AP05

Absolute Position Indicator with RS485 / SIKONETZ5 interface

User manual

50/24

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1 General Information

1.1 Documentation

The following documents describe this product:

- The data sheet describes the technical data, the dimensions, the pin assignments, the accessories and the order key.
- The installation instructions describe the mechanical and electrical installation including all safety-relevant requirements and the associated technical specification.
- The user manual for commissioning and integrating the position indicator into a fieldbus system.

These documents can also be downloaded at **http://www.siko-global.com/p/ap05**.

Additional information and guidance regarding this device can also be found there.

1.1.1 History

Mod. status	Date	Description
160/22	20.07.2022	from Firmware V2.0 Chapter 3.2 LCD display Notice text revised. Chapter 3.2.1 Extended display range Text updated.
50/24	08.04.2024	from Firmware V2.00 Chapter 1.1.1 History new added Chapter 3.1 General, 3.3 LED display, 4.1.1.1 Positioning, 4.1.2 Alpha-numeric display operating mode, 4.3.1.9 LED function, 5 Overview of parameters, 6.3.4 Control word, 6.9.8 07h: LED2 green, 6.9.9 08h: LED1 red, 6.9.10 09h: LED1 green, 6.9.31 39h: LED2 red, 6.9.38 40h: COM-LED, 8 Text displays and their meaning Designation of the LEDs adjusted and corrected

1.2 Definitions

If not explicitly stated otherwise, decimal values are given as figures without an extension (e. g. 1234), binary values are marked after the figure with a b (e. g. 1011b), hexadecimal values with an h (e. g. 280h).

2 Intended use

Absolute position indicator with hollow shaft suitable for direct shaft mounting. Actual and target values are indicated via the backlit two-row LC display. A direction indicator (arrow) is blended in if the actual value deviates from the target value including the adjustable target window. The direction of the arrow indicates the direction of shaft movement necessary to reach the target. Additionally, various visualization tasks can be realized by means of two bi-color LEDs (green and red).

The device parameters can be adjusted by means of 3 keys. You can change the set point, output the position value and adjust all device parameters via the integrated bus interface.

Scanning is magnetically-incremental. In the currentless state, scanning and saving of changes of the position value are battery-supported.

The state of charge of the replaceable battery is monitored and signified.

Display and interface are active with external power supply only.

2.1 Switching on the supply voltage

The AP05 will be initialized after switching on the supply voltage. A display test is executed during initialization, the LEDs are lighted consecutively and the parameters are loaded from the non-volatile memory into the RAM of the controller.
With the display still unconfigured all parameters are set to their default values. See to it that the bus will be connected only after correct adjustment of baud rate and ID (see chapter 4.3 and chapter 6.8). The AP05 functions with the data last parameterized.
AP05 is in the normal operating state. In this state, the display unit can be configured via keyboard/display or SIKONETZ5 interface as per the requirements of the application.

3 Display and control keys

3.1 General

The position indicator has a two-line display with special characters and three control keys. The keys serve for position indicator parameterization and control. Two device status LEDs (LED1, LED2) serve monitoring of positioning. One bus COM-LED indicates the status of bus communication.

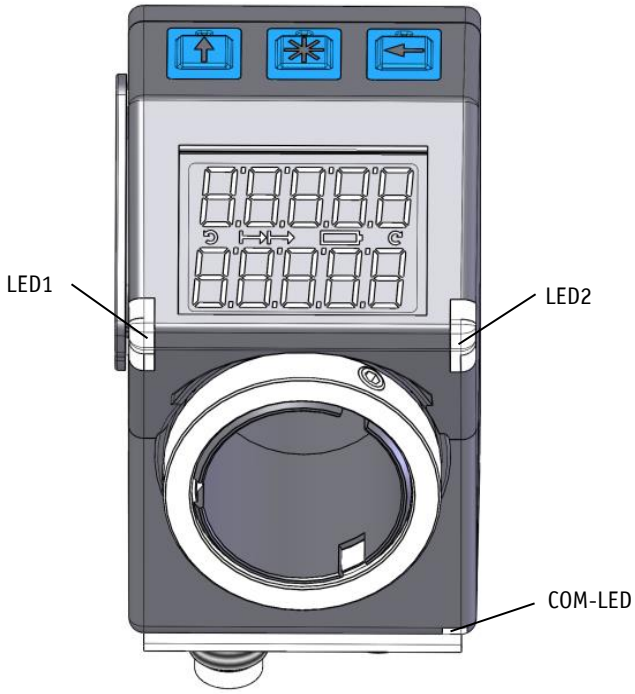

Fig. 1: Control elements

3.2 LCD display

NOTICE	The display range is limited to -19999 ... 99999. Values outside this range are displayed with "FULL".

With supply voltage applied to the position indicator with factory settings, the actual value will be displayed in the 1st row and the set point in the 2nd row. If there is no valid set point, "---" will be displayed in the 2nd row. The values displayed are determined by the operating mode.

Direction indicators (arrows) support positioning.

The battery symbol ▭ is shown with a critical or insufficient battery status. If battery voltage drops to a critical value, the battery symbol on the display will flash. If it falls below the minimum value, the symbol will glow permanently.

With incremental measurement function activated, the incremental measurement symbol ⊢→⊢→ is shown.

Errors are signified by red characters.

3.2.1 Extended display range

Values to -99999 can be displayed by means of the control word. If the relevant bit has been set and the value to be displayed is between -19999 and -99999, then the negative sign and the digit of the highest order will flash alternately. If the value range drops below -99999, "FULL" will be displayed.

3.3 LED display

Device status LED (LED1, LED2):

In its basic state (factory setting) the LED display has different meanings depending on the operating mode (see chapter 4.1).
With the basic function of the LEDs inactivated, every LED can be controlled independently via the control word (see chapters 6.9.8 to 6.9.10 and 6.9.31: LEDs as well as chapter 6.3.4).

COM-LED:

After receiving a valid message, which addressed the device, the LED will shine yellow for the duration of 1 s.

3.4 Keys

Pressing the ↑ key enables or disables the incremental measurement function. With the Auto-ID function, the new ID is adopted by actuating this key (see chapter 6.8).

Pressing the ✱ key starts calibration (see chapter 4.4) and acknowledges a pending error (see chapter 4.6). In the "Alphanumeric display" operating mode, the receipt of a set point is acknowledged by this action.

Pressing the ← key starts the parameterization mode (see chapter 4.3).

4 Functional Description

4.1 Operating modes

The following position-dependent operating modes are differentiated: **Absolute position, Differential value, Modulo** and the position-independent operating mode **Alpha-numeric display**.

Operating mode	Absolute position	Differential value	Modulo	Alpha-numeric Display
Line 1	Actual position	Actual position	Actual position	Set point1
Line 2	Set point2	Differential value	Set point2	Set point2

Table 1: Display with different operating modes

Absolute position:

Linear absolute position values are displayed.

Differential value display:

With factory setting: Differential value = actual position - set point2

Modulo display:

Position values ranging from 0° to 360° are displayed.

Using the parameter decimal places (see chapter 6.9.11) the resolution and the modulo point of the displayed values are set.

Decimal places	Display resolution	Value range
0	1°	0° ... 360°
1	1/10°	0.0° ... 360.0°
2	1/100°	0.00° ... 360.00°
3	1/1000°	0.000° ... 360.000°
4	1/10000°	0.0000° ... 360.0000°

Table 2: Modulo display

Alphanumerische Anzeige:

Both rows can be written freely. Set point1 is received via the SIKONETZ5 parameter FBh "set point1", set point2 via parameter FFh "set point2". The data identifier must be correctly set in the relevant control word. The data identifier differentiates whether the data is interpreted and displayed as figures or alpha-numeric characters (ASCII) (see chapter 6.3.4).

4.1.1 Position-bound operating modes

The measured absolute position value is displayed, calculated depending on the APU, ADI, Decimal place and Display factor parameters. Via the interface, the position value can be provided to an upstream control and a set point can be specified.

4.1.1.1 Positioning

(see chapter 4.1.1.2)

Arrows: (see parameter 0Ch: Direction indicators (CW, CCW))

Arrows are displayed to support the user with positioning as long as the current actual position value is outside (see parameter 20h: Target window1 (near field)) target window1. The direction of the arrow indicates the direction of shaft rotation in order to arrive at the set point2.

LED display: (see e. g. parameter 09h: LED1 green)

With factory setting, the LED glows green as long as the actual position is within the programmed window1. When leaving target window1, the LED glows red. The shaft must be rotated in the direction of the glowing LED in order to arrive at the set point2. The red glowing LED2 means: clockwise (cw) rotation required. Red glowing LED1: counter-clockwise (ccw) rotation required.

An additional target window (target window2) and an associated visualization can also be configured (see parameter 31h: Target window2 (extended)).

With factory settings, the LED display has the following meaning:

Operating state	LED	State	Meaning
There is no valid set point2.	both	off	Positioning disabled.

Operating state	LED	State	Meaning
There is no valid set point2.	LED1	off	Target window not reached! The shaft must be rotated clockwise (cw) in order to reach the target.
		red	Target window not reached! The shaft must be rotated counter-clockwise (ccw) in order to reach the target.
		green	Target window reached.
	LED2	off	Target window not reached! The shaft must be rotated counter-clockwise (ccw) in order to reach the target.
		red	Target window not reached! The shaft must be rotated clockwise (cw) in order to reach the target.
		green	Target window reached.

