YASKAWA

VIPA System SLIO

FM | 054-1DA00 | Manual

HB300 | FM | 054-1DA00 | en | 16-46

Motion module - Pulse Train RS422 - FM 054

www.vipa.com/en/service-support/manual

VIPA CONTROLS

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054-1DA00_000_FM054 PulseTrain,3,GB - © 2016

Table of contents

1 General

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Tel.: +49 9132 744-1150 (Hotline)
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1.2 About this manual

Objective and contents

This manual describes the Motion module FM 054-1DA00 of the System SLIO from VIPA. It contains a description of the structure, project engineering and deployment.

Product	Order number	as of state:	
		HW	FW
FM 054 Pulse Train	054-1DA00	01	1.1.2

Target audience

The manual is targeted at users who have a background in automation technology.

Structure of the manual

The manual consists of chapters. Every chapter provides a self-contained description of a specific topic.

Guide to the document

The following guides are available in the manual:

- An overall table of contents at the beginning of the manual
- References with page numbers

Availability

The manual is available in:

- printed form, on paper
- in electronic form as PDF-file (Adobe Acrobat Reader)

Icons Headings

Important passages in the text are highlighted by following icons and headings:

DANGER!
Immediate or likely danger. Personal injury is possible.

CAUTION!
Damages to property is likely if these warnings are not heeded.

Supplementary information and useful tips.

1.3 Safety information

Applications conforming with specifications

The system is constructed and produced for:

- communication and process control
- general control and automation tasks
- industrial applications
- operation within the environmental conditions specified in the technical data
- installation into a cubicle

DANGER!
This device is not certified for applications in

– in explosive environments (EX-zone)

Documentation

The manual must be available to all personnel in the

- project design department
- installation department
- commissioning
- operation

CAUTION!
The following conditions must be met before using or commissioning the components described in this manual:

– Hardware modifications to the process control system should only be carried out when the system has been disconnected from power!
– Installation and hardware modifications only by properly trained personnel.
– The national rules and regulations of the respective country must be satisfied (installation, safety, EMC ...)

Disposal

National rules and regulations apply to the disposal of the unit!

2 Basics and mounting

2.1 Safety information for users

Handling of electrostatic sensitive modules

VIPA modules make use of highly integrated components in MOS-Technology. These components are extremely sensitive to over-voltages that can occur during electrostatic discharges. The following symbol is attached to modules that can be destroyed by electrostatic discharges.

The Symbol is located on the module, the module rack or on packing material and it indicates the presence of electrostatic sensitive equipment. It is possible that electrostatic sensitive equipment is destroyed by energies and voltages that are far less than the human threshold of perception. These voltages can occur where persons do not discharge themselves before handling electrostatic sensitive modules and they can damage components thereby, causing the module to become inoperable or unusable. Modules that have been damaged by electrostatic discharges can fail after a temperature change, mechanical shock or changes in the electrical load. Only the consequent implementation of protection devices and meticulous attention to the applicable rules and regulations for handling the respective equipment can prevent failures of electrostatic sensitive modules.

Shipping of modules

Modules must be shipped in the original packing material.

Measurements and alterations on electrostatic sensitive modules

When you are conducting measurements on electrostatic sensitive modules you should take the following precautions:

- Floating instruments must be discharged before use.
- Instruments must be grounded.

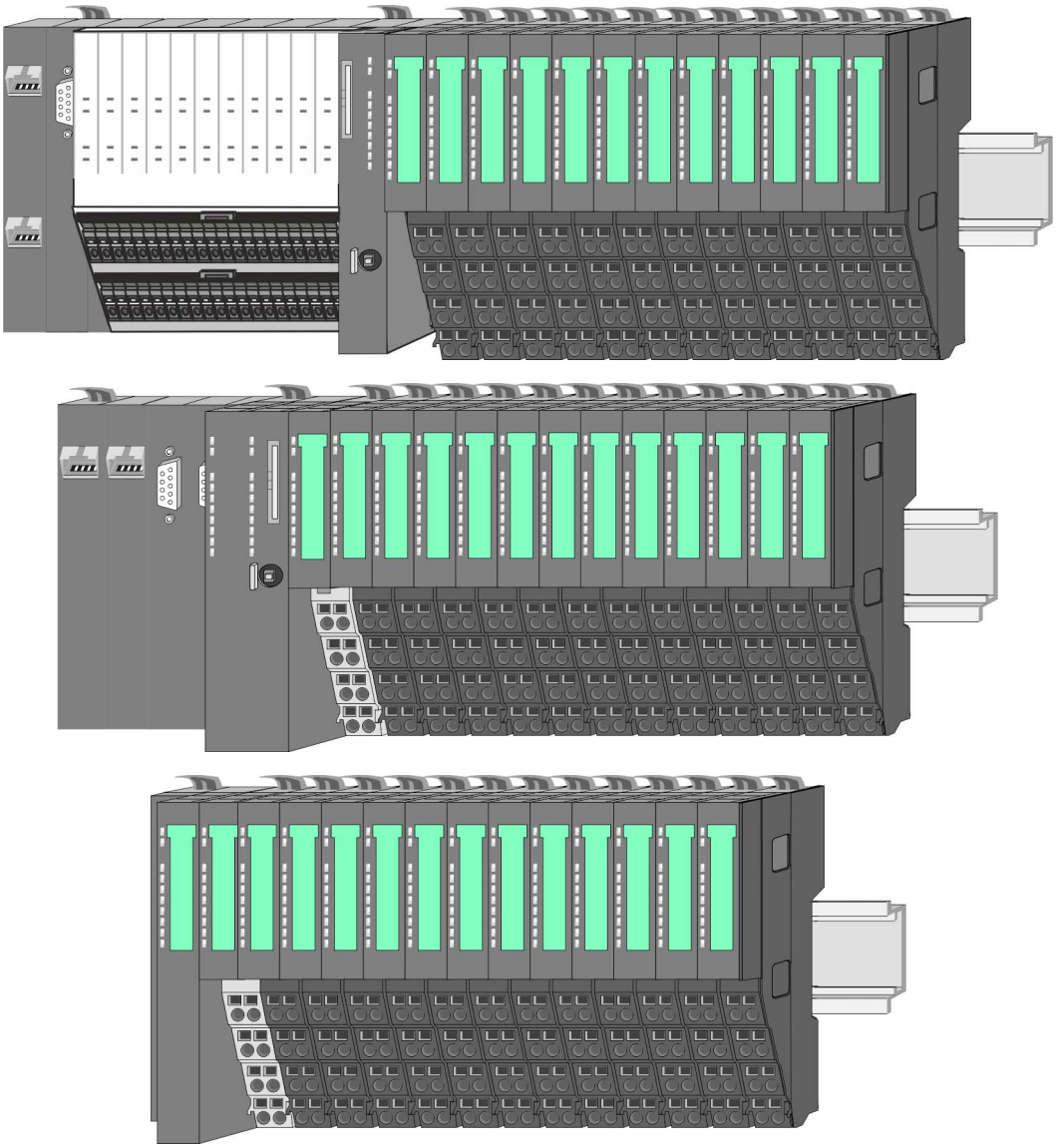
Modifying electrostatic sensitive modules you should only use soldering irons with grounded tips.

CAUTION!
Personnel and instruments should be grounded when working on electrostatic sensitive modules.

2.2 System conception

2.2.1 Overview

System SLIO is a modular automation system for assembly on a 35mm mounting rail. By means of the peripheral modules with 2, 4 or 8 channels this system may properly be adapted matching to your automation tasks. The wiring complexity is low, because the supply of the DC 24V power section is integrated to the backplane bus and defective modules may be replaced with standing wiring. By deployment of the power modules in contrasting colors within the system, further isolated areas may be defined for the DC 24V power section supply, respectively the electronic power supply may be extended with 2A.

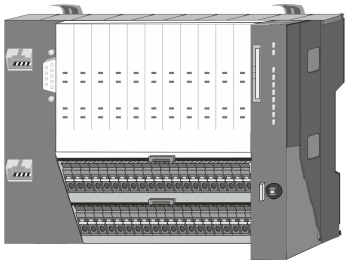


2.2.2 Components

- CPU (head module)
- Bus coupler (head module)
- Line extension
- Periphery modules
- Accessories

CAUTION!
Only modules of VIPA may be combined. A mixed operation with third-party modules is not allowed!

CPU 01xC



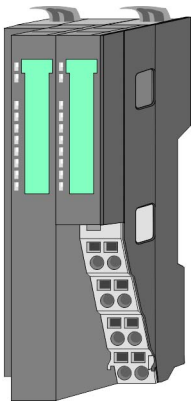
With this CPU 01xC, the CPU electronic, input/output components and power supply are integrated to one casing. In addition, up to 64 periphery modules of the System SLIO can be connected to the backplane bus. As head module via the integrated power supply CPU electronic and the I/O components are power supplied as well as the electronic of the connected periphery modules. To connect the power supply of the I/O components and for DC 24V power supply of via backplane bus connected peripheral modules, the CPU has removable connectors. By installing of up to 64 periphery modules at the backplane bus, these are electrically connected, this means these are assigned to the backplane bus, the electronic modules are power supplied and each periphery module is connected to the DC 24V power section supply.

CPU 01x

With this CPU 01x, the CPU electronic and power supply are integrated to one casing. As head module, via the integrated power module for power supply, CPU electronic and the electronic of the connected periphery modules are supplied. The DC 24 power section supply for the linked periphery modules is established via a further connection of the power module. By installing of up to 64 periphery modules at the backplane bus, these are electrically connected, this means these are assigned to the backplane bus, the electronic modules are power supplied and each periphery module is connected to the DC 24V power section supply.

CAUTION!
CPU part and power module may not be separated!
Here you may only exchange the electronic module!

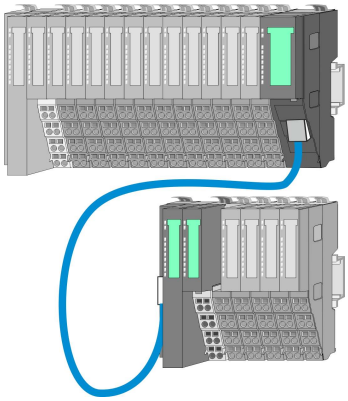
Bus coupler



With a bus coupler bus interface and power module is integrated to one casing. With the bus interface you get access to a subordinated bus system. As head module, via the integrated power module for power supply, bus interface and the electronic of the connected periphery modules are supplied. The DC 24 power section supply for the linked periphery modules is established via a further connection of the power module. By installing of up to 64 periphery modules at the bus coupler, these are electrically connected, this means these are assigned to the backplane bus, the electronic modules are power supplied and each periphery module is connected to the DC 24V power section supply.

CAUTION!
Bus interface and power module may not be separated!
Here you may only exchange the electronic module!

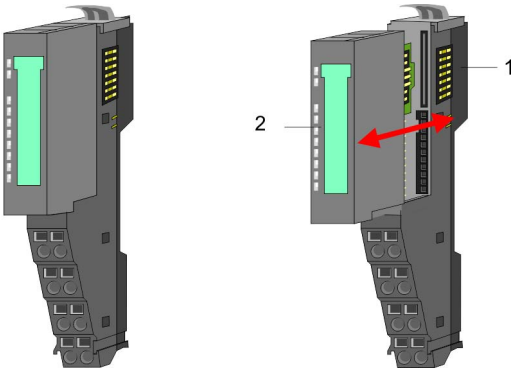
Line extension



In the System SLIO there is the possibility to place up to 64 modules in on line. By means of the line extension you can divide this line into several lines. Here you have to place a line extension master at each end of a line and the subsequent line has to start with a line extension slave. Master and slave are to be connected via a special connecting cable. In this way, you can divide a line on up to 5 lines. To use the line extension no special configuration is required.

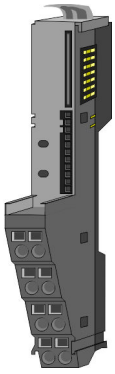
Periphery modules

Each periphery module consists of a *terminal* and an *electronic module*.



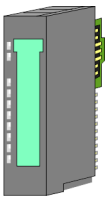
1 Terminal module
2 Electronic module

Terminal module



The *terminal* module serves to carry the electronic module, contains the backplane bus with power supply for the electronic, the DC 24V power section supply and the staircase-shaped terminal for wiring. Additionally the terminal module has a locking system for fixing at a mounting rail. By means of this locking system your SLIO system may be assembled outside of your switchgear cabinet to be later mounted there as whole system.

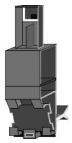
Electronic module



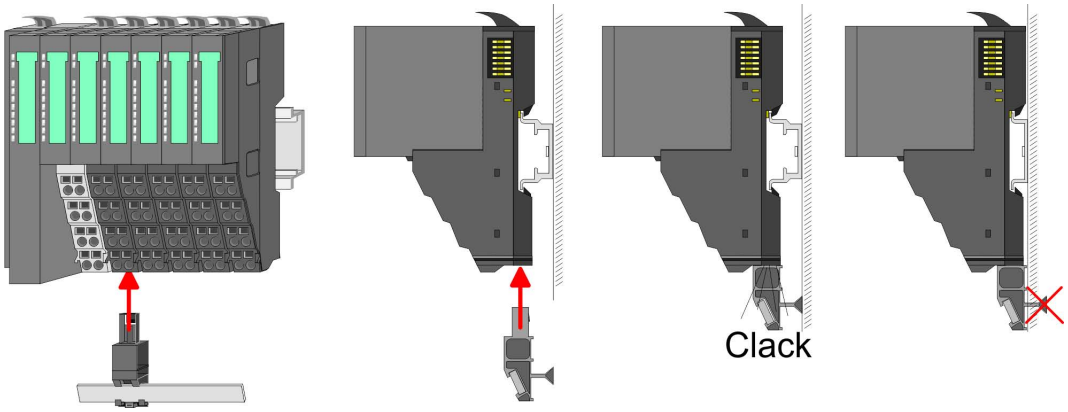
The functionality of a SLIO periphery module is defined by the *electronic* module, which is mounted to the terminal module by a sliding mechanism. With an error the defective module may be exchanged for a functional module with standing installation. At the front side there are LEDs for status indication. For simple wiring each module shows a corresponding connection diagram at the front and at the side.

2.2.3 Accessories

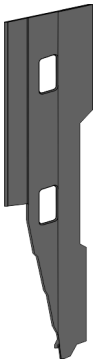
Shield bus carrier



The shield bus carrier (order no.: 000-0AB00) serves to carry the shield bus (10mm x 3mm) to connect cable shields. Shield bus carriers, shield bus and shield fixings are not in the scope of delivery. They are only available as accessories. The shield bus carrier is mounted underneath the terminal of the terminal module. With a flat mounting rail for adaptation to a flat mounting rail you may remove the spacer of the shield bus carrier.



Bus cover



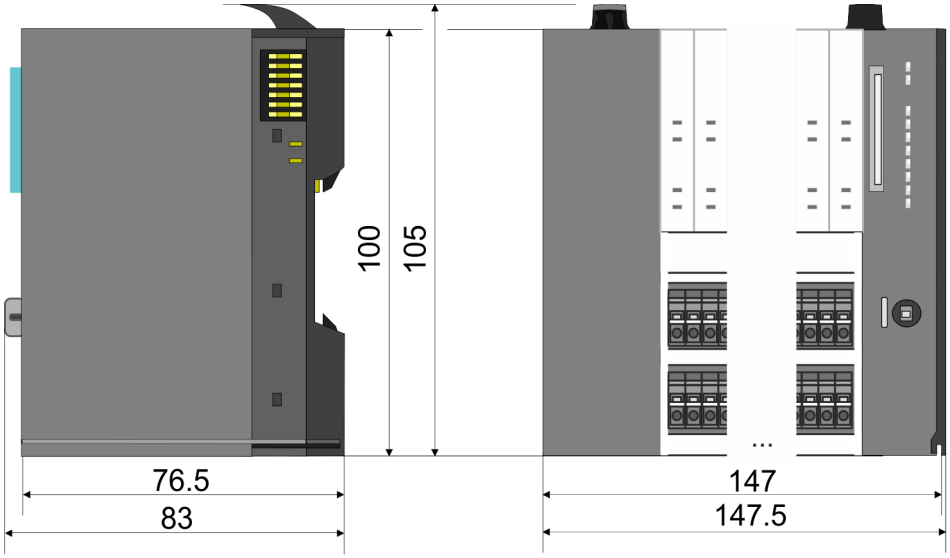
With each head module, to protect the backplane bus connectors, there is a mounted bus cover in the scope of delivery. You have to remove the bus cover of the head module before mounting a System SLIO module. For the protection of the backplane bus connector you always have to mount the bus cover at the last module of your system again. The bus cover has the order no. 000-0AA00.

Coding pins

There is the possibility to fix the assignment of electronic and terminal module. Here coding pins (order number 000-0AC00) from VIPA can be used. The coding pin consists of a coding jack and a coding plug. By combining electronic and terminal module with coding pin, the coding jack remains in the electronic module and the coding plug in the terminal module. This ensures that after replacing the electronics module just another electronic module can be plugged with the same encoding.

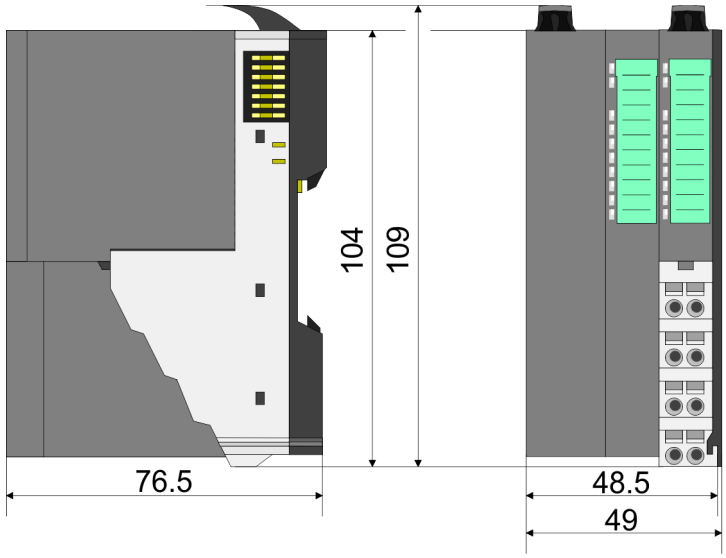
2.3 Dimensions

Dimensions CPU 01xC

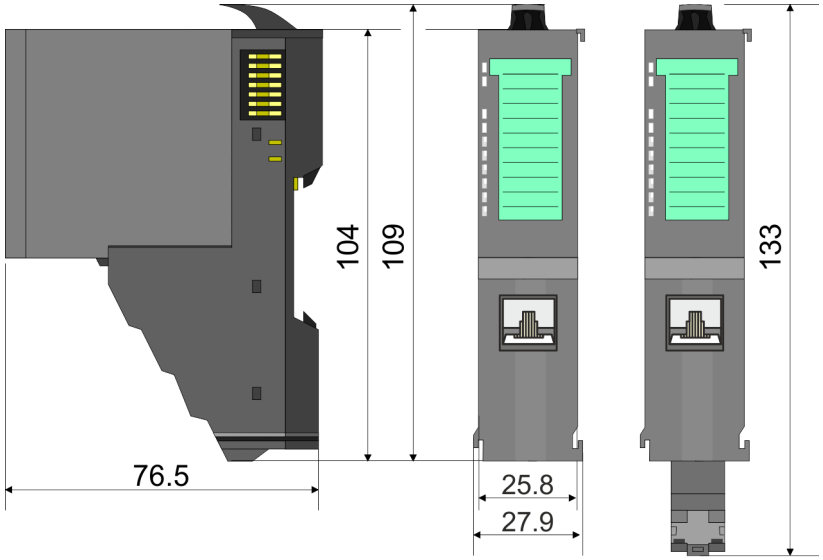


Dimensions CPU 01x

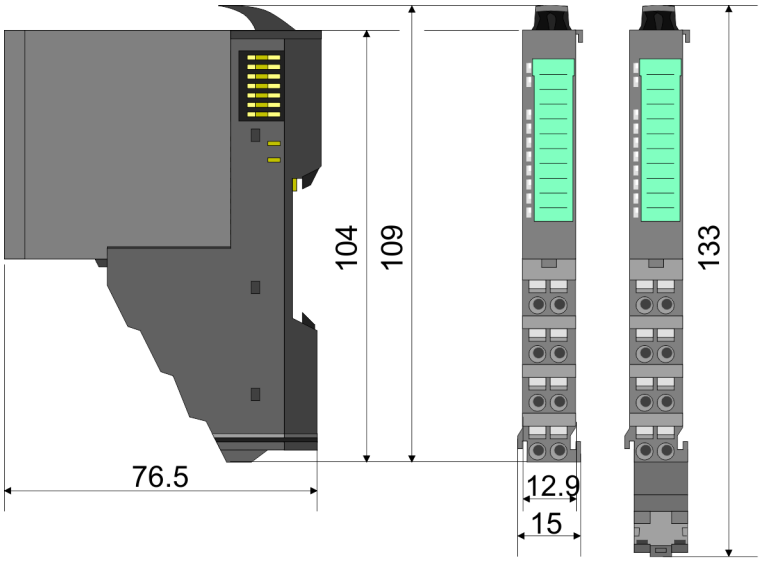
Dimensions bus coupler and line extension slave



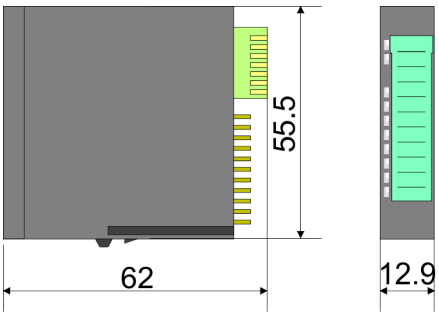
Dimensions line extension master



Dimension periphery module



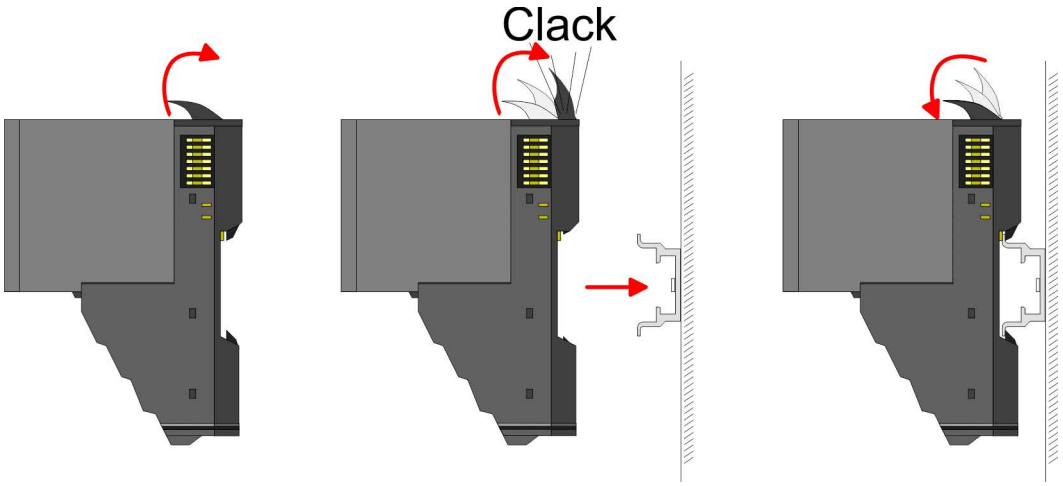
Dimensions electronic module



Dimensions in mm

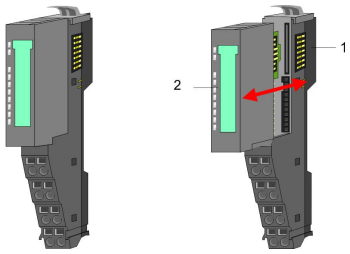
2.4 Mounting periphery modules

There is a locking lever at the top side of the module. For mounting and demounting this locking lever is to be turned upwards until this engages. For mounting place the module to the module installed before and push the module to the mounting rail guided by the strips at the upper and lower side of the module. The module is fixed to the mounting rail by pushing downward the locking lever. The modules may either separately be mounted to the mounting rail or as block. Here is to be considered that each locking lever is opened. The modules are each installed on a mounting rail. The electronic and power section supply are connected via the backplane bus. Up to 64 modules may be mounted. Please consider here that the sum current of the electronic power supply does not exceed the maximum value of 3A. By means of the power module 007-1AB10 the current of the electronic power supply may be expanded accordingly.



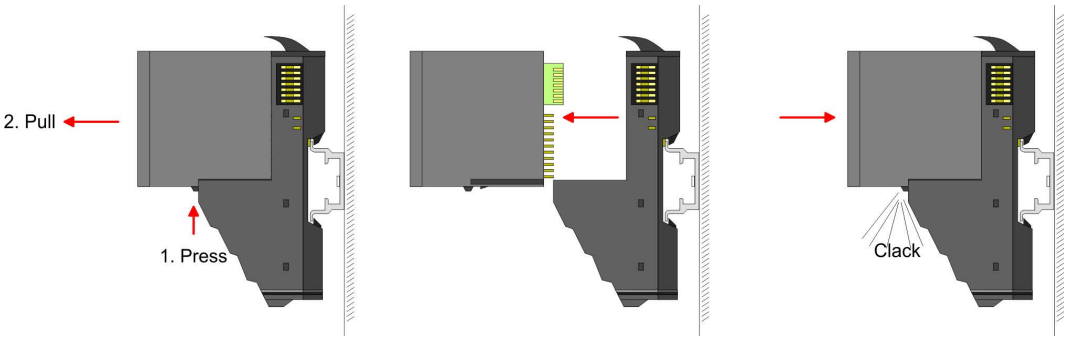
Terminal and electronic module

Each periphery module consists of a *terminal* and an *electronic module*.



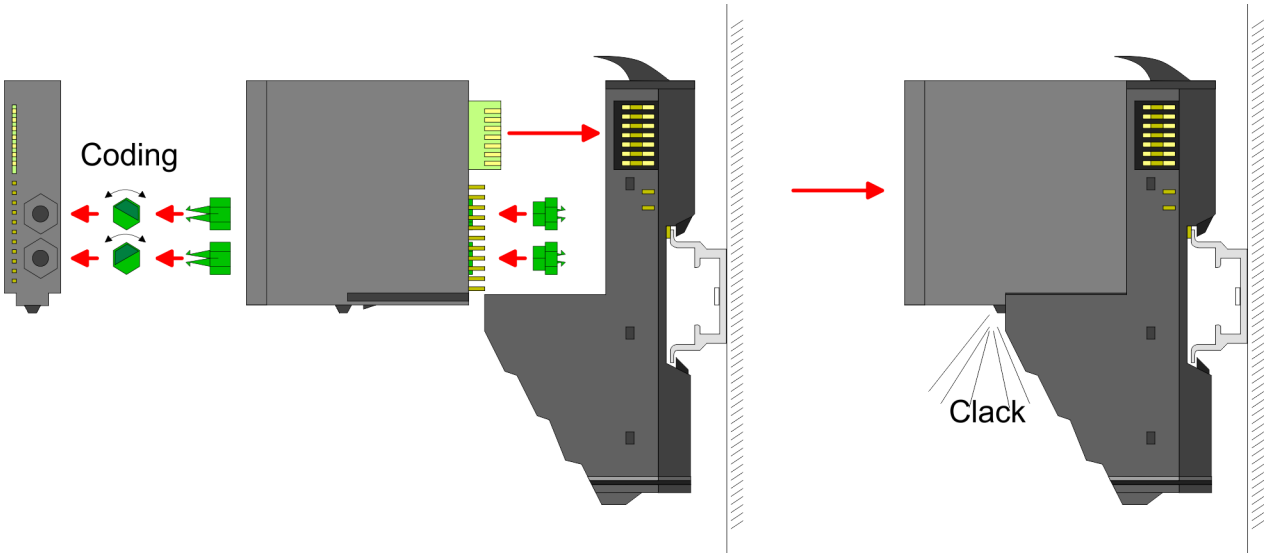
1 Terminal module
2 Electronic module

For the exchange of a electronic module, the electronic module may be pulled forward after pressing the unlocking lever at the lower side of the module. For installation plug the electronic module guided by the strips at the lower side until this engages audible to the terminal module.



Coding

There is the possibility to fix the assignment of electronic and terminal module. Here coding pins (order number 000-0AC00) from VIPA can be used. The coding pin consists of a coding jack and a coding plug. By combining electronic and terminal module with coding pin, the coding jack remains in the electronic module and the coding plug in the terminal module. This ensures that after replacing the electronics module just another electronic module can be plugged with the same encoding.



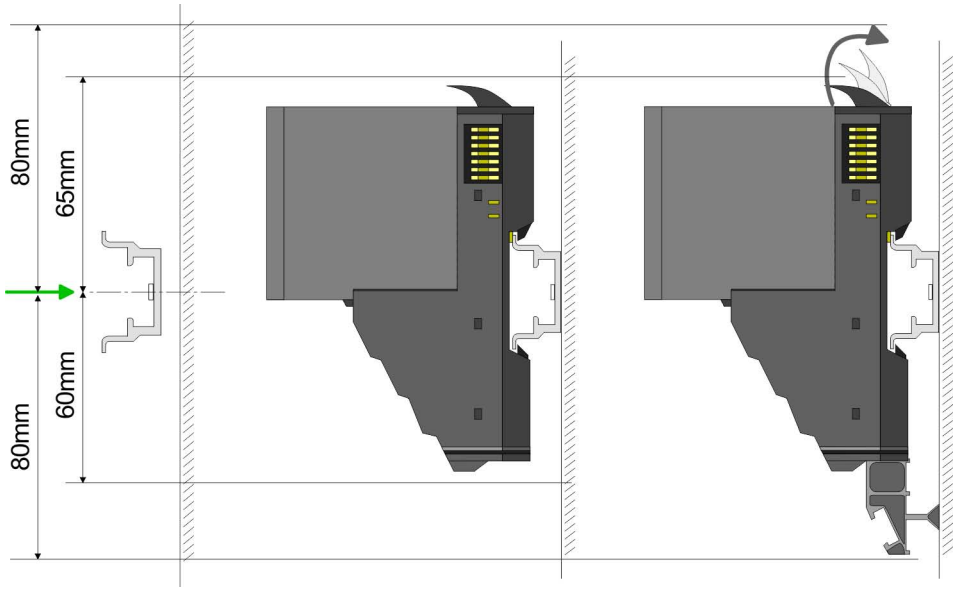
Each electronic module has on its back 2 coding sockets for coding jacks. Due to the characteristics, with the coding jack 6 different positions can be plugged, each. Thus there are 36 possible combinations for coding with the use of both coding sockets.

1. Plug, according to your coding, 2 coding jacks in the coding sockets of your electronic module until they lock
2. Now plug the according coding plugs into the coding jacks.
3. To fix the coding put both the electronic and terminal module together until they lock

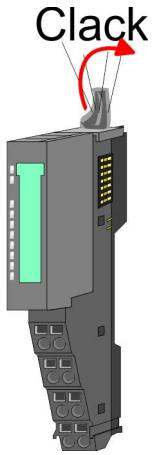
CAUTION!
Please consider that when replacing an already coded electronic module, this is always be replaced by an electronic module with the same coding.

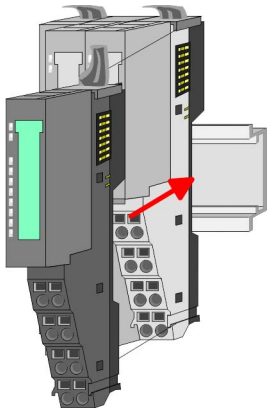
Even with an existing coding on the terminal module, you can plug an electronic module without coding. The user is responsible for the correct usage of the coding pins. VIPA assumes no liability for incorrectly attached electronic modules or for damages which arise due to incorrect coding!

