230**	Transfer status: 2	min.: 0 % / 0 sec. max.: 100 % / 32767 sec. def.: 0 % / 0 sec.	Own value (to be entered!)
	A target / actual value comparison can be undertaken with this function. The result is output via the fieldbus status word or a digital output. Parameter 6.070 can be used to define the tolerance range of the target value. Parameter 6.071 can be used to set the time for which the actual value has to be outside the tolerance range before the output is reset. Example: Operating mode = PID control PID target value = 50 % 6.070 = 10 % 6.071 = 1 sec. As soon as the actual value is between 40 % and 60 %, the output is set. If the actual value is outside 40 % to 60 % for 1 sec., the output is reset.		

5.3.18 MQTT

6.150	MQTT active	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	The MQTT protocol can be activated via the parameter. The MQTT protocol is available via the Profinet and Ethernet IP fieldbus options. 0 = MQTT inactive 1 = MQTT active		

6.151	MQTT Broker adr.	Unit:	
Relationship to parameter:	Transfer status: 0	min.: 0.0.0.0 max.: 255.255.255.255 def.: 192.168.0.2	Own value (to be entered!)
	The IP address of the broker can be entered in this parameter.		

6.152	MQTT Broker Port	Unit: integer	
Relationship to parameter:	Transfer status: 0	min.: 0 max.: 99999 def.: 1883	Own value (to be entered!)
	The port number of the broker can be entered in this parameter.		

6.153	MQTT Sample Rate	Unit: s	
Relationship to parameter:	Transfer status: 2	min.: 0,1 max.: 60 def.: 0,1	Own value (to be entered!)
	This parameter can be used to set the cycle time with which the data is transmitted via MQTT.		

6.160 / 6.161 / 6.162 / 6.163 / 6.164	MQTT Out x	Unit: int	
Relationship to parameter: **6.150 / 6.151 / 6.152 / 6.153**	Transfer status: 2	min.: 0 max.: 69 def.: 6 / 38 / 3 / 8 / 15	Own value (to be entered!)

Two topicals are sent via MQTT.

Topic 1: fixed data package

Topic 2: individually configurable data package

Topic	Message ID	Data 1	Data 2	Data 3	Data 4	Data 5
fix1	A or B Data package with the same time stamp are labelled with the same message ID	Time on grid	Motor current	Shaft speed	Torque	Power stage starts
dyn1	A or B Data package with the same time stamp are labelled with the same message ID	MQTT Out 1 Default: Mains voltage	MQTT Out 2 Default: Operating time	MQTT Out 3 Default: IGBT temperature	MQTT Out 4 Default: Indor temperature	MQTT Out 5 Default: Digital inputs (bit-coded)

Selection of the process variable that should be sent via the topic “dyn1”.

1 = Motor voltage
2 = Motor current
3 = IGBT temperature
4 = Intermediate circuit voltage
5 = Target frequency value
6 = Supply voltage
8 = Inner temperature
11 = Error word 1
13 = Error word 2
15 = Digital inputs bit-coded
16 = Analogue input 1
17 = Analogue input 2
18 = Target frequency value after ramp
20 = PID actual value
21 = PID target value
22 = Analogue output 1
23 = DC-link power
24 = Analogue input 3
25 = Analogue input 4
26 = Analogue output 2
30 = Mechanical speed

Continues on next page

Continuation

6.160 / 6.161 / 6.162 / 6.163 / 6.164	MQTT Out x	Unit: int	
Relationship to parameter: **6.150 / 6.151 / 6.152 / 6.153**	Transfer status: 2	min.: 0 max.: 69 def.: 6 / 38 / 3 / 8 / 15	Own value (to be entered!)
	31 = Torque 32 = Motor rating 33 = Customised PLC output variable 1 (digital 32-bit) 35 = Customised PLC output variable 2 36 = Customised PLC output variable 3 37 = Customised PLC output variable 4 38 = Operating time 39 = Power on Zyklen 40 = Electrical energy 41 = Status of the outputs 47 = Current position 61 = Vibration X- axis RMS 62 = Vibration Y- axis RMS 63 = Vibration Z- axis RMS		

5.3.19 Torque control / limit

7.010	Torque target value source	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 7 def.: 0 hrs	Own value (to be entered!)
	Determines the source from which the torque limit / target value is to be read. 0 = disable, 1 = internal potentiometer 2 = analogue input 1 3 = analogue input 2 4 = Modbus 5 = fixed target value (7.040) 6 = fieldbus (Modbus: 16 bit "1056" / 32 bit "2113" / other fieldbuses via "Process data In x" parameter e.g. 6.110) 7 = INNOMOTICS MD drive controller soft PLC		

7.030	Min. torque limit	Unit: Nm	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1000 def.: 0	Own value (to be entered!)
	This parameter can be used to specify the minimum target value. If a smaller target value is to be specified, work with the min. target value.		

7.031	Max. torque limit	Unit: Nm	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1000 def.: 100	Own value (to be entered!)
	This parameter can be used to specify the maximum target value. If a larger target value is to be specified, work with the max. target value. If a target value is specified via an analogue input, the analogue signal's adjustment range is split between the min. and max. limit.		

7.040	Fixed target value for torque	Unit: Nm	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1000 def.: 50	Own value (to be entered!)
	A fixed target value can be specified here. To do this, selection "5 = fixed target value" must be made for parameter 7.010.		

7.050	Torque delay	Unit: s	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1000 def.: 0	Own value (to be entered!)
If 0 s is entered, the torque is immediately restricted to the set value. If > 0 s is entered, the torque is only reduced once the set torque is exceeded and a torque time period has lapsed. The torque time period results from the set time and 150 % of the set torque limit. **Example:** Torque limit = 10 Nm Torque delay = 30 sec. **Scenario 1** Current torque = 12.5 Nm After 60 sec., the INNOMOTICS MD drive controller restricts the torque to 10 Nm **Scenario 2** Current torque = 15 Nm After 30 sec., the INNOMOTICS MD drive controller restricts the torque to 10 Nm **Scenario 3** Current torque = 20 Nm After 15 sec., the INNOMOTICS MD drive controller restricts the torque to 10 Nm			

5.3.20 Multiple-pump control parameter

(see also chapter 5.2.4 Multiple-pump control)

IMPORTANT INFORMATION

All devices connected in the grid must be assigned a clear fieldbus address.

- Address 1 = master
- Address 2 = auxiliary master or slave (selection under parameter 8.016)
- Address 3 - 6 = all other slaves

Fieldbus baud rate (parameter 6.061)

- Setting 3 = 250 kBaud

8.010	Multiple-pump mode	Unit integer	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 2 def.: 0	Own value (to be entered!)
This parameter can be used to activate or deactivate the auxiliary master. 0 = no auxiliary master, no emergency mode slaves 1 = with auxiliary master, with emergency mode slaves 2 = without auxiliary master with emergency operation slaves (emergency frequency = 2.051 fixed frequency 1) 3 = with auxiliary master with emergency operation slaves (emergency frequency = 2.051 fixed frequency 1)			

8.020	Number of pumps	Unit integer	
Relationship to parameter:	Transfer status: 2	min.: 1 max.: 6 def.: 1 hrs	Own value (to be entered!)
The total number of devices located in the network must be stated under this parameter			

8.040	Start frequency of auxiliary pump	Unit: Hz	
Relationship to parameter:	Transfer status: 2	min.: 5 Hz max.: 599 Hz def.: 40 Hz	Own value (to be entered!)
This parameter specifies the frequency as of which the next pump is to be activated if the active pumps are not able to control the process. Furthermore, once this frequency has been exceeded, the pump settling time (parameter 8.042) also has to lapse for the next pump to be activated. It is always the pump with the lowest operating hours which is activated.			

8.041	Stop frequency of auxiliary pump	Unit: Hz	
Relationship to parameter:	Transfer status: 2	min.: 5 Hz max.: 599 Hz def.: 25 Hz	Own value (to be entered!)
	This parameter specifies the frequency as of which a pump is to be deactivated if too many pumps have been activated to control the process. Furthermore, once the frequency falls below the stated frequency, the pump settling time (parameter 8.042) also has to lapse for a pump to be deactivated. It is always the pump with the lowest operating hours which is activated.		

8.042	Settling time	Unit: s	
Relationship to parameter:	Transfer status: 2	min.: 0.1 s max.: 9999999 s def.: 5 s	Own value (to be entered!)
	To be able to optimise the transition when activating or deactivating pumps, this parameter can be used to set parameters for a time delay. This time is started when the frequency exceeds the start frequency or falls below the stop frequency. A pump is only activated or deactivated after this time.		

8.050	Pump change time	Unit: h	
Relationship to parameter:	Transfer status: 2	min.: 0.1 hrs max.: 2400 hrs def.: 5 hrs	Own value (to be entered!)
	To ensure even wear on all pumps, a time can be set here in hours. Once this time has lapsed, the next pump is automatically enabled as the main pump. A switch is always made to the pump with the lowest operating hours.		

