The Drive & Control Company

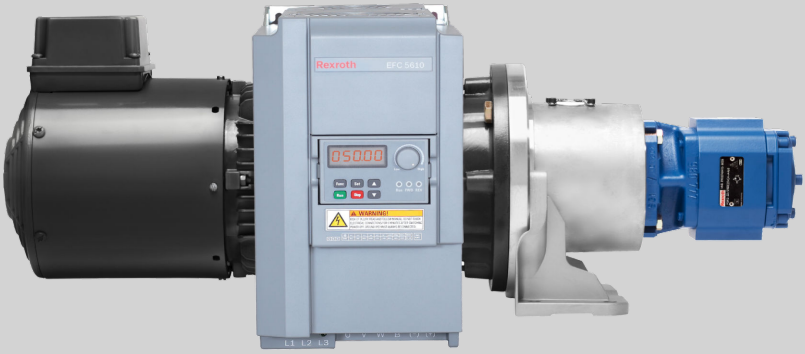
Rexroth
Bosch Group

Sytronix

FcP 5020
Frequency-Controlled Pump Drive System

Quick Start Guide
R912006684

Edition 02



Record of Revision

Edition	Release Date	Notes
DOK-RCON03-FcP5020*Eco-QU01-EN-P	2016.03	Preliminary
DOK-RCON03-FCP5020****-QU02-EN-P	2016.09	New functions

Version Matching Table

Frequency converter EFC 5610 firmware version	ASF version
03V12	01V04 or 01V06
03V14	
03V18 and above	01V08

Introduction of this Documentation

This **Quick Start Guide** is derived from the **Operating Instructions** which includes the product data in details.

⚠ WARNING **Personal injury and property damage caused by incorrect application, installation or operation!**

Never work with or control the product before reading through

- **Safety Instructions** which delivered with EFC 5610
- Safety descriptions in the **Operating Instructions**

Reference

For documentation available in other type or language, please consult your local sales partner or check www.boschrexroth.com.

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1 Type Code

1.1 Frequency Converter Type Code Description

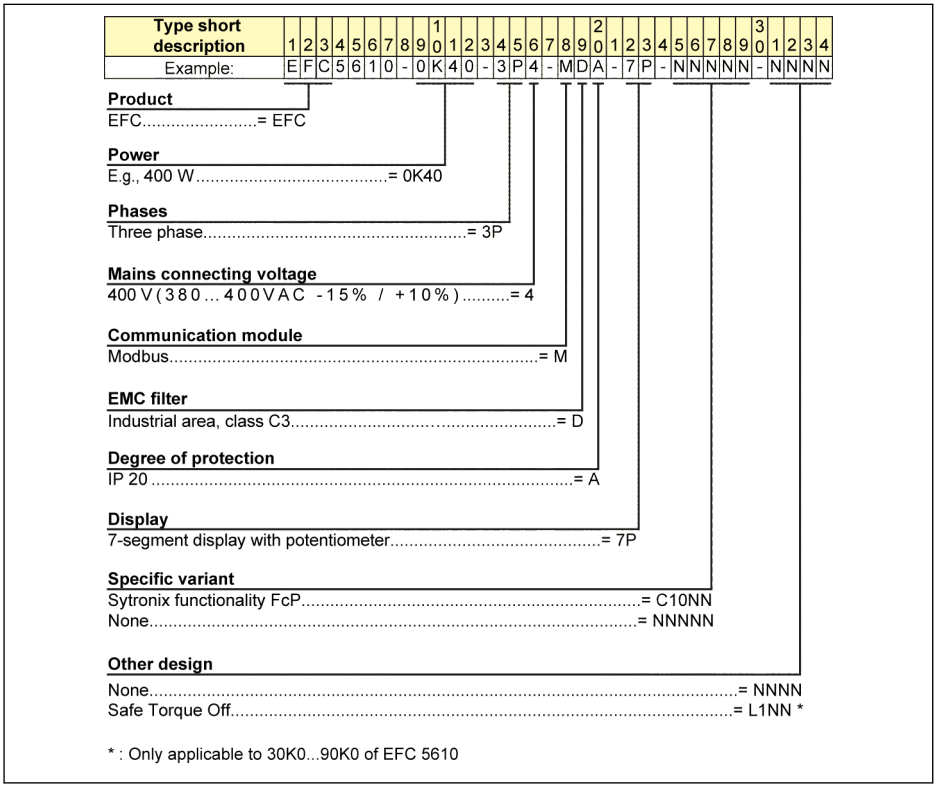


Fig. 1-1: EFC 5610 type code

This type code can be found on the Rexroth EFC converter.

1.2 FcP 5020 ASF Type Code Description

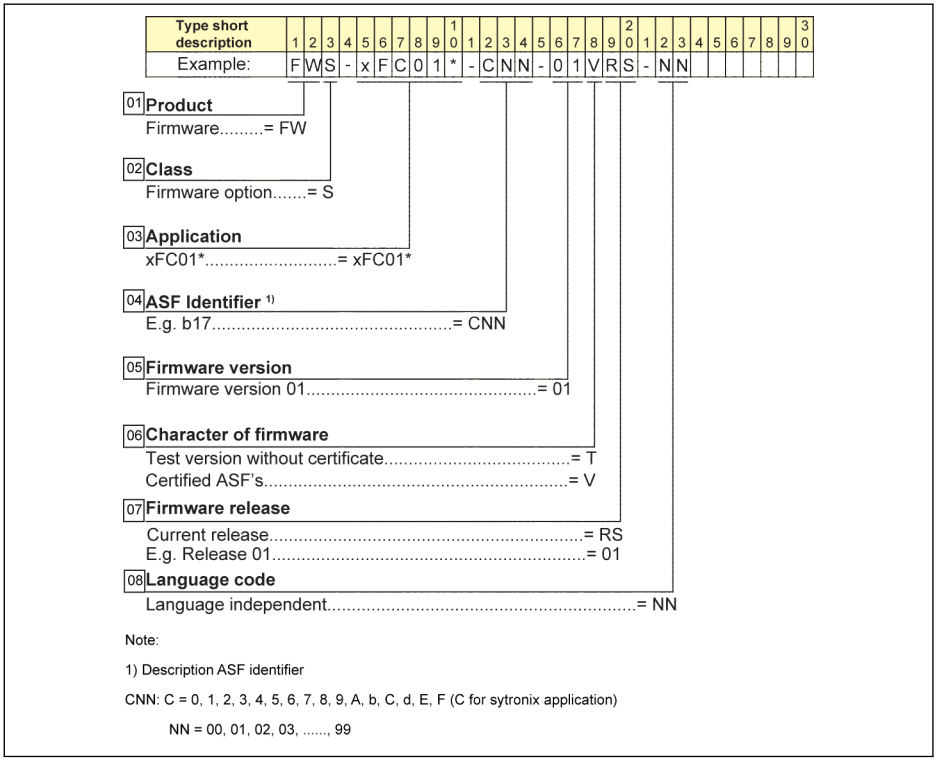


Fig. 1-2: FcP 5020 ASF type code

FcP 5020 ASF software material number: R912006662

FcP 5020 ASF software type code: FWS-XFC01*-C10-01VRS-NN

ASF: Application Specific Firmware.

The ASF type code will not be printed and placed on the EFC converter, but only a square adhesive label on the side, which represents important information from ASF type code:

For example:

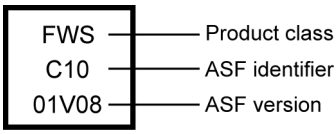


Fig. 1-3: ASF version information

Parameter	Name	Value
F0.01	ASF version	*
F0.02	ASF identifier	0x0C10
F0.03	ASF API required version	*
F0.06	ASF evaluation time	*
F0.07	ASF API version	*
F0.10	ASF status	Bit0: ASF valid
		Bit1: API compatible
		Bit2: ASF certified
		Bit3...Bit7: Reserved
		Bit8: ASF evaluation period expired
		Bit9: ASF invalid
		Bit10: ASF API incompatible
		Bit11: Reserved
		Bit12: ASF runtime exceeded
		Bit13: ASF stack overflow
		Bit14...Bit15: Reserved

Tab. 1-1: FcP 5020 ASF basic information

* For accurate information, refer to the actual data provided on the product.

2 Scope of Supply

If any item is found missing from standard supply package as listed below, please contact Bosch Rexroth's local sales partner at your earliest convenience.

- Frequency Converter EFC 5610 with integrated Sytronix software
- Safety Instructions (available in multiple languages)
- EFC 5610 Quick Start Guide
- FcP 5020 ASF Quick Start Guide

3 Documentation Reference

Following documentations about the components could be found on Bosch Rexroth homepage:

www.boschrexroth.com -> Products -> Electric Drives and Controls -> Product Catalog -> CAD and documentation

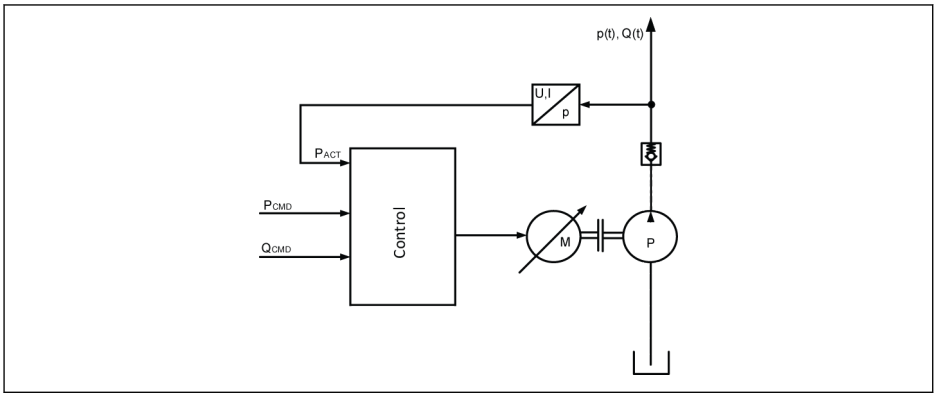
Title	Document number	Document type	Catalog
Rexroth Frequency Converter EFC 3610 / EFC 5610 Series	R912005856	Quick Start Guide	Controller / Converter
Rexroth Frequency Converter EFC 3610 / EFC 5610 Series	R912005854	Operating Instructions	
Pressure transducer with integrated electronics-type HM20	30272	Data sheet	Presssure Sensor
Rexroth IndraDyn E Standard Motors MOT-FC for Frequency Converter Operation	R911343624	Project Planning Manual	Motor

Tab. 3-1: Documentation reference

4 Function Specification

FcP 5020 ASF is developed based on the EFC 5610 hardware platform to be used for pressure and flow control. FcP 5020 has the functionality to automatic switch between pressure and flow mode. The typical application is shown as below.

This document only covers FcP 5020 relating functionalities. Please review documentations in chapter 2 "Scope of Supply" on page 4 prior to applying power to EFC drive.



Control: Drive control
P_{ACT}: Pressure actual value
P_{CMD}: Pressure command
Q_{CMD}: Flow command

Fig. 4-1: The diagram of typical application

FcP 5020 receives the pressure command generated by an external controller, i.e. PLC or CNC, and the pressure feedback generated by the actual pressure sensor mounted in the hydraulic system. By using both of the pressure command and the pressure feedback, the frequency converter is able to control the motor speed automatically and in turn regulate the output flow of hydraulic pump. The same mechanism is applicable to flow-based control mode to achieve the same regulation purpose on the output flow of hydraulic pump.

The product provides the following features.

- Pressure / flow setting
  - Easy command setting (internal commands, and 4 switchable parameters for pressure command)
  - Command setting possibility via analog or communication*
  - Unique digital filtering for pressure command rising and dropping
  - Preset standby mode (with minimum flow and pressure)

  * External hardware for communication is required.

* Supported communication protocols: Profibus, CANopen, SercosIII, Multi-Ethernet, Modbus.

- Pressure signal feedback
  - Compatible with different types of pressure sensors (unlimited scaling for the analog input signal)
  - High resistance capability to electromagnetic interference (with the use of high precision digital filter device for signal filtering)
  - Quick configuration for Rexroth HM20 pressure sensor
- Quick configuration for Rexroth MOT-FC_HOY motor
- p/Q PID control
  - p/Q control with automatic switching between pressure and flow control modes
  - Flow control
  - Pressure control
  - With 2 groups of switchable parameters provided
- Restore ASF parameter
- Extension functions
  - Master / slave control
  - Sleep / wake function
  - Two points / double pump control
  - Pressure drop / overshoot compensation
  - Pump power limitation
  - Hydraulic soft start and separate acceleration ramp
- Protection function
  - Pressure sensor failure detection
  - Actual pressure monitoring
  - Oil change warning / error
  - Pressure and flow command limit
  - Pump thermal protection
  - Sensor monitoring
- CytroPac configuration*
  - Load CytroPac configuration
  - CytroPac sensor monitoring
  - LED flash showing converter status

    * CytroPac is a specified compact Sytronix system with sensors. It applies FcP 5020 application software.

5 Initial Start Up

After the electric hydraulic system has been correctly assembled, users can take following steps for initial start up.

1. Select pressure sensor via F2.10 (for option "0: Others", please set F2.06, F2.07 manually).
2. Choose motor parameter via F1.15 and F1.16 for Rexroth MOT-FC_HOY motor. For other motors set F1.15 to 0, and set motor parameter in EFC parameter group C, please reference EFC 5610 quick start guide (material number is R912005856).
3. Set pressure command via F1.03...F1.08 and flow command via F1.11, F1.12.
4. Run the FcP system.

- The pressure command F1.05 and flow command F.12 default values are set to low values to prevent potential machine damage caused by improper use during initial start up.
- For CytroPac application, set F1.20 according to different CytroPac type.

