DBR AUTOMATION

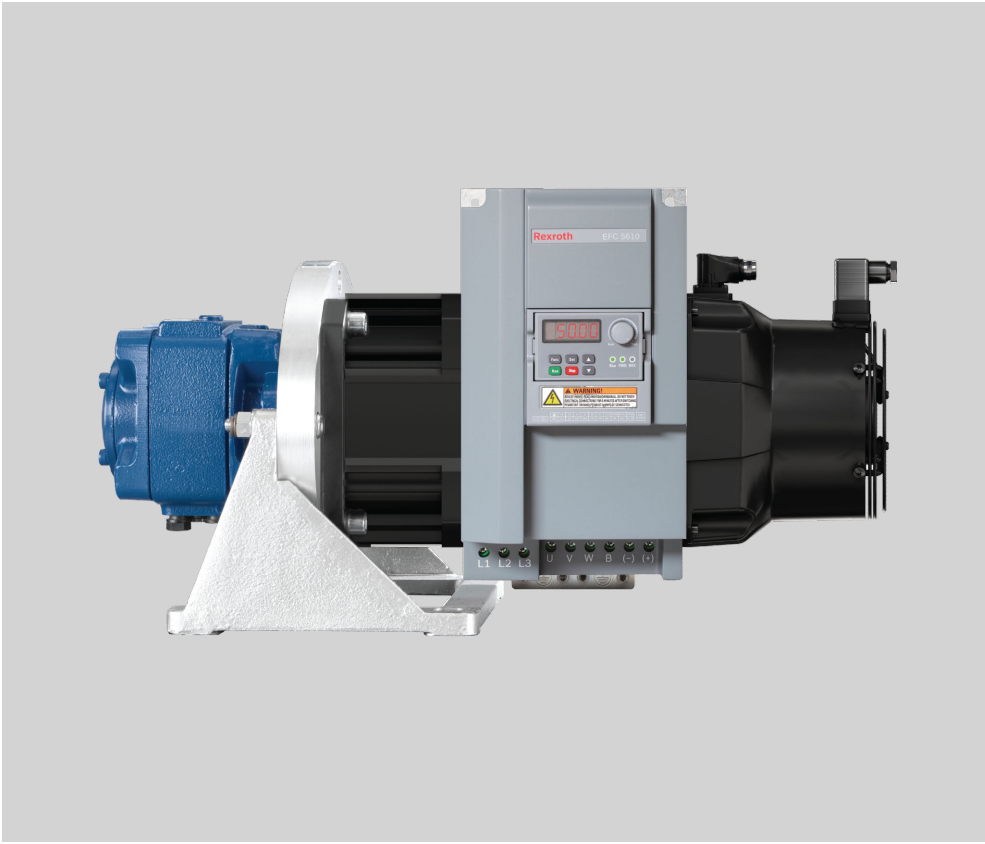
rexroth
A Bosch Company

Sytronix

SvP 5020
Variable-Speed Pump Drive System

Quick Start Guide
R912007444

Edition 05



Record of Revision

Edition	Release Date	Notes
DOK-RCON03-SVP5020****-QU01-EN-P	2019.02	First release
DOK-RCON03-SVP5020****-QU02-EN-P	2020.03	Content modified
DOK-RCON03-SVP5020****-QU03-EN-P	2020.06	Firmware update
DOK-RCON03-SVP5020****-QU04-EN-P	2022.12	Content modified
DOK-RCON03-SVP5020****-QU05-EN-P	2023.08	Content modified

Version matching table

SvP 5020 firmware version	EFC 5610 firmware version
01V06	03V38 and after
01V08	
01V12	
01V14	
01V16	

Introduction to this documentation

This **Quick Start Guide** is derived from the **Operating Instructions** which include detailed product data.

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

Never work with or control the product before reading the

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

Reference

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

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1 Type code

1.1 Pump controller type code description

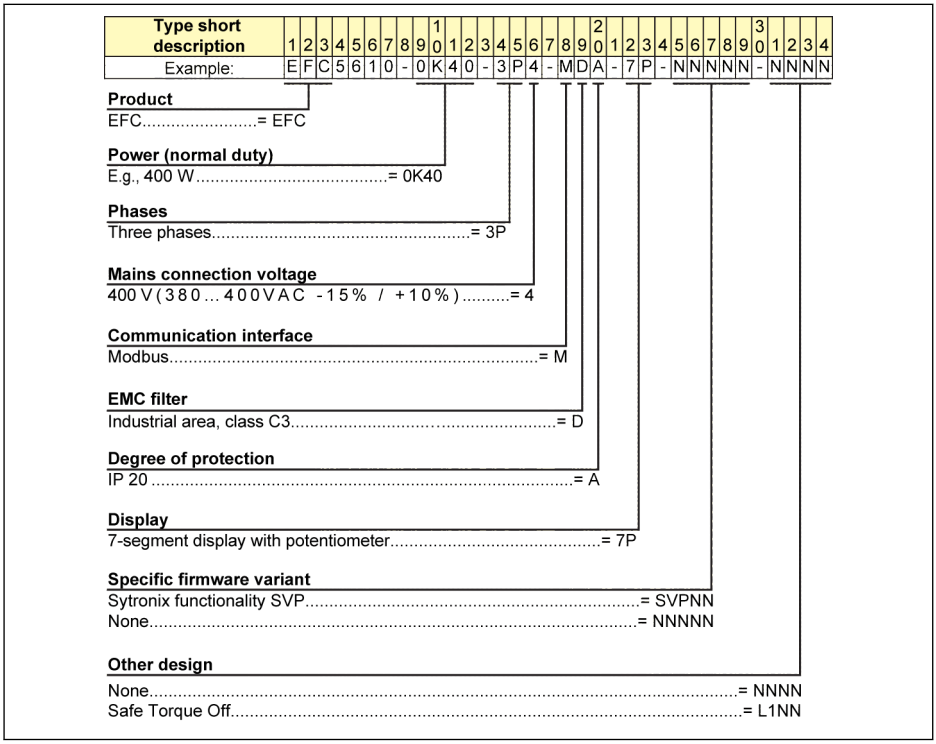


Fig. 1-1: EFC 5610 type code

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

1.2 SvP 5020 ASF type code description

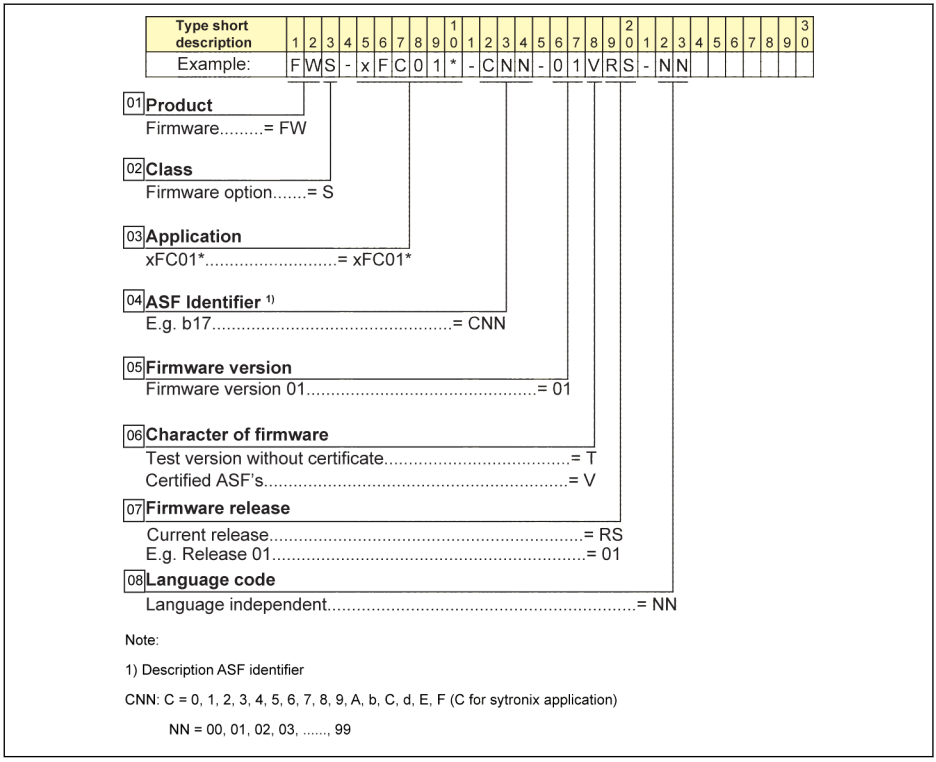


Fig. 1-2: SvP 5020 ASF type code

SvP 5020 ASF software type code: FWS-XFC01*-C11-01VRS-NN

ASF: Application-Specific Firmware.

The ASF type code will not be printed and placed on the EFC converter. The related ASF key information is integrated into the serial number label on the top and side of EFC converters.

For example:

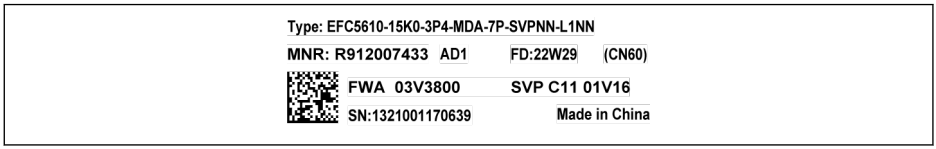


Fig. 1-3: EFC converter serial number label

Parameter	Name	Value
F0.01	ASF version	*
F0.02	ASF identifier	0x0C11
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: SvP 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 firmware
- Safety Instructions (available in multiple languages)
- EFC 5610 Quick Start Guide
- SvP 5020 ASF Quick Start Guide

3 Documentation reference

Following documentations about the components can be found on the Bosch Rexroth homepage via the product catalog or dirctly via the following link:

www.boschrexroth.com/mediadirectory

Title	Document number	Document type
Rexroth Frequency Converter EFC 3610 / EFC 5610 Series	R912005856	Quick Start Guide
Rexroth Frequency Converter EFC 3610 / EFC 5610 Series	R912005854	Operating Instructions
Pressure sensor for hydraulic applications, type HM20	RE 30272	Data sheet
Rexroth IndraDyn S Synchronous Servo Motors MS2N Manual	R911347583	Project Planning Manual
SvP 5020 Variable-Speed Pump Drive System	RE 62317	Operating Instructions - in preparation -

Tab. 3-1: Documentation reference

4 Function specification

An SvP system provides fine open-loop hydraulic flow control with closed-loop pressure override functionality (p/Q control). It can also operate purely as a highly accurate hydraulic pressure source.

The pressure command value for the pump controller is set by the higher-level machine control. The actual pressure value is measured by a pressure sensor in the hydraulic system and fed back to the pump controller. The pump controller manages the speed of the servo motor so that the hydraulic pump driven by it displaces exactly the oil volume required for regulating the command pressure. Alternatively, a flow command value for the pump controller is set. The pump controller then controls the speed of the servo motor so that the hydraulic pump driven by it displaces exactly the oil volume corresponding to the flow command value.

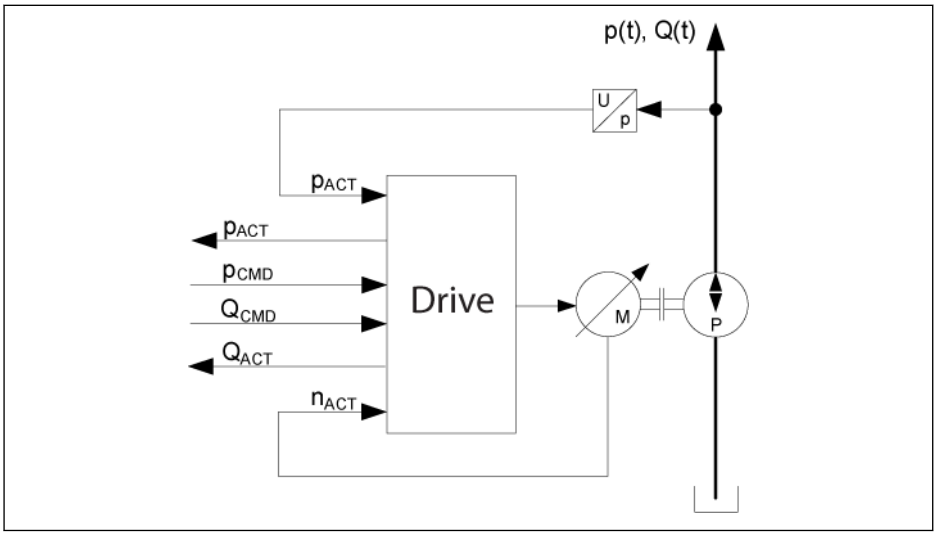


Fig. 4-1: System principle

The product provides the following features.

