maxon

Servo Controllers

# ESCON2

## Firmware Specification

escon.maxongroup.com

ESCON2 Servo Controllers Firmware Specification
CCMC | Edition 2024-03 | DocID rel12245

# Table of Contents

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# 1. About

## 1.1. About this document

### 1.1.1. Read this first

***These instructions are intended for qualified technical personnel. Prior commencing with any activities…***

- *you must carefully read and understand this manual and*
- *you must follow the instructions given therein.*

***The ESCON2** is considered as partly completed machinery according to EU Directive 2006/42/EC, Article 2, Clause (g) and **are intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment**.*

***Therefore, you must not put the device into service,…***

- *unless you have made completely sure that the other machinery fully complies with the EU directive's requirements!*
- *unless the other machinery fulfills all relevant health and safety aspects!*
- *unless all respective interfaces have been established and fulfill the herein stated requirements!*

### 1.1.2. Intended purpose

The purpose of this document is to familiarize the user with the described equipment and the task of its safe and adequate installation and/or commissioning. Follow the described instructions in order to:

- avoid dangerous situations,
- keep installation and/or commissioning time at a minimum,
- increase the reliability and service life of the described equipment.

This document is part of a documentation set. It provides ESCON2 firmware details contains performance data and specifications, information on fulfilled standards, details on connections and pin assignment, and wiring examples. The below overview shows the documentation hierarchy and the interactions of its individual parts:

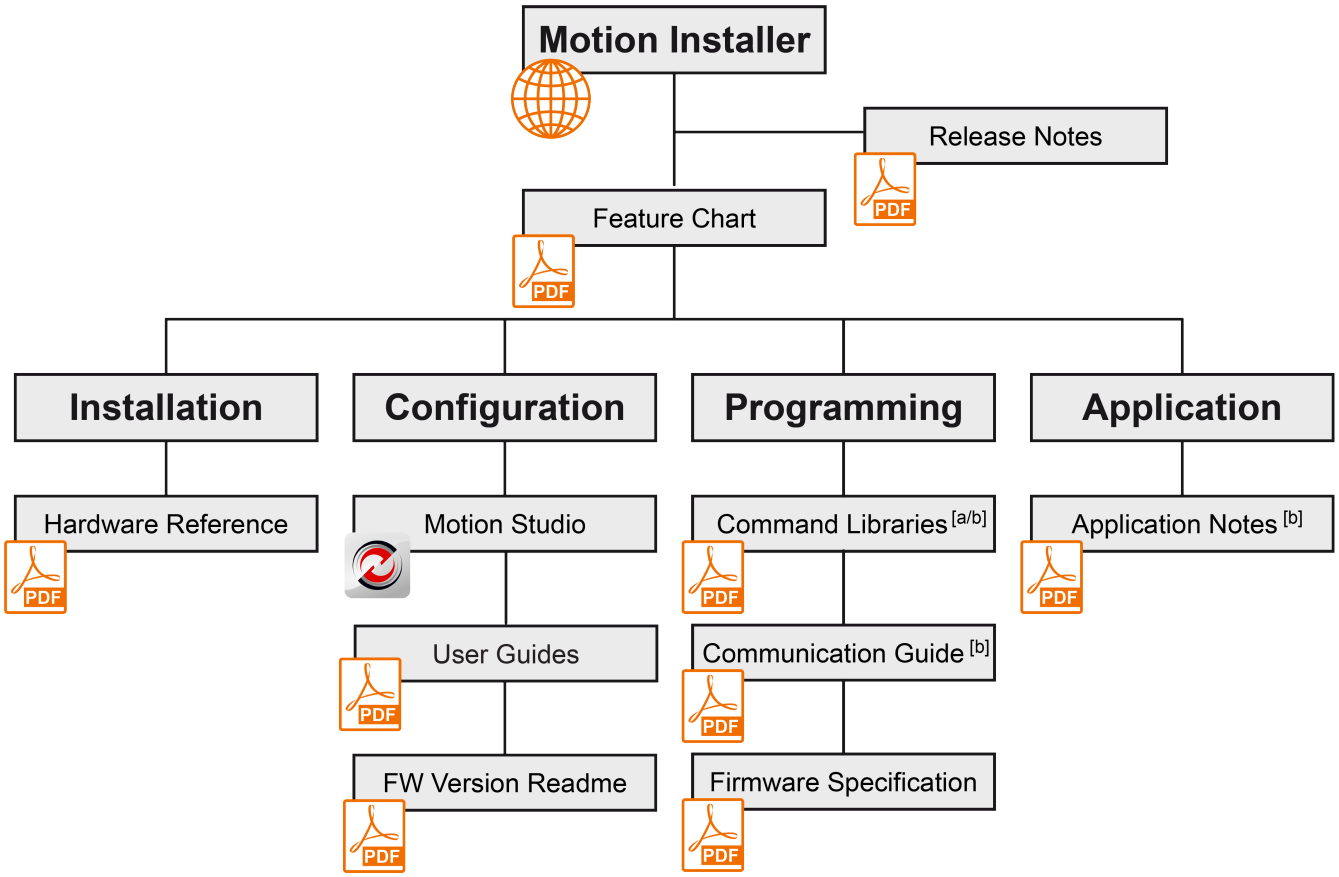


*Figure 1. Documentation structure*

[a] including software programming examples
[b] will be available with upcoming release

The latest edition of this document as well as additional documentation and software for ESCON2 controllers can also be found online: http://escon.maxongroup.com

### 1.1.3. Target audience

This document is a reference book. It requires knowledge and expertise specific to the equipment described.

### 1.1.4. How to use

Throughout the document, the following notations and codes will be used.

| Notation | Explanation |
|---|---|
| **ESCON2** | stands for “ESCON2 servo controller” |
| **«Abcd»** | Indicating a title or a name (such as of document, product, mode, etc.) |
| **(n)** | Referring to an item (such as an order number, list item, etc.) |
| * | Referring to an internal value |
| → | Denotes “see”, “see also”, “take note of”, or “go to” |

*Table 1. Notations used*

In later parts of this document, the following abbreviations and acronyms will be used:

| Short | Description |
|---|---|
| **CCW** | Counterclockwise |
| **CiA** | CAN in Automation |
| **CST** | Cyclic Synchronous Torque Mode |
| **CSV** | Cyclic Synchronous Velocity Mode |
| **CW** | Clockwise |
| **EDS** | Electronic Data Sheet |
| **GPIO** | General Purpose Input/Output |
| **NMT** | Network Management |
| **OBD** | Object Dictionary |
| **PDO** | Process Data Object |
| **PVM** | Profile Velocity Mode |
| **SDO** | Service Data Object |

*Table 2. Abbreviations & acronyms used*

### 1.1.5. Symbols and signs

In the course of the present document, the following symbols and signs will be used.

| Type | Symbol | Meaning |
|---|---|---|
| **Safety alert DANGER** |  | Indicates an **imminent hazardous situation**. If not avoided, **it will result in death or serious injury.** |
| **WARNING** |  | Indicates a **potential hazardous situation**. If not avoided, it **can result in death or serious injury**. |
| **CAUTION** |  | Indicates a **probable hazardous situation** or calls the attention to unsafe practices. If not avoided, it **may result in injury**. |
| **Prohibited action** |  | Indicates a dangerous action. Hence, **you must not!** |
| **Mandatory action** |  | Indicates a mandatory action. Hence, **you must!** |
| **Requirement, Note, Remark** |  | Indicates an activity you must perform prior to continuing, or gives information on a particular point that must be observed. |
| **Best practice** |  | Indicates an advice or recommendation on the easiest and best way to further proceed. |
| **Material Damage** |  | Indicates information particular to possible damage of the equipment. |

*Table 3. Symbols and signs*

### 1.1.6. Trademarks and brand names

For easier legibility, registered brand names are listed below and will not be further tagged with their respective trademark. It must be understood that the brands (the below list is not necessarily conclusive) are protected by copyright and/or other intellectual property rights, even if their legal trademarks are omitted in the latter parts of this document.

| Brand name | Trademark owner |
|---|---|
| **Adobe® Reader®** | © Adobe Systems Incorporated, USA-San Jose, CA |

*Table 4. Brand names and trademark owners*

### 1.1.7. Sources for additional information

For further details and additional information, please refer to the resources listed below:

| Ref.no. | Title / description |
|---|---|
| **[1]** | USB Implementers Forum: Universal Serial Bus Revision 2.0 Specification www.usb.org/developers/docs |
| **[2]** | CiA 301 CANopen application layer and communication profile www.can-cia.org |
| **[3]** | CiA 305 Layer Setting Services (LSS) and protocols www.can-cia.org |
| **[4]** | CiA 306 CANopen electronic data sheet specification www.can-cia.org |
| **[5]** | CiA 402 CANopen device profile for drives and motion control www.can-cia.org |
| **[6]** | Bosch's CAN Specification 2.0 www.can-cia.org |
| **[7]** | Konrad Etschberger: Controller Area Network ISBN 3-446-21776-2 |
| **[8]** | maxon: ESCON2 Communication Guide (will be available with upcomming release) http://escon.maxongroup.com |
| **[9]** | maxon: ESCON2 Application Notes http://escon.maxongroup.com |
| **[10]** | IEC 61158-x-12: Industrial communication networks – Fieldbus specifications (CPF 12) |
| **[11]** | IEC 61800-7: Adjustable speed electrical power drives systems (Profile type 1) |
| **[14]** | EN 5325-4 Industrial communications subsystem based on ISO 11898 (CAN) for controller device interfaces Part4: CANopen |

*Table 5. Sources for additional information*

### 1.1.8. Copyright



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## 1.2. About the devices

The ESCON2 is a small-sized, powerful 4-quadrant PWM servo controller. Its high power density allows flexible use for brushed DC motors and brushless EC (BLDC) motors up to approximately 1'800 Watts with various feedback options, such as Hall sensors, incremental encoders in a multitude of drive applications. The device is specially designed to be commanded and controlled by analog and digital set values.
It also features extensive analog and digital I/O functionality. Latest technology, such as field-oriented control (FOC), acceleration and velocity feed forward, in combination with highest control cycle rates allow sophisticated, ease-of-use motion control.

You might also want to look at the ESCON2 video library. It includes video tutorials that show you how to get started with «Motion Studio» and show you tips and techniques on how to set up communication interfaces, among other things.

## 1.3. About the safety precautions

- Make sure that you have read and understood chapter Read this first.
- Do not engage with any work without possessing the stated skills (chapter Target Audience).
- Refer to chapter Symbols and signs to understand the subsequently used indicators!
- Any regulations applicable to the country and/or at the site of implementation with regard to health and safety/accident prevention, and/or environmental protection, must be observed.

*Danger*

***High voltage and/or electrical shock. Touching live wires causes death or serious injuries!***

- *Consider any power cable as connected to live power, unless having proven the opposite!*
- *Make sure that neither end of cable is connected to live power!*
- *Make sure that power source cannot be engaged while work is in process!*
- *Obey lock-out/tag-out procedures!*
- *Make sure to securely lock any power engaging equipment against unintentional engagement and tag it with your name!*

*Requirements*

- *Make sure that all associated devices and components are installed according to local regulations.*
- *Be aware that, by principle, an electronic apparatus can not be considered fail-safe. Therefore, it must be ensured that any machine/apparatus has been fitted with independent monitoring and safety equipment. If the machine/apparatus should break down, if it is operated incorrectly, if the control unit breaks down or if the cables break or get disconnected, etc., the complete drive system must return – and be kept – in a safe operating mode.*
- *Be aware that you are not entitled to perform any repair on components supplied by maxon.*

*Electrostatic sensitive device (ESD)*

- *Wear working cloth and use equipment in compliance with ESD protective measures.*
- *Handle device with extra care.*
- *Be aware that you are not entitled to perform any repair on components supplied by maxon.*

# 2. System overview

## 2.1. Device architecture

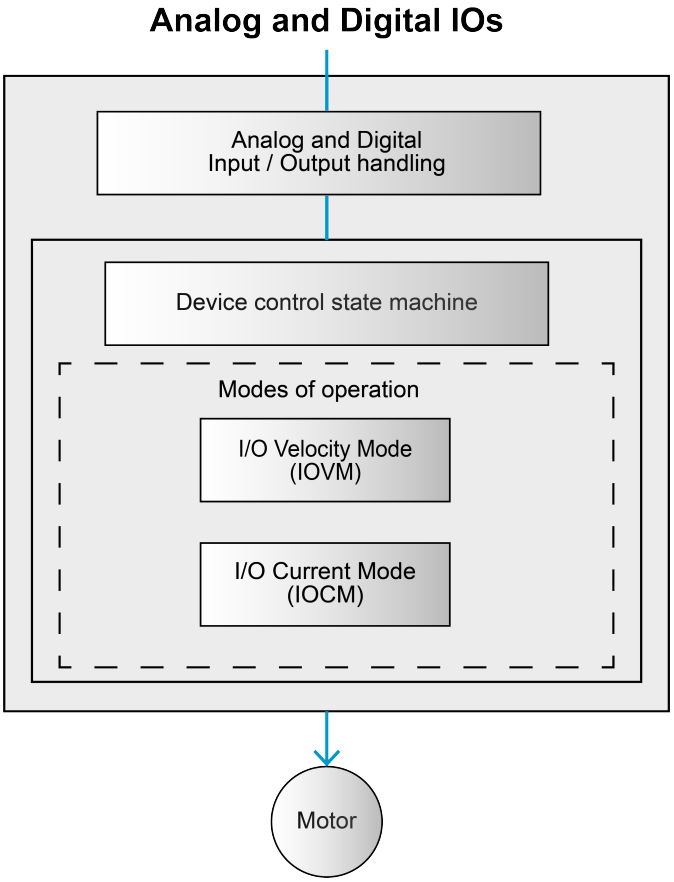



*Figure 2. Communication architecture*

**DEVICE CONTROL**

Starting and stopping of the drive and several mode-specific commands are executed by the state machine.

**MODES OF OPERATION**

The operating mode defines the behavior of the drive.

## 2.2. Device control

The state machine represents the device state as well as the device's potential control sequence. An object's state denotes a unique internal or external behavior. The commands that will be obeyed are also based on the device's status.

States may be changed using the Controlword and/or according to internal events. The actual state can be read using the Statusword. A new state transition must not be initiated before the previous one is completed, and the Statusword is changed accordingly.

Using the Controlword and/or in response to internal events, states can be modified. The Statusword can be used to read the current condition. Before the previous state transition is finished and the Statusword is updated appropriately, a new one cannot be started.

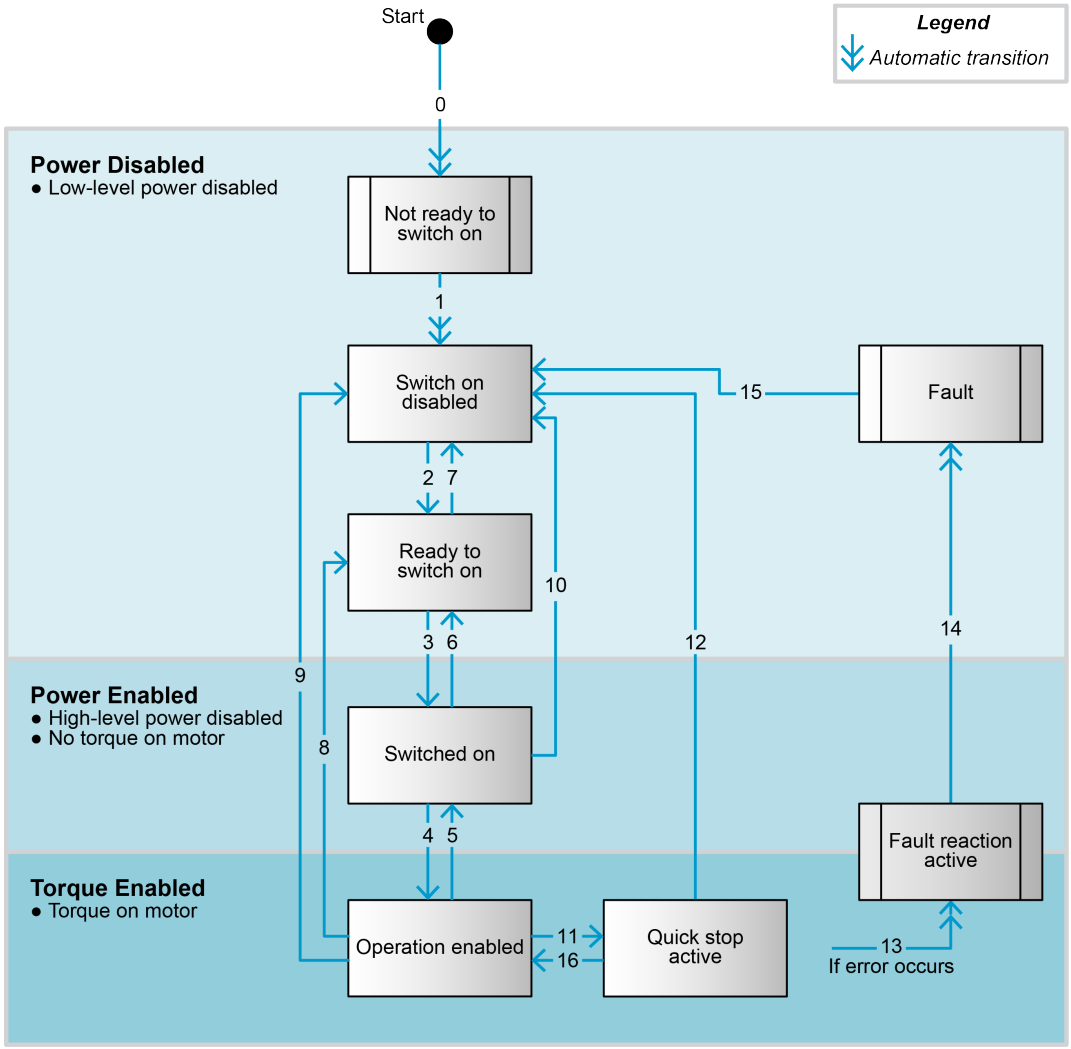



*Figure 3. Device state machine*

### 2.2.1. State of the drive

The following Statusword bits indicate the actual state of the drive.

| State | Statusword [binary] | Description |
|---|---|---|
| Not ready to switch on | xxxx xxxx x00x 0000 | Drive function and communication are disabled. |
| Switch on disabled | xxxx xxxx x10x 0000 | Drive initialization is complete. Communication is enabled. Drive parameters may be changed. Drive function is disabled. |
| Ready to switch on | xxxx xxxx x01x 0001 | Drive parameters may be changed. Drive function is disabled. |
| Switched on | xxxx xxxx x01x 0011 | Drive function is disabled. Current offset calibration done. |
| Operation enabled | xxxx xxxx x01x 0111 | No faults have been detected. Drive function is enabled and power is applied to the motor. |
| Quick stop active | xxxx xxxx x00x 0111 | «Quick stop» function is being executed. Drive function is enabled and power is applied to the motor. |
| Fault reaction active | xxxx xxxx x00x 1111 | A fault has occurred in the drive. Selected fault reaction is being executed. Also see Device errors. |
| Fault | xxxx xxxx x00x 1000 | A fault has occurred in the drive. Drive parameters may have changed. Drive function is disabled. Also see Device errors. |

*Table 6. Device state bits*

### 2.2.2. State transitions

State transitions are caused by internal events in the drive or by commands from the host via the Controlword.

| Note: |
| --- |
| *If a command is received that causes a change of state, this command will be processed completely and the new state attained before the next command can be processed.* |

| Transition | Event | Action |
| --- | --- | --- |
| 0 | Reset | Initialize drive |
| 1 | Drive has initialized successfully | Activate communication |
| 2 | «Shutdown» command received | - |
| 3 | «Switched on» command received | Initialize current sensor. Current offset calibration. Motor must stand still to allow a precise calibration. |
| 4 | «Enable operation» command received | Enable the driving function, including the current controller and any superordinate controllers that may be required. |
| 5 | «Disable operation» command received | Stop movement according to «Disable operation option code». Disable drive function. |
| 6 | «Shutdown» command received | Disable power section |
| 7 | «Quick stop» or «Disable voltage» command received | - |
| 8 | «Shutdown» command received | Stop movement according to «Shutdown option code». Disable drive function and power section. |
| 9 | «Disable voltage» command received | Stop movement according to «Shutdown option code». Disable drive function and power section. |
| 10 | «Quick stop» or «Disable voltage» command received | - |
| 11 | «Quick stop» command received | Stop movement according to «Quick stop option code» |
| 12 | «Disable voltage» command received | Disable drive function and power section |
| 13 | A fault has occurred | Start fault reaction |
| 14 | The fault reaction is completed | Disable drive function and power section |
| 15 | «Fault reset» command received | Reset fault condition if no fault is present |
| 16 | «Enable operation» command received | - |

*Table 7. Device state transitions*

### 2.2.3. Device control commands

Axis control commands are triggered by the following bit patterns in the Controlword.

| Note: |
| --- |
| *If a command is received that causes a change of state, this command will be processed completely and the new state attained before the next command can be processed.* |

| Command | Controlword LowByte [binary] | State transition |
|---|---|---|
| Shutdown | 0xxx x110 | 2, 6, 8 |
| Switch on | 0xxx x111 | 3 |
| Switch on & Enable operation | 0xxx 1111 | 3, 4 (*1) |
| Disable voltage | 0xxx xx0x | 7, 9, 10, 12 |
| Quick stop | 0xxx x01x | 11 |
| Disable operation | 0xxx 0111 | 5 |
| Enable operation | 0xxx 1111 | 4, 16 |
| Fault reset | 0xxx xxxx → 1xxx xxxx | 14, 15 |
| Clear warning | 0xxx xxxx → 1xxx xxxx | N/A (*2) |

*Table 8. Axis control commands*

(*1) Automatic transition to state «Operation enabled» after execution of command «Switch on»
(*2) Warning can be cleared in any state and does not lead to state transition

### 2.2.4. Device LED Status

The device provides a red and a green LED to display the actual operation state and possible errors of the device:

- LED green shows the operation state
- LED red indicates errors

| LED Green | LED Red | Warning / Error | Description |
|---|---|---|---|
| Slow | OFF | No warning/error active. | Power stage is disabled. The ESCON2 is in status<br>- Switch on disabled<br>- Ready to switch on<br>- Switched on |
| Slow | Slow | At least one warning is active. | |
| ON | OFF | No warning/error active. | Power stage is enabled. The ESCON2 is in status<br>- Operation enabled<br>- Quick stop active |
| ON | Slow | At least one warning is active. | |
| ON | ON | At least one error has occurred. | Power stage is enabled. The ESCON2 is in status<br>- Fault reaction active |
| OFF | ON | At least one error has occurred. | Power stage is disabled. The ESCON2 is in status<br>- Fault |
| Flash | ON | n/a | Firmware update in progress or invalid application(*1) |

Flash = LED is flashing (0.9s OFF, 0.1s ON)
Slow = LED is slowly blinking (0.5s OFF, 0.5s ON)
ON = LED is on
OFF = LED is off

(*1) Normally, this LED status is visible for a few seconds only, during a firmware download. If this state is active for a longer time or even after a power cycle, it means that no valid application is loaded. → Firmware download is needed.

*Table 9. LED system state indicator*

## 2.3. System units

The user-defined units for this device are as follows:

- Velocity units (SI unit velocity)
- Acceleration units (SI unit acceleration)

The units are used for all objects that support user-defined units. They are specified by SI unit objects. Objects with factor group-independent values have fixed units specified by the object. The coding of user-defined units and prefixes is structured as described in User-defined units - Parameter structure.

| Bit 31…24 | Bit 24…16 | Bit 15…8 | Bit 7…0 |
|---|---|---|---|
| Prefix | Numerator | Denominator | Reserved(0) |

*Table 10. User-defined units - Parameter structure*

### 2.3.1. Si units

| Description | Name | Symbol | Notation index |
|---|---|---|---|
| Dimensionless | - | - | 0x00 |
| Length | Meter | m | 0x01 |
| Mass | Kilogram | kg | 0x02 |
| Time | Second | s | 0x03 |
| Electric current | Ampere | A | 0x04 |
| Time | Minute | min | 0x47 |
| Square second | Square second | $s^2$ | 0x57 |

*Table 11. SI units - Notation index*

### 2.3.2. CiA 402 Application profile-specific units

| Description | Name | Symbol | Notation Index |
|---|---|---|---|
| Revolutions | revolutions | rev | 0xB4 |
| Increments | increments | inc | 0xB5 |
| Steps | steps | steps | 0xAC |
| Velocity (manufacturer-specific) | revolutions/minute | rpm | 0xC0 |

*Table 12. CiA 402 Application profile-specific units - Notation index*

### 2.3.3. Unit prefixes

| Prefix | Factor | Symbol | Notation index |
|---|---|---|---|
| Mega | $10^6$ | M | 0x06 |
| Kilo | $10^3$ | k | 0x03 |
| Hecta | $10^2$ | h | 0x02 |
| Deca | $10^1$ | da | 0x01 |
| - | $10^0$ | - | 0x00 |
| Deci | $10^{-1}$ | d | 0xFF |
| Centi | $10^{-2}$ | c | 0xFE |
| Milli | $10^{-3}$ | m | 0xFD |
| — | $10^{-4}$ | — | 0xFC |
| — | $10^{-5}$ | — | 0xFB |

| Prefix | Factor | Symbol | Notation index |
|---|---|---|---|
| Micro | $10^{-6}$ | µ | 0xFA |

*Table 13. Unit prefixes - Notation index*

# 3. Operating modes

## 3.1. Operating mode selection guide

The device behavior depends on the currently activated mode of operation.

- Choose desired mode Overview
- Select mode using Modes of operation
- Read currently active mode from Modes of operation display

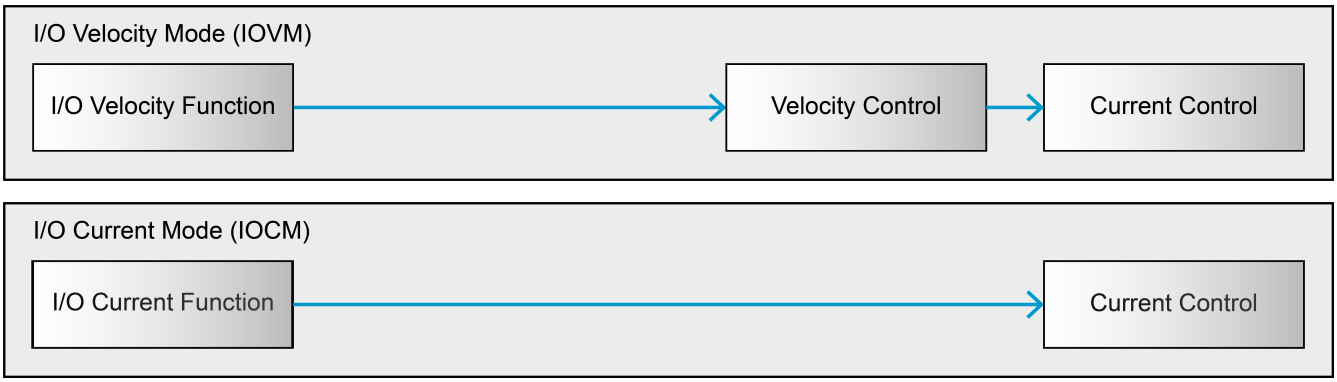



*Figure 4. Functional architecture*

## 3.2. Overview

*I/O Velocity Mode (IOVM)*

An analog input provides a target velocity to the drive device, which then performs velocity control and torque control. For details see I/O Velocity Mode (IOVM)

*I/O Current Mode (IOCM)*

An analog input provides a target current to the drive device. For details see I/O Current Mode (IOCM)

## 3.3. I/O Velocity Mode (IOVM)

The «I/O Velocity Mode» is used for velocity control in correspondence with I/O commanding. The configured input provides a set value velocity to the drive, which then performs velocity control with underlying current control. See Configuration of digital inputs and Configuration of analog inputs for further information.

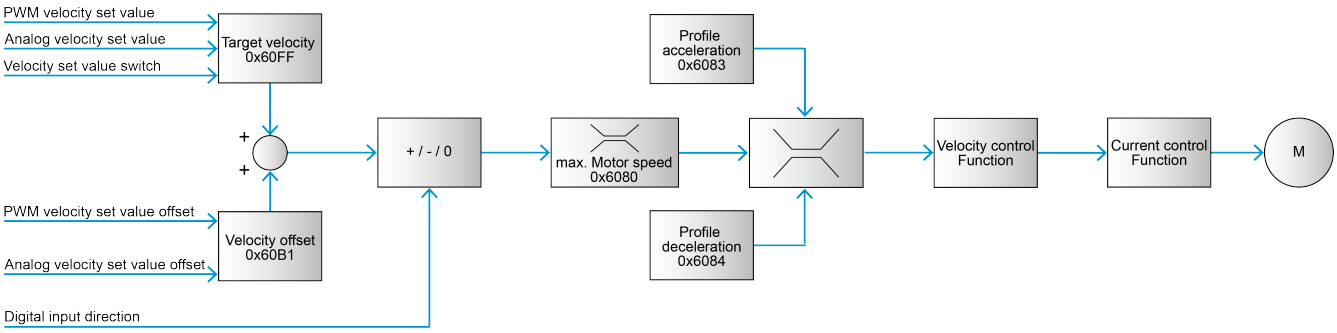



*Figure 5. I/O Velocity Mode - overview*

The I/O Velocity Mode is based on Velocity Control Function. Target velocity is used as the set value while Motor data and Max motor speed are used to determine current and velocity limitations. Furthermore, Profile acceleration and Profile deceleration are used to limit the rate of change for the speed controller input.

### 3.3.1. How to use IOVM

#### 3.3.1.1. Configuration parameters

| Parameter | Index | Description |
|---|---|---|
| Nominal current | 0x3001-0x01 | The maximum permissible continuous current of the motor |
| Current control parameter set | 0x30A0 | Configuration of the current controller gains |
| Velocity control parameter set | 0x30A2 | Configuration of the velocity controller |
| Motor rated torque | 0x6076 | Holds the value to which all torque objects are related to |
| Max motor speed | 0x6080 | Indicates the configured maximum allowed speed for the motor. It serves as protection of the motor and is taken from the motor data sheet. |
| Quick stop deceleration | 0x6085 | Defines the deceleration for the quick stop ramp (for stopping only) |
| Max acceleration | 0x60C5 | Defines the maximum allowed acceleration and deceleration |

*Table 14. I/O Velocity Mode - Configuration parameters*

#### 3.3.1.2. Commanding parameters

| Parameter | Index | Description |
|---|---|---|
| Target velocity | 0x60FF | Velocity input value for the velocity controller |
| Velocity offset | 0x60B1 | Optional velocity feed forward input |
| Profile acceleration | 0x6083 | Defines the acceleration ramp during a movement |
| Profile deceleration | 0x6084 | Defines the deceleration ramp during a movement |

*Table 15. I/O Velocity Mode - Commanding parameters*

#### 3.3.1.3. Controlword

I/O velocity mode does not use mode-specific controlword bits.

#### 3.3.1.4. Output parameters

| Parameter | Index | Description |
|---|---|---|
| Velocity actual value | 0x606C | Actual velocity value |
| Current actual value | 0x30D1-0x02 | Actual current value |

*Table 16. I/O Velocity Mode - Output parameters*

#### 3.3.1.5. Statusword (I/O Velocity Mode - Specific Bits)

| Bit 15, 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9…0 |
|---|---|---|---|---|---|
| Statusword bits | Reserved | drive follows command value | Limits | Reserved | Statusword bits |

*Table 17. I/O Velocity Mode - Statusword*

| Name | Value | Description |
|---|---|---|
| drive follows command value | 0 | Drive does not follow the target value |
| | 1 | Drive is in state operation enables and follows the target and set values of the control device |

*Table 18. I/O Velocity Mode - Statusword bits*

### 3.3.2. Limits

Depending on the configuration, the velocity commanded may not be reached due to limits. When this occurs, bit 11 of the Statusword will be set. This state can also be mapped to an output pin through a Digital outputs functionality.

| Limitation | Description | Effect |
|---|---|---|
| Output current limit | The velocity set value cannot be reached because the required current would exceed the current allowed by the object Output current limit | The Current demand value will be limited to Output current limit. |
| Thermal protection motor | The velocity set value cannot be reached because an internal I2T model estimating the motor temperature is limiting the Current demand value, in order to prevent the motor from overheating. | The model limits the Current demand value to a maximum of between Nominal current and Output current limit. Related Objects: Nominal current, Thermal time constant winding, I2t level motor. |
| Thermal protection power stage | The velocity set value cannot be reached because the power stage temperature (measured and/or I2T model) is limiting the Current demand value, in order to prevent the power stage from overheating. | The Current demand value is limited, in the worst case to 0. Related Objects: I2t level power stage, Temperature power stage, Max temperature power stage. |
| Max motor speed | The velocity set value cannot be reached because it is larger than Max motor speed. | The Velocity demand value is limited to a maximum value of Max motor speed. |
| PWM max duty cycle | The velocity set value cannot be reached because the PWM duty cycle actual value has reached the PWM max duty cycle, indicating that the required voltage cannot be reached. This may be due to the Power supply voltage being too low. | The Current actual value will be lower than the Current demand value. |

*Table 19. I/O Velocity Mode - Limits*

## 3.4. I/O Current Mode (IOCM)

The «I/O Current Mode» is used for current control in correspondence with I/O commanding. The configured input provides a current set value to the drive, which then performs current control. See Configuration of digital inputs and Configuration of analog inputs for further information.

