AG25, AG26

Actuator with EtherCAT® interface

User manual

014/21

Table of contents

1 General Information

1.1 Documentation

The following documents are associated with this product:

- Product data sheet; describes the technical data, the dimensions, the pin assignment, the accessories and the order key.
- Installation instructions, describe the mechanical and electrical installation with all safety-relevant conditions and the associated technical specifications.
- User manual describing the migration of the actuator into an Industrial Ethernet network and its commissioning.

These documents can also be found at *http://www.siko-global.com/de-de/service-downloads*.

"EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Deutschland"

2 Displays and operating elements

2.1 General Information

The drive has various LEDs that indicate the statuses of the drive and of the Ethernet module. The operating elements are located below the cover.

2.2 Displays

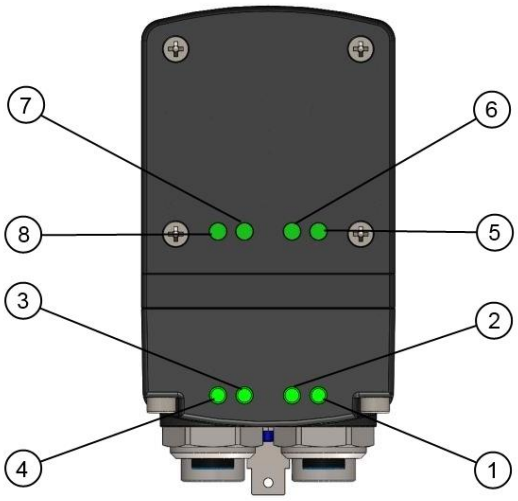

Fig. 1: Displays

2.2.1 Ethernet module statuses

The ①, ②, ③, ④ LEDs inform about the status of the Ethernet module. The Ethernet module LEDs' functions are permanently defined and cannot be changed.

LED	Description
1	ERROR LED
2	Link/Activity LED OUT
3	Link/Activity LED IN
4	RUN LED

2.2.1.1 ERROR LED 1

This LED indicates EtherCAT® communication errors.

LED state	Description
Off	No error or no operating voltage
Red, flashing	Invalid configuration
Red, flashing 1x	Unrequested status change
Red, flashing 2x	Sync manager watchdog timeout
Red	Ethernet module in the EXCEPTION status
Red, flickering	Boot error detected

2.2.1.2 Link/Activity LED 2, 3

These LEDs indicate EtherCAT® connection status and activity.

LED state	Description
Off	No connection or no operating voltage
Green	Connection detected, no activity
Green, flickering	Connection detected, activity

2.2.1.3 RUN LED 4

This LED indicates the EtherCAT® communication status.

LED state	Description
Off	EtherCAT® in the INIT state or no operating voltage
Green	EtherCAT® in the OPERATIONAL state
Green, flashing	EtherCAT® in the PRE-OPERATIONAL state
Green, flashing 1x	EtherCAT® in the SAFE-OPERATIONAL state
Green, flashing	EtherCAT® in the BOOT state
Red	Fatal error

2.2.2 Drive status

In factory setting, the ⑤, ⑥, ⑦, ⑧ LEDs inform about the drive's status.
The function of the drive status LEDs can be configured.

2.2.2.1 Status LED 5

LED statuses valid with factory setting.

LED state	Description
Green	Operating voltage applied to control, no fault
Red, flashing	Operating voltage applied to control, active fault
Red/green, flashing	Operating voltage applied to control, switch lock active
Off	Operating voltage of control missing

2.2.2.2 Status LEDs 6, 7

LED statuses valid with factory setting.

LED state	Description
Off	No function

2.2.2.3 Status LED 8

NOTICE	If the actual value is unequal 0 after switching on the module and if it is outside the programmed positioning window, then the LED status is "red" or "red, flashing" due to volatile storage of the setpoint. The setpoint is initialized with the value 0 after switching on.

LED statuses valid with factory setting.

LED state	Description
Green	Actuator is within the programmed positioning window. Operating voltage of the output stage is applied.
Green, flashing	Actuator is within the programmed positioning window. Operating voltage of final stage missing
Red	Actuator is outside the programmed positioning window. Operating voltage of the output stage is applied.
Red, flashing	Actuator is outside the programmed positioning window. Operating voltage of final stage missing
Off	Operating voltage of control missing.

2.3 Operating elements

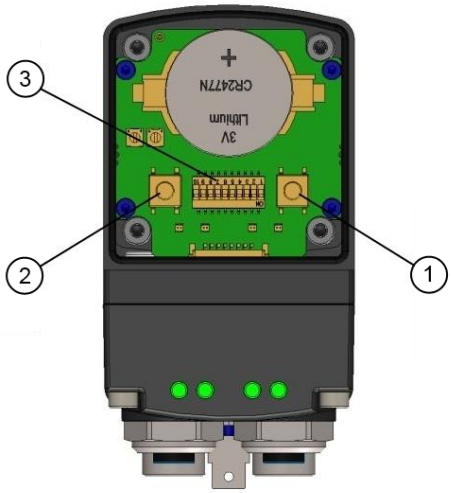

Fig. 2: Operating elements

2.3.1 Operating keys

NOTICE	Manual setup operation is only available if there is no process data exchange

Manual setup mode (corresponding to inching mode 2) can be started by means of the operator keys. This makes it possible to move the actuator without a superordinate control.

Key ①: Inching mode 2 in e direction

Key ②: Inching mode 2 in i direction

2.3.2 DIP switch:

Switch	Assignment
SW1-SW8	Setting of low byte of the 2-byte device ID in binary format The high byte of the device ID is always 00h. 0 = not configured 1 … 255 = device ID
SW9-SW10	No function, always off

SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	Device ID
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	0
ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	1
OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	2
…	…	…	…	…	…	…	…	…
OFF	ON	ON	ON	ON	ON	ON	ON	254
ON	ON	ON	ON	ON	ON	ON	ON	255

You can assign an “Explicit Device ID” to the actuator by means of the DIPswitch, enabling addressing independent of the physical position in the network.

3 Digital inputs and outputs

The actuator has four configurable digital inputs and one configurable digital output.

Function and switching behavior can be set.

No function has been assigned to the digital inputs in the factory setting.

The logical status of the digital inputs is mapped in the process data independent of the assigned function.

If a function was assigned to the digital input, the functional conditions of the digital inputs can be read in the register Digital Input Functionalities State (Object 2405h).

With factory settings, the digital output can be actuated via the process data.

If a function is assigned to the digital output, it is actuated via register Digital Output Functionalities State (Object 2302h).

3.1 Examples of digital input configurations

The following configuration deviates from the factory setting and requires parameterization by the user.

- Digital input 1: Limit switch 1 (low-active) proximity switch DC PNP NC
- Digital input 2: Limit switch 2 (low-active) proximity switch DC PNP NC
- Digital input 3: Inching mode 2 positive travel direction (high-active) pushbutton
- Digital input 4: Inching mode 2 negative travel direction (high-active) pushbutton

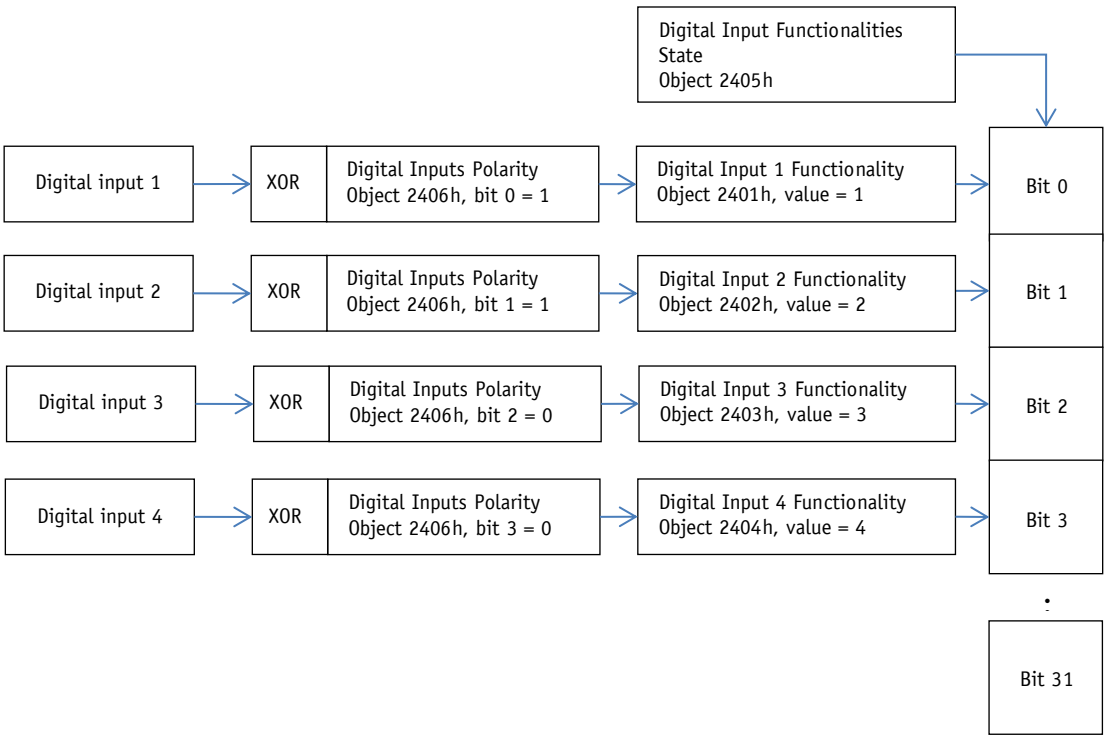

Fig. 3: Examples of digital input configurations

3.2 Example of digital output configuration

- Digital output 1: Inpos (high-active)

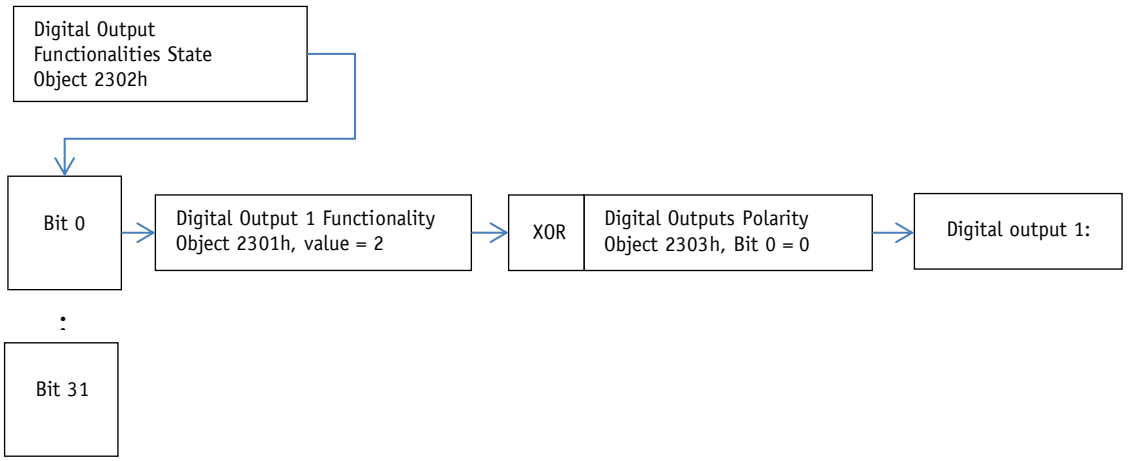

Fig. 4: Example of digital output configuration

4 Functional description

4.1 Control of the drive

The drive can be moved manually via the keys or digital inputs without upstream control. The drive can be controlled and configured in the bus mode and via the service interface.

4.1.1 Operating modes

The following operating modes are distinguished: positioning mode and speed mode. In the positioning mode there is the additional option of traveling in the inching mode. The position control mode can be started via the digital inputs independent of the operating mode chosen.

4.1.1.1 Positioning mode

In the positioning mode, positioning to the specified set point is executed by means of a ramp function (*see* Fig. 5: Ramp travel, direct positioning mode) calculated on the basis of the actual position as well as the programmed controller parameters P (proportional factor), I (integral factor), D (differential factor), acceleration and velocity.

Upon activation of the travel order, the actuator accelerates to the specified velocity with the acceleration programmed. The measure of delay until reaching the setpoint is defined by the parameter A-Pos (Object 2604h) as well.

Alternately, a value deviating from acceleration can be chosen for delay by means of parameter D-Pos (Object 2606h).

Changing controller parameters during a positioning process does not influence the current positioning operation.

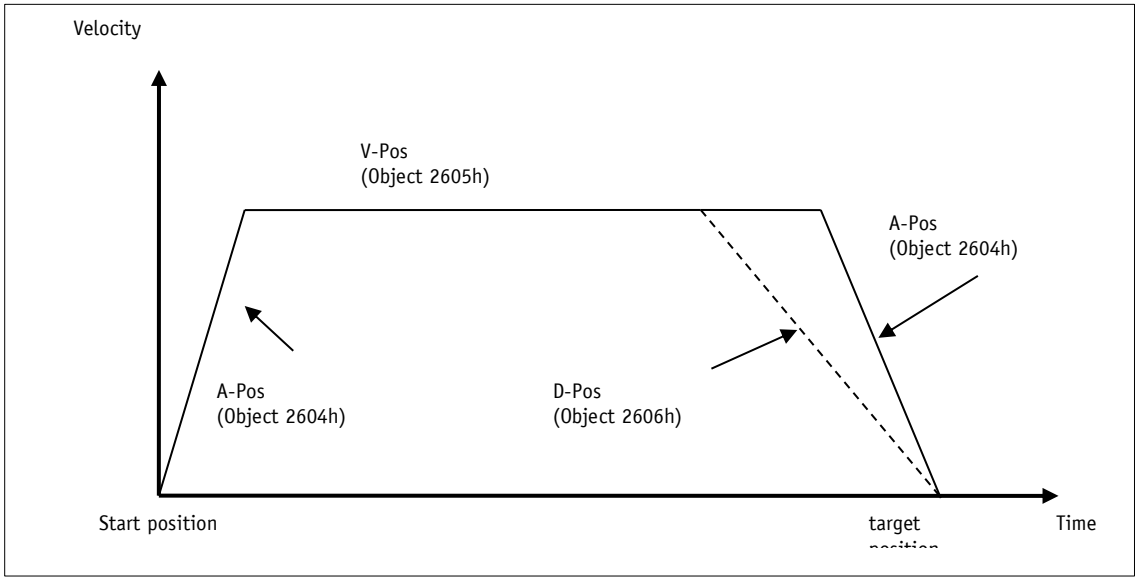

Fig. 5: Ramp travel, direct positioning mode

The status word indicates whether the actual position is within the window defined by parameter Pos Window (Object 260Ah). You can define the behavior of the actuator upon reaching the programmed window via parameter Inpos Mode (Object 2616h).

