Clamping force block
TANDEM KSx3-SM 10L
Software manual

Hand in hand for tomorrow

Imprint

Technical changes:
We reserve the right to make alterations for the purpose of technical improvement.

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Dear Customer,

Thank you for trusting our products and our family-owned company, the leading technology supplier of robots and production machines.

Our team is always available to answer any questions on this product and other solutions. Ask us questions and challenge us. We will find a solution!

Best regards,

Your SCHUNK team

Customer Management

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Please read the software manual in full and keep it close to the product.

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1 General

1.1 Validity

This version of the software manual for the TANDEM clamping force blocks KSP3-SM IOL and KSH3-SM IOL and their variants (-LH / -F) (abbreviated as **KSx3-SM IOL** in the following for better readability) describes the functions for the firmware versions with the main version number 1.0.0. The firmware version can be read out. Information on the corresponding parameter can be found in chapter ▸ 3.1 [🗋 10].

The compliance with the following specifications is fulfilled:

1. IO-Link Interface and System Specification, V1.1.4
2. IO Device Description, V1.1.4

1.2 Applicable documents

- General Terms and Conditions
- Operating manual of the products used
- IO-Link Device Description (IODD)

The documents can be downloaded from **www.schunk.com**.

1.3 IO-Link Basics

Fieldbus-independent interface

IO-Link is a point-to-point interface for connecting a SCHUNK product (IO-Link device) to a control system (IO-Link master). Via this interface it is possible to transfer parameters, process data and diagnostic data. Parameter data are transfered to the IO-Link device from the master (actuator or sensors). In the opposite direction, the master receives cyclical process data and, if required, service and diagnostic data.

Further information on IO-Link can be found at **www.io-link.com**.

1.4 Data exchange

Cyclical data exchange

To exchange cyclic process data between an IO-Link device and a controller, the IO-Link data is transferred from the IO-Link master to the previously set address ranges. The user program of the controller accesses the process values via these addresses and processes them. Conversely, the cyclic data exchange is performed from the controller to the IO-Link device.

Acyclical data exchange

The exchange of acyclic data, such as parameters or events, takes place over a specified index and sub-index range. Using the index and sub-index range, targeted access of the device data is possible (e.g. for reparameterization of the device or master during ongoing operation).

1.5 Data types

The data types mentioned in this version of the software manual are designated according to the "IO-Link Interface and System Specification", Annex F, Version 1.1.9, which is available at **www.io-link.com**. The corresponding designation according to IEC 61131-3 (PLC standard) can be found in the following table:

Description	IO-Link standard	PLC standard IEC 61131-3	Bit length
Logical value	BooleanT	BOOL	1 bit
Integer	IntegerT8	SINT	8 bit
	IntegerT16	INT	16 bit
	IntegerT32	DINT	32 bit
	IntegerT64	LINT	64 bit
Natural number	UIntegerT8	USINT	8 bit
	UIntegerT16	UINT	16 bit
	UIntegerT32	UDINT	32 bit
	UIntegerT64	ULINT	64 bit
Floating-point numbers	Float32T	REAL	32 bit
	Float64T	LREAL	64 bit
Characters	StringT (x)	STRING	x bit

⚠ WARNING

Changes to parameters outside the permitted ranges and manipulation of non-visible and therefore protected parameters can cause damage to the sensory monitoring unit of the clamping force block or misinterpretation of states and thus lead to an unwanted hazard.