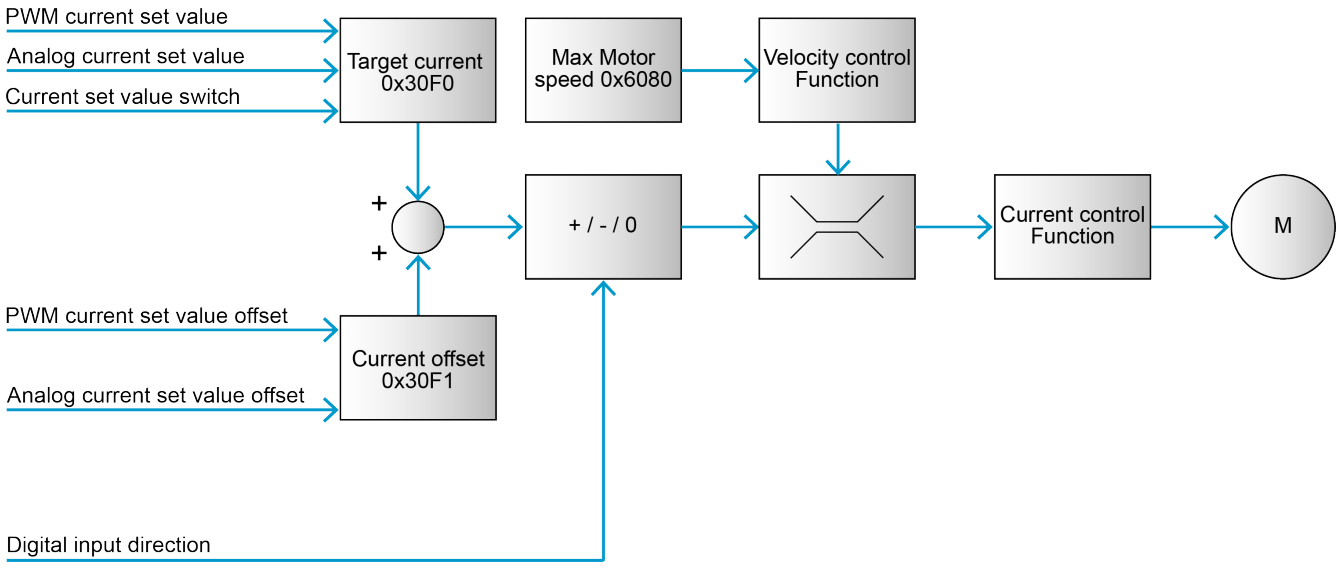



*Figure 6. I/O Current Mode - Overview*

I/O Current Mode is based on the current control function. Inputs are Target current and Current offset. The Motor data is used to define limitations for velocity and current values.

| Note: | |
|---|---|
|  | Speed limitation is only active if the main sensor is configured in Control structure. In this case, the Velocity control parameter set must be configured/tuned. |

### 3.4.1. How to use IOCM

#### 3.4.1.1. Configuration parameters

| Parameter | Index | Description |
|---|---|---|
| Nominal current | 0x3001-0x01 | The maximum permissible continuous current of the motor |
| Current control parameter set | 0x30A0 | Configuration of the current controller gains |
| Velocity control parameter set | 0x30A2 | Configuration of the velocity controller gains. This is necessary in order to optimally limit the velocity to max motor speed |
| Max motor speed | 0x6080 | Indicates the configured maximum allowed speed for the motor. It serves as protection of the motor and is taken from the motor data sheet. |
| Quick stop deceleration | 0x6085 | Defines the deceleration for the quick stop ramp (for stopping only) |

*Table 20. I/O Current Mode - Configuration parameters*

#### 3.4.1.2. Commanding parameters

| Parameter | Index | Description |
|---|---|---|
| Target current | 0x30F0 | Current input value for the current controller |
| Current offset | 0x30F1 | Optional additive current which is added to the target current value |

*Table 21. I/O Current Mode - Commanding parameters*

#### 3.4.1.3. Controlword

I/O current mode does not use mode-specific controlword bits.

#### 3.4.1.4. Output parameters

| Parameter | Index | Description |
|---|---|---|
| Current actual values | 0x30D1 | Current actual values |
| Velocity actual value | 0x606C | Actual velocity value |

*Table 22. I/O Current Mode - Output parameters*

#### 3.4.1.5. Statusword (I/O current mode - Specific bits)

| Bit 15, 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9…0 |
|---|---|---|---|---|---|
| Statusword bits | Reserved | drive follows command value | Limits | Reserved | Statusword bits |

*Table 23. I/O Current Mode - Statusword*

| Name | Value | Description |
|---|---|---|
| drive follows command value | 0 | Drive does not follow the target value |
| | 1 | Drive is in state operation enables and follows the target and set values of the control device |

*Table 24. I/O Current Mode - Statusword bits*

### 3.4.2. Limits

Depending on the configuration, the current commanded may not be reached due to limits. When this occurs, bit 11 of the Statusword will be set. This state can also be mapped to an output pin through a Digital outputs functionality.

| Limitation | Description | Effect |
|---|---|---|
| Output current limit | The current set value cannot be reached because it exceeds the current allowed by the object Output current limit | The Current demand value will be limited to Output current limit. |
| Thermal protection motor | The current set value cannot be reached because an internal I2T model estimating the motor temperature is limiting the Current demand value, in order to prevent the motor from overheating. | The model limits the Current demand value to a maximum of between Nominal current and Output current limit. Related Objects: Nominal current, Thermal time constant winding, I2t level motor. |
| Thermal protection power stage | The current set value cannot be reached because the power stage temperature (measured and/or I2T model) is limiting the Current demand value, in order to prevent the power stage from overheating. | The Current demand value is limited, in the worst case to 0. Related Objects: I2t level power stage, Temperature power stage, Max temperature power stage. |
| Max motor speed | The current set value cannot be reached because it would result in the motor turning faster than Max motor speed. | The Current demand value is limited by the Velocity Control Function to prevent the motor turning faster than Max motor speed until the speed or current set value decrease. |
| PWM max duty cycle | The current set value cannot be reached because the PWM duty cycle actual value has reached the PWM max duty cycle, indicating that the required voltage cannot be reached. This may be due to the Power supply voltage being too low. | The Current actual value will be lower than the Current demand value. |

*Table 25. I/O Current Mode - Limits*

## 3.5. Velocity Control Function

Used for velocity-based modes, and velocity limitation in current-based modes, where applicable.

The control loop is fed with the velocity demand value and velocity actual value as input parameters. The behavior of the control may be influenced by externally applicable control parameters. The output of the controller is a current demand value, which serves as input for the current controller.

| Note: |
|---|
|  Items marked with an asterisk (*) refer to internal values. |

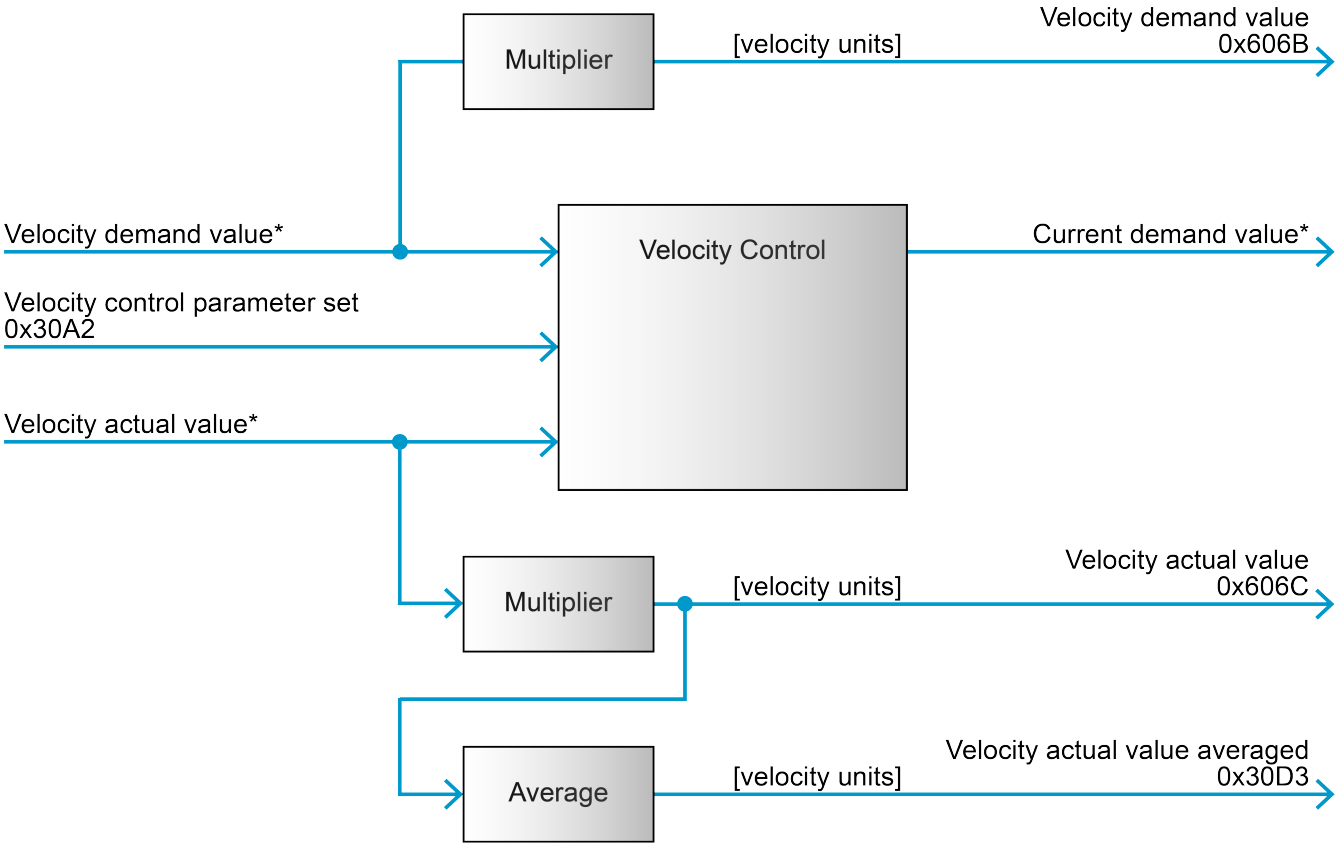



*Figure 7. Velocity Control Function - Block diagram*

### 3.5.1. How to use velocity control function

#### 3.5.1.1. Configuration parameters

| Parameter | Index | Description |
|---|---|---|
| Velocity control parameter set | 0x30A2 | Configuration of the velocity controller gains |

*Table 26. Velocity Control Function - Configuration parameters*

#### 3.5.1.2. Commanding parameters

There are no commanding parameters. The velocity control function is directly commanded by velocity-based operating modes.

#### 3.5.1.3. Output parameters

| Parameter | Index | Description |
|---|---|---|
| Velocity demand value | 0x306B | The operation mode's output. It is used as input for the velocity control function. Generally, the value is the output of the trajectory generator. |
| Velocity actual value | 0x606C | The actual velocity value |
| Velocity actual values | 0x30D3 | The averaged actual velocity value |

*Table 27. Velocity Control Function - Output parameters*

## 3.6. Current Control Function

All operating modes are based on the current control function. The Current demand value is received from a superordinate motion controller.

| Note: |
| --- |
| Items marked with an asterisk (*) refer to internal values. |

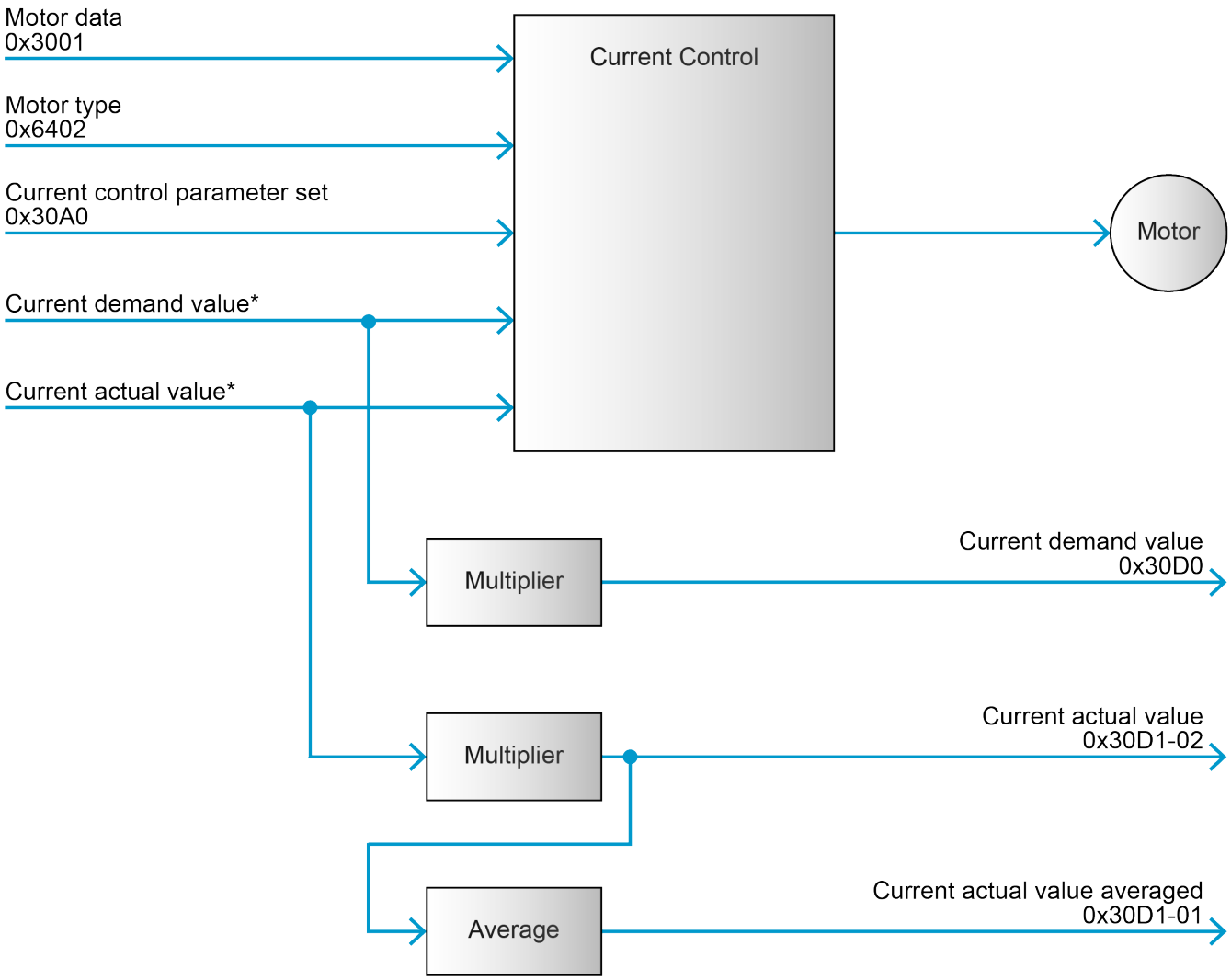



*Figure 8. Current Control Function - Block diagram*

### 3.6.1. How to use current control function

#### 3.6.1.1. Configuration parameters

| Parameter | Index | Description |
| --- | --- | --- |
| Motor data | 0x3001 | Used for configuration of motor-dependent parameters |
| Current control parameter set | 0x30A0 | Configuration of the current controller gains |
| Motor type | 0x6402 | Used to define the type of motor |

*Table 28. Current Control Function - Configuration parameters*

#### 3.6.1.2. Commanding parameters

There are no commanding parameters. The current control function is commanded by the control loop Velocity Control Function or directly by the operating mode I/O Current Mode (IOCM).

#### 3.6.1.3. Output parameters

| Parameter | Index | Description |
|---|---|---|
| Current demand value | 0x30D0 | Set value for current controller |
| Current actual values | 0x30D1 | The averaged and actual current value |

*Table 29. Current Control Function - Output parameters*

### 3.6.2. Output current limitation according to I²T Method

The I²T method is to prevent the motor from overheating. This method is based on the model of the motor's thermal dynamics which serves as the foundation for this technique. Its parameters are Nominal current and Thermal time constant winding. When the motor's I²T level approaches 100%, the procedure reduces the output current to the nominal current. This limit is deactivated when the I²T level of the motor falls below 90% again. Keep in mind that the Nominal current is specified under particular heat dissipation conditions and at a set ambient temperature (often 25 °C). The aforementioned settings need to be changed if these requirements are not met.

Rather than providing the thermal time constant of the winding $\tau_{th}$, the motor manufacturer may provide the peak current Ipeak and the peak current duration Tpeak. In this case, the thermal time constant winding $\tau_{th}$ can be calculated using the following equation:

$$\tau_{th} = -\frac{T_{peak}}{\ln\left(1 - \left(\frac{I_N^2}{I_{peak}^2}\right)\right)}$$

where

ln : natural logarithm function

$\tau_{th}$ : thermal time constant winding

$T_{peak}$ : Time during which peak current is permitted

$I_{peak}$ : Peak current

$I_N$ : Nominal current

The figure below shows the maximum duration of the peak current before the I²T current limit is activated, assuming that the I²T level motor starts at 0%. The peak current duration is normalized by the thermal time constant winding on the horizontal axis (x-axis). The vertical axis (y-axis) represents the magnitude of the peak current normalized by the nominal current.

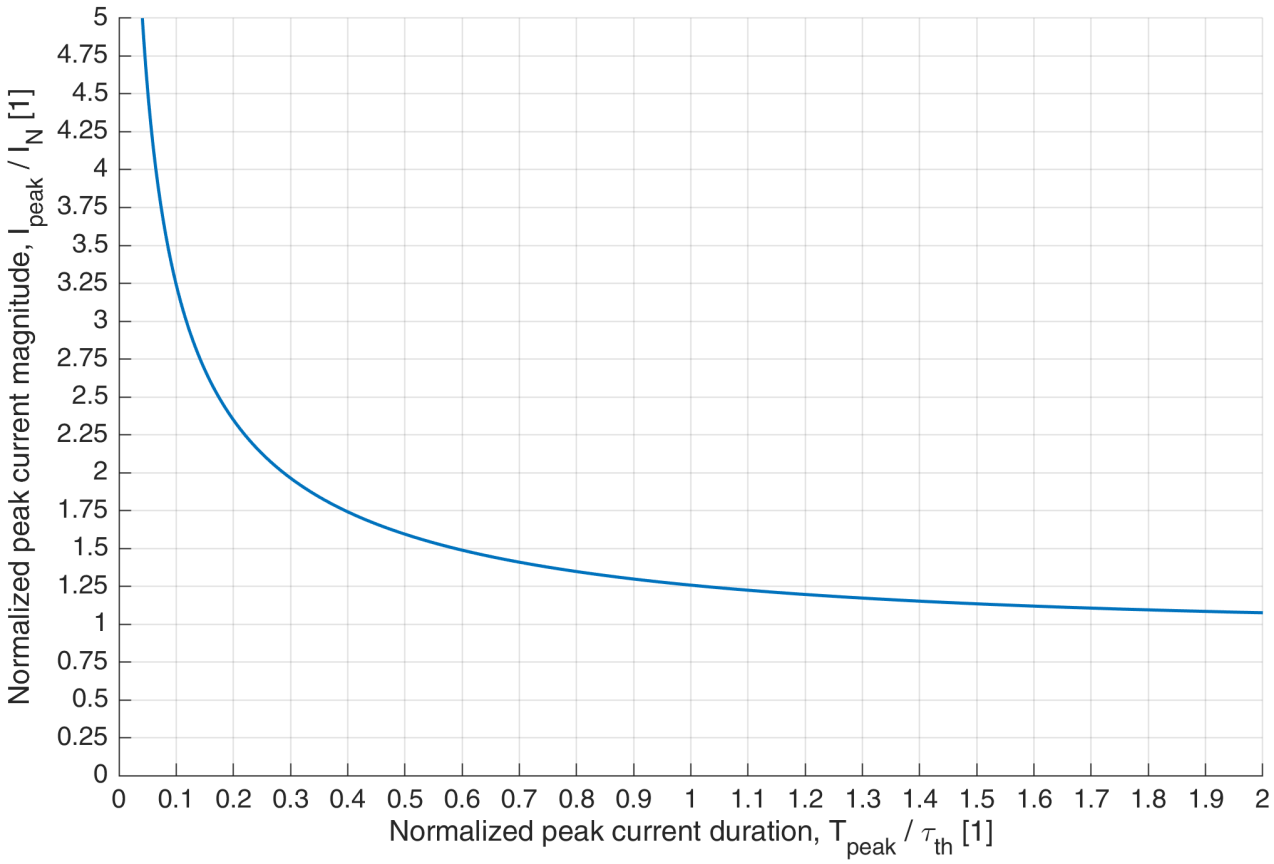



*Figure 9. Normalized peak current magnitude vs. Normalized peak current duration*

EXAMPLE: How long can we accelerate the motor with a steady current of 2940 mA with the following Motor data configuration?

- Current limit: 1470 mA
- Thermal time constant winding $\tau_{th}$: 2.8s

To summarize and clarify the process you've described for calculating the peak current duration for a motor acceleration, follow these steps:

1. Calculate the Normalized Peak Current Magnitude:
   - Use the formula: Normalized Peak Current = Actual Peak Current / Rated Peak Current
   - In our example, this is 2940 mA / 1470 mA = 2
2. Find the Intersection on the figure Normalized peak current magnitude vs. Normalized peak current duration:
   - Use the graph of 'Normalized Peak Current Magnitude vs. Normalized Peak Current Duration'.
   - Find the point where the normalized peak current magnitude (from step 1) intersects with the curve on the graph.
   - In your example, the intersection for a normalized peak current of 2 on the blue curve corresponds to an x-axis value of approximately 0.3.
3. Calculate the Peak Current Duration ($T_{peak}$):
   - Use the formula: $T_{peak}$ = Normalized Peak Current Duration (from graph) × Thermal Time Constant Winding
   - In this example, $T_{peak}$ = 0.3 × 2.8 s = 840 ms

Therefore, for a motor with these specific parameters (2940 mA peak current and 2.8 s thermal time constant winding), it can sustain the acceleration with a constant current of 2940 mA for 840 milliseconds.

The cyclic ON-OFF mode described is a common way to control motors, particularly in applications where varying the motor speed or reducing the heat generated by the motor is important. Let's break down the key components of this mode:

1. ON Time Current Magnitude ($I_{on}$):
   - This is the current magnitude when the motor is in the ON state.
   - Ion can be higher than the motor's nominal current (IN), allowing for greater torque or speed during the ON phase.
2. ON Time ($T_{on}$):
   - The duration for which the motor current is ON and the motor is actively powered.
3. OFF Time ($T_{off}$):
   - The duration for which the motor current is OFF and the motor is not powered.
   - During this time, no current flows through the motor.
4. Total Time ($T_{total}$):
   - The sum of the ON time and OFF time ($T_{total} = T_{on}+T_{off}$).
   - This is the complete cycle duration of one ON-OFF sequence.
5. Duty Cycle:
   - The ratio of ON time to the total time, usually expressed as a percentage.
   - Formula: Duty Cycle = ($T_{total}/T_{on}$) × 100%.
   - It indicates the proportion of one cycle in which the motor is active.

Understanding and controlling these parameters is crucial for efficient motor operation, especially in applications requiring precise control over motor speed, torque, or thermal management. The duty cycle, in particular, is a key parameter as it directly influences the motor's average power output and heat generation over time. Higher duty cycles mean the motor is ON for a greater proportion of the cycle, leading to increased average power output and potentially more heat generation. Conversely, a lower duty cycle reduces average power output and can help manage heat generation in the motor.

The cyclic ON-OFF mode is a very simplified model of the current profile for the case that the current to hold a constant velocity is negligible compared to the current required for acceleration and deceleration.

The following figure Cyclic mode standardized vs. standardized "ON time" shows the maximum $I_{on}$ for continuous operation without reaching the $I^2T$ current limit, with a given motor current duty cycle and $T_{total}$.

1. Motor Current Duty Cycle:
   - Represented on the horizontal axis.
   - Defined as Duty Cycle = $T_{total}/T_{on}$
   - This ratio represents the proportion of time the motor current is ON ($T_{on}$) in relation to the total cycle time ($T_{total}$).
2. 'ON Time' Current Magnitude ($I_{on}$) Normalized:
   - Shown on the vertical axis.
   - It is the ON time current magnitude ($I_{on}$), normalized with the motor's nominal current (IN). Essentially, this shows how much larger the ON current can be compared to the motor's typical operating current.
3. Total Time ($T_{total}$) and Thermal Time Constant Winding ($\tau_{th}$):

- Each curve on the graph represents a different ratio of the total time ($T_{total}$) to the thermal time constant winding ($\tau_{th}$).
- The thermal time constant winding is a measure of how quickly the motor heats up and cools down. Different ratios of $T_{total}$ to $\tau_{th}$ will affect how much current the motor can handle during the ON phase without overheating.

4. Interpreting the Graph:
   - The graph is used to determine the maximum permissible Ion for continuous operation without exceeding the $I_2T$ limit for a given duty cycle and total time.
   - For a specified duty cycle ($T_{on}/T_{total}$), the graph shows the maximum $I_{on}$ (as a multiple of IN) that can be applied without causing thermal damage to the motor.
   - Different curves are useful for motors with different thermal properties (as indicated by $\tau_{th}$).

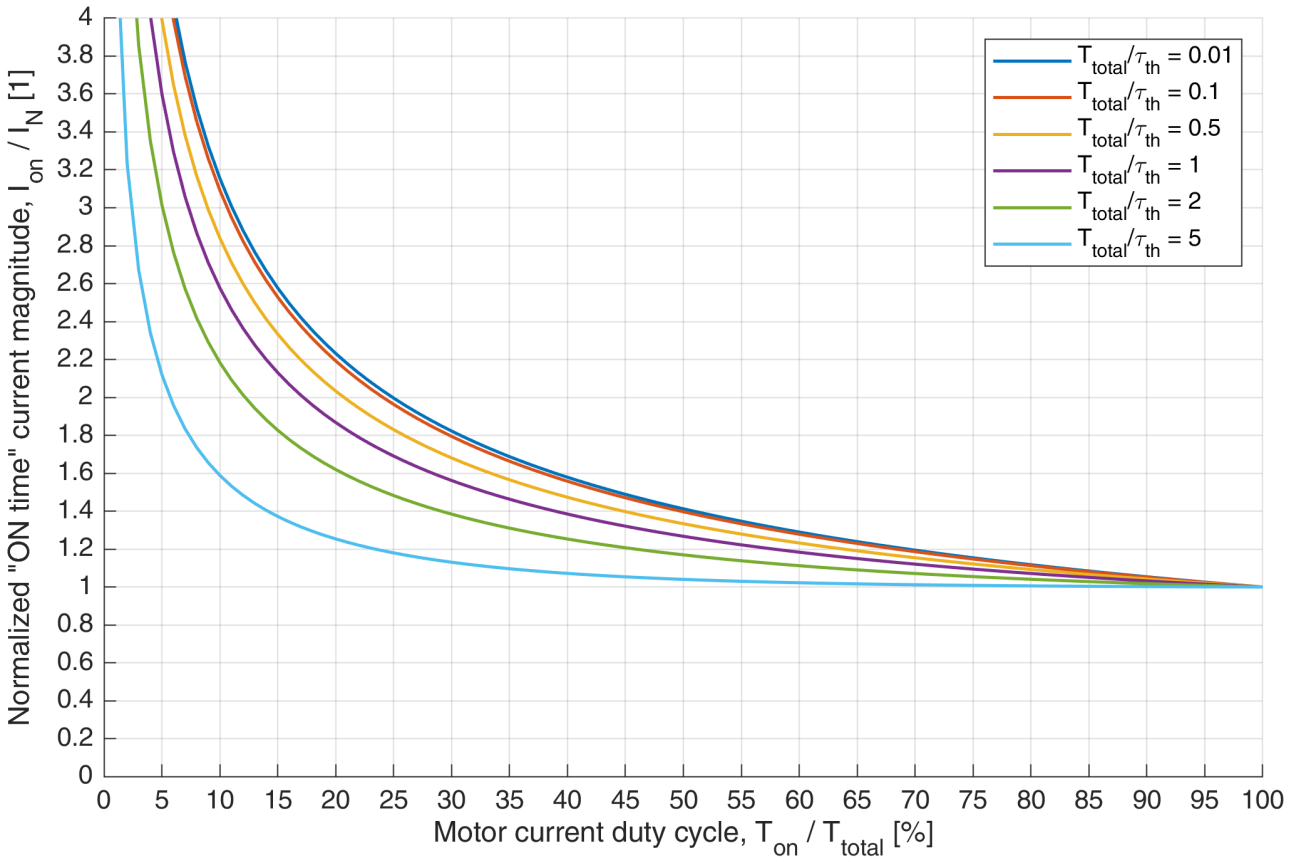



*Figure 10. Cyclic mode standardized vs. standardized "ON time"*

To summarize and calculate the maximum "ON time" current magnitude (for details see Motor data) ($I_{on}$) for the given configuration based on the cyclic ON-OFF mode, follow these steps:

1. Identify the Relevant Curve on the Graph:
   - Since the period of the current ($T_{total}$) is the same as the thermal time constant winding ($\tau_{th}$), which is 2.8s in this case, you should use the purple curve in the figure Cyclic mode standardized vs. standardized "ON time".
2. Find the Intersection on the Graph:
   - Locate the point where the motor current duty cycle of 10% intersects with the purple curve on the graph.
3. Read the Normalized 'ON Time' Current Magnitude ($I_{on}$) Value:
   - From the intersection point, read the y-axis value, which represents the normalized 'ON time' current

magnitude. In this example, it’s approximately 2.6.

4. Calculate the Maximum 'ON Time' Current Magnitude ($I_{on}$):
   - Since the y-axis is normalized with the nominal current (IN), the actual Ion can be calculated by multiplying the normalized value by the nominal current.
   - Formula: $I_{on}$ = Normalized $I_{on}$ × Nominal Current
   - In this example: Ion=2.6×1470 mA=3822 mA.

Therefore, for this specific motor configuration operating in an ON-OFF cyclic mode with a duty cycle of 10%, the maximum 'ON time' current magnitude that can be applied without exceeding the motor’s thermal limits is approximately 3822 mA.

# 4. Inputs and outputs

For further information on voltage levels, resolutions, bandwidth and switching delays, consult the related controller's hardware reference manual (see Documentation structure).

## 4.1. Digital inputs

For process control, there are predefined functions and general-purpose inputs available.
The digital input function configuration is done with Configuration of digital inputs, the polarity is set with Digital input properties.
The functionality state is read using Digital inputs functionality (all functionalities) and Digital inputs (CiA-specified functionalities), while the input logic state is read with Digital input properties.

