Switching and Installation System Rapid Link

User Manual

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We keep power under control.

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Warning!
Dangerous electrical voltage!

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit the device.
- Cover or enclose any adjacent live components.
- Follow the engineering instructions (AWA) for 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 equalisation. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does 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 interface so that an open circuit on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the extra-low voltage of the 24 V supply. Only use power supply units complying with IEC 60364-4-41 or HD384.4.41 S2 (VDE 0100 Part 410).
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, 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-Stop devices must not cause a restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed and with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- 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-Stop devices should be implemented.
- Wherever faults in the automation system may cause injury or material damage, 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.).
- Depending on their degree of protection, frequency inverters may contain live bright metal parts, moving or rotating components or hot surfaces during and immediately after operation.
- The impermissible removal of the required covers, improper installation or incorrect operation of motor or frequency inverter may cause the failure of the device and may lead to serious injury or damage.
- The relevant national accident prevention and safety regulations apply to all work carried out on live frequency inverters.
- The electrical installation must be carried out in accordance with the relevant regulations (e.g. with regard to cable cross sections, fuses, PE).
- Transport, installation, commissioning and maintenance work must only be carried out by qualified personnel (observe IEC 60364, HD 384 and national work safety regulations).
- Installations containing frequency inverters must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations. Modifications to the frequency inverters using the operating software are permitted.
- All covers and doors must be kept closed during operation.

- To reduce the hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure of the drive (increased motor speed or sudden standstill of motor). These measures include:
  – Other independent devices for monitoring safety-related variables (speed, travel, end positions etc.).
  – Electrical or non-electrical system-wide measures (electrical or mechanical interlocks).
  – Never touch live parts or cable connections of the frequency inverter after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be live after disconnection. Fit appropriate warning signs on the frequency inverter.
- The decentralised power distribution systems must only be utilised in accordance with the operating manual for their intended use in technically perfect condition, taking into account safety requirements and any possible hazards.
- Proper transport, storage, installation, careful operation and maintenance must be ensured for the trouble-free and safe operation of the control system. Any faults that may impair safety must be rectified immediately.
- If the decentralised power distribution systems are part of the electrical equipment of a machine, they must be included by the machine manufacturer in the conformity assessment procedure. The IEC/EN 60204-1 standard must be observed.
- The safety requirements of the Machine Directive 89/392/EC must be observed when engineering, installing and commissioning the decentralised power distribution systems as part of the power supply of machines and their control systems. The national occupational safety regulations apply in the specific application. Observe the relevant safety and accident prevention regulations for the application, such as the Safety of Machinery standards. All safety devices of the controlled machine must be implemented so that they operate independently of the control system. Emergency-Stop devices complying with IEC/EN 60204 must be effective in all operating modes of the system. The power supplies of all the switching elements of the control system must be disconnected in the event of an Emergency-Stop. Uncontrolled and undefined startups must not occur, e.g.
  – Startup after unlatching the Emergency-Stop devices and/or
  – Startup of the control systems without the DP master or DP slave responding.
- For stationary installations or systems without all-pole mains switches, the building installation must be provided with a mains switch or fuse.
- The rated voltage range set for load current power supplies and power supply modules must comply with the local mains supply.
- With the 24 V power supply ensure that
  – lightning protection measures are provided and/or
  – the 24 V SELV voltage is provided with safe electrical isolation.
- 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-Stop devices should be implemented.
- Transport, installation, commissioning and maintenance work must only be carried out by qualified personnel (in accordance with IEC 60364, HD 384 and national occupational safety regulations).
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that an open circuit on the signal side does not result in undefined states in the automation devices.
- A suitable electrical tool should be used. The mains supply connection should always be disconnected (remove mains plug or open isolating switch) before opening the device. Fuses should only be replaced with those specified in the technical data.
- The highest permissible operating temperature of the decentralised power supply systems is 50 °C. Cables must be protected from impermissible temperatures by means of shielding or sufficient clearance from the heat source.
- Cables should be laid in a cable duct in areas where there is a risk of mechanical damage to cables or conductors, e.g. with forklift trucks.

Contents

About this manual

This manual contains a description of the Rapid Link system and its various function modules. The first section is an introduction to the overall system. It also contains descriptions that apply to all function modules.

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

Read this manual carefully, before you install theRapid Link system and start using it. We assume that you have a good knowledge of engineering fundamentals and that you are familiar with electrical systems and the applicable principles and are able to read, interpret and apply the information contained in technical drawings.

Abbreviations and symbols

The abbreviations and symbols used in this manual have the following meanings:

DESINA	**De**centralized, **s**tandardized **in**st**a**llation technology
EMC	**E**lectro**m**agnetic **c**ompatibility
ESD	**E**lectro**S**tatic **D**ischarge
Fn No.	Function number
LAS	**L**ist of **A**ctive **S**laves
LCS	**L**ist of **C**orrupted **S**laves
LDS	**L**ist of **d**etected **S**laves
LOS	**L**ist of **O**ffline **S**laves
LPS	**L**ist of **C**onfigured **S**laves
PELV	**P**rotective **E**xtra **L**ow **V**oltage
PES	**PE** - Positive earth cable **s**creen connection
PNU	**P**arameter **N**umber
FS	**F**actory **S**etting

▶ Indicates actions to be taken.

→ Draws your attention to interesting tips and supplementary information.

▽ **Attention!**
Warns of the risk of material damage.

⚠ **Caution!**
Warns of the possibility of serious damage and slight injury.

⚠ **Warning!**
Indicates the risk of major damage to property, or serious or fatal injury.

For greater clarity, the name of the current chapter is shown in the header of the left-hand page and the name of the current section in the header of the right-hand page. This does not apply to pages at the start of a chapter and empty pages at the end of a chapter.

All dimensions are in millimetres, unless otherwise specified.

List of revisions

The following significant amendments have been introduced since previous issues:

Edition date	Page	Keyword	new	Amend-ment	deleted
01/05	Chap. 1, 4 , 5	General revision because of new devices			
01/08	–	General revision			
	chapter 5	Motor starter RA-MO (from Version 3.0)		✓	
	earlier Chap. 6	Programmable function unit RA-LO			✓

1 System Rapid Link

Rapid Link is a modern automation system for material handling systems. Because the Rapid Link modules can be simply fitted into a power and data bus, it allows electrical drives to be installed and taken into operation much more quickly than with conventional methods. A time-saving installation is implemented with the aid of a power and data bus in which the rapid link modules are installed.

System overview

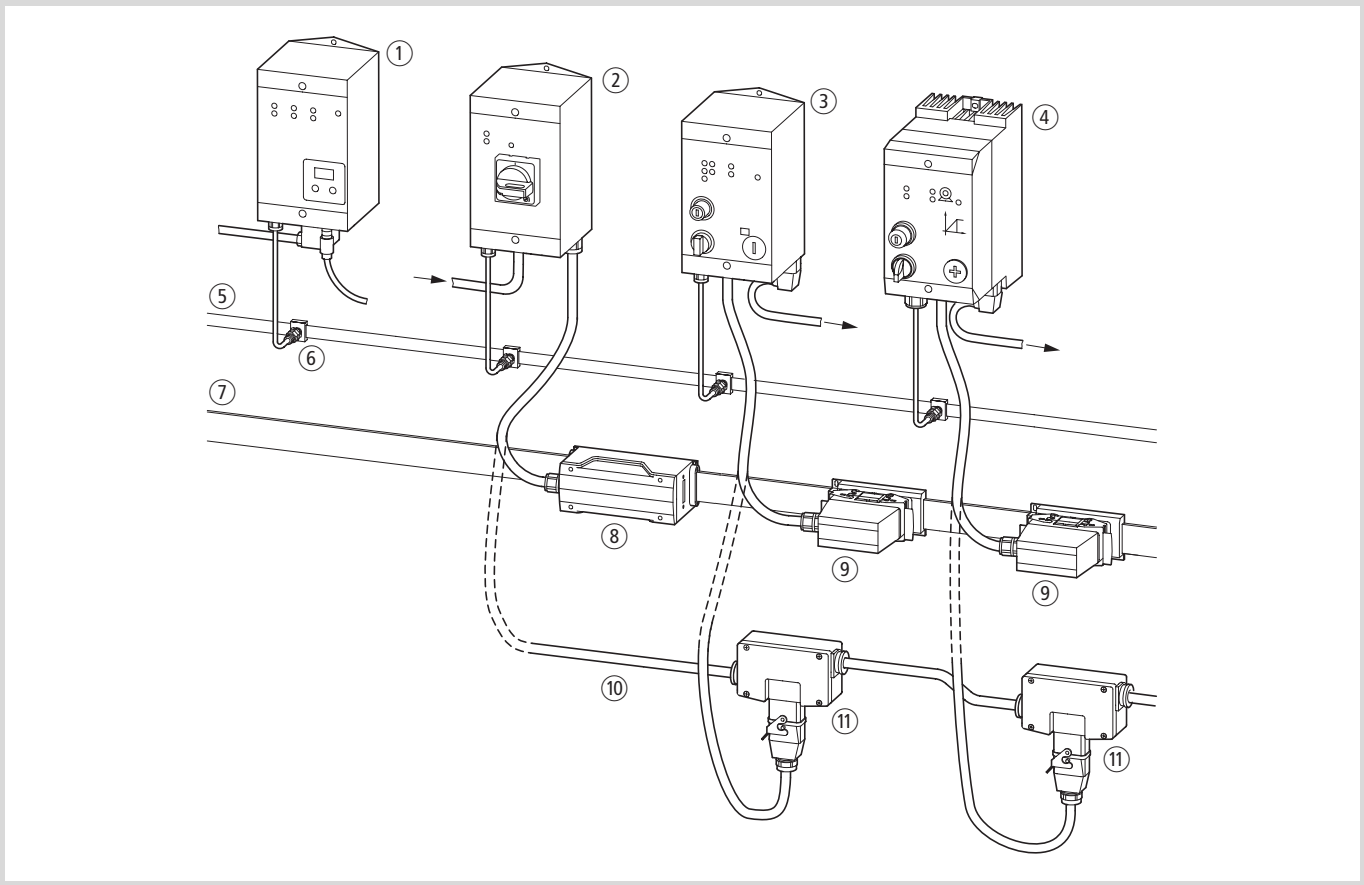


Figure 1: Overview Rapid Link

Function modules:

① Interface control unit A-IN
→ Interface to the open field bus

② Disconnect control unit RA-DI
→ Power infeed with lockable rotary handle;
→ Circuit-breaker to protect from overload and short-circuits

③ Motor control unit
→ Three-phase electronic motor protection with additional use as direct-on-line starter, expandable DOL starter or reversing starter

④ Speed control unit
→ Operation of three-phase asynchronous motors with four fixed speeds, two directions and soft starting

Power and data bus:

⑤ AS interface® flat cable

⑥ Link for M12 connector cables

⑦ Flexible busbar for 400 V ~ and 24 V ⎓ (RA-C1…)

⑧ Power feed for flexible busbar

⑨ Plug-in power link for flexible busbar

⑩ Round cable for 400 V ~ and 24 V ⎓ (RA-C2...)

⑪ Plug-in link for round cable

Proper use

Rapid Link is intended only for switching, protecting and controlling three-phase motors in machines and installations. Any other or additional use is considered improper use. The manufacturer or supplier does not accept liability for damage caused by improper use.
To ensure proper use of the decentralized power supply systems, observe the instructions and guidelines for the mechanical and electrical installation, commissioning and operation.

- Rapid Link must be operated only on 400V-three-phase systems with earthed star point and separate N and PE conductors (TN-S network). It must not be operated unearthed.
- All Rapid Link function modules fulfil the safe isolation requirements of IEC/EN 60947-1, Annex N, between the AS-Interface® voltage and the 24 V ⎓ and 400 V ~ supplies as well as to the thermistor circuit in RA-MO and RA-SP-.
- 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 PSU for the AS-Interface® power supply (interface control unit head station) must meet the safe isolation requirements according to SELV.
- Emergency-Stop devices (according to IEC/EN 60204-1) must be fitted and their function must not be impaired in any way.
- The plant must contain effective lightning protection measures to prevent damage to electronic equipment.

Improper use

Warning!
Risk of hazard from connected actuators (motors, hydraulic units, etc.) through incorrect configuration, installation, maintenance and operation of the complete plant or machine, non-observation of the instructions in this manual and handling by insufficiently qualified personnel.

Engineering

The Rapid Link function modules are installed immediately adjacent to the drives. They can be connected to the power and data bus at any point without having to interrupt the bus.

Data bus

The AS-Interface® data bus is a system solution for networking different modules. AS-Interface® networks are quick and easy to implement.

Data cable

AS-Interface® uses a geometrically encoded, unscreened flat cable with a cross-section of 2 × 1.5 mm^2. It is used to transmit both power as well as all data traffic between PLC and I/O 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.

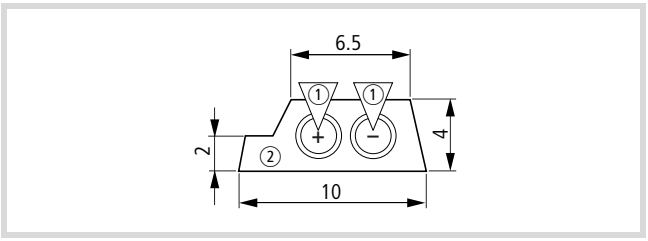


Figure 2: AS-Interface®-flat band conductor

① Piercing pins
② Flat cable, protected against polarity reversal

Rapid Link function modules can be installed and removed any number of times in various locations within the system. The AS-Interface® flat cable is self-healing, dust-proof and protected against spray water. The network can be laid out in a star, linear or tree structure.

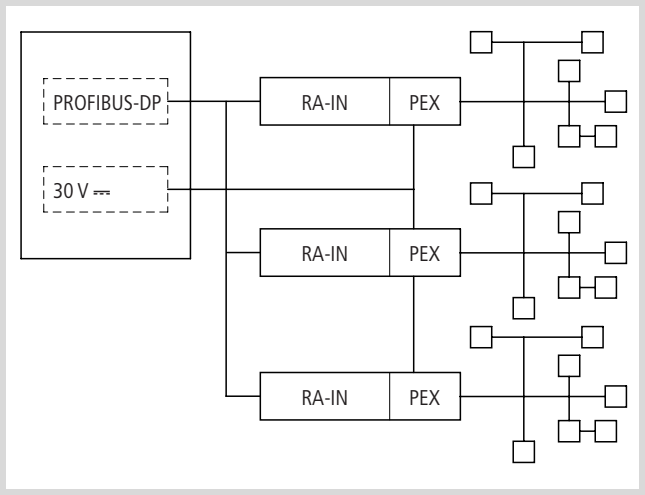


Figure 3: AS interface® network in star design

Data Transfer

Data is transmitted modulated through the power supply, the station's transmitter injecting the data signals into the line in the form of current changes. These current changes induce a voltage in the data coupling coils, which is detected by all stations' receivers along the AS-Interface® line.

The cycle time is determined by the number of stations along the busbar run, regardless whether the stations can have 31 or 62 addresses (A/B slaves). For 31 stations the cycle time is about 5 ms and for 62 stations about 10 ms. The cycle time is calculated as follows: 150 s x (number of stations + 1)

Background information for PLC technicians about the function principle of parameter transmission in RA-MO, RA-SP and RA-IN

Parameters are transmitted according to the possibilities provided by the A²S-i microcontroller. Parameter bits P1 to P4 (bank A) sent by the controller are provided to the RA-MO electronics µc (bank B) unchanged. The data returned to the master (bank C) is generated through an AND gate.

For slaves with A-address, parameter bit P4 on bank A is automatically set to 1, and for slaves with B-address to 0 (for A- and B-addresses, see section "Addressing slaves (with hand-held addressing unit PG2-105-AD2)" on page 17.

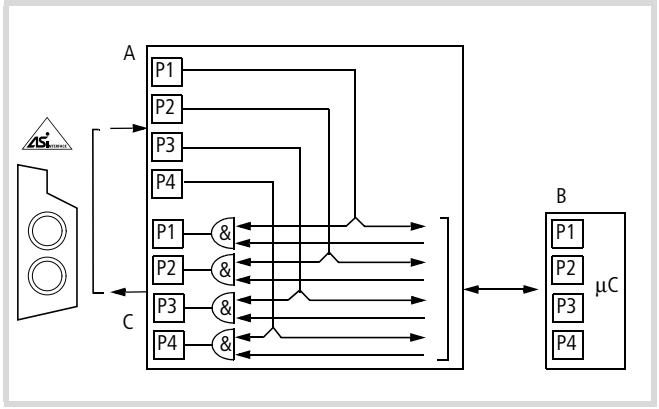


Figure 4: Function principle of parameter transmission

When the PLC sends parameter bits P1 to P3 = 000 (A), only parameter value 000 (C) is returned, regardless of the RA-MO electronic's status.

Reading out diagnostic status:
If the PLC sends the value 111 (A), the motor starter interprets this as a request to return the diagnostic status. To allow correct transfer of the diagnostic status (→ table 2 on page 60), the PLC must send only parameter value 111 until it receives the receive data.

Parameter handling in RA-IN:
In the interface control unit RA-IN parameters are handled with mailbox commands. With the command SET PP (set parameter value) the PLC can permanently save a parameter value for each slave in the EEPROM of the RA-IN. When it is switched on, the RA-IN automatically sends these values to all slaves provided the communication in the AS-i run is working). The parameter values remain available even if the PLC fails.

With the command WRITE P (write parameter value) the PLC can transfer a value other than the set parameter value to each AS-i slave. This does not affect the parameter data written to the RA-IN's EEPROM with SET PP.

→ For further information, see manual "Hardware and Engineering of the AS-i/PROFIBUS Gateway". You can find the latest version of this manual under http://www.moeller.net/support: Search term: AWB2700-1409G)

Head station

The interface control unit RA-IN head station provides the connection to the PROFIBUS-DP field bus and handles all communication within the AS-Interface® run.

The user program receives its input information from the interface control unit RA-IN. To the outside, the overall system acts like a single connection cable. In the higher-level fieldbus the interface control unit RA-IN is a station with its own address.

The interface control unit RA-IN contains a built-in power extender (PEX) with a data link for up to 2.8 A at 30 V ⎓ AS-Interface® voltage. The AS-Interface® power extender is current-limited (self-resetting time-lag fuse, 3 A).

For the power supply of the interface control unit RA-IN, a standard PSU with 30 V ⎓ to AS-Interface® specifications (SELV, smoothing, etc.) with or without data link is needed. Each PSU can supply several interface control units RA-IN. Power supply cables can be standard round cables with 3×1.5 mm² or 3×2.5 mm². The length of these cables are not included in the permissible 100 metres length of the AS-Interface® busbar run.

Cable lengths and voltage drop

When defining the length of the AS-Interface® line, observe the following:

- Te maximum expansion, including all spur lines and M12 plug lines of the function modules (for each assembled 0.5 m long cable with M12 plugs, calculate 0.9 m), is 100 m. The cable between PSU and RA-IN is not included in these 100 m.
- Each slave must be supplied with at least 24 V ⎓ +10/–15 %.
- The interface control unit RA-IN must be supplied with at least 26 V ⎓.

Calculate the current demand and voltage drop to ensure that all sensors, actuators and the interface control unit RA-IN receive the required voltage.

Length of AS-Interface® data cable:
The rule of thumb for the length of the AS-Interface® data cable with 1.5 mm² depending on the voltage of the interface control unit RA-IN is:

- AS-Interface® voltage > 28 V: 80 m cable length
- AS-Interface® voltage > 26 V: 60 m cable length

Voltage at interface control unit RA-IN:
The voltage at the interface control unit RA-IN depends on:

- The length of the supply cable between PSU and RA-IN
- The cross-section of the supply cable between PSU and RA-IN
- the current consumption

Cable length between PSU and RA-IN:
The cable length between PSU and interface control unit RA-IN 8 is calculated from the voltage drop.

$$\text{Voltage drop } \Delta U = \frac{\text{Length } l \times \text{current } I \times 2}{\text{Conductivity } \kappa \times \text{cross-section } A} \quad [V]$$

$$\text{Length } l = \frac{\text{Voltage drop } \Delta U \times \text{conductivity } \kappa \times \text{cross-section } A}{2 \times \text{current } I} \quad [m]$$

$$\text{Conductivity of copper: } \kappa = \frac{57 \text{ m}}{\Omega \text{ mm}^2}$$

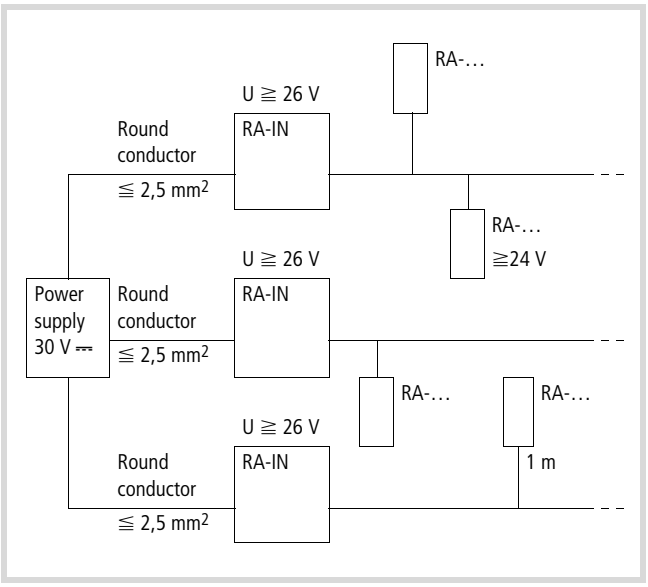


Figure 5: Design of a data bus

Power bus

The power bus supplies the Rapid Link function modules with main and auxiliary power. Plug-in tap-off points can be quickly and safely connected at any point along the bus. The power bus can consist either of a flexible busbar (flat cable) or standard round cables:

Warning!

- Rapid Link must be operated only on 400V-three-phase systems with earthed star point and separate N and PE conductors (TN-S network). It must not be operated unearthed.
- 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. The24 V DC power supply unit must be earthed on the secondary side. The 30 V DC PSU for the AS-Interface®-/RA-IN-power supply must meet the safe isolation requirements according to SELV.

Incoming supply 400 V AC

The power sections are supplied through disconnect control unit RA-DI (see illustration below) with:

- $I_e \leqq$ 20 A/400 V at 2.5 mm^2
- $I_e \leqq$ 25 A/400 V at 4 mm^2.

Round cables up to 6 mm^2 can be used to feed power to disconnect control unit RA-DI.

- The disconnect control unit RA-DI protects the cable from overload.
- It also provides short-circuit protection for the cable and for all connected motor control units RA-MO.

The combination of RA-DI and RA-MO fulfills the requirements of IEC/EN 60947-4-1 as starter with type "1" coordination. That means that the contactor's contacts in the RA-MO are allowed to weld in the event of a short-circuit in the motor terminal strip or the motor supply cable. This arrangement also conforms to IEE wiring regulations.

The affected RA-MO motor control unit must be replaced after a short-circuit!

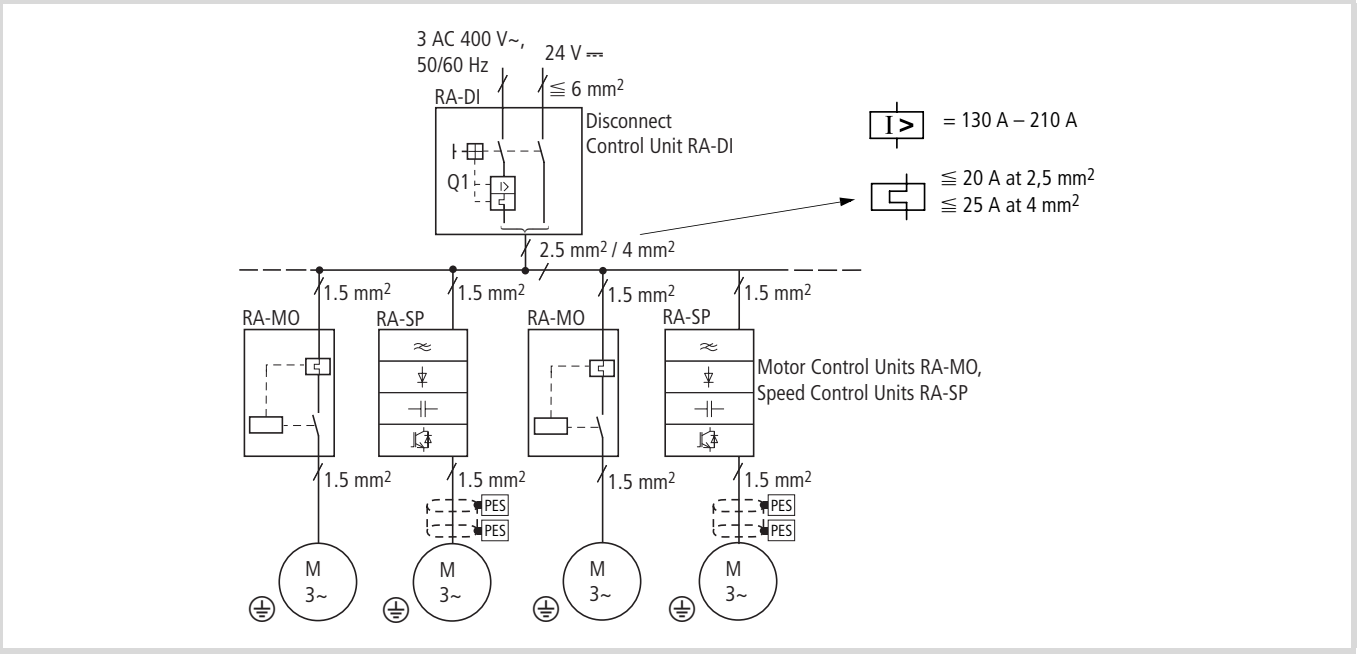


Figure 6: Example arrangement, Rapid Link system with RA-DI, RA-MO and RA-SP

When you configure a power bus with a disconnect control unit, observe the following:

→ The short-circuit release of the RA-DI is factory set top the lowest setting of 130 A. The values in brackets in the list below apply to the maximum setting of 210 A. The configuration of the short-circuit release is described on page 39.

- Even in the event of a single-pole short-circuit at the line end, the short-circuit current must exceed 150 A (250 A). This value is a main factor in determining the length of the power bus.
- The total current of all running and simultaneously starting motors must not exceed 110 A (170 A).
- The incoming circuit-breaker RA-DI (or PKZ2-ZM25-8) can switch on the following number of speed controllers RA-SP without the short-circuit release being tripped by the RA-SP:
  – 10 to 15 (20 to 25) RA-SP...075... or
  – 5 to 8 (10 to 13) RA-SP...1K1... or
  – 3 ti 5 (7 to 9) RA-SP…2K2…

Depending on the length of the power bus and the arrangement of the power links, the incoming circuit-breaker RA-DI can also switch on a higher number of RA-SP units. In any case, the total mains current of the RA-SP units must not exceed 25 A (or 20 A at 2.5 mm^2) in continuous operation. The mains currents change proportionally to the currently flowing motor current.

- Observe the voltage drop in your specific application.

Instead of the disconnect control unit, you can use a 3-pole miniature circuit-breaker $I_n \leqq 20$ A and B or C characteristic. Here, you must observe the following:

- The let-through energy I^2t in the event of a short-circuit must not exceed 29800 A^{2}s.
- Therefore the short-circuit current I_{cc} at the mounting location must not exceed 10 kA (→ characteristic curve figure 7).

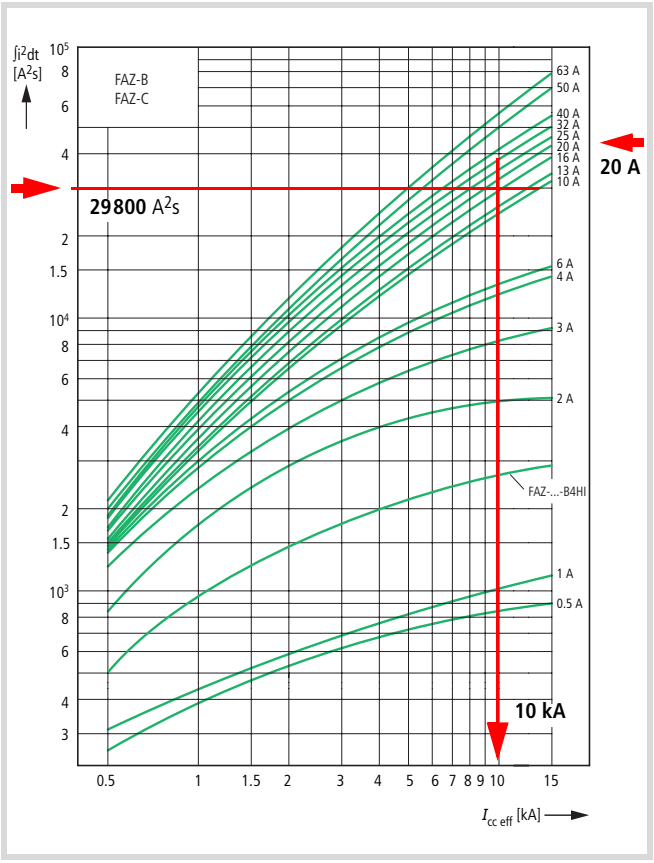


Figure 7: Cable protection with FAZ-3-B20

Incoming supply 24 V DC

Use all power supply devices in combination with safe isolation and earth them on their secondary side.

- Switched-mode power supply units with foldback characteristic limit the short-circuit capacity by reducing the voltage and allowing the highest permissible voltage (depending on model rating) to flow permanently until the fault has been rectified. Once the fault has been rectified, the voltage builds up again (automatic restarting). This type of power supply unit must not supply a continuous short-circuit current higher than 16 A or – if a flat cable RA-C1-7x2,5PVC is used – 6 A.
- Switched-mode power supply units with short-circuit recognition, i.e. with disconnection and automatic restarting, should disconnect a short-circuit current (e.g. 3 × I_N) after no more than 0.1 seconds. The rated current can be up to 16 A or – if a flat cable RA-C1-7x2,5PVC is used – 6 A.
- If non-stabilized power supply units without short-circuit protection are used, an additional short-circuit protection device must be fitted. In the event of a short-circuit, the disconnection should take place after no more than 0.1 seconds. Here miniature circuit-breakers with characteristic R in the secondary circuit are recommended. With a short-circuit release response current of 2 – 3 × I_N, these are suitable for the protection of semiconductor elements . The power supply unit must have a corresponding short-circuit capacity. The fuse specification fo the secondary circuit must not exceed 16 A or – if a flat cable RA-C1-7x2,5PVC is used – 6 A.

Flexible RA-C1 busbar
The flexible busbar RA-C1 is a 7-core flat cable (cross-section 2.5 mm^2 or 4 mm^2) and has the following structure:

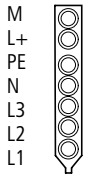


Figure 8: RA-C1-7x... flat cable..

The flexible busbar is supplied through a round cable with a cross-section of up to 4 mm^2 through distribution module RA-C1-VM-7. The distribution module can supply up to three flat cable segments through two-tier terminals with round cables. You can also supply 400 V and 24 V through two round cables (M25 and M20 knockout entries).

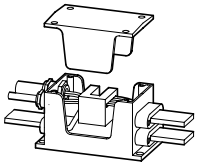


Figure 9: RA-C1-VM7 distribution module with RA-C1-DF

→ Alternatively the RA-C1-7x4 can also be supplied through the new terminal module RA-C1-AM-7:

- +40 °C: 3 x 23,5 A (400 V AC) + 2 x 10 A (24 V DC)
- +38 °C: 3 x 25 A (400 V AC) + 2 x 10 A (24 V DC)

Contacts are easily established with cage clamp terminals for round cables and piercing screws for the flexible busbar RA-C1-7x4.

For connecting the Rapid Link function units RA…/C1, a connection socket for power plugs is available:

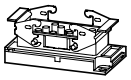


Figure 10: Flexible busbar junction RA-C1-VP-PLF or RA-C1-PLF

These connection sockets are mounted on the flexible busbar. To make the contacts, simply tighten the seven screws. When assembled and connected, they have degree of protection IP65.

For secure termination and for IP65 protection, fit end-pieces to the open cable ends.

Figure 11: End piece RA-C1-END or RA-C1-END1

Current carrying capacity of the flexible busbar:
Supplied through distributor module RA-C1-VM-7, the 7 × 4 mm^2 flat cable has a maximum rating of 25 A at 50 °C. If they are laid in a cable duct, the 400 V strands are rated 25 A at 40 °C. The consumers must form a balanced load. The highest permissible current for the 24 V DC strands is also 25 A. The flexible busbar junctions RA-C1-VP-PLF and RA-C1-PLF have a maximum current rating of 16 A.

The maximum continuous current of the 7 × 2.5 mm^2-flat cable is 20 A at up to 40 °C ambient temperature and three live strands; i.e. the 24 V DC strands carry a current of no more than 5 A.

The flat cable junction RA-C1-VP-SR must be used a feeder module only in combination with the 7 × 2,5 mm^2 flat cable and can be loaded with up to 20 A.

Round cable junction RA-C2
For the power bus you can also use conventional round cables (cross-section 7 × 2.5 mm^2 or 7 × 4 mm^2, outer core diameter < 5 mm, flexible copper conductor to DIN VDE 295, class 5) with round cable feeders RA-C2. The cable can have an external diameter of 10 to 16 mm.

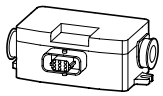


Figure 12: Round cable junction RA-C2-S1-4

The cable strands are inserted in the seven terminals and contacted with screws. The junction socket prewired and conforms with the DESINA specification.

DESINA

In its assembled and connected state, it provides degree of protection IP65.

At the free cable end, a blanking plug is fitted in the free sealing insert.

Current carrying capacity of the round cable junction:
The current carrying capacity of round cables is indicated by the manufacturer. The round cable junction can be loaded up to 25 A at an ambient temperature of 50 °C.

Cable length

When defining the length of the power bus line, observe the following:

- In the event of a short-circuit in a single-pole at the end of the power bus – for example in the motor's terminal board of the last consumer – the upstream safety device must trip. The magnitude of the short-circuit depends on:
  - Cable lengths
  - Conductor cross-section
  - Short-circuit current at the incoming point

- Level of application-specific voltage drop. This depends on:
  - Cable lengths
  - Conductor cross-section
  - Current consumption of motors

Through calculation of the short-circuit current and voltage drop according to the IEE Wiring Regulations, ensure that the protective functions are fulfilled.

You can calculate the cable length of the power bus as follows:

$$L = \frac{\frac{U_0 \times 1000}{i(t)_{rm}} - Z_v - Z_{Stich}}{\int^2 dt_{power\ bus}}$$

L	=	lengt h
u_0	=	230 V (no-load voltage 1-ph.)
$i(t)_{rm}$	=	Tripping current of short-circuit release, e.g. 150 A for RA-DI
$\int^2 dt_v$	=	e.g. 100 mΩ (series impedance of feeder)
Z_{Stich}	=	35,50 mΩ/m (spur line 1,5 mm²)
$\int^2 dt_{power\ bus}$	=	13,40 mΩ/m (power bus 4.0 mm²) 21,50 mΩ/m (power bus 2.5 mm²)

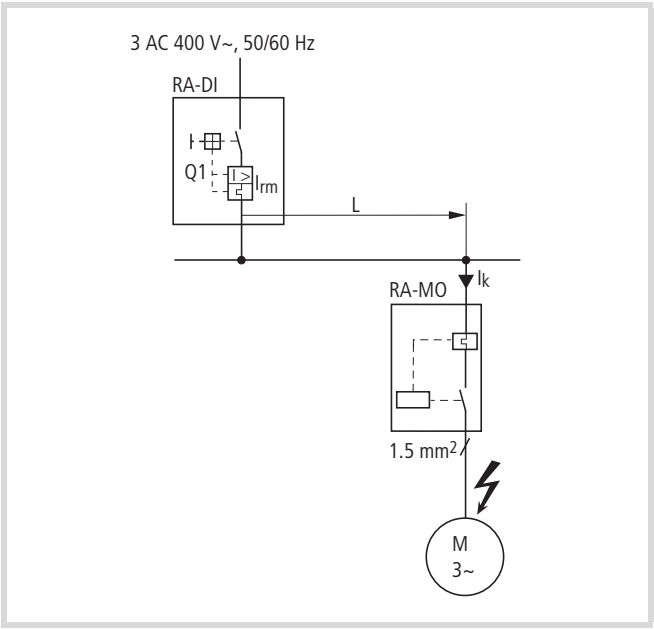


Figure 13: Demands placed on the RA-DI group protection device with short-circuit

Precondition: The short-circuit current I_k must be greater than the tripping current of short-circuit release I_{rm}.
I_k is dependent on the impedance or length of the power bus and the spur line (for Rapid Link about 2 m incomer plus 2 m motor cable)

→ You can obtain a calculation and engineering tool from Moeller GmbH.

▽ **Attention!**
When selecting the cable cross-section, take the voltage drop under load conditions into account. The end user is responsible for the observation of any other applicable standards (for example IEC/EN 60204).

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

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

Tripping currents at short-circuit

The tripping current must also be reliably reached in the event of short-circuit. In operation, observe that the total current of all motors (including the starting currents) or the charging current of all connected speed control units RA-SP remains below the tripping current when mains voltage is applied.

→ Further information can be found at section "Incoming supply 400 V AC" on page 13.

With the disconnect control unit RA-DI you can achieve long cable lengths and high total currents.

	RA-DI at I_n = 20 to 25 A[1]	Cable circuit-breaker 20 A, characteristic B	
Short-circuit tripping current	130 A (210 A)	60 – 100 A	100 – 200 A
Minimum current at single-pole short-circuit	150 A (250 A)	110 A	220 A
Max. total current of all motors (including starting current)	110 A (170 A)	55 A	90 A

1) The values in brackets apply when the short-circuit release is set to 210 A.

Information to EMC

For information about EMC, see the following sections of this manual. See also the engineering notes in manual "Frequency inverter DF5" (AWB 8230-1412G)

Rapid-Link Function modules			
Emitted interference	DIN EN 55011/22 Class A		
Noise immunity			
esd	IEC/EN 61000-4-2	Contact discharge	4 kV
		Air discharge	8 kV
rfi	IEC/EN 61000-4-3	AM/PM	10 V/m
burst	IEC/EN 61000-4-4	Mains/digital I/O	2 kV
		Analog I/O, field bus	1 kV
surge	IEC/EN 61000-4-5	Digital I/O, unsymmetrical	0.5 kV
		Mains DC, unsymmetric	1 kV
		Mains DC, symmetric	0.5 kV
		Mains AC, unsymmetric	2 kV
		Mains AC, symmetric	1 kV
Con-ducted RFI	IEC/EN 60000-4-6	am	10 V

Speed Control Unit			
Emitted interfer-ence	IEC/EN 61800-3 (inclusive A11)		
Noise immunity	IEC/EN 61800-3	Industrial environment	

Loads

Consumers can be any three-phase asynchronous motor. Pole-changing (Dahlander) three-phase motors, slipring motors and reluctance-, induction-type synchronous or servo motors can also be connected, provided their electrical and connection characteristics correspond with asynchronous motors and are approved for the application by their manufacturer.

With user-assembled motor connection plugs the length of the screened motor supply cable with servo cable for the speed control unit RA-SP and the motor supply cable for the motor control unit RA-MO is limited to 25 m.

Addressing slaves (with hand-held addressing unit PG2-105-AD2)

With the addressing unit PG2-105-AD**2** suitable for specification 2.1 you can address the slaves:

- to specification 2.0 with 31 possible stations
- to specification 2.1 with 31 or 62 possible stations.

▶ Plug the M12 plug of the function modules into the socket of the addressing unit and press button ADR.

On the display the currently set address is now shown. The factory settings are:

- For RA-DI and RA-SP: 00 (31 possible stations)
- For RA-MO: 00A (62 possible stations)

With the arrow keys you can select a new address.

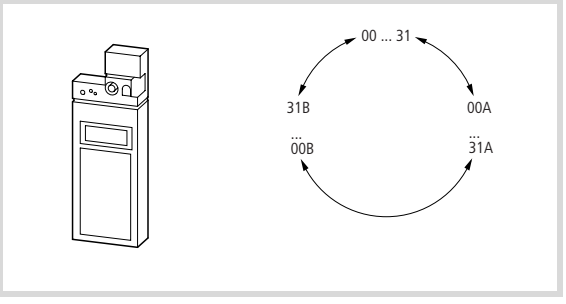


Figure 14: Hand-held addressing unit PG2-105-AD2 and address display structure

No.	Addresses for 31 stations	Adresses for 62 stations
0	00	00A
1	01	01A
2	02	02A
3	03	03A
4	04	04A
5	05	05A
6	06	06A
7	07	07A
8	08	08A
9	09	09A
10	10	10A
11	11	11A
12	12	12A
13	13	13A
14	14	14A
15	15	15A
16	16	16A
17	17	17A
18	18	18A
19	19	19A
20	20	20A
21	21	21A
22	22	22A
23	23	23A
24	24	24A
25	25	25A
26	26	26A
27	27	27A
28	28	28A
29	29	29A
30	30	30A
31	31	31A

No.	Addresses for 31 stations	Adresses for 62 stations
0	00	00B
32	–	01B
33	–	02B
34	–	03B
35	–	04B
36	–	05B
37	–	06B
38	–	07B
39	–	08B
40	–	09B
41	–	10B
42	–	11B
43	–	12B
44	–	13B
45	–	14B
46	–	15B
47	–	16B
48	–	17B
49	–	18B
50	–	19B
51	–	20B
52	–	21B
53	–	22B
54	–	23B
55	–	24B
56	–	25B
57	–	26B
58	–	27B
59	–	28B
60	–	29B
61	–	30B
62	–	31B

Permissible addresses for operation are:

RA-DI and RA-SP: 01 to 31

RA-MO: 01A to 31A and 01B to 31B

- ▶ When you have selected the target address, press the PRG key to transfer it to the slave.
- ▶ With the ADR key you can check the transferred address.

For each new slave, repeat the following steps:

- ▶ Insert M12 plug
- ▶ Read address with ADR key
- ▶ Select new address with arrow keys
- ▶ Overwrite address with PRG key.

Addressing on replacement of a faulty slave

When you replace a faulty slave within an existing busbar run, addressing can be performed directly through the master, → section "Automatic addressing" on page 31.

Precondition: The replacement device must have the same ID/IO code and the address must be 00 (for RA-DI, RA-SP or RA-OP) or 00A (for RA-MO).

Designation of slave addresses

After addressing, the function modules' slave address can be entered on the nameplate.

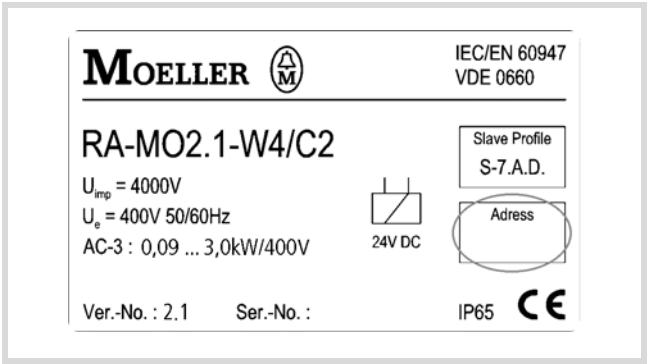


Figure 15: Slave address of function modules on nameplate

Installation of Rapid Link function modules

The Rapid Link function modules are housed in identical enclosures with the same attachment method.

- Diameter of fixing holes, 5.5 mm for M5 screws.
- Length of screws > 10 mm; exception: speed control unit, see chapter 6on page 83.
- Washer with circlip
- Distance between fixing holes 210 mm.

Attention!
Observe the notes in the individual chapters of the units.

→ To facilitate a quick replacement of units, do not tie the units' power and data cables together with the motor supply cable or the sensor cables.

The default mounting position is vertical. Other mounting positions are possible – see chapter for respective unit.

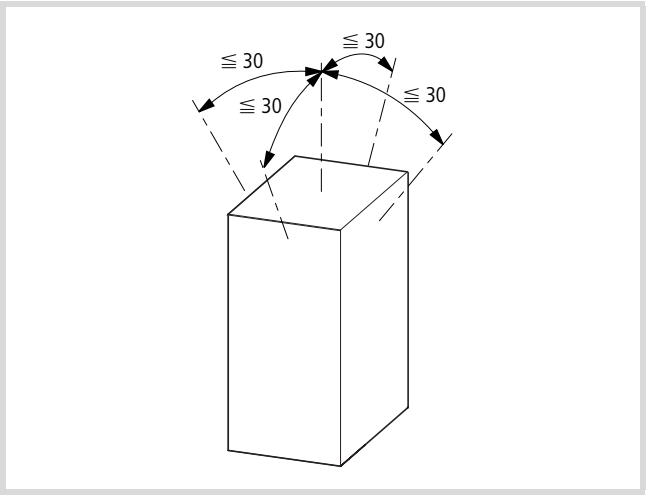


Figure 16: General mounting position

The dimensions can be found in the appendix on page 147.

Attention! !
Please note the section "Information to EMC" on page 17.

Mounting data bus

You can fit M12 branches (ZB2-100-AZ1) at any point on the AS-Interface® flat cable.

The mechanical and electrical connections are established with a single operation:

- ▶ Undo the black union nut far enough that the contact tips no longer protrude.
- ▶ Insert the two-conductor profile flat cable and clip the branch shut.
- ▶ Tighten the black union nut.

The device or station is now ready for operation.

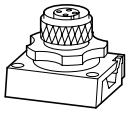


Figure 17: M12 branch (order number: ZB2-100-AZ1)

The Rapid Link function modules have a cable with M12 plugs that fit the M12 branch.

Pin	Function
1	AS-Interface® +
2	–
3	AS-Interface® –
4	–

Installation of flexible busbar RA-C1-7x…

The flexible busbar features a mechanical reverse voltage protection: One edge of the flexible busbar is tapered. The cable connectors in all system components (flat cable junction points, motor starters, etc.) has the same profile. The flexible busbar is fitted so that the tapered side lies opposite to the tapered hinge of the opened tap-off point.

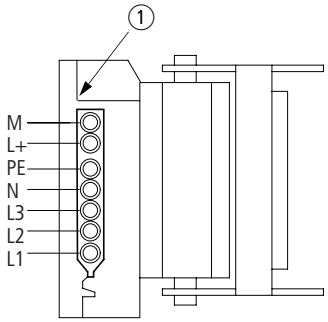


Figure 18: Voltage reversal protection of flexible busbar

① Hinge

Laying the flexible busbar

The flexible busbar is reeled off the drum, cut to length and laid. Before unreeling the cable, position the drum in a suitable position. The cable is marked on its side to indicate the correct polarity. It also contains a metric scale to help you cut it to the required length.

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

If the busbar is not laid in a cable duct, secure it to the subsurface with cable ties or cable clips. Otherwise connection and distribution modules take care of cable routing.

→ In areas where there is a risk of mechanical damage, for example in stacking applications,it is advisable to lay the busbar in cable ducting.

The installation should be performed at an ambient temperature of 10 to 50 °C. For information about cable length, see page 16.

Establishing connections

The feeder and busbar junction modules can be fitted at any point along the flexible busbar. The conductors of the flexible busbar remain uninterrupted. The connection is established with contact screws.

Pin	Function	wire colours $7 \times 2{,}5\ mm^2$	wire numbers $7 \times 4\ mm^2$
1	L1	black	1
2	L2	brown	2
3	L3	black	3
4	N	blue	4
5	+24 V	red	5
6	0 V	white	6
PE	PE	green/yellow	green/yellow

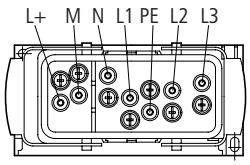


Figure 19: Terminal assignment of flat cable busbar junction RA-C1-VP-PLF or RA-C1-PLF

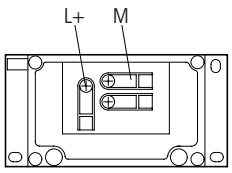


Figure 20: Connection assignment of the RA-C24-VP-AM-2 V connection module

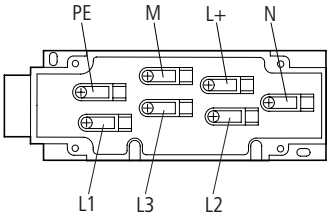


Figure 21: Terminal assignment of flat cable busbar power supply and junction RA-C1-VP-SR

Fitting feeder and junctions

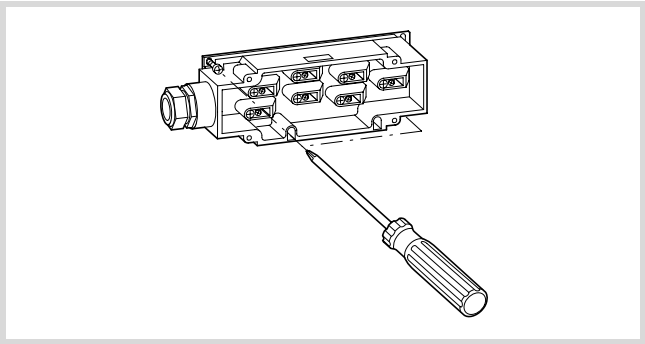
Warning!
Connection and disassembly work must be performed only when the busbar is not live!

Because of its symmetry, flat cable feeders and junctions can be fitted on either side of the flexible busbar.

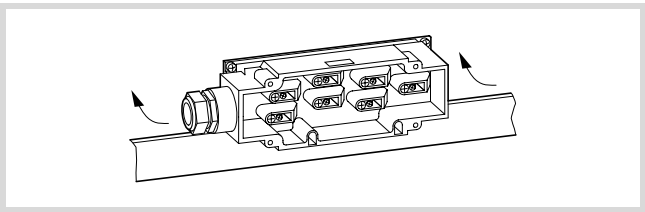
Fit the flexible busbar, ensuring correct polarity, close the upper section and secure it with screws.

The installation is demonstrated here with flexible busbar power supply and junction RA-C1-VP-SR; flexible busbar junction RA-C1-PLF and flexible busbar power supply and junction RA-C1-AM-7 for the flexible busbar are fitted in the same way.

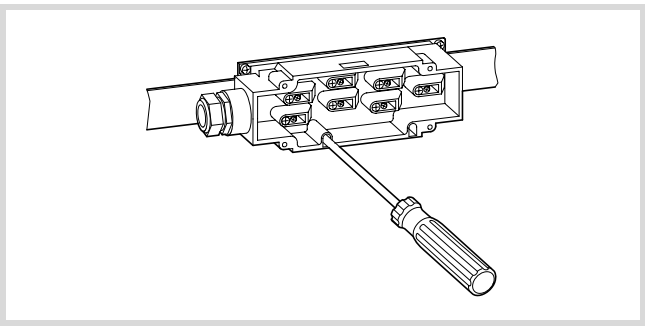
▶ Secure the module to the subsurface with suitable screws, e.g. M4 using the provided slots.



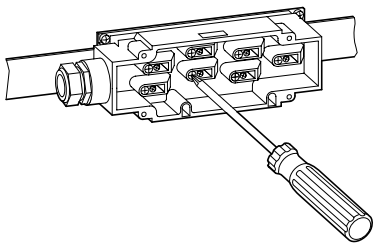
▶ Flip open the top and insert the flexible busbar.



▶ Close the top and screw it shut.
The top section is now protected to IP65.



▶ Tighten all seven contact screws. This makes the contact with the conductors.



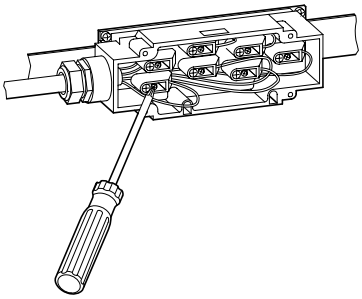
Warning!
Turn the contact screws in all the way to the stop! The tightening torque must not exceed 1 Nm.

We recommend the use of an electrical or pneumatic torque wrench. Phillips (cross-head) screwdriver, size: 1. Shaft length at least 45 mm.

Observe the permissible tightening torque. The installation of the flexible power supply and busbar junction is now completed. All that remains is to fit the plug of the Rapid Link function modules RA-…/C1 or the cover RA-C1-COV and secure it with the clips.

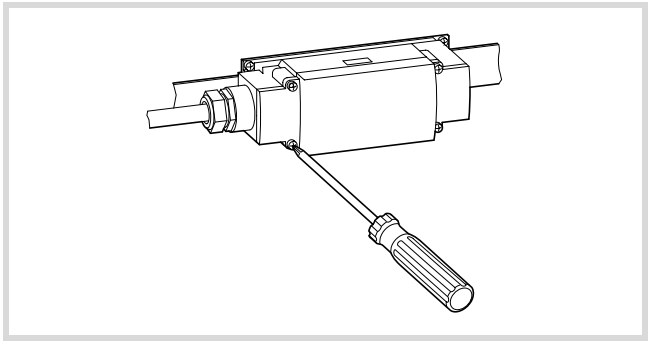
Attention!
Never connect or disconnect the plug under load!

▶ Now connect the cables to the securely screw-fitted power feed unit sing screw terminals. According to DIN EN 60947 all cable types (flexible, solid or stranded) can be connected.



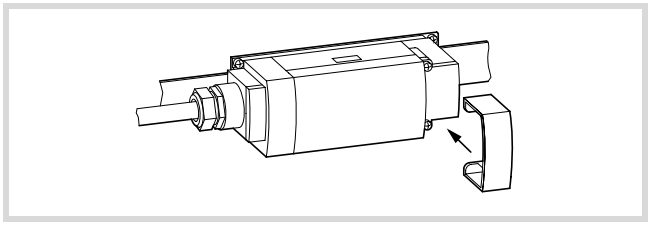
For flexible conductors the use of ferrules is recommended. At a cross-section of 4 mm^2 the ferrules must be assembled in a square.

▶ Fit the sealing cap.



Attention!
If you do not connect round cables, seal the round cable outgoer with a blanking plug.

▶ Fit the screw covers.



If a contact screw breaks, the cable feeder must be replaced with a new one and refitted adjacent to the original one offset by at least 200 mm.

Removing

Disassembly is in reverse order of assembly; see section "Establishing connections", page 21.

Attention!
Observe the applicable safety instructions. Never work on live equipment.

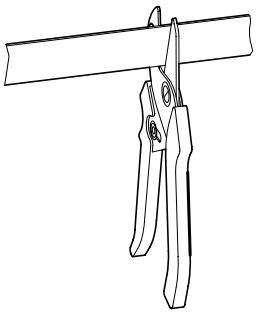
The flexible busbar's insulation must not be damaged. Insulate any points that have been opened by the insulation piercing terminals using an approved insulation tape (Scotch VM from 3M) and observing the manufacturer's instructions about correct insulation.

End pieces and bushings

Once the flexible busbar has been laid, all free cable ends must be safely terminated and sealed to IP65. To do this, use the cable end pieces or bushings. Cable end pieces consist of a shorter lower and a longer upper section, which contains the the seal and the insulation channels.

With bushing RA-C1-DF you can feed the flexible busbar into power supply and distributor module RA-C1-VM-7 or a control panel.

▶ Cut the cable to the required length.

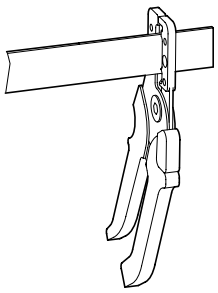


→ For cutting the busbar, we recommend tool RA-C1-CUT.

▶ Strip the flexible busbar ends to the required length (see also following note):
- fir cable termination to 19 mm
- for power supply and distribution unit to 50 mm
- for control panel as required.

→ Fir stripping the 7 × 4 mm² flexiblen busbar a commercial cable knife can be used. Score the rubber sheath, cutting no more than 0.7 mm into the sheath deep so as not to damage the conductor insulation. The blade of tool RA-C1-AZ-4 protrudes by exactly this amount so that there is no possibility of damaging the insulation. The RA-C1-AZ-4 is supplied complete with instructions for use.

For stripping the 7 × 2.5 mm² flexible busbar we recommend cable strippers RA-C1-AZ-2,5, which contains a stop laid out especially for this busbar to ensure a clean cut.
Place the end of the flexible busbar into the busbar strippers and firmly press the strippers shut to cut off the sheath. Hold the strippers shut and slide the yellow slider all the way to the handle to lock the strippers shut. Gently turn the strippers to sever the sheath and then pull it off (→ illustration).



Mounting end piece

▶ Slide the lower (shorter) part of the busbar end-piece RA-C1-END or RA-C1-END1 onto the prepared flexible busbar.
▶ Push the individual conductors into the insulation ducts as far as they will go.
▶ Finally fit the top section to the lower section and tighten the two screws. The flexible busbar is now sealed to IP65.

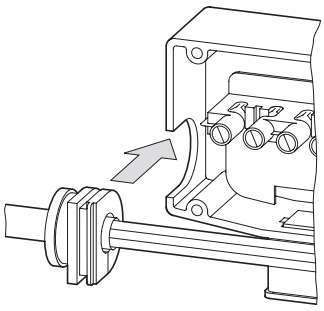
Installing the round cable junction

▶ Secure the round cable junction to the subsurface with suitable screws (M5) using the provided fixing strap.
▶ Strip the round cables to a length of 130 mm (two radial cuts, one longitudinal cut).

→ Set the blade so that the core insulation does not get damaged. Make a test cut at one cable end to check your method.

▶ Fit one of the radially cut seals around the cable sheath and insert the seal into the u-shaped contour in the cable feeder.

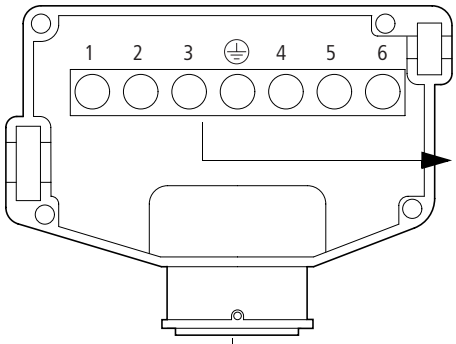
→ Two pairs of seals for conductors with an outer diameter of 10 to 13 mm and of 13 to 16 mm are supplied. Use only the correct provided sealing kits.