2 Incoming process data (status word)

To determine the current device status and jaw position, as well as the current circuit board temperature of the device and the sensor values, the following incoming cyclical data is made available:

Byte	Bit *	Bit offset	Sub index	Data type	[Values]: Description
0	7	223	1	BooleanT	[true]: Ready for operation; [false]: otherwise
	6	222	2	BooleanT	[true]: Calibration procedure active; [false]: otherwise
	5	221			
	4	220			
	3	219	5	BooleanT	[true]: Pressure 2 reached; [false]: otherwise
	2	218	6	BooleanT	[true]: Pressure 1 reached; [false]: otherwise
	1	217	7	BooleanT	[true]: Jaw position, outer end position; [false]: otherwise
	0	216	8	BooleanT	[true]: Jaw position, inner end position; [false]: otherwise
1	7	215			
	6	214			
	5	213			
	4	212			
	3	211			
	2	210	14	BooleanT	[true]: Info; [false]: otherwise
	1	209	15	BooleanT	[true]: Warning; [false]: otherwise
	0	208	16	BooleanT	[true]: Error; [false]: otherwise
2–3	–	192	17	Integer T16	Eventcode
4–7	–	160	18	Float32T	Temperature (°C)
8–11	–	128	19	Float32T	Flux density (mT)
12–15	–	96	20	Float32T	Piston position / jaw position (%)
16–19	–	64	21	Float32T	Jaw opening width (mm)
20–23	–	32	22	Float32T	Pressure 1 (bar)
24–27	–	0	23	Float32T	Pressure 2 (bar)

* Bit 7 has the function of the **M**ost **S**ignificant **B**it (**MSB**) and bit 0 that of the **L**east **S**ignificant **B**it (**LSB**).

Further information is provided via the acyclic device data ▸ 3 [🗋 10].

2.1 Status – Byte 0

The current status of the device and the status of the clamping force block is displayed:

Bit	Bit offset	Sub index	Data type	Values: Description
7	223	1	BooleanT	[true]: Ready for operation; [false]: otherwise
6	222	2	BooleanT	[true]: Calibration procedure active; [false]: otherwise
5	221			
4	220			
3	219	5	BooleanT	[true]: Pressure 2 reached; [false]: otherwise
2	218	6	BooleanT	[true]: Pressure 1 reached; [false]: otherwise
1	217	7	BooleanT	[true]: Jaw position, outer end position; [false]: otherwise
0	216	8	BooleanT	[true]: Jaw position, inner end position; [false]: otherwise

The sensory monitoring unit of the clamping force block detects the piston position/jaw position and the pressure in the hydraulic or pneumatic chambers. The jaw position of clamping force block is determined from this and output via the corresponding status bits.

The operational status of the device is indicated by the Boolean value of bit 7 "Ready for operation". The prerequisite is:

- the 24 V supply voltage L+ is present
- Internal sensors provide valid signals

Bit 6 ''Calibration procedure active'' indicates an active and uncompleted calibration procedure.

Bit 3 "Pressure 2 reached" indicates, for the pneumatic variants, the attainment of the Threshold for process data bit "Pressure 2 reached'" (▶ 3.2 [🗋 11] Index 133) in the "close" pressure chamber. For the hydraulic variants, Bit 3 is always set to 0: [false].

Bit 2 "Pressure 1 reached" indicates the attainment of the Threshold for process data bit "Pressure 1 reached'" (▶ 3.2 [🗋 11] Index 132) in the "open" pressure chamber (pneumatic variants) or in the pressurized pressure chamber (hydraulic variants).

Bit 1 "Jaw position, outer end position" indicates the attainment of the open position. Prerequisite for the value [true] is:

- Jaw position value is greater than threshold 1 (▶ 3.2 [🗋 11] Index 106).

Bit 0 "Jaw position, inner end position" indicates the attainment of the closed position. Prerequisite for the value [true] is:

- Jaw position value is smaller than threshold 2 (▶ 3.2 [🗋 11] Index 107).

2.2 Exception – Byte 1

The occurrence of exception events in the form ofinformation, warnings and errors are displayed:

Bit	Bit offset	Sub index	Data type	Values: Description
2	210	14	BooleanT	[true]: Info; [false]: otherwise
1	209	15	BooleanT	[true]: Warning; [false]: otherwise
0	208	16	BooleanT	[true]: Error; [false]: otherwise

Errors can be deleted by resolving the cause and rebooting the device.