8.060	Pump operating hours correction	Unit: h	
Relationship to parameter:	Transfer status: 2	min.: -9999999 hrs max.: 9999999 hrs def.: 0 hrs	Own value (to be entered!)
	The inverter's operating hours may differ from the pump's operating hours. This is the case when replacing the pump or the inverter. To adjust the actual hours of the pump, the difference between the converter operating hours and the pump operating hours can be specified in parameter 8.060. Example: • Converter fails after 68000 hours ⇨ Pump operating hours = 68000 h ⇨ Operating hours of defective converter = 68000 h • Operating hours of new converter before replacement = 0 h • Value to be entered in parameter 8.060 = Pump operating hours - New converter operating hours ⇨ Parameter 8.060 = 68000 h – 0 = 68000 h		

5.3.21 Positioning

(see also chapter 5.2.5 Positioning)

Target position values that are approached or held in this mode can be transferred via bus (Profinet, Ethercat, Modbus, CAN, SPF, etc.) or via analogue input.

The start-up is as quick as possible while adhering to the set limits:

1. Max. speed as per target frequency value
2. Max. acceleration as per run up time 1 (parameter 1.051)
3. Max. delay as per deceleration time 1 (parameter 1.050)
4. Max. jolt as per S-curve (parameter 1.060)

9.010	Position mode	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0 max.: 1 def.: 0			Own value (to be entered!)
	Drive type	**U/f**	**ASM**	**PMSM**	**SynRM**
				x	**x**
	0 = Profile position mode 1 = Interpolated position mode In the profile position mode, the target position values can be specified in any time intervals. After the transfer, the motor moves as quickly as possible (while keeping within the limits) to the target value, stops there and holds the target position. The braking process is initiated in good time before the target value is reached so that overshooting does not occur. In interpolated position mode, the target position values must be specified in fixed time intervals. It also moves as quickly as possible (while keeping within the limits) to the target value but does not stop there. Instead, it continues evenly to the following target value. In this way, position trajectories can be run.				

9.015	Position target value	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0 max.: 4 def.: 3			Own value (to be entered!)
	Drive type	**U/f**	**ASM**	**PMSM**	**SynRM**
				x	**x**
	0 = Potentiometer 1 = Analogue In 1 2 = Analogue In 2 3 = Fieldbus 4 = Customer PLC				

9.020	STW position	Unit: integer	
Relationship to parameter:	Transfer status: 1	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	Selecting the maximum speed during positioning. 0 = max.speed corresponds to maximum frequency parameter (parameter 1.021) 1 = max. speed is specified via the target frequency value		

9.050	Pos. value unit	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 10 def.: 0	Own value (to be entered!)
	Currently not implemented.		

9.051	Pos.value offset	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0	Own value (to be entered!)
		max.: 1000000	
		def.: 0	
	If necessary, the current position can be adjusted with an offset.		

9.052	Pos. value factor	Unit: -	
Relationship to parameter:	Transfer status: 2	min.: 0	Own value (to be entered!)
		max.: 1000000	
		def.: 1	
	If necessary, the current position can be adjusted with a factor.		

9.100	Pos. control boost	Unit: 1/s	
Relationship to parameter:	Transfer status: 2	min.: 0	Own value (to be entered!)
		max.: 10000	
		def.: 10	
	P amplification of the position controller		

5.4 Performance parameters

5.4.1 Drive type

33.010	Drive type	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0		Own value (to be entered!)	
		max.: 299			
		def.: 20			
	Drive type	V/f	ASM	PMSM	SynRM
		x	x	x	x
	This can be used to select the motor type and type of control. 10 = V/f 20 = ASM open-loop (motor identification needed) 40 = ASM efficiency mode* (motor identification needed) 100 = PMSM standard mode (motor identification needed) 110 = PMSM efficiency mode* (motor identification needed) 120 = PMSM Isotropy (see 5.2.3 Drive type [from firmware 1.50] 210 = SynRM efficiency mode* (motor identification needed) * Loss-opted operation with maximum load capacity, also suitable for special motors				

5.4.2 Motor data

33.020	R optimisation	Unit: %			
Relationship to parameter:	Transfer status: 1	min: 0		Own value (to be entered!)	
		max: 200			
		def.: 100			
	Drive type	V/f	ASM	PMSM	SynRM
			x		
	If necessary, this parameter can be used to optimise the start-up behaviour.				

33.031	Motor current	Unit: A			
Relationship to parameter: **5.070**	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 150			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	This is used to set the nominal motor current $I_{M,N}$ for either the star or delta connection.				

33.032	Motor rating	Unit: W			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 55000			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	A performance value $P_{M,N}$ has to be set here that corresponds to the nominal motor rating. If no power value is specified, it can be calculated from the motor torque $M_{M,N}$ and the motor speed $n_{M,N}$ as follows: $P_{M,N} = M_{M,N} * n_{M,N} / 9.55$				

33.034	Motor speed	Unit: rpm			
Relationship to parameter: **34.120** **5.075**	Transfer status: 1	min: 0			Own value (to be entered!)
		max: 10000			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	The value from the motor's type plate data has to be entered here for the nominal motor rotation speed $n_{M,N}$.				

33 035	Motor frequency	Unit: Hz			
Relationship to parameter:	Transfer status: 1	min.: 10			Own value (to be entered!)
		max.: 599			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	This is where the nominal motor frequency $f_{M,N}$ is set.				

33.050	Stator resistance	Unit: Ohm			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 100			
		def.: 0.001			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	The automatically calculated value (of motor identification) for stator resistance can be adjusted here.				

33.105	Leakage inductance	Unit: H			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		
	The automatically calculated value (of motor identification) for leakage inductance can be adjusted here.				

33.110	Motor voltage	Unit: V			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 1500			
		def.: 0			
	Drive type	V/f	ASM	PMSM	SynRM
		x	x	x	x
	This is used to set the nominal motor voltage $U_{M,N}$ for either the star or delta connection.				

33.111	Motor cos phi	Unit:			
Relationship to parameter:	Transfer status: 1	min.: 0.5			Own value (to be entered!)
		max.: 1			
		def.: 0			
	Drive type	V/f	ASM	PMSM	SynRM
			x		x
	The value from the motor's type plate data has to be entered here for the power factor cos phi.				

33.112	Boost v/f	Unit: V			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 200			
		def.: 0			
	Drive type	V/f	ASM	PMSM	SynRM
		x			
	The torque can be increased here at low frequencies. This parameter determines the output voltage at 0 Hz for increasing the available torque at low speeds. **Note:** If the breakaway torque isn't sufficient, we would recommend setting parameter 33.010 drive type to 20: ASM open-loop.				

33.201	Nominal flux	Unit: mVs			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 10000			
		def.: 0			
	Drive type	V/f	ASM	PMSM	SynRM
				x	
	The automatically determined value (of motor identification) for the nominal flux can be adjusted here.				

33.248	d inductance	Unit: H			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 0			
	Drive type	V/f	ASM	PMSM	SynRM
				x	
	The automatically calculated value (of motor identification) for series inductance can be adjusted here.				

33.249	q inductance	Unit: H			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 0			
	Drive type	V/f	ASM	PMSM	SynRM
				x	
	The automatically calculated value (of motor identification) for shunt inductance can be adjusted here.				

5.4.3 I²t

IMPORTANT INFORMATION

The I²T function also takes into account the heating of the motor below the I²T limit. As a result, the I²T counter counts up to 86 % during continuous operation at the set I²T limit (e.g. nominal point), as the motor can already reach its nominal temperature here.

33.015	I²T function	Unit:			
Relationship to parameter: 33.031 33.012 – 33.014	Transfer status: 2	min.: 0		Own value (to be entered!)	
		max.: 1			
		def.: 1			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	The I²T protective function can be activated here. 0 = I²T function disabled 1 = I²T function enabled				

33.012 to 33.014	I²T limit 1 to 3	Unit: %			
Relationship to parameter: 33.031 33.015	Transfer status: 2	min.: 10		Own value (to be entered!)	
		max.: 500			
		def.: 100			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x

The percentage current threshold (in relation to motor current 33.031) at the start of integration can be set here for various frequency ranges.

Parameter	Frequency range as % of rated frequency	Default value as % of rated current
33.012	0 – 50%	100 %
33.013	50 – 100%	100 %
33.014	> 100 %	100 %

We recommend using winding protection contacts in heat-sensitive applications!

33.011	I²T time	Unit: s			
Relationship to parameter:	Transfer status: 2	min.: 0.1		Own value (to be entered!)	
		max.: 1200			
		def.: 30			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	Time for calculating the I²t time period.				

33.016	Motor phases monitoring	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0		Own value (to be entered!)	
		max.: 1			
		def.: 1			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	The "Motor connection interrupted" error monitoring (error -45) can be disabled with this parameter. 0 = Monitoring disabled 1 = Monitoring enabled				

5.4.4 Switching frequency

The internal switching frequency can be changed in order to control the power element.
A high setting reduces noise in the motor but results in increased EMC emissions and losses in the drive controller.