Code	Name	Setting range	Default	Min.	Attri.
F1.03	Pressure command source	0: Depend on the value of F1.04 1: Select by digital input (F1.04 shows status) 2: Analog input 3: Communication	0	-	Stop
F1.04	Pressure command selection	0: Pressure command digital setting 0 1: Pressure command digital setting 1 2: Pressure command digital setting 2 3: Pressure command digital setting 3	0	-	Run
F1.05	Pressure command digital setting 0	0.0...1,000.0 bar	10.0	0.1	Run
F1.06	Pressure command digital setting 1	0.0...1,000.0 bar	10.0	0.1	Run
F1.07	Pressure command digital setting 2	0.0...1,000.0 bar	10.0	0.1	Run

Code	Name	Setting range	Default	Min.	Attri.
F1.08	Pressure command digital setting 3	0.0...1,000.0 bar	10.0	0.1	Run
F1.11	Flow command source	0: Depend on the value of F1.12 1: Analog input (positive / negative) 2: Communication	0	-	Stop
F1.12	Flow command digital setting	0...5,000 rpm	400	1	Run
F1.15	Motor type	0: Others 1: MOT-FC_HOY	1	-	Stop
F1.16	Motor power level	0: No selection 1...5: Reserved 6: 1.5 kW 7: 2.2 kW 8: 3 kW 9: 4 kW 10: 5.5 kW 11: 7.5 kW 12: 11 kW 13: 15 kW 14: 18.5 kW 15: 22 kW 16: 30 kW 17: 37 kW 18: 45kW 19: 55 kW 20: 75 kW 21: 90 kW	0	-	Stop
F1.20	CytroPac parameter initialization	0: No selection 1: CytroPac Basic 2: CytroPac Advanced 3: CytroPac Advanced + Comm.	0	-	Stop
F2.06	Pressure feedback corresponding to 10V or 20mA	0.1...1,000.0 bar	100.0	0.1	Stop

Code	Name	Setting range	Default	Min.	Attri.
F2.07	Pressure feedback null offset in V or mA	0.0...5.0 V, mA	4.0 (mA)	0.1	Stop
F2.10	Pressure sensor type	0: Others 1: HM20-2X/10-C 2: HM20-2X/50-C 3: HM20-2X/100-C 4: HM20-2X/160-C 5: HM20-2X/250-C 6: HM20-2X/315-C 7: HM20-2X/400-C 8: HM20-2X/630-C 9: Reserved 10: Reserved 11: HM20-2X/10-H 12: HM20-2X/50-H 13: HM20-2X/100-H 14: HM20-2X/160-H 15: HM20-2X/250-H 16: HM20-2X/315-H 17: HM20-2X/400-H 18: HM20-2X/630-H	3	-	Stop

Tab. 5-1: Parameter list of initial start up

6 Electric Connection

6.1 Overview

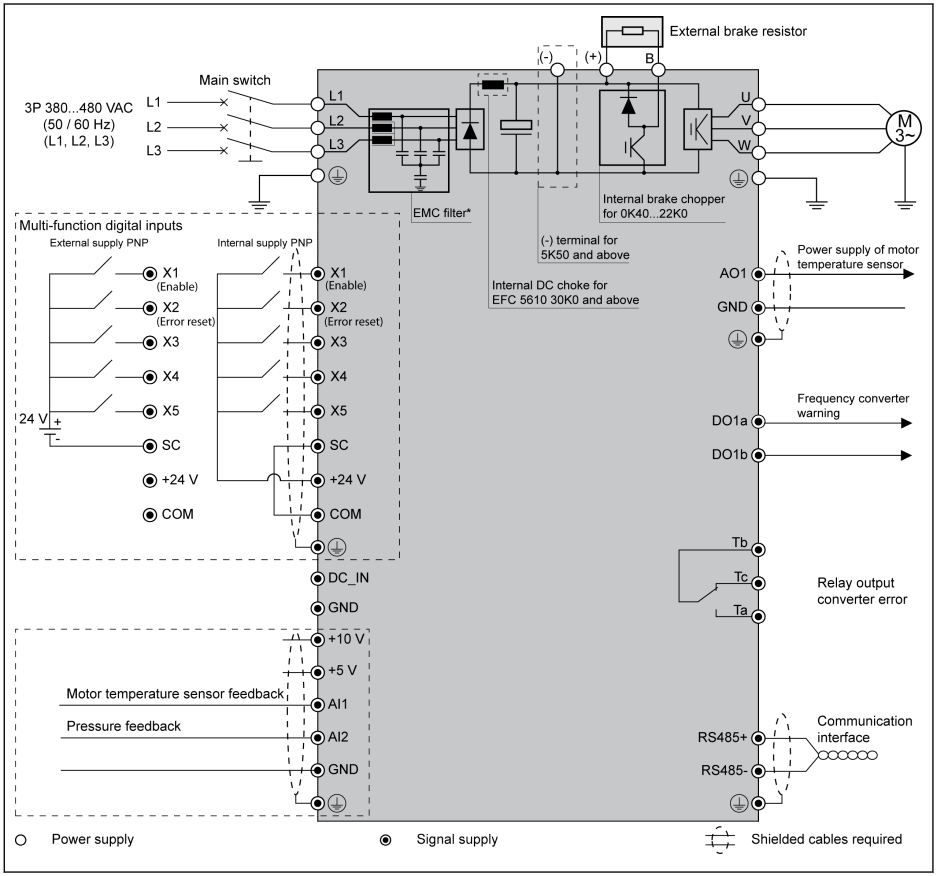


Fig. 6-1: Wiring Diagram

- FcP 5020 I/O functionality is given higher priority over the standard EFC functions. The standard EFC functionality assigned to terminal will be ignored and taken over by the ASF terminal assignment (non-zero entries in ASF).
- For details about the wiring of temperature sensor as shown in the diagram above, please refer to EFC 5610 operating instructions (material number is R912005854).

6.2 Analog Input

This section shows how analog input can be configured. The following figure is an example for analog input AI2, which has been assigned to pressure feedback. The configuration for AI1 and EAI is similar to AI2, only with different parameters shown in the table below.

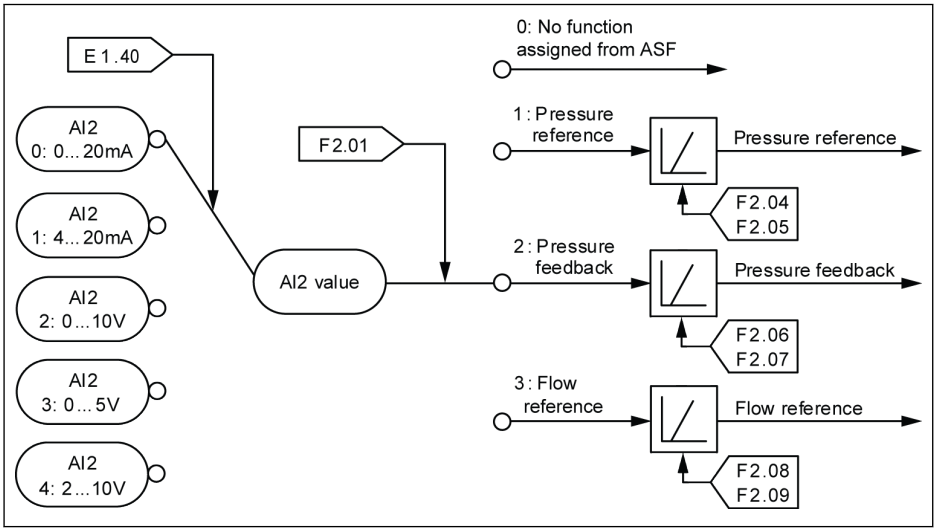


Fig. 6-2: Example with analog input AI2 assigned to pressure feedback

Code	Name	Setting Range	Default	Min.	Attri.
E1.35	AI1 input mode	0: 0...20 mA 1: 4...20 mA 2: 0...10 V 3: 0...5 V 4: 2...10 V	2	-	Run
E1.40	AI2 input mode		1	-	Run
H8.05	EAI input mode	0...4 (same as E1.35) 5: -10V...10V	0	-	Stop
F2.00	Analog input AI1	0: No function assigned from ASF 1: Pressure command 2: Pressure feedback 3: Flow command	0	-	Stop
F2.01	Analog input AI2		2	-	Stop
F2.02	External analog input EAI (-10V...10V, 4...20mA)		0	-	Stop
F2.04	Pressure command corresponding to 10V or 20mA	0.1...1,000.0 bar	10.0	0.1	Stop
F2.05	Pressure command null offset in V or mA	0.0...5.0 V, mA	0.0	0.1	Stop

Code	Name	Setting Range	Default	Min.	Attri.
F2.06	Pressure feedback corresponding to 10V or 20mA	0.1...1,000.0 bar	100.0	0.1	Stop
F2.07	Pressure feedback null offset in V or mA	0.0...5.0 V, mA	4.0 (mA)	0.1	Stop
F2.08	Flow command corresponding to 10V or 20mA	1...5,000 rpm	400	1	Stop
F2.09	Flow command null offset in V or mA	0.0...5.0 V, mA	0.0	0.1	Stop

Tab. 6-1: Analog input parameter list

As the default FcP 5020 configuration, analog input AI2 [F2.01 = 2] is configured as the pressure feedback input. Analog input AI1 or EAI1 has no preassigned configuration by the FcP 5020.

For broken wire protection of analog input, please check the following table for setting range of E1.61. For more information please refer to EFC 5610 converter document (R912005856 or R912005854).

Code	Name	Setting Range	Default	Min.	Attri.
E1.61	Broken wire protection	0: Inactive 1: Warning 2: Error	0	-	Stop

Tab. 6-2: Parameter E1.61 for broken wire protection

Wire broken monitoring function for all analog inputs can be activated by E1.61. Default value of E1.61 has been set to 0 in FcP 5020 and 2 in CytroPac default setting.

6.3 Analog Output

This section shows how analog output can be configured. The following figure is an example for analog input AO1. The configuration for EAO is similar to AO1, only with different parameters shown in the table below.

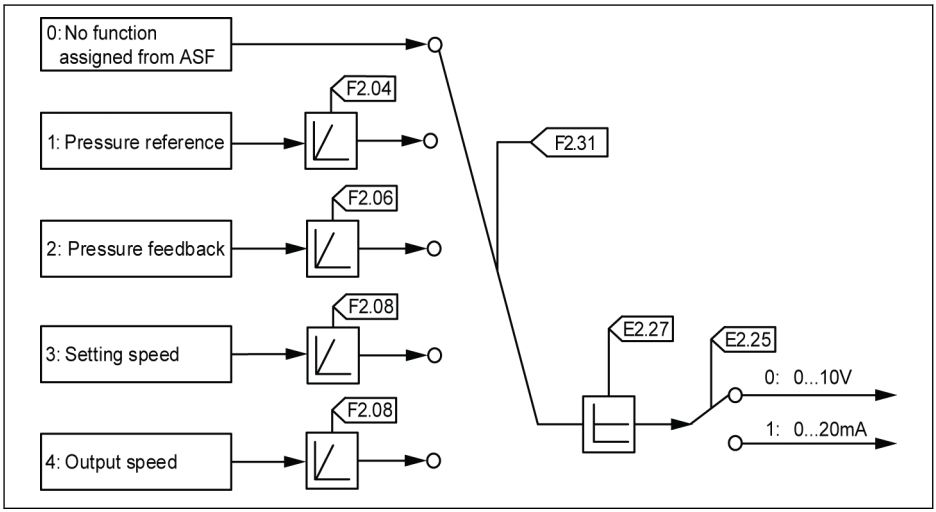


Fig. 6-3: Example with analog output AO1

Code	Name	Setting Range	Default	Min.	Attri.
E2.25	AO1 output mode	0: 0...10 V 1: 0...20 mA	1	-	Run
E2.27	AO1 gain setting	0.00...10.00	1.00	0.00	Run
F2.04	Pressure command corresponding to 10V or 20mA	0.1...1,000.0 bar	10.0	0.1	Stop
F2.06	Pressure feedback corresponding to 10V or 20mA	0.1...1,000.0 bar	100.0	0.1	Stop
F2.08	Flow command corresponding to 10V or 20mA	1...5,000 rpm	400	1	Stop
F2.31	AO1 output (use E2.27 for gain)	0: No function assigned from ASF 1: Pressure command (scaled by F2.04) 2: Pressure feedback (scaled by F2.06) 3: Setting speed (include direction) (scaled by F2.08) 4: Output speed (include direction) (scaled by F2.08)	0	-	Run
F2.32	EAO output (use H8.27 for gain)		0	-	Run

Code	Name	Setting Range	Default	Min.	Attri.
H8.25	EAO output mode	0: 0...10 V 1: 0...20 mA	0	-	Run
H8.27	EAO gain setting	0.00...10.00	1.00	0.01	Run

Tab. 6-3: Analog output parameter list

As the default configuration, FcP 5020 ASF does not set the AO1 output, i.e. [F2.31] = 0. The AO1 output can be used by the EFC function.

6.4 Motor Temperature Thermal Protection

Both AI1 / EAI and AO1 / EAO can be used for motor thermal protection. For Sytronix application with MOT-FC_HOY motor, the PTC connection is arranged by using AO as current output and AI as voltage input, with the parameters being pre-set for C1.72, C1.73, E1.40 and E2.25. Users need to connect PTC sensor accordingly and set [E1.60] = 1, [E2.26] = 11 in order to activate this function.

For more details, please refer to chapter 12.10, motor protection of EFC 5610 operating instruction (R912005854 / edition 05).

6.5 Digital Input

Code	Name	Setting Range	Default	Min.	Attri.
F2.16	X1 input	0: No function assigned from ASF 1: Pressure command selection bit0	0 (RUN)	-	Stop
F2.17	X2 input	2: Pressure command selection bit1 3: p/Q parameter selection	0 (Error reset)	-	Stop
F2.18	X3 input	4: Reserved	0	-	Stop
F2.19	X4 input	5: Master / slave mode switch	0	-	Stop
F2.20	X5 input	6: Oil filter warning	0	-	Stop
F2.21	EX1 input	7: Oil level warning	0	-	Stop
F2.22	EX2 input	8: Oil temperature warning	0	-	Stop
F2.23	EX3 input	9: Oil filter error	0	-	Stop
F2.24	EX4 input	10: Oil level error 11: Oil temperature error 12: Oil level / temperature error 13: Oil filter warning inverse 14: Oil level warning inverse 15: Oil filter error inverse 16: Oil level / temperature error inverse 17: Reserved 18: Reserved 19: Reserved 20: Pressure drop compensation trigger 21: Pressure overshoot compensation trigger	0	-	Stop

Tab. 6-4: Digital input parameter list

The default setting of terminal X1...X5, EX1...EX4 in ASF is "0". This means no function from ASF is assigned, only EFC firmware functions assigned are active.

Part of the EFC firmware parameters, including [E1.01] = 34 (X2 set to "Reset"), will be pre-set automatically in ASF.

The digital inputs F2.16...F2.24, are mutually exclusive, which therefore do not allow for any identical setting (except 0) between the parameters, otherwise warning APF1 will be triggered.

Four pressure command parameters are available in ASF, and these can be switched according to setting of F1.03 and DI or F1.04. The following table shows the correspondence between p/Q parameter selection through DI and F1.04, but DI switches pressure commands without changing F1.04.

Pressure command selection bit0	0	1	0	1
Pressure command selection bit1	0	0	1	1
F1.04	0	1	2	3
Pressure command	F1.05	F1.06	F1.07	F1.08

Tab. 6-5: The setting of digital input selection (F1.04)

Two parameter sets for p/Q controller are available in ASF, and these can be switched according to setting of F3.00 and DI or F3.01. The following table shows the correspondence between p/Q parameter selection through DI and F3.01, but DI switches parameter sets without changing F3.01.

p/Q parameter selection	0	1
F3.01	0	1
p/Q parameter	F3.10...F3.19	F3.30...F3.39

Tab. 6-6: The setting of digital input selection (F3.01)

6.6 Digital and Relay Output

Code	Name	Setting Range	Default	Min.	Attri.
F2.36	DO1 output	0: No function assigned from ASF 1: Converter warning 2: Green CytroPac flashing LED 3: Red CytroPac flashing LED	1	-	Run
F2.37	EDO output		0	-	Run
F2.40	Relay 1 output	0: No function assigned from ASF 1: Converter warning 2: Two points / double pump control	0	-	Run
F2.41	Extension relay output		0	-	Run

Tab. 6-7: Parameter list of digital and relay output

The FcP 5020 default setting of DO1 is "1", i.e. the frequency converter warning. Meanwhile the default setting of relay and EDO when connected to ASF are both "0", which means the function of relay and EDO is assigned by EFC firmware.

