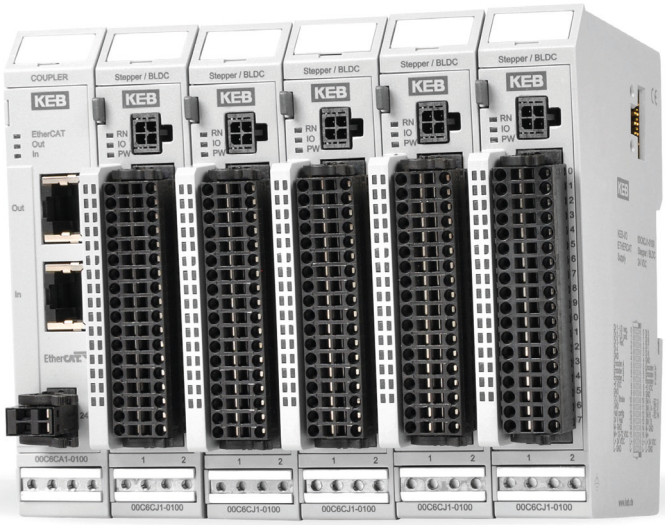

STEPPER/BLDC

INSTRUCTIONS FOR USE | **REMOTE I/OS ETHERCAT**

Translation of the original manual
Document 20106794 EN 02

Preface

The described hard- and software are developments of the KEB Automation KG. The enclosed documents correspond to conditions valid at printing. Misprint, mistakes and technical changes reserved.

Signal words and symbols

Certain operations can cause hazards during the installation, operation or thereafter. There are safety informations in the documentation in front of these operations. Security signs are located on the device or machine. A warning contains signal words which are explained in the following table:

⚠ DANGER	Dangerous situation, which will cause death or serious injury in case of non-observance of this safety instruction.
⚠ WARNING	Dangerous situation, which may cause death or serious injury in case of non-observance of this safety instruction.
⚠ CAUTION	Dangerous situation, which may cause minor injury in case of non-observance of this safety instruction.
NOTICE	Situation, which can cause damage to property in case of non-observance.

RESTRICTION

Is used when certain conditions must meet the validity of statements or the result is limited to a certain validity range.

Is used when the result will be better, more economic or trouble-free by following these procedures.

More symbols

►	This arrow starts an action step.
• / -	Enumerations are marked with dots or indents.
=>	Cross reference to another chapter or another page.

Note to further documentation.
www.keb.de/nc/search

Laws and guidelines

KEB Automation KG confirms with the EC declaration of conformity with the CE mark on the unit name plate, that the device complies with the essential safety requirements.

The EC declaration of conformity can be downloaded on demand via our website. Further information is provided in chapter "Certification".

Warranty

The warranty on design, material or workmanship for the acquired device is given in the current terms and conditions.

Here you will find our current terms and conditions.
www.keb.de/terms-and-conditions

Further agreements or specifications require a written confirmation.

Support

Through multiple applications not every imaginable case has been taken into account. If you require further information or if problems occur which are not treated detailed in the documentation, you can request the necessary information via the local KEB Automation KG agency.

The use of our units in the target products is beyond of our control and therefore exclusively the responsibility of the machine manufacturer, system integrator or customer.

The information contained in the technical documentation, as well as any user-specific advice in spoken and written and through tests, are made to best of our knowledge and information about the application. However, they are considered for information only without responsibility. This also applies to any violation of industrial property rights of a third-party.

Selection of our units in view of their suitability for the intended use must be done generally by the user.

Tests can only be done within the application by the machine manufacturer. They must be repeated, even if only parts of hardware, software or the unit adjustment are modified.

Copyright

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Glossary

0V	Earth-potential-free common point
1ph	1-phase mains
3ph	3-phase mains
AC	AC current or voltage
ASCL	Asynchronous sensorless closed loop
AWG	American wire gauge
B2B	Business-to-business
CAN	Fieldbus system
CODESYS	Operating system of the standard control and programming environment
CODESYS Safety-PS	Safety programming system
COMBIVERT	KEB drive converters
COMBIVIS	KEB start-up and parameterizing software
DC	DC current or voltage
DIN	German Institut for standardization
EMC	Electromagnetic compatibility
Emergency stop	Shutdown of a drive in emergency case (not de-energized)
Emergency switching off	Switching off the voltage supply in emergency case
EN	European standard
EtherCAT	Real-time Ethernet bus system of the company Beckhoff
Ethernet	Real-time bus system - defines protocols, plugs, types of cables
FE	Functional earth
FSoE	Functional Safety over EtherCAT
GND	Reference potential, ground
HFT	Hardware fault tolerance
Head module	Description for the bus coupler or small control in the KEB-I/O EtherCat system
HMI	Human machine interface (touch screen)
IEC	International standard
IP xx	Degree of protection (xx for level)
KEB-I/O EtherCAT SPS	Small control system from the KEB-I/O system
KEB-I/O EtherCAT System	I/O module family
MCM	American unit for large wire cross sections
MTTF	Mean service life to failure
$MTTF_D$	Mean time to dangerous failure
NN	Sea level
PA	Potential equalization
PE	Protective earth
PELV	Protective Extra Low Voltage
PFD	Term used in the safety technology (EN 61508-1...7) for the size of error probability
PFH	Term used in the safety technology (EN 61508-1...7) for the size of error probability per hour
PLC	Programmable logic controller
Port	Part of a network address to the assignment of TCP and UDP connections
POU	Program Organization Unit
RJ45	Modular connector with 8 lines
Safety Package	Plug in for COMBIVIS studio 6 with safety functionally
Safety PLC	Safety programmable logic controller
Safety PLCopen	Library of the certified basic level safety blocks
SELV	Safety Extra Low Voltage (< 60 V)
SFF	Safe failure fraction
SIL	The security integrity level is a measure for quantifying the risk reduction. Term used in the safety technology (EN 61508 -1...7).
USB	Universal serial bus

Standards for control & automation

DGUV regulation 3	Electrical installations and equipment
DIN 46228-1	Wire-end ferrules; Tube without plastic sleeve
DIN 46228-4	Wire-end ferrules; Tube with plastic sleeve
DIN IEC 60364-5-54	Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements, protective conductors and protective bonding conductors (IEC 64/1610/CD)
DIN VDE 0100-729	Low-voltage electrical installations - Part 7-729: Requirements for special installations or locations - Operating or maintenance gangways (IEC 60364-7-729); German implementation HD 60364-7-729
EN 1037	Safety of machinery - Prevention of unexpected start-up; German version EN 1037
EN 55011	Industrial, scientific and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement (IEC/CISPR 11); German version EN 55011
EN 55021	Interference to mobile radiocommunications in the presence of impulse noise - Methods of judging degradation and measures to improve performance (IEC/CISPR/D/230/FDIS); German version prEN 55021
EN 60204-1	Safety of machinery - electrical equipment of machines Part 1: General requirements (VDE 0113-1, IEC 44/709/CDV)
EN 60439-1	Low-voltage switchgear and controlgear assemblies - Part 1: Type-tested and partially type-tested assemblies (IEC 60439-1); German version EN 60439-1
EN 60529	Degrees of protection provided by enclosures (IP Code) (IEC 60529)
EN 60664-1	Insulation coordination for equipment within low-voltage systems Part 1: Principles, requirements and tests (IEC 60664-1)
EN 60721-3-1	Classification of environmental conditions - Part 3-1: Classification of groups of environmental parameters and their severities - Section 1: Storage (IEC 104/648/CD)
EN 60721-3-2	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 2: Transportation and handling (IEC 104/670/CD)
EN 60721-3-3	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities; section 3: Stationary use at weatherprotected locations; Amendment A2 (IEC 60721-3-3); German version EN 60721-3-3
EN 61000-2-1	Electromagnetic compatibility (EMC) - Part 2: Environment - Section 1: Description of the environment - Electromagnetic environment for low-frequency conducted disturbances and signalling in public power supply systems
EN 61000-2-4	Electromagnetic compatibility (EMC) - Part 2-4: Environment; Compatibility levels in industrial plants for low-frequency conducted disturbances (IEC 61000-2-4); German version EN 61000-2-4
EN 61000-4-2	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test (IEC 61000-4-2); German version EN 61000-4-2
EN 61000-4-3	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test (IEC 61000-4-3); German version EN 61000-4-3
EN 61000-4-4	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test (IEC 61000-4-4); German version EN 61000-4-4
EN 61000-4-5	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement

	techniques - Surge immunity test (IEC 61000-4-5); German version EN 61000-4-5
EN 61000-4-6	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields (IEC 61000-4-6); German version EN 61000-4-6
EN 61000-4-34	Electromagnetic compatibility (EMC) - Part 4-34: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests for equipment with mains current more than 16 A per phase (IEC 61000-4-34); German version EN 61000-4-34
EN 61131-2	Programmable controllers - Part 2: Equipment requirements and tests (IEC 61131-2)
EN 61373	Railway applications - Rolling stock equipment - Shock and vibration tests (IEC 61373)
EN 61439-1	Low-voltage switchgear and controlgear assemblies - Part 1: General rules (IEC 121B/40/CDV); German version FprEN 61439-1
EN 61508-1...7	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1...7 (VDE 0803-1…7, IEC 61508-1…7)
EN 61800-2	Adjustable speed electrical power drive systems - Part 2: General requirements - Rating specifications for low voltage adjustable frequency a.c. power drive systems (VDE 0160-102, IEC 61800-2)
EN 61800-3	Speed-adjustable electrical drives. Part 3: EMC requirements and specific test methods (VDE 0160-103, IEC 61800-3)
EN 61800-5-1	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy (IEC 61800-5-1); German version EN 61800-5-1
EN 61800-5-2	Adjustable speed electrical power drive systems - Part 5-2: Safety Requirements - Functional (IEC 22G/264/CD)
EN 62061	Safety of machinery - functional safety of electrical, electronic and programmable electronic safety-related systems (VDE 0113-50, IEC 62061)
EN ISO 13849-1	Safety of machinery - safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1); German version EN ISO 13849-1
UL 61800-5-1	American version of the EN 61800-5-1 with „National Deviations“

1 Basic Safety Instructions

This instrcutions for use contains the information necessary for the intended use of the described product (control unit, operating material, software etc.).

The safety instructions can be supplemented by local, country or application-specific safety instructions. This list is not exhaustive. Non-observance will lead to the loss of any liability claims.

ATTENTION

Hazards and risks through ignorance.

- ► Read the instruction manual!
- ► Observe the safety and warning instructions !
- ► If anything is unclear, please contact KEB !

1.1 Target group

This manual is written for qualified personnel from construction, project planning, service and commissioning. Qualified personnel for the purpose of this instruction manual must have the following qualifications:

Knowledge and understanding of the safety instructions.

- Knowledge of automation technology.
- Knowledge of functional safety.
- Skills for the installation and assembly of electrical equipment.
- Detection of hazards and risks of the electrical drive technology.
- Understanding of the function in the used machine.
- Knowledge of the operation of the operating system Windows.
- Knowledge of the *DIN IEC 60364-5-54*.
- Knowledge of national safety regulations (e.g. *DGUV regulation 3*).

1.2 Transport, storage and proper use

The transport is carried out by qualified persons in accordance with the environmental conditions specified in this manual. The devices shall be protected against excessive strains.

Electronic devices contain electrostatic sensitive components.

- ► Avoid contact.
- ► Wear ESD-protective clothing.

Do not store the devices

- in the environment of aggressive and/or conductive liquids or gases.
- with direct sunlight.
- outside the specified environmental conditions.

1.3 Installation

⚠ DANGER

Do not operate in an explosive environment!

► The device is not intended for the use in potentially explosive environment.

To prevent damages to the device:

- Make sure that no components are bent and/or isolation distances are changed.
- The device must not be put into operation in case of mechanical defects. Non-compliance with the applicable standards.
- Do not allow moisture or mist to penetrate the unit.
- Avoid dust permeating the device. Allow for sufficient heat dissipation if installed in a dust-proof housing.
- Note installation position and minimum distances to surrounding elements. Do not cover the ventilation openings.
- Assembly according to the specified degree of protection.
- Make sure that no small parts fall into the device during assembly and wiring (drilling chips, screws etc.). This also applies to mechanical components, which can lose small parts during operation.
- Check the reliable fit of the device connections in order to avoid contact resistances and sparking.
- The safety instructions are to be kept!

1.4 Electrical connection

⚠ DANGER

Voltage at the terminals and in the device!

Danger to life due to electric shock !

► Never work on the open device or never touch exposed parts.

► For any work on the unit switch off the supply voltage and secure it against switching on.

► Install suitable protective devices for personal protection.

► Never bridge upstream protective devices (also not for test purposes).

► Install all required covers and protective devices for operation.

For a trouble-free and safe operation, please pay attention to the following instructions:

- The electrical installation shall be carried out in accordance with the relevant requirements.
- Cable cross-sections and fuses must be dimensioned according to the design of the machine manufacturer. Specified minimum / maximum values may not be fallen below /exceeded.
- With existing or newly wired circuits the person installing the units or machines must ensure the EN requirements are met.

- When using components without isolated inputs/outputs, it is necessary that equipotential bonding exists between the components to be connected (e.g. by the equipotential line). Disregard can cause destruction of the components by equalizing currents.

1.4.1 EMC-compatible installation

Observance of the limit values required by EMC law is the responsibility of the manufacturer of the installation or machine.

Notes on EMC-compatible installation can be found here.
https://www.keb.de/fileadmin/media/Manuals/emv/0000neb0000.pdf

1.5 Start-up and operation

When the device is installed in machines, startup (i. e. the start of the intended use) is prohibited until it is determined that the machine complies with the machine directive; *EN 60204-1* must be observed.

- During operation, all covers and doors shall be kept closed.
- Use only approved accessories for this device.
- Never touch terminals, busbars or cable ends.

1.6 Maintenance

The following maintenance work has to be carried out when required, but at least once per year by authorized and trained personnel.

► Check unit for loose screws and plugs and tighten if necessary.

► Clean devices from dirt and dust deposits. Pay attention especially to cooling fins and protective grid of the fans.

► Examine and clean extracted air filter and cooling air filter of the control cabinet.

1.7 Preventive Maintenance

⚠ DANGER

Unauthorized exchange, repair and modifications!

Unpredictable malfunctions!

► The function of electronic devices can be affected by the setting and parameterisation. Never replace without knowledge of the application.

► Modification or repair is permitted only by KEB Automation KG authorized personnel.

► Only use original manufacturer parts.

► Infringement will annul the liability for resulting consequences.

1.8 Disposal

Devices with safety function are limited to a service life of 20 years. Then the devices must be replaced and disposed by way that they do not come into circulation again.

Electronic devices of the KEB Automation KG are exclusively professional devices for further industrial processing (so-called B2B devices). Thus the marking does not occur with the symbol of the crossed-out wheeled bin, but by the word mark and the date of manufacture.

Unlike devices mainly used in private households, these devices may not be disposed at the collection centres of public sector disposal organisations. They must be disposed after the end of use in accordance with national applicable law to environmentally correct disposal of electrical and electronic equipment.

The packaging must be feed to paper and cardboard recycling.

2 System Description

2.1 EtherCAT® – Ethernet Control

EtherCAT® is the most powerful Ethernet-based fieldbus system currently available on the market. EtherCAT puts up the top speed mark, and its flexible topology and simple configuration make it the perfect means of controlling extremely fast processes. To give you a clue: 1000 I/Os can be addressed in 30 µs.

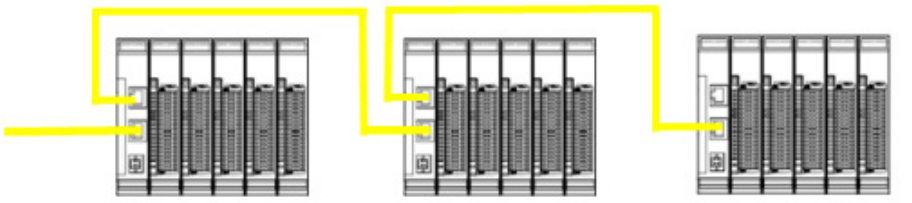
Because of its high performance, the simple wiring and its open protocol support, EtherCAT is often used as a fast motion control and I/O bus driven by an industrial PC or in conjunction with control technology on a smaller scale.

Its interconnections between the controller at one end and both the I/O modules and drives at the other are as fast as those of a backplane bus. EtherCAT controllers thus nearly act like centralised control systems, overcoming the issue of bus transfer times that conventional fieldbus systems are burdened with.

2.2 KEB C6 Remote I/O

KEB C6 Remote I/O is a system of I/O modules for interconnecting the process signals in an EtherCAT network and it consists of the KEB C6 Remote I/O bus coupler and different KEB C6 Remote I/O modules.

The KEB C6 Remote I/O bus coupler converts the physical transfer technology (twisted pair) to LVDS (E-bus) and generates the system voltages required by the LVDS modules. The standard 100 Base TX lines used for office network communications connect to the one side, the KEB C6 Remote I/O modules for the process signals connect to the other. This is how the Ethernet EtherCAT protocol is retained right through to the last I/O module.

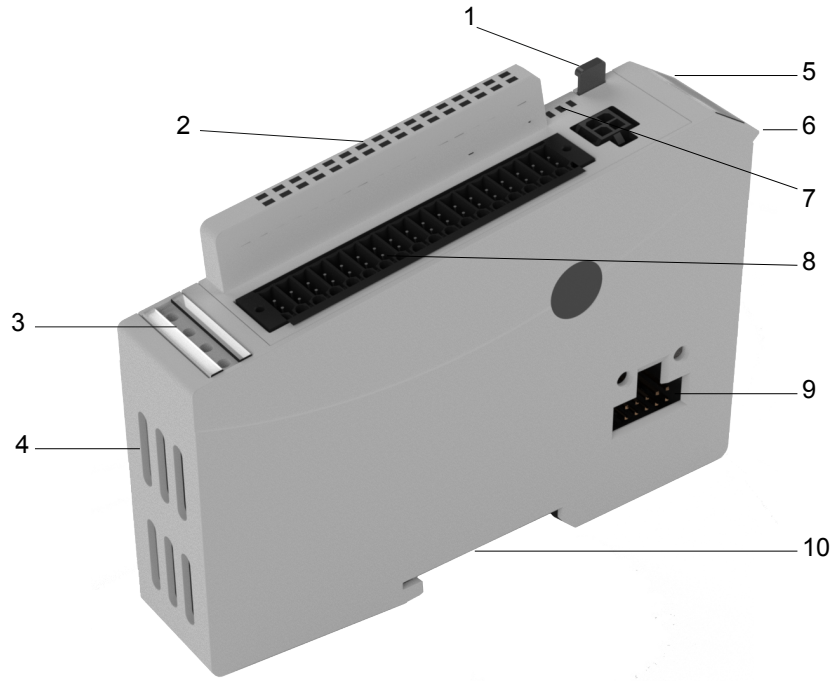


C6 Remote I/O bus coupler with I/O modules

3 Product Description

3.1 General Description

As a remote terminal, KEB C6 Remote I/O Stepper/BLDC module (Part No. 00C6CJ1-0100) is designed to actuate a stepper or brushless DC motor with incremental encoder. The module also features digital inputs for picking up limit stop, reference switch or similar signals and a digital output to a holding brake or similar device.



1	Unlock button	6	Grip
2	Signal state indicators (LEDs)	7	Status LEDs
3	Shield-to-housing mount connector	8	Spring-assisted combi plug slot
4	Ventilation slots	9	Module locking and E-bus
5	Label clip	10	DIN rail mount and operative earth

Table 1: Construction of the KEB C6 Remote I/O Stepper/BLDC (Part No. 00C6CJ1-0100)

The housing mount consists of an aluminium profile with an integral snap-on device used to snap the module to a 35mm DIN rail. The housing trough including the optical fibres for the status indicators, the side face and the front is made of plastic and contains the module. The optical fibres for the signal state indicators (LEDs) are located next to the spring-assisted combi plug. They slightly protrude from the housing and allow a clear diagnosis at a glance.

3.2 Application

3.2.1 Intended Use

The C6 REMOTE I/O Stepper/BLDC is intended to perform motion and speed control tasks within an EtherCAT network.

3.2.2 Foreseeable Misuse

⚠DANGER

Dangerous movements

The movements generated by actuating a drive may cause serious or fatal injuries

- ► Appropriately safeguard the area of motion covered by the drive system
- ► Prevent persons from entering the area of motion covered by the drive system
- ► Do not work within the area of motion covered by the drive system
- ► Verify that emergency stops are in place to turn off the drives and that they are operative.

The units have been designed and rated for IP20 work environments. Your fingers are protected and there is a safeguard against solid foreign matter of particle sizes up to 12.5 mm but no protection against water. The components must not be operated in wet and dusty environments.

3.3 Construction and Function

3.4 Brief Description

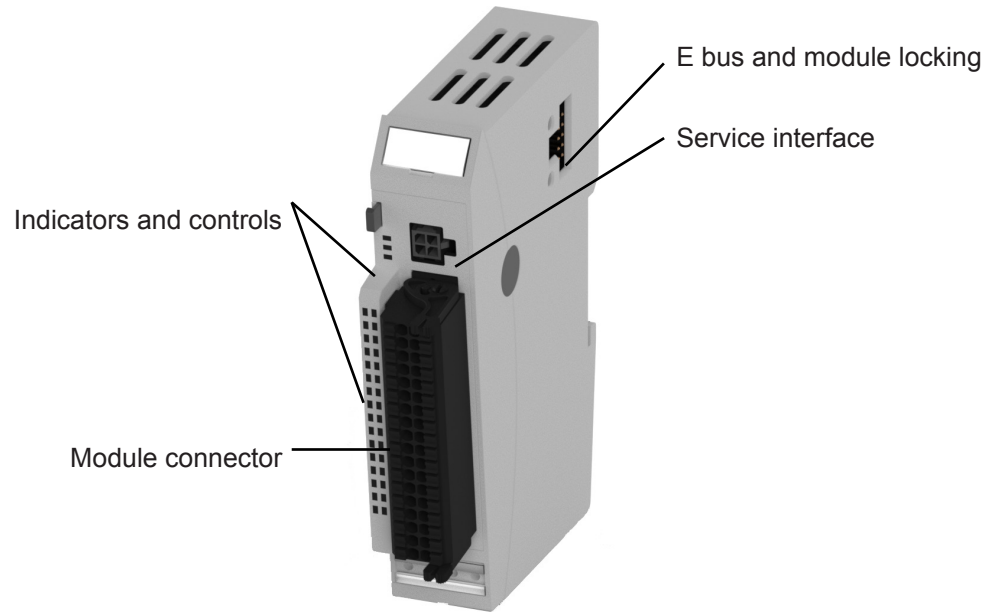


Figure 1: Description of the module

3.5 Labelling and identification

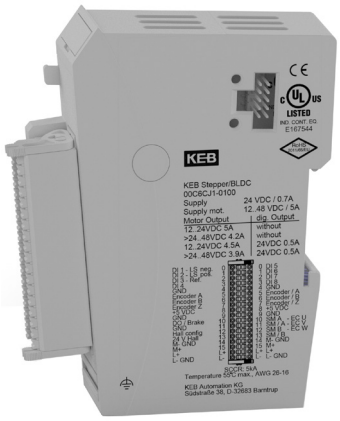


Figure 2: Labelling and identification by lateral laser marking

3.6 Contents of package

C6 REMOTE I/O Stepper/BLDC (material number 00C6CJ1-0100)

The module connector (material number 00C6CD1-0300) is not included and must be ordered separately.

3.7 Connectors

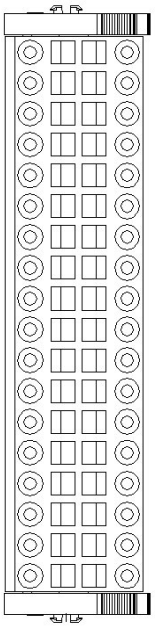
3.7.1 E bus and module locking

The system plugs and the module locking are located on the sides of the Stepper/BLDC module. These contact pins interconnect the modules. Depending on their make and model, they supply power to the module's electronic circuitry and transfer the EtherCAT signals. Verify that the end cap from the package is in place to protect the E-bus connector on the last module at the right-hand side against dirt.

The integrated module lock prevents the modules from coming apart under mechanical load or vibration.

3.7.2 Module connector

The module connector is located at the front of the Stepper/BLDC module. The motor, transmitters, sensors and actuators and the module's power supply all attach to this connector.



Module connector

Pin	Row	Function	Signal
0	1	Dig. input 1 (limit switch neg.)	DI1
0	2	Dig. input 5	DI5
1	1	Dig. input 2 (limit switch pos.)	DI2
1	2	LS Dig. input 6 (Hall gen. track 1)	DI6 (H1)
2	1	Dig. input 3 (reference switch)	DI3
2	2	LS Dig. input 7 (Hall gen. track 2)	DI7 (H2)
3	1	Dig. input 4	DI4
3	2	LS Dig. input 8 (Hall gen. track 3)	DI8 (H3)
4	1	0V / GND	GND
4	2	0V / GND	GND
5	1	incremental encoder track A (+)	Enc. A
5	2	incremental encoder track A (-)	Enc. /A
6	1	incremental encoder track B (+)	Enc. B
6	2	incremental encoder track B (-)	Enc. /B
7	1	incremental encoder track Z (+)	Enc. Z
7	2	incremental encoder track Z (-)	Enc. /Z
8	1	encoder supply 5 VDC	5 VDC
8	2	encoder supply 5 VDC	5 VDC
9	1	0V / GND	GND
9	2	0V / GND	GND
10	1	Dig. output / brake 24 VDC / 0.5A	DO
10	2	motor phase A+ (U)	A+ (U)
11	1	0V / GND brake	GND
11	2	motor phase A- (V)	A- (V)
12	1	Hall generator configuration 24 VDC	24VDC Hall
12	2	motor phase B+ (W)	B+ (W)
13	1	Hall generator 24 VDC	H24V
13	2	motor phase B-	B- (nc)
14	1	0V / GND	GND
14	2	0V / GND	GND
15	1	motor supply voltage	M+
15	2	motor supply voltage	M+
16	1	+24 VDC module power	L+
16	2	+24 VDC module power	L+
17	1	0V / GND	GND
17	2	0V / GND	GND

3.8 Indicators and controls

3.8.1 LED „EtherCAT Run“

LED "EtherCAT Run" indicates the state of EtherCAT communication.

LED „EtherCAT Run“		
LED	State	Explanation
Off	Init	Initialising, no data exchange
Off/green, 1:1	Pre-Op	Pre-operational, no data exchange
Off/green, 5:1	Safe-Op	Safe operation, inputs readable
Green, on	Op	Operational, unrestricted data exchange

3.8.2 LED „Status“

Duo LED "status" indicates the state of the module.

LED „Status“		
LED	State	Explanation
Green, on	OK	No error
Red, on	Error	General error
Red, 1 flash	Error	Digital output short or motor overload
Red, 2 flashes	Error	Power supply out of tolerance
Red, 3 flashes	Error	Watchdog
Red, 4 flashes	Error	EtherCAT communication error
Red, 5 flashes	Error	High temperature
Red, 6 flashes	Error	Module-specific error (other errors of object 1003 Predefined Error Field, e.g. encoder, limit switch, trailing error)
Red, 7 flashes	Error	Configuration error (PDO mapping, parameter out of tolerance, ...)

3.8.3 LED „Power“

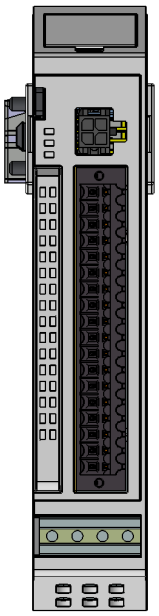
LED "Power" indicates the state of the module's 24 VDC power supply.

LED	State	Explanation
Off		No power supplied to the module. Power out of the specified range.
Green, on	OK	Power within the specified range is supplied to the module and the module is ready.

3.8.4 LED „Signal status“

The digital inputs and outputs as well as the encoder inputs have green signal status LEDs, which are located slightly raised next to the terminal.

DI1			DI5
DI2			DI6
DI3			DI7
DI4			DI8
Enc A			Enc /A
Enc B			Enc /B
Enc Z			Enc /Z
DO			



4 Operation

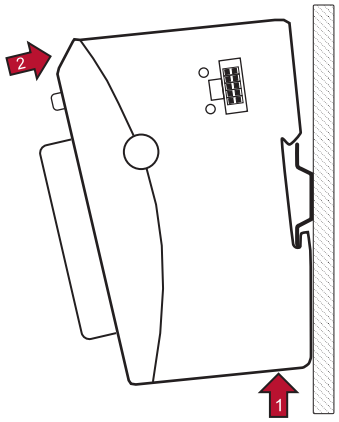
4.1 Installation

4.1.1 Mechanical Installation

The KEB C6 Remote I/O are intended for mounting rail installation (according to DIN EN 50022, 35 mm x 7.5 mm).

