

Hydraulic power unit

CytroPac



The data specified only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information.

The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.

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The cover shows an example configuration. The product delivered may differ from the image on the cover.

The original commissioning instructions were prepared in German.

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1 About this documentation

1.1 Validity of the documentation

The present documentation applies to the following products:

- Hydraulic power unit CytroPac (for material numbers, refer to data sheet 51055)

This documentation is intended for operators, service engineers and system end-users and machine and system manufacturers.

This documentation contains important information on the commissioning of the hydraulic power unit, such as the installation of IndraWorks DS, the switching sequence, connection establishment, the IndraWorks DS, CytroPac and protection functions, as well as diagnosis and troubleshooting.

- Prior to working with the product, read these operating instructions carefully, in particular the [02 Safety instructions](#) chapter.

1.2 Required and amending documentation

- Before commissioning the product, make sure to have received and fully understood the documentations identified by the book symbol  and observe the instructions included in these documentations.

Tabelle 1: Required and amending documentation

Title	Document number	Document type
 CytroPac hydraulic power unit Contains information on the safe and proper transport, assembly, commissioning, operation, use, maintenance, disassembly and simple troubleshooting of the hydraulic power unit.	RE 51055-B	Operating instructions
 CytroPac hydraulic power unit Includes technical data, operating conditions, performance limits and project planning information	RE 51055	Data sheet
 Sytronix FcP 5020, frequency-controlled pump drive system Describes the functions of the frequency-controlled pump drive system FcP 5020.	R911378635	Quick start guide
 Frequency converters series EFC x610 and EFC 3610/EFC 5610 Describes the assembly, commissioning, use, maintenance, diagnosis and troubleshooting of the frequency converters.	R911369847	Operating instructions
 Frequency converters, multi-Ethernet card Contains the data, information and descriptions required in connection with the MEP extension card (Multi-Ethernet Platform). This extension card is part of the accessories of the fieldbus communication module of the EFC x610 series frequency converter.	R911378491	Operating instructions

1.3 Representation of information

Uniform safety instructions, symbols, terms and abbreviations are used so that you can work with your product quickly and safely with this documentation. For better understanding these are explained in the following sections.

1.3.1 Safety instructions

In this documentation, safety instructions are placed before a sequence of actions that involves the risk of personal injury or damage to property. The described measures for hazard avoidance must be observed.

Safety instructions are structured as follows:

 SIGNAL WORD
Type and source of danger Consequences of non-compliance ► Hazard avoidance measures ► <Enumeration>

- **Warning sign:** draws attention to the hazard
- **Signal word:** identifies the hazard level
- **Type and source of danger:** identifies the type and source of the danger
- **Consequences:** describes what occurs when the safety messages are not complied with
- **Precautions:** indicates how the hazard can be avoided

Tabelle 2: Risk classes according to ANSI Z535.6-2006

Warning sign, signal word	Meaning
 DANGER	Indicates a hazardous situation which, if not avoided, will result in death or severe injury.
 WARNING	Indicates a hazardous situation which, if not avoided, could result in death or severe injury.
 CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates damage to property: The product or the environment could be damaged.

1.3.2 Symbols

The following symbols identify information that is not safety-relevant, but that enhances the comprehensibility of the documentation.

Tabelle 3: Meaning of the symbols

Symbol	Meaning
	When this information is not observed, optimum use or operation of the product cannot be ensured.
	Left mouse click
	Double-click
	Right mouse click
	Text input
	Order in picture
	Single, independent action
1.	Numbered instructions:
2.	The number indicates that the different actions are to be performed successively.
3.	

1.3.3 Screenshots



The screenshots were created with IndraWorks 14V24 and may differ from the current version.

1.3.4 Designations

The following designations are used in this documentation:

Tabelle 4: Designations

Designation	Meaning
ASF	Technology function: Application firmware (firmware extension) for implementation of the hydraulic functions (A pplication S pecific F irmware)
EFC 5610	Frequency converter installed in the CytroPac
Firmware EFC 5610	Software running on the frequency converter
Firmware MEP	Software running on the multi-Ethernet-extension card
IndraWorks Ds	Software for parameterization/commissioning
Sytronix FcP 5020	F requency-controlled p ump drive system

1.3.5 Abbreviations

The following abbreviations are used in this documentation:

Tabelle 5: Abbreviations

Abbreviation	Meaning
S3	Communication protocol Sercos III
PN	Communication protocol PROFINET IO
EI	Communication protocol EtherNet/IP
EC	Communication protocol EtherCAT (CoE)
MB	Communication protocol Modbus/TCP
MEP	Multi-Ethernet Platform

2 Safety instructions

WARNING

Improper application, installation or operation!

Risk of injury! Damage to property!

- ▶ Before you work with the hydraulic power unit or control the hydraulic power unit, please read and take note of the following safety instructions:
 - Safety instructions in operating instructions 51055-B, see chapter [1.2 Required and amending documentation](#).
 - Safety instructions in the operating instructions for the machinery/system.

Activation of machine functions by means of commissioning!

Danger to life, risk of injury!

- ▶ Before commissioning the hydraulic power unit, make sure that all electrical, mechanical and hydraulic connections are properly installed and connected as described in the higher-level instructions of the machinery/system manufacturer.
- ▶ Make sure that the safeguards are activated.

Leakage of hydraulic fluid under high pressure due to faulty assembly of the hydraulic power unit!

Risk of injury, damage to property!

- ▶ Ensure that the hydraulic power unit has been mounted by an expert, completely and without any tension stress before commissioning the hydraulic power unit.

3 First steps

3.1 Important information

NOTICE

Adjustment of motor parameters or settings not described in this documentation!

Damage to property!

- Note that the CytroPac is already delivered fully parameterized and functional, so there is no need to select the motor, change, optimize or adjust the motor parameters, such as the direction of rotation of the pump, or adjust the sensor technology.

In order to maintain the functionality of your CytroPac, please refer to the following information:

- Never perform an auto-tuning.
- Do not change motor parameters or settings that are not described in this documentation.
- Do not reset the CytroPac to factory settings as these are not the same as the condition as supplied.

3.2 Software installation

- Download the IndraWorks Ds software from the Bosch Rexroth website and install it.



You can download the software with or without online help via the following link (once there, click Downloads):

<https://www.boschrexroth.com/de/de/produkte/produktgruppen/elektrische-antriebe-und-steuerungen/engineering/software-tools/indraworks-engineering>



If you are asked during the installation if you want to install a driver, please confirm this with yes.

3.3 CytroPac switching sequence

Tabelle 6: Sequence for error-free start-up

Step	Meaning
1.	Provide 24 V power supply (15X1)
2.	Provide power supply (12X1) ¹⁾

1) is also required to access all parameters with IndraWorks Ds



The pressure sensor HM20 of the CytroPac is supplied with 24 V via 15X1.

The CytroPac has a pressure sensor cable break detection system. If the CytroPac is started without the 24 V power supply, the cable break detection is activated and the error "38 Aibe analog input broken wire detection" is displayed. The error can be acknowledged via the reset input after the 24 V supply (15X1) has been switched on.

3.4 Connection with CytroPac (USB)

1. Connect your PC to the CytroPac with a mini USB cable (14X1).
2. Start IndraWorks Ds.

The connection selection window appears automatically, see [Abb. 1: Connection selection](#).

3. Click there under the tab "Serial" on the drop-down menu of the interface, select "xFC (COMX)" and then click on "Connect".

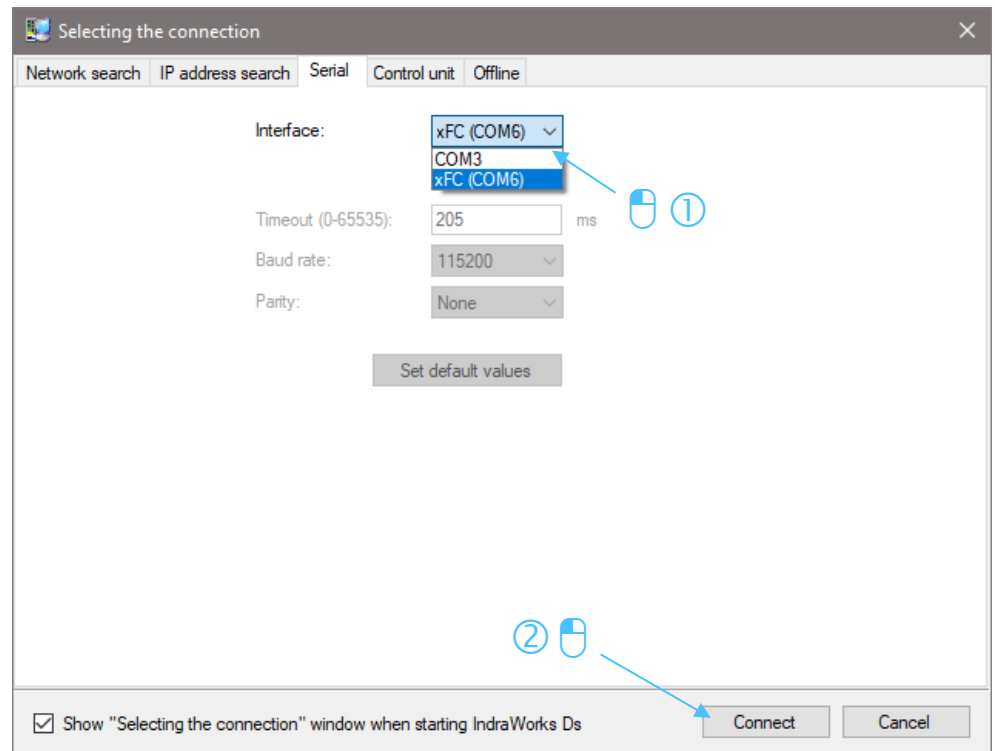


Abb. 1: Connection selection

- If the connection selection window does not appear, but the IndraWorks Ds start window does, click on the symbol .

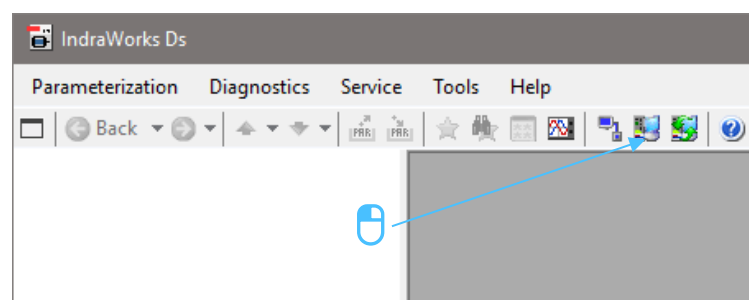


Abb. 2: Connection selection (alternatively)

- If "xFC" does not appear as an interface, disconnect the USB cable from the computer and reconnect it. Alternatively, you can deactivate the interface in the Windows device manager as shown in [Abb. 3: USB port in device manager](#) and then turn it back on.
- Close the connection selection and open it again.

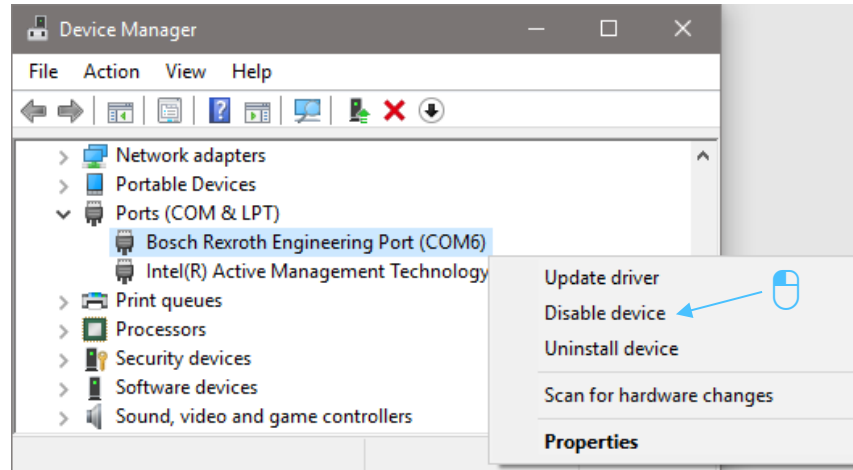


Abb. 3: USB port in device manager

3.5 Only Premium and Premium M12: Establishing a connection with CytroPac (LAN)

You have the possibility of searching a network or an IP range. The network search is described below.

1. Connect your computer to the CytroPac with a suitable Ethernet cable (21X1 or 21X2).
2. Start IndraWorks Ds.

The connection selection window appears automatically, see [Abb. 4: Connection selection](#).

- Click on the drop-down menu for the network adapter under the "Network Search" tab and select the corresponding network adapter you want to connect with and then click on "Connect".

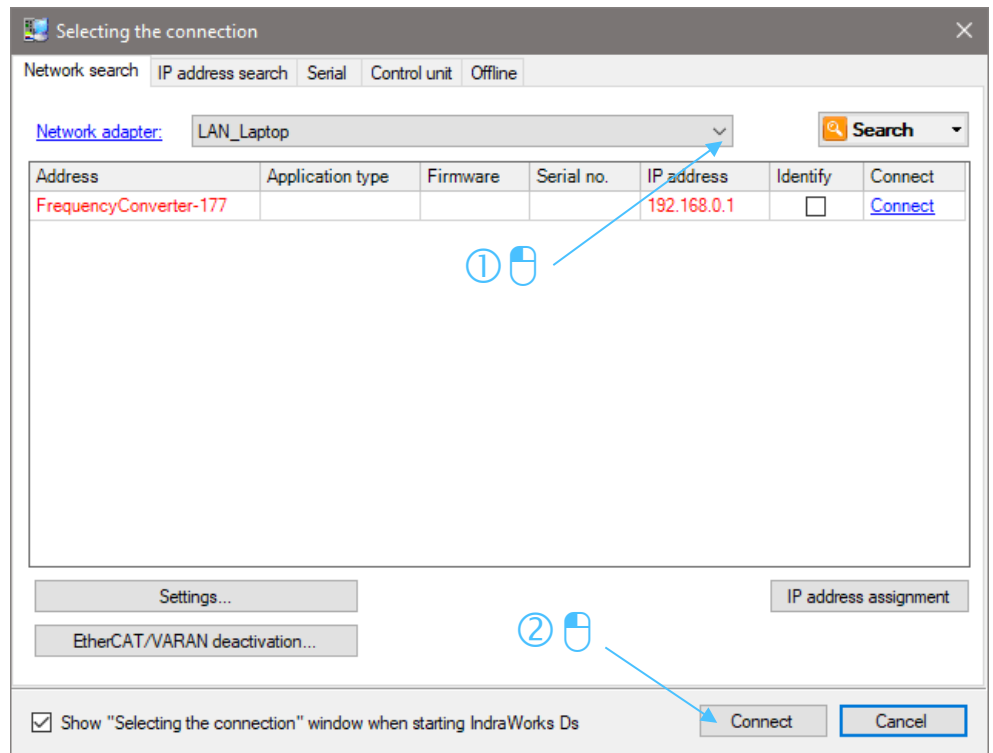


Abb. 4: Connection selection



If your network adapter is in a different IP address range (you can see this by the IP address highlighted in red), you will be asked whether the IP address should be adjusted.

- Click on "Extend IP address settings now".



After exiting IndraWorks Ds, this change will be undone if the checkbox "Restore old settings when exiting" in [Abb. 5: Adjusting the IP configuration](#) is set.

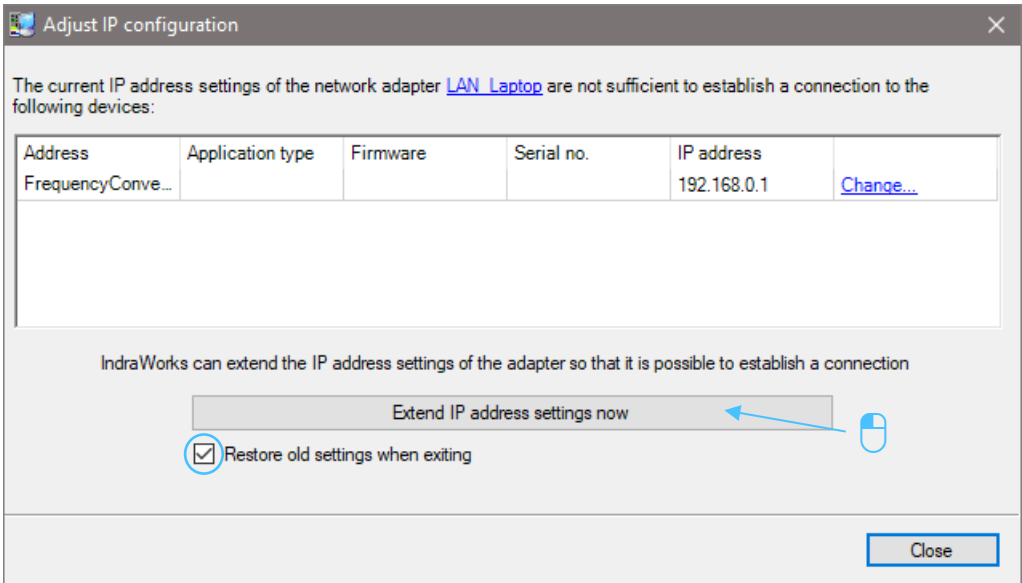


Abb. 5: Adjusting the IP configuration

A window is then opened, see [Abb. 6: IP address added](#), with the customized IP address and then clicking "OK" will establish the connection to the CytroPac.

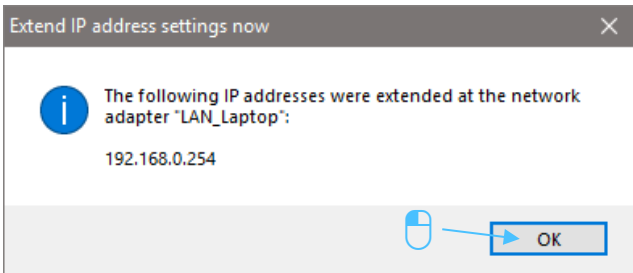


Abb. 6: IP address added



If the connection selection window does not appear, but the IndraWorks Ds start window does, click on the symbol .

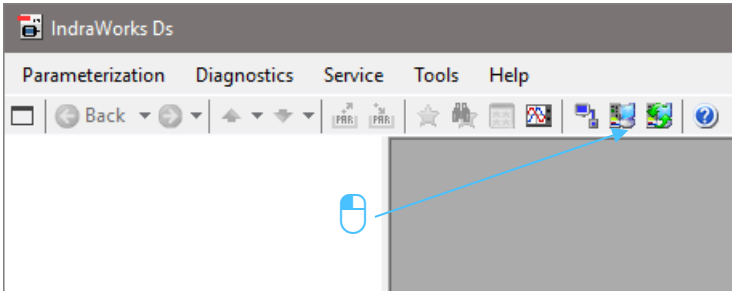


Abb. 7: Connection selection (alternatively)

4 IndraWorks DS functions



Also provide the power supply in addition to the 24V supply so that you have access to all parameters.



Bosch Rexroth recommends making a backup of the delivered parameter set (see chapter [4.1 Saving parameters](#)) before making any changes. This way you can always restore the condition the CytroPac was supplied in by loading this parameter set when this becomes necessary (see chapter [4.2 Loading parameters](#)).

Please also note that the condition as supplied does not match the factory settings of the firmware extension ASF. If you have unintentionally reset the parameters to factory settings and do not have a backed-up parameter set, please contact the Bosch Rexroth customer service team. After specifying the type or material number of your CytroPac, they can send you the corresponding parameter set as supplied.

4.1 Saving parameters

Proceed as follows to backup the parameters:

- In the IndraWorks Ds start window, click "Parameterization", and then click "Save....". The following window is displayed:

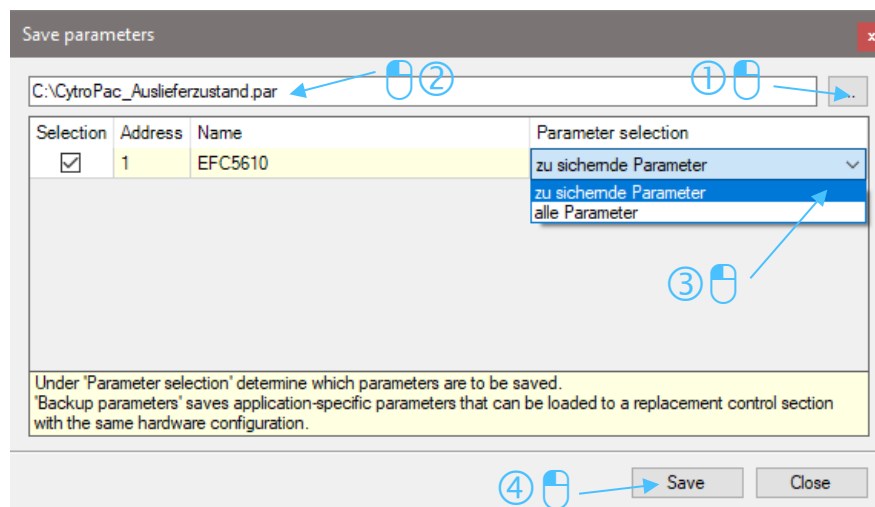


Abb. 8: Save parameters window

- Now, select a path and assign a name for the parameter file. You can save all parameters or the backup parameters (see [Abb. 8: Save parameters window](#)).
 - A backup with the "Backup parameters" is sufficient for a recovery.
 - For a diagnosis (e.g. for service) it is helpful to save a backup with "All parameters". The last errors as well as current values, which are not necessary for the recovery, but contain additional information, are also stored. Then click on "Save". A file with the extension *.par is now saved.



Please do **not** use the function of IndraWorks Ds to restore the condition as supplied, as this will reset the frequency converter to factory settings. The CytroPac-specific parameters will be lost.

4.2 Loading parameters

- ▶ To restore the condition as supplied or another saved status, click on "Parameterization" in the IndraWorks Ds start window and then on "Load...".
- ▶ Now navigate in Windows Explorer to the parameter file you want to restore.
- ▶ Select it and click on "Open".
A window will then open showing the path and name.
- ▶ Now click on "Load" to load the parameter file.

4.3 View/edit parameters in the parameter editor

The fastest way to view or edit parameters is to open the parameter editor.

- ▶ To do this, in the IndraWorks Ds start window, click on "Parameterization", "Parameters" and then on "Parameter Editor".
The parameter editor will then open in a new window.

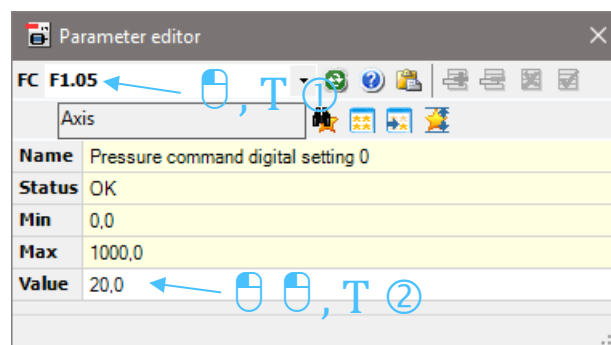


Abb. 9: Parameter Editor window

- ▶ Now click in the empty white field (FC).
- ▶ Now enter a parameter name (e.g. "F1.05") and then press Enter.
At "Value" you will see the current value of the desired parameter.
- ▶ By double clicking you can change the value (if this parameter is writeable) and confirm with Enter.

Tabelle 7: Parameter editor – other functions

Figure	Description
	Refresh parameter
	Parameter search
	Parameter in parameter group



Single bits cannot be set in the parameter editor. A decimal number must be entered.
Conversion from binary to decimal (n=bit position, X=decimal number): $2^n = x$;

Example (for bit5): $2^5 = 32$;

When the parameter is not 0, a 32 (for bit5) must be added.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

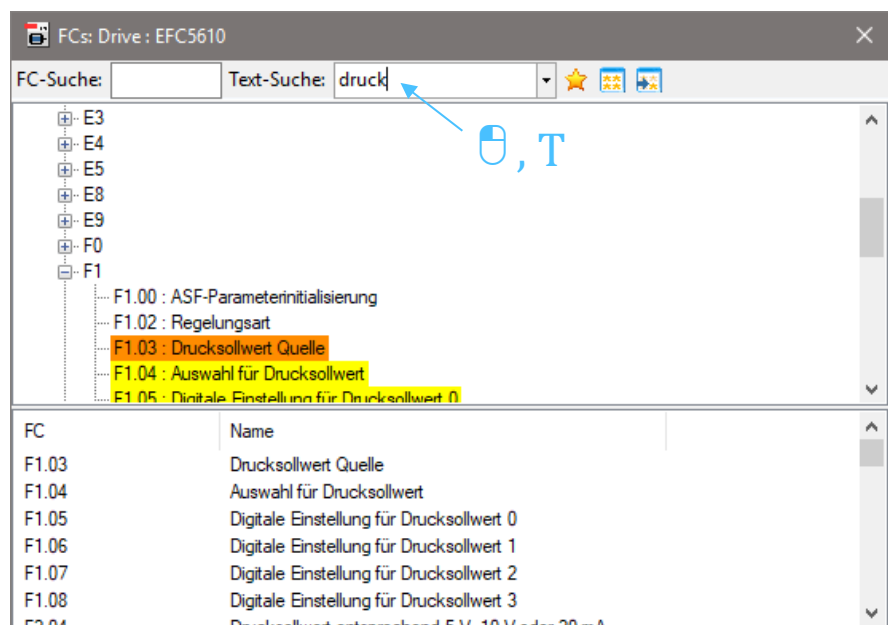
Abb. 10: Bit positions

4.4 Parameter search

If the parameter name is not known, there is the possibility of searching for parameters.

- To do this, in the IndraWorks Ds start window, click on "Parameterization", "Parameters" and then on "Parameter search".

A new window for parameter search will then open (see [Abb. 11: Parameter search window](#)).


Abb. 11: Parameter search window

- By entering a text in the "Text search" field, relevant parameters are displayed in the lower part of the window during the input.

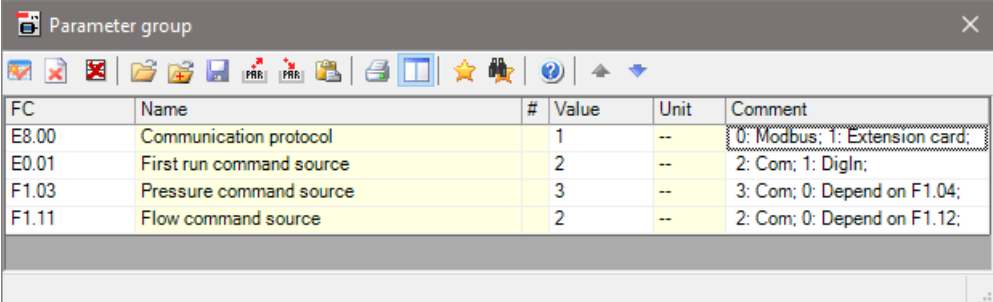
- Double-clicking on a parameter displays it in the parameter editor (alternatively click on the star).
- Likewise, individual (or several) parameters can be displayed in a parameter group (symbol on the right).

4.5 Parameter group

In some cases it is useful to display several parameters in a list.

- To do this, in the IndraWorks Ds start window, click on "Parameterization", "Parameters" and then on "Parameter Group".

A new window for the parameter group will then open (see [Abb. 12: Parameter group window](#)).



FC	Name	#	Value	Unit	Comment
E8.00	Communication protocol	1	--	--	0: Modbus; 1: Extension card;
E0.01	First run command source	2	--	--	2: Com; 1: DigIn;
F1.03	Pressure command source	3	--	--	3: Com; 0: Depend on F1.04;
F1.11	Flow command source	2	--	--	2: Com; 0: Depend on F1.12;

Abb. 12: Parameter group window

- Click on the leftmost symbol to create a new line. Now you can enter a parameter name in the column and confirm by pressing Enter. By pressing Enter again, a new row is automatically created in which further parameters can be entered.
- Alternatively, you can also add further parameters from the parameter editor or from the parameter search to the parameter group (see symbol [Tabelle 7: Parameter editor – other functions](#)).
- In a parameter group, parameters can be provided with comments.
- By clicking the disk symbol the created parameter group can be saved (*.jpg) and reloaded the next time IndraWorks Ds is opened/started by clicking the folder symbol.