▶ Lay the strands into the seven insulation piercing terminals and secure them with the screws.

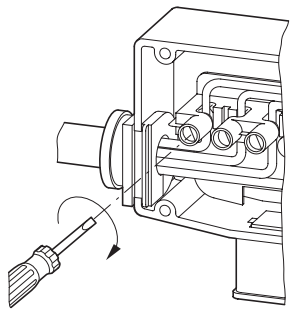
▽ **Attention!**
Only one strand must be connected to each terminal.

Turn the screws in all the way to the stop (tightening torque 0.5 to 1 Nm). Observe the correct assignment of terminals and strands:



Pin	Func.
1	L1
2	L2
3	L3
⏚	⏚
4	N
5	24 V
6	0 V

Pin	Function
1	N
2	L2
3	N/A
4	+24 V (brake)
5	0 V (brake)
6	L3
7	–
8	L1
PE	PE



- ▶ Now fit the second radially split seal around the cable sheath at the other cable end and insert it into the u-contour.
- ▶ Place the cover onto the lower section so that it sits across its entire surface without pivoting. If this is not possible, one or more screws have not been fully tightened.
- ▶ Secure the cover with the four screws (size Pozidriv 2; tightening torque 1.5 to 2 Nm).
- ▶ To ensure IP65, fit a cable tie about each seal and pull it tight.
- ▶ Finally fit the supplied locking clip to the two studs on the bushing enclosure.
- ▶ Make sure that the round cable is laid in such a way that no tensile force acts on it.

→ Close the open seal of the last round cable junction at the end of the power bus with end-piece RA-C2-SBL.

You can now connect the assembled plug of Rapid Link function module RA-…/C2 and secure it with the clip. If you are using ruand cable junction RA-C2-S2-4, fit function modules RA-…/C2 into both distributor sockets.

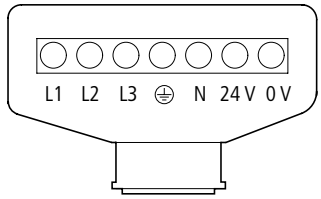


Figure 22: RA-C2-S1-4

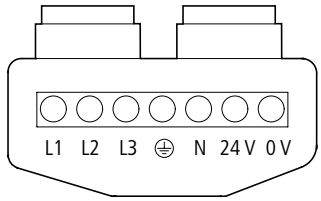


Figure 23: RA-C2-S2-4

⚠ **Attention!**
Before switching on the 400 V ~ and 24 V ⎓ power supplies, check that all strands are securely connected to the correct terminal. The PE conductor must be connected to the middle terminal.

To identify possible wiring faults in the 24 V DC circuit, switch on the 24 V DC voltage and, using the LED display on the motor starters, check whether control voltage is applied. If all UV LEDs are lit, you can connect the 400 V AC supply.

2 Head station RA-IN

Device overview

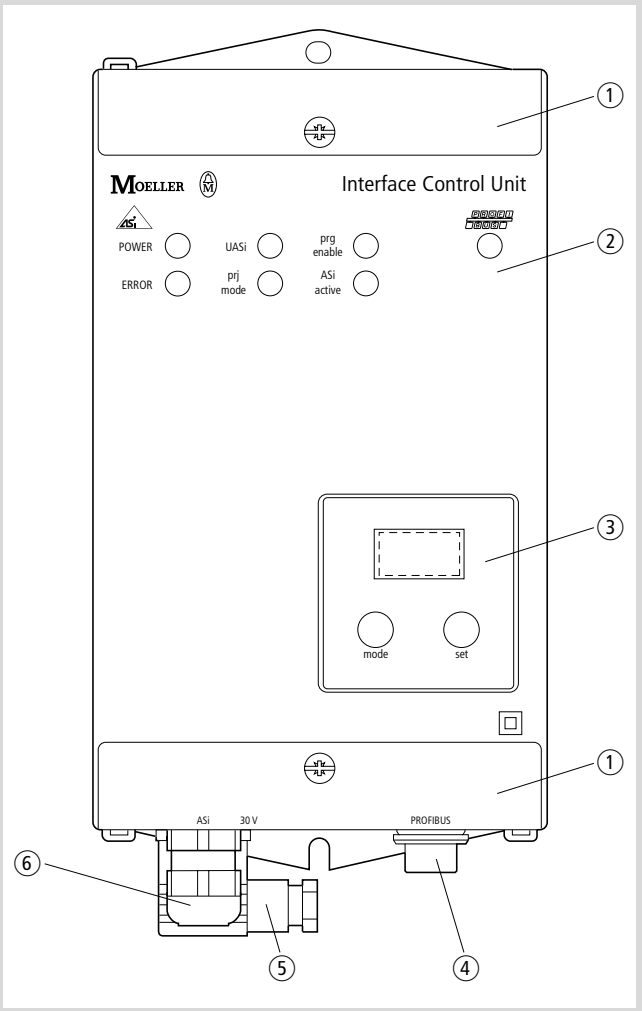


Figure 24: Overview RA-IN

① Space for labelling top and bottom
② 7 Status and diagnostic LEDs
③ Three-digit digital display assembly, Mode and Set keys for device configuration
④ Socket for M12 Y- or T-connector to PROFIBUS-DP
⑤ Socket for 30 V DC supply
⑥ AS-Interface® supply cable, 1.5 m with M12 plug

Key to part numbers

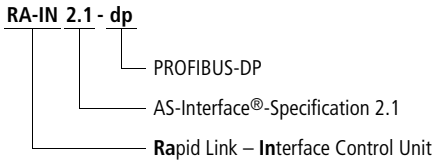


Figure 25: Key to part numbers RA-IN

Proper use

The head station

The interface control unit RA-IN head station provides the connection to the PROFIBUS-DP field bus and handles all communication within the AS-Interface® run.

The user program receives its input information from the interface control unit RA-IN. To the outside, the overall system acts like a single connection cable. In the higher-level fieldbus the interface control unit RA-IN is a station with its own address.

The interface control unit RA-IN contains a built-in power extender (PEX) with a data link for up to 2.8 A at 30 V ⎓ AS-Interface® voltage. The AS-Interface® power extender is current-limited (self-resetting time-lag fuse, 3 A).

For the power supply of the interface control unit RA-IN, a standard PSU with 30 V ⎓ to AS-Interface® specifications (SELV, smoothing, etc.) with or without data link is needed.

Improper use

Danger!
The interface control unit RA-IN must be supplied only fro a PSU that meets the requirements for safe isolation according to IEC/EN 60950 (SELV).

Functions overview

	Basic functions RA-IN		→ Page
Communication	Master to AS-Interface® specification 2.1 for 62 stations PROFIBUS-DP slave with up to 12 MBaud		26
Parameterization and programming	Adjustable through Mode and Set keys		32
Display	Three-digit digital display unit for the addresses; separate diagnostic and status LEDs		32
Power supply	Built-in power extender for data data decoupling up to 2.8 A. With an external 30 V ⎓ PSU several interface control units RA-IN can be supplied. The external PSU dies not require data decoupling but must comply with the AS-Interface® specifications (smoothing, SELV, etc.)		12
Mounting	Connection through plug-in connectors with IP65 degree of protection		
	PROFIBUS-DP	M12 × 1 REVERSED KEYED	28
	as-interface®	1.5 m cable with M12 plug	29
	30 V DC	Through cable socket to DIN 43650-A/ISO 4400 with 3 1.5 mm² or 3 2.5 mm² round cables (L+, L–, low-noise earth)	29

Engineering

Design

The interface control unit is designed according the new AS-Interface® specification 2.1.

- Up to 62 AS-Interface® slaves can be connected to each AS-Interface® run.
- Analog value transmission is built into the master.
- All other functions of the new specification, such as AS-Interface® I/O error processing, are implemented.

The AS-Interface® functions are provided both cyclically and acyclically through PROFIBUS-DP V1

In cyclic data interchange, I/O data are transferred through the AS-Interface® busbar run with up to 32 bytes (adjustable).

In addition, analog values can also be transmitted through the management channel and all other commands of the new AS-Interface® specification through the PROFIBUS.

For commissioning, engineering and troubleshooting the AS-Interface®, the keys and the display and LEDs can be used.

Extended diagnostics functions

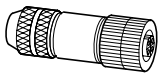
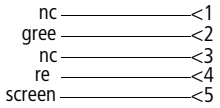
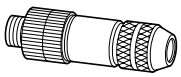
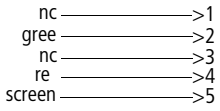
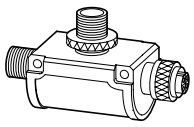
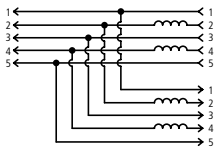
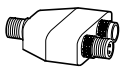
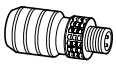
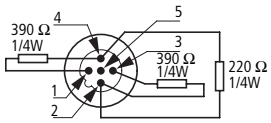
Diagnostics functions in addition to those defined in the AS-Interface® specification allow an easy localization of sporadic configuration errors and interference sources in the AS-Interface® communication. This allows system downtimes caused by errors to be minimized and timely planning of preventive maintenance measures.

Information to EMC

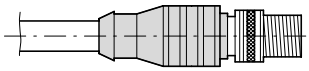
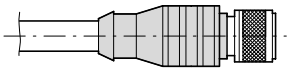
For information about EMC, see the following sections of this manual.

Accessories

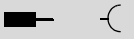
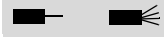
- GSD file: **Moel1745.GSD**. You can download this file from the Moeller website at http://www.moeller.net/support; use the search term "GSD".
- Operating software AS-i Control Tools: With the AS-i Control Tools software from Bihl und Wiedemann you can view the AS-i data online through PROFIBUS-DP V1. In combination with the PROFIBUS-DP simulator you can also use it to configure and program the RA-IN. To commission, engineer and troubleshoot without software, use the test unit and the display and LEDs.
- M12 accessories, PROFIBUS-DP
  The connection between the PROFIBUS-DP master and the interface control units (RA-IN) is made using cables with M12 plug/couplings (see alsofigure 29 on page 28):

Figure	Description		Part no.
	M12 plug connector for PROFIBUS-DP, for assembly by user, B-coded, straight coupling		RA-IN-XF-DP
	M12 plug connector for PROFIBUS-DP, for assembly by user, B-coded, straight plug		RA-IN-XM-DP
	T-type M12 connector for PROFIBUS-DP, B-coded		RA-IN-XT-DP
	Y-type M12 connector for PROFIBUS-DP, B-coded		RA-IN-XY-DP
	M12 terminating resistor for PROFIBUS-DP, B-coded		RA-IN-XTR-DP

- Pre-assembled PROFIBUS-DP M12 cables supplied by HANS TURCK GmbH & Co KG, Witzlebenstr. 7, 5472 Mülheim an der Ruhr, Tel.: +49 208 49520, Fax: +49 208 4952026
  - Cable type: 451
  - Cable sheath: TPUS, oil resistant, abrasion resistant, halogen free, lilac
  - Cores: highly flexible wire structure, colour-coded for PROFIBUS-DP systems
  - Plug/Coupling: Resistance-capable PUR plug connector, M12 straight, B-coded

		M12 × 1	
		RSSW plug	**RKSW coupling**
			
M12 × 1	**45x** 	RSSW 45x-*M	RSSW 45x-*M
	RSSW plug	RSSW RSSW 45x-*M	RSSW RKSW 45x-*M
	RKSW coupling	–	RKSW RKSW 45x-*M

x = type of cable, * = cable length in meters

length	Part no. 	ID No.	Part no. 	ID No.	Part no. 	ID No.
0.5 m	RSSW-RKSW451-0.5M	6914117	–	–	–	–
1 m	RSSW-RKSW451-1M	6914118	–	–	–	–
2 m	RSSW-RKSW451-2M	6914119	–	–	–	–
4 m	RSSW-RKSW451-4M	6914120	–	–	–	–
6 m	RSSW-RKSW451-6M	6914121	RSSW451-6M	6914111	RKSW451-6M	6914114
10 m	RSSW-RKSW451-10M	6914122	RSSW451-10M	6914112	RKSW451-10M	6914115
15 m	RSSW-RKSW451-15M	6914123	RSSW451-15M	6914113	rksw451-15m	6914116
30 m	RSSW-RKSW451-30M	6914124	–	–	–	–

Installation

Mounting position

The device is preferably installed vertically but can also be fitted in any other positions.

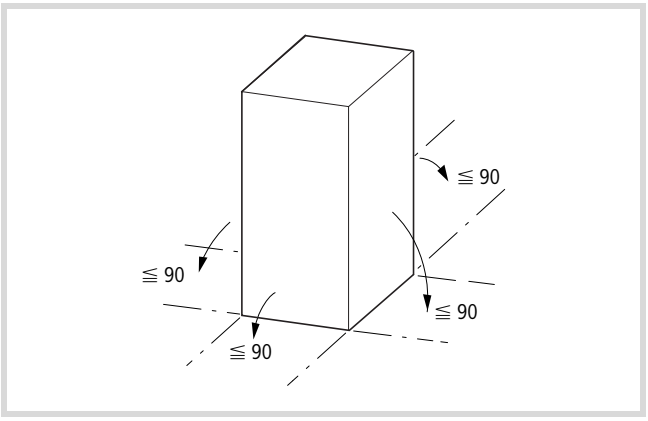


Figure 26: Mounting position

Mounting

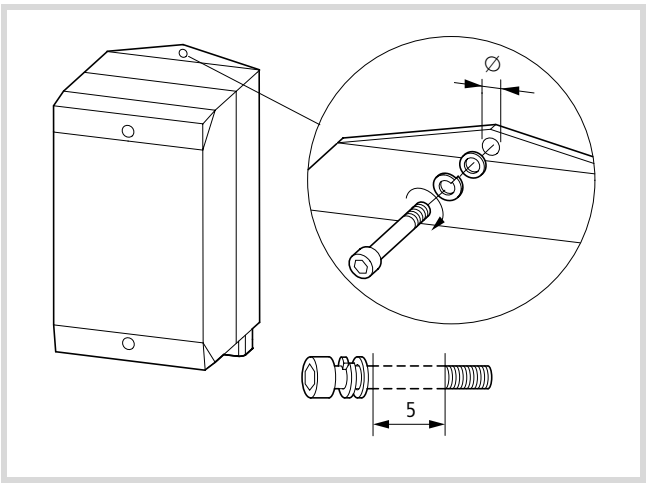


Figure 27: Mounting

∅ [mm]	Thread	Torque [Nm]
5.5	M5	3

PROFIBUS-DP interface

The PROFIBUS-DP interface is implemented as an M12 socket as specified in PROFIBUS guideline "Interconnection Technology".

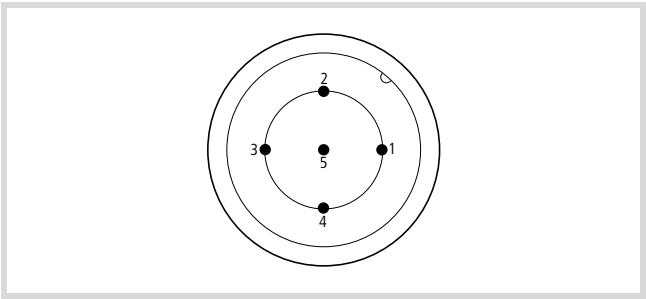


Figure 28: M12 connector for RS 485 in IP65/67

pin	identification
1	VP
2	RxD/TxD-N (data cable A, green)
3	DGND
4	RxD/TxD-P (data cable B, red)
5	screen

For interference-free operation of PROFIBUS, the bus must be terminated with an active bus termination in the form of a bus termination plug. Spur lines are permissible only at baud rates below ≦ 1.5 MBit/s. For higher baud rates, the T- or Y-connector must be connected directly to the RA-IN without spur line. The connectors have the additional advantage that they allow replacement of the RA-IN unit without interrupting the bus.

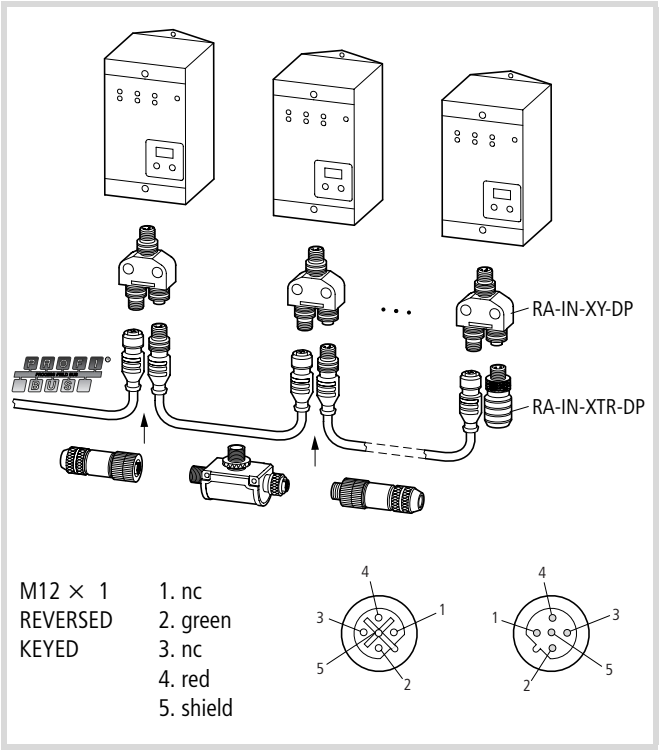


Figure 29: Connection to PROFIBUS-DP

→ Note the combinations:

For space reasons, you can only connect the RA-IN-XY-DP Y connector to one RA-IN-XM-DP user-assembled plug or RA-IN-XF-DP coupling in combination with a RA-IN-XTR-DP terminating resistor or a prefabricated M12 cable.

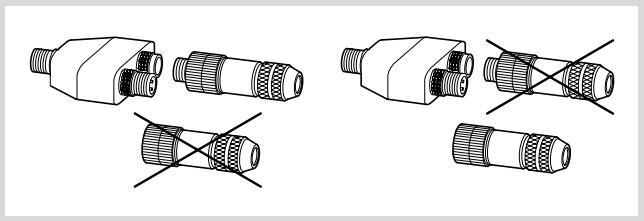


Figure 30: Combination options on RA-IN-XY-DP

as-interface®

▶ Connect the RA-IN unit to the AS-Interface® through the M12 plug.

Connecting the power supply

→ The interface control unit is connected to an external 30 V DC PSU through the supplied power socket. Degree of protection IP65 is achieved only when the unit is fully assembled.

Dimensioning the 30 V supply line
Choose a 30 V DC power supply cable that keeps the voltage drop between PSU and RA-IN as low as possible: a reduced supply voltage at the RA-IN unit can limit the possible cable length of the AS-Interface® run. For information about calculating the voltage drop, see page 12.

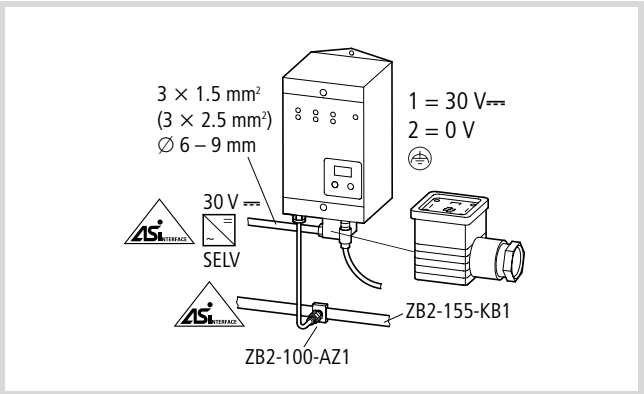


Figure 31: Connection to AS-Interface® and 30 V ⎓

Device operation

Device startup

When you fist switch on the device, all segments of the digital display and all LEDs light up for about one second (self-test). After that, the LEDs indicated the state of the respective flags. The digital display indicates the interface control unit's status.

They have the following meaning:

OFP	offline-phase RA-IN is being initialized; no data exchange through AS-Interface® (see warning note under table). In Engineering mode or automatic start of the AS-Interface®, the unit can leave the offline phase. Accordingly, if PROFIBUS communication is interrupted in protected operation mode, RA-IN changes to offline phase when the watchdog time set on the PROFIBUS master has expired.
SEA	Detection phase Start of startup operation, in which the unit searches for existing slaves. RA-IN remains in detection phase until it detects at least one slave.
42	Activation phase State at the end of detection phase, in which the parameters for all connected and detected AS-Interface® slaves are transmitted. This enables access to the data connections in the AS-Interface® slaves. The activation phase and the start of normal operation can be so short that they are not displayed.
43	Start of normal operation In normal operation RA-IN exchanges data with all active slaves, transmits management messages from and to the host) and searches for or activates newly connected slaves. During normal operation the maximum cycle time of 10 ms for 62 slaves is maintained for reading and writing the AS-Interface® data.

▽ **Caution!**
RA-IN remains in offline phase if the AS-Interface® circuit is not supplied with sufficient voltage ("UAS-i" not lit) or there is no PROFIBUS communication between the PROFIBUS master and the RA-IN.

Engineering mode

Engineering mode is used for configuring the AS-Interface® circuit.

▽ **Caution!**
In engineering mode, all detected slaves are activated even if there are differences between the target and actual configuration.

To set RA-IN into engineering mode, press the Mode key for at least five seconds. In engineering mode the yellow LED prj mode is lit.

On the digital display, all AS-Interface® slaves detected by RA-IN are displayed in ascending order at 0.5 second intervals, starting with the A slaves before the B slaves. blank display indicates that no slave have been detected in the AS-Interface® circuit.

In engineering mode, all detected slaves except for slave 0 are activated. RA-IN is in normal mode. The data exchange on AS-Interface® takes place between the RA-IN and all detected AS-Interface® slaves, regardless of whether or not the latter have already been configured.

▽ **Caution!**
By default, new RA-IN units are supplied with engineering mode selected.

Protected operation mode

→ Unlike in engineering mode, data exchange protected operation mode takes place only between RA-IN and the configured AS-Interface® slaves.

Selecting protected operation mode
To exit engineering mode, press the Mode key.

Press key briefly:
RA-IN changes from engineering mode into protected operation mode without configuring the current actual configuration as target configuration.

Press key for more than 5 s:
RA-IN changes from engineering mode to protected operation mode. At the same time the actual configuration is saved to EEPROM as target configuration.

→ If a slave with address 0 is detected on the AS-Interface®, engineering mode can not be exited!

In protected operation mode only those AS-Interface® slaves that have been configured and whose target configuration corresponds with the actual configuration are activated.

Configuration errors in protected operation mode
If no configuration errors are detected, the digital display is switched off in protected operation mode. Otherwise the address at which an incorrect assignment has been detected is shown. An incorrect assignment means that a slave has been detected or configured but can not be activated.

If more than one incorrect assignment is recognized, the one that was identified first is also displayed first. To view the next highest incorrectly assigned address on the digital display, press the Set key.

Intermittent configuration errors are saved in the device (extended AS-Interface® diagnostics). To view the most recent intermittent configuration error, press the Set key. If the configuration error was caused by an intermittent AS-Interface® power supply failure, a "39" is displayed in this position.

Addressing AS-Interface® slaves in engineering mode

AS-Interface® slave addresses can be assigned with an addressing device.

Alternatively you can conveniently commission AS-Interface® with the operating software AS-i Control Tools from Bihl und Wiedemann.

If there are no aids available, such as a PC or addressing unit, then the addresses can also be input directly on the AS-Interface®-slave devices by means of the pushbuttons. The procedure for this method is described below.

AS-Interface® slave addressing

(assigning an available address to a slave with address 0)

In engineering mode, the addresses of all detected slaves are displayed. To view the next highest unassigned address, briefly press the Set key. To view further unassigned addresses, continue to press the Set key briefly.

To select the currently displayed address as target address, press the Set key for more than five seconds. The displayed address then flashes on the display. RA-IN is in programming mode; to assign the flashing address to a connected slave with address 0, press the Set key again.

If an error occurs, the corresponding error code appears (see section "Digital display", page 32 for explanation of error codes). Otherwise any further unaddressed slaves are displayed in turn, as described under section "Engineering mode", page 30.

▽ **Caution!**
The AS-Interface® circuit must never contain more than one slave with the same AS-Interface® address.

AS-Interface® deleting slave addresses

(assigning address 0 to a known slave)

In engineering mode, the addresses of all detected slaves are displayed. When the Set key is pressed briefly, the master displays the next free address. If the key is pressed for more than five seconds while a known slave is displayed, "00" appears on the display and the currently selected slave's address is reset to 0.

When you release the key again, the display cycles through the detected slaves again.

Addressing AS-Interface® slaves with configuration errors

Automatic addressing

→ One of the great advantages of AS-Interface® is its automatic addresse programming. If a slave fails due to a fault, it can be replaced with another, equivalent slave with address 0. RA-IN detects defective slaves and automatically assigns their address to the replacement unit.

For automatic programming the following conditions must be fulfilled:

- RA-IN must be in protected operation mode.
- The Enable flag Auto_prog 1 must be set.
- There must not be more than one configured slave that is not detected.

→ Automatic addressing is enabled by default.

If these conditions are fulfilled, the LED "prg enable" is lit. As soon as RA-IN detects a slave with address 0, it changes its address to that of the missing slave.

→ The AS-Interface® master can only readdress slaves that have address 0.

▽ **Caution!**
Automatic address programming does not take place if the two slaves contain different configuration data, i.e. do not have the same AS-Interface® design or functionality.

Manual addressing

→ If several slaves fail, the AS-Interface® master can not reprogram them automatically. In that case, the new slaves' addresses must be set manually. This can be done through the interface to the higher-level system, with a hand-held addressing unit or – as described below – with the device's keys and digital display.

In protected operation mode incorrect assignments are displayed as errors (→ section "Configuration errors in protected operation mode", page 30). To view further incorrect assignments, press the Set key. To select the currently displayed address as potential target address, hold the Set key for at least five seconds. The display then begins to flash.

If the faulty slave (flashing address) was first replaced with a slave with address 0, the flashing address can now be assigned to the new slave by briefly pressing the Set key again. A precondition is that the new unit's configuration data correspond with those associated with the flashing address.

Once a slave has been successfully readdressed, the next incorrect assignment is displayed and the process can be repeated. Otherwise an error code (→ section "Digital display", page 32) is displayed. When all incorrect assignments have been corrected, the display is blank.

Setting the PROFIBUS-DP station address

→ The AS-Interface®/PROFIBUS gateway can be addressed according to the PROFIBUS standard as PROFIBUS slave either locally at the gateway or through PROFIBUS.

Station addresses

Station addresses from 1 to 99 can be set. The default station address is "3".

To change the address at the gateway, press the Set and Mode keys at the same time for at least five seconds or until the PROFIBUS address appears on the display. Each additional operation of the Set key increments the station address by one.

When the desired PROFIBUS station address is displayed, press the Mode key to accept it and save it permanently to the EEPROM.

First operation of the AS-Interface® circuit

Example procedure for commissioning an AS-Interface® circuit quickly in six easy steps, regardless of connected equipment. Simply assign addresses to the components connected to the AS-Interface® with the interface control unit. You can usually also configure complex networks directly at the AS-Interface® gateway without additional tools. All further slaves' addresses are assigned in the same way.

Apply correct voltage supply

▶ Connect the interface control unit to a power supply with the correct voltage and switch on the power supply.

Following a self-test, the Power, Error, UASi and prj mode LEDs light up. The display indicates "OFP" (RA-IN is in offline phase). After a brief moment, "SEA" appears (RA-IN remains in detection phase). The yellow prj mode LED is lit.

Change to engineering mode

▶ If the yellow prj mode LED is not lit, press the Mode key for about five seconds.

The yellow prj mode LED is now lit and the device is in engineering mode.

Connect the first slave with address 0

▶ Connect the slave.

The green ASi active LED lights up. The display shows 0, which indicates that the AS-Interface® master has detected the slave.

Change the slave address to 1

▶ Press the Set key several times to select address 1. The next free address is shown with each press.

▶ Press the key until the display shows "1".

▶ Now press and hold the Set key for about five seconds until the displayed address 1 flashes.

Apply the address to the slave by pressing the Set key again briefly. RA-IN recognises the slave with address 1 and displays it.

Connect a second slave with address 0 and assigning address 2

▶ Connect a further AS-Interface® slave to the AS-Interface® line.

To assign addresse to further AS-Interface® slaves, repeat the above procedure. The display now cycles through the addresses of the detected slaves.

Change to protected operation mode and save the AS-Interface® configuration

▶ Exit engineering mode by pressing the Mode key for about five seconds until the prj mode LED goes out.

Configuration of the AS-Interface® master is now completed. You can now take the higher-level fieldbus into operation. The gateway remains in offline phase (display dark, ASi active LED off) until the higher-level fieldbus is operating correctly.

Indicating elements

▽ **Caution!**
For error messages not relating to incorrect assignments in the AS-Interface® circuit, error codes ≧ 50 are displayed, which lie outside the value range for slave addresses. These codes are described in section "Digital display", page 32.

Display and control unit

programming button	meaning
mode	Changeover between engineering mode and protected operation mode, and saving the current AS-Interface® configuration as target configuration
set	Selection and setting of addresses for AS-Interface® slaves

Digital display

In the basic state in engineering mode, the addresses of all detected AS-Interface® slaves are displayed at a rate of two per second. A blank display indicates a blank LDS (**l**ist of **d**etected **s**laves), i.e. no slaves were detected.

In the basic state in protected operation mode the display is blank or shows an incorrectly assigned address (→ section "Configuration errors in protected operation mode", page 30).

During manual address programming the slave address display has a different meaning (→ section "Addressing AS-Interface® slaves in engineering mode" on page 30 and section "Addressing AS-Interface® slaves with configuration errors" on page 31).

→ All displayed values above 31 (the highest possible slave address) are status or error messages from the device.

The displayed values have the following meanings:

Display	meaning
39	Extended AS-Interface® diagnostics: If "39" appears after pressing the Set key, an intermittent voltage breakdown has occurred on the AS-Interface®.
OFP	RA-IN is in offline phase.
SEA	RA-IN is in detection phase.
42	RA-IN is in activation phase.
43	RA-IN is starting normal operation.
E70	Hardware fault: Unable to write to the RA-IN EEPROM.
E72	Hardware fault: No connection to PIC processor
E73	Hardware fault: No connection to PIC processor
E74	Checksum error in EEPROM
E75	Error in internal RAM
E76	Error in external RAM
E80	Error when leaving configuration mode: A slave with address 0 was found.
E81	General error when changing a slave address
E82	Key operation is locked. Until the AS-Interface® master is restarted, the device can be accessed only from the host through the interface.
E83	AS-Interface® control program reset: The AS-Interface® control program is being read out of the EEPROM and copied to RAM.
E88	Dosplay test on AS-Interface® master startup
E90	Error on changing a slave address in protected operation mode: No slave with address 0 was found.
E91	Error on changing a slave address: The target address is already allocated.
E92	Error when changing a slave address: Unable to set the new address.
E93	Error when changing a slave address: The new address was saved only to the slave's temporary memory.
E94	Error on changing a slave address in protected operation mode: The slave contains incorrect configuration data.
E95	Error on changing a slave address in protected operation mode: An excessive slave (not a missing slave) has caused a configuration error.

Diagnose and status via LEDs

LED	colour	meaning	no signal	flashes	signal
AS-Interface® Power	green	The master has sufficient voltage	No voltage	–	Voltage applied
AS-Interface® Error	red	Configuration error: At least one configured slave is missing or the actual configuration of at least one configured and detected slave does not match the target configuration. If both configuration and I/O errors are present, only the configuration error is displayed.	no fault	I/O error at at least one AS-Interface® slave	Communication error, e.g. slave has no address
UASi	green	AS-Interface® circuit has sufficient voltage	No voltage	–	Voltage supply sufficient
prj mode	yellow	RA-IN is in engineering mode	Operation mode	–	Engineering mode
prg enable	green	Automatic address programming is possible. In protected operation mode exactly one slave is missing. This can be replaced with an equivalent slave with address 0. The master automatically assigns an address to the new slave, which cancels the configuration error.	Operation mode	–	Address programming possible
ASi active	green	Normal operation is active	No connection with AS-Interface®	Display of B-slaves	normal operation
PROFIBUS	green	Assignment to RA-IN	RA-IN is not assigned to a PROFIBUS master	–	RA-IN is assigned to a PROFIBUS master

Extended diagnostics of RA-IN

Extended diagnostics are used to localise intermittent configuration errors and assessing the data transfer quality through the AS-Interface®.

List of AS-Interface® slaves that have triggered configuration errors (LCS)

To diagnose the causes of intermittent configuration errors on the AS-Interface®, AS-Interface® masters with extended diagnostic functionality maintain an additional **l**ist of **c**orrupted **s**laves (LCS) that have caused a configuration error in addition to the list of projected slaves (LPS), the list of detected slaves (LDS) and the list of active slaves (LAS). This list contains all AS-Interface® slaves that have caused at least one intermittent configuration error since the last time this list was read or the AS-Interface® masters was started up. In addition, the list contains any intermittent voltage drops at the AS-Interface®, which are shown under slave address 0.

→ With each read operation the LCS is cleared again.

→ The most recent intermittent configuration error can also be viewed on the AS-Interface® master's ´display:

To view the slave responsible for the last intermittent configuration error on the AS-Interface® master's display, press the Set key. An intermittent voltage drop on the AS-Interface® is indicated by a "39" on the display when the Set key is pressed.

For this function the device must be in normal operation in protected operation mode (display is blank) or in offline phase (display shows "OFP").

Telegram transmission error counter

The RA-IN with extended diagnostics provides an error counter for each AS-Interface® slave, which increments with each incorrectly transmitted AS-Interface® telegram. This allows a detection of transmission quality problems even when only occasional telegrams are corrupted without triggering an AS-Interface® slave configuration error.

→ The counter values are read through the corresponding host interface and reset with each read access. The highest valid current count is 254. A count of 255 indicates a counter overflow.

Offline phase on configuration errors

The RA-IN with extended diagnostics can be configured to automatically go into the offline phase in the event of a configuration error to set the AS-Interface® network into a safe state. This allows a faster response to configuration errors and the task does not have to be performed by the host.

Parameterising the AS-Interface® master for this function:

With every configuration error on the AS-Interface® the AS-Interface® master changes from normal operation in protected operation mode to offline phase.
A list of slaves that can trigger offline phase following a configuration error is defined (LOS, **l**ist of **o**ffline **s**laves). You can decide yourself, how the RA-IN reacts to a configuration error on the AS-Interface®. For critical AS-Interface® slaves, for example, the master can be set to offline phase immediately while less critical slaves can send a Configuration Error message to the host without setting AS-Interface® offline.

PROFIBUS-DP

For information about using RA-IN in a PROFIBUS network, see manual "CM4-505-GV1/-GV2, AS-i-/PROFIBUS Gateways" (AWB2700-1409G). You can download this manual as a PDF file from:
http://www.moeller.net/support , search term: AWB2700-1409GB.

3 Incoming circuit-breaker RA-DI

Device overview

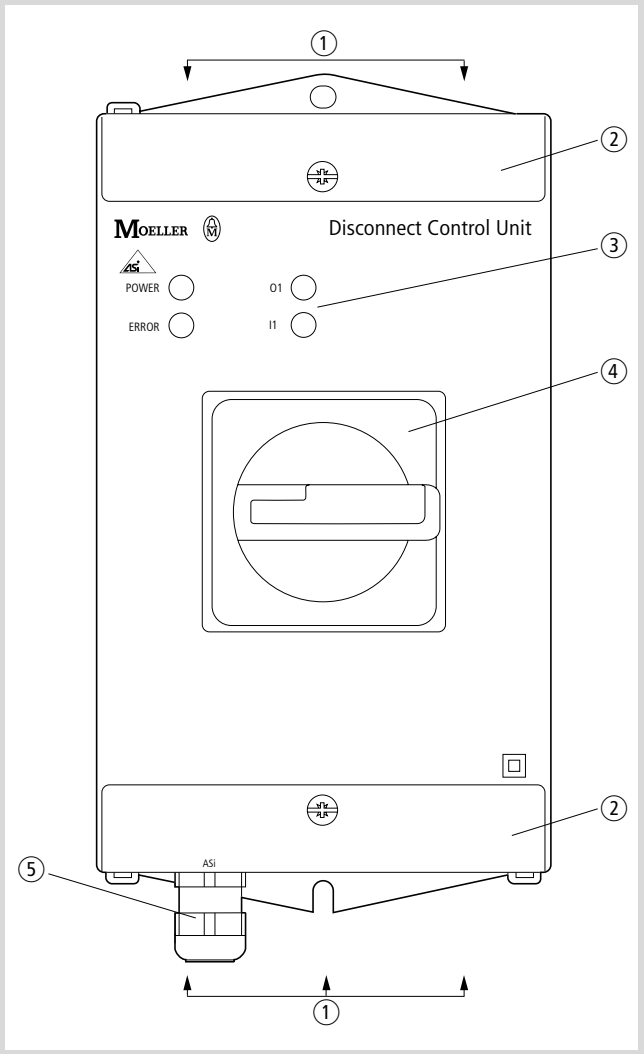


Figure 32: Overview RA-DI

① Cable entry, M20 and M25 cable glands
② Space for labelling top and bottom
③ Status and diagnostic LEDs
④ Lockable rotary handle H-PKZ2
⑤ With AS-Interface® supply cable, approx. 0,5 m with M12 plug

Key to part numbers

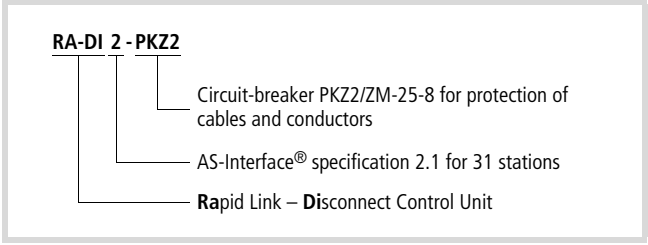


Figure 33: Key to part numbers for RA-DI

Proper use

The Disconnect Control Unit is used as a main switch and for selectively disconnecting individual sections of a materials handling system. It combines the functions of main switch, maintenance switch and cable protection device in one. It is ideal for protecting several starters and long lines by allowing the tripping currents to be set as required for the plant.

Warning! Rapid Link must be operated only on 400V-three-phase systems with earthed star point and separate N and PE conductors (TN-S network). It must not be operated unearthed.

The power supply unit for the 24 V DC supply must be earthed on its output side and meet the safe isolation requirements to IEC/EN 60958 (PELV).

Any other usage constitutes improper use.

Caution!
The disconnect control unit must be taken into operation only in combination with this manual.

Functions overview RA-DI

	Basic functions RA-DI	→ Page
Power incomer	Knockout plate for cable entry with M20 and M25 cable glands Unit power supply via round cable up to 6 mm² Busbar supply with 7 × 2.5/4 mm² round cable	42
Line protection	Line overload and short-circuit protection to IEC/EN 60947-2 and DIN VDE 0100 part 430 Rated operational current: 16 to 25 A (factory default: 20 A)	
Short-circuit protective device for motor starter	Short-circuit protctive device for motor starter (groups) RA-MO to IEC/EN 60947-4-1, type "1" coordination, short-circuit tripping current: 130 A to 210 A (factory default: 130 A)	39
Main and maintenance switches	Power disconnecting device with lockable handle to IEC/EN 60947-1	39
Communication	AS-Interface® slave specification 2.1 for 31 stations	41
Display	Differentiated diagnostics LEDs: States, Power, Error Signalling of switch position via AS-Interface ®	43

Engineering

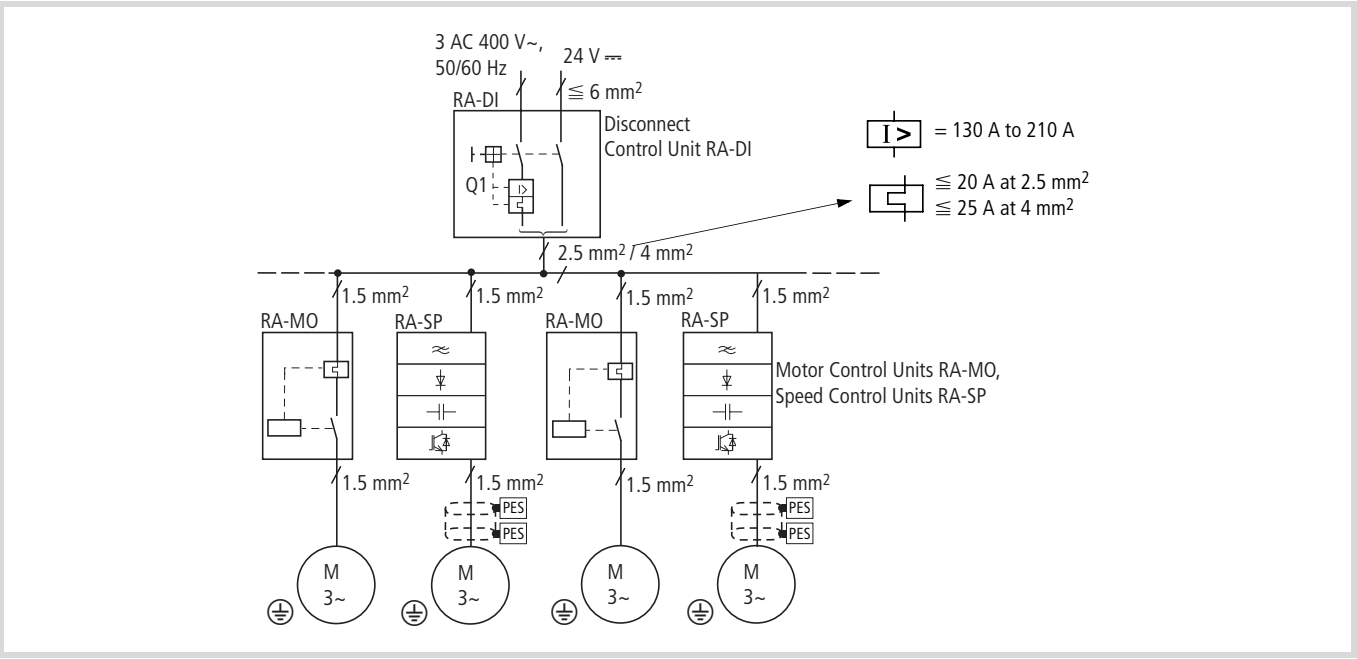


Figure 34: Example arrangement, Rapid Link system with RA-DI, RA-MO and RA-SP

Settings on the device

Response value of non-delayed short-circuit release

- I_{rm} = 130 A (minimum mark, factory default)
- I_{rm} = 210 A (maximum mark)

Setting of overload release

- I_r = 20 A for 1 cable cross-section 2.5 mm^2
- I_r = 20 to 25 A for 1 cable cross-section 4 mm^2

With these settings the requirements of the following standards are fulfilled:

- IEC/EN 60947-4-1, type "1" coordination with motor control unit RA-MO
- DIN VDE 0100 Part 430.

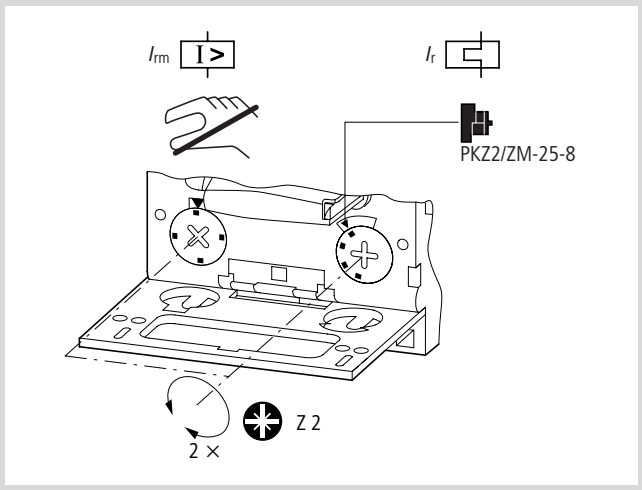


Figure 35: Settings on the device

Core insulation

The core insulation of all used conductors must be laid out for the highest operational voltage occurring in the unit.

Safe isolation

To ensure safe PELV isolation between voltages 24 V ⎓ and 400 V ~ of the control and main circuits and the AS-Interface® voltage, use only the correct provided connections.

For additional protection against loosening of cables, fit the cover plate (→ figure 41 on Page 42).

Accessories

Metric cable glands M20 (V-M20) and M25 (V-M25).

Information to EMC

For information about EMC, see the following sections of this manual.

Installation

Mounting position

The device is preferably installed vertically but can also be fitted in the positions shown in the illustration.

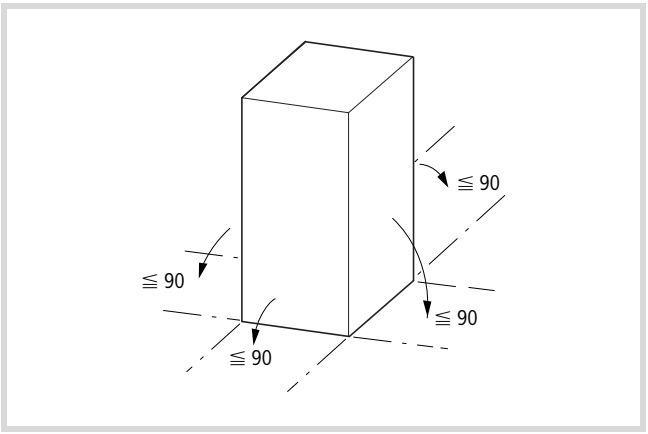


Figure 36: Mounting position

Design

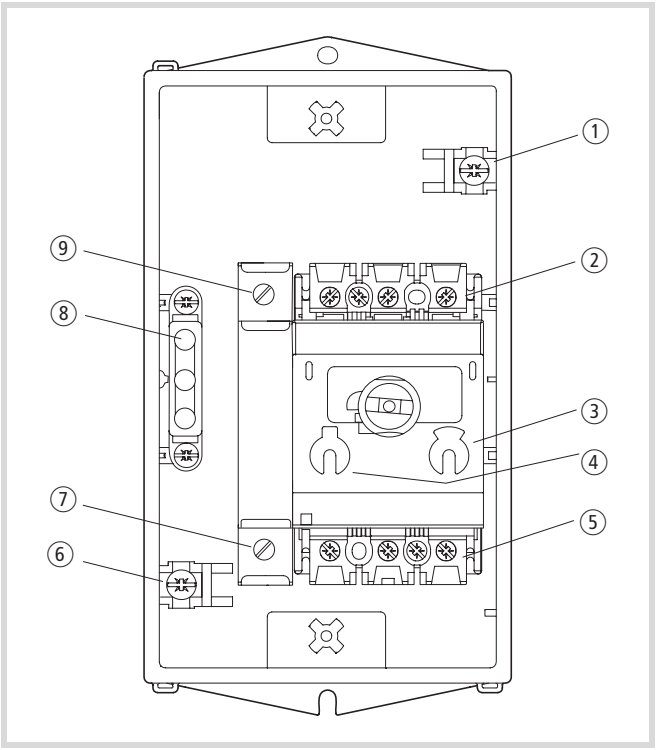


Figure 37: Design (internal view)

① N, tightening torque 2 Nm
② L1, L2, L3, tightening torque 1.8 Nm, to 6 mm²
③ overload release I_r
④ I> short-circuit release I_{rm}
⑤ T1, T2, T3, tightening torque 1.8 Nm, to 6 mm²
⑥ PE, tightening torque 2 Nm
⑦ 24 V DC standard auxiliary contact NHI11, contact 1.14, tightening torque 1 Nm, for conductor cross-sections > 2.5 mm² use with supplied pin-end connector
⑧ 0 V terminal (K10/1) for 1.5 to 6 mm², tightening torque 0.8 Nm
⑨ 24 V DC standard auxiliary contact NHI11, contact 1.13, tightening torque 1 Nm (for conductor cross-sections > 2.5 mm² use with supplied pin-end connector)

Wiring and connections

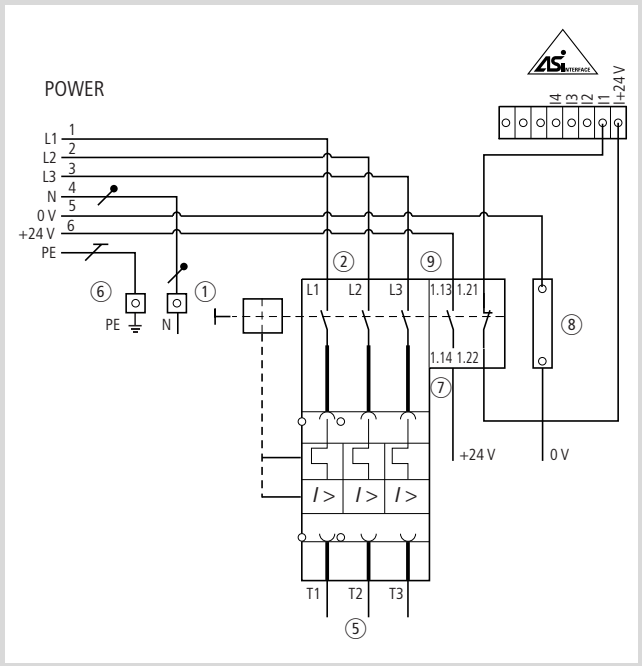


Figure 38: Wiring of disconnect control unit (for legend, see figure 37)

AS-Interface® connection

Connection through plug M12

PIN	Function
1	ASi+
2	–
3	ASi–
4	–

Before establishing the connection to AS-Interface®, you can assign the AS-Interface® address through plug M12 with an addressing device, → page 17.

Mounting

- ▶ Unscrew the cover of the disconnect control unit RA-DI and disconnect the AS-Interface® plug from the circuit-board.
- ▶ Open the required knockout and insert and tighten cable gland V-M20 or V-M25.
- ▶ Secure the bottom section with two M5 screws (see fig. 39).
- ▶ Remove the cover plate.
- ▶ Feed a 7 × 2.5 or 7 × 4 mm² round cable (T1, T2, T3, N, PE, 24 V, 0 V) in to the busbar, fit the connectors and connect it as shown in figure 38.
- ▶ Fed the round cable(s) 5 × 2.5/4/6 mm² (L1, L2, L3, N, PE) and 2 × 2.5/4/6 mm² (24 V, 0 V) or alternatively 7 × 2.5/4 mm² (L1, L2, L3, N, PE, 24 V, 0 V) in to the busbar, fit the connectors and connect them as shown in figure 38.
- ▶ For additional protection of AS-Interface® from loosened cables, fit the cover plate. The procedure is described in fig. 41.
- ▶ Fit the plug in the AS-Interface® circuit-board.
- ▶ Close the cover and secure it with the screws.

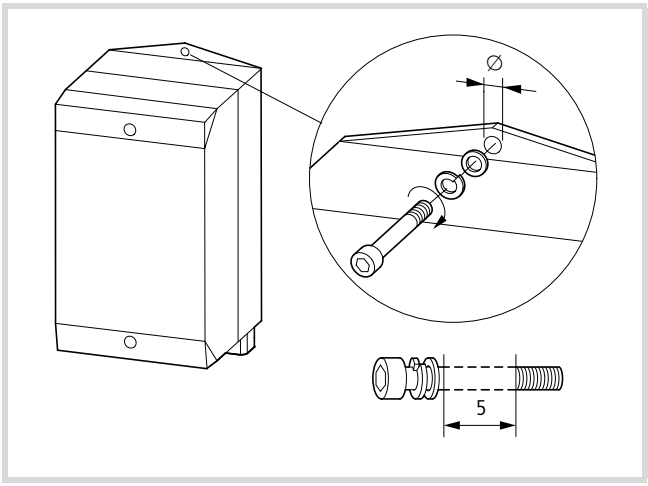


Figure 39: Mounting

∅ [mm]	Thread	Torque [Nm]
5,5	M5	3

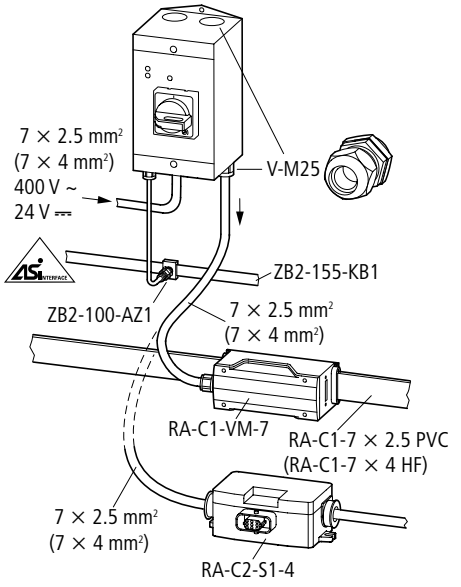


Figure 40: Connection to AS-Interface® and busbar (optionally through ribbon cable RA-C1 or round cable RA-C2)

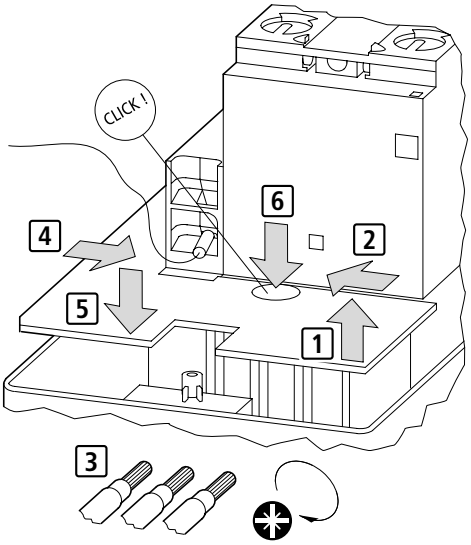


Figure 41: For additional protection of AS-Interface® from loosened cables, fit the cover plate (on).

→ For connecting conductors ≧ 4 mm² to terminals 1.13/ 1.14, suitable pin-end connectors are supplied.

Device operation

Switch on

Before commissioning, all cables of the Rapid Link busbar, the external power supply and the der AS-Interface® must be connected and the cable ends safely insulated. The enclosure must be firmly secured with the screws.

The rotary handle is lockable in position 0 with up to three padlocks.

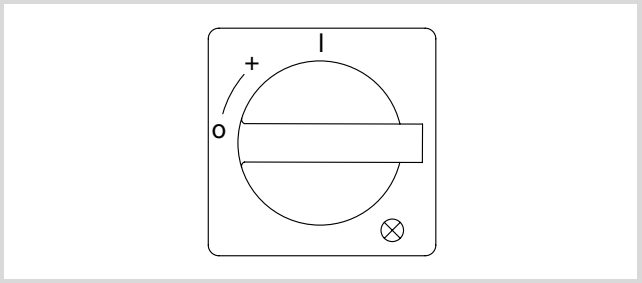


Figure 42: Rotary handle in position 0

After tripping through overload or short-circuit, the switch jumps from I to Trip.

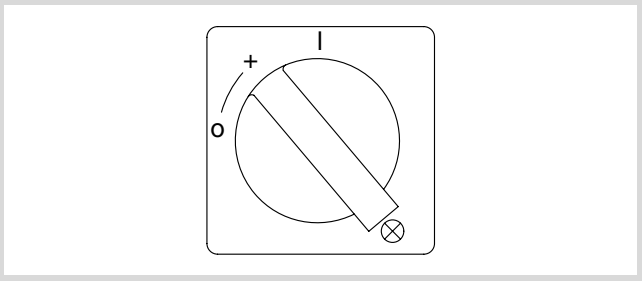


Figure 43: Rotary handle in Trip position

Danger!
When the switch is in Trip position, it must be switched on again only when the cause of tripping has been rectified! Restarting is possible only via switch position 0.

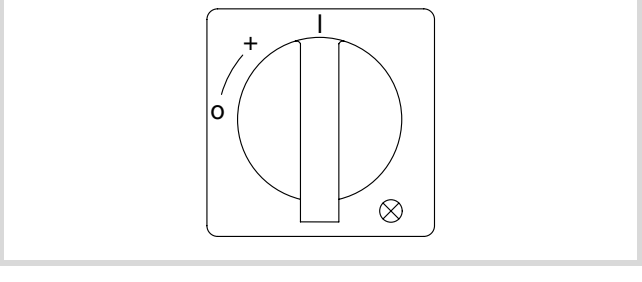


Figure 44: Rotary handle in position 1

Diagnose and status via LEDs

LED	Colour	Meaning	no signal	Signal	Data Bit
AS-Interface® Power	green	AS-Interface®-voltage	No voltage	Voltage applied	–
AS-Interface® Error	red	AS-Interface®-fault	no fault	Communications fault, e.g. slave not addressed	–
Q1	green	Signal LED, can be actuated by PLC.	not actuated	actuated	DO0
I1	green	Switch position	Switch On (I)	Switch in position 0 or Trip	DI0

4 Motor starter RA-MO (to Version 2.x)

Device overview

→ From version 2.x, motor starter RA-MO provides additional functionality over version 1.x. The new functions are indicated. Your device's version number is printed on the nameplate, → page 19.