The EFC parameter E2.15 has been set to "14" (frequency converter error) by ASF as FcP default setting. For more EFC parameter changed as FcP default setting, please refer to chapter 8.6 "Auto-modified EFC Parameters in FcP Initialization" on page 62.

7 Block Diagram of Main Functions

7.1 Overview

The following figure shows an overview of control functions in this ASF, for details information, reference the chapter number which is shown under each function.

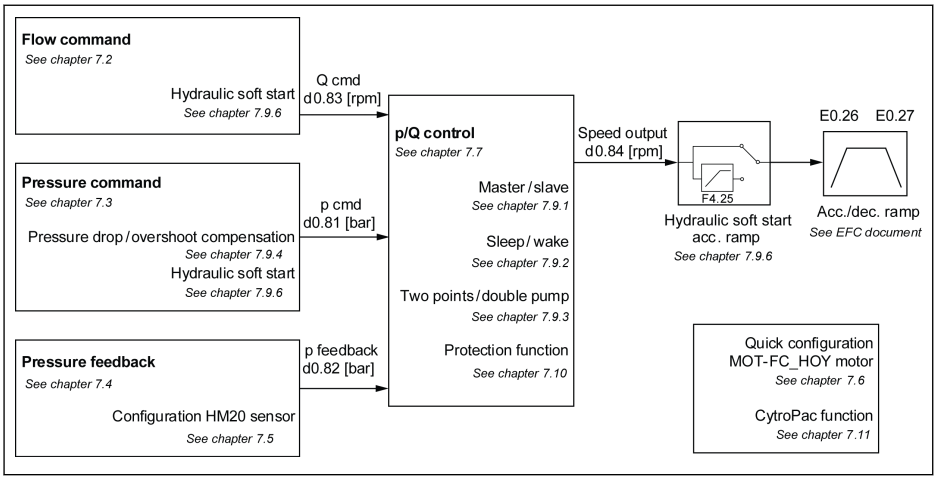


Fig. 7-1: p/Q PID control and relevant functions

7.2 Flow Command Processing

Parameter F1.11 defines the source of flow command. The flow command value can come from either predefined FcP 5020 parameters, analog input or using fieldbus communication.

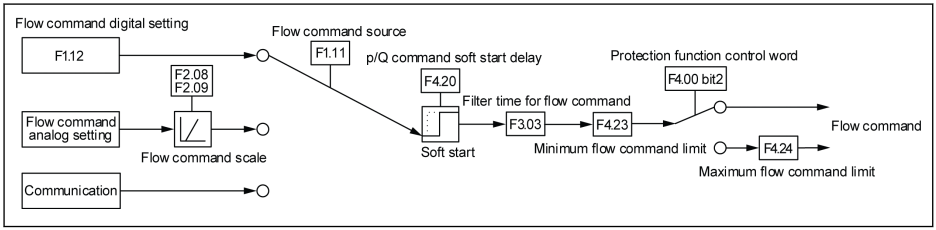


Fig. 7-2: Flow command processing

Code	Name	Setting range	Default	Min.	Attri.
F1.11	Flow command source	0: Depend on the value of F1.12 1: Analog input (positive / negative) 2: Communication	0	-	Stop
F1.12	Flow command digital setting	0...5,000 rpm	400	1	Run
F2.00	Analog input AI1	0: No function assigned from ASF 1: Pressure command 2: Pressure feedback 3: Flow command	0	-	Stop
F2.01	Analog input AI2		2	-	Stop
F2.02	External analog input EAI (-10V...10V, 4...20mA)		0	-	Stop
F2.08	Flow command corresponding to 10V or 20mA	1...5,000 rpm	400	1	Stop
F2.09	Flow command null offset in V or mA	0.0...5.0 V, mA	0.0	0.1	Stop
F3.03	Filter time for flow command	0...999 ms	4	1	Run
F4.00	Protection function control word	0...15 Bit0: Pressure sensor failure (PSF) Bit1: Actual pressure monitoring Bit2: p/Q max. command limit Bit3: Oil changing detection	0	-	Run
F4.20	p/Q command soft start delay	0.0...1,000.0 s	0.0	0.1	Stop
F4.23	Minimum flow command limit	0...[F4.24] rpm	200	1	Stop
F4.24	Maximum flow command limit	[F4.23]...5,000 rpm	3,000	1	Stop

Tab. 7-1: Parameter list of flow command processing

F2.08, F2.09: Scaling for flow command

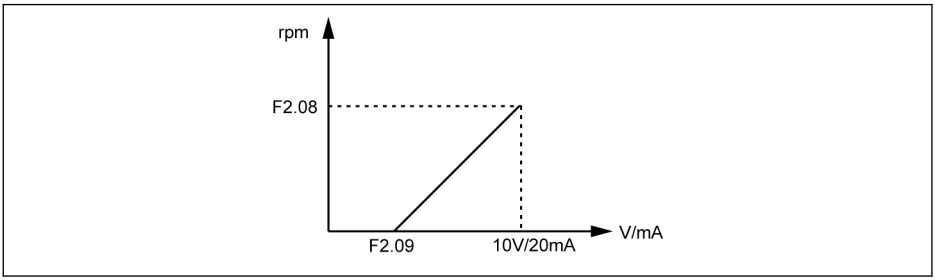


Fig. 7-3: Flow command scaling

7.3 Pressure Command Processing

Pressure command can be generated from multiple sources such as predefined in the parameters, analog input or fieldbus communication. User needs to define the pressure command source prior to start up the system.

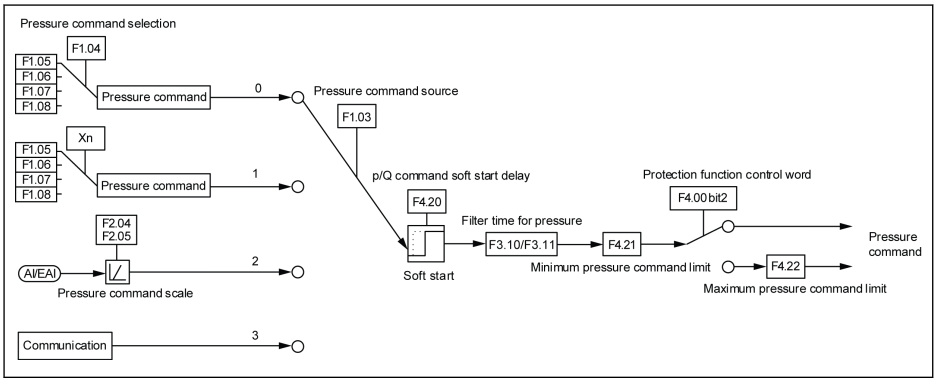


Fig. 7-4: Pressure command processing

Code	Name	Setting range	Default	Min.	Attri.
F1.03	Pressure command source	0: Depend on the value of F1.04 1: Select by digital input (F1.04 shows status) 2: Analog input 3: Communication	0	-	Stop
F1.04	Pressure command selection	0: Pressure command digital setting 0 1: Pressure command digital setting 1 2: Pressure command digital setting 2 3: Pressure command digital setting 3	0	-	Run
F1.05	Pressure command digital setting 0	0.0...1,000.0 bar	10.0	0.1	Run
F1.06	Pressure command digital setting 1	0.0...1,000.0 bar	10.0	0.1	Run
F1.07	Pressure command digital setting 2	0.0...1,000.0 bar	10.0	0.1	Run
F1.08	Pressure command digital setting 3	0.0...1,000.0 bar	10.0	0.1	Run

Code	Name	Setting range	Default	Min.	Attri.
F2.00	Analog input AI1	0: No function assigned from ASF 1: Pressure command 2: Pressure feedback 3: Flow command	0	-	Stop
F2.01	Analog input AI2		2	-	Stop
F2.02	External analog input EAI (-10V...10V, 4...20mA)		0	-	Stop
F2.04	Pressure command corresponding to 10V or 20mA	0.1...1,000.0 bar	10.0	0.1	Stop
F2.05	Pressure command null offset in V or mA	0.0...5.0 V, mA	0.0	0.1	Stop
F3.10	Filter time for pressure rising [0]	0...999 ms	80	1	Run
F3.11	Filter time for pressure dropping [0]	0...999 ms	40	1	Run
F4.00	Protection function control word	0...15 Bit0: Pressure sensor failure (PSF) Bit1: Actual pressure monitoring Bit2: p/Q max. command limit Bit3: Oil changing detection	0	-	Run
F4.20	p/Q command soft start delay	0.0...1,000.0 s	0.0	0.1	Stop
F4.21	Minimum pressure command limit	0.0...[F4.22] bar	5.0	0.1	Stop
F4.22	Maximum pressure command limit	[F4.21]...1,000.0 bar	250.0	0.1	Stop

Tab. 7-2: Parameter list of pressure command processing

The setting is equally applicable to another parameter group related to filter time for pressure command rising and dropping, i.e. F3.30, F3.31.

F2.04, F2.05: Scaling for pressure command

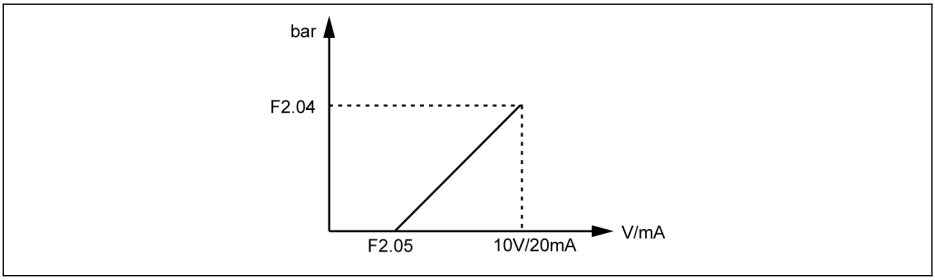


Fig. 7-5: Pressure command scaling

7.4 Pressure Feedback Input

AI2 input is predefined as the pressure sensor input. User can select a different type of pressure sensor and scaling factor. In case of Rexroth HM20 pressure sensor is used the parameter F2.10 use for setting the installed HM20 pressure sensor.

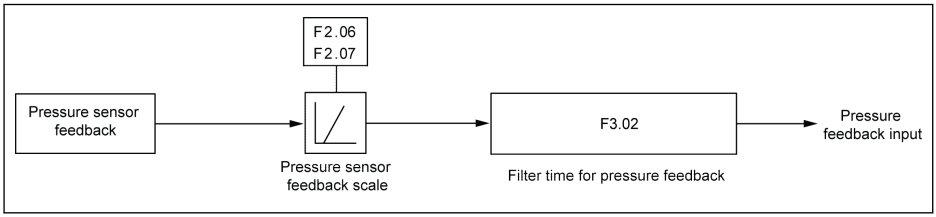


Fig. 7-6: Pressure feedback input

Code	Name	Setting range	Default	Min.	Attri.
F2.06	Pressure feedback corresponding to 10V or 20mA	0.1...1,000.0 bar	100.0	0.1	Stop
F2.07	Pressure feedback null offset in V or mA	0.0...5.0 V, mA	4.0 (mA)	0.1	Stop
F3.02	Filter time for pressure feedback	0...999 ms	4	1	Run

Tab. 7-3: Parameter list of pressure sensor feedback scaling

F2.06, F2.07: Scaling for pressure sensor feedback

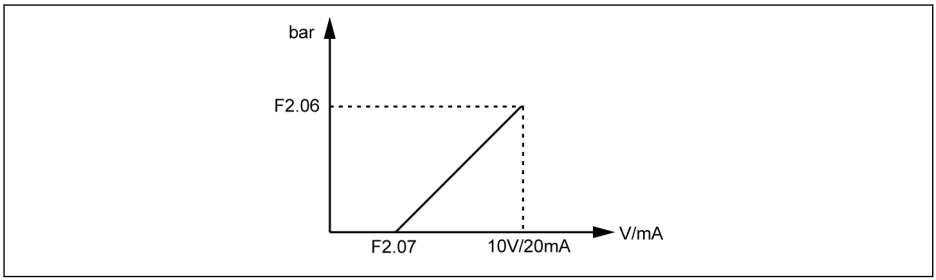


Fig. 7-7: Pressure sensor feedback scaling

7.5 Quick Configuration For Rexroth HM20 Pressure Sensor

For application using Rexroth HM20 pressure transducer, configuration parameters of HM20 sensor can be automatically loaded by selecting the corresponding type code in parameter F2.10. Please make sure the right analog input channel has been set through [F2.00]...[F2.02] before setting [F2.10], since the configuration parameters (AI input mode and scaling factors) will be set for the selected channel for pressure feedback.

Code	Name	Setting range	Default	Min.	Attri.
E1.35	AI1 input mode	0: 0...20 mA 1: 4...20 mA 2: 0...10 V 3: 0...5 V 4: 2...10 V	2	-	Run
E1.40	AI2 input mode		1	-	Run
H8.05	EAI input mode	0...4 (same as E1.35) 5: -10...10 V	0	-	Stop
F2.00	Analog input AI1	0: No function assigned from ASF 1: Pressure command 2: Pressure feedback 3: Flow command	0	-	Stop
F2.01	Analog input AI2		2	-	Stop
F2.02	External analog input EAI (-10V...10V, 4...20mA)		0	-	Stop
F2.06	Pressure feedback corresponding to 10V or 20mA	0.1...1000.0 bar	100.0	0.1	Stop

Code	Name	Setting range	Default	Min.	Attri.
F2.07	Pressure feedback null offset in V or mA	0.0...5.0 V, mA	4.0 (mA)	0.1	Stop
F2.10	Pressure sensor type	0: Others 1: HM20-2X/10-C 2: HM20-2X/50-C 3: HM20-2X/100-C 4: HM20-2X/160-C 5: HM20-2X/250-C 6: HM20-2X/315-C 7: HM20-2X/400-C 8: HM20-2X/630-C 9: Reserved 10: Reserved 11: HM20-2X/10-H 12: HM20-2X/50-H 13: HM20-2X/100-H 14: HM20-2X/160-H 15: HM20-2X/250-H 16: HM20-2X/315-H 17: HM20-2X/400-H 18: HM20-2X/630-H	3	-	Stop

Tab. 7-4: Parameter list of HM20 pressure sensor auto selection

7.6 Quick Configuration For Rexroth MOT-FC_HOY Motor

When MOT-FC_HOY motor is used with FcP 5020 ASF application, saved motor parameters can be loaded via F1.15 and F1.16. Please keep [F1.15]=1 for MOT-FC_HOY motor, for third part motor please set [F1.15]=0 and set the motor parameter in EFC parameter group C1. For more information please reference EFC 5610 quick start guide (material number is R912005856).

