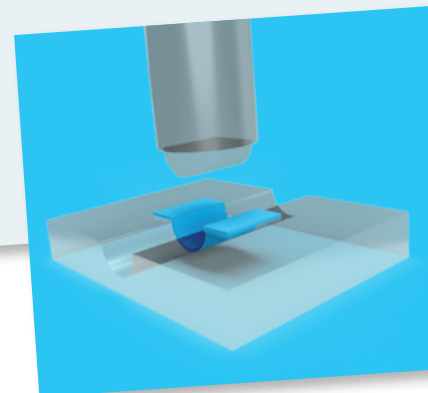
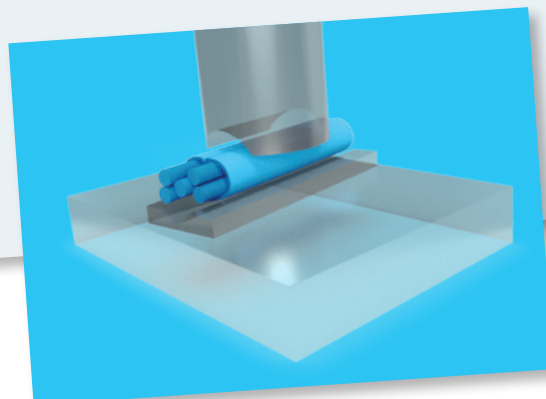
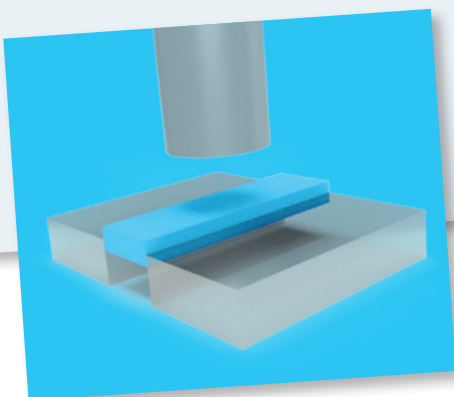
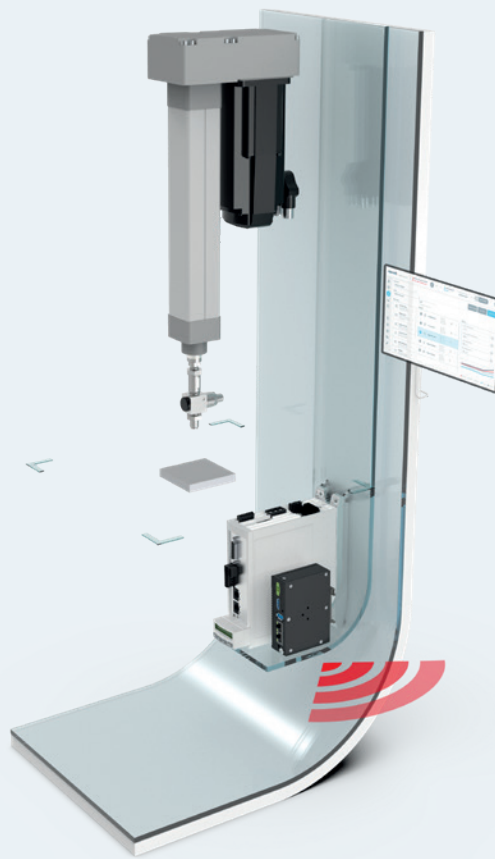


# Smart Function Kit

for pressing and joining applications





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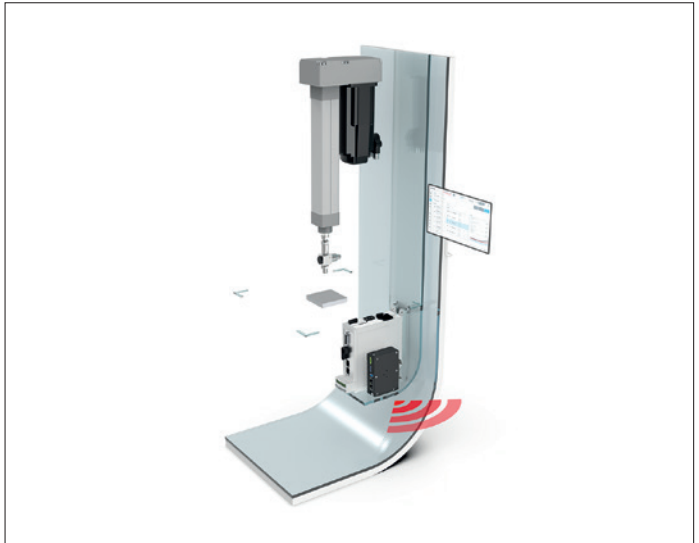
## Product description

The mechatronic modular system Smart Function Kit is suitable for a wide range of pressing and joining applications. The web-based software allows both the fast and easy configuration of a process sequence via drag & drop of building blocks, as well as the recording of a force-displacement curve and its subsequent evaluation (OK/NOK) by using envelopes, windows and thresholds.

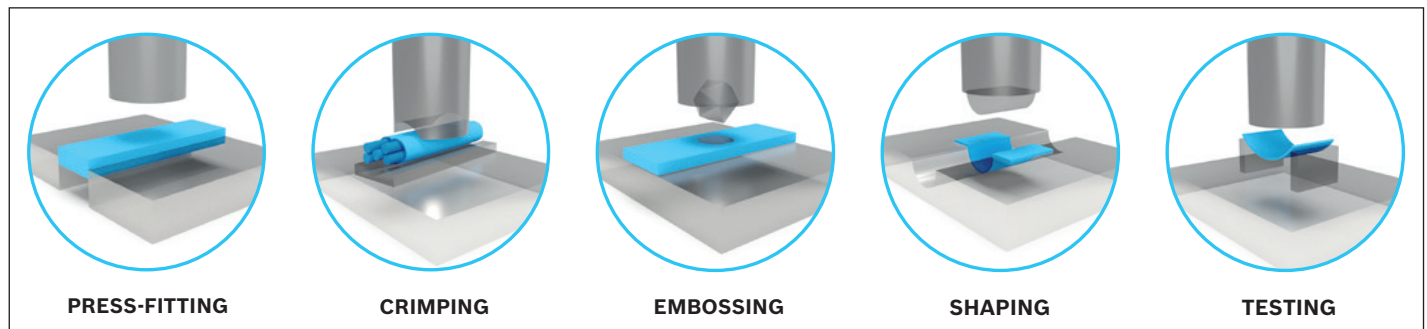
The system works in position control with simultaneous force monitoring.

The Smart Function Kit is therefore a perfect basis for system integrators and end users and can be used as stand-alone solution or integrated in higher-level systems via fieldbus or OPC-UA.

- ▶ Modular system for force range up to 30 kN for assembly and joining processes, forming technology as well as test applications.
- ▶ Preselected kits consisting of an electromechanical cylinder, servo drive with motion control and a web-based operating software for a fast and easy process configuration and evaluation.
- ▶ Easy commissioning with preinstalled software and automatic parametrization of the servo drive.
- ▶ Open interfaces allow the connection to higher-level controls and the data exchange via OPC-UA and ReST API.
- ▶ Outstanding price-performance ratio



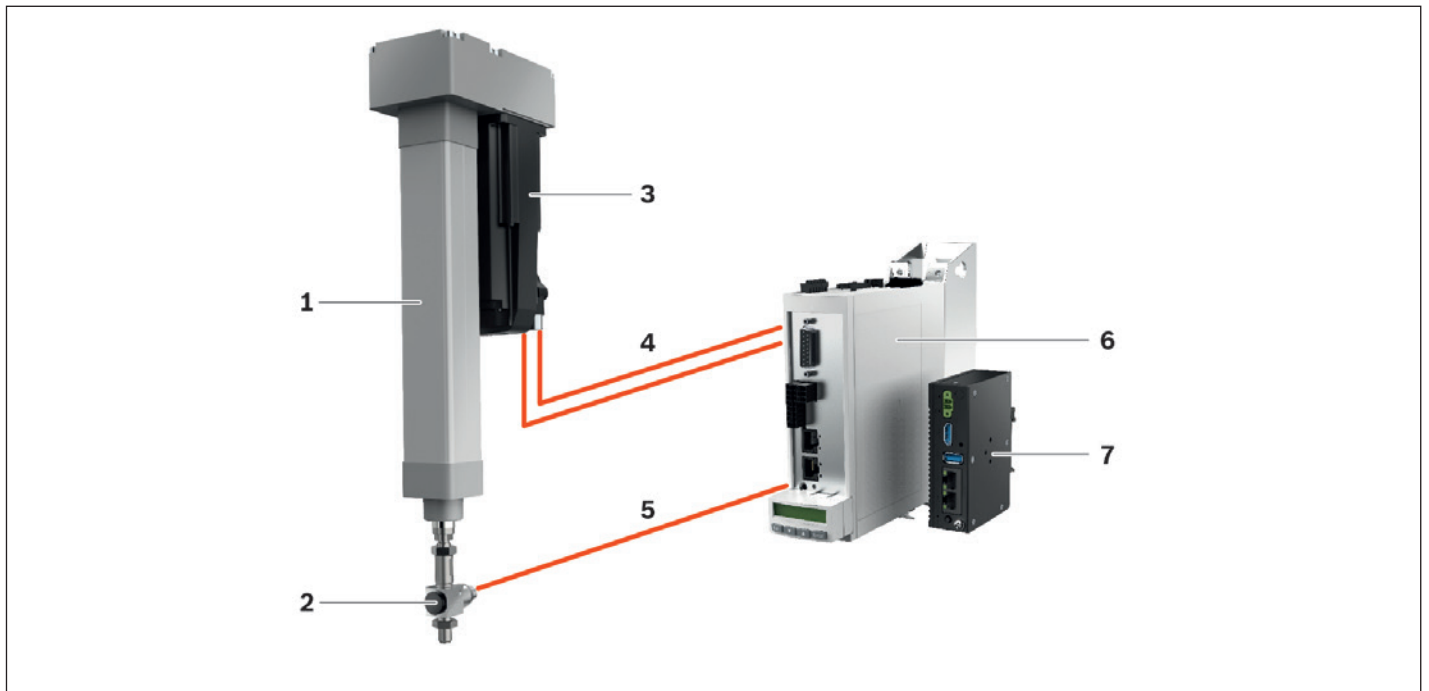
### Fields of application



### Notes

- ▶ The SFK software does not require any programming knowledge. Appropriate knowledge is only required for establishing the communication with higher-level systems (definition of data transfer and bus interfaces as well as digital inputs/outputs). Suitable fieldbus example projects are available in the SFK software.
- ▶ Process data is displayed live in the HMI. After the program has been completed, this data is available in JSON format for further processing.
- ▶ Monitoring of tensile forces in preparation
- ▶ Force control in preparation

