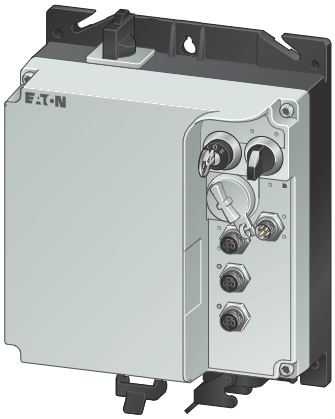
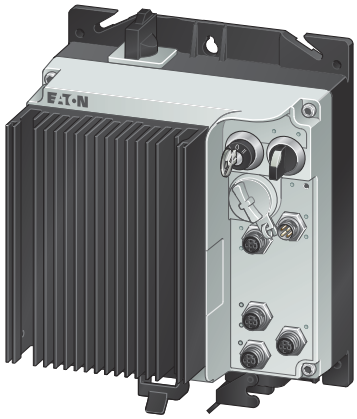
Rapid Link 5
RAMO5
RASP5





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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. edition 2019, publication date 10/19
2. edition 2020, publication date 05/20
3. edition 2020, publication date 09/20
4. edition 2021, publication date 05/21

Author: Mustafa Akel
Editor: René Wiegand

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

These are the original operating instructions and describes the RAMO5 motor starters and RASP5 speed controllers of the Rapid Link 5 system as well as relevant accessories.

The subsequent chapters provide specialist information needed to configure, install and operate these Rapid Link 5 function modules.

0.1 List of revisions

Publication date	Page	Description	New	Modified	Deleted
05/21	18	RASP5 type key (note)		✓	
	22	UL file (number)		✓	
	23	UL file (number)		✓	
09/20	226 ff.	PROFINET	✓		
05/20	–	Complete revision			
	22	UL compliance excerpts in English	✓		
	200 ff.	EtherNet/IP	✓		
	–	OP-Bus			✓
10/19		First version	–	–	–

0.2 Application Notes

Please read this manual carefully before you install the Rapid Link 5 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 11/2019 MZ034003EN "Product Cybersecurity Guideline - Rapid Link 5 AS-Interface".

You can find the document on the Eaton website:
Eaton.eu → Customer Support → Download Center - Documentation

Enter the search string "MZ034003EN" in the **Quick Search** field and click on **Search**.

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

Indicates a potentially hazardous situation that may result in property 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 Hints

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 also take note of the installation information in the instruction leaflets IL034084ZU and IL034092ZU (for RAMO5) or IL034085ZU and IL034093ZU (for RASP5).

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 Eaton website.

Enter a search string 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 Rapid Link topic (assembly instructions, software, manuals, catalogs, product information).

0.4 Abbreviations and symbols

The following symbols and abbreviations are used in this manual:

DS	Default setting
EMC	**E**lectro**m**agnetic **c**ompatibility
FWD	**F**or**w**ar**d** (clockwise rotating field)
LCD	**L**iquid **c**rystal **d**isplay
PES	Functional ground, **PE** connection (ground) of the **S**creen (cable)
pk	Peak
Par No.	**P**arameter **Nu**mber
RAMO	**Ra**pid Link **Mo**tor Starter
RASP	**Ra**pid Link **Sp**eed Control
REV	**Rev**erse (counterclockwise rotating field)
STO	**S**afe **T**orque **O**ff
	The AS-Interface logo (**a**ctuator-**s**ensor interface) indicates 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.

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
AP040051EN	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
L034092ZU	Instruction leaflet	Instruction leaflet for RAMO5 in the EtherNet/IP variant
IL034085ZU	Instruction leaflet	Instruction leaflet for RASP5
L034093ZU	Instruction leaflet	Instruction leaflet for RASP5 in the EtherNet/IP variant
PU05907001Z	Manual	Safety manual
IL040051ZU	Instruction leaflet	DX-COM-STICK3-KIT
11/2019 MZ034003EN	Hardening documentation	"Product Cybersecurity Guideline - Rapid Link 5 AS-Interface"

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 Designation	Anglo 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 value	Revolutions per minute	1 rpm	1 min^{-1}	1
Weight	pound	1 lb	0.4536 kg	2.205

1 Rapid Link 5 system

Rapid Link 5 is a modern, efficient drive and automation system. Customer-specific and sector-specific requirements for material handling systems are the main focus of the innovative Rapid Link 5 system design. It is suitable for both simple and complex tasks in all areas of conveyor technology.

The Rapid Link 5 system allows electrical drives to be installed and put into operation much more quickly and cost-efficiently than conventional, central 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.

The devices of the Rapid Link 5 system are available as customized solutions

- Electronic DOL and reversing starter RAMO5,
- RASP5 frequency-controlled speed controller.

The following versions are available:

- Communication:
  - AS-Interface
  - EtherNet/IP
  - PROFINET
- Brake control voltage:
  - 180/207 V DC
  - 230/277 V AC
  - 400/480 V AC
- Repair switches
- Brake resistor
- Safe Torque Off (STO)
- Power plug:
  - HAN Q5
  - HAN Q4/2

1.1 System overview

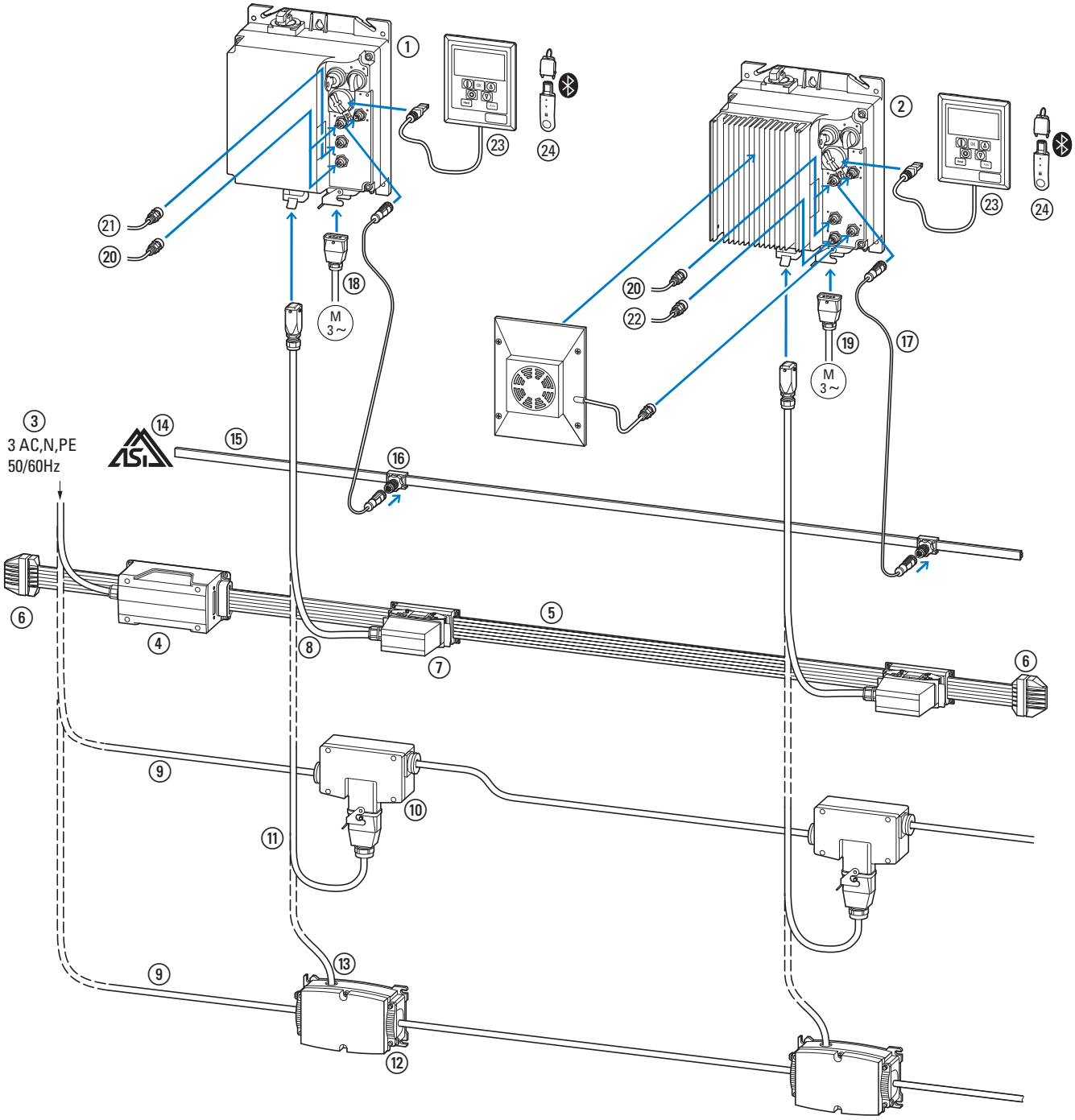


Figure 1: Overview of Rapid Link 5 modules

Function modules:

① RAMO5 motor starter (motor control unit):
Three-phase, electronic DOL starter or reversing starter

② RASP5 speed controller (speed control unit):
3-phase, frequency-controlled motor starter

Power bus:

③ Energy supply (3 AC N/PE 400/480 V AC, 50/60 Hz)
④ Power supply for ribbon cable
⑤ Ribbon cable for 400/480 V AC
⑥ Ribbon cable end piece
⑦ Ribbon cable outlet
⑧ Power adapter cable to ribbon cable junction
⑨ Round cable for 400/480 V AC

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

Data bus:

⑭ AS-Interface
⑮ AS-Interface-flat band conductor
⑯ Link for M12 connector cables
⑰ Extension cable with M12 plug

Motor connection:

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

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.

RAMO5 and RASP5 devices are packaged and dispatched with care.
The devices should be shipped only in their original packaging and using a suitable means of transportation. 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):
  - A RAMO5 device,
  - Instruction leaflet IL034084ZU or IL034092ZU.

or

- Speed controller (speed control unit):
  - A RASP5 device,
  - Instruction leaflet IL034085ZU or IL034093ZU.

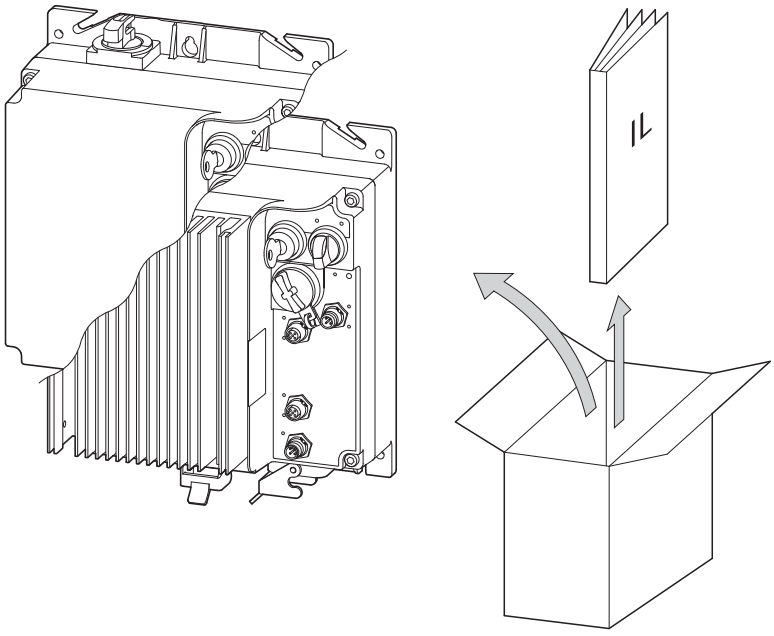


Figure 2: Scope of delivery (RAMO5 or RASP5 device plus instruction leaflet)

1.3 Rating data on the nameplate

The device-specific, rated operational data for the RAMO5 or RASP5 is listed on the name plate of the device.

The following are two example rating plates:

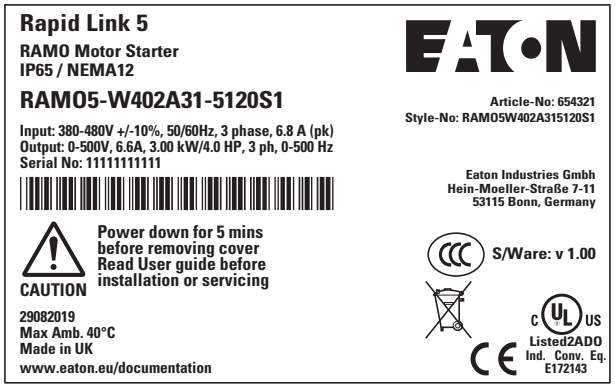


Figure 3: Name plate for RAMO5

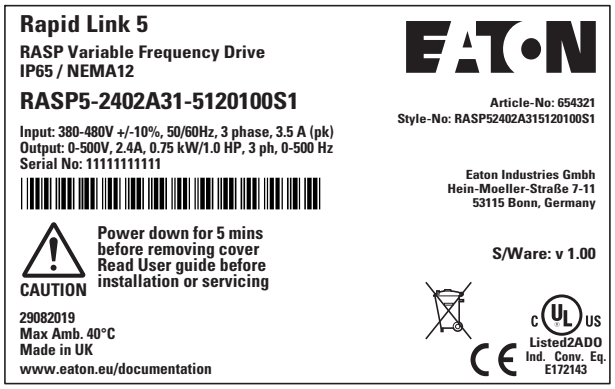


Figure 4: Name plate for RASP5

The inscription on the name plate has the following meaning (example):

Inscription	Meaning
RASP5-2402A31-5120100S1	Type designation: 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 = no repair switch 1 = with brake resistor 0 = without STO 0 = without fan S1 = Version
Input	Rated operational data of mains connection Three-phase AC voltage (U_e 3~ AC) Voltage 380 - 480 V, frequency 50/60 Hz, input phase current 3.5 A (pk)
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 with 460 V for a four-pole, internally cooled or surface-cooled three-phase motor (1500 rpm 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: (in this case, for example: 8/29/2019)
Max. Amb. 40 °C	Maximum permissible ambient air temperature (40 °C)
	The speed controller is a piece of electrical equipment. Read the manual (in this case MN034004EN) before making any electrical connections and commissioning.

1.3.1 RAMO5 type key

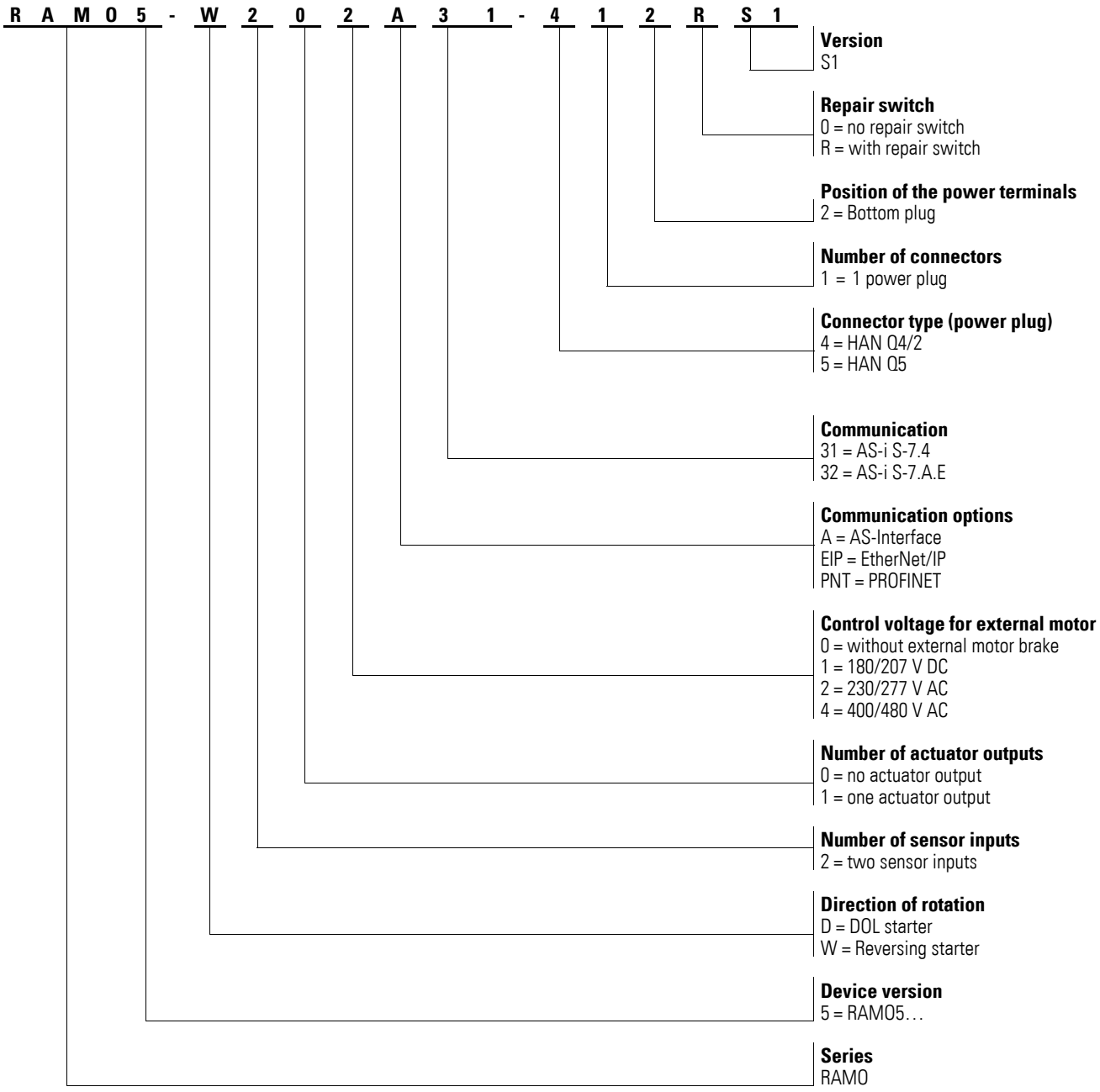


Figure 5: Key to RAMO5 motor starter type references

1.3.2 RASP5 type key

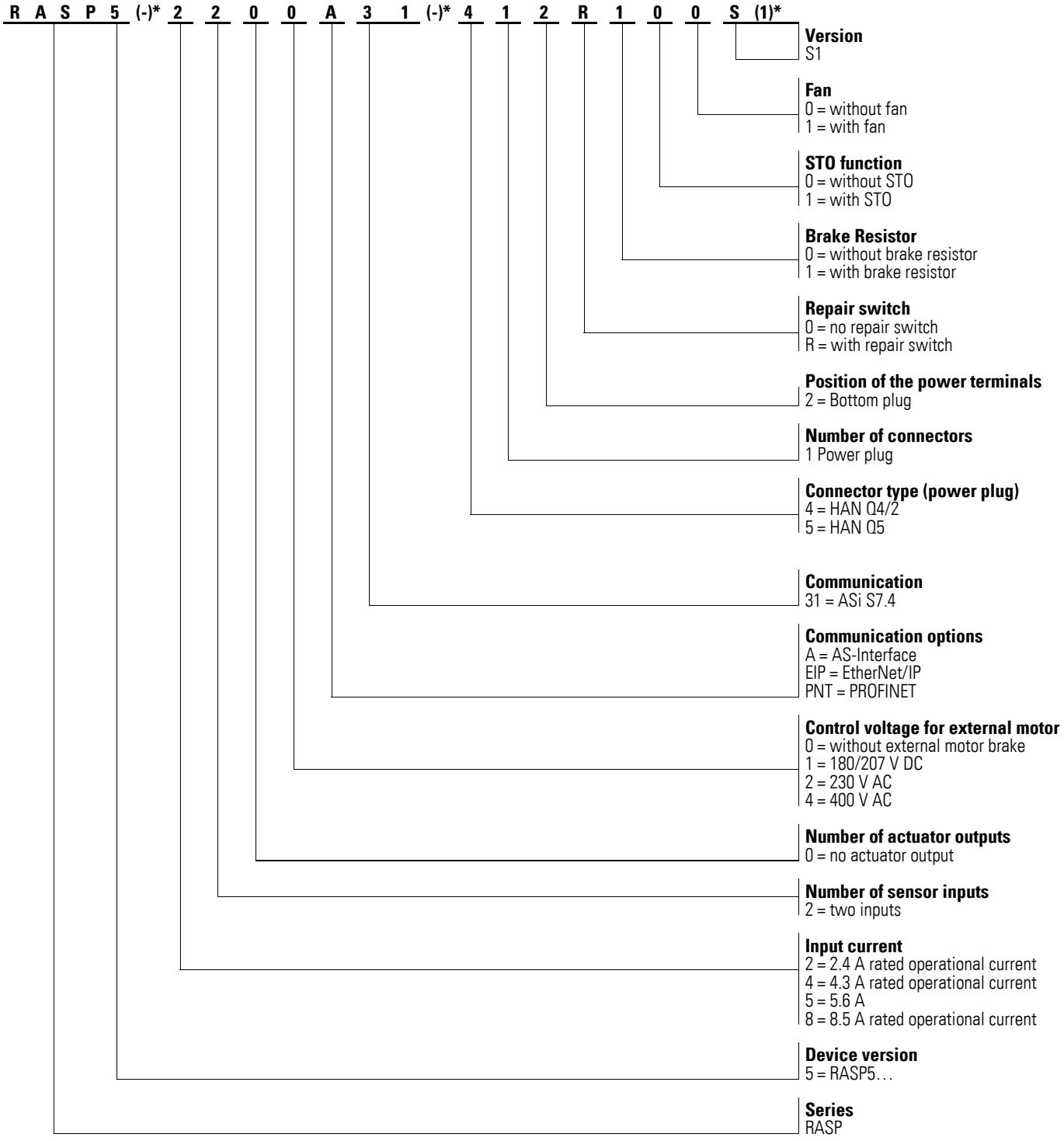


Figure 6: Type code of the RASP5 speed controllers

* Note: These characters are not shown in the US catalog number.

1.4 Technical data

Table 2: General rated operational data (overview)

Technical data	Formula symbol	Unit	Value	
			RAMO5	**RASP5**
General				
Standards			IEC/EN 60947-4-2 EN 50581	IEC/EN 61800-3 IEC/EN 61800-5-1 EN 50581 EN 61800-5-2 EN ISO 13849-1 EN 62061
Approvals, certificates			CE, CCC, cUL	CE, cUL
Production quality			Directive 2011/65/EU (RoHS), ISO 9001	Directive 2011/65/EU (RoHS), ISO 9001
Protection class			IP65, NEMA 12 / NEMA 12K	IP65, NEMA 12 / NEMA 12K
Mounting position			vertical (→ Page 82)	vertical (→ Page 82)
Ambient temperature range				
Operation		°C	-10 - +40	-10 - +40 (without derating)
Storage		°C	-40 - +70	-40 - +70
Set-up altitude	H	m	0 to 2000 above MSL with 1 % power reduction per 100 m over 1000 m	0 to 2000 above MSL with 1 % power reduction per 100 m over 1000 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, Semisinusoidal 15 g/11 ms	1000 shocks per shaft, Semisinusoidal 15 g/11 ms

Technical data	Formula symbol	Unit	Value	
			RAMO5	RASP5
Main circuit				
Feeder unit				
Rated operational voltage	U_e	V	3 AC 400/480	3 AC 400/480
Rated voltage for brake control	U_e	V	180/207 V DC 230/277 V AC 400/480 V AC	180/207 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 configuration			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	–	At least one minute pause between two power-up operations
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/ Degree of pollution (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	U_{LN}	0 - U_{LN}
Output frequency	f_2	Hz	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
Allocated motor output[1)]				
(with motor protection) with 400 V, 50 Hz	P	kW	0.09 - 3	0.18 - 4
at 440 V - 460 V, 60 Hz	P	HP	0.125 - 3	0.25 - 5

Technical data	Formula symbol	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	50 + 160 for sensors	50 + 160 for sensors
Specifications			S-7.4 S-7.A.E	S-7.4
Slave 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 and externally ventilated, three-phase asynchronous motors with 1500 rpm (at 50 Hz) and 1800 rpm (at 60 Hz)

1.5 Compliance with UL standards

1.5.1 Excerpts concerning UL conformity

The following are excerpts from the original English UL compliance documents.

1.5.1.1 RAMO (file E251034)

These devices are enclosed type AC Motor starters incorporating semiconductor switching means. These devices are intended for installation on industrial machines in accordance with Standard for industry Machinery NFPA79.

These devices do not provide reduced voltage starting feature.

These devices do not provide isolation (isolating function).

These devices do provide motor overload protection with thermal memory and phase-loss protection.

These devices or control units have not been evaluated as providing a safety or limiting feature.

These devices are for installation in Overvoltage Category III and pollution degree 3.

Auxiliary Control outputs intended to device resilient Load.

Electrical Ratings:

MODEL – 400V range		INPUT	OUTPUT			BCP Fuse/ Breaker
-		(3 phase)	(3 phase)			
Frame size	Model Number	FLA	FLA	Power	Power	
1A	RAMO5	6.6	6.6	3 kW	3.0 HP	30A
Input Voltage 380-480/277Vac, 50/60Hz | Output Voltage 380-480VAC, 50/60Hz						

Short Circuit Ratings:

MODEL	SHORT CIRCUIT RATING (kA)	
	Fuses (J-Type)	Breakers (Type C)
RAMO5	100kA	10kA
RAMO5-…R (with repair switch)	10kA	10kA

Environmental Ratings: Ambient Temperature: +55 °C, Enclosure Type: 12, Markings

Short Circuit Current Ratings:

"Suitable for use on a circuit capable of delivering not more than 100 000 rms symmetrical amperes, 480 volts maximum. Suitable for motor group installation. When protected by J class fuses rated 30A."

"Suitable for use on a circuit capable of delivering not more than 10 000 rms symmetrical amperes, 480 volts maximum. Suitable for motor group installation. When protected by a circuit breaker having an interrupting rating not less than 10 000 rms symmetrical amperes, 480 volts maximum, rated 32A."

Wiring terminals marked to indicate proper connections for the power supply, load and control circuit.

Use 60/75 deg.C copper field wiring conductors.

The ground terminals are marked with "G", "GR", "GRD", "ground", "grounding", "PE", or the like.
The symbol 5019. IEC publication 417, may be used, but if used alone the symbol shall be defined in the installation Instructions provided with the equipment.

"WARNING"

"The opening of the branch circuit protective device is able to be an indication that a fault current has been interrupted. To reduce the risk of fire or electric shock, current-caring parts and other components of the controller should be examined and replaced if damaged."

For Canadian installations:

"AVERTISSEMENT – L'ouverture du dispositif de protection de la dérivation peut signifier qu'un courant de défaut a été interrompu. Pour réduire le risque d'incendie ou de choc électrique, les pièces porteuses de courant et autres composants du contrôleur devraient être examinées et remplacées s'ils sont endommagés."

1.5.1.2 RASP (file E253552)

Electrical Ratings:

MODEL – 400V range		INPUT	OUTPUT		
		(3 phase)	(3 phase)		
Frame size	Model Number	FLA	FLA	Power kW	Power HP
1A	RASP5-2…	2.4	2.4	0.75	1.0
1A	RASP5-4…	4.3	4.3	1.5	2.0
1A	RASP5-5…	5.6	5.6	2.2	3.0
1B	RASP5-8…	8.5	8.5	4.0	5.0

Input voltage 380-480/277 VAC, 50/60Hz, Output voltage 20-500 VAC, 0-500HZ
A: external fan not fit
B: external fan fitted

Ratings (continued)

Terminals – All Models	Qty	Maximum ratings
Sensor supply	3	24V 100mA
Motor Brake	1	600mA 400V (6A < 120mS)

Short Circuit Rating (kA)		
RASP5	100kA	When protected by Class J fuses
	10kA	When protected by Circuit breaker (Type C)
	65kA	When protected by Type E combination Motor Controller
RASP5-xxR (repair switch)	10kA	When protected by Class J fuses
		When protected by Circuit breaker (Type C)
		When protected by Type E combination Motor Controller

Environmental Ratings:
Maximum ambient air temperature 55 °C
Enclosure Type 12

TECHNICAL CONSIDERATIONS
USL - indicates investigated to United States Standard UL61800-5-1 - listed.
CUL - indicates investigated to Canadian Standard CSA 22.2 No. 274 - listed

General:
These devices are solid state variable/speed AC drive inverters which convert a fixed frequency three phase input voltage to a 3-phase, variable frequency, variable voltage output. The inverter automatically contains the required volts-Hz ratio allowing the AC motor to run at its optimum efficiency and provide constant torque capability through the motor speed range.

The power conversion equipment provides solid state motor overload protection.

Over-current function was evaluated. Maximum current limit is 150 percent of FLC. The adjustable range is 0 to 150 percent of FLC.

Drive is provided with solid state short circuit protection circuit which is the same throughout the series. Current sensing is accomplished by monitoring the DC bus and/or all the motor outputs.

These drives or control units have not been evaluated as providing a safety or limiting feature.

The devices use the supplied thermocouple in the IGBT packs to control thermal functions – 100 % production test used to confirm functionality.

These devices are for installation in Overvoltage Category III and pollution degree 3.

Auxiliary Control outputs intended to drive resistant Load.

Marking (continued):

75 °C wire only

"Use copper conductors only"

Short Circuit Current Ratings:

"Suitable for use on a circuit capable of delivering not more than 100 000 rms symmetrical amperes, 480 volts maximum. Suitable for motor group installation. When protected by J class fuses rated 30A."

"Suitable for use on a circuit capable of delivering not more than 10 000 rms symmetrical amperes, 480 volts maximum. Suitable for motor group installation. When protected by circuit breaker having an interrupting rating not less than 10 000 rms symmetrical amperes, 480 volts maximum, rated 32A."

"Suitable for use on a circuit capable of delivering not more than 65 000 rms symmetrical amperes, 480 volts maximum. When protected by Type E combination motor controller model PKZM4-32 manufactured by Eaton rated 480Y/277Vac 20HP."

RASP…R (disconnect switch):

"Suitable for use on a circuit capable of delivering not more than 10 000 rms symmetrical amperes, 480 volts maximum. Suitable for motor group installation. When protected by J class fuses rated 30A."

"Suitable for use on a circuit capable of delivering not more than 10 000 rms symmetrical amperes, 480 volts maximum. Suitable for motor group installation. When protected by circuit breaker having an interrupting rating not less than 10 000 rms symmetrical amperes, 480 volts maximum, rated 32A."

"Suitable for use on a circuit capable of delivering not more than 10 000 rms symmetrical amperes, 480 volts maximum. When protected by Type E combination motor controller model PKZM4-32 manufactured by Eaton rated 480Y/277Vac 20HP."

75 °C wire only

"Use 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 National Electrical Code and any additional local codes or the equivalent.

UL61800-5-1

WARNING

The opening of the branch circuit protective device may be an indication that a fault has been interrupted. To reduce the risk of fire or electric shock, current-caring parts and other components of the controller should be examined and replaced if damaged.

CSA C22.2 No. 274

ATTENTION

THE OPENING OF THE BRANCH CIRCUIT PROTECTIVE DEVICE MAY BE AN INDICATION

THAT A FAULT HAS BEEN INTERRUPTED. TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, CURRENT-CARING PARTS AND OTHER COMPONENTS OF THE CONTROLLER SHOULD BE EXAMINED AND REPLACED IF APPROPRIATE. IF BURNOUT OF THE CURRENT ELEMENT OF AN OVERLOAD RELAY OCCURS, THE COMPLETE OVERLOAD RELAY MUST BE REPLACED

All models incorporate internal overload protection for the motor load that does not require the use of an external or remote overload protection device. The protection level is adjustable and the method of adjustment is provided within instructions/manual for the product.

Shall be marked with Motor overload protection limit set at 150 % of FLA.

1.5.2 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 operational voltage for brake control	180/207 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
Protection class	IP65 / NEMA 12
Ambient temperature, maximum	55 °C

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

	With fuse (UL listed)		Circuit-breaker (UL listed)	
	With built-in repair switch	Without built-in local disconnect switch	With built-in repair 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 repair switch are approved for use as motor disconnects (lockout/tagout).

RAMO5 motor starters can be installed and operated under the following conditions: The device is suitable for use on a circuit capable of delivering not more than 65000 A 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 65000 A rms symmetrical amperes, 480 V, 32 A maximum.

Only for use with flexible cable connected drives is at the discretion of the AHJ.
Installation may be limited to NFPA 79 applications.

1.5.3 RASP5

RASP5 speed controllers 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 operational voltage for brake control	180/207 V DC 230/480 V AC 400/480 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 % of full load
Thermistor monitoring	integrated
Protection class	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-breaker (UL listed)	
	With built-in repair switch	Without built-in local disconnect switch	With built-in repair 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 repair switch are approved for use as motor disconnects (lockout/tagout).

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

The device is suitable for use on a circuit capable of delivering not more than 65,000 A 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 A rms symmetrical amperes, 480 V, 32 A.

The drive has means to accept and act upon a signal from a thermal sensor mounted in or on the motor.
These devices provide 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 basic insulation for 480 V is provided.
The thermistor circuit must be protected against direct contact for 480 V using basic or supplementary insulation.

- Only for use with flexible cable connected drives is at the discretion of the AHJ. Installation can 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.
Current-carrying parts and other components of the controller must be examined and replaced if damaged to reduce the risk of fire or electric shock. If the current element of an overload relay burns out, the complete overload relay must be replaced.

WARNING

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

1.6 Selection criteria

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

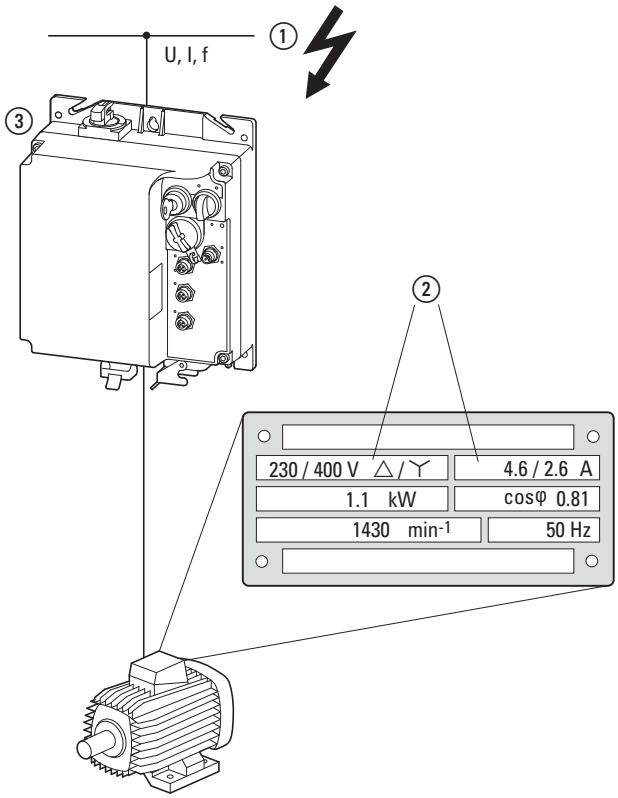


Figure 7: Selection criteria

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

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

ATTENTION

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

1.6.1 Special features of motor selection for RASP5

Check whether your selected RASP5 speed controller and the associated three-phase AC motor are compatible with each other with regard 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 speed controllers, but will normally require additional engineering, modification of the various parameters, and detailed information from the motor manufacturer.
- Only use motors that have insulation class F (maximum steady state temperature of 155 °C) at least.
- 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.
- In the case of undersized motors, the motor output should not be more than one rating level lower than the rated rating level (in order to ensure that the motor will be protected).
  Set Frequency control (V/Hz) mode if the motor output is significantly lower.

1.6.2 Synchronous, reluctance, and PM motors

RASP5 speed controllers enable three-phase motors to be operated with maximum energy efficiency, e.g.:

- Efficiency rating 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 data on the rating plates also differs significantly from the usual data, e.g. 315 V, R_{20*} = 2.1 Ω, L* = 20 mH and U_{Pol} = 195 V/1000 rpm

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 as components for use in commercial applications. RAMO5 and RASP5 are pieces of 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 5 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 an earthed star point and separate N and PE conductors (TN-S grounding system). Unearthed configurations are not permissible.
- All Rapid Link 5 function modules comply with safe isolation between the AS-Interface voltage and the voltages 24 V ⎓ and 400/480 V ~ as stipulated in IEC/EN 60947-1, Appendix N.
- The thermistor circuits in RAMO5 and RASP5 units have double insulation.
- All devices am 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 earthed on the secondary side.
  The 30-V DC power supply unit for the AS-Interface® power supply (head-end controller, interface control unit) must meet safe isolation requirements in line with SELV.
- Emergency switching off devices (to IEC/EN 60204-1) must be present. Their function must not be limited in any way.
- Effective lightning protection measures must be implemented in the plant to prevent damage to electronic components.

The units must not be connected to IT grounding systems (networks without a ground potential reference) because the devices' internal filter capacitors connect the supply system to ground potential (enclosure).

1.7.2 Machinery directive and CE mark

After installation in a machine, the RAMO5 and RASP5 must not be put into operation until the assigned machine has been confirmed to comply with the safety requirements of Machinery directive 2006/42/EC (corresponds to EN 60204). The user is responsible for ensuring the machine application's compliance with EC directives.

The CE labels applied to the RAMO5 and RASP5 units 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 (e.g. phase compensation capacitors),
- connect multiple RAMO5 and RASP5 units in parallel,
- make a direct connection to the input (bypass).

The technical data and connection conditions must be observed.

For details, see the rating plate of the RAMO5 or RASP5 and the documentation.

Any other usage constitutes improper use.

1.8 Maintenance and inspection

If the general rated operational data (→ Table 2, page 19) is observed and the special technical data is taken into account (→ Section 5.4, Specific technical data, page 124 and page 138) for the respective power classes and versions, RAMO5 and RASP5 are maintenance-free. External factors can, however, influence the components'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	please enquire
Check the fan function - RASP5 only	6 - 24 months (depending on the environment)
Check plug-in connectors (AS-Interface, sensors, mains, motor, etc.) and all metallic surfaces for corrosion	6 - 24 months (depending on the environment)
STO function (RASP5 with STO input only)	Activate and deactivate STO at least once every three months.

RAMO5 or RASP5 units have not been designed to allow individual assemblies of a device to be replaced or repaired.

1.9 Storage

If RAMO5 or RASP5 devices must be stored before use, ensure that the ambient conditions at the site of storage are suitable:

- 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.

1.10 Service and warranty

If you have any problems with your 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 your 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 terms and conditions of Eaton Industries GmbH.

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

Email: AfterSalesEGBonn@Eaton.com

2 Engineering

2.1 Rapid Link 5 modules

The Rapid Link 5 devices RAMO5 and RASP5 are installed in the direct vicinity of the motors. Their versions and mounting depend on the required specifications and the local conditions.
They can be connected to the power and data bus at any point without having to interrupt the bus.

The example below provides a simplified overview using RAMO5.

