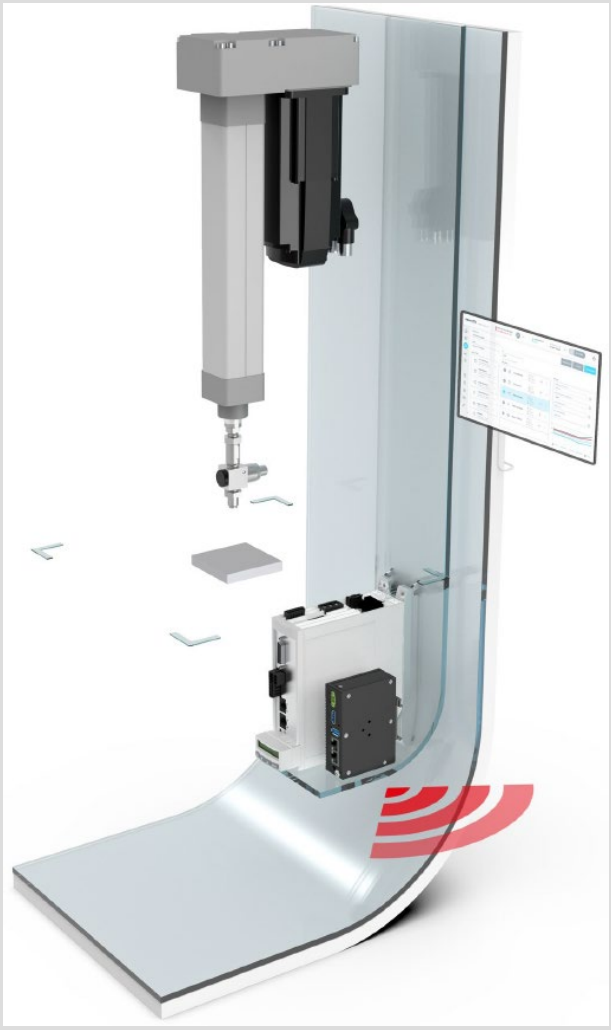
rexroth
A Bosch Company

Smart Function Kit SFK - Software

Manual
R320103208 / 2021-07

English



This data has been provided solely for the purpose of product description. Any references to possible uses are provided merely as a convenience and shall be understood as application examples or suggestions.
Catalog data may not be construed as guaranteed characteristics. The information given does not release the user from the obligation of own judgment and verification.
It should be noted that our products are subject to a natural process of aging and wear.

The title page contains an illustration of a sample configuration. The product as delivered can differ from the illustration.

The original instructions are in German.

Any dissemination of the product must include these instructions.

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1 About this documentation

1.1 Validity of the documentation

This documentation applies to the following products:

- Smart Function Kit (SFK) as described in the ‘Smart Function Kit SFK’ online catalog.

This documentation is intended for assemblers, installers, operators, service technicians and system owners. This documentation contains important information for proper and safe commissioning, operation, usage and to handle errors.

- ▶ This documentation, especially chapter 1.3.1 Safety instructions is to be read completely before working with this product.

1.2 Required and supplementary documentation

- ▶ Only commission the product once you have obtained the system documentation that is marked with the 🕮 and understood and complied with its contents.

Table 1: Required documentation

	Title	Document number	Type of document
🕮	Smart Function Kit SFK – Instruction	R320103194	Instructions
	Smart Function Kit SFK – Fieldbus	R320103209	Instructions
	Smart Function Kit SFK – OPC-UA + REST-API	R320103210	Instructions
	IndraDrive Integrated Safety Technology “Safe Motion” (MPx-18 and above)	R911338920	Instructions

The Rexroth documentation is available for download at www.boschrexroth.com/mediadirectory.

1.3 Presentation of information

To enable users to work rapidly and safely with the product while following these instructions, this documentation uses standardized safety instructions, symbols, terms and definitions, and abbreviations. These are explained in the following sections.

1.3.1 Safety instructions

This documentation contains safety instructions regarding any actions that involve a risk of personal injury or damage to property. The safety precautions described must be adhered to.

Safety instructions are structured as follows:

⚠ SIGNAL WORD

Type and source of hazard!
Consequences if ignored.
▶ Hazard prevention measure.

- Warning sign: Draws attention to the hazard
- Signal word: Indicates the severity of the hazard
- Type and source of hazard: Indicates the type or source of the hazard
- Consequences: Describes the consequences that may occur if the hazard avoidance precautions are ignored
- Hazard prevention measure: Indicates how to avoid the hazard

The safety instructions cover the following hazard classes. The hazard class describes the risk involved if the safety instruction is not complied with.

Table 2: Hazard classes according to ANSI Z535.6-2006

Warning sign, Signal word	Meaning
⚠ DANGER	Indicates a hazardous situation which will result in death or serious injury if not avoided.
⚠ WARNING	Indicates a hazardous situation which may result in death or serious injury if not avoided.
⚠ CAUTION	Indicates a hazardous situation which may result in minor or moderate injury if not avoided.
NOTICE	Property damage: The product or surroundings may be damaged

1.3.2 Symbols

The following symbols indicate information that is not related to safety but makes the documentation easier to understand.

Table 3: Meaning of the symbols

Symbol	Meaning
	If this information is not observed, the product will not be optimally used / operated.
▶	Single, independent work step
1. 2. 3.	Numbered work steps The numbers indicate the sequence of the work steps.

1.3.3 Abbreviations

The following abbreviations are used in this documentation:

Table 4: Abbreviations and definitions

Abbreviation	Meaning
API	**A**pplication **P**rogramming **I**nterface
cURL	**C**lient for **URL**
EMC	**E**lectro**M**echanical **C**ylinder
FE	**F**unctional **E**arth
HCS01	Motor controller
HMI	**H**uman **M**achine **I**nterface
HTTPS	**H**ypertext **T**ransfer **P**rotocol **S**ecure
ID	**Id**entification number
I/O	Digital Input / Output
IP	**I**nternet **P**rotocol
JSON	**J**ava**S**cript **O**bject **N**otation
NOK	NOK evaluation
OK	OK evaluation
OPC-UA	**O**pen **P**latform **C**ommunications **U**nified **A**rchitecture
PC	**P**ersonal **C**omputer
PR21	Industrial PC
REST	**Re**presentational **S**tate **T**ransfer
SMC	**S**equential **M**otion **C**ontrol
PLC	**P**rogrammable **l**ogic **c**ontrol
SYNC	**Sync**hronization
XF5, XF6	Network interfaces at the Industrial PC
X26	Network interfaces at the Motor controller
X31	I/O Interface at the Motor controller

2 Safety instructions

2.1 Intended use

2.1.1 Introduction

The products may only be used as intended. If they are not used as intended, situations can arise that result in damage to property and persons.

NOTICE
As the manufacturer, Bosch Rexroth makes no warranty, liability or compensation for damages in the event of improper use of the products; the risks of improper use of the products lie solely with the user.

Before you use the products of Bosch Rexroth, the following requirements must be met in order to ensure proper use of the products:

- All persons handling the product must first read and understand the relevant safety regulations and the intended use.
- If the products are hardware, they must be left in their original state; in other words, no structural changes may be made to them.
- Software products may not be decompiled and their source codes may not be changed.
- Damaged or defective products may not be installed or put into operation.
- It must be ensured that the products are installed in accordance with the regulations specified in the documentation.
- Only use the provided software to configure the system or its components.

2.1.2 Areas of application

NOTICE
The system may only be used with the accessories and attachments specified in the documentation. Components not expressly mentioned may not be added or connected. The same applies to cables and wires.

NOTICE
The operation may only take place in the configurations and combinations of the components expressly specified and with the software and firmware specified and specified in the respective functional description.

2.2 Non-intended use

The use of the system outside the above-mentioned areas of application or under operating conditions other than those described in the documentation and technical data shall be considered "not intended". In addition, the system may not be used in applications that are not expressly approved by Bosch Rexroth. Please note the statements in the general safety instructions!

3 Commissioning

The Commissioning consists of several steps and is guided by the software. Basic properties such as language and password as well as e.g. hardware-related settings can be configured. After successful commissioning, the system is immediately ready for use.

If the HCS01 drive controller is equipped with safety option S4 (Safe Motion) a separate commissioning of the safety technology is required in order to make use of the safety functions of the drive controller.

3.1 First commissioning

The system must be fully wired and switched on when commissioning it for the first time. After switching on the system, it takes approx. 90 seconds to start up completely.

- Ensure that your HMI terminal device or a commissioning PC is connected with the network of the Smart Function Kit.
- Check the network settings of your HMI device (for initial connection settings see below).
- Open your web browser and enter the IP address of the Smart Function Kit (standard: 192.168.0.1). The web browser will now automatically connect to the Smart Function Kit.
- Depending on the security settings of your web browser and on the browser, a security warning to be confirmed will appear during connection establishment.

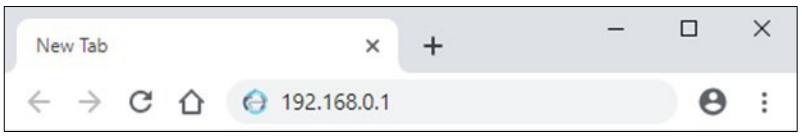


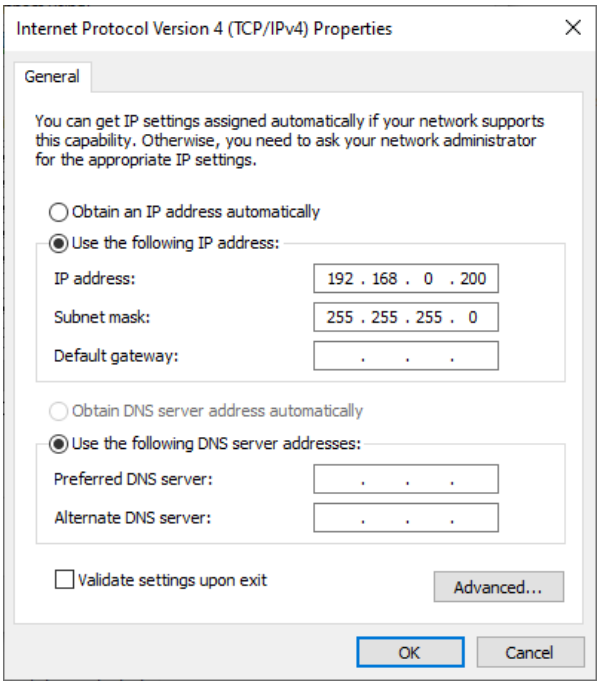
Figure 1: Entering IP Address

The system is configured with the following network settings by default:

- IP-Address: 192.168.0.1
- Subnet mask: 255.255.255.0
- Gateway-Address: 0.0.0.0

Ensure the following network settings for the commissioning PC:

- IPv4-Address static, not automatically obtained
- IP-Address follows the following scheme: 192.168.0.x with x > 1
  eg: 192.168.0.200
- Subnet mask: 255.255.255.0



NOTICE

If the Smart Function Kit UI is not displayed, please check the network settings of your HMI device.

▶ Measure: PING Test

3.2 Commissioning procedure

The Smart Function Kit can be commissioned in just a few steps. During commissioning, all system-related configurations necessary for error-free operation are applied automatically.

If the HCS01 drive controller is equipped with safety option S4 the commissioning of the Smart Function Kit must be done prior to the commissioning of the safety technology. Please consider the instructions in chapter 3.4.

3.2.1 Login

In the first step of commissioning, you must login to the system. Use the default password "admin". If you have already changed the password, use the new, changed password accordingly.

1. Enter the password in the corresponding field.
2. Press *Enter* or click the *Login* button.
3. After successful login, you can switch to the next commissioning step with the *Next* button.

3.2.2 Language and password selection

In the next step of the commissioning, you can select the language of the system. You can choose from one of the following languages:

- German
- English

➢ Select the language in the dropdown selection item.

The Smart Function Kit has two user accounts. An administrator account and an operator account.
The administrator account is password protected and is used for system configuration, program creation, definition of quality evaluation and data export.
The operator account has no password and corresponds to the logged-out state. It is used in actual operation and offers only limited access to the system.

During commissioning, you can change the password for the administrator account.
1. Enter a new password in the field.
2. Confirm the new password in the field below.
3. Save the new password by clicking the *Save* button.

Changing the password overwrites the default password. From then on, a login is only possible with the new password.
If no new password is assigned, the default password "admin" remains active and can be used to login to the administrator account.
You can also change the password for the administrator account at any time in the system settings.

NOTICE
The default password does not comply with security standards and does not provide sufficient protection for the system! Unauthorized access to the system and data. ▶ Change the standard password. ▶ Use a secure password.

NOTICE
The administrator password cannot be reset! If the password is lost, access to the system is only possible after reinstallation. Loss of system configuration and data. ▶ Make a note of the new password and keep it in a safe place.

➢ Click on the *Next* button to proceed with the next commissioning step.

3.2.3 System check

During the system check, the system performs a self-diagnosis and checks whether all components are correctly connected and ready.
Commissioning can only be continued if the system check has identified all the necessary components.

➢ Click on the *Next* button to switch to the next commissioning step.

If a faulty component is detected in the system check, you cannot click on the *Next* button and cannot continue the commissioning directly. Please check the following points. Detailed information on the individual points can be found in the chapter 16 Troubleshooting at the end of this manual.

➢ Make sure that the HCS01 drive controller is properly connected to the PR21.
➢ Make sure that both devices are switched on.
➢ Check the network settings on the HCS01 drive controller.
➢ Check that the software is properly installed on the PR21.

3.2.4 Software Installation

In this step the Smart Function Kit software is installed and configured.

NOTICE
Do not turn off the PR21 or the HCS01 during installation process. Faulty software installation. System cannot be used. ▶ Always run the software installation completely. ▶ Restart the installation process if it has been interrupted.

1. Click on the *Start* button to start with the installation process.
   A progress bar will show the progress of the installation process.
2. When the installation is finished, you can proceed to the next commissioning step by clicking the *Next* button.

If an error occurs during the software installation, please perform the following steps:

➢ Click the *Retry* button, if an error message is shown. Then the last (and faulty) installation step will be repeated.

If an error occurs even after repeating several times, please perform the following steps:

➢ If failures are present in the title bar (see chapter 4.1.2 Messages and Errors), acknowledge them in the title bar. In the case, that failures cannot be acknowledged or reoccur after short time, the root cause of the failure message is still present. This root cause must be solved first.
➢ Check if the system wiring is correct.
➢ Check if additional modules, like safety zone modules, are properly connected and configured.
➢ Click on the *Restart* button. Then the complete software installation will be restarted.

Detailed information on the individual points can be found in the chapter 15 Troubleshooting at the end of this manual.

