Precision in Motion

User Manual

Interface for connecting max. 31 SIKO devices with RS485 interface to Profibus DP

IF09P/1

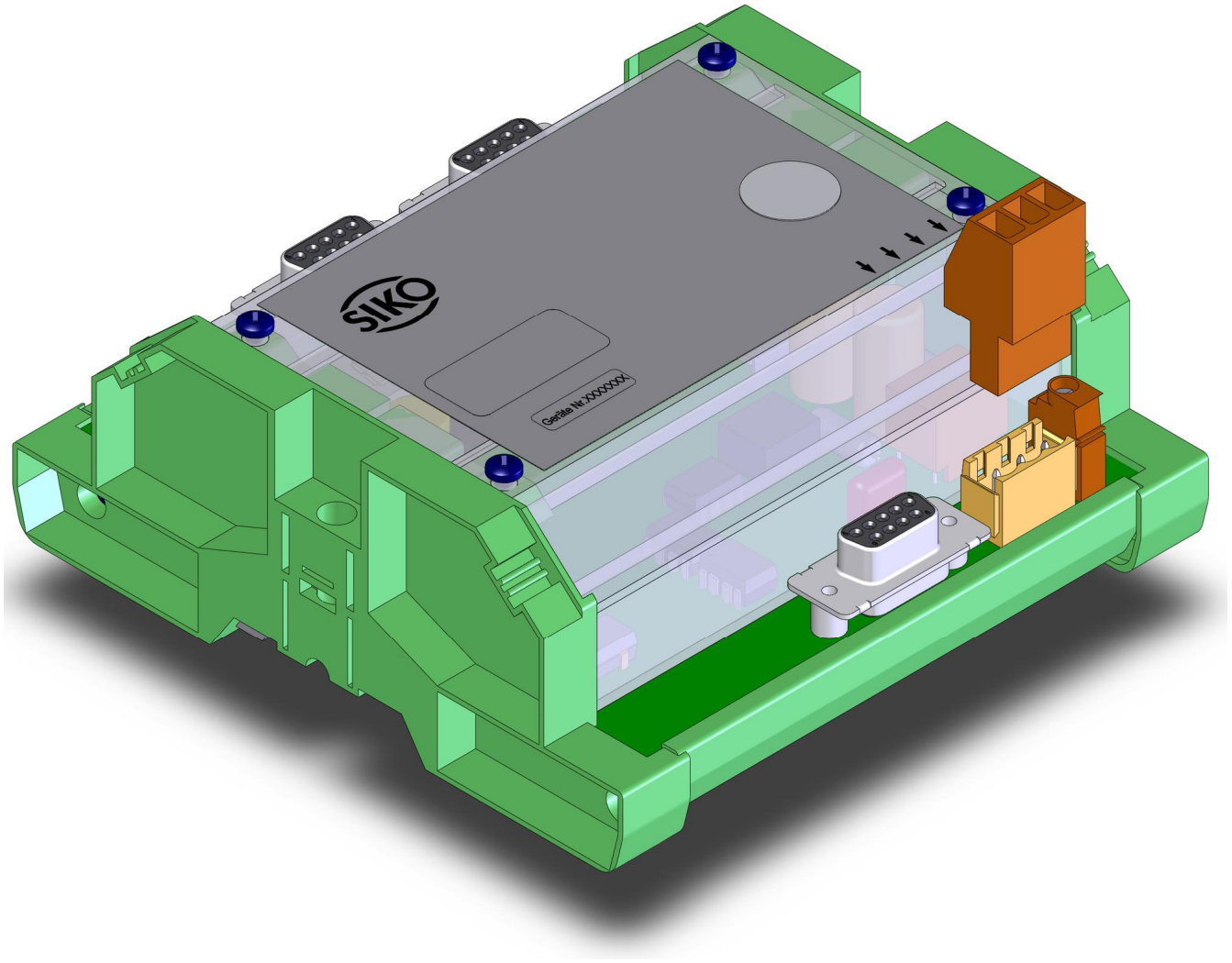


Table of contents

1 General Information

This user manual applies to the IF09P/1 PROFIBUS-gateway with firmware version 3.00 or higher! It describes the interface, its parameterization and commissioning.

The IF09P/1 Profibus gateway couples SIKO position encoders with SIKONETZ3- (SN3) or SIKONETZ4- (SN4) interfaces to the PROFIBUS-DP. Mixed operation of SIKONETZ4 and SIKONETZ3 instruments is **not** possible. The two interface protocols, the PROFIBUS station address as well as some diagnostic functions can be selected comfortably via the IF09P/1 keyboard.

1.1 Definitions

Caution This symbol precedes passages in the text that should be read particularly carefully in order to ensure the intended use of the device and to exclude dangers.

This symbol indicates important information for proper handling of the interface. Disregard of these hints may result in malfunctioning of the device or its environment.

LB	Low Byte;	low-order byte
MB	Middle-Byte;	middle-order byte
HB	High-Byte;	higher-order byte

SN3 **S**IKO**N**ETZ**3**; bus-compatible data transmission protocol defined by SIKO (2 telegram formats, 19200bits/s);

SN4 **S**IKO**N**ETZ**4**; bus-compatible data transmission protocol defined by SIKO (1 telegram format, 115200bits/s); also called **AP09 protocol** for historical reasons.

DP Distributed periphery.

DPM1 DP master (class 1). The DPM1 is the central automation device with Profibus DP.

GSD Device database file. Electronic device data sheet in a pre-defined form for PROFIBUS devices.

1.2 Documentation

This User Manual describes the information required for handling the PROFIBUS gateway IF09P/1 device.

For information regarding guarantee, safety and mechanical mounting of the IF09P/1 device please refer to the User information enclosed with these devices.

1.3 Intended use

Caution

The IF09P/1 gateway is a high-quality electronic device. It serves exclusively for gathering and transferring position and / or parameterization data of connected SIKO devices to a PROFIBUS control. The gateway must be used exclusively for this purpose.

1.4 Numerical data

If not explicitly stated otherwise, decimal values are given as figures without an extension (e.g., 1234), binary values are marked with a **b** behind the figure (e.g., 19011b), hexadecimal values with an **h** (e.g., 280h).

2 Technical Data

- Max. 31 devices with SN3 or SN4 protocols can be connected
- Current supply 24VDC ±20%
- Power input approx. 1.3W
- Galvanically isolated DP interface
- Profibus functionality via Siemens SPC3 Controller
- Bit rate on encoder side 19.2kBit/s (SN3) or 115.2kBit/s, resp. (SN4)
- Bit rate on Profibus side between 9.6 Kbit/s and up to 12 Mbit/s.
- Quick status diagnosis via LED status display
- Configurable via integrated keyboard and 5-digit 7-segment display.
- Diagnostic functions

2.1 Profibus interface (X5 connection)

The IF09P/1 is connected to the Profibus via a 9-pin D-SUB connector according to EN 50170. If bus termination is required it should be in the connector; i.e., use appropriate connectors with terminating resistors that can be switched in. The following data rates are supported: 9.6kBit/s, 19.2kBit/s, 93.75kBit/s, 187.5kBit/s, 500kBit/s, 1.5MBit/s, 3MBit/s, 6MBit/s, and 12Mbit/s. The associated **SIKO00EC.GSD** device database file available for download at www.siko.de contains additional Profibus-specific parameters.

For the D-Sub connector's pin configurations please refer to the pin layout below.

2.2 Interface to SN4 or SN3, resp. (X3 or X4 connection, resp.)

You can choose either of the two D-Sub connectors, X3 or X4 for connecting the encoders. The maximum baud rate is **115.2kBit/s** for the SN4 protocol or **19.2kBit/s** for the SIKONETZ3 protocol. The connected encoders can be supplied directly via two additional pins. Supply current must not exceed **0.75A**! Refer to the connection diagram for the pin configuration (see chapter *2.5*).

If the electricity requirements of the station connected to the IF09P/1 exceeds the above value, these devices shall be supplied via an external power pack. Take care that the external power pack and IF09P/1 have common earth connection.

2.3 Functioning

After switching on, the IF09P/1 determines the number of encoders connected. The addresses of the stations found are entered into a table in ascending order.

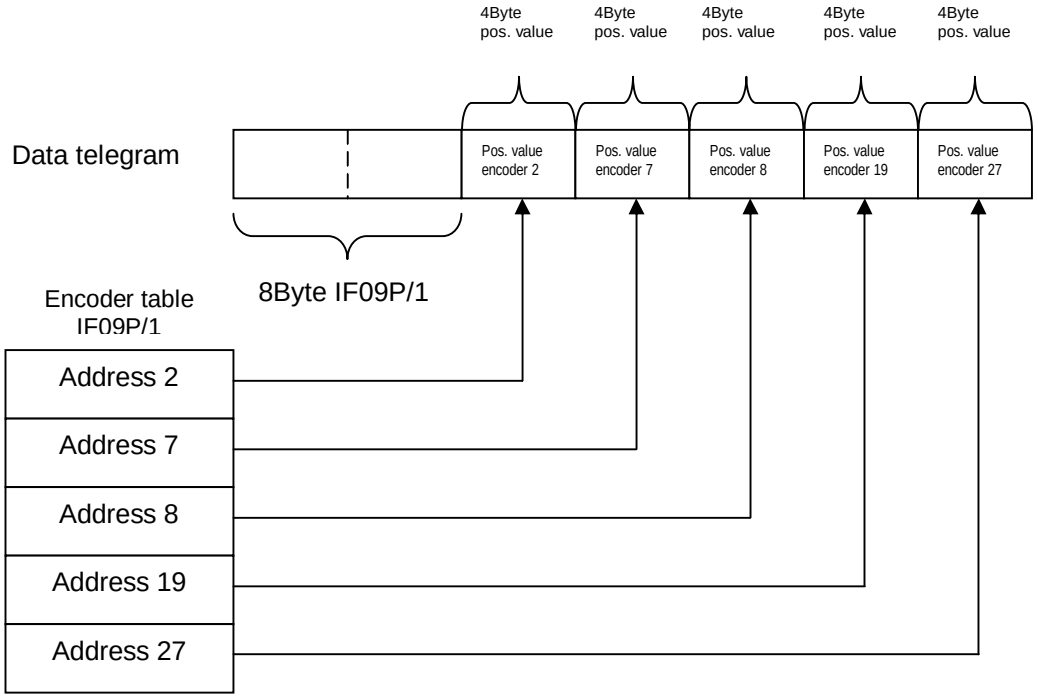
It is not mandatory that the encoder addresses start ascending with address 1; they may be assigned freely in the address range of 1...31; however, avoid address conflicts by double or multiple assignment of identical addresses!

In the data exchange phase, the position values of the encoders detected will then be transferred to the PLC (e.g., SIEMENS S7) in a data telegram with a length of up to 132bytes.

Note for S7 users: The functional building block SFC14 „DPRD_DAT" (SFC15 „DPWR_DAT") is required to enable consistent reading (writing) of these data.

A control/status telegram of 8 byte length supplied by the IF09P/1 itself is always prefixed to the position values. The encoders can be parameterized via these control bytes or status information can be read out, respectively.

The outline below is intended to illustrate the structure of the data telegram. A configuration with 5 encoders serves as an example.