4.6 Firmware update EFC5610

An update of the firmware of the frequency converter (if necessary) can only be carried out via a USB connection.



The mains voltage (power connector 12X1) must be present during a firmware update and must not be switched off.

- Connect to the CytroPac via Mini USB cable (see chapter [3.4 Connection with CytroPac \(USB\)](#)).
- Click on "Service", "Firmware management..." in the IndraWorks Ds start window to open the firmware update window.
Here you can see the existing version in the device.

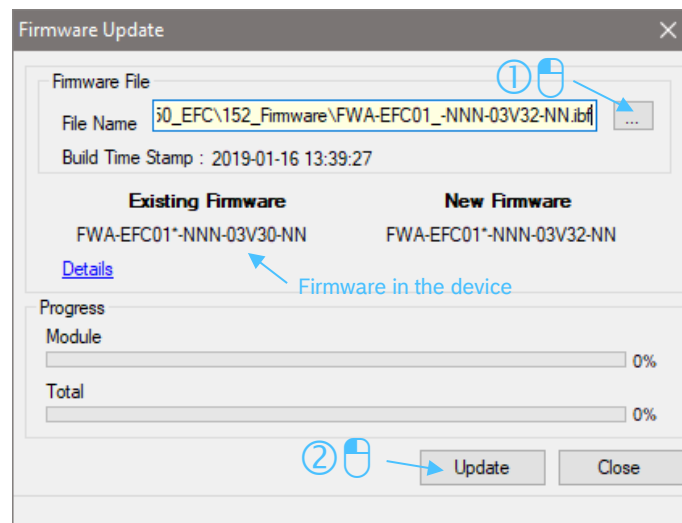


Abb. 13: Firmware update window

- Click on "..." to navigate to a firmware file (*.ibf) and download it to the device by clicking on "Update" (see [Abb. 13: Firmware update window](#)). A firmware downgrade would be performed in the same way.

4.7 Only Premium and Premium M12: Firmware update multi-Ethernet card (MEP)

An update of the firmware of the integrated multi-Ethernet card of the frequency converter (if necessary) can only be carried out via a connection using a network (LAN).



The mains voltage (power connector 12X1) must be present during a firmware update and must not be switched off.

- Connect to the CytroPac using an Ethernet cable (see [3.5 Only Premium and Premium M12: Establishing a connection with CytroPac \(LAN\)](#)).
- In the IndraWorks Ds start window, click on "Service", "Firmware management..." to open the window for a firmware update.

Here you can see the existing version in the device.

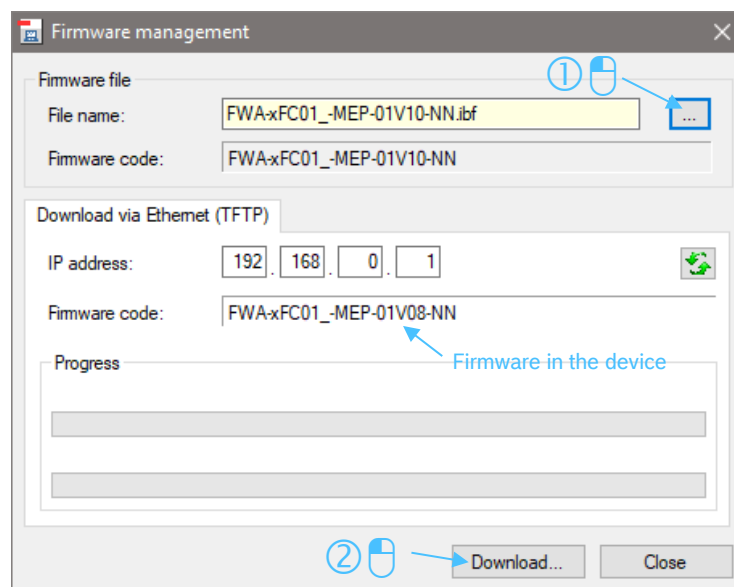


Abb. 14: Firmware update MEP window

- Click on "..." to navigate to a firmware file (*.ibf) and download it to the device by clicking on "Update" (see [Abb. 14: Firmware update MEP window](#)).



A firmware downgrade would be performed in the same way.

4.8 ASF update

An update of the ASF firmware (if necessary) can only be carried out via a USB connection.



The mains voltage (power connector 12X1) must be present during an ASF update and must not be switched off.

- Connect to the CytroPac via Mini USB cable (see chapter [3.4 Connection with CytroPac \(USB\)](#)).
- In the IndraWorks Ds start window, click on "Service", "ASF update" to open the window for an ASF update.
Here you can see the existing version in the device.

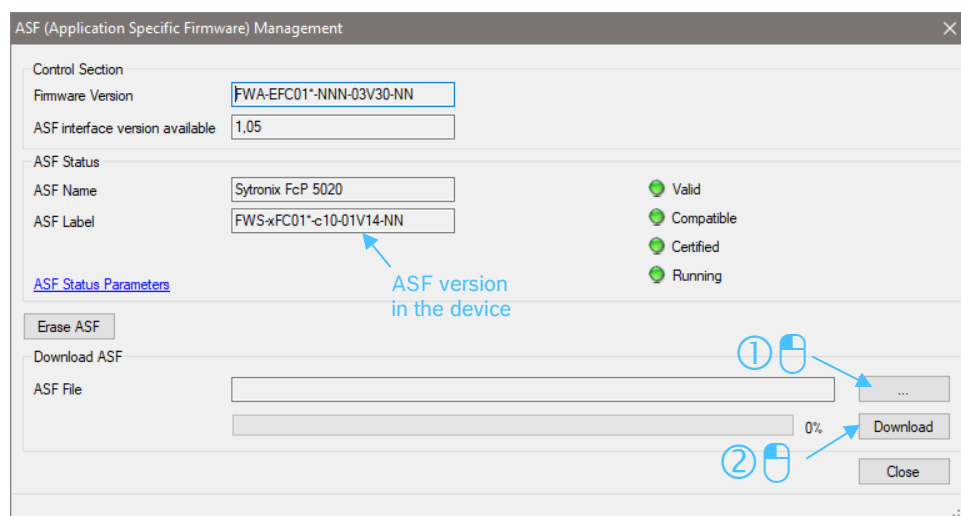


Abb. 15: ASF update window

- Click on "..." to navigate to an ASF file (*.ibf) and download it to the device by clicking on "Download" (see [Abb. 15: ASF update window](#)).



An ASF downgrade would be performed in the same way.
Then, the new ASF version must be licensed.

- Click on "... " to navigate to an ASF license file (*.par) and then click on "Certify" to certify the version (see [Abb. 16: Licensing ASF window](#)).

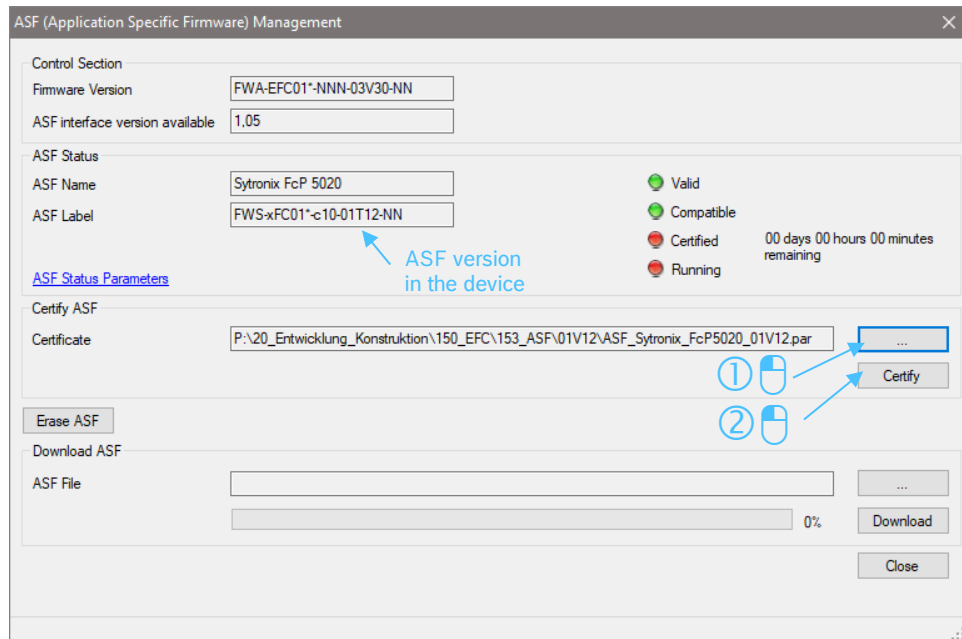


Abb. 16: Licensing ASF window

4.9 Oscilloscope function

The oscilloscope function allows you to perform measurements. Up to four signals can be recorded simultaneously.

- Connect to the CytroPac via Mini-USB cable (see chapter [3.4 Connection with CytroPac \(USB\)](#)) and ensure that you are online.



From MEP firmware version 01V12 it is also possible to use the oscilloscope function via a LAN connection.

- In the IndraWorks Ds start window, click "Diagnosis", "Oscilloscope".
The following window is opened:

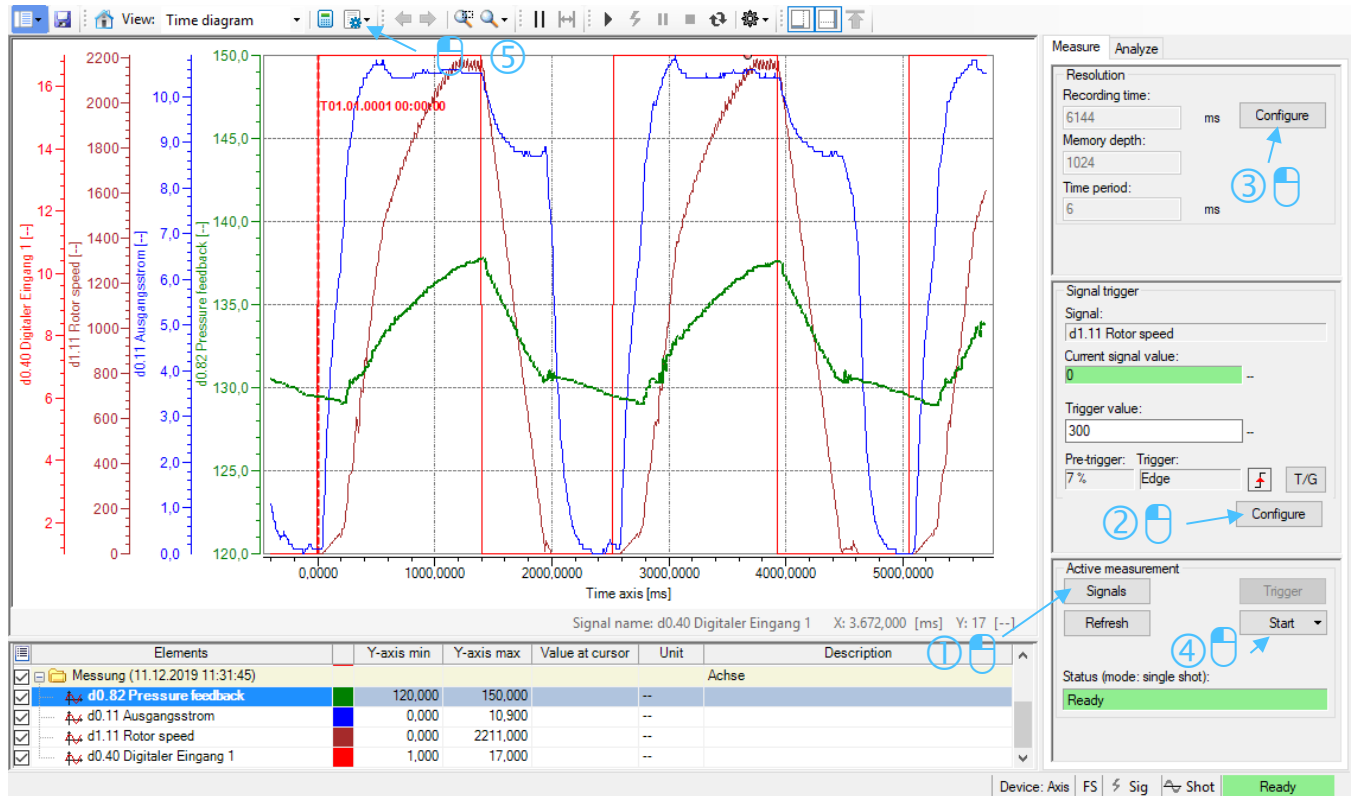


Abb. 17: Oscilloscope function window



Before you can start a measurement, you have to add the signals you want to record ①, set the trigger ② and, if necessary, the resolution ③ depending on the desired measurement duration.

- Click on "Start" to start the measurement ④ (see [Abb. 17: Oscilloscope function window](#)).
- By clicking on ⑤ you have the possibility to display all Y-axes or to select a range in which you can see the min/max/average/RMS values of each channel in a separate table.



For further information, please refer to the IndraWorks Ds oscilloscope's own help function.

Tabelle 8: Overview of the most important signals (parameters)

Parameter	Description
d0.01	Current speed (smoothed value) – for better measurements use d1.11 Rotor speed
d0.11	Output current
d0.12	Output power
d0.20	Power module temperature
d0.40	Digital Input 1 (status of digital inputs X1...X5 $\hat{=}$ bit0...bit4) ¹⁾

Parameter	Description
d0.43	I/O card digital input status (status of digital inputs EX1...EX4 $\triangleq$ bit0...bit3) ¹⁾
d0.60	Relay output (status "ready for operation" 15X1 pin2)
d0.62	I/O card relay output status (status "warning" 15X1 pin6)
d0.80	ASF status word
d0.81	Pressure command value
d0.82	Actual pressure value
d0.83	Flow command value
d0.84	Actual, effective velocity command value – velocity command value (flow command value) generated internally from the pressure control
d0.88	ASF warning
d0.89	ASF error
d0.98	High resolution output current
d1.11	Rotor speed (not smoothed speed value)

1) Single bits can be evaluated by a bit analysis (click on "Calculator")

4.9.1 Example configuration for measuring a pressure drop

① Signals:

- ▶ Add the following signals to the measurement by marking the signal and then clicking on ">" (see [Abb. 18: Adding signals](#)).
- ▶ Confirm the selection with "OK".
 - d0.82 Pressure feedback
 - d1.11 Rotor speed
 - d0.84 Effective speed command
 - d0.98 High resolution output current

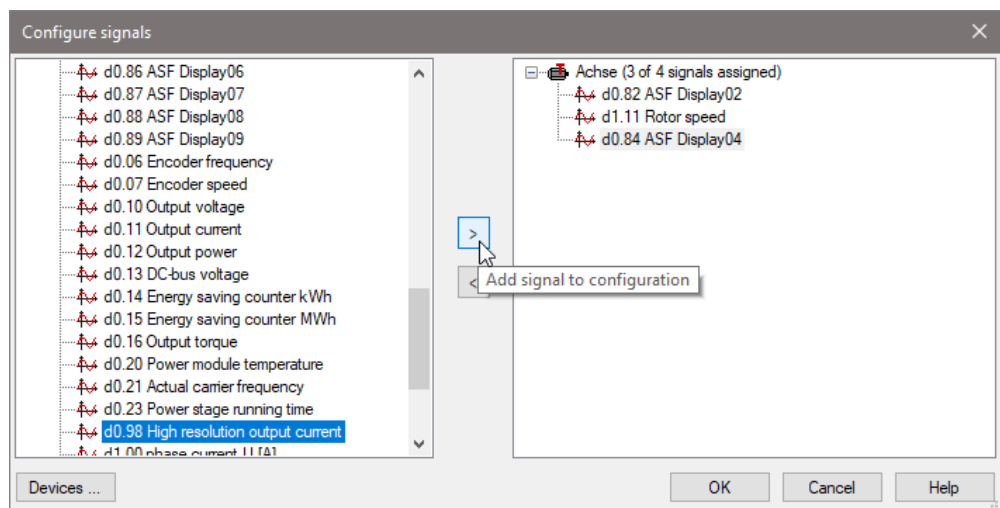


Abb. 18: Adding signals

② Signal trigger:

- ▶ Set the trigger method to "Signal trigger".
- ▶ The pre trigger (recording time in % before the trigger event) should be set low (≤ 10 %).
- ▶ Select the actual pressure value as the trigger signal (d0.82 Pressure feedback).
- ▶ Set the "Falling edge" under "Edge".
- ▶ As "Trigger value" you should select a value which is below the command pressure and which is undershot (here command pressure: 100 bar - trigger value: 95 bar).
- ▶ Confirm the selection with "OK".

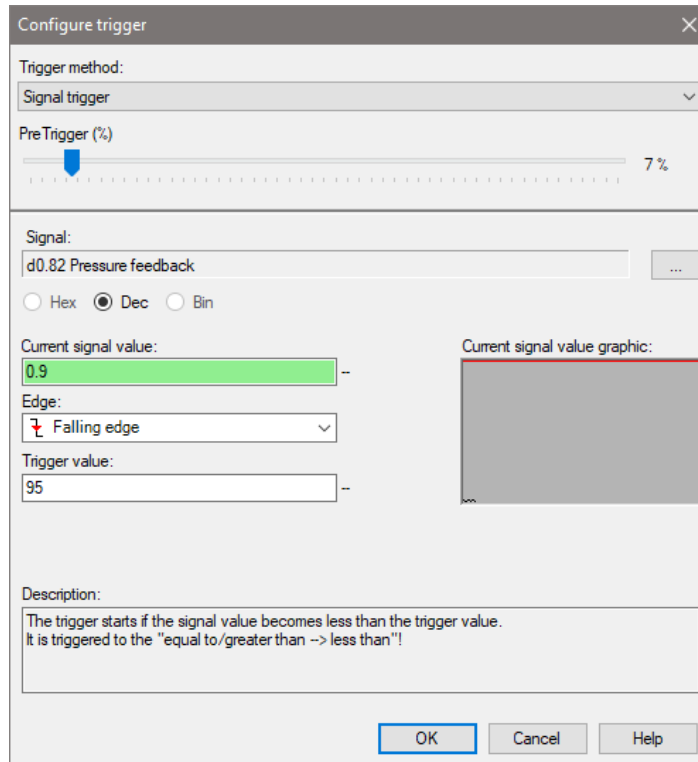


Abb. 19: Configure trigger

③ Resolution:

- ▶ To execute a measurement of about 5 s set the time base to 5 ms.
(Accumulator depth*time period = recording time)
- ▶ Confirm the selection with "OK".

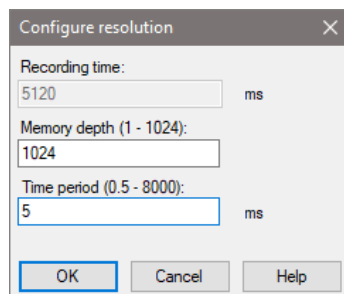


Abb. 20: Configure resolution

④ Start measurement:

By clicking on "Start" the trigger event is waited for before recording starts. This then happens in the background. After the measurement has finished, the signals are saved and then displayed in the diagram.

5 CytroPac functions

5.1 General information about the FCP 5020 ASF

The FcP 5020 ASF is a software extension to the firmware of the EFC5610 converter family and implemented in the CytroPac. The FcP 5020 ASF provides the hydraulic functionality. A Sytronix FcP 5020 system consists of a pressure controller that compares a pressure command value with the actual pressure value of an HM20 pressure sensor installed in the hydraulic system. Depending on the pressure command and actual pressure, the motor speed and thus the flow is readjusted. By overriding the pressure controller, a constant flow can be generated via the flow presetting, which is actually a flow limitation.

The product provides the following features which are relevant for the CytroPac:

- Pressure/flow setting
 - Easy setting of the command value (internal command values and 4 switchable parameters for the pressure command value)
 - Command value setting via communication possible ("Premium" and "Premium M12" only)
- p/Q PID control
 - p/Q control with automatic switching between pressure and flow control modes
 - Flow control
 - Pressure control
 - Two switchable sets of controller parameters
- Extension functions
 - Hydraulic soft start and separate acceleration ramp
 - Sleep/wake function
 - Pressure drop/excessive pressure compensation
 - Pump power limitation
 - Master/slave control ("Premium" and "Premium M12" only)
- Protective function
 - Actual pressure monitoring
 - Limit value for pressure and flow command value
 - Oil change warning/error
 - Thermal pump monitoring
 - CytroPac sensor monitor ("Premium" and "Premium M12" only)
 - LED flashing pattern to indicate the converter status ("Premium" and "Premium M12" only)

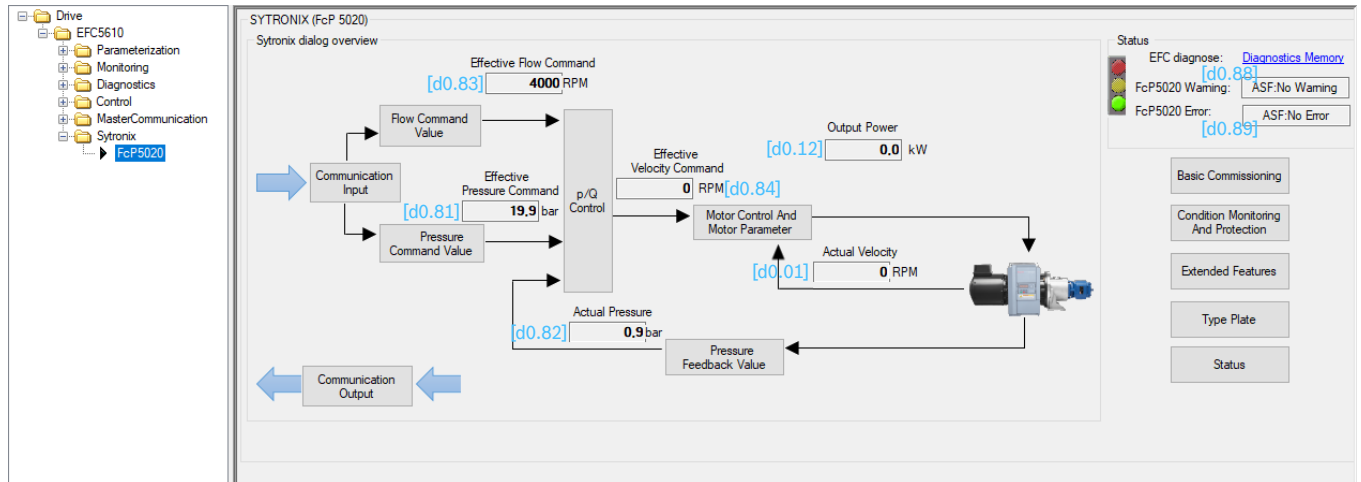


Abb. 21: Overview of the Sytronix FcP 5020 dialog

Tabelle 9: Overview of the parameters of the FcP 5020 dialog

Parameter	Description
d0.01	Display actual speed (smoothed value) – for measurements better use d1.11 Rotor speed
d0.12	Display output power
d0.81	Display current pressure command value
d0.82	Display current actual pressure value
d0.83	Display current velocity command value (flow command value)
d0.84	Display current, effective velocity command value – velocity command value generated internally from the pressure control
d0.88	Display ASF warning – here in plain text (see also page 87)
d0.89	Display ASF error – here in plain text (see also page 95)



The Sytronix FcP 5020 dialog is only available from IndraWorks Ds version 14V20 and onwards.

5.2 Input and outputs (relay outputs, parameter inputs)



Digital inputs and outputs, as well as relay outputs can be assigned functions by both the device firmware of the EFC and the technology function (ASF). Here, assignments made by the ASF have priority over assignments made by the EFC5610 device firmware. The parameters are designated as follows:

Device firmware parameters: [Ex.xx] and [Hx.xx] parameters.

ASF parameters: [Fx.xx] parameters.

Tabelle 10: List of parameters for setting relay outputs

Parameter	Name	Setting range	Default
E2.15	Relay output 1 selection Assignment by firmware EFC5610	0...25 ¹⁾	15
F2.40	Relay 1 output Assignment by ASF	0: No function assigned from ASF 1: Converter warning 2: Two points/double pump control	0
H8.21	Extended relay output selection Assignment by firmware EFC5610	0...25 ¹⁾	0
F2.41	Extension relay output Assignment by ASF	0: No function assigned from ASF 1: Converter warning 2: Two points/double pump control	1

1) See Tabelle 11: Setting range [E2.15 and H8.21]

Tabelle 11: Setting range [E2.15 and H8.21]

Setting	Description
0: Converter ready	After powering on, if no error occurs and there is no run command or output active indication, the frequency converter is ready for operation.
1: Converter running	The output is active when the frequency converter is running and has frequency output (including 0.00 Hz).
10: Converter undervoltage	The output is active when the DC-bus voltage is lower than 230 VDC (model 1P 200 VAC)/ 430 VDC (model 3P 400 VAC). The output will be inactive when DC-bus voltage resumes and becomes stable. In addition, this digital output will be activated by any soft start error.
13: Converter stop due to external error	The output is active as soon as an external error signal is active. The frequency converter stops and the error code 'E-St' is displayed if one X1...X5 input is defined as either "Error signal normally open contact input" or "Error signal normally closed contact input".
14: Converter error	The output is active when an error occurs, inactive when the error is reset.
15: Converter OK	The output is inactive when the frequency converter is powered off or encounters error/warning during running. The output is active when the frequency converter is powered on but not running, or the frequency converter is running without error/warning.
25: Converter error or warning	The output is active when errors/warnings occur on the frequency converter. The output is inactive if there are no errors/warnings on the frequency converter.

Tabelle 12: List of parameters for setting parameter inputs

Parameter	Name	Setting range	Default
E1.03	X4 input (parameter input 1) Assignment by firmware EFC5610	0...36 ¹⁾	0
E1.04	X5 input (parameter input 2) Assignment by firmware EFC5610	0...36 ¹⁾	0
F2.19	X4 input (parameter input 1) Assignment by ASF	0...21 ²⁾	1
F2.20	X5 input (parameter input 2) Assignment by ASF	0...21 ²⁾	2

1) See Tabelle 13: Setting range [E1.03 and E1.04]

2) See Tabelle 14: Setting range [F2.19 and F2.20]

Tabelle 13: Setting range [E1.03 and E1.04]

Setting	Description
0: Inactive	-
31: Second run command source activation	Used to switch to the second run command source.
32: Error signal normally open contact input	Used to receive error signals from external sources (24 V: error signal active, 0 V: error signal inactive).
33: Error signal normally closed contact input	Used to receive error signals from external sources (0 V: error signal active, 24 V: error signal inactive).
34: Error reset	Used to reset errors.
35: Forward running (FWD)	Used to control the Run/Stop command.

Tabelle 14: Setting range [F2.19 and F2.20]

Setting	Description
0: No function assigned from ASF	-
1: Pressure command value selection bit0	See chapter 5.3.2 Pressure command value switchable (via parameter inputs) .
2: Pressure command value selection bit1	See chapter 5.3.2 Pressure command value switchable (via parameter inputs) .
3: p/Q parameter set selection	See chapter 5.5.7 p/Q parameter set switch-over (via parameter input) .
4: Flow command value selection	See chapter 5.4.2 Flow command value switchable (via parameter input) .
5: Master/slave operating mode selector switch	See chapter 7.3.5 Slave operation switch-over via parameter input .
20: Pressure drop compensation trigger	See chapter 5.8 Compensation for pressure drop/excessive pressure compensation .
21: Excessive pressure compensation trigger	See chapter 5.8 Compensation for pressure drop/excessive pressure compensation .

5.3 Pressure command value

There are 3 different ways to provide the pressure command value.

5.3.1 pressure command value fixed

The pressure command value is entered in parameter [F1.05] (Pressure command digital setting 0).

