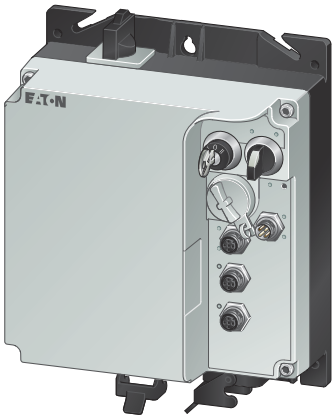
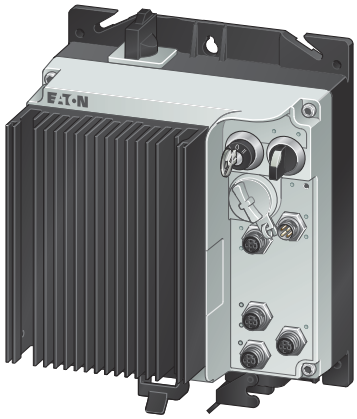
Rapid Link 5
RAMO5
RASP5





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Original operating manual
The German-language edition of this document constitutes the original operating manual.

Translation of the original operating manual

1. 2019 edition, publication date 10/19
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Danger!
Dangerous electrical voltage!

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally retriggered.
- Verify isolation from the supply.
- Ground and short-circuit.
- Cover or enclose neighbouring units that are live.
- Follow the engineering instructions (IL) of the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or to the potential equalizing. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O connection so that a cable or wire breakage on the signal side does not result in undefined states in the automation device.
- Ensure a reliable electrical isolation of the low voltage for the 24 V supply. Only use power supply units complying with IEC 60364-4-41 or HD 384.4.41 S2 (VDE 0100 part 410).
- Deviations of the mains voltage from the nominal value must not exceed the tolerance limits given in the technical data, otherwise this may cause malfunction and dangerous operation.
- Emergency-Stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency switching off devices must not cause restart.
- Built-in devices for enclosures or cabinets must only be run and operated in an installed state, desk-top devices or portable devices only when the housing is closed.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency switching off devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks, etc.).
- During operation, and depending on their degree of protection, variable frequency drives may have live, uninsulated, moving, and/or rotating parts, as well as hot surfaces.
- The impermissible removal of the required cover, improper installation or incorrect operation of the motor or variable frequency drive can cause the failure of the device and serious injury and/or material damage.
- Comply with all applicable national accident prevention regulations (e.g. BGV A3) when working with energized variable frequency drives.
- The electrical installation must be carried out in accordance with the relevant regulations (e.g. with regard to cable cross sections, fuses, PE).
- All transport, installation, commissioning and maintenance work must only be carried out by trained personnel (observe IEC 60364, HD 384 or DIN VDE 0100 and national accident prevention regulations).
- If applicable, systems in which variable frequency drives are installed must be equipped with additional monitoring and protective devices in accordance with the applicable safety regulations, e.g., the German Equipment and Product Safety Act, accident prevention regulations, etc. Making changes to the variable frequency drives by using the operating software is allowed.
- Keep all covers and doors closed during operation.
- When designing the machine, the user must incorporate mechanisms and measures that limit the consequences of a drive controller malfunction or failure (an increase in motor speed or the motor's sudden stop) so as to prevent hazards to people and property, e.g.:
  - Additional stand-alone devices for monitoring parameters that are relevant to safety (speed, travel, end positions, etc.)
  - Electrical and non-electrical safety devices (interlocks or mechanical locks) for mechanisms that protect the entire system
  - Due to the possibility of there being capacitors that are still holding a charge, do not touch live device parts or terminals immediately after disconnecting the variable frequency drives from the supply voltage. Heed the corresponding labels on the variable frequency drives

Content

0 About this manual

This manual is the original operating instructions and describes the RAMO5 motor starters and RASP5 speed controllers of the Rapid Link System 5 as well as relevant accessories.

The subsequent chapters provide special information needed to configure, install and operate these Rapid Link function modules.

0.1 List of revisions

Publication date	Page	Keyword	new	modified	deleted
10/19		First version	–	–	–

0.2 User note

Please read this manual carefully before you install the Rapid Link system and start using it.

We assume that you have a good knowledge of engineering fundamentals and that you are familiar with electrical systems and the applicable principles and are able to read, interpret and apply the information contained in technical drawings.

WARNING

Cyber security
Please observe the notes in the Hardening documentation 08/2019 MZ034003EN "Product Cybersecurity Guideline - Rapid Link 5 AS-Interface".

You can find the document on the Eaton website.

0.3 Writing conventions

Symbols used in this manual have the following meanings:

▶ Indicates instructions to be followed.

0.3.1 Safety warning concerning property damage

ATTENTION

Warns about the possibility of damage.

0.3.2 Safety warning concerning personal injury hazards

CAUTION

Warns of the possibility of hazardous situations that may possibly cause slight injury.

WARNING

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

DANGER

Indicates an imminently hazardous situation that will result in death or serious injury

0.3.3 Tips

Indicates useful tips.

The housing, as well as other safety-relevant parts, has been left out in some of the figures in this manual in order to make the figures easier to understand. However, it is important to note that the components described in this manual must always be operated with their housing installed properly, as well as with all required safety-relevant parts.

Please follow the notes in the IL034084ZU and IL034085ZU instructional leaflets.

All the specifications in this manual refer to the hardware and software versions documented in it.

For more information on the series described in this manual, please visit the Download Center on the Internet at the Eaton website.

http://www.eaton.de/EN/EatonDE/ProdukteundLoesungen/Electrical/Kundensupport/DownloadCenter/index.htm

Enter "MN040034DE" in the **Quick Search** field and click on **Search**.

Alternatively, you can use the selection lists and entries to **switch, protect and drive motors** → **Rapid Link** and click on **Search** to find the information available on the topic Rapid Link (Assembly instructions, software, manuals, catalogs, product information).

0.4 Abbreviations and symbols

The following symbols and abbreviations are used in this manual:

EMC	**E**lectro**m**agnetic **c**ompatibility
FWD	**F**or**w**ar**d** (clockwise rotating field)
LCD	**L**iquid **C**rystal **D**isplay (liquid crystal display)
PES	Functional ground, **PE** connection (ground) of the **S**creen (cable)
pk	Peak
PNU	**P**arameter**Nu**mber
RAMO	**Ra**pid Link **Mo**tor Starter
RASP	**Ra**pid Link **Sp**eed Control
REV	**Rev**erse (left-hand rotating field)
STO	**S**afe **T**orque **O**ff
DS	**F**actory**d**efault setting
	The AS-Interface logo (**A**ctuator-**S**ensor-Interface, actuator-sensor interface) symbolizes those components that comply with the EN 50295 and IEC 6026-2 standards.
	The DESINA logo (**DE**centralized and **s**tandardized **IN**st**A**llation technology) identifies the components that correspond to the DESINA specification. See also: www.desina.de

Note on spelling
The short descriptions RAMO5 and RASP5 are abbreviated for all types RAMO5-…-…S1 or RASP5-…-…S1 according to the type code on pages 17 and 18.

0.5 Documents with additional information

For further information, see the following documentation:

Document	Type	Subject
MN040003EN	Manual	drivesConnect Parameterization software for PowerXL™ frequency converters
MZ034003EN	Manual	"Product Cybersecurity Guideline Rapid Link 5 AS-Interface"
AP040051DE	Application Note	Notes and examples of permanent magnet and brushless DC motors
AP040189	Application Note	Notes on programming via Bluetooth
IL040025ZU	Instruction leaflet	DX-CBL-PC-3M0
IL04012020Z	Instruction leaflet	DX-KEY-LED2 DX-KEY-OLED
IL034084ZU	Instruction leaflet	Instruction leaflet for RAMO5
IL034085ZU	Instruction leaflet	Instruction leaflet for RASP5
PU05907001Z	Manual	Safety manual
IL040051ZU	Instruction leaflet	DX-COM-STICK3-KIT

0.6 Units of measurement

Every physical dimension included in this manual uses international metric system units, otherwise known as SI (Système international d'unités) units. For the purpose of the equipment's UL certification, some of these dimensions are accompanied by their equivalents in imperial units.

Table 1: Unit conversion examples

Designation	US-American	US-American value	SI value	Conversion value
Length	inch	1 inch (")	25.4 mm	0.0394
Output	horsepower	1 HP = 1.014 PS	0.7457 kW	1.341
Torque	pound-force inches	1 lbf in	0.113 Nm	8.851
Temperature	Fahrenheit	1 °F (T_F)	-17.222 °C (T_C)	$T_F = T_C \times 9/5 + 32$
Speed	revolutions per minute	1 rpm	1 min^{-1}	1
Weight	pound	1 lb	0.4536 kg	2.205

1 Rapid Link system 5

Rapid Link 5 is a modern and efficient drive and automation system.
The innovative Rapid Link 5 concept focuses on customer and industry-specific requirements for material handling applications. It is suitable for both simple and complex tasks in all areas of conveyor technology.

Because the Rapid Link 5 System can be fitted into a power and data bus, it allows electrical drives to be installed and taken into operation much more quickly and cost-efficiently than with conventional methods.

Thanks to a power bus and a data bus that are plugged into every Rapid Link 5 module, the system is quick and easy to install.

In the Rapid Link 5 variant, the Rapid Link modules are tailor-made solutions as

- electronic DOL and reversing starter RAMO,
- RASP5 frequency controlled speed control.

The following versions are available:

- Protection type IP65
- For communication and diagnostics: AS interface
- Brake control
- STO (only for RASP5)
- Pluggable terminal design to ISO 23570
- Local operation/hand operation
- Repair and maintenance switch (optional)

1.1 System overview

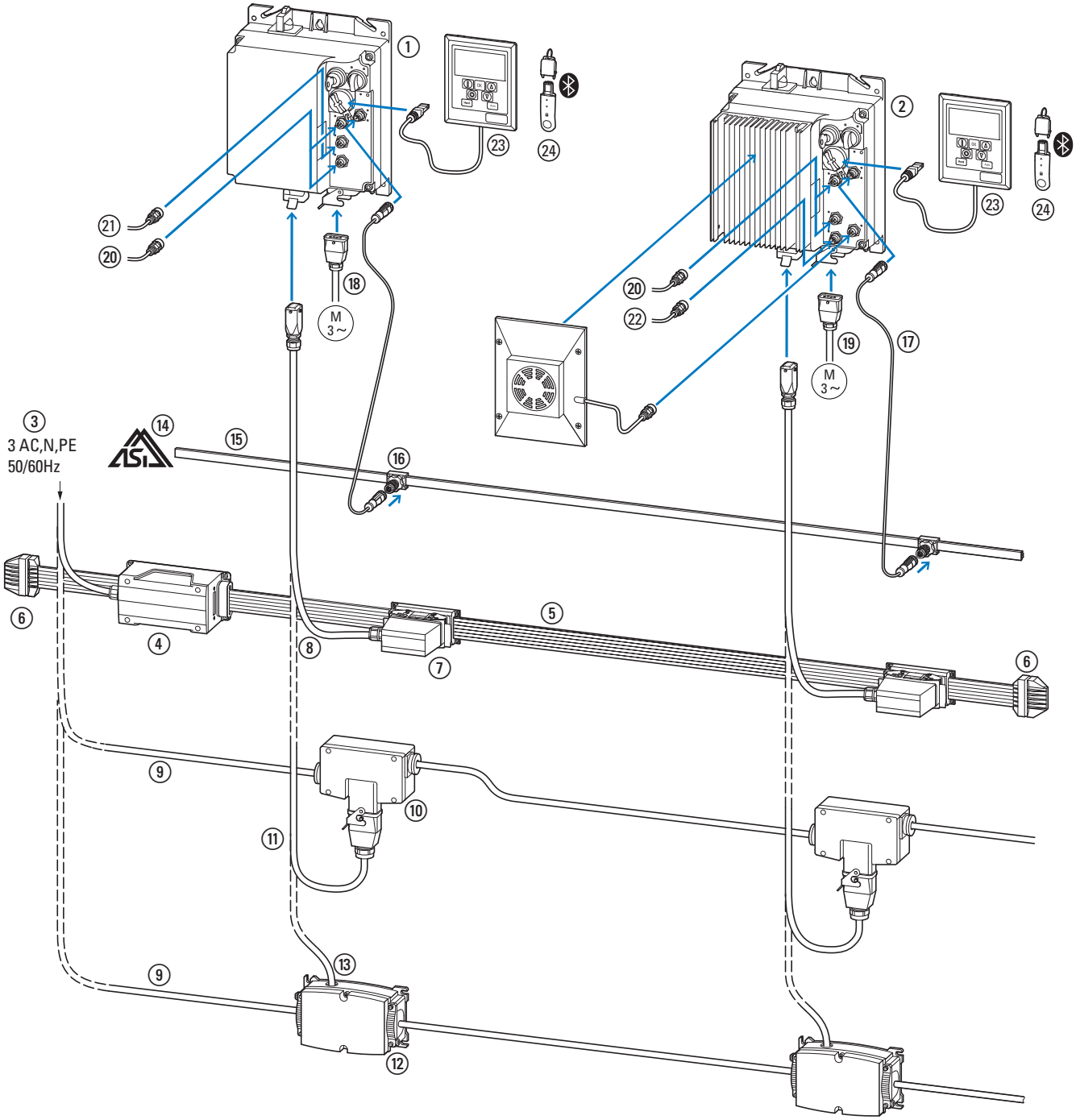


Figure 1: Overview Rapid Link Module 5

Function modules:
① RAMO motor starter (Motor Control Unit):
3-phase electronic DOL starter or reversing starter
② RASP5 speed controller:
3-phase, frequency-controlled motor starter

Power bus:
③ Power supply (3 AC N/PE 400/480 V, 50/60 Hz)
④ Incoming supply for ribbon cable
⑤ Ribbon cable for 400/480 V AC
⑥ End-piece for flat cable
⑦ Flexible busbar junction
⑧ Power adaptor cable to flexible busbar junction
⑨ Round cable for 400/480 V AC

⑩ Plug-in link for round cable
⑪ Power adaptor cable for pluggable round cable junction
⑫ Plug-in link for round cable (Powerbox)
⑬ Power adaptor cable (round cable) to power box

Data bus:
⑭ AS interface
⑮ AS-Interface flat cable
⑯ Link for M12 connector cables
⑰ Extension cable with M12 plug

Motor connection:
⑱ Unshielded motor cable (for RAMO5)
⑲ Screened motor cable (for RASP5)
⑳ Sensor connection via M12 plug connector
21Actuator connection via M12 connector (for RAMO5)
22 STO connector (for RASP5)
23 DX-KEY-OLED operating unit view
24 Bluetooth Stick DX-COM-STICK3-KIT

1.2 Checking the delivery

→ Before opening the packaging go over the nameplate on the packaging and check for whether the delivered component is the same part no. as the one you ordered.

The RAMO5 and RASP5 devices are carefully packed and sent for shipment. Transport must only be carried out in the original packaging and with suitable means of transport. Please take note of the labels and instructions on the packaging, as well as of those meant for the unpacked device.

Open the packaging with adequate tools and inspect the contents immediately after receipt in order to ensure that they are complete and undamaged.

The packaging must contain the following parts:

- Motor starter (Motor Control Unit)
  - One RAMO device,
  - the instructional leaflet IL034084ZU.

or

- Speed Control Unit
  - One RASP device,
  - the instructional leaflet IL034085ZU.

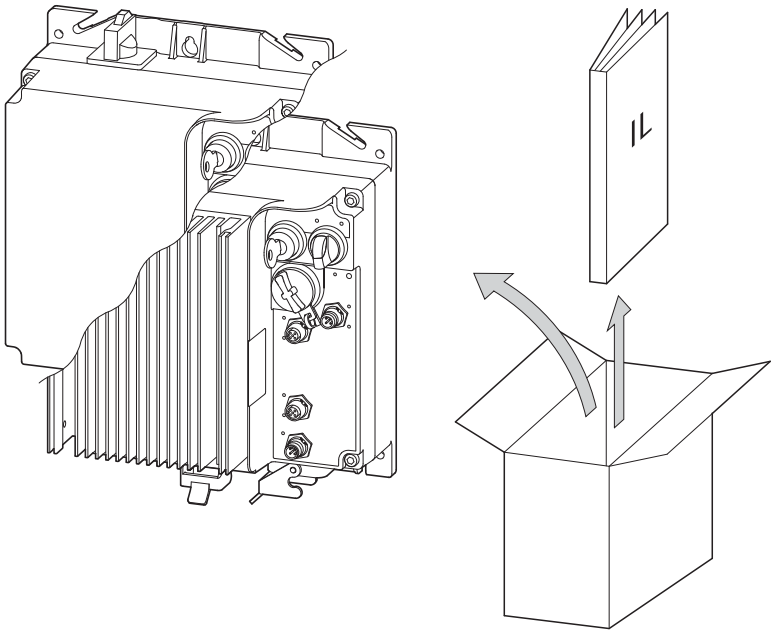


Figure 2: Equipment supplied (RAMO5 or RASP5 device plus instructional leaflet)

1.3 Rated operational data on the nameplate

The device-specific rated operational data for the RAMO 5 or RASP5 is listed on the rating plate of the device.

The following are two example rating plates:

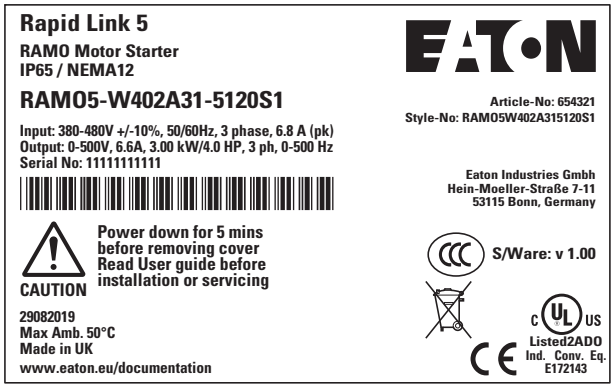


Figure 3: Rating plate at RAMO

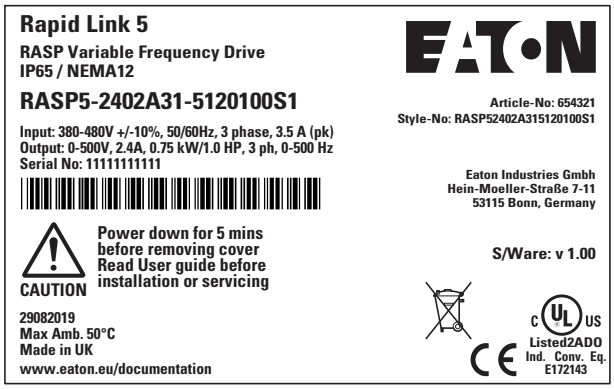


Figure 4: Rating plate at RASP

The inscription of the nameplate has the following meaning (example):

Inscription	Meaning
RASP5-2402A31-5120100S1	Part no.: RASP5 = RASP5 speed controller 2 = 2.4 A rated operational current 4 = 4 Sensor inputs 0 = no actuator output 2 = 230 V AC control voltage for external motor brakes A = AS-Interface communication 31 = AS-Interface profile S7.4 5 = Energy connector HAN Q5 1 = 1 power connector 2 = Bottom power port location 0 = without repair switch 1 = with brake chopper 0 = without STO 0 = without fan S1 = Version
Input	Rated operational data of mains connection Single-phase AC voltage (U_e 3~ AC) Voltage 380 - 480 V, frequency 50/60 Hz, input phase current 3.5 A (peak)
Output	Load side (motor) rated operational data: Three-phase AC voltage (0 - 500 V) output phase current (2.4 A), Output frequency (0 - 500 Hz) Assigned motor output: 0.75 kW at 400 V/1 HP at 460 V for a four-pole, internally or surface-cooled three-phase motor (1500 min^{-1} at 50 Hz/1800 rpm at 60 Hz)
Serial No.:	Serial number
IP65/NEMA 12	Housing protection type: IP65 (NEMA 12), UL (cUL) Open type
Software	Software version (1.00)
29082019	Manufacturing date: 8/29/2019
Max. Amb. 50 °C	Maximum permissible ambient air temperature (50 °C)
	The variable frequency drive is electrical equipment. Read the manual (in this case MN034004EN) before making any electrical connections and commissioning.

1.3.1 Type code RAMO5

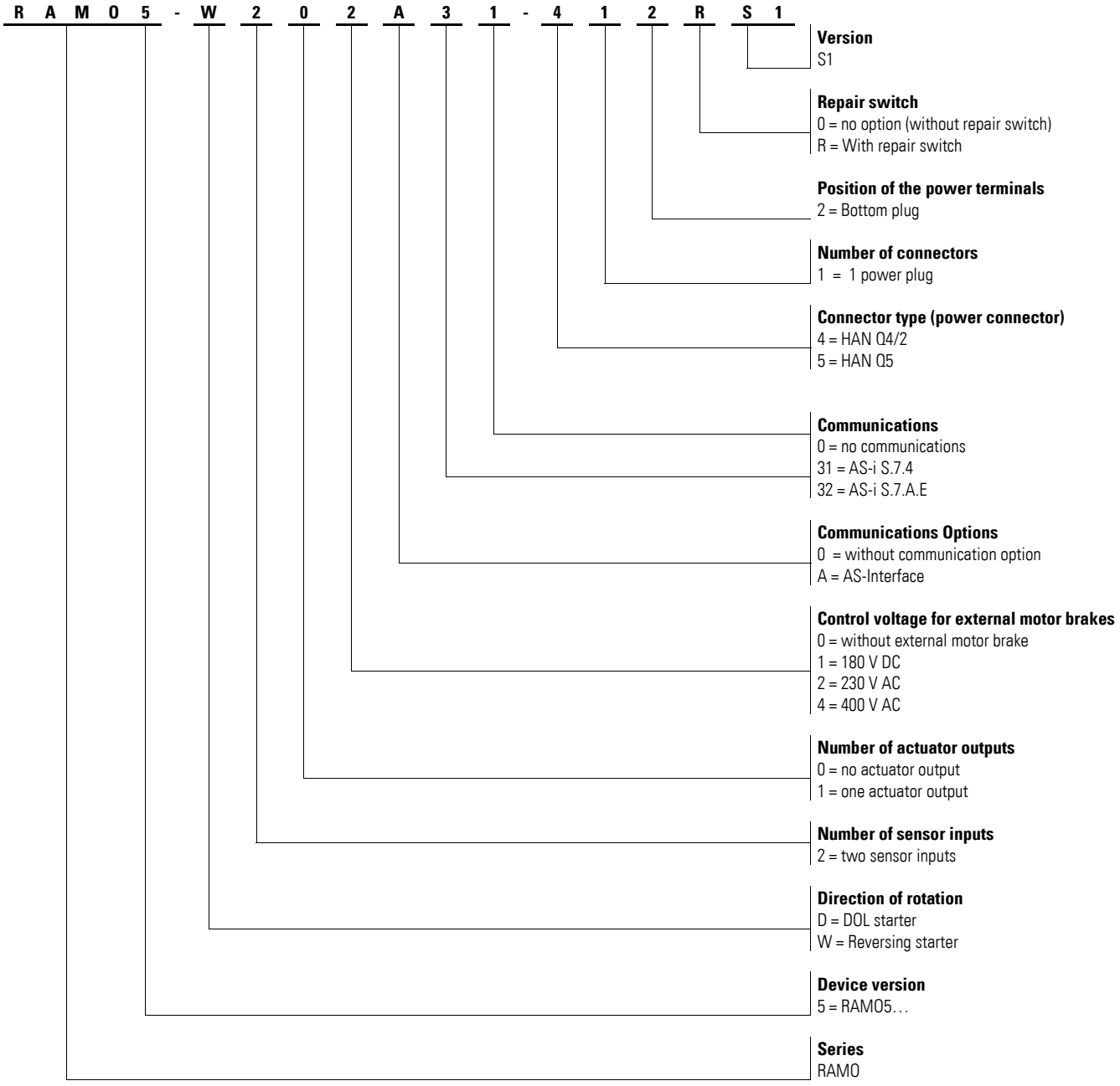


Figure 5: Key to part numbers of RAMO5 motor starter

1.3.2 Type code RASP5

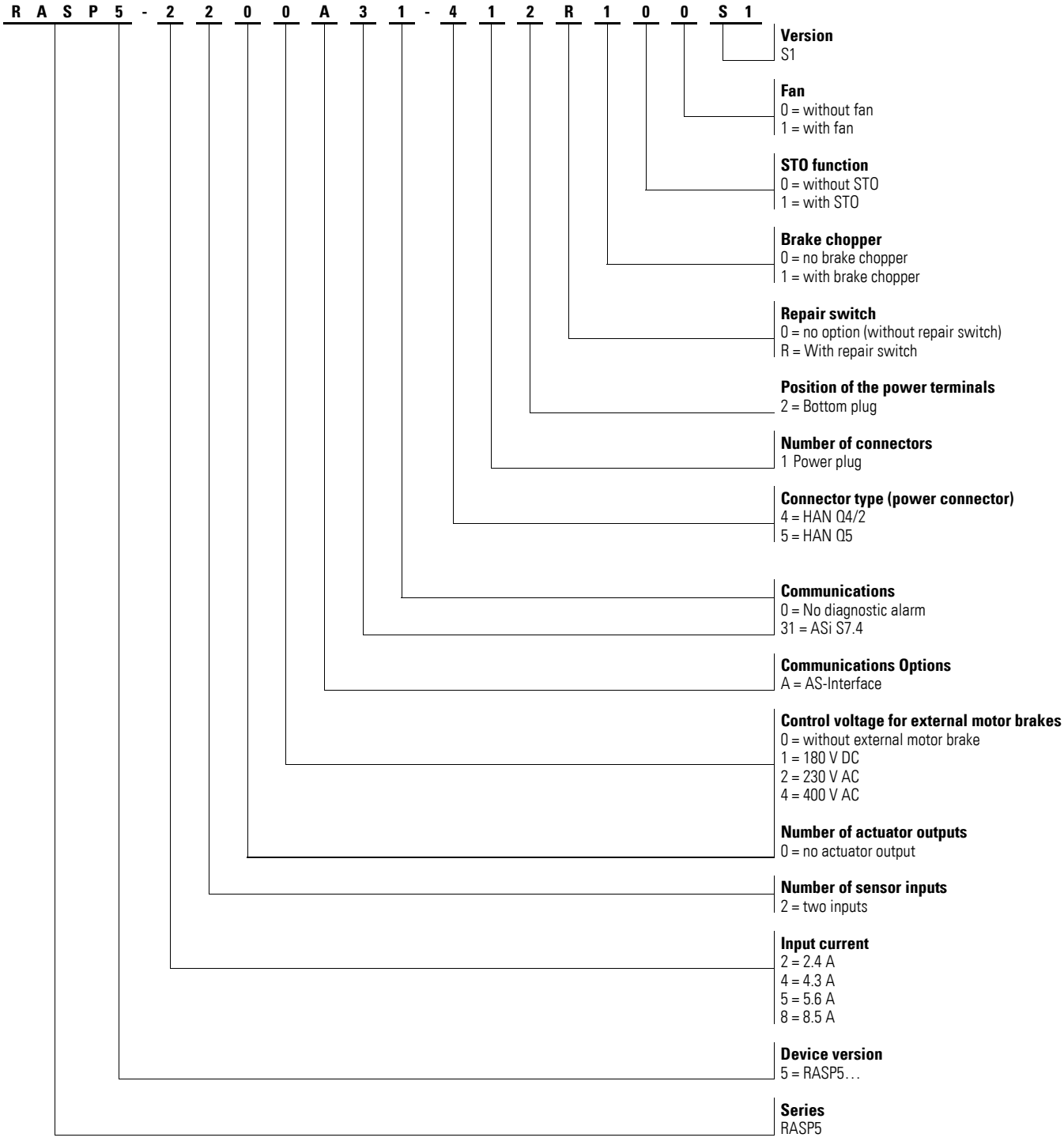


Figure 6: Key to parts numbers of the RASP speed controller

1.4 Technical data

Table 2: General rated operational data (overview)

Technical data	Formula sign	Unit	Value	
			RAMO5	RASP5
General				
Standards			IEC/EN 60947-4-2 EN 50598-2	IEC/EN 61800-2 IEC/EN 61800-3 IEC/EN 61800-5-1 EN 50598-2 EN 61800-5-2:2017 EN ISO 13849-1:2015 EN 62061:2015 EN 61508, Part 1 + 2, 4 - 7: 2010
Approvals, certificates			CE, CCC, UL, CSA	CE, UL, CSA, CCC
Production quality			Directive 2002/95/EC (RoHS), ISO 9001	Directive 2002/95/EC (RoHS), ISO 9001
Degree of protection			IP65, NEMA 12 / NEMA 12K.	IP65, NEMA 12 / NEMA 12K.
Installation site			vertical (→ Page 75)	vertical (→ Page 75)
Ambient temperature range				
Operation		°C	-10 - +55	without derating: -10 - +40 with derating: -10 - +55
Storage		°C	-40 - +70	-40 - +70
Installation altitude	H	m	0 to 2000 over NN, over 1000 m with 1 % power reduction per 100 m	0 to 2000 over NN, over 1000 m with 1 % power reduction per 100 m
Humidity (IEC/EN 50178)	p_w	%	< 95 %, relative humidity, non-condensing	< 95 %, relative humidity, non-condensing
Vibration (IEC/EN 60068-2-6)				
Amplitude		Hz	3 - 15.8 Vibration amplitude: 0.15 mm	3 - 15.8 Vibration amplitude: 0.15 mm
Acceleration		Hz	15.8 - 150 constant acceleration 2 g	15.8 - 150 constant acceleration 2 g
Mechanical shock resistance (IEC/EN 60068-2-27)			1000 shocks per shaft, Half sine 15 g/11 ms	1000 shocks per shaft, Half sine 15 g/11 ms

Technical data	Formula sign	Unit	Value	
			RAMO5	RASP5
Main circuit				
Supply				
Rated operational voltage	U_e	V	3 AC 400/480	3 AC 400/480
Rated operating voltage for brake control	U_e	V	180 V DC 230/277 V AC 400/480 V AC	180 V DC 230/277 V AC 400/480 V AC
Voltage range	U_{LN}	V	380 - 10% - 480 + 10%	380 - 10% - 480 + 10%
Frequency range	f_{LN}	Hz	(50 - 10 %) - (60 + 10 %)	50/60 (45 - 66 Hz ±0 %)
Network type			Alternating voltage, center-point-earthed star network (TN-S network) Phase-earthed AC supply systems are not permitted.	Alternating voltage, center-point-earthed star network (TN-S network) Phase-earthed AC supply systems are not permitted.
Mains switch-on frequency		Quantity	max. one time per minute	max. one time per minute
Mains current	THD	%	< 120	< 120
short-circuit current	I_K	kA	< 10	< 10
Short-circuit protection device (Power bus incoming unit)			PKE3/XTUCP-36 FAZ-3-B20 or FAZ-3-C20	PKE3/XTUCP-36 FAZ-3-B20 or FAZ-3-C20
Overvoltage category/ pollution degree (DIN/VDE 0110)			III	III
Rated impulse withstand voltage	U_{imp}	kV	4	–
Leakage current to PE earth (EN 50178)	I_{PE}	mA	< 3.5	< 3.5
Power section				
Instance			RAMO5-D: Direct-on-line starter with thyristors and bypass contacts RAMO5-W: Reversing starter with relay, thyristors and bypass contacts two-phase controlled	Frequency inverter with internal DC link and IGBT inverter
Service life (AC3)		Quantity	> 10 millions connections	–
Output voltage	U_2	V AC	0 - U_{LN}	0 - U_{LN}
Output frequency	f_2	Hz	0 - 50/60 Hz	0 - 50 Hz, max. 500 Hz
Rated current	I_e	A	6.6	2.4 / 4.3 / 5.6 / 8.5
Load current for the control unit for an external brake	I	A	≦ 0.6 600 mA constant, 6 A for 120 ms	≦ 0.6 600 mA constant, 6 A for 120 ms
Adjustable motor protection	I	A	0.3 - 6.6	0.48 - 8.5
Overload withstand capability				
for 60 s every 600 s at +40 °C	I_L	%	–	150
for 2 s every 20 s at +40 °C	I_H	%	–	200
Assigned motor output[1)]	P	kW		
(with motor protection) with 400 V, 50 Hz	P	kW	0.18 - 4	0.18 - 4
at 440 V - 460 V, 60 Hz	P	HP	0.25 - 5	0.25 - 5

Technical data	Formula sign	Unit	Value	
			RAMO5	RASP5
Control voltage				
External control voltage	U	V	24, for actuators, Maximum load current 1 A	24, for quick stop function via AS-Interface plug
Tolerance		%	-15 - +20	
AS-Interface Specification				
Total power consumption from AS-Interface-power supply unit (30 V-)	I	mA	30 + 160 for sensors	30 + 160 for sensors
Specifications			S-7.4 S-7.A.E	S-7.4
Station addresses		Quantity	31/62	31
I/O Code			7 (hex)	7 (hex)
ID-code			4 (hex)	4 (hex)

1) Assigned motor power for standard, internally ventilated and outdoor three-phase asynchronous motors with 1500 min^{-1} (at 50 Hz) and 1800 min^{-1} (at 60 Hz)

1.5 UL Standards Compliance

1.5.1 RAMO5

The RAMO5 motor starters have been tested in accordance with UL 60947-4-2 and are approved as "listed".

Table 3: RAMO5

Property	Value
Input voltage	480 V AC
Output voltage	480 V AC
Rated operating voltage for brake control	180 V DC / 230/480 V AC / 400/480 V AC
Input current	6,6 A
Output current	6,6 A
Phases	3
Frequency	50/60 Hz
Control voltage, external	24 V DC
Field bus input voltage	30 V DC
Motor protection	integrated
Thermistor monitoring	integrated
SCCR	→ Table 4
Degree of protection	IP65/NEMA 12
Ambient temperature, maximum	55 °C

Table 4: Short circuit current rating for individual and group protection

	With fuse (UL listed)		Circuit-breakers (UL listed)	
	with built-in local disconnect switch	without built-in local disconnect switch	with built-in local disconnect switch	without built-in local disconnect switch
Voltage	480 V AC	480 V AC	480 V AC	480 V AC
Short-circuit current, maximum	30 A	30 A	32 A	32 A
Interrupting Rating	10 kA	65 kA	10 kA	10 kA

→ Devices with an integrated disconnect switch are approved for use as "motor disconnects" ("lockout/tagout").

The RAMO5 motor starter may be installed and operated observing following conditions: The device is suitable for use on a circuit capable of delivering not more than 65000 rms Symmetrical Amperes, 480 V:

- When protected by 30 A fuses; or
- when protected by a circuit breaker having an interrupting rating not less than 65,000 rms Symmetrical Amperes, 480 Volts,32 A maximum.

Use with drives with flexible cables is subject to AHJ. Installation may be limited to NFPA 79 applications.

1.5.2 RASP5

RASP5 motor starters have been tested in accordance with UL 61800-5 and are approved as "listed".

Table 5: RASP5

Property	Value
Input voltage	480 V AC
Output voltage, maximum	480 V AC
Rated operating voltage for brake control	180 V DC 230 V AC 400 V AC
Output current	2.5 A (RASP5-2…S1) 4.3 A (RASP5-4…S1) 5.6 A (RASP5-5…S1) 8.5 A (RASP5-8…S1)
Input current	2.4 A (RASP5-2...) 4.1 A (RASP5-4...) 5.3 A (RASP5-5...) 7.8 A (RASP5-8...)
Frequency	50/60 Hz
Phases	3
Output frequency	0 - 320 Hz
Field bus input voltage	30 V DC
Motor protection	integrated, At 105 % full load
Thermistor monitoring	integrated
Degree of protection	NEMA 12/NEMA 12K
Ambient temperature, maximum	40 °C without fan 55 °C with fan

Table 6: Short circuit current rating for individual and group protection

	With fuse (UL listed)		Circuit-breakers (UL listed)	
	with built-in local disconnect switch	without built-in local disconnect switch	with built-in local disconnect switch	without built-in local disconnect switch
Voltage	480 V AC	480 V AC	480 V AC	480 V AC
Short-circuit current, maximum	30 A	30 A	32 A	32 A
Interrupting Rating	10 kA	65 kA	10 kA	10 kA

→ Devices with an integrated disconnect switch are approved for use as "motor disconnects" ("lockout/tagout").

The speed controller RASP5 can be installed and operated under the following conditions:

The drive is suitable for use on a circuit capable of Delivering not more than 65,000 rms Symmetrical Amperes, 480 Volts maximum:

- When protected by 30 A fuses" or
- when protected by a circuit breaker having an interrupting rating not less than 65,000 rms Symmetrical Amperes, 480 Volts, 32 A maximum.

The drive is able to accept and process a signal from a thermal sensor mounted in or on the motor, which provides motor overload protection. This device offers a motor overload protection at 105 % of the full load current.

Protective separation is not provided between the DVC A thermistor input circuit and DVC C 480 V drive circuit. Only a basic 480 V insulation is provided.
The thermistor circuit is designed with a basic or additional insulation to protect 480 V from direct contact.

- Only for use with flexible cable connected drives is at the discretion of the AHJ. Installation may be limited to NFPA 79 applications.
- Only for use in a TN earthing system, excluding corner grounded systems.
- Use 75 °C copper conductors only.

Integral solid-state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Manufacturer Instructions, National Electrical Code and any additional local codes.

WARNING

The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted.
To reduce the risk of fire or electric shock, current-carrying parts and other components of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.

WARNING

Operation of this equipment requires detailed installation and operation instructions provided in the Installation/Operation manual intended for use with this product.

1.6 Selection criteria

Select RAMO5 or RASP5 ③ according to supply voltage U_{LN} of the supply system ① and the rated operational current of the assigned motor ②.
The circuit type (Δ / Y) of the motor must be selected according to the supply voltage ①. The RASP's rated output current I_e from the RASP5 must be greater than or equal to the rated motor current. For RAMO5, current monitoring must be set to the rated motor current.

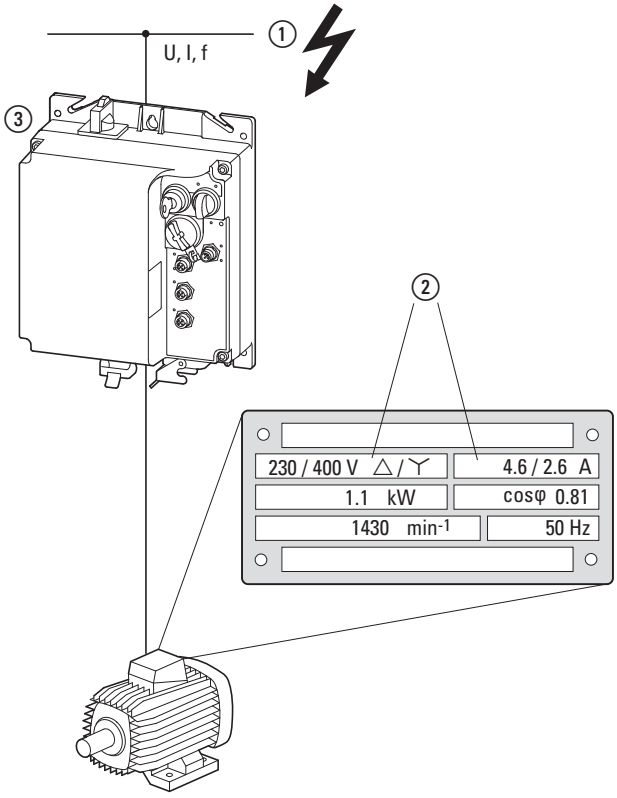


Figure 7: Selection criteria

When selecting the drive, the following criteria must be known:

- Type of motor (three-phase asynchronous motor)
- Grid voltage = rated voltage of the motor (e. g. 3~ 400 V),
- Rated motor current (recommended value, dependent on the circuit type and the supply power supply)
- Load Torque,
- Starting torque,
- Ambient temperature range.

ATTENTION

Do not connect or disconnect power connectors (mains, motor) while RAMO5 and RASP5 are operational.

1.6.1 Special features of the motor selection for RASP5

Check whether your selected RASP5 speed controller and the associated three-phase AC motor are compatible with each other according to voltage (mains and motor voltage) and rated current.

Observe the following general recommendations for motor selection with a RASP5 speed controller:

- Use three-phase induction motors with squirrel-cage rotors and surface cooling – also referred to as three-phase asynchronous motors or standard motors. Other types of motors, such as external rotor motors, wound rotor motors, reluctance motors, permanent magnet motors, synchronous motors, and servomotors can also be run with RASP5 variable frequency drives, but will normally require additional engineering, modifying the various parameters, and detailed information from the motor manufacturer.
- Only use motors of at least class F temperature rating (155 °C maximum constant temperature).
- Take the operating conditions into account for S1 operation (IEC 60034-1).
- Do not oversize the motor, i. e., the motor should not be more than one rating level higher than the rated motor output.
- With undersizing, the motor output may only be one output level less than the allocated output level (to ensure the motor protection). With significantly smaller motor output, the "frequency control U/f)" operating mode must be set.

1.6.2 Synchronous, reluctance, and PM motors

The RASP5 speed controllers enable the operation of three-phase motors with maximum energy efficiency, such as:

- Efficiency classes IE3 and IE4 according to IEC/EN 60034-30, EU No. 4/2014,
- Permanent magnet motors (PM motor),
- Synchronous reluctance motors (SynRM),
- Brushless DC motors.

These motor technologies have comparable efficiencies at their rated operating point and identical efficiency classes, but also have significant differences when it comes to their startup behavior and partial-load operation.
The rating plate details also differ with, e. g., the rating plate details, e.g. 315 V, R_{20*} = 2.1 Ω, L* = 20 mH and U_{PoI} = 195 V/1000 min^{-1} also differ significantly from the usual details.

For information on and examples for permanent magnet and brushless DC-motors, please refer to application note AP040051EN.

1.7 Proper use

DANGER

Incorrect engineering, installation, maintenance or operation of the entire plant or machine, non-observation of the instructions in this manual and modifications by insufficiently qualified persons can cause danger from connected actuators such as motors, hydraulic units etc.

RAMO5 and RASP5 are not devices for household use, and are designed exclusively for use in commercial applications.
RAMO5 and RASP5 are electrical apparatus for controlling variable speed drives with three-phase motors. They are designed for installation in machines or for use in combination with other components within a machine or system.

Rapid Link is intended only for switching, protecting, and controlling three-phase motors in machines and plants. Any other use is not proper use. The vendor does not accept liability for damage resulting from use other than the stated proper use.

1.7.1 Designated power supply systems

Observe the following instructions in this manual regarding mechanical and electrical layout, and commissioning and operation:

- The system must be connected to a three-phase power supply system with a grounded star point and separate N and PE conductors (TN-S network). An ungrounded layout is not allowed.
- All Rapid Link function modules fulfill the safe isolation requirements of.
- The thermistor circuits in RAMO5 and RASP5 units have double basic insulation.
- All devices connected to the power and data bus must also meet the requirements for safe isolation according to IEC/EN 60947-1 Annex N or IEC/EN 60950.
  The 24-V-DC power supply unit must be grounded on the secondary side. The 30 V DC PSU for the AS-Interface power supply (Interface control unit) must meet safe isolation requirements according to SELV.
- Emergency switching off devices (as per IEC/EN 60204-1, corresponding to DIN VDE 0113, Part 1) must be present. Their function must not be impaired in any way.
- Effective lightning protection measures must be implemented in the plant to prevent damage to electronic components.

Connecting the units to IT grounding systems (networks without a reference to ground potential) is not permitted, since the devices' internal filter capacitors connect the supply system to ground potential (enclosure).

1.7.2 Machinery Safety Directive and CE marking

After installation in a machine, the RAMO and RASP must not be taken into operation until the associated machine has been confirmed to comply with the safety requirements of Machinery Safety Directive (MSD) 2006/42/EEC (meets the requirements of EN 60204). The user is responsible for ensuring the machine's usage is in compliance with EC Directives.

