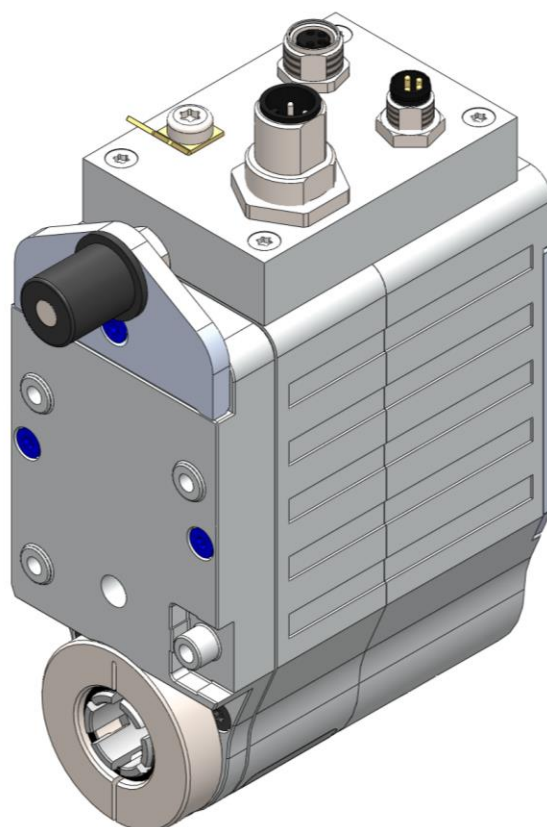

User manual

Actuator
with RS485/SIKONETZ5 interface

AG03/1



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1 General Information

1.1 Documentation

The following documents are associated with this document:

- Product data sheet, describes the technical data, the dimensions, the pin assignment, the accessories and the order key.
- Installation instruction, describes the mechanical and electrical installation with all safety-relevant conditions and the associated technical specifications.
- User manual for commissioning the actuator and integrating it into a fieldbus system.

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

2 Block diagram

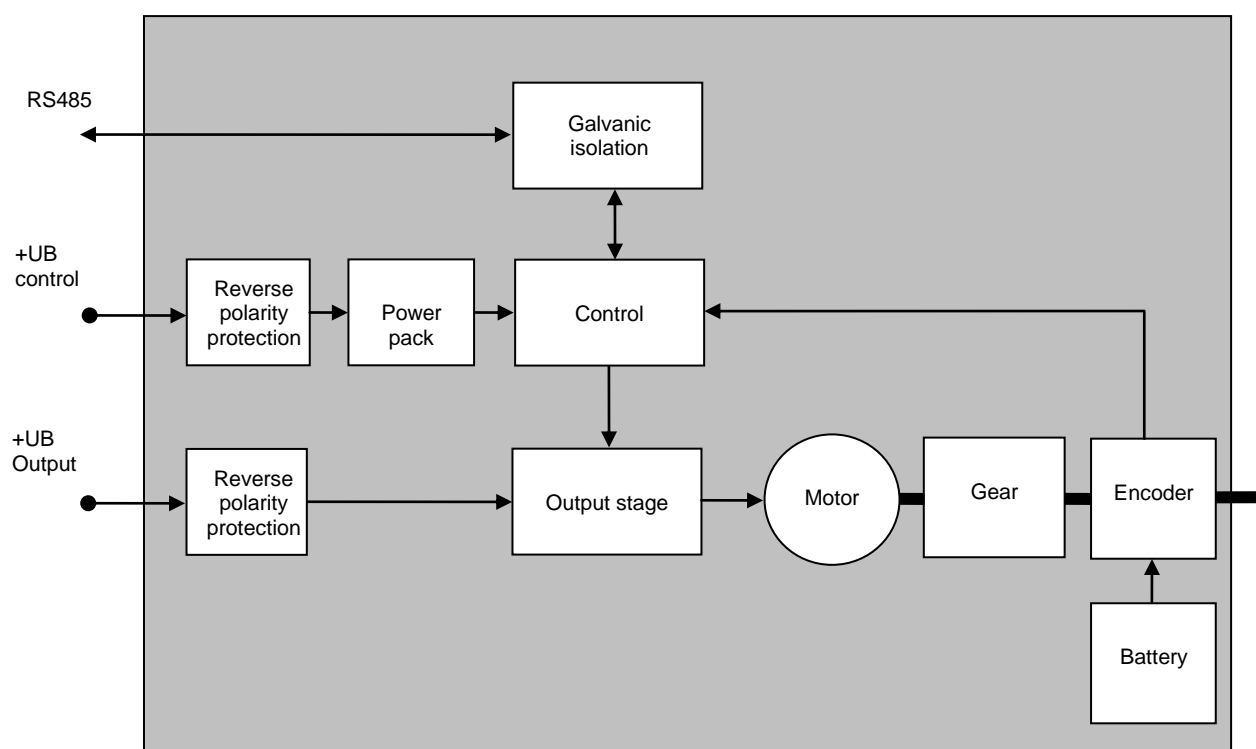


Fig. 1: Block diagram

3 Display and operating elements

3.1 General Information

The actuator has two operator keys (1, 2), two LEDs (3, 4) and one 10-pin DIP switch (5).

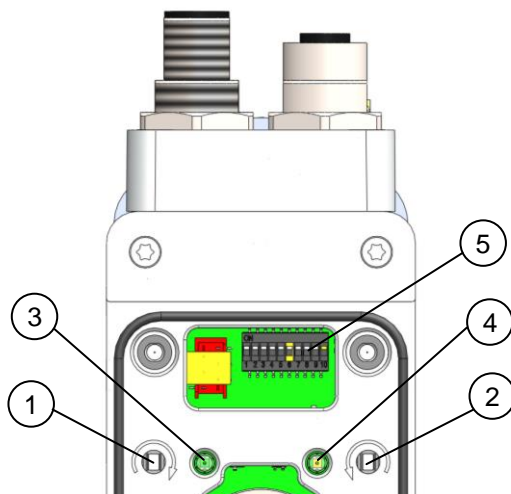


Fig. 2: Display and operating elements

3.2 Operating keys

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) clockwise movement
Key (2) counter-clockwise movement

3.3 DIP switch

Bus-specific settings can be made via the DIP switch
For a more detailed description of the functions refer to the bus-specific part of this manual.

The factory settings can also be restored by means of the DIP switch (see *chapter 4.1.3: Restore factory settings via DIP switches*).

3.4 LED displays

LED	Color	State	Description
LED3	green	on	Supply voltage of the output stage is applied
		blink 1 x	Error: Undervoltage:
		blink 2 x	Error: Shaft blocked
		blink 3 x	Error: Overcurrent
		blink 4 x	Error: Output stage excess temperature
		blink 5 x	Error: SIN COS monitoring
		blink 6 x	Error: Internal error
		blink 7 x	Error: Overvoltage
		blink 8 x	Error: Checksum error SIKONETZ5
		blink 9 x	Error: Timeout SIKONETZ5
		blink 10 x	Error: Low battery voltage:
		off	Supply voltage of the output stage not applied
LED4	orange	on	Bus operation active
		off	no bus operation

Table 1: LED displays

4 Functional description

4.1 Control of the drive

The drive can be moved manually via the 1,2 keys without upstream control. The drive can be controlled and configured in the bus operating mode.

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 inching operation.

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. 3) 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 speed.

Upon activation of the travel order, the actuator accelerates to the specified speed with the acceleration programmed. The measure of delay to the required value is defined by the parameter 'a-pos' as well.

Alternately, a value deviating from acceleration can be chosen for delay (see parameter 'd-Pos').

If the actual position is within the programmed window, this condition will be signaled in the system status word and in the SIKONETZ5 status word.

You can define the behavior of the actuator upon reaching the programmed window.