4.1.1.1 To snap on a single module

- Push up the module against the mounting rail from below, allowing the metal spring to snap in between mounting rail and mounting area as illustrated.
- Push the top of the module against the mounting wall until it snaps in.



4.1.1.2 To interconnect two modules

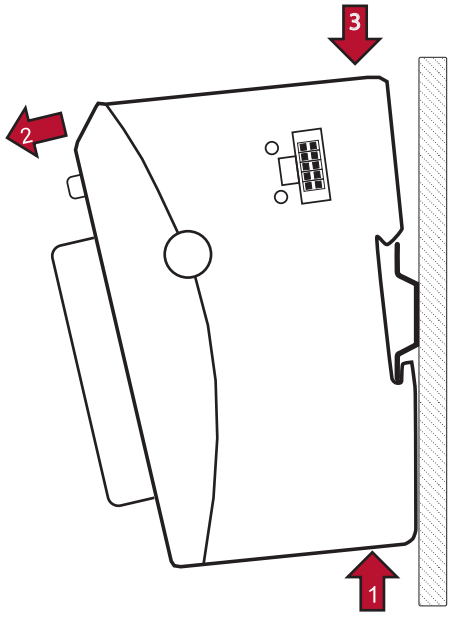
- After snapping on the first module to the rail, snap on the second module about 1 cm away towards the right of the first module.
- Push the second module along the rail towards the first module until you hear the locking device snap in.

4.1.1.3 To disconnect two modules

- Push down the unlock button of the module to be disconnected from the module to the left of it.
- Push the module to be removed to approx. 1 cm distance.

4.1.1.4 Removing a single module

- Push the module up and against the metal spring located on the underside of the rail guide.
- Tip the module away from the rail as shown in the illustration.
- Pull the module down and out of the mounting rail.



4.1.2 Electrical Installation

Functional earth

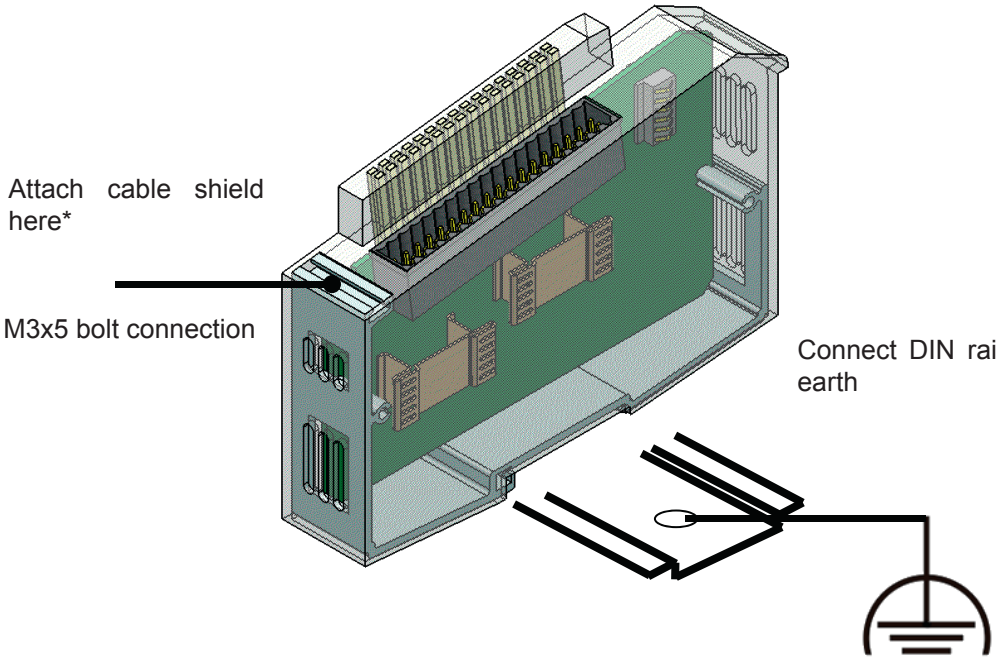
A functional earth is used for large-surface derivation of HF interferences. This reduces the emitted interference and increases interference immunity. This is done via a metallic foot in case of C6 Remote I/O modules, which locks into position on the mounting rail during mounting.

ATTENTION **Undefined conditions due to HF interference.**

Pay attention on large well conducting connections between

- module foot and mounting rail,
- mounting rail and mounting plate,
- mounting plate and earthing.

In special cases, the earthing can also be screwed directly to the front of the module (see next page).



*The following shielding plates are optionally available:

00C6CD1-0400 (shielding 2 x 8 mm)

00C6CD1-0500 (shielding 1 x 14 mm)

Earth wires should be short and have a large surface (copper braiding).

Module interconnection

The different modules connect electrically by pushing the individual modules together. This automatically connects them to the EtherCAT bus system and supplies power to the EtherCAT communication modules. Install Stepper/BLDC module at any point within the I/O block.

Please note that the maximum current supplied by the bus coupler limits the number of KEB I/O modules you may connect to a single block.

Logic power supply (24 VDC)

Power to the logic circuitry is supplied through lines L+ and GND of the module plug. The plug also supplies power to the brake output. The EtherCAT interface connection is electrically isolated and is supplied via a KEB bus coupler or a SMART control.

Motor power supply (12…max. 72 V DC / cULus 12…48V DC)

Power to the motor output stage is supplied through lines M+ and GND of the module connector. Thus, the output stage can be included in and switched off by an emergency off loop.

We recommend placing a bypass capacitor >= 4700 µF and a dielectric strength adapted to the supply voltage as close to the device as possible.

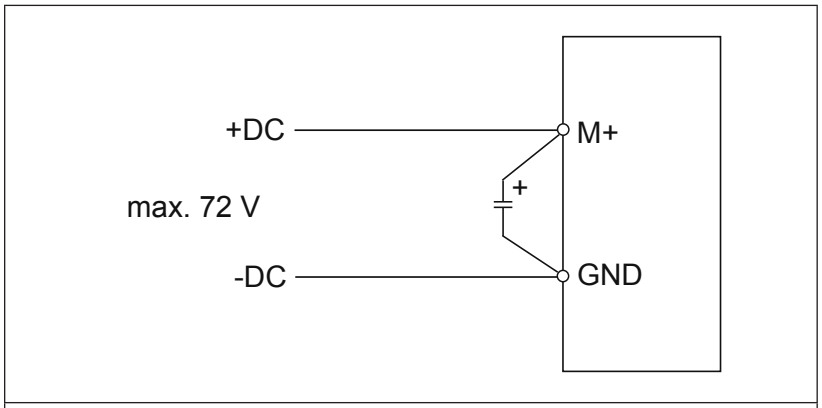


Figure 3: Circuit diagram

A Branch Circuit Protection fuse must be provided for cULus:

Model	Fuse
Fuse Class	CC
Voltage Rating	150 Vdc
Max. Fuse and SCC Rating	15A / 20kA

Wrong supply voltage

An operating voltage higher than the above limit will destroy the output stage.

► Verify that the supply voltage is within the above range at any time!

► Set the supply voltage such way that it will never exceed the motor's admissible operating voltage. Specifically consider voltages induced by other consumers or the motor and set the voltage to a level that includes a sufficient safety margin.

ATTENTION

Device can be destroyed at reverse polarity and cause a short circuit.

► Pay attention to the correct polarity before switching on.

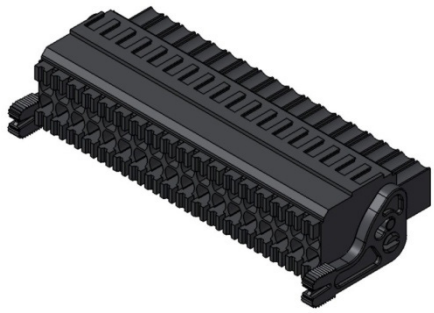
Multiple socket connector

The PUSH IN spring connection enables quick and tool-free conductor connection by means of direct plug-in technology. The stripped solid conductor or flexible conductor with crimped wire end ferrule is inserted into the clamping point until it stops.

in two rows:

Cores: 320V/ 13.4 A/0.14 - 1.5 mm² (IEC)

Rated current: 300V/ 9.5A/ 26-16 AWG (UL)



Connectable conductors with wire-end ferrules:

Conductor cross-section [mm²]							
Type of wire-end ferrule	0.14	0.25	0.34	0.50	0.75	1	1.5
Wire-end ferrule with collar according to DIN 46 228/4	8/10	8/10	8/10	10/12	12/14	12/15	
Wire-end ferrule without collar according to DIN 46 228/1	10/10	10/10	10/10	10/10	10/10	10/10	10/10
Stripping length [mm] / sleeve length [mm]							

The power supply lines must not be connected from one supply connection of the KEB C6 Remote I/O to the next one. To ensure that there is as little interference as possible, install a central power supply point and establish a star topology of as short wires as possible between the central point.

5 Configuration

5.1 Configuration examples

5.1.1 Stepper Motor in Open Loop Mode

All you need to do to operate a simple stepper motor without encoder feedback is to attach the motor to the terminals.

The encoder inputs are not used.

Either do not use the digital inputs and outputs or use them as limit or reference switches.

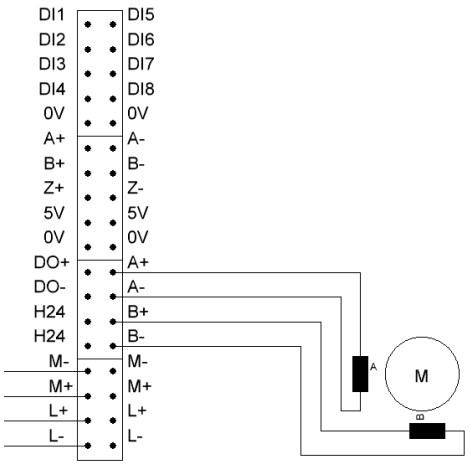


Figure 4: Stepper Motor in Open Loop Mode

Parameter Settings

Motor type setting: (Motor drive submode select 3202_h) Bit 0 (OL/CL) and bit 6 (BLDC) must not be set.

Proceed as follows to calculate the step resolution:

$$\text{Step resolution} = \frac{4 * \text{number of pole pairs (2030)}}{\text{encoder resolution (608F)}}$$

Set the following values to operate a 50-pin stepper motor in full-step mode:

2030_h: 50
$608F_h$: 200

$$1 = \frac{4 * 50}{200} = \frac{200}{200}$$

Enter the following values to set up 256-fold micro stepping:

2030_h: 50
$608F_h$: 51200

$$\frac{1}{256} = \frac{4 * 50}{51200} = \frac{200}{51200}$$

5.1.2 Stepper Motor in Closed Loop Mode

You need an incremental encoder to run a stepper motor in closed loop mode. In this mode, the stepper motor operates like a multi-pole brushless servo motor. Step errors will be corrected and the current will be adapted to the load.

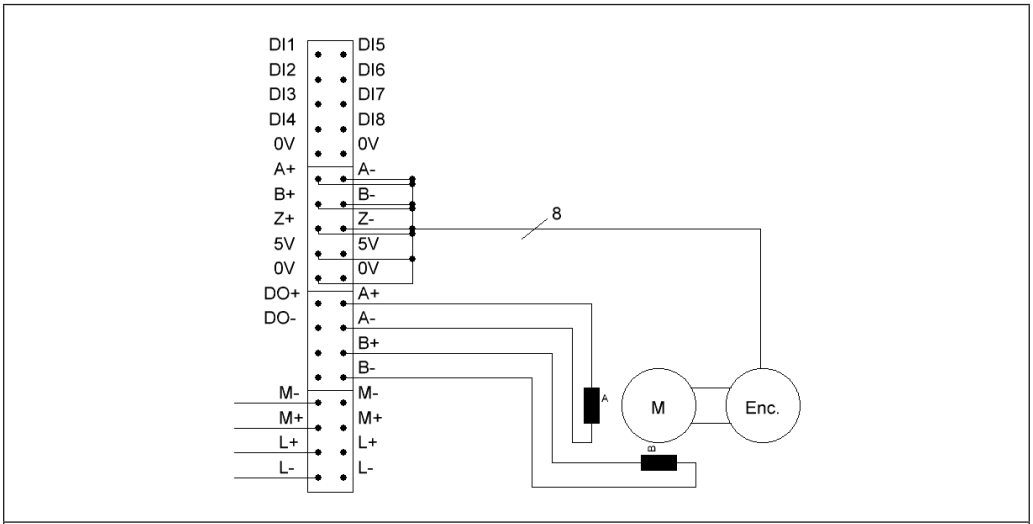


Figure 5: Stepper Motor in Closed Loop Mode

Parameter Settings

Motor type setting: (Motor drive submode select 3202_h). Bit 0 (OL/CL) must be set and bit 6 (BLDC) must not be set.

Auto Setup is mandatory for closed loop operation. Auto Setup retrieves the following values:

- Pole-pair number
- Encoder resolution
- Index width
- Alignment (offset between electric home position and index)
- Compensation of imprecise encoder run

Auto Setup prerequisites:

► Verify that the motor is off-load.

► Verify that nobody and nothing contacts the motor.

► Verify that the motor is free to turn in any direction.

► The maximum current must be set to the corresponding maximum current of the motor.

Auto Setup involves complicated computations which may not leave enough computing power to serve the fieldbuses as quickly as necessary - fieldbus operation may be compromised during the Auto Setup.

5.1.3 Brushless DC motor

Brushless DC motors are operated by means of a Hall generator or an incremental encoder.

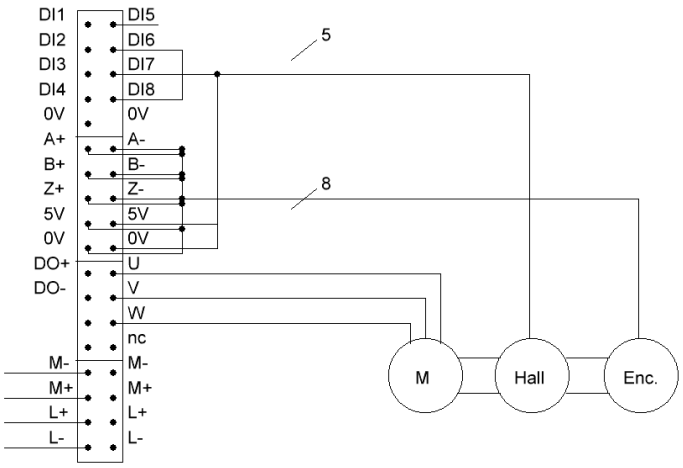


Figure 6: Brushless DC motor

Parameter Settings

Motor type setting: (Motor drive submode select 3202_h) Bit 0 (OL/CL) must be set and bit 6 (BLDC) must be set when using a BLDC motor.

Basic control parameter: Motor drive parameter set 3210_h

$3210_h:05_h$ 12000 ($2EE0_h$)
$3210_h:06_h$ 6000 (1770_h)
$3210_h:07_h$ 12000 ($2EE0_h$)
$3210_h:08_h$ 6000 (1770_h)

If you are operating the motor by means of just a Hall generator, verify that the number of pole pairs is set correctly.

Auto Setup is mandatory for operating a brushless DC motor. Auto Setup retrieves the following values:

- Pole-pair number
- Encoder resolution
- Index width
- Alignment (offset between electric home position and index)
- Compensation of imprecise encoder run

Auto Setup prerequisites:

► Verify that the motor is off-load.

► Verify that nobody and nothing contacts the motor.

► Verify that the motor is free to turn in any direction.

► The maximum current must be set to the corresponding maximum current of the motor.

Auto Setup involves complicated computations which may not leave enough computing power to serve the fieldbuses as quickly as necessary - fieldbus operation may be compromised during the Auto Setup.

5.1.4 Automatically determined encoder resolution

Auto Setup automatically determines and stores the encoder resolution.

5.1.5 Use of 24V encoder systems

5.1.5.1 Incremental encoder

Connect the incremental encoder cables A, B and Z to the corresponding connections of the C6 REMOTE I/O Stepper / BLDC.

The supply voltage for the incremental encoder can be taken from the free pins L+ and L-.

5.1.5.2 Hall encoder

To operate a 24V Hall encoder at the Stepper/BLDC module, it is necessary to bridge the Hconf and H24V terminals. This switches the internal pullup wiring from 5VDC to 24VDC.

Connect the Hall encoder wire H1, H2 and H3 to the corresponding connections of the module.

The supply voltage for the incremental encoder can be taken from the free terminals L+ and L-.

6 EtherCAT Operation

6.1 Generalities

6.1.1 Numeric Values

As a general rule, numeric values are shown as decimals. Exceptional hexadecimal figures are marked by appending a subscript "$_h$".The following notation is used to show the objects of the object dictionary: <index>:<subindex>

Both the index and the subindex are shown as hexadecimal figures. Subindex 00_h applies where a subindex is not set.

Example: to address subindex 5 of object 1003_h, enter "1003_h:05_h", to address subindex 0 of object 6040_h, enter "6040_h".Refer to the end of the manual to find a complete list of objects; references made to this list in the text are shown in blue and underlined, e.g. 6040_h.

6.1.2 Bits

Individual bits of an object are always numbered through from the LSB and starting with 0. See the example below illustrating a data type "UNSIGNED8".

MSB LSB

7	6	5	4	3	2	1	0
0	1	0	1	0	1	0	1

Equivalent to 55_h or 85_{dec}

6.1.3 Counting Direction

All counts in a drawing point in the direction of an arrow.

6.2 General Concepts

6.2.1 CANoverEtherCAT / DS402 Power State Machine

6.2.1.1 State Machine

A state machine cycle is required to make a control unit ready to operate. The state machine is subject to CANopen standard DS402. Changes of state are retrieved from object 6040_h (Controlword). Read object 6041_h (Statusword) to find the actual status of the state machine.

6.2.1.2 Controlword

Changes of state are retrieved from object 6040_h (Controlword). The table below summarises the bit combinations that cause the associated state transitions. X marks a bit status that no longer needs to be considered, the only exception being a fault reset: this transition is only requested by the bit's rising edge.

Command	Bit of object 6040_h					Transition
	7	3	2	1	0	
Shutdown	0	X	1	1	0	1, 5, 8
Switch on	0	0	1	1	1	2
Disable voltage	0	X	X	0	X	6, 7, 9, 12
Quick stop	0	X	0	1	X	10
Disable operation	0	0	1	1	1	4
Enable operation	0	1	1	1	1	3, 11
Fault reset		X	X	X	X	13

6.2.1.3 State Transitions

The diagram below illustrates the possible state transitions.

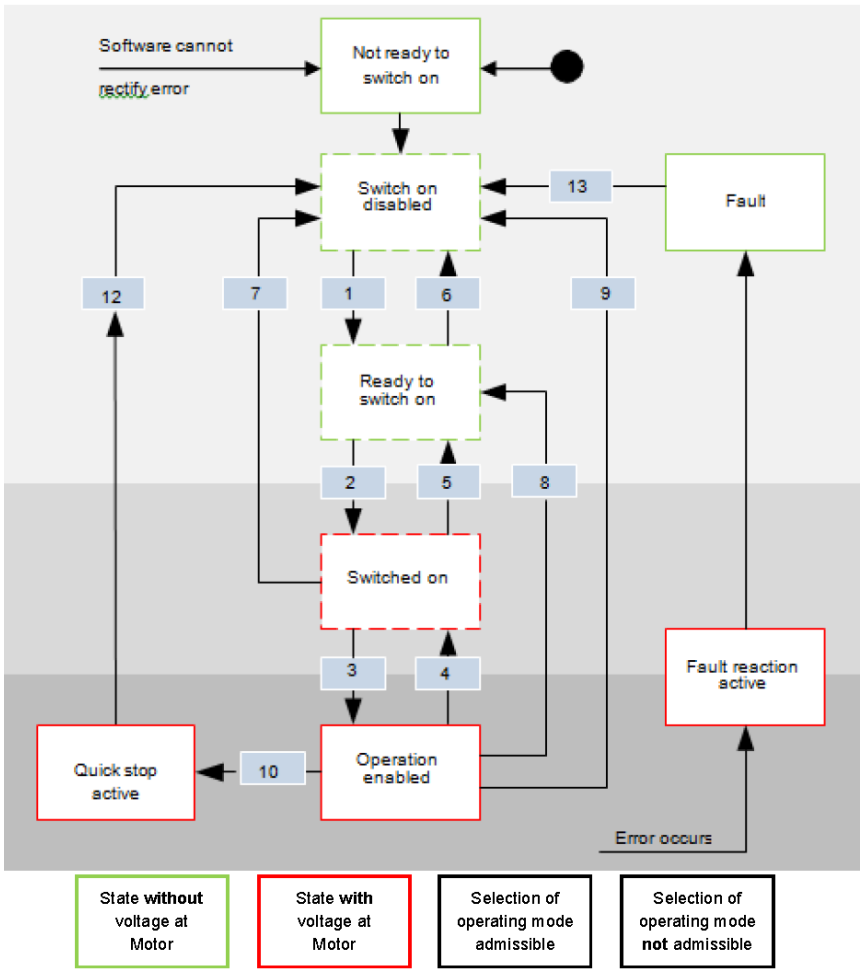


Figure 7: State Transitions

Ready to switch on

The state changes to "ready to switch on" (shutdown option): In this case, the action that has been defined in object Shutdown Option Code $605B_h$ will be executed.

Switched on

The state changes to "switched on" (disable operation option):

In this case, the action that has been defined in object Disable Option Code $605C_h$ will be executed.

Halt

Setting bit 8 in object Controlword 6040_h in the Velocity Mode and Profile Velocity Mode starts the response in Halt Option Code $605D_h$.

Fault

In case of a fault the motor will be decelerated as defined in objekt Fault Option Code $605E_h$ hinterlegt ist.

Quick stop active

The state changes to "quick stop active" (quick stop option): In this case, the action that has been defined in object quick stop Option Code $605B_h$ will be executed.

6.2.2 User-defined UoM

6.2.2.1 Overview

6.2.2.2 Settings

The internal control unit in the module supports user-defined units of measurement (UoM). Thus, parameter settings can be entered and read directly as degree, mm etc.

6.2.2.3 Pole Pair Number Compensation

Compensates for different pole pair numbers of different motors, Therefore the value in object Encoder Configuration is 2059_h.

Name	Encoder Configuration
Index	2059_h
Object Code	VARIABLE
No. of Elements	0
Data type	INTEGER32
Saveable	Yes, Tuning

Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Currently not available.

Compensate polepair count 2060_h must be set to „1“. Later calculations will automatically use the changed pole pair number such that you can connect different motors to the control unit without having to reconfigure the system.

6.2.2.4 Equations for Computing User-defined UoM

Gear ratio

Use the equation below to compute the gear ratio (Gear ratio 6091_h) from the motor revolution ($6091_h:01_h$ (motor revolutions)) per shaft revolution ($6091_h:02_h$ (shaft revolutions)):

$$\text{Gear ratio} = \frac{\text{Motor revolution (6091 : 01)}}{\text{Shaft revolution (6091 : 02)}}$$

In case object $6091_h:01_h$ or object $6091_h:02_h$ are set to "0", the firmware will change the value to "1".

Feed constant

Use the equation below to compute the feed constant (Feed constant 6092_h) from the feed rate ($6092_h:01_h$ (Feed Constant)) per drive shaft revolution ($6092_h:02_h$ (Shaft Revolutions)):

$$\text{Feed constant} = \frac{\text{Feed rate (6092 : 01)}}{\text{Shaft revolution (6092 : 02)}}$$

This is useful to state the screw pitch of a linear shaft. In case object $6092_h:01_h$ or object $6092_h:02_h$ In case object 6092h:01h or object 6092h:02h are set to "0", the firmware will change the value to "1".

Position

Use the equation below to compute the current position as user-defined UoM (Position actual value 6064_h):

$$\text{Position} = \frac{\text{Internal position} * \text{Feed constant}}{\text{Encoder resolution} * \text{Gear ratio}}$$

Velocity

The velocity settings of the objects below may also be made as user-defined UoM:

Object	Mode	Explanation
$606B_h$	Profile Velocity Mode	Value output by the trajectory generator
$60FF_h$	Profile Velocity Mode	Velocity set-point
6099_h	Homing Mode	Velocity for finding the index / switch
6081_h	Profile Position Mode	Target velocity
6082_h	Profile Position Mode	Final velocity

The internal velocity (mechanical revolutions per second) is multiplied by a factor as numerator (Velocity nominator 2061_h) and denominator (Velocity denominator 2062_h and by the shaft polarity in object $607E_h$ bit 6. Setting bit 6 of object $607E_h$ to value „1“ reverses the polarity and is the same as "-1" in the equation:

$$\text{Speed} = \text{Polarity (607E)} = \frac{\text{Internal speed} * \text{numerator (2061)}}{\text{Denominator (2062)}}$$

In case object 2061_h or object 2062_h is "0", the firmware will change the value to "1".

Acceleration

Acceleration values may also be output as user-defined UoM:

Object	Mode	Explanation
$609A_h$	Homing Mode	Acceleration
6083_h	Profile Position Mode	Acceleration
6084_h	Profile Position Mode	Braking acceleration
$60C5_h$	Profile Velocity Mode	Acceleration
$60C6_h$	Profile Position Mode	Braking acceleration
6085_h	State „Quick stop active“ (DS402 power state machine)	Braking acceleration

The internal acceleration (mechanical revolutions per second squared) is multiplied by a factor as numerator (Acceleration nominator 2063_h) and denominator (Acceleration denominator 2064_h).

$$\text{Acceleration} = \frac{\text{Internal acceleration} * \text{numerator (2063)}}{\text{Denominator (2064)}}$$

In case object 2063_h or object 2064_h is "0", the firmware will change the value to "1".

Jerk

For the jerk, objects Profile Jerk $60A4_h$: 01_h to 04_h can be specified as user-defined UoM. These objects apply to the Profile Position Mode and the Profile Velocity Mode only.

Available are the objects Jerk nominator 2065_h for the numerator and Jerk denominator 2066_h for the denominator. To compute the values of objects $60A4_h$:01_h to 04_h, multiply the cubed mechanical revolutions per second by the numerator and denominator:

$$\text{Jerk} = \frac{\text{Internal value} * \text{numerator (2065)}}{\text{Denominator (2066)}}$$

In case object 2065_h or object 2066_h is "0", the firmware will change the value to "1".

Positions

The positions shown in both the open loop and closed loop modes adapt to the resolution of the virtual position encoder which computes as the encoder increments (Position encoder resolution $608F_h$:01_h (Encoder Increments)) per motor revolution (Position encoder resolution $608F_h$:02_h (Motor Revolutions)) multiplied by the shaft polarity in object $607E_h$ Bit 7. Setting bit 7 of object $607E_h$ to value „1“ reverses the polarity and is the same as "-1" in the equation:

$$\text{Encoder resolution} = \text{Polarity (607E)} = \frac{\text{Encoder - Increments (608F : 01)}}{\text{Motor revolutions (608F : 02)}}$$

If value $608F_h$:01_h or value $608F_h$:02_h are set to "0", the control unit internally continues to use "1". Factory defaults:

Encoder increments $608F_h$:01_h = "2000"

Motor revolutions $608F_h$:02_h = "1"

Polarity $607E_h$ bit 7 = "0" (same as reversed polarity)

Object Encoder Resolution 2052_h sets the resolution of the position encoder.

6.3 Profile Position Mode

6.3.1 Overview

6.3.1.1 Description

Profile Position Mode lets you move either to a relative position (with reference to the last target position) or an absolute position (last reference position). The movement takes account of velocity, starting / braking acceleration and jerk limits.

6.3.1.2 Activation

This mode is enabled by "1" in object Modes of operation 6060_h (see "DS402 Power State machine").

6.3.1.3 Controlword

The following bits of object Controlword 6040_h have a special function:

- Bit 4 starts a motion task which is performed when "0" changes to "1".
- Bit 5: "1" immediately performs the motion task requested by bit 4. "0" first completes the current motion task and delays the start of the next task until after that.
- Bit 6: "0" sets an absolute target position ($607A_h$), "1" sets a target position with reference to the current position.
- Bit 9: if set, the velocity will not change until the motion arrives at the first target position. Consequently, there will be no braking before the first target because the motor is not intended to stop at that position.

6040_h Bit 9	**6040_h Bit 5**	**Description**
X	1	Immediately moves to the new target position.
0	0	Completes the current motion before moving to the next target position and applying the new limits.
1	0	Maintains the current velocity to move to the current target position where the new values are applied to move to the next target position.

See the picture in „Setting of Drive Commands“.

