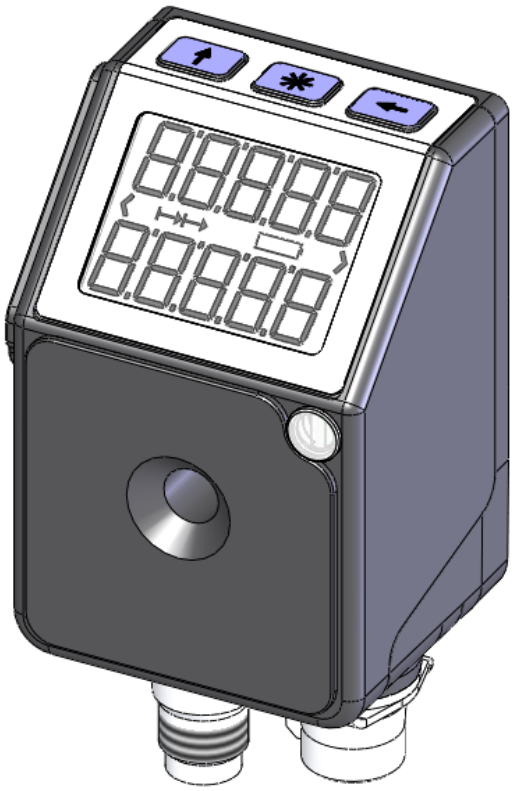
Precision in Motion

User manual

Absolute Position Indicator
with RS485 / SIKONETZ5 interface

AP24 Software SW01



1 General Information

1.1 Documentation

The following documents are associated with this document:

• The Product data sheet describes the technical data, the dimensions, the pin assignment, the accessories and the order key.

• The installation instructions describe the mechanical and electrical installation with all safety-relevant conditions and the associated technical specifications.

• The User manual for actuator commissioning and integration into a fieldbus system.

You can also download these documents at *http://www.siko.de/en/service/downloads/*.

This manual is valid for software version V1.00 or newer!

2 Display and Control Keys

2.1 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. One LED (1) serves for position monitoring.

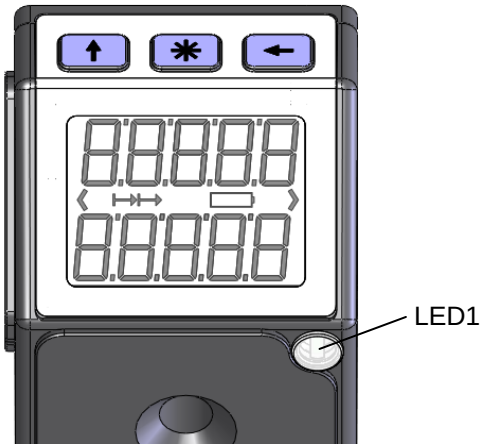


Fig. 1: Control elements

The AP24SW01 serves as a duplicate position indicator. The value to be indicated is transmitted via the RS485. The target value is indicated on the upper line and the position value in the lower line. With the two arrow keys (key = target value; - key upwards arrow = position value), the user can acknowledge the new display values. If the target value (or position value) is not acknowledged, then the value flashes in the display. The acknowledgment status can be read via RS485 and also processed. If there is no valid value displayed (power on), then nothing will be displayed in the corresponding line. If there exists neither a target value nor a position value (after power on), then „---„ will be displayed in the lower line. The status of validity of target and position values as well as the acknowledgment status is displayed with the bi-color LED according to *Table 1*.

2.2 LCD display

With supply voltage supplied, the target value is displayed in the 1st line and the position value in the 2nd line if they have already been transmitted via RS485.

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

2.3 LED display

In the basic state (factory setting), the LED has the following meaning:

LED	Actual position
off	set point invalid position value invalid
green	set point valid set point acknowledged position value invalid
green	set point invalid position value valid position value acknowledged
green	set point valid set point acknowledged position value valid position value acknowledged
red	other combinations

Table 1: LED display

The LED can be actuated independent of the validity or acknowledgment status. For this purpose, activate or deactivate its function correspondingly via parameters 8, 9 and 10, see *Table 2* as well as bits 12, 13 and 15 in the control word, see *Table 6*.

2.4 Keys

By pressing the ↑ key, a new target value is acknowledged.
By pressing the ← key, a new actual value value is acknowledged.
Pressing the ✳ acknowledges an error (*see chapter 5.1: Errors*) or starts the parameterization mode (*see chapter 3.1: Parameterization of the position indicator*).

3 Functional Description

3.1 Parameterization of the position indicator

The position indicator can be completely parameterized via the keys as well as via the bus interface.