2.3 Event code – Byte 2–3

Event codes are indicated by a specific code in combination with the occurrence of a warning (byte 1 bit 1 "Warning" [true]):

Bit offset	Sub index	Data type	Values: Description
192	17	IntegerT16	[tbd]: tbd

2.4 Temperature – Byte 4–7

The circuit board temperature is displayed in units of (°C).

Bit offset	Sub index	Data type	Values: Description
160	18	Float32T	[–]: Temperature (°C)

2.5 Flux density raw value – Byte 8–11

The current raw value of the Hall sensor, the flux density, is displayed in units of (mT).

Bit offset	Sub index	Data type	Values: Description
128	19	Float32T	[–]: Flux density (mT)

2.6 Piston position / jaw position – Byte 12–15

The current position of the piston or jaws is indicated in units of (%) of the maximum value.

Bit offset	Sub index	Data type	Values: Description
96	20	Float32T	[–]: Piston position / jaw position (%)

2.7 Jaw opening width – Byte 16–19

The jaw opening width is displayed in units of (mm).

Bit offset	Sub index	Data type	Values: Description
64	21	Float32T	[–]: Jaw opening width (mm)

2.8 Pressure 1 – Byte 20–23

Pneumatic Variants

Display of the applied pressure in the "open" pressure chamber (bar).

Hydraulic Variants

Display of the applied pressure in the pressurized chamber (bar).

Bit offset	Sub index	Data type	Values: Description
32	22	Float32T	[–]: Pressure 1 (bar)

2.9 Pressure 2 – Byte 24–27

Pneumatic Variants

Display of the applied pressure in the "close" pressure chamber (bar).

Hydraulic Variants

No display (0).

Bit offset	Sub index	Data type	Values: Description
0	23	Float32T	[–]: Pressure 2 (bar)

NOTICE

Bit values of unassigned bits are always set as 0: [false].

3 Acyclical data

Identification data, monitoring values, parameters and diagnostic information including events and error messages are transmitted acyclically from the IO-Link master on request and can be changed depending on the applicable access rights.

3.1 Identification data

The following acyclic data is provided for identification:

Index	Name	Data type	Access rights *	[Values] description
16	Vendor name	StringT (64)	ro	[SCHUNK SE & Co. KG]
17	Vendor text	StringT (64)	ro	[Hand in hand for tomorrow]
18	Product name	StringT (64)	ro	{Produkt name e.g.: TANDEM KSP3 100-SM IOL}
19	Product ID	StringT (64)	ro	{ID number}
20	Product text	StringT (64)	ro	[Sensory clamping force block]
21	Serial number	StringT (16)	ro	{Alphanumeric serial number}
22	Hardware revison	StringT (64)	ro	[HW-V{Version}] (Electronics)
23	Firmware revision	StringT (64)	ro	[HW-V{Version}]
24	Application-specific Tag	StringT (32)	rw	{empty textfield for application-specific identification}
25	Function Tag	StringT (32)	rw	{empty textfield for function identification}
26	Location Tag	StringT (32)	rw	{empty textfield for location identification}
17342	Hardware Identification Key	StringT (16)	ro	[INN-9]

* ro (read only), rw (read and write)

3.2 Parameters

The following acyclical data is provided for setting communication and sensor parameters:

Index	Name	Data type	Access rights *	[Values] description
101	Teach position 1 – jaw (measured jaw opening width)	Float32T	rw	For the individual teaching of the jaw opening width, the value to be determined in mm (▶ 4.2 [🗋 14]).
102	Teach position 1 – piston (read piston position)	Float32T	rw	For the individual teaching of the jaw opening width, the value of the piston position to be read in % (▶ 4.2 [🗋 14]).
103	Teach position 2 – jaw (measured jaw opening width)	Float32T	rw	For the individual teaching of the jaw opening width, the value to be determined in mm (▶ 4.2 [🗋 14]).
104	Teach position 2 – piston (read piston position)	Float32T	rw	For the individual teaching of the jaw opening width, the value of the piston position to be read in % (▶ 4.2 [🗋 14]).
106	Threshold 1 – jaw position outer end position	IntegerT16	rw	Threshold in % for status bit 1: Jaw position outer end position. [95]: Factory default value. Depending on the application, the value can be adjusted within the range [0] – [100].
107	Threshold 2 – jaw position inner end position	IntegerT16	rw	Threshold in % for status bit 0: Jaw position inner end position. [5]: Factory default value. Depending on the application, the value can be adjusted within the range [0] – [100].
120	Pressure sensor tare command	UIntegerT8	wo	[0]: No command [1]: Start taring process
130	Pneumatic variant	BooleanT	ro	[true]: Pneumatic sensor variant detected; [false]: otherwise
131	Hydraulic variant	BooleanT	ro	[true]: Hydraulic sensor variant detected; [false]: otherwise
132	Threshold for process data bit "Pressure 1 reached"	Float32T	rw	Threshold in bar for status bit 2: pressure 1 reached
133	Threshold for process data bit "Pressure 2 reached"	Float32T	rw	Threshold in bar for status bit 3: pressure 2 reached

Index	Name	Data type	Access rights *	[Values] description
152	Two-point calibration command	UIntegerT8	wo	[1]: Calibration command: position 1 closed [2]: Calibration command: position 2 open [255]: Calibration command: apply factory settings
153	Two-point calibration status	UIntegerT8	ro	[0]: No message [1]: Calibration procedure active [3]: Calibration successful [4]: Error

* ro (read only), rw (read and write), wo (write only)

There are additional parameters not shown here. It is not necessary to change these settings for normal operation.

⚠ WARNING

Changes to parameters outside the permitted ranges and manipulation of not displayed or protected parameters can cause damage to the product or misinterpretation of states and thus lead to an unwanted hazard.

4 Teaching in the sensors

The integrated sensors are calibrated from the factory, the jaw opening width has been taught and the pressure sensor has been tared. Acyclical parameters and threshold values have been determined accordingly and these have already been described at the factory.

Due to increased wear or special operating conditions, it is possible that sensors may need to be taught in again. The following sensors can be taught in again:

- Calibrating piston position ▸ 4.1 [🗋 13]
- Teaching jaw opening width ▸ 4.2 [🗋 14]
- Tare pressure sensors ▸ 4.3 [🗋 15]

4.1 Calibrating piston position

The clamping force block has a magnetic sensor system that can permanently detect the piston/jaw position of the module (▸ 2.6 [🗋 8]). The piston position can be recalibrated using an automated two-point calibration function. The following procedure must be carried out for a successful calibration:

- Put the clamping block in a completely closed position (Jaws cannot move any further inwards).
- Set two-point calibration command by writing the acyclic parameter to index 152 with the value:
  - [1] Calibration command: position 1 closed
- Put the clamping force block in the fully open state (Jaws cannot move any further outwards).
- Set two-point calibration command by writing the acyclic parameter to index 152 with the value:
  - [2] Calibration command: position 2 open.

In the process data, status bit 6 “Calibration procedure active” indicates an active and incomplete calibration procedure. The status of the calibration procedure can be monitored via the acyclical parameter “Two-point calibration status” at index 153. In the case of an error, the described procedure must be repeated in full.

Load factory settings:

The factory calibration can be restored by writing the following value to the acyclic parameter at index 152:

- [255] Calibration command: adoption of the factory settings.

4.2 Teach jaw opening width

The jaw opening width (▸ 2.7 [🗋 8]) is calculated depending on the piston position detected by the magnetic sensor system. For a correct calculation, the jaw positions must be taught in manually and individually. In order to minimize deviations due to the backlash between the piston position and jaw position, one of the two processes described below must be carried out.