6.3.1.4 Statusword

The following bits of object Statusword 6041_h have a special function:

- Bit 10 (Target Reached): changes to "1" when the motion arrives at the last target and the motor dwells for a specified time (Position window time 6068_h) within a tolerance range (Position window 6067_h).
- Bit 12 (Set-point acknowledge): acknowledges that a new and valid target has been received. Setting and resetting it is synchronised with setting and resetting bit "new set-point" of the control word. One exception assumes the start of a motion while another motion is still in progress whereas the next motion should not start until the first motion is complete. In this case, the bit will not reset until the command has been accepted and the control unit is ready to execute new drive commands. Sending a new drive command while this bit is still set will lead to the latest drive command being ignored. Any of the conditions below prevent the bit from being set:
- Assuming that all constraints are met, the motion will fail to arrive at the new target position.
- A motion a target position is in progress and another target position has been set. A new target position cannot be set until the current motion has been completed.
- The new position is out of the valid range (Software position limit $607D_h$).
- Bit 13 (Following Error): This bit is set in closed loop mode if the following error exceeds the adjusted limits (Following error window 6065_h and Following error time out 6066_h).

6.3.2 Defining Drive Commands

6.3.2.1 Drive command

Use object Target Position $607A_h$ to set the new target position as user-defined UoM (see User-defined UoM). Setting bit 4 of object Controlword 6040_h then starts the drive command. Assuming that a valid target position has been set, the control unit responds by bit 12 of object Statusword 6041_h and starts the motion. At the target position, bit 10 of the status word is set to "1".

6.3.2.2 Progress of Drive Command

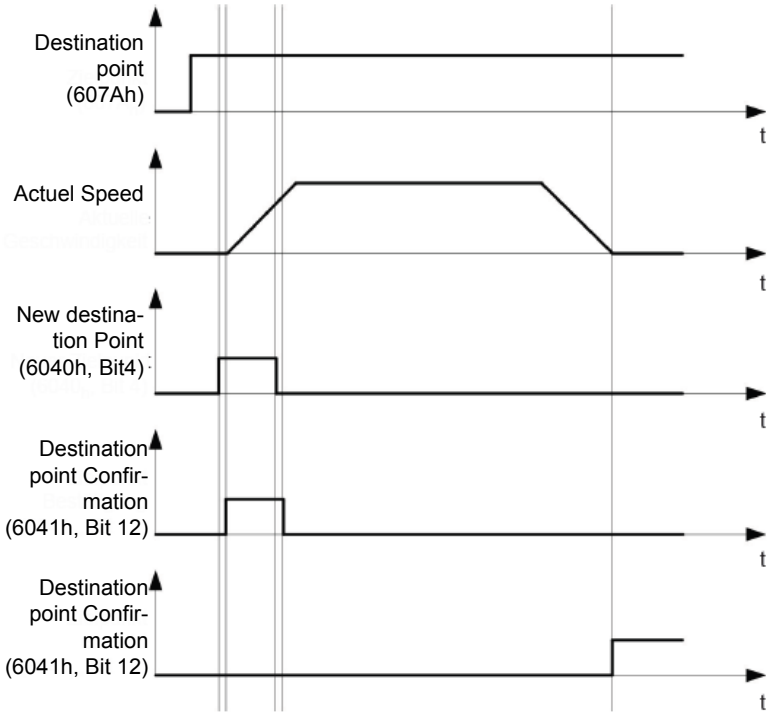


Figure 8: Progress of Drive Command

6.3.2.3 Further Drive Commands

Bit 12 in object Statausword 6041_h (Set-point acknowledge) falls back to "0", if another drive command can be stored (see point 1 in the following figure). As long as a target position is approached, a second target position can be preparatory given to the control. Thereby all parameters - such as speed, acceleration, deceleration, etc. - can be reset (time 2). If the cache memory is empty again, the next time can be enqueued (time 3).

If the cache memory is already full, a new target point is ignored (time 4). If bit 5 is set in object Controlword 6040_h (Change Set-Point Immediately), the control works without the cache memory, new drive commands are directly converted (time 5).

6.3.2.4 Times

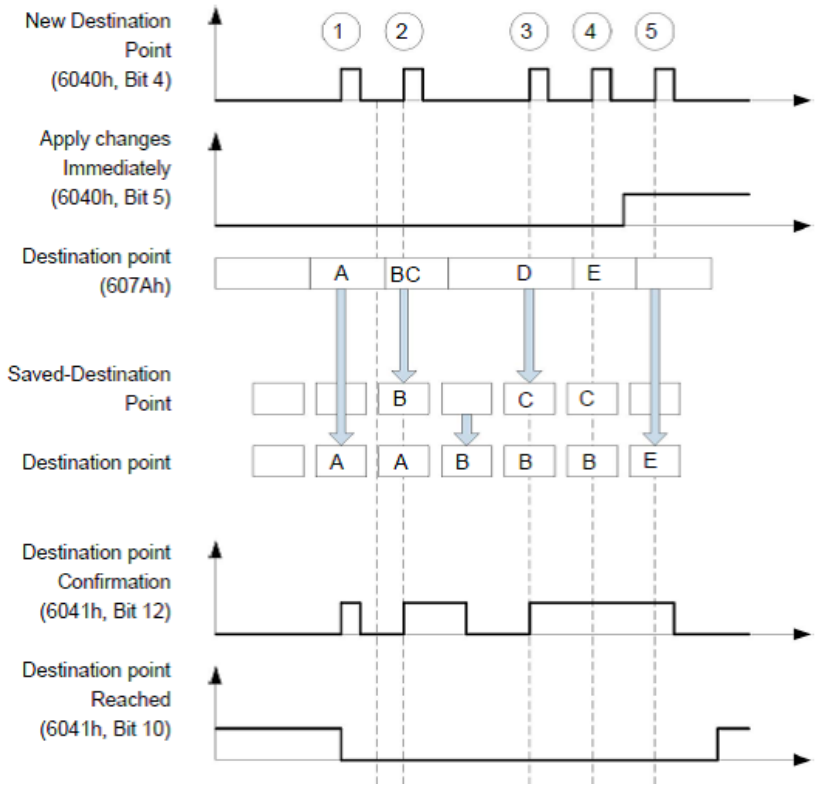


Figure 9: Times

6.3.2.5 Procedure for Activating the Next Target Position

The diagram below shows how the next target position is activated while the motion towards the first target position is still in progress. In this figure, bit 5 of object Controlword 6040_h is set to "1", the new target value will be accepted immediately.

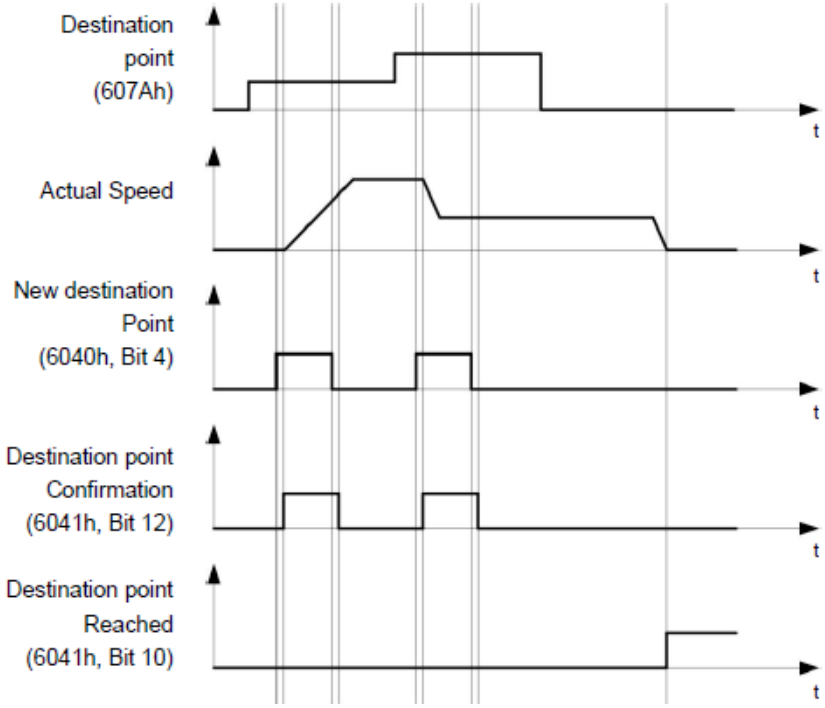


Figure 10: Procedure for Activating the Next Target Position

6.3.2.6 Opportunities for approaching a target position

If bit 9 is "0" in object Controlword 6040_h, the actual target position is completely approached. In this example, the end velocity (End velocity 6082_h) of the first target position is equal to zero.

If bit 9 is set to "1", the end velocity is maintained until the target position has been reached; only then the new limit conditions apply.

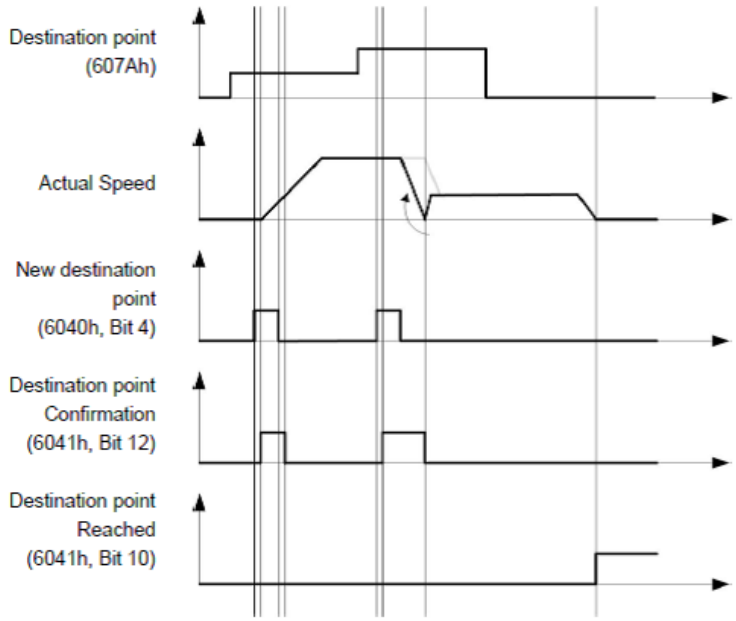


Figure 11: Opportunities for approaching a target position

6.3.3 Object entries

Use the following object dictionary entries to set the constraints of the current drive task:

Position actual value 6064_h: current motor position

Target Position $607A_h$: set target position

Position range limit $607B_h$: defines the limit stops (see section further down below)

Home offset $607C_h$: shifts the machine's home position (see "Homing Mode")

Software position limit $607D_h$: limits of a modulo operation for simulating a continuous axis of rotation (see "Shaft Scaling")

Polarity $607E_h$: Rotation reserval

Profile velocity 6081_h: maximum velocity of moving towards the position

End velocity 6082_h: velocity at the target position

Profile acceleration 6083_h: starting acceleration preset

Profile deceleration 6084_h: braking acceleration preset

Quick Stopp deceleration 6085_h: braking acceleration of emergency stop if the state of the "DS402 power state machine" is "quick stop active"

Motion profile type 6086_h: type of ramp; "0" does not limit the jerk, "3" limits the jerk according to the values in $60A4_h$:1_h- 4_h.

Max acceleration $60C5_h$: maximum acceleration that must not be exceeded while moving towards the final position

Max deceleration $60C6_h$: maximum braking acceleration that must not be exceeded while moving towards the final position

Profile Jerk $60A4_h$, Subindex 01_h to 04_h: Objects for the description of the limit values for the jerk Objects of positioning runs. The diagram below illustrates which objects are involved in setting the constraints of a positioning run.

6.3.3.1 Objects of Positioning Runs

The diagram below illustrates which objects are involved in setting the constraints of a positioning run.

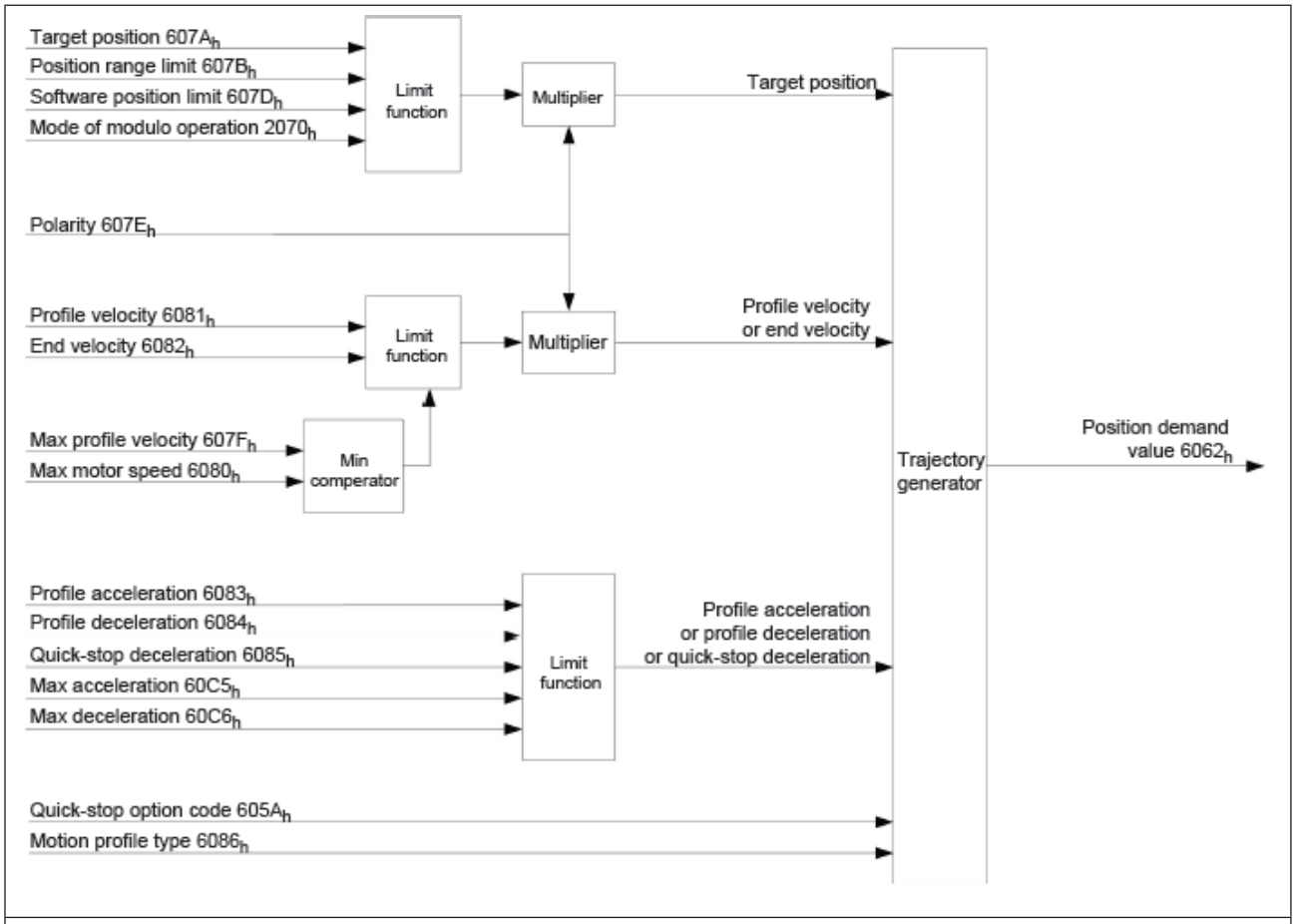


Figure 12: Objects of Positioning Runs

6.4 Velocity Mode

6.4.1 Overview

6.4.1.1 Description

This mode runs the motor with a set target velocity, similar to a frequency converter. As opposed to the Profile Velocity Mode, the Velocity Mode does not monitor the velocity and disallows the selection of ramps with limited jerking.

6.4.1.2 Activation

This mode is enabled by "2" in object Modes of operation 6060_h (see „DS402 Power State machine“).

6.4.1.3 Controlword

The following bits of object Controlword 6040_h have a special function:

- Bit 2 initiates an quick stop. If set to "0" the motor performs a rapid braking with the quick stop ramp set in object Vl velocity quick stop $604A_h$. Then the control changes into the state "Switch on disabled".
- Bit 8 (Halt): when the bit changes from "1" to "0", the motor accelerates up the set acceleration ramp until running at target velocity. When it changes from "0" to "1", the motor decelerates down the braking ramp until it stops.

6.4.1.4 Statusword

The following bits of object Statusword 6041_h have a special function:

- Bit 11: limit exceeded: the target velocity is out of the set limits.

6.4.2 Object entries

The following objects are required to control this mode:

- Vl dimension factor $604C_h$: Sets the UoM of the velocities set in the objects below. Setting subindex 1 and 2 to "1" shows the velocity as revolutions per minute. Otherwise, subindex 1 contains the multiplier and subindex 2 the divisor for further velocity calculations. The result will be interpreted as either electrical (object 2060_h = 0) or mechanical (object 2060_h = 1) revolutions per second. Sets the target velocity to be shown as user-defined UoM.
- Vl target velocity 6042_h: Target velocity.
- Vl velocity acceleration 6048_h: sets the starting acceleration. Subindex 1 contains the change in velocity, subindex 2 the associated time in seconds. Both values are taken to compute the acceleration:

$$\text{Vl\_velocity\_acceleration} = \frac{\text{Delta\_speed (6048 : 01)}}{\text{Delta\_time (6048 : 02)}}$$

- Vl velocity deceleration 6049_h: sets the braking acceleration. The subindices are arranged as described for object 6048_h; remember to add a positive sign to the velocity difference.
- Quick Stopp deceleration 6085_h: sets the quick stop deceleration. The subindices are arranged as described for object 6048_h; remember to add a positive sign to the velocity difference.
- Vl velocity min max amount 6046_h: sets the target velocity limits. 6046_h:01_h sets the minimum velocity. If the target velocity drops below the minimum velocity, the value is limited to the minimum velocity set in 6046_h:01_h. 6046_h:02_h sets the maximum velocity. If the target velocity exceeds the maximum velocity, the value is limited to the maximum velocity set in 6046_h:02_h.
- Vl velocity quick stop $604A_h$: Allows you to set the quick stop ramp. The sub-indices 1 and 2 are identical as described in object Vl velocity deceleration 6049_h .

6.4.2.1 Velocities of Velocity Mode

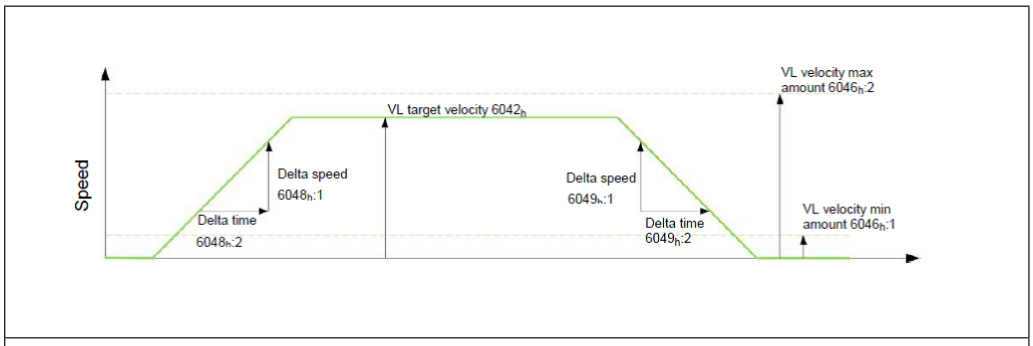


Figure 13: Velocities of Velocity Mode

6.4.2.2 Velocity Mode Objects

The ramp generator observes the target velocity within the set velocity and acceleration limits. Bit 11 of object Statusword 6041_h is set for as long as a limit is active (internal limit active).

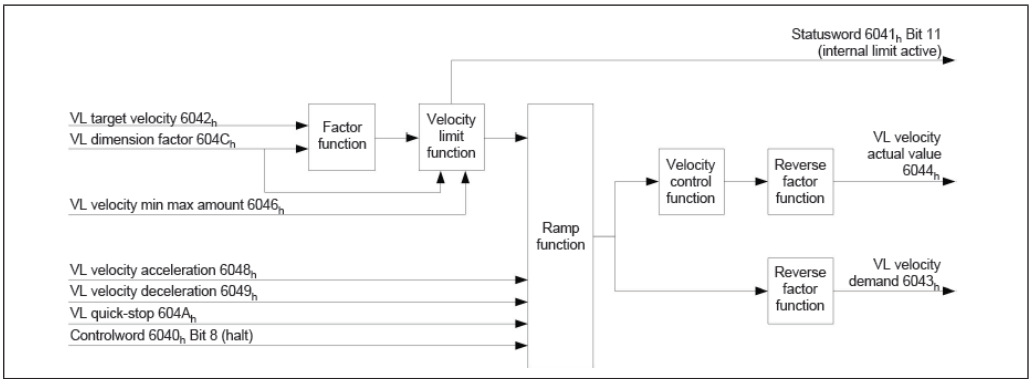


Figure 14: Velocity Mode Objects

6.5 Profile Velocity Mode

6.5.1 Overview

6.5.1.1 Description

This mode runs the motor in Velocity Mode with extended ramps. As opposed to Velocity Mode (see "Velocity"), this mode supports an external encoder for monitoring the current velocity.

6.5.1.2 Activation

This mode is enabled by "3" in object Modes of operation 6060_h (see „DS402 Power State machine“).

6.5.1.3 Controlword

The following bits of object Controlword 6040_h have a special function:

- Bit 2 initiates an quick stop. If set to "0" the motor performs a rapid braking with the quick stop ramp set in object 6085_h. Then the control changes into the state "Switch on disabled" (6040_h).
- Bit 8 (Halt): when the bit changes from "1" to "0", the motor accelerates up the set starting ramp until running at target velocity. When it changes from "0" to "1", the motor decelerates until it stops.

6.5.1.4 Statusword

The following bits of object Statusword 6041_h have a special function:

Bit 10 (at target velocity; Target Reached): Together with bit 8 of the control word, this bit says whether the motor is running at target velocity, is being decelerated or standing still (see table).

6041_h Bit 10	6040_h Bit 8	Description
0	0	Not at target velocity
0	1	Shaft decelerating
1	0	Target velocity within target limits (defined in 606Dh and 606Eh) (defined in $606D_h$ and $606E_h$)
1	1	Shaft velocity is 0

6.5.1.5 Object entries

The following objects are required to control this mode:

- Velocity demand value $606B_h$: Contains the value output by the trajectory generator; this value also serves as the preset of the velocity controller.
- Velocity actual value $606C_h$: Shows the current actual velocity.
- Velocity window $606D_h$: Specifies the maximum difference between actual and set-point velocity for bit 10 ("Target Reached") of object 6041_h (statusword) still being set to "1".
- Velocity Window Time $606E_h$: Specifies how long the real and the set-point velocities are to be close together (see $606D_h$ „Velocity Window“), for bit 10 "Target Reached" of object 6041_h (Statusword) still being set to "1".
- Polarity $607E_h$: bit 6 = "1" reverses the sign of the target velocity.
- Profile acceleration 6083_h: sets the acceleration ramp in Velocity Mode.
- Profile deceleration 6084_h: sets the deceleration ramp in Velocity Mode.
- Quick Stopp deceleration 6085_h: sets the deceleration ramp of rapid braking in Velocity Mode.
- Motion profile type 6086_h: allows you to choose a ramp type (0 = trapezoidal ramp, 3 = jerk-delimited ramp).
- Profile Jerk $60A4_h$: Subindex 01_h to 04_h: Objects for the description of the limit values for the jerk. Objects of positioning runs. The diagram below illustrates which objects are involved in setting the constraints of a positioning run.
- Target velocity $60FF_h$: shows the set target velocity.
- Maximum Current 2031_h: maximum current, mA.

6.5.1.6 Profile Velocity Mode Objects

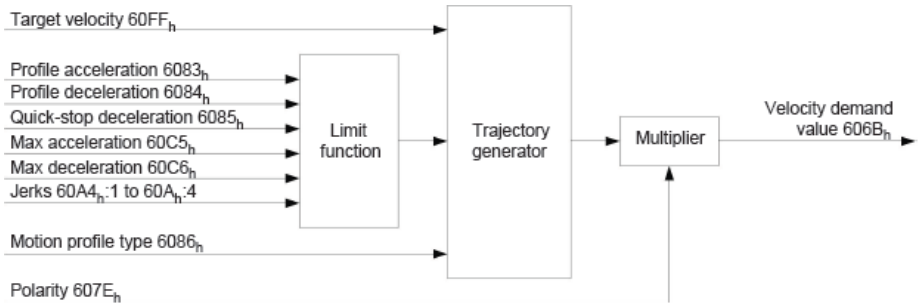


Figure 15: Profile Velocity Mode Objects

6.5.1.7 Activation

After selecting the mode in object Modes of operation 6060$_h$ and setting the "Power State machine" (see "DS402 Power State machine") to "Operation enabled", the motor accelerates to the target velocity set in object 60FF$_h$ (see the diagrams below).

The process takes account of the velocity, acceleration and - if jerk-delimited ramps are set - the jerk limits.

6.5.1.8 Limits of Jerk-delimited Operation

The diagram below illustrates the limits that can be set for jerk-delimited operation (6086$_h$ = 3).

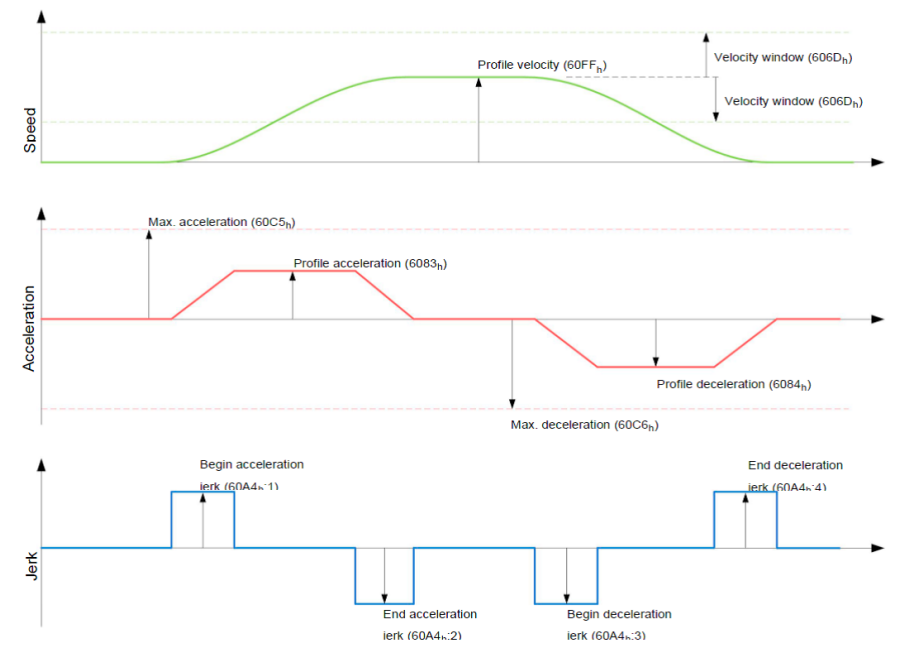


Figure 16: Limits of Jerk-delimited Operation

6.5.1.9 Limits of Trapezoidal Operation

The diagram below illustrates the limits available for trapezoidal operation (6086_h = 0).

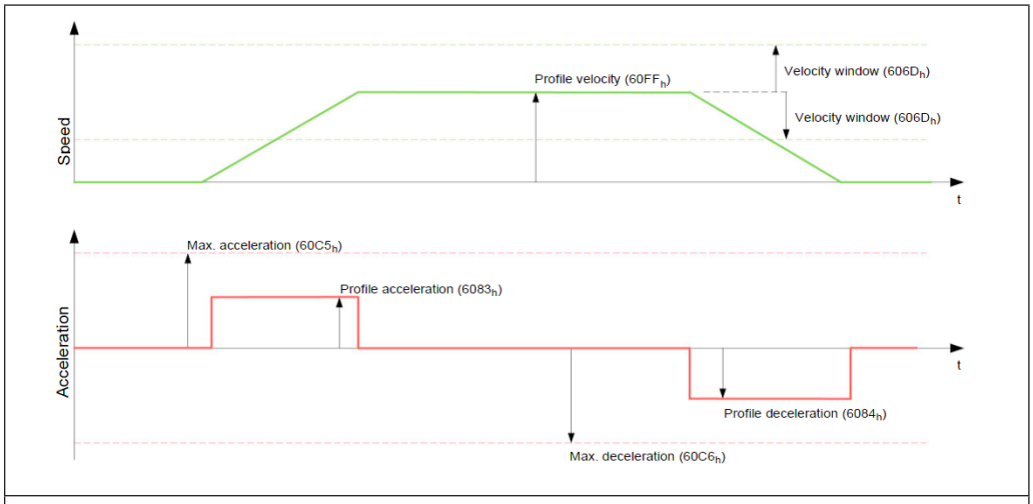


Figure 17: Limits of Trapezoidal Operation

6.6 Profile Torque Mode

6.6.1 Overview

6.6.1.1 Description

This mode presets the torque and uses a ramp function to start the motor.

6.6.1.2 Activation

This mode is enabled by "4" in object Modes of operation 6060_h (see „DS402 Power State machine“).