Alternatively, you can set the pressure command value in the Sytronix FcP 5020 interface:

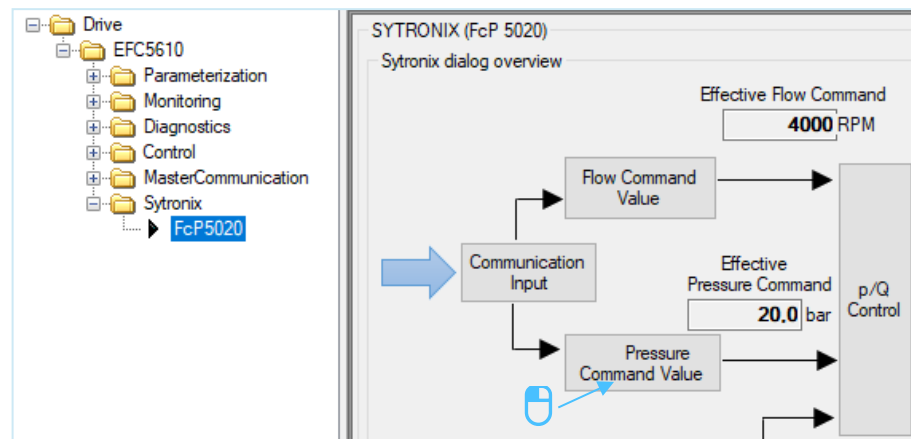


Abb. 22: Pressure command value fixed 1/2

1. Press "Pressure Command Value" (see [Abb. 22: Pressure command value fixed 1/2](#)).
A new dialog opens.
2. Press "Click in this dialog to configure fixed value".
Now a new window opens.

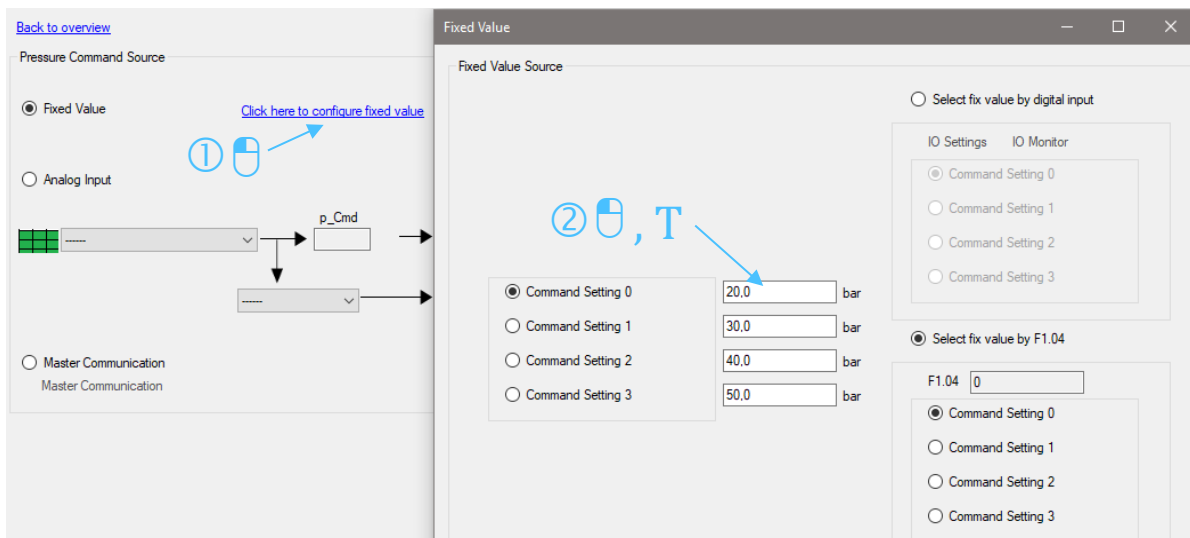


Abb. 23: Pressure command value fixed 2/2

3. Enter the desired pressure command in "Command Setting 0" (see [Abb. 23: Pressure command value fixed 2/2](#)).

5.3.2 Pressure command value switchable (via parameter inputs)

It is possible to set up to 4 different pressure command values. This is done via the digital inputs pin 7 (parameter input 1 – input X4) and pin 8 (parameter input 2 – input X5) of the interface 15X1 (see chapter [5.2 Input and outputs \(relay outputs, parameter inputs\)](#)).

On delivery, both parameter inputs are set as inputs for pressure command values (pressure command selection bit0 and bit1). However, to enable the function, parameter [F1.03] must be set to 1. Which pressure command value is selected is indicated in parameter [F1.04] (0...3) (see tables below).

Tabelle 15: Requirements pressure command value switchable

Parameter	Name	Setting	Value
F2.19	X4 input ¹⁾	Pressure command value selection bit0	1
F2.20	X5 input ²⁾	Pressure command value selection bit1	2
F1.03	Pressure command value source	Select via digital input	1

1) Interface 15X1 pin 7 (parameter input 1)

2) Interface 15X1 pin 8 (parameter input 2)

Tabelle 16: Pressure command value parameter

Pressure command value selection bit0	15X1 pin 7 (X4 input)	0	1	0	1
Pressure command value selection bit1	15X1 pin 8 (X5 input)	0	0	1	1
F1.04		0	1	2	3
Pressure command value		F1.05	F1.06	F1.07	F1.08



It is also possible to use only one parameter input, e.g. to specify only two different pressure command values and use the second parameter input to trigger another function, or additionally to specify two different flow command values.

Alternatively, you can set this in the Sytronix FcP 5020 dialog.

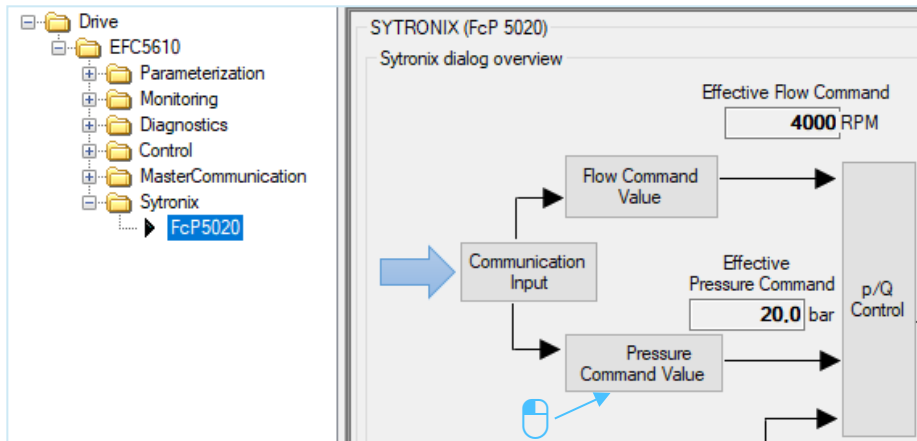


Abb. 24: Pressure command value switchable 1/2

1. Press "Pressure Command Value" (see [Abb. 24: Pressure command value switchable 1/2](#)).
A new dialog opens.
2. Press "Click in this dialog to configure fixed value".
Now a new window opens.

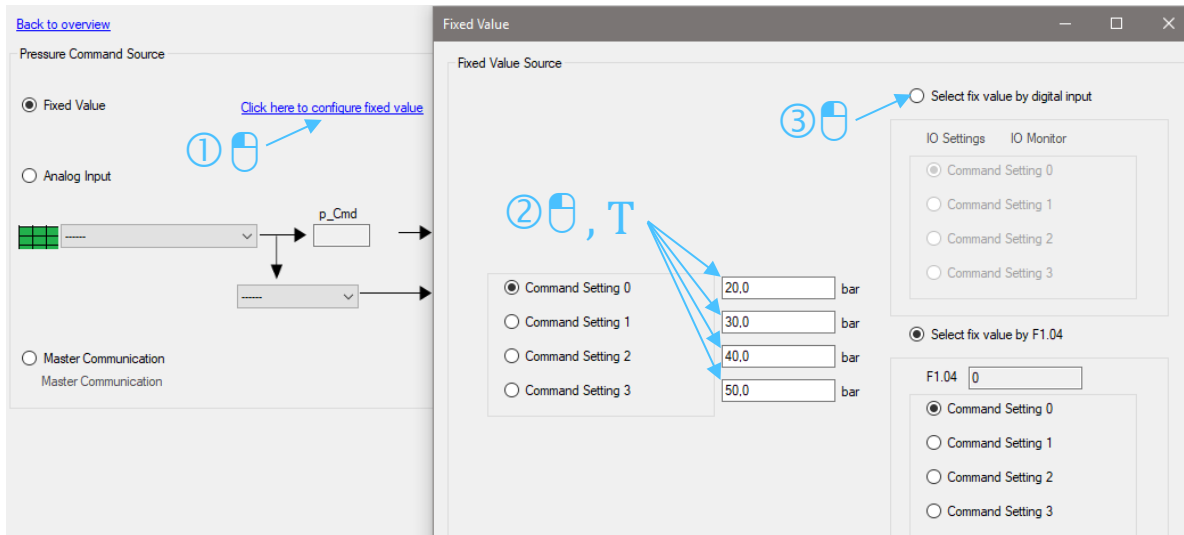


Abb. 25: Pressure command value switchable 2/2

3. Enter the desired pressure command values in "Command Setting 0...3".
4. Then click on the circuit at "Select fix value by digital input"
(see [Abb. 25: Pressure command value switchable 2/2](#)).

5.3.3 Pressure command value via communication (only Premium)

The parameter [F0.21] Pressure command can be written cyclically via field bus. For this, parameter [F1.03] must be set to 3 in the frequency converter (already pre-set).



For further information, see chapter [7.1 Field bus communication](#).

5.4 Flow command value

As for the pressure command value, there are 3 different ways of setting the flow command value. The flow command value is a speed limit and is specified in rpm (revolutions per minute).

5.4.1 Flow command value fixed

The flow command value is entered in parameter [F1.12] (Flow command digital setting 0).

Alternatively, you can set the flow command value in the interface of the Sytronix FcP 5020 dialog:

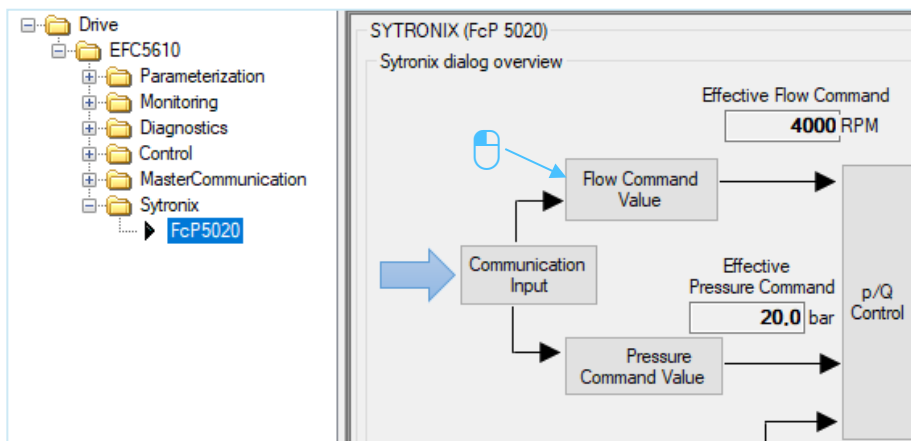


Abb. 26: Flow command value fixed 1/2

1. Press "Flow Command Value" (see [Abb. 26: Flow command value fixed 1/2](#)).
A new dialog opens.
2. Enter the desired flow command value in the field below "Fixed value in parameter" (see [Abb. 27: Flow command value fixed 2/2](#)).

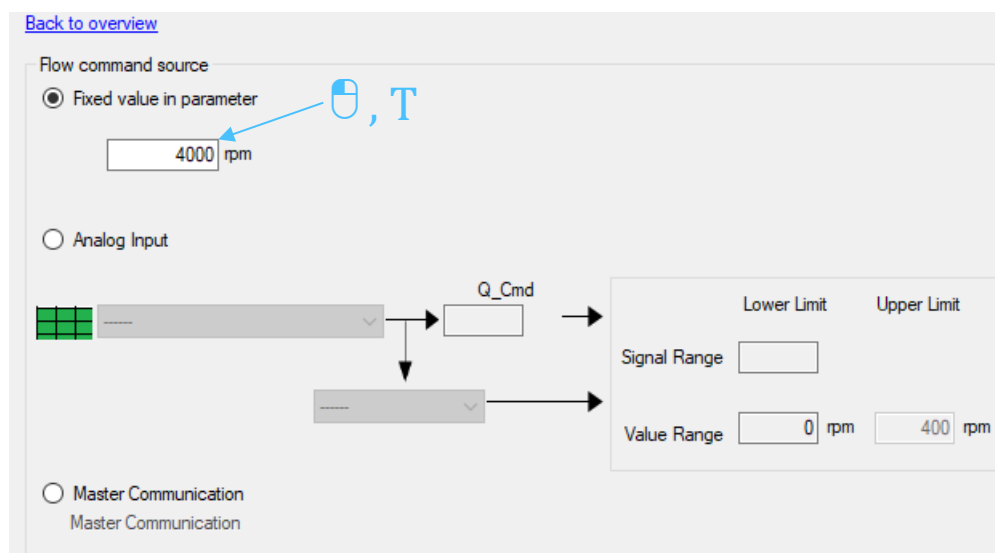


Abb. 27: Flow command value fixed 2/2

5.4.2
Flow command value switchable (via parameter input)

It is possible to set up to 2 different flow command values. This is done via a digital input pin 7 (parameter input 1 – input X4) or pin 8 (parameter input 2 – input X5) of the interface 15X1 (see chapter [5.2 Input and outputs \(relay outputs, parameter inputs\)](#)). To enable the function, parameter [F1.11] must be set to 3. Which flow command value is selected is indicated in parameter [F1.14] (0...1).

Example configuration:

On delivery, both parameter inputs are set as inputs for pressure command values (pressure command selection bit0 and bit1). If 2 pressure command values and 2 flow command values are to be assigned via digital inputs, Bosch Rexroth recommends setting them as follows (see following tables).

Tabelle 17: Requirement flow and pressure command value switchable

Parameter	Name	Setting	Value
F2.19	X4 input ¹⁾	Pressure command value selection bit0	1
F2.20	X5 input ²⁾	Flow command value selection	4
F1.03	Pressure command value source	Select via digital input	1
F1.11	Flow command value source	Select via digital input	3

1) Interface 15X1 pin 7 (parameter input 1)

2) Interface 15X1 pin 8 (parameter input 2)

Tabelle 18: Pressure/flow command value parameters

Pressure command value selection bit0	15X1 pin 7 (X4 input)	0	1	0	1
Flow command value selection	15X1 pin 8 (X5 input)	0	0	1	1
F1.04		0	1	0	1
F1.14		0	0	1	1
Pressure command value		F1.05	F1.06	F1.05	F1.06
Flow command value		F1.12	F1.12	F1.13	F1.13



It is also possible to configure parameter input 1 differently, e.g. to trigger another function, or to use it to switch the flow command values and assign parameter input 2 differently.

5.4.3
Only Premium and Premium M12: Flow command value via communication

The parameter [F0.22] flow command can be written cyclically via field bus. For this, parameter [F1.11] must be set to 2 in the frequency converter (already pre-set).



For further information, see chapter [7.1 Field bus communication](#).

5.5 p/Q PID control

FC		Name	#	Value	Unit	Comment
F3.12	Parameter set 0	P	Proportional gain [0]	8,00	--	
F3.13		I	Integral time 1 [0]	80	--	
F3.14			Integral time 2 [0]	0	--	
F3.15			Integral time T1 switch threshold [0]	0,0	--	
F3.16		D	Differential gain [0]	0,000	--	
F3.17			Filter time for Kd [0]	35	--	
F3.18			Lower limitation for I+D [0]	0	--	
F3.19			System minimum speed [0]	200 ¹⁾	--	
F3.32	Parameter set 1	P	Proportional gain [1]	8,00	--	
F3.33		I	Integral time 1 [1]	80	--	
F3.34			Integral time 2 [1]	0	--	
F3.35			Integral time T1 switch threshold [1]	0,0	--	
F3.36		D	Differential gain [1]	0,000	--	
F3.37			Filter time for Kd [1]	35	--	
F3.38			Lower limitation for I+D [1]	0	--	
F3.39			System minimum speed [1]	200 ¹⁾	--	

Abb. 28: PID control parameter

1) May vary for different CytroPac versions

5.5.1 p/Q PID controller

The p/Q-PID controller consists of a pressure controller followed by a limiter. The limiter ensures that a certain speed is not exceeded (Flow cmd) and that the speed does not fall below a minimum speed.

The pressure control performance is determined by the acceleration capability of the motor/pump combination.

The output of the p/Q PID controller is a speed command value, which is limited in acceleration by a ramp generator.

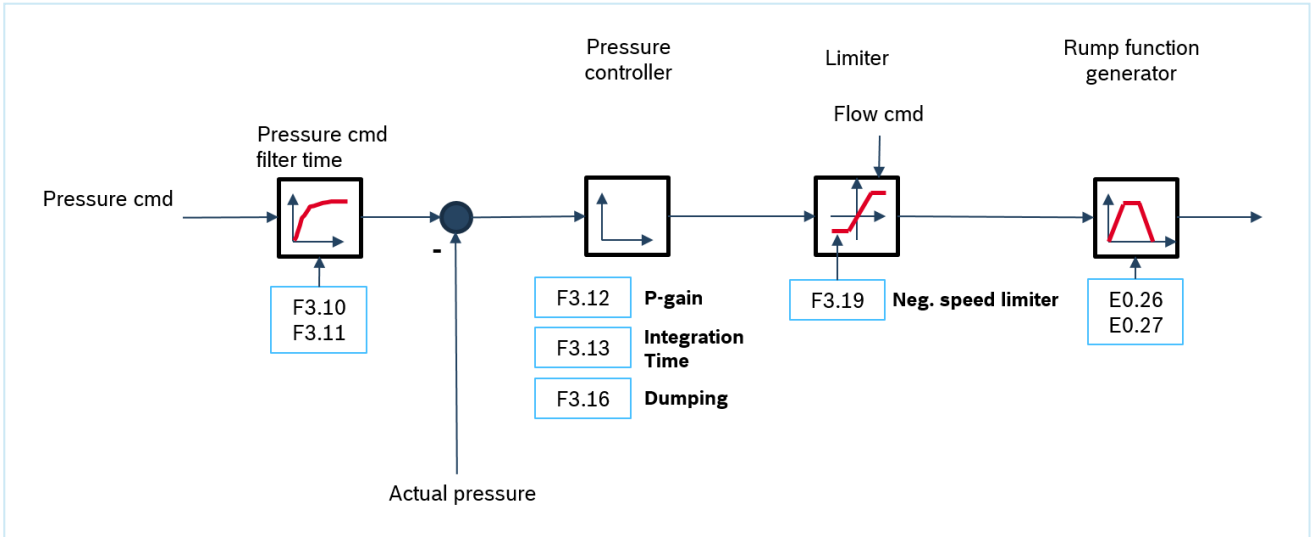


Abb. 29: p/Q-PID controller structure

5.5.2
Pressure command value filter time

Tabelle 19: List of parameters for setting the pressure command value filter time

Parameter	Name	Setting range	Default
F3.10	Filter time for pressure ascending [0]	0...999 ms	80
F3.11	Filter time for pressure descending [0]	0...999 ms	40

With changing pressure command values, the command value step can be damped via filter times. This avoids overshoots or possible undershoots if the command value step is negative.

The cmdnd value filter is designed as a PT1 element.



For systems with constant command pressure, these parameters have no effect.

5.5.3
Pressure controller

Tabelle 20: List of parameters for setting the pressure controller

Parameter	Name	Setting range	Default
F3.12	Gain factor [0]	0.00...500.00 rpm/bar	8.00
F3.13	Integral time 1 [0]	0...999 ms	80
F3.16	Differential gain [0]	0.000...10.000 (rpm/bar)*s	0.000

If there is a pressure drop in the system, the motor/pump combination must accelerate fast enough to compensate the pressure drop.

This can be achieved by increasing the gain or by decreasing the integral time.

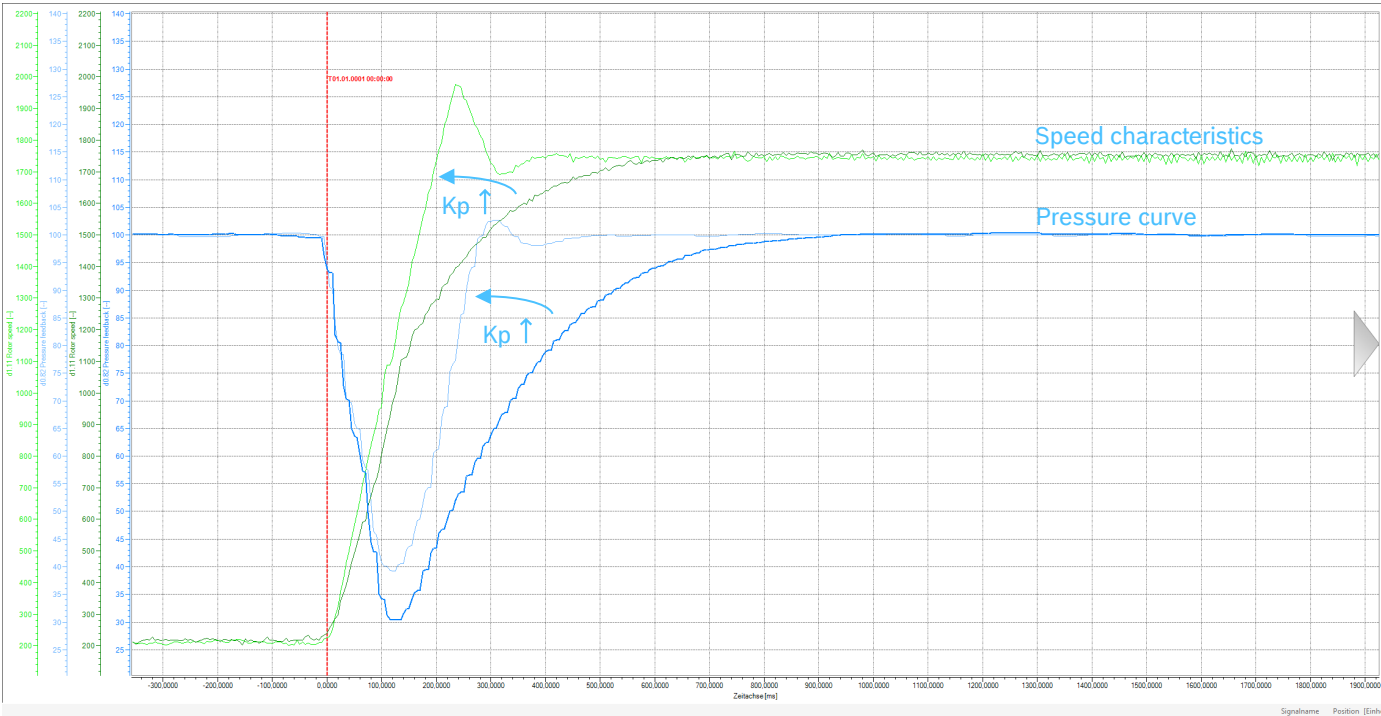


Abb. 30: Effect of change in gain factor (Kp)

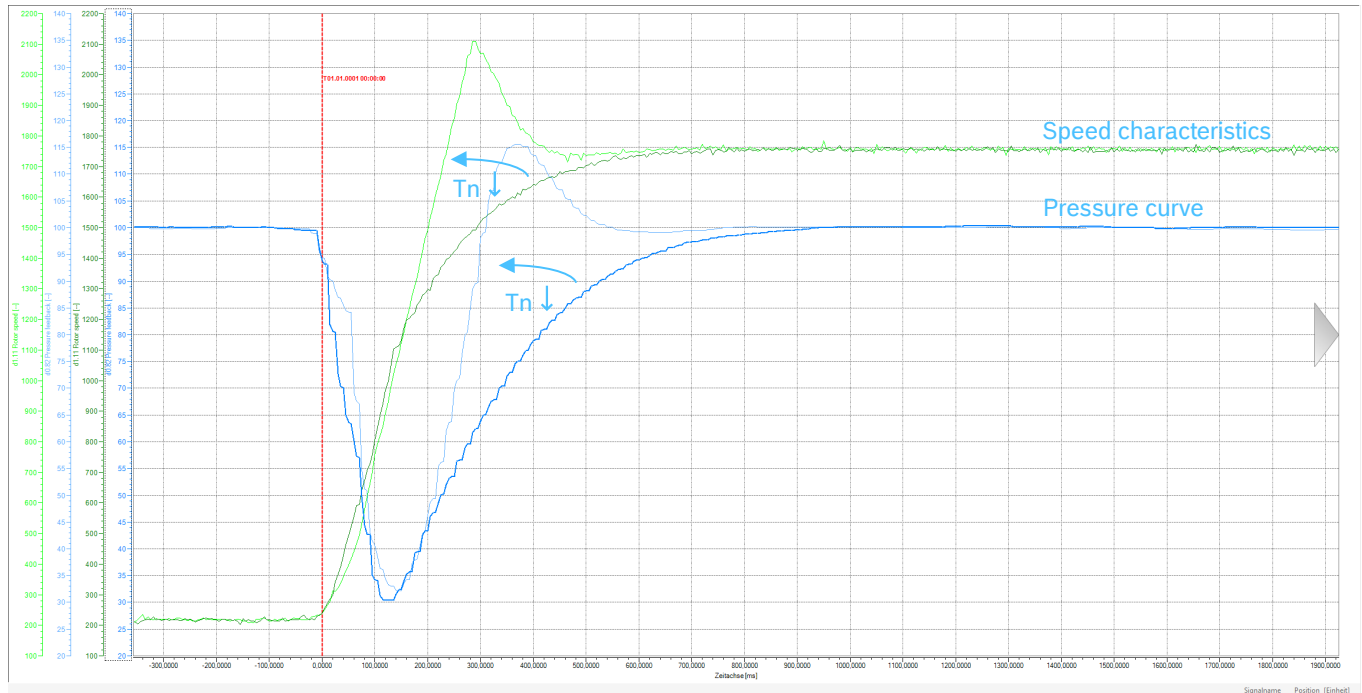


Abb. 31: Effect of change in integral time (Tn)

The differential gain is set to zero by default and is of hardly any significance in constant pressure systems with fixed pressure command value.

With changing pressure command values, it can, similar to PT1 filtering in the command value, counteract a pressure overshoot already during pressure build-up. In this case, it acts as damping, but at the cost of acceleration.

5.5.4 Switching I share

Tabelle 21: List of parameters for setting the integral time

Parameter	Name	Setting range	Default
F3.13	Integral time 1 [0]	0...999 ms	80
F3.14	Integral time 2 [0]	0...999 ms	40
F3.15	Integral time TI switch threshold [0]	-150.0...0.0 bar (with setting 0.0 the switching function is deactivated)	0.0

If a constant pressure system no longer requires a flow rate, a valve is usually closed. Due to the still high speed of the pump, pressure overshooting will then occur. In this situation it is necessary for the pump to decelerate as quickly as possible. A steeper deceleration ramp is achieved by a shorter integral time.



In [F3.15] it is defined from which pressure overshoot on the second integral component is switched. Caution the value must be negative because: pressure command – actual pressure.