The CE labels applied to the RAMO5 and RASP5 variable frequency drives confirm that the devices comply with the Low Voltage Directive (2014/35/EC) and the Electromagnetic Compatibility (EMC) Directive (2014/30/EC).

The RASP5 devices with STO function also comply with the Machinery Directive 2006/42/EC.

At the output of RAMO5 and RASP5 you must not:

- connect several motors,
- connect a voltage or capacitive loads (for example phase-balancing capacitors),
- connect multiple RAMO5 and RASP5 in parallel,
- make a direct connection to the input (bypass).

The technical data and connection conditions must be observed.
For additional information, see the nameplate of RAMO5 or RASP5 and the documentation.

Any other usage constitutes improper use.

1.8 Maintenance and inspection

RAMO and RASP are maintenance-free if the general rated operational data (Table 2, page 19) and the specific technical data and version particulars (→ Section "5.4 Special technical data", page 122, and Page 136) are observed. External factors can, however, influence the component's lifespan and function. We therefore recommend that regular checks and the following general maintenance measures be performed at the specified intervals.

Table 7: Maintenance measures and maintenance intervals

Maintenance measures	Maintenance interval
Clean cooling vents (cooling slits) - RASP5 only	as needed
Check the fan function - RASP5 only	6 - 24 months (depending on the environment)
Check connectors (AS-Interface, sensors, mains, motor, etc.) and all metallic surfaces for corrosion	6 - 24 months (depending on the environment)
Charge capacitors, only for storage of RASP5	12 months → Section "1.10 Service and warranty", page 30
STO function (RASP5 with STO input only)	Activate and deactivate STO at least once every three months.

It is not intended to replace or repair individual RAMO5 or RASP5 assemblies.

Internal DC link capacitors in RASP5

After longer storage periods or longer downtimes without power supply (> 12 months) the capacitors in the the DC link must be charged in a guided manner in order to avoid damage.

For this the RASP5 must be fed with a regulated DC power supply unit via two mains connection terminals (e. g. L1, L2). In order to prevent the capacitors from having excessively high leakage currents, the inrush current should be limited to approximately 300 to 800 mA (depending on the relevant rating). RASP5 must not be enabled (no start signal).
Then set the DC voltage to the values of the corresponding DC link voltage U_{DC} and supply it for approx. two hours (regeneration time), approx. 565 V DC (= 1.42 x U_{LN}) For a three-phase phase voltage of 400 V.

1.9 Storage

Whenever RAMO5 or RASP5 devices are to be stored before use, it must be ensured that there are adequate ambient conditions at the site of storage:

- Storage temperature: -40 - +70 °C
- relative average air humidity: < 95 %, non-condensing (EN 50178)
- Store the devices only in closed original packaging.
- Degree of protection IP65 is obtained only with plug connectors.

Only for RASP5:

- In order to prevent damage to the DC link capacitors in RASP devices, storage periods longer than 12 months should be avoided (see above: Section "Internal DC link capacitors in RASP5").

1.10 Service and warranty

If you have any problem with a RAMO5 or RASP5 device, please contact your local distributor.

When you call, have the following data ready:

- the exact part no.
- the date of purchase,
- a detailed description of the problem which has occurred with RAMO5 or RASP5.

If some of the information printed on the rating plate is not legible, please state only the data which are clearly legible.

Information concerning the warranty can be found in the Eaton Industries GmbH Terms and Conditions.

24-hour hotline: +49 (0) 1805 223 822

Email: AfterSalesEGBonn@Eaton.com

2 Engineering

2.1 Rapid Link modules

RAMO5 and RASP5 rapid Link modules are installed in the direct vicinity of the drives. Design and installation are carried out in accordance with the required specification and local conditions.
Connection to the power and data bus is possible without interruption at any location.

The below example with RAMO5 provides a simplified overview.

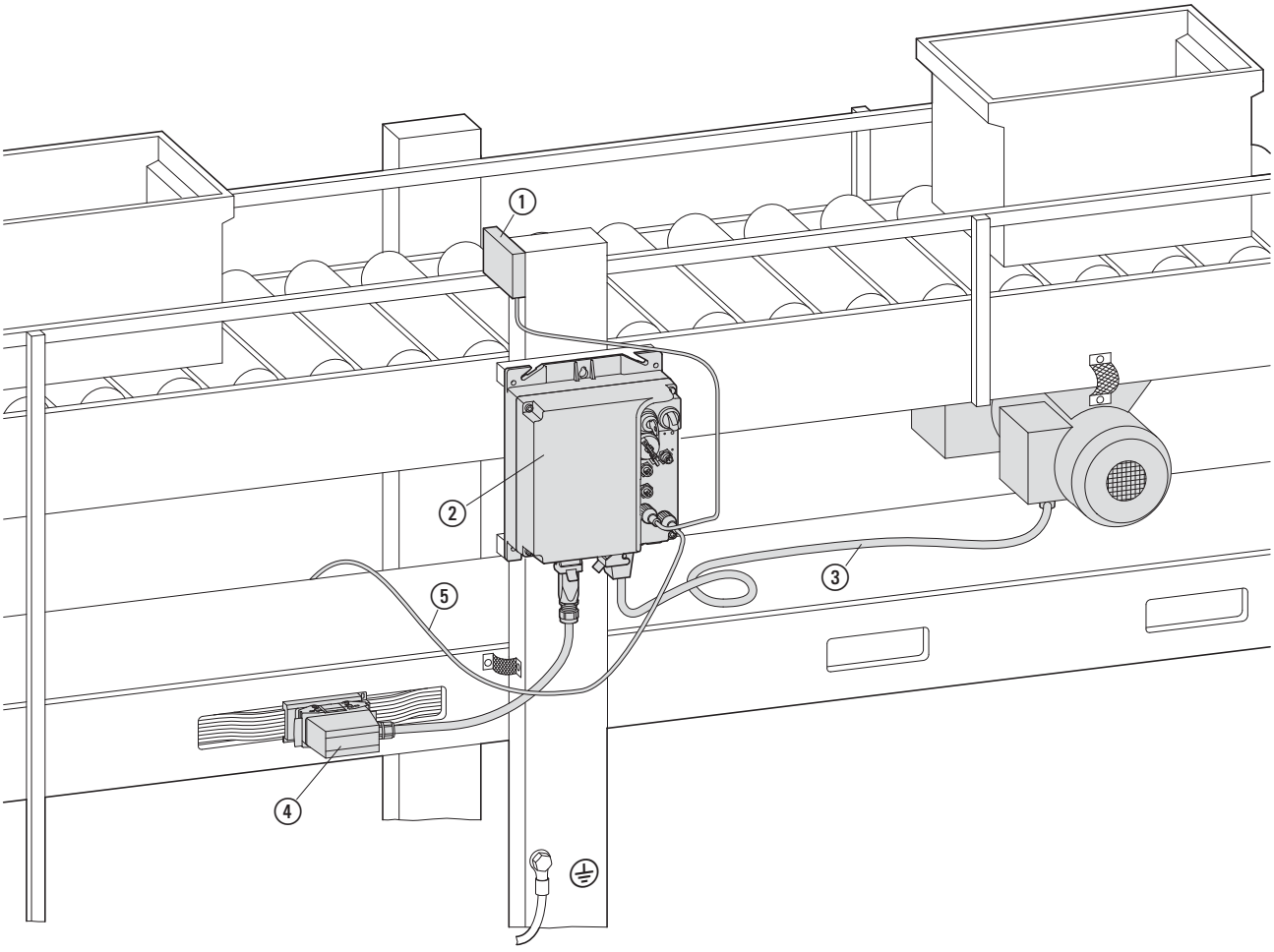
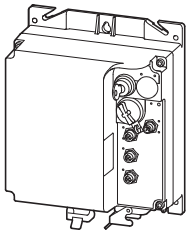


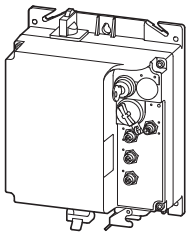
Figure 8: Example showing how to use a RAMO5 unit
① Sensor (light barriers)
② RAMO5
③ Motor connection cable
④ Mains connection on power bus
⑤ AS interface

2.1.1 Instance

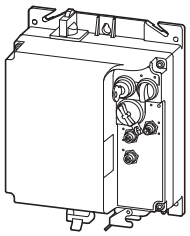
External appearance of various versions:



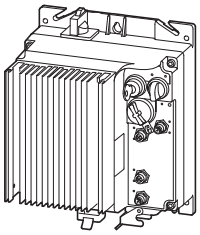
RAMO5-D…-0S1
- Direct starter
- without manual override switch



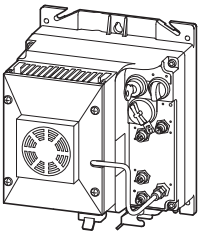
RAMO5-D…-RS1
- Direct starter
- with manual override switch



RAMO5-W…-RS1
- Reversing starter
- with manual override switch



RASP5-…-…R…
- with manual override switch



RASP5-…-1S1
- with fan

2.2 Connections

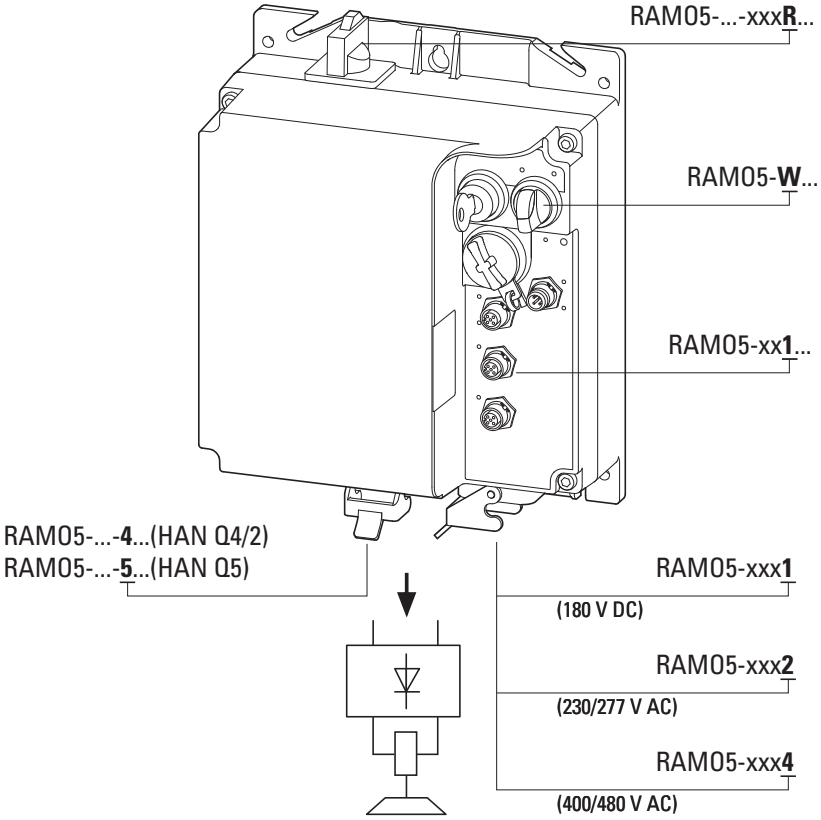


Figure 9: Connections for RAMO5

Designation	Function
I1	Sensor input
I2	Sensor input
Q1	Actuator output
AS-I	AS interface

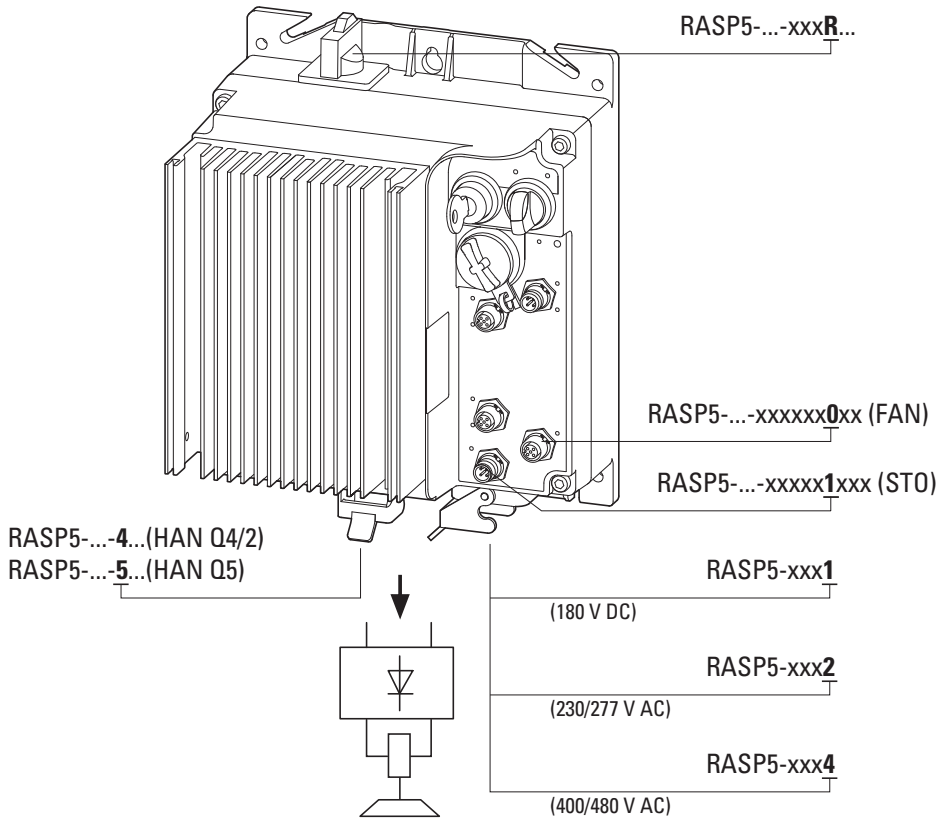


Figure 10: Connections for RASP5

Designation	Function
I1/I3	Sensor input
I1/I4	Sensor input
AS-I	AS interface
STO	STO function
FAN	Connection for device fan

2.3 Repair and maintenance switch

The versions RAMO5-…-…RS1 and RASP5-…-…R…S1 are equipped with a repair and maintenance switch that disconnects the Rapid Link Modules in all three phases ① from the mains voltage.

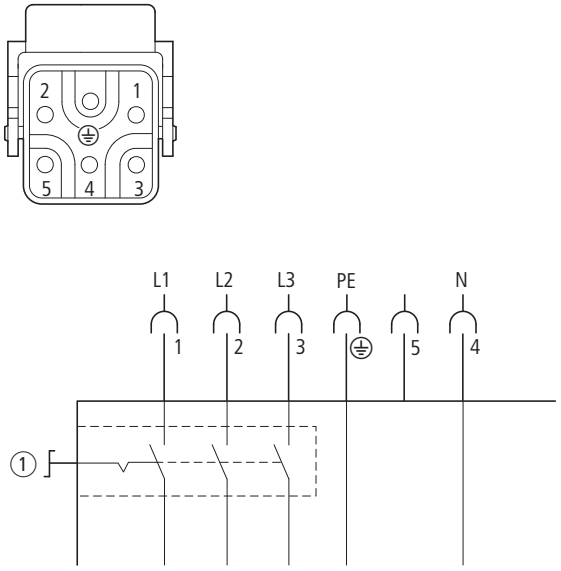


Figure 11: Repair and maintenance switch in position 0 = OFF

The motor must be stopped before the repair and maintenance switch is activated.

DANGER

Before performing maintenance or repair work on RASP5 units, make sure to wait until the DC link voltage discharging time (at least five minutes) has passed.
This also applies when handling the motor.

The contactor state of the repair and maintenance switch is shown in the following figure.

In the case of RAMO5:

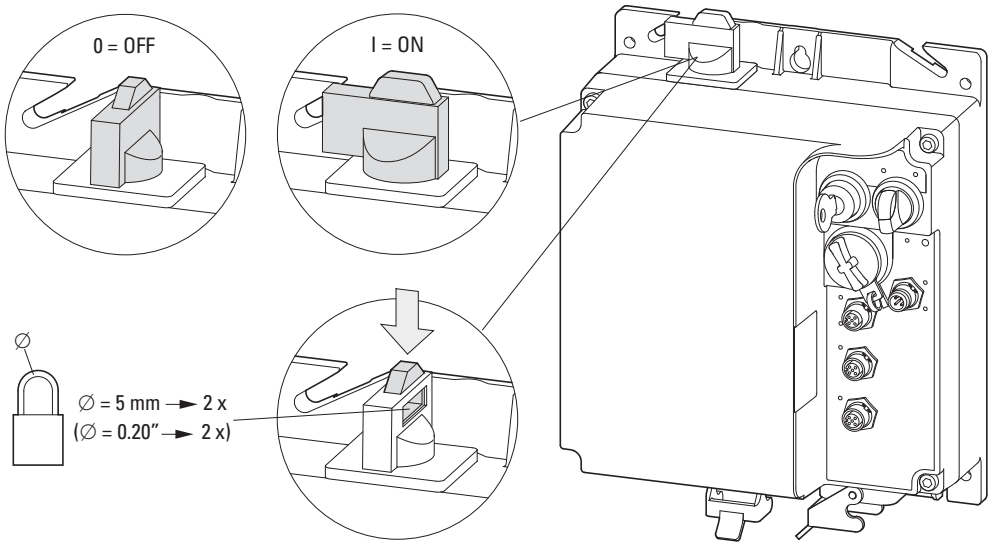


Figure 12: RAMO5 with repair and maintenance switch

In the case of RASP5:

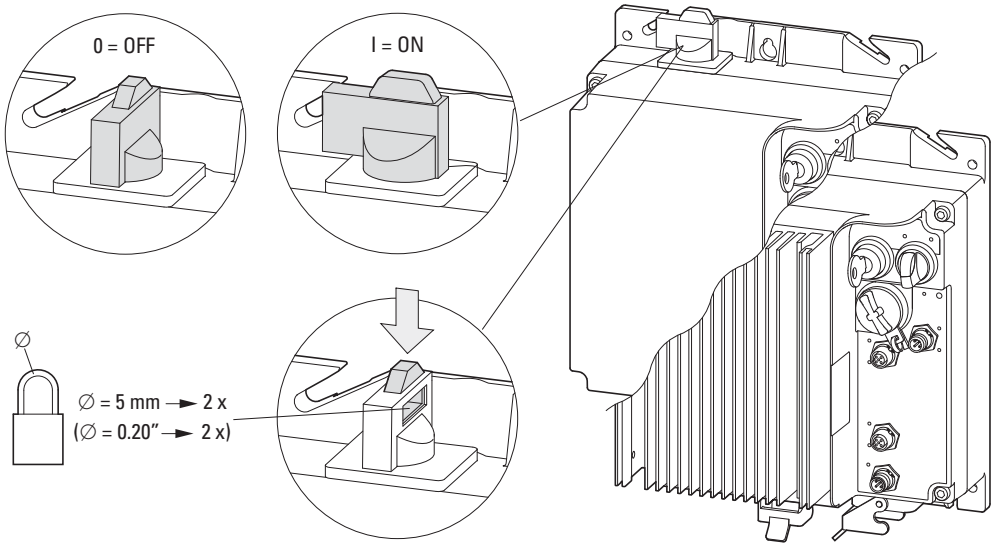


Figure 13: RASP5 with repair and maintenance switch

In switch position 0 (= OFF), the position can be fixed by pulling up the red SVB lock (SVB = locking ring padlock block).
If necessary, up to two padlocks with a bracket diameter of 5 mm can be inserted into the recess of the SVB lock.

After completion of maintenance or repair work, the switch can be released again and returned to position I (= ON). The motor can then be restarted with a start signal in manual or automatic mode.

2.3.1 Power terminals

Plug-in connections in power section for RAMO5 and RASP5:

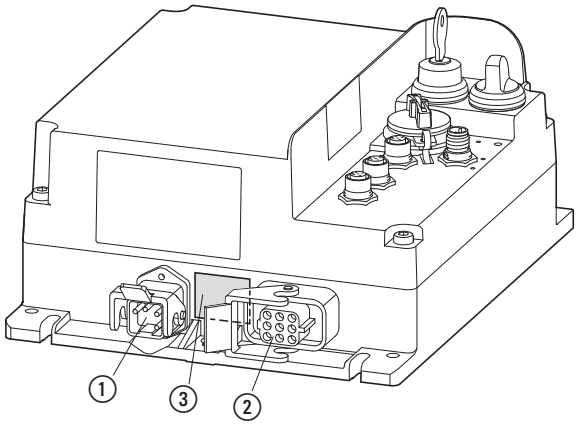


Figure 14: Connections in RAMO5 power section

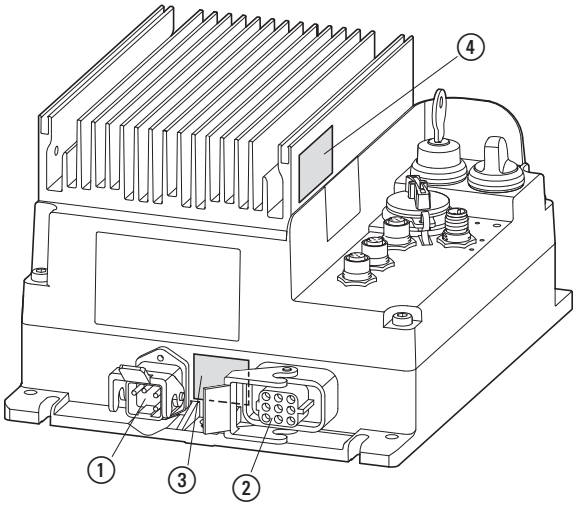
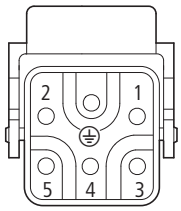


Figure 15: Connections in RAMO5 power section

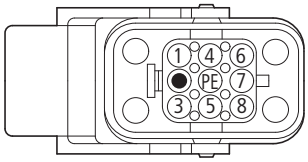
① 5-pin power connector HAN Q5/0 (3 AC 400 V/480 V, N, PE)

Pin	Function
1	L1
2	L2
3	L3
4	N
5	–
PE	PE



② Motor feeder socket (DESINA)

Pin	Function
1	U1, Motor
(2)	Coding
3	W1, motor
4	B2, brake
5	T1, thermistor
6	B1, brake
7	V1, Motor
8	T2, thermistor
PE	PE



DESINA

③ Hazard warning, dangerous voltage - only with RASP5

WARNING

Dangerous voltage from internal DC link capacitors (observe discharge time)!

Pay attention to hazard warnings!

④ Hazard warning, high temperature - only with RASP5

CAUTION

High heat sink temperature.
Do not touch!

ACHTUNG Hohe Temperatur
Kühlkörper nicht berühren
WARNING HOT SURFACE
Do not touch the heat sink

2.4 Electrical power network

2.4.1 Mains connection and configuration

The Rapid Link modules RAMO5 and RASP5 can be connected and operated with all control-point grounded AC power networks (see IEC 60364 for more information in this regard).

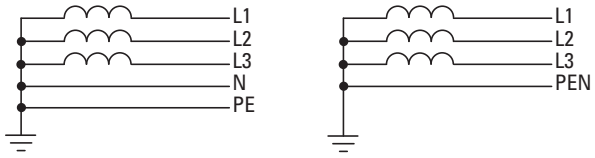


Figure 16: AC power networks with grounded center point (TN-/TT networks)

The connection and operation of frequency inverters to asymmetrically grounded TN networks (phase-grounded Delta network "Grounded Delta", USA) or non-grounded or high-resistance grounded (over 30 Ω) IT networks is not permissible.

→ Measures for electromagnetic compatibility are mandatory in a power drive system, to meet the legal standards for EMC- and Low Voltage Directive.
Good grounding measures are a prerequisite for the effective use of further measures, such as a screenground kit or filters. Without respective grounding measures, further steps are superfluous.

2.4.2 Mains voltage and frequency

The standardized rated operating voltages (IEC 60038, VDE017-1) for power suppliers (EVU) guarantee the following conditions at the transition points:

- Deviation from the rated value of voltage:
  maximum ± 10 %
- Deviation in voltage phase balance:
  maximum ± 3 %
- Deviation from rated value of the frequency:
  maximum ± 4 %

The voltage value below also allows for the permitted voltage drop of 4 % in the consumer circuits, i.e. a total of U_{LN} - 14 %:

400 V - 15 % - 400 V + 10 % (380 V - 10 % - 480 V + 10 %)
(340 V - 0 % - 440 V + 0 %) (342 V - 520 V)

The permissible frequency range for all voltage categories is 50/60 Hz (45 Hz-0 % - 66 Hz+0 %).

2.4.3 Voltage balance

Because of the uneven loading on the conductor and with the direct connection of greater power ratings, deviations from the ideal voltage form and asymmetrical voltages can be caused in three-phase AC supply system.

In the project planning consider only AC power networks that handle permitted asymmetric divergences in the mains voltage ≦ +3 %.

If this condition is not fulfilled, or symmetry at the connection location is not known, the use of a main choke in the mains-side feeder unit of the power bus is recommended.

2.5 Safety and Protection

2.5.1 Fuses and cable cross-sections

The fuses and wire cross-sections allocated for power-side connections depend on the rated mains current ILN of the Rapid Link power bus (without mains reactor).

> *ATTENTION*
>
> When selecting the cable cross-section, take into account the voltage drop under load.
> The consideration of other standards (e. g. VDE 0113 or VDE 0289) is the responsibility of the user.

The national and regional standards (e. g. VDE 0113, EN 60204) must be observed and the necessary approvals (e. g., UL) at the site of installation must be fulfilled.

When the device is operated in a UL-approved system, use only UL-approved fuses, fuse bases and cables.

The leakage currents to ground (to EN 50178) are greater than 3.5 mA.
The connection terminals marked PE and the enclosure must be connected to the ground circuit.

> *ATTENTION*
>
> The specified minimum PE conductor cross-sections (EN 50178, VDE 0160) must be maintained.

→ Choose the cross-section of the PE conductor in the motor lines at least as large as the cross-section of the phase lines (U, V, W).

The cross-sections of the cables and cable protection fuses used must correspond with local standards.

For an installation in accordance with UL guidelines, the fuses and copper cable that are UL-approved and have a heat-resistance of +60/75 °C are to be used.

For a permanent installation with insulation, use power cables that are suitable for the specified mains voltages.

For RASP5 a fully (360°) shielded low-impedance-screened cable on the motor side is required. The length of the motor cable depends on the RFI class and must not exceed 20 m for RASP5.

2.5.2 Residual-current device (RCD)

RCD (Residual Current Device) Residual current protective device, residual current protective device (residual current protective circuit breaker).

Residual current circuit breakers protect persons and animals from the existence (not the origination) of impermissibly high touch voltages.
They prevent dangerous, sometimes fatal injuries in the event of power accidents and also serve to prevent fire.

ATTENTION

Residual current circuit breakers (RCD) are only to be installed between the AC power supply network and the Rapid Link modules RAMO5 and RASP5.

WARNING

For RASP5, only all current-sensitive residual current protective devices (RCD, type B) may be used (EN 50178, IEC 755).

Identification on the residual current circuit breaker	
AC/DC sensitive (RCD, type B)	 

RASP5 work internally with rectified AC currents. If an error occurs, the DC currents can block an RCD circuit breaker of type A from triggering and therefore disable the protective functionality.

On RASP5 safety-relevant leakage currents can occur during operation when RASP5 is not grounded (due to a fault).

Leakage currents to ground are mainly caused by external capacities in RASP5; between the motor phases and the shielding of the motor cable.

The size of the leakage currents is mainly dependent upon the:

- length of the motor cable,
- shielding of the motor cable,
- height of the pulse frequency (switching frequency of the inverter),
- type of RFI filter,
- Grounding measures at the site of the motor.

The leakage current to ground is greater than 3.5 mA for RASP5. A reinforced grounding (PE) must therefore be connected in accordance with the requirements of EN 50178.
The cable cross-section must be at least 10 mm^2, or the grounding system must consist of two separately connected ground cables.

2.6 Power bus

The power bus supplies RAMO5 and RASP5 Rapid Link modules with power. Plug-in outgoers can be quickly and safely connected at any point along the bus. The power bus can consist either of a flexible busbar (ribbon cable) or standard round cables.

ATTENTION

- All devices connected to the apparatus and data bus must also meet the requirements for safe isolation according to IEC/EN 60947-1 Annex N or IEC/EN 60950.
- Power supply units for the AS-Interface power supply must meet the safe isolation requirements according to SELV.

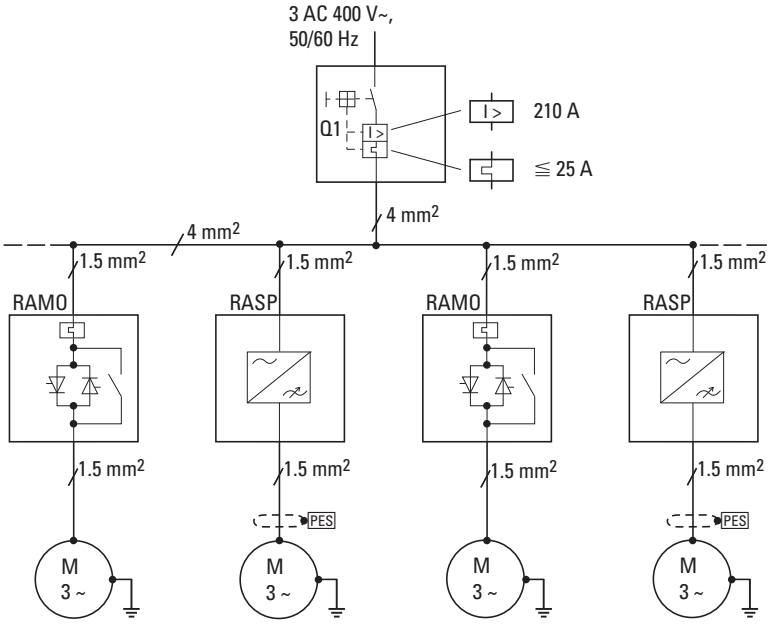


Figure 17: Sample configuration of a Rapid Link system with RAMO5 and RASP5 units

Observe the following when planning the lengths of the power bus cabling:

- In the event of a single-pole short circuit at the end of the energy bus, e. g. in the motor terminal board of the last user, the upstream protective device must be triggered. The level of short-circuit current depends on:
  - Cable length,
  - Conductor cross-section,
  - Short-circuit current at the incoming point
- The level of the application-specific voltage drop depends on:
  - Cable length,
  - Conductor cross-section,
  - Current consumption of motors

Calculate the short-circuit current and the voltage drop as specified in DIN VDE 0100 to make sure that the protection requirements are being met.

The power bus' cable length can be calculated as follows:

$$l = \frac{\frac{U_0 \times 1000}{I_{rm}} - Z_v - (Z_{stub} \times l_{stub})}{Z_{Power\ bus}}$$

l	=	Cable length (maximum 100 m)
U_0	=	230 V (single phase no-load voltage)
I_{rm}	=	Tripping current of short-circuit release
Z_v	=	External supply impedance (e. g. 100 mΩ)
Z_{Stub}	=	35.50 mΩ/m (stub cable 1.5 mm²)
$Z_{Power\ bus}$	=	13.40 mΩ/m (power bus 4.0 mm²) 21.50 mΩ/m (power bus 2.5 mm²)

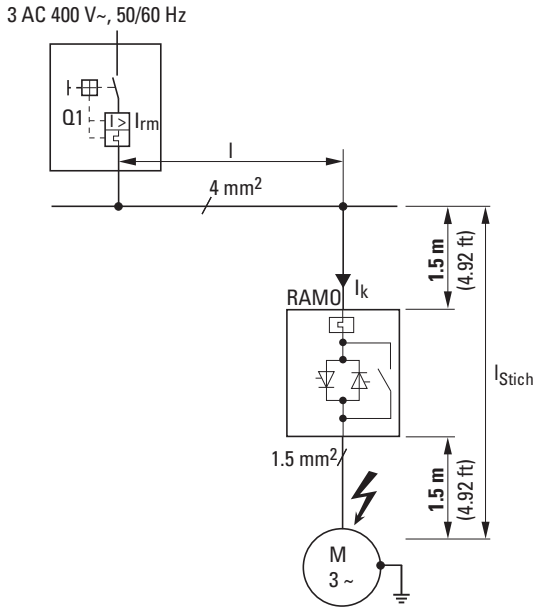


Figure 18: Example: RAMO5

Requirements for the group protection device in the event of a short-circuit: The short-circuit current I_k must be greater than the tripping current of the short-circuit tripping device I_{rm}. The former depends on the impedance and length of the power bus and the stub line.

→ When selecting the cable cross-section, take into account the voltage drop under load.
Consideration of other standards (e. g. VDE 0113, VDE 0289) is the responsibility of the user.

Depending on the power bus' length and the configuration of the power branches, the total of all RAMO5 and RASP5 supply system currents during continuous operation must not exceed 25 A (4 mm²power bus).

2.7 EMC compliant installation for RASP5

The responsibility to comply with the legally stipulated limit values and thus the provision of electromagnetic compatibility is the responsibility of the end user or system operator. They must also take measures to minimize or remove emitted interference in the environment concerned. He must also utilize means to increase the interference immunity of the devices of the system.

In a magnet system (PDS) with RASP5, you should take measures for electromagnetic compatibility (EMC) while doing your engineering, since changes or improvements to the installation site, which are required in the installation or while mounting, are normally associated with additional higher costs as well.

The technology and system of a RASP5 device cause the flow of high frequency leakage current during operation. Because of this, all grounding elements must be low-impedance elements connected across a large surface area.

With leakage currents greater than 3.5 mA, in accordance with VDE 0160 or EN 60335, either

- the cable cross-section of the protective conductor must be ≧ 10 mm^2,
- the protective conductor must be open-circuit monitored, or
- the second protective conductor must be fitted.

For an EMC-compliant installation, we recommend the following measures:

- The unit should be installed in a conductive enclosure with a good connection to ground.
- Use screened motor cables (short cables).

Ground all conductive components and enclosures in a drive system with the shortest possible cable with the largest possible diameter (Cu-braid).

2.8 STO function

2.8.1 Overview

The function STO (STO = Safe Torque Off) is optionally available on the RASP5 speed controller.

This function meets the requirements for variable-speed drive systems defined in Part 5-2 of the IEC 61800 standard and ensures that torque-generating energy is no longer able to act on the motor shaft and that unintended starting is prevented. Moreover, this state is monitored internally in the drive.

The STO function can be used anywhere where the corresponding motor will come to a stop by itself in a sufficiently short amount of time as a result of the corresponding load torque or friction, as well as in cases in which coasting has no safety implications.

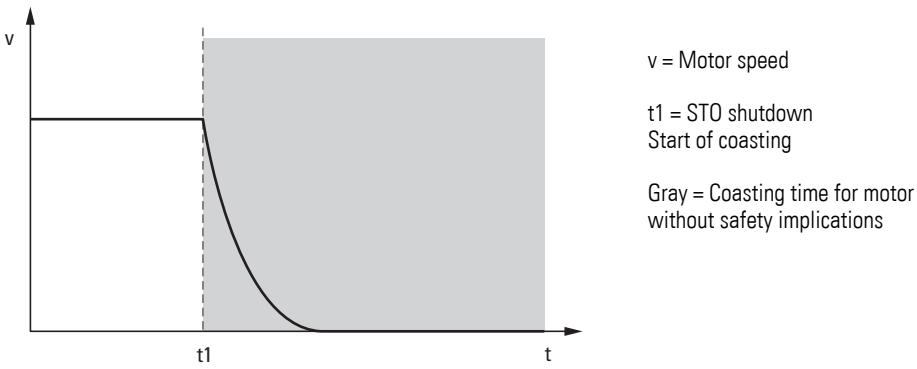


Figure 19: : STO conforming to Stop Category 0

This safety function corresponds to uncontrolled stopping as defined in IEC 60204-1, Stop Category 0.
It can be used if it is necessary to switch off the power in order to prevent unexpected starts.

Additional measures (such as mechanical brakes) may be required in order to prevent hazards in which external factors are involved (e. g., suspended loads falling down).

Application examples can be found in the Eaton safety manual PU05907001Z.

You can find the safety manual as a PDF document on the Eaton website at the following address:
http://www.eaton.eu/DE/Europe/Electrical/CustomerSupport/TechnicalLiterature/SafetyManual/index.htm

CAUTION

When used in conjunction with permanent magnet motors and in the unlikely event of multiple output semiconductors (IGBTs) failing, having the STO function activated may result in a motor shaft rotational movement of 180 degrees/p = Number of motor pole pairs).

DANGER

The STO function is an electronic mechanism that does not provide sufficient protection against electric shock. Additional potential isolation measures may be accordingly required (e. g., switch-disconnecter).

DANGER

Only the STO function of the drive can be used as a safety function of a machine.
None of the other functions of the drive can be used to execute a safety function.

2.8.2 TÜV certification

The RASP5 speed controllers with STO function, which have a TÜV logo on the nameplate, include an STO function in accordance with the standards listed here:

Standard	Classification
EN 61800-5-2:2017	SIL 3: "Safely switched-off torque"
EN ISO 13849-1:2015	PL e
EN 62061:2015	SIL CL 3
EN 61508, Part 1 + 2, 4 - 7: 2010	SIL 3

This safety function corresponds to uncontrolled stopping as defined in IEC60204-1, Stop Category 0.

The following information and descriptions for the STO function are translations of the original description in English (TÜV specification).

2.8.3 STO-compatible installation

DANGER

Make sure to use proper grounding and select cables based on local regulations or standards.

The variable frequency drive may have a leakage current greater than 3.5 mA AC or 10 mA DC. In addition, the grounding cable must be sized for the maximum mains fault current, which is normally limited by fuses or miniature circuit-breakers. Appropriately sized fuses or miniature circuit-breakers should be installed at the mains supply for the variable frequency drive in line with local regulations or standards.

DANGER

The "STO wiring" must be protected against unintended short-circuits and unintended tampering and modifications.
It must be ensured that the "STO input signal" has a safe operating state.

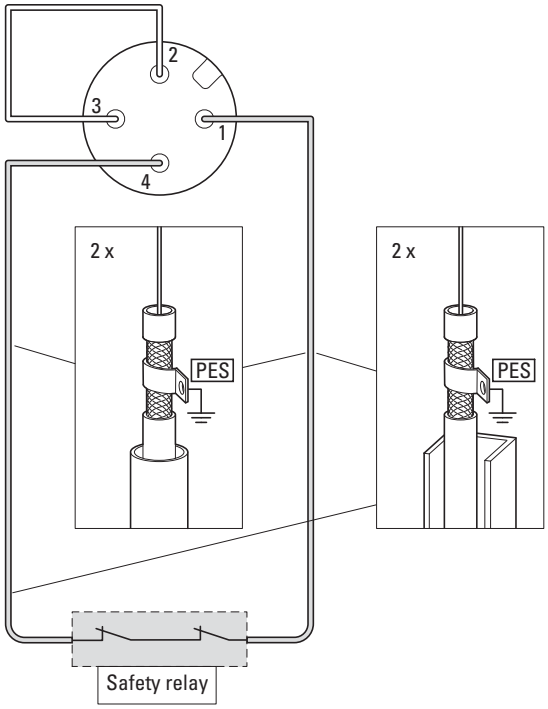
In order to prevent damage to the variable frequency drive, the devices should remain in their original packaging until right before they are installed.
They must be stored in a dry and clean area with a temperature range of -40 °C to 60 °C.

The conductor cross-section used for the STO installation should be between 0.75 and 2.5 mm^2.
The length of the cable connected to the control signal terminals should not exceed 25 meters.

In addition to the wiring guidelines for an installation meeting EMC requirements (), the following requirements must be observed as well for the "STO wiring":

- The STO-compatible installation must be protected against short-circuits and tampering. The cables in the STO circuit can be mechanically protected with a closed cable duct or with a conduit (eks = ground and short-circuit-safe installation).
- The 24-V-DC power supply of the STO inputs can occur from the internal 24-V-DC voltage of the RASP5 variable frequency drive or from an external 24-V-DC power source (External Power Supply).
  The RASP5 variable frequency drive should be wired as described below.

2.8.3.1 STO installation with internal RASP5 internal supply voltage (24 V DC)



Pin 1: 24 V DC, output, max. 100 mA

Pin 2: 0 V

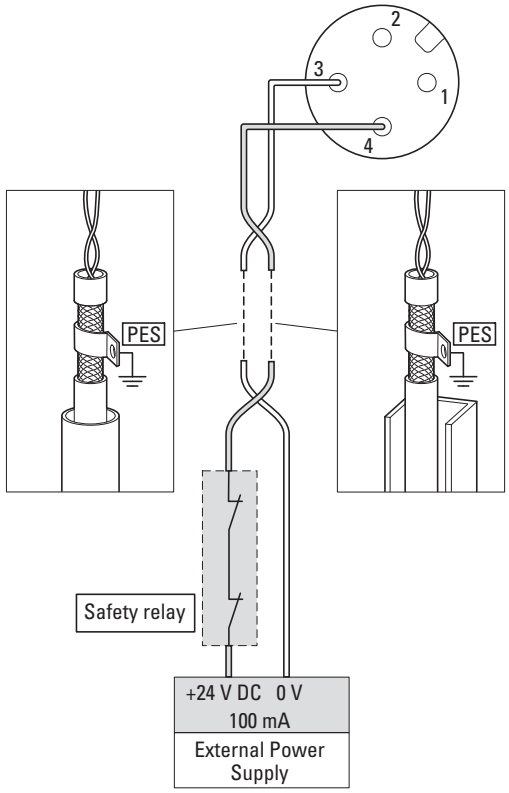
Pin 3: STO-, 0-V connection to internal control voltage

Pin 4: STO+, logical high signal, input = 18 - 30 V DC from the safety controller

Figure 20: STO installation with internal control voltage

The connecting cable from control pin 1 (+24 V) to the safety relay's contact and from there back to the pin 4 (STO+) must be wired individually and installed separately (eks, separate mechanical protection with two closed cable ducts or two conduits). These two separately wired single cables must be screened, and the corresponding cable screen must be grounded (PES).

2.8.3.2 STO installation with external DA1 supply voltage (24 V DC)



Pin 3: STO-, 0-V connection to internal control voltage

Pin 4: STO+, logical high signal, input = 18 - 30 V DC

Figure 21: STO installation with external control voltage

The two connecting leads, from the external power supply and the safety relay, to pin4 (STO +) and pin3 (STO-) must be twisted. These twisted leads must be routed in a closed conduit or conduit (eks) and screened and the screen braid grounded (PES).

The external control voltage should meet the following specifications:

Rated control voltage	24 V DC
Voltage for the logical STO high signal	18 - 30 V DC
Current carrying capacity	100 mA

2.8.4 Direct release

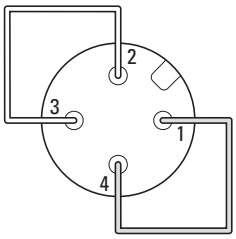


Figure 22: STO control signal terminals (direct enable)

Pin	Configuration
1	+24 V DC
2	0 V (reference potential)
3	STO- (0 V)
4	STO + (+24 V DC)

Pin 2 (0V) must always be connected to pin 3 (STO-) and pin 4 (STO+) must always be connected to pin 1 (+24 V)!

Without the connection of a power supply (24 V DC) to control signal terminals 3 and 4, the RASP5 control section and the inverter will remain blocked. An Inhibit (Inhibit = block) message is displayed.
The LED **STO** does not appear.

WARNING

This function is not suitable for continuous operation!

For applications without a safety function, devices without STO function can be used.

2.8.5 STO function pick-up time

The total pick-up time for the STO function is the time that elapses from the moment a safety-related event occurs on the system's components (aggregate) to the moment a safe state is reached (in this case: Stop category 0 as defined in IEC 60204-1):

- The pick-up time from the moment the STO inputs become de-energized to the moment when the outputs in the power section (U, V, W) are in a state in which no torque is produced in the motor (STO function activated) is less than 1 ms.
- The pick-up time from the moment the STO inputs become de-energized to the moment the STO monitoring status changes is less than 20 ms.
- The pick-up time from the moment a fault is detected in the STO circuit to the moment $5t\,o\text{-}F$ is signaled is less than 20 ms.