6.6.1.3 Controlword

The following bits of object Controlword 6040_h have a special function:

- Bit 8 (Halt): "0" means that the motor will start with reference to the set-points."1" slows down the motor to standstill with reference to the setpoints.
-
-
-
-
-

6.6.1.4 Statusword

The following bits of object Statusword 6041_h have a special function:

Bit 10 (Target Reached): Together with bit 8 of object 6040_h (Controlword), this bit says whether the preset torque is reached (see table below).

6041_h Bit 10	6040_h Bit 8	Description
0	0	Set-point torque not available
0	1	Set-point torque available
1	0	Shaft is accelerating
1	1	Shaft velocity is 0

6.6.2 Object entries

Enter the values of all object dictionary entries as thousandths of the maximum torque equivalent to the maximum current (2031_h). Objects concerned:

- Target torque 6071_h: setting target torque
- Max torque 6072_h: maximum torque delivered for the entire ramp (accelerate, hold torque, decelerate)
- Torque demand 6074_h: actual output value of the ramp generator (torque) for the controller
- Torque slope 6087_h: max. torque change per second

Motor drive submode select 3202_h Bit 5: If this bit is set to "0", the drive controller is operated in the torque limited velocity mode, i.e. the max. speed can be limited in object Maximum speed 2032_h and the controller can operate in the field weakening mode. "1" runs the controller in Torque Mode which does not allow you to delimit the velocity or enable field weakening mode.

6.6.2.1 Ramp Generator Objects

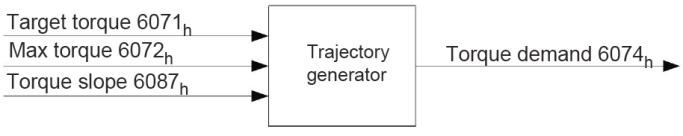


Figure 18: Ramp Generator Objects

6.6.2.2 Torque Diagram

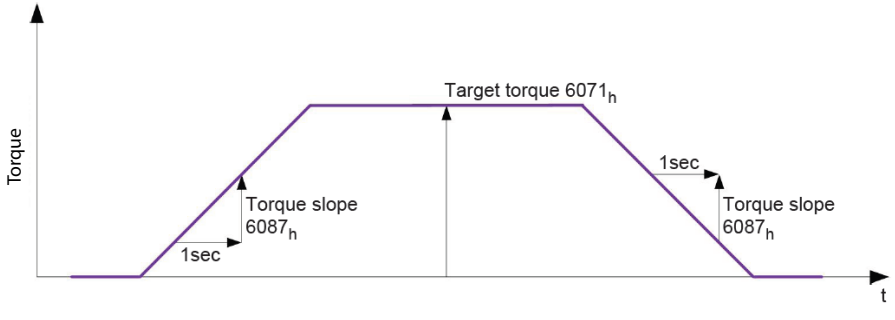


Figure 19: Ramp Generator Objects

6.7 Homing Mode

6.7.1 Overview

6.7.1.1 Description

Referencing (homing method) aims to synchronise the control unit to the encoder index of a system's motor or marker switch.

6.7.1.2 Activation

This mode is enabled by "6" in object Modes of operation 6060_h (see „DS402 Power State machine“).

Before you can use reference and/or limit switches, you must first enable these special functions by changing the I/O configuration (see "Digital Inputs and Outputs").

6.7.1.3 Controlword

The following bits of object Controlword 6040_h have a special function:

Bit 2: initiates an emergency stop. If set to "0" the motor performs a rapid braking with the quick stop ramp set in object Quick Stopp deceleration 6085_h.The state of the motor then changes to "switch on disabled" (see "DS402 power state machine").

Bit 4: "1" starts referencing which will continue until either the reference position has been reached or bit 4 is reset to "0".

6.7.1.4 Statusword

The following bits of object Statusword 6041_h have a special function:

6041_h Bit 13	6041_h Bit 12	6041_h Bit 10	Description
0	0	0	Referencing in progress
0	0	1	Referencing suspended or not started
0	1	0	Referencing started but has not arrived at target yet
0	1	1	Referencing completed
1	0	0	Referencing error, motor is still turning
1	0	1	Referencing error, motor at standstill

6.7.2 Object entries

- The following objects are required to control this mode:
- Homing Method 6098_h: Method to be used for referencing (see "Homing Methods")
- Homing Speeds 6099_h
  - 01_h: velocity for finding the switch
  - 02_h: (Speed During Search For Zero): velocity for finding the index
- Homing acceleration $609A_h$: starting and braking acceleration for referencing:
- Limit Switch Tolerance Band 2056_h: The control unit sets an extra tolerance range that the motor is allowed to keep going after arriving at the positive or negative limit switch. Exceeding this tolerance range stops the motor and changes the state of the control unit to "fault". In case there are any limit switches that may be actuated while referencing, the tolerance range should be large enough to let the motor decelerate properly within it. Referencing will otherwise fail to be successful. If the application requires it, the tolerance range can be reset to "0" when the homing run is over.
- Homing On Block Configuration $203A_h$
  - 01_h (Minimum Current For Block Detection): Minimum current threshold which, when exceeded, is to indicate that the motor blocks at a block.
  - 02_h (Block Detection Time): minimum time in ms, that the current must exceed the minimum current threshold before a block is detected.
  -

The picture shows the speed of the homing using the example of method 4:

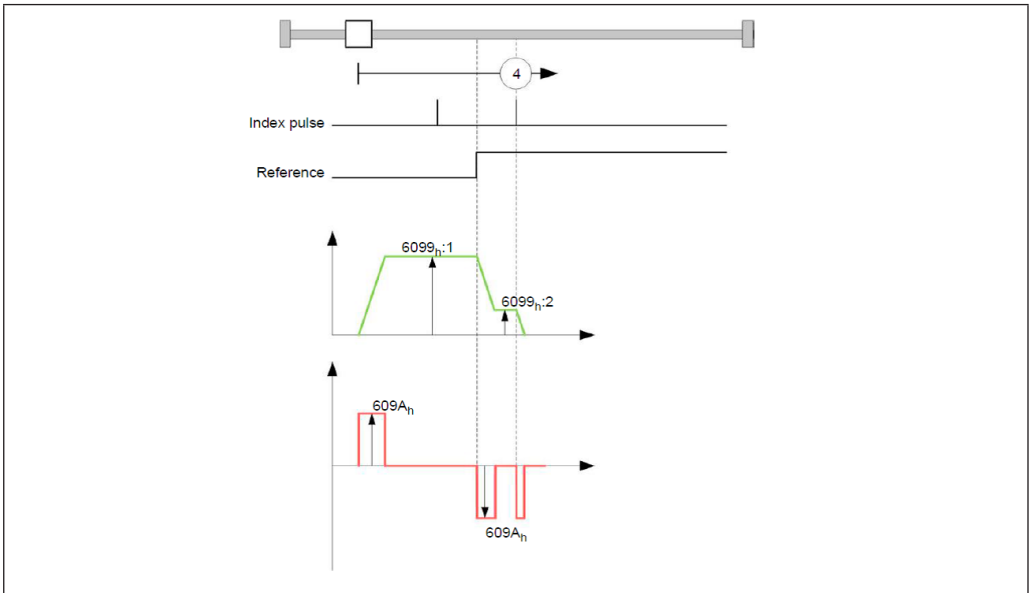


Figure 20: Tolerance Bands of Limit Switches

6.7.3 Tolerance Bands of Limit Switches

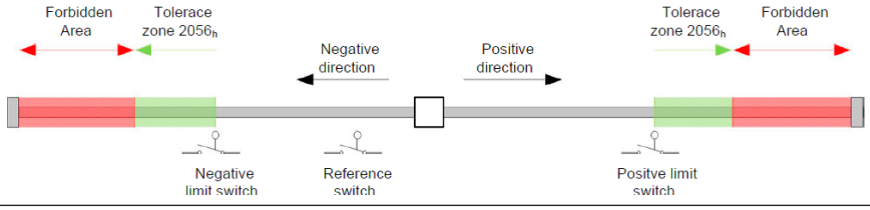


Figure 21: Tolerance Bands of Limit Switches

6.7.4 Homing Methods

6.7.4.1 Description

Enter the number of the homing method into object Homing Method 6098_h. The method decides the element to be referenced (rising/falling edge of a switch, current threshold for block detection, index impulse) and the direction in which homing starts. Numbers 1 to 14, 33 and 34 are reserved for methods using the encoder's index impulse. Whereas numbers 17 to 30 are reserved for methods referencing a limit switch, their motion profiles are the same as the ones of methods 1 to 14. Circles mark these numbers in the pictures below. Prefix a minus sign to the method number if the method does not use any limit switches but is meant to detect a block that the motion runs into.

In the pictures below, a motion to the left means negative. Whereas a limit switch is always located in front of a mechanical blockage, the reference switch ("home switch") is located between the two limit switches. The encoder connected to both the motor shaft and the control unit generates the index impulses.

Methods for homing to a blockage and methods using limit switches share the same pictures. Extra pictures seemed to be unnecessary because both types of methods only differ in whether or not the limit switches are present. Just replace the limit switches with a mechanical blockage and use the same pictures.

6.7.4.2 Homing on block

Homing on block functions perfectly only in closed loop mode at the moment. The finer points that have to be observed for homing on block in closed loop mode, for instance, are given in detail in the section on controls.

For certain applications it is appropriate to travel against the block for a specific time after a block has been detected. This time can be set in object $203A_h:02_h$ in ms.

To ensure very precise detection of the block, the block should be traveled against with a very low speed ($6099_h:01_h$), high current limit ($203A_h:01_h$), and high homing acceleration ($609A_h$). Additionally, detection can be refined by the block detection time ($203A_h:03_h$).

6.7.4.3 Methods Overview

Methods 1 to 14, 33 and 34 use the encoder's index impulse.

Methods 17 to 32 are identical to methods 1 to 14, except homing is made to the limit or home switch but not to the index impulse.

- Methods 1 to 14 contain an index impulse
- Methods 15 and 16 do not exist
- Methods 17 to 30 do not contain an index impulse
- Methods 31 and 32 do not exist
- Methods 33 and 34 only reference the next index impulse
- Method 35 references the current position

The following methods are available for homing to a blockage:

- Methods -1 to -2 and -7 to -14 contain an index impulse
- Methods -17 to -18 and -23 to -30 do not contain an index impulse

6.7.4.4 Methods 1 and 2

Homing to a limit switch and an index impulse.

Method 1 references the negative limit switch and the index impulse:

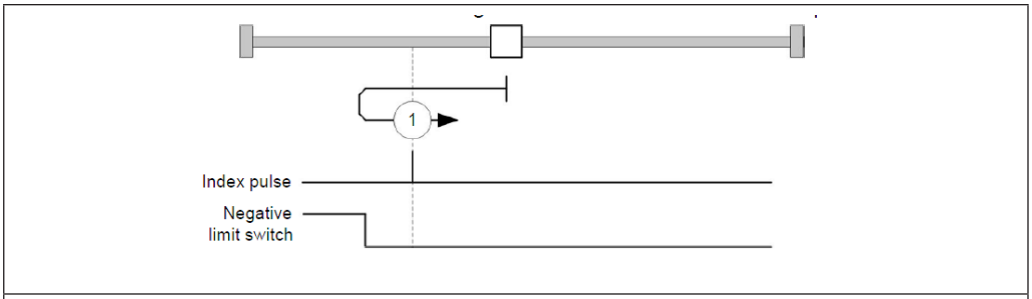


Figure 22: Method 1

Method 2 references the positive limit switch and the index impulse:

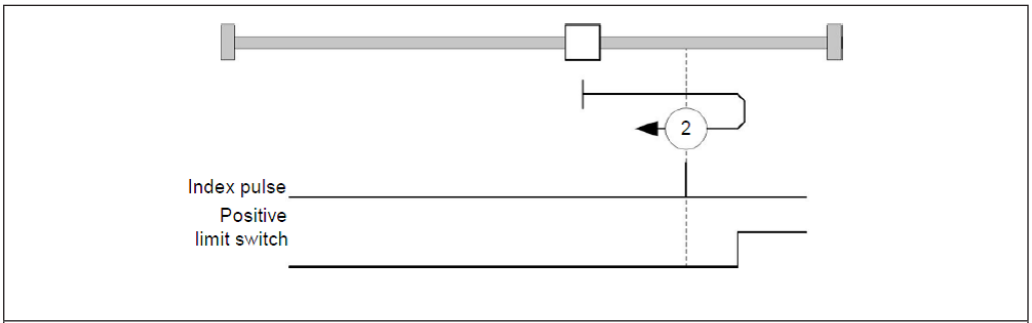


Figure 23: Method 2

6.7.4.5 Methods 3 to 6

Homing to the home switch's switching edge and an index impulse.
Methods 3 and 4 use the reference switch's left switching edge for homing:

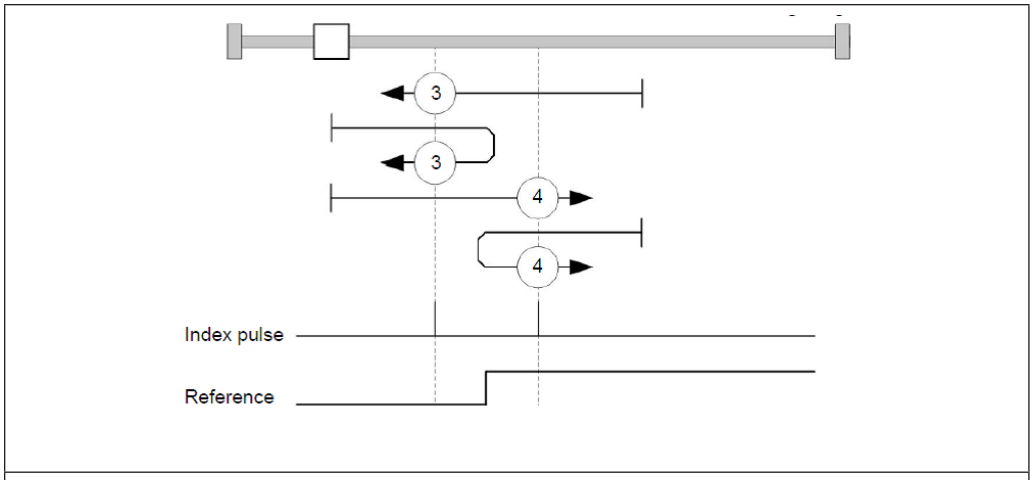


Figure 24: Methods 3 and 4

Methods 5 and 6 use the reference switch's right switching edge for homing:

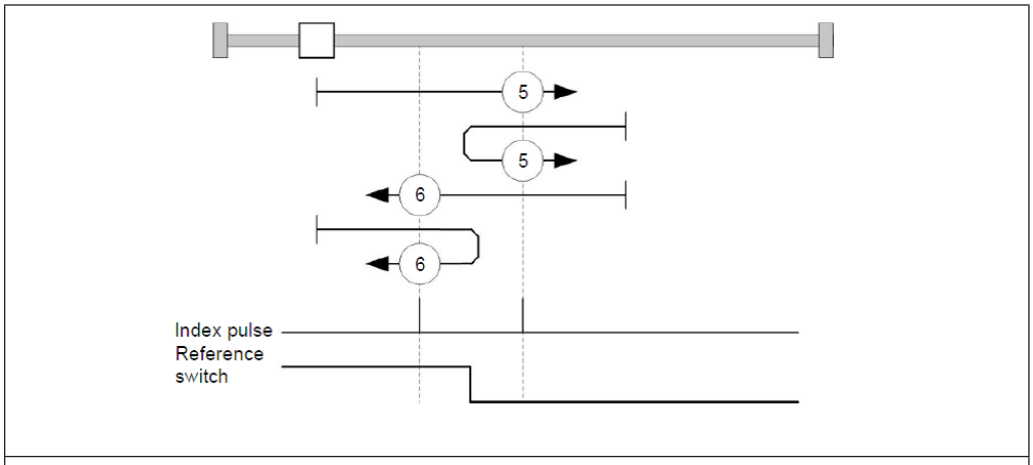


Figure 25: Methods 5 and 6

6.7.4.6 Methods 7 to 14

Homing to a home switch and an index impulse (with limit switches).

These methods do not consider the current position in relation to the home switch. Method 10, for example, always homes in on the index impulse to the right of the right edge of the home switch.

Methods 7 to 10 consider the positive limit switch:

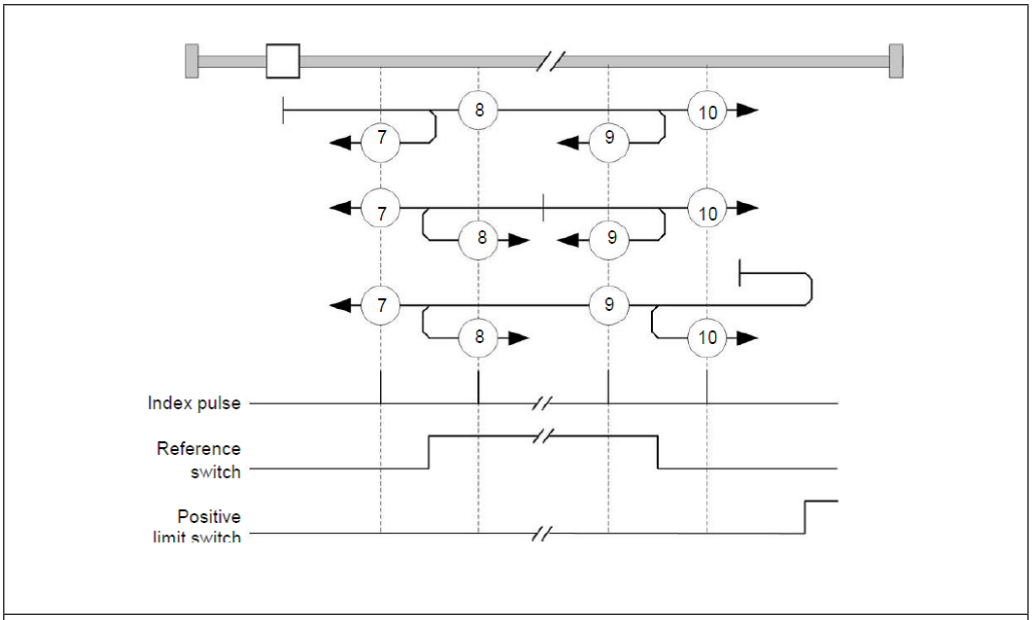


Figure 26: Methods 7 to 10

Methods 11 to 14 consider the negative limit switch:

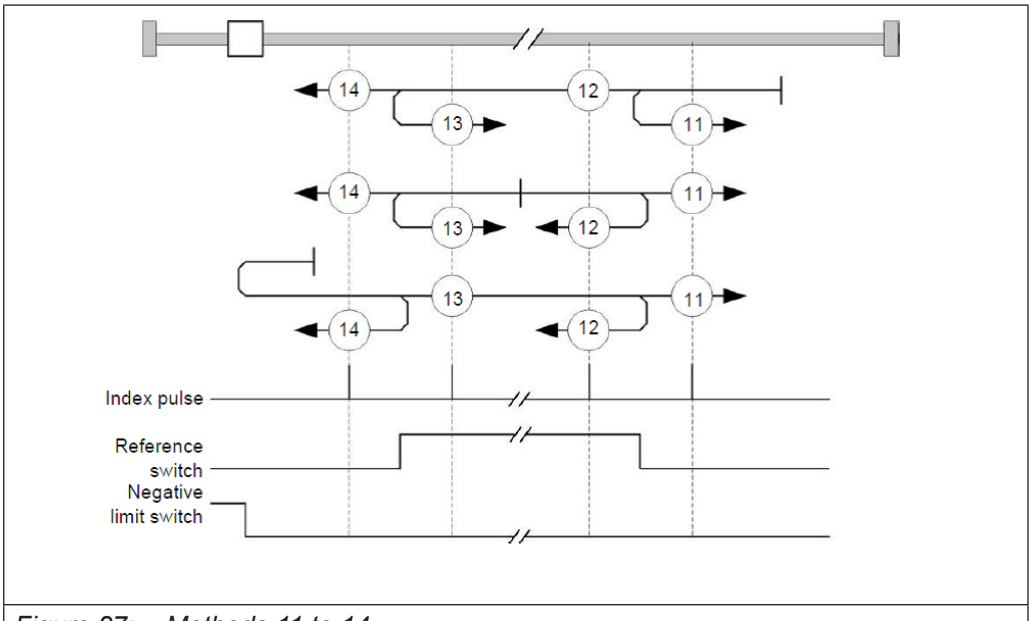


Figure 27: Methods 11 to 14

6.7.4.7 Methods 17 and 18

Homing to the limit switch but without the index impulse.
Method 17 homes in on the negative limit switch.
Method 18 homes in on the positive limit switch.

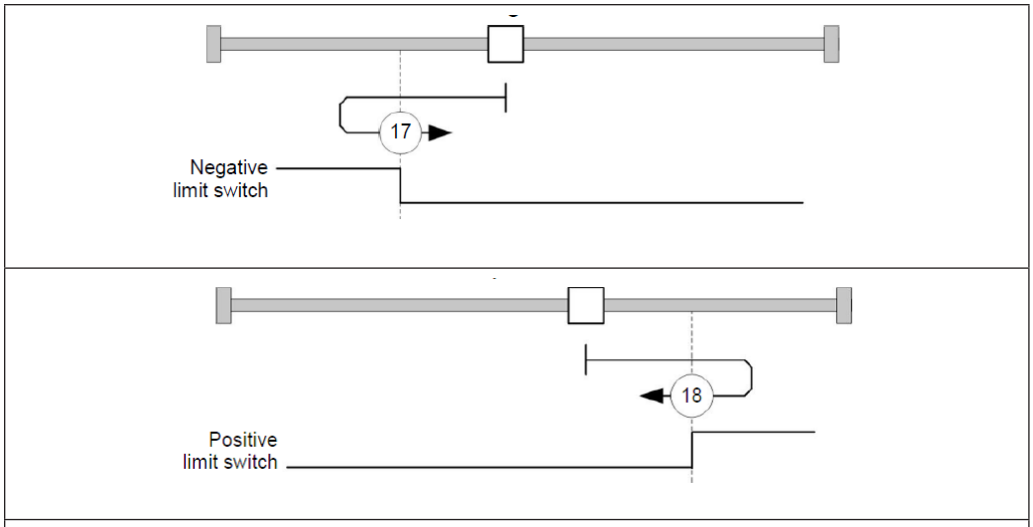


Figure 28: Methods 17 and 18

6.7.4.8 Methods 19 to 22

Homing to the home switch's switching edge but without the index impulse.
Methods 19 and 20 (equivalent to methods 3 and 4) use the home switch's left switching edge as reference:

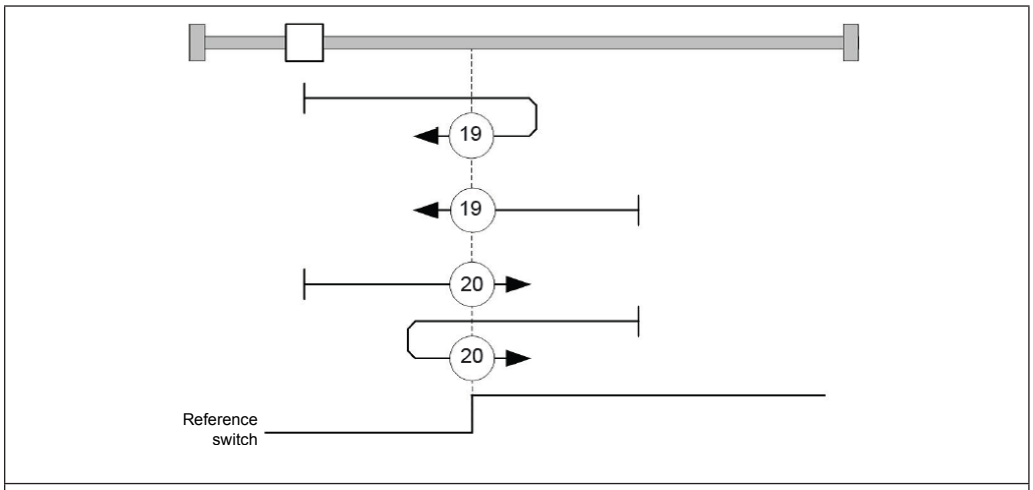


Figure 29: Methods 19 and 20

Methods 21 and 22 (equivalent to methods 5 and 6) use the home switch's right switching edge as reference:

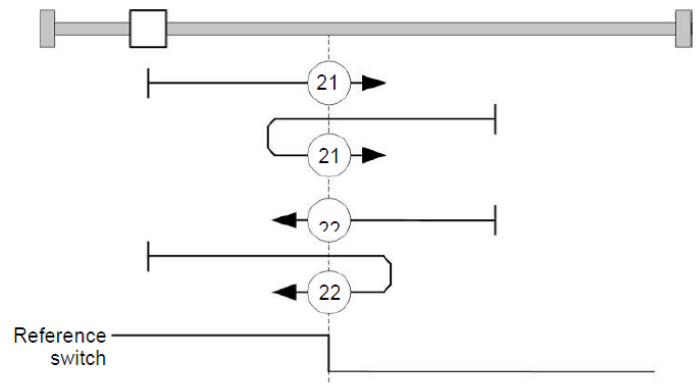


Figure 30: Methods 21 to 22

6.7.4.9 Methods 23 to 30

Homing to a home switch but without the index impulse (with limit switches).

These methods do not consider the current position in relation to the home switch. Method 26, for example, always homes in on the index impulse to the right of the right edge of the home switch.

Methods 23 to 26 consider the positive home switch:

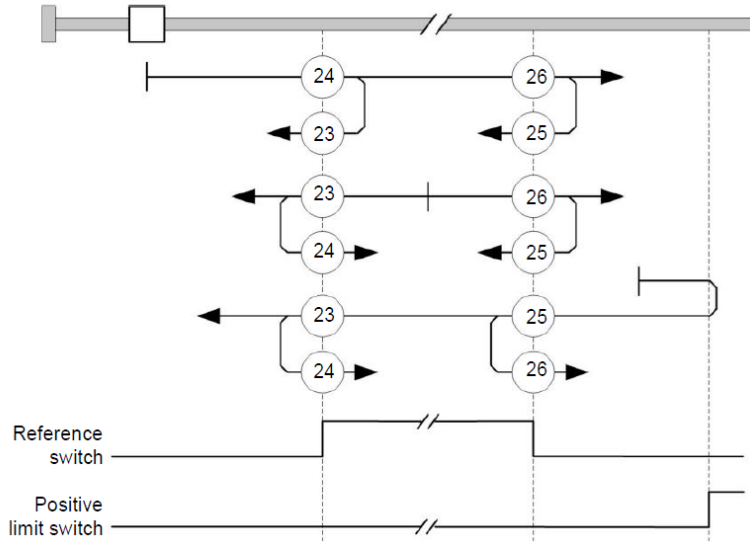


Figure 31: Methods 23 to 26

Methods 27 to 30 consider the negative home switch:

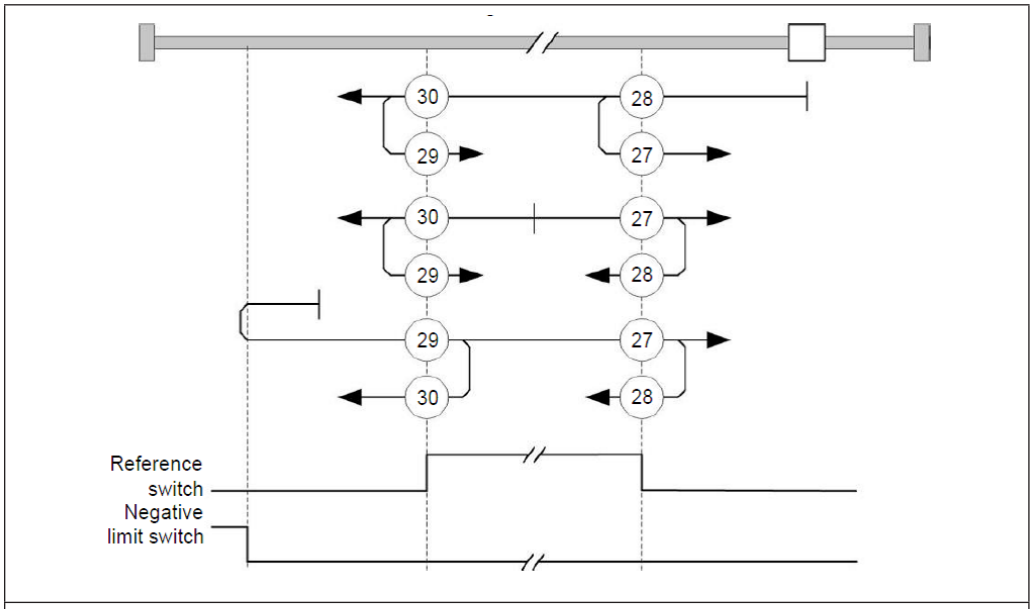


Figure 32: Methods 27 and 30

6.7.4.10 Methods 33 and 34

Homing to the next index impulse.
These methods home in on the nearest following index impulse only:

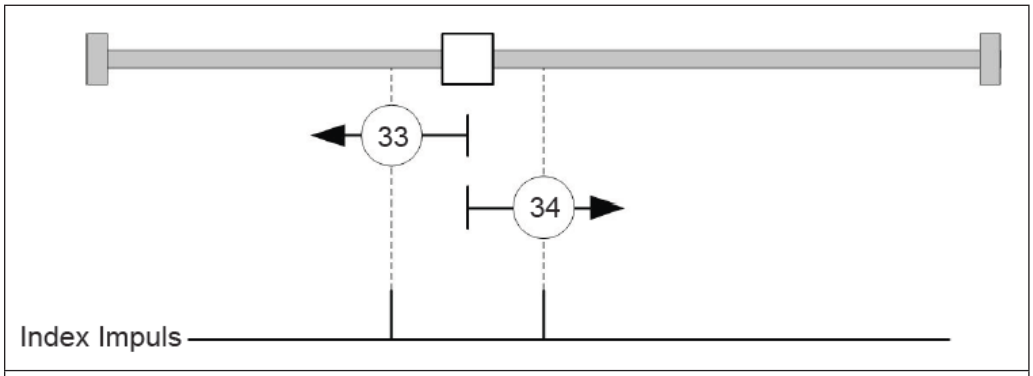


Figure 33: Methods 33 and 34

6.7.4.11 Method 35

Homing to the current position.