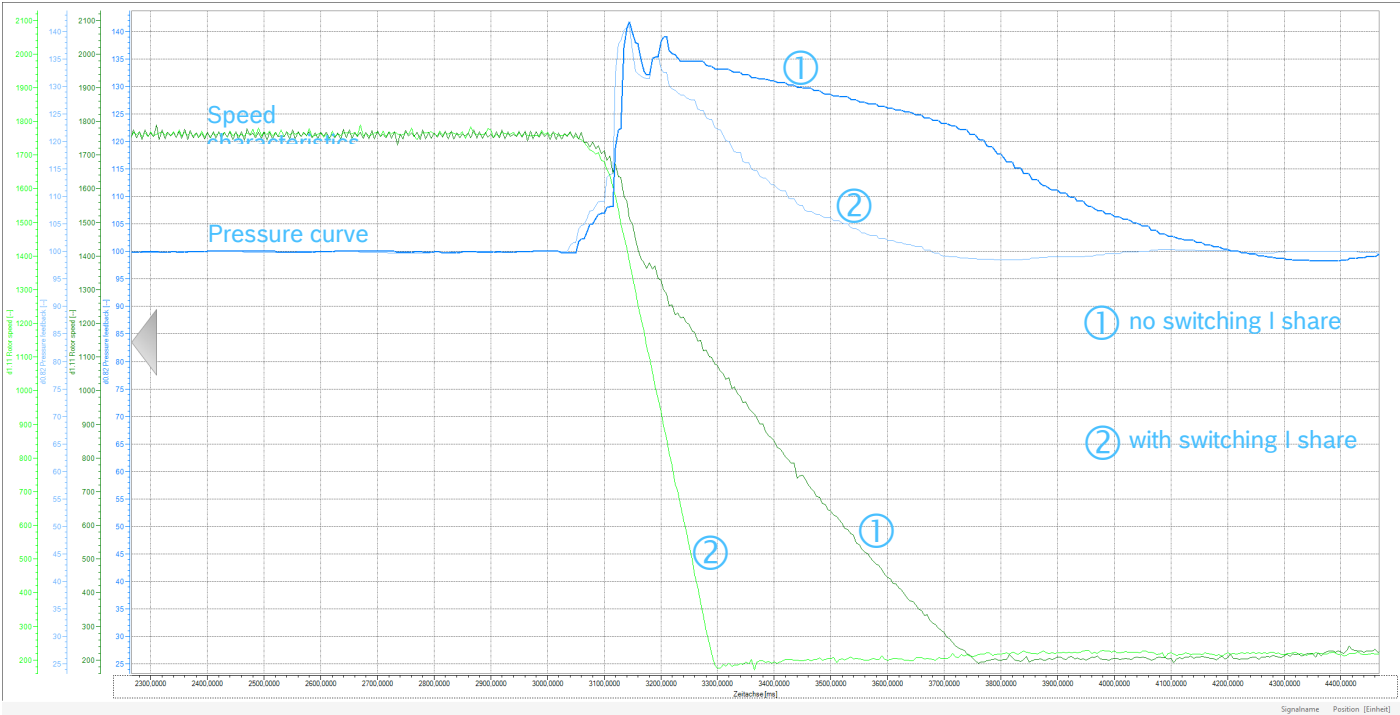


Abb. 32: Effect of switching I share

5.5.5 Acceleration limitation

Tabelle 22: List of parameters for setting the limitation

Parameter	Name	Setting range	Default
E0.26	Acceleration time	0.1...6000.0 s	0.5/1.0 ¹⁾
E0.27	Delay time	0.1...6000.0 s	1.0

1) Depending on CytroPac configuration

The maximum admissible accelerations resp. decelerations are preset in parameters [E0.26] resp. [E0.27].



The value refers in each case to a speed of 4000 rpm. The value for acceleration [E0.26] must not be reduced as otherwise safe operation can no longer be assured.

The acceleration limitation of, for example, 0.5 seconds [E0.26] corresponds to an acceleration of:

$$a = \frac{2 \cdot \pi \cdot n}{t \cdot 60} = \frac{2 \cdot \pi \cdot 4000 \text{ rpm}}{0.5 \text{ s} \cdot 60} = 838 \text{ rad/s}^2$$

The drive is not permitted to accelerate faster.

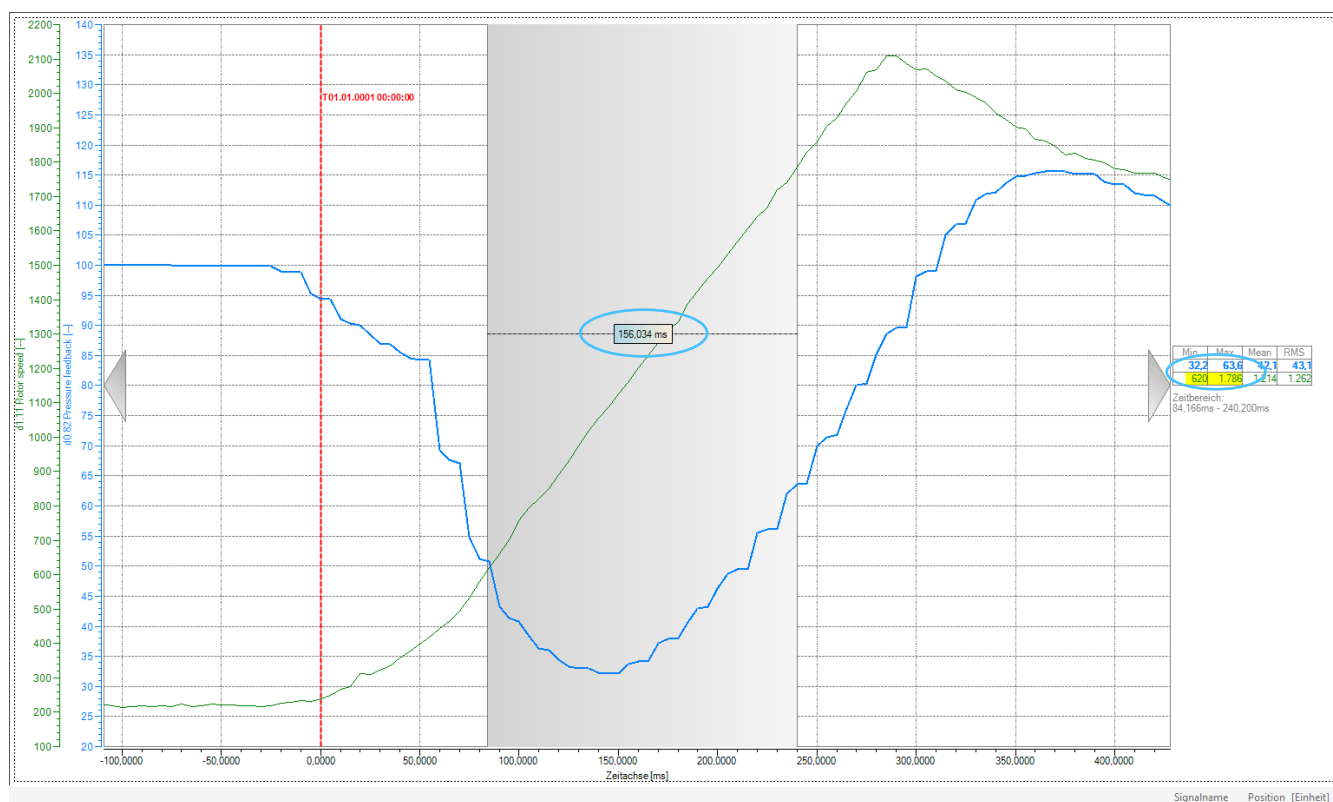
Tabelle 23: Variables of the formula for acceleration calculation

Variable	Unit	Description
a	rad/s ²	Acceleration
n	rpm	Speed to which is accelerated within the time t
t	s	Time of the acceleration limitation [E0.26]

The delay ramp [E0.27] could be reduced to the value of 0.5 s. If an overvoltage error (OE-x error) occurs at an operating point during deceleration, increase the value again.

5.5.6 Assessment of the current acceleration or delay

When optimizing the system with the oscilloscope function of IndraWorks Ds, the speed ramp being driven must be evaluated in order to decide whether the pressure controller can be set even higher, or whether you are already driving at the acceleration limitation of 838 rad/s².

**Abb. 33: Acceleration evaluation**

As in the example measurement, a linear acceleration range of the actual speed value [d1.11] is identified and Δ*n* and Δ*t* are determined.

$$\Delta n = 1786 \text{ rpm} - 620 \text{ rpm} = 1166 \text{ rpm}$$

$$\Delta t = 0.156 \text{ s}$$

$$\Rightarrow a = \frac{2 * \pi * 1166 \text{ rpm}}{0.156 \text{ s} * 60} = 778 \text{ rad/s}^2$$

Since the acceleration value is lower than the maximum 838 rad/s², the drive can be parameterized even more dynamically via the pressure controller settings.

5.5.7 p/Q parameter set switch-over (via parameter input)

This function is used to switch over to other fixed set parameters for the p/Q-PID control or another minimum speed may be set. As standard setting the p/Q parameter set [0] [F3.12...F3.19] is selected. It is also possible to switch to parameter set [1] [F3.32...F3.39] during operation. Parameter set [1] [F3.32...F3.39] has the same function as parameter set [0] [F3.12...F3.19]. This switch-over takes place via a digital input pin 7 (parameter input 1 – input X4) or pin 8 (parameter input 2 – input X5) of the interface 15X1 (see chapter [5.2 Input and outputs \(relay outputs, parameter inputs\)](#)). To enable the function, parameter [F3.00] must be set to 1. Which p/Q parameter set is selected is indicated in parameter [F3.01] (0...1).

Example configuration:

On delivery, both parameter inputs are set as inputs for pressure command values (pressure command selection bit0 and bit1). If 2 pressure command values and p/Q parameter set switching are to be assigned via digital inputs, Bosch Rexroth recommends setting them as follows (see following tables).

Tabelle 24: Requirement p/Q parameter set switching and pressure command value switchable

Parameter	Name	Setting range	Value
F2.19	X4 input ¹⁾	Pressure command value selection bit0	1
F2.20	X5 input ²⁾	p/Q parameter set selection	3
F1.03	Pressure command value source	Select via digital input	1
F3.00	p/Q parameter selection source	Digital input	1

1) Interface 15X1 pin 7 (parameter input 1)
2) Interface 15X1 pin 8 (parameter input 2)

Tabelle 25: Parameter p/Q parameter set switching and pressure command value switchable

Pressure command value selection bit0	15X1 pin 7 (X4 input)	0	1	0	1
p/Q parameter set selection	15X1 pin 8 (X5 input)	0	0	1	1
F1.04		0	1	0	1
F3.01		0	0	1	1
Pressure command value		F1.05	F1.06	F1.05	F1.06



It is also possible to configure parameter input 1 differently, e.g. to trigger another function, or to use it to switch the flow command values and assign parameter input 2 differently.

5.5.8 Premium and Premium M12 only: p/Q parameter set switch-over via communication

This function is used to switch over to other fixed parameters for p/Q-PID control, or another minimum speed can be defined.

The parameter [F0.20] ASF control word can be written cyclically via field bus. The ASF control word must be switched permanently active via bit7 = 1. Now the p/Q parameter set can be switched via bit3. For this, parameter [F3.00] must be set to 2 in the frequency converter (see [Tabelle 26: Requirements p/Q parameter set switchable via communication](#)).

Tabelle 26: Requirements p/Q parameter set switchable via communication

Parameter	Name	Setting range	Value
F3.00	p/Q parameter selection source	Communication	2
F0.20 bit7	ASF control word	0: Inactive 1: Active	1
F0.20 bit3	p/Q parameter set selection	0: Parameter set 0 1: Parameter group 1	

5.6
Hydraulic soft start and separate acceleration ramp

Tabelle 27: List of parameters for setting the hydraulic soft start

Parameter	Name	Setting range	Default
F4.20	p/Q command value soft start delay	0.0...1,000.0 s	0.0 ... 1.0 ¹⁾
F4.21	Minimum pressure command value limit	0.0...[F4.22] bar	5.0
F4.23	Minimum flow command value limit	0...[F4.24] rpm	200
F4.25	Acceleration time hydraulic soft start	0.1...6,000.0 s	5.0

1) Depending on standard parameterization

The soft start function is used to reduce the p/Q command value and acceleration during start-up from standstill to minimize excessive acceleration or potential overcurrent during start-up. This function may already be active on delivery ([F4.20] > 0). Thus, the p/Q command values and the acceleration time are limited to [F4.21], [F4.23] and [F4.25] in the time period [F4.20] after each run command.



Only if the p/Q command value soft start is active is the acceleration time of the hydraulic soft start function activated.

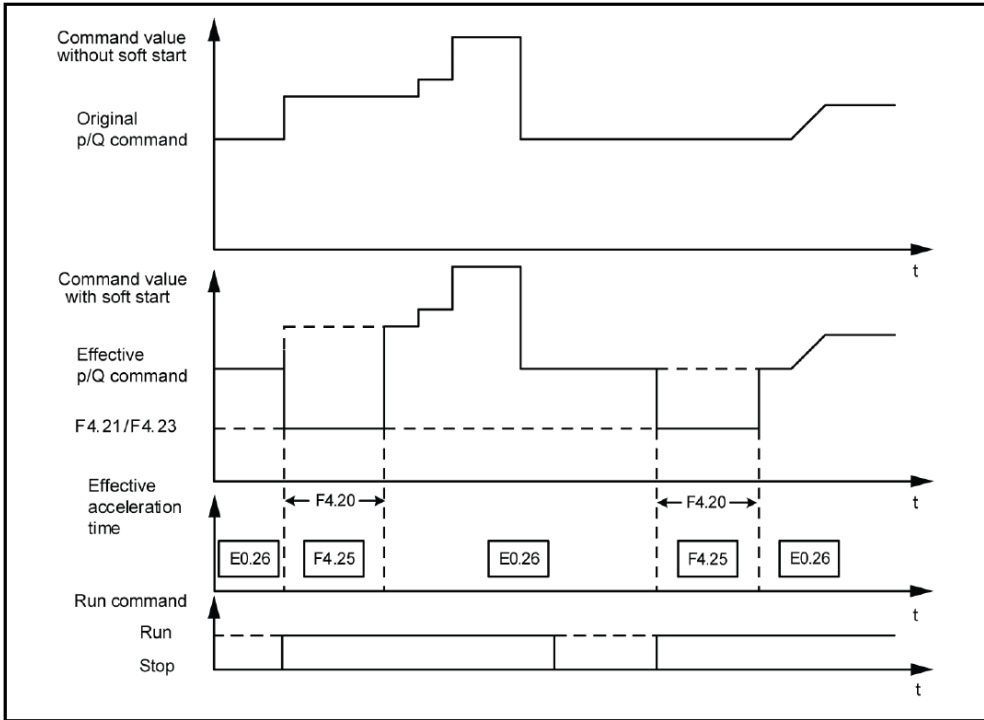


Abb. 34: Hydraulic soft start

5.7 Sleep/wake-up function

This function is used to achieve the maximum extent of energy-saving according to the type of loads in actual applications, for example hydraulic system with small leakage or accumulator. This function runs in the PID control mode. As FcP 5020 ASF is active, it will be assigned to the p/Q PID controller in ASF; at the same time, the basic PID controller of the EFC will be deactivated.



The hydraulic soft start function is active at each wake-up from sleep mode. It should be deactivated by [F4.20] = 0.

Tabelle 28: List of parameters for setting the sleep/wake-up function

Parameter	Name	Setting range	Default
E5.15	Sleep level	0.00...[E0.09] Hz	0.00
E5.16	Sleep delay	0.0...3,600.0 s	60.0
E5.19	Wake up level	0.0...100.0 %	0.0
E5.20	Wake-up delay	0.2...60.0 s	0.5



Conversion of speed (n) into frequency (f): $f = \frac{n}{30}$

The frequency converter may go into the sleep mode when all the conditions below are met:

- [PID actual value] > Pressure command value (x [E5.19] "Wake up level")¹⁾
- [PID output] < [E5.15] "Sleep level"
- [Duration] t ≥ [E5.16] "Sleep delay"

1) Excluded from ASF version 01V16



- PID actual value means actual pressure value in FcP 5020. The wake-up level has unit of percentage. This percentage is referred to the pressure command value in bar.
- PID output means the speed output from the p/Q controller in FcP 5020, without speed ramp from E0.26/E0.27. This value has the same unit as the sleep level, i.e. Hz.

The following figure shows the sleep and wake-up process:

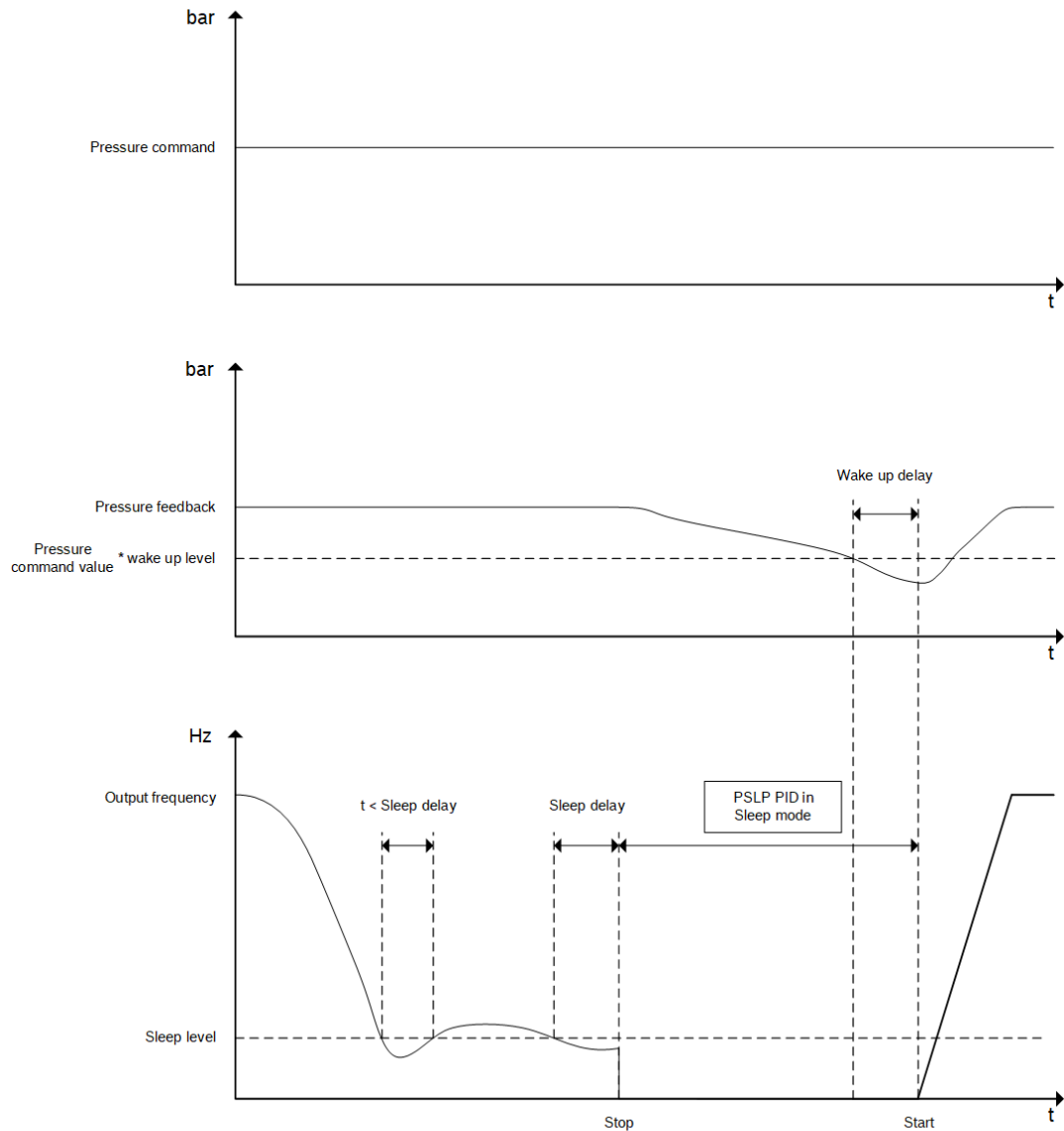


Abb. 35: Sleep and wake-up process

After [E5.16] "Sleep delay", the PID controller changes to the sleep mode. In sleep mode, the frequency converter stops output with "PSLP" displayed in the "Axis status". In the Premium and Premium M12 version, bit1 of [H0.02] Extended status word indicates whether the CytroPac is in sleep mode.

During sleep mode, the frequency converter monitors the PID actual value and wakes up when the following two conditions are met:

- [PID actual value] < Pressure command value x [E5.19] "Wake up level"
- [Duration] t ≥ [E5.20] "Wake up delay"

After having been reactivated, the frequency converter resumes the operational status that it had before changing to the sleep mode.

Alternatively, you can set the sleep/wake-up function in the Sytronix FcP 5020 dialog (see following figures).

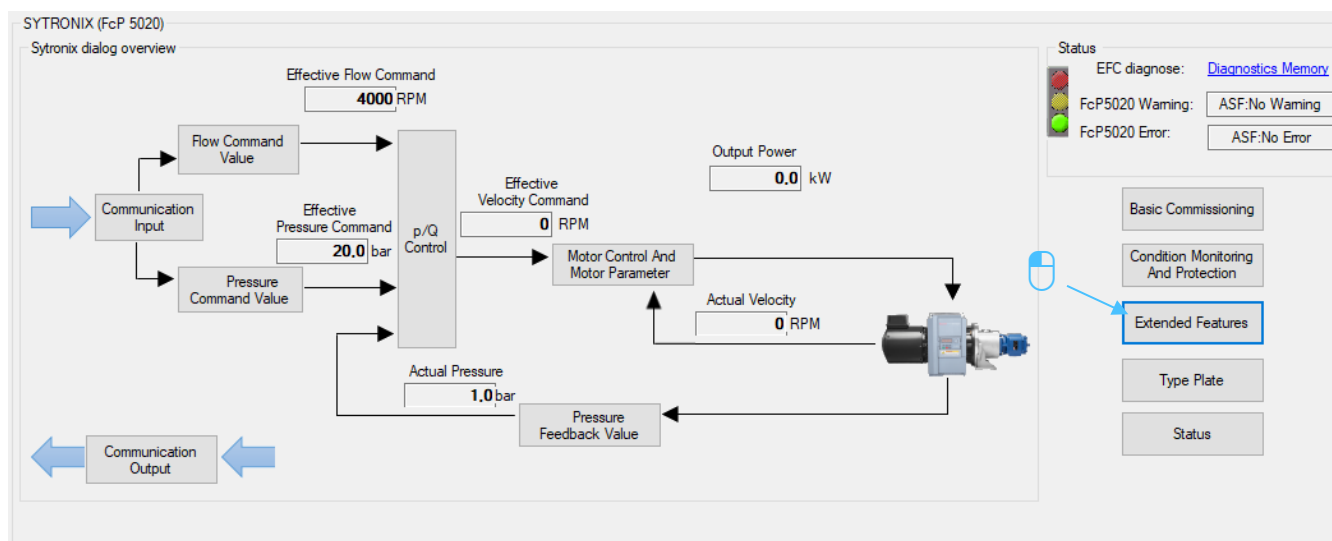


Abb. 36: Configuration of sleep/wake-up function 1/2

The 'Extension Function' dialog box is shown with the 'Sleep/wake function' tab selected. The 'Pump protection control word' is set to 'Sleep/wake function'. The configuration is divided into 'Sleep When' and 'Wake up When' sections.

Sleep When

- Pressure feedback: 1.0 bar, Is greater than pressure command: 20.0 bar, Multiplied by wake up level: 90.0 % [E5.19]
- PID Output: is less than sleep level: 0.00 Hz [E5.15]
- duration: is greater than sleep delay: 60.0 s [E5.16]

Wake up When

- Pressure feedback: 1.0 bar, Is less than pressure command: 20.0 bar, Multiplied by wake up level: 90.0 % [E5.19]
- duration is greater than wake delay: 0.5 s [E5.20]

Abb. 37: Configuration of sleep/wake-up function 2/2

5.8 Compensation for pressure drop/excessive pressure compensation

Pressure drop/overshoot compensation function helps to reduce the incoming pressure drop or excessive pressure. The functions are triggered via digital inputs (parameter inputs), which are set by the customer PLC. This function must be started before the event to be compensated in order to be able to counteract in time.

- ▶ Set the control bit bit4 of [F4.03] to activate this function and configure the corresponding digital input (parameter input 1 or 2) to 20 for pressure drop compensation or 21 for pressure overshoot compensation (see [Tabelle 29: Example configuration of the pressure drop/excessive pressure compensation](#)).
 - If the digital input is set to 1, the pressure command value is modified (added or subtracted) by the value of [F4.45 or F4.46].
 - If the digital input is 0, the effective pressure command value is reset to the original value.

Tabelle 29: Example configuration of the pressure drop/excessive pressure compensation

Parameter	Name	Setting range	Value
F2.19	X4 input ¹⁾	Pressure drop compensation trigger	20
F2.20	X5 input ²⁾	Excessive pressure compensation trigger	21
F4.45	Pressure boost for drop compensation	0.0...1,000.0 bar	Value for desired boost
F4.46	Reduction for excessive pressure compensation	-1.000,0...0,0 bar	Value for desired reduction

- 1) Interface 15X1 pin 7 (parameter input 1)
- 2) Interface 15X1 pin 8 (parameter input 2)

The switching time for the digital input depending on the application should be optimized.

Alternatively, the function can be activated via the Sytronix FcP 5020 dialog and the values for boost and reduction can be entered (see following figures).