Mounting periphery modules

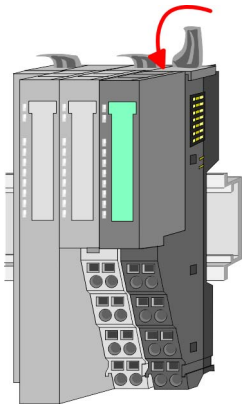


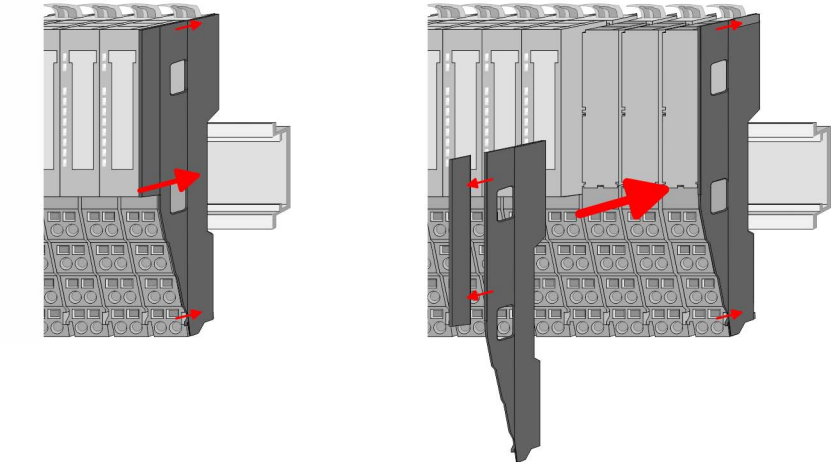
1. Mount the mounting rail! Please consider that a clearance from the middle of the mounting rail of at least 80mm above and 60mm below, respectively 80mm by deployment of shield bus carriers, exist.
2. Mount your head module such as CPU or field bus coupler.
3. Before mounting the periphery modules you have to remove the bus cover at the right side of the Head module by pulling it forward. Keep the cover for later mounting.





4. For mounting turn the locking lever of the module upward until it engages.
5. For mounting place the module to the module installed before and push the module to the mounting rail guided by the strips at the upper and lower side of the module.
6. Turn the locking lever of the periphery module downward, again.





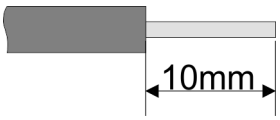
7. After mounting the whole system, to protect the backplane bus connectors at the last module you have to mount the bus cover, now. If the last module is a clamp module, for adaptation the upper part of the bus cover is to be removed.

2.5 Wiring periphery modules

Terminal module terminals

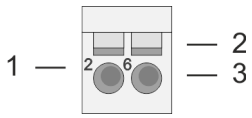
With wiring the terminal modules, terminals with spring clamp technology are used for wiring. The spring clamp technology allows quick and easy connection of your signal and supply lines. In contrast to screw terminal connections this type of connection is vibration proof.

Data

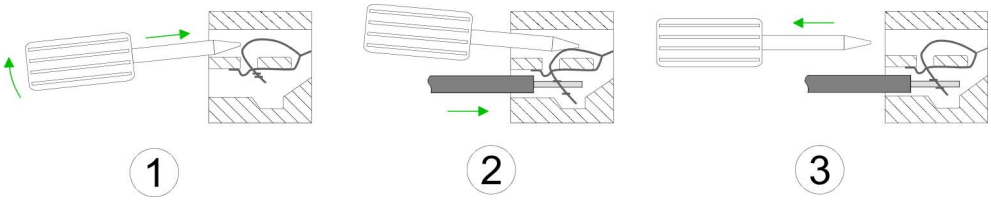


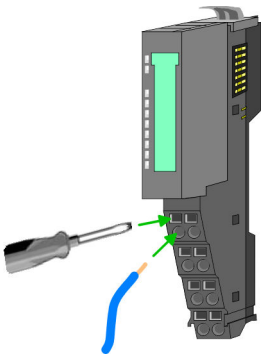
U_{max}	240V AC / 30V DC
I_{max}	10A
Cross section	0.08 ... 1.5mm^2 (AWG 28 ... 16)
Stripping length	10mm

Wiring procedure



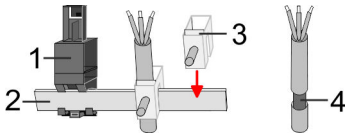
1 Pin number at the connector
2 Opening for screwdriver
3 Connection hole for wire





1. Insert a suited screwdriver at an angel into the square opening as shown. Press and hold the screwdriver in the opposite direction to open the contact spring.
2. Insert the stripped end of wire into the round opening. You can use wires with a cross section of 0.08mm^2 up to 1.5mm^2
3. By removing the screwdriver, the wire is securely fixed via the spring contact to the terminal.

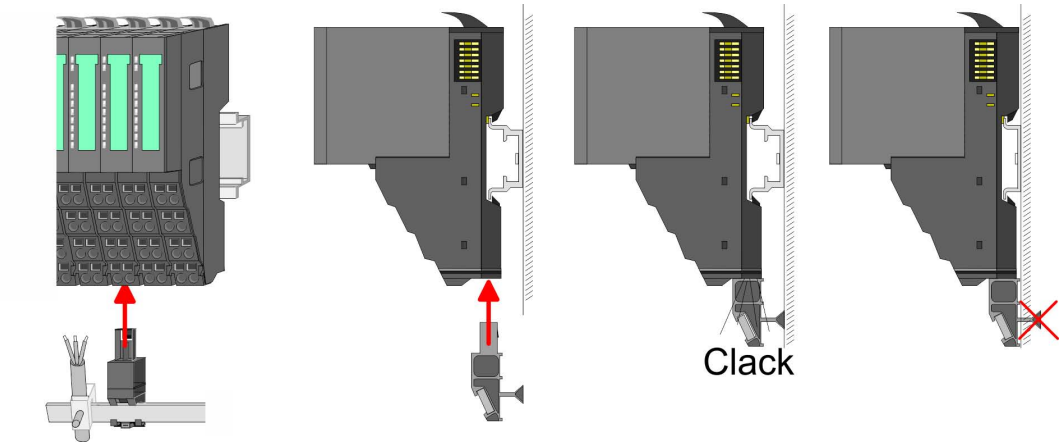
Shield attachment



1 Shield bus carrier
2 Shield bus (10mm x 3mm)
3 Shield clamp
4 Cable shield

To attach the shield the mounting of shield bus carriers are necessary. The shield bus carrier (available as accessory) serves to carry the shield bus to connect cable shields.

1. Each System SLIO module has a carrier hole for the shield bus carrier. Push the shield bus carrier, until they engage into the module. With a flat mounting rail for adaptation to a flat mounting rail you may remove the spacer of the shield bus carrier.
2. Put your shield bus into the shield bus carrier.



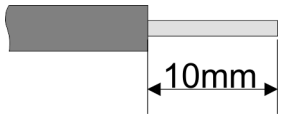
3. Attach the cables with the accordingly stripped cable screen and fix it by the shield clamp with the shield bus.

2.6 Wiring power modules

Terminal module terminals

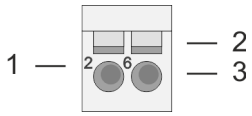
Power modules are either integrated to the head module or may be installed between the periphery modules. With power modules, terminals with spring clamp technology are used for wiring. The spring clamp technology allows quick and easy connection of your signal and supply lines. In contrast to screw terminal connections this type of connection is vibration proof.

Data

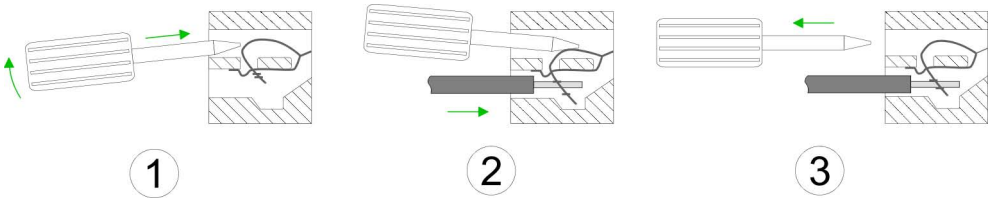


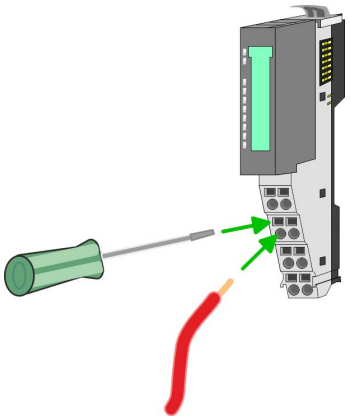
U_{max}	240V AC / 30V DC
I_{max}	10A
Cross section	0.08 ... 1.5mm² (AWG 28 ... 16)
Stripping length	10mm

Wiring procedure



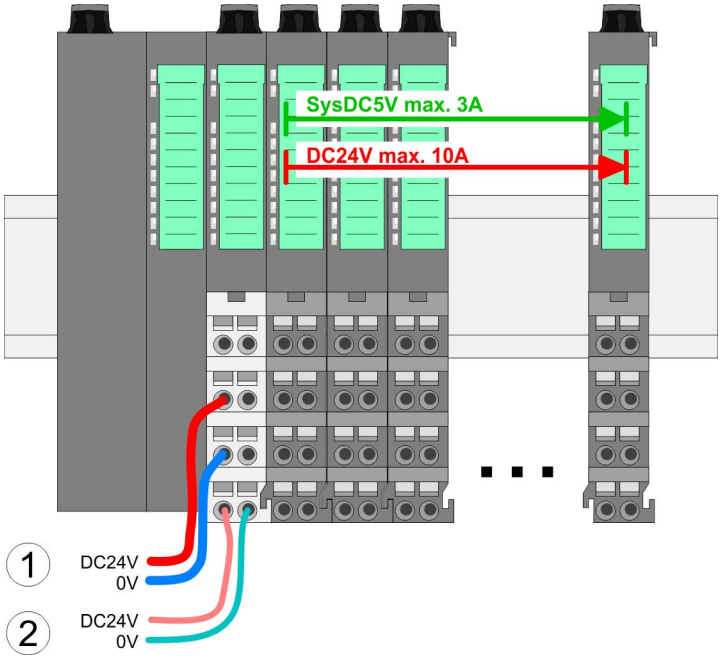
1 Pin number at the connector
2 Opening for screwdriver
3 Connection hole for wire





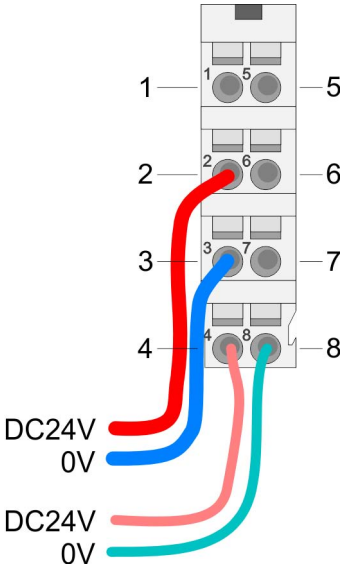
1. Insert a suited screwdriver at an angel into the square opening as shown. Press and hold the screwdriver in the opposite direction to open the contact spring.
2. Insert the stripped end of wire into the round opening. You can use wires with a cross section of 0.08mm² up to 1.5mm²
3. By removing the screwdriver, the wire is securely fixed via the spring contact to the terminal.

Standard wiring



(1) DC 24V for power section supply I/O area (max. 10A)
(2) DC 24V for electronic power supply bus coupler and I/O area

PM - Power module



For wires with a core cross-section of 0.08mm^2 up to 1.5mm^2.

Pos.	Function	Type	Description
1	---	---	not connected
2	DC 24V	I	DC 24V for power section supply
3	0V	I	GND for power section supply
4	Sys DC 24V	I	DC 24V for electronic section supply
5	---	---	not connected
6	DC 24V	I	DC 24V for power section supply
7	0V	I	GND for power section supply
8	Sys 0V	I	GND for electronic section supply

I: Input

CAUTION!
Since the power section supply is not internally protected, it is to be externally protected with a fuse, which corresponds to the maximum current. This means max. 10A is to be protected by a 10A fuse (fast) respectively by a line circuit breaker 10A characteristics Z!

The electronic power section supply is internally protected against higher voltage by fuse. The fuse is within the power module. If the fuse releases, its electronic module must be exchanged!

Fusing

- The power section supply is to be externally protected with a fuse, which corresponds to the maximum current. This means max. 10A is to be protected with a 10A fuse (fast) respectively by a line circuit breaker 10A characteristics Z!
- It is recommended to externally protect the electronic power supply for head modules and I/O area with a 2A fuse (fast) respectively by a line circuit breaker 2A characteristics Z.
- The electronic power supply for the I/O area of the power module 007-1AB10 should also be externally protected with a 1A fuse (fast) respectively by a line circuit breaker 1A characteristics Z.

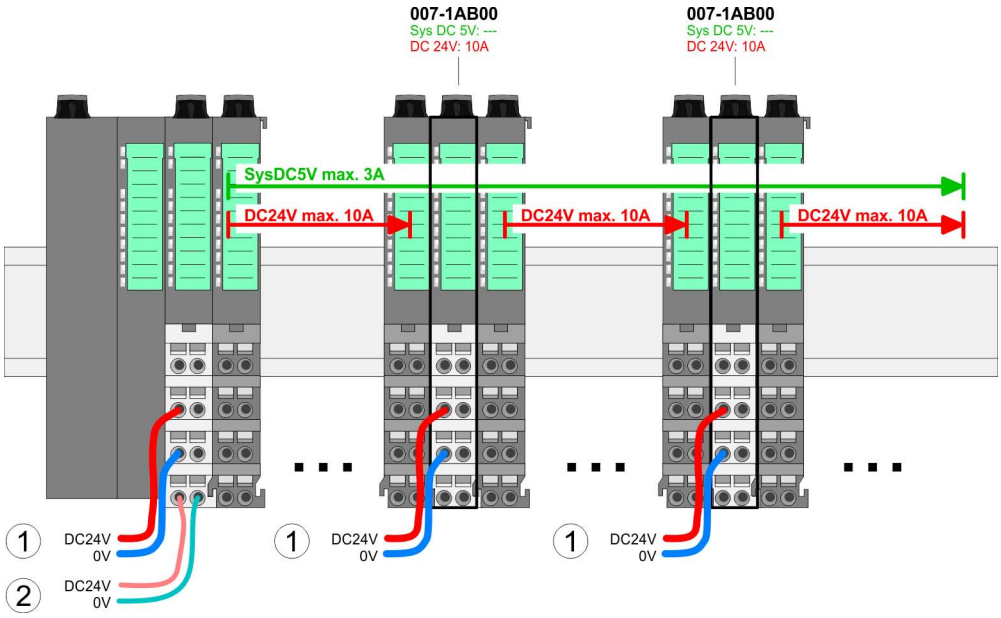
State of the electronic power supply via LEDs

After PowerON of the System SLIO the LEDs RUN respectively MF get on so far as the sum current does not exceed 3A. With a sum current greater than 3A the LEDs may not be activated. Here the power module with the order number 007-1AB10 is to be placed between the peripheral modules.

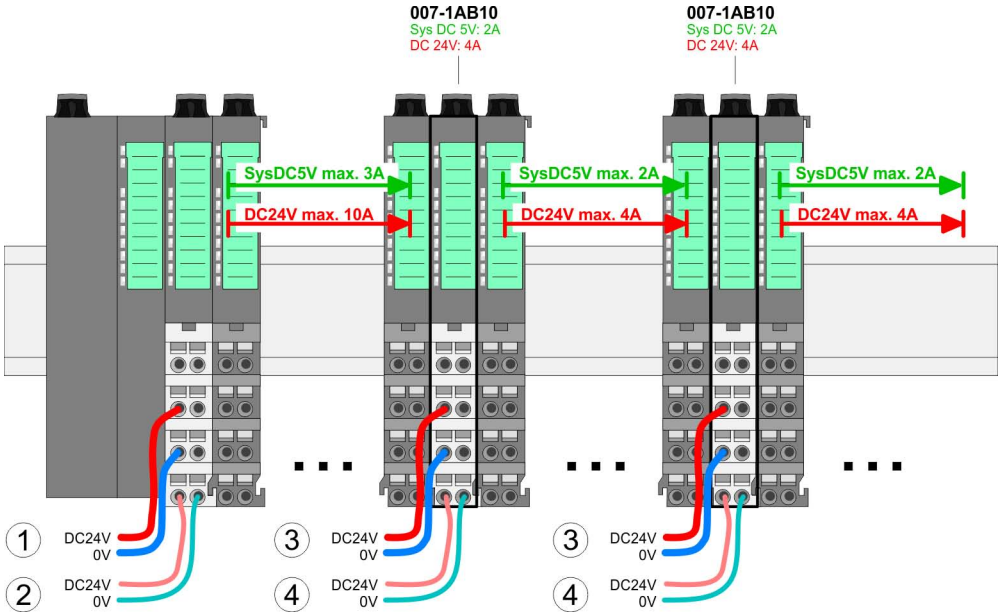
Deployment of the power modules

- If the 10A for the power section supply is no longer sufficient, you may use the power module from VIPA with the order number 007-1AB00. So you have also the possibility to define isolated groups.
- The power module with the order number 007-1AB10 is to be used if the 3A for the electronic power supply at the backplane bus is no longer sufficient. Additionally you get an isolated group for the DC 24V power section supply with max. 4A.
- By placing the power module 007-1AB10 at the following backplane bus modules may be placed with a sum current of max. 2A. Afterwards a power module is to be placed again. To secure the power supply, the power modules may be mixed used.

Power module 007-1AB00

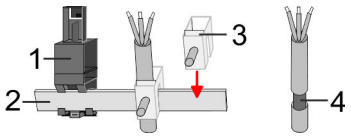


Power module 007-1AB10



(1) DC 24V for power section supply I/O area (max. 10A)
(2) DC 24V for electronic power supply bus coupler and I/O area
(3) DC 24V for power section supply I/O area (max. 4A)
(4) DC 24V for electronic power supply I/O area

Shield attachment

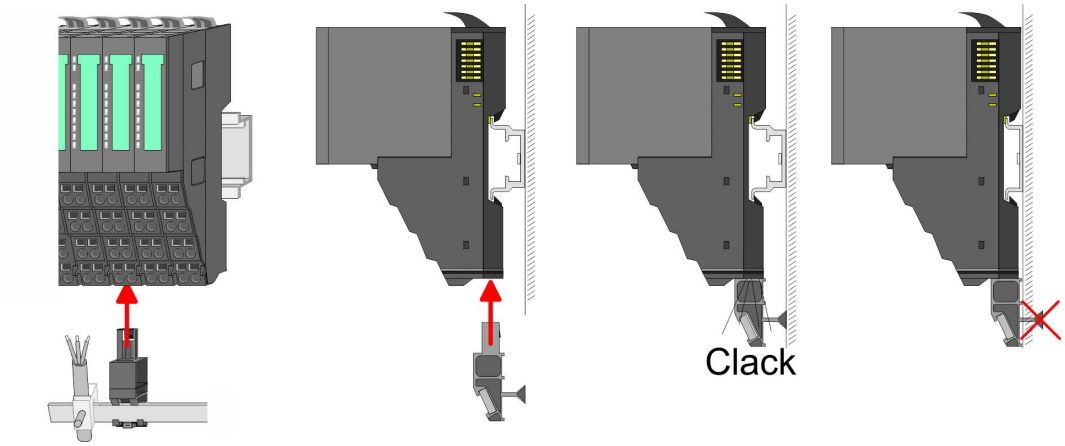


1 Shield bus carrier
2 Shield bus (10mm x 3mm)
3 Shield clamp
4 Cable shield

To attach the shield the mounting of shield bus carriers are necessary. The shield bus carrier (available as accessory) serves to carry the shield bus to connect cable shields.

1. Each System SLIO module has a carrier hole for the shield bus carrier. Push the shield bus carrier, until they engage into the module. With a flat mounting rail for adaptation to a flat mounting rail you may remove the spacer of the shield bus carrier.

2. Put your shield bus into the shield bus carrier.



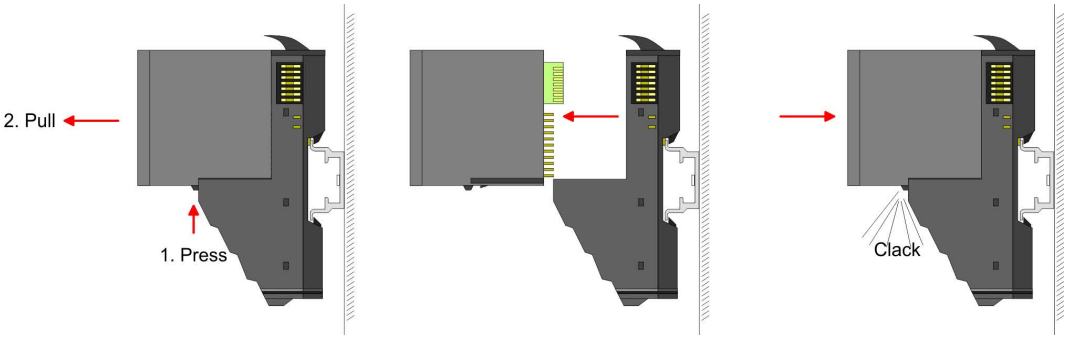
3. Attach the cables with the accordingly stripped cable screen and fix it by the shield clamp with the shield bus.

2.7 Demounting periphery modules

Proceeding

Exchange of an electronic module

1. Power-off your system.



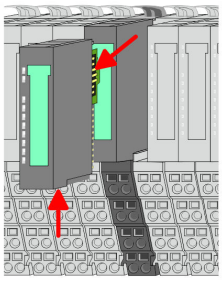
2. For the exchange of a electronic module, the electronic module may be pulled forward after pressing the unlocking lever at the lower side of the module.
3. For installation plug the new electronic module guided by the strips at the lower side until this engages to the terminal module.

   ⇨ Now you can bring your system back into operation.

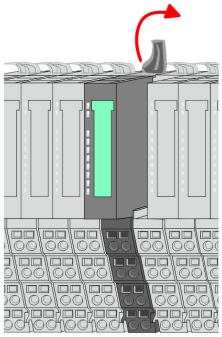
Exchange of a periphery module

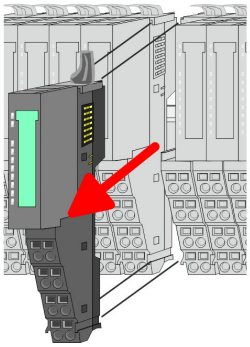
1. Power-off your system.
2. Remove if exists the wiring of the module.
3. *For demounting and exchange of a (head) module or a group of modules, due to mounting reasons you always have to remove the electronic module right beside. After mounting it may be plugged again.*

   Press the unlocking lever at the lower side of the just mounted right module and pull it forward.

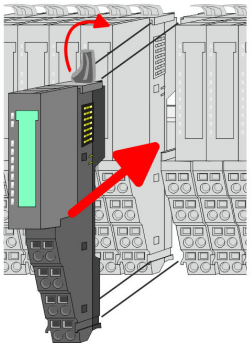


4. Turn the locking lever of the module to be exchanged upwards.

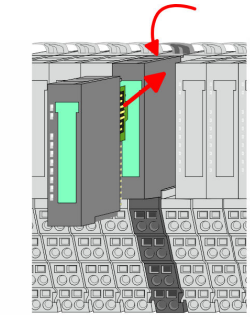




5. Pull the module.
6. For mounting turn the locking lever of the module to be mounted upwards.



7. To mount the module put it to the gap between the both modules and push it, guided by the stripes at both sides, to the mounting rail.
8. Turn the locking lever downward, again.

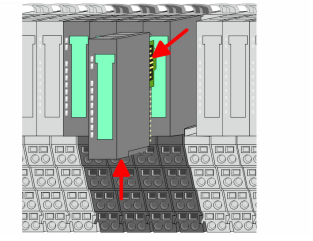


9. Plug again the electronic module, which you have removed before.
10. Wire your module.

    ⇨ Now you can bring your system back into operation.

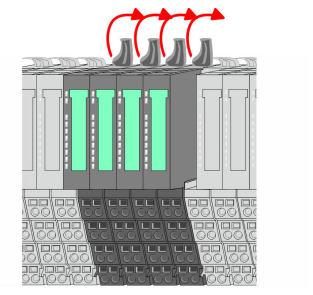
Exchange of a module group

1. Power-off your system.
2. Remove if exists the wiring of the module group.

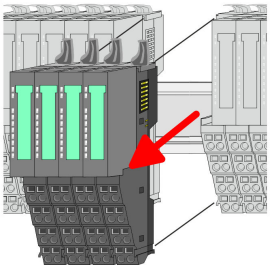


3. *For demounting and exchange of a (head) module or a group of modules, due to mounting reasons you always have to remove the electronic module right beside. After mounting it may be plugged again.*

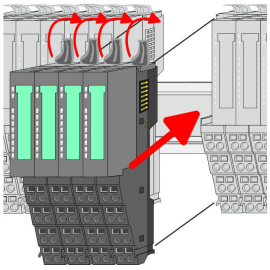
   Press the unlocking lever at the lower side of the just mounted right module near the module group and pull it forward.



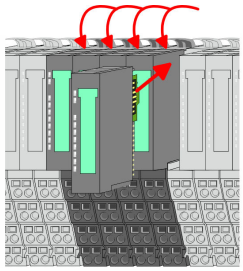
4. Turn all the locking lever of the module group to be exchanged upwards.



5. Pull the module group forward.
6. For mounting turn all the locking lever of the module group to be mounted upwards.



7. To mount the module group put it to the gap between the both modules and push it, guided by the stripes at both sides, to the mounting rail.
8. Turn all the locking lever downward, again.



9. Plug again the electronic module, which you have removed before.
10. Wire your module group.

    ⇨ Now you can bring your system back into operation.

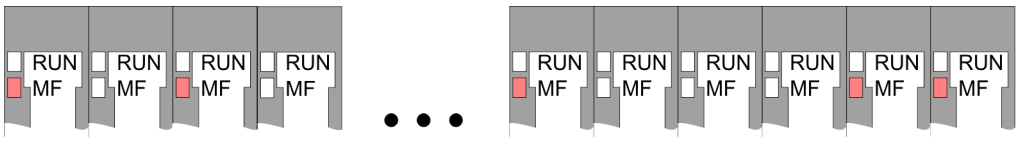
2.8 Trouble shooting - LEDs

General

Each module has the LEDs RUN and MF on its front side. Errors or incorrect modules may be located by means of these LEDs.

In the following illustrations flashing LEDs are marked by ☼.

Sum current of the electronic power supply exceeded

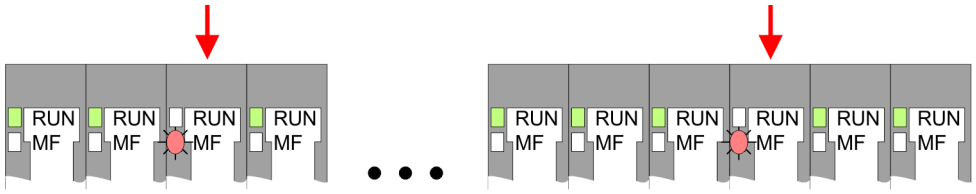


Behaviour: After PowerON the RUN LED of each module is off and the MF LED of each module is sporadically on.

Reason: The maximum current for the electronic power supply is exceeded.

Remedy: As soon as the sum current of the electronic power supply is exceeded, always place the power module 007-1AB10. *Chapter 2.6 'Wiring power modules' on page 20*

Error in configuration

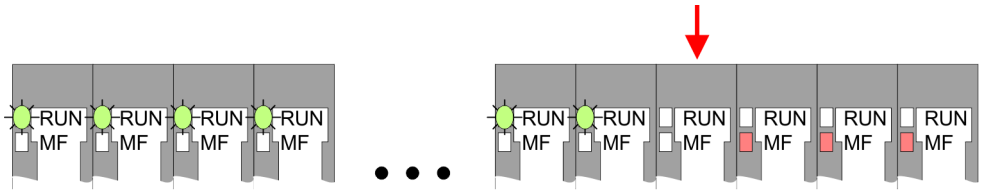


Behaviour: After PowerON the MF LED of one module respectively more modules flashes. The RUN LED remains off.

Reason: At this position a module is placed, which does not correspond to the configured module.

Remedy: Match configuration and hardware structure.

Module failure



Behaviour: After PowerON all of the RUN LEDs up to the defective module are flashing. With all following modules the MF LED is on and the RUN LED is off.

Reason: The module on the right of the flashing modules is defective.

Remedy: Replace the defective module.

2.9 Installation guidelines

General

The installation guidelines contain information about the interference free deployment of a PLC system. There is the description of the ways, interference may occur in your PLC, how you can make sure the electromagnetic compatibility (EMC), and how you manage the isolation.

What does EMC mean?

Electromagnetic compatibility (EMC) means the ability of an electrical device, to function error free in an electromagnetic environment without being interfered respectively without interfering the environment.

The components of VIPA are developed for the deployment in industrial environments and meets high demands on the EMC. Nevertheless you should project an EMC planning before installing the components and take conceivable interference causes into account.

Possible interference causes

Electromagnetic interferences may interfere your control via different ways:

- Electromagnetic fields (RF coupling)
- Magnetic fields with power frequency
- Bus system
- Power supply
- Protected earth conductor

Depending on the spreading medium (lead bound or lead free) and the distance to the interference cause, interferences to your control occur by means of different coupling mechanisms.

There are:

- galvanic coupling
- capacitive coupling
- inductive coupling
- radiant coupling

Basic rules for EMC

In the most times it is enough to take care of some elementary rules to guarantee the EMC. Please regard the following basic rules when installing your PLC.

- Take care of a correct area-wide grounding of the inactive metal parts when installing your components.
  - Install a central connection between the ground and the protected earth conductor system.
  - Connect all inactive metal extensive and impedance-low.
  - Please try not to use aluminium parts. Aluminium is easily oxidizing and is therefore less suitable for grounding.
- When cabling, take care of the correct line routing.
  - Organize your cabling in line groups (high voltage, current supply, signal and data lines).
  - Always lay your high voltage lines and signal respectively data lines in separate channels or bundles.
  - Route the signal and data lines as near as possible beside ground areas (e.g. suspension bars, metal rails, tin cabinet).

- Proof the correct fixing of the lead isolation.
  - Data lines must be laid isolated.
  - Analog lines must be laid isolated. When transmitting signals with small amplitudes the one sided laying of the isolation may be favourable.
  - Lay the line isolation extensively on an isolation/protected earth conductor rail directly after the cabinet entry and fix the isolation with cable clamps.
  - Make sure that the isolation/protected earth conductor rail is connected impedance-low with the cabinet.
  - Use metallic or metallised plug cases for isolated data lines.
- In special use cases you should appoint special EMC actions.
  - Consider to wire all inductivities with erase links.
  - Please consider luminescent lamps can influence signal lines.
- Create a homogeneous reference potential and ground all electrical operating supplies when possible.
  - Please take care for the targeted employment of the grounding actions. The grounding of the PLC serves for protection and functionality activity.
  - Connect installation parts and cabinets with your PLC in star topology with the isolation/protected earth conductor system. So you avoid ground loops.
  - If there are potential differences between installation parts and cabinets, lay sufficiently dimensioned potential compensation lines.

Isolation of conductors

Electrical, magnetically and electromagnetic interference fields are weakened by means of an isolation, one talks of absorption. Via the isolation rail, that is connected conductive with the rack, interference currents are shunt via cable isolation to the ground. Here you have to make sure, that the connection to the protected earth conductor is impedance-low, because otherwise the interference currents may appear as interference cause.

When isolating cables you have to regard the following:

- If possible, use only cables with isolation tangle.
- The hiding power of the isolation should be higher than 80%.
- Normally you should always lay the isolation of cables on both sides. Only by means of the both-sided connection of the isolation you achieve high quality interference suppression in the higher frequency area. Only as exception you may also lay the isolation one-sided. Then you only achieve the absorption of the lower frequencies. A one-sided isolation connection may be convenient, if:
  - the conduction of a potential compensating line is not possible.
  - analog signals (some mV respectively µA) are transferred.
  - foil isolations (static isolations) are used.
- With data lines always use metallic or metallised plugs for serial couplings. Fix the isolation of the data line at the plug rack. Do not lay the isolation on the PIN 1 of the plug bar!
- At stationary operation it is convenient to strip the insulated cable interruption free and lay it on the isolation/protected earth conductor line.
- To fix the isolation tangles use cable clamps out of metal. The clamps must clasp the isolation extensively and have well contact.
- Lay the isolation on an isolation rail directly after the entry of the cable in the cabinet. Lead the isolation further on to your PLC and don't lay it on there again!