6.8 Cyclic Synchronous Position Mode

6.8.1 Overview

6.8.1.1 Description

In this mode, the fieldbus transfers an absolute set-point position to the control unit via at set intervals (called "cycles" below). In this case, the control calculates no ramps, but only follows the specifications.

The target position is transferred via PDO, to which the motor controller responds promptly. Bit 4 of the control word need not be set (as opposed to profile position mode).

Since the set-point target position is absolute, it is not affected by the number of times it is transferred in a cycle.

6.8.1.2 Activation

This mode is enabled by "8" in object Modes of operation 6060_h (see „DS402 Power State machine“).

6.8.1.3 Controlword

In this mode, the bits of Controlword 6040_h do not have a special function.

6.8.1.4 Statusword

The following bits of object Statusword 6041_h have a special function:

Bit	Value	Description
8	0	Control unit not synchronised with the fieldbus
8	1	Control unit is synchronised with the fieldbus
10	0	Reserved
10	1	Reserved
12	0	The motor controller does not follow the target specification; the value in $607A_h$ (Target Position) is ignored.
12	1	The motor controller follows the target specification; the object $607A_h$ (Target Position) is used as the input for the position control.
13	0	Reserved
13	1	Reserved

6.8.2 Object entries

The following objects are required to control this mode:

- Target Position $607A_h$: write the cyclic set-point position into this object.
- Position range limit $607B_h$: sets the upper and lower position limits.
- Software position limit $607D_h$: sets the mandatory limits of the set-point position ($607A_h$).
- Following error window 6065_h: sets a positive and negative tolerance range for the set-point. A contouring error occurs if the actual position is out of this range for longer than the time specified in (6066_h).
- Following error time out 6066_h: sets the time range in milliseconds. A contouring error is triggered if the actual position is out of the range specified in 6065_h for longer than this time.
- Quick Stopp deceleration 6085_h: contains the deceleration applicable to a quick stop.
- Quick Stop Option Code $605A_h$: contains the option to be used in case of a quick stop.
- Motion profile type 6086_h:
- Interpolation time period $60C2_h:01_h$: sets the time of a cycle, i.e. the interval within which $607A_h$ is to receive a new set-point. The following applies: cycle time = value of the $60C2_h:01_h$ * 10 value of 60C2:02 seconds. At this time, only cycle times should be used that correspond to a power of two, i.e. 1, 2, 4, 8, 16, etc. The time unit of the cycle time is defined by object $60C2_h:02_h$.
- Interpolation time period $60C2_h:02_h$: This object specifies the time basis for cycles. At this time, only the value $60C2_h:02_h$=-3 is supported, which results in a time basis of 1 millisecond.
- Maximum Current 2031_h: sets the maximum current in mA.

The following objects can be readout in this mode:

- Position actual value 6064_h
- Velocity actual value $606C_h$
- Following error actual value $60F4_h$

6.9 Cyclic Synchronous Velocity Mode

6.9.1 Overview

6.9.1.1 Description

In this mode, the motor controller receives a speed specification at fixed time intervals (called "cycles" below) via the field bus. In this case, the control calculates no ramps, but only follows the specifications.

The target speed is transferred via PDO, to which the motor controller responds promptly. Bit 4 in the control word does not have to be set (in contrast to Profile Velocity mode).

6.9.1.2 Activation

This mode is enabled by "9" in object 6060_h (Modes Of Operation) (see „DS402 Power State machine“).

6.9.1.3 Controlword

In this mode, the bits of control word 6040_h do not have a special function.

6.9.1.4 Statusword

The following bits in object $6041h_h$ (Statusword) have a special function:

Bit	Value	Description
8	0	Control unit not synchronised with the fieldbus
8	1	Control unit is synchronised with the fieldbus
10	0	Reserved
10	1	Reserved
12	0	The motor controller does not follow the target specification; the specification of the $607A_h$ (Target Velocity) is ignored.
12	1	The motor controller follows the target specification; the object $60FF_h$ (Target Velocity) is used as the input for the position control.
13	0	No following error
13	1	Following error

6.9.2 Object entries

The following objects are required to control this mode:

- $60FF_h$ (Target Velocity): The speed set value must be cyclically written to this object.
- 6085_h (Quick-Stop Deceleration): This object contains the deceleration in case a Quick Stop is triggered (see "DS402 Power State machine").
- $605A_h$ (Quick-Stop Option Code): This object contains the option that is to be executed in the event of a Quick Stop (see "DS402 Power State machine").
- $60C2_h:01_h$ (Interpolation Time Period): This object specifies the time period of a cycle. Within this time period, a new set value must be written to $60FF_h$. The following applies: cycle time = value of the $60C2_h:01_h$ * $10^{\text{value of the 60C2:02}}$ seconds.At this time, only cycle times should be used that correspond to a power of two, i.e. 1, 2, 4, 8, 16, etc. The time unit of the cycle time is defined by object $60C2_h:02_h$.
- $60C2_h:02_h$ (Interpolation Time Index): This object specifies the time basis for cycles. At this time, only the value $60C2_h:02_h$=-3 is supported, which results in a time basis of 1 millisecond.
- 2031_h (Peak Current): sets the maximum current in mA.

The following objects can be readout in this mode:

- $606C_h$ (Velocity Actual Value)
- $607E_h$ (Polarity)

6.10 Cyclic Synchronous Torque Mode

6.10.1 Overview

6.10.1.1 Description

In this mode, the motor controller receives an absolute torque value at fixed time intervals (called "cycles" below) via the field bus. In this case, the control calculates no ramps, but only follows the specifications.

The target position is transferred via PDO, to which the motor controller responds promptly. Bit 4 in the control word does not have to be set (in contrast to Profile Torque mode).

6.10.1.2 Activation

This mode is enabled by "10" in object 6060_h (Modes Of Operation) (see „DS402 Power State machine“).

6.10.1.3 Controlword

In this mode, the bits of control word 6040_h do not have a special function.

6.10.1.4 Statusword

The following bits in object $6041h_h$ (Statusword) have a special function:

Bit	Value	Description
8	0	Control unit not synchronised with the fieldbus
8	1	Control unit is synchronised with the fieldbus
10	0	Reserved
10	1	Reserved
12	0	The motor controller does not follow the target specification; the specification of the 6071_h (Target Torque) is ignored.
12	1	The motor controller follows the target specification; the object 6071_h (Target Velocity) is used as the input for the position control.
13	0	Reserved
13	1	Reserved

6.10.2 Object entries

The following objects are required to control this mode:

- 6071_h (Target Torque): The torque set value must be cyclically written to this 6072_h object.
- 6072_h (Max Torque): Describes the maximum permissible torque.
- $60C2_h:01_h$ (Interpolation Time Period): This object specifies the time period of a cycle. Within this time period, a new set value must be written to $60FF_h$. The following applies: cycle time = value of the $60C2_h:01_h$ * $10^{\text{value of the 60C2:02}}$ seconds.At this time, only cycle times should be used that correspond to a power of two, i.e. 1, 2, 4, 8, 16, etc. The time unit of the cycle time is defined by object $60C2_h:02_h$.
- $60C2_h:02_h$ (Interpolation Time Index): This object specifies the time basis for cycles. At this time, only the value $60C2_h:02_h$=-3 is supported, which results in a time basis of 1 millisecond.
- 2031_h (Peak Current): sets the maximum current in mA.

The following objects can be readout in this mode:

- $606C_h$ (Velocity Actual Value)

6.11 Auto - Setup Mode

6.11.1 Overview

Auto Setup prerequisites:

- ► Verify that the motor is off-load.
- ► Verify that nobody and nothing contacts the motor.
- ► Verify that the motor is free to turn in any direction.
- ► The maximum current must be set to the corresponding maximum current of the motor.

Auto Setup involves complicated computations which may not leave enough computing power to serve the fieldbuses as quickly as necessary. Fieldbus operation may be compromised during the Auto Setup.

6.11.1.1 Description

Auto Setup performs several test and measuring cycles to establish the data below of the motor you use:

- Pole-pair number
- Encoder resolution
- Index width
- Alignment (offset between electric home position and index)
- Compensation of imprecise encoder run

6.11.1.2 Factory defaults

Before the autosetup is activated, the following parameters must be set:

- Maximum Current 2031_h
- I^2T Parameters $203B_h:01_h$ (Nominal current)

If no incremental encoder or an incremental encoder without index track is used, the following parameter must also be set:

- Pole pair count 2030_h

6.11.1.3 Activation

This mode is enabled by "-2" in object Modes of operation 6060_h (=FE_h).

Controlword

The following bits of object Controlword 6040_h have a special function:

- Bit 4: runs Auto-Setup when "0" changes to "1"
- Bit 6: "0" finds all values, "1" only measures the encoder for closed loop operation (alignment, run-out). This requires the pole pair number (2030_h) and the encoder resolution (2052_h) to be set first.

6.11.1.4 Statusword

The following bits of object Statusword 6041_h have a special function:
Bit 10: indexed: turns "1" when the index is passed over for the first time.
Bit 12: aligned: turns "1" when the Auto-Setup has been completed.

6.11.1.5 Process

The Auto-Setup process consists of two phases:
Measuring (see "Measuring")
Parameter testing (see "Parameter Testing")

6.11.2 Measuring

6.11.2.1 Description

At this step, Auto-Setup establishes all motor parameters required for open loop and closed loop operation.

6.11.2.2 Error

Measuring may run into the following errors (Pre- defined error field 1003_h):

Error Code	Description	Suggestions
09207305_h	A/B pulses not detected while the motor is turning.	Are tracks A and B connected properly?
07207305_h	Sensor defective. Occurs when a shifting of the index position is detected. To solve the problem, unplug and replug the control unit.	Is the shield connected to the encoder cable properly?
08207305_h	Index pulse not detected.	Index connected properly? Is the motor's pole pair number greater than 200?

6.11.2.3 Finalising

At the end of the measuring cycle, the control unit automatically restarts and tests the parameters (see "Parameter Testing").

6.11.3 Parameter Testing

6.11.3.1 Test

At this step, the drive is set to Profile Torque Mode and field-generating current Id is slowly increased either up to the maximum current (Maximum Current 2031_h) or until the motor starts to move.

The amount of current at that point is indicative of the quality of the parameters under test. Ideally speaking, current Id can be increased without the motor starting to move.

6.11.3.2 Finalising

The test is passed if the amount of current exceeds 50% of the maximum current (2031_h).

The control restarts automatically after the test and is ready for operation again.

6.11.4 Test Result and Parameter File

6.11.4.1 Test Result

Check bit 15 of object Statusword 6041_h for the test result.If it is set, the test was passed and closed loop operation is supported.

If the bit is cleared, closed loop operation may still be possible but the parameters are not optimally adjusted.

6.11.4.2 Parameters

Auto-Setup stores the parameters it finds in file fs/config/startup/tuning.on. Every time the control unit starts, the parameters in that file are transferred to the object dictionary entries below.

Index	Subindex	Description	Comment
2030_h	00_h	Pole-pair number	e.g. 50 (same as 200 poles)
2050_h	00_h	Encoder alignment	Between 0 and 65535
2051_h	01_h	Encoder correction frequency	
2051_h	02_h	Encoder correction amplitude	
2051_h	03_h	Encoder correction shift	
2052_h	00_h	Encoder Resolution	
2053_h	00_h	Index polarity	0 = normal 1 = inverted
2054_h	00_h	Index width	Internal variable for computation or $FFFFFFFF_h$ (-1) to disable encoder monitoring.

After the Auto Setup, check the encoder settings in object $608F_h$.

6.12 Special Functions

6.12.1 Digital Inputs and Outputs

6.12.1.1 Digital inputs

Types of inputs: (pre-production unit)

- Inputs 1..4 and 8 switch when "high" pursuant to IEC61131-2 Type n (switching thresholds: low <= 5VDC / high >= 15VDC)
- Inputs 5..7 switch when "low" using a pull-up circuit (24 VDC)

Types of inputs: (series-produced unit)

- Inputs 1…5 switch when "high" pursuant to IEC61131-2 Type n (switching thresholds: low <= 5VDC / high >= 15VDC)
- Inputs 6..8 switch when "low" using a reversible pull-up circuit (5VDC / 24VDC), for 24V pull-up the pins "Hall config" and "24 V Hall" are to be bridged at the module connector.

To configure the inputs

The digital inputs are configured via the following subindeces of the object

Subindex 01_h (Special function enable):

Bit-coded configuration object for enabling the digital inputs' special functions.

Bit 0	sets up input 1 as the negative limit switch
Bit 1	sets up input 2 as the positive limit switch
Bit 2	sets up input 3 as the reference switch

These bits are read during a homing run.

Subindex 02_h (Function inverted):

Bit-coded configuration object for inverting the input signals (n.c. / n.o. contact logic); bit 0 inverts the signal of input 1, bit 1 inverts the signal of input 2 etc.

Subindex 03_h (Force enable):

Bit-coded configuration object for enabling the simulation values of object 3240_h:04_h. If a bit is set, reference is no longer made to the actual input signal.

Subindex 04_h (Force value):

Bit-coded object for simulating the digital inputs.

Subindex 05_h (Raw value):

Object containing the unmodified input value

Subindex 06_h (Input Range Select):
No function assigned, just kept for reasons of compatibility.

Subindex 07_h (Differential Select):
No function assigned, just kept for reasons of compatibility.

Subindex 08_h (Routing Enable):
Activation of input routing.

6.12.2 Extended input configuration

To be able to assign the inputs more flexibly, the so-called "Input Routing Modus" is available. This assigns a signal from a source to a bit in object $60FD_h$.

This mode is activated by setting the object 3240_h:08_h (Routing Enable) to 1. Object 3242_h determines which signal source is routed to which bit of the $60FD_h$. The subindex 01_h of the 3242_h determines bit 0, subindex 02_h bit 1 and so on. The signal sources and their numbers are printed in the following lists:

dec	hex	Signal source
0	00	Signal is always 0
1	01	Physical input 1
2	02	Physical input 2
3	03	Physical input 3
4	04	Physical input 4
5	05	Physical input 5
6	06	Physical input 6
7	07	Physical input 7
8	08	Physical input 8
65	41	Hall input “U”
66	42	Hall input “V”
67	43	Hall input “W”
68	44	Encoder input “A”
69	45	Encoder input “B”
70	46	Encoder input “Z”
128	80	Signal is always 1
129	81	Inverted physical input1
130	82	Inverted physical input 2
131	83	Inverted physical input 3
132	84	Inverted physical input 4
133	85	Inverted physical input 5
134	86	Inverted physical input 6
135	87	Inverted physical input 7
136	88	Inverted physical input 8
193	C1	Inverted hall input “U”
194	C2	Inverted hall input “V”

195	C3	Inverted hall input “W”
196	C4	Inverted encoder input “A”
197	C5	Inverted encoder input “B”
198	C6	Inverted encoder input “Z”

Table 2: Extended input configuration

6.12.2.1 Digital Output

The digital output is controlled by object Digital Outputs 60FEh:01h at bit location 16. If the output is used as a brake output, bit 0 contains the signal instead. The digital output is configured via the following sub-indexes by object Digital outputs control 3250h.

Output configuration

The digital output is configured via the following sub-indexes by object Digital outputs control 3250h:

Subindex 01_h (Special function enable)

Bit-coded configuration object for enabling the digital output signal's special functions.

Subindex 02_h (Function inverted)

Bit-coded object for inverting the output signal

Subindex 03_h (Force enable)

Bit-coded object for enabling the manual actuation of the output; object 3250h:04h contains the value.

The same applies if the output is set up as a brake output.

Subindex 04_h (Force value)

Bit-coded object for manually actuating the output.

Subindex 05_h (Raw value)

No function assigned, just kept for reasons of compatibility

Subindex 06_h (Reserved1)

No function assigned, just kept for reasons of compatibility

Subindex 07_h (Reserved2)

No function assigned, just kept for reasons of compatibility

Subindex 08_h (Routing Enabled)

Activation of output routing.

6.12.3 Automatic Brake Control

Description

Power cut-off and brake control are enabled if the motor stands still for longer periods of time or if it is to accelerate from standstill. These functions are not supported by the synchronous modes. Apart from that, they are always available, irrespective of the mode setting (Modes of operation 6060_h).

The control unit's brake output results in a PWM signal, whose frequency (2038_h:05_h) and pulse duty factor settings (2038_h:06_h) can be changed.

The brake output is located at the module connector.

Activation

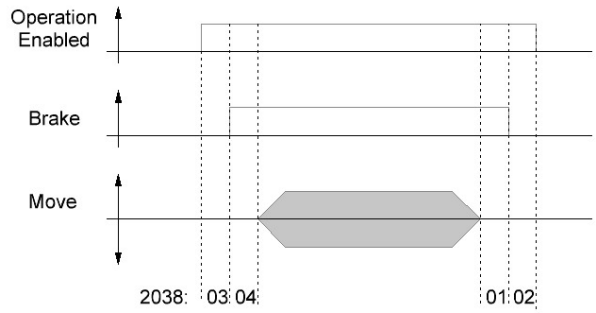
The brake control is activated via the object digitaloutputcontrol $3250_{\_}$:08_h = 1. Object 3252h:02h must be set to 1080h (default value).

Use bit 2 of object 3202_h to control the brake control. "1" starts brake control, "0" means that the control unit will not use the brake. You may also use bit 0 of $60FE_h$ to manually control the brake and the objects for setting up the digital outputs to manipulate it.

Operation of the brake

The brake output is switched on when the state changes from Switched On to Operation enabled. The brake output is switched off when the state changes from Operation enabled to Switched On.

Times



- 2038_h:01_h (Close Brake Idle Time): Time between the time at which the motor stands still and the brake starts being engaged.
- 2038_h:02_h (Shutdown Power Idle Time) Time between the time at which the brake is engaged and the current is lowered.
- 2038_h:03_h (Open Brake Delay Time) Time between the time of setting a new drive command and the brake starts being released.
- 2038_h:04_h (Start Operation Delay Time) Time between releasing the brake and starting the motor.

To brake the motor

The brake is enabled after the time set in 2038_h:01_h has elapsed after the motor has slowed down to standstill. After the time set in 2038_h:02_h, the motor current is cut off.

To set a new drive command.

Whereas the current turns back on immediately after sending a new drive command, releasing the brake is delayed for the time set in 2038_h:03_h. Actual start of the motion is delayed further for the time set in 2038_h:04_h.

6.12.4 I^2T Motor overload protection

6.12.4.1 Description

I^2t motor overload protection aims to keep damage away from the motor and to operate it normally up to its thermal limit.

This function is available only if the control unit is running in closed loop mode (bit 0 of object Maximum speed 2032h = „1“) and if the motor is not in the Profile Torque or Cycle Synchronous Torque modes.

There is one exception: in case I^2t is enabled in open loop mode, the current will be limited to the set rated current even if the set maximum current is the greater of the two. This feature has been included for safety reasons in order to change from closed loop mode with an extremely high transient maximum current to open loop mode without damaging the motor.

6.12.4.2 Object entries

The I^2t motor overload protection is affected by the following objects:

- Maximum Current 2031h - contains the maximum current in mA.
- I2T Parameters $203B_h$.

  - 01_h- contains the rated current in mA.
  - 02_h Maximum Duration Of Peak Current - contains the maximum time, in ms, that the maximum current may be applied.
  - 03_h Threshold - contains the limit, in mA, at which the current changes to maximum or rated current.
  - 04_h CalcValue - contains the calculated value compared to Threshold to set the current.
  - 05_h LimitedCurrent - contains the current value currently set by I^2t.
  - 06_h Status:
    Value = „0“: I^2t deactivated
    Value = „1“: I^2t enabled

6.12.4.3 Activation

Enabling this mode requires the three object entries above to contain appropriate values, i.e. the maximum current must be greater than the rated current and a maximum peak current time must be set. I^2t will remain disabled if these requirements are not met.

6.12.4.4 I^2t Functionality

Setting a rated current, maximum current and the maximum peak current time leads to computing an I^2TLim.

The motor may run under maximum current until the computed I^2TLim is achieved. The current will then be lowered to rated current immediately.

The diagram below summarises these facts.

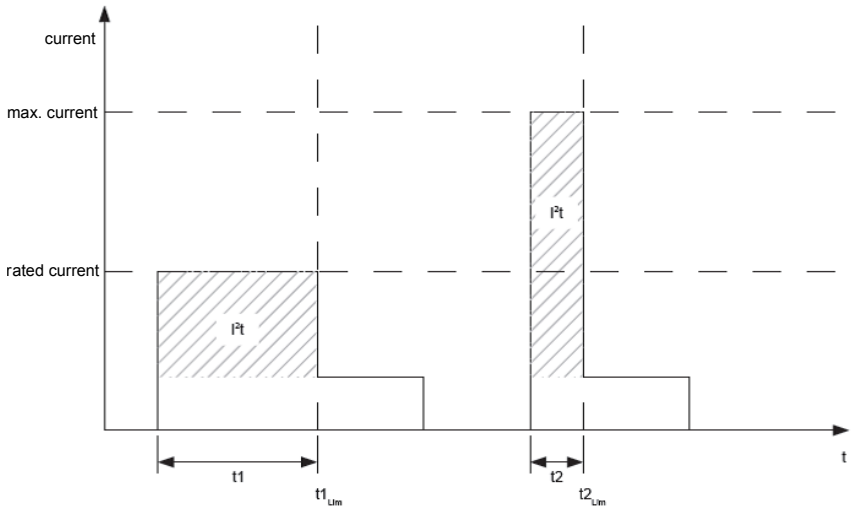


Figure 34: Function I^2t

In the first section (t1), the actual current exceeds the rated current. I^2tLim is achieved at time t1Lim and the actual current is limited to its rated current. Then, during period t2 there is a current which corresponds to the maximum current. Accordingly, the value for I^2tLim is achieved faster than in t1.

6.12.5 Saving Objects

6.12.5.1 General

Some object dictionary entries may be saved to be restored automatically when the control unit restarts. Saved values will also be retained when the firmware is being updated.

Whereas saving always involves entire sets of objects (called "categories" below), you cannot save individual objects.

An object always belongs to one of the following categories:

Object cannot be saved.

Object concerns communication (e.g. fieldbus) and therefore belongs to the "communication" category.

6.12.5.2 Categories

Not saveable

Non-saveable objects are ignored by the saving process. These include all status and control words as well all objects whose value varies with the status of the control unit.

Communication objects

Objects that affect the fieldbus.

The following objects are considered communication objects:

- 1600_h: Receive PDO 1 Mapping Parameter
- 1601_h: Receive PDO 2 Mapping Parameter
- 1602_h: Receive PDO 3 Mapping Parameter
- 1603_h: Receive PDO 4 Mapping Parameter
- $1A00_h$: Transmit PDO 1 Mapping Parameter
- $1A01_h$: Transmit PDO 2 Mapping Parameter
- $1A02_h$: Transmit PDO 3 Mapping Parameter
- $1A03_h$: Transmit PDO 4 Mapping Parameter
- $1C12_h$: Sync Manager PDO Assignment
- $1C13_h$: Sync Manager PDO Assignment
- 2102_h: Fieldbus Module Control

Application

Objects concerned:

- 2033_h: Plunger Block
- 2034_h: Upper Voltage Warning Level
- 2035_h: Lower Voltage Warning Level
- 2036_h: Open Loop Current Reduction Idle Time
- 2037_h: Open Loop Current Reduction Value/Factor
- 2038_h: Brake Controller Timing
- 2056_h: Limit Switch Tolerance Band
- 2057_h: Clock Direction Multiplier
- 2058_h: Clock Direction Divider
- 2059_h: Encoder Configuration
- 2060_h: Compensate Polepair Count
- 2061_h: Velocity Numerator
- 2062_h: Velocity Denominator
- 2063_h: Acceleration Numerator
- 2064_h: Acceleration Denominator
- 2065_h: Jerk Numerator
- 2066_h: Jerk Denominator
- 2084_h: Bootup Delay
- 3202_h: Motor Drive Submode Select
- $320A_h$: Motor Drive Sensor Display Open Loop
- $320B_h$: Motor Drive Sensor Display Closed Loop
- 3210_h: Motor Drive Parameter Set
- 3212_h: Motor Drive Flags

- 3240_h: Digital Inputs Control
- 3250_h: Digital Outputs Control
- 3321_h: Analogue Input Offset
- 3321_h: Analogue Input Pre-scaling
- 3700_h: Following Error Option Code
- 6046_h: VI Velocity Min Max Amount
- 6048_h: VI Velocity Acceleration
- 6049_h: VI Velocity Deceleration
- $604A_h$: VI Velocity Quick Stop
- $604C_h$: VI Dimension Factor
- $605A_h$: Quick Stop Option Code
- $605B_h$: Shutdown Option Code
- $605C_h$: Disable Option Code
- $605D_h$: Halt Option Code
- $605E_h$: Fault Option Code
- 6072_h: Max Torque
- $607B_h$: Position Range Limit
- $607C_h$: Home Offset
- $607D_h$: Software Position Limit
- $607E_h$: Polarity
- 6081_h: Profile Velocity
- 6082_h: End Velocity
- 6083_h: Profile Acceleration
- 6084_h: Profile Deceleration
- 6085_h: Quick Stop Deceleration
- 6086_h: Motion Profile Type
- 6087_h: Torque Slope
- $608F_h$: Position Encoder Resolution
- 6091_h: Gear Ratio
- 6092_h: Feed Constant
- 6098_h: Homing Method
- 6099_h: Homing Speed
- $609A_h$: Homing Acceleration
- $60A4_h$: Profile Jerk
- $60C2_h$: Interpolation Time Period
- $60C5_h$: Max Acceleration
- $60C6_h$: Max Deceleration
- $60F2_h$: Positioning Option Code
- $60FE_h$: Digital Outputs
- $60FF_h$: Target Velocity

Customer

- 2701_h: Customer Storage Area

Drive

- 3202_h: Motor Drive Submode Select

Tuning

- 2030_h: Pole Pair Count
- 2031_h: Maximum Current
- 2032_h: Maximum Speed
- $203B_h$: I^2T Parameters
- 2050_h: Encoder Alignment
- 2051_h: Encoder Optimization
- 2052_h: Encoder Resolution
- 2053_h: Index Polarity
- 2054_h: Index Width
- 2059_h: Encoder Configuration

6.12.5.3 Starting save process

Malfunction or destruction of C6 REMOTE I/Os Stepper/BLDC

File system corruption of malfunction of the total system by interrupting the fieldbus functionality while saving. Saving may take up to 20s.

- Do not cut off the power supply during that time
- Verify that successful saving is indicated by the control unit in object 1010_h.
- Verify that the motor is standing still and does not start while saving is in progress.

Every category has its own subindex in object Store default parameter 1010_h. All you need to do to save all objects of a specific category is to enter 65766173_h into the subindex. At the end of the saving process, the control unit sets the value to "1".