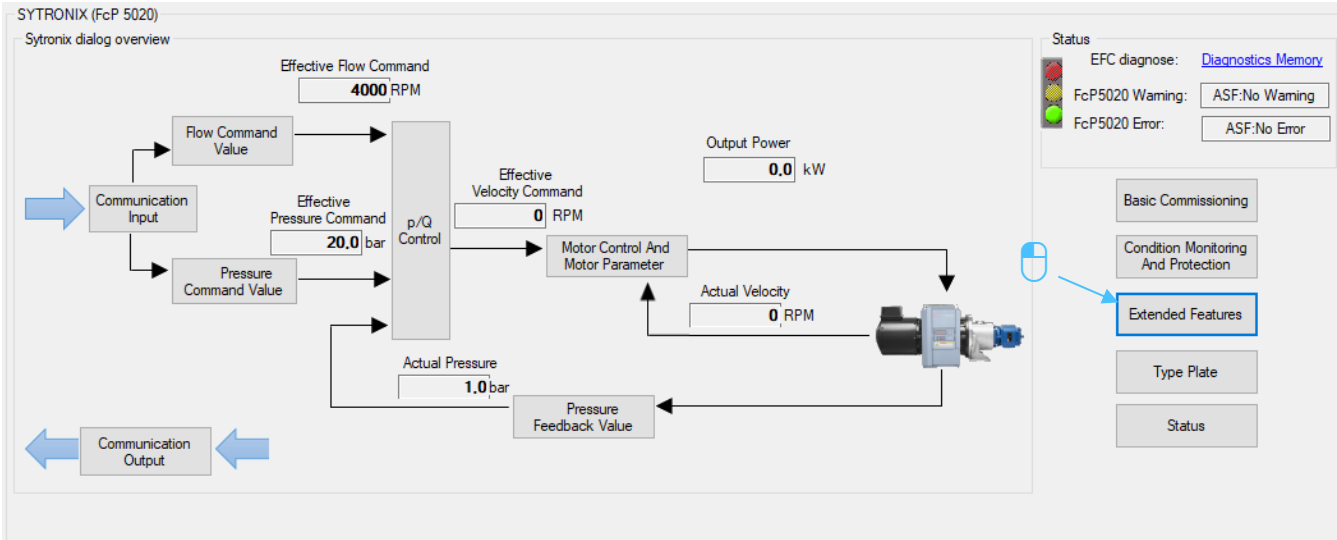


Abb. 38: Configuration of the pressure drop/excessive pressure compensation 1/2

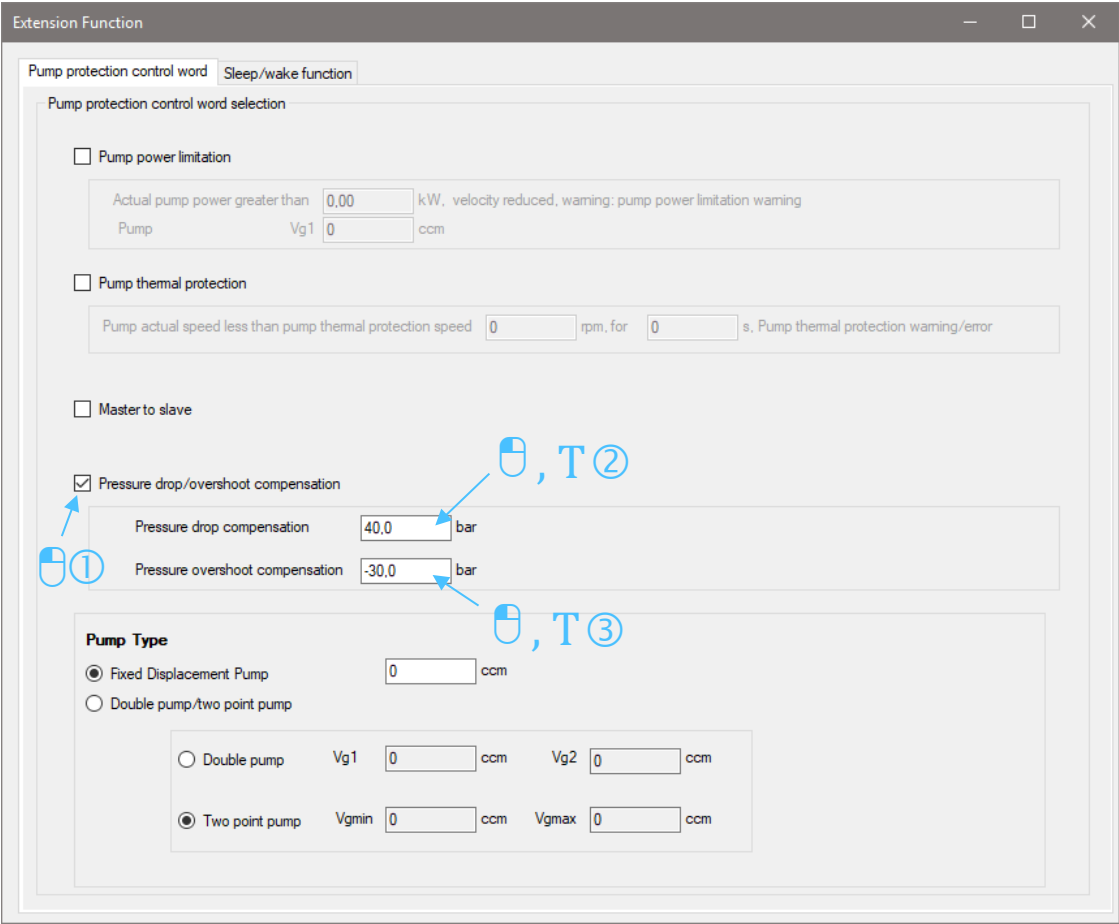


Abb. 39: Configuration of the pressure drop/excessive pressure compensation 2/2

5.9 Pump output limitation

Pump power limitation function can be activated via bit0 of [F4.03].
The real-time pump power can be calculated from the actual pressure value, the actual speed value and pump displacement volume. If the calculated pump power output exceeds the pump power limit value [F4.35] then the speed will be reduced to keep the pump power output within the limit value.

Tabelle 30:List of parameters for pump power limitation

Parameter	Name	Setting range	Value
F4.30	Pump Vg1 ¹⁾	0...1,000 ccm	Pump displacement
F4.35	Pump output ²⁾	0.00...315.00 kW	Set to the value to be limited

1) The CytroPac is available with 4 different pump sizes (4/5.5/8/11 ccm)
2) The CytroPac is available in 4 different power stages (1.5/2.2/3/4 kW)

Alternatively, the pump power limitation can also be configured via the Sytronix FcP 5020 dialog (see following figures).

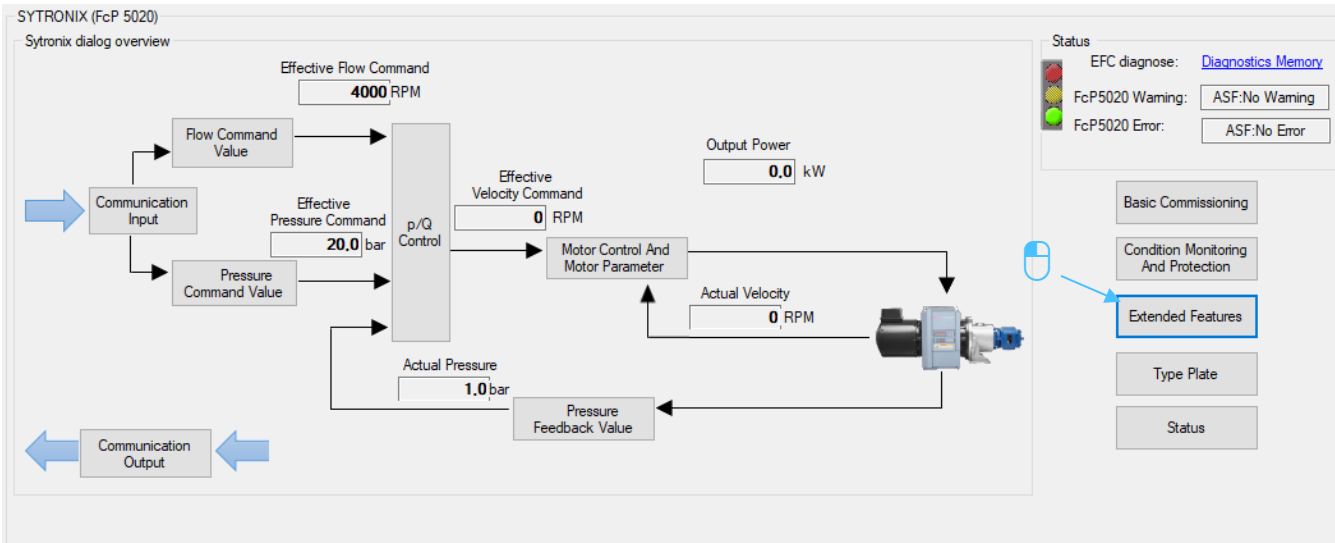


Abb. 40: Configuration of the pump power limitation 1/2

The 'Extension Function' dialog is shown with the 'Pump protection control word' tab selected. The 'Sleep/wake function' sub-tab is active. Under 'Pump protection control word selection', the 'Pump power limitation' checkbox is checked. A blue circle with the number 1 points to this checkbox. The configuration for this function is: 'Actual pump power greater than 4.00 kW, velocity reduced, warning: pump power limitation warning'. A blue circle with the number 2 points to the '4.00' value. The 'Vg1' parameter is set to 4 ccm. Below this, the 'Pump thermal protection' checkbox is unchecked. The 'Master to slave' and 'Pressure drop/overshoot compensation' checkboxes are also unchecked. The 'Pump Type' section shows 'Fixed Displacement Pump' selected. A blue circle with the number 3 points to the '4' value in the 'Vg1' field. The 'Double pump/two point pump' section shows 'Two point pump' selected, with 'Vgmin' set to 4 ccm and 'Vgmax' set to 0 ccm. The 'Double pump' option is also visible with 'Vg1' at 4 ccm and 'Vg2' at 0 ccm.

Abb. 41: Configuration of the pump power limitation 2/2

6 Protective functions

6.1 Actual pressure monitoring

This monitoring is deactivated in the condition as supplied.

Tabelle 31: List of parameters for overpressure detection

Parameter	Name	Setting range	Default
F4.00	Protection function configuration word	0...15 Bit0: Pressure sensor failure (PSF) Bit1: Actual pressure monitoring Bit2: p/Q max. command value limit Bit3: Oil change detection	4
F4.15	Maximum system pressure (warning)	0.0...[F4.16] bar	500.0
F4.16	Maximum pump pressure (error)	[F4.15]...4,000.0 bar	1000.0
F4.17	Maximum system pressure warning time delay	0.0...6000.0 s	0.0
F4.18	Maximum pump pressure error time delay	0.0...6000.0 s	0.0

The detection of actual pressure values can be activated via bit1 of parameter [F4.00].



The actual pressure monitoring function is continuously active, regardless of whether the drive is in operation or in standby mode.

[F4.15]: When the actual pressure value goes beyond [F4.15] bar for [F4.17] s, the warning ([d0.88] = 1) will be triggered for the pressure feedback surpassing the maximum admissible system pressure.

[F4.16]: When the actual pressure value goes beyond [F4.16] bar for [F4.18] s, the error ([d0.89] = 1) will be triggered for the pressure feedback value surpassing the pump limit pressure, and then the drive stops.

Alternatively, actual pressure monitoring can also be configured via the Sytronix FcP 5020 dialog (see following figures).

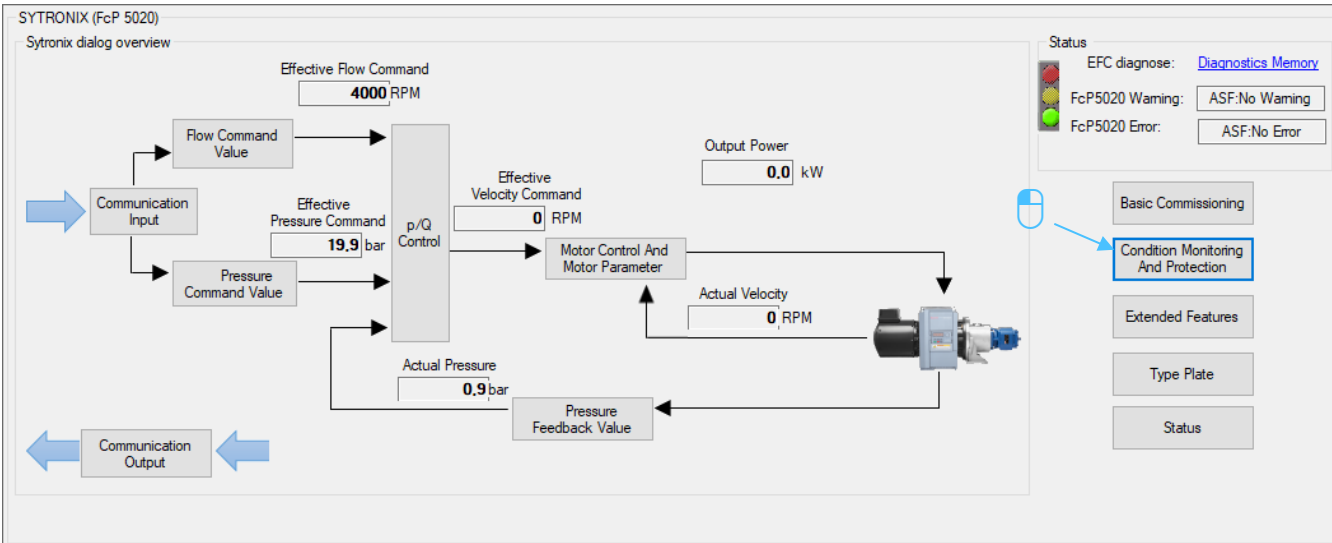


Abb. 42: Actual pressure monitoring 1/2

The 'Condition Monitoring' window is used to configure various protective functions. It includes several sections with checkboxes and input fields:

- ☐ Pressure Feedback failure monitoring (PSF, only needed for voltage pressure sensor)
- Negative Velocity:** Velocity 0 less than -1 rpm, for time greater than 10.0 seconds, PSF Error
- Positive Velocity:** Velocity 0 greater than 200 rpm, for time greater than 2.0 seconds, and sensor feedback < 0.1 bar, PSF error
- Standby:** Pressure feedback is greater than 5.0 bar, and dp/dt < 1 bar / 1.0 seconds, and for time greater than 2 * 1.0 seconds, PSF error
- ☒ Actual pressure monitoring
 - Pressure feedback 0.9 bar, Greater than 500.0 bar, warning: Pressure feedback exceed limit
 - 1000.0 bar, error: Pressure feedback exceed pump limit
- ☒ Maximal pressure/flow command limitation
 - Pressure Command greater than 240.0 bar, Pressure Command = 240.0 bar, warning: Pressure command exceed limit
 - Flow Command greater than 4000 rpm, Flow Command = 4000 rpm, warning: Flow command exceed limit
- ☒ Minimal pressure/flow command limitation
 - Pressure Command less than 5.0 bar, Pressure Command = 5.0 bar, warning: Pressure command exceed limit
 - Flow Command less than 200 rpm, Flow Command = 200 rpm, warning: Flow command exceed limit
- ☒ Oil change detection
 - Oil operating time 5 Greater than 19 000 hours, warning: Oil change warning
 - 20 000 hours, error: Oil change error
 - Reset Oil Operating Time button

Abb. 43: Configuration of actual pressure monitoring 2/2

6.2 Limit value for pressure and flow command value

This monitoring is activated in the condition as supplied.

Tabelle 32: List of parameters for the limit value for the pressure and flow command value

Parameter	Name	Setting range	Default
F4.00	Protection function configuration word	0...15 Bit0: Pressure sensor failure (PSF) Bit1: Actual pressure monitoring Bit2: p/Q max. command value limit Bit3: Oil change detection	4
F4.21	Minimum pressure command value limit	0.0...[F4.22] bar	5.0
F4.22	Upper limit for pressure command value	[F4.21]...1,000.0 bar	240.0
F4.23	Minimum flow command value limit	0...[F4.24] rpm	200
F4.24	Upper limit for flow command value	[F4.23]...5,000 rpm	4000

The minimum pressure and flow command value limitation ([F4.21 and F4.23]) works all the time, independently to any control bit. That means if the setting pressure or flow command value is lower than [F4.21 or F4.23], it will be limited to [F4.21 or F4.23] without any error/warning message.

The maximum pressure and flow command value limitation should not be deactivated. This function will check whether the pressure or flow command value given by customer exceeds the limit value set in [F4.22 and F4.24]. If a given command exceeds its limit value, the effective command value will be limited to the maximum limit, and a warning signal will be raised.

Alternatively the limits of pressure and flow command values can also be set via the Sytronix FcP 5020 dialog (see following figures).

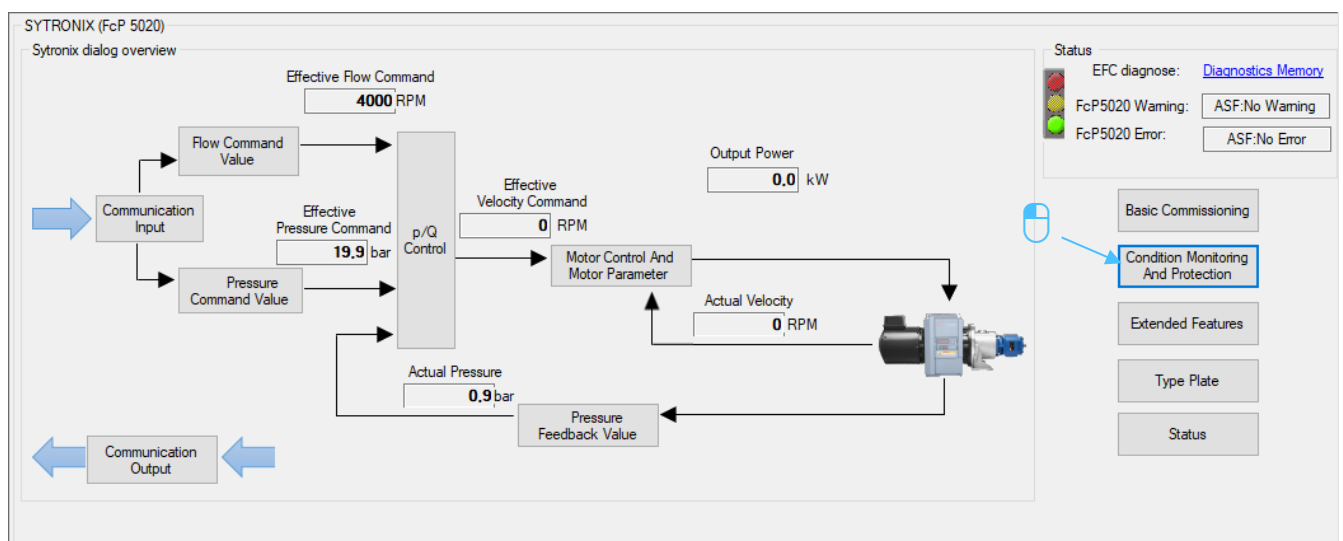


Abb. 44: Configuration of the Limit value for pressure and flow command value 1/2

Condition Monitoring

☐ Pressure Feedback failure monitoring (PSF, only needed for voltage pressure sensor)

Negative Velocity

Velocity less than rpm, for time greater than seconds, PSF Error

Positive Velocity

Velocity greater than rpm, for time greater than seconds, and sensor feedback < 0.1 bar, PSF error

Standby

Pressure feedback is greater than bar, and dp/dt < 1 bar / seconds, and for time greater than 2 * seconds, PSF error

☐ Actual pressure monitoring

Pressure feedback bar, Greater than bar, warning: Pressure feedback exceed limit
 bar, error: Pressure feedback exceed pump limit

☒ Maximal pressure/flow command limitation

Pressure Command greater than bar, Pressure Command = bar, warning: Pressure command exceed limit
 Flow Command greater than rpm, Flow Command = rpm, warning: Flow command exceed limit

☒ Minimal pressure/flow command limitation

Pressure Command less than bar, Pressure Command = bar, warning: Pressure command exceed limit
 Flow Command less than rpm, Flow Command = rpm, warning: Flow command exceed limit

☒ Oil change detection

Oil operating time Greater than hours, warning: Oil change warning
 hours, error: Oil change error

Annotations:

- U, T 1**: Points to the 500,0 bar warning limit for actual pressure monitoring.
- U, T 2**: Points to the 240,0 bar warning limit for maximal pressure command limitation.
- T 3**: Points to the 4000 rpm warning limit for maximal flow command limitation.
- U, T 4**: Points to the 5,0 bar warning limit for minimal pressure command limitation.

Abb. 45: Configuration of the limit values for pressure and flow command value 2/2

6.3 Oil change warning/error

This monitoring is deactivated in the condition as supplied and can be activated via bit3 of [F4.00].

Tabelle 33: List of parameters for the oil change warning/error function

Parameter	Name	Setting range	Default
F4.00	Protection function configuration word	0...15 Bit0: Pressure sensor failure (PSF) Bit1: Actual pressure monitoring Bit2: p/Q max. command value limit Bit3: Oil change detection	4
F4.51	Hours for oil change warning	0...60,000 hours	19,000
F4.52	Hours for oil change error	0...60,000 hours	20,000
F4.53	Oil in operation time	0...60,000 hours	0
F4.54	Reset oil in operation time	0...1	0

Oil in operation time will be counted and saved in [F4.53] when frequency converter starts running. If this time exceeds warning or error level in [F4.51] or [F4.52], a warning or error signal will be generated. Parameter [F4.54] = 1 is used to reset the oil in operation timer [F4.53].



The timer is only active during drive in operation (drive enabled).

Alternatively, the oil in operation time can also be reset via the Sytronix FcP 5020 dialog (see following figures).

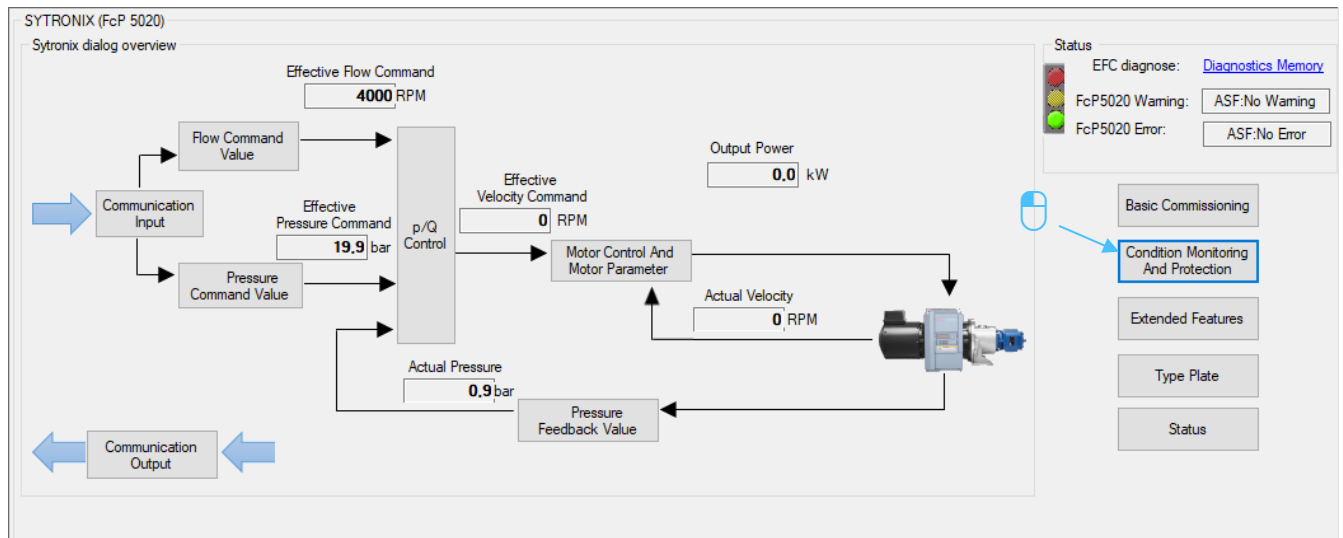


Abb. 46: Reset oil in operation time 1/2

Condition Monitoring

☐ Pressure Feedback failure monitoring(PSF, only needed for voltage pressure sensor)

Negative Velocity

Velocity
0
less than
-1
rpm, for time greater than
10.0
seconds, PSF Error

Positive Velocity

Velocity
0
greater than
200
rpm, for time greater than
2.0
seconds, and sensor feedback < 0.1 bar,PSF error

Standby

Pressure feedback is greater than
5.0
bar, and dp/dt < 1 bar /
1.0
seconds, and for time greater than 2 *
1.0
seconds, PSF error

☐ Actual pressure monitoring

Pressure feedback
0.9
bar, Greater than
500.0
bar, warning:Pressure feedback exceed limit

1000.0
bar, error:Pressure feedback exceed pump limit

☒ Maximal pressure/flow command limitation

Pressure Command greater than
240.0
bar, Pressure Command =
240.0
bar, warning:Pressure command exceed limit

Flow Command greater than
4000
rpm, Flow Command =
4000
rpm, warning:Flow command exceed limit

☒ Minimal pressure/flow command limitation

Pressure Command less than
5.0
bar, Pressure Command =
5.0
bar, warning:Pressure command exceed limit

Flow Command less than
200
rpm, Flow Command =
200
rpm, warning:Flow command exceed limit

☒ Oil change detection

Oil operating time
5
Greater than
19 000
hours, warning:Oil change warning

20 000
hours, error:Oil change error

Reset Oil Operating Time

Abb. 47: Reset oil in operation time 2/2

6.4 Thermal pump monitoring

This monitoring is deactivated in the condition as supplied. To protect the pump, the minimum speed ([F3.19/F3.39] minimum speed of the system) is set appropriately. The thermal pump monitoring can be activated via bit1 in [F4.03]. It is only active when the drive is in operation.

Tabelle 34: List of parameters of for thermal pump monitoring

Parameter	Name	Setting range	Default
F4.36	Pump thermal monitoring speed	0...5,000 rpm	500
F4.37	Pump thermal monitoring time constant	0...6,000 s	0

The pump may overheat at a low speed since the oil volume required for the pump cooling may not be adequate. The pump thermal monitoring function will detect if pump speed is lower than the speed limitation [F4.36] and triggers a warning (for [F4.37] = 0) or error message according to the time [F4.37] (if [F4.37] > 0). For details reference the following table and figure.

Tabelle 35: Protection condition of the

Protection condition	F4.36 (protection speed) = 0 rpm	F4.36 (protection speed) > 0 rpm
F4.37 (protection time constant) = 0 s	Inactive	Warning
F4.37 (protection time constant) > 0 s	Inactive	Error

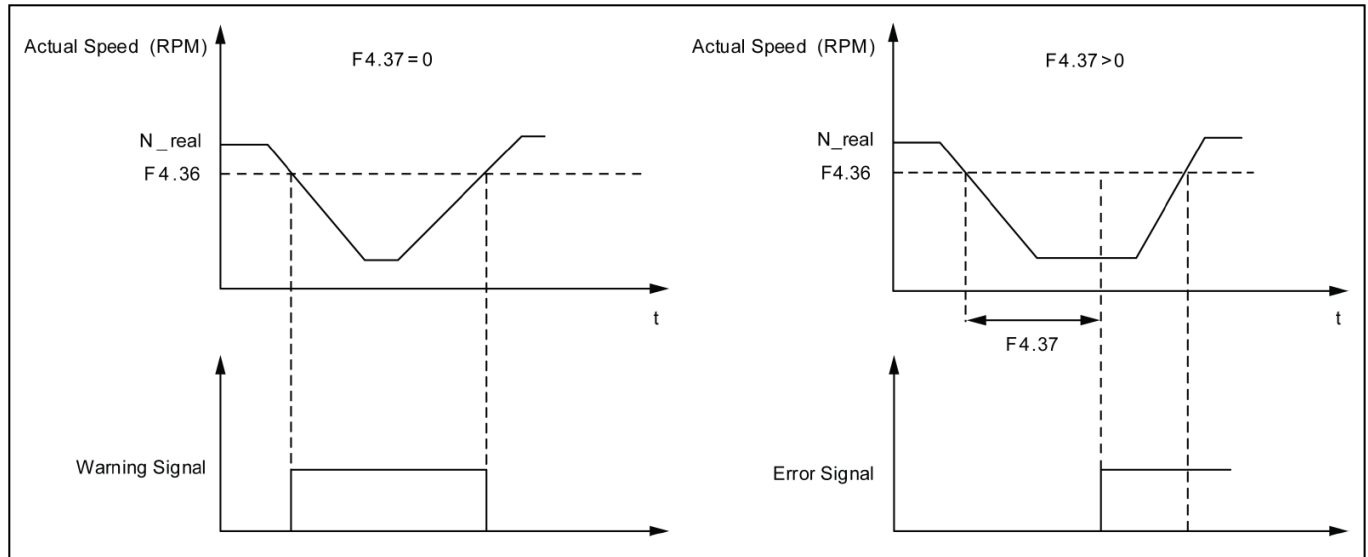


Abb. 48: Thermal pump monitoring

6.5 Sensor monitoring

The CytroPacs of the Premium and Premium M12 versions have wired sensors for monitoring the hydraulic system. These are already parameterized accordingly in the condition as supplied (see following table). The flashing codes of the status LED are described in chapter [10.2 Status LED](#).

Tabelle 36: List of parameters of for sensor monitoring

Parameter	Name	Setting range	Value
F2.18	X3 input	Oil level/temperature error inverted	16
F2.21	EX1 input	Oil filter warning inverted ¹⁾	13
F2.22	EX2 input	Oil temperature warning	8
F2.23	EX3 input	Oil filter error inverted ¹⁾	15
F2.24	EX4 input	Oil level warning	7

1) These signals are automatically delayed, i.e. a "true" signal that is present for longer than [F4.50] seconds is confirmed.

"16: Oil level/temperature error inverted," is the inverted evaluation oil level and temperature error signal. Both oil level and temperature errors are evaluated via a digital input. Since an oil warning comes before an error, the warning information will help the converter to determine if it is an "oil level error," "oil temperature error" or even "oil level or temperature error" if both or no warning is present.

Some signals are inverted for wire break detection; i.e. "true" for no warning/error, "false" for a warning/error.

All warning and error information are presented by parameters [d0.88] and [d0.89].



For further information on this, please see chapter [10 Diagnostics/troubleshooting](#).

Under "Monitoring", "I/O Monitor" you can check the status of the sensor signals.

The following figure shows the signals for the corresponding input/output in the condition as supplied. CytroPac ready for operation, filled with oil, error-free and without warnings.

All sensors deliver the corresponding signal.

