SIEMENS

SIPART

Electropneumatic positioners SIPART PS2/SIPART PS2 BT

Operating Instructions

Introduction	1
Safety information	2
Description	3
Installing/mounting	4
Connection	5
Operating	6
Commissioning	7
Parameter assignment	8
Functional safety	9
Service and maintenance	10
Diagnostics and troubleshooting	11
Technical specifications	12
Dimension drawings	13
Product documentation and support	A
Bluetooth	B
External position detection	C
Internal NCS module (iNCS)	D
Pressure gauge blocks	E
Sealing plug / thread adapter	F
Booster	G
Positioner with remote electronics	H
Abbreviations	I

6DR50..(4...20 mA)
6DR51..(4...20 mA, HART)
6DR52..(4...20 mA, HART, 3/4-wire)
6DR53..(4...20 mA, HART, 3/4-wire)
6DR59..(With remote electronics)

05/2024
A5E00074631-AH

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

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Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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GERMANY

Document order number: A5E00074631
Ⓟ 06/2024 Subject to change

Table of contents

1 Introduction ... 11

1.1 Purpose of this documentation ... 11

1.2 User documentation ... 11

1.3 Scope of documentation ... 11

1.4 Document history PS2 with and without HART ... 13

1.5 Product compatibility ... 16

1.6 Designated use ... 16

1.7 Checking the consignment ... 16

1.8 Cybersecurity information ... 17

1.9 Transportation and storage ... 18

1.10 Notes on warranty ... 18

2 Safety information ... 19

2.1 Precondition for use ... 19

2.2 Warning symbols on the device ... 19

2.3 Laws and directives ... 19

2.4 Conformity with European directives ... 20

2.5 Conformity with UK regulations ... 20

2.6 Product approval and UL compliance ... 20

2.7 Improper device modifications ... 21

2.8 Improper modification on positioner 6DR5...6 ... 21

2.9 Requirements for special applications ... 21

2.10 Use in hazardous areas ... 22

3 Description ... 23

3.1 Structure ... 23
3.1.1 Overview of structure ... 23
3.1.2 Manufacturer nameplate ... 26
3.1.3 Explanation of Ex information ... 26

3.2 Device components ... 27
3.2.1 Overview of device components (without Ex) ... 27
3.2.2 Overview of device components (Ex d) ... 28

3.3 Mode of operation ... 28
3.3.1 Pneumatic actuator ... 28
3.3.2 Mode of operation of the HART function ... 29
3.3.3 HART system configuration ... 29

3.3.4 SIMATIC PDM 30

4 Installing/mounting 31

4.1 Basic safety instructions 31
4.1.1 Proper mounting........ 33
4.2 Mounting to linear actuator 34
4.3 Mounting to part-turn actuator 41
4.4 Installing option modules 46
4.4.1 Basic safety instructions 46
4.4.2 Opening the positioner 47
4.4.3 Digital I/O Module (DIO) 6DR4004-6A / -8A........ 50
4.4.4 Analog Output Module (AOM) 6DR4004-6J / -8J 52
4.4.5 Inductive limit switches (ILS) and mechanic limit switches (MLS) 53
4.4.5.1 Inductive Limit Switches (ILS) - Mode of operation and equipment features 53
4.4.5.2 Mechanic Limit Switches (MLS) - Mode of operation and equipment features........ 54
4.4.5.3 Installing Inductive Limit Switches (ILS) and Mechanic Limit Switches (MLS) 55
4.4.5.4 Setting limits for Inductive Limit Switches (ILS)........ 63
4.4.5.5 Setting limits for Mechanic Limit Switches (MLS) 65
4.4.6 Analog Input Module (AIM) 6DR4004-6F / -8F........ 66
4.4.7 Closing the positioner 70
4.5 Setting and locking the transmission ratio 74

5 Connection........ 77

5.1 Basic safety instructions 77
5.2 Electrical wiring 81
5.2.1 Electronics........ 81
5.2.2 HART: Split range 83
5.2.3 Option modules........ 84
5.2.3.1 Digital I/O Module (DIO) 6DR4004-6A / -8A........ 84
5.2.3.2 Analog Output Module (AOM) 6DR4004-6J / -8J 84
5.2.3.3 Inductive Limit Switches (ILS) 6DR4004-6G / -8G 85
5.2.3.4 Mechanic Limit Switches (MLS) 6DR4004-6K........ 85
5.2.3.5 Analog Input Module (AIM) 6DR4004-6F / -8F........ 86
5.2.4 Optional version M12 device plug 87
5.2.4.1 M12 connector in basic device with and without HART 87
5.2.4.2 M12 Connector in Basic Device with Analog Output Module (AOM) 6DR4004-6J / -8J (-Z D53)........ 87
5.2.4.3 In the basic unit with Position Transmitter (-Z D54)........ 88
5.2.4.4 In the basic unit with Digital I/O Module (DIO) 6DR4004-6A / -8A (-Z D55) 88
5.2.4.5 In the basic unit with Inductive Limit Switches (ILS) 6DR4004-6G /-8G (-Z D56)........ 88
5.2.4.6 In the basic unit with Mechanic Limit Switches (MLS) 6DR4004-6K (-Z D57)........ 89
5.3 Pneumatic connection 89
5.3.1 Basic safety instructions for the pneumatic connection 89
5.3.2 Pneumatic connection in non-flameproof enclosure 90
5.3.2.1 Structure of pneumatic connection 90
5.3.2.2 Integrated pneumatic connection........ 90
5.3.3 Pneumatic connection in the flameproof enclosure 92
5.3.4 Behavior in case of failure of the electrical auxiliary power and/or the supply pressure PZ..... 92
5.4 Restrictors........ 94

6 Operating ... 95

6.1 Operating elements ... 95
6.1.1 Display ... 95
6.1.2 Buttons ... 96
6.1.3 Firmware version ... 97

6.2 Operating modes ... 98
6.2.1 Overview of operating modes ... 98
6.2.2 Changing the operating mode ... 99
6.2.3 Overview of configuration ... 100
6.2.4 Description of operating modes ... 100
6.2.5 Optimization of controller data ... 102

7 Commissioning ... 107

7.1 Basic safety instructions ... 107

7.2 Overview ... 109

7.3 Sequence of automatic initialization ... 110
7.3.1 Sequence of automatic initialization ... 110
7.3.2 Determining the actuator type ... 111
7.3.3 Starting automatic initialization ... 112
7.3.4 RUN 1: Determination of direction of action ... 112
7.3.5 RUN 2: Determination of travel ... 112
7.3.6 RUN 3: Determination and display of travel time (leakage test) ... 113
7.3.7 RUN 4: Minimization of positioning increments ... 113
7.3.8 RUN 5: Optimization of transient response ... 114
7.3.9 RUN 6: Inclusion of Valve Signature ... 114
7.3.10 End ... 114

7.4 Manual adjustment of the pressure sensors ... 114

7.5 Purge air switching ... 115

7.6 Setting the friction clutch ... 115

7.7 Commissioning linear actuators ... 117
7.7.1 With internal wear-free, non-contacting position detection ... 117
7.7.1.1 Preparing linear actuators for commissioning ... 117
7.7.1.2 Automatic initialization of linear actuators ... 117
7.7.1.3 Manual initialization of linear actuators ... 119
7.7.2 With potentiometer, friction clutch and gearbox: ... 121
7.7.2.1 Preparing linear actuators for commissioning ... 121
7.7.2.2 Automatic initialization of linear actuators ... 122
7.7.2.3 Manual initialization of linear actuators ... 124

7.8 Commissioning part-turn actuators ... 127
7.8.1 With internal wear-free, non-contacting position detection ... 127
7.8.1.1 Preparing part-turn actuators for commissioning ... 127
7.8.1.2 Automatic initialization of part-turn actuators ... 127
7.8.1.3 Manual initialization of part-turn actuators ... 129
7.8.2 With potentiometer, friction clutch and gearbox: ... 131
7.8.2.1 Preparing part-turn actuators for commissioning ... 131
7.8.2.2 Automatic initialization of part-turn actuators ... 132
7.8.2.3 Manual initialization of part-turn actuators ... 133

7.9 Canceling initialization ... 136
7.10 Replacing the positioner during operation ... 136
7.10.1 Introduction ... 136
7.10.2 Replacing the positioner with communication ... 138
7.10.3 Replacing the positioner without communication ... 143
8 Parameter assignment ... 145
8.1 Overview of parameters ... 145
8.2 Configuration schematic for parameter operating principle ... 148
8.3 Overview of parameters 1 to 52 (HART) ... 149
8.4 Description of parameters ... 152
8.4.1 Initialization parameters 1 to 5 ... 152
8.4.1.1 '1.YFCT' type of actuator ... 152
8.4.1.2 '2.YAGL' Rated angle of rotation of feedback ... 154
8.4.1.3 '3.YWAY' Range of stroke ... 154
8.4.1.4 '4.INITA' Initialization (automatic) ... 155
8.4.1.5 '5.INITM' Initialization (manual) ... 156
8.4.2 Application parameters 6 to 52 ... 156
8.4.2.1 '6.SCUR' Current range of setpoint ... 156
8.4.2.2 '7.SDIR' Setpoint direction ... 157
8.4.2.3 '8.SPRA' Setpoint split range start / '9.SPRE' Setpoint split range start end ... 157
8.4.2.4 '10.TSUP' Setpoint ramp UP / '11.TSDO' Setpoint ramp DOWN ... 158
8.4.2.5 '12.SFCT' Setpoint function ... 159
8.4.2.6 '13.SL0' ... '33.SL20' Setpoint turning point ... 159
8.4.2.7 '34.DEBA' Deadband of closed-loop controller ... 160
8.4.2.8 '35.YA' Start of manipulated variable limit / '36.YE' End of manipulated variable limit ... 161
8.4.2.9 '37.YNRM' Standardization of manipulated variable ... 161
8.4.2.10 '38.YDIR' Direction of manipulated variable for display and position feedback ... 163
8.4.2.11 '39.YCLS' Tight closing/fast closing with manipulated variable ... 163
8.4.2.12 '40.YCDO' Value for tight closing/fast closing Down ... 164
8.4.2.13 '41.YCUP' Value for tight closing/fast closing Up ... 164
8.4.2.14 '42.DI1' / '43.DI2' Function digital input ... 165
8.4.2.15 '44.AFCT' Alarm function ... 166
8.4.2.16 '45.A1' / '46.A2' Response threshold of alarm ... 168
8.4.2.17 '47.\\FCT' Function of the fault message output ... 168
8.4.2.18 '48.\\TIM' Monitoring period for setting of fault message 'Control deviation' ... 169
8.4.2.19 '49.\\LIM' Response threshold of fault message 'Control deviation' ... 169
8.4.2.20 '50.PRST' Preset (HART/FF) ... 170
8.4.2.21 '51.PNEUM' Pneumatics type ... 170
8.4.2.22 '52.XDIAG' Activating for extended diagnostics ... 171
8.5 Diagnostic values ... 174
8.5.1 Displaying diagnostic values ... 174
8.5.2 Diagnostic values overview ... 175
8.5.3 Diagnostic values for commissioning and initialization ... 177
8.5.3.1 Diagnostic value "Manipulated variable lower endstop (0% position)" (21.P0) ... 177
8.5.3.2 Diagnostic value "Manipulated variable upper endstop (100% position)" (22.P100) ... 179
8.5.3.3 Diagnostic values "Pulse length UP" (23.IMPUP) / "Pulse length DOWN" (24.IMPDN) ... 181
8.5.3.4 Diagnostic value "Pulse interval" (25.PAUTP) ... 182
8.5.3.5 Diagnostic values "Slow step zone UP" (28.SSUP) / "Slow step zone up DOWN" (29.SSDN) ... 182

8.5.3.6 Diagnostic values "Prediction UP" (47.PRUP) / "Prediction DOWN" (48.PRDN) 183
8.5.3.7 Diagnostic value "Procedure for adjustment of electronics" (73.RPL_E) 185
8.5.3.8 Diagnostic value "Position adjustment" (74.TRIM) 186

8.6 Overview of the assignment of the HART variables 187

9 Functional safety 189

9.1 Range of applications for functional safety 189

9.2 Safety function 189

9.3 Type A - Safety Integrity Level (SIL) 192

9.4 Settings 193

9.5 Safety characteristics 194

9.6 Maintenance/check 195

10 Service and maintenance 197

10.1 Basic safety instructions 197
10.1.1 Maintenance.. 197

10.2 Cleaning 198
10.2.1 Positioners 6DR5..0, 6DR5..3 and 6DR5..5 198
10.2.2 Positioners 6DR5..1, 6DR5..2 and 6DR5..6 199

10.3 Maintenance and repair work 199

10.4 Replacing electronics 201

10.5 Replacing the pneumatic block... 202

10.6 Replace the pressure sensor module 204

10.7 Return procedure 206

10.8 Disposal.. 207

11 Diagnostics and troubleshooting.. 209

11.1 Display messages with error code 209

11.2 Display messages 220

11.3 Troubleshooting.. 225

12 Technical specifications 227

12.1 HART operating conditions.. 227

12.2 Pneumatic data for all device versions 228

12.3 Construction for all device versions 229

12.4 Controller for all device versions.. 231

12.5 Explosion protection SIPART PS2.. 231

12.6 Electrical data (HART)... 231

12.7 Electrical data for pressure sensor module 233

12.8 Communication (HART) 233

12.9 Technical data for natural gas as actuator medium.. 234

12.10 Option modules ... 235
12.10.1 Digital I/O Module (DIO) 6DR4004-6A / -8A ... 235
12.10.2 Analog Output Module (AOM) 6DR4004-6J / -8J ... 236
12.10.3 Inductive Limit Switches (ILS) 6DR4004-6G / -8G ... 237
12.10.4 Mechanic Limit Switches (MLS) 6DR4004-6K ... 238
12.10.5 Analog Input Module (AIM) 6DR4004-6F / -8F ... 239
12.10.6 Internal NCS module 6DR4004-5L / 6DR4004-5LE ... 240
12.10.7 Other technical specifications ... 240

13 Dimension drawings ... 241

13.1 Positioner in non-flameproof enclosure ... 241
13.2 Terminal strip for positioners ... 242
13.3 Positioner in flameproof enclosure ... 243

A Product documentation and support ... 245

A.1 Technical support ... 245
A.2 Product documentation ... 246

B Bluetooth ... 247

B.1 Connecting SIPART PS2 BT ... 247
B.1.1 Procedure ... 248
B.2 Connecting field device with SITRANS mobile IQ App ... 252
B.3 Default password ... 253
B.4 Reset Password ... 253
B.5 Security information ... 253
B.6 Access management ... 253
B.7 Information for radio approvals ... 255
B.8 Technical specifications SITRANS AW050 ... 257
B.9 Dimension drawing of SITRANS AW050 Bluetooth adapter ... 257

C External position detection ... 259

C.1 Introduction ... 259
C.2 Non-Contacting Sensor ... 259
C.2.1 Mode of operation ... 259
C.2.2 Mounting the NCS ... 260
C.2.2.1 Mounting the NCS to the part-turn actuator ... 261
C.2.2.2 Mounting the NCS to a linear actuator up to 14 mm (0.55 inch) ... 263
C.2.2.3 Mounting the NCS to a linear actuator > 14 mm (0.55 inch) ... 265
C.2.3 Connecting NCS to Analog Input Module (AIM) ... 268
C.2.4 Commissioning of NCS ... 269
C.2.4.1 Prerequisites / default settings ... 269
C.2.4.2 Initialization of part-turn actuators ... 270
C.2.4.3 Initializing linear actuators with a stroke range up to 14 mm (0.55 inch) ... 270
C.2.4.4 Initializing linear actuators with a stroke range > 14 mm (0.55 inch) ... 270
C.2.5 External NCS sensors 6DR4004-6N/8N and 6DR4004-2ES ... 271
C.2.6 Dimensional drawing of non-contacting sensor ... 272

C.2.7 NCS sensor scope of delivery 273
C.2.7.1 Scope of delivery of NCS for part-turn actuators 273
C.2.7.2 Scope of delivery of NCS for linear actuators up to 14 mm (0.55 inch) 273
C.2.7.3 Scope of delivery of NCS for linear actuators > 14 mm (0.55 inch) 274

C.3 External position detection 275
C.3.1 Mode of operation for external position detection 275
C.3.2 Installation of external position detection system 276
C.3.3 Connecting to Analog Input Module (AIM) 276
C.3.4 Technical specifications of the external position detection system 277
C.3.4.1 Rated conditions for external position detection 277
C.3.4.2 Electrical data for external position detection 277

D Internal NCS module (iNCS) 281

D.1 Internal NCS module (iNCS) 6DR4004-5L / -5LE 281

E Pressure gauge blocks 285

E.1 Pressure gauge block 285

E.2 Venting gauge block 286

E.3 Dimension drawing of pressure gauge blocks 287

F Sealing plug / thread adapter 289

F.1 Purpose 289

F.2 Safety instructions 289

F.3 Technical specifications 290

F.4 Dimension drawings 291

G Booster 293

G.1 Booster introduction 293

G.2 Mounting a booster 293

G.3 Booster commissioning 298

G.4 RUN 3: Determination and display of travel time (leakage test) 299

G.5 Booster dimension drawings 300
G.5.1 For positioners in non-flameproof enclosure 300
G.5.2 For positioners in flameproof enclosure 301

G.6 Technical specifications of booster 302

H Positioner with remote electronics 303

H.1 Introduction to remote electronics 303

H.2 19-inch control unit 303
H.2.1 Description of 19-inch control unit 4 to 20 mA 303
H.2.2 Connecting the 19-inch control unit 4 to 20 mA 304
H.2.2.1 Grounding concept for 19-inch control unit 4 to 20 mA 304
H.2.2.2 Electrical connection of 19" slide-in module 4 to 20 mA 307
H.2.3 Technical specifications for 19-inch control unit 4 to 20 mA 310
H.2.4 Cable specification 311
H.2.5 Dimension drawing for 19-inch control unit 4 to 20 mA 311

H.3 Positioner without electronics 6DR5910 312
I Abbreviations 313
I.1 Abbreviations for PS2 positioners 313
I.2 Abbreviations 314
Index 317

1 Introduction

1.1 Purpose of this documentation

These instructions contain all information required to commission and use the device. Read the instructions carefully prior to installation and commissioning. In order to use the device correctly, first review its principle of operation.

The instructions are aimed at persons mechanically installing the device, connecting it electronically, configuring the parameters and commissioning it, as well as service and maintenance engineers.

1.2 User documentation

The user documentation for this product consists of the following documents:

Document	Availability
Operating Instructions	• Available for download on the Internet.
Compact Operating Instructions, Explosion Protection	
Diagnostics Manual	
Getting Started (leaflet)	• Enclosed with the product. • Available for download on the Internet.

See also

SIPART PS2 product information (http://www.siemens.com/sipartps2)

Manuals (http://www.siemens.com/processinstrumentation/documentation)

Product documentation and support (Page 245)

1.3 Scope of documentation

Article no.	Product
6DR50..	SIPART PS2, 2-wire (4 to 20 mA), without HART
6DR51..	SIPART PS2, 2-wire (4 mA to 20 mA), with HART
6DR52..	SIPART PS2, 2-,3-,4-wire (4 mA to 20 mA), with HART
6DR53..	SIPART PS2, 2-,3-,4-wire (4 mA to 20 mA), without HART
6DR5910-*	SIPART PS2 without basic electronics with Position Transmitter and pneumatics unit
6DR5...-Z D53	M12 device plug (D coding) for Analog Output Module (AOM)

Article no.	Product
6DR5...-Z D54	M12 device plug (D coding) for External Position Transmitter
6DR5...-Z D55	M12 device plug (D coding) for Digital I/O Module (DIO)
6DR5...-Z D53	M12 device plug (D coding) for Inductive Limit Switches (ILS)
6DR5...-Z D53	M12 device plug (D coding) for Mechanic Limit Switches (MLS)
6DR5...-Z F01	Fail in place
6DR5...-Z P01	Pressure sensor module with 1 sensor
6DR5...-Z P02	Pressure sensor module with 2 or 3 sensors
A5E00151560	19-inch control unit 4 mA to 20 mA with 2-wire connection
6DR4004-6A / -8A	Digital I/O Module (DIO)
6DR4004-6F / -8F	Analog Input Module (AIM)
6DR4004-6J / -8J	Analog Output Module (AOM)
6DR4004-6G / -8G	Inductive Limit Switches (ILS)
6DR4004-6K	Mechanic Limit Switches (MLS)
6DR4004-5L / -5LE	Internal NCS module
6DR4004-6N* / -8N*	Non-contacting sensor
6DR4004-1ES ... -4ES	Position Transmitter
6DR4004-1R / -2R / -1RN / -2RN	Pneumatic terminal strip
6DR4004-8D and TGX:16300-1556	Installation for NAMUR part-turn actuators
6DR4004-8V / -8L / -8VK / -8VL	Mounting kit for NAMUR linear actuator
6DR4004-1RJ/K/P/Q and 6DR4004-2RJ/K/P/Q	Booster

1.4 Document history PS2 with and without HART

The table shows the most important changes in the documentation compared to the previous edition.

Edition	Note
05/2024	• New firmware version 5.05.00 • Sections "Installing/mounting" and "Commissioning" updated: – New instructions for positioners with non-contacting position detection • Section "Parameter assignment": – Content contained in the Diagnostics Manual was removed. Example: The description of the "Extended diagnostic parameters" and their diagnostic functions has been included and supplemented in the "Process diagnostics" section of the Diagnostics Manual. • Section "Diagnostics and troubleshooting": – Content contained in the Diagnostics Manual that was removed. Example: The description of the "Diagnostic values" has been added to the "Diagnostic values" section in the Diagnostics Manual. Exception: Diagnostic values required for initialization and commissioning are still included in the operating instructions. – System messages and error codes from several sub-sections have been summarized. • "Technical specifications" section updated. • New: "Bluetooth" section
11/2022	• New firmware version 5.04.00 • Section "Diagnostics and troubleshooting": – New diagnostic values 73.RPL_E and 74.TRIM – New error codes 23 and 24 • Section "Commissioning" – Replacing the positioner during operation • "Technical specifications" section updated • Appendix Installing ILS and MLS (for 6DR50.5/6DR51.5/6DR50.6 and 6DR51.6)

Edition	Note
10/2020	• New firmware version 5.03.00 • All information regarding the new pressure sensors • Section "Connection": Connection of signal source to terminal 7. • Section "Commissioning": – New "RUN 6" for Valve Signature (VS) – Option -Z P02 pressure sensor modules – Manual adjustment of the pressure sensors • Section "Parameter assignment": – New pressure monitoring U.\\PRES – Additional physical variables for HART variables SV, TV and QV • Section "Service and maintenance": Replace pressure sensor module • Section "Diagnostics and troubleshooting": – New "RUN 6" – New or changed diagnostic values for parameters 60.PZ to 72.LMDY2 and associated error codes. – Section "Fault and remedy" expanded to include the fault profile for the pressure sensor module.

Edition	Note
11/2019	• New: Scope of documentation • In the entire operating instructions: Option modules renamed • In the entire operating instructions: Binary output renamed to digital output; binary input renamed to digital input • Section "Installing/mounting" – Change in figure for option module "Analog Output Module (AOM) 6DR4004-6J / -8J" – Text change for option module "Analog Input Module (AIM) 6DR4004-6F / -8F" • Section "Connection" – Change in figure for option module "Analog Input Module (AIM) 6DR4004-6F / -8F" – Terminology change: "Plug M12" renamed to "Device plug M12"; "Outputs" and "Alarm outputs" renamed to "Digital outputs A1 and A2"; Pneumatic connection: "Pneumatic auxiliary power" renamed to "Supply pressure PZ" – Terminological and textual revision of "Behavior in case of failure of the electrical auxiliary power and/or the supply pressure PZ" • Section "Commissioning" – Change to the procedure in the flameproof enclosure Ex d for "Setting the friction clutch" – Note on commissioning of a tight closing valve in "Automatic initialization of linear actuators" and "Automatic initialization of part-turn actuators" • Section "Alarm, error and system messages" is now called "Diagnostics and troubleshooting" – Format change in section "Fault and remedy", tables were combined into one table. • Section "Technical data" – Section "Explosion protection" is now called "Certificates and approvals"; entire section has been revised terminologically; table header for "Basic unit and optional modules" has been changed. – Section "Electrical data for pressure sensor module" completely revised
	• Section "Spare parts/accessories/scope of delivery": Replacement part "2-wire, Ex, with HART" added • Section "External position detection": 6DR4004-1ES to -4ES added, terminology adapted, C73451-A430-D78 no longer exists and was removed. • Section "Booster": Texts revised, procedures for standard device and Ex d device combined.

1.5 Product compatibility

The following table describes the compatibility between document output, device revision, engineering system and associated Electronic Device Description (EDD).

Manual edition, note	Firmware (FW)	Device revision	Electronic Device Description (EDD)	Device Manager software, compatible version
05/2024: New device features	5.05.00	8	25.00.00	SITRANS Mobile IQ Version 4.02 (Bluetooth)
				SITRANS DTM Version 4.x
				SITRANS Mobile IQ Version 4.02 (Bluetooth)
11/2022: New device features	5.04.00	8	25.00.00	SIMATIC PDM V9.1
				SIMATIC PDM V8.2 SP1
				SITRANS DTM V4.1
10/2020: New device features	5.03.00	8	25.00.00	SIMATIC PDM V9.1
				SIMATIC PDM V8.2 SP1
				SITRANS DTM V4.1
11/2019: New manual edition	5.02.00	7	24.00.00	SIMATIC PDM V9.0
				SIMATIC PDM V8.2 SP1
				SITRANS DTM V4.1

1.6 Designated use

Use the device in accordance with the information on the nameplate and in the Technical specifications (Page 227).

1.7 Checking the consignment

1. Check the packaging and the delivered items for visible damages.
2. Report any claims for damages immediately to the shipping company.
3. Retain damaged parts for clarification.
4. Check the scope of delivery by comparing your order to the shipping documents for correctness and completeness.

WARNING

Using a damaged or incomplete device

Risk of explosion in hazardous areas.

- Do not use damaged or incomplete devices.

1.8 Cybersecurity information

Siemens provides products and solutions with industrial cybersecurity functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial cybersecurity concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial cybersecurity measures that may be implemented, please visit
https://www.siemens.com/global/en/products/automation/topic-areas/industrial-cybersecurity.html.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Cybersecurity RSS Feed under
https://new.siemens.com/global/en/products/services/cert.html.

NOTICE
Unauthorized product information or software Use only authorized Siemens websites when accessing any product information or software, including firmware updates, device integration files (EDD, for example), as well as other product documentation. Using unauthorized product information or software could result in a security incident, such as breach of confidentiality, or loss of integrity and availability of the system. For more information, see Product documentation and support (Page 245).

1.9 Transportation and storage

To guarantee sufficient protection during transport and storage, observe the following:

- Keep the original packaging for subsequent transportation.
- Devices/replacement parts should be returned in their original packaging.
- If the original packaging is no longer available, ensure that all shipments are properly packaged to provide sufficient protection during transport. Siemens cannot assume liability for any costs associated with transportation damages.

NOTICE
Insufficient protection during storage The packaging only provides limited protection against moisture and infiltration. • Provide additional packaging as necessary.

Special conditions for storage and transportation of the device are listed in Technical specifications (Page 227).

1.10 Notes on warranty

The contents of this manual shall not become part of or modify any prior or existing agreement, commitment or legal relationship. The sales contract contains all obligations on the part of Siemens as well as the complete and solely applicable warranty conditions. Any statements regarding device versions described in the manual do not create new warranties or modify the existing warranty.

The content reflects the technical status at the time of publishing. Siemens reserves the right to make technical changes in the course of further development.

2 Safety information

2.1 Precondition for use

This device left the factory in good working condition. In order to maintain this status and to ensure safe operation of the device, observe these instructions and all the specifications relevant to safety.

Observe the information and symbols on the device. Do not remove any information or symbols from the device. Always keep the information and symbols in a completely legible state.

2.2 Warning symbols on the device

Symbol	Explanation
	Consult operating instructions

2.3 Laws and directives

Observe the safety rules, provisions and laws applicable in your country during connection, assembly and operation. These include, for example:

- National Electrical Code (NEC - NFPA 70) (USA)
- Canadian Electrical Code (CEC Part I) (Canada)

Further provisions for hazardous area applications are for example:

- IEC 60079-14 (international)
- EN 60079-14 (EU and UK)

See also

Certificates (http://www.siemens.com/processinstrumentation/certificates)

2.4 Conformity with European directives

The CE marking on the device shows conformity with the regulations of the following European guidelines:

Electromagnetic compatibility EMC 2014/30/EU	Directive of the European Parliament and of the Council on the harmonization of the laws of the Member States relating to electromagnetic compatibility.
Atmosphère explosible ATEX 2014/34/EU	Directive of the European Parliament and of the Council on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres.
2011/65/EU RoHS	Directive of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment

The directives applied can be found in the EU declaration of conformity for the associated device.

2.5 Conformity with UK regulations

Conformity with UK regulations

The product described in this document is in conformity with the relevant harmonization legislation, and its amendments, of the United Kingdom. The applicable regulations can be found in the UKCA declaration of conformity of the specific device.

2.6 Product approval and UL compliance

Classification according to pressure equipment directive (PED 2014/68/EU)	For fluid group 1 gases; fulfills requirements according to article 4, paragraph 3 (good engineering practice SEP)
EU conformity	The applicable directives and applied standards can be found in the EU declaration of conformity on the Internet.
UL conformity	Conformity has been proven based on US and Canadian safety requirements. For applicable safety requirements, refer to the UL CERTIFICATE OF COMPLIANCE on the Internet at: Certificates (http://www.siemens.com/processinstrumentation/certificates)

2.7 Improper device modifications

> **WARNING**
>
> **Improper device modifications**
>
> Risk to personnel, system, and environment can result from modifications to the device, particularly in hazardous areas.
>
> - Only carry out modifications that are described in the instructions for the device. Failure to observe this requirement cancels the manufacturer's warranty and the product approvals. Do not operate the device after unauthorized modifications.

2.8 Improper modification on positioner 6DR5...6

> **WARNING**
>
> **Improper modification on positioner 6DR5...6**
>
> Danger of explosion. The pneumatic terminal plate on the SIPART PS2 positioner 6DR5..6 is a safety-related component of the flameproof enclosure.
>
> - Never loosen the screws ① of the pneumatic terminal plate.

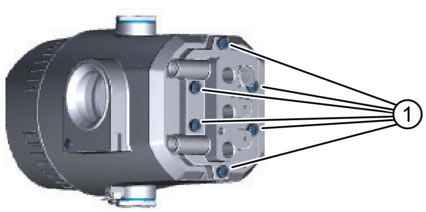


Figure 2-1 Screws of the pneumatic terminal plate on the positioner 6DR5..6

2.9 Requirements for special applications

Due to the large number of possible applications, each detail of the described device versions for each possible scenario during commissioning, operation, maintenance or operation in systems cannot be considered in the instructions. If you need additional information not covered by these instructions, contact your local Siemens office or company representative.

Note

Operation under special ambient conditions

We highly recommend that you contact your Siemens representative or our application department before you operate the device under special ambient conditions as can be encountered in nuclear power plants or when the device is used for research and development purposes.

2.10 Use in hazardous areas

Qualified personnel for hazardous area applications

Persons who install, connect, commission, operate, and service the device in a hazardous area must have the following specific qualifications:

- They are authorized, trained or instructed in operating and maintaining devices and systems according to the safety regulations for electrical circuits, high pressures, aggressive, and hazardous media.
- They are authorized, trained, or instructed in carrying out work on electrical circuits for hazardous systems.
- They are trained or instructed in maintenance and use of appropriate safety equipment according to the pertinent safety regulations.

WARNING

Use in hazardous area

Risk of explosion.

- Only use equipment that is approved for use in the intended hazardous area and labeled accordingly.
- Do not use devices that have been operated outside the conditions specified for hazardous areas. If you have used the device outside the conditions for hazardous areas, make all Ex markings unrecognizable on the nameplate.

WARNING

Loss of safety of device with type of protection "Intrinsic safety Ex i"

If the device or its components have already been operated in non-intrinsically safe circuits or the electrical specifications have not been observed, the safety of the device is no longer ensured for use in hazardous areas. There is a risk of explosion.

- Connect the device with type of protection "Intrinsic safety" solely to an intrinsically safe circuit.
- Observe the specifications for the electrical data on the certificate and/or in Technical specifications (Page 227).

3 Description

3.1 Structure

3.1.1 Overview of structure

The following sections describe the mechanical and electrical structure, components, and principle functionality of the positioner.