Code	Name	Setting range	Default	Min.	Attri.
F1.15	Motor type	0: Others 1: MOT-FC_HOY	1	-	Stop
F1.16	Motor power level	0: No selection 1...5: Reserved 6: 1.5 kW 7: 2.2 kW 8: 3 kW 9: 4 kW 10: 5.5 kW 11: 7.5 kW 12: 11 kW 13: 15 kW 14: 18.5 kW 15: 22 kW 16: 30 kW 17: 37 kW 18: 45kW 19: 55 kW 20: 75 kW 21: 90 kW	0	-	Stop

Tab. 7-5: Motor parameter list

- Only change motor parameter by switching F1.16 to 1...21, when [F1.15] = 1.
- If [F1.15] = 0, no motor parameter will be changed by switching F1.16 and the motor thermal model protection time constant C1.74 is based on the EFC converter.

If the motor parameters from F1.15 / F1.16 are selected, the following parameters in EFC converter will be changed automatically.

Code	Name	Code	Name
C1.05	Motor rated power	C1.21	Stator resistance
C1.06	Motor rated voltage	C1.22	Rotor resistance
C1.07	Motor rated current	C1.23	Leakage inductance
C1.08	Motor rated frequency	C1.24	Mutual inductance
C1.09	Motor rated speed	C1.74	Motor thermal model protection time constant
C1.10	Motor rated power factor	C3.00	Speed loop proportional gain
C1.13	Motor inertia mantissa	C3.01	Speed loop integral time
C1.14	Motor inertia exponent	C3.05	Current loop proportional gain
C1.20	Motor no-load current	C3.06	Current loop integral time

Tab. 7-6: Auto-modified EFC motor control parameter list

Once motor control mode (C0.00) is changed, motor parameter will be reset to factory default (not for MOT-FC parameter) even if F1.16 is set, for that please reload motor parameter by setting F1.16 again.

7.7 p/Q PID Control

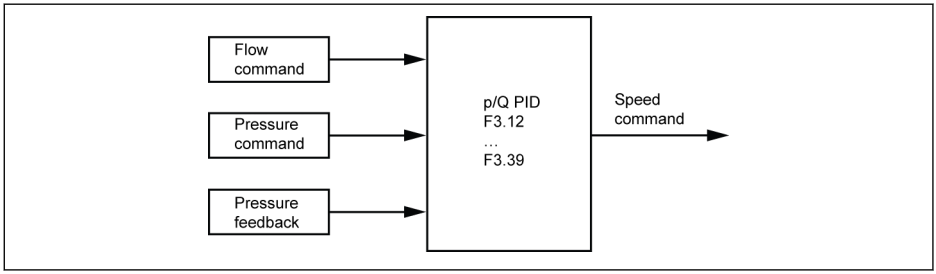


Fig. 7-8: p/Q PID control

Code	Name	Setting range	Default	Min.	Attri.
F3.12	Proportional gain [0]	0.00...500.00 rpm/bar	8.00	0.01	Run
F3.13	Integral time 1 [0]	0...999 ms	80	1	Run
F3.14	Integral time 2 [0]	0...999 ms	0	1	Run
F3.15	Integral time TI switch threshold [0]	-150.0...0.0 bar (set to 0, the switching function is invalid)	0.0	0.1	Run
F3.16	Differential gain [0]	0.000...10.000 (rpm/bar)*s	0.000	0.001	Run
F3.17	Filter time for Kd [0]	0...999 ms	35	1	Run
F3.18	Lower limit for I+D [0]	-5,000...5,000 rpm	0	1	Run
F3.19	System minimum speed [0]	-5,000...5,000 rpm	0	1	Run
F3.32	Proportional gain [1]	0.00...500.00 rpm / bar	8.00	0.01	Run
F3.33	Integral time 1 [1]	0...999 ms	80	1	Run
F3.34	Integral time 2 [1]	0...999 ms	0	1	Run
F3.35	Integral time TI switch threshold [1]	-150.0...0.0 bar (set to 0.0, the switching function is invalid)	0.0	0.1	Run
F3.36	Differential gain [1]	0.000...10.000 (rpm/bar)*s	0.000	0.001	Run
F3.37	Filter time for Kd [1]	0...999 ms	35	1	Run
F3.38	Lower limit for I+D [1]	-5,000...5,000 rpm	0	1	Run
F3.39	System minimum speed [1]	-5,000...5,000 rpm	0	1	Run

Tab. 7-7: Parameter list of p/Q PID control

As default setting the p/Q parameter set 0 (F3.12...F3.19) is selected, switching to the other parameter set during operation is also possible. For details, please refer to the following table and figure.

Code	Name	Setting range	Default	Min.	Attri.
F3.00	p/Q parameter selection source	0: Depend on the value of F3.01 1: Digital input 2: Communication	0	-	Stop
F3.01	p/Q parameter digital selection	0: Parameter group 0 1: Parameter group 1	0	-	Run

Tab. 7-8: Parameter list of p/Q parameter selection

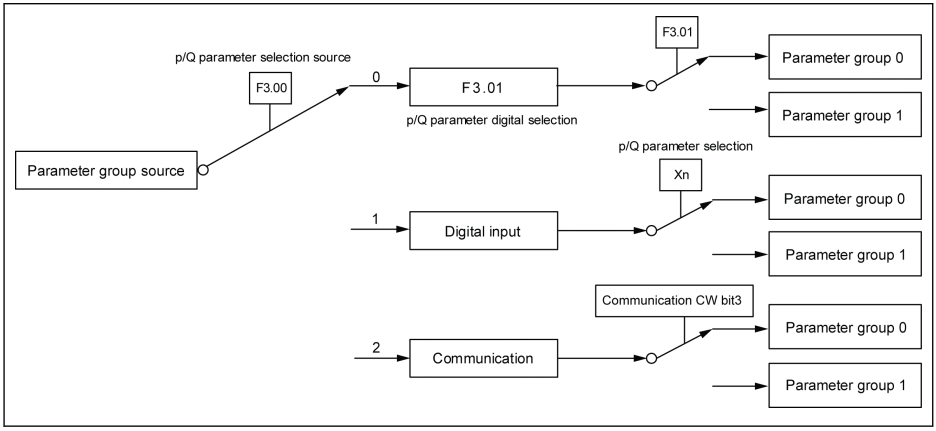


Fig. 7-9: p/Q parameter group selection

If the two points / double pump function is active (see F4.03 bit3), the p/Q parameter selection function shown in the figure above will be deactivated, and the p/Q controller parameter sets can only be switched according to the pump switching logic.

Code	Name	Setting range	Default	Min.	Attri.
F3.12	Proportional gain [0]	0.00...500.00 rpm/bar	8.00	0.01	Run

Tab. 7-9: Parameter list of p/Q PID controller proportional gain setting

The parameter F3.12 is used to set the proportional gain of p/Q PID controller. Pressure loop response is faster with a higher proportional gain. But excessively high proportional gain can cause pressure over modulation and pressure oscillation.

Code	Name	Setting range	Default	Min.	Attri.
F3.13	Integral time 1 [0]	0...999 ms	80	1	Run
F3.14	Integral time 2 [0]	0...999 ms	0	1	Run
F3.15	Integral time TI switch threshold [0]	-150.0...0.0 bar (the switching function is invalid when the setting is 0.0)	0.0	0.1	Run

Tab. 7-10: Parameter list of p/Q PID controller integral time setting

The parameters in the table above are used to set the integral time of p/Q PID controller. Higher integral time will slow down the pressure loop system response which causes the slower pressure system response against external disturbance but will result in the higher system stability. Both integral time TI_1 and TI_2 can be used as time constant at integral stage. Based on the pressure difference (pressure command - pressure feedback), the system will switch to a suitable integral time.

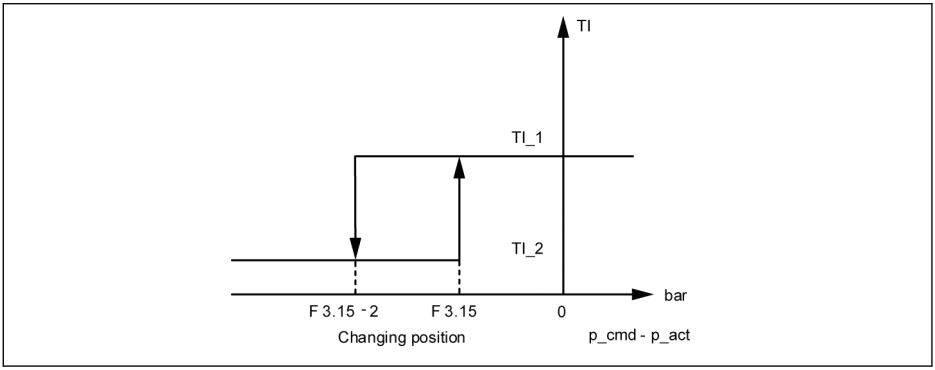


Fig. 7-10: p/Q PID integrator switching

When the integral time TI switching threshold is set to 0, the switching function is inactive, TI_1 is fixed for integral time.

Code	Name	Setting range	Default	Min.	Attri.
F3.16	Differential gain [0]	0.000...10.000 (rpm/bar)*s	0.000	0.001	Run
F3.17	Filter time for Kd [0]	0...999 ms	35	1	Run

Tab. 7-11: Parameter list of p/Q PID controller differential gain setting

The parameter F3.16 is used to set differential gain of p/Q PID controller. The greater the differential gain, the less the system pressure overshoot, but the slower the pressure response. Excessively large differential gain would affect the system stability.

The parameter F3.17 is used to set the filter time of p/Q PID controller at differential stage. Setting this parameter properly can help to suppress the high fre-

quency oscillation at differential stage. However excessively large setting the filter time would cause delay of pressure response.

Code	Name	Setting range	Default	Min.	Attri.
F3.18	Lower limit for I+D [0]	-5,000...5,000 rpm	0	1	Run

Tab. 7-12: Parameter list of p/Q PID controller integral output setting

The parameter F3.18 is used to set the minimum value of integral output, for the effect of preventing integral saturation.

Code	Name	Setting range	Default	Min.	Attri.
F3.19	System minimum speed [0]	-5,000...5,000 rpm	0	1	Run

Tab. 7-13: Parameter list of p/Q PID controller minimum output setting

The parameter F3.19 is used to set the lower limit of p/Q PID controller output.

Parameter set [1] F3.32...F3.39 has the same function as parameter set [0] F3.12...F3.19

7.8 Restore ASF Parameter

User can restore ASF parameter setting to default via F1.00, by doing this following EFC parameters will be re-set to ASF default values as well. Please reference chapter 8.6 "Auto-modified EFC Parameters in FcP Initialization" on page 62 for more details.

Additionally, if b0.10 is executed to restore EFC parameters, please make sure to re-execute F1.00 = 1 to restore all ASF parameters to default values.

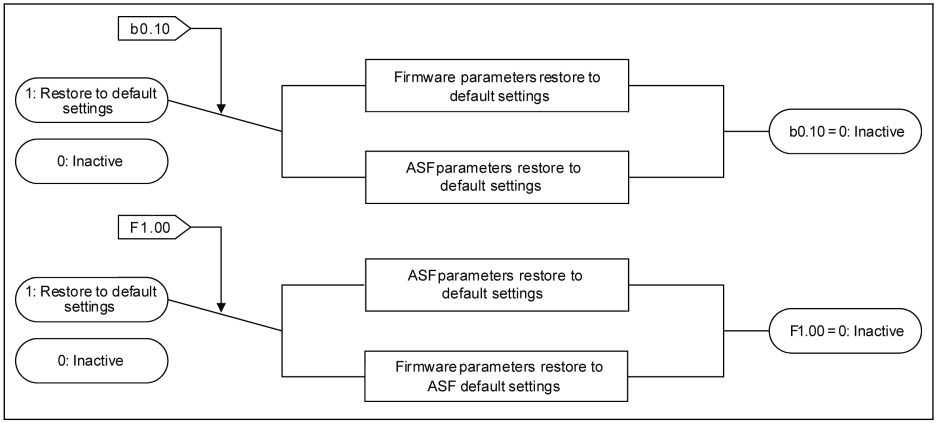


Fig. 7-11: ASF parameter restore to default

By restoring ASF parameter (setting F1.00 = 1), the value of parameter F1.15 and F1.16 will NOT be restored. For CytroPac application, after restoring ASF parameter (setting F1.00 = 1), parameter F1.20 need to set according to different type of CytroPac applications in order to quickly configure setting of CytroPac.

7.9 Extension Functions

7.9.1 Master / Slave Function

Master / slave pump function is designed for multi-pump working as a group to achieve a larger flow. In this application, a master converter is needed to control the speed / flow of slave pumps.

Code	Name	Setting range	Default	Min.	Attri.
F1.11	Flow command source	0: Depend on the value of F1.12 1: Analog input (positive / negative) 2: Communication	0	-	Stop
F2.08	Flow command corresponding to 10V or 20mA	1...5,000 rpm	400	1	Stop
F2.09	Flow command null offset in V or mA	0.0...5.0 V, mA	0.0	0.1	Stop
F2.31	AO1 output (use E2.27 for gain)	0: No function assigned from ASF 1: Pressure command (scaled by F2.04) 2: Pressure feedback (scaled by F2.06) 3: Setting speed (include direction) (scaled by F2.08) 4: Output speed (include direction) (scaled by F2.08)	0	-	Run
F2.32	EAO output (use H8.27 for gain)		0	-	Run
F3.03	Filter time for flow command	0...999 ms	4	1	Run
F4.03	Pump function control word	0...31 Bit0: Pump power limit Bit1: Pump thermal protection Bit2: Switch master to slave Bit3: Two points / double pump Bit4: Pressure drop / overshoot compensation	0	-	Run
F4.20	p/Q command soft start delay	0.0...1,000.0 s	0.0	0.1	Stop
F4.24	Maximum flow command limit	[F4.23]...5,000 rpm	3,000	1	Stop
F4.39	Master / slave switch source	0: Depend on the value of F4.03 1: Digital input 2: Communication	0	-	Stop

Code	Name	Setting range	Default	Min.	Attri.
F4.40	Slave pump speed command lower limit	-5,000...5,000 rpm	0	1	Run
F4.41	Master / slave pump mode switch delay	0...500 ms	100	1	Stop

Tab. 7-14: Parameter list of master / slave function

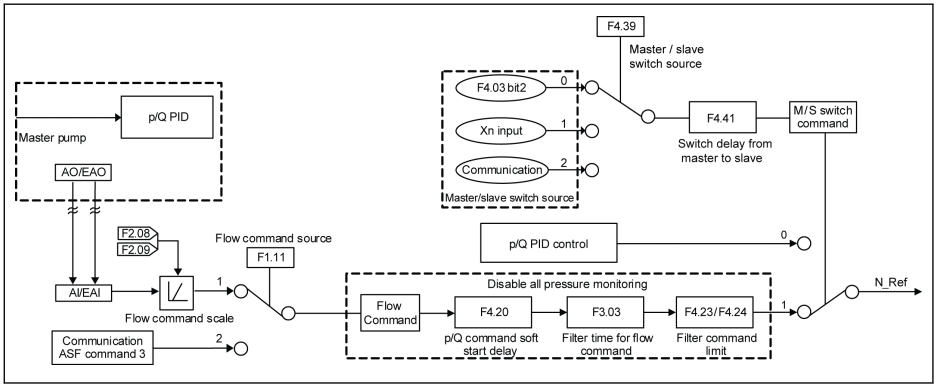


Fig. 7-12: Master / slave control function

7.9.2 Sleep / Wake 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 according to the PID control mode, as FcP 5020 ASF active is, this will be assigned to the p/Q PID controller in ASF, and the basic PID controller of EFC will be deactivated.