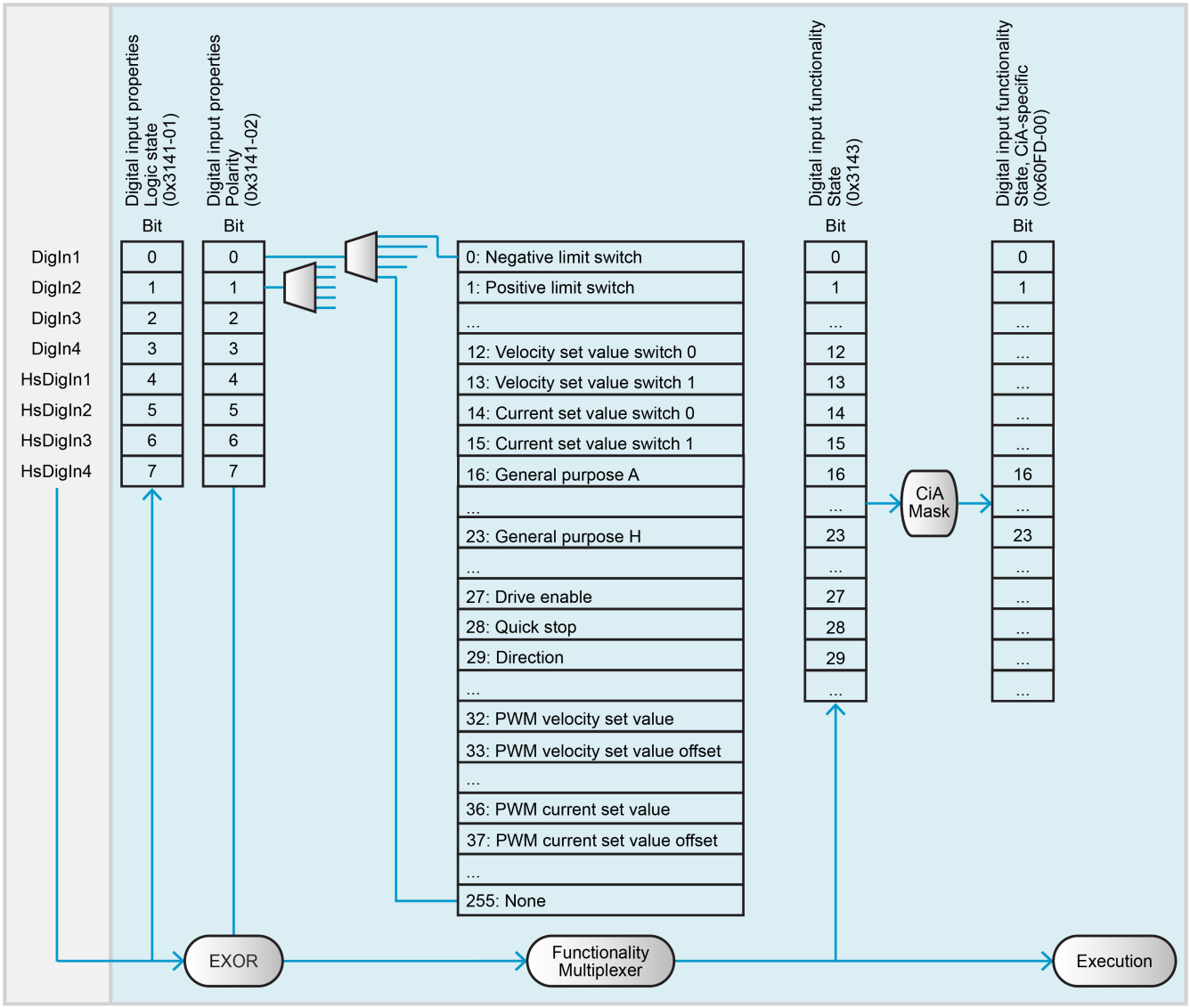



*Figure 11. Digital input functionality*

### 4.1.1. Digital input timing behavior

- **Software filter**
  To prevent spikes, the digital inputs are filtered. The input level needs to stay steady for longer than the filter time in order to detect a state change (edge). The filter lengths are
  - 1ms for "regular" digital inputs

- 500µs for high-speed digital inputs.

- **Update rates**
  The digital input functionality states (Digital inputs, Digital inputs functionality) and the Digital input properties are updated with 1 kHz.

## 4.2. Digital outputs

Predefined functions and general-purpose outputs are available for process control.

The configuration of the digital output functions is configured with Configuration of digital outputs, while the polarity is modified with Digital outputs polarity.

Digital outputs will be used to set the functionality state, and the logic state of the corresponding pin will be read using the Digital outputs logic state.

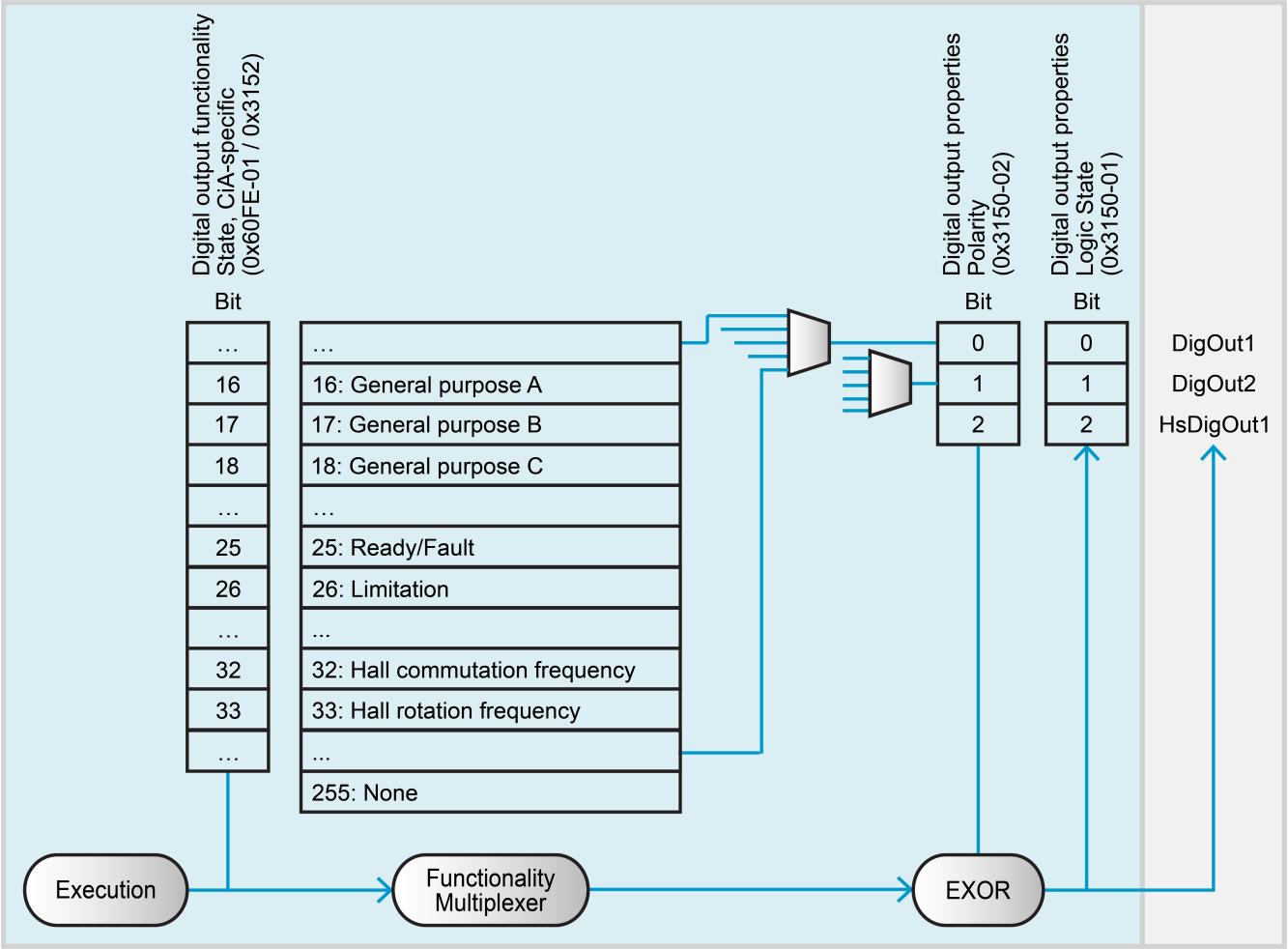



*Figure 12. Digital output functionality*

### 4.2.1. Digital output timing behavior

- **Update rates**
  The digital output logic states are updated with 10 kHz. The functionality states Physical outputs are updated when written.

## 4.3. Analog inputs

The analog inputs may be used for general purpose process values, such as temperature, pressure, torque from

an external sensor, etc. The values are listed in Analog input properties.

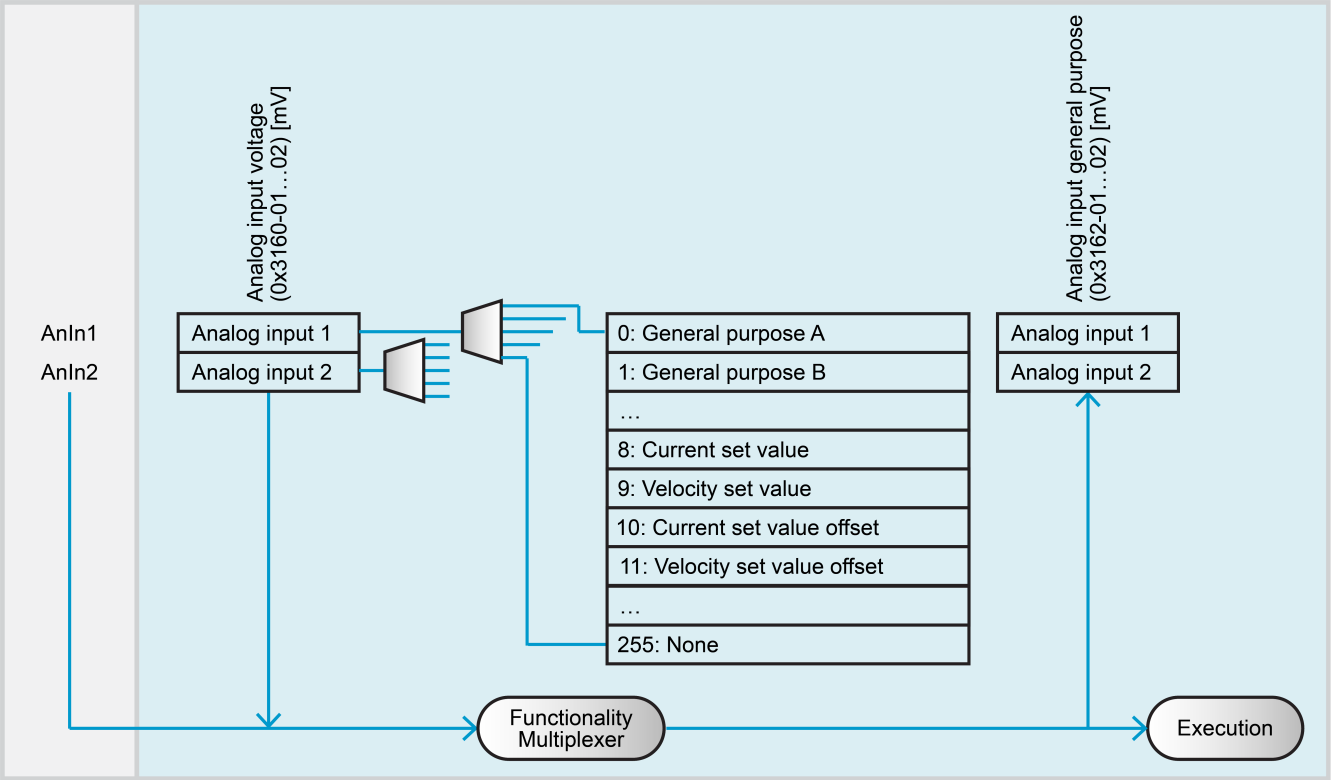



*Figure 13. Analog input functionality*

### 4.3.1. Analog input timing behavior

- **Update rates**
  Only the analog input properties and analog input raw values are updated at 50 kHz. For further usage, these values are low pass filtered with a cut-off frequency of 10kHz.

Therefore, as an example, the following objects see a low pass filtered analog input voltage:

- Analog input general purpose A
- Analog input general purpose B
- Velocity set value first voltage
- Velocity set value second voltage
- Current set value first voltage
- Current set value second voltage
- …

## 4.4. Analog outputs

The analog outputs are open to a variety of uses. These outputs are set by Analog output general purpose and displayed in Analog output properties.
The configuration of analog output functions is done with Configuration of analog outputs.

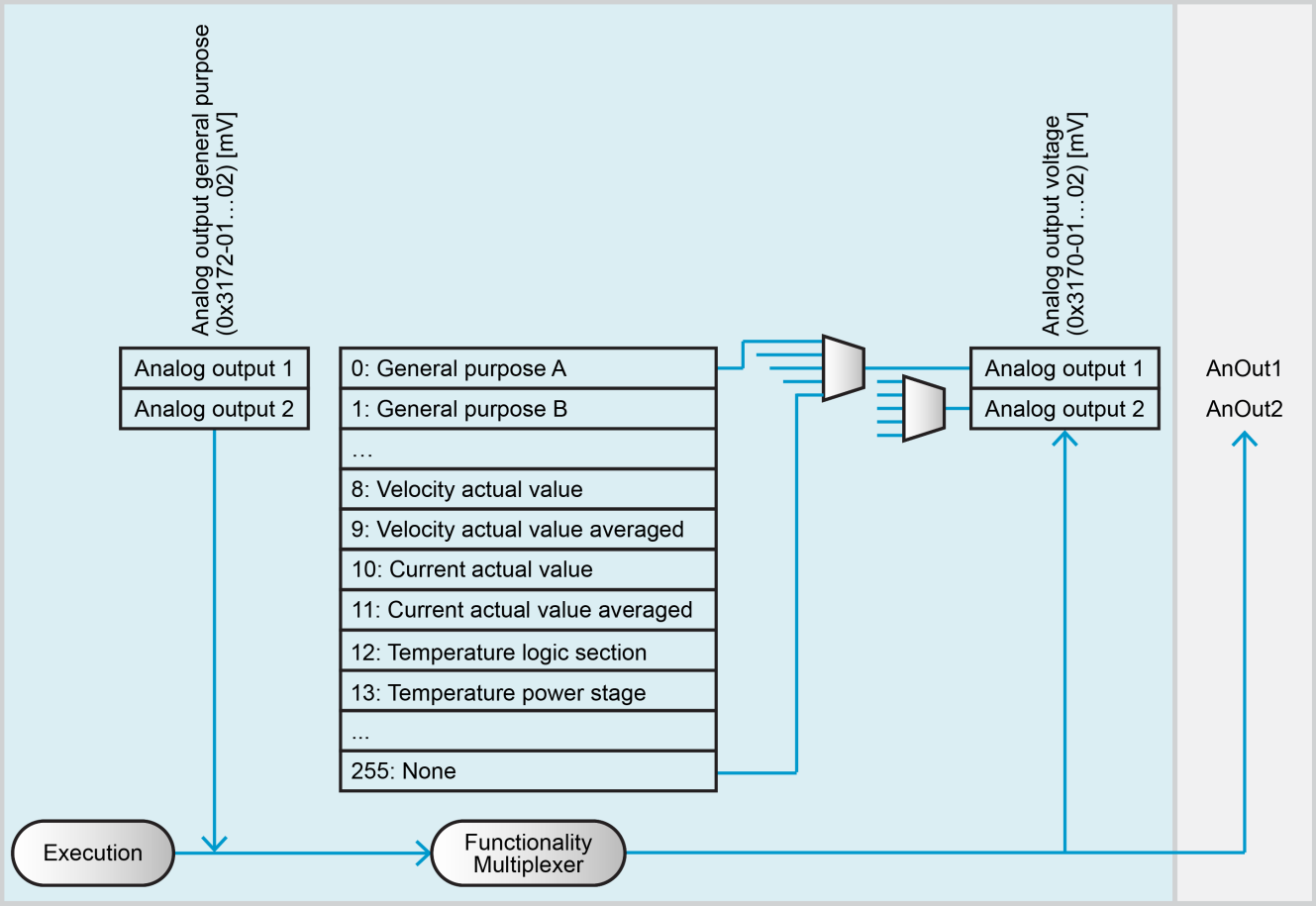



*Figure 14. Analog output functionality*

### 4.4.1. Analog output timing behavior

- **Update rates**
  The analog output properties are updated at 50 kHz, according to the digital output logic. The functionality states Analog output general purpose are updated when written.

# 5. Communication

## 5.1. USB Communication

The device's USB interface follows the «Universal Serial Bus Specification Revision 2.0». The device always communicates as a slave.

# 6. Object dictionary

## 6.1. Overview

### 6.1.1. Object data types

| Index | Name | Base type | Description | Size [Bits] | Range |
|---|---|---|---|---|---|
| 0x0001 | BOOLEAN | BOOL | False/True | 1 | 0.1 |
| 0x0002 | INTEGER8 | SINT | Short Integer | 8 | $-2^{7}…2^{7}-1$ |
| 0x0003 | INTEGER16 | INT | Integer | 16 | $-2^{15}…2^{15}-1$ |
| 0x0004 | INTEGER32 | DINT | Double Integer | 32 | $-2^{31}…2^{31}-1$ |
| 0x0015 | INTEGER64 | LINT | Long Integer | 64 | $-2^{63}…2^{63}-1$ |
| 0x0005 | UNSIGNED8 | USINT | Unsigned Short Integer | 8 | $0…2^{8}-1$ |
| 0x0006 | UNSIGNED16 | UINT | Unsigned Integer | 16 | $0…2^{16}-1$ |
| 0x0007 | UNSIGNED32 | UDINT | Unsigned Double Integer | 32 | $0…2^{32}-1$ |
| 0x001B | UNSIGNED64 | ULINT | Unsigned Long Integer | 64 | $0…2^{64}-1$ |
| 0x0009 | VISIBLE_STRING | STRING(n) | Visible String(1 octet per character) | 8*n | – |
| 0x000A | OCTET_STRING | ARRAY[0…n] of USINT | Sequence of octets (data type USINT) | 8*(n+1) | – |
| 0x0021 | PDO_MAPPING | – | PDO mapping Parameter Record | – | – |
| 0x0023 | IDENTITY | – | Identity Parameter Record | – | – |

*Table 30. Object data types*

### 6.1.2. Object codes

| Object code | Object name |
|---|---|
| 0x0007 | VAR |
| 0x0008 | ARRAY |
| 0x0009 | RECORD |

*Table 31. Object codes*

### 6.1.3. Object access types

| Access type | Description |
|---|---|
| RW | read and write access |
| RO | read only access |
| WO | write only access |
| CONST | read only access value is constant |

*Table 32. Object access types*

### 6.1.4. Object flags

| Flag | Code | Description |
|---|---|---|
| PDO mapping | TXPDO, RXPDO | Entry can be mapped as TxPdo or as RxPdo |
| Backup | YES/NO | Entry can be stored/not stored in non-volatile memory |

*Table 33. Object flags*

### 6.1.5. Entries overview

| Index | Name | Object code |
|---|---|---|
| 0x1000 | Device type | VAR |
| 0x1001 | Error register | VAR |
| 0x1003 | Error history | ARRAY |
| 0x1008 | Manufacturer device name | VAR |
| 0x1010 | Store parameters | ARRAY |
| 0x1011 | Restore default parameters | ARRAY |
| 0x1018 | Identity object | RECORD |
| 0x2100 | Additional identity | RECORD |
| 0x210C | Custom persistent memory | ARRAY |
| 0x2200 | Power supply | RECORD |
| 0x2201 | Power supply supervision | RECORD |
| 0x2202 | Thermal protection | RECORD |
| 0x3000 | Axis configuration | RECORD |
| 0x3001 | Motor data | RECORD |
| 0x3002 | Electrical system parameters | RECORD |
| 0x3010 | Digital incremental encoder S2 | RECORD |
| 0x301A | Digital Hall sensor S1 | RECORD |
| 0x30A0 | Current control parameter set | RECORD |
| 0x30A2 | Velocity control parameter set | RECORD |
| 0x30D0 | Current demand value | VAR |
| 0x30D1 | Current actual values | ARRAY |
| 0x30D2 | Torque actual values | ARRAY |
| 0x30D3 | Velocity actual values | ARRAY |
| 0x30F0 | Target current | VAR |
| 0x30F1 | Current offset | VAR |
| 0x3141 | Digital input properties | RECORD |
| 0x3142 | Configuration of digital inputs | ARRAY |
| 0x3143 | Digital inputs functionality | VAR |
| 0x3146 | Velocity set value switch parameter | ARRAY |
| 0x3147 | Current set value switch parameter | ARRAY |
| 0x314B | Digital input PWM frequencies | ARRAY |
| 0x314C | Digital input PWM duty cycles | ARRAY |
| 0x3150 | Digital outputs properties | RECORD |
| 0x3151 | Configuration of digital outputs | ARRAY |
| 0x3152 | Digital outputs functionality | VAR |
| 0x3160 | Analog input properties | ARRAY |
| 0x3161 | Configuration of analog inputs | ARRAY |
| 0x3162 | Analog input general purpose | ARRAY |
| 0x3163 | Analog input adjustment | RECORD |

| Index | Name | Object code |
|---|---|---|
| 0x3164 | Analog input raw values | ARRAY |
| 0x3170 | Analog output properties | ARRAY |
| 0x3171 | Configuration of analog outputs | ARRAY |
| 0x3172 | Analog output general purpose | ARRAY |
| 0x3180 | Digital input PWM velocity set value scaling | RECORD |
| 0x3181 | Digital input PWM velocity set value offset scaling | RECORD |
| 0x3184 | Digital input PWM current set value scaling | RECORD |
| 0x3185 | Digital input PWM current set value offset scaling | RECORD |
| 0x31B0 | Analog input velocity set value scaling | RECORD |
| 0x31B1 | Analog input velocity set value offset scaling | RECORD |
| 0x31B4 | Analog input current set value scaling | RECORD |
| 0x31B5 | Analog input current set value offset scaling | RECORD |
| 0x31C1 | Analog output velocity scaling | RECORD |
| 0x31C2 | Analog output current scaling | RECORD |
| 0x31C3 | Analog output temperature scaling | RECORD |
| 0x3200 | Thermal protection motor | RECORD |
| 0x3201 | Thermal protection power stage | RECORD |
| 0x3203 | Motor control | RECORD |
| 0x603F | Error code | VAR |
| 0x6040 | Controlword | VAR |
| 0x6041 | Statusword | VAR |
| 0x6060 | Modes of operation | VAR |
| 0x6061 | Modes of operation display | VAR |
| 0x606B | Velocity demand value | VAR |
| 0x606C | Velocity actual value | VAR |
| 0x6076 | Motor rated torque | VAR |
| 0x6077 | Torque actual value | VAR |
| 0x607F | Max profile velocity | VAR |
| 0x6080 | Max motor speed | VAR |
| 0x6083 | Profile acceleration | VAR |
| 0x6084 | Profile deceleration | VAR |
| 0x6085 | Quick stop deceleration | VAR |
| 0x60A9 | SI unit velocity | VAR |
| 0x60AA | SI unit acceleration | VAR |
| 0x60B1 | Velocity offset | VAR |
| 0x60C5 | Max acceleration | VAR |
| 0x60E5 | Additional velocity actual values | ARRAY |
| 0x60FD | Digital inputs | VAR |
| 0x60FE | Digital outputs | ARRAY |
| 0x60FF | Target velocity | VAR |

| Index | Name | Object code |
|---|---|---|
| 0x6402 | Motor type | VAR |
| 0x6502 | Supported drive modes | VAR |

*Table 34. Object dictionary (overview)*

## 6.2. Objects

### 6.2.1. Device type

Describes the device type. The lower word stands for the supported device profile number. The device adheres to CiA 402 "CANopen device profile for drives and motion control" if the value is 0x0192 (402). The higher word contains details about the drive type. Servo drives are those with the value 0x0002.

| | | |
|---|---|---|
| Name | Device type | |
| Index | 0x1000 | |
| Subindex | 0x00 | |
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | 0x00020192 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

### 6.2.2. Error register

The error register for the device. The device maps internal errors in this byte.

| | |
|---|---|
| Name | Error register |
| Index | 0x1001 |
| Subindex | 0x00 |
| Data type | UNSIGNED8 |
| Access type | RO |
| Default value | - |
| Value range | Error Register Bits |
| PDO mapping | NO |
| Persistent | NO |

| Bit | Description |
|---|---|
| 7 | Manufacturer specific |
| 6 | Reserved (always 0) |
| 5 | Device profile-specific |
| 4 | Communication error |
| 3 | Temperature error |
| 2 | Voltage error |
| 1 | Current error |
| 0 | Generic error |

*Table 35. Error Register Bits*

### 6.2.3. Error history

Holds errors that have occurred on the device.

| | |
|---|---|
| Name | Error history |
| Index | 0x1003 |
| Object code | ARRAY |
| Highest subindex supported | 5 |

#### 6.2.3.1. Number of errors

Contains the number of actual errors that are recorded in the array starting at subindex 1. Writing a "0" (zero) deletes the error history (empties the array). Values greater than "0" (zero) are permitted to write.

| | | |
|---|---|---|
| Name | Number of errors | |
| Index | 0x1003 | |
| Subindex | 0x00 | |
| Data type | UNSIGNED8 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

#### 6.2.3.2. Error history 1

Every new error code is stored at subindex 1, the older ones move down the list. The error numbers compose of a 16-bit error code and 16-bit additional error information on higher word.

Errors without a device state change are marked with 0x8000 (bit31) in additional error information.

| | | |
|---|---|---|
| Name | Error history 1 | |
| Index | 0x1003 | |
| Subindex | 0x01 | |
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

| Bit | Value | Description |
|---|---|---|
| 31 | 0 | Error |
| | 1 | Warning (without effect on device states) |
| 30…16 | 0 | Reserved |
| 15…0 | Error code | Device error code |

*Table 36. Error history structure*

### 6.2.3.3. Error history 2

| | | |
|---|---|---|
| Name | Error history 2 | |
| Index | 0x1003 | |
| Subindex | 0x02 | |
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

### 6.2.3.4. Error history 3

| | | |
|---|---|---|
| Name | Error history 3 | |
| Index | 0x1003 | |
| Subindex | 0x03 | |
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

### 6.2.3.5. Error history 4

| | | |
|---|---|---|
| Name | Error history 4 | |
| Index | 0x1003 | |
| Subindex | 0x04 | |
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

### 6.2.3.6. Error history 5

| | | |
|---|---|---|
| Name | Error history 5 | |
| Index | 0x1003 | |
| Subindex | 0x05 | |
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | - | |

| | | |
|---|---|---|
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

### 6.2.4. Manufacturer device name

Holds the manufacturer device name.

| | | |
|---|---|---|
| Name | Manufacturer device name | |
| Index | 0x1008 | |
| Subindex | 0x00 | |
| Data type | VISIBLE_STRING | |
| Access type | RO | |
| Default value | ESCON2 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

### 6.2.5. Store parameters

Controls saving of configuration parameters in a non-volatile memory.

| | |
|---|---|
| Name | Store parameters |
| Index | 0x1010 |
| Object code | ARRAY |
| Highest subindex supported | 1 |

In order to avoid storage of parameters by mistake, storage should only be executed when a specific signature is written to the respective subindex.

| BYTE | MSB | | | LSB |
|---|---|---|---|---|
| Character | 'e' | 'v' | 'a' | 's' |
| Hex value | 0x65 | 0x76 | 0x61 | 0x73 |

*Table 37. Store Parameters Signature Values*

On read access, the device will always return the value 0x00000001 since the device can only store the parameters on command.

| Bit | RW | Description |
|---|---|---|
| 31…2 | X | Reserved |
| 1 (auto) | 1 | The device saves parameters autonomously |
| | 0 | The device does not save parameters autonomously |
| 0 (cmd) | 1 | The device saves parameters on command |
| | 0 | The device does not save parameters on command |

*Table 38. Store Parameters State Values*

#### 6.2.5.1. Save all parameters

In the event that the code "save" is written to the object, all device parameters will be saved in a non-volatile memory.

| | |
|---|---|
| Name | Save all parameters |
| Index | 0x1010 |
| Subindex | 0x01 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | 0x00000001 |
| Value range | Store Parameters Signature Values |
| PDO mapping | NO |
| Persistent | NO |

### 6.2.6. Restore default parameters

Configuration parameters are restored to the default values. Restoring the default parameters is permitted in NMT state «Pre-Operational» and device state «Power Disable» (see Device control) only. The default values are only set as valid after the device is reset or power cycled.

| | |
|---|---|
| Name | Restore default parameters |
| Index | 0x1011 |
| Object code | ARRAY |
| Highest subindex supported | 1 |

In order to avoid restoring of default parameters by mistake, restoring should only be executed when a specific signature is written to the respective subindex. On read access, the device will always return the value 0x00000001.

| BYTE | MSB | | | LSB |
|---|---|---|---|---|
| Character | 'd' | 'a' | 'o' | 'l' |
| Hex value | 0x64 | 0x61 | 0x6F | 0x6C |

*Table 39. Restore default parameters signature values*

#### 6.2.6.1. Restore all default parameters

All parameters of the device will be stored in non-volatile memory if the code "load" is written to the object. Only permitted if device state is "Power Disable" (see Device control).

| | |
|---|---|
| Name | Restore all default parameters |
| Index | 0x1011 |
| Subindex | 0x01 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | 0x00000001 |
| Value range | Restore default parameters signature values |
| PDO mapping | NO |

| | |
|---|---|
| Persistent | NO |

### 6.2.7. Identity object

Provides general identification information on the device.

| | |
|---|---|
| Name | Identity object |
| Index | 0x1018 |
| Object code | RECORD |
| Highest subindex supported | 4 |

#### 6.2.7.1. Vendor ID

Unique "maxon motor ag" vendor identification defined by CiA.

| | | |
|---|---|---|
| Name | Vendor ID | |
| Index | 0x1018 | |
| Subindex | 0x01 | |
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | 0x000000FB | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

#### 6.2.7.2. Product code

The high word contains the hardware version. The low word contains the application number.

| | | |
|---|---|---|
| Name | Product code | |
| Index | 0x1018 | |
| Subindex | 0x02 | |
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

| Hardware version | Hardware |
|---|---|
| 0x1101 | ESCON2 Module 60/30<br>ESCON2 Compact 60/30 |
| 0x1102 | ESCON2 Micro 60/5 |
| 0x1103 | ESCON2 Nano 24/2 |

*Table 40. Definition of hardware version*

#### 6.2.7.3. Revision number

The high word contains the software version. The low word contains the application version.

| | | |
|---|---|---|
| Name | Revision number | |
| Index | 0x1018 | |
| Subindex | 0x03 | |
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

#### 6.2.7.4. Serial number

Contains the last 8 digits of the device serial number.
Related object: Serial number complete

| | | |
|---|---|---|
| Name | Serial number | |
| Index | 0x1018 | |
| Subindex | 0x04 | |
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

### 6.2.8. Additional identity

| | |
|---|---|
| Name | Additional identity |
| Index | 0x2100 |
| Object code | RECORD |
| Highest subindex supported | 1 |

#### 6.2.8.1. Serial number complete

Contains the full 64-bit device serial number.

| | | |
|---|---|---|
| Name | Serial number complete | |
| Index | 0x2100 | |
| Subindex | 0x01 | |
| Data type | UNSIGNED64 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |

| | |
|---|---|
| PDO mapping | NO |
| Persistent | NO |

### 6.2.9. Custom persistent memory

| | |
|---|---|
| Name | Custom persistent memory |
| Index | 0x210C |
| Object code | ARRAY |
| Highest subindex supported | 4 |

#### 6.2.9.1. Custom persistent memory 1

Can be used to store custom values (for example, axis numbers, identifications, etc.) on the device. The stored values are not evaluated by the firmware although the set parameters are restored to default values.
Related object: Restore default parameters.

| | | |
|---|---|---|
| Name | Custom persistent memory 1 | |
| Index | 0x210C | |
| Subindex | 0x01 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 0x00000000 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

#### 6.2.9.2. Custom persistent memory 2

| | | |
|---|---|---|
| Name | Custom persistent memory 2 | |
| Index | 0x210C | |
| Subindex | 0x02 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 0x00000000 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

#### 6.2.9.3. Custom persistent memory 3

| | |
|---|---|
| Name | Custom persistent memory 3 |
| Index | 0x210C |
| Subindex | 0x03 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | 0x00000000 |

| | | |
|---|---|---|
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.9.4. Custom persistent memory 4

| | | |
|---|---|---|
| Name | Custom persistent memory 4 | |
| Index | 0x210C | |
| Subindex | 0x04 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 0x00000000 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

## 6.2.10. Power supply

Used to display the power supply parameters.

| | |
|---|---|
| Name | Power supply |
| Index | 0x2200 |
| Object code | RECORD |
| Highest subindex supported | 1 |

### 6.2.10.1. Power supply voltage

Represents the actual power supply voltage. The value is given as [0.1 V].

| **Note:** |
|---|
|  If the device is only powered via the logic supply, the displayed value is to be considered invalid. |

| | | |
|---|---|---|
| Name | Power supply voltage | |
| Index | 0x2200 | |
| Subindex | 0x01 | |
| Data type | UNSIGNED16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

## 6.2.11. Power supply supervision

Used to customize power supervision.

| | |
|---|---|
| Name | Power supply supervision |
| Index | 0x2201 |
| Object code | RECORD |
| Highest subindex supported | 2 |

### 6.2.11.1. Power supply undervoltage limit

The device can only be enabled if the supply voltage is higher than the undervoltage limit. If the supply voltage falls below this undervoltage limit while the device is enabled, the Undervoltage error will be set. The error can only be cleared if the supply voltage rises above the sum of the undervoltage limit plus the undervoltage hysteresis.
The undervoltage limit must be lower than overvoltage limit minus overvoltage hysteresis minus undervoltage hysteresis.
The value is given in [mV].

| | |
|---|---|
| Name | Power supply undervoltage limit |
| Index | 0x2201 |
| Subindex | 0x01 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | Power supply - undervoltage limit |
| Value range | Power supply - undervoltage limit |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default | Min | Max |
|---|---|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 7'500mV | 7'500mV | 63'750mV |
| ESCON2 Micro 60/5 | 7'500mV | 7'500mV | 63'750mV |
| ESCON2 Nano 24/2 | 4'500mV | 4'500mV | 29'000mV |

*Table 41. Power supply - undervoltage limit*

| Hardware | Undervoltage hysteresis |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 250mV |
| ESCON2 Micro 60/5 | 250mV |
| ESCON2 Nano 24/2 | 50mV |

*Table 42. Power supply - undervoltage hysteresis*

### 6.2.11.2. Power supply overvoltage limit

If the supply voltage rises above this overvoltage limit (regardless of the enabled state), the Overvoltage error will be set. The error can only be cleared if the supply voltage falls below the overvoltage limit minus the overvoltage hysteresis.
The overvoltage limit must be higher than undervoltage limit plus undervoltage hysteresis plus overvoltage hysteresis.
The value is given in [mV].

| | |
|---|---|
| Name | Power supply overvoltage limit |

| | |
|---|---|
| Index | 0x2201 |
| Subindex | 0x02 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | Power supply - overvoltage limit |
| Value range | Power supply - overvoltage limit |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default | Min | Max |
|---|---|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 65'000mV | 8'750mV | 65'000mV |
| ESCON2 Micro 60/5 | 65'000mV | 8'750mV | 65'000mV |
| ESCON2 Nano 24/2 | 31'000mV | 4'550mV | 31'000mV |

*Table 43. Power supply - overvoltage limit*

| Hardware | Overvoltage hysteresis |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 1'000mV |
| ESCON2 Micro 60/5 | 1'000mV |
| ESCON2 Nano 24/2 | 2'000mV |

*Table 44. Power supply - overvoltage hysteresis*

### 6.2.12. Thermal protection

| | |
|---|---|
| Name | Thermal protection |
| Index | 0x2202 |
| Object code | RECORD |
| Highest subindex supported | 1 |

#### 6.2.12.1. Temperature logic section

Displays the logic section temperature. Thermal logic section overload error will be set if the logic section temperature exceeds the over temperature limit. The temperature must drop below temperature limit minus the temperature hysteresis, in order to clear the error. The value is given in [0.1 °C].

| | | |
|---|---|---|
| Name | Temperature logic section | |
| Index | 0x2202 | |
| Subindex | 0x01 | |
| Data type | INTEGER16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

| Hardware | Temperature limit |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 108°C |
| ESCON2 Micro 60/5 | 115°C |
| ESCON2 Nano 24/2 | 108°C |

*Table 45. Logic section over temperature limit*

| Hardware | Hysteresis |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 10°C |
| ESCON2 Micro 60/5 | 10°C |
| ESCON2 Nano 24/2 | 10°C |

*Table 46. Logic section over temperature hysteresis*

### 6.2.13. Axis configuration

Used to setup the main components of the axis by configuring the sensors and the control structure. Write access is only permitted in the device state «Power Disable» (see Device control).