## Hardware



- 1 Electromechanical Cylinder EMC** with freely configurable stroke up to 400 mm (longer strokes on request).  
Parallel or axial motor attachment.
- 2 Force sensor:** Strain gage technology for cost-effective and robust force measurement
- 3 MS2N Servo Motor:** with absolute encoder and brake
- 4 Motor cable**
- 5 Sensor cable**
- 6 IndraDrive HCS01 Servo Drive** with integrated PLC IndraMotion MLD and safety function STO or Safe Motion
- 7 Industrial PC PR21** with integrated web server to provide the web-based operating software, with Linux operating system.

## Software

Thanks to the modern, intuitive web HMI with modular drag-and-drop process configuration, the software is ready for immediate use, with no previous knowledge required. The straightforward process for the graphical creation of all required evaluation and analysis elements is virtually self-explanatory.

### Commissioning with auto configuration

- ▶ Preinstalled software
- ▶ Wizard for easy and fast commissioning
- ▶ Auto parameterization of the servo drive
- ▶ Support for commissioning with homing and jog mode

### Simple programming and operation

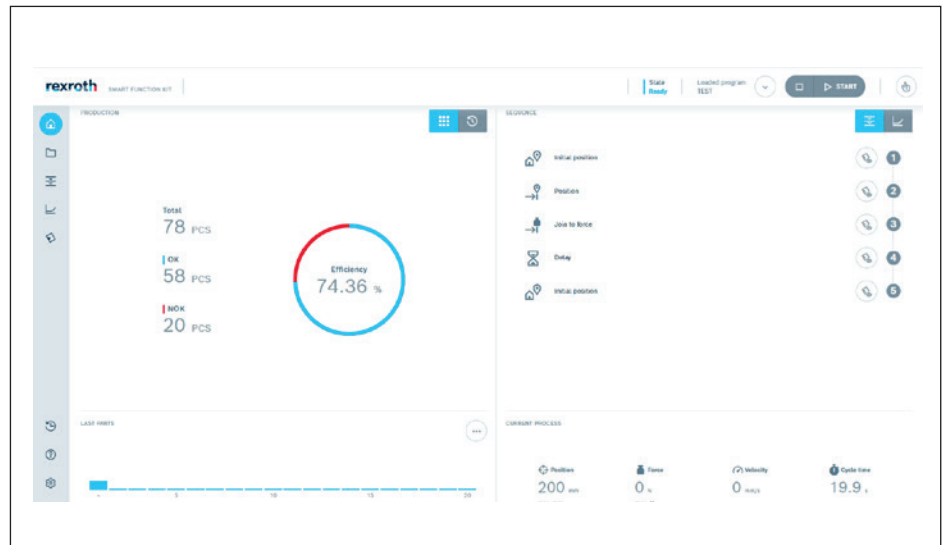
- ▶ Modular process configuration with drag-and-drop
- ▶ Logic check of input data
- ▶ Optimization of the process supported by a control bar with live process values
- ▶ Simple graphical creation of evaluation and analysis elements
- ▶ Visualization of process and status information in the dashboard
- ▶ Fieldbus example projects for the easy integration in higher-level controls

### Analysis and diagnosis via dashboard and log book

- ▶ Live display of the sequence and the force-displacement curves
- ▶ Visualization of the process result (OK/NOK)
- ▶ Storing of process data for quality assurance in internal database
- ▶ Process history with filter and export function (export in JSON format)
- ▶ Diagnostic functions: System parameters as well as status reports and statistics
- ▶ Log book with plain text error messages integrated in the software
- ▶ Data access via ReST programming interface

## Dashboard

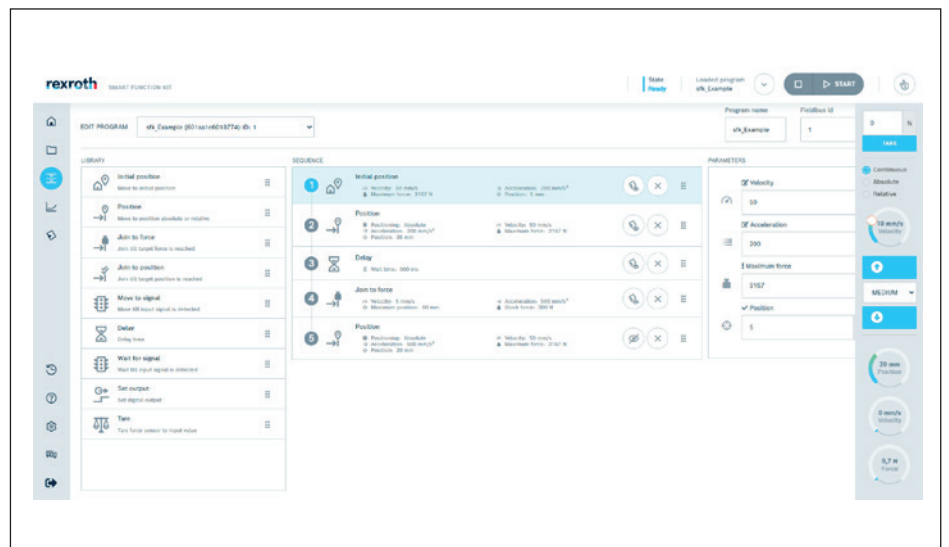
The dashboard provides a compact overview of the plant and production status. The four tiles contain information on production statistics, the quality assessment of the last parts produced, the current program progress and values from the current process.



## Program creation

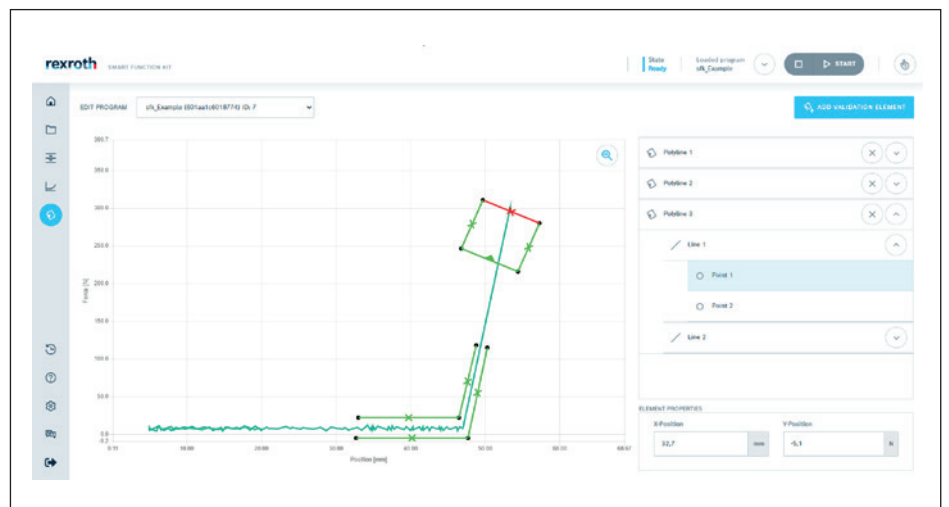
The process is created by dragging and dropping sequence blocks from the library. The selected blocks can then be parameterized individually.

The control bar can be displayed on the right-hand side of every screen for quick and easy process creation. It enables manual movement, taring of the force sensor and shows actual values for position, force and velocity.



## Evaluation elements

In this area, individual evaluation elements can be graphically defined for each program. The elements are used for the automatic quality evaluation and based on their evaluation the system determines whether a produced part is OK or NOK.