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

  *Optional communication board is required.

  *Supported communication protocols: PROFIBUS, Sercos, PROFINET IO, EtherCAT, EtherNet/IP.
- Pressure signal feedback

  - Compatible with different types of pressure sensors (flexible scaling for the analog input signal for voltage and current sensors)
  - Highly resistant 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 servo motor
- p/Q PID control
  - p/Q control with automatic switching between pressure and flow control modes
  - Provided with 4 groups of switchable controller-parameters
- Restore ASF parameters
- Extension functions
  - Master / slave control
  - Two-position / double pump control
  - Pump power limitation
  - Leakage compensation
- Protection function
  - Pressure feedback fault monitoring
  - Actual pressure monitoring
  - Maximum pressure / flow command limitation
  - Minimum pressure / flow command limitation

5 Initial start-up

5.1 Starting up with parameters

After the electric and the hydraulic system have been correctly installed, the initial start-up can be carried out according to the following steps:

1. Select pressure sensor via F2.10 (for option "0: Others", please set F2.06, F2.07 manually).
2. Choose motor parameters via F1.15 and F1.16 for Rexroth servo motor. For other motors, set F1.15 to 0, and set motor parameters in EFC parameter group C, please refer to EFC 5610 quick start guide (material number is R912005856).
3. Set pressure command via F1.03, F1.05 and flow command via F1.11, F1.12.
4. Run the SvP system.

The pressure command F1.05 and flow command F1.12 default values are set to low values to prevent potential machine damage caused by improper use during initial start up.

Code	Name	Setting range	Default	Min.	Attri.
F1.03	Pressure command source	0: Use digital value set in parameter F1.05 2: Analog input 3: Communication	2	-	Stop
F1.05	Pressure command digital setting	0.0...1,000.0 bar	5.0	0.1	Run
F1.11	Flow command source	0: Use digital value set in parameter F1.12 1: Analog input (positive / negative) 2: Communication	1	-	Stop
F1.12	Flow command digital setting	0...5,000 rpm	40	1	Run
F1.15	Motor type	0: Others 1: Rexroth servo motor	1	-	Stop

Code	Name	Setting range	Default	Min.	Attri.
F1.16	Motor power level	0: No selection 12: MS2N10-D0BHN 13: MS2N10-D0BHA/B 14: MS2N10-D0BNA/B 15: MS2N10-E0BHA/B 16: MS2N10-E0BNA/B 17: MS2N10-F0BHA/B 18: MS2N10-F1BHA/B 19: MS2N10-D0BNN 20: MS2N13-C1BHC 21: MS2N13-D1BHC 22: MS2N13-E1BHC 23: MS2N13-C1BNC 24: MS2N13-D1BNC 25: MS2N13-E1BNC 26: MS2N13-C1BNL 27: MS2N13-D1BNL 28: MS2N13-E1BNL	0	-	Stop
F2.06	Pressure feedback corresponding to 5V, 10V or 20mA	0.1...1,000.0 bar	250.0	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	0.1 V	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: Other 4-20mA pressure sensors 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 19: Other 0.1-10V pressure sensors	15	-	Stop

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

5.2 Restoring ASF parameters

5.2.1 General

You can restore the 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 refer to chapter 8.6 "Auto-modified EFC parameters in SvP initialization" on page 57 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.

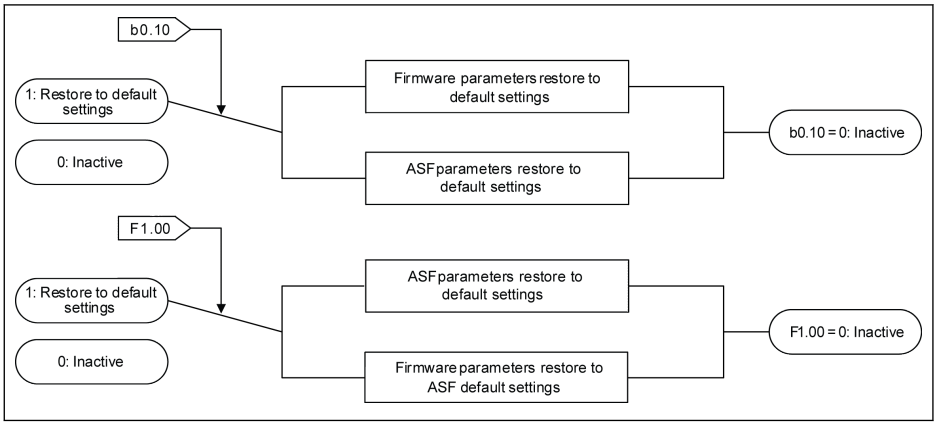
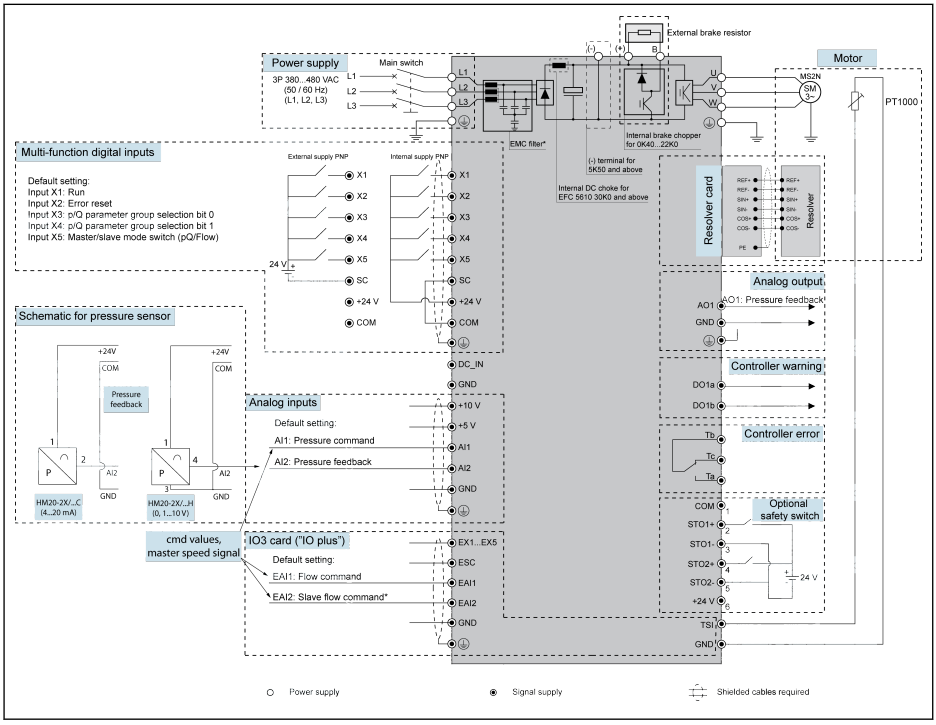


Fig. 5-1: ASF parameter restore to default

By restoring ASF parameters (setting F1.00 = 1), the value of parameters F1.15 and F1.16 will NOT be restored.

6 IO configuration

6.1 Overview of electrical connection



* Effective from ASF version 01V14

Fig. 6-1: Example wiring diagram with Rexroth MS2N motor analog set point control scheme

- The SvP 5020 I/O functionality is given higher priority over 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 optional I/O Plus Card, please refer to I/O Plus Card Product Insert (R912007670).
- For details about Resolver Card, please refer to Resolver Card Product Insert (R912007839).

6.2 Analog inputs

6.2.1 General

This section shows how the analog input can be configured. The following figure is an example of analog input AI2, which has been assigned to pressure feedback. The configurations for AI1, EAI1 and EAI2 are similar to AI2, only with different parameters shown in the table below.

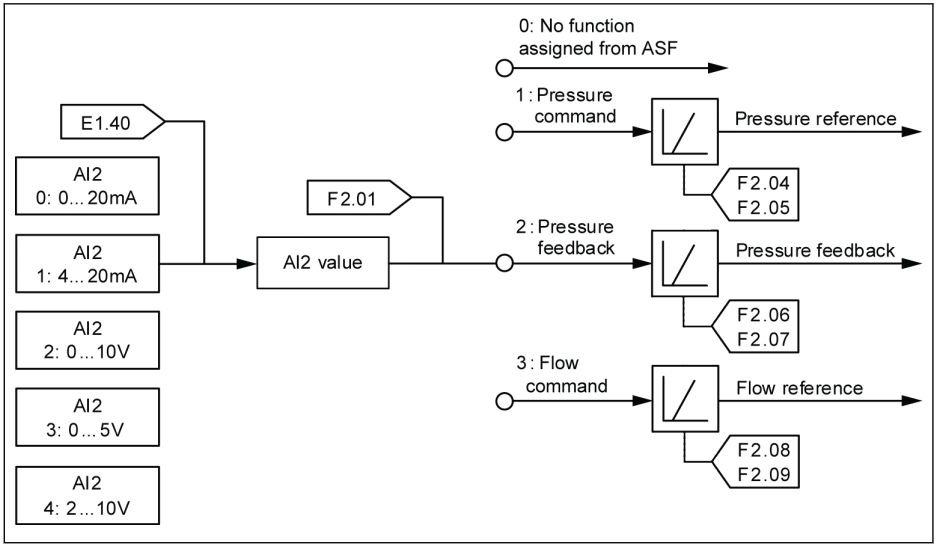


Fig. 6-2: Example with analog input AI2 assigned to pressure feedback

Code	Name	Setting range	Default	Min.	Attri.
E1.35	AI1 input mode	0: 0...20 mA	2	-	Run
E1.40	AI2 input mode	1: 4...20 mA 2: 0...10 V 3: 0...5 V 4: 2...10 V	1	-	Run
H8.05	EAI1 input mode	0...4 (same as E1.35) 5: -10V...10V	0	-	Stop
H8.30	EAI2 input mode				
F2.00	Analog input AI1	0: No function assigned from ASF	1	-	Stop
F2.01	Analog input AI2	1: Pressure command	2	-	Stop
F2.02	External analog input EAI1	2: Pressure feedback	3	-	Stop
F2.03	External analog input EAI2	3: Flow command 5: Slave flow command	5	-	Stop

Code	Name	Setting range	Default	Min.	Attri.
F2.04	Pressure command corresponding to 5V, 10V or 20mA	0.1...1,000.0 bar	175.0	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 5V, 10V or 20mA	0.1...1,000.0 bar	250.0	0.1	Stop
F2.07	Pressure feedback null offset in V or mA	0.0...5.0 V, mA	0.1 V	0.1	Stop
F2.08	Flow command corresponding to 5V, 10V or 20mA	1...5,000 rpm	3,000	1	Stop
F2.09	Flow command null offset in V or mA	0.0...5.0 V, mA	0.0	0.1	Stop
F4.43	Slave flow command corresponding to 5V, 10V or 20mA	0 --- 5000 rpm	3,000	1	Stop
F4.44	Slave flow command null offset in V or mA	0.0 --- 5.0 V, mA	0.0	0.1	Stop
F4.45	Slave flow command linear offset in V	-0.10---0.10V	0.00	0.01	Run

Tab. 6-1: Analog input parameter list

With the default SvP 5020 configuration, analog input AI2 [F2.01 = 2] is configured as pressure feedback input. Analog input AI1 [F2.00 = 1] is configured as pressure command input, analog input EA1 [F2.02 = 3] is configured as flow command input.

The analog inputs F2.00...F2.03 are mutually exclusive and therefore do not allow for any identical setting (except 0) between the parameters. When a repeated non-zero value is entered, the former will reset to 0 automatically, i.e. the last entered value is active.

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	Wire break protection	0: Inactive 1: Warning 2: Error	0	-	Stop

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

Wire break monitoring function for all analog inputs can be activated by E1.61. Default value of E1.61 has been set to 0 in SvP 5020 default setting.