CAUTION!

Please regard at installation!

At potential differences between the grounding points, there may be a compensation current via the isolation connected at both sides.

Remedy: Potential compensation line

2.10 General data

Conformity and approval		
Conformity		
CE	2014/35/EU	Low-voltage directive
	2014/30/EU	EMC directive
Approval		
UL	-	Refer to Technical data
others		
RoHS	2011/65/EU	Product is lead-free; Restriction of the use of certain hazardous substances in electrical and electronic equipment

Protection of persons and device protection		
Type of protection	-	IP20
Electrical isolation		
to the field bus	-	electrically isolated
to the process level	-	electrically isolated
Insulation resistance	-	-
Insulation voltage to reference earth		
Inputs / outputs	-	AC / DC 50V, test voltage AC 500V
Protective measures	-	against short circuit

Environmental conditions to EN 61131-2		
Climatic		
Storage / transport	EN 60068-2-14	-25…+70°C
Operation		
Horizontal installation hanging	EN 61131-2	0…+60°C
Horizontal installation lying	EN 61131-2	0…+55°C
Vertical installation	EN 61131-2	0…+50°C
Air humidity	EN 60068-2-30	RH1 (without condensation, rel. humidity 10…95%)
Pollution	EN 61131-2	Degree of pollution 2
Installation altitude max.	-	2000m
Mechanical		
Oscillation	EN 60068-2-6	1g, 9Hz ... 150Hz
Shock	EN 60068-2-27	15g, 11ms

General data

Mounting conditions		
Mounting place	-	In the control cabinet
Mounting position	-	Horizontal and vertical

EMC	Standard		Comment
Emitted interference	EN 61000-6-4		Class A (Industrial area)
Noise immunity zone B	EN 61000-6-2		Industrial area
		EN 61000-4-2	ESD 8kV at air discharge (degree of severity 3), 4kV at contact discharge (degree of severity 2)
		EN 61000-4-3	HF field immunity (casing) 80MHz … 1000MHz, 10V/m, 80% AM (1kHz) 1.4GHz ... 2.0GHz, 3V/m, 80% AM (1kHz) 2GHz ... 2.7GHz, 1V/m, 80% AM (1kHz)
		EN 61000-4-6	HF conducted 150kHz … 80MHz, 10V, 80% AM (1kHz)
		EN 61000-4-4	Burst, degree of severity 3
		EN 61000-4-5	Surge, installation class 3 *

*) Due to the high-energetic single pulses with Surge an appropriate external protective circuit with lightning protection elements like conductors for lightning and overvoltage is necessary.

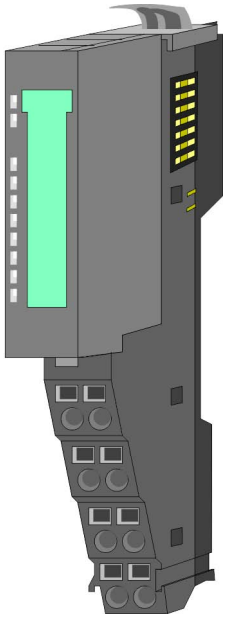
3 Hardware description

3.1 Properties

054-1DA00

The FM 054-1DA00 integrates a compact motion control solution for direct connection with a power stage with motor. The motion module outputs a specified pulse sequence with RS422 level via differential outputs.

- Pulse train output module
- Operating modes: CW/CCW, PLS/DIR, ENC/SIM
- Motor types:
  - YASKAWA Sigma 5 mini
  - YASKAWA Sigma 5/7
  - YASKAWA A1000, V1000
- 1 channel RS422
- 4 configurable in-/outputs I/O1 ... I/O4

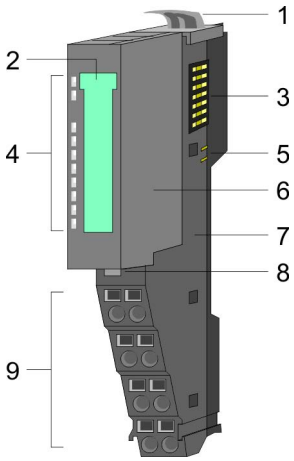


Ordering data

Type	Order number	Description
FM 054	054-1DA00	SLIO 1xPulseTrain RS422 0 ... 1000kHz, DC 24V, feedback (2DI)

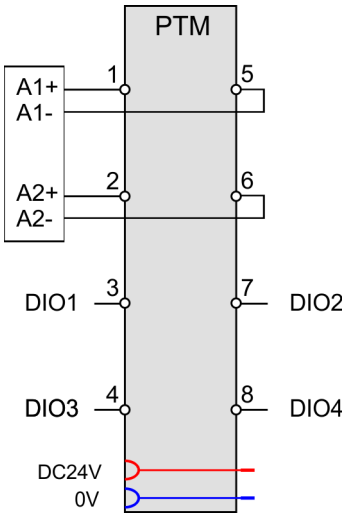
3.2 Structure

054-1DA00



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

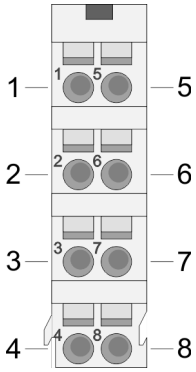
Connections



CAUTION!
Danger of injury from electrical shock and damage to the unit!
Put the System SLIO in a safe, powered down state before starting installation, disassembly or wiring of the System SLIO modules!

You can use wires with a cross section of 0.08mm^2 up to 1.5mm^2. For the connection lines the following requirements apply:

- For the digital I/O connection with DIO operation single lines can be used.
- A power stage must be connected via shielded lines.
- Generally, lines for power supply and signal lines must be laid separately.
- The motion module outputs a specified pulse sequence with RS422 level via differential outputs. The frequency pattern can be specified via the object dictionary.
- The digital connections I/O1...I/O4 are freely configurable via the object dictionary.



Default assignment

Pos.	Function	Type	↳ *'0x8E00-01 - Pulse train configuration' on page 133*		
			P/D	CW/CCW	A/B
1	A1+	O	P	CW	A
2	A2+	O	D	CCW	B
3	I/O1	I/O	Digital input		
4	I/O3	I/O	Digital input		
5	A1-	O	/P	/CW	/A
6	A2-	O	/D	/CCW	/B
7	I/O2	I/O	Digital input		
8	I/O4	I/O	Digital input		
I: Input, O: Output					

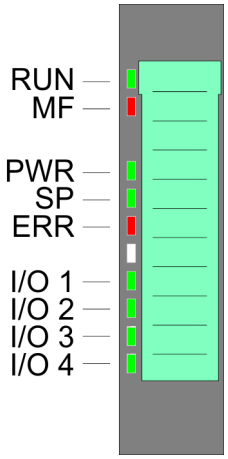
In this module, the state machine emulates the states of the connected power stage. It does not represent its current states. Only by adjusting the DIO signals on the signals of the power stage as e.g. S-ON, ALM-RST, S-RDY and COIN, you can control its states.

↳ *Chapter 4.8 'Deployment I/O1...I/O4' on page 70*

Assignment for YASKAWA Sigma 5mini via pulse train

Pos.	Function	Type	P/D	CW/CCW	A/B
1	A1+	O	P	CW	A
2	A2+	O	D	CCW	B
3	I/O1	I/O	S-ON: Servo drive On/Off		
4	I/O3	I/O	ALM-RST: Reset Interrupts		
5	A1-	O	/P	/CW	/A
6	A2-	O	/D	/CCW	/B
7	I/O2	I/O	S-RDY: Servo ready		
8	I/O4	I/O	COIN: Position reached		
I: Input, O: Output					

Status indication



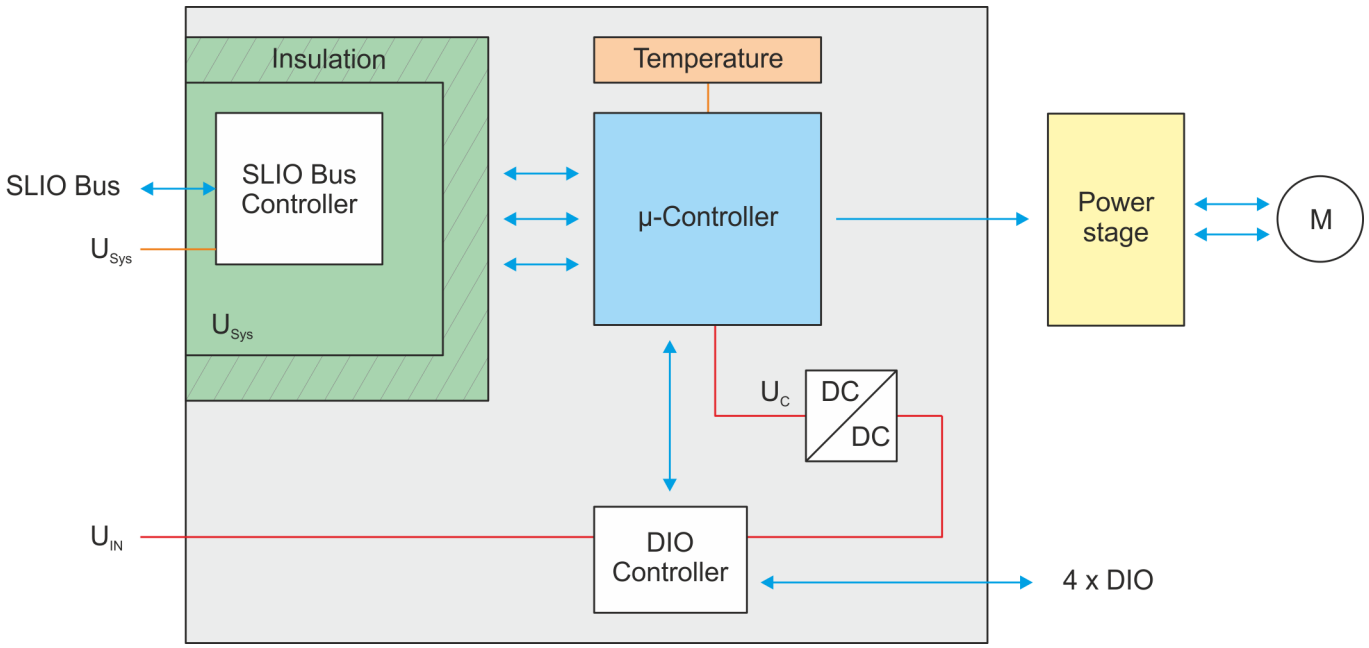
RUN	MF	Description
green ■	red ■	
●	○	Bus communication is OK Module status is OK
●	●	Bus communication is OK Module status reports an error
○	●	Bus communication is not possible Module status reports an error
○	○	Error at bus power supply
X	☼	Error in configuration ↳ *Chapter 2.8 'Trouble shooting - LEDs' on page 28*

PWR	green ■	○	The state of the module is beyond *'Switched on'* and *'Operation enabled'* ↳ *Chapter 4.4.2 'States' on page 49*
		☼	Module is in state *'Switched on'*
		●	Module is in state *'Operation enabled'*
SP	green ■	○	Velocity set point value is 0. In state *'Operation enabled'* there is no reaction of the motor.
		●	Velocity set point value > 0. In state *'Operation enabled'* there is a reaction of the motor.
ERR	red ■	○	No Error
		☼	Warning: 0x80 in ↳ *'0x8100-02 - Status word' on page 111*
		●	Error: 0x08 in ↳ *'0x8100-02 - Status word' on page 111*
I/O1	green ■	○	Digital input/output 1 has "0" signal
		●	Digital input/output 1 has "1" signal
I/O2	green ■	○	Digital input/output 2 has "0" signal
		●	Digital input/output 2 has "1" signal
I/O3	green ■	○	Digital input/output 3 has "0" signal
		●	Digital input/output 3 has "1" signal
I/O4	green ■	○	Digital input/output 4 has "0" signal
		●	Digital input/output 4 has "1" signal

on: ● | off: ○ | blinking: ☼ | not relevant: X

3.3 Block diagram

Structure



Voltages

U_{Sys} - DC 24V electronic section supply

Power supply for electronic and back plane bus communication

U_{IN} - DC 24V power section supply

Power supply for the I/O area

Area: DC 20.4 ... 28.8V

U_C - DC 3.3V µ-controller supply

The power supply is built via U_{IN} via a DC-DC converter.

ON: Edge 0-1 at 16V from U_{IN}

OFF: Edge 1-0 at 14V from U_{IN}

Temperature monitoring

The motion module has an internal temperature monitoring of the µ-controller. Via the object dictionary limit temperatures can be defined. If the temperature over or under runs the limit values, there is an error reaction of the motion module, which can be configured.
'0x8780-02 - Temperature µ-Controller actual value' on page 131

3.4 Technical data

Order no.	**054-1DA00**
Type	FM 054
Module ID	0983 6800
Current consumption/power loss	
Current consumption from backplane bus	50 mA
Power loss	1 W

Order no.	054-1DA00
Technical data digital inputs	
Number of inputs	4
Cable length, shielded	1000 m
Cable length, unshielded	600 m
Rated load voltage	-
Current consumption from load voltage L+ (without load)	-
Rated value	DC 20.4...28.8 V
Input voltage for signal "0"	DC 11...28.8 V
Input voltage for signal "1"	DC 0...5 V
Input voltage hysteresis	-
Frequency range	-
Input resistance	-
Input current for signal "1"	3 mA
Connection of Two-Wire-BEROs possible	✓
Max. permissible BERO quiescent current	0.5 mA
Input delay of "0" to "1"	1.5 ms
Input delay of "1" to "0"	1.5 ms
Number of simultaneously utilizable inputs horizontal configuration	2
Number of simultaneously utilizable inputs vertical configuration	2
Input characteristic curve	IEC 61131-2, type 3
Initial data size	4 Bit
Technical data digital outputs	
Number of outputs	4
Cable length, shielded	1000 m
Cable length, unshielded	600 m
Rated load voltage	DC 20.4...28.8 V
Reverse polarity protection of rated load voltage	-
Current consumption from load voltage L+ (without load)	-
Output current at signal "1", rated value	500 mA
Output delay of "0" to "1"	1.5 ms
Output delay of "1" to "0"	1.5 ms
Minimum load current	-
Lamp load	10 W
Parallel switching of outputs for redundant control of a load	not possible
Parallel switching of outputs for increased power	not possible

Order no.	054-1DA00
Actuation of digital input	✓
Switching frequency with resistive load	max. 300 Hz
Switching frequency with inductive load	max. 0.5 Hz
Switching frequency on lamp load	max. 10 Hz
Internal limitation of inductive shut-off voltage	L+ (-45 V)
Short-circuit protection of output	yes, electronic
Trigger level	1 A
Number of operating cycle of relay outputs	-
Switching capacity of contacts	-
Output data size	-
Status information, alarms, diagnostics	
Status display	green LED per channel
Interrupts	yes, parameterizable
Process alarm	no
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED
Group error display	red LED
Channel error display	red LED per channel
Isolation	
Between channels	-
Between channels of groups to	-
Between channels and backplane bus	✓
Insulation tested with	AC 500 V
Technical data positioning module	
Number of channels	1
Input voltage (rated value)	DC 24 V
Input voltage (permitted range)	DC 20.4...28.8 V
Motor current	-
Power stage	RS422
Short-circuit protection	✓
Brake-Chopper required	-
PWM frequency	-
Pulse train frequency	1 MHz
Micro steps	-

Order no.	054-1DA00
Steps per rotation	-
Type of encoder	A/B phase 24V single ended
Encoder frequency	100 kHz
Encoder resolution	24 Bit
Control type	open loop
Temperature sensor	✓
Operating modes position functions	
Homing via homing switch	✓
Homing torque	-
Positioning without encoder	✓
Positioning with encoder	-
Speed control	✓
Torque control	-
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL certification	in preparation
KC certification	in preparation

4 Deployment

4.1 Basics

Addressing

The System SLIO motion module provides its data, such as "Profiling target position" via an object dictionary. In this object dictionary the objects are organized and addressable a unique number consisting of *Index* and *Subindex*. The number is specified as follows:

0x	Index (hexadecimal)	-	Subindex (decimal)
Example: 0x8400-03			

To improve the structure and for expansion at System SLIO Motion Module another object numbering (index-assignment) is used besides the standard CiA 402.

Index area

By separating into index and subindex a grouping is possible. The individual areas are divided into groups of related objects. With the System SLIO motion module this object directory is structured as follows:

Index area	Content
0x1000 up to 0x6FFF	General data and system data
0x7000 up to 0x7FFF	Data of the digital input and output part
0x8000 up to 0x8FFF	Data of the axis

Each object has a subindex 0. Calling an object with subindex 0, the number of available subindexes of the corresponding object is returned.

Accessing the object dictionary

You have the following options for accessing the objects in the object dictionary:

- Access via acyclic channel
  - Any access to the object dictionary is acknowledged by the motion module.
  - *Chapter 4.11 'Acyclic channel' on page 76*
- Access via I/O area
  - The main objects are mapped in the I/O area.
  - The mapping cannot be changed.
  - *Chapter 4.10 'In-/Output area' on page 74*

Please note if you write via the Acyclic Channel to objects, which are mapped in the I/O area, these values are overwritten with the next cycle.

Overview

The motion module uses 36byte input and 36byte output data.

Head module	Backplane bus	Motion module	
CPU respectively bus coupler	→	Process data	Acyclic channel
	←	36byte	

The data exchange with the motion module must be consistent across the 36 bytes! It is recommended to control it via the process image.

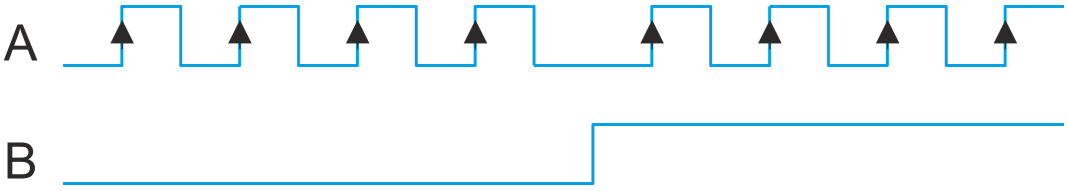
4.1.1 Pulse train module

Frequency pattern

The FM 054-1DA00 integrates a compact motion control solution for direct connection with a power stage with motor. The motion module outputs a specified pulse sequence with RS422 level via differential outputs to the power stage. A feedback of the position from the power stage back to the motion module does not take place. For output you can preset the following frequency pattern via the object *'0x8E00-01 - Pulse train configuration' on page 133*:

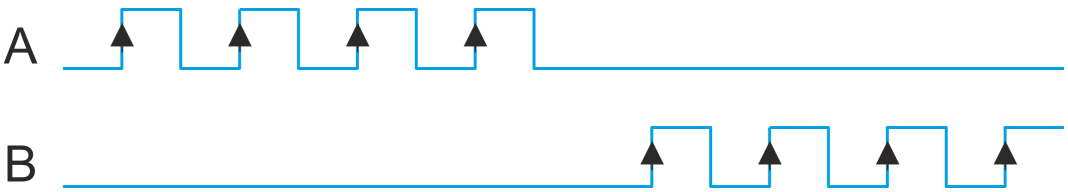
- Pulse and direction (P/D)
- Frequency modulation (CW/CCW)
- Incremental encoder simulation (A/B)

Pulse and direction (P/D)



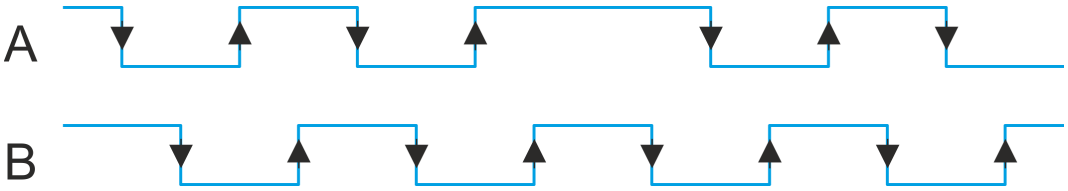
- 0x8E00-01 = 1
- The output of the frequency pattern happens by output A1 (P)
- The direction of rotation marks A2 (D) with "high" level for clockwise and "low" level for counter-clockwise rotation.

Frequency modulation (CW/CCW)



- 0x8E00-01 = 2
- With clockwise rotation the frequency signal is output at A1 (CW) respectively counter-clockwise rotation at A2 (CCW).
- The inactive channel is always at logic "low".

Incremental encoder simulation (A/B)

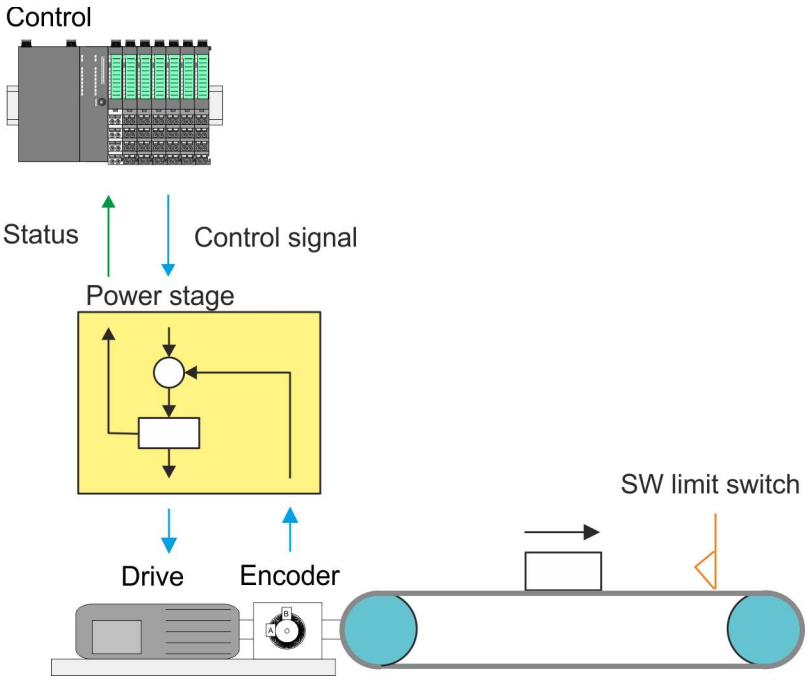


- 0x8E00-01 = 3
- Signal corresponds to the signal of an incremental encoder. By direct connection to a power stage synchronous axes in the master/slave structure can be realized.
- A1 (A) and A2 (B) output a phase-shifted by 90° signal.
- The shift from A1 to A2 is positive for clockwise rotation and negative for counter-clockwise rotation.

4.1.2 Structure of a positioning control

Structure

The figure below shows the structure of a typical positioning control



Control

The *Control* consists of the PLC with the user program for the processing and the motion module to control the power stage. The control of the power stage happens via RS422 signals. You can define a software limit switch in the motion module and react in the user program on the overrun.

Power stage with motor

The power stage receives from the motion module the corresponding control commands and controls automatically the connected motor. A *motor* is a engine for high-precision positioning. Motor and power stage are to be harmonized

CAUTION!
Please provide for track limits (general position limit) respectively to avoid damages besides software limit switch hardware limit switches and also consider this in your safety concept.

Encoder

- The encoder respectively rotation encoder provides the controller with the position of the motor by means of digital signals. This can accordingly be evaluated by the PLC.
- The encoder respectively rotation encoder supply a certain number of pulses per revolution.
- The value generation is done by counting the pulses.

4.2 Commissioning

4.2.1 Installation

1. Build your System SLIO and connect it. *Chapter 2 'Basics and mounting' on page 8*.
2. Connect your drive. *Chapter 4.3 'Connecting a power stage' on page 46*

4.2.2 Inspections and tests before the test operation

Preparation

Please check the following items, and take appropriate measures in the event of an error, before you start the test operation.

- Are all wiring and connections correct?
- Are all nuts and bolts at the drive properly tightened?
- For a motor with oil seal: Is the seal not damaged and is the motor lubricated? Please always regard the start-up instructions of your motor!

4.2.3 Start-up of the System SLIO motion module

Preparation

Please check the following items, and take appropriate measures in the event of an error, before you start the test operation.

- Check the correct setting of the set points for the drive and the I/O signals from the superordinate control.
- Check wiring between the superordinate control and your drive as well as the polarity of the wires.
- Check all operational settings of your drive.

Setting the limits

Set the respective system limits, the system behavior and characteristics in the object dictionary via the *Acyclic channel* *76*. These are e.g.:

- Behavior at quick stop and on error
- Velocity limit values
- Position limitations
- Assignment of the digital inputs and outputs

Steps of commissioning

Always adapt parameters to the operating mode!
Please ensure that the module always has the correct parameters according to the selected operating mode!

Start parameter

- *‘Start - Start parameter homing’ on page 52*
- *‘Start - Start parameter PtP position profile’ on page 57*
- *‘Start - Start parameter velocity profile’ on page 67*

1. Perform for your System SLIO and your motion module a hardware configuration and create your application program.
2. Enter the parameters that are to be loaded at start-up in the motion module. Otherwise you can parametrize during operation via the *Acyclic channel*.
3. ***Power supply***
   The module is to be power supplied with the both DC 24V voltages power section supply I/O area and electronic power supply. When commissioning these may simultaneously or electronic power supply must be switched on first. When commissioning these may simultaneously or electronic power supply must be switched on first. ‘Standard wiring’ on page 21

   Transfer your project into your CPU.
4. Set the power stage in operation.

   The settings in the power stage to be controlled are important for the safe and proper operation of your drive. More information may be found in the manual of the power stage.
5. Thus, the signals are scaled correctly at the power stage, you need to set a transmission ratio of the power stage.
6. Switch your CPU to RUN state.
7. Switch on the drive.

   ⇨ Your system is now ready for communication and you can establish parameter setting via the *Acyclic channel*.
8. Send the command "Shutdown".

   Bit 3...0: x110 *‘0x8100-01 - Control word’ on page 110*

   ⇨ The motion module shows the state *‘Ready to switch on’*.
9. Send the command "Switch on".

   Bit 3...0: 0111 *‘0x8100-01 - Control word’ on page 110*

   ⇨ The motion module shows the state *‘Switched on’*.
10. Reset by edge 0-1 of bit 7 in *‘0x8100-01 - Control word’ on page 110* a previously encountered possible error.
11. Send the command "Enable operation".

    Bit 3...0: 1111 *‘0x8100-01 - Control word’ on page 110*

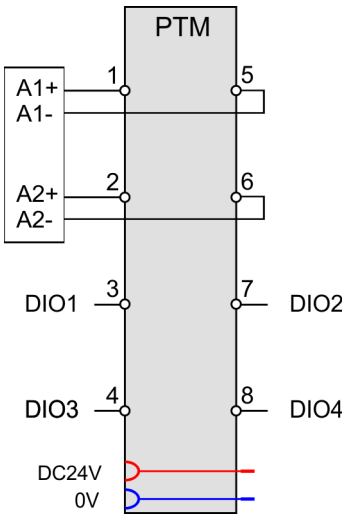
    ⇨ The motion module shows the state *‘Operation enabled’*. The drive is now ready for your move commands.

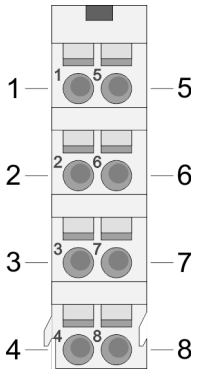
Application example *Chapter 4.16 'Example: 054-1DA00 with YASKAWA Sigma 5 mini' on page 90*

4.3 Connecting a power stage

4.3.1 Connection options

Connections





CAUTION!
Danger of injury from electrical shock and damage to the unit!
Put the System SLIO in a safe, powered down state before starting installation, disassembly or wiring of the System SLIO modules!

You can use wires with a cross section of 0.08mm² up to 1.5mm². For the connection lines the following requirements apply:

- For the digital I/O connection with DIO operation single lines can be used.
- A power stage must be connected via shielded lines.
- Generally, lines for power supply and signal lines must be laid separately.
- The motion module outputs a specified pulse sequence with RS422 level via differential outputs. The frequency pattern can be specified via the object dictionary.
- The digital connections I/O1...I/O4 are freely configurable via the object dictionary.

Default assignment

Pos.	Function	Type	*'0x8E00-01 - Pulse train configuration' on page 133*		
			P/D	CW/CCW	A/B
1	A1+	O	P	CW	A
2	A2+	O	D	CCW	B
3	I/O1	I/O	Digital input		
4	I/O3	I/O	Digital input		
5	A1-	O	/P	/CW	/A
6	A2-	O	/D	/CCW	/B
7	I/O2	I/O	Digital input		
8	I/O4	I/O	Digital input		
I: Input, O: Output					

In this module, the state machine emulates the states of the connected power stage. It does not represent its current states. Only by adjusting the DIO signals on the signals of the power stage as e.g. S-ON, ALM-RST, S-RDY and COIN, you can control its states.

Chapter 4.8 'Deployment I/O1...I/O4' on page 70

Assignment for YASKAWA Sigma 5mini via pulse train

Pos.	Function	Type	P/D	CW/CCW	A/B
1	A1+	O	P	CW	A
2	A2+	O	D	CCW	B
3	I/O1	I/O	S-ON: Servo drive On/Off		
4	I/O3	I/O	ALM-RST: Reset Interrupts		
5	A1-	O	/P	/CW	/A
6	A2-	O	/D	/CCW	/B
7	I/O2	I/O	S-RDY: Servo ready		
8	I/O4	I/O	COIN: Position reached		
I: Input, O: Output					

4.4 Drive profile

4.4.1 Overview

Drive profile *CiA 402*

- The System SLIO motion module FM 054-1DA00 is based largely on the drive profile *CiA 402*.
- The drive profile *CiA 402* defines state machine, operating modes and objects (parameters) of components for the drive technology.
- Here significant objects for control and evaluation of the state machine are *Control word*, *Status word* and *Operation mode*.
- Further object serve for configuration and diagnostics of the motion module.
- All the object are summarized in *Chapter 5 'Object dictionary' on page 97*.
- The most important objects can be found in *Chapter 4.10 'In-/Output area' on page 74*.
- The access of the objects during runtime happens via *Chapter 4.11 'Acyclic channel' on page 76*.

Term definitions

State machine	- The motion module has a state machine implemented. The status of the state machine can be controlled by means of commands.
State change	- The relevant command or any errors cause a state change.
State	- The state is the current state of the state machine. Via the *Status word* *'0x8100-02 - Status word' on page 111* you can access the state. Here the state is output via appropriate combinations of bits.
Command	- For triggering of state transitions, certain combinations of bits must be set in the *Control word* *'0x8100-01 - Control word' on page 110*. Such a combination is called *Command*.