34.030	Switching frequency	Unit: Hz			
Relationship to parameter: 33.010	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 6			
		def.: 1			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	Selection of the switching frequency for the drive controller: 0 = 2 kHz 1 = 4 kHz 2 = 6 kHz 3 = 8 kHz 4 = 12 kHz 5 = 16 kHz 6 = auto* * The drive starts with the maximum switching frequency set in parameter 34.032. Depending on the interior or IGBT temperature, the switching frequency is reduced step by step, up to a maximum of the parametrised 34.031 minimum switching frequency. As soon as the temperature drops again, the switching frequency is gradually increased again.				

34.031	Auto sw.f. min	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 5			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	0 = 2 kHz 1 = 4 kHz 2 = 6 kHz 3 = 8 kHz 4 = 12 kHz 5 = 16 kHz				

34.032	Auto sw.f. max	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 5			
		def.: 5			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	0 = 2 kHz 1 = 4 kHz 2 = 6 kHz 3 = 8 kHz 4 = 12 kHz 5 = 16 kHz				

5.4.5 Controller data

34.015	Ramp corr. active	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 1			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	0 = the ramp correction can be disabled to increase dynamism. With slow ramps, this may lead to an unintended dead time. 1 = the ramp generator takes account of the actual frequency. An impermissibly large deviation between target and actual value is suppressed.				

34.020	Flying restart	Unit:			
Relationship to parameter: 34.021	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 1			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	The flying restart can be used to switch the drive controller to a rotating motor. 0 = disable 1 = enable				

34.021	Catch time	Unit: ms			
Relationship to parameter:	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 10000			
		def.: 100			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		x
	For asynchronous motors: The catch time can be optimised here, if the automatically determined results (of the motor identification) are insufficient.				

34.060 - 61	Current regulator for trimmer for d and q direction	Unit: %			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 1000 %			
		def.: 100 %			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	Here, the control boost of the current controller can be optimised in longitudinal (d) and transverse (q) direction, if the automatically determined results (of the motor identification) should not be sufficient. **Only for asynchronous motors:** For high speed applications (maximum frequency (parameter 1.020): Switching frequency (parameter 34.030) in the range 1:10 or higher), the current controllers for trimmers should be increased.				

34.090	Speed controller K_p	Unit: mNm / rad / s			
Relationship to parameter:	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 10000			
		def.: 150			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	The control boost of the speed controller can be optimised here, if the automatically determined results (of the motor identification) are insufficient.				

34.091	Speed controller T_n	Unit: s			
Relationship to parameter:	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 10			
		def.: 4			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	For asynchronous motors: The reset time of the speed controller can be optimised here, if the automatically determined results (of the motor identification) are insufficient. For synchronous motors: The reset time of the speed controller must be optimised here, the recommendation being a value between 0.1 s and 0.5 s.				

34.092	Actual speed filter	Unit: s			
Relationship to parameter: **34.090**	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 100			
		def.: 0.005			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	The time constant of the speed filter can be set here. For an optimal setting, the speed filter should be 2 to 4 times faster than the speed controller's cut-off frequency, which results from speed controller Kp / rotor inertia * number of pole pairs.				

34.110	Slip trimmer	Unit:			
Relationship to parameter: 5.080 33.034	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 1.5			
		def.: 1			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		
	This parameter can be used to optimise or deactivate slippage compensation. 0 = disable (performance as on the grid) 1 = compensation for slippage. Example: 4 pole asynchronous motor at 1410 rpm, target frequency 50 Hz Motor idling 0 = approx. 1500 rpm 1 = 1500 rpm Motor at nominal point 0 = 1410 rpm 1 = 1500 rpm 50 Hz is always displayed as the actual frequency. Deactivating slip compensation may result in blocking detection no longer working reliably.				

34.122	max. flux reduction	Unit: %			
Relationship to parameter: 34.090 34.091	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 75			
		def.: 25			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		
	Determines the maximum by which the flux may be reduced depending on load. Is stated relative to the nominal flux calculated from type plate data. Only for drive type 40: ASM efficiency. This parameter influences the speed controller settings determined during self-commissioning. If the parameter is changed after commissioning, the speed controller may have to be adjusted manually. The following applies: the further the flux may be reduced, the slower the speed controller should be.				

34.130	Voltage utilization	Unit:			
Relationship to parameter:	Transfer status: 2	min.: 0 %			Own value (to be entered!)
		max.: 300 %			
		def.: 97.4 %			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	This parameter can be used to adjust voltage output. It tells the field weakening logic which part of the supply voltage is to be used for torque generation. The remaining part enables the compensation of control deviations.				

34.132	Overmodulation	Unit:			
Relationship to parameter:	Transfer status: 2	min.: 0 %			Own value (to be entered!)
		max.: 10 %			
		def.: 4 %			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	This parameter can be used to increase the voltage output (motor voltage) in the nominal point / field weakening range using overmodulation in order to reduce the motor current (motor heating). Detail Explanation: The percentage value indicates the increase in the voltage fundamental, whereby voltage harmonics arise. In the 0 %-4.9 % range, the corners of the possible voltage hexagon are increasingly driven into, above 5 %-10 % the hexagon corners are increasingly lingered on until block operation is reached at 10 %. The voltage harmonics increase progressively over the gain in fundamental wave, so that the last percentage points in particular are no longer worthwhile. As a rough guide, the optimum efficiency for asynchronous motors is in the 4-5 % range and for synchronous motors in the 7-8 % range, with the latter overmodulation values being able to cause audible noises, particularly in the case of synchronous servomotors.				

34.138	Holding current time	Unit: s			
Relationship to parameter: 33.010	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 3600			
		def.: 2			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		
	This is the time during which the drive is held at continuous current after the brake ramp has been completed.				

34.193	Start freq.	Unit: %			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 100			
		def.: 0.5			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	Target frequency as % of the nominal frequency from which the control starts. If a lower target frequency is specified during operation, the motor is stopped.				
	INFORMATION For drive type 10: V/f, values < 4 % are ignored. For drive type 20: ASM open-loop, values < 1 % are ignored.				

34.226	Starting current	Unit: %			
Relationship to parameter: 34.227	Transfer status: 2	min.: 5			Own value (to be entered!)
		max.: 1000			
		def.: 25			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	Only during start-up procedure: controlled. Here the current which was stamped in the motor before starting the control can be adjusted. Value as % of nominal motor current.				

34.228 – 34.230	Start-up procedure	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	0 = regulated, the drive controller is run with regulation over the entire speed range. 1 = controlled, after the stamping phase the rotation field is increased by the control with start ramp 34.229 up to start-up frequency 34.230, then switched to the controller.				

34.233	Brake current	Unit: %			
Relationship to parameter:	Transfer status: 1	min.: - 400			Own value (to be entered!)
		max.: + 400			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	Faster braking even without chopper due to loss generation by means of reactive current in the motor. The percentage value refers to the motor current (rated current). Positive values use the standard current injection, which produces the fastest and smoothest possible braking processes during usual operation. Negative values may produce better braking properties in applications with particularly high speed (field weakening), which may have to be assessed by the user.				

34.249	Field weakening filter	Unit: s			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 100			
		def.: 0.01			
	Drive type	**U/f**	**ASM**	**PMSM**	**SynRM**
			x	x	
	Filter time constant for applying the field weakening current. Larger values smoothen the field weakening and also the overmodulation, but can lead to delays in fast speed transients				

36.020	Deact grid monitoring	Unit: integer			
Relationship to parameter:	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	Grid monitoring can be deactivated here. 0: deactivated 1: activated				

5.4.6 Quadratic characteristic curve

34.120	Quadratic characteristic curve	Unit: integer			
Relationship to parameter: 34.121	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		
	A flux reduction logic can be activated here, which is suitable for loads with a quadratic torque-speed characteristic. 0 = disable 1 = enable				

34.121	Flux adjustment	Unit: %			
Relationship to parameter: 34.120	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 100			
		def.: 50			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		
	The percentage by which the flux for small speeds is to be reduced can be set here. An overvoltage shutdown can occur if there are any major changes in operation.				

System-specific settings

For load applications performed vertically with a controlled motor operation (crane or lifting applications), a value of 10 (vertical drive/lifting application) should be set in parameter 37.020.
During the start-up phase, this setting activates a servo control during which the holding torque is always built up first in a positive target value direction. To ensure a jolt-free start, this direction must always be against gravity. In V/f mode, deactivate the servo control using the value 20.

During horizontal movement (conveyor belt or linear conveyance of load) a value of 20 should be set in parameter 37.020. In such cases, servo control is always undertaken in a direction of motion dependent on the current target value. A holding torque is also built up.

For rotating machines, “0” must be entered for the Br. opening time and Br. opening time. No holding torque is then built up and the machine can start and stop freely.