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

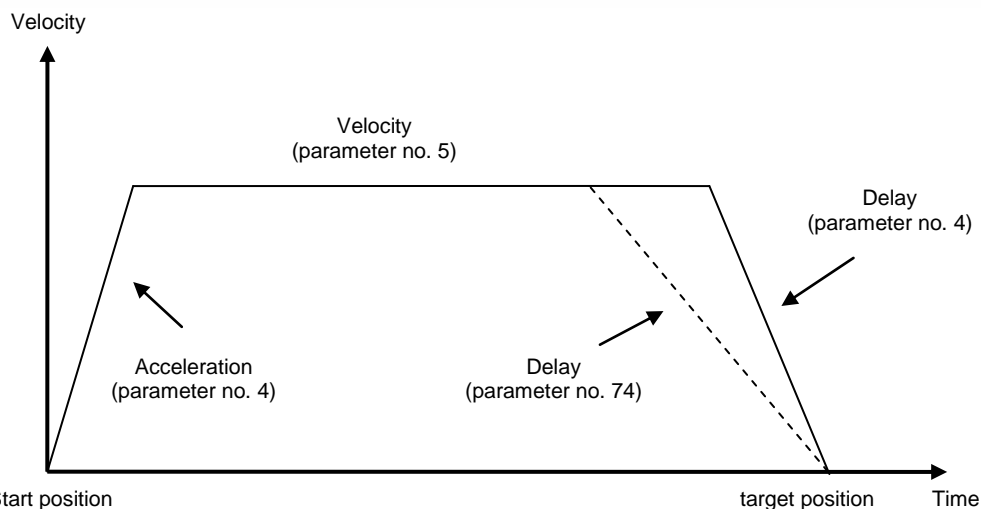


Fig. 3: Ramp travel, direct positioning mode

4.1.1.1.1 Loop positioning

If the actuator is operated on a spindle or an additional 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 direction of approach can be defined (see *chapter 8: Parameter description* ⇒ [Parameter no. 19](#)).

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 the target 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.

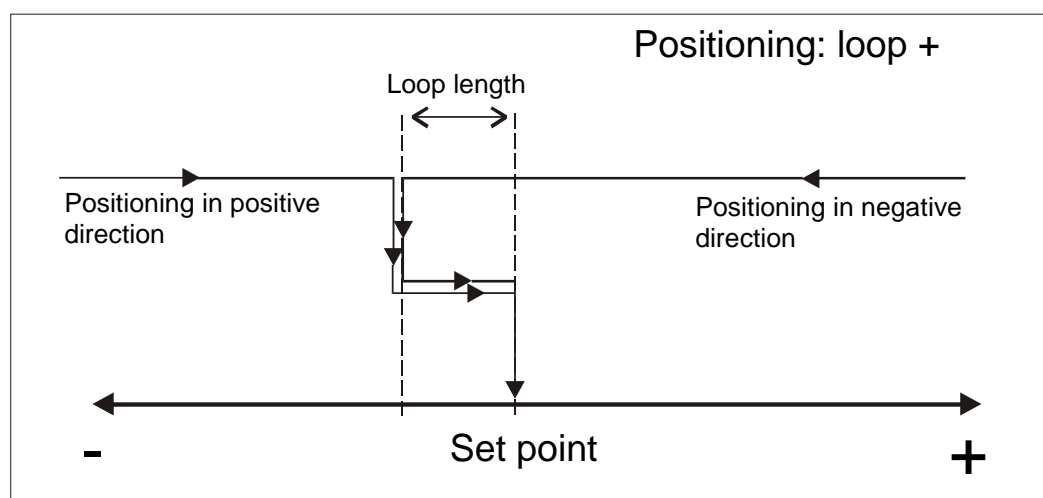


Fig. 4: Loop+ positioning

4.1.1.2 Inching mode

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

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

4.1.1.2.1 Inching mode 1

The drive travels once from the current actual position by the position 'Delta Tipp' depending on the mathematical sign of the value entered.

'Delta Tipp' < 0: negative travel direction
 'Delta Tipp' > 0: positive travel direction

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

Reaching of the target position will be signaled accordingly.

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

- The actuator must not be switched to error
- No active travel job
- Supply voltage of the output stage is applied

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

4.1.1.2.2 Inching mode 2

The actuator travels from the current actual 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 - Tipp (*Parameter no. 9*) = 10 rpm (can only be changed in the idle state)

Offset inching 2 (*Parameter no. 30*) = 85 % (can be changed during inching operation)

The resulting inching speed in this example will be:

$$\text{Inching speed} = v - \text{Tipp} * \text{Offset inching 2} = 10 \text{ rpm} * 85 \% = \mathbf{9 \text{ rpm}}$$

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

4.1.1.3 Rotational speed mode

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.

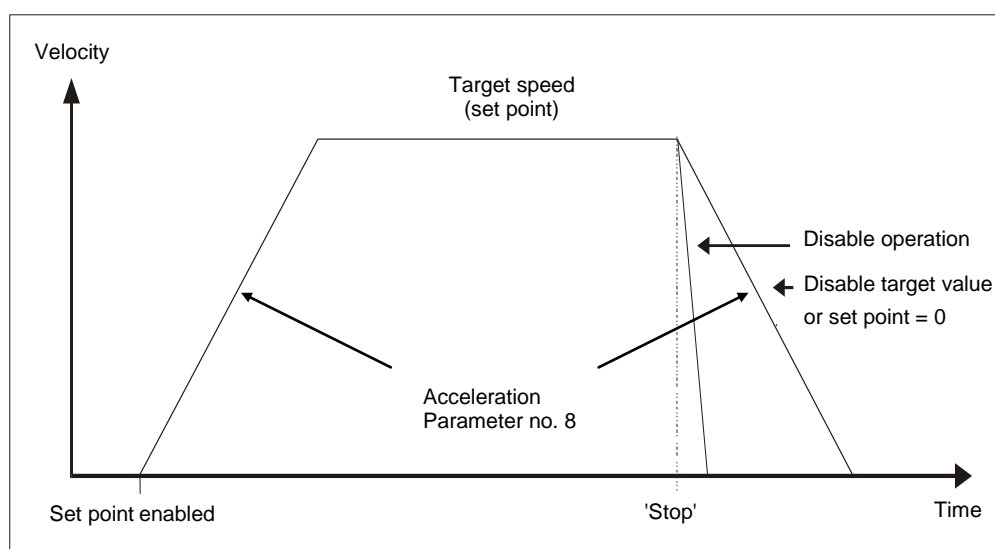


Fig. 5: Ramp speed mode

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

- The actuator must not be switched to error
- No active travel job
- Supply voltage of the output stage is applied

NOTICE	Limits 1 + 2 are inactivated in this operational mode.
---------------	--

4.1.2 Torque deactivation

Via the torque deactivation parameter (see chapter 8: Parameter description ⇒ [Parameter no. 75](#)) a switch-off threshold is defined. The values are indicated in % of nominal current. With a parameter value of 125 %, torque disable is deactivated.

The drive decelerates with max. delay when the switch-off threshold is exceeded. The drive continues to be controlled.

NOTICE	Active torque deactivation causes no error!
---------------	---

Active torque disable is reported via SW.12 = 1. This bit will be automatically reset when the current travel order is continued.