# Technical data

## General

| Smart Function Kit size        |     | 002        | 004        | 007        | 012        | 019        | 030        |
|--------------------------------|-----|------------|------------|------------|------------|------------|------------|
| Stroke <sup>1)</sup>           | mm  | 35 ... 400 | 40 ... 400 | 65 ... 400 | 80 ... 400 | 70 ... 400 | 90 ... 400 |
| Nominal force                  | kN  | 2          | 4          | 7          | 12         | 19         | 30         |
| Maximum force                  | kN  | 3          | 6          | 10         | 15         | 20         | 40         |
| Maximum velocity <sup>1)</sup> | m/s | 0.38       | 0.32       | 0.55       | 0.5        | 0.37       | 0.5        |
| Repeatability                  | mm  | ± 0.01     |            |            |            |            |            |

<sup>1)</sup> Higher values are also possible on request

## Hardware

### Electromechanical Cylinder EMC

| Smart Function Kit size                                            |     | 002                 | 004          | 007          | 012          | 019          | 030          |
|--------------------------------------------------------------------|-----|---------------------|--------------|--------------|--------------|--------------|--------------|
| EMC size                                                           |     | EMC-040-NN-2        | EMC-050-NN-2 | EMC-063-NN-2 | EMC-080-NN-2 | EMC-100-NN-2 | EMC-100-XC-2 |
| Screw lead                                                         | mm  | 5                   | 5            | 10           | 10           | 10           | 10           |
| Max. piston rod backlash (as new)                                  | °   | 0.32                | 0.27         | 0.22         | 0.16         | 0.13         |              |
| Service life life (based on an internally defined reference cycle) |     | > 10 million cycles |              |              |              |              |              |
| Lubrication interval in screw revolutions                          | Mio | 50                  | 50           | 50           | 50           | 50           | 10           |

#### Length calculation:

Total length of EMC for motor attachment axial
 =
 

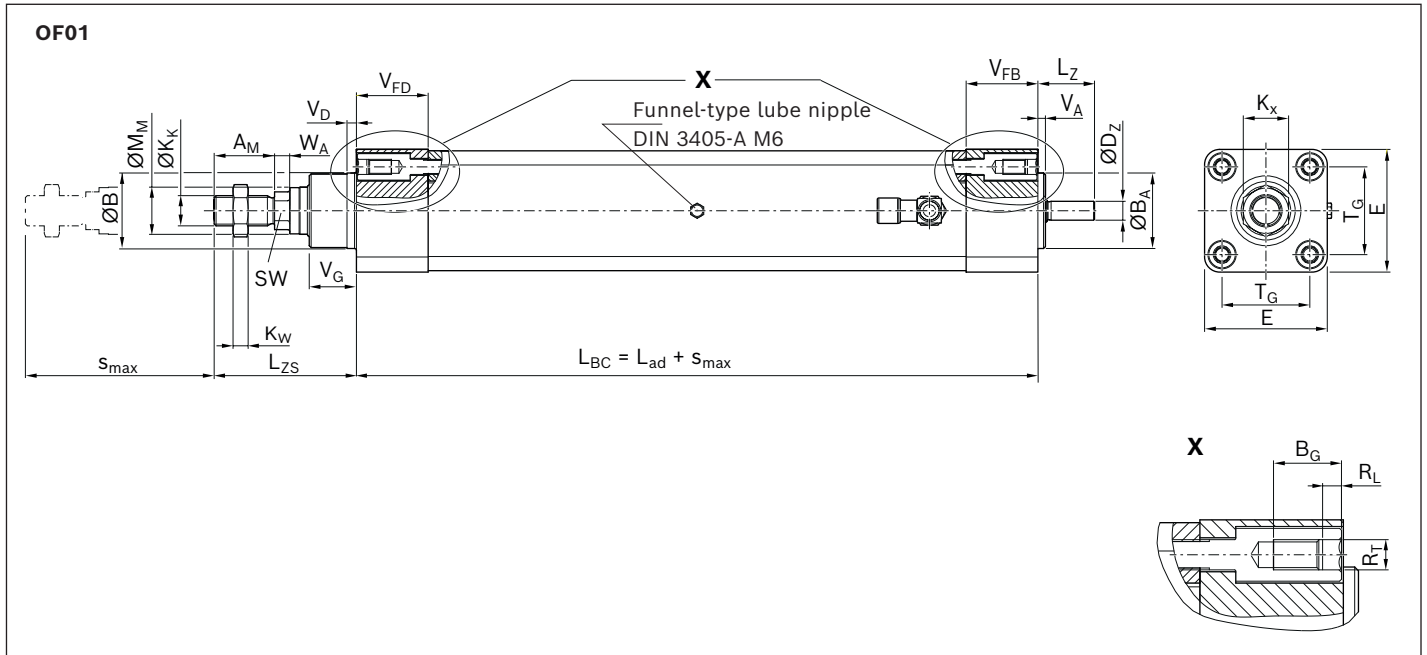
$L_{zs} + s_{max} + L_{ad} + L_f + L_m$

Total length of EMC for motor attachment parallel
 =
 

$L_{zs} + s_{max} + L_{ad} + G$

(for L<sub>f</sub>, L<sub>m</sub> and G see following page)



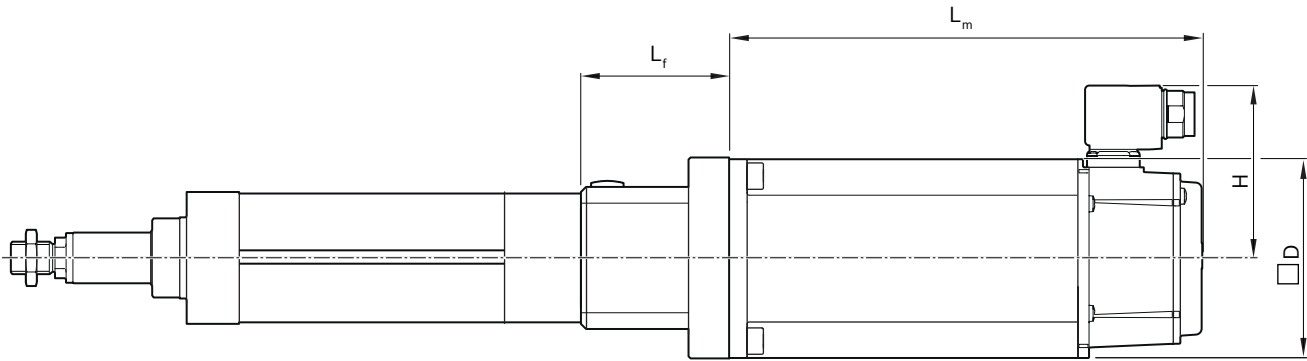


| EMC / SPK   | BASA (ball screw assembly)<br>d <sub>0</sub> x P | Dimensions (mm)        |                                      |                   |           |                |                |                |                 |
|-------------|--------------------------------------------------|------------------------|--------------------------------------|-------------------|-----------|----------------|----------------|----------------|-----------------|
|             |                                                  | A <sub>M</sub><br>-0,1 | B <sub>d11</sub> / B <sub>A</sub> h7 | D <sup>Z</sup> h7 | E<br>±0,1 | K <sub>K</sub> | K <sub>W</sub> | K <sub>X</sub> | L <sub>ZS</sub> |
| 40 / 002    | 16 x 5                                           | 24                     | 35                                   | 8                 | 53        | M12x1.25       | 7              | 19             | 61.50           |
| 50 / 004    | 20 x 5                                           | 32                     | 40                                   | 10                | 65        | M16x1.5        | 8              | 24             | 76.75           |
| 63 / 007    | 25 x 10                                          | 32                     | 45                                   | 15                | 75        | M16x1.5        | 8              | 24             | 76.50           |
| 80 / 012    | 32 x 10                                          | 40                     | 55                                   | 18                | 95        | M20x1.5        | 10             | 30             | 94.50           |
| 100 / 019   | 40 x 10                                          | 40                     | 65                                   | 25                | 115       | M20x1.5        | 10             | 30             | 99.25           |
| 100XC / 030 | 50 x 10                                          | 72                     | 75                                   | 32                | 115       | M36x2          | 18             | 55             | 144.00          |

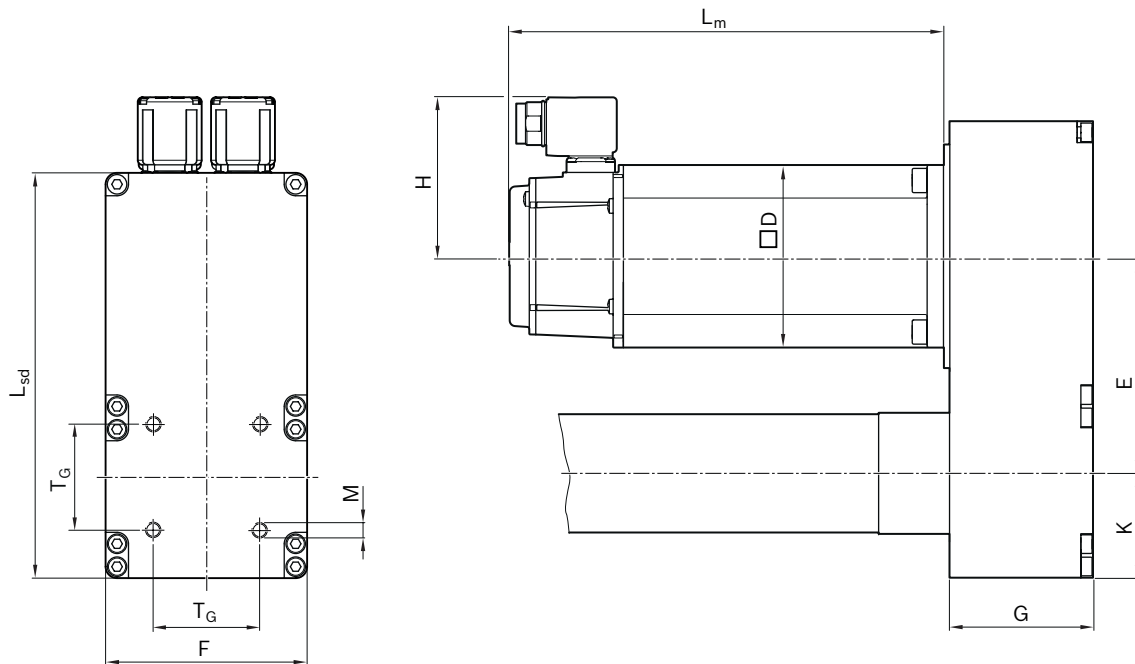
| EMC / SPK   | Dimensions (mm) |                |                   |                |                |                |    |                |                        |                |                 |                 |                        |                |
|-------------|-----------------|----------------|-------------------|----------------|----------------|----------------|----|----------------|------------------------|----------------|-----------------|-----------------|------------------------|----------------|
|             | L <sub>ad</sub> | L <sub>Z</sub> | M <sub>M</sub> f8 | R <sub>T</sub> | B <sub>G</sub> | R <sub>L</sub> | SW | T <sub>G</sub> | V <sub>A</sub><br>±0,1 | V <sub>D</sub> | V <sub>FB</sub> | V <sub>FD</sub> | V <sub>G</sub><br>±0,1 | W <sub>A</sub> |
| 40 / 002    | 134             | 25             | 20                | M6             | 18             | 4              | 13 | 38.0           | 4                      | 5              | 33              | 30              | 20                     | 6              |
| 50 / 004    | 142             | 30             | 25                | M8             | 18             | 5              | 17 | 46.5           |                        |                | 38              | 38              | 25                     | 8              |
| 63 / 007    | 148             | 35             | 30                | M8             | 18             | 5              | 17 | 56.5           |                        |                | 40              | 38              | 25                     | 8              |
| 80 / 012    | 163             | 46             | 38                | M10            | 22             | 6              | 22 | 72.0           |                        |                | 44              | 45              | 33                     | 10             |
| 100 / 019   | 171             | 57             | 50                | M10            | 22             | 6              | 22 | 89.0           |                        |                | 54              | 45              | 38                     | 10             |
| 100XC / 030 | 316             | 62             | 60                | M12            | 28             | 7              | 36 | 89.0           |                        |                | 121             | 62              | 38                     | 18             |