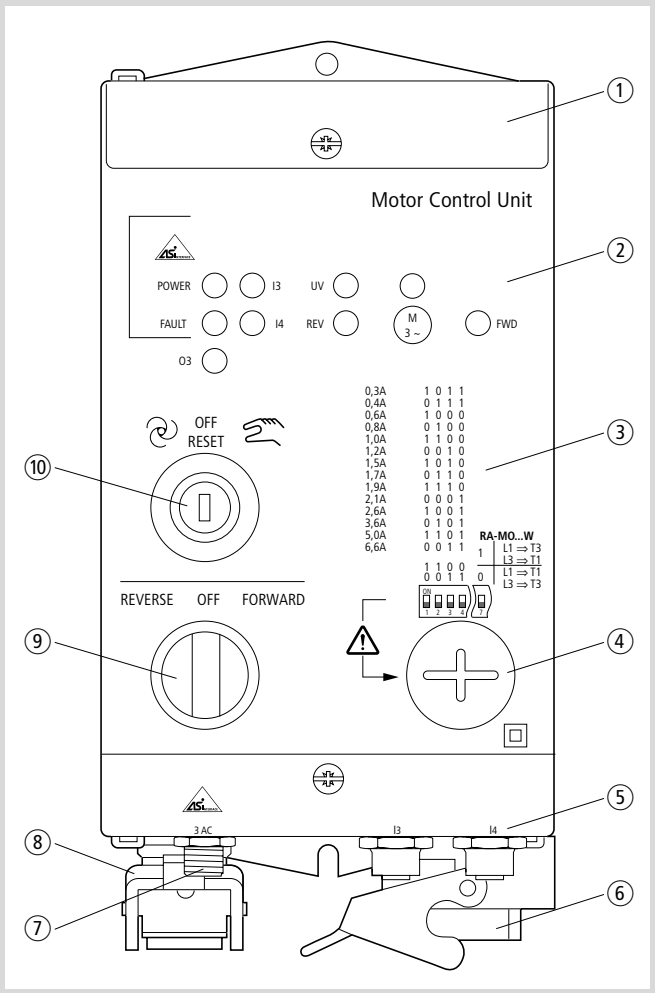


Figure 45: Overview RA-MO (here: RA-MO2.1.../C3A)

① Space for labelling top and bottom
② Status and diagnostic LEDs
③ Lasering: Assignment of DIP switch position to motor protection values
④ Locking screw: Configuration and parameterization with DIP switch
⑤ For version RA-MO…4, two additional inputs through M12 for external sensors. For version RA-MO…4A… one additional output through M12 for external actuators (from version 2.x).
⑥ Motor output plug for motor cable SET-M3/…
⑦ AS-Interface® connection with M12 prefabricated cable (approx. 0.5 m) or M12 plugs for fitting by user
⑧ Power bus connection with prefabricated cable 7 × 1.5 mm² (approx. 1.45 m incl. plug) or user-assembled power plug for fitting by user (5-pole)
⑨ Selector switch for clockwise and anticlockwise operation
⑩ Key-switch for manual and automatic mode

Key to part numbers

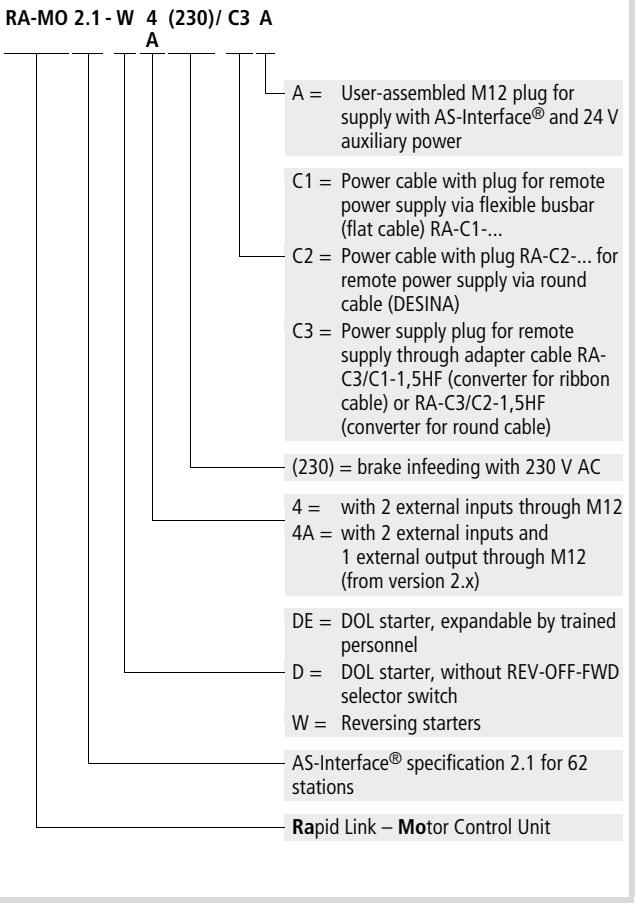


Figure 46: Key to part numbers RA-MO

Proper use

The Motor Control Unit RA-MO is an electrical apparatus for controlling drives with constant-speed three-phase motors. It is designed for installation in machines or for use in combination with other components within a machine or system.

After installation in a machine, the RA-MO must not be taken into operation until the associated machine has been confirmed to comply with the safety requirements of Machinery Safety Directive (MSD) 89/392/EEC. The user of the equipment is responsible for ensuring that the machine use complies with the relevant EU Directives.

The CE markings confirm that, when used in a typical drive configuration, the apparatus complies with the European Low Voltage Directive (LVD) and the EMC Directives (Directive 73/23/EEC, as amended by 93/68/EEC and Directive 89/336/EEC, as amended by 93/68/EEC).

Observe the technical data and terminal requirements. For additional information, refer to the equipment nameplate or label and the documentation.

Any other usage constitutes improper use.

Caution!

The Motor Control Unit must be operated only in combination with this user manual.

Caution!

Rapid Link must be operated only on 400/480 V three-phase systems with earthed star point and separate N and PE conductors (TN-S network). It must not be operated unearthed.

The motor control unit protects the motor against overload but not against short-circuiting. For short-circuit protection (of one or a group of RA-MO units) a short-circuit protective device according to IEC 60364-4-43, → section "Incoming supply 400 V AC" on page 13. Following a short circuit (not overload) the complete affected motor starter must be replaced.

The devices must be opened only in a de-energized state:

- Key-switch in "OFF" position
- Pull power supply plug and secure against reconnection.
- Pull motor plug and plug M12.

Do not touch the electronics in the cover! They are protected with a cover.

Engineering

Functions overview RA-DIMO

	Basic functions	→ Page
Communication	• AS-Interface® connection, specification 2.1 for 62 stations • Reading a detailed diagnostics status through the AS-Interface® parameter channel (from version 2.x)	20 59
Motor protection	Electronic motor protection • V1.x: from 0.18 to 2.2 kW • V2.x: from 0.09 to 3 kW	46
Parameterization	Defining the current ranges through DIP switches	60
Auto configuration on replacement	Automatic transmission of slave address on replacement of RA-MO during running operation.	
Variants	DOL starter, expandable DOL starter, reversing starter[1)], each for flexible busbar and round cable	54
Monitoring	Thermistor monitoring PTC and Thermoclick	53
Braking	Brake actuation through AC 3 switching contact (230/400 V)	53
Phase reversal	Configurable: clockwise or anticlockwise operation through DIP switch	57
Mounting	Plug-in connections	13
Display	Separate status and diagnostic LEDs	65
Manual mode	AUTO-OFF-HAND with key-switch, commissioning without higher-level control possible, actuation of direction(s) of rotation with REV-OFF-FWD selector switch for RA-MO…DE… and RA-MO…W…	57, 56
External inputs	Connection of two light barriers, sensors or limit switches through two M12 sockets. Additional functions: Interlocked manual operation and quick stop	57
external output (from Version 2.x)	Connection of a 24 V consumer, such as lamp or, solenoid valve in addition to the external inputs	
Motor connection	Pluggable, pin assignment to DESINA specification	52
Safety switch-off	According to cat. 2 to EN 954-1 by group	55

1) The reversing starter interlock is implemented in the processor through firmware and with mechanical interlock MV-DILE. The mechanical interlock prevents switching on of one contactor when the other is closed without actuation signal (welded or stuck in closed position).

I/O assignment

Data Bit	I/O	Meaning
DI0	I1	Automatic mode/Ready signal
		0: Not ready for automatic operation
		1: Ready for automatic operation
DI1	I2	Group error, see table on page 65, keyword "Motor"
		0: Fault
		1: no fault
DI2	I3	external input via M12 socket
DI3	I4	0: no signal
		1: Signal applied
DO0	O1	Main contactor
		0: not actuated
		1: actuated
DO1	O2	Reversing contactor
		0: not actuated
		1: actuated
DO0 + DO1	O1 + O2	Reset
		0: no Reset
		1: Reset
DO2	O3	Free LED signal or – from version 2.x – external output through M12 socket
		0: no signal
		1: Signal applied

Sensor connection through M12 (RA-MO…4…)

The sensor connection cables for inputs I3 and I4 must not be longer than 20 m each. The sensors are supplied through the AS-Interface®. Do not connect capacitive sensors. The sensors' total power consumption must not exceed 160 mA. The power supply is short-circuit proof. On overload or short circuit the RA-MO generates a group fault message.

Actuator connection through M12 (RA-MO…4A…)

The connection cable for output 03 must not be longer than 20 m. The actuator is supplied by the power bus with 24 V DC. The current consumption must not exceed 1 A. Output 03 is short-circuit proof. On overload or short circuit the RA-MO generates a group error message and switches off the power for output 03. Once the fault has been rectified, you can issue a Reset command.

Motor cable/motor plug

If user-assembled motor connection plugs are fitted, the motor cable for motor control unit RA-MO must not be longer than 25 m.

Selection of short-circuit devices

→ section "Incoming supply 400 V AC" on page 13.

Cable routing

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

Do not lay the control and signal lines directly adjacent to mains or motor cables. Avoid laying them in a common cable duct and do not bundle them with cable ties.

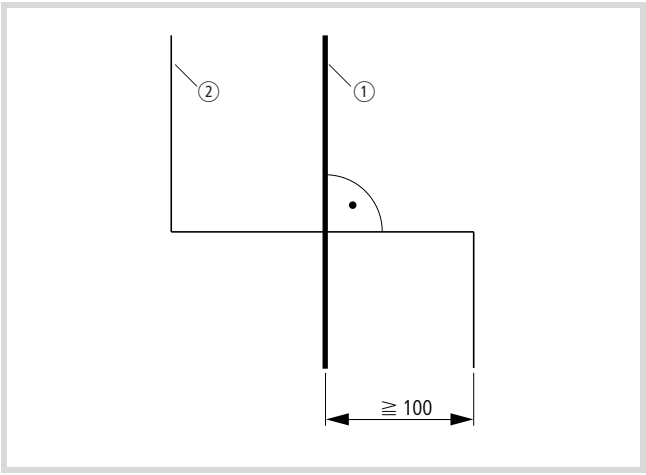


Figure 47: Crossover of signal and power cables

① Power cable: Mains connection, motor cable
② Control cable: AS-Interface®

Accessories

- Motor cable SET-M3/…-HF with assembled, halogen-free cable, 2/3/5/10 m.
- Lock shackle SET-M-LOCK for motor cables SET-M3… (→ page 152).
- Motor connection plug SET-M3-A for user assembly, cable length ≦ 25 m
- Adapter cables for power supply through ribbon or round cable RA-C3/C…-1,5HF
- Power plug RA-C3-PLF for user assembly for motor starter RA-MO…/C3A
- Spare key for key-switch M22-ES-MS1.
- Conversion accessories, from the expandable DOL starter to the reversing starter (→ page 54).

Installation

Mounting position

The device is preferably installed vertically but can also be fitted in the positions shown.

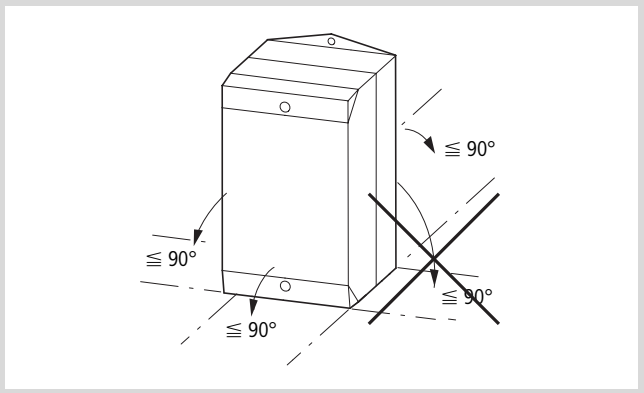


Figure 48: Mounting position

Caution!
Do not fit the unit rotated 90° to the right.

Mounting

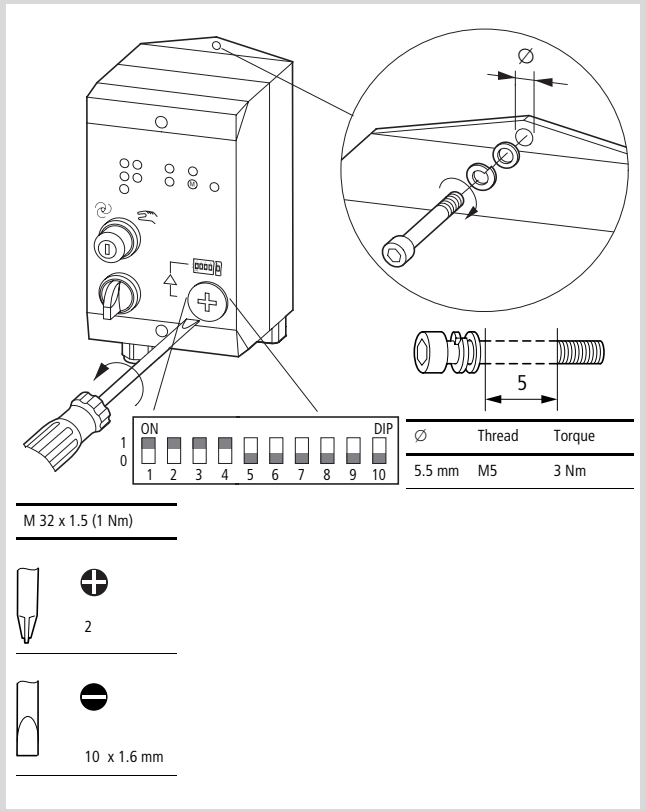


Figure 49: Mounting

Connections

Motor control unit RA-MO is supplied ready for connection. It allows the direct operation of a 400 V 3AC motor without special technical knowledge.

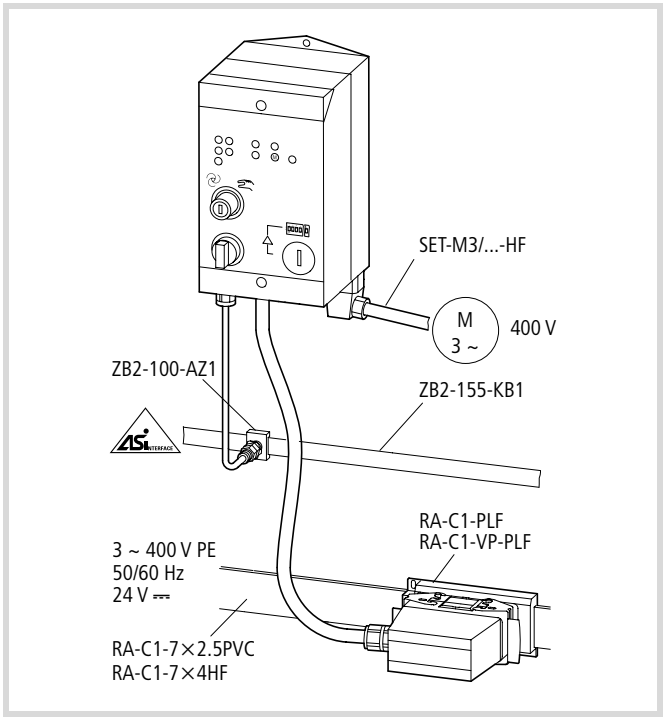


Figure 50: Mounting example RA-MO2.1.../C1

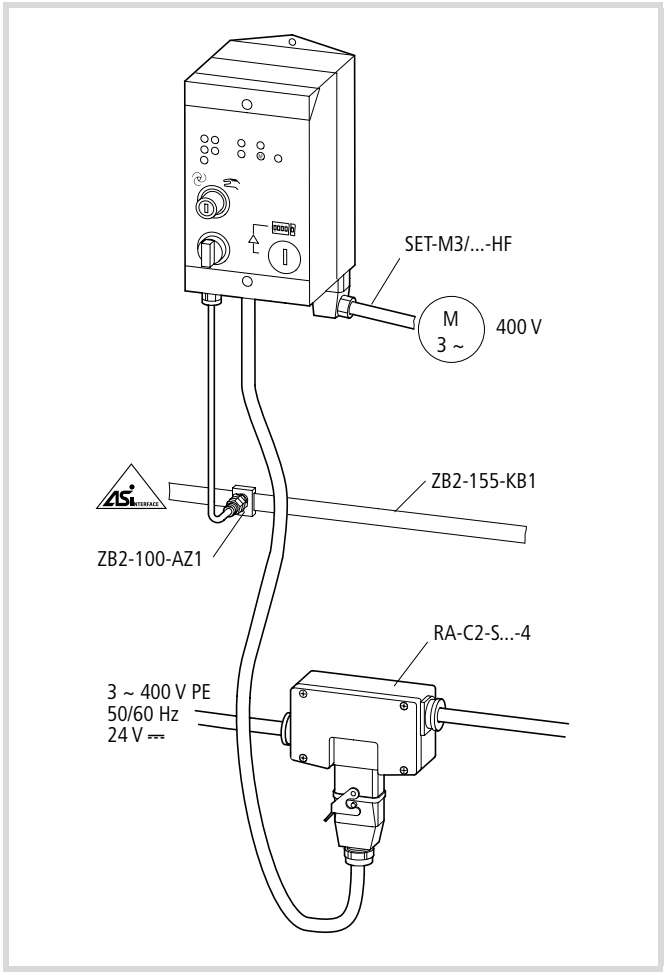


Figure 51: Mounting example RA-MO2.1.../C2

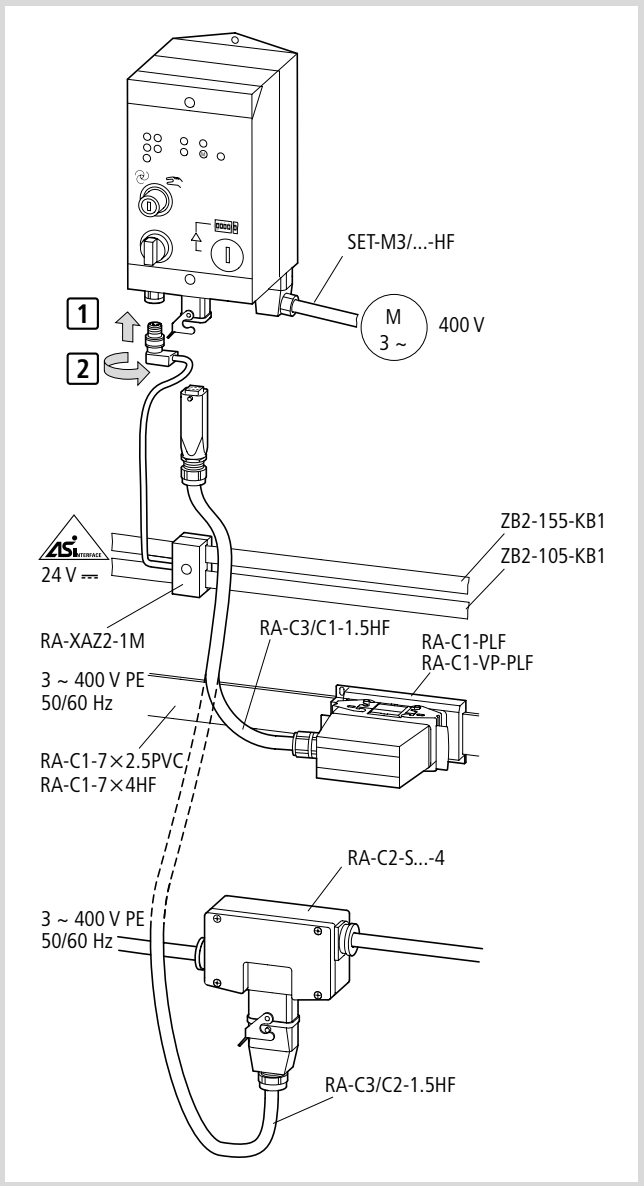


Figure 52: Mounting example RA-MO2.1.../C3A

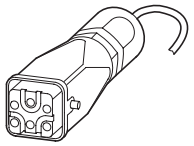
Connecting the power supply

Terminations → section "Power bus" on page 13.

Part no.	Connection types
RA-MO…/C1	Mains incomer (L1-L2-L3-N-PE-24V-0V) with plug for flexible busbar (**flat** cable) junction RA-C1-VP-PLF or RA-C1-PLF
RA-MO…/C2	Mains incomer (L1-L2-L3-N-PE-24V-0V) with plug for **round** cable junction RA-C2-S…-4
RA-MO…/C3	Power supply plug with L1-L2-L3-N-PE for the adapter cables to ribbon- or round cable
RA-MO…/C…A	The 24 V are supplied together with AS-Interface® through the user-assembled M12 plug

Table 1: Pin assignment of power plug RA-MO…/C3… (model HAN Q5/0)

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



AS-Interface® connection

Connection through cable with M12 plugs

PIN	Function
1	ASi+
2	–
3	ASi–
4	–

Connecting AS-Interface® and 24 V (RA-MO…/C…A)

Connection through user-assembled plug M12

PIN	Function
1	ASi+
2	0 V
3	ASi–
4	24 V

Before establishing the connection to AS-Interface®, you can assign the AS-Interface® address through plug M12 with an addressing device, → page 17.

Connecting sensor and actuator

RA-MO provides an M12 socket for two sensors and, optionally, one actuator.

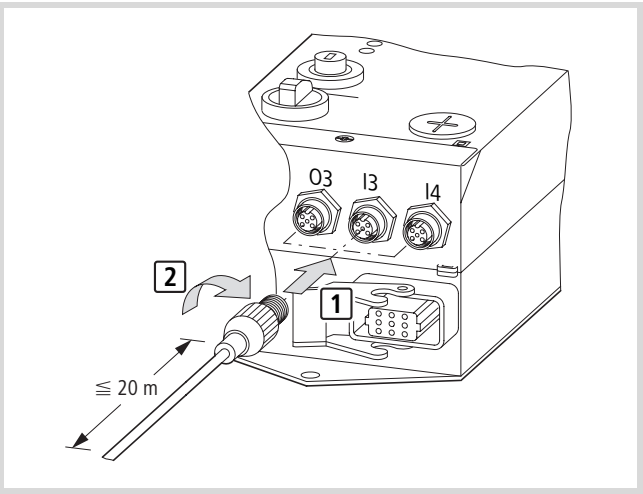
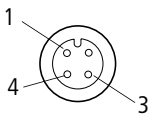


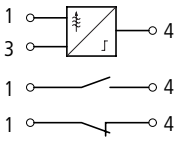
Figure 53: Connection sockets for sensors and actuators

M12 	I3	I4	O3
RA-MO2.1…2…	–	–	–
RA-MO2.1…4…	×	×	–
RA-MO2.1…4A…	×	×	×



„A"-coded (IEC/EN 60947-5-2)
1 = brown
3 = blue
4 = black

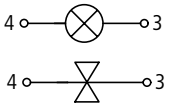
I3 + I4	
1	L+
3	L–
4	I

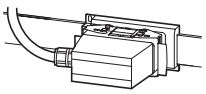


24 V ⎓ Σ I ≦ 160 mA

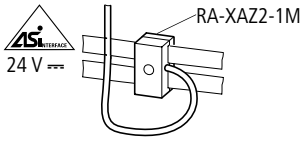
On M12 sockets I3 and I4 with visible nut, pin 2 is not assigned. On M12 sockets I3 and I4 without visible nuts, pins 2 and 4 are bridged.

O3	
1	–
2	–
3	0 V
4	⎍





24 V ⎓ I ≦ 1.0 A



Motor connection

On the RA-MO the motor feeder features a plastic-encapsulated socket. The length of the motor cable is limited to 25 m.

The motor is connected through motor cable SET-M3/…-HF, 8 × 1.5 m^2, 2 – 10 m, unscreened, DESINA-conformant.

Alternatively you can assemble your own motor supply cable with plug SET-M3-A with 8 x 1.5 mm2 contacts

Pin on motor outgoer plug	Core No. Motor cable	Function on motor
1	1	L1 (U1)
2	–	Coding adapter
3	3	L3 (W1)
4	5	Brake ~
5	6	Thermistor 1
6	4	Brake 230 V ~/400 V ~
7	2	L2 (V1)
8	7	Thermistor 2
PE	*	PE

Pin assignment to DESINA specification → page 24

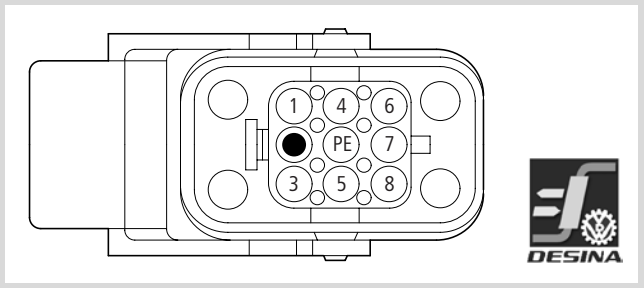


Figure 54: Pin assignment at motor output socket (DESINA)

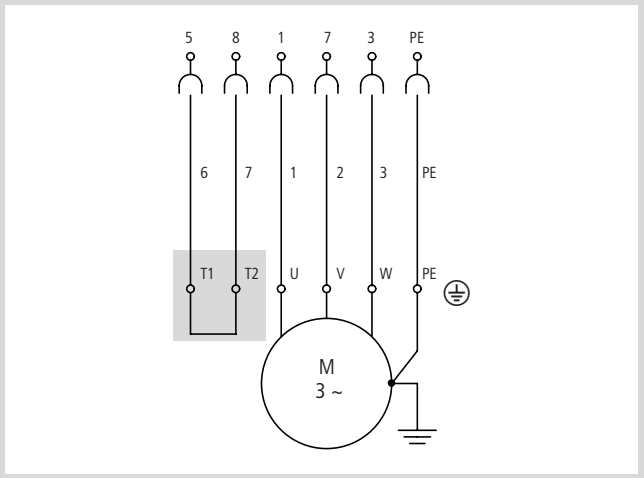


Figure 55: Motor connection without thermistor

→ If motors are connected without PTC thermistor (thermoclick), cables 6 and 7 must be linked at the motor.

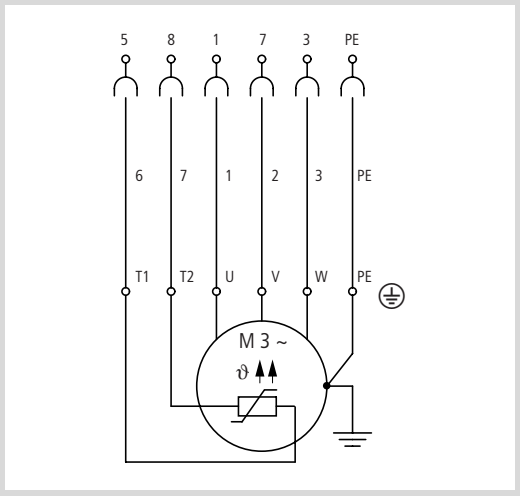


Figure 56: Motor connection with thermistor

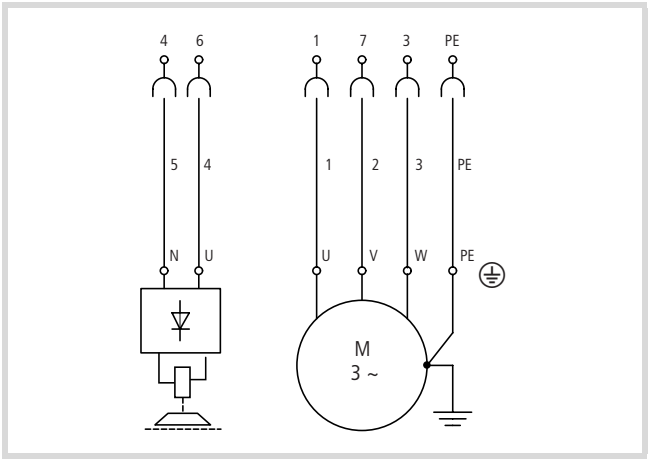


Figure 57: Connection of a 230 V AC brake for RA-MO…4(230)/…

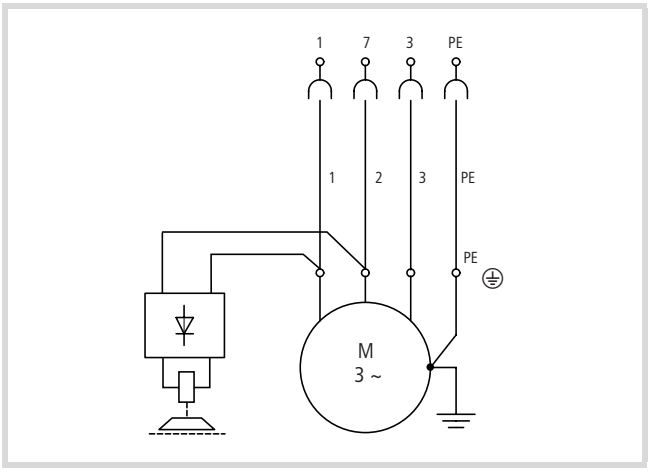


Figure 58: Connection of a 400-V-AC brake

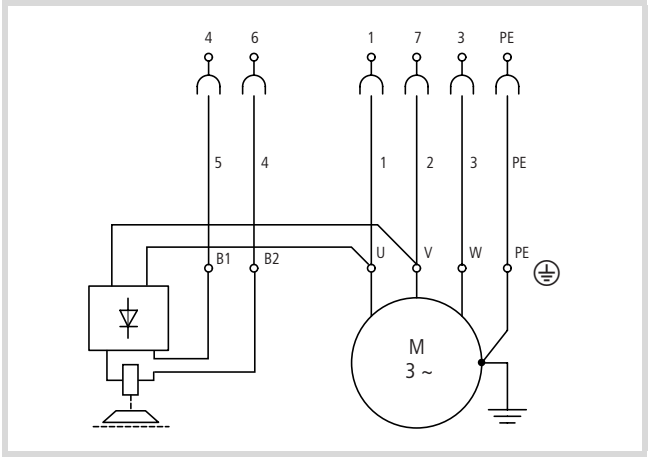


Figure 59: Connection of a 400 V AC brake with rapid braking

For controlling braking motors, their manufacturers provide braking rectifiers, which are fitted in the motor terminal strip. If the DC circuit (→ fig. 59) is opened at the same time, the voltage at the braking coil drops off much quicker, causing the motor to also brake more quickly.

Conversion of DOL starter RA-MO…DE… into a reversing starter

The DOL starter RA-MO…DE… can be converted into a reversing starter. The selector switch for reverse operation in manual control mode is already fitted.

Danger!
Conversion must be performed only by trained electricians. Incorrect work causes a risk of death through electric shock.

Conversion accessories

- Reversing contactor DILEM4-G(24VDC)
- Mechanical interlock MVDILE
- Reversing starter wiring kit MVS-WB-EM
- Connection strands for brake contact, length 90 mm, cross-section 1.5 mm^2

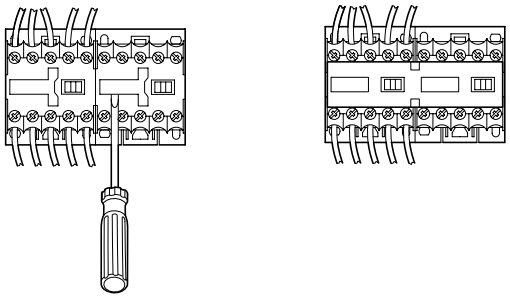
Conversion steps

▶ Disconnect the device from its power supply.

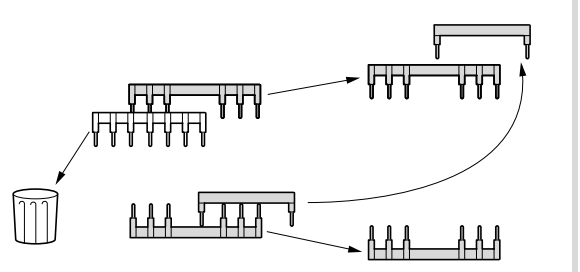
Warning!
Open the devices only in a de-energized state:

- Key-switch in "OFF" position
- Pull power supply plug and secure against reconnection.
- Pull motor plug and plug M12.

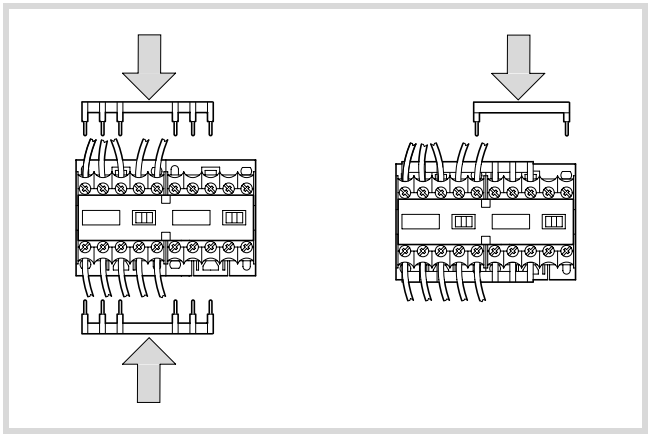
▶ Fit the reversing contactor and remove the marking labels.
▶ Fit the mechanical interlock.



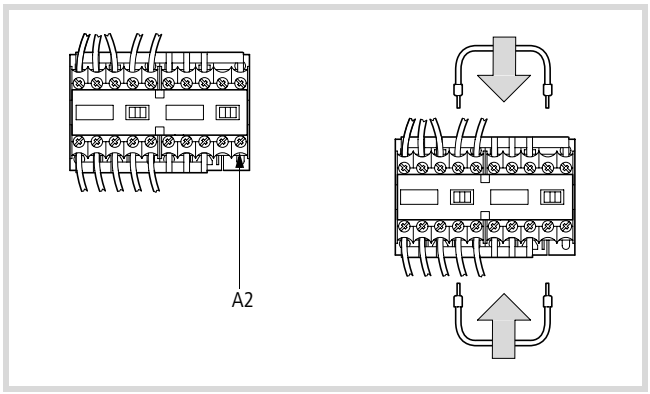
▶ Prepare the reversing starter wiring kit.



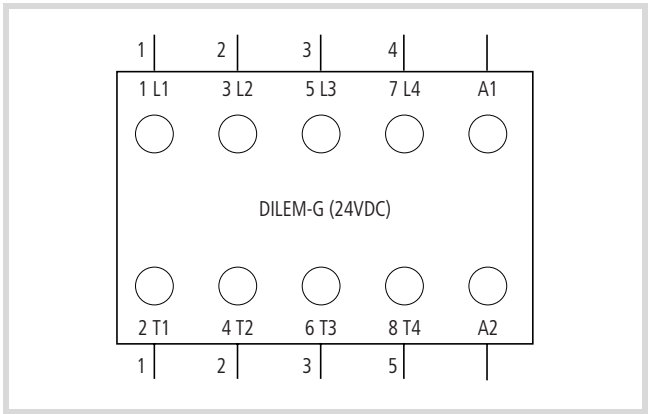
▶ Fit the reversing starter wiring kit (link L1…3, T1…3, A1).



▶ Connect the factory-prepared strand in the device with A2 and bridge terminal 7 with 7 and 8 with 8.



▶ Assigning strand labels to the contactor contacts; terminal assignment



▶ Change the jumper settings to reversing starter function (→ section "Setting the functions with DIP switches/jumpers", page 60).

Device operation

Motor control unit RA-MO is supplied ready for connection. It allows the direct operation of a 0.09 to 3 kW, 400 V 50 Hz motor (on RA-MO V1.x: 0.18 – 2.2 kW) without special technical knowledge.

You can set the following operating modes with key-switches:

- Manual (setup, commissioning, maintenance). In this mode, the motor can also be operated without PLC.
- Auto (continuous operation through AS-Interface® control). Enable with preselected direction.
- Off or Reset. In switch position Off the contactor actuation is interrupted and the drive is switched off. At the same time, setting the switch to Off resets any fault identified by the RA-MO, such as motor overtemperature (thermistor required) or overload. Faults are indicated by the red LED in the motor symbol and signalled through AS-Interface®.

Functions through AS-Interface®

In addition to the normal control functions, Clockwise Operation and Anticlockwise Operation and signals Automatic Operation and Group Error, sensor signals assigned to the drive can be read and internally processed. The configurable quick stop allows precise stopping, for example on connection points and (eccentric elevating platforms). Interlocked manual mode can prevent damage to the conveyed material and the plant in also manual operation.

With RA-MO from version 2.x you can also perform a Reset and read out a detailed diagnostics status through AS-Interface® . This allows preventive maintenance and simplifies servicing, → page 48 and page 56.

From version 2.2 you can also use specify whether monitoring of the motor plug (thermistor monitoring) is part of the Group error or Ready signal.

Commissioning the drive

⚠ **Warning!**
Do not disconnect the motor and power plugs while they are live.

- ▶ Key-switch in "OFF" position
- ▶ Selector switch REV-OFF-FWD in Off position

Before commissioning the motor control unit, make sure that the motor is correctly connected and the motor cable is plugged in. The plug M12 to the AS-Interface® connection must be live. The LED ASi-POWER is lit.

Before commissioning, the motor's current value must be set with the DIP switch (→ section "Setting the functions with DIP switches/jumpers", page 60). This ensures that the motor is also protected against overload during commissioning. When the mains cable is connected, the load switch (disconnect control unit RA-DI) then applies mains voltage. LED display UV on the motor symbol indicates readiness for operation. A lit red LED in the motor symbol indicates a group fault.

Error handling

- ▶ Set the key-switch in the OFF position.
- ▶ Check the DIP switch position (→ page 60).
  On version 1.x devices, pull and reconnect the mains plug after changing the DIP switch settings. On version 2.x devices the new DIP switch settings take effect immediately.
- ▶ Check whether
  - – the motor plug is plugged in.
  - – the thermistor is correctly connected or whether wires 6 and 7 are bridged in the motor terminal board (→ fig. 55 and fig. 56, page 53)
  - – the motor is overloaded or too hot
  - – there is a short circuit or an overload of sensor inputs I3 or I4 or actuator output O3.
- ▶ Key-switch in "HAND" position
- ▶ Selector switch REV-OFF-FWD is used to enable forward (FWD) and reverse (REV) operation. The current selection is indicated by LEDs REV and FWD on the motor symbol.

Safety-relevant power off

RA-MO features a safety power-off function up to Category 2 according to EN 954-1. By isolating the 24 V at the infeed position, all RA-MO devices on one busbar run are switched off. To activate this function, I/O error signalling must be enabled for all RA-MO units on the busbar run, → table 9 on page 64.

⚠ **Warning!**

To avoid unexpected starting after a power failure, take the following steps:

- In automatic mode, 24 V DC or 400 V AC:
  Disconnect the 24 V or 400 V and reset the actuation command in the PLC.
- In manual mode, 24 V DC:
  If a direction of rotation has been selected, the drive does not automatically restart when power is restored. The direction LED flashes. To continue manual operation, a Reset command must be issued (key-switch to OFF).
- In manual operation, 400 V AC:
  Activate function "Monitoring lower current limit only in Manual mode" (→ table 8 on page 64). If the 400 V AC fail with this setting, a group fault is generated.
  Observe the current limit values on page 59.

I/O fault messages, internal device faults

The RA-MO generates an I/O error message (FID), when

- the AS-Interface® voltage is applied but the 24 V is not. A subsequent failure of the 24 V supply does not cause an I/O error, so that this fault can occur only during commissioning.
- motor current is flowing even though the contactor is not energized (internal device fault, from RA-MO version 2.1). This can be caused by welded contactors. Replace the DILEM4-G (24 V DC) in that case.

Danger!
Conversion must be performed only by trained electricians. Incorrect work causes a risk of death through electric shock.

I/O errors are indicated on the RA-MO and on the interface control unit RA-IN by a flashing LED AS-Interface® Error. The PLC contains a list of slaves with I/O errors (LPF).

In the event of an internal device fault, the motor and FWD/REV LEDs also flash. In addition, on devices from version 2.1 with information number 3.6.4c (→ table 3 on page 61), diagnostics status scanning must be activated through the AS-Interface® parameter channel.

Intrernal device faults can be uniquely identified with a RA-MO diagnostic status request (→ table 2 on page 60) with the command WRITE P = 111. If an internal device fault occurs, the 400 V supply of the affected busbar run must be switched off. A reset can be carried out by switching off the 24 V DC supply. From version 2.2 a Reset can be performed with the key-switch or through AS-Interface®.

Auto configuration for servicing

When you replace a RA-MO with an identical device, the AS-Interface® is automatically transferred.

Requirement:

- Auto-addressing mode is enabled (default setting for RA-IN).
- The 400 V~/24 V supply and AS-Interface® are active.

Procedure:

▶ Connect the new motor starter with the key-switch in the OFF position.

After no more than 0.5 seconds all error LEDs must have gone out.

▶ Select manual or auto operating mode.

Key-switches

The key-switches engage in all positions.

Switch postion	AUTO	OFF RESET	Hand
Key withdrawable	yes	yes	No
Function	Operation through AS-Interface®, Status signal to PLC	Reset motor protection, no contactor actuation, secured against restarting.	Contactors can be actuated manually through the selector switch.

Reset

As soon as LED Motor has changed from continuously lit to flashing, triggering of the motor preotection function or thermistor protection can be manually reset with switching sequence AUTO → OFF or MANUAL → OFF. To perform a Reset, hold the key-switch in the OFF position for about half a second.

From version 2.x: The Reset signal through AS-i provides an additional possibility for a motor starter reset in case the motor starter is not accessible for a local reset. The local reset with the key-switch remains the main reset function, since it is necessary for analysing and eliminating fault causes locally.

In automatic operation the RA-MO interprets simultaneous setting of the forward and reverse operation outputs (data bits DO0 and DO1) as a Reset. Before a reset, data bits DO0 and DO1 must be Low for at least 18.5 ms. The reset is performed when the data bits are then High for at least 18.5 ms.

A built-in logic circuit and a mechanical interlock prevent fault conditions.

On a motor overload a reset is possible only when the motor is ready for operation again due to the thermal memory or the thermistor resistance.

After failure of the 24 V DC supply, a manual acknowledge is not required when power is restored. The error signal from each RA-MO to the PLC caused by the 24 V DC supply failure is reset automatically.

Selector switch

The key-switches engage in all positions.

Switch postion	REV	OFF	FWD
Function (with key-switch in MANUAL position only)	Reversing contactor actuated (DOL starter has no actuation)	No actuation of contactors	Main contactor actuated

Description of functions

Phase reversal

Three-phase motors work with clockwise rotating fields (viewed from the motor shaft) when phase L1 is connected to U1, L2 to V1 and L3 to W1. This default operating direction may be reversed through gearboxes or different mounting positions. With the reversing starter, the operating direction can be reversed with the phase reversal switch (pole 7 of the DP switch under the front locking screw, → table 5, page 63) without rewiring or reprogramming.

With control signal FWD (LED FWD lit) a clockwise rotating field is output in switch position Top (default) and an anticlockwise rotating field in switch position Bottom.

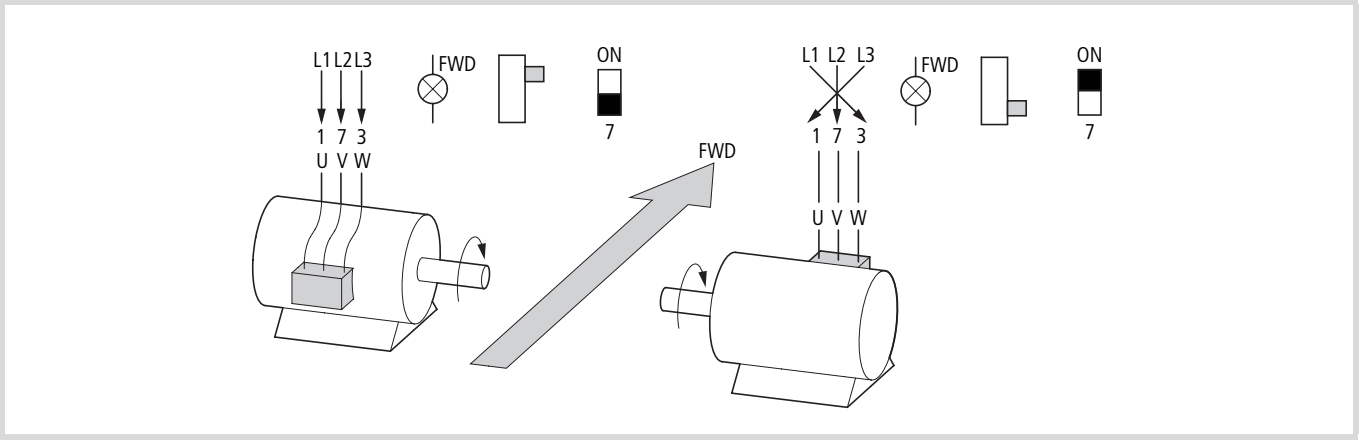


Figure 60: Direction of rotation

Quick stop and interlocked manual mode

Motor starter RA-MO...4 has two external inputs, through which two light barriers, sensors or limit switches can be connected. You can configure these inputs as Quick Stop or Interlocked Manual operation with DIP switches.

The Quick Stop function allows precision stopping of the drive. When the limit switch is reached, the drive switched off directly through preprocessing of the motor starter. PLC and bus cycle times do not affect the power-off times. From version 2.x the power-off times are even shorter and more precise than in version 1.x.

From version 2.x and depending on your application, there are several ways of configuring the Quick Stop function:

→ The version number is printed under "Ver-No.:" on the nameplate, → page 19.

- From Version 2.1:
  - Input I3 acts on both directions of rotation and I4 has no additional function.
  - Input I3 acts on Forward direction and I4 on Reverse direction.

- New from version 2.2:
  - Inputs I3 and I4 act in Forward direction.

Interlocked manual mode can prevent damage to the conveyed material and the plant in also manual operation. If you have selected this function, limit switch I3 limits the possible forward travel and limit switch I4 limits the possible reverse travel.

If the material reaches the limit switch in Manual mode, the drive stops even if the selector switch remains in an actuating position.

In addition you can use this function to adjust the light barriers before commissioning the PLC.

Quick stop

When the input signal arrives (rising edge), the motor starter electronics de-energize the assigned contactor. The input signal must be applied for at least 18.5 ms. As soon as the PLC output is reset (falling edge), the contactor can be switched on again. Whether the input signal is still applied during the reset or during restarting of the PLC output as no effect → figure 61.

Sensors with break contacts can also be used. In this case the motor starter's DIP switch must be set accordingly.

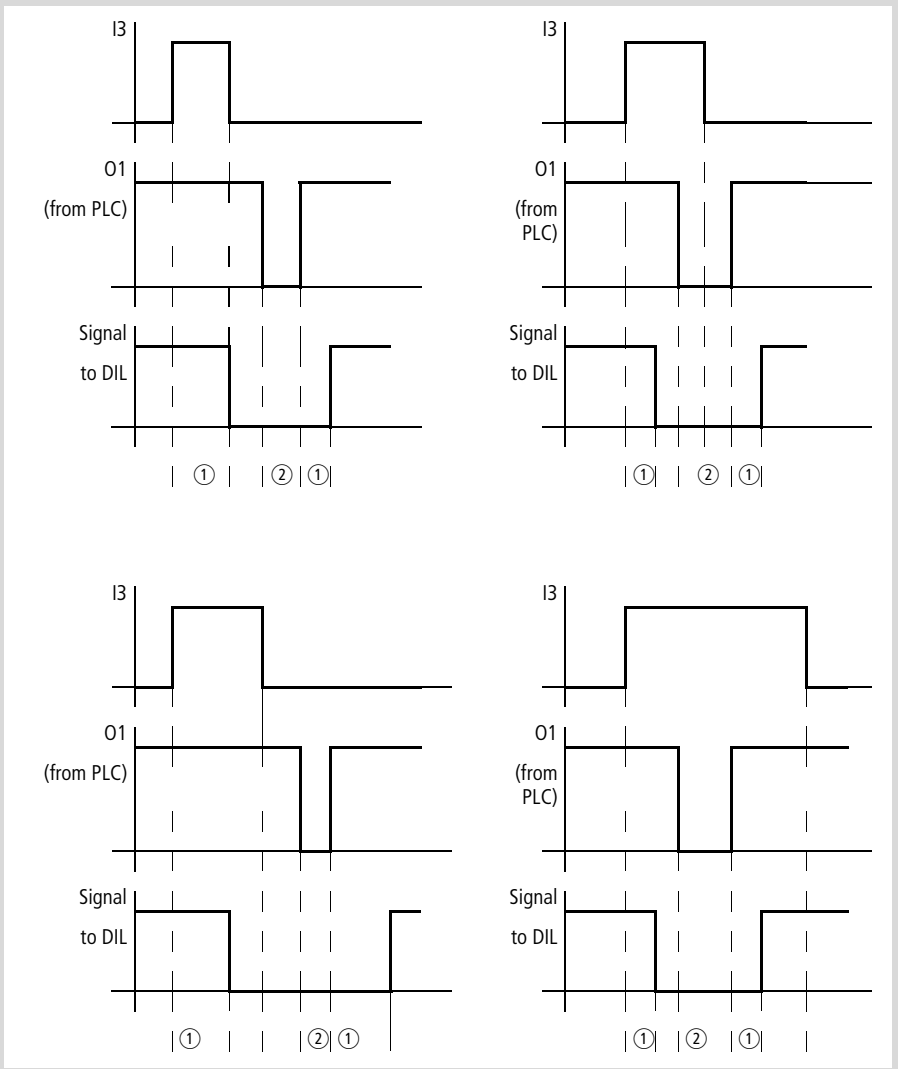


Figure 61: Quick stop in Automatic mode
(Example: I3 and forward rotation)

① 13.5 ms ± 5 ms
② dependant upon PLC programme

LED signal on Quick stop:

LED FWD or REV is lit when the PLC has set the associated direction of rotation bit. LED FWD or REV flashes when the contactor has been switched off through the Quick stop and the PLC' direction of rotation bit continues to be set.

Interlocked manual mode
After the rising signal edge of I3 (and from version 2.2 also on a continuous signal) forward rotation can be selected only in automatic operation; reverse operation can be selected manually. Manual selection of forward rotation is possible again only after a falling edge at I3 during reverse operation (or, from version 2.2 also after a changeover to automatic mode and back again). The same applies for I4 and reverse rotation.

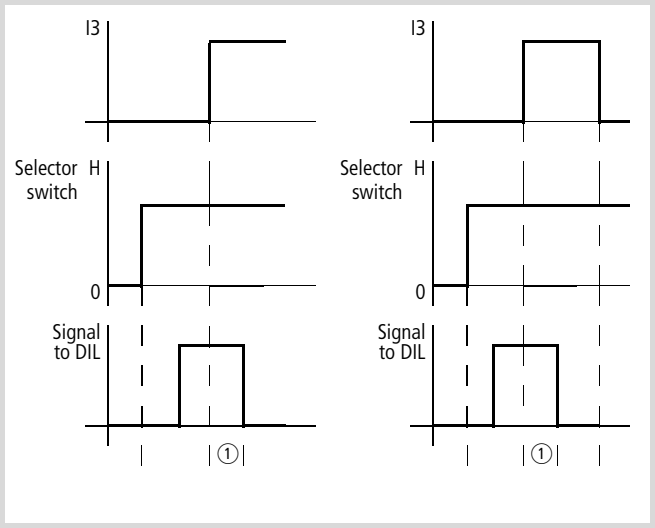


Figure 62: Interlocked manual operation (example: I3 and forward rotation)

① 13.5 ms ± 5 ms

- Interlocked manual operation for 360° rotation with two break points (from version 2.2):

With jumper setting DOL starter and DIP switch setting pole 6 = 1 and pole 8 = 0 interlocked manual mode is edge-controlled only. When a break point is reached, this allows continued manual operation in the same direction by briefly switching over to automatic mode and back again.

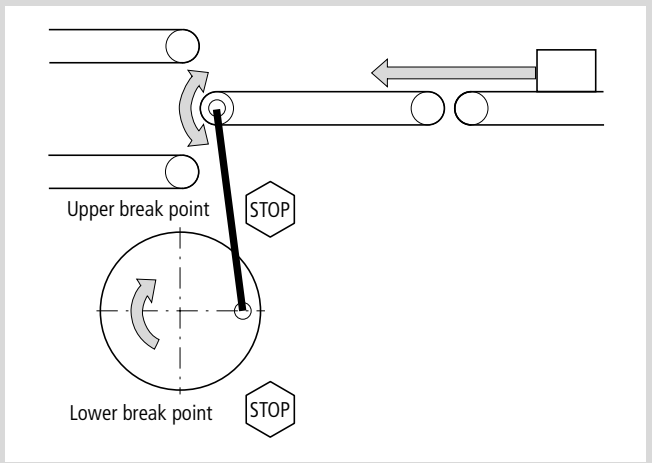


Figure 63: Example: vertical sorter with 360° eccentric

- LED signal on interlocked manual mode:

LED FWD or REV is lit when the assigned direction has been set with the selector switch. LED FWD or REV flashes when the selector switch is being operated but the contactor is switched off due to interlocked manual mode.

→ Because the sensor inputs are supplied through AS-Interface®, interlocked manual operation works only when the AS-Interface® voltag is applied.

Monitoring of lower current limit

After the assigned jumper or DIP switch has been set (→ figure 64, 65), the lower current limit is monitored in all three phases. This provides detection of load unbalance and phase failure. If the current drops below 35 percent of the set value in at least one phase (→ table 4 to page 62), a group error message is generated and the contactor is switched off. Current values above 40 percent of I_n do not trigger lower current level monitoring. After a Reset command the RA-MO can be operated in both manual and automatic mode.

Reading diagnostic status through AS-Interface®parameter channel

To be able to read out the diagnostic status (left jumper in right position, → figure 64 r DIP switch 10 = 1 from version 2.2) the PLC with WRITE P must send the parameter bit combination 111. The motor starter returns the diagnostic status (→ table 2). If no diagnostic data is available, the motor starter returns the parameter bit combination 111.

If two or more diagnostic messages apply at the same time, the message with the highest priority is displayed until the fault that triggered the diagnosis has been rectified and the Reset command has been issued. Then the diagnostic message with the next highest priority is displayed. The messages are listed in order of their priority, with the highest-priority message at the top of the list.

Diagnostic messages Manual Operation (status_local_operation) and Current Thresholds (status_overload_warning and status_load_indication) are reset automatically and do not therefore need a Reset command.

→ In addition to the detailed error messages, load messages are also transmitted to allow preventive plant maintenance.

If the PLC sends a value other than 111, the same value is returned as parameter echo.

Further information can be found at section "Background information for PLC technicians about the function principle of parameter transmission in RA-MO, RA-SP and RA-IN" on page 11.

Table 2: Indication of diagnostic status

Diagnosic-status	Status			Group faults[1]	Peripheral error (FID)	Explanation
	P1	P2	P3	DI1		
Contactor faulty	0	0	1	1	1	Contactor in On position without actuation signal
Overload trip	0	1	0	1	0	Trip from 110 % of thermal motor simulation value
Thermistor tripping	0	1	1	1	0	Tripping through excessive resistance in thermistor sensor circuit
No diagnostic signal	1	1	1	1	0	Possible causes: • Overload or short circuit of external inputs I3, I4 • Overload or short circuit of external output O3 • Incorrect DIP switch setting • No 24 V supply voltage • Tripping on drop below lower current threshold
Manual mode	1	0	0	0	0	Key-switch in MANUAL position
Load signal	1	0	1	0	0	Signal from 90 % of thermal motor simulation value
Load signal	1	1	0	0	0	Signal from 70 % of thermal motor simulation value

1) see I/O error message on page 56

Set plug monitoring as part of Ready message

From version 2.2 the motor plug monitoring message can also be assigned to Ready message DI0 (→ section "I/O assignment" on page 48).

This is recommended if

- the motor plug is used as isolating switch in combination with lock shackle SET-M-LOCK (→ page 152).
- motors without temperature sensor winding are used and T1/T2 in the motor's terminal board are bridged (→ figure 55 on page 53).

If maintenance work is performed under these conditions with disconnected and locked motor plug, a Not Ready signal makes more sense than a fault message.

To activate this operating mode, close the left hook jumper (→ table 3 on page 61).

In this operating mode, a high-resistance connection between pins 5 and 8 of the motor plug (thermistor tripping or no motor plug) the following effects:

- The motor switches off (as in the normal operating mode).
- No group fault message is applied to DI1.
- LED Motor does not indicate a group fault message.
- No Ready signal is applied to DI0, even if the key-switch is set to AUTO.

Setting the functions with DIP switches/jumpers

When the locking screw in the cover is undone, the electronics can be configured through jumpers and DIP switches.

→ Before you change the configuration and parameter settings, make sure the key-switch is in its OFF position.

→ RA-MO version 1.x registers changes in the DIP switch settings only when power supply is interrupted and reconnected or the 24 V are applied again. From version 2.x changed DIP switch settings take effect immediately.