The positioner is used to move and control pneumatic actuators. The positioner works electropneumatically, using compressed air as auxiliary power. The positioner is used to control valves, for example, with:

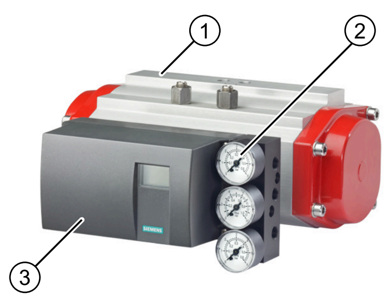
- Linear actuator
- Part-turn actuator VDI/VDE 3845

Various add-on extensions are available for linear actuators:

- IEC 60534-6-1 (NAMUR)
- Integrated mounting on ARCA, except with flameproof stainless steel enclosure (6DR5..6)
- Integrated mounting on SAMSON, not for Ex d

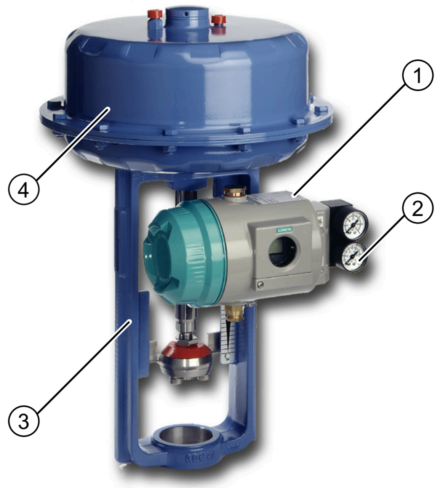
① Pressure gauge block, single-acting
② Process valve
③ Yoke / actuator yoke
④ Single-acting positioner in non-flameproof aluminum enclosure
⑤ Actuator

Figure 3-1 Positioner attached to a single-acting linear actuator



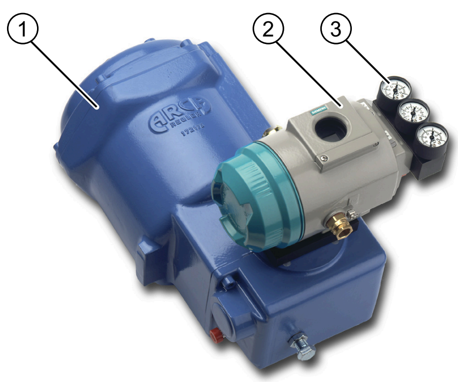
① Part-turn actuator
② Pressure gauge block, double-acting
③ Double-acting positioner in polycarbonate enclosure

Figure 3-2 Positioner attached to double-acting part-turn actuator



① Single-acting positioner in flameproof aluminum enclosure
② Pressure gauge block, single-acting
③ Yoke / actuator yoke
④ Actuator

Figure 3-3 Positioner in flameproof aluminum enclosure attached to linear actuator

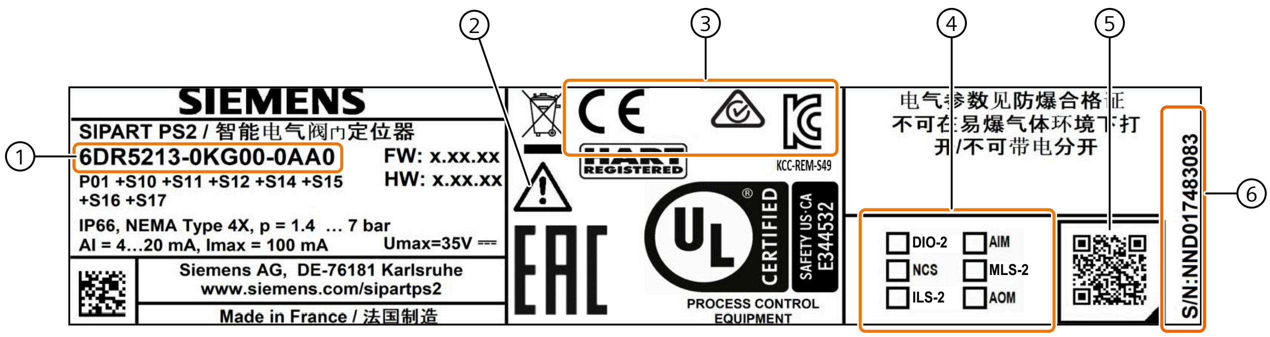


① Part-turn actuator
② Double-acting positioner in flameproof aluminum enclosure
③ Pressure gauge block, double-acting

Figure 3-4 Positioner in flameproof aluminum enclosure attached to part-turn actuator

3.1.2 Manufacturer nameplate

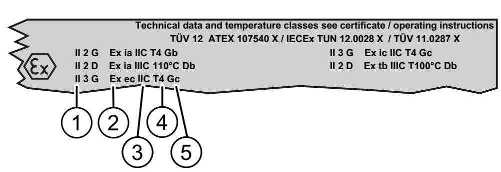
Example



①	Article number and order suffix (order code)
②	Follow operating instructions
③	Conformity with country-specific directives
④	Built-in option modules
⑤	QR code to the mobile website with device-specific product information
⑥	Serial number

3.1.3 Explanation of Ex information

Explanation of Ex information

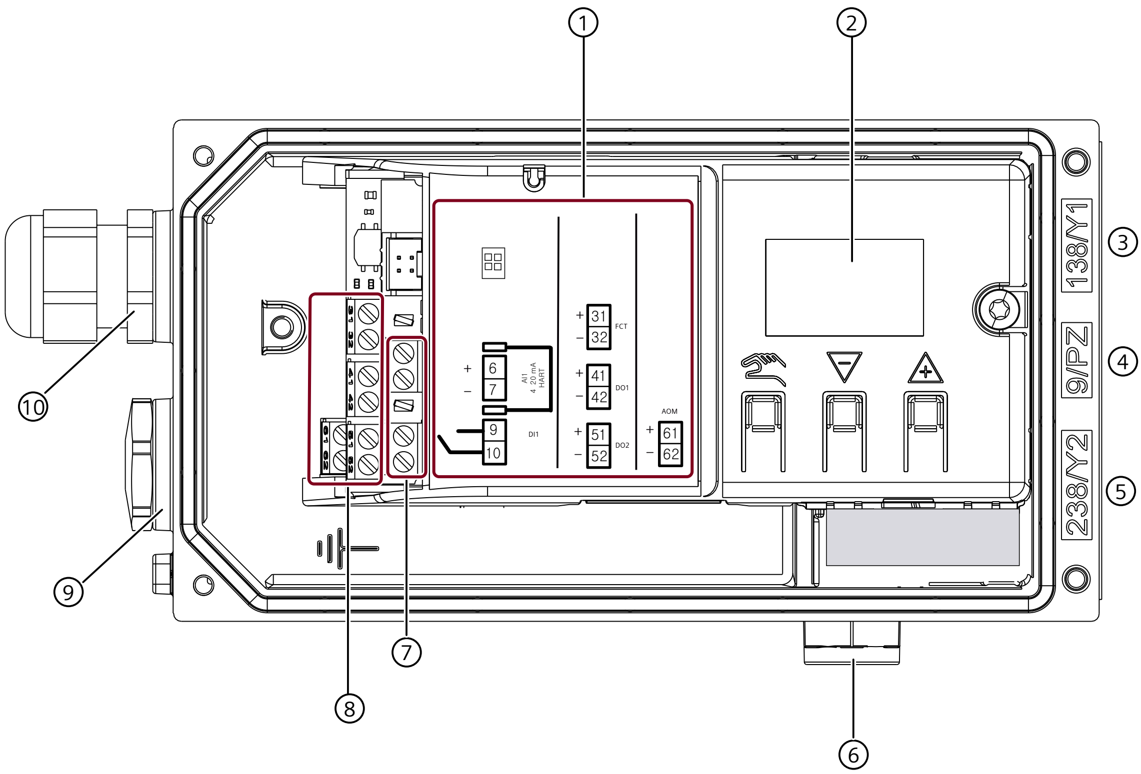


① Category for operating range
② Type of protection
③ Group (gas, dust)
④ Maximum surface temperature (temperature class)
⑤ Device protection level

Figure 3-5 Explanation of Ex information

3.2 Device components

3.2.1 Overview of device components (without Ex)



①	Wiring diagram on module cover	⑥	Exhaust air outlet with a sound absorber
②	Display	⑦	Connecting terminals of electronics
③	Output: Actuating pressure Y1	⑧	Connecting terminals of option modules
④	Input: Supply pressure PZ	⑨	Blanking plug
⑤	Output: Actuating pressure Y2[1)]	⑩	Cable gland

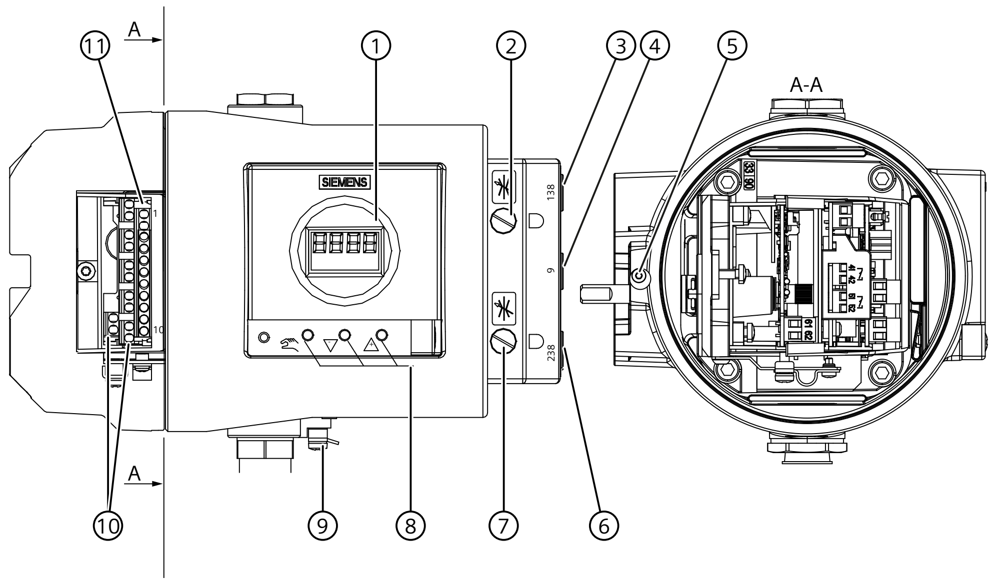
[1)] for double-acting actuators

Figure 3-6 View of positioner with cover open

See also

Structure of pneumatic connection (Page 90)

3.2.2 Overview of device components (Ex d)



①	Display	⑧	Buttons
②	Restrictor Y1	⑨	Ground terminal
③	Output: Actuating pressure Y1	⑩	Connecting terminals of option modules
④	Input: Supply pressure PZ	⑪	Connecting terminals of electronics
⑤	Safety catch		
⑥	Output: Actuating pressure Y2[1)]		
⑦	Restrictor Y2[1)]		

[1)] for double-acting actuators

Figure 3-7 View of positioner in flameproof enclosure, cover opened

3.3 Mode of operation

3.3.1 Pneumatic actuator

Pneumatic actuators are available in single and double-acting versions. In a single-acting version, only one pressure chamber is ventilated and depressurized. The pressure developed works against a spring. In a double-acting version, two pressure chambers work against each other. Ventilating the volume of one chamber simultaneously depressurizes the volume of the other.

3.3.2 Mode of operation of the HART function

Note

Priority of operation / failure of power supply

- Operation at the positioner has priority over specifications from the HART communicator.
- Failure of the auxiliary power to the positioner also interrupts communications.

Function

The positioner is also available with built-in HART functionality. The HART protocol allows you to communicate with your device using a HART communicator, PC, or programming unit. You can do the following with your device:

- Convenient configuration
- Store configurations
- Call up diagnostic data
- Show online measured values

Communication takes place as frequency modulation on the existing signal lines for the setpoint of 4 to 20 mA.

The positioner is integrated into the following parameter assignment tools:

- HART communicator
- PDM (Process Device Manager)
- AMS (Asset Management System)

3.3.3 HART system configuration

Overview

The positioner can be used in a number of system configurations:

- Stand-alone, supplied with the required auxiliary power supply; communication with supplementary units (handheld), for example
- As part of a complex system environment, e.g. SIMATIC S7

System communication

Communication is via the HART protocol, using:

- HART Communicator (load 230 ... 1100 Ω)
- PC with HART modem, on which appropriate software is installed, e.g. SIMATIC PDM (load 230 ... 500 Ω)
- Control system which can communicate via the HART protocol, e.g. SIMATIC PCS7

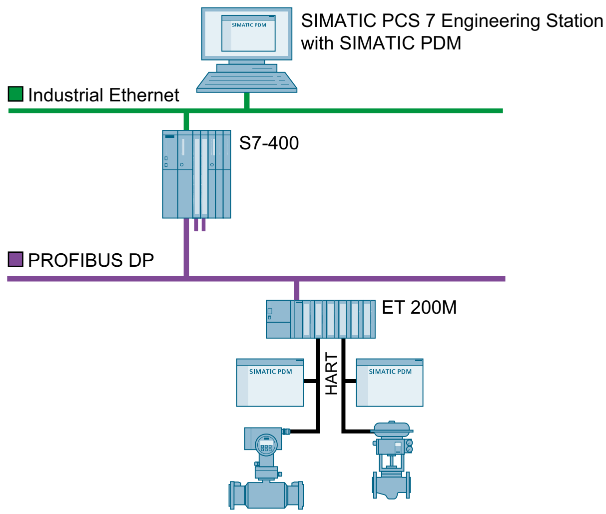


Figure 3-8 Typical system configurations

3.3.4 SIMATIC PDM

SIMATIC PDM is a software package for configuring, parameter assignment, commissioning, diagnostics and maintenance of this device and other process devices.

SIMATIC PDM offers simple monitoring of process values, alarms, and device status information.

SIMATIC PDM allows the process device data to be:

- displayed
- set
- modified
- saved
- diagnosed
- checked for plausibility
- managed
- simulated

Additional information on SIMATIC PDM can be found at www.siemens.com/simatic-pdm (www.siemens.com/simatic-pdm).

See also

Overview of the assignment of the HART variables (Page 187)

Installing/mounting 4

4.1 Basic safety instructions

WARNING

High operating force with pneumatic actuators

Risk of injury when working on control valves due to the high operating force of the pneumatic actuator.

- Please observe the corresponding safety instructions for the pneumatic actuator in use.

WARNING

Lid gasket may be damaged

If the lid gasket is not positioned correctly in the groove of the base plate, it could be damaged when the lid is mounted and screwed tight.

- Therefore, make sure that the lid gasket is seated correctly.

WARNING

Exceeded maximum permissible operating pressure

Risk of injury or poisoning.

The maximum permissible operating pressure depends on the device version, pressure limit and temperature rating. The device can be damaged if the operating pressure is exceeded. Hot, toxic and corrosive process media could be released.

Ensure that maximum permissible operating pressure of the device is not exceeded. Refer to the information on the nameplate and/or in Technical specifications (Page 227).

WARNING

Electrostatic charging of nameplates

The nameplates used on the device can reach a capacity of 5 pF.

- Keep the device and the cables at a distance from strong electromagnetic fields.

CAUTION

Unsuitable compressed air

Device damage. As a general rule, the positioner must only be operated with dry and clean compressed air.

- Use the customary water separators and filters. An additional dryer is required in extreme cases.
- Use dryers, especially if you operate the positioner at low ambient temperatures.

CAUTION

Adhere to the following instructions before working on the control valve and when attaching the positioner

Danger of injury.

- Prior to working on the control valve, you must move the actuator and the process valve into a completely pressureless state. Proceed as follows:
  - Depressurize the actuator chambers.
  - Switch off the supply pressure PZ.
  - Secure the process valve.
- Make sure that the actuator has reached the pressureless state.
- If you interrupt the supply pressure PZ to the positioner, the pressureless position can only be reached after a certain waiting time.
- When mounting, adhere strictly to the following order to avoid injuries or mechanical damage to the positioner/mounting kit:
  - Mount the positioner mechanically.
  - Electric connection.
  - Connect supply pressure PZ.
  - Commission the positioner.

WARNING

Mechanical impact energy

To ensure the degree of protection of the enclosure (IP66), protect the positioner versions listed below from mechanical impact energy:

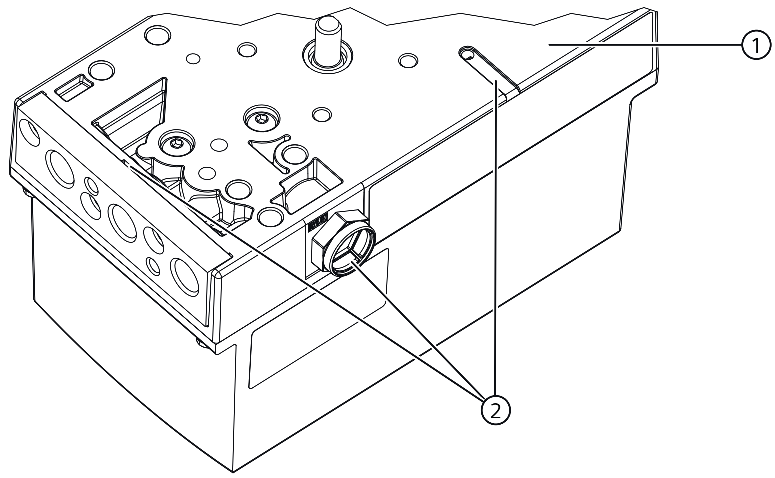
- 6DR5..0; polycarbonate enclosure with inspection window: ≤ 1 joule on total enclosure
- 6DR5..1; aluminum enclosure with inspection window: ≤ 2 joules applied to the inspection window
- 6DR5..3; aluminum enclosure with inspection window: ≤ 2 joules applied to the inspection window

NOTICE
Torque with NPT screwed gland Device damage. The maximum torque of the cable gland must not be exceeded. • To avoid damage to the device, the NPT adapter must be held in place while the NPT gland is screwed into the NPT adapter. Refer to the section "Technical specifications > Construction for all device versions (Page 229)" for the torque value.

4.1.1 Proper mounting

NOTICE
Incorrect mounting The device can be damaged, destroyed, or its functionality impaired through improper mounting. • Before installing ensure there is no visible damage to the device. • Make sure that process connectors are clean, and suitable gaskets and glands are used. • Mount the device using suitable tools. Refer to the information in Technical specifications (Page 227).

NOTICE
Freezing of the exhaust air outlets When devices of the type 6DR5..0/1/2/3 are used, the exhaust air outlets ② may freeze. The function of the device is impaired. • Do **not** install the positioner with the base plate ① pointing up.



① Base plate

② Exhaust air outlets

Figure 4-1 Exhaust air outlets, base plate

4.2 Mounting to linear actuator

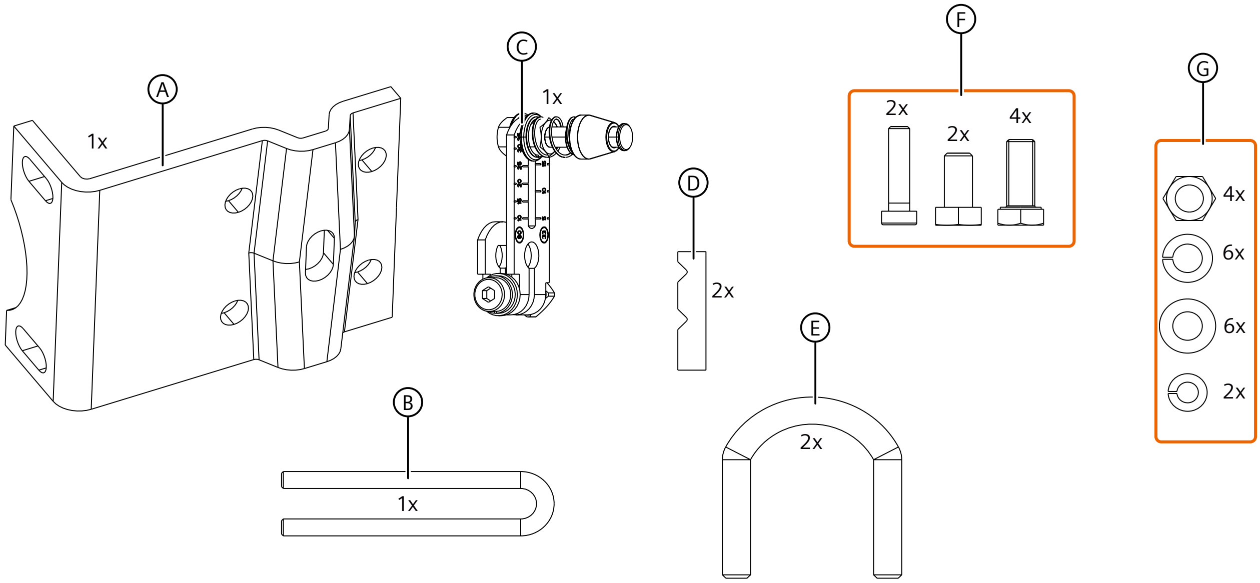
There are linear actuators for standard mounting in accordance with IEC 60534 and for integrated mounting. Use the reduced mounting kit 6DR4004-8VK for actuators with integrated mounting. Integrated mounting is not possible with flameproof stainless steel enclosure (6DR5..6).

The following describes how to connect the positioner to the linear actuator according to IEC 60534.

Depending on the stroke height, you will need the following mounting kit:

- 3 to 35 mA: Mounting kit 6DR4004-8V
- 35 to 130 mm: Mounting kit 6DR4004-8V and additionally 6DR4004-8L

Mounting kit 6DR4004-8V



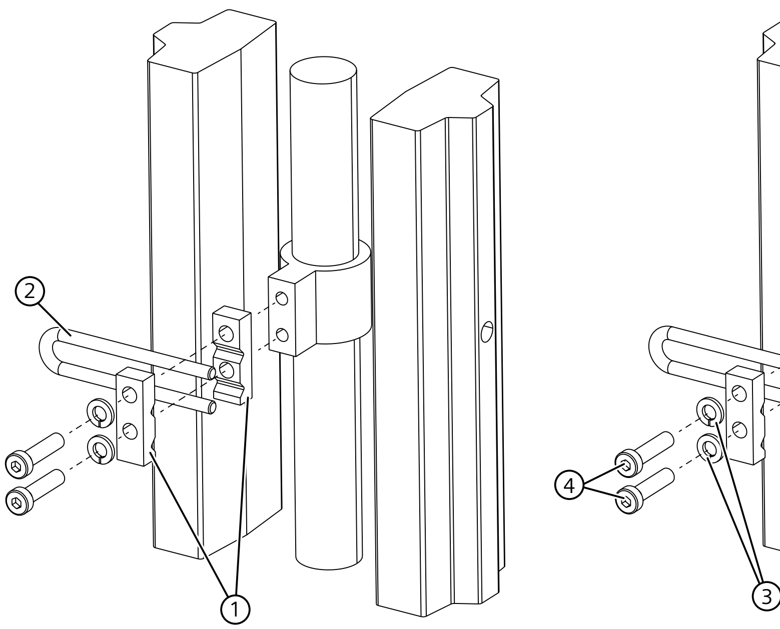
A	NAMUR mounting bracket IEC 60534
B	Pick-up bracket
C	Lever
D	Clamping pieces
E	U–bolts
F	Cylinder head screws M6x25 DIN 7984–A2
	Hexagon head bolts M8x20 DIN 933–A2
	Hexagon head bolts M8x16 DIN 933–A2
G	Hexagon head bolts M8 - DIN 934–A4
	Spring lock washers A8 - DIN 127–A2
	Washer B8,4 - DIN 125–A2
	Spring lock washers A6 - DIN 127–A2

Figure 4-2 Mounting kit 6DR4004-8V

For stroke ranges > 35 to 130 mm, you also need lever 6DR4004–8L.

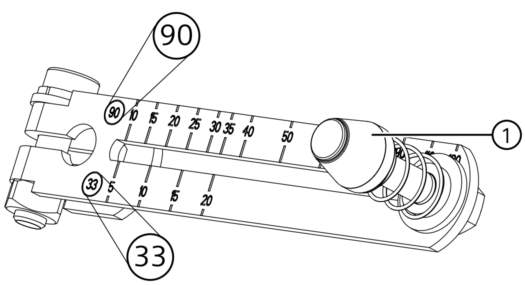
Procedure

1. Install the clamping pieces on the actuator spindle.
2. Slide the pick-up bracket into the notches of clamping pieces.
   – Tighten the cylinder head screws so that you can still shift the pick-up bracket.



①	Clamping pieces
②	Pick-up bracket
③	Cylinder head screws M6x25 DIN 7984–A2
④	Spring lock washers A6 - DIN 127–A2

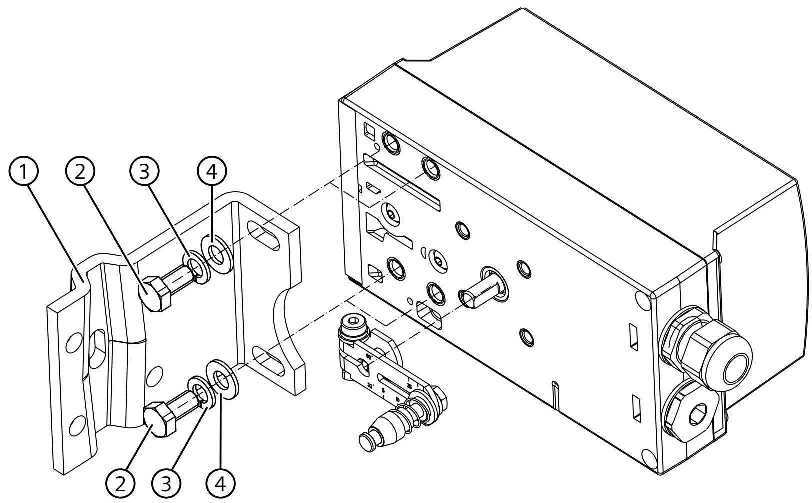
3. Set the stroke value using the lever by positioning the center of the carrier pin ① on the appropriate value on the scale.

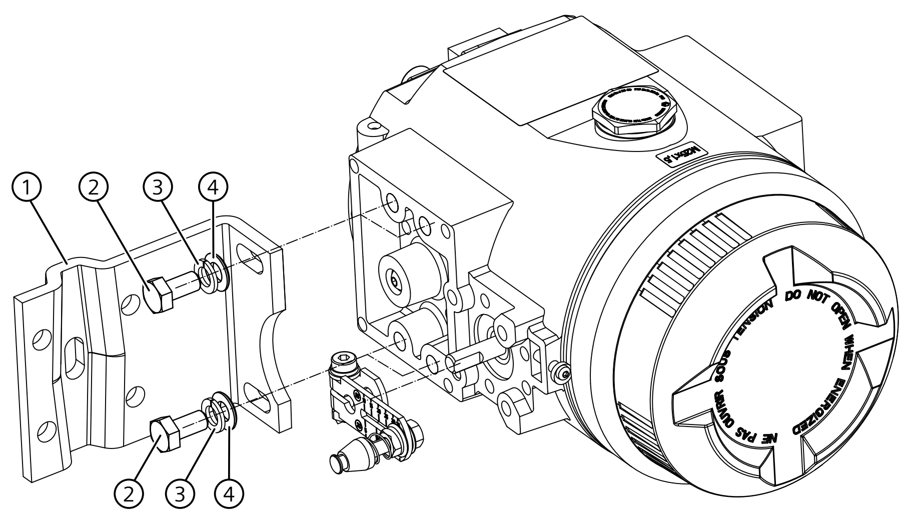


   ⇒ The stroke value is specified on the nameplate of the actuator. If none of the values on the lever scale matches the stroke value of the actuator, select the next higher value on the scale.
   ⇒ For devices with non-contacting position detection, use the scale 90.

4. Push the lever up to the endstop on the positioner shaft.
   Fasten the lever with cylinder head screw.

5. Install the mounting bracket on the rear of the positioner.
   - Select the row of holes depending on the yoke width of the actuator.
   - The carrier pin must engage close to the spindle in the pick-up bracket.





① Mounting bracket
② Hexagon head bolts M8x16 DIN 933–A2
③ Spring lock washers A8 - DIN 127–A2
④ Washer B8,4 - DIN 125–A2

6. Keep the positioner and the fastening bracket on the actuator.
   Ensure that the carrier pin for the entire range of stroke of the actuator is guided inside the pick-up bracket.
   Ensure that the carrier pin does not touch the clamping pieces.
7. Tighten the pick-up bracket.

Note

Display of the stroke range in mm

If you want to display the value of the travel in mm after initialization, make sure that the set travel value matches the value of the "3.YWAY" parameter.

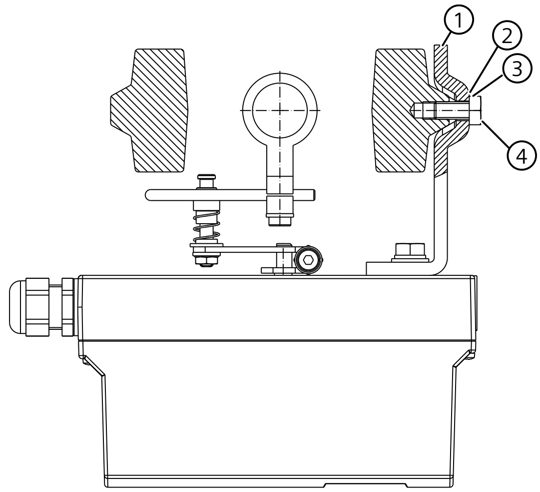
Fasten to the yoke

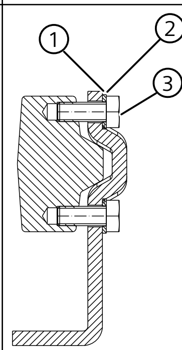
Note

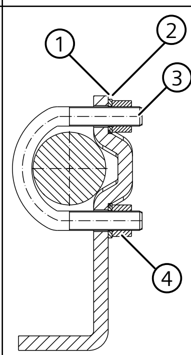
Height adjustment of the positioner

When you attach the positioner to the yoke, follow the steps below to adjust the height of the positioner:

1. Set the height of the positioner in such a way that the horizontal lever position is near the center of the stroke.
2. Orient yourself by the lever scale of the actuator.
3. If symmetrical mounting is not possible, you must always ensure that the horizontal lever position is maintained within the range of stroke.
   – With 4 ... 20 mA/Highway Addressable Remote Transducer device versions as of FW version 5.04.00, this step is omitted.

<table>
<tr><th>Required installation components</th><th></th></tr>
<tr><td>Mounting bracket ①
Washer B8,4 - DIN 125–A2 ②
Spring lock washer A8 - DIN 127–A2 ③
Hexagon head bolts M8x20 DIN 933–A2 ④</td><td>

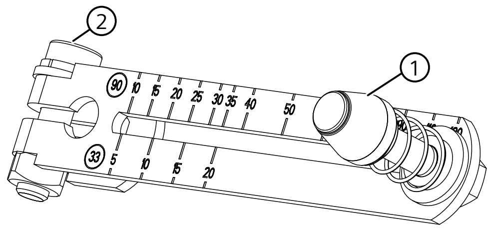
Yoke with fin</td></tr>
<tr><td>Mounting bracket
Washer B8,4 - DIN 125–A2 ①
Spring lock washer A8 - DIN 127–A2 ②
4 hexagon head bolts M8x20 DIN 933–A2 ③</td><td>

Yoke with plane surface</td></tr>
<tr><td>Mounting bracket
Washer B8,4 - DIN 125–A2 ①
Spring lock washer A8 - DIN 127–A2 ②
2 U-bolts ③
4 hexagon head bolts M8 - DIN 934–A4 ④</td><td>

Yoke with columns</td></tr>
</table>

Lever for stroke ranges > 35 to 130 mm (6DR4004–8L)

Fit the carrier pin to the lever using the existing parts from the mounting kit 6DR4004-8V:



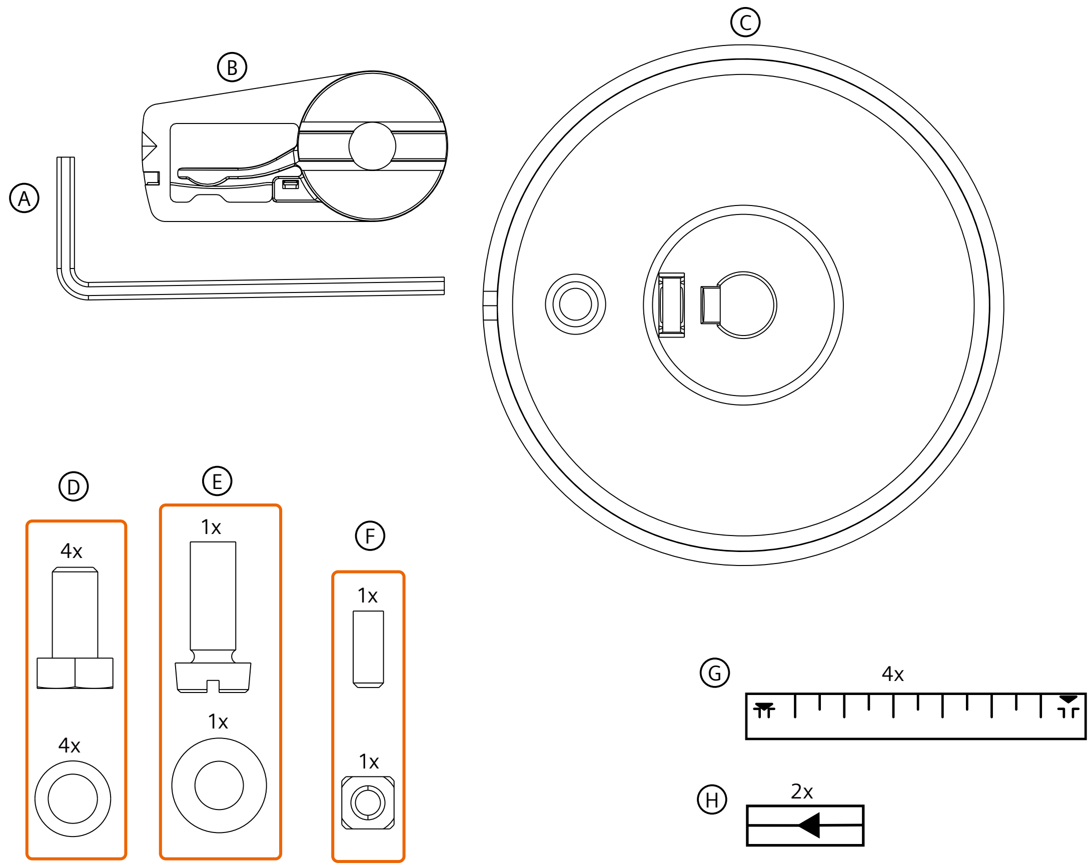
① Carrier pin

② Cylinder head screw M6x25 DIN 7984–A2

4.3 Mounting to part-turn actuator

Requirements

"Part-turn actuator" mounting kit 6DR4004–8D



A	Machinist's wrench
B	Carrier
C	Plastic coupling wheel
D	Hexagon head bolts DIN 933 - M6x12
	Lock washer S6
E	Cylinder head screw DIN 84 - M6x16
	Washer DIN 125 - 6.4
F	Threaded pin DIN 916 - M4x10
	Square nut DIN 562 - M4
G	Scales with different directions and ranges of rotation
H	Pointer mark

Mounting console

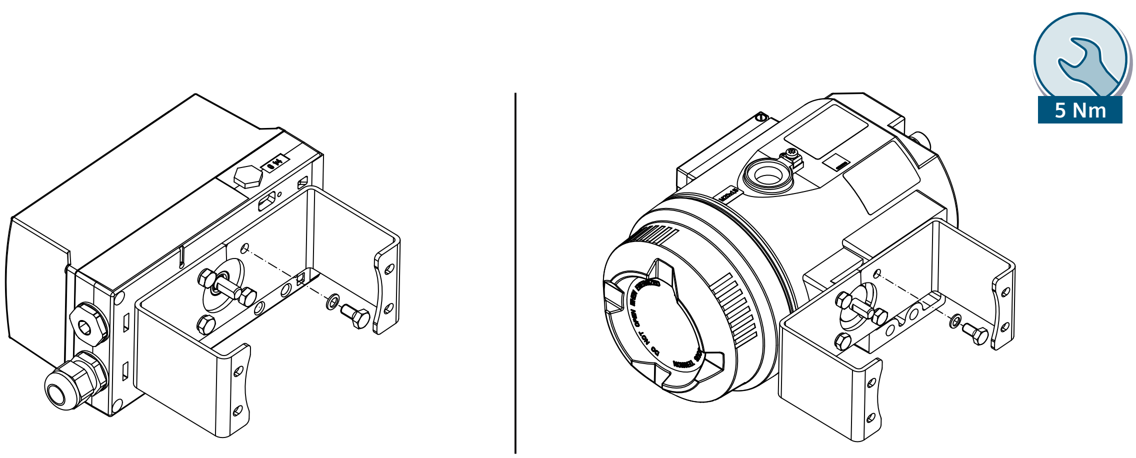
You require an actuator-specific mounting console to install the positioner on a part-turn actuator.