## Motor attachment

Axial



Parallel

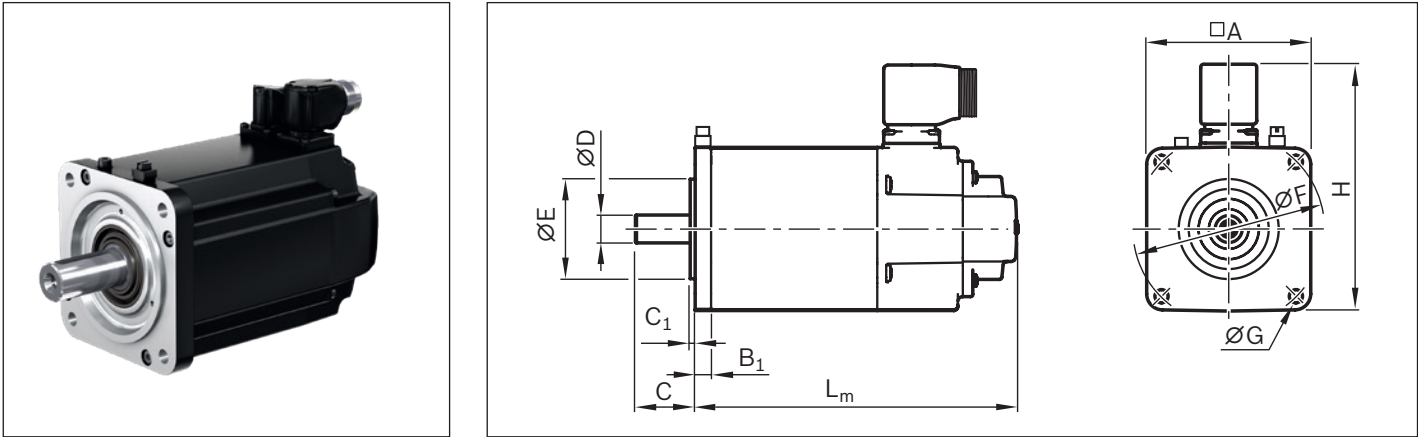


| EMC<br>SPK           | for motor | i   | Dimensions (mm) |     |       |     |       |       |    |                |                |                 |         | T <sub>G</sub> | Max.<br>permissible<br>screw-in<br>depth <sup>1)</sup> |
|----------------------|-----------|-----|-----------------|-----|-------|-----|-------|-------|----|----------------|----------------|-----------------|---------|----------------|--------------------------------------------------------|
|                      |           |     | A               | □D  | E     | F   | G     | H     | K  | L <sub>f</sub> | L <sub>m</sub> | L <sub>sd</sub> | M       |                |                                                        |
| <b>40<br/>002</b>    | MS2N04-B  | 1   | —               | 82  | 82.2  | 88  | 55.5  | 83.5  | 44 | 61             | 194.5          | 177             | M6      | 38.0           | 16.0                                                   |
| <b>50<br/>004</b>    | MS2N04-C  | 1   | —               | 82  | 82.2  | 88  | 55.5  | 83.5  | 44 | 73             | 226.5          | 177             | M8      | 46.5           | 16.0                                                   |
| <b>63<br/>007</b>    | MS2N05-D  | 1   | 3.0             | 98  | 117.2 | 116 | 77.0  | 85.5  | 56 | 95             | 290.0          | 245             | M8      | 56.5           | 16.0                                                   |
| <b>80<br/>012</b>    | MS2N06-D  | 2   | 2.5             | 116 | 117.2 | 160 | 102.0 | 98.5  | 77 | —              | 261.0          | 324             | M10     | 72.0           | 16.0                                                   |
|                      | MS2N06-E  | 1   | 2.5             | 116 | —     | —   | —     | 98.5  | —  | 100            | 301.0          | —               | —       | —              |                                                        |
| <b>100<br/>019</b>   | MS2N06-E  | 2   | 2.5             | 116 | 151.4 | 160 | 102.0 | 98.5  | 77 | —              | 301.0          | 324             | M10     | 89.0           | 16.0                                                   |
|                      | MS2N07-D  | 1   | 3.0             | 140 | —     | —   | —     | 110.0 | —  | 119            | 317.0          | —               | —       | —              |                                                        |
| <b>100XC<br/>030</b> | MS2N07-E  | 1.5 | 3.0             | 140 | 175.6 | 197 | 113.5 | 132.0 | 89 | —              | 375.0          | 375             | M12/M16 | 89.0/140.0     | 24.0                                                   |
|                      | MS2N10-D  | 1   | 4.0             | 192 | —     | —   | —     | 166.0 | —  | 145            | 356.0          | —               |         |                |                                                        |

<sup>1)</sup> Do not exceed max. permissible screw-in depth for "M" threads

IndraDyn S - servo motors MS2N

|                           |                        |              |              |              |              |              |
|---------------------------|------------------------|--------------|--------------|--------------|--------------|--------------|
| Smart Function Kit size   | 002                    | 004          | 007          | 012          | 019          | 030          |
| Motor attachment axial    | MS2N04-B0BTN           | MS2N04-C0BTN | MS2N05-D0BRN | MS2N06-E0BRN | MS2N07-D0BRN | MS2N10-D0BNN |
| Motor attachment parallel | MS2N04-B0BTN           | MS2N04-C0BTN | MS2N05-D0BRN | MS2N06-D0BRN | MS2N06-E0BRN | MS2N07-E1BNN |
| Encoder type              | Absolute value encoder |              |              |              |              |              |
| Brake                     | With holding brake     |              |              |              |              |              |



Schematic motor representation

| Motor code   | Dimensions (mm) |                |    |                |                   |                   |     |     |       |     |                |
|--------------|-----------------|----------------|----|----------------|-------------------|-------------------|-----|-----|-------|-----|----------------|
|              | □ A             | B <sub>1</sub> | C  | C <sub>1</sub> | Ø D <sub>k6</sub> | Ø E <sub>j7</sub> | Ø F | Ø G | Cable |     | L <sub>m</sub> |
|              |                 |                |    |                |                   |                   |     |     | 2     | 1   |                |
| MS2N04-B0BTN | 82              | 8              | 30 | 2.5            | 14                | 50                | 95  | 6.6 | 108   | 123 | 194.5          |
| MS2N04-C0BTN | 82              | 8              | 30 | 2.5            | 14                | 50                | 95  | 6.6 | 108   | 123 | 226.5          |
| MS2N05-D0BRN | 98              | 9              | 40 | 3              | 19                | 95                | 115 | 9   | 124   | 139 | 290            |
| MS2N06-E0BRN | 116             | 14             | 50 | 3              | 24                | 95                | 130 | 9   | 156   | 156 | 301            |
| MS2N07-E1BNN | 140             | 18             | 58 | 4              | 32                | 130               | 165 | 11  | 180   | 180 | 375            |
| MS2N10-D0BNN | 196             | 20             | 80 | 4              | 38                | 180               | 215 | 14  | 270   | 270 | 356            |

### Version

- Plain shaft without shaft seal ring
- Multi-turn encoder
- Standard encoder (B) in conjunction with 2-cable connector (HIPERFACE interface)
- Advanced encoder (B) in conjunction with 1-cable connector (AcuroLink interface)
- IP64 rating
- With holding brake
- Special ground connection terminal near motor flange (used as needed))