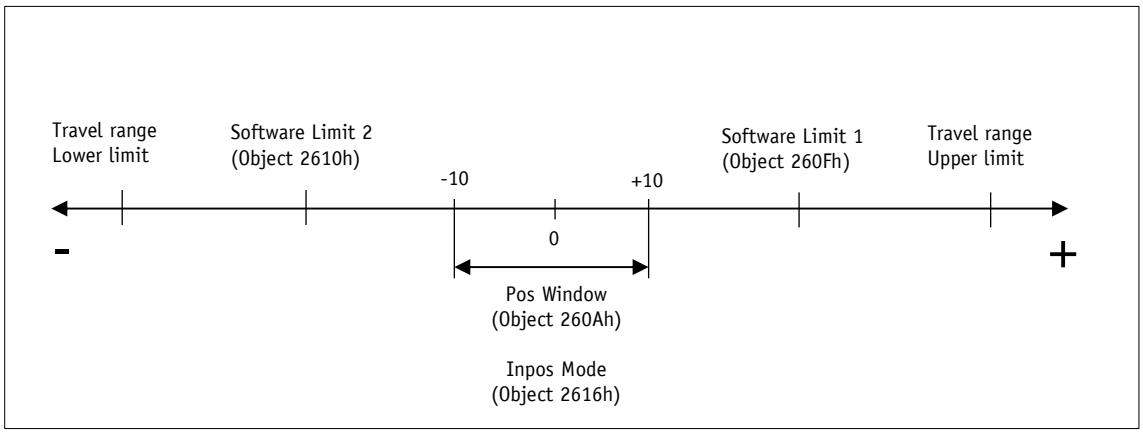

Fig. 6: Positioning mode

The max. travel range depends on gear and scaling. The number of revolutions specified in the product data sheet must not be exceeded.

4.1.1.1.1 Loop positioning

NOTICE	A travel order will not be executed if a loop positioning would exceed the limiting values specified by parameters Software Limit 1 (Object 260Fh) and Software Limit 2 (Object 2610h) although the setpoint is within the limiting values.

If the actuator is operated on a spindle or an additional transmission gear, the spindle or external gear backlash can be compensated by means of loop positioning. In this case, traveling to the target value is always from the same direction. This travel direction can be determined via parameter Pos Type (Object 2613h). The loop length is set via parameter Loop Length (Object 2617h).

Example:

The direction from which every target position shall be driven to is positive.

Case 1 ⇒ new position is greater than actual position:

Direct travel to required position

Case 2 ⇒ new position is smaller than actual position:

The actuator drives beyond the target position by the loop length; afterwards, the set point is approached in positive direction.

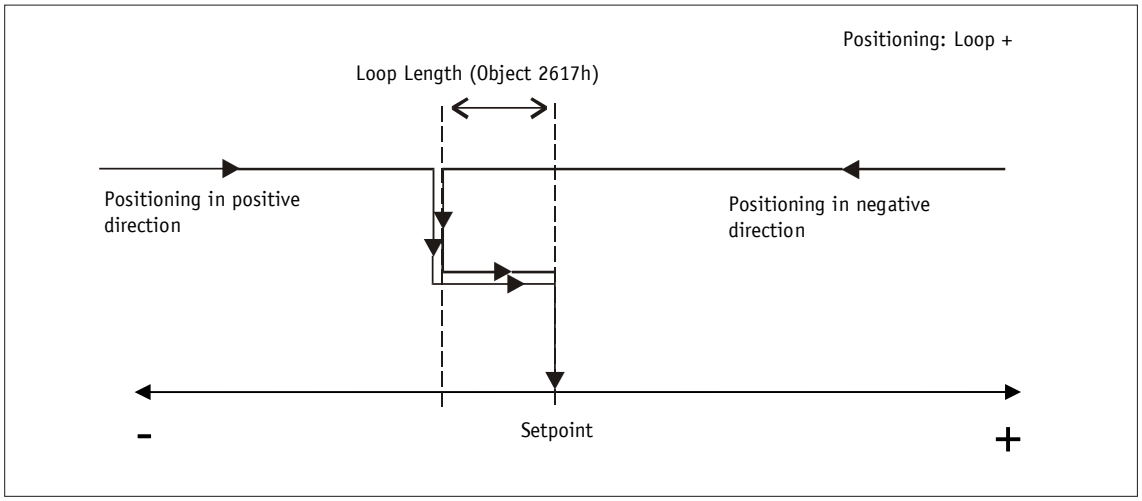

Fig. 7: Loop+ positioning

4.1.1.2 Inching mode

NOTICE	There is no compensation for spindle backlash (loop positioning) in this operating mode.

Inching mode is enabled in the positioning mode only. You can program via parameters acceleration as well as speed in the inching mode.

4.1.1.2.1 Inching mode 1

NOTICE	If the Spindle pitch parameter is programmed to zero, then the traveling distance occurs by steps. If Spindle pitch is unequal zero, then the information of the Delta Tipp parameter refers to the travel distance in 1/100 mm.

NOTICE	If the actual position is outside the programmed limiting values, then traveling from this position in the respective direction must be performed by means of inching mode 1 or 2!

The drive travels once from the current actual position by the value Delta Inch (Object 2611h) depending on the mathematical sign of the value entered.

Delta Inch < 0: negative travel direction

Delta Inch > 0: positive travel direction

Reaching of the target position will be indicated accordingly.

A digital input can be configured for starting inching mode 1.

The following conditions must be met for enabling the start of inching modes 1 and 2:

- Supply voltage of the output stage is applied.
- Operation enabled
- Drive stands still

4.1.1.2.2 Inching mode 2

The actuator travels from the current position as long as the relevant command is active. You can influence the inching speed via two parameters and it will be calculated in the actuator as illustrated in the example below:

V-Inch (Object 2609h) = 10 rpm (can only be changed in the idle state)

Inching 2 Offset (Object 261Ah) = 85 % (can be changed during inching operation)

The resulting inching speed in this example will be:

Inching speed= v - Tipp * Offset inching 2 = 10 rpm * 85 % = 9 rpm

The results are always rounded to integers.
The minimum speed is 1 rpm.

4.1.1.3 Rotational speed mode

NOTICE	Limits 1 + 2 are inactivated in this operational mode

NOTICE	Exceeding the resolution of the absolute encoder results in a jump of the actual position.

With the set point enabled, the actuator when in the rotational speed mode accelerates to the target speed and maintains this speed until the set point is disabled or a different target speed specified. The speed is adjusted immediately to the new value when the rotational target speed is changed.

The arithmetical sign of the set point determines the travel direction in the rotational speed mode.

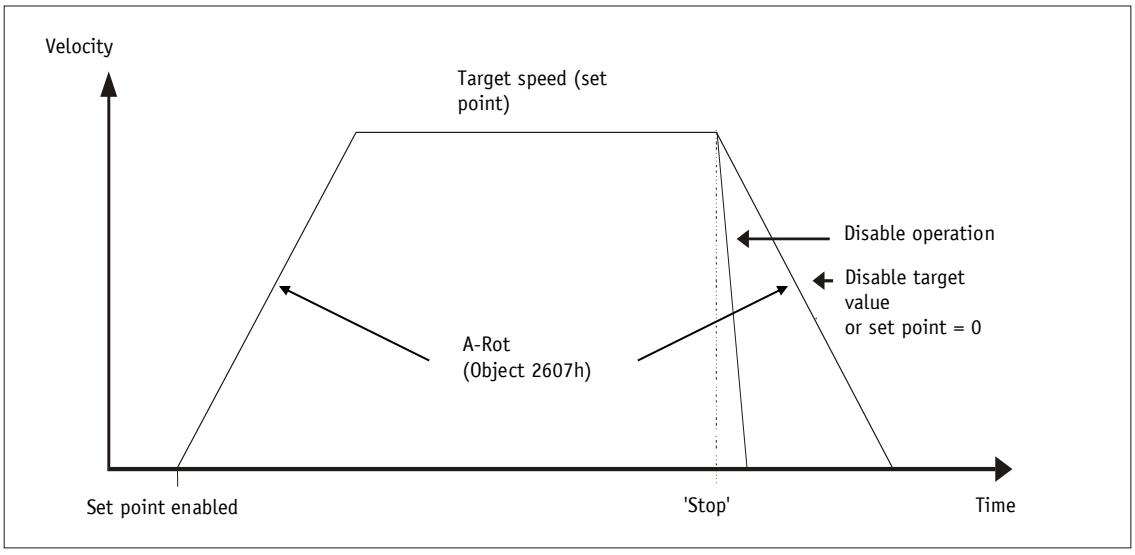

Fig. 8: Ramp speed mode

The following conditions must be met for enabling the start of the rotational speed mode:

- Supply voltage of the output stage is applied.
- Operation enabled

- Drive stands still

4.1.1.4 Position Control Mode

NOTICE	Via the control word in the process data, the superordinate control can cancel travel orders started by the position control mode. For this purpose, a negative slope must be created on bits OFF1, OFF2, or OFF3 in the control word. Conversely, the PCM mode cannot cancel a travel order initiated via the superordinate control.

The position control mode enables travel data sets to be called via the digital inputs. A total of 7 travel data sets can be saved.

The use of the position control mode requires previous configuration of the digital inputs.

The desired travel data set can be selected via inputs PCM input 1 to 3 in binary addressing. Travel data set 0 does not exist.

4.1.1.4.1 Examples of configuration of the digital inputs for the PCM

- Digital input 1: PCM Start (high-active)
- Digital input 2: PCM input 1 (high-active)
- Digital input 3: PCM input 2 (high-active)
- Digital input 4: PCM input 3 (high-active)

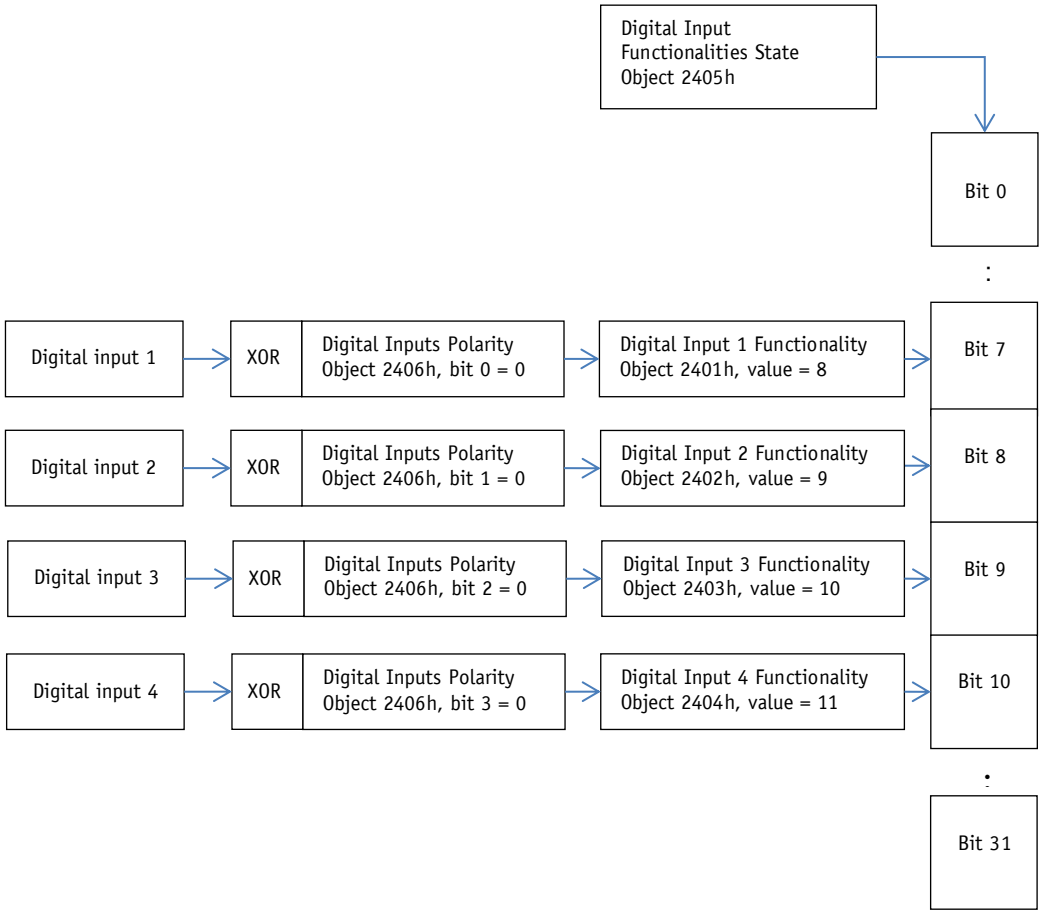

Fig. 9: Examples of configuration of the digital inputs for the PCM

Example of the parameter set of travel data set no. 3

Parameter	Object
PCM Position 3	2924h
PCM Acceleration 3	2944h
PCM Velocity 3	2964h
PCM Deceleration 3	2984h

After applying the coding to the inputs, the desired travel job can be started by a positive slope on the PCM Start input.

Resetting the PCM Start input during an active positioning process will result in cancellation of the travel job but the drive will continue to be controlled.

An example of calling travel data set no. 3 is shown below

Step 1: Create number of travel data set

Input	State
PCM Start	0
PCM input 1	1
PCM input 2	1
PCM input 3	0

Step 2: Starting the positioning job

Input	State
PCM Start	0/1
PCM input 1	1
PCM input 2	1
PCM input 3	0

4.1.2 Current limiting

NOTICE	Measuring the supply current cannot indicate the actual motor current. With cycled output stages, the supply current does not correspond to the motor current. Actual motor current can be read via the interface.

The current limit is set via Parameter Current Limiting (Object 2619h), which serves primarily for protecting the drive against overload.

With the default set, the nominal torque indicated on the product data sheet is achieved.

Drive overload results in limiting the motor current to the set value.

As a consequence, the actuator cannot maintain the speed set, the contouring error increases. The actuator changes to the error status if the contouring error exceeds the contouring error limit defined by the Contouring Error Limit parameter (Object 2618h): Contouring error.

4.1.3 Limit switch

Two digital inputs must be configured correspondingly if the limit switch function is to be used.

4.1.3.1 Example of limit switch configuration

Exemplary configuration for the connection of proximity switches DC PNP NC.

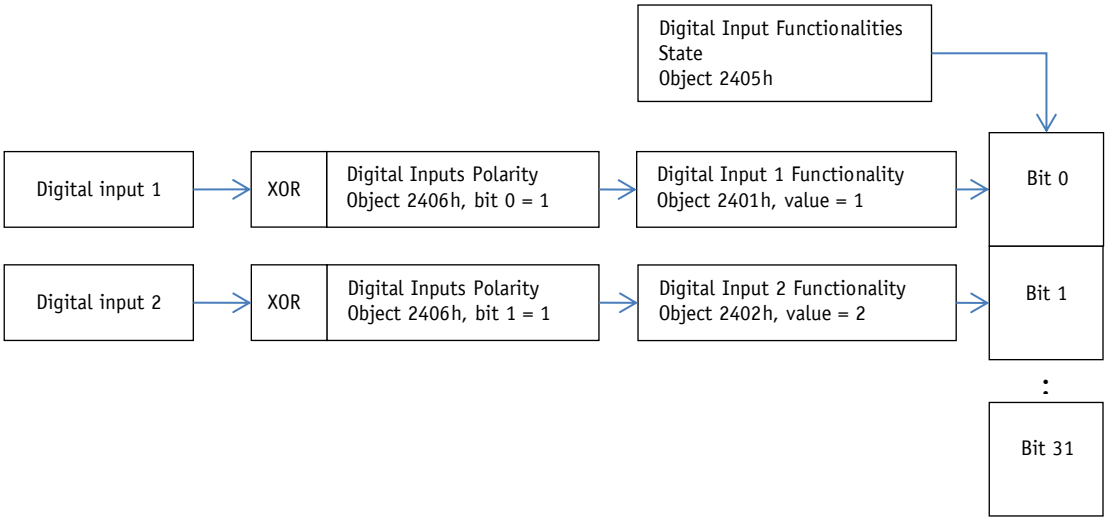

Fig. 10: Example of limit switch configuration

4.1.3.2 Arrangement of the limit switches

The limit switches are arranged according to the following pattern independent of the configured sense of rotation:

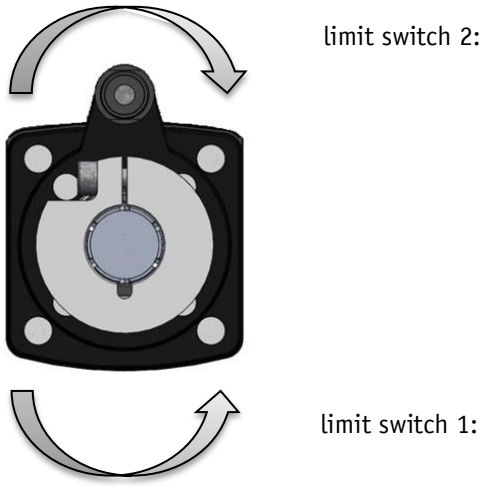

Fig. 11: Arrangement of the limit switches

5 Calibration

NOTICE	Calibration is only possible when no travel job is active!