Related objects: Motor type

| | |
|---|---|
| Name | Axis configuration |
| Index | 0x3000 |
| Object code | RECORD |
| Highest subindex supported | 5 |

#### 6.2.13.1. Sensors configuration

Used to define the sensor types used for the axis.

- If Motor type is set to “brushed DC motor”, the field value “Digital Hall sensor” is set to “none”, and cannot be set to another value.

Related objects: Digital incremental encoder S2, Digital Hall sensor S1

| | |
|---|---|
| Name | Sensors configuration |
| Index | 0x3000 |
| Subindex | 0x01 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | 0x00000110 |
| Value range | Sensor configuration - Bits |
| PDO mapping | NO |
| Persistent | YES |

| Bit | Name | Value | Description |
|---|---|---|---|
| 31..16 | Reserved | 0x00 | – |

| Bit | Name | Value | Description |
|---|---|---|---|
| 15..8 | Sensor 2 type | 0x00 | None |
| | | 0x01 | Digital incremental encoder |
| 7..0 | Sensor 1 type | 0x00 | None |
| | | 0x10 | Digital Hall Sensor (EC motors only) |

*Table 47. Sensor configuration - Bits*

| Note: |
|---|
| For detailed information on socket and pin assignment, see the separate document «Hardware Reference» Documentation structure of the respective controller. |

### 6.2.13.2. Control structure

Defines the control structure of the axis depending on the available sensors.

- The main sensor can only be selected if the corresponding value of Sensors configuration has been configured (i.e, not "None").
- Take into account that the control quality depends, among other factors, on the resolution of the main sensor.
- If the values in Commutation sensors are incompatible with the new control structure, Commutation sensors is set to 0 (no commutation sensors configured).

| | |
|---|---|
| Name | Control structure |
| Index | 0x3000 |
| Subindex | 0x02 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | 0x00020011 |
| Value range | Control structure - Bits and Control structure - value range |
| PDO mapping | NO |
| Persistent | YES |

| Bit | Name | Value | Description |
|---|---|---|---|
| 31..20 | Reserved | 0x00 | – |
| 19..16 | Main Sensor | 0x00 | None |
| | | 0x01 | Sensor 1 |
| | | 0x02 | Sensor 2 |
| 15..8 | Reserved | 0x00 | – |
| 7..4 | Velocity control structure | 0x00 | None |
| | | 0x01 | PI velocity controller (low-pass filter) |
| 3..0 | Current Control Structure | 0x01 | PI current controller |

*Table 48. Control structure - Bits*

| Value (hex) | Description | DC | EC |
|---|---|---|---|
| 0x0000'0001 | PI current controller<br>No velocity controller<br>No main sensor | x | x |
| 0x0001'0011 | PI current controller<br>PI velocity controller (low-pass filter)<br>Sensor 1 is main sensor | - | x |
| 0x0002'0011 | PI current controller<br>PI velocity controller (low-pass filter)<br>Sensor 2 is main sensor | x | x |

*Table 49. Control structure - value range*

| Note: | |
|---|---|
|  | Speed limitation in current-based modes of operation is only supported if the main sensor is configured (not None). In this case, the Velocity control parameter set must be configured or tuned. |

### 6.2.13.3. Commutation sensors

Defines the control structure of the axis dependent on the available sensors and their disposition, as well as the commutation sensors for the axis motor.
In the case of a "brushed DC motor", the value is ignored.
For “brushless DC motor", the entry may not be set to 0x0000 (no commutation sensor defined). "Sensor commutation absolute" is used for sensors that do not require additional alignment to perform commutation (e.g, digital Hall sensors). In contrast, "Sensor commutation relative" is used if additional algorithms are required to use the sensor as a commutation sensor (e.g, digital incremental encoder). Combinations of both relative and absolute commutation sensors are possible.

- Only if the relevant value of Sensors configuration is configured (i.e., not "None") may "Sensor commutation absolute" or "Sensor commutation relative" be chosen.
- A sensor must be installed on the motor shaft if it is to be utilized as a commutation sensor.
- The object Control structure is reset to 0x0000 (no commutation sensor defined) if it is written to and the new value is incompatible with the current setup. Enabling the axis will yield an error until a valid configuration is selected.

| | |
|---|---|
| Name | Commutation sensors |
| Index | 0x3000 |
| Subindex | 0x03 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | 0x00000012 |
| Value range | Commutation sensors - Bits and Commutation sensors - value range |
| PDO mapping | NO |
| Persistent | YES |

| Bit | Name | Value | Description |
|---|---|---|---|
| 31..8 | Reserved | 0x00 | – |
| 7..4 | Commutation Sensor Absolute | 0x00 | None |
| | | 0x01 | Sensor 1 |

| Bit | Name | Value | Description |
|---|---|---|---|
| 3..0 | Commutation Sensor Relative | 0x00 | None |
| | | 0x02 | Sensor 2 |

*Table 50. Commutation sensors - Bits*

| Value | Description | Motor type supported |
|---|---|---|
| 0x0000'0000 | No commutation sensor defined | DC motor |
| 0x0000'0010 | Sensor 1 used for commutation [a] | EC motor |
| 0x0000'0012 | Sensor 1 and Sensor 2 used for commutation [a] | EC motor |
| [a] The value can only be set if a supported motor type is selected Motor type | | |

*Table 51. Commutation sensors - value range*

### 6.2.13.4. Axis configuration miscellaneous

Used to define various options regarding the axis configuration.

| | |
|---|---|
| Name | Axis configuration miscellaneous |
| Index | 0x3000 |
| Subindex | 0x04 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | 0x00000000 |
| Value range | Axis configuration miscellaneous – Bits |
| PDO mapping | NO |
| Persistent | YES |

| Bit | Name | Value | Description |
|---|---|---|---|
| 31..10 | Reserved | 0 | - |
| 9 | Commutation sensor supervision | 1 | Commutation sensor supervision is disabled |
| | | 0 | Commutation sensor supervision is enabled |
| 8 | Main sensor supervision | 1 | Main sensor supervision is disabled |
| | | 0 | Main sensor supervision is enabled |
| 7..1 | Reserved | 0 | - |
| 0 | Axis polarity | 1 | Inverse polarity – rotational direction of the axis is CW when positive demand values are attached. |
| | | 0 | Normal polarity – rotational direction of the axis is CCW when positive demand values are attached. |

*Table 52. Axis configuration miscellaneous – Bits*

### 6.2.13.5. Main sensor resolution

Displays the resolution of the main sensor given in [increments/revolution].

| | |
|---|---|
| Name | Main sensor resolution |
| Index | 0x3000 |
| Subindex | 0x05 |

| | | |
|---|---|---|
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

### 6.2.14. Motor data

Used to configure the parameters of the motor.
Some parameters are used to limit the output current according to the I2t method. For detailed motor specifications, see maxon catalog.
Related object: Motor type

| | |
|---|---|
| Name | Motor data |
| Index | 0x3001 |
| Object code | RECORD |
| Highest subindex supported | 5 |

#### 6.2.14.1. Nominal current

Represents the nominal current of the motor [mA].
Continuous operation of the motor at this current level and at 25 °C ambient will ultimately cause the winding to reach the specified maximum winding temperature. This assumes no heat sink. The value can be substantially increased if the motor mount is made of heat-dissipating materials.
Related object: Motor rated torque

| | |
|---|---|
| Name | Nominal current |
| Index | 0x3001 |
| Subindex | 0x01 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | Nominal current |
| Value range | Nominal current |
| PDO mapping | RXPDO |
| Persistent | YES |

| Hardware | Default | Min | Max |
|---|---|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 30'000mA | 0mA | 30'000mA |
| ESCON2 Micro 60/5 | 5'000mA | 0mA | 5'000mA |
| ESCON2 Nano 24/2 | 2'000mA | 0mA | 2'000mA |

*Table 53. Nominal current*

#### 6.2.14.2. Output current limit

Represents the maximum permissible current of the motor [mA].
We recommend setting the value to double Nominal current.
Related object: Thermal time constant winding

| | |
|---|---|
| Name | Output current limit |
| Index | 0x3001 |
| Subindex | 0x02 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | Output current limit |
| Value range | Output current limit |
| PDO mapping | RXPDO |
| Persistent | YES |

| Hardware | Default | Min | Max |
|---|---|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 60'000mA | 0mA | 60'000mA |
| ESCON2 Micro 60/5 | 15'000mA | 0mA | 15'000mA |
| ESCON2 Nano 24/2 | 6'000mA | 0mA | 6'000mA |

*Table 54. Output current limit*

### 6.2.14.3. Number of pole pairs

Represents the number of magnetic pole pairs (number of poles divided by 2) of the rotor of a brushless DC motor (maxon EC motor/BLDC motor).
Write access is only permitted in device state «Power disabled»: Device control.
Related object: Max motor speed

| | | |
|---|---|---|
| Name | Number of pole pairs | |
| Index | 0x3001 | |
| Subindex | 0x03 | |
| Data type | UNSIGNED8 | |
| Access type | RW | |
| Default value | 1 | |
| Value range | 1 | 255 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.14.4. Thermal time constant winding

Represents the thermal time constant of the motor winding. It is used to calculate the length of time the Output current limit is permitted to be connected to the motor. The value is given in [0.1 s].

| | | |
|---|---|---|
| Name | Thermal time constant winding | |
| Index | 0x3001 | |
| Subindex | 0x04 | |
| Data type | UNSIGNED16 | |
| Access type | RW | |
| Default value | 40 | |
| Value range | 1 | 10'000 |

| | |
|---|---|
| PDO mapping | NO |
| Persistent | YES |

#### 6.2.14.5. Torque constant

Represents the motor's torque constant. The value is given in [µNm/A].
Write access is only permitted in device state «Power Disabled»: Device control.
Related object: Motor rated torque

| | | |
|---|---|---|
| Name | Torque constant | |
| Index | 0x3001 | |
| Subindex | 0x05 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | 0 | 10'000'000 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.15. Electrical system parameters

The parameters are evaluated during the regulation, tuning, and identification of the electrical system. They are used during the regulation tuning identification of the mechanical system to calculate the torque constant as well as for sensor supervision.

| | |
|---|---|
| Name | Electrical system parameters |
| Index | 0x3002 |
| Object code | RECORD |
| Highest subindex supported | 2 |

#### 6.2.15.1. Electrical resistance

Represents the electrical system's resistance. The value is given in [mΩ].

| | | |
|---|---|---|
| Name | Electrical resistance | |
| Index | 0x3002 | |
| Subindex | 0x01 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

#### 6.2.15.2. Electrical inductance

Represents the electrical system's inductance. The value is given in [µH].

| | |
|---|---|
| Name | Electrical inductance |

| | | |
|---|---|---|
| Index | 0x3002 | |
| Subindex | 0x02 | |
| Data type | UNSIGNED16 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.16. Digital incremental encoder S2

Defines the configuration of the digital incremental encoder for sensor 2 (S2).
Related object: Sensors configuration

| | |
|---|---|
| Name | Digital incremental encoder S2 |
| Index | 0x3010 |
| Object code | RECORD |
| Highest subindex supported | 2 |

#### 6.2.16.1. Digital incremental encoder number of pulses

Defines the resolution of the digital incremental encoder. The value is given in [pulses/revolution]. Unit conversion is as follows:

$$4 * \frac{\text{pulses}}{\text{revolutions}} = \frac{\text{increments[inc]}}{\text{revolutions[rev]}} = \frac{\text{quadcounts[qc]}}{\text{revolutions[rev]}}$$

Write access is only permitted in device state «Power Disabled»: Device control.

| | | |
|---|---|---|
| Name | Digital incremental encoder number of pulses | |
| Index | 0x3010 | |
| Subindex | 0x01 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 500 | |
| Value range | 16 | 2'500'000 |
| PDO mapping | NO | |
| Persistent | YES | |

#### 6.2.16.2. Digital incremental encoder type

Defines the configuration of the digital incremental encoder.
Write access is only permitted in device state «Power Disabled»: Device control. Non-zero writes to reserved bits are not allowed. In this case, an abort code is returned.

| | |
|---|---|
| Name | Digital incremental encoder type |
| Index | 0x3010 |
| Subindex | 0x02 |

| | |
|---|---|
| Data type | UNSIGNED16 |
| Access type | RW |
| Default value | 0x0000 |
| Value range | Digital incremental encoder type – Bits |
| PDO mapping | NO |
| Persistent | YES |

| Bit | Name | Value | Description |
|---|---|---|---|
| 15…10 | Reserved | 0 | – |
| 9 | Method | 0 | Speed measured as time between two sensor edges |
| | | 1 | Speed measured as number of sensor edges per control cycle |
| 8…5 | Reserved | 0 | – |
| 4 | Direction | 0 | maxon |
| | | 1 | Inverted (or encoder mounted on motor shaft) |
| 3…2 | Reserved | 0 | – |
| 1…0 | Index | 0 | Encoder without index (2-channel) |
| | | 1…3 | Reserved |

*Table 55. Digital incremental encoder type – Bits*

### 6.2.17. Digital Hall sensor S1

Defines the configuration of the digital Hall sensor for sensor 1 (S1). Make sure to activate the digital Hall sensor using Axis configuration.

| | |
|---|---|
| Name | Digital Hall sensor S1 |
| Index | 0x301A |
| Object code | RECORD |
| Highest subindex supported | 2 |

#### 6.2.17.1. Digital Hall sensor type

Defines the configuration of the digital Hall sensor.
Write access is only permitted in device state «Power Disabled»: Device control. Non-zero writes to reserved bits are not allowed. In this case, an abort code is returned.

| | |
|---|---|
| Name | Digital Hall sensor type |
| Index | 0x301A |
| Subindex | 0x01 |
| Data type | UNSIGNED16 |
| Access type | RW |
| Default value | 0x0000 |
| Value range | Digital hall sensor type – bits |
| PDO mapping | NO |
| Persistent | YES |

| Bit | Name | Value | Description |
|---|---|---|---|
| 15…5 | Reserved | - | – |
| 4 | Method | 0 | Speed measured as time between two sensor edges |
| | | 1 | Speed measured as number of sensor edges per control cycle |
| 3…1 | Reserved | - | – |
| 0 | Polarity | 0 | maxon |
| | | 1 | Inverted |

*Table 56. Digital hall sensor type – bits*

### 6.2.17.2. Digital Hall sensor pattern

Displays the actual state of the three digital Hall sensors as a pattern.

| | | |
|---|---|---|
| Name | Digital Hall sensor pattern | |
| Index | 0x301A | |
| Subindex | 0x02 | |
| Data type | UNSIGNED16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

| Bit | Name |
|---|---|
| 2 | Digital Hall sensor 3 |
| 1 | Digital Hall sensor 2 |
| 0 | Digital Hall sensor 1 |

*Table 57. Digital hall sensor pattern – bits*

## 6.2.18. Current control parameter set

Holds the current controller parameters. The current controller is a digital PI controller.

| | |
|---|---|
| Name | Current control parameter set |
| Index | 0x30A0 |
| Object code | RECORD |
| Highest subindex supported | 2 |

### 6.2.18.1. Current controller P gain

Represents the proportional gain of the current controller. The value is given in

$$\left[\frac{\mu V}{A}\right]$$

| | |
|---|---|
| Name | Current controller P gain |
| Index | 0x30A0 |

| | | |
|---|---|---|
| Subindex | 0x01 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 1'171'880 | |
| Value range | - | - |
| PDO mapping | RXPDO | |
| Persistent | YES | |

#### 6.2.18.2. Current controller I gain

Represents the integral gain of the current controller. The value is given in

$$\left[\frac{\mu V}{A \cdot ms}\right]$$

| | | |
|---|---|---|
| Name | Current controller I gain | |
| Index | 0x30A0 | |
| Subindex | 0x02 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 3'906'250 | |
| Value range | - | - |
| PDO mapping | RXPDO | |
| Persistent | YES | |

### 6.2.19. Velocity control parameter set

Velocity regulation is implemented with a digital PI controller. The object holds all the parameters of the velocity controller.

| | |
|---|---|
| Name | Velocity control parameter set |
| Index | 0x30A2 |
| Object code | RECORD |
| Highest subindex supported | 5 |

#### 6.2.19.1. Velocity controller P gain

Represents the proportional gain of the velocity controller. The value is given in

$$\left[\frac{\mu A \cdot s}{rad}\right]$$

| | |
|---|---|
| Name | Velocity controller P gain |
| Index | 0x30A2 |
| Subindex | 0x01 |
| Data type | UNSIGNED32 |
| Access type | RW |

| | | |
|---|---|---|
| Default value | 20'000 | |
| Value range | - | - |
| PDO mapping | RXPDO | |
| Persistent | YES | |

### 6.2.19.2. Velocity controller I gain

Represents the integral gain of the velocity controller. The value is given in

$$\left[\frac{\mu A}{rad}\right]$$

| | | |
|---|---|---|
| Name | Velocity controller I gain | |
| Index | 0x30A2 | |
| Subindex | 0x02 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 500'000 | |
| Value range | - | - |
| PDO mapping | RXPDO | |
| Persistent | YES | |

### 6.2.19.3. Velocity controller FF velocity gain

Represents the speed feedforward gain of the velocity controller. The value is given in

$$\left[\frac{\mu A \cdot s}{rad}\right]$$

| | | |
|---|---|---|
| Name | Velocity controller FF velocity gain | |
| Index | 0x30A2 | |
| Subindex | 0x03 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | RXPDO | |
| Persistent | YES | |

### 6.2.19.4. Velocity controller FF acceleration gain

Represents the acceleration feedforward gain of the velocity controller. The value is given in

$$\left[\frac{\mu A \cdot s^2}{rad}\right]$$

| | |
|---|---|
| Name | Velocity controller FF acceleration gain |

| | | |
|---|---|---|
| Index | 0x30A2 | |
| Subindex | 0x04 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | RXPDO | |
| Persistent | YES | |

#### 6.2.19.5. Velocity controller filter cut-off frequency

Represents the velocity low-pass filter cut-off frequency of the velocity controller. The value is given in [Hz].

| | | |
|---|---|---|
| Name | Velocity controller filter cut-off frequency | |
| Index | 0x30A2 | |
| Subindex | 0x05 | |
| Data type | UNSIGNED16 | |
| Access type | RW | |
| Default value | 600 | |
| Value range | 1 | 10'000 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.20. Current demand value

The set value for the current controller. The value is given in [mA].

| | | |
|---|---|---|
| Name | Current demand value | |
| Index | 0x30D0 | |
| Subindex | 0x00 | |
| Data type | INTEGER32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.21. Current actual values

Provides the actual current values.

| | |
|---|---|
| Name | Current actual values |
| Index | 0x30D1 |
| Object code | ARRAY |
| Highest subindex supported | 2 |

#### 6.2.21.1. Current actual value averaged

Represents the Current actual value filtered by 1st order digital low-pass filter with a cutoff frequency of 50 Hz. The value is given in [mA].

| | | |
|---|---|---|
| Name | Current actual value averaged | |
| Index | 0x30D1 | |
| Subindex | 0x01 | |
| Data type | INTEGER32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

#### 6.2.21.2. Current actual value

Provides the actual value of the motor's current. The value is given in [mA].

| | | |
|---|---|---|
| Name | Current actual value | |
| Index | 0x30D1 | |
| Subindex | 0x02 | |
| Data type | INTEGER32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.22. Torque actual values

Provides the actual torque values.

| | |
|---|---|
| Name | Torque actual values |
| Index | 0x30D2 |
| Object code | ARRAY |
| Highest subindex supported | 1 |

#### 6.2.22.1. Torque actual value averaged

Represents the Torque actual value filtered by 1st order digital low-pass filter with a cutoff frequency of 50 Hz. The value is given in

$$\left[\frac{\mathrm{MotorRatedTorque}}{1000}\right]$$

Related object: Torque actual value

| | |
|---|---|
| Name | Torque actual value averaged |

| | | |
|---|---|---|
| Index | 0x30D2 | |
| Subindex | 0x01 | |
| Data type | INTEGER16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.23. Velocity actual values

| | |
|---|---|
| Name | Velocity actual values |
| Index | 0x30D3 |
| Object code | ARRAY |
| Highest subindex supported | 1 |

#### 6.2.23.1. Velocity actual value averaged

Represents the Velocity actual value filtered by a 1-st order digital low-pass filter with a cutoff frequency of 5 Hz. Provides the actual averaged velocity value of the axis, derived by the main sensor defined in Axis configuration. If no main sensor is configured, an estimated velocity is displayed. The value is given in [velocity units].
Related objects: Velocity actual value, Additional velocity actual values

| | | |
|---|---|---|
| Name | Velocity actual value averaged | |
| Index | 0x30D3 | |
| Subindex | 0x01 | |
| Data type | INTEGER32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.24. Target current

Indicates the configured input value for the current controller in I/O Current Mode (IOCM). The value is given in [mA].

| | | |
|---|---|---|
| Name | Target current | |
| Index | 0x30F0 | |
| Subindex | 0x00 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | NO | |

| | |
|---|---|
| Persistent | NO |

### 6.2.25. Current offset

Indicates the configured input offset value for the current controller in I/O Current Mode (IOCM). The value is given in [mA].

| | | |
|---|---|---|
| Name | Current offset | |
| Index | 0x30F1 | |
| Subindex | 0x00 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

### 6.2.26. Digital input properties

Related objects: Configuration of digital inputs, Digital inputs functionality, Digital inputs

| | |
|---|---|
| Name | Digital input properties |
| Index | 0x3141 |
| Object code | RECORD |
| Highest subindex supported | 2 |

#### 6.2.26.1. Digital inputs logic state

Displays the state of the digital input logic signal (before polarity correction). A bit is read as "1" if the signal at the corresponding pin is high.

If sensor 2 is configured (Sensors configuration), the bits corresponding to high-speed digital inputs 1 to 4 will be zero. The status is also zero if a PWM input functionality (Digital input 1 configuration) is configured on the corresponding input.

| | | |
|---|---|---|
| Name | Digital inputs logic state | |
| Index | 0x3141 | |
| Subindex | 0x01 | |
| Data type | UNSIGNED16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

| Bit | Default value |
|---|---|
| 7 | High-speed digital input 4 |
| 6 | High-speed digital input 3 |

| Bit | Default value |
|---|---|
| 5 | High-speed digital input 2 |
| 4 | High-speed digital input 1 |
| 3 | Digital input 4 |
| 2 | Digital input 3 |
| 1 | Digital input 2 |
| 0 | Digital input 1 |

*Table 58. Digital input bits*

### 6.2.26.2. Digital inputs polarity

Used to set the polarity of the digital input functionalities. If a bit is set to "0" (zero), the associated pin is active-high. The polarity setting has no effect if a PWM input functionality (Digital input 1 configuration) is configured on the corresponding input.
For bit description see table Digital input bits.
Related objects: Digital inputs functionality, Digital inputs.

| | | |
|---|---|---|
| Name | Digital inputs polarity | |
| Index | 0x3141 | |
| Subindex | 0x02 | |
| Data type | UNSIGNED16 | |
| Access type | RW | |
| Default value | 0x0000 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

## 6.2.27. Configuration of digital inputs

Configures the functionality that will be assigned to digital inputs.

If sensor 2 is configured (Sensors configuration), the high-speed digital inputs 1 to 4 will be disabled. This configuration cannot be overridden as long as sensor 2 is configured.

Related objects: Digital input properties, Digital inputs functionality, Digital inputs

| | |
|---|---|
| Name | Configuration of digital inputs |
| Index | 0x3142 |
| Object code | ARRAY |
| Highest subindex supported | 8 |

### 6.2.27.1. Digital input 1 configuration

Maps functions to digital inputs. Each function can only be mapped once, and each digital input can only hold one function.

| | |
|---|---|
| Name | Digital input 1 configuration |
| Index | 0x3142 |
| Subindex | 0x01 |

| | |
|---|---|
| Data type | UNSIGNED8 |
| Access type | RW |
| Default value | 16 |
| Value range | Digital Inputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

| Value | Functionality | Description |
|---|---|---|
| 255 | None | No functionality assigned |
| 254…38 | Reserved | – |
| 37 | PWM current set value offset [a][c][e] | Set current offset over PWM input signal. Scaling Object Digital input PWM current set value offset scaling |
| 36 | PWM current set value [a][c][e] | Set current over PWM input signal. Scaling Object Digital input PWM current set value scaling |
| 35…34 | Reserved | – |
| 33 | PWM velocity set value offset [a][b][e] | Set velocity offset over PWM input signal. Scaling Object Digital input PWM velocity set value offset scaling |
| 32 | PWM velocity set value [a][b][e] | Set velocity over PWM input signal. Scaling Object Digital input PWM velocity set value scaling |
| 31…30 | Reserved | – |
| 29 | Direction [b][c][d] | Switch direction |
| 28 | Quick stop | Stop movement and switch to «Quick stop active» state (see Device control) |
| 27 | Drive enable | Enable / disable the drive or clear errors in “Fault“ state (see Device control) |
| 26…24 | Reserved | – |
| 23 | General purpose H | State can be read |
| 22 | General purpose G | State can be read |
| 21 | General purpose F | State can be read |
| 20 | General purpose E | State can be read |
| 19 | General purpose D | State can be read |
| 18 | General purpose C | State can be read |
| 17 | General purpose B | State can be read |
| 16 | General purpose A | State can be read |
| 15 | Current set value switch 1 [c][e] | Select current value (see Current set value switch parameter) |
| 14 | Current set value switch 0 [c][e] | Select current value (see Current set value switch parameter) |
| 13 | Velocity set value switch 1 [b][e] | Select velocity value (see Velocity set value switch parameter) |
| 12 | Velocity set value switch 0 [b][e] | Select velocity value (see Velocity set value switch parameter) |
| 11…2 | Reserved | – |
| 1 | Positive limit switch | Generates Positive limit switch error |
| 0 | Negative limit switch | Generates Negative limit switch error |
| [a] Supported on Digital input 1 configuration and Digital input 2 configuration only. | | |
| [b] In I/O Velocity Mode (IOVM) only. | | |
| [c] In I/O Current Mode (IOCM) only. | | |

| Value | Functionality | Description |
|---|---|---|
| [d] A positive set value is inverted if direction is inactive.<br>A positive set value is not modified if direction is active.<br>A negative set value is limited to zero.<br>For details, see diagrams I/O Velocity Mode - overview and I/O Current Mode - Overview. | | |
| [e] For every target to control, only one input functionality (analog or digital) can be active. | | |

*Table 59. Digital Inputs - Configuration*

### 6.2.27.2. Digital input 2 configuration

| | |
|---|---|
| Name | Digital input 2 configuration |
| Index | 0x3142 |
| Subindex | 0x02 |
| Data type | UNSIGNED8 |
| Access type | RW |
| Default value | 17 |
| Value range | Digital Inputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

### 6.2.27.3. Digital input 3 configuration

| | |
|---|---|
| Name | Digital input 3 configuration |
| Index | 0x3142 |
| Subindex | 0x03 |
| Data type | UNSIGNED8 |
| Access type | RW |
| Default value | 18 |
| Value range | Digital Inputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

### 6.2.27.4. Digital input 4 configuration

| | |
|---|---|
| Name | Digital input 4 configuration |
| Index | 0x3142 |
| Subindex | 0x04 |
| Data type | UNSIGNED8 |
| Access type | RW |
| Default value | 19 |
| Value range | Digital Inputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

### 6.2.27.5. High-speed digital input 1 configuration

| | |
|---|---|
| Name | High-speed digital input 1 configuration |

| | |
|---|---|
| Index | 0x3142 |
| Subindex | 0x05 |
| Data type | UNSIGNED8 |
| Access type | RW |
| Default value | 255 |
| Value range | Digital Inputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

### 6.2.27.6. High-speed digital input 2 configuration

| | |
|---|---|
| Name | High-speed digital input 2 configuration |
| Index | 0x3142 |
| Subindex | 0x06 |
| Data type | UNSIGNED8 |
| Access type | RW |
| Default value | 255 |
| Value range | Digital Inputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

### 6.2.27.7. High-speed digital input 3 configuration

| | |
|---|---|
| Name | High-speed digital input 3 configuration |
| Index | 0x3142 |
| Subindex | 0x07 |
| Data type | UNSIGNED8 |
| Access type | RW |
| Default value | 255 |
| Value range | Digital Inputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

### 6.2.27.8. High-speed digital input 4 configuration

| | |
|---|---|
| Name | High-speed digital input 4 configuration |
| Index | 0x3142 |
| Subindex | 0x08 |
| Data type | UNSIGNED8 |
| Access type | RW |
| Default value | 255 |
| Value range | Digital Inputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