|  | Motordata                           |               |                    |                         |                             |                                       |               |                         | Motor<br>connection | Brake | Type code                   |
|--|-------------------------------------|---------------|--------------------|-------------------------|-----------------------------|---------------------------------------|---------------|-------------------------|---------------------|-------|-----------------------------|
|  | $n_{\max}$<br>( $\text{min}^{-1}$ ) | $M_0$<br>(Nm) | $M_{\max}$<br>(Nm) | $M_{\text{br}}$<br>(Nm) | $J_m$<br>( $\text{kgm}^2$ ) | $J_{\text{br}}$<br>( $\text{kgm}^2$ ) | $m_m$<br>(kg) | $m_{\text{br}}$<br>(kg) |                     |       |                             |
|  | 6 000                               | 1.75          | 5.9                | 5.0                     | 0.00007                     | 0.000040                              | 2.7           | 0.7                     | 2                   | Y     | MS2N04-B0BTN-BMDH1-NNNNE-NN |
|  |                                     |               |                    |                         |                             |                                       |               |                         | 1                   | Y     | MS2N04-B0BTN-CMSH1-NNNNE-NN |
|  | 6 000                               | 2.80          | 12.0               | 5.0                     | 0.00011                     | 0.000050                              | 3.7           | 0.7                     | 2                   | Y     | MS2N04-C0BTN-BMDH1-NNNNE-NN |
|  |                                     |               |                    |                         |                             |                                       |               |                         | 1                   | Y     | MS2N04-C0BTN-CMSH1-NNNNE-NN |
|  | 6 000                               | 7.90          | 31.3               | 10.0                    | 0.00040                     | 0.000110                              | 7.3           | 1.1                     | 2                   | Y     | MS2N05-D0BRN-BMDH1-NNNNE-NN |
|  |                                     |               |                    |                         |                             |                                       |               |                         | 1                   | Y     | MS2N05-D0BRN-CMSH1-NNNNE-NN |
|  | 6 000                               | 13.0          | 49.0               | 15.0                    | 0.00089                     | 0.000140                              | 11.5          | 1.5                     | 2                   | Y     | MS2N06-E0BRN-BMUH2-NNNNE-NN |
|  |                                     |               |                    |                         |                             |                                       |               |                         | 1                   | Y     | MS2N06-E0BRN-CMSH2-NNNNE-NN |
|  | 6 000                               | 25.8          | 128.5              | 36.0                    | 0.00752                     | 0.000041                              | 23.0          | 3.0                     | 2                   | Y     | MS2N07-E1BNN-BMVH2-NNNNE-NN |
|  | 6 000                               | 51.0          | 142.0              | 53.0                    | 0.00810                     | 0.001470                              | 34.0          | 5.0                     | 2                   | Y     | MS2N10-D0BNN-BMVH2-NNNNE-NN |

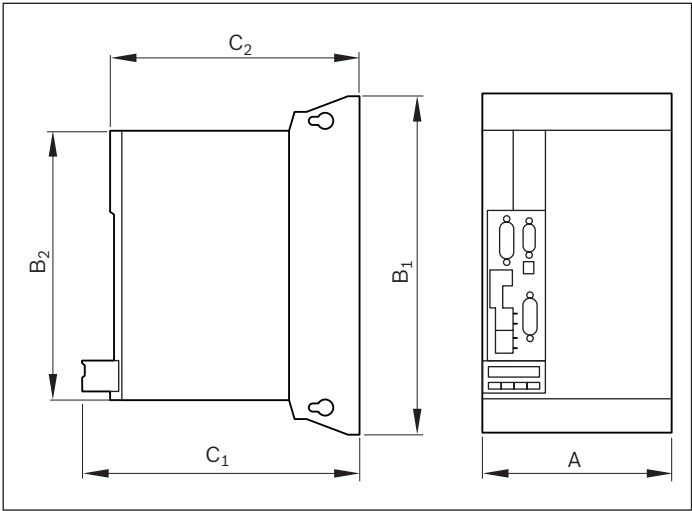
Servo drive HCS01 (with integrated control)

| Smart Function Kit Size                                                                         |                                   |                           | 002 / 004                                                                                                              |                   | 007             | 012 | 019              | 030              |
|-------------------------------------------------------------------------------------------------|-----------------------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------|-----|------------------|------------------|
| Size                                                                                            | Axial motor attachment            |                           | HCS01.1E-W0008                                                                                                         | HCS01.1E-W0013    | HCS01.1E-W0028  |     | HCS01.1E-W0054   |                  |
|                                                                                                 | Parallel motor attachment         |                           |                                                                                                                        |                   | HCS01.1E-W0028  |     |                  | HCS01.1E-W0054   |
| Mains connection voltage                                                                        | 1 x AC                            |                           | –                                                                                                                      | 110 ... 230 V     | –               |     |                  |                  |
|                                                                                                 | 3 x AC                            |                           | 200 ... 500 V                                                                                                          | 110 ... 230 V     | 200 ... 500 V   |     |                  |                  |
| Maximum current (output-side)                                                                   | Axial motor attachment            |                           | 8                                                                                                                      | 13                | 28              |     | 54               |                  |
|                                                                                                 | Parallel motor attachment         |                           |                                                                                                                        |                   | 28              |     | 54               |                  |
| Continuous input mains current I <sub>LN</sub> at U <sub>LN_nenn</sub> and P <sub>DC_cont</sub> | single-phase, without mains choke |                           | –                                                                                                                      | 8,3 <sup>1)</sup> | –               |     |                  |                  |
|                                                                                                 | three-phase, without mains choke  | Axial motor attachment    | 2,5 A <sup>1)</sup>                                                                                                    | 4,5 <sup>1)</sup> | 8 <sup>1)</sup> |     | 25 <sup>1)</sup> |                  |
|                                                                                                 |                                   | Parallel motor attachment |                                                                                                                        |                   | 8 <sup>1)</sup> |     |                  | 25 <sup>1)</sup> |
|                                                                                                 |                                   |                           |                                                                                                                        |                   |                 |     |                  |                  |
|                                                                                                 |                                   |                           |                                                                                                                        |                   |                 |     |                  |                  |
| Safety function according to EN 61800-5-2                                                       |                                   |                           | Safety Option L3: safe torque off (STO) <sup>2)</sup><br>On demand: Safety Option S4: SMES, SMST1, SMST2 <sup>2)</sup> |                   |                 |     |                  |                  |
| Field bus interface                                                                             |                                   |                           | Profinet, Ethernet/IP, EtherCAT, Sercos III                                                                            |                   |                 |     |                  |                  |
| IP protection class                                                                             |                                   |                           | IP20                                                                                                                   |                   |                 |     |                  |                  |

<sup>1)</sup> The actual phase current on the supply side highly depends on the application (cycle, load case etc.) and must be calculated.

<sup>2)</sup> Category 4, Performance Level e according to EN 13849-1 and SIL 3 acc. to EN 62061

|                   | HCS01.1E-W0013-A-02 | HCS01.1E-W0008-A-03 | HCS01.1E-W0028-A-03 | HCS01.1E-W0054-A-03 |
|-------------------|---------------------|---------------------|---------------------|---------------------|
| Size              | 1                   | 1                   | 2                   | 3                   |
| A mm              | 50                  | 50                  | 70                  | 130                 |
| B <sub>1</sub> mm | 215                 | 215                 | 268                 | 268                 |
| B <sub>2</sub> mm | 160                 | 160                 | 213                 | 213                 |
| C <sub>1</sub> mm | 220                 | 220                 | 220                 | 220                 |
| C <sub>2</sub> mm | 196                 | 196                 | 196                 | 196                 |
| Weight kg         | 0.72                | 0.72                | 1.7                 | 4.22                |

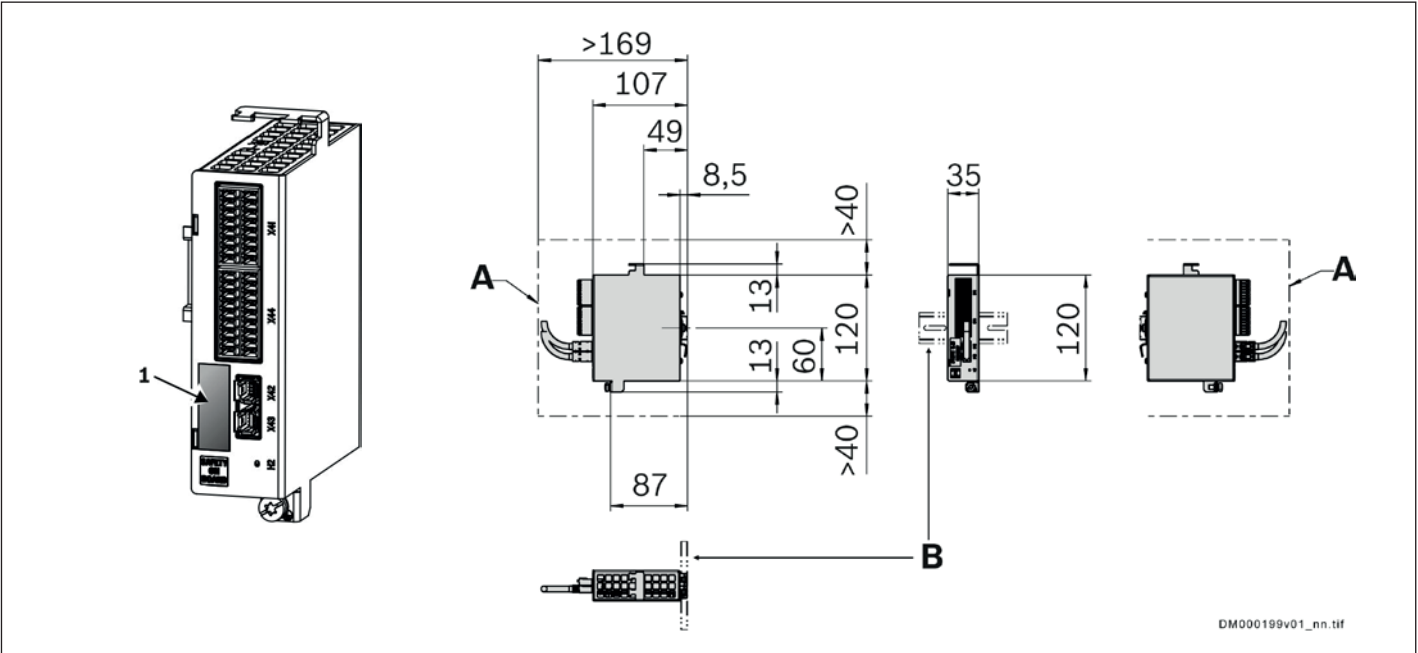


Safety zone module HSZ01

Together with the servo drive option S4 the safety zone module HSZ01.1 comes into use.  
Also included in the scope of delivery: 2 x bus cables, 1m length.