Two steps are required for executing calibration:

Write calibration value: see Calibration Value (Object 260Eh)

Execute calibration (software command or calibration input)

Calibration can be performed by a positive edge at control word bit 15, or initiated by writing the value 7 to parameter S-Command (Object 2C01h) Alternately, a digital input can be configured as calibration input as well.

Since the measuring system is an absolute system, calibration is necessary only once with commissioning. With calibration, the calibration value is adopted for calculation of the position value. The following equation is applied in case of calibration:

Position value = 0 + Calibration Value (Object 260Eh) + Offset Value (Object 261Ch)

6 External gear

If an external gear is used, a factor can be programmed via the parameters Gear Ratio Numerator (Object 260Bh) and Gear Ratio Denominator (Object 260Ch) in order to include the gear ratio in position sensing.

Example (see Fig. 12: external):

The actuator is operated on a gear with transmission reduction of 5:1. For this purpose, the Gear Ratio Numerator and Gear Ratio Denominator parameters must be programmed as follows:

Parameter Gear Ratio Numerator = 5

Parameter Gear Ratio Denominator = 1

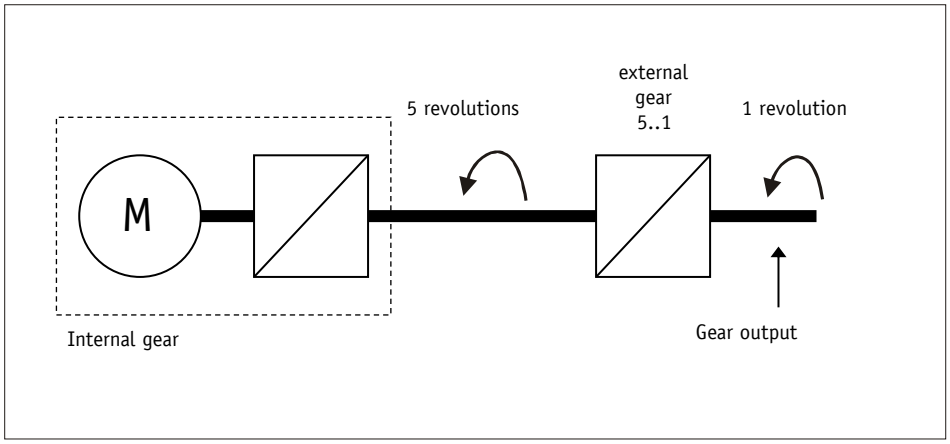

Fig. 12: external gear

Input of an odd transmission reduction value is possible according to the following example:

Transmission reduction = 3.78

- Parameter Gear Ratio Numerator = 378
- Parameter Gear Ratio Denominator = 100

7 Warnings / Errors

7.1 Warnings

Warnings do not influence the operation of the actuator.
Warnings disappear after removing the cause.

Possible warnings:

- Battery voltage for absolute encoder is below the limit ⇒ exchange battery within the next 6 months.
- Current limiting active

7.2 Errors

Errors cause an immediate stop of drive movement.

Errors are indicated via the drive status LEDs.

The error bit is set in the status word.

The error messages are entered in the error memory in the order of their detection. The last 10 error messages are displayed when the error memory is full.

The cause of error can be tracked down with the help of the error codes.

7.2.1 Error codes

NOTICE	If the error cannot be acknowledged after removal of the cause of error and the error persists after power-on reset, then the drive must be inspected in the factory.

Error code	Fault
00h	No error
06h	Low battery voltage: → Empty battery, replace battery → Bonding error, check battery bonding → Wrong battery type inserted, insert correct battery type
07h	Low voltage of control electronic system → Check control operating voltage
08h	Overvoltage of control electronic system → Check control operating voltage
09h	Overvoltage of power electronic system → Check output stage operating voltage
0Ah	Output stage excess temperature → Reduce ambient temperature → Reduce load
0Bh	Contouring error → Reduce load → Reduce acceleration → Reduce velocity
0Ch	Output shaft blocked → Disengage shaft
0Fh	SIN COS monitoring → Shield from stray magnetic fields → Check EMC measures
10h	EEPROM queue overrun → Internal error
13h	EEPROM check sum → Reset parameters to factory settings
14h	Ethernet module watchdog → Internal error
15h	Ethernet module in the ERROR state while travel job is active → Internal error
16h	Ethernet module in the EXCEPTION state → Internal error The behavior of the drive when this fault occurs can be set with the parameter configuration, bit 6 (see chapter 8.2.1.99).

Table 1: Error codes

8 EtherCAT®

8.1 Description

The actuator is an EtherCAT® slave. The actuator supports the CANopen over EtherCAT protocol (CoE) according to the DS301 communication profile.

8.1.1 Cyclic data exchange

Cyclic process data is exchanged via PDO frames. Mapping is static and cannot be changed.

8.1.2 Acyclic data exchange

Acyclic data is exchanged via SDO frames.

8.1.3 Operating modes and synchronization

The actuator supports only the Free Run operating mode. The actuator is not synchronized.

8.1.4 Emergency Messages

Any errors occurring trigger emergency messages in the drive, which are sent to the EtherCAT® master via mailbox communication. A drive-internal error code is converted into the Emergency Error Code according to the following table and transmitted as part of the CoE Emergency Frame.

Code	Emergency Error Code	Description
06h	FF06h	Low battery voltage:
07h	FF07h	Low voltage of control electronic system
08h	FF08h	Overvoltage of control electronic system
09h	FF09h	Overvoltage of power electronic system
0Ah	FF0Ah	Output stage excess temperature
0Bh	FF0Bh	Contouring error
0Ch	FF0Ch	Output shaft blocked
0Fh	FF0Fh	SIN COS monitoring
10h	FF10h	EEPROM queue overrun
13h	FF13h	EEPROM check sum
14h	FF14h	Ethernet module watchdog
15h	FF15h	Ethernet module in the ERROR state while travel job is active
16h	FF16h	Ethernet module in the EXCEPTION state

8.2 Object directory (CANopen over EtherCAT®)

The actuator uses the following object areas:

1000h - 1FFFh standard objects according to DS301

2000h - 5FFFh manufacturer-specific objects

8.2.1 Parameter description of manufacturer-specific objects

8.2.1.1 Digital Outputs Control

Object	2001h
Description	Digital output control byte
Access	rw (component of process data)
Data type	UNSIGNED8
Default	No
EEPROM	No
Value range	UNSIGNED8

Bit	Description
0	Digital output 1:
1 ... 7	Reserved, always 0

8.2.1.2 Control Word

Object	2002h
Description	Control word
Access	rw (component of process data)
Data type	UNSIGNED16
Default	No
EEPROM	No
Value range	UNSIGNED16

8.2.1.2.1 Control word Positioning mode (master ⇒ slave)

Bit	Description
Bit 0 OFF1 (enable)	0 = OFF1 active Current travel job is canceled. The actuator is enabled.
	1 = OFF1 inactive
Bit 1 OFF2 (max. delay)	0 = OFF2 active Current travel job is canceled. The actuator is decelerated with max. delay; the actuator continues to be controlled.
	1 = OFF2 inactive
Bit 2 OFF3 (progr. delay)	0 = OFF3 active Current travel job is canceled. The actuator is decelerated with prog. delay, the actuator continues to be controlled.
	1 = OFF3 inactive
Bit 3 Intermediate stop	0 = no intermediate stop
	1 = intermediate stop active
Bit 4 Start travel job	Positive slope starts a travel job
Bit 5 Acknowledge error	Positive slope acknowledges an error Afterwards, the actuator changes to the switch-lock state.
Bit 6 Inching mode 1	0 = no inching mode 1 If the travel job is not completed yet it will be canceled.
	1 = inching mode 1 As long as this bit is set, the actuator travels over the distance specified in parameter Delta Tipp.
Bit 7 Inching mode 2 positive	0 = no inching mode 2 positive
	1 = inching mode 2 positive The actuator travels in positive direction
Bit 8 Inching mode 2 negative	0 = no inching mode 2 negative
	1 = inching mode 2 negative The actuator travels in negative direction
Bit 9	Reserved, always 0
Bit 10 Relative positioning	0 = absolute positioning
	1 = relative positioning
Bit 11 ... 14	Reserved, always 0
Bit 15 Calibration	Positive edge calibrates the drive (see chapter 5).

Table 2: Control word of positioning mode

8.2.1.2.2 Flow chart: Operating mode: Positioning mode

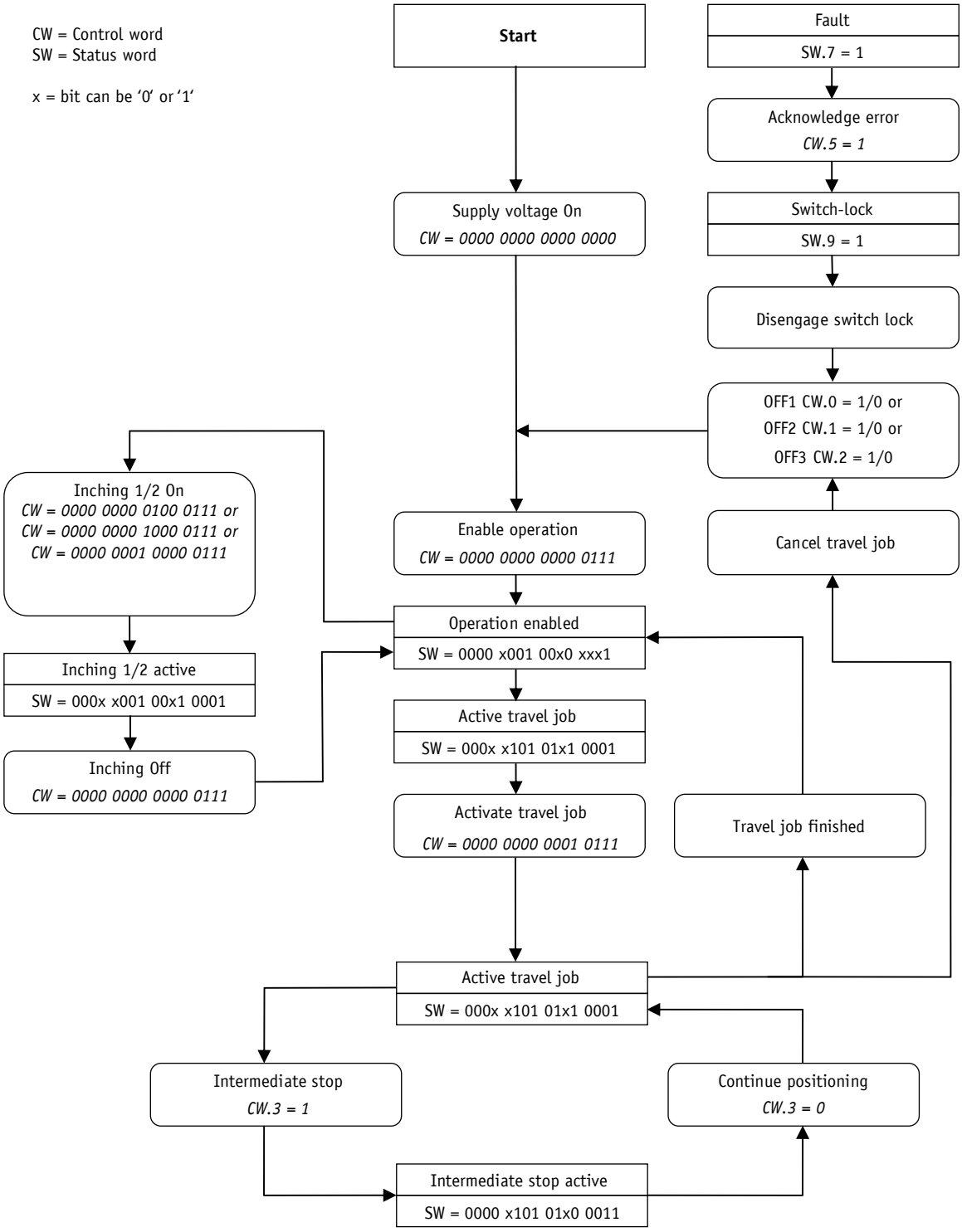

Fig. 13: Flowchart positioning mode EtherCAT®

8.2.1.2.3 Control word: Speed mode

Bit	Description
Bit 0 OFF1 (enable)	0 = OFF1 active Current travel job is canceled. The actuator is enabled.
	1 = OFF1 inactive
Bit 1 OFF2 (max. delay)	0 = OFF2 active Current travel job is canceled. The actuator is decelerated with max. delay, the actuator continues to be controlled.
	1 = OFF2 inactive
Bit 2 OFF3 (progr. delay)	0 = OFF3 active Current travel job is canceled. The actuator is decelerated with prog. delay, the actuator continues to be controlled.
	1 = OFF3 inactive
Bit 3	Reserved, always 0
Bit 4 Start travel job	Positive slope starts a travel job
Bit 5 Acknowledge error	Positive slope acknowledges an error Afterwards, the actuator changes to the switch-lock state.
Bit 6 ... 15	Reserved, always 0