Subindices:

01_h: all categories
02_h: Communication
03_h: Application
04_h: User
05_h: Drive
06h: Tuning

6.12.5.4 Discarding the Saved Data

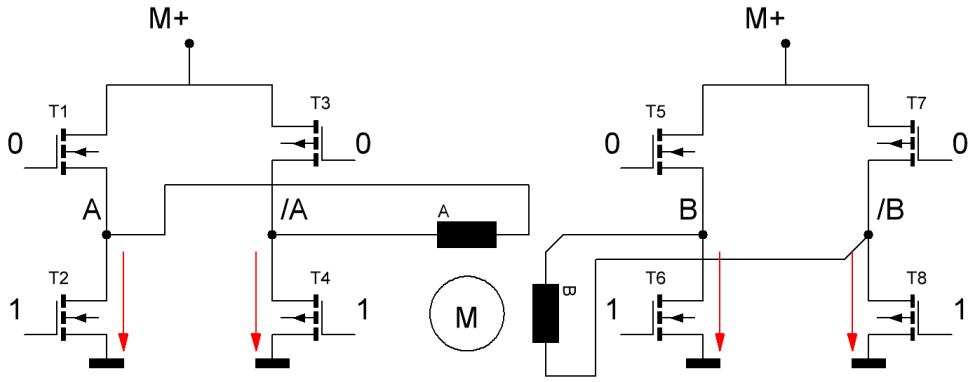
The control unit will restart after clearing the saved values.

Every category has its own subindex in object Restore default parameter 1011h. All you need to do to clear all objects of a specific category is to enter 64616F6C$_h$ into the subindex. This will discard the saved data and restore the control unit's factory defaults. The control unit will automatically restart after clearing the data.

6.12.6 Short-Circuit braking

During short-circuit braking, the coils of the drive are short-circuited, which causes the motor to come to a standstill much faster.

The following example shows the short-circuit braking in stepper motor mode:



This function can be parameterized in the following objects:

- Following Error Option Code 3700$_h$
- Quick Stop Option Code 605A$_h$
- Shutdown Option Code 605B$_h$
- Disable Option Code 605C$_h$
- Halt Option Code 605D$_h$
- Fault Option Code 605E$_h$

6.13 Object Dictionary

6.13.1 Device Type 1000h

Name	Device Type
Index	1000_h
Object Code	VARIABLE
No. of Elements	-
Data Type	UNSIGNED32
Access	read only
PDO Mapping	No
Value Range	set
Default Value	00 06 0192_h

Device type description

Mode bits [8] Bit 31…24

00_h always 0

Type [8]Bit 23..16 (describes the supported motor type)

06_h = $0000\ 0110_b$

Bit 16 = Frequency converter	-
Bit 17 = Servo drive	✓
Bit 18 = Stepper motor drive	✓

Device Profile number [16] Bit 15…0

$0192_h = 402_d$ = DS402 standard supported

6.13.2 Error Register 1001h

Name	Error Register
Index	1001_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED8
Access	read only
PDO Mapping	yes, TX-PDO
Value Range	
Default Value	00_h

In case of an error, the associated error bit is set. The bit is cleared automatically when the cause of the error has been removed.

7	6	5	4	3	2	1	0
MAN	RES	PROF	COM	TEMP	VOL	CUR	GEN

GEN: General error
CUR: Current
VOL: Voltage
TEMP: Temperature
COM: Communication
PROF: Device profile
RES: not used, always "0"
MAN: Manufacturer-specific

6.13.3 Pre-defined Error Field 1003h

Name	Pre- defined error field
Index	1003_h
Object Code	RECORD
No. of Elements	9
Data Type	UNSIGNED32

Name	Number of Errors
Subindex	00_h
Data Type	UNSIGNED8
Access	read write
PDO Mapping	No
Default Value	00_h

Name	Standard Error Field
Subindex	01_h … 08_h
Data Type	UNSIGNED32
Access	read only
PDO Mapping	No
Default Value	$00\ 00\ 0000_h$

A new error occurring is entered in subindex 1. Previous entries in subindices 1 to 7 are moved one place back. The error in subindex 7 is removed.

Check the object with subindex 0 to find the number of previous errors. Setting this object to "0" starts a new count.

31	30	29	28	27	26	25	24
Error Number [8]							

23	22	21	20	19	18	17	16
Error Class [8]							
15	14	13	12	11	10	9	8
7	6	5	4	3	2	1	0
Error Code [16]							

Error Number [8]

Used to accurately characterise the cause of an error. The table below explains what the figures stand for.

No.		Description
1	01_h	Input voltage too high
2	02_h	Output current too high
3	03_h	Input voltage too low
4	04_h	Fieldbus error
5	05_h	Motor turning in the wrong direction although the block is enabled
6	06_h	Only CANopen: NMT master takes too long to send a Nodeguarding request
7	07_h	Encoder error caused by electrical fault or defective hardware
8	08_h	Encoder error; Auto Setup failed to find the index
9	09_h	AB track error
10	$0A_h$	Positive limit switch and tolerance range exceeded
11	$0B_h$	Negative limit switch and tolerance range exceeded
12	$0C_h$	Device temperature above 80 °C
13	$0D_h$	Values of object 6065h (Following Error Window) and object 6066h (Following Error Time Out) exceeded and provoked a fault.
14	$0E_h$	Nonvolatile memory is full, restart of the control required
15	$0F_h$	Motor blocked
16	10_h	Nonvolatile memory damaged, restart of the control required
17	11_h	Slave took too long to send PDO messages.
18	12_h	Hall sensor defective
19	13_h	PDO not processed due to a length error
20	14_h	PDO length exceeded
21	15_h	Nonvolatile memory is full, restart of the control required.
22	16_h	Nominal current must be set (203B:01)
23	17_h	Parameter error (Encoder resolution, Polepair count, …)
24	18_h	Output current too high, adjust PI parameters
25	19_h	Internal software error
26	$1A_h$	Overcurrent at the digital output
27	$1B_h$	Unexpected Sync length
28	$1C_h$	Motor active during an EtherCAT state change (OP -> SafeOp, PreOp, ...)

Table 3: Error Number [8]

Error Class [8]
Same as object 1001_h

Error Code [16]
The table below explains what the two bytes signify.

1000_h	general error
2300_h	current at controller output too high
3100_h	high/low voltage at controller input
4200_h	Temperature error in control unit
6320_h	Nominal current not set (BLDC)
7121_h	motor blocked
7305_h	incremental or Hall sensor defective
7600_h	nonvolatile memory full or corrupt
8000_h	fieldbus monitoring error
8130_h	CANopen only: „Life Guard“ error or „Heartbeat“ – error
8200_h	CANopen only: Slave takes too long to send PDO messages
8210_h	CANopen only: PDO not processed due to a length error
8220_h	CANopen only: PDO length exceeded
8611_h	position monitoring error: excessive trailing error
8612_h	position monitoring error: homing limit
9000_h	

6.13.4 Manufacturer Device Name 1008h

Name	Manufacturer Device Name
Index	1008_h
Object Code	VARIABLE
No. of Elements	0
Data Type	VISIBLE_STRING

Access	read only
PDO Mapping	No
Units	-
Value Range	set
Default Value	

Subindex 0 of this object contains the string length. Subindex 1 contains each of the characters. The character string has no terminating zero.

6.13.5 Manufacturer Hardware Version 1009h

Name	Manufacturer Hardware Version
Index	1009_h
Object Code	VARIABLE
No. of Elements	0
Data Type	VISIBLE_STRING

Access	read only
PDO Mapping	No
Units	-
Value Range	set
Default Value	

Subindex 0 of this object contains the string length. Subindex 1 contains each of the characters. The character string has no terminating zero.

6.13.6 Manufacturer Software Version 100Ah

Name	Manufacturer Software Version
Index	$100A_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	VISIBLE_STRING

Access	read only
PDO Mapping	No
Value Range	set
Default Value	

6.13.7 Store Default Parameter 1010h

Name	Store Parameters
Index	1010_h
Object Code	RECORD
No. of Elements	7
Data Type	UNSIGNED32

Name	Highest Sub-index Supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	06_h

Name	Save All The Parameters To Non-volatile Memory
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Save The Comm Parameters To Non-volatile Memory
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Save Application Parameters To Non-volatile Memory
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Save Customer Parameters To Non-volatile Memory
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Save Drive Parameters To Non-volatile Memory
Subindex	05_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Save Tuning Parameters To Non-volatile Memory
Subindex	06_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Entering 65766173h (ASCII „save“) in subindex 01h .. 06h starts the saving process

Restore Default Parameter 1011h

Name	Restore Default Parameter
Index	1011_h
Object Code	RECORD
No. of Elements	2
Data Type	UNSIGNED32

Name	Highest Sub-index Supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	03_h

Name	Restore All Default Parameters
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Restore The Comm Default Parameters
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Restore The Application Default Parameters
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Restore Customer Parameters To Non-volatile Memory
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Restore Drive Parameters To Non-volatile Memory
Subindex	05_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Restore Tuning Parameters To Non-volatile Memory
Subindex	06_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Entering 64616F6Ch (ASCII „load“) in subindex 01h .. 06h starts the associated restoring process.

Subindex 01h (restore all default parameters) resets the complete object dictionary except for the parameters determined from the Auto-setup (Tuning Parameters (corresponds to subindex 02h, 03h, 04h, 05h).

It is important to check whether the board should be completely reset to the default values.Settings or data can be lost.

The control unit reboots afterwards to let the reset take effect.

6.13.8 Identity Oject 1018h

Name	Identity Object
Index	1018_h
Object Code	RECORD
No. of Elements	0
Data Type	IDENTITY

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	04_h

Name	Vendor ID
Subindex	01_h
Data Type	UNSIGNED32
Access	read only
PDO Mapping	No
Default Value	$0048554B_h$

Name	Product Code
Subindex	02_h
Data Type	UNSIGNED32
Access	read only
PDO Mapping	No
Default Value	$0002BA67_h$

Name	Revision Number
Subindex	03_h
Data Type	UNSIGNED32
Access	read only
PDO Mapping	No
Default Value	

Name	Serial Number
Subindex	04_h
Data Type	UNSIGNED32
Access	read only
PDO Mapping	No
Default Value	

The object contains details of the manufacturer, the product code and the revision and serial number.

6.13.9 Verify Configuration 1020h

This object displays the day and time of the saved configuration.

A network configuration tool or a CANopen manager can use this object to check the stored configuration after a restart and test whether a reconfiguration is necessary.

The tool must set the date and time before starting the storage mechanism (set a sub-index in 1010_h to 65766173).

Name	Verify Configuration
Index	1020_h
Object Code	RECORD
No. of Elements	3
Data Type	

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read write
PDO Mapping	No
Default Value	02_h

Name	Configuration Date
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Configuration Time
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Subindex 01_h (configuration date) should contain the number of days since January 1, 1984.

Subindex 02_h (configuration time) should contain the number of milliseconds since midnight.

6.13.10 Mapping 1600h (Drive Control)

Name	Drive Control
Index	1018_h
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING
Saveable	Yes, Communication

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	08_h

Name	1st Object To Be Mapped
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	60400010_h

Name	2nd Object To Be Mapped
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	$607A0020_h$

Name	3rd Object To Be Mapped
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	32020020_h

Name	4th Object To Be Mapped
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	60600008_h

Name	6th Object To Be Mapped
Subindex	06_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	7th Object To Be Mapped
Subindex	07_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	8th Object To Be Mapped
Subindex	08_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]Bit 31..16Index of object to be mapped

SubIndex[8]Bit 15..8Subindex of object to be mapped

Length[8]Bit 7..0Length of object to be mapped

6.13.11 Mapping 1601h (Position Control)

Name	Position Control
Index	1018_h
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING
Saveable	Yes, Communication

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	2nd Object To Be Mapped
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	60810020_h

Name	3rd Object To Be Mapped
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	4th Object To Be Mapped
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	5th Object To Be Mapped
Subindex	05_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	6th Object To Be Mapped
Subindex	06_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	7th Object To Be Mapped
Subindex	07_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	8th Object To Be Mapped
Subindex	08_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]Bit 31..16Index of object to be mapped

SubIndex[8]Bit 15..8Subindex of object to be mapped

Length[8]Bit 7..0Length of object to be mapped

6.13.12 Mapping 1602h (Velocity Control)

Name	Velocity Control
Index	1018_h
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING
Saveable	Yes, Communication

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	01_h

Name	1st Object To Be Mapped
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	60420010_h

Name	2nd Object To Be Mapped
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	3rd Object To Be Mapped
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	4th Object To Be Mapped
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	5th Object To Be Mapped
Subindex	05_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	6th Object To Be Mapped
Subindex	06_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	7th Object To Be Mapped
Subindex	07_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	8th Object To Be Mapped
Subindex	08_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]Bit 31..16Index of object to be mapped

SubIndex[8]Bit 15..8Subindex of object to be mapped

Length[8]Bit 7..0Length of object to be mapped

6.13.13 Mapping 1603h (Output Control)

Name	Output Control
Index	1018_h
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING
Saveable	Yes, Communication

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	01

Name	1st Object To Be Mapped
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	60420010_h

Name	2nd Object To Be Mapped
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	3rd Object To Be Mapped
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	4th Object To Be Mapped
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	5th Object To Be Mapped
Subindex	05_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	6th Object To Be Mapped
Subindex	06_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	7th Object To Be Mapped
Subindex	07_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	8th Object To Be Mapped
Subindex	08_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]Bit 31..16Index of object to be mapped

SubIndex[8]Bit 15..8Subindex of object to be mapped

Length[8]Bit 7..0Length of object to be mapped

6.13.14 Mapping 1A00h (Drive Status)

Name	Drive Status
Index	1018_h
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING
Saveable	Yes, Communication

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	03_h

Name	1st Object To Be Mapped
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	60410010_h

Name	2nd Object To Be Mapped
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	60640020_h

Name	3rd Object To Be Mapped
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	60610008_h

Name	4th Object To Be Mapped
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	5th Object To Be Mapped
Subindex	05_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	6th Object To Be Mapped
Subindex	06_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	7th Object To Be Mapped
Subindex	07_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	8th Object To Be Mapped
Subindex	08_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]Bit 31..16Index of object to be mapped

SubIndex[8]Bit 15..8Subindex of object to be mapped

Length[8]Bit 7..0Length of object to be mapped

6.13.15 Mapping 1A01h (Position Status)

Name	Position Status
Index	1018_h
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING
Saveable	Yes, Communication

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	01_h

Name	1st Object To Be Mapped
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	60640020_h

Name	2nd Object To Be Mapped
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	3rd Object To Be Mapped
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	4th Object To Be Mapped
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	5th Object To Be Mapped
Subindex	05_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	6th Object To Be Mapped
Subindex	06_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	7th Object To Be Mapped
Subindex	07_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	8th Object To Be Mapped
Subindex	08_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]Bit 31..16Index of object to be mapped

SubIndex[8]Bit 15..8Subindex of object to be mapped

Length[8]Bit 7..0Length of object to be mapped

6.13.16 Mapping 1A02h (Velocity Status)

Name	Velocity Status
Index	1018_h
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING
Saveable	Yes, Communication

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	01_h

Name	1st Object To Be Mapped
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	60440010_h

Name	2nd Object To Be Mapped
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	3rd Object To Be Mapped
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	4th Object To Be Mapped
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	5th Object To Be Mapped
Subindex	05_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	6th Object To Be Mapped
Subindex	06_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	7th Object To Be Mapped
Subindex	07_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	8th Object To Be Mapped
Subindex	08_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]Bit 31..16Index of object to be mapped

SubIndex[8]Bit 15..8Subindex of object to be mapped

Length[8]Bit 7..0Length of object to be mapped

6.13.17 Mapping 1A03h (Input Status)

Name	Input Status
Index	1018_h
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING
Saveable	Yes, Communication

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	03_h

Name	1st Object To Be Mapped
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	$60FD0020_h$

Name	2nd Object To Be Mapped
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	64020120_h

Name	3rd Object To Be Mapped
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	64020220_h

Name	4th Object To Be Mapped
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	5th Object To Be Mapped
Subindex	05_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	6th Object To Be Mapped
Subindex	06_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	7th Object To Be Mapped
Subindex	07_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	8th Object To Be Mapped
Subindex	08_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]Bit 31..16Index of object to be mapped

SubIndex[8]Bit 15..8Subindex of object to be mapped

Length[8]Bit 7..0Length of object to be mapped

6.13.18 Sync Manager Communication Type 1C00h

Name	Sync Manager Communication Type
Index	1018_h
Object Code	RECORD
No. of Elements	5
Data Type	UNSIGNED8

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	04_h

Name	Sync Manager Communication Type
Subindex	01_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	01_h

Name	Sync Manager Communication Type
Subindex	02_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	Sync Manager Communication Type
Subindex	03_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	03_h

Name	Sync Manager Communication Type
Subindex	04_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	04_h

This object contains the allocation of the four EtherCAT SyncManagers. The allocation is set and cannot be changed.

Subindex/ Syncmanager	Function
1	receive mailbox messages
2	send mailbox messages
3	receive cyclic process data
4	send cyclic process data

6.13.19 Sync Manager PDO Assignment 1C12h

Name	Sync Manager PDO Assignment
Index	1018_h
Object Code	RECORD
No. of Elements	5
Data Type	UNSIGNED16
Saveable	Yes, Communication

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	04_h

Name	PDO Mapping Index
Subindex	01_h
Data Type	UNSIGNED16
Access	read write
PDO Mapping	No
Default Value	1600_h

Name	PDO Mapping Index
Subindex	02_h
Data Type	UNSIGNED16
Access	read write
PDO Mapping	No
Default Value	0000_h

Name	PDO Mapping Index
Subindex	03_h
Data Type	UNSIGNED16
Access	read write
PDO Mapping	No
Default Value	0000_h

Name	PDO Mapping Index
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0000_h

This object lists all active output PDO mappings (see 1600_h ff.); it is filled by the EtherCAT master.

6.13.20 Sync Manager PDO Assignment 1C13h

Name	Sync Manager PDO Assignment
Index	1018_h
Object Code	RECORD
No. of Elements	5
Data Type	UNSIGNED16
Saveable	Yes, Communication

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	04_h

Name	PDO Mapping Index
Subindex	01_h
Data Type	UNSIGNED16
Access	read write
PDO Mapping	No
Default Value	$1A00_h$

Name	PDO Mapping Index
Subindex	02_h
Data Type	UNSIGNED16
Access	read write
PDO Mapping	No
Default Value	0000_h

Name	PDO Mapping Index
Subindex	03_h
Data Type	UNSIGNED16
Access	read write
PDO Mapping	No
Default Value	0000_h

Name	PDO Mapping Index
Subindex	04_h
Data Type	UNSIGNED16
Access	read write
PDO Mapping	No
Default Value	0000_h

6.13.21 Output Sync Manager Synchronization 1C32h

Name	Output Sync Manager Synchronization
Index	1018_h
Object Code	RECORD
No. of Elements	9
Data Type	SYNCMGR_SYNCHRONZATION
Saveable	Yes, Communication

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	05_h

Name	Synchronization Type
Subindex	01_h
Data Type	UNSIGNED16
Access	read write
PDO Mapping	No
Default Value	0000_h

Name	Cycle Time
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Shift Time
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Contains the synchronisation parameters for EtherCAT's output PDO mapping (see $1C12_h$). Parameter values are set by the EtherCAT master.

6.13.22 Input Sync Manager Synchronization 1C33h

Name	Input Sync Manager Synchronization
Index	$1C33_h$
Object Code	RECORD
No. of Elements	4
Data Type	SYNCMGR_SYNCHRONIZATION
Saveable	Yes, Communication

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	03_h

Name	Synchronization Type
Subindex	01_h
Data Type	UNSIGNED16
Access	read write
PDO Mapping	No
Default Value	0000_h

Name	Cycle Time
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Shift Time
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

6.13.23 Pole Pair Count 2030h

Name	Pole Pair Count
Index	2030_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Tuning

Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000032_h

Number of pole pairs provided by your motor

6.13.24 Maximum Current 2031h

Name	Maximum Current
Index	2031_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Tuning

Access	read write only
PDO Mapping	No
Units	mA
Value Range	
Default Value	00000708_h

Your motor's maximum current

6.13.25 Maximum Speed 2032h

Name	Maximum Speed
Index	2032_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Tuning

Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	$00030D40_h$

Admissible maximum speed of the V controller in U/s (RPS) or rpm

Depends on the numerator and denominator set in object $604C_h$.

6.13.26 Plunger Block 2033h

Name	Plunger Block
Index	2033_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32
Saveable	Yes, Application

Access	read write only
PDO Mapping	No
Units	-
Value Range	
Default Value	00000000_h

Admissible maximum change in position in user-defined UoM (same as the Target Position $607A_h$ allowed for the direction concerned).

Allows you to define an electronic bolting device.

"0" disables monitoring.

"100", for example, means that the drive may infinitely turn in the negative direction but only for 100 steps in the positive direction; if it goes beyond that, the motor will stop and an error will be indicated immediately (Error Rigister Bit 7 – MAN).

Assuming you are coiling up threads, this method will avoid any unintentional uncoiling.

6.13.27 Upper Voltage Warning Limit 2034h

Name	Upper Voltage Warning Limit
Index	2034_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	mV
Value Range	
Default Value	$00013C68_h$

Threshold, in millivolt, of the "overvoltage" error.

The motor will stop and an error will be indicated immediately when the value exceeds the set threshold. The error will reset automatically when the input voltage drops below the threshold minus 2000 mV.

6.13.28 Lower Voltage Warning Limit 2035h

Name	Lower Voltage Warning
Index	2035_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	mV
Value Range	
Default Value	00000000_h

Threshold, in millivolt, of the "low voltage" error.

The motor will stop and an error will be indicated immediately when the value drops below the set threshold. The error will reset automatically when the input voltage drops rises above the threshold plus 2000 mV.

6.13.29 Open Loop Current Reduction Idle Time 2036h

Name	Open Loop Current Reduction Idle Time
Index	2036_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	ms
Value Range	
Default Value	$000003E8_h$

When the motor is at standstill, the current will be reduced after the time set in milliseconds.

6.13.30 Open Loop Current Reduction Value/Factor 2037h

Name	Open Loop Current Reduction Value/Factor
Index	2037_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	% / mA
Value Range	
Default Value	00000000_h

A negative value between -100 and -1 is considered the reduction factor, in percent of the maximum current (2031h). "-100" is equivalent to 100% of the value in object 2031h, "-50" is equivalent to 50% of object 2031h, etc.

A positive value reduces the current to the value in object 2037h.

6.13.31 Brake Controller Timing 2038h

Name	Brake Controller Timing
Index	2038_h
Object Code	RECORD
No. of Elements	7
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	06_h

Name	Close Brake Idle Time
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	ms
Value Range	
Default Value	$000003E8_h$

Name	Shut Down Power Idle Time
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	ms
Value Range	
Default Value	$000003E8_h$

Name	Open Brake Delay Time
Subindex	03_h
Data Type	UNSIGNED32
Access	read write only
PDO Mapping	No
Units	ms
Value Range	
Default Value	$000003E8_h$

Name	PWM Frequency
Subindex	05_h
Data Type	UNSIGNED32
Access	read write only
PDO Mapping	No
Units	Hz
Value Range	
Default Value	00000000_h

Name	PWM Duty Cycle
Subindex	06_h
Data Type	UNSIGNED32
Access	read write only
PDO Mapping	No
Units	%
Value Range	2…100
Default Value	00000000_h

The subindices have the following functions:

01_h: Time between the time at which the motor stands still and the brake starts being engaged.

02_h: Time between the time at which the brake is engaged and the current is lowered.

03_h: Time between the time of setting a new drive command and the brake starts being released.

04_h: Time between releasing the brake and starting the motor.

05_h: Frequency, in Hertz, of the brake PWM.

06h: Pulse duty factor, in per cent, of the brake PWM.

6.13.32 Motor Currents 2039h

Name	Motor currents
Index	2039_h
Object Code	RECORD
No. of Elements	5
Data Type	UNSIGNED32

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	04_h

Name	I_d
Subindex	01_h
Data Type	INTEGER32
Access	read only
PDO Mapping	No
Units	mA
Value Range	
Default Value	00000000_h

Name	I_q
Subindex	02_h
Data Type	INTEGER32
Access	read only
PDO Mapping	No
Units	mA
Value Range	
Default Value	00000000_h

Name	I_a
Subindex	03_h
Data Type	INTEGER32
Access	read only
PDO Mapping	No
Units	mA
Value Range	
Default Value	00000000_h

Name	I_b
Subindex	04_h
Data Type	INTEGER32
Access	read only
PDO Mapping	No
Units	mA
Value Range	
Default Value	00000000_h

Motor current measured and shown as mA

Stepper motor Closed Loop:

I_d: Field-weakening component of the current, is nearly zero.

I_q: Torque-forming component of the current, from which you can read the actual phase current.

I_a: Actual current by the winding A

I_b: Actual current by the winding B

Stepper motor Open Loop:
The phase current is calculated from

$$\sqrt{({I_d}^2 + {I_q}^2)}$$

6.13.33 Homing On Block Configuration 203Ah

Name	Homing on Block Configuration
Index	$203A_h$
Object Code	RECORD
No. of Elements	3
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	Minimum Current for Block Detection
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	mA / %
Value Range	
Default Value	$FFFFFFBA_h$ / -70

Name	Block Detection Time
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	$000000C8_h$ / 200

$01_{h:}$ specifies the current limit as of which blocking is detected. Positive numbers indicate the current limit in milliseconds, negative numbers indicate a percentage value of the set maximum current (2031h).

$02_{h:}$ Minimum time, in ms, that the current needs to exceed the specified current threshold to detect the blocking.

6.13.34 I2T Parameters 203Bh

Name	I2T Parameters
Index	$203B_h$
Object Code	RECORD
No. of Elements	8
Data Type	UNSIGNED32
Saveable	Yes, Tuning

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	07_h

Name	Nominal Current
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Maximum duration fo peak current
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Threshold
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	CalcValue
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Limited Current
Subindex	05_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Status
Subindex	06_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Actual Resistance
Subindex	07_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Entering a value greater than 0 in $203B_h:02_h$ enables I^2t monitoring (see section Motor Overload Protection).

I^2t is only available in closed loop mode but there is one exception: in case I^2t is enabled in open loop mode, the current will be limited to the set rated current even if the set maximum current is the greater of the two.

This feature has been included for safety reasons in order to change from closed loop mode with an extremely high transient maximum current to open loop mode without damaging the motor.

$01_{h:}$ rated current, in mA; to be lower than the peak current 2031_h or else monitoring will not be enabled.

02_h: maximum time, in ms, that the peak current is applied.

$03_{h:}$ threshold - contains the limit, in mA, at which the current changes to maximum or rated current.

$04_{h:}$ CalcValue - contains the calculated value compared to Threshold to set the current.

$05_{h:}$ 05h LimitedCurrent - contains the current value currently set by I2t.

$06_{h:}$ Current status. A sub-entry value of "0" disables I2t, "1" enables I2t.

$07_{h:}$ Currently calculated resistance, the motor must be energized and at standstill for a correct result.

6.13.35 Encoder Alignment 2050h

Name	Encoder Alignment
Index	2050_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32
Saveable	Yes, Tuning

Access	read write
PDO Mapping	No
Units	-
Value Range	
Default Value	00000000_h

Offset angle between rotor and electric field.

Only Auto-Setup can establish it accurately. This value is required for closed loop operation.

6.13.36 Encoder optimization 2051h

Name	Encoder optimization
Index	2051_h
Object Code	RECORD
No. of Elements	4
Data Type	UNSIGNED32
Saveable	Yes, Tuning

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	03_h

Name	Parameter 1
Subindex	01_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	Parameter 2
Subindex	02_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	Parameter 3
Subindex	03_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Only Auto Setup can establish these parameters.

6.13.37 Encoder Resolution 2052h

Name	Encoder Resolution
Index	2052_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32
Saveable	Yes, Tuning

Access	read write
PDO Mapping	No
Units	-
Value Range	
Default Value	00000000_h

A negative value is saying that the encoder runs in the opposite direction of the motor. A means of correction is to reverse the polarity of the motor winding.

6.13.38 Index Polarity 2053h (Obsolete)

Name	Index Polarity
Index	2053_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED8

Access	read write
PDO Mapping	No
Units	-
Value Range	
Default Value	00_h

"0" is indicative of the index not being inverted.

"1" means that the index connection is inverted and that the index is inverted by the firmware.

6.13.39 Index Width 2054h (Obsolete)

Name	Index Width
Index	2054_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32

Access	read write
PDO Mapping	No
Units	-
Value Range	
Default Value	$FFFFFFFF_h$

Any value other than 0 means that the encoder is monitored for errors.

-1 (FFFFFFFFh) disables encoder monitoring.

6.13.40 Limit Switch Tolerance Band 2056h

Name	Limit Switch Tolerance Band
Index	2056_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	TX_PDO
Units	-
Value Range	
Default Value	$000001F4_h$

Specifies by how far positive or negative limit switches may be passed over before the control unit sends an error signal.

One practical use of this tolerance band is the successful completion of homing runs during which limit switches may be actuated.

6.13.41 Clock Direction Multiplier 2057h

Name	Clock Direction Multiplier
Index	2057_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000080_h

Value by which the clock count is multiplied in clock/direction mode before the clock count is processed.

6.13.42 Clock Direction Divider 2058h

Name	Clock Direction Divider
Index	2058_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000001_h

Value by which the clock count is divided in clock/direction mode before the clock count is processed.