Addressing

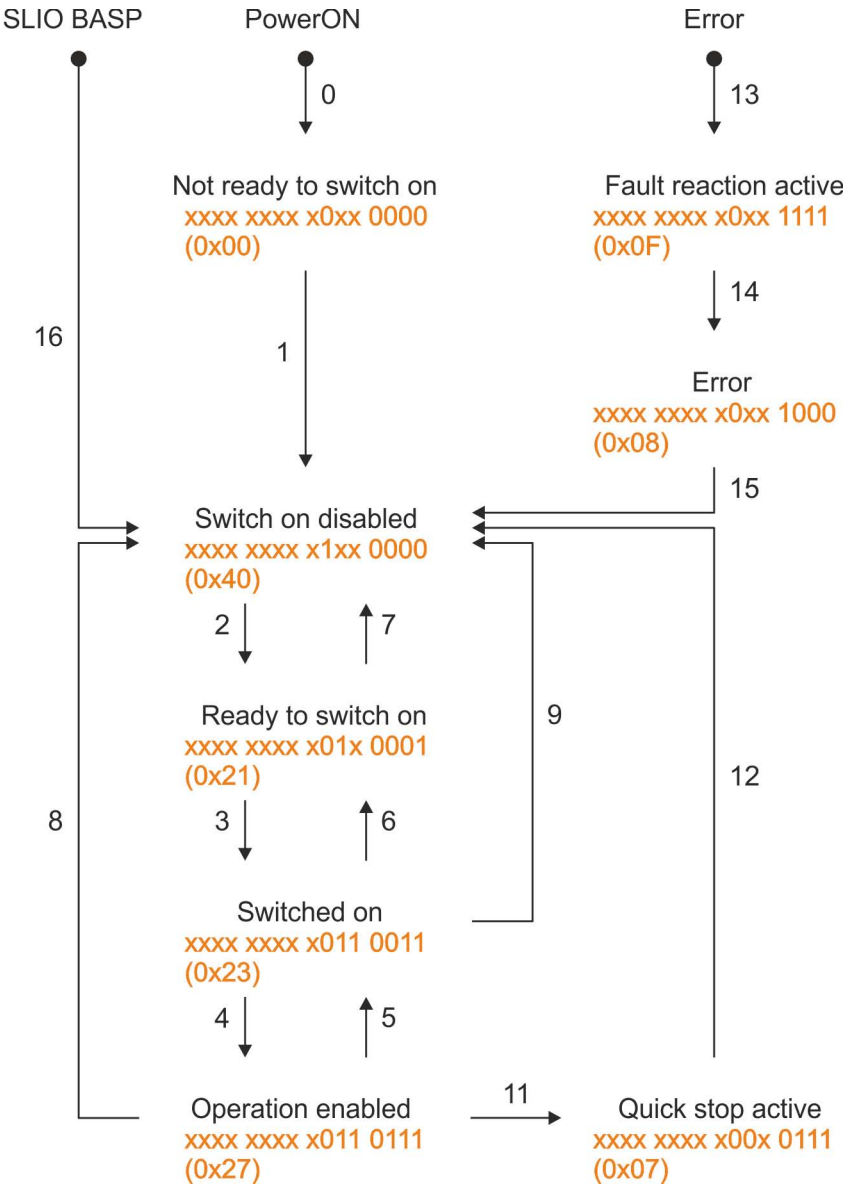
The System SLIO motion module provides its data, such as "Profiling target position" via an object dictionary. In this object dictionary the objects are organized and addressable a unique number consisting of *Index* and *Subindex*. The number is specified as follows:

0x	Index (hexadecimal)	-	Subindex (decimal)
Example: 0x8400-03			

To improve the structure and for expansion at System SLIO Motion Module another object numbering (index-assignment) is used besides the standard CiA 402.

4.4.2 States

State machine according to CiA 402



	Transition by:
0,1	Device start-up and self-test after PowerON
13	Drive or communication error
14	Internal fault reaction
16	Disabling command output disable (BASP) ↳ *'0x8100-01 - Control word' on page 110*:
2,6	Bit 3...0: x110: Command "Shutdown"
3	Bit 3...0: 0111: Command "Switch on"
4	Bit 3...0: 1111: Command "Enable operation". According to CiA 402 the automatic transition from *Ready to switch on* to *Operation enabled* is possible.
5	Bit 3...0: 0111: Command "Disable operation"
11	Bit 3...0: x01x: Command "Quick stop"
7,8,9,12	Bit 3...0: xx0x: Command "Disable voltage"
15	Bit 7: Edge 0-1: Command "Fault reset"

In this module, the state machine emulates the states of the connected power stage. It does not represent its current states. Only by adjusting the DIO signals on the signals of the power stage as e.g. S-ON, ALM-RST, S-RDY and COIN, you can control its states.

Chapter 4.8 'Deployment I/O1...I/O4' on page 70

Accessing the state machine

At CiA 402 the total control is realized via the following two objects. Both objects are mapped in the cyclic data exchange:

'0x8100-01 - Control word' on page 110 → State machine → *'0x8100-02 - Status word' on page 111*

4.4.3 Operating modes

4.4.3.1 Overview

Operating modes

The communication takes place via the I/O area. The main data of the object dictionary are mapped into the I/O area.

Chapter 4.10 'In-/Output area' on page 74

The objects, which are not mapped, can be accessed by the *Acyclic channel*.

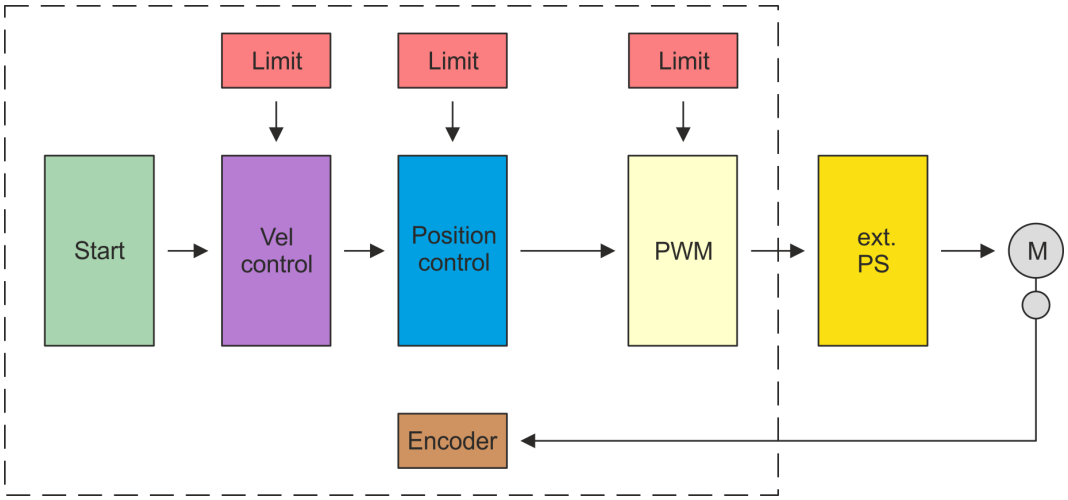
Chapter 4.11 'Acyclic channel' on page 76

The following modes according to the device profile CiA 402 are available:

- *Chapter 4.5 'Homing' on page 51*
- *Chapter 4.6 'PtP positioning profile' on page 56*
- *Chapter 4.7 'Velocity profile' on page 67*

Controller structure and controller parameters

Basis of the individual modes is the cascaded controller structure of the System SLIO motion module. This will give you a high dynamic and position precision. The set point for the higher-level position controller is generated by the profile generators of the individual modes. Position and velocity control loop are not closed, i.e. a feedback of the position from the power stage back to the motion module does not take place. This structure consists of the following components:



Start: Start parameters
Limit: Limitations
Vel control: Velocity control - 8kHz clock
Position control: Position controller - 8kHz clock
PWM: PWM part - 32kHz clock
ext. PS: External power stage
E: Encoder value
M: Motor and encoder

Application data

In addition to the control parameters you have to specify the data from your application, consisting of the nominal drive data and scaling.

‘0x8180-02 - Gear factor’ on page 116	→	Application data
‘0x8E00-02 - Pulse train pulses per revolution’ on page 134	→	

4.5 Homing

Overview

Here you will find information on how the System SLIO motion module searches the *reference position*. The reference position is also called "basic position", "start position" or "home position". *Homing* is an initialisation drive of an axis, where the correct position is determined by means of an reference signal. This process is called "referencing", "home drive" or "homing". When referencing you can determine velocity, acceleration, deceleration and type of homing. The FM 054-1DA00 supports the following homing types:

- *Chapter 4.5.1 ‘Homing by means of a homing switch’ on page 52*
- *Chapter 4.5.2 ‘Homing to current position’ on page 55*

Start - Start parameter homing

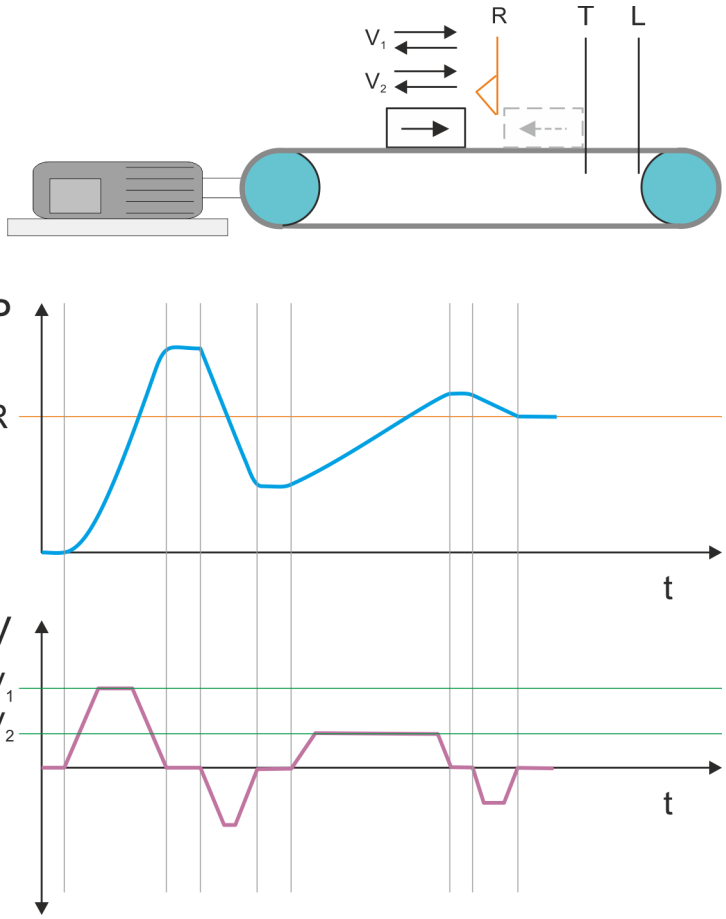
Please note:
- *↳ Chapter 4.2 'Commissioning' on page 44*
- *↳ 'Application data' on page 51*

↳ '0x8280-01 - Operating mode requested' on page 118 6: Homing mode (*↳ '0x8280-02 - Operating mode actual' on page 118*)	→	Homing	→	*↳ '0x8100-02 - Status word' on page 111*
↳ '0x8300-02 - Homing method' on page 119				
↳ '0x8300-03 - Homing digital input I/O1…I/O4' on page 119				
↳ '0x8300-04 - Homing digital input active polarity I/O1…I/O4' on page 120				*↳ '0x8280-02 - Operating mode actual' on page 118*
↳ '0x8300-05 - Homing target position' on page 120				
↳ '0x8300-06 - Homing velocity V1' on page 120				
↳ '0x8300-07 - Homing velocity V2' on page 121				
↳ '0x8300-08 - Homing acceleration' on page 121				
↳ '0x8300-09 - Homing deceleration' on page 121				
↳ '0x8300-10 - Homing offset value' on page 121				

4.5.1 Homing by means of a homing switch

Homing by means of a homing switch

- Homing can only be accessed from the*PtP positioning profile* mode.
- If homing is completed, it is returned to the *PtP positioning profile* mode, again.
- The *target position* is the reference position, which is maximally moved to. This is to be specified with sign.
- The homing happens according to the following steps:
  - It is traversed with the high *velocity V1* toward the target position *T* until the homing switch *R* is overrun.
  - Then it is decelerated and traversed in the opposite direction with *velocity V1*.
  - If the homing value *R* is overrun again, it is again decelerated and it is again accelerated in the positive direction with slower *velocity V2*.
  - With the next overrun of the homing switch the reference position *R* is set and moved to with *velocity V2*.
- Use To connect the home switch one of the digital inputs of the motion module and specify the polarity of the switch with the parametrization.



V_1 High velocity
V_2 Low velocity
R Homing switch respectively homing value
T Target position
L General position limit

Proceeding

1. For commissioning ↳ *Chapter 4.2 'Commissioning' on page 44*

   Homing objects ↳ *Chapter 5.2.11 'Homing - 0x8300' on page 119*

2. ■ Switch the state machine to state *'Switch on disabled'* ↳ *Chapter 4.4.2 'States' on page 49*
   – Send the command "Disable voltage"
   ↳ *'0x8100-01 - Control word' on page 110* Bit 3...0: xx0x:

   ⇨ The motion module shows the state *'Switch on disabled'*.

3. ■ ↳ *'0x8400-03 - Positioning profile target velocity' on page 122*
   – Enter the value 0.

4. ■ Switch your motion module to the *Positioning* mode. ↳ *'0x8280-01 - Operating mode requested' on page 118*
   – Enter the value 1.

5. Set the following parameters:
   ■ ↳ *'0x8300-02 - Homing method' on page 119*
   – Enter the value 17.
   ■ ↳ *'0x8300-03 - Homing digital input I/O1…I/O4' on page 119*
   – Select the input to which the homing switch is connected.
   ■ ↳ *'0x8300-04 - Homing digital input active polarity I/O1…I/O4' on page 120*
   – Define the polarity of the switch
   ■ ↳ *'0x8300-05 - Homing target position' on page 120*
   – Define by specifying a target position the maximum axis movement path, that during movement the homing switch is passed over.
   ■ ↳ *'0x8300-06 - Homing velocity V1' on page 120*
   – Specify the high velocity for the movement to the homing switch.
   ■ ↳ *'0x8300-07 - Homing velocity V2' on page 121*
   – Specify the low velocity for the movement to the homing switch.
   ■ ↳ *'0x8300-08 - Homing acceleration' on page 121*
   – Specify the acceleration for homing.
   ■ ↳ *'0x8300-09 - Homing deceleration' on page 121*
   – Specify the deceleration for homing.
   ■ ↳ *'0x8300-10 - Homing offset value' on page 121*
   – If necessary specify an offset for the homing position.

6. Send the command "Shutdown"

   ↳ *'0x8100-01 - Control word' on page 110* Bit 3...0: x110:

   ⇨ The motion module shows the state *'Ready to switch on'*.

7. Send the command "Switch on".

   ↳ *'0x8100-01 - Control word' on page 110* Bit 3...0: 0111

   ⇨ The motion module shows the state *'Switched on'*.

8. Send the command "Enable operation".

   ↳ *'0x8100-01 - Control word' on page 110* Bit 3...0: 1111

   ⇨ The motion module shows the state *'Operation enabled'*. The drive is now ready for your move commands.

9. ■ Switch your motion module to the *Homing* mode. ↳ *'0x8280-01 - Operating mode requested' on page 118*
   – Enter the value 6.

   ⇨ The drive starts homing. Upon completion of the homing, the position of the reference switch is used as the reference point. The motion module then automatically switches back to the *Positioning* mode.

4.5.2 Homing to current position

Proceeding

1. For commissioning *Chapter 4.2 'Commissioning' on page 44*

   Homing objects *Chapter 5.2.11 'Homing - 0x8300' on page 119*

2. ■ Switch the state machine to state *'Switch on disabled'* *Chapter 4.4.2 'States' on page 49*
   – Send the command "Disable voltage"
   '0x8100-01 - Control word' on page 110 Bit 3...0: xx0x:

   ⇨ The motion module shows the state *'Switch on disabled'*.

3. ■ *'0x8400-03 - Positioning profile target velocity' on page 122*
   – Enter the value 0.

4. ■ Switch your motion module to the *Positioning* mode. *'0x8280-01 - Operating mode requested' on page 118*
   – Enter the value 1.

5. Set the following parameters:
   ■ *'0x8300-02 - Homing method' on page 119*
   – Enter the value 37.
   ■ *'0x8300-10 - Homing offset value' on page 121*
   – If necessary specify an offset for the homing position.

6. Send the command "Shutdown"

   '0x8100-01 - Control word' on page 110 Bit 3...0: x110:

   ⇨ The motion module shows the state *'Ready to switch on'*.

7. Send the command "Switch on".

   '0x8100-01 - Control word' on page 110 Bit 3...0: 0111

   ⇨ The motion module shows the state *'Switched on'*.

8. Send the command "Enable operation".

   '0x8100-01 - Control word' on page 110 Bit 3...0: 1111

   ⇨ The motion module shows the state *'Operation enabled'*. The drive is now ready for your move commands.

9. ■ Switch your motion module to the *Homing* mode.
   '0x8280-01 - Operating mode requested' on page 118
   – Enter the value 6.

   ⇨ The current position is directly taken as a reference point in consideration to the offset.

   '0x8300-10 - Homing offset value' on page 121

   The motion module then automatically switches back to the *Positioning* mode.

4.6 PtP positioning profile

Overview

Always adapt parameters to the operating mode!
Please ensure that the module always has the correct parameters according to the selected operating mode!

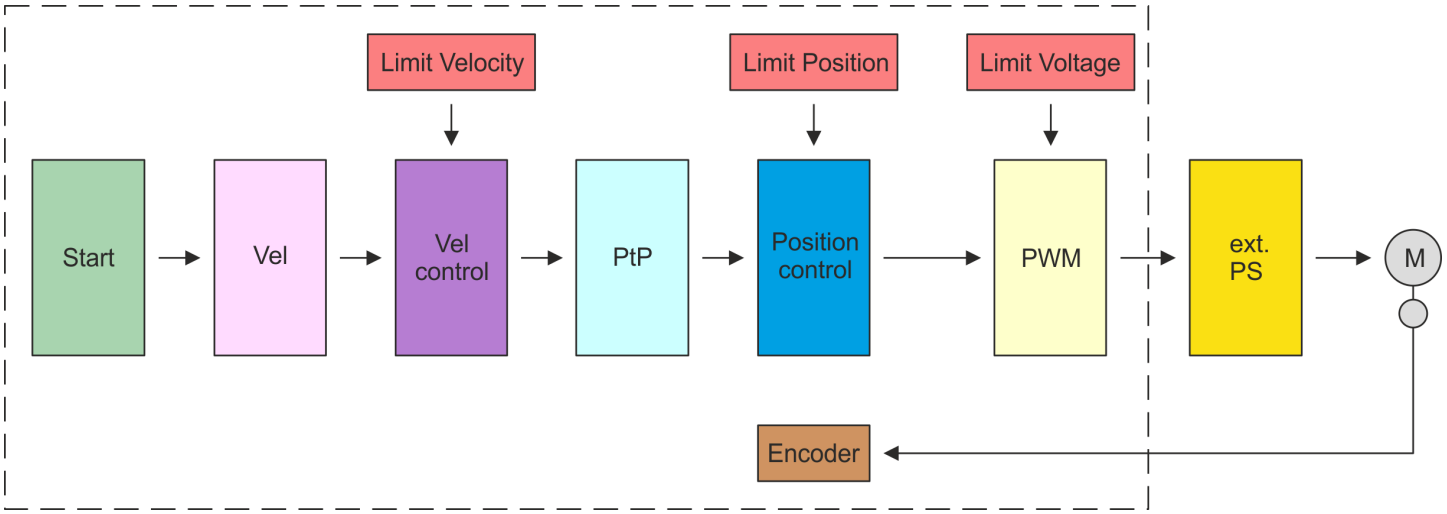
Start parameter

- *'Start - Start parameter homing' on page 52*
- *'Start - Start parameter PtP position profile' on page 57*
- *'Start - Start parameter velocity profile' on page 67*

With the PtP positioning profile, you can move to target positions by specifying profile velocity, profile acceleration and profile deceleration. Here, the limits for velocity and maximum traversing position are always be considered. Due to changes of values are immediately used and activated, "on the fly" changes of the move process are possible.

- Changes in acceleration respectively deceleration are directly used with the profile generation.
- Deceleration and reversing is automatically executed when a new target position requires a change of direction. A separated activation by starting the job in the *control word* is not necessary.
- If a specified target position is reached or a limit is activated during the traversing, this is indicated in *'0x8100-02 - Status word' on page 111*.
- The System SLIO motion module works in a controlled mode. Here, the position and velocity control loop are open and there is no evaluation of the encoder feedback.
- Current values of position, velocity, acceleration and deceleration are calculated by the System SLIO motion module itself.

Structure



Start: Start parameters
Limit Velocity: Limitation velocity
Limit Position: Limitation position
Limit Voltage: Limitation voltage
Vel: Velocity profile
Vel control: Velocity control
PtP: PtP positioning profile
Position control: Position controller
PWM: PWM stage
ext. PS: External power stage
M: Motor and encoder
Encoder: Encoder current value

Start - Start parameter PtP position profile

Please note:

– *‘Chapter 4.2 ‘Commissioning’ on page 44*
– *‘Application data’ on page 51*

‘0x8280-01 - Operating mode requested’ on page 118 1: PtP positioning profile (*‘0x8280-02 - Operating mode actual’ on page 118*)	→	Start:	→	Vel Velocity profile generator
‘0x8400-03 - Positioning profile target velocity’ on page 122				
‘0x8400-04 - Positioning profile target acceleration’ on page 123				
‘0x8400-05 - Positioning profile target deceleration’ on page 123				
‘0x8F00-01 - Encoder Feedback configuration’ on page 138				

Vel - velocity profile

Start:	→	Vel	→	Vel control Velocity control

Limit - limitation velocity

‘0x8500-04 - Velocity control limit positive direction’ on page 127	→	Limit Velocity	→	Vel control Velocity control
‘0x8500-05 - Velocity control limit negative direction’ on page 127				
‘0x8580-04 - Acceleration limit’ on page 128				
‘0x8580-06 - Deceleration limit’ on page 128				

Velocity control - Velocity control

Limit Velocity Limitation velocity	→	Vel control	→	PtP Positioning profile generator
Vel Velocity profile generator				
'0x8500-01 - Velocity control configuration' on page 126				*'0x8500-02 - Velocity control actual value' on page 126*
'0x8500-03 - Velocity control set value' on page 126				
'0x8580-03 - Deceleration quick stop value' on page 128				*'0x8580-02 - Acceleration/Deceleration actual value' on page 127*
'0x8F00-01 - Encoder Feedback configuration' on page 138				

PtP - Positioning profile generator

Vel control Velocity control	→	PtP	→	Position control Position controller
'0x8400-02 - Positioning profile target position' on page 122				
'0x8400-03 - Positioning profile target velocity' on page 122				*'0x8100-02 - Status word' on page 111*
'0x8400-04 - Positioning profile target acceleration' on page 123				
'0x8400-05 - Positioning profile target deceleration' on page 123				
'0x8F00-02 - Encoder actual value' on page 138				

Limit Position - Limitation position

↳ *'0x8400-02 - Positioning profile target position' on page 122* ↳ *'0x8480-05 - Software position limit positive direction' on page 124* ↳ *'0x8480-06 - Software position limit negative direction' on page 124* ↳ *'0x8480-07 - Range limit positive direction' on page 125* ↳ *'0x8480-08 - Range limit negative direction' on page 125* ↳ *'0x8580-04 - Acceleration limit' on page 128* ↳ *'0x8580-06 - Deceleration limit' on page 128*	→	Limit Position	→	Position control Position controller

Position control - Position controller

Limit Position Limitation position PtP Positioning profile generator ↳ *'0x8480-09 - In-position window' on page 125* ↳ *'0x8F00-02 - Encoder actual value' on page 138*	→	Position control	→	PWM PWM stage ↳ *'0x8480-02 - Position actual value' on page 123* Encoder value ↳ *'0x8480-03 - Position set value' on page 124* ↳ *'0x8480-10 - Lag error' on page 125*

Limit Voltage - Limitation voltage

‘0x8680-04 - Power section supply voltage min. warning level’ on page 129 *‘0x8680-05 - Power section supply voltage max. warning level’ on page 129* *‘0x8680-06 - Power section supply voltage min. error level’ on page 129* *‘0x8680-07 - Power section supply voltage max. error level’ on page 130* *‘0x8680-10 - Control voltage power stage min. warning level’ on page 130* *‘0x8680-11 - Control voltage power stage max. warning level’ on page 130* *‘0x8680-12 - Control voltage power stage min. error level’ on page 131* *‘0x8680-13 - Control voltage power stage max. error level’ on page 131*	→	Limit Voltage	→	PWM PWM stage

PWM - PWM stage

Limit Voltage Position control Position controller	→	PWM	→	ext. PS external power stage

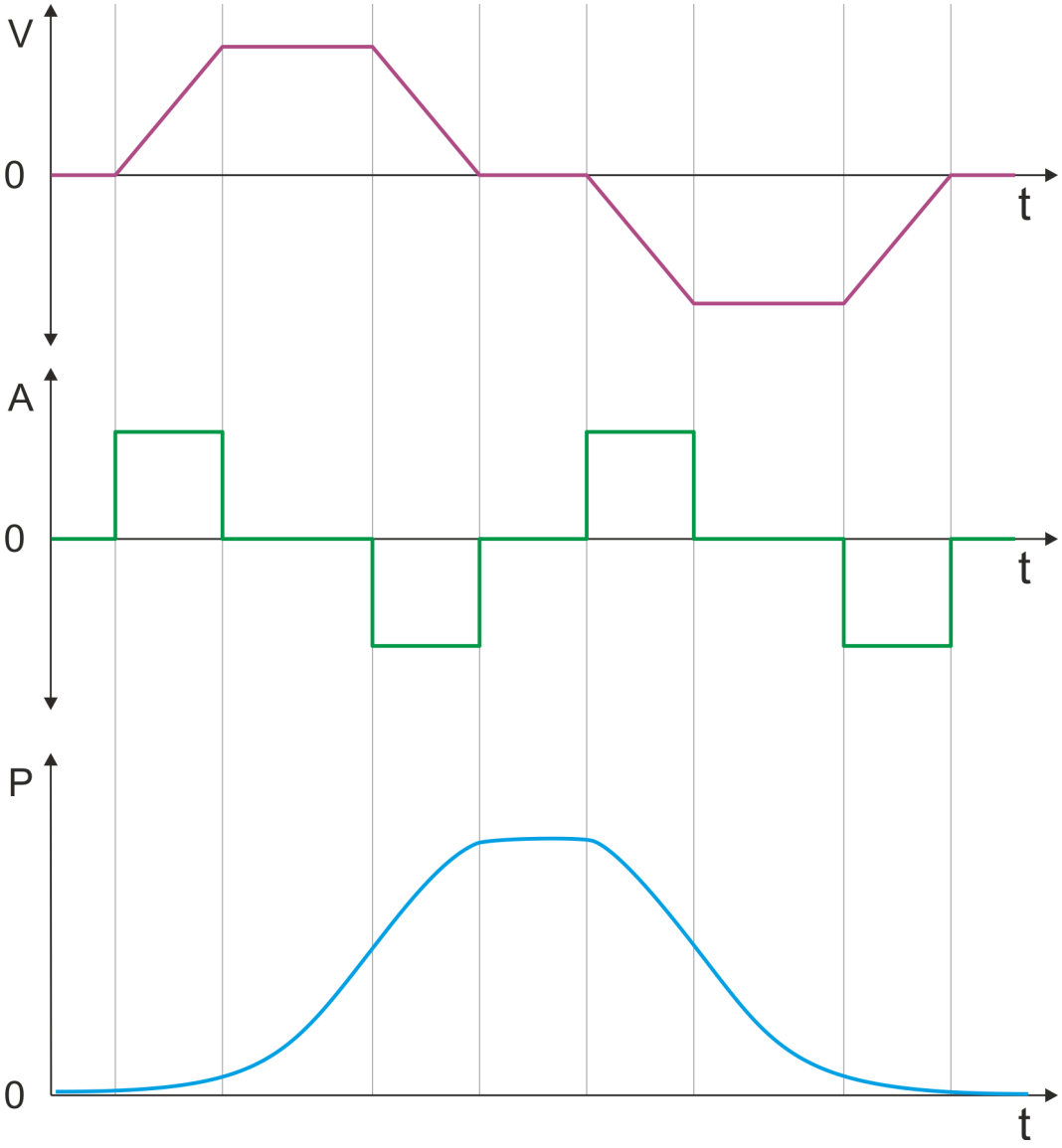
Ext. PS - External power stage, motor, encoder

PWM PWM stage	→	ext. PS	→ ←	Motor Encoder *‘0x8F00-02 - Encoder actual value’ on page 138* *‘0x8680-02 - Power section supply voltage actual value’ on page 129* *‘0x8680-08 - Control voltage power stage actual value’ on page 130*

4.6.1 Examples

Symmetrical acceleration and deceleration with reaching the target velocity

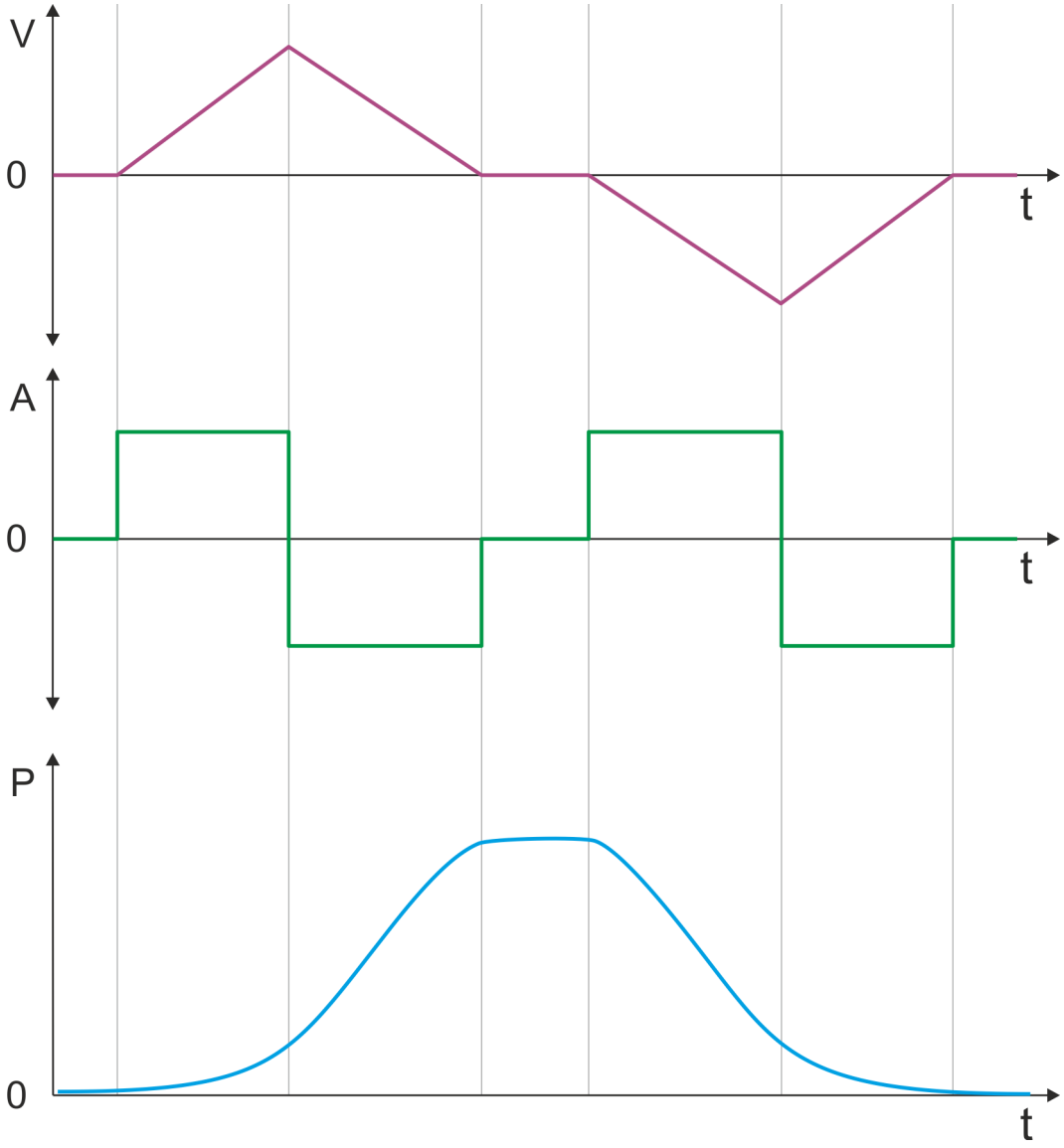
- Setting
  - Target position
  - Profile velocity
  - Profile acceleration
  - Profile deceleration
- Target velocity is reached.
- Specifying a new target position as starting position.