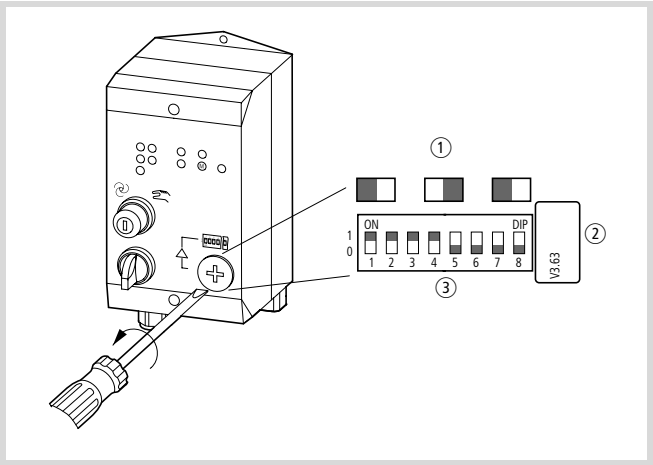


Figure 64: DIP switches/jumpers from version 2.1

① Jumper settings → table 3
② Information digit for service
③ DIP switches: 1 – 4 for setting current values → page 62
5 – 8 for setting additional functions
→ page 63

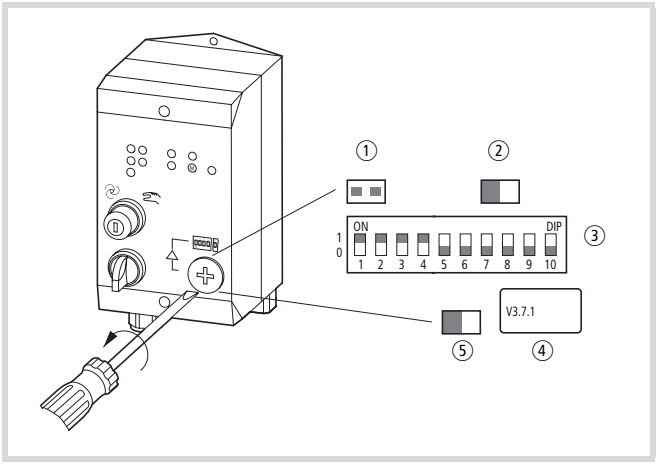


Figure 65: DIP switches/jumpers from version 2.2

① Left jumper, settings → table 3
② Right jumper
③ DIP switches: 1 – 4 for setting current values → page 62
5 – 10 for setting additional functions
→ page 63, 64
④ Information digit for service
⑤ Middle jumper

Table 3: Function of jumper settings depending on device version

Device version[1)]	**Information number[2)]**	**Left jumper in position...**		**Middle jumper in position...**		**Right jumper in position....**	
		left	**right**	**left**	**right**	**left**	**right**
Version 1.x	–	–		–		**Reversing starter**	**DOL starter**
Version 2.1	V 3.6.3	FS	invalid	FS	invalid		
	V3.6.4:	**Diagnostic status through AS-Interface® parameter channel [3)]**		**Monitoring of lower current limit**			
		Off (FS)	On	Off (FS)	On		
Version 2.2[3)]	V3.7.1:	**Monitoring of motor plug[4)] (= thermistor monitoring)**		**Monitoring of lower current limit** → table 8 on page 64.			
		Open: Part of group error message (FS)	Closed: Part of Ready message				

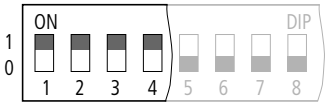
DS = default setting

1) Your device's version number is printed on the nameplate under "Ver.-No.:", → figure 15 on page 19
2) The information number is printed at the jumpers, → figure 64
3) From version 2.2 the function "Diagnostic status through AS-Interface® parameter channel" is activated through DIP switch 10, → table 9 on page 63.
4) → section "Set plug monitoring as part of Ready message" on page 60.

Setting current values (pins 1 to 4)

The current values can be set with pins 1 to 4 of the DIP switch:

Table 4: Setting of the current with DIP switch



1	1	1	1	No function (factory setting)1
1	0	1	1	0.3 A
0	1	1	1	0.4 A
1	0	0	0	0.6 A
0	1	0	0	0.8 A
1	1	0	0	1.0 A
0	0	1	0	1.2 A
1	0	1	0	1.5 A
0	1	1	0	1.7 A
1	1	1	0	1.9 A
0	0	0	1	2.1 A
1	0	0	1	2.6 A
0	1	0	1	3.6 A
1	1	0	1	5.0 A
0	0	1	1	6.6 A
0	0	0	0	no function[1]

1) RA-MO can not be operated. The red LED in the motor symbol is lit. A group fault is active.

Configuration overview (pins 5 to 8)

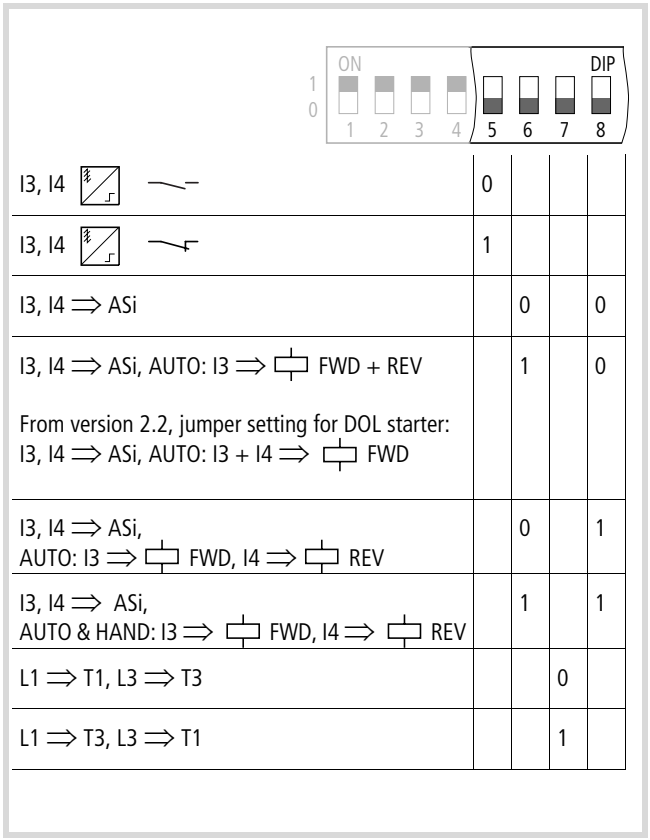


Figure 66: Configuring the RA-MO2.1-W4… (from version 2.x)

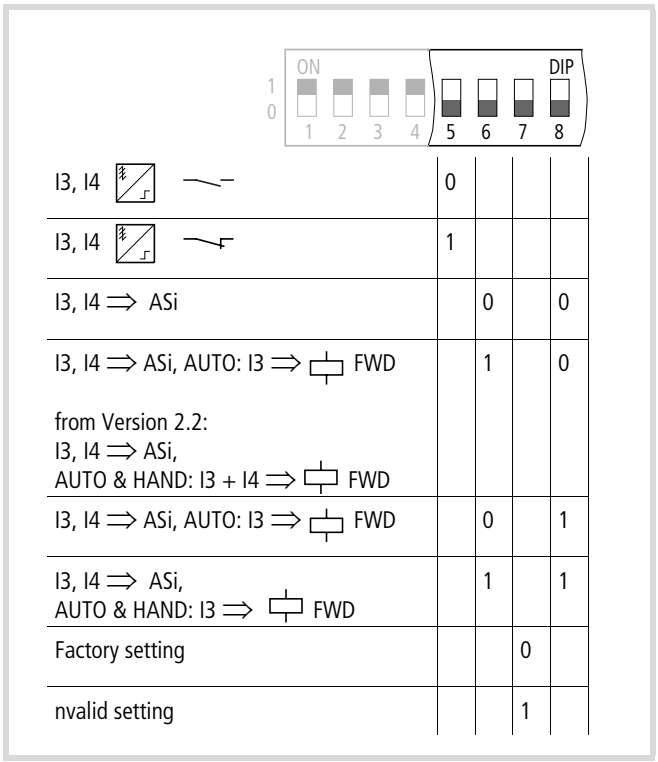


Figure 67: Configuring the RA-MO2.1-D(E)4…
(from version 2.x)

Activate phase reversal switch (pole 7)

→ For this setting, the jumper on the right must be in its left position (→ fig. 64).

⚠ **Danger!**
Safety risk! The jumper positions and the setting of DIP switch pole 7 must be changed only by trained persons and only in accordance with this manual. Incorrect settings will cancel the reversing starter's interlock or reverse the operating direction.

→ From version 2.2: If DIP switch pole 7 is set to 1 on a DOL starter, the contactor is no longer actuated. DOL starters work only with DIP switch pole 7 in position 0.

Table 5: Phase reversal and reversing function

pole 7	Configuration
0	Reversing starter (factory setting)
1	Reversing starters and phases L1 and L3 reversed (phase reversal)

Configure external outputs (pole 5 – 6, 8)

The RA-MO...4 provides two external inputs for connecting light barriers, sensors, etc. Add-on functions are:

- Quick stop with a light barrier for both directions
- Quick stop and interlocked manual mode with both light barriers for clockwise rotation (from version 2.2)
- Quick stop with one light barrier per direction of rotation
- Interlocked manual operation with one light barrier per operating direction
- When using break contacts, inversion of the signals for internal processing.

You can configure the external inputs through pins 5, 6 and 8 of the DIP switch:

Table 6: Sensors

pole 5	Configuration
0	Sensor signals through AS-Interface®, no add-on function (factory setting)
1	When using sensors with break contacts: Signals are inverted for internal processing; the original signals are sent through AS-Interface®.

Table 7: Setting quick stop and interlocked manual mode

→ On RA-MO version 1.x only pole 6 has a function.

pole		Configuration for RA-MO from version…		
6	8	V 2.2	V 2.1	V 1.x
0	0	No add-on function (factory setting)		
1	0	For jumper setting "reversing starter": → column …V2.1	Quick stop I3 enabled. I3 is assigned to both operating directions, I4 has no add-on function; typical application example: chain discharger	–
		With jumper setting DOL starter: Quick stop and interlocked manual operation (edge-controlled only), I3 and I4 enabled. I3 and I4 are assigned to operating direction FWD; typical application: vertical sorter with > 360° eccentric		
0	1	Quick stop, I3 and I4 enabled. I3 is assigned to operating direction FWD, I4 is assigned to operating direction REV; Typical application: Vertical sorter with < 360° eccentric		–
1	1	Quick stop and interlocked manual operation, I3 and I4 enabled. I3 is assigned to operating direction Forward, I4 to operating direction Reverse; typical example: Vertical sorter with < 360 ° eccentric		

Monitoring of lower current limit

→ On RA-MO up to version 2.1 this function is set with the jumpers, → table 3 on page 61.

Table 8: Monitoring of lower current limit

pole 9	Middle jumper	Configuration for RA-MO… from version 2.2
0	right	Monitoring of lower current limit disabled (factory setting)
1	right	Monitoring of lower current limit enabled only in manual mode
0	left	Monitoring of lower current limit enabled only in automatic mode
1	left	Monitoring of lower current limit enabled in both manual and automatic modes

Diagnostic status through AS-Interface® parameter channel

→ On RA-MO up to version 2.1 this function is set with the jumpers.

Table 9: Diagnostic status through AS-Interface® parameter channel

pole 10	Configuration for RA-MO… from version 2.2
0	Diagnostic status through AS-Interface® parameter channel and I/O error signal disabled (factory setting).
1	Diagnostic status through AS-Interface® parameter channel and I/O error message enabled.

Diagnose and status via LEDs

LED	Colour	Meaning	no signal	flashes	Signal
AS-Interface® Power	green	AS-Interface®-voltage	missing	–	applied
AS-Interface® FAULT	red	AS-Interface®-fault	no fault	Peripheral fault, → page 56 FWD/REV LED and motor LED flashing:Internal device fault, → page 56	Communica-tions fault, e.g. slave not addressed.
UV	green	Auxiliary power 24 V	missing	–	applied
FWD	green	Forward operation (main contactor)	not actuated	not actuated because • light barrier has been reached in interlocked manual operation or quick stop • 24 V supply failed and returned in manual mode[1)] If motor LED and AS-Interface® LED also flash: Internal device error, → page 56	actuated
REV	green	Reverse operation (reversing contactor)	not actuated		actuated
O3	green[2)]	User-configurable LED or external output through M12 socket on RA-MO…4A/…	not actuated	–	actuated
–	–	Automatic, indicated by key-switch	–	–	–
„Motor"	red	Group error: • Overload motor • Thermistor tripping[3)] • motor plug not plugged in[3)] • DIP switch position invalid • No 24 V auxiliary power (without LED indication) from Version 2.x: • Overload/short-circuit O3[4)] • Overload/short-circuit I3/I4[4)] • Current below lower limit[5)]	no fault	tripped, Reset ready (motor cooled down) If AS-Interface® error LED and FWD/REV LED also flash: Internal device error, → page 56	applied
I3 (RA-MO…4 only)	green	external input via M12 socket	not actuated	–	actuated
I4 (RA-MO…4 only)	green	external input via M12 socket	not actuated	–	actuated

1) Automatic restarting after a 24 V power failure is prevented. To continue manual operation, a Reset command must be issued (key-switch to OFF).

2) On deviced made on or before February 2005 the LEDs are red; on later devices they are green.

3) From version 2.2: When the jumper is closed, thermistor tripping or a disconnected motor plug do not cause a group error signal but suppress Ready signal DI0.

4) On overload or short circuit at I3/I4 or O3, the RA-MO generates a group error message.

5) → section "Monitoring of lower current limit" on page 59.

5 Motor starter RA-MO (from Version 3.0)

Device overview

→ Your device's version number is printed on the nameplate, → page 19.

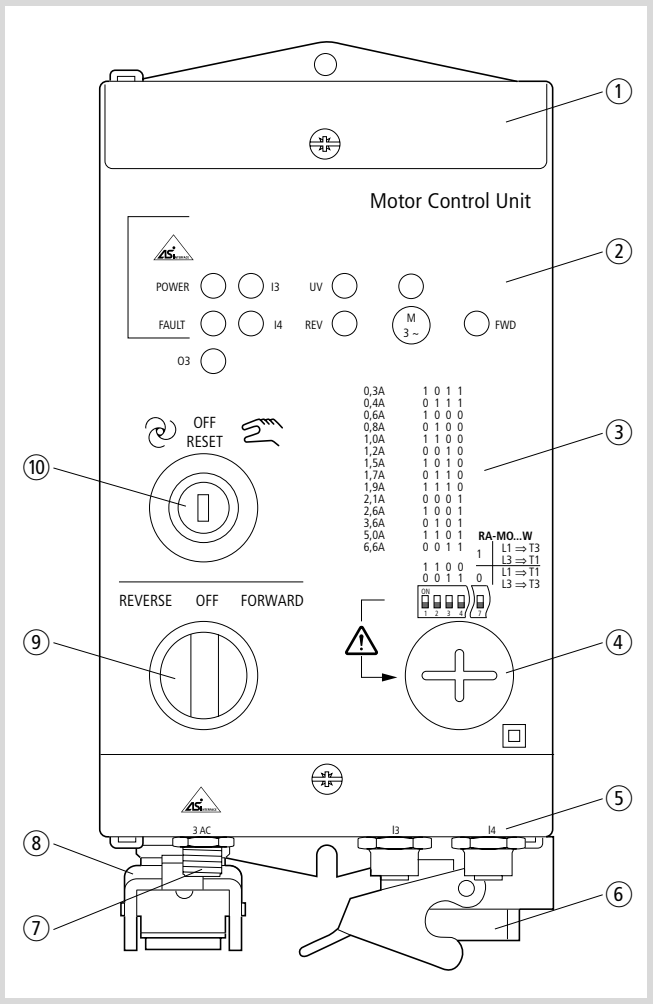


Figure 68: Overview RA-MO (here: RA-MO2.1.../C3A)

① Space for labelling top and bottom
② Status and diagnostic LEDs
③ Lasering: Assignment of DIP switch position to motor protection values
④ Locking screw: Configuration and parameterization with DIP switch
⑤ Two additional inputs through M12 for external sensors. For version RA-MO…A… one additional output through M12 for external actuators.
⑥ Motor output plug for motor cable SET-M3/…
⑦ Connection AS-Interface® with user-assembled M12 plug
⑧ User-assembled power plug (5-pole)
⑨ Selector swicht for clockwise and anticlockwise operation
⑩ Key-switch for manual and automatic mode

Key to type references

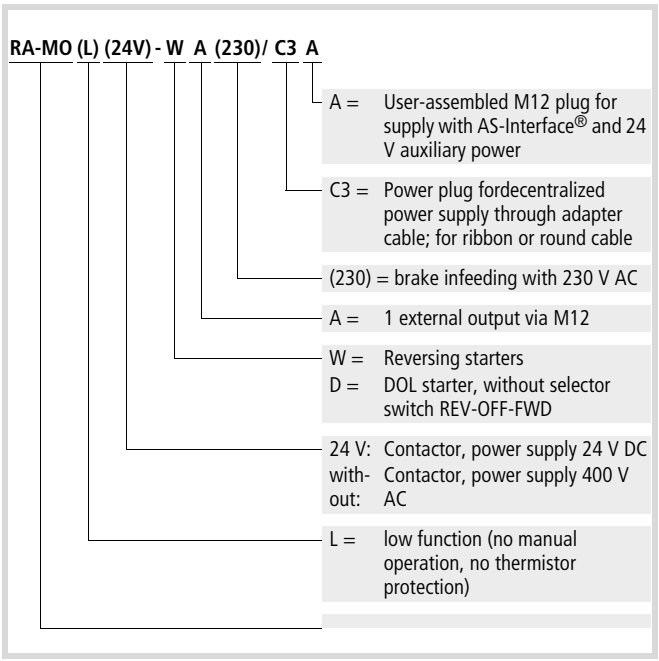


Figure 69: Key to part numbers RA-MO

Proper use

The Motor Control Unit RA-MO is an electrical apparatus for controlling drives with constant-speed three-phase motors. It is designed for installation in machines or for use in combination with other components within a machine or system.

After installation in a machine, the RA-MO must not be taken into operation until the associated machine has been confirmed to comply with the safety requirements of Machinery Safety Directive (MSD) 89/392/EEC. The user of the equipment is responsible for ensuring that the machine use complies with the relevant EU Directives.

The CE markings confirm that, when used in a typical drive configuration, the apparatus complies with the European Low Voltage Directive (LVD) and the EMC Directives (Directive 73/23/EEC, as amended by 93/68/EEC and Directive 89/336/EEC, as amended by 93/68/EEC).

Observe the technical data and terminal requirements. For additional information, refer to the equipment nameplate or label and the documentation.

Any other usage constitutes improper use.

Caution!
The Motor Control Unit must be operated only in combination with this user manual.

Caution!
Rapid Link must be operated only on 400/440 V three-phase systems with earthed star point and separate N and PE conductors (TN-S network). It must not be operated unearthed.

The motor control unit protects the motor against overload but not against short-circuiting. For short-circuit protection (of one or a group of RA-MO units) a short-circuit protective device according to IEC 60364-4-43, → section "Incoming supply 400 V AC" on page 13. Following a short circuit (not overload) the complete affected motor starter must be replaced.

The devices must be opened only in a de-energized state:

- Key-switch in "OFF" position
- Pull power supply plug and secure against reconnection.
- Pull motor plug and plug M12.

Do not touch the electronics in the cover!

Engineering

Functions overview RA-DIMO

	Basic functions	→ Page
Communication	• AS-Interface® connection, specification 2.1 for 62 stations • Reading a detailed diagnostics status through the AS-Interface® parameter channel	20 78
Motor protection	Electronic motor protection	68
Auto configuration on replacement	Automatic transmission of slave address on replacement of RA-MO during running operation.	
Monitoring	Thermistor monitoring PTC and Thermoclick	73
Braking	Brake actuation through AC 3 switching contact (230/400 V)	73
Phase reversal	Configurable: clockwise or anticlockwise operation through DIP switch	76
Mounting	Plug-in connections	13
Display	Separate status and diagnostic LEDs	82
Manual mode	AUTO-OFF-HAND with key-switch, commissioning without higher-level control possible, actuation of direction(s) of rotoation with selector switch "REV-OFF-FWD" for RA-MO…W…	76, 75
External inputs	Connection of two light barriers, sensors or limit switches through two M12 sockets. Additional functions: Interlocked manual operation and quick stop	76
External output	Commection of a 24 V acutator, suchas lamp or solenoid valve in addition to the external inputs	
Motor connection	Pluggable, pin assignment to DESINA specification	72
Safety switch-off	According to cat. 2 to EN 954-1 by group	74

1) The reversing starter interlock is implemented in the processor through firmware and with a mechanical interlock. The mechanical interlock prevents switching on of one contactor when the other is closed without actuation signal (welded or stuck in closed position).

I/O assignment

Data Bit	I/O	Meaning
DI0	I1	Automatic mode/Ready signal
		0: Not ready for automatic operation
		1: Ready for automatic operation
DI1	I2	Group error, see table on page 82, keyword "Motor"
		0: Fault
		1: no fault
DI2	I3	external input via M12 socket
DI3	I4	0: no signal
		1: Signal applied
DO0	O1	Main contactor
		0: not actuated
		1: actuated
DO1	O2	Reversing contactor
		0: not actuated
		1: actuated
DO0 + DO1	O1 + O2	Reset
		0: no Reset
		1: Reset
DO2	O3	Free LED signal or external output through M12 socket
		0: no signal
		1: Signal applied

Sensor connection through M12

The sensor connection cables for inputs I3 and I4 must not be longer than 20 m each. The sensors are supplied through the AS-Interface®. Do not connect capacitive sensors. The sensors' total power consumption must not exceed 160 mA. The power supply is short-circuit proof. On overload or short circuit the RA-MO generates a group error message.

Actuator connection through M12 (RA-MO…A…)

The connection cable for output 03 must not be longer than 20 m. The actuator is supplied by the power bus with 24 V DC. The current consumption must not exceed 1 A. Output 03 is short-circuit proof. On overload or short circuit the RA-MO generates a group error message and switches off the power for output 03. Once the fault has been rectified, you can issue a Reset command.

Motor cable/motor plug

If user-assembled motor connection plugs are fitted, the motor cable for motor control unit RA-MO must not be longer than 25 m.

Selection of short-circuit devices

→ section "Incoming supply 400 V AC" on page 13.

Cable routing

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

Do not lay the control and signal lines directly adjacent to mains or motor cables. Avoid laying them in a common cable duct and do not bundle them with cable ties.

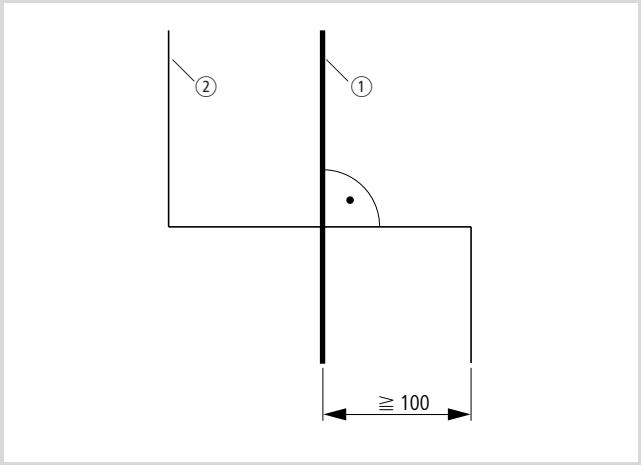


Figure 70: Crossover of signal and power cables

① Power cable: Mains connection, motor cable
② Control cable: AS-Interface®

Accessories

- Motor cable SET-M3/…-HF with assembled, halogen-free cable, 2/3/5/10 m.
- Lock shackle SET-M-LOCK for motor cables SET-M3… (→ page 152).
- Motor connection plug SET-M3-A for user aassembly, cable length ≦ 25 m
- Adapter cables for power supply through ribbon or round cable RA-C3/C…-1,5HF
- Power plug RA-C3-PLF for user assembly for motor starter RA-MO…/C3A
- Spare key for key-switch M22-ES-MS1.

Installation

Mounting position

The device is preferably installed vertically but can also be fitted in the positions shown.

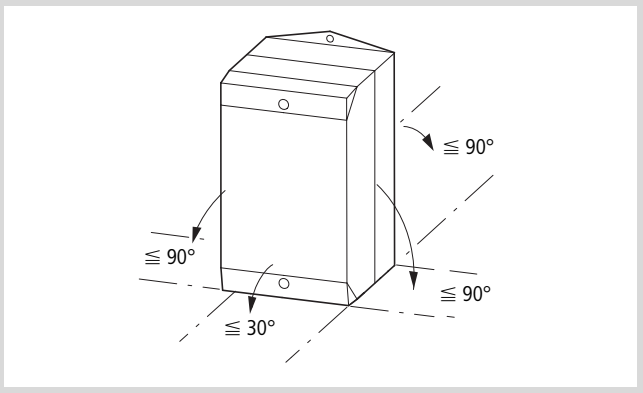


Figure 71: Mounting position

Mounting

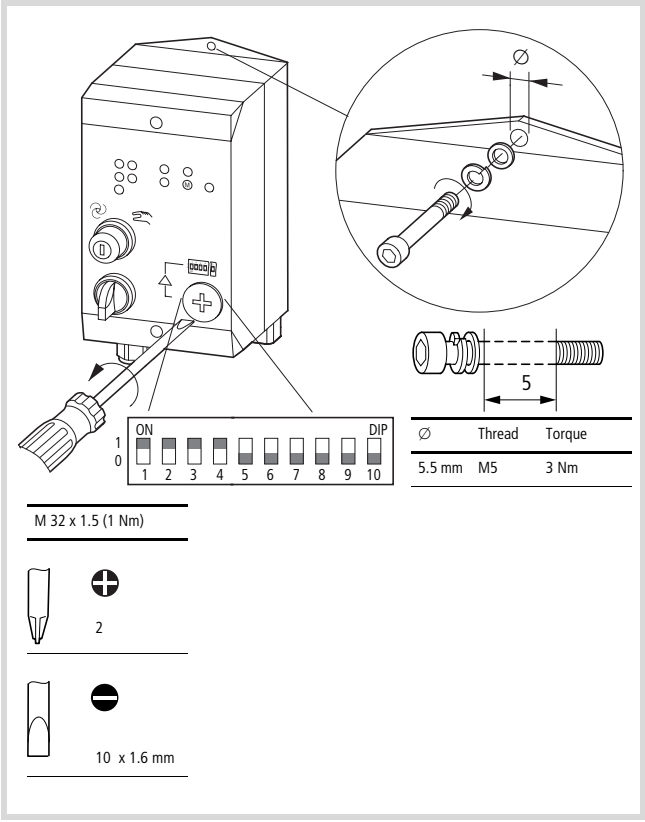


Figure 72: Mounting

Connections

Motor control unit RA-MO is supplied ready for connection. It allows the direct operation of a 400 V 3AC motor without special technical knowledge.

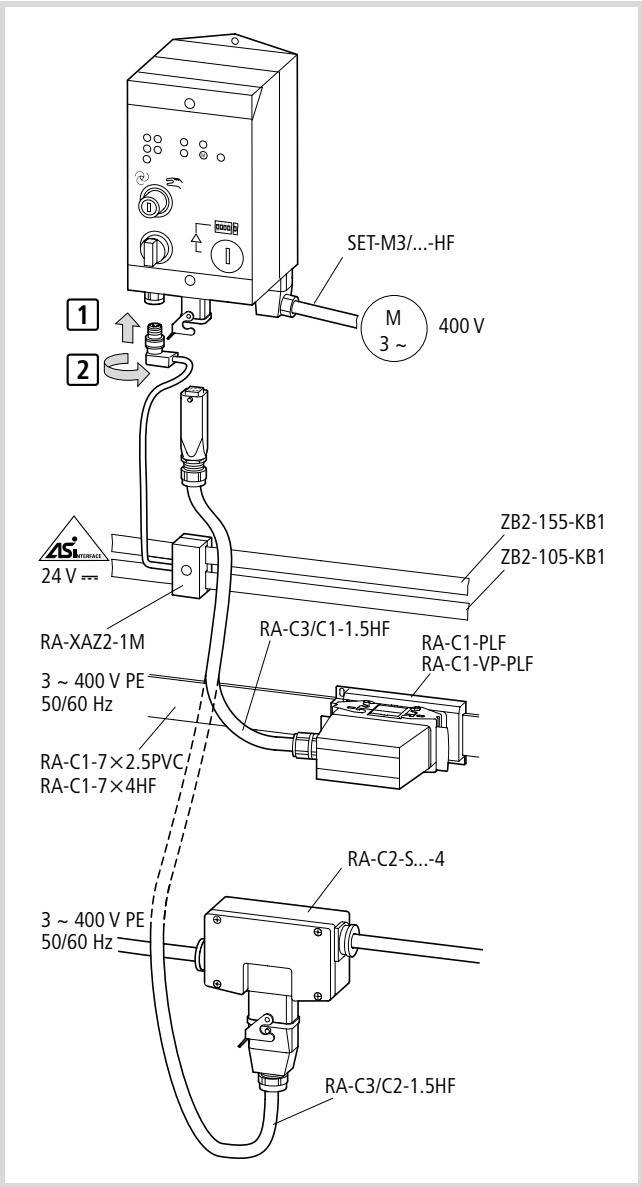


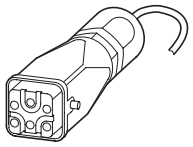
Figure 73: Mounting example RA-MO.../C3A

Connecting the power supply

Terminations → section "Power bus" on page 13.

Part no.	Connection types
RA-MO…/C3	Power supply plug with L1-L2-L3-N-PE for the adapter cables to **ribbon**- or **round** cable
RA-MO…/C3A	The 24 V are supplied together with AS-Interface® through the user-assembled M12 plug

Table 10: Pin assignment of power plug RA-MO…/C3… (model HAN Q5/0)

PIN	Function	
1	L1	
2	L2	
3	L3	
4	N[1)]	
5	–	
PE	PE	

1) Required only for brake infeed with 230 V.

Connecting AS-Interface® and 24 V (RA-MO…/C3A)

Connection through user-assembled plug M12

PIN	Function
1	ASi+
2	0 V
3	ASi–
4	24 V

→ 24 V DC connection only for models with output O3 or 24 V DC contactors

Before establishing the connection to AS-Interface®, you can assign the AS-Interface® address through plug M12 with an addressing device, → page 17.

Connecting sensor and actuator

RA-MO provides an M12 socket for two sensors and, optionally, one actuator.

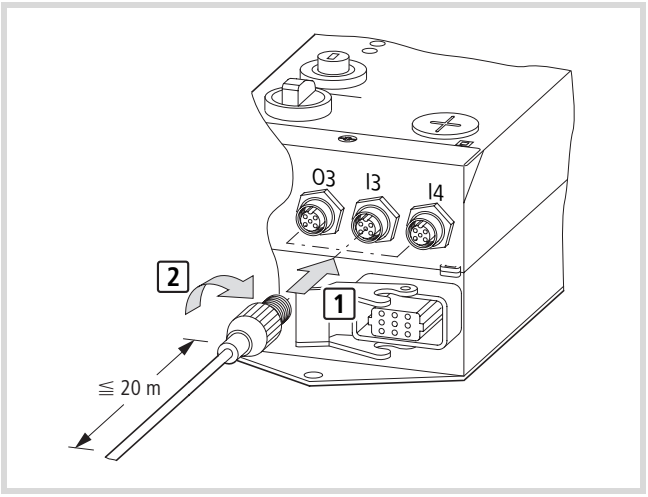
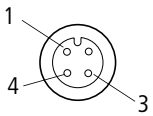


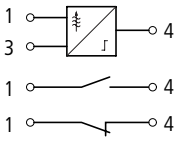
Figure 74: Connection sockets for sensors and actuators

M12		I3	I4	O3
RA-MO…		×	×	–
RA-MO…A…		×	×	×



„A"-coded (IEC/EN 60947-5-2)
1 = brown
3 = blue
4 = black

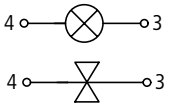
I3 + I4	
1	L+
3	L–
4	I

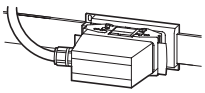


24 V ⎓ Σ I ≦ 160 mA

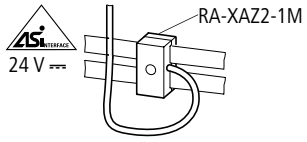
On M12 sockets I3 and I4 with visible nut, pin 2 is not assigned.

O3	
1	–
2	–
3	0 V
4	⎍





24 V H I ≦ 1.0 A



Motor connection

On the RA-MO the motor feeder features a plastic-encapsulated socket. The length of the motor cable is limited to 25 m.

The motor is connected through motor cable SET-M3/…-HF, 8 × 1.5 m^2, 2 – 10 m, unscreened, DESINA-conformant.

Alternatively you can assemble your own motor supply cable with plug SET-M3-A with 8 × 1,5 mm^2

Pin on motor outgoer plug	Core No. Motor cable	Function on motor
1	1	L1 (U1)
2	–	Coding adapter
3	3	L3 (W1)
4	5	Brake ~
5	6	Thermistor 1[1)]
6	4	Brake 230 V ~/400 V ~
7	2	L2 (V1)
8	7	Thermistor 2[1)]
PE	*	PE

1) not with low function types

Pin assignment to DESINA specification → page 24

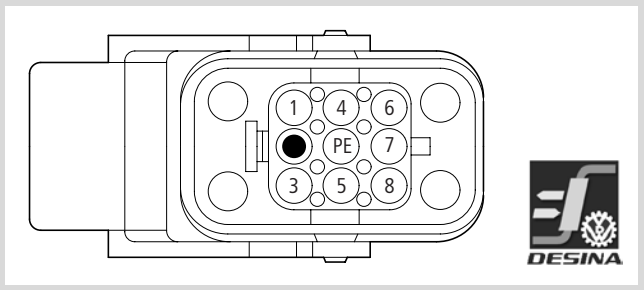


Figure 75: Pin assignment at motor output socket (DESINA)

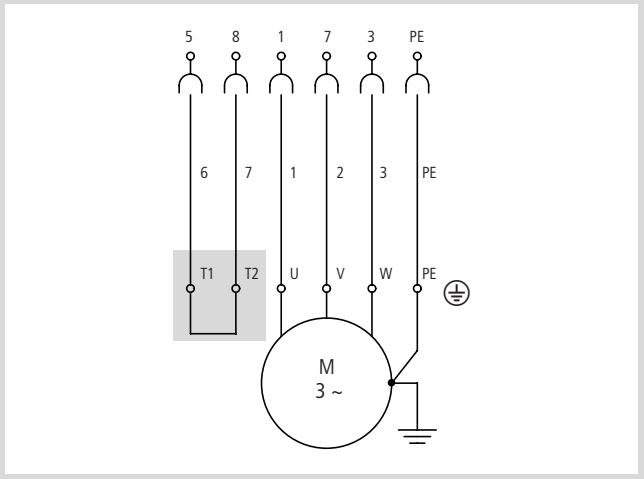


Figure 76: Motor connection without thermistor

→ If motors are connected without PTC thermistor (thermoclick), cables 6 and 7 must be linked at the motor.

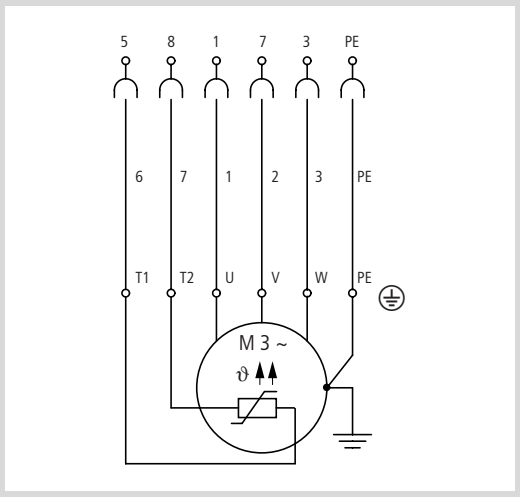


Figure 77: Motor connection with thermistor

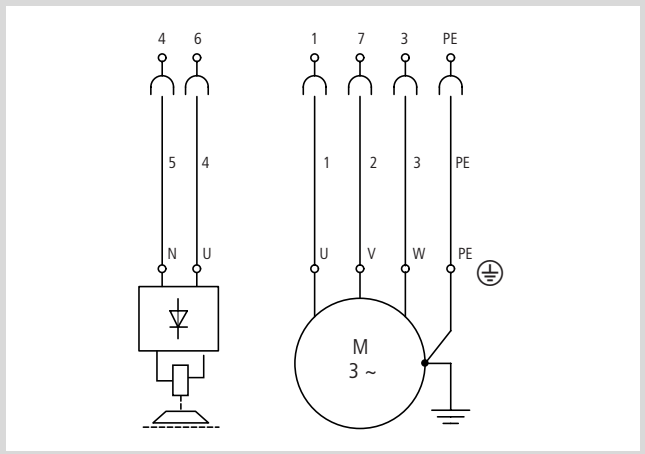


Figure 78: Connection, 230 V AC brake for RA-MO…(230)/…

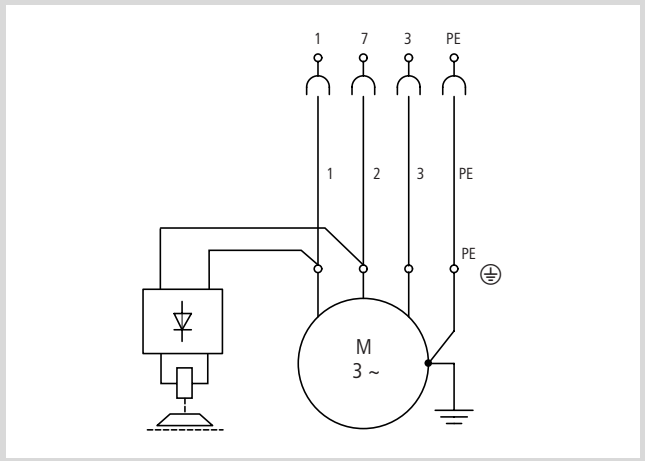


Figure 79: Connection of a 400-V-AC brake

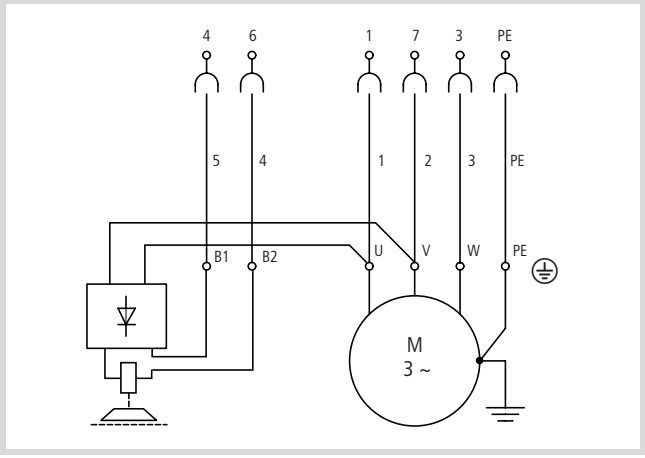


Figure 80: Connection of a 400 V AC brake with rapid braking

For controlling braking motors, their manufacturers provide braking rectifiers, which are fitted in the motor terminal strip. If the DC circuit (→ fig. 80) is opened at the same time, the voltage at the braking coil drops off much quicker, causing the motor to also brake more quickly.

Device operation

Motor control unit RA-MO is supplied ready for connection. It allows the direct operation of a 0.09 to 3 kW, 400 V 50 Hz motor without special technical knowledge.

You can set the following operating modes with key-switches:

- Manual (setup, commissioning, maintenance). In this mode, the motor can amos be operated without PLC.
- Auto (continuous operation through AS-Interface® control). Enable with preselected direction.
- Off or Reset". In switch position Off the contactor actuation is interrupted and the drive is switched off. At the same time, setting the switch to Off resets any fault identified by the RA-MO, such as motor overtemperature (thermistor required) or overload. Faults are indicated by the red LED in the motor symbol and signalled through AS-Interface®.

Functions through AS-Interface®

In addition to the normal control functions, Clockwise Operation and Anticlockwise Operation and signals Automatic Operation and Group Error, sensor signals assigned to the drive can be read and internally processed. The configurable quick stop allows precise stopping, for example on connection points and (eccentric levating platforms). Interlocked manual mode can prevent damage to the conveyed material and the plant in also manual operation.

Through AS-Interface® you can also perform a Reset and read out a detailed diagnostics status. This allows preventive maintenance and simplifies servicing, → page 69 and page 75.

You can also use AS-Interface® to specify whether monitoring of the motor plug (= thermistor monitoring) is part of the Group error or Ready signal.

Commissioning the drive

Caution!
Do not disonnect the motor and power plugs while they are live.

▶ Key-switch in "OFF" position
▶ Selector switch REV-OFF-FWD in Off position

Before commissioning the motor control unit, make sure that the motor is correctly connected and the motor cable is plugged in. The plug M12 to the AS-Interface® connection must be live. The LED ASi-POWER is lit.

Before commissioning, the motor's current value must be set with the DIP switch (→ section "Setting the functions with DIP switches/jumpers", page 79). This ensures that the motor is also protected against overload during commissioning. When the mains cable is connected, the load switch (disconnect control unit RA-DI) then applies mains voltage. LED display UV on the motor symbol indicates readiness for operation. A lit red LED in the motor symbol indicates a group error.

Error handling

▶ Set the key-switch in the OFF position.
▶ Check the DIP switch position (→ page 79).
▶ Check whether
  – the motor plug is plugged in.
  – the thermistor is correctly connected or whether wires 6 and 7 are bridged in the motor terminal board (→ fig. 76 and fig. 77, page 73)
  – the motor is overloaded or too hot
  – there is a short circuit or an overload of sensor inputs I3 or I4 or actuator output O3.
▶ Key-switch in "HAND" position
▶ Selector switch REV-OFF-FWD is used to enable forward (FWD) and reverse (REV) operation. The current selection is indicated by LEDs REV and FWD on the motor symbol.

Safety-relevant power-off (RA-MO24V… only)

→ Only RA-MO24V… features a safety power-off function up to Category 2 according to EN 954-1. By isolating the 24 V at the infeed position, all RA-MO24V… devices on one busbar run are switched off. To activate this function, I/O fault messaging must be on the busbar run on all RA-MO24V… units, → table 18 on page 81.

Warning!

To avoid unexpected starting after a power failure, take the following steps:

- In automatic mode, 24 V DC or 400 V AC:
  Disconnect the 24 V or 400 V and reset the actuation command in the PLC.
- In manual mode, 24 V DC:
  If a directionof rotation has been selected, the drive does not automatically restart when power is restored. The direction LED flashes. To continue manual operation, a Reset command must be issued (key-switch to OFF).
- In manual operation, 400 V AC:
  Activate function "Monitoring lower current limit only in Manual mode" (→ table 17 on page 81). If the 400 V AC fail with this setting, a group error is generated.
  Observe the current limit values on page 78.

I/O fault messages, internal device faults

The RA-MO generates an I/O fault signal (FID) when motor current is flowing even though the contactor is not energized (internal device fault). This can be caused by welded contactors. Replace the contactor in that case.

Warning!
Conversion must be performed only by trained electricians. Incorrect work causes a risk of death through electric shock.

I/O errors are indicated on the RA-MO and on the interface control unit RA-IN by a flashing LED AS-Interface® Error. The PLC contains a list of slaves with I/O errors (LPF) → section "Reading diagnostic status through AS-Interface® parameter channel", page 78.

In the event of an internal device fault, the motor and FWD/REV LEDs also flash. In addition, diagnostics status scanning must be activated through the AS-Interface ® parameter channel.

Internal device faults can be uniquely identified with a RA-MO diagnostic status request (→ table 11 on page 79) with the command WRITE P = 111. If an internal device fault occurs, the 400 V supply of the affected busbar run must be switched off. A Reset can be performed with the key-switch or through AS-Interface®.

Auto configuration for servicing

When you replace a RA-MO with an identical device, the AS-Interface® is automatically transferred.

Requirement:

- Auto-addressing mode is enabled (default setting for RA-IN).
- The 400 V~/24 V supply and AS-Interface® are active.

Procedure:

▶ Connect the new motor starter with the key-switch in the OFF position.

After no more than 0.5 seconds all error LEDs must have gone out.

▶ Select manual or auto operating mode.

Key-switches

The key-switches engage in all positions.

Switch postion	AUTO	0FF RESET	Hand
Key with-drawable	yes	yes	yes
Function	Operation through AS-Interface®, Status signal to PLC	Reset motor protection, no contactor actuation, secured against restarting.	DOL starter: Contactor is actuated directly. Reversing starter: Contactors can be actuated manually through the selector switch.

Reset

As soon as LED Motor has changed from continuously lit to flashing, triggering of the motor preotection function or thermistor protection can be manually reset with switching sequence AUTO → OFF or MANUAL → OFF. To perform a Reset, hold the key-switch in the OFF position for about half a second.

→ With RA-MOL… no local Reset is possible.

The Reset signal through AS-i provides an additional possibility for a motorstarter reset in case the motorstarter is not accessible for a local reset. The local reset with the key-switch reamins the main reset function, since it is necessary for analysing and eliminating fault causes locally.

In automatic operation the RA-MO interprets simultaneous setting of the forward and reverse operation outputs (data bits DO0 and DO1) as a Reset. Before a reset, data bits DO0 and DO1 must be Low for at least 18.5 ms. Thereset is performed when the data bits are then High for at least 18.5 ms.

On a motor overload a reset is possible only when the motor is eady for operation again due to the thermal memory or the thermistor resistance.

Selector switch

The key-switches engage in all positions.

Switch postion	REV	OFF	FWD
Function (with key-switch in MANUAL position only)	Reversing contactor actuated	No actuation of contactors	Main contactor actuated

Description of functions

Phase reversal

Three-phase motors work with clockwise rotating fields (viewed from the motor shaft) when phase L1 is connected to U1, L2 to V1 and L3 to W1. This default operating direction may be reversed through gearboxes or different mounting positions. With the reversing starter, the operating direction can be reversed with the phase reversal switch (pole 7 of the DP switch under the front locking screw, → table 14, page 81) without rewiring or reprogramming.

With control signal FWD (LED FWD lit) a clockwise rotating field is output in switch position Top (default) and an anticlockwise rotating field in switch position Bottom.

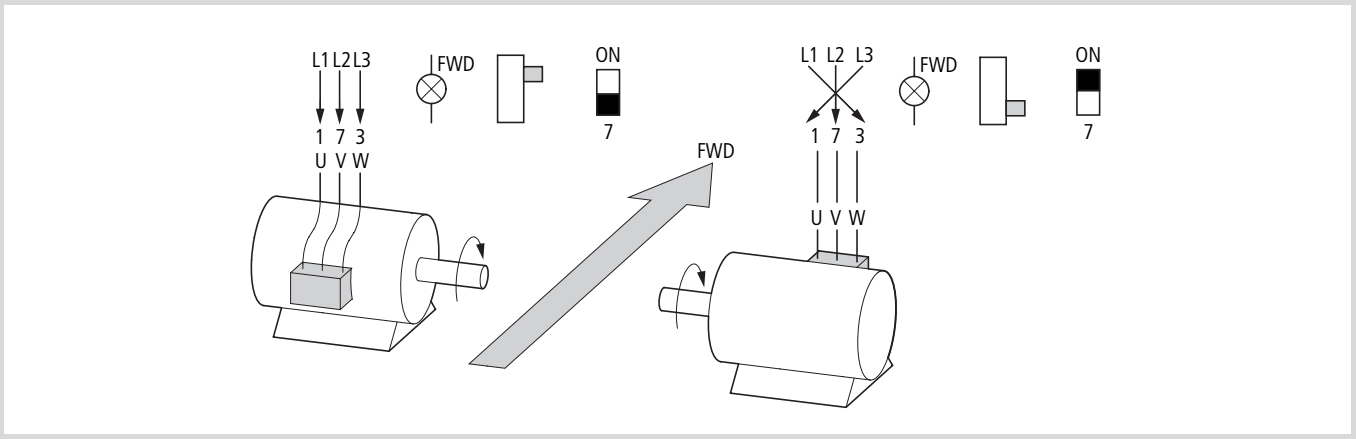


Figure 81: Direction of rotation

Quick stop and interlocked manual mode

Motor starter RA-MO has two external inputs, through which two light barriers, sensors or limit switches can be connected. You can configure these inputs as Quick Stop or Interlocked Manual operation with DIP switches.

The Quick Stop function allows precision stopping of the drive. When the limit switch is reached, the drive switched off directly through preprocessing of the motor starter. PLC and bus cycle times do not affect the power-off times.

Depending on yuor application, there are several ways of configuring the Quick Stop function:

- Input I3 acts on both directions of rotation and I4 has no additional function.
- Input I3 acts on Forward direction and I4 on Reverse direction.
- Inputs I3 and I4 act on Forward direction, → section "Configuration overview (pins 5 to 8)", page 80.

Interlocked manual mode can prevent damage to the conveyed material and the plant in also manual operation. If you have selected this function, limit switch I3 limits the possible forward travel and limit switch I4 limits the possible reverse travel.

If the material reaches the limit switch in Manual mode, the drive stops even if the selector switch remains in an actuating position.

In addition you can use this function to ajust the light barriers before commissioning the PLC.

Quick stop

When the input signal arrives (rising edge), the motor starter electronicsde-energize the assigned contactor. The input signal must be applied for at least 7 ms. As soon as the PLC output is reset (falling edge), the contactor can be switched on again. Whether the input signal is still applied during the reset or during restarting of the PLC output as no effect → figure 82.

Sensors with break contacts can also be used. In this case the motor starter's DIP switch must be set accordingly.

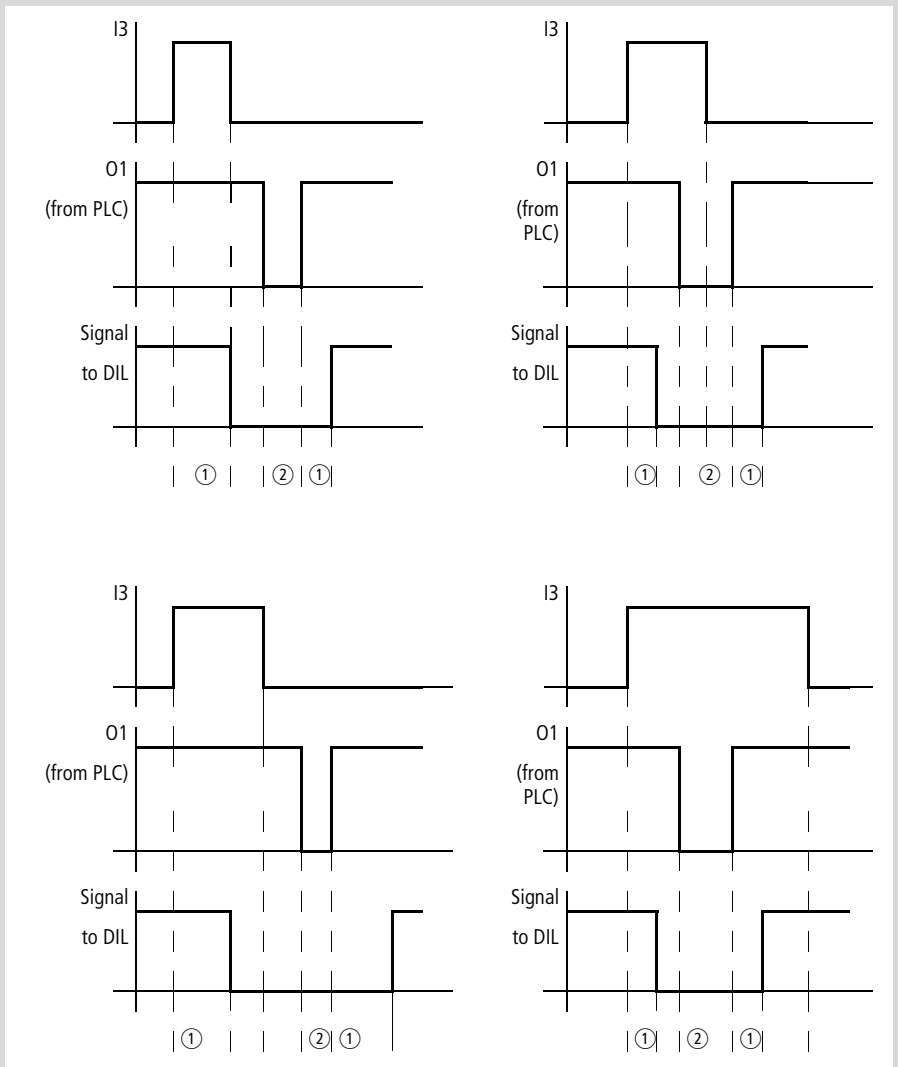


Figure 82: Quick stop in Automatic mode (Example: I3 and forward rotation)

① 13.5 ms ± 5 ms

② dependant upon PLC programme

LED signal on Quick stop:

LED FWD or REV is lit when the PLC has set the associated operating direction bit. LED FWD or REV flashes when the contactor has been switched off through the Quick stop and the PLC' directio of rotation bit continues to be set.

Interlocked manual mode
After the rising signal edge of I3 or on a continuous signal forward rotation can be selected only in automatic operation; manual selection is possible only for reverse operation. Manual selection of forward rotation is possible again only after a falling edge at I3 during reverse operation or after a changeover to automatic mode and back again). The same applies for I4 and reverse rotation.

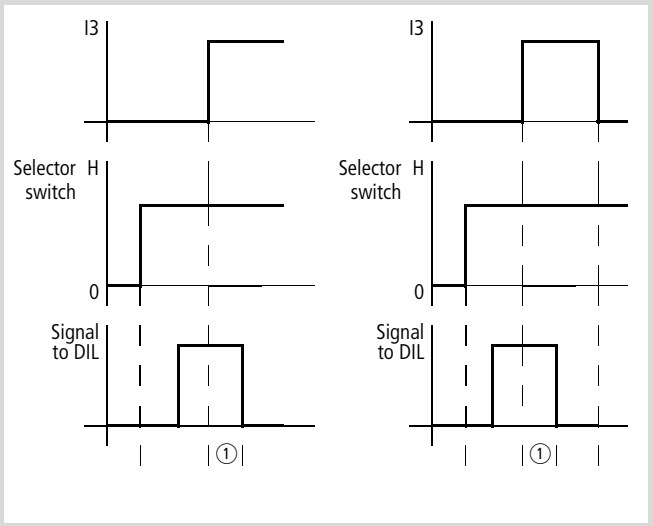


Figure 83: Interlocked manual operation (example: I3 and forward rotation)

① 13.5 ms ± 5 ms

- Interlocked manual mode for 360° movements with two break points:

With jumper setting DOL starter and DIP switch setting pole 6 = 1 and pole 8 = 0 interlocked manual mode is edge-controlled only. When a break point is reached, this allows continued manual operation in the same direction by briefly switching over to automatic mode and back again.

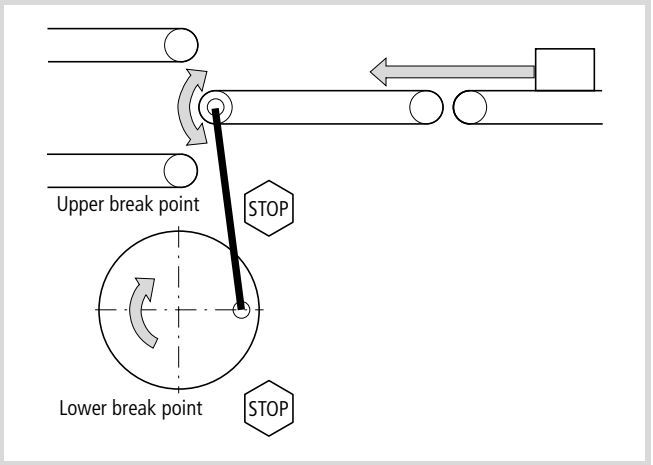


Figure 84: Example: vertical sorter with 360° eccentric

- LED signal on interlocked manual mode:

LED FWD or REV is lit when the assigned direction has been set with the selector switch. LED FWD or REV flashes when the selector switch is being operated but the contactor is switched off due to interlocked manual mode.

Monitoring of lower current limit

After the assigned jumper or DIP switch has been set (→ figure 85), the lower current limit is monitored. When the current drops below 25 percent of the set value (→ table 13 auf page 80), a group error message is generated and the contactor is switched off. Current values above 30 percent of I_n do not trigger lower current level monitoring. After a Reset command the RA-MO can be operated in both manual and automatic mode.

Reading diagnostic status through AS-Interface® parameter channel

To be able to read out the diagnostic status (DIP pole 10 = 1) the PLC with WRITE P must send the parameter bit combination 111. The motor starter returns the diagnostic status (→ table 11). If no diagnostic data is available, the motor starter returns the parameter bit combination 111.

If two or more diagnostic messages apply at the same time, the message with the highest priority is displayed until the fault that triggered the diagnosis has been rectified and the Reset command has been issued. Then the diagnostic message with the next highest priority is displayed. The messages are listed inorder of their priority, with the highest-priority message at the top of the list.

Diagnostic messages Manual Operation (status_local_operation) and Current Tresholds (status_overload_warning and status_load_indication) are reset automatically and do not therefore need a Reset command.

→ In addition to the detailed error messages, load messages are also transmitted to allow preventive plant maintenance.

If the PLC sends a value other than 111, the returned value is undefined.

Further information can be found at section "Background information for PLC technicians about the function principle of parameter transmission in RA-MO, RA-SP and RA-IN" on page 11.

Table 11: Indication of diagnostic status

Diagnosic-status	Status			group errors[1]	Peripheral error (FID)	Explanation
	P1	P2	P3	DI1		
Contactor faulty	0	0	1	1	1	Contactor in On position without actuation signal
Overload trip	0	1	0	1	0	Trip from 110 % of thermal motor simulation value
Thermistor tripping	0	1	1	1	0	Tripping through excessive resistance in thermistor sensor circuit
NO diagnostic signal	1	1	1	1	0	Possible causes: • Overload or short circuit of external inputs I3, I4 • Overload or short circuit of external output O3 • Incorrect DIP switch setting • No 24 V supply voltage • Tripping on drop below lower current threshold
Manual mode	1	0	0	0	0	Key-switch in MANUAL position
Load signal	1	0	1	0	0	Signal from 90 % of thermal motor simulation value
Load signal	1	1	0	0	0	Signal from 70 % of thermal motor simulation value

1) see I/O error message on page 75

Set plug monitoring as part of Ready message

The motor plug monitoring message can also be assigned to Ready message DI0 (→ section "I/O assignment" on page 69).