|                                                |                     |    |                                                                                                                                                                                               |
|------------------------------------------------|---------------------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description                                    |                     |    | HSZ01.1-D08-D04-NNNN                                                                                                                                                                          |
| Degree of protection                           |                     |    | IP20                                                                                                                                                                                          |
| Conductive dirt contamination                  |                     |    | Not allowed<br>(You can protect the devices against conductive dirt contamination, e.g., by mounting them in control cabinets with a degree of protection of IP54 in accordance with IEC529). |
| Allowed mounting position                      |                     |    | Vertical in a control cabinet                                                                                                                                                                 |
| Weight                                         | m                   | kg | 0.65                                                                                                                                                                                          |
| Minimum distance from the top of the device    | d <sub>top</sub>    | mm | 40                                                                                                                                                                                            |
| Minimum distance from the bottom of the device | d <sub>bot</sub>    | mm | 40                                                                                                                                                                                            |
| Minimum distance from the side of the device   | d <sub>hor</sub>    | mm | –                                                                                                                                                                                             |
| Allowed ambient temperature range              | T <sub>a,work</sub> | °C | 0 ... 55                                                                                                                                                                                      |
| Allowed relative humidity                      |                     | %  | 5 ... 85                                                                                                                                                                                      |
| Cooling type                                   |                     |    | natural convection                                                                                                                                                                            |
| Control voltage supply                         |                     |    |                                                                                                                                                                                               |
| Control voltage input <sup>1)</sup>            | U <sub>ext</sub>    | V  | 19.2 ... 30                                                                                                                                                                                   |
| Internal consumption                           | P <sub>ext</sub>    | W  | 0.5                                                                                                                                                                                           |
| Output current <sup>2)</sup>                   | I <sub>max</sub>    | A  | 3.4                                                                                                                                                                                           |

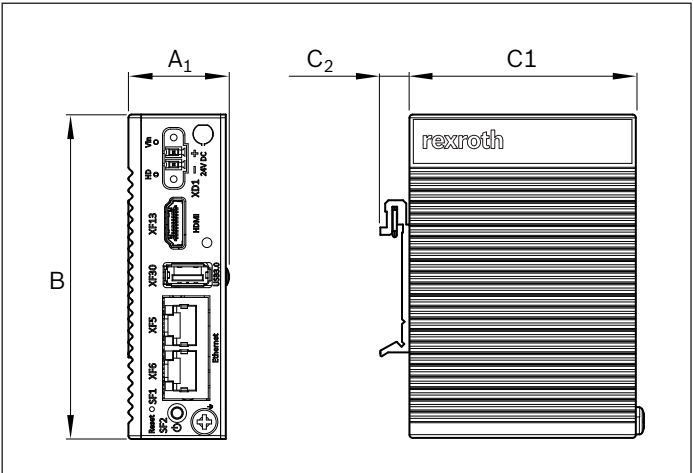
<sup>1)</sup> When selecting a control voltage supply, observe the requirements of the door locking device  
<sup>2)</sup> Sum of all output currents at the outputs (without SDL\_Ch2)



Industrial PC PR21

|                     |                                   |
|---------------------|-----------------------------------|
| Operating system    | Linux Ubuntu Core                 |
| CPU                 | Intel Atom E3815; 1,46 GHz        |
| Memory              | 4G DDR3L, 1066 MHz RAM            |
| Mass storage        | 32 GB eMMC onboard                |
| Interfaces          | 1 × USB 3.0                       |
|                     | 2 × Realtek RTL8111E GbE Ethernet |
|                     | 1 × HDMI Video-Port               |
| RTC-battery         | RTC-battery button cell BR2032    |
| Mounting            | Top hat rail mounting             |
| Input voltage       | DC 24 V + 25%, -20%               |
| Power consumption   | Maximum 20 W                      |
| IP protection class | IP20                              |

|                |    |     |
|----------------|----|-----|
| A <sub>1</sub> | mm | 30  |
| B              | mm | 100 |
| C <sub>1</sub> | mm | 70  |
| C <sub>2</sub> | mm | 6,5 |
| Weight         | kg | 0,4 |







## Force sensor

### Features

- ▶ Corrosion-resistant stainless steel version
- ▶ High reproducibility
- ▶ Easy mounting directly at the EMC piston rod

### Notes

- ▶ If the process requires joining to a specified force value, a force sensor is required, as otherwise no stable process result can be achieved.
- ▶ Calibration certificates available on request.



### Metrological specifications

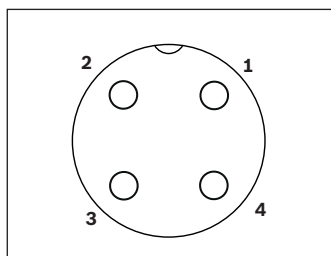
| Smart Function Kit / Size                                               |    | 002               | 004 | 007 | 012 | 019 | 030 |
|-------------------------------------------------------------------------|----|-------------------|-----|-----|-----|-----|-----|
| Measurement technology                                                  |    | Strain gauge      |     |     |     |     |     |
| Compressive force measuring range <sup>1)</sup>                         | kN | 3                 | 6   | 10  | 15  | 20  | 40  |
| Traction force measuring range                                          | kN | 0.3               | 0.6 | 1   |     |     |     |
| IP protection class                                                     |    | IP67              |     |     |     |     |     |
| Operating load (of measuring range)                                     | %  | 150               |     |     |     |     |     |
| Breaking load (of measuring range)                                      | %  | 300               |     |     |     |     |     |
| non-linearity (of measuring range)                                      | %  | ± 0.3             |     |     |     |     |     |
| Relative creeping (of measuring range)                                  | %  | 0.1               |     |     |     |     |     |
| Hysteresis (of measuring range)                                         | %  | 0.1               |     |     |     |     |     |
| Temperature drift zero point (of the measuring range per Kelvin)        | %  | 0.02              |     |     |     |     |     |
| Temperature drift above measuring range (of measuring range per Kelvin) | %  | 0.02              |     |     |     |     |     |
| Compensated temperature (min ... max)                                   |    | -20 °C ... +80 °C |     |     |     |     |     |
| Working temperature (min ... max)                                       |    | -30 °C ... +80 °C |     |     |     |     |     |

<sup>1)</sup> Smaller measuring ranges possible on request

### Electrical specifications

| Smart Function Kit / Size       |     | 002              | 004 | 007  | 012           | 019           | 030           |
|---------------------------------|-----|------------------|-----|------|---------------|---------------|---------------|
| Output signal (0kN)             |     | 0.909 V ±0.01    |     |      | 0.625 V ±0.01 | 0.476 V ±0.01 | 0.244 V ±0.01 |
| Output signal (measuring range) |     | 0 ... +10 V      |     |      |               |               |               |
| Nominal rating                  | N/V | 330              | 660 | 1100 | 1600          | 2100          | 4100          |
| Power supply voltage            |     | 14 ... 30 V      |     |      |               |               |               |
| Current consumption             |     | 8 mA (24V)       |     |      |               |               |               |
| Bandwidth                       |     | 1 kHz ±0.2       |     |      |               |               |               |
| Connector                       |     | Plug M12x1 4-pin |     |      |               |               |               |