V Velocity
A Acceleration
P Position
t Time

Symmetrical acceleration and deceleration without reaching the target velocity

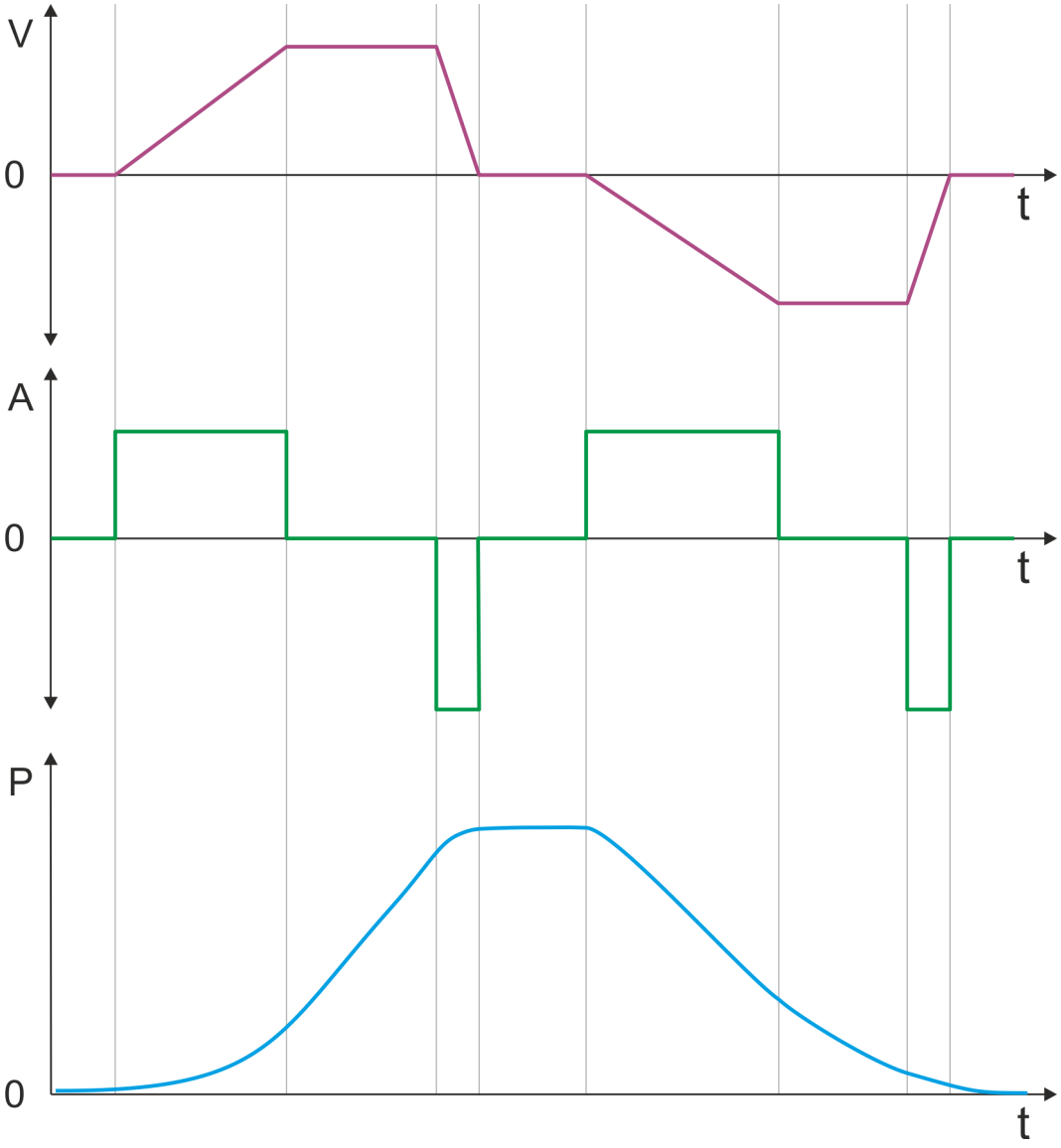
- Setting
  - Target position
  - Profile velocity
  - Profile acceleration
  - Profile deceleration
- Target velocity is not reached, since before deceleration is initiated to reach the target position.
- Specifying a new target position as starting position.



V Velocity
A Acceleration
P Position
t Time

Asymmetrical acceleration and deceleration with reaching the target velocity

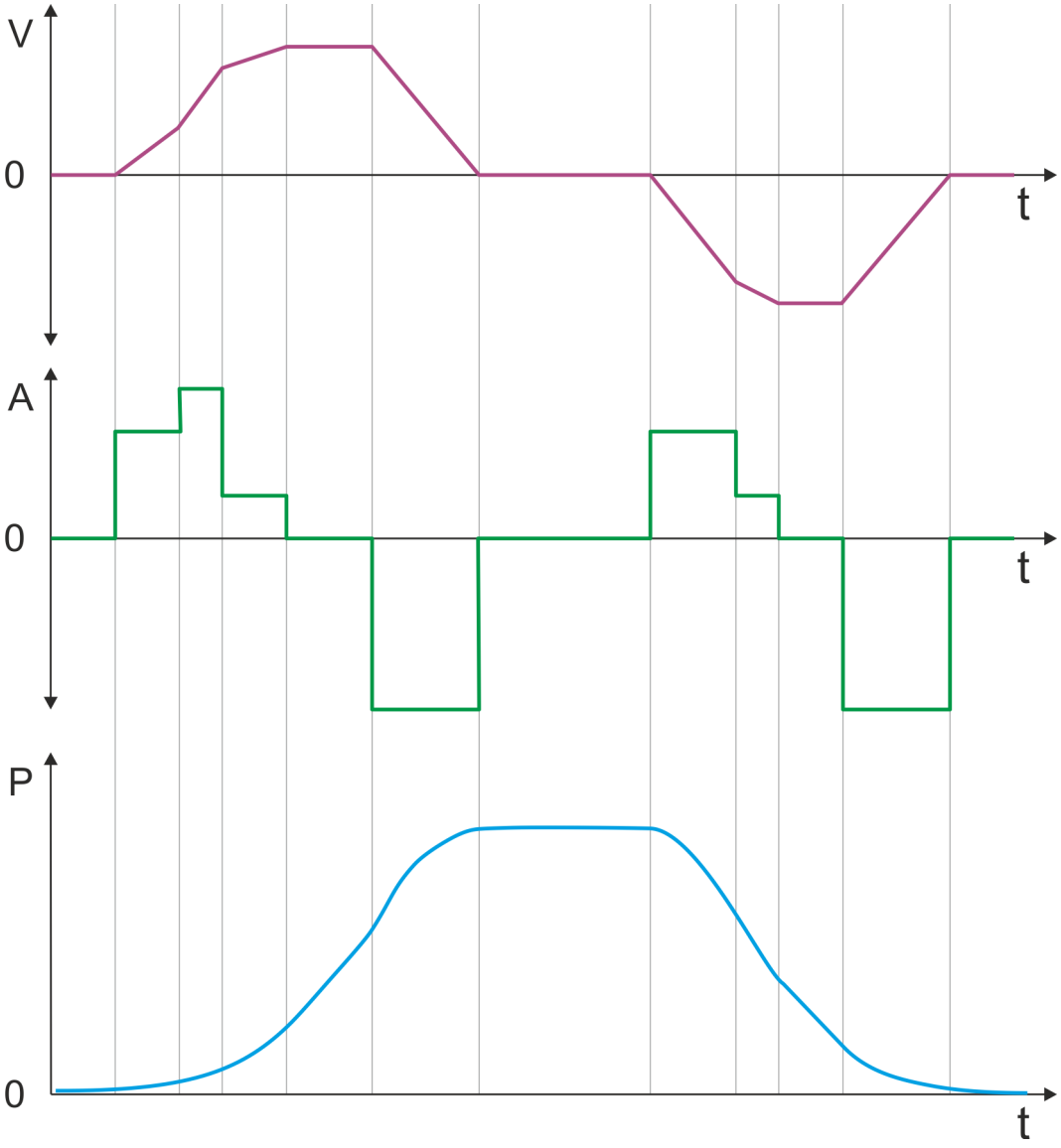
- Setting
  - Target position
  - Profile velocity
  - Profile acceleration
  - Profile deceleration
- Target velocity is reached.
- Specifying a new target position as starting position.



V Velocity
A Acceleration
P Position
t Time

Asymmetrical acceleration and deceleration with reducing the acceleration during the move

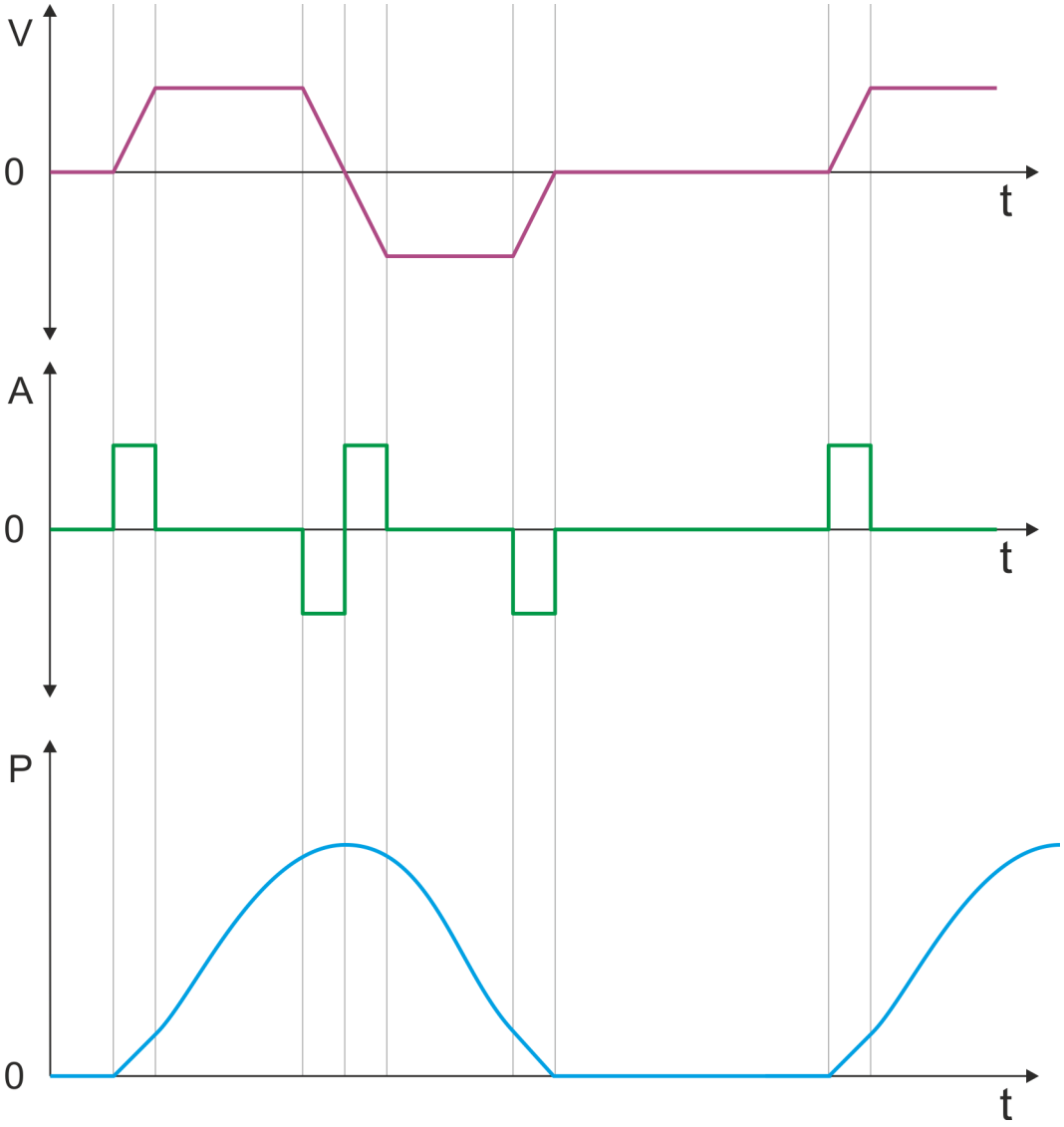
- Setting
  - Target position
  - Profile velocity
  - Profile acceleration
  - Profile deceleration
- Target velocity is reached.
- Specifying a new target position as starting position.



V Velocity
A Acceleration
P Position
t Time

Symmetrical acceleration and deceleration with reaching the target velocity

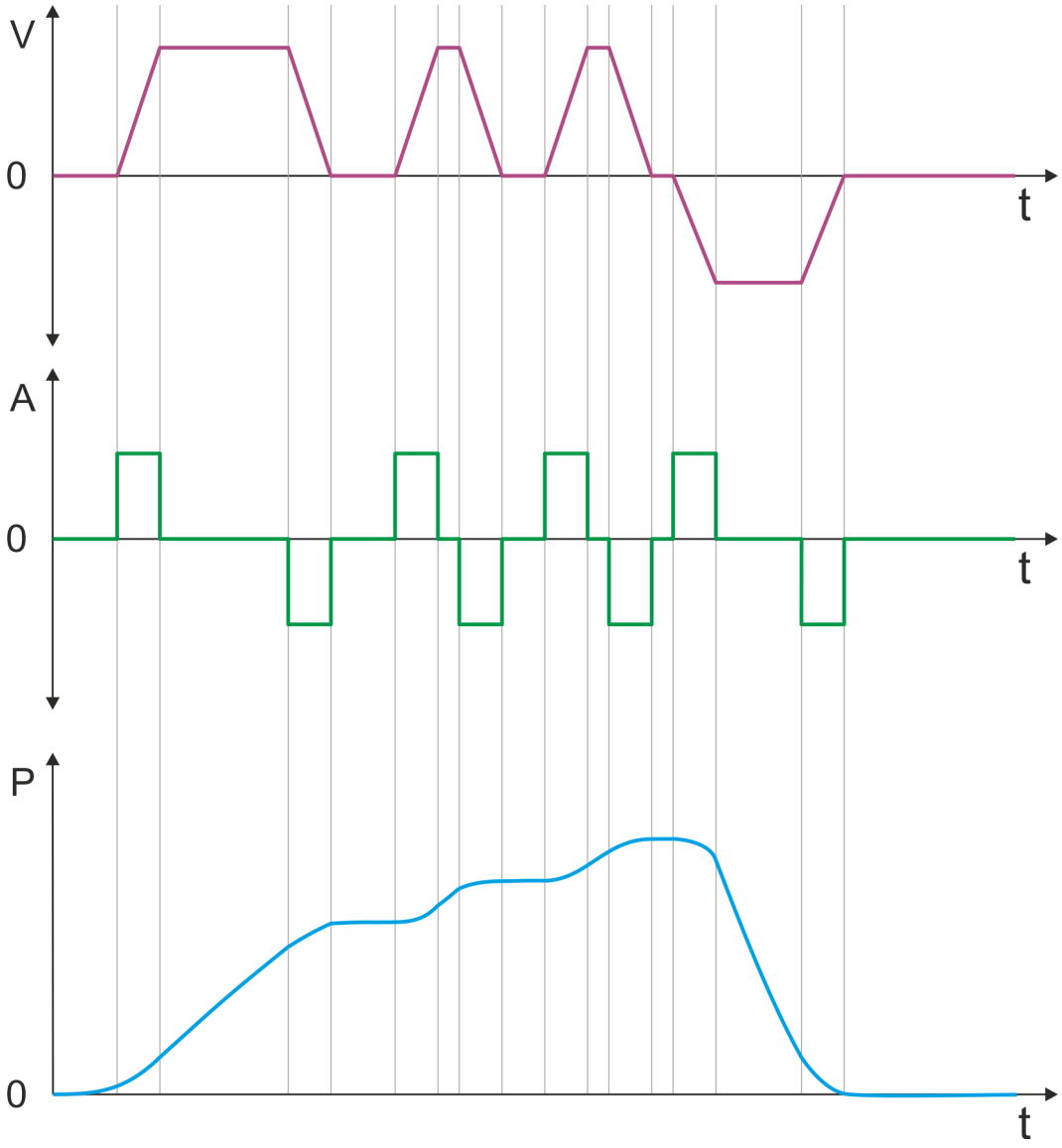
- Setting
  - Target position
  - Profile velocity
  - Profile acceleration
  - Profile deceleration
- Target velocity is reached.
- Specifying a new target position as starting position during deceleration.



V Velocity
A Acceleration
P Position
t Time

Symmetrical acceleration and deceleration with specifying a target position, twice

- Setting
  - Target position
  - Profile velocity
  - Profile acceleration
  - Profile deceleration
- Target velocity is reached.
- Specifying a new target position, after the previous target position was reached.



V Velocity
A Acceleration
P Position
t Time

4.7 Velocity profile

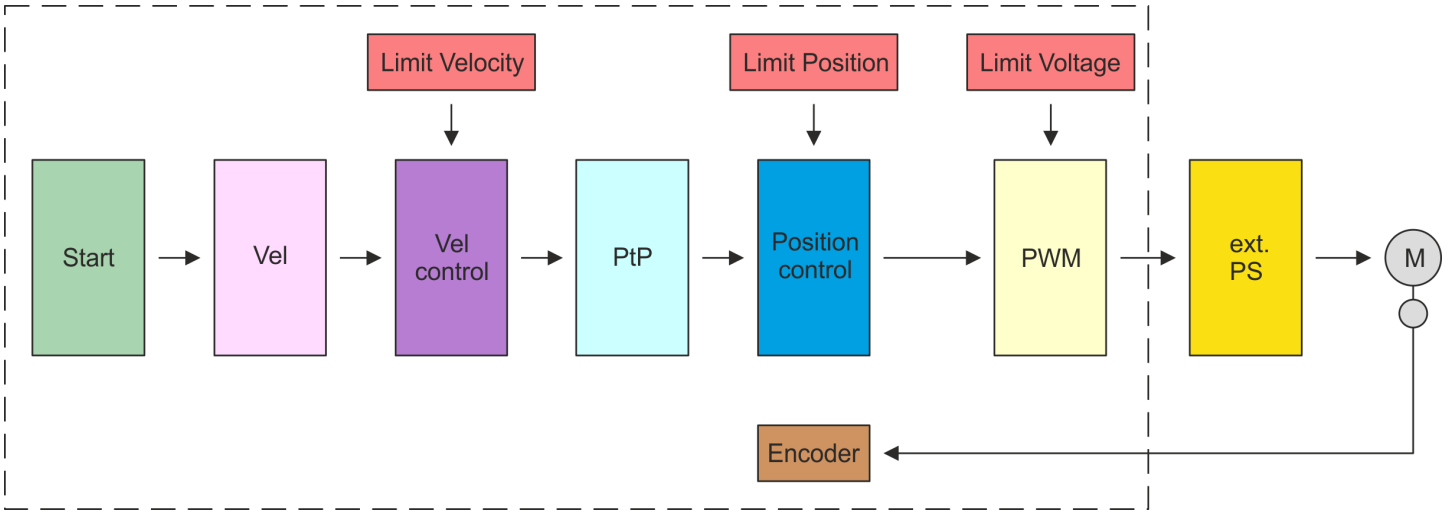
Structure

Always adapt parameters to the operating mode!
Please ensure that the module always has the correct parameters according to the selected operating mode!

Start parameter

- *‘Start - Start parameter homing’ on page 52*
- *‘Start - Start parameter PtP position profile’ on page 57*
- *‘Start - Start parameter velocity profile’ on page 67*

In the operation mode *Velocity profile* the velocity is output according to profile acceleration and profile deceleration until the target velocity is reached. This operation mode bases on the *PtP positioning profile*, except that position settings such as target and limit values have no effect. With this object *‘0x8500-01 - Velocity control configuration’ on page 126*, you can specify the frequency pulse patterns.



Start: Start parameters
Limit Velocity: Limitation velocity
Limit Position: Limitation position
Limit Voltage: Limitation voltage
Vel: Velocity profile
Vel control: Velocity control
PtP: PtP positioning profile
Position control: Position controller
PWM stage
ext. PS: External power stage
M: Motor and encoder
Encoder: Encoder current value

Start - Start parameter velocity profile

Please note:

- *Chapter 4.2 ‘Commissioning’ on page 44*
- *‘Application data’ on page 51*

‘0x8280-01 - Operating mode requested’ on page 118 3: Velocity profile (*‘0x8280-02 - Operating mode actual’ on page 118*)	→	Start:	→	Vel Velocity profile generator
‘0x8400-03 - Positioning profile target velocity’ on page 122				

↳ *'0x8400-04 - Positioning profile target acceleration' on page 123* ↳ *'0x8400-05 - Positioning profile target deceleration' on page 123* ↳ *'0x8F00-01 - Encoder Feedback configuration' on page 138*				

Vel - velocity profile

Start:	→	Vel	→	Vel control Velocity control

Limit - limitation velocity

↳ *'0x8500-04 - Velocity control limit positive direction' on page 127* ↳ *'0x8500-05 - Velocity control limit negative direction' on page 127* ↳ *'0x8580-04 - Acceleration limit' on page 128* ↳ *'0x8580-06 - Deceleration limit' on page 128*	→	Limit Velocity	→	Vel control Velocity control

Velocity control - Velocity control

Limit Velocity Limitation velocity	→	Vel control	→	PtP Positioning profile generator
Vel Velocity profile generator				
↳ *'0x8500-01 - Velocity control configuration' on page 126*				
↳ *'0x8500-03 - Velocity control set value' on page 126*				↳ *'0x8500-02 - Velocity control actual value' on page 126*
↳ *'0x8580-03 - Deceleration quick stop value' on page 128*				
↳ *'0x8F00-01 - Encoder Feedback configuration' on page 138*				↳ *'0x8580-02 - Acceleration/Deceleration actual value' on page 127*

PtP - Positioning profile generator

Vel control Velocity control	→	PtP	→	Position control Position controller
↳ *'0x8400-03 - Positioning profile target velocity' on page 122*				
↳ *'0x8400-04 - Positioning profile target acceleration' on page 123*				↳ *'0x8100-02 - Status word' on page 111*
↳ *'0x8400-05 - Positioning profile target deceleration' on page 123*				
↳ *'0x8F00-02 - Encoder actual value' on page 138*				

Position control - Position controller

PtP Positioning profile generator	→	Position control	→	PWM PWM stage
				↳ *'0x8480-02 - Position actual value' on page 123* Encoder value
				↳ *'0x8480-03 - Position set value' on page 124*
				↳ *'0x8480-10 - Lag error' on page 125*

Limit Voltage - Limitation voltage

↳ *'0x8680-04 - Power section supply voltage min. warning level' on page 129*	→	Limit Voltage	→	PWM PWM stage
↳ *'0x8680-05 - Power section supply voltage max. warning level' on page 129*				
↳ *'0x8680-06 - Power section supply voltage min. error level' on page 129*				
↳ *'0x8680-07 - Power section supply voltage max. error level' on page 130*				
↳ *'0x8680-10 - Control voltage power stage min. warning level' on page 130*				
↳ *'0x8680-11 - Control voltage power stage max. warning level' on page 130*				
↳ *'0x8680-12 - Control voltage power stage min. error level' on page 131*				
↳ *'0x8680-13 - Control voltage power stage max. error level' on page 131*				

PWM - PWM stage

Limit Voltage Position control Position controller	→	PWM	→	ext. PS external power stage

Ext. PS - External power stage, motor, encoder

PWM PWM stage	→	ext. PS	→ ←	Motor Encoder *‘0x8F00-02 - Encoder actual value’ on page 138* *‘0x8680-02 - Power section supply voltage actual value’ on page 129* *‘0x8680-08 - Control voltage power stage actual value’ on page 130*

4.8 Deployment I/O1...I/O4

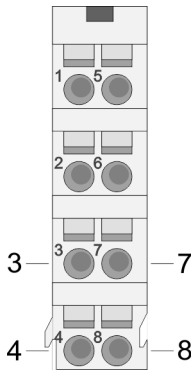
Overview

The module has 4 digital connectors I/O1...I/O4. The ports can be used with the following configurable modes:

- Used as digital input
- Used as digital output
- Pairwise use as encoder input for 24V HTL signal

Default settings

The 4 digital ports of the motion module have the following default settings, which fit to the standard pin-out to connect a power stage via pulse train like e.g. YASKAWA Sigma 5mini:



Default setting

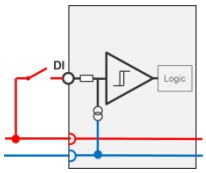
Pos.	Function	Type	Description
3	I/O1	I	Digital input
4	I/O3	I	Digital input
7	I/O2	I	Digital input
8	I/O4	I	Digital input
I: Input, O: Output			

Via the Objects 0x8E00-08 ... 15 the I/O2 and I/O4 can be assigned to pre-defined signals. Chapter 5.2.18.1 ‘0x8E00-08 ... 15 - Signals of the power stage’ on page 134

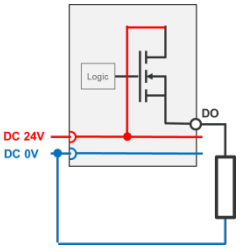
Connecting a YASKAWA Sigma 5

Pos.	Function	Type	Description
3	I/O1	I/O	S-ON: Servo drive On/Off
4	I/O3	I/O	S-RDY: Servo ready
7	I/O2	I/O	ALM-RST: Reset Interrupts
8	I/O4	I/O	COIN: Position reached
I: Input, O: Output			

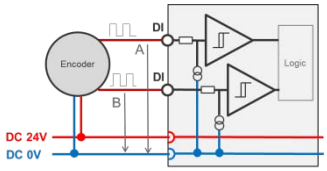
Connections



Digital input: DC 24V
IEC 61131-2 type 3
High-side (sink)



Digital output: DC 24V
500 mA
High-side (source)



Encoder mode: 24V HTL signal
Phase A and B
100 kHz
4-fold evaluation
Chapter 4.8.2.2 'Encoder - deployment' on page 72

4.8.1 Objects

Structure

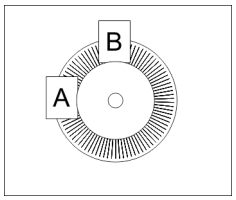
DIO Control

'0x7100-01...04 - Digital input configuration I/O1...I/O4' on page 105	→	DIO Control	→	*'0x7100-05 - Digital input states I/O1...I/O4' on page 106*
'0x7200-01...04 - Digital output configuration I/O1...I/O4' on page 107				
'0x7200-05 - Digital output states I/O1...I/O4 actual states' on page 108				
'0x7200-06 - Digital output states I/O1...I/O4 requested states' on page 109				

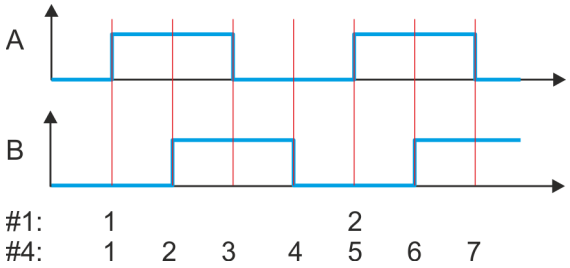
4.8.2 Usage as input for incremental encoder

4.8.2.1 Encoder - signal evaluation

Signal evaluation



- Incremental encoder are sensors for detecting angular or positional changes.
- Depending on the sensor type and the desired resolution, the scanning happens by sliding contact, photo electrically or magnetically.
  - The scanning via *sliding contact* works in principle like a switch, which is mechanically operated.
  - With the *optical scanning* a disk, which has a fine raster, is optically scanned.
  - With the magnetic scanning a pole wheel or magnetic band is scanned which has been written with a raster by a magnetization, before.
- The incremental encoder has two sensors *Track A* and *Track B* for scanning.
- The sensors are arranged at an angle of 90 degrees from each other on the system to be scanned.
- In a rotational movement of the system, the sensors generate a specific number of pulses. These are a measure of the covered angel or way. With the electrical phase shift of the two signals the direction of rotation can be determined.
  - If the axis rotates to the right, then the signal of *Track A* is leading 90° towards the signal of *Track B*.
  - If the axis rotates to the left, then the signal of *Track A* is lagging 90° towards the signal of *Track B*.
- During the sensor evaluation from the difference between two counter values the velocity and direction can be determined.
- With *1-fold* evaluation one signal edge 0-1 of *Track A* corresponds to one counter pulse respectively one division of the system to be scanned corresponds to one counter pulse.
- With *4-fold* evaluation one signal edge of *Track A* and *Track B* corresponds to one counter pulse. The 4-fold evaluation is very often used.



#1 1-fold evaluation
#4 4-fold evaluation

4.8.2.2 Encoder - deployment

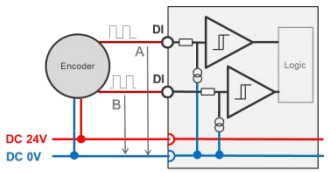
Connections

There is the possibility to connect an encoder via I/O1 and I/O3. With the value 1 of object *‘0x8F00-01 - Encoder Feedback configuration’ on page 138* the encoder function for I/O1 and I/O3 is enabled. Please note that the determined encoder value is not further evaluated in the module. Via object *‘0x8F00-02 - Encoder actual value’ on page 138* the encoder value can be read and further processed in you user program. The unused digital in-/outputs I/O2 and I/O4 are further free for usage.

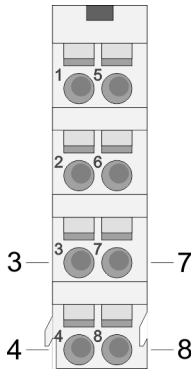
Objects

‘0x8F00-01 - Encoder Feedback configuration’ on page 138	→	DIO Control Encoder	→	*‘0x8F00-02 - Encoder actual value’ on page 138*

Connections



Encoder mode: 24V HTL signal
Phase A and B
100 kHz
4-fold evaluation



Pos.	Function	Type	Description
3	I/O1	I	Encoder function
4	I/O3	I	Encoder function
7	I/O2	I/O	for free usage
8	I/O4	I/O	for free usage
I: Input, O: Output			

Via the Objects 0x8E00-08 ... 15 the I/O2 and I/O4 can be assigned to pre-defined signals. *Chapter 5.2.18.1 '0x8E00-08 ... 15 - Signals of the power stage' on page 134*

4.9 Brake control

Overview

With this motion module the break control is largely defined by the power stage and the connected motor. The brake control options, which are listed below, should only be used as a supplement to the brake control and not as replacement:

- Braking via external brake
- Quick stop via ramping

You have the possibility to control a brake via a digital input / output channel.

Braking via external brake

You have the possibility to control a brake via a digital input/output channel. By integration into your user program, you can control it if necessary.

Quick stop

Quick stop is a ramp function, with which the connected motor can be decelerated and brought to stop. During normal operation it is not necessary to activate this brake functions manually, since normal braking operations are performed by the profile generator. Quick stop is used when the operating conditions require a rapid stopping.

For quick stop there are the following possibilities:

- Direct stop with short-circuit braking and subsequent state change to *'Switch on disabled'*.
- Brake with quick stop deceleration and state change to *'Switch on disabled'*.

Quick stop - objects

'0x8100-01 - Control word' on page 110 *'0x8200-01 - Configuration quick stop' on page 117* *'0x8580-03 - Deceleration quick stop value' on page 128*	→	Quick stop configuration	→	*'0x8100-02 - Status word' on page 111*

4.10 In-/Output area

Overview The motion module uses 36byte input and 36byte output data.

Head module	Backplane bus	Motion module	
CPU respectively bus coupler	→	Process data	Acyclic channel
	←	36byte	

The data exchange with the motion module must be consistent across the 36 bytes! It is recommended to control it via the process image.

Input area

Offset	Size	Area	Description
0	2	Drive	*'0x8100-02 - Status word' on page 111*
2	2	Drive	*'0x8280-02 - Operating mode actual' on page 118*
4	4	Drive	*'0x8480-02 - Position actual value' on page 123*
8	4	Drive	*'0x8500-02 - Velocity control actual value' on page 126*
12	4	Drive	*'0x8580-02 - Acceleration/Deceleration actual value' on page 127*
16	4	Drive	*'0x8480-10 - Lag error' on page 125*
20	2	-	reserved
22	2	-	reserved
24	1	DIOs	*'0x7100-05 - Digital input states I/O1...I/O4' on page 106*
25	1	DIOs	*'0x7200-05 - Digital output states I/O1...I/O4 actual states' on page 108*
26	1	Acyclic	Acyclic communication channel: Status
27	1	Acyclic	Acyclic communication channel: Subindex in the object dictionary
28	2	Acyclic	Acyclic communication channel: Index in the object dictionary
30	4	Acyclic	Acyclic communication channel: Data

Offset	Size	Area	Description
34	1	-	reserved
35	1	-	reserved

Please note if you write via the Acyclic Channel to objects, which are mapped in the I/O area, these values are overwritten with the next cycle.