2.8.6 STO function checklist

The STO function is always activated and enabled in the RASP5 speed controller - regardless of the operating mode.

During normal operation (supply voltage present), there are various options for monitoring the STO inputs' state.

If the STO inputs are de-energized, the STO LED **does not light** up and $I\,nH\,ibt$ is displayed in the associated operating unit (Inhibit - German: Lock, locked state).

If the RASP5 variable frequency drive detects a fault, the corresponding fault code will be displayed (not:$5t\,oF$) (not:. $I\,nh\,ibt$).

2.8.7 Error messages

The following table lists the error messages relevant to the STO function, as well as potential causes and fixes.

Table 8: Error messages

Keypad indicator	LED display STO	Meaning
Inhibit	off	there is no release
STOP	green	there is release
$5t\,o\text{-}F$	-	Internal STO fault

2.8.8 STO function checklist

A drive's STO function should always be checked before initial commissioning, after maintenance, and at regular maintenance intervals.

This check should include the following tests:

No.	Activity	Note
1	The STO inputs are de-energized. With motor standstill and a stop command on the RASP5 variable frequency drives, *InHibit* is displayed (locked state). The **STO LED** is off.	
2	The STO inputs are voltage-free and the RASP5 speed controller receives a start command. The **STO LED** is off.	
3	The STO inputs are supplied with 24 V DC and the RASP5 speed controller receives a start command. The **STO LED** lights up green. The motor starts normally and is controlled by the RASP5.	
4	The motor is running while being controlled by the RASP5and an STO input is de-energized. *InHibit* The **STO LED** is off.	

2.8.9 Regular maintenance

DANGER

The STO function should always be included in a scheduled maintenance process (at least every three months) so that the function will be tested on a regular basis to make sure it is intact and complete – especially after changes are made to the safety system and after repairs are made.

During the corresponding inspection and testing, the variable frequency drive's installation and operating environment must be checked:

- The ambient temperature must fall within the admissible range.
- The heat sink and fan must be free of dust and other foreign particles. The fan must be able to rotate freely.
- The enclosure in which the variable frequency drive is installed must be free of dust and condensation .
- The enclosure fan and air filter must provide the required airflow.
- All electrical connections must be checked:
  The screw terminals must be properly tightened and the power cables must not show any signs of heat damage.

2.8.10 "Safe stop" function

The purpose of the STO function is to prevent the drive from making the motor produce a torque when there is no input signal at terminals 3 and 4. This makes it possible to integrate the drive into a complete safety system in which the "safe stop" function needs to be fully implemented.

DANGER

The STO function cannot prevent an unexpected restart or an automatic restart if the STO inputs receive a signal. Accordingly, it must not be used to perform maintenance or cleaning work on the machine.

The STO function eliminates the need to use electro-mechanical contactors with self-monitoring auxiliary contacts in order to implement safety functions.

DANGER

In certain applications, additional measuring and monitoring equipment may be needed in order to meet the requirements for the system's safety function.
The STO function does not include motor braking, and the RASP5's braking function cannot be considered a fail-safe method by itself.
If a motor braking function is required, an appropriate safety relay and/or a mechanical braking system or a similar method must be used.

The STO function is approved for use as a fail-safe method even in cases in which the STO signal is not present and a single fault has occurred in the drive.

The drive was accordingly tested in accordance with the following safety standards:

EN ISO 13849-1	PL e	Cat. 3	$MTTF_d$ 10000 years (High)	DC_{avg} 91 % (Medium)
IEC61508	SIL 3	PFH_d: 1.5 x 10^{-10} 1/h (1.5 % of SIL 3) (High demand or continuous mode)	PFD_{avg} (T1 = 20 years): 1.6 x 10^{-5} (0.2 % of SIL 3) (Low demand mode)	
IEC62061	SIL CL 3			
IEC61800-5-2	SIL 3			

Cat. = Category
DC_{avg} = Average Diagnostic Coverage
$MTTF_d$ = Mean Time to dangerous failure
PFH_d = Probability of dangerous failure per hour
PFD_{avg} = Average probability of dangerous failure on demand
PL = Performance level
SIL = Safety Integrity Level
SIL CL = Safety Integrity Level Claim Limit

The values specified here can only be observed if the STO function is requested at least once every three months and if the RASP5 speed controller is installed in an environment whose values meet the permissible limits:

- Ambient temperature range: -10 to +50 °C, taking into account any limits that depend on frame size and protection.
- Maximum altitude for rated operation: 1000 m above sea level,
- Relative humidity: < 95 % (non-condensing).
  The RASP5 variable frequency drive must always be free of frost and moisture.

2.9 Sensor inputs I1 and I2

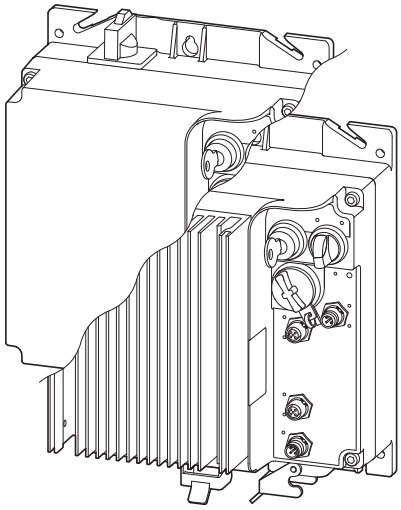
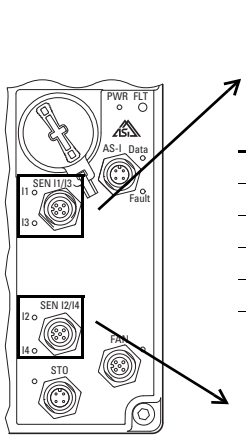
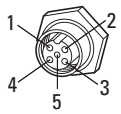


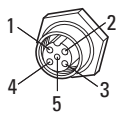
Figure 23: Terminal sockets for I1 and I2 sensor inputs

The RAMO5 and RASP5 Rapid Link Modules have two M12 sockets for direct connection of sensors.





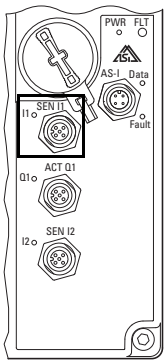
1	L+
2	I3
3	L-
4	I1
5	–

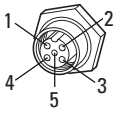


1	L+
2	I4
3	L-
4	I2
5	–

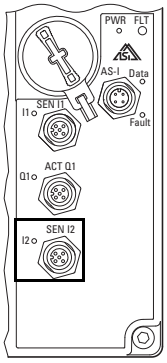
Pin	Configuration
1	+24 V DC (160 mA) output
2	Sensor input
3	0 V (reference potential)
4	Sensor input
5	not used

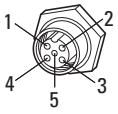
Figure 24: Pin assignment (here using the example of RASP5)





1	+24 V DC/160 mA
2	–
3	0 V
4	I1
5	–





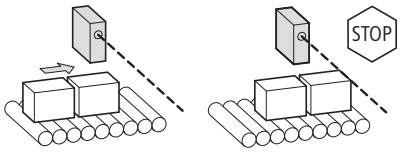
1	+24 V DC/160 mA
2	–
3	0 V
4	I2
5	–

Pin	Configuration
1	+24 V DC (160 mA) output
2	not used
3	0 V (reference potential)
4	Sensor input
5	not used

Figure 25: Pin assignment (here using the example of RAMO5)

The following sensors can be connected, for example:

- optical (light barriers),
- inductive (proximity switches),
- mechanical (end switch).



The length of the sensor connection cables for inputs I1 and I2 is limited to 5 m. The sensors are supplied with 24 V DC from the RAMO5 and RASP5 rapid-link modules. The total current of all sensors is limited to 160 mA.

The sensor supply is short-circuit proof. In the event of an overload or short-circuit, a group fault signal will be generated and the "Motor" LED will light up **FLT** in red to indicate this. As soon as the fault is fixed, the error message can be reset with the RESET command. In addition, the S1 bit will be set to high during a short-circuit (peripheral fault). It will be set back to low automatically once the short-circuit is eliminated.

The input signals of the sensors at I1 and I2 are either incorporated directly in the internal controller of RAMO5 and RASP5 and transmitted to a higher-level PLC through AS-Interface . The signal adaptation and integration into the controller sequence is carried out via parameter P1-13.

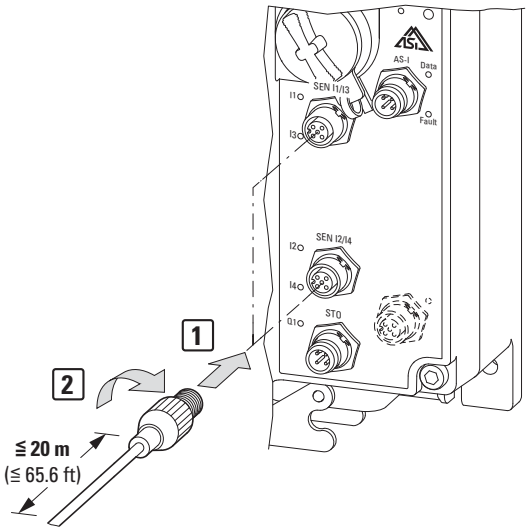
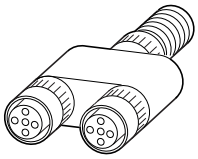
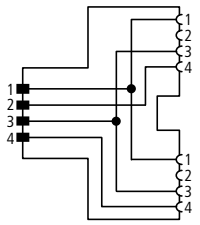
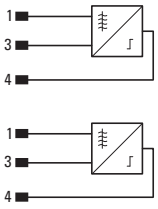
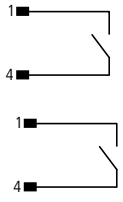
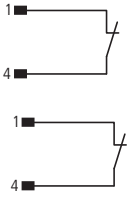


Figure 26: Connection to sensor inputs (RASP5 as an example)

Y connector

RASP only!

With the optional Y-connector RA-XM12-Y up to four sensors can be connected to these two M12 sockets.

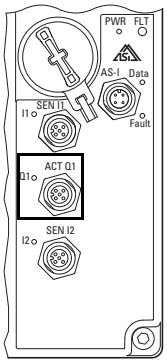
Y connector RA-XM12-Y		Optical or inductive sensors	N/O contact	N/C contact	Sensor cables coding
			Mechanical sensors		
					"A"-coded (IEC/EN 1 = brown 2 = white 3 = blue 4 = black

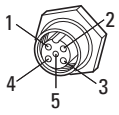
2.10 Actuator output

Actuator output

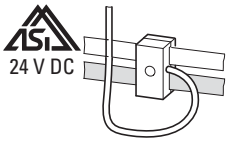
An actuator output is only available in the form RAMO5-xx**1**…-…S1.

The actuator output (M12 connections) enables the control of external signaling elements or relays.
To do this, pin 4 of the ASi connection must be supplied with an external voltage of +24 V DC. The corresponding reference point is pin 2 (0V) on the AS-i connector. The actuator (indicator lamp, relay, valve) can be connected using Q3 pin 4 (+24 V, max. 1 A). Reference point (0V) is pin 3.

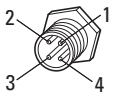




1	–
2	–
3	0 V Actuator output (Q1)
4	+24 V DC Actuator output (Q1)
5	–



RA-XAZ2-1M



1	(ASi+)
2	external 0 V
3	(ASi–)
4	external 24 V

The actuator output is controlled internally; the response time is up to 20 ms. The permitted length of the connection cable is 20 m.

Maximum load current

- The maximum permissible load current is 1 A with external power supply.
- If there is no external power supply, the maximum permissible load current is only 100 mA.

The actuator output is short-circuit proof.

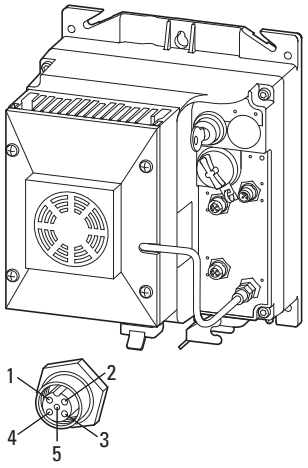
In the event of an overload or short-circuit, a group fault signal will be generated and the Motor LED will light up red to indicate this.

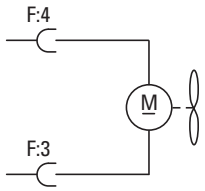
2.11 Device fan connection

RASP only!

A device fan connection is only available for the RASP5 types in the variant RASP5-...-...**1**S1.

The device fan connection is only available with RASP5; itis already assigned in the factory in the version RASP5-… 1 S1.





1	–	not used
2	–	not used
3	0 V	reference potential
4	⎍ +24 V	output for fan, temperature controlled
5	–	not used

Figure 27: Device fan connection

The output voltage at the device fan connection is 24 V DC and is automatically controlled by the speed controller RASP5.

→ Do not connect any loads other than the RASP unit's device fan to device fan connection!
Any other load connected here is considered contrary to intended use!

→ The device fan starts up briefly when the voltage is applied.

ATTENTION

The device fan should always be included in a scheduled maintenance process (at least twice per year) so that the function will be tested on a regular basis to make sure it is intact and complete – especially after changes are made to the safety system and after repairs are made.

2.12 Motor and Application

2.12.1 Motor selection

General recommendations for motor selection:

- RAMO5 and RASP three-phase AC motors with squirrel-cage rotor and surface-cooling can be basically connected to the output of the rapid link modules; the output is also suitable for three-phase asynchronous motors or standard motors. Other motor types, such as external-rotor motors, slip-ring motors, reluctance motors, or synchronous or servo motors can also be connected provided their electrical and connection characteristics are the same as those of asynchronous motors and their manufacturer has approved them for the application.
- Only motors with at least temperature class F (155 °C max. steady state temperature) should be connected to the frequency-controlled RASP5.
- Choose 4-pole motors where possible (with synchronous speeds of: 1500 min^{-1} at 50 Hz or 1800 min^{-1} at 60 Hz).
- Operating conditions for S1 operation according to IEC 60034-1.
- The rated operational current of motor and RAMO5 or RASP5 should be the same (avoid overdimensioning the motor!).

2.12.2 Motor and circuit type

The motor's stator winding can be connected in a star or delta circuit as per the rated operational data on the rating plate.

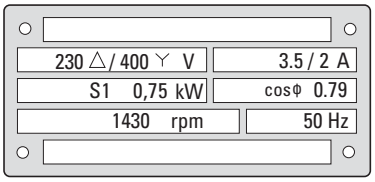


Figure 28: Example of a motor ratings plate

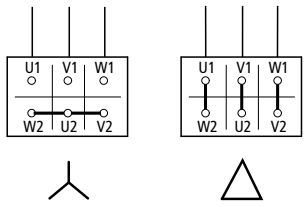


Figure 29: Configuration types:
Star-connected circuit (left), delta circuit (right)

A three-phase motor with the rating plate shown in Figure 28 can only be run on the RAMO5 (U_{LN} = 400 V) in a star connection.

The rated operational current of the motor with 2 A at 400 V requires a Rapid Link module (RAMO5 or RASP5) with a rated operational current of at least 2 A.

Example

- RASP5-2… Rated operational current 2.4 A.

Other operational characteristics and speeds are possible only with the frequency-controlled RASP5 Rapid Link module.

2.12.3 Change of rotation

Three-phase motors work with a clockwise rotating field (viewed from the motor shaft) when phase L1 is connected to U1, L2 to V1 and L3 to W1. This default operating direction can be reversed with gearboxes or different mounting positions. A reversal of the direction of rotation without changing the wiring can be set for RAMO5-W... using parameter P6-08.

With the default settings (switch position Down) a clockwise rotating field is produced with control command FWD, and an anticlockwise rotating field with switch position Up. The LED for both directions is: FWD.

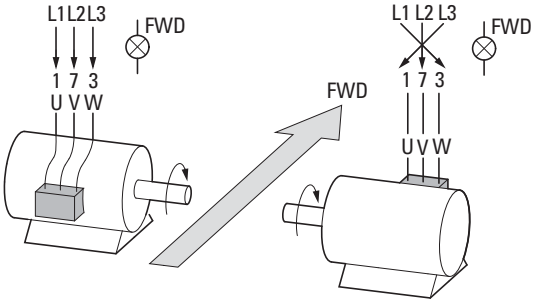


Figure 30: Example showing how to change the phase sequence

Table 9: Phase sequence (only for RAMO5-W… and RASP5-…)

P6-08	Phase sequences
0	U – V – W
1	W - V - U

2.12.4 Quick Stop

The fast stop indicates that the motor is stopped in automatic mode via pin 4 of the sensor inputs I1 and I2 for RAMO5 and RASP5.

The input signals are directly processed in RAMO5 as per RASP5. PLC and bus cycle times have no influence on the switch-off time.

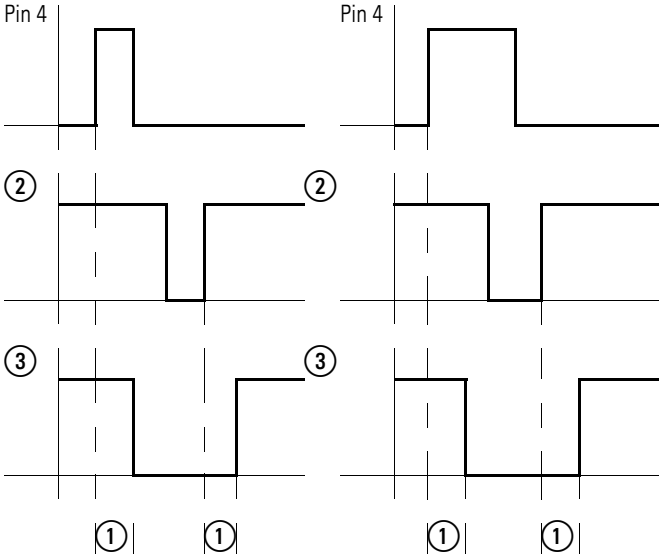


Figure 31: Examples: Edge-controlled quick stop in automatic mode (pin 4 = I1)

① Internal response time
② Signal O1 from PLC through AS-Interface
③ Internal signal to motor output as response to the rising edge of the sensor at pin 4 (Stop) and to the subsequently rising edge of PLC O1 (Start)

The type of edge control (rising/falling) for the sensor inputs is defined via parameters.

- RAMO5: P3-06, P3-07
- RASP5: P3-06, P3-07, P3-08, P3-09

The pin 4 input signal (rising edge) switches the motor output off. When the PLC output (AS-I signal Q1) is reset (falling edge), the motor output can be switched back on. Whether or not the input signal is still being applied when the PLC output is reset or switched back on is irrelevant → Figure 31.

The **FWD** or **REV** LED flashes when the motor output is switched off by means of quick stop and the PLC continues to set the corresponding rotational direction bit.

During operation, the **FWD** or **REV** LED will light up as applicable if the PLC has set the corresponding operating direction bit.

Example of quick stop function

Vertical sorter with 360° eccentric drive:

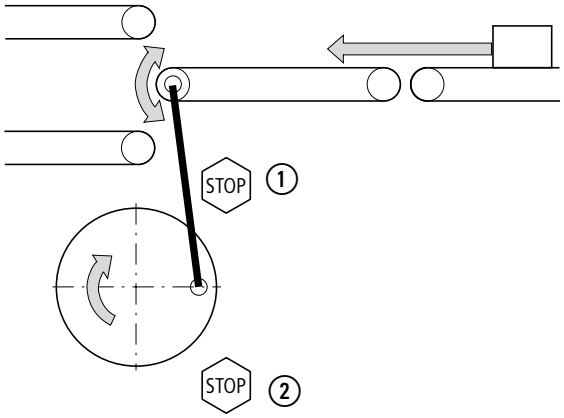


Figure 32: Example for eccentric drive

① upper break point
② lower break point

2.12.5 Interlocked manual operation

In interlocked manual operation damage to conveyed goods or plant through incorrect handling can be avoided. Limit switches connected to inputs I1 and I2, for example, can be used to reliably limit the travel path. This function also allows adjustment of, for example, light barriers before automatic control through a PLC (AS-Interface) is activated.

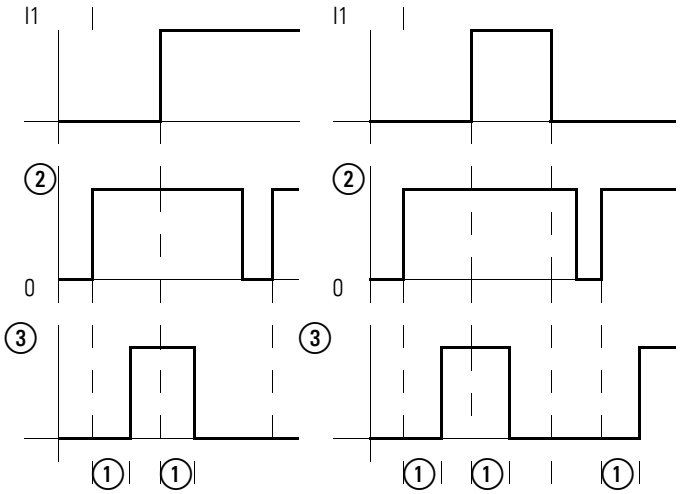


Figure 33: Interlocked manual operation

① Internal response time
② Selector switch in manual mode
③ Output signal

As shown in Figure 33, the FWD rotating field direction will be disabled in manual mode when the interlocked manual operation is activated after a rising edge (on I1, for example) or during a continuous signal. The motor can then only be operated in automatic mode on the RAMO5-W, or in the opposite direction in manual mode on the RASP5.

Rotating field direction FWD in manual mode is possible again only after a falling edge is registered at I1 or after a changeover to automatic mode and back again). This also applies for sensor input I2 and rotating field direction REV.

For RAMO5-D… and depending on parameter P1-13, the interlocked manual mode is exclusively edge-controlled. This allows continued manual operation in the same direction after a break point is reached by simply briefly switching over to Automatic and back again.

LED-signal under interlocked manual operation of RAMO5-W and RASP5:

- LED **FWD** or **REV** is lit when the associated operating direction is selected with the selector switch.
- LED **FWD** or **REV** flashes while the selector switch is operated but RAMO5-W or RASP5 is switched off through interlocked manual operation. (For an example of interlocked manual operation with RASP5).

2.13 External brake

A mechanical spring-loaded brake fitted to the motor (disk or spring-applied brake) brakes the rotation of the motor shaft when the brake coil's supply voltage is switched off. If quick brake engagement times are required, DC air solenoids are used. In this case, the brake is supplied with AC power through a functional rectifier built into the motor.

RAMO5 and RASP5 Rapid Link modules feature a faster internal electronic switch for powering and actuating the external motor brake. It is connected using pins 4 and 6 of the motor feeder socket. The highest permissible continuous holding current is 0.6 A. For releasing the brake, up to 6 A are available for up to 120 ms.

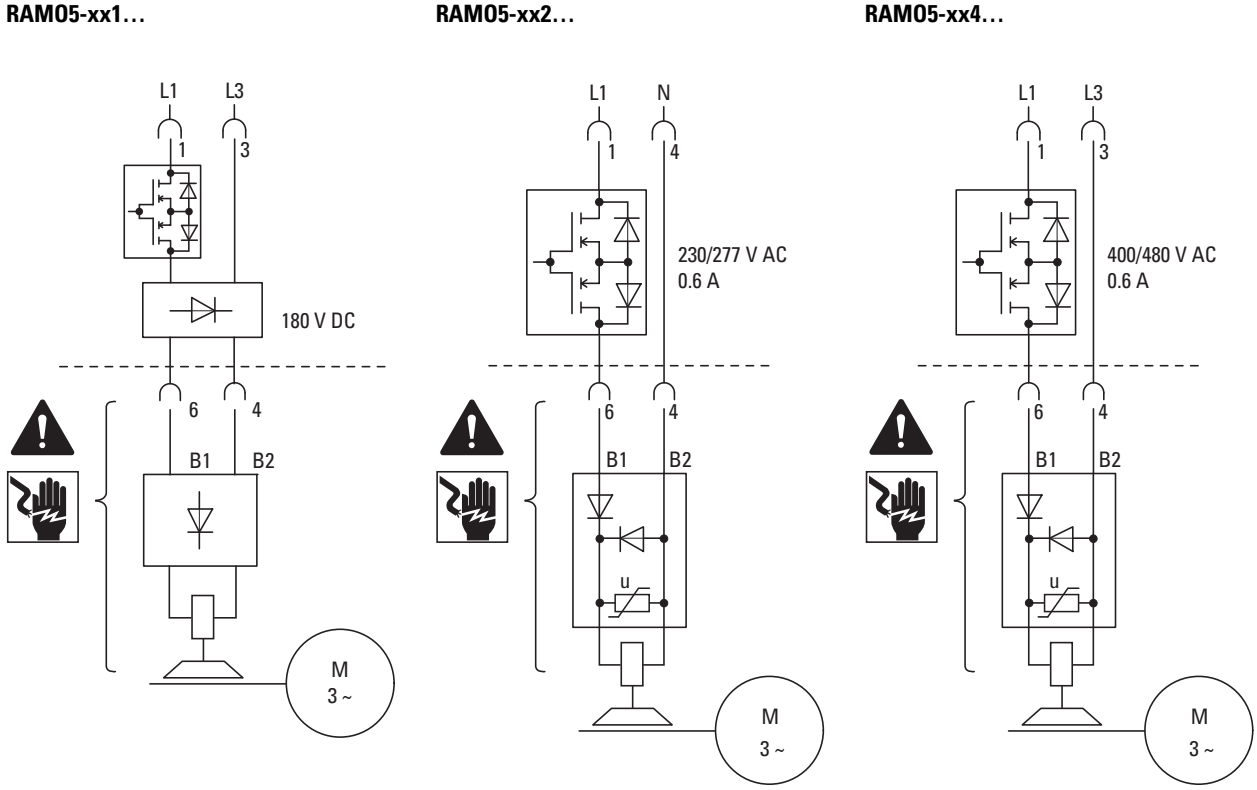


Figure 34: Control of the external brake with 180 V DC, 230 V AC/277 V AC and 400 V AC/480 V AC

The brake is actuated:

- With RAMO5 automatically with the start signal, in automatic and manual modes,
- With RASP5 via the frequency converter.

Mechanical brake (control) for RASP5

The control of an external mechanical brake can be set for RASP5 with parameters P3-01 to P3-05.

Table 10: Parameters for brake with RASP5

Parameter	Designation	Description	Unit	Min	Max	DS
P3-01	Brake mode	Mechanical brake actuation 0: Simple mode (P3-02, P3-03) 1: Advanced mode (P3-02 - P3-05)	–	0	1	0
P3-02	Open brake f-open	Frequency limit at which the external brake is opened. Condition: RUN (start enable)	Hz/rpm	0	P1-01	1.5
P3-03	Close brake f-close	Frequency limit at which the external brake is closed.	Hz/rpm	0	P1-01	1
P3-04	Brake M-Level Release	Required motor torque at which the brake may be released. Determines the torque as a percentage of the rated motor torque that must be present before the mechanical brake can be released. It is used to ensure that the motor is connected and produces sufficient torque to prevent the load dropping on release of the mechanical brake. **Note:** This function is not active in U/f mode (P6-01 = 6)	A	0	P1-07	0
P3-05	Brake Release Delay	Determines the time before the mechanical brake is released.	s	0	320	0

Table 11: Simple Mode (Simple Mode): P3-01 =0: (default settings)

Control commands	Action of the drive
Start signal	Unblock device → The frequency increases and releases the brake when the output frequency exceeds the value set in P3-02.
	Normal operation - drive is running
Stop order	The frequency drops and the brake is applied when the output frequency falls below the value set in P3-03. → The drive continues the ramp to a standstill. → The output of the drive is disabled.

Table 12: Advanced Mode (Advanced Mode): P3-01 = 1

Control commands	Action of the drive
Start signal	Unblock device → The frequency increases to the value set in P3-02. → The current and/or torque are monitored until they reach the level set in P3-04. → The brake releases. → The output frequency remains at the value set in P3-02 for the time (delay) set in P3-05. → The ramps are on the set point. The drive continues the ramp up to the setpoint value.
	Normal operation - drive is running
Stop order	The frequency drops and the brake is applied when the output frequency falls below the value set in P3-03. → The drive continues the ramp to a standstill. → The output of the drive is disabled.

Mechanical brake (control) for RAMO5

The brake is switched off with the stop command according to the deceleration time.

The brake is released with the start command.
The deceleration time is set via the parameters P3-04 and P3-05.

Table 13: Parameters for brake for RAMO5

Parameter	Designation	Description	Unit
P3-04	Brake Release Delay	Determines the time before the mechanical brake is released.	s
P3-05	Brake Apply Delay	Determines the time between the signal to close the brake and disabling of the drive.	s

2.14 Regenerative braking

→ Only for RASP5-…-xxxx1xxS1

In certain operating conditions, the motor may run as a generator in certain applications (regenerative braking operation).

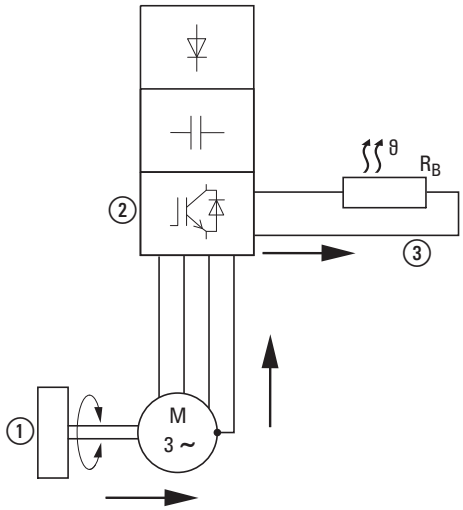


Figure 35: Regenerative braking with external braking resistance
① Machine flywheel mass
② Inverter with brake chopper (brake transistor)
③ Braking resistance (R_B)

Examples include:

- Lowering in hoisting gear and conveyor applications
- Controlled speed reduction in the case of large load inertias (flywheels)
- A fast speed reduction in dynamic travel drives

When the motor operates as a generator, its braking energy will be fed into the variable frequency drive's DC link via the inverter. The DC link voltage U_{DC} will be increased as a result. If the voltage value is too high, the RASP5 variable frequency drive will disable its inverter. The motor will then coast uncontrolled.

A braking chopper is integrated in the RASP5 speed controller.
The function of the braking chopper must be activated in parameter P4-05.
The braking chopper will be switched on automatically if the braking energy being fed back causes the DC link voltage to increase to the switch-on voltage of the braking chopper.

Table 14: Parameters for brake chopper

Parameter	Designation	Description	Unit	Min	Max	DS
P4-05	Brake chopper on	Parameter function only for devices with internal braking resistor 0 = deactivated 1 = active in RUN 2 = active in RUN and STOP	–	0	2	2

ATTENTION

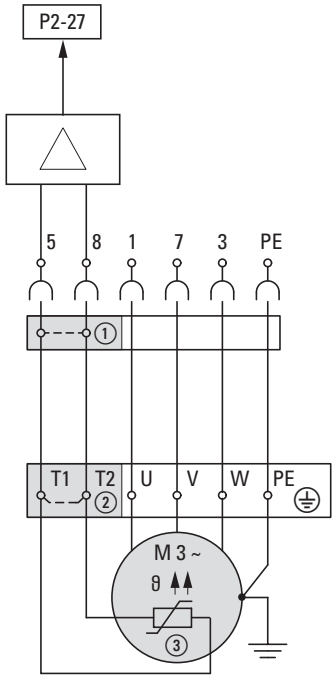
The motor's metal enclosure must always be grounded, irrespective of the type and version of motor cable used!

ATTENTION

When using RAMO5 or RASP5 units, do **not** connect external brakes directly (to U, V, or W) inside the motor's terminal box!

2.15 Thermistor and motor cable monitoring

A thermistor, the motor cable and the plug-in connection of the motor cable are set for RAMO5 and RASP5 via parameter P2-27.



① Link in motor plug:
Only the plugged-in status of the motor connector is monitored.

② Link in motor terminal box:
The plugged-in status of the motor plug and the motor cable's connection are monitored.

③ Thermistor connection:
The plugged-in status of the motor plug, the motor cable's connection, and the thermistor (or thermostat, Thermo-Click) in the motor are monitored.

Figure 36: Thermistor monitoring

Table 15: Parameter P2-27 for thermistor and motor cable monitoring

Parameter	Designation	Description	Unit	Min	Max	DS
P2-27	Thermistor Fault Response	Device response (device-dependent) after occurrence of "Motor thermistor error." 0: Deactivated (OFF) 1: Activated (ON)	–	0	1	1

ATTENTION

The setting of parameter P2-27 may only be changed by trained specialist personnel!

3 Installation

3.1 Introduction

This chapter describes the mounting and electrical connection of Rapid Link modules RAMO5 and RASP5.

→ During installation and mounting, cover the operator control and display elements and the plug connectors in the control and power sections, either with a cover or with masking tape, in order to prevent foreign bodies from entering them.
On RASP5 it is also advisable to protect the cooling fins and, if fitted, the fan from ingress of foreign bodies.

→ Perform all installation work with the specified tools and without the use of excessive force.

3.2 Installation instructions

The mounting instructions in this manual apply to RAMO5 and RASP5 with standard equipment and IP65 degree of protection.

For installation instructions, see instructional leaflet IL034084ZU for RAMO5 or IL034084ZU for RASP5

3.2.1 Installation site

Rapid Link modules RAMO5 and RASP5 are preferably installed vertically.

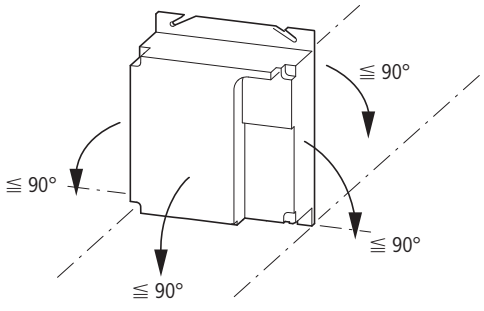


Figure 37: RAMO5 mounting position maximum inclination in all directions: 90°

Do not rotate 180°!

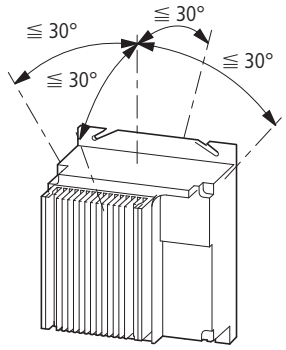


Figure 38: Mounting position of RASP5

Do not rotate by 180°!

3.2.2 Free space

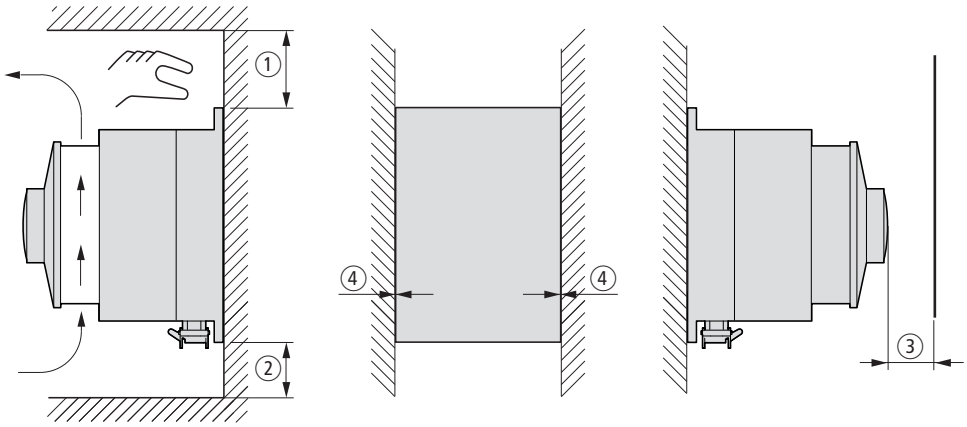


Figure 39: Clearances for thermal air cooling (example: RASP5)

Depending on the version, thermal clearances must be provided around the RAMO5 and RASP5 Rapid Link modules. On versions with a repair and maintenance switch (RAMO5-…-...RS1 and RASP5-…-...R…S1) or in the area of the pluggable cable connections ②, these must also provide unobstructed handling.

The table below lists the recommended minimum clearances.

Job description	Instance	RAMO5 Clear Zone mm	RASP5 Clear Zone mm
① top	• without repair and maintenance switch	25	100
	• with repair and maintenance switch	~150	~150
② bottom	• without power connection	25	100
	• with power connection	~100	~100
③ front	• without fan	15	25
	• with fan	–	50
④ lateral	• without repair and maintenance switch	~0[1)]	~0[1)]
	• with repair and maintenance switch	~150	~150
	• without power connection	~0[1)]	~0[1)]
	• with power connection	~100	~100

1) No lateral clearance is required up to 1000 m and up to an ambient temperature of +40 °C.
Higher ambient temperatures (up to a maximum of +50 °C), Pulse frequencies f_{PWM} up to a maximum of 16 kHz and installation heights up to 2000 m require a lateral distance of at least 20 mm.

→ Devices with high magnetic fields (e. g. reactors or transformers) should not be mounted close to the RAMO5 or RASP5.

3.2.3 Mounting

Rapid Link modules RAMO5 and RASP5 are mounted with screws.

→ Install RAMO5 and RASP5 units on a non-flammable mounting base only (e. g., on a metal plate).

→ For RAMO5 and RASP5 unit weights and dimensions, please refer to the corresponding technical data.

3.2.3.1 Fixing with screws

The permitted maximum tightening torque for the fixing screws is 1.3 Nm (11.5 lb-in).

→ Washer and split washer provide a firm seat during fixing.

		
2x/4x	2x/4x	2x/4x
M6	DIN 127, M6	DIN 125, M6

Vertical arrangement

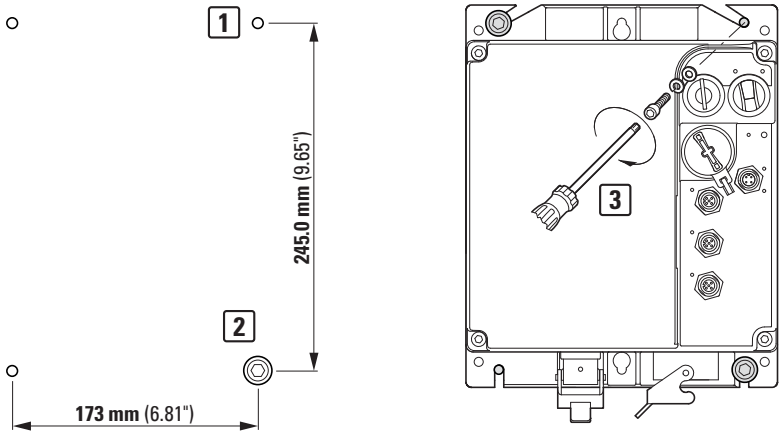


Figure 40: Fixing dimensions (standard) and mounting

1 4 x Drill hole with thread for M6-screw.

2 Where screws are prefitted, a clearance of about 12 mm should be provided between mounting surface and washer.

3 Tighten the screws to a torque of 1.3 Nm.

Vertical arrangement, center fixing

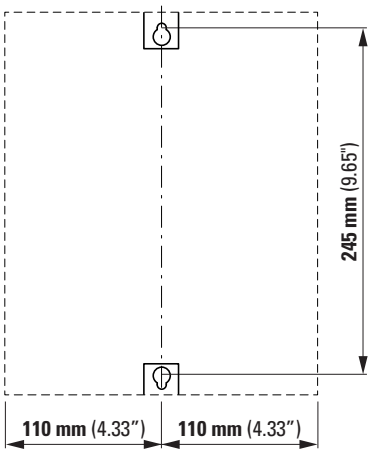


Figure 41: Fixing dimensions (center)

Two M6 screws, tightening torque 1.3 Nm.

Horizontal arrangement

(base rotated by 90 °)

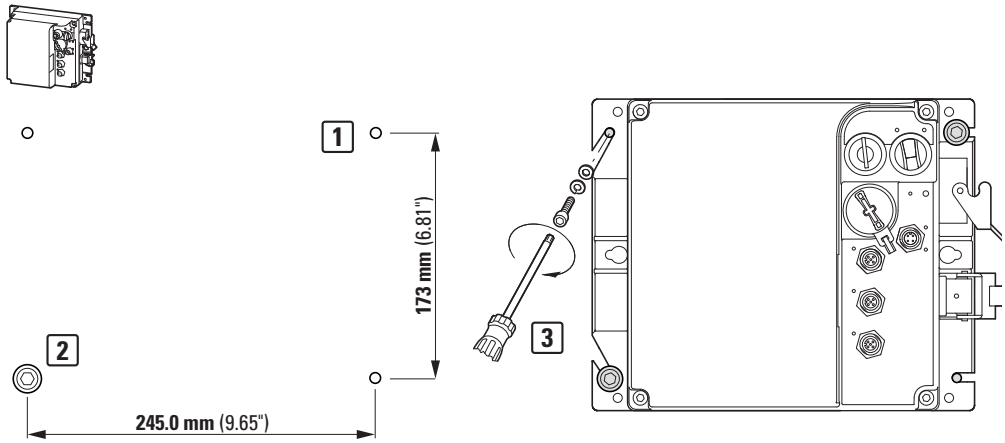


Figure 42: Fixing dimensions (standard) and mounting

1	Drill hole with thread for M6-screw.
2	Where screws are prefitted, a clearance of about 12 mm should be provided between mounting surface and washer.
3	Tighten the screws to a torque of 1.3 Nm.

Horizontal arrangement, center fixing

(base rotated by 90 °)

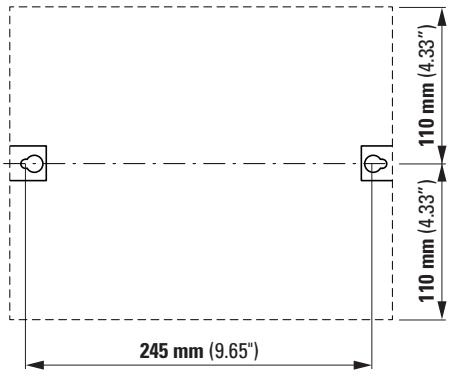


Figure 43: Fixing dimensions (center)

Two M6 screws, tightening torque 1.3 Nm.

3.2.4 Position of the power terminals

The standard arrangement of the power connections is vertical downward.

A horizontal arrangement can be implemented by qualified specialists by turning the black enclosure base 90° to the left or right. To do this, remove the four screws in the enclosure cover.

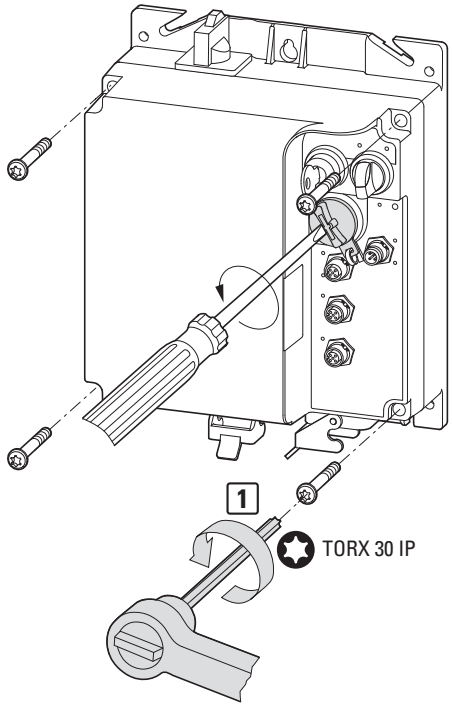


Figure 44: Dismantling the enclosure cover

▶ Fix the enclosure cover at the side and lift off carefully.