6.2.2 Flow command processing

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

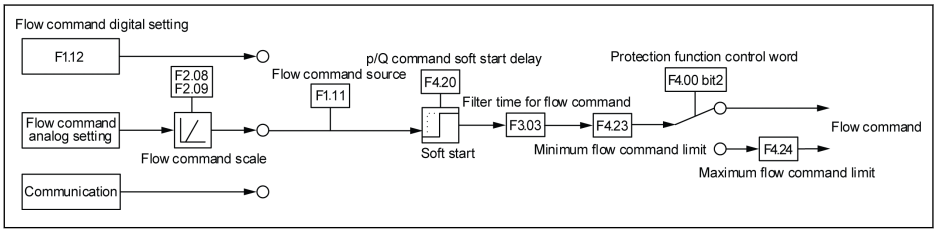


Fig. 6-3: Flow command processing

Code	Name	Setting range	Default	Min.	Attri.
F1.11	Flow command source	0: Use digital value set in parameter F1.12 1: Analog input (positive / negative) 2: Communication	1	-	Stop
F1.12	Flow command digital setting	0...5,000 rpm	40	1	Run
F2.00	Analog input AI1	0: No function assigned from ASF	1	-	Stop
F2.01	Analog input AI2	1: Pressure command	2	-	Stop
F2.02	External analog input EAI1	2: Pressure feedback	3	-	Stop
F2.03	External analog input EAI2	3: Flow command 5: Slave flow command	5	-	Stop
F2.08	Flow command corresponding to 5V, 10V or 20mA	1...5,000 rpm	3,000	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

Tab. 6-3: Parameter list of flow command processing

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

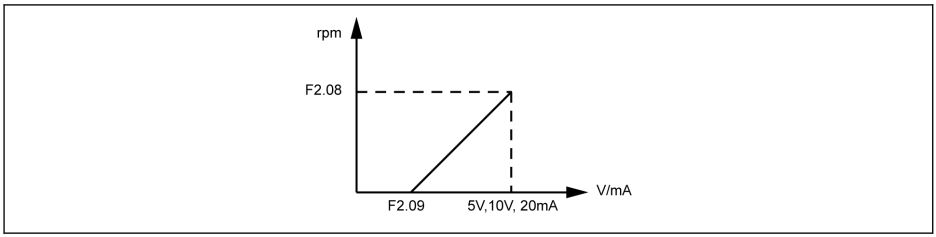


Fig. 6-4: Flow command scaling

6.2.3 Pressure command processing

The pressure command can be generated from multiple sources such as predefined in the parameters, analog input or fieldbus communication. The pressure command source has to be defined prior to the start-up of the system.

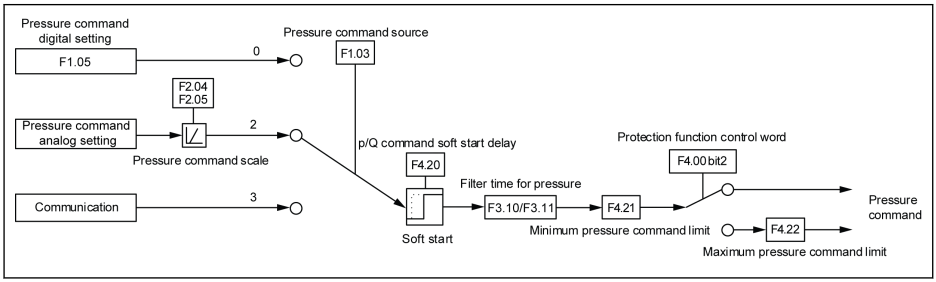


Fig. 6-5: Pressure command processing

Code	Name	Setting range	Default	Min.	Attri.
F1.03	Pressure command source	0: Use digital value set in parameter F1.05 2: Analog input 3: Communication	2	-	Stop
F1.05	Pressure command digital setting	0.0...1,000.0 bar	5.0	0.1	Run
F2.00	Analog input AI1	0: No function assigned from ASF 1: Pressure command 2: Pressure feedback 3: Flow command 5: Slave flow command	1	-	Stop
F2.01	Analog input AI2		2	-	Stop
F2.02	External analog input EAI1		3	-	Stop
F2.03	External analog input EAI2		5	-	Stop
F2.04	Pressure command corresponding to 5V, 10V or 20mA	0.1...1,000.0 bar	175.0	0.1	Stop
F2.05	Pressure command null offset in V or mA	0.0...5.0 V, mA	0.0	0.1	Stop

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

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

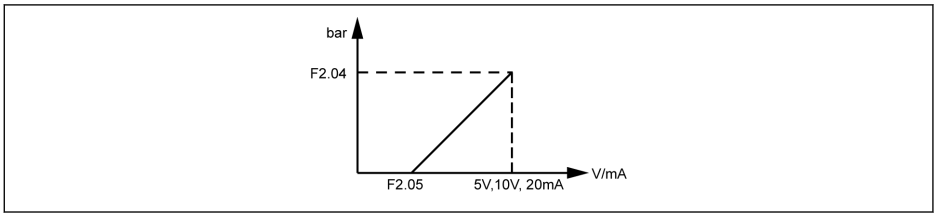


Fig. 6-6: Pressure command scaling

6.3 Analog output

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

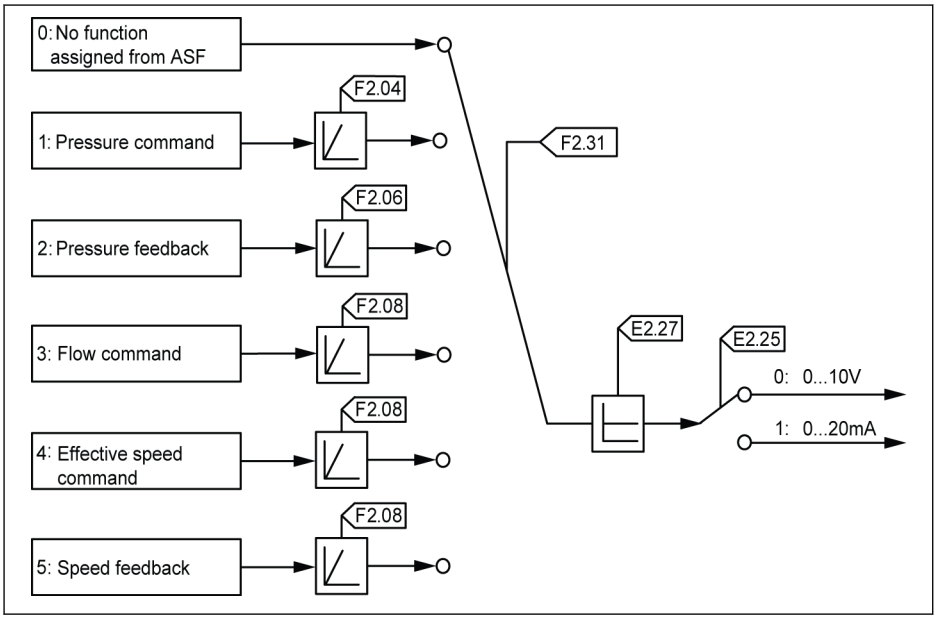


Fig. 6-7: Example with analog output AO1

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 5V, 10V or 20mA	0.1...1,000.0 bar	175.0	0.1	Stop
F2.06	Pressure feedback corresponding to 5V, 10V or 20mA	0.1...1,000.0 bar	250.0	0.1	Stop
F2.08	Flow command corresponding to 5V, 10V or 20mA	1...5,000 rpm	3,000	1	Stop

Code	Name	Setting range	Default	Min.	Attri.
F2.31	AO1 output	0: No function assigned from ASF	2	-	Run
F2.32	EAO output	1: Pressure command 2: Pressure feedback 3: Flow command 4: Effective speed command 5: Speed feedback	5	-	Run
H8.25	EAO output mode	0: 0...10 V 1: 0...20 mA 2: -10...10 V (only for IO plus card)	0	-	Run
H8.27	EAO gain setting	0.00...10.00	1.00	0.01	Run
H8.39	EAO curve minimum	-100.0 %...[H8.41]	0.0	0.1	Run
H8.40	EAO curve minimum value	-100.0...100.0 %	0.00	0.01	Run
H8.41	EAO curve maximum	[H8.39]...100.0 %	100.0	0.1	Run
H8.42	EAO curve maximum value	-100.0...100.0 %	100.0	0.1	Run

Tab. 6-4: Analog output parameter list

As the default configuration, SvP 5020 ASF sets the AO1 output, i.e. [F2.31] = 2. The AO1 output can be used by SvP 5020. If SvP 5020 ASF does not set the AO1 output, i.e. [F2.31] = 0, the AO1 output can be used by the EFC function.

Output parameters which are part of the EFC basic Firmware (e.g. motor current) have to be set via the firmware parameters E2.26, H8.20 or H8.22. In this case, "0:No function assigned from ASF" has to be set. You can find further information in the EFC Operation Instructions R912005854.

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: Flow command

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

- F2.31 = 4: Effective speed command

$$AO1 = \frac{Active\ speed\ command}{F2.08} * 10V\ (20mA)$$

- F2.31 = 5: Speed feedback

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

Output parameters which are part of the EFC basic Firmware (e.g. motor current) have to be set via the firmware parameters E2.26, H8.20 or H8.22. In this case, "0:No function assigned from ASF" has to be set. You can find further information in the EFC Operation Instructions R912005854.

6.4 Digital inputs

Code	Name	Setting range	Default	Min.	Attri.
F2.16	X1 input	0: No function 3: p/Q parameter group bit 0 4: p/Q parameter group bit 1 5: Master/slave mode switch (pQ/Flow) 6: External warning with delay 7: External warning without delay 9: External error with delay 10: External error without delay	0 (RUN *)	-	Run
F2.17	X2 input		0 (Error reset *)	-	Run
F2.18	X3 input		3	-	Run
F2.19	X4 input		4	-	Run
F2.20	X5 input		5	-	Run
F2.21	EX1 input		0	-	Run
F2.22	EX2 input		0	-	Run
F2.23	EX3 input		0	-	Run
F2.24	EX4 input		0	-	Run
F2.25	EX5 input		0	-	Run

Tab. 6-5: Digital input parameter list

*: The functions in brackets come from presetting of EFC parameters. See .chapter 8.6 "Auto-modified EFC parameters in SvP initialization" on page 57

The digital inputs F2.16...F2.25 are mutually exclusive, and therefore do not allow for any identical setting (except 0) between the parameters. When a repeated non-zero value is entered, the former will reset to 0 automatically, i.e. the last entered value is active.

6.5 Digital and relay outputs

Code	Name	Setting range	Default	Min.	Attri.
F2.36	DO1 output	0: No function 1: Controller warning	1	-	Run
F2.37	EDO1 output	0: No function 1: Controller warning 2: Two point / double pump control	0	-	Run
F2.38	EDO2 output				
F2.40	Relay 1 output				

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

The SvP 5020 default setting of DO1 is "1", i.e. pump controller warning. Meanwhile, the default setting of relay, EDO1 and EDO2 when connected to ASF is "0", which means the function of relay and EDO1 / EDO2 is assigned by EFC firmware.

The EFC parameter E2.15 has been set to "14" (pump controller error) by ASF as SvP default setting. For more EFC parameters changed as SvP default setting,

please refer to chapter 8.6 "Auto-modified EFC parameters in SvP initialization" on page 57.

6.6 Quick configuration for Rexroth servo motor

When a Rexroth servo motor is used with SvP 5020 ASF applications, saved motor parameters can be loaded via F1.15 and F1.16. Please keep [F1.15] = 1 for Rexroth MS2N motors.

Code	Name	Setting range	Default	Min.	Attri.
F1.15	Motor type	0: Others 1: Rexroth MS2N motor	1	-	Stop
F1.16	Motor power level	0: No selection 12: MS2N10-D0BHN 13: MS2N10-D0BHA/B 14: MS2N10-D0BNA/B 15: MS2N10-E0BHA/B 16: MS2N10-E0BNA/B 17: MS2N10-F0BHA/B 18: MS2N10-F1BHA/B 19: MS2N10-D0BNN 20: MS2N13-C1BHC 21: MS2N13-D1BHC 22: MS2N13-E1BHC 23: MS2N13-C1BNC 24: MS2N13-D1BNC 25: MS2N13-E1BNC 26: MS2N13-C1BNL 27: MS2N13-D1BNL 28: MS2N13-E1BNL	0	-	Stop

Tab. 6-7: Motor parameter list

- If [F1.15] = 0, no motor parameter will be changed by switching F1.16.
- If [F1.15] = 1, motor parameter will be changed by switching F1.16 to 12...28.