### Electrical connection



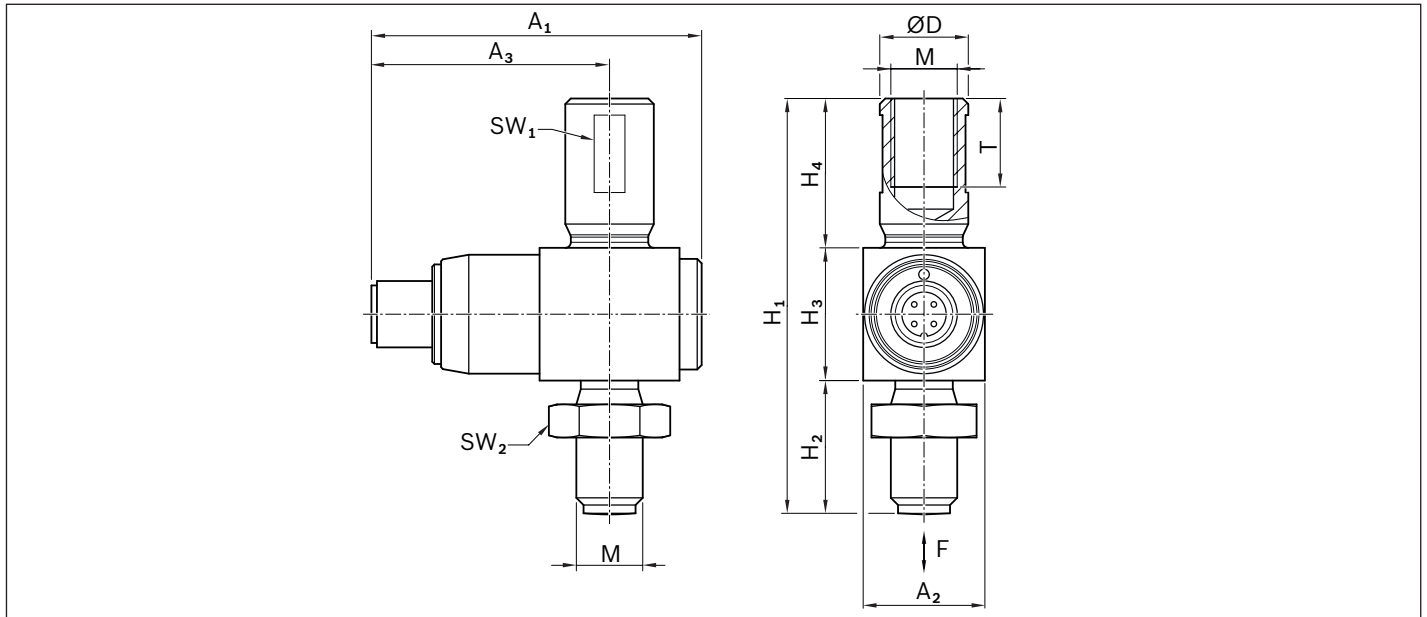
#### Force sensor

- 1 supply (+)
- 2 -
- 3 GND
- 4 output

#### Connection cable

- 1 brn
- 2 -
- 3 blu
- 4 blk

Connection cable length 15 m;  
with M12 plug with free cable ends



| Smart Function Kit / Size |    | 002      | 004     | 007 | 012     | 019 | 030   |
|---------------------------|----|----------|---------|-----|---------|-----|-------|
| A <sub>1</sub>            | mm | 60       |         |     |         |     | 68    |
| A <sub>2</sub>            | mm | 22       |         | 26  |         | 35  |       |
| A <sub>3</sub>            | mm | 43       |         |     |         |     |       |
| ØD                        | mm | 18       | 24.5    |     | 30      |     | 50    |
| H <sub>1</sub>            | mm | 75       | 100     |     | 134     |     | 185   |
| H <sub>2</sub>            | mm | 24       | 32      |     | 40      |     | 57    |
| H <sub>3</sub>            | mm | 24       | 33      |     | 50      |     |       |
| H <sub>4</sub>            | mm | 27       | 35      |     | 44      |     | 78    |
| M                         |    | M12x1.25 | M16x1.5 |     | M20x1.5 |     | M36x2 |
| T                         | mm | 16       | 23      |     | 29      |     | 49    |
| SW <sub>1</sub>           | mm | 16       | 22      |     | 26      |     | 46    |
| SW <sub>2</sub>           | mm | 19       | 24      |     | 30      |     | 55    |
| Tightening torque Nut     | Nm | 69       | 166     |     | 356     |     | 570   |

## Ordering data

| Smart Function Kit / Size | Force sensor material number |
|---------------------------|------------------------------|
| 002                       | R156623001                   |
| 004                       | R156633001                   |
| 007                       | R156643001                   |
| 012                       | R156653001                   |
| 019                       | R156663001                   |
| 030                       | R156673001                   |

Accessories

Fastening elements

| Flange mount                                                                      | Foot mount                                                                          |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|  |  |

Electrical accessories

| Uninterruptible power supply                                                        | Mains filter                                                                        | Power supply unit                                                                   | Panel-PC                                                                             | Ethernet cable 5 m                                                                    |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| VAU                                                                                 | NFE/NFD                                                                             | VAP01                                                                               | VR                                                                                   | RKB                                                                                   |
|  |  |  |  |  |

You find data on accessories and other accessories at: [www.boschrexroth.de/smart-function-kit](http://www.boschrexroth.de/smart-function-kit)

## Software

### General

|                                               |                                                                                                                                                   |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Access to frontend via</b>                 | Webbrowser, e. g. Firefox, Chrome                                                                                                                 |
| <b>Display format of HMI device</b>           | >10 inches, automatic adaption of software                                                                                                        |
| <b>Languages in HMI</b>                       | English, German                                                                                                                                   |
| <b>Number of user levels</b>                  | Two: User and Admin                                                                                                                               |
| <b>Rights "User"</b>                          | Selection of program, start program, inspection of log files, change of language                                                                  |
| <b>Rights "Admin"</b>                         | Like "User", additionally adjusting programs, configuration of validation elements, commissioning, homing axis, access to configuration parameter |
| <b>Availability software updates</b>          | Download available on website                                                                                                                     |
| <b>Software license</b>                       | No additional license required for SFK software                                                                                                   |
| <b>Hosting of frontend</b>                    | Hosting by Industrial PC PR21                                                                                                                     |
| <b>Connection between PR21 and HMI device</b> | Connection through network cable or WiFi (scope of delivery does not contain a WiFi router)                                                       |

## Dashboard

|                                           |                                                                                                |
|-------------------------------------------|------------------------------------------------------------------------------------------------|
| <b>Data displayed in dashboard</b>        | Production statistics, evaluation of the last parts produced, live sequence, process live data |
| <b>Data of production statistics</b>      | Number of OK/NOK parts and efficiency                                                          |
| <b>Time horizon production statistics</b> | Unlimited (as long as memory is available), reset of statistics possible                       |
| <b>Data of last parts</b>                 | Visual representation of production statistics                                                 |
| <b>Data of live sequence</b>              | Live view of program steps of selected program or display of live curve of process data        |
| <b>Data in live curve</b>                 | X-axis: Position<br>Y-axis: Force                                                              |
| <b>Configurability of live curve</b>      | Not configurable, only force-displacement curve possible                                       |
| <b>Process live data</b>                  | Position, force, velocity                                                                      |
| <b>Additional cycle data</b>              | Max. position, max. force, cycle time                                                          |

## Programming

|                                                  |                                                                                                                                                                                                                                         |
|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Programming scheme</b>                        | Programming with graphical building blocks. A block represents a sequence step that can be parametrized individually.                                                                                                                   |
| <b>Available sequence blocks</b>                 | Initial position, positioning, join to force (with position monitoring), join to position (with force monitoring), move to signal, delay, wait for signal, set output, taring sensor, set variable, check position/force target window. |
| <b>Configurable parameters</b>                   | Depends on the sequence step, e. g. velocity, acceleration, target force, target position, max. force, max. position,...                                                                                                                |
| <b>Configurable abort criteria</b>               | Exceeding max. force or max. position                                                                                                                                                                                                   |
| <b>Treatment of erroneous entries</b>            | Entries are subject to a logic check to avoid grave erroneous entries                                                                                                                                                                   |
| <b>Max. number of programs</b>                   | 99                                                                                                                                                                                                                                      |
| <b>Max. number of sequence steps per program</b> | 500                                                                                                                                                                                                                                     |
| <b>Behavior between program steps</b>            | Sluring of movement, no abrupt transition (exception: Initial position)                                                                                                                                                                 |
| <b>Relevance of program steps for validation</b> | Each program step can be configured as a valid or hidden step for validation                                                                                                                                                            |
| <b>External interaction during program run</b>   | Interaction via digital I/Os (at servo drive HCS01) and virtual I/Os (via fieldbus)                                                                                                                                                     |
| <b>Number of digital I/Os</b>                    | 7 digital inputs (1 of them preset for E-Stop),<br>1 digital output (can also be used as eighth input)                                                                                                                                  |
| <b>Number of virtual I/Os</b>                    | 16 inputs, 16 outputs                                                                                                                                                                                                                   |
| <b>Format program export / import</b>            | Export to / import of JSON file                                                                                                                                                                                                         |

## Process and Data

|                                                  |                                                                                                                                                                             |
|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Monitoring possibility</b>                    | Force monitoring, position monitoring                                                                                                                                       |
| <b>Control behavior</b>                          | Position control                                                                                                                                                            |
| <b>Opportunities for manual moving (jogging)</b> | Continuous, absolute and relative moving with determined velocity                                                                                                           |
| <b>Options for stop command</b>                  | Via HMI, digital I/Os, fieldbus                                                                                                                                             |
| <b>Error reaction</b>                            | Aborting program, displaying error report, if necessary request for error acknowledgement                                                                                   |
| <b>Reaction time at program abortion</b>         | 2 ms + stop time                                                                                                                                                            |
| <b>Live data evaluation</b>                      | Program termination when abort criteria is exceeded, or if the window defined in the sequence block „Check position/force target window“ is violated, no analysis of trends |
| <b>Max. frequency of data recording</b>          | 500 Hz (recording of a data point every 2 ms)                                                                                                                               |
| <b>Max. number of measurement points</b>         | Total duration of press cycle / 2 ms                                                                                                                                        |
| <b>Storage of process data</b>                   | Storage of every press cycle in the press history                                                                                                                           |
| <b>Stored process data</b>                       | Timestamp, validation (OK/NOK), max. position, max. force, cycle time, serial number, program name, force-displacement curve with validation elements                       |
| <b>Filter function in press history</b>          | Filtering by date, program name and validation possible                                                                                                                     |
| <b>Max. number of stored curves</b>              | Roughly 1 million (free memory ~25 GB)                                                                                                                                      |
| <b>Format curve export</b>                       | JSON file                                                                                                                                                                   |

## Reference curve and Validation

|                                                                |                                                                                                           |
|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <b>Validation basis</b>                                        | Evaluation elements in combination with reference curve                                                   |
| <b>Choice of evaluation elements</b>                           | Thresholds, evaluation windows, envelope curves                                                           |
| <b>Type of reference curve</b>                                 | Force-displacement curve                                                                                  |
| <b>Recommended max. number of reference curves per program</b> | 30                                                                                                        |
| <b>Parameters for validation</b>                               | Force, position (real values only, no slope)                                                              |
| <b>Max. number of points per envelope curve</b>                | 100                                                                                                       |
| <b>Max. number of evaluation elements per program</b>          | 50                                                                                                        |
| <b>Adding evaluation elements by</b>                           | Graphical drawing in Web-HMI                                                                              |
| <b>Editing evaluation element after drawing</b>                | By graphically moving the element or manually adjusting the X- and Y-coordinates of its points            |
| <b>Display of evaluation result</b>                            | OK/NOK                                                                                                    |
| <b>Record of intersections with validation elements</b>        | Visual representation in force-displacement curve, not listed in export file                              |
| <b>Error diagnosis for NOK stamps</b>                          | Display of NOK, visual representation in force-displacement curve                                         |
| <b>Reaction to NOK result</b>                                  | Display of NOK result in dashboard ➡ evaluation elements are no abort criterion during the press cycle    |
| <b>Evaluation of trends / reaction to trends</b>               | Trends cannot be evaluated within the SFK software                                                        |
| <b>Evaluation of individual evaluation elements</b>            | Holistic evaluation of force-displacement curve, no separate evaluation of individual evaluation elements |
| <b>Validation results via fieldbus</b>                         | OK/NOK result readable as status bit                                                                      |