- Because of the high weight of the version in the flameproof stainless steel enclosure 6DR5..6, you should select a particularly stable mount.
- For actuators according to VDI/VDE 3845 the following mounting brackets with the corresponding screws are available:

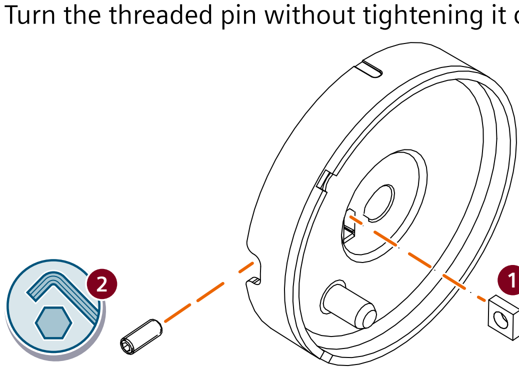
Dimensions according to VDI/VDE 3845	Article number
AA1	6DR4004-1D
AA2	6DR4004-2D
AA3	6DR4004-3D
AA4	6DR4004-4D

Procedure

1. Screw the mounting bracket onto the rear of the positioner: Use the hexagon head screw DIN 933 - M6x12 and the lock washers S6.



2. Install the threaded pin and the square nut in the coupling wheel.
   – Hold the square nut in place with your fingers.
   – Turn the threaded pin without tightening it completely.



3. Push the coupling wheel up to the endstop on the positioner shaft. Screw the threaded pin tight.

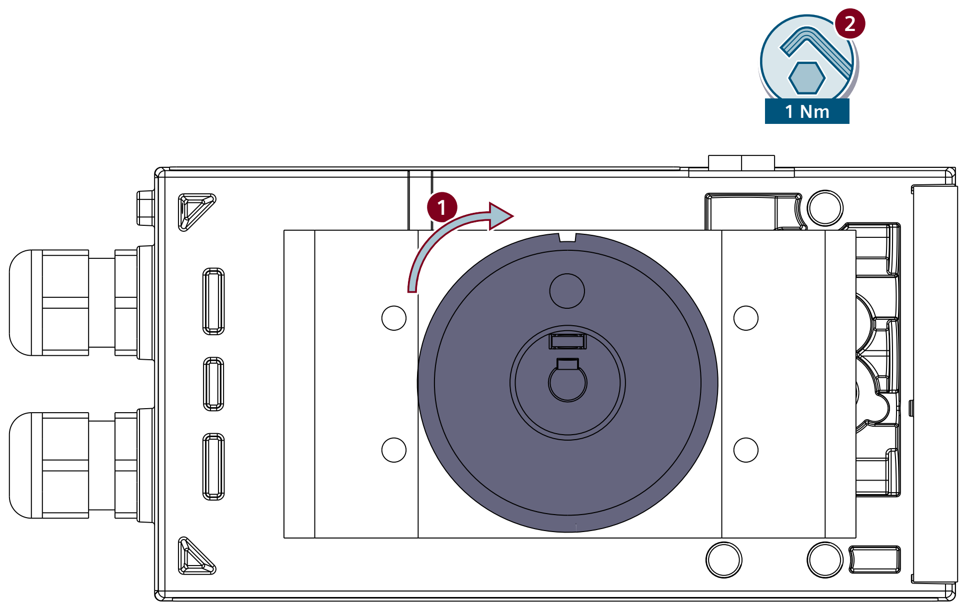
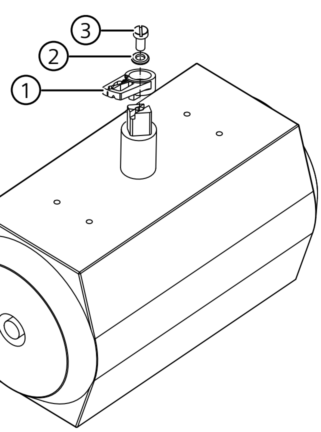


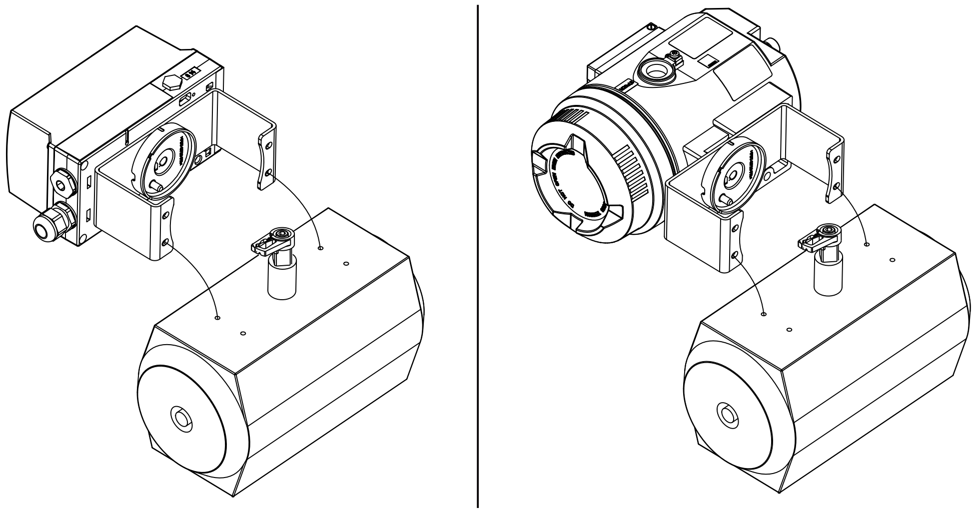
Figure 4-3 Top view

4. Place the carrier on the actuator shaft as follows:

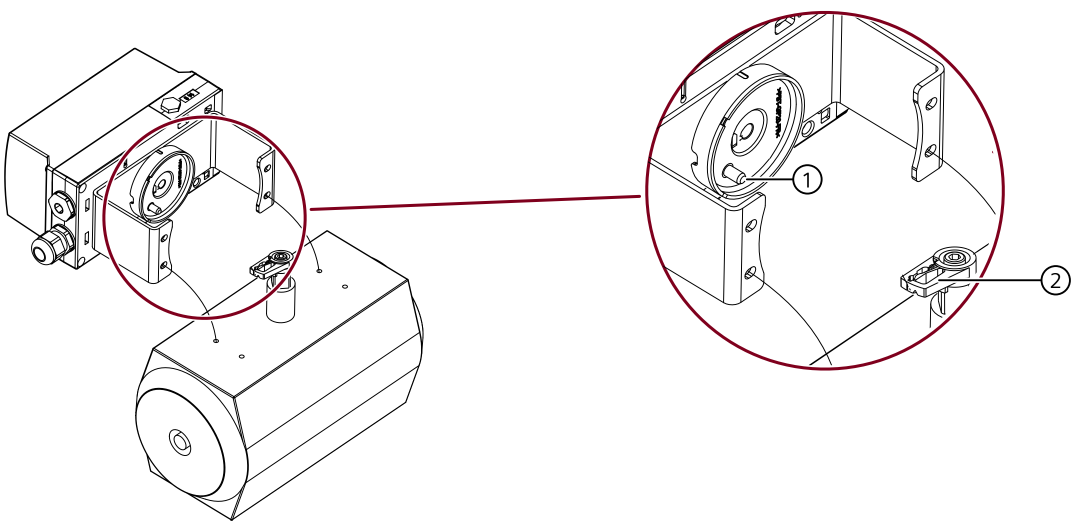


① Carrier
② Washer DIN 125 - 6.4
③ Cylinder head screw DIN 84 - M6x16

5. Place the positioner and the mount on the actuator carefully.



① must engage in the carrier ②.



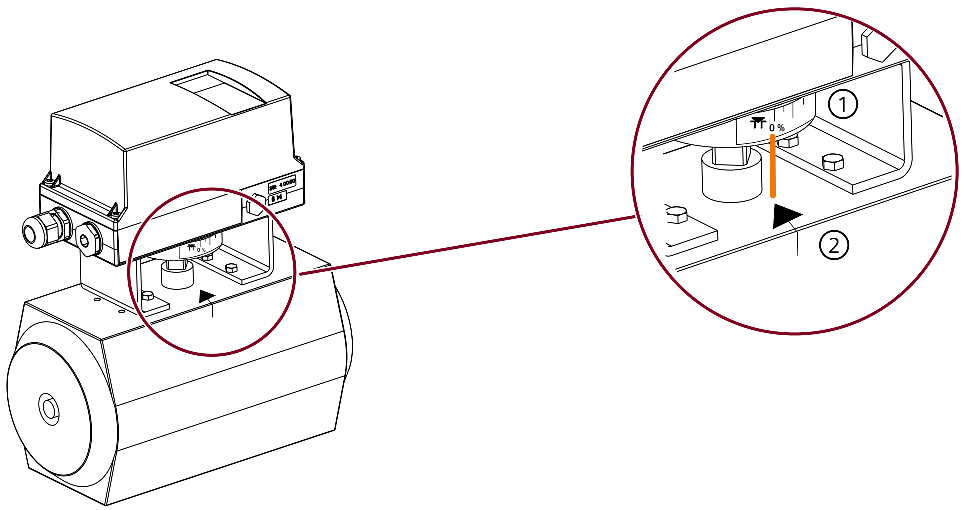
6. Align the positioner with mount at the center of the actuator.
7. Fasten the positioner with mounting console unit to the actuator.
   The screws and lock washers are supplied with the 6DR4004-*D mounting bracket.

The positioner is attached to the part-turn actuator.

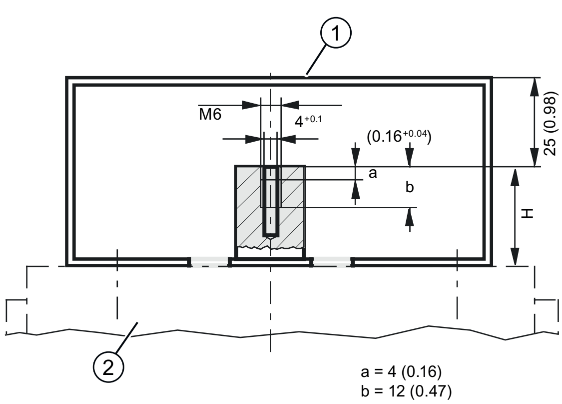
Display of the position with scale and pointer mark

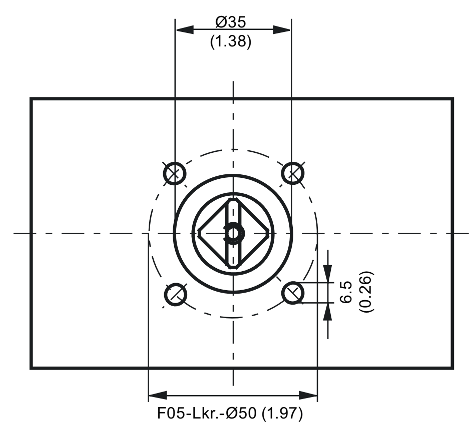
You can check the position of the actuator using the supplied scale and pointer mark.

1. When initialization is complete, move the positioner to the end position.
2. Stick the scale with the direction or the range of rotation on the coupling wheel ①.
3. Use the pointer marker ② to mark the current position of the actuator according to the scale.



Dimensions of mounting console in accordance with VDI/VDE 3845





H = height of shaft butt

① Fixing level of positioner on mount

② Part-turn actuator

Stainless steel (article number TGX:16300-1556)

Instead of the polycarbonate coupling wheel, you can use a stainless steel coupling for special applications.

- If you place the positioner with the mounting bracket on the actuator, place the stainless steel coupling directly on the stub of the positioner shaft of the actuator.

See also

Construction for all device versions (Page 229)

4.4 Installing option modules

4.4.1 Basic safety instructions

> **WARNING**
>
> **Use in hazardous area**
>
> Risk of explosion.
>
> - Only use equipment that is approved for use in the intended hazardous area and labeled accordingly.
> - Do not use devices that have been operated outside the conditions specified for hazardous areas. If you have used the device outside the conditions for hazardous areas, make all Ex markings unrecognizable on the nameplate.

> **NOTICE**
>
> **Improper installation of option modules**
>
> Risk of explosion in hazardous areas.
>
> - If you upgrade the device with an option module, mark the corresponding box on the nameplate with a cross, as in the example below.
> - Before you commission the device, follow the safety-related requirements according to the specifications in the valid certificate and in the "Technical specifications" section.

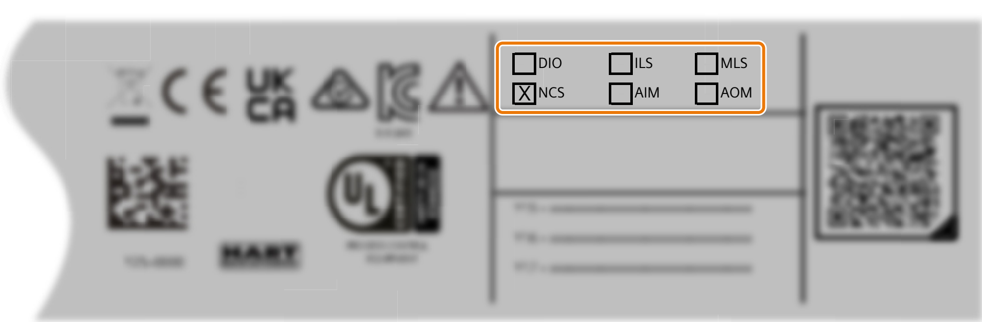


Figure 4-4 Example

4.4.2 Opening the positioner

Requirement

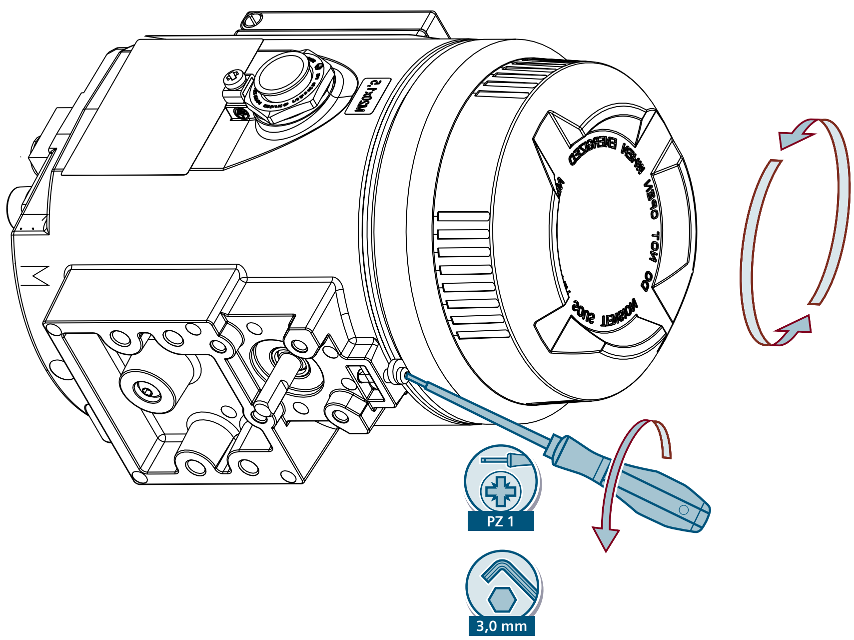
The positioner has been removed from the actuator.

Procedure: Standard and intrinsically safe device version

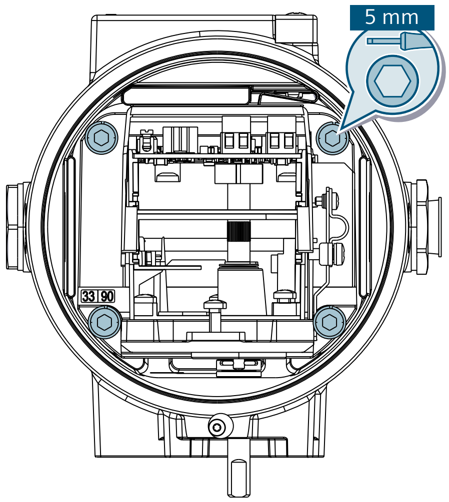
1. De-energize the device.
2. Remove the enclosure cover by unscrewing the 4 screws with a Phillips screwdriver PZ 2.

Procedure: Device version with "flameproof enclosure"

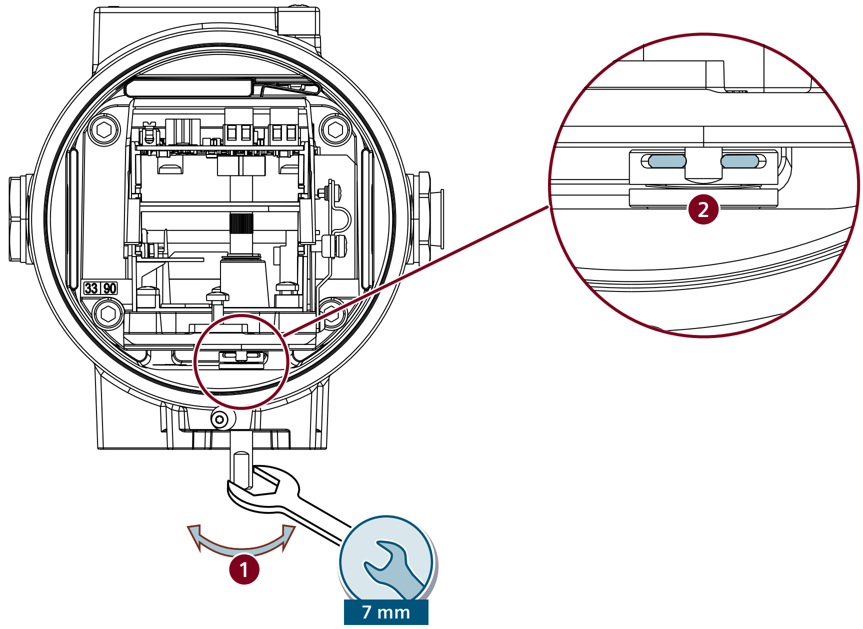
1. De-energize the device.
2. Open the enclosure by loosening the locking screw and unscrewing the enclosure cover.

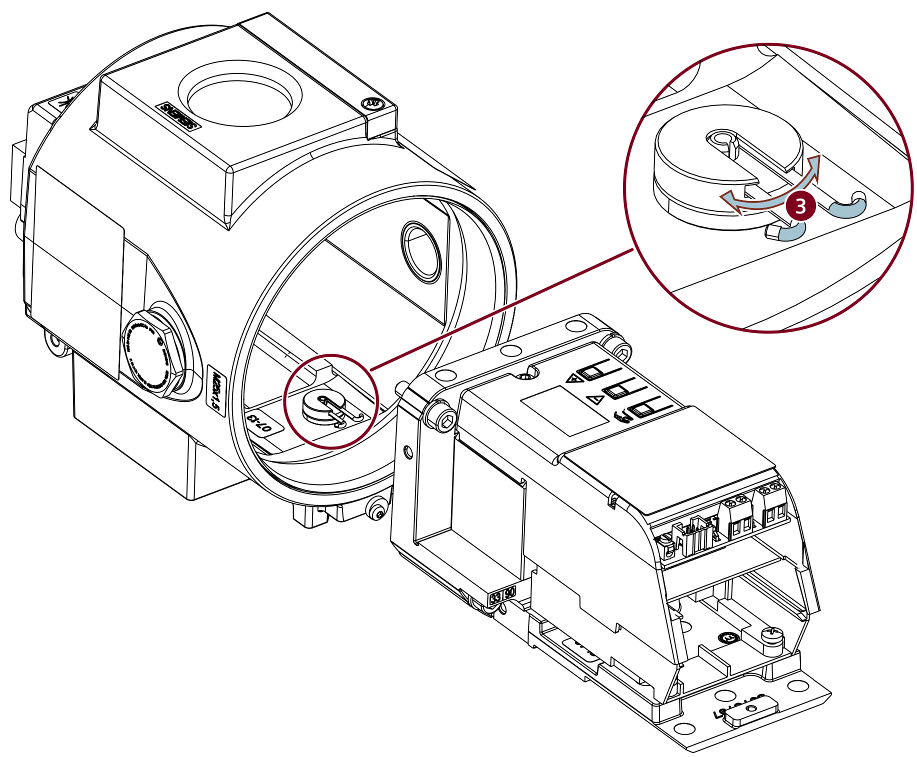


3. Unscrew the adapter.



4. Turn the feedback shaft ① until the clip is oriented as shown in ②.





5. Remove the adapter from the enclosure.

– There are several O-rings between the adapter and enclosure.

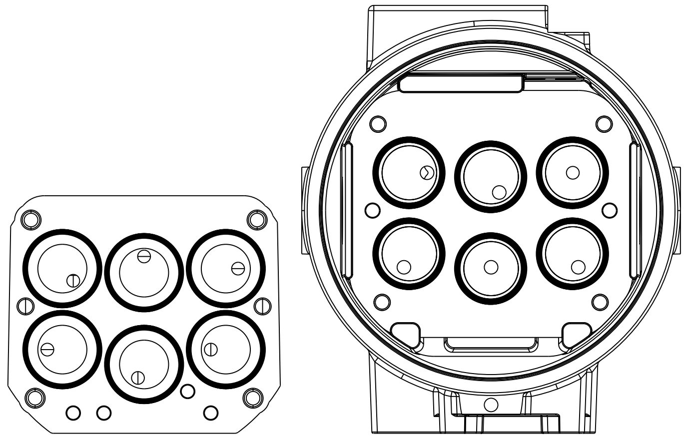


Figure 4-5 O-rings on the adapter and in the enclosure of 6DR5..5. (No O-rings in the enclosure of 6DR5..6)

– The O-rings may come off during removal. Be sure to save the O-rings when removing the adapter.

4.4.3 Digital I/O Module (DIO) 6DR4004-6A / -8A

Function

The Digital I/O Module (DIO) triggers fault messages and alarms via three digital outputs.

- If there is no alarm, the digital output is conductive (not triggered).
- If there is an alarm, the digital output is deactivated (triggered).
- Set the following parameters to activate, invert and configure the output of alarms and fault messages:
  - "AFCT" - Alarm function
  - "A1" - Response threshold, alarm 1
  - "A2" - Response threshold, alarm 2
  - "FCT" - Function for fault message output
  - "TIM" - Monitoring time
  - "LIM" - Response threshold

The Digital I/O Module (DIO) also has a digital input DI2 in addition to the digital outputs. Depending on the selected parameters, this digital input is used, for example, to block the actuator or to move it to its end position. You make the corresponding settings with the "DI2" parameter.

Device features

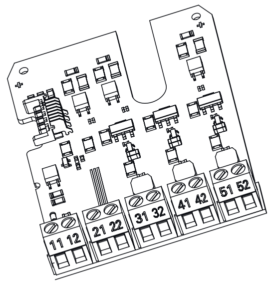


Figure 4-6 Digital I/O Module (DIO), schematic representation

The Digital I/O Module (DIO) has the following features:

- Available in two versions
  - Explosion-proof version for connection to a switching amplifier in conformity with EN 60947-5-6
  - Non-explosion-proof version for connecting to power sources having a maximum of 35 V.
- 3 digital outputs. The digital outputs are galvanically isolated from the standard controller and from each other.
- The digital input DI2 has 2 inputs. Both inputs are implemented as logical OR combination.
  - Digital input DI1 on terminal 11/12: Is electrically isolated, and is triggered by an active signal.
  - Digital input DI2 on terminal 21/22: Is not electrically isolated, and is triggered by a passive NO contact.

Procedure

1. Open the positioner as in the description depending on the device version.
1. Slide the Digital I/O Module (DIO) into the adapter below the electronics. Ensure that you slide it up to the endstop.
2. Connect the Digital I/O Module (DIO) to the electronics. To do this, use the 8-pin flat ribbon cable provided.
3. Close the positioner as in the description depending on the device version.

See also

Opening the positioner (Page 47)

Closing the positioner (Page 70)

4.4.4 Analog Output Module (AOM) 6DR4004-6J / -8J

Function

- The Analog Output Module (AOM) indicates the current position of the actuator as a two-wire signal between 4 mA and 20 mA. The Analog Output Module (AOM) is galvanically isolated from the basic unit.
- The current position is indicated as a passive mA signal only after successful initialization.
- Operational faults are signaled by a fault current of 3.6 mA.

Device features

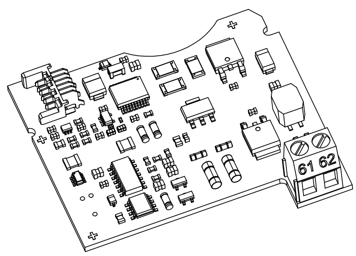


Figure 4-7 Analog Output Module (AOM) 6DR4004-6J (Ex) and 6DR4004-8J (non-Ex), schematic representation

The Analog Output Module (AOM) is:

- Single channel
- Galvanically isolated from the basic device

Requirement

A supply source corresponding to the technical specifications of the option module must be available.

Procedure

1. Open the positioner as in the description depending on the device version.
2. Slide the Analog Output Module (AOM) into the lower bay of the adapter as far as it will go.
3. Connect the Analog Output Module (AOM) to the electronics. To do this, use the 6-pin flat ribbon cable provided.
4. Close the positioner as in the description depending on the device version.

See also

Opening the positioner (Page 47)

Closing the positioner (Page 70)

4.4.5 Inductive limit switches (ILS) and mechanic limit switches (MLS)

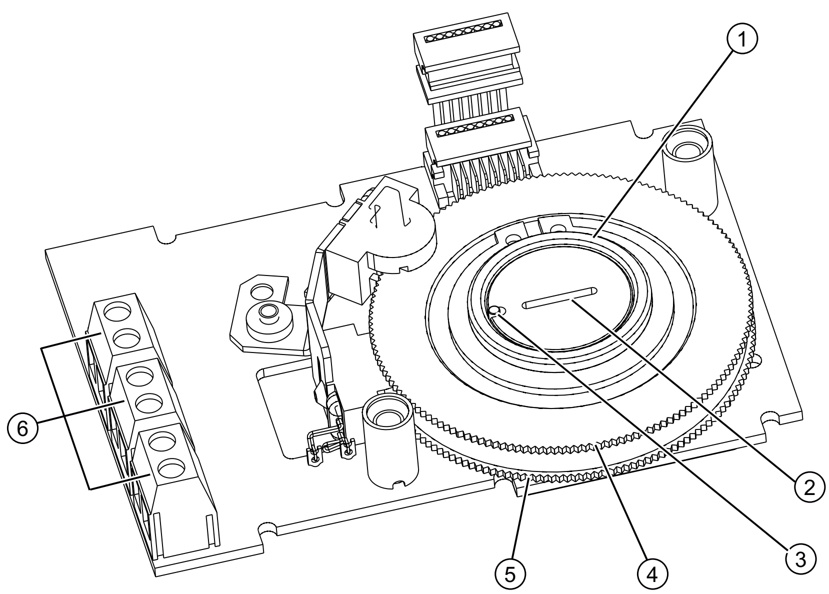
4.4.5.1 Inductive Limit Switches (ILS) - Mode of operation and equipment features

Function

If the basic unit requires electrically independent limit messages, the Inductive Limit Switches (ILS) with slotted initiators is used instead of the Digital I/O Module (DIO).

- A digital output is used to display a group fault message. Compare with the function of the Digital I/O Module (DIO). The floating digital output is implemented as an automatic fault indicating semiconductor output.
- The other two digital outputs are used to signal the two limits L1 and L2 which can be adjusted mechanically using slotted initiators. These two digital outputs are electrically independent from the remaining electronic unit.

Device features



① Actuating disk bearings	② Special screw
③ Pin	④ Upper actuating disk for limit L1, terminals 41/42
⑤ Lower actuating disk for limit L2, terminals 51/52	⑥ Digital outputs

Figure 4-8 Inductive Limit Switches (ILS), schematic representation

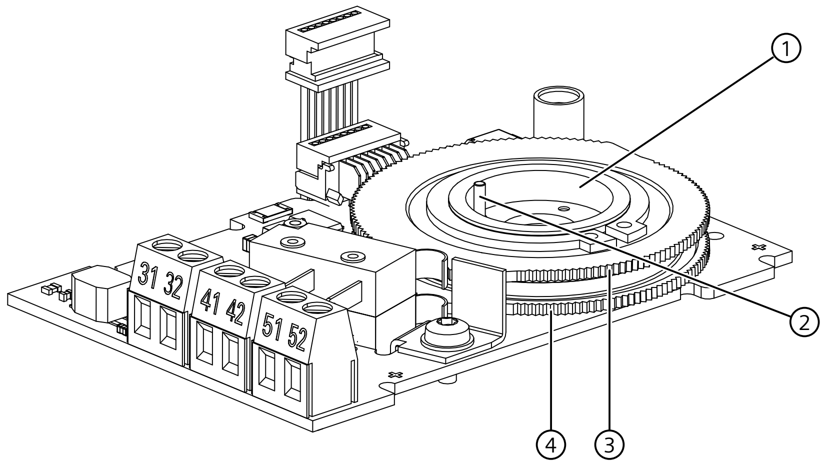
The Inductive Limit Switches (ILS) have three digital outputs ⑥.

4.4.5.2 Mechanic Limit Switches (MLS) - Mode of operation and equipment features

Function

Mechanic Limit Switches (MLS) are used to report two limits. These limits are reported using galvanic switching contacts.

Device features



①	Actuating disk bearings	③	Upper actuating disk for limit L1, terminals 51/52
②	Pin	④	Lower actuating disk for limit L2, terminals 41/42

Figure 4-9 Mechanic Limit Switches (MLS), schematic representation

Mechanic Limit Switches (MLS) contain:

- One digital output to display a group fault message. Compare with the device features of the Mechanic Limit Switches (MLS).
- Two switches to report two mechanically adjustable limits. Both these switches are electrically independent from the remaining electronic unit.

4.4.5.3 Installing Inductive Limit Switches (ILS) and Mechanic Limit Switches (MLS)

The following figures show the mechanic limit switches (MLS) as an example.

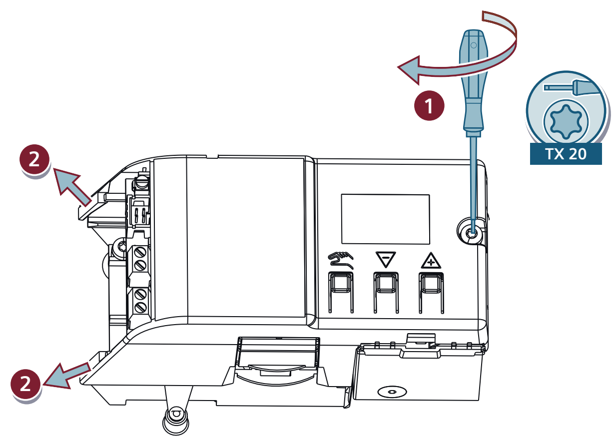
Requirement

You have opened the positioner.

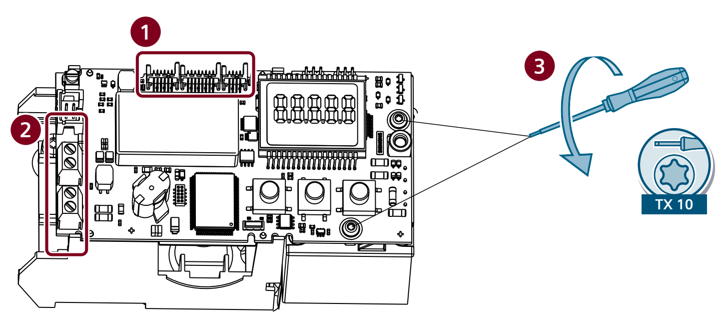
- Opening the positioner (Page 47)

Procedure

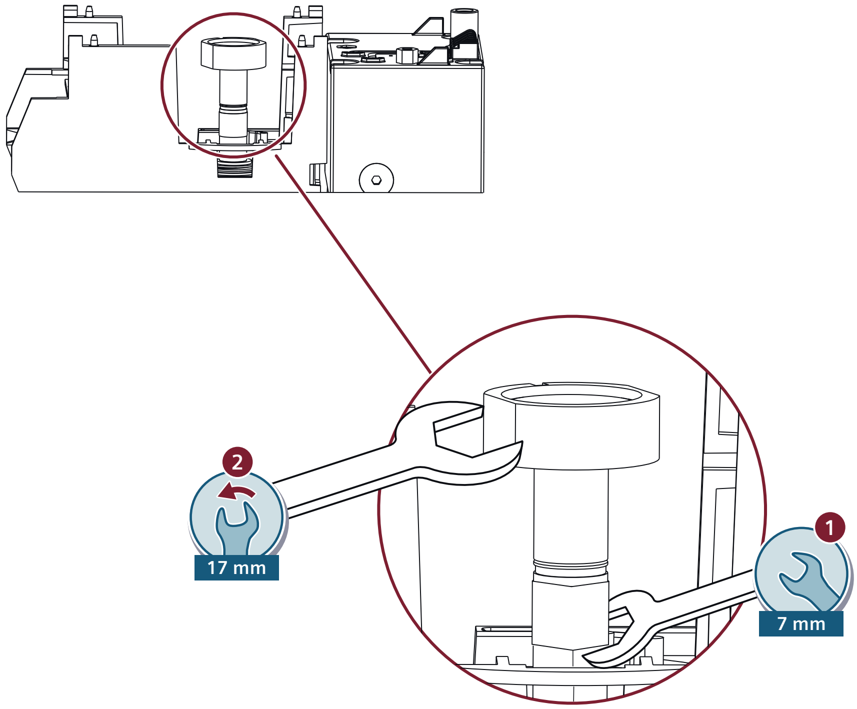
1. Loosen the module cover.