This is recommended if

- the motor plug is used as isolating switch in combination with lock shackle SET-M-LOCK (→ page 152).
- motors without temperature sensor winding are used and T1/T2 in the motor's terminal board ae bridged (→ figure 76 on page 73).

If maintenance work is performed under these conditions with disconnected and locked motor plug, a Not Ready signal makes more sense than a fault message.

To activate this operating mode, close the left hook jumper (→ table 12 on page 80).

In this opeating mode, a high-resistance connection between pins 5 and 8 of the motor plug (thermistor tripping or no motor plug) the following effects:

- The motor switches off (as in the normal operating mode).
- No group error message is applied to DI1.
- LED Motor does not indicate a group error message.
- No Ready signal is applied to DI0, even if the key-switch is set to AUTO.

Setting the functions with DIP switches/jumpers

When the locking screw in the cover is undone, the electronics can be configured through jumpers and DIP switches.

→ Before you change the configuration and parameter settings, make sure the key-switch is in its OFF position.

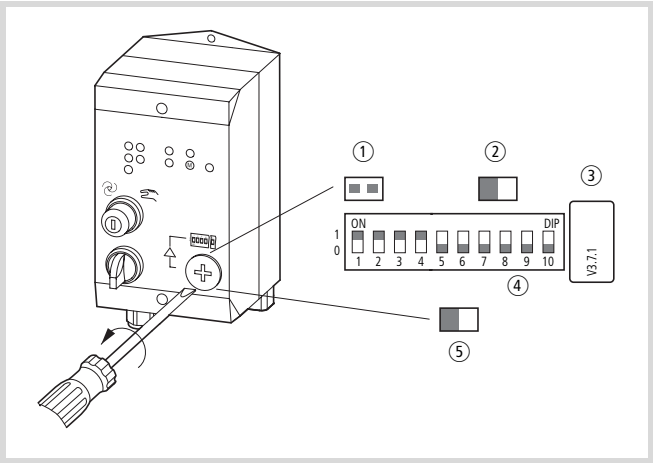


Figure 85: DIP switch/jumper

① Jumper left, settings → table 12
② Jumpers right → table 12
③ Information digit for service
④ DIP switches: 1 – 4 for setting current values → page 80
5 – 10 for setting additional functions → page 81
⑤ Jumper bottom, → table 12

Table 12: Function of jumper settings

Jumper left		Jumper bottom		Jumper right	
Monitoring of motor plug (= thermistor monitoring)[1]		Supply voltage, contactors		Starter type	
open (default)	closed	left	right	left	right
Part of group error message	Part of Ready message	24 V DC	400 V AC	Reversing starters	DOL Starters

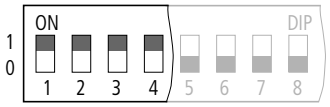
1) → section "Set plug monitoring as part of Ready message" on page 79.

Caution!
Do not change the Jumper bottom and Jumper right settings.

Setting current values (pins 1 to 4)

The current values can be set with pins 1 to 4 of the DIP switch:

Table 13: Setting of the current with DIP switch



1	2	3	4	
1	1	1	1	No function (factory setting)[1]
1	0	1	1	0.3 A
0	1	1	1	0.4 A
1	0	0	0	0.6 A
0	1	0	0	0.8 A
1	1	0	0	1.0 A
0	0	1	0	1.2 A
1	0	1	0	1.5 A
0	1	1	0	1.7 A
1	1	1	0	1.9 A
0	0	0	1	2.1 A
1	0	0	1	2.6 A
0	1	0	1	3.6 A
1	1	0	1	5.0 A
0	0	1	1	6.6 A
0	0	0	0	No function[1]

1) RA-MO can not be operated. The red LED in the motor symbol is lit. A group error is active.

Configuration overview (pins 5 to 8)

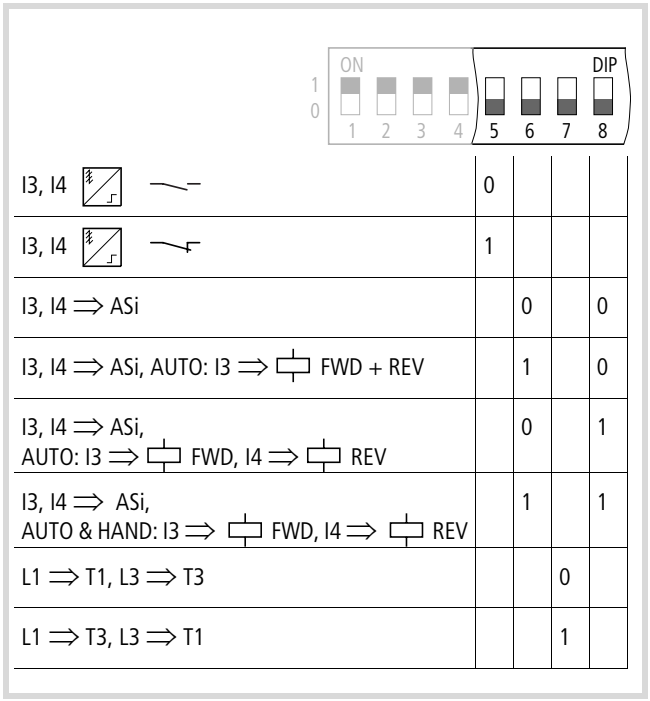


Figure 86: Configuring the RA-MO…W…

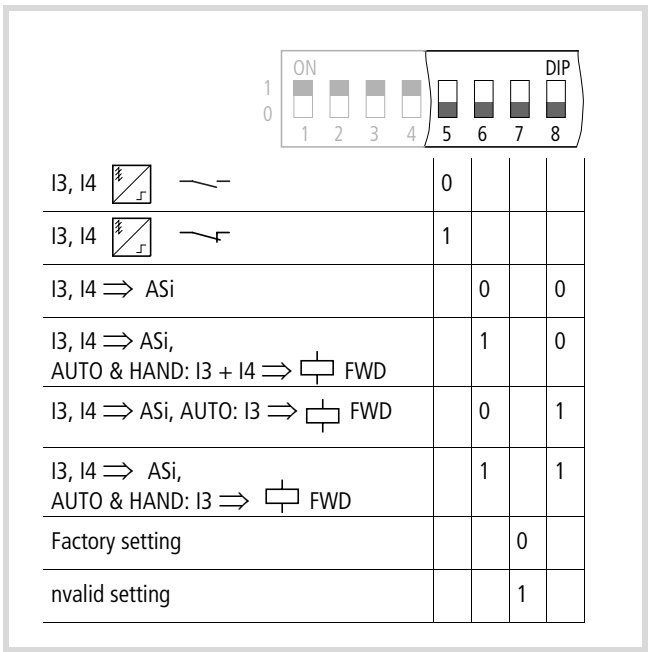


Figure 87: Configuring the RA-MO…D…

Activate phase reversal switch (pole 7)

→ For this setting, the jumper on the right must be in its left position (→ fig. 85).

Danger!
Safety risk! The jumper positions and the setting of DIP switch pole 7 must be changed only by trained persons and only in accordance with this manual. Incorrect settings will reverse the operating direction.

Table 14: Phase reversal and reversing function

pole 7	Configuration
0	Reversing starter (factory setting)
1	Reversing starters and phases L1 and L3 reversed (phase reversal)

Configure external outputs (pole 5 – 6, 8)

The RA-MO provides two external inputs for connecting light barriers, sensors, etc. Add-on functions are:

- Quick stop with a light barrier for both directions
- Quick stop and interlocked manual mode with both light barriers for clockwise rotation
- Quick stop with one light barrier per operating direction
- Interlocked manual operation with one light barrier per operating direction
- When using break contacts, inversion of the signals for internal processing.

You can configure the external inputs through pins 5, 6 and 8 of the DIP switch:

Table 15: Sensors

pole 5	Configuration
0	Sensor signals through AS-Interface®, no add-on function (factory setting)
1	When using sensors with break contacts: Signals are inverted for internal processing; the original signals are sent through AS-Interface®.

Table 16: Setting quick stop and interlocked manual mode

Pole 6	Pole 8	Configuration for RA-MO…
0	0	No add-on function (factory setting)
1	0	With jumper setting Reversing starter: Quick stop, I3 enabled. I3 is assigned to both operating directions, I4 has no add-on function; typical application example: chain discharger
		With jumper setting DOL starter: Quick stop and interlocked manual operation (edge-controlled only), I3 and I4 enabled. I3 and I4 are assigned to operating direction FWD; typical application: vertical sorter with > 360° eccentric
0	1	Quick stop, I3 and I4 enabled. I3 is assigned to operating direction FWD, I4 is assigned to operating direction REV; Typical application: Vertical sorter with < 360° eccentric
1	1	Quick stop and interlocked manual operation, I3 and I4 enabled. I3 is assigned to operating direction Forward, I4 to operating direction Reverse; typical example: Vertical sorter with < 360 ° eccentric

→ With RA-MOL… manual operation is not possible.

Monitoring the lower current limit with RA-MO24V

Table 17: Monitoring the lower current limit

pole 9	Configuration
0	Monitoring of lower current limit disabled (factory setting)
1	Monitoring of lower current limit enabled

→ In 400 V models current monitoring is always enabled.

Diagnostic status through AS-Interface® parameter channel

Table 18: Diagnostic status through AS-Interface® parameter channel

pole 10	Configuration
0	Diagnostic status through AS-Interface® parameter channel and I/O error signal disabled (factory setting).
1	Diagnostic status through AS-Interface® parameter channel and I/O error message enabled.

Diagnose and status via LEDs

LED	Colour	Meaning	no signal	flashes	Signal
AS-Interface® Power	green	AS-Interface®-voltage	missing	–	applied
AS-Interface® FAULT	red	AS-Interface®-fault	no fault	Peripheral fault, → page 75 FWD/REV LED and motor LED flashing:Internal device fault, → page 75	Communication error, e.g. slave not addressed.
UV	green	Auxiliary power 1)	missing	–	applied
FWD	green	Forward operation (main contactor)	not actuated	not actuated because • light barrier has been reached in interlocked manual operation or quick stop • auxiliary power or AS-Interface® power failed and was restored in manual operation2) If motor LED and AS-Interface® LED also flash: Internal device error, → page 75	actuated
REV	green	Reverse operation (reversing contactor)	not actuated		actuated
O3	green2)	User-configurable LED or external output through M12 socket on RA-MO…A/…	not actuated	–	actuated
–	–	Automatic, indicated by key-switch	–	–	–
„Motor"	red	Group error: • Overload motor • Thermistor tripping3) • motor plug not plugged in3) • DIP switch position invalid • No 24 V/400 V auxiliary power (without LED indication) • Overload/short-circuit O34) • Overload/short-circuit I3/I44) • Current below lower limit5)	no fault	tripped, Reset ready (motor cooled down) If AS-Interface® error LED and FWD/REV LED also flash: Internal device error, → page 75	applied
I3	green	external input via M12 socket	not actuated	–	actuated
I4	green	external input via M12 socket	not actuated	–	actuated

1) Auxiliary power: 400 V AC for devices with 400 V AC contactors, 24 V DC for devices with 24 V DC contactors)

2) Automatic restarting after a 24 V power failure is prevented. To continue manual operation, a Reset command must be issued (key-switch to OFF).

3) When the jumper is closed, thermistor tripping or a disconnected motor plug do not cause a group error signal but suppress Ready signal DI0.

4) On overload or short circuit at I3m I4 or O3, the RA-MO generates a group error message.

5) → section "Monitoring of lower current limit" on page 78.

6 Speed controller RA-SP

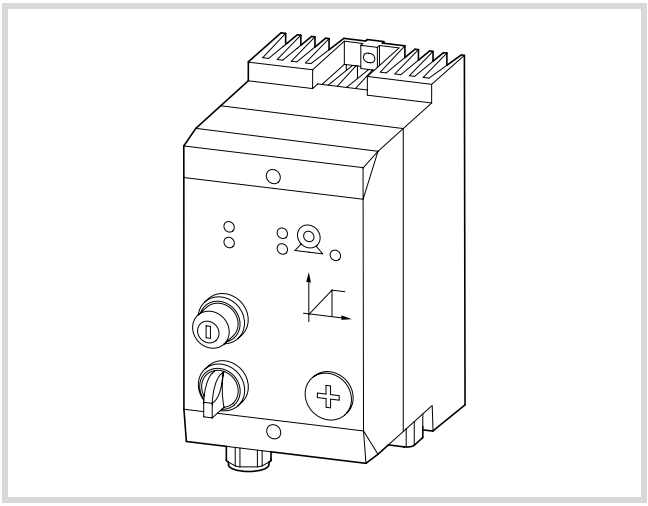


Figure 88: Speed Control Unit

Speed control unit RA-SP is used for electronic variable speed control of three-phase motors.

→ Unlike the other Rapid Link system devices, the RA-SP speed control unit's enclosure is fitted with a heat sink and requires an EMC-conformant mounting and connection.

Device overview

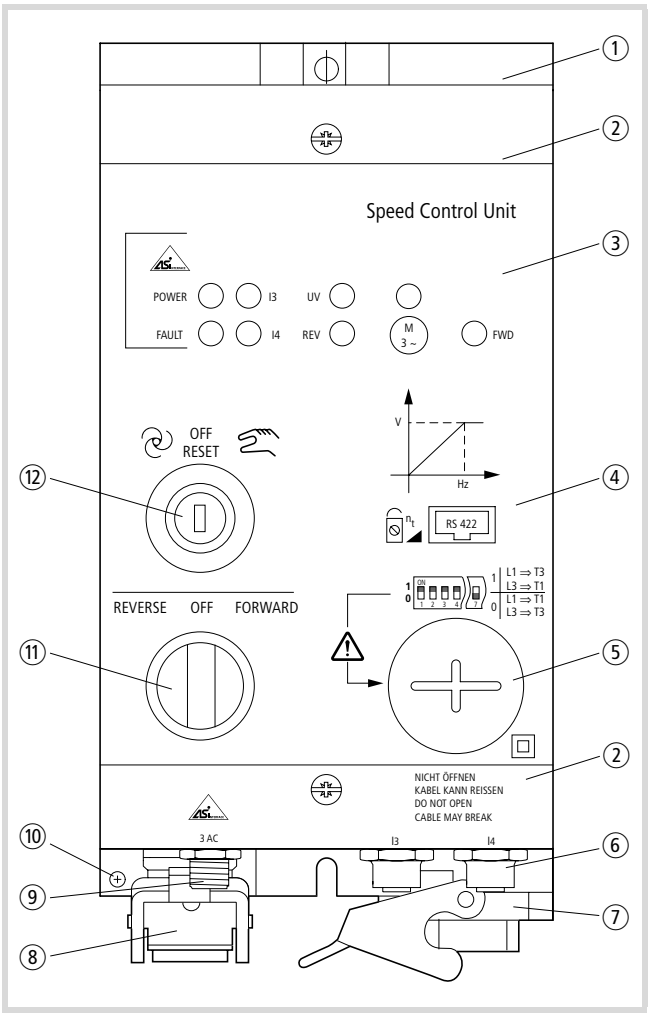


Figure 89: Overview RA-SP

① Heat sink
② Space for labelling top and bottom
③ Status and diagnostic LEDs (→ page 106)
④ Graphical representation: Operating characteristic and setting possibilities
⑤ Locking screw: Opening for configuration of DIP switch, Parameterization through RS 422 and reference value potentiometer (→ page 103)
⑥ For version RA-SP…342 (343): Two additional inputs through M12 for external sensors
⑦ Motor output plug (screened version) for motor cable SET-M4/…-HF with servo cable, halogen-free, screened
⑧ Power bus connection with prefabricated cable 7 × 1.5 mm² (approx. 1.45 m incl. plug) or power plug for fitting by user (5-pole)
⑨ AS-Interface® connection with M12 prefabricated cable, approx. 0,5 m or M12 plugs for fitting by user
⑩ Earthing bolt
⑪ Selector switch for setting direction of rotation in manual mode
⑫ Key-switch for manual and automatic mode

Key to part numbers

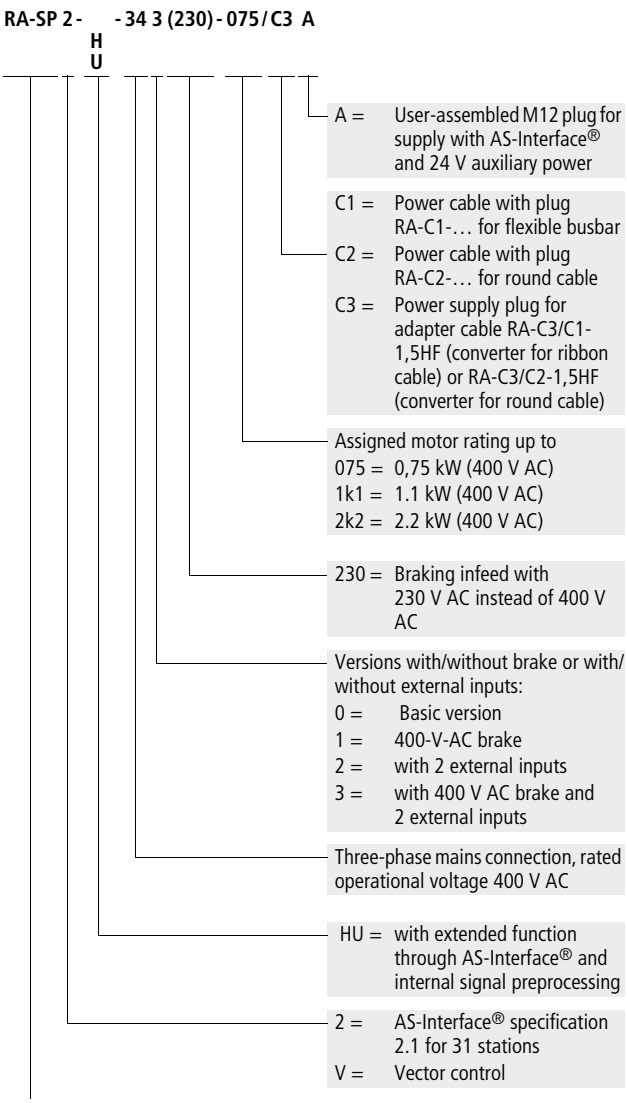


Figure 90: Key to part numbers RA-SP

Proper use

Die Speed Control Unit RA-SP is not a domestic appliance. It is designed only for industrial use as a system component.

The Speed Control Unit is an electrical apparatus for controlling variable speed drives with variable-speed drives with three-phase motors. It is designed for installation in machines or for use in combination with other components within a machine or system.

After installation in a machine, the RA-SP must not be taken into operation until the associated machine has been confirmed to comply with the safety requirements of Machinery Safety Directive (MSD) 89/392/EEC. The user of the equipment is responsible for ensuring that the machine use complies with the relevant EU Directives.

The CE markings confirm that, when used in a typical drive configuration, the apparatus complies with the European Low Voltage Directive (LVD) and the EMC Directives (Directive 73/23/EEC, as amended by 93/68/EEC and Directive 89/336/EEC, as amended by 93/68/EEC).

In the described system configurations, the Speed Control Unit RA-SP is suitable for use in public and non-public networks. Depending on their location of use, external filtering may be necessary.

Only three-phase motors must be connected to the output of the RA-SP. Connecting of any of the following is not permissible:

- Voltage,
- capacitive loads,
- other outputs (parallel connection of RA-SP, RA-MO),
- Bypass circuit
- direct connection to input.

Observe the technical data and terminal requirements. For additional information, refer to the equipment nameplate or label and the documentation.

Any other usage constitutes improper use.

Features of the Speed Control Unit

The speed control unit RA-SP allows soft starting and operation of motors at up to four different fixed speeds. RA-SP supplies a linear torque, even at low speeds. The controlled motor start reduces mechanical strain as well as power consumption.

With AS-Interface® you can select direction enable and three fixed frequencies (30, 40 and 50 Hz) in AUTO operating mode. In HAND (manual)mode you can set a speed of 0 to 50 Hz through the spindle potentiometer (10-turn, under the screw cover on the device front; default setting → page 114). Enable and operating direction are defined with the selector switch. The individual operating states are indicated by LEDs.

Version RA-SP2-… allows direct operation (without parameterization) of four-pole three-phase asynchronous motors up to a shaft rating of 0.75, 1.1 or 2.2 kW at 400 V.
For motors with different ratings or a different number of poles, check and, if necessary, change the parameters.

▽ **Caution!**
The speed control unit must be used only in combination with this user manual.

Engineering

Overview of functions, RA-SP

→ The speed control unit RA-SP2-340-… is based on the series DF5-340-… frequency inverters.

The DF5-340-… is a voltage-controlled frequency inverter with *U/f* characteristic control. All functions, parameters and technical data are described in manual AWB8230-1412. For RA-SP2-340-… only some of the corresponding frequency inverter's functions and parameters can be used.

The speed control unit (RA-SP2-34…) has the following characteristics:

- Voltage disconnection through decentralized power supply (RA-DI).
- Protection against reconnection of motor cable during motor maintenance with Lock shackle SET-M-LOCK (→ page 152).
- Fixed frequencies for up to four independent motor speeds.
- Three digital and one analog fixed frequency.
- Parameterizable operating data (acceleration and deceleration time, current limitation, etc.)
- Actuation of motors featuring brakes with an external 400 V AC or 230 V AC power supply.
- Connection of two light barriers, sensors or limit switches through two M12 sockets.
- Automatic actuation through AS-Interface® (start forward operation, start reverse operation, digital reference frequency input board).
- The lower section of the enclosure acts as a heat sink.

→ The speed control unit RA-SPV-HE-340-… is based on the series DV5-340-… vector frequency inverters.

The DV5-340-… is a frequency inverter with sensorless vector control and extended functionality compared to the DF5-340-… (RA-SP2-340-…). All functions, parameters and technical data are described in manual AWB8230-1414. For RA-SPV-HE-340-… only some of the corresponding frequency inverter's functions and parameters can be used.

Additional feature of the RA-SPV-… over the RA-SP2-… is its built-in brake chopper with braking resistor for dynamic braking.

	Basic functions RA-SP	→ Page
Communication and actuation	AS-Interface® connection, specification 2.1 for 31 stations RA-SP2-HE…: Reading a detailed diagnostics status through the AS-Interface® parameter channel	20
Motor actuation	0.37 to 0.75 kW/0.75 to 1.1 kW/1.1 to 2.2 kW (assigned shaft rating at 400 V)	–
Parameterization	Through serial RS 422 interface (under screw cover)	105
Variants	Prefabricated for flexible busbar (RA-SP…C1), round cable (RA-SP…C2) or user-assembled power plug (RA-SP…C3)[1]	9
Monitoring	Thermistor monitoring, short-circuit and earth-fault protection on Power-On, thermal overload, overvoltage	99
Frequencies	Frequency range 0.5 to 360 Hz (motor), rated frequency 50/60 Hz (power supply), pulse frequency 0.5 to 5 kHz	123, 128, 136
Phase reversal	Configurable: forward or reverse operation through DIP switch or parameterization with PC	105
Mounting	Plug-in connections	13, , 99
Display	Separate status and diagnostic LEDs	106
EMC	Built-in mains filter for environment 2 (industrial systems), limit value class A	92
Manual mode	AUTO-OFF-HAND with key-switch, commissioning without higher-level control possible; in manual operation the specified speed can be selected in both directions with selector switch REV-OFF-FWD (spindle potentiometer).	103
Ramp function	Acceleration and deceleration through adjustable times from 0.1 to 3000 s	126
Motor connection	Pluggable, pin assignment to DESINA specification	99
Characteristic curves	*U*/*f* control for four-quadrant operation with linear and square-wave load characteristic	125
Startup behaviour	Matching through adjustment of breakaway torque (boost) and S-curve characteristic (soft starting or for conveying systems)	125, 127
Inching operation	Through optional hand-held keypad (DEX-KEY-10) for setup and maintenance work	115

1) Actuation of brakes with 400 V AC (RA-SP…341/343) or 230 V AC (RA-SP…341(230)/343(230))
Connection of two light barriers, sensors or limit switches through M12 sockets (RA-SP…342/343)
RA-SP-HE… with extended functionality through AS-Interface® and built-in signal preprocessing

Sensor connection through M12

The sensor connection cables for inputs I3 and I4 must not be longer than 20 m each. The sensors are supplied through the AS-Interface®. Do not connect capacitive sensors. The sensors' total power consumption must not exceed 160 mA. The power supply is short-circuit proof.

Accessories (optional)

- Motor cable SET-M4/…-HF with prefabricated, halogen-free servo cable, screened, 2/3/5/10 m.
- Lock shackle SET-M-LOCK for motor cables SET-M4… (→ page 152).
- Motor connection plug SET-M4-A with metal-encapsulated housing for user assembly. The permissible length of a screened motor cable depends on the model, → table 19 on page 87.
- Adapter cable for power supply to flat or round cable RA-C3/C…-1,5HF
- Power plug RA-C3-PLF for user assembly for speed controller RA-SP…/C3A
- Spare key for key-switch M22-ES-MS1
- External keypad DEX-KEY-10 with memory function and required connection cable DEX-CBL-1M0-ICS, 1 m or DEX-CBL-3M0-ICS, 3 m.
- Connection cable with interface converter DEX-CBL-2M0-PC, 2 m, for communication with PC through RS 422 serial interface (under screw cover) for Moeller parameterization Drives Soft (ftp://ftp.moeller.net/DRIVES/).

Selection criteria, RA-SP2…

Select a suitable RA-SP2-34…-… according to the rated motor current. The RA-SP's rated output current must be greater than or equal to the motor's rated current.

Table 19: Overview of technical data of RA-SP2:

	Permissible setting ranges/ supply data			Factory setting		
	075	1K1[1]	2K2	075	1K1	2K2
Assigned motor shaft rating						
At 400 V	0,37 ti 0,75 kW	0,75 to 1,1 kW	1,1 to 2,2 kW	0.75 kW	1.1 kW	2.2 kW
At 460 V	¼ to 1 HP	½ to 1 HP	1 to 3 HP	1 HP	1 HP	3 HP
Apparent power at output	≦ 1,9 kVA	≦ 2,2 kVA	≦ 4,3 kVA	1.9 kVA	2.2 kVA	4.3 kVA
Mains supply voltage	3 AC 400 V (342 V – 0 % to 506 V +0 %)					
Supply frequency	50/60 Hz (47 Hz – 0 % to 63 Hz +0 %)					
Mains input current	3, 3 A	3.6 A[2]	6.4 (7) A[4]	3.3 A	3, 5 A	7A
Rated operational current I_e (motor connection)	2, 5 A	2.8 A[3]	5 (5.5) A[5]	2, 5 A	2, 8 A	5A
Permissible overcurrent (b22) * for a duration of 60 s (once every 10 min)	3.75 A* (= 150 %)	4.2 A* (= 110 %)	7.5 A* (= 136 %)	3, 1 A (= 125 %)	3.5 A (= 92 %)	6, 25 A (= 114 %)
Tripping current for electronic motor protection (b12)	1.25 to 3 A	1,9 to 4,56 A	2.75 to 6.25 A	2, 5 A	3.53 A	5A
Heat dissipation at 5 kHz pulse frequency	≦ 44 W	≦ 50 W	≦ 92 W	44 W	50 W	92 W
Output frequency						
1. Fixed frequency (A21)	0.5 to 50 Hz, max. 360 Hz			30 Hz	30 Hz	30 Hz
2. Fixed frequency (A22)	0.5 to 50 Hz, max. 360 Hz			40 Hz	40 Hz	40 Hz
3. Fixed frequency (A23)	0.5 to 50 Hz, max. 360 Hz			50 Hz	50 Hz	50 Hz
Analog fixed frequency through potentiometer	0.5 to 50 Hz, max. 360 Hz			approx. 10 Hz	approx. 10 Hz	approx. 10 Hz
Acceleration time (F02)	0.1 to 3000 s			10 s	10 s	10 s
Delay time (F03)				2 s	2 s	2 s
U/*f*-characteristic (A44)	Linear, square-wave			linear	linear	linear
Pulse frequency (b83)	0.5 to 16 kHz	0.5 to 5 kHz	0.5 to 5 kHz	5 kHz	5 kHz	5 kHz
Max. permissible length of motor cable (EMC, second environment, limit value class A)	15 m	15 m	10 m	15 m	15 m	10 m

1) The speed control unit RA-SP2…1K1… is based on the series DF5-340-1K5 frequency inverters and has the same enclosure as the RA-SP2…075. The supply ratings are reduced due to the smaller heat sink.

2) At a motor current of 2.8 A the supply current is 3.6 A.

3) The power section's rated operational current (DF5-340-1K5) is 3.8 A and results in a mains input current of 5 A. To prevent inadmissible heat generation, the output current is limited to 2.8 A.

4) At a motor current of 5 A the supply current is 6.4 A.

5) The power section's rated operational current (DF5-340-2K2) is 5.5 A and results in a mains input current of 7 A. To prevent inadmissible heat generation, the output current is limited to 5 A.

Selection criteria, RA-SPV…

Select a suitable RA-SPV-34…-… according to the rated motor current. The RA-SP's rated output current must be greater than or equal to the motor's rated current.

Table 20: Overview of technical data of RA-SPV:

	Permissible setting ranges/ supply data			Default settings		
	075	**1K1**[1]	**2K2**	**075**	**1K1**	**2K2**
Assigned motor shaft rating						
At 400 V	0,55 to 0,75 kW	0,75 to 1,1 kW	1,5 to 2,2 kW	0.75 kW	1.1 kW	2.2 kW
At 460 V	½ to 1 HP	¾ to 1 HP	2 to 3 HP	1 HP	1 HP	3 HP
Apparent power at output	≦ 1,9 kVA	≦ 2,2 kVA	≦ 4,3 kVA	1.9 kVA	2.2 kVA	4.3 kVA
Mains supply voltage	3 AC 400 V (342 V – 0 % to 506 V +0 %)					
Supply frequency	50/60 Hz (47 Hz – 0 % to 63 Hz +0 %)					
Mains input current	3,3 A	3.6 A[2]	6,4 (7) A[4]	3.3 A	3.5 A	7 A
Rated operational current I_e (motor connection)	2,5 A	2.8 A[3]	5 (5,5) A[5]	2.5 A	2, 8 A	5 A
Permissible overcurrent (b22) * for a duration of 60 s (once every 10 min)	3,75 A* (= 150 %)	4,2 A* (= 110 %)	7,5 A* (= 136 %)	3.1 A (= 125 %)	3.5 A (= 92 %)	6.25 A (= 114 %)
Tripping current for the electronic motor protection (b12)	1,25 to 3 A	1,9 to 4,56 A	2,75 to 6,25 A	2.5 A	3.53 A	5 A
Heat dissipation at 5 kHz pulse frequency	≦ 44 W	≦ 50 W	≦ 92 W	44 W	50 W	92 W
Output frequency						
1. Fixed frequency (A21)	0,5 to 50 Hz, max. 360 Hz			30 Hz	30 Hz	30 Hz
2. Fixed frequency (A22)	0,5 to 50 Hz, max. 360 Hz			40 Hz	40 Hz	40 Hz
3. Fixed frequency (A23)	0,5 to 50 Hz, max. 360 Hz			50 Hz	50 Hz	50 Hz
Analog fixed frequency through potentiometer	0,5 to 50 Hz, max. 360 Hz			approx. 10 Hz	approx. 10 Hz	approx. 10 Hz
Acceleration time (F02)	0,1 to 3000 s			10 s	10 s	10 s
Delay time (F03)				2 s	2 s	2 s
U/*f*-characteristic (A44)	SLV (linear, b square-law)[6]			SLV	SLV	SLV
Pulse frequency (b83)	0,5 to 16 kHz	0,5 to 5 kHz	0,5 to 5 kHz	5 kHz	5 kHz	5 kHz
Brake chopper (b90)[7]	0 – 100 %	0 – 100 %	0 – 100 %	0 %	0 %	0 %
Max. permissible length of motor cable (EMC, second environment, limit value class A)	15 m	15 m	10 m	15 m	15 m	10 m

1) The speed control unit RA-SPV…1K1… is based on the series DV5-340-1K1 frequency inverters and has the same enclosure as the RA-SPV…075. The supply ratings are reduced due to the smaller heat sink.

2) At a motor current of 2.8 A the supply current is 3.6 A.

3) The power section's rated operational current (DV5-340-1K5) is 3.8 A and results in a mains input current of 5 A. To prevent inadmissible heat generation, the output current is limited to 2.8 A.

4) At a motor current of 5 A the supply current is 6.4 A.

5) The power section's rated operational current (DV5-340-2K2) is 5.5 A and results in a mains input current of 7 A. To prevent inadmissible heat generation, the output current is limited to 5 A.

6) SLV = sensorless vector control

7) To activate the brake chopper, the duty factor must be higher than 0 percent. The continuous duty of the built-in braking resistor is typically at least 20 W. Pulse rating for 1 ms is about 20 kW.

Design RA-SP

The main components of speed control unit RA-SP are:

- Enclosure top with control and display elements.
- Enclosure base with heat sink and plug-in motor connection.

Caution!
The two enclosure sections are internally connected only through the power module's control cable. When you open the enclosure, make sure that this cable is not under any mechanical tension.

Enclosures must be opened only in a de-energized state and by trained personnel:

- Key-switch in OFF position.
- Pull power supply plug and secure against reconnection.
- Pull motor plug and plug M12.
- To prevent reconnection of the motor cable, it can be secured with lock shackle SET-M-LOCK (→ page 152).

Danger!
Dangerous voltage through internal DC link capacitors! Discharging time is 5 minutes.

Release the two connectors on the RA-SP's mains side only in a de-energized state; otherwise there is a risk of electric shock from the connector's pins during the discharge time. Secure the mains-side connectors against unintentional disconnection and contact with its pins on RA-SP…/C2 and RA-SP…/C3A.

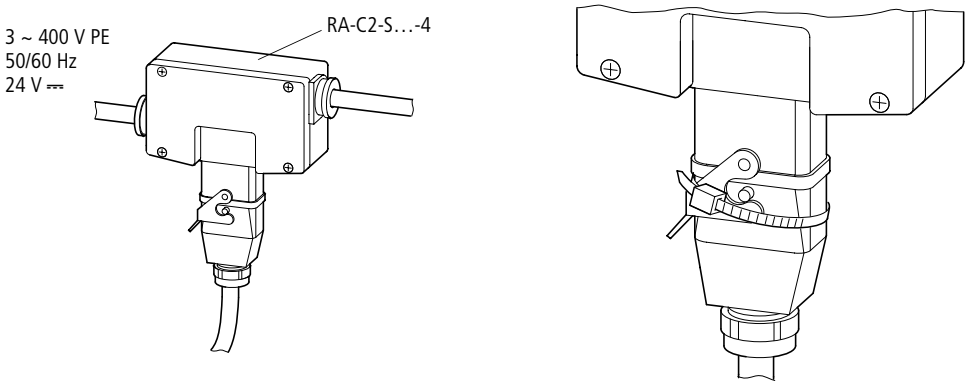


Figure 91: Securing mains-side connector with cable tie

→ The speed control unit fulfills the requirements for safe isolation between the AS-Interface® voltage and the 24 V ⎓ and 400 V ~ supply voltages according to IEC/EN 60947-1, Annex N.

Do not touch the AS-Interface® connection and power module actuation cards.

In the enclosure base, the power supply lines are connected to the power module through a radio interference (RFI) filter. The RFI filter allows interference-free operation according to EN 55011, Group 2, Class A, provided the following are fulfilled:

- EMC-conformant mounting and installation,
- a pulse frequency of 5 kHz and
- a motor cable with a maximum length as specified in table 19.

The power module is thermally connected with the heat sink and contains all components required for controlling variable-speed drives:

- Three-phase rectifier bridge
- Internal DC link with charging current monitoring and switched-mode power supply unit
- Inverter with IGBTs (**i**nsulated **g**ate **b**ipolar **t**ransistors)
- Circuits and protective circuits
- Microprocessor with isolated interface

Caution!
Do not sever internal connections or change the wiring: Danger of unpredictable and critical operating states!

Power supply

Network configuration

The speed control unit RA-SP can not be used in every network configuration without limitations (network configuration according to IEC 364-3). It must be used only on three-phase networks with earthed star point (TN-S networks).

Mains voltage, mains frequency

The ratings of the RA-SP cover European and American standard voltages:

- 400 V, 50 Hz (EU),
- 460 V, 60 Hz (USA)

The permissible mains voltage range is:

- 380/460 V: 342 V – 0 % to 506 V + 0 %

The permissible frequency range is 50/60 Hz: 47 Hz – 0 % to 63 Hz + 0 %.

Interaction with p.f. correction equipment

The speed control unit RA-SP absorbs only a small fundamental reactive power from the AC supply. Compensation is therefore unnecessary.

▽ **Caution!**
The RA-SP must be operated on networks with power factor correction devices only if these devices are dampened with reactors.

Protective devices and cable cross-sections

The ratings of the protective devices and the cable cross-sections required for the network connection depend on the rating of the RA-SP and the drive's operating mode.

The incoming circuit-breaker RA-DI (or PKZ2-ZM25-8) can switch on the following number of speed controllers RA-SP without the short-circuit release being tripped by the RA-SP:

– 10 to 15 (20 to 25) RA-SP...075... or
– 5 to 8 (10 to 13) RA-SP...1K1... or
– 3 ti 5 (7 to 9) RA-SP…2K2…

▽ **Caution!**
When selecting the cable cross-section, take the voltage drop under load conditions into account. The user is responsible for ensuring the adherence to all other applicable standards (e.g. IEC/EN 60204, EN 60289).

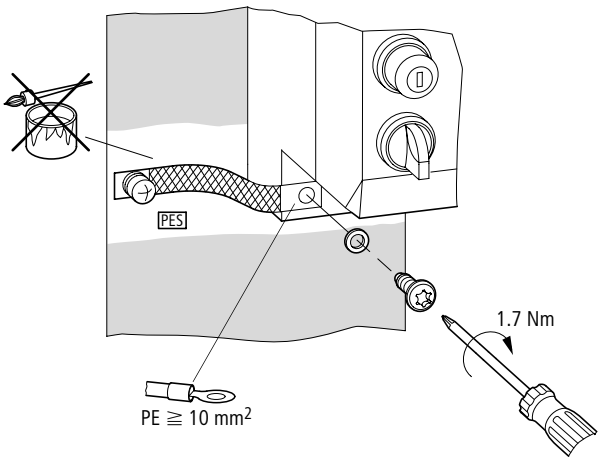
The national and regional standards (for example IEC/EN 60204) must be observed and the necessary approvals (for example UL) at the site of installation must be fulfilled.

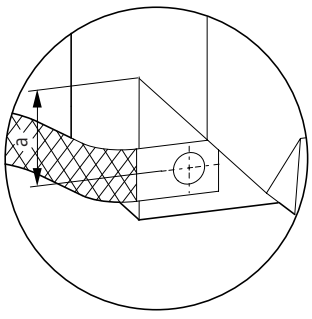
When the device is operated in a UL-approved system, use only UL-approved fuses, fuse bases and cables.

→ For further details, see „Incoming supply 400 V AC" on page 13.

The leakage currents to earth (to EN 50178) can be greater than 3.5 mA. The RA-SP's heat sink must hae a large-area connection with the earth-current circuit.

▽ **Caution!**
The specified minimum cross-sections for PE conductors (EN 50178, EN 61800) must be observed. Use a PE conductor whose cross-section is as least as large as the terminal capacity of the power terminals.



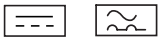


	a [mm]
RA-SP2…075	6.5
RA-SP2…1K1	
RA-SP2…2K2	11

Figure 92: Earthing

Protection of persons and domestic animals with residual-current protective devices

Residual-current circuit breakers (RCCBs also called earth-leakage circuit breakers or ELCBs) according to IEE Wiring Regulations. Universal current sensitive RCCBs according to EN 50178 and IEC 755 must be used.

	Identification on the residual-current circuit-breakers		
Logo			
Part no.	alternating current sensitive (RCCB, Type AC)	pulse current sensitive (RCCB, Type A)	universal current sensitive (RCCB, Type B)

The speed control unit RA-SP has a built-in mains rectifier. In the event of a frame fault, this can cause a DC leakage current to inhibit tripping of the AC or pulse-current sensitive RCCB, thereby preventing it from fulfilling its protective function. We therefore recommend the use of universal-current sensitive RCCBs with a rated leakage current of ≧ 300 mA.

Spurious tripping of a residual-current circuit breaker can be caused by the following:

- capacitive compensation currents in the cable screens, particularly with long, screened motor cables,
- simultaneous connection of multiple speed control units to the mains supply,
- use of additional reactors and filters (radio interference filters, line filters).

Caution!
RCCBs must be installed only on the primary side.

Warning!
Use only cables, residual-current circuit breakers and switching elements with a suitable rating. Risk of fire!

Current peaks

In the following cases, a relatively high peak current can occur on the primary side of the RA-SP (i.e. on the supply voltage side), which, under certain conditions, can destroy the RA-SP's input rectifier:

- Imbalance of the voltage supply greater than 3 %.
- The maximum power output of the point of supply must be at least 10 times greater than the RA-SP's maximum rating (about 500 kVA).
- If sudden voltage dips in the supply voltage are to be expected, for example when:
  - several RA-SPs are operated on a common supply voltage.
  - a thyristor system and an RA-SP are operated on a common supply voltage of the Rapid Link system.
  - power factor correction devices are switched on or off.

In these cases, a line reactor with about 4 % voltage drop at rated operation should be installed upstream of the group's disconnect control unit.

Mains choke

The mains choke (also called commutating choke or line reactor) is connected to the mains side input cables L1, L2, L3 (depending on type). It reduces the harmonics, and therefore the apparent mains current, by up to 30 percent.

A mains reactor also limits any current peaks caused by potential dips (for example caused by p.f. correction equipment or earth faults) or switching operations on the mains.

The mains reactor increases the lifespan of the DC link capacitors and consequently the lifespan of the RA-SP. Its use is also recommended for the following:

- with derating (temperatures above +40 °C, sites of installation more than 1000 m above sea level),
- Parallel operation of several RA-SP on a single mains infeed point.

EMC Guidelines

The limit values for emitted interference and immunity for variable-speed drives are described in **product standard IEC/EN 61800-3**.

When RA-SPs are operated in European Union (EU) member countries, conformance to EMC Directive 89/336/EEC is mandatory. This includes compliance with the following conditions:

Supply voltage (mains voltage) for the RA-SP:

- Voltage fluctuation ± 0 % or less
- Voltage imbalance ±3 % or less
- Frequency variation ±4 % or less

If one of the conditions listed here cannot be fulfilled, you must install an appropriate line reactor.

EMC Interference class

Installed according to the EMC criteria described in chapter "System Rapid Link", the speed control unit RA-SP is conformant with the following standards:

- Emitted interference:
  IEC/EN 61800-3 (incl. A11)
- Noise immunity:
  IEC/EN 61800-3, industrial environment

With speed control units RA-SP, performance-related and emitted interference increase with the pulse frequency. The frequency at which performance-related interference occurs also increases with the length of the motor cable.

Noise immunity

RA-SP fulfil the requirements of EMC product standard IEC/EN 61800-3 in industrial environments (second environment). The stricter limit values for domestic environments (first environment) can be achieved with upstream RFI filters.

A "domestic environment" is defined here as a connection point (transformer feeder) to which domestic households are also connected.

For industrial systems, the EMC Directive requires electromagnetic compatibility with the environment as a whole. The Product Standard regards a typical drive system as a complete unit, i.e. the combination of frequency inverter, cables and motor.

Emitted interference and radio interference suppression

RA-SP fulfil the requirements of EMC product standard IEC/EN 61800-3 for industrial environments (second environment).

To ensure adherence to the limit values, observe the following points:

- Reduce electromagnetic emission interference by screening motor cables and signal cables.
- Compliance with installation requirements (EMC-compliant installation).

Cable routing

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

Do not lay the control and signal lines directly adjacent to mains or motor cables. Avoid laying them in a common cable duct and do not bundle them with cable ties.

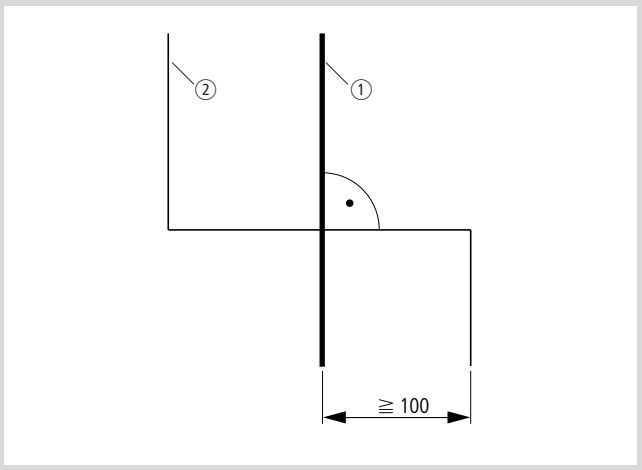


Figure 93: Crossover of signal and power cables

① Power cable: Mains connection, motor cable
② Control cable: AS-Interface®

EMC correct mounting and installation

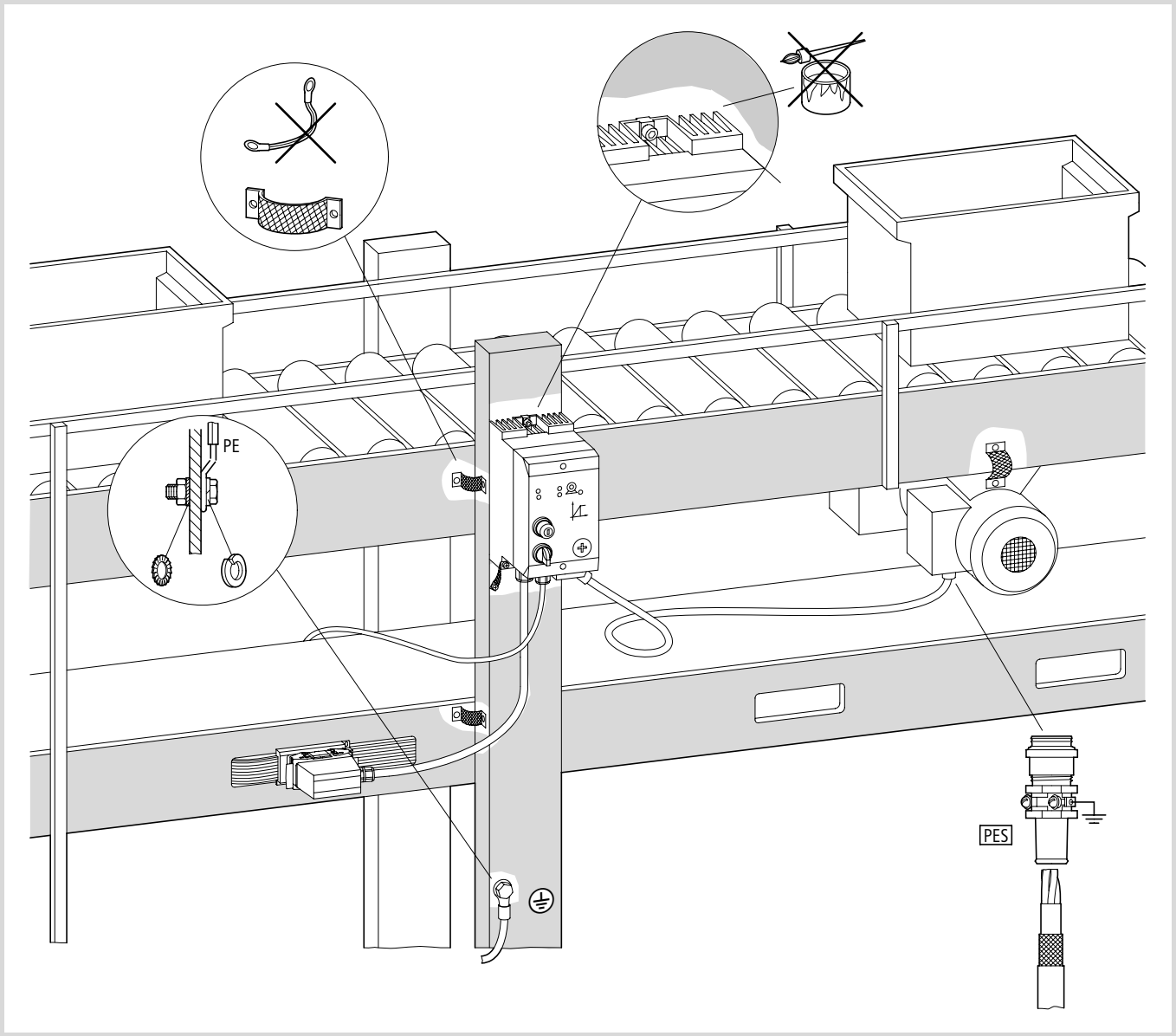


Figure 94: Installation example

PES: Connect the motor cable screen to PE with a large-area connection, for example cable glands with strain relief

Installation

Mounting position

The speed control unit RA-SP is preferably fitted vertically. In this mounting position the best heat dissipation is achieved. If horizontal mounting is necessary due to limited available space, the derating conditions outlined below must be taken into consideration.

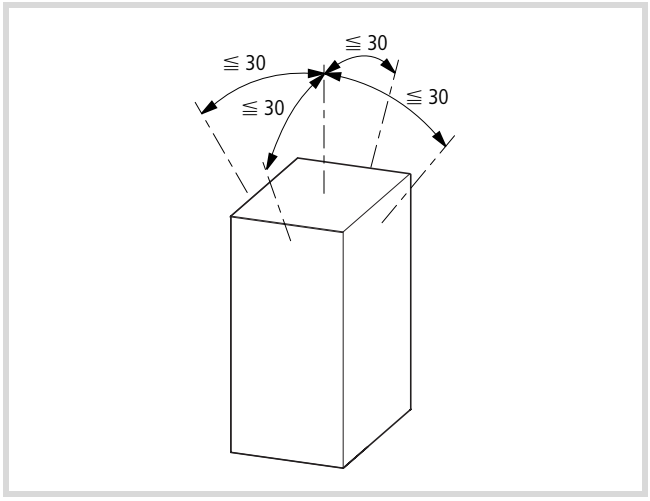


Figure 95: For mounting position, see also derating (figure 96 to figure 98)

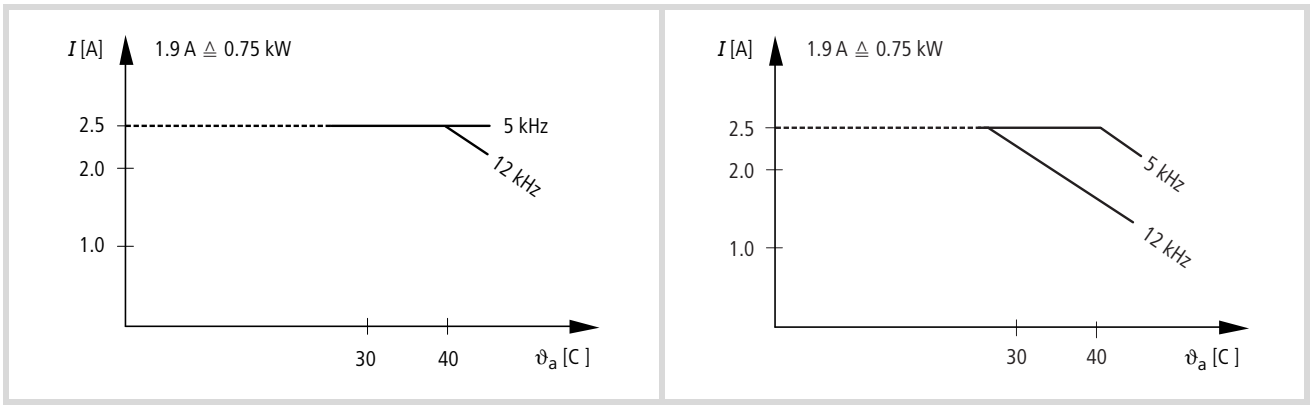


Figure 96: RA-SP…075 in vertical (left) and horizontal (right) mounting positions

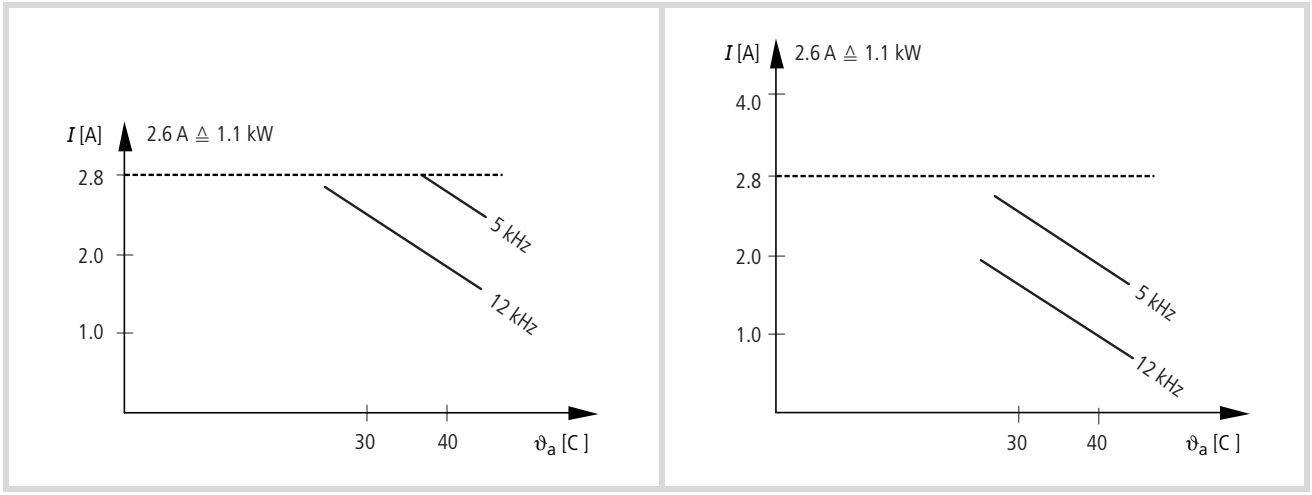


Figure 97: RA-SP…1K1 in vertical (left) and horizontal (right) mounting positions

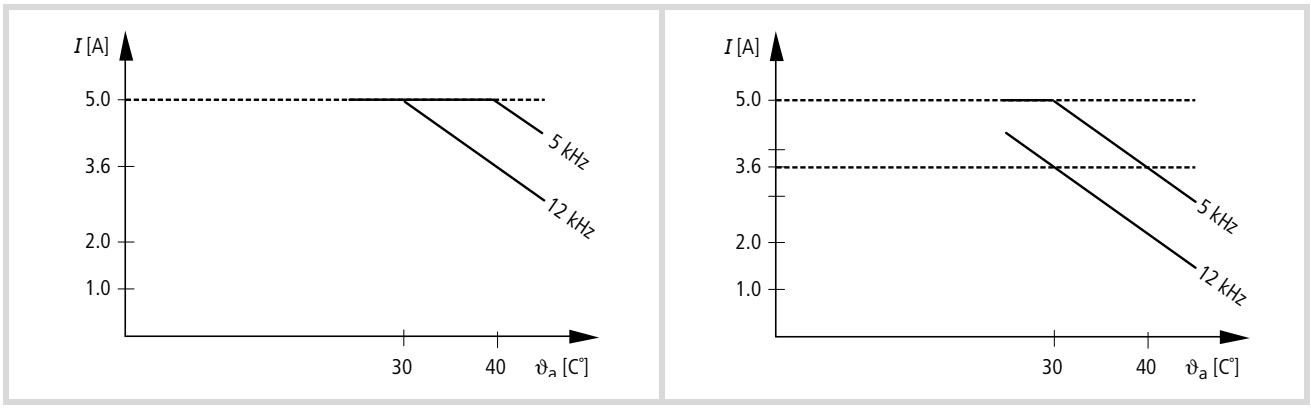


Figure 98: RA-SP…2K2 in vertical (left) and horizontal (right) mounting positions

Mounting dimensions

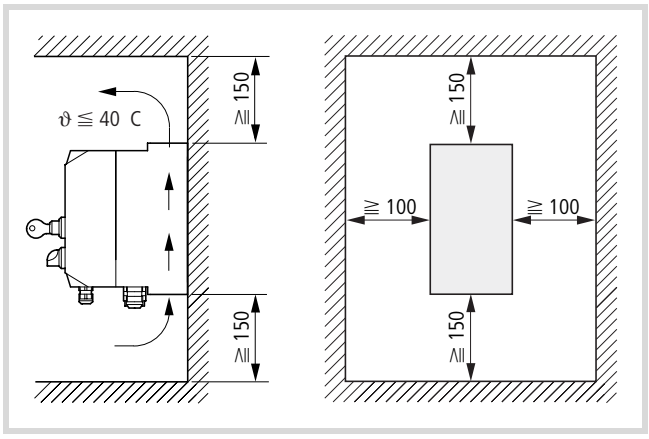


Figure 99: Mounting dimensions

A free space of at least 150 mm is required above and below the device to allow air circulation for cooling and connection of the motor cable. The lateral space can be reduced to 25 mm if no further RA-SP or other self-cooling device is to be fitted there.