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

Code	Name	Code	Name
C1.05	Motor rated power	C1.72	Motor thermal sensor type
C1.06	Motor rated voltage	C1.73	Motor thermal sensor protection level
C1.07	Motor rated current	C3.00	Speed loop proportional gain
C1.08	Motor rated frequency	C3.01	Speed loop integral time
C1.09	Motor rated speed	C3.02	Speed loop proportional gain 2
C1.11	Motor pole pairs	C3.03	Speed loop integral time 2
C1.13	Motor inertia mantissa	C3.05	Current loop proportional gain
C1.14	Motor inertia exponent	C3.06	Current loop integral time
C1.15	Motor torque constant	C3.22	Resolver commutation offset
C1.16	Motor EMF constant	H7.01	Resolver direction
C1.21	Stator resistance	H7.31	Resolver poles
C1.23	Leakage inductance	C0.07	Voltage Overmodulation
C3.30	Maximum FW current factor for SM	C3.44	Torque positive limit
C3.45	Torque negative limit		

Tab. 6-8: Auto-modified EFC motor control parameter list

Once motor control mode C0.00 is changed, please reload motor parameter by setting F1.16 again.

For other motor types,which are not listed in the motor table set F1.15=0 (other) and use the IndraWorksDs motor commissioning dialogues in the folder "Control" to make the correct settings for this motor.

6.7 Pressure feedback input

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

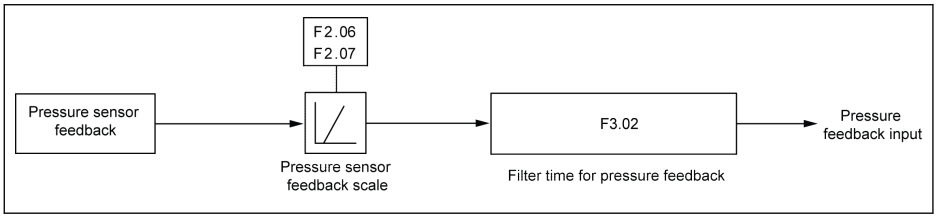


Fig. 6-8: Pressure feedback input

Code	Name	Setting range	Default	Min.	Attri.
F2.06	Pressure feedback corresponding to 5V, 10V or 20mA	0.1...1,000.0 bar	250.0	0.1	Stop
F2.07	Pressure feedback null offset in V or mA	0.0...5.0 V, mA	0.1 V	0.1	Stop
F3.02	Filter time for pressure feedback	0...999 ms	4	1	Run
E1.35	AI1 input mode	0: 0...20 mA	2	-	Run
E1.40	AI2 input mode	1: 4...20 mA 2: 0...10 V 3: 0...5 V 4: 2...10 V	2	-	Run
H8.05	EAI input mode	0...4 (same as E1.35) 5: -10...10 V	2	-	Stop
F2.00	Analog input AI1	0: No function assigned from ASF 1: Pressure command 2: Pressure feedback 3: Flow command 5: Slave flow command	1	-	Stop
F2.01	Analog input AI2		2	-	Stop
F2.02	External analog input EAI1		3	-	Stop
F2.03	External analog input EAI2		5	-	Stop

Tab. 6-9: Parameter list of pressure sensor feedback scaling

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

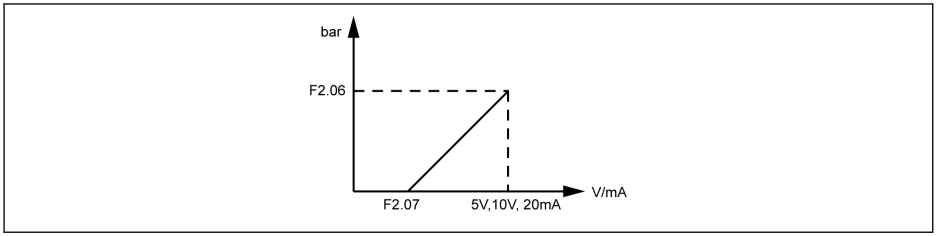


Fig. 6-9: Pressure sensor feedback scaling

6.8 Quick configuration for Rexroth HM20 pressure sensor

For applications using the Rexroth HM20 pressure sensor, configuration parameters of the HM20sensor 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]...[F2.03] 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.
F2.00	Analog input AI1	0: No function assigned from ASF 1: Pressure command 2: Pressure feedback 3: Flow command 5: Slave flow command	1	-	Stop
F2.01	Analog input AI2		2	-	Stop
F2.02	External analog input EAI1		3	-	Stop
F2.03	External analog input EAI2		5	-	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: Other 4-20mA pressure sensors 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 19: Other 0.1-10V pressure sensors	15	-	Stop

Tab. 6-10: Parameter list of HM20 pressure sensor auto-selection

7 Main functions

7.1 Overview

The following figure shows an overview of control functions in this ASF. For detailed information, refer to the chapter number which is shown under each function.

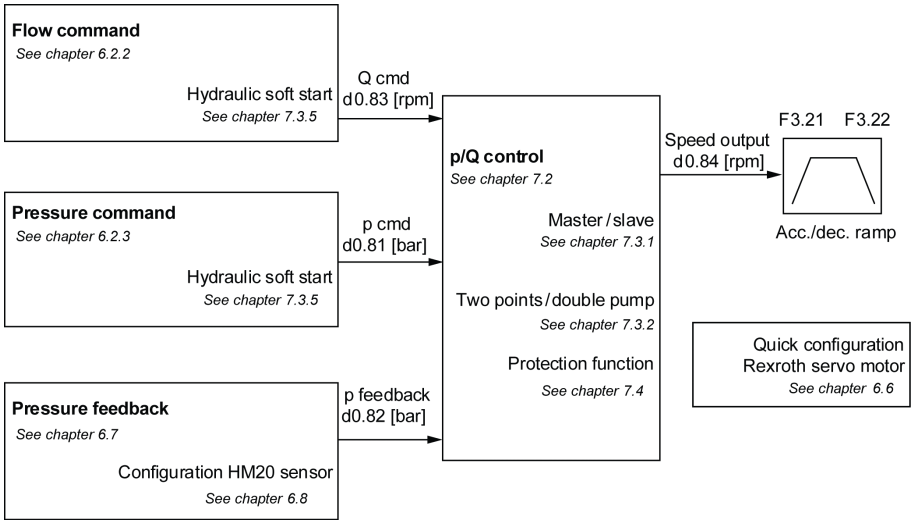


Fig. 7-1: p/Q PID-control and relevant functions

7.2 p/Q PID-control

7.2.1 Basic p/Q control structure and related parameters

The basic p/Q control structure and related parameters are shown in the following figure in 5 sections:

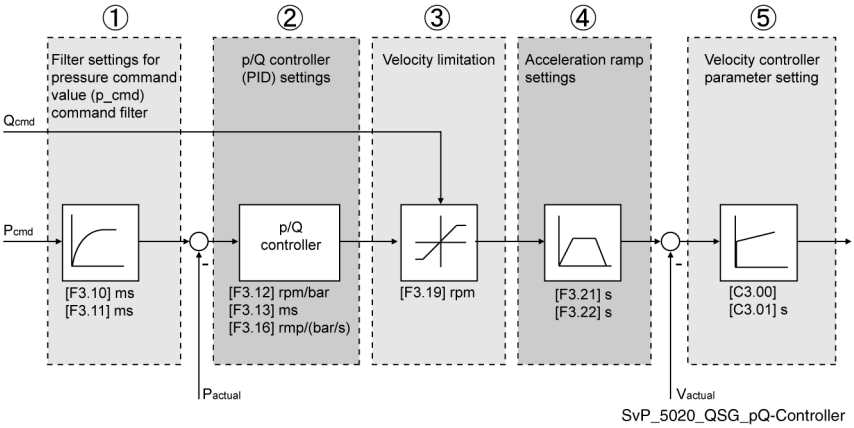


Fig. 7-2: p/Q controller structure

The information in this chapter will help you optimize the p/Q controller according to the customer application at hand.

Code	Name	Setting range	Default	Min.	Attri.
F3.10	Filter time for pressure rising [0]	0...999ms	40	1	RUN
F3.11	Filter time for pressure dropping[0]	0...999ms	20	1	RUN
F3.12	Proportional gain [0]	0.00...500.00 rpm/bar	6.00	0.01	Run
F3.13	Integral time 1 [0]	0...999 ms	30	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	Derivative gain [0]	0.000...10.000 (rpm/bar)*s	0.100	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	-1,500	1	Run
F3.30	Filter time for pressure rising [1]	0...999ms	80	1	Run
F3.31	Filter time for pressure dropping [1]	0...999ms	40	1	Run
F3.32	Proportional gain [1]	0.00...500.00 rpm / bar	6.00	0.01	Run
F3.33	Integral time 1 [1]	0...999 ms	30	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

Code	Name	Setting range	Default	Min.	Attri.
F3.36	Derivative gain [1]	0.000...10.000 (rpm/bar)*s	0.300	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	-1,500	1	Run
F3.50	Filter time for pressure rising [2]	0...999 ms	100	1	Run
F3.51	Filter time for pressure dropping [2]	0...999 ms	60	1	Run
F3.52	Proportional gain [2]	0.00...500.00 rpm/bar	6.00	1.00	Run
F3.53	Integral time 1 [2]	0...999 ms	30	1	Run
F3.54	Integral time 2 [2]	0...999 ms	0	1	Run
F3.55	Integral time TI switch threshold [2]	-150.0...0.0 bar	0.0	1.0	Run
F3.56	Derivative gain [2]	0.000...10.000 (rpm/bar)*s	0.100	1.000	Run
F3.57	Filter time for Kd [2]	0...999 ms	35	1	Run
F3.58	Lower limit for I+D [2]	-5,000...5,000 rpm	0	1	Run
F3.59	System minimum speed [2]	-5,000...5,000 rpm	-1,500	1	Run
F3.70	Filter time for pressure rising [3]	0...999 ms	120	1	Run
F3.71	Filter time for pressure dropping [3]	0...999 ms	80	1	Run
F3.72	Proportional gain [3]	0.00...500.00 rpm/bar	6.00	1.00	Run
F3.73	Integral time 1 [3]	0...999 ms	30	1	Run
F3.74	Integral time 2 [3]	0...999 ms	0	1	Run
F3.75	Integral time TI switch threshold [3]	-150.0...0.0 bar	0.0	1.0	Run
F3.76	Derivative gain [3]	0.000...10.000 (rpm/bar)*s	0.000	1.000	Run
F3.77	Filter time for Kd [3]	0...999 ms	35	1	Run
F3.78	Lower limit for I+D [3]	-5,000...5,000 rpm	0	1	Run
F3.79	System minimum speed [3]	-5,000...5,000 rpm	-1,500	1	Run

7.2.2 Effect of the controller parameters

The designation and the effect of the controller parameters is explained with the parameters for parameter set 0.

Code	Name	Setting range	Default	Min.	Attri.
F3.12	Proportional gain [0]	0.00...500.00 rpm/bar	6.00	0.01	Run

Tab. 7-1: Parameter list of p/Q PID controller proportional gain setting

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

Code	Name	Setting range	Default	Min.	Attri.
F3.13	Integral time 1 [0]	0...999 ms	30	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. 7-2: Parameter list of p/Q PID controller integral time setting

The parameters in the table above are used to set the integrator update rate delay of the p/Q PID controller. Increasing integrator values will slow down the pressure loop system response which reduces the pressure system response against external disturbance, but will result in higher system stability. Both integral time TI_1 and TI_2 can be utilized after setting F3.15 to values smaller than 0. Based on the pressure difference (pressure command - pressure feedback), the system will switch to a suitable integrator delay time.