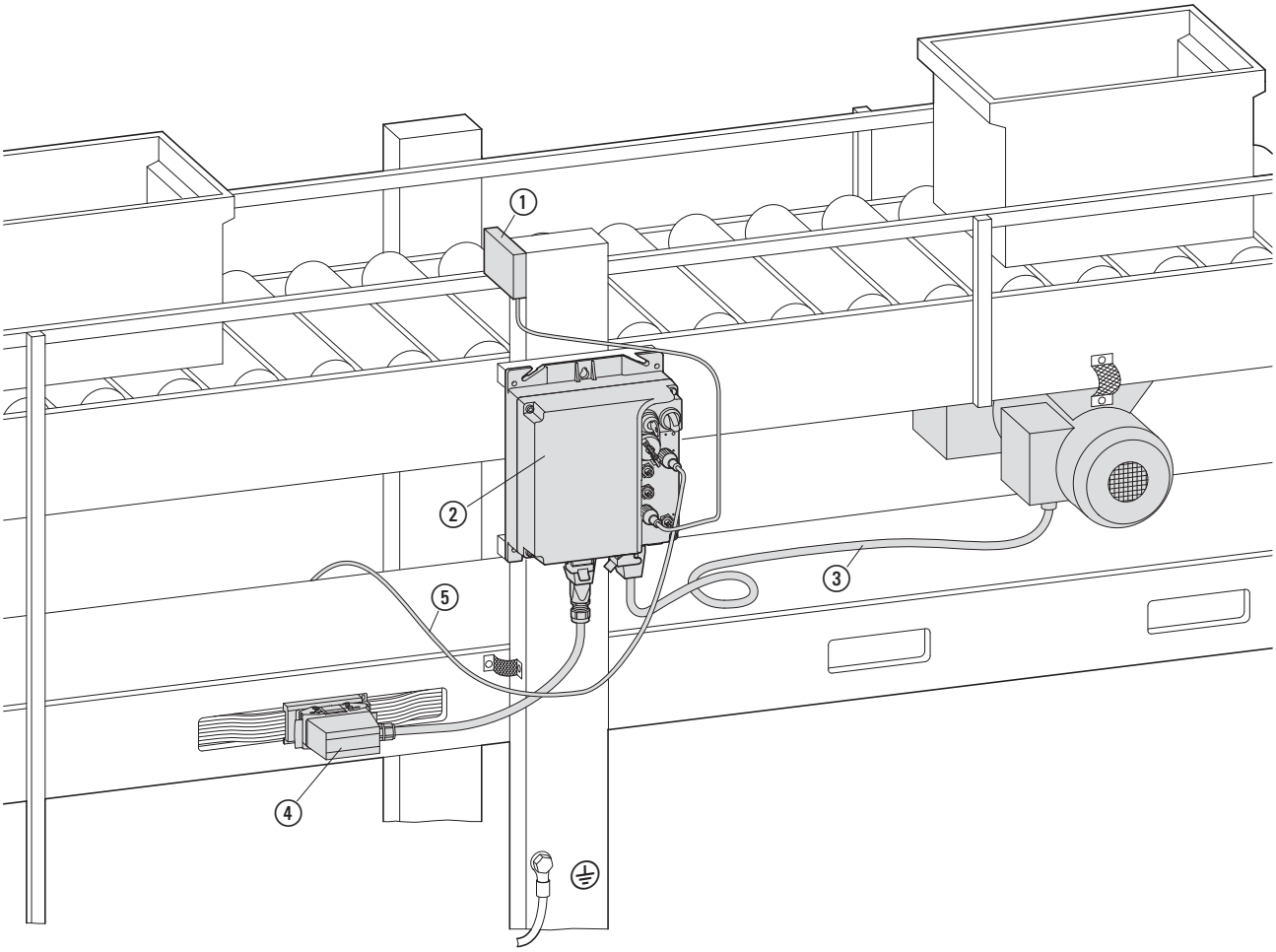
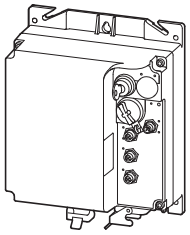


Figure 8: Example showing how to use a RAMO5 unit
① Sensor (light barriers)
② RAMO5
③ Motor connection cable
④ Mains connection on power bus
⑤ AS-Interface

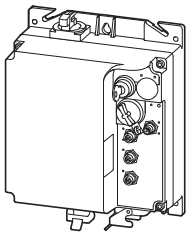
2.1.1 Versions

Examples of externally visible differences between the Rapid Link 5 modules:



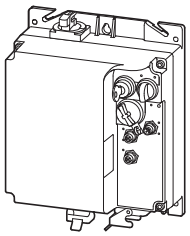
RAMO5-D…-0S1

- DOL starter
- without repair switch



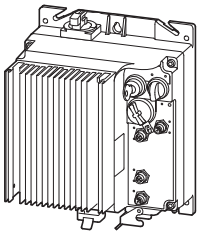
RAMO5-D…-RS1

- DOL starter
- with repair switch



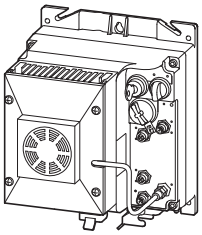
RAMO5-W…-RS1

- Reversing starter
- with repair switch



RASP5-…-…R…

- with repair switch



RASP5-…-…1S1

- with fan

2.2 Connections

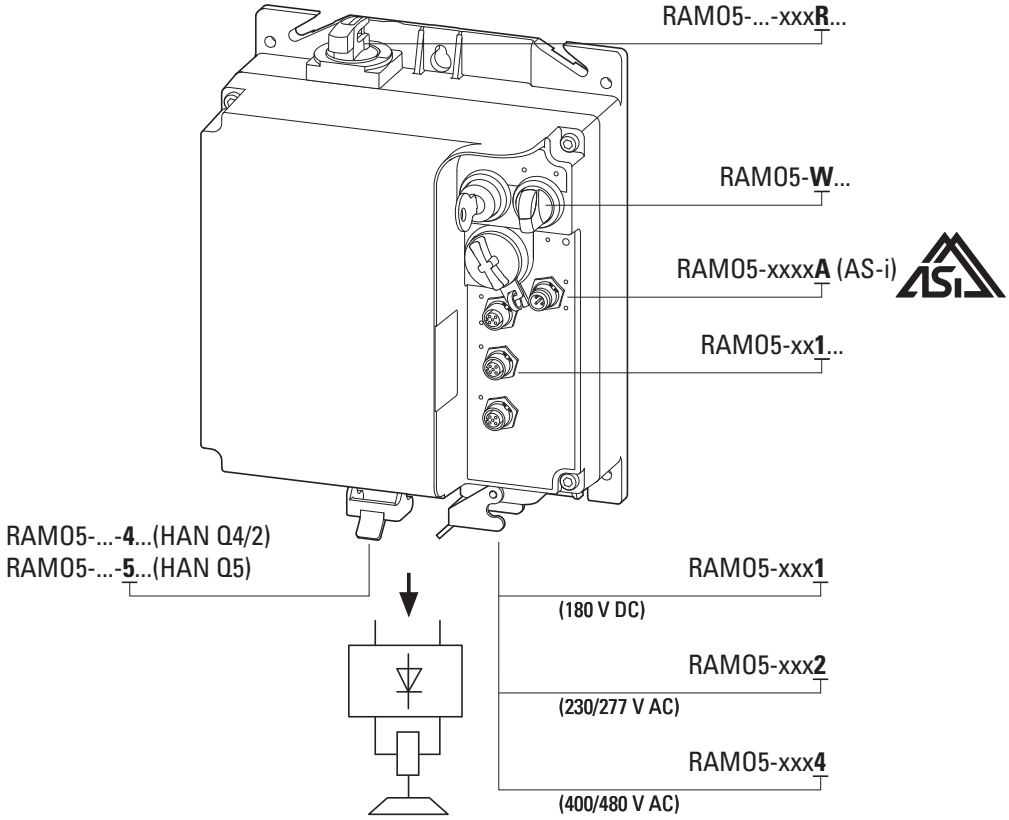


Figure 9: Connections on the RAMO5

Designation	Function
RAMO5-xxxR	Repair switches
RAMO5-W…	Switch for selecting the direction of rotation
RAMO5-xx1…	Actuator output
RAMO5-xxxxA	AS-Interface

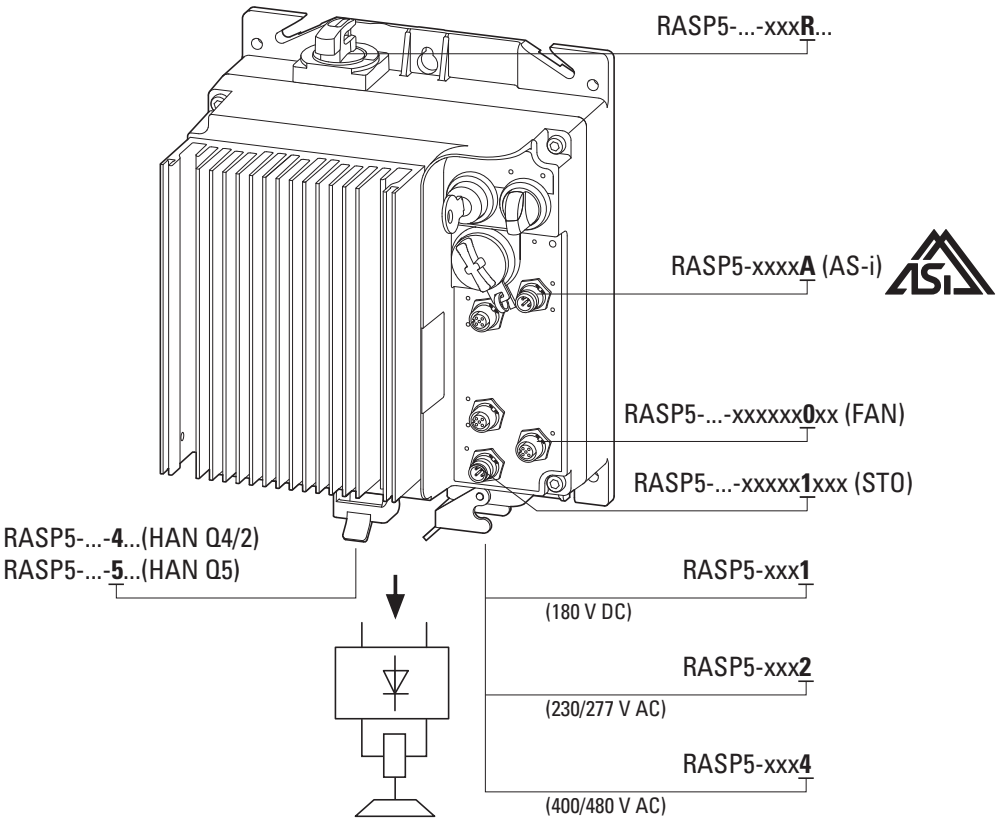


Figure 10: Connections on the RASP5

Designation	Function
RASP5-…-xxxR…	Repair switches
RASP5-xxxxA	Connection to AS-Interface
RASP5-xxxxx1x	= no STO function
RASP5-xxxxxx0xx	Connection for device fan

2.2.1 Connections in the power section

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

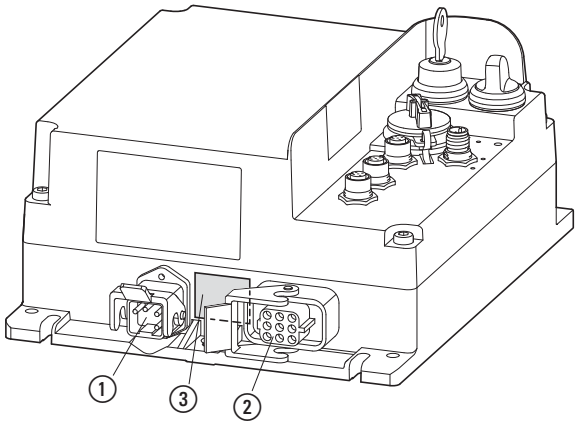


Figure 11: Connections in RAMO5 power section

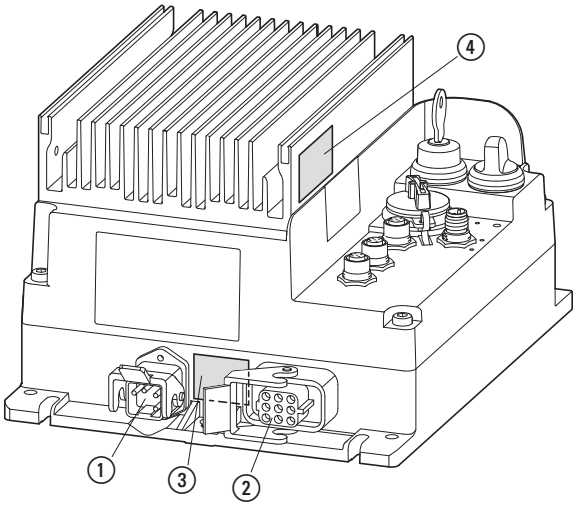


Figure 12: Connections in RASP5 power section

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

② Motor feeder socket (DESINA)

③ Warning: "Dangerous voltage" – only for RASP5

WARNING

Dangerous voltage from internal DC-Link capacitors (observe discharge time).

④ Warning: "High temperature" – only for RASP5

CAUTION

High heat sink temperature.
Do not touch!

For detailed information about the connectors, see chapters → Section 3.5, Power plug, page 97 and → Section 3.6, Motor feeder, page 105

2.3 Repair switches

The device versions RAMO5-…-…RS1 and RASP5-…-…R…S1 are equipped with arepair switch that disconnects the Rapid Link 5 modules from the mains voltage in all three phases ①.

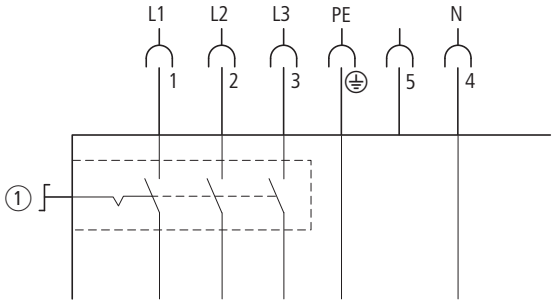


Figure 13: Repair switch in position 0 = OFF

→ Before operating the repair switch, the motor must have stopped.

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.

ATTENTION

For RASP5 units, the pause between two power-on operations must be at least one minute.

The positions of the repair switch are shown in the illustration below.

In the case of RAMO5:

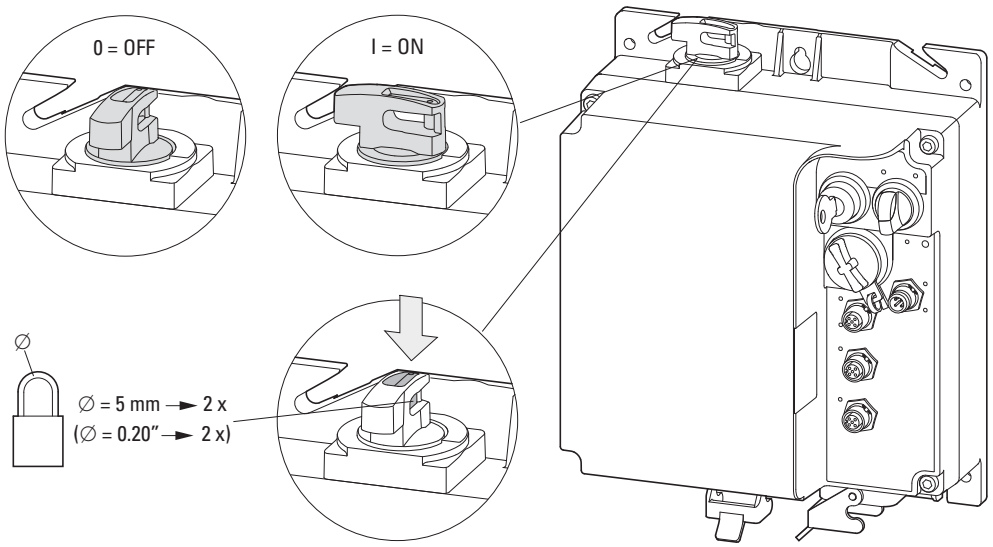


Figure 14: RAMO5 with repair switch

In the case of RASP5:

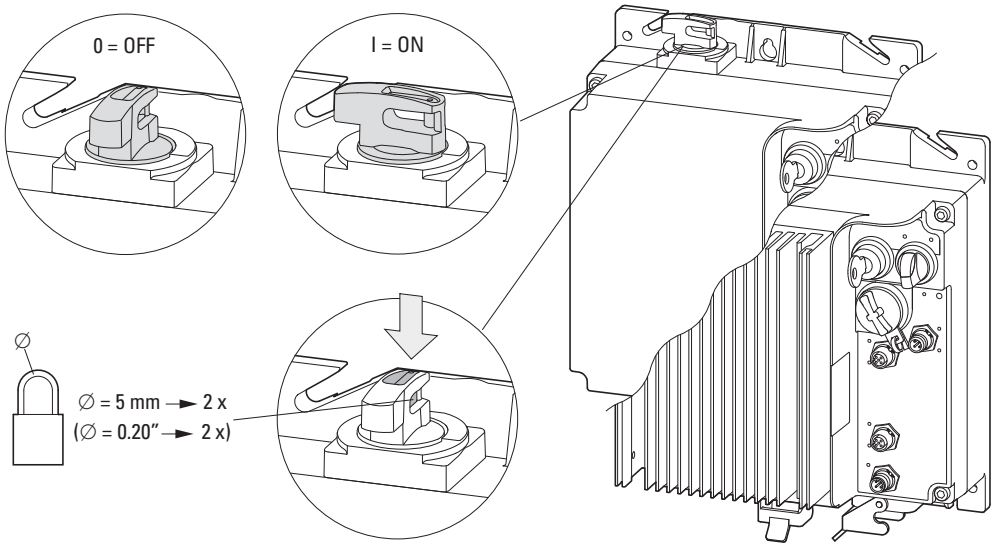


Figure 15: RASP5 with repair switch

Switch position 0 (= OFF) can be locked in place by pulling up the red padlock locking collar.
If necessary, up to two padlocks with a 5 mm diameter bracket can be inserted into the recess of the padlock locking collar.

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.

2.4 Electrical power network

2.4.1 Mains connection and configuration

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

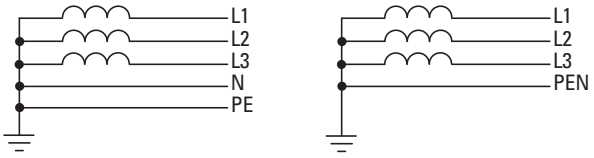


Figure 16: AC power networks with earthed center point (TN-/TT networks)

It is not permitted to connect or operate frequency inverters in asymmetrically grounded TN networks (phase-grounded Delta network, grounded Delta, USA), non-grounded networks, or high-resistance grounded (over 30 Ω) IT networks.

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

2.4.2 Mains voltage and frequency

The standardized rated operating voltages (IEC 60038, VDE017-1) of utility companies guarantee the following conditions at the transition points:

- Deviation from the rated voltage value:
  ±10 % or less
- Deviation in the voltage balance:
  ±3 % or less
- Deviation from the rated frequency value:
  ±4 % or less

The lower voltage value also makes allowance for the permitted voltage drop of 4 % in consumer networks, 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 permitted frequency range in all voltage ranges is 50/60 Hz here (45 Hz - 0 % – 66 Hz + 0 %).

2.4.3 Voltage balance

The uneven load on the conductor and the direct connection of greater power ratings can cause deviations from the ideal voltage waveform and unbalanced voltages in three-phase AC supply systems.

→ 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 allocated for power-side connections and wire cross-sections depend on the rated mains current of the Rapid Link 5 power bus.

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

The national and regional standards (for example VDE 0113, EN 60204) must be observed and the necessary approvals at the site of installation (for example UL) 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 (in line with EN 50178) are greater than 3.5 mA. The connection terminals marked PE and the enclosure must be connected to the earth-current 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 to be used and the line-protection fuses must be selected in accordance with local standards.

UL-approved fuses and approved copper cable that are heat-resistant to +60/75 °C must be used for installation in line with UL regulations.

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

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

2.5.2 Residual current devices

Other names include: RCD Residual current protective device, residual current protective device (residual current protective circuit breaker).

Residual current circuit breakers protect persons and animals from the presence (not the generation) 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 devices (RCD) must only be installed on the power side between the AC power supply network and the RAMO5 and RASP5 Rapid Link 5 modules.

WARNING

Only AC/DC-sensitive residual current devices (RCD, type B) must be used for RASP5 (EN 50178, IEC 755).

Markings on the residual current device	
AC/DC sensitive (RCD, part no. B)	 

RASP5 works 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.

Safety-relevant leakage currents can occur during operation if a RASP5 unit is not earthed (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. 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 consist of two separately connected ground cables.

2.6 Power bus

The power bus supplies RAMO5 and RASP5 Rapid Link 5 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.

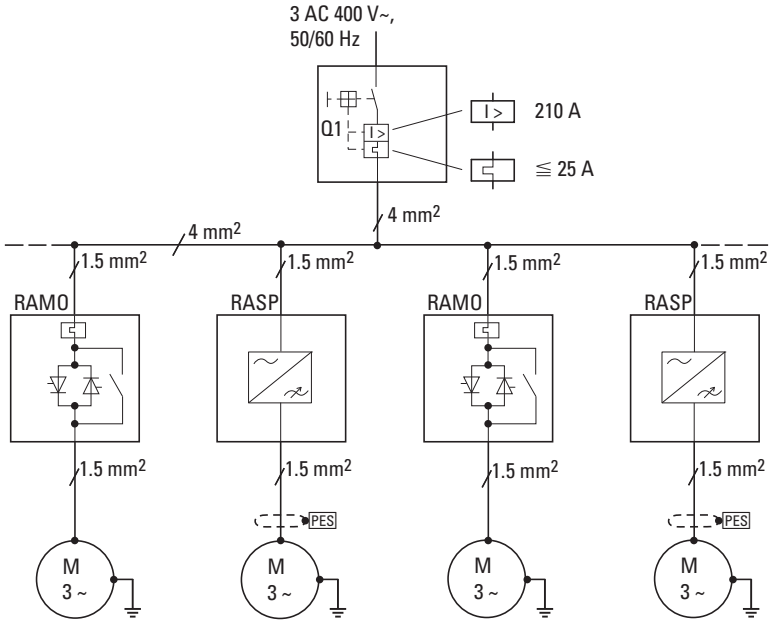


Figure 17: Sample configuration of a Rapid Link 5 system with RAMO5 and RASP5 units

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

- On a short circuit in one pole at the end of the power bus, for example in the terminal board of the last consumer, the upstream safety device must trip. 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 line 1.5 mm²)
$Z_{power\ bus}$	=	13.40 mΩ/m (power bus 4.0 mm²) 21.50 mΩ/m (power bus 2.5 mm²)

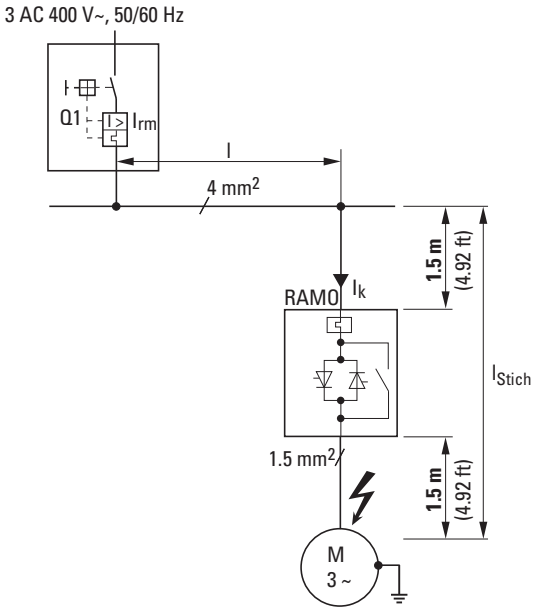


Figure 18: Example: RAMO5

Requirements for the group protection device during short-circuits.
The short-circuit current I_k must be greater than the tripping current of the short-circuit trip actuator I_{rm}. It depends on the impedance or length of the energy bus and the stub line.

→ Take the voltage drop under load into account when selecting the cable cross-section.
The user is responsible for taking other applicable standards (e.g., VDE 0113, VDE 0289) into account.

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-mm² power 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 high frequency leakage current during operation. Therefore, all earthing elements must be low-impedance elements connected in such a way as to establish an electrical contact 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 must be installed in a conductive enclosure with a good connection to ground.
- Use screened motor cables (short cables).

Ground all conductive components and housings in a drive system using as short a line as possible with the greatest possible cross-section (Cu braid).

2.8 Safe Torque Off (STO)

2.8.1 Overview

The function STO (STO = Safe Torque Off) is optionally available for 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. Moreover, this state is monitored internally in the drive.

The STO function can be used anywhere where the corresponding motor will come to a zero speed 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 uncontrolled run-down (coasting to a stop) has no safety implications.

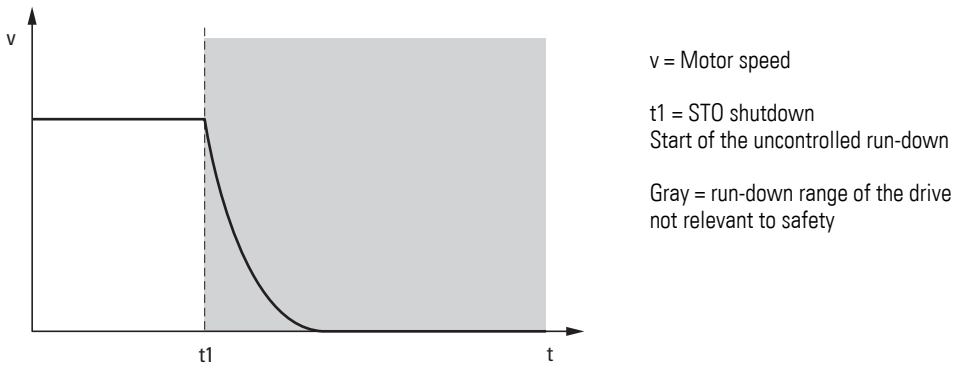


Figure 19: : STO conforming to Stop Category 0

This safety function corresponds to uncontrolled stopping as defined in IEC 60204-1, Stop category 0.

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 case of multiple output semiconductors (IGBTs) failing, having the STO function activated may result in a motor shaft rotational movement of 180 degrees/p (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-disconnector).

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.

WARNING

The STO control inputs act statically and in a similar way to a contactor:
As long as the STO inputs are voltage-free, the torque-generating energy is no longer supplied and thus the drive is also reliably prevented from starting up. If the STO inputs are supplied with power again, the drive can also start up automatically if all other requirements are met. This is the case, for example, when the voltage supply returns.

2.8.2 Safe stop and preventing a restart

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 pin 3 and pin 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.

If an unintended restart is to be reliably prevented using the STO function, this can be implemented by providing an external circuit for the STO inputs. For example, an upstream safety relay can be used that only releases the voltage for the STO inputs via a manually initiated reset function. According to the requirements (e.g. PL r in line with ISO13849-1) for all safety functions (e.g. EMERGENCY STOP), all components of the safety function (input/logic/output) must be selected. The safety relay must be selected and the wiring connected correspondingly.
The STO function implements a partial safety function via the output and makes the use of electromechanical contactors with self-monitoring auxiliary contacts superfluous.

Parameter bit P2-24 (start mode) is not suitable for preventing a restart in safety-related applications.

There are two situations that result in a restart:

Manual mode

After an STO has been triggered, the drive does not restart unless a manual reset has been performed using a switch on the device (key switch).
The prerequisite for this is that parameter bit P2-24 for configuring start-up behavior is set to the default setting.

Automatic mode

After an STO has been triggered, the drive starts again as soon as the STO is supplied with 24 V and the RUN command is still being transmitted via the bus. The setting of parameter bit P2-24 is not relevant in this case.

2.8.3 TÜV certification

RASP5 speed controllers with STO function that 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: "Safe torque off"
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 shutdown 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).

2.8.4 STO-compatible installation

DANGER

Make sure to use proper earthing 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 must 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 is in a safe operating state.

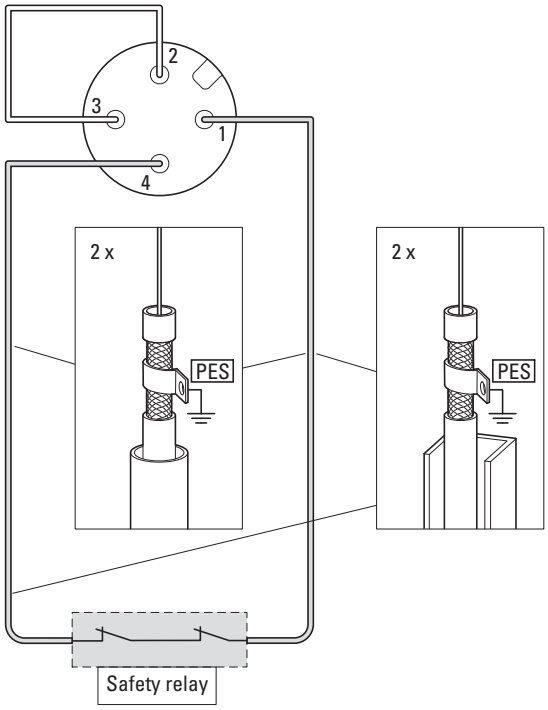
In order to prevent damage to the variable frequency drive, the devices should remain in their original packaging until right before they are installed.
They must be stored in a dry and clean area with a temperature range of -40 °C to 60 °C.

The conductor cross-section used for the STO installation must 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 also be observed for 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 (ESC = ground and short-circuit-safe installation).
- The 24 V DC power supply for the STO inputs can be supplied from the RASP5 internal 24 V DC voltage or from an external 24 V DC power supply. The RASP5 must be wired as described below.

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



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

Pin 2: 0 V

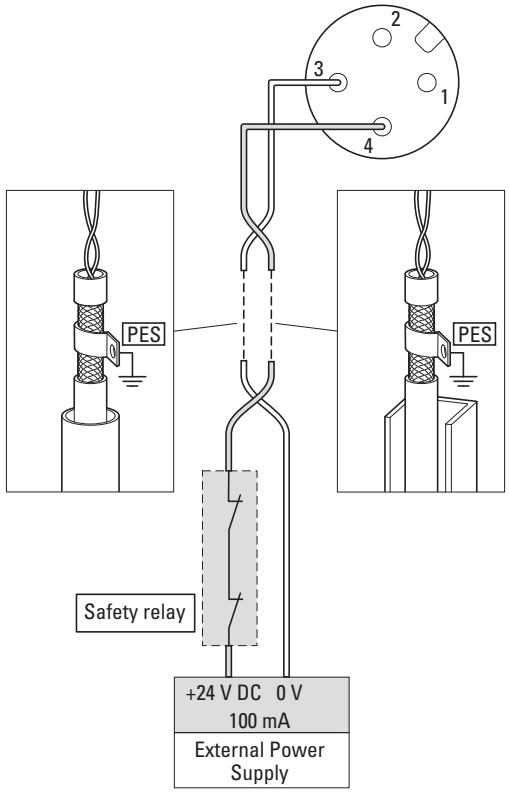
Pin 3: STO-: 0-V connection to internal control voltage

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

Figure 20: STO installation with internal control voltage

The two connecting cables from control signal terminal 1 (+24 V) to the safety relay's contact and from there back to pin 4 (STO+) must be wired individually and installed separately (ESC, 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 earthed (PES).

2.8.4.2 STO installation with external 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 from the safety controller

Figure 21: STO installation with external control voltage

The two connecting cables from the external power supply and the safety relay to the pin 4 (STO+) and pin 3 (STO-) must be twisted cables.
This twisted pair must be routed inside a closed cable duct or conduit (ESC) and must also be screened, with the corresponding cable screen being earthed (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

2.8.5 Direct enable

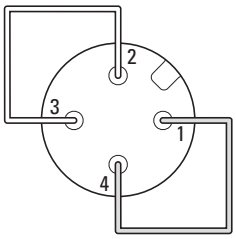


Figure 22: STO control signal terminals (direct enable)

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

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

The control section and the speed controller RASP5 remain blocked if no control voltage (24 V DC) is connected to pin 3 and pin 4.
$InHibit$ will be displayed. The **STO** LED stays off.

WARNING

This function is not suitable for continuous operation!

WARNING

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

2.8.6 STO function pick-up time

The total pick-up time for the STO function is the time that elapses from the moment a safety-relevant 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.

2.8.7 STO function messages

→ 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 state of the STO inputs.

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 ($5t\,o\text{-}F$) (not: $I\,nh\,ibt$).

2.8.8 Error Messages

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

Table 8: Error Messages

Keypad display	LED display STO	Meaning
$I\,nh\,ib\,it$	Off	there is no release
$5tOP$	Green	there is release
$5t\,o\text{-}F$	–	Internal STO fault

2.8.9 STO function checklist

The STO function of a drive must 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. I nH ıb ıE (locked state) is displayed when the motor is at a standstill and a Stop command has been issued to the RASP5 speed controller. The **STO** LED is off.	
2	The STO inputs are de-energized and the RASP5 speed controller receives a Start command. I nH ıb ıE (locked state) is displayed. The motor does not start. 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. I nH ıb ıE is displayed and the motor coasts to a stop. The **STO** LED is off.	

2.8.10 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.
- Check all electrical connections:
  The screw terminals must be properly tightened and the power cables must not show any signs of heat damage.

2.8.11 Application of the STO function and safety parameters

DANGER

In certain applications, additional measuring and monitoring equipment may be needed in order to meet the requirements of the system's safety function.
The STO function does not include a motor brake and the RASP5 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 adhered to 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 degree of protection.
- Maximum installation height for rated operation: 1000 m above mean sea level
  with a power reduction of 1 % per 100 m above 1000 m
  (up to max. 4000 m IEC/max. 2000 m UL).
- Relative humidity: < 95 % (non-condensing).
  The RASP5 speed controller must always be free of frost and moisture.

2.9 Sensor inputs

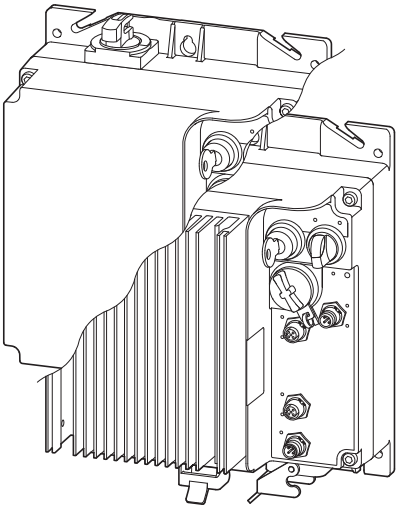
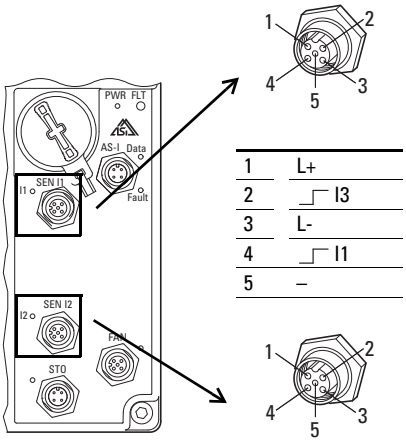


Figure 23: Connection sockets of sensor inputs

The RAMO5 and RASP5 Rapid Link 5 modules have two M12 sockets for direct connection of sensors.



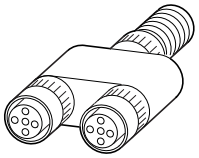
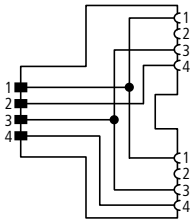
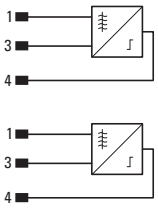
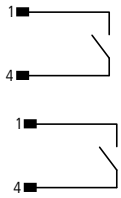
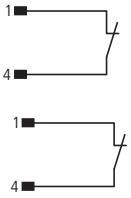
Pin	Configuration
1	+24 V DC (160 mA) – output
2	Sensor input
3	0 V (reference potential)
4	Sensor input
5	Not used

Figure 24: Pin assignment for RASP5

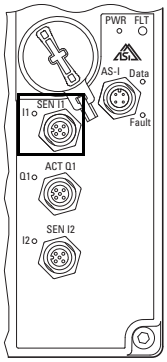
Y connector

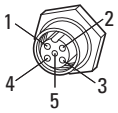
Only for RASP!

Up to four sensors can be connected to these two M12 sockets using optional RA-XM12-Y Y connectors.

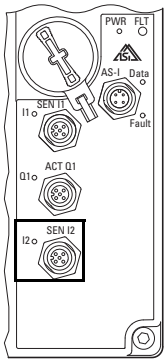
RA-XM12-Y Y connectors		Optical or inductive sensors ∑ I ≦ 160 mA; 24 V DC	N/O closing contact	N/C opening contact	Sensor cable coding
			Mechanical sensors		
					A coded (IEC/EN 60947-5-2) 1 = brown 2 = white 3 = blue 4 = black

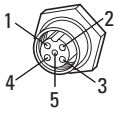
Pin assignment for RAMO5





1	+24 V DC/160 mA
2	–
3	0 V
4	I1
5	–





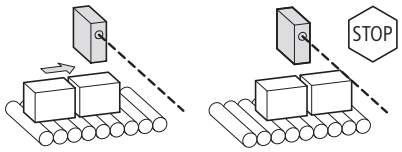
1	+24 V DC/160 mA
2	–
3	0 V
4	I2
5	–

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 for 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 **FLT** LED will light up 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 incorporated directly in the internal controller of RAMO5 and RASP5 and transmitted to a higher-level PLC through the AS-Interface. The signal adaptation and integration into the controller sequence is carried out via parameter P1-13.

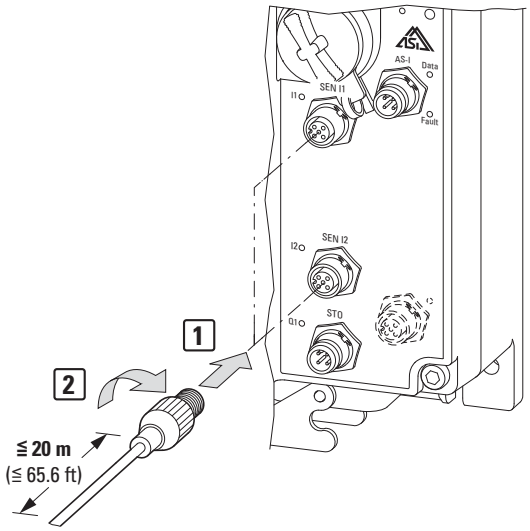


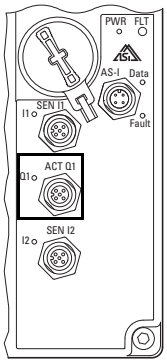
Figure 26: Connection to sensor inputs (RASP5 as an example)

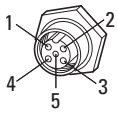
2.10 Actuator output

Actuator output

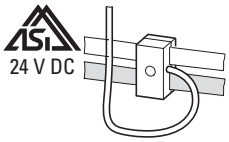
An actuator output is only present in the version RAMO5xx**1**…-…S1.

Actuator output ACT Q1 (M12 connectors) can be used to trigger external indicator elements or relays.
In this case, pin 4 of the AS-i connector must be supplied with an external +24 V DC voltage. The corresponding reference point is pin 2 (0 V) on the AS-i connector. The actuator (indicator lamp, relay, valve) can be connected using Q3 pin 4 (+24 V, max. 1 A). The reference point (0 V) is pin 3.

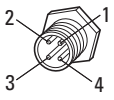




1	–
2	–
3	0 V actuator output (ACT Q1)
4	24 V DC actuator output (ACT Q1)
5	–



RA-XAZ2-1M



1	(AS-Interface+)
2	External 0 V
3	(AS-Interface–)
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 no external power supply is present, the maximum permissible load current is only 100 mA.

The actuator output is short-circuit proof.

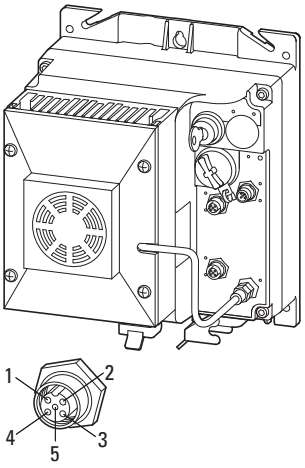
In the event of an overload or short-circuit, a group fault signal will be generated and the **FLT** LED will light up red to indicate this.

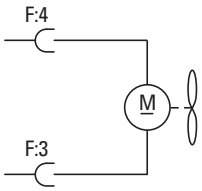
2.11 Device fan connection

Only for RASP!

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 RASP5 speed controller.

Only connect the RASP5 device fan to the device fan connection. Any other load connected here is considered contrary to intended use!

The device fan starts up briefly when the mains 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:

- Basically, three-phase AC motors with squirrel-cage rotors and surface-cooling (also know as three-phase asynchronous motors or standard motors) can be connected to the output of RAMO5 and RASP5 Rapid Link modules. 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 one motor with at least temperature class F (155 °C maximum continuous temperature) should be operated on the frequency-controlled RASP5.
- Four-pole motors should preferably be selected (synchronous speed: 1500 rpm at 50 Hz or 1800 rpm at 60 Hz).
- Operating conditions for S1 operation according to IEC 60034-1.
- The rated current of the motor and RAMO5 or RASP5 should be identical.

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 name plate.

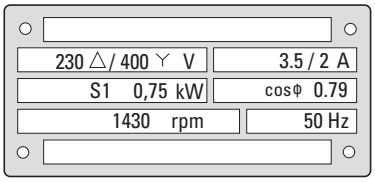


Figure 28: Example of a motor ratings plate

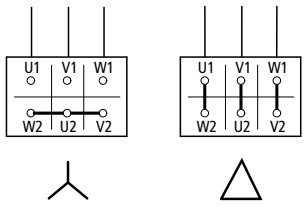


Figure 29: Circuit types:
Star-connected circuit (left), delta circuit (right)

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

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 only possible with the frequency-controlled RASP5 Rapid Link 5 module.

→ If motors are to be operated with frequencies higher than the standard 50 or 60 Hz, then these operating ranges must be approved by the motor manufacturer.
The motors could otherwise be damaged.

2.12.3 Direction reversal

Three-phase motors use a clockwise rotating field (viewed along the motor shaft) when phase L1 is connected to U1, L2 to V1 and L3 to W1.
This default operating direction can be reversed using additional gear mechanisms or modified installation positions. In for RAMO5-W... units, the direction of rotation can be reversed without changing the wiring using parameter P6-08.

In the default settings (P6-08 = 0), a clockwise rotating field is produced with the control command FWD; and the setting P6-08 = 1 produces a counter-clockwise rotating field.

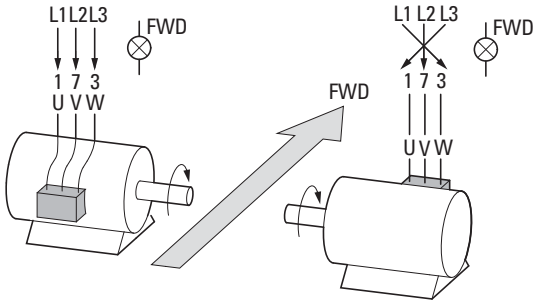


Figure 30: Example showing how to change the phase sequence

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

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

2.12.4 Quick stop

A Quick stop describes when the motor is stopped in Auto mode via pin 4 of the sensor inputs I1 and I2 in RAMO5 and RASP5 units.

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

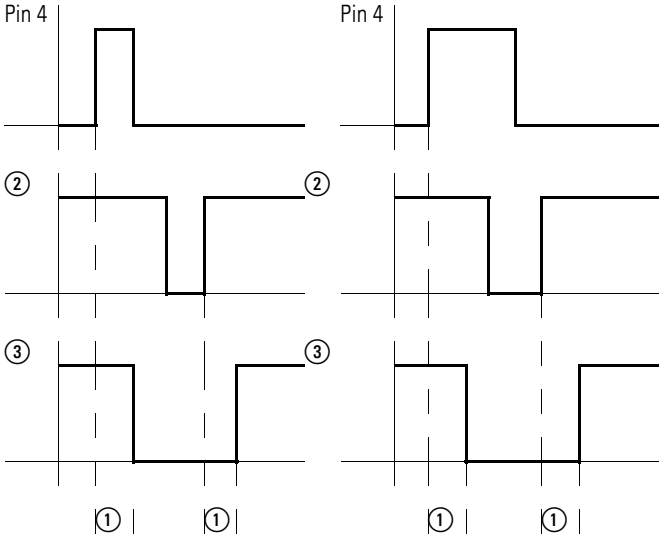


Figure 31: Examples: Edge-controlled Quick stop in Auto mode (Pin 4 = I1)

① Internal response time
② Start signal from the PLC via the AS-Interface
③ Internal signal to motor output as a response to the rising edge of the sensor at pin 4 (Stop) and to the subsequently rising edge of PLC (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 input signal at pin 4 (rising edge) switches the motor output off.
If the start signal is reset via the PLC (falling edge), the motor output can be switched on again.

The **FWD** or **REV** LED flashes if the motor output is switched off by a Quick stop and the corresponding rotational direction bit is still set in the PLC.