Code	Name	Setting range	Default	Min.	Attri.
E5.15	Sleep level	0.00...[E0.09] Hz	0.00	0.01	Run
E5.16	Sleep delay	0.0...3,600.0 s	60.0	0.1	Run
E5.17	Sleep boost time	0.0...3,600.0 s	0.0	0.1	Run
E5.18	Sleep boost amplitude	0.0...100.0 %	0.0	0.1	Run
E5.19	Wake up level	0.0...100.0 %	0.0	0.1	Run
E5.20	Wake up delay	0.2...60.0 s	0.5	0.1	Run

Tab. 7-15: Parameter list of sleep / wake function

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

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

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

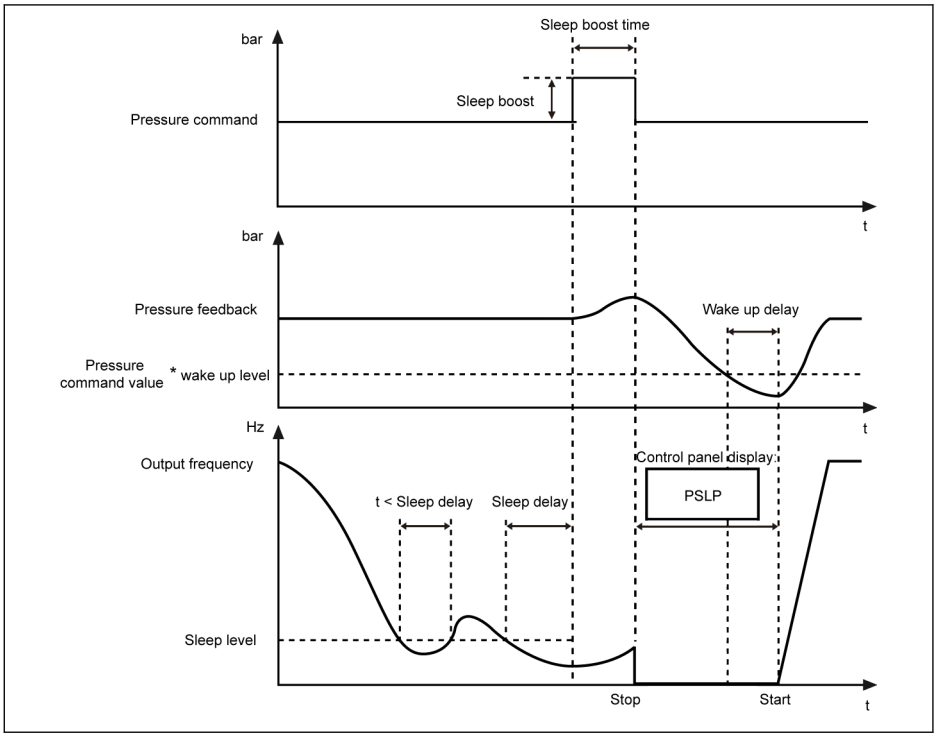


Fig. 7-13: Sleep and wake up process in FcP

After [E5.16] "Sleep delay", the PID controller boosts up with [E5.18] "Sleep boost amplitude" within [E5.17] "Sleep boost time", and then enters to sleep mode. In sleep mode, the frequency converter stops output with "PSLP" displayed on the operating panel.

[Sleep boost] = [E5.18] x [Pressure command value]

During sleeping, the frequency converter monitors the actual PID feedback and wakes up when the following two conditions are met:

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

The frequency converter resumes to its previous running status after waking up.

7.9.3 Two Points / Double Pump Control

Code	Name	Setting range	De-fault	Min.	Attri.
F2.40	Relay 1 output	0: No function assigned from ASF 1: Converter warning 2: Two points / double pump control	0	-	Run
F2.41	Extension relay output		0	-	Run
F4.03	Pump function control word	0...31 Bit0: Pump power limit Bit1: Pump thermal protection Bit2: Switch master to slave Bit3: Two points / double pump Bit4: Pressure drop / over-shoot compensation	0	-	Run
F4.28	Two points / double pump selection	0: Two points pump 1: Double pump	0	-	Stop
F4.29	Pump logic selection	0: Positive 1: Negative	0	-	Stop
F4.30	Pump Vg1	0...1,000 ccm	0	1	Stop
F4.31	Pump Vg2	0...1,000 ccm	0	1	Stop
F4.32	Upper pressure difference switching threshold	0.0...350.0 bar	15.0	0.1	Stop
F4.33	Lower pressure difference switching threshold	0.0...350.0 bar	10.0	0.1	Stop
F4.34	Speed switching threshold adjustment	0.1...1.0	0.9	0.1	Stop

Tab. 7-16: Parameter list of two points / double pump control

Choose different control mode and logic according to the type of pump by F4.28.

For two points pump F4.30 (Vg1) reference the smaller displacement, and F3.31 (Vg2) represents the maximal displacement. For double pump F4.30 (Vg1) reference the main pump, and F3.31 (Vg2) is equal to the displacement of additional pump.

According to the pressure feedback, actual speed, F4.32, F4.33 and F4.34, the pump switching logic will be calculated and carried out via the relay output, once the output has been set, see F2.40, F2.41.

Please refer to the figure below for pump switching logic (F4.28 = 0, F4.29 = 0). This pump switching logic can also be inversed via F4.29 or different terminal connecting from relay.

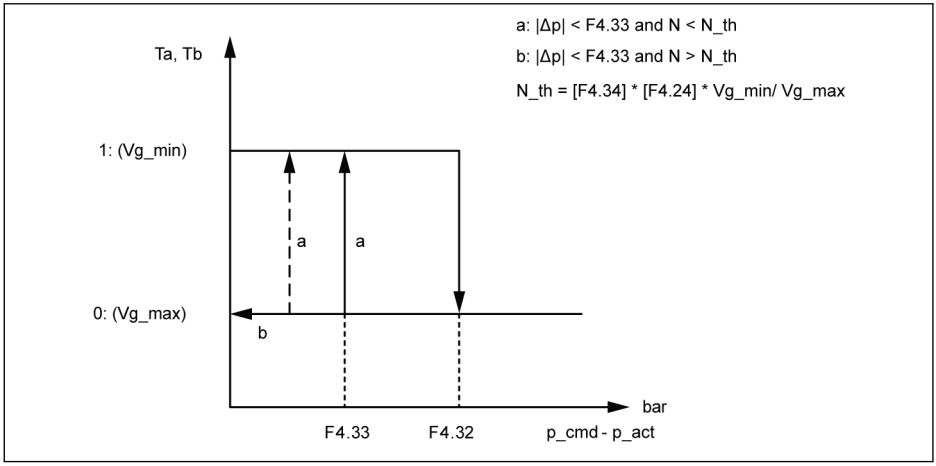


Fig. 7-14: Action logic of relay

$\Delta p = p_{cmd} - p_{actual}$

When the pump logic has been switched to different logic (Vg_{max} or Vg_{min}), the control parameter need also to be changed:

For logic Vg_{max}:

- Vg = Vg1 (two points) or Vg = Vg1 + Vg2 (double pump)
- p/Q controller parameter set [0], e.g. [F3.10]...[F3.19]

For logic Vg_{min}:

- Vg = Vg2 (two points) or Vg = Vg1 (double pump)
- p/Q controller parameter set [1], e.g. [F3.30]...[F3.39]

When the two points / double pump control is active, the p/Q parameter selection function via digital input (F2.16...F2.24) is deactivated.

Application example:

24V power supply, normal open relay terminal Ta, Tb and Rexroth two points pump controller is connected in series, [F4.28] is set to "0: Two points pump" and [F4.29] is set to "0: Positive", when Δp and N_{th} satisfy the condition of relay action, pump switches to the minimum displacement.

7.9.4 Pressure Drop / Overshoot Compensation

Pressure drop / overshoot compensation function helps to compensate the incoming pressure drop or overshoot by previously changing pressure command with digital from customer PLC.

Code	Name	Setting range	Default	Min.	Attri.
F2.16 ... F2.24	X1...EX4 input	0...19 20: Pressure drop compensation trigger 21: Pressure overshoot compensation trigger	0	-	Stop
F4.03	Pump function control word	0...31 Bit0: Pump power limit Bit1: Pump thermal protection Bit2: Switch master to slave Bit3: Two points / double pump Bit4: Pressure drop / overshoot compensation	0	-	Run
F4.45	Pressure boost for drop compensation	0.0...1,000.0 bar	0.0	0.1	Run
F4.46	Pressure reduce for overshoot compensation	-1,000.0...0.0 bar	0.0	0.1	Run

Tab. 7-17: Parameter list of pressure drop / overshoot compensation

Set control bit: bit4 of F4.03 to active this function, and configure the corresponding digital input Xn to 15 or 16 for compensation command (from customer PLC). For a high input (=1), the pressure command will be modified with the value from F4.45 / F4.46. If the digital input is 0, the effective pressure command value will be reset to original.

The switch time of digital input should be optimized according to application.

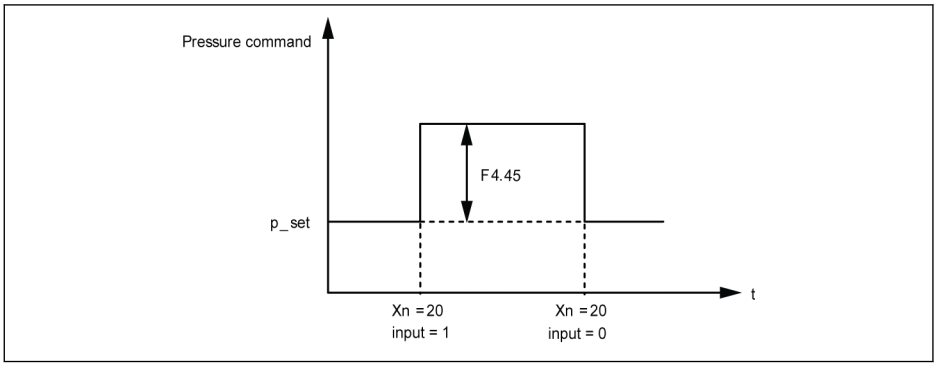


Fig. 7-15: F4.45: Pressure boost for drop compensation

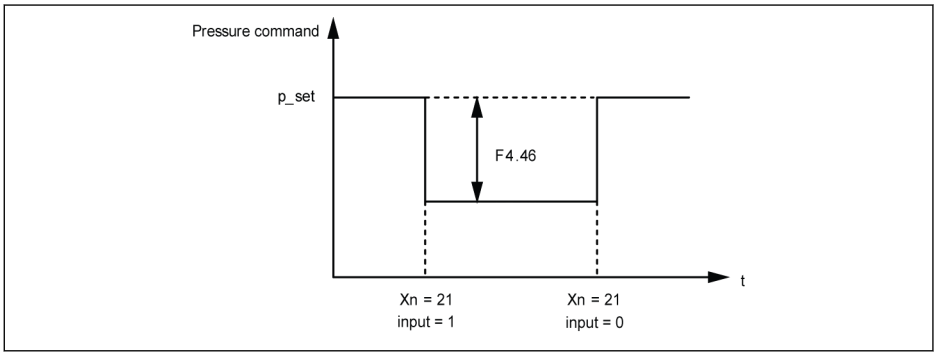


Fig. 7-16: F4.46: Pressure reduce for overshoot compensation

7.9.5 Pump Power Limitation

Code	Name	Setting range	Default	Min.	Attri.
F4.03	Pump function control word	0...31 Bit0: Pump power limit Bit1: Pump thermal protection Bit2: Switch master to slave Bit3: Two points / double pump Bit4: Pressure drop / overshoot compensation	0	-	Run
F4.30	Pump Vg1	0...1,000 ccm	0	1	Stop
F4.35	Pump power	0.00...315.00 kW	0.00	0.01	Stop

Tab. 7-18: Parameter list of pump power limitation

Pump power limitation function can be activated via bit0 of F4.03.

The real-time pump power can be calculated from pressure feedback, the actual speed and pump displacement. If the calculated pump power output exceeds the pump power limitation [F4.35] then the speed will be reduced to keep the pump power output within the limit.

In pump power limitation function only pump displacement Vg1 (F4.30) will be used for the calculation, Vg2 (F4.31) will not, so for double pump application please only consider the main pump for pump power F4.35.

7.9.6 Hydraulic Soft Start and Separate Acceleration Ramp

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

Tab. 7-19: Parameter list of hydraulic soft start

Soft start function is designed to reduce the p/Q command and acceleration during start up period to minimize the too high of acceleration or potential over current condition during start up. Once this function is active (set F4.20 > 0), the p/Q commands and acceleration time will be switched to F4.21, F4.23 and F4.25, in a time period of F4.20 after every run command.

☞ Only when p/Q command soft start is active will the acceleration time hydraulic soft start function be activated.

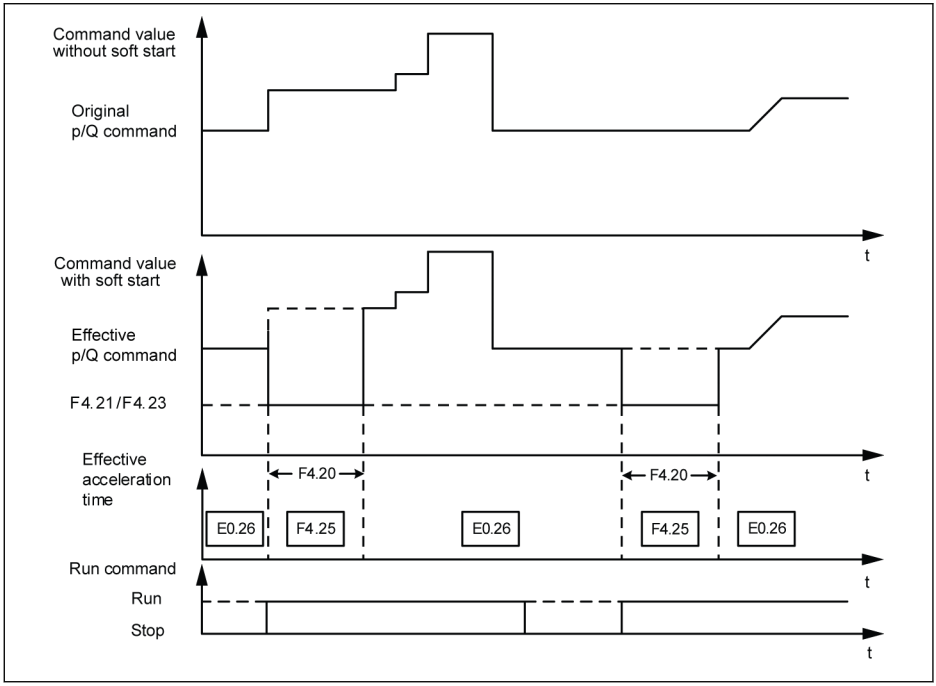


Fig. 7-17: Hydraulic soft start

7.10 Protection Function

7.10.1 Overview

FcP 5020 ASF provides a multiple of protection functions, including detection of pressure sensor failure, actual pressure monitoring, pressure / flow command monitoring, pump power limitation and so on.