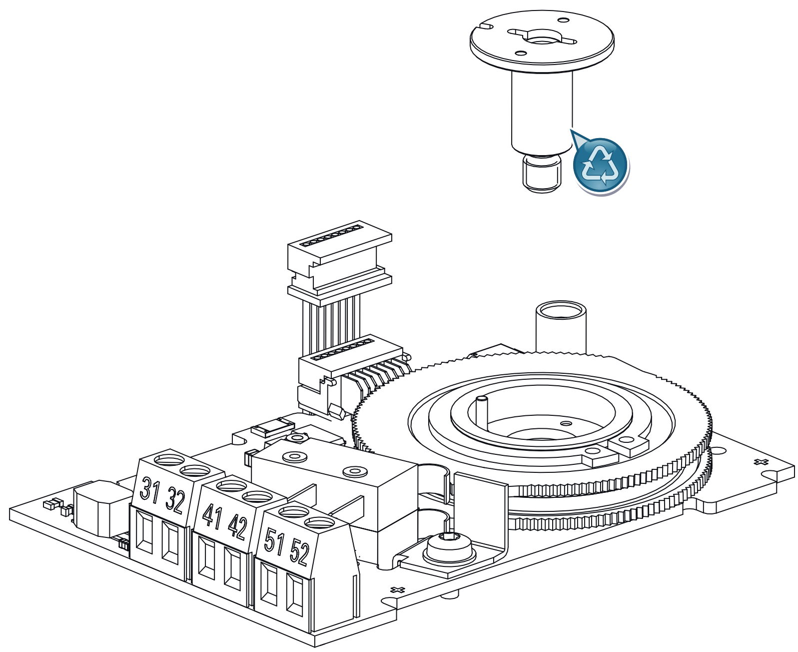
2. Remove the electronics by disconnecting the optional flat cable, electrical connectors and screws.



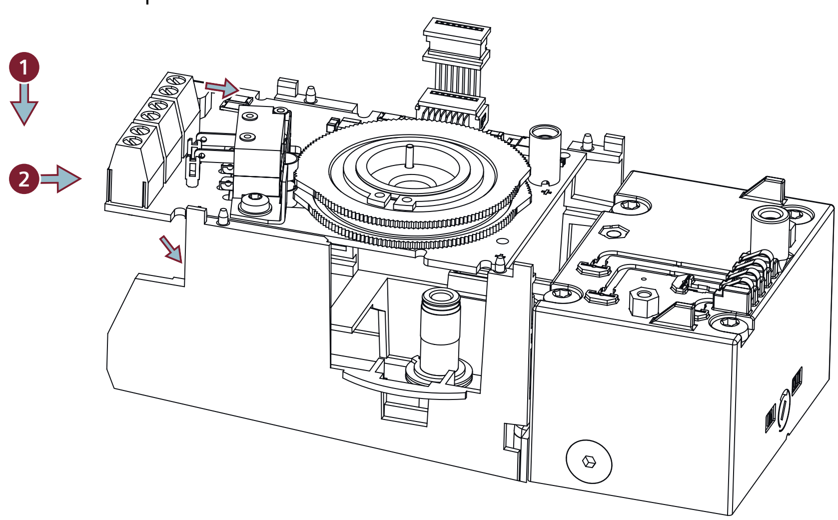
3. Remove the magnet holder.



4. Install the option module.
   - Remove the special screw from the option module. The special screw is no longer required.



   - Install the option module as follows:



– Ensure that the shaft is visible through the option module.

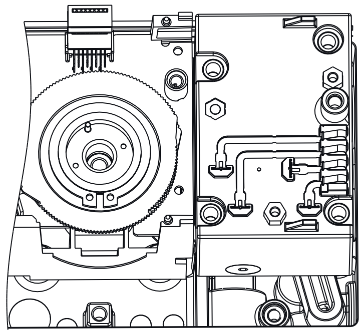
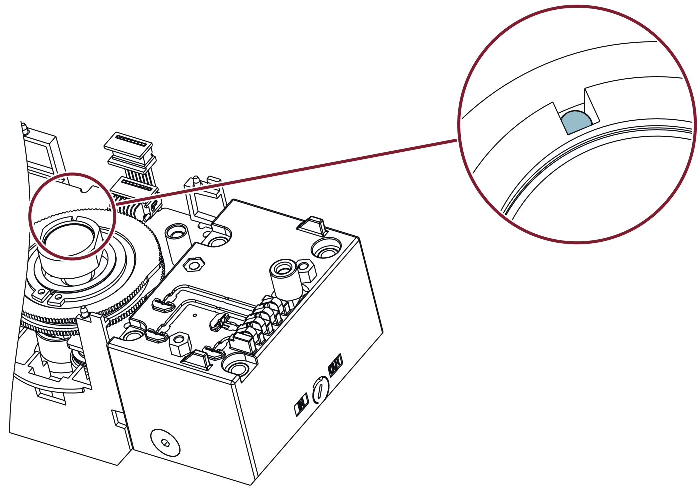
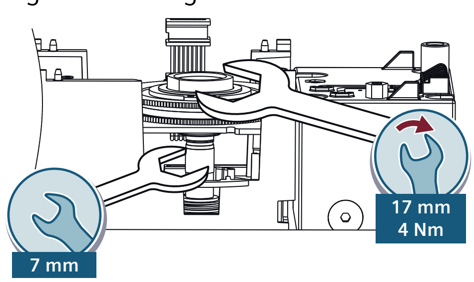


Figure 4-10 Top view

5. Screw the magnet holder tight.
   – Ensure that the carrier pin of the option module is in the groove of the magnet holder.

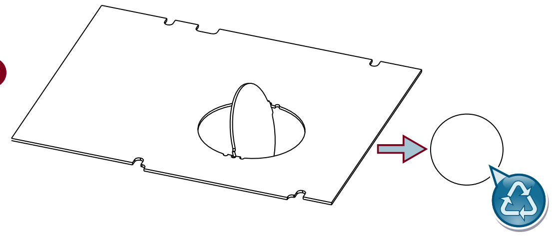


   – Tighten the magnet holder:

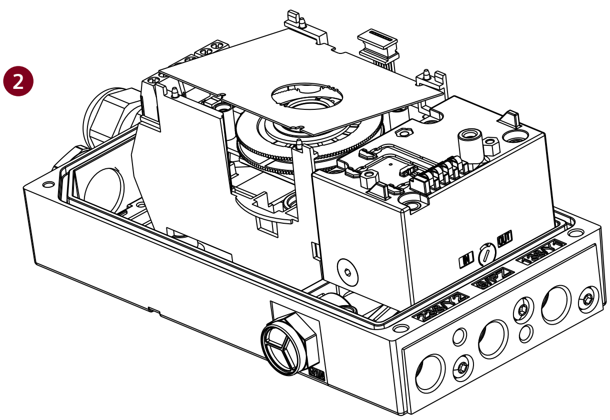


– Cover the option module with the supplied insulating plate (optional).

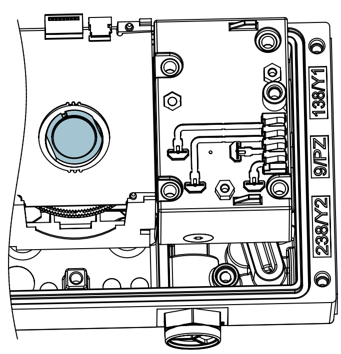
❶



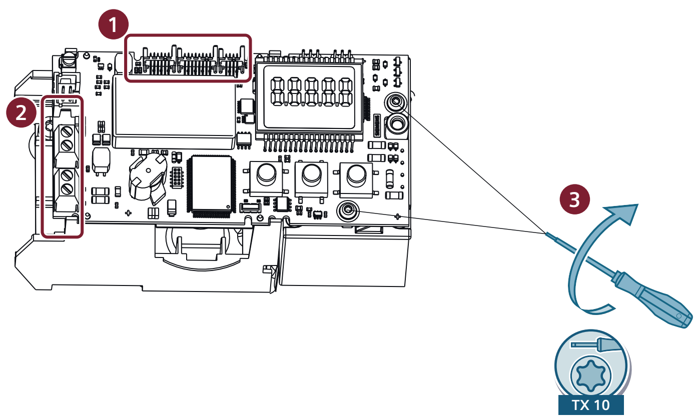
❷



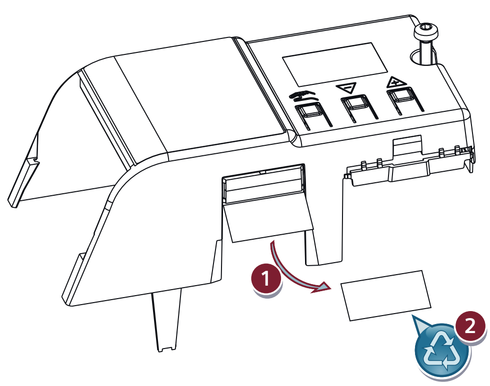
❸



6. Install the electronics.
   - Screw the electronics tight.
   - Connect the ribbon cables and the electrical connections.



7. Install the module cover.
   - Break off the module cover as follows:



   - Adhere the supplied connection diagram to the module cover:

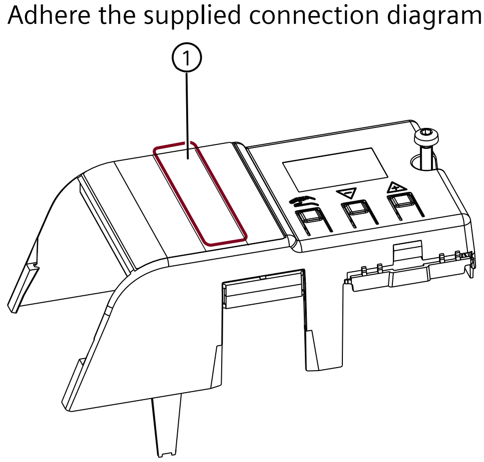
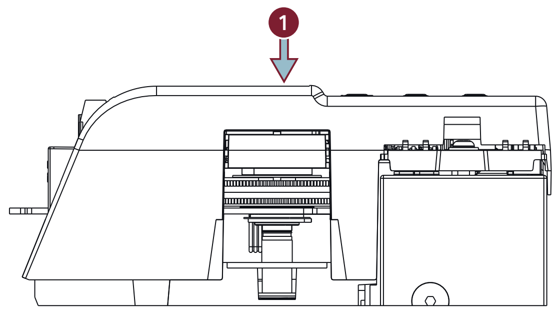
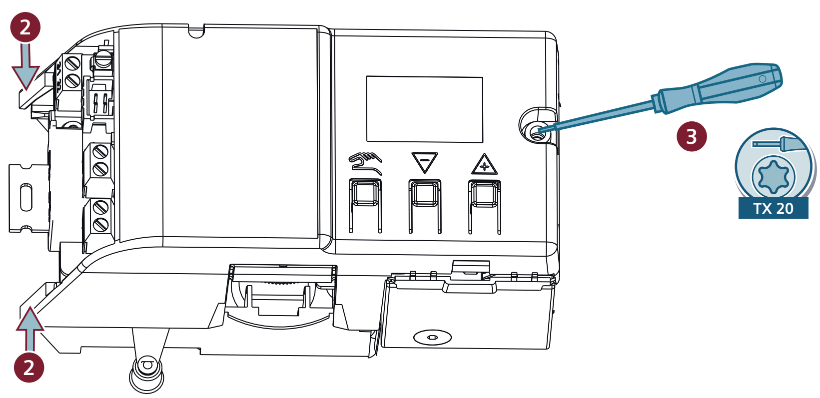


Figure 4-11 ① Place for connection diagram of the ILS or MLS

   - Be careful not to pinch any cables.





– Make sure that the module cover is seated correctly.

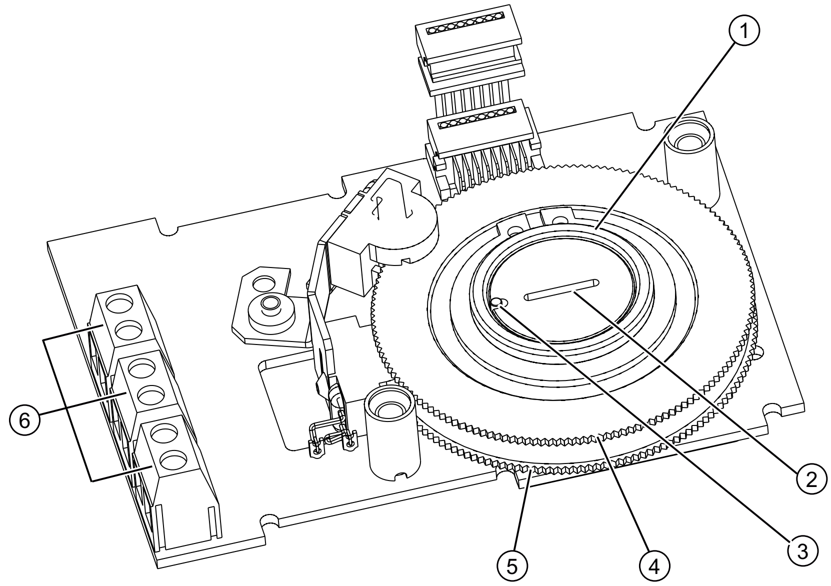
Result

The option module and the module cover are installed.

To close the positioner, follow the steps in the following section:

- Closing the positioner (Page 70)

4.4.5.4 Setting limits for Inductive Limit Switches (ILS)



①	Actuating disk bearings	②	Special screw
③	Pin	④	Upper actuating disk for limit L1, terminals 41/42
⑤	Lower actuating disk for limit L2, terminals 51/52	⑥	Digital outputs

Procedure: Determining the switch status of the slot-type initiators

You will require a suitable display device to determine the switch status. For example, use the initiator tester type 2 / Ex from Pepperl + Fuchs.

1. Connect the display device to the following terminals of the Inductive Limit Switches (ILS):
   - 41 and 42
   - 51 and 52
2. Read the switch status of the slot-type initiators.

Procedure: Setting the L1 and L2 limits

The consecutive numbers in the following text refer to the figure above in this section. Proceed as follows to set the limits:

1. Move the actuator to the first desired mechanical position.
2. Adjust the upper actuating disk ④ manually until the output signal at terminals 41 and 42 changes.
   - Rotate the actuating disc ④ beyond the switching point until you reach the next switching point.

3. Move the actuator to the second desired mechanical position.
4. Adjust the lower actuating disk ⑤ manually until the output signal at terminals 51 and 52 changes.
   – Rotate the actuating disc ⑤ beyond the switching point until you reach the next switching point.

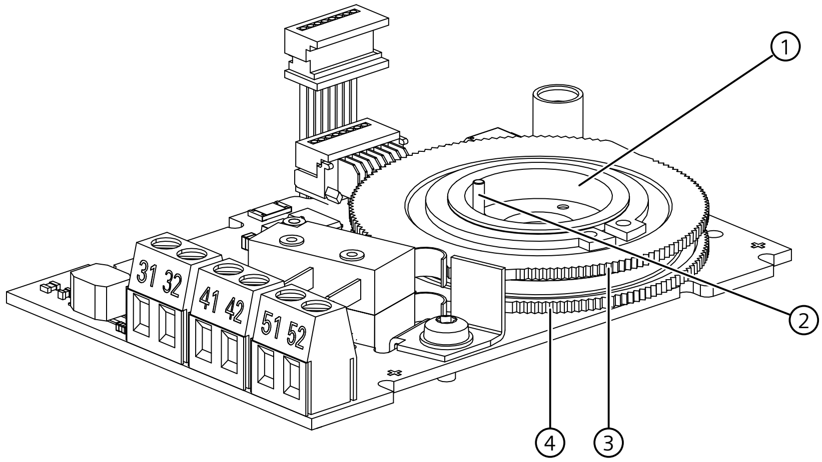
Note

Adjusting the actuating disk

The actuating disks ④ and ⑤ are relatively difficult to move. This design prevents their unintentional movement during operation. You can achieve an easier and finer adjustment by reducing stiction temporarily.

- Move the actuator to and fro while simultaneously holding the actuating disks ④ and ⑤.

4.4.5.5 Setting limits for Mechanic Limit Switches (MLS)



①	Actuating disk bearings	③	Upper actuating disk for limit L1, terminals 51/52
②	Pin	④	Lower actuating disk for limit L2, terminals 41/42

Procedure: Setting the L1 and L2 limits

1. Move the actuator to the first desired mechanical position.
2. Adjust the upper actuating disk manually until the output signal at terminals 51 and 52 changes.
   – Rotate the actuating disc beyond the switching point until you reach the next switching point.
3. Move the actuator to the second desired mechanical position.
4. Adjust the lower actuating disk manually until the output signal at terminals 41 and 42 changes.
   – Rotate the actuating disc beyond the switching point until you reach the next switching point.

Note

Adjusting the actuating disk

The actuating disks ④ and ⑤ are relatively difficult to move. This design prevents their unintentional movement during operation. You can achieve an easier and finer adjustment by reducing stiction temporarily.

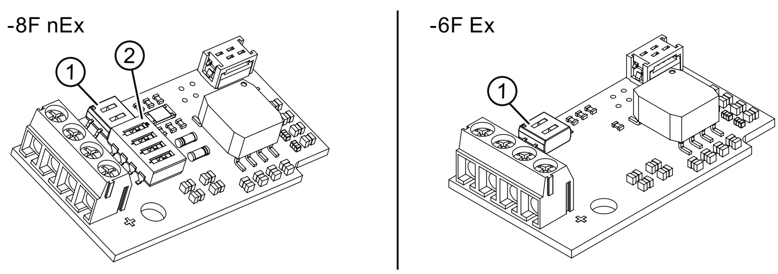
- Move the actuator to and fro while simultaneously holding the actuating disks ③ and ④.

4.4.6 Analog Input Module (AIM) 6DR4004-6F / -8F

Function

If you use a Position Transmitter on the positioner, you will need the Analog Input Module (AIM). The Analog Input Module (AIM) forms the interface between the Position Transmitter and the electronics of the positioner.

Device features



① Switch block 1
② Switch block 2

Figure 4-12 Analog Input Module (AIM), schematic representation

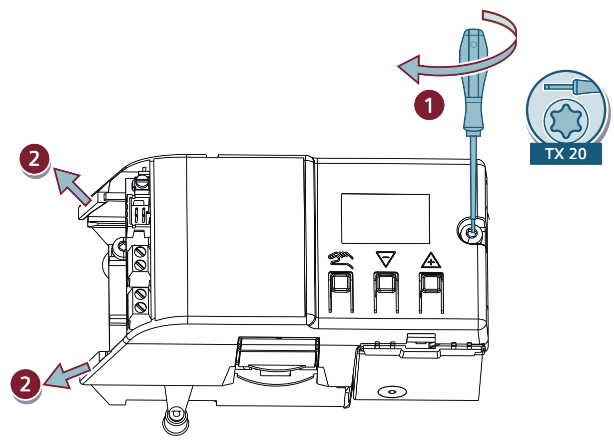
- Connection to electronics
- Connection terminals for:
  - Position Transmitter (Potentiometer) with 3 kΩ, 5 kΩ or 10 to 20 kΩ
  - Signals 0 to 20 mA
  - Signals 0 to 10 V

Requirement

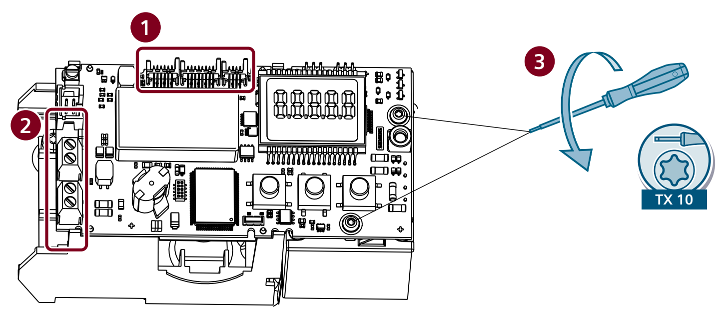
- You have at least one of the following modules:
  - 6DR4004-8F Analog Input Module (AIM) - nEx
  - 6DR4004-6F Analog Input Module (AIM) - Ex
- You have opened one of the following Position Transmitters:
  - 6DR4004-6N*/-8N* NCS sensor
  - 6DR4004-1ES Position Transmitter (Potentiometer)
  - 6DR4004-2ES Position Transmitter (NCS)
  - 6DR4004-3ES Position Transmitter (NCS, ILS)
  - 6DR4004-4ES Position Transmitter (NCS, MLS)

Procedure

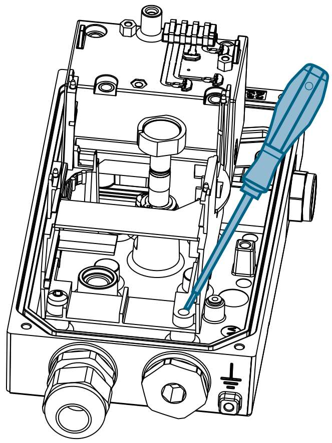
1. Open the positioner as in the description depending on the device version.
   Opening the positioner (Page 47)
2. Loosen the module cover.



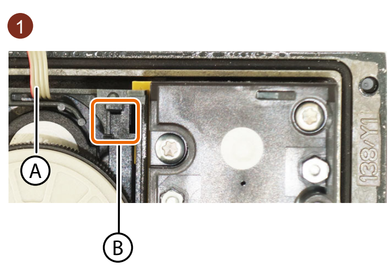
3. Remove the electronics by disconnecting the flat cable, electrical connectors and screws.

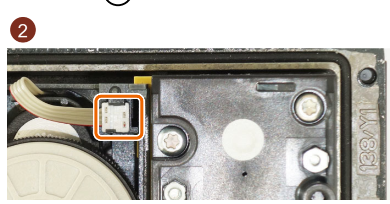


4. Loosen the screw in the terminal compartment of the positioner.

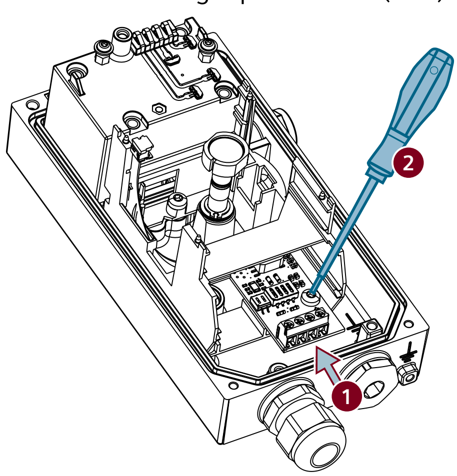


– If the positioner has a potentiometer, plug the ribbon cable of the potentiometer (A) into the position shown (B).

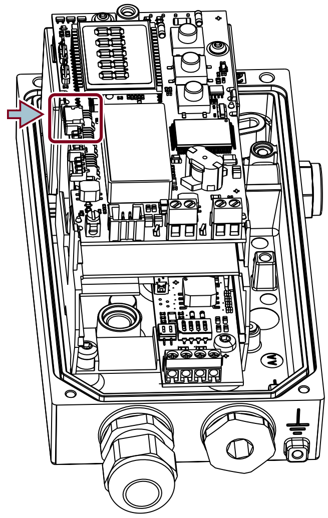




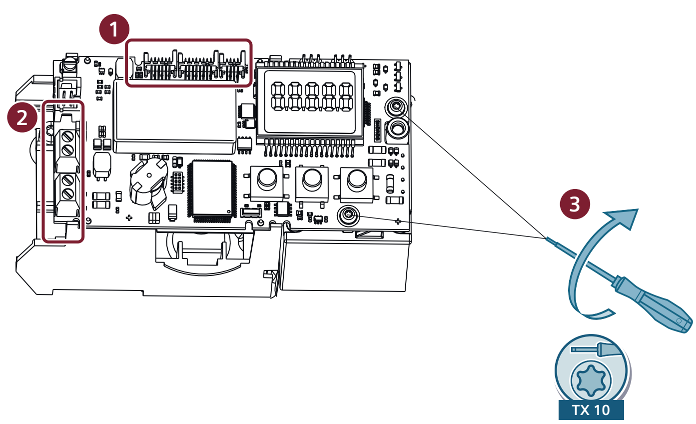
5. Install the Analog Input Module (AIM) .



6. Install the electronics.
   – Screw the electronics tight.
   – Insert the ribbon cable plug of the Analog Input Module (AIM) into the electronics of the positioner.



   – Connect the ribbon cable for additional option modules and the electrical connections.



7. Close the positioner as described in Closing the positioner (Page 70).

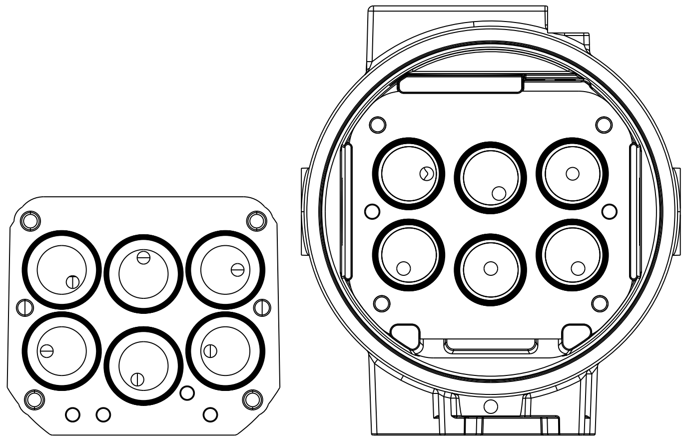
4.4.7 Closing the positioner

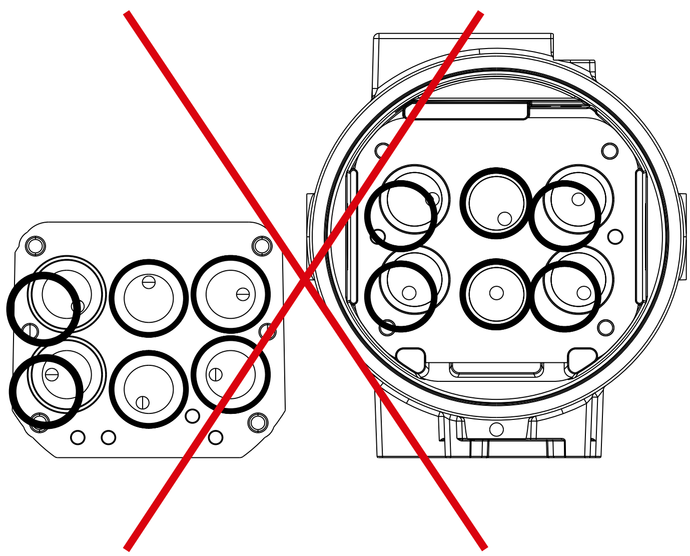
Procedure: Standard and intrinsically safe device version

1. Put on the enclosure cover.
2. Tighten the fixing screws of the enclosure cover.

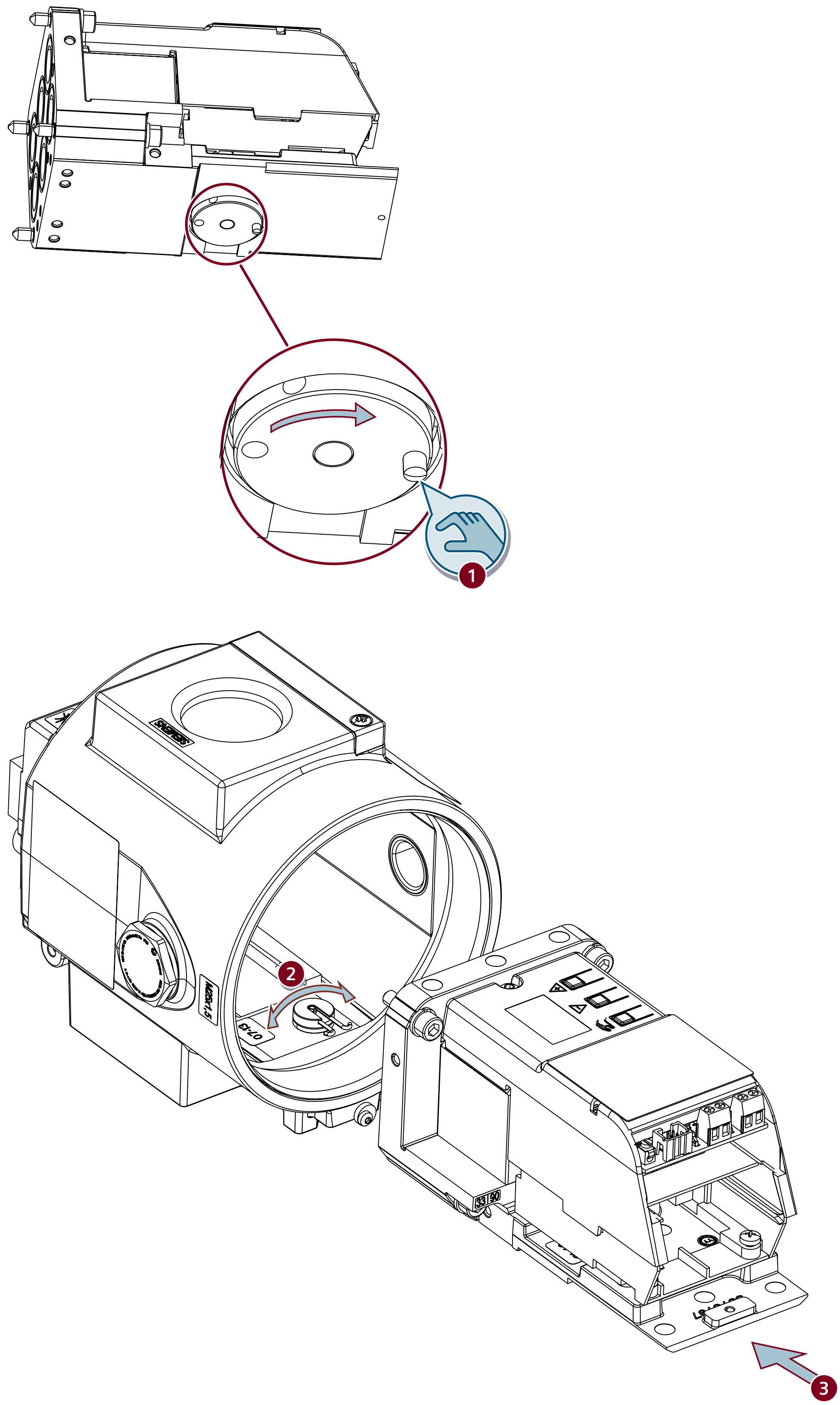
Procedure: Device version with "flameproof enclosure"

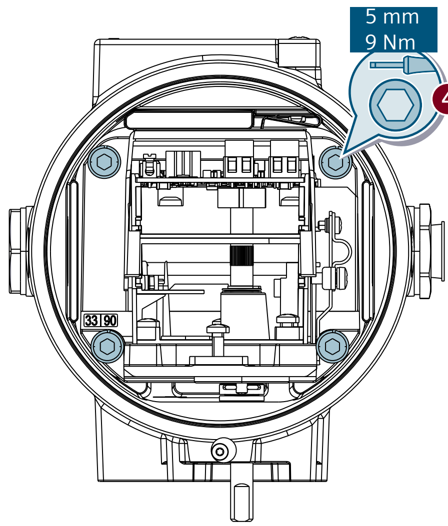
1. Ensure that the O-rings of the adapter and enclosure are in the correct position.

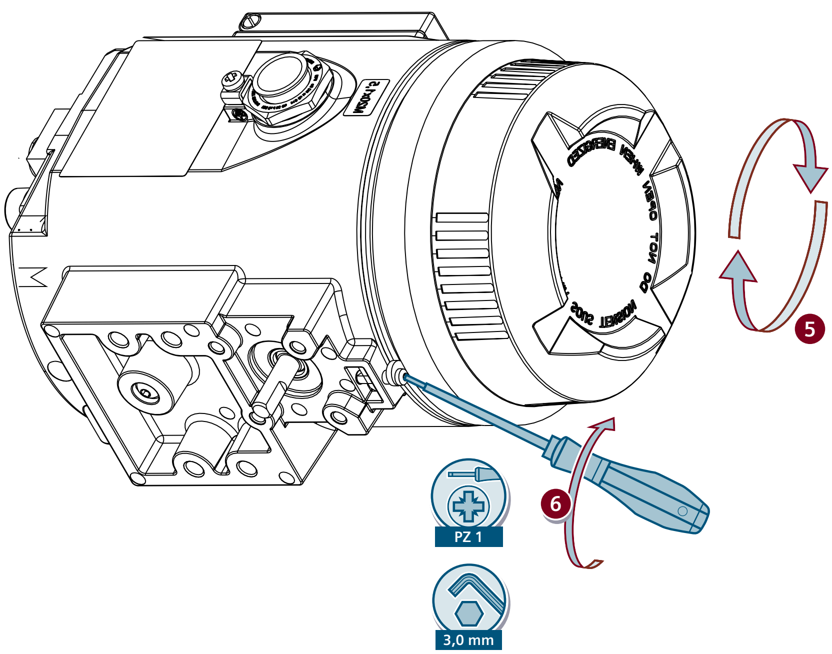




2. Insert the adapter into the enclosure.


1
2
3





See also

Analog Input Module (AIM) 6DR4004-6F / -8F (Page 66)

4.5 Setting and locking the transmission ratio

Introduction

Some positioner versions have a friction clutch and a transmission ratio selector. The positioner can therefore be used on a variety of mechanically different part-turn and linear actuators.