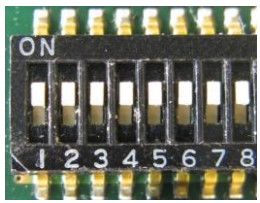
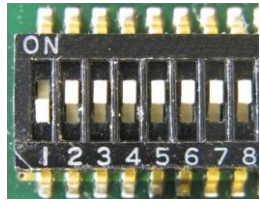
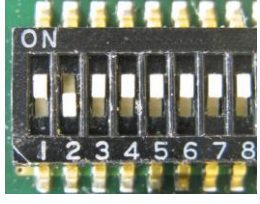
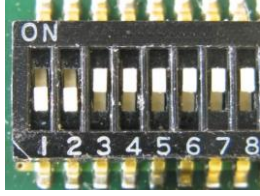
NOTICE	This function is available in the positioning mode only!
---------------	--

NOTICE	The actual motor current cannot be indicated by measuring the supply current. With cycled output stages, the supply current does not correspond to the motor current. Actual motor current can be read via the interface.
---------------	---

4.1.3 Reset factory settings via DIP switches

Procedure for restoring the factory settings via the 10-pin DIP switch:

1. Switch off supply voltage
2. Set DIP switches 1 – 8 depending on the parameters to be reset:

Reset all parameters to factory settings (see chapter 8: Parameter description)	
Reset only standard parameters to factory settings (see chapter 8: Parameter description)	
Reset only controller parameters to factory settings (see chapter 8: Parameter description)	
Reset only bus parameters to factory settings (see chapter 8: Parameter description)	

3. Turn on supply voltage. AG03/1 acknowledges with alternating blinking of the status LED and the bus LED.
4. Switch off supply voltage.
5. Setting of the original bus address and baud rate via DIP switches 1 - 7.
6. DIP switch number 8 must be set to the OFF position.
7. The parameters chosen before will have the factory settings again after switching on supply voltage.

5 Calibration

Two steps are required for executing calibration:

1. Write the calibration value
2. Execute calibration

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:

$$\text{Position value} = 0 + \text{calibration value} + \text{offset value}$$

Calibration value (see chapter 8: Parameter description \Rightarrow [Parameter no. 14](#))

Offset value (see chapter 8: Parameter description \Rightarrow [Parameter no. 32](#))

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

6 External gear

When using an external gear you can program a factor via parameter no. 11 'ü-numerator' and parameter no. 12 'ü-denominator' to include gear ratio into position sensing.

Example (see Fig. 6):

The actuator is operated on a gear with transmission reduction of 5:1. For this purpose, the parameters 'ü-numerator' and 'ü-denominator' must be programmed as follows:

- Parameter 'ü-numerator': 5
- Parameter 'ü-denominator': 1

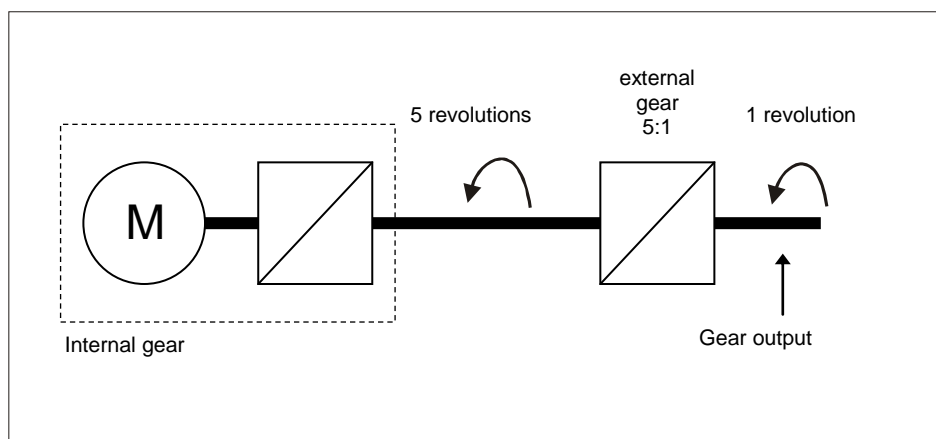


Fig. 6: External gear

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

Transmission reduction = 3.78

- Parameter 'ü - numerator': 378
- Parameter 'ü - denominator': 100

7 Warnings / Errors

7.1 Warnings

Warnings do not influence the operation of the positioning drive.
Warnings disappear after correcting the cause.

Possible warnings:

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

7.2 Errors

Errors cause an immediate stop of the positioning drive.

An error is signaled in the SW.7 = 1 status word and with a blink code on LED3.

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

Error code	Error
0x00	No error
0x06	Low battery voltage:
0x07	Low control electronics voltage
0x08	Excess control electronics voltage
0x09	Excess power electronics voltage
0x0A	Output stage excess temperature
0x0C	Shaft blocked
0x0D	Power electronics: supply missing
0x20	Internal error
0x21	Overcurrent
0x80	Checksum SIKONETZ5
0x81	Timeout SIKONETZ5

Table 2: Error codes

7.3 Acknowledgment of errors

Errors cannot be acknowledged until the cause of the error has been corrected.

Acknowledgment is via the bus.

8 Parameter description

Column	Explanation
S	"S" = Parameter transferred is saved in the device non-volatilely "- " = Parameter transferred is saved in the device volatilely
C	Parameter class 1 = Standard parameter 2 = Controller parameter 3 = reserved 4 = Bus parameter 5 = General parameter

No.	Name	Selection / value	Default	Description	S	C
1	Controller parameter P	1 - 500	100	P gain of controller applies to all operating modes (positioning mode, speed mode, inching mode)	S	2
2	Controller parameter I	0 - 500	5	I gain of controller applies to all operating modes (positioning mode, speed mode, inching mode)	S	2
3	Controller parameter D	0 - 500	0	D gain of controller applies to all operating modes (positioning mode, speed mode, inching mode)	S	2
4	a - Pos	1 - 100	50	Acceleration in the positioning mode: values in % 100 % correspond to 4 rps ²	S	2
5	v - Pos	1 - 100 1 - 200	30	Maximum velocity in the positioning mode: values in rpm gear 48:1 ⇒ max. 100 rpm gear 24:1 ⇒ max. 200 rpm	S	2
6	a - rot	1 - 100	50	Acceleration in rotational speed mode values in % 100 % correspond to 4 rps ²	S	2
7				reserviert		
8	a - inch	1 - 100	50	Acceleration in inching mode 1/2: values in % 100 % correspond to 4 rps ²	S	2
9	v - inch	1 - 100 1 - 200	30	Maximum speed in inching mode 1/2 values in rpm gear 48:1 ⇒ max. 100 rpm gear 24:1 ⇒ max. 200 rpm	S	2
10	Pos window	0 - 1000	10	Operating mode: Positioning mode Positioning window If the actual position of the drive is within the programmed set point ± this window, this is signaled by setting bit 3 in the drive's status word. Spindle pitch = 0: Values refer to increments 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, this is signaled by setting bit 3 in the drive's system status word.	S	1

No.	Name	Selection / value	Default	Description	S	C
11	ü - numerator	1 - 10000	1	Numerator gear ratio: a transmission factor can be programmed here when a gear is used.	S	1
12	ü - denominator	1 - 10000	1	Denominator gear ratio a transmission factor can be programmed here when a gear is used.	S	1
13	Spindle pitch	0 - 1000000	0	Spindle pitch Spindle pitch parameter = 0: Position value is output in increments (1600 increments per revolution of the driving 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 increments. Input of required position is now in 1/100 mm as well. E. g., spindle with a pitch of 2 mm. ⇒ Spindle pitch parameter = 200.	S	1
14	Calibration value	-999999 to 999999	0	Calibration value Changes to the calibration value are adopted for calculation of the position value via command only after calibration Position value = 0 + calibration value + offset value	S	1
15	Limit 1	-9999999 to 9999999	1000000	Operating mode: Positioning mode: Limit 1 Spindle pitch = 0: Values refer to increments Spindle pitch > > 0: values refer to travel distance in 1/100 mm If drive's position is beyond the range defined by limit 1 and limit 2 (travel range), traveling will only be possible in inching mode in the direction of the travel range. Caution! Limit monitoring is deactivated if 'limit 1' is equal 'limit 2'. Take into account that there will be a jump of the actual position when the resolution of the absolute value encoder is exceeded! Operating mode: Speed mode: irrelevant	S	1
16	Limit 2	-9999999 to 9999999	- 1000000	Operating mode: Positioning mode: Limit 2 Spindle pitch = 0: Values refer to increments Spindle pitch > > 0: values refer to travel distance in 1/100 mm If the drive's position is outside the area defined by limit 1 and limit 2 (traveling range) then traveling is only enabled in inching mode in the direction of the traveling range. Caution! Limit monitoring is deactivated if 'limit 1' is equal 'limit 2'. Take into account that there will be a jump of the actual position when the resolution of the absolute value encoder is exceeded! Operating mode: Speed mode: irrelevant	S	1