Table 3: LED display

Control word (see chapter 6.3.4):

The set point is not displayed and positioning not monitored unless the set point2 is marked as valid in the control word.

Status word (see chapter 6.3.5):

Upon reaching target window1, the static and dynamic target-window-reached bits are set in the status word. The dynamic bit is deleted when leaving target window1. The user must acknowledge the static bit.

Example Position monitoring:
Parameterization: Factory setting
Additionally: Set point2 = 100

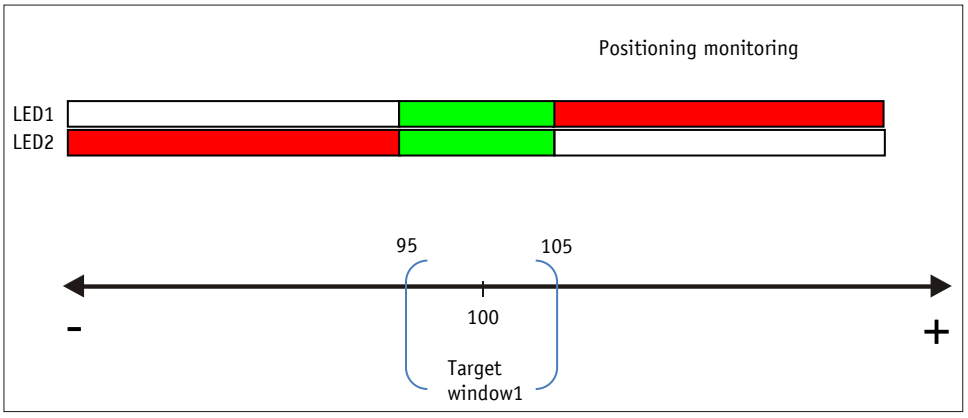

Fig. 2: Positioning monitoring

Example of position monitoring with additionally activated target window2 parameter:
Parameterization: Factory setting
Additionally: Target window2 = 15
Visualization target window2 = 1
Set point = 100

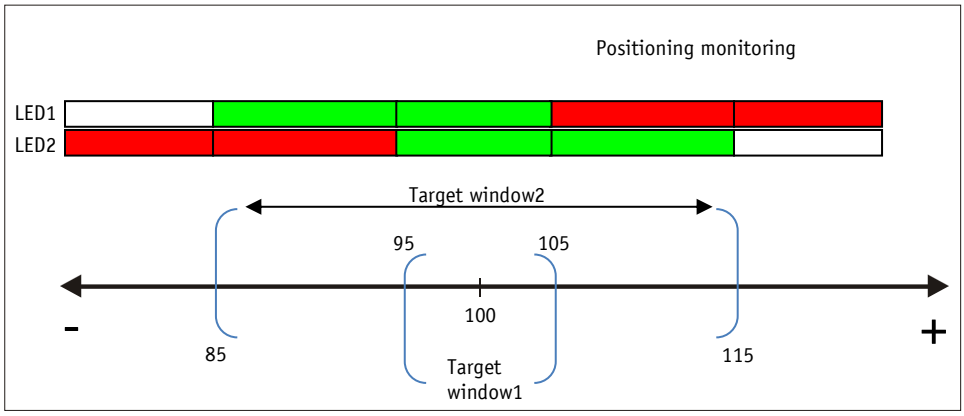

Fig. 3: Positioning monitoring with target window2

4.1.1.2 Loop positioning

NOTICE	Target window1 is also applied to the loop length.

If the position indicator is operated on a spindle or an additional gear, the spindle or external gear backlash can be compensated by means of loop positioning. Therefore, movement towards the set point is always in the same direction. This direction of approach can be defined.

Example:

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

- Case 1 ⇒ the new position is greater than actual position:
  Direct travel to the target position.
- Case 2 ⇒ the new position is smaller than actual position:
  The position indicator's arrows show that the set point is to be overrun by the loop length.
  Afterwards, the set point is approached in positive direction.

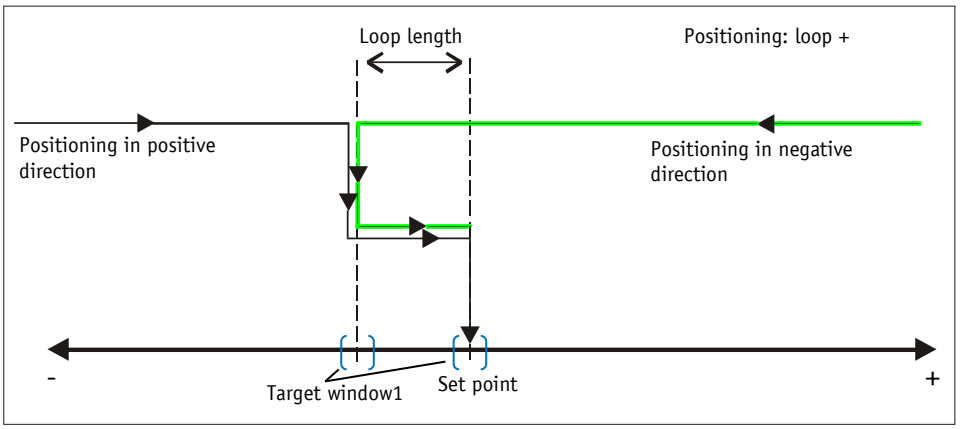

Fig. 4: Positioning Loop+

4.1.2 Alpha-numeric display operating mode

Two 5-digit set points can be displayed in this operating mode. With factory settings, the set points are acknowledged by pressing the ✳ key (see chapter 3.4 and parameter 3Eh: Acknowledgement settings).

LCD display:

In the absence of a valid set point, the 1st row is displayed empty (blank). "---" appears in the 2nd row.
A valid set point is displayed flashing until its receipt is acknowledged. If neither set point has been acknowledged, both values are acknowledged jointly by pressing the ✳ key.

LED display:

With factory settings, the LED display (LED1, LED2) works according to the following table.

Operating state	LED	State	Meaning
There is no valid set point.	both	off	
There is a valid set point.	LED1	red	Set point1 not acknowledged
		green	Set point1 acknowledged
	LED2	red	Set point2 not acknowledged
		green	Set point2 acknowledged

Table 4: LED display in the alpha-numeric display operating mode

Control word:

In the control word, the relevant type (number or character string) and the validity of the set point is transmitted to the display. As an additional option, the set point can be acknowledged via the control word.

Status word:

Type, validity and acknowledgement status of the set points are fed back in the status word.

4.2 Battery buffering

The battery makes possible the detection of currentless displacement. Battery life is approx. 8 years depending on the duration of battery operation (including storage) and frequency of currentless adjustments. Battery voltage is checked at intervals of approx. 5 min. If battery voltage drops below a specified value, the battery symbol ▭ will blink on the display. If the battery voltage continues to drop, ▭ will be displayed permanently. The battery should be replaced within approx. three months after the first appearance of the battery symbol. The battery can be replaced by the SIKO distribution partners or at the SIKO main factory. For battery replacement it is mandatory to follow the instructions of the installation instructions.

Status word:

The charge status of the battery is signified in the status word. Bit 11 is set when the charging voltage is critical and an error is signified with the additional bit 7 set when the battery is empty.

4.3 Parameterization of the position indicator

The position indicator can be fully parameterized via the bus interface. All parameters can also be set manually by means of the keyboard.

4.3.1 Manual parameterization

4.3.1.1 Starting parameterization

By actuating the ← key, the set node address and baud rate is displayed. Parameterization starts if it is actuated for the duration of the enable time (see parameter 04h: Keys enable time: Parametrization start delay and 3Dh: Key function enable3: Parametrization enable via keyboard).

4.3.1.2 Value input

Enter values via the ↑ key and the ← key. Confirm values entered by pressing the ✳ key.

← - decimal place selection key

↑ - value input key

4.3.1.3 Value selection

For some parameters you can select values from a list.

Direct value input is not possible there.

Pressing the ↑ key, the value can be selected from the list. By pressing the ✳ key, the selection is confirmed.