### 6.2.28. Digital inputs functionality

Displays the state of the CiA digital input functionalities and manufacturer-specific digital input functionalities (after polarity correction by Digital inputs polarity). A bit is read as "1" if the signal at the corresponding pin is high. For values of CiA digital input functionalities only, see Digital inputs.
Related objects: Digital input properties / Configuration of digital inputs, Digital inputs

| | |
|---|---|
| Name | Digital inputs functionality |
| Index | 0x3143 |
| Subindex | 0x00 |
| Data type | UNSIGNED32 |
| Access type | RO |
| Default value | - |
| Value range | Digital Inputs |
| PDO mapping | TXPDO |
| Persistent | NO |

| Bit | Functionality | Description |
|---|---|---|
| 31..30 | Reserved | – |
| 29 | Direction | Switch direction |
| 28 | Quick stop | Stop movement and switch to «Quick stop active» state (see Device control) |
| 27 | Drive enable | Enable / disable the drive or clear errors in “Fault“ state (see Device control) |
| 26..24 | Reserved | - |
| 23 | General purpose H | State can be read |
| 22 | General purpose G | State can be read |
| 21 | General purpose F | State can be read |
| 20 | General purpose E | State can be read |
| 19 | General purpose D | State can be read |
| 18 | General purpose C | State can be read |
| 17 | General purpose B | State can be read |
| 16 | General purpose A | State can be read |
| 15 | Current set value switch 1 | Select current value (see Current set value switch parameter) |
| 14 | Current set value switch 0 | Select current value (see Current set value switch parameter) |
| 13 | Velocity set value switch 1 | Select velocity value (see Velocity set value switch parameter) |
| 12 | Velocity set value switch 0 | Select velocity value (see Velocity set value switch parameter) |
| 11..2 | Reserved | - |
| 1 | Positive limit switch | Generates Positive limit switch error |
| 0 | Negative limit switch | Generates Negative limit switch error |

*Table 60. Digital Inputs*

### 6.2.29. Velocity set value switch parameter

Preset velocity values to be selected by digital inputs. Values given in [velocity units]. Write access is only permitted in device state «Power Disable» (see Device control). The functionality is supported in I/O Velocity Mode (IOVM) when at least one corresponding functionality («velocity set value switch», see Digital Inputs) is mapped to a digital input pin in Configuration of digital inputs. The selected velocity is then written to Target

velocity.
Unmapping both «velocity set value switch» functionalities does not restore a previously written Target velocity value.
Related objects: Configuration of digital inputs, Target velocity, SI unit velocity

| | |
|---|---|
| Name | Velocity set value switch parameter |
| Index | 0x3146 |
| Object code | ARRAY |
| Highest subindex supported | 4 |

| «Velocity set value switch 1» input state | «Velocity set value switch 0» input state | Selected Velocity |
|---|---|---|
| 0 (or unmapped) | 0 (or umapped) | Set velocity value 0 (if at least one «velocity set value switch» functionality is mapped to a pin) |
| 0 (or unmapped) | 1 | Set velocity value 1 |
| 1 | 0 (or unmapped) | Set velocity value 2 |
| 1 | 1 | Set velocity value 3 |

*Table 61. Velocity set value switch*

### 6.2.29.1. Set velocity value 0

| | | |
|---|---|---|
| Name | Set velocity value 0 | |
| Index | 0x3146 | |
| Subindex | 0x01 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | -120'000 rpm | +120'000 rpm |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.29.2. Set velocity value 1

| | | |
|---|---|---|
| Name | Set velocity value 1 | |
| Index | 0x3146 | |
| Subindex | 0x02 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | -120'000 rpm | +120'000 rpm |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.29.3. Set velocity value 2

| | |
|---|---|
| Name | Set velocity value 2 |
| Index | 0x3146 |

| | | |
|---|---|---|
| Subindex | 0x03 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | -120'000 rpm | +120'000 rpm |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.29.4. Set velocity value 3

| | | |
|---|---|---|
| Name | Set velocity value 3 | |
| Index | 0x3146 | |
| Subindex | 0x04 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | -120'000 rpm | +120'000 rpm |
| PDO mapping | NO | |
| Persistent | YES | |

## 6.2.30. Current set value switch parameter

Preset current values to be selected by digital inputs. Values given in [mA]. Write access is only permitted in device state «Power Disable» (see Device control). The functionality is supported in I/O Current Mode (IOCM) when at least one corresponding functionality («current set value switch», see Digital Inputs) is mapped to a digital input pin in Configuration of digital inputs. The selected current is then written to Target current. Unmapping both «current set value switch» functionalities does not restore a previously written Target current value.
Related objects: Configuration of digital inputs, Target current

| | |
|---|---|
| Name | Current set value switch parameter |
| Index | 0x3147 |
| Object code | ARRAY |
| Highest subindex supported | 4 |

| «Current set value switch 1» input state | «Current set value switch 0» input state | Selected Velocity |
|---|---|---|
| 0 (or unmapped) | 0 (or umapped) | Set current value 0 (if at least one «current set value switch» functionality is mapped to a pin) |
| 0 (or unmapped) | 1 | Set current value 1 |
| 1 | 0 (or unmapped) | Set current value 2 |
| 1 | 1 | Set current value 3 |

*Table 62. Current set value switch*

### 6.2.30.1. Set current value 0

| | |
|---|---|
| Name | Set current value 0 |
| Index | 0x3147 |

| | | |
|---|---|---|
| Subindex | 0x01 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - Max Output current limit | + Max Output current limit |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.30.2. Set current value 1

| | | |
|---|---|---|
| Name | Set current value 1 | |
| Index | 0x3147 | |
| Subindex | 0x02 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - Max Output current limit | + Max Output current limit |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.30.3. Set current value 2

| | | |
|---|---|---|
| Name | Set current value 2 | |
| Index | 0x3147 | |
| Subindex | 0x03 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - Max Output current limit | + Max Output current limit |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.30.4. Set current value 3

| | | |
|---|---|---|
| Name | Set current value 3 | |
| Index | 0x3147 | |
| Subindex | 0x04 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - Max Output current limit | + Max Output current limit |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.31. Digital input PWM frequencies

Displays the actual PWM frequencies and represents the PWM signal measured at the configured digital input. Values given in [0.1 Hz].

**Note:**

PWM input supports a frequency range of 50…10'000 Hz. Outside this range a warning (Digital input 1 PWM frequency warning or Digital input 2 PWM frequency warning) is active and the frequency is limited to the specified range. If the PWM frequency deviates too much from the specified range and becomes unreadable, Digital input 1 PWM error or Digital input 2 PWM error is triggered and this objects displays the value of 0 Hz.

| | |
|---|---|
| Name | Digital input PWM frequencies |
| Index | 0x314B |
| Object code | ARRAY |
| Highest subindex supported | 2 |

#### 6.2.31.1. Digital input 1 PWM frequency

| | | |
|---|---|---|
| Name | Digital input 1 PWM frequency | |
| Index | 0x314B | |
| Subindex | 0x01 | |
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

#### 6.2.31.2. Digital input 2 PWM frequency

| | | |
|---|---|---|
| Name | Digital input 2 PWM frequency | |
| Index | 0x314B | |
| Subindex | 0x02 | |
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.32. Digital input PWM duty cycles

Displays the actual PWM duty cycles and represents the PWM signal measured at the configured digital input. Given in [0.1%].

| Note: |
| --- |
|  PWM input is specified to support duty cycles in the range 10…90 %. Duty cycles outside this range are limited and the device will show a Digital input 1 PWM duty cycle warning or Digital input 2 PWM duty cycle warning, but there is a slightly threshold until the warning appears. The warning disappears, if the detected duty cycle enters the valid range again. While the warning is active, the duty cycle is restricted to the range 10…90 %. When reaching a pulse width (positive or negative) smaller than 5 µs, error Digital input 1 PWM error or Digital input 2 PWM error is triggered. |

| | |
| --- | --- |
| Name | Digital input PWM duty cycles |
| Index | 0x314C |
| Object code | ARRAY |
| Highest subindex supported | 2 |

### 6.2.32.1. Digital input 1 PWM duty cycle

| | | |
| --- | --- | --- |
| Name | Digital input 1 PWM duty cycle | |
| Index | 0x314C | |
| Subindex | 0x01 | |
| Data type | UNSIGNED16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.32.2. Digital input 2 PWM duty cycle

| | | |
| --- | --- | --- |
| Name | Digital input 2 PWM duty cycle | |
| Index | 0x314C | |
| Subindex | 0x02 | |
| Data type | UNSIGNED16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.33. Digital outputs properties

Related objects: Configuration of digital outputs, Digital outputs, Digital outputs functionality.

| | |
| --- | --- |
| Name | Digital outputs properties |
| Index | 0x3150 |
| Object code | RECORD |
| Highest subindex supported | 2 |

### 6.2.33.1. Digital outputs logic state

Displays the digital output logic state (after polarity correction). A bit is read as “1” if the signal at the

corresponding pin is high. The state is set to zero if a frequency output functionality (Configuration of digital outputs) is configured on the corresponding output.

| | | |
|---|---|---|
| Name | Digital outputs logic state | |
| Index | 0x3150 | |
| Subindex | 0x01 | |
| Data type | UNSIGNED16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

| Bit | Description |
|---|---|
| 2 | High-speed digital output 1 |
| 1 | Digital output 2 |
| 0 | Digital output 1 |

*Table 63. Digital output bits*

### 6.2.33.2. Digital outputs polarity

Used to set the polarity of the digital outputs. If a bit is set to “1”, the associated output will be inverted; thus, “1” in Digital outputs functionality (and Digital outputs if applicable) will set the output pin low.
Polarity only applies to outputs with configured functionality (Configuration of digital outputs); not configured pins will remain zero. The polarity setting has no effect if a frequency output functionality (Configuration of digital outputs) is configured on the corresponding output.
For bit description, see Digital output bits.

| | | |
|---|---|---|
| Name | Digital outputs polarity | |
| Index | 0x3150 | |
| Subindex | 0x02 | |
| Data type | UNSIGNED16 | |
| Access type | RW | |
| Default value | 0x0000 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.34. Configuration of digital outputs

Configures the functionality that will be assigned to the digital outputs. A functionality can only be mapped to an output once, except for the frequency outputs, where only one functionality can be used simultaneously.

If sensor 2 is configured (Sensors configuration), the high-speed digital output 1 will be disabled. This configuration cannot be overridden as long as sensor 2 is configured.

Related objects: Digital outputs properties, Digital outputs functionality, Digital outputs

| | |
|---|---|
| Name | Configuration of digital outputs |

| | |
|---|---|
| Index | 0x3151 |
| Object code | ARRAY |
| Highest subindex supported | 3 |

### 6.2.34.1. Digital output 1 configuration

| | |
|---|---|
| Name | Digital output 1 configuration |
| Index | 0x3151 |
| Subindex | 0x01 |
| Data type | UNSIGNED8 |
| Access type | RW |
| Default value | Digital outputs - Default values |
| Value range | Digital outputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

| Digital Output | Default Value |
|---|---|
| DigOut1 | 16: General purpose A |
| DigOut2 | 17: General purpose B |
| HsDigOut1 | 255: None |

*Table 64. Digital outputs - Default values*

| Value | Functionality | Description |
|---|---|---|
| 255 | None | No functionality assigned |
| 254..34 | Reserved | - |
| 33 | Hall sensor rotation frequency | Corresponding output (DigOut1 or DigOut2) is configured as hall sensor rotation frequency output. Functionality can only be mapped if a hall sensor is present (Sensors configuration) and cannot be mapped to an HsDigOut. |
| 32 | Hall sensor commutation frequency | Corresponding output (DigOut1 or DigOut2) is configured as hall sensor commutation frequency output. Functionality can only be mapped if a hall sensor is present (Sensors configuration) and cannot be mapped to an HsDigOut. |
| 31..27 | Reserved | - |
| 26 | Limitation | Active if an internal limit (Statusword Bit 11) is active |
| 25 | Ready/Fault | Inactive on device fault or fault reaction state, otherwise active |
| 24..19 | Reserved | - |
| 18 | General purpose C | State can be read/written by the host |
| 17 | General purpose B | State can be read/written by the host |
| 16 | General purpose A | State can be read/written by the host |
| 15…0 | Reserved | - |

*Table 65. Digital outputs - Configuration*

### 6.2.34.2. Digital output 2 configuration

| | |
|---|---|
| Name | Digital output 2 configuration |
| Index | 0x3151 |

| | |
|---|---|
| Subindex | 0x02 |
| Data type | UNSIGNED8 |
| Access type | RW |
| Default value | Digital outputs - Default values |
| Value range | Digital outputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

### 6.2.34.3. High-speed digital output 1 configuration

| | |
|---|---|
| Name | High-speed digital output 1 configuration |
| Index | 0x3151 |
| Subindex | 0x03 |
| Data type | UNSIGNED8 |
| Access type | RW |
| Default value | Digital outputs - Default values |
| Value range | Digital outputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

## 6.2.35. Digital outputs functionality

Displays the state of the digital output functionalities (before polarity correction by Digital outputs polarity). If a bit is set to “1” and the polarity bit is set to “0”, the signal at the corresponding pin is high.
This object is read/write, however, bits 24…31 are ignored upon writing.
This value is a superset of Digital outputs
Related objects: Digital outputs properties, Configuration of digital outputs, Digital outputs.

| | | |
|---|---|---|
| Name | Digital outputs functionality | |
| Index | 0x3152 | |
| Subindex | 0x00 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 0x0 | |
| Value range | - | - |
| PDO mapping | RXPDO | |
| Persistent | NO | |

| Bit | Functionality | Description |
|---|---|---|
| 31..27 | Reserved | - |
| 26 | Limitation | Active if an internal limit (Statusword Bit 11) is active |
| 25 | Ready/Fault | Inactive on device fault or fault reaction state, otherwise active |
| 24..19 | Reserved | - |
| 18 | General purpose C | State can be read/written by the host |
| 17 | General purpose B | State can be read/written by the host |

| Bit | Functionality | Description |
|---|---|---|
| 16 | General purpose A | State can be read/written by the host |
| 15…0 | Reserved | - |

*Table 66. Digital outputs - values*

### 6.2.36. Analog input properties

| | |
|---|---|
| Name | Analog input properties |
| Index | 0x3160 |
| Object code | ARRAY |
| Highest subindex supported | 2 |

#### 6.2.36.1. Analog input 1 voltage

Represents the voltage measured at Analog Input 1. The value is given in [mV].

| | | |
|---|---|---|
| Name | Analog input 1 voltage | |
| Index | 0x3160 | |
| Subindex | 0x01 | |
| Data type | INTEGER16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

#### 6.2.36.2. Analog input 2 voltage

Represents the voltage measured at Analog Input 2. The value is given in [mV].

| | | |
|---|---|---|
| Name | Analog input 2 voltage | |
| Index | 0x3160 | |
| Subindex | 0x02 | |
| Data type | INTEGER16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.37. Configuration of analog inputs

Configures the functionality that will be assigned to analog inputs.
Related object: Analog input properties

| | |
|---|---|
| Name | Configuration of analog inputs |
| Index | 0x3161 |

| | |
|---|---|
| Object code | ARRAY |
| Highest subindex supported | 2 |

### 6.2.37.1. Analog input 1 configuration

Maps functions to analog inputs. Each function can only be mapped once, and each analog input can only hold one function.

| | |
|---|---|
| Name | Analog input 1 configuration |
| Index | 0x3161 |
| Subindex | 0x01 |
| Data type | UNSIGNED8 |
| Access type | RW |
| Default value | Analog Inputs - Default Values |
| Value range | Analog Inputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

| Analog Input | Default Value |
|---|---|
| AnIn1 | 0 : General Purpose A |
| AnIn2 | 1 : General Purpose B |

*Table 67. Analog Inputs - Default Values*

| Value | Functionality | Description |
|---|---|---|
| 255 | None | No functionality assigned |
| 254…12 | Reserved | – |
| 11 | Velocity set value offset [a] | Set Velocity offset over analog input signal. Scaling Object Analog input velocity set value offset scaling |
| 10 | Current set value offset [a] | Set Current offset over analog input signal. Scaling Object Analog input current set value offset scaling |
| 9 | Velocity set value [a] | Set Target velocity over analog input signal. Scaling Object Analog input velocity set value scaling |
| 8 | Current set value [a] | Set Target current over analog input signal. Scaling Object Analog input current set value scaling |
| 7…2 | Reserved | – |
| 1 | General purpose B | Value can be read |
| 0 | General purpose A | Value can be read |
| [a] For every target to control, only one input functionality (analog or digital) can be active. | | |

*Table 68. Analog Inputs - Configuration*

### 6.2.37.2. Analog input 2 configuration

| | |
|---|---|
| Name | Analog input 2 configuration |
| Index | 0x3161 |
| Subindex | 0x02 |
| Data type | UNSIGNED8 |
| Access type | RW |

| | |
|---|---|
| Default value | Analog Inputs - Default Values |
| Value range | Analog Inputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

### 6.2.38. Analog input general purpose

Displays the actual value measured at the analog inputs. The value is only displayed if the analog input is configured as general purpose. The value is given in [mV].
Related object: Analog input properties

| | |
|---|---|
| Name | Analog input general purpose |
| Index | 0x3162 |
| Object code | ARRAY |
| Highest subindex supported | 2 |

#### 6.2.38.1. Analog input general purpose A

| | | |
|---|---|---|
| Name | Analog input general purpose A | |
| Index | 0x3162 | |
| Subindex | 0x01 | |
| Data type | INTEGER16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

#### 6.2.38.2. Analog input general purpose B

| | | |
|---|---|---|
| Name | Analog input general purpose B | |
| Index | 0x3162 | |
| Subindex | 0x02 | |
| Data type | INTEGER16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.39. Analog input adjustment

Adjust individual analog input voltages with a gain factor and offset value. Offset is applied before gain.

| | |
|---|---|
| Name | Analog input adjustment |
| Index | 0x3163 |
| Object code | RECORD |

| | |
|---|---|
| Highest subindex supported | 4 |

### 6.2.39.1. Analog input 1 adjustment offset

Represents the adjustment offset voltage of analog input 1. The value is given in [mV].

| | | |
|---|---|---|
| Name | Analog input 1 adjustment offset | |
| Index | 0x3163 | |
| Subindex | 0x01 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | -1'000 | 1'000 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.39.2. Analog input 1 adjustment gain factor

Represents the adjustment gain factor of analog input 1. The value is given in [1/10'000].

| | | |
|---|---|---|
| Name | Analog input 1 adjustment gain factor | |
| Index | 0x3163 | |
| Subindex | 0x02 | |
| Data type | UNSIGNED16 | |
| Access type | RW | |
| Default value | 10'000 | |
| Value range | 5'000 | 20'000 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.39.3. Analog input 2 adjustment offset

Represents the adjustment offset voltage of analog input 2. The value is given in [mV].

| | | |
|---|---|---|
| Name | Analog input 2 adjustment offset | |
| Index | 0x3163 | |
| Subindex | 0x03 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | -1'000 | 1'000 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.39.4. Analog input 2 adjustment gain factor

Represents the adjustment gain factor of analog input 2. The value is given in [1/10'000].

| | | |
|---|---|---|
| Name | Analog input 2 adjustment gain factor | |
| Index | 0x3163 | |
| Subindex | 0x04 | |
| Data type | UNSIGNED16 | |
| Access type | RW | |
| Default value | 10'000 | |
| Value range | 5'000 | 20'000 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.40. Analog input raw values

| | | |
|---|---|---|
| Name | Analog input raw values | |
| Index | 0x3164 | |
| Object code | ARRAY | |
| Highest subindex supported | 2 | |

#### 6.2.40.1. Analog input 1 raw value

Represents the measured Analog Input 1 as raw value [ADC counts].

| | | |
|---|---|---|
| Name | Analog input 1 raw value | |
| Index | 0x3164 | |
| Subindex | 0x01 | |
| Data type | UNSIGNED16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

#### 6.2.40.2. Analog input 2 raw value

Represents the measured Analog Input 2 as raw value [ADC counts].

| | | |
|---|---|---|
| Name | Analog input 2 raw value | |
| Index | 0x3164 | |
| Subindex | 0x02 | |
| Data type | UNSIGNED16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.41. Analog output properties

Represents the voltage output at analog outputs. The value is given in [mV].

| | |
|---|---|
| Name | Analog output properties |
| Index | 0x3170 |
| Object code | ARRAY |
| Highest subindex supported | 2 |

#### 6.2.41.1. Analog output 1 voltage

| | | |
|---|---|---|
| Name | Analog output 1 voltage | |
| Index | 0x3170 | |
| Subindex | 0x01 | |
| Data type | INTEGER16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

#### 6.2.41.2. Analog output 2 voltage

| | | |
|---|---|---|
| Name | Analog output 2 voltage | |
| Index | 0x3170 | |
| Subindex | 0x02 | |
| Data type | INTEGER16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.42. Configuration of analog outputs

Configures the functionality that will be assigned to analog outputs.

| | |
|---|---|
| Name | Configuration of analog outputs |
| Index | 0x3171 |
| Object code | ARRAY |
| Highest subindex supported | 2 |

| Analog Output | Default value |
|---|---|
| AnalogOut1 | 0: General Purpose A |
| AnalogOut2 | 1: General Purpose B |

*Table 69. Analog outputs - Default values*

| Value | Functionality | Description |
|---|---|---|
| 255 | None | No functionality assigned |
| 254..14 | Reserved | - |
| 13 | Temperature power stage | Monitor temperature values as analog output voltage. Scaling object Analog output temperature scaling |
| 12 | Temperature logic section | |
| 11 | Current actual value averaged | Monitor current values as analog output voltage. Scaling object Analog output current scaling |
| 10 | Current actual value | |
| 9 | Velocity actual value averaged | Monitor velocity values as analog output voltage. Scaling object Analog output velocity scaling |
| 8 | Velocity actual value | |
| 7…2 | Reserved | - |
| 1 | General purpose B | Value can be read/written by the host |
| 0 | General purpose A | Value can be read/written by the host |

*Table 70. Analog outputs - Configuration*

### 6.2.42.1. Analog output 1 configuration

| | |
|---|---|
| Name | Analog output 1 configuration |
| Index | 0x3171 |
| Subindex | 0x01 |
| Data type | UNSIGNED8 |
| Access type | RW |
| Default value | Analog outputs - Default values |
| Value range | Analog outputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

### 6.2.42.2. Analog output 2 configuration

| | |
|---|---|
| Name | Analog output 2 configuration |
| Index | 0x3171 |
| Subindex | 0x02 |
| Data type | UNSIGNED8 |
| Access type | RW |
| Default value | Analog outputs - Default values |
| Value range | Analog outputs - Configuration |
| PDO mapping | NO |
| Persistent | YES |

### 6.2.43. Analog output general purpose

Used to set the actual voltage on the analog outputs. Writing to this object only has an effect if the analog output is configured as general purpose. The value is given in [mV].
Related object: Analog output properties

| | |
|---|---|
| Name | Analog output general purpose |
| Index | 0x3172 |

| | |
|---|---|
| Object code | ARRAY |
| Highest subindex supported | 2 |

### 6.2.43.1. Analog output general purpose A

| | |
|---|---|
| Name | Analog output general purpose A |
| Index | 0x3172 |
| Subindex | 0x01 |
| Data type | INTEGER16 |
| Access type | RW |
| Default value | 0 |
| Value range | Analog Out - value range |
| PDO mapping | RXPDO |
| Persistent | YES |

| Hardware | Lower Limit | Upper Limit |
|---|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -4'000mV | 4'000mV |
| ESCON2 Micro 60/5 | -4'000mV | 4'000mV |
| ESCON2 Nano 24/2 | 0mV | 3'300mV |

*Table 71. Analog Out - value range*

### 6.2.43.2. Analog output general purpose B

| | |
|---|---|
| Name | Analog output general purpose B |
| Index | 0x3172 |
| Subindex | 0x02 |
| Data type | INTEGER16 |
| Access type | RW |
| Default value | 0 |
| Value range | Analog Out - value range |
| PDO mapping | RXPDO |
| Persistent | YES |

### 6.2.44. Digital input PWM velocity set value scaling

A set value function for the PWM input. Write access is only permitted in device state «Power Disable» (see Device control). It configures the velocity set value, which is set by a PWM input value. Invalid scaling settings (first and second duty cycle identical) results in the first velocity being used (Velocity set value first velocity). The functionality is supported in I/O Velocity Mode (IOVM).

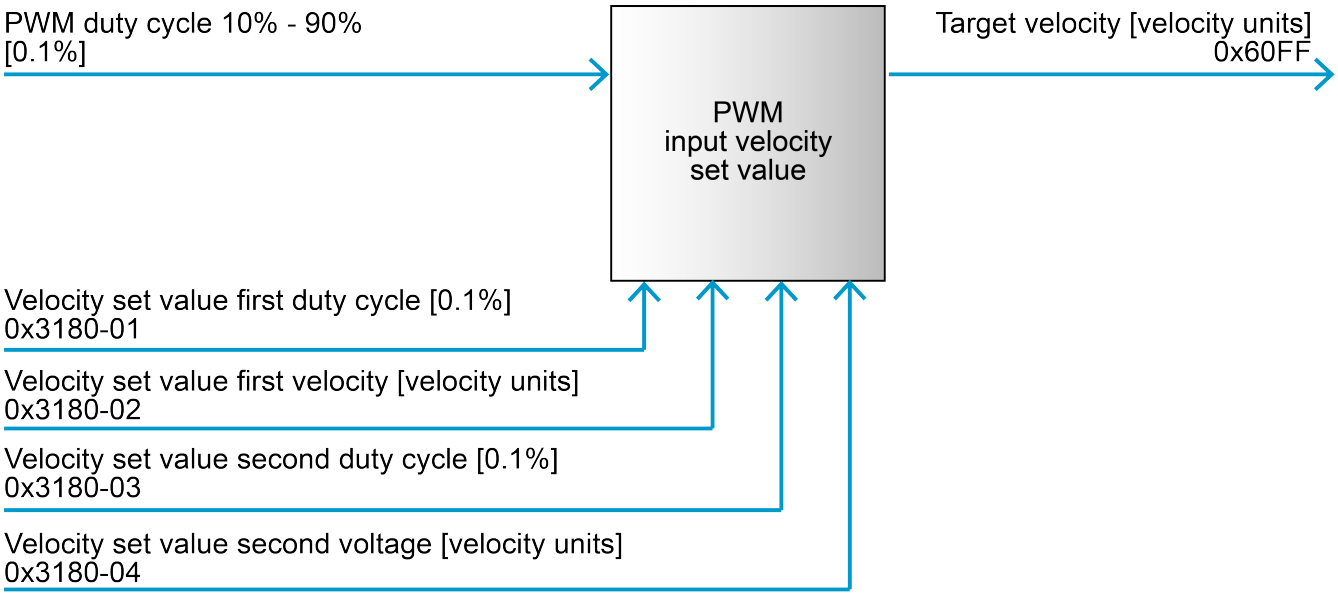



*Figure 15. Digital input PWM velocity set value scaling – Set value function*

| | |
|---|---|
| Name | Digital input PWM velocity set value scaling |
| Index | 0x3180 |
| Object code | RECORD |
| Highest subindex supported | 4 |

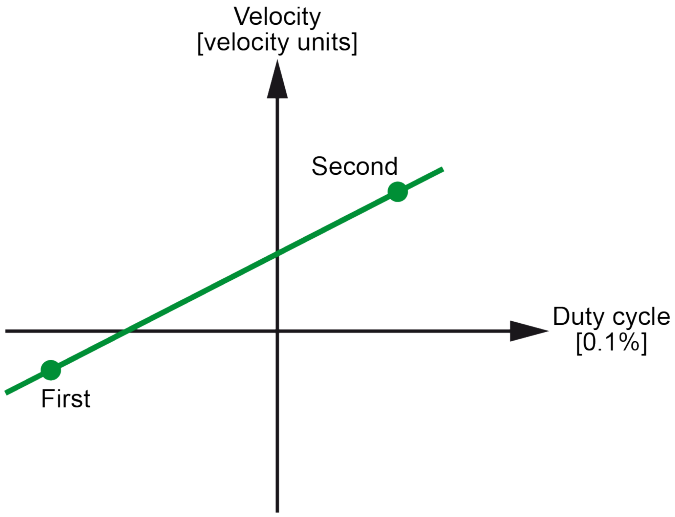



*Figure 16. Digital PWM velocity set value scaling – Set value*

### 6.2.44.1. Velocity set value first duty cycle

Represents the set duty cycle for the first slope point. The value is given as [0.1%].

| | |
|---|---|
| Name | Velocity set value first duty cycle |
| Index | 0x3180 |
| Subindex | 0x01 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | 100 |

| | | |
|---|---|---|
| Value range | 100 | 900 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.44.2. Velocity set value first velocity

Represents the set velocity for the first slope point. The value is given in [velocity units].

| | | |
|---|---|---|
| Name | Velocity set value first velocity | |
| Index | 0x3180 | |
| Subindex | 0x02 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - 120'000 rpm | + 120'000 rpm |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.44.3. Velocity set value second duty cycle

Represents the set duty cycle for the second slope point. The value is given as [0.1%].

| | | |
|---|---|---|
| Name | Velocity set value second duty cycle | |
| Index | 0x3180 | |
| Subindex | 0x03 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 900 | |
| Value range | 100 | 900 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.44.4. Velocity set value second velocity

Represents the set velocity for the second slope point. The value is given in [velocity units].

| | | |
|---|---|---|
| Name | Velocity set value second velocity | |
| Index | 0x3180 | |
| Subindex | 0x04 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - 120'000 rpm | + 120'000 rpm |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.45. Digital input PWM velocity set value offset scaling

A set value function for the PWM input. Write access is only permitted in device state «Power Disable» (see Device control). It configures the velocity set value offset which is set by a PWM input value. Invalid scaling settings (first and second duty cycle identical) results in the first velocity set value offset being used (Velocity set value offset first velocity). The functionality is supported in I/O Velocity Mode (IOVM).

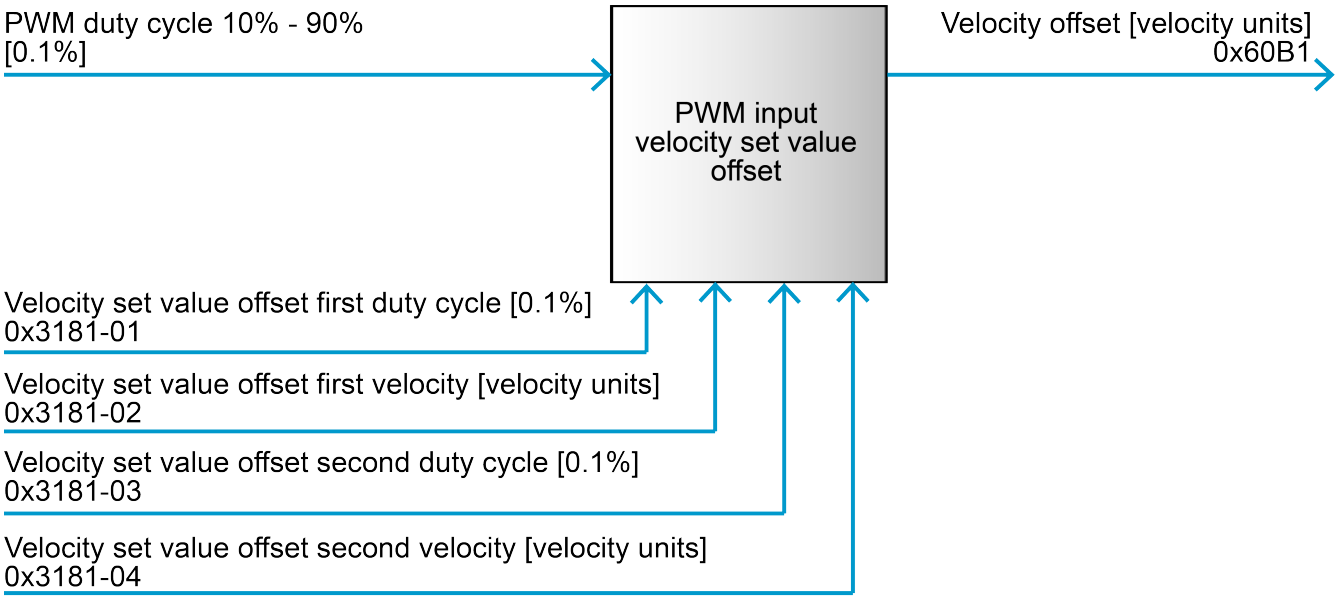



*Figure 17. Digital input PWM velocity set value offset scaling – Set value function*

| | |
|---|---|
| Name | Digital input PWM velocity set value offset scaling |
| Index | 0x3181 |
| Object code | RECORD |
| Highest subindex supported | 4 |

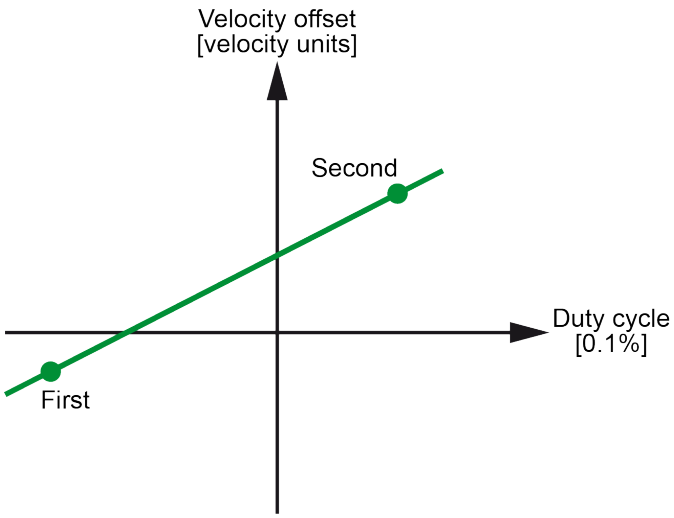



*Figure 18. Digital input PWM velocity set value offset scaling – Set value*

#### 6.2.45.1. Velocity set value offset first duty cycle

Represents the set duty cycle for the first slope point. The value is given in [0.1 %].

| | |
|---|---|
| Name | Velocity set value offset first duty cycle |

| | | |
|---|---|---|
| Index | 0x3181 | |
| Subindex | 0x01 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 100 | |
| Value range | 100 | 900 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.45.2. Velocity set value offset first velocity

Represents the set velocity for the first slope point. The value is given in [velocity units].

| | | |
|---|---|---|
| Name | Velocity set value offset first velocity | |
| Index | 0x3181 | |
| Subindex | 0x02 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - 120'000 rpm | + 120'000 rpm |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.45.3. Velocity set value offset second duty cycle

Represents the set duty cycle for the second slope point. The value is given in [0.1 %].

| | | |
|---|---|---|
| Name | Velocity set value offset second duty cycle | |
| Index | 0x3181 | |
| Subindex | 0x03 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 900 | |
| Value range | 100 | 900 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.45.4. Velocity set value offset second velocity

Represents the set velocity for the second slope point. The value is given in [velocity units].

| | |
|---|---|
| Name | Velocity set value offset second velocity |
| Index | 0x3181 |
| Subindex | 0x04 |
| Data type | INTEGER32 |
| Access type | RW |

| | | |
|---|---|---|
| Default value | 0 | |
| Value range | - 120'000 rpm | + 120'000 rpm |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.46. Digital input PWM current set value scaling

A set value function for the PWM input. Write access is only permitted in device state «Power Disable» (see Device control). It configures the current set value, which is set by a PWM input value. Invalid scaling settings (first and second duty cycle identical) results in the first current being used (Current set value first current). The functionality is supported in I/O Current Mode (IOCM).