No.	Name	Selection / value	Default	Description	S	C
17	Delta inch	-1000000 to 1000000	1600	Delta traveling distance with inching operation 1: indicates the relative traveling distance. positive value ⇒ positive travelling direction negative value ⇒ negative travelling direction Spindle pitch = 0: Values refer to increments Spindle pitch > 0: values refer to travel distance in 1/100 mm	S	1
18	Sense of rotation	i,e	i	Counting direction of the measuring system: With shaft rotating counter-clockwise (view on the clamping ring of the actuator) i sense of rotation (cw): ⇒ positive counting direction e sense of rotation (ccw): ⇒ negative counting direction	S	1
19	Pos type	direct loop + loop -	direct	Operating mode: Positioning mode: Type of positioning <i>direct</i> : direct traveling from actual position to target value <i>loop +</i> : traveling to the target value occurs always in positive direction to compensate for spindle play <i>loop -</i> : traveling to the target value occurs always in negative direction to compensate for spindle play Caution! Loop positioning only in positioning mode Operating mode: Speed mode: irrelevant	S	1
20	Operating mode	positioning mode / speed mode	Positioning mode	Operating mode: Positioning mode (see chapter 4.1.1.1: Positioning mode) Operating mode: Speed mode: (see chapter 4.1.1.3: Speed mode)	S	1
21				reserved		
22	Node address	read-only	-	Setting of the node address is via the DIP switch	-	-
23				reserved		
24	Set point	see Column Description	0	Operating mode: Positioning mode indicates absolute target position. Spindle pitch = 0: Values refer to increments Spindle pitch > 0: values refer to travel distance in 1/100 mm Value range: depends on the pre-programmed limits (<i>parameters 15/16</i>) Operating mode: Speed mode: indicates the target rotational speed in rpm. Value range: Transmission 48:1 ⇒ max. ±100 rpm Transmission 24:1 ⇒ max. ±200 rpm	-	1

No.	Name	Selection / value	Default	Description	S	C
25	Stop mode Inching 2	0 - 1	0	Stop mode inching mode 2 / Inching key operation: The stop behavior of inching mode 2 or inching key operation can be configured in different ways. Stop mode = 0 stop with maximum delay Stop mode = 1 stop with programmed delay (parameter no. 8)	S	1
26	Inpos mode	0 - 2	0	Operating mode: Positioning mode With this parameter you can define the behavior of the actuator upon reaching the position window: Inposmode = 0 Position control to set point Inposmode = 1 Position control OFF and short circuit of the motor windings Inposmode = 2 Position control OFF and enabling of the drive Operating mode: Speed mode: irrelevant	S	1
27	Loop length	0 - 30000	800	Operating mode: Positioning mode Values refer to increments Operating mode: Speed mode: irrelevant	S	1
28	Contouring error limit	1 - 30000	400	Contouring error limit: exceeding the contouring error limit during ongoing positioning results in a "Contouring error" error.	S	1
30	Inching 2 Offset	10 – 100	100	Inching operation 2 The inching speed in Inching operation 2 can be influenced via this parameter Values are entered in percentage of parameter no. 9	-	1
31	Type of acceleration Inching mode 2	0 – 1	0	Inching operation 2 The type of acceleration can be set with this parameter. 0 = static acceleration Acceleration to final speed occurs in one step as defined under parameter no. 8. 1 = incremental acceleration Acceleration occurs to final speed as defined under parameter no. 8 with the following steps: 4 s to 20 % of final speed 2 s to 50 % of final speed 1 s to 100 % of final speed	S	1
32	Offset	-999999 to 999999	0	Offset value: Changes to the offset value are immediately considered in the calculation of the position value. The following equation applies to calibration: Position value = 0 + calibration value + offset value	S	1

No.	Name	Selection / value	Default	Description	S	C
33	Baud rate RS485	read-only	-	The baud rate is set via DIP switches SW.6 + SW.7 0 = 19200 baud 1 = 57600 baud 2 = 115200 baud	-	-
35	Bus Timeout	0 – 20	20	SIKONETZ5 Caution! Unintended device reactions. Unintended device reactions may occur with missing time monitoring (0= deactivated) and concurrent cable break. Time monitoring is activated ex-factory. Mode: Time monitoring "deactivated = 0" is only allowed for test purposes. Activate time monitoring after test mode. 1-20 = Indication of bus timeout values in x100 ms	S	4
36	Reply parameter Write to set point	0 – 8	1	SIKONETZ5 This parameter defines the reply to the Write set point command 0 = set point 1 = Actual value 2 = Output stage temperature 3 = Controller voltage 4 = Output stage voltage 5 = Battery voltage 6 = Motor current: 7 = Actual position 8 = Actual rotational speed	S	4
46	Programming mode: Configuration	0 – 1	0	SIKONETZ5 0 = no programming mode 1 = apply programming mode	S	5
47	Programming mode	0 – 1	0	SIKONETZ5 0 = Programming mode Off 1 = Programming mode On	-	1
50	Output stage temperature	Read only	-	Output stage temperature: Values in 1/10 °C	-	-
51	Voltage of controller	Read only	-	Controller voltage Values in 1/10 V	-	-
52	Voltage of output stage	Read only	-	Output stage voltage: Values in 1/10 V	-	-
53	Voltage of battery	Read only	-	Battery voltage: Values in 1/100 V	-	-
54	Motor current	Read only	-	Motor current: Values in mA	-	-
55	Actual position	Read only	-	Actual position: Spindle pitch = 0: values in increments Spindle pitch > 0: values in 1/100 mm	-	-
56	Actual rotational speed	Read only	-	Actual rotational speed: values in rpm	-	-
57	Serial number	Read only	-	Serial number	S	-
58	Production date	Read only	-	Production date: Format: DDMMYYYY	S	-

No.	Name	Selection / value	Default	Description	S	C
59	Software version Main controller	Read only	-	Main controller software version	S	-
60	Software version Secondary controller 1	Read only	-	Secondary controller 1 software version	S	-
61	number of Errors	Read only	-	Number of errors in the error memory	S	-
62	Error 1	Read only	-	Error 1	S	-
63	Error 2	Read only	-	Error 2	S	-
64	Error 3	Read only	-	Error 3	S	-
65	Error 4	Read only	-	Error 4	S	-
66	Error 5	Read only	-	Error 5	S	-
67	Error 6	Read only	-	Error 6	S	-
68	Error 7	Read only	-	Error 7	S	-
69	Error 8	Read only	-	Error 8	S	-
70	Error 9	Read only	-	Error 9	S	-
71	Error 10	Read only	-	Error 10	S	-
72	Step-down gear	Read only	-	Step-down gear	S	-
73	System Status Word	Read only	-	System Status Word	-	-
74	d – Pos	1 – 101	101	Delay in the positioning mode: 101= Delay determined by parameter no. 4 1-100 = Delay in per cent 100 % correspond to 4 rps ²	S	2
75	Torque disable	20 - 125	125	Operating mode: Positioning mode This parameter determines the threshold of torque disable The values are indicated in % of nominal current. Value 125: Torque disable deactivated Operating mode: Speed mode: irrelevant	S	1

Table 3: Parameter description

9 Communication via SIKONETZ5

9.1 Interface

9.1.1 Technical Data

Available baud rates: 19200 baud, 57600 baud (factory setting), 115200 baud

No parity, 8 data bits, 1 stop bit, no handshake

9.1.2 Setting of node address

The node address is set via DIP switches 1 – 5.