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

Example of the Quick stop function

Vertical sorter with 360° eccentric drive:
The Quick stop function makes it possible for the drive to stop at the exact point the limit switch is reached. Preprocessing in RAMO5 or RASP5 enables the motor to be switched off directly. PLC and bus cycle times have no influence on the switch-off time.

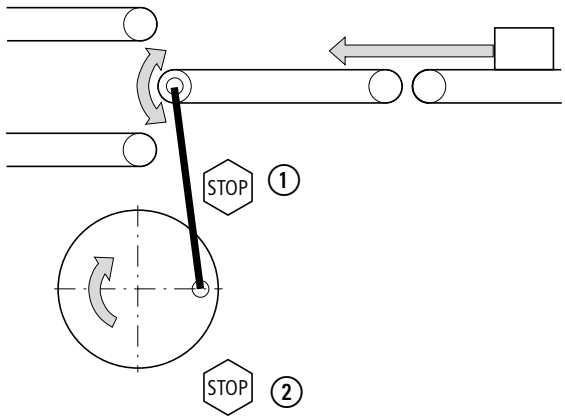


Figure 32: Example for eccentric drive
① upper break point
② lower break point

2.12.5 Interlocked manual operation

Interlocked manual operation prevents damage to conveyed goods or the equipment through incorrect handling. 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.

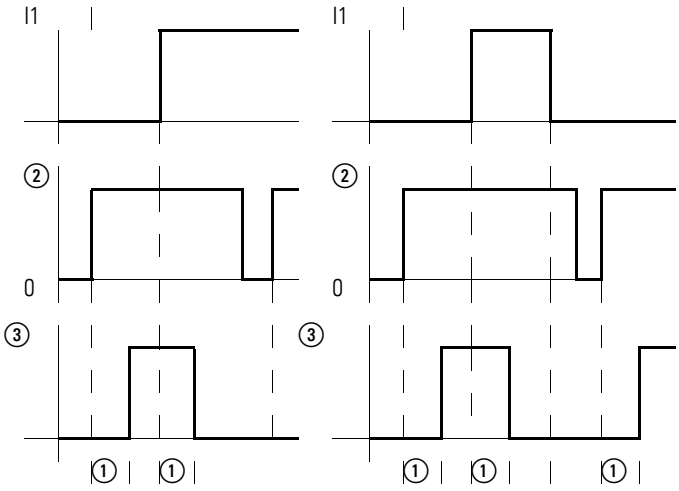


Figure 33: Interlocked manual operation
① Internal response time
② Selector switch in Manual mode
③ Output signal

As shown in Figure 33, the FWD rotating field direction is disabled in Manual mode when interlocked manual operation is activated after a rising edge (on I1, for example) with a continuous signal. The motor can then be operated in Manual and Auto mode with an opposite direction of rotation in RAMO5-W and RASP5 units.

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 notifications in interlocked Manual mode for RAMO5 and RASP5:

- The **FWD** or **REV** LED lights up if the associated rotation direction is selected using the selector switch.
- The **FWD** or **REV** LED flashes when the selector switch is operated, but RAMO5 or RASP5 is switched off by interlocked manual operation (as an example of interlocked manual operation in RASP5).

2.13 External brake

A mechanical spring-loaded brake fitted to the motor (disc or spring-applied brake) brakes the rotation of the motor shaft if 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 5 modules feature a fast, internal electronic switch for powering and actuating the external motor brake. It is connected using pin 4 and pin 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.

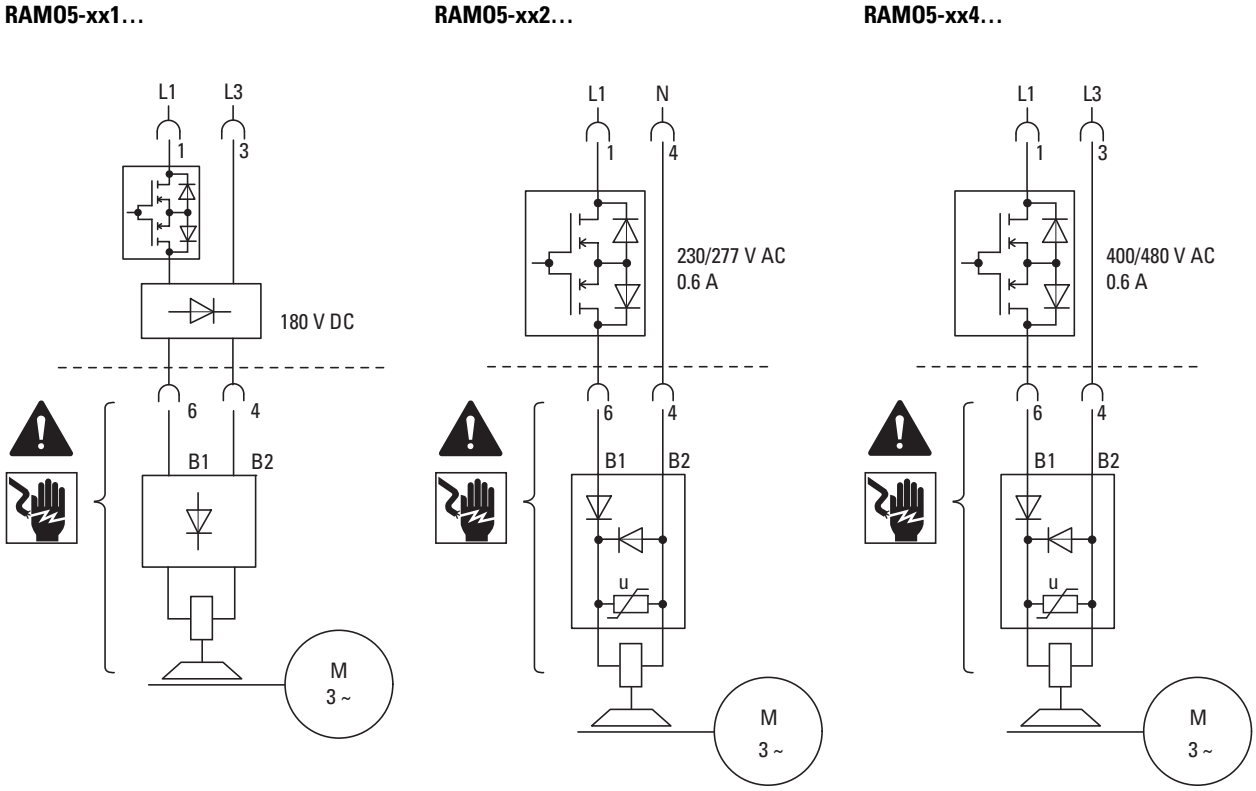


Figure 34: External brake actuated with 180 V DC, 230 V AC/277 V AC or 400 V AC/480 V AC

The brake is actuated

- Automatically with the Start command in Auto and Manual modes in RAMO5,
- With RASP5 via the frequency converter.

Mechanical brake (actuation) 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	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	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 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. **Note:** This function is not active in V/Hz 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 setting)

Control commands	Action of the drive
Start signal	Enable 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	Enable 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 is released. → 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 (actuation) 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 delay is set using 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 mechanical brake and the drive being disconnected.	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).

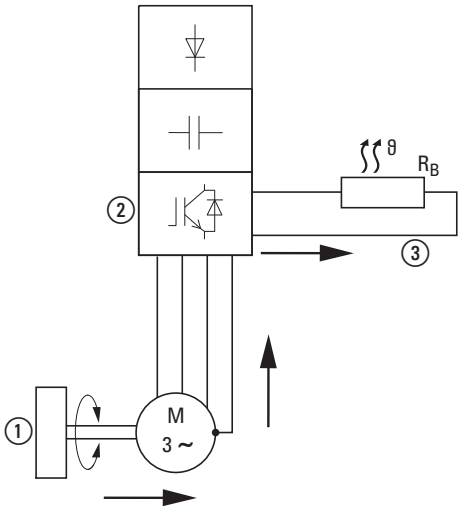


Figure 35: Regenerative braking with external braking resistance

① Machine flywheel mass
② Inverter with brake chopper (brake transistor)
③ Brake resistor (R_B) → Energy flow (braking torque)

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} is increased as a result. If the voltage value is too high, the RASP5 variable frequency drive will disable its inverter. after which the motor will coast uncontrolled.
If a braking chopper is present, the braking energy fed back into the drive can be dissipated in order to limit the DC-Link voltage.

A braking chopper is integrated in the RASP5 speed controller.
The braking chopper function must be activated in parameter P4-05.
The braking chopper is 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: Braking chopper parameters

Parameter	Designation	Description	Unit	Min	Max	DS
P4-05	Brake chopper mode	Parameter function only for devices with internal brake resistors 0: Disabled 1: Active in RUN 2: Active in RUN and STOP	–	0	2	2

ATTENTION

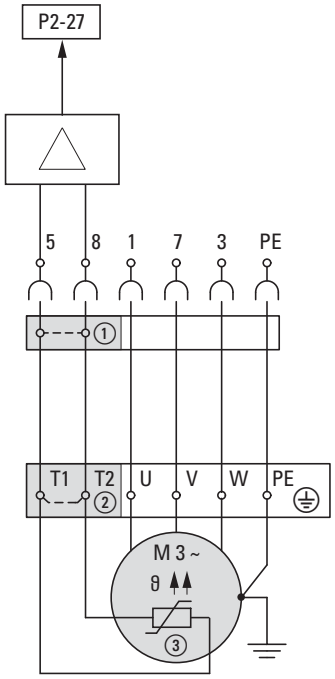
When using RAMO5 or RASP5 units, do **not** connect external brakes directly (to U, V, or W) in the motor's terminal box.

Table 15: Technical data (applicable to all RASP5… devices)

Size	Value
Resistance R	400 Ω
Tolerance	±20 %
Energy E	200 Ws
Power P	100 W
Isolation voltage V_t	4000 V
Maximum barrier layer temperature T_{jmax}	125 °C
Switch-on threshold for the braking transistor U_{DC}	to: 780 V DC OFF 756 V DC

2.15 Thermistor and motor cable monitoring

In RAMO5 and RASP5, the reaction of the thermistor fitted in the motor and the motor cable are set using parameter P2-27.



① Bridge in the motor connector:
Only monitors the plugged-in status of the motor connector.

② Bridge in the motor terminal box:
Monitors the plugged-in status of the motor connector and the motor cable connection.

③ Thermistor connection:
Monitors the plugged-in status of the motor plug, the motor cable connection, and the thermistor (or temperature switch, Thermo-Click) in the motor.

Figure 36: Thermistor monitoring

Table 16: Parameter P2-27 for thermistor and motor cable monitoring

Parameter	Designation	Description	Unit	Min	Max	DS
P2-27	Action@ Motor thermistor fault	Device response (depending on device) after "Thermistor Fault" occurs. 0: Disabled (OFF) 1: Enabled (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 installation and electrical connection of Rapid Link 5 modules RAMO5 and RASP5.

During installation and mounting, cover or tape over the plug-in connectors in the control and power sections to prevent foreign bodies from entering them.
On RASP5 units it is also advisable to protect the cooling fins and, if fitted, the fan from ingress of foreign bodies.

Perform all installation work using only the specified, proper tools and without the use of excessive force.

3.2 Instruction leaflets

The installation instructions in this manual apply to RAMO5 and RASP5 units with standard equipment and IP65 protection class.

Refer to the appropriate RAMO5 or RASP5 instruction leaflets for the required installation instructions.

Instruction leaflet for RAMO5:

- IL034084ZU
- IL034092ZU (variant "EtherNet/IP")

Instruction leaflet for RASP5:

- IL034085ZU
- IL034093ZU (variant "EtherNet/IP")

3.2.1 Mounting position

RAMO5 and RASP5 Rapid Link 5 modules are preferably installed vertically.

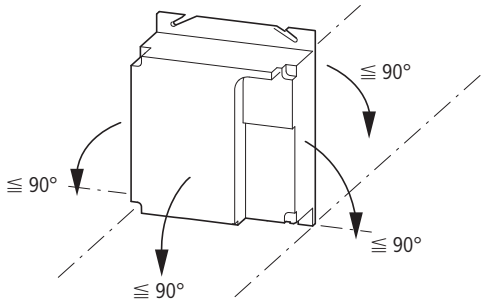


Figure 37: RAMO5 mounting position
Maximum inclination in all directions: 90°
Do not rotate by 180°.

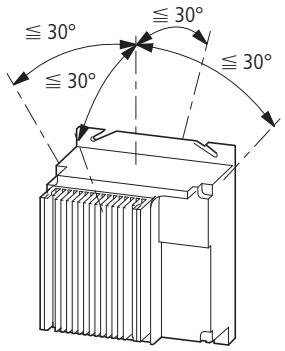


Figure 38: RASP5 mounting position
Maximum inclination in all directions: 30°
Do not rotate by 180°

3.2.2 Clearances

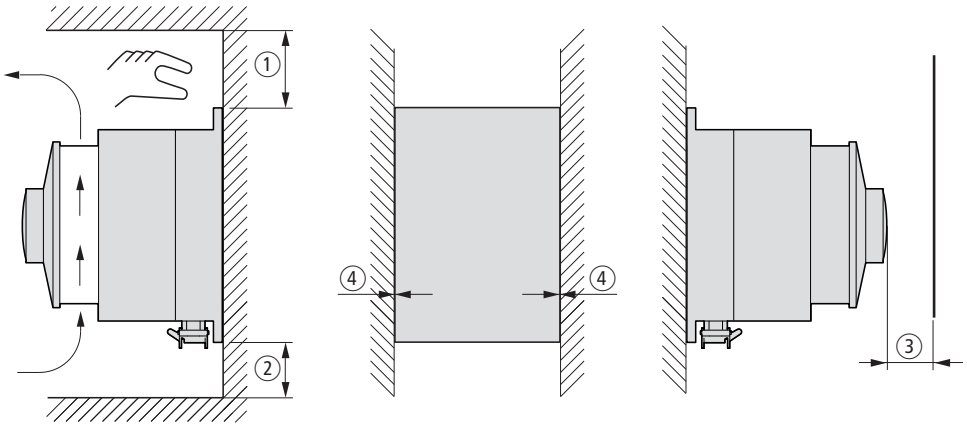


Figure 39: Clearances for thermal air cooling (example: RASP5)

Depending on the version, thermal clearances must be provided around the RAMO5 and RASP5 Rapid Link 5 modules. Unobstructed handling must also be ensured for versions with a repair and maintenance switch (RAMO5-…-...RS1 and RASP5-…-...R…S1) and in the area of the plug-in power connections ②.

The table below lists the recommended minimum clearances.

Position	Instance	RAMO5 Clearance mm	RASP5 Clearance 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) At an installation altitude up to 1000 m and at an ambient temperature of up to +40 °C no clearance is required to the sides.
Units installed in higher ambient temperatures (up to a maximum of +50 °C), pulse frequencies f_{PWM} (up to maximum 32 kHz) and higher set-up altitudes (up to 2000 m) require lateral spacing of at least 20 mm.

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

3.2.3 Attachment

Rapid Link 5 devices RAMO5 and RASP5 are mounted with screws.

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

→ Details of RAMO5 and RASP5 unit weights and dimensions can be found in 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

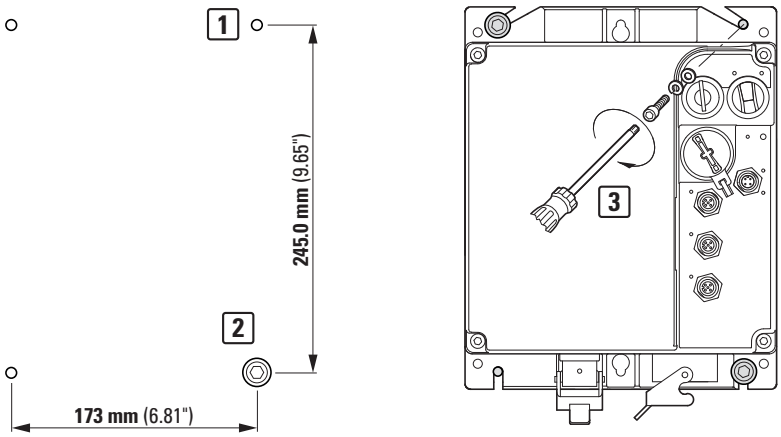


Figure 40: Fixing dimensions (standard) and mounting

1 4 x drill holes with threads for M6 screws.

2 When using pre-assembled screws, there must be a clearance between the mounting surface and the washer of about 12 mm.

3 Tighten the screws to a torque of 1.3 Nm.

Vertical arrangement, center fixing

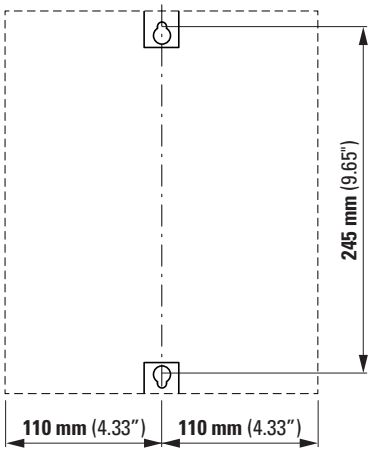


Figure 41: Fixing dimensions (center)

Two M6 screws, tightening torque 1.3 Nm.

Horizontal arrangement

(base rotated by 90°)

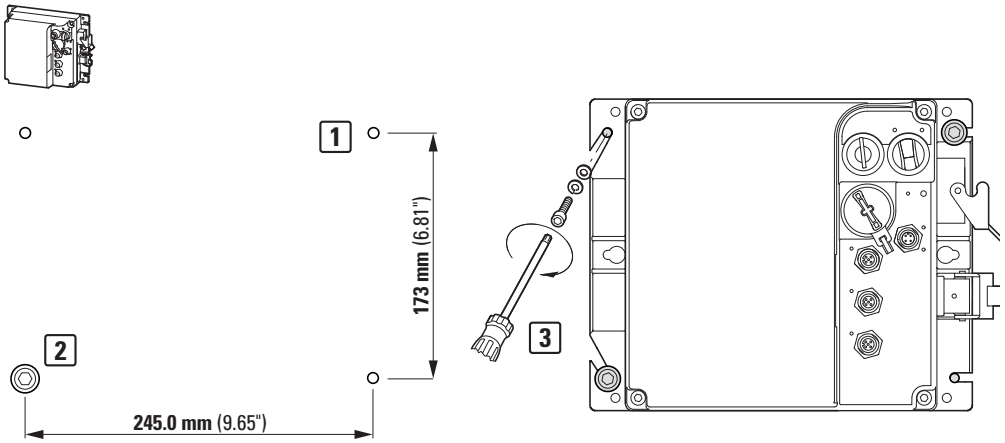


Figure 42: Fixing dimensions (standard) and mounting

1 Drill hole with thread for M6 screw.

2 When using pre-assembled screws, there must be a clearance between the mounting surface and the washer
of about 12 mm.

3 Tighten the screws to a torque of 1.3 Nm.

Horizontal arrangement, center fixing

(base rotated by 90°)

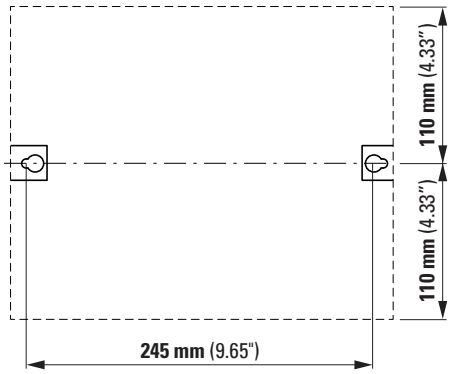


Figure 43: Fixing dimensions (center)

Two M6 screws, tightening torque 1.3 Nm.

3.2.4 Position of the power connections

The standard arrangement of the power connections is vertical and downwards.

Qualified specialists can create a horizontal arrangement by turning the black enclosure base 90° to the left or right. To do this, remove the four screws in the enclosure cover.

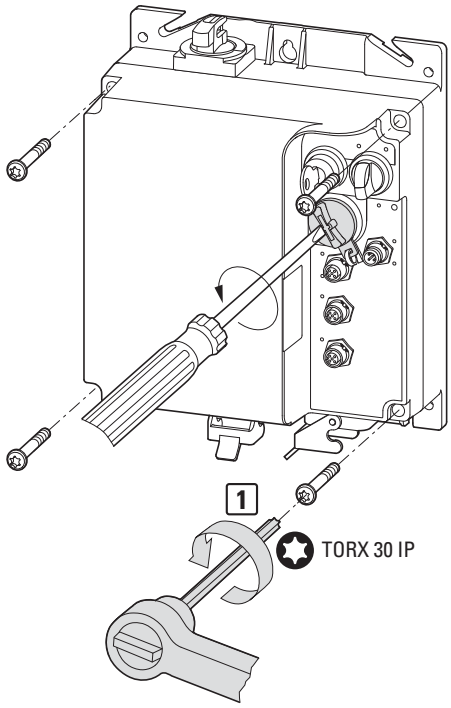


Figure 44: Dismantling the enclosure cover

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

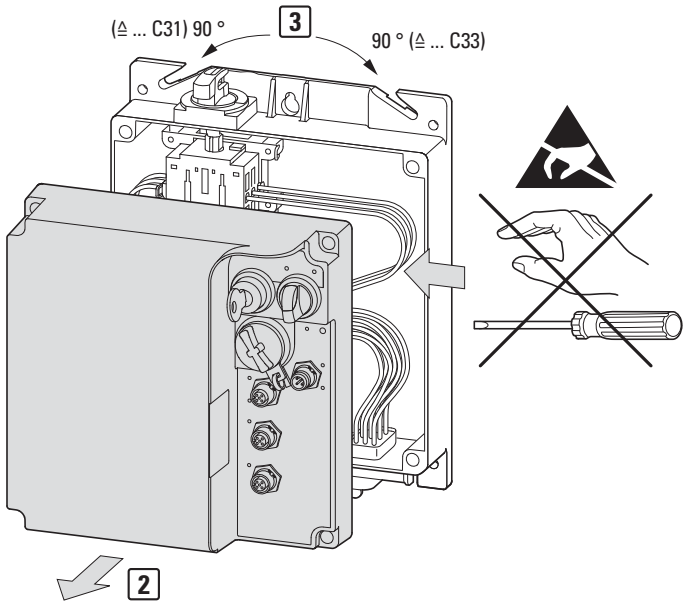


Figure 45: Example: Lift off the housing cover on a RASP5

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.

▶ Then carefully replace the housing cover.

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

▶ Secure the enclosure cover on the base using the four screws.

Tighten the screws in two passes in a crosswise pattern.
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 with a torque of 3 Nm.

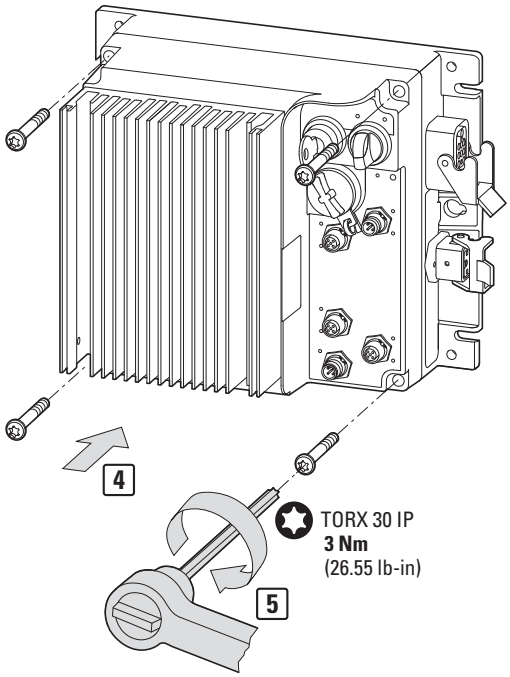


Figure 46: Mounting the enclosure cover

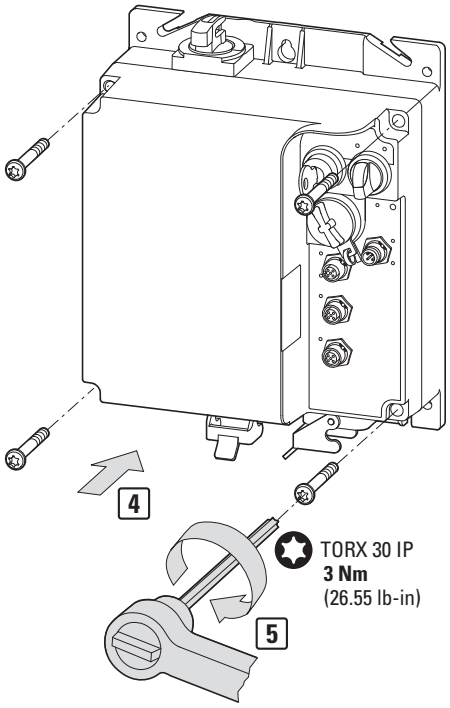


Figure 47: Attaching the M32 screw-on cover

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

3.3 Electrical installation

DANGER

Risk of injury due to electric shock!
Carry out wiring work only if the unit is de-energized.

ATTENTION

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

DANGER

The components in the RASP5 power section remain energized up to five minutes after the supply voltage has been switched off (internal DC-Link capacitor discharging time).
On RASP5 units, only disconnect the motor feeder cable and only perform work on the motor terminal box after the discharging time has elapsed.

3.4 Power bus

The Rapid Link 5 system can have one of two types of power bus:

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

3.4.1 Flexible busbar (RA-C1-7…)

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) is 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.

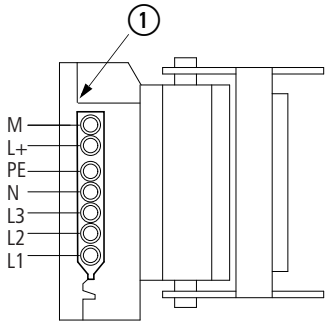


Figure 48: Keying on RA-C1-7… flexible busbar

① Hinge

→ L+ and M are not used on the RAMO5 and RASP5 Rapid Link 5 modules.

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

3.4.1.1 Routing 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 duct 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 protection class IP65. To do this, use cable end pieces (RA-C1-END1) and bushings (RA-C1-DF) as necessary.

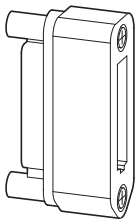


Figure 49: RA-C1-DF bushing for ribbon cable

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

▶ Cut the cable to the desired dimension.

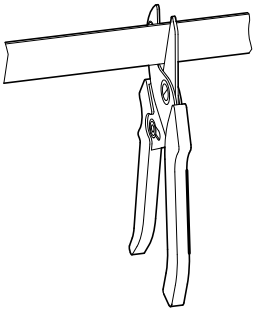


Figure 50: RA-C1-CUT
Hand tool for cutting ribbon cables

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

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

→ Tool RA-C1-AZ-4 is recommended for stripping 7 x 4 mm^2 flexible bus bar.
When using a standard cable stripper, do not cut into the rubber sheath by more than 0.7 mm in order to avoid damaging the insulation of the conductor.

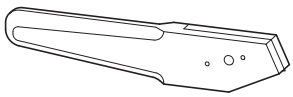


Figure 51: RA-C1-AZ-4
Tool for stripping the cable sheath

3.4.1.3 Installing the end piece

- First slide the lower (shorter) part of the RA-C1-END1 ribbon cable end piece onto the prepared flexible busbar.
- Slot the individual conductors into the insulation channels in the ribbon cable end piece as far as they will go.
- Join the upper and lower sections using the two clamping screws. Installed correctly, the flexible busbar offers degree of protection IP65.

Figure 52: RA-C1-END1 ribbon cable end piece

3.4.1.4 Flexible busbar junction connections

The supply and outgoer modules can be installed at any point along the flexible busbar without interrupting the busbar's conductors.
The connection is made with contact screws.

Pin	Function	Wire 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 on RAMO5 and RASP5.

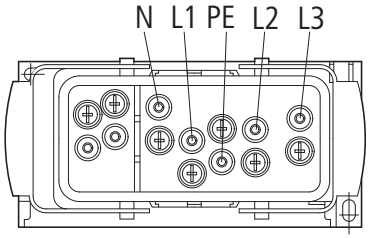


Figure 53: Pin assignment of the Flexible busbar junction RA-C1-PLF1

3.4.2 Round cable

3.4.2.1 Round cable junction RA-C2-S1-4

The RA-C2-S1-4 round cable junction is a T connector for the RA-C3/C2-1.5HF plug-in power adapter cable. It makes it possible to connect a Rapid Link 5 module (RAMO5/RASP5) directly.

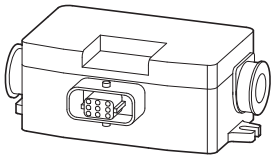


Figure 54: Round cable junction RA-C2-S1-4

Insulation piercing terminals are used for conductor contacting in the power bus.
The bushings are dimensioned for a conductor with an outer diameter from 10 to 16 mm.

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

- For mounting, secure the round pipe outlet on the ground using the appropriate screws (M5).
- Strip the round cables to a length of 130 mm (two radial cuts, one longitudinal cut) using, for example, a Weidmüller AM16 stripping tool.

→ To strip the cable, 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.

→ Two pairs of seals for cable outer diameters from 10 to 13 mm and from 13 to 16 mm are always included as standard.
Only these matched seal inserts installed correctly guarantee protection class IP65.

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

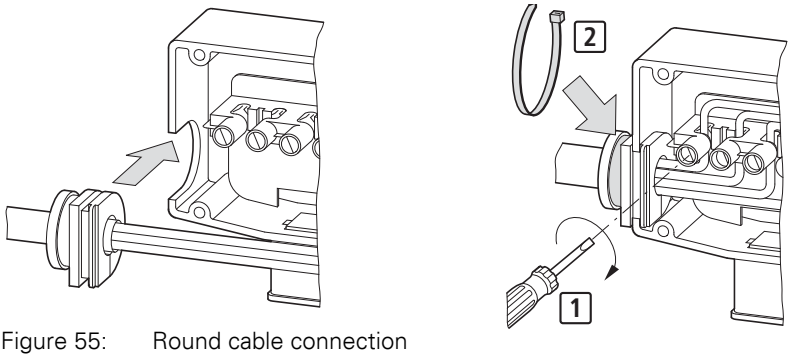
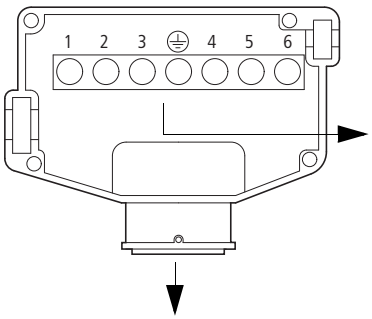


Figure 55: Round cable connection

- Insert the individual wires into the insulation piercing terminals and secure them with the screws one at a time.
- Screw in the screws [1] as far as they will go (tightening torque 0.5 to 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.
- Secure the cover with the four screws (size POZIDRIVE 2; 1.5 to 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 using 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 on RAMO5 and RASP5.

3.4.2.3 RA-C4-PB65 round cable junction

The RA-C4-PB65 round cable junction (power box) is a contact unit for uncut round cables with a cross-section of 2.5 to 6 mm^2 with protection class IP65.

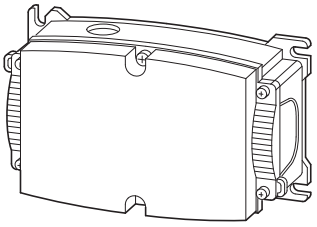


Figure 56: RA-C4-PB65 round cable junction (power box)

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

Seals RA-C4-D…

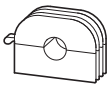


Figure 57: Enclosure Grommets

Figure 58: Dummy plugs (RA-C4-D0)

3.5 Power plug

3.5.1 RAMO5

Two types of power plugs are available.

RA-C3… (for RAMO5…512…)

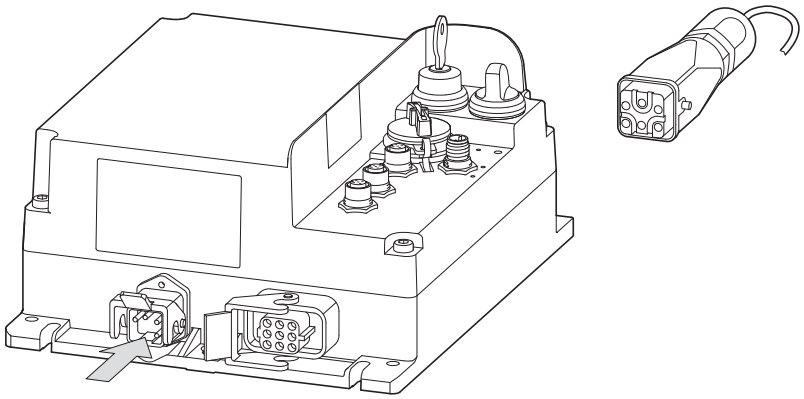
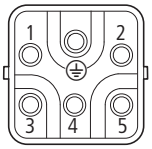
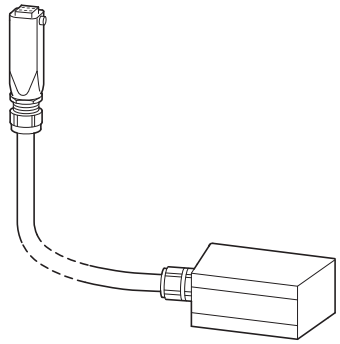
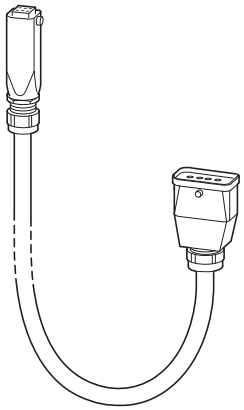
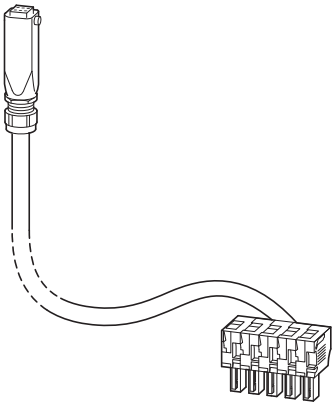
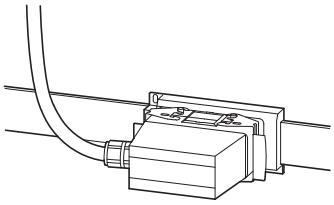
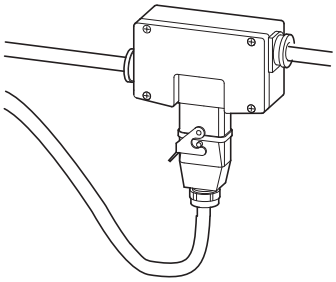
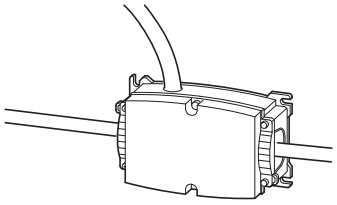


Figure 59: Energy connector RA-C3…

Table 17: Pin assignment of the RA-C3… power plug of type HANQ5/0

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…)

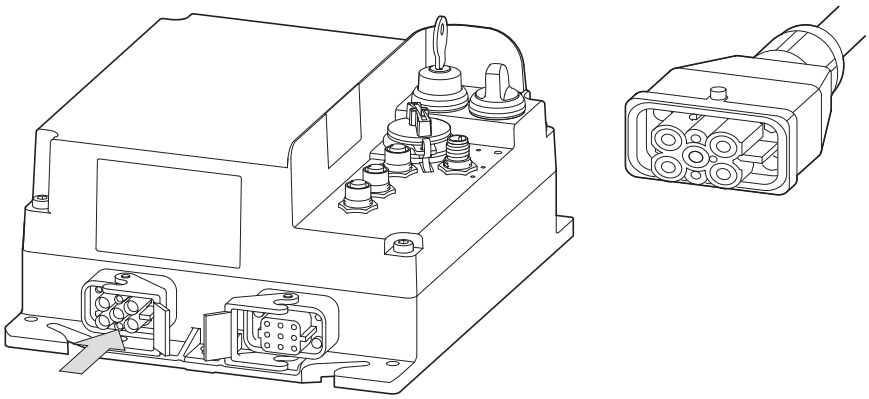
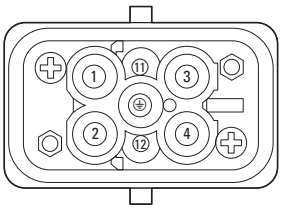
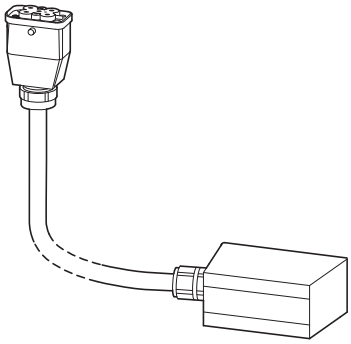


Figure 60: Energy connector RA-Q4…

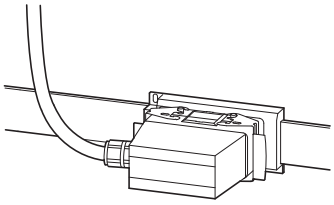
Table 18: Pin assignment of the RA-Q4… power plug of type HANQ4/2-F.

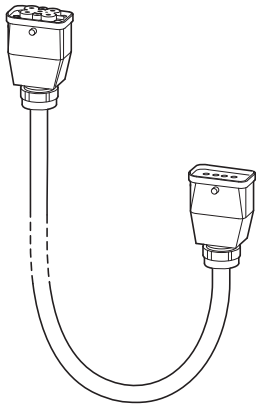
Pin	Function	Power plug
1	L1	
2	L2	
3	L3	
4	N	
5	–	
PE	PE	
11	–	
12	–	



RA-Q4/C1-1M5

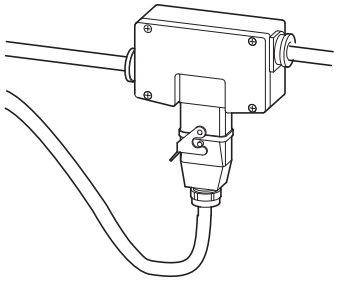
→ RA-C1-PLF1

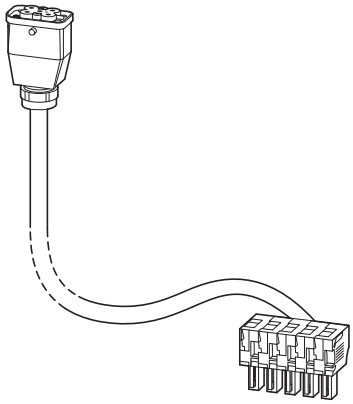




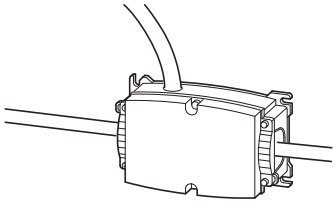
RA-Q4/C2-1M5

→ RA-C2-S1-4





→ RA-C4-PB65



After installing the power bus outgoers (RA-C1-PLF1, RA-C2-S1-4, RARA-C4-PB65), you can connect the Rapid Link 5 module RAMO5 to the power plug using the assigned power adapter cables.

ATTENTION

Compatibility with cables from other manufacturers cannot be guaranteed!

3.5.2 RASP5

Two types of power plugs are available.