Three status LEDs inform about the interface's operational state:

- Green LED: Power on (operating voltage applied);

- Red LED: A failure occurred (blinking LED);

- Yellow LED: Ongoing data exchange between IF09P/1 and PLC master;

In case of failure, the 5-digit display informs about the encoder that causes the error(s).

The keyboard serves for entering parameter values directly relating to the IF09P/1 and also for diagnosis of the encoders recognized by IF09P/1.

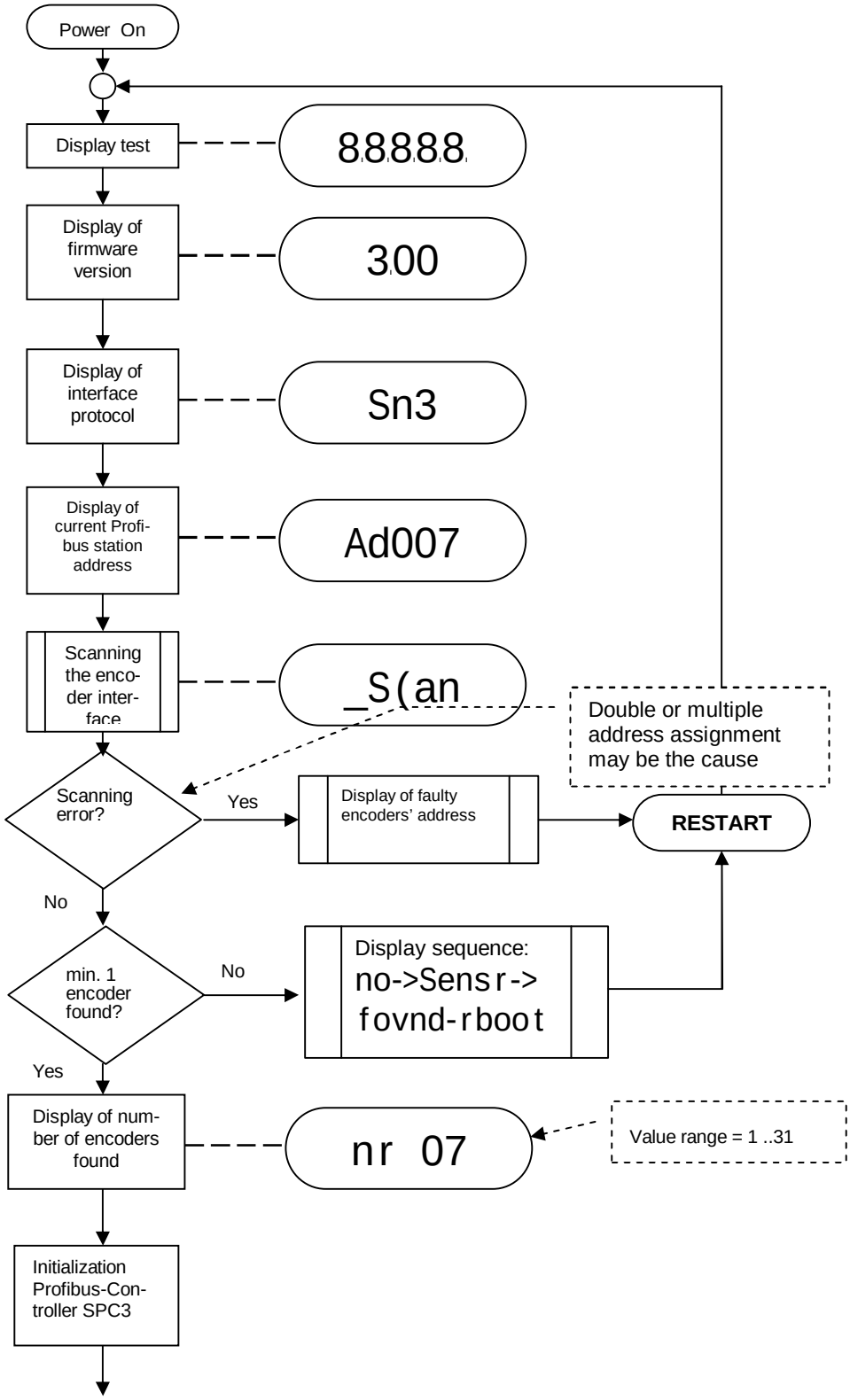
2.3.1 Starting phase

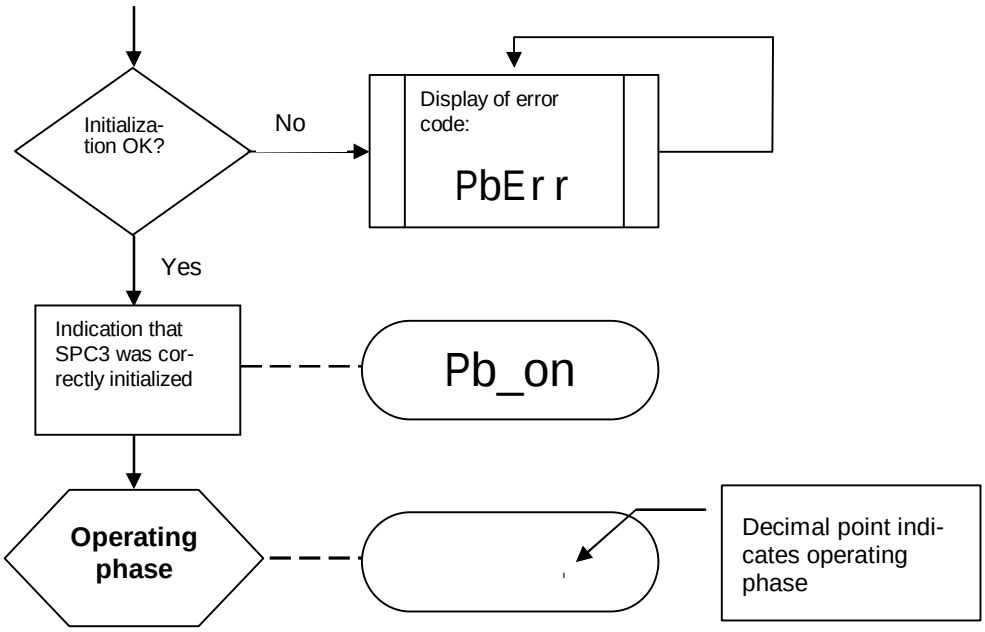
On the condition that all devices, IF09P/1 and the encoders (SN4 or SN3 stations, resp.) are switched on together[1], the following switch-on sequence will take place:

[1] It should be avoided to switch on the IF09P/1 before switching on the connected encoders because otherwise the encoders would not be identified correctly or not identified at all! Subsequent re-initialization with repeated scanning operation is only possible by entering a defined control code IFP09/1. For the description refer to chapter 0.

The opposite case of first starting the encoder and subsequently the IF09P/1 is possible without problems.

- The encoders initialize.
- The IF09P/1 goes through the initialization sequence shown below:





2.3.2 Operating phase

Having correctly completed the initialization sequence shown above, the IF09P/1 will cyclically fetch the position data of the encoders recognized and provides them to the IC SPC3 Profibus protocol.

Errors detected during this phase (transfer errors, checksum errors) are indicated on the display by a blinking red error LED and additionally as plain text with indication of the faulty encoder's address.

If the IF09P/1 has been set to the SN3 protocol operating mode, then error messages output by the addressed encoders will be indicated transiently on the display (F02, F03 or F05 error messages; for details on the error messages refer to the relevant User information; *see also chapter 4*).

2.3.3 Parameterization/status query

The PLC user can parameterize the encoders connected via the IF09P/1 or query the values of parameters. The interface expects receiving a parameterization telegram of 8byte length, which contains the parameter command, the address of the encoder to be addressed and the data proper for the encoder to be addressed.

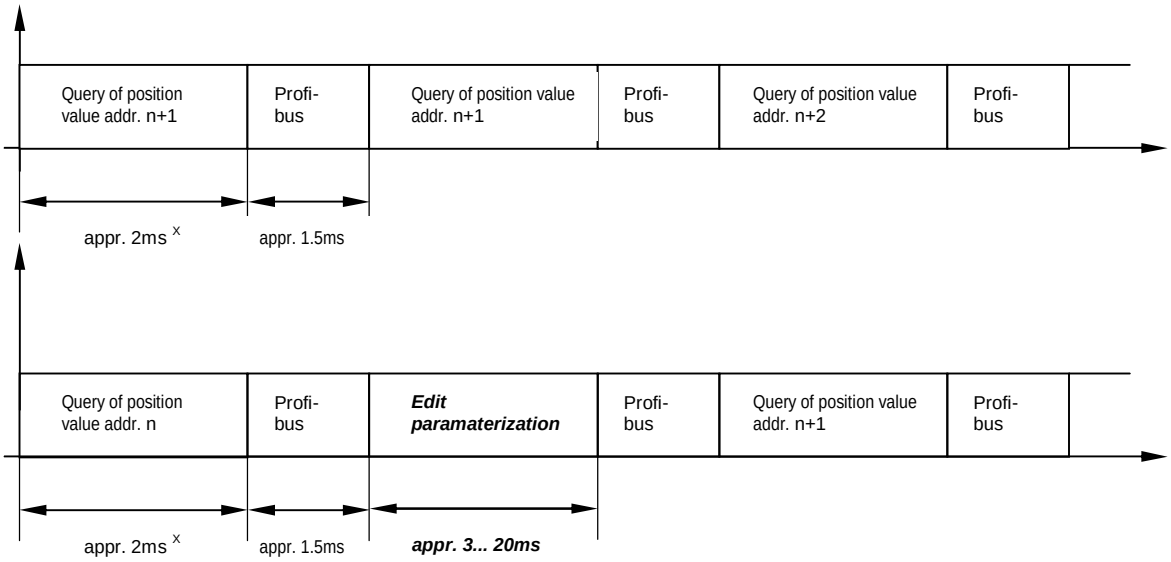
If the PLC sends a parameterization telegram to the IF09P/1, the position value query will be suppressed until the parameter query has been processed. The PLC will be informed about the end of the query via a confirmation code (see *Table **1 – Order codes***

The user shall ensure that the command telegram output by the PLC master will be removed from PROFIBUS immediately after acknowledgement of a parameterization or status query event, since otherwise the IF09P/1 gateway will be strongly impeded by permanent parameterization or status query events in cyclic position value query.

The time between two parameter telegrams must not be shorter than 20ms in order to enable correct saving of the values in the encoder-internal EEPROMs.