Mounting

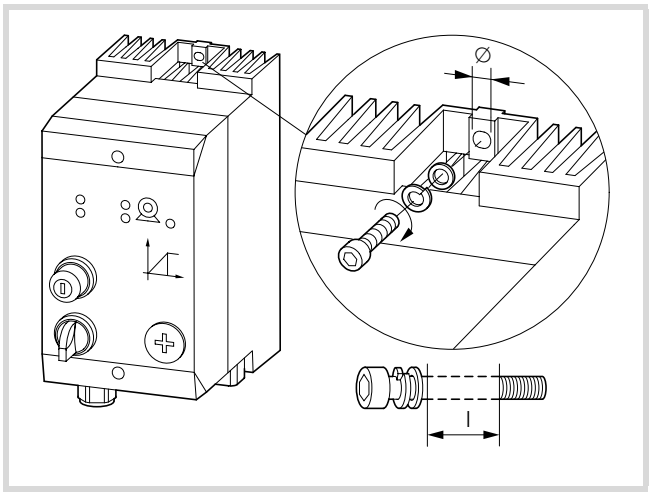


Figure 100: Mounting

Part no.	∅ [mm]	Thread	Torque [Nm]	l [mm]
RA-SP…075… RA-SP…1K1…	5,5	M5	3	5
RA-SP…2K2…	6,5	M6	3	7

Connections

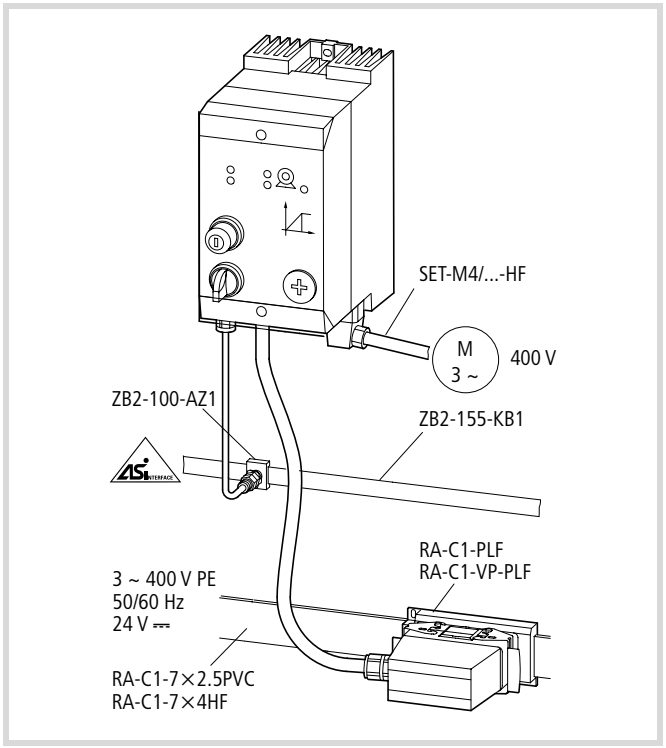


Figure 101: Mounting example RA-SP.../C

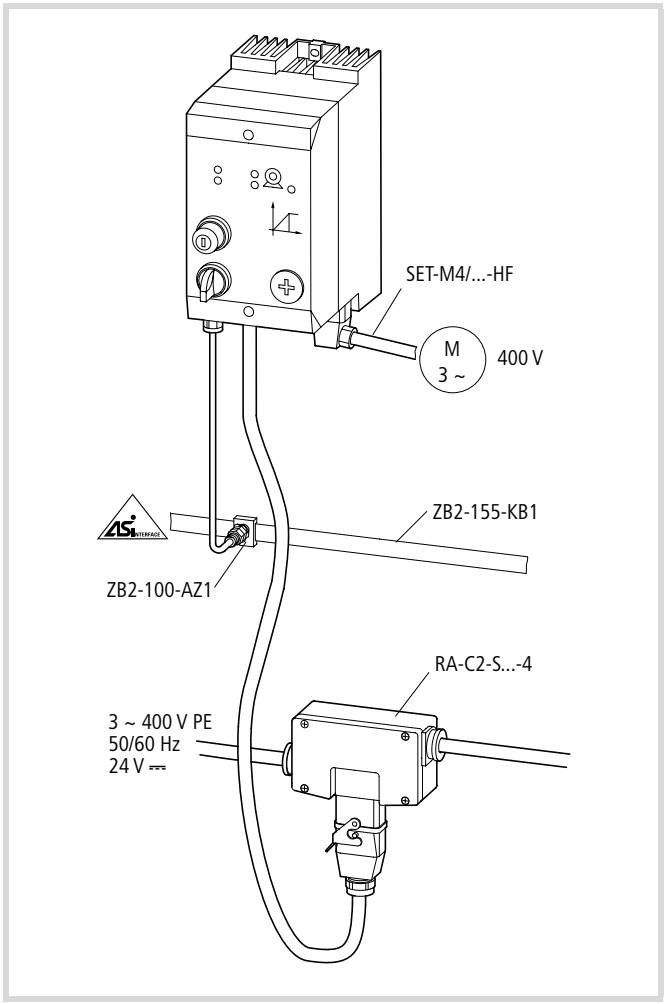


Figure 102: Mounting example RA-SP.../C2

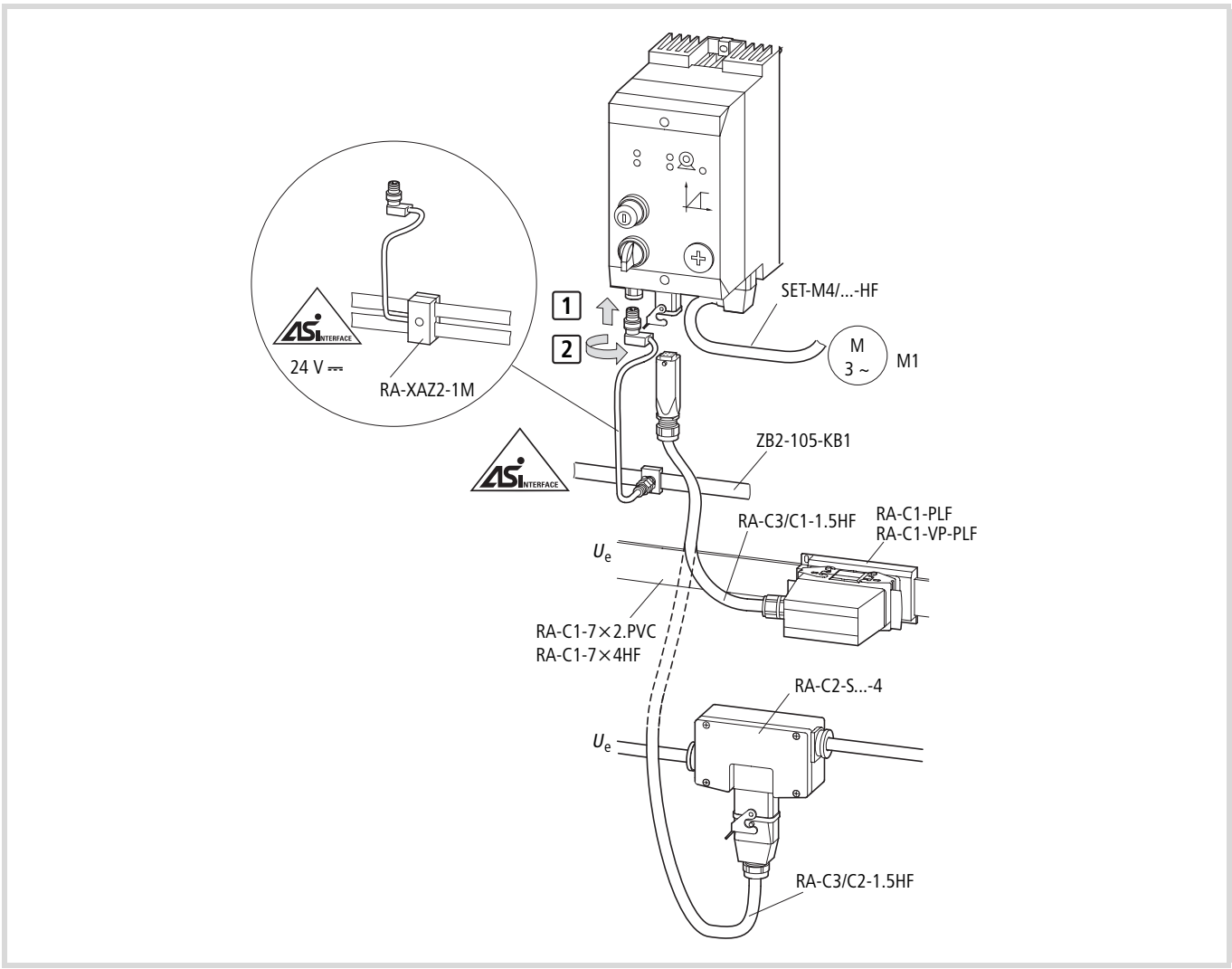


Figure 103: Mounting example RA-SP-HE.../C3

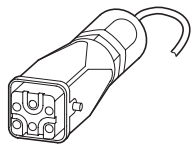
Connecting the power supply

Terminations → section "Power bus" on .page 13

The mains incomer is connected directly with the built-in RFI filter. The 24 V DC supply from the power bus is connected or wired only with RA-SP-HE…IC…A, not with RA-SP2-34…

Part no.	Connection types
RA-SP…/C1	Mains incomer (L1-L2-L3-N-PE) with plug for flexible busbar (**flat** cable) junction RA-C1-VP-PLF or RA-C1-PLF
RA-SP…/C2	Mains incomer (L1-L2-L3-N-PE) with plug for **round** cable junction RA-C2-S…-4
RA-SP…/C3	Power supply plug with L1-L2-L3-N-PE for the adapter cables to **ribbon**- or **round** cable
RA-SP…/C…A	The 24 V are supplied together with AS-Interface® through the user-assembled M12 plug

Table 21: Pin assignment of power plug RA-MO…/C3… (model HAN Q5/0)

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

→ With RA-SP-HE…/C…A the external 24 V are needed only if a shutdown with the second ramp is required on failure of the 24 V supply.

AS-Interface® connection

Connection through cable with M12 plugs

PIN	Function
1	ASi+
2	–
3	ASi–
4	–

Connecting AS-Interface® and 24 V (RA-SP…/C…A)

Connection through user-assembled plug M12

PIN	Function
1	ASi+
2	0 V
3	ASi–
4	24 V

Before establishing the connection to AS-Interface®, you can assign the AS-Interface® address through plug M12 with an addressing device, → page 17.

Connecting sensors (RA-SP2-34…)

RA-SP…342/343… features two M12 sockets for connecting two sensors. To each of the M12 sockets I3 and I4 of the RA-SP-HE… you can connect two sensors. In this case the signals must be split through the Y-connector RA-XM12-Y.

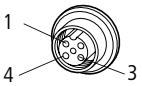
→ On M12 sockets I3 and I4 with visible nut, pin 2 is not assigned.
On M12 sockets I3 and I4 without visible nuts, pins 2 and 4 are bridged.

Exception: RA-SP-HE…

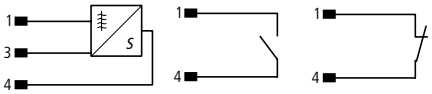
RA-SP2-342…
RA-SP2-343…

„A"-coded (IEC/EN 60947-5-2)
1 = brown
2 = white
3 = blue
4 = black

I3 + I4	
1	L+
2	–
3	L–
4	I

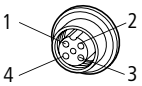


24 V ⎓ $\Sigma I \leqq$ 70 mA

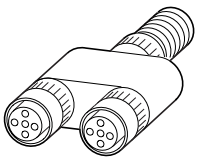


RA-SP-HE-…

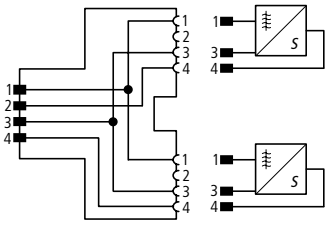
I3 + I4	
1	L+
2	I…B
3	L–
4	I…A



or



24 V ⎓ $\Sigma I \leqq$ 160 mA



RA-XM12-Y

→ If you have connected 4-wire sensors to RA-SP-HE... on which pin 2 carries, for example, a Live signal, the colours of LED indicators I3 and I4 change; → page 112

Motor connection

On the RA-SP the motor feeder features a metal-encapsulated socket. To meet EMC requirements, this is connected with PE and heat sink over a large area. The matching plug is also metal-encapsulated and the motor cable is screened. The length of the motor cable is limited, → table 19 on page 87. The motor cable's screen must have a large-area connection with PE at both ends and the motor connection terminals must also, therefore, meet EMC requirements.

The motor is connected through motor cable SET-M4/…HF or through connector SET-M4-A, contacts 4 × 1.5 mm^2 + 2 × (2 × 0.75) mm^2.

Pin assignment to DESINA specification → page 24.

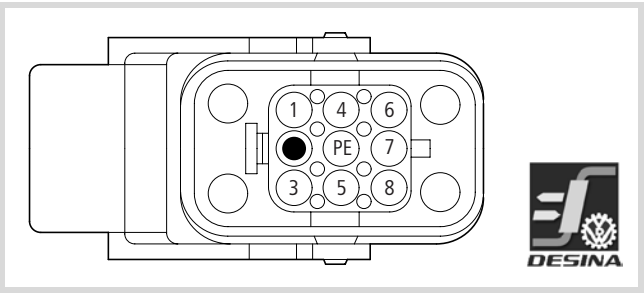


Figure 104: Pin assignment at motor output socket (DESINA)

The speed of a three-phase motor is determined by the ratio of pole pairs to frequency.

⚠ **Caution!**
The operation of a motor at speeds higher than the rated speed (see nameplate) can cause mechanical damage to the motor (bearings, unbalance) and the machinery to which it is connected and can lead to dangerous operating conditions!

▽ **Caution!**
Uninterrupted operation in the lower frequency range (less than about 25 Hz) can lead to thermal damage (overheating) of self-ventilated motors. Possible remedies include over-dimensioning and external cooling independent of motor speed.

Observe the manufacturers recommendations for operation of the motor.

Pole-changing three-phase motors (Dahlander pole-changing motors), rotor-fed three-phase commutator shunt motors (slipring rotor) or reluctance motors, synchronous motors and servo motors can be connected, provided they are approved for use with frequency inverters by the motor manufacturer.

Pins of the motor outgoer plug	Core No. Motor cable	Function on motor
1	1	U1
2	–	Coding adapter
3	3	W 1
4	5	Brake B1 ~
5	7	Thermistor 1
6	6	Brake B2 230 V ~/400 V ~
7	2	V1
8	8	Thermistor 2
PE	PE	PE

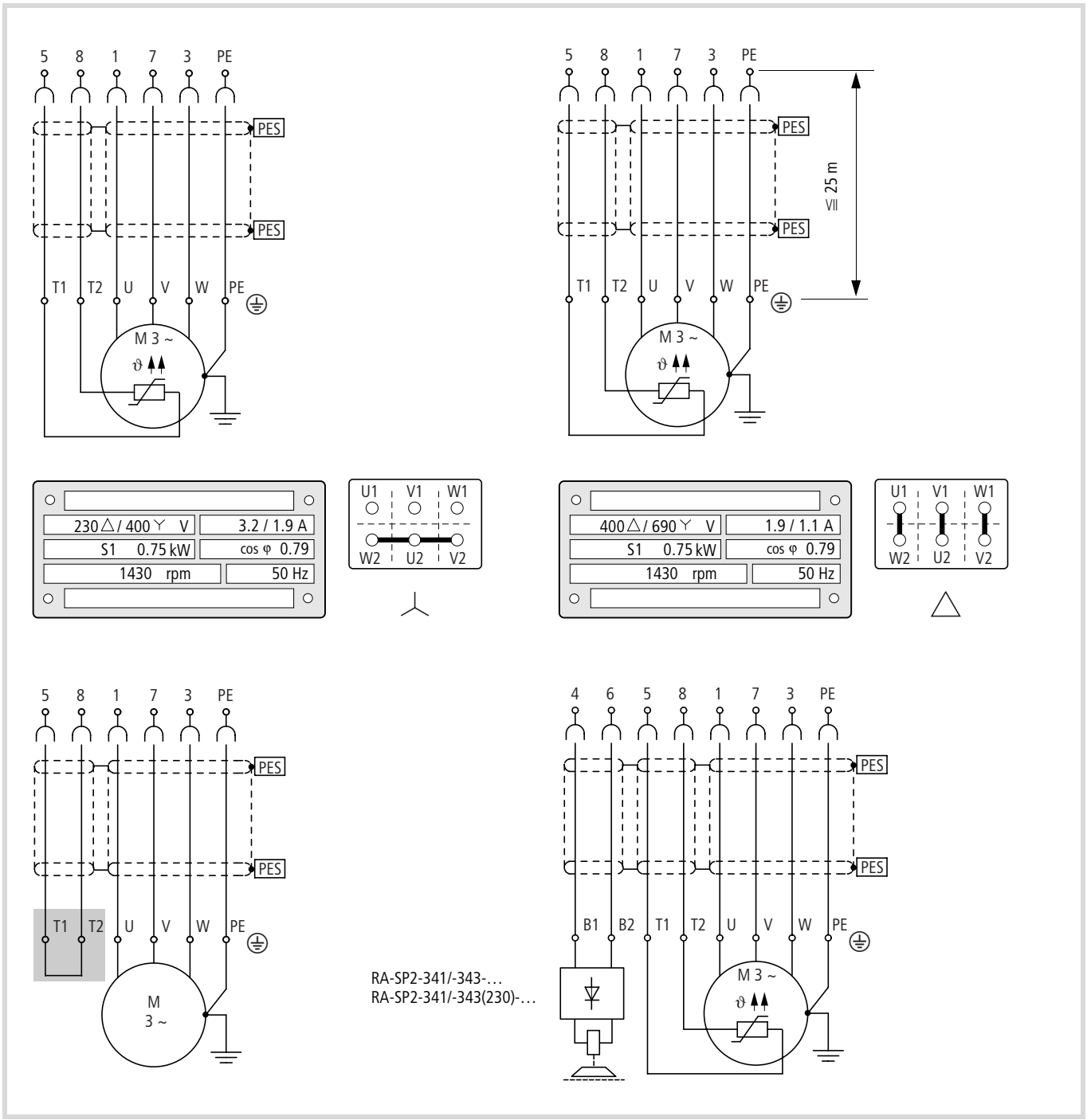


Figure 105: Examples of motor connections

If motors are connected without PTC thermistor or thermal switch, cables 7 and 8 must be linked at the motor; otherwise the RA-SO issues a fault message.

→ The motor circuit must be laid out for the rated operational voltage (400 V).

⚠ **Warning!**
If motors are used whose insulation is not suitable for operation with RA-SP, the motor may be destroyed.

⚠ **Warning!**
Risk of destruction of the motor through the RA-SP's frequency-controlled output if braking units or braking rectifiers are connected directly to the motor's terminals.

Actuation for spring-applied brake with DC air magnet
RA-SP2-341…/RA-SP2-343…/RA-SP2-341(230) and RA-SP2-343(230) contain a built-in DC air magnet actuating device (see also function principle of actuation on page 113). The maximum actuating current is 8 A.

Part no.	Actuating voltage
RA-SP2-341 RA-SP2-343	400 V AC
RA-SP2-341(230) RA-SP2-343(230)	230 V AC

→ To replace the device's internal fuses, the device must be opened up. This operation should therefore be performed only by qualified persons.

Table 22: Fuse model

	RA-SP2…/C1 RA-SP2…/C2	RA-SP2…/C3A
Supplier/maufacturer:	Wickmann	Schurter
Order code:	356 1800	7022.0700
Type:	356	A12FA500V
Rated voltage:	440 V	500 V
Rated current:	T 8 A	FF 10 A

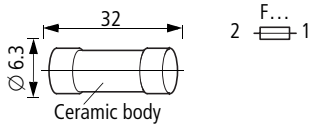


Figure 106: Built-in device fuse

① Ceramic body

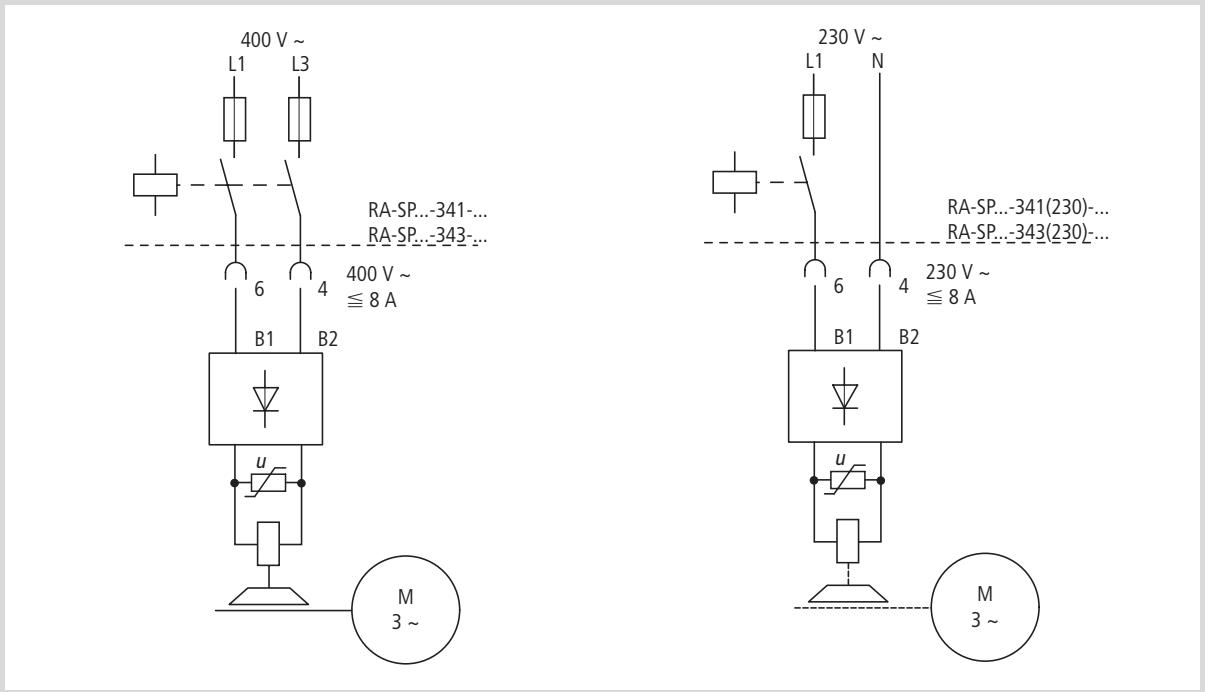
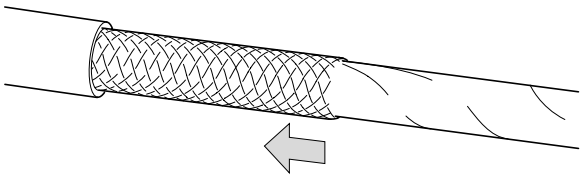
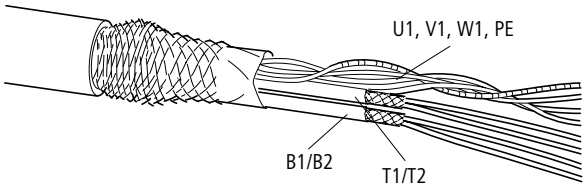


Figure 107: Actuation for spring-applied brake with DC air magnet

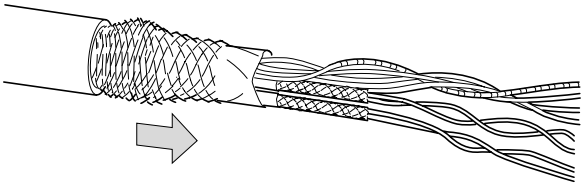
Screen motor cable



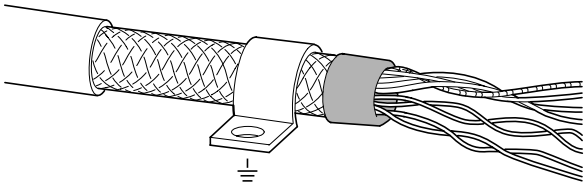
▶ Strip the cable's outer sheath and pull back the screen braid.



▶ Strands B1/B2 (brake) and T1/T2 (thermistor) have a separate screen braid. Expose these.



▶ Push the motor cable's screen braid forward so as to cover the screen braids of strands B1/B2 and T1/T2 over a large area.



▶ Secure the clip where the braids overlap.
▶ Secure the braid ends with a rubber grommet or with insulating tape to prevent the braid from fraying.
▶ Connect the intertwisted strands (U, V, W and PE) and the separately twisted strands B1/B2 and T1/T2 to the corresponding terminals in the motor or in the connector (SET-M4-A).
▶ Connect the screen braids to earth potential over a large area:
  – in the motor connection cable's plug
  – in the motor's screw connections.

The illustrated screen clamp provides an example of large-area earth connections.

Figure 108: EMC-conformant connection of the screened motor cable

Device operation

Speed control unit RA-SP is supplied ready for connection. It allows the direct operation of a 0.75/1.1/2.2 kW (400 V 50 Hz) motor without parameterization or special technical knowledge. The following operating modes are possible:

- HAND (Manual – setup, commissioning, maintenance): In this mode, the motor can also be operated without AS-Interface® connection. The motor speed is set with the built-in spindle potentiometer (analog reference value memory under the screw cover on the device font).
- Auto: (continuous operation through AS-Interface® control). Enable with preselected operating direction and selection of a speed reference value (three saved electronic values: 30, 40 and 50 Hz and an analog value).
- Reset: Resetting a fault detected by RA-SP, such as mains undervoltage, overvoltage, overtemperature of RA-SP or motor (thermistor required), overload or earth fault. Identified faults are signalled by the red LED in the motor symbol and through AS-Interface®. To reset, bring the key-switch into its OFF position.

→ RA-SP2-34…: If a Start signal (FWD/REV) is applied, the key-switch must be held in its RESET/OFF position for at least one second to switch over from HAND to AUTO through RESET/OFF or vice versa.

Functions through AS-Interface®

The RA-SP-HE… provides the normal control functions Forward Operation, Reverse Operation, Fixed Frequency Selection as well as signals Automatic Operation and Group Error. In addition it can read and process signals from up to four sensors assigned to the drive.

The configurable quick stop allows precise stopping, for example on connection points and (eccentric elevating platforms). Interlocked manual mode can prevent damage to the conveyed material and the plant in also manual operation. In quick stop with creep speed the signals from the two additional sensors (I…B) are read only internally and result in a changeover to creep speed.

With RA-SP-HE... you can also perform a Reset and read out a detailed diagnostics status through AS-Interface® .

You can also specify whether monitoring of the motor plug (= thermistor monitoring) is part of the Group error or Ready signal.

Commissioning the drive

⚠ **Warning!**
For testing insulation resistance or voltages according to EN 60204-1 or similar, the RA-SP units must not be connected to the power bus as this would destroy the device's electronics.

⚠ **Warning!**
Do not disconnect the motor and power plugs while they are live.

- Key-switch in "OFF" position
- Selector switch REV-OFF-FWD in Off position

Before commissioning the speed control unit, make sure that the motor is correctly connected and the motor cable is plugged in. The RA-SP2-34… can be parameterized only with the motor connected. Alternatively you can convert the motor plug SET-M4-A into a "parameterization plug" by bridging pins 5 and 8.

When the mains cable is connected, the load switch (disconnect control unit RA-DI) then applies mains voltage. When mains voltage is applied, the RA-SP performs a self-test (red LED in the motor symbol briefly lights up). LED display UV on the motor symbol indicates readiness for operation.

- Key-switch in "HAND" position
- Selector switch REV-OFF-FWD is used to enable forward (FWD) and reverse (REV) operation. The current selection is indicated by LEDs REV and FWD on the motor symbol.

In manual operation the drive accelerates with a ramp duration of ten seconds (default setting) to the value set with potentiometer n_0 (default is 10 Hz) and decelerates with a ramp duration of two seconds (default setting). The potentiometer (spindle, 10-turn) is located under the screw cover on the device front (→ figure 94). With a screwdriver, turn the potentiometer in a clockwise direction to adjust the output frequency in the range from 0 to 50 Hz. The required speed can be measured at the system or as motor speed. A direct frequency indication is possible through the RS 422 interface located next to the potentiometer, for example with display unit DE5-KEY-RO3 (connection cable DE5-CBL-…ICL required).

→ To prevent mechanical damage and ensure the degree of protection, open and close the screw covers only with the specified tools and tightening torques.

⚠ **Warning!**

To avoid unexpected starting after a power failure, take the following steps:

- In automatic mode, 400 V AC:
  Disconnect the 400 V and reset the actuation command in the PLC.
- In manual mode, 400 V AC or with DIP pole 8 = 1 and 24 V DC:
  If a direction of rotation has been selected, the drive does not automatically restart when power is restored. The direction LED flashes. To continue manual operation, a Reset command must be issued (key-switch to OFF).

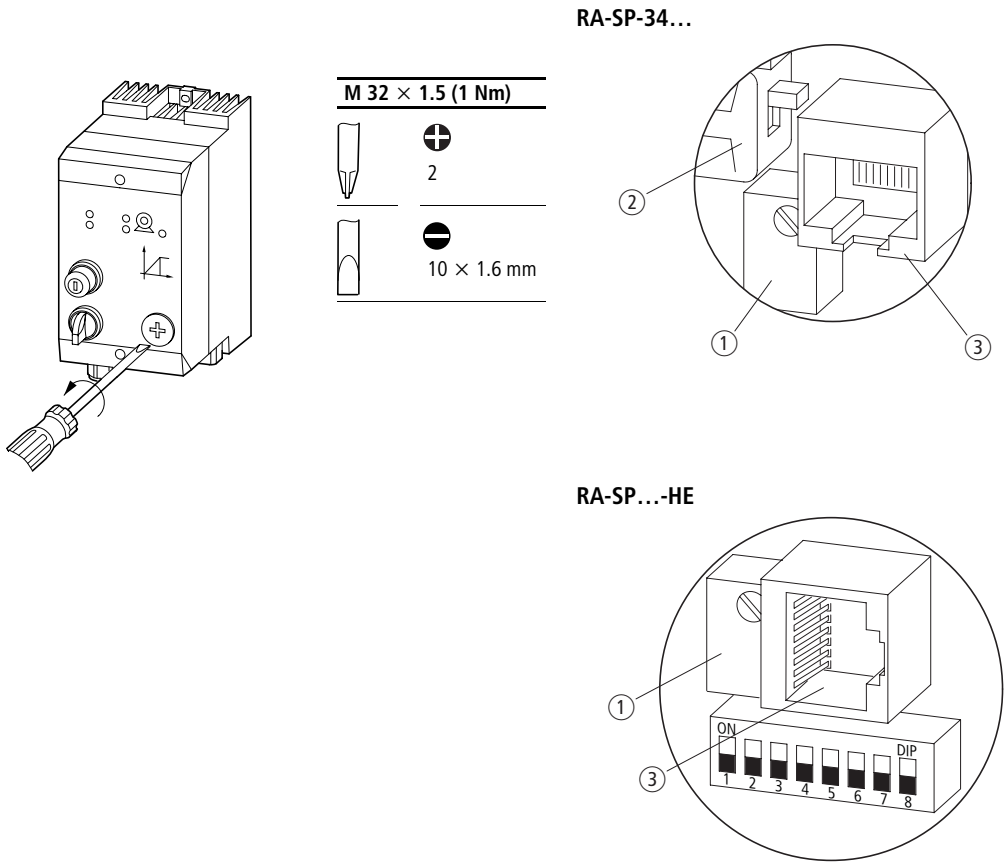


Figure 109: Modification of default setting for frequency, direction and parameters

① Spindle potentiometer n_0
② Direction reversal
③ Serial interface RS 422 (RJ45)
④ DIP switch

① Spindle potentiometer n_0 (→ fig. 109)

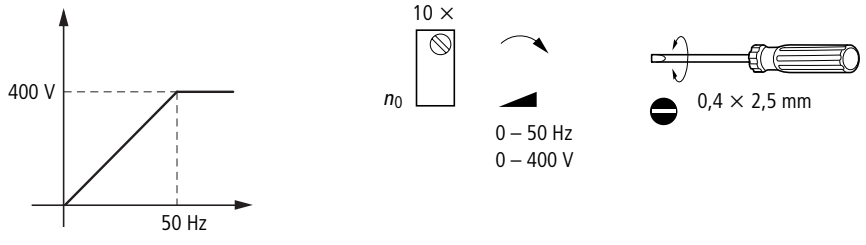


Figure 110: Spindle potentiometer n_0

To change the speed up to a maximum value of 50 Hz (default setting), turn potentiometers n_0 in a clockwise direction; to reduce it, turn the potentiometer anticlockwise.

② **Phase reversal** (⟶ fig. 109)

Three-phase motors work with clockwise rotating fields (viewed from the motor shaft) when phase L1 is connected to U1, L2 to V1 and L3 to W1. This default operating direction may be reversed through gearboxes or different mounting positions. With the reversing starter, the operating direction can be reversed with the phase reversal switch (DIP switch under the front locking screw) without rewiring or reprogramming ⟶ page 111.

With control signal FWD (LED FWD lit) a clockwise rotating field is output in switch position Top (default) and an anticlockwise rotating field in switch position Bottom. The changeover can be performed during drive operation.

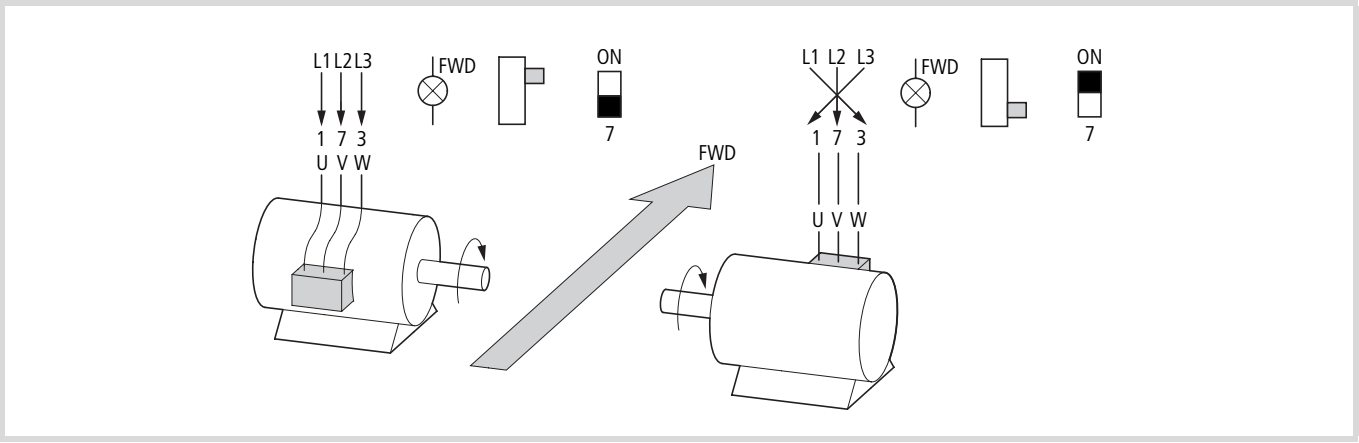


Figure 111: Direction of rotation

③ **Serial interface RS 422** (⟶ fig. 109)

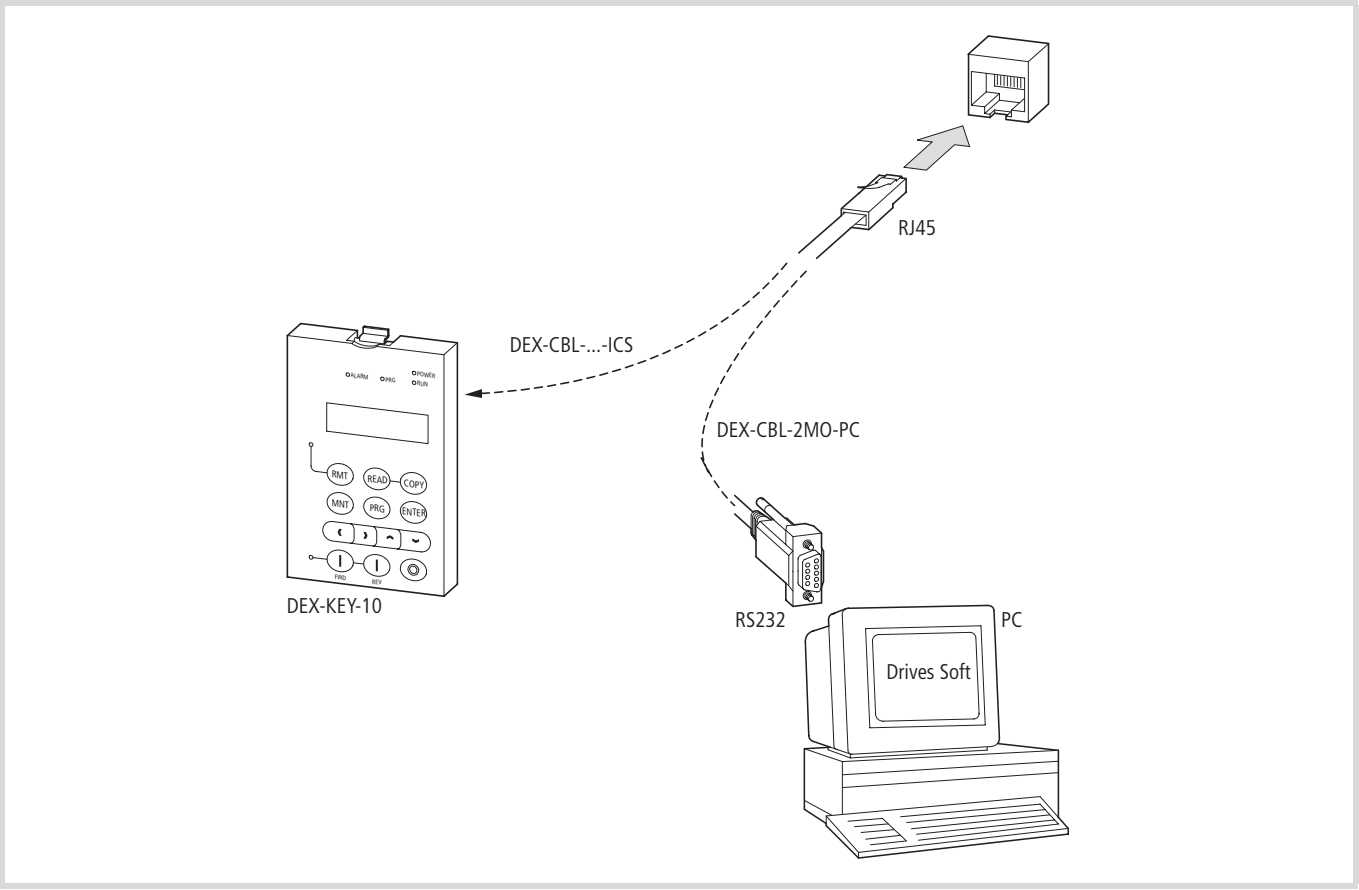


Figure 112: Optional accessories

The following devices can be connected to the serial interface:

- Display unit DE5-KEY-RO3, for example for direct frequency indication (connection cable DE5-CBL-…-ICL required).
- Keypad DEX-KEY-10 for parameterization (connection cable DEX-CBL-…-ICS required).
  With the Copy function, parameters can be read out of RA-SP and copied to another RA-SP. This simplifies commissioning, for example for series machines. For further information about parameterization and operation of the DEX-KEY-10, see manual AWB8240-1416.
- PC through connection cable DEX-CBL-2MO-PC (with built-in RS 422/RS 232 interface converter). With the Moeller parameterization software DrivesSoft (ftp://ftp.moeller.net/DRIVES/SOFTWARE/) all parameters can be read and written. In addition, parameters can be copied, saved and printed, and the operating modes displayed graphically in a trend analyzer.

The parameters of speed control unit RA-SP2-34… are assigned equivalent to frequency inverter DF5-340-... Basic functions → section "Parameterization", page 114.

Selector switch

The key-switches engage in all positions.

	Switch postion		
	REV	**OFF**	**FWD**
Function (with key-switch in HAND position only)	Anti-clockwise	No actuation	Clockwise

Key-switch

In operating mode HAND (key-switch) start, stop and direction reversal are performed with selector switch REV-OFF-FWD (REV = reverse, FWD = forward, OFF = stop and reset following a fault detected by the power module). The selected direction is indicated by the LED on the motor.

The speed control unit is controlled through AS-Interface® (from interface control unit RA-IN). The AS-Interface® connection must be established. The AS-Interface® Power LED in the AS-Interface® symbol is lit. The key-switch must be in AUTO position. Selector switch REV-OFF-FWD has no function in this case.

The key-switches engage in all positions.

	Switch postion		
	AUTO	**OFF RESET**	**HAND**
Key with-drawable	yes	yes	no
Function	Operation through AS-Interface®, Status signal to PLC	Reset on fault signal (red LED in motor symbol)	Start, stop, direction reversal

figure 113 indicates the interaction between automatic and manual operation as well as the phase reversal switch.

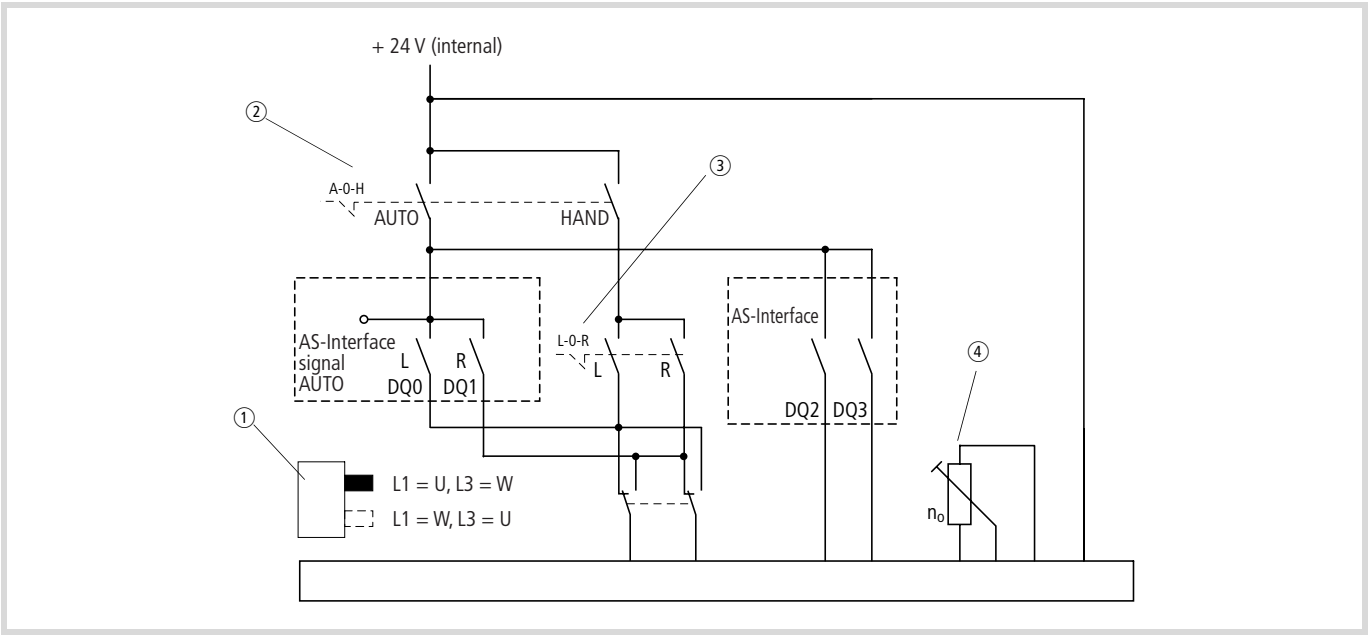


Figure 113: Controlling the speed control unit

① Switch for setting phase reversal
② Key-switch AUTO–OFF–HAND
③ Selector switch REV–OFF–FWD
④ Potentiometers

Description of functions

Quick stop and interlocked manual mode with RA-SP-HE…

Speed control unit RA-SP2-HE… has two M12 sockets to which up to four light barriers, sensors or limit switches can be connected. The input signals at pin 4 of the M12 socket are transmitted to the PLC as well as being internally processed. The input signals at pin 2 are only processed internally and are not transmitted to the PLC. With the DIP switch you can configure these inputs as Quick Stop, Quick Stop with Creep Speed, Interlocked Manual Mode, or Interlocked Manual Mode with Creep Speed.

The Quick Stop function allows precision stopping of the drive. The automatic changeover to creep speed provides convenient control of, for example, rotary tables.

When the limit switch is reached, the drive switched off directly through preprocessing of the RA-SP-HE… . PLC and bus cycle times do not affect the power-off times.

Interlocked manual mode can prevent damage to the conveyed material and the plant in also manual operation.

If you have selected this function, limit switch I3 limits the possible forward travel and limit switch I4 limits the possible reverse travel.

If the material reaches the limit switch in Manual mode, the drive stops even if the selector switch remains in an actuating position.

In addition you can use this function to adjust the light barriers before commissioning the PLC.

Quick stop with RA-SP-HE…
When the input signal is applied to pin 4 (rising edge), the RA-SP switches the drive off. The input signal must be applied for at least 18.5 ms. As soon as the PLC output is reset (falling edge), the drive can be switched on again. Whether the input signal is still applied during the reset or during restarting of the PLC output has no effect (→ figure 114).

Sensors with break contacts can also be used. In this case the speed control unit's DIP switch must be set accordingly.

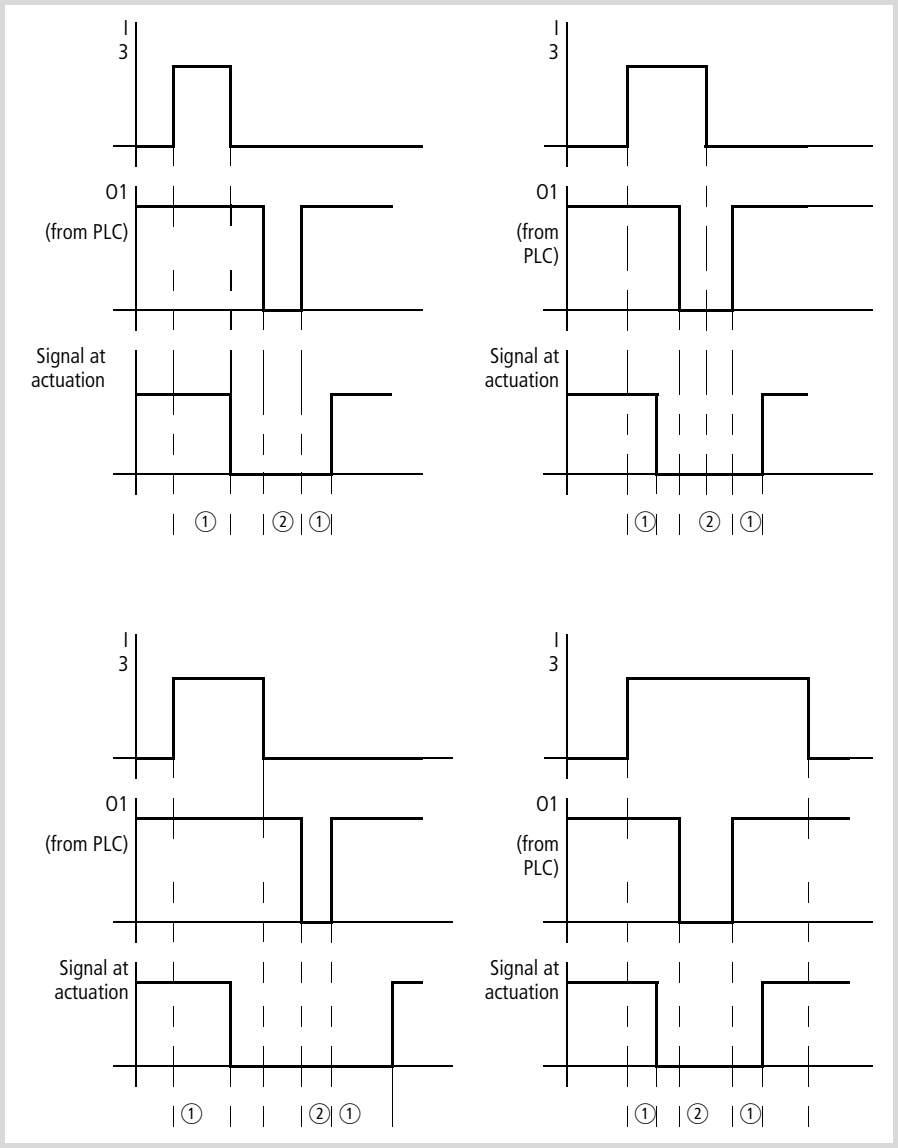


Figure 114: Quick stop in Automatic mode (Example: I3 and forward rotation)

① 13.5 ms ± 5 ms
② dependant upon PLC programme

LED signal on quick stop with RA-SP-HE…:

LED FWD or REV is lit when the PLC has set the associated direction of rotation bit. LED FWD or REV flashes when the drive has been switched off through the quick stop and the PLC' direction of rotation bit continues to be set.

Interlocked manual mode with RA-SP-HE…

After the rising signal edge of I3 or on a continuous signal forward rotation can be selected only in automatic operation; manual selection is possible only for reverse operation.

Manual selection of forward rotation is possible again only after a falling edge at I3 during reverse operation or after a changeover to automatic mode and back again). The same applies for I4 and reverse rotation.

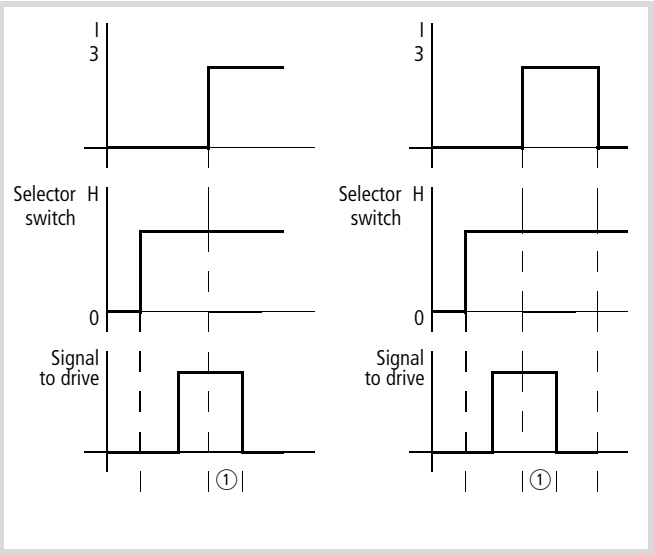


Figure 115: Interlocked manual operation (example: I3 and forward rotation)

① 13.5 ms ± 5 ms

LED signal on interlocked manual mode:

LED FWD or REV is lit when the assigned direction has been set with the selector switch. LED FWD or REV flashes when the selector switch is being operated but the drive is switched off due to interlocked manual mode.

→ Because the sensor inputs are supplied through AS-Interface®, interlocked manual operation works only when the AS-Interface® voltag is applied.

- Interlocked manual mode for 360° movements with two break points with RA-SP-HE…:

With DIP settings 4/5/6 = 1/0/0 interlocked manual mode works only with edge control. When a break point is reached, this allows continued manual operation in the same direction by briefly switching over to automatic mode and back again, → figure 63 on page 59.

Quick stop with creep speed with RA-SP-HE…

When the input signal is applied to pin 2 (rising edge or continuous signal), the RA-SP-HE switches the drive over to fixed frequency 1. The input signal must be applied for at least 18.5 ms. Creep speed remains active until the end light barrier (pin 4 of M12 sockets I3 and I4) is reached and the drive switches off (→„Quick stop with RA-SP-HE…"). If the PLC output is reset and reactivated while the signal is applied to pin 2 (changeover light barrier) fixed frequency 1 remains set.

If no signal is applied to pin 2 when the drive is switched on, the fixed frequency defined by the PLC applies.

Signal on quick stop with creep speed:

The sensor input LEDs have three colours:

- Green if only pin 4 has a signal
- Red if only pin 2 has a signal
- Yellow if both pins 2 and 4 have a signal.

LED signals I3 and I4 are the same in manual and automatic operation.

LED FWD or REV is lit when the PLC has set the associated direction of rotation bit. LED FWD or REV flashes when the changeover or end light barriers have been reached and the PLC continues to have the associated direction of rotation bit set.

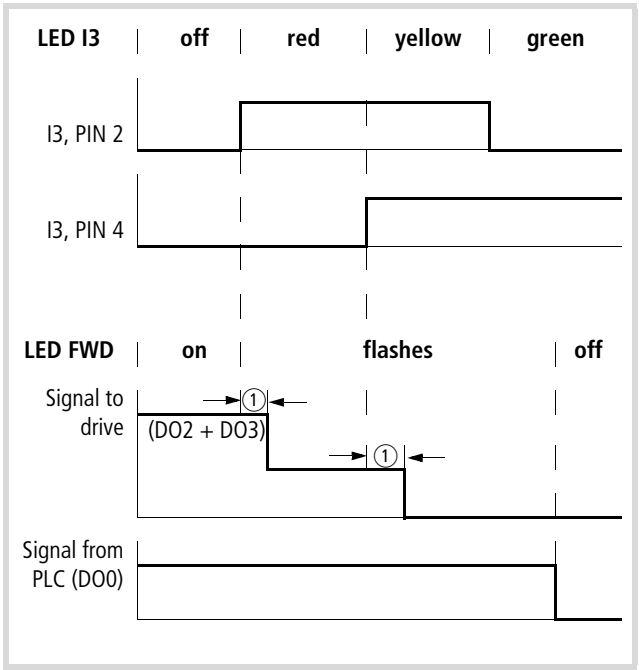


Figure 116: Quick stop with creep speed in automatic mode (example: I3 and forward operation)

① 13.5 ms ± 5 ms

Interlocked manual mode with creep speed with RA-SP-HE…

When the input signal is applied to pin 2 (rising edge or continuous signal), the RA-SP-HE switches the drive over from the potentiometer frequency to fixed frequency 1. The input signal must be applied for at least 18.5 ms. Creep speed remains active until the end light barrier (pin 4 of M12 sockets I3 and I4) is reached and the drive switches off (→„Quick stop with RA-SP-HE…"). If the key-switch is manually changed over to automatic mode and back, fixed frequency 1 remains set if the signal to pin 2 (changeover light barrier) is still applied. Otherwise, the potentiometer frequency applies.

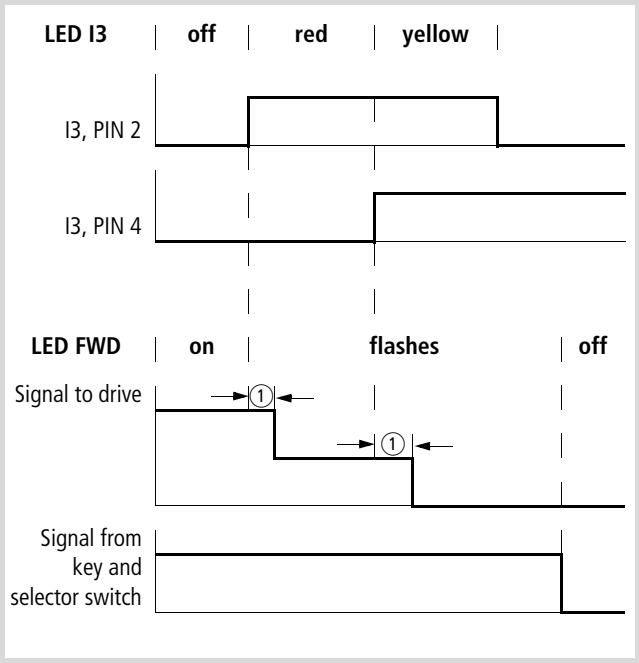


Figure 117: Interlocked manual operation with creep speed (example: I3 and forward rotation)

① 13,5 ms ± 5 ms

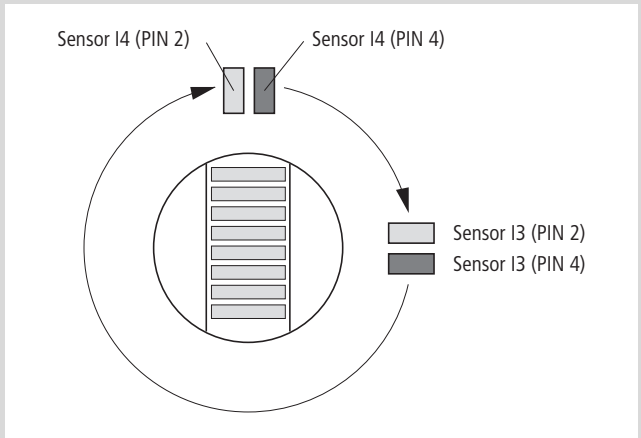


Figure 118: Example: Rotary table control with clockwise operation
Pin 2: Creep speed
Pin 4: Stop

Setting the functions with DIP switches (RA-SP-HE…)

When the locking screw in the cover is undone, the electronics can be configured through jumpers and DIP switches.

→ Before you change the configuration and parameter settings, make sure the key-switch is in its OFF position.

Configuring signal management (pins 1 and 2)

On the RA-SP-HE… The motor plug monitoring message can also be assigned to Ready message DI0 (→ section "I/O assignment" on page 48).

This is recommended if

- the motor plug is used as isolating switch in combination with lock shackle SET-M-LOCK (→ page 152).
- motors without temperature sensor winding are used and T1/T2 in the motor's terminal board ae bridged (→ figure 55 on page 53).

If maintenance work is performed under these conditions with disconnected and locked motor plug, a Not Ready signal makes more sense than a fault message.

Do enable this operating mode, use pole 1 of the DIP switch.

In this operating mode, a high-resistance connection between pins 5 and 8 of the motor plug (thermistor tripping or no motor plug) the following effects:

- The motor switches off (as in the normal operating mode).
- No group fault message at DI1.
- No group fault message with Motor LED
- No Ready signal is applied to DI0, even if the key-switch is set to AUTO.

Table 23: Thermistor evaluation and plug monitoring

Pole 1	Configuration
0	Thermistor evaluation as part of group fault DI1 (default state)
1	Thermistor evaluation or plug monitoring as part of Ready signal DI0

⚠ **Warning!**
Connect and pull the motor plug only with the key-switch in its OFF position. If a Run command has been issued manually or by the PLC, the motor would otherwise start up as soon as the plug is connected.