6.13.43 Encoder Configuration 2059h

Name	Encoder Configuration
Index	2059_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32
Saveable	Yes, Tuning

Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Currently not available.

6.13.44 Compensate polepair count 2060h

Name	Compensate polepair count
Index	2060_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000001_h

Allows you to define drive commands without reference to a specific motor.

"0" uses the pole pair number to compute the set-points like in conventional stepper motor control. The figure therefore has to be considered when changing motors.

"1" automatically takes account of the pole pair number when computing the position, velocity, acceleration and jerk parameters.

6.13.45 Velocity nominator 2061h

Name	Velocity nominator
Index	2061_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	-
Value Range	
Default Value	00000001_h

Contains the numerator used to convert the velocity set-points.

The control unit internally uses integers of mechanical (2060_h=1) or electrical (2060_h=0) revolutions per second.

Assuming you wish to see the velocity as revolutions per minute, you would set object 2061_h=1 and object 2062_h=60.

Validity: Profile Position, Profile Velocity, Homing

6.13.46 Velocity denominator 2062h

Name	Velocity denominator
Index	2062_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write only
PDO Mapping	yes / no
Units	
Value Range	
Default Value	$0000003C_h$

Contains the denominator used to convert the velocity set-points.

The control unit internally uses integers of mechanical (2060_h=1) or electrical (2060_h=0) revolutions per second.

Assuming you wish to see the velocity as revolutions per minute, you would set object 2061_h=1 and object 2062_h=60.

Validity: Profile Position, Profile Velocity, Homing

6.13.47 Acceleration nominator 2063h

Name	Acceleration nominator
Index	2063_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000001_h

Contains the numerator used to convert the acceleration set-points.

The control unit internally uses integers of mechanical (2060_h=1) or electrical (2060_h=0) revolutions per second.

Assuming you wish to see the acceleration as revolutions per minute, you would set object 2063_h=1 and object 2064_h=60.

Validity: Profile Position, Profile Velocity, Homing

6.13.48 Acceleration denominator 2064h

Name	Acceleration denominator
Index	2064_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	$0000003C_h$

Contains the denominator used to convert the acceleration set-points.

The control unit internally uses integers of mechanical (2060_h=1) or electrical (2060_h=0) revolutions per second.

Assuming you wish to see the acceleration as revolutions per minute, you would set object 2063_h=1 and object 2064_h=60.

Validity: Profile Position, Profile Velocity, Homing

6.13.49 Jerk nominator 2065h

Name	Jerk nominator
Index	2065_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000001_h

Contains the numerator used to convert the jerk set-points.

The control unit internally uses integers of mechanical (2060h=1) or electrical (2060h=0) revolutions per second cubed.

Assuming you wish to see the jerk as revolutions per minute, you would set object 2065_h=1 and object 2066_h=60.

Validity: Profile Position, Profile Velocity, Homing

6.13.50 Jerk denominator 2066h

Name	Jerk denominator
Index	2066_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	$0000003C_h$

Contains the denominator used to convert the jerk set-points.

The control unit internally uses integers of mechanical (2060_h=1) or electrical (2060_h=0) revolutions per second cubed.

Assuming you wish to see the jerk as (revolutions per minute)/s, you would set object 2065_h=1 and object 2066_h[3].

Validity: Profile Position, Profile Velocity, Homing

6.13.51 Bootup Delay 2084h

Name	Bootup Delay
Index	2084_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Default Value	00000000_h

Allows you to specify the time, in milliseconds, between voltage is first supplied to the control unit and the control unit first providing its functions.

6.13.52 Fieldbus Module Availability 2101h

Name	Fieldbus Module Availability
Index	2101_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32

Access	read only
PDO Mapping	No
Units	
Value Range	set
Default Value	00000000_h

Bits 0..4not used

Bit 5 ECAT

Bit 6...31 not used

6.13.53 Fieldbus Module Control 2102h

Name	Fieldbus Module
Index	2102_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32
Saveable	Yes, Communication

Access	read write
PDO Mapping	No
Default Value	00000020_h

Bits 0..4not used

Bit 5 ECAT

Bit 6...31 not used

6.13.54 Fieldbus Module Status 2103h

Name	Fieldbus Module Status
Index	2103_h
Object Code	RECORD
No. of Elements	3
Data Type	PDO_MAPPING

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	Fieldbus Module Disable Mask
Subindex	01_h
Data Type	UNSIGNED32
Access	read only
PDO Mapping	No
Default Value	00000000_h

Name	Fieldbus Module Enabled
Subindex	02_h
Data Type	UNSIGNED32
Access	read only
PDO Mapping	No
Default Value	00000020_h

01_h: Currently not available.

02_h: Bits 0..4not used

Bit 5 ECAT

Bit 6...31 not used

6.13.55 EtherCAT Slave Status 2110h

Name	EtherCAT Slave Status
Index	2110_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED16

Access	read only
PDO Mapping	No
Units	
Value Range	
Default Value	0000_h

15	14	13	12	11	10	9	8

7	6	5	4	3	2	1	0
	Sync		ERR	ECAT Bus Status [4]			

ECAT Bus Status [4] - current status of the EtherCAT bus
- Value = 01h: bus status INIT
- Value = 02h: bus status PREOPERATIONAL
- Value = 03h: bus status BOOT
- Value = 04h: bus status SAFEOPERATIONAL
- Value = 08h: bus status OPERATIONAL

ERR
- 0: No error
- 1: Error

Sync
- 0: No synchronisation
- 1: EtherCAT synchronisation active (Distributed Clocks)

6.13.56 Sampler Control 2200_h (Obsolete)

Name	Sampler Control
Index	2200_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00000000_h

31	30	29	28	27	26	25	24

23	22	21	20	19	18	17	16

15	14	13	12	11	10	9	8

7	6	5	4	3	2	1	0
							ON

on:

Value = „0“: The sampler is disabled

Value = „1“: The sampler is activated

6.13.57 Sampler Status 2201_h (Obsolete)

Name	Sampler Status
Index	2201_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00000000_h

31	30	29	28	27	26	25	24

23	22	21	20	19	18	17	16

15	14	13	12	11	10	9	8

7	6	5	4	3	2	1	0
						OVER	ACT

ACT:

Value = „0“: The sampler is inactive

Value = „1“: The sampler is active and is recording data.

OVER:

Value = „1“: The recording buffer has not been read out fast enough and data have been lost. The sampler has therefore been stopped and must be restarted by a rising flank in object 2200_h bit 0.

6.13.58 Sample Data Selection 2202h (Obsolete)

Name	Sample Data Selection
Index	2202_h
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	08_h

Name	Sample Value #1
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	60430010_h

Name	Sample Value #2
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	22030220_h

Name	Sample Value #3
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Sample Value #4
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Sample Value #5
Subindex	05_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Sample Value #6
Subindex	06_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Sample Value #7
Subindex	07_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Sample Value #8
Subindex	08_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]Bit 31..16Index of object to be mapped

SubIndex[8]Bit 15..8Subindex of object to be mapped

Length[8]Bit 7..0Length of object to be mapped

6.13.59 Sample Buffer Information 2203h (Obsolete)

Name	Sample Buffer Information
Index	2203_h
Object Code	RECORD
No. of Elements	4
Data Type	UNSIGNED32

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	03_h

Name	Sample Buffer Size
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Sample Buffer Watermark
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

Name	Sample Tick
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

The subindices have the following functions:

01_h specifies the maximum size of the sampler buffer in bytes.

02_h contains the momentary filling level of the sampler buffer in bytes.

03_h contains a numerator that is incremented with each scan.

6.13.60 Sample Time In Ms 2204h (Obsolete)

Name	Sample Time In Ms
Index	2204_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Units	ms
Value Range	
Default Value	00000001_h

This object contains the scan interval of the sampler in milliseconds.

6.13.61 Motor drive submode select 3202h

Name	Motor drive submode select
Index	3202_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Drive

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00000000_h

31	30	29	28	27	26	25	24

23	22	21	20	19	18	17	1

15	14	13	12	11	10	9	8

7	6	5	4	3	2	1	0
	BLDC	Torque		CurRed	Brake	VoS	CL/OL

CL/OL: toggles between open loop and closed loop
Value = “0”: Open Loop
Value = “1”: Closed Loop

VoS
Value = „1“: use S ramp to simulate the V controller

Brake
Value = „1“: Switching on the brake control CurRed (Current Reduction)
Value = „1“: current reduction in open loop enabled

CurRed
Value = „1“: current reduction in open loop enabled

Torque (available in Profile Torque mode only)
Value = „1“: M controller active or else it is superimposed by a V controller

BLDC
Value = „1“: Motor type „BLDC“ (brushless DC motor)

6.13.62 Motor Drive Sensor Display Open Loop 320Ah

Name	Motor Drive Sensor Display Open Loop
Index	$320A_h$
Object Code	RECORD
No. of Elements	5
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	04_h

Name	Commutation
Subindex	01_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	Torque
Subindex	02_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	Velocity
Subindex	03_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	Position
Subindex	04_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Changes the source of objects 6044_h and 6064_h in „Open Loop“ mode. Subindices:

01_h: not used

02_h: not used

03_h: changes the source of object 6044h:
Value = „-1“: enters the internally computed value in object 6044h
Value = „0“: keeps the value at 0
Value = „1“: enters the encoder value in object 6044h

04_h: changes the source of object 6064h:
Value = „-1“: enters the internally computed value in object 6064h
Value = „0“: keeps the value at 0
Value = „1“: enters the encoder value in object 6064h

6.13.63 Motor Drive Sensor Display Closed Loop 320Bh

Name	Motor Drive Sensor Display Closed Loop
Index	$320B_h$
Object Code	RECORD
No. of Elements	5
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	04_h

Name	Commutation
Subindex	01_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	Torque
Subindex	02_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	Velocity
Subindex	03_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	Position
Subindex	04_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Changes the source of objects 6044_h and 6064_h in „Closed Loop“ mode.

Subindices:

01_h: not used

02_h: not used

03_h: changes the source of object 6044h:
Value = „-1“: enters the internally computed value in object 6044h
Value = „0“: keeps the value at 0
Value = „1“: enters the encoder value in object 6044h

04_h: changes the source of object 6064h:
Value = „-1“: enters the internally computed value in object 6064h
Value = „0“: keeps the value at 0
Value = „1“: enters the encoder value in object 6064h

7.13.69 Motor drive parameter set 3210h

Name	Motor drive parameter set
Index	3210_h
Object Code	RECORD
No. of Elements	11
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	$0A_h$

Name	S_P
Subindex	01_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	S_I
Subindex	02_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	V_P
Subindex	03_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	V_I
Subindex	04_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	Id_P
Subindex	05_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	Id_I
Subindex	06_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	Iq_P
Subindex	07_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	Iq_I
Subindex	08_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	I_P
Subindex	09_h
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Name	I_I
Subindex	$0A_h$
Data Type	INTEGER32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Contains the P and I portions of the current, path and position controllers in open loop (only current controller is active) and closed loop.

Subindices

00_h: number of entries

01_h: S controller's proportional portion

02_h: S controller's integral portion

03_h: V controller's proportional portion

04_h: V controller's integral portion

05_h: (closed loop) proportional portion of the field-generating component's current controller

06h: (closed loop) integral portion of the field-generating component's current controller

07_h: (closed loop) proportional portion of the torque-generating component's current controller

08_h: (closed loop) integral portion of the torque-generating component's current controller

09_h: (open loop) proportional portion of the torque-generating component's current controller

0Ah: (open loop) integral portion of the torque-generating component's current controller

6.13.64 Motor drive flags 3212h

Name	Motor drive flags
Index	3212_h
Object Code	RECORD
No. of Elements	4
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	03_h

Name	enable legacy power mode
Subindex	01_h
Data Type	INTEGER8
Access	read write
PDO Mapping	No
Default Value	00_h

Name	override field inversion
Subindex	02_h
Data Type	INTEGER8
Access	read write
PDO Mapping	No
Default Value	00_h

Name	do not touch controller settings
Subindex	03_h
Data Type	INTEGER8
Access	read write
PDO Mapping	No
Default Value	00_h

This object is used to determine whether or not the output voltage for the motor is active in the "switched on" mode of the DS 402 Statemachine. Furthermore, the direction of the rotating field can be changed.

Changes in subindex 02 must be saved. Then the KEB Remote I/O Stepper/BLDC module must be restarted.

Subindices

$00_{h:}$ number of entries

$01_{h:}$ enable legacy power mode

Value = „ 0“: The output voltage for the motor (PWM) is set to 50% in the "Switched On" status of the "DS402 Power State machine". No holding torque is generated.

Value = „1“: The output voltage for the motor (PWM) is active in the "Switched On" status of the "DS402 Power State machine" via the controller, a holding torque is generated. The motor is kept still.

$02_{h:}$ override field inversion

Value = „0“: Use default values of the firmware

Value = „1“: do not force inversion of the rotary field (mathematically positive)

Value = „-1“: force inversion of the rotary field (mathematically negative)

$03_{h:}$ do not touch controller settings

Value = “0”: The control parameters from object 3210_h are changed during Autosetup
Value <> “0“: The control parameters from object 3210_h are NOT changed during Autosetup.

6.13.65 Digital inputs control 3240h

Name	Digital inputs control
Index	3240_h
Object Code	RECORD
No. of Elements	9
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	08_h

Name	Special Function Enable
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Name	Function Inverted
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Name	Force Enable
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Name	Force Value
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Name	Raw Value
Subindex	05_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Name	Input range select
Subindex	06_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Name	Differential select
Subindex	07_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Name	Routing Enable
Subindex	08_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Mit dem Objekt Digital inputs control 3240_h lassen sich digitale Eingänge manipulieren. Bit 0 in any of the subindices below affects digital output 1.

Subindices

$01_{h:}$ The special functions of the respective inputs are switched on with this subindex if the bit has the value "1".

Bit 0: „0“ = without special function, „1“ = negative limit switch

Bit 1: „0“ = without special function, „1“ = positive limit switch

Bit 2: „0“ = without special function, „1“ = reference switch

$02_{h:}$ The input logic is inverted with this subindex if the bit of the respective input has the value "1".

$03_{h:}$ An input value is enforced with this subindex if the bit is set to "1".An input which value is enforced, is independent on the applied voltage level always at the value which is entered in subindex 04h.

$04_{h:}$ This subindex defines the input value to be enforced.

$05_{h:}$ This subindex always contains the read, unmodified input value.

$06_{h:}$ not used

$07_{h:}$ not used

$08_{h:}$ This subindex deactivates (value "0") or activates the Input-Routing.

(Value „1“).

6.13.66 Digital input capture 3241h

Name	Digital input capture
Index	3241_h
Object Code	RECORD
No. of Elements	5
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	4

Name	Control
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	
Default Value	00000000_h

Name	Capture Count
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	
Default Value	00000000_h

Name	Value
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	
Default Value	00000000_h

Name	Encoder Raw Value
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	
Default Value	00000000_h

Description of object 3241_h:

Subindices:

01_h: Control

Value = “0”: Function deactivated

Value = “1”: Capture function with rising edge

Value = “2“: Capture function with falling edge

Value = “3“: Capture function with rising and falling edge

02_h: Capture Count

Actual number of detected level changes since activation of the function. Can be reset to 0 via subindex 01h Control.

03_h: Value

Contains the stored value from the object “Position Actual Value (6064_h)“ at the time of the level change.

04_h: Encoder Raw Value

Contains the stored value from the object “Position Actual Internal Value (6063_h)“ at the time of the level change.

6.13.67 Digital Input Routing 3242h

Name	Digital Input Routing
Index	3242_h
Object Code	RECORD
No. of Elements	37
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	24_h

Name	Input Source 1#…36#
Subindex	01_h…24_h (1…36)
Data Type	UNSIGNED8
Access	read write
PDO Mapping	TX-PDO
Units	
Value Range	
Default Value	00_h

Subindex 01_h contains the source for bit 0 of the object $60FD_h$. Subindex 02_h contains the source for bit 1 of the object $60FD_h$ and so on.

The number, which is written in a subindex determines the source for the corresponding bit.

The following table specifies all possible signal sources.

dec	hex	Signal source
0	00	Signal is always 0
1	01	Physical input 1
2	02	Physical input 2
3	03	Physical input 3
4	04	Physical input 4
5	05	Physical input 5
6	06	Physical input 6
7	07	Physical input 7
8	08	Physical input 8
65	41	Hall input “U”
66	42	Hall input “V”
67	43	Hall input “W”
68	44	Encoder input “A”
69	45	Encoder input “B”
70	46	Encoder input “Z”
128	80	Signal is always 1
129	81	Inverted physical input1
130	82	Inverted physical input 2
131	83	Inverted physical input 3
132	84	Inverted physical input 4
133	85	Inverted physical input 5
134	86	Inverted physical input 6
135	87	Inverted physical input 7
136	88	Inverted physical input 8
193	C1	Inverted hall input “U”
194	C2	Inverted hall input “V”
195	C3	Inverted hall input “W”
196	C4	Inverted encoder input “A”
197	C5	Inverted encoder input “B”
198	C6	Inverted encoder input “Z”

6.13.68 Digital outputs control 3250h

Name	Digital outputs control
Index	3250_h
Object Code	RECORD
No. of Elements	6
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	05_h

Name	no function
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	$000F0001_h$

Name	Function Inverted
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Name	Force Enable
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Name	Force Value
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Name	Raw Value
Subindex	05_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Name	Reserved 1
Subindex	06_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Name	Reserved 2
Subindex	07_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Name	Routing Enable
Subindex	08_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Default Value	00000000_h

Allows you to control the digital outputs. Bit 0 in any of the subindices below affects digital output 1.

Subindices

01_h: No function

02_h: Inverts the logical function
(from n.c. to n.o. function).

03_h: "1" of this subindex enforces an output value. The output's signal level is set in subindex 4_h.

04_h: defines the signal level to be applied to the output. "0" supplies a logical low-level signal to the digital output, "1" supplies a logical high-level signal.

05_h: sets the bit combination to be applied to the outputs.

06h: no function.

07_h: no function.

08_h: This subindex deactivates (value "0") or activates (value „1“) the Output Routing (3252_h).

6.13.69 Digital Output Routing 3252h

Name	Digital Output Routing
Index	3252_h
Object Code	RECORD
No. of Elements	6
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	5_h

Name	Output Source #1…#5
Subindex	01_h…05_h (1…5)
Data Type	UNSIGNED16
Access	read write
PDO Mapping	TX-PDO
Units	
Value Range	
Default Value	

Subindex 01_h contains the source for bit 8 of the object $60FE_h$. Subindex 02_h contains the source for bit 9 of the object $60FE_h$ and so on.

The number, which is written in a subindex determines the source for the corresponding bit.

The Output Routing assigns a signal source to an output. A control bit in object $60FE_h$:01_h switches the signal on or off.

The selection of the source occurs with the object 3252_h:01_h…05_h in high byte (Bit 15…8), the control bit is selected in the low byte (Bit 7…0).

Since only one output is currently available, only bit 0 is relevant.

With bit 7 = 1 the signal, which is assigned to the output, can be inverted again.

The following table specifies possible signal sources.

hex	Signal source
00xx	Output is always 1
01xx	Output is always 0
02xx	Encoder signal with frequency divider 1
03xx	Encoder signal with frequency divider 2
04xx	Encoder signal with frequency divider 4
05xx	Encoder signal with frequency divider 8
06xx	Encoder signal with frequency divider 16
07xx	Encoder signal with frequency divider 32
08xx	Encoder signal with frequency divider 64
09xx	Position Actual Value (6064_h) with frequency divider 1
0Axx	Position Actual Value (6064_h) with frequency divider 2
0Bxx	Position Actual Value (6064_h) with frequency divider 4
0Cxx	Position Actual Value (6064_h) with frequency divider 8
0Dxx	Position Actual Value (6064_h) with frequency divider 16
0Exx	Position Actual Value (6064_h) with frequency divider 32
0Fxx	Position Actual Value (6064_h) with frequency divider 64
10xx	Inverted braking PWM signal, configuration with object 2038h:05h and 06h.
11xx	Inverted braking PWM signal, configuration with object 2038_h:05_h and 06_h.

Example 1:

The encoder signal shall be assigned with a frequency divider 4 to the output. The following settings must be done:

3252_h:02_h = 0400_h results from $04xx_h$ + 0000_h

- $04xx_h$ = Encoder signal with frequency divider 4
- 0000_h = Selection Bit 0 of object $60FE_h$:01_h

Example 2:

The brake PWM signal shall be assigned to the output. The following settings must be done:

3252_h:02_h = 1080_h results from $10xx_h$ + 0080_h

- $10xx_h$ = Braking PWM signal
- 0080_h = Selection of inverted bit 0 of object $60FE_h$:01_h

6.13.70 Following Error Option Code 3700h

Name	Following Error Option Code
Index	3700_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER16
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	
Value Range	-1…2
Default Value	$FFFF_h$ / -1

Contains the action to be taken, i.e. how the motor shall be decelerated to standstill in case of error.

-32786…-2:	reserved
-1:	No response
0:	Immediate stop with short-circuit braking
1:	Decelerate down “Slow Down Ramp” (deceleration depends on mode).
2:	Decelerate down "quick stop ramp", then change state to "Switch on disabled".
3…32767:	reserved

Further objects:

- Following error window 6065_h
- Following error time out 6066_h

6.13.71 HW Information 4012h

Name	HW Information
Index	4012_h
Object Code	RECORD
No. of Elements	2
Data Type	VISUBLE_STRING

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	01_h

Name	EEPROM size in bytes
Subindex	01_h
Data Type	UNSIGNED32
Access	read only
PDO Mapping	No
Default Value	00000000_h

For internal use only: This object contains information about the hardware.

6.13.72 HW configuration 4013h

Name	HW configuration
Index	4013_h
Object Code	RECORD
No. of Elements	2
Data Type	VISUBLE_STRING

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	01_h

Name	HW configuration #1
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	00000000_h

For internal use only.

6.13.73 Operating conditions 4014h

Name	Operating conditions
Index	4014_h
Object Code	RECORD
No. of Elements	4
Data Type	INTEGER32

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	03_h

Name	Voltage UB Power [mV]
Subindex	01_h
Data Type	INTEGER32
Access	read only
PDO Mapping	TX-PDO
Default Value	00000000_h

Name	Voltage UB Logic [mV]
Subindex	02_h
Data Type	INTEGER32
Access	read only
PDO Mapping	TX-PDO
Default Value	00000000_h

Name	Temperature PCB [d°C]
Subindex	03_h
Data Type	INTEGER32
Access	read only
PDO Mapping	TX-PDO
Default Value	00000000_h

6.13.74 Drive Serial Number 4040h

Name	Drive Serial Number
Index	4040_h
Object Code	VARIABLE
No. of Elements	0
Data Type	VISUBLE_STRING

Access	read only
PDO Mapping	No
Default Value	-

Contains the control unit's serial number.

6.13.75 Device-ID 4041h

Name	Device-ID
Index	4041
Object Code	VARIABLE
No. of Elements	0
Data Type	OCTET_STRING

Access	read only
PDO Mapping	No
Default Value	-

For internal use only.

6.13.76 Error Code 603Fh

Name	Error Code
Index	$603F_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED16

Access	read only
PDO Mapping	TX-PDO
Units	
Value Range	
Default Value	0000_h

6.13.77 Controlword 6040h

Name	Controlword
Index	6040_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED16
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	0000_h

Controls the DS402 power state machine. The function of some parts of this parts depend on the currently enabled mode.

15	14	13	12	11	10	9	8	Mode
					RES	OMS	HALT	
						Change on setpoint		PP
								PV
								Homing

7	6	5	4	3	2	1	0	Mode
FR	OMS [3]			EO	QC	EV	SO	
	abs/rel	Change Set immediatly	New Setpoint					PP
	reserved							PV
	reserved		Start homing					Homing

SO (Switched On)

Value = „1“: changes the state to "Switched on"

EV (Enable Voltage)

Value = „1“: changes the state to "Enable voltage"

QS (Quick Stop)

Value = „0“: changes the state to "Quick stop"

EO (Enable Operation)

Value = „1“: changes the state to "Enable operation"

OMS [3], OMS (Operation mode specific)

Function depends on chosen mode

FR (Fault Reset)

Resets a fault (if possible)

HALT

Value = „1“: halts the drive

RES

reserved

MS (Manufacturer specific)

Manufacturer-specific

6.13.78 Statusword 6041h

Name	Status word
Index	6041_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED16

Access	read only
PDO Mapping	TX-PDO
Units	
Value Range	
Default Value	0000_h

Provides status details of the drive controller and the DS402 power state machine.

15	14	13	12	11	10	9	8	Mode
CLA		OMS [2]		ILA	TARG	REM	MS	
		Following error	Setpoint acknowledge					PP
								Vel
		Maximum slippage reached	Speed is equal 0					PV
		Following error	Drive follows the com-mand value		Res		Fieldbus sychron	CSP

7	6	5	4	3	2	1	0	Mode
WARN	SOD	QC	VE	FAULT	OE	SO	RTSO	

RTSO (Ready To Switch On)

Value = „1“: the state of the control unit is "Ready To Switch On"

SO (Switched On)

Value = „1“: the state of the control unit is "Switched On"

OE (Operational Enabled)

Value = „1“: the state of the control unit is "Operational Enabled"

FAULT

A fault occurred

VE (Voltage Enabled)

Voltage is supplied

QS (Quick Stop)

Value = „0“: the state of the control unit is "Quick Stop"

SOD (Switched On Disabled)

Value = “1”: the state of the control unit is "Switched On Disabled"

WARN (Warning)
Value = „1“: Warning
REM (Remote)
Remote (bit is always "1")
TARG (Target reached)
Motion arrived at set target position
ILA (Internal Limit Reached)
Limit exceeded
OMS (Operation Mode Specific)
Function depends on chosen mode
CLA (Closed Loop Available)
Value = “1”: Auto Setup successful and Closed Loop possible

6.13.79 Vl Target Velocity 6042h

Name	Vl Target Velocity
Index	6042_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER16
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	-
Value Range	
Default Value	$00C8_h$

Target velocity in user-defined UoM

6.13.80 Vl velocity demand 6043h

Name	Vl velocity demand
Index	6043_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER16

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00000000_h

Current target velocity in user-defined UoM

6.13.81 Vl velocity actual value 6044h

Name	Vl Velocity Actual Value
Index	6044_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER16

Access	read only
PDO Mapping	TX-PDO
Units	
Value Range	
Default Value	0000_h

Shows the current actual velocity in user-defined UoM.

In open loop mode, you can use object $320A_h:03_h$ to set this object to either the internally computed value or the encoder.

In closed loop mode, you can use object $320B_h:03_h$ to set this object to either the internally computed value or the encoder.

6.13.82 Vl velocity min max amount 6046h

Name	Vl velocity min max amount
Index	6046_h
Object Code	RECORD
No. of Elements	3
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	MinAmount
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00000000_h

Name	MaxAmount
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Sets the minimum and maximum velocities to be shown in user-defined UoM.

Subindex 1 contains the minimum velocity.

Subindex 2 contains the maximum velocity.

The minimum velocity applies in case the target velocity you enter (Object 6042_h) is slower than the minimum velocity. The motor stops when the target velocity is 0.

The maximum velocity applies in case the target velocity you enter is higher than the maximum velocity; also, bit 11 "Limit exceeded" of object 6041_h (Status word) is set.

6.13.83 VI velocity acceleration 6048h

Name	VI velocity acceleration
Index	6048_h
Object Code	RECORD
No. of Elements	3
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	DeltaSpeed
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	$000001F4_h$

Name	DeltaTime
Subindex	02_h
Data Type	UNSIGNED16
Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	0001_h

Defines the acceleration ramp in velocity mode (see "Velocity").
(change of velocity / time).

- 01_h: change of velocity in steps per second
- 02_h: change of time in seconds

6.13.84 Vl velocity deceleration 6049h

Name	Vl velocity deceleration
Index	6049_h
Object Code	RECORD
No. of Elements	3
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	DeltaSpeed
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	$000001F4_h$

Name	DeltaTime
Subindex	02_h
Data Type	UNSIGNED16
Access	read write
PDO Mapping	RX-PDO
Units	s
Value Range	
Default Value	0001_h

Defines the deceleration ramp in velocity mode (see "Velocity").
(change of velocity / time).

- 01_h: change of velocity in steps per second
- 02_h: change of time in seconds

6.13.85 Vl velocity quick stop 604Ah

Name	Vl Velocity Quick Stop
Index	$604A_h$
Object Code	RECORD
No. of Elements	3
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	DeltaSpeed
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00001388_h

Name	DeltaTime
Subindex	02_h
Data Type	UNSIGNED16
Access	read write
PDO Mapping	RX-PDO
Units	s
Value Range	
Default Value	0001_h

Defines the quick stop ramp in velocity mode (see "Velocity").
(change of velocity / time).