37.010	Manual brake activation	Unit: integer	
Relationship to parameter:	Transfer status: 1	min.: 0	Own value (to be entered!)
		max.: 30	
		def.: 0	
	Selection of an input for manually activating the brake module 0 = disable 1 = digital input 1 2 = digital input 2 3 = digital input 3 4 = digital input 4 5 = analogue input 1 6 = analogue input 2 7 = fieldbus (via bit 8 in process variable 0x9c Dig Outs) 8 = customer PLC 9 = virtual output 20 = digital input 1 + HW enable / STO 21 = digital input 2 + HW enable / STO 22 = digital input 3 + HW enable / STO 23 = digital input 4 + HW enable / STO 24 = analogue input 1 + HW enable / STO 25 = analogue input 2 + HW enable / STO 26 = fieldbus (via bit 8 in process variable 0x9c Dig Outs) + HW enable / STO 27 = customer PLC + HW enable / STO 28 = virtual output + HW enable / STO		

37.020	Auto brake activation	Unit: integer	
Relationship to parameter:	Transfer status: 1	min.: 0	Own value (to be entered!)
		max.: 20	
		def.: 0	
	Activation of automatic activation of brake module based on parameters 37.030 – 37.060 0 = disable 10 = vertical drive/lifting application 20 = horizontal drive		

37.030	Br. min. frequency	Unit: Hz	
Relationship to parameter:	Transfer status: 1	min.: 0 max.: 499 def.: 2	Own value (to be entered!)
	Servo control variable for the controller when starting and stopping as well as speed at which the brake opens and closes.		

37.040	Br. opening time	Unit: s	
Relationship to parameter:	Transfer status: 1	min.: 0 max.: 10 def.: 0.2	Own value (to be entered!)
	Opening time of brake. (see data sheet from brake manufacturer)		

37.050	Br. closing time	Unit: s	
Relationship to parameter:	Transfer status: 1	min.: 0 max.: 10 def.: 0.2	Own value (to be entered!)
	Closing time of brake. (see data sheet from brake manufacturer)		

37.060	Brake activation invert	Unit: integer	
Relationship to parameter:	Transfer status: 1	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	DANGER! **Changing the parameter switches the brake module's output!** **This may result in venting of the brake!**		
	Inversion of activation signal for brake module 0 = disable 1 = enable		

6. Error detection and troubleshooting

This chapter contains the following:

- a list of the LED flash codes for error recognition
- a description of error recognition using PC tools
- a list of errors and system errors
- notes on error detection with the MMI

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

De-energise the drive controller, wait until the motor has come to a standstill, determine that it is voltage-free and secure it against being restarted.

If damaged parts or components need replacing, only ever replace with original parts.

Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down.

6.1 List of the LED flash codes for error recognition

When an error occurs, the LEDs on the drive controller display a flashing code that allows the errors to be diagnosed.

The following table contains an overview:

Red LED	Green LED	State
☀	○	Boot loader active (flashing in turn)
○	☀	Ready for operation (activate En_HW for operation)
○	●	Operation / ready
☀	●	Warning
●	○	Error
●	●	Identification of motor data
○	✺	Initialisation
✺	✺	Firmware update
✺	●	Bus error operation
✺	☀	Bus error ready for operation

Tab. 10: LED flash codes

Key			
○	LED off	●	LED on
☀	LED flashing	✺	LED flashing quickly

6.2 List of errors and system errors

The driver controller shuts down if an error occurs. Consult the flash code table / PC tool for the corresponding error numbers.

IMPORTANT INFORMATION

Error messages can only be acknowledged once the error has been remedied.

Error messages can be acknowledged as follows:

- digital input (can be programmed)
- using MMI (handheld controller)
- Automatic acknowledge function (Parameter 1.181)
- switch device off and on again

via fieldbus (e.g. CANOpen, Profibus DP, EtherCAT)

Errors must always be rectified before acknowledgement, otherwise the drive controller may be damaged.

The following section contains a list of possible error messages. Please contact the INNOMOTICS service department if you encounter errors that are not listed here.

No.	Error name	Description of error	Possible causes/remedy
1	Undervoltage 24 V application	Supply voltage for the application is less than 15 V	24 V supply overload
2	Overvoltage 24 V application	Supply voltage for the application is greater than 31 V	Internal 24 V supply is not OK or external supply is not OK
4	Warning: Customer PLC runtime environment	The customer PLC is not running	The customer PLC is being downloaded / The customer PLC has a programming error, e.g. division by 0
6	Customer PLC version error	The version of the customer PLC doesn't match the device firmware	Check the version numbers of the customer PLC and device firmware
8	Communication application<>power	Internal communication between the application plate and the power-conducting plate is not OK	EMC interference
9	Warning: Multi-pump error	A fault has occurred in the multi-pump system: One participant has a fault The CANopen connection is disturbed/interrupted	Check that all participants are available and the status LED is green. Check CANopen connection
10	Parameter distributor	The internal distribution of parameters during initialisation failed	Parameter set is incomplete
11	Time-out power	The power stack does not respond	Operation with 24 V without mains feed-in
13	Cable break at analogue In1 (4–20 mA / 2–10 V)	Current or voltage is less than the lower limit of analogue input 1 (monitoring for this error is activated automatically by setting parameter 4.021 to 20 %).	Cable break, faulty external sensor
14	Cable break at analogue in 2 (4–20 mA / 2– 10 V)	Current or voltage is less than the lower limit of analogue input 2 (monitoring for this error is activated automatically by setting parameter 4.021 to 20 %)	Cable break, faulty external sensor
15	Blocking detection	The drive shaft of the motor is stalled. 5.080	Remove the blockage
16	PID dry run	No PID actual value despite maximum speed	PID actual value sensor defective. Extend dry run time parameter 3.072

No.	Error name	Description of error	Possible causes/remedy
17	Start-up error	Motor not starting up or starting up incorrectly. 5.082	Check motor connections/check motor and controller parameters; if necessary, disable error (5.082).
18	Excess temperature for FC application	Inner temperature too high	Insufficient cooling, low motor speed and high torque, switching frequency too high.
19	Firmware update error	A firmware update could not be completed.	Connection aborted during a FW update. Repeat the FW update The INNOMOTICS MD drive controller is supplied externally with 24 V. **Note:** During a firmware update, 24 V must not be connected externally.
21	Bus timeout	Bus communication aborted, no telegrams were received during the bus timeout time (6.062).	Check external wiring. Check fieldbus communication. Increase bus timeout time.
22	Acknowledgement error	The number of maximum automatic acknowledgements (1.182) was exceeded	Check error history and remedy error
23	External error 1	The parameterised fault input is active. 5.010	Correct the external error
24	External error 2	The parameterised fault input is active. 5.011	Correct the external error
25	Motor detection	Motor identification error	Check INNOMOTICS MD drive controller /motor and PC / MMI / INNOMOTICS MD drive controller connections / restart motor identification
26	STO inputs plausibility	The statuses of the two STO inputs have not been identical for more than 2 sec.	Incorrect activation of the STO inputs / Check corresponding external wiring / Indoor temperature too high.
27	Bus address invalid	CANopen fieldbus address invalid	The ID must be > 0 and < 127
28	Limit frequency exceeded / not met	The parameterised minimum / maximum frequency has not been met / has been exceeded.	The parameterised time 5.085 or 5.086 is too short / Motor blocked / Brake not opened / Motor overloaded
32	Trip IGBT **	Protection of the IGBT module against overcurrent has been triggered	Short circuit in the motor or motor feed line / controller settings
33	Overvoltage of intermediate circuit **	The maximum intermediate circuit voltage has been exceeded	Feedback by motor in generator mode / supply voltage too high / incorrect setting of speed controller / brake resistor not connected or defective / ramp times too short / operation on transformer / operation with mains choke
34	Undervoltage of intermediate circuit	The minimum intermediate circuit voltage has not been reached	Supply voltage too low, grid connection defective / check wiring
35	Excess motor temperature	Motor PTC has been triggered	Overload of the motor (e.g. high torque at low motor speed) / ambient temperature too high
36	Power failure	The supply voltage has dropped briefly	Grid fluctuation / grid voltage interrupted
38	Excess IGBT module temperature	Excess IGBT module temperature	Insufficient cooling, low motor speed and high torque, switching frequency too high

No.	Error name	Description of error	Possible causes/remedy
39	Overcurrent **	Maximum output current of drive controller exceeded	Motor stalled / check motor connection / incorrect speed controller setting / check motor parameters / ramp times too short / brake not open
40	Excess frequency converter temperature	Inner temperature too high	Insufficient cooling / low motor speed and high torque / switching frequency too high permanent overload / reduce ambient temperature / check fan
42	I^2t motor protection shut-off	The internal I^2t motor protection (can be parametrised) has been triggered	Permanent overload
43	Ground leak **	Ground leak during a motor phase	Insulation fault
45	Motor connection disrupted	No motor current in spite of control through frequency converter	No motor connected or not completely connected. Check phases or motor connections and connect correctly when necessary. *
46	Motor parameters	Plausibility check for motor parameters failed	Parameter set not OK
47	Drive controller parameters	Plausibility check for drive controller parameters failed	Parameter set not OK Motor type 33.001 and control method 34.010 not plausible.
48	Type plate data	No motor data entered	Please enter the motor data according to the rating plate
49	Power class restriction	Max. overload of the drive controller exceeded for more than 60 sec.	Check application / reduce load / use larger drive controller.
53	Motor tipped	Only for synchronous motors, field orientation lost	Load too high. Optimise controller parameters.
56	Grid overvoltage	The mains input voltage is above 528 V AC	Check the mains supply
57	Warning: Switching frequency reduction active	The switching frequency was reduced due to the ambient temperature	Insufficient cooling/low speed and high torque/permanent overload/reduce ambient temperature/check fan
58	IGBT module overheating	The IGBT module overheating at high starting current and high clocking frequency	Reduce clocking frequency Reduce load in the lower speed range

Tab. 11: Error detection

***** In exceptional cases, the error may be displayed erroneously in standby (very low motor current) with synchronous motors. Set parameter 33.016 accordingly when the phases or motor connections are connected correctly.