2.4 Cycle times

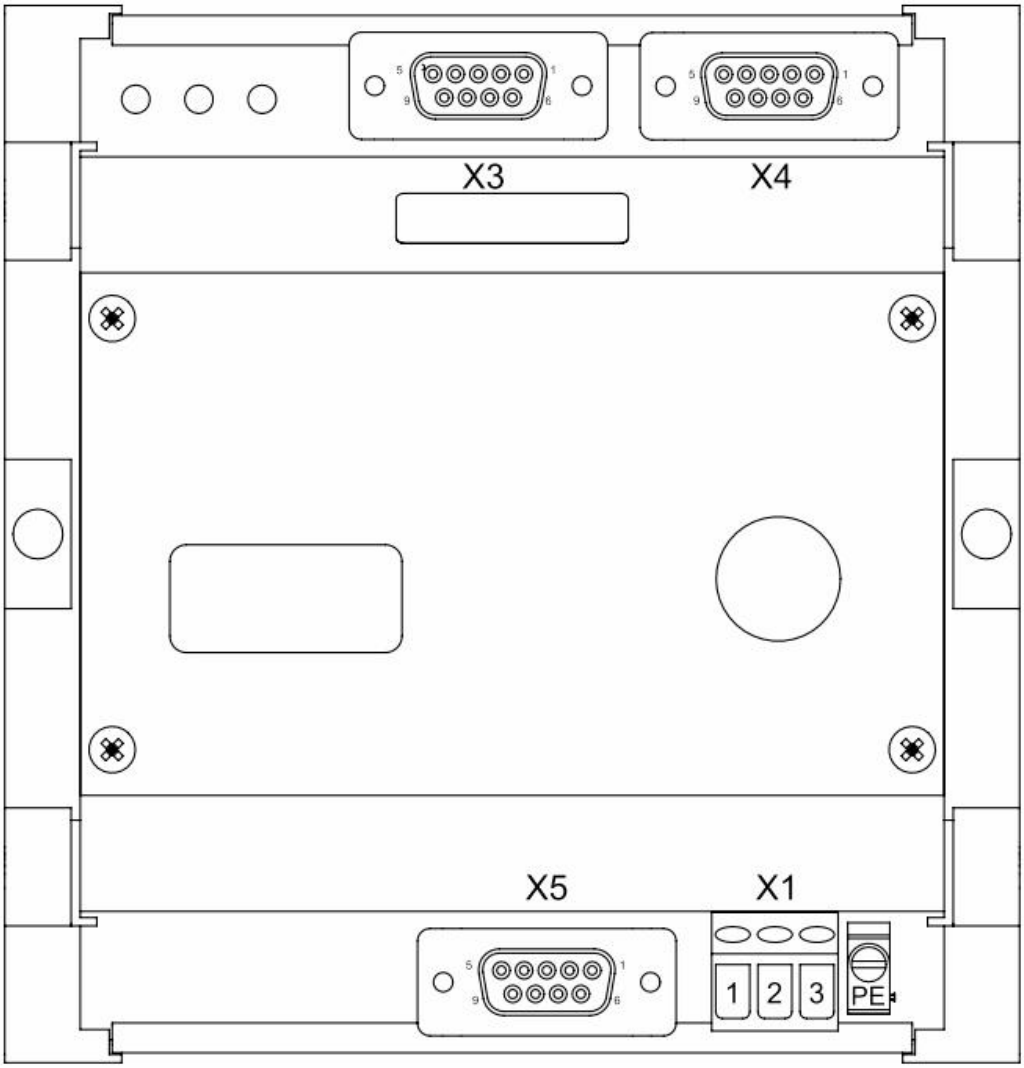
The timing of the position value query and of Profibus interface operation is illustrated in the diagram below (SN4 protocol!):



The times marked with X are extended to approx. 5.6ms with SIKONETZ3 operation

The times shown above apply to the simplest system structure with one encoder connected. The times indicated for position value query and Profibus operation will be extended by approx. 0.16ms for every additional encoder connected.

2.5 Connection diagram



Sensor X3 and X4 connection	
Pin	Assignment
1	+Ub (with 0.75A max. load!)
3	DÜA
5	GND
8	DÜB
2, 4, 6, 7, 9	N.C.

Profibus X5 connection	
Pin	Assignment
3	B-Line
4	RTS
5	2M
6	2P5
8	A-Line
1,2,7,9	N.C.

Current supply X1	
Pin	Assignment
1	PE
2	0V
3	+24VDC ±20%

3 Operation

After removing the transparent cover, you can parameterize the IF09P/1 via the keyboard. The 5-digit LED display provides the user with the relevant information. The 4 keys have the following functions:

P-key By holding down this key for >5sec. the parameter mode will be activated. The name of the parameter and its current value are displayed alternately. By pressing the key once more you will be led through the whole menu consisting of three parameters. Having arrived at the third parameter, repeated pressing of the P key will return you to normal operation. If no key is pressed for 30 seconds during parameterization, the F09P/1 will automatically return to normal operation.

Parameter 1: Protocol setting,

Parameter 2: Address setting of Profibus station,

Parameter 3: Diagnostic functions.

Left arrow key: Selection of digit to be changed.

Up arrow key: Selection of digits 0 .. 9.

Asterisk key: Adopting/saving the value selected by means of the arrow key

3.1 Protocol setting

On the display, the _PrOT value alternates with protocol name set. The protocols shown below can be set via the *Up arrow* key:

Sn4, Sn3

Acknowledge via the *Asterisk* key. The value will be adopted with the next restart.

3.2 Profibus address

On the display, the P_Adr value alternates with the address set. The address can be set in the 0 ... 125 range by pressing the *Up arrow* and *Left arrow* keys. Acknowledge by pressing the *Asterisk* key. The value will be adopted with the next restart.

3.3 Diagnostic and control functions

On the display, the _(odE value alternates with the 00000 sequence of digit, with the active digit position blinking. Now, you may use the arrow keys to enter combinations of figures as shown below.

Control code	Description
00100	The position values of the encoders found are displayed. The display alternates between the address of the first encoder found and its position value in a 2-sec rhythm. You can switch forward to the next encoder by means of the *Up arrow* key. Having arrived at the encoder with the highest address, t he value and address of the first encoder will be displayed after the next keystroke. In this operating mode, the encoder position values continue to be updated and transferred via the Profibus. You can leave this mode by pressing the ***P-key***.
00200	In this operating mode, information on the data transfer quality is displayed on the encoder side. 3 values are displayed in succession: t(Err ... Number of corrupt data telegrams (value range: 00000 ... 99999) t_nr ... Overall number of data transfer events since switching on the IF09P/1 dtErr percentage representation of the relationship of tCErr/t_nr (max. 99.999%, min. 00.001%) The number of data transfer events is displayed in the exponential format. However, the full number range cannot be displayed for greater values due to the limitation to 5 digit places. The following display ranges apply: 001E0 ... 999E0 Number < 1000 001E3 ... 999E3 1000 < Number < 999999 001E6 ... 999E6 1000000 < Number < 999999999 001E9 ... 004E9 1000000000 < Number < 4293967296
11100	This code initiates restart with resetting the Profibus address and the protocol type to their default values (***Profibus_Address = 1, Protocol = SN4***)
10110	This code triggers a restart. The values set for Profibus address and protocol are maintained.

3.4 Configuration

For the PROFIBUS-DP gateway a device database file named **SIKO00EC.GSD** has been created. This file can be included in the device library by means of the configuration tool used for the procedure to be applied please refer to the documentation of the configuration tool.

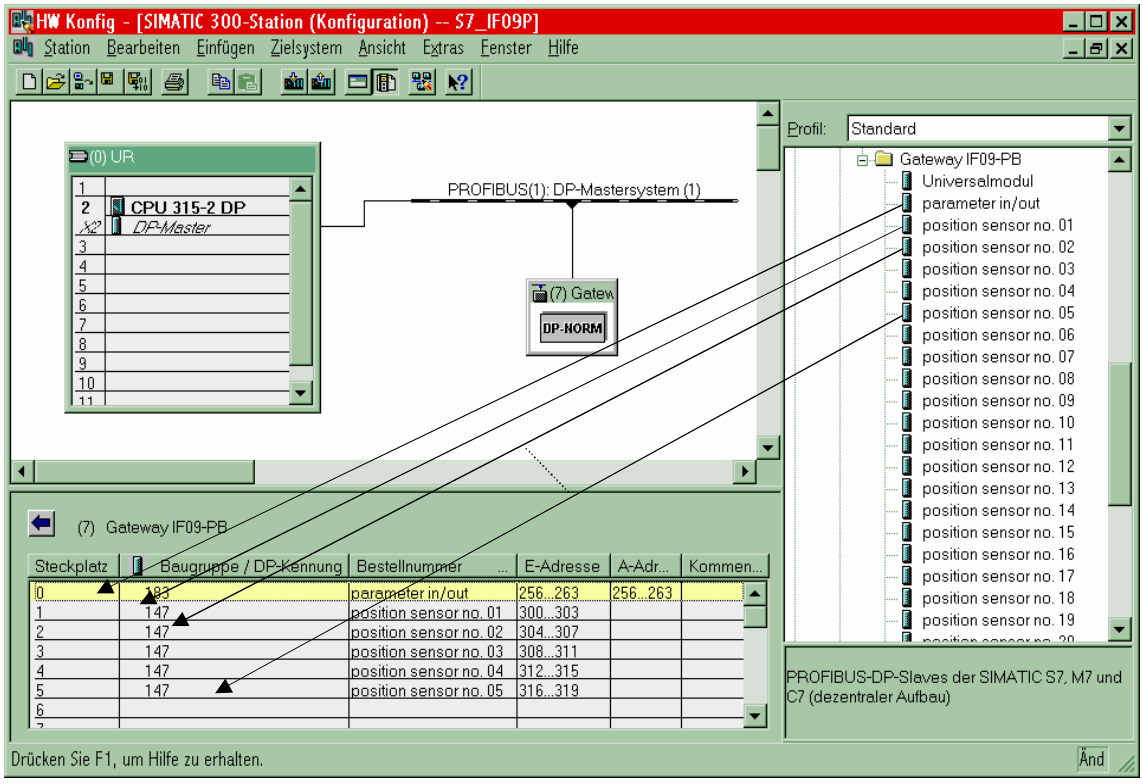
The procedure for integrating the IF09P/1 into a Profibus unit will be described below based on the example of the IF09P/1 configuration with 5 encoders (*see chapter 2.3*). The hardware manager of the S7 configuration tool shall be used. The following conditions are assumed:

1st The device database file (*SIKO00EC.GSD*) is in the correct directory

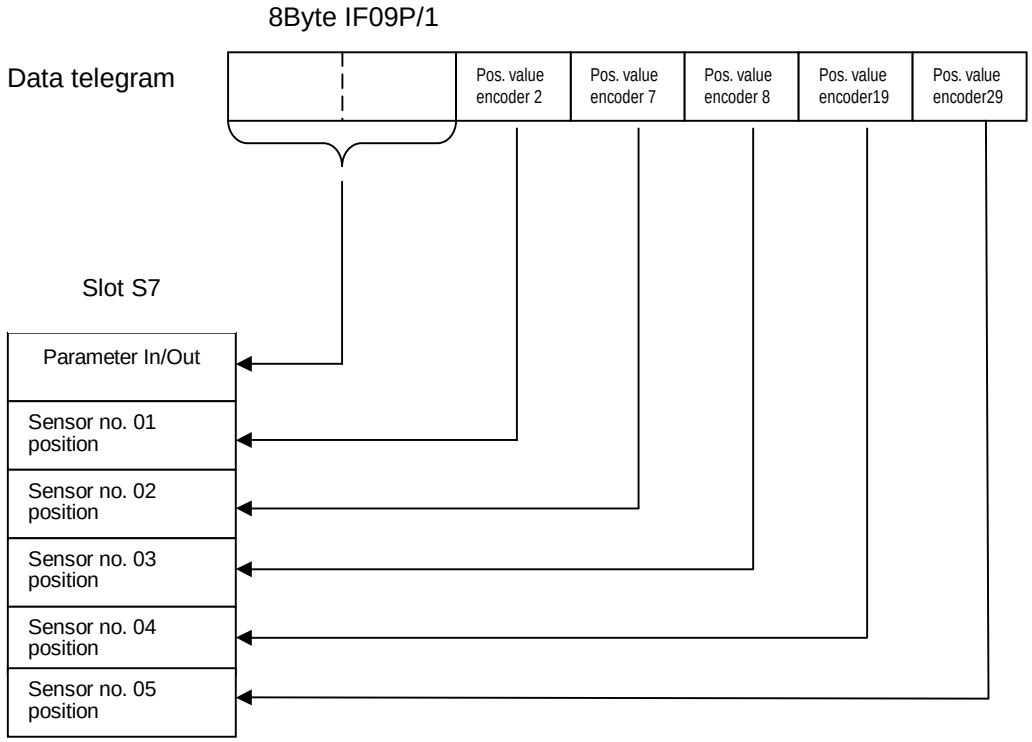
2nd at least 1 master module was selected.