- 01_h: change of velocity in steps per second
- 02_h: change of time in seconds

6.13.86 VI dimension factor 604Ch

Name	VI dimension factor
Index	$604C_h$
Object Code	RECORD
No. of Elements	3
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	VI dimension factor numerator
Subindex	01_h
Data Type	INTEGER32
Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00000001_h

Name	VI dimension factor denumerator
Subindex	02_h
Data Type	INTEGER32
Access	read write
PDO Mapping	RX-PDO
Units	s
Value Range	
Default Value	$0000003C_h$

Specifies the unit to be used for the velocity of objects affecting Velocity mode.

Setting subindex 1 and 2 to "1" shows the velocity as revolutions per minute.

Otherwise, subindex 1 contains the denominator (multiplier) and subindex 2 the numerator (divisor) for further velocity calculations.

The result will be interpreted as either electrical (object 2060_h = 0) or mechanical (object 2060_h = 1) revolutions per second.

6.13.87 Quick Stop Option Code 605Ah

Name	Quick Stop Option Code
Index	$605A_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER16
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	
Value Range	0…2
Default Value	0001_h

Contains the action to be taken when the state of the DS402 power state machine changes to Quick Stop.

-32786…-1:	reserved
0:	Immediate stop with short-circuit braking
1:	Decelerate down “Slow Down Ramp” (deceleration depends on mode), then change state to “Switch on disabled”.
2:	Decelerate down "quick stop ramp", then change state to "Switch on disabled".
3…32767:	reserved

6.13.88 Shutdown Option Code 605Bh

Name	Shutdown Option Code
Index	$605B_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER16
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	
Value Range	0…1
Default Value	0001_h

Contains the action to be taken when the state of the DS402 power state machine changes from "Operation enabled" to "Ready to switch on".

-32786…-1:	reserved
0:	Immediate stop with short-circuit braking
1:	Decelerate down “Slow Down Ramp” (deceleration depends on mode), then change state to “Switch on disabled”.
2:	reserved

6.13.89 Disable Option Code 605Ch

Name	Disable Option Code
Index	$605C_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER16
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	
Value Range	0…1
Default Value	0001_h

Contains the action to be taken when the state of the DS402 power state machine changes from "Operation enabled" to "Ready to switch on".

-32786…-1:	reserved
0:	Immediate stop with short-circuit braking
1:	Decelerate down “Slow Down Ramp” (deceleration depends on mode), then change state to “Switch on disabled”.
2…32767:	reserved

6.13.90 Halt Option Code 605Dh

Name	Halt Option Code
Index	$605D_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER16
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	
Value Range	0…2
Default Value	0001_h

Contains the action to be taken when halt bit 8 of controlword 6040_h is set.

-32786…-0:	reserved
1:	Decelerate down “Slow Down Ramp” (deceleration depends on mode).
2:	Decelerate down "quick stop ramp".
3…32767:	reserved

6.13.91 Fault Option Code 605Eh

Name	Fault Option Code 605E
Index	$605E_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER16
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	
Value Range	1…2
Default Value	0002_h

Contains the action to be taken, i.e. how the motor shall be decelerated to standstill in case of error.

-32786…-0:	reserved
1:	decelerate down “Slow Down Ramp” (deceleration depends on mode), then change state to “Switch on disabled”
2:	Decelerate down "quick stop ramp", then change state to "Switch on disabled".
3…32767:	reserved

6.13.92 Modes of Operation 6060h

Name	Modes of Operation
Index	6060_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER8
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	-2…6, 8…10
Default Value	00_h

Mode of operation

-128…-3:	manufacturer-specific operation modes
-2:	Auto- Setup
-1:	clock/direction mode
0:	no mode assigned / no mode change
1:	Profile Position Mode
2:	Velocity Mode
3:	Profile Velocity Mode
4:	Profile Torque Mode
5:	Reserved
6:	Homing Mode
7:	Interpolated Position Mode (not available)
8:	Cyclic Synchronous Position Mode
9:	Cyclic Synchronous Velocity Mode
10:	Cyclic Synchronous Torque Mode
11…127:	Reserved

6.13.93 Modes of operation display 6061h

Name	Modes of operation display
Index	6061_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER8

Access	read only
PDO Mapping	TX-PDO
Units	
Value Range	
Default Value	00_h

Contains the current mode of operation as set in object 6060_h (Modes of Operation).

6.13.94 Position demand value 6062h

Name	Position Demand Value
Index	6062_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32

Access	read only
PDO Mapping	TX-PDO
Default Value	00000000_h

Target position in user-defined UoM

6.13.95 Position actual internal value 6063h

Name	Position actual internal value
Index	6063_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32

Access	read only
PDO Mapping	TX-PDO
Default Value	00000000_h

Current encoder position in increments since turning on the drive.

6.13.96 Position actual value 6064h

Name	Position actual value
Index	6064_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32

Access	read only
PDO Mapping	TX-PDO
Units	
Value Range	
Default Value	00000000_h

Current actual position (encoder position computed with reference to the feed constant (6092_h), the gear ratio (6091_h) and the reference position)

In open loop mode, you can use object $320A_h:04_h$ to set this object to either the internally computed value or the encoder.

In closed loop mode, you can use object $320B_h:04_h$ to set this object to either the internally computed value or the encoder.

6.13.97 Following error window 6065h

Name	Following error window
Index	6065_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00000100_h

Contains the maximum trailing error with reference to the setpoint position.

In case the actual position differs from the set position by more than the value set in this object, bit 11 "Limit exceeded" of object 6041_h (status word) will be set. The difference must prevail longer than the time set in object 6066_h.

The action to be executed is parameterized in object Following Error Option Code 3700_h.

Following error time out 6066h

Name	Following error time out
Index	6066_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED16
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	ms
Value Range	
Default Value	0064_h (100_d)

Time, in milliseconds, until an excessive trailing error provokes an error message.

In case the actual position differs from the set position by more than the value set in object 6065_h, bit 11 "Limit exceeded" of object 6041_h (status word) will be set. The difference must prevail longer than the time set in this object.

The action to be executed is parameterized in object Following Error Option Code 3700_h.

6.13.98 Position window 6067h

Name	Position window
Index	6067_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	$0000000A_h$

Specifies a symmetrical range before and after the target position in which the target is considered reached.

6.13.99 Position window time 6068h

Name	Position window time
Index	6068_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED16
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	Ms
Value Range	
Default Value	0064_h

To consider the target position reached, the actual position must remain within the "Position window" (6067h) for the time, in milliseconds, set in this object.

6.13.100 Velocity Demand Value 606Bh

Name	Velocity Demand Value
Index	$606B_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32

Access	read only
PDO Mapping	TX-PDO
Units	
Value Range	
Default Value	00000000_h

Controller's set-point velocity in Profile Velocity mode.

This object is converted into the user-defined UoM (see User-defined UoM). The factory default is revolutions per minute.

Contains the value output by the trajectory generator; this value also serves as the preset of the velocity controller.

6.13.101 Velocity actual value 606Ch

Name	Velocity Actual Value
Index	$606C_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32

Access	read only
PDO Mapping	TX-PDO
Units	
Value Range	
Default Value	00000000_h

Current actual velocity in Profile Velocity mode.

6.13.102 Velocity window 606Dh

Name	Velocity Window
Index	$606D_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED16
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	0000_h

Velocity window in Profile Velocity mode.

Specifies by how much the real velocity may differ from the set-point velocity to allow bit 10 "target reached" of the status word (6041h) to be set to "1".

6.13.103 Velocity Window Time 606Eh

Name	Velocity Window
Index	$606D_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED16
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	0000_h

Time window in Profile Velocity mode.

Specifies how long the real velocity must remain within the velocity window (606Dh) to allow bit 10 "target reached" of the status word (6041h) to be set to "1".

6.13.104 Target torque 6071h

Name	Target Torque
Index	6071_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER16
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	0000_h

Sets the target torque for the Profile Torque mode.

6.13.105 Max torque 6072h

Name	Max Torque
Index	6072_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED16
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	0000_h

6.13.106 Torque demand 6074h

Name	Torque Demand
Index	6074_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER16

Access	read only
PDO Mapping	TX-PDO
Units	
Value Range	
Default Value	0000_h

Actual output value of the ramp generator (torque) for the internal the controller.

6.13.107 Target Position 607Ah

Name	Target Position
Index	$607A_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	$00000FA0_h$

Target position

6.13.108 Position range limit 607Bh

Name	Position range limit
Index	$607B_h$
Object Code	RECORD
No. of Elements	3
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	Min position range limit
Subindex	01_h
Data Type	INTEGER32
Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	80000000_h

Name	Max Position Range Limit
Subindex	02_h
Data Type	INTEGER32
Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	$7FFFFFFF_h$

Values below or above this range are considered an overflow. To prevent this, set target position limits in object $607D_h$ ("Software Position Limit").

6.13.109 Home Offset 607Ch

Name	Home Offset
Index	$607C_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00000000_h

Difference between the application's home position and the machine's reference point. This object is computed using the same unit of measurement used for computing object $607A_h$ (see User-defined UoM).

6.13.110 Software position limit 607Dh

Name	Software position limit
Index	$607D_h$
Object Code	RECORD
No. of Elements	3
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	Min position limit
Subindex	01_h
Data Type	INTEGER32
Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	80000000_h

Name	Max position limit
Subindex	02_h
Data Type	INTEGER32
Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	$7FFFFFFF_h$

The target position must stay within the limits set in this object. To verify whether it actually is, the Home Offset ($607C_h$) is deducted:

Corrected Min Position Limit = Min Position Limit - Home Offset

Corrected Max Position Limit = Max Position Limit - Home Offset.

6.13.111 Polarity 607Eh

Name	Polarity
Index	$607E_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED8
Saveable	Yes, Application

Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00_h

Reversing the polarity is subject to the following general rule: a bit being "1" enables polarity reversal.

"0" retains the sense of rotation as described for the mode concerned

7	6	5	4	3	2	1	0
POS	VEL						

VEL (Velocity) - reverses the sense of rotation in the following modes:

Profile Velocity Mode

Cyclic Synchronous Velocity Mode

Velocity Mode

POS (Position) - reverses the sense of rotation in the following modes:

Profile Position Mode

Cyclic Synchronous Position Mode

6.13.112 Profile Velocity 6081h

Name	Profile Velocity
Index	6081_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	$000001F4_h$

Maximum driving velocity in revolutions per second.

This object is converted into the user-defined UoM (see User-defined UoM). The factory default is revolutions per minute.

6.13.113 End velocity 6082h

Name	End Velocity
Index	6082_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00000000_h

Velocity at the end of the ramp.

This object is converted into the user-defined UoM (see User-defined UoM). The factory default is revolutions per minute.

6.13.114 Profile acceleration 6083h

Name	Profile Acceleration
Index	6083_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	$000001F4_h$

Maximum acceleration in revolutions per s^2.

6.13.115 Profile deceleration 6084h

Name	Profile Deceleration
Index	6084_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	$000001F4_h$

Maximum deceleration in revolutions per s^2.

6.13.116 Quick Stop deceleration 6085h

Name	Quick Stop Deceleration
Index	6085_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00001388_h

Maximum quick stop deceleration in revolutions per s^2.

6.13.117 Motion profile type 6086h

Name	Motion Profile Type
Index	6086_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER16
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	0000_h

Ramp type

Value = „0“: trapezoidal ramp

Value = „3“: jerk-delimited ramp

6.13.118 Torque Slope 6087h

Name	Torque Slope
Index	6087_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00000000_h

Slope of the torque in Profile Torque mode.

6.13.119 Position encoder resolution 608Fh

Name	Position encoder resolution
Index	$608F_h$
Object Code	RECORD
No. of Elements	3
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	Encoder increments
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	$000007D0_h$

Name	Motor revolutions
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000001_h

Position Encoder Resolution = Encoder Increments ($608F_h$:01_h) / Motor Revolutions ($608F_h$:02_h)

6.13.120 Gear ratio 6091h

Name	Gear ratio
Index	6091_h
Object Code	RECORD
No. of Elements	3
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	Motor revolutions
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000001_h

Name	Shaft revolutions
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000001_h

Gear Ratio = Motor Revolutions (6091_h:01_h) / Shaft Revolutions (6091_h:02_h)

6.13.121 Feed constant 6092h

Name	Feed constant
Index	6092_h
Object Code	RECORD
No. of Elements	3
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	Feed
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000001_h

Name	Shaft revolutions
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000001_h

Feed rate per revolution of a linear drive.

Feed Constant = Feed (6092_h:01_h) / Shaft Revolutions (6092_h:02_h

6.13.122 Homing Method 6098h

Name	Homing Method
Index	6098_h
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER8
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	23_h

Selects the Homing Method.

6.13.123 Homing Speeds 6099h

Name	Homing speeds
Index	$Nnnn_h$
Object Code	RECORD
No. of Elements	3
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	Speed during search for Switch
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00000032_h

Name	Speed during search for zero
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00000001_h

Contains the velocities in Homing Mode (6098_h) in revolutions per second.

This object is converted into the user-defined UoM (see User-defined UoM). The factory default is revolutions per minute.

The numerator of object 2061_h and the denominator of object 2062_h is used for computation.

Subindex 01 specifies the velocity for searching for the switch.

Subindex 02 specifies the (lower) velocity for searching for the reference position

The velocity of subindex 02 is also the initial velocity at the beginning of the acceleration ramp. If this velocity is too high, the motor will miss out on steps or fail to turn in the first place. Too high a setting will cause the index mark to be missed. The velocity of subindex 02 should therefore be lower than 1000 steps per second.

Verify that the velocity of subindex 01 is higher than the velocity of subindex 02.

6.13.124 Homing acceleration 609Ah

Name	Homing Acceleration
Index	$609A_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	$000001F4_h$

Acceleration ramp, in user-defined UoM, in Homing mode (section).

This ramp applies to the start of the motion only. Upon arriving at the switch, the velocity will be reduced to the lower setting and the motor will stop instantly upon arriving at the end position.

6.13.125 Profile Jerk 60A4h

Name	Profile jerk
Index	$60A4_h$
Object Code	RECORD
No. of Elements	5
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	04_h

Name	Begin acceleration jerk
Subindex	01_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	$000003E8_h$

Name	End acceleration jerk
Subindex	02_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	$000003E8_h$

Name	Begin deceleration jerk
Subindex	03_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	$000003E8_h$

Name	End deceleration jerk
Subindex	04_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	$000003E8_h$

Use this object to set the jerk value for jerk-delimited ramps. "0" does not limit the jerk.

6.13.126 Interpolation time period 60C2h

Name	Interpolation Time Period
Index	$60C2_h$
Object Code	RECORD
No. of Elements	3
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	02_h

Name	Interpolation Time Period Value
Subindex	01_h
Data Type	UNSIGNED8
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	00000001_h

Name	Interpolation Time Index
Subindex	02_h
Data Type	INTEGER8
Access	read write
PDO Mapping	No
Units	
Value Range	
Default Value	$000000FD_h$

Cycle time = value of $60C2_h:01_h$ * $10^{60C2h:02h\ seconds}$

At this time, only cycle times should be used that correspond to a power of two, i.e. 1, 2, 4, 8, 16, etc. The time unit of the cycle time is defined by object $60C2_h:02_h$.

- 01_h (Interpolation Time Period): sets the time of a cycle, i.e. the interval within which $607A_h$ is to receive a new set-point.
- 02h (Interpolation Time Index): This object specifies the time basis for cycles. For the time being, only 60C2h:02h= -3 is supported, i.e. a time base of 1 millisecond.

6.13.127 Max acceleration 60C5h

Name	Max acceleration
Index	$60C5_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	$FFFFFFFD_h$

Contains the admissible maximum acceleration ramp.

For the deceleration ramp: see object $60C6_h$ „Max Deceleration“.

6.13.128 Max Deceleration 60C6h

Name	Specifies how long the real velocity must remain within the velocity window (606Dh) to allow bit 10 "target reached" of the status word (6041h) to be set to "1".
Index	$60C6_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00001388_h

Contains the admissible maximum deceleration ramp.

For the acceleration ramp: see object $60C5_h$ „Max Acceleration“.

6.13.129 Position Option Code 60F2h

Name	Position Option Code
Index	$60F2_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED16
Saveable	Yes, Application

Access	read write
PDO Mapping	yes, Rx-PDO
Units	
Value Range	
Default Value	0000_h

15	14	13	12	11	10	9	8
MS	RESERVED [3]			IP OPTION [4]			

7	6	5	4	3	2	1	0
RADO [2]		RRO [2]		CIO [2]		REL. OPT. [2]	

REL. OPT.:

These bits set the response to rotary motions in Profile Position mode if bit 6 of the control word 6040_h = "1“.

Bit 1	Bit 0	Description
0 0		Position movements are made in relation to the previous (internal and absolute) target position (or, if there is no previous target position, in relation to 0)
0	1	Position movements are made in relation to the trajectory generator's current set-point value (or output).
1	0	Position movements are made in relation to the current position (object 6064h).
1	1	reserved

CIO:

- Currently not used

RRO

- Currently not used

RADO (Rotary Axis Direction Option)

- These bits define the sense of rotation in Profile Position mode.

Bit 7	Bit 6	Description
0	0	Normal positioning similar to a linear shaft: At the Position Range Limits $607B_h:01_h$ and 02_h or when exceeding one of them, the set-point value is automatically transferred to the other end of the limits. This bit combination is the only way of supporting movements in excess of the modulo value.
0	1	Positioning in negative direction only: if the target position is greater than the current position, the shaft will go to the target position via the Min Position Range Limit of object $607D_h:01_h$.
1	0	Positioning in positive direction only: if the target position is smaller than the current position, the shaft will go to the target position via the Max Position Range Limit of object $607D_h:01_h$.
1	1	Positioning at the shortest distance to the target position. **NOTE** In a 360° system, the shaft will move in positive direction if the difference between the current position and the target position is smaller than 180°.

IP OPTION

- Currently not used

RESERVED

- reserved

MS

- Currently not used

6.13.130 Following error actual value 60F4h

Name	Following error actual value
Index	$60F4_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32
Access	read only
PDO Mapping	TX-PDO
Units	
Value Range	
Default Value	00000000_h

Current trailing error in user-defined UoM

6.13.131 Digital inputs 60FDh

Name	Digital inputs
Index	$60FD_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32
Access	read only
PDO Mapping	TX-PDO
Units	
Value Range	
Default Value	00000000_h

31	30	29	28	27	26	25	24

23	22	21	20	19	18	17	16
DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1

15	14	13	12	11	10	9	8

7	6	5	4	3	2	1	0
					REF	LS+	LS-

LS- (Limit Switch -): negative limit switch
LS+ (Limit Switch +): positive limit switch
REF: reference switch
DI n: digital input (n=1...8)

6.13.132 Digital Outputs 60FEh

Name	Digital outputs
Index	$60FE_h$
Object Code	RECORD
No. of Elements	2
Data Type	UNSIGNED32
Saveable	Yes, Application

Name	Highest sub index supported
Subindex	00_h
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	01_h

Name	Digital Outputs #1
Subindex	00_h
Data Type	UNSIGNED32
Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00000000_h

Allows you to write to the motor's digital outputs.

Doing so must take account of the entries in object 3250h, subindices 02h to 05h.

31	30	29	28	27	26	25	24

23	22	21	20	19	18	17	16
							Out1

15	14	13	12	11	10	9	8

7	6	5	4	3	2	1	0

6.13.133 Target velocity 60FFh

Name	Target velocity
Index	$60FF_h$
Object Code	VARIABLE
No. of Elements	0
Data Type	INTEGER32
Saveable	Yes, Application

Access	read write
PDO Mapping	RX-PDO
Units	
Value Range	
Default Value	00000000_h

Contains the target velocity of Profile Velocity mode.

This object is converted into the user-defined UoM (see User-defined UoM). The factory default is revolutions per minute.

6.13.134 Supported drive modes 6502h

Name	Supported drive modes
Index	6502_h
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32

Access	read only
PDO Mapping	TX-PDO
Units	
Value Range	
Default Value	$000003AF_h$ ($0000\ 0011\ 1110\ 1111_d$)

The object describes the supported drive modes. (Bit 16...31 are not used)

15	14	13	12	11	10	9	8
						CST	CSV

7	6	5	4	3	2	1	0
CSP	IP	HM		PT	PV	VL	PP

Bit	Description	Availability
0	PP: Profile Position Modus	✓
1	VL: Velocity Mode	✓
2	PV: Profile Velocity Mode	✓
3	PT: Profile Torque Mode	✓
4		
5	HM: Homing Mode	✓
6	IP: Interpolated Position Modus	✓
7	CSP: Cyclic Synchronous Position Mode	✓
8	CSV: Cyclic Synchronous Velocity Modus	✓
9	CST: Cyclic Synchronous Torque Mode	✓

6.13.135 Drive Catalogue Number 6503h

Name	Drive catalogue number
Index	6503_h
Object Code	VARIABLE
No. of Elements	0
Data Type	VISIBLE_STRING

Access	read only
PDO Mapping	No
Units	
Value Range	
Default Value	00000000_h

Contains the control unit's MAC address as a character string.

6.13.136 HTTP drive catalogue address 6505h

Name	HTTP drive catalogue address
Index	6505_h
Object Code	VARIABLE
No. of Elements	0
Data Type	VISIBLE_STRING

Access	read only
PDO Mapping	No
Units	
Value Range	
Default Value	http://www.keb.de

6.14 Technical Data

6.14.1 General Specifications

Fieldbus	EtherCAT 100 Mbit/s
EtherCAT controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus port	10-pin system plug in side wall
Electrical insulation	Modules electrically insulated from one another and from the bus.
Diagnosis	LED: bus status, module status
IO/power connection	36-pin spring-assisted combi plug with mechanical ejector-
E-bus load	max. 100 mA
Term. module	not required
Supply voltage logic part (L+)	24 VDC -20%/+25%
Noise immunity	Zone B to EN 61131-2, mounted on earthed DIN rail in earthed control cabinet.
Service conditions	
Ingress protection	IP20
Mounting position	vertical, stackable
Storage temperature	-25°C … + 70°C
Operating temperature	0°C ... + 55°C
Rel. humidity	5% … 95%, non-condensing
Mechanical properties	
Installation	35 mm DIN rail (top-hat rail)
Dimensions	25mm x 120mm x 90mm (W x H x D)
Housing mount	aluminium
Shield	connects straight to module housing

Module-specific details						
Product name	KEB C6 Remote I/O Stepper/BLDC					
Article number	00C6CJ1-0100					
Motor connection	2-phase stepper motor or brushless DC motor					
Motor supply voltage (M+)	max. 72 VDC					
Motor voltage	12…24 VDC		>24…48 VDC		>48…72 VDC 1)	
Nominal motor current	5A 2)	4.2A 3)	4.5A 2)	3.9A 3)	Tbd.	Tbd.
Peak current	stepper motor: 10A / brushless DC motor: 15A					
Incremental encoder	5V / 24V (A, /A, B, /B, Z, /Z) Count frequency RS422: 200kHz, 24V Single ended 25kHz Note: Connect unused encoder signals to + 5V DC!					
Hall encoder	5V / 24V (H1, H2, H3) or 3 extra low side switching digital inputs Count frequency 25kHz					
Digital inputs	5x 1ms (configurable, e.g. reference switch, limit switch, enable)					
Digital outputs	1x 0.5A (brake output or standard output)					

1) Not cULus approved 2) without load at the digital output 3) with max. 0.5A load at the digital output

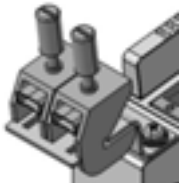
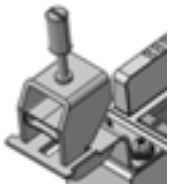
Table 4: General Specifications

6.15 Ordering information

6.15.1 Basic device KEB C6 Remote I/O

KEB C6 Remote Stepper/BLDC	00C6CJ1-0100	

6.15.2 Accessories

KEB C6 Remote I/O shield terminal 2x8mm	00C6CD1-0400	
KEB C6 Remote I/O shield terminal 1x14mm	00C6CD1-0500	

6.16 Approvals

6.16.1 CE conformity declaration

EU KONFORMITÄTSERKLÄRUNG

Dokument-Nr. / Monat.Jahr: ce_ca_remv-C6C-IO-e_de / 04.2018

Hersteller:	KEB Automation KG Südstraße 38 32683 BARNTRUP	
Produktbezeichnung:	Steuerung - Typenreihe	yy**C6C**xx – xxxx
	Größe	yy = 00 x = beliebige Ziffer oder Buchstabe
	Spannungsklasse	24 Vdc

Das bezeichnete Produkt stimmt mit den Vorschriften folgender Europäischer Richtlinien überein:

Nummer: **EMV : 2014 / 30 / EU**
Text: Richtlinie des Rates zur Angleichung der Rechtsvorschriften der Mitgliedsstaaten über die elektromagnetische Verträglichkeit.

Number: **Gefährliche Substanzen: 2011 / 65 / EU**
Text: Richtlinie des Rates zur Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten.

Weitere Angaben zur Einhaltung dieser Richtlinien enthält der Anhang.

Anbringung der CE-Kennzeichnung: ja

Aussteller: KEB Automation KG
Südstraße 38
32683 BARNTRUP

Ort, Datum Barntrup, 10.04.2018

Rechtsverbindliche Unterschrift:

i. A. W. Hovestadt / Normenbeauftragter

W. Wiele / Technischer Leiter

Die Anhänge sind Bestandteil dieser Erklärung.
Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, beinhaltet jedoch keine Zusicherung von Eigenschaften.

Die Sicherheitshinweise der mitgelieferten Produktdokumentation sind zu beachten.

ANHANG 1

Dokument-Nr. / Monat.Jahr:	ce_ca_remv-C6C-IO-e_de / 04.2018	
Produktbezeichnung:	Steuerung - Typenreihe	yy**C6C**xx – xxxx
	Größe	yy = 00 x = beliebige Ziffer oder Buchstabe
	Spannungsklassen	24 Vdc

Die Übereinstimmung des bezeichneten Produktes mit den Vorschriften der der Richtlinie 2014/30/EU wird nachgewiesen durch die vollständige Einhaltung der folgend angegebenen Normen. Grundlage für die Bewertung ist eine typische Konfiguration mit Zubehör und Antriebssystemen. Für die Einhaltung der Grenzwerte ist die Beachtung der EMV - Installationshinweise notwendig. Diese liegen jedem ausgelieferten Produkt als Teil der Dokumentation bei.

Berücksichtigte harmonisierte Europäische Normen:

EN - Norm	Text	Referenz	Ausgabe
EN 61000 – 6 – 4 Ausgabe 2007 + A1 aus 2011	Fachgrundnorm Funkentstörung Teil 2: Industriebereich	VDE 0839 – 6 - 4	09/2011
EN 61000 – 6 – 2 Ausgabe 2005 +Ber. 2011	Fachgrundnorm Störfestigkeit Teil 2: Industriebereich	VDE 0839 – 6 - 2	03/2006

Die Übereinstimmung des bezeichneten Produktes mit den Vorschriften der Richtlinie 2011/65/EG wird nachgewiesen durch die Qualifikation von Bauteilen und Fertigungsverfahren im Rahmen der durch die ISO 9001 vorgegebene Qualitätssicherung. Die entsprechenden Informationen und Beschreibungen sind dokumentiert und abgelegt.

Das bezeichnete Produkt wurde unter einem umfassenden Qualitätsmanagementsystem entwickelt, hergestellt und geprüft.

Die Konformität des Qualitätsmanagementsystems nach DIN ISO 9001 wurde bescheinigt durch:

Notifizierte Stelle:	TÜV - CERT
Anschrift:	Zertifizierungstelle des RWTÜV Steubenstrasse 53 D - 45138 Essen
Nummer der Bescheinigung	041 004 500
Ausstelldatum:	20.10.94
Gültig durch Nachprüfung bis:	12.2018

6.16.2 UL certification

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Power Conversion Equipment

See General Information for Power Conversion Equipment

KEB AUTOMATION KG E167544
Suedstrasse 38
32683 Barntrup, GERMANY

Trademark and/or Tradename: KEB

Investigated to ANSI/UL 508C

Converter (DC-AC), "Combivert Series" Model(s) Power Conversion Equipment, Open Types, R housing - Series Combivert, Cat. Nos. 25., followed by R6 followed by S or N , followed by 3, followed by R-, followed by four digits of numbers or letters.

Enclosed types 1, motor/drive combinations, "Combivert Series" Model(s) Model 12F5CDZ-Y000, Model 12F5CDZ-Z000, Model 14F5CDZ-Y000

Open type, AC Drive, "Combivert Series" Model(s) 28, 29, 30, followed by F5, followed by A, D, E, G, H, K, L, M or P, followed by 0, 1, A or B , followed by P -, followed by YV, followed by one suffix (except character ?M?), followed by one suffix

Open type, DC Drive Model(s) Cat. No. 00C6CJ1-0100

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KEB AUTOMATION KG E167544
Suedstrasse 38
32683 Barntrup, GERMANY

Investigated to CAN/CSA C22.2 No. 14-13

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