****** Should the error occur again, depending on frequency, it can only be acknowledged after the following times:

1 - 3 acknowledgements permitted = 1 s waiting time

4 -5 acknowledgements permitted = 5 s waiting time

> 5 acknowledgements permitted = 30 s waiting time

The number of acknowledgements is deleted after 120 s without any errors!

7. Disassembly and disposal

7.1 Preparing for disassembly

Disassembly of the machine must be carried out and/or supervised by qualified personnel with appropriate expert knowledge.

1. Contact a certified waste disposal organization in your vicinity. Clarify what is expected in terms of the
2. quality of dismantling the machine and provision of the components.
3. Carefully follow the 5 safety rules
    a. Disconnect the system. Also disconnect the auxiliary circuits, for example, anti-condensation heating.
    b. Secure against reconnection.
    c. Verify absence of operating voltage.
    d. Ground and short-circuit.
    e. Provide protection against adjacent live parts
4. Remove all liquids e.g. oil and cooling liquids. Collect the liquids separately and dispose of them in a professional manner.
5. Detach the machine fixings.
6. Transport the machine to a suitable location for disassembly

7.2 Dismantling the machine

Dismantle the machine using the general procedures commonly used in mechanical engineering.

DANGER!

The machine is made up of heavy parts. These parts are liable to fall during dismantling. This can result in

death, serious injury or material damage.

– Before you release any machine parts, secure them so that they cannot fall.

7.3 Danger due to magnetic fields for permanent magnet machines

DANGER!

Strong magnetic field when the machine is open

A strong magnetic field is always present inside the machine. If the housing is open, e.g. when maintenance

openings are open or when working inside the machine, magnetic objects can be suddenly attracted

by this magnetic field. This can result in death, serious injury or material damage.

– Working in the vicinity of the rotor is only permitted in exceptional circumstances. Establish clear and

unambiguous access rules in accordance with the magnetic fields prevailing in the workplace. Clearly

mark the boundaries of the areas where standing is permitted.

– People who need to use electronic or magnetic medical aids such as pacemakers, hearing aids, implants

or similar devices are at particularly high risk. Such persons must undergo an industrial medicine

assessment.

– Comply with the following measures

Personal protective measures

- Ensure that under no circumstances you wear or carry any of the following objects, and that you keep these away from the machine:
    - All kinds of magnetic metal parts such as, keys, glasses, tools, knives, scissors, tape measures or similar
    - Magnetic jewelry such as rings, chains, needles, watches, etc.
    - Electronic devices and data carriers such as service cards, check cards, credit cards, calculators, cellphones, etc.
    - Wallets or other iron-containing objects
    - Electrically conductive foreign bodies
- Do not use any magnetic tools or lifting devices.
- Wear only occupational safety items without magnetic metal parts, e.g. occupational safety shoes with non-magnetic protective caps and soles.
- Keep your shoes and clothing free from chips and waste containing iron.
- Exercise caution when installing accessories. Ensure that no parts fall into the inside of the machine.
- Do not perform any cutting at the machine, e.g. manufacturing threaded holes. Any exceptions require written approval from the manufacturer.

DANGER!

Risk of death because of permanent magnet fields

The permanent magnets of rotors generate strong magnetic fields and forces of attraction. The motor permanent magnets represent a danger for people with active medical implants, who come close to the motors. Examples of such implants include Heart pacemakers, metal implants, insulin pumps. Further, people that have magnetic or electrically conductive implants are at risk.

- If you are personally affected, always stay a minimum distance of 300 mm from an opened motor (tripping threshold for static magnetic fields of 0.5 mT according to Directive 2013/35/EU).
- Only the Service Center should remove the rotor.

IMPORTANT INFORMATION

Data loss due to strong magnetic fields

- If you are close to the rotor, any magnetic or electronic data storage media as well as electronic devices hat you might be carrying could be damaged.
- Do not wear or carry any magnetic or electronic data storage media (e.g. credit cards, USB flash drives, floppy disks) and no electronic devices (e.g. watches) if you are close to a rotor.

7.4 Disposing of permanent magnets

If the entire motor is melted down, no special action is required for the permanent magnets. Remove all cables before the melting process.

Demagnetizing the motor
If the motor is disassembled and dismantled, the permanent magnets must be demagnetized. To do this,
the motor is heated up to 350 °C so that during and after disposal, the rotors do not represent any danger.
The disposal must be carried out by an authorized waste disposal company.

Note
Removing the permanent magnet rotor
Injury and material damage can occur if the permanent magnet rotor is incorrectly removed. Only authorized workshops and waste disposal companies are permitted to remove the rotor.

Demagnetizing the rotors
Waste disposal companies that are authorized to demagnetize rotors use a specially designed disposal furnace.
The insides of the disposal furnace consist of non-magnetic material. The rotors are put in the furnace
in a solid, heat-resistant container made of non-magnetic material and left in the furnace during the entire demagnetization procedure. Demagnetization is achieved by heating the rotor in the furnace until the permanent magnets have reached a temperature of 350 °C.

IMPORTANT INFORMATION

- **Emissions**
  Exhaust gas that is released must be collected and rendered harmless without damaging the environment

- **Note**
  Authorized waste disposal companies
  Information regarding authorized disposal companies and workshops can be obtained from the Service

7.5 Drive controller disassembly

DANGER!

Risk of death due to electrical shock!
Death or serious injury!
De-energise the drive controller, wait until the motor has come to a standstill, determine that it is voltage-free and secure it against being restarted.

Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down.

1. Open drive controller cover.
2. Release cables at terminals.
3. Remove all cables.
4. Remove connection screws for drive controller / adapter plate.
5. Remove drive controller.

7.6 Information on correct disposal

Components

The machines consist mainly of steel and various proportions of copper and aluminum. Metals are generally considered to be unlimitedly recyclable.
Sort the components for recycling according to whether they are:
– Iron and steel
– Aluminum
– Non-ferrous metal, e.g. windings
The winding insulation is incinerated during copper recycling.
– Insulating materials
– Cables and wires
– Electronic waste

Process materials and chemicals

Sort the process materials and chemicals for recycling according to whether they are for example:

– Oil
– Grease
– Cleaning substances and solvents
– Paint residues
– Anti-corrosion agent
– Coolant additives such as inhibitors, antifreeze or biocides

Dispose of the separated components according to local regulations or via a specialist disposal company.
The same applies for cloths and cleaning agents that have been used while working on the machine.

Packaging material

– If necessary, contact a suitable specialist disposal company.
– Wooden packaging for sea transport consists of impregnated wood. Comply with the local regulations.
– The foil used for water-proof packaging is an aluminum composite foil. It can be recycled thermally. Dirty
foil must be disposed of through incineration.