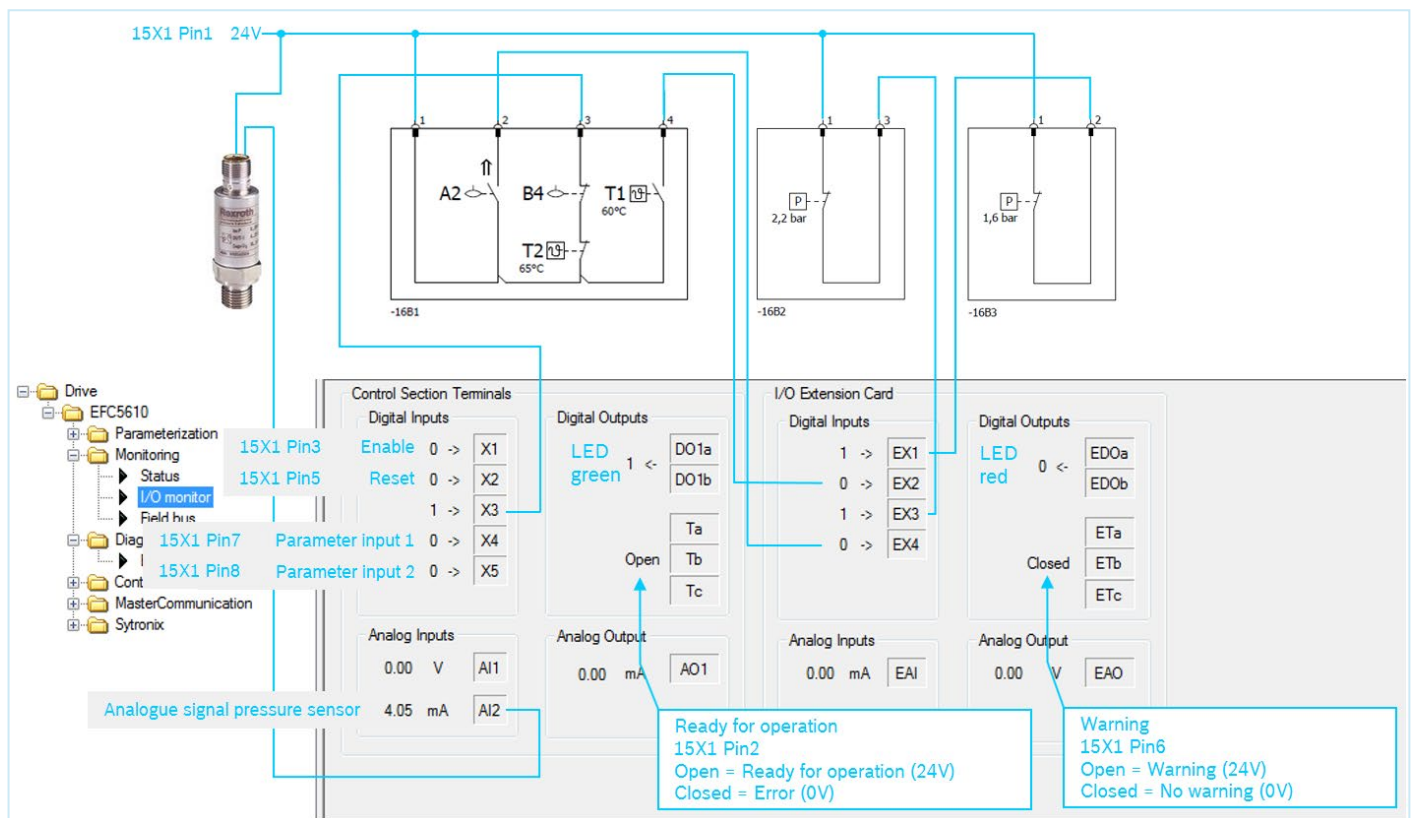


Abb. 49: I/O monitor – assignment of the corresponding signals

7 Premium and Premium M12

All functions explained so far are also valid for the CytroPac Premium and Premium M12 version. This chapter describes functions and field bus communication that are only valid for this version. The device description files for the different protocol variants are available for download in the "Downloads" area at <https://www.boschrexroth.com/de/de/produkte/produktgruppen/elektrische-antriebe-und-steuerungen/frequenzumrichter/efc5610>.

7.1 Field bus communication

The CytroPac is configured in order that all command values are done via communication. Enable, stop and reset are set via bits in the control word, and status messages are signaled via bits in status words (see chapter [7.4 Parameters involved](#)).

Tabelle 37: Communication parameters in the condition as supplied

Parameter	Name	Setting range	Default
H3.03	MEP: IP Address	xxx.xxx.xxx.xxx	192.168.0.1
H3.04	MEP: Subnet Mask	xxx.xxx.xxx.xxx	255.255.255.0
H3.05	MEP: Gateway Address	xxx.xxx.xxx.xxx	0.0.0.0
H3.06	MEP: IP Options	0: DHCP deactivated 1: DHCP activated	0
H3.20	MEP: Station Name (PROFINET)	-...0x50014x	axis01
H3.23	MEP: Device Address	-...0x50014x	1

7.1.1 Protocol

The desired protocol variant must be selected and activated by a restart. Profinet is already pre-set and activated. If error 48 (idA-): Internal communication error is displayed, acknowledge it.

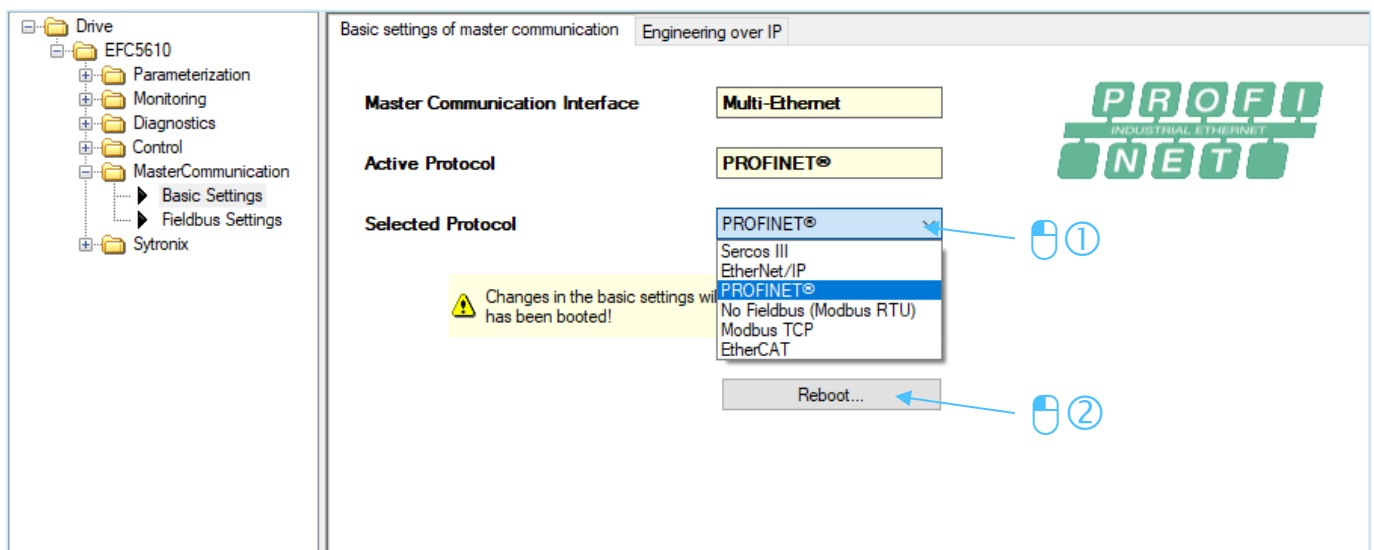


Abb. 50: Protocol

7.1.2
Process data

In the condition as supplied, the process data input and output in the frequency converter is configured as follows (8 input words, 4 output words). A more detailed description of the parameters can be found in chapter [7.4 Parameters involved](#). These can be changed either in the parameter editor ([H3.30, H3.31]) or in a dialog (see following figures).

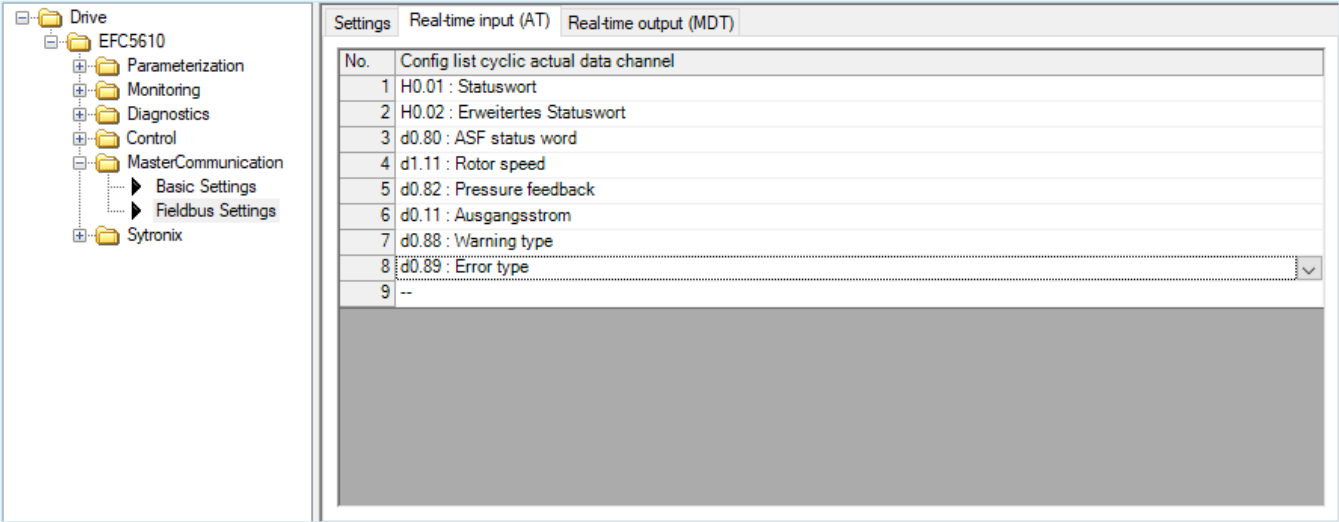


Abb. 51: Setting of input process data (CytroPac output data)

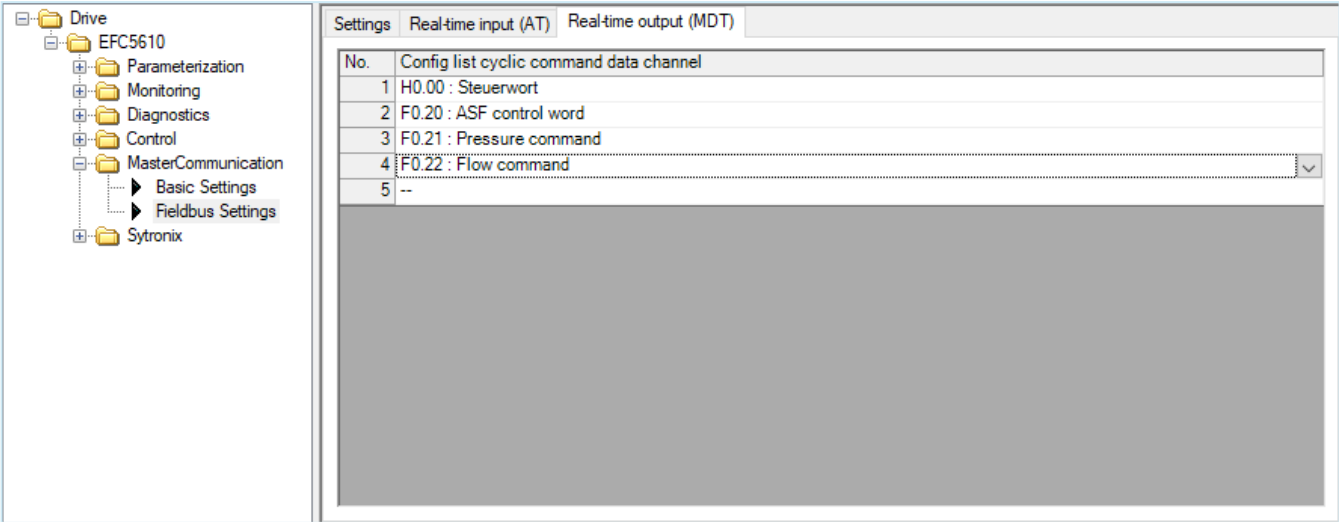


Abb. 52: Setting of output process data (CytroPac input data)



The process data list that is configured in the frequency converter can only be defined for the protocol variants Profinet, Ethernet/IP and Modbus TCP.

7.1.3 Topology

The MEP communication extension card integrates a Cut-Through-Switch that enables the possibility for connecting several MEP communication extension cards in a line topology as an alternative to the typical star topology. Typically a mixed line and star topology connecting with an industrial Ethernet switch is applied in the field.



Abb. 53: Example of connection line topology



Abb. 54: Example of connection ring topology

7.1.4 Profinet

- ▶ Add the downloaded device description file to your hardware catalog by installing the GSDML file ("GSDML-V2.1-BoschRexroth-011F-xFC01-20151105.xml") in the GSD file management.
- ▶ Then double-click on the device "xFC0x 01V01 GSDML V2.1" to add it.

- Process data

Change the modules to "Input 08 Words" and "Output 04 Words" – this corresponds to the condition as supplied of the process data. If the process data were changed, the modules must be adapted accordingly. The process data are read and written in sequence. The sequence and length must match in the frequency converter and the control system (see chapter [7.1.2 Process data](#)).

If a different address range is used in the existing Profinet network, or if these addresses are already assigned, they must be adapted accordingly. The same applies to the device name. Usually, the IP address assignment and the device naming are done from the controller (afterwards, the CytroPac should be repowered).

Bosch Rexroth recommends that the communication settings in the drive be carried out first and only then the communication from the controller be established. As soon as Profinet is in operation mode, the frequency converter does not allow any more parameter changes.



With Siemens control systems, the low and high bytes may have to be swapped.

7.1.5 Ethernet/IP

- Protocol

Change the protocol to Ethernet/IP as described in chapter [7.1.1 Protocol](#).
- Generic device

The MEP extension card is implemented as a "Generic Device" when it is configured in the EtherNet/IP network. The EtherNet/IP object directory implemented contains the objects:

 - Identity Object (16#01)
 - Message Router Object (16#02)
 - Ethernet Link Object (16#F6)
 - TCP/IP Object (16#F5)
 - Port Object (16#F4)
 - Connection Manager Object (16#06)
 - Assembly Object (16#04)

The cyclic communication is implemented via the "EtherNet/IP-I/O messaging" (Class 1). Up to 15 objects can be configured in both data directions.
- Topology

The star and the line topology are both supported.
- Process data

For information on process data, see chapter [7.1.2 Process data](#).
- Error codes

If a manufacturer-specific error occurs during the parameter access, the supplementary error code provides pointers to the cause of the error. Excerpts of the main error codes are listed in the following table:

Tabelle 38: Error codes

Error number	Meaning
16#03	Invalid parameter value - Value is less than the minimum value - Value is greater than the maximum value - Value is not correct - Invalid indirect addressing - Command execution not possible (invalid or wrong parameters)
16#0E	Parameter cannot be changed
16#0F	Parameter is password-protected

Error number	Meaning
16#10	Parameter is write-protected - Parameter currently write-protected - Parameter is write-protected, as configured cyclically in the MDT - Parameter write-protected on account of other settings (parameters, operating mode, ...) - Command execution is not possible (e.g. command cannot be enabled in this phase)
16#13	Parameter transmitted for too short time period
16#15	Parameter transmitted for too long time period
16#1F	- Command is already active - Command interruption is not possible



If write access is provided to two-byte type parameters, any values exceeding 65,535 (16xFFFF) will be reduced automatically to a two-byte value. If the reduced two-byte value is in the valid range, then it will be accepted without transmitting the limit value indication.

For further information, see chapter 6 of the “Frequency converter, multi-Ethernet card” operating instructions, see chapter [1.2 Required and amending documentation](#).

7.1.6 Modbus/TCP

- Protocol

Change the protocol to Modbus/TCP as described in chapter [7.1.1 Protocol](#).

- Protocol configuration

If necessary, adjust the IP address, subnet mask and gateway address (see [Tabelle 37: Communication parameters in the condition as supplied](#)).

A Modbus/TCP client can connect to default TCP port 502. Additionally, you can specify another port by writing a port number to parameter [H3.51]. However, only one client connection is accepted by the multi-Ethernet card.

- System configuration

For information on process data, see chapter [7.1.2 Process data](#).

The multi-Ethernet card supports the following Modbus/TCP transactions:

Tabelle 39: Modbus/TCP transactions

Modbus function code	Transaction name	Max. Value of N
3	Read N register words	16
6	Write one register word	-
16	Write N register words	16
23	Read/write N register words	16/16
43 (sub-function code 14)	Read Device Identification	-

Besides accessing parameters by their function code virtual address, there are some special register addresses that can be used, e.g. for reading/writing the complete process data image. The following table gives an overview.

Tabelle 40: Overview of special register addresses

Register address	Contents
16#7F00	Control word [H0.00]
16#7FA0	Status word [H0.01]
16#7FE0	Input Process Data Image as specified by [H3.30]
16#7FF0	Output Process Data Image as specified by [H3.31]



1. When a Modbus/TCP client has established a new connection to the multi-Ethernet card, the output process data status initially is set to invalid at the multi-Ethernet card. The output data status changes to valid, as soon as all parameters were written at least once to the output process data list. The output data status then remains valid, until the TCP connection is closed or terminated.
2. Special Register Addresses mentioned above only can be used without any offset. Example: It is not allowed to use address 16#7FF2 for accessing second output process data item.

- Exception codes

In Modbus/TCP, error cases will cause the multi-Ethernet card to return exception codes at the Modbus response telegram. The exception codes are listed in the following table:

Tabelle 41: Exception codes

Exception code	Name	Meaning/possible causes
1	Illegal function	Unknown function code, transaction contained a Modbus function code not supported by the multi-Ethernet card.
2	Illegal data address	• Access to unknown address • Error occurred during function code 43 transaction
3	Illegal data value	• Invalid read/write length value in Modbus transaction • Malformed request telegram • Invalid object ID in function code 43 transaction
4	Server device failure	Read/write access failed

7.1.7 Sercos III

- Protocol

Change the protocol to Sercos III as described in chapter [7.1.1 Protocol](#).

- Device address

The unique device address in the Sercos III network must be set using parameter [H3.23]. However, the Sercos address can also be assigned in the project from the automatically calculated topology index. The resulted address reflects in parameter [H3.24].

- Process data

The process data configuration is transmitted from Sercos III master during bus startup.

S-0-0135 (device status) and P-0-1098.0.1 (status word [H0.01]) must always be added in sequence to the input list. S-0-0134 (drive control) and P-0-1098.0.0 (control word [H0.00]) must also be added to the output list in sequence (see [Abb. 55: Process data configuration Sercos III-Master, here: IndraControl XM](#)).

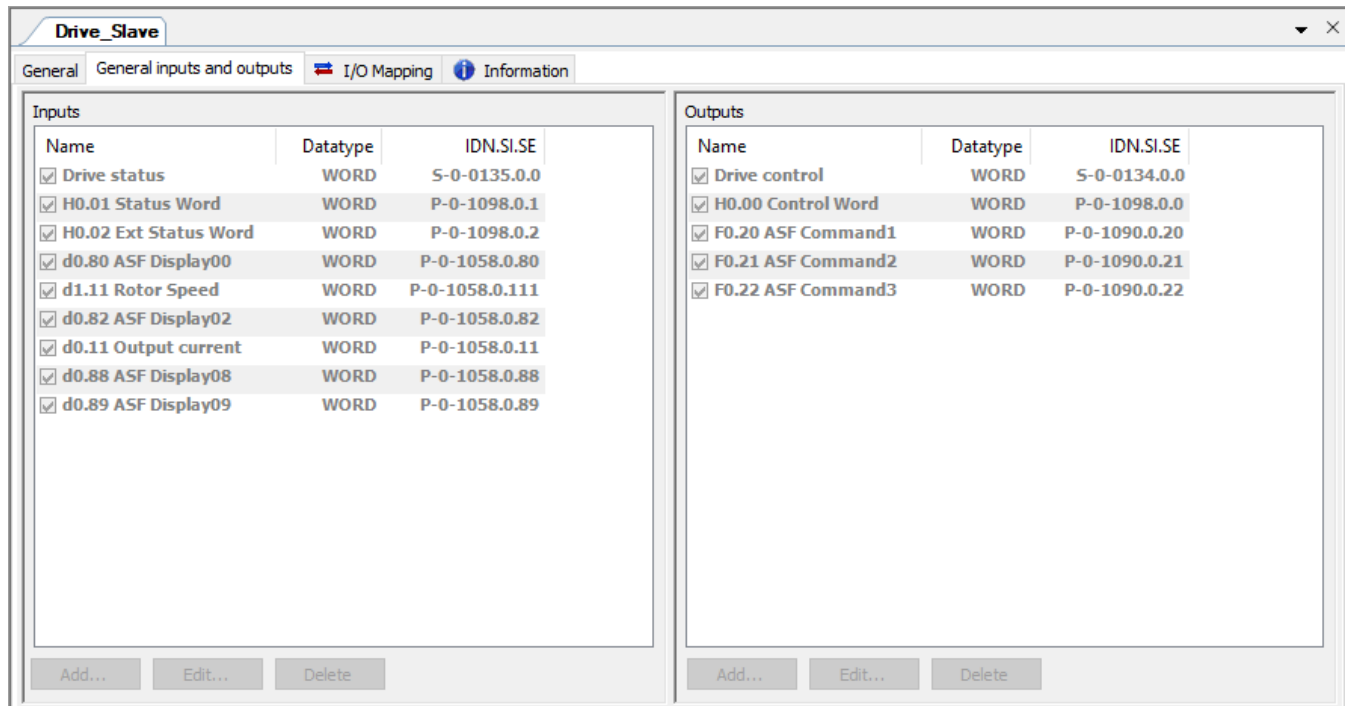


Abb. 55: Process data configuration Sercos III-Master, here: IndraControl XM

With Sercos III the drive enable (16#E000) and stop (16#A000) is set via drive control word S-0-0134.

The parameters must be specified in Sercos parameter format (IDN addresses) (see [Tabelle 42: Parameter address Sercos III](#)).

Tabelle 42: Parameter address Sercos III

Code range	IDN range
b0.00...b0.99	P-0-1050.0.0 --- P-0-1050.0.99
d0.00...d0.99	P-0-1058.0.0 --- P-0-1058.0.99
C0.00...C0.99	P-0-1066.0.0 --- P-0-1066.0.99
C1.00...C1.99	P-0-1066.0.100 --- P-0-1066.0.199
C2.00...C2.99	P-0-1067.0.0 --- P-0-1067.0.99
C3.00...C3.99	P-0-1067.0.100 --- P-0-1067.0.199
E0.00...E0.99	P-0-1074.0.0 --- P-0-1074.0.99
E1.00...E1.99	P-0-1074.0.100 --- P-0-1074.0.199
E2.00...E2.99	P-0-1075.0.0 --- P-0-1075.0.99
E3.00...E3.99	P-0-1075.0.100 --- P-0-1075.0.199
E4.00...E4.99	P-0-1076.0.0 --- P-0-1076.0.99
E5.00...E5.99	P-0-1076.0.100 --- P-0-1076.0.199
E8.00...E8.99	P-0-1078.0.0 --- P-0-1078.0.99
E9.00...E9.99	P-0-1078.0.100 --- P-0-1078.0.199
U0.00...U0.99	P-0-1082.0.0 --- P-0-1082.0.99
U1.00...U1.99	P-0-1082.0.100 --- P-0-1082.0.199
F0.00...F0.99	P-0-1090.0.0 --- P-0-1090.0.99
F1.00...F1.99	P-0-1090.0.100 --- P-0-1090.0.199
F2.00...F2.99	P-0-1091.0.0 --- P-0-1091.0.99
F3.00...F3.99	P-0-1091.0.100 --- P-0-1091.0.199
F4.00...F4.99	P-0-1092.0.0 --- P-0-1092.0.99
F5.00...F5.99	P-0-1092.0.100 --- P-0-1092.0.199
H0.00...H0.99	P-0-1098.0.0 --- P-0-1098.0.99
H1.00...H1.99	P-0-1098.0.100 --- P-0-1098.0.199
H2.00...H2.99	P-0-1099.0.0 --- P-0-1099.0.99
H3.00...H3.99	P-0-1099.0.100 --- P-0-1099.0.199
H4.00...H4.99	P-0-1100.0.0 --- P-0-1100.0.99
H8.00...H8.99	P-0-1102.0.0 --- P-0-1102.0.99
H9.00...H9.99	P-0-1102.0.100 --- P-0-1102.0.199

7.1.8 EtherCAT

In order to fully support an EtherCAT slave running CoE (CAN over EtherCAT), an EtherCAT master needs both EtherCAT slave information (ESI - *.xml) and an electronic data sheet (EDS - *.eds). ESI provides a description of the slave device for EtherCAT PLC controls as well as information about the configuration of the EtherCAT communication. The EDS describes the CAN objects of the device that can be accessed. Copy both files into the TwinCAT application folders.

- Protocol

Change the protocol to EtherCAT as described in chapter [7.1.1 Protocol](#).



No further settings need to be made on the frequency converter for EtherCAT communication. Length of the input and output words are set by the EtherCAT master.

- Topology

The line topology is supported. Make sure that network connector 21X1 (network input) is used as input "IN" and network connector 21X2 (network output) as output "OUT".

- Operating mode/cyclic communication

When configuring the slave in your control project, use the "Rexroth mode" operating mode, because only this supports free configuration of the PDOs. It is necessary to expand cyclic communication via PDOs.

PDO5 cannot be changed. PDO22 is empty and can be extended with additional parameters (see [Abb. 56: Process data configuration EtherCAT master, here: IndraControl XM](#)).

The process data can be configured by writing CAN object indexes to the following lists:

- Producer data list [16#1A15]
- Consumer data list [16#1615]



Frequency command values are ignored here. The CytroPac does not react to frequency command values, instead it receives a flow command value as command value (see chapter [5.4 Flow command value](#)).

Ausgänge auswählen			Eingänge auswählen		
Name	Typ	Index	Name	Typ	Index
☒ 16#1605 RxPDO5			☒ 16#1A05 TxPDO5		
Control Word H0.00	UINT	16#3770:01	Status Word H0.01	UINT	16#3771:01
Frequency Command No function	UINT	16#377A:01	Setting Frequency No function	UINT	16#23EA:01
☒ 16#1615 RxPDO22			☒ 16#1A15 TxPDO22		
F0.20 ASF Control word	UINT	16#339C:01	Data (H0.02: Extended status word)	UINT	16#3772:01
F0.21 Pressure command	UINT	16#339D:01	Data (D0.80: ASF status word)	UINT	16#2438:01
F0.22 Flow command	UINT	16#339E:01	Data (D1.11: Rotor speed)	UINT	16#2457:01
			Data (D0.82: Pressure feedback)	UINT	16#243A:01
			Data (D0.11: Output current)	UINT	16#23F3:01
			Data (D0.88: Warning type)	UINT	16#2440:01
			Data (D0.89: ASF Error type)	UINT	16#2441:01

Abb. 56: Process data configuration EtherCAT master, here: IndraControl XM

- Acyclic communication

With supporting of CAN over Ethernet (CoE), all function code parameters of the EFC series frequency converter can be read, and if admissible can be written, directly by SDO. Table below shows the CAN indexes corresponding to the function code parameters.

Tabelle 43: CAN indexes corresponding to the function code parameters

Code range	CAN index range
b0.00...b9.99	16#2000...16#23E7
d0.00...d9.99	16#23E8...16#27CF
C0.00...C9.99	16#27D0...16#2BB7
E0.00...E9.99	16#27B8...16#2F9F
U0.00...U9.99	16#2FA0...16#3387
F0.00 ...F9.99	16#3388...16#376F
H0.00...H9.99	16#3770...16#3B57

7.2 Running Premium and Premium M12 without control communication

If it is desired/necessary to operate the CytroPac without a higher-level control (control communication), a Premium CytroPac can be configured to behave like a CytroPac without control communication. Change the following parameters as shown in [Abb. 57: Running Premium and Premium M12 without control communication](#).