3.2.5 Hardware Configuration

The Smart Function Kit automatically detects which hardware is used in the system. In this step of commissioning the recognized components and system parameters are listed.

NOTICE
Invalid system parameters! Using the system with invalid parameters can cause system damage. ▶ Validate the correctness of the system parameters.

1. Check the displayed components and the system parameters for correctness.
2. Click on the *Next* button to go to the next commissioning step.

If the displayed parameters do not match the ordered configuration, you can adjust them manually.
To do so, click on the *Extended parameters* button.
Further information on the topic of extended parameters can be found in the *System settings* chapter.

NOTICE
Changing the standard parameters can cause system damage.

3.2.6 Homing

In the last step of the commissioning you can perform a homing procedure. With homing the system zero point is set. Alternatively, you can finish the commissioning without homing. Then the homing can be performed later in the system settings dialogue.

➢ Click the button *Finish* to finish the commissioning without homing.

During homing procedure, the system moves to the motor side mechanical end stop. According to the position of the mechanical end stop, the system zero point and software limit switch are set.
The homing procedure can always be repeated in the system settings dialogue.

Setting the reference point may only be started in a load free state. If there is any load on the Smart Function Kit please use the jog-mode with the "relative" radio button checked.

WARNING

Risk due to moving parts!
Reversible injuries, including severe stab wounds.
- Never reach into moving parts.

Risk due to axis movements!
Damage to the product and the system.
- Ensure the cylinder can retract without collision.

1. Ensure the cylinder can retract without collision
2. If system errors are displayed in the title bar, acknowledge them.
   For details, refer to the chapter 15 Troubleshooting at the end of this manual.
3. Click the *Homing* button to start the homing procedure.

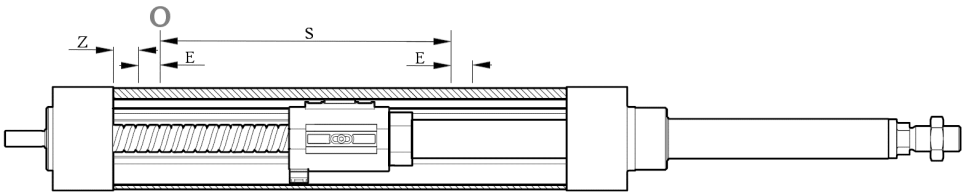


Figure 2: Position of software limit switch

Position of the software limit switch
- The mechanical end stop is at -3 mm of the system zero point (0).
- The upper / rear software limit switch is at -1 mm of the system zero point (0).
- The usable stroke S of the system is the dimension S_{MAX} of the ordered configuration.
- The lower / front software limit switch is at S +1 mm of the system zero point (0).

3.3 Recommissioning after standstill

If the system is restarted after it has been switched off, it is not necessary to recommission it. All relevant information is stored in the system so that a direct restart of the production process is guaranteed.

3.4 Commissioning of the safety technology

The commissioning of the safety technology requires the software tool IndraWorks DS. It can be downloaded on the website of Bosch Rexroth via the following link:
https://www.boschrexroth.com/de/de/produkte/produktgruppen/elektrische-antriebe-und-steuerungen/engineering/software-tools/indraworks-engineering

The commissioning of the safety technology takes place after the commissioning of the Smart Function Kit. The safety technology has to be deactivated in IndraWorks DS during the commissioning of the Smart Function Kit. Furthermore, the plugs X42 and X43 of the safety zone module must be unplugged. In order to be able to do the homing of the axis at the end of the Smart Function Kit commissioning, the intermediate

circuit voltage must be released at the HCS01 drive controller. This requires the activation of the Functional Commissioning in IndraWorks DS. Safe Motion must still remain deactivated.

During the commissioning of safety, it has to be ensured that the PLC program is stopped in IndraWorks DS. Detailed instructions regarding the commissioning of the safety technology can be found in chapter 9 of the manual “Integrated Safety Technology “Safe Motion” (MPx-18 and above)” (R911338920), which is available in the Media Directory on the Bosch Rexroth homepage.

After the commissioning of the safety technology the machine acceptance can be done. Please note that recordings for machine acceptance by the drive-internal oscilloscope cannot be made during the regular program run (e.g. start program in the user interface).
If you have any questions or problems with this process, please contact us directly. Corresponding contact information can be found in this documentation or in the help area in the user interface.

4 Operation

The Smart Function Kit provides a modern and intuitive UI for system operation. The UI is displayed by a web browser and consists of three main areas.

1. Title bar: Display of status information
2. Navigation bar: Navigation to the Smart Function Kit functions
3. Content area: Display of the actual Smart Function Kit function

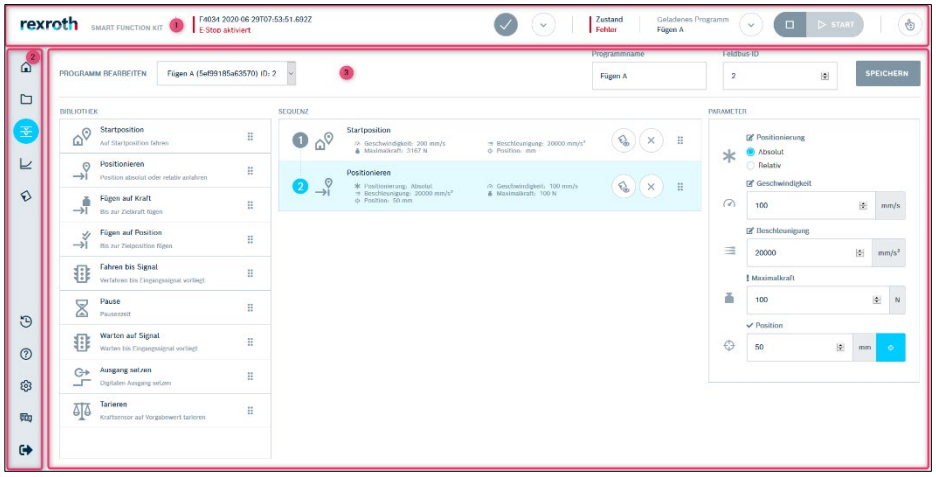


Figure 3: Smart Function Kit user interface

4.1 Title bar

The title bar shows the system status at a glance and offers the possibility to change the program at any time and to start and stop it manually.

Figure 4: Title bar

4.1.1 Icon and title

This section shows the Rexroth logo and the caption “Smart Function Kit”. Click on the caption to change to the full-screen mode. See also chapter 4.4.

4.1.2 Messages and Errors

System messages and errors are displayed centrally in the title bar. If several errors are present, the error with the highest priority is always displayed.

Error messages can be acknowledged (deleted) via the *Acknowledge* button. Only the last error is acknowledged. If there are several pending errors, the button must be pressed repeatedly.

The *Info* button can be used to switch to the diagnostics area in order to obtain further information on the errors.

4.1.3 System status

The system status indicates whether the system is ready for production. A distinction is made here between the following states:

- Ready: The system is ready for production
- Error: An error is pending. A production is not possible
- Parameter mode: The system is in parameter mode, e.g. to write system parameters. Switching between parameter and operating mode is performed automatically.
- Power is missing: Power is not activated.
- Reference is missing: System zero point is currently not set.

4.1.4 Program selection

The active program can be selected in the program selection. The selection control contains all programs that have been created and saved in the program management. The *Start* button can be used to start the selected program so that it runs once. The button can only be clicked when the system is not performing any other action.
The *Stop* button can be used to stop any system movement. A currently running program is aborted and the produced part is evaluated with NOK.

4.1.5 Control bar

The *Control bar* button can be used to show or hide the control bar for manual operation of the system. For more information on the control bar, see the *Control bar* chapter.

4.2 Navigation bar

You can use the navigation elements to switch to the individual areas of the system. For detailed information, please refer to the chapters of the individual functions.
The navigation bar contains the following navigation elements (from top to bottom).

Symbol	Function	Symbol	Function
	Dashboard		History
	Programs		Help
	Sequence		Settings
	Reference curve		Language
	Evaluation		Login

Figure 5 Symbols in the navigation bar

The navigation elements programs, sequence, reference curves and evaluation are only visible and accessible when logged in (as system administrator).

4.3 Content area

The content area displays the function that is currently selected in the navigation bar. In the content areas programming, reference curves and evaluation, an individual program is always processed.
The selection element in the content area determines which program is edited. With this selection element it is also possible to quickly switch between different programs without first calling the program overview site.

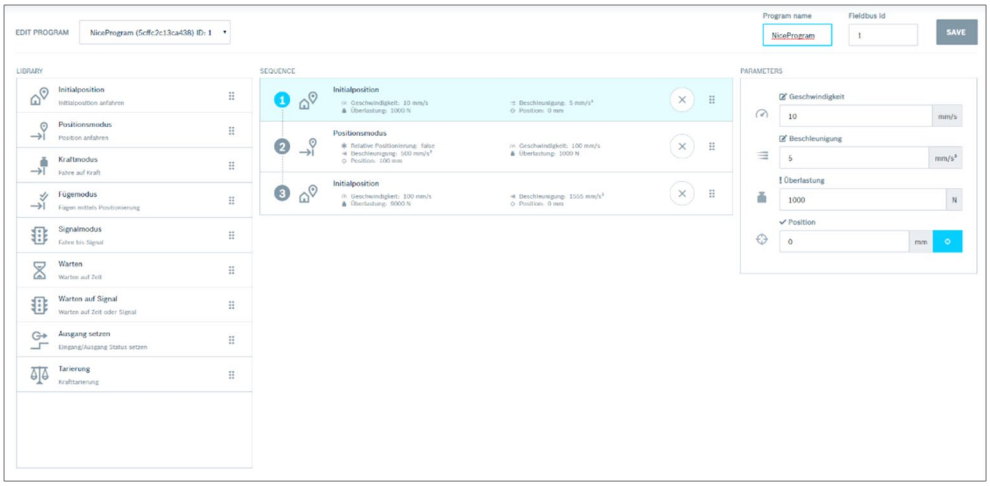


Figure 6: Content area - Sequence

4.4 Full screen mode

The HMI of the Smart Function Kit can be operated in full screen mode. The navigation elements of the browser are hidden and the entire screen area is used to display the HMI. Especially with small screens or mobile devices, the screen size can be used more efficient and navigation is easier.

To activate the full screen mode click on the Rexroth logo in the title bar. After that the full screen mode will be activated automatically. With a second click, the width of the navigation bar can also be adjusted. To deactivate it, follow the instructions of the respective web browser or the operating instructions of the device.

5 Settings

In the Settings area, various system settings can be made on the Smart Function Kit.
With the tabs the following setting areas can be switched:

- General configuration
- System configuration
- Hardware configuration
- I/O Configuration

5.1 General configuration

5.1.1 System status

The current system status is displayed in the *General Configuration* tab.
The system performs a self-diagnosis and checks if all components are properly connected and ready.

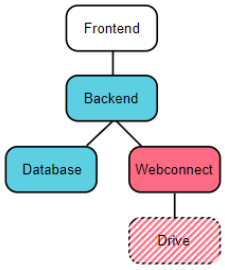


Figure 7: System check

The status is displayed as follows:

- Blue: Component ready
- Red: Component not ready or connection error

The system can only be used when all components are ready.

If an error is detected, please check the following points. Detailed information on the individual points can be found in the chapter 15 Troubleshooting at the end of this manual.

- Restart the system (system main switch).
- Ensure that the HCS01 motor controller is properly connected to the PR21.
- Make sure that both devices are switched on.
- Check the network settings on the HCS01 motor controller.
- Restart the system.
- Check that the software is properly installed on the PR21.

5.1.2 Homing

With the *Homing* button, the homing procedure can be started.
During homing procedure, the system moves to the motor side mechanical end stop. According to the position of the mechanical end stop, the system zero point and software limit switch are set.

⚠ WARNING

Risk due to moving parts!
Reversible injuries, including severe stab wounds.
- ▶ Never reach into moving parts.

Risk due to axis movements!
Damage to the product and the system.
- ▶ Ensure the cylinder can retract without collision.

1. Ensure the cylinder can retract without collision
2. If system errors are displayed in the title bar, acknowledge them.
   For details, refer to Troubleshooting at the end of this manual.
3. Click the Homing button to start the homing procedure.

Position of the software limit switch

- The mechanical end stop is at -3 mm of the system zero point (0).

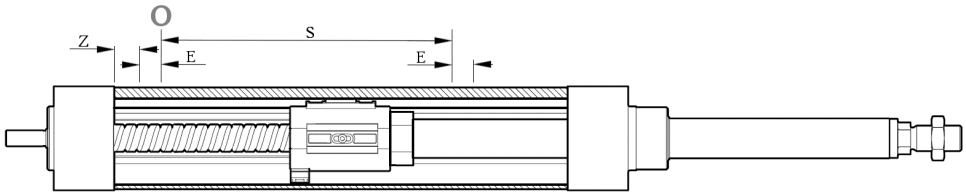


Figure 8: Position of software limit switch

- The upper / rear software limit switch is at -1 mm of the system zero point (0).
- The usable stroke S of the system is the dimension S_{MAX} of the order configuration.
- The lower / front software limit switch is at S +1 mm of the system zero point (0).

5.1.3 Set absolute reference

The *Set Absolute Reference* button is used to set the system zero point at the current position of the cylinder.

NOTICE

If using the Set Absolute Reference function, the system limits and the software limit switches are not automatically adapted to the new system zero point.
Faulty software limit switches can cause damage to the system.
- ▶ Use the Set Absolute Reference function only if absolutely necessary.
- ▶ Adjust the parameter Y-1044 Maximum travel positive in the extended parameters according to the new zero point.

5.1.4 Restart

The *Restart* button restarts the entire system. During the process, a message is displayed in the user interface.

The restart can take up to 90 seconds. Do not close the browser window during this time. The user interface is automatically displayed again after the restart and the Smart Function Kit can be operated as usual.

5.1.5 Commissioning

If a recommissioning is necessary, the *Commissioning Wizard* can be started with the *Commissioning* button.
All production data and programs are retained when the system is recommissioned. All system settings are reset to default values.

NOTICE
All system settings are lost during recommissioning. Functionality of the system may be limited. ▶ Save all settings before recommissioning.

5.1.6 Factory defaults

The system can be reset to factory settings using the *Factory defaults* button. All settings and data will be lost.
Before factory reset it is recommended to perform a data backup.

NOTICE
All data and settings are lost in the factory defaults function! Loss of production data. ▶ Perform a data backup before resetting.

5.2 System configuration

5.2.1 Change password

The Smart Function Kit has two user accounts. An administrator account and an operator account.
The administrator account is password protected and is used for system configuration, program creation, quality evaluation definition and data export.
The operator account has no password and corresponds to the logged out state. It is used in actual operation and offers only limited access to the system.