3.1.1 Manual parameterization

3.1.1.1 Starting parameterization

After applying supply voltage, the position indicator will be on the uppermost level of the menu structure (default/delivery state).

Upon actuation of the ✳ key, the baud rate will be displayed in the lower line whereas the protocol and the node address will be displayed alternately in the upper line. Parameterization starts after expiry of the release time *(see chapter 4: Parameter description Parameter no. 9)*.

3.1.1.2 Value input

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

← - Decimal place selection key

↑ - Value change key

NOTICE	With value input via the keys, the display range is limited to -19999 … 99999. When entering values beyond this range via SIKONETZ5, "FULL" will be displayed when you call up the parameter.

3.1.1.3 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.

3.1.1.4 Parameters

Parameter display	Parameter no. acc. to chapter 4	Description
Id	3	Node address Value range: 0 - 31
PrOt	5	Protocol Selection: SnS: SIKONETZ5
bAUd	4	Baud rate Selection: 576: 57600 baud 1152: 115200 baud 192: 19200 baud
t_OUt	6	Bus timeout Value range: 0 - 20
dE2	11	Decimal places Selection: 0: 0 01: 0.1 002: 0.02 0003: 0.003 00004: 0.0004
rEd	8	Red LED function Selection: on: Indication of the operating status OFF: Off
grEEn	9	Green LED function Selection: on: Indication of the operating status OFF: Off
FLASH	10	LED blinking function Selection: on: LED blinking On OFF: Off
dELAY	7	Key enable time Value range: 1 … 60
CodE		System commands Selection: 1101: set all parameters to default (restore factory settings) 1102: only standard parameters to default 1105: only bus parameters to default
dISPL	12	Display orientation Selection: 0: 0° 180: 180°

Table 2: Parameter menu

3.1.2 Parameterization via interface

The position indicator can be completely parameterized in the SIKONETZ5 protocol via the RS485 interface *(see chapter 7.8: Parameterization via SIKONETZ5).*

4 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 = Bus parameter
P	Write access to the parameter can be locked via the "Configuration programming mode" parameter *no. 21*.

No.	Name	Selection / value	Default	Description	S	C	P
1	Actual position	-999999 … 999999	0	**Absolute actual position**	-	-	P
2	Set point	-999999 … 999999	0	**Absolute target position** Can be displayed by the indicator: -19999 … 99999	-	-	P
3	Node address	0 … 31	1	**SIKONETZ5:** Setting the SIKONETZ5 node address Parameter changes become active only after cold start or software reset.	S	2	P
4	Baud rate RS485	0 … 2	1	**Baud rate of the RS485 interface:** 0 = 19200 1 = 57600 2 = 115200 Parameter changes become active only after cold start or software reset.	S	2	P
5	Protocol	0	0	**Protocol of the RS485 interface:** 0 = SIKONETZ5 Parameter changes become active only after cold start or software reset.	S	2	P
6	Bus Timeout	0 … 20	20	**SIKONETZ5:** Bus Timeout values in x 100 ms 0 = Function disabled *(see chapter 7.7.1: Bus-Timeout)*	S	2	P
7	Key enable time	1 … 60	15	**Display / key control:** Time in seconds how long the ✳ key must be held down until configuration starts.	S	1	P
8	LED 1 red	0 … 1	1	**Red LED 1 function:** 0 = Off 1 = Display of acknowledgment status (On)	S	1	P
9	LED 1 green	0 … 1	1	**Green LED 1 function:** 0 = Off 1 = Display of acknowledgment status (On)	S	1	P
10	LED blinking	0 … 1	1	**LED blinking function:** 0 = LED display glows constantly (when On) 1 = LED display glows (when On)	S	1	P

No.	Name	Selection / value	Default	Description	S	C	P
11	Decimal places	0 … 4	0	**Display:** Input of decimal places 0 = 0 1 = 0.0 2 = 0.00 3 = 0.000 4 = 0.0000	S	1	P
12	Display orientation	0 … 1	0	**Display:** Display orientation 0 = 0° 1 = rotated by 180°	S	1	P
13	Programming mode configuration	0 … 1	0	**SIKONETZ5:** 0 = programming not locked 1 = locking of programming depends on the programming mode	S	1	P
14	Programming mode	0 … 1	0	**SIKONETZ5:** 0 = Programming mode Off 1 = Programming mode On	-	1	-
15	System Status Word	Read only	-	**System Status Word** *see chapters 7.3.5: Status word*	-	-	-
16	Software version	Read only	-	**Software version**	S	-	-
17	Acknowledg-ment status	0…3		1 = Target value acknowledgment 2 = Position value acknowledgment 3 = Target and position value acknowledgment	-	-	-