F1.11	Flow command source	2 → 0: Dep. on F1.c	--	2: Com; 0: Depend on F1.12;
E8.00	Communication protocol	1 → 0: Modbus	--	0: Modbus; 1: Extension card;
E0.01	First run command source	2 → 1: Digital input	--	2: Com; 1: DigIn;
F1.03	Pressure command source	3 → 0: Dep. on F1.04	--	3: Com; 0: Depend on F1.04;
F1.12	Flow command digital setting	4000 adjust ☐	--	Flow-setpoint
F1.05	Pressure command digital setting 0	20.0 adjust ☐	--	Pressure-setpoint

Abb. 57: Running Premium and Premium M12 without control communication

If the enable signal cannot be set digitally via the enable input, it is possible to set the enable from the IndraWorks Ds remote control.

- To do this, click on "Control", "Remote Control" and then on "Take Over Remote Control" ①.

The window expands.

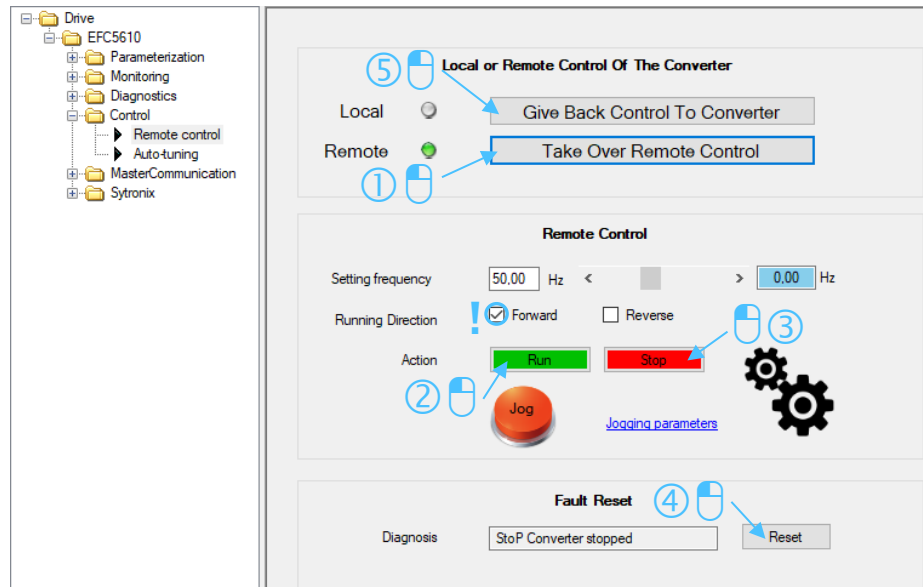


Abb. 58: Remote control

- Enable by pressing "Run" ②.
- Stop the drive by pressing "Stop" ③.
- Acknowledge errors via the Reset key ④.

NOTICE: Wrong direction of rotation!

Rotating of the pump in the wrong direction may damage the CytroPac.

- If you are enabling via remote control, make sure that direction of rotation is set to Forward.

The true direction of rotation is backwards. The default direction is forward - by internal inversion the pump therefore rotates backwards.



Frequency command values are ignored here.

If the connection to the CytroPac is lost while it is running via remote control, the converter will exit with error (Error 54 (PcE-): Remote control communication error).

- Then click on "Give Back Control To Converter" ⑤ again to give back control to the converter.

7.3 Master/slave operation

Requirement:

- Insert two CytroPacs with the same pump size, as they work with the same speed command value.

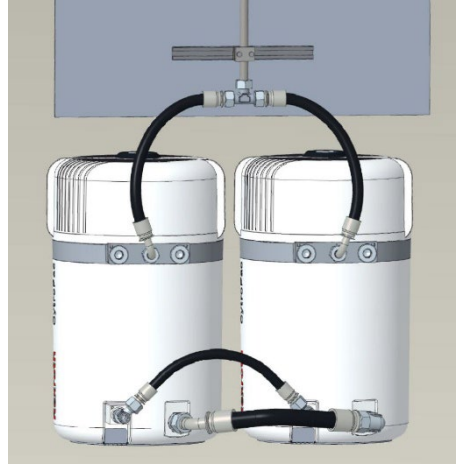


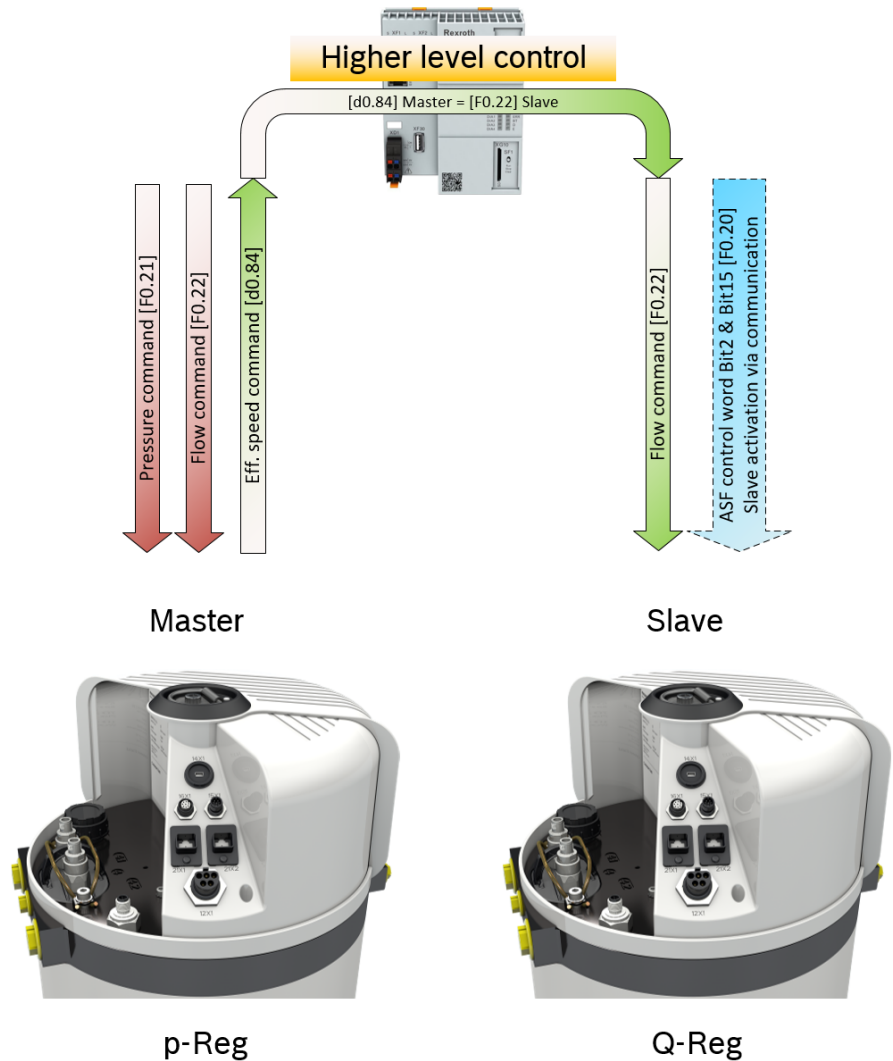
Abb. 59: Two CytroPacs in master/slave operation

Master and slave operation with two CytroPacs can be implemented only with control communication (control), because no direct communication is possible between the CytroPacs. This means that two CytroPacs of the Premium version are absolutely necessary, as well as a higher-level control to transmit the command value from the CytroPac master to the CytroPac slave.

The CytroPac master assumes the pressure control. The speed command value generated for this purpose is passed on by the higher-level control to the CytroPac slave for flow control (see [Abb. 60: Functional overview](#)). This doubles the flow with unchanged pressure. Two CytroPacs of the same power class should be used. If two CytroPacs with the same pump but different power class are used, the characteristic curve of the CytroPac with lower power class should be used with double the flow.



It should be noted that the minimum volume flow (minimum speed) doubles (minimum speed master + minimum speed slave).



Slave activation on EFC: F4.03 Bit 2

For slave activation via communication: F4.39 = 2

Abb. 60: Functional overview

The CytroPacs are factory set as masters. In order to work as a slave, they must be configured as a slave. This can be done directly in the frequency converter (see chapter [7.3.4 Permanently activating slave operation in the converter](#)) or it must be set in the frequency converter that the higher-level control can do this (see chapter [7.3.6 Enabling slave operation switch-over via the control system in the frequency converter](#)).

7.3.1 Requirements

For master/slave operation, you need 2 CytroPacs with option A1. These have an additional oil tank connection/tank port T: G1



For information on the port of the hydraulic and water supply in master/slave operation, see the operating instructions 51055-B, an overview drawing and a hydraulic circuit diagram in data sheet 51055, see chapter [1.2 Required and amending documentation](#).

7.3.2
Parameterization

To configure the CytroPacs, Bosch Rexroth recommends that you connect using the mini USB service interface. This prevents confusion between master and slave.

The procedure below refers to parameterization via the mini USB service interface. Parameterization via LAN would be possible, but is too cumbersome here. Fieldbus parameters can only be changed as long as no communication with the higher-level control is active.

Likewise, the IP address, as well as the device address or device name should be adapted for the CytroPac slave, even if these are assigned by the controller depending on the protocol variant, in order to avoid confusion between CytroPac master and slave. For an example setting, see the following table.

Tabelle 44: Example setting of communication parameters

Parameter	CytroPac-Master	CytroPac-Slave
H3.03 MEP: IP Address	192.168.0.1	192.168.0.2
H3.20 MEP: Station Name (PROFINET)	axis01	axis02
H3.23 MEP: Device Address	1	2

7.3.3
Process data

The CytroPac-Master must additionally transmit the parameter "d0.84 Effective speed command" in the process data input word, so that the higher-level control can pass it on as command value for the CytroPac slave.

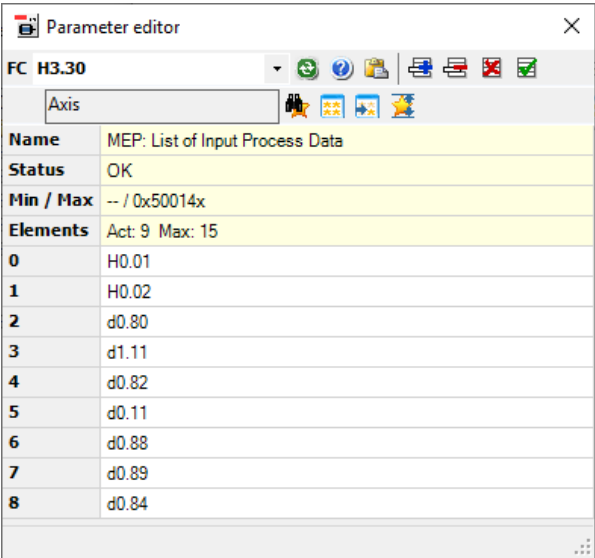


Abb. 61: CytroPac-master process data input e.g. for Profinet

7.3.4 Permanently activating slave operation in the converter

To permanently switch on slave operation in the frequency converter, bit2 in parameter [F4.03] must be set.

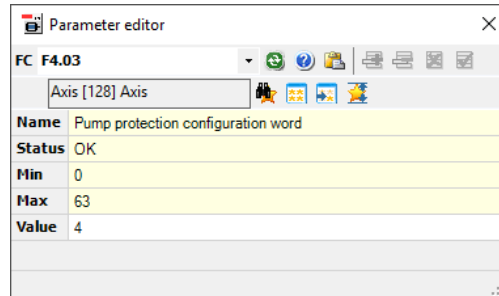


Abb. 62: [F4.03] Pump guard control word

Alternatively, you can activate slave operation in the Sytronix FcP 5020 interface. Click on "Extended Features" and activate the checkbox "Master to slave" (see [Abb. 63: Extended Features](#) and [Abb. 64: Pump guard control word](#)).

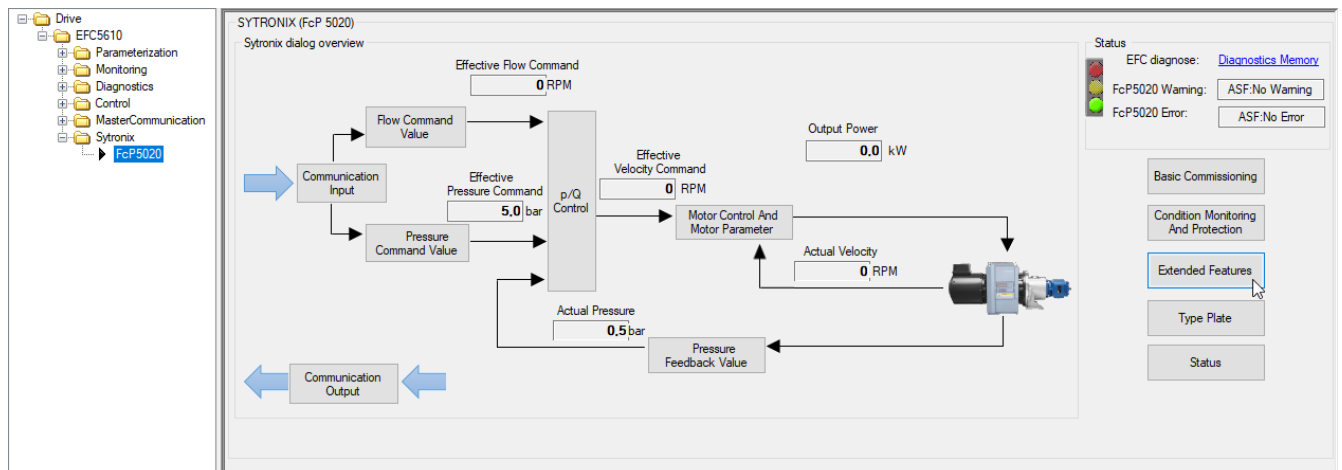


Abb. 63: Extended Features

Extension Function

Pump protection control word

Sleep/wake function

Pump protection control word selection

☐ Pump power limitation

Actual pump power greater than kW, velocity reduced, warning: pump power limitation warning
 Pump ccm

☐ Pump thermal protection

Pump actual speed less than pump thermal protection speed rpm, for s, Pump thermal protection warning/error

☒ Master to slave

☐ Pressure drop/overshoot compensation

Pressure drop compensation bar
 Pressure overshoot compensation bar

Pump Type

☒ Fixed Displacement Pump ccm
☐ Double pump/two point pump

☐ Double pump

Vg1 ccm
 Vg2 ccm

☒ Two point pump

Vgmin ccm
 Vgmax ccm

Abb. 64: Pump guard control word

7.3.5 Slave operation switch-over via parameter input

If the switch-over between master and slave mode is to be made via a parameter input, i.e. via a digital input, value 1 must be written in parameter [F4.39] in the frequency converter (see [Abb. 65: \[F4.39\] Master/slave switch source](#)). A digital input (parameter input) must be assigned the function of the master/slave selection accordingly. To do this, set either parameter [F2.19] (input X4) or parameter [F2.20] (input X5) to 5 (master/slave operating mode selector switch).

Parametereditor

FC F4.39

Achse

Name

Master/slave switch source

Status

OK

Min

0

Max

2

Wert

1

Abb. 65: [F4.39] Master/slave switch source

7.3.6 Enabling slave operation switch-over via the control system in the frequency converter

If the switch-over between master and slave mode is to be made via a communication, i.e. via the higher-level control, value 2 must be written in parameter [F4.39] in the frequency converter (see [Abb. 66: \[F4.39\] Master/slave switch source](#)). This allows slave operation to be activated from the control.

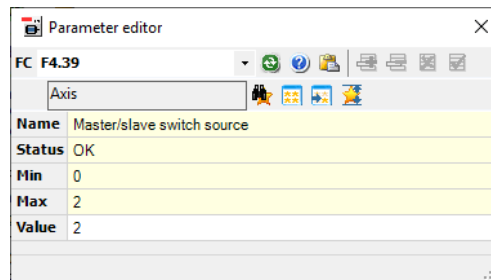


Abb. 66: [F4.39] Master/slave switch source

7.3.7 Enabling slave operation via the control system

To activate the slave functionality of the CytroPac slave, bit2 and bit15 must be set in the process data output parameter "F0.20 ASF control word" (see [Tabelle 56: Definition \[F0.20\] ASF control word](#)).



This only has an effect if chapter "[7.3.6 Enabling slave operation switch-over via the control system in the frequency converter](#)" has been implemented and **not** chapter "[7.3.4 Permanently activating slave operation in the converter](#)" and **not** chapter "[7.3.5 Slave operation switch-over via parameter input](#)".

7.3.8 Slave active status

Whether the CytroPac slave works in slave mode can be seen either in IndraWorks Ds in the Sytronix FcP 5020 interface under "Status" (see [Abb. 67: FcP5020 status](#) and [Abb. 68: Slave operation status](#)) or this is indicated by the bit2 in the parameter [d0.80] ASF status word.

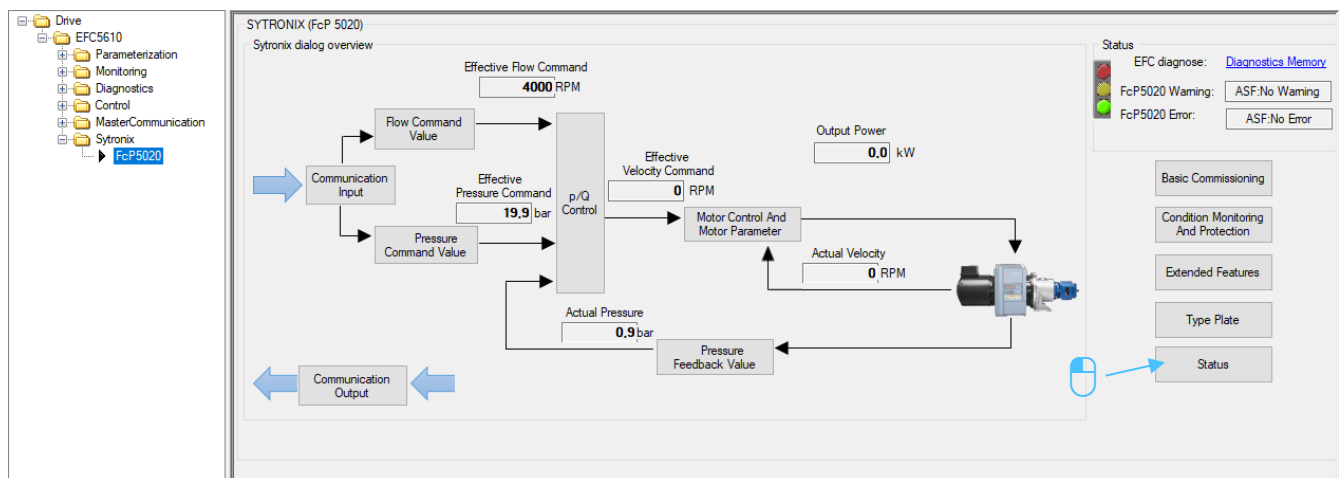


Abb. 67: FcP5020 status

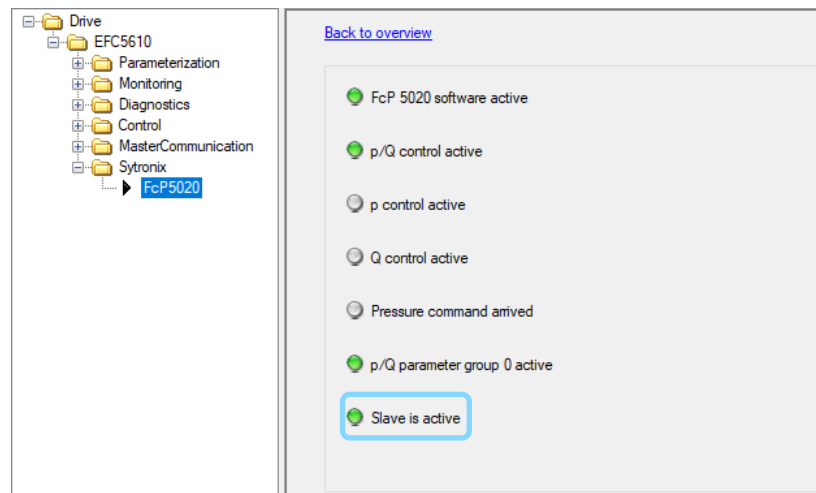


Abb. 68: Slave operation status

7.3.9 Command value for CytoPac slave

The process data input parameter "d0.84 Effective speed command value" is read in from the CytoPac master via the controller and passed on directly to the CytoPac slave as command value for the flow control of the CytoPac slave (process data output parameter "F0.22 Flow command").

7.3.10 Information for operation

CytoPac master and slave must be started and stopped separately (this can be done simultaneously e.g. by using a variable for the control word which is used for both CytoPacs).

- Make sure via the controller that both CytoPacs are stopped in case of an error, as this is not done automatically.

7.4 Parameters involved

7.4.1 Process data input parameters

The process data input parameters (CytoPac output parameters) are described in detail below.

Tabelle 45: Overview of involved parameters of process data input (CytoPac output)

Code	Name	Description	S3 (IDN.SI.SE)	EC Index	MB Register	Protocol
	Drive status	Drive status word	S-0-0135.0.0			S3
H0.01	Status word	Status word	P-0-1098.0.1	16#3771:01	16#7FA0	S3/PN/EI/EC/MB
H0.02	Extended status word	Extended status word	P-0-1098.0.2	16#3772:01	16#6002	S3/PN/EI/EC/MB
H0.03	STO safety status word	STO status word	P-0-1098.0.3	16#3773:01	16#6003	S3/PN/EI/EC/MB
d0.80	ASF status word	ASF status word	P-0-1058.0.80	16#2438:01	16#1050	S3/PN/EI/EC/MB
d1.11	Rotor speed	Actual speed	P-0-1058.0.111	16#2457:01	16#110B	S3/PN/EI/EC/MB
d0.82	Pressure feedback	Actual pressure value	P-0-1058.0.82	16#243A:01	16#1052	S3/PN/EI/EC/MB
d0.11	Output current	Output current	P-0-1058.0.11	16#23F3:01	16#100B	S3/PN/EI/EC/MB
d0.88	Warning type	Warning (Code)	P-0-1058.0.88	16#2440:01	16#1058	S3/PN/EI/EC/MB
d0.89	Error type	Error (Code)	P-0-1058.0.89	16#2441:01	16#1059	S3/PN/EI/EC/MB
d0.84 ¹⁾	Effective speed command	Effective speed command value	P-0-1058.0.84	16#243C:01	16#1054	S3/PN/EI/EC/MB

1) Necessary for master/slave operation for master Cytopac

Tabelle 46: Definition [S-0-0135] status word Sercos III

Bit	Description	Setting range
13	Error	0: No error 1: Error
15...14	Drive status	00: Drive not ready 01: Drive ready for main power on 10: Drive ready and mains voltage applied 11: Drive enabled

Tabelle 47: Definition [H0.01] status word

Bit	Description	Setting range
0	Direction of rotation	0: Forward 1: Reverse ¹⁾
1	Running/Stopped	0: Stop 1: Running
3	Acceleration	0: Not in acceleration 1: Acceleration
4	Delay	0: Not in delay 1: Delay
5	Overvoltage limitation	0: Normal 1: Overvoltage limitation
6	Over-current limitation	0: Normal 1: Over-current limitation
7	Error	0: No error 1: Error
8...15	Error code	

1) The CytroPac rotates reverse to build up pressure. There is no need to specify the direction of rotation.

- Bit8...15 Error code

A detailed error code description can be found in chapter [10.5 Error code](#). The specified error code is the error which occurs when the frequency converter is in error mode (i.e. bit7 = 1). The last entry remains even if the error has been acknowledged (bit7 = 0).

Tabelle 48: Definition [H0.02] advanced status word

Bit	Description	Setting range
0	Voltage supply	0: Mains voltage available 1: 24 V mode
1	Sleep mode	0: Normal 1: Sleep mode
2	Converter OK	0: Converter not OK 1: Converter OK
14	General warning	0: No warning 1: Warning

Tabelle 49: Definition [H0.03] STO status word

Bit	Description	Setting range
0	STO-Alarm	0: Normal 1: STO-A
1	STO-Request	0: Normal 1: STO-r
2	STO-Error	0: Normal 1: STO-E

Tabelle 50: Definition [d0.80] ASF status word

Bit	Description	Setting range
2	Master/slave status	0: Master 1: Slave
3	p/Q parameter group	0: Parameter set 0 1: Parameter group 1
11	Pressure drop/excessive pressure compensation	0: No compensation 1: Compensation
12	Pressure command value reached	0: Pressure deviation bigger than tolerance range 1: Pressure deviation within tolerance range
13	ASF status	0: Active 1: Inactive
14	ASF warning	0: No warning 1: Warning
15	ASF error	0: No error 1: Error

[d1.11] Rotor speed

- Velocity actual value in rpm (revolutions per minute)
- Decimal places: 0

[d0.82] Output current

- Output current in A (Ampère)
- Decimal places: 1

[d0.88] Warning type

- ASF warning type (interpret as decimal number – not bitwise!)
- Decimal places: 0

Tabelle 51: Definition [d0.88] warning type

Value (decimal)	Description
0	No warning
1	Actual pressure value exceeds limit value
2	Pressure command value exceeds limit value
3	Flow command value exceeds limit value
4	Oil filter warning
5	Oil level warning
6	Oil temperature warning
7	Oil change warning
8	(Reserved)
9	Pump thermal monitoring warning
10	Pump power limitation warning

[d0.89] Error type

- ASF error type (interpret as decimal number – not bitwise!)
- Decimal places: 0

Tabelle 52: Definition [d0.89] error type

Value (decimal)	Description
0	No error
1	Actual pressure value exceeds pump limit value
2	Pressure sensor error
3	Parameter setting error
4	Oil filter error
5	Oil level error
6	Oil temperature error
7	Oil change error
8	Oil level or temperature error
9	Pump thermal monitoring error

[d0.84] Effective speed command

- Internal generated velocity command value in rpm (revolutions per minute) for pressure control
- Decimal places: 0

7.4.2 Process data output parameters

The process data output parameters (CytroPac input parameters) are described in detail below.

Tabelle 53: Overview of involved parameters of process data output (CytroPac input)

Code	Name	Description	S3 (IDN.SI.SE)	EC Index	MB Register	Protocol
	Drive Control	Drive control word	S-0-0134.0.0			S3
H0.00	Control word	Control word	P-0-1098.0.0	16#3770:01	16#6000	S3/PN/EI/EC/MB
F0.20	ASF control word	ASF control word	P-0-1090.0.20	16#339C:01	16#5014	S3/PN/EI/EC/MB
F0.21	Pressure command	Pressure command value	P-0-1090.0.21	16#339D:01	16#5015	S3/PN/EI/EC/MB
F0.22	Flow command	Flow command value	P-0-1090.0.22	16#339E:01	16#5016	S3/PN/EI/EC/MB

Tabelle 54: Definition [S-0-0134] control word Sercos III

Bit	Description	Setting range
13	Drive halt/restart	0: Drive halt 1: Drive restart
14	Enable drive	0: Disable drive 1: Enable drive
15	Drive OFF/ON	0: Drive OFF 1: Drive ON

Tabelle 55: Definition [H0.00] control word

Bit	Description	Setting range
0	Run command	0: Inactive 1: Run command active
3	Stop command	0: Inactive 1: Stop
4	E-stop	0: Inactive 1: E-stop active
5	Fault reset	0: Inactive 1: Fault reset active
7	Control word enable ¹⁾	0: Inactive 1: Control word active

1) The control word must be permanently active for the CytroPac to accept commands.

NOTICE: Wrong direction of rotation of the pump!

Rotating of the pump in the wrong direction may damage the CytroPac.

- Make sure that bit2 of control word [H0.00] remains at 0 (= forward).