8. Technical data

8.1 General data

8.1.1 General technical data for 400V devices

Motor Shaft height 71 / 90, controller size A / B

	Motor shaft height	71	71	71	71	71	90	90	90	90	90
	Drive controller size	A							B		
Electrical data	Power rating [kW]	0.37	0.55	0,75	1.1	1,5	2,2	3	4	5,5	
	Supply voltage	3 x 200 V AC -10 %...480 V AC +10 % 280 V DC -10 %...680 V DC +10 % [1)]									
	Grid frequency	50/60Hz ± 6 %									
	Network configurations	TN / TT									
	Line current [A]	See configurator (www.innomotics.com/configurators)									
	Overload for 3 sec. in %	185									
	Overload for 60 sec. in %	140									
	Switching frequency	Auto, 2 kHz, 4 kHz, 6 kHz, 8 kHz, 12 kHz, 16 kHz, (factory setting 4 kHz)									
	Output frequency	0 Hz – 112,5Hz/225Hz (depended on rated speed) See configurator (www.innomotics.com/configurators)									
	Mains cycles of operation	Unlimited [2)]									
	DIN EN 61800-5 touch current	< 3.5 mA [3)]									
Functions	Protective function	Overvoltage and undervoltage, I^2t restriction, Motor PTC, short-circuit, ground leak, motor and drive controller temperature, stall prevention, blocking detection, PID dry run protection									
	Software functions	Process control (PID controller), fixed frequencies, data record changeover, flying restart, motor current limit									
	Soft PLC	IEC61131-3, FBD, ST, AWL									
Mechanical data	Housing	Aluminium die-cast casing									
	Dimensions (w/o options) [L x W x H] mm	See configurator (www.innomotics.com/configurators)									
	Weight (w/o options)	17.9 kg						27.1 kg			
	Type of construction (IEC 60034-7)	IM B3, IM V5, IM V6, IM B5, IM B35, IMV1 IM V3, IM B14, IM V19, IM V18, IM B34, IM V15, IM V35									
	Protection class (IEC 60034-5)	IP55, IP 65 as option									
	Cooling	Passive cooling (Motor IC411)									
	Ambient temperature	- 20 °C (non-condensing) to + 40 °C (without derating)									
	Storage temperature	- 20 °C…+ 50 °C									
	Altitude of the installation location	up to 1000 m above sea level/over 1000 m with reduced performance									
	Relative air humidity	≤ 55 %, condensation not permitted									
	Relative air humidity storage	≤ 60 %, condensation not permitted									
	Vibration resistance (DIN EN EN 60721-3-3:1995) [4)]	3M3									
	EMC (DIN-EN-61800-3)	C2									
	Energy efficiency class drive controller (EN 61800-9-2)	IE2									
	Energy efficiency class motor (IEC/TS 60034-30-2)	IE5									
	System efficiency class (IEC 61800-9-2:2023)	IES5									
	Certificates and conformity	RoHS 2011/65/EU						CE			

Technical data for MOTOR DRIVE SYSTEMS MD 400 V devices (subject to technical changes)

[1] In compliance with the overvoltage category.

[2] < 3 s may result in power failure/intermediate circuit undervoltage errors.

[3] With 1LA7 asynchronous motor, motor-mounted.

[4] Installation- and application-related resonance frequencies may cause damage to devices

Motor Shaft height 132, controller size C / D

	Motor shaft height	132				
	Drive controller size	**C**	**D**			
Electrical data	Power rating [kW]	7,5	11	15	18,5	22
	Supply voltage	3 x 200 V AC -10 %...480 V AC +10 % 280 V DC -10 %...680 V DC +10 % [1]				
	Grid frequency	50/60Hz ± 6 %				
	Network configurations	TN / TT				
	Line current [A]	See configurator (www.innomotics.com/configurators)				
	Overload for 3 sec. in %	185				
	Overload for 60 sec. in %	140				
	Switching frequency	Auto, 2 kHz, 4 kHz, 6 kHz, 8 kHz, 12 kHz, 16 kHz, (factory setting 4 kHz)				
	Output frequency	0Hz – 112,5Hz/190Hz/225Hz See configurator (www.innomotics.com/configurators)				
	Mains cycles of operation	Unlimited [2]				
	DIN EN 61800-5 touch current	< 3.5 mA [3]				
Functions	Protective function	Overvoltage and undervoltage, I^2t restriction, Motor PTC, short-circuit, ground leak, motor and drive controller temperature, stall prevention, blocking detection, PID dry run protection				
	Software functions	Process control (PID controller), fixed frequencies, data record changeover, flying restart, motor current limit				
	Soft PLC	IEC61131-3, FBD, ST, AWL				
Mechanical data	Housing	Aluminium die-cast casing				
	Dimensions (w/o options) [L x W x H] mm	See configurator (www.innomotics.com/configurators)				
	Weight (w/o options)	54.5 kg	85,8 kg			
	Type of construction (IEC 60034-7)	IM B3, IM V5, IM V6, IM B5, IM B35, IMV1 IM V3, IM B14, IM V19, IM V18, IM B34, IM V15, IM V35				
	Protection class (IEC 60034-5)	IP55, IP 65 as option				
	Cooling	Passive cooling (Motor IC411)	Drive controller: Active cooling Motor: passive cooling (IC411)			
	Ambient temperature	- 20 °C (non-condensing) to + 40 °C (without derating)				
	Storage temperature	- 20 °C…+ 50 °C				
	Altitude of the installation location	up to 1000 m above sea level/over 1000 m with reduced performance				
	Relative air humidity	≤ 55 %, condensation not permitted				
	Relative air humidity storage	≤ 60 %, condensation not permitted				
	Vibration resistance (DIN EN EN 60721-3-3:1995) [4]	3M2				
	EMC (DIN-EN-61800-3)	C2				
	Energy efficiency class drive controller (EN 61800-9-2)	IE2				
	Energy efficiency class motor (IEC/TS 60034-30-2)	IE5				
	System efficiency class (IEC 61800-9-2:2023)	IES5				
	Certificates and conformity	RoHS 2011/65/EU		CE		

Technical data for MOTOR DRIVE SYSTEMS MD 400 V devices (subject to technical changes)

[1] In compliance with the overvoltage category.

[2] < 3 s may result in power failure/intermediate circuit undervoltage errors.

[3] With 1LA7 asynchronous motor, motor-mounted.

[4] Installation- and application-related resonance frequencies may cause damage to devices

8.1.2 Specification of interfaces

Designation	Function
Digital inputs 1 – 4	- Switching level low < 2 V / high > 18 V - Imax (at 24 V) = 3 mA - Rin = 8.6 kOhm
Hardware approval for input	- Switching level low < 3 V / high > 18 V Imax (at 24 V) = 8 mA
Analogue inputs 1, 2	- In +/- 10 V or 0 – 20 mA - In 2 – 10 V or 4 – 20 mA - 10-bit resolution - Tolerance +/- 2 % Voltage input: - Rin = 10 kOhm Current input: - Working resistance = 500 Ohm
Digital outputs 1, 2	- Short-circuit proof - Imax = 20 mA
Relays 1, 2	1 changeover contact (NO/NC) Maximum switching power * - at ohmic load (cos □□□□1□□□5 A at ~ 230 V or = 30 V - at inductive load (cos □□□□0.4 and L/R = 7 ms□□□2 A at ~ 230 V or = 30 V Maximum reaction time: 7 ms ± 0.5 ms Electric life: 100 000 switching cycles
Analogue output 1 (current)	- Short-circuit proof - I out = 0.. 20 mA - Working resistance = 500 Ohm - Tolerance +/- 2 %
Analogue output 1 (voltage)	- Short-circuit proof - Uout = 0..10 V - Imax = 10 mA - Tolerance +/- 2 %
Power supply 24 V	- Auxiliary voltage U = 24 V DC - SELV - Short-circuit proof - Imax = 100 mA - external feed-in of 24 V possible
Power supply 10 V	- Auxiliary voltage U = 10 V DC - Short-circuit proof - Imax = 30 mA

Tab. 12: Specification of interfaces

***** in terms of the UL 508C standard, the maximum allowed is 2 A!

8.1.3 Table of power loss

MOTOR DRIVE SYSTEMS MD Variant	Supply voltage [V]	Nominal current [A]	Measurement (90; 100)	Measurement (50; 100)	Measurement (10; 100)	Measurement (90; 50)	Measurement (50; 50)	Measurement (10; 50)	Measurement (50; 25)	Measurement (10; 25)	Standby losses	IE class
			Absolute power loss [W] 1) 2)									
			Relative losses [%] 1) 2) 3)									
Size A 0.55 kW	400	1.7	24	24	27	22	20	25	24	25	5	IE2
			2.3	2.2	2.5	2	1.9	2.4	2.2	2.3		
Size A 0.75 kW	400	2.3	29	28	32	23	21	28	25	27	5	IE2
			2	1.9	2.2	1.6	1.5	2	1.7	1.9		
Size A 1.1 kW	400	3.1	35	30	38	27	26	31	26	28	5	IE2
			1.8	1.6	2	1.4	1.3	1.6	1.4	1.4		
Size A 1.5 kW	400	4.0	45	39	46	31	27	36	25	31	5	IE2
			1.8	1.6	1.8	1.3	1.1	1.4	1	1.2		
Size B 2.2 kW	400	5.6	61	60	65	46	38	48	37	42	7	IE2
			1.7	1.7	1.9	1.3	1.1	1.4	1	1.2		
Size B 4.0 kW	400	9.5	107	80	98	66	51	70	31	58	7	IE2
			1.8	1.4	1.7	1.1	0.9	1.2	0.5	1		
Size C 5.5 kW	400	13.0	149	114	125	69	52	76	44	70	7	IE2
			1.8	1.4	1.5	0.9	0.6	0.9	0.5	0.9		
Size C 7.5 kW	400	16.5	203	157	166	98	75	95	58	78	7	IE2
			2	1.5	1.6	0.9	0.7	0.9	0.6	0.8		
Size D 11.0 kW	400	28.0	249	222	245	148	133	140	101	109	18	IE2
			1.4	1.3	1.4	0.8	0.8	0.8	0.6	0.6		
Size D 15.0 kW	400	34.0	314	279	298	181	163	173	122	134	18	IE2
			1.5	1.3	1.4	0.9	0.8	0.8	0.6	0.6		
Size D 18.5 kW	400	40.0	381	333	347	211	189	202	140	152	18	IE2
			1.5	1.3	1.4	0.8	0.8	0.8	0.6	0.6		
Size D 22.0 kW	400	46.0	485	398	392	247	189	276	197	194	18	IE2
			1.7	1.4	1.4	0.9	0.7	1	0.7	0.7		

1) Loss values at 4 kHz switching frequency
2) Loss values include 10% mark-up as per guideline
3) Relative losses in relation to the device's rated apparent output power

8.2 Derating of output power

Drive controllers of the INNOMOTICS MD series have two integrated PTC resistors as standard which monitor both the heat sink temperature and the inner temperature. As soon as a permissible IGBT temperature of 95°C or a permissible inner temperature of 85°C is exceeded, the drive controller shuts down.