Table 3: Control word of speed mode

8.2.1.2.4 Flow chart: Speed mode

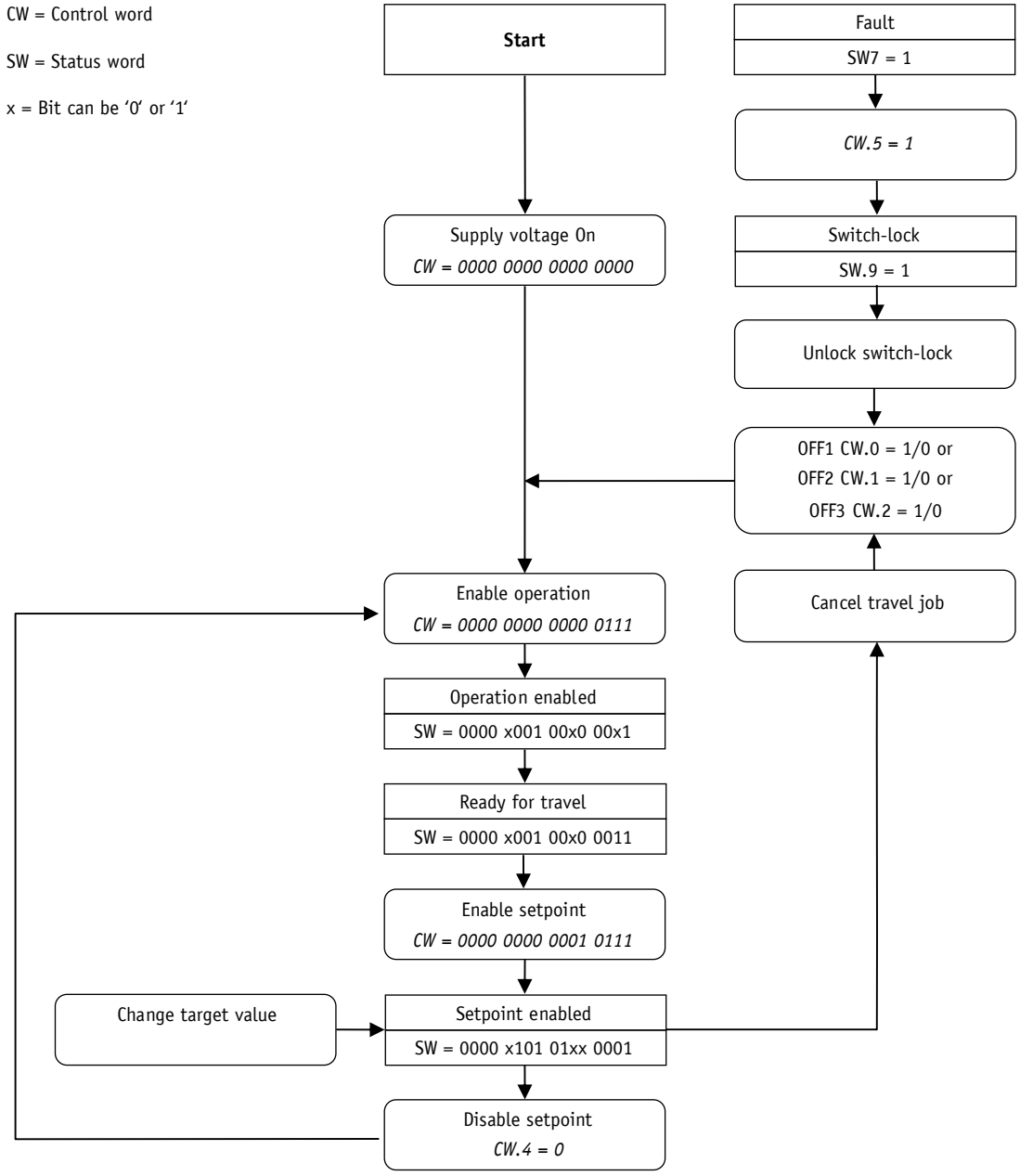

Fig. 14: Flowchart of speed mode EtherCAT®

8.2.1.3 Target Value

Positioning mode: Target position (volatile)
with spindle pitch = 0: Indicated as steps
with spindle pitch > 0: Indicated as 1/100 mm

Speed mode: Target speed (volatile)
indicated as min^{-1}

Object	2003h
Description	Setpoint
Access	rw (component of process data)
Data type	INTEGER32
Default	No
EEPROM	No
Value range	INTEGER32

8.2.1.4 Digital Inputs State

Object	2101h
Description	States of the digital inputs
Access	ro (component of process data)
Data type	UNSIGEND8
Default	No
EEPROM	No

Bit	Description
0	State of digital input 1
1	State of digital input 2
2	State of digital input 3
3	State of digital input 4

8.2.1.5 Status Word

Object	2102h
Description	Status word:
Access	ro (component of process data)
Data type	UNSIGNED16
Default	No
EEPROM	No

8.2.1.5.1 Status word: Positioning mode (slave ⇒ master)

Bit	Description
Bit 0 Supply	0 = Output stage supply voltage missing
	1 = Supply voltage of the output stage is applied
Bit 1 Readiness to travel	0 = not ready to travel
	1 = ready to travel
Bit 2 upper limit	0 = no violation of limit
	1 = upper limit exceeded
Bit 3 lower limit:	0 = no violation of limit
	1 = lower limit undercut
Bit 4 Actuator travels/stands still	0 = actuator stands still
	1 = actuator travels:
Bit 5 Inpos	0 = actuator is outside the position window.
	1 = actuator is inside the position window.
Bit 6 Active travel job	0 = no active travel job
	1 = active travel job
Bit 7 Fault	0 = no error
	1 = error Acknowledgment with positive slope on Control word bit 5
Bit 8 Operation enabled	0 = operation not enabled
	1 = operation enabled
Bit 9 Switch-lock	0 = no switch-lock
	1 = switch-lock
Bit 10 Travel job acknowledgment	0 = no acknowledgment
	1 = acknowledgment The bit is set when the travel job was accepted. If bit 4 is reset in the control word, this bit will be reset as well.
Bit 11 Battery warning	0 = no warning, battery loading state is OK
	1 = battery warning Battery voltage is below 2.6 V. Battery change is required.
Bit 12 Current limiting	0 = current limiting inactive
	1 = current limiting active Motor current exceeds the value set under parameter Current Limiting (Object 2619h).
Bit 13 Limit switch 1	0 = Limit switch not active
	1 = Limit switch active (configuration of a digital input required, see chapter 4.1.3)
Bit 14 Limit switch 2	0 = Limit switch not active
	1 = Limit switch active (configuration of a digital input required, see chapter 4.1.3)
Bit 15 Calibration acknowledgment	0 = No acknowledgment
	1 = Acknowledgment The bit is set when the calibration has been performed successfully. If bit 15 is reset in the control parameter, this bit is also reset.

Table 4: Status word of positioning mode

8.2.1.5.2 Status word: Speed mode

Bit	Description
Bit 0 Supply	0 = output stage supply voltage missing
	1 = supply voltage of the output stage is applied
Bit 1 Readiness to travel	0 = not ready to travel
	1 = ready to travel
Bit 2	no function
Bit 3	no function
Bit 4 Actuator travels/stands still	0 = actuator stands still
	1 = actuator travels
Bit 5 Inpos	0 = actuator is outside the position window.
	1 = actuator is inside the position window.
Bit 6 Active travel job	0 = no active travel job
	1 = active travel job
Bit 7 Fault	0 = no error
	1 = error Acknowledgment with positive slope on control word bit 5
Bit 8 Operation enabled	0 = operation not enabled
	1 = operation enabled
Bit 9 Switch-lock	0 = no switch-lock
	1 = switch-lock
Bit 10 Travel job acknowledgment	0 = no acknowledgment
	1 = acknowledgment The bit is set when the travel job was accepted. If bit 4 is reset in the control word, this bit will be reset as well.
Bit 11 Battery warning	0 = no warning, battery loading state is OK
	1 = battery warning Battery voltage is below 2.6 V. Battery change is required.
Bit 12 Current limiting	0 = current limiting inactive
	1 = current limiting active Motor current exceeds the value set under parameter Current Limiting (Object 2619h).

Table 5: Status word of speed mode

8.2.1.6 Actual Value

Positioning mode: Actual position
with spindle pitch = 0: Indicated as steps
with spindle pitch > 0: Indicated as 1/100 mm

Speed mode: Actual speed
indicated as min^{-1}

Object	2103h
Description	Actual value
Access	ro (component of process data)
Data type	INTEGER32
Default	No
EEPROM	No

8.2.1.7 LED Functionality

This parameter determines the functions of the four system LEDs. With factory settings, the four LEDs indicate the operational states of the drive. Alternately, the LEDs can represent the states of the digital inputs.

Object	2201h
Description	Functionality of the system LEDs
Access	rw
Data type	UNSIGNED8
Default	0
EEPROM	Yes
Value range	0 … 1

Description, see chapter Table 6: Functionality of the system LEDs

Value	LED	State	Description
0	LED5	Green	Operating voltage applied to control. No fault
		Red, flashing	Operating voltage applied to control. Error is active
		Off	Operating voltage of control missing
	LED6	Off	No function
	LED7	Off	No function
	LED8	Green	Actuator is within the programmed positioning window. Operating voltage of the output stage is applied.
		Green, flashing	Actuator is within the programmed positioning window. Operating voltage of the output stage missing.
		Red	Actuator is outside the programmed positioning window. Operating voltage of the output stage is applied.
		Red, flashing	Actuator is outside the programmed positioning window. Operating voltage of the output stage missing.
		Off	Operating voltage of control missing
1	LED5	Red	Digital input 1 inactive
		Red, flashing	Error is active
		Green	Digital input 1 active:
		Off	Operating voltage of control missing
	LED6	Red	Digital input 2 inactive
		Red, flashing	Error is active
		Green	Digital input 2 active:
		Off	Operating voltage of control missing
	LED7	Red	Digital input 3 inactive
		Red, flashing	Error is active
		Green	Digital input 3 active:
		Off	Operating voltage of control missing
	LED8	Red	Digital input 4 inactive
		Red, flashing	Error is active
		Green	Digital input 4 active:
		Off	Operating voltage of control missing

Table 6: Functionality of the system LEDs

8.2.1.8 Service Interface Baud Rate

Object	2221h
Description	Baud rate of the service interface.
Access	rw
Data type	UNSIGNED8
Default	1
EEPROM	Yes
Value range	0 ... 3 0 = 19.2 Kbit/s 1 = 57.6 Kbit/s 2 = 115.2 Kbit/s 3 = 9.6 Kbit/s

8.2.1.9 Digital Output 1 Functionality

This parameter determines the function of digital output 1.

This setting determines the bit position in the Digital Outputs Status register, which governs the state of the digital output.

Object	2301h
Description	Digital output 1 functionality
Access	rw
Data type	UNSIGNED8
Default	0
EEPROM	Yes
Value range	0 ... 3

Value	Description
0	General use Control of the digital output is directly via BIT DO1 in the process data.
1	Fault The output is switched active in case of fault.
2	Inpos The state of bit Inpos in the status word defines the state of the digital output.
3	Output on The output is switched on permanently.

8.2.1.10 Digital Output Functionalities State

The functional states that can be assigned to the digital output can be read from this register.

Object	2302h
Description	Status of the digital output functionalities
Access	ro
Data type	UNSIGNED32
Default	No
EEPROM	No

Bit	Description
0	Error 0 = no error 1 = error active
1	Inpos 0 = actual value outside the positioning window 1 = actual value inside the positioning window
2	Output on The bit is permanently set
3 ... 31	Not assigned

8.2.1.11 Digital Outputs Polarity

This parameter determines the switching behavior individually for every digital output.
A bit that defines the switching logics is assigned to every digital output.

Object	2303h
Description	Polarity of the digital output
Access	rw
Data type	UNSIGNED8
Default	0
EEPROM	Yes
Value range	0 ... 15

Value of the assigned bits:
0 = positive logics (high-active)
1 = negative logics (low-active)

Bit	Description
0	Digital output 1 polarity
1 ... 15	Not assigned

8.2.1.12 Digital Input 1 Functionality

This parameter determines the functionality of digital input 1.
With a value greater than 0 set, a function is assigned to the digital input.

The functional state can be read from the Digital Input Functionalities State register.

Object	2401h
Description	Digital input 1 functionality
Access	rw
Data type	UNSIGNED8
Default	0
EEPROM	Yes
Value range	0 ... 11

Value	Description
0	General use No function is assigned to the digital input.
1	Limit switch 1:
2	Limit switch 2:
3	Inching operation 2 positive direction
4	Inching operation 2 negative direction
5	Calibrate
6	Acknowledge error
7	Inching mode 1
8	PCM Start
9	PCM input 1
10	PCM input 2
11	PCM input 3

Table 7: Configuration of digital inputs

8.2.1.13 Digital Input 2 Functionality

This parameter determines the functionality of digital input 2.
With a value greater than 0 set, a function is assigned to the digital input.

The functional state can be read from the Digital Input Functionalities State register.

Object	2402h
Description	Digital input 2 functionality
Access	rw
Data type	UNSIGNED8
Default	0
EEPROM	Yes
Value range	0 ... 11

Description, see Table 7: Configuration of digital inputs.

8.2.1.14 Digital Input 3 Functionality

This parameter determines the functionality of digital input 3.
With a value greater than 0 set, a function is assigned to the digital input.

The functional state can be read from the Digital Input Functionalities State register.

Object	2403h
Description	Digital input 3 functionality
Access	rw
Data type	UNSIGNED8
Default	0
EEPROM	Yes
Value range	0 … 11

Description, see Table 7: Configuration of digital inputs.

8.2.1.15 Digital Input 4 Functionality

This parameter determines the functionality of digital input 4.
With a value greater than 0 set, a function is assigned to the digital input.

The functional state can be read from the Digital Input Functionalities State register.

Object	2404h
Description	Digital input 4 functionality
Access	rw
Data type	UNSIGNED8
Default	0
EEPROM	Yes
Value range	0 … 11

Description, see Table 7: Configuration of digital inputs.

8.2.1.16 Digital Input Functionalities State

The states of the digital inputs are mapped in this register according to the functionalities set. A bit is assigned to every function.

Object	2405h
Description	Status of the digital input functionalities
Access	ro
Data type	UNSIGNED32
Default	No
EEPROM	No

Bit	Description
0	Limit switch 1:
1	Limit switch 2:
2	Inching operation 2 positive direction
3	Inching operation 2 negative direction
4	Calibrate
5	Acknowledge error
6	Inching mode 1
7	PCM Start
8	PCM input 1
9	PCM input 2
10	PCM input 3
11 … 31	Not assigned

Table 8: States of the digital inputs

8.2.1.17 Digital Inputs Polarity

This parameter determines the switching behavior individually for every digital input.
A bit that defines the switching logics is assigned to every digital input.

Object	2406h
Description	Polarity of the digital output
Access	rw
Data type	UNSIGNED8
Default	0
EEPROM	Yes
Value range	0 … 15

Value of the assigned bit
0 = positive logics (high-active)
1 = negative logics (low-active)

Bit	Description
0	Digital input 1 polarity
1	Digital input 2 polarity
2	Digital input 3 polarity
3	Digital input 4 polarity
4 … 15	Not assigned

8.2.1.18 Controller Parameter P

This setting applies to all operating modes.

Object	2601h
Description	P gain of controller
Access	rw
Data type	INTEGER16
Default	300
EEPROM	Yes
Value range	1 … 500

8.2.1.19 Controller Parameter I

This setting applies to all operating modes.

Object	2602h
Description	I gain of controller
Access	rw
Data type	INTEGER16
Default	2
EEPROM	Yes
Value range	0 … 500

8.2.1.20 Controller Parameter D

This setting applies to all operating modes.

Object	2603h
Description	D gain of controller
Access	rw
Data type	INTEGER16
Default	0
EEPROM	Yes
Value range	0 … 500

8.2.1.21 A-Pos

Object	2604h
Description	Acceleration in the positioning mode
Access	rw
Data type	INTEGER16
Default	50
EEPROM	Yes
Value range	1 … 100 % 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.22 V-Pos

Object	2605h
Description	Maximum velocity in the positioning mode
Access	rw
Data type	INTEGER16
Default	10
EEPROM	Yes
Value range	Transmission 66:1 ⇒ max. 75 rpm Transmission 98:1 ⇒ max. 50 rpm Transmission 188:1 ⇒ max. 30 rpm Transmission 368:1 ⇒ max. 15 rpm

8.2.1.23 D-Pos

Object	2606h
Description	Delay in the positioning mode
Access	rw
Data type	INTEGER16
Default	101
EEPROM	Yes
Value range	1 … 101 % 101 % = the delay is determined by the A-Pos parameter 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.24 A-Rot

Object	2607h
Description	Acceleration in speed mode
Access	rw
Data type	INTEGER16
Default	50
EEPROM	Yes
Value range	1 … 100 %100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.25 A-Inch

Object	2608h
Description	Acceleration in inching mode 1 /2
Access	rw
Data type	INTEGER16
Default	50
EEPROM	Yes
Value range	1 … 100 % 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.26 V-Inch

Object	2609h
Description	Maximum velocity in inching mode 1/2
Access	rw
Data type	INTEGER16
Default	10
EEPROM	Yes
Value range	Transmission 66:1 ⇒ max. 75 rpm Transmission 98:1 ⇒ max. 50 rpm Transmission 188:1 ⇒ max. 30 rpm Transmission 368:1 ⇒ max. 15 rpm

8.2.1.27 Pos Window

Operating mode: Positioning mode

If the actual position of the drive is within the programmed set point ± this window, setting bit 5 in the status word of the drive signals this.