Teaching with O.D. clamping:

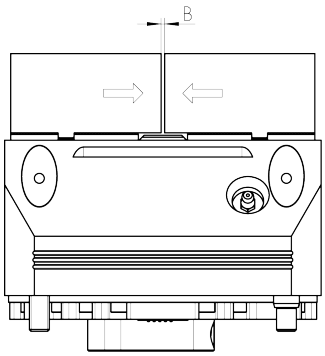

Fig. 1: "Closed" clamping force block – Teach position 1, O.D. clamping

- bring the clamping force block without the workpiece into a completely closed state (jaws cannot move any further inwards).
- Using a suitable measuring device (e.g. measuring caliper), determine dimension B between the jaws in units of (mm), cf. Figure 1, and write this as the new value of the acyclic parameter "Teach position 1 – jaw (measured jaw opening width)" to index 101.
- Write the current value of the piston position displayed via the process data in units of (%) (▸ 2.6 [🗋 8]) as the new value of the acyclic parameter "Teach position 1 – piston (read piston position)" to index 102.

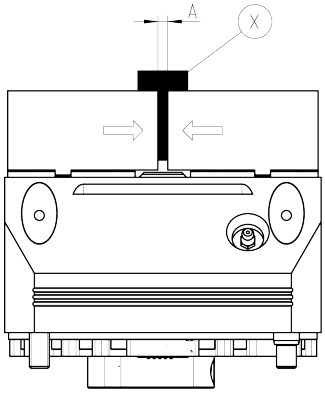

Fig. 2: clamping force block with workpiece "clamped" – Teach position 2, O.D. clamping

- Bring the clamping force block with workpiece into the clamped state (O.D. clamping).
- Using a suitable measuring device (e.g. measuring caliper), determine dimension A between the jaws in units of (mm), see Figure 2, and write this as the new value of the acyclic parameter "Teach position 2 – jaw (measured jaw opening width)" to index 103.
- Write the current value of the piston position displayed via the process data in units of (%) (▸ 2.6 [🗋 8]) as the new value of the acyclic parameter "Teach position 2 – piston (read piston position)" to index 104.

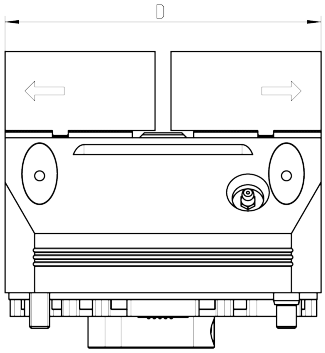

Fig. 3: Clamping force block "Open" – Teach position 1, I.D. clamping

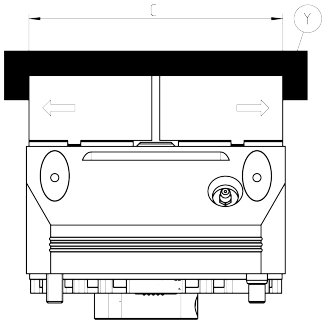

Fig. 4: Clamping force block with workpiece "clamped" – Teach position 2, I.D. clamping

Teaching with I.D. clamping:

- Bring the clamping force block into the fully open state without the workpiece (jaws cannot move any further outwards).
- Use a suitable measuring device (e.g. measuring caliper) to determine the dimension D in units of (mm), see Figure 3, and write this as the new value of the acyclic parameter "Teach position 1 – jaw (measured jaw opening width)" at index 101.
- Write the current value of the piston position displayed via the process data in units of (%) (▸ 2.6 [🗋 8]) as the new value of the acyclical parameter "Teach position 1 – piston (read piston position)" to index 102.
- Bring the clamping block with workpiece into a clamped state (internal clamping).
- Determine the dimension C in units of (mm) using a suitable measuring device (e.g. measuring caliper), see Figure 4, and write this as the new value of the acyclical parameter "Teach position 2 – jaw (measured jaw opening width)" to index 103.
- Write the current value of the piston position displayed via the process data in units of (%) (▸ 2.6 [🗋 8]) as the new value of the acyclic parameter "Teach position 2 – piston (read piston position)" to index 104.

4.3 Tare pressure sensors

The pressure sensor value can be tared. The following procedure must be carried out for successful taring:

- Fully vent the pressure chamber of the clamping force block
- Set pressure sensor tare command by writing the value to the acyclic parameter at index 120:
  - [1]: Start taring process.

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