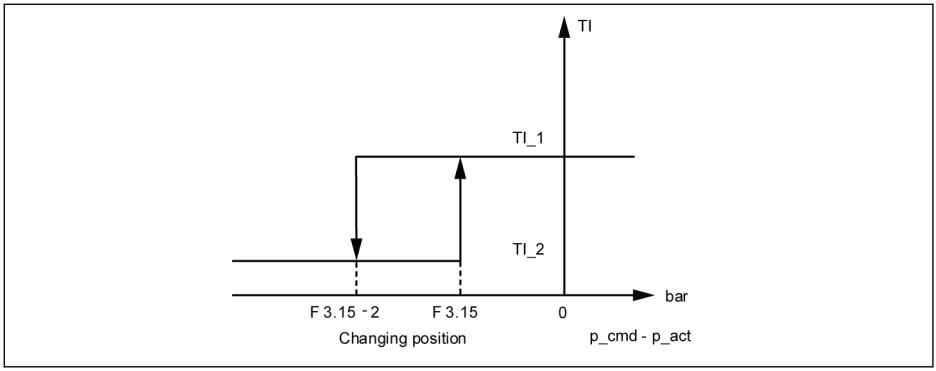


Fig. 7-3: p/Q PID integrator switching

When the integrator time TI switching threshold is set to 0, the switching function is inactive, and integrator interval T1_1 becomes dominant and fixed.

Code	Name	Setting range	Default	Min.	Attri.
F3.16	Derivative gain [0]	0.000...10.000 (rpm/bar)*s	0.100	0.001	Run
F3.17	Filter time for Kd [0]	0...999 ms	35	1	Run

Tab. 7-3: Parameter list of p/Q PID controller derivative gain setting

Parameter F3.16 is used to set the derivative gain of the p/Q PID-controller. The greater the derivative gain, the less the system pressure overshoots, but the

slower the pressure response. An excessively large derivative gain would affect the system stability.

Parameter F3.17 is used to set the filter time at the derivative part of the p/Q PID-controller. Setting this parameter properly can help to suppress high frequency oscillation in the derivative part of the PID-controller.

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

Tab. 7-4: Parameter list of p/Q PID-controller integral output setting

Parameter F3.18 is used to set the minimum value of the integral output for preventing pressure undershoots in case of descending pressure steps.

Code	Name	Setting range	Default	Min.	Attri.
F3.19	System minimum speed [0]	-5,000...5,000 rpm	-1,500	1	Run

Tab. 7-5: Parameter list of p/Q PID controller minimum output setting

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

Parameter set [1] F3.32...F3.39, set [2] F3.52...F3.59, set [3] F3.72...F3.79 have the same function as parameter set [0] F3.12...F3.19.

⚠ WARNING **In case of using a check valve in the pressure line, a negative speed as minimum system speed is not allowed.**

7.2.3 p/Q-Parameter sets

The SvP5020 system provides 4 different parameter groups for the p/Q controller parameters. This allows the user to adjust the controller parameters depending on the hydraulic load by switching to another group. As default setting the p/Q parameter group 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: Use digital value set in parameter F3.01 1: Digital input 2: Communication	0	-	Stop
F3.01	p/Q parameter digital selection	0: Parameter group 0 1: Parameter group 1 2: Parameter group 2 3: Parameter group 3	0	-	Run

Tab. 7-6: Parameter list of p/Q parameter selection

How to select a p/Q parameter group is described in the following figure.

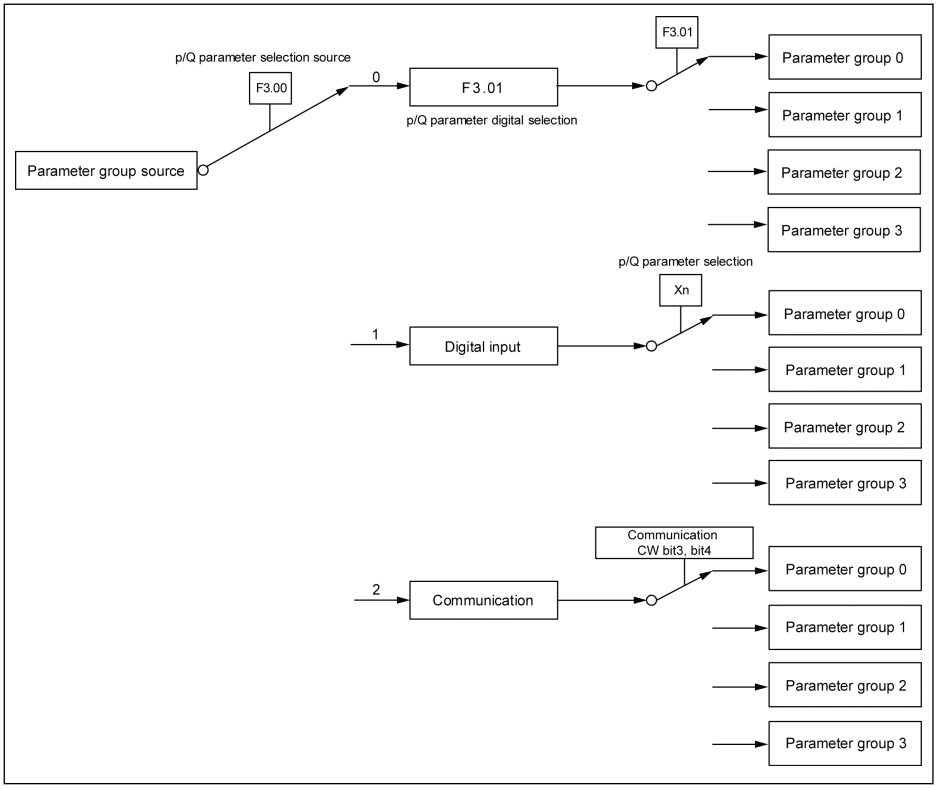


Fig. 7-4: p/Q parameter group selection

7.3 Additional functions

7.3.1 Master / slave function

The master / slave pump function is designed for multiple pumps working as a group to achieve a larger flow. In this application, a "master" pump controller is needed to control the speed / flow of downstream "slave" pump controllers.

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 5: Slave flow command	1	-	Stop
F2.01	Analog input AI2		2	-	Stop
F2.02	External analog input EAI1		3	-	Stop
F2.03	External analog input EAI2		5	-	Stop
F2.31	AO1 output	0: No function assigned from ASF 1: Pressure command 2: Pressure feedback 3: Flow command 4: Active speed command 5: Speed feedback	2	-	Run
F2.32	EAO output		5	-	Run
F4.03	Pump control word	Bit 0: Pump power limit Bit 2: Master/slave Bit 3: Two point/double pump Bit 6: Monitoring speed direction reverse Other bits: Reserved	0	-	Run
F4.39	Master/slave (pQ/Flow) switch source	0: Use digital value set in parameter 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	Slave pump flow mode switch delay	0...500 ms	100	1	Stop
F4.42	Slave flow command source	0: No 1: Analog input 2: Communication	1	-	Stop

Code	Name	Setting range	Default	Min.	Attri.
F4.43	Slave flow command corresponding to 5V, 10V or 20mA	0 --- 5000 rpm	3,000	1	Stop
F4.44	Slave flow command null offset in V or mA	0.0 --- 5.0 V, mA	0.0	0.1	Stop
F4.45	Slave flow command linear offset in V	-0.10---0.10V	0.0	0.01	Run

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

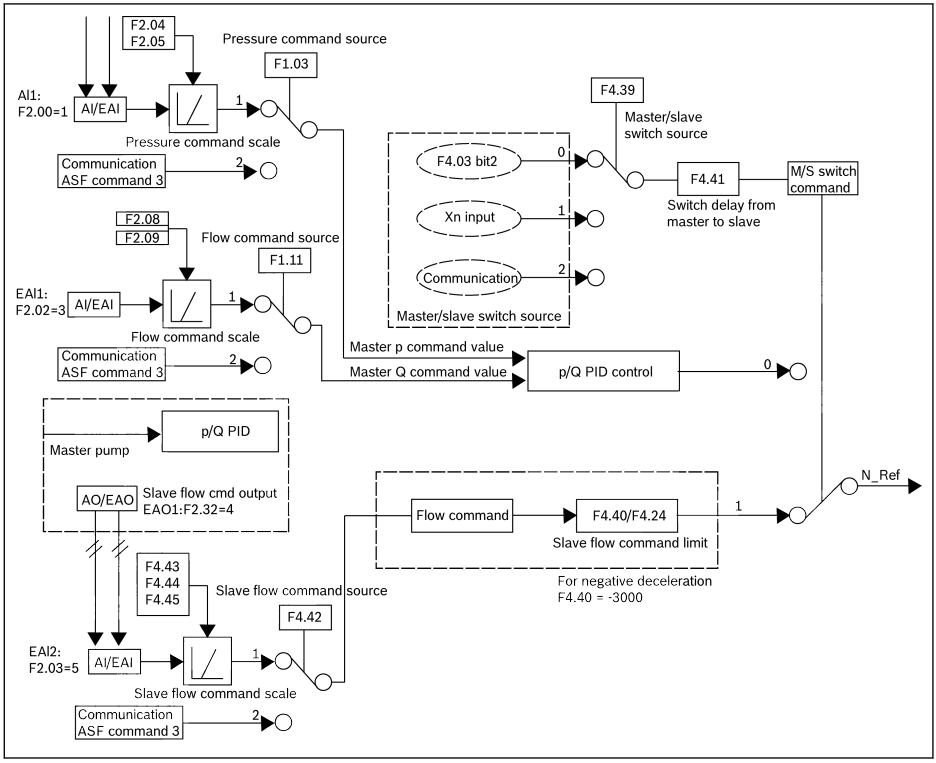


Fig. 7-5: Master / slave control function

7.3.2 Two-position / double pump control

Code	Name	Setting range	Default	Min.	Attri.
F2.37	EDO output	0: No function	0	-	Run
F2.38	EDO2 output	1: Controller warning	0	-	Run
F2.40	Relay 1 output	2: Two-position/double pump control	0	-	Run
F4.03	Pump control word	Bit 0: Pump power limit Bit 2: Master/slave Bit 3: Two-position/double pump Bit 6: Monitoring speed direction reverse Other bits: Reserved	0	-	Run
F4.28	Two point / double pump selection	0: Two-position 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. 7-8: Parameter list of two-position / double pump control

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

For the two-position pump, F4.30 (Vg1) represents the maximum displacement, and F4.31 (Vg2) represents the smaller displacement. For double pumps, F4.30 (Vg1) refers to the main pump, and F4.31 (Vg2) corresponds to the displacement of an 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 digital output, once the output has been set.

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.

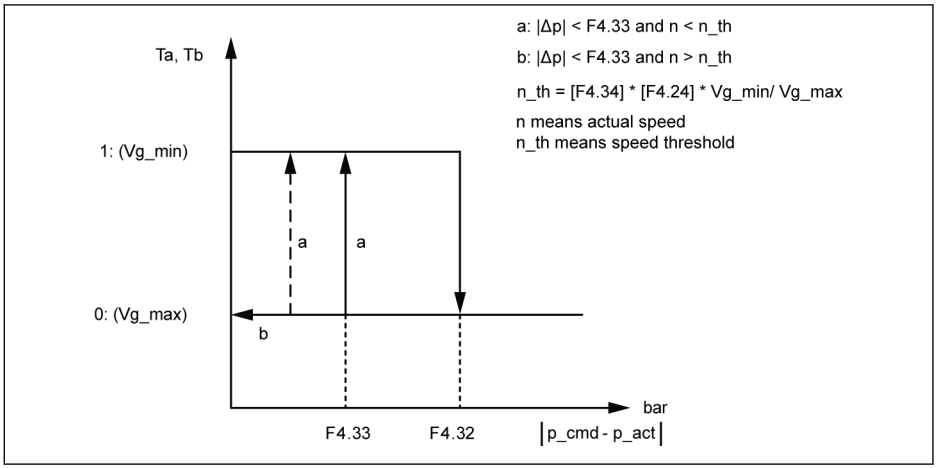


Fig. 7-6: Action logic of relay

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

Vg_max is always active if: IΔpI > F4.32.

For switching to Vg_min, IΔpI must be<F4.33 and the actual speed must be lower than N_th.

The switch back condition to Vg_max depends again only from the IΔpI > F4.32.

To avoid switching back and forth, be sure that a pressure overshoot is smaller than the value of F4.32.

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

For logic Vg_{max}:

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

For logic Vg_{min}:

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

When the two-position / double pump control is active, the p/Q parameter selection function via digital input (F2.16...F2.25) is deactivated.

Application example:

24 V power supply, normally open relay terminal Ta, Tb and Rexroth two-position pump controller are connected in series, [F4.28] is set to "0: Two-position

pump'' and [F4.29] are set to ''0: Positive'', when Δp and n_{th} satisfy the condition of relay action, the pump switches to the minimum displacement.