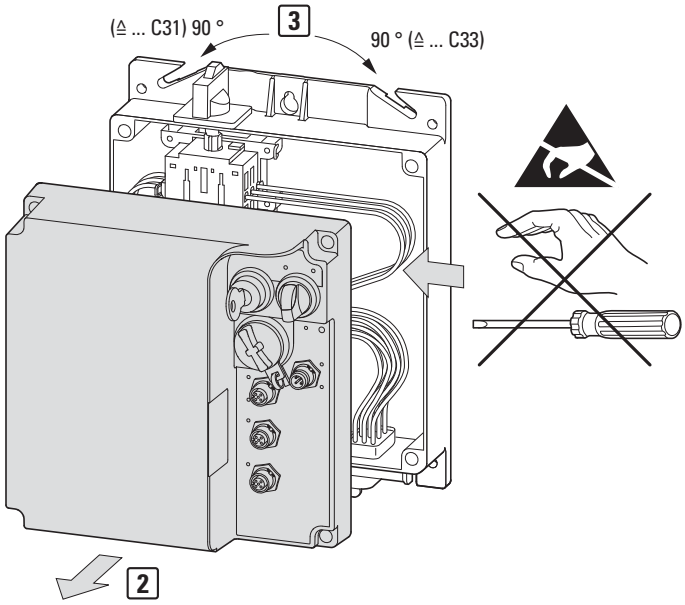


Figure 45: Example: Lift off the housing cover on a RASP5

ATTENTION

Do not reach into the opened base or the enclosure cover!
as this can damage assemblies and connections and impair the device's function.

The enclosure base can now be rotated, for example by 90° counterclockwise (to the left). The power terminals now point to the right.
Finally carefully refit the enclosure cover.

When assembling, make sure that the rubber seals are seated correctly (protection type IP65).

With the four screws secure the enclosure cover on the base.
Tighten the screws in two passes, always tightening two diagonally opposite screws at a time. For example, tighten all four screws to about 2 Nm and then to 3 Nm, always working in a crosswise pattern.

→ Use a suitable tool (TORX 30 IP) to tighten the screws to a torque of 3 Nm.

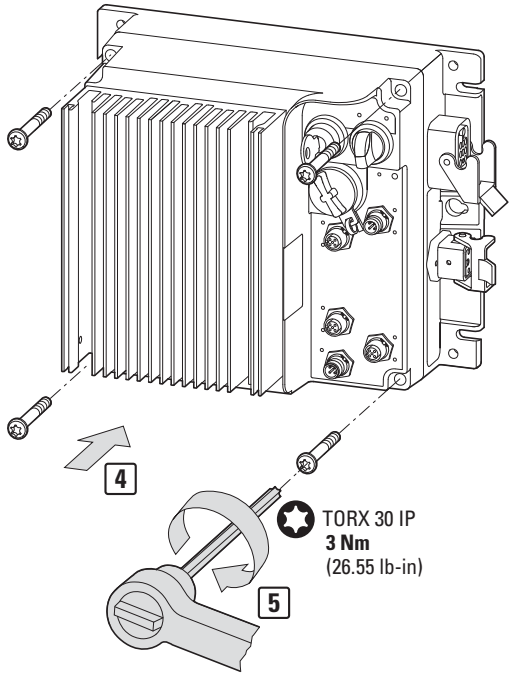


Figure 46: Mounting the enclosure cover

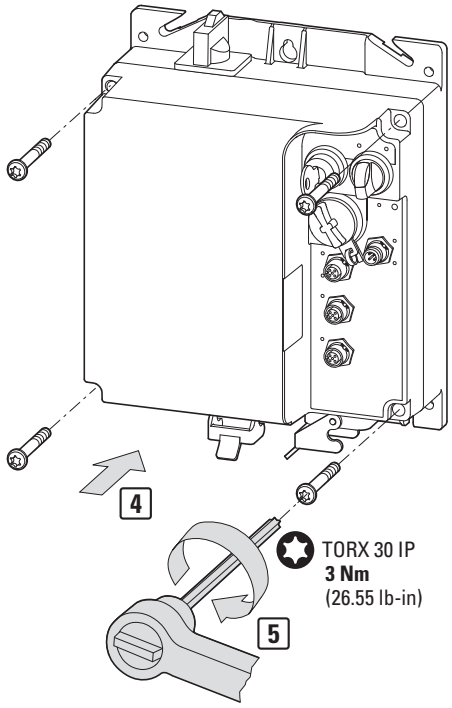


Figure 47: Fastening the M32 screw-on cover

→ Tighten the M32 screw-on cover with the required tool using a torque of 2 Nm.

3.3 Electrical Installation

DANGER

Electric shock hazard - risk of injuries!
Carry out wiring work only if the unit is de-energized.

ATTENTION

Fire hazard!
Only use cables, circuit-breakers, and contactors that feature the indicated permissible nominal current value.

DANGER

The components in the variable frequency drive's power unit remain energized up to five 5 minutes after the supply voltage has been switched off (intermediate circuit capacitor discharging time).
On RASP5 the motor feeder cable must be disconnected or work on the motor terminal box performed only after the discharging time.

Complete the following steps with the specified tools and without using force.

3.4 Power bus

The Rapid Link system can have one of two types of power bus:

- Flexible (RA-C1-7…) busbar,
- Round conductor (standard cable).

3.4.1 Flexible (RA-C1-7...) busbar

The RA-C1-7… flexible busbar is keyed in order to prevent it from being connected the wrong way around. More specifically, one of the busbar edges has a tapered shape. The cable connector in all system components (ribbon cable outgoers) will be shaped accordingly. In other words, the flexible busbar needs to be inserted in such a way that the tapered side will be on the opposite side of the hinge of the opened cable connector.

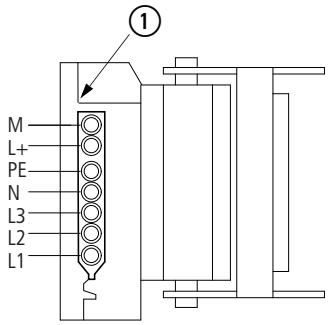


Figure 48: Keying on RA-C1-7… flexible busbar

① Hinge

→ L+ and M are not used on Rapid Link modules RAMO5 and RASP5.

→ RAMO5 and RASP5 must always be connected to the power bus with five conductors: L1, L2, L3, N, PE.

3.4.1.1 Laying the flexible busbar

Unwind the flexible busbar, cut it to length, and route it as necessary. There is an inscription on one side of the busbar that is designed to work as a keying guide. A metric marker on the jacket aids with cutting to length.

ATTENTION

The flexible busbar is not suitable for drawing in and must not be used as trailing cable!

Where the flexible busbar is not laid within cable ducts, secure it to the ground with cable binders or cable clamps.

→ In areas in which mechanical damage is likely to occur, we recommend laying the busbar in cable ducting for protection.

3.4.1.2 End-pieces and lead-throughs

Once the flexible busbar has been routed, all free busbar ends must be safely terminated and sealed as required to achieve an IP65 degree of protection. To do this, use cable end pieces (RA-C1-END1) and bushings (RA-C1-DF) as necessary.

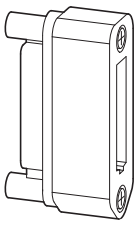


Figure 49: Bushing RA-C1-DF for ribbon cable

With bushing RA-C1-DF the flexible busbar can be fed into distribution module RA-C1-VM-7 or a control panel.

▶ Cut the busbar to the required length.

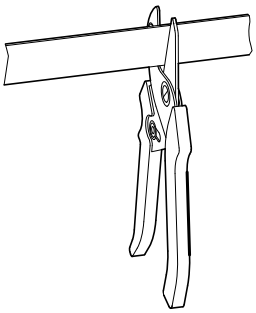


Figure 50: RA-C1-CUT hand ribbon cable cutter

→ For cutting to length we recommend tool RA-C1-CUT.

▶ Strip the flexible busbar to the required length:
- For cable end piece to 19 mm,
- With distributor module at 50 mm,
- for control panel as required.

→ Tool RA-C1-AZ-4 is recommended for stripping 7 x 4 mm^2 flexible bus bar.
If using a standard cable stripping knife, make sure not to cut into the rubber jacket by more than 0.7 mm in order to avoid damaging the conductor's insulation.

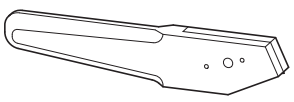


Figure 51: RA-C1-AZ-4

3.4.1.3 End-piece mounting

- First slide the lower (shorter) part of busbar end piece RA-C1-END1 onto the prepared flexible busbar.
- Slot the individual conductors into the insulation channels in the busbar end piece up to the stop.
- Connect the top and bottom sections to the two clamping screws. The flexible busbar meets the IP65 degree of protection when properly installed.

3.4.1.4 Connections flexible busbar junction

The supply and outgoer modules can be installed at any point along the flexible busbar The busbar's conductors are not interrupted. The connection is made with contact screws.

Pin	Function	Conductor number (7 x 4 mm²)
1	L1	1
2	L2	2
3	L3	3
4	N	4
5	+24 V[1)]	5
6	0 V[1)]	6
PE	PE	yellow/green

1) Not used for RAMO5 and RASP5.

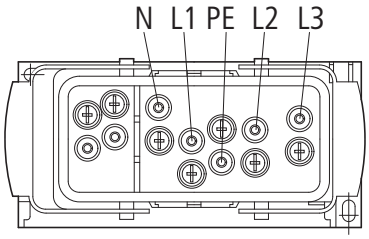


Figure 52: Pin assignment for flexible busbar junction RA-C1-PLF1

3.4.2 Round conductor

3.4.2.1 Round cable junction RA-C2-S1-4

Round cable junction RA-C2-S1-4 is a T connector for the RA-C3/C2-1.5HF plug-in power adaptor cable. It makes it possible to connect a Rapid Link module (RAMO5/RASP5) directly.

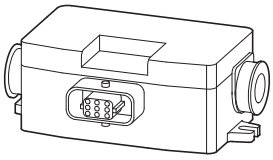


Figure 53: Round cable junction RA-C2-S1-4

The conductor contacts in the energy bus are made using insulation displacement technology.
The feedthroughs enable the conductor outer diameter from 10 TO 16 mm.

Accessories (seal insert, locking clip, the fully wired bushing insert, etc.) is included as standard.

- For mounting, secure the round pipe outlet on the ground using the appropriate screws (M5).
- Coat the round cables with a length of 130 mm (two radial sections, one longitudinal section) - for example with Weidmüller's AM16 stripping tool.

→ Position the blade in such a way that the conductor insulation will not be damaged.

- Cut the seals radially, place them around the cable jacket and insert the seals into the U-shaped contour provided in the cable outlet.

→ The supplied equipment includes two pairs of seals for cable outer diameters from 10 to 13 mm and from 13 to 16 m.
Only these matched gasket inserts guarantee the proper degree of protection IP65 when used correctly.

→ The round cable must be laid without tension.
Install only one conductor per terminal.

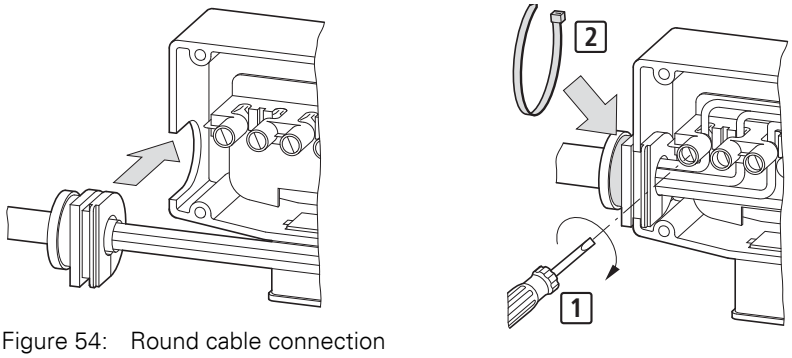
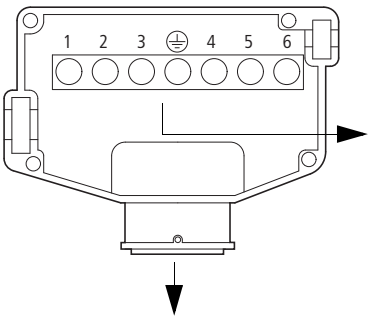


Figure 54: Round cable connection

- Insert the individual wires into the insulation piercing terminals and secure them with the screws one at a time.
- Turn in the screws [1] all the way to the stop (0.5 - 1 Nm).
- Place the cover on the base so that it rests fully on the base. All screws must be turned in all the way.
- Fasten the cover with the four screws. (POZIDRIVE 2; 1,5 - 2 Nm)
- In order to ensure that an IP65 degree of protection is maintained, firmly tighten a cable binder [2] around each outer gasket.
- Slot the attached locking clip for the outgoer plug onto the two studs of the bushing housing.

→ The open end of the last round cable junction (at the end of the power bus) must be sealed off with an RA-C2-SBL end-piece.

3.4.2.2 Assignment of terminals and conductors



Pin	Function
1	L1
2	L2
3	L3
4	N
5	24 V[1)]
6	0 V[1)]

Pin	Function
1	N
2	L2
3	n. c.
4	+24 V[1)]
5	0 V[1)]
6	L3
7	–
8	L1
PE	PE

1) Not used for RAMO5 and RASP5.

3.4.2.3 Round cable junction RA-C4-PB65

The RA-C4-PB65 round cable junction (power box) is a contact unit for uncut round cables with a cross-sectional area of 2.5 to 6 mm^2 that has an IP65 degree of protection.

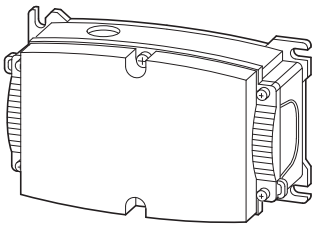


Figure 55: RA-C4-PB65 round cable junction (power box)

→ The power box's IP65 enclosure is supplied without gaskets (RA-C4-D… or RA-CU-PB65 required).

Gaskets RA-C4-D…

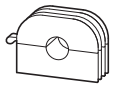


Figure 56: Enclosure bushing seal

Figure 57: Blanking plug (RA-C4-D0)

3.5 Power plug

3.5.1 RAMO5

Two types of power connector are available.

RA-C3… (for RAMO5…512…)

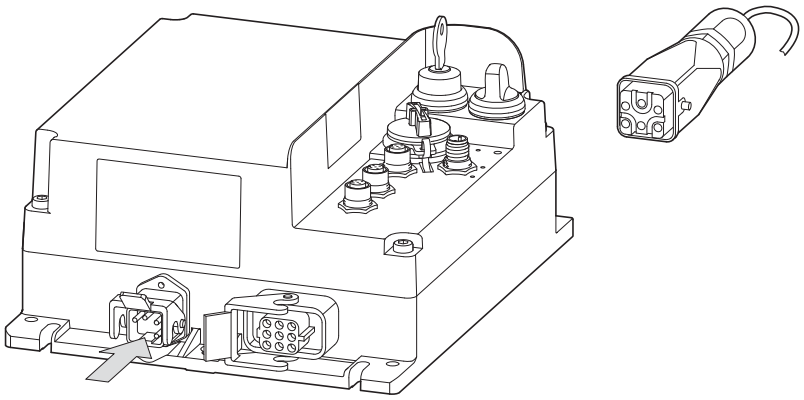
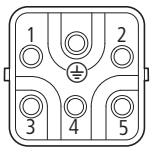
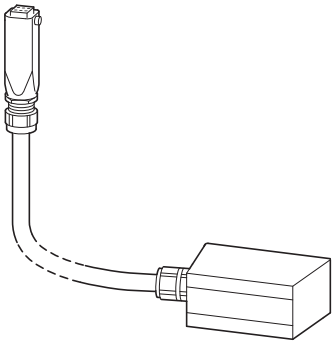
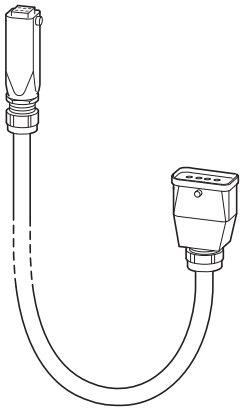
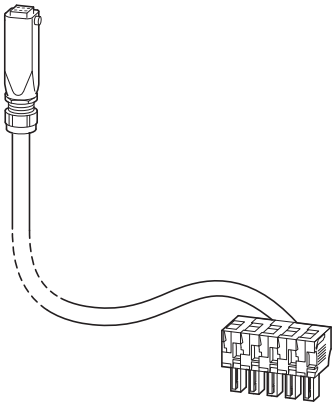
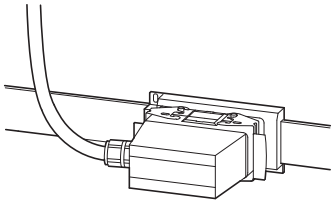
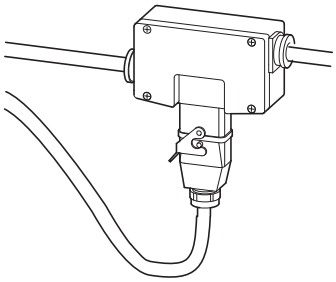
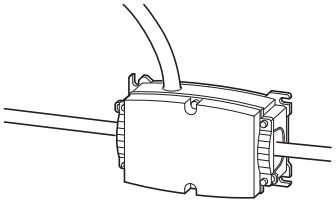


Figure 58: Energy connector RA-C3…

Table 16: Pin-Assignment of the RA-C3… power connector of type HAN Q5/0

Pin	Function	Power plug
1	L1	
2	L2	
3	L3	
4	N	
5	–	
PE	PE	

		
RA-C3/C1-1, 5HF	RA-C3/C2-1, 5HF	RA-C4-PPB/C3-1M5
→ RA-C1-PLF1	→ RA-C2-S1-4	→ RA-C4-PB65
		

RA-Q4… (for RAMO5…412…)

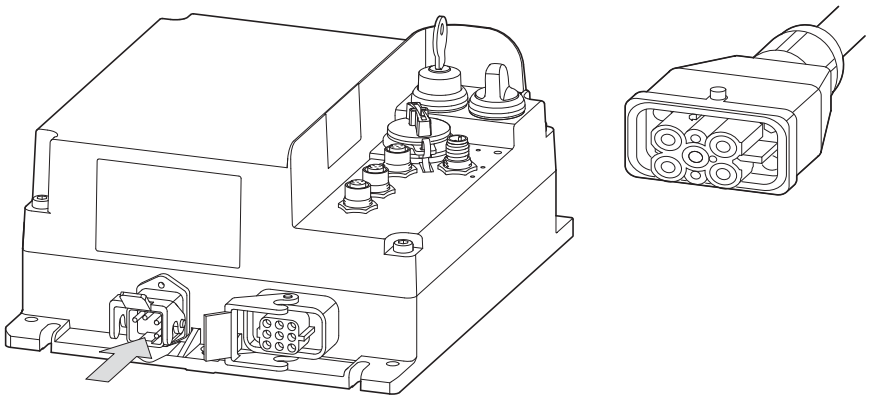
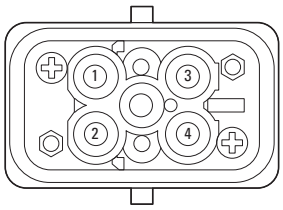
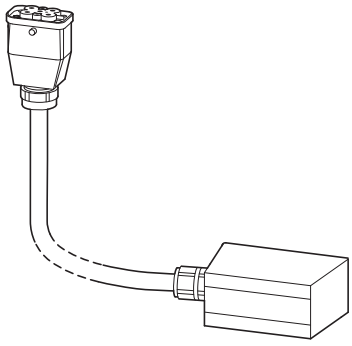


Figure 59: Energy connector RA-Q4…

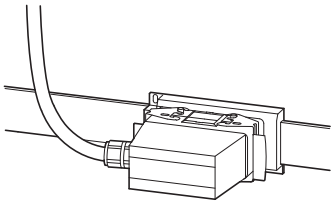
Table 17: Pin-Assignment of the RA-Q4… power connector of type HAN Q4/2-F.

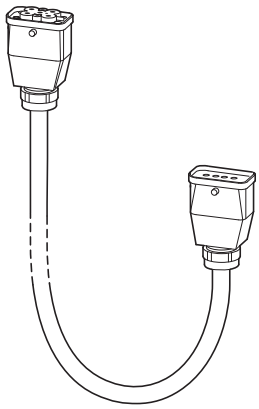
Pin	Function	Power plug
1	L1	
2	L2	
3	L3	
4	N	
5	–	
PE	PE	



RA-Q4/C1-1M5

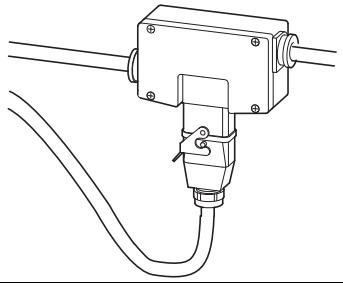
→ RA-C1-PLF1

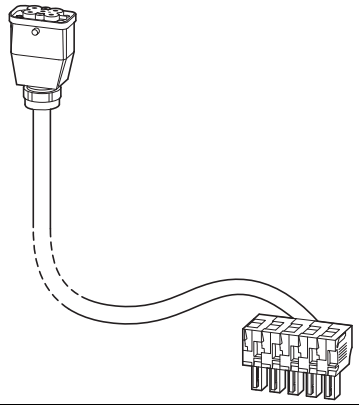




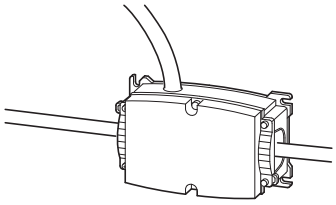
RA-Q4/C2-1M5

→ RA-C2-S1-4





→ RA-C4-PB65



After installing the power bus outgoers (RA-C1-PLF1, RA-C2-S1-4, RA-C4-PB65) you can connect the Rapid Link module (RAMO5/RASP) to the power plug using the assigned power adaptor cables.

ATTENTION

Compatibility with cables from other manufacturers cannot be guaranteed!

3.5.2 RASP5

Two types of power connector are available.

RA-C3… (with RASP5…512…)

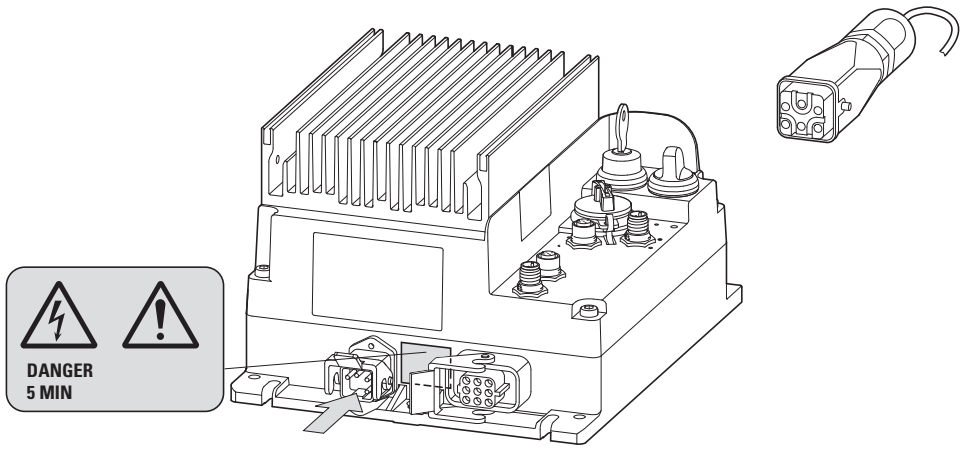
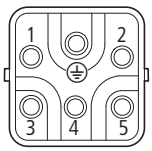
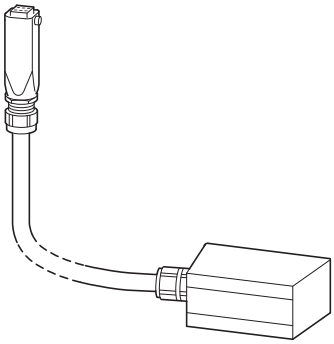
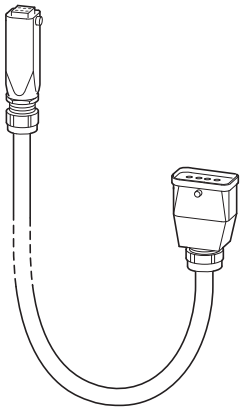
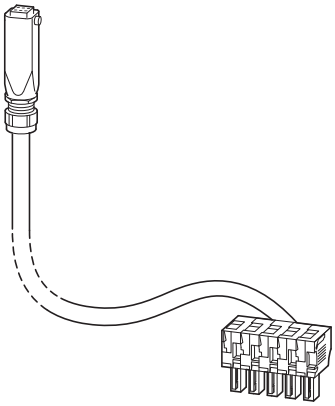
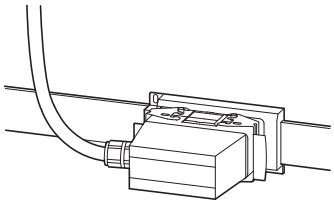
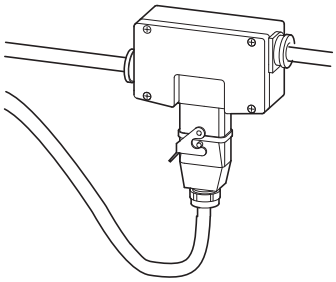
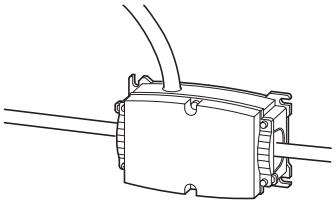


Figure 60: Energy connector RA-C3…

Table 18: Pin-Assignment of the RA-C3… power connector of type HAN Q5/0

Pin	Function	Power plug
1	L1	
2	L2	
3	L3	
4	N	
5	–	
PE	PE	

		
RA-C3/C1-1, 5HF	RA-C3/C2-1, 5HF	RA-C4-PPB/C3-1M5
→ RA-C1-PLF1	→ RA-C2-S1-4	→ RA-C4-PB65
		

RA-Q4… (for RAMO5…412…)

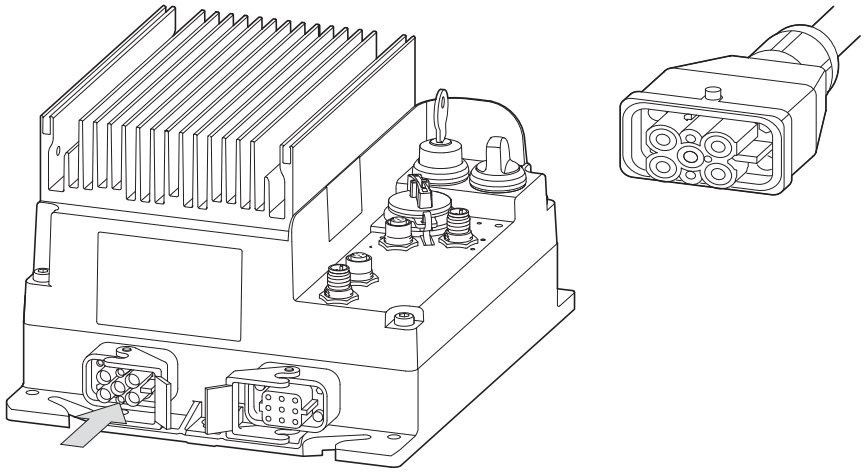
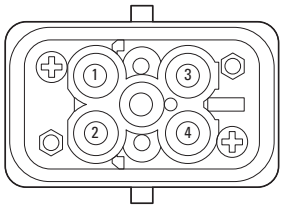
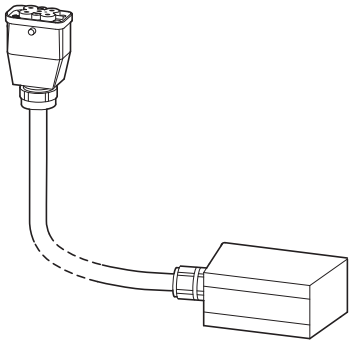
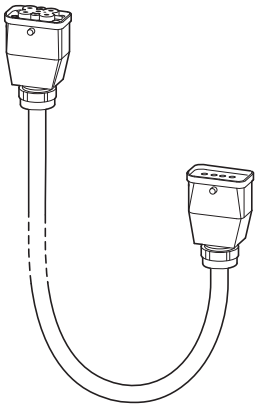
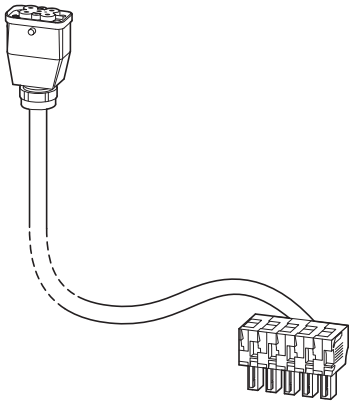
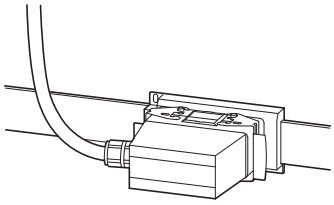
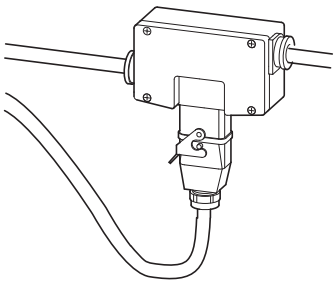
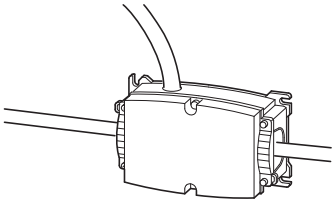


Figure 61: Energy connector RA-Q4…

Table 19: Pin-Assignment of the RA-Q4… power connector of type HAN Q4/2-F.

Pin	Function	Power plug
1	L1	
2	L2	
3	L3	
4	N	
5	–	
PE	PE	

		
RA-Q4/C1-1M5	RA-Q4/C2-1M5	
→ RA-C1-PLF1	→ RA-C2-S1-4	→ RA-C4-PB65
		

After installing the power bus outgoers (RA-C1-PLF1, RA-C2-S1-4, RA-C4-PB65) you can connect the Rapid Link module (RAMO5/RASP) to the power plug using the assigned power adaptor cables.

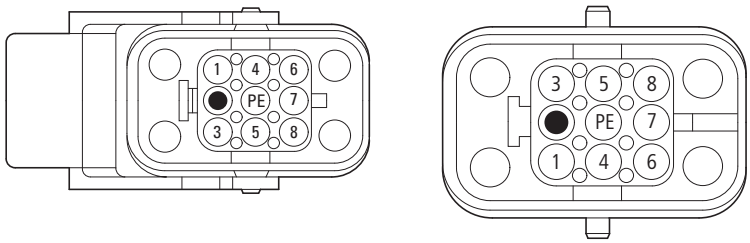
> *ATTENTION*
>
> Compatibility with cables from other manufacturers cannot be guaranteed!

3.6 Motor feeder

3.6.1 Motor feeder plug

RAMO5 and RASP5 are connected to the motor through a socket connector. The pin assignment of this motor feeder socket complies with the DESINA-specification for:

- Three-phase motor (U1, V1, W1)
- Temperature sensor (T1, T2)
- Motor brake (B1, B2)

Pin	Function	Arrangement of pins
		DESINA
		Motor outgoer socket / **Plug connector**
1	U1 motor	
2	Coding	
3	W 1 Motor	
4	B2 brake	
5	T1 thermistor	
6	B1 brake	
7	V1 motor	
8	T2 thermistor	
PE	PE	

After installing the power bus outgoers (RA-C1-PLF1, RA-C2-S1-4, RA-C4-PB65) you can connect the Rapid Link module (RAMO5/RASP5) to the power plug using the assigned power adaptor cables.

3.6.2 Motor feeder connecting examples

The following examples show preferred connections for the motor feeder plug in the Rapid Link System.

→ The PE connection of the motor feeder socket is always connected directly with the PE connection of the power plug.

RAMO-CM1-2MO for RAMO5
(plastic plug)

Rasp-CM2-2MO for RASP5
(metal plug)

Figure 62: Motor cable for connecting the motor starter to the motor

ATTENTION

Compatibility with cables from other manufacturers cannot be guaranteed!

3.6.2.1 Motor cable monitoring

Pin 5 and pin 8 of the motor feeder socket are used to monitor the motor cable's motor feeder plug and for thermistor protection.

Monitoring is performed depending on the setting in parameter P2-27.

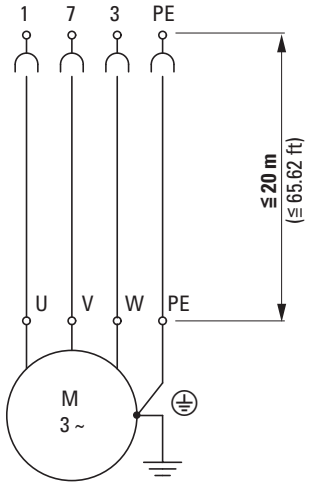


Figure 63: General motor connection with motor feeder plug and motor cable monitoring

For motor cable monitoring and operation without a thermistor, the cable ends of PIN 5 and PIN 8 must be bridged in the terminal box of the motor (cable monitoring T1 - T2).

3.6.2.2 Motor cable with thermistor connection

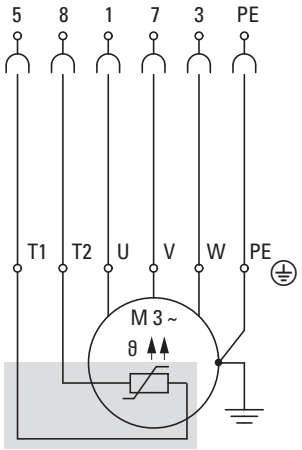


Figure 64: General motor connection with thermistor, motor feeder plug and motor cable monitoring

The cable ends (Pin 5 and Pin 8) on motors with thermistors or thermostats (thermoclick) must be connected in the terminal box of the motor (T1 - T2).

On motor cables without the conductors for pins 5 and 8 (e. g., 4-core motor cables) the pin 5 and pin 8 connections must be connected directly in the motor plug. In this case, T1 and T2 in the motor terminal box are connected with a separate cable and connected to an external monitoring device (e. g., EMT6).

Monitoring is performed depending on the setting in parameter P2-27.

3.6.2.3 Motor cable with connection for motor brake

For motors with an attached mechanical spring-loaded brake, the control unit of this brake can be controlled by RAMO5 or RASP5 depending on the type with the following voltages.

Table 20: Control with RAMO5

Type	Activation
RAMO5-xxx**1**…	180 V
RAMO5-xxx**2**…	230 V
RAMO5-xxx**4**…	400 V

Table 21: Control with RASP5

Type	Activation
Rasp5-xxx**1**…	180 V
Rasp5-xxx**2**…	230 V
Rasp5-xxx**4**…	400 V

The connection is implemented via Pin 4 and Pin 6 in the motor plug (→ Page 98).

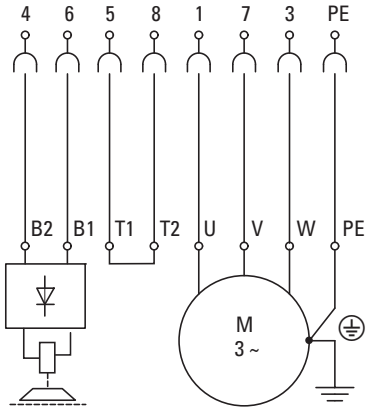


Figure 65: General connection with brake

3.6.3 Motor output for RASP5

The RASP5 speed control unit is frequency-controlled (with a built-in variable frequency drive) and requires screened motor cables in the motor feeder.

- Cat C3: 25 m
- Cat C2: C2 5 m

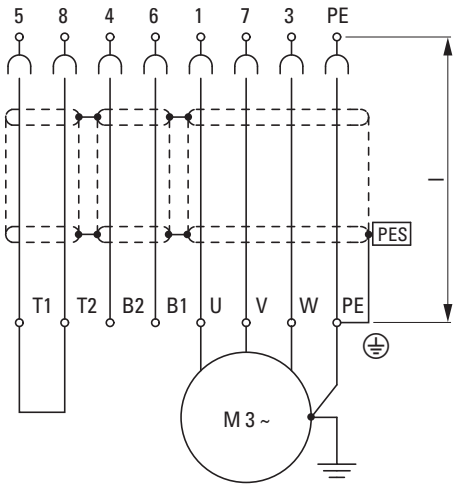


Figure 66: Shielded motor cable for RASP5.
Maximum permissible motor cable length l =20 m

→ On operation without thermistor the cable ends of pin 5 and pin 8 must be bridged in the terminal box (→ section 3.6.2.1, “Motor cable monitoring”, page 100).

→ For RASP5 the motor cable’s screen braid has to be grounded only at the motor (PES).

→ RASP5 has a metal grounded motor outlet socket.
The motor cable RASP-CM2-2M0 is grounded on the device side.

ATTENTION

The motor’s metal enclosure must always be grounded - irrespective of the type and version of motor cable used!

3.6.4 Screened motor cable for RASP5.

3.6.4.1 General notes

The following information uses the example of a DESINA MOTORFLEX cable with 4G1.0 2 x (2 x 0.75), to describe the steps required for the EMC connection of a mains cable to the RASP5.

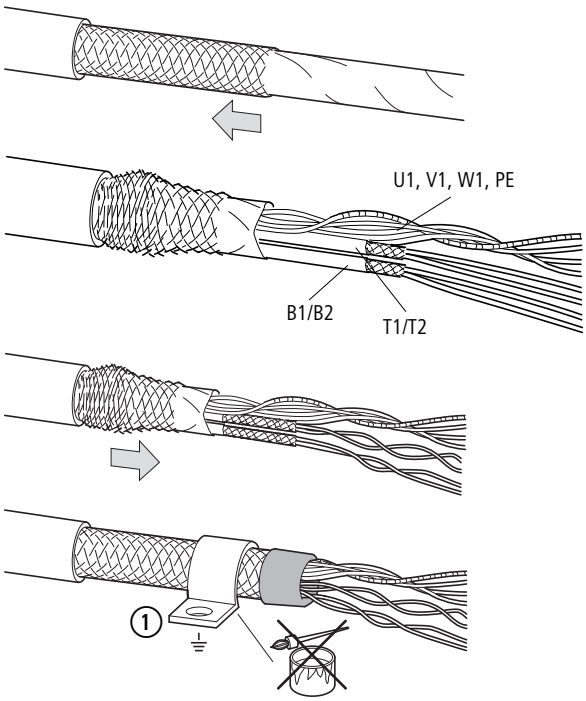


Figure 67: EMC-compliant connection of the screened motor cable
① 360° contact fuse ≙ power

- Stripping the motor cable ends (radial and longitudinal cut).

→ To strip the cable, set the blade so that the conductor insulation and the screen braid remain undamaged.

- Push the screen braid back to reveal the individual conductors.
- The conductors B1 (= N) and B2(= L) for the external brake as well as T1 and T2 for the thermistor have a sheath and a separate screen braid. These conductors must be stripped separately.
- Then slide the outer screen braid of the motor cable back toward the cable end far enough that conductors B1/B2 and T1/T2 are covered over a large area and connected with each other.

→ Wrap insulating or textile tape or slide a rubber grommet around the screen ends to prevent the screen braid from splicing.

▶ At the motor's terminal box, connect the motor cable's braid to ground potential (PES).

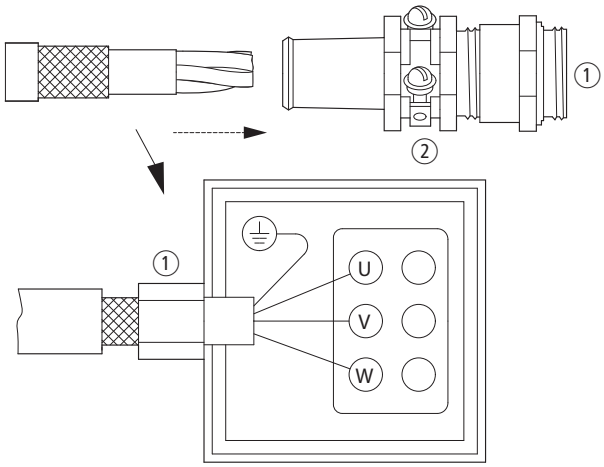


Figure 68: 360° screen contact at the motor terminal box

① 360° contact screen for the motor cable
② Clamp strap with screw for the screen braid

▶ Connect the jointly twisted strands (U, V, W, and PE) and separately twisted strands B1/B2 and T1/T2 to the corresponding terminals in the motor or in the connector.

The substrate must be free from varnish (direct contacting).

The screen clamp shown in the illustration is an example of a large-area ground connection (PES).

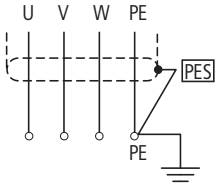


Figure 69: Connecting a screen braid (PES)to the motor terminal box

3.6.4.2 Operational safety of plug-in connectors

→ To increase the operational safety of the plug-in connection (inadvertent loosening of the locking clips) we recommend securing the plug-in connections with a cable binder at the locking clip.

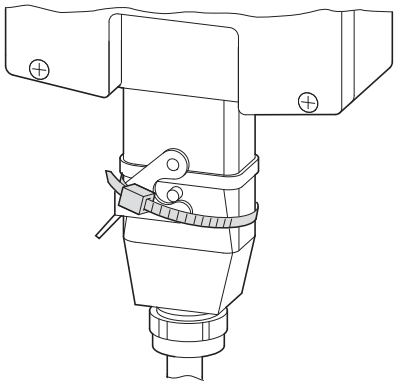


Figure 70: Securing the motor outlet plug by cable ties

3.7 Isolation test

The Rapid Link modules RAMO5 and RASP5 are tested, delivered and require no additional testing.

DANGER

Do not perform insulation resistance tests with an insulation tester at the control terminals (SI1, SI2, SI3, SI4, AS-Interface, etc.) and power terminals (power plug and motor feeder plug).

If insulation testing is required in the power circuit of the PDS, you must consider the following measures.

Rapid Link modules

Disconnect all plug-in connections in the control and power sections.

DANGER

With RASP5, wait at least 5 minutes after switching off the supply voltage before disconnecting a cable connection.

Testing the motor cable insulation

Always disconnect the motor feeder plug before disconnecting RAMO5 and RASP5 Rapid Link modules. Measure the insulation resistance of the motor cable between the individual phase conductors and between the phase conductor and the protective conductor.

The insulation resistance must be greater than 1 MΩ.

Testing the mains cable insulation

Always disconnect the power plug from Rapid Link modules RAMO5 and RASP5. Measure the insulation resistance of the mains cable between the individual phase conductors and between each phase conductor and the protective conductor.

The insulation resistance must be greater than 1 MΩ.

Testing the motor insulation

The motor cable must be disconnected at all terminals (U, V, W, B1, B2, T1, T2, PE) and the bridge circuits (star or delta) open. Measure the insulation resistance between the individual motor windings. The measured voltage must at least match the rated operating voltage of the motor but must not exceed 1,000 V.

The insulation resistance must be greater than 1 MΩ.

→ Consider the notes from the motor manufacturer in testing the insulation resistance.

4 Operation

4.1 Checklist for commissioning

Before commissioning Rapid Link Modules RAMO5 and RASP5, check the following points (checklist):

Number	Activity	Note
1	Mounting and wiring completed in accordance with the applicable instructional leaflets (→ IL034084ZU and IL034085ZU).	
2	All wiring and line section leftovers, as well as all the tools used, have been removed from the RAMO5, RASP5, motor's and drive unit's proximity.	
3	All plug connectors in the power section are made as described in this manual. → The AS-i bus must be plugged in and powered in manual mode as well.	
4	The cables connected to the RAMO5 and RASP5 Rapid Link Modules are **not** shorted and **not** connected to ground (PE), except PE cable.	
5	On speed control unit RASP5 the heat sink is correctly grounded (PE).	
6	All electrical connections on the motor are established correctly. → On RASP5, metal motor plugs are permissible only with a motor cable length of up to 5 m.	
7	Each single phase of the supply voltage (power bus L1, L2, L3) is protected with a fuse.	
8	The Rapid Link modules RAMO5, RASP5 and the motor are adapted to the mains voltage. → section 1.3, "Rated operational data on the nameplate", page 15, connection type (star, delta) of the motor tested.	
9	The quality and volume of cooling air are in line with the environmental conditions required for the RAMO5, RASP5 and the motor.	
10	All connected control cables and switchgear will ensure that the required stop conditions will be met.	
11	The parameters that were preset at the factory have been checked with the list of parameters.	
12	The effective direction of a coupled machine will allow the motor to start.	
13	All emergency stop functions and safety functions are in an appropriate condition.	