You can change the password for the administrator account in the system configuration.
1. To do this, enter a new password in the field.
2. Confirm the new password in the field below.
3. Then save the new password by clicking the *Save* button.

Changing the password overwrites the default password. From then on, a login is only possible with the new password.

If no new password is assigned, the default password "admin" remains active and can be used to login to the administrator account.

NOTICE
The default password does not comply with usual security standards and does not provide sufficient protection for the system! Unauthorized access to the system and data. ▶ Change the standard password. ▶ Use a secure password.

NOTICE
The administrator password cannot be reset! If the password is lost, access to the system is only possible after reinstallation. Loss of system configuration and data ▶ Make a note of the new password and keep it in a safe place.

5.2.2 Network settings

In order to integrate the Smart Function Kit into a specific local network, the IP address and the subnet mask can be adapted.

1. Enter a valid IP address and subnet mask in the input mask.
2. Accept the settings by clicking on the *Save* button.

- The address range 192.168.1.X cannot be used for the Smart Function Kit.
- Make sure that the HMI device is in the same subnet, otherwise there will be no communication with the Smart Function Kit.

The following network settings are preset for the system

- IP address: 192.168.0.1
- Subnet mask: 255.255.255.0
- Gateway address: 0.0.0.0

The motor controller (X26) is directly connected to the PR21 (XF5). This connection represents a separate network, which is not visible to the outside. The network settings for this network cannot be adjusted for security reasons.

NOTICE
Loss of connection between motor controller and PR21. The Smart Function Kit cannot be used. ▶ Do not change the IP address of the motor controller (X26) manually.

The motor controller (X26) has a fixed IP address of 192.168.1.1

5.2.3 System memory

This section shows the available system storage memory of the PR21. If the memory is full, no new production data can be stored.
Initially about 25 gigabytes of memory are available for production data. The amount of data for a production data record depends strongly on the program and recording length and is usually between 10 and 100 kilobytes.

- ➢ If necessary, save the production data in the *History* section.
- ➢ Delete no longer required production data in the *History* section to free up memory.

NOTICE
PR21 system memory is full! No new production data can be saved. Data loss. ▶ Backup production data and free up memory.

5.2.4 Synchronize system time

The system time is automatically synchronized during commissioning. The *SYNC* button can be used to repeat the process at any time. The system time of the HMI device is read out and used as the system time in the Smart Function Kit. All future production data will be timestamped with the new system time.

- ➢ Click the *SYNC* button to synchronize the system time.

NOTICE
Later change of system time. Inconsistent time stamps in the production data. The time stamp is not adjusted for data records that have already been saved.

5.2.5 Component information

In the Component information area, the version and identification of the used software and hardware is displayed.

- Smart Function Kit Software Version
- Interpreter Version (SMC)
- Motor Controller Firmware Version
- Motor Controller Hardware Version

5.2.6 System Backup

The Smart Function Kit can save the entire system data as a backup. All Programs, reference curves, evaluation elements, production data, configurations and device profile parameters are saved.

- ➢ Click the *Backup* button to perform a system backup.
- ➢ Then select a location on the HMI device for the backup.

It is possible to load a backup and restore the system as a whole after e.g. a reset to factory defaults. Furthermore, the settings can be transferred from one system to another identical system.

➢ Click the *Restore* button to restore a backup.
➢ Then select the location of the backup on the HMI device.

NOTICE
After restoring a backup, recommissioning must be performed to ensure all settings are valid for a safe operation.

⚠ WARNING
Data are being streamed between Client and System ▶ At the export procedure (System → Client), the data are continuously streamed. Therefore, an unstable network connection can cause delays or aborts of this stream.

5.2.7 Fieldbus selection

The Smart Function Kit can be operated as a subsystem on a fieldbus master. The following fieldbuses are available for the Smart Function Kit

- Sercos III
- EtherCAT (SoE)
- Profinet
- Ethernet/IP

The fieldbus protocol can be selected with the selection list. To save the fieldbus selection the drive must be restarted.

If the EtherCAT protocol is selected, the cycle time of the system (4000 µs) is shown. To avoid inconsistencies, this time should be set in the master PLC. To override previous configurations, save the fieldbus settings while the bus status is not in “OP”.

For detailed information to the fieldbus topic, refer to chapter 13.1 Fieldbus.

5.3 Hardware configuration

The hardware configuration shows an overview of the hardware of the Smart Function Kit.
During commissioning, the hardware configuration is read out and all parameters and limit values are set automatically.

5.3.1 Extended parameters

In the extended parameters section, system parameters and limit values can be adjusted manually.

➢ To view the extended parameters, click the *Show extended parameter* button.

NOTICE

Invalid system parameters!
Using the system with wrong parameters can cause system damage.
▶ Change the standard parameters only if absolutely necessary.
▶ Validate the correctness of the system parameters.

Various components of the Smart Function Kit have got own configuration interfaces and can be adjusted with individual parameters. For detailed information about these parameters, refer to the respective documentation of the individual products.

S and P parameters: Configuration of the IndraDrive motor controller.
Y parameter: Configuration of the technology package SMC.
VFR variables: Configuration of the interpreter firmware.

List of system parameters:

ID	Name
S-0-0052	Position at system zero reference [mm]
S-0-0121	Gear reduction input rate
S-0-0122	Gear reduction output rate
S-0-0123	Ball screw lead [mm]
P-0-0001	Switching frequency of the power output stage
P-0-0279	Resolution of curve recording [ms]
P-0-0217	Analog input filter [ms]
P-0-1320	Activation of StrictMode
P-0-1321	Force limit for homing
Y0015	Activation of E-Stop functionality
Y1004	Maximum velocity
Y1006	Maximum acceleration
Y1007	Maximum force [%]
Y1011	Negation of position data
Y1044	Maximum stroke positive [mm]
Y1045	Maximum stroke negative [mm]
Y1049	Activation of analog force sensor
Y1050	Sensor characteristic (Pull) [N/V]
Y1053	Sensor characteristic (Push) [N/V]
Y1054	Sensor zero signal [V]
VFR002	"Join to force": Maximum overload [N]
VFR004	Force limit of positioning command [N]
MFR001	Endless mode
MFR002	Filter actual values
MFR003	SafeMotion
MFR004	SMO: Pause program
MFR005	Cyclic documentation of variable values
MFR006	Program persistent after reboot

S-0-0052 Position at system zero reference
In this parameter, the desired actual position value with respect to a specific axis position (reference position) is entered. The value entered in parameter S-0-0052 becomes effective as the actual position value at the reference position via the commands *Homing* or *Set absolute reference*.

S-0-0121 Gear reduction input rate
Gearbox input rate. Transmission ratio together with S-0-0122.

S-0-0122 Gear reduction output rate
Gearbox output rate. Transmission ratio together with S-0-0121.

S-0-0123 Ball screw lead
The ball screw lead is the distance the axis is moving when the gear output shaft or motor shaft makes one revolution.

P-0-0001 Switching frequency of the power output stage
The switching frequency of the power output stage can be set via the parameter.
A higher value reduces the noticeable noise of the motor controller but leads to a lower efficiency and controller performance. The parameter can only be assigned with the following values: 4000, 8000, 12000, 16000.

P-0-0279 Resolution of curve recording
In this parameter the time between two measuring points for force and displacement (curve points) is set. By default, every 4 ms values are recorded. The parameter can only be assigned with the following values: 2, 4, 8, 16, 32, ..., 2^n.

P-0-0217 Analog input filter
The signal of the force sensor can be captured with a digital low pass filter. This parameter is used to set the time constant of the filter in milliseconds. The parameter can be assigned with values from 0.25 ms to 60 ms.
A value of 0.25 ms deactivates filtering.

P-0-1321 Force limit for homing
Limits the force generated at the mechanical end stop during homing. If the specified force is reached, the end stop is detected and the reference point is set. The value is specified as a percentage of the nominal motor force.

Y0015 Activation of E-Stop functionality
The parameter can be used to configure whether the signal for E-Stop is to be evaluated at connection X31 Pin 3. The parameter can be set to TRUE or FALSE.
The signal for the E-Stop is processed as active low, i.e. as soon as the signal at X31 pin 3 is missing, error F4034 E-Stop activated is set.

Y1004 Maximum velocity
The Y-parameter Y1004 can be used to configure the maximum velocity of the system in m/s. When a program is created, the velocity input is validated to this value.

Y1006 Maximum acceleration

The maximum acceleration of the system in m/s^2 can be configured using the Y-parameter Y1006. When a program is created, the acceleration input is validated to this value.

Y1007 Maximum force

The maximum force of the system can be set using the Y-parameter Y1007. The value is given as a percentage of the nominal motor force.

Y1011 Negation of position data

The Y-parameter Y1011 can be used to set the operating direction of the actuator. This is necessary if the direction of rotation is reversed by a gearbox or a belt side drive. The parameter can be set to TRUE (negation enabled) or FALSE (negation disabled). For a system with belt side drive the parameter must be set to TRUE.

Y1044 Maximum stroke positive

Y parameter Y1044 is used to configure the position of the software limit switch in the positive direction in mm. By default, the parameter is assigned the value
S_{Max} + 1mm.
When a program is created, the position input values are validated
to ≤ (Y1044 - 1 mm).
This parameter can be used to limit the maximum stroke if the application makes this necessary, or if the *Set absolute reference* function is used to set a zero point for the system that deviates from the standard (mechanical end stop).

Y1045 Maximum stroke negative

Y parameter Y1045 is used to configure the position of the software limit switch in the negative direction in mm. By default, the parameter is assigned the value -1 mm. When a program is created, the position input values are validated to a
value ≥ (Y1045 + 1 mm).

Y1049 Activation of analogue force sensor

Parameter Y1049 indicates whether a force sensor is present. The parameter can be set to TRUE (sensor activated) or FALSE (sensor deactivated).
If the force sensor is deactivated, all force values in the system are calculated on base of the motor torque.

Y1050 Sensor characteristic (Pull)

This parameter is used to convert the analog force sensor value into a force in Newton. It is only considered if parameter Y1049 is set to TRUE. The sensor characteristic value is entered in N/V.

Y1053 Sensor characteristic (Push)

This parameter is used to convert the analog force sensor value into a force in Newton. It is only considered if parameter Y1049 is set to TRUE. The sensor characteristic value is entered in N/V.

Y1054 Sensor zero signal
The parameter specifies the signal the force sensor has at a force of 0 N.
This parameter is used to convert the analog force sensor value into a force in Newton.
It is only considered if parameter Y1049 is set to TRUE.
The zero signal is entered in V.

VFR002 "Join to force": Maximum overload
This parameter can be used to set the tolerance when approaching a target force (tool protection). The value describes the tolerable positive deviation of force, before a failure is reported (typ. 041004, see chapter 15.5.2).
The parameter is specified in Newton.

VFR004 Force limit of positioning command
This parameter can be used to set the force limit of the positioning command. If this limit is reached, the movement stops and error 040304 is displayed (see chapter 15.5.2). If this limit is exceeded on triggering the command, the command will not be executed and error 030304 is displayed.
On default, this function is deactivated by the value 0. To move again after force limitation, either retract (move towards the negative direction) or set the value to a higher force or deactivate the function by typing in 0. The limitation affects positioning via fieldbus and the control bar.

MFR001 Endless mode
In endless mode, a program is repeated infinitely and processed as an endless loop. When the last program block is finished, the system automatically jumps to the beginning of the sequence and repeats the cycle. If this parameter is set to the value 1, the mode is activated. With 0 it is deactivated. To end endless processing, this can be done, for example, by using the Stop button in the user interface.

NOTICE

No data recording active.
No data is recorded and stored in endless mode. Only the current values are displayed and updated in the dashboard. If an endless cycle is manually aborted, an entry is made in the database but without the corresponding curve data.

MFR002 Filter actual values
This parameter allows to activate or deactivate the filtering of the current force, position and velocity. Is the filter activated (value 1, standard), the current values will be only updated when a program is running. A deactivation of the filter (value 0) will make the system to update these values on the dashboard and the activated fieldbus continuously.

MFR003 SafeMotion
This parameter allows to activate SafeMotion functionality of a S4 drive controller. The assignment of the safe input pairs must correspond exactly to the specification.

MFR004 SMO: Pause program
An activation of the system function “SafePause” (Configuration > Hardware > Extended configuration) leads to a change in the system behavior. In case of SMST the running program will not be aborted but paused and will continue automatically if SMST conditions are not met anymore. The subsequent evaluation is carried out as usual, using the evaluation elements.

MFR005 Cyclic documentation of variable values
This parameter controls the de-/activation of the cyclic documentation of variable values at the program start. The variable values are recorded during the program run. By default, the parameter is set to 1 (active). The values of used variables will be saved for each curve within press history.
There will be no documentation of the variable values if you set this parameter to 0 (not active).

MFR006 Program persistent after reboot
The last activated program will be loaded on startup of the system, or by leaving the parameter mode. This behavior can be deactivated to avoid possible complications with e. g. a master control, which also performs a program change. There is no program active at bootup after setting this parameter to 0.

5.4 I/O Configuration

The Smart Function Kit has different kinds of in- and outputs. These are split up into digital and virtual interfaces. The digital interface has 7 digital inputs and 1 digital output. These are located on the motor controller at connection X31.
The inputs and outputs can be freely assigned to system or program functions. For the inputs, it can be set whether a rising or falling edge is to be reacted to. The output can be used as system status or program function.
The virtual I/Os are linked via a fieldbus parameter to a master control. These can be freely assigned to program bits, which can be used within the program sequence.

NOTICE

Inconsistency to existing programs after changing I/O settings.
System malfunction.
- The settings for the inputs and outputs are valid globally. If the settings are changed, programs that use an older configuration must be manually adapted to the new assignment.

5.4.1 System functions (digital only)

To be able to use a system function, select the *SYS* function with the selection button for the corresponding input or output. This turns the text field into a selection list and you can choose from the following functions.

Inputs (**I**X31...):
- Start current program (start)
- Cancel current program/command (cancel)
- Jog negative (jogNegative)
- Jog positive (jogPositive)
- Start homing(referenceAxis)
- Set absolute reference (setReference)
- Tare force sensor (tare)
- Clear error (clearError)

Output (**Q**X31...):
- Program is running (programRunning)
- PM active (parameterMode)
- Power available (powerOn)
- Reference set (referenceSet)
- Evaluation active (validating)
- Evaluation result (validated, High = OK / Low = NOK)

A function cannot be assigned to two or more inputs at the same time.
All changes must be manually saved with the *Save* button.

5.4.2 Program functions

To define an input or output for a program function, use the selection button to select the *PRG* function (preset at virtual I/Os). Then you can enter an alias name for the input or output in the adjacent text field. This alias name can then be used in the program sequence.
All changes must be manually saved with the *Save* button.