Spindle pitch = 0: Values refer to steps
Spindle pitch > 0 Values refer to travel distance in 1/100 mm

Operating mode: Speed mode:

If the actual rotational speed is within the target rotational speed ± this window, setting bit 5 in the drive's system status word signals this.

Object	260Ah
Description	Positioning window
Access	rw
Data type	INTEGER16
Default	10
EEPROM	Yes
Value range	0 ... 1000

8.2.1.28 Gear Ratio Numerator

a transmission factor can be programmed here when an external gear unit is used.

Object	260Bh
Description	Numerator transmission ratio
Access	rw
Data type	INTEGER16
Default	1
EEPROM	Yes
Value range	1 ... 10000

8.2.1.29 Gear Ratio Denominator

A transmission factor can be programmed here when an external gear unit is used.

Object	260Ch
Description	Denominator gear ratio
Access	rw
Data type	INTEGER16
Default	1
EEPROM	Yes
Value range	1 ... 10000

8.2.1.30 Spindle Pitch

Spindle pitch parameter = 0:

The position value is output in steps (720 steps per revolution of the output shaft).

Spindle pitch parameter > 0 (when operating the actuator on a spindle):

The position value is output as traveling distance in 1/100 mm, rather than in steps. Input of the target position is now in 1/100 mm as well,
e.g., spindle with a pitch of 2 mm ⇒ spindle pitch parameter = 200.

Object	260Dh
Description	Spindle pitch
Access	rw
Data type	INTEGER32
Default	0
EEPROM	Yes
Value range	0 ... 1000000

8.2.1.31 Calibration Value

Changes to the calibration value are adopted for calculation of the position value only after calibration via S command

Position value = 0 + calibration value + offset value

Object	260Eh
Description	Calibration value
Access	rw
Data type	INTEGER32
Default	0
EEPROM	Yes
Value range	-999999 ... 999999

8.2.1.32 Software Limit 1

NOTICE	Operating mode: Positioning mode Software limit value monitoring is deactivated if Software Limit 1 is equal Software Limit 2. Exceeding the resolution of the absolute encoder results in a jump of the actual position. Operating mode: Speed mode: Irrelevant

Operating mode: Positioning mode

Spindle pitch = 0: Values refer to steps
Spindle pitch > 0 values refer to travel distance in 1/100 mm

If the drive's position is beyond the range defined by Software Limit 1 and Software Limit 2 (travel range), traveling will only be possible in inching mode in the direction of the travel range.

Object	260Fh
Description	Limit 1
Access	rw
Data type	INTEGER32
Default	99999
EEPROM	Yes
Value range	-9999999 ... 9999999

8.2.1.33 Software Limit 2

NOTICE	Operating mode: Positioning mode Software limit value monitoring is deactivated if Software Limit 1 is equal Software Limit 2. Exceeding the resolution of the absolute encoder results in a jump of the actual position. Operating mode: Speed mode: Irrelevant

Operating mode: Positioning mode

Spindle pitch = 0: Values refer to steps
Spindle pitch > 0 values refer to travel distance in 1/100 mm

If the drive's position is beyond the range defined by Software Limit 1 and Software Limit 2 (travel range), traveling will only be possible in inching mode in the direction of the travel range.

Object	2610h
Description	Limit 2
Access	rw
Data type	INTEGER32
Default	-19999
EEPROM	Yes
Value range	-9999999 ... 9999999

8.2.1.34 Delta Inch

Indicates the relative traveling distance.

Positive value ⇒ positive travel direction
Negative value ⇒ negative travel direction

Spindle pitch = 0: Values refer to steps
Spindle pitch > 0 values refer to travel distance in 1/100 mm

Object	2611h
Description	Travel distance inching mode 1
Access	rw
Data type	INTEGER32
Default	720
EEPROM	Yes
Value range	-1000000 ... 1000000

8.2.1.35 Sense of Rotation

With shaft rotating counter-clockwise (view on the output shaft)

i sense of rotation: positive counting direction
e sense of rotation: negative counting direction

Object	2612h
Description	Sense of rotation
Access	rw
Data type	UNSIGNED8
Default	0
EEPROM	Yes
Value range	0 = i sense of rotation (cw): 1 = e sense of rotation (ccw)

8.2.1.36 Pos Type

NOTICE	Loop positioning is executed in positioning mode only.

Operating mode: Speed mode:

Irrelevant

Operating mode: Positioning mode

Type of positioning	Description
Direct	Direct traveling from actual position to target value
Loop +	Traveling to the target value occurs always in positive direction to compensate for spindle play
Loop -	Traveling to the target value occurs always in negative direction to compensate for spindle play

Object	2613h
Description	Positioning type
Access	rw
Data type	UNSIGNED8
Default	0
EEPROM	Yes
Value range	0 = direct 1 = loop + 2 = loop -

8.2.1.37 Operating Mode

Object	2614h
Description	Operating mode
Access	rw
Data type	UNSIGNED8
Default	0
EEPROM	Yes
Value range	0 = positioning mode 1 = speed mode

8.2.1.38 Inching 2 Stop Mode

The delay ramp in Inching operation 2 can be influenced via this parameter.

Object	2615h
Description	Stop mode inching 2
Access	rw
Data type	UNSIGNED8
Default	0
EEPROM	Yes
Value range	0 = stop with maximum delay 1 = stop with programmed delay

8.2.1.39 Inpos Mode

This parameter determines the drive's behavior after reaching the positioning window.

Object	2616h
Description	Inpos mode
Access	rw
Data type	UNSIGNED8
Default	0
EEPROM	Yes
Value range	0 ... 2

Operating mode: Speed mode:

irrelevant

Operating mode: Positioning mode:

Value	Description
0	Permanent positioning control to setpoint.
1	Position control Off and short circuit of the motor windings
2	Position control Off and drive enable

8.2.1.40 Loop Length

This parameter determines the loop length for the loop + and loop - positioning types.

Operating mode: Positioning mode

Spindle pitch = 0: Values refer to steps
Spindle pitch > 0 values refer to travel distance in 1/100 mm

Operating mode: Speed mode:

Irrelevant

Object	2617h
Description	Loop length
Access	rw
Data type	INTEGER16
Default	360
EEPROM	Yes
Value range	0 ... 30000

8.2.1.41 Contouring Error Limit

Upon starting a travel job, the ramp generator generates target position values in order to reach the target position with the desired velocity profile (A-Pos, V-Pos, D-Pos).

Position regulation attempts to readjust the drive's actual position and to keep the regulation deviation as small as possible.

Disturbance variables such as load or friction can disable the drive's following the position values.

The control deviation (contouring error) will increase steadily. If the control deviation exceeds the value of the contouring error limit, this will result in the contouring error fault.

The maximum admissible contouring error is indicated in steps.

Object	2618h
Description	Contouring error limit
Access	rw
Data type	INTEGER16
Default	400
EEPROM	Yes
Value range	1 ... 30000

8.2.1.42 Current Limiting

This parameter determines the setting for limiting the motor current.

The setting of current limiting is indicated as percentage of the nominal current.

Object	2619h
Description	Current limiting
Access	rw
Data type	UNSIGNED8
Default	110
EEPROM	Yes
Value range	25 ... 110 %

8.2.1.43 Inching 2 Offset

The inching speed in Inching operation 2 can be influenced via this parameter
Values are given as percentage of parameter V-Inch, Object 2609h.

Object	261Ah
Description	Inching 2 Offset
Access	rw
Data type	UNSIGNED8
Default	100
EEPROM	No
Value range	10 ... 100 %

8.2.1.44 Inching 2 Acceleration Type

The acceleration type in Inching operation 2 can be influenced via this parameter.

Object	261Bh
Description	Inching mode 2 acceleration type
Access	rw
Data type	UNSIGNED8
Default	0
EEPROM	Yes
Value range	0 ... 1

Value	Description
0	Static acceleration Acceleration occurs to final velocity as defined under parameter A-Inch (Object 2608h.
1	Incremental acceleration Acceleration occurs to final velocity as defined under parameter A-Inch (Object 2608h) with the following steps: 4 s to 20 % of final velocity 2 s to 50 % of final velocity 1 s to 100 % of final velocity

8.2.1.45 Offset Value

Changes to the offset value are immediately considered in the calculation of the position value.

The following equation is applied in case of calibration:
Position value = 0 + calibration value + offset value

Object	261Ch
Description	Offset value
Access	rw
Data type	INTEGER32
Default	0
EEPROM	Yes
Value range	-999999 ... 999999

8.2.1.46 PCM Position 1

Spindle pitch = 0: Values refer to steps
Spindle pitch > 0 values refer to travel distance in 1/100 mm

Object	2922h
Description	Positioning mode via digital inputs: Position 1
Access	rw
Data type	INTEGER32
Default	0
EEPROM	Yes
Value range	INTEGER32

8.2.1.47 PCM Position 2

Spindle pitch = 0: Values refer to steps
Spindle pitch > 0 values refer to travel distance in 1/100 mm

Object	2923h
Description	Positioning mode via digital inputs: Position 2
Access	rw
Data type	INTEGER32
Default	0
EEPROM	Yes
Value range	INTEGER32

8.2.1.48 PCM Position 3

Spindle pitch = 0: Values refer to steps
Spindle pitch > 0 values refer to travel distance in 1/100 mm

Object	2924h
Description	Positioning mode via digital inputs: Position 3
Access	rw
Data type	INTEGER32
Default	0
EEPROM	Yes
Value range	INTEGER32

8.2.1.49 PCM Position 4

Spindle pitch = 0: Values refer to steps
Spindle pitch > 0 values refer to travel distance in 1/100 mm

Object	2925h
Description	Positioning mode via digital inputs: Position 4
Access	rw
Data type	INTEGER32
Default	0
EEPROM	Yes
Value range	INTEGER32

8.2.1.50 PCM Position 5

Spindle pitch = 0: Values refer to steps
Spindle pitch > 0 values refer to travel distance in 1/100 mm

Object	2926h
Description	Positioning mode via digital inputs: Position 5
Access	rw
Data type	INTEGER32
Default	0
EEPROM	Yes
Value range	INTEGER32

8.2.1.51 PCM Position 6

Spindle pitch = 0: Values refer to steps
Spindle pitch > 0 values refer to travel distance in 1/100 mm

Object	2927h
Description	Positioning mode via digital inputs: Position 6
Access	rw
Data type	INTEGER32
Default	0
EEPROM	Yes
Value range	INTEGER32

8.2.1.52 PCM Position 7

Spindle pitch = 0: Values refer to steps
Spindle pitch > 0 values refer to travel distance in 1/100 mm

Object	2928h
Description	Positioning mode via digital inputs: Position 7
Access	rw
Data type	INTEGER32
Default	0
EEPROM	Yes
Value range	INTEGER32

8.2.1.53 PCM Acceleration 1

Object	2942h
Description	Positioning mode via digital inputs: Acceleration 1
Access	rw
Data type	INTEGER16
Default	50
EEPROM	Yes
Value range	1 … 100 % 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.54 PCM Acceleration 2

Object	2943h
Description	Positioning mode via digital inputs: Acceleration 2
Access	rw
Data type	INTEGER16
Default	50
EEPROM	Yes
Value range	1 … 100 % 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.55 PCM Acceleration 3

Object	2944h
Description	Positioning mode via digital inputs: Acceleration 3
Access	rw
Data type	INTEGER16
Default	50
EEPROM	Yes
Value range	1 … 100 % 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.56 PCM Acceleration 4

Object	2945h
Description	Positioning mode via digital inputs: Acceleration 4
Access	rw
Data type	INTEGER16
Default	50
EEPROM	Yes
Value range	1 … 100 % 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.57 PCM Acceleration 5

Object	2946h
Description	Positioning mode via digital inputs: Acceleration 5
Access	rw
Data type	INTEGER16
Default	50
EEPROM	Yes
Value range	1 … 100 % 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.58 PCM Acceleration 6

Object	2947h
Description	Positioning mode via digital inputs: Acceleration 6
Access	rw
Data type	INTEGER16
Default	50
EEPROM	Yes
Value range	1 … 100 % 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.59 PCM Acceleration 7

Object	2948h
Description	Positioning mode via digital inputs: Acceleration 7
Access	rw
Data type	INTEGER16
Default	50
EEPROM	Yes
Value range	1 … 100 % 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.60 PCM Velocity 1

Object	2962h
Description	Positioning mode via digital inputs: Velocity 1
Access	rw
Data type	INTEGER16
Default	10
EEPROM	Yes
Value range	Transmission 66:1 ⇒ max. 75 rpm Transmission 98:1 ⇒ max. 50 rpm Transmission 188:1 ⇒ max. 30 rpm Transmission 368:1 ⇒ max. 15 rpm

8.2.1.61 PCM Velocity 2

Object	2963h
Description	Positioning mode via digital inputs: Velocity 2
Access	rw
Data type	INTEGER16
Default	10
EEPROM	Yes
Value range	Transmission 66:1 ⇒ max. 75 rpm Transmission 98:1 ⇒ max. 50 rpm Transmission 188:1 ⇒ max. 30 rpm Transmission 368:1 ⇒ max. 15 rpm

8.2.1.62 PCM Velocity 3

Object	2964h
Description	Positioning mode via digital inputs: Velocity 3
Access	rw
Data type	INTEGER16
Default	10
EEPROM	Yes
Value range	Transmission 66:1 ⇒ max. 75 rpm Transmission 98:1 ⇒ max. 50 rpm Transmission 188:1 ⇒ max. 30 rpm Transmission 368:1 ⇒ max. 15 rpm

8.2.1.63 PCM Velocity 4

Object	2965h
Description	Positioning mode via digital inputs: Velocity 4
Access	rw
Data type	INTEGER16
Default	10
EEPROM	Yes
Value range	Transmission 66:1 ⇒ max. 75 rpm Transmission 98:1 ⇒ max. 50 rpm Transmission 188:1 ⇒ max. 30 rpm Transmission 368:1 ⇒ max. 15 rpm

8.2.1.64 PCM Velocity 5

Object	2966h
Description	Positioning mode via digital inputs: Velocity 5
Access	rw
Data type	INTEGER16
Default	10
EEPROM	Yes
Value range	Transmission 66:1 ⇒ max. 75 rpm Transmission 98:1 ⇒ max. 50 rpm Transmission 188:1 ⇒ max. 30 rpm Transmission 368:1 ⇒ max. 15 rpm

8.2.1.65 PCM Velocity 6

Object	2967h
Description	Positioning mode via digital inputs: Velocity 6
Access	rw
Data type	INTEGER16
Default	10
EEPROM	Yes
Value range	Transmission 66:1 ⇒ max. 75 rpm Transmission 98:1 ⇒ max. 50 rpm Transmission 188:1 ⇒ max. 30 rpm Transmission 368:1 ⇒ max. 15 rpm

8.2.1.66 PCM Velocity 7

Object	2968h
Description	Positioning mode via digital inputs: Velocity 7
Access	rw
Data type	INTEGER16
Default	10
EEPROM	Yes
Value range	Transmission 66:1 ⇒ max. 75 rpm Transmission 98:1 ⇒ max. 50 rpm Transmission 188:1 ⇒ max. 30 rpm Transmission 368:1 ⇒ max. 15 rpm