4.3.1.4 Overview of the operating menu

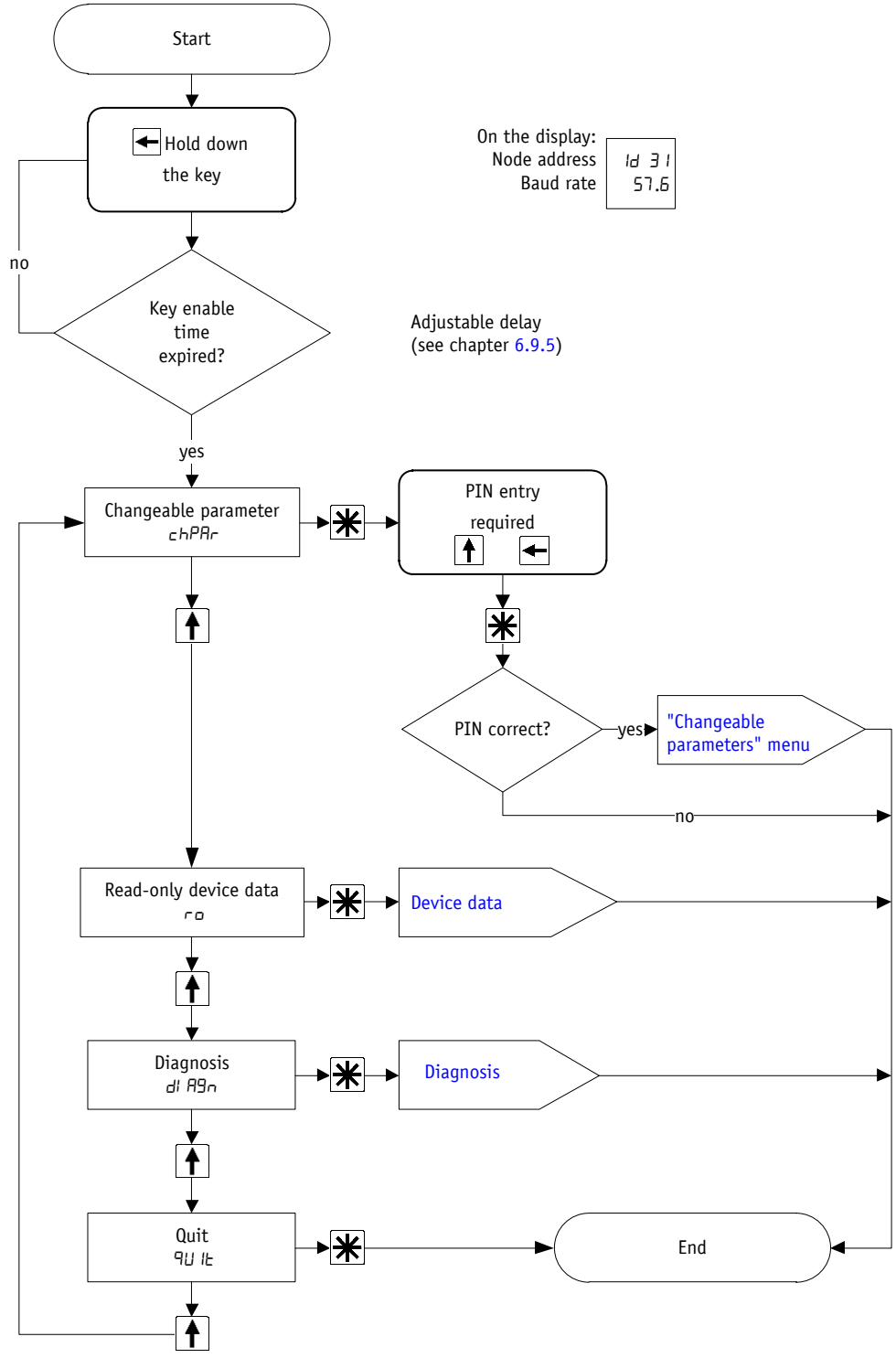

Fig. 5: Operating menu

All device parameters can be viewed and changed in the "Changeable parameters" ("CHPAR") submenu (see chapter 4.3.1.5).
All fixed device data are displayed in the "Readable parameters" (Read Only = "ro") submenu (see chapter 4.5.1).
The "Diagnosis" ("di AGn") submenu provides various diagnostic options (see chapter 4.5.2).

4.3.1.5 "Changeable parameters" menu

When choosing the "Changeable parameters" submenu, a PIN must be entered first. The factory-set PIN is "00000".
After confirming the correct PIN, you can choose among the following parameter menus.

Description	Display
Interface parameters	bUS
Positioning	POSI t
Visualization	U IS 10
LED function	LEd
Device options	OPtI O

Table 5: "Changeable parameters" menu structure

4.3.1.6 Interface parameters

The following parameters can be set in the "Interface parameters" menu:

Description	Display
Node address	Id
Baud rate	bAUd
Transmission protocol	PrtcL
Bus timeout	bUSto
Reponse delay	Inhbt

Table 6: "Interface parameters" menu

4.3.1.7 Positioning

The following parameters can be set in the "Positioning" menu:

Description	Display
Display per revolution (APU)	APU
Decimal plases	dP
Display divisor (ADI)	Adi
Counting direction	rotAt
Enter calibration value	CAL Ib
Calibrate	CAL Ib no YES
Application Offset	OFFSt
Target window near field	tAr9 I
Positioning type	POtyP
Loop length	LOOP
Target window far	

Table 7: "Positioning" menu

4.3.1.8 Visualization

The following parameters can be set in the "Visualization" menu:

Description	Display
Display orientation	d ISPL
Visualization target window far field	t2U IS
Direction indication	Ind ic
Display in the 2nd row	L InE2
White display backlight	bL
Red display backlight	bL rd
Display backlight blinking	bL FL

Table 8: "Visualization" menu

4.3.1.9 LED function

The following parameters can be set in the "LED function" menu:

Description	Display
LED1 green	Gn 1
LED1 red	rd 1
LED2 green	Gn 2
LED2 red	rd 2
LED blinking	FLASH
COM-LED	bUS 3

Table 9: "LED function" menu

4.3.1.10 Device options

The following parameters can be set in the "Additional device options" menu:

Description	Display
Key enable time / parameterization delay	CdELA
Calibration enable	CALEn
Incremental measurement enable	IncEn
Type of difference calculation	dI FF
Operating mode	OPtyP
Display factor	FACtr
Application of the display divisor	Ad IUS
Change the PIN	PI n
Load the factory setting	LOAdP

Table 10: "Additional device options" menu

4.3.2 Parameterization via interface

The position indicator can be completely parameterized in the RS485-SIKONETZ5 interface (see chapter 5).

4.4 Calibration

Two steps are required for executing calibration:

1. Write calibration value (see object 1Fh: Calibration value)
2. Execute calibration (reset) (see chapter 3.4 or object A0h: System commands with the data content 7 or object A7h: Calibration travel)

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 + offset value

Calibration value (see object 1Fh: Calibration value)

Offset value (see object 1Eh: Offset value)

4.5 Additional system commands

4.5.1 Device data

The following values can be read in the "Device data" menu:

Description	Display
Battery voltage	UbAtt
Firmware version number	UErSn
Serial number	SErno

Table 11: "Device data" menu

4.5.2 Diagnosis

The AP05 features various diagnostic options, which can be selected from the "Diagnosis" submenu. The following diagnostic options are differentiated:

Description	Display
Interface	rS485
Reading the error memories	Error
Presentation	PrSnt

Table 12: "Diagnosis" menu

4.5.2.1 Interface

In interface diagnosis, bus communication can be checked in three different ways:

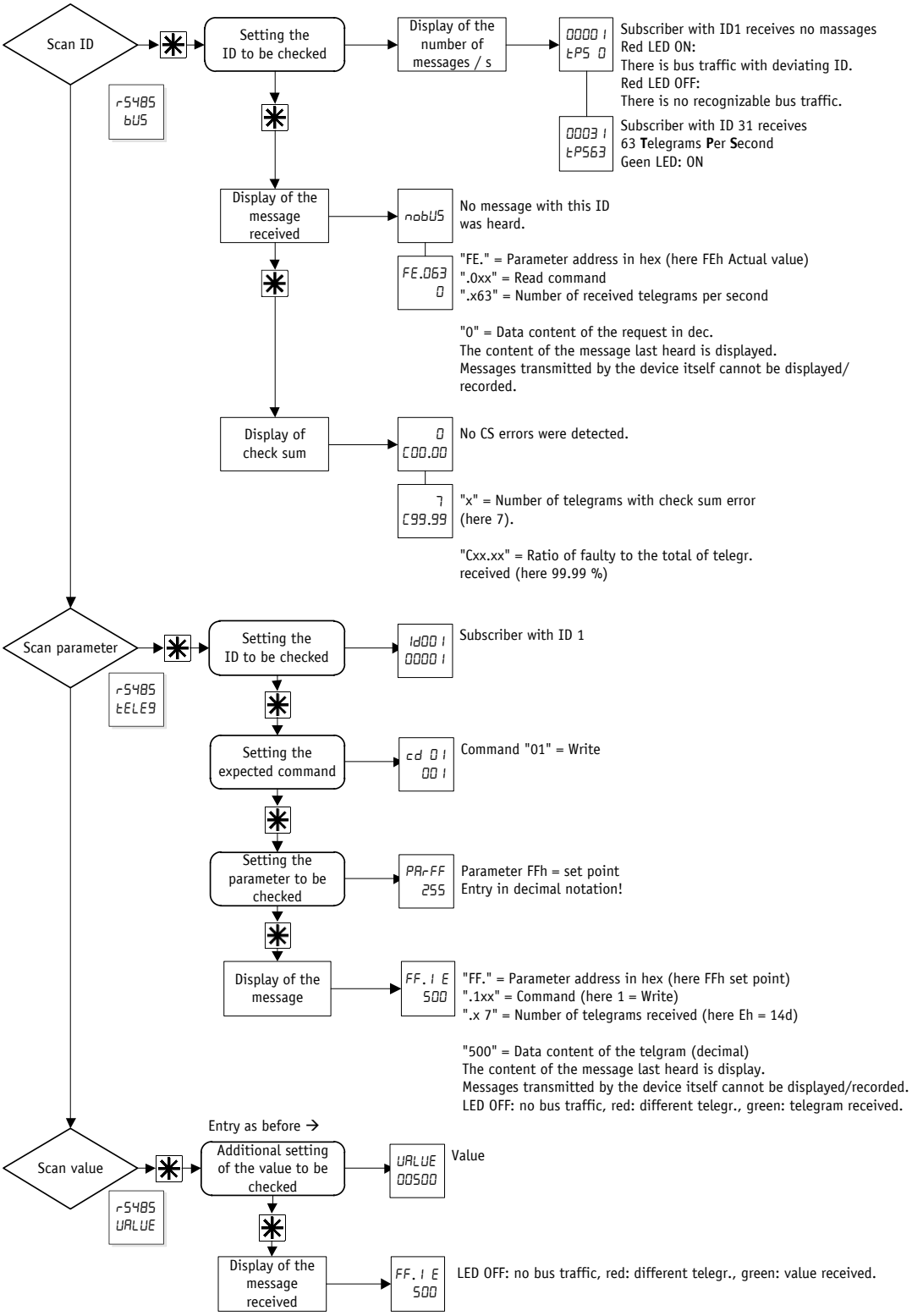

Fig. 6: Interface diagnosis

4.5.2.2 Reading the error memories

Two different error histories can be output here.