RA-C3… (for RASP5…512…)

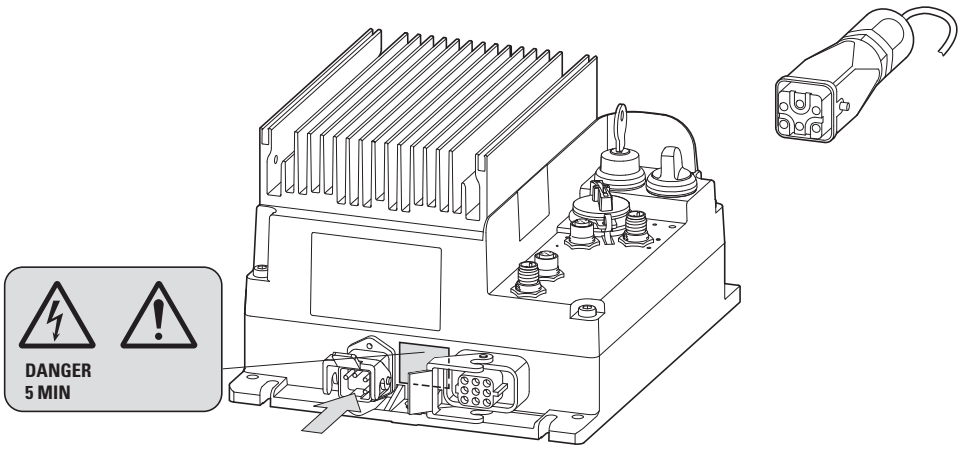
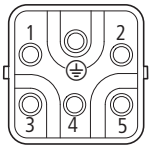
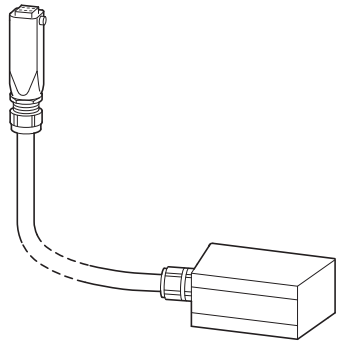


Figure 61: Energy connector RA-C3…

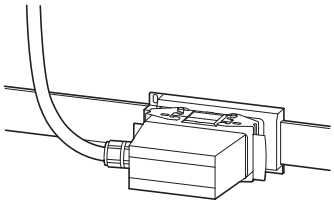
Table 19: Pin assignment of the RA-C3… power plug of type HANQ5/0

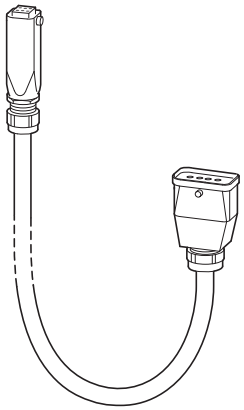
Pin	Function	Power plug
1	L1	
2	L2	
3	L3	
4	N	
5	–	
PE	PE	



RA-C3/C1-1, 5HF

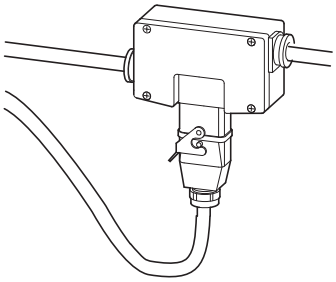
→ RA-C1-PLF1

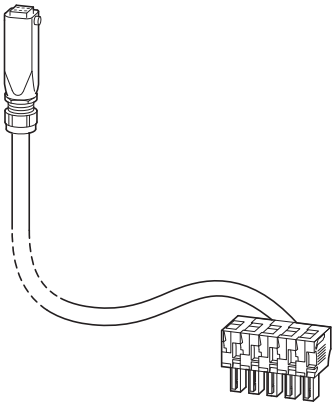




RA-C3/C2-1, 5HF

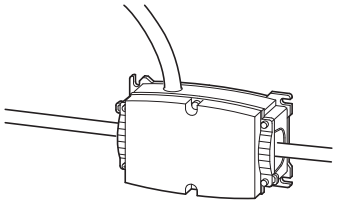
→ RA-C2-S1-4





RA-C4-PPB/C3-1M5

→ RA-C4-PB65



RA-Q4… (for RASP5…412…)

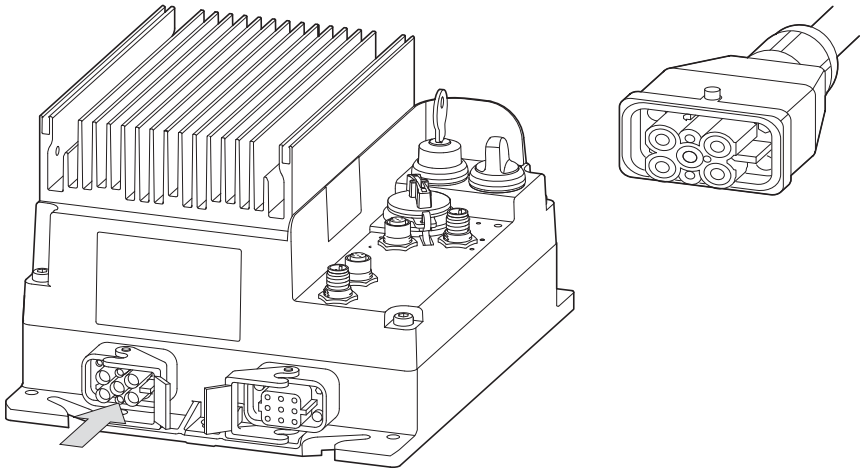
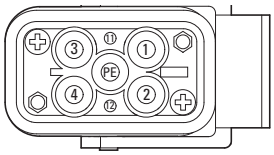
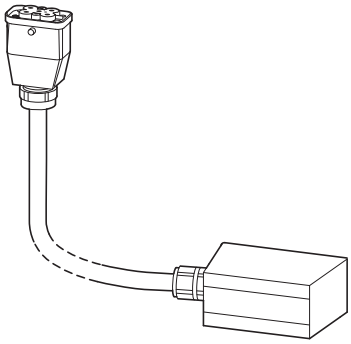


Figure 62: Energy connector RA-Q4…

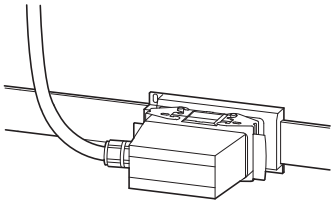
Table 20: Pin assignment of the RA-Q4… power plug of type HANQ4/2-F.

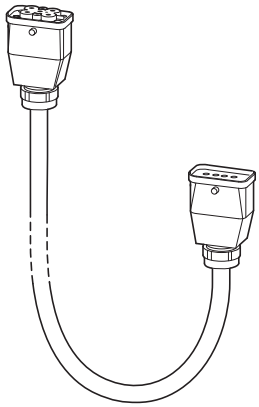
Pin	Function	Power plug
1	L1	
2	L2	
3	L3	
4	N	
PE	PE	
11	–	
12	–	



RA-Q4/C1-1M5

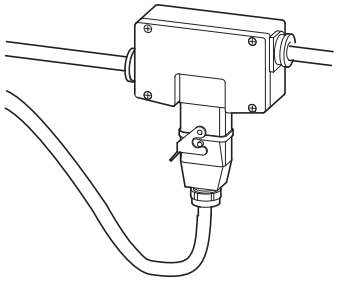
→ RA-C1-PLF1

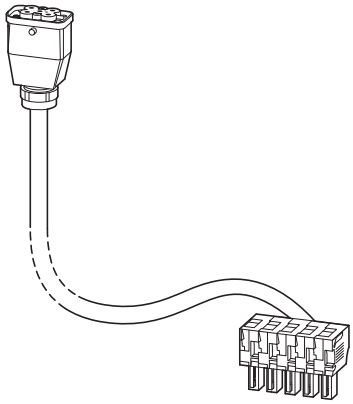




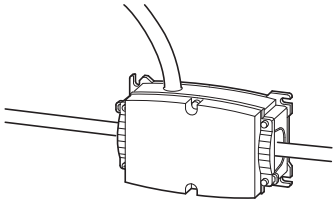
RA-Q4/C2-1M5

→ RA-C2-S1-4





→ RA-C4-PB65



After installing the power bus outgoers (RA-C1-PLF1, RA-C2-S1-4, RARA-C4-PB65), you can connect the Rapid Link 5 module RASP5 to the power plug using the assigned power adapter cables.

ATTENTION

Compatibility with cables on plug connectors from other manufacturers cannot be guaranteed!

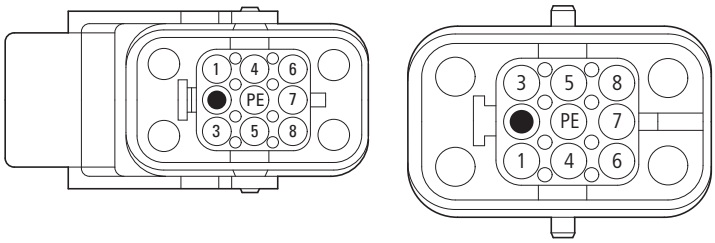
3.6 Motor feeder

3.6.1 Motor feeder plug

RAMO5 and RASP5 are connected to the motor using a socket connector.

The pin assignment of this motor feeder socket complies with DESINA specifications for:

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

Pin	Function	Pin arrangement
		DESINA
		Motor feeder 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	

3.6.2 Motor feeder connection 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 **RAMO-CM1-5MO** **RAMO-CM1-10M** Plastic connectors for RAMO5	**RASP-CM2-2MO** **RASP-CM2-5MO** **RASP-CM2-10M** Metal connectors for RASP5

Figure 63: Motor cable for connecting the motor starter to the motor

ATTENTION

Compatibility with cables on plug connectors 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 to protect the thermistor.

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

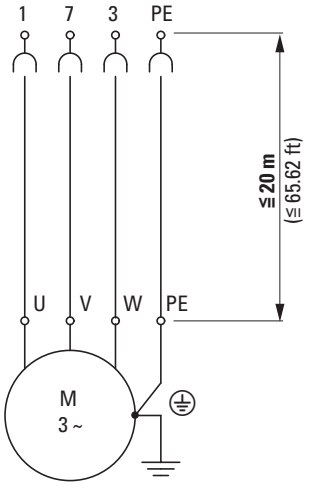


Figure 64: General motor connection with motor feeder plug and motor cable monitoring

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

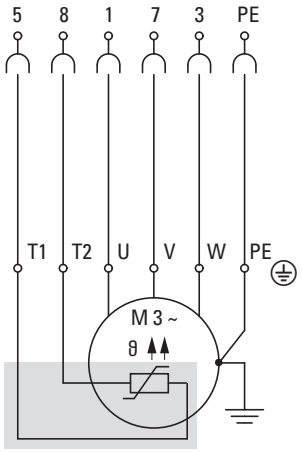


Figure 65: General motor connection with thermistor plug, motor feeder plug and motor cable monitoring

The cable ends (pin 5 and pin 8) on motors with thermistors or thermostats (Thermo-Click) 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

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

Table 21: Control with RAMO5

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

Table 22: Control with RASP5

Type	Control section
RASP5-xxx**1**…	180 V
RASP5-xxx**2**…	230 V
RASP5-xxx**4**…	400 V

The connection is made using pin 4 and pin 6 in the motor plug (→ Page 105)

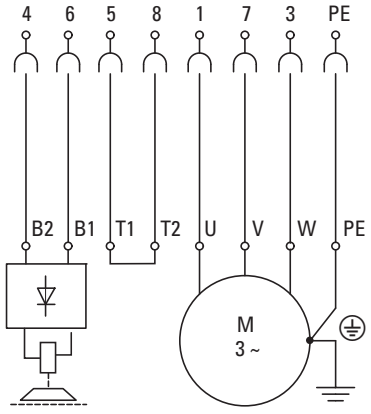


Figure 66: General connection with brake

3.6.3 RASP5 motor feeder

The RASP5 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: 5 m

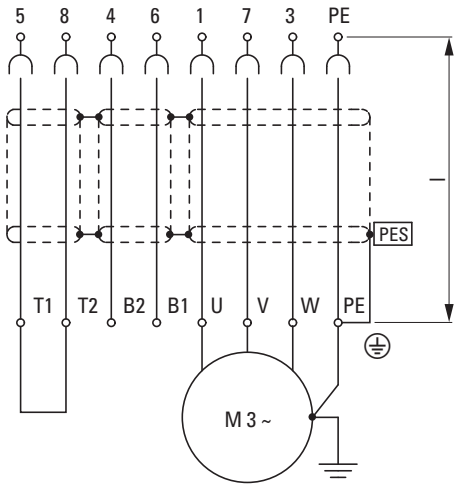


Figure 67: Screened motor cable for RASP5.
Longest permissible length of motor cable: l = 20 m

→ When operating without a 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 107).

→ IN RASP5, the motor cable screen braid must only be grounded at the motor (PES).

→ RASP5 has a metal grounded motor outlet socket.
The RASP-CM2-2M0 motor cable (or RASP-CM2-5M0, RASP-CM2-10M) is grounded on the device side.

ATTENTION

The motor's metal enclosure must always be earthed - 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 to establish an EMC-compliant connection between a mains cable and the RASP.

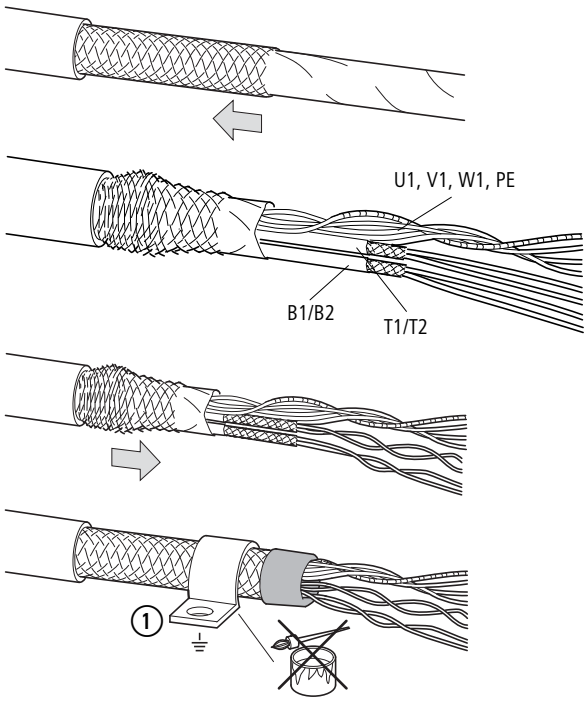


Figure 68: EMC-compliant connection of the screened motor cable
① 360° contact fuse ≙ PES

- 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 forwards far enough that a large area of the screen braids of conductors B1/B2 and T1/T2 are covered and connected with each other.

→ Cover the screen ends with a rubber grommet or with insulating tape or textile tape, so that the screen braid does not fray.

▶ Connect the motor cable screen braid to the ground potential (PES) at the motor's terminal box.

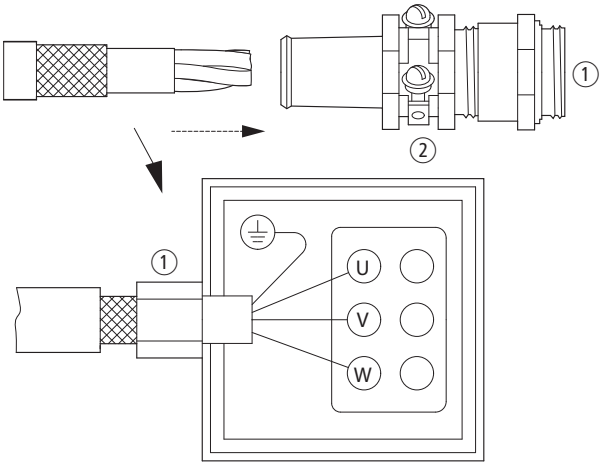


Figure 69: 360° screen contact at the motor terminal box

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).

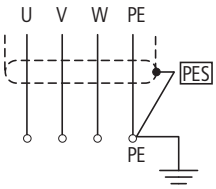


Figure 70: Connect the screen mesh (PES) to the motor terminal box

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.

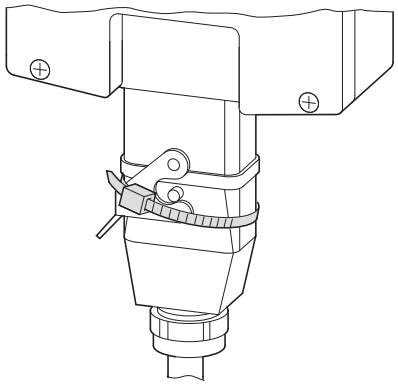


Figure 71: Secure the motor feeder plug using cable ties

3.7 Isolation test

The RAMO5 and RASP5 Rapid Link 5 modules are delivered pre-tested 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 5 modules

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

DANGER

For RASP5, wait at least five 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 the RAMO5 and RASP5 Rapid Link 5 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 RAMO5 and RASP5 Rapid Link 5 modules. 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 measurement voltage must at least match the rated operating voltage of the motor but is not to exceed 1000 V.

The insulation resistance must be greater than 1 MΩ.

Observe the motor manufacturer's notes on testing the insulation resistance.

4 Operation

4.1 Commissioning checklist

Before commissioning the RAMO5 and RASP5 Rapid Link 5 modules, check the following points (checklist):

No.	Activity	Note
1	Installation and wiring have been carried out in line with the instruction leaflets (→ IL034084ZU and IL034085ZU).	
2	All wiring and cable remnants and all the tools used have been removed from the proximity of the RAMO5, RASP5, motor and drive unit.	
3	All plug connectors in the power section are made as described in this manual. → The ASi bus must be plugged in and powered in manual mode as well.	
4	The cables connected to the RAMO5 and RASP5 Rapid Link 5 modules are **not** shorted and **not** connected to ground (PE), except the PE cable.	
5	The heat sink is correctly earthed (PE) on the RASP5 speed control unit.	
6	All electrical connections on the motor are established correctly.	
7	Each single phase of the supply voltage (power bus L1, L2, L3) is protected with a fuse.	
8	The RAMO5 and RASP5 Rapid Link 5 modules and the motor are adapted to the mains voltage. → Section 1.3, Rating data on the nameplate, page 15, connection type (star, delta) of the motor has been tested.	
9	The quality and volume of cooling air are in line with the environmental conditions required for RAMO5, RASP5 and the motor.	
10	The motor and operating parameters have been set.	
11	The effective direction of a coupled machine will allow the motor to start.	
12	All emergency stop functions and safety functions are in an appropriate condition.	

4.2 Operational warnings

Please observe the following notes.

DANGER

Commissioning must only 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 cables are connected to the correct terminals and that all PE and earth connections have been established.

ATTENTION

For RASP5 units, the pause between two power-on operations must be at least one minute.

DANGER

The contacts of the motor feeder sockets may be live when the supply voltage (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 plug or 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 RASP5

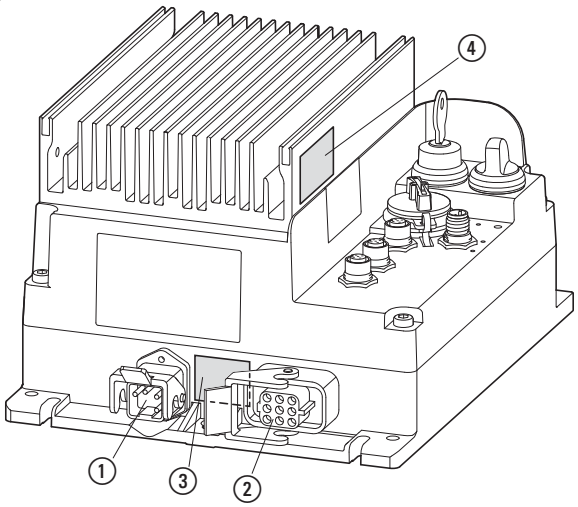


Figure 72: Connections in the RASP5 power section and hazard warnings

① Power plug
② Motor feeder 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.

Heat sink
Do not touch!

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

4.3 Manual control

RAMO5 and RASP5 Rapid Link 5 modules come with a manual controller (local controller) as standard. This controller is made up of a key switch and, in the case of RAMO5-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 Auto mode,
- secure (interlocked) manual operation within an area secured with limit switches (→ Section 2.9, Sensor inputs, page 61).

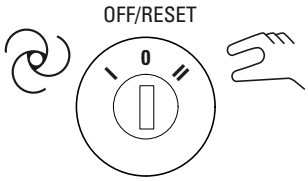


Figure 73: Key-operated switch

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

The key switch has three different positions.

Position	Function	Description
	Automatic mode	Automatic operation through
	Manual mode	Local operation, even without AS-Interface parameters. Start enable is issued using the direction selector switch (FWD, REV) on RAMO5-W… and RASP5 units. On RAMO5-D… units, the start enable signal is sent using the key switch. (Manual position).
OFF/RESET	Off Reset command	In this position, RAMO5 and RASP5 do not execute any control commands, regardless of the source of the control commands.

On RAMO5-W… (reversing switch) and RASP5 (speed controller) Rapid Link 5 modules, the required rotating field direction can be selected when the selector switch is in Manual mode:

- FWD = Forward. Clockwise rotating field enable (L1 → U, L2 → V, L3 → W)
- REV = Reverse. Anticlockwise rotating field enable (L1 → W, L2 → V, L3 → U)

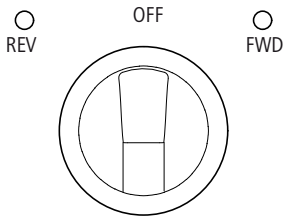


Figure 74: Direction of rotating field

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.

When the switch is in the OFF position, the Rapid Link 5 modules are locked in Manual mode.

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

5 RAMO5 motor starter

5.1 Designation

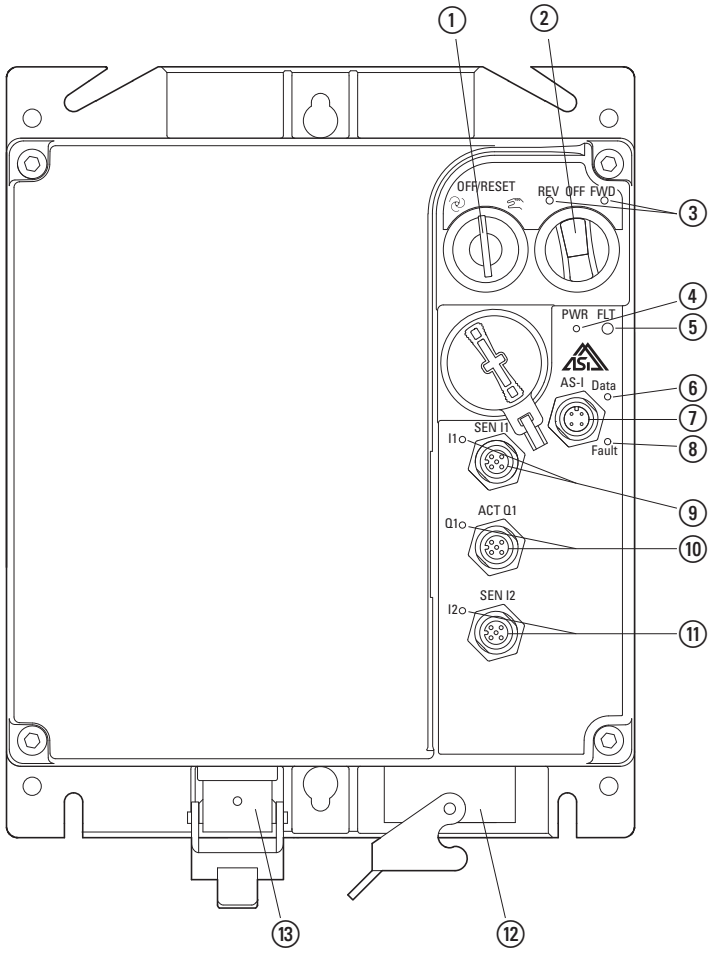


Figure 75: Overview of RAMO5

① Key-switch for manual and automatic mode and Reset
② Selector switch for rotating field direction (FWD, REV) in Manual mode, only for RAMO5-W...
③ LED for indicating motor voltage rotating field
– FWD = Clockwise rotating field (Forward Run)
– REV = Counterclockwise rotating field (Reverse Run)
④ LED indicator for supply voltage
⑤ LED indicator for fault or error messages
⑥ LED indicator for AS-Interface
⑦ Connection AS-Interface (M12 connector)
⑧ LED indicator for AS-Interface communication error
⑨ Sensor input I1 (M12 socket) with LED
⑩ Actuator output Q1 (M12 connector) with LED indicator - 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 (**Ra**pid Link **mo**tor control unit) is an electronic motor starter for direct start-up of three-phase motors up to 6.6 A (≙ 3 kW at 400 V).
RAMO5 uses thyristors and relays for switching in the power circuit.
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 direction of rotation
- RAMO-**W**… = Reversing starter for two directions of rotation (FWD, REV)

After run-up, the speed of the controlled motor is constant and is determined by the frequency of the supply voltage (power bus, 50/60 Hz). The three-phase motor protection allows protected operation of three-phase motors in the range from 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. A controlled supply voltage of 180 V AC, 230 V AC or 400 V AC is output for the brake rectifier (→ Figure 64, page 107).

DANGER

Open only in voltage-free state!

5.3 Connections

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

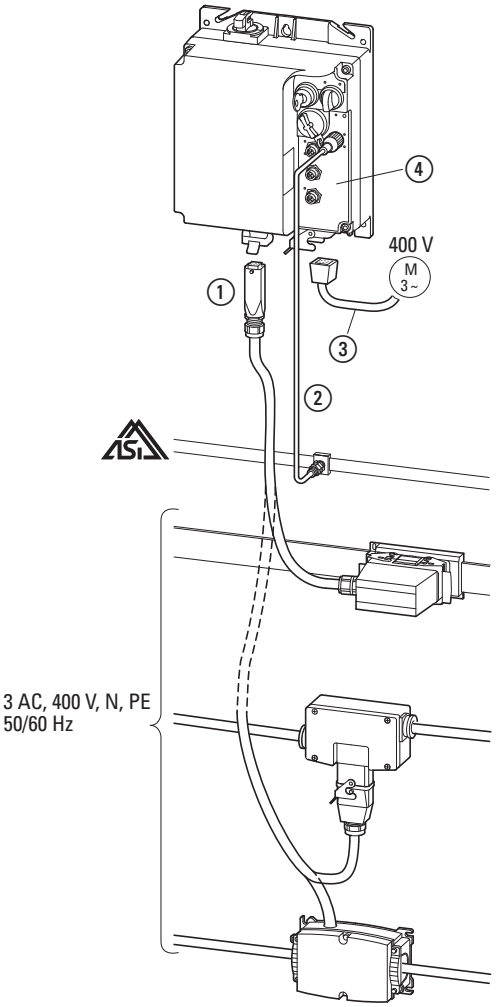


Figure 76: Connections on the RAMO5

① Power plug: Power supply (3 AC 400 V, N, PE) through a power adapter cable (→ Section 3.5, Power plug, page 97)
② Data bus for controlling RAMO5 in automatic mode
③ Motor connection: Motor feeder socket according DESINA specifications
④ Sensor and fan actuators

5.4 Specific technical data

The following tables show the technical data of the RAMO5 motor control unit in the individual power classes along with the allocated motor output.

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

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

	Symbol	Unit	RAMO5-D…	RAMO5-W…
Instance			DOL 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 125	→ Page 126
Rated current (I_e)	I_e	A	6.6	
Adjustable motor protection		A	0.3 - 6.6	
Assigned motor power at 400 V, 50 Hz 440 - 460 V, 60 Hz	P	kW	0.18 - 3	
	P	HP	0.25 - 4	
Power supply 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 repair switch)	m	kg	1.6/1.8	
Response 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

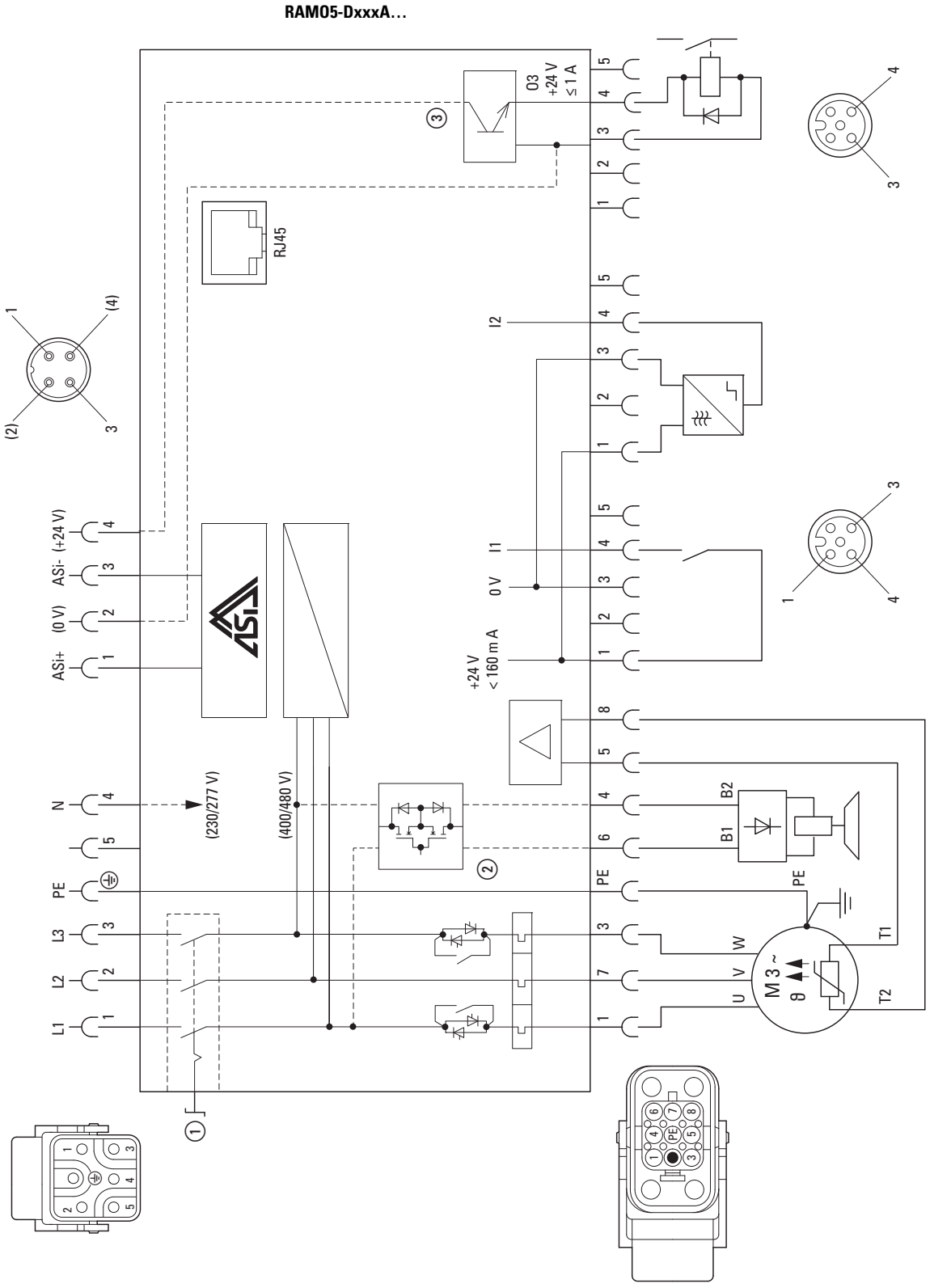


Figure 77: Block diagram of RAMO5-D…
① RAMO5-…-xxxRxx
② RAMO5-xxx2… (230/277 V), RAMO5-xxx4… (400/480 V)
③ RAMO5-xx1…

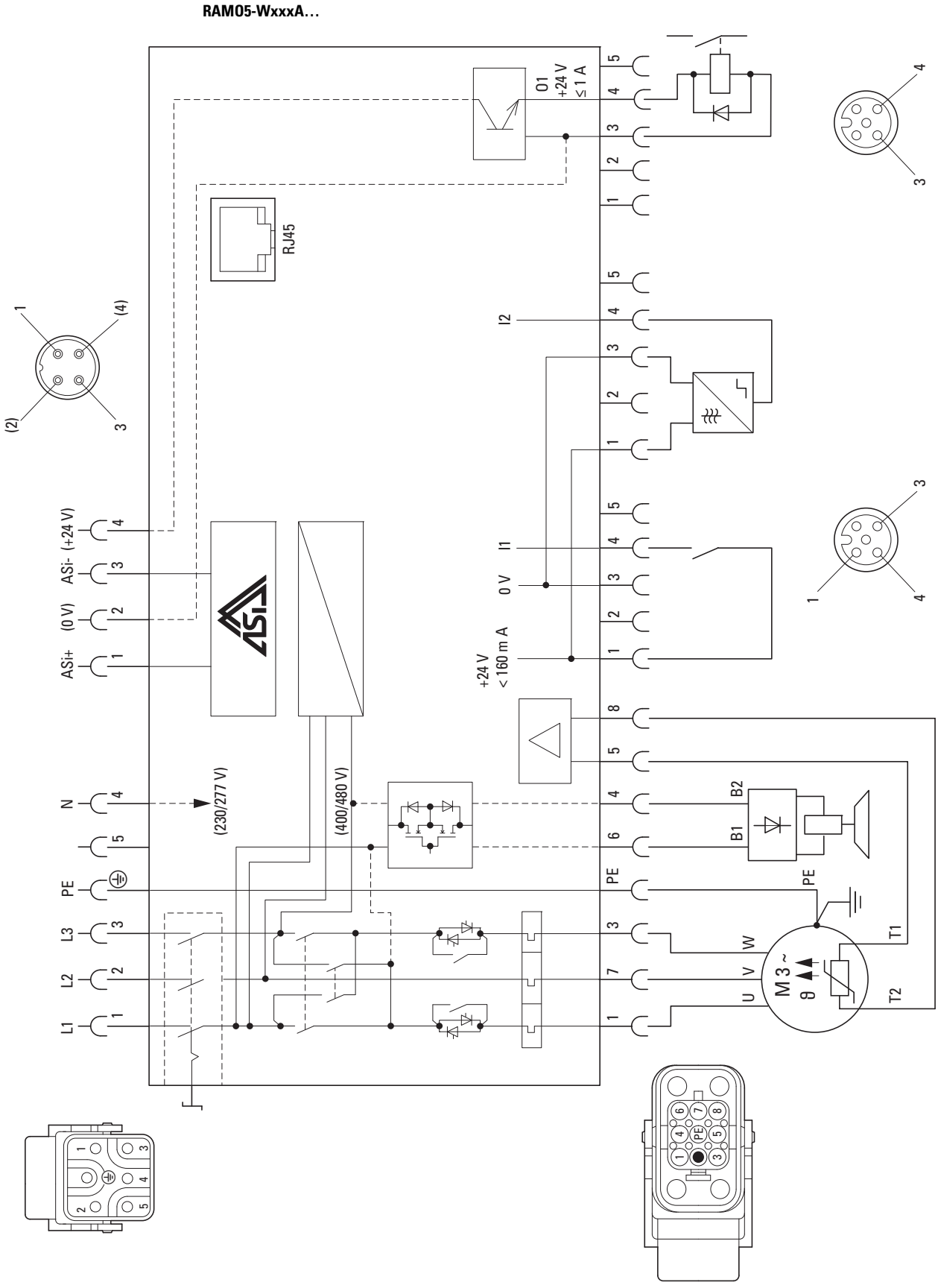
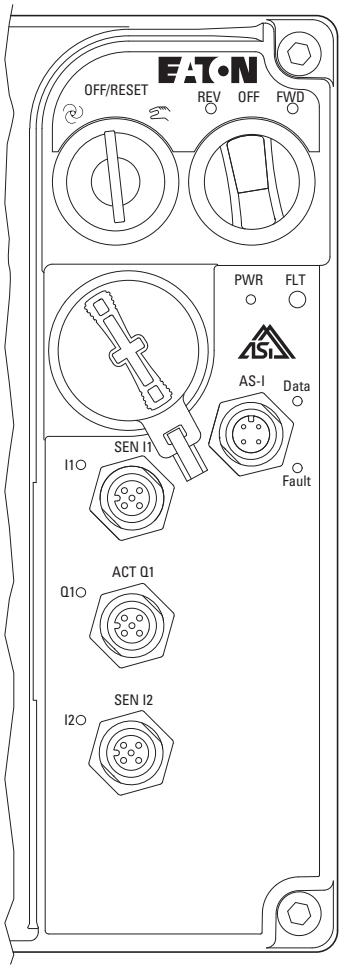


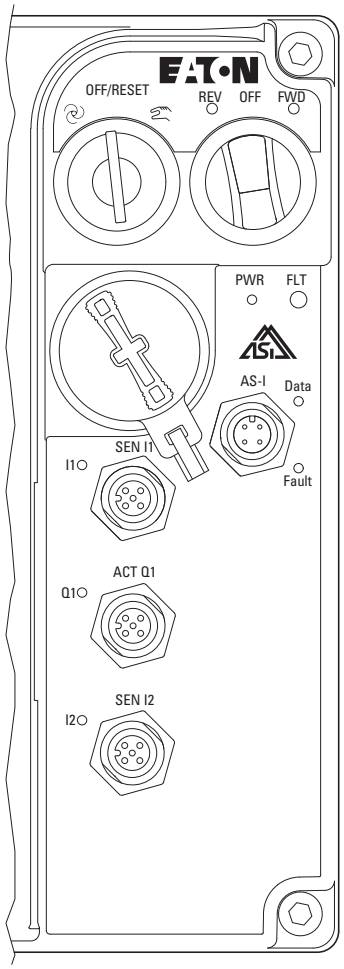
Figure 78: Block diagram RAMO5-W…

5.6 LED indicators

The LEDs indicators of the RAMO5 motor control unit display the operating states and allow problems to be quickly diagnosed.



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 by the Quick stop function of sensor inputs I1 and I2 • But blocked because when the supply voltage was switched on (400 V or ASi), the key switch was in the MANUAL position. → A Reset command required.
REV		**Counterclockwise rotating field** of motor voltage (W–V–U) Only for reversing starter RAMO5-W…!
	Off	Not actuated
	Green	enabled (RUN-Mode)
	Green flashing	controlled: • but inhibited by the Quick stop function of sensor inputs I1 and I2 • But blocked because when the supply voltage was switched on (400 V or ASi), the key switch was in the MANUAL position. → A Reset command required.
AS-I		**AS-Interface**
Data		
	Off	ASi electronics have no supply voltage: Check ASi connection cables Check ASi power supply unit (head-end controller)
	Green	Communication active, normal operation
	Red	No communication: • Head-end controller (master) in STOP mode. • RAMO5 not entered or entered with the wrong address (ID). • RAMO5 in Reset mode.
	Yellow flashing, red	ASi address = 0 → Adjust ASi address
	Green, Red flashing	fatal peripheral error, internal ASi error
Fault		
	Red	No data exchange, communication error
	Red flashing	Peripheral fault,
I1		**Sensor input SEN I1**
	Off	• not connected • not triggered (no input signal)
	Green	SEN I1 triggered (input signal)



LED	State	Description
I2		**Sensor input SEN I2**
	Off	• not connected • not triggered (no input signal)
	Green	SEN I2 triggered (input signal)
Q1		**Actuator output Q1** Only for **RAMO5-xx1…**!
	Off	Not actuated
	Green	ACT Q1 triggered (output signal) **Note:** If the external supply voltage for Q1 (24 V DC) is missing, no signal is issued at the output.
PWR	Off	**Voltage supply** The 400 V supply voltage is missing or the repair switch is switched off.
	Green	400 V supply voltage is present.
	Off	No fault message
FLT	Red	**Collective fault message** An error has been detected and is permanently present - in the case of: • Motor overload (overcurrent) → Check the motor and the drive unit (Reset when the motor has cooled) → Short circuit in the motor cable → Check parameters • Thermistor/cable monitoring → Check the motor and the drive unit (Reset when the motor has cooled) → No motor cable connected (motor outlet socket) → Bridge T1/T2 in the motor terminal box is missing in motors without temperature sensors → Wire jumper with motor cable disconnected, not closed (→ for Service 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.
	Red flashing	The detected fault (the fault signal's cause) has been fixed. The fault signal can now be acknowledged in the OFF/RESET position using the key switch. → The **FLT** LED goes out.

5.7 Configure specialist settings

5.7.1 Commissioning

Before commissioning the RAMO5 motor starter, the functions must be adjusted using parameters. The screw plug must be opened to adjust the parameters.

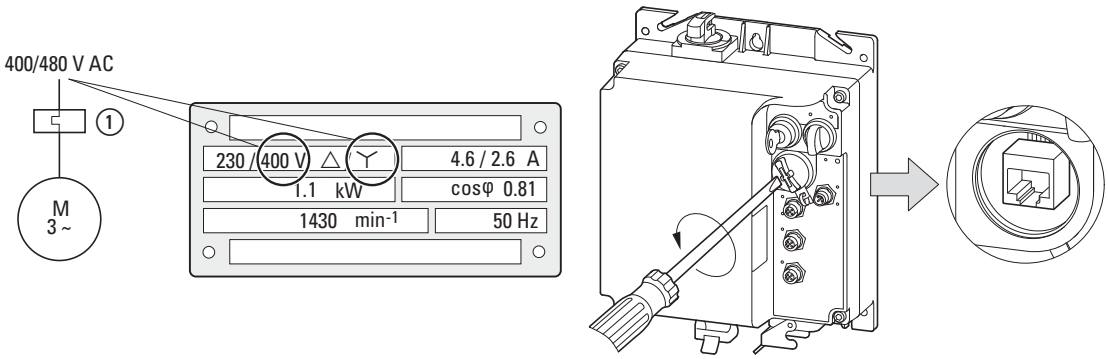


Figure 79: RJ 45 interface

The parameterization can be via :

- drivesConnect software
- Keypad
- drivesConnect mobile app

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

5.7.2 Set the rated motor current (P1-08)

Before commissioning the RAMO5 motor starter, the current monitor must be set to the rated motor current (using parameter P1-08).

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

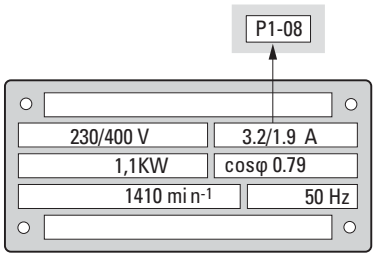


Figure 80: Set rated motor current

Table 23: Parameter P1-08

Parameter	Description	Unit	Value range
P1-08	Nominal motor current	A	0.3 - 6.6

5.7.3 Sensor inputs

Sensor inputs I1 and I2 are designed for rising-edge input signals (N/O closing contact, fail-safe).
In the default setting, parameters P3-06 and P3-07 are set to 0.

When using sensors (open) that switch to zero, parameters P3-06 and P3-07 must be set to 1. The signal is then inverted.

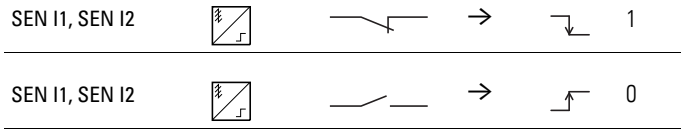


Figure 81: Configuring sensors inputs SEN I1 and SEN I2

Parameter	Designation	Description	Unit	Min	Max	DS
P3-06	SEN I1 logic	0: N/O closing contact 1: N/C opening contact **Note:** A change only becomes active after POWER ON/OFF.	–	0	1	0
P3-07	SEN I2 logic	0: N/O closing contact 1: N/C opening contact **Note:** A change only becomes active after POWER ON/OFF.	–	0	1	0

5.7.4 Quick stop and interlocked Manual mode

RAMO5-D… DOL starter

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

RAMO5-W… reversing starter

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

Parameter P1-13

Table 24: 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 25: Signal detection for RAMO5-W… reversing starter

	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

5.7.5 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 indicators 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 Phases equence Motor	Changes the sequence of the output phases. This prevents two phases of the motor cable from having to be swapped 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

5.7.6 Monitoring the low current limit

Parameter	Designation	Description	Unit	Min	Max	DS
P6-05	Action@Under-load Motor	Device response (depending on device) after "Motor underload" occurs. 0: deactivated 1: Error (shutdown)	–	0	1	0

When set to P6-05 = 1 (= ON), an error message will be issued (**FLT** LED will light up red) if a phase (L1, L2, L3) carries less than 25 % of the rated current I_e.

5.7.7 Quick stop

The Quick stop function is activated using parameter P5-10 and deactivated with DQ3. The Quick stop function is enabled via DQ3 (ASi).