8.2.1.67 PCM Deceleration 1

Object	2982h
Description	Positioning mode via digital inputs: Delay 1
Access	rw
Data type	INTEGER16
Default	101
EEPROM	Yes
Value range	1 ... 101 % 101 % = the delay is determined by the PCM Acceleration 1 parameter. 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.68 PCM Deceleration 2

Object	2983h
Description	Positioning mode via digital inputs: Delay 2
Access	rw
Data type	INTEGER16
Default	101
EEPROM	Yes
Value range	1 ... 101 % 101 % = the delay is determined by the PCM Acceleration 2 parameter. 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.69 PCM Deceleration 3

Object	2984h
Description	Positioning mode via digital inputs: Delay 3
Access	rw
Data type	INTEGER16
Default	101
EEPROM	Yes
Value range	1 ... 101 % 101 % = the delay is determined by the PCM Acceleration 3 parameter. 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.70 PCM Deceleration 4

Object	2985h
Description	Positioning mode via digital inputs: Delay 4
Access	rw
Data type	INTEGER16
Default	101
EEPROM	Yes
Value range	1 ... 101 % 101 % = the delay is determined by the PCM Acceleration 4 parameter. 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.71 PCM Deceleration 5

Object	2986h
Description	Positioning mode via digital inputs: Delay 5
Access	rw
Data type	INTEGER16
Default	101
EEPROM	Yes
Value range	1 ... 101 % 101 % = the delay is determined by the PCM Acceleration 5 parameter. 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.72 PCM Deceleration 6

Object	2987h
Description	Positioning mode via digital inputs: Delay 6
Access	rw
Data type	INTEGER16
Default	101
EEPROM	Yes
Value range	1 ... 101 % 101 % = the delay is determined by the PCM Acceleration 6 parameter. 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.73 PCM Deceleration 7

Object	2988h
Description	Positioning mode via digital inputs: Delay 7
Access	rw
Data type	INTEGER16
Default	101
EEPROM	Yes
Value range	1 ... 101 % 101 % = the delay is determined by the PCM Acceleration 7 parameter. 100 % correspond to: Transmission 66:1 ⇒ 3.04 rps² Transmission 98:1 ⇒ 2.05 rps² Transmission 188:1 ⇒ 1.06 rps² Transmission 368:1 ⇒ 0.54 rps²

8.2.1.74 Output Stage Temperature

Object	2A01h
Description	Output stage temperature
Unit	1/10 °C
Access	ro
Data type	INTEGER16
Default	No
EEPROM	No

8.2.1.75 Voltage of Control

Object	2A02h
Description	Operating voltage of control
Unit	1/10 V
Access	ro
Data type	INTEGER16
Default	No
EEPROM	No

8.2.1.76 Voltage of Output Stage

Object	2A03h
Description	Operating voltage of output stage
Unit	1/10 V
Access	ro
Data type	INTEGER16
Default	No
EEPROM	No

8.2.1.77 Voltage of Battery

Object	2A04h
Description	Battery voltage
Unit	1/100 V
Access	ro
Data type	INTEGER16
Default	No
EEPROM	No

8.2.1.78 Motor Current

Object	2A05h
Description	Motor current
Unit	mA
Access	ro
Data type	INTEGER16
Default	No
EEPROM	No

8.2.1.79 Actual Position

Object	2A06h
Description	Actual position
Unit	Spindle pitch = 0: Steps Spindle pitch > 0: 1/100 mm
Access	ro
Data type	INTEGER32
Default	No
EEPROM	No

8.2.1.80 Actual Rotational Speed

Object	2A07h
Description	Actual speed
Unit	rpm
Access	ro
Data type	INTEGER16
Default	No
EEPROM	No

8.2.1.81 Serial Number

Object	2A08h
Description	Serial number
Unit	-
Access	ro
Data type	INTEGER32
Default	No
EEPROM	Yes

8.2.1.82 Production Date

Object	2A09h
Description	Production date
Unit	DDMMYYYY
Access	ro
Data type	INTEGER32
Default	No
EEPROM	Yes

8.2.1.83 SW Motor Controller

Object	2A0Ah
Description	Motor Controller software version
Unit	-
Access	ro
Data type	INTEGER32
Default	No
EEPROM	No

8.2.1.84 Gear Reduction

Object	2A0Bh
Description	Gear reduction
Unit	-
Access	ro
Data type	INTEGER16
Default	No
EEPROM	Yes

8.2.1.85 System Status Word

The system status word consists of 2 bytes and reflects the state of the actuator.

High Byte								Low Byte							
Bit number															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	1	0	1	0	0	1	0	1	0	0	1	0	0	0
2				9				4				8			

Fig. 15: Structure of the system status word

Example (gray background):

binary: ⇒ 0010 1001 0100 1000

hex: ⇒ 2 9 4 8

Object	2A0Ch
Description	System status word
Unit	-
Access	ro
Data type	UNSIGNED16
Default	No
EEPROM	No

Description of the bits, see Table 9: System status word

The table below informs about the meaning of the individual bits of the system status word:

Bit	State	Description
Bit 0	‘0‘	Irrelevant
Bit 1	‘0‘	Irrelevant
Bit 2	‘0‘	Irrelevant
Bit 3	‘1‘ ‘0‘	Positioning mode: In Position Actual position is within the positioning window of the programmed target value. Actual position is outside the positioning window of the programmed target value.
	‘1‘ ‘0‘	Speed mode: In Position Actual speed is inside the specified tolerance window of target speed Actual speed is outside the specified tolerance window.
Bit 4	‘1‘ ‘0‘	Actuator travels: Actuator travels Actuator stands still (rotational speed < 2 rpm)
Bit 5	‘1‘ ‘0‘	Positioning mode: upper limit Actual position is above the programmed limiting value. Traveling is possible only in negative direction in inching mode. Actual position is below the programmed limiting value.
	‘0‘	Speed mode: irrelevant
Bit 6	‘1‘ ‘0‘	Positioning mode: lower limit Actual position is below the programmed limiting value. Traveling is possible only in positive direction in inching mode. Actual position is above the programmed limiting value.
	‘0‘	Speed mode: irrelevant
Bit 7	‘1‘ ‘0‘	Driver state Motor is enabled Motor in control
Bit 8	‘1‘ ‘0‘	Error: Actuator has switched to error. The cause of the error must be removed and acknowledged. No error present
Bit 9	‘1‘ ‘0‘	Positioning mode: Loop travel If travel direction unequal start direction (with loop travel) If travel direction equal start direction
	‘0‘	Speed mode: irrelevant
Bit 10	‘1‘ ‘0‘	Output stage supply voltage No voltage, no traveling possible Voltage applied
Bit 11	‘1‘ ‘0‘	Ready for travel: Not ready for travel Ready for travel: Actuator not in error state No active positioning Supply voltage of the output stage is applied Actual position within limits (only positioning mode)

Bit	State	Description
Bit 12	‘1‘ ‘0‘	Battery voltage: Battery voltage < 2.6 V Battery voltage OK
Bit 13	‘1‘ ‘0‘	Current limiting Current limiting active Current limiting not active
Bit 14	‘1‘ ‘0‘	Positioning mode: Status Positioning active in positioning mode. Positioning inactive.
	‘1‘ ‘0‘	Speed mode: Status Enable target speed Target speed disabled
Bit 15	‘1‘ ‘0‘	Contouring error: Contouring error ⇒ the actuator cannot reach the preset speed due to too high load. The actuator switches the contouring error fault. Remedy: reduce programmed speed! no contouring error ⇒ actual speed corresponds with target speed.

Table 9: System status word

8.2.1.86 Encoder Resolution

Object	2A0Dh
Description	Encoder resolution
Unit	Steps per revolution of the output shaft
Access	ro
Data type	INTEGER16
Default	No
EEPROM	Yes

8.2.1.87 Device ID

Object	2A0Eh
Description	Device identification
Unit	-
Access	ro
Data type	UNSIGNED8
Default	No
EEPROM	Yes

1 = AG25
2 = AG26

8.2.1.88 Number of Errors

Object	2B01h
Description	Number of errors
Unit	-
Access	ro
Data type	UNSIGNED8
Default	No
EEPROM	No

8.2.1.89 Error Number 1

Object	2B02h
Description	Error 1
Unit	-
Access	ro
Data type	UNSIGNED8
Default	No
EEPROM	Yes

8.2.1.90 Error Number 2

Object	2B03h
Description	Error 2
Unit	-
Access	ro
Data type	UNSIGNED8
Default	No
EEPROM	Yes

8.2.1.91 Error Number 3

Object	2B04h
Description	Error 3
Unit	-
Access	ro
Data type	UNSIGNED8
Default	No
EEPROM	Yes

8.2.1.92 Error Number 4

Object	2B05h
Description	Error 4
Unit	-
Access	ro
Data type	UNSIGNED8
Default	No
EEPROM	Yes

8.2.1.93 Error Number 5

Object	2B06h
Description	Error 5
Unit	-
Access	ro
Data type	UNSIGNED8
Default	No
EEPROM	Yes

8.2.1.94 Error Number 6

Object	2B07h
Description	Error 6
Unit	-
Access	ro
Data type	UNSIGNED8
Default	No
EEPROM	Yes

8.2.1.95 Error Number 7

Object	2B08h
Description	Error 7
Unit	-
Access	ro
Data type	UNSIGNED8
Default	No
EEPROM	Yes

8.2.1.96 Error Number 8

Object	2B09h
Description	Error 8
Unit	-
Access	ro
Data type	UNSIGNED8
Default	No
EEPROM	Yes

8.2.1.97 Error Number 9

Object	2B0Ah
Description	Error 9
Unit	-
Access	ro
Data type	UNSIGNED8
Default	No
EEPROM	Yes

8.2.1.98 Error Number 10

Object	2B0Bh
Description	Error 10
Unit	-
Access	ro
Data type	UNSIGNED8
Default	No
EEPROM	Yes

8.2.1.99 Configuration

Various performance of the actuator can be configured via this parameter.

Object	2B21h
Description	Configuration of the actuator
Access	rw
Data type	UNSIGNED16
Default	15
EEPROM	yes
Value range	0 ... 65535

Bit	Description
0 ... 3	reserved, always 1
4 ... 5	reserved, always 0
6	Auto reset in the EXCEPTION state 0 = switched off (factory setting): In the EXCEPTION state, the drive stops participating in network traffic and can no longer be addressed. To exit this state, a Power On Reset is required. 1 = switched on: In the EXCEPTION state, the drive automatically performs a reset. After the restart, the EXCEPTION fault is triggered.
7 ... 15	reserved, always 0

8.2.1.100 S-Command

Object	2C01h
Description	S command
Unit	-
Access	rw
Data type	UNSIGNED8
Default	No
EEPROM	No

Value	Description
1	All parameters to default
2	Only standard parameters to default
3	Controller parameters to default
6	Reset error
7	Calibrate
8	Delete error memory

8.2.2 Standard objects parameter description

8.2.2.1 Device Type

Object	1000h
Sub-index	00h
Description	Information on the device profile
Access	ro
Data type	UNSIGNED32
Default	0000 0000h (no profile)

8.2.2.2 Error Register

Object	1001h
Sub-index	00h
Description	Actuator's error condition
Access	ro
Data type	UNSIGNED8
Default	No

8.2.2.3 Pre-defined error field

Object	1003h
Sub-index	00h
Description	Number of errors
Access	rw
Data type	UNSIGNED8
Default	0

Object	1003h
Sub-index	01h - 05h
Description	Error 1-5
Access	ro
Data type	UNSIGNED32
Default	No

8.2.2.4 Manufacturer Device Name

Object	1008h
Sub-index	00h
Description	Device name
Access	ro
Data type	VISIBLE_STRING
Default	Device-dependent "AG25-66" "AG25-98" "AG26-188" "AG26-368"

8.2.2.5 Manufacturer Hardware Version

Object	1009h
Sub-index	00h
Description	Hardware version
Access	ro
Data type	VISIBLE_STRING
Default	Current hardware version format: "HW_1.00"

8.2.2.6 Manufacturer Software Version

Object	100Ah
Sub-index	00h
Description	Software version
Access	ro
Data type	VISIBLE_STRING
Default	Current software version “SW_1.04”

8.2.2.7 Restore default parameters

Object	1011h
Sub-index	00h
Description	Largest sub-index supported
Access	ro
Data type	UNSIGNED8
Default	01h

Object	1011h
Sub-index	01h
Description	Set all parameters to default values
Access	rw
Data type	UNSIGNED32
Default	No

8.2.2.8 Identity Object

Object	1018h
Sub-index	00h
Description	Number of entries
Access	ro
Data type	UNSIGNED8
Default	4

Object	1018h
Sub-index	01h
Description	Vendor ID
Access	ro
Data type	UNSIGNED32
Default	0000 0195h (SIKO GmbH)

Object	1018h
Sub-index	02h
Description	Product code
Access	ro
Data type	UNSIGNED32
Default	0001 0104h (AG25-66) 0001 0100h (AG25-98) 0001 0202h (AG26-188) 0001 0203h (AG26-368)

Object	1018h
Sub-index	03h
Description	Revision number
Access	ro
Data type	UNSIGNED32
Default	Current revision number

Object	1018h
Sub-index	03h
Description	Serial number
Access	ro
Data type	UNSIGNED32
Default	Current serial number

8.2.2.9 Receive PDO Mapping

Object	1600h
Sub-index	00h
Description	Number of objects in PDO
Access	ro
Data type	UNSIGNED8
Default	3

Object	1600h
Sub-index	01h
Description	Mapped object 001
Access	ro
Data type	UNSIGNED32
Default	2002 0010h

Object	1600h
Sub-index	02h
Description	Mapped object 002
Access	ro
Data type	UNSIGNED32
Default	2003 0020h

Object	1600h
Sub-index	03h
Description	Mapped object 003
Access	ro
Data type	UNSIGNED32
Default	2001 0008h

8.2.2.10 Transmit PDO Mapping

Object	1A00h
Sub-index	00h
Description	Number of objects in PDO
Access	ro
Data type	UNSIGNED8
Default	3

Object	1A00h
Sub-index	01h
Description	Mapped object 001
Access	ro
Data type	UNSIGNED32
Default	2102 0010h

Object	1A00h
Sub-index	02h
Description	Mapped object 002
Access	ro
Data type	UNSIGNED32
Default	2103 0020h

Object	1A00h
Sub-index	03h
Description	Mapped object 003
Access	ro
Data type	UNSIGNED32
Default	2101 0008h

8.2.2.11 Sync Manager Communication Type

Object	1C00h
Sub-index	00h
Description	Number of Sync manager channels used
Access	ro
Data type	UNSIGNED8
Default	4

Object	1C00h
Sub-index	01h
Description	Communication type of Sync manger 0
Access	ro
Data type	UNSIGNED8
Default	1 (mailbox receive)

Object	1C00h
Sub-index	02h
Description	Communication type of Sync manger 1
Access	ro
Data type	UNSIGNED8
Default	2 (mailbox send)

Object	1C00h
Sub-index	03h
Description	Communication type of Sync manger 2
Access	ro
Data type	UNSIGNED8
Default	3 (Rx PDO)

Object	1C00h
Sub-index	04h
Description	Communication type of Sync manger 3
Access	ro
Data type	UNSIGNED8
Default	4 (Tx PDO)

8.2.2.12 Sync Manager Rx PDO assign

Object	1C12h
Sub-index	00h
Description	Number of entries
Access	ro
Data type	UNSIGNED8
Default	1