5.5 Variables Configuration

Variables must be configured before they can be used within programs (configuration > variable configuration). The variables range starts at VF500 and a maximum of 100 variables can be used. Changes in the configuration have to be saved using the SAVE button at the top right (see Figure 9).

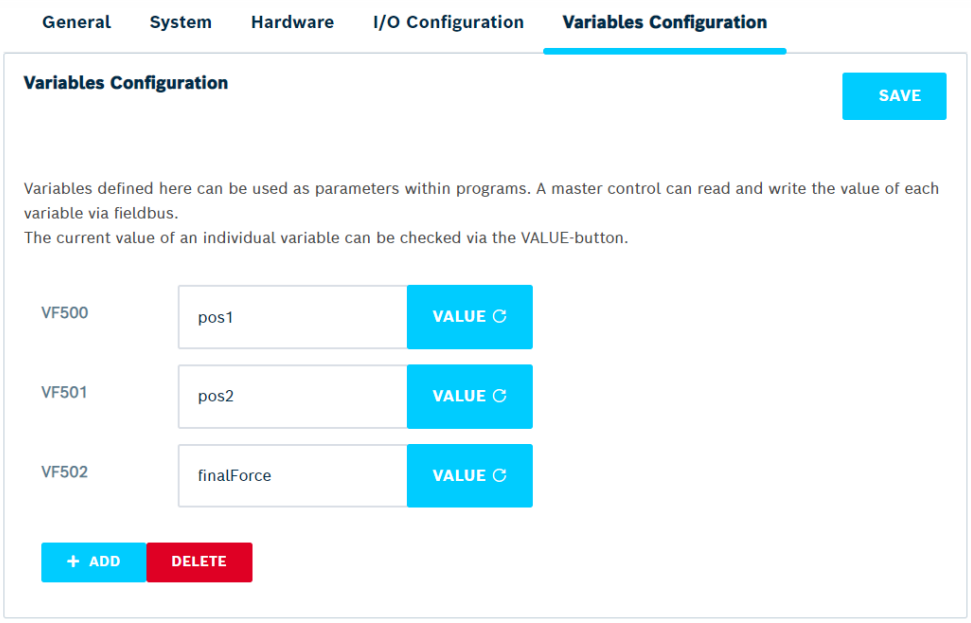


Figure 9: Variable configuration

An alias name can be assigned to every variable, which can then be selected as a parameter within program steps. (e. g. “pos1”, Figure 10).
The current value of a variable can be displayed and checked by using the VALUE ↻ button.

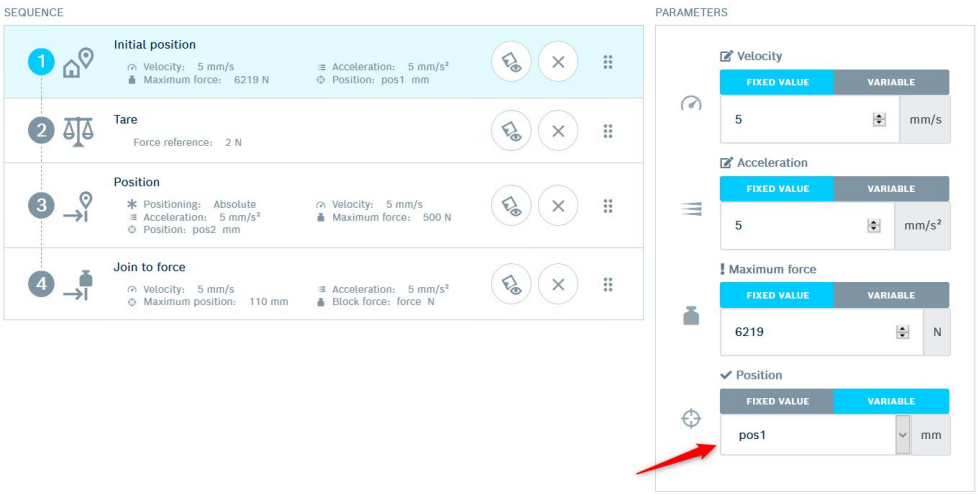


Figure 10: Use variable within sequence

NOTICE

Inconsistency to existing programs after changing variable settings.
System malfunction.
- The settings for variables are valid globally. If the settings are changed, programs that use an older configuration must be manually adapted to the new assignment.

The press history will show the variables used in a program and the variable values at the program start – see Figure 11. The variable values are recorded in parallel to the program run.
This feature is activated by default and can be de-/activated via parameter MFR005 in the extended configuration. Deactivating it might lower the cycle time.

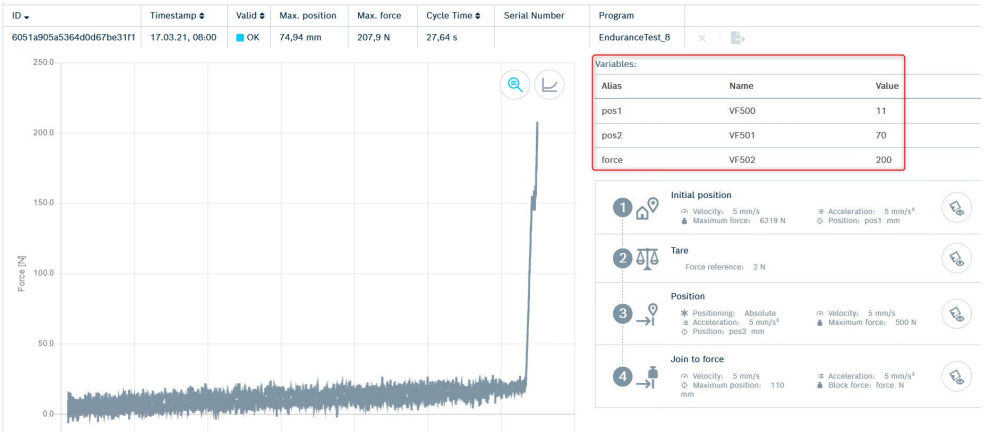


Figure 11 Press history with documentation of variables and variable values: Variable values within press history

NOTICE

Variable values inconsistent with the intended use in the program.
Program abort.
- Variable values are checked for plausibility during program run. In case of inconsistent values, the program will be aborted. The error message “SPS error” appears.

- Ensure to set variable values used for positions only within the allowed travel range.
- Ensure to set variable values used for velocities positive and smaller or equal the maximum allowed velocity.
- Ensure to set variable values used for accelerations positive and smaller or equal the maximum allowed acceleration.
- Ensure to set variable values used for times greater or equal 0.

Variables can be accessed via fieldbus, OPC-UA and the SFK-web interface (see 9.2.10 Set variable).

A program change will not affect variable values– they remain and are *not* set to 0.

Please note, that VF-variables are non-remaining variables. Thus, after restarting the SFK their value will be 0.

6 Dashboard

The dashboard provides an overview of the system and production status.
Distributed over four tiles, it provides information on production statistics, quality evaluation of the last parts produced, current program progress and current machine values.
The dashboard is displayed automatically after system startup and can alternatively be opened at any time with the *Dashboard* button in the navigation bar.
All information shown always refers to the program selected in the status bar. As soon as the program is switched in the status bar, the content of the dashboard is updated.

6.1 Tile Production statistics

The production statistics tile shows how many parts already have been produced with the currently selected program. It also shows how many of these parts have been OK or NOK.
The effectiveness graphically indicates the percentage of OK and NOK parts, providing a quick overview of production quality.
The values of the production statistics are recorded individually for each program and are not reset, even if the program is changed.

A part is a produced part as soon as the production process is started in the title bar or by an external command. The recording of reference curves does not count as a produced part.

6.1.1 Detailed shift information

Production statistics can also be separated into shifts. This feature enables a more detailed analysis (Figure 8).

Please use the clock icon (1) to activate this feature. A reset for the statistic can be done with the icon (2).
“Since 10/22/2019 11:48” shows the timestamp of the last reset.

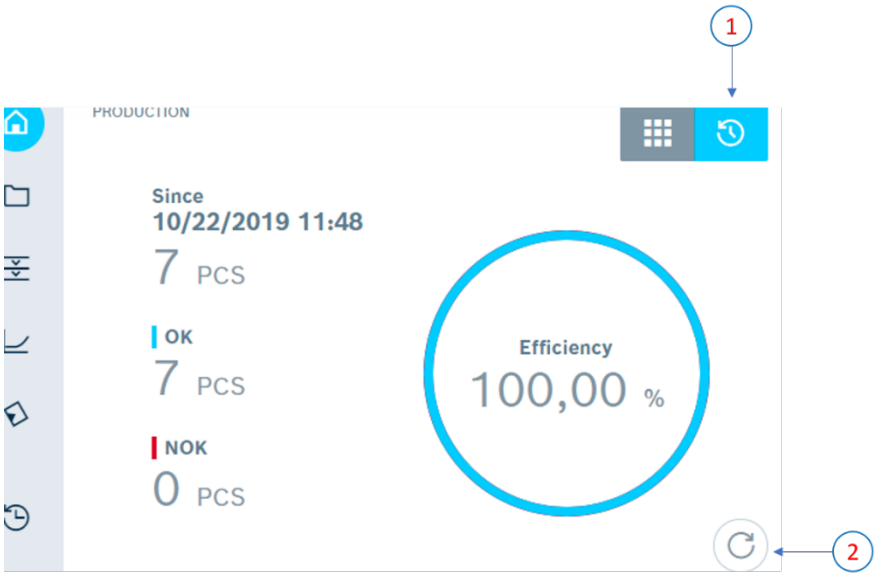


Figure 12: Shift statistics

6.2 Tile Production process

The tile production process graphically displays the quality evaluation of the last 20 parts produced with the currently selected program.
With the button ... you can switch to the production history area and view all production data of the current program.
If the evaluation of a part is selected directly, the view also changes, but immediately displays detailed information for exactly this produced part.

6.3 Tile Program progress

6.3.1 Program steps

By default, the program progress tile displays the steps of the currently selected program. With that view the loaded program can be checked.
If a part is currently being produced, therefore a program is running, the currently active step is highlighted. If an error occurs during processing and the system has to stop, it can be seen in which step a deviation occurred.

6.3.2 Live Preview

Using the buttons in the top right corner of the tile, the view can be switched to a live preview of the force-displacement curve.
If a program is currently running, the display shows the recording of the force-displacement curve, the position of the evaluation elements and the quality evaluation for this part. Since the data for this display is not processed in real time, the display may differ slightly from the exact actual values.
If no program is running, the last recorded curve including quality evaluation is shown. The display can be moved, enlarged or reduced. The view offers the possibility to perform a first analysis of the force-displacement curve and quality evaluation.

6.4 Process data tile

The Process data tile displays current values for position, force, velocity and acceleration. If a program is running, the values are updated live. The force is not displayed in real time and the values are filtered for better representability. Therefore, there may be slight deviations between the displayed force value and the real force value.
Below the current actual values, the maximum values reached are displayed. This gives the option for a fast control of the maximum force or position that occurs during production. If a program is currently running, the maximum values are adjusted live accordingly. If no program is running, the maximum values of the last produced part of this program are displayed.

7 Control bar

The control bar of the Smart Function Kit can be faded in and out using the index finger button in the upper right corner. It can be used for manual positioning of the system and for showing the actual values for position, force and velocity. It also offers the possibility of taring the force sensor.

7.1 Tare force sensor

The control bar offers the possibility to tare the force sensor. The sensor can be tare to any value. This makes it possible, for example, to compensate for the weight of a tool.

To tare, enter the value in the input field and press the Tare button. When taring, the current sensor value is equated with the taring value and this then serves as the reference point for all future sensor values. The value is stored and remains stored until you tare again.

Taring applies globally to all force values and therefore also, for example, to force values in program steps, curve recording and quality evaluation.

7.2 Manual positioning

The control bar offers three modes for manual positioning

- Continuous
- Absolute
- Relative

These can be selected via the button. Depending on the selection, the display of the control bar and the behavior of the system changes.

For all modes, the velocity can be set via a control element.

7.2.1 Continuous

In continuous mode, the Smart Function Kit moves continuously if the corresponding arrow button (up/down) is pressed.

To ensure that the system is stop in the event of a communication interruption, cyclic status monitoring is performed. If this is interrupted, the system is stopped for safety reasons and a new motion command must be started via the arrow button.

The sensitivity selection element can be used to set how sensitive the system reacts to a communication interruption.

- High: A communication interruption immediately causes a system stop.
- Low: The system is only stopped after a longer interruption.

NOTICE
High movement delay of the system with low sensitivity setting! System damage. ▶ Use the low sensitivity setting only at low velocity.

7.2.2 Absolute

In Absolute mode, a defined target position is approached absolutely. The Smart Function Kit detects whether the specified target position is in the positive or negative direction and only displays the corresponding arrow button as selectable.
The system checks the entered target position and automatically disables the buttons if that lies outside the system limits.

7.2.3 Relative

In the Relative mode, each click on the arrow button moves a defined step size. In the input field the step size can be defined.

7.3 Display of the current values

In the lower area of the control bar, current values for position, force and velocity are displayed. The force is not displayed in real time and the values are filtered for better representability. There may therefore be slight deviations between the displayed force value and the real force value.

8 Programs

In programs area, all programs available on the system can be managed. On the left side, the program list with the program name and the program fieldbus ID is displayed. A preview of the program selected in the list is displayed on the right-hand side. The preview contains the sequence and the parameters of the individual program steps.

8.1 Create new program

The *New* button can be used to create a new program. The view automatically switches to the Sequence area. The program name is automatically assigned with New Program and the program Fieldbus ID is automatically assigned with the next free Fieldbus ID. Both values can be adjusted manually in the Sequence area.

8.2 Edit program

Via the *Edit* button, you can switch to the Sequence area for an existing program and make changes to the program. The program sequence with all parameters as well as the program name and the program fieldbus ID can be adapted

8.3 Delete program

The *Delete* button can be used to delete a program and thus permanently remove it from the program list. The program as well as entries in the history and the corresponding production data are retained in the database. Deleting a program from the program list therefore does not lead to the loss of production data.

8.4 Copy program

The *Copy* button makes it possible to duplicate a program including reference curves and evaluation elements. The duplicate can then be modified, for example, without affecting the original program. A copied program automatically receives a new program name and a new program fieldbus ID. Both values can be adjusted manually in the Sequence area. When copying, the system automatically switches to Sequence area. The program must be saved once in order to finish the copying process.

8.5 Export program

With the *Export* button the currently marked program can be exported to the local storage of the HMI device. The export is in the JSON file format and contains the program, the reference curves and the definition of the evaluation elements. The export can be used as a data backup or to transfer a program to another system.