4.2 Operational hazard warnings

Please observe the following notes.

DANGER

Commissioning is only to be completed by qualified technicians.

DANGER

Dangerous electrical voltage!

The safety instructions on pages I and II must be followed.

ATTENTION

Before switching on the supply voltage (400 V AC) for the first time, check that all wires are connected to the correct terminals and that all PE and ground connections have been made.

DANGER

The motor outgoing sockets are live when the supply (mains) voltage is connected.
The control signal terminals are isolated from the line power potential.

DANGER

RAMO5 unit outputs carry a dangerous voltage whenever the supply voltage is switched on - even if the unit is in the OFF/ STOP state.

DANGER

Do not remove the motor and power plug when the system is live.

DANGER

The output to the brake carries a dangerous voltage whenever the supply voltage is switched on - even if in the Off state!

4.2.1 Specific hazard warnings for RAMO5

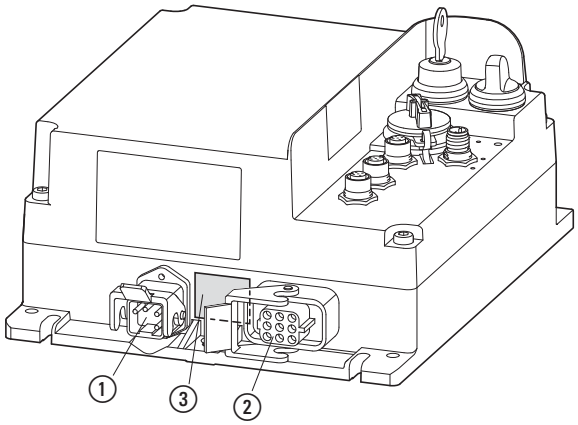


Figure 71: Connections in RAMO5 power section
① Power plug
② Motor outgoer socket
③ Warning notice

Examples of RAMO5 warnings

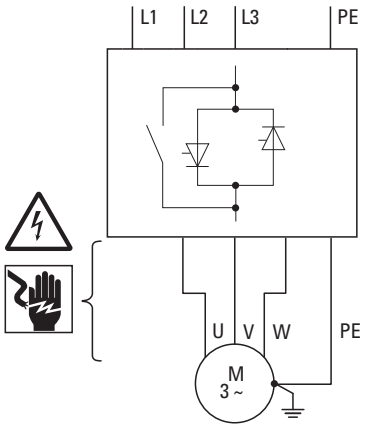


Figure 72: Direct starter RAMO5-D…-…0S1 (without repair switch)

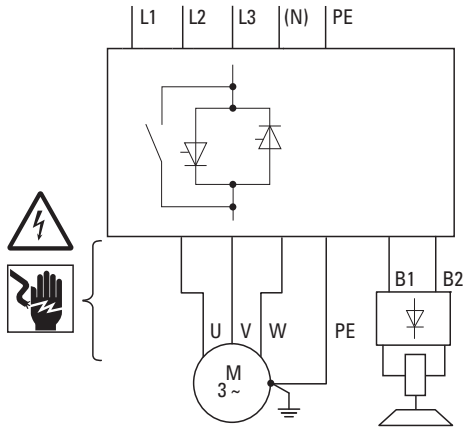


Figure 73: Direct starter with brake control RAMO5-Dxx1(2)(4)…-…0S1 (without repair switch)

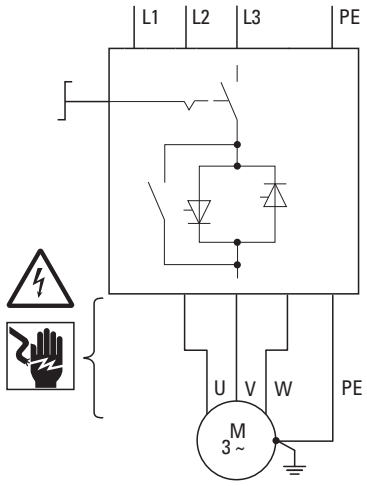


Figure 74: Direct starter with repair and maintenance switch RAMO5-D…-…RS1

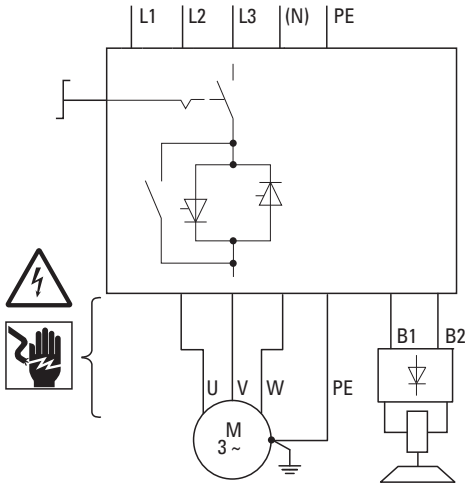


Figure 75: Direct starter with repair and maintenance switch and brake control RAMO5-Dxx1(2)(4)…-…RS1

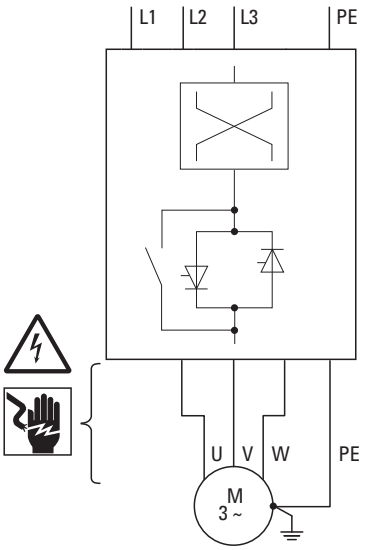


Figure 76: Reversing starter RAMO5-W…-…0S1

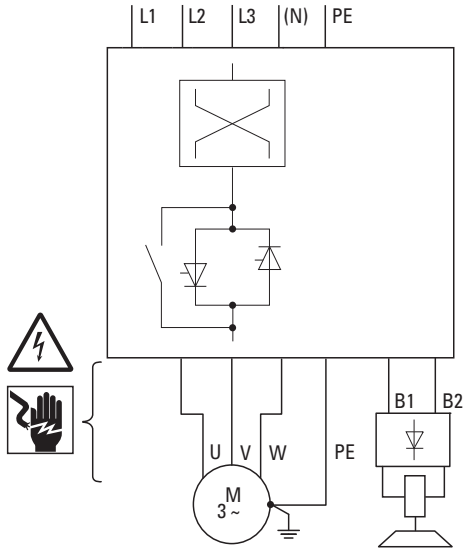


Figure 77: Reversing starter with brake control RAMO5-Wxx1(2)(4)…-…0S1

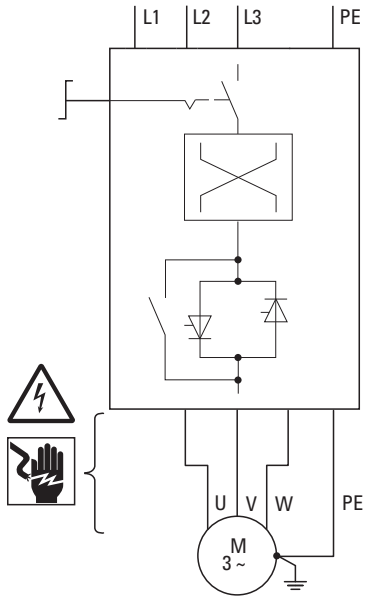


Figure 78: Reversing starter with repair and maintenance switch RAMO5-W…-…RS1

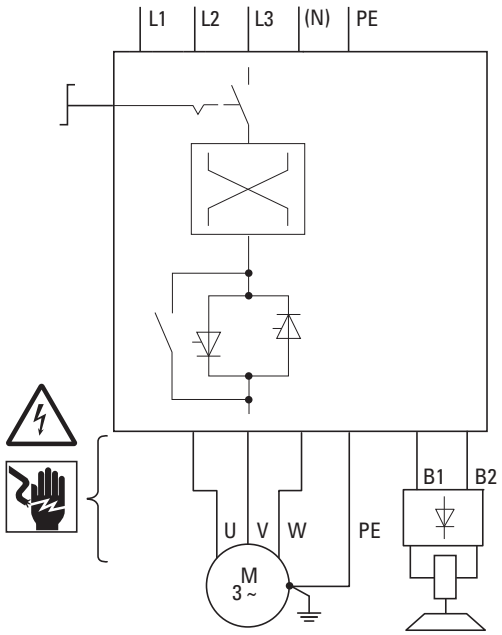


Figure 79: Reversing starter with repair and maintenance switch and brake control RAMO5-Wxx1(2)(4)…-…RS1

4.2.2 Specific hazard warnings for RASP5

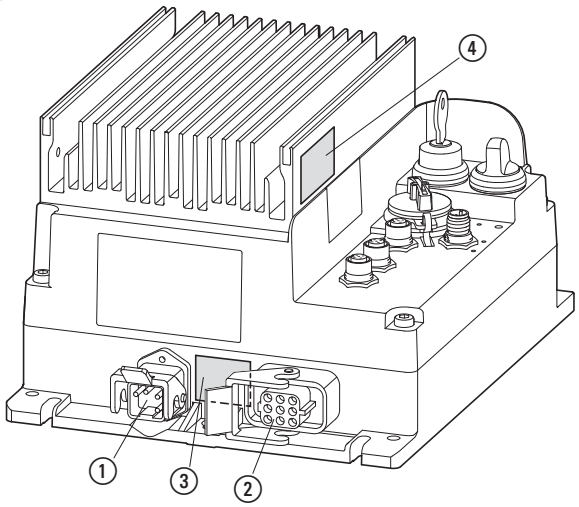


Figure 80: Connections in RASP5 power section and hazard warnings

① Power plug
② Motor socket
③ Hazard warning (discharge time of internal DC link capacitors)
④ Hazard warning (heat sink overtemperature)

DANGER

For RASP5, The components and connections in the power section (power plug, motor socket) remain energized up to 5 minutes after the supply voltage has been switched off (internal DC link capacitor discharging time).

Pay attention to hazard warnings!

DANGER

High temperatures may occur on the heat sink of the RASP5 during operation.

Do not touch the heat sink!

ATTENTION

Make sure that there is no danger in starting the motor. Disconnect the driven machine if there is a danger in an incorrect operating state.

If motors are to be operated at frequencies higher than the standard 50 or 60 Hz, these operating ranges must be approved by the engine manufacturer, otherwise the motors may be damaged.

4.3 Manual control

RAMO5 and RASP5 Rapid Link modules come with a manual controller (local controller) as standard. This controller is made up of a key switch and, in the case of RAMO-W and RASP5, of a direction selector switch.

The manual control allows:

- a simple commissioning
- local operation during setup and maintenance,
- manual operation of a single drive unit with the overall system in automatic mode,
- secure (interlocked) manual operation within an area secured with limit switches (→ section 2.9, "Sensor inputs I1 and I2", page 57).

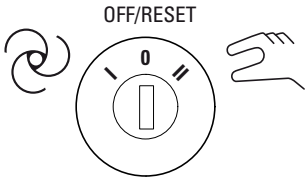


Figure 81: Key-switches

→ The key is maintained in all switch positions and can be inserted and removed in all positions.

The key switch has three positions.

Position	Function	Description
	Automatic mode	Automatic operation through
	Manual mode	Local operation, even without Start enable is issued with the direction selector switch (FWD, REV) on RAMO5-W and RASP5. In the case of RAMO5-D, the start enable signal is sent using the key switch ("Manual" position).
OFF/RESET	From Reset command	In this position RAMO5 and RASP5 do not issue control signals.

On Rapid Link modules RAMO5-W… (reversing switch) and RASP5 (speed controller) the required rotating field direction can be selected with the selector switch in manual mode:

- FWD = Forward. Enable clockwise rotating field (L1 → U, L2 → V, L3 → W)
- REV = Reverse. Enable left-hand rotating field (L1 → W, L2 → V, L3 → U)

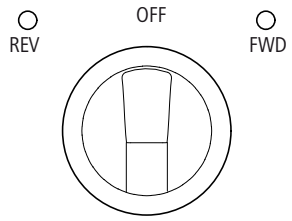


Figure 82: Direction of rotating field

The selected and enabled rotating field direction is indicated by the green FWD and REV LEDs. The selector switch for the rotating field direction has three positions. In switch position OFF the Rapid Link modules are inhibited in manual mode.

→ The selector switch for the direction of rotating field maintained in all positions.

5 RAMO5 Motor starter

5.1 Description

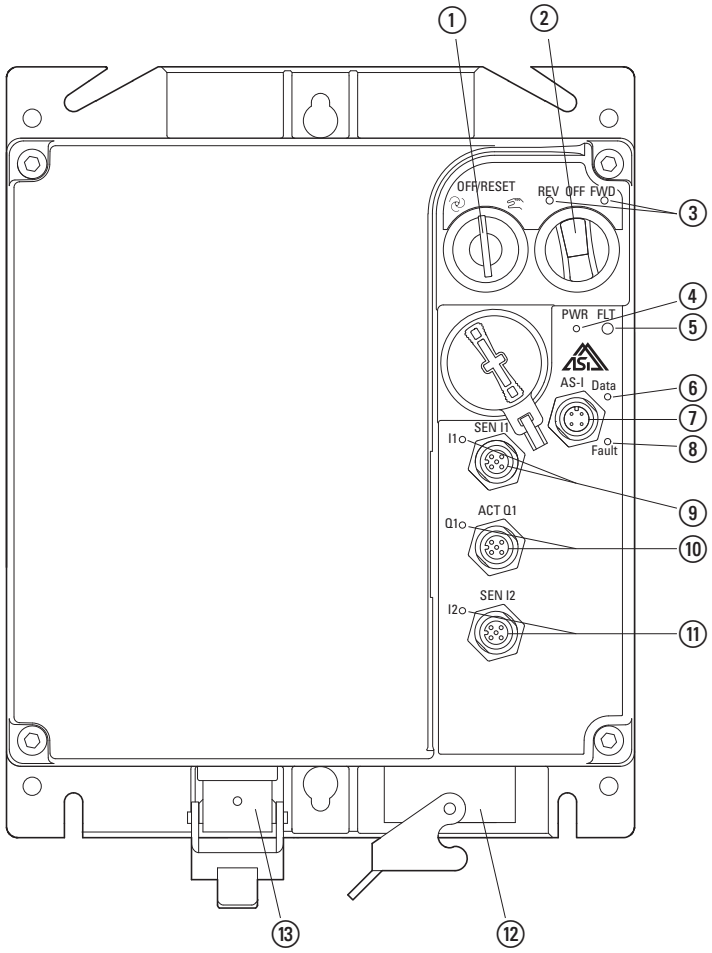


Figure 83: Overview RAMO5

① Key-switch for manual and automatic mode and Reset
② Selector switch for rotating field direction (FWD, REV) in manual mode, RAMO5-W... only
③ LED for indicating motor voltage rotating field
– FWD = Clockwise rotating field (Forward Run)
– REV = Counterclockwise rotating field (Reverse Run)
④ LED display for supply voltage
⑤ LED display for fault or error messages
⑥ LED display for AS-Interface
⑦ Connection AS-Interface (M12 connector)
⑧ LED display for AS-Interface communication error
⑨ Sensor input I1 (M12 socket) with LED
⑩ Actuator output Q1 (M12 connector) with LED display - only in the version RAMO5-xx1…
⑪ Sensor input I2 (M12 socket) with LED
⑫ Motor feeder plug
⑬ Power plug (supply voltage 3 AC 400 V, N, PE)

5.2 Features

RAMO5 (Rapid Link Motor Control Unit) is an electronic motor starter for the direct start of three-phase motors up to 6.6 A (≥ 3 kW at 400 V). RAMO5 switches with thyristors and relays in the energy branch. This makes it possible for the units to have a lifespan of more than 10 million switching cycles.

RAMO5 is available in two versions with respect to the direction of rotation:

- RAMO5-**D**… = DOL starter for one operating direction
- RAMO5-**W**… = Reversing starter for two operating directions (FWD, REV)

The speed of the controlled motors is constant after run-up and is determined by the frequency of the supply voltage (energy bus, 50/60 Hz).
The three-phase motor protection enables the protected operation of three-phase motors in the range of 0.3 A (≥ 90 W at 400 V) to 6.6 A (≥ 3 kW at 400 V). This enables the so-called thermistor motor protection to be implemented in conjunction with the integrated thermistor monitoring.

The built-in transistor switch allows actuation of spring-loaded brakes with DC air solenoid valve. For the brake rectifier a controlled supply voltage of 180 V AC, 230 V AC or 400 V AC is output (→ Figure 63, page 100).

DANGER

RAMO5 is not intended to be opened by the user.
Open only in voltage-free state!

5.3 Connections

The RAMO5 motor starter is supplied ready for connection.
All connections are made via plug-in connections.

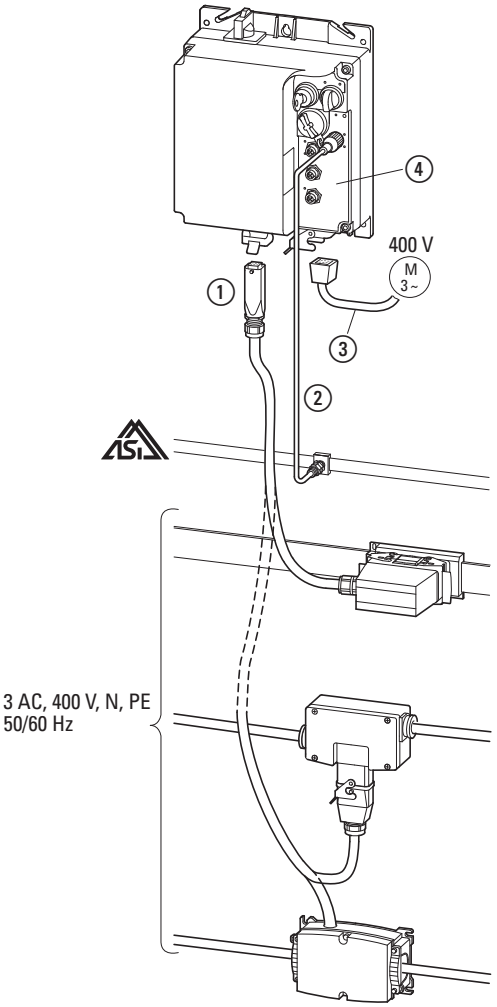


Figure 84: Connections to RAMO5

① Power plug: Power supply (3 AC 400 V, N, PE) through a power adaptor cable (→ section 3.5, "Power plug", page 90)
② Data bus for controlling RAMO5 in automatic mode
③ Motor connection: Motor connection according DESINA specification
④ Sensor and fan connections

5.4 Special technical data

The following tables show the technical data of the RAMO5 Motor Control Unit in the individual power classes with the allocated motor output.

→ The motor output allocation is based on the rated operational current.

→ The motor output designates the respective active power output to the drive shaft of a normal, four pole, internally or externally ventilated three-phase asynchronous motor with 1500 min^{-1} (at 50 Hz) and 1800 min^{-1} (at 60 Hz).

	Symbol	Unit	RAMO5-D…	RAMO5-W…
Instance			Direct starter L1 → U, L2 → V, L3 → W.	Reversing starter FWD: L1 → U, L2 → V, L3 → W REV: L1 → W, L2 → V, L3 → U.
Block diagram			→ Page 123	→ Page 124
Rated operational current (I_e)	I_e	A	6.6	
Adjustable motor protection		A	0.3 - 6.6	
Assigned motor output at 400 V, 50 Hz 440 - 460 V, 60 Hz				
	P	kW	0.18 - 3	
	P	HP	0.25 - 4	
Power side (primary side)				
Number of phases			3	
Rated voltage	U_{LN}	V	380 V - 10 % - 480 V + 10 %, 45 - 66 Hz	
Input current	I_{LN}	A	0.3 - 6.6	
Braking				
Control voltage (external brake)	U	V	RAMO5-xxx1…: 180 V DC RAMO5-xxx2…: 230/277 V AC RAMO5-xxx4…: 400/480 V AC	
Load current (external brake)	I	A	0.6 A, max. 6 A for 120 ms	
Heat dissipation at rated current (I_e)	P_v	W	max. 8 W, depending on motor current and brake	
Weight (without/with manual override switch)	m	kg	1.6/1.8	
Reaction time				
Motor On (automatic)[1)]	t_{ON}	ms	Motor 20-35, brake 20-35	
Motor Off (automatic)[1)]	t_{OFF}	ms	Motor 20-35, brake 20-35	
Switch off the motor (quick stop)	t_{Off}	ms	Motor 20-35, brake 20-35	
Switch on Q1	t_{ON}	ms	2 - 20	
Switch off Q1	t_{OFF}	ms	2 - 20	
Minimum pulse duration I1/I2	t_{ON}	ms	5	

1) without bus runtime, depending on PLC

5.5 Block diagrams

RAMO5-D

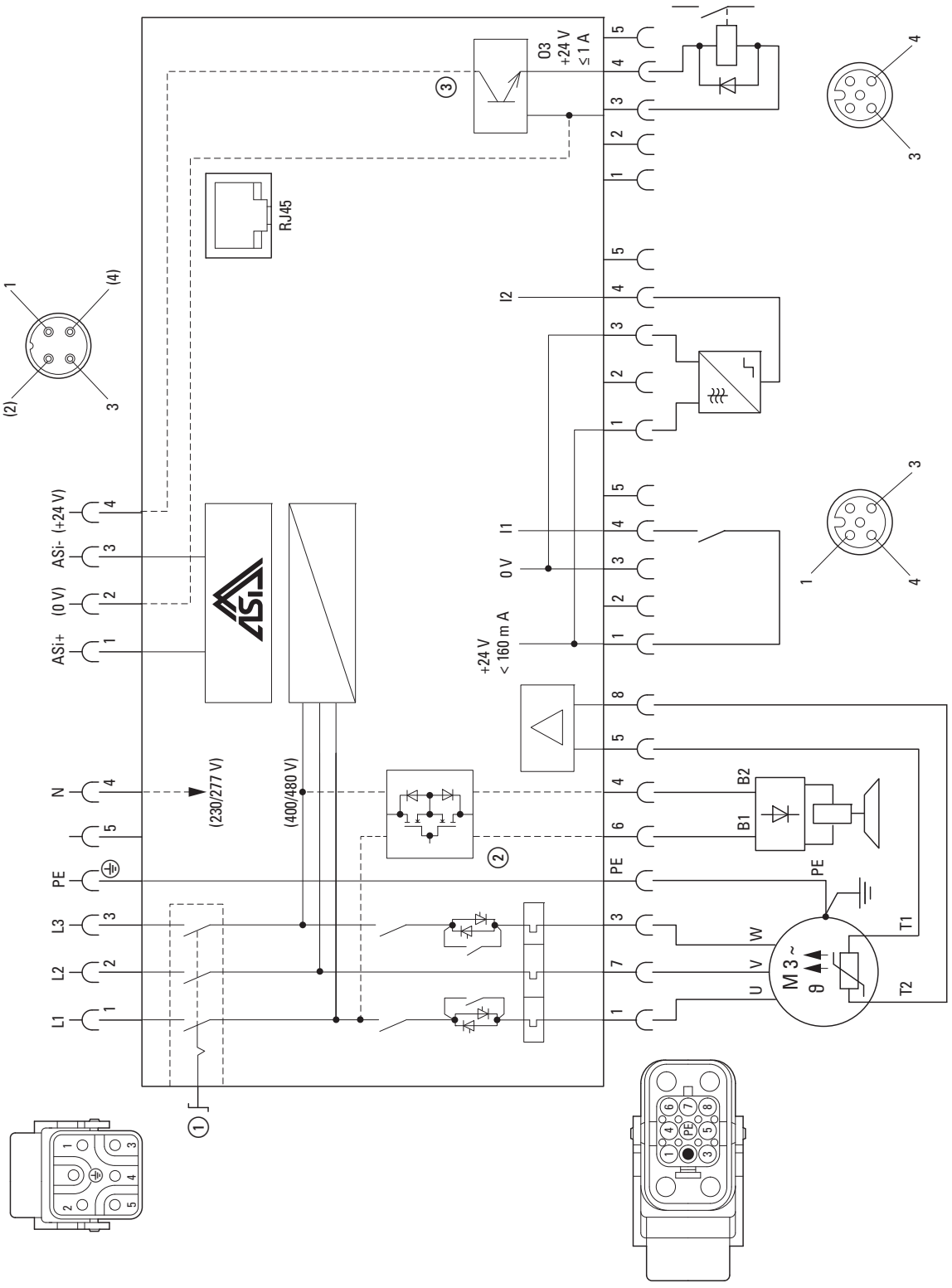


Figure 85: Block diagram RAMO-D…

① RAMO5-…-xxxRxx
② RAMO5-xxx2… (230/277 V), RAMO-xxx4… (400/480 V)
③ RAMO5-xx1…

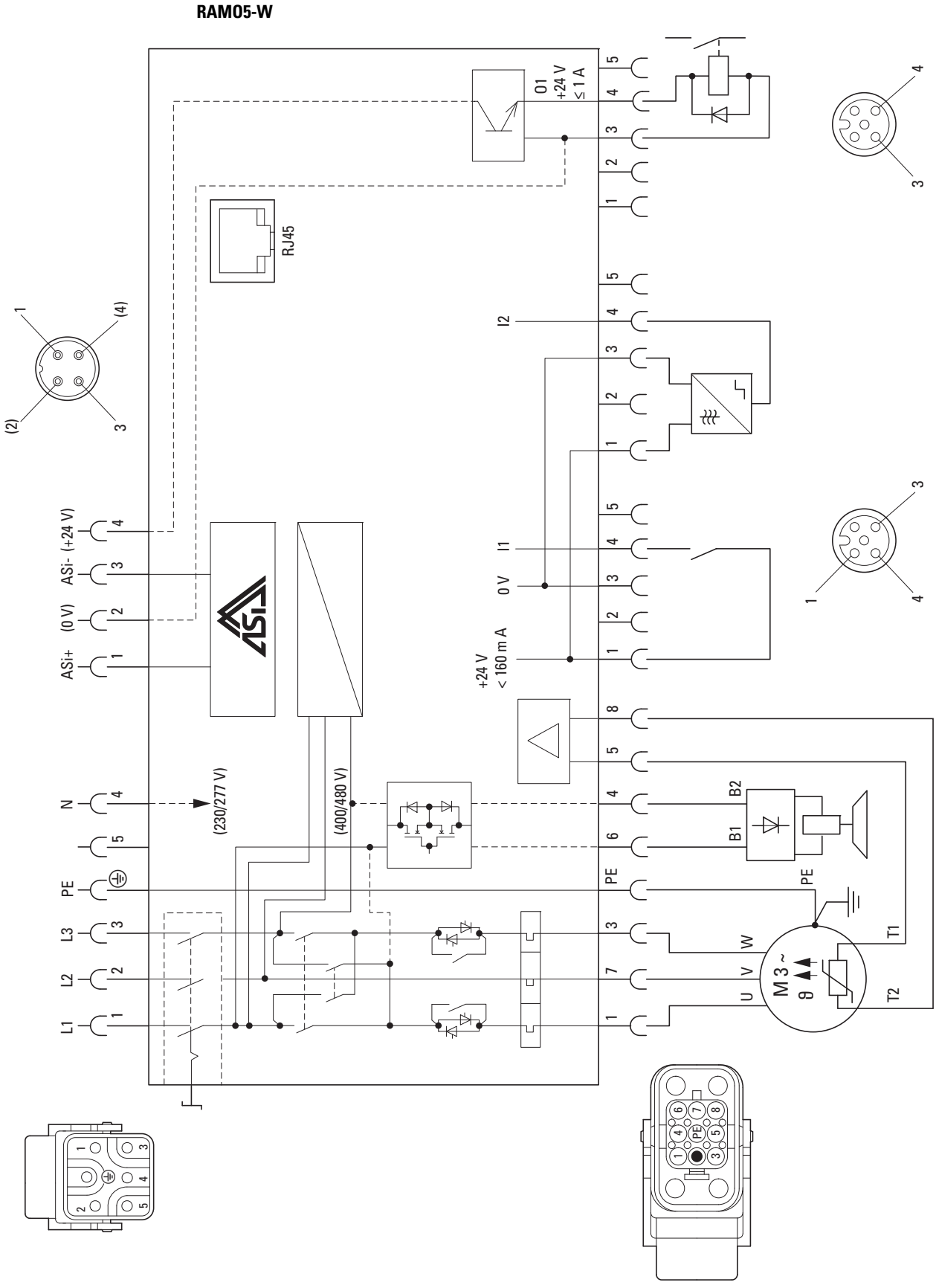
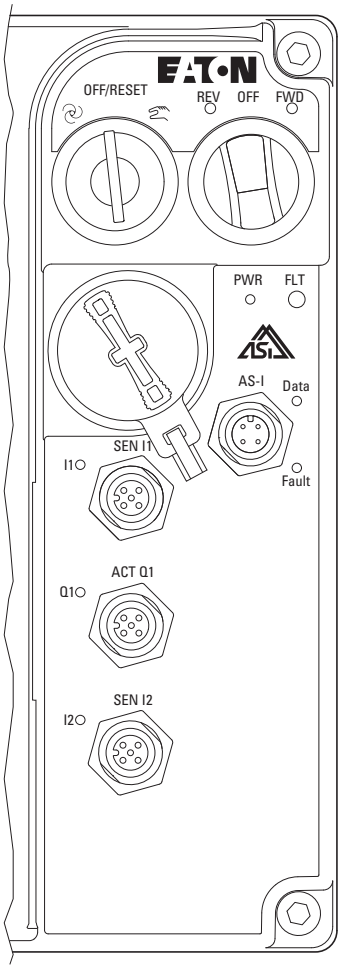


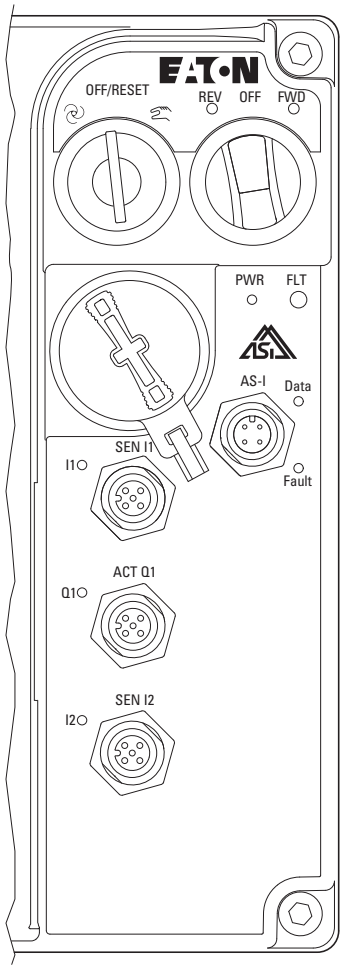
Figure 86: Block diagram RAMO-W…

5.6 LED displays

The LEDs of motor control unit RAMO5 indicate the operating states and allow a quick diagnosis.



LED	State	Description
FWD		**Clockwise rotating field** of motor voltage (U-V-W)
	Off	Not actuated
	Green	enabled (RUN mode)
	Flashing (green)	controlled: • but inhibited through quick stop function of sensor inputs I1 and I2) • but inhibited because the key-operated switch was in the MANUAL position when the supply voltage → A Reset command required.
REV		**Counterclockwise rotating field** of motor voltage (W-V-U) Only for reversing starters!
	Off	Not actuated
	Green	enabled (RUN mode)
	Flashing (green)	controlled: • but inhibited through quick stop function of sensor inputs I1 and I2 • but inhibited because the key-operated switch was in the MANUAL position when the supply voltage → A Reset command required.
		AS-Interface
	Off	AS-Interface electronics have no supply voltage: Check AS interface connection cables Check AS interface power supply unit (head-end controller)
	Green	Communication active, normal operation
	Red Green flashing	No communication: • Head-end controller (master) in STOP mode. • RAMO5 not entered or entered with the wrong address (ID). • RAMO5 in Reset mode.
	Flashing Green/Red	AS-i address = 0 → AS interface setting the address
	Green Red flashing	fatal peripheral error, internal ASi error
I1		**Sensor input I1**
	Off	• not connected • Not triggered (no input signal)
	Green	I1 triggered (input signal)



LED	State	Description
I2		**Sensor input SI2**
	Off	• not connected • Not triggered (no input signal)
	Green	SI2 triggered (input signal)
Q1		**Actuator output Q1** Only for **RAMO5-xx1…**!
	Off	• Not actuated
	Green	Q1 triggered (output signal) **Note:** If the external supply voltage for Q1 (24 V DC) is missing, no signal is applied at the output.
PWR	Off	The 400 V supply voltage is missing or the repair switch is switched off.
	Green	Supply voltage 400 V
		RAMO group fault indication
	Off	No fault message
FLT	Red	Fault message: An error has been detected and is permanently present - in the case of: • Motor overload (overcurrent) → Check motor and drive unit (reset with engine cooled down)≥ parameters → Check short shot in motor lead → parameters • Thermistor/cable monitoring → Check motor and drive unit (reset when motor has cooled down) → No motor cable connected (motor outgoer socket) → Wire jumper not closed with motor cable disconnected (→ for servicing only) • Overload/short circuit on sensor inputs or actuator output On a temporary or rectified fault this LED flashes until the Reset command is issued.
	Flashing (red)	The detected fault (the fault signal's cause) has been fixed. The fault signal can now be acknowledged with key switch OFF/RESET (→ The LED **FLT** goes out).

5.7 Configure special settings

5.7.1 Configure set rated motor current (P1-08)

Before commissioning the RAMO5 motor control unit, the current monitoring function must be set to the rated motor current.

To set parameter P1-08, the screw plug must be opened.

> *ATTENTION*
>
> Parameter P1-08 can only be changed if the key switch is in the OFF/RESET position.
> Switching during operation may cause an accidental motor start.

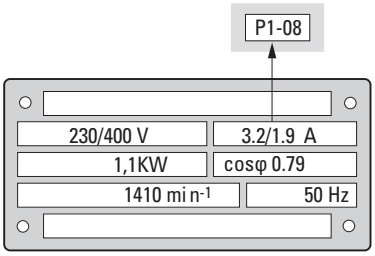


Figure 87: Set rated motor current

The parameterization can be via:

- App,
- Keypad,
- "drivesConnect" software.

Table 22: Parameter P1-08

Parameter	Description	Unit	Value range
P1-08	Motor nominal current	A	0.3 - 6.6

5.7.2 Sensor inputs I1 and I2

Sensor inputs I1 and I2 are laid out for rising-edge input signals (N/O, fail-safe). Parameter P3-06 is set to the value 1 when delivered.

When using sensors (open) that switch to zero, parameter P3-07 must be set to 1. The signal is then inverted.

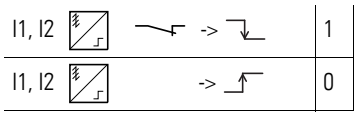


Figure 88: Configuring the sensors inputs I1 and I2

Parameter	Designation	Description	Unit	Min	Max	DS
P3-06	DI1 Logic	0 = close 1 = open **Note:** Change active only after POWER ON/OFF	–	0	1	0
P3-07	DI2 Logic	0 = close 1 = open **Note:** Change active only after POWER ON/OFF	–	0	1	0

5.7.3 Quick stop and interlocked manual operation

RAMO5-D… direct starter

P1-13	Configuration		
	Functions of I1 and I2	**Restart conditions in manual mode**	**Restart conditions in automatic mode**
1	No function (as supplied)	–	–
2	I1 and I2 stop the motor in automatic and manual mode	Key switch reset on rising edge	Command change via ASi
3	I1 stops the motor in automatic mode	–	Command change via ASi
4	I1 stops the motor in automatic and manual mode	Key-operated switch reset and I1 no longer active on rising edge or level detection	Command change via ASi

RAMO5-W… reversing starter

P1-13	Configuration		
	Functions of I1 and I2	**Restart conditions in manual mode**	**Restart conditions in automatic mode**
1	No function	–	–
2	I1 stops the motor in both rotation directions in automatic mode	–	Command change via ASi
3	I1 stops the motor in FWD in automatic mode	–	Command change via ASi
	I2 stops the motor in REV in automatic mode		
4	I1 stops the motor during FWD in automatic and manual mode	REV: Change direction of rotation to FWD for edge or level control	Command change via ASi
		FWD: from REV and reset I1	
		FWD: Key switch reset and I1 no longer active for edge or level control	
	I2 stops the motor in REV in automatic and manual mode	FWD: Change direction of rotation to REV for edge or level control	
		REV: of FWD and reverse I2 for edge or level control	
		REV: Key switch reset and I2 no longer active for edge or level control	

5.7.4 Phase change

Parameter P6-08 changes the rotating field at the output of RAMO5-W… from FWD to REV. The control logic and the LED indication remain in the FWD function.

→ For RAMO5-W… the P6-08 parameter setting should be changed by competent users according to the instructions in the manual.

→ For RAMO5-D…, parameter P6-08 has no function.

Parameter	Designation	Description	Unit	Min	Max	DS
P6-08	Change motor phase sequence	Changes the sequence of the output phases. This prevents, two phases of the motor cable from having to be changed in case the motor runs in the wrong direction. 0: U V W (clockwise rotating field) 1: U - W - V (counterclockwise rotating field)	–	0	1	0

5.7.5 Monitoring the current lower limit

Parameter	Designation	Description	Unit	Min	Max	DS
P6-05	Underload Protection	Device response (depending on device) after "underload motor" occurs. 0 = deactivated 1 = Warning 2 = Error (shutdown)	–	0	1	0

When P6-05 = 1 (= ON), an error message (the motor LED will light up red) will be output when a phase (L1, L2, L3) carries less than 25 % of rated operational current I_e.

5.7.6 Quick Stop

The quick-stop function is performed via DQ3 (ASi signal).
The function can be activated via parameter P5-10.

Parameter	Designation	Description	Unit	Min	Max	DS
P5-10	QuickStop lock	0: Quick stop via sensors deactivated. 1: Quick stop via sensors activated (ASi signal active).	–	0	1	0

P5-10	DQ3	Function	Description
1	0	Quick stop ON	Response to sensors
1	1	Quick stop OFF	No response to sensors
0	0	None	DQ3 signals will not be transmitted
0	1	None	DQ3 signals will not be transmitted

6 RASP5 Speed controller

6.1 Description

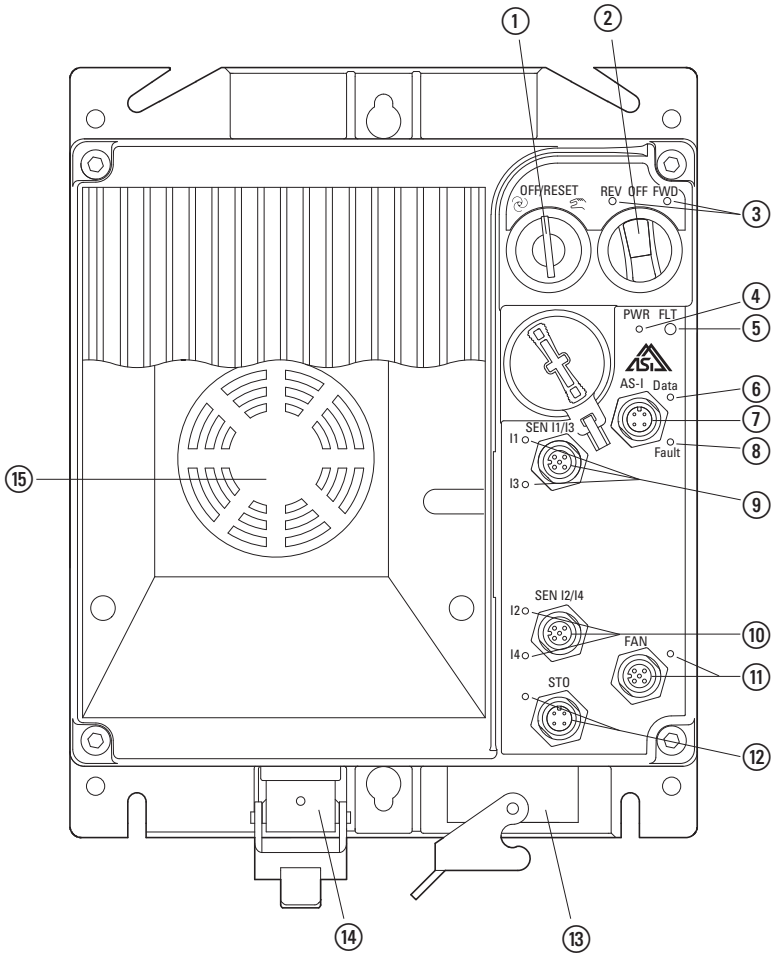


Figure 89: Overview RASP5

① Key-switch for manual and automatic mode and Reset
② Selector switch for rotating field direction (FWD, REV) in manual mode
③ LED for indicating motor voltage rotating field
– FWD = Clockwise rotating field (Forward Run)
– REV = Counterclockwise rotating field (Reverse Run)
④ LED display for supply voltage
⑤ LED display for fault or error messages
⑥ LED display for AS interface
⑦ Connection AS interface (M12 connector)
⑧ LED display for AS interface communication error
⑨ Sensor input I1/I3 (M12 plug) with LED display
⑩ Sensor input I2/I4 (M12 plug) with LED
⑪ Fan connection F (M12 socket) with LED display
⑫ STO input, with LED display
⑬ Motor-outgoer plug
⑭ Power plug, (supply voltage 3 AC 400 V, N, PE)
⑮ Device fan, mounted at the factory on RASP5-8… (4 kW)

6.2 Features

RASP5 (Rapid Speed Control Unit) is an electronic speed controller for the frequency-controlled start and operation of three-phase motors up to 8.5 A (4 kW at 400 V). RASP5 supplies a constant torque across the entire frequency/speed range and is popular for hoist and rotary drives. The fixed speed value (standard: Four, maximum eight) enables process-controlled speeds.

The frequency control (gentle start-up) protects the motor and the mechanical system and relieves the power supply (no current peaks).

RASP5 is available in four power sizes: From 2.4 TO 8.5 A.
The internal electronic motor protection (I^2t controller) allows the protected operation of three-phase motors in the range of 0.2 A (0.75 kW at 400 V) to 8.5 A (4 kW at 400 V). The startup current and thus almost proportionally the starting torque of the motor enables values up to 200 % for 2 s every 20 s and 150 % for 60 s every 600 s. This enables the so-called thermistor motor protection to be implemented in conjunction with the integrated thermistor monitoring.

The built-in transistor switch allows actuation of spring-loaded brakes with DC air solenoid valve.

For the brake rectifier, a controlled supply voltage of 180 V DC, 230 V/277 V AC or 400 V/480 V AC output. In addition versions of RASP5 with built-in braking resistance also allow dynamic braking.

DANGER

RASP5 is not intended to be opened by the user.
Open only in voltage-free state!

6.3 Connections

The RASP5 speed controller is supplied ready for connection.
All connections are made via plug-in connections.