SW1 [2 ⁰]	SW2 [2 ¹]	SW3 [2 ²]	SW4 [2 ³]	SW5 [2 ⁴]	Set Slave address
OFF	OFF	OFF	OFF	OFF	0
ON	OFF	OFF	OFF	OFF	1
OFF	ON	OFF	OFF	OFF	2
:	:	:	:	:	:
OFF	ON	ON	ON	ON	30
ON	ON	ON	ON	ON	31

Table 4: Setting of node address

9.1.3 Setting the baud rate

The baud rate is set via DIP switches 6 – 7.

SW6	SW7	Baud rate set
OFF	OFF	57600 baud
ON	OFF	115200 baud
OFF	ON	19200 baud
ON	ON	-

Table 5: Setting the baud rate

NOTICE	The node address and baud rate settings are only read in when switching on supply voltage. Changing the settings during operation has no effect.
---------------	--

9.1.4 Bus termination

The internal bus terminator can be switched in via DIP switches 9 + 10:

SW9	SW10	Bus termination
OFF	OFF	deactivated
ON	ON	active

Table 6: Bus termination

NOTICE	Please note that both DIP switches are always required to ensure the correct function of bus termination.
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9.2 Data exchange

The protocol functions according to the master – slave principle.

The actuator acts as a slave. Every act of communication must be initiated by the master. When the master has sent a command telegram, the addressed slave sends a reply telegram.

Broadcast commands are an exception, they remain always unanswered by the slave.

The protocol is optimized for cyclical data exchange. The relevant data such as set point and actual value can be transferred between master and slave by a single telegram exchange.

The parameter to be returned by the slave as a reply to the master's Write set point command can be defined via the "Write Set point reply parameter".

9.3 Telegram setup

CW, SW and data are transferred in the Big-Endian format.

Command telegram (from master)

1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte	9. Byte	10. Byte
Command	Node ID	Parameter address	CW		data				check sum

Reply telegram (by slave)

1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte	9. Byte	10. Byte
Reply	Node ID	Parameter address	SW		data				check sum

9.3.1 Command

0x00 = read

0x01 = write

0x02 = broadcast

9.3.2 Node ID

Node address (see chapter 8: Parameter description ⇒ [Parameter no. 22](#)).

9.3.3 Parameter address

Description, see chapter 9.9: Parameterization via SIKONETZ5.

9.3.4 Control word

Control word (CW) master to slave.

9.3.5 Status word:

Status word (SW) slave to master.

9.3.6 Data

Range for data exchange. Size: 4 bytes.

9.3.7 Check sum

For checking error-free data transfer, a check sum is formed at the end of the telegram. The check sum is the exclusive-OR-link of bytes 1 – 9.

Check sum [Byte10] =
 [Byte1] XOR [Byte2] XOR [Byte3] XOR [Byte4] XOR [Byte5] XOR [Byte6] XOR [Byte7] XOR
 [Byte8] XOR [Byte9]

The following applies for checking the telegram received:
 [Byte1] XOR [Byte2] XOR [Byte3] XOR [Byte4] XOR [Byte5] XOR [Byte6] XOR [Byte7] XOR
 [Byte8] XOR [Byte9] XOR [Byte 10] = 0

With a result unequal 0 a transmission error is to be assumed.

9.4 Synchronization

Byte/telegram synchronization is via "Timeout" The intervals of the individual bytes of a telegram must not exceed the value of 10 ms. If an addressed device does not respond, the master may send a new telegram not earlier than after 30 ms.

9.5 Error telegram

Illegal entries are replied with an error telegram.
 An error telegram consists of parameter address 0xFD and an error code.
 The error code is in the data range of the reply telegram. The error code is divided in two bytes.
 Code 1 describes the error proper, code 2 contains additional information if available.

In the following example it was attempted to write a value of 1000 to the v-Pos parameter address.
 However, a maximum value of only 30 is admissible for this parameter.

Telegram from master to slave

1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte	9. Byte	10. Byte
Command	Node ID	Parameter address	CW		data				check sum
0x01	0x01	0x14	0x00	0x00	0x00	0x00	0x03	0xE8	0xFF

Reply telegram from slave

1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte	9. Byte	10. Byte
Command	Node ID	Parameter address	SW		data				check sum
0x01	0x01	0xFD	0x00	0x21	0x00	0x00	Code 2	Code 1	0x5C

9.5.1 SIKONETZ5 error codes

Code 1	Description	Code 2	Description
0x80	Checksumme SIKONETZ5	0x00	No further information available
0x81	Timeout SIKONETZ5	0x00	No further information available
0x82	Value range exceeded / inadequate	0x00	No further information available
		0x01	Value < MIN
		0x02	Value > MAX
0x83	Unknown parameter	0x00	No further information available
0x84	Access is not supported	0x00	No further information available
		0x01	Write on read only
		0x02	Read on write only
0x85	Error due to device status	0x00	No further information available
		0x01	EEPROM write access active
		0x02	Positioning active.
		0x03	Programming locked

Table 7: SIKONETZ5 Error codes

9.6 Errors

If a slave is in the error state, the slave signals the error with ZSW.7 = 1.

An error must be acknowledged with CW.5 = 0/1. If the cause of the error has not been resolved at the time of acknowledgment, the error will not be reset.

After acknowledgment of an error, the slave is in the switch-lock state. The switch-lock can be released via a negative flank on CW.0 or CW.1 or CW.2.

Errors are stored in the error memory and can be read out.

In order to receive the last error occurring the number of errors must first be read in parameter address 0x80.

With 0x80 + number of errors the parameter address with the latest error is received. Under this address the error code can be found (see chapter 7.2.1: Error codes).

9.7 Communication monitoring

9.7.1 Bus timeout

The first telegram received by the slave starts time monitoring.

Every new telegram recognized as valid by the slave (correct check sum) triggers time monitoring.

If timeout occurs during an active travel job, this will result in the Timeout error, i. e. the current travel job is canceled. Thus, a broken cable can be detected for instance and the actuator set into a defined state.

For this purpose the master must address all slaves cyclically.

9.7.2 Locking the programming mode

Locking of programming is controlled via parameter "Programming mode: Configuration" (see chapter 8: Parameter description ⇒ [Parameter no. 46](#)). If it is activated, locking must be disabled by a write command on parameter "Programming mode" (see chapter 8: Parameter description ⇒ [Parameter no. 47](#)) prior to write access to a parameter which is stored non-volatily in the device. Correspondingly, locking should be re-enabled immediately after write access. This approach enhances protection from unwanted configuration. Write access to locked parameters is answered with "Error due to device status" (see chapter 9.5.1: SIKONETZ5 error codes).

9.8 Functional description of the control units

9.8.1 System Status Word

The system status word consists of 2 bytes and reflects the state of the drive independent of the operating mode. The system status word can be read as a parameter.

The mode-dependent status words are available for cyclical data exchange.

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. 7: System Status Word

Example (gray background):

binary: ⇒ 0010 1001 0100 1000

hex: ⇒ 2 9 4 8

The table below informs about the meaning of the individual bits of the status word. System Status Word:

Bit	State	Description
Bit 0	'0'	irrelevant
Bit 1	'0'	irrelevant
Bit 2	'0'	irrelevant
Bit 3	'1'	Operating mode: Positioning mode In Position Actual position is within the positioning window of the programmed target value.
	'0'	
	'1'	Operating mode: Speed mode: In Position Actual speed is inside the specified tolerance window of target speed
	'0'	
Bit 4	'1'	Drive travels: Drive travels
	'0'	