- The transmission ratio selector allows you to adapt the positioner to small or large strokes.
- You can then use the friction clutch to adjust the working area.

Strong acceleration forces act on control valves that are subjected to heavy mechanical loads, e.g. breakaway valves, strongly shaking or vibrating valves, as well as in case of "vapor shocks". These forces may be much higher than the specified data. This may move the transmission ratio in extreme cases. In these cases it is possible to lock the transmission ratio selector by means of the gear fixing.

When the positioner is mounted and fully operational, set the friction clutch as described in the section Setting the friction clutch (Page 115).

NOTICE
Wrong registration of the rotary or part-turn movement
A different setting of the transmission ratio selector and the gear latch results in a hysteresis in position detection. The hysteresis in position detection can result in unstable control response of the higher level control loop. • Make sure the transmission ratio selector ⑤ and the gear latch ① are set to the same value, either to 33° or to 90°.

Note

Use of external NCS sensor / internal NCS module

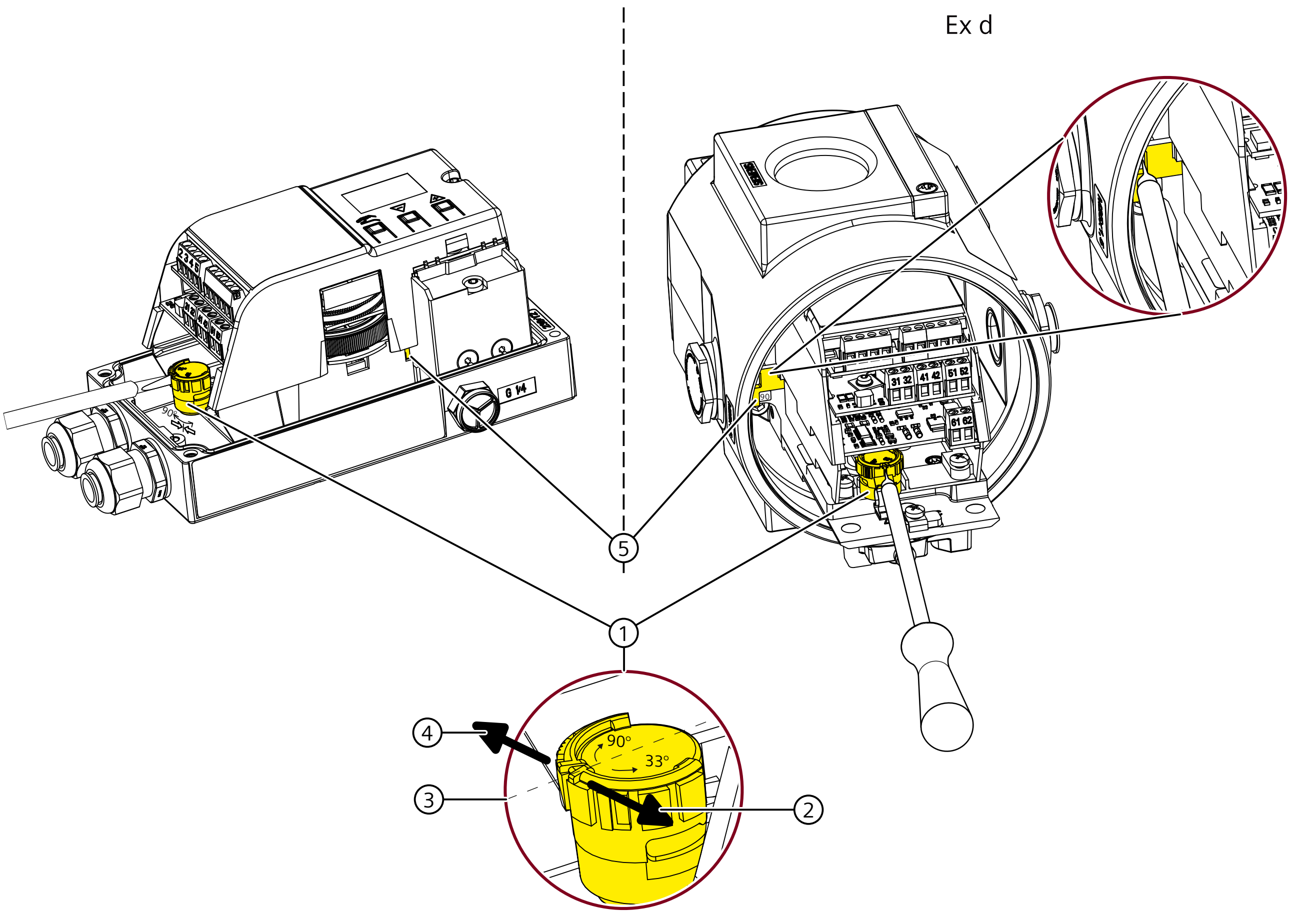
If you use the accessory part "NCS sensor for non-contacting position detection" or a built-in internal NCS module, the locking and fixing measures described in this section are **not** necessary.

Requirement

- The positioner is mounted.
- You know whether the transmission ratio is to be set to 33° or 90°.

Procedure

On the right in the graphic the positioner is shown in the flameproof enclosure Ex d with open cover. The procedure is the same for both enclosure versions.



① Wheel for gear latch (yellow)
② Locking transmission ratio to 33°
③ Neutral position
④ Locking transmission ratio to 90°
⑤ Transmission ratio selector (yellow)

Figure 4-13 Locking the transmission ratio

1. Ensure that the wheel for the gear latch ① is in neutral position ③. The neutral position is between 33° and 90°. The setting of the transmission ratio selector ⑤ can only be changed effectively if the gear latch ① is in the neutral position ③.
2. Make sure the transmission ratio selector ⑤ is set to the same value as the gear latch ①, either to 33° or to 90°.
3. Turn the wheel for the gear latch ① until the gear latch ① perceptibly locks. Use an approx. 4 mm wide standard screwdriver.
   Turning right locks the transmission ratio to 33° ②. Turning left locks the transmission ratio to 90° ④.

The transmission ratio ② is set and locked.

5 Connection

5.1 Basic safety instructions

WARNING

Lever for position detection

Danger of crushing and shearing with mounting kits which use a lever for position detection. During commissioning and ongoing operation, severing or squeezing of limbs could occur as a result of the lever. Risk of injury when working on control valves due to the high operating force of the pneumatic actuator.

- Do not reach into the range of motion of the lever following mounting of the positioner and mounting kit.

WARNING

With intrinsically device version (Ex i)

Risk of explosion in hazardous areas.

For intrinsically safe device versions only the certified circuits may be connected as auxiliary power supply, control and signal circuits.

- Make sure that the power source of the used circuits is marked as intrinsically safe.

WARNING

Leaky threads for "Flameproof enclosure Ex d / XP" type of protection

Risk of explosion in hazardous areas. Threads must be completely screwed into the enclosure.

- Screw the cable glands, thread adapter or blanking plug with at least 5 thread rotations into the enclosure.

WARNING

Unsuitable cables, cable glands and/or plugs

Risk of explosion in hazardous areas.

- Use only cable glands/plugs that comply with the requirements for the relevant type of protection.
- Tighten the cable glands in accordance with the torques specified in Technical specifications (Page 227).
- Close unused cable inlets for the electrical connections.
- When replacing cable glands, only use cable glands of the same type.
- After installation, check that the cables are seated firmly.

NOTICE

Ambient temperature too high

Damage to cable sheath.

- At an ambient temperature ≥ 60 °C (140 °F), use heat-resistant cables suitable for an ambient temperature at least 20 °C (36 °F) higher.

WARNING

Improper power supply

Risk of explosion in hazardous areas as result of incorrect power supply.

- Connect the device in accordance with the specified power supply and signal circuits. The relevant specifications can be found in the certificates, in Technical specifications (Page 227) or on the nameplate.

WARNING

Lack of equipotential bonding

Risk of explosion through compensating currents or ignition currents through lack of equipotential bonding.

- Ensure that the device is potentially equalized
- The cable cross-section of the equipotential bonding cable must be greater than or equal to the connecting cable of the electronics

WARNING

Unprotected cable ends

Risk of explosion through unprotected cable ends in hazardous areas.

- Protect unused cable ends in accordance with IEC/EN 60079-14.

WARNING

Improper laying of shielded cables

Risk of explosion through compensating currents between hazardous area and the non-hazardous area.

- Shielded cables that cross into hazardous areas should be grounded only at one end.
- If grounding is required at both ends, use an equipotential bonding conductor.

WARNING

Connecting or disconnecting device in energized state

Risk of explosion in hazardous areas.

- Connect or disconnect devices in hazardous areas only in a de-energized state.
- Install a suitable switch-off device.

Exceptions:

- Devices having the type of protection "Intrinsic safety Ex i" may also be connected in energized state in hazardous areas.

WARNING

Incorrect selection of type of protection

Risk of explosion in areas subject to explosion hazard.

This device is approved for several types of protection.

1. Decide in favor of one type of protection.
2. Connect the device in accordance with the selected type of protection.
3. In order to avoid incorrect use at a later point, make the types of protection that are not used permanently unrecognizable on the nameplate.

NOTICE

Standard cable gland/torque

Device damage.

- Owing the reasons pertaining to tightness (IP enclosure rating) and the required tensile strength, only use the cables having a diameter ≥ 8 mm for standard M20x1.5 cable gland, or use a suitable seal insert in case of smaller diameters.
- In the NPT version, the positioner is delivered with a coupling. When inserting a counter piece in the coupling, ensure that the maximum permissible torque of 10 Nm is not exceeded.

NOTICE
Condensation in the device
Damage to device through formation of condensation if the temperature difference between transportation or storage and the mounting location exceeds 20 °C (36 °F). • Before taking the device into operation, let the device adapt for several hours in the new environment.

Two-wire mode

NOTICE
Connection of voltage source to current input
Device damage if a voltage source is connected to the current input I_w (terminals 6 and 7). • Never connect the current input I_w to a low-resistance voltage source, otherwise the positioner may be destroyed. • Always use a high-impedance power source. • Observe the static destruction limit specified in the "Electrical data (HART) (Page 231)".

Note

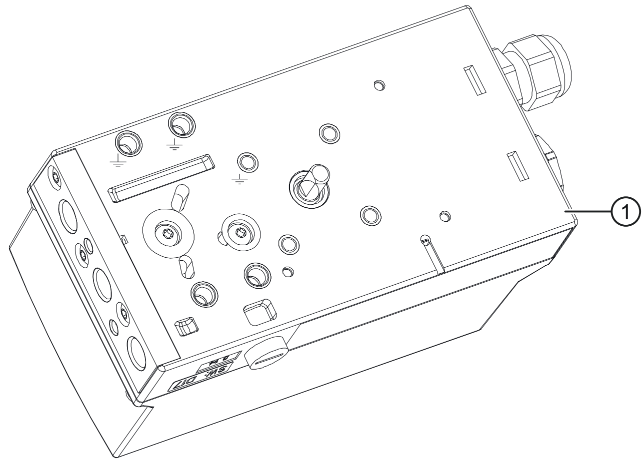
Improvement of interference immunity

- Lay signal cables separate from cables with voltages > 60 V.
- Use cables with twisted wires.
- Keep device and cables at a distance from strong electromagnetic fields.
- Take account of the conditions for communication specified in the Electrical data (HART) (Page 231).
- Use shielded cables to guarantee the full specification according to HART/PA/FF/Modbus/EIA-485/Profibus DP.

Electromagnetic compatibility

The polycarbonate enclosure is metalized from inside to increase the electromagnetic compatibility (EMC) with respect to high-frequency radiation. The shield is connected to the threaded bush shown in the following picture such that it is electrically conductive.

Note that this protection is effective only if you connect at least one of these bushes to the earthed control valves through electrically conductive (bare) attachments.

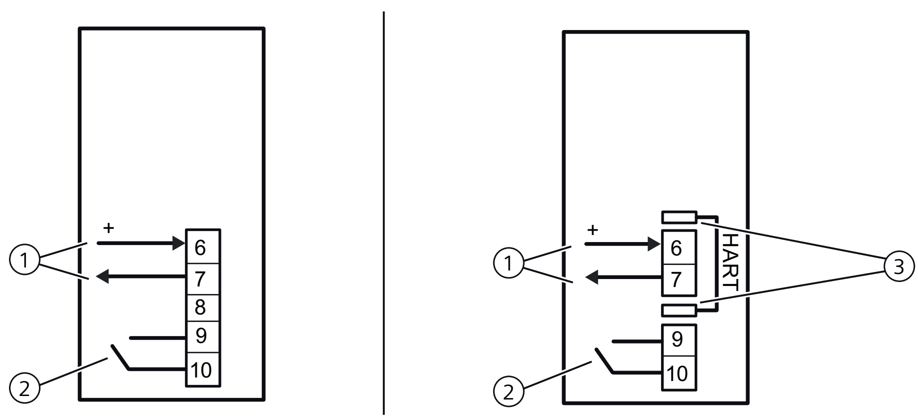


⏚ Shield

Figure 5-1 Base plate ①

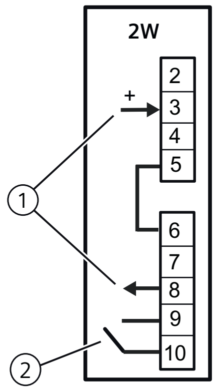
5.2 Electrical wiring

5.2.1 Electronics



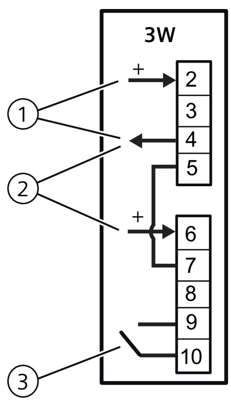
① Setpoint 4 ... 20 mA, terminals 6 and 7
② Digital input DI1, terminals 9 and 10
③ HART connection

Figure 5-2 Connection diagram for electronics, 2-wire



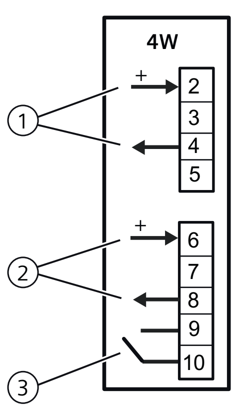
① Setpoint 4 ... 20 mA, terminals 3 and 8
② Digital input DI1, terminals 9 and 10

Figure 5-3 Connection diagram for electronics, 2/3/4-wire, with wiring configuration 2-wire



① Power source 18 ... 30 V, terminals 2 and 4
② Setpoint 0/4 ... 20 mA, terminals 6 and 4
③ Digital input DI1, terminals 9 and 10

Figure 5-4 Connection diagram for electronics, 2/3/4-wire, with 3-wire wiring configuration



① Power source 18 ... 30 V, terminals 2 and 4
② Setpoint 0/4 ... 20 mA, terminals 6 and 8
③ Digital input DI1

Figure 5-5 Connection diagram for electronics, 2/3/4-wire, with wiring configuration 4-wire

5.2.2 HART: Split range

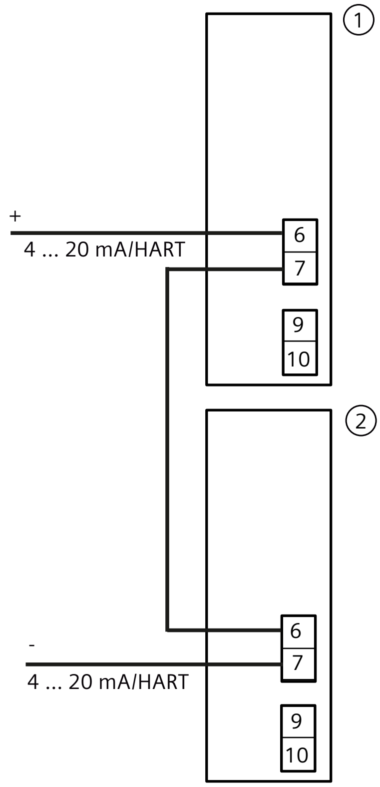
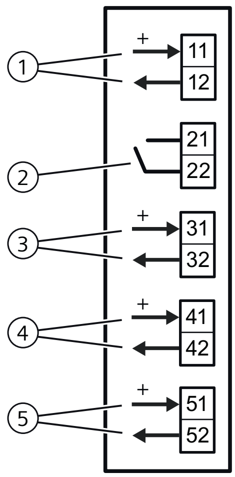


Figure 5-6 Series connection of 2 positioners ①, ②

5.2.3 Option modules

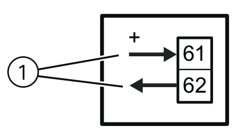
5.2.3.1 Digital I/O Module (DIO) 6DR4004-6A / -8A



① Digital input 2, galvanically isolated
② Digital input 2, floating contact
③ Fault message output
④ Digital output 1
⑤ Digital output 2

Figure 5-7 Digital I/O Module (DIO)

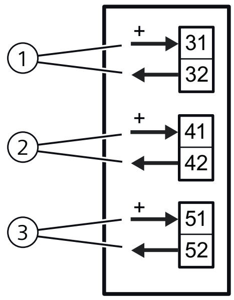
5.2.3.2 Analog Output Module (AOM) 6DR4004-6J / -8J



① Analog output AO

Figure 5-8 Analog Output Module (AOM)

5.2.3.3 Inductive Limit Switches (ILS) 6DR4004-6G / -8G

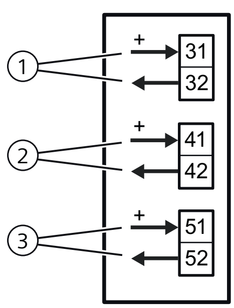


① Fault message output, has no function in combination with 6DR4004-3ES
② Digital output 1
③ Digital output 2

Figure 5-9 Inductive Limit Switches (ILS)

5.2.3.4 Mechanic Limit Switches (MLS) 6DR4004-6K

Connection diagram Mechanic Limit Switches (MLS) 6DR4004-6K



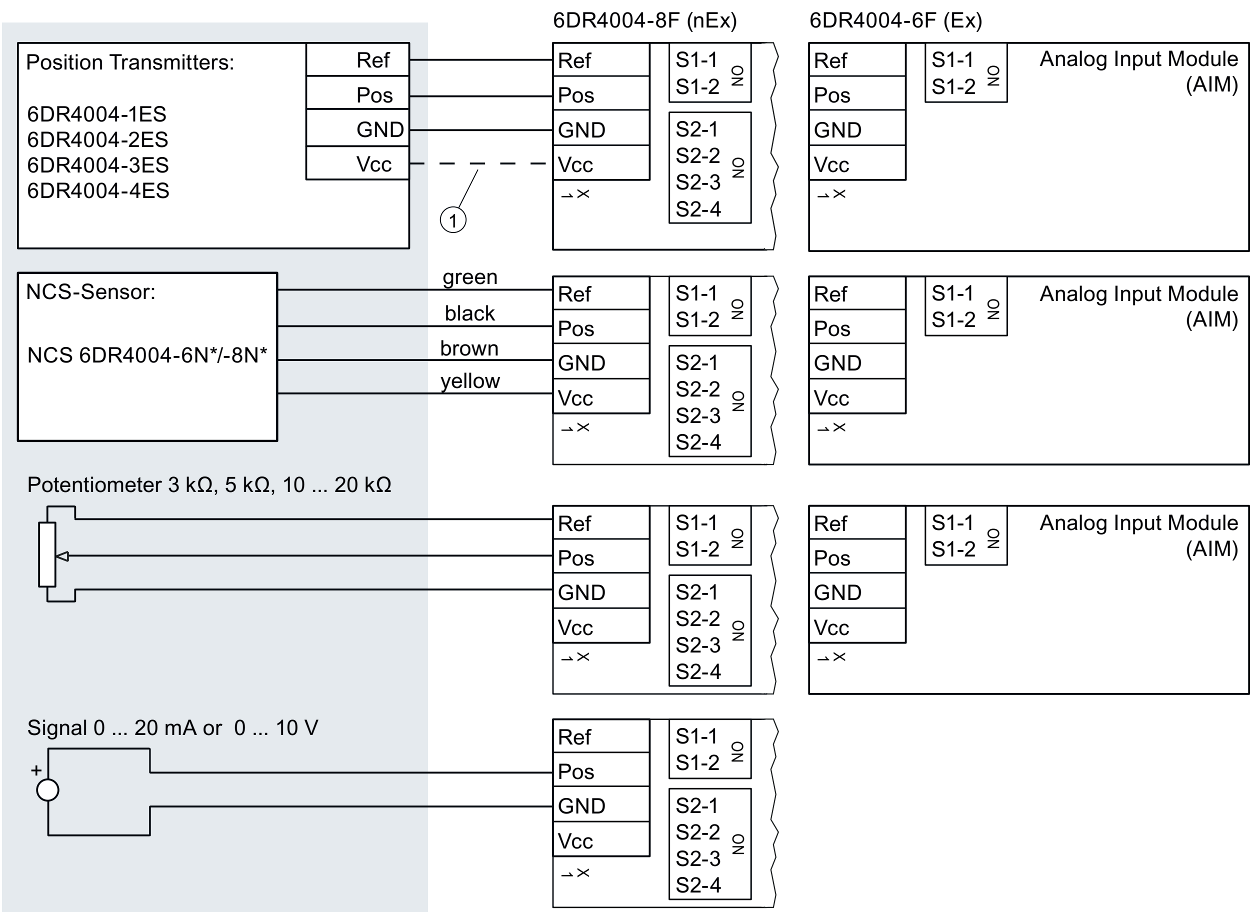
① Fault message output, has no function in combination with 6DR4004-4ES
② Digital output 1
③ Digital output 2

Figure 5-10 Mechanic Limit Switches (MLS)

5.2.3.5 Analog Input Module (AIM) 6DR4004-6F / -8F

Procedure

Connect the external position detection as follows.



① Connection of terminal Vcc is only needed for 6DR4004-2ES, -3ES and -4ES.

If potentiometers or external signal sources are used, configure the switch blocks in accordance with the following table:

Measuring range	Switch block 1			Switch block 2			
	S1-1	S1-2		S2-1	S2-2	S2-3	S2-4
6DR4004-.N/P/R (NCS)	ON	OFF		ON	OFF	OFF	OFF
6DR4004-1ES/-2ES/-3ES/-4ES	ON	OFF		ON	OFF	OFF	OFF
10 ... 20 kΩ	ON	OFF		ON	OFF	OFF	OFF
5 kΩ	OFF	ON		ON	OFF	OFF	OFF
3 kΩ	OFF	OFF		ON	OFF	OFF	OFF
20 mA	OFF	OFF		ON	OFF	ON	OFF
10 V	OFF	OFF		OFF	ON	OFF	OFF

5.2.4 Optional version M12 device plug

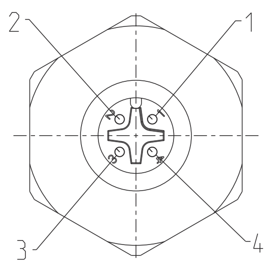
This section describes which terminal of the devices and option modules listed below is connected with the respective pole of the M12 connector.

Note

Technical specifications

Observe the specifications for the electrical data in the certificate and/or in section "Technical specifications (Page 227)".

View of the mating side pole pattern



Pole designation	Wire color of M12 basic connector socket
1	Brown
4	Black
3	Blue
2	White

5.2.4.1 M12 connector in basic device with and without HART

You have a positioner 6DR50/1..-0.**R**.. or 6DR50/1..-0.**S**. In this version of the positioner, the current input I_W 4 to 20 mA of the electronics is connected via the M12 device plug.

Table 5-1 Assignment diagram

Current input terminal	Pole designation
6 (+)	1 - Brown
Shield support of enclosure	4 - Black
7 and 8 (-)	3 - Blue

5.2.4.2 M12 Connector in Basic Device with Analog Output Module (AOM) 6DR4004-6J / -8J (-Z D53)

You have a positioner with order suffix -Z order code D53. In this version of the positioner, the current output of Analog Output Module (AOM) is electrically connected to the M12 connector.

Table 5-2 Assignment diagram

Current output terminal	Pole designation
61 (+)	1 - Brown
Shield support of enclosure	4 - Black
62 (-)	3 - Blue

5.2.4.3 In the basic unit with Position Transmitter (-Z D54)

You have a positioner with order suffix -Z order code D54. In this version of the positioner, the installed Analog Input Module (AIM) 6DR4004-6F/-8F is electrically connected to the M12 connector. You connect the Position Transmitter 6DR4004-1ES/-2ES using the M12 connector.

Table 5-3 Assignment diagram

Terminal	Pole designation
REF	2 - White
POS	3 - Blue
GND	4 - Black
VCC	1 - Brown

5.2.4.4 In the basic unit with Digital I/O Module (DIO) 6DR4004-6A / -8A (-Z D55)

You have a positioner with order suffix -Z order code D55. In this version of the positioner, the current output of Digital I/O Module (DIO) is electrically connected to the M12 connector.

Table 5-4 Assignment diagram

Terminal of digital outputs A1 and A2	Pole designation
41 (+)	1 - Brown
52 (-)	4 - Black
42 (-)	3 - Blue
51 (+)	2 - White

5.2.4.5 In the basic unit with Inductive Limit Switches (ILS) 6DR4004-6G /-8G (-Z D56)

You have a positioner with order suffix -Z order code D56. In this version of the positioner, the digital outputs A1 and A2 of the Inductive Limit Switches (ILS) are electrically connected to the M12 device plug.

Table 5-5 Assignment diagram

Terminal of digital outputs A1 and A2	Pole designation
41 (+)	1 - Brown
52 (-)	4 - Black
42 (-)	3 - Blue
51 (+)	2 - White

5.2.4.6 In the basic unit with Mechanic Limit Switches (MLS) 6DR4004-6K (-Z D57)

You have a positioner with order suffix -Z order code D57. In this version of the positioner, the digital outputs A1 and A2 of the Mechanic Limit Switches (MLS) are electrically connected to the M12 connector.

Table 5-6 Assignment diagram

Terminal of digital outputs A1 and A2	Pole designation
41 (+)	1 - Brown
52 (-)	4 - Black
42 (-)	3 - Blue
51 (+)	2 - White

5.3 Pneumatic connection

5.3.1 Basic safety instructions for the pneumatic connection

WARNING

Supply pressure PZ

For safety reasons, the supply pressure PZ can be fed after installation only if the positioner is switched to "P-manual mode" when an electrical signal is present. This operating mode is preset in the delivery state.

Note

Specifications regarding air quality

Observe the specifications regarding the air quality in section "Technical specifications > Pneumatic data for all device versions (Page 228)".

Note

Leakage

Besides continuous air consumption, a leakage can cause the positioner to try to compensate the position deviation. This will result in premature wear in the entire control device.

- Check offline for leakage using the "11.LEAK" diagnostic value.
- If there is leakage, check the pneumatic connections for leaks.

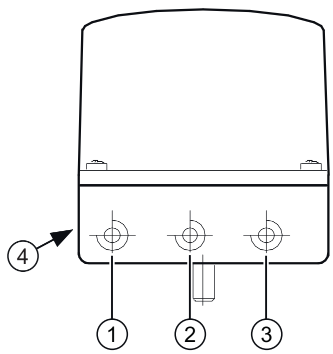
See also

Behavior in case of failure of the electrical auxiliary power and/or the supply pressure PZ (Page 92)

Changing the operating mode (Page 99)

5.3.2 Pneumatic connection in non-flameproof enclosure

5.3.2.1 Structure of pneumatic connection



① Output: Actuating pressure Y2 *)
② Input: Supply pressure PZ
③ Output: Actuating pressure Y1
④ Exhaust air outlet with sound absorber, thread G¼

*) for double-acting actuators

Figure 5-11 Pneumatic connection, example

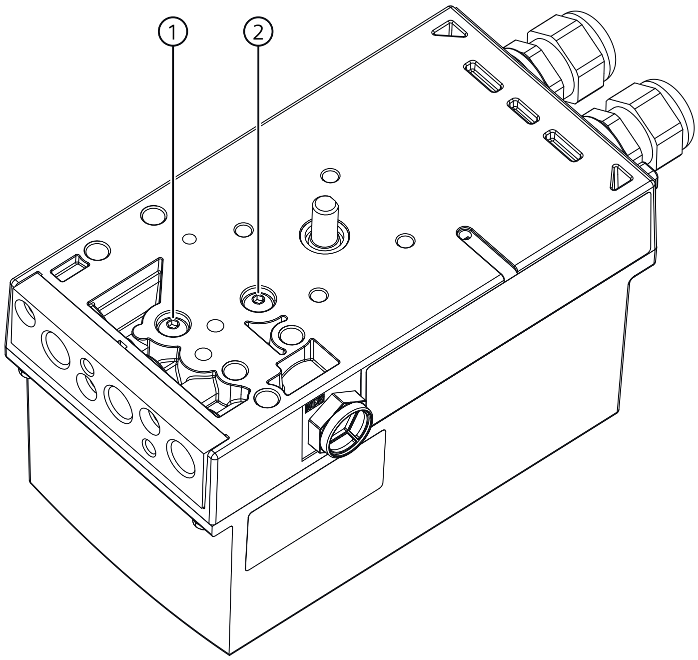
5.3.2.2 Integrated pneumatic connection

The following pneumatic connections are provided at the rear side of the basic device for the integrated attachment for single-acting linear actuators:

- Actuating pressure Y1
- Exhaust air outlet

These connections are sealed with screws when the device is delivered.

The exhaust air outlet is corrosion-resistant for the blanketing of the pick-up room and the spring chamber with dry instrument air.



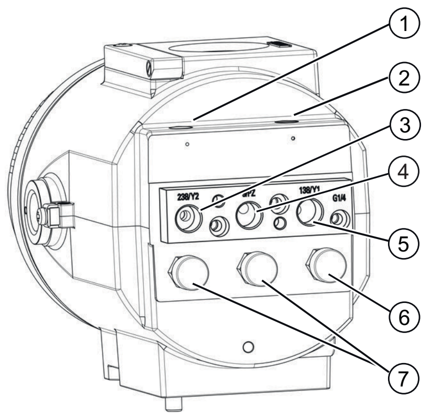
① Actuating pressure Y1
② Exhaust air outlet

Figure 5-12 Integrated pneumatic connection

5.3.3 Pneumatic connection in the flameproof enclosure

Structure

The pneumatic connections are provided on the right side of the positioner.



1. Restrictor Y2 *)
2. Restrictor Y1
3. Output: Actuating pressure Y2 *)
4. Input: Supply pressure PZ

5. Output: Actuating pressure Y1
7. Enclosure ventilation (2x)
6. Exhaust air outlet

*) for double-acting actuators

Figure 5-13 Pneumatic connection in the flameproof enclosure

5.3.4 Behavior in case of failure of the electrical auxiliary power and/or the supply pressure PZ

Overview

⚠ CAUTION
Note the following before working on the control valve
Note that, before working on the control valve, you must first move it to the safety position. Make sure that the process valve has reached the safety position. If you only interrupt the supply pressure PZ to the positioner, the safety position may in some cases only be attained after a certain delay period.

The difference between a failure of supply pressure PZ and a failure of electrical auxiliary power:

- Failure of **electrical auxiliary power** means:
  - Device version 2-wire: Failure of signal source 4 to 20 mA
  - Device version 3/4-wire: Failure of power source 18 to 30 V
- Failure of the **supply pressure PZ**

With 3-wire/4-wire device version, the 0% position is approached if the 4 to 20 mA signal source fails. The following table shows the pneumatic connection versions for different actuator types, regulating action and safety position after failure.

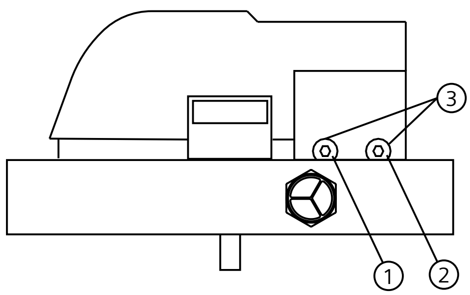
Table 5-7 Behavior in case of failure:

	Single-acting actuator type	Double-acting actuator type
Fail to close		
• Failure of electrical auxiliary power	Y1 = depressurized	Y1 = pressurized Y2 = depressurized
• Failure of supply pressure PZ	Y1 = depressurized	Y1 = closed Y2 = closed
Fail in place, order suffix F01 or 6DR5...-.....-..F*		
• Failure of electrical auxiliary power	Y1 = closed	Y1 = closed Y2 = closed
• Failure of supply pressure PZ	Y1 = closed	Y1 = closed Y2 = closed
Fail to Open 6DR5...-.....-..G*		
• Failure of electrical auxiliary power	Y1 = pressurized	Y1 = pressurized Y2 = depressurized
• Failure of supply pressure PZ	Y1 = closed	Y1 = closed Y2 = closed

With single-acting actuator type, the actuator goes to safety setting.

5.4 Restrictors

- Reduce the air output to achieve travel times of T > 1.5 s for small actuators. Use restrictors Y1 ① and Y2 ② for this purpose.
- When turned clockwise, they reduce the air output and finally shut it off.
- In order to set the restrictors, we recommend closing them and then opening slowly.
- In case of double-acting valves, ensure that both restrictors have approximately the same setting.



① Restrictor Y1
② Restrictor Y2, only in the version for double-acting actuators *)
③ Hexagon socket-head screw 2.5 mm

Figure 5-14 Schematic representation

*) Restrictor Y2 ② is not active for single-acting Fail in Place (order suffix F01).

See also

Sequence of automatic initialization (Page 110)

Operating 6

6.1 Operating elements

6.1.1 Display

Introduction

Note

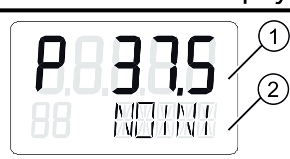
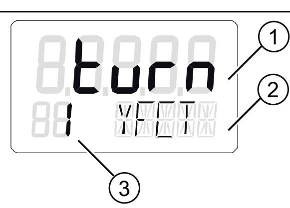
Repetition rate display

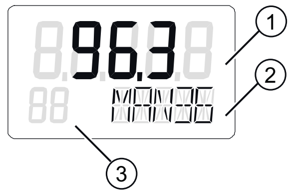
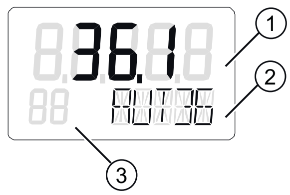
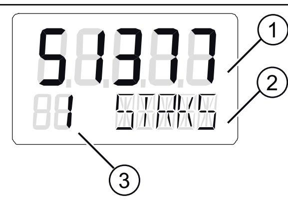
When operated in temperature ranges below -10°C, the liquid crystal display of the positioner becomes sluggish and the repetition rate display reduces considerably.