The "AP05" list contains errors found by the device such as "Low battery voltage" or "Velocity exceeded".
The "bUS" list contains input or receipt errors on the interface.

With errors occurring, the error number and overall quantity are output on the upper line. The type of error appears in the lower line, with error number 1 containing the latest error. The oldest error is output with the highest error number. "noErr" appears if no errors have been detected so far.

The error memory of the AP05 can be deleted via SIKONETZ5 by executing the system command A0h with data content 8.

4.5.2.3 Presentation

A fixed set point (850) is set and switched valid in the presentation mode. So, the mode of operation of the device can be presented without the need of specifying a set point via an interface.

4.5.3 Restore factory settings

There are various options for restoring the factory settings of the device:

Access	Coding		Factory settings are restored
Manuell	CODE	11100	all parameters
		11102	all except bus parameters
		11105	only bus parameters
	Load Default	ALL	all parameters
		StAnd	all except bus parameters (standard)
		bUS	only bus parameters
SIKONETZ5 (see parameter A0h: System commands)	A0h	1	all parameters
		2	all except bus parameters
		5	only bus parameters

Table 13: Access to factory settings

The bus parameters are:

Display	Parameter address	Parameter
Id	00h	Node-ID
bAUd	01h	Baud rate
ProtcL	-	Protocol
bUStO	02h	Bus-Timeout
-	03h	Response parameter to set point write access
-	0Eh	Configuration programming mode

Display	Parameter address	Parameter
rnhbt	D0h	Response delay time

Table 14: Bus parameter

4.6 Warnings / Errors

4.6.1 Warnings

Warnings do not influence the acquisition of the absolute position value.
Warnings are deleted after removing the cause.

Possible warnings:

- Battery voltage for absolute position detection is below limit ⇒ immediately exchange battery!
  This warning is displayed with a blinking battery symbol ▭. Via status word warning messages are output via the interface (see chapter 6.3.5 and chapter 4.5.2).

Display	Bit assignment in the status word	Error
▭ flashing	11	Low battery voltage (critical) Position value is still valid!

Table 15: Warnings

4.6.2 Errors

Error states are signalled via display (written in red or battery symbol) and interface.
To return to normal operation, the cause must be removed (see Table 17). Afterwards you can acknowledge or delete the error message by pressing the ✳ key or via the interface (see chapter 6.3.4).

(For signaling see chapter 6.3.5 and chapter 4.5.2)

Display	Error code SIKONETZ5	Bit assignment in the status word	Error
▭ permanent	0006h	11+7	Low battery voltage (empty)
SEnbnd	000Fh	12+7	Tape-sensor gap exceeded
noSEnS	001Ah	12+7	No sensor connected
SPEEd	0019h	12+7	Travel speed exceeded
CSbUS	0080h	7	Checksum SIKONETZ5
tobUS	0081h	7	Timeout SIKONETZ5

Table 16: Error messages

Display	Error	Possible effect	Corrective actions
▭ permanent	Battery empty	Position value not reliable	Battery change + calibration travel

Display	Error	Possible effect	Corrective actions
SPEEd	Admissible speed exceeded (see installation instruction)	Position value not reliable	Reduce speed + calibration travel

Table 17: Corrective actions

A list of errors that occurred can be read in the Diagnosis/Error memory operating menu (see chapter 4.5.2.2). This error memory can be deleted via SIKONETZ5 by executing the system command A0h with data content 8.

5 Overview of parameters

Name	Description	see page
00h: Note address	Node address	31
01h: Baud rate	Baud rate of the RS485 interface	31
02h: Bus Timeout	Indication of bus timeout in x100 ms	31
03h: Response parameter to a set point write access	Defines the response to the command "Write set point".	32
04h: Keys enable time: Parametrization start delay	Period of key actuation in order to start parametrization.	32
05h: Key function enable1: Calibration enable	Enable calibration	32
06h: LED flashing	All LEDs flashing	33
07h: LED2 green	LED2 green	33
08h: LED1 red	LED1 red	33
09h: LED1 green	LED1 green	34
0Ah: Decimal places	Number of decimal places.	34
0Bh: Display divisor (ADI)	ADI display divisor	34
0Ch: Direction indicators (CW, CCW)	Visualization of direction indicators.	35
0Dh: Display orientation	Display orientation	35
0Eh: Configuration programming mode	Basic setting of programming interlock.	36
0Fh: PIN change	PIN required for parameterization via keys and display.	36
1Bh: Counting direction	Counting direction	36
1Ch: Resolution per revolution	Resolution of the measuring system.	37
1Eh: Offset value	Offset value	37
1Fh: Calibration value	Calibration value	37
20h: Target window1 (near field)	The set point has been reached when the actual value is within the target window1	38
21h: Positioning type (loop type)	Travel towards set point in this direction.	38
22h: Loop length	Loop length	38
28h: Operating mode	Operating mode	39

Name	Description	see page
30h: Display in the 2nd row	Controls the display of the 2nd row of the display.	39
31h: Target window2 (extended)	Extended target window for easier positioning.	39
32h: Target window2 visualization	Visualization of target window2	40
33h: Application of the display divisor (ADI application)	ADI application	40
34h: Formation of the differential value	Formation of the differential value.	41
35h: Key function enable2: Incremental measurement enable	Incremental measurement enable	41
39h: LED2 red	LED2 red	41
3Ah: LCD backlight flashing	Flashing LCD backlight	42
3Bh: LCD backlight white	LCD backlight white	42
3Ch: LCD backlight red	LCD backlight red	42
3Dh: Key function enable3: Parametrization enable via keyboard	Parametrization enable	43
3Eh: Acknowledgement settings	Acknowledgment settings (alpha-numeric display)	43
3Fh: Display factor	Display factor (inch indication)	43
40h: COM-LED	COM-LED indicates valid bus traffic	44
63h: Battery voltage	Battery state of charge	45
65h: Device identification	SIKONETZ5 device identification (AP05 = 11)	45
67h: Software version	Software version	45
80h: Number of errors	Number of error incidents	46
81h until 8Ah: Errors	Error list	46
96h: Input errors	Input error list	46
A0h: System commands	Various system commands	47
A7h: Calibration travel	Starting calibration travel	47
A8h: Programming mode	Programming disable	48
AAh: Freeze actual value	Freeze position value	48
C5h: ADC values of the sensor	Hardware analysis	48
CFh: Period counter	Hardware analysis	49
D0h: Response delay	Delay until a SIKONETZ5 bus telegram is answered.	49
D2h: Auto-ID assignment	Automated node address assignment.	49
FAh: Status word	Device status	50
FBh: Set point1	Set point1 (alpha-numeric display)	50
FCh: Differential value	Deviation between actual and target positions.	50
FDh: Error telegram	Error telegram	51
FEh: Position value	Actual position	51
FFh: Set point2	Target position	51

Table 18: Parameter description

6 Communication via SIKONETZ 5

6.1 Interface

RS485 interface

Available baud rates: 19.2 kBit / 57.6 kBit (factory setting) / 115.2 kBit

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

6.2 Data exchange

The protocol functions according to the master – slave principle.

The position indicator acts as a slave. Every instance of communication must be initiated by the master. When the master has sent a command telegram, the 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 as well as control and status words 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".

6.3 Telegram setup

Control word (CW), status word (SW) and data are transferred in the Big-Endian format.

1st byte	2nd byte	3rd byte	4th byte	5th byte	6th byte	7th byte	8th byte	9th byte	10th byte
Command	Node address	Parameter address	high Byte	low Byte	MSB			LSB	Check sum
			CW		Data				

Table 19: Command telegram (from master)

1st byte	2nd byte	3rd byte	4th byte	5th byte	6th byte	7th byte	8th byte	9th byte	10th byte
Command	Node address	Parameter address	high Byte	low Byte	MSB			LSB	Check sum
			SW		Data				

Table 20: Reply telegram (from slave)

6.3.1 Command

The following access types are provided by SIKONETZ5.

Access code	Meaning	Description
00h	read	The master requests the addressed slave to output the relevant value in a response telegram.
01h	write	The master requests the addressed slave to accept the value transferred in the same telegram.

Access code	Meaning	Description
02h	broadcast	The master requests all connected slaves to execute the command transferred in the same telegram.

6.3.2 Node address

The device address can be freely set in the range of 0 to 127. The delivered devices are preset to node address 31 ex works and must be reset to the desired address to enable their operation with multiple slaves on the SIKONETZ5 fieldbus (see parameter 00h: Note address and chapter 6.8).