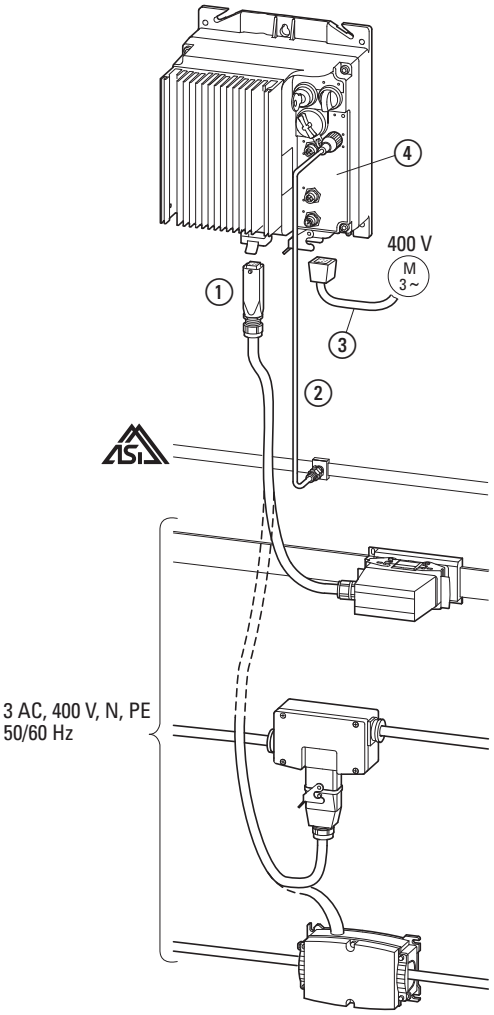


Figure 90: Connections to RASP5

① Power supply (3 AC 400 V, N, PE) through a power adaptor cable (→ section 3.5, “Power plug”, page 90)
② Data bus for controlling RASP5 in automatic mode
③ Motor connection according DESINA specification
④ Sensor and fan connections

6.4 Special technical data

The following tables show the technical data of the RASP5 Motor Control Unit in the individual power classes with the allocated motor output.

→ The motor output allocation is based on the rated operational current.

→ The motor output designates the respective active power output to the drive shaft of a normal, four pole, internally or externally ventilated three-phase asynchronous motor with 1500 min^{-1} (at 50 Hz) and 1800 min^{-1} (at 60 Hz).

	Symbol	Unit	RASP5-2…	RASP5-4…	RASP-5…	RASP-8…
Rated operational current (I_e)	I_e	A	2.4	4.3	5.6	8.5
Overload current for 60 s every 600 s at 40 °C	I_L	A	3.6	6.5	8.4	12.75
Overload current for 2 s every 20 s at 40 °C	I_L	A	4.8	8.6	11.2	17
Apparent power at 400 V rated operation	S	kVA	1.84	3.27	4.24	6.49
Assigned motor output at 440 V, 60 Hz						
	P	kW	0.75	1.5	2.2	4
	P	HP	1	2	3	5
Settings range Setting range current limitation (P1-08)	I_2	A	0.2 - 2.4	0.4 - 4.3	0.5 - 5.6	0.8 - 8.5
Power side (primary side)						
Number of phases			3	3	3	3
Rated voltage	U_{LN}	V	380 V - 15 % - 480 V + 10 %, 50/60 Hz (380 - 480 V ±0 %, 45 - 66 Hz ±0 %)			
Input current	I_{LN}	A	2.5	4.1	5.3	7.8
Braking						
Braking value	I/I_e	%	≦ 30	≦ 30	≦ 30	≦ 30
Switch-on threshold for the braking transistor	U_{DC}	V DC	765	765	765	765

	Symbol	Unit	RASP5-2…	RASP5-4…	RASP-5…	RASP-8…
DC-braking	I/I_e	%	≦ 100, adjustable	≦ 100, adjustable	≦ 100, adjustable	≦ 100, adjustable
Rated operating voltage for brake control	U	V AC	RASP5-xx1… (180 V DC) RASP5-xx2… (230/277 V AC) RASP5-xx4… (400/480 V AC)			
Switching frequency	f_{PWM}	kHz	8 (adjustable 4 - 32)			
V/f characteristic			linear	linear	linear	linear
Heat dissipation at rated operational current (I_e) and a pulse frequency (f_{PWM}) of 6 kHz	P_v	W	32	46	…58	95
Heat dissipation during no-load operation (standby) with AS-i supply voltage	P_v	W	< 9	< 9	< 9	< 12
Efficiency	η		0.97	0.98	0.98	0.98
Fan						
internal			temperature controlled			
Device fans on heat sink			–	–	–	Fan
Output frequency	f_z	Hz	50/60 Hz, adjustable 0 - 320 Hz			
1. Fixed frequency (P1-12)	f_z	Hz	30	30	30	30
2. Fixed frequency (P2-01)	f_z	Hz	40	40	40	40
3. Fixed frequency (P2-02)	f_z	Hz	50	50	50	50
Factory set response time						
Motor On (automatic)[1)]	t_{ON}	ms	< 10	< 10	< 10	< 10
Motor Off (automatic)[1)]	t_{OFF}	ms	< 10	< 10	< 10	< 10
Switch off the motor (quick stop)	t_{OFF}	ms	< 10	< 10	< 10	< 10
Minimum pulse duration I3/I4	t_{ON}	ms	5	5	5	5
Longest permissible length of motor cable	l	m	25	25	25	25
Weight	m	kg	3.4/3.7	3.4/3.7	3.4/3.7	3.4/3.8

1) without bus runtime, depending on PLC.

6.4.1 Overload Capacity

The variable frequency drive modules in the RASP5 speed control unit allow for an overload cycle of 150 % I_e for 60 s every 600 s of operation.

After the overload phase (150 % I_e for 60 s or 200 % I_e for 2 s), 100 %rated current $I_{e\ can\ be\ continuously}$ recalled.

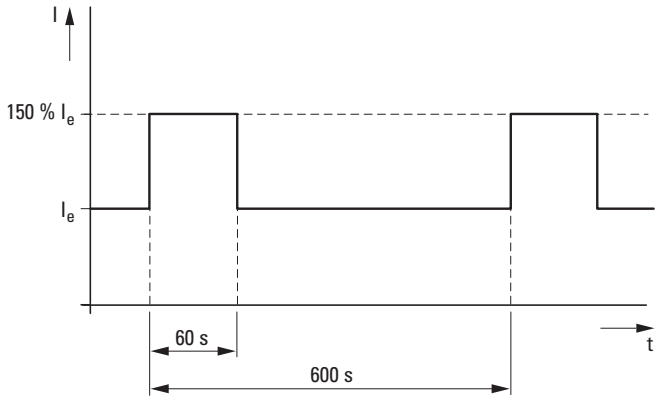


Figure 91: Overload cycle in operation

6.4.2 Derating curves

Although high pulse frequencies allow for low running noise and shorter response times, they also produce higher losses at the power output stages, as well as greater interference in the mains and motor cables. Because of this, the pulse frequency should be set to the lowest possible value.

In expert mode (P1-14 = 101), the switching frequency can be changed in parameter P2-22.

With higher pulse frequencies, the RASP5 heats up.
Therefore, the output current (I_{2N}) must be reduced (derating) at high pulse frequencies, depending on the ambient temperature.

→ For requirements for higher switching frequencies (> 16 kHz), the load (output current) and/or the ambient temperature must be reduced.
The RASP-FAN-S1 makes it possible to run the unit at higher ambient temperatures.

The following derating curves show the output current in continuous operation as a function of the pulse frequency (f_{PWM}) and ambient temperature.

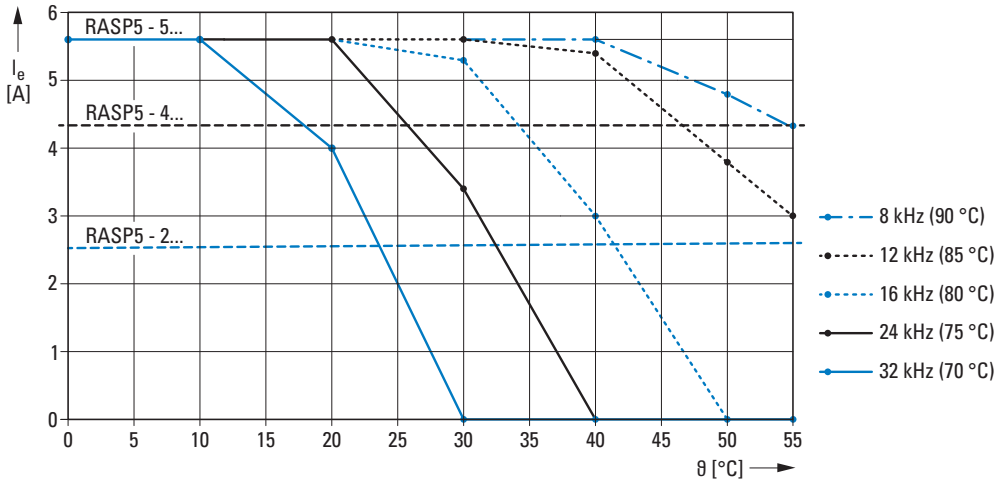


Figure 92: f_{PWM} = 8 - 32 kHz at RASP5-2…, RASP5-4…, RASP5-5…

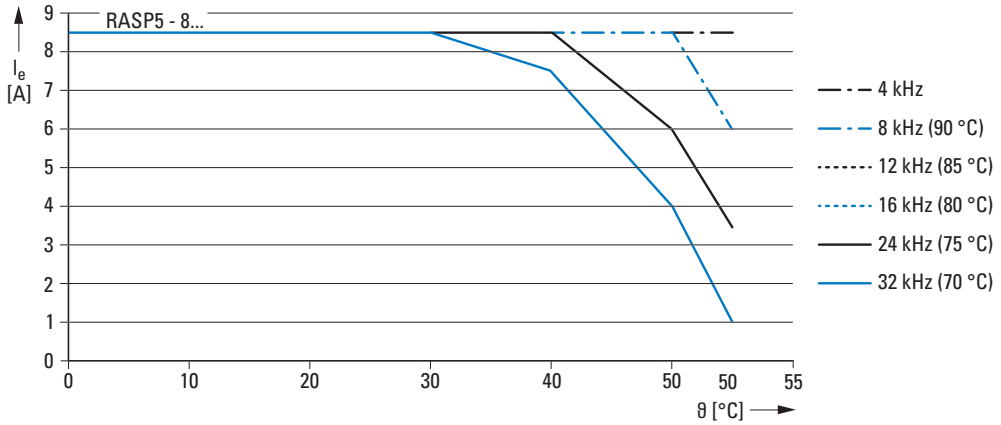


Figure 93: f_{PWM} = 4 - 32 kHz for RASP5-8…

6.5 Block diagram

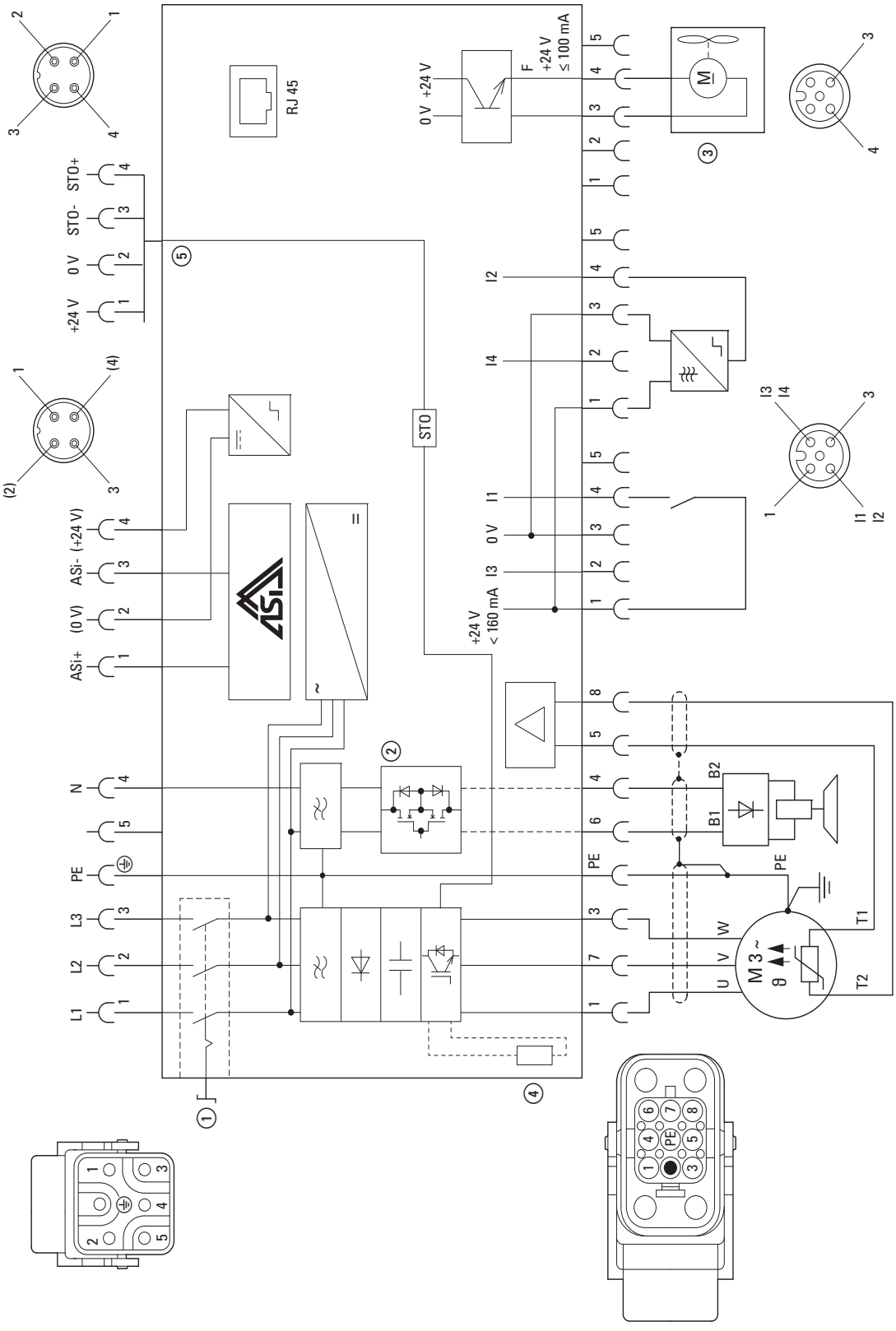
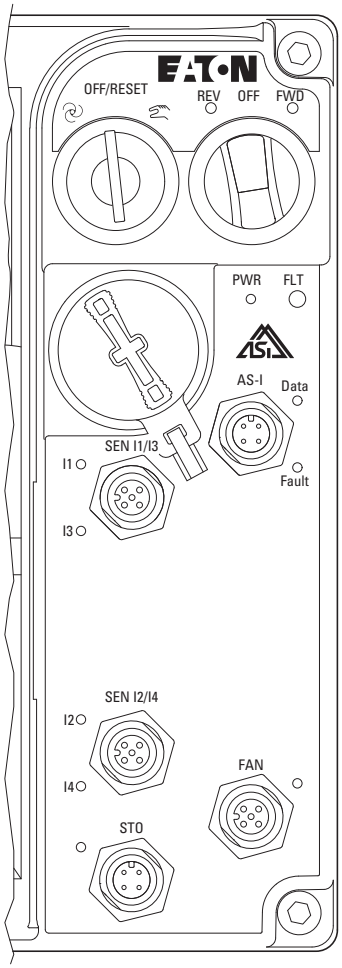


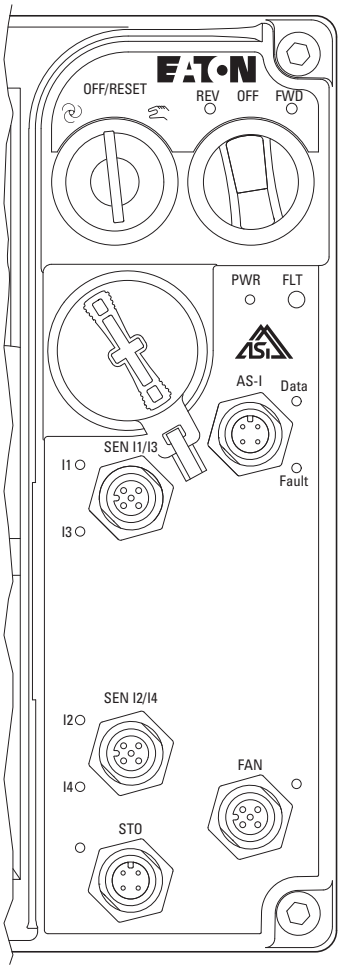
Figure 94: RASP5 Block diagram
① RASP5-…-xxxR…
② RASP5-xx1… (180 V DC)
RASP5-xx2… (230/277 V AC)
RASP5-xx4… (400/480 V AC)
③ RASP5-…-xxxxxx1xx (FAN)
④ RASP5-…-xxx1...
⑤ RASP5-…-xxxxx1xxx (STO)

6.6 LED Indicators

The LEDs indicators of motor control unit RASP5 display the operating states and allow a quick diagnosis.



LED	Display	Description
FWD		**Clockwise rotating field** of motor voltage (U-V-W)
	Off	Not actuated
	Green	enabled (RUN-Mode)
	Flashing (green)	controlled: • but inhibited through quick stop function of sensor inputs • but inhibited because the key switch was in position MANUAL when the supply voltage (400 V or AS interface) was switched on. → Reset order required. • STO signal present (inhibit)
REV		**Counterclockwise rotating field** of motor voltage (W-V-U)
	Off	Not actuated
	Green	enabled (RUN-Mode)
	Flashing (green)	controlled: • but inhibited through quick stop function of sensor inputs • but inhibited because the key-operated switch was in the MANUAL position when the supply voltage(400 V or AS-i) was switched on. → Reset order required • STO signal present (inhibit)
		AS interface
	Off	No supply voltage in the AS-i electronics: → Check AS interface connection cables → Check AS interface power supply unit (master control)
	Green	Communication active, normal operation
	Red Green Flashing	No communication: • RASP5 not entered or entered with the wrong address (ID).
	Flashing Green/Red	AS interface address = 0: → AS interface setting the address
	Green Red flashing	→ fatal peripheral error; internal ASi error
I1		**Sensor input I1**
	Off	• not connected • Not triggered (no input signal)
	Green	SI1 triggered (input signal)



LED	Display	Description
I2		**Sensor input I2**
	Off	• not connected • Not triggered (no input signal)
	Green	I2 triggered (input signal)
I3		**Sensor input I3**
	Off	• not connected • Not triggered (no input signal)
	Green	I3 triggered (input signal)
I4		**Sensor input I4**
	Off	• not connected • Not triggered (no input signal)
	Green	I4 triggered (input signal)
FAN		**Device fan** (output F = Fan)
	Off	• not connected • Not actuated
	Green	Output signal (24 V DC) for the device fan. The output is controlled according to the temperature of RASP5.
PWR	Off	The 400 V supply voltage is missing or the repair switch is switched off.
	Green	Supply voltage 400 V switched on.
FLT		**Collective fault message** of the RASP5
	Off	No fault message
	Red	Fault message: An error has been detected and is permanently present - for example: → Check the motor and the drive unit • Fault message of the internal frequency converter → Error code can be read out using the drivesConnect parameterization software • Thermistor/cable monitoring → Check motor and drive unit (reset when motor has cooled down) → No motor cable connected (motor feeder socket) → Jumper T1/T2 in motor terminal box missing on motors without temperature sensor • Overload/short-circuit on sensor inputs On a temporary or rectified fault this LED flashes until the Reset command is issued (key switch).
	Flashing (red)	The detected fault (the fault signal's cause) has been fixed. The fault signal can now be acknowledged with key switch "OFF/RESET".
STO	Off	No signal present (logic 0)
	Green	Signal present (logic 1)

6.7 Configure special settings

6.7.1 Commissioning

Before commissioning the RASP5 speed controller, the functions must be set using parameters. The screw plug must be opened to adjust the parameters.

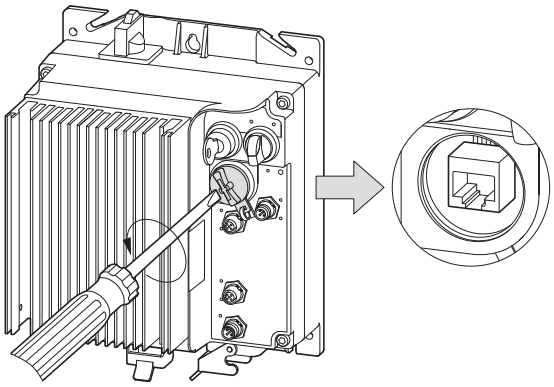


Figure 95: RJ45 interface

The parameterization can be via:

- App,
- Keypad,
- "drivesConnect" software.

> *ATTENTION*
>
> The RJ45 interface is not designed for Ethernet communication.

6.7.2 Motor cable monitoring

The monitoring is carried out via parameter P2-27.
Parameter P2-27 is set to the value 1 in the factory setting.
In position 0, the fault message of the thermistor and motor cable monitoring is deactivated.

6.7.2.1 Sensor inputs

Sensor inputs I1 and I4 are laid out for rising-edge input signals (N/O, fail-safe). Parameters P3-06 to P3-09 are set to 0 (= OFF) in the factory setting.

When using sensors (normally closed) that switch to zero, the parameters must be set to 1 (= ON). The signal is then inverted.

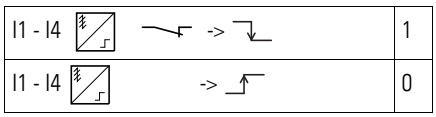


Figure 96: Configuring the sensors inputs I1 and I2#

Four sensors are currently available:

Parameter	Designation	Description	Unit	Min	Max	DS
P3-06	DI1 Logic	0 = close 1 = open **Note:** Change only after POWER ON/OFF active	–	0	1	0
P3-07	DI2 Logic	0 = close 1 = open **Note:** Change only after POWER ON/OFF active	–	0	1	0
P3-08	DI3 Logic	0 = close 1 = open **Note:** Change only after POWER ON/OFF active	–	0	1	0
P3-09	DI4 Logic	0 = close 1 = open **Note:** Change only after POWER ON/OFF active	–	0	1	0

→ Sensors I3 and I4 require a Y connector of type RA-XM12-Y.

6.7.2.2 Quick stop and interlocked manual operation

P1-13	Additional function RASP5
0	reserved
1	No add-on functions (as supplied)
2	Quick stop: Auto operation only I1 and I2 enabled. I1 is assigned to the direction of rotation “right”, I2 is assigned to the direction of rotation “left”; Application example: Vertical sorter < 360° eccentric
3	Quick stop: Auto operation only I1 is activated. I1 is assigned to both operating directions. I2 has no add-on function; Application example: Chain ejector
4	Quick stop and interlocked manual mode (edge- and signal-controlled): I1 and I2 enabled. I1 is assigned to operating direction “right”, I2 is assigned to operating direction “left”; Application example: Vertical sorter < 360° eccentric **Note:** In automatic mode, only edge-controlled
5	Quick stop and interlocked manual mode (only edge controlled): I1 and I2 enabled. I1 and I2 are assigned to operating direction “right”. The operating direction “left” is locked: Application example: Vertical sorter > 360° eccentric and > 360° turntable
6	Quick stop and creep speed: In automatic mode I1 to I4 are activated. I1, I3 are assigned to operating direction Clockwise, I2 and I4 to operating direction Counterclockwise. When I3/I4 is reached, RASP5… switches to creep speed FF1. When I1/I2 is reached, the drive switches off edge and signal controlled). Application example: Turntable **Note:** I3 and I4 require the RA-XM12-Y connector.
7	Quick stop and creep speed: In automatic mode I1 to I4 are activated. I1, I3 are assigned to operating direction Clockwise, I2 and I4 to operating direction Counterclockwise. When I3/I4 is reached, RASP5… switches to creep speed FF1. When I1/I2 is reached, the drive switches off. Application example: Turntable I1 and I2: Edge-controlled I3 and I4: edge and signal controlled **Note:** I3 and I4 require the RA-XM12-Y connector.
8	Quick stop and interlocked manual mode (edge- and signal-controlled) and creep speed: I1 to I4 are activated. I1, I3 are assigned to operating direction Clockwise, I2 and I4 to operating direction Counterclockwise. When I3/I4 is reached, RASP5… switches to creep speed FF1. When SI1/SI2 is reached, the drive switches off. Application example: Turntable **Note:** I3 and I4 require the RA-XM12-Y connector.

Example: Turntable

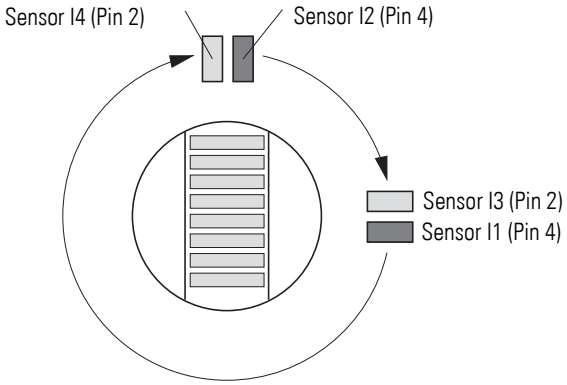


Figure 97: Example of clockwise rotary table control
pin 2: Creep speed
pin 4: Stop

If there is an input signal on pin 2 (I3/I4) (rising edge or continuous signal), the RASP5 unit will switch the drive from potentiometer frequency n_0 to fixed frequency 1 (FF1). The creep speed will remain active until the limit switch (pin 4 of M12 sockets I1 and I2) is reached and the drive stops. If the key switch is set from Manual to Automatic and back, fixed frequency 1 (FF1) remains set when the signal at pin 2 (I3/I4) is still applied. Otherwise, the potentiometer frequency $n_0$will be applied.

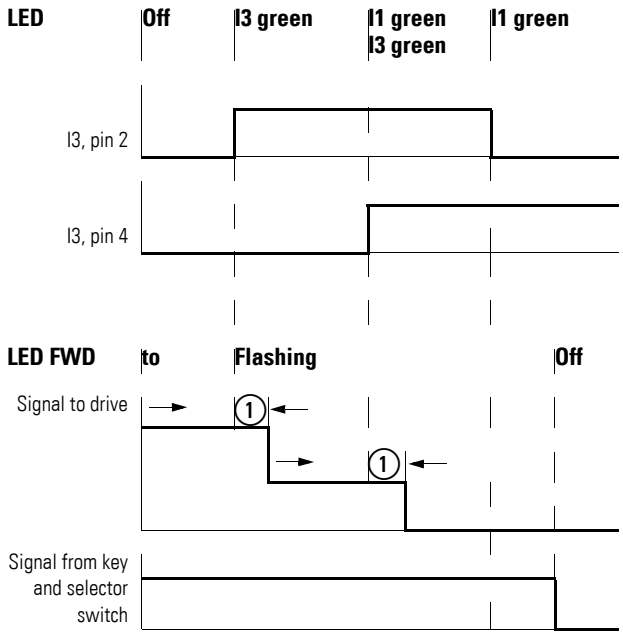


Figure 98: Interlocked manual operation with creep speed
(example: sensor input I1 and clockwise motion)

① 13.5 ms ± 5 ms

6.7.3 Phase change

For RASP5, parameter P6-08 changes the rotary field at the output from FWD to REV. The control logic and the LED signals stay in the FWD function.

Parameters should only be changed by expert users as specified in the manual.

Parameter	Designation	Description	Unit	Min	Max	DS
P6-08	Change Phase sequence Motor	Changes the sequence of the output phases. This prevents, that two phases of the motor cable have to be changed in case the motor runs in the wrong direction. 0: U, V, W (cw) 1: U, W, V (ccw)	–	0	1	0

6.7.4 Stop behavior

RASP5 units do not require an external 24 VDC control voltage.

Parameter	Designation	Description	Unit	Min	Max	DS
P3-11	t-dec Select B0	Deceleration Ramp Select Bit 0 External stop function: 0: deactivated 1: Enabled	–	0	1	0

However, with their AS interface connection, RASP5 can be used to decelerate the motor to a controlled stop in the event that the connection's external 24 V DC voltage drops out with the second ramp (P2-13). To do this, the 24 V DC voltage must be supplied via the AS-interface connection M12.

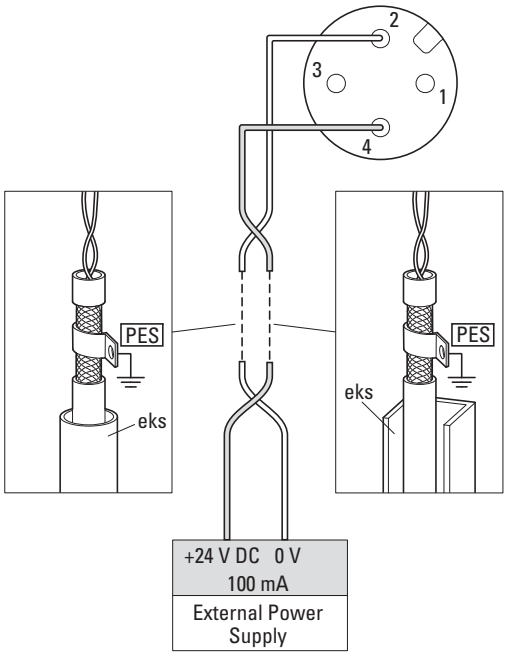


Figure 99: Example of a motor ratings plate

→ The second deceleration time can be set with parameter P2-13.

7 Configuration

Below you will find special information on the parameterization of the Rapid Link Module in order to adapt it to your requirements. The Rapid Link Modules are factory-set for direct operation in the Rapid Link system.

7.1 Parameterization via PC/App.

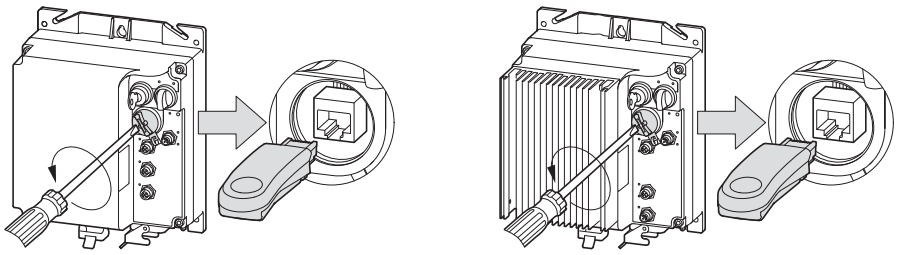


Figure 100: Parameterization via Bluetooth stick DX-COM-STICK-KIT

A change of the parameter values in the RASP requires a connection with the RJ45-socket. This is provided under the front locking screw.

→ The parameters can be displayed and edited, e. g. via Bluetooth (DX-COM-STICK3-KIT) via the external control unit DX-KEY-LED2 or DX-KEY-OLED or the parameterizing software drivesConnect.
The connection to the external control unit is made via a patch cable with RJ45 plug, the connection to the PC via the DX-CBL-PC-3M0 connecting cable or the DX-COM-STICK3-KIT Bluetooth stick.
The components listed here are not supplied as standard with RASP units (optional accessories). The corresponding accessories are listed and described in the appendix to the manual.

ATTENTION

Changing the parameter range to P-14 = 201 will require additional engineering and careful parameter configuration.
The operation and function of the RASP unit may considerably deviate from the settings in the Rapid Link system and lead to different operating states.

→ For more information on programming via the app, please visit the Download Center.

Enter "AP040189" in the **Quick Search** field and click on **Search**.

7.2 Parameterization with PC and the drivesConnect software

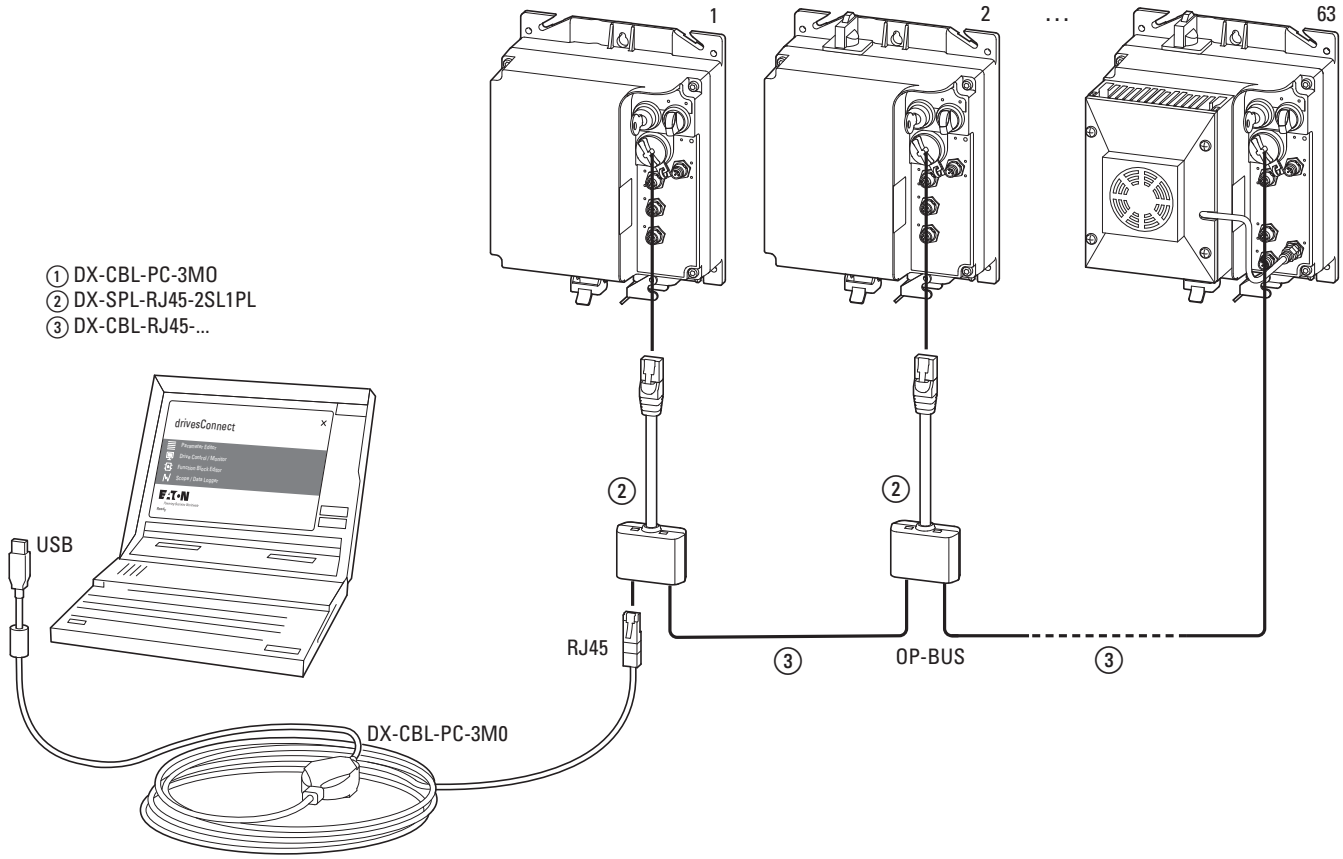


Figure 101: Parameterization with PC

The optional DX-CBL-PC-3M0 communication cable is required for PC connection.

8 PC tool

8.1 Surface

When you run the drivesConnect parameter configuration program by clicking on the corresponding icon, your computer screen will display the drivesConnect start screen.

Figure 102: drivesConnect start screen

To access one of the four main components, simply click on it:

- **Parameter Editor**
- **Drive control/monitor** (not available with Rapid Link)
- **Function block editor** (not available with Rapid Link)
- **Scope/Data Logger**

8.2 Parameter Editor

The parameters of the respective Rapid Link module are listed in the Parameter Editor area. They can be changed and called up manually .

Figure 103: drivesConnect start screen

When you open the **Parameter Editor** component, the program will show the following user interface:

Figure 104: User interface for the "Parameter Editor" component - for RAMO

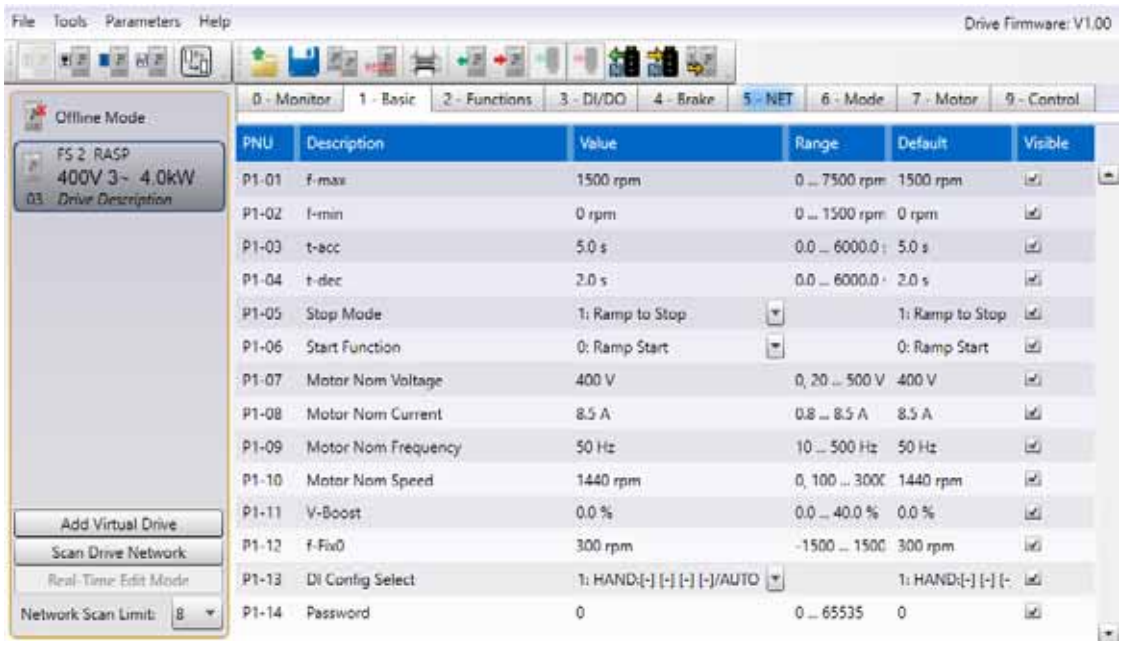


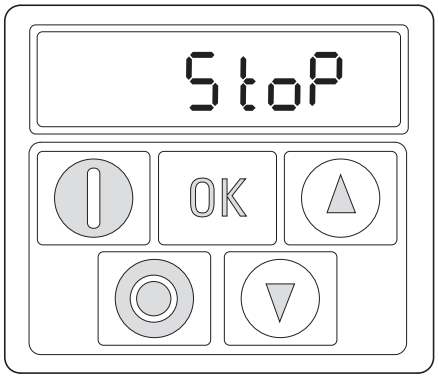
Figure 105: User interface for the "Parameter Editor" component - for RASP

→ For more information on drivesConnect software, refer to MN040003EN manual.

9 Control Unit

The parameters of Rapid Link can be configured and its operation monitored via the control unit (DX-KEY-LED2 or DX-KEY-OLED).

The following figures show the DX-KEY-LED2 and DX- KEY-OLED control panels.



Display (7-segment LEDs)

Buttons

Figure 106: View of the DX-KEY-LED2 control unit

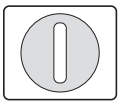
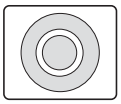
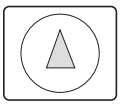
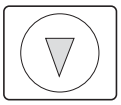
The DX-KEY-LED2 control unit has a 7-segment LED display.

The DX-KEY-OLED control unit has a multilingual plain text display (OLED = organic LED display).
The function of the control keys is identical.

On OLED displays, language selection can be activated by pressing **START** + ▲.
Display: **Select Language**.
The display language can be changed using the ▲ and ▼ arrow keys.
The selected language setting can then be saved by pressing the **OK** button.

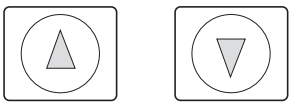
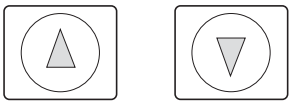
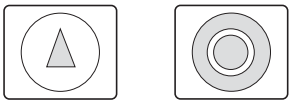
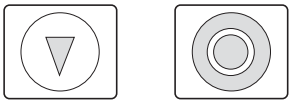
9.1 Elements of the DX-KEY LED2 external control unit

Table 23: Keypad elements – Buttons

Button	Command	Explanation
	**OK**	• Navigating in parameter mode • Opens and closes the parameter interface(press the button and hold it down for more than two seconds) • Saves parameter changes • Changes the value being displayed: A, rpm, etc. (real-time information)
	**START**	• Parameter selection
	**STOP**	• Reset – Resetting after an error message
	**UP**	• Increment numeric value or parameter number
	**DOWN**	• Decrement numeric value or parameter number

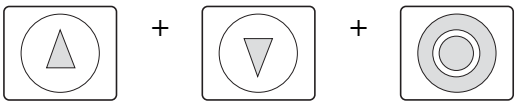
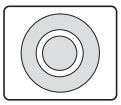
9.1.1 Adjust parameters

Table 24: Modify parameters

Command	Description
	Press the **OK** button and hold it down for two seconds in order to access the parameter interface. -> The display will show the parameter that was last used.
	Select the parameter using the ▲ and ▼ buttons.
	Press the **OK** button. The value of the selected parameter can be changed.
	Use the ▲ and ▼ buttons to change the parameter's value.
	Press the **OK** button to confirm the parameter value change. As soon as the parameter is displayed, the value will have been saved. Press the **OK** button and hold it down for two seconds in order to exit the parameter interface (display: "StoP").
	Switching between two parameter groups The parameters are in sequential order. This means that moving forward from the last parameter in a parameter group will take you directly to the first parameter in the next parameter group and the other way around. **Note:** To access the extended parameter groups, you will need to enter the corresponding password in parameter P1-14 (default setting: level 2 = 101).
	Press the ▲ and **STOP** buttons to jump to the first parameter in the next parameter group.
	Press the ▼ and **STOP** buttons to jump to the first parameter in the previous parameter group.

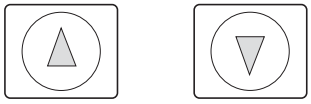
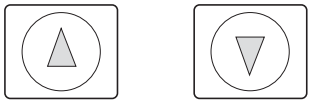
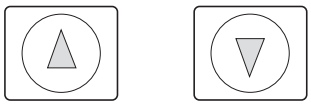
9.1.2 Resetting Parameters (RESET)

Table 25: Resetting parameters (RESET)

Command	Description
Reset to default settings	
	Press the ▲ and ▼ and STOP buttons and hold them down for two seconds. **-> All parameters will be restored to their default settings.** The display will show P - dEF.
Resetting after a fault	
	Press the **STOP** button to reset a fault message. The display will show StoP.

9.2 Extended parameter set

Table 26: Enabling and disabling access to the extended parameter set

Commands	Description
Enabling access to the extended parameter set	
	Press the **OK** button and hold it down for two seconds in order to access the parameter interface. -> The display will show the parameter that was last used.
	Use the ▲ and ▼ buttons to select parameter P1-14.
	Press the **OK** button.
	Use ▲ or▼- to select the password set with parameter P2-40 (Level 2, default setting 101).
	Press the **OK** button to confirm. -> The extended parameter set will now be available.
Disabling access to the extended parameter set	
	Use the ▲ and ▼ buttons to set a value for P1-14 that does not match the password (P2-32).
	Press the **OK** button to confirm. -> Only the "basic parameters," i. e., the parameters in the first parameter group (P1-01 to P1-14), will be accessible now.

For more information and technical data on the DX-KEY-LED2 and DX-KEY-OLED control units, please refer to instructional leaflet IL04012020Z.

10 Parameter list

10.1 Parameter groups

The functions of the Rapid Link Modules are configured using parameters that are divided into 8 groups (P0 to P7):

Table 27: Parameter groups

Parameter group	Subject	RAMO	RASP
P0	Monitor	✓	✓
P1	Basic	✓	✓
P2	Advanced functions	✓	✓
P3	Mechanical brake and digital inputs	✓	✓
P4	Brake chopper and DC brake	–	✓
P5	Communications	✓	✓
P6	Advanced motor control	✓	✓
P7	Motor	–	✓

→ On the following page (“Menu structure”) the change between the parameter groups is graphically sketched.

Default setting

By default (= unit as supplied), only parameter group 1 (“Basic”) will be accessible.