7.3.3 Sleep / wake function

This function is used to achieve the maximum extent of energy-saving according to the type of loads in the actual application, for example hydraulic system with small leakage or accumulator. This function works according to the PID-control mode, when SvP 5020 ASF is active. The function is assigned to the p/Q PID-controller in ASF, and the basic PID-controller of EFC is 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
E5.19	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. 7-9: 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
- [PID output] < [E5.15] "Sleep level"
- [Duration] t ≥ [E5.16] "Sleep delay"

- PID feedback means pressure feedback in SvP 5020. The unit of wake up level or sleep boost amplitude has is percentage. This percentage is referred to the pressure command value in bar.
- PID output means the speed output from the p/Q controller in SvP 5020. This value has the same unit as the sleep level, i.e. Hz.

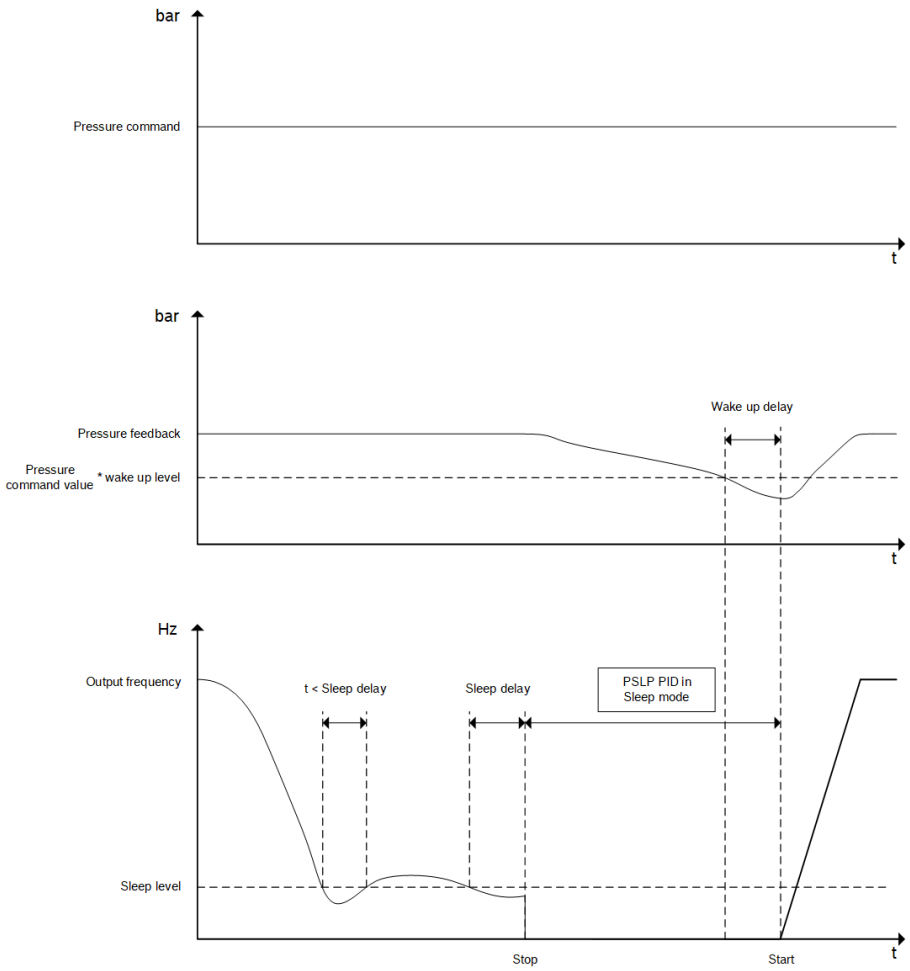


Fig. 7-7: Sleep and wake-up process in SvP

After [E5.16] "Sleep delay" the pump controller goes to the sleep mode. In the sleep mode, the pump controller stops output with "PSLP" displayed on the operating panel.

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 its previous running status after waking up.

7.3.4 Pump power limitation

Code	Name	Setting range	Default	Min.	Attri.
F4.03	Pump control word	Bit 0: Pump power limit Bit 2: Master/slave Bit 3: Two-position/double pump Bit 6: Monitoring speed direction reverse Other bits: Reserved	0	-	Run
F4.30	Pump Vg1	0...1,000 ccm	0	1	Stop
F4.31	Pump Vg2				
F4.35	Pump power	0.00...315.00 kW	0.00	0.01	Stop

Tab. 7-10: Parameter list of pump power limitation

The pump power limitation function can be activated via bit 0 of F4.03.

The real-time pump power can be calculated from the pressure feedback, the actual speed and the 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 and a warning is issued.

7.3.5 Hydraulic soft start

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	40	1	Stop

Tab. 7-11: Parameter list of hydraulic soft start

The soft start function is designed to reduce the p/Q command or potential overcurrent condition during start-up. Once this function is active (set F4.20 > 0), the p/Q commands will be switched to F4.21 and F4.23 within a time period of F4.20 after every run command.

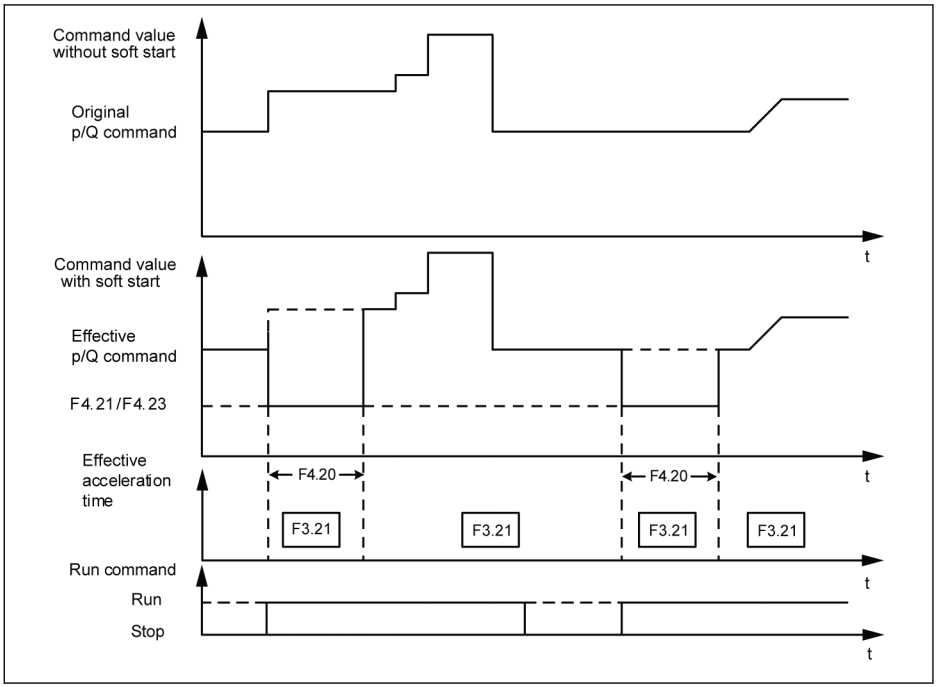


Fig. 7-8: Hydraulic soft start

7.3.6 Leakage compensation

Code	Name	Setting range	Default	Min.	Attri.
F4.26	Leakage compensation determination pressure	0.0...1,000.0 bar	0.0	0.1	Run
F4.27	Leakage compensation determination flow	0...3,000 rpm	0	1	Run

Tab. 7-12: Parameter list of leakage compensation

The leakage compensation serves to guarantee an exact oil flow from the pump.

It compensates, for example, the leakage within the pump so that the cylinders work at a constant speed. Without leakage compensation, a difference between the command value specified by the external control and the actual oil flow in the system will result due to the pressure-dependent leakage.

The principle of operation is as follows:

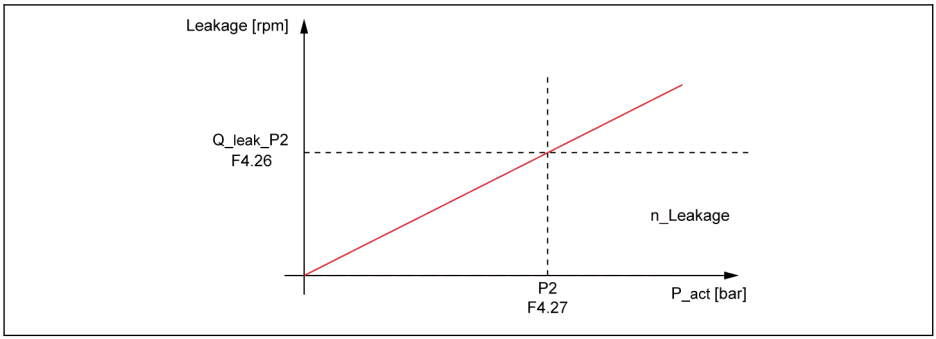


Fig. 7-9: Leakage compensation

The value calculated for the leakage compensation is added to the flow command. The compensation value is shown in the figure above by means of the line which shows the working point with the following two parameters.

- Leakage compensation determination pressure: F4.26
- Leakage compensation determination flow: F4.27

7.4 Protection functions

7.4.1 Overview

SvP 5020 ASF provides a multiple of protection functions, including detection of pressure sensor fault, actual pressure monitoring, pressure / flow command monitoring, pump power limitation.

7.4.2 Pressure sensor fault detection

Code	Name	Setting range	Default	Min.	Attri.
F4.00	Protection control word	Bit 0: Pressure sensor fault (PSF) Bit 1: Actual pressure monitoring Bit 2: p/Q maximum command limit Other bits: Reserved	0	-	Run
F4.06	Pressure sensor fault detection threshold 1 (negative direction)	-5,000...0 rpm	-1	1	Stop
F4.07	Pressure sensor fault detection time 1 (negative direction)	0.1...100.0 s	10.0	0.1	Stop
F4.08	Pressure sensor fault detection threshold 2 (positive direction)	0...5,000 rpm	200	1	Stop
F4.09	Pressure sensor fault detection time 2 (positive direction)	0.1...100.0 s	10.0	0.1	Stop

Tab. 7-13: Parameter list of pressure sensor fault detection

The pressure sensor fault detection can be activated via bit0 of F4.00.

The pressure sensor fault detection works in two different phases:

- Motor runs in negative direction

  Once the 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 fault for this.

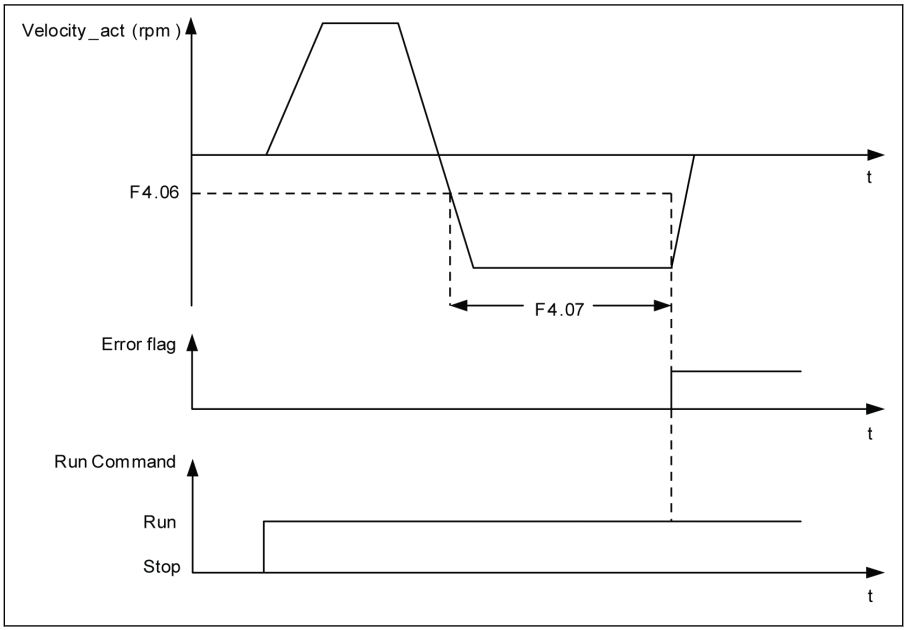


Fig. 7-10: Motor reverse speed limit

- Motor runs in positive direction

  Once the motor runs in positive direction at a 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 fault for this.