In addition to the standard signals of the RA-SAP2-34..., the RA-SP-HE... provides a specific diagnostics signal through the AS-Interface parameter channel.

Table 24: Diagnostic status through AS-Interface® parameter channel

Pole 2	Configuration
0	Diagnostics through AS-Interface® parameter channel disabled (default setting)
1	Diagnostics through AS-Interface® parameter channel enabled

Configuring external inputs for RA-SP-HE… (pins 3–6)

The RA-SP-HE provides two plus two external inputs for connecting light barriers, sensors, etc. Add-on functions are:

- Quick stop and interlocked manual mode with two light barriers for one operating direction
- Quick stop with a light barrier for both directions
- Quick stop with one light barrier per direction of rotation
- Interlocked manual operation with one light barrier per operating direction
- Quick stop and creep speed with two light barriers for each operating direction
- Interlocked manual mode and creep speed with two light barriers for each operating direction
- When using break contacts, inversion of the signals for internal processing.

Table 25: Sensors

Pole 3	Configuration
0	Sensor signals through AS-Interface®, no add-on function (default)
1	When using sensors with break contacts: Signals are inverted for internal processing; the original signals are sent through AS-Interface®.

Table 26: Setting quick stop and interlocked manual mode

DIP pins			Add-on functions, RA-SP-HE…
4	5	6	
0	0	0	No additional functions (default)
1	0	0	Quick stop and interlocked manual operation (edge-controlled only): I3A and I4A enabled. I3A and I4A are assigned to forward operating direction. Reverse direction is disabled; Application example: vertical sorter > 360° eccentric and > 360° rotary table
0	1	0	Quick stop: I3A enabled. I3A is assigned to both operating directions. I4A has no additional function; Application example: chain discharger
0	0	1	Quick stop: I3A and I4A enabled. I3A is assigned to operating direction Forward, I4A to operating direction Reverse; Application example: vertical sorter < 360° eccentric
0	1	1	Quick stop and interlocked manual mode (edge- and signal-controlled): I3A and I4A enabled. I3A is assigned to operating direction Forward, I4A to operating direction Reverse; Application example: vertical sorter < 360° eccentric
1	1	0	Invalid/error message at DI1
1	0	1	Quick stop and creep speed: I3A/B and I4A/B enabled. I3A and B are assigned to operating direction Forward, I4A and B to direction Reverse. When I…B is reached, RA-SP-HE… switches to creep speed at fixed frequency 1. When I…A is reached, the drive switches off; Application example: rotary table
1	1	1	Quick stop and interlocked manual mode (edge- and signal-controlled) and creep speed: I3A/B and I4A/B enabled. I3A and B are assigned to operating direction Forward, I4A and B to direction Reverse. When I…B is reached, RA-SP-HE… switches to creep speed at fixed frequency 1. When I…A is reached, the drive switches off; Application example: rotary table

Activate phase reversal switch (pole 7)

Danger!
Safety risk! The jumper positions and the setting of DIP switch pole 7 must be changed only by trained persons and only in accordance with this manual. Incorrect settings will cancel the reversing starter's interlock or reverse the operating direction.

Table 27: Phase reversal and reversing function

Pole 7	Configuration
0	Reversing starter (default)
1	Reversing starters and phases L1 and L3 reversed (phase reversal)

Configuring stop behaviour of RA-SP-HE… (pole 8)

Pole 8	Configuration
0	No response to external 24 V DC control voltage (default)
1	Power-off with second ramp when external 24 V DC fails

RA-SP does not need an external 24 V DC control voltage. RA-SP-HE… allows a controlled power-off with the second ramp when the external 24 V DC fails. This function requires the 24 V DC to be supplied through the user-assembled M12 plug.

For parameterizing the second deceleration time with parameter number PNU A93 → page 127.

Reading diagnostic status through AS-Interface® parameter channel with RA-SP-HE…

To be able to read out the diagnostic status (DIP pole 2 = 1, → table 24) the PLC with WRITE P must send the parameter bit combination 111. The RA-SP-HE… responds with the diagnostic status (→ table 28). If no diagnostic data is available, the RA-SP-HE… returns the parameter bit combination 111.

If two or more diagnostic messages apply at the same time, the message with the highest priority is displayed until the fault that triggered the diagnosis has been rectified and the Reset command has been issued. Then the diagnostic message with the next highest priority is displayed. The messages are listed in order of their priority.

The highest-priority message is at the top of the list.

Table 28: Diagnostic status

Diagnostic status	P1	P2	P3	P4	Group error at DI1	Explanation/parameter number
Device defective	0	0	1	0/1	1	Processor defective (E11 and E22) EEPROM fault (E08)
Overload tripping	0	1	0	0/1	1	Overcurrent in output stage (E01, E02, E03, E04) Overload (E05) Overvoltage in regenerative mode (E07)
Thermistor tripping	0	1	1	0/1	1 (only when DIP pole 1 = 0)	Tripping through excessive resistance in thermistor sensor circuit
No special diagnostics message	1	1	1	0/1	1	Possible causes: • Undervoltage (E09) • Unattended start protection tripped (E13) • Earth-fault, (E14) • Mains overvoltage (E15) • Overtemperature (E21) • Power plug removed • Overload/short-circuit I3/I4
Manual mode	1	0	0	0/1	0	Key-switch in MANUAL (HAND) position
Load signal	1	0	1	0/1	0	Threshold for overload alarm signal (value adjustable through parameter C41)

Diagnose and status via LEDs

LED	Colour	Meaning	no signal	flashes	Signal
AS-Interface® Power	green	AS-Interface®-voltage	missing	–	applied
AS-Interface® Fault	red	AS-Interface®-fault	no fault	–	Communication error, e.g. slave has no address.
UV	green	Auxiliary power 24 V internal or external for RA-SP-HE… and DIP pole 8 = 1	missing	–	applied
FWD	green	Clockwise	not actuated	Not actuated on RA-SP-HE… because: • light barrier has been reached in interlocked manual operation or quick stop • 400 V supply failed and returned in manual mode[1)] • 24 V supply failed and returned with DIP pole 8 = 1 in manual mode[1)]	Start Forward rotating field
REV	green	Anti-clockwise	not actuated		Start Reverse rotating field
–	–	Automatic, indicated by key-switch	–	–	–
Motor:	red	Group error from power module, thermistor, motor plug not connected. In addition, on RA-SP-HE: • DIP switch position invalid • Overload/short-circuit I3/I4	no fault	–	applied
I 3, I4					
RA-SP…342/343 RA-SP-HE	green	external input via M12 socket, PIN 4	not actuated	–	actuated
RA-SP-HE	red	external input via M12 socket, PIN 2	not actuated	–	actuated
	yellow	external input via M12 socket, PIN 2 + 4	not actuated	–	actuated

1) Automatic restarting after a 400 V power failure is prevented. To continue manual operation, a Reset command must be issued (set key-switch to OFF).

Controlling the speed control unit

The speed control unit is controlled through AS-Interface® as per specification 2.1 for 31 stations:

Function	Signal on RA-SP AS-Interface® outputs				Signal on RA-SP AS-Interface® inputs			
	DQ0	DQ1	DQ2	DQ3	DI0	DI1	DI2*	DI3*
No controller enable	0	0						
Anti-clockwise "REV"	0	1						
Clockwise "FWD"	1	0						
No controller enable	1	1						
f_0 = Analog value per potentiometer; alternatively: digital with F01 & A20,)			0	0				
f_1 = 30 Hz			1	0				
f_2 = 40 Hz			0	1				
f_3 = 50 Hz			1	1				
Automatic mode					1			
No automatic mode					0			
Group error						0		
No group error						1		
External input I3 through M12 socket[1]								
no signal							0	
Signal applied							1	
External input I4 through M12 socket[1]								
no signal								0
Signal applied								1

1) for RA-SP342/343

The Start command or the Enable signal for the required operating direction is issued through DQ0 (FWD) or DQ1 (REV). Fixed frequencies f_1 to f_3 (digital reference value memory) are called up binary-coded through outputs DQ2 and DQ3. If DQ2 and DQ3 are not actuated, the fixed frequency value (f_0) set with spindle potentiometer n_0 is output (analog reference value memory, 0 to 50 Hz).

Diagnostics and troubleshooting

All errors detected by the power module are forwarded internally to the AS-Interface® module as a group error: DI1 (Error). In the motor symbol, the red LED lights up. The connected motor decelerates uncontrolled. With RA-SP-HE… the motor is stopped at the default deceleration in the event of a thermistor fault (also thermal switch, interruption of motor cable).

To reset the error message, turn the key-switch to the Off position. Hold the switch in this position for about 0.5 seconds to allow the RA-SP to recognize the command.

The Reset signal through AS-i provides an additional possibility for resetting the RA-SP-HE… in case it is not accessible for a local reset. The local reset with the key-switch remains the main reset function, since it is necessary for analysing and eliminating fault causes locally.

In automatic operation the RA-SP-HE… interprets simultaneous setting of the forward and reverse operation outputs (data bits DO0 and DO1) as a Reset. Before a reset, data bits DO0 and DO1

must be Low for at least 18.5 ms. The reset is performed when the data bits are then High for at least 18.5 ms. A built-in logic circuit prevents fault conditions.

When mains power is switched on, the frequency inverter performs a self-test. The power module detects the following errors, which can be read through the serial interface.

- Mains overvoltage, mains undervoltage
- Overvoltage in internal DC link
- Overcurrent (overload, short-circuit, ground fault)
- EEPROM and microprocessor errors
- Overtemperature in power module
- Overtemperature in motor (with thermistor or thermal switch only) or interruption of motor line. For RA-SP-HE… this error message is not detected by the power module. It is available as diagnostics status through the parameter channel, → page 111.

For RA-SP-341… , RA-SP-342…, RA-SP-341(230) and RA-SP-343(230)… the following applies:

The device's built-in fuses for the DC air solenoid is not reported separately. For testing, a voltage measurement between pin 4 and pin 6 is required. This test must be performed by a trained electrician.

Auto configuration for servicing

When you replace a RA-SP with an identical device, the AS-Interface® is automatically transferred.

Requirement:

- Auto-addressing mode is enabled (default setting for RA-IN).
- The 400 V~ supply and AS-Interface® are active.

Procedure:

▶ Make the plug-in connections to the new RA-SP…

The key-switch is in its Off position. After no more than 0.5 seconds all error LEDs must have gone out.

▶ Select HAND (manual) or AUTO operating mode.

Parameterization

Caution!
The processor of the RA-SP contains parameters of frequency inverter DF5, which can not be activated with the Rapid Link system. Incorrectly parameter settings can lead to undefined operating states and malfunction.

The parameters of the frequency inverter DF5 are described in manual AWB8230-1412.

The descriptions below include only those parameters that are applicable for use of the RA-SP in the Rapid Link system.

The parameters can be changed only with the keypad DEX-KEY-10 or the Moeller parameterization software Drive-Soft (→ page 105).

Caution!
The parameters listed in this section must be changed only by trained personnel and according to the instructions in manual AWB8230-1412.

The speed control unit RA-SP is factory-configured for operation in the Rapid Link system. Depending on your application, individual functions of the RA-SP can be adapted to the assigned drive in one of several ways:

- With a PC running the Moeller parameterization software Drives Soft
- Through the keypad DEX-KEY-10

The PC or keypad is connected through the serial RS 422 port (→ page 103), which is located under the screw cover.

The default settings of the RA-SP are:

- Acceleration time = 10 s
- Delay time = 2 s
- PTC monitoring enabled:
  - On RA-SP2-34… PTC monitoring is performed in the power module and is enabled through digital input 5.
  - On RA-SP-HE… monitoring is independent of the power module.
- Reference frequency 1 = 30 Hz
- Reference frequency 2 = 40 Hz
- Reference frequency 3 = 50 Hz
- Reference value potentiometer n_0 (under the screw cover on the device front), about 10 Hz

Caution!
Do not connect or disconnect the connection cable between HMI device and speed control unit in operation, as this could cause unpredictable drive behaviour.

Caution!
During operation or parameterization with the remote HMI device contact faults orwire breakages can cause the Stop function to fail. Make sure that a second Stop function is enabled in all operating states. If necessary an Emergency Stop must be forced.

RA-SP and keypad DEX-KEY-10

The description below covers only those features of the keypad DEX-KEY-10 that are relevant for its use in combination with RA-SP. For further information about the keypad DEX-KEY-10 see manual AWB8240-1416GB. You can download this manual as a PDF file from the Moeller Website: Go to http://www.moeller.net/support: and enter the document number in the Quick Search field.

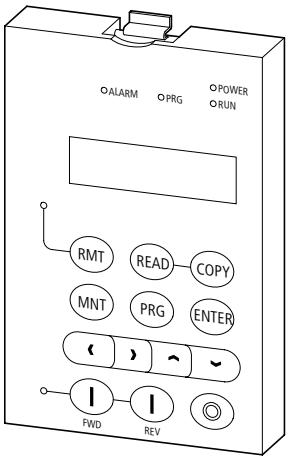


Figure 119: DEX-KEY-10 keypad

On first use, keypad DEX-KEX-10 must be configured speed control unit RA-. Do this as follows:

▶ Press and hold the RMT and PRG keys at the same time and switch on the supply voltage. All LEDs light up.

```
LOCAL MODE
```

▶ Release the RMT and PRG keys.

```
CONFIGURATION
DIAGNOSE
```

The cursor ▯ flashes next to the active function or the activated input value. To move the cursor, select a function and change the values, use the arrow keys ›, ‹ and ˇ. Changed values and functions are indicated by an asterisk (*) and can be saved with the ENTER key. To change the settings or return to the previous settings without saving any changes, use the arrow keys ›, ‹ and ˇ.

▶ Select CONFIGURATION with the ENTER key.
BPS (bits per second) indicates the data transfer rate. For RA-SP, this value should be set to 4800.

```
BPS
              4800
```

▶ Press arrow key ˇ.

```
OPERATOR TYPE
SRW
```

▶ Press arrow key ›.

```
OPERATOR TYPE
SRW
```

▶ Press arrow key ˇ twice and confirm selection DRW2 with the ENTER key.

```
OPERATOR TYPE
             *DRW2
```

▶ Then press the RMT key twice. All LEDs except POWER and RMT go out. The keypad is now correctly configured.

→ The RMT and ‹ keys have no function in connection with the RA-SP.

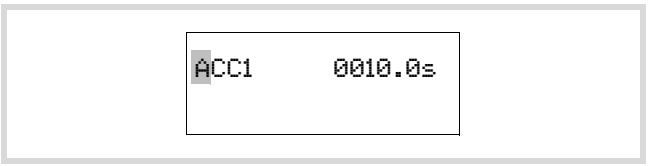
Monitor menu of DEX-KEY-10

To call up the Monitor menu, press the MNT key. For RA-SP "TM 005.0 0.0Hz" on the left indicates the reference value from spindle potentiometer n_0 (default = 5 Hz) and on the right the output frequency is indicated.

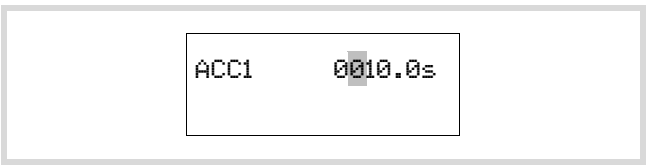
```
TM 005.0   0.0Hz
```

To change the settings in the Monitor menu, use arrow keys ‹ and ˇ. In addition to the indication of reference and actual values and error messages, inputs can also be made.

To view the acceleration time, press arrow key ‹.



Use the › key to select each digit or function and the ∧ or ∨ key to change it.



→ The table below gives only those Monitor menu display functions that are used for the RA-SP. The remaining parameters displayed on the keypad are not used with the RA-SP.

To select a function and change the current value, use the arrow keys › and ∧ or ∨; to return, press the MNT key.

Display text	DF5 PNU	Meaning	Access rights	Change
TM 005.0F 0.0Hz	–	TM = (terminal) reference value of spindle potentiometer n_0 005.0 = reference frequency, indication in Hz (e.g. 5 Hz) F = enable forward operation; R = enable reverse operation 0.0Hz = actual frequency	ro	–
ACC1 0010.0s	F02	ACC1 = first acceleration time from 0 Hz to end frequency 0010.0s = 10 s (default)	rw	online
DEC1 0002.0s	F03	DEC1 = first deceleration time from end frequency to 0 Hz 0002.0s = 2 s (default)	rw	online
F-SET-SELECT TRM	A01	F-SET-SELECT = frequency setting selection through: TRM = terminal (spindle potentiometer n_0) VR = not used with RA-SP REM = remote keypad DEX-KEY-10, not affected by key-switch position AUTO-OFF-HAND	rw	STOP
F/R-SELECT TRM	A02	F-SET-SELECT = enable with forward/reverse rotating field through: TRM = (terminal) selector switch REV-OFF-FWD or AS-Interface® REM = remote keypad DEX-KEY-10, not affected by key-switch position AUTO-OFF-HAND and selector switch REV-OFF-FWD	rw	STOP
/Hz01.0 0.00	b86	/Hz01.0 = output frequency [Hz], factor (0.1 to 99.9) 0.00 = display value (output frequency × factor)	rw	online
Im 0.0A 0.0%	–	Im0.0A = Motor current 0.0% = Display value; percent of rated operational current	ro	–
I0 00.00A	b32	I0 = Magnetization current 00.00A = Matching for motor protection and display value Im	rw	online
V-Boost code‹11›	A42	V-Boost = voltage boost (→ F-04) code‹11› = manual boost: 11 % of maximum output voltage	rw	online
V-Boost F 10.0%	A43	V-Boost F = voltage boost, end frequency (→ F-04) 10.0% = manual frequency value: 10 % of transition frequency	rw	online
V-Boost Mode 0	A41	V-Boost Mode = voltage boost, characteristic (→ F-04) 0 = Manual boost 1 = Automatic boost	rw	STOP
V-Gain 100%	A45	V-Gain = output voltage (→ F-03 and F-04) 100% = 50 to 100 % of mains input voltage	rw	STOP
Jogging 1.00Hz	A38	Jogging = Inching operation Not used with RA-SP	rw	online

Display text	DF5 PNU	Meaning	Access rights	Change
Jog Mode 0	A39	Jog Mode = stop mode in jogging (inching) duty Not used with RA-SP	rw	STOP
ADJ 80	b81	ADJ = (Analog adjustment) Not used with RA-SP	rw	online
PANEL d01	b89	PANEL = panel display value for DE5-KEY-R03. d01 = actual frequency [Hz] d02 = Motor current (I0) [A] d03 = direction of rotating field (R, F) d04 = PID actual value d05 = Status of digital inputs (1 to 5) d06 = status of digital outputs (fault signal, 11, 12) d07 = display value [Hz] (output frequency × factor)	ro rw[1)]	– online[1)]
TERM LLL LLLLL	–	TERM = (terminal) signal state of internal control inputs H = (High) input/output energized L = (Low) input/output not energized LLL = Fault signal and internal message HLLLL = PTC (function enabled) HLLLH = PTC, switch positions HAND and FWD HLLHL = PTC, switch positions HAND and REV HLHLL = PTC, switch positions AUTO and AS-Interface® Q2 = 1 HHLLL = PTC, switch positions AUTO and AS-Interface® Q3 = 1 HHHLL = PTC, switch positions AUTO and AS-Interface® Q2 = 1 and Q3 = 1	ro	–
ERR1 ---	–	ERR1 = last fault message _ _ _ = Type of detected fault, frequency on fault, current on fault, DC link voltage on fault [Vdc]	ro	–
ERR1 0.0Hz	–	0.0Hz = frequency on fault ERR1	ro	–
ERR1 0.0A	–	0.0A = current on fault ERR1	ro	–
ERR1 000.0Vdc	–	000.0Vdc = DC link voltage on fault ERR1	ro	–
ERR1 RUN 000000H	–	RUN 000000H = operating hours on fault ERR1	ro	–
ERROR COUNT 000	–	ERROR COUNT 000 = number of faults to date	ro	–
ERR2 ---	–	ERR2 = last but one fault message; additional indication as for ERR1	ro	–
ERR3 ---	–	ERR3 = second from last fault message, additional indication as for ERR1	ro	–

You can configure the Monitor menu to display the following additional information:

FS 000.0F 0.0Hz	–	FS = frequency setpoint through keypad DEX-KEY-10	rw	online
1S 000.0F 0.0Hz		1S to 3S = fixed reference frequency 1 to 3 (4 to 15 are not used with RA-SP)	ro	–
ACC2 0015.0S	A92	ACC1 = second acceleration time from 0 Hz to end frequency; displayed only when enabled (→ F06)	rw	online
DEC2 0001.5S	A93	DEC2 = second deceleration time from end frequency to 0 Hz; displayed on ly when enabled (→ F06)	rw	online

PNU = parameter number of frequency inverter DF5

ro = parameter is read-only

rw = parameter is read/write

online = changed values take effect immediately

STOP = settings can be changed only at standstill (output frequency = 0: selector switch in OFF position or STOP key pressed).

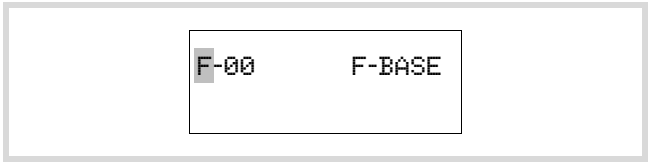
Fault messages on the DEX-KEY-10

For the speed control unit fault messages are indicated as group fault messages by the red LED in the motor symbol. The cause can be determined with the external keypad DEX-KEY-10.

Display text	Fault signal		Description	
CPU 1	E11	Processor malfunction	Fault in processor, e.g. through radio interference or excessive temperature	
CPU 2	E22			
EEPROM	E08	EEPROM fault	Fault in program memory due to radio interference or excessive temperature	
GND. Flt	E14	Earth fault	Earth fault between outputs U, V or W and earth	
OC. Drive	E01	Overcurrent	In static operation	• Short circuit in output or in motor cable, • the motor is blocked. • extreme impact loads causing high current peaks in output, • switching in output voltage during operation.
OC. Accel	E02		In the acceleration phase	
OC. Decel	E03		In the deceleration phase	
Over. C	E04		At standstill	
Over. L	E05	Overload	Power-off through built-in electronic motor protection	
Over. V	E15	Overvoltage	Power-off through overvoltage in regenerative operation	
OV. SRC			The mains voltage exceeds the permissible value. Power-off after about 100 s.	
OH FIN	E21	Overtemperature	Temperature sensor in power section: the operating temperature has exceeded the limit value.	
PTC	E35	Temperature fault in motor circuit	Excessive resistance of PTC thermistor input (3 kΩ ±10 %): • Overtemperature in motor (thermistor, themoclick) • Motor cable interrupted	
Under. V	E09	Undervoltage	Undervoltage in internal DC link, for example due to insufficient mains voltage or phase failure. Risks: malfunction of electronics, motor overheating, insufficient torque.	

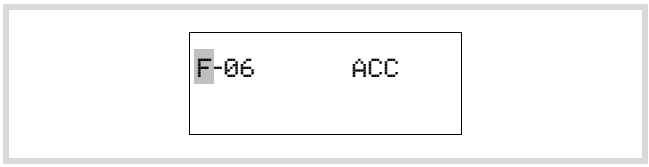
Function menu of DEX-KEY-10

To select the Function menu, press the PRG key. Here you can change all parameter settings of the RA-SP. Use arrow keys ∧ and ∨ to select the function numbers (Fn No.)

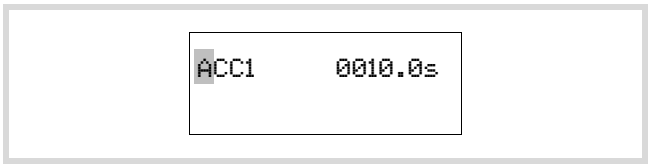


Example: Function F-06, acceleration ramp ACC

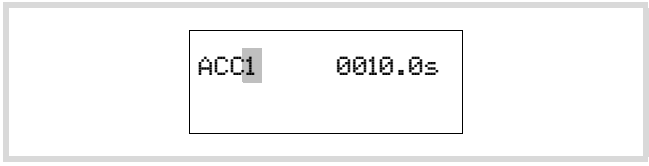
To select the input levels (ACC) of function F-06, press the PRG key.

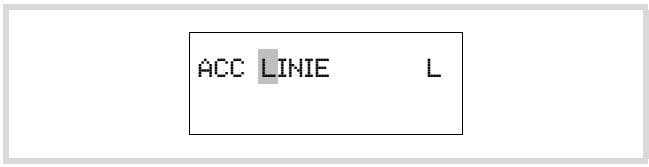


The indication and input level is labelled ACC. The digit "1" stands for the first acceleration time and "0010.0s" indicates the associated value. To select the value 10, use the > keys (press 2+n times) and press ∧ or ∨ to change it. To confirm your changes, press ENTER.

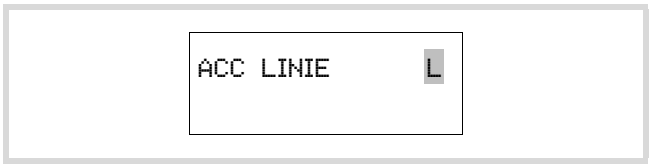


To call up the remaining acceleration ramp functions (for example the characteristic of acceleration ramp ACC LINE), select digit 1 and then use the ∧ key. To change the settings, use the arrow keys >, ∧ and ∨; to confirm your changes, press ENTER.





To go back to the Function menu (F-xx), press the PRG key; to return to the Monitor menu, press MNT.



→ The values and functions in the Function menu can be changed only at standstill (STOP function, output frequency = 0 Hz).

DEX-KEY-10 Fn No./indication	DF5 PNU	Meaning (display code DF5)	Value range	FS	→ Page
F-00 F-BASE	A03	Base frequency	50 to 360 Hz	50	123
F-01 F-MAX	A04	End frequency	50 to 360 Hz	50	
F-02 F-MIN	b82	Increased starting frequency	0.5 to 9.9 Hz	0,5	123
F-03 AVR	Motor voltage stabilization				
AVR AC 000V	A82	Motor voltage • 230 V (DF5-322); not permissible for RA-SP! • 400 V (DF5-340)	200 to 240 V, 380 to 460 V	400	124
AVR MODE DOFF	A81	Function • ON = 00 (active) • OFF = 01 (inactive) • DOFF = 02 (disabled during deceleration time)	ON, OFF, DOFF	DOFF	
F-04 CONTROL	A44	*U/f*-characteristic VC = 00 (linear) VP1 = 01 (square-wave)	VC, VP1	VC	124
F-06 ACC	Acceleration time				
ACC 1 0010.0s	F02	1. Acceleration time	0,1 to 3000 s	10	126
ACC CHG TM	A94	Changeover from first to second acceleration time • TM = 00 (digital input 2CH) • FRE = 01 (frequency CHFr)	TM, FRE	TM	
ACC 2 0015.0s	A92	2. Acceleration time	0,1 to 3000 s	1.5	
ACC CHFr 000.0Hz	A95	Changeover frequency from first to second acceleration time	0 to 360 Hz	0	
ACC LINE L	A97	Acceleration characteristic • L = 00 (linear) • S = 01 (S-shaped)	L, S	L	
F-07 DEC	Delay time				
DEC 1 0010.0s	F03	1. Delay time	0,1 to 3000 s	2	126
DEC 2 0015.0s	A93	2. Delay time	0,1 to 3000 s	1.5	
DEC CHFr 000.0Hz	A96	Changeover frequency on changeover from first to second deceleration time	0 to 360 Hz	0	
DEC LINE L	A98	Delay characteristic • L = 00 (linear) • S = 01 (S-shaped)	L, S	L	
F-10 RUN	b88	Motor restart after cancellation of FRS signal • ZST = 00 (with 0 Hz) • fST = 01 (at current motor frequency)	ZST, fST	ZFT	
F-11 SPD	Fixed frequency				
SPD 1 030.0Hz	A21	1. Fixed frequency	0 to 360 Hz	30	128
SPD 2 040.0Hz	A22	2. Fixed frequency	0 to 360 Hz	40	
SPD 3 050.0Hz	A23	3. Fixed frequency	0 to 360 Hz	50	
SPD 4 000.0Hz	A24	4. Fixed frequency (no function with RA-SP)	0 to 360 Hz	0	
SPD... 000.0Hz	A…	… fixed frequency (not used with RA-SP)	0 to 360 Hz	0	
SPD 15 000.0Hz	A35	15. Fixed frequency (no function with RA-SP)	0 to 360 Hz	0	
F-20 DCB	DC braking				

DEX-KEY-10 Fn No./indication	DF5 PNU	Meaning (display code DF5)	Value range	FS	→ Page
DCB SW OFF	A51	DC braking • OFF = 00 (inactive) • ON = 01 (active)	OFF, ON	OFF	128
DCB F 00.5Hz	A52	Startup frequency	0.5 to 10 Hz	0,5	
DCB WAIT 0.0s	A53	Waiting time	0 to 5 s	0	
DCB V 000	A54	Braking torque	0 to 100 %	0	
DCB T 00.0s	A55	Braking duration	0 to 60 s	0	
F-22 IPS	Mains failure duration				
IPS UVTIME 01.0s	b02	Permissible mains failure duration	0,3 to 25 s	5	131
IPS WAIT 001.0s	b03	Waiting time before restart	0,3 to 100 s	1	
IPS POWR ALM	b01	Restarting mode • ALM = 00 (no automatic starting after a fault message) • ZST = 01 (with 0 Hz) • RST = 02 (synchronization and acceleration) • FTP = 03 (synchronized and deceleration to 0 Hz)	ALM, ZST, RST, FTP	ALM	
F-23 E-THM	Electronic motor protection device				
E-THM CHAR CRT	b13	Motor protection - characteristic • CRT = 01 (constant) • SUB = 00 (enhanced)	CRT, SUB	CRT	132
E-THM LVL 00.00A	b12	Tripping current (I_e = rated operational current of frequency inverter)	0,5 to 1,2 × I_e [A]	→ table 19on page 87	
F-24 OLOAD	Current limit				
OLOAD LVL 00.00A	b22	Tripping current	0,5 to 1,5 × I_e [A]	→ table 19on page 87	134
OLOAD CONST 01.0	b23	Time constant	0,1 to 30 Hz/s	1	
OLOAD MODE	b21	Motor current limitation • OFF = 00 (inactive) • ON = 01 (active) • CRT = 02 (inactive during acceleration)	OFF, ON, CRT	ON	
F-25 S-LOCK	b31	Parameter protection • MD0 = 00 (with SFT digital input; all functions inhibited) • MD1 = 01 (with SFT digital input; all functions except PNU F01 inhibited) • MD2 = 02 (without SFT digital input; all functions inhibited) • MD3 = 03 (without SFT digital input; all functions except PNU F01 inhibited)	MD0, MD1, MD2, MD3	MD1	135
F-26 LIMIT	Frequency limit values				
LIMIT H 000.0Hz	A61	Maximum operating frequency	0 to 360 Hz	0	135
LIMIT L 000.0Hz	A62	Minimum operating frequency	0 to 360 Hz	0	
F-27 JUMP	Frequency jump				
JUMP F1 000.0Hz	A63	1st frequency jump	0 to 360 Hz	0	
JUMP F2 000.0Hz	A65	2st frequency jump	0 to 360 Hz	0	
JUMP F3 000.0Hz	A67	3st frequency jump	0 to 360 Hz	0	
JUMP W1 00.5Hz	A64	Jump width of the 1st frequency jump	0 to 10 Hz	0	
JUMP W2 00.5Hz	A66	Jump width of the 2st frequency jump	0 to 10 Hz	0	

DEX-KEY-10 Fn No./indication	DF5 PNU	Meaning (display code DF5)	Value range	FS	→ Page
JUMP W3 00.5Hz	A68	Jump width of the 3st frequency jump	0 to 10 Hz	0	
F-28 STOP-SW	b87	STOP button • ON = 00 (active) • OFF = 01 (disabled in control through digital inputs FWD/REV)	ON, OFF	ON	
F-31 IN	Frequency initialization				
IN EXS 000.0Hz	A11	Frequency on minimum reference value	0 to 360 Hz	0	
IN EXE 000.0Hz	A12	Frequency on maximum reference value	0 to 360 Hz	0	
IN EX%S 000%	A13	Minimum reference value in %	0 to 100 %	0	
IN EX%E 000%	A14	Minimum reference value in %	0 to 100 %	0	
IN LEVEL 0Hz	A15	Conditions for starting frequency • EXS = 00 (with value PNU A11) • 0Hz = 01 (with 0 Hz)	EXS, 0Hz	0 Hz	
IN F-SAMP 8	A16	Filter for time constant of analog reference value input	1 to 8	8	
F-32 ARV	Frequency signal output FA2				
ARV ACC 000.0Hz	C42	In the acceleration ramp	0 to 360 Hz	0	
ARV DEC 000.0Hz	C43	In the deceleration ramp	0 to 360 Hz	0	
F-33 OV	Overload signal				
OV LOAD 00.0A	C41	Threshold for signal to digital output 11 or 12	0 to 2 × I_e [A]	I_e	
OV PID 003.0%	C44	PID control deviation	0 to 100 %	3	
F-34 IN-TM	Initialization of digital inputs				
IN-TM 1 FW	C01	AS-Interface® DQ0 = 1 FW = Clockwise rotating field FWD	**Caution:** Do not change!	FW	136
IN-TM 2 RV	C02	AS-Interface® DQ1 = 1 RV = Anticlockwise rotating field REV		RV	
IN-TM 3 CF1	C03	AS-Interface® DQ2 = 1 CF1 = Fixed frequency FF1		CF1	
IN-TM 4 CF2	C04	AS-Interface® DQ3 = 1 CF2 = Fixed frequency FF2		CF2	
IN-TM 5 RS	C05	PTC = PCT thermistor input		PTC	
IN-TM O/C-1 NO	C11	Not used with RA-SP	**Caution:** Do not change!	NO	
IN-TM O/C-2 NO	C12				
IN-TM O/C-3 NO	C13				
IN-TM O/C-4 NO	C14				
IN-TM O/C-5 NO	C15				
F-35 OUT-TM	Initialization of digital outputs				
OUT-TM 1 FA1	C21	Not used with RA-SP	**Caution:** Do not change!	FA1	136
OUT-TM 2 RUN	C22			RUN	
OUT-TM O/C-A NC	C33	AS-Interface® DI1 = 0 Fault signal		NC	
OUT-TM O/C-1 NO	C31	Not used with RA-SP		NO	
OUT-TM O/C-2 NO	C32				
F-36 CARRIER	b83	Switching frequency	0,5 to 16 Hz	→ table 19 on page 87	136

DEX-KEY-10 Fn No./indication	DF5 PNU	Meaning (display code DF5)	Value range	FS	→ Page
F-37 MONITOR	C23	Not used with RA-SP		A-F	
F-38 INIT	Initialization				
INIT SEL EUR	b85	Software initialization EUR = 01 Note: Other settings are not permissible for RA-SP!	**Caution:** Do not change!	EUR	
INIT DEBG OFF	C91	Reserved (indication error) Caution: Do not change setting!		OFF	
INIT DOPE FWD	F04	Direction of rotating field		FWD	
INIT MODE TRP	b84	Intialization mode		TRP	
F-43 PID	PID regulation				
PID SW OFF	A71	Not used with RA-SP	**Caution:** Do not change!	OFF	
PID P 1.0	A72			1,0	
PID I 001.0s	A73			1,0	
PID D 000.0	A74			0,0	
PID CONV 01.00	A75			1,00	
PID INPT CUR	A76			CUR	

Description of parameters applicable to RA-SP

F-00 transition frequency (F-BASE)

The base frequency is the frequency at which the output voltage has its maximum value.

PNU	Designation	Adjustable in RUN mode	Value	FS
A03	Base frequency	–	50 to 360 Hz	50

F-01 End frequency (F-MAX)

To define another constant-voltage frequency range that lies beyond the transition frequency (F-00), use PNU A04. This end frequency (F-01) must not be smaller than the transition frequency.

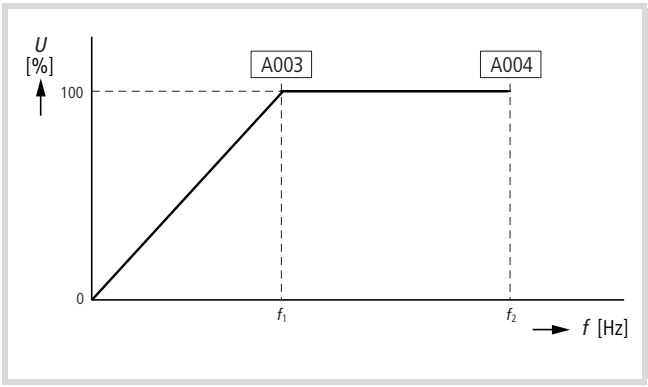


Figure 120: End frequency (f_1 = transition frequency, f_2 = end frequency)

PNU	Designation	Adjustable in RUN mode	Value	FS
A04	End frequency	–	50 to 360 Hz	50

Caution!
The operation of a motor at speeds higher than the rated speed (see nameplate) can cause mechanical damage to the motor (bearings, unbalance) and the machinery to which it is connected and can lead to dangerous operating conditions!

F-03 Automatic voltage regulation (AVR)

The AVR function stabilizes the motor voltage if there are fluctuations on the DC bus voltage. These fluctuations are caused, for example, by:

- unstable mains supplies or
- DC bus voltage dips or peaks caused by short acceleration and deceleration times.

A stable motor voltage provides a high level of torque, particularly during acceleration.

Regenerative motor operation (without AVR function) results in a rise in the DC bus voltage in the deceleration phase (particularly at very short deceleration times), which also leads to a corresponding rise in the motor voltage. The increase in the motor voltage causes an increase in the braking torque. For deceleration, you can therefore deactivate the AVR function under PNU A81.

PNU	Designation	Adjustable in RUN mode	Value	Function	FS
A81	Characteristic of the AVR function	–	00 = ON	AVR function active during entire operation.	02
			01 = OFF	AVR function is not active.	
			02 = DOFF	AVR function active during operation except for deceleration	
A82	Motor voltage for AVR function	–	380, 400, 415, 440, 460	The settings depend on the device series used: • 400 V series: 380, 400, 415, 440, 460 V Caution! Other settings are not permissible.	400

If the mains voltage is higher than the rated motor voltage, enter the mains voltage under PNU A82 and reduce the output voltage in PNU A45 (V gain in Monitor menu) to the rated motor voltage.

Example: With 440 V mains voltage and 400 V rated motor voltage, enter 82 under PNU A440 and 91 % (= 400/ 440 × 100 %) under PNU A45.

F-04 Voltage/frequency characteristic and boost

Voltage/frequency characteristic matching to load torque, e.g. square-wave characteristic for pumps and fans.

Boost

The boost function increases the voltage of the U/f characteristic (thereby boosting the torque) in the lower frequency range. Manual voltage boost raises the voltage in the frequency range from the starting frequency (default setting: 0.5 Hz) to half the base frequency (25 Hz at the default setting of 50 Hz) in every operating state (acceleration, static operation, deceleration), irrespective of the motor load. With automatic boost, by contrast, the voltage is boosted according to the motor load. A voltage boost may cause a fault message and trip due to the higher currents involved.

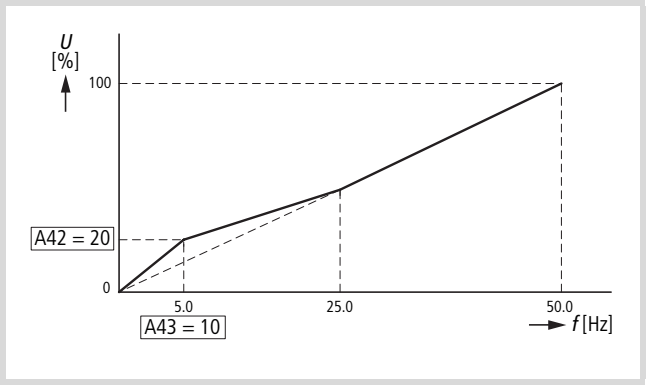
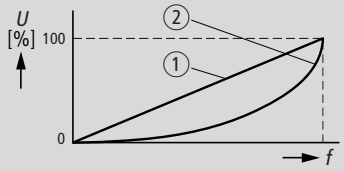
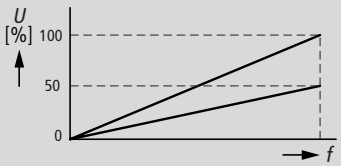


Figure 121: Boost characteristic

Parameter settings:
A41 = 00
A42 = 50
A43 = 10.0
A44 = 00
A45 = 100

PNU	Designation	Adjustable in RUN mode	Value	Function	FS
A41	Boost characteristic	–	00	Manual boost	00
			01	Automatic boost	
A42	Manual boost percentage	✓	0 to 99 %	Setting the voltage increase with manual boost.	11
A43	Manual boost,end value in %, transition frequency	✓	0 to 50 %	Setting the frequency with the highest voltage boost as a percentage of the base frequency (PNU A03).	10,0
A44	Voltage/frequency characteristics	–	 ① linear ② Quadratic	You can select a square-law or a *U f* characteristic for accelerating or decelerating the motor.	00
			00 = VC	Linear U/f characteristic (constant torque).	
			01 = VP1	Quadratic U/f characteristic (reduced torque)	
A45	Output voltage	✓	50 to 100 % of the input voltage	 The output voltage can be set from 50 to 100 % of the input voltage.	100

F-06, F-07 time ramps (ACC, DEC)

Acceleration time 1 defines the time in which the motor reaches its end frequency after a start signal is issued.

PNU	Designation	Adjustable in RUN mode	Value	Function	FS
F02	Acceleration time 1	✓	0,1 to 3000 s	Resolution of 0.1 s at an input of 0.1 to 999.9 Resolution of 1 s at an input of 1000 to 3000	10,0

Deceleration time 1 defines the time in which the motor decelerates to 0 Hz after a Stop signal.

PNU	Designation	Adjustable in RUN mode	Value	Function	FS
F03	Delay time 1	✓	0.1 to 3000 s	Resolution of 0.1 s at an input of 0.1 to 999.9 Resolution of 1 s at an input of 1000 to 3000	2

During operation, a changeover from the time ramps set under PNU F02 and F03 to those programmed under PNU A92 and A93 can be performed. This can take place when the fixed frequencies defined with PNU A95 and A96 are reached.

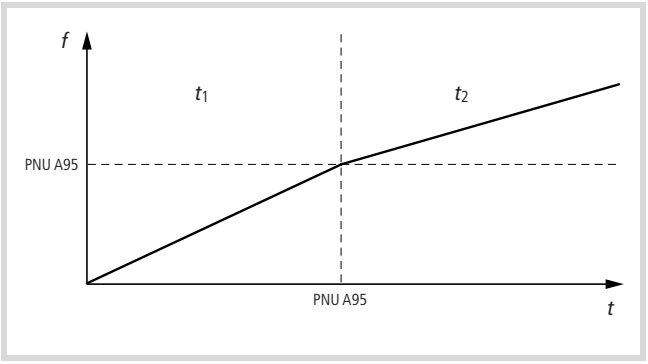
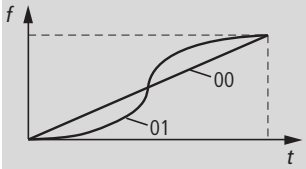


Figure 122: Time ramp

t_1: Acceleration time 1

t_2: Acceleration time 2

PNU	Designation	Adjustable in RUN mode	Value	Function	FS
A92	Second acceleration time	✓	0,1 to 3000 s	Setting times for the second acceleration and deceleration time 0.1 to 9999 s: resolution 0.1 s 1000 to 3000 s: resolution 1 s	15
A93	Second delay time				1.5
A94	Changeover from the first to the second time ramp	–	00 = TM	Can be used with RA-SP2-34… if the standard functionality is to be retained. With RA-SP-HE… and DIP pole 8 set to 1, a failure of the external 24 V power supply causes a changeover to the second ramp.	00
			01 = FRE	Changeover to the second time ramp when the frequencies entered in PNU A95 and/or A96 are reached.	
A95	Acceleration time changeover frequency	–	0.0 to 360.0 Hz	Here, set a frequency at which the changeover from the first to the second acceleration time is to take place.	0,0
A96	Deceleration time changeover frequency	–	0.0 to 360.0 Hz	Here, set a frequency at which the changeover from the first to the second deceleration time is to take place.	0,0
A97	Acceleration characteristic	–	Here, you can set a linear or an S-curve acceleration characteristic for motor acceleration (first and second time ramp): 		00
			00 = L	Linear acceleration of the motor from the first to the second time ramp	
			01 = S	S-curve characteristic for acceleration of the motor from the first to the second time ramp	
A98	Deceleration characteristic	–	00 = L	Linear deceleration of the motor from the second to the first time ramp	00
			01 = S	S-curve characteristic for deceleration of the motor from the second to the first time ramp	

F-11 Fixed frequencies (SPD)

With RA-SP up to four user-definable fixed frequencies can be selected.

Designation		PNU	Fn No. F-11	Parameterization	AS-Interface® DQ0	DQ1	DQ2	DQ3	Manual mode
0	f_0	–	–	Spindle potentiometer n_0; alternatively: PNU F01&A20	–	–	0	0	Selector switch (HAND, FWD, REV)
FF1	f_1	A21	SPD1	digital (30 Hz)	–	–	1	0	–
FF2	f_2	A22	SPD2	digital (40 Hz)	–	–	0	1	–
FF3	f_3	A23	SPD3	digital (50 Hz)	–	–	1	1	–
FWD	–	–	–	–	1	0	–	–	FWD, HAND
REV	–	–	–	–	0	1	–	–	REV, HAND

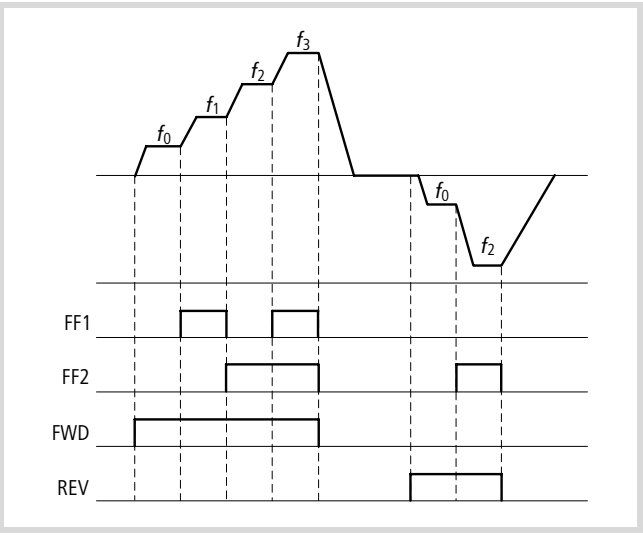


Figure 123: Functional overview: fixed frequencies

→ If one or more of the fixed frequencies exceeds 50 Hz you must first increase the end frequency with PNU A04 (→ section "F-01 End frequency (F-MAX)", page 123).

→ Fixed frequency stage 0 (none of the inputs FF1 to FF3 are activated) corresponds to the frequency reference value, which an be specified with the built-in potentiometer.

Alternatively, you can set the fixed frequency with PNU F01&A20, → table 29.

Table 29: Defining reference fixed frequency stage 0

PNU	Designation	Value	Function	FS
A01	Reference frequency input	00	–	01
		01	Definition through potentiometer under the screw cap, → figure 109 on page 104.	
		02	Derfinition through PNU F01&A20	
A20	Reference frequency	0.5 to 360 Hz	You can enter a frequency reference value. You must set PNU A01 to 02 for this purpose.	0.0

F-20 DC braking

DC braking for decelerating the motor is activated automatically when the frequency falls below the value set with PNU A52.

By applying a pulsed DC voltage to the motor stator, a braking torque is induced in the rotor and acts against the rotation of the motor. With DC braking, a high level of stopping and positioning accuracy can be achieved.

Under PNU A51, specify whether DC braking is used.

Under PNU A52, enter the frequency at which DC braking is activated.

Under PNU A53, enter the waiting time which is to elapse before DC braking becomes active when the set startup frequency is reached.

Under PNU A54 enter the braking torque between 0 and 100 %.

In PNU A55, enter the DC braking duration.

▽ **Caution!**
DC braking results in additional heating of the motor. You should therefore configure the braking torque (PNU A54) as low and the braking duration (PNU A55) as short as possible.

PNU	Designation	Adjustable in RUN mode	Value	Function	FS
A51	DC braking active/ inactive	–	00	Automatic DC braking disabled	00
			01	Automatic DC braking activated	
A52	DC braking starting frequency		0.5 to 10 Hz	When PNU A51 is set to 01, DC braking is activated when the actual frequency falls below the frequency entered here.	0,5
A53	DC braking waiting time		0.0 to 5 s	When the frequency set with PNU A52 is reached, the motor coasts for the time duration entered here before DC braking is activated.	0.0
A54	DC braking torque		0 to 100 %	Adjustment range for the level of braking torque.	0
A55	DC braking duration		0.0 to 60 s	The time during which DC braking is active.	0,0

Actuation for spring-applied brake with DC air magnet

Connection → page 100

By default, the RA-SP…341/343 activates the brake during motor operation. As long as the motor is driven at a frequency higher than 0 Hz, the brake is disengaged. Do not change this setting if possible.

In specific cases it may be necessary to release the brake with a delay or actuate it prematurely, for example to compensate for delayed brake engagement caused by a rectifier built into the motor's terminal board. This setting can be parameterized.

→ To prevent wear and excessive heating of the brake, keep motor operation times with engaged brake as short as possible.

Set brake actuation through digital output 11. By default, this output is active during motor operation: operating mode RUN.

Alternatively you can actuate digital output 11 through the frequency value signal: operating mode FA2, → page 130.

In operating mode FA2 fixed frequency stage 0 must be set digitally with F01&A20, → table 29 on page 128. This setting can not be made with a potentiometer.

Table 30: Parameterizing digital output 11 (brake actuation, RA-SP…341/343)

PNU	Digital output	Value	Function	Description	FS
C21	11	00	RUN	Signal during motor operation	00
		02	FA2	Frequency exceeded	

F-32 Frequency value signal FA2

The digital output configured as FA2 becomes active when the frequency falls below the frequency set under PNU C42. FA2 is deactivated as soon as the actual frequency falls below the value set in PNU C42. If PNU F01 or PNU A20 is used for the reference input, the frequency set with PNU C42 can be smaller than the value in PNU C43. (→ fig. 124)

To ensure system hysteresis, signal FA2 is activated each time the actual frequency is 0.5 Hz below the frequency set with PNU C42 and deactivated 1.5 Hz past the frequency set with PNU C43.

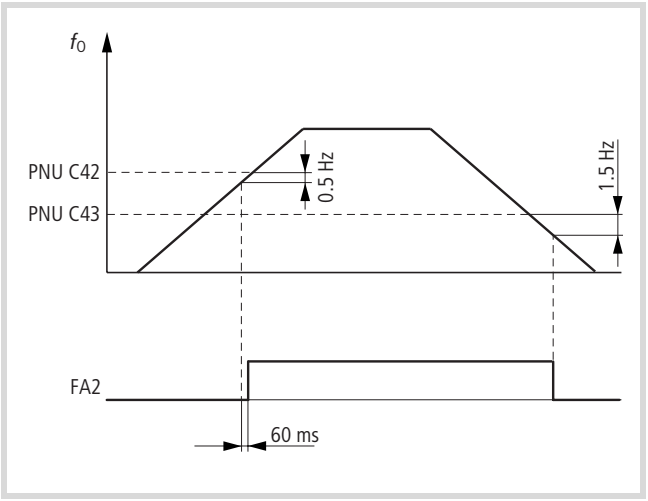
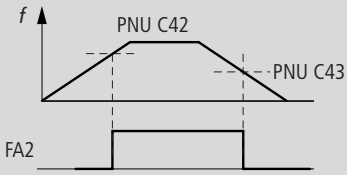


Figure 124: Function chart for FA2 (frequency exceeded)

f_0: Output frequency

- ▶ If you configure a programmable digital output as FA2, you must also, under PNU C42, enter the frequency from which the FA2 signal is active during acceleration.
- ▶ With PNU C43, set the respective frequency which is to remain active until the FA2 signal is deactivated during deceleration.

→ The transition of an FA1 or FA2 signal from the inactive to the active state takes place with a delay of about 60 ms.

PNU	Designation	Adjustable in RUN mode	Value	Function	FS
C42	Frequency from which FA2 becomes active during acceleration	–	0 to 360 Hz	 The digital output (2 or 11) configured as FA12 becomes active when the frequency entered here is exceeded during acceleration.	0,0
C43	Frequency at which FA2 becomes inactive during deceleration			Digital output 11, configured as FA2, remains active during deceleration as long as the actual frequency remains higher than the frequency entered here (a also the illustration for PNU C42).	

F-22 Mains failure duration (IPS)

Danger!
In the event of a fault, this function causes an automatic restart of the RA-SP after the set delay when a Start signal is applied (through AS-Interface®) or if an operating direction is enabled in manual mode (selector switch). Ensure that an automatic restart does not present a danger for personnel.

With the default settings, each fault triggers a fault message. An automatic restart is possible after the following fault messages have occurred:

- Overcurrent (E01 to E04, up to four restart attempts within ten minutes before a fault message is issued)
- Overvoltage (E07 and E15, up to three restart attempts within then minutes, then fault signal)
- Undervoltage (E09, up to 16 restart attempts within 10 minutes, then a fault message is issued) → section "Diagnostics and troubleshooting", page 113

With PNU b01, specify the restarting behaviour.

With PNU b02 and b03, specify the behaviour on mains failure (→ fig. 125 and fig. 126).

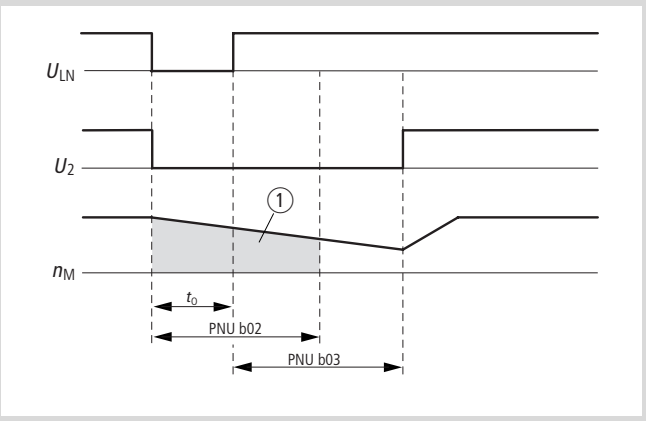


Figure 125: Motor frequency lower than set under PNU b02

U_{LN}: Supply voltage
U_2: Output voltage
n_M: Motor speed
t_0: Duration of supply failure
① Free run stop (coasting)

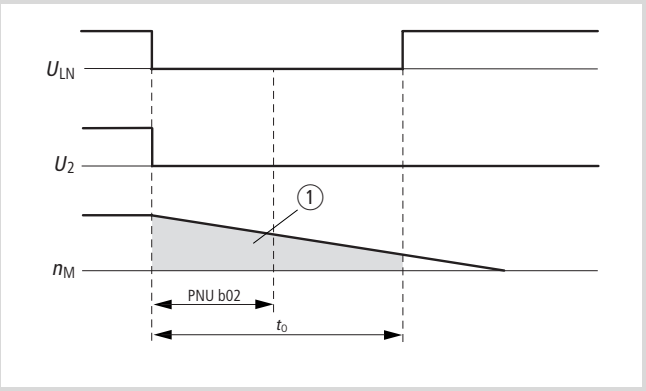


Figure 126: Duration of power failure longer than set under PNU b02

U_{LN}: Supply voltage
U_2: Output voltage
n_M: Motor speed
t_0: Duration of supply failure
① Free run stop (coasting)

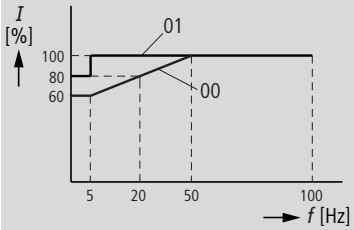
PNU	Designation	Adjustable in RUN mode	Value	Function	FS
b01	Restart mode	–	00 = ALM	The above fault messages are displayed when the associated fault occurs (restart is not activated).	00
			01 = ZST	A restart at the starting frequency after the time set under PNU b03 has elapsed.	
			02 = RST	After the time set under PNU b03 has elapsed, the inverter synchronizes to the current motor rotation speed and the motor accelerates for the set acceleration time.	
			03 = FTP	After the time set under PNU b03 has elapsed, the inverter synchronizes to the current motor rotation speed and the motor brakes for the set deceleration time. A fault message is then displayed.	
b02	Permissible power failure duration	–	0,3 to 25 s	Here, you set a time duration during which the undervoltage condition is met without the corresponding fault message in PNU E 09 being initiated.	5
b03	Waiting time to restart	–	0.3 to 100 s	Here, set a time which is to expire before an automatic restart is initiated after a fault signal.	1,0

F-23 Electronic motor protection (E-THM)

Caution!
At low motor speeds, the output of the motor cooling fan is diminished, which can cause the motor to overheat despite motor protection, You should therefore provide protection with PTC thermistors or thermal contacts.

RA-SP can be configured to provide thermal monitoring of the connected motor through an electronic bimetal tripping device. With PNU b12, match the electronic motor protection to the motor's rated current. If the values entered here exceed the rated motor current, the motor cannot be monitored with this function. In this case, PTC thermistors or thermal contacts in the motor windings must be used.

In PNU b13, set the overload protection according to the applicable motor load.

PNU	Designation	Adjustable in RUN mode	Value	Function	FS
b12	Tripping current for electronic motor protection device	–	→ table 19 on page 87	Setting range of the tripping current as a multiple of the RA-SP's rated current, i.e. the range is given in amperes (A).	1)
b13	Characteristic for electronic motor protection device	–	The electronic thermal protection of the motor in the low speed range can be increased to improve thermal monitoring of the motor at low frequencies.  *I*: Output current		01
			00 = SUB	Enhanced motor protection	
			01 = CRT	Constant motor protection	

1) Rated operational current of RA-SP, → table 19 on page 87

Calibrating current indication and motor protection

With this parameter you match the current display value (PNU d02) to the actual motor current.