Each address can be assigned in the fieldbus only once!

6.3.3 Parameter address

A distinct address is assigned to every parameter (e.g. calibration value) or functional value (e. g. set point) (see chapter 6.9).

6.3.4 Control word

The control word consists of 16 bits.

Control word															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSB			High Byte					Low Byte							LSB

The following table lists the designations of the individual bits of the control word and their meanings.

Bit	Meaning	Value = 0	Value = 1
0	reserved	ever 0	-
1	reserved	ever 0	-
2	Validity of set point1	invalid	valid
3	Display range	standard	extended
4	Acknowledgment target window1 static	not acknowledged	acknowledged
5	Error	not acknowledged	acknowledged
6	With "Display" operating mode: Acknowledgement of set point2	not acknowledged	acknowledged
7	With "Display" operating mode: Data identifier	number	ASCII
8	reserved	ever 0	-
9	Validity of set point2	invalid	valid
10	With "Display" operating mode: Acknowledgement of set point1	not acknowledged	acknowledged
11	LED1 green	Off	On
12	LED2 green	Off	On
13	LED2 red	Off	On

Bit	Meaning	Value = 0	Value = 1
14	LED1 red	Off	On
15	LED blinking	Off	On

Table 21: Control word

6.3.5 Status word

NOTICE	The response to a set point write command contains a status word which was not updated yet.

The status word indicates the current status of AP05. It consists of 16 bits.

Status word															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSB			High Byte					Low Byte							LSB

The following table lists the designations of the individual bits of the status word and their meanings.

Bit	Meaning	Value= 0	Value= 1
0	Direction indication CW	Off	On
1	Direction indication CCW	Off	On
2	Validity set point1	invalid	valid
3	Target window2 dynamic	not reached	reached
	With "Display" operating mode: Acknowledgement of set point2	not acknowledged	acknowledged
4	Target window1 static	never reached	reached
5	Target window1 dynamic	not reached	reached
	With "Display" operating mode: Acknowledgement of set point2	not acknowledged	acknowledged
6	Deviation	actual position <= set point	actual position > set point
7	General error	not present	is present
8	Output of position value	dynamic	freezed
9	Position value = incremental measurement	Off	On
	With "Display" operating mode: Data identifier	number	ASCII-String
10	Validity set point2	invalid	valid
11	Battery status (critical or empty)	alright	critical or empty
12	Sensor error (Tape-Sensor or Lost-Sensor or Speed)	not present	is present
13	← key	not actuated	actuated
14	✳ key	not actuated	actuated
15	↑ key	not actuated	actuated

Table 22: Status word

6.3.6 Data

Range for data exchange. Size: 4 bytes.

6.3.7 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.

When a check sum error is detected, it is answered with an error telegram.
With three subsequent check sum errors, the check sum SIKONETZ5 error will be triggered.

6.4 Synchronization

NOTICE	Processing of the "Restore factory settings" system command may take up to 600 ms. Acknowledgment is reported only after proper updating of all parameters in the non-volatile memory.

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

6.5 Error telegram

Illegal entries are replied with an error telegram.

An error telegram consists of parameter address FDh and an error code.

The error code is in the data section 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 an attempt was made at writing a value of 90 to the key enable time parameter address.

However, a maximum value of only 60 is admissible for this parameter.

1st byte	2nd byte	3rd byte	4th byte	5th byte	6th byte	7th byte	8th byte	9th byte	10th byte
Command	Node address	Parameter address	CW		Data				Check sum
01h	01h	04h	00h	00h	00h	00h	00h	5Ah	5Eh

Table 23: Telegram from master to slave

1st byte	2nd byte	3rd byte	4th byte	5th byte	6th byte	7th byte	8th byte	9th byte	10th byte
Command	Node address	Parameter address	SW		Data				Check sum
					-	-	Code 2	Code 1	
01h	01h	FDh	00h	81h	00h	00h	02h	82h	FCh

Table 24: Reply telegram from slave

6.5.1 SIKONETZ5 error codes

Code 2	Code 1	Description
00h	80h	Check sum SIKONETZ5
00h	81h	Timeout SIKONETZ5
00h	82h	Value rage exceeded / inadequate
01h		Value < MIN
02h		Value > MAX
00h	83h	Unknown parameter
00h	84h	Access is not supported
01h		write attempt to read only
02h		read attempt to write only
00h	85h	Error due to device status
03h		Programming locked

Table 25: SIKONETZ5 error codes

6.6 Communication errors

Error states of the slave are signified with the status word.7 = 1.

Every error must be acknowledged with control word.5 = 0/1 or by pressing the ✱ key. If the cause of the error has not been resolved at the time of acknowledgment, the error will not be reset or triggered anew, resp.

Errors that have not been acknowledged can be read via a read command on parameter Error telegram (see chapter 6.9.56). The error code will be output (see chapter 4.6 and 6.5.1).

A list of errors occurring is output in Diagnosis (see chapter 4.5.2.2).

6.7 Communication monitoring

6.7.1 Bus-Timeout

Bus timeout monitoring is activated by configuring a valid time value (>0) for timeout (see parameter 02h: Bus Timeout).

The first telegram received by the slave starts time monitoring.

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

If timeout occurs, this will result in the Timeout SIKONETZ5 error.

After establishing cyclic communication between master and slave, this function can detect a broken cable of the connection line for instance and signal the defect.

6.7.2 Programming interlock

Programming interlock is controlled via parameter Configuration programming mode (see chapter 6.9.15). This parameter being enabled, the interlock must be canceled prior to write access to a lockable parameter (see entry at the relevant parameter) by applying a write access to parameter Programming mode (see chapter 6.9.47). Correspondingly, the interlock should be enabled again immediately after a write access.

This mechanism enhances protection against unintentional parameterization.

Write access to locked parameters is replied with "Error due to device state" (see chapter 6.5.1).

6.8 Auto-ID

This function facilitates first commissioning of the devices in the plant. The node numbers can be assigned by the superordinate control or by pressing the relevant button on the device concerned. The functional principle is illustrated in Fig. 7.

The Node ID 1Fh (31d) is factory-set. Now, the SIKONETZ5 master must send a write command on parameter Auto-ID assignment (see chapter 6.9.52) with the new Node ID to be set to the bus subscriber(s) with the current Node-ID 1Fh and wait for an SIKONETZ5 response. A write command on devices with a node ID different from 1Fh is responded to with an error message.

"New ID" will be displayed on all devices that have the current Node-ID 1Fh.

The user must press the ↑ key on the device intended to adopt the new Node ID. Afterwards, this device sends a SIKONETZ5 response with the original Node-ID (1Fh) and the parameter Auto-ID assignment. The new Node-ID is taken over and stored in the EEPROM. The initialization phase is finally repeated so that the new Node ID applies henceforth. All other devices do not react. Afterwards, the control unit can execute a read command on a parameter for the node with the node ID 1Fh for instance in order to detect any other devices with node ID 1Fh present in the bus. If so, the procedure may be repeated until all devices have received the desired Node-ID. The Auto-ID function is aborted in the AP05 when an illegal value was sent for the new ID. Error messages will be returned in this case.

Use of this function is optional. The node numbers can also be set via parameterization (see chapter 4.3).