The display has two lines. These two lines are segmented differently. Each element in the upper line has 7 segments, whereas that in the lower line has 14 segments. Contents of the display depend on the selected mode.

Display options as per the mode

An overview of mode-specific display options is given below.

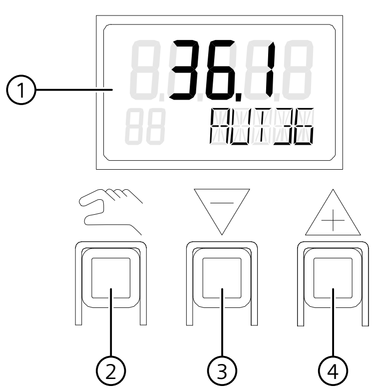
Operating mode	Representation in the display	Pos.	Legend
P manual mode		①	Sensor setting [%]
		②	Blinking indicator for the non-initialized status.
Initialization mode		①	Sensor setting [%]
		②	Display of the current status of initialization or a fault message.
		③	Indicator for ongoing initialization or a fault message.
Configuring		①	Parameter value
		②	Parameter name
		③	Parameter number

Operating mode	Representation in the display	Pos.	Legend
Manual mode (MAN)		①	Position [%]
		②	Setpoint [%]
		③	Fault message
Automatic (AUT)		①	Position [%]
		②	Setpoint [%]
		③	Fault message
Diagnostics		①	Diagnostics value
		②	Diagnostics name
		③	Diagnostics number

See also

Changing the operating mode (Page 99)

6.1.2 Buttons



① Display
② Operating mode button
③ Decrement button
④ Increment button

Figure 6-1 Display and buttons of the positioner

- You can use three buttons to operate the positioner.
- The function of the buttons depends on the mode selected.
- In a positioner with a flameproof enclosure, the buttons are protected by a lid. The button lid can be opened after unlatching the locking screw.

Note

Button lid

In positioners with flameproof enclosures, the button lid prevents liquids from seeping through. The IP66 / type 4X degree of protection is not ensured when the enclosure or the button lid is open.

You have to remove the enclosure lid to operate the buttons of the basic device or the "intrinsically safe" version.

Note

Degree of protection

The IP66 / type 4X degree of protection is not ensured as long as the positioner is open.

Function of buttons:

- The button is used to select the modes and to forward the parameters.
- The ▽ button is used to select parameter values in "Configuration" mode. You can use this button to move the actuator in "Manual" mode.
- The △ button is also used to select parameter values in "Configuration" mode. You can use this button to move the actuator in "Manual" mode.

Note

Order

Parameters are activated in the reverse order when the and ▽ buttons are pressed simultaneously.

6.1.3 Firmware version

The current firmware version is displayed when you exit the operating mode "Configuration".

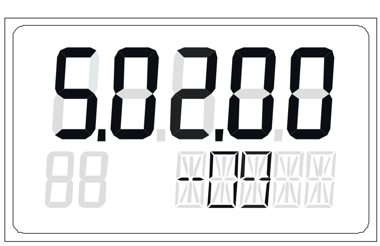


Figure 6-2 Firmware version, example

6.2 Operating modes

6.2.1 Overview of operating modes

You have five operating modes at your disposal to operate the positioner:

1. P-manual mode (as-delivered condition)
2. Configuration and initialization mode
3. Manual mode (MAN)
4. Automatic (AUT)
5. Diagnostics

6.2.2 Changing the operating mode

The following picture illustrates the available operating modes and switching between the operating modes.

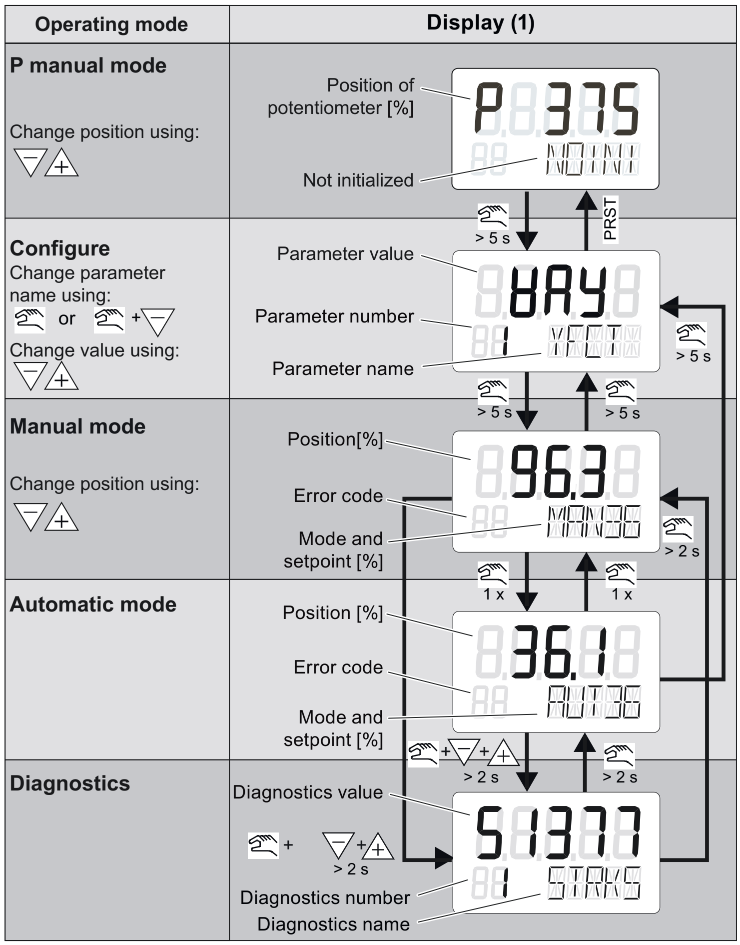


Figure 6-3 Switching between the operating modes

See also

Display (Page 95)

6.2.3 Overview of configuration

The following picture illustrates the handling of operating modes such as "Configuration" and "Initialization mode":

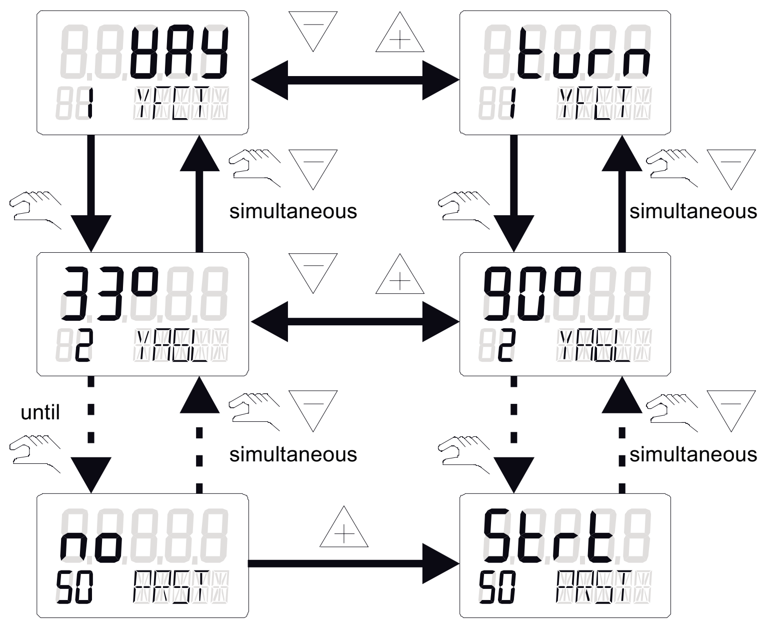


Figure 6-4 Overview of the "Configuration" operating mode

6.2.4 Description of operating modes

P manual mode

Note

Delivery state

The "P manual mode" is preset for the positioner in the delivery state.

The display of the positioner shows the current potentiometer position in the upper line. "NOINI" flashes in the second line of the display.

Move to the actuator with the ▽ or △ buttons.

Switch to "Configuration" mode to adapt the actuator to the positioner.

Alarms or position feedbacks can be triggered after initializing the positioner completely.

Configuration and initialization

To get to the "Configuration" mode, press the button for at least 5 seconds.

You can use the "Configuration" mode to adjust the positioner individually as per your actuator and start commissioning or initialization.

The positioner reports the "Configuration" mode with a configurable fault message. A position feedback or display of limits A1 and A2 is not possible.

Note

Failure of electrical auxiliary power

If electrical auxiliary power supply fails when configuring, the positioner responds as follows when the power supply is reestablished:

- The positioner switches over to the first parameter.
- Settings of the values already configured are retained.

In order to save the changed parameter values, exit the "Configuration" mode or switch to another parameter. When "Configuration" mode is restarted, the output in the display switches to the last activated parameter.

Manual mode (MAN)

In this mode, you move the actuator with ▽ or △. The positioner holds the selected position irrespective of the setpoint current or any leakages that have occurred.

Note

Accelerating the actuator movement

Proceed as follows:

1. Keep one of the two direction buttons pressed.
2. Press the remaining direction button simultaneously.

Note

Power supply failure

When the power supply is reestablished after a failure, the positioner switches to "Automatic" mode.

Automatic (AUT)

In this mode, the positioner compares the setpoint position with the actual position. The positioner moves the actuator until the control deviation reaches the configurable deadband. If the deadband is not reached, a fault message is output.

Diagnostics

Proceed as follows to call the "Diagnostics" mode from the "Automatic" or "Manual" modes:

- Press the 3 buttons on the display ▭ ▽ △ simultaneously for at least 2 seconds.

Current operating data can be called and displayed in this mode, e.g.:

- Number of total strokes
- Number of changes in direction
- Number of fault messages

> **Note**
>
> **Setting the mode**
>
> The "Automatic" and "Manual" modes remain set when switching to the "Diagnostics" mode. The positioner responds as per the configured mode:
> - The predefined setpoint is used as the control variable in "Automatic" mode.
> - The last reached position is retained in "Manual" mode.

See also

Overview (Page 109)

6.2.5 Optimization of controller data

> **Note**
>
> **Initializing**
>
> Initialize the positioner automatically before changing the parameter settings to meet the specific requirements.

The positioner determines the data for control quality automatically during the initialization process.

The data determined is optimized for a short transient time in the case of minor overshoots.

The adjustment can be accelerated or the attenuation can be intensified by optimizing the data.

The following special cases are suitable for targeted data optimization:

- Small actuators with travel times < 1 s.
- Operation with boosters, described in section "Booster commissioning (Page 298)"

Procedure

In order to optimize the controller data, change the values of the diagnostic values listed below.

- Pulse length UP (23.IMPUP) / Pulse length DOWN (24.IMPDN)
- Slow step zone UP (28.SSUP) / Slow step zone DOWN (29.SSDN)
- Prediction UP (47.PRUP) / Prediction DOWN (48.PRDN)

The modified diagnostics values are effective immediately. The effects on the controller results can then be tested.

Diagnostic values	**Pulse length UP (direction 100% position)** **Short designation: 23.IMPUP** **Pulse length DOWN (direction 0% position)** **Short designation: 24.IMPDN**
Function	The smallest possible pulse lengths that can be used to move the actuator are determined during the initialization. The pulse lengths are determined separately for the UP direction (direction 100% position) and the DOWN direction (direction 100% position) and displayed in these diagnostic values.
Note	The optimum value depends in particular on the volume of the actuator. The values can be adapted if needed: • Low values lead to small actuating pulses and frequent activation of the actuator. • Large values are advantageous for large actuator volumes.
Setting range	6 ... 160
Factory setting	6
Unit	ms (milliseconds)

Change pulse length

Note

Pulse length

- There is no movement if the values are too small.
- High values also lead to large movements with small actuators.

1. Switch the positioner to "Diagnostics" mode by pressing the 3 buttons on the display ▽ △ simultaneously for at least 2 seconds.
2. Select the diagnostic value.
3. Activate the setting function by pressing the △ or ▽ button for at least 5 seconds.
4. Set the diagnostic values to the desired values.
5. Switch the positioner to "Manual (MAN)" or "Automatic (AUT)" mode by pressing the button for at least 2 seconds.

Diagnostic values	**Slow step zone UP (direction 100% position)** **Short designation: 28.SSUP** **Slow step zone DOWN (direction 0% position)** **Short designation: 29.SSDN**
Function	The diagnostic values define the size of the slow step zones as a percentage. The slow step zone is the area of mean control deviation.
Notes	The values are taken into account for the initialization. The values can be adapted if needed. • A low value means: High actuating speeds are achieved even with small setpoint changes. • A high value means: Overshoot is reduced in the event of large setpoint changes. • If the system deviation is greater than the value of the slow step zone, the pneumatic outputs are permanently activated. • If the system deviation is less than the value of the slow step zone, the pneumatic outputs are clock controlled. The clock pulse length is proportional to the size of the system deviation. Pneumatic outputs: • Single-acting: Output Y1 • Double-acting: Outputs Y1 and Y2
Setting range	0.1 ... 100.0
Factory setting	10.0
Unit	%

Change the size of the slow step zone

NOTICE
Overshoots or too low speeds of shifting Values too small for the slow step zones can cause overshooting. • Enter a higher value. Values too high for the slow step zones lead to slow actuating speeds close to the compensated state. • Enter a smaller value.

1. Switch the positioner to "Diagnostics" mode by pressing the 3 buttons on the display simultaneously for at least 2 seconds.
2. Select the diagnostic value.
3. Activate the setting function by pressing the or button for at least 5 seconds.
4. Set the diagnostic values to the desired values.
5. Switch the positioner to "Manual (MAN)" or "Automatic (AUT)" mode by pressing the button for at least 2 seconds.

Diagnostic values	**Prediction UP (direction 100% position)** **Short designation: 47.PRUP**
	Prediction DOWN (direction 0% position) **Short designation: 48.PRDN**
Function	The diagnostic values show the predictions of the positioner for the upward movement (direction 100% position) and the downward movement (direction 0% position) The diagnostic values act as damping factors to set the control dynamics.
Notes	The values are taken into account for the initialization. The values can be adapted if needed. Changes in the diagnostic values have the following effect: • Small values result in quick adjustments with overshoots. • Large values result in slow adjustments without overshoots.
Setting range	1 ... 40
Factory setting	1

Change the diagnostic value

1. Switch the positioner to "Diagnostics" mode by pressing the 3 buttons on the display simultaneously for at least 2 seconds.
2. Select the diagnostic value.
3. Activate the setting function by pressing the or button for at least 5 seconds.
4. Set the diagnostic values to the desired values.
5. Switch the positioner to "Manual (MAN)" or "Automatic (AUT)" mode by pressing the button for at least 2 seconds.

Commissioning 7

7.1 Basic safety instructions

⚠ WARNING
Lever for position detection
Danger of crushing and shearing with mounting kits which use a lever for position detection. During commissioning and ongoing operation, severing or squeezing of limbs could occur as a result of the lever. Risk of injury when working on control valves due to the high operating force of the pneumatic actuator.
• Do not reach into the range of motion of the lever following mounting of the positioner and mounting kit.

⚠ WARNING
Improper commissioning in hazardous areas
Device failure or risk of explosion in hazardous areas.
• Do not commission the device until it has been mounted completely and connected in accordance with the information in Technical specifications (Page 227).
• Before commissioning take the effect on other devices in the system into account.

⚠ WARNING
Commissioning and operation with error message
If an error message displays, correct operation is no longer guaranteed.
• Check the severity of the error.
• Correct the error.
• If the error still exists:
– Take the device out of operation.
– Do not restart the device.
The same risk continues to apply when error messages are switched off or disabled.

⚠ WARNING
Loss of explosion protection
Risk of explosion in hazardous areas if the device is open or not properly closed.
• Close the device as described in Installing/mounting (Page 31).

WARNING

Opening device in energized state

Risk of explosion in hazardous areas

- Only open the device in a de-energized state.
- Check prior to commissioning that the cover, cover locks, and cable inlets are assembled in accordance with the directives.

Exception: Devices having the type of protection "Intrinsic safety Ex i" may also be opened in energized state in hazardous areas.

WARNING

Water in compressed air line

Device damage.

The factory setting for the purging air selector is "IN". In the "IN" position, water from the compressed air line may enter the device from the pneumatics during initial commissioning.

- Before commissioning, make sure that no water is present in the compressed air line.

If you cannot be sure that there is no water in the compressed air line:

- Set the purging air selector to "OUT". In this way, you prevent water from the compressed air line from penetrating the device.
- Only set the purging air selector to "IN" again when all water has been discharged from the compressed air line.

CAUTION

Increased sound pressure level

Changes to the sound absorber of the positioner or the mounting of pneumatic components or pneumatic options on the positioner can cause a sound pressure with a level of 80 dBA to be exceeded.

- Wear suitable hearing protection to protect yourself against hearing damage.

When operating the positioner with natural gas, you must follow and adhere to the following safety notes:

WARNING

Operation with natural gas

1. Only positioners and option modules which are connected to power supplies with type of protection "Intrinsic safety, protection level [ia]" may be operated with natural gas.
2. Do not operate the positioner with natural gas in closed spaces.
3. Natural gas is continuously blown off, depending on the model. Special care must therefore be taken during maintenance activities near the positioner. Always ensure that the immediate surroundings of the positioner are adequately ventilated.
   The maximum values for ventilation are listed in section "Technical specifications (Page 227)".
4. If you operate the positioner with natural gas, it is not permitted to use Mechanic Limit Switches (MLS).
5. You must depressurize devices operated with natural gas adequately for maintenance work. Open the lid in an explosion-free atmosphere and depressurize the device for at least two minutes.

Note

Quality of natural gas

Only use natural gas which is clean, dry and free from additives.

7.2 Overview

Note

- During the initialization process, the operating pressure must be at least one bar more than that required to close or open the valve. However, the operating pressure should not be greater than the maximum permissible operating pressure for the actuator.

General information about commissioning

1. After installing the positioner on a pneumatic actuator, you must supply electric and pneumatic auxiliary power to it.
2. The positioner is in the "P manual mode" before initialization. At the same time, "NOINI" blinks in the lower line of the display.
3. Adjust the positioner as per the respective actuator with the help of the initialization process and by setting the parameters. If required, use the "PRST" parameter to cancel the adjustment of the positioner on the actuator. The positioner is again in the "P manual mode" after this process.

Types of initialization

The following initialization types are available:

- Automatic initialization
  The optional manual setting of parameters optimally adapts the positioner to the valve.
- Manual initialization
  Use this function to initialize the positioner and define the end positions manually.

Parameter setting in the initialization types

- Automatic: The positioner automatically determines and adjusts the parameters.
- Adjustable: Manual adaptation by the user.

	Automatic initialization	Manual initialization
Actuator type	Adjustable	Adjustable
Direction of action	Adjustable	Adjustable
Limit positions	Automatically	Adjustable
Travel times of the actuator	Adjustable	Adjustable
Leakage measurement	Adjustable	Adjustable
Operation with boosters	Adjustable	Adjustable

Replacing the positioner during operation

The initialization data of a positioner can be read out via the communications interface and copied to another positioner.

A defective device can thus be exchanged without interrupting an ongoing process through initialization.

See also

Overview of operating modes (Page 98)

7.3 Sequence of automatic initialization

7.3.1 Sequence of automatic initialization

Overview

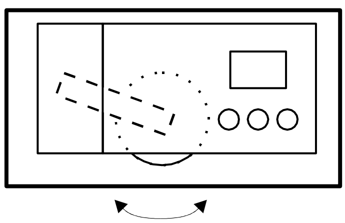
The automatic initialization takes place in the following phases:

Automatic initialization phase	Description
Start	-
RUN 1	Determination of direction of action.

Automatic initialization phase	Description
RUN 2	Check of actuator travel and adjustment of lower and upper endstops.
RUN 3	Determination and display of the travel time (leakage test)
RUN 4	Minimization of controller increments
RUN 5	Optimization of the transient response
RUN 6 with option -Z P02	Recording of the Valve Signature (VS)
End	-

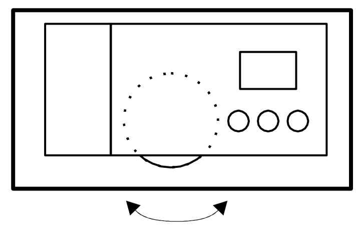
The following structured charts describe the sequence of initialization. The "Up/Down" names indicate the direction of action of actuators.

Linear actuator



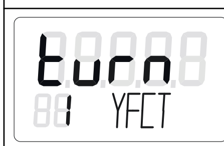
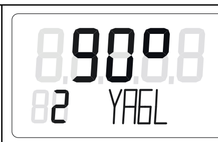
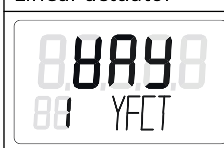
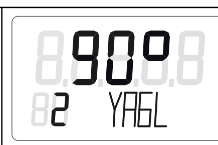
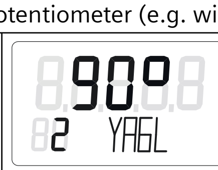
Open **Closed**

Part-turn actuator



Closed **Open**

7.3.2 Determining the actuator type

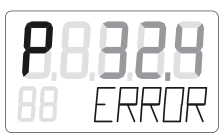
Part-turn actuator		
		
Linear actuator		
		
Linear actuator - external linear potentiometer (e.g. with cylinder drives)		
		

7.3.3 Starting automatic initialization

	Press △ > 5 s. The remaining steps run automatically.

7.3.4 RUN 1: Determination of direction of action

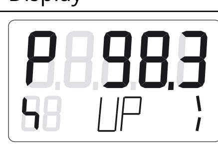
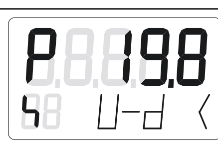
Possible messages

Display	Meaning	Measures
 	Actuator does not move.	Acknowledge message with: • Pressure supply checked? • Restrictor(s) checked and, if necessary, opened? Move the actuator into the working area with: ▽ △ Restart device. Repeat initialization.

7.3.5 RUN 2: Determination of travel

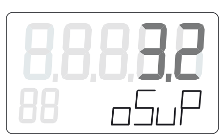
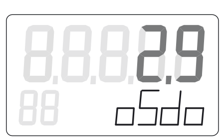
	Determination of the travel. Zero point and stroke are adjusted from endstop to endstop.

Possible messages

Display	Meaning	Measures
	Measuring range of distance detection exceeded.	Calibrate the electronics using the diagnostic value "73.RPL_E".
	The "UP-Down" span is undershot.	Acknowledge message with: Set the next lower stroke value on the lever. Restart the initialization.

7.3.6 RUN 3: Determination and display of travel time (leakage test)

<table>
<tr><td rowspan="4"></td><td colspan="2">The travel time is determined and displayed with "down" (dxx.x) and "up" (Uxx.x). The time between 17% and 83% travel is measured. The result extrapolated for 0% to 100% travel is accepted as the diagnostic values "Travel time" (TUP, TDOWN).
Stop with: ▽</td></tr>
<tr><td>PNEUM</td><td></td></tr>
<tr><td>Std / FIP</td><td>Start leakage measurement with: △</td></tr>
<tr><td>booSt</td><td>Display of the overshoot
down (3.2 oSuP), up (2.9 oS-do)△</td></tr>
<tr><td rowspan="5"></td><td colspan="3">Possible messages</td></tr>
<tr><td>Display</td><td>Meaning</td><td>Measures</td></tr>
<tr><td>Std / FIP

</td><td>Actuator does not move.
The travel time cannot be changed.</td><td>Acknowledge message with:
Change the travel time using the restrictor screws.
Continue with:▽△</td></tr>
<tr><td>booSt

</td><td>The overshoot is determined.</td><td>Adjust the booster bypass using the adjusting screw on the booster until the display indicates the following:

Continue with: ▽△</td></tr>
</table>

7.3.7 RUN 4: Minimization of positioning increments

	The minimum length of the controller increments is determined.

7.3.8 RUN 5: Optimization of transient response

7.3.9 RUN 6: Inclusion of Valve Signature

	Inclusion of Valve Signature; only for positioners with option -Z P02

7.3.10 End

	Initialization was completed successfully. Travel in mm for linear actuators. Angle of rotation for part-turn actuators.

If you want to change the direction of action, set the "1.YFCT" parameter on an actuator with inverse direction of action, e.g. "turn" to "-turn".

7.4 Manual adjustment of the pressure sensors

Adjust the pressure sensors manually in the following cases:

- When manual initialization is to be performed using the initialization parameter 5.INITM (Page 156).
- If the device is operated at an elevation greater than 160 m above sea level.

Requirements

- The positioner is connected electrically and switched on.
- The positioner is depressurized.
- The positioner is not connected pneumatically.
- Pneumatic outputs PZ, Y1 and Y2 are open to the environment.

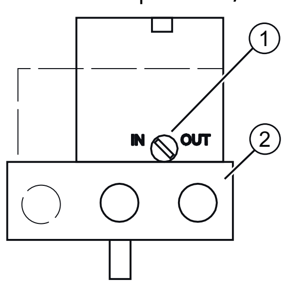
Procedure

1. Call up the diagnostic values at → Displaying diagnostic values (Page 174).
2. Select the pressure value you want to adjust to the atmospheric pressure.
3. Adjust the atmospheric pressure by pressing the button for 5 seconds.
   You can find more information on the diagnostic values "60.PZ", "61.P1" and "62.P2" in the Diagnostics Manual.

7.5 Purge air switching

When the enclosure is open, the purging air selector above the pneumatic manifold on the pneumatic block can be accessed.

- In the IN position, the enclosure is flushed from inside with a small volume of clean and dry instrument air.
- In the OUT position, the purge air is directly directed towards outside.



① Purging air selector
② Pneumatic connections Y1, PZ and Y2

Figure 7-1 Purging air selector on the pneumatic block; view of the pneumatic connection side of the positioner with open lid

The factory setting is the "IN" position.

7.6 Setting the friction clutch

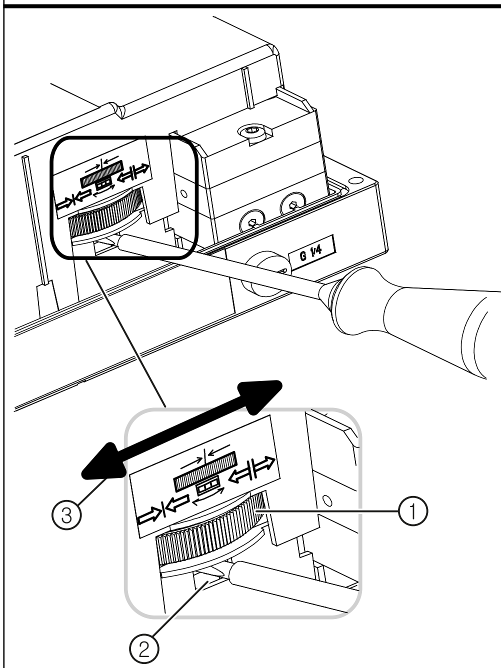
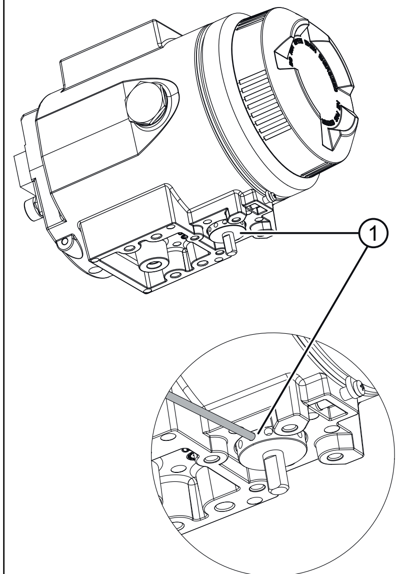
Introduction

In order for the positioner to be used on a wide variety of mechanically different part-turn and linear actuators, some positioner versions have a friction clutch and a selectable transmission (Page 74). Use the friction clutch to adjust the position detection area. For positioners in non-flameproof enclosures, you also have the option of locking the friction clutch.

Requirement

- The positioner is mounted.

Procedure

In non-flameproof enclosure	In flameproof enclosure Ex d
	
1. Adjust the working area to your application by turning the adjustment wheel of the friction clutch ①. 2. Fasten the friction clutch. Insert a standard approx. 4 mm wide screwdriver in the friction clutch gear latch ②. 3. Use the screwdriver to turn the friction clutch gear latch ② counterclockwise ③ until it engages. The friction clutch ① is locked.	1. Adjust the working range by **slightly** turning the adjustment wheel of the friction clutch ① over the hole with a pin. **CAUTION** Follow the steps below to avoid damage to your device. • The friction clutch ① is outside the flameproof enclosure at the bottom. • Do **not** loosen the screws on the adjustment wheel of the friction clutch ① . • Frequent twisting of the friction clutch is not provided for due to the design. • It is not necessary to lock the friction clutch.

7.7 Commissioning linear actuators

7.7.1 With internal wear-free, non-contacting position detection

7.7.1.1 Preparing linear actuators for commissioning

Requirement

You have already installed the positioner using the suitable mounting kit.

Connecting the positioner

1. Connect a suitable power supply. The positioner is now in "P manual mode". The current sensor setting (P) in percent is shown in the top line of the display, e.g. "P37.5", and 'NOINI' flashes in the bottom line:

2. Connect the actuator and the positioner to the pneumatic lines.
3. Supply the positioner with supply pressure PZ.

Setting the actuator

1. Check whether the mechanical unit can be moved freely in the entire travel range. Move the actuator to the respective end position for this purpose using the △ or ▽ button.

   Note

   End position

   By simultaneously pressing the △ and ▽ buttons, you reach the end position faster.

2. Move the actuator to a middle position.
3. A value between 'P48.0' and 'P52.0' is shown on the display.

7.7.1.2 Automatic initialization of linear actuators

Requirements

The following conditions must be fulfilled before activating the automatic initialization:

1. The actuator spindle can be moved completely.
2. The actuator spindle is at a central position after travel.

Initializing the linear actuator automatically

Note

Interrupting initialization

An ongoing initialization can be interrupted at any time. To do this, press . The settings configured until then are retained.

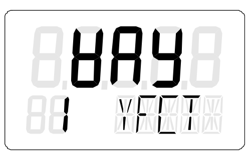
All parameters are reset to factory settings only if you have explicitly activated the preset settings in the "PRST" parameter.

Note

Commissioning of a tight-closing valve

If the valve is tight-closing, set the "YCLS" parameter before commissioning. This ensures that the end positions are approached for at least 15 seconds during initialization.

1. Switch to the "Configuration" mode. To do this, keep the button pressed for at least 5 seconds. The display shows the following:

2. Call the "2.YAGL" parameter. To do this, press . The display shows the following:

3. Set the "3.YWAY" parameter to determine the total stroke in mm. The setting of parameter 3 is optional. The display shows the determined total stroke at the end of the initialization phase.

   – Press the button if you do not require any information about the total stroke in mm. You then reach parameter 4.

   – Call the "3.YWAY" parameter. To do this, press . The display shows the following:

   Note

   Set the "3.YWAY" parameter

   1. On the scale of the lever, read the value marked by the carrier pin.
   2. Set the parameter with the buttons △ and ▽ to the read value.

4. Call the "4.INITA" parameter. To do this, briefly press the button. The display shows the following:

5. Start the initialization process. To do this, keep the button pressed for at least 5 seconds until the display shows the following:

The positioner runs through several initialization steps during the automatic initialization process. The lower line of the display indicates which initialization step is currently being run through. The initialization process depends on the actuator used, and takes up to 15 minutes.

6. The following display indicates that the initialization is complete:

7.7.1.3 Manual initialization of linear actuators

You can use this function to initialize the positioner without needing to move the actuator to the lower and upper endstops. The lower and upper endstops of the actuator travel are set manually. When the control parameters are optimized, the further initialization process runs automatically.

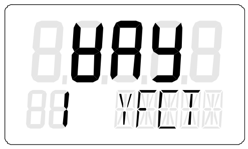
Requirements

The following requirements must be met before you activate the manual initialization:

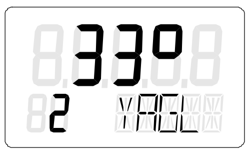
1. The positioner is prepared for use on linear actuators.
2. The actuator spindle can be moved completely.
3. The displayed sensor setting is within the permissible range of "P5.0" to "P95.0".
4. For positioners with option -Z P02, adjust the pressure sensors manually.

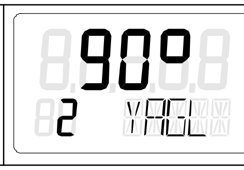
Initializing the linear actuator manually

1. Switch to "Configure" mode by pressing the button for at least 5 seconds.

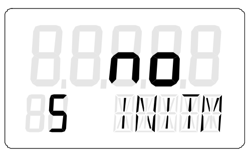


2. Navigate to the "2.YAGL" parameter with the button. The following is shown on the display depending on the setting:

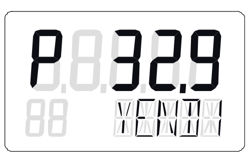




3. Navigate to the "5.INITM" parameter with the button. The display shows the following:

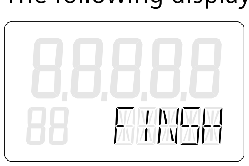


4. Start the initialization by pressing the △ button for at least 5 seconds.
   After 5 seconds, the display shows the position for the lower end position (YEND1).



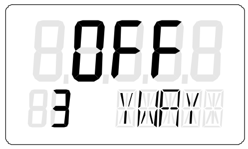
5. Set the YEND1 position of the actuator by pressing the △ or ▽ button.
6. Confirm with the button.
7. Set the YEND2 position (upper end position) of the actuator by pressing the △ or ▽ button.

8. Confirm with the button.
   The position of the actuator is applied.
9. The initialization process is automatically resumed. The lower line of the display indicates which initialization step is currently being run through.
   The following display indicates that the initialization is complete:



Determining total stroke (optional)

1. On the scale of the lever, read the value marked by the carrier pin.
2. In "Configure" mode, navigate to the "3.YWAY" parameter with the button.