All MOTOR DRIVE SYSTEMS MD type drive controllers are designed for an overload of 150 % for 60 sec. and 200 % for 3 sec.
(every 10 min.).

Reductions in the ability to handle overload and/or its duration should be considered in the following circumstances:

- A clocking frequency permanently set too high > 4 kHz (load-dependent).
- A permanently increased heat sink temperature, caused by a blocked air flow or a thermal blockage (dirty cooling ribs).
- Depending on the type of assembly, permanently excessive ambient temperature.

The respective max. output values can be determined from the following characteristic curves.

8.2.1 Derating due to increased ambient temperature

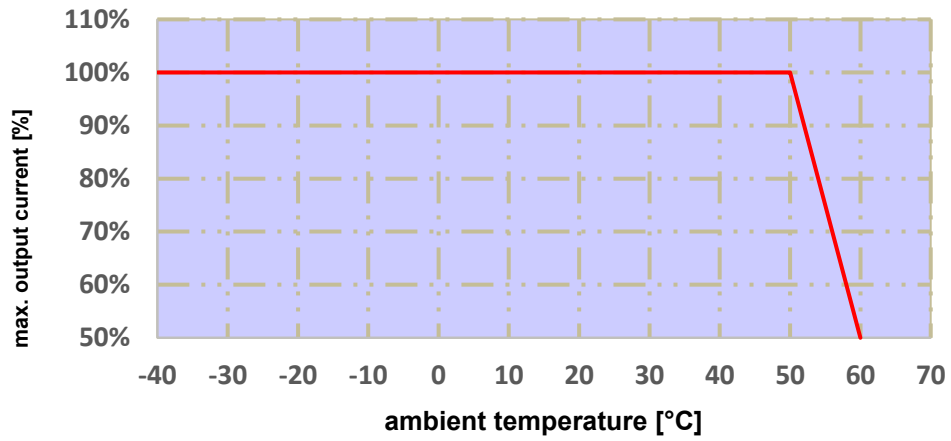


Fig. 21: Derating for motor-mounted drive controller

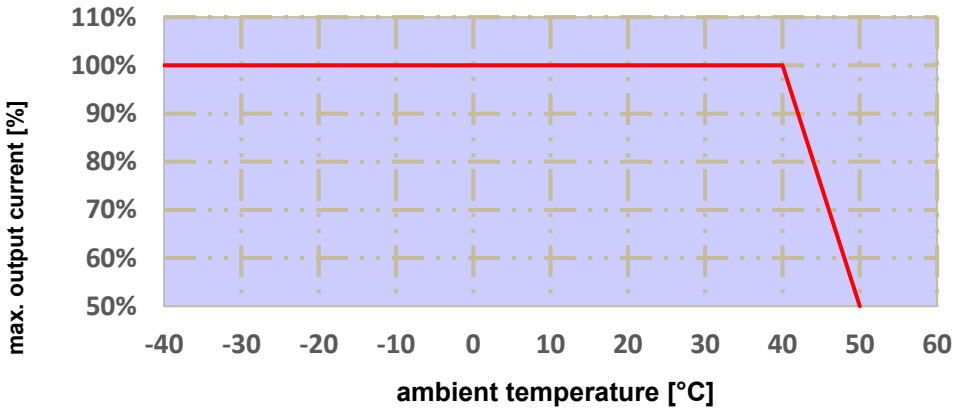


Fig. 22: Derating for wall-mounted drive controller

8.2.2 Derating due to installation altitude

The following applies to all INNOMOTICS MD drive controllers:

- No reduction in performance is needed in S1 mode up to 1000m above sea level.
- A reduction in performance of 1% every 100 m is needed from 1000m ≤ 2000m. Overvoltage category 3 is observed!
- Overvoltage category 2 should be observed from 2000 m ≤ 4000 m because of the lower air pressure!

In order to observe the overvoltage category:

- use external overvoltage protection in the INNOMOTICS MD drive controller's mains cable.
- reduce the input voltage.

Please contact the INNOMOTICS Service department.

The respective max. output values can be determined from the following characteristic curves.

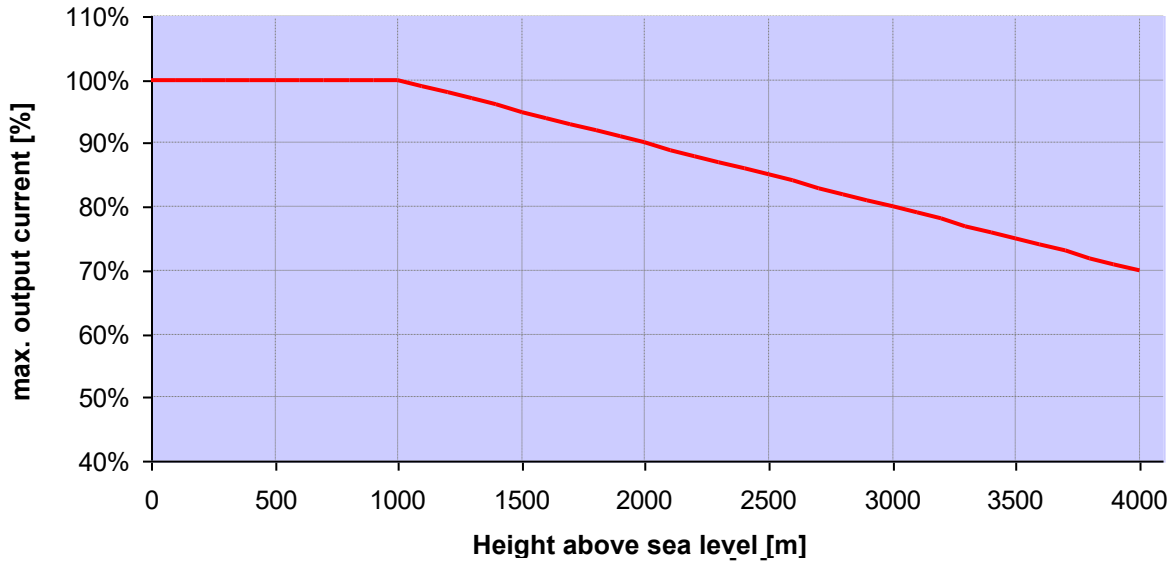


Fig. 23: Derating of maximum output current as a result of installation altitude

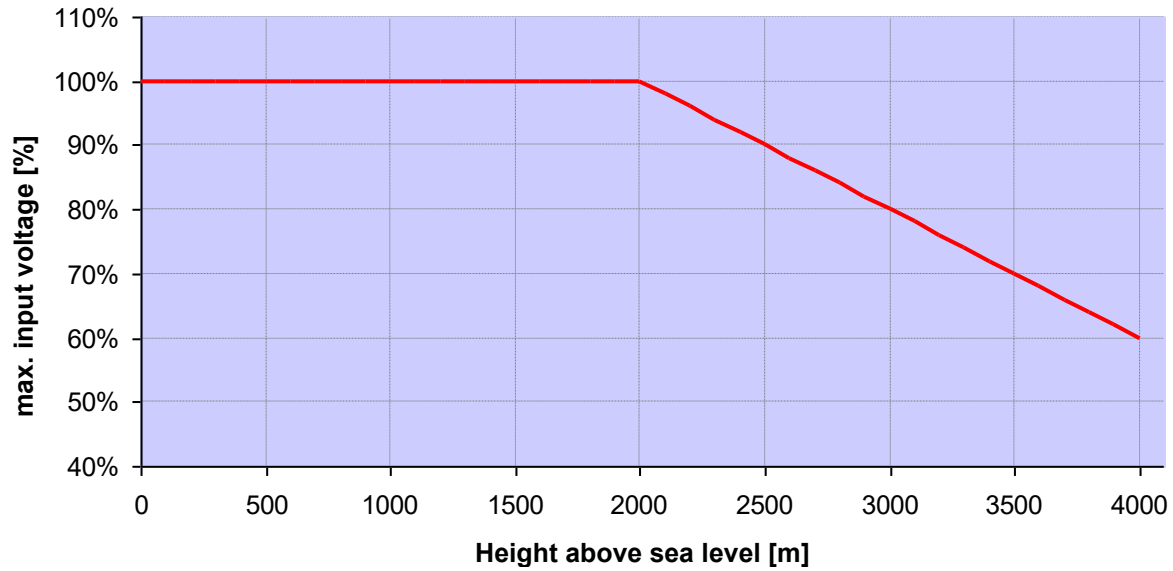


Fig. 24: Derating of maximum input voltage as a result of installation altitude

8.2.3 Derating due to switching frequency

The following diagram shows the output current, depending on switching frequency. To limit the thermal losses in the drive controller, the output current must be reduced.