7.10.2 Pressure Sensor Failure Detection

Code	Name	Setting range	Default	Min.	Attri.
F4.00	Protection function control word	0...15 Bit0: Pressure sensor failure (PSF) Bit1: Actual pressure monitoring Bit2: p/Q max. command limit Bit3: Oil changing detection	0	-	Run
F4.06	Pressure sensor failure detection threshold 1 (negative direction)	-5,000...0 rpm	-1	1	Stop
F4.07	Pressure sensor failure detection time 1 (negative direction)	0.1...100.0 s	10.0	0.1	Stop
F4.08	Pressure sensor failure detection threshold 2 (positive direction)	0...5,000 rpm	200	1	Stop
F4.09	Pressure sensor failure detection time 2 (positive direction)	0.1...100.0 s	10.0	0.1	Stop
F4.10	Pressure detection threshold	1.0...1,000.0 bar	5.0	0.1	Stop
F4.11	Pressure detection period	0.1...100.0 s	1.0	0.1	Stop

Tab. 7-20: Parameter list of pressure sensor failure detection

The pressure sensor failure protection can be activated via bit0 of F4.00.

The pressure sensor failure detection works in three different phases:

- Motor runs in negative direction

  Once motor runs in negative direction, this function will check if the motor speed is consistently lower than [F4.06] for [F4.07] seconds and signal a failure for this.

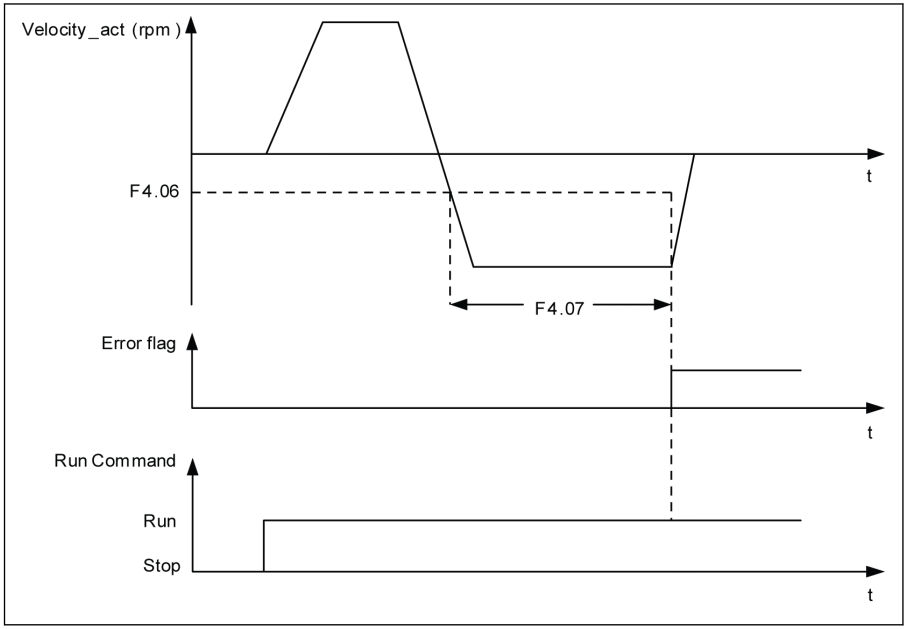


Fig. 7-18: Motor reverse speed limit

- Motor runs in positive direction

  Once motor runs in positive direction with the speed higher than [F4.08], this function will check if the pressure feedback is consistently lower than 0.5 bar for [F4.09] seconds and signal a failure for this.

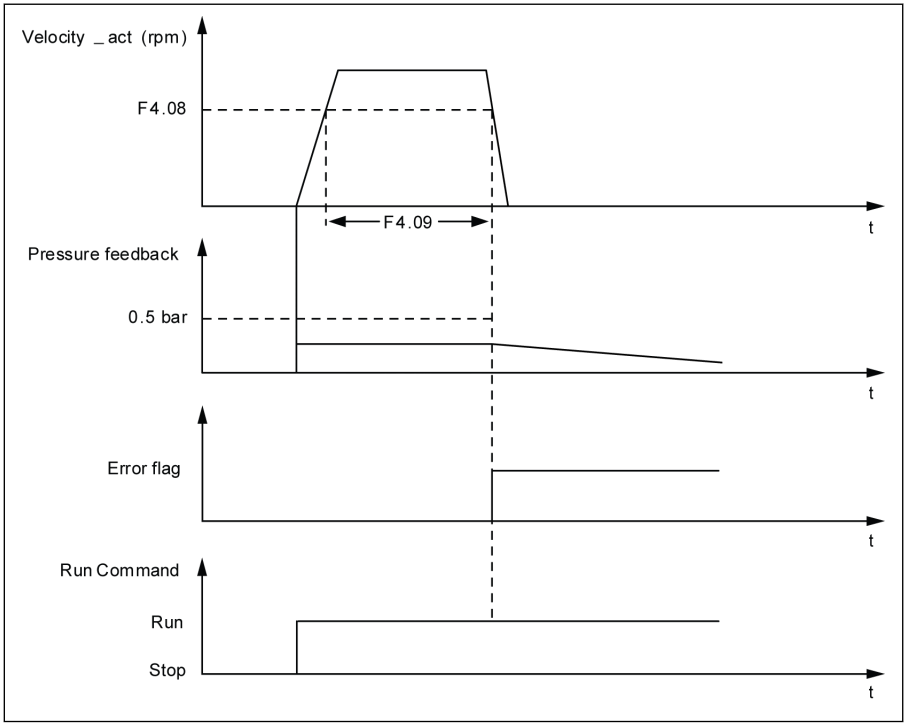


Fig. 7-19: Motor forward speed limit

- Motor stops

  If the motor stops and the feedback pressure is higher than [F4.10], the detection function will check if the system pressure feedback keeps dropping with decreasing rate higher than 1/[F4.11] bar/s, if the pressure drops slower than this rate consistently for 2x[F4.11] seconds, a failure for sensor defect will be signalled.

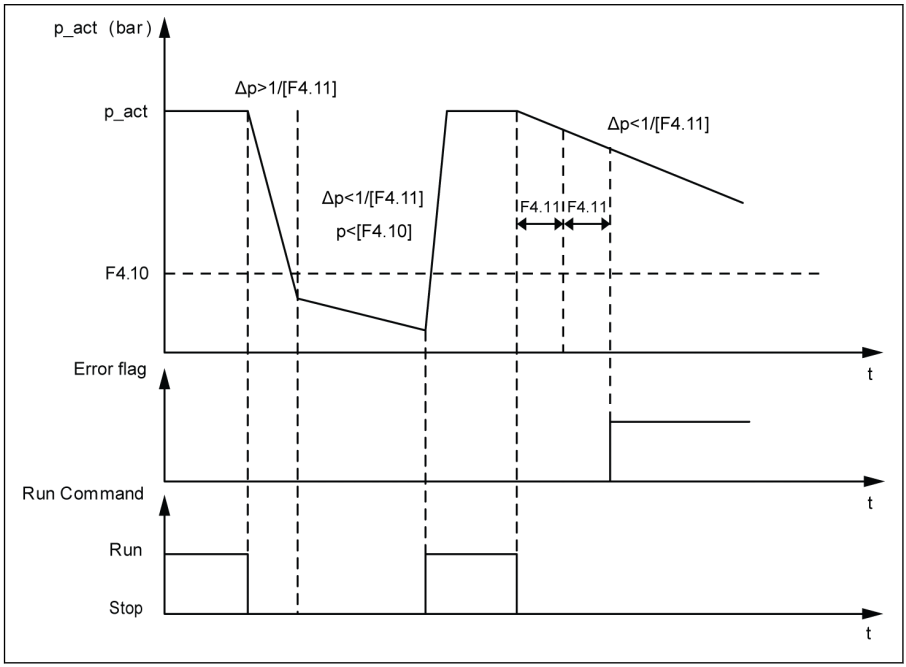


Fig. 7-20: Pressure sensor failure

7.10.3 Actual Pressure Monitoring

Code	Name	Setting range	Default	Min.	Attri.
F4.00	Protection function control word	0...15 Bit0: Pressure sensor failure (PSF) Bit1: Actual pressure monitoring Bit2: p/Q max. command limit Bit3: Oil changing detection	0	-	Run
F4.15	Maximum system pressure (warning)	0.0...[F4.16] bar	500.0	0.1	Stop
F4.16	Maximum pump pressure (error)	[F4.15]...4,000.0 bar	1,000.0	0.1	Stop

Tab. 7-21: Parameter list of pressure over limit detection

The detection of pressure feedback can be activated via bit1 of F4.00.

F4.15: When the feedback pressure goes beyond [F4.15], the warning (d0.88=1) will be triggered for the pressure feedback surpassing the maximum system allowed pressure.

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

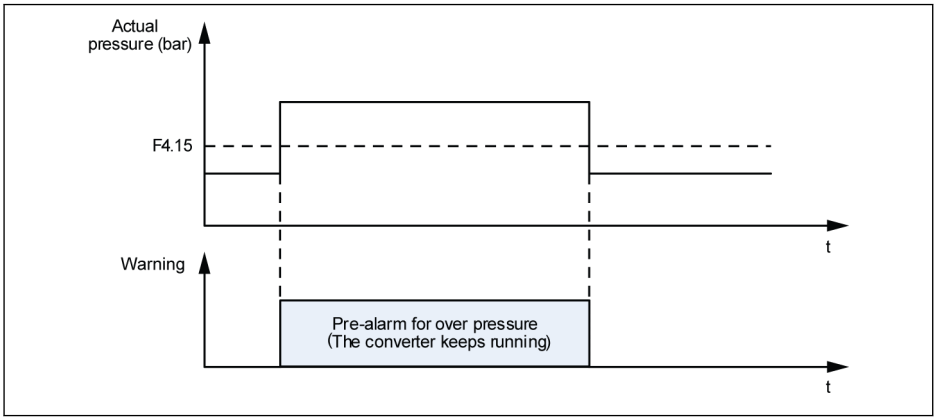


Fig. 7-21: F4.15 maximum system pressure warning

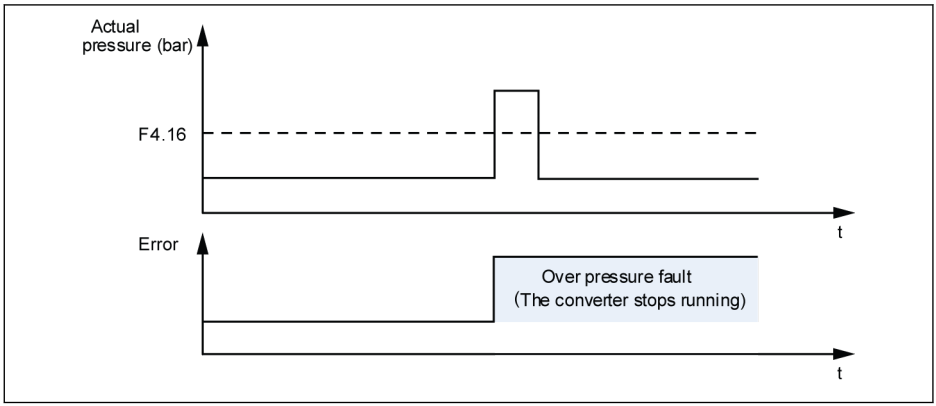


Fig. 7-22: F4.16 maximum pump pressure failure

7.10.4 Oil Change Warning / Error Function

Code	Name	Setting range	Default	Min.	Attri.
F4.00	Protection function control word	0...15 Bit0: Pressure sensor failure (PSF) Bit1: Actual pressure monitoring Bit2: p/Q max. command limit Bit3: Oil changing detection	0	-	Run
F4.51	Warning hours of oil change	0...60,000 hours	36,000	1	Run
F4.52	Error hours of oil change	0...60,000 hours	40,000	1	Run
F4.53	Oil in operation time	-	-	-	Read
F4.54	Reset oil in operation time	0...1	0	-	Run

Tab. 7-22: Parameter list of oil change warning / error function

Once oil change monitoring function has been activated (F4.00 bit3), oil operation time will be counted and saved in [F4.53], if this time exceeds warning or error level in [F4.51] or [F4.52], warning or error signal will be generated. Parameter F4.54 = 1 is used to reset the oil operation timer F4.53.

7.10.5 Pressure and Flow Command Limit

Code	Name	Setting range	Default	Min.	Attri.
F4.00	Protection function control word	0...15 Bit0: Pressure sensor failure (PSF) Bit1: Actual pressure monitoring Bit2: p/Q max. command limit Bit3: Oil changing detection	0	-	Run
F4.21	Minimum pressure command limit	0.0...[F4.22] bar	5.0	0.1	Stop
F4.22	Maximum pressure command limit	[F4.21]...1,000.0 bar	250.0	0.1	Stop
F4.23	Minimum flow command limit	0...[F4.24] rpm	200	1	Stop
F4.24	Maximum flow command limit	[F4.23]...5,000 rpm	3,000	1	Stop

Tab. 7-23: Parameter list of pressure and flow command limit

The minimum pressure and flow command limitation (F4.21 and F4.23) works all the time, independently to any control bit. That means if the setting pressure or flow command 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 limitation can be activated via bit2 of F4.00. This function will check whether the pressure or flow command given by customer exceeds the limitation set in [F4.22] and [F4.24]. If a given command exceeds its limitation, the effective command value will be limited to the maximum limit, and a warning signal will be raised.

7.10.6 Pump Thermal Protection

Code	Name	Setting range	Default	Min.	Attri.
F4.03	Pump function control word	0...31 Bit0: Pump power limit Bit1: Pump thermal protection Bit2: Switch master to slave Bit3: Two points / double pump Bit4: Pressure drop / overshoot compensation	0	-	Run
F4.36	Pump thermal protection speed	0...5,000 rpm	500	1	Stop
F4.37	Pump thermal protection time constant	0...6,000 s	0	1	Stop

Tab. 7-24: Parameter list of pump thermal protection

The pump may overheat at a low speed due to the oil volume required for the pump cooling may not be adequate. The pump thermal protection function will detect if pump speed is lower than the speed limitation [F4.36], and trigger warning or error message according to [F4.37]. For details reference the following table and figure.

This function can be activated by bit1 of F4.03.