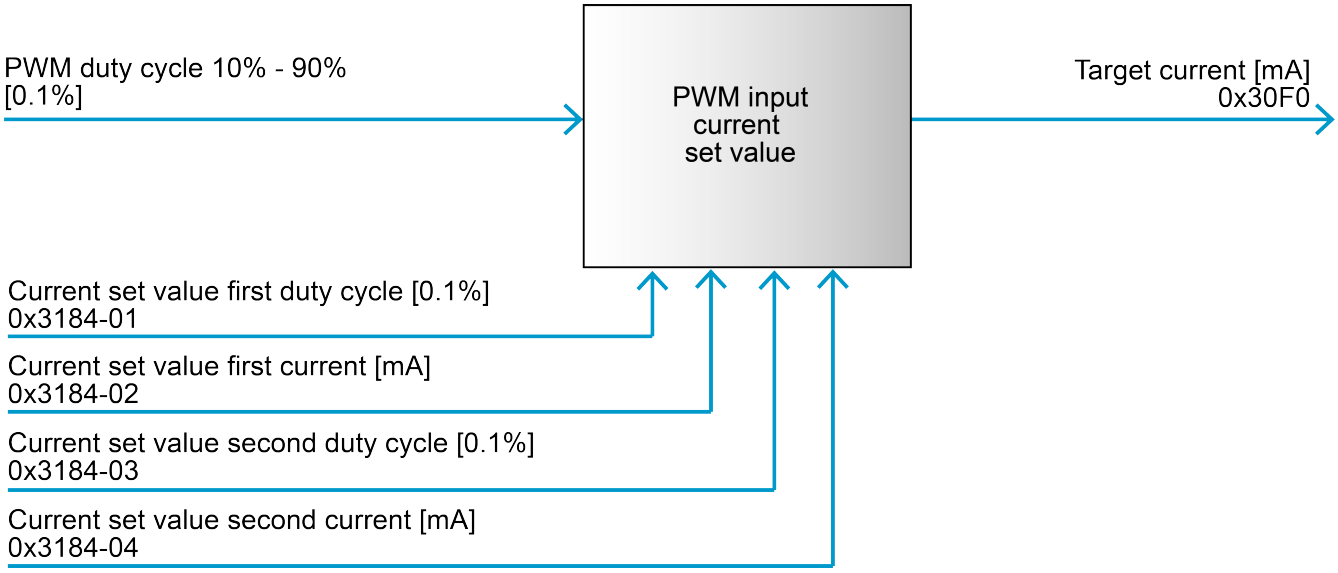



*Figure 19. Digital input PWM current set value scaling – Set value function*

| | |
|---|---|
| Name | Digital input PWM current set value scaling |
| Index | 0x3184 |
| Object code | RECORD |
| Highest subindex supported | 4 |

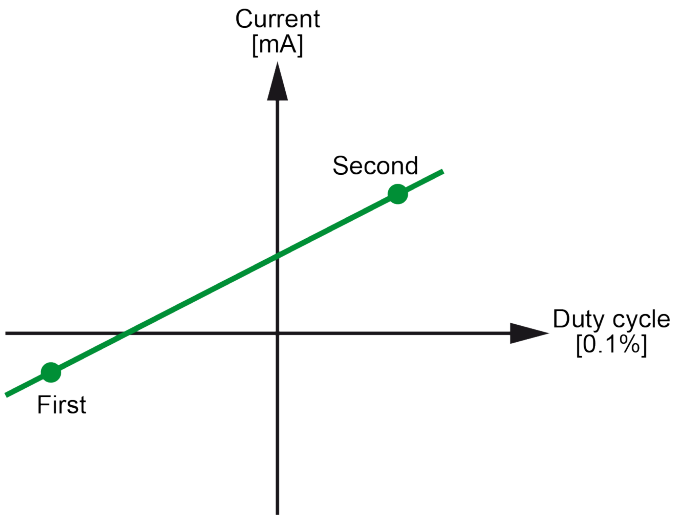



*Figure 20. Digital input PWM current set value scaling – Set value*

### 6.2.46.1. Current set value first duty cycle

Represents the set duty cycle for the first slope point. The value is given as [0.1%].

| | | |
|---|---|---|
| Name | Current set value first duty cycle | |
| Index | 0x3184 | |
| Subindex | 0x01 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 100 | |
| Value range | 100 | 900 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.46.2. Current set value first current

Represents the output current for the first slope point. The value is given in [mA].

| | | |
|---|---|---|
| Name | Current set value first current | |
| Index | 0x3184 | |
| Subindex | 0x02 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - Max Output current limit | + Max Output current limit |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.46.3. Current set value second duty cycle

Represents the set duty cycle for the second slope point. The value is given as [0.1%].

| | | |
|---|---|---|
| Name | Current set value second duty cycle | |
| Index | 0x3184 | |
| Subindex | 0x03 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 900 | |
| Value range | 100 | 900 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.46.4. Current set value second current

Represents the output current for the second slope point. The value is given in [mA].

| | |
|---|---|
| Name | Current set value second current |

| | | |
|---|---|---|
| Index | 0x3184 | |
| Subindex | 0x04 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - Max Output current limit | + Max Output current limit |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.47. Digital input PWM current set value offset scaling

A set value function for the PWM input. Write access is only permitted in device state «Power Disable» (see Device control). It configures the current set value offset which is set by a PWM input value. Invalid scaling settings (first and second duty cycle identical) results in the first current set value offset being used (Current set value offset first current). The functionality is supported in I/O Current Mode (IOCM).

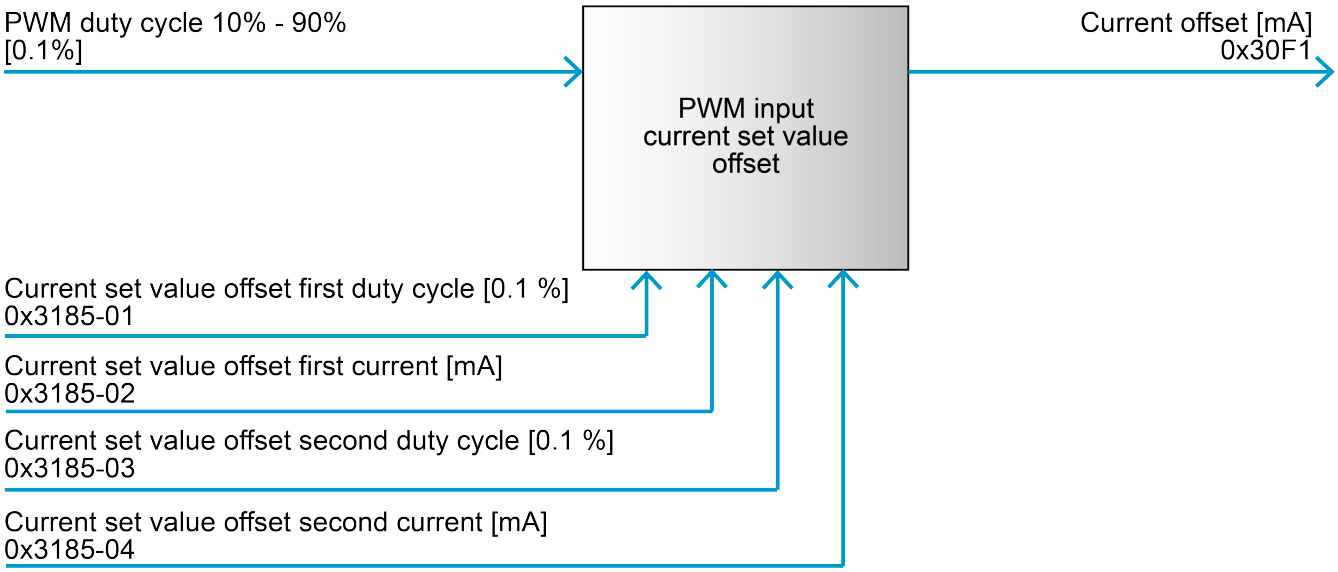



*Figure 21. Digital input PWM current set value offset scaling – Set value function*

| | |
|---|---|
| Name | Digital input PWM current set value offset scaling |
| Index | 0x3185 |
| Object code | RECORD |
| Highest subindex supported | 4 |

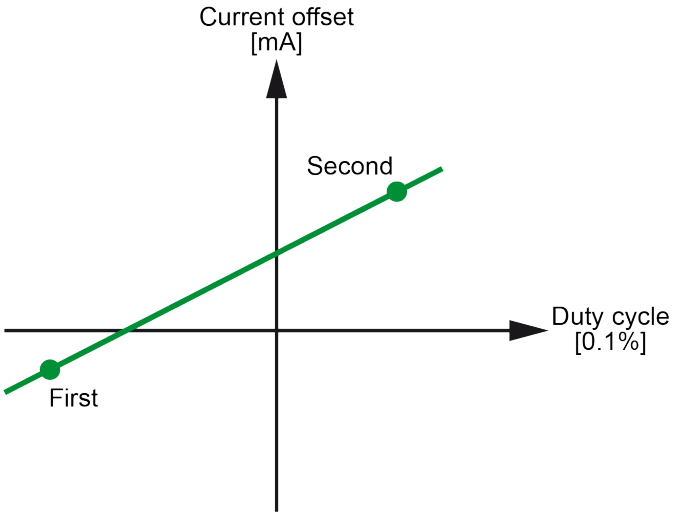



*Figure 22. Digital input PWM current set value offset scaling – Set value*

### 6.2.47.1. Current set value offset first duty cycle

Represents the set duty cycle for the first slope point. The value is given in [0.1 %].

| | | |
|---|---|---|
| Name | Current set value offset first duty cycle | |
| Index | 0x3185 | |
| Subindex | 0x01 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 100 | |
| Value range | 100 | 900 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.47.2. Current set value offset first current

Represents the output current for the first slope point. The value is given in [mA].

| | | |
|---|---|---|
| Name | Current set value offset first current | |
| Index | 0x3185 | |
| Subindex | 0x02 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - Max Output current limit | + Max Output current limit |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.47.3. Current set value offset second duty cycle

Represents the set duty cycle for the second slope point. The value is given in [0.1 %].

| | |
|---|---|
| Name | Current set value offset second duty cycle |

| | | |
|---|---|---|
| Index | 0x3185 | |
| Subindex | 0x03 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 900 | |
| Value range | 100 | 900 |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.47.4. Current set value offset second current

Represents the output current for the second slope point. The value is given in [mA].

| | | |
|---|---|---|
| Name | Current set value offset second current | |
| Index | 0x3185 | |
| Subindex | 0x04 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - Max Output current limit | + Max Output current limit |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.48. Analog input velocity set value scaling

A set value function for the analog input. Write access is only permitted in device state «Power Disable» (see Device control). It configures the velocity set value, which is set by an analog input value. Invalid scaling settings (first and second voltage identical) results in the first velocity being used (Velocity set value first velocity). The functionality is supported in I/O Velocity Mode (IOVM).

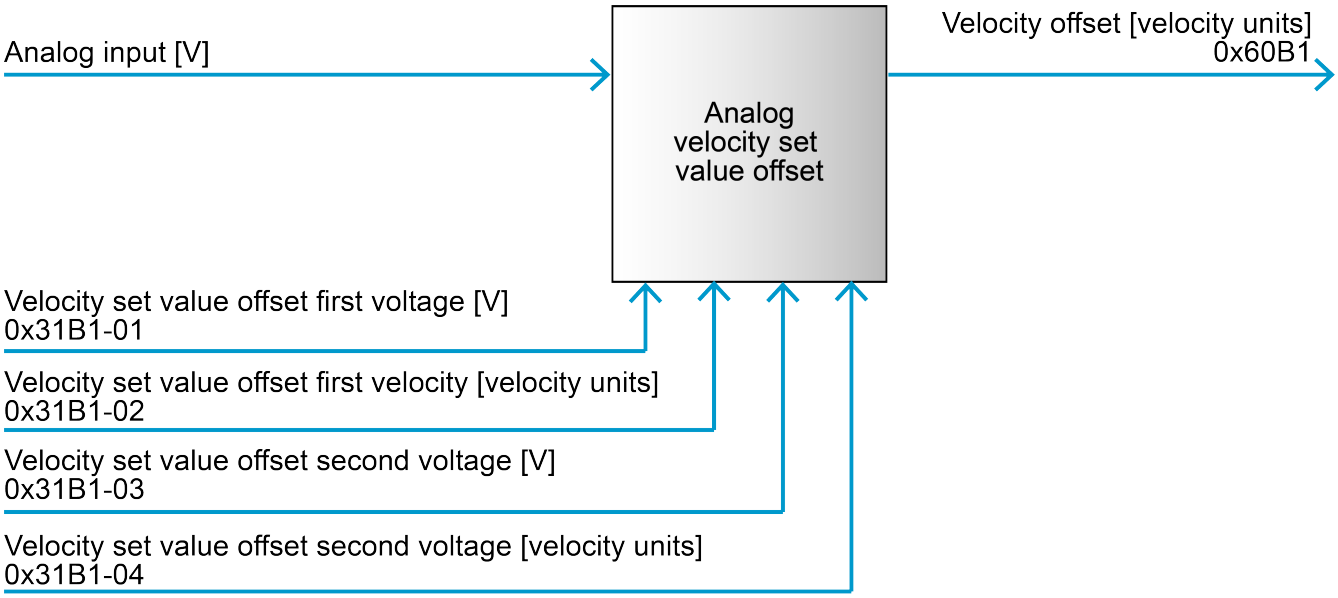



*Figure 23. Analog input velocity set value scaling – Set value function*

| | |
|---|---|
| Name | Analog input velocity set value scaling |
| Index | 0x31B0 |
| Object code | RECORD |
| Highest subindex supported | 4 |

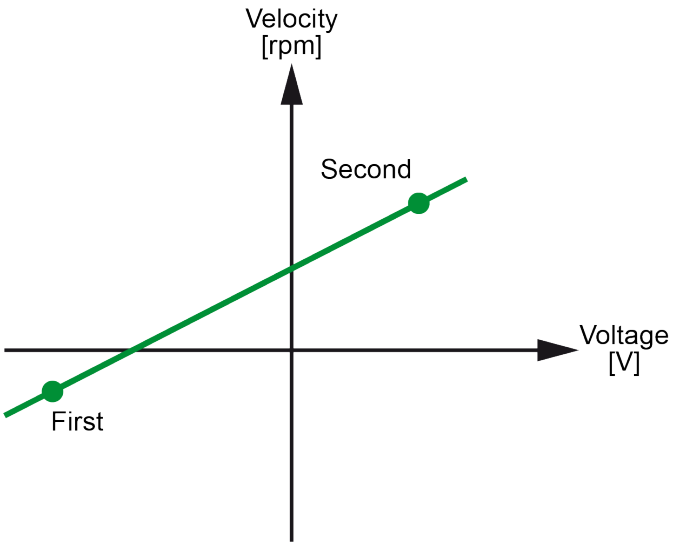



*Figure 24. Analog input velocity set value scaling – Set value*

### 6.2.48.1. Velocity set value first voltage

Represents the set voltage for the first slope point. The value is given in [mV].

| | |
|---|---|
| Name | Velocity set value first voltage |
| Index | 0x31B0 |
| Subindex | 0x01 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog In - default value first slope point |
| Value range | Analog In - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -10'000mV |
| ESCON2 Micro 60/5 | -10'000mV |
| ESCON2 Nano 24/2 | 0mV |

*Table 72. Analog In - default value first slope point*

| Hardware | Lower Limit | Upper Limit |
|---|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -10'000mV | 10'000mV |
| ESCON2 Micro 60/5 | -10'000mV | 10'000mV |
| ESCON2 Nano 24/2 | 0mV | 5'000mV |

*Table 73. Analog In - value range*

### 6.2.48.2. Velocity set value first velocity

Represents the set velocity for the first slope point. The value is given in [velocity units].

| | | |
|---|---|---|
| Name | Velocity set value first velocity | |
| Index | 0x31B0 | |
| Subindex | 0x02 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - 120'000 rpm | + 120'000 rpm |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.48.3. Velocity set value second voltage

Represents the set voltage for the second slope point. The value is given in [mV].

| | |
|---|---|
| Name | Velocity set value second voltage |
| Index | 0x31B0 |
| Subindex | 0x03 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog In - default value second slope point |
| Value range | Analog In - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 10'000mV |
| ESCON2 Micro 60/5 | 10'000mV |
| ESCON2 Nano 24/2 | 5'000mV |

*Table 74. Analog In - default value second slope point*

### 6.2.48.4. Velocity set value second velocity

Represents the set velocity for the second slope point. The value is given in [velocity units].

| | |
|---|---|
| Name | Velocity set value second velocity |
| Index | 0x31B0 |
| Subindex | 0x04 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | 0 |

| | | |
|---|---|---|
| Value range | - 120'000 rpm | + 120'000 rpm |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.49. Analog input velocity set value offset scaling

A set value function for the analog input. Write access is only permitted in device state «Power Disable» (see Device control). It configures the velocity set value offset which is set by an analog input value. Invalid scaling settings (first and second voltage identical) results in the first velocity set value offset being used (Velocity set value offset first velocity). The functionality is supported in I/O Velocity Mode (IOVM).

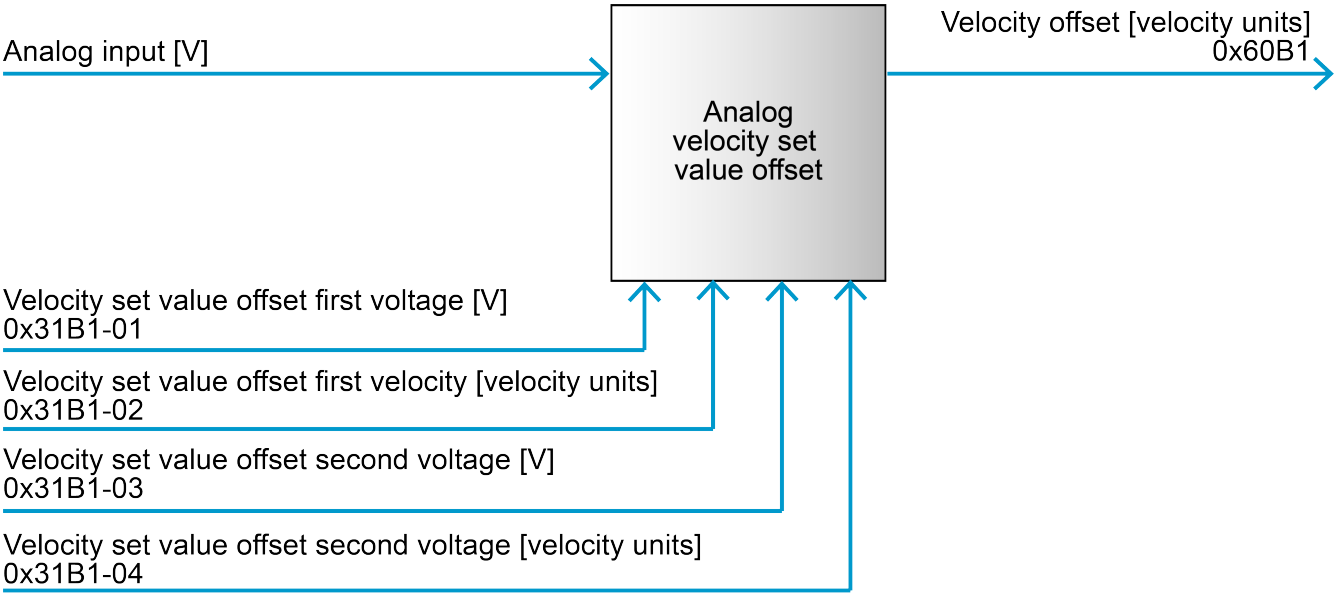



*Figure 25. Analog input velocity set value offset scaling – Set value function*

| | |
|---|---|
| Name | Analog input velocity set value offset scaling |
| Index | 0x31B1 |
| Object code | RECORD |
| Highest subindex supported | 4 |

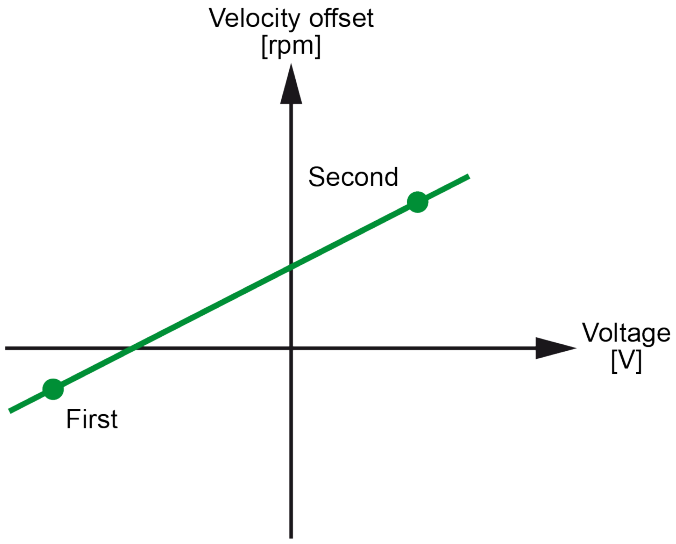



*Figure 26. Analog input velocity set value offset scaling – Set value*

### 6.2.49.1. Velocity set value offset first voltage

Represents the set voltage for the first slope point. The value is given in [mV].

| | |
|---|---|
| Name | Velocity set value offset first voltage |
| Index | 0x31B1 |
| Subindex | 0x01 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog In - default value first slope point |
| Value range | Analog In - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -10'000mV |
| ESCON2 Micro 60/5 | -10'000mV |
| ESCON2 Nano 24/2 | 0mV |

*Table 75. Analog In - default value first slope point*

| Hardware | Lower Limit | Upper Limit |
|---|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -10'000mV | 10'000mV |
| ESCON2 Micro 60/5 | -10'000mV | 10'000mV |
| ESCON2 Nano 24/2 | 0mV | 5'000mV |

*Table 76. Analog In - value range*

### 6.2.49.2. Velocity set value offset first velocity

Represents the set velocity for the first slope point. The value is given in [velocity units].

| | | |
|---|---|---|
| Name | Velocity set value offset first velocity | |
| Index | 0x31B1 | |
| Subindex | 0x02 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - 120'000 rpm | + 120'000 rpm |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.49.3. Velocity set value offset second voltage

Represents the set voltage for the second slope point. The value is given in [mV].

| | |
|---|---|
| Name | Velocity set value offset second voltage |
| Index | 0x31B1 |

| | |
|---|---|
| Subindex | 0x03 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog In - default value second slope point |
| Value range | Analog In - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 10'000mV |
| ESCON2 Micro 60/5 | 10'000mV |
| ESCON2 Nano 24/2 | 5'000mV |

*Table 77. Analog In - default value second slope point*

### 6.2.49.4. Velocity set value offset second velocity

Represents the set velocity for the second slope point. The value is given in [velocity units].

| | | |
|---|---|---|
| Name | Velocity set value offset second velocity | |
| Index | 0x31B1 | |
| Subindex | 0x04 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - 120'000 rpm | + 120'000 rpm |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.50. Analog input current set value scaling

A set value function for the analog input. Write access is only permitted in device state «Power Disable» (see Device control). It configures the current set value, which is set by an analog input value. Invalid scaling settings (first and second voltage identical) results in the first current being used (Current set value first current). The functionality is supported in I/O Current Mode (IOCM).

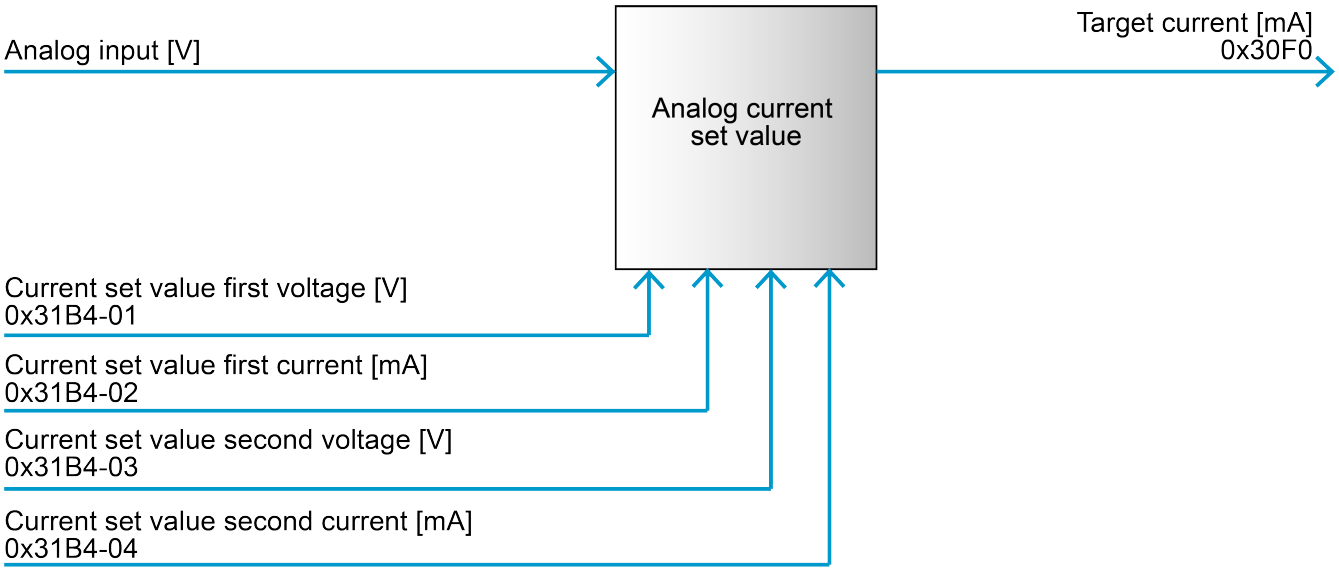



*Figure 27. Analog input current set value scaling – Set value function*

| | |
|---|---|
| Name | Analog input current set value scaling |
| Index | 0x31B4 |
| Object code | RECORD |
| Highest subindex supported | 4 |

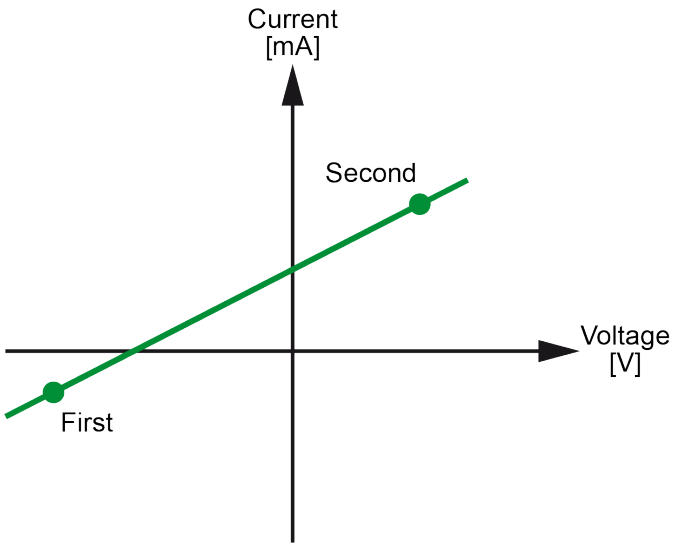



*Figure 28. Analog input current set value scaling – Set value*

### 6.2.50.1. Current set value first voltage

Represents the set voltage for the first slope point. The value is given in [mV].

| | |
|---|---|
| Name | Current set value first voltage |
| Index | 0x31B4 |
| Subindex | 0x01 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog In - default value first slope point |

| | |
|---|---|
| Value range | Analog In - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -10'000mV |
| ESCON2 Micro 60/5 | -10'000mV |
| ESCON2 Nano 24/2 | 0mV |

*Table 78. Analog In - default value first slope point*

| Hardware | Lower Limit | Upper Limit |
|---|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -10'000mV | 10'000mV |
| ESCON2 Micro 60/5 | -10'000mV | 10'000mV |
| ESCON2 Nano 24/2 | 0mV | 5'000mV |

*Table 79. Analog In - value range*

### 6.2.50.2. Current set value first current

Represents the output current for the first slope point. The value is given in [mA].

| | | |
|---|---|---|
| Name | Current set value first current | |
| Index | 0x31B4 | |
| Subindex | 0x02 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - Max Output current limit | + Max Output current limit |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.50.3. Current set value second voltage

Represents the set voltage for the second slope point. The value is given in [mV].

| | |
|---|---|
| Name | Current set value second voltage |
| Index | 0x31B4 |
| Subindex | 0x03 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog In - default value second slope point |
| Value range | Analog In - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 10'000mV |
| ESCON2 Micro 60/5 | 10'000mV |
| ESCON2 Nano 24/2 | 5'000mV |

*Table 80. Analog In - default value second slope point*

#### 6.2.50.4. Current set value second current

Represents the output current for the second slope point. The value is given in [mA].

| | | |
|---|---|---|
| Name | Current set value second current | |
| Index | 0x31B4 | |
| Subindex | 0x04 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - Max Output current limit | + Max Output current limit |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.51. Analog input current set value offset scaling

A set value function for the analog input. Write access is only permitted in device state «Power Disable» (see Device control). It configures the current set value offset which is set by an analog input value. Invalid scaling settings (first and second voltage identical) results in the first current set value offset being used (Current set value offset first current). The functionality is supported in I/O Current Mode (IOCM).