Output area

Offset	Size	Area	Description
0	2	Drive	*'0x8100-01 - Control word' on page 110*
2	2	Drive	*'0x8280-01 - Operating mode requested' on page 118*
4	4	Drive	*'0x8400-02 - Positioning profile target position' on page 122*
8	4	Drive	*'0x8400-03 - Positioning profile target velocity' on page 122*
12	4	Drive	*'0x8400-04 - Positioning profile target acceleration' on page 123*
16	4	Drive	*'0x8400-05 - Positioning profile target deceleration' on page 123*
20	2	-	reserved
22	2	-	reserved
24	1	-	reserved
25	1	Drive	*'0x7200-06 - Digital output states I/O1...I/O4 requested states' on page 109*
26	1	Acyclic	Acyclic communication channel: Command
27	1	Acyclic	Acyclic communication channel: Subindex in the object dictionary
28	2	Acyclic	Acyclic communication channel: Index in the object dictionary
30	4	Acyclic	Acyclic communication channel: Data
34	1	-	reserved
35	1	-	reserved

4.11 Acyclic channel

Overview

Please note if you write via the Acyclic Channel to objects, which are mapped in the I/O area, these values are overwritten with the next cycle.

Via the *Acyclic channel* you can perform acyclic read and write commands. For this in the input/output area of the motion module a data area for the acyclic communication has been implemented. This area includes 8 bytes output and 8 bytes input data. These have the following assignment:

Request		Response
Output data ■ Byte 0: CMD - Command ■ Byte 1: SUBIDX - Subindex ■ Byte 2: IDX0 - Index (low byte) ■ Byte 3: IDX1 - Index (high byte) ■ Byte 4: DATA0 - Data (low byte) ■ Byte 5: DATA1 - Data ■ Byte 6: DATA2 - Data ■ Byte 7: DATA3 - Data (high byte)	→ ←	Input data ■ Byte 0: STATUS - Status ■ Byte 1: SUBIDX - Subindex ■ Byte 2: IDX0 - Index (low byte) ■ Byte 3: IDX1 - Index (high byte) ■ Byte 4: DATA0 - Data (low byte) ■ Byte 5: DATA1 - Data ■ Byte 6: DATA2 - Data ■ Byte 7: DATA3 - Data (high byte)
IDLE → Request → Response → IDLE		

CMD - Command

Code	Name	Description
0x11	READ_ONCE	Reading a data object With this command you can request the data once after the command has been recognized.
0x21	WRITE_ONCE	Writing a data object With this command data are written only once after the command has been recognized.

SUBIDX - Subindex Subindex in the object dictionary

IDX0/IDX1 - Index Index in the object dictionary

DATA0 ... DATA3 - Data Data which are to be transmitted.

STATUS - Status

Code	Name	Description
0x00	IDLE	Idle - waiting for commands
0x14	READ_ONCE	Command READ_ONCE has been recognized, data are valid.
0x24	WRITE_ONCE	Command WRITE_ONCE has been recognized, data were accepted.

Code	Name	Description
0x81:	READ_NOT_EXIST	Error - read access - data do not exist Command rejected!
0x91	WRITE_NOT_EXIST	Error - write access - data do not exist Command rejected!
0x92	WRITE_RNG_ERR	Error - write access - data out of range Command rejected!
0x93	WRITE_RDO_ERR	Error - write access - data can only be read Command rejected!
0x94	WRITE_WPR_ERR	Error - write access - data are write protected Command rejected!
0x99	ACYC_COM_ERR	Error during acyclic communication Command rejected!

For the VIPA *SPEED7 Studio* and the Siemens SIMATIC Manager there is the block FB 320 ACYC_RW for simplified access available.

4.11.1 FB 320 - ACYC_RW - Acyclic access to the System SLIO motion module

Description

With this block you can access the object dictionary of the System SLIO motion modules by means of your user program. Here the block uses an acyclic communication channel based on a request/response sequence. This is part of the input/output area of motion module.

Due to the blocks FB 320 and FB 321 access the same data base, for each channel (if multichannel) you can use only one of these blocks in your user program! Also this block must be called per cycle only once!

Parameters

Parameter	Declaration	Data type	Description
REQUEST	IN	BOOL	The job is started with edge 0-1.
MODE	IN	BYTE	Enter 0x01 for the acyclic protocol
COMMAND	IN	BYTE	0x11 = Reading a data object (max. 4byte) 0x21 = Writing a data object (max. 4byte)
INDEX	IN	WORD	Index of the object
SUBINDEX	IN	BYTE	Subindex of the object
WRITE_LENGTH	IN	DINT	Length of the data to be written in byte (max. 4byte)
WRITE_DATA	IN	ANY	Pointer to the data to be written.
READ_DATA	IN	ANY	Pointer to the received data.

Parameter	Declaration	Data type	Description
CHANNEL_IN	IN	ANY	Pointer to the beginning of the acyclic channel in the input area of the motion module. Enter as length 10bytes. Examples P#E100.0 BYTE 10 or P#DB10.DBX0.0 BYTE 10
CHANNEL_OUT	IN	ANY	Pointer to the beginning of the acyclic channel in the output area of the motion module. Enter as length 8bytes. Examples P#A100.0 BYTE 8 or P#DB10.DBX10.0 BYTE 8
READ_LENGTH	OUT	DInt	Length of the received data in byte. This value is to be rounded up to a multiple of 4, because the length specification is not transmitted.
DONE	OUT	BOOL	1: Job has been executed without error
BUSY	OUT	BOOL	0: There is no job being executed 1: Job is currently being executed
ERROR	OUT	BOOL	0: No Error 1: There is an error. The cause of the error is shown on the *ERROR_ID* parameter
ERROR_ID	OUT	WORD	Detailed error information

Please note that the parameters WRITE_DATA and READ_DATA are not checked for data type and length!

Behavior of the block parameters

- Exclusiveness of the outputs
  - The outputs *BUSY, DONE* and *ERROR* are mutually exclusive. There can only one of these outputs be TRUE at the same time.
  - As soon as the input *REQUEST* is TRUE, one of the outputs must be TRUE.
- Output status
  - The outputs *DONE, ERROR, ERROR_ID* and *READ_LENGTH* are reset by an edge 1-0 at the input *REQUEST*, when the function block is not active (*BUSY* = FALSE).
  - An edge 1-0 at *REQUEST* does not affect the job processing.
  - If *REQUEST* is already reset during job processing, so it is guaranteed that one of the outputs is set at the end of the command for a PLC cycle. Only then the outputs are reset.
- Input parameter
  - The input parameters are taken with edge 0-1 at *REQUEST*. To change parameters, you have to trigger the job again.
  - If there is again an edge 0-1 at *REQUEST* during the job processing, an error is reported, no new command is activated and the answer rejected by the current command!
- Error handling
  - The block has 2 error outputs for displaying errors during order processing. ERROR indicates the error and ERROR_ID shows an additional error number.
  - The outputs *DONE* and *READ_LENGTH* designates a successful command execution and are not set when *ERROR* becomes TRUE.

- Behavior of the *DONE* output
  - The *DONE* output is set, when a command was successfully executed.
- Behavior of the *BUSY* output
  - The *BUSY* output indicates that the function block is active.
  - Busy is immediately set with edge 0-1 of *REQUEST* and will not be reset until the job was completed successfully or failed.
  - As long as *BUSY* is TRUE, the function block must be called cyclically to execute the command.

If there is again an edge 0-1 at REQUEST during the job processing, an error is reported, no new command is activated and the answer rejected by the current command!

ERROR_ID

ERROR_ID	Description
0x0000	There is no Error
0x8070	Faulty parameter *MODE*
0x8071	Faulty parameter *COMMAND*
0x8072	Parameter *WRITE_LENGTH* exceeds the maximum size
0x8073	Parameter *CHANNEL_IN* does not fit the parameter *MODE*
0x8074	Parameter *CHANNEL_OUT* does not fit the parameter *MODE*
0x8075	Impermissible command (edge 0-1 at *REQUEST* during job is executed)
0x8081	Error - read access - data do not exist Command rejected!
0x8091	Error - write access - data do not exist Command rejected!
0x8092	Error - write access - data out of range Command rejected!
0x8093	Error - write access - data can only be read Command rejected!
0x8094	Error - write access - data are write protected Command rejected!
0x8099	Error during acyclic communication Command rejected!

Program code

If no job is active, all output parameters must be set to 0 (Command = IDLE). With an edge 0-1 at *REQUEST*, with the following approach a job is activated:

1. Check if a job is already active, if necessary terminate job and output error.
   ⇨ Wait until Status = IDLE

2. Check input parameters:
   - MODE
   - COMMAND
   - WRITE_LENGTH
   - CHANNEL_IN
   - CHANNEL_OUT

   ⇨ Terminate job on error, otherwise continue with step 3.
3. Save input parameters internally.
4. Execute the desired command and wait until this has been carried out.
5. Save and output the result of the command execution internally.
6. Set the command to IDLE again.

4.12 Parameter data

Here via the parameters you may define among others:

- Interrupt behavior
- Universal parameter

4.12.1 Parameter

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT with Index 3100h + EtherCAT-Slot

More can be found in the according manual of your bus coupler.

Name	Bytes	Function	Default	DS	IX	SX
DIAG_EN	1	Diagnostic interrupt *	00h	00h	3100h	01h
IDX_1	2	Universal parameter 1: Index	00h	80h	3101h... 3102h	02h
SUBIDX_1	2	Universal parameter 1: Sub-index	00h	80h	3103h... 3104h	03h
DATA_1	4	Universal parameter 1: Value	00h	80h	3105h... 3108h	04h
IDX_2	2	Universal parameter 2: Index	00h	81h	3109h... 310Ah	05h
SUBIDX_2	2	Universal parameter 2: Sub-index	00h	81h	310Bh... 310Ch	06h
DATA_2	4	Universal parameter 2: Value	00h	81h	310Dh... 3110h	07h
IDX_3	2	Universal parameter 3: Index	00h	82h	3111h... 3112h	08h
SUBIDX_3	2	Universal parameter 3: Sub-index	00h	82h	3113h... 3114h	09h

Name	Bytes	Function	Default	DS	IX	SX
DATA_3	4	Universal parameter 3: Value	00h	82h	3115h... 3118h	0Ah
IDX_4	2	Universal parameter 4: Index	00h	83h	3119h... 311Ah	0Bh
SUBIDX_4	2	Universal parameter 4: Sub-index	00h	83h	311Bh... 311Ch	0Ch
DATA_4	4	Universal parameter 4: Value	00h	83h	311Dh... 3120h	0Dh
IDX_5	2	Universal parameter 5: Index	00h	84h	3121h... 3122h	0Eh
SUBIDX_5	2	Universal parameter 5: Sub-index	00h	84h	3123h... 3124h	0Fh
DATA_5	4	Universal parameter 5: Value	00h	84h	3125h... 3128h	10h
IDX_6	2	Universal parameter 6: Index	00h	85h	3129h... 312Ah	11h
SUBIDX_6	2	Universal parameter 6: Sub-index	00h	85h	312Bh... 312Ch	12h
DATA_6	4	Universal parameter 6: Value	00h	85h	312Dh... 3130h	13h
IDX_7	2	Universal parameter 7: Index	00h	86h	3131h... 3132h	14h
SUBIDX_7	2	Universal parameter 7: Sub-index	00h	86h	3133h... 3134h	15h
DATA_7	4	Universal parameter 7: Value	00h	86h	3135h... 3138h	16h

*) This record set may only be transferred at STOP state.

4.12.2 FB 321 - ACYC_DS - Acyclic parametrization System SLIO motion module

Description

With this block you can parametrize you motion module motion module by means of your user program. Here you can store your parameters as *Object list* in a data block an transfer them via the acyclic communication channel in your motion module

Due to the blocks FB 320 and FB 321 access the same data base, for each channel (if multichannel) you can use only one of these blocks in your user program! Also this block must be called per cycle only once!

Parameter

Parameter	Declaration	Data type	Description
REQUEST	IN	BOOL	The job is started with edge 0-1.
MODE	IN	BYTE	Enter 0x01 for the acyclic protocol.

Parameter	Declaration	Data type	Description
READ_BACK	IN	BOOL	0: Written objects are not read back. 1: Written objects are read back immediately after the write operation and compared.
GROUP	IN	WORD	0x01...0x7F: Selection of a group in the object list. 0xFF: Section of all the objects in the object list.
OBJECT_DATA	IN	ANY	Pointer to the object list.
CHANNEL_IN	IN	ANY	Pointer to the beginning of the input data of the *Acyclic channel* of the motion module. *Chapter 4.10 'In-/Output area' on page 74*
CHANNEL_OUT	IN	ANY	Pointer to the beginning of the output data of the *Acyclic channel* of the motion module. *Chapter 4.10 'In-/Output area' on page 74*
DONE	OUT	BOOL	1: Job has been executed without error.
BUSY	OUT	BOOL	0: There is no job being executed. 1: Job is currently being executed.
DATASET_INDEX	OUT	INT	Object that is currently being processed.
ERROR	OUT	BOOL	0: No Error 1: There is an error. The cause of the error is shown on the *ERROR_ID* parameter.
ERROR_ID	OUT	WORD	Detailed error information

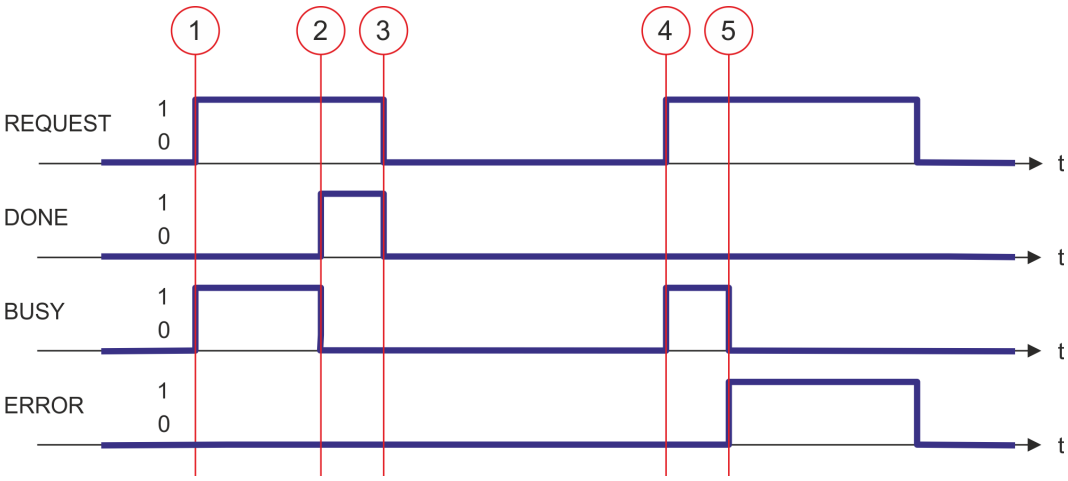
Behavior of the block parameters

- Exclusiveness of the outputs:
  - The outputs *BUSY*, *DONE* and *ERROR* are mutually exclusive. There can only one of these outputs be TRUE at the same time.
  - As soon as the input *REQUEST* is TRUE, one of the outputs must be TRUE.
- Output status
  - The outputs *DONE, ERROR, ERROR_ID* and *DATASET_INDEX* are reset by an edge 1-0 at the input *REQUEST*, when the job is finished.
  - If *REQUEST* is already reset during job processing, so it is guaranteed that the whole object list is processed.
  - At the end of the job with no error, *DONE* is set for one PLC cycle. Only then the outputs are reset.
- Input parameter
  - The input parameters are taken with edge 0-1 at *REQUEST*. To change parameters, you have to trigger the job again.
  - If there is again an edge 0-1 at *REQUEST* during the job, an error is reported (invalid command sequence) and the processing of the object list is finished.
- Input parameter *READ_BACK*
  - With activated parameter *READ_BACK* written objects are read back immediately after the write operation by a read job.
  - The written an read values are compared.
    If they are identical, the next object is handled
    If they are not identical, an error message (*ERROR ID* = 0x8079) is returned and the development of the object list is finished.

- Input parameter *GROUP*
  - For a better structure you can assign a group to each object.
  - Via *GROUP* you define the group whose parameters are to be transferred.
    0x01...0x7F: Transfer the objects of the selected group.
    0xFF: Transfer the objects of all the groups.
- Error handling
  - The block has error outputs to show errors during job processing. *ERROR* indicates the error, *ERROR_ID* shows an additional error number and *DATASET_INDEX* informs at which object the error occurred.
  - The output *DONE* designates a successful job execution and is not set when ERROR becomes TRUE.
- Behavior of the *DONE* output
  - The *DONE* output is set, when a command was successfully executed.
- Behavior of the *BUSY* output
  - The *BUSY* output indicates that the function block is active.
  - *BUSY* is immediately set with edge 0-1 of *REQUEST* and will not be reset until the job was completed successfully or failed.
  - As long as *BUSY* is TRUE, the function block must be called cyclically to execute the command.
- Behavior of the *DATASET_INDEX* output
  - The *DATASET_INDEX* output indicates, which object of the object list is currently being processed.
  - If there is no job active, *DATASET_INDEX* = 0 is returned.
  - If there is an error during the object processing, *DATASET_INDEX* shows the faulting object.

If there is again an edge 0-1 at REQUEST during the job processing, an error is reported (ERROR_ID = 0x8075), no new command is activated and the answer rejected by the current command!

Status diagram



(1) The job is started with edge 0-1 at *REQUEST* and *BUSY* becomes TRUE.
(2) At the time (2) the job is completed. *BUSY* has the value FALSE and *DONE* den value TRUE.
(3) At the time (3) the job is completed and *REQUEST* becomes FALSE and thus each output parameter FALSE respectively 0.
(4) At the time (4) with an edge 0-1 at *REQUEST* the job is started again and *BUSY* becomes TRUE.
(5) At the time (5) an error occurs during the job. *BUSY* has the value FALSE and *ERROR* den value TRUE.

ERROR_ID

ERROR_ID	Description
0x0000	There is no Error
0x8070	Faulty parameter *MODE*
0x8071	Faulty parameter *OBJECT_DATA*
0x8075	Invalid command (edge 0-1 at *REQUEST* during job is executed)
0x8078	Faulty parameter *GROUP*
0x8079	*READ_BACK* detects an error (written and read value unequal)
0x807A	Pointer at *OBJECT_DATA* not valid

Within the function block the FB 320 is called. Here, any error of the FB 320 is passed to the FB 321. ↳ *'ERROR_ID' on page 79*

4.12.2.1 UDT - ACYC_OBJECT-DATA

Data structure for the object list

The parameters are to be stored in a data block as *object list*, which consists of individual *objects*. The structure of an *objects* is defined via an UDT.

Structure of an object

Variable	Declaration	Data type	Description
Group	IN	WORD	0 < *Group* < 0x80 permitted
COMMAND	IN	BYTE	0x11 = Read from the object list 0x21 = Write to the object list
Index	IN	WORD	Index of the object
Subindex	IN	BYTE	Subindex of the object
Write_Length	IN	BYTE	Length of the data to be written in byte
Data_Write	IN	DWORD	Data to be written.
Data_Read	OUT	DWORD	Read data
State	OUT	BYTE	0x00 = never processed 0x01 = *BUSY* - in progress 0x02 = *DONE* - successfully processed 0x80 = *ERROR* - an error has occurred during the processing

Please note that you always specify the appropriate length for the object during a write job! ↳ *Chapter 5.2.1 'Overview' on page 98*

Example DB

Addr.	Name	Type	Start value	Current value	Comment
0.0	Object(1).Group	WORD			1. Object
2.0	Object(1).Command	BYTE			
4.0	Object(1).Index	WORD			
6.0	Object(1).Subindex	BYTE			
7.0	Object(1).Write_Length	BYTE			
8.0	Object(1).Data_Write	DWORD			
12.0	Object(1).Data_Read	DWORD			
16.0	Object(1).State	BYTE			
18.0	Object(2).Group	WORD			2. Object
...	...	...			
34.0	Object(2).State	BYTE			
36.0	Object(3).Group	WORD			3. Object
...	...	...			
52.0	Object(3).State	BYTE			
...	...	...			...

4.13 Scaling and units

Scaling and units

- As a "normalization" for position, velocity and acceleration, you can specify a *Gear factor* ↬ *'0x8180-02 - Gear factor' on page 116* in the object dictionary. This gear factor represents *units* in thousands with the rotary axis makes exactly one revolution.
- With the pulse train module the "normalization" should be the same as the "normalization" of the power stage.
- Depending on the "normalization" and the set frequency pattern the motion module sends pulses to the power stage.

Direction of rotation

Positive direction of rotation is turning to the right (clockwise) with view towards the motor flange.

Current unit

- All currents are normalized to the unit [mA].
- [User] is a user-defined unit, which depends on the *Gear factor*. ↬ *'0x8180-02 - Gear factor' on page 116*

4.14 Monitoring and error reaction

4.14.1 Overview

General

The System SLIO motion module has monitor functions. The monitoring works in 3 steps:

- 1. Limitation
  - Status: *'0x8100-04 - Limit active bits' on page 113*
  - Limitations within the normal operating range, adapted to the respective application.
- 2. Warning
  - Status: *'0x8100-05 - Warnings active bits' on page 114*
  - The permissible operating range is almost exhausted and the system is about to initiate a fault response.
- 3. Error
  - Status: *'0x8100-06 - Error active bits' on page 115*
  - The permissible operating range is exceeded and a configurable fault response is automatically triggered.
  - Error messages are also shown via *'0x8100-02 - Status word' on page 111*.

CAUTION!
Please consider that incorrectly set monitoring functions can cause damages to persons and materials!

Voltage monitoring

The DC 24V voltage of the module supply is monitored. If the voltage over or under runs the limit values, a warning or error is reported by *'0x8100-02 - Status word' on page 111*. On an error, there is an error reaction of the motion module, which can be configured.

Temperature monitoring

The motion module has an internal temperature monitoring of the µ-controller. Via the object dictionary limit temperatures can be defined. If the temperature over or under runs the limit values, there is an error reaction of the motion module, which can be configured. *'0x8780-02 - Temperature µ-Controller actual value' on page 131*

Position monitoring

The motion module monitors the traversing of a positioning. When specifying a target position, with exceeding a configurable limit in positive or negative direction of movement, the target position changed to a limit value. You will get a feedback on an active limitation via *'0x8100-02 - Status word' on page 111*. Exceeds the actual position one of the configurable values in positive or negative direction of movement, this is also reported via *'0x8100-02 - Status word' on page 111*. The module monitors the internally generated position set point and actual value.

Velocity monitoring

The motion module monitors the velocity. The set velocity is limited to a configurable value and with active limitation reported via *'0x8100-02 - Status word' on page 111*.

Error reaction

The following errors can trigger an error reaction:

- Temperature error µ-Controller
  ‘0x8780-02 - Temperature µ-Controller actual value’ on page 131 **>** *‘0x8780-04 - Temperature µ-Controller error level’ on page 132*
- Error system communication timeout
  ‘0x6100-10 - System message timeout maximum’ on page 104
- Error command output disable (BASP)

On error, the motion module starts an error reaction. The error reaction can be configured. Here you have the following possibilities:

- Immediate state change to *‘Switch on disabled’*.
- Break with quick stop deceleration *‘0x8580-03 - Deceleration quick stop value’ on page 128* and subsequent state change to *‘Switch on disabled’*.

4.14.2 Monitoring

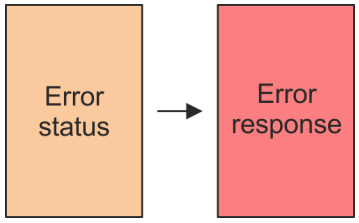
Monitoring limitation

‘0x8400-02 - Positioning profile target position’ on page 122 *‘0x8480-02 - Position actual value’ on page 123* *‘0x8480-05 - Software position limit positive direction’ on page 124* *‘0x8480-06 - Software position limit negative direction’ on page 124* *‘0x8400-03 - Positioning profile target velocity’ on page 122* *‘0x8500-04 - Velocity control limit positive direction’ on page 127* *‘0x8500-05 - Velocity control limit negative direction’ on page 127*	→	Monitoring Limitation	→	*‘0x8100-02 - Status word’ on page 111* *‘0x8100-04 - Limit active bits’ on page 113*

Monitoring warning

‘0x8680-02 - Power section supply voltage actual value’ on page 129 *‘0x8680-04 - Power section supply voltage min. warning level’ on page 129* *‘0x8680-05 - Power section supply voltage max. warning level’ on page 129* *‘0x8780-02 - Temperature µ-Controller actual value’ on page 131* *‘0x8780-03 - Temperature µ-Controller warning level’ on page 132* *‘0x8480-10 - Lag error’ on page 125*	→	Monitoring Warning	→	*‘0x8100-02 - Status word’ on page 111* *‘0x8100-05 - Warnings active bits’ on page 114*

Monitoring error



Error status - monitoring error

‘0x8680-02 - Power section supply voltage actual value’ on page 129	→	Error status Monitoring error	→	Error response Error reaction
‘0x8680-06 - Power section supply voltage min. error level’ on page 129				*‘0x8100-06 - Error active bits’ on page 115*
‘0x8680-07 - Power section supply voltage max. error level’ on page 130				
‘0x8780-02 - Temperature µ-Controller actual value’ on page 131				*‘0x8100-03 - Error code’ on page 112*
‘0x8780-04 - Temperature µ-Controller error level’ on page 132				
‘0x8480-10 - Lag error’ on page 125				
‘0x8500-02 - Velocity control actual value’ on page 126				*‘0x8100-02 - Status word’ on page 111*

Error response - error reaction

Error status Monitoring errors	→	Error response Configuration reaction	→	*‘0x8100-02 - Status word’ on page 111*
‘0x8200-05 - Configuration fault reaction’ on page 117				
‘0x8580-03 - Deceleration quick stop value’ on page 128				

4.15 Diagnostics and interrupt

Diagnostic data

Via the parametrization you may activate a diagnostic interrupt for the module. With a diagnostics interrupt the module serves for diagnostics data for diagnostic interrupt$_{incoming}$. As soon as the reason for releasing a diagnostic interrupt is no longer present, the diagnostic interrupt$_{going}$ automatically takes place. Within this time window (1. diagnostic interrupt$_{incoming}$ until last diagnostic interrupt$_{going}$) the MF-LED of the module is on.

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT with Index 5005h.

More can be found in the according manual of your bus coupler.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	18h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	reserved	00h			05h
CHTYP	1	Channel type	72h			06h
NUMBIT	1	Number diagnostics bits per channel	08h			07h
NUMCH	1	Number channels of the module	04h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error	00h			0Ah
CH1ERR	1	Channel-specific error	00h			0Bh
CH2ERR	1	Channel-specific error	00h			0Ch
CH3ERR	1	Channel-specific error	00h			0Dh
CH4ERR… CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker (32bit)	00h			13h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 6 ... 4: reserved ■ Bit 7: set at error in parametrization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: Module class – 1000b: Function module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 72h: Digital output ■ Bit 7: 0 (fix)

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR - Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set on error output I/O1 ■ Bit 1: set on error output I/O2 ■ Bit 2: set on error output I/O3 ■ Bit 3: set on error output I/O4 ■ Bit 7 ... 4: reserved

CH0ERR...CH3ERR channel specific

Byte	Bit 7 ... 0
0	Diagnostics interrupt due to ... ■ Bit 2 ... 0: reserved ■ Bit 3: Short circuit ■ Bit 7 ... 4: reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0 ... 3	Value µs ticker at the moment of the diagnostic

ERR_C/D, CH4ERR ... CH7ERR reserved

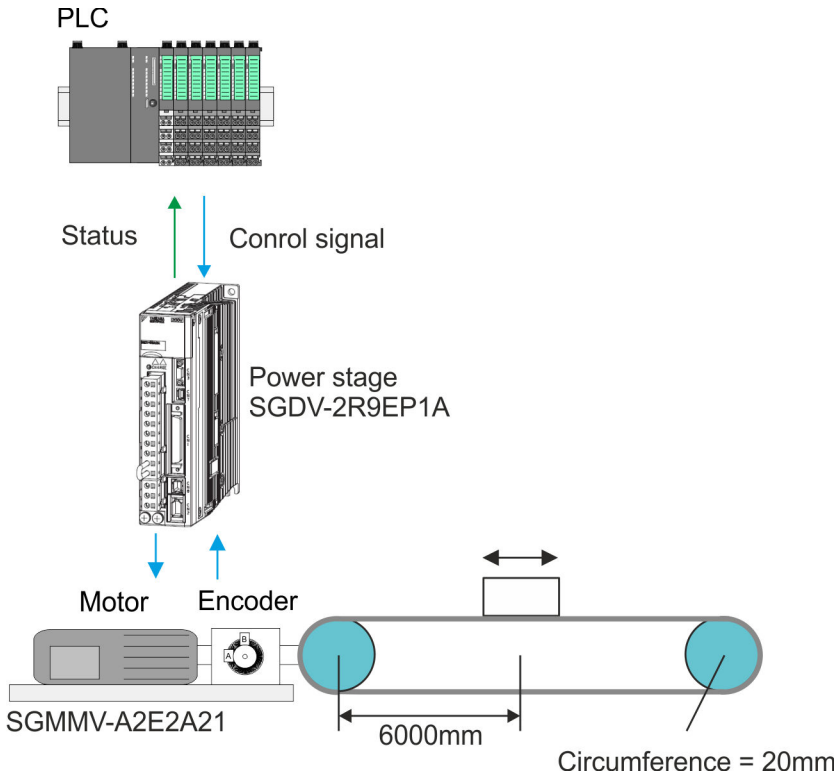
Byte	Bit 7 ... 0
0	reserved

4.16 Example: 054-1DA00 with YASKAWA Sigma 5 mini

4.16.1 Job definition

In the following there is an example of the commissioning of the System SLIO motion module 054-1DA00 with a YASKAWA Sigma 5 mini power stage (servopack). In the example the motor is to be coupled 1:1 to a disk, which has a circumference of 20mm and drives a belt. Thus with one rotation of the motor a small load, coupled by the belt, is moved about 20mm. For this the following drive components are required:

- YASKAWA power stage SGDV-2R9EP1A (pulse train reference with 17bit encoder)
- YASKAWA Servo drive SGMMV-A2E2A21 (6000 U/min)



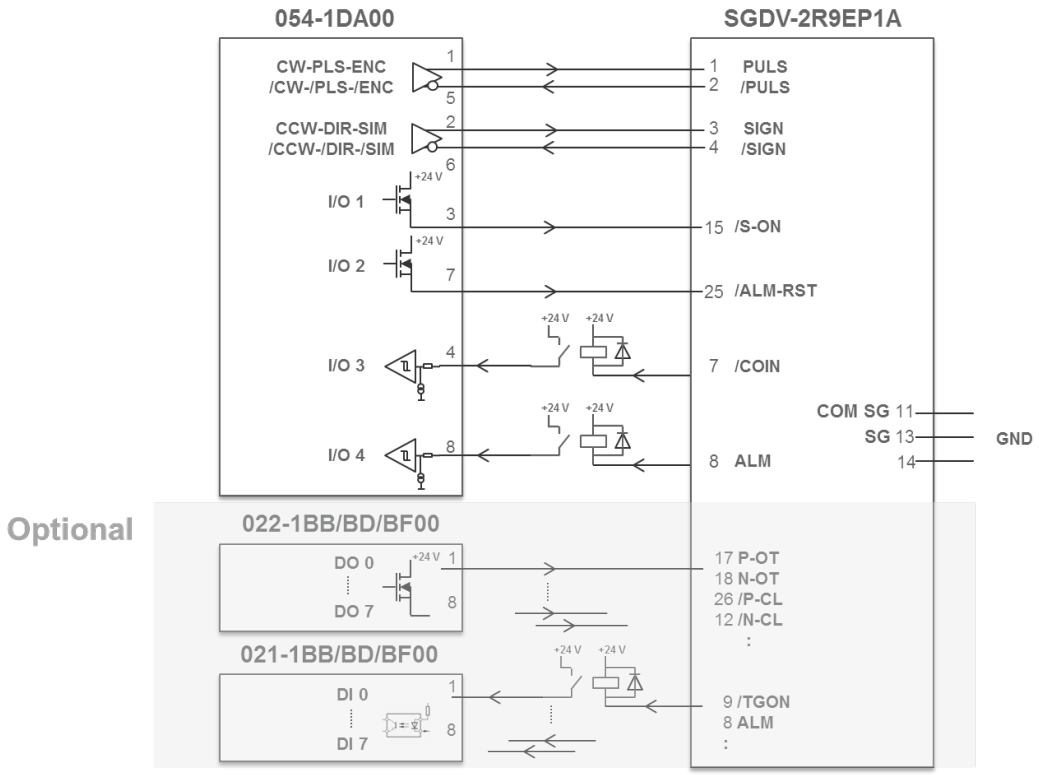
4.16.2 Wiring

Basic structure

- Perform the wiring of the servo components as specified in the YASKAWA manual.
- Please regard the requirements for the wiring of the System SLIO
  ↳ *Chapter 2.5 'Wiring periphery modules' on page 18*
  ↳ *'Connections' on page 46*

Connection power stage System SLIO

- Connect the power stage according to the following illustration to the System SLIO Motion module:



4.16.3 Commissioning of the power stage

Basic commissioning

- Perform the basic commissioning, configuration and optimization of the power stage according to the specifications in the YASKAWA manuals. For this the software SigmaWin+ from YASKAWA is required.