Parameter	Designation	Description	Unit	Min	Max	DS
P5-10	Disable quick stop	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 Designation

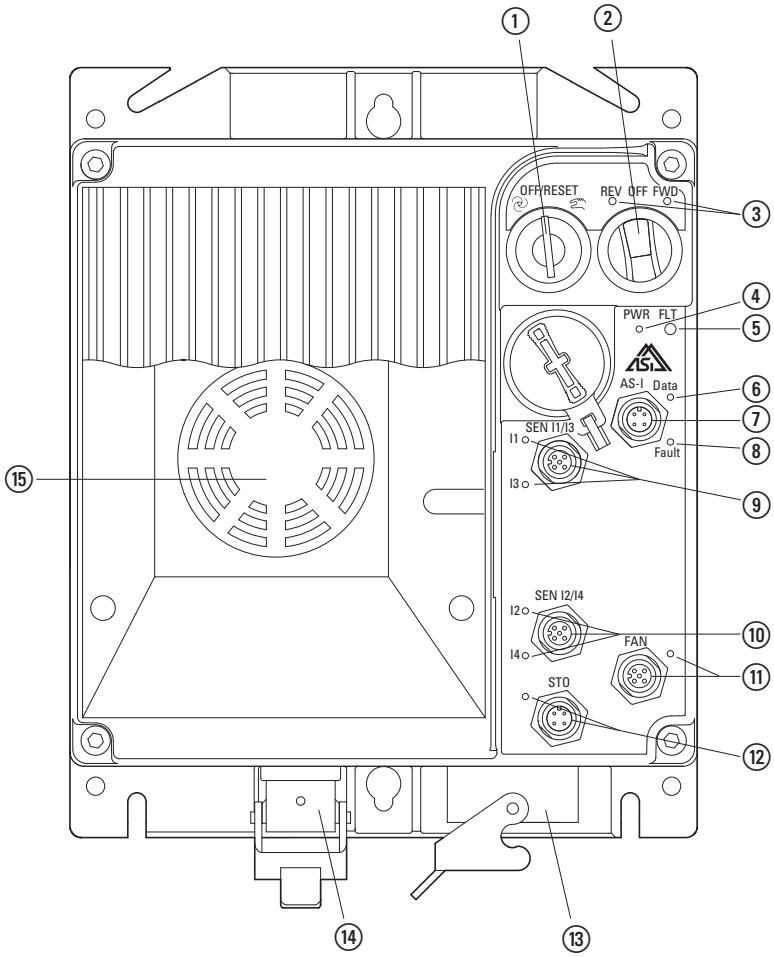


Figure 82: Overview of RASP5

① Key-switch for manual and automatic mode and Reset
② Selector switch for rotating field direction (FWD, REV) in manual mode
③ LED indicators for the rotating field of the motor voltage
– FWD = Clockwise rotating field (Forward Run)
– REV = Counterclockwise rotating field (Reverse Run)
④ LED indicator for supply voltage
⑤ LED indicator for fault or error messages
⑥ LED indicator for AS-Interface
⑦ Connection AS-Interface (M12 connector)
⑧ LED indicator for AS-Interface communication error
⑨ Sensor input I1/I3 (M12 plug) with LED indicator
⑩ Sensor input I2/I4 (M12 plug) with LED indicator
⑪ Fan connection FAN (M12 socket) with LED indicator
⑫ STO input, with LED indicator
⑬ Motor output 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 (**Ra**pid Link **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 primarily used for hoist drives and rotary drives. The fixed speed values (standard: four, maximum: eight) allow for process-controlled speeds.
The frequency control (soft starting) is gentle on motor, mechanics and energy supply (no current peaks).

RASP5 is available in four rating sizes from 2.4 A to 8.5 A.
The internal electronic motor protection (I_t controller) allows the protected operation of three-phase motors in the range from 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. In connection with the integrated thermistor monitoring, a so-called "full motor protection" can be guaranteed.

The built-in transistor switch allows actuation of spring-loaded brakes with DC air solenoid valve. A controlled supply voltage of 180 V DC, 230 V/277 V AC or 400 V/480 V AC is output for the brake rectifier.

In addition, versions of RASP5 with built-in brake resistors also allow dynamic braking.

DANGER

Open only in voltage-free state!

6.3 Connections

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

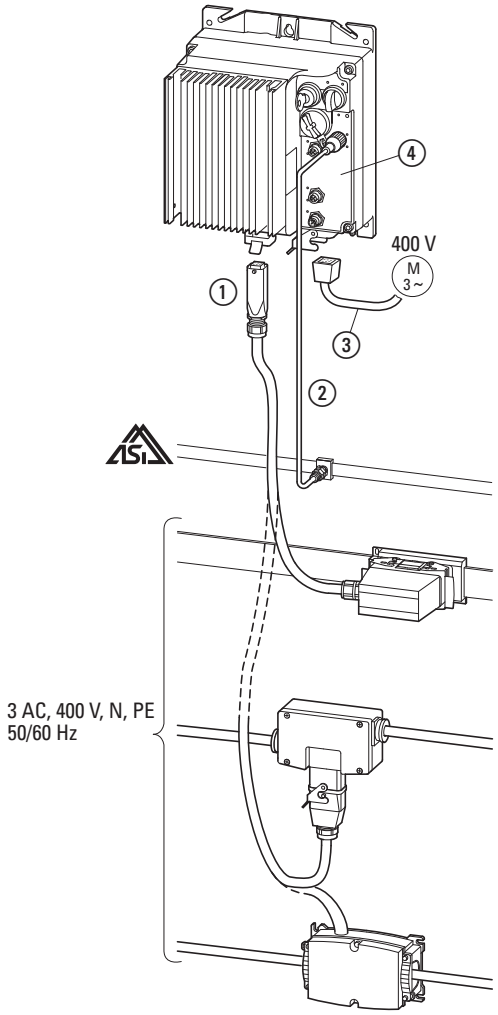


Figure 83: Connections on the RASP5

① Power supply (3 AC 400 V, N, PE) through a power adapter cable (→ Section 3.5, Power plug, page 97)
② Data bus for controlling RASP5 in automatic mode
③ Motor connection according DESINA specification
④ Sensor and fan actuators

6.4 Specific technical data

The following tables show the technical data of the RASP5 speed controller in the individual power classes with the assigned motor power.

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

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

	Symbol	Unit	RASP5-2…	RASP5-4…	RASP5-5…	RASP5-8…
Rated 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
Startup 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 power at 440 V, 60 Hz						
	P	kW	0.75	1.5	2.2	4
	P	HP	1	2	3	5
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 supply 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…	RASP5-5…	RASP5-8…
DC braking	I/I_e	%	≦ 100, adjustable	≦ 100, adjustable	≦ 100, adjustable	≦ 100, adjustable
Rated 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 current (I_e) and switching frequency (f_{PWM}) of 6 kHz	P_v	W	32	46	58	95
Heat dissipation at idle (standby) with AS-Interface 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
4. Fixed frequency (P2-03)	f_z	Hz	50	50	50	50
Response time with default settings						
Motor On (automatic)[1)]	t_{ON}	ms	< 10	< 10	< 10	< 10
Motor Off (automatic)[1)]	t_{OFF}	ms	< 10	< 10	< 10	< 10
Motor Off (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 (EMC, 2nd environment, C3)	l	m	25	25	25	25
Weight (Without/with repair switch)	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 % of the rated current I_e can be continuously retrieved.

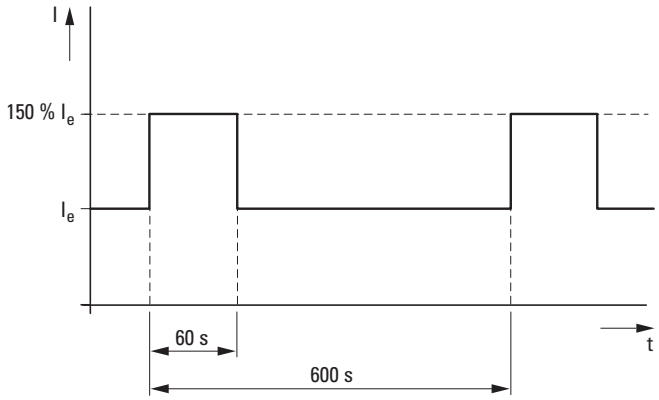


Figure 84: Overload cycle in operation

6.4.2 Derating curves

Although high switching frequencies allow for low running noise and faster 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 switching 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.

The temperature of the RASP5 increases at higher switching frequencies. The output current (I_{2N}) should therefore be reduced (derating) according to the ambient air temperature, when higher switching frequencies are used.

→ If higher switching frequencies (>16 kHz) are required, the load (output current) and/or the ambient temperature must be reduced.

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

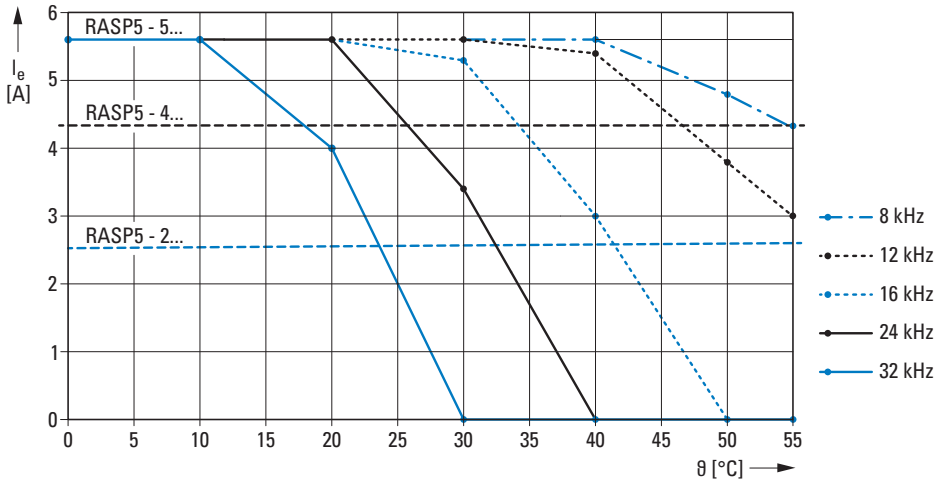


Figure 85: f_{PWM} = 8 - 32 kHz with RASP5-2…, RASP5-4…, RASP5-5…

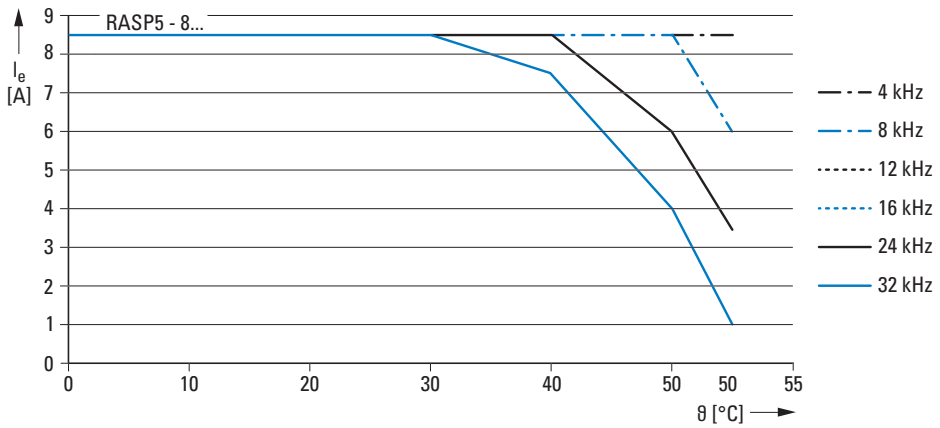


Figure 86: f_{PWM} = 4 - 32 kHz with RASP5-8…

6.5 Block diagram

RASP5-xxxxA…

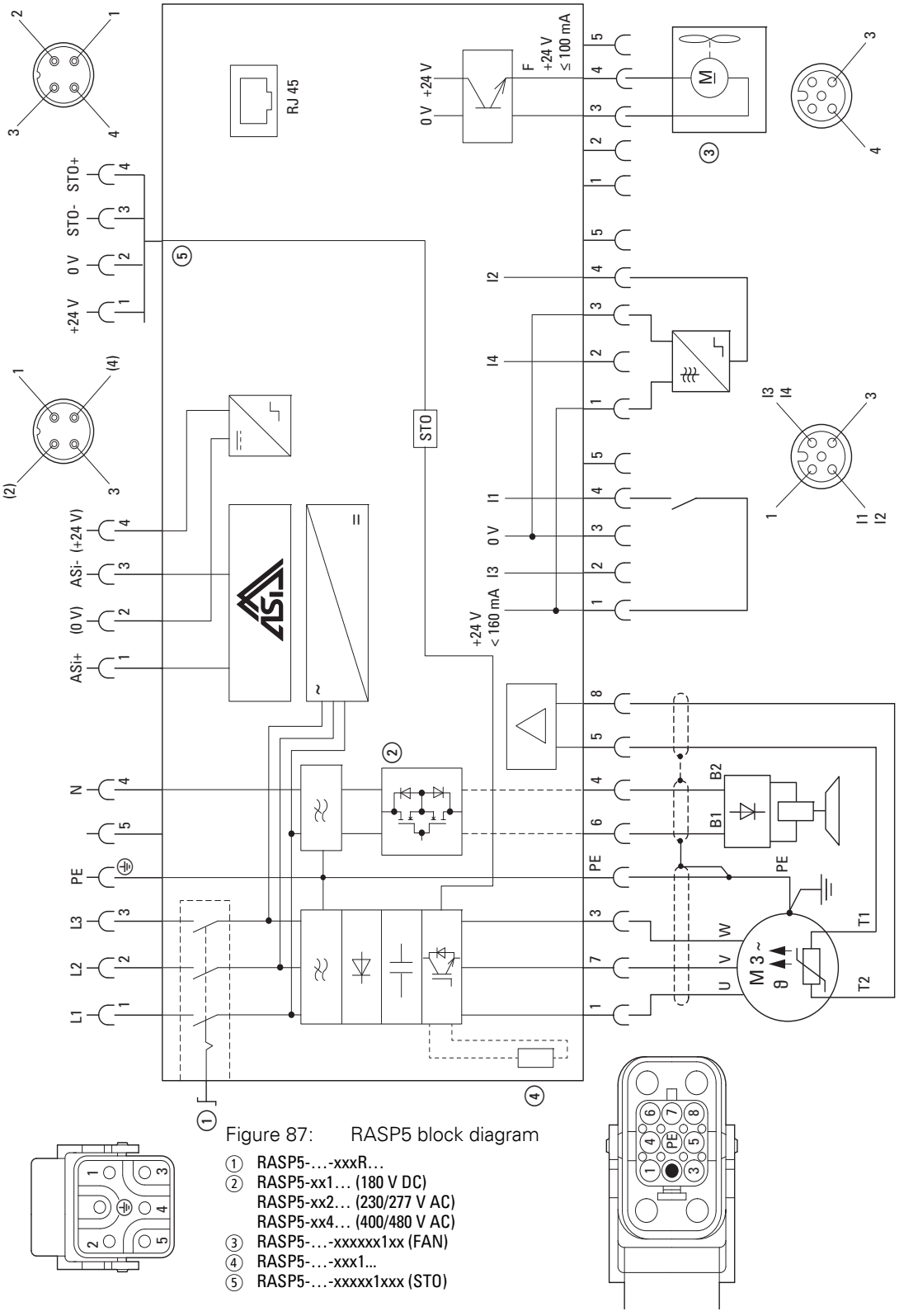
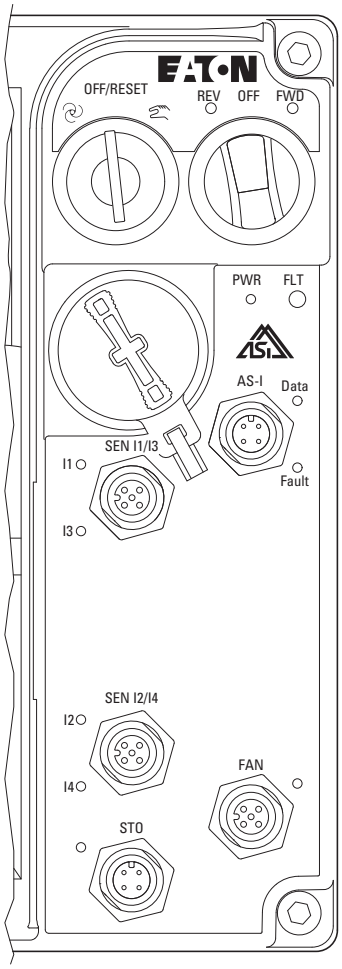


Figure 87: RASP5 block diagram

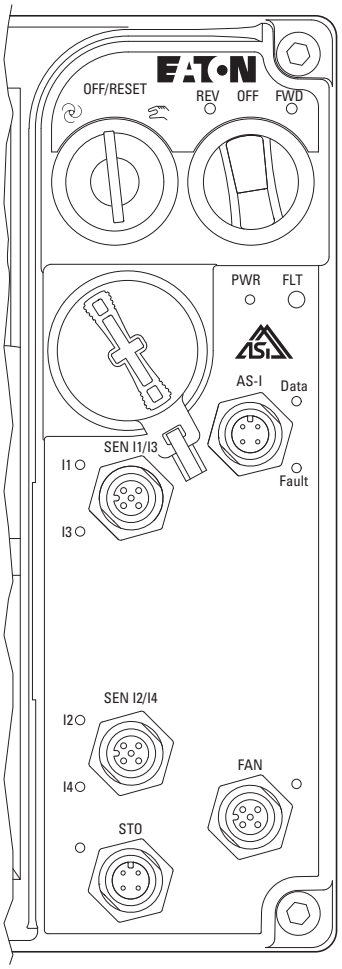
① RASP5-…-xxxR…
② RASP5-xx1… (180 V DC)
RASP5-xx2… (230/277 V AC)
RASP5-xx4… (400/480 V AC)
③ RASP5-…-xxxxxx1xx (FAN)
④ RASP5-…-xxx1...
⑤ RASP5-…-xxxxx1xxx (STO)

6.6 LED indicators

The LED indicators of the RASP5 speed controller display the operating states and allow problems to be quickly diagnosed.



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 by the Quick stop function of the sensor inputs • But blocked because when the supply voltage was switched on (400 V or ASi), the key switch was in the MANUAL position. → A Reset command 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 by the Quick stop function of the sensor inputs • But blocked because when the supply voltage was switched on (400 V or ASi), the key switch was in the MANUAL position. → Reset command required. • STO signal present (inhibit)
AS-I		**AS-Interface**
Data		
	Off	ASi electronics have no supply voltage: → Check ASi connection cables → Check ASi power supply unit (master control)
	Green	Communication active, normal operation
	Red	No communication: • Head-end controller (master) in STOP mode. • RASP5 not entered or entered with the wrong address (ID). • RASP5 in Reset mode.
	Yellow flashing, red	ASi address = 0 → Adjust ASi address
	Green, Red flashing	→ fatal peripheral error; internal ASi error
Fault		
	Red	No data exchange, communication error
	Red flashing	Peripheral fault,
I1		**Sensor input I1**
	Off	• not connected • Not triggered (no input signal)
	Green	SEN I1 triggered (input signal)



LED	Display	Description
I2		**Sensor input I2**
	Off	• not connected • not triggered (no input signal)
	Green	SEN I2 triggered (input signal)
I3		**Sensor input I3**
	Off	• not connected • not triggered (no input signal)
	Green	SEN I3 triggered (input signal)
I4		**Sensor input I4**
	Off	• not connected • not triggered (no input signal)
	Green	SEN I4 triggered (input signal)
FAN		**Device fan** (output F = Fan)
	Off	• not connected • not actuated
	Green	Output signal (24 V DC) for device fan. Temperature-controlled by the RASP5.
PWR	Off	The 400 V **supply voltage** is missing or the repair switch is switched off.
	Green	400 V supply voltage 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 from the internal frequency converter → Error code can be read using the drivesConnect parameter configuration software • Thermistor/cable monitoring → Check the motor and the drive unit (Reset when the motor has cooled) → No motor cable connected (motor output socket) → Bridge T1/T2 in the motor terminal box is missing in motors without temperature sensors • Overload/short-circuit on sensor inputs If a temporary or rectified fault is present, this LED flashes until the Reset command is given (key switch).
	Flashing (red)	The detected fault (the fault signal's cause) has been fixed. The fault signal can now be acknowledged in the OFF/RESET position using the key switch.
STO		**Safe Torque Off**
	Off	No enable for STO hardware
	Green	Enable present for STO hardware

6.7 Configuration of specific 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.

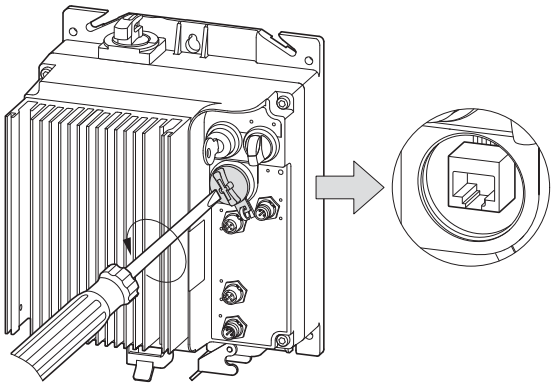


Figure 88: RJ 45 interface

The parameterization can be done via :

- drivesConnect software
- Keypad
- drivesConnect mobile app

ATTENTION

The RJ45 interface is not designed for Ethernet communication.

6.7.2 Set the rated motor current (P1-08)

Before commissioning the RASP5 speed controller, the current monitoring function must be set to the rated motor current.

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

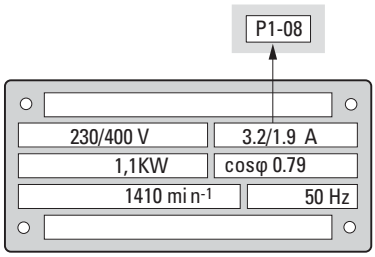


Figure 89: Set rated motor current

Table 26: Parameter P1-08

Parameter	Description	Unit	Value range
P1-08	Nominal motor current	A	0.3 - 6.6

6.7.3 Sensor inputs

The four sensor inputs SEN I1, SEN I2, SEN I3 and SEN I4 are designed for rising-edge input signals (N/O closing contact, fail-safe).

In the factory setting, parameters P3-06, P3-07, P3-08 and P3-09 are set to 0.

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

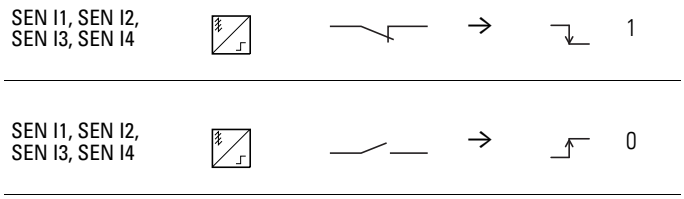


Figure 90: Configure the sensor inputs SEN I1, SEN I2, SEN I3, SEN I4

Parameter	Designation	Description	Unit	Min	Max	DS
P3-06	SEN I1 logic	0: N/O closing contact 1: N/C opening contact **Note:** A change only becomes active after POWER ON/OFF.	–	0	1	0
P3-07	SEN I2 logic	0: N/O closing contact 1: N/C opening contact **Note:** A change only becomes active after POWER ON/OFF.	–	0	1	0
P3-08	SEN I3 logic	0: N/O closing contact 1: N/C opening contact **Note:** A change only becomes active after POWER ON/OFF.	–	0	1	0
P3-09	SENI4 logic	0: N/O closing contact 1: N/C opening contact **Note:** A change only becomes active after POWER ON/OFF.	–	0	1	0

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

6.7.4 Quick stop and interlocked manual operation

Table 27: Settings for parameter P1-13, "SEN Config Select"

P1-13	Description
0	Reserved
1	No add-on functions (as supplied)
2	Quick stop: Automatic mode only SEN I1 and SEN I2 activated. SEN I1 is assigned to the clockwise direction of rotation, SEN I2 is assigned to the counterclockwise direction of rotation: Application example: Vertical sorter < 360° eccentric
3	Quick stop: Automatic mode only SEN I1 activated. SEN I1 is assigned to both directions of rotation. SEN I2 has no additional function. Application example: Chain ejector
4	Quick stop and interlocked manual mode (edge- and signal-controlled): SEN I1 and SEN I2 activated. SEN I1 is assigned to the clockwise direction of rotation, SEN I2 is assigned to the counterclockwise direction of rotation; Application example: Vertical sorter < 360° eccentric **Note:** In automatic mode, only edge-controlled
5	Quick stop and interlocked manual mode (only edge controlled): SEN I1 and SEN I2 activated. SEN I1 and SEN I2 are assigned to the clockwise direction of rotation. The operating direction "left" is blocked: Application example: Vertical sorter > 360° eccentric and > 360° turntable
6	Quick stop and creep speed: In automatic mode SEN I1 to SEN I4 are activated. SEN I1 and SEN I3 are assigned to the clockwise direction of rotation; SEN I2 and SEN I4 are assigned to the counterclockwise direction of rotation. When SEN I3/SEN I4 is reached, RASP5… switches to creep speed FF1. When SEN I1/SEN I2 is reached, the drive switches off (edge-controlled and signal-controlled). Application example: Turntable **Note:** SEN I3 and SEN I4 require a RA-XM12-Y Y connector.
7	Quick stop and creep speed: In automatic mode SEN I1 to SEN I4 are activated. SEN I1 and SEN I3 are assigned to the clockwise direction of rotation; SEN I2 and SEN I4 are assigned to the counterclockwise direction of rotation. When SEN I3/SEN I4 is reached, RASP5… switches to creep speed FF1. When SEN I1/SEN I2 is reached, the drive switches off. Application example: Turntable SEN I1 and SEN I2: edge-controlled SEN I3 and SEN I4: edge-controlled and signal-controlled **Note:** SEN I3 and SEN I4 require a RA-XM12-Y Y connector.
8	Quick stop and interlocked manual mode (edge- and signal-controlled) and creep speed: SEN I1 to SEN I4 are activated. SEN I1 and SEN I3 are assigned to the clockwise direction of rotation, SEN I2 and SEN I4 are assigned to the counterclockwise direction of rotation. When SEN I3/SEN I4 is reached, RASP5… switches to creep speed FF1. When SEN I1/SEN I2 is reached, the drive switches off. Application example: Turntable **Note:** SEN I3 and SEN I4 require a RA-XM12-Y Y connector.

The following two tables provide an overview of the conditions under which the sensors cause the drive to stop

Table 28: Signal detection in Manual mode

	Manual mode			
P1-13	**SEN I1**	**SEN I2**	**SEN I3**	**SEN I4**
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 operation with edge or signal control	Stop in REV operation with edge or signal control	No function	No function
5	Stop in FWD operation with edge control	Stop in FWD operation with edge control	Operation with fixed frequency 1 (f-Fix1) with edge control	Operation with fixed frequency 1 (f-Fix1) with edge control
6	No function	No function	No function	No function
7	Stop in FWD operation with edge control	Stop in REV operation with edge control	FWD operation with fixed frequency 1 (f-Fix1) with edge control or signal control	REV operation with fixed frequency 1 (f-Fix1) with edge control or signal control
8	Stop in FWD operation with edge or signal control	Stop in REV operation with edge or signal control	FWD operation with fixed frequency 1 (f-Fix1) with edge control or signal control	REV operation with fixed frequency 1 (f-Fix1) with edge control or signal control

Table 29: Signal detection in Auto mode

	Auto mode			
P1-13	**SEN I1**	**SEN I2**	**SEN I3**	**SEN I4**
0	–	–	–	–
1	No function	No function	No function	No function
2	Stop in FWD operation with edge or signal control	Stop in REV operation with edge control	No function	No function
3	Stop in FWD or REV operation with edge or signal control	No function	No function	No function
4	Stop in FWD operation with edge or signal control	Stop in REV operation with edge control	No function	No function
5	Stop in FWD operation with edge or signal control	Stop in FWD operation with edge control	Operation with fixed frequency 1 (f-Fix1) with edge control	Operation with fixed frequency 1 (f-Fix1) with edge control
6	Stop in FWD operation with edge or signal control	Stop in REV operation with edge control	FWD operation with fixed frequency 1 (f-Fix1) with edge control or signal control	REV operation with fixed frequency 1 (f-Fix1) with edge control or signal control
7	Stop in FWD operation with edge or signal control	Stop in REV operation with edge control	FWD operation with fixed frequency 1 (f-Fix1) with edge control or signal control	REV operation with fixed frequency 1 (f-Fix1) with edge control or signal control
8	Stop in FWD operation with edge or signal control	Stop in REV operation with edge control	FWD operation with fixed frequency 1 (f-Fix1) with edge control or signal control	REV operation with fixed frequency 1 (f-Fix1) with edge control or signal control

Example: Turntable

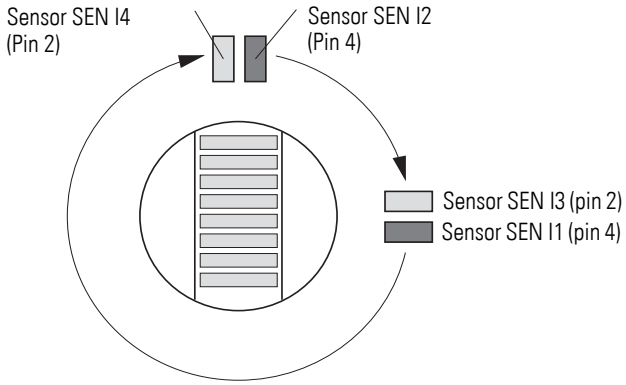


Figure 91: Example of clockwise turntable control
Pin 2: Creep speed
Pin 4: Stop

If there is an input signal on pin 2 (I3/I4) (rising edge or continuous signal), the RASP5 unit will switch the drive from f-Fix1 frequency to fixed frequency 2 (f-Fix2). 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 Auto mode and back, the fixed frequency 1 (f-Fix1) remains set if the signal is still present on pin 2 (I3/I4). Otherwise, the frequency of f-Fix1 applies.

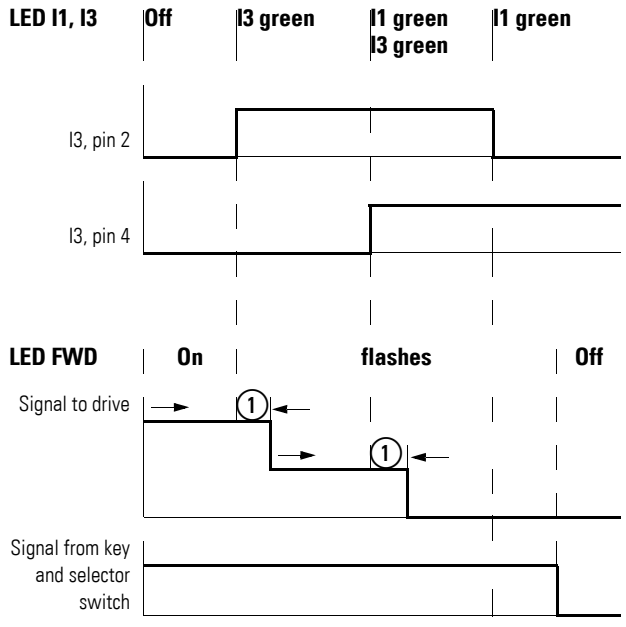


Figure 92: Interlocked manual mode with creep speed (Example of sensor input I1 and clockwise rotation)

① 13.5 ms ± 5 ms

6.7.5 Phase change

In RASP5, the parameter P6-08 changes the rotating field at the output from FWD to REV. The control logic and the LED signals remain 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 two phases of the motor cable from having to be swapped 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

6.7.6 Motor cable monitoring

Monitoring is carried out using 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.

6.7.7 Stop behavior

The following description of the stop behavior applies only to the RASP5-xxxxA… variants

RASP5 units do not require an external 24 V DC control voltage.

Parameter	Designation	Description	Unit	Min	Max	DS
P3-11	t-dec Select B0	Deceleration ramp selection - bit 0 External stop function: 0: deactivated 1: activated	–	0	1	0

However, via the AS-Interface connection, RASP5 offers the option of using the second ramp (P2-13) to bring the motor to a controlled stop when the external 24 V DC voltage is removed. For this purpose, this 24 V DC voltage must be fed in using the M12 AS-Interface connector.

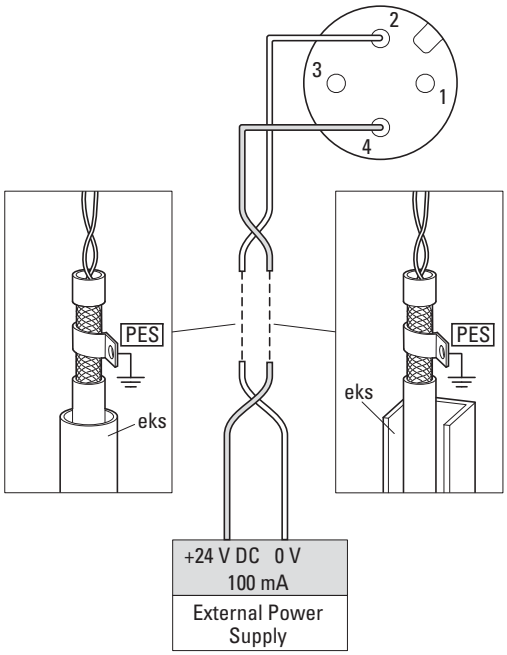


Figure 93: Example of a 24 V DC power connection

The second deceleration time can be set using the parameter P2-13.

7 Parameterization

The following section contains special information on configuring the Rapid Link 5 module in order to adapt it to your requirements.

A change of the parameter values requires a connection with the RJ45 socket. The socket is located under the screw plug on the front.

Connection and configuration options

1. **Connect the module to the PC** using the DX-COM-STICK3 KIT Bluetooth stick or the DX-CBL-PC-3M0 connection cable.

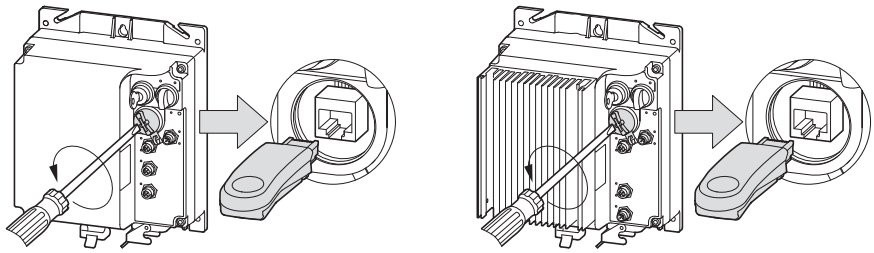


Figure 94: Connection using the DX-COM-STICK3-KIT Bluetooth stick

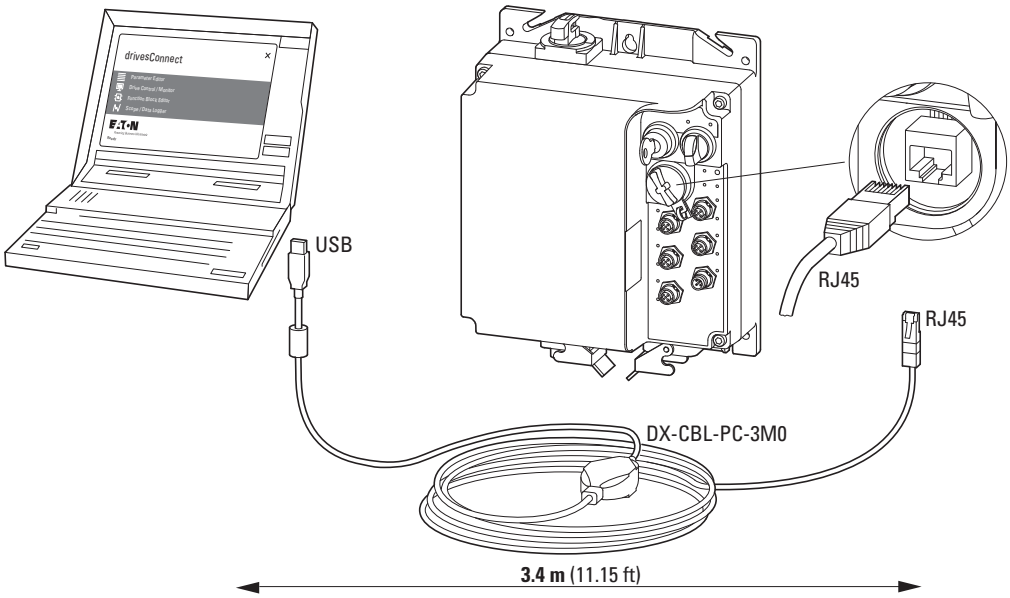


Figure 95: Connection using the DX-CBL-PC-3M0 parameterization cable

2. Connect the module **to the tablet or smartphone** using the DX-COM-STICK3-KIT Bluetooth stick.

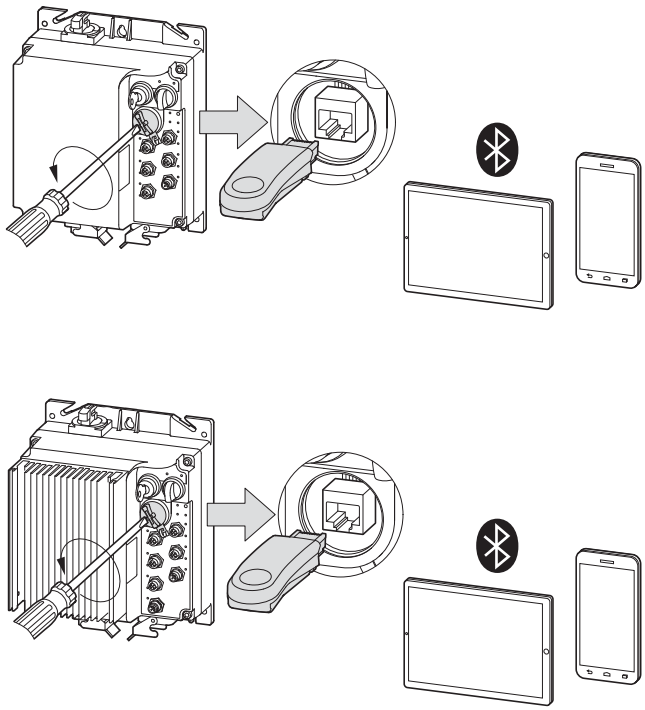


Figure 96: Connection using the DX-COM-STICK3-KIT Bluetooth stick
Top: for the RAMO5, bottom: for the RASP5

3. Connect the module **to the external control unit** using a patch cable with an RJ45 plug.

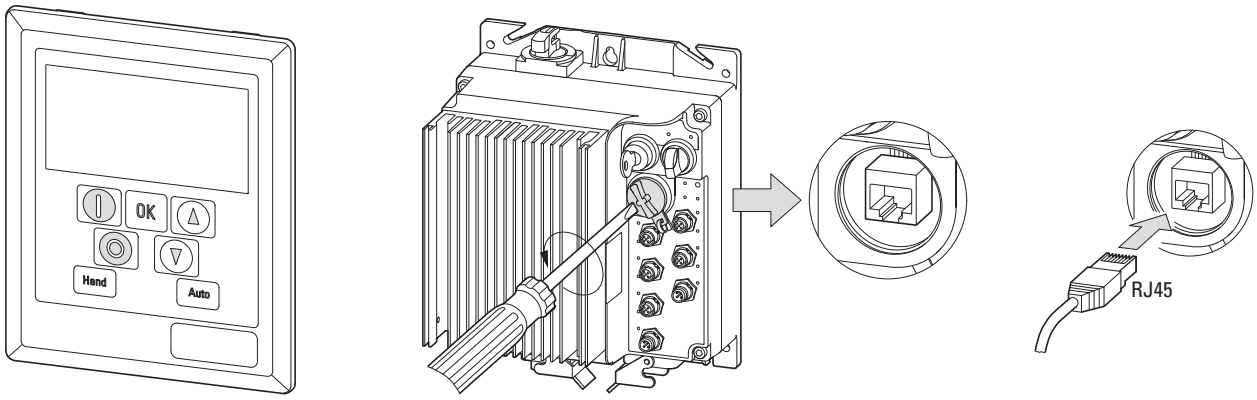


Figure 97: Connection to the external control unit using a patch cable with an RJ45 plug

→ The components listed here are not included as standard (optional accessories).

ATTENTION

Changing the parameter range to P1-14 = 201 requires additional configuration and meticulous parameter settings.
The operation and function of the Rapid Link 5 may considerably deviate from the standard settings of the Rapid Link 5 system and lead to different operating statuses.

7.1 Configuration using the drivesConnect software

When you run the drivesConnect parameter configuration software by clicking on the corresponding icon, your computer screen will display the 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 5)
- **Function block editor** (not available with Rapid Link 5)
- **Scope/data logger**

Parameter Editor

The **Parameter Editor** contains a list of the parameters of the respective Rapid Link 5 module. These parameters can be manually changed and accessed.

Figure 98: drivesConnect start screen

When you open the **Parameter Editor**, the following user interface will be displayed:

Figure 99: User interface for the Parameter Editor when using RAMO5

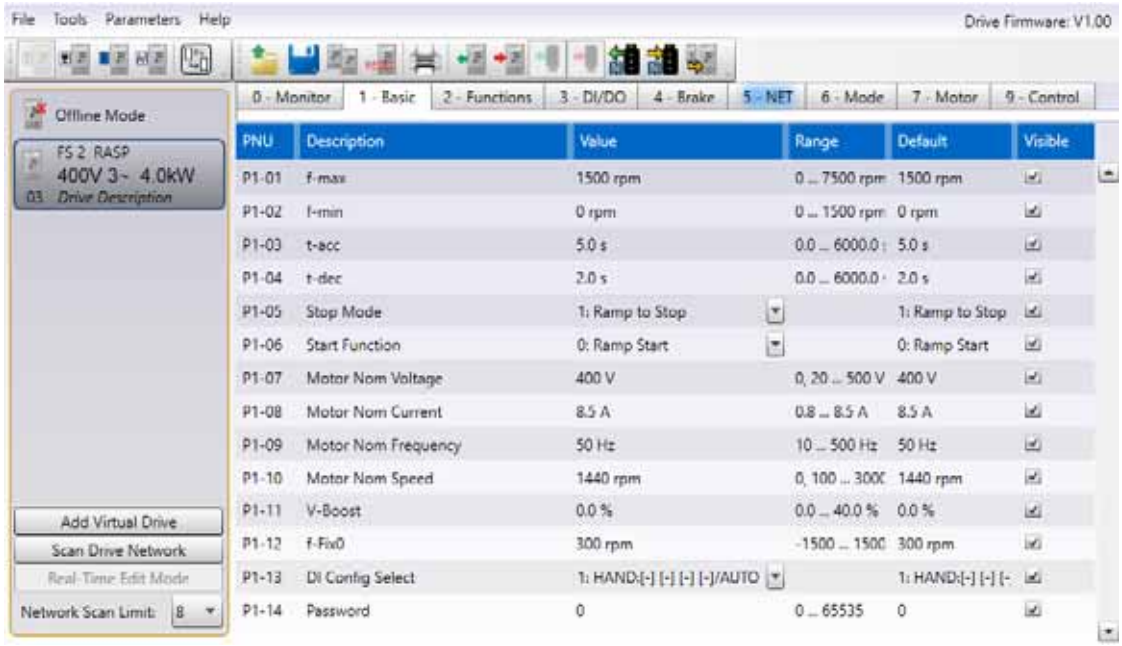


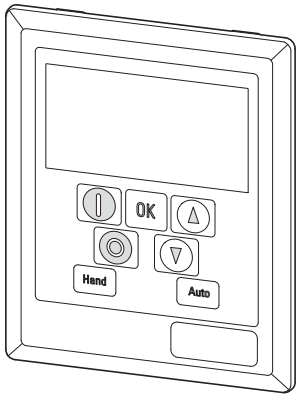
Figure 100: User interface for the Parameter Editor when using RASP5

→ More information on the drivesConnect software can be found in the MN040003EN manual.