The true direction of rotation is backwards. The default direction is forward - by internal inversion the pump therefore rotates backwards.

The control bits (bit0...6) in the control word are all edge sensitive. Bosch Rexroth recommends resetting value 0#0080 (80 hexadecimal) at the time when the program starts to run initially.

The control bits are only effective when the control word is switched to active (Bit7 = 1).

- Bit4 E-stop active

Freewheel stop will be triggered in conjunction with display error 'E-St' when bit4 = 1.

Tabelle 56: Definition [F0.20] ASF control word

Bit	Description	Setting range
2	Master/slave selection	0: Master 1: Slave
3	p/Q parameter set selection	0: Parameter set 0 1: Parameter group 1
15	ASF control word enable	0: Inactive 1: Active

The control bits are only effective when the control word is switched to active (bit15 = 1).

[F0.21] Pressure command

- Pressure command value in bar (55.5 bar $\triangleq$ 555)
- Decimal places: 1

[F0.22] Flow command

- Velocity command value (limit) in rpm (revolutions per minute)
- Decimal places: 0

8 Optimization options

8.1 Pressure drop/Acceleration

If the pressure drops too much during pressure control, e.g. by a large cylinder/load moving, there are several ways to minimize this as described below.

8.1.1 Optimization through PID controller setting

First try to counteract the pressure drop by increasing the proportional gain [F3.12] (typical values 8...25). This makes the pressure control loop respond faster (see chapter [5.5 p/Q PID control](#)).

8.1.2 Optimization by pressure drop compensation

Another possibility is to use the pressure drop compensation. In this case, the current pressure command value is increased by [F4.45]. This function can be started by a digital signal at a parameter input and should be carried out a certain amount of time before the pressure drops (see chapter [5.8 Compensation for pressure drop/excessive pressure compensation](#)). Experience has shown that the pressure drop compensation is at its lowest when the pressure is switched on 50...100 ms before the pressure drops. The optimum time must be determined empirically. For this purpose, use the oscilloscope function of the frequency converter (see chapter [4.9 Oscilloscope function](#)).



With the Premium and Premium M12 version, the pressure command value can simply be increased via communication a certain amount of time in advance to achieve the same effect.

8.1.3 Optimization through parameter set switch-over

In practice, the method of parameter set switching with a defined velocity command value (increased minimum speed) has been successfully applied. Here, the parameter set switch-over is activated either by a digital signal at a parameter input (see chapter [5.5.7 p/Q parameter set switch-over \(via parameter input\)](#)) or, in the case of Premium and Premium M12 versions, also via the ASF control word (see chapter [5.5.8 Premium and Premium M12 only: p/Q parameter set switch-over via communication](#)). A certain time before the pressure drops, the system switches to the second parameter set, which has a higher minimum speed (system minimum speed) in order to accelerate to a defined speed. Experience has shown that the pressure drop compensation is at its lowest when the pressure is switched on 50...100 ms before the pressure drops. The optimum time must be determined empirically. For this purpose, use the oscilloscope function of the frequency converter (see chapter [4.9 Oscilloscope function](#)).

This method, however, only works if the second parameter set is not yet used for other purposes, e.g. use of parameter sets with different controller settings.

9 Typical errors during commissioning

NOTICE

Adjustment of motor parameters or settings not described in this documentation!

Damage to property!

- Note that the CytroPac is already delivered fully parameterized and functional, so there is no need to select the motor, change, optimize or adjust the motor parameters, such as the direction of rotation of the pump, or adjust the sensor technology.

9.1 Minimum speed not observed

NOTICE

Overheating the pump by reducing the minimum speed!

Damage to property!

- Make sure that the minimum speed of the CytroPac is not undershot, as this is absolutely necessary for cooling the pump.

The built-in pump of the CytroPac requires a certain speed (minimum speed) to ensure its cooling. Even when the CytroPac has reached its pressure, or the hydraulic system has little or no leakage, the speed does not drop to zero, but always runs at the minimum speed. These situations can cause the CytroPac to generate more pressure than the pressure command value.

9.2 Auto tuning performed

The motor parameters are adjusted by an auto-tuning. The motor parameters are already optimized and the CytroPac is delivered parameterized accordingly. By adjusting the motor parameters, it is possible that the CytroPac will no longer function properly.

- Never perform an auto-tuning.
- If an auto-tuning was performed, Bosch Rexroth recommends loading a suitable parameter set (see chapter [4.1 Saving parameters](#) and chapter [4.2 Loading parameters](#)).

9.3 Reset to factory settings

Resetting the parameters to factory settings does not reset the frequency converter parameters to the condition as supplied, because the factory defaults of the firmware extension ASF do not correspond to the condition as supplied in CytroPac. As a result, the CytroPac will no longer work properly.



Bosch Rexroth recommends making a backup of the delivered parameter set (see chapter [4.1 Saving parameters](#)) before making any changes. This way you can always restore the condition the CytroPac was supplied in by loading this parameter set when this becomes necessary (see chapter [4.2 Loading parameters](#)).

If you have unintentionally reset the parameters to factory settings and do not have a backed-up parameter set, please contact the Bosch Rexroth customer service team. After specifying the type or material number of your CytroPac, they can send you the corresponding parameter set as supplied.

10 Diagnostics/troubleshooting

10.1 General procedure

- ▶ Proceed calmly and carefully during troubleshooting.
- ▶ Avoid switching on and off unnecessarily, as the error memory may be filled needlessly and with incorrect information.
- ▶ For initial diagnostics, observe which flashing code the status LED (Premium and Premium M12 only) is showing (see [10.2 Status LED](#)).

Next, do the following:

1. Connect to the CytroPac (see [3.4 Connection with CytroPac \(USB\)](#)).
2. Check the diagnostic messages (see [Abb. 69: Diagnosis](#)):
 - Axis status (converter status) ①
 - FcP 5020 (ASF) status ②
3. Try to find a remedy by following the suggested solutions in the warning and error codes (see [10.4 Warning code](#) and [10.5 Error code](#)).



You can check whether the sensors provide the corresponding signal by looking at the display of the I/O monitor (see [Abb. 49: I/O monitor – assignment of the corresponding signals](#)).

4. Acknowledge the error (Reset).

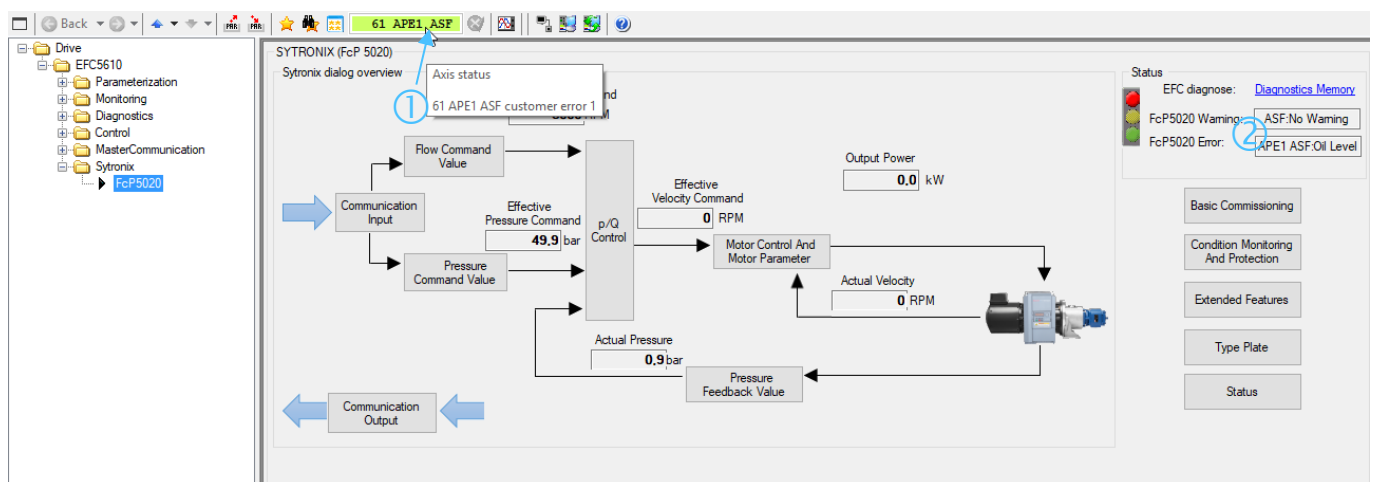


Abb. 69: Diagnosis



FcP 5020 warnings and errors are displayed by the frequency converter as APF1 (application warning) and APE1 (application error), as these messages come from the ASF. These messages are also stored in the error memory. To interpret these messages you have to check the parameters [d0.88] (warning code) and [d0.89] (error code) or the messages in the Sytronix FcP 5020 dialog while the message is still pending.

10.2
Status LEDstrip

The status LED strip is only installed in the Premium and Premium M12 versions.
 The following figure shows the flashing codes and the corresponding status information.

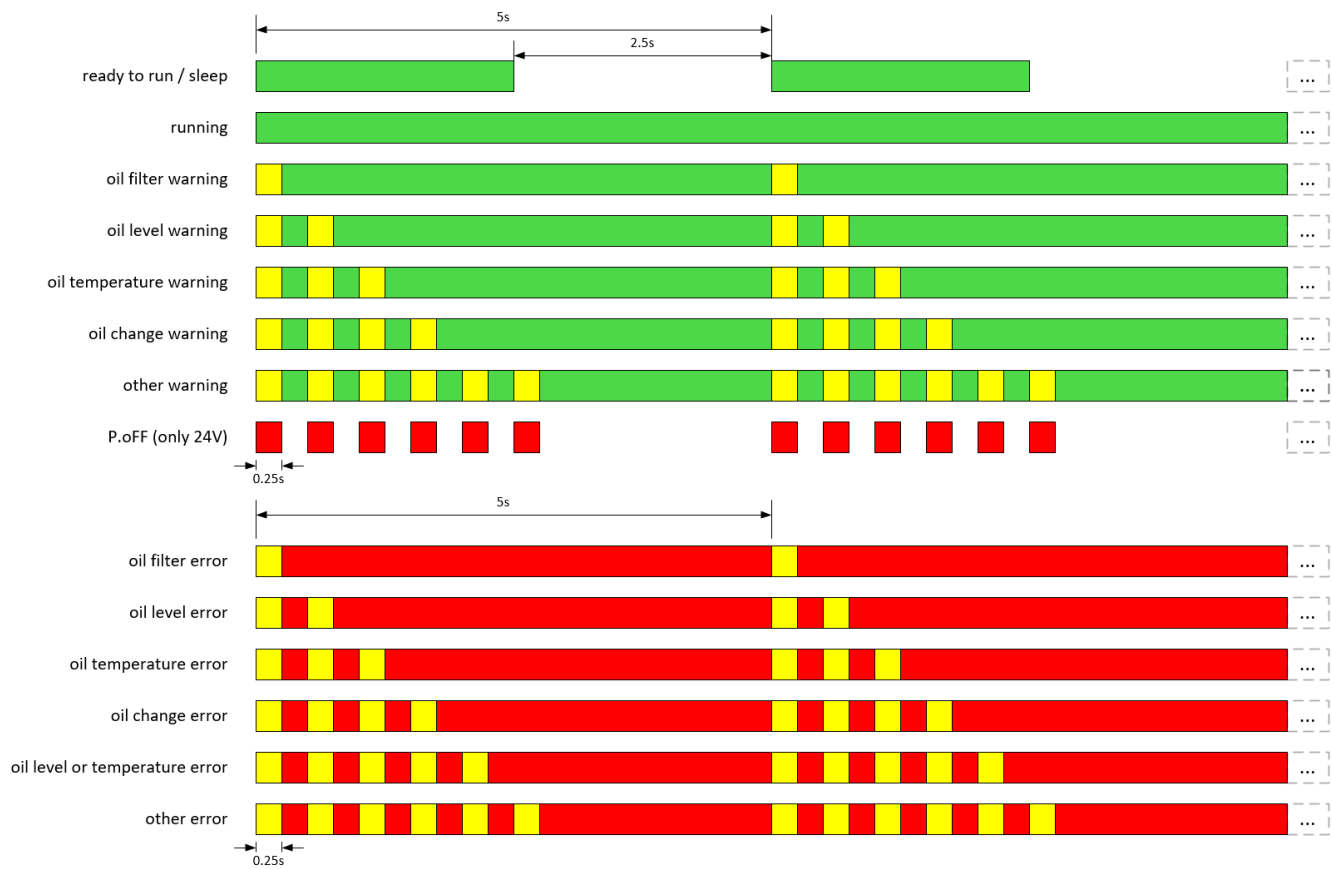


Abb. 70: Flash codes of the status LED strip

10.3
Status codes

Tabelle 57: Status codes

Code	Designation
P.oFF	Displayed only at shut-off drop in stop state (only 24V supplied)
PSLP	PID in sleep mode
-PF-	Modified parameters that differ from the standard value
-EP-	Parameters with invalid settings
StO-A	Safe torque off enabled
S.Err	Parameter change blocked
PrSE	Parameter setting contradiction

10.4 Warning codes

Tabelle 58: Warning codes

Code	Designation
C-dr	Communication disconnection
FLE	Fan maintenance period expired
noCP	No modified parameter
PLE	Pump leakage
Aib-	Analog input wire break detection
OCi	Communication data exceeds value range
Fdi	Fieldbus process data invalid
APF1	Warning that can be triggered by the application - ASF warning (see [d0.88])
UH-A	Under-temperature converter
SLi-	Velocity limitation

Code APF1: Application warning (ASF customer warning 1)

Function code	Error information (value)	Cause	Solution
[d0.88]	0: No warning	-	-
	1: Actual pressure value exceeds limit value	- Excessive pressure setting - Pressure sensor error	- Set pressure to a lower value - Check that the wiring is properly connected for actual pressure value transmission.
	2: Pressure command value exceeds limit value	Pressure command value set too high by user [F4.22]	Set pressure to a lower value
	3: Flow command value exceeds limit value	Flow command value set too high by user [F4.24]	Set flow to a lower value.
	4: Oil filter warning	Oil filter almost clogged	Clean or replace filter.
	5: Oil level warning	Oil level too low	Refill oil.
	6: Oil temperature warning	Max. oil temperature reached	Reduce hydraulic losses or improve oil cooling.
	7: Oil change warning	Operation time exceeds oil life time	Change oil and reset oil in operation timer [F4.54].
	8: (Reserved)	-	-
	9: Pump thermal monitoring warning	Pump speed is lower than required for pump cooling [F4.36]	Increase system minimum speed.
	10: Pump power limitation warning	Required pump power exceeds power limitation set in [F4.35]	Adjust power limitation or system load.

10.4.1 Multi-Ethernet card warning code

Warning code	Description	Cause	Solution
Fdi	Fieldbus process data invalid	- Cyclic communication had been established, but was stopped because of an error - Cyclic communication is running, but fieldbus master has set data status invalid	- Check the fieldbus master status. If the controller is in stop mode, the Fdi warning will also appear - Check the Ethernet cables and switches. - On the PLC side, set the application status and/or process data status to valid.

10.5 Error codes

Error 1 (OC-1): Over-current at constant speed

Possible cause	Solution
Sudden load change in operating mode	Reduce occurrence and scale of sudden change
Low mains voltage	Check the power supply.
Excessive inertia or load	- Check motor and frequency converter power. - Check the load.
Excessive torque compensation	Reduce the torque compensation setting [C2.22] until the current decreases.
Excessive overexcitation braking factor	Reduce [E0.55].

Error 2 (OC-2): Over-current during acceleration

Possible cause	Solution
Excessively short acceleration time	Increase the acceleration time [E0.26].
Excessive start-up frequency	Decrease the start frequency [E0.36].
Excessive load rotation inertia or impact	- Increase the acceleration time [E0.26]. - Reduce sudden load cycles.
Running command active while motor is coasting	Restart after stopping the motor or start with speed recording [E0.35].
Wrong settings of V/f curve-related parameters	Adjust settings of V/f curve-related parameters.
Excessive torque compensation	Reduce the torque compensation setting [C2.22] until the current decreases.
Excessive overexcitation braking factor	Reduce [E0.55].
Wrong motor parameter settings	Correct the motor parameter settings.

Error 3 (OC-3): Over-current during delay

Possible cause	Solution
Excessively short delay time	Increase the delay time [E0.27].
Excessive overexcitation braking factor	Reduce [E0.55].
Wrong motor parameter settings	Correct the motor parameter settings.

Error 4 (OE-1): Overvoltage at constant speed

Possible cause	Solution
Surge voltage from mains connection	Check the power supply.
Motor-to-earth short-circuit causes DC-bus capacitors overcharged	Check the motor connection.
EMC interference	Check the wiring of the control circuit, main circuit and grounding.

Error 5 (OE-2): Overvoltage during acceleration

Possible cause	Solution
Surge voltage from mains connection	Check the power supply.
Motor-to-earth short-circuit causes DC-bus capacitors overcharged	Check the motor connection.
Direct start during motor running	Restart after stopping the motor or start with speed recording [E0.35].
Excessively short acceleration time	Increase acceleration time [E0.26] or use the S characteristic curve [E0.25, E0.28, E0.29].

Error 6 (OE-3): Overvoltage during delay

Possible cause	Solution
Surge voltage from mains connection	Check the power supply.
Motor-to-earth short-circuit causes DC-bus capacitors overcharged	Check the motor connection.
Excessively short delay time	• Increase the delay time [E0.27]. • During delay, release the protection against overvoltage [C0.25].

Error 7 (OE-4): Overvoltage during stop

Possible cause	Solution
Excessive inertia on the load	• Increase the delay time [E0.27]. • Use suitable braking components.
Surge voltage from mains connection	Check the power supply.

Error 8 (UE-1): Undervoltage during operation

Possible cause	Solution
Power failure during operation	Check the power supply.
Deterioration of main flow capacitor	Contact customer service.

Error 9 (SC): Surge current or short-circuit

Possible cause	Solution
External phase-phase short-circuit of motor	Check the motor wiring.
Earth surge	Remove the ground connection and check the motor.
Internal error of power module	Contact customer service.
Surge current	• Increase the acceleration time [E0.26]; overexcitation. • Reduce the braking factor [E0.55].

Error 10 (IPH.L): Input phase loss

Possible cause	Solution
Abnormal, omitted or broken connections of frequency converter power supply	• Check the power connections. • Replace missing or broken ports.
Broken fuse	Check the fuse.
Imbalance in the three phases of input power supply	Check if the imbalance situation exceeds the converter overload capacity.
Deterioration of main flow capacitor	Contact customer service.

Error 11 (OPH.L): Output phase loss

Possible cause	Solution
Abnormal, omitted or broken connections of frequency converter outputs	• Check the ports at the frequency converter outputs. • Remove missing or broken ports.
Imbalance in the three phases of outputs	Check the motor.

Error 12 (ESS): Soft start error

Possible cause	Solution
Soft start resistance value has been changed due to overtemperature	Contact customer service.
Power failure	Check the power supply.
Input phase loss occurs during start-up (three-phase)	Correct the input phase loss.
Deterioration of main flow capacitor	Contact customer service.

Error 20 (OL-1): Converter overload

Possible cause	Solution
Long time overload	• Reduce the overload time. • Reduce the load.
Wrong settings of V/f curve-related parameters	Adjust settings of V/f curve-related parameters.
Overload happens at lower speed	• Reduce the load at low speed. • Use a higher performance frequency converter.
Excessive load, excessively short acceleration/delay time or cycle	• Adjust the load, acceleration/delay time or cycle. • Use a higher performance frequency converter.
Low mains voltage	Check the power supply.
Excessive torque compensation	Reduce the torque compensation setting [C2.22] until the current decreases.
Excessive overexcitation braking factor	Reduce [E0.55].

Error 21 (OH): Converter overtemperature

Possible cause	Solution
Frequency converter temperature [d0.20] is higher than max. admissible temperature 70°C	• Reduce ambient temperature, improve ventilation and heat dissipation; remove dust and deposits from ventilation ducts; check the fan and power connector (if installed). • If necessary, reduce the load.
Error in temperature detection circuit	Contact customer service.

Error 25 (CoL): Command value lost

Possible cause	Solution
Command value lost	Contact customer service.

Error 26 (StO-r): STO request

Possible cause	Solution
STO function is activated correctly in operating mode, after re-activation of input channels and reset of the device, the device goes to normal state	Check the signal on the STO input terminal.

Error 27 (StO-E): STO error

Possible cause	Solution
STO function is activated incorrectly, this happens only, if one channel is energized but the other is de-energized	Check the signal on the STO input terminal.

Error 30 (OL-2): Motor overload

Possible cause	Solution
Motor blocked	Prevent the motor from blocking.
Normal motor runs for a long time with large load at low speed	• Reduce the load. • Adjust the load to a higher value in standstill [C1.76]. • Set the correct temperature model motor protection time constant [C1.74].
Low mains voltage	Check the power supply.
Wrong settings of V/f curve-related parameters	Adjust settings of V/f curve-related parameters.
Excessive sudden load change	Check the load.
Excessive overexcitation braking factor	Reduce [E0.55].
Wrong motor protection parameter settings	Adjust the settings of [C1.74, C1.75 and C1.76] according to the actual motor situations.

Error 31 (Ot): Motor overtemperature

Possible cause	Solution
Excessive load or bad cooling	• Check the load. • Create better cooling conditions.
Wrong motor protection parameter settings	Set the motor protection parameters according to the actual protection circuits [C1.74].

Error 35 (SPE-): Speed control loop error

Possible cause	Solution
The speed loop difference is outside [C3.26] over a time of [C3.25]	Contact customer service.

Error 38 (AibE): Analog input wire break detection

Possible cause	Solution
24 V supply was switched on after the power supply	Note the activation sequence.
Analog input wire is disconnected	Check the wiring of AI1, AI2 and EAI.

Error 39 (EPS-): DC_IN power supply error

Possible cause	Solution
DC_IN power supply voltage is out of the range 20...28 V	Check the supply voltage on terminal DC_IN and make sure that the voltage is in the range 20...28 V.

Error 42 (E-St): Terminal error signal

Possible cause	Solution
External error caused by input signals via external terminals	Check the state of the external terminals.
Wrong wiring/setting of multi-function external terminals	Ensure the right external signals have been connected correctly to the right multi-function external terminals which are assigned to external error input ([E1.00]...[E1.04] = 32, 33).
Converter stop caused by active emergency stop command via Modbus communication	Check the stop command via the Modbus communication (0X0088: Stop according to parameter setting; 0X0090: emergency stop active). If the converter receives 0X0090, E-St will be displayed.

Error 43 (FFE-): Firmware version compatibility issue

Possible cause	Solution
Operating panel may be placed to the frequency converter with older/newer firmware	Contact customer service.
Control board may be installed in another device	Contact customer service.
Extension card may be installed to the frequency converter with older/newer firmware	Contact customer service.

Error 44 (rS-): Modbus communication error

Possible cause	Solution
Device connection problem	Check the device communication port.
Communication target error	Check the status of the communication target.

Error 45 (E.Par): Invalid parameter settings

Possible cause	Solution
Parameter settings are invalid after firmware update or extension card removal or parameter backup	- Check the "-EP-" parameter group and change the parameter values which appeared under "-EP-". - Charging the saved parameters.

Error 46 (U.Par): Unknown parameter restore error

Possible cause	Solution
If one or more parameters in the backup were not found in the device, they will be skipped during parameter retrieval.	Check the differences between the different firmware versions.

Error 48 (idA-): Internal communication error

Possible cause	Solution
Internal error caused by communication between control boards	- Restart the frequency converter. - Contact customer service.

Error 49 (idP-): Internal parameter error

Possible cause	Solution
Internal error caused by parameter handling	Contact customer service.

Error 50 (idE-): Internal converter error

Possible cause	Solution
Internal error occurs	Contact customer service.

Error 51 (OCd-): Internal extension card error

Possible cause	Solution
Extension card was successfully detected by the device at startup, but the communication failed afterwards	Contact customer service.

Error 52 (OCc): Extension card PDOs configuration error

Possible cause	Solution
Internal communication error between communication card and converter control board	• Update the firmware version. • Contact customer service.

Error 53 (Fdi-): No valid process data

Possible cause	Solution
No valid process data is received from remote communication server, the remote communication server may be turned off	Check the remote communication server.

Error 54 (PcE-): Remote control communication error

Possible cause	Solution
Error if communication to IndraWorks is lost during remote control	• Check the status of the communication between the frequency converter and IndraWorks. • Contact customer service.

Error 60 (ASF-): Application firmware error

Possible cause	Solution
Error message if the application firmware was not loaded correctly or trial use is over	Contact customer service.

Error 61 (APE1): Application error (ASF customer error 1)

Function code	Error information (value)	Cause	Solution
[d0.89]	0: No error	-	-
	1: Actual pressure value exceeds pump limit value	Actual pressure exceeded [F4.16] (maximum pump pressure)	- Set pressure to a lower value - Check that the wiring is properly connected for actual pressure value transmission. - Increase [F4.16].
	2: Pressure sensor error	- The negative motor speed exceeds [F4.06] with duration time exceeding [F4.07] - Slow decrease of actual pressure value after switching off	- Check if the pressure sensor can work properly. Increase the value of [F4.06, F4.07, F4.08 and F4.09]. - Check if the pressure sensor can work properly. Increase the value of [F4.10 and F4.11].
	3: Parameter setting error	Identical parameter settings	Check if parameter settings are in conflict.
	4: Oil filter error	Oil filter clogged	Clean or replace filter.
	5: Oil level error	Oil level too low	Refill oil.
	6: Oil temperature error	Max. oil temperature reached	Reduce hydraulic losses or improve oil cooling.
	7: Oil change error	Operation time exceeds oil life time	Change oil and reset oil in operation timer [F4.54]
	8: Oil level or temperature error	No warning signal for oil level and temperature available, or both are active	- Check warning signal/sensor. - Same solution as oil level/temperature error
	9: Pump thermal monitoring error	Pump speed is lower than required for pump cooling [F4.36]	Increase system minimum speed.

10.5.1 Multi-Ethernet card error codes

Error code	Description	Cause	Solution
Fin-	Initialization failed	- Error while parameterizing MEP. MEP could not start up completely [H3.03] IP Address and [H3.05] Gateway Address do not match.	- Check the [H3.62] list of invalid parameters and write valid values onto invalid parameters. - Write a consistent set of [H3.03] IP address, [H3.04] subnet mask and [H3.05] gateway address. Set [H3.05] to 0.0.0.0 if no gateway is required.
FnC-	Network setup error	- Parametrized IP address already present in network - No DHCP response from DHCP server - Incorrect fieldbus parametrization at MEP	- Change the [H3.03] IP address to a valid IP address on the subnet. - Check if the DHCP server is up and running. - Check that the installed GSD file is the right one.
FPC- (Error 134)	Process data configuration mismatch	Parametrized process data configuration between MEP and fieldbus master are differing in length. Check [H3.28/H3.29 and H3.32/H3.33] to allow a comparison	Correct the process data configuration either at the MEP ([H3.30/H3.31]) or at the master. Before correcting the process data configuration at MEP side, the active connection between master and MEP should be disabled. After the fix, set up the connection to reset this error.
Fdi-	Fieldbus process data invalid	Telegrams are lost or an error occurs when frequency converter is running	- Check master status and cable connection. - Check the switch status, if applicable. - Check screening and laying of cables in case of EMC problems. - Reduce Ethernet traffic, set up a separate network for fieldbus communication if the bus load is too high.

Error code	Description	Cause	Solution
Ocd-	MEP extension card error	- Two fieldbus extension cards are installed simultaneously - Internal communication was disturbed.	- Keep only one fieldbus extension card in the slots. - Check the installation of the MEP card and attempt to reset the error.
FCd-	Internal communication Watchdog error	Internal communication is timed out.	Reset the error; if the problem persists, [H3.38] timeout input data can be increased.
FnF-	Subsystem corrupted	Firmware file corrupted	Update the MEP firmware. If the problem persists, replace the MEP hardware.
FCE-	Internal error	Fatal error or exception	Boot the frequency converter again. If the problem persists, replace the MEP hardware.

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