Configuration of the interface to the power stage for test operation

In the following the configuration of the interface to the power stage for test operation is described. First check whether this configuration is suitable for your application and does not cause any damages! Also consider the chapter trial operation in the YASKAWA manuals. Exemplary the interface between power stage and motion module is to be described as follows:

- Operating mode: Positioning
- Encoder resolution power stage: 17bit (131072 Encoder pulses / U)
- Pulse shape interface: Incremental encoder simulation (A/B) (freely chosen, other possible)
- The direct coupling between the motor shaft and belt pulley results in a 1:1 translation.
- The System SLIO motion module provides 40000 encoder pulses / revolution. Thus, the gear factor in the power stage results in: 131072 / 40000
- Controlling and evaluation of the signals /SO-N, /ALM-RST, COIN and ALM should directly take place via the System SLIO motion module.
- Set the following parameters in the power stage:

Parameter of the power stage

No.	Name	Value
Pn000	Basic Function Select Switch 0	0010H
1. digit	Direction Selection	0: Sets CCW as forward direction.
2. digit	Control Method Selection	1: Position control (pulse train reference)
3. digit	Reserved (Do not change.)	0: Reserved (Do not use.)
4. digit	Reserved (Do not change.)	0: Reserved (Do not use.)
Pn200	Position Control Reference Form Selection Switch	0014H
1. digit	Reference Pulse Form	4: Two-phase pulse train with 90° phase differential (phase A + phase B) ×4, positive logic.
2. digit	Clear Signal Form	1: Clears position error at the rising edge of the signal.
3. digit	Clear Operation	0: Clears position error at the baseblock (servomotor power OFF or alarm occurred).
4. digit	Filter Selection	0: Uses reference input filter 1 for line driver signal (to 1 Mpps).
Pn20E	Electronic Gear Ratio (Numerator)	131072 (17 Bit Encoder)
Pn210	Electronic Gear Ratio (Denominator)	40000 (units)
Pn50A	Input Signal Selection 1	x701H
1. digit	Input Signal Allocation Mode	1: Changes the sequence input signal allocation for each signal.
2. digit	Servo ON (/S-ON) Signal Mapping	0: Active when CN1-15 input signal is ON (L-level).
3. digit	/P-CON Signal Mapping	7: Always active (fixed).
4. digit	P-OT Signal Mapping	x: Application specific
Pn50B	Input Signal Selection 2	xx4xH
1. digit	N-OT Signal Mapping	x: Application specific
2. digit	/ALM-RST Signal Mapping	4: Active on the falling edge of CN1-25 input signal.
3. digit	/P-CL Signal Mapping	x: Application specific
4. digit	/N-CL Signal Mapping	x: Application specific
Pn50E	Output Signal Selection 1	3xx1H
1. digit	Positioning Completion Signal Mapping (/COIN)	1: Outputs the signal from CN1-7 output terminal.
2. digit	Speed Coincidence Detection Signal Mapping (/V-CMP)	x: Application specific
3. digit	Servomotor Rotation Detection Signal Mapping (/TGON)	x: Application specific
4. digit	Servo Ready Signal Mapping (/S-RDY)	x: Application specific

4.16.4 Configuration of the System SLIO motion module

Parameters for the operation

Operating mode:	Positioning
Pulse shape:	Incremental encoder simulation (A/B), suitable to the setting of the power stage
Coupling motion module to power stage:	1:1
User unit:	0.01mm
Traverse due to the mechanics:	$20\frac{mm}{r}$ with r: revolutions
→	2000 units ≙ Traverse path of 20mm
Position limits:	±6000mm
→	$\frac{\pm 6000mm}{0.01mm} \mathrel{\hat{=}} \pm 600000units$
Max. Motor speed:	$\pm 6000\frac{r}{min} = \pm 100\frac{r}{s} \mathrel{\hat{=}} \pm 2000\frac{mm}{s}$
→	$\frac{\pm 2000\frac{mm}{s}}{0.01mm} \mathrel{\hat{=}} 200000\frac{units}{s}$
Required max. Acceleration:	$100\frac{mm}{s^2}$
→	$\frac{100\frac{mm}{s^2}}{0.01mm} \mathrel{\hat{=}} 10000\frac{units}{s^2}$
Required max. Deceleration:	$200\frac{mm}{s^2}$
→	$\frac{200\frac{mm}{s^2}}{0.01mm} \mathrel{\hat{=}} 20000\frac{units}{s^2}$
Specific I/O signals of the power stage:	Controlling and evaluation is done via the System SLIO motion module

4.16.5 Setting of the objects

According to the operation, the following object of the motion module are to be set. The initial setting can be done via up to 7 module parameters. After the module start-up the other objects are to be transmitted via the *Acyclic channel*.

Objects

Index-subindex	Value
‘0x8180-02 - Gear factor’ on page 116	2000000 (2000 units * 1000)
‘0x8480-05 - Software position limit positive direction’ on page 124	600000
‘0x8480-06 - Software position limit negative direction’ on page 124	-600000
‘0x8500-04 - Velocity control limit positive direction’ on page 127	200000
‘0x8500-05 - Velocity control limit negative direction’ on page 127	-200000
I/O2 *‘0x7100-01...04 - Digital input configuration I/O1...I/O4’ on page 105*	0 (I/O2 is used as output)
I/O2 *‘0x7200-01...04 - Digital output configuration I/O1...I/O4’ on page 107*	1 (I/O2 is activated)
I/O3 *‘0x7200-01...04 - Digital output configuration I/O1...I/O4’ on page 107*	0 (I/O3 is de-activated)
I/O4 *‘0x7200-01...04 - Digital output configuration I/O1...I/O4’ on page 107*	0 (I/O4 is de-activated)
‘0x8E00-01 - Pulse train configuration’ on page 133	3 (incremental encoder simulation (A/B))
‘0x8E00-09 - Pulse train Servo-On digital output active polarity I/O1…I/O4’ on page 135	1 (Low level with activated DO)
‘0x8E00-08 - Pulse train Servo-On digital output I/O1…I/O4’ on page 135	1 (assigned to I/O1)
‘0x8E00-11 - Pulse train Alarm-Reset digital output active polarity I/O1…I/O4’ on page 136	1 (Low level with activated DO)
‘0x8E00-10 - Pulse train Alarm-Reset digital output I/O1…I/O4’ on page 135	2 (assigned to I/O2)
‘0x8E00-13 - Pulse train In-Position digital input active polarity I/O1…I/O4’ on page 136	1 (low level with activated DI)
‘0x8E00-12 - Pulse train In-Position digital input I/O1…I/O4’ on page 136	3 (assigned to I/O3)
‘0x8E00-14 - Pulse train Alarm digital input I/O1…I/O4’ on page 137	4 (assigned to I/O4)
‘0x8E00-15 - Pulse train Alarm digital input active polarity I/O1…I/O4’ on page 137	0 (high level with activated DI)

4.16.6 Test operation

Proceeding

The System SLIO motion module and the power stage are now ready for a test operation. The system can be controlled via the cyclic data and the state machine.

↳ *Chapter 4.10 'In-/Output area' on page 74*

↳ *Chapter 4.4.2 'States' on page 49*

1. Reset a previously encountered possible error with ↳ *'0x8100-01 - Control word' on page 110*.
2. Switch the motion module to the status *Operation enabled* by means of ↳ *'0x8100-01 - Control word' on page 110*.
3. Check in ↳ *'0x8100-02 - Status word' on page 111* the individual responded status and switch to the next status only if the responded status corresponds to the expected status. ↳ *Chapter 4.4.2 'States' on page 49*
4. In the status *Operation enabled* you can now specify additional setpoints like *Target position*, *Velocity*, *Acceleration* and *deceleration*.

5 Object dictionary

5.1 Use

Addressing

The System SLIO motion module provides its data, such as "Profiling target position" via an object dictionary. In this object dictionary the objects are organized and addressable a unique number consisting of *Index* and *Subindex*. The number is specified as follows:

0x	Index (hexadecimal)	-	Subindex (decimal)
Example: 0x8400-03			

To improve the structure and for expansion at System SLIO Motion Module another object numbering (index-assignment) is used besides the standard CiA 402.

Index area

By separating into index and subindex a grouping is possible. The individual areas are divided into groups of related objects. With the System SLIO motion module this object directory is structured as follows:

Index area	Content
0x1000 up to 0x6FFF	General data and system data
0x7000 up to 0x7FFF	Data of the digital input and output part
0x8000 up to 0x8FFF	Data of the axis

Each object has a subindex 0. Calling an object with subindex 0, the number of available subindexes of the corresponding object is returned.

Accessing the object dictionary

The communication takes place via the I/O area. The main data of the object dictionary are mapped into the I/O area. ↳ *Chapter 4.10 'In-/Output area' on page 74*

Included in the mapping is also the *Acyclic Channel* through which you can acyclically access the objects of the motion module. With the acyclic access, any access to the object dictionary is acknowledged by the motion module. ↳ *Chapter 4.11 'Acyclic channel' on page 76*

The mapping cannot be changed.

Please note if you write via the Acyclic Channel to objects, which are mapped in the I/O area, these values are overwritten with the next cycle.

5.2 Objects

5.2.1 Overview

Explanation of the elements

Explanation of the elements

Index-Sub	-	Index and subindex
Sx	-	Data type SIGNEDx
Ux	-	Data type UNSIGNEDx
RW	-	Read- write access
[degC]	-	Temperature in degree celsius (°C)
[inc]	-	Increment - pulse of an encoder *Chapter 4.8.2.1 'Encoder - signal evaluation' on page 72*
[User]	-	The unit [User] is a user defined unit, which can be set via *'0x8180-02 - Gear factor' on page 116*.
*	-	Object, which is mapped in the *Chapter 4.10 'In-/Output area' on page 74*. If you write via the *Acyclic Channel* to this object, the value is overwritten with the next cycle.
**	-	Object, which can be written in all states of the state machine. Otherwise objects can only be written in the state *'Switch on disabled'*. *'Accessing the state machine' on page 50* *Chapter 5.2.3 'Passwords and security - 0x1100' on page 103*

Available objects

‘0x8780-02 - Temperature µ-Controller actual value’ on page 131
‘0x8780-03 - Temperature µ-Controller warning level’ on page 132
‘0x8780-04 - Temperature µ-Controller error level’ on page 132
‘0x8780-05 - Temperature µ-Controller offset’ on page 132
‘0x8780-06 - Temperature µ-Controller gain’ on page 132
‘0x8E00-00 - Pulse train parameter - number of entries’ on page 132
‘0x8E00-01 - Pulse train configuration’ on page 133
‘0x8E00-02 - Pulse train pulses per revolution’ on page 134
‘0x8E00-03 - Pulse train set frequency’ on page 134
‘0x8E00-04 - Pulse train max. frequency’ on page 134
‘0x8E00-08 - Pulse train Servo-On digital output I/O1…I/O4’ on page 135
‘0x8E00-09 - Pulse train Servo-On digital output active polarity I/O1…I/O4’ on page 135
‘0x8E00-10 - Pulse train Alarm-Reset digital output I/O1…I/O4’ on page 135
‘0x8E00-11 - Pulse train Alarm-Reset digital output active polarity I/O1…I/O4’ on page 136
‘0x8E00-12 - Pulse train In-Position digital input I/O1…I/O4’ on page 136
‘0x8E00-13 - Pulse train In-Position digital input active polarity I/O1…I/O4’ on page 136
‘0x8E00-14 - Pulse train Alarm digital input I/O1…I/O4’ on page 137
‘0x8E00-15 - Pulse train Alarm digital input active polarity I/O1…I/O4’ on page 137
‘0x8F00-00 - Encoder - number of entries’ on page 137
‘0x8F00-01 - Encoder Feedback configuration’ on page 138
‘0x8F00-02 - Encoder actual value’ on page 138

5.2.2 Information about the product - 0x1000...0x1018

0x1000-00 - Device type

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x1000-00	U32	R	0	0 … 0xFFFFFFFF		Device type

‘Explanation of the elements’ on page 98

Here according to CiA 402 the device type is shown.

MSB			LSB
31 … 24	23 … 16	15 … 0	
Additional information		Device profile number	
Mode bit = 0x00	Type = 0x00	0x0192	

0x1008-00 - Manufacturer device name

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x1008-00	U32	R	0	0 … 0xFFFFFFFF		Manufacturer device name

‘Explanation of the elements’ on page 98

Here you can find the name of the motion module ASCII coded: 0x50544D31: *‘PTM1’*

0x100A-00 - Manufacturer software version

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x100A-00	U32	R	0	0 … 0xFFFFFFFF		Manufacturer software version

‘Explanation of the elements’ on page 98

Here you can find the software version of the motion module 8bit coded e.g. 0x01050300: V1.5.3.0

0x1018-00 - Product - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x1018-00	U08	R	5	5		Product - number of entries

‘Explanation of the elements’ on page 98

0x1018-02 - Product ID

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x1018-02	U32	R	0	0 … 0xFFFFFFFF		Product ID

‘Explanation of the elements’ on page 98

Here according to CiA 402 the product ID of the motion module can be found: 0x534C494F

0x1018-03 - Revision number

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x1018-03	U32	R	0	0 … 0xFFFFFFFF		Revision number

‘Explanation of the elements’ on page 98

Here according to CiA 402 the revision number of the module can be found. Currently this object is not used and returns 0.

0x1018-04 - Serial number

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x1018-04	U32	R	0	0 … 0xFFFFFFFF		Serial number
'Explanation of the elements' on page 98						

Here according to CiA 402 the serial number of the module can be found. Currently this object is not used and returns 0.

0x1018-05 - Module category

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x1018-05	U32	R	0	0 … 200		Module category
'Explanation of the elements' on page 98						

Here according to CiA 402 you can find the module category of the motion module: 0x41: PTM

5.2.3 Passwords and security - 0x1100

0x1100-00 - Passwords and security - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x1100-00	U08	R	2	2		Passwords and security - number of entries
'Explanation of the elements' on page 98						

0x1100-01 - User password

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x1100-01	U32	R/W**	0	0 … 0xFFFFFFFF		User password
'Explanation of the elements' on page 98						

With this object you can enable a password, which allows to write objects in all states of the state machine. Otherwise objects can only be written in the state *'Switch on disabled'*. Password: 0xABCDABCD *'Accessing the state machine' on page 50*

5.2.4 System command - 0x6100

0x6100-00 - System command - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x6100-00	U08	R	17	17		System command - number of entries
'Explanation of the elements' on page 98						

0x6100-10 - System message timeout maximum

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x6100-10	U32	R/W	0	0 … 0xFFFFFFFF	[mS]	System message timeout maximum

'Explanation of the elements' on page 98

With this object, you can enable the monitoring of the cyclic communication to the System SLIO bus and thus to the fieldbus. If there is no communication within the specified time in ms, the motion module enters the error state. Should the application require a cyclic communication with the motion module but the monitoring of the cycle can not be ensured on the side of the fieldbus coupler or CPU, by means of this object a monitoring time should be entered. By default, no monitoring is active.

5.2.5 Digital inputs I/O1...I/O4 - 0x7100

0x7100-00 - Digital inputs - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x7100-00	U08	R	7	7		Digital inputs - number of entries

'Explanation of the elements' on page 98

Chapter 4.8 'Deployment I/O1...I/O4' on page 70

0x7100-01...04 - Digital input configuration I/O1...I/O4

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x7100-01	U08	R/W**	1	0 … 1		Digital input configuration I/O1
0x7100-02	U08	R/W**	1	0 … 1		Digital input configuration I/O2
0x7100-03	U08	R/W**	1	0 … 1		Digital input configuration I/O3
0x7100-04	U08	R/W**	1	0 … 1		Digital input configuration I/O4

'Explanation of the elements' on page 98

With these objects, the four digital inputs/outputs I/O1...I/O4 are configured as inputs.

- 0: The I/Ox is used as digital output
  - DC 24V
  - 500 mA
  - High-side (source)
- 1: The I/Ox is used as digital input
  - DC 24V
  - IEC 61131-2 Typ 3
  - High-side (sink)
- The inputs can always be read, so its configuration is independent of the configuration as outputs (object 0x7200-01 ... -04).
- If a digital input/output is defined as output via object 0x7200, it can be read via the cyclic data *Status DO*. It is the really pending state at the digital driver part and not set point value, generated by the cyclic data *Status DI* or system.
- If a digital input/output is used by the system (set by object 0x8300 or 0x8E00), this also can be read via the cyclic data *Status DI*.

0x7100-05 - Digital input states I/O1...I/O4

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x7100-05*	U08	R	0	0 … 0xFF		Digital input states I/O1...I/O4

'Explanation of the elements' on page 98

This object contains the current values of the digital inputs I/O1...I/O4. They also can be found in the I/O area.

Please note if you write via the Acyclic Channel to objects, which are mapped in the I/O area, these values are overwritten with the next cycle.

Bit 3 ... 0

3	2	1	0	Description
x	x	x	0	Input I/O1 has signal "0"
x	x	x	1	Input I/O1 has signal "1"
x	x	0	x	Input I/O2 has signal "0"
x	x	1	x	Input I/O2 has signal "1"
x	0	x	x	Input I/O3 has signal "0"
x	1	x	x	Input I/O3 has signal "1"
0	x	x	x	Input I/O4 has signal "0"
1	x	x	x	Input I/O4 has signal "1"

5.2.6 Digital output I/O1...I/O4 - 0x7200

0x7200-00 - Digital outputs - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x7200-00	U08	R	8	8		Digital outputs - number of entries

'Explanation of the elements' on page 98
Chapter 4.8 'Deployment I/O1...I/O4' on page 70

0x7200-01...04 - Digital output configuration I/O1...I/O4

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x7200-01	U08	R/W**	0	0 … 1		Digital output configuration I/O1
0x7200-02	U08	R/W**	0	0 … 1		Digital output configuration I/O2
0x7200-03	U08	R/W**	0	0 … 1		Digital output configuration I/O3
0x7200-04	U08	R/W**	0	0 … 1		Digital output configuration I/O4

↳ *'Explanation of the elements' on page 98*

With these objects, the four digital inputs/outputs I/O1...I/O4 are configured as outputs. If a digital input/output is defined as output, it can be read via the cyclic data. This is the really pending state at the digital driver part.

Value	Description
0	The output is de-activated.
1	The output is activated and can be controlled by the cyclic data ↳ *'0x7200-06 - Digital output states I/O1...I/O4 requested states' on page 109*.

0x7200-05 - Digital output states I/O1...I/O4 actual states

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x7200-05*	U08	R	0	0 … 0xFF		Digital output states I/O1...I/O4 actual states

'Explanation of the elements' on page 98

This object contains the current values of the digital outputs. They also can be found in the I/O area.

Please note if you write via the Acyclic Channel to objects, which are mapped in the I/O area, these values are overwritten with the next cycle.

Bit 3 ... 0

3	2	1	0	Description
x	x	x	0	I/O1 has signal "0"
x	x	x	1	I/O1 has signal "1"
x	x	0	x	I/O2 has signal "0"
x	x	1	x	I/O2 has signal "1"
x	0	x	x	I/O3 has signal "0"
x	1	x	x	I/O3 has signal "1"
0	x	x	x	I/O4 has signal "0"
1	x	x	x	I/O4 has signal "1"

0x7200-06 - Digital output states I/O1...I/O4 requested states

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x7200-06*	U08	R/W**	0	0 … 0xFF		Digital output states I/O1...I/O4 requested states

'Explanation of the elements' on page 98

This object contains the set values of the digital outputs I/O1...I/O4. They also can be found in cyclic data in the I/O area.

Please note if you write via the Acyclic Channel to objects, which are mapped in the I/O area, these values are overwritten with the next cycle.

Bit 3 ... 0

3	2	1	0	Description
x	x	x	0	Output I/O1 has signal "0"
x	x	x	1	Output I/O1 has signal "1"
x	x	0	x	Output I/O2 has signal "0"
x	x	1	x	Output I/O2 has signal "1"
x	0	x	x	Output I/O3 has signal "0"
x	1	x	x	Output I/O3 has signal "1"
0	x	x	x	Output I/O4 has signal "0"
1	x	x	x	Output I/O4 has signal "1"

5.2.7 Control drive - 0x8100

0x8100-00 - Control drive - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8100-00	U08	R	6	6		Control drive - number of entries

'Explanation of the elements' on page 98

In this module, the state machine emulates the states of the connected power stage. It does not represent its current states. Only by adjusting the DIO signals on the signals of the power stage as e.g. S-ON, ALM-RST, S-RDY and COIN, you can control its states.

Chapter 4.8 'Deployment I/O1...I/O4' on page 70

0x8100-01 - Control word

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8100-01*	U16	R/W**	0	0 … 65535		Control word

↳ *'Explanation of the elements' on page 98*
↳ *Chapter 4.4.2 'States' on page 49*

With the *Control word* you can change the current state of the motor controller respectively reset all the error bits.

Bit 3 ... 0 - Control drive state

3	2	1	0	Description
x	1	1	0	Shutdown
0	1	1	1	Switch on
1	1	1	1	Switch on and enable operation
x	x	0	x	Disable voltage
0	1	1	1	Disable operation
1	1	1	1	Enable operation
x	0	1	x	Quick stop

Bit 15 ... 4 - Reset error bits

15...8	7	6	Description
reserved	0→1	reserved	Edge 0-1 resets all error bits in ↳ *'0x8100-06 - Error active bits' on page 115*.

0x8100-02 - Status word

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8100-02*	U16	R	0	0 … 65535		Status word

‘Explanation of the elements’ on page 98
Chapter 4.4.2 ‘States’ on page 49

Please consider that the data bits are not latched and may need to be temporarily stored for further processing!

Bit 7 ... 0 - Control drive state

7	6	5	4	3	2	1	0	Description
x	0	x	x	0	0	0	0	State *‘Not ready to switch on’*
x	1	x	x	0	0	0	0	State *‘Switch on disabled’*
x	0	1	x	0	0	0	1	State *‘Ready to switch on’*
x	0	1	x	0	0	1	1	State *‘Switched on’*
x	0	1	x	0	1	1	1	State *‘Operation enabled’*
x	0	0	x	0	1	1	1	State *‘Quick stop active’*
x	0	x	x	1	1	1	1	State *‘Fault reaction active’*
x	0	x	x	1	0	0	0	State *‘Error’* ‘0x8100-03 - Error code’ on page 112
1	x	x	x	x	x	x	x	A warning has occurred ‘0x8100-05 - Warnings active bits’ on page 114

Bit 15 ... 8 - Operating mode state

15	14	13	12	11	10	9	8	Description
x	x	x	x	x	0	x	x	Target position not reached (axis is stopped)
x	x	x	x	x	1	x	x	Target position reached (axis velocity = 0)
x	x	x	x	0	x	x	x	There is no internal limitation
x	x	x	x	1	x	x	x	There is an internal limitation The type of limitation depends on the operating mode.

0x8100-03 - Error code

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8100-03	U16	R	0	0 … 65535		Error code
↳ *'Explanation of the elements' on page 98*						

This object shows the most recent error code, which has occurred in the System SLIO motion module. A group message can be obtained from bit 3 in ↳ *'0x8100-02 - Status word' on page 111*. There are the following error messages:

Error

Code	Description
0x3210	Power section supply overvoltage ↳ *'0x8680-07 - Power section supply voltage max. error level' on page 130*
0x3220	Power section supply reduced voltage ↳ *'0x8680-12 - Control voltage power stage min. error level' on page 131*
0x4310	Temperature µ-Controller exceeded ↳ *'0x8780-04 - Temperature µ-Controller error level' on page 132*
0x5115	Control voltage power stage exceeds the range of values ↳ *'0x8680-12 - Control voltage power stage min. error level' on page 131* ↳ *'0x8680-13 - Control voltage power stage max. error level' on page 131*
0xF010	System communication timeout ↳ *'0x6100-10 - System message timeout maximum' on page 104*
0xF011	Command output disable (BASP) is active.
0xF020	The selected Operation mode is not supported. ↳ *'0x8280-01 - Operating mode requested' on page 118*
0xF030	The power stage reports an interrupt via I/Ox. ↳ *'0x8E00-14 - Pulse train Alarm digital input I/O1…I/O4' on page 137*
0xF080	There is an internal error - please contact our support!

0x8100-04 - Limit active bits

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8100-04	U32	R	0	0 … 0xFFFFFFFF		Limit active bits

0: de-activated, 1: activated

- Bit 3 ... 0: reserved
- Bit 4: Limit velocity
  - *‘0x8500-03 - Velocity control set value’ on page 126* **>** *‘0x8500-04 - Velocity control limit positive direction’ on page 127*
  - *‘0x8500-03 - Velocity control set value’ on page 126* **<** *‘0x8500-05 - Velocity control limit negative direction’ on page 127*
- Bit 7 ... 5: reserved
- Bit 8: Location of the set point position
  - 0: Position is out of the permissible limits
  - 1: Position is within the permissible limits
  - *‘0x8400-02 - Positioning profile target position’ on page 122* **>** *‘0x8480-05 - Software position limit positive direction’ on page 124*
  - *‘0x8400-02 - Positioning profile target position’ on page 122* **<** *‘0x8480-06 - Software position limit negative direction’ on page 124*
  - *‘0x8480-03 - Position set value’ on page 124* **>** *‘0x8480-05 - Software position limit positive direction’ on page 124*
  - *‘0x8480-03 - Position set value’ on page 124* **<** *‘0x8480-06 - Software position limit negative direction’ on page 124*
- Bit 9: Location of the current position

  ‘0x8480-07 - Range limit positive direction’ on page 125

  ‘0x8480-08 - Range limit negative direction’ on page 125
  - 0: Position is out of the permissible limits
  - 1: Position is within the permissible limits
  - *‘0x8480-02 - Position actual value’ on page 123* **>** *‘0x8480-05 - Software position limit positive direction’ on page 124*
  - *‘0x8480-02 - Position actual value’ on page 123* **<** *‘0x8480-06 - Software position limit negative direction’ on page 124*
- Bit 31 ... 10: reserved

‘Explanation of the elements’ on page 98

0x8100-05 - Warnings active bits

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8100-05	U32	R	0	0 … 0xFFFFFFFF		Warnings active bits

0: de-activated, 1: activated

- Bit 11...0: reserved
- Bit 12: Temperature warning µ-Controller
  - *‘0x8780-02 - Temperature µ-Controller actual value’ on page 131* **>** *‘0x8780-03 - Temperature µ-Controller warning level’ on page 132*
- Bit 15 ... 13: reserved
- Bit 16: Warning under-voltage U_{IN} $24V_{DC}$
  - *‘0x8680-02 - Power section supply voltage actual value’ on page 129* **<** *‘0x8680-04 - Power section supply voltage min. warning level’ on page 129*
- Bit 17: Warning over-voltage U_{IN} $24V_{DC}$
  - *‘0x8680-02 - Power section supply voltage actual value’ on page 129* **>** *‘0x8680-05 - Power section supply voltage max. warning level’ on page 129*
- Bit 18: Warning under-voltage triggering power stage motion module
  - *‘0x8680-08 - Control voltage power stage actual value’ on page 130* **<** *‘0x8680-10 - Control voltage power stage min. warning level’ on page 130*
- Bit 19: Warning over-voltage triggering power stage motion module
  - *‘0x8680-08 - Control voltage power stage actual value’ on page 130* **>** *‘0x8680-11 - Control voltage power stage max. warning level’ on page 130*
- Bit 31...20: reserved

‘Explanation of the elements’ on page 98

Chapter 4.14 ‘Monitoring and error reaction’ on page 86

0x8100-06 - Error active bits

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8100-06	U32	R	0	0 … 0xFFFFFFFF		Error active bits

0: de-activated, 1: activated

- Bit 11 ... 0: reserved
- Bit 12: Temperature error µ-controller [1)]
  - *‘0x8780-02 - Temperature µ-Controller actual value’ on page 131* **>** *‘0x8780-04 - Temperature µ-Controller error level’ on page 132*
- Bit 15 ... 13: reserved
- Bit 16: Under-voltage U $error_{IN}$ $24V_{DC}$
  - *‘0x8680-02 - Power section supply voltage actual value’ on page 129* **<** *‘0x8680-06 - Power section supply voltage min. error level’ on page 129*
- Bit 17: Over-voltage U $error_{IN}$ $24V_{DC}$
  - *‘0x8680-02 - Power section supply voltage actual value’ on page 129* **>** *‘0x8680-07 - Power section supply voltage max. error level’ on page 130*
- Bit 18: Under-voltage triggering power stage error motion module
  - *‘0x8680-08 - Control voltage power stage actual value’ on page 130* **<** *‘0x8680-12 - Control voltage power stage min. error level’ on page 131*
- Bit 19: Over-voltage triggering power stage error motion module
  - *‘0x8680-08 - Control voltage power stage actual value’ on page 130* **>** *‘0x8680-13 - Control voltage power stage max. error level’ on page 131*
- Bit 20: reserved
- Bit 21: Error power stage reports an interrupt via I/Ox.
  ‘0x8E00-14 - Pulse train Alarm digital input I/O1…I/O4’ on page 137
  ‘0x8E00-15 - Pulse train Alarm digital input active polarity I/O1…I/O4’ on page 137
- Bit 22: Error system communication timeout [1)]
  - *‘0x6100-10 - System message timeout maximum’ on page 104*
- Bit 23: Error command output disable (BASP) active [1)]
- Bit 27 ... 24: reserved
- Bit 28: System error
  - There is an internal error - please contact our VIPA support!
- Bit 31...29: reserved

‘Explanation of the elements’ on page 98

[1)] Triggers an error reaction *Chapter 4.14 ‘Monitoring and error reaction’ on page 86*

5.2.8 Configure drive - 0x8180

0x8180-00 - Configure drive - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8180-00	U08	R	3	3		Configure drive - number of entries

‘Explanation of the elements’ on page 98

0x8180-02 - Gear factor

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8180-02	U32	R/W	10000000	800000 … 16000000		Gear factor

‘Explanation of the elements’ on page 98

Gear factor for normalization of position, velocity and acceleration values. The value represents "units" in thousands with the rotary axis makes exactly one revolution. "Units" may thus be regarded as user units such as µm, mm, inch, degree angle and revolutions.