1st step: Selection of the Profibus station to be included (here: Gateway IF09P/1). It is found in the device catalogue under the path “Profibus-DP\Additional field devices\Gateway”

2. Step: The modules presented are positioned on the slots shown via drag & drop.
IMPORTANT NOTE: The “Parameter In/Out” module must always be placed on the **first** place!



The modules “*Position Sensor No. **XX***“ (**XX** = 01 .. 31) represent the storage locations where the position values of the encoders connected to the IF09P/1 are stored.



3.5 Parameterization in the DATA-EXCHANGE state

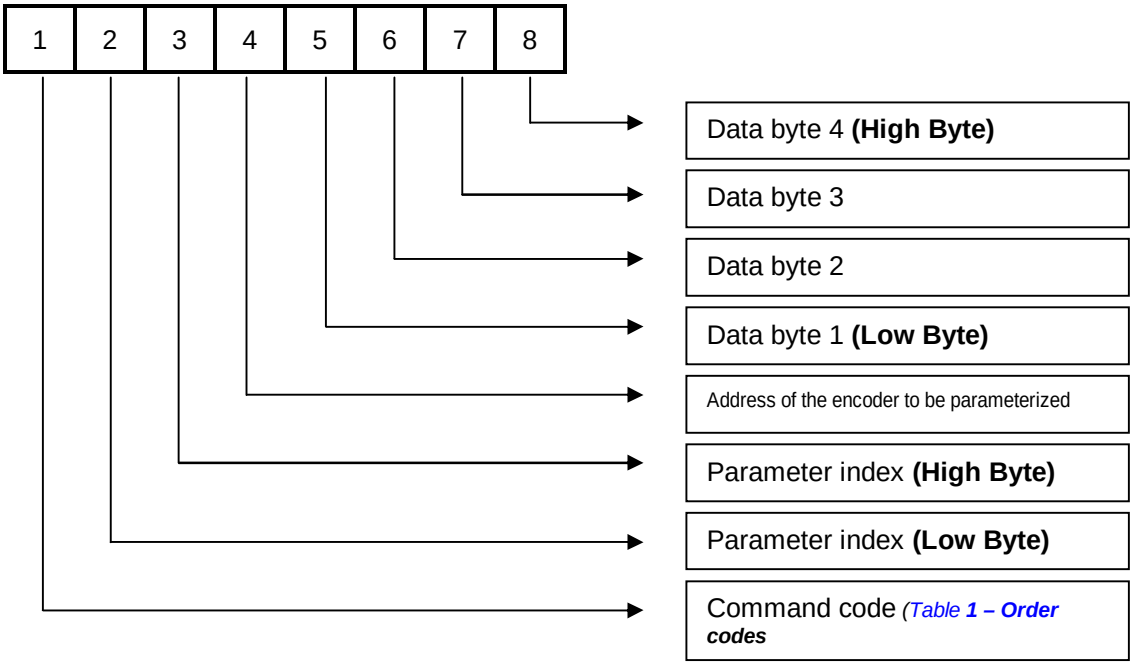
Usually, parameterization of a slave is carried out once in the start-up phase only. The parameters are determined during configuration by means of a suitable software tool.

PROFIBUS-DPV0 is not designed for slave parameterization during the DATA EXCHANGE phase (Acyclic data exchange between master and slave is possible from PROFIBUS-DPV1 onwards).

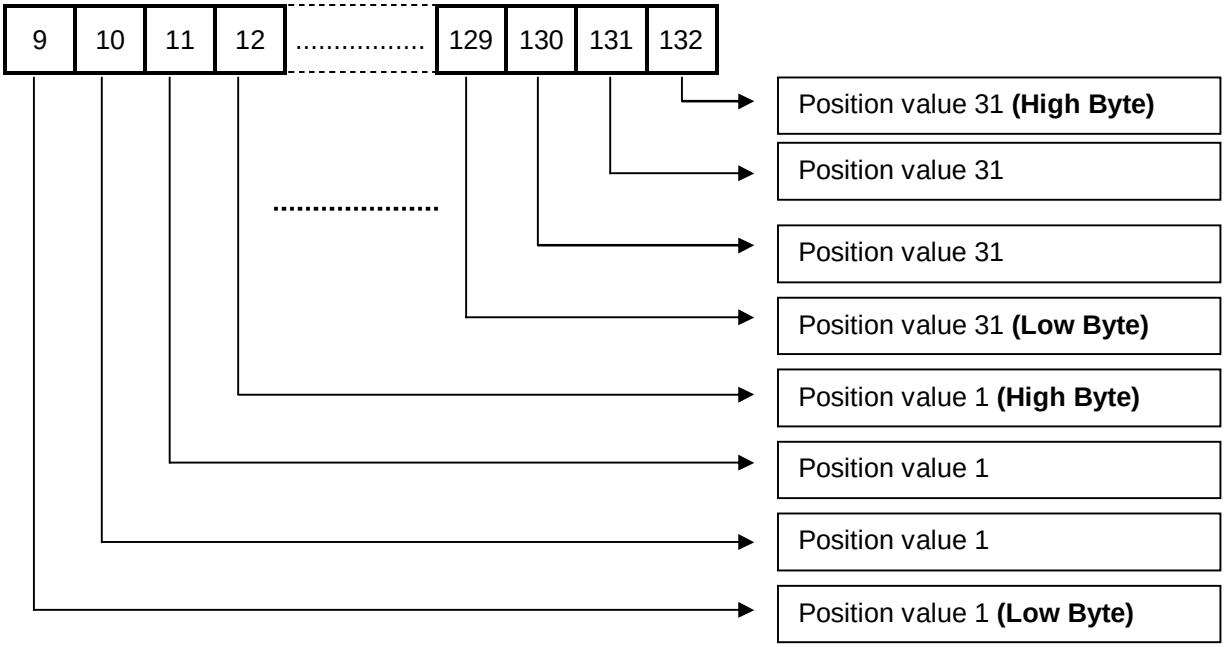
Since the IF09P/1 is based on DPV0, the possibility of overcoming this limitation was provided in order to enable reprogramming of the gateway-linked encoders also during on-going operation.

For this purpose, an input/output range of 8byte has been reserved, which is marked *"Parameter In/Out"* in the configuration. The PLC user transfers parameterization data and receives diagnostic and status messages via this range.
All 8 bytes are set to the 0 value during regular data exchange operation.

Structure of the first 8 bytes of the data telegram



Structure of the subsequent bytes of the data telegram (position values):
(Bytes 8 + n*4; n = 1..31)



Byte 1: *Command code*

Command (Service)	Command code (hexadecimal)	Command code (decimal)	Meaning
Write Request	**23h**	35	send parameter to IF09P/1 gateway
Write Response	**60h**	96	response of the IF09P/1 gateway to Write Request
Read Request	**40h**	64	parameter request from the IF09P/1 gateway
Read Response	**42h**	66	Response to the request with current value
Error Response	**80h**	128	Error message

Table 1 – Order codes

Byte 2.3: *Parameter index*

The parameter index is entered in the user data byte 2 (low byte) and in the user data byte 3 (high byte) using the Intel data format (see sections 3.6.1 or 3.6.2, respectively)

Byte 4: *Address*

This is the position of the address of the encoder to be parameterized. The values are in the range of 1 .. 31. Address value 0 is reserved for the IF09P/1.

The following statement applies only if the SIKONETZ3 protocol has been set:
Bit 6 controls broadcasting, whether or not a command shall apply to all stations. With the bit set (=1), the address (of the SIKONETZ3 station) is ignored and the command sent to all devices. With value 0, broadcasting bit is ignored and only the device with the indicated address addressed. For broad-cast-compatible commands, please refer to the command list (see 3.6.1).

Bit 7:	Bit 6:	Bit 5:	Bit 4:	Bit 3:	Bit 2:	Bit 1:	Bit 0:
0	broad-cast bit	0	Addresses 1 .. 31				

Table 2 – Broadcast

Bytes 5…8: *data byte 1 .. data byte 4*

In the data range, the value of the parameter is entered in left-aligned Intel notation. Byte 5 = low byte ... Byte 8 = high byte

3.6 Command list (index table)

Since the commands for devices with SN3 protocol differ in some regard from those with SN4 protocol, we have listed two sets of commands below:

3.6.1 Command list for the SN3 protocol

Parameter	Parameter index	Address	Data type	Data length	Access	see chapter
Position value	5F00h	1..31	Integer32	4	R	3.7.1
Oalibration value	5F01h	1..31	Integer32	4	R/W	3.7.2
Offset[5)]	5F02h	1..31	Integer32	4	R/W	3.7.3
Device code IF09P/1	5F03h	0	Integer32	4	R	3.7.4
Sense of rotation (counting direction)	5F04h	1..31	Integer32	4	R/W	3.7.5.3
Steps per revolution[5)]	5F05h	1..31	Integer32	4	R/W	3.7.6
IF09P/1 status	5F06h	0	Integer32	4	R	3.7.7
Calibration (setting the position value to the calibration value)	5F07h	1..31	Integer32	4	W[1)]	3.7.8
System status of SN3 encoder	5F08h	1..31	Integer32	4	R/W[1)2)]	3.7.9
Not implemented (causes error message)	*5F09h*	-	-	-	-	-
Set point	5F0Ah	1..31	Integer32	4	W	3.7.11
Switch on keyboard [1)4)5)]	5F0Bh	1..31	Integer32	4	W[1)]	3.7.12
Switch off keyboard [1)4)5)]	5F0Ch	1..31	Integer32	4	W[1)]	3.7.13
Start positioning [1)5)]	5F0Dh	1..31	Integer32	4	W[1)]	3.7.14
Stop positioning [1)4)5))]	5F0Eh	1..31	Integer32	4	W[1)]	3.7.15
Switch on display [1)4)5)]	5F0Fh	1..31	Integer32	4	W[1)]	3.7.16
Switch off display [1)4)5)]	5F10h	1..31	Integer32	4	W[1)]	3.7.17
InPos window	5F11h	1..31	Integer32	4	R/W	3.7.19
Loop reversal point	5F12h	1..31	Integer32	4	R/W	3.7.20