7.2 Parameterization using OLED operating unit

The parameters of the Rapid Link 5 system can be configured and its operation monitored using the DX-KEY-OLED operating unit.

The figure below shows the DX-KEY-OLED operating unit.



Display

Buttons

Figure 101: DX-KEY-OLED operating unit view

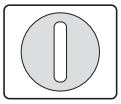
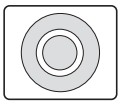
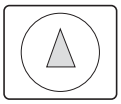
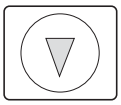
→ The DX-KEY-OLED operating unit has a multi-language plain text display unit (OLED = organic LED display).

→ Activate language selection using the key combination **START** + ▲.
Display: **Select Language**.
Change the display language using the ▲ and ▼ arrow keys.
The selected language setting can then be saved by pressing the **OK** button.

→ More information and technical data on the DX-KEY-LED operating unit can be found in the instruction leaflet IL04012020Z.

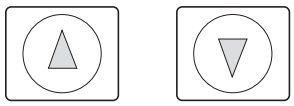
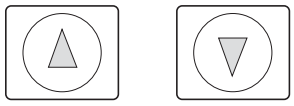
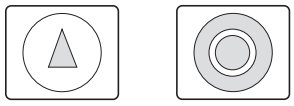
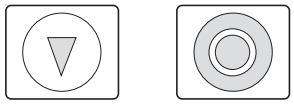
7.2.1 DX-KEY-OLED operating unit elements

Table 30: Elements (buttons) of the DX-KEY-OLED operating unit

Button	Command	Explanation
	**OK**	• Navigating in parameter mode • Opens and closes the parameter interface (Press and hold the button for more than two seconds) • Saves parameter changes
	**START**	• Parameter selection
	**STOP**	• Reset – Reset after an error message
	**UP**	• Increment numeric value or parameter number.
	**DOWN**	• Decrement numeric value or parameter number.

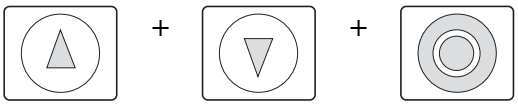
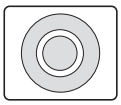
7.2.2 Set parameters

Table 31: Modify parameters

Commands	Description
	Press the **OK** button and hold it down for two seconds in order to access the parameter interface. -> The display shows the parameter that was used last.
	Select the parameters using the ▲ and ▼ buttons.
	Press the **OK** button. The value of the selected parameter can be changed.
	Change the parameters using the ▲ and ▼ buttons.
	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. In other words: Moving forward from the last parameter in a parameter group will take you to the first parameter in the next parameter group and vice versa. **Note:** To access the extended parameter groups, you will need to enter the 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.

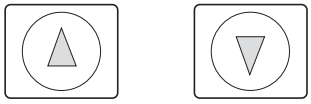
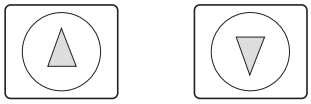
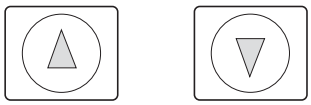
7.2.3 Reset parameters (RESET)

Table 32: Resetting parameters (RESET)

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

7.2.4 Extended parameter set

Table 33: Open and exit the extended parameter set

Commands	Description
Open the extended parameter set	
	Press the **OK** button and hold it down for two seconds in order to access the parameter interface. -> The display shows the parameter that was used last.
	Use the ▲ and ▼buttons to select parameter P1-14.
	Press the **OK** button.
	Use the ▲ or ▼ buttons to select the password set using parameter P2-32 (Level 2, default setting 101).
	Press the **OK** button to confirm. -> The extended parameter set is now available.
Exit 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 now be accessible.

7.3 Configure parameters using an app

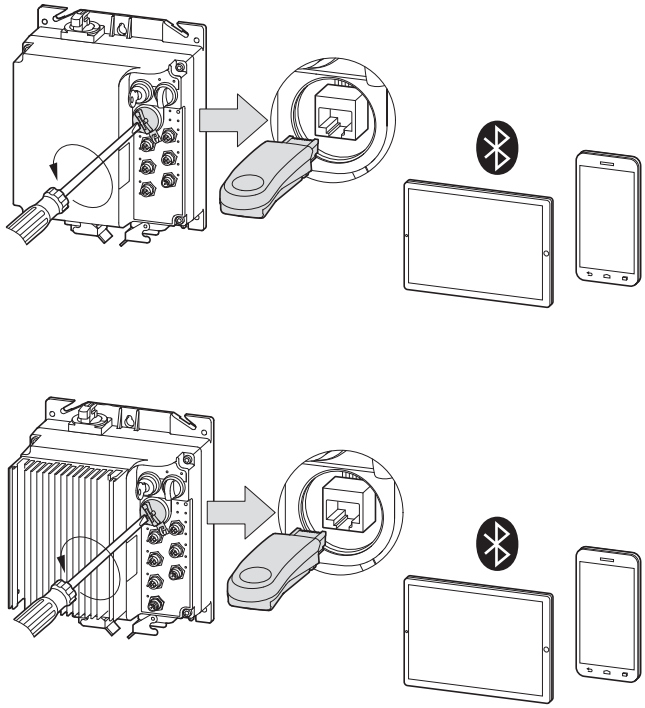


Figure 102: Configure parameters using an app

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

The parameters can be displayed using Bluetooth (DX-COM-STICK-KIT), for example.
The components listed here are not included as standard (optional accessories).

For more information on configuring parameters using the app, please visit the Eaton Download Center.

Eaton.eu → Customer Support → Download Center - Documentation

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

8 Parameter list

8.1 Parameter Groups

The functions of the RAMO5 and RASP5 Rapid Link 5 modules are configured using parameters that are divided into 8 groups (P0 to P7):

Table 34: Parameter Groups

Parameter group	Subject	RAMO5	RASP5
P0	Monitor	✓	✓
P1	Basic	✓	✓
P2	Advanced Functions	✓	✓
P3	Mechanical brake and digital inputs	✓	✓
P4	Brake chopper and DC brake	–	✓
P5	Communication	✓	✓
P6	Advanced motor control	✓	✓
P7	Motor	–	✓

→ The graphic of the following page (Menu structure) shows how to switch between the parameter groups.

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

8.2 Menu structure

The acronyms used in the following tables are defined below:

Abbreviation	Meaning
Default	Default setting (the parameter's value when using the device's factory settings)
Min./max.	Minimum/maximum value that can be specified

8.3 Parameter groups for RAMO5

8.3.1 Parameter group 0 (Monitor)

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

Parameter	Designation	Description	Unit
P0-02	Thermistor input1	Thermistor status 0: Motor temperature OK 1: Motor temperature too high	%
P0-03	SEN 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	°C
P0-06	Overload	Calculated overload in % above the current set with P1-08. If the value rises to 100 %, the device will trip with error message "iT-Trp".	%
P0-07	Output frequency	Instantaneous output frequency	Hz/rpm
P0-09	Motor current	Instantaneous output current	A
P0-10	Motor Power Rel	Motor Power (actual value) in kW/HP	kW
P0-13	Trip Log	Display of the 4 latest faults	–
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
P0-22	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

Para-meter	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 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 + checksum Level 2: System version + checksum	–
	System Version	System version	–
P0-29	–	Device information	–
	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	–
P0-31	t-Run	Total operating time of the drive since the date of manufacture Displayed in hours, minutes and seconds. Pressing Δ 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 occurred or power down in hours, minutes and seconds. Pressing Δ 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 Δ 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 Δ 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
P0-39	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

Parameter	Designation	Description	Unit
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" occurred	–
P0-43	FaultCounter DC-Undervoltage	Counts how often "DC-Undervoltage" occurred	–
P0-46	FaultCounter Overtemperature Ambient	Counts how often "Overtemperature Ambient" occurred	–
P0-47	FaultCounter Internal Fault (IO)	Counts how often "Internal Fault (IO)" occurred	–
P0-48	FaultCounter Internal Fault (DSP)	Counts how often "Internal Fault (DSP)" occurred	–
P0-49	FaultCounter Local COM Loss	Counts how often "Local COM Loss" occurred	–
P0-50	FaultCounter Communication Loss	Counts how often "Communication Loss" occurred	–
P0-51	Input Data Value	Input Data Value Process Input Data (PDI, received from the fieldbus). There are four entries for this parameter (PDI1, …, PDI4).	–
P0-52	Output Data Value	Output Data Value Process Output Data (PDO, received from the fieldbus). There are four entries for this parameter (PDO1, …, PDO4).	–
P0-53	Phase U Current Offset Ref.	Phase U, current offset and reference (value for diagnosis in case of problems)	–
P0-54	Phase V Current Offset Ref.	Phase V, current offset and reference (value for diagnosis in case of problems)	–
P0-55	Phase W Current Offset Ref.	Phase W, current offset 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 Δ 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	–	–

8.3.2 Parameter group 1 (Basic)

Table 35: 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	SEN Config Select	Configuration of sensor 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 (factory setting: 101)	–	0	65535	0

8.3.3 Parameter group 2 (Extended functions)

Table 36: 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 sensor 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 a start signal (FWD/REV) is still present. 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	Auto Reset Delay Determines the time that 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 “Thermistorfault Motor” occurs. Possibilities device dependent	–	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 parameter 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 by the remote keypad if they are locked.	–	0	1	0

Parameter	Designation	Description	Unit	Min	Max	DS
P2-34	TCP Enable Service	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 parameter @24V-ext.	List of defined parameters 0: No function – automatically set to 0. 1: If control voltage is present, the Parameters will be saved. After that, the parameter is automatically set to 0.	–	0	1	0

8.3.4 Parameter group 3 (Mechanical brake and digital inputs)

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

Parameter	Designation	Description	Unit	Min	Max	DS
P3-04	Brake Release Delay	Determines the time before the mechanical brake is released.	s	0	2.50	0
P3-05	Brake Apply Delay	Determines the time between the signal to close the brake and disabling of the drive.	s	0	25.00	0
P3-06	SEN I1 Logic	0: normally open 1: normally closed **Note:** Change only after POWER ON / OFF active	–	0	1	0
P3-07	SEN I2 Logic	0: normally open 1: normally closed **Note:** Change only after POWER ON / OFF active	–	0	1	0
P3-08	SEN I3 Logic	0: normally open 1: normally closed **Note:** Change only after POWER ON / OFF active	–			
P3-09	SEN I4 Logic	0: normally open 1: normally closed **Note:** Change only after POWER ON / OFF active	–			

8.3.5 Parameter group 5 (Communication)

Table 38: 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 "Communication Loss" occurs. Possibilities device dependent 0: Trip 1: reserved 2: Stop	–	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 two decimal places, e.g. 400 ≙ 4.00 kW 2: Status of the sensor inputs (SEN I). Bit 0 = status SEN I1, bit 1 = status SEN I2, etc.	–	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 two decimal places, e.g. 400 ≙ 4.00 kW 2: Status of the sensor inputs (SEN I). Bit 0 = status SEN I1, bit 1 = status SEN I2, etc.	–	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	–	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	–	0	3	0
P5-10	Disable QuickStop	0: Quick stop via sensors deactivated 1: Quick stop via sensors activated; ASi signal active	–	0	1	0

8.3.6 Parameter group 6 (Extended motor control)

Table 39: 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: Trip (stop)	–	0	1	0
P6-08	Change Phasesequence Motor	Changes the sequence of the output phases. This prevents two phases of the motor cable 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) **Note:** Only for RASP5… and RAMO5-W…	–	0	1	0

8.4 Parameter groups for RASP5

8.4.1 Parameter group 0 (Monitor)

Table 40: Parameter group 0 (Monitor)

Parameter	Designation	Description	Unit
P0-02	Thermistor input1	Thermistor status 0: Motor temperature OK 1: Motor temperature too high	–
P0-03	SEN 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 current level set with P1-08. If the value rises to 100 %, the device will trip with error message “iT-Trp”.	%
P0-07	Output frequency	Instantaneous output frequency	Hz/rpm
P0-08	Motor speed	Motor speed (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 I_d	Calculated magnetizing current I_d – providing an autotune has been completed successfully.	A
P0-15	Torque current I_q	Calculated torque-producing current I_q – providing an autotune has been completed successfully.	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 (in hours). 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 heatsink 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 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 kWh. 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 + checksum Level 2: System version + checksum	–
P0-28	System Version	System version	
P0-29	n/a	Device information	–
	NoOfInputPhases	Number of input phases	
	FrameSize	Frame size	
	kW/HP	Motor output	
	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	–
P0-31	t-Run	Total operating time of the drive since the date of manufacture Displayed in hours, minutes and seconds. Pressing Δ 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 occurred or power down in hours, minutes and seconds. Pressing Δ 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 Δ 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 Δ 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-Link 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” occurred	–
P0-42	FaultCounter DC-Overvoltage	Counts how often “DC-Overvoltage” occurred	–
P0-43	FaultCounter DC-Undervoltage	Counts how often “DC-Undervoltage” occurred	–
P0-44	FaultCounter Overtemperature Heatsink	Counts how often “Overtemperature Heatsink” occurred	–
P0-45	FaultCounter Overcurrent Brake Chopper	Counts how often “Overcurrent Brake Chopper” occurred	–
P0-46	FaultCounter Overtemperature Ambient	Counts how often “Overtemperature Ambient” occurred	–
P0-47	FaultCounter Internal Fault (IO)	Counts how often “Internal Fault (IO)” occurred	–
P0-48	FaultCounter Internal Fault (DSP)	Counts how often “Internal Fault (DSP)" occurred	–
P0-49	FaultCounter Local COM Loss	Counts how often “Local COM Loss” occurred	–
P0-50	FaultCounter Communication Loss	Counts how often “Communication Loss” occurred	–
P0-51	Input Data Value	Input Data Value Process Input Data (PDI, received from the fieldbus). There are four entries for this parameter (PDI1, …, PDI4).	–
P0-52	Output Data Value	Output Data Value Process Output Data (PDO, received from the fieldbus). There are four entries for this parameter (PDO1, …, PDO4).	–
P0-53	Phase U Current Offset Ref.	Phase U, current offset and reference (value for diagnosis in case of problems)	–
P0-54	Phase V Current Offset Ref.	Phase V, current offset and reference (value for diagnosis in case of problems)	–
P0-55	Phase W Current Offset Ref.	Phase W, current offset 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 Δ on the drive keypad will change the display from “hours” to “minutes and seconds”.	hh:mm:ss
P0-57	V d axis	V_d and V_q of the stator voltage 1. value = V_d (d at the beginning of the line) Pressing the Δ on the drive keypad will change the display to V_q (q at the beginning of the line).	V
	V q axis		–
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	–	–

Parameter	Designation	Description	Unit
P0-61	Reserved	–	–
P0-62	T-accNET	Ramp time received via fieldbus interface.	s
P0-63	f-Ref Interface0	Speed reference received via fieldbus interface	Hz/rpm
P0-64	Actual switching frequency	Current switching frequency. The value may be less than the one set with P2-22. See also P2-23.	kHz
P0-65	System Software Version	System software version	–

8.4.2 Parameter group 1 (Basic)

Table 41: 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). Nominal motor speed (P1-10) = 0: the maximum speed limit will be displayed in Hz. Nominal motor 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 max. frequency (P1-01). Nominal motor speed (P1-10) = 0: the minimum speed limit will be displayed in Hz. Nominal motor 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 the brake chopper is disabled, even during normal operation. **Note:** A brake chopper is activated via P4-05.	–	0	2	1
P1-06	Reserved	–	–	–	–	–
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).	V	0	500	400
P1-08	Motor Nom Current	Motor nom 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, preventing thermal overload of the motor. Display: I.t-trP	A	Depending on device	Depending on device	Depending on device
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) Hz

Parameter	Designation	Description	Unit	Min	Max	DS
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 50Hz 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. **Note:** This parameter will only be enabled when using speed control (extended V/f, P6-01 = 6).	%	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	SEN Config Select	Configuration of sensor 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

8.4.3 Parameter group 2 (Extended functions)

Table 42: 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 slurred Transition to Start and End of Acceleration (P1-03) and Deceleration Ramps (P1-04). The time set here applies for both ramps. 0.0 = linear	s	0	10	0
P2-09	Overvoltage control	The overvoltage 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: 0: REV activated - motor is running forward and in reverse 1: REV deactivated - motor will only run 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 ASi.	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). Nominal motor speed (P1-10) = 0: Displayed in Hz Nominal motor 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	Center 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	Center 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 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, Disadvantage: Higher loss in the device. 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 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 sensor 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 a start signal (FWD/REV) is still present. 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	Auto reset delay Determines the time that will elapse between consecutive drive reset attempts when Auto Reset is enabled in P2-24.	s	0.1	60	0.5
P2-27	Action@Thermistor-fault Motor	Device reaction after “Thermistorfault Motor” occurs. 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. If 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	Default settings, 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	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	–	0	15	0
P2-35	–	–				
P2-36	Save parameter @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. 0: Spin Start Off 1: Spin Start On	–	0	1	0

8.4.4 Parameter group 3 (Mechanical brake and digital inputs)

Table 43: Parameter group 3 (Mechanical brake and digital inputs)

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 to 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 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	SEN I1 Logic	0: normally open 1: normally closed **Note:** Change only after POWER ON / OFF active	–	0	1	0
P3-07	SEN I2 Logic	0: normally open 1: normally closed **Note:** Change only after POWER ON / OFF active	–	0	1	0
P3-08	SEN I3 Logic	0: normally open 1: normally closed **Note:** Change only after POWER ON / OFF active	–	0	1	0
P3-09	SENI4 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

8.4.5 Parameter group 4 (Brake chopper and DC brake)

Table 44: 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. **Note:** 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 thermal protection of the brake resistor. **Note:** 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

8.4.6 Parameter group 5 (Communication)

Table 45: 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 "Communication Loss" occurs. 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 by 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 two decimal places, e.g. 400 ≙ 4.00 kW 2: Status of the sensor inputs (SEN I). Bit 0 = status SEN II1, bit 1 = status SEN I2, etc. 3: Internal temperature. -500 - 1500 ≙ -50 - 150 °C	–	0	6	0
P5-06	NETSendPZD4	Configuration of the 4th 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 two decimal places, e.g. 400 ≙ 4.00 kW 2: Status of the sensor inputs (SEN I). Bit 0 = status SEN II1, bit 1 = status SEN I2, etc. 3: Internal temperature. -500 - 1500 ≙ -50 - 150 °C	–	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, e.g. 500 ≙ 5.00 s.	–	0	3	1
P5-08	NETReceivePZD4	Configuration of the 4th process data word PDI-4 from the network master to the drive during cyclic communication. 0: reserved	–	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 vir Process Data Word 3 (PZD3, to be set with P5-05) or 4 (PZD4, to be set with P5-06). P5-09 is mostly used in conjunction with the Function Block Editor.	–	0	200	0
P5-10	Disable QuickStop	0: Quick stop via sensors deactivated 1: Quick stop activated via sensors; DQ3 signal active	–	0	1	0
P5-11	AS-i command configuration	Configuration of the 4 AS-Interface outputs DQ0, …, DQ3 0: Clockwise rotation, anticlockwise rotation, FF1 - FF4 (binary coded via Select f-Fix Bit0-1); FWD + REV = Reset 1: Clockwise rotation, FF1 - FF8 (binary coded via Select f-Fix Bit0-2) 2: Clockwise rotation, selection between 1st and 2nd ramp time (0= P1-03, P1-04 / 1 = P2-11, P2-13), FF1 - FF4 (binary coded via Select f-Fix Bit0-1)	–	0	2	0

8.4.7 Parameter group 6 (Extended motor control)

Table 46: 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 (P6-01 = 0, 1, 2, 3, 4, 5)	%	0.0	400.0	50.0
P6-03	MSC1 Ti	Integral time Ti at Motor speed Control (P6-01 = 0, 1, 2, 3, 4, 5)	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 other 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 2: Trip (stop)	–	0	1	0
P6-06	M-Min (f-Ref>5Hz) Limit	Minimum torque required, when the output frequency is above 5 Hz in the motor range	%	10	150	50
P6-07	M-Min (f>P1-09) Limit	Minimum torque required when the output frequency is above the field weakening point.	%	5	150	10
P6-08	Change Phasese-quence Motor	Changes the sequence of the output phases. This prevents two phases of the motor cable 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) **Note:** Only for 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-Current-Limit	0: deactivated - motor overload management switched off 1: activated - speed decrease The output torque is reduced to avoid overload.				
P6-11	EnhancedGenerator-Control	Adaptation of regenerative operation 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 Current-limit	Current limitation to prevent over voltage trips This parameter is only active at Speed Control with Torque Limit (P6-01 = 1) 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 (J_{tot}/J_{mot}) 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 default setting should not be changed.		0	600	10
P6-14	t-Excitation-V/f	Magnetizing period Induction motors (P6-01 = 0, 1, 6): This parameter defines a delay time for the control of the magnetizing current after a Start signal for the drive. 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. **Remark**: 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-MotorSignalIn-Level	Selection of voltage and duration of the signal to identify the rotor position at PM motors The default setting is 10. Setting this value too low can cause the rotor position not to be detected, whereas too high values can cause a trip due to over current.	–	0	200	10
P6-18	Overmodulation	Enabling overmodulation 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

8.4.8 Parameter group 7 (Motor)

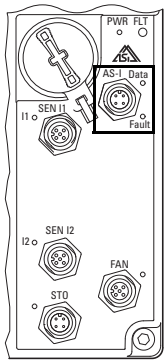
Table 47: Parameter group 7 (Motor)

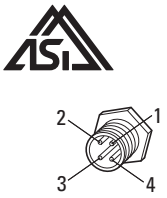
Parameter	Designation	Description	Unit	Min	Max	DS
P7-01	Motor Identification	Motor Identification When set to 1, the drive immediately carries out a non-rotating autotune to measure the motor parameters for optimum control and efficiency. Following completion of the autotune, the parameter automatically returns to 0. 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 value of the power factor stated on the motor name plate.		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

9 Communication

9.1 AS-Interface

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





1	AS-Interface+
2	–
3	AS-Interface–
4	–

Figure 103: M12 connection AS-I

9.1.1 AS-I LED

The **AS-I** LED indicates the operating states and allows problems to be quickly diagnosed.

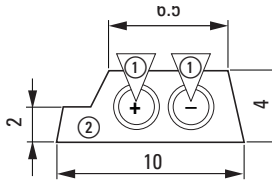
Table 48: Status of the AS-I LED

LED	State	Description
Data		
	Off	ASi electronics have no supply voltage: Check ASi connection cables. Check ASi power supply unit (head-end controller).
	Green	Communication active, normal operation
	Red	No communication: • Head-end controller (master) in STOP mode. • RAMO5 not entered or entered with the wrong address (ID). • RAMO5 in Reset mode.
	Yellow flashing, red	ASi address = 0 → Adjust ASi address
	Green, Red flashing	fatal peripheral error, internal ASi error
Fault		
	Red	No data exchange, communication error
	Red flashing	Peripheral fault,

9.1.2 Data cable

AS-Interface uses a geometrically coded, unscreened ribbon cable with a cross-section of 2 x 1.5 mm^2. It is used to transmit both power and 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 Ribbon cable protected against polarity reversal

Figure 104: ASi ribbon cable

Rapid Link 5 function modules can be installed and removed any number of times at various locations. The AS-Interface ribbon cable is self-healing, dust-tight and resistant to sprayed water. The network can have a star, linear or tree structure.

9.1.3 ASi profile

9.1.3.1 ASi profile with standard addressing range

- RAMO5-xxxxA31… has the ASi profile S-7.4.
- RASP5 has the ASi profile S-7.4

When using RASP5 and RAMO5-xxxxA31… units, a maximum of 31 modules can be connected to (assigned an address on) a single AS-i line.

9.1.3.2 ASi profile with extended addressing range (RAMO5-xxxxA32…)

When using ASi slaves (A/B slaves) with an extended address range with ASi 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 purpose (maximum: 31A and 31B).

9.1.3.3 Replacing the devices

If the RASP5 devices are replaced, the master (gateway) must perform a new initialization due to the possible differences in the ASi profiles.
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 hard-coded into the slave modules during production 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.

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

9.1.4 Gateway

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

9.1.5 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.

9.1.6 Addressing

Every slave must be assigned an address before data can be transmitted between the ASi gateway and the Rapid Link 5 devices. Rapid Link 5 devices have a default address of 0.

ASi slaves can be assigned an address as follows:

- offline: Addressing with the handset
- online: Assigning addresses via the ASi gateway

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

9.1.7 Replacing Rapid Link devices in the ASi 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 5 device address and assign a new address.

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

9.1.8 ASi ribbon cable

You can position M12 branches (ZB2-100-AZ1) at any point along the ASi 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.

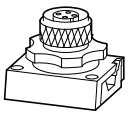


Figure 105: Junction M12 (order no.: ZB2-100-AZ1)

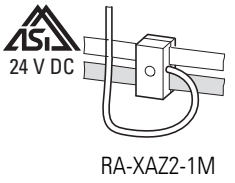
The Rapid Link 5 function modules have an ASi M12 plug-in connector that fits the M12 junction.

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

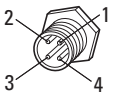
9.1.9 External Quick stop (for RASP5)

RASP5 provides the option of activating a second Stop function on pins 2 and 4 of the AS-Interface with an external control voltage (+24 V DC).
This requires a second ASi ribbon cable and RA-XAZ2-1M connector.

A Quick stop with the second ramp is activated via parameter P3-11.
The ramp time (second ramp) is set using parameter P2-13.



RA-XAZ2-1M



1	AS-Interface+
2	0 V
3	AS-Interface–
4	24 V

Figure 106: RA-XAZ2-1M, ASi branch

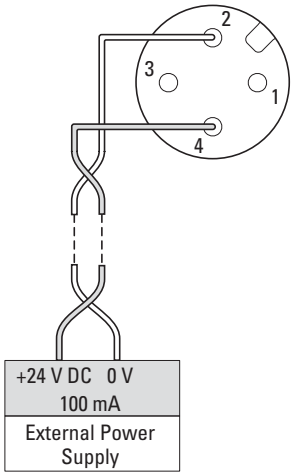


Figure 107: Connection example for quick stop

9.1.10 Extension cable

Extension cable RA-XM12-1M can be used to connect the M12 junction ZB2-100-A21 with Rapid Link 5 modules RAMO5 or RASP5.
This 1 m long connection cable is prefabricated with an M12 socket (connection to RAMO or RASP) and an M12 plug (M12 junction).

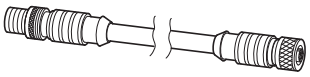


Figure 108: Extension cable RA-XM12-1M

9.1.11 Cable Routing

Route the control cables and signal cables separately from the mains cables 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 adapter 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. Further measures are necessary to ensure EMC-compliant installation of the frequency-controlled RASP5.

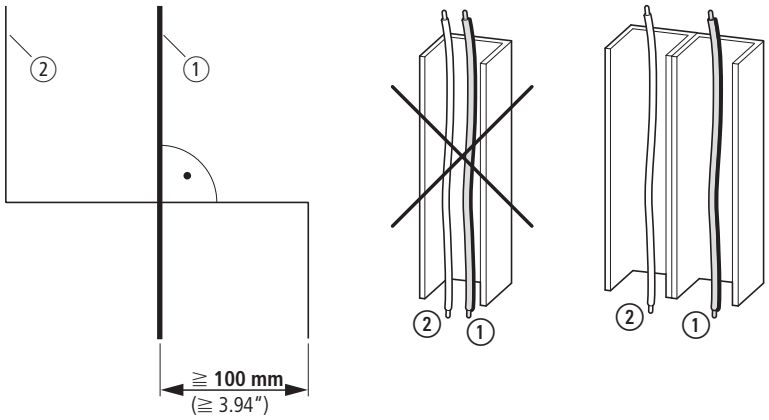


Figure 109: Laying of signal and power cables

① Power cable: Mains connection (power bus, adaptor cable), motor cable
② Control cables: AS-Interface (data bus), sensor/actuator connection

9.1.12 Controlling RAMO5 via the AS-Interface

Table 49: Controlling RAMO5

Function	Signal to RAMO5							
	AS-Interface outputs				AS-Interface inputs			
	DQ0	DQ1	DQ2	DQ3	DI0	DI1	DI2	DI3
Zero speed	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 SEN I1 via M12 socket								
no signal							0	
Signal available							1	
External input SEN 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 the actuator output ACT Q1 to High or Low.

9.1.13 Controlling RASP5 via the AS-Interface

Table 50: Controlling RASP5

Function	Signal to RASP5							
	Outputs				Inputs			
	DQ0	DQ1	DQ2	DQ3	DI0	DI1	DI2	DI3
No controller enable	0	0						
Anticlockwise rotating field (REV)	0	1						
Clockwise rotating field (FWD)	1	0						
No controller enable/reset	1	1						
f-Fix1 (P1-12 = 10 Hz)			0	0				
f-Fix2 (P2-01 = 30 Hz)			1	0				
f-Fix3 (P2-02 = 40 Hz)			0	1				
f-Fix4 (P2-03 = 50 Hz)			1	1				
Automatic mode					1			
No automatic mode					0			
Accumulative error						0		
No accumulative error						1		
External input SEN I1								
no signal							0	
Signal available							1	
External input SEN I2								
no signal								0
Signal available								1

- The START signal or enable for the requested operating direction is issued through DQ0 (FWD) or DQ1 (REV).
- The fixed frequencies f-Fix1 to f-Fix4 (digital setpoint value memory) are called up in binary code through outputs DQ2 and DQ3.
- If DQ2 and DQ3 are not activated, the frequency set in f-Fix1 is issued.

9.1.14 Diagnostics and troubleshooting via the AS-Interface

All faults identified are transmitted to the AS-Interface assembly as group fault messages: DI = 0 (Low). The **FLT** LED lights up red.

▶ 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 from ASi provides an additional reset option in case the unit 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.

9.2 EtherNet/IP

→ The following section only concerns the device variants RAMO5-xxxxEIP… and RASP5-xxxxEIP…

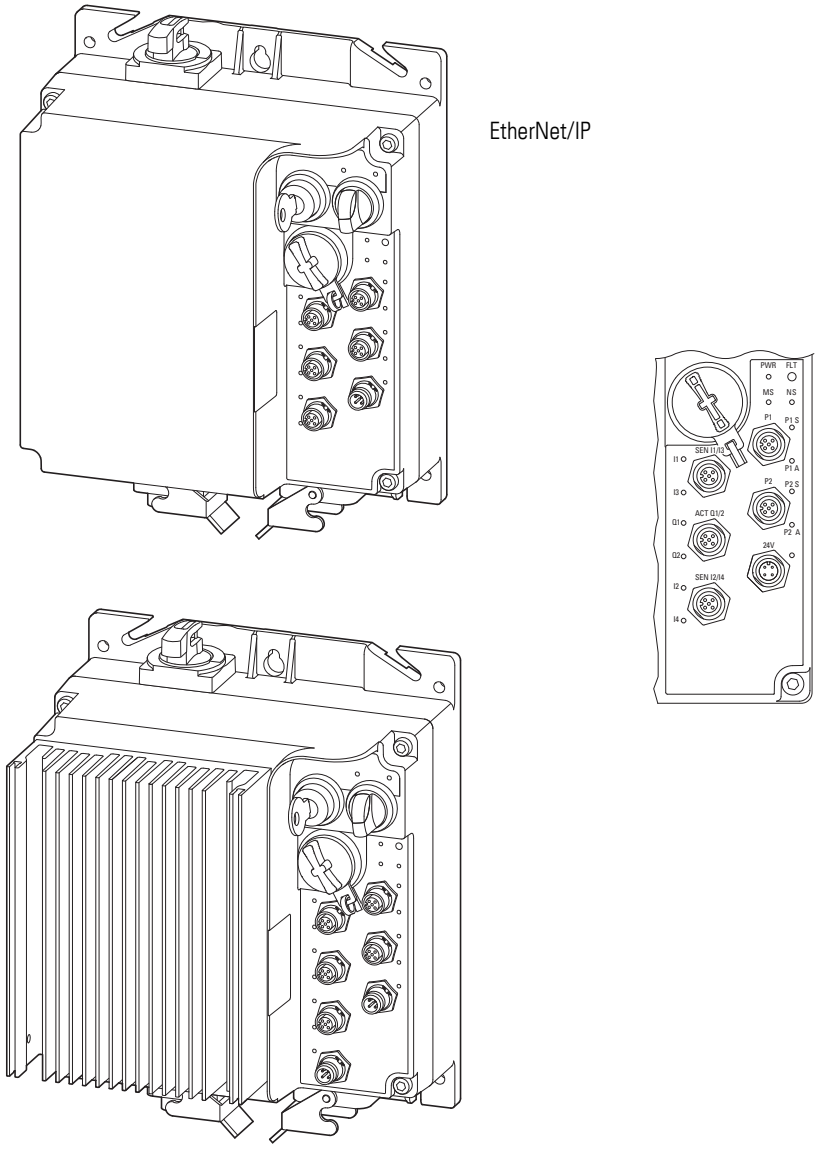


Figure 110: EtherNet/IP connections for Rapid Link 5

9.2.1 Introduction

EtherNet/IP (Ethernet Industrial Protocol) is an open industrial standard that is based on the standards for normal Ethernet (IEEE 802.3) and that expands on them with an industrial protocol. EtherNet/IP can be used to connect devices from different vendors to each other, as well as to have these devices communicate with each other.
The EtherNet/IP protocol supports communications between various control products, enabling devices to transfer time-critical application data between each other in an industrial environment.
The spectrum of supported devices ranges from simple I/O devices (e.g., sensors) to complex controllers.
EtherNet/IP supports the TCP/IP protocol family and expands it for controller applications with the Common Industrial Protocol (CIP).
CIP is used as a real-time application protocol for inputs/outputs.

9.2.2 Proper use

The communication interface of the Rapid Link 5 module is used for controlling and switching on the EtherNet/IP fieldbus system. It is intended to be installed in a machine or assembled with other components into a machine or system. It enables the Rapid Link 5 modules of the RAMO5-xxxxEIP and RASP5-xxxxEIP device series to be integrated into the EtherNet/IP fieldbus system as I/O devices.

To make it easier to understand some of the images included in this manual, the housing and other safety-relevant parts have been left out.
The components described here must be used only with a properly fitted housing and all necessary safety-relevant parts.

Please take note of the installation information in the instruction leaflet IL034092ZU (for RAMO5-xxxxEIP) or IL034093ZU (for RASP5-xxxxEIP).

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

Cover or tape over M12 interfaces during installation to prevent foreign objects from entering the device.

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

9.2.3 EtherNet/IP interface of the Rapid Link 5 module

An M12 plug is used to establish a connection to the EtherNet/IP field bus.

The following figure shows the EtherNet/IP interface of the Rapid Link 5 module with two M12 sockets.

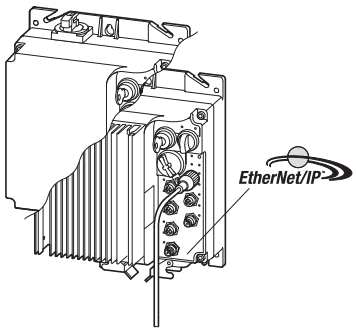
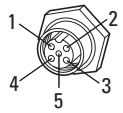


Figure 111: EtherNet/IP interface

Generally, connection cables with M12 plugs for EtherNet/IP are available as standard ready-to-use cables. They can also be prepared individually.
This will require the connections shown below (Observe pin assignment!).



1	TD+
2	RD+
3	TD-
4	RD-
5	⏚

Figure 112: Pin assignment E/IP P1 AND E/IP P2

9.2.4 LED indicators for EtherNet/IP

The Rapid Link 5 module's LED indicators are used to indicate operating and network statuses and to allow problems to be quickly diagnosed.

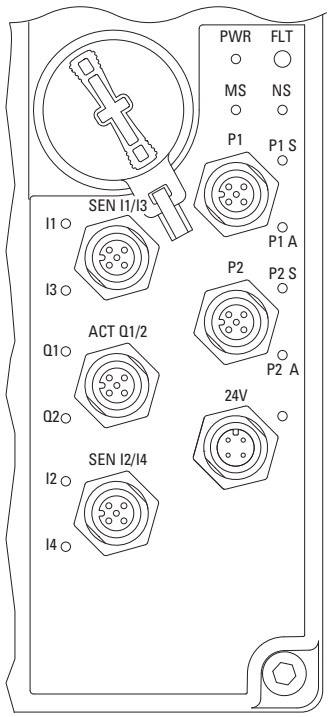


Figure 113: LEDs

The following tables show the meaning of the LED indicators for communication via EtherNet/IP.

9.2.4.1 NS LED ("network status")

The **NS** LED (network status) is used to indicate network statuses.

LED state	Description
Off	No supply voltage or IP address not assigned
Green flashing	online, but no communication
Green illuminating	Connection to EtherNet/IP network established
Red flashing	Fault detected (e.g., connection request timeout)
illuminated red	Error detected (e.g., same IP address assigned twice)
Green-red flashing	Self-test/initialization

9.2.4.2 MS LED ("module status")

The **MS** (module status) LED indicates the status of the Rapid Link 5 module.

LED state	Description
Off	No supply voltage or device not turned on
Green flashing	Configuration error or module in standby mode
Green illuminating	Connection to EtherNet/IP controller established
Red flashing	A reversible error has occurred[1)]
illuminated red	Fatal error detected[2)]
Green-red flashing	Self-test/initialization

1) Reversible errors can be reset by means of a reset or by power cycling the supply voltage (turning it off and then back on).
2) In contrast, fatal errors can only be reset by power cycling the supply voltage or by changing the hardware configuration while the supply voltage is off, as the case may be.

9.2.4.3 E/IP P1 and E/IP P2 LEDs

The **E/IP P1** and **E/IP P2** LEDs indicate the status of general communication.

LED state	Description
Off (green)	Port not connected
Off (yellow)	Data transfer at 10 MBit/s active or no communication
Green illuminating	Port connected but no communication
Green flashing	Data transfer present and communication active
illuminated yellow	Data transfer active at 100 MBit/s

9.2.5 Integrating Rapid Link 5 into an EtherNet/IP network

Rapid Link 5 has a connection to the EtherNet/IP fieldbus system.
The Rapid Link 5 module's EtherNet/IP port has a switch.
The devices can be connected to each other in a daisy chain.

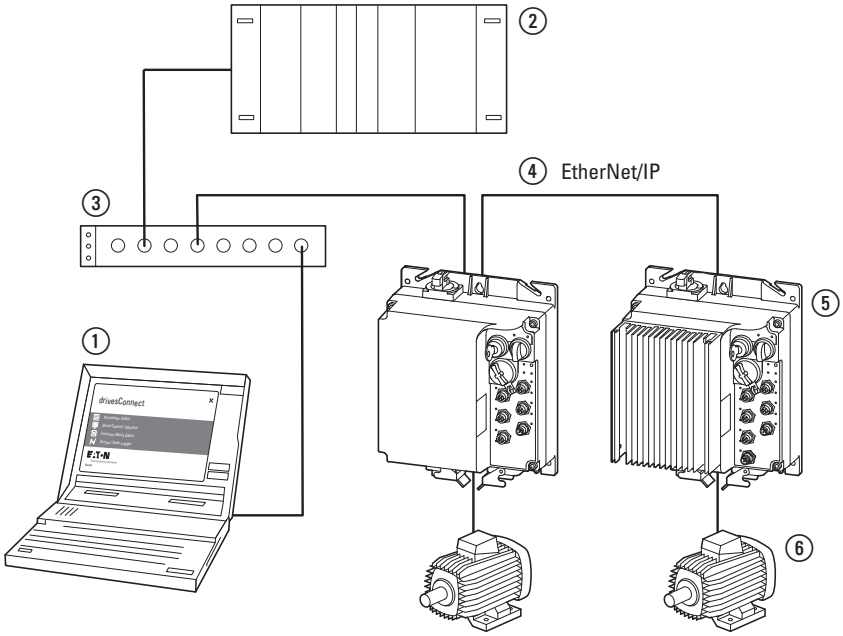


Figure 114: Integrating Rapid Link 5 into an EtherNet/IP network

① PC
② Head controller (I/O controller)
③ Switch
④ EtherNet/IP cable
⑤ Rapid Link 5 modules
⑥ Motor(s)

→ Rapid Link 5 is not a device for household use and is designed exclusively for use in commercial applications.

→ Observe the technical data and connection requirements described in this manual. Any other usage constitutes improper use.

9.2.6 Installation instructions

During installation, ensure that the control cables, signal cables (0-10 V, 4-20 mA, 24 V DC, etc.), and the field bus system's (EtherNet/IP) connection cables are not routed directly parallel to energy-carrying mains connection cables or motor connection cables. With parallel cable routing, the clearances between control, signal and field bus cables ② and energy-carrying mains and motor cables ① must be greater than 30 cm.
Cables should always intersect at right angles.