8.6 Import program

The *Import* button allows you to import a previously exported program, of this or another system.
If the button is clicked, a file selection dialog opens and the program to be imported can be selected on the local storage of the HMI device.
During import, the system automatically switches to the Sequence area. The program must be saved there once in order to finish the import. When saving the imported program, it is checked whether the program is compatible with this system and all limit values are valid. If individual settings do not fit, they can be adjusted manually.

9 Programming

Programming is done by arranging blocks graphically in a program sequence. The individual arrangement and parameterization of the blocks results in the desired program sequence.

9.1 Building block properties

The Smart Function Kit records the corresponding force-displacement curve for a program sequence. It is possible to set individually for each building block whether it is included in the evaluation or not. And in case a block is excluded from the evaluation, it can also be specified whether it is displayed in the force- displacement curve.
The properties can be activated or deactivated via a dropdown menu in the program block.

- Evaluated → Curve section is displayed and evaluated
- Visible but not evaluated → Curve section is displayed but not evaluated.
- Hidden → Curve section is not displayed and not evaluated

NOTICE
If a module is configured in such a way that it is included in the process evaluation, it is always displayed. Only modules that are excluded from the evaluation can be hidden.

In the display, components or their force-displacement curves that are not taken into account in the evaluation but should nevertheless be displayed are drawn with reduced opacity in order to achieve an optical delimitation.

9.2 Library

The system provides a library with predefined building blocks on the left-hand side. The required blocks can be inserted into the sequence by drag and drop or by clicking on them.
Every predefined building block fulfills a specific task in a joining sequence.

9.2.1 Initial position

The Initial position command is used to move the system to a defined start position. This position describes the starting point of the joining sequence. When the position is reached, the system switches to the next block in the program sequence.
The velocity and acceleration with which the system moves can be specified individually. However, there is no check whether the velocity can be reached with the specified acceleration.
In addition, a maximum force can be specified. If no force is specified, the maximum force of the system is automatically used.
While approaching the target position, the current force is monitored at the force sensor. If the actual force exceeds the specified maximum value, the system is stopped immediately to prevent damage to the system or tool. The overload causes the program sequence to be aborted and the currently produced part is evaluated as NOK.

9.2.2 Position

The Position command is used to move to a defined position. The position can be approached absolutely or relatively. With absolute positioning, the target position is approached directly. With relative positioning, the specified distance is moved starting from the current position. When the position is reached, the system switches to the next block in the program sequence.
The velocity and acceleration with which the system moves can be specified individually. However, there is no check whether the velocity can be reached with the specified acceleration.
In addition, a maximum force can be specified. If no force is specified, the maximum force of the system is automatically used.
While approaching the target position, the current force is monitored at the force sensor. If the actual force exceeds the specified maximum value, the system is stopped immediately to prevent damage to the system or tool. The overload causes the program sequence to be aborted and the currently produced part is evaluated as NOK.

9.2.3 Join to force

The Join to force command moves the system until a defined target force is reached at the force sensor. Then the system switches to the next block in the program sequence.
The velocity and acceleration with which the system moves can be specified individually. However, there is no check whether the velocity can be reached with the specified acceleration.
In addition, a maximum position can be specified. If no position is specified, the maximum position of the system is automatically used.
While the target force is approached, the current position is monitored. If the current position exceeds the specified maximum position, the system is stopped immediately to prevent damage to the system or the tool. This causes the program sequence to be aborted and the currently produced part is evaluated as NOK.

NOTICE

Too high joining velocities can lead to an exceeding of the target force due to the high kinetic energy.
Exceeding the target force. “Error 041004 - Program error: Max force exceeded" is displayed, see chapter 15.5.2. Possible damage to the workpiece.
- ▶ Reduce the velocity.

9.2.4 Join to position

The command Join to position is used to join a product with a specific target position. The position can be approached absolutely or relatively. With absolute positioning, the target position is approached directly. With relative positioning, the specified distance is moved starting from the current position. When the position is reached, the system switches to the next block in the program sequence.

The velocity and acceleration with which the system moves can be specified individually. However, there is no check whether the velocity can be reached with the specified acceleration.
In addition, a maximum force can be specified. If no force is specified, the maximum force of the system is automatically used.
While approaching the target position, the current force is monitored at the force sensor. If the actual force exceeds the specified maximum value, the system is stopped immediately to prevent damage to the system or tool. The overload causes the program sequence to be aborted and the currently produced part is evaluated as NOK.

9.2.5 Check force/position target window

The Check force/position target window command checks the current values of force and position against predefined target values.
The current values are determined at the same time when entering the command, also considering the system tolerance. If the current values are within the target values, the program sequence continues with the next block. If there is a breach of at least one value, the program sequence is aborted with a message (numbers 041010 – 041024, see Chapter 16.5.2). Before that, an optional position command can be executed.
This can be defined using a selection field. If activated, the target position is approached directly (input of the absolute position). The velocity and acceleration with which the system moves can be specified individually. However, there is no check whether the velocity can be reached with the specified acceleration.

9.2.6 Move to signal

The Move to signal command moves the system until a specific digital or virtual input provides a high signal. Then the system switches to the next block in the program sequence.
This command makes it possible to integrate an external sensor and, for example, probing the surface of a work piece. Additionally, the program step can be triggered by the master control via virtual I/Os.
The velocity and acceleration with which the system moves can be specified individually. However, there is no check whether the velocity can be reached with the specified acceleration.
In addition, a maximum position can be specified. If no position is specified, the maximum position of the system is automatically used.
While the target force is approached, the current position is monitored. If the current position exceeds the specified maximum position, the system is stopped immediately to prevent damage to the system or the tool. This causes the program sequence to be aborted and the currently produced part is evaluated as NOK.

9.2.7 Delay

The Delay command causes the system to wait for a defined time. Then the system switches to the next block in the program sequence.

9.2.8 Waiting for signal

The Wait for signal command waits until a defined digital or virtual input has a high signal. Then the system switches to the next block in the program sequence. The command allows the system to be synchronized with other machine parts, such as a clamping element.
A maximum time can be entered after which the program sequence is aborted. The currently produced part is then evaluated as NOK.

9.2.9 Set output

The Set output command sets a defined digital or virtual output to a high or low signal for a defined period of time. This command can be used to send a signal to another machine part, such as a conveyor belt.

9.2.10 Tare

The Tare command tares the force sensor. The sensor can be tare to any value. This makes it possible, for example, to compensate for the weight of a tool.
When taring, the current sensor value is set with the taring value and this then serves as the reference point for all future sensor values. The value is stored and remains stored until you tare again.
Taring applies globally to all force values and therefore also, for example, to force values in other programs, curve recording and quality evaluation.

9.2.11 Set variable

The Set variable command sets a defined variable to a defined fixed value or the value of another variable.

9.3 Transition groups

A transition group comprises at least two successive components of a sequence. The building blocks of this group are no longer considered individually, but as a unit. The movements of these building blocks are combined and automatically optimized for their cycle time. This process is indicated by the addition of "slur" on the relevant building blocks.

9.3.1 Effects

Building blocks of a transition group perform a continuous movement without standstill during the change of building blocks. Instead of the short-term standstill between the building blocks, there is a transition zone. In this, a transition from the previously applied speed to the speed of the subsequent building block takes place.
This is accompanied by a reduced cycle time.

9.3.2 Requirements

During sequence editing, the building blocks used and their parameter values are continuously evaluated. Several conditions must be met to apply slurring.

The following two building blocks can initiate slurring. They are marked in the sequence with "Slur (Start)":

- Position
- Join to position

The following two building blocks can follow as intermediate steps as often as desired. The target positions must lie between the start and end positions of the transition group and must always be consecutive. They are marked with “Slur (Intermediate)":

- Position
- Join to position

The transition group must end with one of the following blocks. They are marked with "Slur (End)":

- Position
- Join to position
- Join to force
- Move to signal

In addition, the absolute position must be known for the first building block of the transition group.

Position values have to be assigned either by fixed values or variables.

9.3.3 Use of variables

If the position values are specified by variables, it is not checked whether the position values are consecutive. The relevant building blocks are automatically combined to form a transition group.
If this behavior is not desired, the transition group must be interrupted in accordance with the following chapter.

9.3.4 Interrupting a transition group

A transition group typically leads to an improvement of the cycle time. However, in some applications a short-term standstill of the axis is desired. In these cases, the group can be broken up by the following means:

- Use the building block "Initial position" instead of "Position" or “Join to position”. This building block is never part of a transition group.
- Add one of the following building blocks to the position you want to interrupt:
    - Delay (0ms delay time)
    - Tare
    - Set output

10 Reference curves

In the Reference curves area, one or more reference curves can be recorded for a program. A reference curve is a force-displacement curve that is recorded specifically when the joining process is set up. The recording is usually done with sample parts.
The creation of reference curves is an optional step and not necessary for the pure program flow.
In order to define evaluation elements and set up automatic quality evaluation, however, at least one reference curve is required.

10.1 Recording

A reference curve can only be recorded if no other program is currently running on the system. The recording itself is started via the *Record curve* button. The program then runs once and the force-displacement curve is displayed live in the diagram.
If several curves are recorded, all these curves appear in the diagram as a set of curves.
The recording of reference curves is not counted as production. The production data in the database and the production statistics are not affected by this.

NOTICE
If program sequences or evaluation properties of single functions blocks are changed after reference curves have already been generated, their course must be checked manually and, if necessary, re-recorded. This prevents misinterpretations when setting evaluation elements. Existing reference curves are not automatically deleted when changes are made to the program!

10.2 Rating

If the recording of a curve is completed, an entry for the curve appears in the table view. The curve is initially marked as a good curve. The selection element can be used to switch the rating for the curve between unrated, good and bad. In the diagram, curves rated as good are displayed in green and curves rated as bad in red.
Curves with the selection unrated are hidden in the diagram and are not considered any further. The rating can be changed at any time and the curve can be redisplayed again.

10.3 Deleting

The Delete button can be used to delete a reference curve from the table. If a reference curve is deleted, it is removed from the database and cannot be restored.

10.4 Renaming

The reference curves are given an automatically generated name. The name can be changed by clicking on it in the table and entering a new name.
The renaming to individual names can help to assign the reference curves to individual sample parts.

10.5 Reference options

The Smart Function Kit supports dynamic displacement of evaluation elements to enable robust quality evaluation even with varying product tolerances. In the Reference options section, you can set how and in which direction the displacement should take place.

10.5.1 Position Absolute

The *Position Absolute* setting is the default setting. For *Position Absolute*, the X- coordinates of all evaluation elements are fixed. The position of the evaluation elements in the X-axis direction is a fixed distance from the coordinate system origin. The distance is set when the rating element is created.

10.5.2 Force Absolute

The *Force Absolute* setting is the default setting. For *Force Absolute*, the Y-coordinates of all evaluation elements are fixed. The position of the evaluation elements in the direction of the Y axis is a fixed distance from the coordinate system origin. The distance is set when the rating element is created.

10.5.3 Position Maximum

When setting *Position Maximum*, all evaluation elements are moved dynamically along the X-axis. The position of the evaluation elements along the X-axis results as a fixed distance to a trigger point. The distance to the trigger point is set when creating the evaluation element.
The position of the trigger point is individual for each part produced. The trigger point is at the point where the maximum position value is present. This position value is displayed in the Trigger input field.

Activating the *Position Maximum* setting causes:

1. The maximum position of **all** reference curves marked as **good** reference (see section 10.2 Rating) is determined.
2. This determined maximum position is set as the trigger position.
3. The determined trigger position is marked on the X-axis and displayed with a vertical dashed line in the plot.
4. All following curves are moved along the X-axis so that the end position ends at the determined trigger position. This shift is done graphically – the shift offset is saved with the data record.

10.5.4 Force Maximum

When setting *Force Maximum*, all evaluation elements are moved dynamically along the Y-axis. The position of the evaluation elements along the Y-axis results as a fixed distance to a trigger point. The distance to the trigger point is set when creating the evaluation element.
The position of the trigger point is individual for each part produced. The trigger point is at the point where the maximum force value is present. This force value is displayed in the Trigger input field.

Activating the *Force Maximum* setting causes:

1. The maximum force of **all** reference curves marked as **good** reference (see section 10.2 Rating) is determined.
2. This determined maximum force is set as the trigger force.
3. The determined trigger force is marked on the Y-axis and displayed with a horizontal dashed line in the plot.
4. All following curves are moved along the Y-axis so that the end force ends at the determined trigger force. This shift is done graphically – the shift offset is saved with the data record.

10.5.5 Position Cross

When setting *Position Cross*, all evaluation elements are moved dynamically along the Y-axis. The position of the evaluation elements along the Y-axis results as a fixed distance to a trigger point. The distance to the trigger point is set when creating the evaluation element.
The position of the trigger point is individual for each part produced. The trigger point is at the point where a defined position value has been reached for the first time. This position value can be specified in the Trigger input field.

Activating the *Position Cross* setting causes:

1. The **first** reference curve marked as "good reference" (see section 10.2 Rating) is determined and chosen for the following steps.
2. The selected trigger position is marked on the X-axis and displayed with a vertical dashed line in the plot. The force present at that position is referred to as the "reference force".
3. All following curves are moved along the Y-axis so that the force at the trigger position corresponds to the reference force. This shift is done graphically – the shift offset is stored with the data record.

10.5.6 Force Cross

When setting *Force Cross*, all evaluation elements are moved dynamically along the X-axis. The position of the evaluation elements along the X-axis results as a fixed distance to a trigger point. The distance to the trigger point is set when creating the evaluation element.
The position of the trigger point is individual for each part produced. The trigger point is at the point where a defined force value has been reached for the first time. This force value can be specified in the Trigger input field.

Activating the *Force Cross* setting causes:

1. The **first** reference curve marked as "good reference" (see section 10.2 Rating) is determined and chosen for the following steps.
2. The selected trigger force is marked on the Y-axis and displayed with a horizontal dashed line in the plot. The position present at that force value is referred to as the "reference position".
3. All following curves are moved along the X-axis so that the position at the trigger force corresponds to the reference position. This shift is done graphically – the shift offset is stored with the data record.

10.5.7 Position Block

The *Position Block* setting dynamically moves all evaluation elements along the Y-axis. The position of the evaluation elements along the Y-axis results as a fixed distance to the block point. The distance to the block point is set when creating the evaluation element.
The position of the block point is individually for each part produced. The block point is at the maximum position of the first reference curve. This position value is displayed in the Trigger input field.

Activating the Position Block setting causes:

1. The **first** reference curve marked as "good reference" (see section 10.2 Rating) is determined and chosen for the following steps.
2. The block position (maximum position) is marked on the X-axis and displayed with a vertical dashed line in the plot. The force applied there is referred to as "reference force".
3. All following curves are moved along the Y-axis in such a way that the force at its maximum position corresponds to the reference force. This shift is done graphically – the shift offset is stored with the data record.