Parameter	Parameter index	Address	Data type	Data length	Access	see chapter
Encoder device code	5F13h	1..31	Integer32	4	R	3.7.21
Decimal places	5F14h	1..31	Integer32	4	R/W	3.7.22.2
Enable key's incremental measurement function	5F15h	1..31	Integer32	4	W[1)]	3.7.23
Disable key's incremental measurement function	5F16h	1..31	Integer32	4	W[1)]	3.7.24
Display divisor	5F17h	1..31	Integer32	4	R/W	3.7.25.2
Loop approach direction	5F18h	1..31	Integer32	4	R/W	3.7.26.2
Zero enable	5F19h	1..31	Integer32	4	R/W	3.7.27
Display orientation and LED functionality	5F1Ah	1..31	Integer32	4	R/W	3.7.29
Free factor	5F1Bh	1..31	Integer32	4	R/W	3.7.30
Keyboard status AP24	5F1Ch	1..31	Integer32	4	R	3.7.31

3.6.2 Command list for the SN4 protocol

Parameter	Parameter index	Address	Data type	Data length	Access	see chapter
Position value	5F00h	1..31	Integer32	4	R	3.7.1
Calibration value	5F01h	1..31	Integer32	4	R/W	3.7.2
Not implemented (causes error message)	*5F02h*	-	-	-	-	-
Device code IF09P/1	5F03h	0	Integer32	4	R	3.7.4
Read status	5F04h	1..31	Integer32	4	R	3.7.5.1
Write configuration	5F04h	1..31	Integer32	4	W	3.7.5.2
Steps per revolution	5F05h	1..31	Integer32	4	R/W	3.7.6
IF09P/1 Status	5F06h	0	Integer32	4	R	3.7.7
Calibration (setting the position value to the calibration value)	5F07h	1..31	Integer32	4	W[1)]	3.7.8

Parameter	Parameter index	Address	Data type	Data length	Access	see chapter
Not implemented (causes error message)	*5F08h*	-	-	-	-	-
Incremental measurement	5F09h	1..31	Integer32	4	W[1)]	3.7.10
Target value	5F0Ah	1..31	Integer32	4	W	3.7.11
Not implemented (causes error message)	*5F0Bh*	-	-	-	-	-
Not implemented (causes error message)	*5F0Ch*	-	-	-	-	-
Not implemented (causes error message)	*5F0Dh*	-	-	-	-	-
Not implemented (causes error message)	*5F0Eh*	-	-	-	-	-
Not implemented (causes error message)	*5F0Fh*	-	-	-	-	-
Not implemented (causes error message)	*5F10h*	-	-	-	-	-
Write sense of rotation (counting direction)	5F11h	1..31	Integer32	4	W	3.7.18
Write decimal places	5F12h	1..31	Integer32	4	W	3.7.22
Write display divisor	5F13h	1..31	Integer32	4	W	3.7.25
Write loop approach direction	5F14h	1..31	Integer32	4	W	3.7.26
Write display orientation	5F15h	1..31	Integer32	4	W	3.7.28
Write enable key function	5F16h	1..31	Integer32	4	W	3.7.32
Enable/disable “Incremental measurement” and “Reset” key functions	5F17h	1..31	Integer32	4	W	3.7.33
Green LED function	5F18h	1..31	Integer32	4	W	3.7.34
Red LED function	5F19h	1..31	Integer32	4	W	3.7.35

[1] The content of the user data bytes is irrelevant.

[2] Write access deletes the system status of the addressed encoder.

[3] Write/read access with this index generates an error message

[4] These commands are *broadcast*-compatible.

[5] This parameter is not implemented with all devices

Access = R: Read access enabled only.

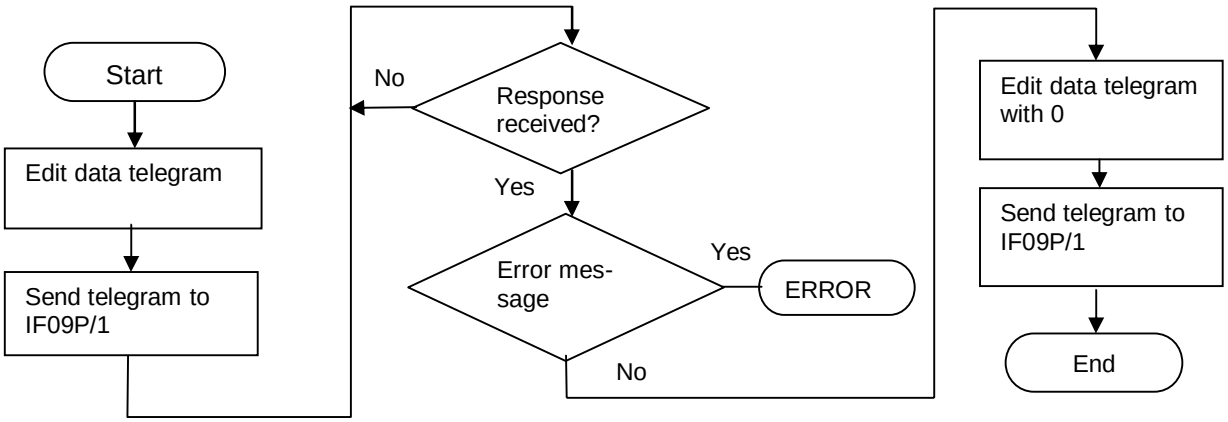
Access = W: Write access enabled only.

Access = R/W Write and Read access enabled.

All values are represented in the Intel format (the lowest-value byte first).

3.7 Command output (flowchart)

The flowchart below demonstrates the fundamental process of parameterization:



3.7.1 Output position value parameter (SN3 and SN4 protocols)

This parameter is present for the sake of completeness only. The position or display values of the connected encoders are always transferred to the Profibus master during the *Data Exchange* phase.

By executing this command, a specific encoder is addressed. This parameter is read-only, write access is acknowledged with an error message.

Example of a call: Read position value of encoder with addr. 5

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
40h	**00h**	**5Fh**	**05h**	**00h**	**00h**	**00h**	**00h**

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected encoders		
42h	**00h**	**5Fh**	**05h**	**79h**	**65h**	**3Ah**	**00h**		**xxh**	**xxh**

Reply: Position value = 3A6579h (=3.827.065)

3.7.2 Write/read calibration value parameter (SN3 and SN4 protocols)

This parameter reads or writes the calibration value of the addressed encoder.

By writing the calibration value, the addressed encoder's position value will **not** be set to this value yet! The position value is set to the calibration value after execution of the command with parameter index 5F0H only (*see 3.7.8 0 below*).

When writing the calibration value, take into account the value range of addressed encoder!

Example of a call: Set calibration value of encoder with addr. 22 to 10000h

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**01h**	**5Fh**	**16h**	**00h**	**00h**	**01h**	**00h**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= ad-dress)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected en-coders		
60h	**01h**	**5Fh**	**16h**	**00h**	**00h**	**01h**	**00h**		**xxh**	**xxh**

3.7.3 Write/read offset parameter (SN3 protocol)

A certain figure (offset) can be added to the position or display value, resp. Positive as well as negative values are permitted.

Example of a call: Set offset value of encoder with addr. 12 to 360 (= 0168h)

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**02H**	**5Fh**	**0Ch**	**68h**	**01h**	**00h**	**00h**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= ad-dress)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected en-coders		
60h	**02H**	**5Fh**	**0Ch**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.4 Read IF09P/1device code parameter (SN3 and SN4 protocols)

This parameter is read-only, write access is acknowledged with an error message.

Data byte 1: Coding of the IF09P/1 device (**07h**),
Data byte 2: Version number (**30h** for V3.00),
Data byte 3: Hardware version (**0 = IF09P, 1 = IF09P/1**).
Data byte 4: Occupied with 0.

Example of a call: Read IF09P/1 device code

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
40h	**03H**	**5Fh**	**00h**	**xxh**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= ad-dress)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected en-coders		
42h	**03H**	**5Fh**	**00h**	**07H**	**30h**	**01h**	**00h**		**xxh**	**xxh**

3.7.5 Status / configuration parameter

3.7.5.1 Read status parameter (SN4 protocol)

With this function, the following information is read from an addressed device. For detailed information on the terms listed below please refer to the relevant User information of the connected devices.

- Battery status
- Key mode
- Version number
- Display orientation
- "Incremental measurement and Reset" key mode
- Loop approach direction
- Sense of rotation (counting)
- Decimal places
- Display divisor or LED function, resp.

Data byte 4: always 0

Data byte 3: Version number (e.g., AP09: 2.02)

0	0	1	0	0	0	1	0

Data byte 3: Version number (e.g., AP09: 1.04)

0	1	1	0	1	0	0	0

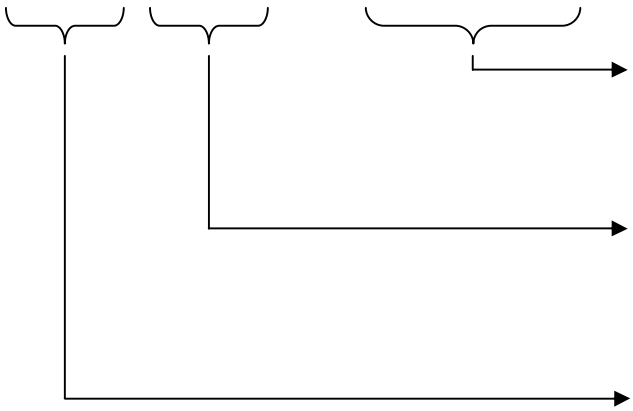
The AP04 and AP04-S differ from the other SN4 devices with regard to the coding of the firmware version:

AP04 (AP04-S): V1.04 = 104 = 68h

AP09: V2.02 = 22h

Data byte 2: Number of decimal places (0 ... 3), Display divisor or LED function, resp., loop approach direction

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Z	Z	Y	Y	0	X	X	X



Decimal places: 000 = none
001 = 1
010 = 2
011 = 3
100 = 4

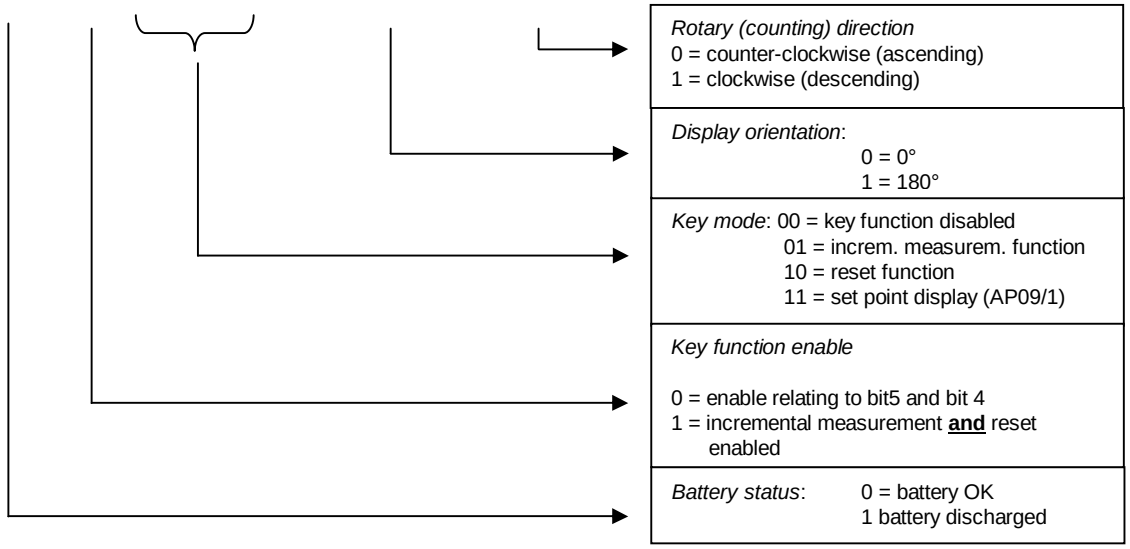
Display divisor (AP04):
00 = 1
01 = 10
10 = 100
11 = 1000