Bit	State	Description
Bit 5	'1'	Operating mode: Positioning mode: upper limit The actual position is above the programmed upper limit of limit 1+2. Traveling is possible only in negative direction in inching mode.
	'0'	Actual position is below the programmed limiting value.
	'0'	Operating mode: Speed mode: irrelevant
Bit 6	'1'	Operating mode: Positioning mode: lower limit The actual position is below the programmed lower limit of limit 1+2. Traveling is possible only in negative direction in inching mode.
	'0'	Actual position is above the programmed limiting value.
	'0'	Operating mode: Speed mode: irrelevant
Bit 7	'1'	Driver state: Motor is enabled
	'0'	Motor in control
Bit 8	'1'	Error: Drive has switched to error. The cause of the error must be cleared and acknowledged via 'CW.7=1'. Cause of error, see chapter 7.
	'0'	No error present
Bit 9	'1'	Operating mode: Positioning mode Loop travel If travel direction unequal start direction (with loop travel)
	'0'	If travel direction equal start direction
	'0'	Operating mode: Speed mode: irrelevant
Bit 10	'1'	Output stage supply voltage Supply voltage of the output stage not applied No traveling of the drive is possible!
	'0'	Supply voltage of the output stage is applied
Bit 11	'1'	Ready for travel: Not ready for travel
	'0'	Ready for travel: <ul style="list-style-type: none"> • Drive not in error condition • No active positioning • Supply voltage of the output stage is applied • Actual position within limits (only positioning mode)
Bit 12	'1'	Battery voltage: battery voltage too low for absolute encoder. Replace the battery within half a year after notice of error bit!
	'0'	Battery voltage OK
Bit 13	'1'	Motor current: Motor current beyond permissible range. If this condition persists longer than 4 s, the drive will switch to Error.
	'0'	Motor current within permissible range.
Bit 14	'1'	Operating mode: Positioning mode Status Positioning active in positioning mode.
	'0'	Positioning inactive
	'0'	Operating mode: Speed mode: irrelevant
Bit 15	'1'	Contouring error: Contouring error ⇒ the actuator cannot reach the preset speed due to too high load. This state should be avoided! Remedy: reduce programmed speed!
	'0'	No contouring error ⇒ actual speed corresponds with required speed.

Table 8: System Status Word

9.8.2 Control word in positioning mode (master ⇒ slave)

Bit	Description
Bit 0 OFF1 (enable)	0 = OFF1 active Current travel job is canceled. The actuator is activated. 1 = OFF1 inactive
Bit 1 OFF 2 (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 OFF 3 (progr. delay)	0 = OFF3 active Current travel job is canceled. The actuator is decelerated with progr. 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 flank starts a travel job
Bit 5 Acknowledge error	Positive flank acknowledges an error Afterwards, the actuator changes to the switch-lock state.
Bit 6 Inching mode 1	0 = no inching mode1 If the travel job is not completed yet it will be canceled. 1 = inching operation 1 As long as this bit is set, the actuator travels the distance specified in parameter Delta Inch.
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 -15	Reserved, always 0

Table 9: Control word in positioning mode SIKONETZ5

9.8.3 Status word: Positioning mode (slave ⇒ master)

Bit	Description
Bit 0 Supply	0 = Output stage 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 Error	0 = no error 1 = Error Acknowledgment with positive flank 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 taken over. 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 Torque deactivation	0 = Torque deactivation inactive 1 = Torque deactivation active Motor current exceeds the value set under parameter 0x35. The drive was stopped

Table 10: Status word in positioning mode SIKONETZ5

9.8.4 Flow chart of positioning mode

CW = Control word SIKONETZ5

SW = Status word SIKONETZ5

x = bit can be '0' or '1'

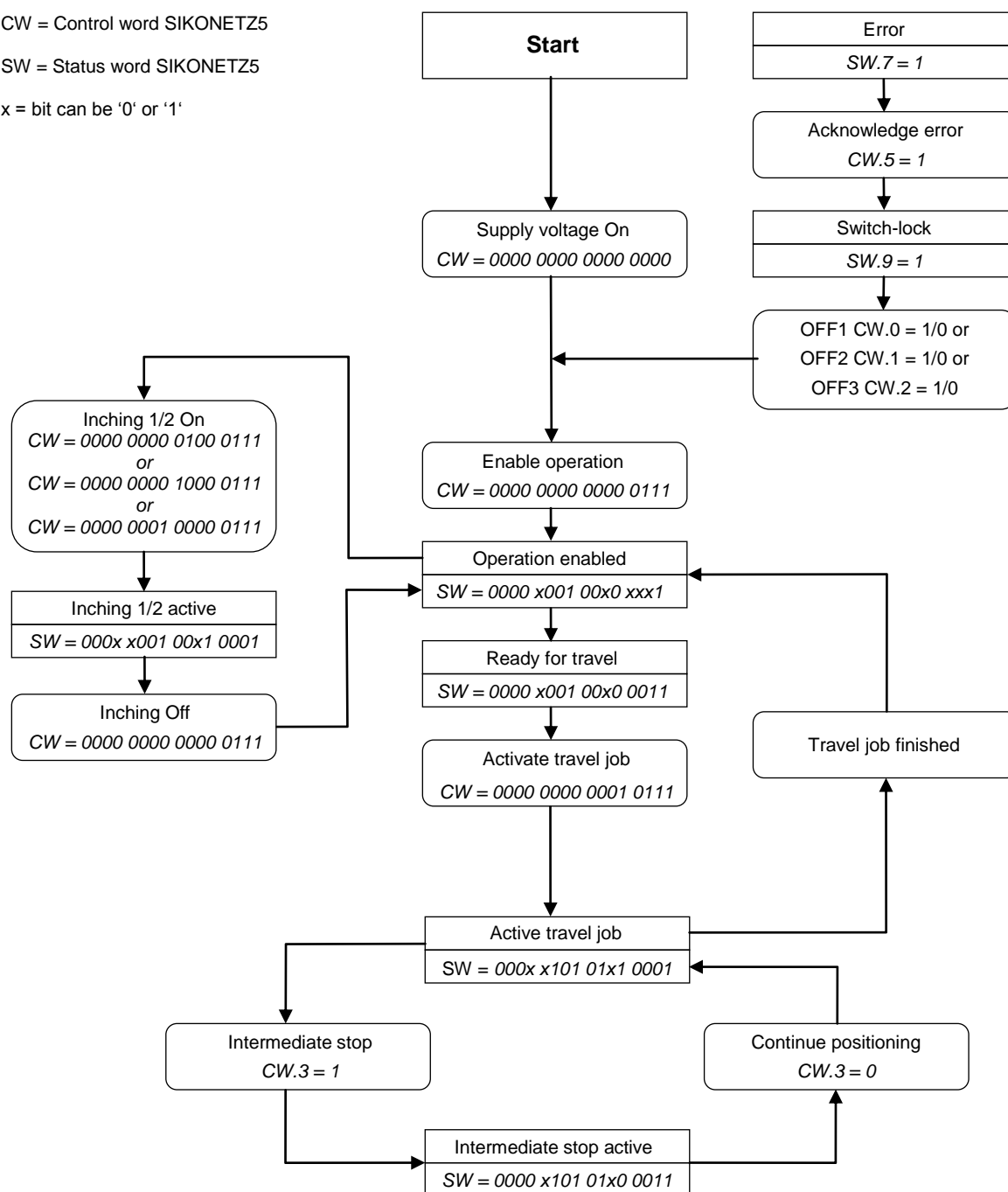


Fig. 8: Flowchart positioning mode SIKONETZ5

9.8.5 Control word in speed mode

Bit	Description
Bit 0 OFF1 (enable)	0 = OFF1 active Current travel job is canceled. The actuator is activated. 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 flank starts a travel job
Bit 5 Acknowledge error	Positive flank acknowledges an error Afterwards, the actuator changes to the switch-lock state.
Bit 6 – 15	Reserved, always 0

Table 11: Control word speed mode SIKONETZ5

9.8.6 Status word in speed mode

Bit	Description
Bit 0 Supply	0 = Output stage 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 Error	0 = no error 1 = Error Acknowledgement with positive flank 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 taken over. 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.