3. Set the parameter to the read value with the or button.
   Once the initialization phase has ended, the display shows the determined total stroke in mm.

See also

Manual adjustment of the pressure sensors (Page 114)

7.7.2 With potentiometer, friction clutch and gearbox:

7.7.2.1 Preparing linear actuators for commissioning

Requirement

You have already installed the positioner using the suitable mounting kit.

Setting the transmission ratio selector

Note

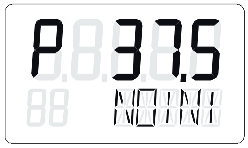
Commissioning

The setting of the transmission ratio selector is extremely important to commission the positioner.

Stroke [mm]	Position of the transmission ratio selector
5 to 20	33°
25 to 35	90°
40 to 130	90°

Connecting the positioner

1. Connect a suitable power supply. The positioner is now in "P manual mode". The current sensor setting (P) in percent is shown in the top line of the display, e.g. "P37.5", and 'NOINI' flashes in the bottom line:



2. Connect the actuator and the positioner to the pneumatic lines.
3. Supply the positioner with supply pressure PZ.

Setting the actuator

1. Check whether the mechanical unit can be moved freely in the entire travel range. Move the actuator to the respective end position for this purpose using the △ or ▽ button.

Note

End position

By simultaneously pressing the △ and ▽ buttons, you reach the end position faster.

2. Now move the actuator to the horizontal position of the lever.
3. A value between 'P48.0' and 'P52.0' is shown on the display.
4. If a value beyond this value range is shown on the display, you must move the friction clutch. Move the friction clutch until a value between 'P48.0' and 'P52.0' is reached. The closer this value is to 'P50.0', the more accurately the positioner determines the stroke travel.

Note

For device versions with flameproof enclosure

The inner friction clutch is fixed. Therefore, only move the outer friction clutch. This also applies when using an internal NCS module.

The following applies to device versions without flameproof enclosure with internal NCS module 6DR4004-5L.:

The inner friction clutch has no function. Therefore, only adjust the adjustment wheel of the magnet holder; see section "Internal NCS module (iNCS) 6DR4004-5L / -5LE (Page 281)". Requirement: The '1.YFCT' type of actuator (Page 152) parameter is set.

7.7.2.2 Automatic initialization of linear actuators

Requirements

The following conditions must be fulfilled before activating the automatic initialization:

1. The actuator spindle can be moved completely.
2. The actuator spindle is at a central position after travel.

Initializing the linear actuator automatically

Note

Interrupting initialization

An ongoing initialization can be interrupted at any time. To do this, press . The settings configured until then are retained.

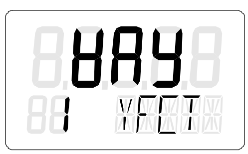
All parameters are reset to factory settings only if you have explicitly activated the preset settings in the "PRST" parameter.

Note

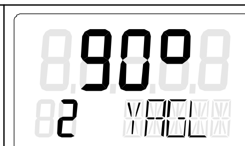
Commissioning of a tight-closing valve

If the valve is tight-closing, set the "YCLS" parameter before commissioning. This ensures that the end positions are approached for at least 15 seconds during initialization.

1. Switch to the "Configuration" mode. To do this, keep the button pressed for at least 5 seconds. The display shows the following:

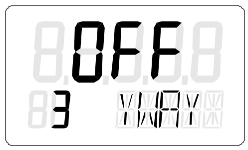


2. Call the "2.YAGL" parameter. To do this, press . The following is shown on the display depending on the setting:



3. Check whether the value displayed in the "2.YAGL" parameter matches the setting of the transmission ratio selector. If required, change the setting of the transmission ratio selector to 33° or 90°.

4. Set the "3.YWAY" parameter to determine the total stroke in mm. The setting of parameter 3 is optional. The display shows the determined total stroke at the end of the initialization phase.
   – Press the button if you do not require any information about the total stroke in mm. You then reach parameter 4.
   – Call the "3.YWAY" parameter. To do this, press . The display shows the following:



Note

Set the "3.YWAY" parameter

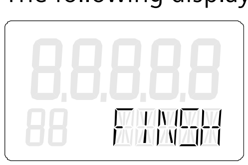
1. On the scale of the lever, read the value marked by the carrier pin.
2. Set the parameter with the buttons and to the read value.

5. Call the "4.INITA" parameter. To do this, briefly press the button. The display shows the following:

6. Start the initialization process. To do this, keep the button pressed for at least 5 seconds until the display shows the following:

   The positioner runs through several initialization steps during the automatic initialization process. The lower line of the display indicates which initialization step is currently being run through. The initialization process depends on the actuator used, and takes up to 15 minutes.

7. The following display indicates that the initialization is complete:



7.7.2.3 Manual initialization of linear actuators

You can use this function to initialize the positioner without needing to move the actuator to the lower and upper endstops. The lower and upper endstops of the actuator travel are set manually. When the control parameters are optimized, the further initialization process runs automatically.

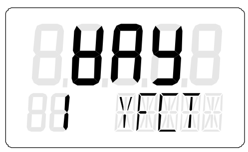
Requirements

The following requirements must be met before you activate the manual initialization:

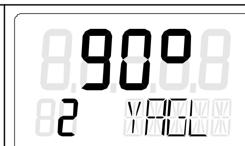
1. The positioner is prepared for use on linear actuators.
2. The actuator spindle can be moved completely.
3. The displayed sensor setting is within the permissible range of "P5.0" to "P95.0".
4. For positioners with option -Z P02, adjust the pressure sensors manually.

Initializing the linear actuator manually

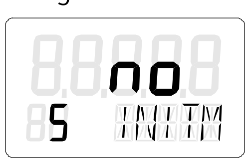
1. Switch to "Configure" mode by pressing the button for at least 5 seconds.



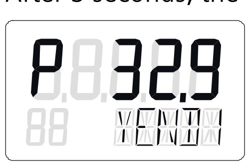
2. Navigate to the "2.YAGL" parameter with the button. The following is shown on the display depending on the setting:

3. Check whether the value displayed in the "2.YAGL" parameter matches the setting of the transmission ratio selector. If required, change the setting of the transmission ratio selector to 33° or 90°.
   - This step is omitted for devices without a transmission ratio selector.
4. Navigate to the "5.INITM" parameter with the button. The display shows the following:



5. Start the initialization by pressing the button for at least 5 seconds.
   After 5 seconds, the display shows the position for the lower end position (YEND1).



6. Set the YEND1 position of the actuator by pressing the or button.

7. Confirm with the button.

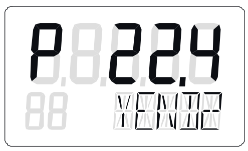
Note

"RANGE" appears on the display

The lower end position is outside the permissible measuring range.

- Adjust the friction clutch until the display shows "OK" and press the △ button.

8. Set the YEND2 position (upper end position) of the actuator by pressing the △ or ▽ button.



9. Confirm with the button.
The position of the actuator is applied.

Note

"RANGE" appears on the display

The upper end position is outside the permissible measuring range.

1. Adjust the friction clutch until the display shows "OK" and press the △ button.
2. Start the initialization process again.

10. The initialization process is automatically resumed. The lower line of the display indicates which initialization step is currently being run through.
The following display indicates that the initialization is complete:

Determining total stroke (optional)

1. On the scale of the lever, read the value marked by the carrier pin.
2. In "Configure" mode, navigate to the "3.YWAY" parameter with the button.

3. Set the parameter to the read value with the △ or ▽ button.
Once the initialization phase has ended, the display shows the determined total stroke in mm.

See also

Manual adjustment of the pressure sensors (Page 114)

7.8 Commissioning part-turn actuators

7.8.1 With internal wear-free, non-contacting position detection

7.8.1.1 Preparing part-turn actuators for commissioning

Condition

The following conditions must be fulfilled before activating the initialization:

1. You have installed the positioner for the part-turn actuators using the suitable mounting kit.
2. You have connected the actuator and the positioner to the pneumatic lines.
3. Supplying the positioner with the supply pressure PZ.
4. The positioner has been connected to a suitable power supply.

Setting the actuator

1. Connect a suitable power supply. The positioner is now in "P-manual mode". The current sensor setting (P) in percent is shown in the upper line of the display, e.g.: 'P37.5', and 'NOINI' blinks in the lower line:

2. Check whether the mechanical unit can be moved freely in the entire travel range. Move the actuator to the respective end position for this purpose using the △ or ▽ button.

   Note

   End position

   By simultaneously pressing the △ and ▽ buttons, you reach the end position faster.

   ---

3. After checking, move the actuator to a central position. This accelerates the initialization process.

7.8.1.2 Automatic initialization of part-turn actuators

Requirement

The following conditions must be fulfilled before activating the automatic initialization:

1. The travel range of the actuator can be passed through completely.
2. The actuator shaft is at a central position.

Initializing the part-turn actuator automatically

Note

Interrupting initialization

An ongoing initialization can be interrupted at any time. To do this, press . The settings configured until then are retained.

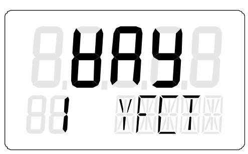
All parameters are reset to factory settings only if you have explicitly activated the preset settings in the "PRST" parameter.

Note

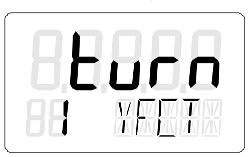
Commissioning of a tight-closing valve

If the valve is tight-closing, set the "YCLS" parameter before commissioning. This ensures that the end positions are approached for at least 15 seconds during initialization.

1. Switch to the "Configuration" mode. To do this, press the button for at least 5 seconds until the display shows the following:



2. Use the button to change from linear actuator to part-turn actuator until the display shows the following:

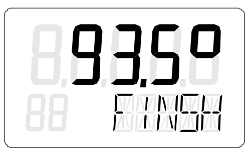


3. Call the "4.INITA" parameter. To do this, briefly press the button. The display shows the following:

4. Start the initialization process. To do this, press the button for at least 5 seconds until the display shows the following:

The positioner runs through several initialization steps during the automatic initialization process. The lower line of the display indicates which initialization step is currently being run through. The initialization process depends on the actuator used, and takes up to 15 minutes.

5. The following display indicates that the initialization is complete. The total angle of rotation of the actuator is shown in the upper line of the display.



7.8.1.3 Manual initialization of part-turn actuators

You can use this function to initialize the positioner without needing to move the actuator to the lower and upper endstops. The lower and upper endstops of the actuator travel are set manually. When the control parameters are optimized, the further initialization process runs automatically.

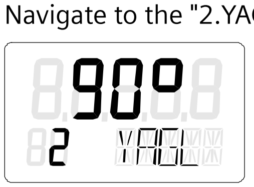
Requirements

1. The positioner is prepared for use on part-turn actuators.
2. The actuator can be moved completely.
3. The position is within the permissible range of "P5.0" to "P95.0".
4. For positioners with option -Z P02, adjust the pressure sensors manually.

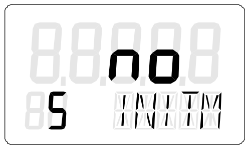
Initializing the positioner manually

1. Switch to "Configure" mode by pressing the button for at least 5 seconds.
2. Set the "1.YFCT" parameter (Actuator type) to "turn" by pressing the or button.

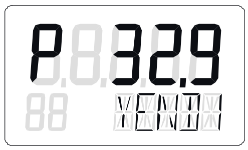
3. Navigate to the "2.YAGL" parameter with the button. The display shows the following:



4. Navigate to the "5.INITM" parameter with the button. The display shows the following:



5. Start the initialization by pressing the button for at least 5 seconds.
   After 5 seconds, the display shows the position for the lower end position (YEND1).



6. Set the YEND1 position of the actuator by pressing the or button.
7. Confirm with the button.
8. Set the YEND2 position (upper end position) of the actuator by pressing the or button.

9. Confirm with the button.
   The position of the actuator is applied.
10. The initialization process is automatically resumed. The lower line of the display indicates which initialization step is currently being run through.
    The following display indicates that the initialization is complete:

See also

Manual adjustment of the pressure sensors (Page 114)

7.8.2 With potentiometer, friction clutch and gearbox:

7.8.2.1 Preparing part-turn actuators for commissioning

Note

Setting of the adjustment angle

The usual adjustment angle for part-turn actuators is 90°.

- Set the transmission ratio selector in the positioner to 90°.

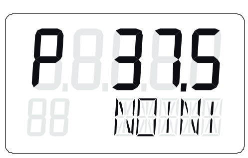
Condition

The following conditions must be fulfilled before activating the initialization:

1. You have installed the positioner for the part-turn actuators using the suitable mounting kit.
2. You have connected the actuator and the positioner to the pneumatic lines.
3. Supplying the positioner with the supply pressure PZ.
4. The positioner has been connected to a suitable power supply.

Setting the actuator

1. Connect a suitable power supply. The positioner is now in "P-manual mode". The current sensor setting (P) in percent is shown in the upper line of the display, e.g.: 'P37.5', and 'NOINI' blinks in the lower line:

2. Check whether the mechanical unit can be moved freely in the entire travel range. Move the actuator to the respective end position for this purpose using the △ or ▽ button.

   Note

   End position

   By simultaneously pressing the △ and ▽ buttons, you reach the end position faster.

   ---

3. After checking, move the actuator to a central position.

7.8.2.2 Automatic initialization of part-turn actuators

Requirement

The following conditions must be fulfilled before activating the automatic initialization:

1. The travel range of the actuator can be passed through completely.
2. The actuator shaft is at a central position.

Initializing the part-turn actuator automatically

Note

Interrupting initialization

An ongoing initialization can be interrupted at any time. To do this, press . The settings configured until then are retained.

All parameters are reset to factory settings only if you have explicitly activated the preset settings in the "PRST" parameter.

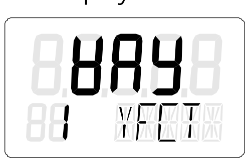
Note

Commissioning of a tight-closing valve

If the valve is tight-closing, set the "YCLS" parameter before commissioning. This ensures that the end positions are approached for at least 15 seconds during initialization.

---

1. Switch to the "Configuration" mode. To do this, press the button for at least 5 seconds until the display shows the following:

2. Use the button to change from linear actuator to part-turn actuator until the display shows the following:

3. Call the "2.YAGL" parameter. To do this, briefly press the button. This parameter has already been set to 90° automatically. The display shows the following:

4. Call the "4.INITA" parameter. To do this, briefly press the button. The display shows the following:

5. Start the initialization process. To do this, press the button for at least 5 seconds until the display shows the following:

   The positioner runs through several initialization steps during the automatic initialization process. The lower line of the display indicates which initialization step is currently being run through. The initialization process depends on the actuator used, and takes up to 15 minutes.

6. The following display indicates that the initialization is complete. The total angle of rotation of the actuator is shown in the upper line of the display.

7.8.2.3 Manual initialization of part-turn actuators

You can use this function to initialize the positioner without needing to move the actuator to the lower and upper endstops. The lower and upper endstops of the actuator travel are set manually. When the control parameters are optimized, the further initialization process runs automatically.

Requirements

The following requirements must be met before you activate the manual initialization:

1. The positioner is prepared for use on part-turn actuators.
2. The actuator can be moved completely.
3. The displayed potentiometer position is within the permissible range of "P5.0" to "P95.0".

Note

Setting of the adjustment angle

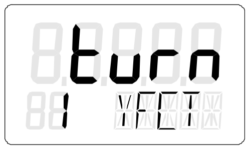
The usual adjustment angle for part-turn actuators is 90°. Accordingly set the transmission ratio selector in the positioner to 90°.

---

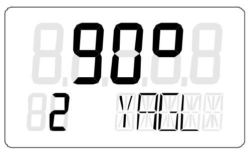
4. For positioners with option -Z P02, adjust the pressure sensors manually.

Initializing the positioner manually

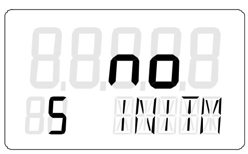
1. Switch to "Configure" mode by pressing the button for at least 5 seconds.
2. Set the "1.YFCT" parameter (Actuator type) to "turn" by pressing the ▽ or △ button.



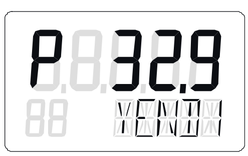
3. Navigate to the "2.YAGL" parameter with the button. The display shows the following:



4. Navigate to the "5.INITM" parameter with the button. The display shows the following:



5. Start the initialization by pressing the △ button for at least 5 seconds.
   After 5 seconds, the display shows the position for the lower end position (YEND1).



6. Set the YEND1 position of the actuator by pressing the △ or ▽ button.
7. Confirm with the button.

Note

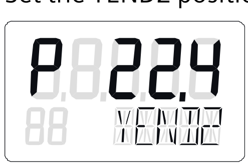
"RANGE" appears on the display

The lower end position is outside the permissible measuring range.

- Adjust the friction clutch until the display shows "OK" and press the △ button.

---

8. Set the YEND2 position (upper end position) of the actuator by pressing the △ or ▽ button.



9. Confirm with the button.
   The position of the actuator is applied.

Note

"RANGE" appears on the display

The upper end position is outside the permissible measuring range.

1. Adjust the friction clutch until the display shows "OK" and press the button.
2. Start the initialization process again.

---

10. The initialization process is automatically resumed. The lower line of the display indicates which initialization step is currently being run through.
    The following display indicates that the initialization is complete:

See also

Manual adjustment of the pressure sensors (Page 114)

7.9 Canceling initialization

1. Press the button.
   - Canceling automatic initialization: the display shows "INITA".
   - Canceling manual initialization: the display shows "INITM".

   The positioner is in the "Configuration" mode.
2. Exit the "Configuration" mode. To do this, press the button for at least 5 seconds. The software version is displayed.
   After releasing the button, the positioner is in "P manual mode". The positioner is not initialized.

7.10 Replacing the positioner during operation

7.10.1 Introduction

There are two ways of replacing a positioner when the equipment is in operation, without having to interrupt the process.

The two options depend on whether your positioner has communication.

Note

Initialization

The positioner can be replaced without having to interrupt the ongoing process. However, copying and transferring of the initialization parameters only allows an approximate adjustment of the positioner to your actuator. Following initialization, the positioner initially works with the manually defined parameters.

- For this reason, an automatic or manual initialization should be carried out as soon as possible.

Note

Deferred initialization

Initialize the new positioner as soon as possible. The following properties can be ensured only after initializing:

- Optimum adjustment of the positioner as per the mechanical and dynamic properties of the actuator
- Non-deviating position of endstops
- Correctness of the maintenance data

General requirements

- The rotation angle range is ≤ 100°.
- The positioners are interchangeable with the following HW versions:

HW version on the name-plate	Interchangeable with	≥ 1.00.xx	≥ 1.01.xx
≥ 1.00.xx	⇒	✓	✓
≥ 1.01.xx	⇒	-	✓

The devices that do not have a HW version on the nameplate correspond to HW version ≥ 1.00.xx.

7.10.2 Replacing the positioner with communication

Requirement

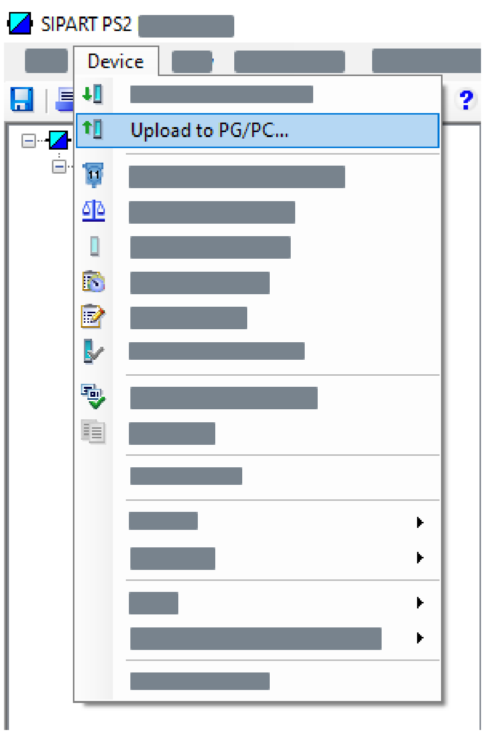
You have an engineering system with the current device description file.

Product compatibility (Page 16)

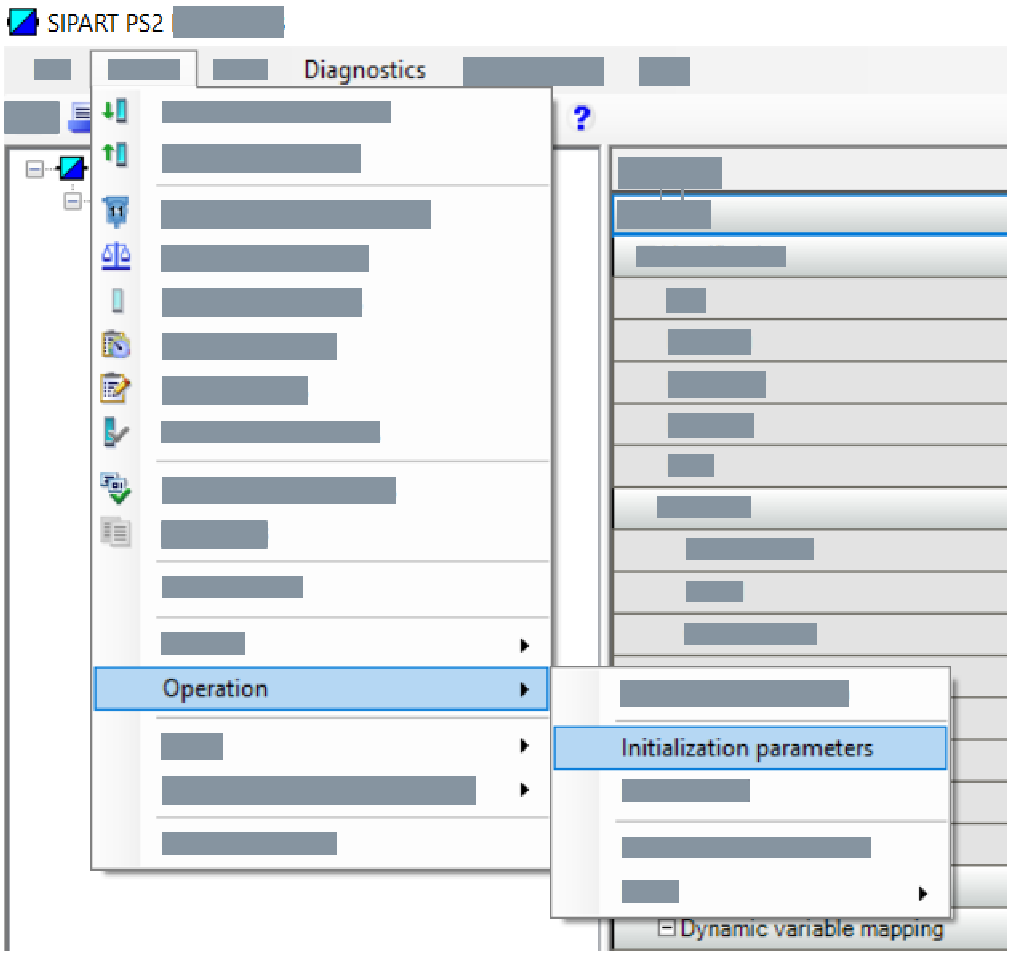
Your previous positioner is already initialized and in operation.

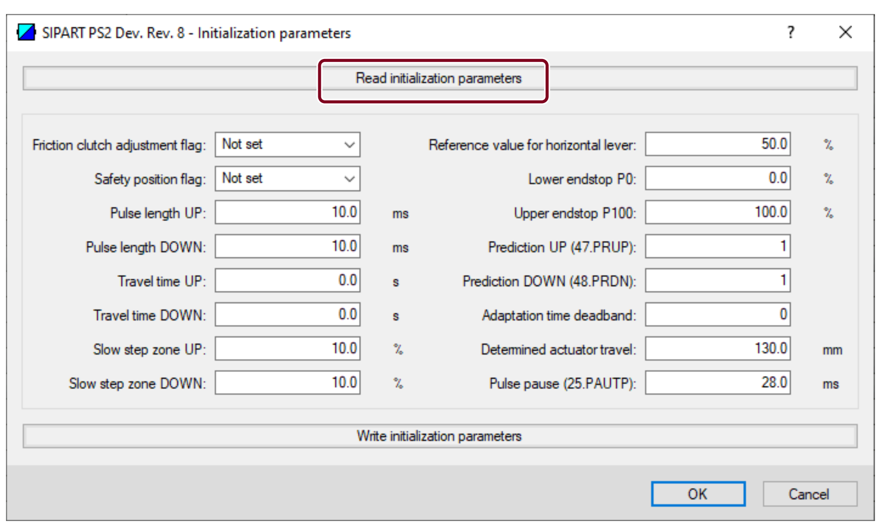
With communication

1. Fix the actuator at its current position mechanically or pneumatically.
   Use the locking function of your mounting kit, if available.
2. Note the actual position value from the previous positioner.
3. Transfer the configuration parameters of the previous positioner to the Engineering System.
   Shown below using SIMATIC PDM as an example:



4. Transfer the initialization parameters from the previous positioner to the engineering system using the "Initialization parameters" function:

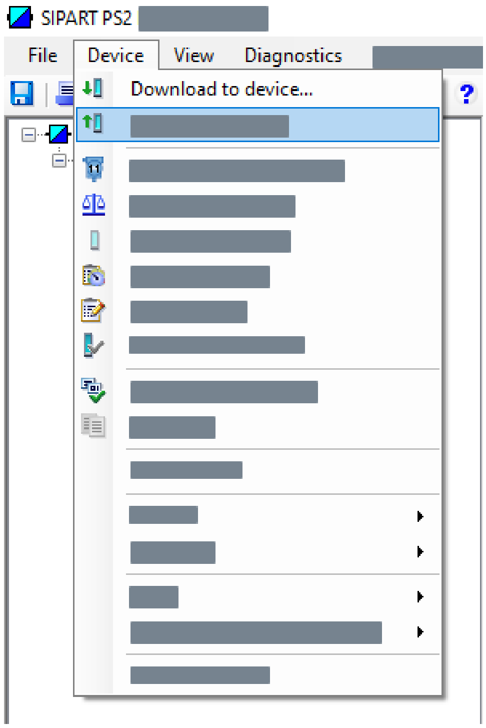


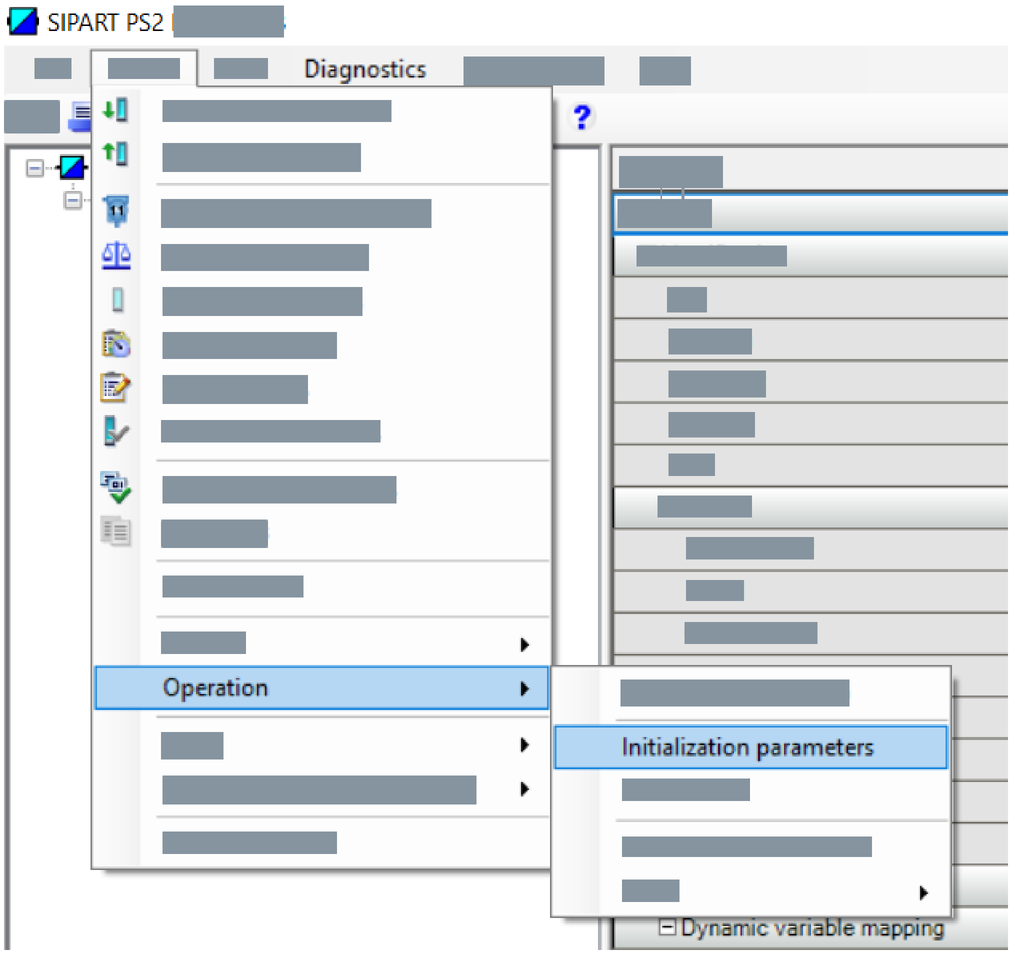


5. Save the configuration and initialization parameters in the engineering system by clicking on the icon.

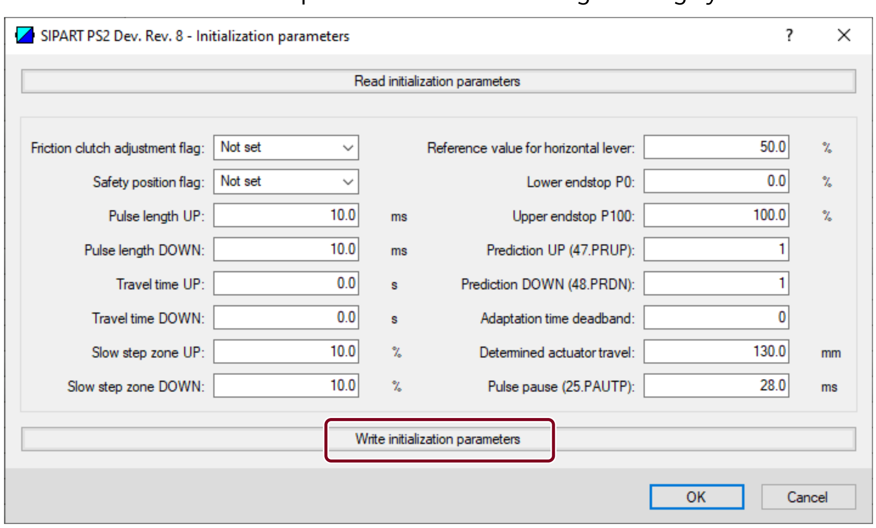
6. Replace the positioner.

7. Transfer the configuration parameters from the engineering system to the new positioner.





8. Transfer the initialization parameters from the engineering system to the new positioner.



9. Correct the deviation between the displayed actual position value and the noted actual position value using diagnostic value "74.TRIM" → Diagnostic value "Position adjustment" (74.TRIM) (Page 186).
   – If the diagnostic value "74.TRIM" is not available in your device version, correct the deviation by adjusting the friction clutch.
10. Loosen the locking mechanism.

    Note

    Use "Manual (MAN)" mode for this step.

Result

The positioner is ready for operation.

You can set the positioner to "Automatic (AUT)" mode.

7.10.3 Replacing the positioner without communication

Replacing the positioner without communication

1. Fix the actuator at its current position mechanically or pneumatically. Use the locking function of your mounting kit, if available.
2. Note the actual position value from the previous positioner.
3. Dismount the previous positioner from the actuator.
4. To prevent interference with the ongoing process, initialize the new positioner on an actuator with a similar stroke or swivel range. Attach the new positioner to this actuator. Initialize the new positioner.
5. Then dismount the new, initialized positioner from this actuator.
6. Mount the new, initialized positioner on the fixed actuator.
7. If the displayed actual position value deviates from the noted value, follow these steps:
   – Set the noted actual position value with the diagnostic value "74.TRIM" using the buttons: Diagnostic value "Position adjustment" (74.TRIM) (Page 186)
   – If you have a device with a friction clutch, correct the deviation by adjusting the friction clutch.
8. Use the buttons on the positioner to enter the parameters which deviate from the factory setting, such as type of actuator or tight closing.
9. Switch to automatic mode (AUT) with the button:
   Section "Description of operating modes (Page 100)"
10. Release the fixing of the actuator.

Parameter assignment 8

8.1 Overview of parameters

A positioner is responsible for controlling a valve and for monitoring the status of a valve. This "Parameter assignment" section describes the parameters with which the positioner can be optimally adapted to the valve and its application: Initialization parameters, application parameters and diagnostic values.

You can find the description of the other diagnostic values and diagnostic parameters for monitoring and the diagnostic functions of the positioner in the Diagnostics Manual.

- **"1.YFCT" to "5.INITM" -** Initialization parameters 1 to 5 (Page 152)
  The initialization parameters start the automatically running initialization and adapt the positioner to the actuator. The actuator is ready for operation.
- **"6.SCUR" to "52.XDIAG" -** Application parameters 6 to 52 (Page 156)
  The application parameters adapt the positioner to the valve application. The following additional functions are available:
  - Setpoint preparation
  - Actual value preparation
  - Digital signals
  - Tight closing function
  - Limit detection

- **"1.STRKS" bis "74.TRIM" - Diagnostic values**
  The diagnostic values have the following functions and properties:
  - The diagnostic values support the initialization/commissioning of the valve and monitor the valve.
  - The diagnostic values can be read out in all operating states of the positioner.
  - The positioner saves the diagnostic results every 15 minutes, so that the diagnostic values of the last 15 minutes are lost at most in the event of a power failure.
  - Some diagnostic values can be reset.
  - More information:
    → Displaying diagnostic values (Page 174)
    → Diagnostic values overview (Page 175)

  The diagnostic values are divided into the following 2 categories:
  - Diagnostic values for commissioning/initializing the positioner → Diagnostic values for commissioning and initialization (Page 177)
  - Diagnostic values of the meters, maintenance information or values for process diagnostics: You can find the description and information on the application in the Diagnostics Manual.
- **"A.\PST" to "U.\PRES" - Diagnostic parameters**
  The diagnostic parameters are used to activate and set the process diagnostics of the positioner, e.g. leak monitoring or Partial Stroke Test. Following activation of these process diagnostics, the positioner continuously monitors the status of the valve. If you enter thresholds in the parameters of the process diagnostics, the positioner actively signals high or low violation of these thresholds.
  - You can find the description and information on using the process diagnostics in the Diagnostics Manual.