LED-function (AP04-S):
Bit5 = 1: LED red ON if outside target window
Bit5 = 0: LED red OFF
Bit4 = 1: LED green ON if inside target window
Bit4 = 0: LED green OFF

Loop approach direction
00 = direct
01 = clockwise
10 = counter-clockwise

Data byte 1: Battery status, key mode, display orientation, sense of rotation

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
X	U	Y	Y	0	V	0	Z



Example of a call: Read status of encoder with addr. 17

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
40h	**04h**	**5Fh**	**11h**	**00h**	**00h**	**00h**	**00h**

Reply: Battery discharged, key mode = reset, display orientation = 0°, counting direction = descending, 2nd decimal place, version 1.01

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected encoders -		
42h	**04h**	**5Fh**	**11h**	**A1h**	**02h**	**11h**	**00h**		**xxh**	**xxh**

3.7.5.2 Write configuration parameter (SN4 protocol)

This function influences various encoder functions

Prior to executing this function, the user must get and evaluate the encoder's current status. Afterwards, the desired operation can be executed by setting/deleting the appropriate bits in data bytes 1 and 2!

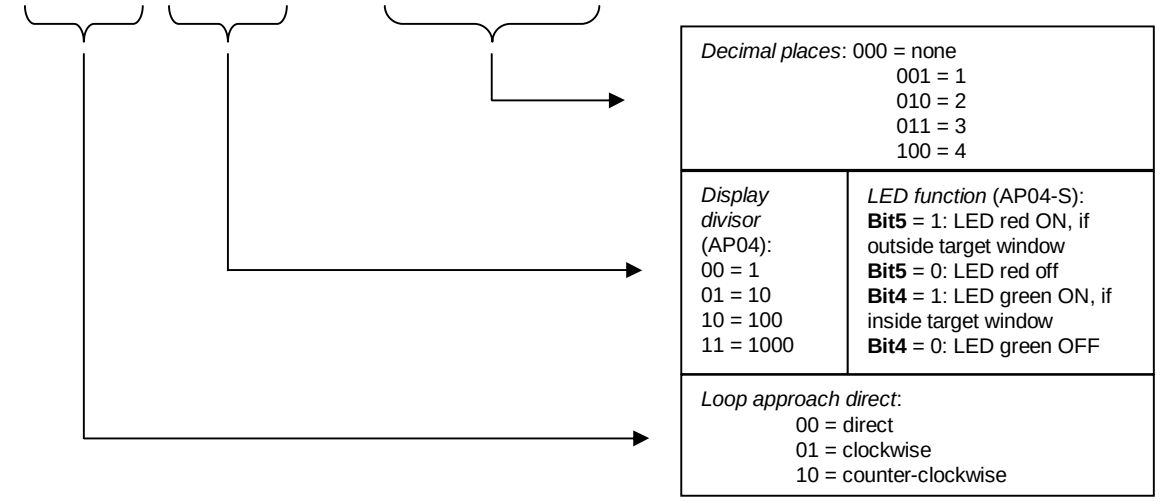
- Battery status
- Key mode
- Version number
- Display orientation
- "Incremental measurement and Reset" key mode
- Loop approach direction
- Sense of rotation (counting)
- Decimal places
- Display divisor or LED function, resp.

Data byte 4: not relevant (can contain any value)

Data byte 3: not relevant (can contain any value)

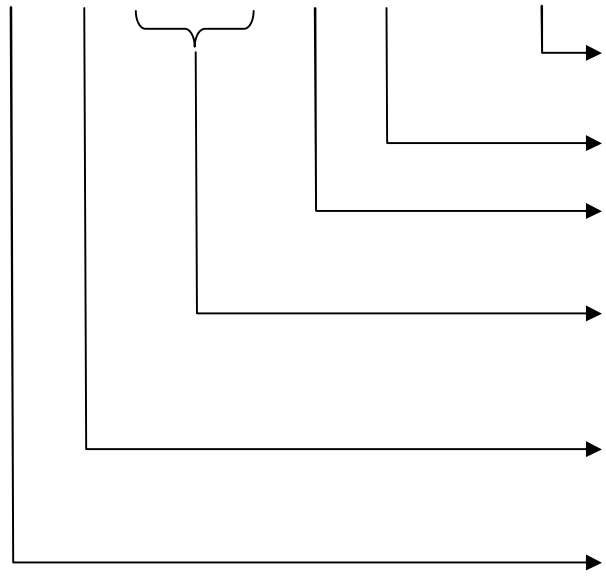
Data byte 2: Number of decimal places (0 ... 3), Display divisor or LED function, resp., loop approach direction

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Z	Z	Y	Y	0	X	X	X



Data byte 1: Display orientation, key mode, sense of rotation (counting), enable/disable incremental measurement, reset function

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
X	U	Y	Y	W	V	0	Z



Rotary (counting) direction:
0 = counter-clockwise (ascending)
1 = clockwise (descending)

Enable/disable incremental measurement

Reset (set position value to calibration value)

Key mode: 00 = no key function
01 = incrrem. measurem. function
10 = reset function
11 = set point display (AP09/1)

Enable key functions:

0 = enable depending on Bit5 and Bit 4
1 = enable incremental measurement **and** reset

Display orientation:
0 = 0°
1 = 180°

Example of a call: The AP04-S sensor (adr. 17) shall be parameterized so that it will display 2 decimal places, the loop approach direction will be cw, the green LED switched to ON upon reaching the target position, the display orientation set to 0°, the key function controlled according to bits 4 and 5, the incremental measurement function executed upon key actuation and the counting direction descending:

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
40h	**04h**	**5Fh**	**11h**	**11h**	**52h**	**00h**	**00h**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected encoders -		
42h	**04h**	**5Fh**	**11h**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.5.3 *Write/read counting direction parameter (SN3 protocol)*

Parameter (data byte 1)	Rotary encoder	Linear encoder
00h	Ascending numerical values with clockwise (**CW**) rotation	**Ascending** numerical values with sensor movement into connector outlet direction
01h	Ascending numerical values with counter-clockwise (**CCW**) rotation	**Descending** numerical values with sensor movement into connector outlet direction

Data bytes 2, 3, and 4 are not relevant and can have any values.

Example of a call: Set clockwise counting direction of encoder with addr. 17

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**04h**	**5Fh**	**11h**	**00h**	**00h**	**00h**	**00h**

Reply:

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected encoders		
60h	**04h**	**5Fh**	**11h**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.6 *Write/read steps per revolution parameter (SN3 and SN4 protocols)*

This parameter serves for scaling the measuring range of a rotary encoder. SIKO encoders always interpret value 0 as maximum value. Values exceeding the number predefined by the encoder resolution cause sequences of steps > 1.

Example of a call: Read number of steps per revolution from encoder with addr. 9

Command code	Parameter-Index Low	Parameter-Index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
40h	**05h**	**5Fh**	**09h**	**00h**	**00h**	**00h**	**00h**

Reply: number of steps per revolution = 3600_{dec} (= $0E10h_{ex}$)

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected encoders		
42h	**05h**	**5Fh**	**09h**	**10h**	**0Eh**	**00h**	**00h**		**xxh**	**xxh**

3.7.7 Read IF09P/1 status parameter (SN3 and SN4 protocols)

The status of the IF09P/1 is mapped to the user data bytes 1 .. 4. In byte 1, value 1 represents OK and 0 not ready. In byte 2, the number of the connected encoders is output (value range 0 ..31), bytes 3 and 4 are assigned 0.

Data byte 1: 0 → gateway not ready; 1 → gateway ready for data exchange

Data byte 2: number of encoders connected to the gateway

Data bytes 3, 4: occupied with value 0.

Example of a call:

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
40h	**06h**	**5Fh**	**00h**	**00h**	**00h**	**00h**	**00h**

Reply: IF09P/1ready, 31 SIKONETZ stations available

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected encoders		
42h	**06h**	**5Fh**	**00h**	**01h**	**1Fh**	**00h**	**00h**		**xxh**	**xxh**

3.7.8 Calibration parameter (setting the position value to the calibration value) (SN3 and SN4 protocols)

This serves for setting the addressed encoder to the calibration value. The data in user data bytes 1 .. 4 are not relevant and can be set to any values.

Example of a call: Encoder with address13 (0Dh) is to be set to the calibration value:

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**07h**	**5Fh**	**0Dh**	**00h**	**00h**	**00h**	**00h**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected encoders		
60h	**07h**	**5Fh**	**0Dh**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.9 Output/delete system status parameter (SN3 protocol)

This parameter serves for querying or deleting the status of the addressed SN3 station.

The bits identified with * are encoder-dependent, refer to the relevant User information for the corresponding meaning!

Data byte 1:

Bit 0: *Actuator 1 On**
Bit 1: *Actuator 2 On**
Bit 2: *Actuator 3 On**
Bit 3: Position value frozen
Bit 4: *Keyboard switched on **
Bit 5: Programming state On
Bit 6: *Limit comparison active **
Bit 7: *Blockage monitoring active **

Data byte 2:

Bit 0: *Error F01 occurred (display overflow)* *
Bit 1: Error F02 occurred (data transfer error, CRC error)
Bit 2: Error F03 occurred (illegal or unknown command)
Bit 3: Error F05 occurred (illegal value input) *
Bit 4: *
Bit 5: *
Bit 6: *
Bit 7: *Axle was blocked **

Data byte 3:

Bit 0: *target value achieved **
Bit 1: *break-over point reached **
Bit 2: *
Bit 3: *
Bit 4: *lower limit reached *:*
Bit 5: *upper limit reached *:*
Bit 6: *
Bit 7: *on-going positioning **

A set bit (=1) means active. Bits 0 to 7 of data byte 1 cannot be deleted by a write request of the *System status* command and are always up to date. Bits 0..7 (byte2) and 0..7 (byte3) are set automatically, but must be deleted with a write request of the *System status* command.