Extended parameter set

Level 2 (menu P0 to menu P7) can be accessed by entering a password in parameter P1 14.

The default passwords are:

- Access to level 2: 101

Users can change this password as required:

- Password for level 2: With parameter P2-32

10.2 Menu structure

The following tables use a number of acronyms. These acronyms are defined below:

Abbreviation	Meaning
DS	Default setting (the parameter's value when using the device's factory settings)

→ None of the parameters in parameter group 0 can be modified by the user, i.e., they are read-only parameters.

10.3 Parameter groups for RAMO

10.3.1 "Monitor" parameter group 0

Parameter	Designation	Description	Unit
P0-02	Thermistor Input1	Thermistor Status 0: Motor temperature ok 1: Motor temperature too high	%
P0-03	DI Status	Status of the Sensor Inputs and ASI Pin 4	
P0-05	T-Controlboard	Internal ambient temperature of the device, measured on the control board	%
P0-06	Overload	Calculated overload in % above the currentlevel set with P1-08. If the value rises to 100 %, the device will trip with error message *I.t-trP*.	Hz/rpm
P0-07	Output Frequency	Instantaneous output frequency	A
P0-09	Motor Current	Instantaneous output current	kW
P0-10	Motor Power Rel	Motor Power (actual value) in kW/HP	
P0-13	Trip Log	Display of the 4 latest faults	V
P0-17	HOA Status	Key switch status 1 hand 2: auto	MWh
P0-18	FWD/REV Status	Selector switch status FWD / REV 1: FWD 2: REV	
P0-19	DO 1 to 3 Status	Status of the actuators	
P0-20	DC-Link Voltage	Instantaneous DC Link Voltage Display 600 = 600 V	V
P0-22	TimeToNextService	Time remaining to next service The service interval is set with P2-28.	Hours
P0-24	t-Run PCB in OT	Time elapsed, in which the drive has operated with a high temperature at the PCBs (ambient temperature). Displays the time in hours and minutes above 80 °C. The value is used for various internal protective functions.	hh:mm:ss

Parameter	Designation	Description	Unit
P0-26	kWh Meter	Energy Consumption kWh Meter (not resettable) Displays the energy consumption in kWh. When the value reaches 1000, it is reset back to 0 and the number of MWh in P0-27 is increased by 1. The value cannot be reset and shows together with P0-27 the energy consumption since the day of manufacture.	kWh
P0-27	MWh Meter	Energy Consumption MWh Meter (not resettable) Displays the energy consumption in MWh. The value cannot be reset and shows together with P0-26 the energy consumption since the day of manufacture.	MWh
P0-28	Application Version	Application Version Level 1: Application version + Check sum Level 2: System version + Check sum	
P0-28	System Version	System Version	
P0-29	n/a	Device Information	
P0-29	NoOfInputPhases	Number of input phases	
P0-29	FrameSize	Frame Size	
P0-29	kW/HP	Motor Power	
P0-29	Power@Ue	Device Power at Device Voltage Rating	
P0-29	Device Voltage	Device Voltage Rating	
P0-29	DeviceType	Device Type	
P0-30	Serial Number	Serial Number of the device (don't use for new devices)	
P0-31	t-Run	Total operating time of the drive since the date of manufacture Displayed in hours, minutes and seconds. Pressing the UP key on the drive keypad will change the display from "hours" to "minutes and seconds".	hh:mm:ss
P0-32	t-Run since Restart	Run time since power on or last Reset Total operating time of the drive since the last trip occured or power down in hours, minutes and seconds. Pressing the UP key on the drive keypad will change the display from "hours" to "minutes and seconds".	hh:mm:ss
P0-33	t-Run since Trip	Total operating time of the drive since the last trip occurred Displayed in hours, minutes and seconds. Pressing the UP key on the drive keypad will change the display from "hours" to "minutes and seconds".	hh:mm:ss
P0-34	t-HoursRun Enable	Total operating time of the drive since the last drive ENABLE signal was applied. Displayed in hours, minutes and seconds. Pressing the UP key on the drive keypad will change the display from "hours" to "minutes and seconds".	hh:mm:ss
P0-36	DC-Link Log	DC link voltage log Displays the most recent 8 samples of the DC bus voltage prior to a drive trip condition occurring. The sample interval is 256 ms.	V
P0-37	DC-Link V-Ripple Log	DC bus Voltage Ripple Log Displays the most recent 8 samples of the ripple of the DC bus voltage prior to a drive trip condition occurring. The sample interval is 20 ms.	

Parameter	Designation	Description	Unit
P0-39	AmbientTemp Log	Internal Ambient Temperature Log Displays the most recent 8 samples of the internal ambient temperature prior to a drive trip condition occurring. The sample interval is 30 s.	°C
P0-40	MotorCurrent Log	Motor current log Displays the most recent 8 samples of the Motor current prior to a drive trip condition occurring. The sample interval is 256 ms.	A
P0-42	FaultCounter DC-Overvoltage	Counts, how often "DC-Overvoltage" occured	
P0-43	FaultCounter DC-Undervoltage	Counts, how often "DC-Undervoltage" occured	
P0-46	FaultCounter Overtemperature Ambient	Counts, how often "Overtemperature Ambient" occured	
P0-47	FaultCounter Internal Fault (IO)	Counts, how often "Internal Fault (IO)" occured	
P0-48	FaultCounter Internal Fault (DSP)	Counts, how often "Internal Fault (DSP)" occured	
P0-49	FaultCounter Local COM Loss	Counts, how often "Local COM Loss" occured	
P0-50	FaultCounter Communication Loss	Counts, how often "Communication Loss" occured	
P0-51	Input Data1 Value	Input Data Value Process Input Data (PDI, received from the fieldbus). There are 4 entries for this parameter (PDI1, …, PDI4).	
P0-52	Ouput Data Value	Output Data Value Process Output Data (PDO, received from the fieldbus). There are 4 entries for this parameter (PDO1, …, PDO4).	
P0-53	Phase U Current Offset Ref	Phase U, current ofset and reference (value for diagnosis in case of problems)	
P0-54	Phase V Current Offset Ref	Phase V, current ofset and reference (value for diagnosis in case of problems)	
P0-55	Phase W Current Offset Ref	Phase W, current ofset and reference (value for diagnosis in case of problems)	
P0-56	t-PowerOn	Total time for which the drive was powered up since the day of manufacture. Displayed in hours, minutes and seconds. Pressing the UP key on the drive keypad will change the display from "hours" to "minutes and seconds".	hh:mm:ss
P0-58	UserProgramID	ID of a program generated by the Function Block Editor. This ID can be set by the user when developing the program.	
P0-59	Value@Pointer	Pointer on an internal parameter Displays the value selected with P5-09.	
P0-60	reserved	–	
P0-61	reserved	–	

10.3.2 Parameter group 1 (“Basic”)

Table 28: Parameter group 1 (“Basic”)

Parameter	Designation	Description	Unit	Min	Max	DS
P1-08	Motor Nom Current	Motor rated current. By setting the "Motor Nom Current" in the drive, the motor overload protection is configured to match the motor rating. When the measured motor current exceeds "Motor Nom Current", the decimal points on the display will flash to indicate an overload condition. If this condition persists, the drive will eventually trip, displaying *I.t-trP*, preventing thermal overload of the motor.	Amps	0.3	6.6	6.6
P1-13	DI Config Select	Configuration of digital inputs with a fix set of combinations	–	1	4	1
P1-14	Access Key	Entry of the password to get access to the extended parameter set. The value to be put in is determined by the level to be accessed. Level 2 (Access to parameter groups 0 to 8): P1-14 = P2-32 (Default: 101)	–	0	65535	0

10.3.3 Parameter group 2 ("Extended functions")

Table 29: Parameter group 2 ("Extended functions")

Parameter	Designation	Description	Unit	Min	Max	DS
P2-24	Start Mode	Defines the behaviour of the drive relating to the enable digital input and also configures the automatic restart function. 0: Edge-r : Following power on or reset, the drive will not start if a start signal (FWD/REV) is still present. To start a rising edge is necessary. 1: Auto-0 : Following a power on or reset, the drive will automatically start if digital input 1 is closed. 2, …, 9: Auto-1 to 9 : Following a trip, the drive will make up to 9 attempts to restart at intervals set in P2-26. The drive must be powered down to reset the counter. The number of restart attempts are counted, and if the drive fails to start on the final attempt, the drive will trip, and will require the user to manually reset the fault.	–	0	10	0
P2-26	Auto Reset Delay	AutoResetDelay Determines the time which will elapse between consecutive drive reset attempts when Auto Reset is enabled in P2-24.	s	0.1	60	0.5
P2-27	Action@Thermistorfault Motor	Device reaction after occuring of "Thermistorfault Motor". Possibilities device dependent 0: deactivated 1: activated	–	0	1	1
P2-28	Service Interval Time	Service Interval Time Defines the number of operating hours, after which the service indicator is shown on the display. With P2 -29 = 1 the counter is set to the value defined here. The remaining time until the next service is indicated with P0-22.	h	0	60000	0
P2-29	Reset ServiceIndicator	Reset Service Indicator With P2-29 = 1 the counter for the remaining hours until the next service is set to the value defined in P2-28. Reset of P2-29 to 0 is done automatically.	–	0	1	0
P2-30	Parameter Set	Restores factory parameter settings.	–	0	1	0
P2-32	Access Key Level2	Defines the password which is used to get access to extended parameter set (Level 2). Access via P1-14.	–	0	65535	101
P2-33	Parameter Lock	Determines whether to lock the parameters 0: OFF. All parameters can be accessed and changed 1: ON. Parameter values can be displayed, but cannot be changed. If a remote keypad is connected, parameters cannot be accessed.	–	0	1	0

Parameter	Designation	Description	Unit	Min	Max	DS
P2-34	TCP Enable Service	BACnet MSTP Communication Cyber Security Enable communications interfaces P2-34 is a bitmap parameter where; • 0000b = All services disabled off • xxx1b = reserved • xx1xb = TFTP/FTP server enable • x1xxb = reserved P2-34 will return to disabled state after a timeout period (10 min/600 sec).	–	0	15	0
P2-35	PLC Operation Enable	Enables the use of function blocks, which are created with the function block editor. 0: Function blocks disabled 1: Function blocks enabled				
P2-36	Save Parameters @24V-ext.	List of defined parameters 1: If control voltage is present, the parameters will be saved. After that, the parameter is automatically set to 0.	–	0	1	0

10.3.4 Parameter group 3 ("Mechanical brake and digital inputs")

Table 30: Parameter group 3 ("Digital inputs/outputs")

Parameter	Designation	Description	Unit	Min	Max	DS
P3-04	Brake M-Level Release	Determines the time before the mechanical brake is released.	s	0	2.50	0
P3-05	Brake Release Delay	Determines the time between the signal to close the brake and disabling of the drive.	s	0	25.00	0
P3-06	DI1 Logic	0 = normally open 1 = normally closed **Note:** Change only after POWER ON/OFF active	–	0	1	0
P3-07	DI2 Logic	0 = normally open 1 = normally closed **Note:** Change only after POWER ON/OFF active	–	0	1	0
P3-08	DI3 Logic	0 = normally open 1 = normally closed **Note:** Change only after POWER ON/OFF active				
P3-09	DI4 Logic	0 = normally open 1 = normally closed **Note:** Change only after POWER ON/OFF active				
P3-10	DI5 Logic	0 = normally open 1 = normally closed **Note:** Change only after POWER ON/OFF active				
P3-11	t-dec Select B0	Selection deceleration ramp bit 0 External stop function 0: deactivated 1: activated				

10.3.5 Parameter group 5 ("Communication")

Table 31: Parameter group 5 ("Communication")

Parameter	Designation	Description	Unit	Min	Max	DS
P5-01	RS485-0 Address	Unique address of the drive (keypad, OP bus)	–	1	63	1
P5-02	COM Loss Timeout	With an active communication link, if a valid telegram is not received by the drive within the period set with this parameter, the drive will react as set in P5-03.	s	0	5.0	2
P5-03	Action@Communication Loss	Device reaction after occuring of "Communication Loss". Possibilities device dependent 0: Trip 1: Ramp to stop, then trip 2: Ramp to stop only (no trip) 3: Run at preset speed 2 (P2-01)	–	0	2	0
P5-05	NETSendPZD3	Configuration of the 3rd process data word PDO-3 from the drive to the network master during cyclic communication. 0: Motor current in A with one decimal place, e.g. 100 ≙ 10.0 A 1: Output power in kW with 2 decimal places, e.g. 400 ≙ 4.00 kW 2: Status of the digital inputs (DI). Bit 0 = Status DI1, Bit 1 = Status DI2 …) 3: Heatsink temperature. 0 - 100 ≙ 0 - 100 °C 4: User register 1. Configuration with Function Block Editor 5: User register 2. Configuration with Function Block Editor 6: P0-59 value (Selection via P5-09)	–	0	6	0
P5-06	NETSendPZD4	Configuration of the 4th process data word PDO-4 from the drive to the network master during cyclic communication. 0: Motor current in A with one decimal place, e.g. 100 ≙ 10.0 A 1: Output power in kW with 2 decimal places, e.g. 400 ≙ 4.00 kW 2: Status of the digital inputs (DI). Bit 0 = Status DI1, Bit 1 = Status DI2 …) 3: Heatsink temperature. 0 - 100 ≙ 0 - 100 °C 4: User register 1. Configuration with Function Block Editor 5: User register 2. Configuration with Function Block Editor 6: P0-59 value (Selection via P5-09)	–	0	6	1
P5-07	NETReceivePZD3	Configuration of the 3rd process data word PDI-3 from the network master to the drive during cyclic communication. 0: reserved 1: User defined ramp times with 2 decimal places 2: User register 3. Configuration with Function Block Editor. 3: User register 4. Configuration with Function Block Editor.	–	0	3	0
P5-08	NETReceivePZD4	Configuration of the 4th process data word PDI-4 from the network master to the drive during cyclic communication. 0: reserved 1: User defined ramp times with 2 decimal places 2: User register 3. Configuration with Function Block Editor. 3: User register 4. Configuration with Function Block Editor.	–	0	3	0

Parameter	Designation	Description	Unit	Min	Max	DS
P5-09	PointerToParameter	Pointer to an internal variable P5-09 defines the internal variable (or the parameter), whose value is displayed with P0-59. In addition the value can be transferred to a fieldbus master via Process Data Word 3 (PZD3, to be set with P5-05) or 4 (PZD4, to be set with P5-06). P5-09 is monstly used in conjunction with the Function Block Editor.	–	0	200	0
P5-10	Disable QuickStop	0: Quick stop via sensors deactivated 1: Quick stop via sensors activated; DQ3 signal active	–	0	1	0

10.3.6 Parameter group 6 ("Extended motor control")

Table 32: Parameter group 6 ("Extended motor control")

Parameter	Designation	Description	Unit	Min	Max	DS
P6-05	Action@Underload Motor	Device reaction after occuring of "Underload Motor". Possibilities device dependent 0 = deactivated 1 = Warning 2 = Trip (stop)	–	0	1	0
P6-08	Change Phasesequence Motor	Changes the sequence of the output phases. This prevents, that two phases of the motor cable have to be changed in case the motor runs in the wrong direction. 0 = U, V, W (cw) 1 = U, W, V (ccw) **Note:** Only with RASP5… and RAMO5-W…	–	0	1	0

10.3.7 Parameter P1-13

Table 33: Signal detection for RAMO5-D… direct starter

	Manual mode		Auto mode	
P1-13	SI1	SI2	SI1	SI2
0	–	–	–	–
1	No function	No function	No function	No function
2	Stop for edge control	Stop for edge control	Stop for edge control	Stop for edge control
3	No function	No function	Stop for edge control	No function
4	Stop for edge or signal control	No function	Stop for edge control	No function

Table 34: Signal detection for RAMO5-W… reversing starters

	Manual mode		Auto mode	
P1-13	SI1	SI2	SI1	SI2
0	–	–	–	–
1	No function	No function	No function	No function
2	No function	No function	Stop for edge control	No function
3	No function	No function	Stop in FWD mode with edge control	Stop in REV mode with edge control
4	Stop in FWD mode for edge or signal control	Stop in REV mode for edge or signal control	Stop in FWD mode for edge or signal control	Stop in REV mode for edge or signal control

10.4 Parameter groups for RASP

10.4.1 "Monitor" parameter group 0

Parameter	Designation	Description	Unit
P0-02	Thermistor Input1	Thermistor Status 0: Motor temperature ok 1: Motor temperature too high	
P0-03	DI Status	Status of the Sensor Inputs and ASI Pin 4	
P0-04	f-PreRamp	Speed reference in front of the ramp	Hz/rpm
P0-05	T-Controlboard	Internal ambient temperature of the device, measured on the control board	°C
P0-06	Overload	Calculated overload in % above the currentlevel set with P1-08. If the value rises to 100 %, the device will trip with error message *I.t-trP*.	%
P0-07	Output Frequency	Instantaneous output frequency	Hz/rpm
P0-08	Motor Speed	Motorspeed (calculated or measured)	Hz/rpm
P0-09	Motor Current	Instantaneous output current	A
P0-10	Motor Power Rel	Motor Power (actual value) in kW/HP	kW
P0-11	Motor Voltage	Instantaneous output voltage	V
P0-12	Motor Torque	Motor-Torque Display 1000 ≙ 100 %	%
P0-13	Trip Log	Display of the 4 latest faults	
P0-14	Magnetizing current Id	Calculated Magnetizing Current (I_d), providing an autotune has successfully been completed.	A
P0-15	Torque current Iq	Calculated Torque producing Current (I_q), providing an autotune has successfully been completed.	A
P0-16	DC-Link Voltage Ripple	DC-Link Voltage Ripple	V
P0-17	HOA Status	Key switch status 1 hand 2: auto	
P0-18	FWD/REV Status	Selector switch status FWD / REV 1: FWD 2: REV	
P0-19	DO 1 to 3 Status	Status of the actuators	
P0-20	DC-Link Voltage	Instantaneous DC Link Voltage Display 600 = 600 V	V
P0-21	Heatsink Temperature	Instantaneous Heatsink Temperature Display 40 = 40 °C	°C
P0-22	TimeToNextService	Time remaining to next service The service interval is set with P2-28.	Hours
P0-23	t-Run IGBT in OT	Time elapsed, in which the drive has operated with a high heat-sink temperature Displays the time in hours and minutes above 85 °C. The value is used for various internal protective functions.	hh:mm:ss

Parameter	Designation	Description	Unit
P0-24	t-Run PCB in OT	Time elapsed, in which the drive has operated with a high temperature at the PCBs (ambient temperature) Displays the time in hours and minutes above 80 °C. The value is used for various internal protective functions.	hh:mm:ss
P0-25	f-PostRamp	Speed reference after the ramp	Hz/rpm
P0-26	kWh Meter	Energy Consumption kWh Meter (not resettable) Displays the energy consumption in kWh. When the value reaches 1000, it is reset back to 0 and the number of MWh in P0-27 is increased by 1. The value cannot be reset and shows together with P0-27 the energy consumption since the day of manufacture.	kWh
P0-27	MWh Meter	Energy Consumption MWh Meter (not resettable) Displays the energy consumption in MWh. The value cannot be reset and shows together with P0-26 the energy consumption since the day of manufacture.	MWh
P0-28	Application Version	Application Version Level 1: Application version + Check sum Level 2: System version + Check sum	
P0-28	System Version	System Version	
P0-29	n/a	Device Information	–
P0-29	NoOfInputPhases	Number of input phases	
	FrameSize	Frame Size	
	kW/HP	Motor Power	
	Power@Ue	Device Power at Device Voltage Rating	
	Device Voltage	Device Voltage Rating	
	DeviceType	Device Type	
P0-30	Serial Number	Serial Number of the device (don't use for new devices)	–
P0-31	t-Run	Total operating time of the drive since the date of manufacture Displayed in hours, minutes and seconds. Pressing the UP key on the drive keypad will change the display from "hours" to "minutes and seconds".	hh:mm:ss
P0-32	t-Run since Restart	Run time since power on or last Reset Total operating time of the drive since the last trip occured or power down in hours, minutes and seconds. Pressing the UP key on the drive keypad will change the display from "hours" to "minutes and seconds".	hh:mm:ss
P0-33	t-Run since Trip	Total operating time of the drive since the last trip occurred Displayed in hours, minutes and seconds. Pressing the UP key on the drive keypad will change the display from "hours" to "minutes and seconds".	hh:mm:ss
P0-34	t-HoursRun Enable	Total operating time of the drive since the last drive ENABLE signal was applied. Displayed in hours, minutes and seconds. Pressing the UP key on the drive keypad will change the display from "hours" to "minutes and seconds".	hh:mm:ss
P0-35	Fan Runtime	Run time of the integrated fan (not resettable) Displayed in hours. ("F" is displayed at the beginning of the line)	hh:mm:ss
P0-36	DC-Link Log	DC link voltage log Displays the most recent 8 samples of the DC bus voltage prior to a drive trip condition occurring. The sample interval is 256 ms.	V

Parameter	Designation	Description	Unit
P0-37	DC-Link V-Ripple Log	DC bus Voltage Ripple Log Displays the most recent 8 samples of the ripple of the DC bus voltage prior to a drive trip condition occurring. The sample interval is 20 ms.	V
P0-38	Heatsink Log	Heatsink temperature log Displays the most recent 8 samples of the heat sink temperature prior to a drive trip condition occurring. The sample interval is 30 s.	°C
P0-39	AmbientTemp Log	Internal Ambient Temperature Log Displays the most recent 8 samples of the internal ambient temperature prior to a drive trip condition occurring. The sample interval is 30 s.	°C
P0-40	MotorCurrent Log	Motor current log Displays the most recent 8 samples of the Motor current prior to a drive trip condition occurring. The sample interval is 256 ms.	A
P0-41	FaultCounter Overcurrent	Counts, how often “Overcurrent” occured	
P0-42	FaultCounter DC-Overvoltage	Counts, how often “DC-Overvoltage” occured	
P0-43	FaultCounter DC-Undervoltage	Counts, how often “DC-Undervoltage” occured	
P0-44	FaultCounter Overtemperature Heatsink	Counts, how often “Overtemperature Heatsink” occured	
P0-45	FaultCounter Overcurrent Brake Chopper	Counts, how often “Overcurrent Brake Chopper” occured	
P0-46	FaultCounter Overtemperature Ambient	Counts, how often “Overtemperature Ambient” occured	
P0-47	FaultCounter Internal Fault (IO)	Counts, how often “Internal Fault (IO)” occured	
P0-48	FaultCounter Internal Fault (DSP)	Counts, how often “Internal Fault (DSP)” occured	
P0-49	FaultCounter Local COM Loss	Counts, how often “Local COM Loss” occured	
P0-50	FaultCounter Communication Loss	Counts, how often “Communication Loss” occured	
P0-51	Input Data1 Value	Input Data Value Process Input Data (PDI, received from the fieldbus). There are 4 entries for this parameter (PDI1, …, PDI4).	
P0-52	Ouput Data Value	Output Data Value Process Output Data (PDO, received from the fieldbus). There are 4 entries for this parameter (PDO1, …, PDO4).	
P0-53	Phase U Current Offset Ref	Phase U, current ofset and reference (value for diagnosis in case of problems)	
P0-54	Phase V Current Offset Ref	Phase V, current ofset and reference (value for diagnosis in case of problems)	
P0-55	Phase W Current Offset Ref	Phase W, current ofset and reference (value for diagnosis in case of problems)	
P0-56	t-PowerOn	Total time for which the drive was powered up since the day of manufacture. Displayed in hours, minutes and seconds. Pressing the UP key on the drive keypad will change the display from “hours” to “minutes and seconds”.	hh:mm:ss
P0-57	V d-Axis	Motor parameters for PM control U_d and U_q of the stator voltage. 1st value = Ud (“d” at the beginning of the line) Pressing the UP key on the drive keypad the display will change to Uq (“q” at the beginning of the line).	V

Parameter	Designation	Description	Unit
P0-57	V q-Axis	Motor parameters for PM control U_d and U_q of the stator voltage. 1st value = U_d ("d" at the beginning of the line) Pressing the UP key on the drive keypad the display will change to U_q ("q" at the beginning of the line).	
P0-58	UserProgramID	ID of a program generated by the Function Block Editor. This ID can be set by the user when developing the program.	
P0-59	Value@Pointer	Pointer on an internal parameter Displays the value selected with P5-09.	
P0-60	reserved		
P0-61	reserved		s
P0-62	t-accNET	Ramp time received via fieldbus interface.	Hz/rpm
P0-63	f-Ref Interface0	Speed reference received via fieldbus interface	kHz
P0-64	Actual Switching Frequency	Actual switching frequency. The value may be less than the one set with P2-22. See also P2-23	–
P0-65	System Software Version	System Software Version	

10.4.2 Parameter group 1 ("Basic")

Table 35: Parameter group 1 ("Basic")

Parameter	Designation	Description	Unit	Min	Max	DS
P1-01	f-max	Sets the upper limit for the speed of the motor. This can be set to any value between "f-min" and 5x the "motor nom frequency" (P1-09). "Motor Nom Speed" (P1-10) = 0, the maximum speed limit will be displayed in Hz. "Motor Nom Speed" (P1-10) > 0, the maximum speed limit will be displayed in rpm.	Hz/rpm	P1-02	500	50 (60) Hz
P1-02	f-min	Sets the lower limit for the speed of the motor This can be set to any value between 0 and "f-max" (P1-01) "Motor Nom Speed" (P1-10) = 0, the minimum speed limit will be displayed in Hz. "Motor Nom Speed" (P1-10) > 0, the minimum speed limit will be displayed in rpm.	Hz/rpm	0	P1-01	0
P1-03	t-acc	Sets the acceleration ramp time in seconds. The time interval set in "t-acc" represents the time taken to accelerate from zero to "Motor Nom Frequency" (P1-09).	s	0.1	3000	5.0
P1-04	t-dec	Sets the deceleration ramp time in seconds. The time interval set in "t-dec" represents the time taken to decelerate from "Motor Nom Frequency" (P1-09) to zero.	s	0.1	3000	2.0
P1-05	Stop Mode	Determines the action taken by the drive in the event of the drive enable signal being removed. Possible values: 0: Coast to stop. When the enable signal is removed, the drive output is immediately disabled, and the motor will coast (freewheel) to stop. 1: Ramp to stop. When the enable signal is removed, the drive will ramp to stop, with the ramp time set by "t-dec" (P1-04). 2: AC flux braking. When stopping the drive, AC flux braking is used to reduce the stopping time. In this mode is a brake chopper always locked, too during normal operation. **Note:** A brake chopper is activated via P4-05.	–	0	2	1
P1-06	n/a					
P1-07	Motor Nom Voltage	Defines the Motor rated voltage. If P1-07 = 0 the DC bus voltage compensation is disabled (in V/f mode only) and the output voltage will be equal to the incoming supply voltage when operating at "Motor Nom Frequency" (P1-09).	Volts	0	500	400
P1-08	Motor Nom Current	Motor rated current. By setting the "Motor Nom Current" in the drive, the motor overload protection is configured to match the motor rating. When the measured motor current exceeds "Motor Nom Current", the decimal points on the display will flash to indicate an overload condition. If this condition persists, the drive will eventually trip, displaying *I.t-trP*, preventing thermal overload of the motor.	Amps	Rating Dep	Rating Dep	Rating Dep

Parameter	Designation	Description	Unit	Min	Max	DS
P1-09	Motor Nom Frequency	The rated frequency of the motor. This is the frequency at which "Motor Nom Voltage" is applied to the motor. Below this frequency, the applied motor voltage will be reduced. Above this frequency the voltage remains limited to "Motor Nom Voltage".	Hz	10	500	50 (60)
P1-10	Motor Nom Speed	Motor rated speed P1-10 = 0: the speed of the motor will be displayed in Hz. P1-10 > 0: the speed related parameters (f-max, f-min etc.) will be displayed in rpm. The slip compensation is also activated, where the shaft speed of the motor is maintained under varying load conditions by compensating for the load-dependent slip of the motor. If "Motor Nom Speed" = motor synchronous speed (e.g. 3000 rpm for a 2-pole 50 Hz motor), the speed can be displayed in rpm without activating the slip compensation.	rpm	0	30000	0
P1-11	V-Boost	Voltage is used to increase the applied motor voltage at low output frequency, in order to improve low speed and starting torque. Excessive voltage boost levels may result in increased motor current and temperature, and forced ventilation may be required. An automatic setting (Auto) is also possible, whereby the drive will automatically adjust this parameter based on the motor parameters measured during an Autotune.	%	0	40	0
P1-12	f-Fix1	Preset Fixed Frequency 1 Value can be adjusted between f-min and f-max. Selection via a digital control signal.	Hz	P1-02	P1-01	10.0Hz
P1-13	DI Config Select	Configuration of digital inputs with a fix set of combinations		0	12	1
P1-14	Access Key	Entry of the password to get access to the extended parameter set. The value to be put in is determined by the level to be accessed. Level 2 (Access to parameter groups 0 to 8): P1-14 = P2-32 (Default: 101)	–	0	65535	0

10.4.3 Parameter group 2 ("Extended functions")

Table 36: Parameter group 2 ("Extended functions")

Parameter	Designation	Description	Unit	Min	Max	DS
P2-01	f-Fix2	Preset Fixed Frequency 2 Value can be adjusted between f-min and f-max. Selection via a digital control signal.	Hz/rpm	P1-02	P1-01	30 Hz
P2-02	f-Fix3	Preset Fixed Frequency 3 Value can be adjusted between f-min and f-max. Selection via a digital control signal.	Hz/rpm	P1-02	P1-01	40 Hz
P2-03	f-Fix4	Preset Fixed Frequency 4 Value can be adjusted between f-min and f-max. Selection via a digital control signal.	Hz/rpm	P1-02	P1-01	50 Hz
P2-04	f-Fix5	Preset Fixed Frequency 5 Value can be adjusted between f-min and f-max. Selection via a digital control signal.	Hz/rpm	P1-02	P1-01	10 Hz
P2-05	f-Fix6	Preset Fixed Frequency 6 Value can be adjusted between f-min and f-max. Selection via a digital control signal.	Hz/rpm	P1-02	P1-01	15 Hz
P2-06	f-Fix7	Preset Fixed Frequency 7 Value can be adjusted between f-min and f-max. Selection via a digital control signal.	Hz/rpm	P1-02	P1-01	20 Hz
P2-07	f-Fix8	Preset Fixed Frequency 8 Value can be adjusted between f-min and f-max. Selection via a digital control signal.	Hz/rpm	P1-02	P1-01	25 Hz
P2-08	t-SRamp1	Curve shape, temporal S-shape Linear acceleration and deceleration time according to P1-03 and P1-04. Timed slured Transition to Start and End of Acceleration (P1-03) and Deceleration Ramps (P1-04). The time set here applies to both ramps. 0.0 = linear.	s	0	10	0
P2-09	Overvoltage Control	The over voltage control prevents the drive from tripping in case of regenerative energy feedback from the motor to the DC link. When disabled, the drive will trip "Over Voltage" instead of automatically increasing the motor ramp times.	-	0	1	1
P2-10	REV Enable	Activates or deactivates reverse rotation of the motor 0: REV activated - motor is running forward and revers 1: REV deactivated - motor is only forward	-	0	1	0
P2-11	t-acc2	Sets the acceleration ramp time 2 in seconds.	s	0	3000	5.0
P2-12	n-accMulti1	Frequency / speed, at which the acceleration ramp changes from t-acc1 to t-acc2. This can be set to any value between 0 and "f-max" (P1-01) "Motor Nom Speed" (P1-10) = 0, displayed in Hz. "Motor Nom Speed" (P1-10) > 0, displayed in rpm. Frequency/Speed > P2-12 = t-acc2 Frequency/Speed < P2-12 = t-acc1	Hz/rpm	0	P1-01	0
P2-13	t-dec2	Sets the deceleration ramp time 2 in seconds. Activation via pin 4 at AS-i.	s	0	3000	5.0

Parameter	Designation	Description	Unit	Min	Max	DS
P2-14	n-decMulti1	Frequency / speed, at which the deceleration ramp changes from t-dec2 to t-dec1. This can be set to any value between 0 and "f-max" (P1-01) "Motor Nom Speed" (P1-10) = 0, displayed in Hz. "Motor Nom Speed" (P1-10) > 0, displayed in rpm. Frequency/Speed > P2-14 = t-dec2 Frequency/Speed < P2-14 = t-dec1	Hz/rpm	0	P1-01	0
P2-15	f-Skip1	Centre point of the frequency band defined by f-Skip-Band1 in which the drive doesn't work in steady-state.	Hz/rpm	0	P1-01	0
P2-16	f-SkipBand1	Skip frequency band width Defines the frequency range around f-Skip1 in which the drive doesn't work in steady-state to avoid mechanical resonances in the application. Lower limit: = P2-15 - P2-16/2 Upper limit = P2-15 + P2-16/2 The definition applies for both senses of rotation.	Hz/rpm	0	P1-01	0
P2-17	f-Skip2	Centre point of the frequency band defined by f-Skip-Band2 in which the drive doesn't work in steady-state.	Hz/rpm	0	P1-01	0
P2-18	f-SkipBand2	Skip frequency band width Defines the frequency range around f-Skip2 in which the drive doesn't work in steady-state to avoid mechanical resonances in the application. Lower limit: = P2-17 - P2-18/2 Upper limit = P2-17 + P2-18/2 The definition applies for both senses of rotation.	Hz/rpm	0	P1-01	0
P2-19	V/f-Characteristic	V/f characteristic 0: linear characteristic 1: square characteristic 2: parameterizable via P2-20 and P2-21	–	0	2	0
P2-20	f-MidV/f	Frequency to shape V/f curve When operating in V/f mode (P6-01 = 6) this parameter is used in conjunction with P2-21 and sets a frequency point at which the voltage set in P2-21 is applied to the motor. Care must be taken to avoid overheating and damaging the motor when using this function	%	0	100%	0
P2-21	V-MidV/f	Voltage to shape V/f curve Used in conjunction with P2-20.	%	0	100%	0
P2-22	Switching Frequency	Power stage switching frequency. Higher frequency reduces the audible 'ringing' noise from the motor, and improves the output current waveform, at the expense of increased heat losses within the drive. 0: 4 kHz 1: 8 kHz 2: 12 kHz 3: 16 kHz 4: 24 kHz 5: 32 kHz **Attention:** In case a sine wave filter is used, the switching frequency has to be in the range which is permissible for the filter. In this case P2-22 has to be set to twice the switching frequency mentioned on the filter. Example: Sine wave filter for 4 kHz --> Setting of P2-22: 8 kHz!	kHz	0	Mod Dep	1

Parameter	Designation	Description	Unit	Min	Max	DS
P2-23	Auto Thermal Management	AutoThermalManagement In case of too high temperature at the heatsink, the drive reduces the switching frequency set with P2-22 to reduce the likelihood of an overtemperature trip.	–	0	1	0
P2-24	Start Mode	Defines the behaviour of the drive relating to the enable digital input and also configures the automatic restart function. 0: Edge-r : Following power on or reset, the drive will not start if a start signal (FWD/REV) is still present. To start a rising edge is necessary. 1: Auto-0 : Following a power on or reset, the drive will automatically start if digital input 1 is closed. 2, …, 9: Auto-1 to 9 : Following a trip, the drive will make up to 9 attempts to restart at intervals set in P2-26. The drive must be powered down to reset the counter. The number of restart attempts are counted, and if the drive fails to start on the final attempt, the drive will trip, and will require the user to manually reset the fault.	–	0	10	0
P2-25	REAF Start Function	Start function after an automatic restart 0 = acceleration time (ramp) 1 = Spin Start 2 = according to P2-37	–	0	2	0
P2-26	Auto Reset Delay	AutoResetDelay Determines the time which will elapse between consecutive drive reset attempts when Auto Reset is enabled in P2-24.	s	0.1	60	0.5
P2-27	Action@Thermistorfault Motor	Device reaction after occuring of "Thermistorfault Motor". Possibilities device dependent 0: deactivated 1: activated	–	0	1	1
P2-28	Service Interval Time	Service Interval Time Defines the number of operating hours, after which the service indicator is shown on the display. With P2 -29 = 1 the counter is set to the value defined here. The remaining time until the next service is indicated with P0-22.	h	0	60000	0
P2-29	Reset ServiceIndicator	Reset Service Indicator With P2-29 = 1 the counter for the remaining hours until the next service is set to the value defined in P2-28. Reset of P2-29 to 0 is done automatically.	–	0	1	0
P2-30	Parameter Set	Restores factory parameter settings.	–	0	1	0
P2-31	Default Selection	Factory setting, country-specific 0 = EU (Europe, 50 Hz networks) 1 = USA (North America, 60 Hz networks)	–	0	1	0
P2-32	Access Key Level2	Defines the password which is used to get access to extended parameter set (Level 2). Access via P1-14.	–	0	65535	101
P2-33	Parameter Lock	Determines whether to lock the parameters 0: OFF. All parameters can be accessed and changed 1: ON. Parameter values can be displayed, but cannot be changed. If a remote keypad is connected, parameters cannot be accessed (except P1-14 and P2-33).	–	0	1	0

Parameter	Designation	Description	Unit	Min	Max	DS
P2-34	TCP Enable Service	BACnet MSTP Communication Cyber Security Enable communications interfaces P2-34 is a bitmap parameter where; • 0000b = All services disabled off • xxx1b = reserved • xx1xb = TFTP/FTP server enable • x1xxb = reserved P2-34 will return to disabled state after a timeout period (10 min/600 sec).	–	0	15	0
P2-35	PLC Operation Enable	Enables the use of function blocks, which are created with the function block editor. 0: Function blocks disabled 1: Function blocks enabled				
P2-36	Save Parameters @24V-ext.	List of defined parameters 1: If control voltage is present, the parameters will be saved. After that, the parameter is automatically set to 0.	–	0	1	0
P2-37	Spin Start Enable	Spin Start Enable The drive starts from the detected motor speed. A short start delay is possible if the rotor is stationary. Possible values: 0: Spin Start Off 1: Spin Start On	–	0	1	0

10.4.4 Parameter group 3 ("Mechanical brake and digital inputs")

Table 37: Parameter group 3 ("Digital inputs/outputs")

Parameter	Designation	Description	Unit	Min	Max	DS
P3-01	Brake Mode	Control of the mechanical brake 0: simple mode (P3-02, P3-03) 1: extended mode (P3-02 - P3-05)	-	0	1	0
P3-02	Brake f-open	Frequency limit at which the external brake is opened. Condition: RUN (start enable)	Hz/rpm	0	P1-01	1.5
P3-03	Brake f-close	Frequency limit at which the external brake is closed.	Hz/rpm	0	P1-01	1
P3-04	Brake M-Level Release	Required motor torque level at which the mechanical brake may be released. Determines the torque in % of the rated motor torque, which has to be present, before the mechanical brake may be released. It is used to ensure, that the motor is connected and produces sufficient torque to prevent the load dropping on release of the mechanical brake. This function is not active in V/f mode (P6-01 = 6).	A	0	P1-07	0
P3-05	Brake Release Delay	Determines the time before the mechanical brake is released.	s	0	320	0
P3-06	DI1 Logic	0 = normally open 1 = normally closed **Note:** Change only after POWER ON/OFF active	–	0	1	0
P3-07	DI2 Logic	0 = normally open 1 = normally closed **Note:** Change only after POWER ON/OFF active	–	0	1	0
P3-08	DI3 Logic	0 = normally open 1 = normally closed **Note:** Change only after POWER ON/OFF active	–	0	1	0
P3-09	DI4 Logic	0 = normally open 1 = normally closed **Note:** Change only after POWER ON/OFF active	–	0	1	0
P3-10	DI5 Logic	0 = normally open 1 = normally closed **Note:** Change only after POWER ON/OFF active	–	0	1	0
P3-11	t-dec Select B0	Selection deceleration ramp bit 0 External stop function 0: deactivated 1: activated	–	0	1	0

10.4.5 Parameter group 4 ("Brake chopper and DC brake")

Table 38: Parameter group 4 ("Motor braking")

Parameter	Designation	Description	Unit	Min	Max	DS
P4-01	DC-Brake Current	DC braking is active in all control modes (P6-01 = 0, …, 6) and with any stop mode (P1-05 = 0, 1, 2). To enable DC current injection at START set a DC braking current (P4-01) and a DC braking time at start (P4-02). After receiving the start signal the Drive injects a DC current (P4-01) for the time specified at P4-02. After P4-02 times-out, drive resumes normal operation. To enable DC current injection at STOP set a DC braking current (P4-01), a DC braking time (P4-04) and a DC braking frequency (P4-03). When the drive receives the STOP command, it will start to decelerate down to 0. As soon as it reaches the frequency set in P4-03, the drive will start to inject a DC current (P4-01) for the time specified at P4-04. After P4-04 times out, PWM is disabled, drive status changes to STOP. If coast to stop is selected, DC injection is executed just after receiving the stop command.	%	0	100%	0
P4-02	t-DCBrake@Start	Duration of DC braking before Start	s	0	600	0
P4-03	f-DCBrake@Stop	Output frequency in Hz at which DC braking starts during the deceleration phase.	Hz	0	10	1.5
P4-04	t-DCBrake@Stop	Duration of DC braking at Stop	s	0	600	0
P4-05	Brake Chopper Mode	Parameter function only for devices with internal brake resistor 0: deactivated 1: active in RUN 2: active in RUN and STOP	–	0	2	2
P4-06	Brake Resistor	Resistance of the brake resistor in Ohms This value, together with P4-07, is used for the thermal protection of the brake resistor. With internal brake resistor, do not change the value.	ohms	50	500	400
P4-07	P-Brake Resistor	Power of the brake resistor in kW Resolution 0.1 kW. This value, together with P4-06, is used for the thermal protection of the brake resistor. With internal brake resistor, do not change the value.	kW	0	20.00	0.1
P4-08	Brake Chopper ED Heat-Up	Brake Chopper Duty Cycle At very low temperatures (< -10 °C) the drive doesn't work and indicates "Under temperature" (Fault code 09 "U-t"). Devices with internal brake resistor can use this to heat up the device. Parameter P4-08 determines the load cycle.	%	0	20.0	2.0

10.4.6 Parameter group 5 ("Communication")

Table 39: Parameter group 5 ("Communication")

Parameter	Designation	Description	Unit	Min	Max	DS
P5-01	RS485-0 Address	Unique address of the drive (keypad, OP bus)	–	1	63	1
P5-02	COM Loss Timeout	With an active communication link, if a valid telegram is not received by the drive within the period set with this parameter, the drive will react as set in P5-03.	s	0	5.0	2
P5-03	Action@Communication Loss	Device reaction after occuring of "Communication Loss". Possibilities device dependent 0: Trip 1: Ramp to stop, then trip 2: Ramp to stop only (no trip) 3: Run at preset speed 2 (P2-01)	–	0	3	0
P5-04	FieldbusRampControl	Fieldbus Ramp Control 0: OFF. Ramps are controlled from internal drives parameters 1: ON. Ramps are controlled by the fieldbus.	–	0	1	0
P5-05	NETSendPZD3	Configuration of the 3rd process data word PDO-3 from the drive to the network master during cyclic communication. 0: Motor current in A with one decimal place, e.g. 100 ≙ 10.0 A 1: Output power in kW with 2 decimal places, e.g. 400 ≙ 4.00 kW 2: Status of the digital inputs (DI). Bit 0 = Status DI1, Bit 1 = Status DI2 …) 3: Heatsink temperature. 0 - 100 ≙ 0 - 100 °C 4: User register 1. Configuration with Function Block Editor 5: User register 2. Configuration with Function Block Editor 6: P0-59 value (Selection via P5-09)	–	0	6	0
P5-06	NETSendPZD4	Configuration of the 4th process data word PDO-4 from the drive to the network master during cyclic communication. 0: Motor current in A with one decimal place, e.g. 100 ≙ 10.0 A 1: Output power in kW with 2 decimal places, e.g. 400 ≙ 4.00 kW 2: Status of the digital inputs (DI). Bit 0 = Status DI1, Bit 1 = Status DI2 …) 3: Heatsink temperature. 0 - 100 ≙ 0 - 100 °C 4: User register 1. Configuration with Function Block Editor 5: User register 2. Configuration with Function Block Editor 6: P0-59 value (Selection via P5-09)	–	0	6	1
P5-07	NETReceivePZD3	Configuration of the 3rd process data word PDI-3 from the network master to the drive during cyclic communication. 0: reserved 1: User defined ramp times with 2 decimal places 2: User register 3. Configuration with Function Block Editor. 3: User register 4. Configuration with Function Block Editor.	–	0	3	1