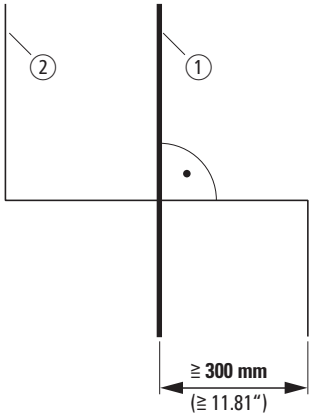


Figure 115: Cable routing for EtherNet/IP ② and mains/motor cables ①

→ Never lay the cable of a field bus system directly parallel to the energy carrying cables.

If the system requires a parallel routing in cable ducts, a partition must be installed between the field bus cable ② and the mains and motor cable ①, in order to prevent electromagnetic interference on the field bus.

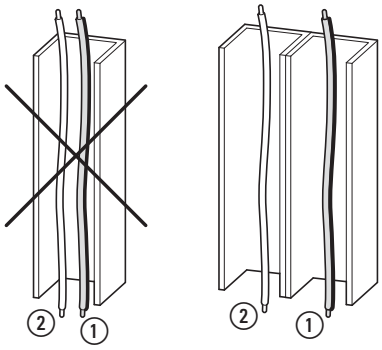


Figure 116: Separate routing in the cable duct
① Mains and motor connection cable
② EtherNet/IP cable

→ In all cases only use approved EtherNet/IP cables.

9.2.7 EDS file

The properties of an EtherNet/IP module are described in the corresponding EDS file. This file is required to integrate a Rapid Link 5 module into an EtherNet/IP network.

You can find the EDS file called "Eatn69122.eds" online on the Eaton website at:

Eaton.eu → Customer Support → Download Center - Software

Enter the search term "Eatn69122.eds".

9.2.8 Configuration

The following instructions describe the configuration of the Rapid Link 5 modules in an EtherNet/IP network.

▶ Connect the device to the EtherNet/IP environment.

You will need the following components to do so:

- Head-end controller (PLC)
- Computer (for programming and configuration purposes)
- Rapid Link 5 modules

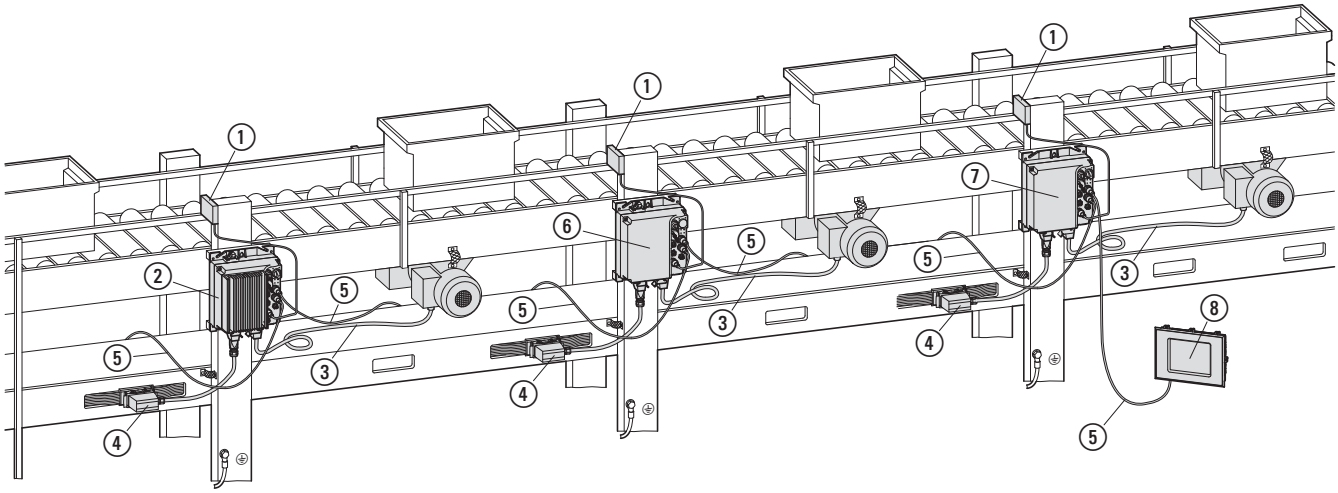


Figure 117: Example of using Rapid Link 5
(RASP5-xxxxEIP…, RAMO5-WxxxEIP…and RAMO5-DxxxEIP…)

① Sensor (light barriers)
② RASP5
③ Motor connection cable
④ Mains connection on power bus
⑤ EtherNet/IP cable
⑥ RAMO5-D…
⑦ RAMO5-W…
⑧ Head-end controller (PLC)

▶ Switch on the device (switch on the power supply L1-L3 400 V AC or power supply 24 DC via socket M12).
▶ Address the Rapid Link 5 modules (i.e. assign IP addresses).
(→ Section 9.2.9, Configuring the IP address, page 211)
▶ Now configure the project.
(For information on a detailed configuration, please consult the manual provided by the PLC's manufacturer.)
▶ Check the LED indicators. The head-end controller must recognize the device address and the **MS** and **NS** LEDs must light up green
(→ Section 9.2.4, LED indicators for EtherNet/IP, page 204).
▶ Now download the project and navigate through the programming software (such as CODESYS or Studio 5000) to RUN/Online.

If you make any changes to the network, the data sizes may be affected. For example, deviations caused by a configuration mismatch are indicated by the status display of the Rapid Link 5 module on the EtherNet/IP interface
If this happens, transfer the modified project back to the Rapid Link 5 module and update the details in the aforementioned dialog box as necessary.

9.2.9 Configuring the IP address

The Rapid Link 5 modules are addressed using MAC and IP addresses. Each device has a globally unique MAC address (a six-byte Ethernet address): The first three bytes specify the manufacturer-specific ID, while the other three bytes specify the device's serial number.

IP address configuration can be changed using the TCP/IP class 0xF5.

→ The MAC address is printed on the name plate of the Rapid Link 5 module.
Static IP address: 192.168.1.254
Subnet mask: 255.255.255.0

The following instructions describe how to configure the IP address of the Rapid Link 5 module.

The configuration is carried out using the software Molex.

→ Molex can be downloaded from the Internet free of charge at:
https://www.molex.com/molex/contact/icccDownload.jsp

Perform the following instructions :

- ▶ Connect the Rapid Link 5 module and the PC on the network side.
- ▶ Switch on the device.
- ▶ Open the Molex program.
- ▶ Click on the **Options** button.

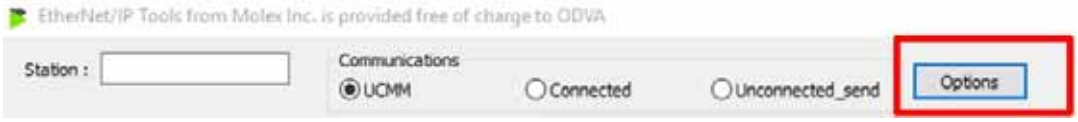


Figure 118: Options button

- ▶ Select the PC network adapter and confirm using **OK**.

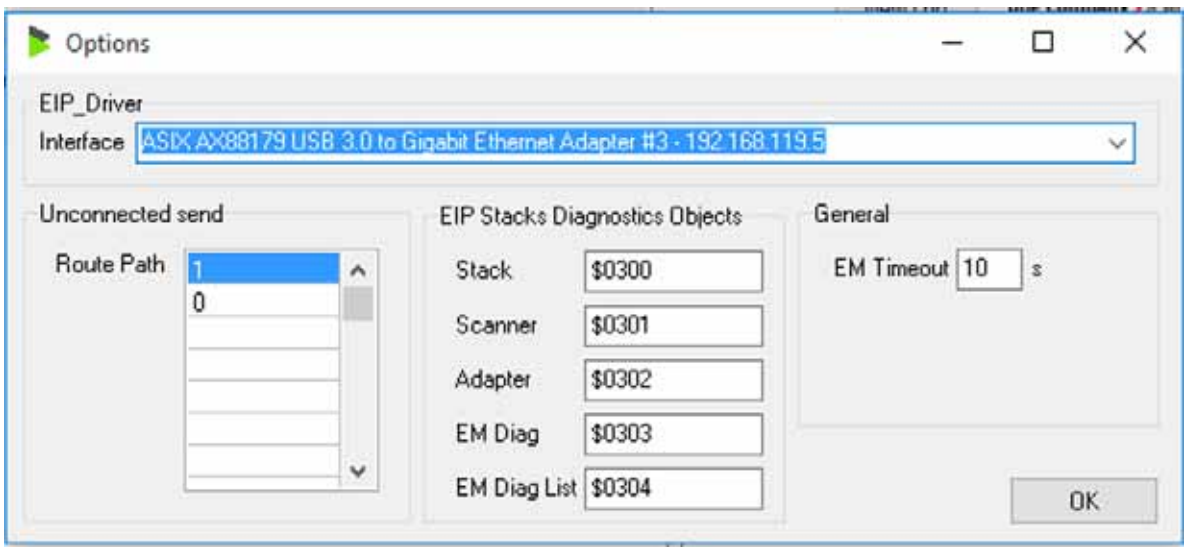


Figure 119: Select the PC adapter (interface)

- ▶ Click on the **List Identity** tab.
- ▶ Select **Broadcast**.
- ▶ Click **Send List Identity Request on UDP**.

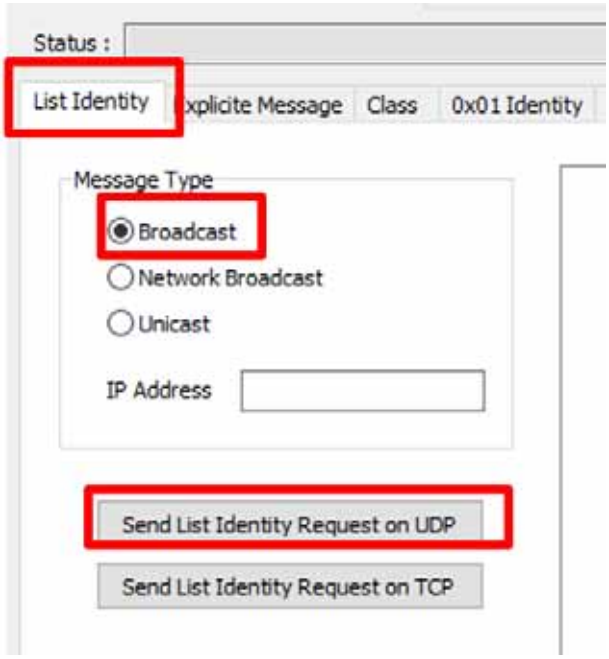


Figure 120: The List Identity tab

The program will show you all available modules.

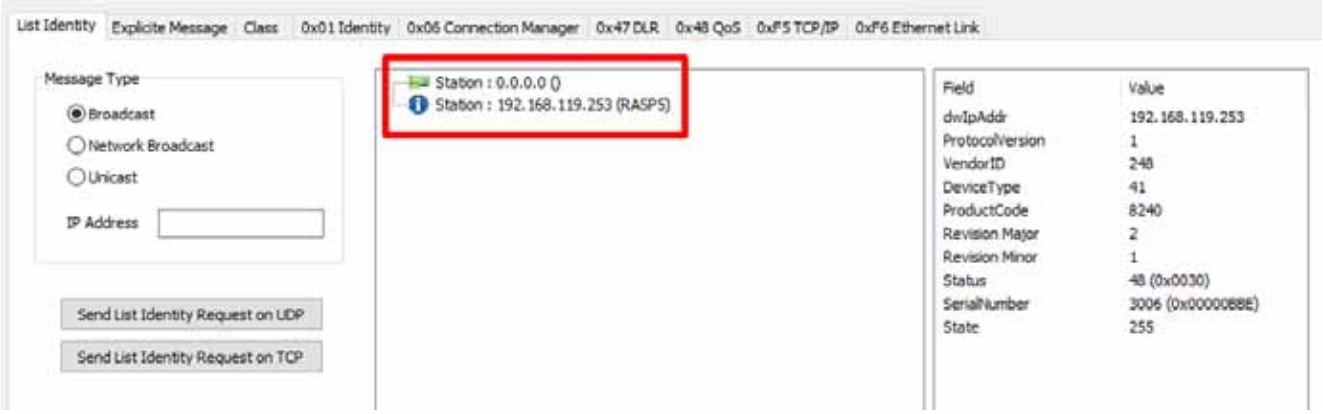


Figure 121: Select the station

- ▶ Select the station on the right-hand side (RASP5).
- ▶ Now click on the **0xF5 TCP/IP** tab.

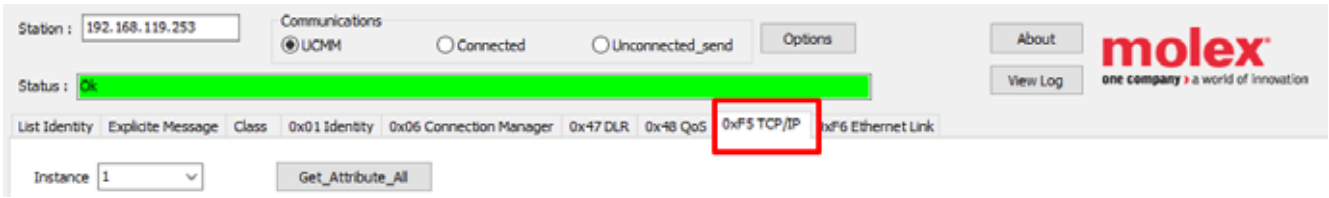


Figure 122: The 0xF5 TCP/IP tab

- ▶ Select **Interface configuration (attr 5) > Get_Attribute.**
  The current IP address will be displayed.

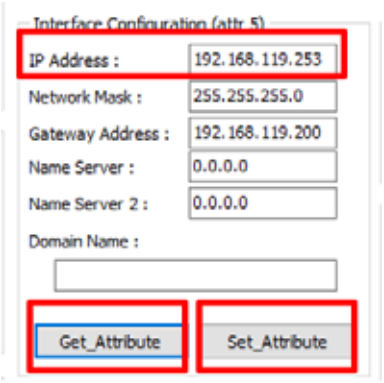


Figure 123: The current IP address

- ▶ Now set an IP address.
- ▶ Confirm the information by clicking **Set_Attribute**.
- ▶ You can now close the Molex program.

9.2.10 External 24 V DC control voltage

The control section of the RASP5 speed controller (M12 input 24 V) can be supplied with an external voltage of 24 V DC via an external power supply.

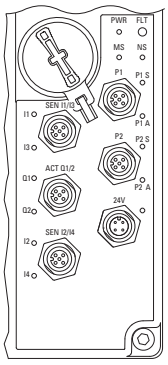
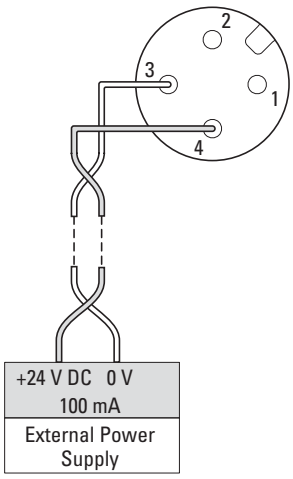


Figure 124: M12 input 24 V



1	Not used
2	Not used
3	0 V
4	+24 V DC

Figure 125: External 24-V DC control voltage

→ The external control voltage (+24 V DC) must be able to handle a load of at least 100 mA.
The residual ripple of this external control voltage must be less than ±5 % $\Delta U_a/U_a$.

If the power is supplied by an external power supply unit, the control board of the Rapid Link 5 module and the RJ45 interface will be active.

You can:

- Change parameters (but not save them) to save the parameters, parameter P2-36 must be set to 1.
- Read measured values and error registers
- Address and read out parameters via the RJ45 interface, the parameterization software drivesConnect, and field buses.
- Control control level functions without the power section being powered.

Status LED	Description
Off	External 24 V DC voltage not present
Green illuminating	External 24 V DC voltage present

9.2.11 General information regarding the EtherNet/IP and CIP protocols

The EtherNet/IP protocol uses the CIP (Common Industrial Protocol) protocol for data transmission.

It supports the following types of communication:

- 0x01 Identity
- 0x02 Message router
- 0x04 Assembly
- 0x06 Connection manager
- 0x0F Parameters
- 0x44 Modbus
- 0x45 Modbus serial
- 0xF4 Port
- 0xF5 TCP/IP
- 0xF6 Ethernet link

The EtherNet/IP protocol provides access to the module's data via standard services (CIP object classes) and manufacturer-specific object classes (VSC object classes, VSC = vendor-specific class). CIP object classes contain, for example, basic information concerning the device (device name, manufacturer, etc), as well as access to cyclic input/output data.

Standard CIP object classes

The following standard EtherNet/IP classes are supported in accordance with the CIP Specification:

Class	Object name	Description
01 (0x01)	Identity object	Information about the device, such as the manufacturer, device model, etc.
02 (0x02)	Message Router Object	Communication interface that can be used to generate requests for all of the device's classes and instances
04 (0x04)	Assembly Object	A collection of multiple data creating a data object in a data field. A typical application is using them to group all cyclic input or output data.
06 (0x06)	Connection manager object	Used to manage internal resources for I/O and explicit messaging connections
244 (0xF4)	Port Object	Device port description
245 (0xF5)	TCP/IP interface object	Information regarding the TCP/IP interface's settings
246 (0xF6)	Ethernet link object	Status information for an Ethernet 802.3 interface

Service codes

The following standard EtherNet/IP service codes are used in accordance with the CIP specification:

Service code	Service name
0x0E	Get_Attribute_Single
0x10	Set_Attribute_Single
0x4E	Read_Holding_Registers
0x50	Write_Holding_Registers
0x18	Get_Member
0x19	Set_Member

Identity object 01h

The 01h identity object provides information about the EtherNet/IP module. This includes information regarding the device name, the device version, the serial number, and version information.

Instance attributes for the identity object 01h

Attribute number	Attribute name	Access right ro | rw	Data type	Description
1 (0x01)	VENDOR	ro	UINT	Manufacturer's code
2 (0x02)	DEVICE TYPE	ro	UINT	Classifies the product as a communication adapter
3 (0x03)	PRODUCT CODE	ro	UINT	Order number
4 (0x04)	REVISION MAJOR MINOR	ro	STRUCT of USINT USINT	Device version
5 (0x05)	DEVICE STATUS	ro	WORD	Device status
6 (0x06)	SERIAL NUMBER	ro	UINT	Serial number of the device
7 (0x07)	PRODUCT NAME	ro	SHORT STRING	Length (first byte) and product name

9.2.12 General design data of the EtherNet/IP interface

Property	Value
Connections	M12 D-coded
Data transfer	10/100 Mbit/s Full-duplex/half-duplex automatic baud rate detection
Transmission cable	Twisted two-pair balanced cable, screened
Communication protocol	
Standard	IEC 61158
Baud rate	10/100 Mbit/s

9.2.13 Commissioning

- First carry out all the measures for commissioning the Rapid Link 5 module described in the previous chapter.
- Check the settings and installations for the switching on the EtherNet/IP fieldbus system that are described in this manual.

> *ATTENTION*
>
> Ensure that no danger will be caused by starting the motor. Disconnect the driven machine if an incorrect operating status is causing a hazard.

9.2.14 Cyclic data

Process Data

The process data of Rapid Link 5 consists of input process data (Master → Rapid Link 5) and output process data (Rapid Link 5 → Master).

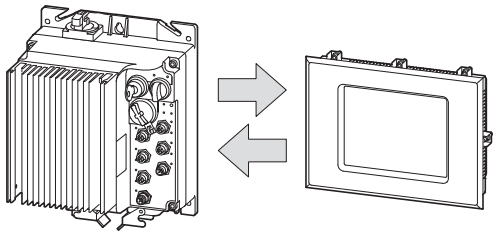


Figure 126: Data exchange

9.2.14.1 Input process data (NETReceivePDZ)

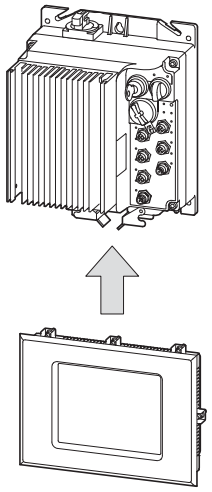


Figure 127: Input process data: Master → Rapid Link 5

There are 4 items of input process data (NETReceivePDZ x; x = 1, 2, 3, 4) available:

NETReceivePDZ	Explanation
NETReceivePDZ 1	Status word
NETReceivePDZ 2	Frequency reference **Note:** RASP5 only
NETReceivePDZ 3	Field bus ramp time **Note:** RASP5 only
NETReceivePDZ 4	Reserved

NETReceivePDZ 1 – control word

The two following tables break down the control word **NETReceivePDZ 1**.

RAMO5

Table 51: Bit assignment of NETReceivePDZ 1 – with RAMO5

Bit [no.]	Function – Value = 0	Function – Value = 1
0	Stop	Start
1	Clockwise rotating field (FWD)	Anticlockwise rotating field (REV)
2	No action	Reset fault
3	Not used	–
4	Not used	–
5	Not used	–
6	Not used	–
7	Not used	–
8	Action – actuator 1 off	Action – actuator 1
9	Action – actuator 2 off	Action – actuator 2
10	Not used	–
11	Not used	–
12	Not used	–
13	Not used	–
14	Not used	–
15	Not used	–

RASP

Table 52: Bit assignment of NETReceivePDZ 1 – with RASP5

Bit [no.]	Function – Value = 0	Function – Value = 1
0	Stop	Start
1	Clockwise rotating field (FWD)	Anticlockwise rotating field (REV)
2	No action	Reset fault
3	No action	Free run-down
4	Not used	–
5	No action	Quick stop (ramp)
6	No action	Fixed frequency 1 (f-Fix1)
7	No action	Overwrite setpoint value with 0
8	Action – actuator 1 off	Action – actuator 1
9	Action – actuator 2 off	Action – actuator 2
10	Not used	–
11	Not used	–
12	Not used	–
13	Not used	–
14	Not used	–
15	Not used	–

NETReceivePDZ 2 – reference (RASP5 only)

The permissible values fall within a range of P1-02 (minimum frequency) to P1-01 (maximum frequency).
This value will be scaled by a factor of 0.1 in the application.

NETReceivePDZ 3 – field bus ramp time (RASP5 only)

The acceptable values range from 0 to 3000 seconds.
The values are set using parameter P5-07. The enable is issued using parameter P5-04.
This value will be scaled by a factor of 0.01 in the application.
Example: 500 ≙ 5.00 s

NETReceivePDZ 4

NETReceivePDZ 4 has no function.

9.2.14.2 Output process data (NETSendPDZ)

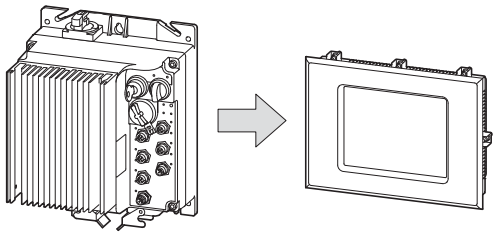


Figure 128: Output process data: Rapid Link 5 → Master

There are 6 items of output process data (NETSendPDZ x; x = 1, 2, 3, 4, 5, 6) available:

NETSendPDZ	Explanation
NETSendPDZ 1	Status word
NETSendPDZ 2	Actual frequency
NETSendPDZ 3	In the default setting: Current Setting options can be selected via parameter P5-05
NETSendPDZ 4	In the default setting: Heatsink temperature Setting options can be selected via parameter P5-06
NETSendPDZ 5	Motor Power
NETSendPDZ 6	Current error message

NETSendPDZ 1 - status word

Device status information is provided in the status word

RAMO5

Table 53: Bit assignment of NETSendPDZ 1 – with RAMO5

Bit [no.]	Function – Value = 0	Function – Value = 1
0	Drive not ready – fault present or OFF	Ready for operation (READY)
1	Stop (drive not started)	Operation (RUN)
2	Clockwise rotating field (FWD)	Anticlockwise rotating field (REV)
3	No fault	Fault detected (FAULT)
4	Not used	Not used
5	Not used	Not used
6	Not used	Not used
7	Reserved	Reserved
8	Sensor 1 off	Sensor 1 on
9	Sensor 2 off	Sensor 2 on
10	Sensor 3 off	Sensor 3 on
11	Sensor 4 off	Sensor 4 on
12	Reserved	Reserved
13	Mains voltage not present	Mains voltage present
14	24 V DC voltage not present	24 V DC voltage present
15	Reserved	Reserved

RASP5

Table 54: Bit assignment of NETSendPDZ 1 – with RASP5

Bit [no.]	Function – Value = 0	Function – Value = 1
0	Drive not ready – fault present or OFF	Ready for operation (READY)
1	Stop (drive not started)	Operation (RUN)
2	Clockwise rotating field (FWD)	Anticlockwise rotating field (REV)
3	No fault	Fault detected (FAULT)
4	Acceleration ramp	Frequency actual value equals setpoint input
5	Not used	Zero speed
6	Speed control deactivated	Speed control activated
7	STO status – hardware lockout (inhibit)	STO status – hardware enable
8	Sensor 1 off	Sensor 1 on
9	Sensor 2 off	Sensor 2 on
10	Sensor 3 off	Sensor 3 on
11	Sensor 4 off	Sensor 4 on
12	Voltage for Quick stop is not present	Voltage for Quick stop is present
13	Mains voltage not present	Mains voltage present
14	24 V DC voltage not present	24 V DC voltage present
15	Reserved	Reserved

NETSendPDZ 2 – actual frequency (actual value)

NETSendPDZ 2 supplies the actual output frequency.
This value will be scaled by a factor of 0.1 in the application.
Example: 500 ≙ 50 Hz

NETSendPDZ 3

In the default setting, NETSendPDZ 3 supplies the actual motor current.
NETSendPDZ 3 can be selected via parameter P5-05.

The following values can be sent to the PLC via NETSendPDZ 3:

NETSendPZD3	Values
	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 two decimal places2: Status of the sensor inputs (SEN Ix; x = 1, 2, 3, 4) Bit 0 = status SEN I1, bit 1 = status SEN I2, etc. 3: Internal temperature, -500 - 1500 ≙ -50.0 - 150.0 °C (RASP5 only)

NETSendPDZ 4

In the default setting, FB process data output 4 supplies the sensor status for RAMO5; in RASP5, NETSendPDZ 4 supplies the internal temperature in the default setting.

NETSendPDZ 4 can be selected via parameter P5-06.

The following values can be sent to the PLC via NETSendPDZ 4:

NETSendPZD4	Values
	Configuration of the 4th 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 two decimal places 2: Status of the sensor inputs (SEN Ix; x = 1, 2, 3, 4). Bit 0 = status SEN I1, bit 1 = status SEN I2, etc. 3: Internal temperature, -500 - 1500 ≙ -50.0 - 150.0 °C (RASP5 only)

NETSendPDZ 5 – motor current

NETSendPDZ 5 sends the motor current to the master.
The value is displayed with one decimal place (example: 34 ≙ 3.4 A).

NETSendPDZ 6 – error message

NETSendPDZ 6 returns the corresponding error code when an error occurs.

→ You can find the error codes and the description in → section 10.2, “Error Messages”, page 258.

9.2.15 Acyclic data

The drive parameters are accessed via the following object classes:

Class	Service name and code	Description
0x0F Parameters	0x0E Get_Attribute_Single	Delivers the contents of a single attribute.
	0x10 Set_Attribute_Single	Modifies a single attribute.
0x44 Modbus	0x4E Read_Holding_Registers	Delivers the contents of the class or instance of the relevant object.
	0x50 Write_Holding_Registers	Modifies the contents of the instance or the class attributes of the relevant object.
0x04 Assembly	0x18 Get_Member	Delivers the contents of the class or instance of the relevant object.
	0x19 Set_Member	Modifies the contents of the instance or the class attributes of the relevant object.

Example

Assembly objects (0x04)

Input and output assembly objects are groups of multiple individual objects that are used in order to be able to easily read or write large data volumes with a single connection.

Acyclic data of the Rapid Link 5 module is accessed via object class 0x04. Select the value of 0x18 (read parameter) or 0x19 (write parameter) for service.

For instance attributes, select the value assigned to the corresponding parameter.

The associated instance number can be found in the → Table 59 and → Table 60.

Multiple messages cannot be sent at the same time.

Perform the following steps (within the PLC program) to transmit messages acyclically:

- Interrupt cyclic communication.
  (Ask your PLC manufacturer how to interrupt cyclic communication.)
- Send an acyclic query.
- Receive acyclic data.
- Restart cyclic communication.

9.3 PROFINET

The following section only concerns device variants RAMO5-xxxxPNT… and RASP5-xxxxPNT…

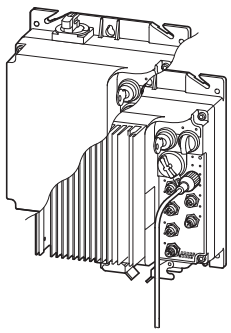


Figure 129: Connections for Rapid Link 5 in the PROFINET variant

RAMO5

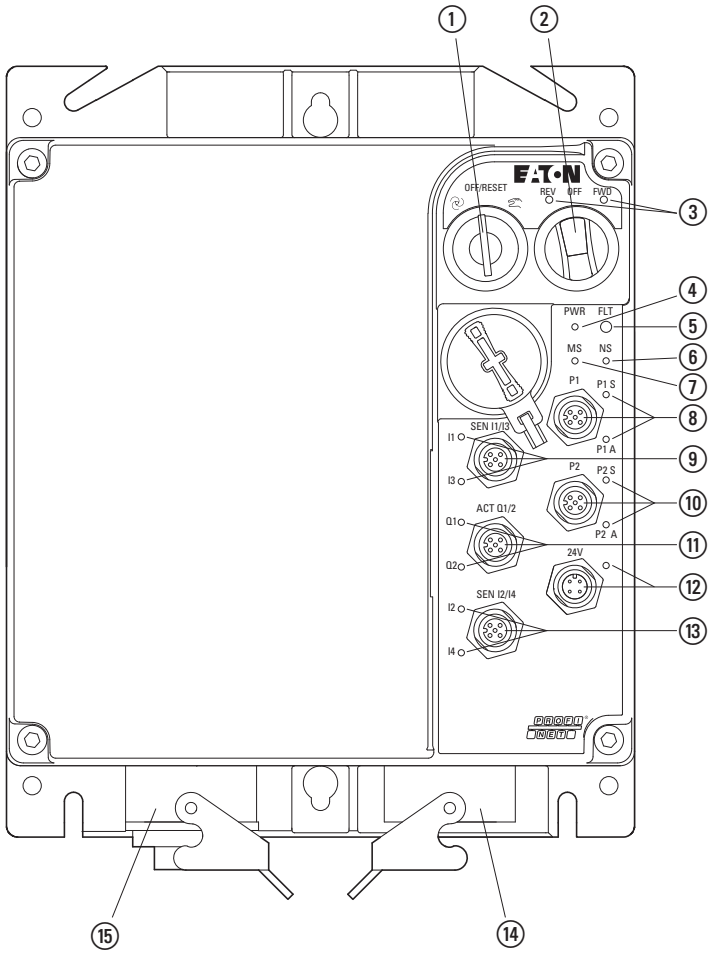


Figure 130: RAMO5

① Key-switch for manual and automatic mode and Reset
② Selector switch for rotating field direction (FWD, REV) in manual mode – only for RAMO5-W...
③ LED indicators for motor voltage rotating field
– FWD = Clockwise rotating field (Forward Run)
– REV = Counterclockwise rotating field (Reverse Run)
④ LED indicator for supply voltage
⑤ LED indicator for fault or error messages
⑥ LED indicator for network status
⑦ LED indicator for module status
⑧ PROFINET connection and status LED (M12 connector)
⑨ Sensor input I1/I3 (M12 socket) with LED indicator
⑩ PROFINET connection and status LED (M12 connector)
⑪ Actuator output Q1/Q2 (M12 connector) with LED indicator – only in the version RAMO5-xx1…
⑫ 24 V DC power supply and LED indicator (M12 connector)
⑬ Sensor input I2/I4 (M12 socket) with LED indicator
⑭ Motor feeder plug
⑮ Power plug, (supply voltage 3 AC 400 V, N, PE)

RASP5

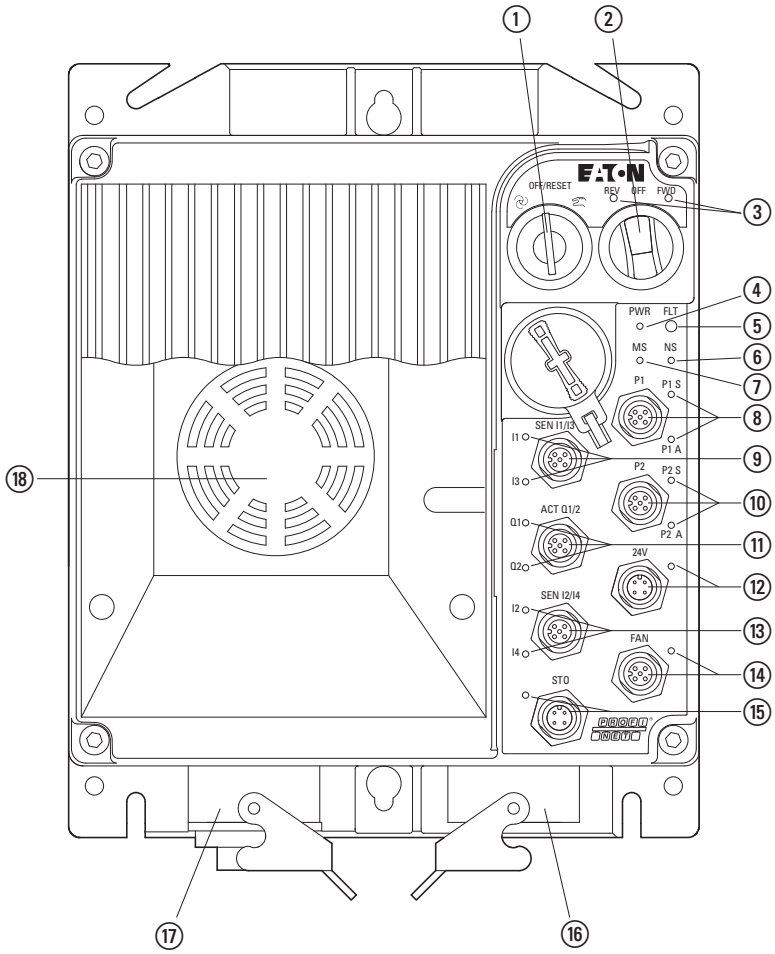


Figure 131: RASP5

① Key-switch for manual and automatic mode and Reset
② Selector switch for rotating field direction (FWD, REV) in manual mode
③ LED indicators for motor voltage rotating field
– FWD = Clockwise rotating field (Forward Run)
– REV = Counterclockwise rotating field (Reverse Run)
④ LED indicator for supply voltage
⑤ LED indicator for fault or error messages
⑥ LED indicator for network status
⑦ LED indicator for module status
⑧ PROFINET connection and status LED (M12 connector)
⑨ Sensor input I1/I3 (M12 socket) with LED indicator
⑩ PROFINET connection and status LED (M12 connector)
⑪ Actuator output Q1/Q2 (M12 plug) with LED indicator
⑫ 24 V DC power supply and LED indicator (M12 connector)
⑬ Sensor input I2/I4 (M12 socket) with LED indicator with LED indicator
⑭ Fan connector with LED indicator
⑮ STO input
⑯ Motor feeder plug
⑰ Power plug, (supply voltage 3 AC 400 V, N, PE)
⑱ Fan

9.3.1 Introduction

PROFINET is an open Industrial Ethernet standard (IEC 61158) designed for a wide range of applications. PROFINET can be used to connect devices from different manufacturers and implement communication between them.

PROFINET has developed from a combination of PROFIBUS and Industrial Ethernet. This makes it possible to integrate existing PROFIBUS systems into a PROFINET system. Since PROFINET is based on 100-Mbit/s full-duplex Ethernet, it enables all devices to access the corresponding network at any time.

In a PROFINET system, the devices are divided into controllers and devices (master and slave devices). Controllers are responsible for controlling the communications on the bus. A controller can send a message without first receiving an external request. Meanwhile, devices consist of peripheral devices that can be further subdivided into sensors and actuators, e.g., light barriers, valves, and variable frequency drives.
Devices respond to requests from controllers by sending information or executing commands.

PROFINET system allows for a variety of topologies. Many PROFINET devices feature an integrated switch and two integrated ports to enable formation of a linear or tree topology, eliminating the need for external switches. The number of devices in a PROFINET system is virtually unlimited.

9.3.2 Proper use

The communication interface of the Rapid Link 5 modules in versions RAMO5-xxxxPNT and RASP5-xxxxPNT is used for control and for connecting to the PROFINET system. It is intended to be installed in a machine or assembled with other components to form a machine or system.

→ To make it easier to understand some of the images included in this manual, the housing and other safety-relevant parts have been left out.
The components described here must be used only with a properly fitted housing and all necessary safety-relevant parts.

→ Please take note of the installation information in the instruction leaflet IL034092ZU (for RAMO5-xxxxPNT) or IL034093ZU (RASP5-xxxxPNT).

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

→ Cover or tape over M12 interfaces during installation to prevent foreign objects from entering the device.

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

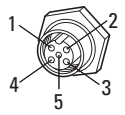
9.3.3 PROFINET interface of the Rapid Link 5 module

A Rapid Link 5 module is connected to the PROFINET communication system via an M12 connector.

Figure 133 shows the PROFINET interface of the Rapid Link 5 module with two M12 sockets.

Property	Value
Connections	M12 D-coded
Data transfer	10/100 MBit/s Full-duplex/half-duplex automatic baud rate detection
Transmission cable	Twisted two-pair balanced cable, screened
Communication protocol	
Standard	IEC 61158
Baud rate	10/100 MBit/s

Generally, connection cables with M12 plugs for PROFINET are available as standard ready-to-use cables. They can also be prepared individually.
This will require the connections shown below (Observe pin assignment!)



1	TD+
2	RD+
3	TD-
4	RD-
5	⏚

Figure 132: Pin assignment for P1 and P2

9.3.4 LED indicators for PROFINET

The LEDs on the Rapid Link 5 modules are used to indicate operating and network statuses and to allow rapid diagnosis of problems.

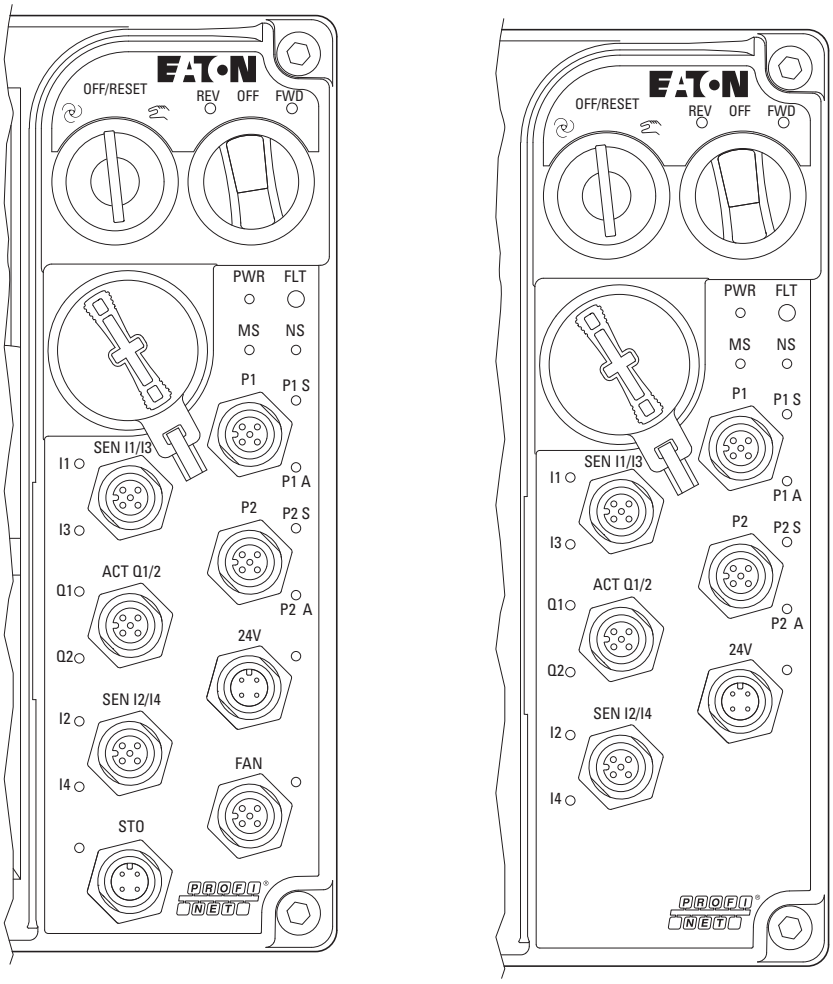


Figure 133: LED indicators

The following tables show the meaning of the LED indicators for communication via PROFINET.

9.3.4.1 NS LED ("network status")

The **NS** LED ("network status") is used to indicate network statuses.

LED state	Description
Off	No supply voltage or IP address not assigned
Green flashing	online, but no communication
Green constant	Connection to the PROFINET network established
Red flashing	Fault detected (e.g., connection request timeout)
Red constant	Error detected (e.g., same IP address assigned twice)
Green/red flashing	Self-test/initialization

9.3.4.2 MS LED ("module status")

The **MS** ("module status") LED indicates the status of the Rapid Link 5 module.

LED state	Description
Off	No supply voltage or device not turned on
Green flashing	Configuration error or module in standby mode
Green constant	Connection to EtherNet/IP controller established
Red flashing	A reversible error has occurred[1)]
Red constant	Fatal error detected[2)]
Green/red flashing	Self-test/initialization

1) Reversible errors can be resolved by a reset or by power cycling the supply voltage (turning it off and then back on).
2) In contrast, fatal errors can only be reset by power cycling the supply voltage or by changing the hardware configuration while the supply voltage is off.