Note: The switching frequency is not reduced automatically!

The max. output values can be determined from the following characteristic curve.

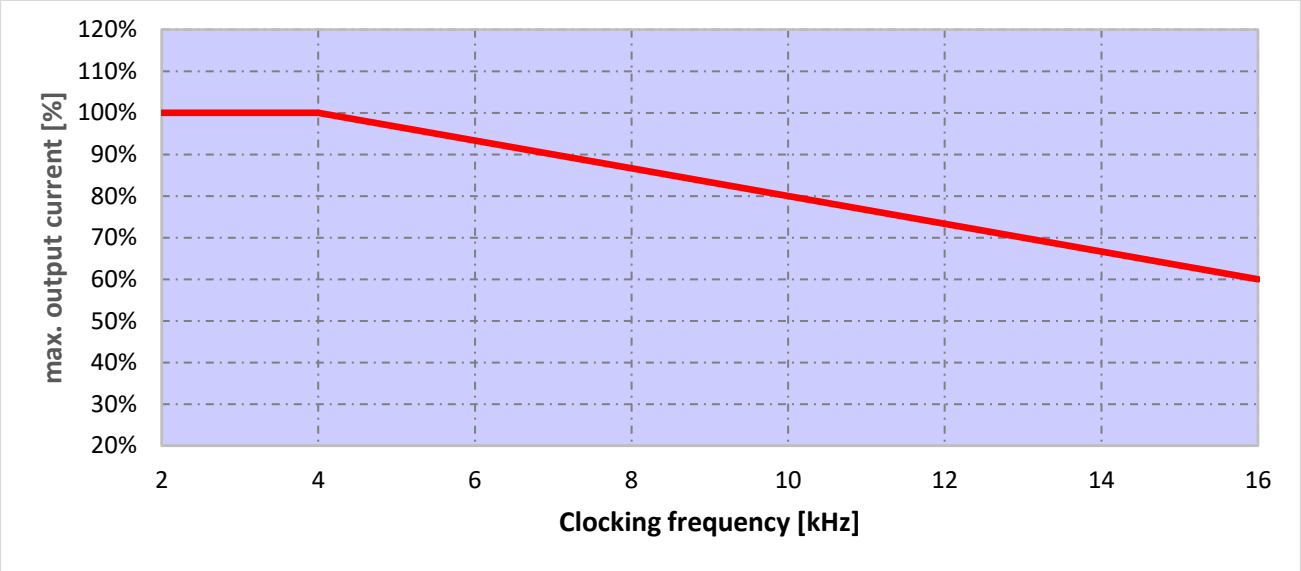


Fig. 25: Derating of maximum output current as a result of switching frequency

9. Optional accessories

This chapter contains brief descriptions of optional accessories

9.1 Foil keypad

As an option, the devices of the INNOMOTICS MD drive controller family are also available as a variant with an integrated foil keypad. This keypad can be used to operate the drive controller locally.

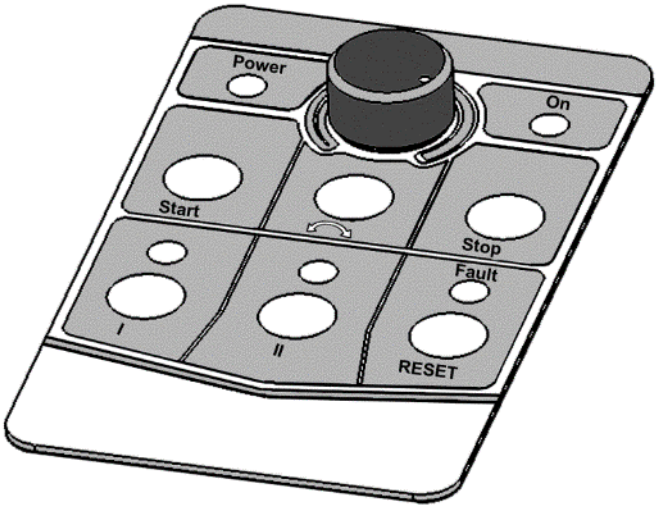


Fig. 26: Standard foil keypad

The following functionalities can be realised using the integrated foil keypad:

- **Target value specification:** A target value (parameter 1.130) can be specified using the potentiometer integrated in the foil keypad (select internal potentiometer).
- **Target value approval:** The start and stop keys integrated in the foil keypad (select foil keypad) can be used to approve the drive software (parameter 1.131).

9.2 PC communication cable USB on M12/RS485 plug (converter integrated)

As an alternative to the MMI handheld controller, an MOTOR DRIVE SYSTEMS MD can also be put into operation using the PC communication cable (art no. 10023950) and the INNOMOTICS MD connect software.
The INNOMOTICS MD connect software is available free of charge from the INNOMOTICS homepage at
https://www.innomotics.com/downloadcenter

10. Approvals, standards and guidelines

This chapter contains information about electromagnetic compatibility (EMC), and applicable guidelines, norms and standards.

For binding information about the relevant drive controller approvals, please refer to the relevant type plate!

10.1 EMC limit classes

The following applies to the essential requirements of the EMC-Directive 2014/30/EU.

10.2 Classification acc. to IEC/EN 61800-3

The generic standard defines test procedures and severity levels for every environment in the drive controller category; these have to be complied with.

The EU-types are intended for use in an industrial environment or according to EN 61800-3 environment class C2

10.3 Harmonics currents and grid impedance for devices > 16 A and ≤ 75 A

Extract from EN 61000-3-12, applies to devices with a rated current > 16 A and ≤ 75 A, which are intended for connection to public low-voltage grids.

This device complies with IEC 61000-3-12 provided that the short-circuit power S_{SC} at the point where the customer's system connects with the public grid is greater than or equal to $R_{SCE} \times S_{equ}$. If found to be necessary after contacting the distributor grid operator, the installer or operator of the device is responsible for ensuring that the device is only connected at a point with a short-circuit power S_{SC} greater than or equal to $R_{SCE} \times S_{equ}$.	
S_{SC}	Grid's short-circuit power at point where customer's system connects with the public grid.
S_{equ}	Rated apparent power for three-phase devices: $S_{equ} = \sqrt{3} \times U_l \times I_{equ}$ (Ul = external wire voltage, see technical data → supply voltage) (Iequ = rated current of device, see technical data → line current)
R_{SCE}	Short-circuit power relation for these devives: $R_{SCE} \geq 350$

In case of problems with power supply quality of the low voltage grid when operating multiple EU-type units at one location the use of a harmonic filter may be advised by the manufacturer.

10.4 Standards and guidelines

The following specifically apply:

- Directive 2014/53/EU - Radio Equipment Directive
  (OJ L 153 from 22.05.2014, p. 62) *****
- Directive 2011/65/EU - RoHS Directive
  (OJ L 174 from 01.07.2011, p. 88)

***** The Radio Equipment Directive fulfils the essential requirements of both the EMC Directive (2014/30/EU) and the Low Voltage Directive (2014/35/EU).

10.5 Waste disposal

10.5.1 Introduction

Protecting the environment and preserving its resources are corporate goals of the highest priority for us. Our worldwide environmental management system to ISO 14001 ensures compliance with legislation and sets high standards in this regard. Environmentally friendly design, technical safety and health protection are always firm goals even at the product development stage.
Recommendations for the environmentally friendly disposal of the machine and its components are given in the following section. Be sure to comply with local disposal regulations.

Country-specific legislation

The machine uses materials that can be recovered or recycled. Correctly separating materials helps to simply recycle important materials.

- When disposing of the machine or of waste that is created during the individual phases of its life cycle, please observe the statutory requirements applicable in the country of use.
- Please contact your local authorities for more information about disposal.

10.5.2 RoHS - restricting the use of certain hazardous substances

In compliance with RoHS ("Restriction of certain Hazardous Substances") we replace substances that are damaging to the environment by those that are not based on state-of-the-art technology. In doing so, safety in operation and handling will take priority at all times.

10.5.3 Information according to Article 33 of the REACH regulation

This product contains one or several subproducts in which the following substance – belonging to the "list of candidates" – exists in a concentration exceeding 0.1 percent by weight.

- CAS: 1317-36-8; Lead-monoxid
- CAS: 7439-92-1; Lead
- CAS: 1303-86-2; Diboron-trioxide
- CAS: 12626-81-2; Lead titanium zirconium oxide
- CAS: 79-94-7; TBBA
- CAS: 12060-00-3; Lead-titanium-trioxide
-

Based on the currently available information, we assume that this substance does not represent any risk when correctly used, including its disposal.

11. Index

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V

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