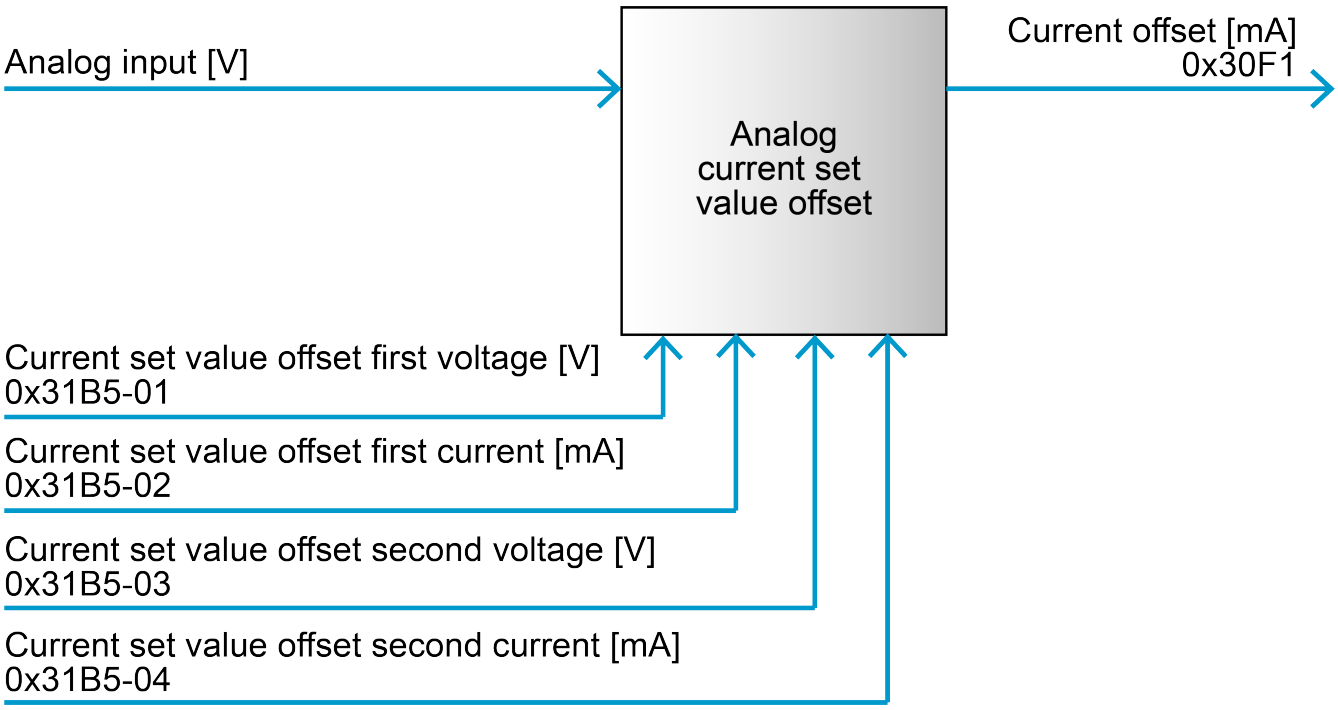



*Figure 29. Analog input current set value offset scaling – Set value function*

| | |
|---|---|
| Name | Analog input current set value offset scaling |

| | |
|---|---|
| Index | 0x31B5 |
| Object code | RECORD |
| Highest subindex supported | 4 |

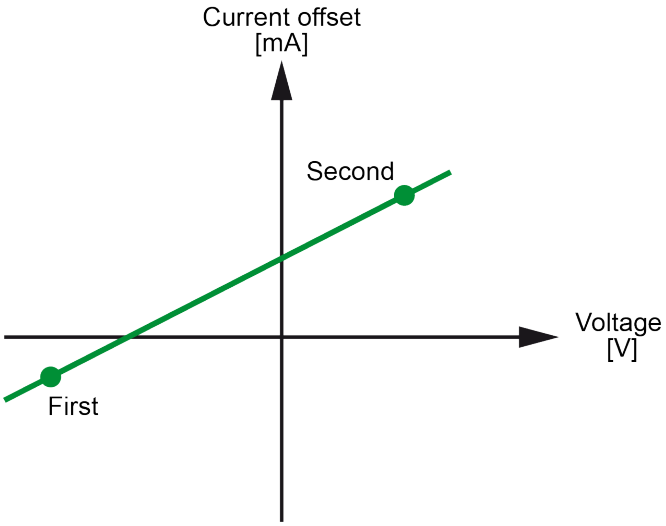



*Figure 30. Analog input current set value offset scaling – Set value*

### 6.2.51.1. Current set value offset first voltage

Represents the set voltage for the first slope point. The value is given in [mV].

| | |
|---|---|
| Name | Current set value offset first voltage |
| Index | 0x31B5 |
| Subindex | 0x01 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog In - default value first slope point |
| Value range | Analog In - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -10'000mV |
| ESCON2 Micro 60/5 | -10'000mV |
| ESCON2 Nano 24/2 | 0mV |

*Table 81. Analog In - default value first slope point*

| Hardware | Lower Limit | Upper Limit |
|---|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -10'000mV | 10'000mV |
| ESCON2 Micro 60/5 | -10'000mV | 10'000mV |
| ESCON2 Nano 24/2 | 0mV | 5'000mV |

*Table 82. Analog In - value range*

### 6.2.51.2. Current set value offset first current

Represents the output current for the first slope point. The value is given in [mA].

| | | |
|---|---|---|
| Name | Current set value offset first current | |
| Index | 0x31B5 | |
| Subindex | 0x02 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - Max Output current limit | + Max Output current limit |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.51.3. Current set value offset second voltage

Represents the set voltage for the second slope point. The value is given in [mV].

| | |
|---|---|
| Name | Current set value offset second voltage |
| Index | 0x31B5 |
| Subindex | 0x03 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog In - default value second slope point |
| Value range | Analog In - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 10'000mV |
| ESCON2 Micro 60/5 | 10'000mV |
| ESCON2 Nano 24/2 | 5'000mV |

*Table 83. Analog In - default value second slope point*

### 6.2.51.4. Current set value offset second current

Represents the output current for the second slope point. The value is given in [mA].

| | | |
|---|---|---|
| Name | Current set value offset second current | |
| Index | 0x31B5 | |
| Subindex | 0x04 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - Max Output current limit | + Max Output current limit |
| PDO mapping | NO | |

| | |
|---|---|
| Persistent | YES |

### 6.2.52. Analog output velocity scaling

Configures how Velocity actual value and Velocity actual value averaged are scaled for analog output monitoring. Write access is only permitted in device state «Power Disable» (see Device control). Invalid scaling settings (first and second values identical) will output the voltage configured in Velocity actual first voltage.
Related objects: Velocity actual value, Velocity actual value averaged, Configuration of analog outputs

| | |
|---|---|
| Name | Analog output velocity scaling |
| Index | 0x31C1 |
| Object code | RECORD |
| Highest subindex supported | 4 |

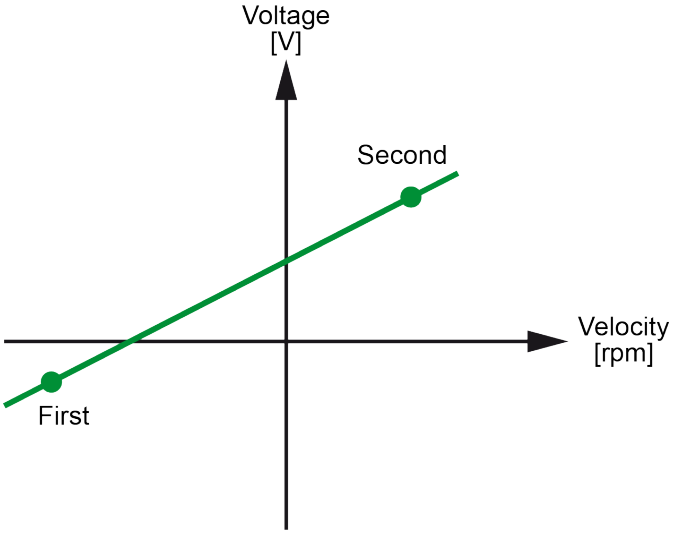



*Figure 31. Analog output velocity monitor scaling*

#### 6.2.52.1. Velocity actual first velocity

Represents the velocity value for the first slope point. The value is given in [velocity units].

| | | |
|---|---|---|
| Name | Velocity actual first velocity | |
| Index | 0x31C1 | |
| Subindex | 0x01 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

#### 6.2.52.2. Velocity actual first voltage

Represents the output voltage for the first slope point. The value is given in [mV].

| | |
|---|---|
| Name | Velocity actual first voltage |

| | |
|---|---|
| Index | 0x31C1 |
| Subindex | 0x02 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog Out - default value first slope point |
| Value range | Analog Out - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -4'000mV |
| ESCON2 Micro 60/5 | -4'000mV |
| ESCON2 Nano 24/2 | 0mV |

*Table 84. Analog Out - default value first slope point*

| Hardware | Lower Limit | Upper Limit |
|---|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -4'000mV | 4'000mV |
| ESCON2 Micro 60/5 | -4'000mV | 4'000mV |
| ESCON2 Nano 24/2 | 0mV | 3'300mV |

*Table 85. Analog Out - value range*

### 6.2.52.3. Velocity actual second velocity

Represents the velocity value for the second slope point. The value is given in [velocity units].

| | | |
|---|---|---|
| Name | Velocity actual second velocity | |
| Index | 0x31C1 | |
| Subindex | 0x03 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.52.4. Velocity actual second voltage

Represents the output voltage for the second slope point. The value is given in [mV].

| | |
|---|---|
| Name | Velocity actual second voltage |
| Index | 0x31C1 |
| Subindex | 0x04 |
| Data type | INTEGER32 |
| Access type | RW |

| | |
|---|---|
| Default value | Analog Out - default value second slope point |
| Value range | Analog Out - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 4'000mV |
| ESCON2 Micro 60/5 | 4'000mV |
| ESCON2 Nano 24/2 | 3'300mV |

*Table 86. Analog Out - default value second slope point*

### 6.2.53. Analog output current scaling

Configures how Current actual value averaged and Current actual value are scaled for analog output monitoring. Write access is only permitted in device state «Power Disable» (see Device control). Invalid scaling settings (first and second value identical) will output the voltage configured in Current actual first voltage.
Related objects: Current actual value averaged, Current actual value, Configuration of analog outputs

| | |
|---|---|
| Name | Analog output current scaling |
| Index | 0x31C2 |
| Object code | RECORD |
| Highest subindex supported | 4 |

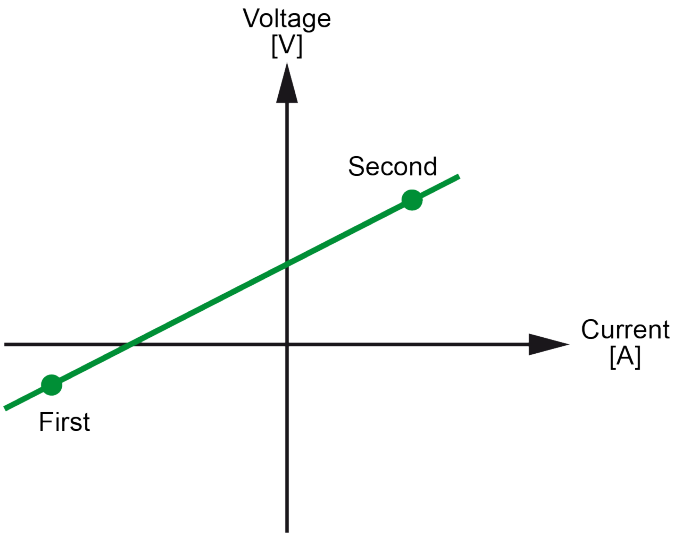



*Figure 32. Analog output current monitor scaling*

#### 6.2.53.1. Current actual first current

Represents the current value for the first slope point. The value is given in [mA].

| | |
|---|---|
| Name | Current actual first current |
| Index | 0x31C2 |
| Subindex | 0x01 |
| Data type | INTEGER32 |
| Access type | RW |

| | | |
|---|---|---|
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.53.2. Current actual first voltage

Represents the output voltage for the first slope point. The value is given in [mV].

| | |
|---|---|
| Name | Current actual first voltage |
| Index | 0x31C2 |
| Subindex | 0x02 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog Out - default value first slope point |
| Value range | Analog Out - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -4'000mV |
| ESCON2 Micro 60/5 | -4'000mV |
| ESCON2 Nano 24/2 | 0mV |

*Table 87. Analog Out - default value first slope point*

| Hardware | Lower Limit | Upper Limit |
|---|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -4'000mV | 4'000mV |
| ESCON2 Micro 60/5 | -4'000mV | 4'000mV |
| ESCON2 Nano 24/2 | 0mV | 3'300mV |

*Table 88. Analog Out - value range*

### 6.2.53.3. Current actual second current

Represents the current value for the second slope point. The value is given in [mA].

| | | |
|---|---|---|
| Name | Current actual second current | |
| Index | 0x31C2 | |
| Subindex | 0x03 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.53.4. Current actual second voltage

Represents the output voltage for the second slope point. The value is given in [mV].

| | |
|---|---|
| Name | Current actual second voltage |
| Index | 0x31C2 |
| Subindex | 0x04 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog Out - default value second slope point |
| Value range | Analog Out - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 4'000mV |
| ESCON2 Micro 60/5 | 4'000mV |
| ESCON2 Nano 24/2 | 3'300mV |

*Table 89. Analog Out - default value second slope point*

### 6.2.54. Analog output temperature scaling

Configures how Temperature logic section and Temperature power stage are scaled for analog output monitoring. Write access is only permitted in device state «Power Disable» (see Device control). Invalid scaling settings (first and second values identical) will output the voltage configured in Logic section temperature first voltage or Power stage temperature first voltage respectively.
Related objects: Temperature logic section, Temperature power stage, Configuration of analog outputs

| | |
|---|---|
| Name | Analog output temperature scaling |
| Index | 0x31C3 |
| Object code | RECORD |
| Highest subindex supported | 8 |

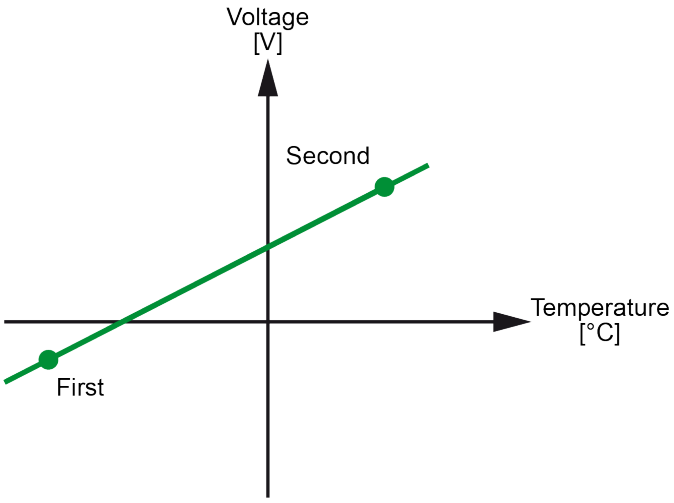



*Figure 33. Analog output temperature monitor scaling*

### 6.2.54.1. Logic section temperature first temperature

Represents the temperature value for the first slope point. The value is given in [0.1 °C].

| | | |
|---|---|---|
| Name | Logic section temperature first temperature | |
| Index | 0x31C3 | |
| Subindex | 0x01 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.54.2. Logic section temperature first voltage

Represents the output voltage for the first slope point. The value is given in [mV].

| | |
|---|---|
| Name | Logic section temperature first voltage |
| Index | 0x31C3 |
| Subindex | 0x02 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog Out - default value first slope point |
| Value range | Analog Out - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -4'000mV |
| ESCON2 Micro 60/5 | -4'000mV |
| ESCON2 Nano 24/2 | 0mV |

*Table 90. Analog Out - default value first slope point*

| Hardware | Lower Limit | Upper Limit |
|---|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -4'000mV | 4'000mV |
| ESCON2 Micro 60/5 | -4'000mV | 4'000mV |
| ESCON2 Nano 24/2 | 0mV | 3'300mV |

*Table 91. Analog Out - value range*

### 6.2.54.3. Logic section temperature second temperature

Represents the temperature value for the second slope point. The value is given in [0.1 °C].

| | |
|---|---|
| Name | Logic section temperature second temperature |
| Index | 0x31C3 |

| | | |
|---|---|---|
| Subindex | 0x03 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.54.4. Logic section temperature second voltage

Represents the output voltage for the second slope point. The value is given in [mV].

| | |
|---|---|
| Name | Logic section temperature second voltage |
| Index | 0x31C3 |
| Subindex | 0x04 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog Out - default value second slope point |
| Value range | Analog Out - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 4'000mV |
| ESCON2 Micro 60/5 | 4'000mV |
| ESCON2 Nano 24/2 | 3'300mV |

*Table 92. Analog Out - default value second slope point*

### 6.2.54.5. Power stage temperature first temperature

Represents the temperature value for the first slope point. The value is given in [0.1 °C].

| | | |
|---|---|---|
| Name | Power stage temperature first temperature | |
| Index | 0x31C3 | |
| Subindex | 0x05 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.54.6. Power stage temperature first voltage

Represents the output voltage for the first slope point. The value is given in [mV].

| | |
|---|---|
| Name | Power stage temperature first voltage |
| Index | 0x31C3 |
| Subindex | 0x06 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog Out - default value first slope point |
| Value range | Analog Out - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | -4'000mV |
| ESCON2 Micro 60/5 | -4'000mV |
| ESCON2 Nano 24/2 | 0mV |

*Table 93. Analog Out - default value first slope point*

### 6.2.54.7. Power stage temperature second temperature

Represents the temperature value for the second slope point. The value is given in [0.1 °C].

| | | |
|---|---|---|
| Name | Power stage temperature second temperature | |
| Index | 0x31C3 | |
| Subindex | 0x07 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | YES | |

### 6.2.54.8. Power stage temperature second voltage

Represents the output voltage for the second slope point. The value is given in [mV].

| | |
|---|---|
| Name | Power stage temperature second voltage |
| Index | 0x31C3 |
| Subindex | 0x08 |
| Data type | INTEGER32 |
| Access type | RW |
| Default value | Analog Out - default value second slope point |
| Value range | Analog Out - value range |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 4'000mV |
| ESCON2 Micro 60/5 | 4'000mV |
| ESCON2 Nano 24/2 | 3'300mV |

*Table 94. Analog Out - default value second slope point*

### 6.2.55. Thermal protection motor

Represents the model-based I2t power limitation parameters.

| | |
|---|---|
| Name | Thermal protection motor |
| Index | 0x3200 |
| Object code | RECORD |
| Highest subindex supported | 1 |

#### 6.2.55.1. I2t level motor

Provides the actual thermal state of the internal i2t motor protection feature. The number is given in percent, values higher than 100% are possible.

| | |
|---|---|
| Name | I2t level motor |
| Index | 0x3200 |
| Subindex | 0x01 |
| Data type | UNSIGNED16 |
| Access type | RO |
| Default value | - |
| Value range | - |
| PDO mapping | TXPDO |
| Persistent | NO |

### 6.2.56. Thermal protection power stage

Limits output current based on power stage temperature and I2t model. The smaller of the two output values is used as the limit after accounting for both values.

| Note: | |
|---|---|
|  | For ESCON2 Nano 24/2, the output current is limited based only on the power stage temperature; the I2t model is not used. |

| | |
|---|---|
| Name | Thermal protection power stage |
| Index | 0x3201 |
| Object code | RECORD |
| Highest subindex supported | 3 |

#### 6.2.56.1. I2t level power stage

Provides the actual thermal state of the internal i2t power stage protection feature. The number is given in

percent, values higher than 100% are possible.

| | |
|---|---|
| Name | I2t level power stage |
| Index | 0x3201 |
| Subindex | 0x01 |
| Data type | UNSIGNED16 |
| Access type | RO |
| Default value | - |
| Value range | - |
| PDO mapping | TXPDO |
| Persistent | NO |

### 6.2.56.2. Temperature power stage

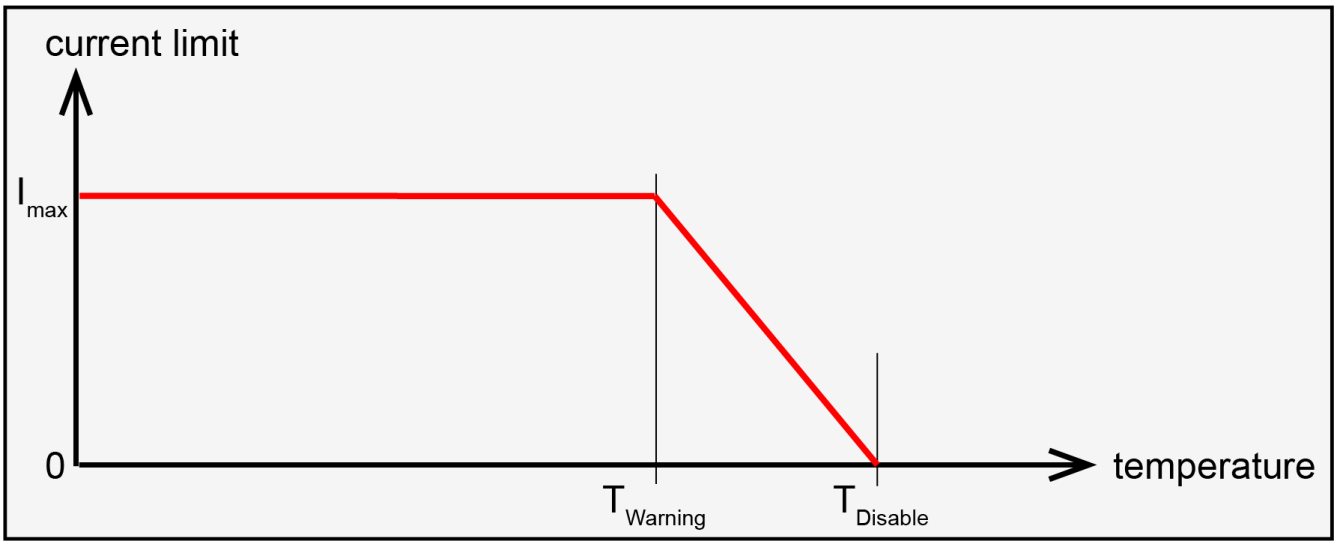
Displays the power stage temperature. The value is given in [0.1 °C].

From the warning temperature, the maximum allowed output current is linearly reduced with increasing temperature up to the maximum temperature. The Thermal power stage overload warning cannot be removed while restrictions are in effect. Once the temperature drops below the warning threshold, it could be cleared. Upon reaching the upper limit, Thermal power stage overload error is set, which disables the device.

| | | |
|---|---|---|
| Name | Temperature power stage | |
| Index | 0x3201 | |
| Subindex | 0x02 | |
| Data type | INTEGER16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

| Hardware | Warning | Disable |
|---|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | Max temperature power stage - 10°C | Max temperature power stage |
| ESCON2 Micro 60/5 | Max temperature power stage - 10°C | Max temperature power stage |
| ESCON2 Nano 24/2 | Max temperature power stage - 10°C | Max temperature power stage |

*Table 95. Temperature power stage - Temperature limits*




### 6.2.56.3. Max temperature power stage

Maximum power stage temperature [0.1 °C]. The power stage is turned off when Temperature power stage reaches this level.

| | |
|---|---|
| Name | Max temperature power stage |
| Index | 0x3201 |
| Subindex | 0x03 |
| Data type | UNSIGNED16 |
| Access type | RW |
| Default value | Max temperature power stage |
| Value range | Max temperature power stage |
| PDO mapping | NO |
| Persistent | YES |

| Hardware | Default | Min | Max |
|---|---|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 110°C | 0°C | 110°C |
| ESCON2 Micro 60/5 | 100°C | 0°C | 100°C |
| ESCON2 Nano 24/2 | 90°C | 0°C | 90°C |

*Table 96. Max temperature power stage*

### 6.2.57. Motor control

Handles the motor control.

| | |
|---|---|
| Name | Motor control |
| Index | 0x3203 |
| Object code | RECORD |
| Highest subindex supported | 1 |

### 6.2.57.1. PWM duty cycle actual value

Displays the motor's actual duty cycle for the PWM signal of the output stage. The value is given in [0.1%].

If the value reaches the PWM max duty cycle the limitation bit in Statusword will be set.
Related object: Statusword

| | | |
|---|---|---|
| Name | PWM duty cycle actual value | |
| Index | 0x3203 | |
| Subindex | 0x01 | |
| Data type | UNSIGNED16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

| Hardware | Max |
|---|---|
| ESCON2 Module 60/30<br>ESCON2 Compact 60/30 | 950 [0.1%] |
| ESCON2 Micro 60/5 | 950 [0.1%] |
| ESCON2 Nano 24/2 | 900 [0.1%] |

*Table 97. PWM max duty cycle*

### 6.2.58. Error code

Provides the error code of the last error or warning that occurred in the device. Note that a non-erasable error takes priority over an erasable error, which takes priority over a warning. The error code of a warning is only represented in this object while the warning is active. The object Error history contains the detailed listing of the errors. This value differs from the value in object Error register.

| | | |
|---|---|---|
| Name | Error code | |
| Index | 0x603F | |
| Subindex | 0x00 | |
| Data type | UNSIGNED16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.59. Controlword

Comprises bits for the following items:

- Device control commands (bits 0…3, 7)
- Supervision of operating modes (bits 4…6, 8):

For bit patterns of triggered commands, see Device control commands
Related object: Statusword

| | |
|---|---|
| Name | Controlword |

| | | |
|---|---|---|
| Index | 0x6040 | |
| Subindex | 0x00 | |
| Data type | UNSIGNED16 | |
| Access type | RW | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | RXPDO | |
| Persistent | NO | |

| Bit | Description | IOVM | IOCM |
|---|---|---|---|
| 15 | Operating mode-specific | Reserved | Reserved |
| 14… 11 | Reserved | | |
| 10, 9 | Reserved | | |
| 8 | Operating mode-specific | | |
| 7 | Fault reset | | |
| 6 | Operating mode-specific | | |
| 5 | Operating mode-specific | | |
| 4 | Operating mode-specific | | |
| 3 | Enable operation | | |
| 2 | Quick stop | | |
| 1 | Enabled voltage | | |
| 0 | Switched on | | |

*Table 98. Controlword bits*

### 6.2.60. Statusword

Comprises bits for the following items:

- State of the drive
- Operating state of the mode (bits 10, 12, and 13):
  - Statusword (I/O Velocity Mode - Specific Bits)
  - Statusword (I/O current mode - Specific bits)
- Internal limit active, see Limits in IOVM, Limits in IOCM
- Warning (bit 7: indicates the presence of a warning condition)

Related object: Controlword.

| | | |
|---|---|---|
| Name | Statusword | |
| Index | 0x6041 | |
| Subindex | 0x00 | |
| Data type | UNSIGNED16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |

| | |
|---|---|
| PDO mapping | TXPDO |
| Persistent | NO |

| Bit | Description | IOVM | IOCM |
|---|---|---|---|
| 15 | Reserved | | |
| 14 | Reserved | | |
| 13 | Operating mode-specific | | |
| 12 | Operating mode-specific | Drive follows command value | Drive follows command value |
| 11 | Internal limit active | I2t, Current, Max motor speed, Supply voltage | I2t, Current, Max motor speed, Supply voltage |
| 10 | Operating mode-specific | Reserved | Reserved |
| 9 | Remote | | |
| 8 | Reserved (0) | | |
| 7 | Warning | | |
| 6 | Switch on disabled | | |
| 5 | Quick stop | | |
| 4 | Voltage enabled (power stage on) | | |
| 3 | Fault | | |
| 2 | Operation enabled | | |
| 1 | Switched on | | |
| 0 | Ready to switch on | | |

*Table 99. Statusword bits*

### 6.2.61. Modes of operation

Switches the actual chosen operating mode. We recommend to using Modes of operation display after changing the operation mode.
Related object: Modes of operation display

| | |
|---|---|
| Name | Modes of operation |
| Index | 0x6060 |
| Subindex | 0x00 |
| Data type | INTEGER8 |
| Access type | RW |
| Default value | -121 |
| Value range | Modes of operation |
| PDO mapping | RXPDO |
| Persistent | YES |

| Operation mode | Description |
|---|---|
| -121 | I/O Velocity Mode (IOVM) |
| -120 | I/O Current Mode (IOCM) |

*Table 100. Modes of operation*

### 6.2.62. Modes of operation display

Displays the actual mode of operation. The meaning of the returned value corresponds to the code in Modes of operation.
Related object: Modes of operation

| | |
|---|---|
| Name | Modes of operation display |
| Index | 0x6061 |
| Subindex | 0x00 |
| Data type | INTEGER8 |
| Access type | RO |
| Default value | - |
| Value range | Modes of operation |
| PDO mapping | TXPDO |
| Persistent | NO |

### 6.2.63. Velocity demand value

Used as input for the velocity controller. The value is given in [velocity units].

| | | |
|---|---|---|
| Name | Velocity demand value | |
| Index | 0x606B | |
| Subindex | 0x00 | |
| Data type | INTEGER32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.64. Velocity actual value

Provides the actual velocity value of the axis derived by the main sensor defined in Axis configuration. If no main sensor is configured, an estimated velocity is displayed. The value is given in [velocity units].
Related objects: Velocity actual values, Additional velocity actual values

| | | |
|---|---|---|
| Name | Velocity actual value | |
| Index | 0x606C | |
| Subindex | 0x00 | |
| Data type | INTEGER32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.65. Motor rated torque

Holds the value to which all torque objects are related. The value is defined as Nominal current multiplied by the Torque constant. The value is given in [µNm].
Changing the value with write access is not permitted.
Related object: Motor data

| | | |
|---|---|---|
| Name | Motor rated torque | |
| Index | 0x6076 | |
| Subindex | 0x00 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | NO | |
| Persistent | NO | |

### 6.2.66. Torque actual value

Provides the actual torque and corresponds to the motor's instantaneous torque. The value is given in per thousand of Motor rated torque.
Related object: Motor rated torque

| | | |
|---|---|---|
| Name | Torque actual value | |
| Index | 0x6077 | |
| Subindex | 0x00 | |
| Data type | INTEGER16 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.67. Max profile velocity

Used as a velocity limit in regulation tuning.
The value is given in [velocity units].

| | | |
|---|---|---|
| Name | Max profile velocity | |
| Index | 0x607F | |
| Subindex | 0x00 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 120'000 | |
| Value range | 1 | Max motor speed |
| PDO mapping | RXPDO | |
| Persistent | YES | |

### 6.2.68. Max motor speed

Indicates the configured maximum allowed speed for the motor. It serves as protection for the motor. The value is given in [rpm]. For detailed motor specifications, see the maxon catalog.

Related objects:

- Motor type
- Number of pole pairs
- Target velocity

| | |
|---|---|
| Name | Max motor speed |
| Index | 0x6080 |
| Subindex | 0x00 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | 120'000 |
| Value range | Max motor speed values |
| PDO mapping | RXPDO |
| Persistent | YES |

| Motor type | Description | Maximum speed [rpm] |
|---|---|---|
| 1 | Brushed DC motor (maxon DC motor) | 120'000 |
| 10 | Brushless DC motor (maxon EC motor/BLDC motor), sinus commutated | 120'000 / number of pole pairs |

*Table 101. Max motor speed values*

### 6.2.69. Profile acceleration

Defines the acceleration value used during a profiled move. The value is given in [acceleration units].
Supported mode is I/O Velocity Mode (IOVM).

| | | |
|---|---|---|
| Name | Profile acceleration | |
| Index | 0x6083 | |
| Subindex | 0x00 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 10'000 | |
| Value range | 1 | Max acceleration |
| PDO mapping | RXPDO | |
| Persistent | YES | |

### 6.2.70. Profile deceleration

Defines the deceleration value used during a profiled move.
The value is given in [acceleration units].
Supported mode is I/O Velocity Mode (IOVM).

| | |
|---|---|
| Name | Profile deceleration |

| | | |
|---|---|---|
| Index | 0x6084 | |
| Subindex | 0x00 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 10'000 | |
| Value range | 1 | Max acceleration |
| PDO mapping | RXPDO | |
| Persistent | YES | |

### 6.2.71. Quick stop deceleration

Determines the deceleration of the quick stop profile.
Is also be used with a «quick stop» command (see Device control commands).
The value is given in [acceleration units].

Related object: Controlword

| | | |
|---|---|---|
| Name | Quick stop deceleration | |
| Index | 0x6085 | |
| Subindex | 0x00 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 10'000 | |
| Value range | 1 | Max acceleration |
| PDO mapping | RXPDO | |
| Persistent | YES | |

### 6.2.72. SI unit velocity

Defines the velocity units. The coding of the user-defined units and prefixes follows System units.

Write access is only permitted in the device state «Power Disable» Device control.

| | |
|---|---|
| Name | SI unit velocity |
| Index | 0x60A9 |
| Subindex | 0x00 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | 0x00B44700 |
| Value range | SI Units Velocity - value range |
| PDO mapping | NO |
| Persistent | YES |

| Bit 31…24 | Bit 24…16 | Bit 15…8 | Bit 7…0 |
|---|---|---|---|
| Prefix | Numerator | Denominator | Reserved(0) |

*Table 102. SI Units Velocity - Bits*

| Value | Description | Symbol |
|---|---|---|
| 0x00B44700 | Revolutions/minute | rev/min (rpm) |
| 0xFDB44700 | 0.001 revolutions/minute | milli rev/min (mrpm) |

*Table 103. SI Units Velocity - value range*

### 6.2.73. SI unit acceleration

Defines the acceleration units. The coding of the user-defined units and prefixes follows System units.