10.5.8 Force Block

The *Force Block* setting dynamically moves all evaluation elements along the X-axis. The position of the evaluation elements along the X-axis results as a fixed distance to the block point. The distance to the block point is set when creating the evaluation element.
The position of the block point is individually for each part produced. The block point is at the maximum force of the first reference curve. This position value is displayed in the Trigger input field.

Activating the Force Block setting causes:

1. The **first** reference curve marked as "good reference" (see section 10.2 Rating) is determined and chosen for the following steps.
2. The block force (maximum force) is marked on the Y-axis and displayed with a horizontal dashed line in the plot. The position present there is referred to as "reference position".
3. All following curves are moved along the X-axis in such a way that the position at its maximum force corresponds to the reference position. This shift is done graphically – the shift offset is stored with the data record.

10.5.9 Visual diagram representation

If a setting other than Position absolute or Force absolute is selected as the reference option, the representation of the curves in the diagram changes. The modified display takes dynamic positioning of the evaluation elements into account by displacing the reference curves accordingly.
The customized display can be switched on and off via the control element “curve consolidation”.

11 Evaluation Elements

In the Evaluation Elements area, you can define individual evaluation elements for each program. The elements are used for automatic quality evaluation and the system uses their evaluation to determine whether a produced part is OK or NOK.

NOTICE
There has to be at least one reference curve in order to create an evaluation element.

11.1 Create element

The drawing mode can be activated via the Add Evaluation Element button. A new evaluation element can then be drawn in the diagram.
With the left mouse button a new point is created in the diagram. Another mouse click creates another point. Successive points are automatically connected by a line. Any number of points can be set when defining evaluation elements.

To draw a closed polygon, the end point must be set to the start point. A non-closed polygon can also be used as a valid evaluation element.
The drawing is ended by clicking the End Evaluation Element button, clicking the right mouse button or completing a polygon.
For a new evaluation element, the drawing mode must be activated again via the button.

11.2 Move element

To move an evaluation element as a whole, click in the center of the element. To move only one line or point of the element, click directly on the line or point.
Then click again with the left mouse button at the target position to move the element.

11.3 Detailed positioning

The position of the points of an element can be defined exactly in the list of elements. To do so, expand the corresponding element and select the individual points. Then enter the coordinates of the points in the input fields in the lower area.

11.4 Delete element

An element can be deleted from the list of elements using the Delete button. An element can only be deleted as a whole.

11.5 Element properties

Evaluation elements are used for the automatic quality evaluation of the produced parts. For this purpose, to the lines of an evaluation element are assigned one of the following properties

- Passage from left to right required
- Passage from right to left required
- No passage allowed
- No restriction

After a part has been produced, the course of the force-displacement curve is automatically checked for compliance with these criteria. If one of the criteria is violated, the produced part is evaluated as NOK. Only if all criteria are compliant, the part will be rated OK.

The property of an element line can be adjusted directly in the diagram. To do so, click in the middle of the line. Each mouse click changes the property. The drawing mode must not be active.
Alternatively, the property can be adjusted using the list of elements. To do so, expand the element in the list and select the corresponding line. Then adjust the property in the lower area accordingly.

11.6 Live Evaluation

A live preview of the evaluation is displayed in the diagram. For the evaluation, all curves with a good rating (shown in green) are taken into account. The evaluation result is displayed via color for each evaluation element line. A red line means that the course of one of the good rated curves violates the criterion. A green display means that the criterion is valid for all good evaluated curves.

The curves rated as bad (red) are not taken into account for the evaluation and are only used for visual orientation.

NOTICE
For the live evaluation, the current program and its evaluation properties are always used. Reference curves that do not correspond to this configuration can lead to unexpected behavior in the display.

12 History

12.1 Production history

During production, all production data is stored in a database and can then be viewed in the Production history section.
The production data includes:

- Unique part ID
- Time stamp
- Program name
- Force-displacement curve
- Result of quality evaluation
- Maximum force and position
- Serial Number (optional, see chapter 13.1 Fieldbus)

12.1.1 Display and filtering

In the Production history, the production data is viewed in tabular form. The table can be sorted in ascending or descending order for the individual columns. In addition, production data can be filtered by program name, timestamp, and rating result.
The force-displacement curve can be displayed for each data set. The view can be moved and zoomed to analyze the curves in detail.

12.1.2 Export

The export is in the JSON file format and contains all production history data for the selected data record.
Each record can be exported individually using the Export button located at this data entry. A file selection dialog opens in the browser and the storage location on the HMI device can be selected.
All currently filtered data sets can be exported as a collective export using the main Export button. Also, here a file selection dialog opens in the browser and the storage location on the HMI device can be selected. With collective export, all data records are stored in one file.

The export of data is only possible when logged in as administrator.

⚠ WARNING

Data are being streamed between Client and System

- At the export procedure (System → Client), the data are continuously streamed. Therefore, an unstable network connection can cause delays or aborts of this stream.

NOTICE
Interference of download speed in case of parallel production operations Download speed can decrease significantly, if the system runs productive operations. **Long duration at export of high amount of data** The duration of an export can increase significantly, if a high amount of data has to be transferred in a single download. This occurs due to the continuous data stream from the internal database, which has to be established.

12.1.3 Delete production data

The Delete button can be used to delete production data in order to free up storage space. If a filter is active, only the filtered results are deleted.
Data can only be deleted when logged in as an administrator.

NOTICE
If data in the press history is deleted, it is permanently removed from the system. To avoid data loss, export the data first!

12.2 Logbook

In the Logbook area, information messages, warnings and errors of the Smart Function Kit are displayed in tabular form. The table can be sorted in ascending or descending order for the individual columns. The entries can also be filtered by time stamp and category.

There are the following three categories for the messages

- Info
- Warning
- Error

The Logbook can be exported in JSON file format. Detailed information on the individual points can be found in the chapter 15 Troubleshooting at the end of this manual. Also refer to the documentation of the individual products.

13 Safety technology

The software of the Smart Function Kit supports several safety functions of the EN-61800-5-2. As soon as safety gets active the Smart Function Kit initiates the configured reaction (e. g. immediate shutdown of the drive). The HCS01 drive controller of the Smart Function Kit can be ordered with safety option L3 or S4. The safety option of your Smart Function Kit is indicated by the model code of your drive controller.

13.1 Safety option L3

The HCS01 drive controller with safety option L3 supports the safety function “Safe Torque Off” (STO). A safety level up to Category 4, Ple, SIL3 is achievable. A detailed description of the STO functionality can be found in the application manual “Rexroth IndraDrive Integrated Safety Technology “Safe Torque Off” (as of MPx-16)” (R911332634), which is available in the Media Directory on the Bosch Rexroth homepage.

13.2 Safety option S4

The HCS01 drive controller with safety option S4 supports the safety technology “Safe Motion”. In combination with the Smart Function Kit software the following safety functions can be used.

- Safe Torque Off (STO)
- Safe Brake Control (SBC)
- Safe Operating Stop (SOS)
- Safe Stop 1 – time prioritized (SS1-t)
- Safe Stop 1 – standstill prioritized (SS1-r)
- Safe Stop 2 (SS2-r)
- Safely-Monitored Deceleration (SMD)
- Safe Maximum Speed (SMS)

With these safety functions a safety level up to Category 4, PLe, SIL3 can be achieved. A detailed description of the safety technology “Safe Motion” can be found in the application manual “IndraDrive Integrated Safety Technology “Safe Motion” (MPx-18 and above)” (R911338920), which is available in the Media Directory on the Bosch Rexroth homepage.

The Smart Function Kit is suitable for the use of the safety option S4 in a “stand-alone-operation”. The integration in a global safety system (e.g. using PROFIsafe) is currently not intended.

13.3 Connection to peripherals

Both safety options allow the connection of safety-related peripherals (e. g. light barriers, emergency stop buttons or two hand controls) to the Smart Function Kit.

The peripherals of a HCS01 drive controller with safety option L3 are connected directly to the drive. In case of an emergency stop the E-Stop must be triggered before the STO-Input. The STO-Input immediately interrupts the power supply to the motor.

That’s why it should be triggered after the axis has already stopped its movement to prevent it from coasting down.

When selecting safety option S4 for the HCS01 drive controller the HSZ01 safety zone module is included in the scope of delivery of the Smart Function Kit. The peripherals are connected to the input pairs of the safety zone module. Through this, signals of the peripherals are transmitted to the drive controller. The shutdown of the drive is done by the configured transition function (SS1-t, SS1-r or SS2-r). It’s not necessary to trigger the E-Stop in addition to stop the movement. In order to use the Safe Motion functionalities the parameter MFR003 has to be set to 1 (default configuration when ordering a Smart Function Kit with safety option S4).

More information about the connection of peripherals to the Smart Function Kit can be found in the assembly instructions (R320103194) and the example circuit diagram. Both documents are available in the Media Directory on the Bosch Rexroth homepage.

13.4 Behavior of the software

In general, the behavior of the software depends on the safety option of the HCS01 drive controller. Furthermore, the desired reaction to an intervention of the safety technology can be configured in IndraWorks and the Smart Function Kit software. A HCS01 drive controller equipped with safety option S4 allows for example to choose if a program sequence gets aborted or paused when safety (SMST) becomes active.

13.4.1 Behavior without pause function

When safety gets active the Smart Function Kit aborts pending movement commands. A program sequence which is running during the intervention of the safety technology gets immediately aborted. The press curve gets evaluated as NOK. When restarting the program the Smart Function Kit starts with the first sequence step. Before the restart can be done the system state has to be “ready”. Therefore, errors must be cleared and the safety technology must not longer be active.

In order to achieve the described behavior the parameter MFR004 in the extended configuration must be set to 0 (default configuration).

13.4.2 Behavior with pause function

A safety intervention during a program run leads to an interruption of the sequence right at the time of the intervention. The sequence is being paused until the safety technology is not active anymore. After the pause the sequence continues from the point at which it was interrupted. A new start command is not required. Thus, a previously paused program can still be evaluated as OK.

In order to achieve the described behavior the parameter MFR004 (SMO: Pause program) in the extended configuration must be set to 1. The pause function can only be used with a drive controller with safety option S4.

14 Interfaces

14.1 Fieldbus

The Smart Function Kit can be used as a subsystem via the fieldbus interface.
A detailed description of the fieldbus interface can be found in the corresponding documentations.

Table 5: Additional documentation

	Title	Document number	Type of document
🕮	Smart Function Kit SFK - instruction	R320103194	Instructions
	Smart Function Kit SFK - Fieldbus	R320103209	Instructions

The Rexroth documentation is available for download at www.boschrexroth.com/mediadirectory.

Via the fieldbus interface, the *Smart Function Kit* can be used as a subsystem in an automation plant.
The following fieldbus protocols are available for the *Smart Function Kit*

- SercosIII
- EtherCAT (SoE)
- Profinet
- Ethernet/IP

The fieldbus protocol can be selected via the *Selection list* in the *System Configuration* area. For the protocols Profinet and Ethernet/IP, the device name can be changed individually. The exact procedure for this is explained in the following chapter.

14.1.1 Example projects

It is also possible to use the supplied example implementations for the IndraWorks Engineering and TIA Portal development environment. The examples serve as an abstraction layer with the aim of making it easier for the user to familiarize himself with the request and response scheme. The function blocks based on the PLCOpen notation simplify the interface and enable a more intuitive use.
The example projects can be accessed in the ‘help’ section of the user interface.

14.1.2 Configure cyclic data

For communication between the *Smart Function Kit* and the higher-level control, specific data is transmitted via the fieldbus in the form of "words". These are recorded by the fieldbus master as inputs or outputs.
The following figure shows an overview of the fieldbus data.

To enable the fieldbus master to access the corresponding fieldbus data via functions, it is useful to assign these data to global variables.
A practical implementation consists of creating one global array of the "WORD" data type each for the input and output data.
The corresponding assignment of the input and output data of the fieldbus to the corresponding array elements (mapping) is explained below for the respective field-bus protocols.

ET-Master (Input 20 Words)
responseHandle (Word)
responseStatus (Word)
responseValue1 (DWord)
responseValue2 (DWord)
responseValue3 (DWord)
notificationID (Word)
notificationValue (DWord)
notificationStatus (Word)
notificationPosition (DWord)
notificationVelocity (DWord)
notificationForce (DWord)
digital IOMapping (Word)
vitual IO input (Word)

ET-Master (Output 9 Words)
requestHandle (Word)
requestAction (Word)
requestValue1 (DWord)
requestValue2 (DWord)
requestValue3 (DWord)
vitual IO output (Word)

Figure 13: Data on the field bus for cyclic communication

14.1.3 Communication

Control via the fieldbus is carried out via requests, responses and notifications. For each request, the response corresponding to the request is sent. Notifications are divided into cyclic and acyclic information.

The following figure schematically shows the functional principle of the communication.

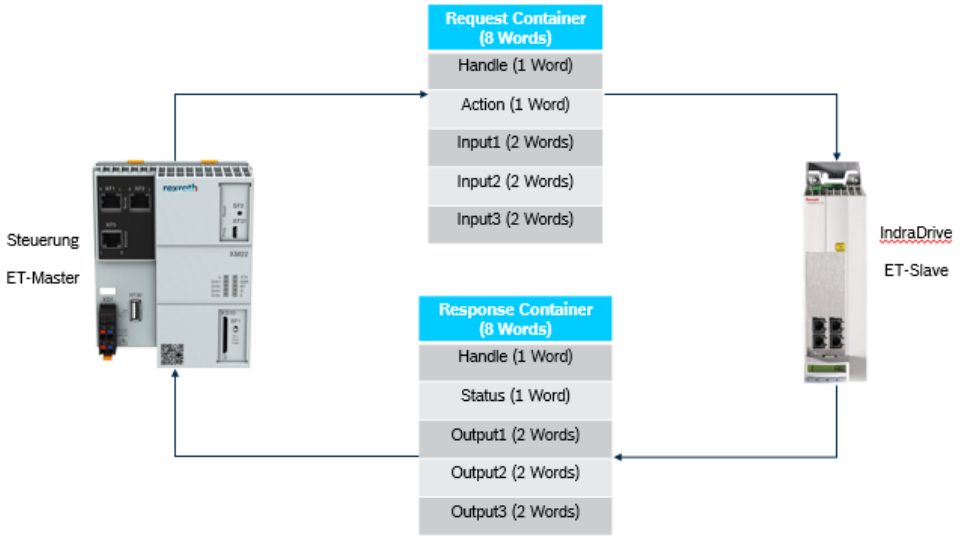


Figure 14: Schematic structure of field bus communication

14.1.4 Requests

The response to a request is given after the entire command/request has been processed.

The following table contains all available commands that can be sent via the fieldbus.