- Position
  - A to be traversed position thus results directly from the specified number of units.
- Velocity
  - The velocity is normalized to unit/s
- Acceleration and deceleration
  - Acceleration and deceleration are normalized to unit/s^2

Example 1:

A motor directly drives a toothed disk. Via a toothed belt, a drilling machine is 1:1 coupled. It is to be used with a resolution of 0.0001 U (= 1 unit). In order to drive a speed of 900 U/min, therefore, a value of 150000 must be reported.

$$Units = \frac{1U/U}{0.0001U} = 10000\ 1/U$$

Gear factor = 10000 · 1000 = 10000000

Example 2:

A motor directly drives a spindle with a pitch of 20 mm/U. It is to be used with a resolution of 10µm (= 1 unit). In order to traverse a difference in position of 7000µm, 7000 can directly be specified (relative to the previous value).

$$Units = \frac{20mm/U}{10\mu m} = 20000\ 1/U$$

Gear factor = 20000 · 1000 = 20000000

5.2.9 Options - 0x8200

0x8200-00 - Options - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8200-00	U08	R	5	5		Options - number of entries

‘Explanation of the elements’ on page 98

0x8200-01 - Configuration quick stop

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8200-01	S16	R/W**	2	-32768 … 32767		Configuration quick stop

‘Explanation of the elements’ on page 98
Chapter 4.9 ‘Brake control’ on page 73

The object contains the action to be used at a *Quick stop*.

Mode	Description
0	Instant state change to *‘Switch on disabled’*
1	reserved
2	Break with quick stop deceleration 0x8580-03 and subsequent state change to *‘Switch on disabled’*
4...	reserved

0x8200-05 - Configuration fault reaction

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8200-05	S16	R/W**	2	0 … 2		Configuration fault reaction

‘Explanation of the elements’ on page 98

The object contains the action to be used on an error of the System SLIO motion module.

Mode	Description
0	Instant state change to *‘Switch on disabled’*
1	reserved
2	Break with 0x8580-03 and subsequent state change to *‘Switch on disabled’*
4...	reserved

5.2.10 Operating modes - 0x8280

0x8280-00 - Operating mode - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8280-00	U08	R	2	2		Operating mode - number of entries

‘Explanation of the elements’ on page 98

0x8280-01 - Operating mode requested

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8280-01*	S16	R/W	0	-128 … 127		Operating mode requested

‘Explanation of the elements’ on page 98
Chapter 4.4.3 ‘Operating modes’ on page 50

With the object 0x8280-01 the mode of the motor controller can be set. The following operating modes are supported:

Value	Description
0	No operating mode
1	Chapter 4.6 ‘PtP positioning profile’ on page 56 ■ The *Homing mode* can be called during the operation, if you have previously set a homing method via ‘0x8300-02 - Homing method’ on page 119. ■ A change to the *Velocity profile* is only possible if the state machine is in state *‘Switch on disabled’*.
3	Chapter 4.7 ‘Velocity profile’ on page 67
4	reserved
6	Chapter 4.5 ‘Homing’ on page 51

0x8280-02 - Operating mode actual

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8280-02*	S16	R	0	-128 … 127		Operating mode actual

‘Explanation of the elements’ on page 98
Chapter 4.4.3 ‘Operating modes’ on page 50

In object 0x8280-02 the current operating mode of the motor controller can be read. The following values are supported:

Value	Description
0	No operating mode selected
-1	Invalid operating mode or operating mode change
1	Chapter 4.6 ‘PtP positioning profile’ on page 56
3	Chapter 4.7 ‘Velocity profile’ on page 67
4	reserved
6	Chapter 4.5 ‘Homing’ on page 51

5.2.11 Homing - 0x8300

0x8300-00 - Homing - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8300-00	U08	R	13	13		Homing - number of entries

‘Explanation of the elements’ on page 98
Chapter 4.5 ‘Homing’ on page 51

0x8300-02 - Homing method

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8300-02	S08	R/W**	0	-128 … 127		Homing method

‘Explanation of the elements’ on page 98

This object is used to select the homing method. Homing is an initialization drive of an axis, where the correct position is determined by means of an reference signal. For complete configuration of a homing run, all index 0x8300 associated objects are required.

Supported homing method

Mode	Description
17	It is referenced to a switch at the end of the position area (= homing switch). For the evaluation of the reference switch, a digital input of the System SLIO motion module is used. A pulse signal is expected.
37	The current position is used as reference position and the position value is reset to zero.

Please note that neither homing nor other operation modes of System SLIO motion module are monitored by limit switches, which cause a shut-down or stopping when reached. If you wish a surveillance and response, you have to ensure this through separate measures.

0x8300-03 - Homing digital input I/O1…I/O4

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8300-03	U08	R/W**	0	0 … 4		Homing digital input I/O1…I/O4

‘Explanation of the elements’ on page 98

This object sets for homing *Mode 17* the digital input I /O1 ... I /O4 to which the homing switch is connected.

Enter here number:

- 0: inactive
- 1: Input of DIO1
- 2: Input of DIO2
- 3: Input of DIO3
- 4: Input of DIO4

0x8300-04 - Homing digital input active polarity I/O1…I/O4

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8300-04	U08	R/W**	1	0 … 1		Homing digital input active polarity I/O1…I/O4

'Explanation of the elements' on page 98

This object sets for homing *Mode 17* the polarity of the digital input I/O1...I/O4 of the System SLIO motion module. The internal logic of the System SLIO motion module evaluates a pulse signal from the reference switch. This makes it possible to refer also to a zero track signal of an encoder. Please note in this case, the correct electrical connection!

Value	Description
0	The reference switch triggers an edge 1-0 at the end position.
1	The reference switch triggers an edge 0-1 at the end position.

0x8300-05 - Homing target position

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8300-05	S32	R/W**	0	-8388608 … 8388607	[user]	Homing target position

'Explanation of the elements' on page 98

This object defines the target position for the homing and is signed. If the homing and the mechanical structure are configured correctly, this position should not be reached during homing. It thus serves for:

- set a maximum traversing position, if the initial position is not reached
- to specify the traversing direction by the sign

0x8300-06 - Homing velocity V1

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8300-06	S32	R/W**	0	-8388608 … 8388607	[user]	Homing velocity V1

'Explanation of the elements' on page 98

This object specifies the search speed for traversing to the initial position. Homing *Mode 17* is a two step process.

1. With velocity V1 (0x8300-06) it is traversed toward the target position (0x8300-05) until the homing switch is overrun.
2. Then it is decelerated to speed 0 and again accelerated (0x8300-08 and 09) and moved in the negative direction at velocity V1.
3. If the reference switch is overrun again it is again slowed down and it is again accelerated in the positive direction at velocity V2 (0x8300-07).
4. With the third overrun of the homing switch the initial position (Offset: 0x8300-10) is set and moved to.

0x8300-07 - Homing velocity V2

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8300-07	S32	R/W**	0	-8388608 … 8388607	[user]	Homing velocity V2

'Explanation of the elements' on page 98

This object specifies the velocity V2 for traversing to the initial position. The velocity V2 (0x8300-07) is used in the final stage of homing when approaching the initial position (offset: 0x8300-10).

0x8300-08 - Homing acceleration

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8300-08	S32	R/W**	0	1000 … 10000000	[user]	Homing acceleration

'Explanation of the elements' on page 98

This object specifies the value for the homing acceleration for traversing the initial position.

0x8300-09 - Homing deceleration

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8300-09	S32	R/W**	0	1000 … 10000000	[user]	Homing deceleration

'Explanation of the elements' on page 98

This object specifies the value for the homing deceleration for traversing the initial position.

0x8300-10 - Homing offset value

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8300-10	S32	R/W**	0	-8388608 … 8388607	[user]	Homing offset value

'Explanation of the elements' on page 98

This object specifies the offset between the zero position of the application and the reference point (by homing determined) of the drive. The value is to specify with sign. If the homing is completed and the initial position is reached, the offset is added to the initial position.

5.2.12 Parameter for the PtP positioning profile - 0x8400

0x8400-00 - Positioning profile - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8400-00	U08	R	5	5		Positioning profile - number of entries

‘Explanation of the elements’ on page 98
Chapter 4.6 ‘PtP positioning profile’ on page 56

0x8400-02 - Positioning profile target position

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8400-02*	S32	R/W**	0	-8388608 … 8388607	[user]	Positioning profile target position

‘Explanation of the elements’ on page 98

For the "PtP positioning profile" in this object the new target position is to be specified in user units. ‘0x8180-02 - Gear factor’ on page 116 You can find this object in the I/O area and it may not be written via the acyclic channel. The positioning is active, if:

- the operation mode "PtP positioning profile" is selected
- the System SLIO motion module is in state *‘Operation enabled’*

The positioning must not be started specifically by ‘0x8100-01 - Control word’ on page 110. During an ongoing positioning or after reaching the target position 0x8400-02 can be changed and it starts positioning to the new target value. For complete configuration of a positioning and to execute other objects of the index group 0x8400 are required.

0x8400-03 - Positioning profile target velocity

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8400-03*	S32	R/W**	0	-8388608 … 8388607	[user]	Positioning profile target velocity

‘Explanation of the elements’ on page 98

This object specifies the speed for traversing to the initial position and is processed as absolute value. You can find this object in the I/O area and it may not be written via the acyclic channel. During a running positioning 0x8400-03 can be changed. It is directly accelerated or decelerated, provided the remaining room allows the positioning to the new target value.

0x8400-04 - Positioning profile target acceleration

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8400-04*	S32	R/W**	10000	300 … 100000000	[user]	Positioning profile target acceleration

‘Explanation of the elements’ on page 98

This object specifies the acceleration for traversing to the initial position and is processed as absolute value. You can find this object in the I/O area and it may not be written via the acyclic channel. During a running positioning 0x8400-04 can be changed and is immediately active.

0x8400-05 - Positioning profile target deceleration

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8400-05*	S32	R/W**	10000	300 … 100000000	[user]	Positioning profile target deceleration

‘Explanation of the elements’ on page 98

This object specifies the deceleration for traversing to the initial position and is processed as absolute value. You can find this object in the I/O area and it may not be written via the acyclic channel. During a running positioning 0x8400-05 can be changed and is immediately active.

5.2.13 Positions and limit values - 0x8480

0x8480-00 - Positions and limits - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8480-00	U08	R	16	16		Positions and limits - number of entries

‘Explanation of the elements’ on page 98

0x8480-02 - Position actual value

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8480-02*	S32	R	0	-8388608 … 8388607	[user]	Position actual value

‘Explanation of the elements’ on page 98

This object specifies the value of the actual position. You can find this object in the I/O area and it may not be written via the acyclic channel. In open-loop operation, the object has an internally calculated value, not the current encoder value.

0x8480-03 - Position set value

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8480-03	S32	R	0	-8388608 … 8388607	[user]	Position set value

↳ *'Explanation of the elements' on page 98*

This object specifies the internal value of the target position at the input of the position controller. It is generated by the superior modules (e.g. PtP ramp generator).

0x8480-05 - Software position limit positive direction

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8480-05	S32	R/W**	8388607	-8388608 … 8388607	[user]	Software position limit positive direction

↳ *'Explanation of the elements' on page 98*

This object indicates the positive limit for the position set point. Each target position is checked against this limit. Before matching always the reference offset ↳ *'0x8300-10 - Homing offset value' on page 121* is subtracted.

- Is a specified target position above the positive limit:
  - the positioning process is not performed
  - Bit 11: "Internal limitation active" in ↳ *'0x8100-02 - Status word' on page 111* is set
  - Bit 10: "Target position" reached in ↳ *'0x8100-02 - Status word' on page 111* is **not** set
  - Bit 9: in ↳ *'0x8100-04 - Limit active bits' on page 113* is set
- Is a measured actual position above the positive limit:
  - Bit 8: in ↳ *'0x8100-04 - Limit active bits' on page 113* is set

0x8480-06 - Software position limit negative direction

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8480-06	S32	R/W**	-8388608	-8388608 … 8388607	[user]	Software position limit negative direction

↳ *'Explanation of the elements' on page 98*

This object indicates the negative limit for the position set point. Each target position is checked against this limit. Before matching always the reference offset 0x8300-10 is subtracted.

- Is a specified target position below the negative limit:
  - the positioning process is not performed
  - Bit 11: "Internal limitation active" in ↳ *'0x8100-02 - Status word' on page 111* is set
  - Bit 10: "Target position" reached in ↳ *'0x8100-02 - Status word' on page 111* is **not** set
  - Bit 9: in ↳ *'0x8100-04 - Limit active bits' on page 113* is set
- Is a measured actual position below the negative limit:
  - Bit 8: in ↳ *'0x8100-04 - Limit active bits' on page 113* is set

0x8480-07 - Range limit positive direction

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8480-07	S32	R/W	8000000	10000 … 8388607	[user]	Range limit positive direction

'Explanation of the elements' on page 98

This object defines the positive overflow limit for the processing of position values. When this value is exceeded, the position values are set to *'0x8480-08 - Range limit negative direction' on page 125*. Together with the object 0x8480-07 you can define a position range. For example, by presetting *'0x8480-05 - Software position limit positive direction' on page 124* and *'0x8480-06 - Software position limit negative direction' on page 124* out of the range you will get an endless movement, since the software limits can never be reached during the movement.

0x8480-08 - Range limit negative direction

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8480-08	S32	R/W	-8000000	-8388608 … -10000	[user]	Range limit negative direction

'Explanation of the elements' on page 98

This object defines the negative overflow limit for the processing of position values. When this value is exceeded, the position values are set to *'0x8480-07 - Range limit positive direction' on page 125*. Together with the object 0x8480-08 you can define a position range. For example, by presetting *'0x8480-05 - Software position limit positive direction' on page 124* and *'0x8480-06 - Software position limit negative direction' on page 124* out of the range you will get an endless movement, since the software limits can never be reached during the movement.

0x8480-09 - In-position window

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8480-09	S32	R/W**	10	-8388608 … 8388607	[user]	In-position window

'Explanation of the elements' on page 98

This object specifies with relation to the target position a symmetrical range, within which the target position is reached.

0x8480-10 - Lag error

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8480-10*	S32	R	0	-8388608 … 8388607	[user]	Lag error

'Explanation of the elements' on page 98

This object contains the current system deviation as a deviation between position set point and actual value. This deviation is called *Lag error*. You can find this object in the I/O area.

5.2.14 Velocities and limit values - 0x8500

0x8500-00 - Velocity - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8500-00	U08	R	15	15		Velocity - number of entries
'Explanation of the elements' on page 98						

0x8500-01 - Velocity control configuration

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8500-01	U32	R/W	0	0 … 0xFFFFFFFF		Velocity control configuration
'Explanation of the elements' on page 98						

With this object, you can disable the PtP position profile respectively the velocity profile for the velocity control. Here, the set point velocity setting happens by the following objects:

- 0: Velocity control via PtP position profile and velocity profile with set point velocity setting via '0x8400-03 - Positioning profile target velocity' on page 122. This is the default setting.
- 1: Velocity control exclusively velocity profile with set point velocity setting via '0x8500-03 - Velocity control set value' on page 126.
- 2: PtP position profile and velocity profile are disabled with set point velocity setting as set point frequency for the PWM stage.

0x8500-02 - Velocity control actual value

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8500-02*	S32	R	0	-10000000 … 10000000	[user]	Velocity control actual value
'Explanation of the elements' on page 98						

This object specifies the value of the actual velocity. You can find this object in the I/O area and it may not be written via the acyclic channel. In open-loop operation, the object has an internally calculated value, not determined from the current encoder value.

0x8500-03 - Velocity control set value

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8500-03	S32	R/W**	0	-10000000 … 10000000	[user]	Velocity control set value
'Explanation of the elements' on page 98						

This object specifies the internal value of the set point velocity at the input of the velocity controller. It is generated by the superior modules (e.g. PtP ramp generator).

0x8500-04 - Velocity control limit positive direction

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8500-04	S32	R/W**	100000	0 … 10000000	[user]	Velocity control limit positive direction
'Explanation of the elements' on page 98						

This object indicates the positive limit for velocity. Each target velocity is checked against this limit.

0x8500-05 - Velocity control limit negative direction

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8500-05	S32	R/W**	-100000	-10000000 … 0	[user]	Velocity control limit negative direction
'Explanation of the elements' on page 98						

This object indicates the negative limit for velocity. Each target velocity is checked against this limit.

5.2.15 Acceleration and deceleration - 0x8580

0x8580-00 - Acceleration and deceleration - number entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8580-00	U08	R	7	7		Acceleration and deceleration - number entries
'Explanation of the elements' on page 98						

0x8580-02 - Acceleration/ Deceleration actual value

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8580-02*	S32	R	0	-100000000 … 100000000	[user]	Acceleration/Deceleration actual value
'Explanation of the elements' on page 98						

This object specifies the value of the actual acceleration (positive sign) respectively deceleration (negative sign). You can find this object in the I/O area and it may not be written via the acyclic channel. In open-loop operation, the object has an internally calculated value, not determined from the current encoder value.

0x8580-03 - Deceleration quick stop value

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8580-03	S32	R/W**	10000	10 … 100000000	[user]	Deceleration quick stop value

‘Explanation of the elements’ on page 98

This object specifies the value of the target deceleration in case of a *quick stop*.

0x8580-04 - Acceleration limit

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8580-04	S32	R/W**	10000	10 … 100000000	[user]	Acceleration limit

‘Explanation of the elements’ on page 98

This object indicates the bidirectional limit value for the set point acceleration value. Each set point acceleration value is checked against this limit value. Please note that the lower limit is unequal 0. As soon as a set point velocity value is active, the movement starts, although the set point acceleration is 0.

0x8580-06 - Deceleration limit

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8580-06	S32	R/W**	10000	10 … 100000000	[user]	Deceleration limit

‘Explanation of the elements’ on page 98

This object indicates the bidirectional limit value for the set point deceleration value. Each set point deceleration value is checked against this limit value. Please note that the lower limit is unequal 0. As soon as a set point velocity value is active, the movement starts, although the set point deceleration is 0.

5.2.16 Voltages - 0x8680

0x8680-00 - Voltages - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8680-00	U08	R	19	19		Voltages - number of entries

‘Explanation of the elements’ on page 98

0x8680-02 - Power section supply voltage actual value

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8680-02	U16	R	0	0 … 5500	[0.01V]	Power section supply voltage actual value
'Explanation of the elements' on page 98						

This object specifies the level of the actual supply voltage.

0x8680-04 - Power section supply voltage min. warning level

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8680-04	U16	R/W	2000	0 … 5500	[0.01V]	Power section supply voltage min. warning level
'Explanation of the elements' on page 98						

This object specifies a lower limit for the supply voltage of the module. If the limit is exceeded, via '0x8100-02 - Status word' on page 111 respectively '0x8100-05 - Warnings active bits' on page 114 a warning is shown.

0x8680-05 - Power section supply voltage max. warning level

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8680-05	U16	R/W	2800	0 … 5500	[0.01V]	Power section supply voltage max. warning level
'Explanation of the elements' on page 98						

This object specifies an upper limit for the supply voltage of the module. If the limit is exceeded, via '0x8100-02 - Status word' on page 111 respectively '0x8100-05 - Warnings active bits' on page 114 a warning is shown.

0x8680-06 - Power section supply voltage min. error level

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8680-06	U16	R/W	1800	0 … 5500	[0.01V]	Power section supply voltage min. error level
'Explanation of the elements' on page 98						

This object specifies a lower limit for the supply voltage of the module. If the limit is undershot, via '0x8100-02 - Status word' on page 111 respectively '0x8100-06 - Error active bits' on page 115 an error is shown.

0x8680-07 - Power section supply voltage max. error level

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8680-07	U16	R/W	3000	0 … 5500	[0.01V]	Power section supply voltage max. error level

‘Explanation of the elements’ on page 98

This object specifies an upper limit for the supply voltage of the module. If the limit is exceeded, via ‘0x8100-02 - Status word’ on page 111 respectively ‘0x8100-06 - Error active bits’ on page 115 an error is shown.

0x8680-08 - Control voltage power stage actual value

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8680-08	U16	R	0	0 … 4000	[0.01V]	Control voltage power stage actual value

‘Explanation of the elements’ on page 98

This object specifies the level of the actual supply voltage of the power stage.

0x8680-10 - Control voltage power stage min. warning level

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8680-10	U16	R/W	850	0 … 4000	[0.01V]	Control voltage power stage min. warning level

‘Explanation of the elements’ on page 98

This object specifies a lower limit for the control voltage of the power stage. If the limit is exceeded, via ‘0x8100-02 - Status word’ on page 111 respectively ‘0x8100-05 - Warnings active bits’ on page 114 a warning is shown.

0x8680-11 - Control voltage power stage max. warning level

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8680-11	U16	R/W	1200	0 … 4000	[0.01V]	Control voltage power stage max. warning level

‘Explanation of the elements’ on page 98

This object specifies an upper limit for the control voltage of the power stage. If the limit is exceeded, via ‘0x8100-02 - Status word’ on page 111 respectively ‘0x8100-05 - Warnings active bits’ on page 114 a warning is shown.

0x8680-12 - Control voltage power stage min. error level

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8680-12	U16	R/W	800	0 … 4000	[0.01V]	Control voltage power stage min. error level
‘Explanation of the elements’ on page 98						

This object specifies a lower limit for the control voltage of the power stage. If the limit is undershot, via ‘0x8100-02 - Status word’ on page 111 respectively ‘0x8100-06 - Error active bits’ on page 115 an error is shown.

0x8680-13 - Control voltage power stage max. error level

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8680-13	U16	R/W	1400	0 … 4000	[0.01V]	Control voltage power stage max. error level
‘Explanation of the elements’ on page 98						

This object specifies an upper limit for the control voltage of the power stage. If the limit is exceeded, via ‘0x8100-02 - Status word’ on page 111 respectively ‘0x8100-06 - Error active bits’ on page 115 an error is shown.

5.2.17 Temperatures - 0x8780

0x8780-00 - Temperatures - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8780-00	U08	R	12	12		Temperatures - number of entries
‘Explanation of the elements’ on page 98						

0x8780-02 - Temperature µ-Controller actual value

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8780-02	S16	R	0	-50 … 120	[degC]	Temperature µ-Controller actual value
‘Explanation of the elements’ on page 98						

This object specifies the measured temperature of the µ-Controller of the motion module.

0x8780-03 - Temperature µ-Controller warning level

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8780-03	S16	R/W	90	-50 … 120	[degC]	Temperature µ-Controller warning level
'Explanation of the elements' on page 98						

This object specifies the temperature limit of the µ-Controller of the motion module. If the temperature limit is exceeded, via *'0x8100-02 - Status word' on page 111* respectively *'0x8100-05 - Warnings active bits' on page 114* a warning is shown.

0x8780-04 - Temperature µ-Controller error level

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8780-04	S16	R/W	105	-50 … 120	[degC]	Temperature µ-Controller error level
'Explanation of the elements' on page 98						

This object specifies the temperature limit of the µ-Controller of the motion module. If the limit is reached, via *'0x8100-02 - Status word' on page 111* respectively *'0x8100-06 - Error active bits' on page 115* an error is shown and the status of the motion module changes to *'Fault reaction active'*.

0x8780-05 - Temperature µ-Controller offset

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8780-05	S16	R/W	1173	900 … 1500		Temperature µ-Controller offset
'Explanation of the elements' on page 98						

This object specifies an offset for the temperature of the µ-Controller.

0x8780-06 - Temperature µ-Controller gain

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8780-06	S16	R/W	386	300 … 500		Temperature µ-Controller gain
'Explanation of the elements' on page 98						

This object specifies a gain for the temperature of the µ-Controller.

5.2.18 Pulse train parameter - 0x8E00

0x8E00-00 - Pulse train parameter - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8E00-00	U08	R	15	15		Pulse train parameter - number of entries
'Explanation of the elements' on page 98						

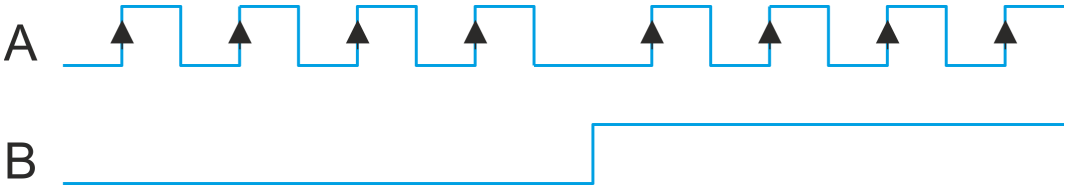
0x8E00-01 - Pulse train configuration

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8E00-01	U32	R/W	3	0 … 3		Pulse train configuration

'Explanation of the elements' on page 98

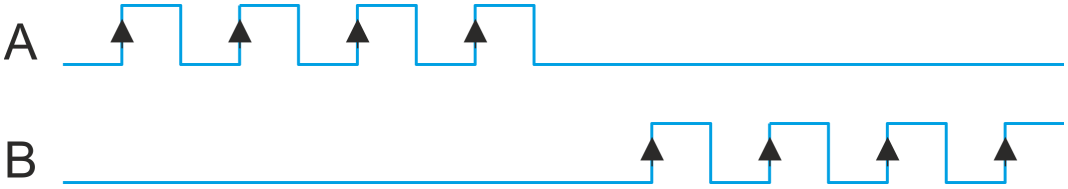
With this object, you can specify the frequency pulse patterns. There are the following possibilities:

Pulse and direction (P/D)



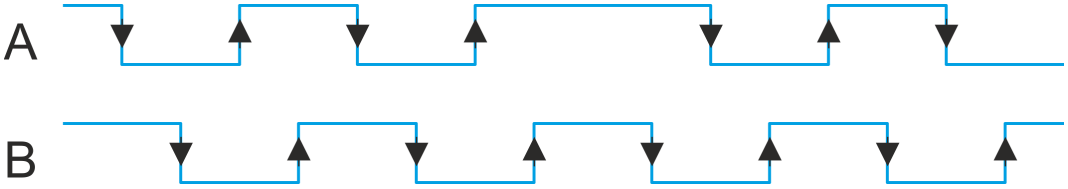
- 0x8E00-01 = 1
- The output of the frequency pattern happens by output A1 (P)
- The direction of rotation marks A2 (D) with "high" level for clockwise and "low" level for counter-clockwise rotation.

Frequency modulation (CW/CCW)



- 0x8E00-01 = 2
- With clockwise rotation the frequency signal is output at A1 (CW) respectively counter-clockwise rotation at A2 (CCW).
- The inactive channel is always at logic "low".

Incremental encoder simulation (A/B)



- 0x8E00-01 = 3
- Signal corresponds to the signal of an incremental encoder. By direct connection to a frequency converter synchronous axes in the master/slave structure can be realized.
- A1 (A) and A2 (B) output a phase-shifted by 90° signal.
- The shift from A1 to A2 is positive for clockwise rotation and negative for counter-clockwise rotation.

0x8E00-02 - Pulse train pulses per revolution

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8E00-02	U16	R/W	40000	100 … 65535	[pls]	Pulse train pulses per revolution
'Explanation of the elements' on page 98						

This object specifies the number of pulses per rotation of the connected power stage. Please regard that usually the same settings are to be made at the power stage.

0x8E00-03 - Pulse train set frequency

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8E00-03	S32	R/W	0	-5000000 … 5000000	[Hz]	Pulse train set frequency
'Explanation of the elements' on page 98						

This object indicates the current set point of the pulse frequency, which is output to the connected power stage. It is generated by the superior modules (e.g. PtP ramp generator).

0x8E00-04 - Pulse train max. frequency

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8E00-04	U32	R/W	5000000	0 … 5000000	[Hz]	Pulse train max. frequency
'Explanation of the elements' on page 98						

This object specifies the maximum pulse frequency which is output to the connected power stage.

5.2.18.1 0x8E00-08 ... 15 - Signals of the power stage

The System SLIO motion module can directly control power stage via digital signals. These signals are generated and evaluated directly from the internal state machine. They no longer need to be processed by the user program. Via subindices -08...15 you can assign these signals to a digital input respectively output.

0x8E00-08 - Pulse train Servo-On digital output I/O1…I/O4

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8E00-08	U08	R/W	0	0 … 4		Pulse train Servo-On digital output I/O1…I/O4

'Explanation of the elements' on page 98

Returns in state *'Operation enabled'* this signal. The signal is used to enable the power stage for motor controlling. Here you have the following bit assignment:

- Bit 0: to set for de-activated
- Bit 1: to set for I/O1
- Bit 2: to set for I/O3
- Bit 3: to set for I/O2
- Bit 4: to set for I/O4

0x8E00-09 - Pulse train Servo-On digital output active polarity I/O1…I/O4

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8E00-09	U08	R/W	0	0 … 1		Pulse train Servo-On digital output active polarity I/O1…I/O4

'Explanation of the elements' on page 98

Here you can specify the polarity for the output:

- 0: High level with activated DO
- 1: Low level with activated DO

0x8E00-10 - Pulse train Alarm-Reset digital output I/O1…I/O4

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8E00-10	U08	R/W	0	0 … 4		Pulse train Alarm-Reset digital output I/O1…I/O4

'Explanation of the elements' on page 98

Returns in state *'Operation enabled'* this signal. The signal is used to reset pending alarms in the power stage. Here you have the following bit assignment:

- Bit 0: to set for de-activated
- Bit 1: to set for I/O1
- Bit 2: to set for I/O3
- Bit 3: to set for I/O2
- Bit 4: to set for I/O4

0x8E00-11 - Pulse train Alarm-Reset digital output active polarity I/O1…I/O4

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8E00-11	U08	R/W	0	0 … 1		Pulse train Alarm-Reset digital output active polarity I/O1…I/O4

‘Explanation of the elements’ on page 98

Here you can specify the polarity for the output:

- 0: High level with activated DO
- 1: Low level with activated DO

0x8E00-12 - Pulse train In-Position digital input I/O1…I/O4

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8E00-12	U08	R/W	0	0 … 4		Pulse train In-Position digital input I/O1… I/O4

‘Explanation of the elements’ on page 98

This signal is expected as feedback from the power stage when it has completed the positioning. Here you have the following bit assignment:

- Bit 0: to set for de-activated
- Bit 1: to set for I/O1
- Bit 2: to set for I/O3
- Bit 3: to set for I/O2
- Bit 4: to set for I/O4

0x8E00-13 - Pulse train In-Position digital input active polarity I/O1…I/O4

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8E00-13	U08	R/W	0	0 … 1		Pulse train In-Position digital input active polarity I/O1…I/O4

‘Explanation of the elements’ on page 98

Here you can specify the polarity for the output:

- 0: High level with activated DI
- 1: Low level with activated DI

0x8E00-14 - Pulse train Alarm digital input I/O1…I/O4

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8E00-14	U08	R/W	0	0 … 4		Pulse train Alarm digital input I/O1…I/O4
'Explanation of the elements' on page 98						

This signal is expected as feedback from the power stage when it has pending an alarm. Here you have the following bit assignment:

- Bit 0: to set for de-activated
- Bit 1: to set for I/O1
- Bit 2: to set for I/O3
- Bit 3: to set for I/O2
- Bit 4: to set for I/O4

0x8E00-15 - Pulse train Alarm digital input active polarity I/O1…I/O4

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8E00-15	U08	R/W	0	0 … 1		Pulse train Alarm digital input active polarity I/O1…I/O4
'Explanation of the elements' on page 98						

Here you can specify the polarity for the output:

- 0: High level with activated DI
- 1: Low level with activated DI

5.2.19 Encoder resolution - 0x8F00

0x8F00-00 - Encoder - number of entries

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8F00-00	U08	R	3	3		Encoder - number of entries
'Explanation of the elements' on page 98						

0x8F00-01 - Encoder Feedback configuration

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8F00-01	U32	R/W	0	0 … 1		Encoder Feedback configuration

‘Explanation of the elements’ on page 98

With this object the digital in-/outputs I/O1 and I/O3 are physically configured as encoder input.

- 0: Encoder functionality for I/01 and I/O3 is disabled
- 1: Encoder functionality for I/01 and I/O3 is enabled
  - 24V HTL signal
  - Phase A and B
  - 100 kHz
  - 4-fold evaluation

0x8F00-02 - Encoder actual value

Index-Sub	Type	RW	Default	Value range	Unit	Description
0x8F00-02	U16	R	0	0 … 65535	[inc]	Encoder actual value

‘Explanation of the elements’ on page 98

With this object you can get the actual value of a possibly connected encoder. Please note that this value is not further evaluated in the motion module. You can further process it in your user program.