Write access is only permitted in the device state «Power Disable» Device control.

| | |
|---|---|
| Name | SI unit acceleration |
| Index | 0x60AA |
| Subindex | 0x00 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | 0x00C00300 |
| Value range | SI Units Acceleration - value range |
| PDO mapping | NO |
| Persistent | YES |

| Bit 31…24 | Bit 24…16 | Bit 15…8 | Bit 7…0 |
|---|---|---|---|
| Prefix | Numerator | Denominator | Reserved(0) |

*Table 104. SI Units Acceleration - Bits*

| Value | Description | Symbol |
|---|---|---|
| 0x00C00300 | (Revolutions/minute)/second | rpm/s |

*Table 105. SI Units Acceleration - value range*

### 6.2.74. Velocity offset

The velocity offset value is internally added to the Target velocity. The value is given in [velocity units]. Supported mode is I/O Velocity Mode (IOVM).

| | | |
|---|---|---|
| Name | Velocity offset | |
| Index | 0x60B1 | |
| Subindex | 0x00 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | RXPDO | |
| Persistent | NO | |

### 6.2.75. Max acceleration

Used to limit the maximum allowed acceleration to prevent mechanical damage. It represents the limit of all other acceleration/deceleration objects on the axis.

The value is given in [acceleration units].
Operation mode IOCM is not limited by this value.

Related objects: Quick stop deceleration

| | | |
|---|---|---|
| Name | Max acceleration | |
| Index | 0x60C5 | |
| Subindex | 0x00 | |
| Data type | UNSIGNED32 | |
| Access type | RW | |
| Default value | 4'294'967'295 | |
| Value range | 1 | 4'294'967'295 |
| PDO mapping | RXPDO | |
| Persistent | YES | |

### 6.2.76. Additional velocity actual values

Provides the actual velocity values of the axis derived by the sensors defined in Axis configuration. If no sensor is configured in the corresponding field, the actual velocity value is “0” (zero).
The value is given in [velocity units].
The averaged velocity values represent the actual velocity value filtered by a 1st, order digital low-pass filter with a cut-off frequency of 5 Hz.
Related objects: Velocity actual values, Velocity actual value

| | |
|---|---|
| Name | Additional velocity actual values |
| Index | 0x60E5 |
| Object code | ARRAY |
| Highest subindex supported | 10 |

#### 6.2.76.1. Velocity actual value sensor 1

| | | |
|---|---|---|
| Name | Velocity actual value sensor 1 | |
| Index | 0x60E5 | |
| Subindex | 0x01 | |
| Data type | INTEGER32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

#### 6.2.76.2. Velocity actual value sensor 2

| | |
|---|---|
| Name | Velocity actual value sensor 2 |
| Index | 0x60E5 |
| Subindex | 0x02 |
| Data type | INTEGER32 |
| Access type | RO |

| | | |
|---|---|---|
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.76.3. Velocity actual value averaged sensor 1

| | | |
|---|---|---|
| Name | Velocity actual value averaged sensor 1 | |
| Index | 0x60E5 | |
| Subindex | 0x09 | |
| Data type | INTEGER32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.76.4. Velocity actual value averaged sensor 2

| | | |
|---|---|---|
| Name | Velocity actual value averaged sensor 2 | |
| Index | 0x60E5 | |
| Subindex | 0x0A | |
| Data type | INTEGER32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

### 6.2.77. Digital inputs

Displays the state of the CiA digital input functionalities (after polarity correction by Digital input properties, Polarity). A bit is read as "1" if the signal at the corresponding pin is high. This value is a subset of Digital inputs functionality.
Related objects: Digital input properties / Configuration of digital inputs, Digital inputs functionality

| | | |
|---|---|---|
| Name | Digital inputs | |
| Index | 0x60FD | |
| Subindex | 0x00 | |
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | - | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

| Bit | Functionality | Description |
|---|---|---|
| 31..24 | Reserved | – |
| 23 | General purpose H | State can be read |
| 22 | General purpose G | State can be read |
| 21 | General purpose F | State can be read |
| 20 | General purpose E | State can be read |
| 19 | General purpose D | State can be read |
| 18 | General purpose C | State can be read |
| 17 | General purpose B | State can be read |
| 16 | General purpose A | State can be read |
| 15..2 | Reserved | - |
| 1 | Positive limit switch | Generates Positive limit switch error |
| 0 | Negative limit switch | Generates Negative limit switch error |

*Table 106. Digital Inputs*

### 6.2.78. Digital outputs

Configures the state of the digital output functionalities (before polarity correction by Digital outputs polarity). If a bit is set to “1” and the polarity bit is set to “0”, the signal at the corresponding pin is high.
This value is a CiA-conforming subset of Digital outputs functionality
Related objects: Digital outputs properties, Configuration of digital outputs, Digital outputs functionality.

| | |
|---|---|
| Name | Digital outputs |
| Index | 0x60FE |
| Object code | ARRAY |
| Highest subindex supported | 1 |

#### 6.2.78.1. Physical outputs

This object is read/write, however, bits 24→31 are ignored upon writing.

| | |
|---|---|
| Name | Physical outputs |
| Index | 0x60FE |
| Subindex | 0x01 |
| Data type | UNSIGNED32 |
| Access type | RW |
| Default value | 0x0 |
| Value range | Digital outputs - values |
| PDO mapping | RXPDO |
| Persistent | NO |

| Bit | Functionality | Description |
|---|---|---|
| 31..19 | Reserved | - |
| 18 | General purpose C | State can be read/written by the host |
| 17 | General purpose B | State can be read/written by the host |
| 16 | General purpose A | State can be read/written by the host |

| Bit | Functionality | Description |
|---|---|---|
| 15…0 | Reserved | - |

*Table 107. Digital outputs - values*

### 6.2.79. Target velocity

Indicates the configured target velocity and is used as input for the trajectory generator. The value is given in [velocity units]. Supported mode is I/O Velocity Mode (IOVM).

Related objects:

- Max motor speed

| | | |
|---|---|---|
| Name | Target velocity | |
| Index | 0x60FF | |
| Subindex | 0x00 | |
| Data type | INTEGER32 | |
| Access type | RW | |
| Default value | 0 | |
| Value range | - | - |
| PDO mapping | RXPDO | |
| Persistent | NO | |

### 6.2.80. Motor type

Defines the motor type. Changes are only supported in device state «Power Disable» Device control.
Related objects: Axis configuration, Motor data

| | |
|---|---|
| Name | Motor type |
| Index | 0x6402 |
| Subindex | 0x00 |
| Data type | UNSIGNED16 |
| Access type | RW |
| Default value | 10 |
| Value range | Motor type values |
| PDO mapping | NO |
| Persistent | YES |

| Value | DS-402 Name | Description |
|---|---|---|
| 1 | Phase-modulated DC motor | Brushed DC motor (maxon DC motor) |
| 10 | Sinusoidal PM BL motor | Brushless DC motor BLDC sinus commutated (maxon EC motor) |

*Table 108. Motor type values*

### 6.2.81. Supported drive modes

Provides an overview of the implemented operating modes on the device. Supported are the following modes:

- I/O Velocity Mode (IOVM)

- I/O Current Mode (IOCM)

| | | |
|---|---|---|
| Name | Supported drive modes | |
| Index | 0x6502 | |
| Subindex | 0x00 | |
| Data type | UNSIGNED32 | |
| Access type | RO | |
| Default value | 0x0006'0000 | |
| Value range | - | - |
| PDO mapping | TXPDO | |
| Persistent | NO | |

| Bit | | Description |
|---|---|---|
| 31…19 | 0 | Reserved |
| 18 | 1 | I/O Current Mode (IOCM) |
| 17 | 1 | I/O Velocity Mode (IOVM) |
| 16…11 | 0 | Reserved |
| 10 | 0 | Cyclic Synchronous Torque Mode With Commutation Angle (CSTCA) |
| 9 | 0 | Cyclic Synchronous Torque Mode (CST) |
| 8 | 0 | Cyclic Synchronous Velocity Mode (CSV) |
| 7 | 0 | Cyclic Synchronous Position Mode (CSP) |
| 6 | 0 | Interpolated Position Mode (IPM) |
| 5 | 0 | Homing Mode (HMM) |
| 4 | 0 | Reserved |
| 3 | 0 | Torque Mode |
| 2 | 0 | Profile Velocity Mode (PVM) |
| 1 | 0 | Velocity Mode |
| 0 | 0 | Profile Position Mode (PPM) |

*Table 109. Supported drive modes - Bits*

# 7. Error Handling

## 7.1. Device errors

The device can detect a variety of device errors. The reaction to an error depends on the error type and Fault reaction code. After execution of the fault reaction, the device changes to a fault state, and the drive will be disabled.

The Error history holds the error codes that occurred.

The Error register holds all set error flags and provides a summary of possible errors.

For fault reaction codes, the following notations will be used:

- f: Decelerate with a quick stop ramp and disable the drive function
- d: A secure movement is no longer possible; disable the drive function
- w: No effect on device status (warning)

| Error code | Error register | Name | Fault reaction code |
|---|---|---|---|
| 0x0000 | 0000 0000b | No Error | - |
| 0x1000 | 0000 0001b | Generic error | d |
| 0x1080 | 0000 0001b | Generic initialisation error | d |
| 0x2310 | 0000 0011b | Overcurrent error | d |
| 0x2320 | 0000 0011b | Power stage protection error | d |
| 0x2380 | 0000 0011b | Power stage protection error | d |
| 0x3210 | 0000 0101b | Overvoltage error | d |
| 0x3220 | 0000 0101b | Undervoltage error | d |
| 0x4382 | 0000 1001b | Thermal power stage overload error | d |
| 0x4383 | 0000 1001b | Thermal power stage overload warning | w |
| 0x4384 | 0000 1001b | Thermal logic section overload error | d |
| 0x5480 | 0000 0001b | Hardware error | d |
| 0x5481 | 0000 0001b | Hardware defect loading parameter error | d |
| 0x5482 | 0000 0001b | Hardware configuration error | d |
| 0x5483 | 0000 0001b | Hardware configuration error | d |
| 0x6180 | 0000 0001b | Internal software error | d |
| 0x6181 | 0000 0001b | Internal software error | d |
| 0x6380 | 0000 0001b | Loading parameter failed error | d |
| 0x6381 | 0000 0001b | Loading parameter failed error | d |
| 0x6382 | 0000 0001b | Loading parameter failed error | d |
| 0x6388 | 0000 0001b | Torque constant parameter error | d |
| 0x7280 | 0000 0001b | Current offset adjustment warning | w |
| 0x7380 | 0010 0001b | Main sensor breach error | d |
| 0x7388 | 0010 0001b | Hall sensor signal error | d |
| 0x738A | 0010 0001b | Hall angle detection error | d |
| 0x7390 | 0010 0001b | Missing main sensor error | d |

| Error code | Error register | Name | Fault reaction code |
|---|---|---|---|
| 0x7391 | 0010 0001b | Missing commutation sensor error | d |
| 0x7392 | 0010 0001b | Main sensor direction error | d |
| 0x8A80 | 0010 0001b | Negative limit switch error | f |
| 0x8A81 | 0010 0001b | Positive limit switch error | f |
| 0x8A89 | 0000 0001b | Digital input 1 PWM frequency warning | w |
| 0x8A8A | 0000 0001b | Digital input 1 PWM duty cycle warning | w |
| 0x8A8C | 0000 0001b | Digital input 1 PWM error | d |
| 0x8A8D | 0000 0001b | Digital input 2 PWM frequency warning | w |
| 0x8A8E | 0000 0001b | Digital input 2 PWM duty cycle warning | w |
| 0x8A90 | 0000 0001b | Digital input 2 PWM error | d |
| 0xFF01 | 0000 0001b | System overloaded warning | w |
| 0xFF02 | 0000 0001b | Watchdog error | d |
| 0xFF03 | 0000 0001b | Watchdog error | d |
| 0xFF06 | 0000 0001b | System peak overloaded error | d |
| 0xFF07 | 0000 0001b | System peak overloaded error | d |
| 0xFF0D | 0000 0001b | Mode of operation not supported error | d |
| 0xFF11 | 0010 0001b | Regulation tuning identification error | d |
| 0xFF12 | 0010 0001b | Regulation tuning current error | d |
| 0xFF13 | 0010 0001b | Regulation tuning identification current error | d |
| 0xFF14 | 0010 0001b | Regulation tuning unrealistic result error | d |
| 0xFF15 | 0010 0001b | Regulation tuning identification error | d |
| 0xFF16 | 0010 0001b | Regulation tuning identification error | d |
| 0xFF17 | 0010 0001b | Regulation tuning identification error | d |
| 0xFF19 | 0010 0001b | Regulation tuning identification error | d |
| 0xFF20 | 0010 0001b | Regulation tuning standstill error | d |
| 0xFF21 | 0010 0001b | Regulation tuning torque constant error | d |
| 0xFF22 | 0010 0001b | Regulation tuning max system speed error | d |
| 0xFF23 | 0010 0001b | Regulation tuning motor connection error | d |
| 0xFF24 | 0010 0001b | Regulation tuning sensor signal error | d |

*Table 110. Device error codes*

### 7.1.1. Generic error

| | |
|---|---|
| Error code | 0x1000 |
| Error register | 0000 0001b |
| Cause | Unspecific error occurred |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword |

### 7.1.2. Generic initialisation error

| | |
|---|---|
| Error code | 0x1080 |
| Error register | 0000 0001b |
| Cause | Critical error occurred during boot-up. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset device. If the problem persists, contact your supplier. |

### 7.1.3. Overcurrent error

| | |
|---|---|
| Error code | 0x2310 |
| Error register | 0000 0011b |
| Cause | Short circuit in motor winding. Controller gains too high and/or deceleration too high. Damaged power stage. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword |

### 7.1.4. Power stage protection error

| | |
|---|---|
| Error code | 0x2320 |
| Error register | 0000 0011b |
| Cause | Short circuit of the motor winding against the ground.<br>Short circuit of motor winding against operating voltage Vcc.<br>Damaged power stage.<br>Strong motor ripple (on top of a high peak current draw).<br>High deceleration or acceleration demands (which push the control to its limits).<br>Max. peak current configured, which is close to the power stage current protection level.<br>Poor current control parameter set.<br>Possible loose contact. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword |

### 7.1.5. Power stage protection error

| | |
|---|---|
| Error code | 0x2380 |
| Error register | 0000 0011b |
| Cause | Short circuit of the motor winding against the ground.<br>Short circuit of motor winding against operating voltage Vcc.<br>Damaged power stage.<br>Strong motor ripple (on top of a high peak current draw).<br>High deceleration or acceleration demands (which push the control to its limits).<br>Max. peak current configured, which is close to the power stage current protection level.<br>Poor current control parameter set.<br>Possible loose contact. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword |

### 7.1.6. Overvoltage error

| | |
|---|---|
| Error code | 0x3210 |

| | |
|---|---|
| Error register | 0000 0101b |
| Cause | Power supply voltage too high. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | In most cases, this error occurs at deceleration, where the motor works as a generator and the energy flows from the motor to the power supply (resulting in an increased voltage).<br>Usually, a capacitor (for example, 2200 µF) close to the device will solve the problem. If not, a shunt regulator will be necessary to dissipate brake energy.<br>Reset the fault with Controlword (only possible if the supply voltage is in a valid range). |

### 7.1.7. Undervoltage error

| | |
|---|---|
| Error code | 0x3220 |
| Error register | 0000 0101b |
| Cause | Either:<br>- Supply voltage is too low for operation.<br>- Power supply cannot supply the required acceleration current. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword (only possible if the supply voltage is in a valid range or the drive is not enabled). |

### 7.1.8. Thermal power stage overload error

| | |
|---|---|
| Error code | 0x4382 |
| Error register | 0000 1001b |
| Cause | Temperature power stage reached critical level. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword when the temperature has fallen below the critical threshold. |

### 7.1.9. Thermal power stage overload warning

| | |
|---|---|
| Error code | 0x4383 |
| Error register | 0000 1001b |
| Cause | Temperature power stage is high. |
| Effect | Maximum output current is actively reduced with rising temperatures.<br>Red LED "Slow"<br>Warning bit set in Statusword |
| Error recovery | The warning auto clears if the temperature falls below the warning threshold. |

### 7.1.10. Thermal logic section overload error

| | |
|---|---|
| Error code | 0x4384 |
| Error register | 0000 1001b |
| Cause | Temperature logic section reached critical level. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword (only possible if temperature is in a valid range) |

### 7.1.11. Hardware error

| | |
|---|---|
| Error code | 0x5480 |
| Error register | 0000 0001b |
| Cause | A hardware problem was detected. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset device. If the problem persists, contact your supplier. |

### 7.1.12. Hardware defect loading parameter error

| | |
|---|---|
| Error code | 0x5481 |
| Error register | 0000 0001b |
| Cause | Loading (restoring) persistent parameter failed due to hardware error. The parameters may have an inconsistent state. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset device. If the problem persists, contact your supplier. |

### 7.1.13. Hardware configuration error

| | |
|---|---|
| Error code | 0x5482 |
| Error register | 0000 0001b |
| Cause | A hardware error occurred during configuration. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset device. If the problem persists, contact your supplier. |

### 7.1.14. Hardware configuration error

| | |
|---|---|
| Error code | 0x5483 |
| Error register | 0000 0001b |
| Cause | A hardware error occurred during configuration. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset device. If the problem persists, contact your supplier. |

### 7.1.15. Internal software error

| | |
|---|---|
| Error code | 0x6180 |
| Error register | 0000 0001b |
| Cause | Internal software error occurred. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset device. If the problem persists, contact your supplier. |

### 7.1.16. Internal software error

| | |
|---|---|
| Error code | 0x6181 |
| Error register | 0000 0001b |
| Cause | Internal software error occurred. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword. If the problem persists, contact your supplier. |

### 7.1.17. Loading parameter failed error

| | |
|---|---|
| Error code | 0x6380 |
| Error register | 0000 0001b |
| Cause | Loading persistent parameter failed. The default values are restored. |
| Effect | Default parameters are set<br>Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword<br>Set or load device parameters again |

### 7.1.18. Loading parameter failed error

| | |
|---|---|
| Error code | 0x6381 |
| Error register | 0000 0001b |
| Cause | Loading persistent parameter failed. The default values are restored. |
| Effect | Default parameters are set<br>Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset device<br>If the problem persists, contact your supplier. |

### 7.1.19. Loading parameter failed error

| | |
|---|---|
| Error code | 0x6382 |
| Error register | 0000 0001b |
| Cause | Loading persistent parameter failed. The default values are restored. |
| Effect | Default parameters are set<br>Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset device<br>If the problem persists, contact your supplier. |

### 7.1.20. Torque constant parameter error

| | |
|---|---|
| Error code | 0x6388 |
| Error register | 0000 0001b |
| Cause | The open loop velocity control structure can be used only, if the torque constant is parameterized/tuned. |

| | |
|---|---|
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Configure the torque constant with the value in the datasheet. If a torque constant derived from tuning is desired, disable open loop velocity control structure and execute regulation tuning.<br>Reset fault with Controlword |

### 7.1.21. Current offset adjustment warning

| | |
|---|---|
| Error code | 0x7280 |
| Error register | 0000 0001b |
| Cause | During the current offset calibration an error occurred.<br>This usually occurs if the motor is already turning upon enable. |
| Effect | Red LED "Slow"<br>Warning bit set in Statusword |
| Error recovery | Auto clears after a successful current offset calibration.<br>Ensure the motor is stationary when enabling. |

### 7.1.22. Main sensor breach error

| | |
|---|---|
| Error code | 0x7380 |
| Error register | 0010 0001b |
| Cause | Sensor supervision has detected a bad working condition due to:<br>- wrong/broken wiring of encoder<br>- defective encoder<br>- regulation parameters are not well tuned (see Current control parameter set) |
| Effect | Device disabled Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Ensure Main Sensor is properly connected.<br>Reset fault with Controlword |

### 7.1.23. Hall sensor signal error

| | |
|---|---|
| Error code | 0x7388 |
| Error register | 0010 0001b |
| Cause | Either: incorrect wiring of Hall sensors, or incorrect wiring of Hall sensor supply voltage, or damaged Hall sensors, or big Hall sensor signal noise |
| Effect | Device disabled Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword |

### 7.1.24. Hall angle detection error

| | |
|---|---|
| Error code | 0x738A |
| Error register | 0010 0001b |
| Cause | Angle difference measured between the encoder and Hall sensors is too high due to:<br>- wrong wiring of Hall sensors<br>- defective Hall sensors<br>- wrong wiring of encoder<br>- defective encoder<br>- wrong setting of encoder resolution or pole pairs |
| Effect | Device disabled Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Check that the pole pair number setting is correct. Check sensor connections. Reset fault with Controlword |

### 7.1.25. Missing main sensor error

| | |
|---|---|
| Error code | 0x7390 |
| Error register | 0010 0001b |
| Cause | No main sensor available. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Adapt settings in Axis configuration<br>Reset fault with Controlword |

### 7.1.26. Missing commutation sensor error

| | |
|---|---|
| Error code | 0x7391 |
| Error register | 0010 0001b |
| Cause | No commutation sensor available. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Adapt settings in Axis configuration<br>Reset fault with Controlword |

### 7.1.27. Main sensor direction error

| | |
|---|---|
| Error code | 0x7392 |
| Error register | 0010 0001b |
| Cause | Sensor supervision has detected a turn-away of the motor in the opposite direction due to:<br>- wrong setting of sensor polarity<br>- wrong sensor wiring<br>- wrong motor wiring |
| Effect | Device disabled Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword |

### 7.1.28. Negative limit switch error

| | |
|---|---|
| Error code | 0x8A80 |
| Error register | 0010 0001b |
| Cause | Negative limit switch was/is active or wrong configuration of limit switch function |
| Effect | Fault reaction is defined in the Fault reaction code. |
| Error recovery | Reset fault with Controlword |

### 7.1.29. Positive limit switch error

| | |
|---|---|
| Error code | 0x8A81 |
| Error register | 0010 0001b |
| Cause | Positive limit switch was/is active or wrong configuration of limit switch function |
| Effect | Fault reaction is defined in the Fault reaction code. |
| Error recovery | Reset fault with Controlword |

### 7.1.30. Digital input 1 PWM frequency warning

| | |
|---|---|
| Error code | 0x8A89 |
| Error register | 0000 0001b |
| Cause | PWM input 1 is configured in Configuration of digital inputs, the measured PWM frequency is outside the specified range. |
| Effect | The frequency of pwm input 1 in Digital input 1 PWM frequency is restricted to a range of 50 Hz to 10 kHz.<br>Red LED "Slow"<br>Warning bit set in Statusword |
| Error recovery | If the detected frequency is between 50 Hz and 10 kHz, the warning is cleared. |

### 7.1.31. Digital input 1 PWM duty cycle warning

| | |
|---|---|
| Error code | 0x8A8A |
| Error register | 0000 0001b |
| Cause | PWM input 1 is configured in Configuration of digital inputs, the measured PWM duty cycle is outside the specified range. |
| Effect | The duty cycle of pwm input 1 in Digital input 1 PWM duty cycle is restricted to a range of 10% and 90%.<br>Red LED "Slow"<br>Warning bit set in Statusword |
| Error recovery | If the detected duty cycle is between 10% and 90%, the warning is cleared. |

### 7.1.32. Digital input 1 PWM error

| | |
|---|---|
| Error code | 0x8A8C |
| Error register | 0000 0001b |
| Cause | PWM input 1 is configured in Configuration of digital inputs, the measured PWM signal is invalid.<br>For details, see display values Digital input 1 PWM frequency and Digital input 1 PWM duty cycle. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Set PWM input into valid range. Reset fault with Controlword |

### 7.1.33. Digital input 2 PWM frequency warning

| | |
|---|---|
| Error code | 0x8A8D |
| Error register | 0000 0001b |
| Cause | PWM input 2 is configured in Configuration of digital inputs, the measured PWM frequency is outside the specified range. |
| Effect | The frequency of pwm input 2 in Digital input 2 PWM frequency is restricted to a range of 50 Hz to 10 kHz.<br>Red LED "Slow"<br>Warning bit set in Statusword |
| Error recovery | If the detected frequency is between 50 Hz and 10 kHz, the warning is cleared. |

### 7.1.34. Digital input 2 PWM duty cycle warning

| | |
|---|---|
| Error code | 0x8A8E |
| Error register | 0000 0001b |
| Cause | PWM input 2 is configured in Configuration of digital inputs, the measured PWM duty cycle is outside the specified range. |

| | |
|---|---|
| Effect | The duty cycle of pwm input 2 in Digital input 2 PWM duty cycle is restricted to a range of 10% and 90%.<br>Red LED "Slow"<br>Warning bit set in Statusword |
| Error recovery | If the detected duty cycle is between 10% and 90%, the warning is cleared. |

### 7.1.35. Digital input 2 PWM error

| | |
|---|---|
| Error code | 0x8A90 |
| Error register | 0000 0001b |
| Cause | PWM input 2 is configured in Configuration of digital inputs, the measured PWM signal is invalid.<br>For details, see display values Digital input 2 PWM frequency and Digital input 2 PWM duty cycle. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Set PWM input into valid range. Reset fault with Controlword |

### 7.1.36. System overloaded warning

| | |
|---|---|
| Error code | 0xFF01 |
| Error register | 0000 0001b |
| Cause | The system load of the device has reached a critical value. |
| Effect | Red LED "Slow"<br>Warning bit set in Statusword |
| Error recovery | Reset warning with Controlword (possible in every device state) |

### 7.1.37. Watchdog error

| | |
|---|---|
| Error code | 0xFF02 |
| Error register | 0000 0001b |
| Cause | Device reset by watchdog due to fatal system overload or system fault. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword |

### 7.1.38. Watchdog error

| | |
|---|---|
| Error code | 0xFF03 |
| Error register | 0000 0001b |
| Cause | Device reset by watchdog due to fatal system overload or system fault. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword |

### 7.1.39. System peak overloaded error

| | |
|---|---|
| Error code | 0xFF06 |
| Error register | 0000 0001b |
| Cause | The device has not enough free resources to provide proper regulation. |

| | |
|---|---|
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword |

### 7.1.40. System peak overloaded error

| | |
|---|---|
| Error code | 0xFF07 |
| Error register | 0000 0001b |
| Cause | The device has not enough free resources to provide proper regulation. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword |

### 7.1.41. Mode of operation not supported error

| | |
|---|---|
| Error code | 0xFF0D |
| Error register | 0000 0001b |
| Cause | The requested mode of operation is not supported with the configured control structure. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Change either the mode of operation or the control structure.<br>Reset fault with Controlword |

### 7.1.42. Regulation tuning identification error

| | |
|---|---|
| Error code | 0xFF11 |
| Error register | 0010 0001b |
| Cause | An error occurred during regulation tuning identification. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword |

### 7.1.43. Regulation tuning current error

| | |
|---|---|
| Error code | 0xFF12 |
| Error register | 0010 0001b |
| Cause | Required current could not be reached during regulation tuning. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Increase Nominal current and/or Output current limit (make sure not to exceed the maximum values of the motor specification). Reset fault with Controlword |

### 7.1.44. Regulation tuning identification current error

| | |
|---|---|
| Error code | 0xFF13 |
| Error register | 0010 0001b |

| | |
|---|---|
| Cause | Identification current could not be reached during regulation tuning identification. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Increase Nominal current and/or Output current limit (make sure not to exceed the maximum values of the motor specification). Reset fault with Controlword |

### 7.1.45. Regulation tuning unrealistic result error

| | |
|---|---|
| Error code | 0xFF14 |
| Error register | 0010 0001b |
| Cause | The resulting resistance or inductance value is unrealistic. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Check the motor parameters in Motor data. Reset fault with Controlword Run tuning again. |

### 7.1.46. Regulation tuning identification error

| | |
|---|---|
| Error code | 0xFF15 |
| Error register | 0010 0001b |
| Cause | An error occurred during regulation tuning identification. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword |

### 7.1.47. Regulation tuning identification error

| | |
|---|---|
| Error code | 0xFF16 |
| Error register | 0010 0001b |
| Cause | An error occurred during regulation tuning identification. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Check the motor parameters in Motor data. Reset fault with Controlword Run all tuning again. |

### 7.1.48. Regulation tuning identification error

| | |
|---|---|
| Error code | 0xFF17 |
| Error register | 0010 0001b |
| Cause | An error occurred during regulation tuning identification. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword. Run tuning again. |

### 7.1.49. Regulation tuning identification error

| | |
|---|---|
| Error code | 0xFF19 |
| Error register | 0010 0001b |

| | |
|---|---|
| Cause | An error occurred during regulation tuning identification. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword Run tuning again. |

### 7.1.50. Regulation tuning standstill error

| | |
|---|---|
| Error code | 0xFF20 |
| Error register | 0010 0001b |
| Cause | Regulation tuning identification motor not in standstill, please ensure that the motor is not moving when starting tuning process. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Make sure the motor is at standstill when starting tuning. Reset fault with Controlword Run tuning again. |

### 7.1.51. Regulation tuning torque constant error

| | |
|---|---|
| Error code | 0xFF21 |
| Error register | 0010 0001b |
| Cause | Regulation tuning identification motor torque value invalid, please ensure that the motor movement is not being obstructed during tuning process. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Ensure the motor movement is not being obstructed. Reset fault with Controlword Run tuning again. |

### 7.1.52. Regulation tuning max system speed error

| | |
|---|---|
| Error code | 0xFF22 |
| Error register | 0010 0001b |
| Cause | Max system speed exceeded during Regulation tuning identification, reduce step amplitude to reduce max speed |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Increase max motor speed. Reset fault with Controlword Run tuning again. |

### 7.1.53. Regulation tuning motor connection error

| | |
|---|---|
| Error code | 0xFF23 |
| Error register | 0010 0001b |
| Cause | Identification current is very small. Check the motor connection. |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Reset fault with Controlword |

### 7.1.54. Regulation tuning sensor signal error

| | |
|---|---|
| Error code | 0xFF24 |

| | |
|---|---|
| Error register | 0010 0001b |
| Cause | Sensor signal was not found during tuning identification, check the sensor or motor connection |
| Effect | Device disabled<br>Red LED “ON”<br>Error bit set in Statusword |
| Error recovery | Check sensor connection. Reset fault with Controlword Run tuning again. |

## 7.2. Communication Errors (Abort Codes)

The abort codes will be sent as part of the response to any interface request (e.g. USB).

The following abort codes are defined by CANopen Communication Profile CiA 301. Codes above 0x0F00'0000 are maxon-specific.

| Abort code | Name | cause |
|---|---|---|
| 0x0000 0000 | No abort | Communication successful |
| 0x0503 0000 | Toggle error | Toggle bit not alternated |
| 0x0504 0001 | Command unknown | Command specifier unknown |
| 0x0504 0004 | CRC error | CRC check failed |
| 0x0601 0000 | Access error | Unsupported access to an object |
| 0x0601 0001 | Write only error | Read command to a write only object |
| 0x0601 0002 | Read only error | Write command to a read only object |
| 0x0601 0003 | Subindex cannot be written | Subindex cannot be written, subindex 0 must be “0” (zero) for write access |
| 0x0602 0000 | Object does not exist error | Last read or write command had wrong object index or subindex |
| 0x0604 0043 | General parameter error | General parameter incompatibility |
| 0x0604 0047 | General internal incompatibility error | General internal incompatibility in device |
| 0x0606 0000 | Hardware error | Access failed due to hardware error |
| 0x0607 0010 | Service parameter error | Data type does not match, length or service parameter do not match |
| 0x0607 0012 | Service parameter too high error | Data type does not match, length of service parameter too high |
| 0x0607 0013 | Service parameter too low error | Data type does not match, length of service parameter too low |
| 0x0609 0011 | Subindex error | Last read or write command had wrong object subindex |
| 0x0609 0030 | Value range error | Value range of parameter exceeded |
| 0x0800 0000 | General error | General error |
| 0x0800 0020 | Transfer or store error | Data cannot be transferred or stored |
| 0x0800 0022 | Wrong device state error | Data cannot be transferred or stored to application because of present device state |
| 0x0F00 FFC1 | Segmented transfer expected | Unsupported access to an object, segmented access is expected |

*Table 111. CANopen abort codes*

# 8. Firmware version history

## 8.1. Version overview

| Date [yyyy-mm] | Version | | Application | | Firmware Specification DocID | Description |
|---|---|---|---|---|---|---|
| | Software | Hardware | # | Version | | |
| 2024-03 | 0100h | 1101h, 1102h, 1103h | 1000h | 0000h | rel12245 | Initial release |

*Table 112. Version overview*