Table 12: Status word in speed mode SIKONETZ5

9.8.7 Flow chart of speed mode

CW = Control word SIKONETZ5

SW = Status word SIKONETZ5

x = bit can be '0' or '1'

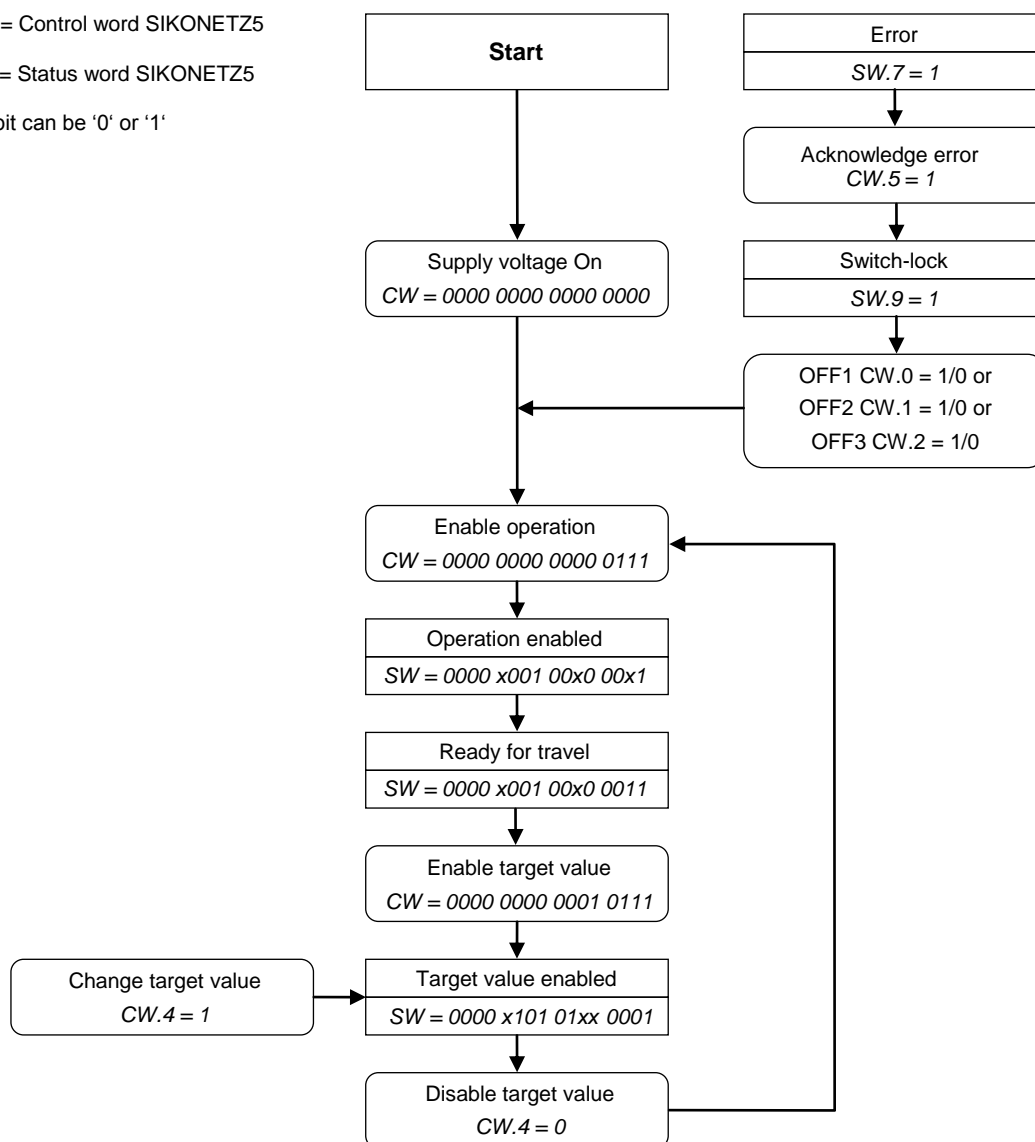


Fig. 9: Flow chart speed mode SIKONETZ5

9.9 Parameterization via SIKONETZ5

On principle, the actuator sends a telegram acknowledging write and read commands of the master. With the command able to be executed, the value adopted is in the reply telegram.

If the actuator was unable to execute the command, e. g. because it was attempted to write a value beyond the admissible range, the actuator will send an error telegram in reply.

Access

rw = read write

ro = read only

wo = write only

Parameter no. [hex]	Access	Access	Format	Description
0x00	Node address	ro	Unsigned8	Node address (see chapter 8: Parameter description ⇒ Parameter no.22)
0x01	Baud rate	ro	Unsigned8	Baud rate (see chapter 8: Parameter description ⇒ Parameter no.33)
0x02	Bus Timeout	rw	Unsigned16	Value range 0 – 20 (see chapter 8: Parameter description ⇒ Parameter no.35)
0x03	Reply parameter to command Write set point	rw	Unsigned8	0 = set point 1 = Actual value 2 = Output stage temperature 3 = Control voltage 4 = Output stage voltage 5 = Battery voltage 6 = Motor current: 7 = Actual position 8 = Actual rotational speed (see chapter 8: Parameter description ⇒ Parameter no.36)
0x0E	Programming mode Configuration	rw	Unsigned8	0 = no programming mode 1 = apply programming mode (see chapter 8: Parameter description ⇒ Parameter no.46)
0x10	Controller parameter P	rw	Unsigned16	Value range 1 – 500 (see chapter 8: Parameter description ⇒ Parameter no.1)
0x11	Controller parameter I	rw	Unsigned16	Value range 0 – 500 (see chapter 8: Parameter description ⇒ Parameter no.2)
0x12	Controller parameter D	rw	Unsigned16	Value range 0 – 500 (see chapter 8: Parameter description ⇒ Parameter no.3)
0x13	a – Pos	rw	Unsigned8	Value range 1 – 100 (see chapter 8: Parameter description ⇒ Parameter no.4)

Parameter no. [hex]	Access	Access	Format	Description
0x14	v – Pos	rw	Unsigned8	Value range Gear 48 : 1 ⇒ 1 – 100 rpm Gear 24 : 1 ⇒ 1 – 200 rpm (see chapter 8: Parameter description ⇒ Parameter no.5)
0x15	a – Rot	rw	Unsigned8	Value range 1 – 100 (see chapter 8: Parameter description ⇒ Parameter no.6)
0x16	a – Inch	rw	Unsigned8	Value range 1 – 100 (see chapter 8: Parameter description ⇒ Parameter no.8)
0x17	v – Inch	rw	Unsigned8	Value range Gear 48 : 1 ⇒ 1 – 100 rpm Gear 24 : 1 ⇒ 1 – 200 rpm (see chapter 8: Parameter description ⇒ Parameter no.9)
0x18	ü – Numerator	rw	Unsigned16	Value range 1 – 10000 (see chapter 8: Parameter description ⇒ Parameter no.11)
0x19	ü – Denominator	rw	Unsigned16	Value range 1 – 10000 (see chapter 8: Parameter description ⇒ Parameter no.12)
0x1A	Encoder resolution	ro	Unsigned16	Constant: Value 1600
0x1B	Sense of rotation	rw	Unsigned8	0 = i sense of rotation (cw) 1 = e sense of rotation (ccw) (see chapter 8: Parameter description ⇒ Parameter no.18)
0x1C	Spindle pitch	rw	Unsigned16	Value range 0 – 1000000 (see chapter 8: Parameter description ⇒ Parameter no.13)
0x1E	Offset	rw	Integer32	Value range -999999 ... 999999 (see chapter 8: Parameter description ⇒ Parameter no.32)
0x1F	Calibration value	rw	Integer32	Value range -999999 ... 999999 (see chapter 8: Parameter description ⇒ Parameter no.14)
0x20	Pos window	rw	Unsigned16	Value range 0 – 1000 (see chapter 8: Parameter description ⇒ Parameter no.10)
0x21	Pos type	rw	Unsigned8	0 = direct 1 = loop + 2 = loop – (see chapter 8: Parameter description ⇒ Parameter no.19)
0x22	Loop length	rw	Unsigned16	Value range 0 – 30000 (see chapter 8: Parameter description ⇒ Parameter no.27)
0x23	Inpos mode	rw	Unsigned8	0 = position control 1 = short circuit of the motor windings 2 = motor activated (see chapter 8: Parameter description ⇒ Parameter no.26)