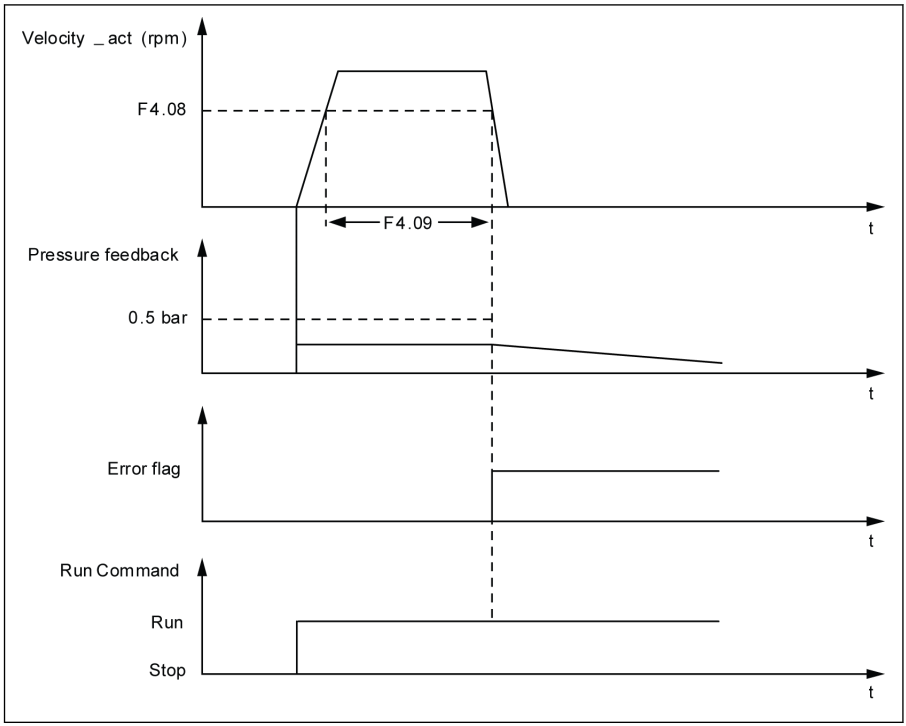


Fig. 7-11: Motor forward speed limit

7.4.3 Actual pressure monitoring

Code	Name	Setting range	Default	Min.	Attri.
F4.00	Protection control word	0...7 Bit 0: Pressure sensor fault (PSF) Bit 1: Actual pressure monitoring Bit 2: p/Q maximum command limit Other bits: Reserved	0	-	Run
F4.15	Maximum system pressure (warning)	0.0...[F4.16] bar	200.0	0.1	Stop
F4.16	Maximum pump pressure (error)	[F4.15]...4,000.0 bar	350.0	0.1	Stop
F4.17	Maximum system pressure warning time delay	0.0...6000.0s	0.0	0.1	Run
F4.18	Maximum pump pressure error time delay	0.0...6000.0s	0.0	0.1	Run

Tab. 7-14: 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] bar, the warning (d0.88 = 1) will be triggered for the pressure feedback exceeding the maximum system pressure allowed.

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

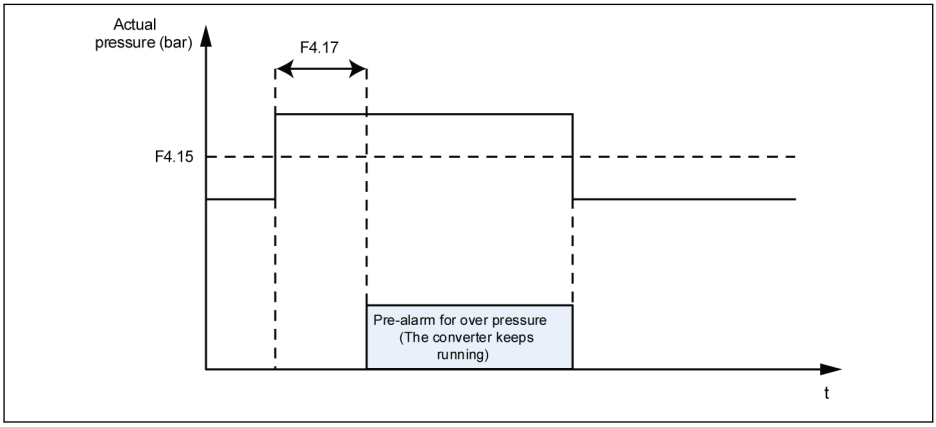


Fig. 7-12: F4.15 maximum system pressure warning

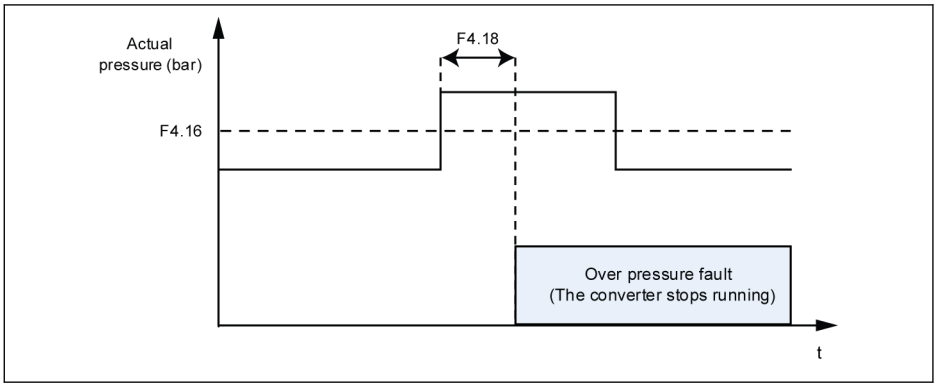


Fig. 7-13: F4.16 maximum pump pressure fault

Actual pressure monitoring function works all the time, no matter whether the drive is in operation or standby.

7.4.4 Pressure and flow command limit

Code	Name	Setting range	Default	Min.	Attri.
F4.00	Protection control word	0...7 Bit 0: Pressure sensor fault (PSF) Bit 1: Actual pressure monitoring Bit 2: p/Q maximum command limit Other bits: Reserved	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	175.0	0.1	Stop
F4.23	Minimum flow command limit	0...[F4.24] rpm	40	1	Stop
F4.24	Maximum flow command limit	[F4.23]...5,000 rpm	3,000	1	Stop

Tab. 7-15: Parameter list of pressure and flow command limit

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 the customer exceeds the limitation set in [F4.22] and [F4.24]. If a given command exceeds its limitation, the active command value will be limited to the maximum limit, and a warning signal will be issued.

8 SvP 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
- **Min.:** Minimum setting step
- **Attri.:** Parameter attribute
  - **Run:** Parameter setting can be modified when the controller is in run or stop status.
  - **Stop:** Parameter setting can only be modified when the controller is in stop status.
  - **Read:** Parameter setting is read-only and cannot be modified.

8.2 Group F1: Quick start parameters

Code	Name	Setting range	Default	Min.	Attri.
F1.00	ASF parameter initialization	0: Inactive 1: Restore to SvP default settings 2: Deactivate ASF	0	-	Stop
F1.02	Control mode	0: p/Q control	0	-	Stop
F1.03	Pressure command source	0: Use digital value set in parameter F1.05 2: Analog input 3: Communication	2	-	Stop
F1.05	Pressure command digital setting	0.0...1,000.0 bar	5.0	0.1	Run
F1.11	Flow command source	0: Use digital value set in parameter F1.12 1: Analog input (positive / negative) 2: Communication	0	-	Stop
F1.12	Flow command digital setting	0...5,000 rpm	40	1	Run

Code	Name	Setting range	Default	Min.	Attri.
F1.15	Motor type	0: Others 1: Rexroth servo motor	1	-	Stop
F1.16	Motor power level	0: No selection 12: MS2N10-D0BHN 13: MS2N10-D0BHA/B 14: MS2N10-D0BNA/B 15: MS2N10-E0BHA/B 16: MS2N10-E0BNA/B 17: MS2N10-F0BHA/B 18: MS2N10-F1BHA/B 19: MS2N10-D0BNN 20: MS2N13-C1BHC 21: MS2N13-D1BHC 22: MS2N13-E1BHC 23: MS2N13-C1BNC 24: MS2N13-D1BNC 25: MS2N13-E1BNC 26: MS2N13-C1BNL 27: MS2N13-D1BNL 28: MS2N13-E1BNL	0	-	Stop

Tab. 8-1: Parameter list of group F1

8.3 Group F2: Input and output parameters

Code	Name	Setting range	Default	Min.	Attri.
F2.00	Analog input AI1	0: No function assigned from ASF	1	-	Stop
F2.01	Analog input AI2	1: Pressure command	2	-	Stop
F2.02	External analog input EAI1	2: Pressure feedback	3	-	Stop
F2.03	External analog input EAI2	3: Flow command 5: Slave flow command	5	-	Stop
F2.04	Pressure command corresponding to 5V, 10V or 20mA	0.1...1,000.0 bar	175.0	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 5V, 10V or 20mA	0.1...1,000.0 bar	250.0	0.1	Stop
F2.07	Pressure feedback null offset in V or mA	0.0...5.0 V, mA	0.1 V	0.1	Stop
F2.08	Flow command corresponding to 5V, 10V or 20mA	1...5,000 rpm	3,000	1	Stop
F2.09	Flow 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.
F2.10	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: Other 4-20mA pressure sensors 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 19: Other 0.1-10V pressure	15	-	Stop
F2.16	X1 input	0: No function 3: p/Q parameter group bit 0 4: p/Q parameter group bit 1 5: Master/slave mode switch (pQ/ Flow) 6: External warning with delay 7: External warning without delay 9: External error with delay 10: External error without delay	0 (RUN)	-	Run
F2.17	X2 input		0 (Error reset)	-	Run
F2.18	X3 input		3	-	Run
F2.19	X4 input		4	-	Run
F2.20	X5 input		5	-	Run
F2.21	EX1 input		0	-	Run
F2.22	EX2 input		0	-	Run
F2.23	EX3 input		0	-	Run
F2.24	EX4 input		0	-	Run
F2.25	EX5 input		0	-	Run

Code	Name	Setting range	Default	Min.	Attri.
F2.31	AO1 output	0: No function assigned from ASF	2	-	Run
F2.32	EAO output	1: Pressure command 2: Pressure feedback 3: Flow command 4: Effective speed command 5: Speed feedback	5	-	Run
F2.36	DO1 output	0: No function 1: Controller warning	1	-	Run
F2.37	EDO1 output	0: No function	0	-	Run
F2.38	EDO2 output	1: Controller warning	0	-	Run
F2.40	Relay 1 output	2: Two point/double pump control	0	-	Run

Tab. 8-2: Parameter list of group F2

8.4 Group F3: p/Q PID parameters

Code	Name	Setting range	Default	Min.	Attri.
F3.00	p/Q parameter selection source	0: Use digital value set in parameter F3.01 1: Digital input 2: Communication	0	-	Stop
F3.01	p/Q parameter digital selection	0: Parameter group 0 1: Parameter group 1 2: Parameter group 2 3: Parameter group 3	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	40	1	Run
F3.11	Filter time for pressure dropping [0]	0...999 ms	20	1	Run
F3.12	Proportional gain [0]	0.00...500.00 rpm/bar	6.00	0.01	Run
F3.13	Integral time 1 [0]	0...999 ms	30	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	Derivative gain [0]	0.000...10.000 (rpm/bar)*s	0.100	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	-1,500	1	Run
F3.21	SvP acceleration	1...65,535 rad / s^2	8,000	1	Run
F3.22	SvP deceleration	1...65,535 rad / s^2	12,000	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	6.00	0.01	Run
F3.33	Integral time 1 [1]	0...999 ms	30	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	Derivative gain [1]	0.000...10.000 (rpm/bar)*s	0.300	0.001	Run