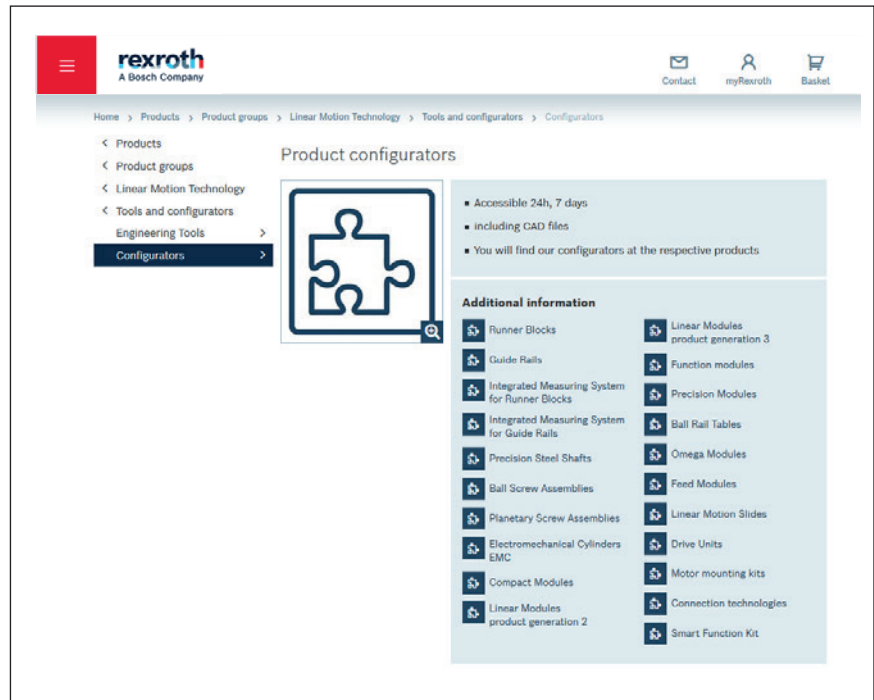
## Interfaces

|                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Available interfaces</b>                     | Fieldbus, REST-API, WebSocket-API, OPC/UA, digital I/Os                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Supported fieldbus protocols</b>             | SERCOS III, PROFINET, EtherCAT, EtherNet/IP                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Fieldbus commands</b>                        | Start program, set program active, positioning absolute, positioning relative, clear error, stop movement, reboot drive, tare sensor, homing axis, set variable, lock invoker, set reference, max.force / max.position in the cycle (in preparation).                                                                                                                                                                                                               |
| <b>Live data via fieldbus</b>                   | Active program number, live position, live velocity, live force                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Status information via fieldbus (0 or 1)</b> | Program active, last pressing OK, last pressing NOK, sensor tared, press ready, error, warning, data recording active, request possible, response available, notification available                                                                                                                                                                                                                                                                                 |
| <b>Trigger opportunities</b>                    | 7 digital inputs (1 of them preset for E-Stop), 1 digital output at HCS01;<br>in each direction 16 bits which can be used as virtual inputs / outputs (via fieldbus)                                                                                                                                                                                                                                                                                                |
| <b>Possible traceability</b>                    | Optional assignment of serial number (max. 21 digits, numerical format only) at program start via fieldbus                                                                                                                                                                                                                                                                                                                                                          |
| <b>HMI</b>                                      | Visual display of SFK-frontend is only available via web browser; every functionality of the HMI is also usable via REST-API and in reduced scope via OPC/UA                                                                                                                                                                                                                                                                                                        |
| <b>Opportunity of remote maintenance</b>        | Access via remote maintenance software (e. g. TeamViewer, VNC Viewer,...) possible                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Readable variables via OPC/UA</b>            | Active programID, current error, current position, current program step, current force, current velocity, system database available (0 or 1), system available (0 or 1), free memory, program running (0 or 1)                                                                                                                                                                                                                                                      |
| <b>Methods via OPC/UA</b>                       | Cancel, clear error, load Y-parameter (SMC parameters), positioning, reboot system, read command history, read I/Os, read S-parameter or P-parameter (drive parameters), read active command with call context, read SMC variable, read Y-parameter, switching between parametrization mode and operating mode, set program active, set reference, start program, homing axis, tare sensor, write S-parameter or P-parameter, write SMC variable, write Y-parameter |
| <b>Available data via REST-API</b>              | Account data, authentication data, configuration, curves, programs, user data, validation elements, activity, commissioning                                                                                                                                                                                                                                                                                                                                         |
| <b>Functionalities via WebSocket-API</b>        | Reading status information, controlling of the drive via RPC-calls                                                                                                                                                                                                                                                                                                                                                                                                  |



## Selection and CAD Data

The SFKs with their nominal forces were specified on the basis of an internally specified reference cycle. We recommend to recalculate each application in our LinSelect selection and sizing tool in order to determine the perfect solution for the application. Based on this selection, CAD files can then be generated and downloaded in the online configurator.



<https://www.boschrexroth.com/en/xc/products/product-groups/linear-motion-technology/tools-and-configurators>

Order key

|                                        |   |                                                                                   |             |   |       |   |                   |   |   |
|----------------------------------------|---|-----------------------------------------------------------------------------------|-------------|---|-------|---|-------------------|---|---|
| <b>Example</b>                         |   | 004                                                                               | 200         | - | Axial | - | with force sensor | - | 5 |
| Size depending on the nominal force    | = | 2 kN:                                                                             | 002         |   |       |   |                   |   |   |
|                                        |   | 4 kN:                                                                             | 004         |   |       |   |                   |   |   |
|                                        |   | 7 kN:                                                                             | 007         |   |       |   |                   |   |   |
|                                        |   | 12 kN:                                                                            | 012         |   |       |   |                   |   |   |
|                                        |   | 19 kN:                                                                            | 019         |   |       |   |                   |   |   |
|                                        |   | 30 kN:                                                                            | 030         |   |       |   |                   |   |   |
| <b>Stroke</b><br>depending on the size |   | 002                                                                               | 35 - 400 mm |   |       |   |                   |   |   |
|                                        |   | 004                                                                               | 40 - 400 mm |   |       |   |                   |   |   |
|                                        | = | 007                                                                               | 65 - 400 mm |   |       |   |                   |   |   |
|                                        |   | 012                                                                               | 80 - 400 mm |   |       |   |                   |   |   |
|                                        |   | 019                                                                               | 70 - 400 mm |   |       |   |                   |   |   |
|                                        |   | 030                                                                               | 90 - 400 mm |   |       |   |                   |   |   |
| <b>Motor attachment</b>                | = | <u>Axial</u>                                                                      |             |   |       |   |                   |   |   |
|                                        |   |  |             |   |       |   |                   |   |   |
|                                        |   | <b>Parallel</b>                                                                   |             |   |       |   |                   |   |   |
|                                        |   |  |             |   |       |   |                   |   |   |
| <b>Force sensor <sup>1)</sup></b>      | = | without force sensor                                                              |             |   |       |   |                   |   |   |
|                                        |   | <u>with force sensor</u>                                                          |             |   |       |   |                   |   |   |
| <b>Cable length</b>                    | = | 5 m                                                                               |             |   |       |   |                   |   |   |
|                                        |   | 10 m                                                                              |             |   |       |   |                   |   |   |

<sup>1)</sup> Observe the notes in the "Force sensor" chapter

# Supplementary documentation

## Required and supplementary documentation

|                                                                                   | <b>Title</b>                                                            | <b>Document number</b> | <b>Document type</b>    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------|------------------------|-------------------------|
|  | Electromechanical cylinders EMC                                         | R999000493             | Catalog                 |
|  | Instructions for electromechanical cylinders EMC                        | R320103102             | Instructions            |
|  | IndraDrive Cs drive control units with HCS01                            | R911322210             | Project Planning Manual |
|  | MS2N synchron servo motors                                              | R911347583             | Project Planning Manual |
|  | IndraControl PR21                                                       | R911389662             | Operating Instructions  |
|  | SMC                                                                     | R911343865             | Manual                  |
|  | Smart Function Kit                                                      | R320103194             | Instructions            |
|  | Smart Function Kit software                                             | R320103208             | Instructions            |
|  | Smart Function Kit - Field bus                                          | R320103209             | Instructions            |
|  | Smart Function Kit - OPC-UA + REST-API                                  | R320103210             | Instructions            |
|  | IndraDrive integrated safety technology „Safe Torque Off“ (from MPx-16) | R911332634             | Application Manual      |
|  | Integrated safety technology "Safe Motion" (from MPx-18)                | R911338920             | Application Manual      |
|  | Additional components and accessories                                   | R911306140             | Project Planning Manual |

The Rexroth documentation is available for download at [www.boschrexroth.com/medienverzeichnis](http://www.boschrexroth.com/medienverzeichnis)

## Environmental conditions

| <b>Smart Function Kit size</b>                     | <b>002</b>                                                                       | <b>004</b> | <b>007</b> | <b>012</b> | <b>019</b> | <b>030</b> |
|----------------------------------------------------|----------------------------------------------------------------------------------|------------|------------|------------|------------|------------|
| <b>Ambient temperature operation <sup>1)</sup></b> | 0 °C ... 50 °C                                                                   |            |            |            |            |            |
| <b>IP protection class</b>                         | Mechanics: Standard IP54 (up to IP65 possible)<br>Control cabinet hardware: IP20 |            |            |            |            |            |
| <b>Duty cycle</b> %                                | 100                                                                              |            |            |            |            |            |

<sup>1)</sup> loss of performance at temperatures exceeding 40°C

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[www.boschrexroth.com/contact](http://www.boschrexroth.com/contact)