Object	1C12h
Sub-index	01h
Description	Index of Rx PDO
Access	ro
Data type	UNSIGNED16
Default	1600h

8.2.2.13 Sync Manager Tx PDO assign

Object	1C13h
Sub-index	00h
Description	Number of entries
Access	ro
Data type	UNSIGNED8
Default	1

Object	1C13h
Sub-index	01h
Description	Index of Tx PDO
Access	ro
Data type	UNSIGNED16
Default	1A00h

8.2.2.14 SM output parameters

Object	1C32h
Sub-index	00h
Description	Largest sub-index supported
Access	ro
Data type	UNSIGNED8
Default	12

Object	1C32h
Sub-index	01h
Description	Sync Mode
Access	rw
Data type	UNSIGNED16
Default	00h (Free Run)

Object	1C32h
Sub-index	02h
Description	Cycle time
Access	rw
Data type	UNSIGNED32
Default	001E 8480h (2000000 ns)

Object	1C32h
Sub-index	03h
Description	Shift time
Access	rw
Data type	UNSIGNED32
Default	0

Object	1C32h
Sub-index	04h
Description	Supported synchronization types
Access	ro
Data type	UNSIGNED16
Default	0001h

Object	1C32h
Sub-index	05h
Description	Minimum cycle time
Access	ro
Data type	UNSIGNED32
Default	0001 86A0h (100000 ns)

Object	1C32h
Sub-index	06h
Description	Calc to Copy Time
Access	ro
Data type	UNSIGNED32
Default	0000 01F5h (500 ns)

Object	1C32h
Sub-index	09h
Description	Delay time
Access	ro
Data type	UNSIGNED32
Default	0

Object	1C32h
Sub-index	0Ch
Description	Cycle Time Too Small
Access	ro
Data type	UNSIGNED16
Default	0

8.2.2.15 SM input parameters

Object	1C33h
Sub-index	00h
Description	Largest sub-index supported
Access	ro
Data type	UNSIGNED8
Default	12

Object	1C33h
Sub-index	01h
Description	Sync Mode
Access	rw
Data type	UNSIGNED16
Default	00h (Free Run)

Object	1C33h
Sub-index	02h
Description	Cycle time
Access	rw
Data type	UNSIGNED32
Default	001E 8480h (2000000 ns)

Object	1C33h
Sub-index	03h
Description	Shift time
Access	rw
Data type	UNSIGNED32
Default	0

Object	1C33h
Sub-index	04h
Description	Supported synchronization types
Access	ro
Data type	UNSIGNED16
Default	0001h

Object	1C33h
Sub-index	05h
Description	Minimum cycle time
Access	ro
Data type	UNSIGNED32
Default	0001 86A0h (100000 ns)

Object	1C33h
Sub-index	06h
Description	Calc to Copy Time
Access	ro
Data type	UNSIGNED32
Default	0000 01F5h (500 ns)

Object	1C33h
Sub-index	0Ch
Description	Cycle Time Too Small
Access	ro
Data type	UNSIGNED16
Default	0

9 Service protocol

NOTICE	If there is process data exchange with a network master, then writing of parameters and execution of commands via the service protocol are disabled. In this case, the drive replies with the error code “?03”, no operating authorization.

9.1 General Information

The service protocol enables parameterization and control of the drive with ASCII commands via an ASCII terminal.

9.1.1 Communication

9.1.2 Settings

Available baud rates: 9.6 Kbit/s / 19.2 Kbit/s / 57.6 Kbit/s (factory setting), 115.2 Kbit/s

Additional settings: no parity, 8 data bits, 1 stop bit, no handshake

9.1.3 ASCII commands

An ASCII command consists of an ASCII character and additional arguments such as parameter address, mathematical sign and value.

Length and format of an ASCII command are defined unchangeably.

9.1.4 Responses

Except for a few cases, the actuator responds to ASCII commands with a terminating string (ASCII-character ">" + Carriage Return "<CR>"). The responses to read commands contain return values in addition. Length and format of the response are defined unchangeably for every ASCII command.

9.2 Overview of parameters

Chapter	starting with page
Error memory	99

9.3 Parameters

9.3.1 Positioning

9.3.1.1 Target Value

Read command	E0	see chapter 9.8 ASCII command structure
Write command	F0±xxxxxxx	
Description	see chapter 8.2.1.3 Target Value	

9.3.1.2 Actual Position

Read command	Z	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	Decimal format see chapter 8.2.1.79 Actual Position	

Read command	W	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	Binary format see chapter 8.2.1.79 Actual Position	

9.3.1.3 Actual Rotational Speed

Read command	V	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.80 Actual Rotational Speed	

9.3.1.4 Calibration Value

Read command	E3	see chapter 9.8 ASCII command structure
Write command	F3±xxxxxxx	
Description	see chapter 8.2.1.31 Calibration Value	

9.3.1.5 Loop Length

Read command	G17	see chapter 9.8 ASCII command structure
Write command	H17xxxxx	
Description	see chapter 8.2.1.40 Loop Length	

9.3.1.6 Offset Value

Read command	E5	see chapter 9.8 ASCII command structure
Write command	F5±xxxxxxx	
Description	see chapter 8.2.1.45 Offset Value	

9.3.1.7 Pos Type

Read command	Q	see chapter 9.8 ASCII command structure
Write command	Lx	
Description	see chapter 8.2.1.36 Pos Type	
Info	Reading of the positioning type is via the flag register (see chapter 9.3.6.6: Flag Register). x = 0: Positioning direct x = 1: positioning with loop positive x = 2: positioning with loop negative	

9.3.1.8 Pos Window

Read command	G09	see chapter 9.8 ASCII command structure
Write command	H09xxxxx	
Description	see chapter 8.2.1.27 Pos Window	

9.3.1.9 Sense of Rotation

Read command	Q	see chapter 9.8 ASCII command structure
Write command	Tx	
Description	see chapter 8.2.1.35 Sense of Rotation	
Info	Reading of the sense of rotation is via the flag register (see chapter 9.3.6.6: Flag Register). x = 0: i sense of rotation x = 1: e sense of rotation	

9.3.1.10 Spindle Pitch

Read command	G13	see chapter 9.8 ASCII command structure
Write command	H13xxxxx	
Description	see chapter 8.2.1.30 Spindle Pitch	

9.3.2 Actuator

9.3.2.1 A-Pos

Read command	G03	see chapter 9.8 ASCII command structure
Write command	H03xxxxx	
Description	see chapter 8.2.1.21 A-Pos	

9.3.2.2 V-Pos

Read command	G04	see chapter 9.8 ASCII command structure
Write command	H04xxxxx	
Description	see chapter 8.2.1.22 V-Pos	

9.3.2.3 D-Pos

Read command	G44	see chapter 9.8 ASCII command structure
Write command	H44xxxxx	
Description	see chapter 8.2.1.23 D-Pos	

9.3.2.4 A-Rot

Read command	G05	see chapter 9.8 ASCII command structure
Write command	H05xxxxx	
Description	see chapter 8.2.1.24 A-Rot	

9.3.2.5 A-Inch

Read command	G07	see chapter 9.8 ASCII command structure
Write command	H07xxxxx	
Description	see chapter 8.2.1.25 A-Inch	

9.3.2.6 V-Inch

Read command	G08	see chapter 9.8 ASCII command structure
Write command	H08xxxxx	
Description	see chapter 8.2.1.26 V-Inch	

9.3.2.7 Gear Ratio Denominator

Read command	G11	see chapter 9.8 ASCII command structure
Write command	H11xxxxx	
Description	see chapter 8.2.1.29 Gear Ratio Denominator	

9.3.2.8 Gear Ratio Numerator

Read command	G10	see chapter 9.8 ASCII command structure
Write command	H10xxxxx	
Description	see chapter 8.2.1.28 Gear Ratio Numerator	

9.3.3 Limiting values

9.3.3.1 Software Limit 1

Read command	E1	see chapter 9.8 ASCII command structure
Write command	F1±xxxxxxx	
Description	see chapter 8.2.1.32 Software Limit 1	

9.3.3.2 Software Limit 2

Read command	E2	see chapter 9.8 ASCII command structure
Write command	F2±xxxxxxx	
Description	see chapter 8.2.1.33 Software Limit 2	

9.3.3.3 Current Limiting

Read command	G24	see chapter 9.8 ASCII command structure
Write command	H24xxxxx	
Description	see chapter 8.2.1.42 Current Limiting	

9.3.3.4 Contouring Error Limit

Read command	G18	see chapter 9.8 ASCII command structure
Write command	H18xxxxx	
Description	see chapter 8.2.1.41 Contouring Error Limit	

9.3.4 Options

9.3.4.1 Operating Mode

Read command	Q	see chapter 9.8 ASCII command structure
Write command	Xy	
Description	see chapter 8.2.1.37 Operating Mode	
Info	Reading of the operating mode is via the flag register (see chapter 9.3.6.6: Flag Register). y = 0: Positioning mode y = 1: Rotational speed mode	

9.3.4.2 Inpos Mode

Read command	G16	see chapter 9.8 ASCII command structure
Write command	H16xxxxx	
Description	see chapter 8.2.1.39 Inpos Mode	

9.3.4.3 Delta Inch

Read command	E4	see chapter 9.8 ASCII command structure
Write command	F4±xxxxxxx	
Description	see chapter 8.2.1.34 Delta Inch	

9.3.4.4 Inching 2 Acceleration Type

Read command	G39	see chapter 9.8 ASCII command structure
Write command	H39xxxxx	
Description	see chapter 8.2.1.44 Inching 2 Acceleration Type	

9.3.4.5 Inching 2 Offset

Read command	G27	see chapter 9.8 ASCII command structure
Write command	H27xxxxx	
Description	see chapter 8.2.1.43 Inching 2 Offset	

9.3.4.6 Inching 2 Stop Mode

Read command	G15	see chapter 9.8 ASCII command structure
Write command	H15xxxxx	
Description	see chapter 8.2.1.38 Inching 2 Stop Mode	

9.3.4.7 LED Functionality

Read command	G45	see chapter 9.8 ASCII command structure
Write command	H45xxxxx	
Description	see chapter 8.2.1.7 LED Functionality	

9.3.4.8 Service Interface Baud Rate

Read command	G25	see chapter 9.8 ASCII command structure
Write command	H25xxxxx	
Description	see chapter 8.2.1.8 Service Interface Baud Rate	

9.3.4.9 Configuration

Read command	G61	see chapter 9.8 ASCII command structure
Write command	H61xxxxx	
Description	see chapter 8.2.1.99 Configuration	

9.3.5 Controller parameters

9.3.5.1 Controller Parameter P

Read command	G00	see chapter 9.8 ASCII command structure
Write command	H00xxxxx	
Description	see chapter 8.2.1.18 Controller Parameter P	

9.3.5.2 Controller Parameter I

Read command	G01	see chapter 9.8 ASCII command structure
Write command	H01xxxxx	
Description	see chapter 8.2.1.19 Controller Parameter I	

9.3.5.3 Controller Parameter D

Read command	G02	see chapter 9.8 ASCII command structure
Write command	H02xxxxx	
Description	see chapter 8.2.1.20 Controller Parameter D	

9.3.6 Device information

9.3.6.1 Motor Current

Read command	B04	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.78 Motor Current	

9.3.6.2 Output Stage Temperature

Read command	B00	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.74 Output Stage Temperature	

9.3.6.3 Voltage of Control

Read command	B01	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.75 Voltage of Control	

9.3.6.4 Voltage of Output Stage

Read command	B02	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.76 Voltage of Output Stage	

9.3.6.5 Voltage of Battery

Read command	B03	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.77 Voltage of Battery	

9.3.6.6 Flag Register

Read command	Q	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	x x x x x x x x = binary representation of the flag register 7 6 5 4 3 2 1 0 Bit Bit 0: Sense of rotation: '0' = i '1' = e Bit 1+2: Type of positioning: '00' = direct '01' = loop + '10' = loop – Bit 3: not assigned Bit 4: operating mode: '0' = positioning mode '1' = speed mode Bits 5+6+7: not assigned	

9.3.6.7 System Status Word

Read command	R	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.85 System Status Word	

9.3.6.8 Device Type

Read command	A0	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	Response format: "AG25 >"	

9.3.6.9 Gear Reduction

Read command	A4	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	Response format: "98 >"	

9.3.6.10 Motor Type

Read command	A7	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	Response format: "50W >"	

9.3.6.11 Network Type

Read command	A3	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	Response format: "ECT >"	

9.3.6.12 Production Date

Read command	A6	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	Response format: "DDMMYYYY>"	

9.3.6.13 Serial Number

Read command	A5	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	Response format: "12345678>"	

9.3.6.14 SW Ethernet Module

Read command	A2	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	Response format: "01:02:63>"	

9.3.6.15 SW Motor Controller

Read command	A1	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	Response format: "V1.00 >"	

9.3.7 Digital input/output

9.3.7.1 Digital Input 1 Functionality

Read command	G49	see chapter 9.8 ASCII command structure
Write command	H49xxxxx	
Description	see chapter 8.2.1.12 Digital Input 1 Functionality	

9.3.7.2 Digital Input 2 Functionality

Read command	G50	see chapter 9.8 ASCII command structure
Write command	H50xxxxx	
Description	see chapter 8.2.1.13 Digital Input 2 Functionality	

9.3.7.3 Digital Input 3 Functionality

Read command	G51	see chapter 9.8 ASCII command structure
Write command	H51xxxxx	
Description	see chapter 8.2.1.14 Digital Input 3 Functionality	

9.3.7.4 Digital Input 4 Functionality

Read command	G52	see chapter 9.8 ASCII command structure
Write command	H52xxxxx	
Description	see chapter 8.2.1.15 Digital Input 4 Functionality	

9.3.7.5 Digital Input Functionalities State

Read command	U1029	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.16 Digital Input Functionalities State	

9.3.7.6 Digital Inputs Polarity

Read command	G54	see chapter 9.8 ASCII command structure
Write command	H54xxxxx	
Description	see chapter 8.2.1.17 Digital Inputs Polarity	

9.3.7.7 Digital Inputs State

Read command	B05	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.4 Digital Inputs State	

9.3.7.8 Digital Output 1 Functionality

Read command	G46	see chapter 9.8 ASCII command structure
Write command	H46xxxxx	
Description	see chapter 8.2.1.9 Digital Output 1 Functionality	

9.3.7.9 Digital Outputs Control

Read command	G60	see chapter 9.8 ASCII command structure
Write command	H60xxxxx	
Description	see chapter 8.2.1.1 Digital Outputs Control	

9.3.7.10 Digital Output Functionalities State

Read command	U0770	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.10 Digital Output Functionalities State	

9.3.7.11 Digital Outputs Polarity

Read command	G48	see chapter 9.8 ASCII command structure
Write command	H48xxxxx	
Description	see chapter 8.2.1.11 Digital Outputs Polarity	

9.3.8 Error memory

9.3.8.1 Number of Errors

Read command	J00	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.88 Number of Errors	

9.3.8.2 Error Number 1

Read command	J01	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.89 Error Number 1	

9.3.8.3 Error Number 2

Read command	J02	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.90 Error Number 2	

9.3.8.4 Error Number 3

Read command	J03	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.91 Error Number 3	

9.3.8.5 Error Number 4

Read command	J04	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.92 Error Number 4	

9.3.8.6 Error Number 5

Read command	J05	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.93 Error Number 5	

9.3.8.7 Error Number 6

Read command	J06	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.94 Error Number 6	

9.3.8.8 Error Number 7

Read command	J07	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.95 Error Number 7	

9.3.8.9 Error Number 8

Read command	J08	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.96 Error Number 8	

9.3.8.10 Error Number 9

Read command	J09	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.97 Error Number 9	

9.3.8.11 Error Number 10

Read command	J10	see chapter 9.8 ASCII command structure
Write command	read-only	
Description	see chapter 8.2.1.98 Error Number 10	

9.4 Commands

9.4.1 Start travel job

Command	M	see chapter 9.8 ASCII command structure
Description	Positioning mode: – start of positioning process to programmed set point Speed mode: –start of speed mode	

9.4.2 Start of inching mode 1

Command	Y	see chapter 9.8 ASCII command structure
Description	only in positioning mode	

9.4.3 Start inching mode 2 positive travel direction

Command	, ($2C_{hex}$)	see chapter 9.8 ASCII command structure
Description	Drive travels in positive direction as long as the "," ASCII character is permanently sent (only in positioning mode).	