Table 3: Parameter description

5 Warnings / Errors

5.1 Errors

Error states are signaled via display and interface.
Pending errors can be read via the interface. For returning to normal operation, the errors must be acknowledged or deleted via the ✳ key or bus interface.
(or signaling and acknowledging see in the system status word or via SIKONETZ5 chapter 7.3.4: Control word and 7.3.5: Status word)

Display	Error code SIKONETZ5	Bit assignment in the system status word or status word	Error
CSbUS	0x0080	7	Check sum SIKONETZ5
tobUS	0x0081	7	Timeout SIKONETZ5

Table 4: Error messages

6 System commands

6.1 Restore factory settings

In some instance, for instance for evaluating the position indicator, it may be useful to restore the device's factory settings. This may be done as follows:

Access	Coding		Factory settings are restored
Manually		CodE 11101	all parameters
		CodE 11102	only standard parameters
		CodE 11105	only bus parameters
SIKONETZ5	0xA0	1	all parameters
		2	only standard parameters
		5	only bus parameters

Table 5: Access to factory settings

7 Communication via SIKONETZ5

7.1 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

7.2 Data exchange

The protocol functions according to the master – slave principle.
The actuator 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.

7.3 Telegram setup

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

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	CW MSB	LSB	Data MSB			LSB	Check sum

Reply telegram (from slave)

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

7.3.1 Command

The following access types are provided by SIKONETZ5.

Access code	Meaning	Description
0x00	read	The master requests the addressed slave to output the relevant value in a response telegram.
0x01	write	The master requests the addressed slave to accept the value transferred in the same telegram.
0x02	broadcast	The master requests all connected slaves to execute the command transferred in the same telegram.

7.3.2 Node address

The device address can be freely set in the range of 0 to 31. The delivered devices are preset to node address 1 ex works and must be reset to the desired address to enable their operation with multiple slaves on the SIKONETZ5 fieldbus. Each address can be assigned in the fieldbus only once!
Description see chapter 4: Parameter description ⇒ Parameter no. 3.

7.3.3 Parameter address

A distinct address is assigned to every parameter (e. g. calibration value) or functional value (e. g. set point). *Description see chapter 7.8: Parameterization via SIKONETZ5.*

7.3.4 Control word

The master can give the following commands to the slave in the control word (CW).

Bit	Meaning	Value = 0	Value = 1
0	reserved	ever 0	-
1	reserved	ever 0	-
2	reserved	ever 0	-
3	reserved	ever 0	-
4	reserved	ever 0	-
5	Error	not acknowledged	acknowledged
6	reserved	ever 0	-
7	reserved	ever 0	-
8	reserved	ever 0	-
9	reserved	ever 0	-
10	reserved	ever 0	-
11	reserved	ever 0	-
12	LED green	OFF	ON[1]
13	LED red	OFF	ON[1]
14	reserved	ever 0	-
15	LED blinking	OFF	ON[1]

Table 6: Control word (Master ⇒ Slave) SIKONETZ5

7.3.5 Status word

The current status of the slave is transferred to the master in the status word (SW).

Bit	Meaning	Value = 0	Value = 1
0	Target value acknowledgment	not acknowledged	acknowledged
1	Position value acknowledgment	not acknowledged	acknowledged
2	Target value validity	invalid	valid
3	Position value validity	invalid	valid
4	reserved	-	-
5	reserved	-	-
6	reserved	-	-
7	General error	not present	reached
8	reserved	-	-
9	reserved	-	-
10	reserved	-	-
11	reserved	-	-
12	reserved	-	-
13	reserved	-	-
14	reserved	-	-
15	reserved	-	-

Table 7: Status word (Slave ⇒ Master) SIKONETZ5

7.3.6 Data

Range for data exchange. Size: 4 bytes.

[1] *In order to get access to the LED via the control word, the position-dependent function must be inactivated via* Parameter no. 12, 13 *and* 14.

7.3.7 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.

7.4 Synchronization

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.

NOTICE	Processing of the "Restore factory settings" system command may take up to 100 ms. Acknowledgment is reported only after proper updating of all parameters in the non-volatile memory.

7.5 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 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.