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

Tab. 7-25: Protection condition

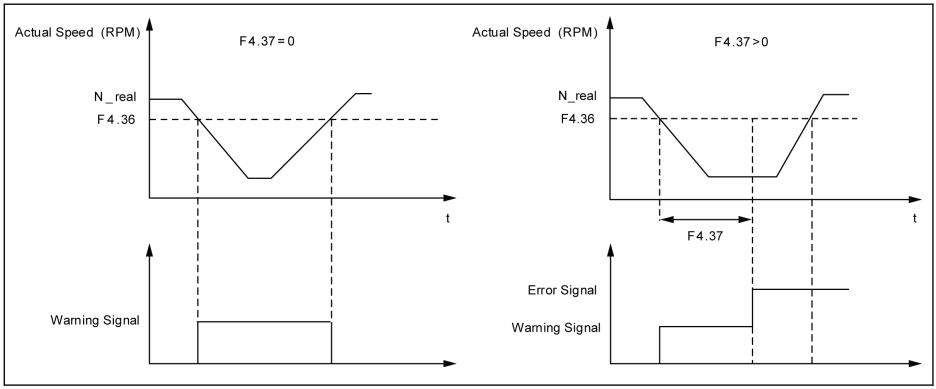


Fig. 7-23: Pump thermal protection

7.10.7 Sensor Monitoring

Code	Name	Setting range	Default	Attri.
F2.16	X1 input	0: No function assigned from ASF	See chapter 8.7 "Changed Setting Parameter by Load CytroPac Configuration" on page 63	Stop
F2.17	X2 input	1: Pressure command selection bit0		Stop
F2.18	X3 input	2: Pressure command selection bit1		Stop
F2.19	X4 input	3: p/Q parameter selection		Stop
F2.20	X5 input	4: Reserved		Stop
F2.21	EX1 input	5: Master / slave mode switch		Stop
F2.22	EX2 input	6: Oil filter warning		Stop
F2.23	EX3 input	7: Oil level warning		Stop
F2.24	EX4 input	8: Oil temperature warning 9: Oil filter error 10: Oil level error 11: Oil temperature error 12: Oil level / temperature error 13: Oil filter warning inverse 14: Oil level warning inverse 15: Oil filter error inverse 16: Oil level / temperature error inverse 17: Reserved 18: Reserved 19: Reserved 20: Pressure drop compensation trigger 21: Pressure overshoot compensation trigger		Stop

Tab. 7-26: Parameter list of sensor monitoring

There are different sensors used for monitoring the hydraulic system, and there are also corresponding options for digital input to be selected, see option 6...16 in the table above. Most of these options can be clarified by name, the others are described below:

"6: Oil filter warning" and "9: Oil filter error" for oil filter warning and error sensor. These signals will be automatically delayed by F4.50, that means a true signal lasted longer than [F4.50] seconds will be acknowledged.

"12: Oil level / temperature error", for oil level and temperature error sensor. Both oil level and temperature can be connected parallel to one digital input, since oil warning comes earlier than error, the warning information will help controller 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 available.

"13: Oil level warning inverse" and "14: Oil level / temperature error inverse" are inversed evaluation from "7: Oil level warning" and "12: Oil level / temperature error", i.e. true signal for no warning, and false signal for warning. Signal has been inversed for wire broken monitoring.

All warning and error information are presented by d0.88 and d0.89, see chapter 8.8 "Monitoring Parameter" on page 65.

7.11 CytroPac Configuration

7.11.1 Overview

CytroPac is a variation of Bosch Rexroth hydraulic system similar to FcP functionalities. To support easy use of CytroPac, the FcP 5020 ASF provides quick way to configure predefined CytroPac applications.

7.11.2 Load CytroPac Configuration

Code	Name	Setting range	Default	Min.	Attri.
F1.20	CytroPac parameter initialization	0: No selection 1: CytroPac Basic 2: CytroPac Advanced 3: CytroPac Advanced + Comm.	0	-	Stop

Tab. 7-27: Parameter list of load CytroPac configuration

Parameter F1.20 can be used for quick setting of CytroPac product, by setting F1.20 to 1...3 parameter listed in the table above will be changed to CytroPac default setting.

Set F1.20 to 0 will NOT bring the converter back to FcP status, for details please reference chapter 7.8 "Restore ASF Parameter" on page 30.

7.11.3 CytroPac Sensor Monitoring

For sensor evaluation in CytroPac, defaulted sensor monitoring function can be selected in F2.16...F2.24, for more information please see option 6...16 of parameter F2.16...F2.24 in chapter 7.10.7 "Sensor Monitoring" on page 49.

Through CytroPac configuration in F1.20, different sensor setting is predefined as in tab. 8-7 "Different parameter list between CytroPac and FcP default setting" on page 63.

7.11.4 LED Flash Showing Converter Status

Code	Name	Setting range	Default	Attri.
F2.36	DO1 output	0: No function assigned from ASF 1: Converter warning 2: Green CytroPac flashing LED 3: Red CytroPac flashing LED	See chapter 8.7 "Changed Setting Parameter by Load CytroPac Configuration" on page 63	Run
F2.37	EDO output			Run

Tab. 7-28: Parameter list of LED flash function

With active CytroPac functionality, the output is automatically configures to control the LED flash function. For normal status the light is always green, for warning condition the light will flash between green and yellow, and for error condition flash between red and yellow. The flash time of the yellow light represents the warning / error type. More details refer to the following figure.

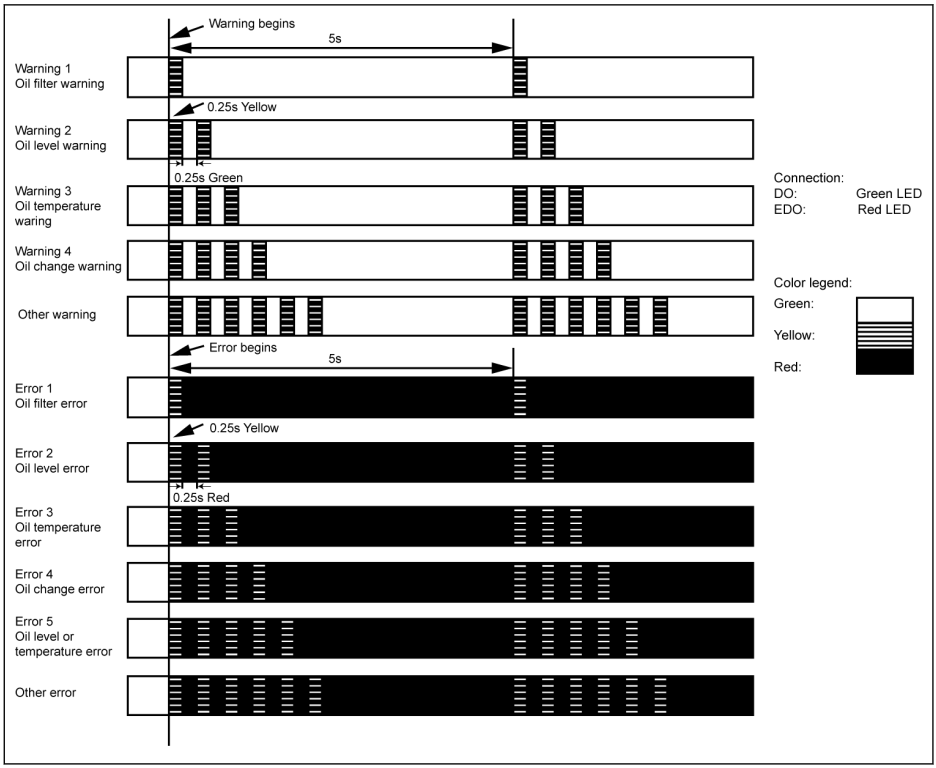


Fig. 7-24: LED flash function

8 FcP 5020 Parameter List

8.1 Terminology and Abbreviation in Parameter List

- **Code:** Function / parameter code, written in Cx.xx, dx.xx, Ex.xx, Fx.xx
- **Name:** Parameter name
- **Default:** Factory default
- **Attri.:** Parameter attribute
  - **Run:** Parameter setting can be modified when the converter is in run or stop status.
  - **Stop:** Parameter setting can only be modified when the converter is in stop status.
  - **Read:** Parameter setting is read-only and cannot be modified.

8.2 Group F1: Quick Start Parameter

Code	Name	Setting range	Default	Min.	Attri.
F1.00	ASF parameter initialization	0: Inactive 1: Restore to FcP default settings 2: Deactivate ASF	0	-	Stop
F1.02	Control mode	0: p/Q control 1: Flow control 2: Pressure control	0	-	Stop
F1.03	Pressure command source	0: Depend on the value of F1.04 1: Select by digital input (F1.04 shows status) 2: Analog input 3: Communication	0	-	Stop
F1.04	Pressure command selection	0: Pressure command digital setting 0 1: Pressure command digital setting 1 2: Pressure command digital setting 2 3: Pressure command digital setting 3	0	-	Run
F1.05	Pressure command digital setting 0	0.0...1,000.0 bar	10.0	0.1	Run
F1.06	Pressure command digital setting 1	0.0...1,000.0 bar	10.0	0.1	Run
F1.07	Pressure command digital setting 2	0.0...1,000.0 bar	10.0	0.1	Run
F1.08	Pressure command digital setting 3	0.0...1,000.0 bar	10.0	0.1	Run
F1.11	Flow command source	0: Depend on the value of F1.12 1: Analog input (positive / negative) 2: Communication	0	-	Stop
F1.12	Flow command digital setting	0...5,000 rpm	400	1	Run
F1.15	Motor type	0: Others 1: MOT-FC_HOY	1	-	Stop

Code	Name	Setting range	Default	Min.	Attri.
F1.16	Motor power level	0: No selection 1...5: Reserved 6: 1.5 kW 7: 2.2 kW 8: 3 kW 9: 4 kW 10: 5.5 kW 11: 7.5 kW 12: 11 kW 13: 15 kW 14: 18.5 kW 15: 22 kW 16: 30 kW 17: 37 kW 18: 45kW 19: 55 kW 20: 75 kW 21: 90 kW	0	-	Stop
F1.20	CytroPac parameter initialization	0: No selection 1: CytroPac basic 2: CytroPac advanced 3: CytroPac advanced + comm.	0	-	Stop

Tab. 8-1: Parameter list of group F1

8.3 Group F2: Input and Output Parameter

Code	Name	Setting range	Default	Min.	Attri.
F2.00	Analog input AI1	0: No function assigned from ASF 1: Pressure command 2: Pressure feedback 3: Flow command	0	-	Stop
F2.01	Analog input AI2		2	-	Stop
F2.02	External analog input EAI (-10V...10V, 4...20mA)		0	-	Stop
F2.04	Pressure command corresponding to 10V or 20mA	0.1...1,000.0 bar	10.0	0.1	Stop
F2.05	Pressure command null offset in V or mA	0.0...5.0 V, mA	0.0	0.1	Stop
F2.06	Pressure feedback corresponding to 10V or 20mA	0.1...1,000.0 bar	100.0	0.1	Stop
F2.07	Pressure feedback null offset in V or mA	0.0...5.0 V, mA	4.0 (mA)	0.1	Stop
F2.08	Flow command corresponding to 10V or 20mA	1...5,000 rpm	400	1	Stop
F2.09	Flow command null offset in V or mA	0.0...5.0 V, mA	0.0	0.1	Stop
F2.10	Pressure sensor type	0: Others 1: HM20-2X/10-C 2: HM20-2X/50-C 3: HM20-2X/100-C 4: HM20-2X/160-C 5: HM20-2X/250-C 6: HM20-2X/315-C 7: HM20-2X/400-C 8: HM20-2X/630-C 9: Reserved 10: Reserved 11: HM20-2X/10-H 12: HM20-2X/50-H 13: HM20-2X/100-H 14: HM20-2X/160-H 15: HM20-2X/250-H 16: HM20-2X/315-H 17: HM20-2X/400-H 18: HM20-2X/630-H	3	-	Stop

Code	Name	Setting range	Default	Min.	Attri.
F2.16	X1 input	0: No function assigned from ASF 1: Pressure command selection bit0 2: Pressure command selection bit1 3: p/Q parameter selection 4: Reserved 5: Master / slave mode switch 6: Oil filter warning 7: Oil level warning 8: Oil temperature warning 9: Oil filter error 10: Oil level error 11: Oil temperature error 12: Oil level / temperature error 13: Oil filter warning inverse 14: Oil level warning inverse 15: Oil filter error inverse 16: Oil level / temperature error inverse 17: Reserved 18: Reserved 19: Reserved 20: Pressure drop compensation trigger 21: Pressure overshoot compensation trigger	0 (RUN)	-	Stop
F2.17	X2 input		0 (Error reset)	-	Stop
F2.18	X3 input		0	-	Stop
F2.19	X4 input		0	-	Stop
F2.20	X5 input		0	-	Stop
F2.21	EX1 input		0	-	Stop
F2.22	EX2 input		0	-	Stop
F2.23	EX3 input		0	-	Stop
F2.24	EX4 input		0	-	Stop

Code	Name	Setting range	Default	Min.	Attri.
F2.31	AO1 output (use E2.27 for gain)	0: No function assigned from ASF 1: Pressure command (scaled by F2.04) 2: Pressure feedback (scaled by F2.06) 3: Setting speed (include direction) (scaled by F2.08) 4: Output speed (include direction) (scaled by F2.08)	0	-	Run
F2.32	EAO output (use H8.27 for gain)		0	-	Run
F2.36	DO1 output	0: No function assigned from ASF 1: Converter warning 2: Green CytroPac flashing LED 3: Red CytroPac flashing LED	1	-	Run
F2.37	EDO output		0	-	Run
F2.40	Relay 1 output	0: No function assigned from ASF 1: Converter warning 2: Two points / double pump control	0	-	Run
F2.41	Extension relay output		0	-	Run

Tab. 8-2: Parameter list of group F2

Analog output setting:

For example:

- F2.31=1: Pressure command

$$AO1 = \frac{Pressure\ command\ output}{F2.04} * 10V\ (20mA)$$

- F2.31 = 2: Pressure feedback

$$AO1 = \frac{Pressure\ feedback\ output}{F2.06} * 10V\ (20mA)$$

- F2.31 = 3: Setting speed

$$AO1 = \frac{Speed\ setting}{F2.08} * 10V\ (20mA)$$

- F2.31 = 4: Output speed

$$AO1 = \frac{Output\ setting}{F2.08} * 10V\ (20mA)$$

8.4 Group F3: p/Q PID Parameter

Code	Name	Setting range	Default	Min.	Attri.
F3.00	p/Q parameter selection source	0: Depend on the value of F3.01 1: Digital input 2: Communication	0	-	Stop
F3.01	p/Q parameter digital selection	0: Parameter group 0 1: Parameter group 1	0	-	Run
F3.02	Filter time for pressure feedback	0...999 ms	4	1	Run
F3.03	Filter time for flow command	0...999 ms	4	1	Run
F3.10	Filter time for pressure rising [0]	0...999 ms	80	1	Run
F3.11	Filter time for pressure dropping [0]	0...999 ms	40	1	Run
F3.12	Proportional gain [0]	0.00...500.00 rpm/bar	8.00	0.01	Run
F3.13	Integral time 1 [0]	0...999 ms	80	1	Run
F3.14	Integral time 2 [0]	0...999 ms	0	1	Run
F3.15	Integral time TI switch threshold [0]	-150.0...0.0 bar (set to 0.0, the switching function is invalid)	0.0	0.1	Run
F3.16	Differential gain [0]	0.000...10.000 (rpm/bar)*s	0.000	0.001	Run
F3.17	Filter time for Kd [0]	0...999 ms	35	1	Run
F3.18	Lower limit for I+D [0]	-5,000...5,000 rpm	0	1	Run
F3.19	System minimum speed [0]	-5,000...5,000 rpm	0	1	Run
F3.30	Filter time for pressure rising [1]	0...999 ms	80	1	Run
F3.31	Filter time for pressure dropping [1]	0...999 ms	40	1	Run
F3.32	Proportional gain [1]	0.00...500.00 rpm/bar	8.00	0.01	Run
F3.33	Integral time 1 [1]	0...999 ms	80	1	Run
F3.34	Integral time 2 [1]	0...999 ms	0	1	Run
F3.35	Integral time TI switch threshold [1]	-150.0...0.0 bar (set to 0.0, the switching function is invalid)	0.0	0.1	Run
F3.36	Differential gain [1]	0.000...10.000 (rpm/bar)*s	0.000	0.001	Run
F3.37	Filter time for Kd [1]	0...999 ms	35	1	Run
F3.38	Lower limit for I+D [1]	-5,000...5,000 rpm	0	1	Run
F3.39	System minimum speed [1]	-5,000...5,000 rpm	0	1	Run

Tab. 8-3: Parameter list of group F3

8.5 Group F4: System Protection and Pump Function Parameter

Code	Name	Setting range	Default	Min.	Attri.
F4.00	Protection function control word	0...15 Bit0: Pressure sensor failure (PSF) Bit1: Actual pressure monitoring Bit2: p/Q max. command limit Bit 3: Oil changing detection	0	-	Run
F4.03	Pump function control word	0...31 Bit0: Pump power limit Bit1: Pump thermal protection Bit2: Switch master to slave Bit3: Two points / double pump Bit4: Pressure drop / overshoot compensation	0	-	Run
F4.06	Pressure sensor failure detection threshold 1 (negative direction)	-5,000...0 rpm	-1	1	Stop
F4.07	Pressure sensor failure detection time 1 (negative direction)	0.1...100.0 s	10.0	0.1	Stop
F4.08	Pressure sensor failure detection threshold 2 (positive direction)	0...5,000 rpm	200	1	Stop
F4.09	Pressure sensor failure detection time 2 (positive direction)	0.1...100.0 s	10.0	0.1	Stop
F4.10	Pressure detection threshold	1.0...1,000.0 bar	5.0	0.1	Stop
F4.11	Pressure detection period	0.1...100.0 s	1.0	0.1	Stop
F4.15	Maximum system pressure (warning)	0.0...[F4.16] bar	500.0	0.1	Stop
F4.16	Maximum pump pressure (error)	[F4.15]...4,000.0 bar	1,000.0	0.1	Stop
F4.20	p/Q command soft start delay	0.0...1,000.0 s	0.0	0.1	Stop
F4.21	Minimum pressure command limit	0.0...[F4.22] bar	5.0	0.1	Stop
F4.22	Maximum pressure command limit	[F4.21]...1,000.0 bar	250.0	0.1	Stop
F4.23	Minimum flow command limit	0...[F4.24] rpm	200	1	Stop
F4.24	Maximum flow command limit	[F4.23]...5,000 rpm	3,000	1	Stop

Code	Name	Setting range	Default	Min.	Attri.
F4.25	Acceleration time hydraulic soft start	0.1...6,000.0 s	5.0	0.1	Run
F4.28	Two points / double pump selection	0: Two points pump 1: Double pump	0	-	Stop
F4.29	Pump logic selection	0: Positive 1: Negative	0	-	Stop
F4.30	Pump Vg1	0...1,000 ccm	0	1	Stop
F4.31	Pump Vg2	0...1,000 ccm	0	1	Stop
F4.32	Upper pressure difference switching threshold	0.0...350.0 bar	15.0	0.1	Stop
F4.33	Lower pressure difference switching threshold	0.0...350.0 bar	10.0	0.1	Stop
F4.34	Speed switching threshold adjustment	0.1...1.0	0.9	0.1	Stop
F4.35	Pump power	0.00...315.00 kW	0.00	0.01	Stop
F4.36	Pump thermal protection speed	0...5,000 rpm	500	1	Stop
F4.37	Pump thermal protection time constant	0...6,000 s	0	1	Stop
F4.39	Master / slave switch source	0: Depend on the value of F4.03 1: Digital input 2: Communication	0	-	Stop
F4.40	Slave pump speed command lower limit	-5,000...5,000 rpm	0	1	Run
F4.41	Master / slave pump mode switch delay	0...500 ms	100	1	Stop
F4.45	Pressure boost for drop compensation	0.0...1,000.0 bar	0	0.1	Run
F4.46	Pressure reduce for overshoot compensation	-1,000.0...0.0 bar	0	0.1	Run
F4.50	Oil filter warning / error delay time	0...1,000 s	60	1	Run
F4.51	Warning hours of oil change	0...60,000 hours	36,000	1	Run
F4.52	Error hours of oil change	0...60,000 hours	40,000	1	Run
F4.53	Oil in operation time	-	-	-	Read
F4.54	Reset oil in operation time	0...1	0	1	Run
F4.55	Oil in operation time minute	-	-	-	Read

Tab. 8-4: Parameter list of group F4

8.6 Auto-modified EFC Parameters in FcP Initialization

Code	Name	Setting range	Default	Min.	Attri.
E0.01	First run command source	0...2	1	-	Stop
E0.02	Second frequency setting source	0...99	0	1	Stop
E0.08	Maximum output frequency	50.00...400.00 Hz	100.00	0.01	Stop
E0.09	Output frequency high limit	[E0.10]...[E0.08] Hz	100.00	-	Run
E0.17	Direction control	0: Forward / reverse 1: Forward only 2: Reverse only 3: Swap default direction	3	-	Stop
E0.26	Acceleration time	0.1...6,000.0 s	0.5	0.1	Run
E0.27	Deceleration time	0.1...6,000.0 s	1.0	0.1	Run
E1.01	X2 input	0...46	34	-	Stop
E1.61	Broken wire protection	0: Inactive 1: Warning 2: Error	0	-	Stop
E2.15	Relay1 output selection	0...99	14	-	Stop
E2.25	AO1 output mode	0: 0...10 V 1: 0...20 mA	1	-	Run

Tab. 8-5: Auto-modified EFC parameter list

8.7 Changed Setting Parameter by Load CytroPac Configuration

Code	Name	Setting range	Default	Min.	Attri.
F1.20	CytroPac parameter initialization	0: No selection 1: CytroPac basic 2: CytroPac advanced 3: CytroPac advanced + comm.	0	-	Stop

Tab. 8-6: Auto-modified FcP 5020 parameter list in CytroPac initialization

When CytroPac parameter is initialized (via F1.20), all F group parameters and some EFC parameters will be changed to CytronPac default settings according to diverse CytroPac variants. The CytroPac default settings are different from FcP default setting by following parameters shown in the list:

Code	Name	FcP default setting	CytroPac basic	CytroPac advanced	CytroPac advanced + comm.
E0.17	Direction control	3	1	1	1
E1.61	Broken wire protection	0	2	2	2
E2.15	Relay1 output selection	14	15	15	15
F1.03	Pressure command source	0	-*	-	3
F1.11	Flow command source	0	-	-	2
F1.15	Motor type	1	0	0	0
F2.18	X3 input	0	-	16	16
F2.19	X4 input	0	-	15	15
F2.20	X5 input	0	-	7	7
F2.21	EX1 input	0	-	6	6
F2.22	EX2 input	0	-	8	8
F2.23	EX3 input	0	-	1	-
F2.24	EX4 input	0	-	2	-
F2.36	DO1 output	1	0	2	2
F2.37	EDO output	0	-	3	3
F3.00	p/Q parameter selection source	0	-	-	2
F4.00	Protection function control word	0	8	8	8
F4.36	Pump thermal protection speed	500	0	0	0

Tab. 8-7: Different parameter list between CytroPac and FcP default setting

* Not changing current value of this parameter.

- Recommended order in which CytroPac is set and switched:

  Initialize via F1.00 -> Select CytroPac type via F1.20 -> Commissioning of other parameters
- CytroPac setting switches to FcP default via F1.00. Set F1.20 to 0 will NOT change any other parameter.

8.8 Monitoring Parameter

Name	Description	Setting range
d0.80	ASF status word *	0x0000...0xFFFF
d0.81	Pressure command	0.0...1,000.0 (0.0...1,000.0 bar)
d0.82	Pressure feedback	0.0...1,000.0 (0.0...1,000.0 bar)
d0.83	Flow command	-5,000...5,000 (-5,000...5,000 rpm)
d0.84	Speed command	-5,000...5,000 (-5,000...5,000 rpm)
d0.85	Reserved	-
d0.86	Reserved	-
d0.87	Reserved	-
d0.88	Warning type	0: No warning 1: Pressure feedback exceed limit 2: Pressure command exceed limit 3: Flow command exceed limit 4: Oil filter warning 5: Oil level warning 6: Oil temperature warning 7: Oil change warning 8: Reserved 9: Pump thermal protection warning 10: Pump power limitation warning
d0.89	Error type	0: No error 1: Pressure feedback exceed pump limit 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 protection error

Tab. 8-8: Monitoring parameter

* For detail information of d0.80 ASF status word please reference tab. 9-4 "ASF status word definition" on page 67.

9 Fieldbus Communication

9.1 Brief Introduction

FcP 5020 frequency converter provides standard communication interface to realize the communication between the master and slave via Modbus, Profibus, Profinet, CANopen, Ethernet and other protocols. With the help of a PC, a PLC or an external computer a "single master / multiple slaves" network control can be realized (setting of pressure command, flow command, modification of parameters, monitoring of frequency converter running status and error messages) to address the specific requirements of applications.

- Cycle time for command and status value exchanging is 2ms.
- Bus communication and internal ASF data communication are not synchronized.

9.2 Frequency Converter Parameter Address

Frequency converter parameter registers correspond to the function codes one-to-one. Reading and writing of related function codes can be achieved through reading and writing of the contents in frequency converter parameter registers via communication. The characteristics and scope of reading and writing function codes are in compliance with the frequency converter function code description. The address of a frequency converter parameter register is composed of a higher byte representing the function code group and a lower byte representing the index in the group. The groups are mapped as follows:

Address high byte	0x50	0x51	0x52	0x53	0x54
Group	F0	F1	F2	F3	F4

Tab. 9-1: Frequency converter parameter registers

Name	Description	Setting range
ASF command 1	ASF control word	0...65,535
ASF command 2	Pressure command	0.0...1,000.0 (0.0...1,000.0 bar)
ASF command 3	Flow command	0...5,000 (0...5,000 rpm)
ASF command 4	Reserved	-

Tab. 9-2: Communication protocol

Bit	Description	Setting range
0	Reserved	-
1	Reserved	-

Bit	Description	Setting range
2	Master / slave selection	0: Master 1: Slave
3	p/Q parameter group selection	0: Parameter group 0 1: Parameter group 1
4	Reserved	-
5	Reserved	-
6	Reserved	-
7	Reserved	-
8	Reserved	-
9	Reserved	-
10	Reserved	-
11	Reserved	-
12	Reserved	-
13	Reserved	-
14	Reserved	-
15	ASF control word enable	0: Inactive 1: Active

Tab. 9-3: ASF control word definition

Bit	Description	Setting range
0	Control mode	0: p/Q control mode 1: Flow control mode 2: p control mode
1		
2	Master / slave status	0: Master 1: Slave
3	p/Q parameter group	0: Parameter group 0 1: Parameter group 1
4	Reserved	-
5	Reserved	-
6	Pressure command digital selection	0: F1.05 Pressure command digital setting 0 1: F1.06 Pressure command digital setting 1 2: F1.07 Pressure command digital setting 2 3: F1.08 Pressure command digital setting 3
7		
8	Reserved	-
9	Reserved	-

Bit	Description	Setting range
10	Two points / double pump control status	0: Vg_{max} 1: Vg_{min}
11	Pressure drop / overshoot compensation	0: No compensation 1: Compensation
12	Reserved	-
13	ASF status	0: Active 1: Inactive
14	ASF warning	0: No warning 1: Warning
15	ASF error	0: No error 1: Error

Tab. 9-4: ASF status word definition

10 Diagnosis

10.1 Warning Code

Panel display	Function code	Error information	Reason	Solution
APF1	d0.88	0: No warning	-	-
		1: Pressure feedback exceed limit	1. Excessive pressure setting 2. Pressure transducer failure	1. Set pressure to a lower value 2. Check if the wiring is properly connected for pressure feedback transmission
		2: Pressure command exceed limit	Pressure command upon user's input exceeding [F4.22]	Set pressure to a lower value
		3: Flow command exceed limit	Flow command upon user's input exceeding [F4.24]	Set flow to a lower value
		4: Oil filter warning	Oil filter almost full	Clean or replace filter
		5: Oil level warning	Oil level too low	Refill oil
		6: Oil temperature warning	Oil temperature reached	Reduce hydraulic loses or enhance oil cooling
		7: Oil change warning	Operation time exceeds oil life time	Change oil and reset operation timer (F4.54)
		8: (Reserved)	-	-
		9: Pump thermal protection 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 limitation set in F4.35	Adjust limitation or system load

Tab. 10-1: Warning code

10.2 Error Code

Panel display	Function code	Error information	Reason	Solution
APE1	d0.89	0: No error	-	-
		1: Pressure feedback exceed pump limit	Actual pressure exceeding [F4.16] (pump maximum pressure)	1. Set pressure to a lower value 2. Check if the wiring is properly connected for pressure feedback transmission 3. Increase [F4.16]
		2: Pressure sensor error	1. The motor negative speed exceeding [F4.06] with duration time exceeding [F4.07] 2. The slow decrease of actual pressure after the shutdown	1. Check if pressure transducer can work properly. Increase the setting of F4.06, F4.07, F4.08 and F4.09 2. Check if pressure transducer can work properly. Increase the setting of F4.10 and F4.11
		3: Parameter setting error	Parameter setting repetition	Check if parameter settings are in conflict
		4: Oil filter error	Oil filter full	Clean or replace filter
		5: Oil level error	Oil level too low	Refill oil
		6: Oil temperature error	Oil temperature reached	Reduce hydraulic loses or enhance oil cooling
		7: Oil change error	Operation time exceeds oil life time	Change oil and reset operation timer F4.54
		8: Oil level or temperature error	No warning signal for oil level and temperature available, or both are active.	1. Check warning signal / sensor 2. Same solution as oil level / temperature error
		9: Pump thermal protection error	Pump speed is lower than required for pump cooling F4.36	Increase system minimum speed

Tab. 10-2: Error code

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Notes

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