Code	Name	Setting range	Default	Min.	Attri.
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	-1,500	1	Run
F3.50	Filter time for pressure rising [2]	0...999 ms	100	1	Run
F3.51	Filter time for pressure dropping [2]	0...999 ms	60	1	Run
F3.52	Proportional gain [2]	0.00...500.00 rpm/bar	6.00	1.00	Run
F3.53	Integral time 1 [2]	0...999 ms	30	1	Run
F3.54	Integral time 2 [2]	0...999 ms	0	1	Run
F3.55	Integral time TI switch threshold [2]	-150.0...0.0 bar	0.0	1.0	Run
F3.56	Derivative gain [2]	0.000...10.000 (rpm/bar)*s	0.100	1.000	Run
F3.57	Filter time for Kd [2]	0...999 ms	35	1	Run
F3.58	Lower limit for I+D [2]	-5,000...5,000 rpm	0	1	Run
F3.59	System minimum speed [2]	-5,000...5,000 rpm	-1,500	1	Run
F3.70	Filter time for pressure rising [3]	0...999 ms	120	1	Run
F3.71	Filter time for pressure dropping [3]	0...999 ms	80	1	Run
F3.72	Proportional gain [3]	0.00...500.00 rpm/bar	6.00	1.00	Run
F3.73	Integral time 1 [3]	0...999 ms	30	1	Run
F3.74	Integral time 2 [3]	0...999 ms	0	1	Run
F3.75	Integral time TI switch threshold [3]	-150.0...0.0 bar	0.0	1.0	Run
F3.76	Derivative gain [3]	0.000...10.000 (rpm/bar)*s	0.000	1.000	Run
F3.77	Filter time for Kd [3]	0...999 ms	35	1	Run
F3.78	Lower limit for I+D [3]	-5,000...5,000 rpm	0	1	Run
F3.79	System minimum speed [3]	-5,000...5,000 rpm	-1,500	1	Run

Tab. 8-3: Parameter list of group F3

8.5 Group F4: System protection and pump function parameters

Code	Name	Setting range	Default	Min.	Attri.
F4.00	Protection control word	Bit 0: Pressure sensor fault (PSF) Bit 1: Actual pressure monitoring Bit 2: p/Q maximum command limit Other bits: Reserved	0	-	Run
F4.03	Pump control word	Bit 0: Pump power limit Bit 2: Master/slave Bit 3: Two point/double pump Bit 6: Monitoring speed direction reverse Other bits: Reserved	0	-	Run
F4.06	Pressure sensor fault detection threshold 1 (negative direction)	-5,000...0 rpm	-1	1	Stop
F4.07	Pressure sensor fault detection time 1 (negative direction)	0.1...100.0 s	10.0	0.1	Stop
F4.08	Pressure sensor fault detection threshold 2 (positive direction)	0...5,000 rpm	200	1	Stop
F4.09	Pressure sensor fault detection time 2 (positive direction)	0.1...100.0 s	10.0	0.1	Stop
F4.15	Maximum system pressure (warning)	0.0...[F4.16] bar	200.0	0.1	Stop
F4.16	Maximum pump pressure (error)	[F4.15]...4,000.0 bar	350.0	0.1	Stop
F4.17	Maximum system pressure warning time delay	0.0...6000.0s	0.0	0.1	Run
F4.18	Maximum pump pressure error time delay	0.0...6000.0s	0.0	0.1	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	175.0	0.1	Stop
F4.23	Minimum flow command limit	0...[F4.24] rpm	40	1	Stop
F4.24	Maximum flow command limit	[F4.23]...5,000 rpm	3,000	1	Stop
F4.26	Leakage compensation determination pressure	0.0...1,000.0 bar	0.0	0.1	Run

Code	Name	Setting range	Default	Min.	Attri.
F4.27	Leakage compensation determination flow	0...3,000 rpm	0	1	Run
F4.28	Two point / double pump selection	0: Two point 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
F4.38	Effective pump Vg	-	0	-	Read
F4.39	Master/slave (pQ/Flow) switch source	0: Use digital value set in parameter 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	Slave pump flow mode switch delay	0...500 ms	100	1	Stop
F4.42	Slave flow command source	0: No 1: Analog input 2: Communication	1	-	Stop
F4.43	Slave flow command corresponding to 5V, 10V or 20mA	0 --- 5000 rpm	3,000	1	Stop
F4.44	Slave flow command null offset in V or mA	0.0 --- 5.0 V, mA	0.0	0.1	Stop
F4.45	Slave flow command linear offset in V	-0.10 --- 0.10V	0.00	0.01	Run
F4.47	Maximum torque limitation	200.0...400.0 %	200.0	0.1	Stop
F4.50	External warning / error delay time	0...1,000 s	60	1	Run

Tab. 8-4: Parameter list of group F4

8.6 Auto-modified EFC parameters in SvP initialization

Code	Name	Setting range	Default	Min.	Attri.
C0.00	Control mode (EFC 5610 only)	0: V/f control 1: Sensorless vector control 2: Vector control with encoder	2	-	Stop
C0.15	Brake chopper start voltage	3P 380 VAC: 600...785 V	720	1	Stop
C1.00	Motor type	0: Asynchronous motor 1: Synchronous motor (only for EFC 5610)	1	-	Stop
C3.44	Torque positive limit	0.0...200.0 %	200.0	0.1	Run
C3.45	Torque negative limit	0.0...200.0 %	200.0	0.1	Run
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	400.00	0.01	Stop
E0.09	Output frequency high limit	[E0.10]...[E0.08] Hz	400.00	-	Run
E0.17	Direction control	0: Forward / reverse 1: Forward only 2: Reverse only 3: Swap default direction	3	-	Stop
E1.00	X1 input	0...51	35	-	Stop
E1.01	X2 input	0...51	34	-	Stop
E1.40	AI2 input mode	0: 0...20 mA 1: 4...20 mA 2: 0...10 V 3: 0...5 V 4: 2...10 V	2	-	Run
E1.60	Motor temperature sensor channel	0: Inactive 1: AI1 analog input 2: AI2 analog input 3: EAI1 analog input 4: EAI2 analog input 5: TSI input (only for IO plus card)	5	-	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

Code	Name	Setting range	Default	Min.	Attri.
H8.05	EAI1 input mode	0: 0...20 mA 1: 4...20 mA 2: 0...10 V 3: 0...5 V 4: 2...10 V 5: -10...10 V	2	-	Stop
H8.25	EAO output mode	0: 0...10 V 1: 0...20 mA 2: -10...10 V (only for IO plus card)	0	-	Run
H8.30	EAI2 input mode	0...4 (same as E1.35) 5: -10V...10V	0	-	Stop
H8.39	EAO curve minimum	-100.0 %...[H8.41]	0.0	0.1	Run
H8.40	EAO curve minimum value	-100.0...100.0 %	0.00	0.01	Run
U1.00	Run monitoring display	0: Output frequency	1	-	Run
U1.10	Stop monitoring display	1: Actual speed 2: Setting frequency 3: Setting speed	3	-	Run

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

8.7 Monitoring parameters

Name	Description	Displaying range
d0.80	ASF status word*	0x0000...0xFFFF
d0.81	Pressure command	0...10000 (0.0...1,000.0 bar)
d0.82	Pressure feedback	0...10000 (0.0...1,000.0 bar)
d0.83	Flow command	-5,000...5,000 (-5,000...5,000 rpm)
d0.84	Effective speed command	-5,000...5,000 (-5,000...5,000 rpm)
d0.85	Speed feedback	-5,000...5,000 (-5,000...5,000 rpm)
d0.86	Slave flow command	-5,000...5,000 (-5,000...5,000 rpm)
d0.88	Warning type	0: No warning 1: Pressure feedback exceeds limit 2: Pressure command exceeds limit 3: Flow command exceeds limit 4: External warning with delay 5: External warning without delay 10: Pump power limitation warning 15: Wrong direction selection from fieldbus
d0.89	Error type	0: No error 1: Pressure exceeds pump limit 2: Pressure sensor error 3: Host parameter access error 4: External error with delay 5: External error without delay

Tab. 8-6: Monitoring parameter

* For detailed information of d0.80 ASF status word, please refer to tab. 9-3 "ASF status word d0.80 definition" on page 61.

9 Fieldbus communication

9.1 Brief introduction

The SvP 5020 pump controller provides the possibility to communicate with an overlying plc via different fieldbus systems. Via this communication, the pump controller can receive control words and command values. On the other side, the controller can transmit status words and actual values. The controller can be equipped with different communication option cards.

Two option cards are available:

- A Profibus option for PROFIBUS DP
- A Multi-Ethernet card for the Ethernet-based fieldbus systems.
  - PROFINET I/O
  - EtherCAT CoE
  - Ethernet / IP
  - Sercos

- Cycle time for command and status value exchanging is 2ms.
- Bus communication and internal ASF data communication are not synchronized.
- If the reverse bit is set through the control word, then the speed will be limited to 0rpm and the converter will alarm APF1 at this time. (warning code = 15).

9.2 Command values MDT

Command values are written on the parameters F0.20.....F0.22.

Code	Name	Description	Setting range
F0.20	ASF command 1	ASF control word	0...65,535
F0.21	ASF command 2	Pressure command	0...10,000 (0.0...1000.0 bar)
F0.22	ASF command 3	Flow command	0...5,000 (0...5,000 rpm)

Tab. 9-1: Communication protocol

The ASF control word has the following bit assignment.

Bit	Description	Setting range
0, 1	Reserved	-
2	Master / slave selection	0: Master 1: Slave

Bit	Description	Setting range
3, 4	p/Q parameter group selection	0: Select Parameter group 0 1: Select Parameter group 1 2: Select Parameter group 2 3: Select Parameter group 3
5...14	Reserved	-
15	ASF control word enable	0: Inactive 1: Active

Tab. 9-2: ASF control word F0.20 definition

To activate the ASF control word it is recommended to keep bit 15 enabled permanently.

9.3 Actual values AT

There is a big variety of actual values available in the SvP 5020 pump controller. It is possible to configure the AT telegram. Every d-parameter can be sent back to the plc.

More information about the available d-parameters can be found in EFC5610 operating instructions: R912005854.

The ASF status word has the following bit assignment.

Bit	Description	Setting range
0, 1	ASF control mode	0: P/Q Others: Reserved
2	Master / slave status	0: Master 1: Slave
3	Reserved	-
4	Leakage compensation function status	0: Function disabled 1: Function enabled
5	Pump power limitation function status	0: Function disabled 1: Function enabled
6, 7	p/Q parameter group selection	0: Parameter set 0 selected 1: Parameter set 1 selected 2: Parameter set 2 selected 3: Parameter set 3 selected
8	Reserved	-

Bit	Description	Setting range
9	Two point / double pump function status	0: Function disabled 1: Function enabled
10	Two point / double pump control status	0: Vg_{max} 1: Vg_{min}
11	Speed command direction	0: Forward 1: Reverse
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. 9-3: ASF status word d0.80 definition

Hydraulic specific monitoring parameters are listed in the following table.

Code	Description	Unit
H0.01	Status word standard firmware	-
H0.02	Extended status word	-
d0.80	ASF status word	-
d0.82	Pressure feedback	bar
d0.85	Speed feedback	rpm
d0.88	Warning type	-
d0.89	Error type	-

This configuration of the cyclic data is a suggestion and can be adjusted by the user. A list of parameters which can be configured in the AT telegram is shown in parameter b8.62.

9.4 Profibus DP

GSD file for the pump controller can be downloaded here.

To configure the Profibus configuration on the drive side the following parameters can be set.

Code	Name	Description
H1.10	Output PZD 1	1: Control word: H0.00
H1.11	Output PZD 2	4: ASF command 1: ASF control word
H1.12	Output PZD 3	5: ASF command 2: Pressure command

Code	Name	Description
H1.13	Output PZD 4	6: ASF command 3: Flow command
H1.30	Input PZD 1	1: Status word: H0.01
H1.31	Input PZD 2	2: Extended status word: H0.02
H1.32	Input PZD 3	180: ASF status word: d0.80
H1.33	Input PZD 4	182: actual pressure: d0.82
H1.34	Input PZD 5	185: actual speed: d0.85
H1.35	Input PZD 6	188: warnings: d0.88
H1.36	Input PZD 7	189: errors: d0.89

As PPO type it is recommended a type with 10PZDs (PPO5 or PPO10). That is the only way to read the maximum actual values from the plc side.

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 exceeding [F4.15] 2. Pressure sensor fault	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: External warning with delay	-	Check external alarm source
		5: External warning without delay	-	Check external alarm source
		10: Pump power limitation warning	Required pump power exceeds limitation set in F4.35	Adjust limitation or system load
		15: Wrong direction selection from fieldbus	Reverse command through communication	Given forward command through communication

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 sensor can work properly. Increase the setting of F4.06, F4.07, F4.08 and F4.09 2. Check if pressure sensor can work properly.
		3: Parameter setting error	Parameter setting repetition	Check if parameter settings are in conflict
		4: External error with delay	-	Check external error source
		5: External error without delay	-	Check external error source

Tab. 10-2: Error code

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Notes

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