Example of a call: Read system status of encoder with addr. 7

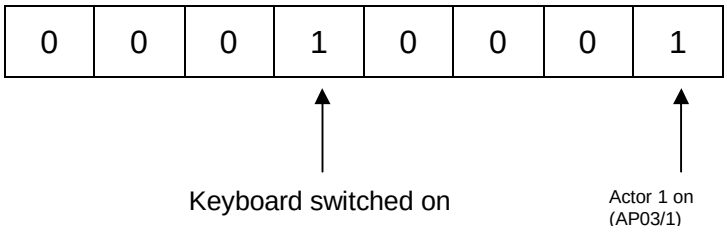
Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
40h	**08h**	**5Fh**	**07h**	**00h**	**00h**	**00h**	**00h**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= ad-dress)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected en-coders		
42h	**08h**	**5Fh**	**07h**	**11h**	**00h**	**82h**	**00h**		**xxh**	**Xxh**

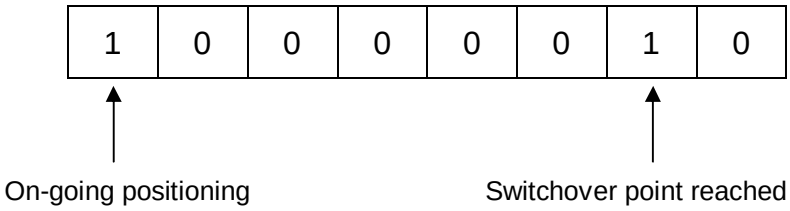
Meaning of the data bytes:

Data byte 1:



Data byte 2: no active status messages

Data byte 3:



3.7.10 Activate/deactivate incremental measurement parameter (SN4 protocol)

This parameter serves for activating or deactivating the addressed encoder's incremental measurement function. The data in the user data bytes 1 .. 4 are not relevant and can be set to any values.

The interval of two subsequent "Activate/deactivate incremental measurement" commands must be > 100ms!

Example of a call: Incremental measurement function is to be activated in the encoder with address 14 (0Eh)

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**09h**	**5Fh**	**0Eh**	**xxh**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected encoders		
60h	**09h**	**5Fh**	**0Eh**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

Another call of this function will deactivate the incremental measurement function again!

3.7.11 Write/read set point (SN3 and SN4 protocols)

This command is used in connection with positioning tasks. The desired position value to be travelled to (= set point) is programmed and put into operation via the *Start positioning* command described below (*3.7.14*).
An appropriate system structure, e.g., with a type AP04 SIKONETZ rotary encoder is the precondition for this procedure. With the SN4 protocol set, a read access will result in an error message!

Example of a call: Read set point of encoder with addr. 6

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
40h	**0Ah**	**5Fh**	**06h**	**00h**	**00h**	**00h**	**00h**

Reply: Set point = 25000 (= 61A8h)

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected encoders		
42h	**0Ah**	**5Fh**	**06h**	**A8h**	**61h**	**00h**	**00h**		**xxh**	**xxh**

3.7.12 Switch on keyboard (SN3 protocol)

This parameter serves for switching on a keyboard (if available on the device). Data bytes 1 to 4 can have any content.

This command is *broadcast-compatible* (see Table 2 – Broadcast

All SIKONETZ stations are addressed by setting bit 6 in the sub-index byte. If bit 6 is not set, a valid encoder address must be indicated in the sub-index byte.

Example of a call: The keyboards of all SIKONETZ stations are to be addressed. (The bits representing the address in the sub-index field may have any values!)

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**0BH**	**5Fh**	**4xh**	**xxh**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= ad-dress)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected en-coders		
60h	**0BH**	**5Fh**	**4xh**	**xxh**	**xxh**	**xxh**	**xxh**		**xxh**	**xxh**

3.7.13 Switch off keyboard (SN3 protocol)

This parameter serves for switching off a keyboard (if available on the device). (Broadcast-compatible; *see* *Table 2 –* ***Broadcast***

Example of a call: Switch off keyboard, device with address 02H

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**0Ch**	**5Fh**	**02h**	**xxh**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= ad-dress)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected en-coders		
60h	**0Ch**	**5Fh**	**02h**	**xxh**	**xxh**	**xxh**	**xxh**		**xxh**	**xxh**

3.7.14 Start positioning (SN3 protocol)

This command is used in connection with SIKONETZ stations that are able to execute positioning in order to travel to a desired position defined by the *Set point* command described above. The content of user data bytes 1 .. 4 is irrelevant.

Example of a call: Start positioning, device with addr. 23(= 17h)

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**0Dh**	**5Fh**	**17h**	**xxh**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= ad-dress)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected encoders -		
60h	**0Dh**	**5Fh**	**17h**	**xxh**	**xxh**	**xxh**	**xxh**		**xxh**	**xxh**

3.7.15 Stop positioning (SN3 protocol)

This command stops a positioning job previously started. The content of user bytes 1 .. 4 is irrelevant. (broadcast-compatible; *see* *Table 2 –* ***Broadcast***

Example of a call: Stop positioning; all SIKONETZ devices are addressed independent of the address entered in the *sub-index* field.

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**0Eh**	**5Fh**	**4xh**	**xxh**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= ad-dress)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected encoders		
60h	**0Eh**	**5Fh**	**4xh**	**xxh**	**xxh**	**xxh**	**xxh**		**xxh**	**xxh**

3.7.16 Switch on display (SN3 protocol)

This command serves for switching on the display of devices that have a display unit. The content of user bytes 1 .. 4 is irrelevant. (broadcast-compatible; *see* *Table 2 –* ***Broadcast***

Example of a call: Switch on display; all SIKONETZ devices are addressed independent of the address entered in the *sub-index* field.

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**0Fh**	**5Fh**	**4xh**	**xxh**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= ad-dress)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the con-nected en-coders	
60h	**0Fh**	**5Fh**	**4xh**	**xxh**	**xxh**	**xxh**	**xxh**		**xxh**	**xxh**

3.7.17 Switch off display (SN3 protocol)

This command serves for switching off the display of devices that have a display unit. The content of user bytes 1 .. 4 is irrelevant. (Broadcast-compatible; *see* *Table 2 –* ***Broadcast***

Example of a call: Switch off display; all SIKONETZ devices are addressed independent of the address entered in the *sub-index* field.

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**10h**	**5Fh**	**4xh**	**xxh**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders -	
60h	**10h**	**5Fh**	**4xh**	**xxh**	**xxh**	**xxh**	**xxh**		**xxh**	**xxh**

3.7.18 Set sense of rotation (SN4 protocol

This command serves for parameterizing the sense of rotation (counting direction) of the selected encoder. The content of *data byte 1* is relevant only. The content of data byte 1 has the following meaning:

01h = clockwise sense of rotation or “descending” counting direction

00h = counter-clockwise sense of rotation or “ascending” counting direction

Example of a call: The sense of rotation of the encoder with address 21 (15h) is to be set so that it delivers ascending position values with ***clockwise*** rotation:

Command	Param.	Param.	Sub-index	Data byte 1	Data byte 2	Data byte 3	Data byte 4

code	index Low	index High	(= address)				
23h	**11h**	**5Fh**	**15h**	**01h**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**11h**	**5Fh**	**15h**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.19 Read/program InPos window (SN3 protocol)

This command serves for reading or programming the window showing the deviation of actual value from set point.

Value range: **-9999 .. +9999**

Example of a call: The InPos window of the encoder with address 21 (15) shall be set to value 25.

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**11h**	**5Fh**	**15h**	**19h**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**11h**	**5Fh**	**15h**	**19h**	**xxh**	**xxh**	**xxh**		**xxh**	**xxh**

3.7.20 Read/program the loop reversal point

This command serves for reading or programming the loop reversal point (in display units).

Value range: **-9999 .. +9999**

Example of a call: The loop reversal point of the encoder with address 14 (10h) shall be set to value 50.

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**12h**	**5Fh**	**0Eh**	**32h**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**12h**	**5Fh**	**0Eh**	**32h**	**xxh**	**xxh**	**xxh**		**xxh**	**xxh**

3.7.21 Read device code (SN3 protocol)

This command serves for reading the device code, the firmware version as well as the hardware status of the addressed encoder.

Example of a call: The device code of the encoder with address 10 (0Ah) shall be read:

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
40h	**13h**	**5Fh**	**0Ah**	**xxh**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
42h	**13h**	**5Fh**	**0Ah**	**22h**	**11h**	**10h**	**00h**		**xxh**	**xxh**

Data byte 1: 22h → Code of SIKO device MSA501-SN3

Data byte 2: 11h → Firmware version V1.01

Data byte 3: 10h → Hardware version V1.0

For the numerical values of the device codes please refer to the relevant User information of the devices concerned.

The firmware version coding of the AP04 and AP04-S devices differs from that of the other SN3 devices Examples:

AP04 (AP04-S): V1.04 = 104 = 68h

MSA111C (MSA501): V1.02 = 12h

3.7.22 Read/program decimal places

3.7.22.1 Devices with SN4 protocol

This command enables programming of decimal places for devices that have a display unit. SN devices that have no display unit respond to this command with an error message.

Value range: **0 .. 4 (AP04, AP04-S)**

0 .. 3 (AP09, AP09/1)

00h = display format **XXXXX.**

01h = display format **XXXX.X**

02h = display format **XXX.XX**

03h = display format **XX.XXX**

04h = display format **X.XXXX** (only with AP04!)

If an AP09 connected to the IF09P/1 is parameterized with the value 04h, the AP09 will interpret it as value 00h (no decimal point or decimal point at the right-most position). With the AP09, a decimal point will be displayed farthest to the right with the **00h** format; with the AP04, **no** decimal point will be displayed in this case!

Example of a call: The position value shall be displayed with 3 decimal places in the encoder with address 2 (02h):

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**12h**	**5Fh**	**02h**	**03h**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param.-Index Low	Param.-Index High	Sub-index (=address)	Daten-byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**12h**	**5Fh**	**02h**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.22.2 Devices with SN3 protocol

This command enables reading or programming of decimal places for devices that have a display unit. SN3 devices that have no display unit respond to this command with an error message.

Value range: **0 .. 4 (or 3 for AP09)**

Example of a call: 3 decimal places shall be displayed on an AP04 (device address 30):

Take care that you enter the numerical value representing the decimal places at the position of data byte 2!

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**14h**	**5Fh**	**1Eh**	**00h**	**03h**	**00h**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**14h**	**5Fh**	**1Eh**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

If this command is applied in reading, the encoder will return the encoder address of the addressed device in addition to the number of decimal places:

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
40h	**14h**	**5Fh**	**1Eh**	**xxh**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
42h	**14h**	**5Fh**	**1Eh**	**1Eh**	**03h**	**00h**	**00h**		**xxh**	**xxh**

Data byte 1: Encoder address (1Eh = address 31)

Data byte 2: Number of decimal places (03h = 3 decimal places)

Attempts to apply the “Program decimal places” command to a device with no display unit will cause the gateway to return the following response (Example: Encoder address 26):

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders -	
80h	**14h**	**5Fh**	**1Ah**	**06h**	**08h**	**83h**	**00h**		**xxh**	**xxh**

Data bytes 1 and 2: Error code 0806h → SIKONETZ3 error

Data byte 3: Error message 83h → illegal command (see also chapter *4.2*)

3.7.23 Enable key's incremental measurement function (SN3 protocol)

This command enables the incremental measurement function of the addressed encoder's key.

Value range: The content of data bytes 1 .. 4 is irrelevant.