9.3.4.3 P2 LED ("general communication")

The **P2** LED indicates the status of general communication.

LED state	Description
Off (green)	Port not connected
Green constant	Port connected but no communication
Green flashing	Data transfer present and communication active

9.3.5 Integrating Rapid Link 5 into a PROFINET network

Rapid Link 5 has a connection to the PROFINET fieldbus system.
The Rapid Link 5 module PROFINET port has a switch. The Rapid Link 5 devices can be connected to each other in a daisy chain.

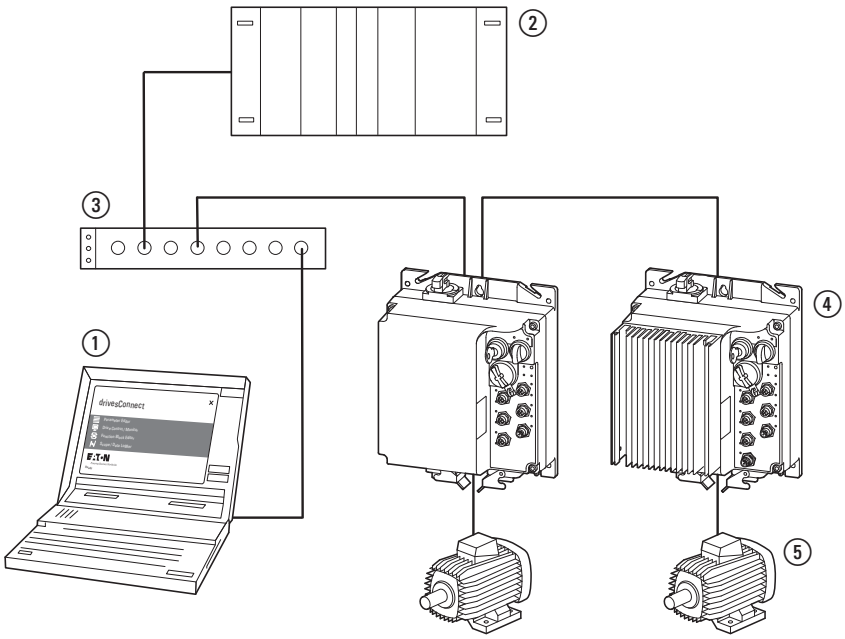


Figure 134: Integrating Rapid Link 5 into a PROFINET network
① PC
② Head controller (I/O controller)
③ Switch
④ Rapid Link 5 module
⑤ Motor(s)

→ Rapid Link 5 is not a device for household use and is designed exclusively for use in commercial applications.

→ Observe the technical data and connection requirements described in this manual.
Any other usage constitutes improper use.

9.3.6 Connection to the PLC

The following instructions describe the connection of a Rapid Link 5 module to a PROFINET network.

- Connect one end of the PROFINET cable to the Rapid Link 5 module using M12 connectors. Connect the other end to the PROFINET network in which the PLC or switch is located.
- Turn the key switch to the center position (OFF/Reset) and the selector switch (FWD/REV) to the "0" position.
  Note: This is essential if the motor is to be operated unattended.
- Connect the motor connector to the Rapid Link 5 module.
- Connect the mains plug (e.g. HAN Q4/2) to the Rapid Link 5 module.
- Supply the device with a voltage of 400 V AC.
- Before switching on, make sure that the motor and motor cable are connected correctly.
  If only a test connection to the PLC is required, you can also apply a voltage of 24 V DC to the M12 connector of the Rapid Link 5 module.
  See → section 9.2.10, "External 24 V DC control voltage", page 214.
- Set the repair switch to ON (for RASP5-...-xxxR... or RAMO5-…-xxxR only).
- Use the HMS IP Configuration Tool to set the IP address for the Rapid Link 5 module. To do so, see the → section 9.3.10, "Configuring the IP address", page 240.

The Rapid Link 5 module is now ready for programming!

→ In order to enable communication via PROFINET, the selector switch must be switched to automatic mode!

9.3.7 Installation instructions

Please refer to the information in → section 9.2.6, "Installation instructions", page 207.

9.3.8 GSDML file

The properties of a PROFINET device are described in the corresponding GSDML file. This file is required to integrate a Rapid Link 5 module into a PROFINET network.

You will find the corresponding GSDML file with name

for RAMO5:
GSDML-V2.34-EATON Rapid Link 5 RAMO-RAMO5-20200812.xml

or

for RASP5:
GSDML-V2.34-EATON Rapid Link 5 RASP-RASP5-20200706.xml

available on the Eaton website at:

Eaton.eu → **Customer Support** → **Download Center – Software**

Enter the search term "GSDML".

9.3.9 Engineering

The following instructions describe the configuration of the Rapid Link 5 modules in a PROFINET network.

▶ Connect the device to the PROFINET environment.

You will need the following components:

- Head-end controller (PLC)
- Computer (for programming and configuration purposes)
- Rapid Link 5 modules

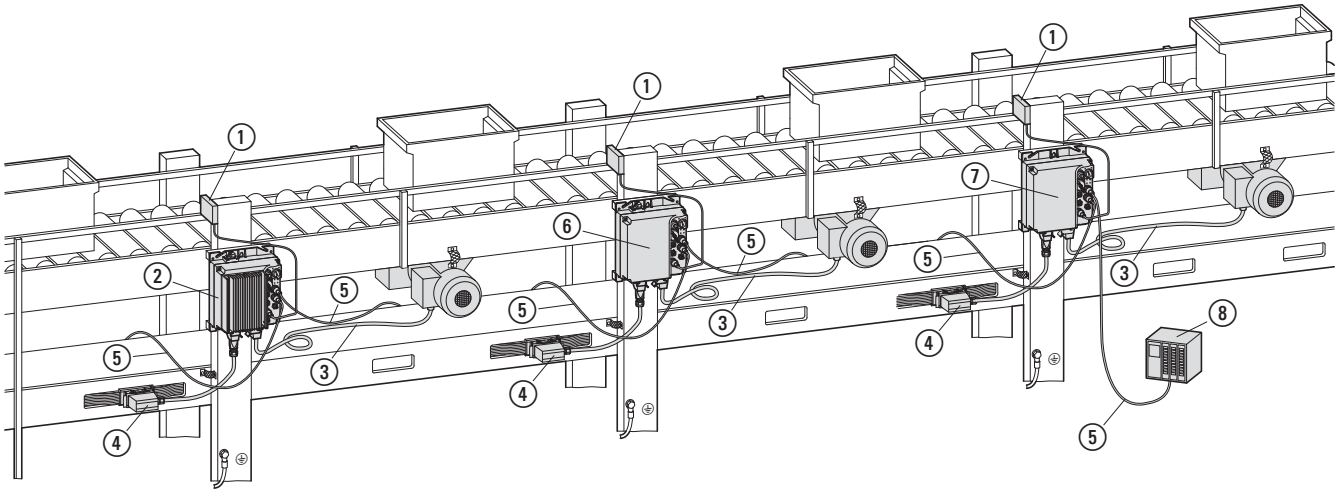


Figure 135: Example for the use of Rapid Link 5 (RASP5-xxxxPNT…, RAMO5-WxxxPNT… and RAMO5-DxxxPNT…) in a PROFINET network

① Sensor (light barriers)
② RASP5
③ Motor connection cable
④ Mains connection on power bus
⑤ PROFINET cable
⑥ RAMO5-D…
⑦ RAMO5-W…
⑧ Head-end controller (PLC)

▶ Switch on the device (switch on the power supply L1-L3 400 V AC or power supply 24 V DC via socket M12).
▶ Assign IP addresses to the Rapid Link 5 modules (→ section 9.2.9, "Configuring the IP address", page 211).
▶ Now configure the project.
(For information on a detailed configuration, please consult the manual provided by the PLC manufacturer.)
▶ Check the LED indicators. The head end controller must recognize the device address and the MS and NS LEDs must light up green (→ section 9.2.4, "LED indicators for EtherNet/IP", page 204).
▶ Next, download the project and go to RUN/Online with the engineering software.

If you make any changes to the network, the data sizes may be affected.
For example, deviations caused by a configuration mismatch are indicated by the status indicator of the Rapid Link 5 module on the interface.
If this happens, transfer the modified project back to the Rapid Link 5 module and update the details in the aforementioned dialog box as necessary.

9.3.10 Configuring the IP address

PROFINET I/O devices are addressed with a MAC address and an IP address. Each device has a globally unique MAC address (6-byte Ethernet address): The first three bytes specify the manufacturer-specific ID, while the other three bytes specify the device's serial number.

→ The MAC address will be printed on the corresponding name-plate.
The DHCP function will be enabled by default.

PROFINET modules have specific names, ensuring that it will be possible to assign every I/O device uniquely within a project. All I/O devices within a project can be set up and configured using this name. It will not be possible to establish a connection to the PLC if the name is incorrect or if there is an incorrect configuration, as the PLC uses this name to recognize the I/O device on the network.

→ The IP address can be configured using a network tool (e.g. STEP 7/HW configuration or IPconfig from HMS).

→ The IP address is configured in this description using the "IPconfig" software.
It can be downloaded from the Internet at:

www.anybus.com

- ▶ Connect the device on the PC and network side (connect the M12 socket).
- ▶ Switch on the device.
- ▶ Open the "IPconfig" program and click **Settings**.

Figure 136: "Settings" tab

- ▶ Select the computer network adapter from the drop-down menu of the network interface.

Figure 137: Select the network adapter

The program displays all available modules.

▶ Select RASP5 and set the desired address on the right.

Figure 138: Setting the IP address

Addressing is now complete!

9.3.11 Commissioning

First carry out all the measures for commissioning the Rapid Link 5 module described in the previous sections.

Check the settings and installations for the switching on the PROFINET communication system that are described in this manual.

> *ATTENTION*
>
> Ensure that no danger will be caused by starting the motor. Disconnect the driven machine if an incorrect operating status is causing a hazard.

9.3.12 Cyclic data

Process Data

The process data of Rapid Link 5 consists of input process data (Master → Rapid Link 5) and output process data (Rapid Link 5 → Master).

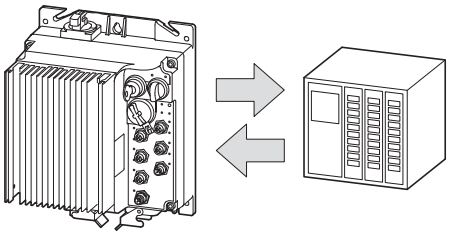


Figure 139: Data exchange

9.3.12.1 Input process data (NETReceivePDZ)

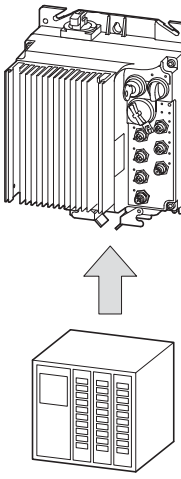


Figure 140: Input process data: Master → Rapid Link 5

There are 4 items of input process data (**NETReceivePDZ x**; x = 1, 2, 3, 4) available:

NETReceivePDZ	Explanation
NETReceivePDZ 1	Control word
NETReceivePDZ 2	Frequency reference **Note:** RASP5 only
NETReceivePDZ 3	Fieldbus ramp time **Note:** RASP5 only
NETReceivePDZ 4	reserved

NETReceivePDZ 1 – control word

The two following tables break down the control word **NETReceivePDZ 1**.

RAMO5

Table 55: Bit assignment of NETReceivePDZ 1 – with RAMO5

Bit [no.]	Function – Value = 0	Function – Value = 1
0	Stop	Start
1	Clockwise rotating field (FWD)	Anticlockwise rotating field (REV)
2	No action	Reset fault
3	not used	–
4	not used	–
5	not used	–
6	not used	–
7	not used	–
8	Action – actuator 1 off	Action – actuator 1 on
9	Action – actuator 2 off	Action – actuator 2 on
10	not used	–
11	not used	–
12	not used	–
13	not used	–
14	not used	–
15	not used	–

RASP5

Table 56: Bit assignment of NETReceivePDZ 1 – with RASP5

Bit [no.]	Function – Value = 0	Function – Value = 1
0	Stop	Start
1	Clockwise rotating field (FWD)	Anticlockwise rotating field (REV)
2	No action	Reset fault
3	No action	Coast to stop
4	not used	–
5	No action	Quick stop (ramp)
6	No action	Fixed frequency 1 (f-Fix1)
7	No action	Overwrite setpoint value with 0
8	Action – actuator 1 off	Action – actuator 1 on
9	Action – actuator 2 off	Action – actuator 2 on
10	not used	–
11	not used	–
12	not used	–
13	not used	–
14	not used	–
15	not used	–

NETReceivePDZ 2 – reference (RASP5 only)

The permissible values fall within a range of P1-02 (minimum frequency) to P1-01 (maximum frequency).

This value is scaled by a factor of 0.1 in the application.
Example: 500 ≙ 50 Hz

NETReceivePDZ 3 – fieldbus ramp time (RASP5 only)

The acceptable values range from 0 to 3000 seconds.
The values are set using parameter P5-07.
Enable is carried out using parameter P5-04.

This value is scaled by a factor of 0.01 in the application.
Example: 500 ≙ 5.00 s

NETReceivePDZ 4

NETReceivePDZ 4 currently has no function.

9.3.12.2 Output process data (NETSendPDZ)

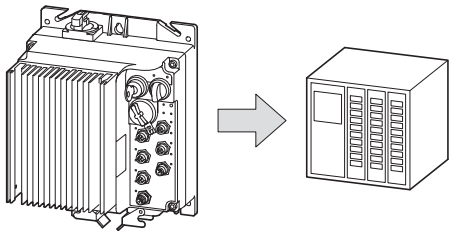


Figure 141: Output process data: Rapid Link 5 → Master

Six items of output process data are available (**NETSendPDZ x**x; x = 1, 2, 3, 4, 5, 6):

NETSendPDZ	Explanation
NETSendPDZ 1	Status word
NETSendPDZ 2	Actual frequency
NETSendPDZ 3	In the default setting: Current Setting options can be selected via parameter P5-05
NETSendPDZ 4	In the default setting: Heatsink Temperature Setting options can be selected via parameter P5-06
NETSendPDZ 5	Motor Power
NETSendPDZ 6	Current error message

NETSendPDZ 1 - status word

Device status information is provided in the status word

RAMO5

Table 57: Bit assignment of NETSendPDZ 1 – with RAMO5

Bit [no.]	Function – Value = 0	Function – Value = 1
0	Drive not ready – fault present or OFF	Ready for operation (READY)
1	Stop (drive not started)	Operation (RUN)
2	Clockwise rotating field (FWD)	Anticlockwise rotating field (REV)
3	No error	Fault detected (FAULT)
4	not used	not used
5	not used	not used
6	not used	not used
7	reserved	reserved
8	Sensor 1 off	Sensor 1 on
9	Sensor 2 off	Sensor 2 on
10	Sensor 3 off	Sensor 3 on
11	Sensor 4 off	Sensor 4 on
12	reserved	reserved
13	Mains voltage not present	Mains voltage present
14	24 V DC voltage not present	24 V DC voltage present
15	reserved	reserved

RASP5

Table 58: Bit assignment of NETSendPDZ 1 – with RASP5

Bit [no.]	Function – Value = 0	Function – Value = 1
0	Drive not ready – fault present or OFF	Ready for operation (READY)
1	Stop (drive not started)	Operation (RUN)
2	Clockwise rotating field (FWD)	Anticlockwise rotating field (REV)
3	No error	Fault detected (FAULT)
4	Acceleration ramp	Frequency actual value equals specified setpoint
5	not used	Zero speed
6	Speed control deactivated	Speed control activated
7	STO status – hardware lockout (inhibit)	STO status – hardware enable
8	Sensor 1 off	Sensor 1 on
9	Sensor 2 off	Sensor 2 on
10	Sensor 3 off	Sensor 3 on
11	Sensor 4 off	Sensor 4 on
12	Voltage for Quick stop is not present	Voltage for Quick stop is present
13	Mains voltage not present	Mains voltage present
14	24 V DC voltage not present	24 V DC voltage present
15	reserved	reserved

NETSendPDZ 2 – actual frequency (actual value)

NETSendPDZ 2 supplies the actual output frequency.

This value is scaled by a factor of 0.1 in the application.
Example: 500 ≙ 50 Hz

NETSendPDZ 3

In the default setting, NETSendPDZ 3 supplies the actual motor current.
NETSendPDZ 3 can be selected using parameter P5-05.

The following values can be sent to the PLC via NETSendPDZ 3:

NETSendPZD 3	Values
	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 two decimal places2: Status of the sensor inputs (SEN Ix; x = 1, 2, 3, 4) Bit 0 = status SEN I1, bit 1 = status SEN I2, etc. 3: Internal temperature, -500 - 1500 ≙ -50.0 - 150.0 °C (RASP5 only)

NETSendPDZ 4

In the default setting, FB process data output 4 supplies the sensor status for RAMO5; in RASP5, NETSendPDZ 4 supplies the internal temperature in the default setting.

NETSendPDZ 4 can be selected via parameter P5-06.

The following values can be sent to the PLC via NETSendPDZ 4:

NETSendPZD 4	Values
	Configuration of the 4th 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 two decimal places2: Status of the sensor inputs (SEN Ix; x = 1, 2, 3, 4). Bit 0 = status SEN I1, bit 1 = status SEN I2, etc. 3: Internal temperature, -500 - 1500 ≙ -50.0 - 150.0 °C (RASP5 only)

NETSendPDZ 5 – output

NETSendPDZ 5 sends the output power to the master.

The value is displayed to two decimal places.
Example: 4.00 ≙ 4 kW

NETSendPDZ 6 – error message

NETSendPDZ 6 returns the corresponding error code when an error occurs.

You can find the error codes and the description in
→ section 10.2, “Error Messages”, page 258.

9.3.13 Acyclic data

Rapid Link 5 supports acyclic communication via PROFINET.

Base Mode Parameter Access can be used to read or change parameters. The corresponding index number can be found in → section 9.4, "Acyclic parameters", page 250.

Access to drive parameters via PROFINET uses the Record Data Read or Write Service of the API.

Depending on the operating mode of the drive, all parameter values can be read from the drive and written to the drive. However, some parameters cannot be changed while the drive is enabled.

Further information on acyclic data can be found in DP-V1 under PROFINET technology.

An example for creating an acyclic program can be found in the AP040215EN application note.

9.4 Acyclic parameters

9.4.1 RAMO5

Table 59: Acyclic parameters for RAMO5

Parameters	Designation	Access right	Data format	Value range	Scaling	Default setting	EtherNet/IP			PROFINET
							Instance	Service code Read	Service code Write	Index
P0-02	Thermistor Input1	R	U16	0, 1	–	–	21	0x18	–	21
P0-03	SEN Status	R	U16	–	–	–	6	0x18	–	6
P0-05	T-Controlboard	R	S16	-500 - +1500	10 ≙ 1 °C	–	39	0x18	–	39
P0-07	Output Frequency	R	S16	-5000 - +5000	500 ≙ 50.0 Hz	–	7	0x18	–	7
P0-09	Motor Current	R	U16	0 - 65535	10 ≙ 1.0 A	–	8	0x18	–	8
P0-10	Motor Power Rel	R	U16	0 - 65535	100 ≙ 1.00 kW	–	10	0x18	–	10
P0-20	DC-Link voltage	R	U16	0 - 65535	100 ≙ 100 V DC	–	23	0x18	–	23
P0-22	TimeToNextService	R	U16	0 - 65535	1 = 1 h	–	38	0x18	–	38
P0-26	kWh Meter	R	U16	0 - 65535	10 ≙ 1.0 kWh	–	32	0x18	–	32
P0-27	MWh Meter	R	U16	0 - 65535	1 ≙ 1 MWh	–	33	0x18	–	33
P0-28.1	Application Version	R	U16	0 - 65535	100 ≙ 1.00	–	15	0x18	–	15
P0-28.2	System Version	R	U16	0 - 65535	100 ≙ 1.00	–	16	0x18	–	16
P0-29.1	Device Type	R	U16	0 - 65535	–	–	17	0x18	–	17
P0-29.2	NoOfInputPhases	R	U16	0 - 65535	–	–	12	0x18	–	12
P0-29.3	FrameSize	R	U16	0 - 65535	–	–	12	0x18	–	12
P0-29.4	kW/HP	R	U16	0 - 65535	–	–	12	0x18	–	12
P0-29.5	Power@Ue	R	U16	0 - 65535	100 ≙ 1.00	–	13	0x18	–	13
P0-29.6	Device Voltage	R	U16	0 - 65535	–	–	12	0x18	–	12
P0-29.7	DeviceType	R	U16	0 - 65535	–	–	12	0x18	–	12
P0-30	Serial Number	R	U16	0 - 65535	–	–	25	0x18	–	25
P0-30	Serial Number	R	U16	0 - 65535	–	–	26	0x18	–	26
P0-30	Serial Number	R	U16	0 - 65535	–	–	27	0x18	–	27
P0-30	Serial Number	R	U16	0 - 65535	–	–	28	0x18	–	28
P0-31	t-Run	R	U16	0 - 65535	1 ≙ 1 s	–	34	0x18	–	34
P0-31	t-Run	R	U16	0 - 65535	1 ≙ 1 h	–	35	0x18	–	35
P0-34	t-HoursRun Enable	R	U16	0 - 65535	1 ≙ 1 s	–	36	0x18	–	36
P0-34	t-HoursRun Enable	R	U16	0 - 65535	1 ≙ 1 h	–	37	0x18	–	37

Parameters	Designation	Access right	Data format	Value range	Scaling	Default setting	EtherNet/IP			PROFINET
							Instance	Service code Read	Service code Write	Index
P1-08	Motor Nom Current	R/W	U16	0.3 - 6.6 A	1 ≙ 0.1 A	Depending on device	0108	0x18	0x19	0108
P1-13	SEN Config Select	R/W	U16	1, 2, 3, 4	–	1	0113	0x18	0x19	0113
P1-14	Access key	R/W	U16	0 - 65535	–	0	0114	0x18	0x19	0114
P2-24	Start Mode	R/W	U16	0, 1, …, 10	–	0	0224	0x18	0x19	0224
P2-26	Auto Reset Delay	R/W	U16	0.1 - 60.0 s	300 ≙ 30.0 s	0.5 s	0226	0x18	0x19	0226
P2-27	Action@Thermistorfault Motor	R/W	U16	0, 1	–	1	0227	0x18	0x19	0227
P2-28	Service Interval Time	R/W	U16	0 - 60000	–	0	0228	0x18	0x19	0228
P2-29	Reset ServiceIndicator	R/W	U16	0, 1	–	0	0229	0x18	0x19	0229
P2-30	Parameter Set	R/W	U16	0, 1	–	0	0230	0x18	0x19	0230
P2-32	Access Key Level2	R/W	U16	0 - 65535	–	101	0232	0x18	0x19	0232
P2-33	Parameter Lock	R/W	U16	0, 1	–	0	0233	0x18	0x19	0233
P2-34	TCP Enable Service	R/W	U16	0, 1, …, 15	–	0	0234	0x18	0x19	0234
P2-36	Save Parameters @24V-ext.	R/W	U16	0, 1	–	0	0236	0x18	0x19	0236
P3-04	Brake Release Delay	R/W	U16	0 - 2.5 s	25 ≙ 2.5 s	0.00 s	0304	0x18	0x19	0304
P3-05	Brake Apply Delay	R/W	U16	0 - 25.00 s	2500 ≙ 25.00 s	0.00 s	0305	0x18	0x19	0305
P3-06	SEN I1 logic	R/W	U16	0, 1	–	0	0306	0x18	0x19	0306
P3-07	SEN I2 Logic	R/W	U16	0, 1	–	0	0307	0x18	0x19	0307
P5-01	RS485-0 Address	R/W	U16	1, 2, …, 63	–	2	0501	0x18	0x19	0501
P5-02	COM Loss Timeout	R/W	U16	0.0 - 5.0 s	50 ≙ 5 s	2.0 s	0502	0x18	0x19	0502
P5-03	Action@Communication Loss	R/W	U16	0, 1, 2	–	0	0503	0x18	0x19	0503
P5-05	NETSendPZD3	R/W	U16	0, 1, 2	–	0	0505	0x18	0x19	0505
P5-06	NETSendPZD4	R/W	U16	0, 1, 2	–	2	0506	0x18	0x19	0506
P5-07	NETReceivePZD3	R/W	U16	0	–	0	0507	0x18	0x19	0507
P5-08	NETReceivePZD4	R/W	U16	0	–	0	0508	0x18	0x19	0508
P5-10	Disable QuickStop	R/W	U16	0, 1	–	0	0510	0x18	0x19	0510
P6-05	Action@Underload Motor	R/W	U16	0, 1	–	0	0605	0x18	0x19	0605
P6-08	Change Phasesequence Motor	R/W	U16	0, 1	RAMO5-W only	0	0608	0x18	0x19	0608

Notes:
Length (word = 0 for parameter group P0; length (word = 1 for other parameter groups; object class = 0x04 for all parameters for EtherNet/IP
API = 0, slot = 0, sub-slot = 1 for all parameters for PROFINET

9.4.2 RASP5

Table 60: Acyclic parameters for RASP5

Parameters	Designation	Access right	Data format	Value range	Scaling	Default setting	EtherNet/IP Instance	PROFINET Index
P0-02	Thermistor Input1	R	U16	0, 1	–	–	21	21
P0-03	SEN Status	R	U16	–	–	–	6	6
P0-04	f-PreRamp	R	S16	-5000 - +5000	500 ≙ 50.0 Hz	–	22	22
P0-05	T-Controlboard	R	S16	-500, 1500	10 ≙ 1.0 °C	–	39	39
P0-07	Output Frequency	R	S16	-5000 - +5000	500 ≙ 50.0 Hz	–	7	7
P0-09	Motor Current	R	U16	0 - 65535	10 ≙ 1.0 A	–	8	8
P0-10	Motor Power Rel	R	U16	0 - 65535	100 ≙ 1.00 kW	–	10	10
P0-11	Motor Voltage	R	U16	0 - 65535	100 ≙ 100 V AC	–	43	43
P0-20	DC-Link Voltage	R	U16	0 - 65535	100 ≙ 100 V DC	–	23	23
P0-21	Heatsink Temperature	R	S16	-500, 1500	10 ≙ 1.0 °C	–	24	24
P0-22	TimeToNextService	R	U16	0 - 65535	1 ≙ 1 h	–	38	38
P0-26	kWh Meter	R	U16	0 - 65535	10 ≙ 1.0 kWh	–	32	32
P0-27	MWh Meter	R	U16	0 - 65535	1 ≙ 1 MWh	–	33	33
P0-28.1	Application Version	R	U16	0 - 65535	100 ≙ 1.00	–	15	15
P0-28.2	System Version	R	U16	0 - 65535	100 ≙ 1.00	–	16	16
P0-29.1	Device Type	R	U16	0 - 65535	–	–	17	17
P0-29.2	NoOfInputPhases	R	U16	0 - 65535	–	–	12	12
P0-29.3	FrameSize	R	U16	0 - 65535	–	–	12	12
P0-29.4	kW/HP	R	U16	0 - 65535	–	–	12	12
P0-29.5	Power@Ue	R	U16	0 - 65535	100 ≙ 1.00	–	13	13
P0-29.6	Device Voltage	R	U16	0 - 65535	–	–		12
P0-29.7	DeviceType	R	U16	0 - 65535	–	–		12
P0-30	Serial Number	R	U16	0 - 65535	–	–	25	25
P0-30	Serial Number	R	U16	0 - 65535	–	–	26	26
P0-30	Serial Number	R	U16	0 - 65535	–	–	27	27
P0-30	Serial Number	R	U16	0 - 65535	–	–	28	28
P0-31	t-Run	R	U16	0 - 65535	1 ≙ 1 s	–	34	34
P0-31	t-Run	R	U16	0 - 65535	1 ≙ 1 h	–	35	35
P0-34	t-HoursRun Enable	R	U16	0 - 65535	1 ≙ 1 s	–	36	36

Parameters	Designation	Access right	Data format	Value range	Scaling	Default setting	EtherNet/IP Instance	PROFINET Index
P0-34	t-HoursRun Enable	R	U16	0 - 65535	1 ≙ 1 h	–	37	37
P1-01	f-max	R/W	U16	0.0 - 250.0 Hz	0 - 3000 ≙ 0 - 50 Hz	50.0 Hz	101	101
P1-02	f-min	R/W	U16	0.0 - 50.0 Hz	0 - 3000 ≙ 0 - 50 Hz	0.0 Hz	102	102
P1-03	t-acc	R/W	U16	0.1 - 3000.0 s	300 ≙ 30.0 s	5.0 s	103	103
P1-04	t-dec	R/W	U16	0.1 - 3000.0 s	300 ≙ 30.0 s	2.0 s	104	104
P1-05	Stop Mode	R/W	U16	0, 1, 2	–	1	105	105
P1-07	Motor Nom Voltage	R/W	U16	0, 20 - 500 V	230 ≙ 230 V	400 V	107	107
P1-08	Motor Nom Current	R/W	U16	2.4 A: 0.2 - 2.4 A. 4.3 A: 0.4 - 4.3 A. 5.6 A: 0.5 - 5.6 A. 8.5 A: 0.8 - 8.5 A.	1 ≙ 0.1 A	Depending on device	108	108
P1-09	Motor Nom Frequency	R/W	U16	10 – 500 Hz	50 ≙ 50 Hz	50 Hz	109	109
P1-10	Motor Nom Speed	R/W	U16	0.100 - 3000 rpm	–	0 rpm	110	110
P1-11	V-Boost	R/W	U16	0.0 ±40 %	–	0.00 %	111	111
P1-12	f-Fix1	R/W	U16	0.0 - P1-01	0 - 3000 ≙ 0 - 50 Hz	10.0 Hz	112	112
P1-13	DI Config Select	R/W	U16	1, 2, …, 8	–	1	113	113
P1-14	Access key	R/W	U16	0 - 65535	–	0	114	114
P2-01	f-Fix2	R/W	U16	0.0 - P1-01	0 - 3000 ≙ 0 - 50 Hz	30.0 Hz	201	201
P2-02	f-Fix3	R/W	U16	0.0 - P1-01	0 - 3000 ≙ 0 - 50 Hz	40.0 Hz	202	202
P2-03	f-Fix4	R/W	U16	0.0 - P1-01	0 - 3000 ≙ 0 - 50 Hz	50.0 Hz	203	203
P2-04	f-Fix5	R/W	U16	0.0 - P1-01	0 - 3000 ≙ 0 - 50 Hz	10.0 Hz	204	204
P2-05	f-Fix6	R/W	U16	0.0 - P1-01	0 - 3000 ≙ 0 - 50 Hz	15.0 Hz	205	205
P2-06	f-Fix7	R/W	U16	0.0 - P1-01	0 - 3000 ≙ 0 - 50 Hz	20.0 Hz	206	206
P2-07	f-Fix8	R/W	U16	0.0 - P1-01	0 - 3000 ≙ 0 - 50 Hz	25.0 Hz	207	207
P2-08	t-SRamp1	R/W	U16	0.0 - 10.0 s	100 ≙ 10.0 s	0.0 s	208	208
P2-09	Overvoltage Control	R/W	U16	0, 1	–	1	209	209
P2-10	REV Enable	R/W	U16	0, 1	–	0	210	210
P2-11	t-acc2	R/W	U16	0.0 - 3000.0 s	300 ≙ 30.0 s	5.0 s	211	211
P2-12	n-accMulti1	R/W	U16	0.0 - P1-01	–	0.0 Hz	212	212
P2-13	t-dec2	R/W	U16	0.0 - 3000.0s	300 ≙ 30.0 s	5.0 s	213	213
P2-14	n-decMulti1	R/W	U16	0.0 - P1-01	0 - 3000 ≙ 0 - 50 Hz	0.0 Hz	214	214
P2-15	f-Skip1	R/W	U16	0.0 - P1-01	0 - 3000 ≙ 0 - 50 Hz	0.0 Hz	215	215
P2-16	f-SkipBand1	R/W	U16	0.0 - P1-01	0 - 3000 ≙ 0 - 50 Hz	0.0 Hz	216	216
P2-17	f-Skip2	R/W	U16	0.0 - P1-01	0 - 3000 ≙ 0 - 50 Hz	0.0 Hz	217	217
P2-18	f-SkipBand2	R/W	U16	0.0 - P1-01	0 - 3000 ≙ 0 - 50 Hz	0.0 Hz	218	218
P2-19	V/f-Characteristic	R/W	U16	0, 1, 2	–	0	219	219
P2-20	f-MidV/f	R/W	U16	0.0 ±100 %	–	0.00 %	220	220
P2-21	V-MidV/f	R/W	U16	0.0 ±100 %	–	0.00 %	221	221
P2-22	Switching Frequency	R/W	U16	0, 1, …, 5	0	1	222	222
P2-23	Auto Thermal Management	R/W	U16	0, 1	–	0	223	223

Parameters	Designation	Access right	Data format	Value range	Scaling	Default setting	EtherNet/IP Instance	PROFINET Index
P2-24	Start Mode	R/W	U16	0, 1, …, 10	–	0	224	224
P2-25	REAF Start Function	R/W	U16	0, 1, 2	–	0	225	225
P2-26	Auto Reset Delay	R/W	U16	0.1 - 60.0 s	300 ≙ 30.0 s	0.5 s	226	226
P2-27	Action@Thermistorfault Motor	R/W	U16	0, 1	–	1	227	227
P2-28	Service Interval Time	R/W	U16	0 - 60000	–	0 h	228	228
P2-29	Reset ServiceIndicator	R/W	U16	0, 1	–	0	229	229
P2-30	Parameter Set	R/W	U16	0, 1	–	0	230	230
P2-31	Default Selection	R/W	U16	0, 1	–	0	231	231
P2-32	Access Key Level2	R/W	U16	0 - 65535	–	101	232	232
P2-33	Parameter Lock	R/W	U16	0, 1	–	0	233	233
P2-34	TCP Enable Service	R/W	U16	0, 1, …, 15	–	0	234	234
P2-36	Save Parameters @24V-ext.	R/W	U16	0, 1	–	0	236	236
P2-37	Spin Start Enable	R/W	U16	0, 1	–	0	237	237
P3-01	Brake Mode	R/W	U16	0, 1	–	0	301	301
P3-02	Brake f-open	R/W	U16	0.0 - P1-01	–	1.5 Hz	302	302
P3-03	Brake f-close	R/W	U16	0.0 - P1-01	–	1.0 Hz	303	303
P3-04	Brake M-Level Release	R/W	U16	2.4 A: 0.6 - 2.4 A 4.3 A: 1.1 - 4.3 A 5.6 A: 1.4 - 5.6 A 8.5 A: 2.1 - 8.5 A	1 ≙ 0.1 A	0.0 A	304	304
P3-05	Brake Release Delay	R/W	U16	0 - 320.0 s	3200 ≙ 320.0 s	0.0 s	305	305
P3-06	SEN I1 Logic	R/W	U16	0, 1	–	0	306	306
P3-07	SEN I2 Logic	R/W	U16	0, 1	–	0	307	307
P3-08	SEN I3 Logic	R/W	U16	0, 1	–	0	308	308
P3-09	SEN I4 Logic	R/W	U16	0, 1	–	0	309	309
P3-10	DI5 Logic	R/W	U16	0, 1	–	0	310	310
P3-11	t-dec Select B0	R/W	U16	0, 1	–	0	311	311
P4-01	DC-Brake Current	R/W	U16	0.0 - 100 %	–	0.00 %	401	401
P4-02	t-DCBrake@Start	R/W	U16	0.0 ±600.0 %	–	0.0 s	402	402
P4-03	f-DCBrake@Stop	R/W	U16	0.0 - 10.0 Hz	0 - 3000 ≙ 0 - 50 Hz	1.5 Hz	403	403
P4-04	t-DCBrake@Stop	R/W	U16	0.0 ±600.0 %	–	0.0 s	404	404
P4-05	Brake Chopper Mode	R/W	U16	0, 1, 2	–	2	405	405
P4-06	Brake Resistor	R/W	U16	50 - 500	–	400 Ω	406	406
P4-07	P-Brake Resistor	R/W	U16	0.00 - 20.00 kW	–	0.10 kW	407	407
P4-08	Brake Chopper ED Heat-Up	R/W	U16	0.0 ±20.0 %	–	2.00 %	408	408
P5-01	RS485-0 Address	R/W	U16	1, 2, …, 63	–	2	501	501
P5-02	COM Loss Timeout	R/W	U16	0.0 - 5.0 s	50 ≙ 5 s	2.0 s	502	502
P5-03	Action@Communication Loss	R/W	U16	0, 1, 2, 3	–	0	503	503
P5-04	FieldbusRampControl	R/W	U16	0, 1	–	0	504	504
P5-05	NETSendPZD3	R/W	U16	0, 1, 2, 3	–	0	505	505

Parameters	Designation	Access right	Data format	Value range	Scaling	Default setting	EtherNet/IP Instance	PROFINET Index
P5-06	NETSendPZD4	R/W	U16	0, 1, 2, 3	–	3	506	506
P5-07	NETReceivePZD3	R/W	U16	0, 1	–	1	507	507
P5-08	NETReceivePZD4	R/W	U16	0	–	0	508	508
P5-09	PointerToParameter	R/W	U16	0 - 200	–	0	509	509
P5-10	Disable QuickStop	R/W	U16	0, 1	–	0	510	510
P5-11	AS-i command configuration	R/W	U16	0, 1, 2	–	0	511	511
P6-01	Motor Control Mode	R/W	U16	0, 1, …, 6	–	0	601	601
P6-02	MSC Kp	R/W	U16	0 ±400 %	–	50.00 %	602	602
P6-03	MSC1 Ti	R/W	U16	0.010 - 1.000 s	–	0.050 s	603	603
P6-04	M-Max Motoring	R/W	U16	0 ±200 %	–	150 %	604	604
P6-05	Action@Underload Motor	R/W	U16	0, 1	–	0	605	605
P6-06	M-Min (f-Ref=0) limit	R/W	U16	10.0 - 150.0 %	–	50.00 %	606	606
P6-07	M-Min (f>f-Umax) limit	R/W	U16	5.0 - 150.0 %	–	10.00 %	607	607
P6-08	Change Phasesequence Motor	R/W	U16	0, 1	–	0	608	608
P6-09	T-Memory Enable	R/W	U16	0, 1	–	1	609	609
P6-10	Action @I-CurrentLimit	R/W	U16	0, 1	–	0	610	610
P6-11	EnhancedGeneratorControl	R/W	U16	0, 1	–	0	611	611
P6-12	Overvoltage Currentlimit	R/W	U16	0.0 ±100.0 %	–	5.00 %	612	612
P6-13	LoadInertiaFactor	R/W	U16	0 - 600	–	10	613	613
P6-14	t-Excitation-V/f	R/W	U16	0 - 5000 m	–	30 ms	614	614
P6-15	Torque Boost	R/W	U16	0.0 ±100.0 %	–	0.00 %	615	615
P6-16	f-Torque Boost Limit	R/W	U16	0.0 ±50.0 %	–	0.00 %	616	616
P6-17	PM-MotorSignalInLevel	R/W	U16	0 - 200	–	0	617	617
P6-18	Overmodulation	R/W	U16	0, 1	–	0	618	618
P7-01	Motor Identification	R/W	U16	0	–	0	701	701
P7-02	Motor PF	R/W	U16	0.50 - 1.00	–	0.8	702	702
P7-03	Motor Stator Resistance R1	R/W	U16	0.00 - 655.35	–	8.00 Ω	703	703
P7-04	Motor Rotor Resistance R2	R/W	U16	0.00 - 655.35	–	6.00 Ω	704	704
P7-05	Motor Stator Inductance d-Axis	R/W	U16	0.0 - 6553.5	–	650.0 mH	705	705
P7-06	Motor Stator Inductance q-Axis	R/W	U16	0.0 - 6553.5	–	65.0 mH	706	706

Notes:
Length (word = 0 for parameter group P0; length (word = 1 for other parameter groups; object class = 0x04 for all parameters for EtherNet/IP
API = 0, slot = 0, sub-slot = 1 for all parameters for PROFINET

10 Error Messages

10.1 Introduction

The Rapid Link 5 Modules have several internal monitoring functions.
If deviations from the correct operating state are detected, an error message is displayed.

10.1.1 Trip Log

The most recent four error messages will be stored in the order in which they occurred (with the most recent one in the first place).
Fault messages can be read from the monitor-parameter P0-13.
The values will not be deleted if the variable frequency drive is reset to its default settings!

10.1.2 Acknowledge fault (Reset)

Acknowledge and reset the current error message as follows:

- Switch off the supply voltage.
- Press the STOP button (DX-KEY-OLED).
- Set key switch to OFF/RESET.

10.1.3 Automatic reset

Set the auto reset function using parameters P2-24 and P2-26.

The parameter P2-26 determines the time between start-up attempts if the Auto Reset function is enabled using parameter P2-24.

10.2 Error Messages

The following table lists the error messages (fault codes) and possible causes and indicates corrective measures.

10.2.1 RAMO5 error messages

Table 61: List of error messages for RAMO5

Message	Error no. [dec]	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 motor nom 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 a fault register with the last values before the unit was switched off (sample 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 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 STOP 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. [dec]	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 is disconnected.
Sc-FO1	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

10.2.2 RASP5 error messages

Table 62: List of error messages for RASP5

Message	Error no. [dec]	Possible cause and remedy
StoP	–	Ready for operation. There is no drive enable signal present. There are no error messages present.
Inhibt	–	STO inputs (pin 3 and pin 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. • Extend the P1-04 and P2-13 ramp times to reduce the frequency of 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 using 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 motor nom 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. [dec]	Possible cause and remedy
PS-trP	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 a fault register with the last values before the unit was switched off (sample 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 a fault register with the last values before the unit was switched off (sample 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 device's vents must not be obstructed, e.g., by dirt or as a result of devices being installed too close to each other. • 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. P0-37 contains a fault register with the last values before the unit was switched off (sample 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. [dec]	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.
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.
U-tor9.̈.̈	30	Underload in the motor range
U-tor9.'.''	32	Underload in the field weakening range
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.
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.

Message	Error no. [dec]	Possible cause and remedy
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	69	Sensor fault - overload or short circuit

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