Parameter no. [hex]	Access	Access	Format	Description
0x24	Delta Inch	rw	Integer32	Value range -1000000 ... 1000000 (see chapter 8: Parameter description ⇒ Parameter no.17)
0x25	Acceleration type with Inching mode 2	rw	Unsigned8	0 = static acceleration 1 = incremental acceleration (see chapter 8: Parameter description ⇒ Parameter no.31)
0x26	Inching 2 Offset	rw	Unsigned8	Value range 10 – 100 (see chapter 8: Parameter description ⇒ Parameter no.30)
0x27	Stop mode inching 2	rw	Unsigned8	0 = maximum delay 1 = programmed delay (see chapter 8: Parameter description ⇒ Parameter no.25)
0x28	Operating mode	rw	Unsigned8	0 = positioning mode 1 = speed mode (see chapter 8: Parameter description ⇒ Parameter no.20)
0x29	Limit 1	rw	Integer32	Value range -9999999 ... 9999999 (see chapter 8: Parameter description ⇒ Parameter no.15)
0x2A	Limit 2	rw	Integer32	Value range -9999999 ... 9999999 (see chapter 8: Parameter description ⇒ Parameter no.16)
0x2D	Contouring error limit	rw	Unsigned16	Value range 1 – 30000 (see chapter 8: Parameter description ⇒ Parameter no.28)
0x36	d – Pos	rw	Unsigned8	Value range 1 – 101 (see chapter 8: Parameter description ⇒ Parameter no.74)
0x37	Torque disable	rw	Unsigned8	Value range 20 – 125 (see chapter 8: Parameter description ⇒ Parameter no.75)
0x60	Output stage temperature	ro	Integer16	Temperature values in 1/10 °C (see chapter 8: Parameter description ⇒ Parameter no.50)
0x61	Voltage of control	ro	Integer16	Voltage values in 1/10 V (see chapter 8: Parameter description ⇒ Parameter no.51)
0x62	Voltage of output stage	ro	Integer16	Voltage values in 1/10 V (see chapter 8: Parameter description ⇒ Parameter no.52)
0x63	Voltage of battery	ro	Integer16	Voltage values in 1/100 V (see chapter 8: Parameter description ⇒ Parameter no.53)
0x64	Motor current	ro	Integer16	Current values in mA (see chapter 8: Parameter description ⇒ Parameter no.54)
0x65	Device code	ro	Unsigned8	2 = AG03/1

Parameter no. [hex]	Access	Access	Format	Description
0x66	Software version Secondary controller 1	ro	Unsigned16	Version number e. g. 103 corresponds to V1.03 (see chapter 8: Parameter description ⇒ Parameter no.60)
0x67	Software version Main controller	ro	Unsigned16	Version number e. g. 108 corresponds to V1.08 (see chapter 8: Parameter description ⇒ Parameter no.59)
0x68	Serial number	ro	Unsigned32	Serial number (see chapter 8: Parameter description ⇒ Parameter no.57)
0x69	Production date	ro	Unsigned32	Production date in format DDMMJJJJ (see chapter 8: Parameter description ⇒ Parameter no.58)
0x6A	Gear reduction	ro	Unsigned16	48 = gear 48:1 24 = gear 24:1
0x6B	Actual position	ro	Integer32	Spindle pitch = 0 Values in increments Spindle pitch > 0 Values in 1/100 mm (see chapter 8: Parameter description ⇒ Parameter no.55)
0x6C	Actual rotational speed	ro	Integer32	Actual speed in rpm (see chapter 8: Parameter description ⇒ Parameter no.56)
0x80	Number of Errors	ro	Unsigned8	Returns the number of errors in the error memory. (see chapter 8: Parameter description ⇒ Parameter no.61)
0x81	Error 1	ro	Unsigned8	see chapter 7.2.1: Error codes (see chapter 8: Parameter description ⇒ Parameter no.62)
0x82	Error 2	ro	Unsigned8	see chapter 7.2.1: Error codes (see chapter 8: Parameter description ⇒ Parameter no.63)
0x83	Error 3	ro	Unsigned8	see chapter 7.2.1: Error codes (see chapter 8: Parameter description ⇒ Parameter no.64)
0x84	Error 4	ro	Unsigned8	see chapter 7.2.1: Error codes (see chapter 8: Parameter description ⇒ Parameter no.65)
0x85	Error 5	ro	Unsigned8	see chapter 7.2.1: Error codes (see chapter 8: Parameter description ⇒ Parameter no.66)
0x86	Error 6	ro	Unsigned8	see chapter 7.2.1: Error codes (see chapter 8: Parameter description ⇒ Parameter no.67)
0x87	Error 7	ro	Unsigned8	see chapter 7.2.1: Error codes (see chapter 8: Parameter description ⇒ Parameter no.68)

Parameter no. [hex]	Access	Access	Format	Description
0x88	Error 8	ro	Unsigned8	see chapter 7.2.1: Error codes (see chapter 8: Parameter description ⇒ Parameter no.69)
0x89	Error 9	ro	Unsigned8	see chapter 7.2.1: Error codes (see chapter 8: Parameter description ⇒ Parameter no.70)
0x8A	Error 10	ro	Unsigned8	see chapter 7.2.1: Error codes (see chapter 8: Parameter description ⇒ Parameter no.71)
0xA0	S command	wo	Unsigned16	1 = all parameters to default Caution! All parameter classes are reset The factory settings are active after restart 2 = only standard parameters to default 3 = controller parameters to default 5 = bus parameters to default 6 = reset error 7 = calibration 8 = delete error memory 9 = software reset
0xA8	Programming mode On / Off temporary	wo	Unsigned8	Depending on the parameter programming mode configuration Programming mode configuration = 0 no function Programming mode configuration = 1 0 = programming mode Off Write parameter disabled. Write attempts are acknowledged with an error message. 1 = Programming mode On Write parameter enabled.
0xAA	Freeze actual value	wo	Unsigned8	1 = freeze actual value: the current actual value is cached until next reading of actual value
0xFA	System Status Word	ro	Unsigned16	(see chapter 9.3.4: System status word)
0xFE	Actual value	ro	Integer32	Positioning mode Actual position Rotational speed mode Actual rotational speed
0xFF	Set point	rw	Integer32	Positioning mode target position Rotational speed mode Target rotational speed

Table 13: Parameter description SIKONETZ5

9.9.1 Example: Read parameter

Reading the parameter Limit 1 of node address 1.

NOTICE	With read commands the data range shall be set to value 0.
---------------	--

Read command: 0x00

Node ID 0x01

Parameter address: 0x29 Limit 1

Data: 0x00 00 00 00

Telegram from master to slave

1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte	9. Byte	10. Byte
Command	Node ID	Parameter address	CW		data				check sum
0x00	0x01	0x29	0x00	0x00	0x00	0x00	0x00	0x00	0x28

Reply telegram from slave

1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte	9. Byte	10. Byte
Command / reply	Node ID	Parameter address	SW		data				check sum
0x00	0x01	0x29	0x00	0x01	0x00	0x01	0x86	0x9F	0x31

The reply telegram contains the current value of parameter limit 1.

Data: 0x00 01 86 9F \Rightarrow 99 999_{dec}

9.9.2 Example: Write parameter

Set parameter v-Pos of node address 1 to value 15:

Write command: 0x01

Node ID: 0x01

Parameter address: 0x14 v-Pos

Data: 0x00 00 00 0F

Telegram from master to slave

1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte	9. Byte	10. Byte
Command	Node ID	Parameter address	CW		data				check sum
0x01	0x01	0x14	0x00	0x00	0x00	0x00	0x00	0x0F	0x1B

Reply telegram from slave

1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte	9. Byte	10. Byte
Command / reply	Node ID	Parameter address	SW		data				check sum
0x01	0x01	0x14	0x00	0x01	0x00	0x00	0x00	0x0F	0x1A