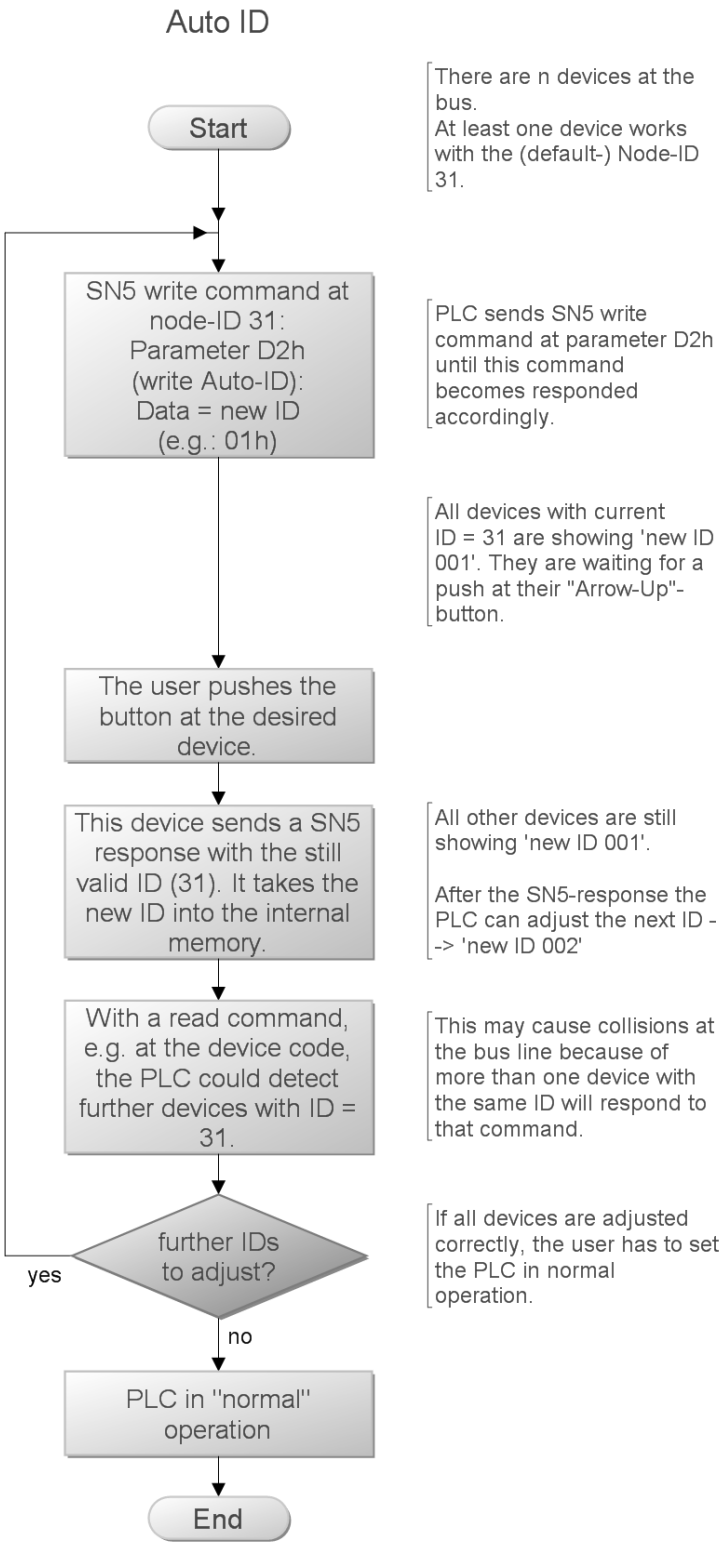

Fig. 7: Auto-ID function

6.9 Parameter description

Here, numbering follows the parameter address in SIKONETZ5.

6.9.1 00h: Note address

Setting of the SIKONETZ5 node address.
Changes become active only after restart of the device.

Parameter address	00h
Description	node address
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	31
Data content	1 ... 127

6.9.2 01h: Baud rate

Setting of the SIKONETZ5 baud rate.
Changes become active only after restart of the device.

Parameter address	01h
Description	Baud rate of the RS485 interface
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	57600 kBaud
Data content	0 = 19200 1 = 57600 2 = 115200

6.9.3 02h: Bus Timeout

See chapter 6.7.1.

Parameter address	02h
Description	Indication of bus timeout in x100 ms
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0 ... 20

6.9.4 03h: Response parameter to a set point write access

Parameter address	03h
Description	This parameter defines the response to the command "Write set point"
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0 = set point 1 = actual value 2 = differential value

6.9.5 04h: Keys enable time: Parametrization start delay

Parametrization start delay (key enable time) is set via parameter 04h.

Parameter address	04h
Description	Duration of key actuation to start parametrization.
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	5
Data content	1 ... 60 s

6.9.6 05h: Key function enable1: Calibration enable

The parameter 05h indicates whether calibration of the position value is enabled via key actuation.

Parameter address	05h
Description	Key enable
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	1
Data content	0: Calibration disabled 1: Calibration enabled

6.9.7 06h: LED flashing

Flashing of the LEDs can be set via parameter 06h (see chapter 3.3). This setting applies to all LEDs.

Parameter address	06h
Description	Flashing of all LEDs
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0 = no flashing 1 = any glowing LED is flashing

6.9.8 07h: LED2 green

LED2 green can be set via parameter 07h (see chapter 3.3). The control word can be freely accessed only if the LED is switched off here.

Parameter address	07h
Description	LED2 green
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	1
Data content	0 = Off 1 = position-dependent

6.9.9 08h: LED1 red

LED1 red can be set via parameter 08h (see chapter 3.3). The control word can be freely accessed only if the LED is switched off here.

Parameter address	08h
Description	LED1 red
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	1
Data content	0 = Off 1 = position-dependent

6.9.10 09h: LED1 green

LED1 green can be set via parameter 09h (see chapter 3.3). The control word can be freely accessed only if the LED is switched off here.

Parameter address	09h
Description	LED1 green
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	1
Data content	0 = Off 1 = position-dependent

6.9.11 0Ah: Decimal places

The parameter 0Ah indicates the number of decimal places.

Parameter address	0Ah
Description	number of decimal places
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0 ... 4

6.9.12 0Bh: Display divisor (ADI)

The display divisor can be changed via parameter 0Bh.

Parameter address	0Bh
Description	display divisor ADI
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0: 1 1: 10 2: 100 3: 1000

Examples:
(ADI application see chapter 6.9.27)

Position value ascertained	ADI (0Bh)	ADI-application (33h)	Display	Output interface	Set point2 received	Target attained
12348	1	2	1235	12348	12348	yes
12348	1	2	1235	12348	1235	no
12348	3	0	12	12	12	yes
12348	3	1	12	12348	12	yes
12348	3	2	12	12348	12348	yes
12348	3	2	12	12348	1235	no

Table 26: ADI and ADI application

6.9.13 0Ch: Direction indicators (CW, CCW)

The display of the direction arrows is set via parameter 0Ch.

Parameter address	0Ch
Description	Representation of the direction indicators
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0 = On
	1 = inverted
	2 = Off

6.9.14 0Dh: Display orientation

Display orientation can be set via parameter 0Dh.

Parameter address	0Dh
Description	Display orientation
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0 = 0° 1 = 180° rotated

6.9.15 0Eh: Configuration programming mode

Basic settings of programming interlock (see chapter 6.7.2).

Parameter address	0Eh
Description	Configuration programming mode
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0 = no active programming interlock 1 = active programming interlock

6.9.16 0Fh: PIN change

PIN required to be able to change parameters via keys and display (see chapter 4.3.1).

Parameter address	0Fh
Description	PIN
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 32
Default	0
Data content	0 ... 99999

6.9.17 1Bh: Counting direction

The counting direction can be set via parameter 1Bh.

Parameter address	1Bh
Description	counting direction
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0 = clockwise sense of rotation I (CW) 1 = counter-clockwise sense of rotation E (CCW)

I sense of rotation: ascending position values with clockwise shaft rotation (CW, view on the display)

E sense of rotation: ascending position values with counter clockwise shaft rotation (CCW, view on the display)

6.9.18 1Ch: Resolution per revolution

The number of measurement steps per revolution (display / revolution = APU) is defined via parameter 1Ch.

Parameter address	1Ch
Description	Number of measurement steps per revolution
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 16
Default	720
Data content	1 ... 65535

6.9.19 1Eh: Offset value

The offset value is determined via parameter 1Eh.

Parameter address	1Eh
Description	Offset enables the shifting of a scaled value range. The offset value is added to the position value in the encoder. Both positive and negative values are allowed. Position value = measured value + calibration value + offset value
Access	rw
EEPROM	yes
Programming mode	yes
Data type	SIGNED 16
Default	0
Data content	-19999 ... 19999

6.9.20 1Fh: Calibration value

Via parameter 1Fh, the encoder's position value can be set to a calibration value when calibrating.
To enable the execution of calibration, the "Calibration" system command must be executed (see chapter 4.4).

Parameter address	1Fh
Description	calibration value (position value = measured value + calibration value + offset value)
Access	rw
EEPROM	yes
Programming mode	yes
Data type	SIGNED 32
Default	0
Data content	-19999 ... 99999

6.9.21 20h: Target window1 (near field)

The parameter 20h indicates the window within which the set point is considered reached (see chapter 4.1.1.1).

Parameter address	20h
Description	The set point is reached when the actual value is within the target window.
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 16
Default	5
Data content	0 ... 9999

6.9.22 21h: Positioning type (loop type)

The positioning type, loop type is indicated via parameter 21h, thereby selecting the direction from which the set point shall be approached (see chapter 4.1.1.2).

Parameter address	21h
Description	Set point is approached in this direction.
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0: no loop 1: loop + 2: loop -

6.9.23 22h: Loop length

Parameter 22h specifies the loop length by which the set point shall be moved over with loop travel (see chapter 4.1.1.2).

Parameter address	22h
Description	loop length
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 16
Default	0
Data content	0 ... 9999

6.9.24 28h: Operating mode

The operating mode can be set via parameter 28h.

Parameter address	28h
Description	operating mode
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0: Absolute position
	1: Difference
	2: Modulo (360° angle display)
	3: Alpha-numeric display

6.9.25 30h: Display in the 2nd row

Via parameter 30h the display of the 2nd row of the display unit is controlled. The setting is not effective in the "Display" operating mode.

Parameter address	30h
Description	controls the display of the 2nd row of the display unit
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0: Set point or differential value (depending on mode, see chapter 4.1.1)
	1: Off

6.9.26 31h: Target window2 (extended)

Via parameter 31h, the size of target window2 can be set (see chapter 4.1.1.2 and parameter 32h: Target window2 visualization).

Parameter address	31h
Description	Extended target window to facilitate positioning at fast travel speed.
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 16
Default	0
Data content	0 ... 9999

6.9.27 32h: Target window2 visualization

Target window2 visualization can be set via parameter 32h (see chapter 4.1.1.1 and parameter 31h: Target window2 (extended)).

Parameter address	32h
Description	target window2 visualization
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0 = Off 1 = On

6.9.28 33h: Application of the display divisor (ADI application)

By means of parameter 33h, the application of the ADI (see chapter 6.9.12) can be adjusted for the position values ascertained (absolute position value, frozen position value) as well as the setpoints received (examples see chapter 6.9.12).