Example of a call: The key's incremental measurement function is enabled for an AP04 (device address 29):

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**15h**	**5Fh**	**1Dh**	**xxh**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**15h**	**5Fh**	**1Dh**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.24 Disable key's incremental measurement function (SN3 protocol)

This command disables the incremental measurement function of the addressed encoder's key.

Value range: The content of data bytes 1 .. 4 is irrelevant.

Example of a call: The key's incremental measurement function is disabled for an AP04 (device address 29):

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**16h**	**5Fh**	**1Dh**	**xxh**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders -	
60h	**16h**	**5Fh**	**1Dh**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.25 Display divisor

3.7.25.1 Write with SN4 protocol

This parameter serves for reducing by the selected factor the resolution indicated on the display unit. Example: The measurement resolution of the measuring system consisting of rotary encoder AP04 and spindle has been parameterized to a resolution of 1/1000mm. However, a resolution of 1/10mm is sufficient for the representation of the measured value on the display unit. Therefore, the display divisor is set to the value 100.

The content of *data byte* 1 is relevant only. The content of data byte 1 has the following meaning:

Value range: **0 .. 3**
0: DDI = 1
1: DDI = 10
2: DDI = 100
3: DDI = 1000

Example of a call: The display divisor shall be set for the encoder with address 17 (11h):

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**13h**	**5Fh**	**11h**	**02h**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**13h**	**5Fh**	**02h**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.25.2 Read/write with SN3 protocol

This parameter serves for programming the display divisor (DDI). This influences the representation of the numerical value on the display unit of the addressed encoder. The value set for the display divisor can be read via the read function.

The command is only valid for devices that have a display unit. The command will be acknowledged with an error message if the device addressed does not recognize this command.

Value range: **0 .. 3**
0: DDI = 1
1: DDI = 10
2: DDI = 100
3: DDI = 1000

Example of a call: The DDI value 10 is programmed for an AP04-S (device address 6):

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**17h**	**5Fh**	**06h**	**01h**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**17h**	**5Fh**	**06h**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.26 Loop approach direction

3.7.26.1 Write with SN4 protocol

This command serves for setting the loop approach direction of the selected encoder. For more detailed information on loop travel please refer to the User information of the AP04 or AP04-S devices, respectively.

The content of *data byte* 1 is relevant only. Data byte 1 can be set to the following value; different values trigger an error message.

Value range: **0 .. 2**
0: direct
1: clockwise
2: counter-clockwise

Example of a call: "Counter-clockwise" loop approach direction shall be set for the encoder with address 7 (07h):

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**14h**	**5Fh**	**07h**	**02h**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**14h**	**5Fh**	**07h**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.26.2 Read/write with SN3 protocol

This command serves for reading or programming the loop approach direction.

Value range: **0 .. 2**

0: direct

1: clockwise

2: counter-clockwise

Example of a call: "Clockwise" loop approach direction shall be programmed for an AP04 (device address 1):

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**18h**	**5Fh**	**01h**	**01h**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**18h**	**5Fh**	**01h**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.27 Read/program Zeroing enable (SN3 protocol)

This command enables or disables the addressed device's key for the zeroing function The key's status can also be queried.

With the function enabled, actuating the key sets the position value to the value "calibration value + offset value". If the two above-mentioned values are set to 0, pressing the key will result in "zeroing" of the display.

Value range: **0 .. 1**

0: Zeroing disabled

1: Zeroing enabled

Example of a call: "Counter-clockwise" loop approach direction shall be programmed for an AP04 (device address 1):

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**19h**	**5Fh**	**01h**	**02h**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**19h**	**5Fh**	**01h**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.28 Write display orientation (SN4 protocol)

This command serves for aligning the display of the selected encoder.

The content of *data byte* 1 is relevant only. Data byte 1 can be set to the following value; different values trigger an error message.

Value range: **0 .. 1**

0: Display orientation 0°

1: Display orientation 180°

Example of a call: The display orientation shall be set to 180° for the encoder with address 11 (0Bh):

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**15h**	**5Fh**	**0Bh**	**01h**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**15h**	**5Fh**	**0Bh**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.29 Read/program display orientation and LED functionality (SN3 protocol)

This command serves for influencing or determining the display orientation and LED functionality of the AP04 and AP04-S devices.

The values obtained in data bytes 1 and 2 with a read access inform on the current states of display orientation and LED functionality.

Data byte 1							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	0	0	0	0	0	0	X

Data byte 2							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	0	X	X	X	0	X	X

Display orientation:
Bit0 = 0: 0°
Bit0 = 1: 180°

LED functionality:
Bit5 = 1: LED red ON independent of target window
Bit4 = 1: LED green ON, independent of target window
Bit3 = 1: LEDs blinking
Bit1 = 1: LED red ON, if outside target window
Bit0 = 1: LED green ON, if target window reached

Bits 0 .. 3 in data byte 2 are saved non-volatilely. For setting bits 4 and 5, target window dependence (bits 0 and 1) must be deactivated.

Example of a call: On the AP04 (device address 2), the status of display orientation and the LED statuses shall be read:

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
40h	**1Ah**	**5Fh**	**02h**	**xxh**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
42h	**1Ah**	**5Fh**	**02h**	**01h**	**01h**	**00h**	**00h**		**xxh**	**xxh**

Result: Data byte 1 = 1 → display orientation = 180°

Data byte 2 = 1 → LED green = ON if position value within the target window.

3.7.30 Program free factor (SN3 protocol)

The AP04-S position indicator offers the possibility of setting a *free factor* instead of the "steps per revolution" parameter. This becomes particularly necessary when this indicator is used in a rotating measurement system. For more detailed information on the free factor please refer to the User information of the AP04-S device. [2]

Value range: **1 .. 30000** (default setting: 10000)

Example of a call: An AP04-S (encoder address 7) shall be programmed with a free factor of value 8000:

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**1Bh**	**5Fh**	**07h**	**40h**	**1Fh**	**00h**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**1Bh**	**5Fh**	**07h**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.31 Read AP24 keyboard status (SN3 protocol)

This command serves for reading the current keyboard status of the AP24 position indicator. Write access would trigger an error message.

Example of a call: The keyboard status of an AP24 (encoder address 11) shall be read:

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
40h	**1Ch**	**5Fh**	**0Bh**	**xxh**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
42h	**1Ch**	**5Fh**	**0Bh**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

[2] Available at http://www.siko.de/service/downloads/ausgewaehlte-downloads/details/ap04s/

3.7.32 Enable key function (SN4 protocol)

This command assigns a particular function to the key(s) of encoder AP09 or AP04, resp. The functionality is influenced via data byte 1. This byte may assume the following values:

00h: The key has no function

01h: The key is enabled for the incremental measurement function

02h: The key is enabled for the reset function

03h: The key is enabled for the set point display (**only AP09**)

Example of a call: The "**Reset**" key function shall be set for the encoder with address 12 (0Bh):

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**16h**	**5Fh**	**0Ch**	**02h**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**16h**	**5Fh**	**0Ch**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.33 Incremental measurement <u>and</u> Reset key functions (SN4 protocol)

The "Incremental measurement" **and** "Reset" key functions of the AP04 can be enabled or disabled simultaneously by means of this command. The necessary parameter is provided in data byte 1. Data bytes 2 .. 4 are irrelevant.

The following values are valid:

00h: "Incremental measurement <u>and</u> Reset" function disabled

01h: "Incremental measurement <u>and</u> Reset" function enabled

Example of a call: The "**Enable Incremental measurement <u>and</u> Reset**" key function shall be set for the encoder with address 15 (0Fh):

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4

23h	**17h**	**5Fh**	**0Fh**	**01h**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**17h**	**5Fh**	**0Fh**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.34 Green LED function (SN4 protocol)

With this command, the functionality of the green LED is set in the AP04-S. The necessary parameter is stored in data byte 1. Data bytes 2 .. 4 are irrelevant.

The following values are valid:

00h: LED **OFF**

01h: LED **ON** upon reaching the target window.

Example of a call: The green LEDE shall be switched on upon reaching the target position (encoder address 15):

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**18h**	**5Fh**	**0Fh**	**01h**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders	
60h	**18h**	**5Fh**	**0Fh**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

3.7.35 Red LED function (SN4 protocol)

With this command, the functionality of the red LED is set in the AP04-S. The necessary parameter is stored in data byte 1. Data bytes 2 .. 4 are irrelevant.

The following values are valid:

00h: LED **OFF**

01h: LED **ON** when the position value is outside the target window.

Example of a call: The red LED shall be switched on when the position value is outside the target window (encoder address 15):

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**18h**	**5Fh**	**0Fh**	**01h**	**xxh**	**xxh**	**xxh**

Reply:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4		Position values of the connected encoders -	
60h	**18h**	**5Fh**	**0Fh**	**00h**	**00h**	**00h**	**00h**		**xxh**	**xxh**

4 Trouble shooting

4.1 Error indication via status bytes

In case an error has occurred (illegal command index, illegal address, illegal access, e.g. Write request to read variable or communication error between IF09P/1 and the encoders), an error response and a corresponding error number in the user data byte will be returned instead of a Write or Read response.

Command code	Data byte 3	Data byte 4	Meaning
80h	8	6	SIKONETZ error
80h	7	6	Wrong parameter
80h	6	6	Wrong index
80h	5	6	Wrong sub-index (=AP09/1 or SIKONETZ address)
80h	3	6	Access rejected, e.g., Write request to Read variable or parameter not available
80h	4	6	Broadcast not allowed with this command
80h	1	6	Communication error between IF09P/1 and RS485 bus (connection down or checksum error)

Example: Write parameter *Display per revolution* on device with address higher 31, e.g., 72 (=48h)

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4
23h	**05h**	**5Fh**	**48h**	**00h**	**20h**	**00h**	**00h**

Reply: Error response, wrong sub-index (= wrong address)

Command code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected encoders		
80h	**05h**	**5Fh**	**48h**	**00h**	**00h**	**05h**	**06h**		**xxh**	**xxh**

The error message with code 80h in the *command code* field is maintained until the command has been executed with the correct parameters.

Upon application of the SN3 protocol, an addressed SN3 station will response with an error message in case of faulty parameterization. This code is transferred in data byte 2 in addition to data bytes 3 and 4. Example:

Com-mand code	Param. index Low	Param. index High	Sub-index (= address)	Data byte 1	Data byte 2	Data byte 3	Data byte 4	Position values of the connected en-coders		
80h	**05h**	**5Fh**	**48h**	**00h**	**83h**	**05h**	**06h**		**xxh**	**xxh**

Meaning of the SN3 error codes:

- **82h**: Error code F02; data transfer error (checksum error)
- **83h**: Error code F03; illegal or unknown command
- **85h**: Error code F05; illegal value input

The error code appears also on the 5-digit display of the IF09P/1 for a short time.

4.2 Error representation on the display

Errors in data transfer between IF09P/1 and the connected encoders are indicated by a red blinking LED and as plain text on the 5-digit 7-segment display.

Two error types are differentiated: Time-out errors and checksum errors. Time-out errors indicate that the connection to the addressed encoder is down or that the encoder is defective. Checksum errors occur in a disturbed environment, e.g., if two or more encoders are operated with the identical address on the same bus.

In case of error, the error type (time-out or checksum error) and the address of the disturbed encoder are output on the display. Both values are alternately output on the display (example: faulty encoder with address 19).