9.4.4 Start inching mode 2 negative travel direction

Command	. ($2E_{hex}$)	see chapter 9.8 ASCII command structure
Description	Drive travels in negative direction as long as the "." ASCII character is permanently sent (only in positioning mode).	

9.4.5 Cancel current travel job in positioning mode

Command	I (49_{hex})	see chapter 9.8 ASCII command structure
Description	Motor remains in control state	

9.4.6 Motor stop fast

NOTICE	If a contouring error is pending at the time of the 'N' command, the motor will be enabled.

Command	N	see chapter 9.8 ASCII command structure
Description	Motor decelerates with maximum delay. Motor remains in control state!	

9.4.7 Motor stop

NOTICE	If a contouring error is pending at the time of the "O" command, the motor will be enabled.

Command	O	see chapter 9.8 ASCII command structure
Description	Motor decelerates with programmed delay. Motor remains in control state!	

9.4.8 Enable motor

Command	P	see chapter 9.8 ASCII command structure
Description	Motor is enabled	

9.4.9 Factory setting: all parameters

Command	S11100	see chapter 9.8 ASCII command structure
Description	Reset all parameters to factory settings	

9.4.10 Factory setting: Standard parameter

Command	S11101	see chapter 9.8 ASCII command structure
Description	Reset only standard parameters to factory settings	

9.4.11 Factory setting: Controller parameters

Command	S11102	see chapter 9.8 ASCII command structure
Description	Reset only controller parameters to factory settings	

9.4.12 Acknowledge error

Command	S11103	see chapter 9.8 ASCII command structure
Description	Acknowledge active error	

9.4.13 Calibrate

Command	S11104	see chapter 9.8 ASCII command structure
Description	Calibrate actuator	

9.4.14 Delete error memory

Command	S11105	see chapter 9.8 ASCII command structure
Description	Deleting of the error memory	

9.4.15 Software Reset

Command	K	see chapter 9.8 ASCII command structure
Description	Execute software reset	

9.5 Flow charts

9.5.1 Flow chart: Positioning mode

The flow chart below shows the control of positioning in the positioning mode via service protocol (see chapter 9: Service protocol).

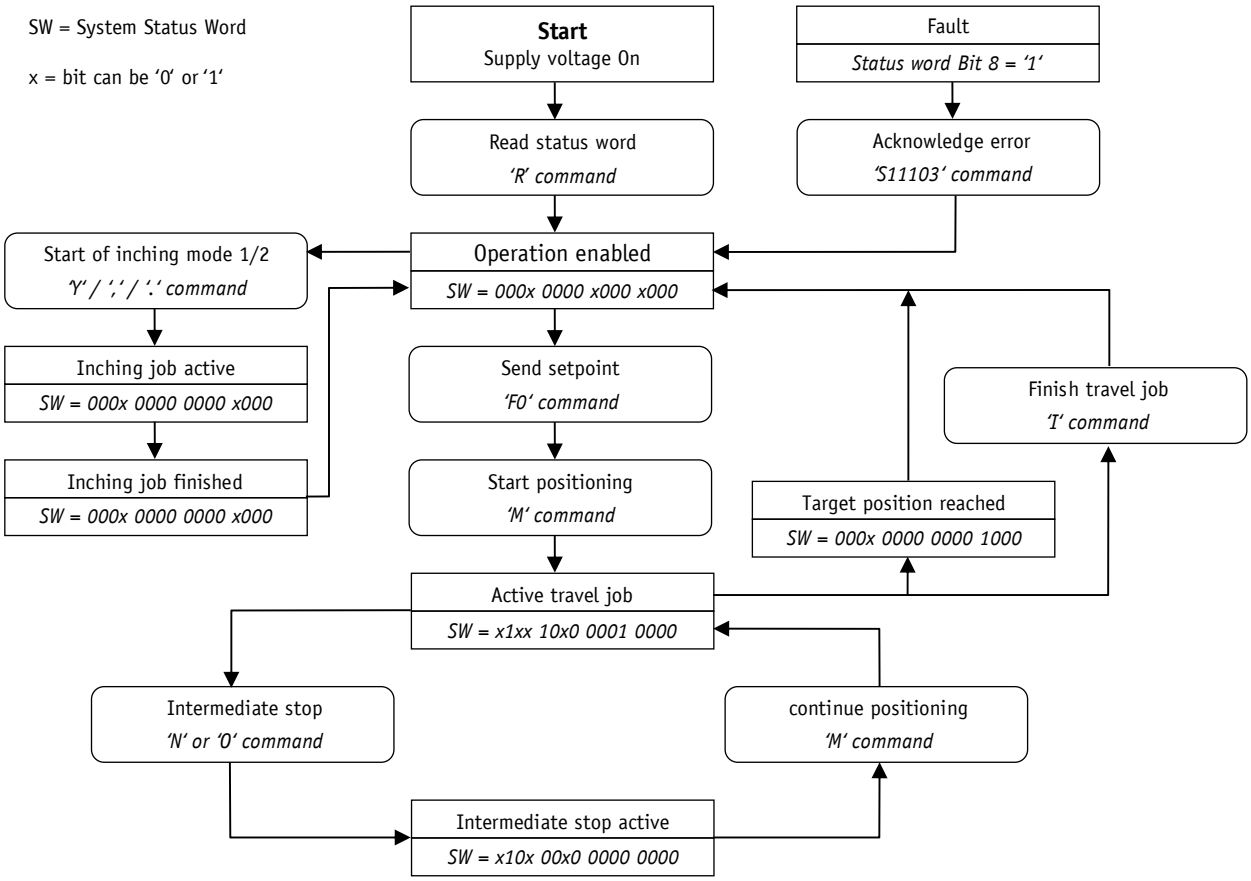

Fig. 16: Flowchart of positioning mode service protocol

9.5.2 Flow chart: Speed mode

The flow chart below illustrates the control in the rotational speed mode via service protocol (see chapter 9: Service protocol).

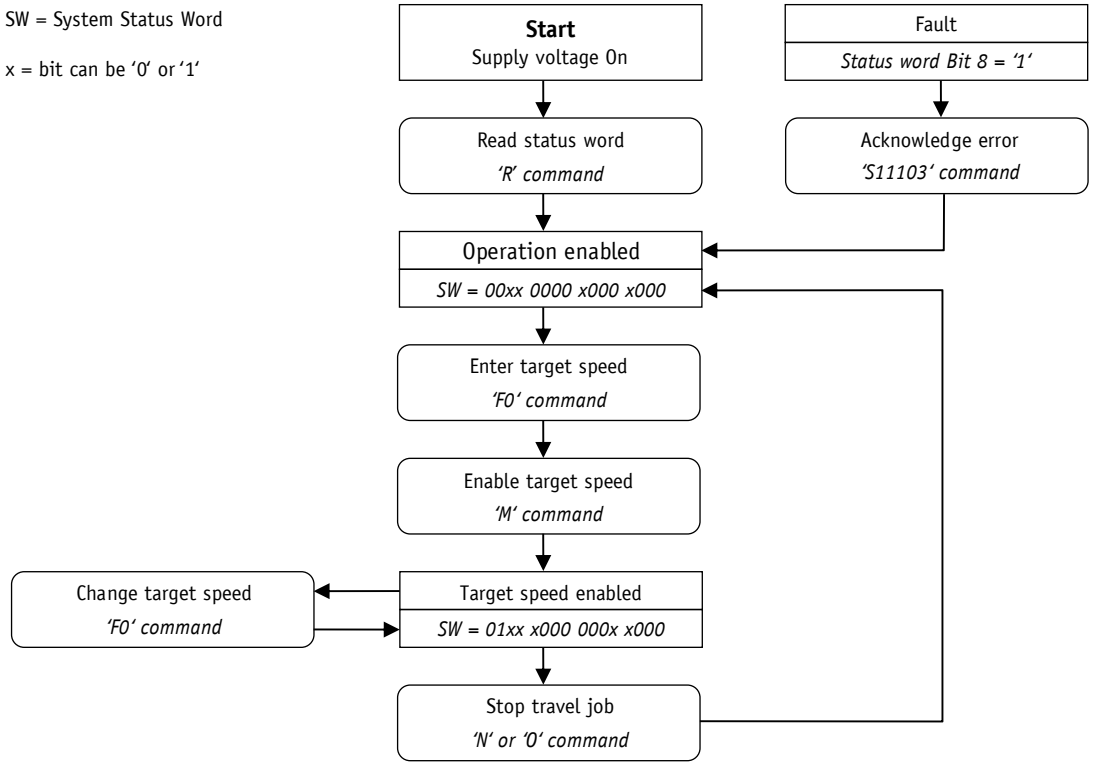

Fig. 17: Flow chart speed mode service protocol

9.6 Error number encoding

Faulty inputs are acknowledged with an error message. An error message is always prefixed by a question mark, followed by a two-digit error code. The error message ends with a carriage return "<CR>".

Code	Description
?01	Input of illegal parameter number
?02	Illegal value range:
?03	No operating authorization (active process data exchange with network master)
?04	Input disabled due to operating state
?05	Limit switch 1 active
?06	Limit switch 2 active
?07	Actual or target value > upper software limit
?08	Actual or target value < lower software limit
?09	Setpoint entered exceeds limiting value
?10	Fault
?11	Active EEPROM write access
?12	Actual or target value < lower area limit
?13	Actual or target value > upper area limit
?14	Operating voltage of control missing

9.7 Examples

9.7.1 Write and read setpoint +500

Write command: F0+0000500 (10 characters)

Reply: ><CR> (2 characters)

Read command: E0 (2 characters)

Reply: +0000500><CR> (10 characters)

9.7.2 Start travel job

Command M (1 character)

Reply: ><CR> (2 characters)

9.8 ASCII command structure

Command	Length	Access	Reply	CR	Length	Description
Ay	2	read	xxxxxxxx>	x	10	Device information (constants) y = address xxxxxxxx = string
Byy	3	read	±xxxxxxx>	x	10	Device information (actual values) yy = address ±xxxxxxx = decimal value
Ey	2	read	±xxxxxxx>	x	10	Read parameter (3-byte) y = address ±xxxxxxx = decimal value
Fy±xxxxxxx	10	write	>	x	2	Write parameter (3-byte) y = address ±xxxxxxx = decimal value
Gyy	3	read	"xxxxx>"	x	7	Read parameter (2-byte) yy = address xxxxx = decimal value
Hyyxxxxx	8	write	>	x	2	Write parameter (2-byte) yy = address xxxxx = decimal value
I	1	write	>	x	2	Cancel current travel job in positioning mode
Jyy	3	read	0xhh>	x	6	Error memory yy = address hh = hexadecimal value
K	1	write	>	x	2	Software Reset
Lx	2	write	>	x	2	Type of positioning x = decimal value
M	1	write	>	x	2	Start travel job

Command	Length	Access	Reply	CR	Length	Description
N	1	write	>	x	2	Motor stop fast
O	1	write	>	x	2	Motor stop
P	1	write	>	x	2	Enable motor
Q	1	read	0xhh>	x	6	Flag Register hh = hexadecimal value
R	1	read	0xhhll>	x	8	System status word hh = hexadecimal value High byte ll = hexadecimal value Low byte
Sxxxxx	6	write	>	x	2	System command xxxxx = code
Tx	2	write	>	x	2	Sense of rotation x = decimal value
Uxxxx	5	read	bbbb		4	Read parameter (4-byte) bbbb = binary value in the Big-Endian format
V	1	read	±xxxx>	x	7	Actual rotational speed ±xxxx = decimal value with arithmetical sign
W	1	read	bbbb		4	Position value in binary format bbbb = binary value in the Big-Endian format
Xy	2	write	>	x	2	Operating mode y = decimal value
Y	1	write	>	x	2	Start of inching mode 1
Z	1	read	±xxxxxxx>	x	10	Position value ±xxxxxxx decimal value
, ($2C_{hex}$)	1	write			0	Start inching mode 2 positive travel direction
. ($2E_{hex}$)	1	write			0	Start inching mode 2 negative travel direction

10 Block diagram

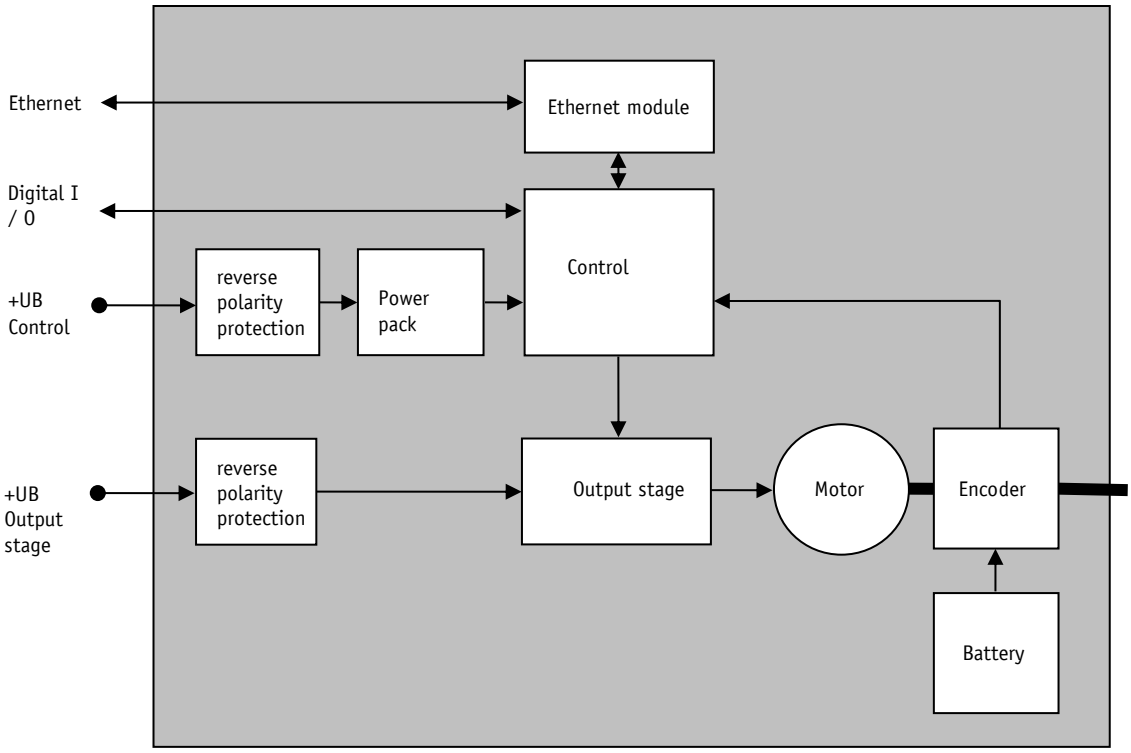

Fig. 18: Block diagram