Parameter address	33h
Description	ADI application
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0: Display = Position value / ADI Interface = Position value / ADI Setpoint received = Set position value / ADI
	1: Display = Position value / ADI Interface = Position value with original resolution Setpoint received = Set position value / ADI
	2: Display = Position value / ADI Interface = Position value with original resolution Setpoint received = Set position value with original resolution

6.9.29 34h: Formation of the differential value

Calculation of the differential value is set via parameter 34h.

Parameter address	34h
Description	formation of the differential value
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0: DIFF = ACT – SET 1: DIFF = SET - ACT

6.9.30 35h: Key function enable2: Incremental measurement enable

The parameter 35h indicates whether setting of the position value as incremental measurement is enabled via key actuation.

Parameter address	35h
Description	Key enable
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	1
Data content	0: Incremental measurement disabled 1: Incremental measurement enabled

6.9.31 39h: LED2 red

The LED2 red can be set via parameter 39h (see chapter 3.3). Free access via the control word is only enabled if the LED is switched off here.

Parameter address	39h
Description	LED2 red
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	1
Data content	0 = Off 1 = position-dependent

6.9.32 3Ah: LCD backlight flashing

Flashing of the LCD backlight can be set via parameter 3Ah. This setting applies to either color.

Parameter address	3Ah
Description	Flashing of the LCD backlight
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0 = no flashing 1 = the current backlight is flashing.

6.9.33 3Bh: LCD backlight white

The white LCD backlight can be set via parameter 3Bh.

Parameter address	3Bh
Description	LCD backlight white
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	1
Data content	0 = Off 1 = On

6.9.34 3Ch: LCD backlight red

The red LCD backlight can be set via parameter 3Ch.

Parameter address	3Ch
Description	LCD backlight red
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	1
Data content	0 = Off 1 = On

6.9.35 3Dh: Key function enable3: Parametrization enable via keyboard

Parameter 3Dh indicates whether parametrization via key actuation is enabled.

Parameter address	3Dh
Description	Key enable
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	1
Data content	0: parametrization disabled 1: parametrization enabled

6.9.36 3Eh: Acknowledgement settings

Parameter 3Eh serves for determining the key to be used as acknowledgement key.
The setting is only relevant in the **alpha-numeric display** mode. A flashing set point is displayed until its receipt is acknowledged via keystroke.

Parameter address	3Eh
Description	acknowledgement settings
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0: ✳ key 2: ↑ and ← key

6.9.37 3Fh: Display factor

If a display factor> 0 is set, all values on the display are indicated in inch.
It should be noted that the transmission values from and to the interface are present in the metric system (depending on resolution and ADI). The control delivers target, calibration, and offset values as well as loop length and target window metrically as well. Device-internal position monitoring is metrical. Therefore, the superordinate control can only function in the metric system. The values for position, setpoint and the differential value if applicable are calculated by means of the following formula (for position value):

$$\text{Display value} = \text{position value} \times \text{calculation factor}$$

$$\text{Calculation factor} = \frac{1}{0.254} \times 10^{4-\text{Display factor}}$$

9 different calculation factors can be set (see Table 27). The number of decimal places is selected via parameter 0Ah: Decimal places.

Display factor	Calculation factor	Meaning	Examples of indication (APU = 400) Position after 1 revolution = 400
0	1	Metric indication after APU and ADI	400
1	$\frac{10^3}{0.254}$	Imperial indication (inch)	1574803
2	$\frac{10^2}{0.254}$		157480
3	$\frac{10^1}{0.254}$		15748
4	$\frac{10^0}{0.254}$		1575
5	$\frac{10^{-1}}{0.254}$		158
6	$\frac{10^{-2}}{0.254}$		16
7	$\frac{10^{-3}}{0.254}$		2
8	$\frac{10^{-4}}{0.254}$		0

Table 27: Value table of display factor

Parameter address	3Fh
Description	Display factor
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0 … 8

6.9.38 40h: COM-LED

The function oft he COM-LED can be set via parameter 40h (see chapter 3.3). No access to this LED via control word is supported.

Parameter address	40h
Description	COM-LED
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	1
Data content	0 = Off 1 = Bus traffic-dependent (glows for 1 s when receiving a message)

6.9.39 63h: Battery voltage

Battery voltage can be read via parameter 63h. The voltage is indicated in 10 mV resolution.

Parameter address	63h
Description	battery voltage
Access	ro
EEPROM	no
Programming mode	no
Data type	UNSIGNED 16
Default	0
Data content	0 … 310 (0 V … 3.10 V)

6.9.40 65h: Device identification

Parameter address	65h
Description	Device identification
Access	ro
EEPROM	no
Programming mode	no
Data type	UNSIGNED 8
Default	11
Data content	11 = AP05

6.9.41 67h: Software version

Parameter address	67h
Description	Software version number
Access	ro
EEPROM	no
Programming mode	no
Data type	UNSIGNED 32
Default	-
Data content	100 (= version 1.00) or higher

6.9.42 80h: Number of errors

See chapter 4.4.

Parameter address	80h
Description	Number of errors recorded
Access	ro
EEPROM	yes
Programming mode	no
Data type	UNSIGNED 8
Default	0
Data content	0 … 10

6.9.43 81h until 8Ah: Errors

See chapter 4.6. The oldest error is found under parameter address 81h, the most recent error is found under the highest address.

Parameter address	81h until 8Ah
Description	error
Access	ro
EEPROM	yes
Programming mode	no
Data type	UNSIGNED 16
Default	0
Data content	see Table 16

6.9.44 96h: Input errors

Output of a list (10 entries) of input errors (see chapter 6.5.1). The list is deleted with initialization of the device at program start (reset or power-on).
The error number must be transferred in data byte 3 of the telegram.
Data byte 3 with the request = 0 ⇒ number of errors occurring is reported.
Data byte 3 with the request = 1 ⇒ error number 1 (oldest error) is reported.

Example:
Telegram structure of master: oldest error (= no. 1) shall be read:

Command	ID	Parameter	ZSW		Error number				CS
00h	1Fh	96h	XX	YY	01h	00h	00h	00h	NNh

Telegram structure of slave: oldest error (1) is output:

Command	ID	Parameter	ZSW		Error number	Error code			CS
00h	1Fh	96h	XX	YY	01h	00h	00h	83h	NNh

Parameter address	96h
Description	error
Access	ro
EEPROM	yes
Programming mode	no
Data type	UNSIGNED 16
Default	0
Data content	see chapter 6.5.1

6.9.45 A0h: System commands

Various system commands can be executed via parameter A0h (see chapter 4.4 and 4.5.3).

Parameter address	A0h
Description	System commands
Access	wo, broadcast-compatible
EEPROM	no
Programming mode	yes
Data type	UNSIGNED 32
Default	0
Data content	1: Reset all parameters to factory settings
	2: Reset all parameters to factory settings, except the bus parameters
	5: Reset only the bus parameters to factory settings
	7: Calibrate
	9: Software reset (warm start)

6.9.46 A7h: Calibration travel

Calibration travel or calibration, respectively, can be executed via parameter A7h.

Parameter address	A7h
Description	Execute calibration (see chapter 4.4)
Access	wo
EEPROM	no
Programming mode	no
Data type	UNSIGNED 32
Default	0
Data content	1

6.9.47 A8h: Programming mode

Programming interlock (see chapter 6.7.2).

Parameter address	A8h
Description	Programming mode
Access	wo, broadcast-compatible
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0 = parameter programming disabled 1 = parameter programming enabled

6.9.48 AAh: Freeze actual value

The actual position value can be freezed via this parameter. So, synchronized recording of all position values in the unit can be generated. The status word signifies whether the position value treansmitted is updated or freezed (see chapter 6.3.5). Updating of the position value will be reenabled with the next readout operation.

Parameter address	AAh
Description	The current actual position value is cached (freezed) until the next readout operation of the actual position.
Access	wo, broadcast-compatible
EEPROM	no
Programming mode	no
Data type	UNSIGNED 8
Default	0
Data content	1 = freeze actual position

6.9.49 C5h: ADC values of the sensor

The current ADC values of the sensor can be retrieved via parameter C5h.

Parameter address	C5h			
Description	ADC values of the sensor			
Access	ro			
EEPROM	no			
Programming mode	no			
Data type	UNSIGNED 32			
Default	0			
Data content	Byte 0	Byte 1	Byte 2	Byte 3
	ADC_SIN		ADC_COS	

6.9.50 CFh: Period counter

The current values of the period counter can be retrieved via parameter CFh.

Parameter address	CFh			
Description	values of the period counter			
Access	ro			
EEPROM	no			
Programming mode	no			
Data type	UNSIGNED 32			
Default	0			
Data content	Byte 0	Byte 1	Byte 2	Byte 3
	Quadrant	Period counter		

6.9.51 D0h: Response delay

Number of internal program cycles deferred before responding to a SIKONETZ5 bus telegram. The response to a telegram can be delayed until the master is ready to receive. The value 10 corresponds to a delay of approx. 3 ms.

Parameter address	D0h
Description	Response delay
Access	rw
EEPROM	yes
Programming mode	yes
Data type	UNSIGNED 8
Default	0
Data content	0 … 40

6.9.52 D2h: Auto-ID assignment

See chapter 6.8.