PNU d02 contains the motor current with an accuracy of about ±20 %.

The default setting considers a four-pole three-phase asynchronous motor with the respective shaft output power. If, for example, you are using a smaller or a two-pole motor, the motor current indication (PNU d02) may deviate from the actual motor current. You can correct this deviation with PNU b32. In this case the motor is best run in rated load.

▶ Compare the motor's load current with the current indicated by PNU d02.

If the indicated current is not the same as the known current, adjust the indication with PNU b32 as follows:

▶ If the displayed current is too low, increase the value under PNU b32.
▶ If the displayed current is too high, decrease the value under PNU b32.

If the motor's load current is unknown, you have to measure it:

▶ Connect the motor under load directly to the three-phase system and let it run at no load.
▶ Measure the load current, for example with a multimeter.

The current indicated by PNU d02 forms the basis for calibrating the electronic motor protection (PNU b12). Current limitation (PNU b22, → page 132) is not affected by PNU b32.

PNU	Designation	Adjustable in RUN mode	Value	Function	FS
b32	Calibration factor	–	0 to 1.4 × I_e[1)]	Setting range of the motor current in multiples of the inverter's rated current	0.58 × I_e[1)]

1) Inverter rated current in A

F-24 Current limit (OLOAD)

With the current limit setting, the motor current can be limited. To reduce the load current, the frequency rise ends in the acceleration phase or the output frequency is reduced in the static phase, as soon as the output current exceeds the set current limit. The time constant for control at the current limit is entered under PNU b23. As soon as the output current drops below the set current limit, the frequency increases again to the configured reference value. To allow higher currents to flow for a brief period, the current limit can be switched off for the acceleration phase (→ PNU b21).

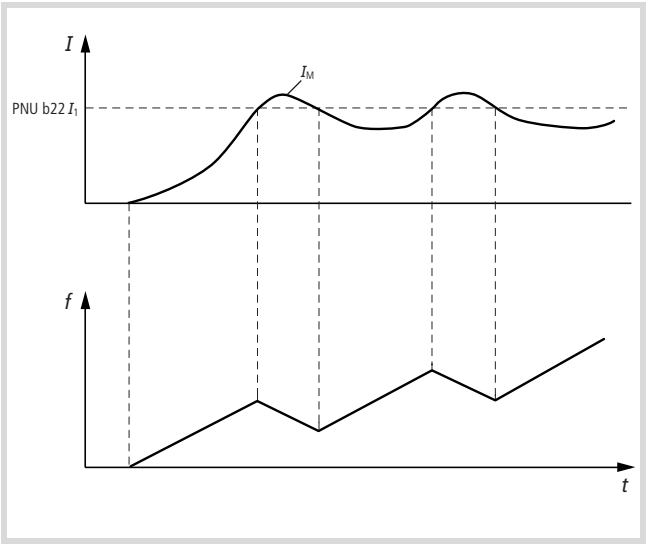


Figure 127: Current limit

I_M: Motor current
I_1: Current limit

Caution!
Note that the current limit cannot prevent a fault message and shutdown due to a sudden overcurrent (e.g. caused by a short-circuit).

PNU	Designation	Adjustable in RUN mode	Value	Function	FS
b21	Motor current limitation	–	00 = OFF	Motor current limit not active	01
			01 = ON	Motor current limit active in all operating states	
			02 = CRT	Motor current limit not active during acceleration	
b22	Tripping current	–	→ table 19 on page 87	Setting range of the tripping current as a multiple of the RA-SP's rated current, i.e. the range is given in amperes (A).	1)
b23	Time constant	–	0,1 to 30 Hz/s	When specified current limit is reached, the frequency is reduced in the time set here. Attention: If possible, do not enter a value below 0.3 here!	1.0

1) Rated operational current of RA-SP, → table 19 on page 87

F-25 Parameter protection (S-LOOK)

The four following methods of parameter protection are available (SFT = software lock):

PNU	Designation	Adjustable in RUN mode	Value	Function	FS
b31	Software parameter protection	–	00 = MD0	Can not be used with RA-SP	01
			01 = MD1	Can not be used with RA-SP	
			02 = MD2	Parameter protection; all functions inhibited	
			03 = MD3	Parameter protection; input through reference value potentiometer n_0 possible	

F-26 Operating frequency range (LIMIT)

The frequency range which is determined by the values configured under PNU b82 (start frequency) and PNU A04 (end frequency) can be limited by PNU A61 and A62 (→ fig. 128). As soon as the RA-SP receives a Start signal it outputs the frequency set under PNU A62.

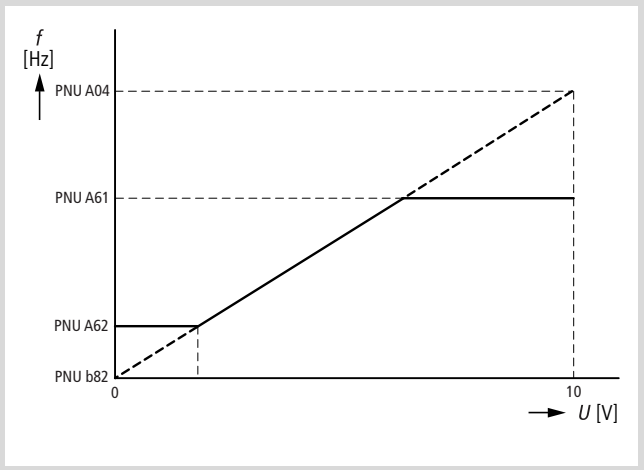


Figure 128: Upper frequency limit (PNU A61) and lower frequency limit (PNU A62)

PNU	Designation	Adjustable in RUN mode	Value	Function	FS
A61	Maximum operating frequency	–	0.5 to 360 Hz	This function can be deactivated by entering 0.0	0.0
A62	Minimum operating frequency		0.5 to 360 Hz		0.0

F-34, F-35 Initialization of built-in digital inputs/outputs (IN-TM, OUT-TM)

→ With RA-SP, initialization is used only to check the factory default settings.

▽ **Caution!**
These settings must not be changed for RA-SP.

F-36 Pulse frequency (CARRIER)

High pulse frequencies reduce motor noise but cause higher hysteresis losses in the motor and higher losses in the power output stage as well as increased noise levels in the mains and motor cables. You should therefore set the pulse frequency as low as possible.

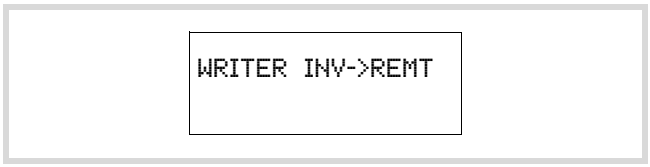
▽ **Caution!**
To prevent overheating of the RA-SP, reduce its output current to 80 % of its rated operational current I_e at pulse frequencies over 12 kHz.

PNU	Designation	Adjustable in RUN mode	Value	FS
b83	Switching frequency	–	→ table 19 on page 87	

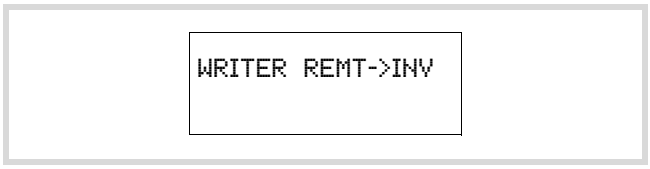
Copier function with DEX-KEY-10

With the Copy function of keypad DEX-KEY-10, you can transfer the parameters to RA-SP units with the same rating. The data are retained even when the power supply is switched off. The memory is an EEPROM and has a lifespan of at least 100000 read operations.

Once you have fully parameterized the first RA-SP, you can transfer the parameters from the RA-SP to the keypad with the READ key.



Reconnect the keypad or the connection cable to an other RA-SP and press the COPY key. The data saved to the keypad are then copied to the RA-SP.



→ Error messages and the content of the fault register are not transferred by the Copy function.

The Read and Copy operations may take several seconds (observe display).

→ The Copy function can be used only when the drive is at standstill. During operation, in error condition, during resetting and with software protection enabled, this function is not available.

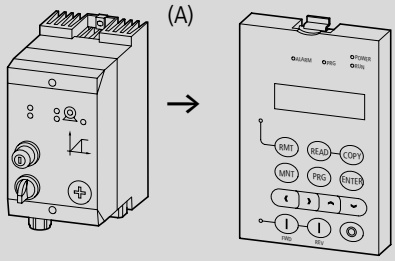
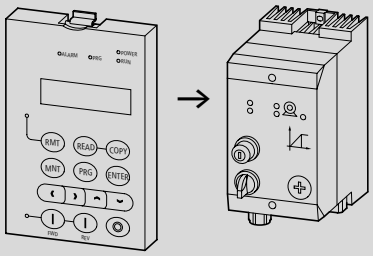
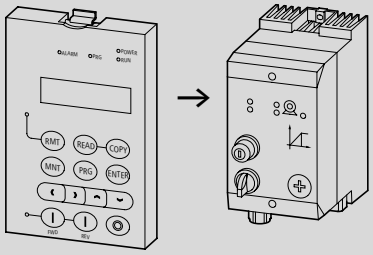
For further information about the keypad DEX-KEY-10 see manual AWB8240-1416.

Copy and Read function example

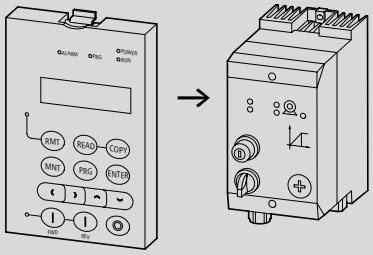
Speed control unit RA-SP (A) with connected and configured keypad DEX-KEY-10.

The parameters of RA-SP (A) are configured for the connected drive unit (application, series machine).

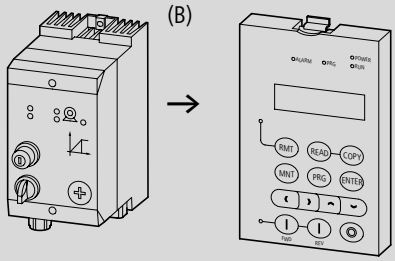
The table below describes the steps required to copy the parameters of RA-SP (A) to three further, identical RA-SP units (B, C and D), with the same application (drive unit):

Step	Pushbutton	Description	Data exchange
1	READ	The parameters saved in RA-SP (A) are read into the keypad.	 (A)
2		Switch off the power supply of RA-SP (A) and disconnect the keypad's connection cable.	
3		Connect the keypad's connection cable to RA-SP (B) and switch on the power supply.	
4[1)]	COPY	The parameters saved to the keypad are copied to RA-SP (B). This takes about 10 seconds.	 (B)
5		Switch off the power supply of RA-SP (B) and disconnect the keypad's connection cable.	
6	COPY	Repeat steps 3 to 5 for RA-SP units (C) and (D).	 (C, D)

1) Note on step 4
If individual parameters are changed after you have pressed the COPY key (for example the acceleration time), you can carry out step 4a here without changing the keypad's saved data.

4a	RMT	After issuing the COPY command, you can use the keypad to change the copied parameters of RA-SP (B). The changed data is automatically saved to RA-SP (B). The keypad's memory content is not affected by this operation.	 (B)

To also apply the parameters changed in step 4a to RA-SP units (C) and (D), save them to the keypad.

4b	READ	The parameters saved in RA-SP (B) are read into the keypad. This overwrites the parameters saved in step 1 so that the keypad now contains the parameters changed in step 4a.	 (B)

Parameterization with DrivesSoft

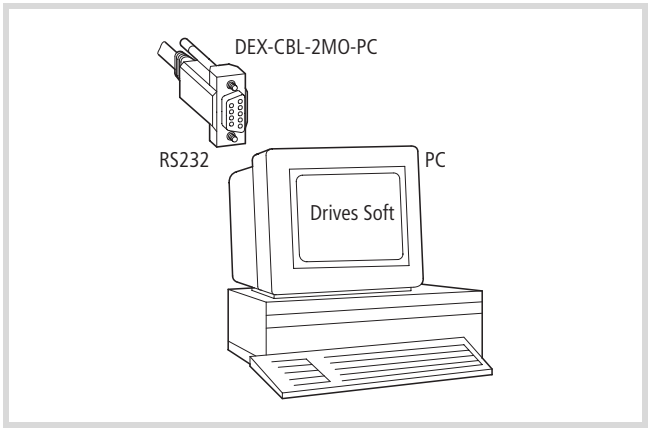


Figure 129: Parameterization with DrivesSoft

DrivesSoft provides a convenient, easy way of parameterizing the speed control unit RA-SP.

System requirements

- DrivesSoft runs on a PC with Windows 95, 98, 2000, ME or NT operating system.
- To connect the PC to the RA-SP, you will need a connection cable with interface converter: DEX-CBL-2M0-PC.

→ DrivesSoft is available for download free of charge from the Moeller website: http://www.moeller.net/support. If you already have an older version of DrivesSoft installed on your PC, you must uninstall it before installing the new version.

Parameterization

Once you have installed DrivesSoft on your PC, you can parameterize your devices as follows:

- ▶ Remove the screw cover, → figure 109 on page 104.
- ▶ Plug in connection cable DEX-CBL-2M0-PC into the unit (RJ45 plug) and to your PC's RS 232 port.
- ▶ Start DrivesSoft.

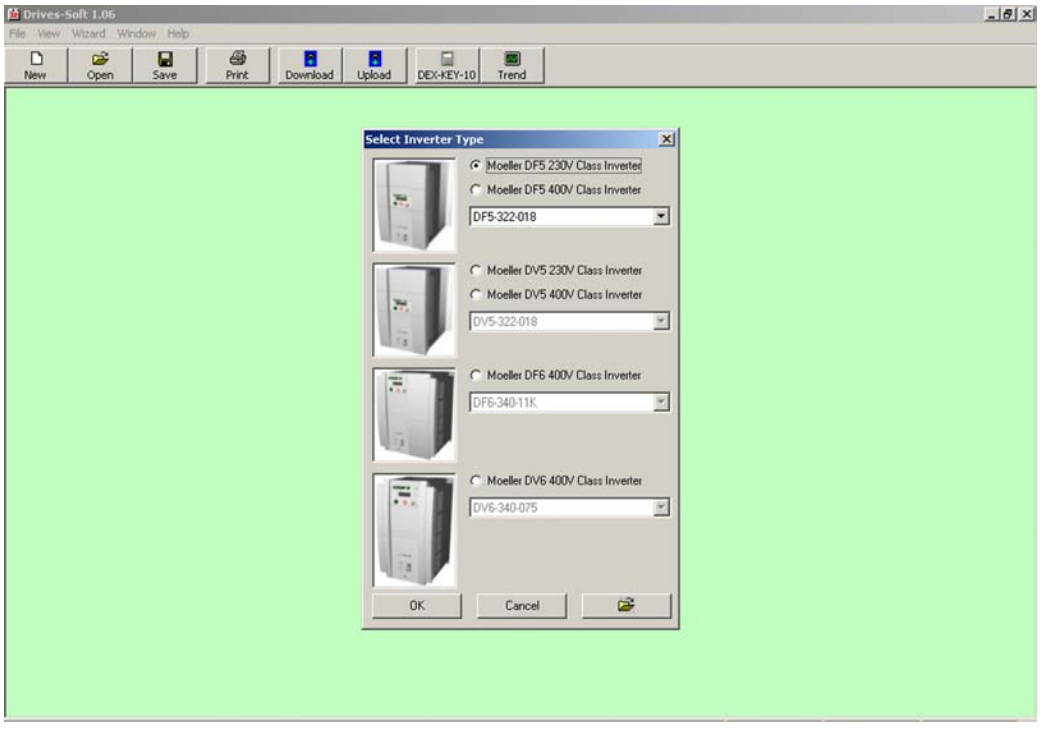


Figure 130: Main window of the DrivesSoft parameterization software

The default interface language is English. To select a different language, close the device selection dialog by clicking Cancel. Then, in the View menu, select Options and in the Options dialog under Language select the desired language. Click OK to confirm your choice.

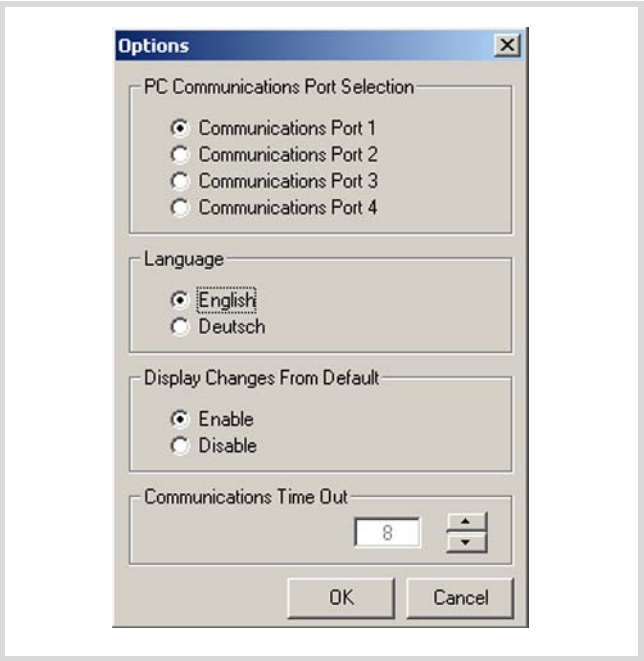


Figure 131: Selecting interface language

To open the device selection dialog, click the New button on the toolbar.

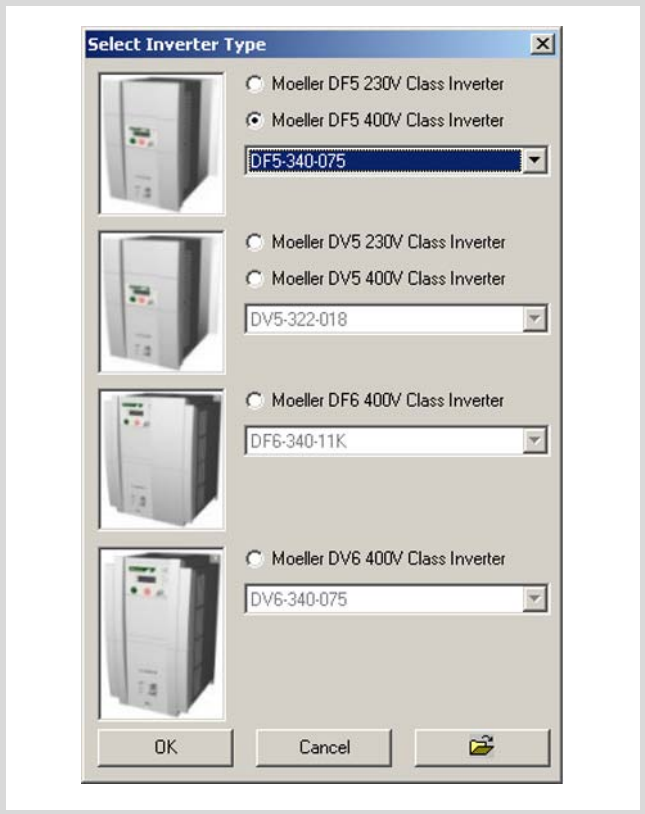


Figure 132: Selection of assigned frequency inverters DF5-340...

The speed control unit RA-SP is not listed here. It is based on the frequency inverters DF5-340…

RA-SP2-…-075… DF5-340-075

RA-SP2-…-1K1… DF5-340-1K5

RA-SP2-…-2K2… DF5-340-2K2.

▶ Select one of the assigned frequency inverters.

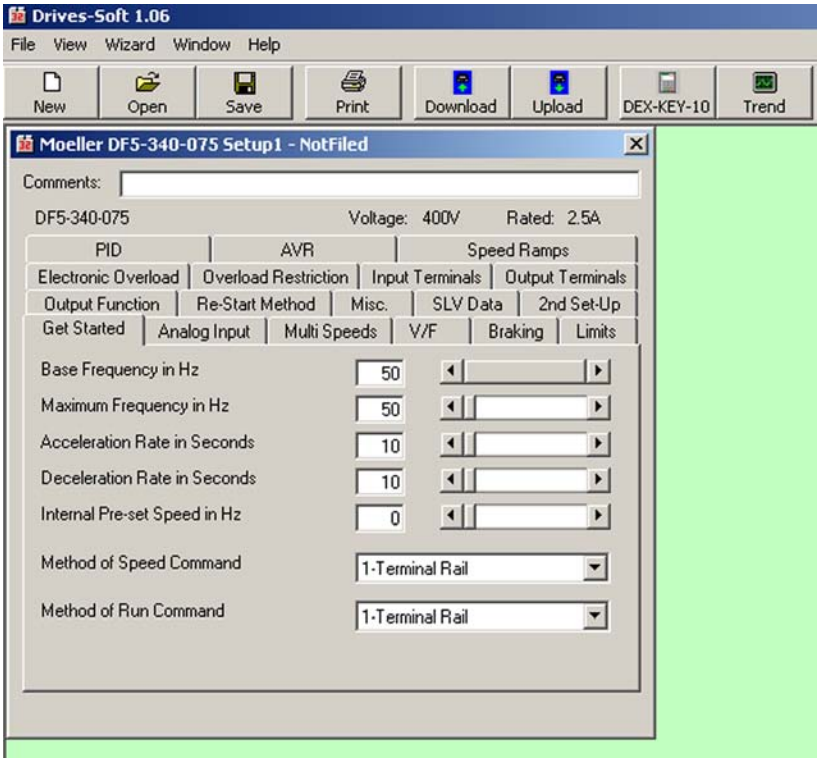


Figure 133: Menu overview

Danger!
Undefined operating states. With DrivesSoft you can access all parameters of the RA-SP's built-in frequency inverter module. Select only the specified parameters,
→ section "Parameterization" from page 114.

The buttons have the following functions:

- Upload: read the parameters of the connected RA-SP.
- Download: copy the parameters to other identical RA-SP units with the same application (function).
- Print: print the parameters.
- Save: Save the parameters to a selected data medium. DrivesSoft uses the standard Windows settings.

Use the menu to change the drive unit's parameters. Any changes are transferred directly to the connected speed control unit (online). Changed values are marked in red. To view the parameter number associated with a setting, move the cursor over the entry; example: acceleration time = F02 (=ACC1).

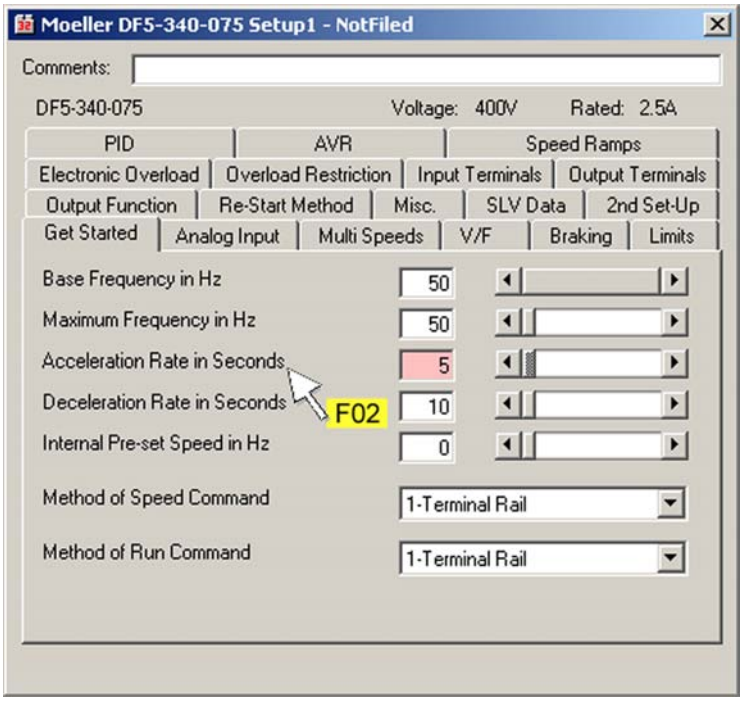


Figure 134: Example: acceleration time

Appendix

Special technical data

System Rapid Link

			RA-IN	RA-DI	RA-MO	RA-SP		
						..0.75..	..1K1..	..2K2..
General								
Standards			• EN 50081 • EN 50082	• IEC/EN 60947	• EN 50081-1 • EN 50082-2 • IEC/EN 55011/A1 class A • IEC/EN 55022 class A • IEC/EN 60947 • DIN VDE 0660 T. 303	• EN 50178 • IEC/EN 55011/A1 class A • IEC/EN 55022 class A • IEC/EN 61800-3, inclusive A11		
Protection type (IEC/EN 60529)			IP 65	IP 65	IP 65	IP 65		
Ambient temperature, operation		°C	0 to 40	0 to 40	–25 to 40	–5 to 40		
Ambient temperature for storage		°C	–25 to 70	–25 to 70	–25 to 70	–25 to 70		
Vibration resistance (IEC/EN 60068-2-6, constant amplitude 0.15 mm/constant acceleration 2 g)		Hz	–	–	–	10 to 57/57 to 150		
Mechanical shock resistance (IEC/EN 60068-2-27)			–	–	6 shocks/axis	6 shocks/axis		
Mounting position			vertical, → page 28	vertical, → page 40	vertical, → page 49	vertical, → page 94		
Weight		kg	0.8	2	2.7	4.3	4.3	5
Indicating element			7-Segment/ LED	LED	LED	LED		
Power circuit								
Supply								
Rated operational voltage	U_e	V ~	–	400	400	400		
Mains current	I	A	–	20	6.6	3.3	3.6	6.4
Rated operational current	I_e	A	–	20	6.6	2.5	2.8	5
Rated uninterrupted current	I_u	A	–	20	–	–		
Rated impulse withstand voltage	U_{imp}	kV	–	6	4	–		
Overvoltage category/degree of pollution			–	III/3	III/2	III (nach DIN VDE 0110)		
Frequency range		Hz	–	50 to 60	50 to 60	50 to 60		
Short-circuit protective device, type "1" coordination		Part no.	–	–	RA-DI	RA-DI		
					PKZ2/ZM25-8	PKZ2/ZM25-8		
					FAZ-3-B20 or FAZ-3-C20	FAZ-3-B20 or FAZ-3-C20		
Rated conditional short-circuit current AC		kA_{eff}	–	10	10	10		
Leakage current to PE		mA	–	–	–	< 3.5 mA (to EN 50178)		

			RA-IN	RA-DI	RA-MO	RA-SP		
						..0.75..	..1K1..	..2K2..
Power loss		W	–	–	–	44	65	92
Motor circuit								
Assigned motor rating		kW	–	–	0,09 to 3,0	0.37 to 0.75	0.75 to ?1.1?	1.1 to 2.2
Setting range, motor protection		A	–	–	0.3 to 6.6	(0.5 to 1.2) × I_e electronic		
Tripping class		A	–	–	10	–		
Output voltage	U_L	V ~	–	–	U_e	0 to U_e		
Frequency range, Motor output		Hz	–	–	50 to 60	0.5 to 360		
Control circuit								
24 V ⎓								
Rated voltage	U_e	V ⎓	30	–	24	24 (internal)		
Tolerance		%	–	–	–15 to 20	–		
Typical current consumption at 24 V ⎓		mA	–	–	200[1) 2)]	–		
AS-Interface®								
Max. total power consumption from AS-Interface® (30 V ⎓ power supply unit)		mA	200	90	50 – 200[3)]	25 – 220		
max. current supply in AS-Interface®		mA	2800	–	–	–		
AS-Interface® specification			2.1	2.1	2.1	2.1		
Slave addresses		Number	62	31	62	31		
IO Code or I/O configuration			–	7 (hex)	7 (hex)	7 (hex)		
ID-code			–	F (hex)	A (hex)	E (hex)		
ID1-Code			–	0 (hex)	Address: xxA = o xxB = F	0 (hex)		
ID2-Code			–	E (hex)	D (hex)	0 (hex)		
Inputs								
Data input 0		DI0	–	Switch position (I1)	Automatic	Automatic		
Data input 1		DI1	–	–	Group fault	Group fault		
Data input 2		DI2	–	–	external input RA-MO-4 (I3)	–		
Data input 3		DI3	–	–	external input RA-MO-4 (I4)	–		
Outputs								
Datenausgang 0		DO0	–	LED O1	Main contactor	Enable FWD rotation (right)		
Datenausgang 1		DO1	–	–	Reversing contactor	Enable REV rotation (left)		
Datenausgang 2		DO2	–	–	LED O3 or ext. output RA-MO-4A(03)	Setpoints		
Datenausgang 3		DO3	–	–	–	Setpoints		
Mains connection cable								
Terminal capacity	mm^2		–	–	1.5	1.5		

1) RA-MO2.x and RA-MO 24 V… only

2) plus power for actuator (03) for RA-MO…A…

3) plus power supply for connected sensors

			Flexible busbar RA-C1-7X4HF EVA	Flexible busbar RA-C1-7X2,5 PVC	Infeed, flexible busbar RA-C1-VM-7	Outgoer, flexible busbar RA-C1-VP-PLF RA-C1-PLF	RA-C2-S...-4 round cable junction
General							
Standards			• IEC 60332-1 • DIN VDE 0295 Class 6 • DIN VDE 0281 Part 404		• IEC 60047-7-1 • DIN VDE 0470 Part 1	• IEC/EN 68000-2-27 • IEC/EN 60998-3 • DIN VDE 0660 Part 1535	• EN 61684 • DIN VDE 0110 • DESINA
Protection type (IEC/EN 60529)			IP 65	IP 65	IP 65	IP 65	IP 65
Ambient temperature, operation		°C	–15 to 50	–15 to 40	–15 to 50	–15 to 40	–15 to 50
Ambient temperature, Mounting		°C	–5 to 70	10 to 50	10 to 50	10 to 50	10 to 50
Mounting position			any	any	any	any	any
Flame retardance, fire resistance			Self-extinguishing to IEC 60332-1		–	–	–
Resistance to oils and acids			according to VDE 0473, Part 811-2-1	Good to very good	–	–	–
Sheathing			Material according to DIN VDE 0282, EVA mixture EM4, black	PVC oil-resistant to CENELEC HD 21.1 S3, TM5, paint film contaminant/ silicon-free	–	–	–
Minimum bending radius		mm	18	100	–	–	–
Cable weight		kg/ km	440	402	–	–	–
External dimensions L × W × H		mm	L × 34,8 × 6,0	L × 34,8 × 6,0	175 × 83 × 78	119 × 57,5 × H	158 × 112,5 × 55
Overvoltage category/ degree of pollution			–	–	III/3	III/3	III/3
Termination			–	–	Twin-level terminal block, 1.5 to 4 mm^2	Penetration contact	Piercing/screw terminals
External diameter of cable		mm	–	–	9 to 17	–	10 to 13 13 to 16
Power circuit							
Rated operational voltage	U_e	V ~	400	400	400	400	400
Rated operational current	I_e	A	25	20	25	–	20/25 (2,5/4 mm^2)
Rated current per junction		A	–	–	–	16	16
Circuit protection device		Part no.	RA-DI	RA-DI	RA-DI	RA-DI	RA-DI
			PKZ2/ZM25-8	PKZ2/ZM25-8	PKZ2/ZM25-8	PKZ2/ZM25-8	PKZ2/ZM25-8
			FAZ-3-B20, FAZ-3-C20	FAZ-3-B20, FAZ-3-C20	FAZ-3-B20, FAZ-3-C20	FAZ-3-B20, FAZ-3-C20	FAZ-3-B20, FAZ-3-C20
Control circuit							
Rated voltage	U_e	V ⎓	24	24	24	24	24
Rated operational current	I_e	A	25	6	25	–	20/25 (2,5/4 mm^2)

			SET-M3 motor cable and motor feeder plug	SET-M4 motor cable and motor feeder plug
General				
Standards			EN 61684	EN 61684
			DIN VDE 0110	DIN VDE 0110
Protection type (IEC/EN 60529)			IP 65	IP 65
Ambient temperature, operation		°C	–30 to 70	–30 to 70
Rated operational voltage	U_e	V ~	300/500	500 (Signal wires: 300)
Connection cable				
Terminal capacity		mm^2	8 × 1,5	4 × 1,5 + 2 × (2 × 0,75) screened
External diameter of cable		mm	10 – 13	11 – 14
Minimum bending radius		mm	6 × external diameter of cable	10 × external diameter of cable
Conductor material			Cu flexible to VDE 0295 Class 5	Cu highly flexible to VDE 0295 Class 6
Material of outer casing			Halogen free	Halogen free
Colour			Silver grey (RAL 7001)	Orange (RAL 2003)
Resistance to oils and acids			VDE 0472 Part 803 B	VDE 0472 Part 803 A/B
Flame retardance, fire resistance			EN 50265-2-1	IEC 60332-2
Plug connector				
Conductor cross-section of contact pins		mm^2	8 × 1,5	4 × 1,5 + 4 × 0,75
Material				
Contact inserts			Polycarbonate	Polycarbonate
Contact material			Cu silver-plated	Cu silver-plated
Housing			Polycarbonate	Metal
Lock mechanism			Polyamide	Metal

Dimensions

System Rapid Link

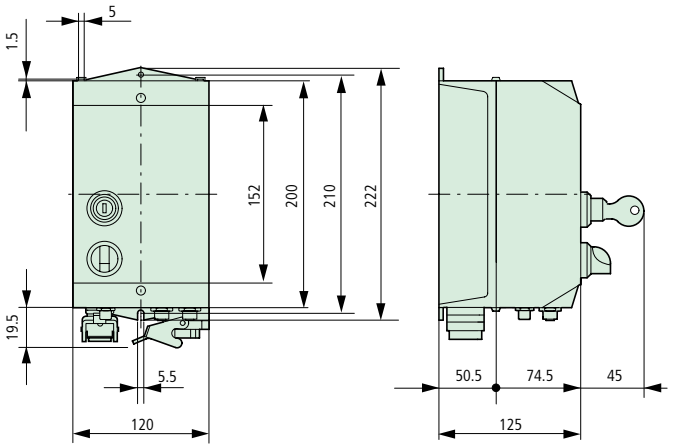


Figure 135: Motor starter RA-MO

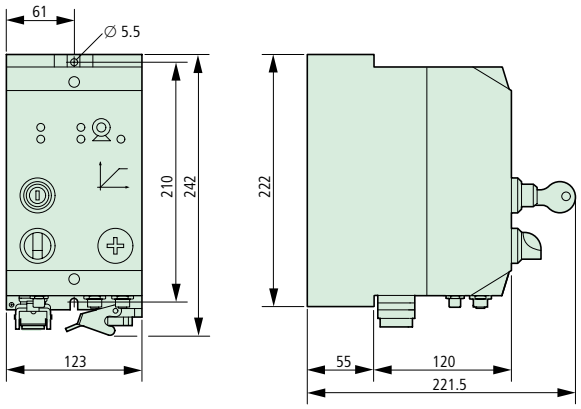


Figure 136: Speed controller RA-SP 0.75 to 1.1 kW

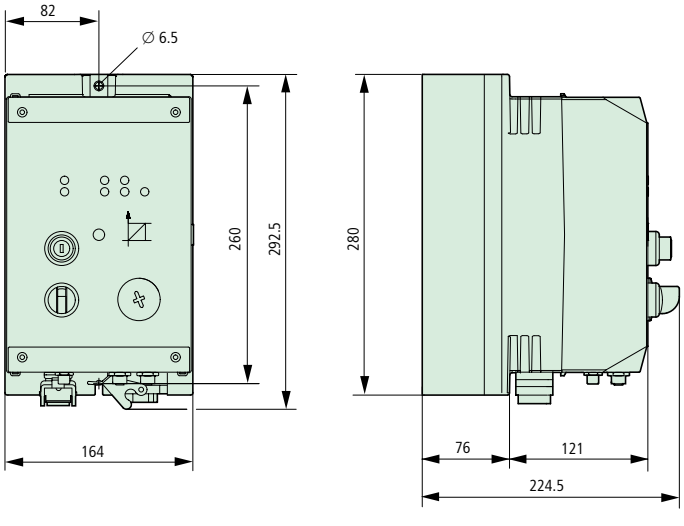


Figure 137: RA-SP speed control unit up to 2.2 kW

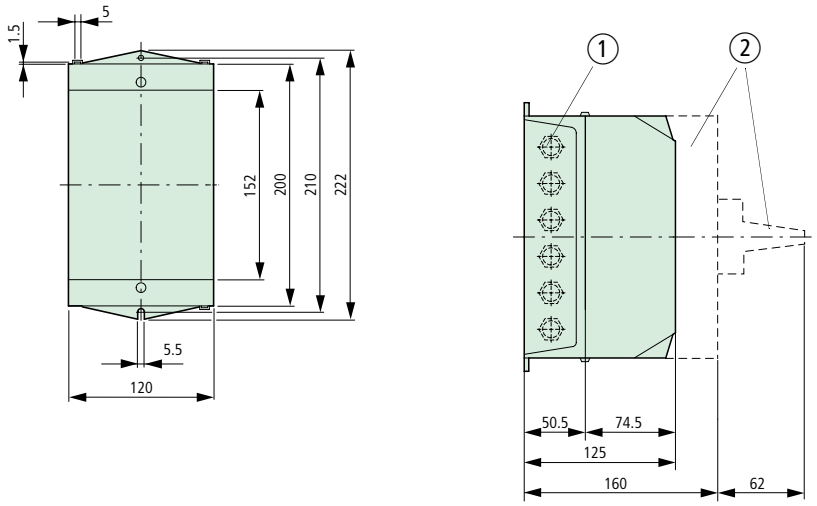


Figure 138: Incoming circuit-breaker RA-DI and head station RA-IN

① Inputs and outputs with RA-LO

② Wider housing depth and rotary handle for RA-DI
Knockout plate RA-DI: top 2 × M20/M25, bottom 2 × M20/M25 and 1 × M20

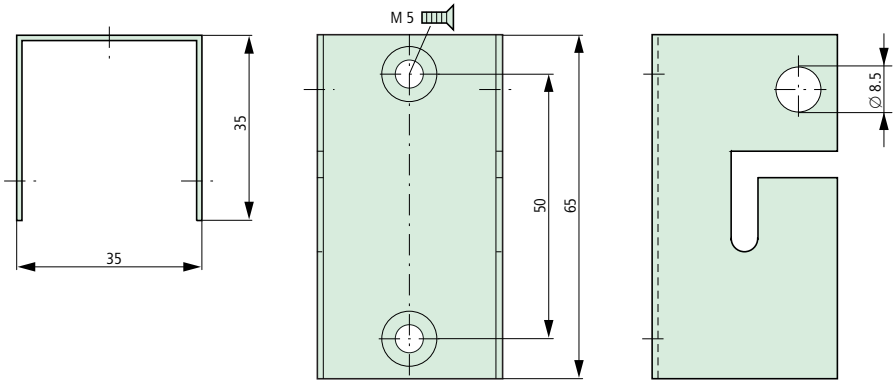


Figure 139: Lock shackle SET-M-LOCK

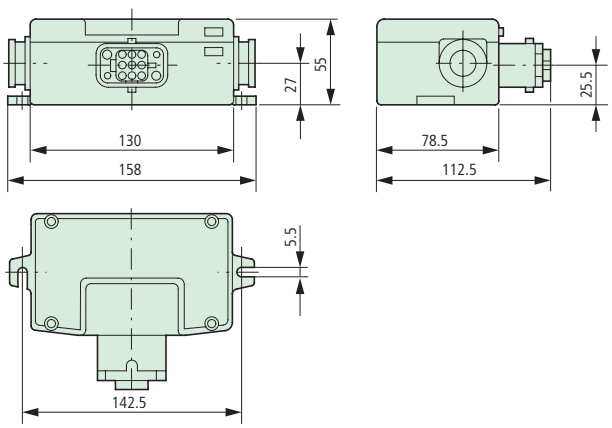


Figure 140: Round cable junction RA-C2-S1-4

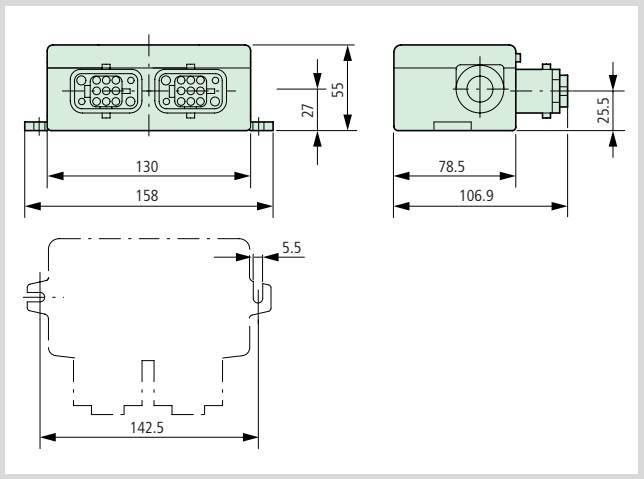


Figure 141: Round cable junction RA-C2-S2-4

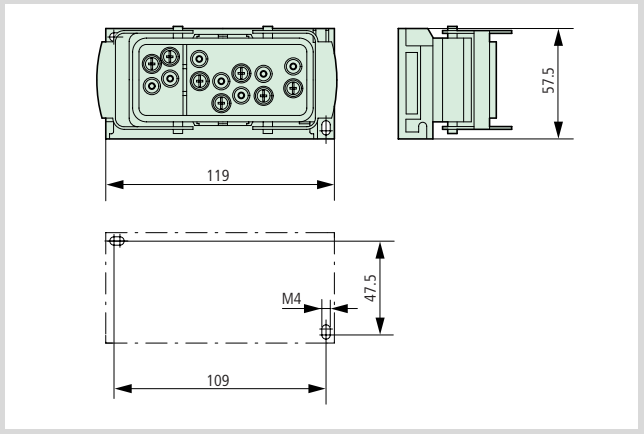


Figure 142: Flexible busbar junction RA-C1-VP-PLF or RA-C1-PLF

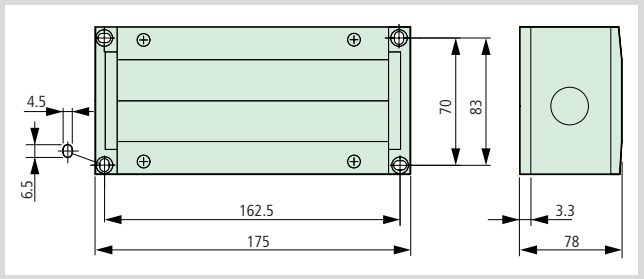


Figure 143: Distribution module RA-C1-VM-7

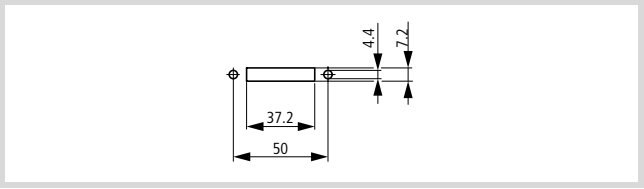


Figure 144: Drilling pattern for RA-C1-DF knockout

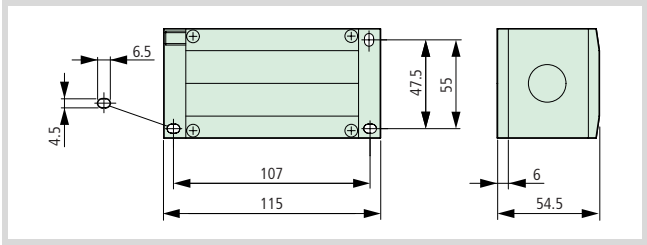


Figure 145: Terminal module RA-C1-VP-AM-2 with screw terminals for 24 V

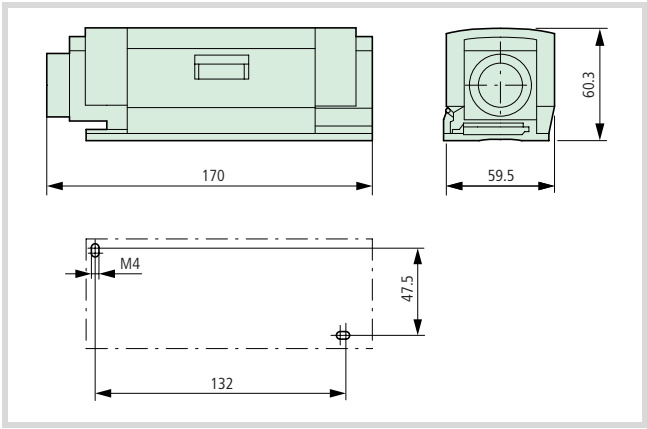


Figure 146: Terminal module RA-C1-VP-SR with screw terminals for 24 V and 400 V

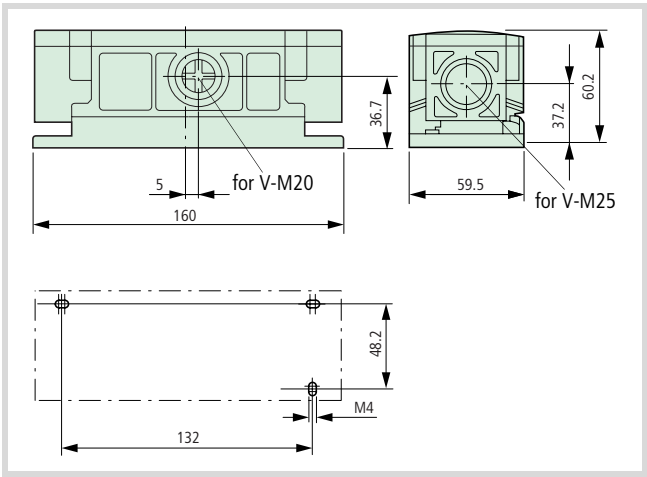


Figure 147: Terminal module RA-C1-AM-7 with cage clamp terminals for 24 V und 400 V

Head station RA-IN

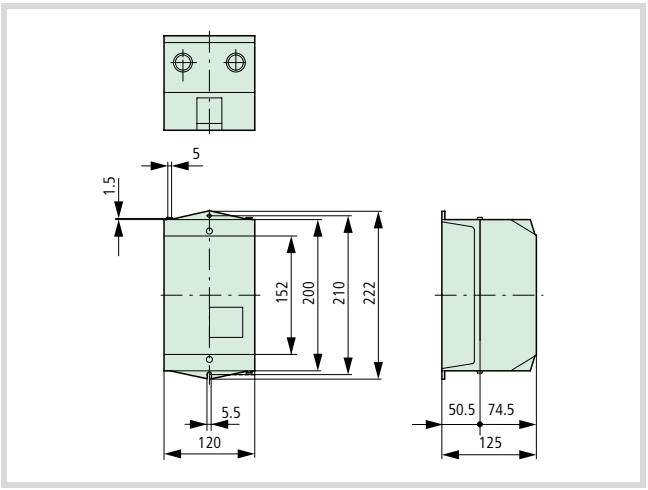


Figure 148: Dimensions

RA-DI incoming circuit-breaker

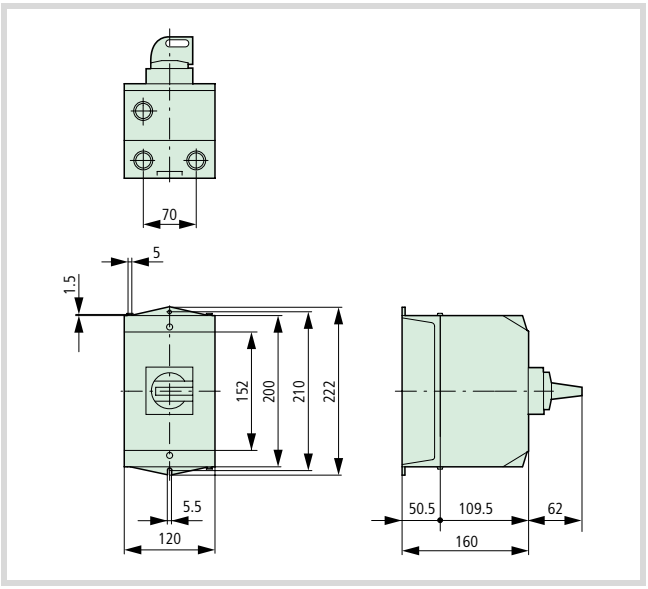


Figure 149: Dimensions RA-DI

Motor starter RA-MO (to Version 2.x)

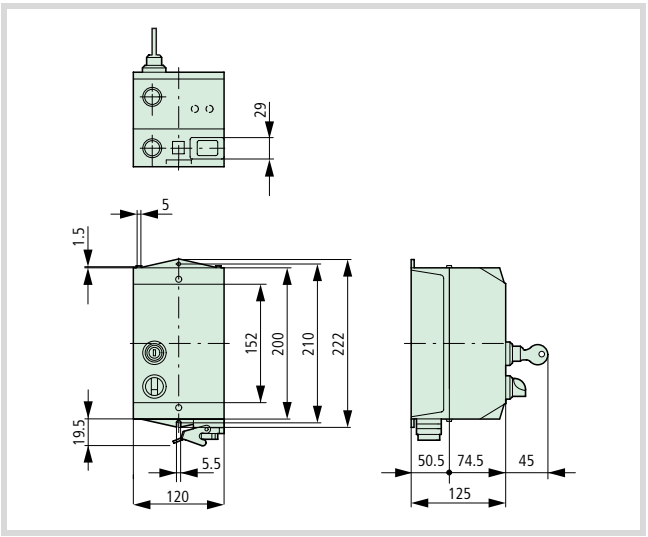


Figure 150: Dimensions RA-MO

Motor starter RA-MO (from Version 3.0)

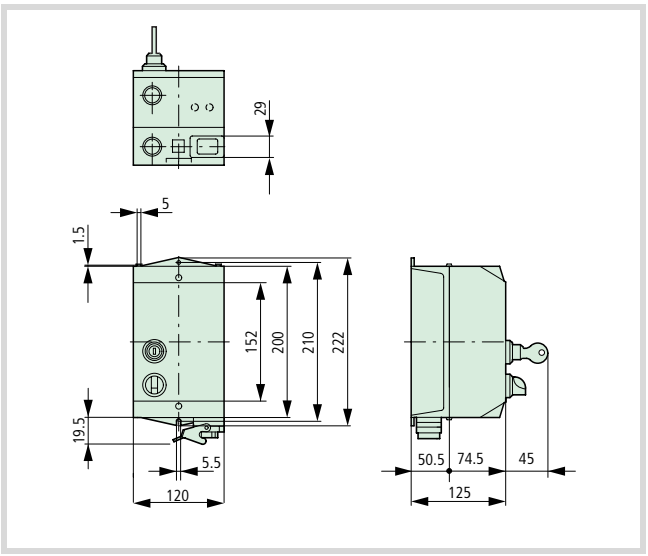


Figure 151: Dimensions:RA-MO from Version 3.0

Speed controller RA-SP

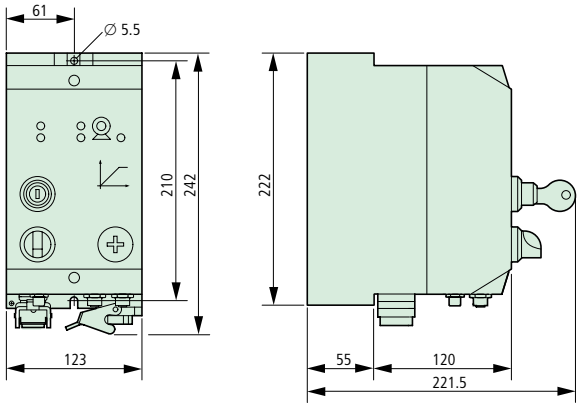


Figure 152: RA-SP075 and RA-SP...1K1

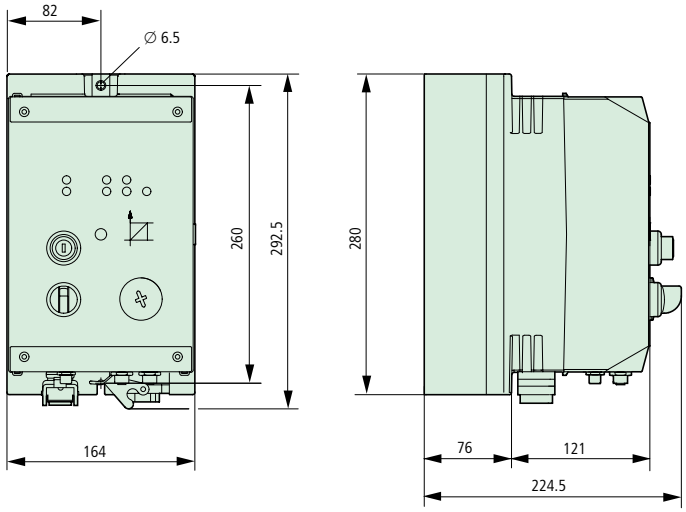


Figure 153: RA-SP…2K2x

Optional accessories

Lock shackle SET-M-LOCK

If the plant operator requires an isolating device and locking facility for padlocks at each motor, you can use lock shackle SET-M-LOCK. With this lock shackle, motor cables SET-M3… and SET-M4… can be safely isolated from the power supply with one or two padlocks with a hasp thickness up to 8 mm.

In connection with motor starters RA-MO and speed control units RA-SP the lock shackle meets the requirements of IEC/EN 60204-1:

- for mains isolating devices up to 16 A according to section 5.3
- for power switches to prevent unexpected starting according to section 5.4
- for isolating equipment for electrical apparatus according to section 5.5
- for protection from inadvertent and/or accidental closing according to section 5.6

The lock shackle can be fitted next to any motor starter RA-MO and speed control unit RA-SP with one or two 90° countersunk M5 screws (e.g. to ISO 2009 or ISO 7046).

Alternatively, the lock shackle can be made available as an accessory to maintenance personnel.

Procedure:

- ▶ Set the key-switch of the motor control unit (RA-MO or RA-SP) to its OFF position [1].
- ▶ Wait until the motor has come to a complete halt [2].
- ▶ Undo the lock shackle of the motor feeder and disconnect the motor plug from the motor control unit [3].
- ▶ Insert the motor plug into the lock shackle [4] and secure it with your padlock [5].

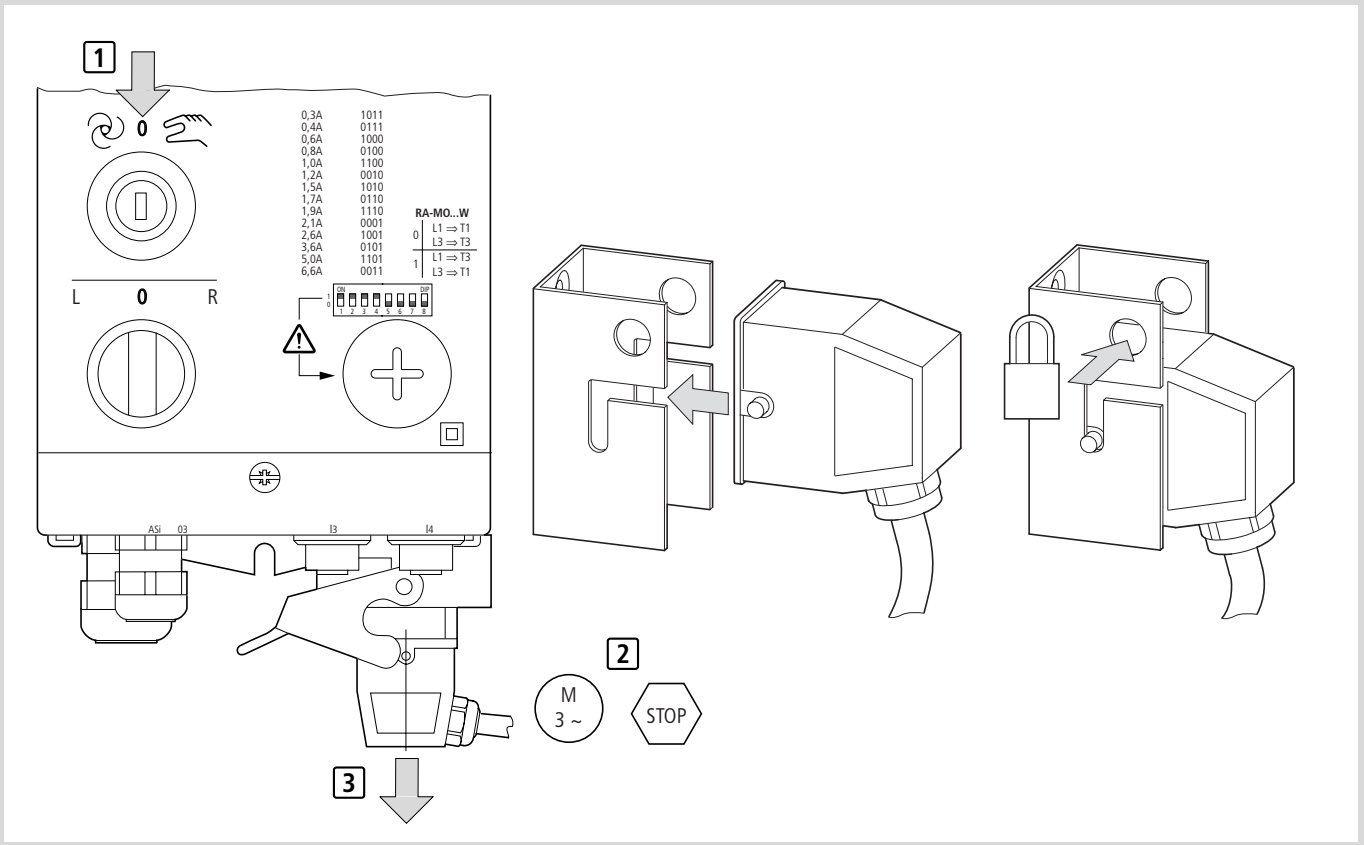


Figure 154: Fitting the lock shackle

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