Parameter	Designation	Description	Unit	Min	Max	DS
P5-08	NETReceivePZD4	Configuration of the 4th process data word PDI-4 from the network master to the drive during cyclic communication. 0: reserved 1: User defined ramp times with 2 decimal places 2: User register 3. Configuration with Function Block Editor. 3: User register 4. Configuration with Function Block Editor.	–	0	3	0
P5-09	PointerToParameter	Pointer to an internal variable P5-09 defines the internal variable (or the parameter), whose value is displayed with P0-59. In addition the value can be transferred to a fieldbus master via Process Data Word 3 (PZD3, to be set with P5-05) or 4 (PZD4, to be set with P5-06). P5-09 is monstly used in conjunction with the Function Block Editor.	–	0	200	0
P5-10	Disable QuickStop	0: Quick stop via sensors deactivated 1: Quick stop via sensors activated; DQ3 signal active	–	0	1	0

10.4.7 Parameter group 6 ("Extended motor control")

Table 40: Parameter group 6 ("Extended motor control")

Parameter	Designation	Description	Unit	Min	Max	DS
P6-01	Motor Control Mode	Motor Control Mode An autotune must be performed if setting 1 / 2 / 3 / 4 / 5 is used 0: Smart-Vector Speed Control 1: Speed Control with Torque Limit (vector) 2: PM Motor Speed Control 3: LSPM Motor Speed Control 4: SyncRel Motor Speed Control 5: Brushless DC Motor Speed Control 6: Speed Control (enhanced V/f)	–	0	6	0
P6-02	MSC Kp	Proportional gain Kp at Motor Speed Control (P4-01 = 0, 3, 5, 6)	%	0.0	400.0	50.0
P6-03	MSC1 Ti	Integral time Ti at Motor speed Control (P4-01 = 0, 3, 5, 6)	s	0.010	1.000	0,050
P6-04	M-Max Motoring	M-Max Motoring When working in Vector mode (P4-01 = 1) this parameter defines the max. torque limit. In the remaining control modes, this parameter specifies the current limit.	%	0	200%	150%
P6-05	Action@Underload Motor	Device reaction after occuring of "Underload Motor". Possibilities device dependent 0 = deactivated 1 = Warning 2 = Trip (stop)	–	0	1	0
P6-06	M-Min (f-Ref=0) Limit	Minimum torque allowed with zero frequency.	%	10	150	50
P6-07	M-Min (f>f-Vmax) Limit	Minimum torque allowed when the output frequency is above the field weakening point.	%	5	150	10
P6-08	Change Phasesequence Motor	Changes the sequence of the output phases. This prevents, that two phases of the motor cable have to be changed in case the motor runs in the wrong direction. 0 = U, V, W (cw) 1 = U, W, V (ccw) **Note:** Only with RASP5… and RAMO5-W…	–	0	1	0
P6-09	T-Memory Enable	When enabled, the motor thermal memory retention function will save the calculated motor thermal history on drive power down, using this saved value as the starting value on next power up. If this function is disabled, the motor thermal history is reset to zero on every power up. 0: Thermal memory OFF 1: Thermal memory ON	-	0	1	1
P6-10	Action @I-CurrentLimit	0: deactivated - motor overload management switched off 1: activated - speed decrease The output torque is reduced to avoid overload.				
P6-11	EnhancedGeneratorControl	EnhancedGeneratorControl Adaptation of the motor model in vector mode and with PM motors to achieve a better performance of the drive when regenerating. 0: disable 1: enable	-	0	1	0

Parameter	Designation	Description	Unit	Min	Max	DS
P6-12	Overvoltage Currentlimit	Current limitation to prevent over voltage trips This parameter is only active at Speed Control with Torque Limit (P4-01 = 0) and becomes effective in case the DC link voltage exceeds a threshold. This value, set internally, is just below the one for a trip because of over voltage. P6-04 limits the torque producing current at the output, to prevent energy feedback which may lead to an over voltage trip. A small value of P6-12 limits the torque of the motor, when the DC link voltage exceeds the threshoild. A high value can lead to current distorsions and to a rough behavior of the motor.	%	0	100	5
P6-13	LoadInertiaFactor	Ratio of the inertia of a complete system to the one of a motor only (Jtot / Jmot) The default value (10) can mostly be kept. It is used as feed forward, to provide the optimal torque during the acceleration phase. By using the exact value, a better reaction and dynamics of the complete system will be achieved. If the ratio of the inertias is not known, the factory setting should not be changed.		0	600	10
P6-14	t-Excitation-V/f	Magnetizing period in V/f and PM Mode Induction motors (P6-01 = 6): This parameter defines a delay time for the control of the magnetizing current after a Start signal for the drive in V/f mode. Too low values can cause an over current trip, if the acceleration ramp is very short. PM-motors (P6-01 = 2, 3): This value is used to align the rotor flux on enable.	ms	0	5000	Mod Dep
P6-15	Torque Boost	Torque Boost at low speeds Set in % of the motor rated current (P1-08). At lower speeds a current is injected into the motor, to achieve an effective operation. Parameter P6-16 determines, up to which speed P6-15 is effective. Setting of P6-15: • Run the motor at the lowest speed, which is required by the application • Increase value of P6-15, until the reuired torque is present as well as a smooth opreation of the motor. **Note:** This function is not active with Speed Control (V/f, P6-01 = 6).	%	0	100	0
P6-16	f-Torque Boost Limit	Torque Boost Range Determines the frequency in % of P1-09, up to which the torque boost, set with P6-15, is active. Above this frequency the torque boost is not active.	%	0	50	0
P6-17	PM-MotorSignalInLevel	Selection of voltage and duration of the signal to identify the rotor position at PM motors Factory setting is 10. Setting this value too low can cause that the rotor position is not detected, whereas too high values can cause a trip due to over current.	–	0	200	10
P6-18	Overmodulation	Enabling over-modulation increases the maximum available output voltage to the motor, thereby reducing the motor current for a given power. This can reduce thermal losses in the motor and drive, but will result in a less sinusoidal motor current waveform.	–	0	1	0

10.4.8 Parameter group 7 ("Motor")

Table 41: Parameter group 7 ("Motor")

Parameter	Designation	Description	Unit	Min	Max	DS
P7-01	Motor Identification	Motor Identification When set to 1, the drive immediately carries out a non-rotating autotune to measure the motor parameters for optimum control and efficiency. Following completion of the autotune, the parameter automatically returns to 0. **Note:** This function cannot be activated by using the drivesConnect software! When operating with Vector Control (P6-01 = 1) this parameter must be set to the motor nameplate power factor (P7-02) before performing auto tune.	-	0	1	0
P7-02	Motor PF	Power factor cos φ of the motor When operating with Vector Control (P7-02 = 1) this parameter must be set to the motor nameplate power factor.		0.50	1.00	0.85
P7-03	Motor Stator Resistance R1	Stator resistance of the motor For induction and PM motors: phase to phase resistance value [Rs] in Ohms	Ohms	0	655.35	Mod Dep
P7-04	Motor Rotor Resistance R2	Rotor resistance of the motor For induction motors: phase to phase resistance value [Rr] in Ohms	Ohms	0	655.35	Mod Dep
P7-05	Motor Stator Inductance d-Axis	Stator inductance of the motor, torque producing For induction motors: Phase to phase inductance value in Henry [H} For PM-Motors: phase d-axis inductance value [Lsd] in Henry [H]	mH	0	6553.5	Mod Dep
P7-06	Motor Stator Inductance q-Axis	Stator inductance of the motor, magnetizing For PM-Motors: phase d-axis inductance value [Lsd] in Henry [H]	mH	0	6553.5	Mod Dep

10.4.9 Parameter P1-13

Table 42: Signal detection in manual mode

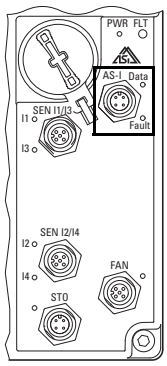
	Manual mode			
P1-13	**SI1**	**SI2**	**SI3**	**SI4**
0	–	–	–	–
1	No function	No function	No function	No function
2	No function	No function	No function	No function
3	No function	No function	No function	No function
4	Stop in FWD mode for edge or signal control	Stop in REV mode for edge or signal control	No function	No function
5	Stop in FWD mode with edge control	Stop in FWD mode with edge control	Operation with fixed frequency 1 (FF1) for edge control	Operation with fixed frequency 1 (FF1) for edge control
6	No function	No function	No function	No function
7	Stop in FWD mode with edge control	Stop in REV mode with edge control	FWD operation with fixed frequency 1 (FF1) for edge or signal control	REV operation with fixed frequency 1 (FF1) for edge or signal control
8	Stop in FWD mode for edge or signal control	Stop in REV mode for edge or signal control	FWD operation with fixed frequency 1 (FF1) for edge or signal control	REV operation with fixed frequency 1 (FF1) for edge or signal control

Table 43: Signal detection in auto mode

	Auto mode			
P1-13	**SI1**	**SI2**	**SI3**	**SI4**
0	–	–	–	–
1	No function	No function	No function	No function
2	Stop in FWD mode for edge or signal control	Stop in REV mode with edge control	No function	No function
3	Stop in FWD or REV mode for edge or signal control	No function	No function	No function
4	Stop in FWD mode for edge or signal control	Stop in REV mode with edge control	No function	No function
5	Stop in FWD mode for edge or signal control	Stop in FWD mode with edge control	Operation with fixed frequency 1 (FF1) for edge control	Operation with fixed frequency 1 (FF1) for edge control
6	Stop in FWD mode for edge or signal control	Stop in REV mode with edge control	FWD operation with fixed frequency 1 (FF1) for edge or signal control	REV operation with fixed frequency 1 (FF1) for edge or signal control
7	Stop in FWD mode for edge or signal control	Stop in REV mode with edge control	FWD operation with fixed frequency 1 (FF1) for edge or signal control	REV operation with fixed frequency 1 (FF1) for edge or signal control
8	Stop in FWD mode for edge or signal control	Stop in REV mode with edge control	FWD operation with fixed frequency 1 (FF1) for edge or signal control	REV operation with fixed frequency 1 (FF1) for edge or signal control

11 Communications

11.1 ASi data bus



1	ASi+
2	–
3	ASi–
4	–

Figure 107: ASi data bus

The ASi data bus is a system solution that makes it possible to network various assemblies. AS-Interface networks are quick and easy to set up.

11.1.1 ASi LED display

The **ASi** LED displays of motor control unit RASP5 indicate the operating states and allow a quick diagnosis.

Table 44: AS interface

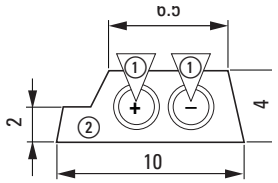
LED	Display	Description AS interface
	off	AS-interface electronics have no supply voltage: → Check AS-Interface connection cables → Check AS-Interface power supply unit (master control)
	green	Communication active, normal operation
	red green flashing	No communication: • RAPID LINK 5 not entered or entered with the wrong address (ID)
	flashing green/ red	AS-Interface address = 0: → Setting the AS-Interface address
	green red flashing	→ fatal peripheral error; internal ASi error

The START signal or enable for the requested operating direction is issued through DQ0 (FWD) or DQ1 (REV). Through outputs DQ2 and DQ3 fixed frequencies FF1 to FF3 (digital setpoint value memory) are called up in binary code. If DQ2 and DQ3 are not activated, frequency value f_0 set at spindle potentiometer n_0 is output (analog setpoint memory, 0 to 50 Hz).

11.1.2 Data cable

AS-Interface uses a geometrically coded, unscreened flat cable with a cross-section of 2 x 1.5 mm^2. It is used to transmit both power as well as all data traffic between control and the peripherals and – to some extent – supplies the connected devices with energy. The installation meets the usual requirements. Engineering is simplified by full flexibility in system layout and mounting.

When a link is connected to the flat cable, two metal pins pierce through the cable's jacket and into the two cores to establish a contact with the AS-Interface cable. There is no need to cut and strip cables, apply ferrules or connect individual cores.



① Piercing pins
② Flat cable, protected against polarity reversal

Figure 108: ASi ribbon cable

Rapid Link function modules can be installed and removed any number of times at various locations. The AS-Interface flat ribbon cable is self-repairing, dust-proof and water-proof. The network can have a star, linear or tree structure.

11.1.3 Data Transfer

Data is modulated onto the supply voltage so that it can be transmitted. During this process, each card's transmitter injects data signals into the cable. This causes a change in the voltage induced in the data coupling coils. This change is detected by the receiver of each card along the AS-i cable.

11.1.3.1 AS-i slaves with expanded address range

When using AS-i slaves (A/B slaves) with an expanded address range with AS-i profile S-7.A.E, an address can be assigned to a maximum of 62 modules. Addresses 1A and 1B can be assigned for this (maximum: 31A and 31B).

→ When using RASP5 units, a maximum of 31 modules can be connected to (assigned an address on) a single AS-i line.

The response time when a command is sent via an AS-Interface is 160 µs per card; for 31 cards this is 5 ms.

11.1.3.2 ASi profiles

Rapid Link 5 has the ASi profile S-7.A.E.

Due to the possible differences in ASi profiles, the master (gateway) must perform a new initialization when the RASP5 devices are replaced. For this the ASi master must be switched to configuration mode. In this mode, the ASi master detects the type and profile of the connected ASi slaves on the ASi cable.

The profile is "permanently burned in" to the slave modules during manufacture and cannot be changed. As a rule, this configuration mode can only be activated for an ASi gateway if there is no communication with the gateway.

REPLACEMENT OF THE DEVICES

If you are replacing the devices, please contact the manufacturer of the PLC used to ensure correct reinitialization.

11.1.4 Gateway

The gateway establishes the connection to the field bus and as the master handles all communication in the AS-Interface line.

11.1.5 Cable length

The maximum cable length is 100 m in all segments of the ASi circuit.
The distance between an ASi gateway and an ASi slave of the network can be extended by two repeaters of 100 m each to a maximum of 300 m.

11.1.6 Addressing

Every slave must be assigned an address before data can be transmitted between the AS-i-/DP gateway and the Rapid Link devices. Rapid Link devices have a default address of 0.

AS-i slaves can be assigned an address as follows:

- offline: Addressing with the handset
- online: Addressing via the ASi/DP gateway

The addresses that can be assigned are 1A to 31A and 1B to 31B (on AS-i version 2.1 and higher). The slaves' addresses do not have to be consecutive.

For information on how to assign addresses for and configure the AS-Interface, please consult the manual for the gateway you are using.

11.1.7 Replacing Rapid Link devices in the AS-i circuit

If a slave fails due to a fault, it can be replaced with an identical device with an address of 0. The gateway will detect the replacement and will automatically reassign the faulty slave's address to the new slave. It may be necessary to configure this feature on the gateway.

If the replacement device does not have a default address of 0, it will be necessary to program it with the faulty device's address.

→ You can use the AS-i gateway to delete the existing Rapid Link address and assign a new address.

→ For detailed information on addressing and troubleshooting the gateway , refer to the manufacturer's manual.

11.2 ASI flat cable

You can fit M12 branches (ZB2-100-AZ1) at any point along the AS-Interface ribbon cable.

Both the mechanical and electrical connections are carried out in one operation:

- Release the black union nut until the contact tips no longer protrude.
- Insert the two-wire profile ribbon cable and clip the junction shut.
- Retighten the black union nut.

The device or module is now ready for operation.

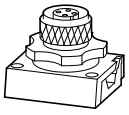


Figure 109: Junction M12 (order no.: ZB2-100-AZ1)

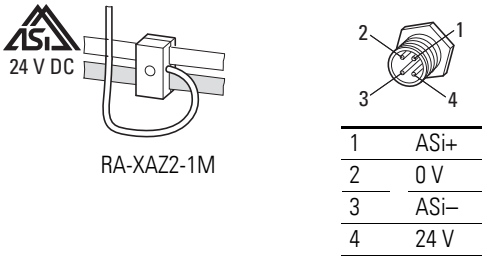
The Rapid Link function modules have an AS-Interface M12 plug-in connector that fits the M12 junction.

Pin	Function
1	AS-Interface+
2	0 V
3	AS-Interface -
4	+24 V DC
5	–

11.3 External quick stop

RASP5 offers the possibility of activating a second Stop function through pin 2 and pin 4 of AS-Interface with an external control voltage (+24 V DC). This requires a second AS-Interface ribbon cable and connector RA-XAZ2-1M.

A quick stop with the second ramp is activated via P3-11. The ramp time (2nd Ramp) is set via P2-13.



1	ASi+
2	0 V
3	ASi–
4	24 V

Figure 110: RA-XAZ2-1M, AS-i branch

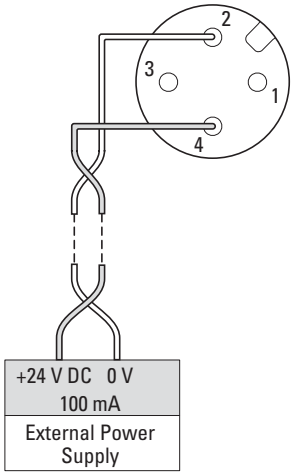


Figure 111: Connection example for quick stop

11.3.1 Extension circuit

For connecting the M12 junction ZB2-100-A21 with Rapid Link modules RAMO5 or RASP5, extension cable RA-XM12-1M can be used. This 1 m long connection cable is prefabricated with an M12 socket (connection to RAMO or RASP) and an M12 plug (M12 junction).

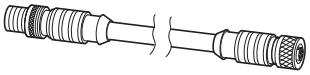


Figure 112: Extension cable RA-XM12-1M

11.3.2 Cable routing

→ Lay the control and signal cables separately from the mains and motor cables.

Do not lay the data bus (AS interface) and the sensor and actuator cables directly parallel with the power bus (mains cable), to a power adaptor cable or to a motor cable. Avoid laying them in a common cable duct or conduit or tying them together with cable binders. Signal and power cables should, as far as possible, cross at right angles. This increases their interference immunity (EMC) and therefore operational reliability. On the frequency-controlled RASP5 further measures are necessary to ensure an EMC-compliant installation.

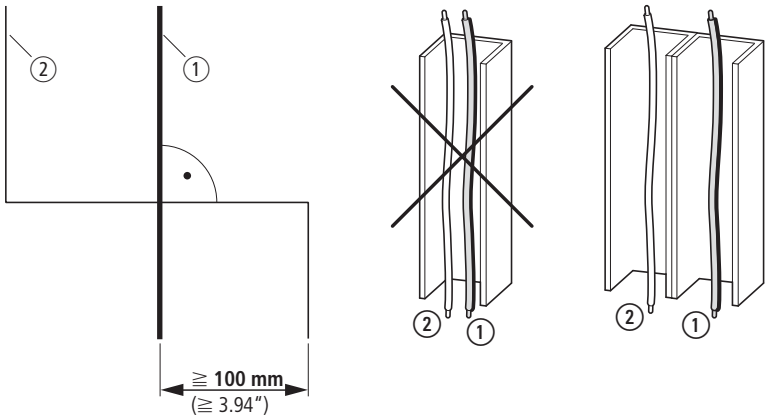


Figure 113: Laying of signal and power cables
① Power cable: Mains connection (power bus, adaptor cable), motor cable
② Control cables: As-Interface (data bus), sensor/actuator connection

11.3.3 RASP actuation

Table 45: Control RASP5

Function	Signal to RASP							
	Outputs				Inputs			
	DQ0	DQ1	DQ2	DQ3	DI0	DI1	DI2	D13
No controller enable	0	0						
Anticlockwise rotating field (REV)	0	1						
Clockwise rotating field (FWD)	1	0						
No controller enable	1	1						
FF0 (P1-12 = 10 Hz)			0	0				
FF1 (P2-01 = 30 Hz			1	0				
FF2 (P2-02 = 40 Hz			0	1				
FF3 (P2-03 = 50 Hz			1	1				
Automatic mode					1			
No automatic mode					0			
Accumulative error						0		
No accumulative error						1		
external input I1 via M12 socket								
no signal							0	
Signal available							1	
external input I2 via M12 socket								
no signal								0
Signal available								1

- The START signal or enable for the requested operating direction is issued through DQ0 (FWD) or DQ1 (REV).
- Through outputs DQ2 and DQ3 fixed frequencies FF1 to FF3 (digital setpoint value memory) are called up in binary code.
- If DQ2 and DQ3 are not activated, the frequency set in FF0 is output.

11.3.4 ASi control RAMO

Table 46: RAMO actuation

Function	Signal at RAMO							
	AS-Interfaceoutputs				AS-Interfaceinputs			
	DQ0	DQ1	DQ2	DQ3	DI0	DI1	DI2	D13
Stop	0	0						
Anticlockwise rotating field (REV)	0	1						
Clockwise rotating field (FWD)	1	0						
Zero Speed/reset	1	1						
Actuator output = High			1					
Actuator output = Low			0					
Quick stop ON				0				
Quick stop OFF				1				
Automatic mode					1			
No automatic mode					0			
Accumulative error						0		
No accumulative error						1		
external input I1 via M12 socket								
no signal							0	
Signal available							1	
external input I2 via M12 socket								
no signal								0
Signal available								1

- The START signal or enable for the requested operating direction is issued through DQ0 (FWD) or DQ1 (REV).
- DQ2 can be used to switch output O3 to HIGH or LOW.

11.4 Diagnostics and troubleshooting via AS-Interface

All faults identified by the power module (DQL) are internally transmitted to the AS-Interface component as group fault messages:
Di = 0 (Low). The red LED in the motor symbol lights up.

▶ Turn the key switch to the OFF position to reset the error message. Hold the switch in this position for at least one second so that the RAMO5 unit will detect the command.

The Reset signal via AS-i provides an additional reset option for RAMO5 units in case the latter cannot be locally reset due to accessibility issues.
The local reset via the keyswitch remains the main application, as each diagnosis has a cause that needs to be analyzed and eliminated on-site.

Table 47: RAMO5 internal diagnostic status (for briefed service personnel only)

Diagnostics status	**Status**				**Accumulative error**	**Peripheral error (FID)**	**Explanation**
	P1	**P2**	**P3**	**P4**[1)]	**DI1**		
Thyristor/bypass contact defective	0	0	1	0	0	1	Output switched through (On position) without actuation signal Possible causes: • Thyristor failed • Bypass contact welded • I3/I4 sensor short-circuit • actuator short-circuit
Overload release	0	1	0	0	0	0	Triggering at 110 % of the thermal motor simulation value
Thermistor tripping	0	1	1	0	0	0	Possible causes: Motor plug not plugged • Thermistor in motor not connected • Jumper in terminal box of motor or in motor feeder plug missing (T1 = Pin 5, T2 = Pin 8). • Tripping due to excessive resistance in thermistor sensor circuit (e.g. overtemperature)
No diagnostic alarm	1	1	1	0	0	0	Possible causes: • Overload or short-circuit of external inputs I3, I4 • Overload or short-circuit of external output • Incorrect DIP switch setting • Supply voltage 400 V missing • Trip in event of undershooting current lower limit
Manual mode (status_local_operation)	1	0	0	0	1	0	Key-switch in MANUAL (HAND) position
Load message 1 (status_overload_warning)	1	0	1	0	1	0	Message at 90 % of thermal motor simulation value (preventive maintenance, message reset automatically).
Load message 2 (status_load_indication)	1	1	0	1	1	0	Message at 70 % of thermal motor simulation value (preventive maintenance; message will be reset automatically).

1) P4 diagnostics possible only with standard slave profile (S-7.4)

The unit can be switched back on after approximately one minute.
If the fault continues to be present, the motor LED will show a solid red light.
If the error is corrected within this time, the red motor LED flashes. A reset must then be performed via the key switch.

11.5 OP-Bus

All Rapid Link devices use the internal OP system bus for parameterization and control via an external control unit.

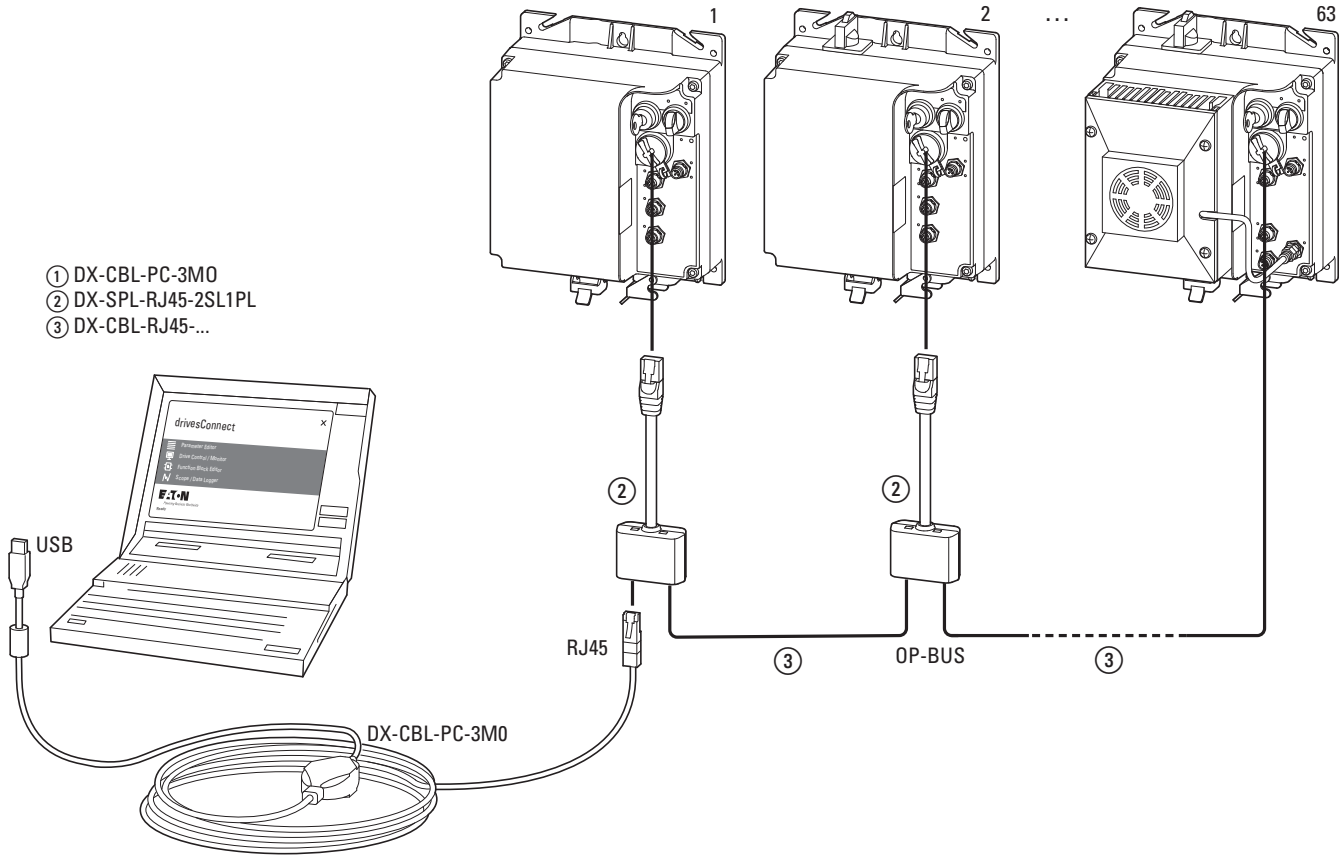


Figure 114: System configuration for system bus

11.5.1 Hardware

The devices of the RAMO5 and RASP5 series have an 8-pin RJ45 socket on the front. This socket is used for the devices to communicate. Depending on the series of devices, ports are available for the various bus protocols. One of these protocols is the OP system bus, which connects the devices with one another, but also with other bus users such as PCs (for parameterization with the drivesConnect parameter software) and operator panels.

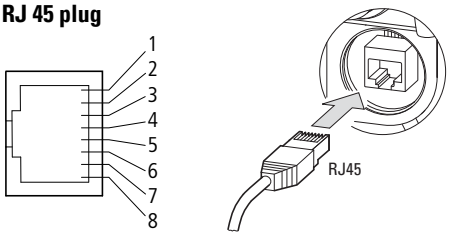
All participants can be arranged in any order. The OP system bus operates at a fixed baud rate and does not require a bus terminating resistor.
Patch cables and splitters are used for the connection.

Accessories	Type
Patch cable	DX-CBL-RJ45-xxx (xxx stands for the cable length)
Splitter	• DX-SPL-RJ45-3SL (8-pin, 3 sockets) • DX-SPL-RJ45-2SL1PL (8-pin, 2 sockets, 1 plug)
PC connection	DX-CBL-PC-3M0

11.5.1.1 RJ45 socket wiring

Note that the reference points (0 V) of the individual bus nodes are connected by the patch cable. In addition to converting the OP system bus signal to the USB interface of the PC, the connecting cable to the PC also contains a galvanic isolation between the bus and the USB port on the PC.

RJ 45 plug



PIN 1	–
PIN 2	–
PIN 3	–
PIN 4	OP-Bus -
PIN 5	OP-Bus +
PIN 6	–
PIN 7	–
PIN 8	–

11.5.1.2 Addressing

Up to 63 nodes can be connected to the OP system bus, but communication can only take place between the DX-KEY… operator panel and a node or between the PC and a node at the same time. The address of the subscriber determines which subscriber is to be communicated with. It may only occur once within the system.

The address assignment is arbitrary. This means that there must be no continuous numbering.

The devices must already be addressed when they are addressed via the bus for the first time. The DX-KEY-… control units do not require an address of the OP system bus. However, it must be ensured here that in the case where two control units are connected to a bus, they must work on different ports. A possibly integrated PC for parameterization or display also does not require an address.

The devices are supplied with the address "1" when delivered. This setting does not need to be changed as long as only one device is operated on the OP system bus. However, as soon as several devices are connected to an OP system bus, they must have different addresses. The address is set using parameter P5-01:

Addressing has to be done before the connection to the OP system bus. This can be done using the DX-KEY-OLED operator panel.

11.5.1.3 Configuration of the DX-KEY… control units (port)

Up to two DX-KEY control units can be connected to the OP system bus. If only one operator panel is used, no configuration is required.

In the case of two control units, ensure that they operate with different ports.

All DX-KEY… are factory-set to port "1". When switching to port "2", proceed as follows:

- ▶ Press and hold the **OK** button.
- ▶ Press the **STOP** and ▼ buttons simultaneously:
  →Display: Port 1
- ▶ Use the ▲ or ▼ buttons to select the desired port.
- ▶ Press and hold the **OK** button.
- ▶ In addition, press the **STOP** and ▼ buttons simultaneously.
  → The port of the control unit is now set.

11.5.1.4 Changing the address with an external DX-KEY control unit...

It is also possible to change the address of a connected device with an external DX-KEY… control unit.

- ▶ Press the **STOP** and ▼buttons simultaneously.
  → Display: Adr - xx (xx stands for the address with which the control unit last communicated)
- ▶ Preselect the corresponding device with the operating unit.
- ▶ -Preselect parameter P5 01 ("PDP address") and enter the new address. The operator panel now loses communication with the device due to the address change. → Display: Err-5c
- ▶ Press the **STOP**button.
  → The previous address of the device is displayed.
- ▶ Use the ▲ or ▼ button to select the desired (new) address.
- ▶ Press the **STOP** and ▼ buttons simultaneously.
  → Communication is restored.

11.5.1.5 Parameterization and operation

The devices connected to the OP system bus can be parameterized and operated via the operating units and the drivesConnect parameter software.

The control unit can only communicate with one device at a time (no broadcast). To do this, select the set address of the device.

- ▶ Press the **STOP** and ▼buttons simultaneously.
  → Display: Adr - xx (xx stands for the address with which the control unit last communicated)
- ▶ Use the ▲ or ▼ buttons to select the one you want.
- ▶ Press the **STOP** and ▼ buttons simultaneously.
  → The control unit searches for the preselected address in the network.
  → Display: ScAn
  - If the address is present, LoAd and then StoP
    → The control unit communicates with the device with the preselected address.
  - If the address is not found, Adr - xx appears (xx stands for the previously selected address).
- ▶ Select the correct address and try again.

The DX-KEY… control units store the address with which the last communication was made. If the saved address and that of the device are not the same, Adr - xxxx appears (xx stands for the last used preselected address). The address of the connected device must be preselected on the operating unit. In the delivery condition, this is always "1". If the address of the device has already been reconfigured, the current value can be read in the drivesConnect parameter software and in the RAMO5 and RASP5 series devices on the control unit in the device.

12 Error messages

12.1 Introduction

The Rapid Link Modules have several internal monitoring functions.
If deviations from the correct operating status are detected, an error message is displayed.

12.1.1 Error messages

The last four error messages are stored in the order in which they occurred (the most recent error in the first place).
The error messages can be read out under monitor parameter P0-13.
The values are not deleted when resetting to the factory settings!

12.1.2 Acknowledge fault (Reset)

The current error message can be acknowledged and reset as follows:

- Switch off the supply voltage
- Press the stop button
- Set key switch to OFF/RESET

12.1.3 Automatic reset

The auto reset function can be set using parameters P2-24 and P2-26.

The P2-26 parameter determines the time which will elapse between consecutive drive reset attempts when Auto Reset is enabled by P2-24.

12.1.4 Error list

The following table lists the failure codes, the possible causes and indicates corrective measures.

12.2 RAMO Error list

Table 48: RAMO Fault messages list

Message	Error no.	Possible cause and remedy
StoP	–	Ready for operation. There is no drive enable signal present. There are no error messages present.
no-FLt	00	Shown for P0-13 if there are no messages in the error register.
I.t-trP	04	Motor overload. The thermal protection mechanism has tripped as a result of the device being run above the rated motor current set with P1-08 longer than a specific time. • Check to make sure that the motor data was entered correctly in P1-08. • Check the motor's connection configuration (e. g., start/delta). • Make sure that the motor is not being mechanically blocked and that there are no additional loads on the motor.
OUoLt	06	Overvoltage in DC link The DC-Link Voltage value can be viewed using parameter P0-20. P0-36 contains an error register with the last values before the unit was switched off (scan time: 256 ms). • Check to make sure that the supply voltage falls within the range for which the variable frequency drive is sized.
UUoLt	07	Undervoltage in DC link **Note:** Generally, this message will appear when the supply voltage is switched off on the device and the DC link voltage dies away. In this case, there is no fault. If the message appears during operation: • Check whether the power supply voltage is too low. • Check all components/devices in the variable frequency drive's feeder circuit (circuit-breaker, contactor, choke, etc.) to make sure they are connected properly and have an adequate contact resistance.
P-dEF	10	The parameters' default settings have been loaded. • Press the STOPP button: The drive can then be reconfigured:
SC-Obs	12	Communication fault with an external operating unit or with a PC. • Check connections.
P-LOSS	14	Failure of one phase of the infeed
dAtA-F	17	Error in internal memory. The parameters have not been saved and the default settings have been loaded. • Change the parameter values (again) and save them once more. • If the message appears again, please contact your nearest Eaton sales branch.
dAtA-E	19	Error in internal memory. The parameters have not been saved and the default settings have been loaded. • Change the parameter values (again) and save them once more. • If the message appears again, please contact your nearest Eaton sales branch.
F-PtC	21	Motor PTC thermistor overtemperature

Message	Error no.	Possible cause and remedy
O-hEAt	23	The measured ambient temperature exceeds the specified value. • Check the device's internal fan. • Make sure that there is enough free space around the device. If possible: Reduce load.
U-tor9	25	Underload If the motor current is 25 % below the rated motor current, this error message appears.
OUt-Ph	49	A phase in the motor cable is not connected or has a discontinuity.
Sc-F01	50	No valid field bus telegram was received within the time specified in P5-02. • Check to make sure that the network master is working correctly. • Check connecting cables. • Increase the value of P5-02 to an acceptable value.
OF-01	60	No internal connection to an optional card
OF-02	61	Optional module in undefined operating state
OF-10	70	Sensor fault - overload or short circuit

12.3 RASP Error list

Table 49: RASP Fault messages list

Message	Error no.	Possible cause and remedy
StoP	–	Ready for operation. There is no drive enable signal present. There are no error messages present.
Inh ibt	–	STO inputs (terminals 3 and 4) de-energized • Safety relay switched off • Voltage source overloaded Consequence: The drive is disabled.
no-FLt	00	Shown for P0-13 if there are no messages in the error register.
OI -b	01	Excessively high braking current • Check the brake resistor and its wiring for short-circuits and ground faults. • Make sure that the braking resistance value is not lower than the minimum permissible braking resistance.
OL -br	02	Thermal overload on brake resistor The drive has been switched off in order to prevent the brake resistor from being thermally destroyed. • Make the P1-04 and P2-13 ramp times longer in order to have less frequent braking. • Reduce the load's inertia, if possible.
O-I	03	Overcurrent at variable frequency drive output Occurs right after switching on the unit: • Check the cable connection between inverter and motor. • Check the motor for shorted turns and ground faults. Occurs when starting the motor: • Check whether the motor can rotate freely and make sure that it is not being blocked mechanically. • Motor with mechanical brake: Check whether this has been triggered. • Check the connection configuration (star/delta). • Check to make sure that the motor data was entered correctly in P1-07, P1-08, and P1-09. • In vector mode (P6-01 = 1): Check whether the value cos φ (P7-02) has been entered correctly and a motor identification run has been successfully performed. • Increase the acceleration ramp time (t-acc, P1-03) if necessary. • With speed control (P6-01 = 6): Reduce the voltage boost with P1-11. Occurs during operation at a constant speed: • Check whether the motor is overloaded. Occurs during acceleration/deceleration: • The ramp times are too short and require too much power. If P-03/P-04 cannot be increased, a larger device may be required.
I.t-trP	04	Motor overload. The thermal protection mechanism has tripped as a result of the device being run above the rated motor current set with P1-08 longer than a specific time. • Check to make sure that the motor data was entered correctly in P1-07, P1-08, and P1-09. • In vector mode (P6-01 = 1): Check whether the value cos φ (P7-02) has been entered correctly and a motor identification run has been successfully performed. • Check the motor's connection configuration (e. g., start/delta). • If the decimal points on the display flash during operation, this means that the unit is being run in its overload range (> P1-08). In this case, use P1-03 to make the acceleration ramp longer or reduce the load. • Make sure that the motor is not being mechanically blocked and that there are no additional loads on the motor.

Message	Error no.	Possible cause and remedy
PS-ErP	05	Overcurrent (Hardware) • Check the wiring to the motor and the motor itself for short-circuits and ground faults. • Disconnect the motor cable from the variable frequency drive and switch the variable frequency drive back on. If the error message still appears, the device needs to be replaced. Before commissioning the new device, check the system for short-circuits or ground faults that could have caused the device to fail.
O.Volt	06	Overvoltage in DC link The DC-Link Voltage value can be viewed using parameter P0-20. P0-36 contains an error register with the last values before the unit was switched off (scan time: 256 ms). • Check to make sure that the supply voltage falls within the range for which the variable frequency drive is sized. • If the error occurs during deceleration or stopping: Extend delay ramp (P1-04/P2-13) or use a brake resistor. • In vector mode (P6-01 = 1): Reduce the speed controller's amplification (P6-02).
U.Volt	07	Undervoltage in DC link **Note:** Generally, this message will appear when the supply voltage is switched off on the device and the DC link voltage dies away. In this case, there is no fault. If the message appears during operation: • Check whether the power supply voltage is too low. • Check all components/devices in the variable frequency drive's feeder circuit (circuit-breaker, contactor, choke, etc.) to make sure they are connected properly and have an adequate contact resistance.
O-t	08	Overtemperature at heat sink. The drive is too hot. The heat sink temperature can be viewed by using P0-21. P0-38 contains an error register with the last values before the unit was switched off (scan time: 30 s). • Check to make sure that the variable frequency drive is being operated within the ambient temperature range specified for it. • Make sure that cooling air can circulate freely (clearances to neighboring devices above and below the variable frequency drive). • The ventilation vent on the device must not be blocked, e.g., by dirt or due to devices being installed too closely together. • Reduce the switching frequency with P2-24. • Reduce the load, if possible.
U-t	09	Under-temperature The message will appear if the ambient temperature falls below -10 °C. In order to be able to start the drive, the temperature must be higher than this.
P-dEF	10	The parameters' default settings have been loaded. • Press the STOP button: The drive can then be reconfigured:
SC-Obs	12	Communication fault with an external operating unit or with a PC. • Check connections.
FLt-dc	13	Excessively high DC link voltage ripple The DC link voltage ripple can be viewed using P0-16. An error register with the last values before the unit was switched off contains P0-37 (scan time: 20 ms). • Check to make sure that all the mains supply phases are present and that their voltage balance falls within the permissible tolerance range (3 %. • Reduce the load if possible. • If the fault persists, please contact your nearest Eaton sales branch.

Message	Error no.	Possible cause and remedy
P-LOSS	14	Failure of one phase of the infeed
h O-I	15	Overcurrent at output • See Error no. 03.
th-FLt	16	Malfunctioning heat sink thermistor. • Please contact your nearest Eaton sales branch.
dAtA-F	17	Error in internal memory. The parameters have not been saved and the default settings have been loaded. • Change the parameter values (again) and save them once more. • If the message appears again, please contact your nearest Eaton sales branch.
dAtA-E	19	Error in internal memory. The parameters have not been saved and the default settings have been loaded. • Change the parameter values (again) and save them once more. • If the message appears again, please contact your nearest Eaton sales branch.
F-PtC	21	Motor PTC thermistor overtemperature
O-hEAt	23	The measured ambient temperature exceeds the specified value. • Make sure that the required clearance around the device is being maintained and that cooling air can flow through the vents on the device unimpeded. • Reduce the switching frequency with P2-22. • If possible: Reduce load.
O-torq	24	Maximum permissible torque exceeded. • If possible: Reduce the load or increase acceleration time t-acc.
U-torq	25	Underload If the motor current is 25 % below the rated motor current, this error message appears.
OUt-F	26	Device output fault • Please contact your nearest Eaton sales branch.
Sto-F	29	Internal STO circuit fault • Please contact your nearest Eaton sales branch.
AtF-01	40	Motor identification failed: The measured stator resistance varies between the phases. • Make sure that the motor is connected properly and working correctly. • Check the motor windings to make sure they have the same resistance values.
AtF-02	41	Motor identification failed: The measured stator resistance is too large. • Make sure that the motor is connected properly and working correctly. • Check to make sure that the device's rated output matches the motor's rated output. The difference should not exceed one full output class.
AtF-03	42	Motor identification failed: The measured motor inductance is too low. • Make sure that the motor is connected properly and working correctly.
AtF-04	43	Motor identification failed: The measured motor inductance is too high. • Make sure that the motor is connected properly and working correctly. • Check to make sure that the device's rated output matches the motor's rated output. The difference should not exceed one full output class.

Message	Error no.	Possible cause and remedy
AtF-05	44	Motor identification failed: The measured motor parameters do not match. • Make sure that the motor is connected properly and working correctly. • Check to make sure that the device's rated output matches the motor's rated output. The difference should not exceed one full output class.
OUt-Ph	49	A phase in the motor cable is not connected or is disconnected.
Sc-F01	50	No valid field bus telegram was received within the time specified in P5-02. • Check to make sure that the network master is working correctly. • Check connecting cables. • Increase the value of P5-02 to an acceptable value.
OF-01	60	No internal connection to an optional card
OF-02	61	Optional module in undefined operating state
OF-10	69	Sensor fault - overload or short circuit

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