Parameter address	D2h
Description	Automated assignment of a node address
Access	wo
EEPROM	yes, the node number is stored with its adoption
Programming mode	no
Data type	UNSIGNED 8
Default	-
Data content	1 … 31

6.9.53 FAh: Status word

The status word can be read via this parameter. Bit 4: "Target window1 static" is deleted in the status word with this operation. With this function, it can be detected whether the actual position was ever in the target window even if this is not the case at present (see chapter 6.3.5).

Parameter address	FAh
Description	Read status word and delete "Target window1 static"
Access	ro
EEPROM	no
Programming mode	no
Data type	UNSIGNED 16
Default	-
Data content	0

6.9.54 FBh: Set point1

The current set point1 (**alpha-numeric display** operating mode) can be written and read via address FBh (see chapter 4.1.2).

Parameter address	FBh
Description	Set point1
Access	rw
EEPROM	no
Programming mode	no
Data type	UNSIGNED 32
Default	-
Data content	0h ... FFFFFFFFh

6.9.55 FCh: Differential value

The differential value can be read via parameter FCh. Formation of the differential value is set via parameter 34h: Formation of the differential value.

Parameter address	FCh
Description	Differential value: Deviation between actual and target positions
Access	ro
EEPROM	no
Programming mode	no
Data type	SIGNED 32
Default	-
Data content	-5242880 ... 5242880

6.9.56 FDh: Error telegram

Illegal entries are answered with an error telegram.
An error telegram consists of the parameter address FDh and an error code (see chapter 6.5).

Parameter address	FDh
Description	Error telegram
Access	-
EEPROM	no
Programming mode	no
Data type	UNSIGNED 32
Default	-
Data content	see chapter 6.5

6.9.57 FEh: Position value

The current position value of the device is output under FEh.

Parameter address	FEh
Description	Actual position (see chapter 4.1.1)
Access	ro
EEPROM	no
Programming mode	no
Data type	SIGNED 32
Default	-
Data content	-5242880 ... 5242880

Position value = measured value + calibration value + offset value

6.9.58 FFh: Set point2

The current set point2 can be written and read via address FFh.

Parameter address	FFh
Description	Set point2
Access	rw
EEPROM	no
Programming mode	no
Data type	SIGNED / UNSIGNED 32 (depending on the operating mode)
Default	-
Data content	0h ... FFFFFFFFh

6.10 Examples of access

6.10.1 Example: Read parameter

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

Reading the parameter target window1 of node address 1:

Read command: 00h
Node address: 01h
Parameter address: 20h Target window1
Data: 00h 00h 00h 00h

Telegram from master to slave

1st byte	2nd byte	3rd byte	4th byte	5th byte	6th byte	7th byte	8th byte	9th byte	10th byte
Command	Node address	Parameter address	CW		Data				Check sum
00h	01h	20h	00h	00h	00h	00h	00h	00h	21h

Reply telegram from slave

1st byte	2nd byte	3rd byte	4th byte	5th byte	6th byte	7th byte	8th byte	9th byte	10th byte
Command	Node address	Parameter address	CW		Data				Check sum
00h	01h	20h	00h	01h	00h	00h	00h	05h	25h

The current value oft he target window1 parameter is in the response telegram.
Data: 00 00 00 05h $\Rightarrow 5_{dec}$

6.10.2 Example: Write parameter

Set parameter offset value of node address 1 to value 500:

Write command: 01h
Node address: 01h
Parameter address: 1Eh Offset value
Data: 000001F4h $\Rightarrow 500_{dec}$

Telegram from master to slave

1st byte	2nd byte	3rd byte	4th byte	5th byte	6th byte	7th byte	8th byte	9th byte	10th byte
Command	Node address	Parameter address	CW		Data				Check sum
01h	01h	1Eh	00h	00h	00h	00h	01h	F4h	EBh

Reply telegram from slave

1st byte	2nd byte	3rd byte	4th byte	5th byte	6th byte	7th byte	8th byte	9th byte	10th byte
Command / Reply	Node address	Parameter address	SW		Data				Check sum
01h	01h	1Eh	00h	01h	00h	00h	01h	F4h	EAh

Set set point value parameter of node address 1 to value 1234, switch set point2 to valid

Write command: 01h
Node address: 01h
Parameter address: FFh Sollwert2
Data: 000004D2h ⇒ 1234_{dec}

Telegram from master to slave

1st byte	2nd byte	3rd byte	4th byte	5th byte	6th byte	7th byte	8th byte	9th byte	10th byte
Command	Node address	Parameter address	CW		Data				Check sum
01h	01h	FFh	02h	00h	00h	00h	04h	D2h	2Bh

Reply telegram from slave

1st byte	2nd byte	3rd byte	4th byte	5th byte	6th byte	7th byte	8th byte	9th byte	10th byte
Command / Reply	Node address	Parameter address	SW		Data				Check sum
01h	01h	FFh	04h	01h	00h	00h	04h	D2h	2Ch

7 Communication via Service Standard Protocol

7.1 General

The service protocol enables the control of the position indicator via ASCII commands. No additional devices must be connected to the RS485 interface since this protocol is not bus-compatible.

An ASCII terminal sends a letter and additional parameters if required (ASCII).
Subsequently, the position indicator sends a reply with a concluding <CR>.

Available baud rates: 19.2 kBit / 57.6 kBit (factory setting) / 115.2 kBit
Additional settings: No parity, 8 data bits, 1 stop bit, no handshake

7.2 Error number encoding

The following error messages are returned in case of wrong input.

Error number	Description
?1	input of illegal parameter number
?2	illegal value range

Table 28: Error number encoding

7.3 Service protocol commands list

Command	Length	Reply	Description
Ay	2/17	"AP05 SN5 zW xxxx>"	Device type / software version
			y=0: hardware version; z = H y=1: software version; z = S
L	1/2	">"	Calibration (see chapter 4.4)
Sxxxxx	6/2	">"	System commands
			x=11100: all parameters into basic state After restart, the factory settings will be active, this applies to bus protocol and baud rate as well.
			x=11101: reset all to factory settings, except bus parameters
			x=11102: only bus parameters into basic state
			x=11105: activate bootloader
U	1/6	"xxyy>"	Current SIN/COS values of the sensor unit
			x=SIN y=COS
Z	1/11	"±xxxxxxxx>"	Output actual position

Table 29: Service protocol commands list

8 Text displays and their meaning

Display	Meaning	Description
Stnd	Standard	
AdJSt	Adjustment	Adjustment
SEnbd	Sensor-Band	Sensor-magnetic strip gap
noSEn	No Sensor	No sensor
bUSPA	Bus Passive	Bus passive error state (CANopen)
bUSOF	Bus Off	Bus off error state (CANopen)
bAtcr	Battery critical	Critical battery status
bAtLo	Battery low	Empty battery status
PrtcL	Protocol	Bus protocol
SErvC	Service	Service Standard protocol (RS485)
bUSto	Bus-Time-Out	Bus-Time-Out (Parameter)
Inhbt	Inhibit	Inhibit-Time
CSbUS	Checksum Bus	Bus telegram check sum
tobUS	Time-Out Bus	Bus time-out (fault)
L i Lo	Limit Low	Range limit undercut
L i hi	Limit high	Range limit exceeded
noPAr	No Parameter	No known parameter

Display	Meaning	Description
rdOLY	Read Only	Read-only, no write access
no rd	No Read	Write-only, no read access
noPrG	No Programming	Not in the programming mode
POSI t	Positioning	Positioning
UI SI O	Vision	Visualization
OPtI O	Options	Options
ro	Read Only	Device data
APU	APU	Display per revolution
dP	Decimal Point	Decimal place
Adi	ADI	Display divisor
rotAt	Rotation	Sense of rotation
CALI b	Calibration	Calibration value / Calibration
OFFSt	Offset	Offset
tAr91	Target1	Target window1
tAr92	Target2	Target window2
POtyP	Positioning Type	Type of positioning
dI SPL	Display	Display orientation or "alphanumeric display" mode
t2UI S	Target2 Visualisation	Visualization of target window2
I nd ic	Indicators	Indicators
LI nE2	Line 2	Lower line
bL	Backlight	Display backlight
bL rd	Backlight red	Red display backlight
bL FL	Backlight flash	Red display backlight
FACtr	Factor	Display factor
Grn 1	Green 1	LED green 1
rEd 1	Red 1	LED red 1
FLASH	Flash	LED flash
bUS 3	Bus 3	COM-LED
CdELA	Config Delay	Configuration start delay
CALEn	Calibration Enable	Calibration permitted
InCEn	Increment Enable	Incremental measurement permitted
CnFEn	Configuration Enable	Configuration permitted
d iFF	Difference	Difference value calculation
OPtyP	Operation Type	Mode of operation
UbAtt	U Battery	Battery voltage
SErno	Serial Number	Serial number
POS	Positive	Positive
nEG	Negative	Negative
d ir	Direct	Direct

Display	Meaning	Description
inUrS	Invers	Inverted
tArGt	Target	Target
P0-tA	Position - Target	Position value – target value
tA-P0	Target - Position	Target value – position value
Abs	Absolut	Absolute
AnGLE	Angle	Angle display
uErSn	Version	(Firmware) version
chPAr	Changeable Parameter	Changeable device parameters
dIAGn	Diagnosis	Diagnostic functions
PIn	PIN	
LoAdP	Load Parameter	Load default values of parameters
AdIUS	ADI Use	Use of ADI
StAnd	Standard	
tELEG	Telegramm	
PrSnt	Presentation	Presentation mode
InVAL	Invalid	Invalid

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