Requests:

ID	Command	Value 1	Value 2	Value 3
1	Start program	(Serial number digit 1-7)	(Serial number digit 8-14)	(Serial number digit 15-21)
2	Set program active	Fieldbus ID	x	x
3	Positioning	Target position	Travel speed	Acceleration
4	Jog	Distance	Travel speed	Acceleration
5	Delete error	x	x	x
6	Stop movement	x	x	x
7	Restart drive	x	x	x
8	Reserved	-	-	-
9	Tare	Offset		
10	Start Homing	x	x	x
11	Set system variable	Type	Number	Value
12	Lock Invoker	Invoker	Lock (1) / Unlock (0)	x
13	Set Reference	x	x	x
14	Get system variable	Type	Variable number	x

Start program:
With this command, the currently active program is started. It is processed completely and then the corresponding response is provided. The program sequence is considered to be finished when the quality assessment has been completed.
Optionally, a serial number with up to 21 digits can be linked to the started program dataset, which will be stored in the database. Depending on the length of the serial number, it has to be divided in up to 3 REAL values. See the table for a reference.
Example:
Serial number: '123451234567541'

- Value 1 = 4567.541
- Value 2 = 2345.123
- Value 3 = 0000.001

Set program active:
The command activates the program specified in value 1. The fieldbus ID corresponds to the fieldbus ID assigned during program creation. If the program is switched, the corresponding response is provided.

Positioning:
The command enables the movement to a defined target position. The desired travel speed profile can be realized via the parameters travel speed and acceleration. When the target position is reached, the corresponding response is provided.

Jog:
With the *Jog* command, a distance relative to the current position can be covered. The desired travel speed profile can be realized via the parameters travel speed and acceleration. When the target position is reached, the corresponding response is provided.

Delete error:
The command acknowledges all errors present on the Smart Press Kit. When the command has been processed by the system, the corresponding response is provided.

Stop movement:
The command terminates any currently pending command. If a movement is active, it is aborted, and the drive is stopped. When the drive is stopped, the corresponding response is provided.

Restart drive:
The command restarts the drive controller.

Tare:
Executes the Tare command and sets the actual force value to the specified offset. When the command has been completed, the corresponding response is provided.

Start Homing:
The command starts the homing procedure. Check the notes in chapter 5.1.2 Homing before executing.

⚠ WARNING

Risk due to moving parts!
Reversible injuries, including severe stab wounds.
- Never reach into moving parts.

Risk due to axis movements!
Damage to the product and the system.
- Ensure the cylinder can retract without collision.

Set system variable
With this command, the system variables specified in the table below can be modified. For these values, the system does not switch to parametrization mode. Check the chapter “Extended parameters” for further information.

Encoding of variable types:
0: VFR 10: VF
1: MFR 11: MF

Example: Set system variable VF500
Arg. 1: 10
Arg. 2: 500
Arg. 3: Value

Variable	Description	Type	Number	Value
VFR004	Set maximal positioning force	0	4	Force-Value [N] 0=inactive (default)
MFR002	Filter actual values	1	2	0= No | 1= Yes
MFR005	Cyclic variables documentation	1	5	0= No | 1= Yes

Lock Invoker:
This command locks or unlocks access to the SFK, filtered by the type of invoker. Commands from a locked invoker do not affect the system anymore. The lock settings do last until a reboot. The HMI will still show current values if locked. Types of invokers:

- Web HMI (**1**)
- Fieldbus (**2**)
- Physical In- & Outputs (**3**)

The first input parameter selects the invoker to be locked – see the numbers above. The second input parameter is used to decide between locking and unlocking of the specified invoker (first input parameter). Set the value like:
0: Unlock Invoker
1: Lock Invoker

Set Reference:
"Set reference" command will set the absolute reference for the system at the current position. By default, the value is set to 0 mm, but can be changed globally for the system inside extended hardware configuration settings.

Get system variable:
This command can be used to read system variables. The first parameter specifies the variable type (s. table "Encoding of variable types"). The second parameter specifies the variable number.

Encoding of variable types:

0: VFR	10: VF
1: MFR	11: MF

Example: Get system variable VF500
Arg. 1: 10
Arg. 2: 500
The Smart Function Kit will return the value of VF500 within ResponseValue[1].

Also, the following values can be read for the last pressing cycle via the fieldbus interface:

VF600	Max. position
VF601	Max. force
VF602	Cycle time

These values are only valid after a pressing process and must be read before starting the next pressing. The duration required for the readout is non-deterministic, as this is done via the NRT channel.
An invalid return value shows as -1. This can occur, for example, due to a program abort in the case of the cycle time.

14.1.5 Status information

With the status information, the states of the *Smart Function Kit* can be queried. This enables targeted control of the *Smart Function Kit* via the fieldbus master. The following tables show the corresponding commands (ID) and assignments within the status word.

Status information:

ID	Description	Functional description
301	Active program ID	The program number active in the drive is read out.
401	Current position	Cyclically transmitted position is read out
402	Current travel speed	Cyclically transmitted travel speed is read out
403	Current force	Cyclically transmitted force is read out

Status word:

Bit	Description	Functional description
0 - 2	Reserve	
3	Program active	1 – pressing active, program is being processed Data is recorded (force - travel curve) 0 – No program active No data is recorded
4	Last pressing OK	1 – Last pressing provides result Good 0 – No result
5	Last pressing NOK	1 – Last pressing provides result Bad 0 – No result
6	Sensor tared	1 – Force sensor is tared (offset active) 0 – Force sensor is not tared (no offset active)
7	Press ready	1 – Press is ready and can be moved 0 – Press is not ready, check status
8	Errors	1 – Error active 0 – No error active
9	Warning	1 – Warning active 0 – No warning active
10	Reserve	
11	Request possible	1 – A request can be sent to the system. 0 – No request can be sent to the system
12	Response available	1 – Valid response available 0 – Response pending
13	Notification available	1 – Valid notification available 0 – Notification pending
14 - 15	Reserve	

14.1.6 Virtual I/O

Virtual I/Os can be used within the program sequence of the *Smart Function Kit* (slave) to interact between the running program and the master control. This enables a variety of use cases, such as dynamic stops during the running program sequence to wait for external evaluations or signals.

For each direction, 16 bits can be written and read any time via fieldbus. To access the functionalities, mapping of the required input and output bits has to be done in the *Smart Function Kit* settings menu.

14.2 OPC-UA + REST API

The Smart Function Kit has an OPC-UA interface and a REST (Representational State Transfer) API to retrieve data or configurations.
A detailed description of these interfaces can be found in the help section of the Smart Function Kit user interface or in the corresponding documentations.

Table 6: Additional documentation

	Title	Document number	Type of document
	Smart Function Kit SFK – OPC-UA + REST-API	R320103210	Instructions

The Rexroth documentation is available for download at www.boschrexroth.com/mediadirectory.

15 Software Update

A software update is always done via an installation file provided by Bosch Rexroth. The newest software version is available on the Bosch Rexroth website in the Smart Function Kit product area.

NOTICE

The system cannot be operated during the update process!
Production downtime.
▶ Stop the running production before the update.

NOTICE

Data loss due to errors in the update process!
Loss of production data.
▶ Create a backup of the production data before an update.

15.1 Installation

Follow this procedure to perform an update:

1. Download the new software version from Bosch Rexroth.
2. Save the file on a device with Windows operating system.
3. Connect your device to the PR21 industrial PC using the XF6 interface on the PR21, which is normally used by the HMI device.
4. Make sure that the network settings on the machine match the Smart Function Kit settings and that you can establish a connection.
5. Unpack the file.
6. Start the executable installation file. The installation program opens after a short loading time.
7. In the installation program, enter the IP address of the Smart Function Kit and click connect.
8. The installation program will now automatically perform the update and then validate the correct installation of the Smart Function Kit.
9. Close the installation program as soon as the installation has been completed successfully.

15.2 Commissioning

Once a new version of the Smart Function Kit software has been installed, the commissioning wizard is automatically displayed the next time you connect to the system. The update can only be completed successfully by recommissioning the system. No system data is lost in this process.

1. Perform the commissioning as described in the chapter Commissioning.
2. Check user-defined settings in the extended parameter configuration, as these may be overwritten by the update.

NOTICE

Invalid system parameters after software update!

System damage. System malfunction.

- After recommissioning, check all parameters for validity.
- First of all, check user-defined settings in the extended parameter configuration, as these may be overwritten by the update.

16 Troubleshooting

16.1 Display errors

If display errors occur in the Web HMI, they can usually be corrected by reloading the page.

- ➢ Activate (depending on the browser used) the reload page function.
- ➢ Alternatively use the function key F5.
- ➢ Clear the cache of the web browser.

16.2 Web HMI is not displayed

If the web browser cannot load the Web HMI (even after a short waiting time), this may be due to a display problem with the content. This can be caused, for example, by software updates. Depending on the browser settings, content is kept in the cache and can therefore no longer be displayed correctly or loaded.

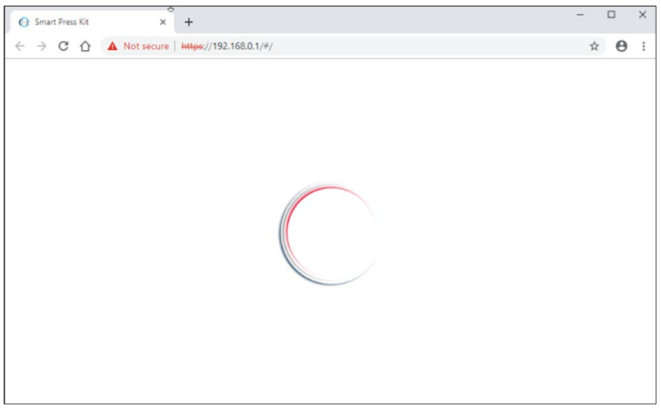


Figure 15: Web HMI loading spinner

The spinner shown above is then permanently displayed and the HMI is not loaded.

- ➢ Clear the cache of the web browser to eliminate this error. Use the shortcut Ctrl+Shift+Del to open the corresponding dialog of your browser or find a corresponding procedure on the Internet.

16.3 Troubleshooting a problem

Troubleshooting may only be carried out by authorized, trained and instructed personnel.

- Proceed systematically and purposefully, even under time pressure.
  Random disassembly and adjustment of individual values can lead to the fact that the original cause of the error can no longer be determined.
- Get an overview of the function of the product in connection with the overall system.
- Try to clarify whether the product has performed the required function in the overall system before the fault occurs.
- Try to record changes to the overall system in which the product is installed:
  - Have the operating conditions or the range of application of the product been changed?

  - Have any changes (e.g. modifications) or repairs been made to the overall system (machine/system, electrical system, control system) or to the product? If so, which?
  - Has the product or machine been operated as intended?
  - How does the problem manifest itself?
- Get a clear idea of the cause of the error. Consult the immediate operator or machine operator if necessary.
- If you have been unable to correct the error, please contact one of the contact addresses at: www.boschrexroth.com/adressen.

NOTICE

The system will lose its functionality if changes by external programs are done!

▶ Please do not change any settings of the industrial PC or the drive with external programs like IndraWorks DS etc. otherwise the system will not be able to function properly anymore.

16.4 Service tool – creation of a logfile

In case of an error you would like to discuss with us, please use the service tool and send us the service log file.
This file contains the hardware and system configuration, settings of the industrial PC and system logs of your Smart Function Kit. This helps us to get a faster overview.

How do you create the log file?

- Download the newest software update file for your Smart Function Kit from our Website please. Find it here: *Smart Function Kit > Downloads* or use the shortcut on the configuration page under *help > product info*.
- Run the exe file you just downloaded
- Insert the IP-address of your Smart Function Kit to ensure a connection. Please select the option *Service* then.
- The log file is saved to your desktop afterwards. Please send us this file.

16.5 Error codes

16.5.1 HCS01 drive errors

All drive errors are listed in the Error Log section of the Smart Function Kit. For further information please refer to chapter Error Log.
Detailed information on the errors can be found in the IndraDrive MPx-20 documentation (DE: R911345607 and EN: R911345608), which can be downloaded online at www.boschrexroth.com/medienverzeichnis

16.5.2 System errors

All system-specific errors are listed below. These are not included in the standard documentation IndraDrive MPx-20 and are therefore described in more detail here.

Error code	Error text
010001	No function or invalid input
020101	Command active, command transition not permitted
020102	Access of participant locked
030001 - 030303	Internal Error
030304	Manual positioning command not started: Force limit exceeded
030401 - 031901	Internal Error
040101	Command acknowledge error not possible
040201	Reading of SMC variables not possible
040301	Positioning command cannot be started
040302	Error in the processing of the stop command
040303	Target position was not reached
040304	Manual positioning command: Force limit exceeded
040401	Reading of motor feedback memory not possible
040501	Drive cannot be restarted
040601	Homing could not be started
040602	Referencing under load not possible
040701	Program could not be activated
040702	Timeout while program will be activated
040703	Timeout after program is activated
040801	SMC variable could not be written
040901	Error when switching the operating mode
041001	Program could not be started
041002	Program stop error
041003	Program error: Max. position exceeded
041004	Program error: Max. force exceeded
041005	Program error: Program aborted manually
041006	Program error: Abort due to drive error
041007	Program error: Y parameter could not be written
041008	Program error: Timeout exceeded
041009	Program error: Safety active
041010	Program error: Out of target window, force too low
041011	Program error: Out of target window, force exceeded
041012	Program error: Out of target window, invalid force evaluation
041013	Program error: Out of target window, position too low
041014	Program error: Out of target window, force and position too low
041015	Program error: Out of target window, force exceeded, position too low
041016	Program error: Out of target window, invalid force evaluation, position too low
041017	Program error: Out of target window, position exceeded
041018	Program error: Out of target window, force too low, position exceeded
041019	Program error: Out of target window, force and position exceeded
041020	Program error: Out of target window, invalid force evaluation, position exceeded
041021	Program error: Out of target window, invalid position evaluation
041022	Program error: Out of target window, force too low, invalid position evaluation

041023	Program error: Out of target window, force exceeded, invalid position evaluation
041024	Program error: Out of target window, invalid force and position evaluation
041101	S- or P-parameter could not be read
041201	S- or P-parameter could not be written
041301	Y Parameter file could not be loaded during commissioning
041401	Taring not possible
041501	Basic parameter loading not possible at drive commissioning
041601	Reference could not be set
041701	Y-parameter could not be read
041801	Y parameter could not be written
041901	Maximum number of participants to be locked reached
041902	Lock participant failed
050001	Character string too long, error while writing

Error 020101 – Command active, command transition not permitted

This error occurs if a command has been triggered but processing cannot be started due to an active program.

Possible solution:

- Exit the currently active command via the Stop command of the user interface, OPC-UA or fieldbus.
- Wait until the current command has been processed.