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
0x01	0x01	0x04	0x00	0x00	0x00	0x00	0x00	0x5A	0x5E

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	SW		Data				Check sum
							Code 2	Code 1	
0x01	0x01	0xFD	0x00	0x81	0x00	0x00	0x02	0x82	0xFC

7.5.1 SIKONETZ5 error codes

Code 1	Description	Code 2	Description
0x80	Check sum SIKONETZ5	0x00	no further information available
0x81	Timeout SIKONETZ5	0x00	no further information available
0x82	Value rage 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 attempt to read only
		0x02	read attempt to write only
0x85	Error due to device status	0x00	no further information available
		0x03	Programming locked

Table 8: SIKONETZ5 error codes

7.6 Errors

If a slave is in the error state the slave signals the error with SW.7 = 1.
An error must be acknowledged by CW.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 address 0xFD*. The error code will be output *(see chapter 5.1: Errors and 7.5.1: SIKONETZ5 error codes).*

7.7 Communication monitoring

7.7.1 Bus Timeout

Bus timeout monitoring is activated via parameterization of a valid time value (>0) for timeout (*see chapter 4: Parameter description ⇒ Parameter no. 6).*
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 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.

7.7.2 Programming interlock

Programming interlock is controlled via *Parameter no. 13*: *Programming mode configuration"*
This parameter being enabled, the interlock must be canceled prior to write access to a lockable parameter (*see* Table 3: Parameter description*)* by applying a write access to *Parameter no. 14*: *"Programming mode."* 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 7.5.1: SIKONETZ5 error codes)*.

7.8 Parameterization via SIKONETZ5

On principle, the position indicator sends a telegram acknowledging write and read commands of the master. With the command executable the value adopted is in the reply telegram.

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

Access
rw = read write
ro = read only
wo = write only

Parameter		Name	Access	Format	Description
no. acc. to chapter 4	Adr. [hex]				
3	0x00	Node address	rw	Unsigned8	Value range 0 … 31 Parameter changes become active only after cold start or software reset.
4	0x01	Baud rate	rw	Unsigned8	0 = 19200 1 = 57600 2 = 115200 Parameter changes become active only after cold start or software reset.
6	0x02	Bus Timeout	rw	Unsigned16	Value range 0 … 20 *(see chapter 7.7.1: Bus-Timeout)*
7	0x04	Enable keys time	rw	Unsigned8	Value range 1 … 60
10	0x07	LED blinking	rw	Unsigned8	0 = LED display glows constantly 1 = LED display blinks
8	0x08	LED 1 red	rw	Unsigned8	0 = LED 1 red Off 1 = LED 1 red On
9	0x09	LED 1 green	rw	Unsigned8	0 = LED 1 green Off 1 = LED 1 green On
11	0x0A	Decimal places	rw	Unsigned8	Value range 0 … 4 0 = 0 1 = 0.0 2 = 0.00 3 = 0.000 4 = 0.0000
12	0x0D	Display orientation	rw	Unsigned8	0 = normal 1 = rotated by 180°
13	0x0E	Programming mode Configuration	rw	Unsigned8	0 = no programming mode 1 = apply programming mode
	0x65	Device code	ro	Unsigned8	1 = AP24
16	0x67	Software version	ro	Unsigned16	Versions number Ex.: 101_{dec} corresponds to V1.01

Parameter		Name	Access	Format	Description
no. acc. to chapter 4	Adr. [hex]				
	0xA0	S command	wo	Unsigned16	1 = all parameters to default **Caution!** All parameter classes will be reset. After restart, the factory settings will be active, this applies to node address and baud rate as well. 2 = only standard parameters to default 5 = bus parameters to default 7 = calibration 9 = software reset
14	0xA8	Programming mode On / Off temporary	wo	Unsigned8	Programming interlock depending on the parameter "Configuration programming mode" 0 = Programming mode Off: Write parameter disabled. Write attempts are acknowledged with an error message. 1 = Programming mode On: Write parameter enabled *(see chapter 7.7.2: Programming interlock)*
	0xAE	Acknowledge target / position values	rw	Unsigned8	Write and read acknowledge-ment of new target and/or position values
	0xFA	Status word	ro	Unsigned16	*(see chapter 7.3.5: Status word)*
	0xFD	Error		Integer32	*(see chapter 7.5: Error telegram)*
	0xFE	Actual position	ro	Integer32	Actual position
	0xFF	Set point	rw	Integer32	Set point

Table 9: Parameter description SIKONETZ5

7.9 Examples of access

7.9.1 Example: Read parameter

Reading the parameter target window1 of node address 1:

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

Read command: 0x00
Node address: 0x01
Parameter address: 0x20 Target window1
Data: 0x00 00 00 00

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
0x00	0x01	0x20	0x00	0x00	0x00	0x00	0x00	0x00	0x21

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
0x00	0x01	0x20	0x00	0x01	0x00	0x00	0x00	0x05	0x25

The reply telegram contains the current value of parameter target window1.
Data: 0x00 00 00 05 $\Rightarrow 5_{dec}$