Error 020102 – Access of participant locked

This error occurs if a command has been triggered from a locked participant.

Possible solution:

- Unlock the participant.
- Restart the system to unlock all participants.

Error 030304 – Manual positioning command not started: Force limit exceeded

A positioning command, e.g. absolute positioning or continuous jogging, was executed and the defined maximum force has been exceeded on command triggering.

Possible solutions:

- Check the value of parameter VFR004. If necessary, adjust the value of the parameter (see chapter 5.3.1).
- Check whether the system is correctly tared. If necessary, tare to the value 0 N.
- Check whether the system is ready to move (no error, not in parameter mode).
- Check the plausibility of the displayed force value. If necessary, loosen mechanical blockings.

Error 040101 – Command active, command transition not permitted

This error occurs if the Clear error command has been triggered, but processing is not possible.

Possible solution:

- Terminate a currently active command via the Stop command of the user interface, OPC-UA or fieldbus.

Error 040201 – Reading of SMC variables not possible

The system requests an SMC variable from the SMC technology package, which cannot be read out.

Possible solution:

- Check the entered variable name.
- Restart the system and try to read the variable again.

Error 040301 – Positioning command cannot be started

A positioning command, e.g. absolute positioning, continuous jogging or a program with a position command was sent but cannot be executed.

Possible solutions:

- Terminate a currently active command via the Stop command of the user interface, OPC-UA or fieldbus.
- Check whether the reference is set for the system.
- Check whether power is connected to the system.
- Check whether the system is ready for operation (no error, not in parameter mode).

Error 040302 – Error in the processing of the stop command

The Stop Axis command is executed in various subordinate system functions to stop the Smart Function Kit. An error was detected during processing.

Possible solutions:

- Check the parameterization of the system. If necessary, restore the default values of the extended configuration.
- Restart the system and re-execute the command sequence.

Error 040303 – Target position was not reached

A positioning command, e.g. absolute positioning, continuous jogging or a program with a position command was executed but the target position was not reached.

Possible solutions:

- Terminate a currently active command via the Stop command of the user interface, OPC-UA or fieldbus.
- Check whether the reference is set for the system.
- Check whether power is connected to the system.
- Check whether the system is ready for operation (no error, not in parameter mode).

Error 040304 – Manual positioning command: Force limit exceeded

A positioning command, e.g. absolute positioning or continuous jogging, was executed and the defined maximum force has been reached or exceeded.

Possible solutions:

- Check the value of parameter VFR004. If necessary, adjust the value of the parameter (see chapter 5.3.1).
- Check whether the system is correctly tared. If necessary, tare to the value 0 N.
- Check whether the system is ready to move (no error, not in parameter mode).
- Check the plausibility of the displayed force value. If necessary, loosen mechanical blockings.

Error 040401 – Reading of motor feedback memory not possible

During commissioning, the system parameters are read from the motor feedback memory of the MS2N motor. An error occurred while reading the motor feedback memory.

Possible solutions:

- Restart the commissioning step.
- Restart the commissioning process from the beginning.
- Contact service. An incorrectly parameterized system can lead to serious damage to the system.

Error 040501 – Drive cannot be restarted

The Restart command was sent at the motor controller. However, the restart could not be executed.

Possible solutions:

- Check whether a drive command, e.g. homing, is active.
- Restart the system manually (main switch).

Error 040601 – Homing could not be started

The homing system command could not be started.

Possible solutions:

- Check if power is switched on.
- Check whether the system is ready for operation (no error, not in parameter mode).

Error 040602 – Referencing under load not possible

Setting the reference point may only be started in a load free state. If there is any load on the Smart Function Kit please use the jog-mode with the "relative" radio button checked.

Error 040701 – Program could not be activated

An error has occurred while switching a program so that the program cannot be activated.

Possible solutions:

- A program is currently being processed. Try switching as soon as the system has completed the process.

Error 040702 – Timeout while program will be activated

An error has occurred while switching a program so that the program cannot be activated.

Possible solutions:

- A program is currently being processed. Try switching as soon as the system has completed the process.

Error 040703 – Timeout after program is activated

An error has occurred while switching a program so that the program cannot be activated.

Possible solutions:

- Ensure that the selected program ID is available.
- Try to multiply the program ID with 1000.
- A program is currently being processed. Try switching as soon as the system has completed the process.

Error 040801 – SMC variable could not be written

An attempt is made to write an SMC variable of the underlying technology package SMC. The write operation was aborted with an error.

Possible solution:

- The SMC variable is write-protected. Check the correct use of the variable in the SMC documentation.

Error 040901 – Error when switching the operating mode

An error occurred while attempting to change the operating status of the motor controller (Parameter mode <> Operating mode)

Possible solutions:

- The system is in motion. Terminate the active motion command and perform the command again.
- Incorrect parameterization in the extended configuration. Enter valid parameter values for the parameters or reset the parameters to default values.

Error 041001 – Program could not be started

An error occurred when starting the active program.

Possible solutions:

- Check if power is switched on. If necessary, switch on the power.
- Check if the system is referenced. Start homing if necessary.
- Check whether the system is ready for operation (no error, not in parameter mode).
- Reboot the system. Load the program again with the selection list in the status bar and repeat the start command.

Error 041002 – Program stop error

A program can be aborted using the Stop command or a detected program error. A malfunction occurred during the abort.

Possible solutions:

- Reboot the system. Load the program again with the selection list in the status bar and repeat the stop command. If the error occurs again, contact the service.

Error 041003 – Program error: Max. position exceeded

During program execution, the programmed maximum position has been exceeded. The active program step can be checked in the dashboard.

Possible solutions:

- Check the parameterization of the step and adjust the maximum position.
- Check the parameterized dynamics of the overall process and adjust them.

Error 041004 – Program error: Max. force exceeded

During program execution, the programmed maximum force (calculated by target force plus force sensor tolerance VFR002) has been exceeded. The active program step can be checked in the dashboard.

Possible solutions:

- Check the parameterization of the step and adjust the maximum force.
- Check the parameterization of the next step, too.
- Check the parameterized dynamics of the overall process and adjust it accordingly.

The system could not be stopped fast enough to safely reach the specified target force value. The system has initiated an emergency shutdown.

- Check the parameterized dynamics of the overall process and reduce the speed in the join to force step.
- Restart the program.

Error 041005 – Program error: Program aborted manually

A program was aborted manually by the Stop command. Possible solutions:

- Check whether the Stop command was executed by the HMI, OPC-UA or Fieldbus.

Error 041006 – Program error: Abort due to drive error

A drive error occurred during program execution that prevented further processing.

Possible solutions:

- Eliminate the drive error and restart the program.

Error 041007 – Program error: Y parameter could not be written

When a program is created, Y parameters of the subordinate technology package SMC are written in the program sequence. One of these parameters is write-protected at the time of program execution or its value range is exceeded.

Possible solutions:

- Check the operating status of the system. Check if the system is not ready (see information in the status bar).
- Check the parameterization of the system e.g. with regard to limit value violations.

Error 041008 – Program error: Timeout exceeded

During program execution, the programmed timeout in a step has expired. The active program step can be checked in the dashboard.

Possible solutions:

- Check the parameterization of the step and adjust the timeout.

Error 041009 – Program error: Safety active

During program execution, the safety technology has been activated.

Possible solutions:

- Check the safety technology.

Error 041010 – Program error: Out of target window, force too low

During program execution, the building block “Check force/position target window” detected that the force has been lower than the parameterized minimum force. The position has been within the target window. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.

Error 041011 – Program error: Out of target window, force exceeded

During program execution, the building block “Check force/position target window” detected that the force has exceeded the parameterized maximum force. The position has been within the target window. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.

Error 041012 – Program error: Out of target window, invalid force evaluation

During program execution, the building block “Check force/position target window” detected that the force has been lower than the parameterized minimum force and at the same time exceeded the parameterized maximum force. The position has been within the target window. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.
- Ensure that the minimum force is at most the maximum force.

Error 041013 – Program error: Out of target window, position too low

During program execution, the building block “Check force/position target window” detected that the position has been lower than the parameterized minimum position. The force had been within the target window. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.

Error 041014 – Program error: Out of target window, force and position too low

During program execution, the building block “Check force/position target window” detected that the force and position has been lower than the parameterized minimum force, respectively position. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.

Error 041015 – Program error: Out of target window, force exceeded, position too low

During program execution, the building block “Check force/position target window” detected that the force has exceeded the parameterized maximum force and at the same time the position has been lower than the minimum position. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.

Error 041016 – Program error: Out of target window, invalid force evaluation, position too low

During program execution, the building block “Check force/position target window” detected that the force has been lower than the parameterized minimum force and at the same time exceeded the parameterized maximum force. The position has been lower than the minimum position. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.
- Ensure that the minimum force is at most the maximum force.

Error 041017 – Program error: Out of target window, position exceeded

During program execution, the building block “Check force/position target window” detected that the position has exceeded the parameterized maximum position. The force has been within the target window. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.

Error 041018 – Program error: Out of target window, force too low, position exceeded

During program execution, the building block “Check force/position target window” detected that the force has been lower than the parameterized minimum force and at the same time the position has exceeded the maximum position. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.

Error 041019 – Program error: Out of target window, force and position exceeded

During program execution, the building block “Check force/position target window” detected that the force and position have exceeded the parameterized maximum force, respectively position. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.

Error 041020 – Program error: Out of target window, invalid force evaluation, position exceeded

During program execution, the building block “Check force/position target window” detected that the force has been lower than the parameterized minimum force and at the same time exceeded the parameterized maximum force. The position has exceeded the maximum position. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.
- Ensure that the minimum force is at most the maximum force.

Error 041021 – Program error: Out of target window, invalid position evaluation

During program execution, the building block “Check force/position target window” detected that the position has been lower than the parameterized minimum position and at the same time exceeded the parameterized maximum position. The force has been within the target window. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.
- Ensure that the minimum position is at most the maximum position.

Error 041022 – Program error: Out of target window, force too low, invalid position evaluation

During program execution, the building block “Check force/position target window” detected that the position has been lower than the parameterized minimum position and at the same time exceeded the parameterized maximum position. The force has been lower than the parameterized minimum force. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.
- Ensure that the minimum position is at most the maximum position.

Error 041023 – Program error: Out of target window, force exceeded, invalid position evaluation

During program execution, the building block “Check force/position target window” detected that the position has been lower than the parameterized minimum position and at the same time exceeded the parameterized maximum position. The force has exceeded the parameterized maximum force. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.
- Ensure that the minimum position is at most the maximum position.

Error 041024 – Program error: Out of target window, invalid force and position evaluation

During program execution, the building block “Check force/position target window” detected that the force has been lower than the parameterized minimum force and at the same time exceeded the parameterized maximum force. The position has been lower than the parameterized minimum position and at the same time exceeded the parameterized maximum position. The active program step can be checked in the dashboard.

Possible solutions:

- Check the part against the parameters of the building block.
- Check the parameters of the building block and modify them if needed.
- Ensure that the minimum force is at most the maximum force.
- Ensure that the minimum position is at most the maximum position.

Error 041101 – S- or P-parameter could not be read

An error occurred while reading an internal S- or P-parameter.

Possible solutions:

- Check the correct spelling of the parameters IDN and repeat the procedure.
- Restart the system and try to read the parameter again.
- Incorrect parameterization in the extended configuration. Enter valid parameter values for the parameters or reset the parameters to default values.

Error 041201 - S- or P-parameter could not be written

An error has occurred while writing a drive-internal S- or P-parameter.

Possible solutions:

- Check the correct spelling of the parameters IDN and repeat the procedure.
- Check whether the parameter is currently write-protected. If necessary, activate the parameter mode operating state.
- Check in the documentation of the motor controller whether the value to be written corresponds to the value range of the parameter. Adjust the value and repeat the write operation.

Error 041301 - Y Parameter file could not be loaded during commissioning

The SMC technology package is automatically configured during commissioning. The parameters required for the configuration are read from a parameter file. One or more parameters of this file could not be set.

Possible solutions:

- Repeat the commissioning step.
- Restart the commissioning process from the beginning.
- Contact service. An incorrectly parameterized system can lead to serious damage to the system.

When using OPC-UA:
The function loadYParameterFile() was called via OPC-UA. One or more parameters of this file could not be set.
Possible solutions:
- Check the path to the parameter file.
- Check the operating status of the system. Some parameters can only be written to in parameter mode. Switch to the parameter mode and call the function again.

Error 041401 - Taring not possible
An error occurred while executing the Tare command. The actual force value of the analog force sensor was not set to the defined offset.
Possible solutions:
- Restart the system and repeat the procedure. If the error occurs again, contact the service.

Error 041501 - Basic parameter loading not possible at drive commissioning
During commissioning, the drive parameters are reset to their default values and the initial configuration is carried out.
Possible solutions:
- Repeat the commissioning step.
- Restart the commissioning process from the beginning.
- Stop the system. No movement (program start, positioning, etc.) must be active for basic parameter loading.
- Contact service. An incorrectly parameterized system can lead to serious damage to the system.

Error 041601 - Absolute dimension could not be set
The command Set absolute dimension was aborted with error. The value has not been set.
Possible solutions:
- Check the parameterization of the system. Check whether the value (S-0- 0052 extended configuration) has been set outside the system limits.
- Stop the system. No movement (program start, positioning, etc.) must be active.
- Check whether the system is ready for operation (no error, not in parameter mode).

Error 041701 – Y-parameter could not be read
A Y-parameter of the technology package SMC is to be read. An error has occurred that prevents a readout.
Possible solutions:
- Check the correct spelling of the parameters IDN and repeat the procedure.
- Restart the system and try to read the parameter again.

Error 041801 - Y parameter could not be written

An error occurred while writing a Y-parameter of the technology package SMC.

Possible solutions:

- Check the correct spelling of the parameters IDN and repeat the procedure.
- Check whether the parameter is currently write-protected. If necessary, activate the parameter mode operating state.

Error 041901 – Maximum number of participants to be locked reached

This error occurs if the last unlocked participant has to be locked.

Possible solution:

- Unlock other participants.
- Restart the system to unlock all participants.

Error 041902 – Lock participant failed

This error occurs if locking a participant has failed.

Possible solution:

- Ensure that the participant is error free.
- Restart the system to unlock all participants.

Error 050001 - Character string too long, error while writing

An error has occurred in the communication between PR21 and the drive controller in which the data cannot be transmitted completely.

Possible solutions:

- Repeat the command sequence that led to the error. In exceptional cases, too much data on the interface may lead to an error.
- Restart the system and repeat the command sequence.
- Contact the service.

Bosch Rexroth AG
Zum Eisengießer 1
97816 Lohr am Main
Germany
Phone +49 9352 18-1234
Fax +49 9352 18-5678
info@boschrexroth.com
www.boschrexroth.com

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