Note

Display

Diagnostic parameters and their sub-parameters are only displayed if setting "On1", "On2" or "On3" has been activated in the parameter "'52.XDIAG' Activating for extended diagnostics (Page 171)". The content of the diagnostic parameter is displayed if the diagnostic parameter has been activated with "On".

Communications interface HART

The positioners with HART communications interface in combination with a host system, e.g. SIMATIC PDM or HART-Communicator, have the following advantages:

- Maintenance diagnostics such as z. B. Full Stroke Test (FST), Step Response Test (SRT), Multi Step Response Test (MSRT), Valve Performance Test (VPT).
- Diagnostics cockpit, which provides an overview of the state of positioner and valve.
- Alarm logbook with time stamp for documentation of all events, such as violation of thresholds.
- Wizards that guide you through the relevant parameters during commissioning, the Partial Stroke Test and for the maintenance diagnostics.

You can find information on using the maintenance diagnostics, the wizards and the alarm logbook in the Diagnostics Manual.

8.2 Configuration schematic for parameter operating principle

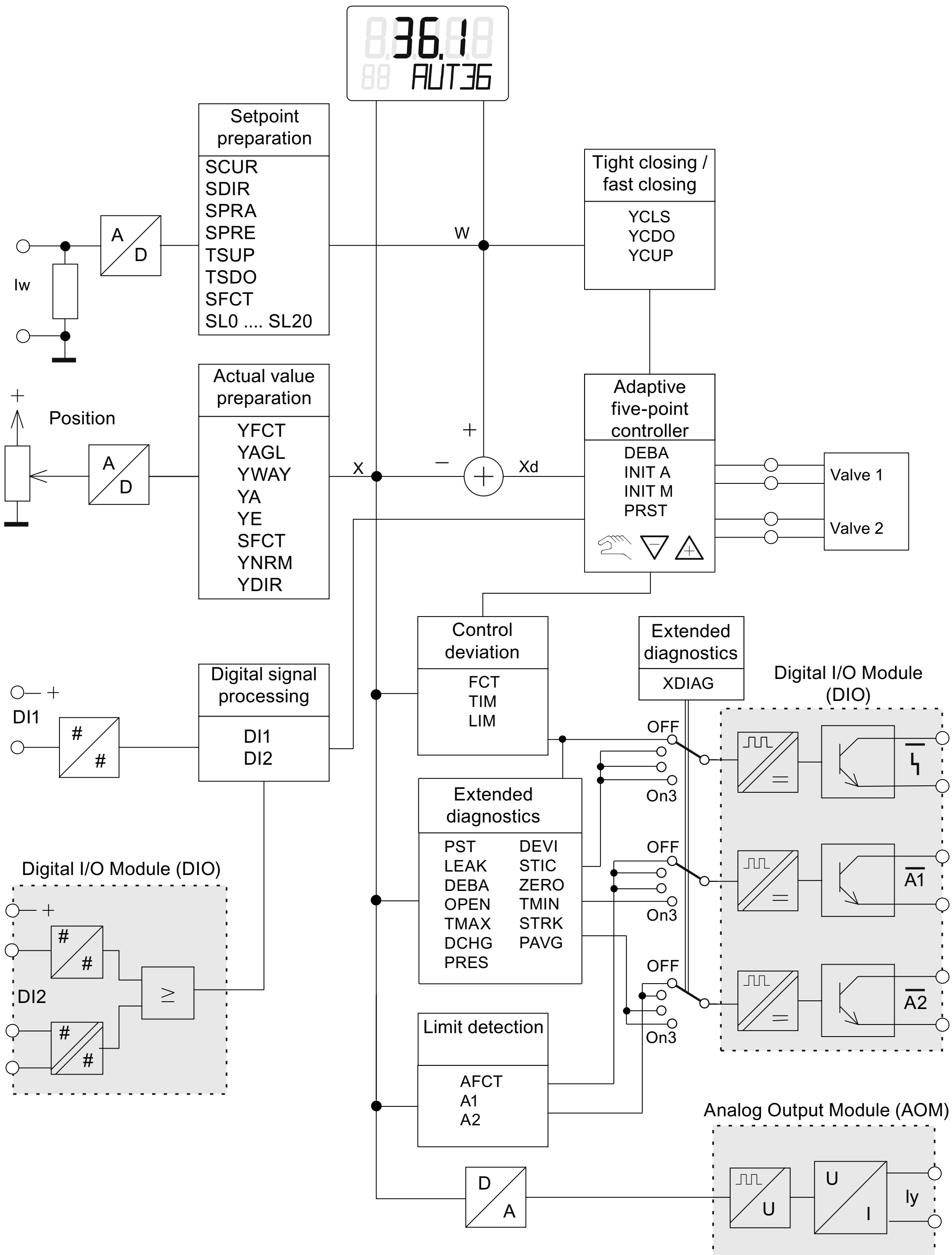


Figure 8-1 Configuration block schematic

8.3 Overview of parameters 1 to 52 (HART)

Parameter	Function	Parameter values		Unit
1.YFCT	Type of actuator (Page 152)	Normal	Inverted	
	Part-turn actuator	turn	-turn	
	Linear actuator	**WAY**	-WAY	
	Linear actuator - carrier pin on actuator spindle	FWAY	-FWAY	
	Linear actuator - external linear potentiometer (e.g. with cylinder drives)	LWAY	-LWAY	
	Part-turn actuator with NCS/iNCS	ncSt	-ncSt	
	Linear actuator with NCS	ncSL	-ncSL	
	Linear actuator with NCS/iNCS and lever	ncSLL	-ncLL	
2.YAGL	Rated angle of rotation of positioner shaft (Page 154) [1]			
		33°		Degrees
		90°		
3.YWAY [2]	Range of stroke (Page 154) (optional setting) [3]			
		OFF		mm
		5 | 10 | 15 | 20 (Short lever 33°, range of stroke 5 to 20 mm)		
		25 | 30 | 35 (Short lever 90°, range of stroke 25 to 35 mm)		
		40 | 50 | 60 | 70 | 90 | 110 | 130 (Long lever 90°, range of stroke 40 to 130 mm)		
4.INITA	Initialization (automatic) (Page 155)	**NOINI** | no / ###.# | Strt		
5.INITM	Initialization (manual) (Page 156)	**NOINI** | no / ###.# | Strt		
6.SCUR	Current range of setpoint (Page 156)			
	0 ... 20 mA	0 mA		
	4 ... 20 mA	**4 mA**		
7.SDIR	Setpoint direction (Page 157)			
	Rising	**riSE**		
	Falling	FALL		
8.SPRA	Setpoint split range start (Page 157)	**0.0** ... 100.0		%
9.SPRE	Setpoint split range end (Page 157)	0.0 ... **100.0**		%
10.TSUP	Setpoint ramp up (Page 158)	Auto / **0** ... 400		s
11.TSDO	Setpoint ramp down (Page 158)	**0** ... 400		s

<table>
<tr><th>Parameter</th><th colspan="2">Function</th><th>Parameter values</th><th>Unit</th></tr>
<tr><td rowspan="9">12.SFCT</td><td colspan="4">Setpoint function (Page 159)</td></tr>
<tr><td colspan="2">Linear</td><td>LIN</td><td rowspan="8"></td></tr>
<tr><td rowspan="3">Equal percentage</td><td>1 : 25</td><td>1 - 25</td></tr>
<tr><td>1 : 33</td><td>1 - 13</td></tr>
<tr><td>1 : 50</td><td>1 - 50</td></tr>
<tr><td rowspan="3">Inverse equal percentage</td><td>25 : 1</td><td>n1 - 25</td></tr>
<tr><td>33 : 1</td><td>n1 - 33</td></tr>
<tr><td>50 : 1</td><td>n1 - 50</td></tr>
<tr><td colspan="2">Freely adjustable</td><td>FrEE</td></tr>
<tr><td>13.SLO ...
33.SL20 4)</td><td colspan="4">Setpoint turning point (Page 159) at</td></tr>
<tr><td>13.SL0</td><td colspan="2">0 %</td><td rowspan="4">0.0 ... 100.0</td><td rowspan="4">%</td></tr>
<tr><td>14.SL1 ...</td><td colspan="2">5 %</td></tr>
<tr><td>32.SL19</td><td colspan="2">95 %</td></tr>
<tr><td>33.SL20</td><td colspan="2">100 %</td></tr>
<tr><td>34.DEBA</td><td colspan="2">Deadband of closed-loop controller (Page 160)</td><td>Auto / 0.1 ... 10.0</td><td>%</td></tr>
<tr><td>35.YA</td><td colspan="2">Start of the manipulated variable limit (Page 161)</td><td>0.0 ... 100.0</td><td>%</td></tr>
<tr><td>36.YE</td><td colspan="2">End of the manipulated variable limit (Page 161)</td><td>0.0 ... 100.0</td><td>%</td></tr>
<tr><td rowspan="3">37.YNRM</td><td colspan="4">Standardization of manipulated variable (Page 161)</td></tr>
<tr><td colspan="2">To mechanical travel</td><td>MPOS</td><td rowspan="2"></td></tr>
<tr><td colspan="2">To flow</td><td>FLoW</td></tr>
<tr><td rowspan="3">38.YDIR</td><td colspan="4">Direction of action of manipulated variable for display and position feedback (Page 163)</td></tr>
<tr><td colspan="2">Rising</td><td>riSE</td><td rowspan="2"></td></tr>
<tr><td colspan="2">Falling</td><td>FALL</td></tr>
<tr><td rowspan="10">39.YCLS</td><td colspan="4">Tight closing / fast closing with manipulated variable (Page 163)</td></tr>
<tr><td colspan="2">None</td><td>no</td><td rowspan="9"></td></tr>
<tr><td colspan="2">Tight closing Up</td><td>uP</td></tr>
<tr><td colspan="2">Tight closing Down</td><td>do</td></tr>
<tr><td colspan="2">Tight closing Up and Down</td><td>up do</td></tr>
<tr><td colspan="2">Fast closing Up</td><td>Fu</td></tr>
<tr><td colspan="2">Fast closing Down</td><td>Fd</td></tr>
<tr><td colspan="2">Fast closing Up and Down</td><td>Fu Fd</td></tr>
<tr><td colspan="2">Tight closing Up and fast closing Down</td><td>uP Fd</td></tr>
<tr><td colspan="2">Fast closing Up and tight closing Down</td><td>Fu do</td></tr>
<tr><td>40.YCDO</td><td colspan="2">Lower value for fast closing / tight closing (Page 164)</td><td>0.0 ... 0.5 ... 100.0</td><td>%</td></tr>
<tr><td>41.YCUP</td><td colspan="2">Upper value for fast closing / tight closing (Page 164)</td><td>0.0 ... 99.5 ... 100.0</td><td>%</td></tr>
</table>

Parameter	Function	Parameter values		Unit
42.DI1 5))	Function digital input DI1 (Page 165)	NO contact	NC contact	
	None	**OFF**		
	Message only	on	-on	
	Block configuration	bLoc1		
	Block configuring and manual operation	bLoc2		
	Move process valve to position YE	uP	-uP	
	Move process valve to position YA	doWn	-doWn	
	Block movement	StoP	-StoP	
	Partial Stroke Test	PSt	-PSt	
43.DI2 5)	Function digital input DI2 (Page 165)	NO contact	NC contact	
	None	**OFF**		
	Message only	on	-on	
	Move process valve to position YE	uP	-uP	
	Move process valve to position YA	doWn	-doWn	
	Block movement	StoP	-StoP	
	Partial Stroke Test	PSt	-PSt	
44.AFCT 6)	Alarm function (Page 166)	Normal	Inverted	
	None	**OFF**		
	A1 = Min, A2 = Max	Mi MA	-Mi -MA	
	A1 = Min, A2 = Min	Mi Mi	-Mi -Mi	
	A1 = Max, A2 = Max	MA MA	-MA -MA	
45.A1	Response threshold, alarm 1 (Page 168)	0.0 ... **10.0** ... 100.0		%
46.A2	Response threshold, alarm 2 (Page 168)	0.0 ... **90.0** ... 100.0		%
47. ϟFCT 6)	Function of fault message output (Page 168)	Normal	Inverted	
	Fault	ϟ	-ϟ	
	Fault + not automatic 7)	ϟnA	-ϟnA	
	Fault + not automatic + DI 7)	ϟnAb	-ϟnAb	
48. ϟTIM	Monitoring period for setting of fault message 'Control deviation' (Page 169)	**Auto** / 0 ... 100		s
49. ϟLIM	Response threshold for fault message 'Control deviation' (Page 169)	**Auto** / 0 ... 100		%
50.PRST	Preset (Page 170)			
	Reset all parameters which can be reset by "Init", "PArA" and "diAg".	**ALL**		
	Reset parameters 'YFCT' to 'INITM'.	Init		
	Reset parameters 'SCUR' to 'LIM'.	PArA		
	Reset parameters A to U of the extended diagnostics function as well as parameter 'XDIAG'.	diAg		
51.PNEUM	Pneumatics type (Page 170)			
	Standard pneumatic block	**Std**		
	Fail in Place pneumatic block	FIP		
	Operation with boosters	booSt		

Parameter	Function	Parameter values	Unit
52.XDIAG	Activation of extended diagnostics (Page 171)		
	Off	**OFF**	
	Single stage message	On1	
	Two stage message	On2	
	Three stage message	On3	

1) Set transmission ratio selector accordingly.

2) Parameter only appears with "WAY", "-WAY", "ncSLL" and "-NCLL"

3) If used, the value on the actuator must correspond to the set range of stroke on the lever arm. Carrier must be set to the value of the actuator travel or, if this value is not scaled, to the next higher scaled value.

4) Setpoint turning points only appear when '12.SFCT = FrEE' is selected.

5) NO contact: Action when signal state is 1; NC contact: Action when signal state is 0

6) Normal: conductive, no fault; Inverted: deactivated, fault

7) '+' means: OR logic operation

8.4 Description of parameters

8.4.1 Initialization parameters 1 to 5

8.4.1.1 '1.YFCT' type of actuator

Requirement: Type of actuator as well as mounting type and direction of action are known.

Possible settings:

Actuator with normal direction of action	Actuator with inverted direction of action
• turn	• -turn
• WAY	• -WAY
• FWAY	• -FWAY
• LWAY	• -LWAY
• ncSt	• -ncSt
• ncSL	• -ncSL
• ncSLL	• -ncLL

Purpose: Use this parameter to adjust the positioner to the respective actuator.

- turn/-turn: Use this setting for a part-turn actuator with a directly mounted positioner.
- WAY/-WAY: Use this setting.
  - For a linear actuator with a carrier pin mounted on the lever
  - In conjunction with devices that use an internal sensor

- FWAY/-FWAY: Use this setting.
  - For a linear actuator with a carrier pin mounted on the actuator spindle
  - In conjunction with devices that use an internal sensor
- LWAY/-LWAY: Use this setting for an external linear potentiometer on a linear actuator (e.g. with cylinder drives).
- ncSt/-ncSt: Use this setting for a part-turn actuator for:
  - An NCS sensor 6DR4004-. N.10 and -.N.40
  - A positioner 6DR5...-0..9.-....- L1A with internal NCS module
  - A positioner 6DR59* with accessory NCS module 6DR4004-5L/-5LE
  - Position Transmitter 6DR4004-2ES, -3ES and -4ES
- ncSL/-ncSL: Use this setting for an NCS sensor 6DR4004-.N.20 on a linear actuator for strokes < 14 mm (0.55 inch).
- ncSLL/-ncLL: Use this setting for a linear actuator for:
  - An NCS sensor 6DR4004-.N.30 for strokes > 14 mm (0.55 inch).
  - A positioner 6DR5...-0..9.-....- L1A with internal NCS module
  - A positioner 6DR59* with accessory NCS module 6DR4004-5L/-5LE
  - Position Transmitter 6DR4004-2ES, -3ES and -4ES

In the case of actuators with inverted direction of action, use the settings with the minus sign, e.g. "-turn".

Description:

Meaning of actuator with normal direction of action:

- Part-turn actuator closes when the actuator shaft, positioner shaft or magnet of the NCS sensor rotates in the **clockwise** direction.
- Linear actuator closes when the actuator spindle moves downwards and the positioner shaft or magnet of the NCS sensor rotates in the **anti-clockwise** direction.

Meaning for actuator with inverted direction of action:

- Part-turn actuator closes when the actuator shaft, positioner shaft or magnet of the NCS sensor rotates in the **anti-clockwise** direction.
- Linear actuator closes when the actuator spindle moves upwards and the positioner shaft or magnet of the NCS sensor rotates **clockwise**.

Additional information:

- The '3.YWAY' Range of stroke (Page 154) parameter is displayed only for 'WAY', '-WAY', 'ncSLL' or '-ncLL'.
- turn/-turn: The '2.YAGL' Rated angle of rotation of feedback (Page 154) parameter is automatically set to 90° and cannot be changed.

- WAY/-WAY: The positioner then compensates the non-linearity. The non-linearity is caused by the transformation of the linear movement of the linear actuator into the rotary movement of the positioner shaft. For correct compensation, follow the instructions in section "Preparing linear actuators for commissioning (Page 121)".

Factory setting: WAY

8.4.1.2 '2.YAGL' Rated angle of rotation of feedback

Condition: Transmission ratio selector and the value set in the '2.YAGL' parameter match. Only then does the value shown on the display match the actual position.

Possible settings:
- 33°
- 90°

Purpose: Use this parameter for a linear actuator. For a linear actuator, set an angle of 33° or 90° depending on the range of stroke. The current setting of the actuator is then measured more accurately. The following is applicable:
- 33°: Strokes ≤ 20 mm
- 90°: Strokes 25 mm to 35 mm
- 90°: Strokes > 40 mm to 130 mm

Use the mounting kit:
- 6DR4004-8V for strokes up to 35 mm
- 6DR4004-8L for strokes greater than 35 mm up to 130 mm

'2.YAGL' can only be adjusted if '1.YFCT' is set to 'WAY'/'-WAY' or 'FWAY'/'-FWAY'.

With all other settings of '1.YFCT', an angle of 90° is automatically set for '2.YAGL'.

Factory setting: 33°

See also

Sequence of automatic initialization (Page 110)

8.4.1.3 '3.YWAY' Range of stroke

Condition:
- Positioner is mounted.
- Carrier pin is mounted on the lever according to the stroke range of the actuator → Mounting to linear actuator (Page 34).

Possible settings:
- OFF
- 5.0 | 10.0 | 15.0 | 20.0 | 25.0 |30.0 | 35.0 | 40.0 | 50.0 | 60.0 | 70.0 | 90.0 | 110.0 | 130.0

Purpose: Use this parameter to display the determined stroke value in mm when initialization of a linear actuator has been completed.

If the 'OFF' setting is selected, the real stroke is not displayed after initialization.

From the setting options listed above, select the value that corresponds to the stroke range of the actuator in mm.

If the range of stroke of the actuator does not correspond to a possible setting, use the next higher value. Use the value specified on the nameplate of the actuator for this purpose.

'3.YWAY' is only displayed if '1.YFCT' is set to 'WAY'/'-WAY' or 'ncSLL'/'-ncLL'.

Factory setting: OFF

8.4.1.4 '4.INITA' Initialization (automatic)

Possible settings:

- NOINI
- no / ###.#
- Strt

Purpose: Use this parameter to start the automatic initialization process.

1. Select the "Strt" setting.
2. Then press the button for at least 5 seconds.

The lower line of the display indicates which initialization step is currently being run through.

Factory setting: NOINI

8.4.1.5 '5.INITM' Initialization (manual)

Possible settings:	• NOINI • no / ###.# • Strt
Purpose:	Use this parameter to start the manual initialization process. 1. Select the "Strt" setting. 2. Then press the △ button for at least 5 seconds.
Description:	If the positioner has already been initialized and if the "4.INITA" and "5.INITM" values are set, it is possible to reset the positioner to the non-initialized status. To do this, press the ▽ button for at least 5 seconds.
Factory setting:	NOINI

8.4.2 Application parameters 6 to 52

8.4.2.1 '6.SCUR' Current range of setpoint

Requirement:	• You have a positioner in the 2-wire, 3-wire, 4-wire version. • Positioner is connected in accordance with the connection graphics for 2/3/4-wire systems shown in section "Electrical wiring (Page 81)".
Possible settings:	• 0 MA • 4 MA
Purpose:	This parameter is used to set the current range of the setpoint. The selection of the current range depends on the type of connection. The "0 MA" setting (0 to 20 mA) is only possible for three-wire and four-wire connections.
Factory setting:	4 MA

8.4.2.2 '7.SDIR' Setpoint direction

Possible settings:	• riSE • FALL
Purpose:	This parameter is used to set the setpoint direction. The setpoint direction is used to reverse the direction of action of the setpoint. • Rising (riSE): A higher value at the setpoint input results in opening of the valve. • Falling (FALL): A higher value at the setpoint input results in closing of the valve. The setpoint direction is primarily used for the split-range mode and for single-acting actuators with the safety setting 'uP'.
Factory setting:	riSE

8.4.2.3 '8.SPRA' Setpoint split range start / '9.SPRE' Setpoint split range start end

Adjustment range:	0.0 ... 100.0	
Purpose:	With these two parameters in combination with parameter "'7.SDIR' Setpoint direction (Page 157)", you can limit the effective setpoint. Solve split-range tasks with the following characteristic curves: • Rising/falling • Falling/rising • Falling/falling • Rising/rising	
Factory setting:	With "SPRA": 0.0	With "SPRE": 100.0

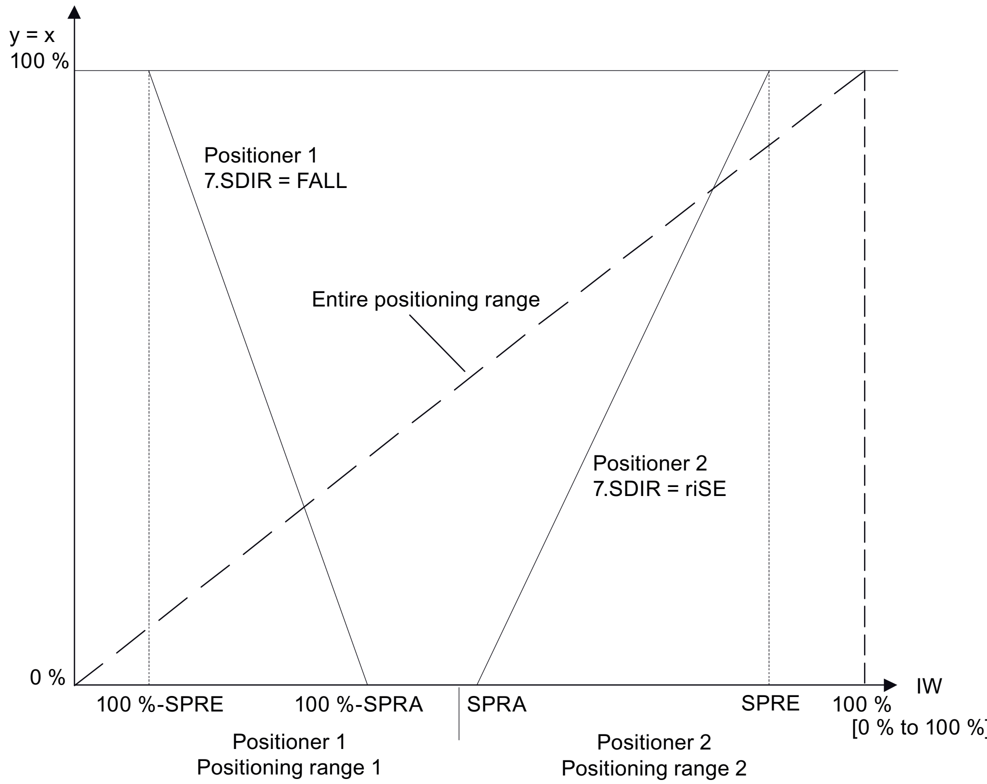


Figure 8-2 Example: Split-range operation with 2 positioners

8.4.2.4 '10.TSUP' Setpoint ramp UP / '11.TSDO' Setpoint ramp DOWN

Possible settings:	With "TSUP" • Auto • 0 ... 400	With "TSDO" • 0 ... 400

Purpose:

The setpoint ramp is effective in "Automatic" mode and limits the speed of change of the effective setpoint. The parameter specifies the duration in seconds that the positioner needs to move the stroke from 0 to 100%. Example: If "TSUP" = 10 is set, the positioner needs 10 s to move the stroke from 0 to 100% and 1 s to move the stroke from 0 to 10%.

When switching over from "Manual" mode to "Automatic" mode, the setpoint ramp is used to adjust the effective setpoint to the setpoint of the positioner.

This smooth switching from "Manual" mode to "Automatic" mode prevents pressure excess in long pipelines.

The "TSUP = Auto" parameter means that the slower of the two actuating times determined during initialization is used for the setpoint ramp. Parameter value "TSDO" then has no effect.

Factory setting: 0

8.4.2.5 '12.SFCT' Setpoint function

Possible settings:
- Lin
- 1 - 25
- 1 - 33
- 1 - 50
- n1 - 25
- n1 - 33
- n1 - 50
- FrEE

Purpose: This parameter is used to linearize nonlinear process valve characteristics. Optional flow characteristics as shown in the figure in the '13.SL0' ... '33.SL20' Setpoint turning point (Page 159) parameter description are simulated for linear process valve characteristics.

Factory setting: Lin

Seven process valve characteristics are stored in the positioner and are selected using the 'SFCT' parameter:

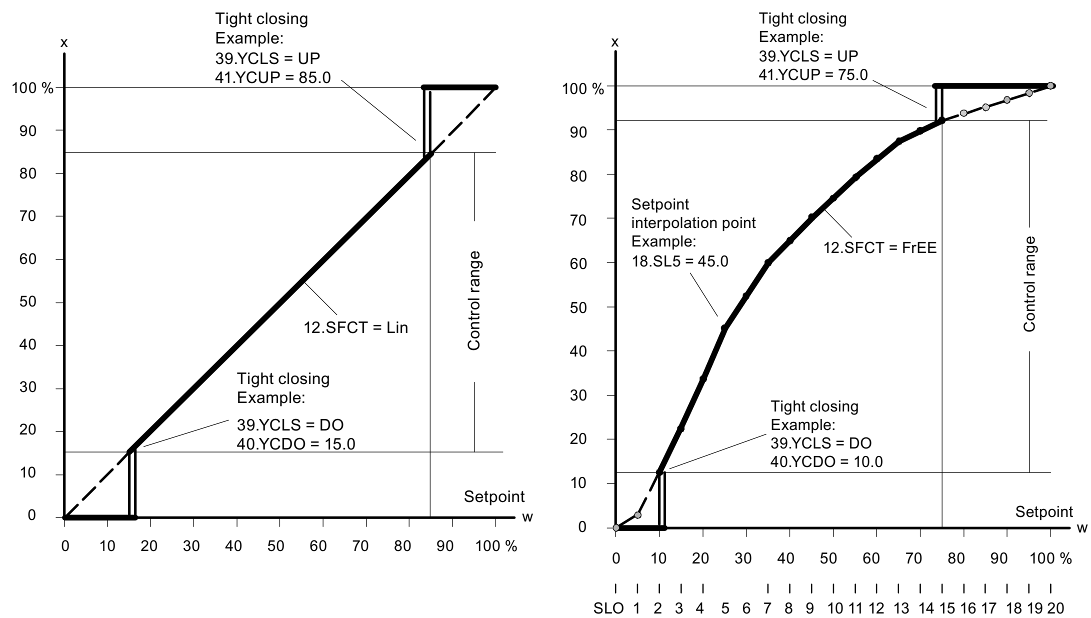
Process valve characteristic		**Set with parameter value**
Linear		Lin
Equal percentage	1:25	1-25
Equal percentage	1:33	1-33
Equal percentage	1:50	1-50
Inverse equal percentage	25:1	n1-25
Inverse equal percentage	33:1	n1-33
Inverse equal percentage	50:1	n1-50
Freely adjustable		FrEE

8.4.2.6 '13.SL0' ... '33.SL20' Setpoint turning point

Setting range: 0.0 ... 100.0

Purpose: These parameters are used to assign a flow coefficient in units of 5% to each setpoint turning point. The setpoint breakpoints form a polyline with 20 linear segments which models the process valve characteristic; see figure below.

Factory setting: "0", "5" ... "95", "100"



Setpoint characteristic curves, standardization of manipulated variables, and tight closing function

Input of the setpoint turning points is only possible if the "'12.SFCT' Setpoint function (Page 159)" parameter is set to "FrEE". You can only enter one monotone rising characteristic curve and two consecutive interpolation points must differ by at least 0.2%.

8.4.2.7 '34.DEBA' Deadband of closed-loop controller

Possible settings:
- Auto
- 0.1 ... 10.0

Purpose: This parameter is used with the "Auto" setting to adjust the deadband in automatic mode continually and adaptively to the requirements of the control loop. If a regulator oscillation is detected, then the deadband is incrementally enlarged. The reverse adaptation takes place using a time criterion.

The deadband is set using the values 0.1 to 10.0. The value is given in percent. Control oscillations can then be suppressed. The smaller the deadband, the better the control accuracy.

Factory setting: Auto

8.4.2.8 '35.YA' Start of manipulated variable limit / '36.YE' End of manipulated variable limit

Setting range:	0.0 ... 100.0	
Purpose:	These parameters are used to limit the mechanical actuator travel from stop to stop to the configured values. The value is given in percent. This allows the mechanical travel range of the actuator to be limited to the effective flow, preventing integral saturation of the controlling closed-loop controller. See the figure in the description of the '37.YNRM' Standardization of manipulated variable (Page 161) parameter. **'Dead angle' function** The dead angle is the angle range in which the process valve allows no flow. The dead angle range starts at the lower endstop of the valve, for example, and ends at the angle at which the medium begins to flow. Use this function if you want to use the entire signal range for valve control (for example, 4 mA to 20 mA). To now use the entire signal range for process valve control, set the lower manipulated variable limit (YA) to the percentage value at which the medium begins to flow. To display the new initial value as 0%, set '37.YNRM' Standardization of manipulated variable (Page 161) to 'FloW'.	
Factory setting:	When 'YA': 0.0	When 'YE': 100.0

Note

'YE' must always be set larger than 'YA'.

8.4.2.9 '37.YNRM' Standardization of manipulated variable

Possible settings:
- MPOS
- FLoW

Purpose:

Use the '35.YA' Start of manipulated variable limit / '36.YE' End of manipulated variable limit (Page 161) parameters to limit the manipulated variable. This limitation causes two different scaling types 'MPOS' and 'FLoW' for the display and for the position feedback through the current output.

The MPOS scale shows the mechanical positions from 0% to 100% between the upper and lower endstops of the initialization. The position is not influenced by the '35.YA' Start of manipulated variable limit / '36.YE' End of manipulated variable limit (Page 161) parameters. The 'YA' and 'YE' parameters are shown in the MPOS scale.

The FLoW scale is the standardization from 0% to 100% in the range between the 'YA' and 'YE' parameters. Over this range, the setpoint w is also always 0% to 100%. This results in a more or less flow-proportional display and position feedback. The flow-proportional display and position feedback also results from the use of process valve characteristics.

In order to calculate the control deviation, the setpoint in the display is also shown in the corresponding scale.

Below, the example of an 80-mm linear actuator is used to illustrate the dependence of the stroke on the scaling as well as on the 'YA' and 'YE' scaling parameters; see the following figure.

Factory setting: MPOS

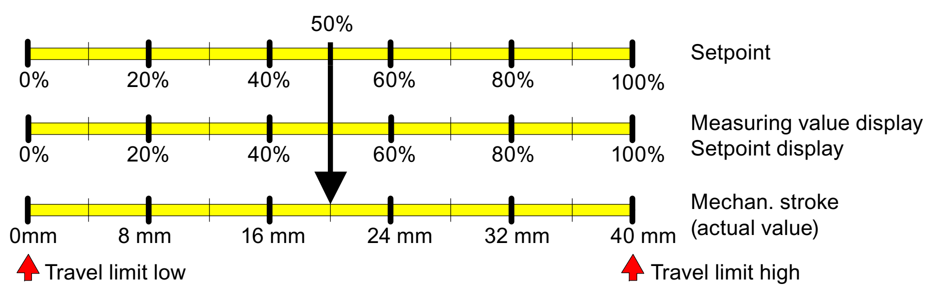


Figure 8-3 YNRM = MPOS or YNRM = FLoW; default: YA = 0 % and YE = 100 %

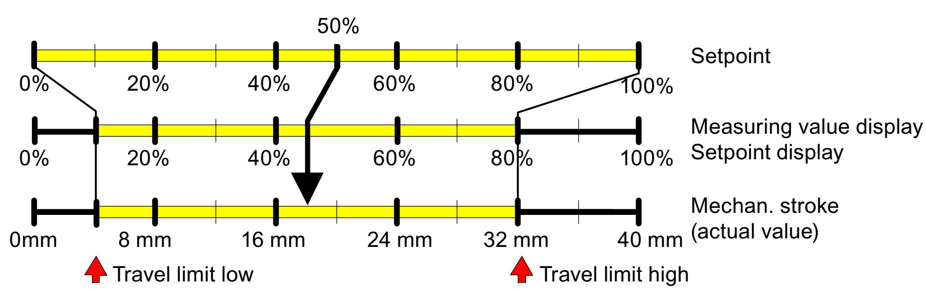


Figure 8-4 Example: YNRM = MPOS with YA = 10 % and YE = 80 %

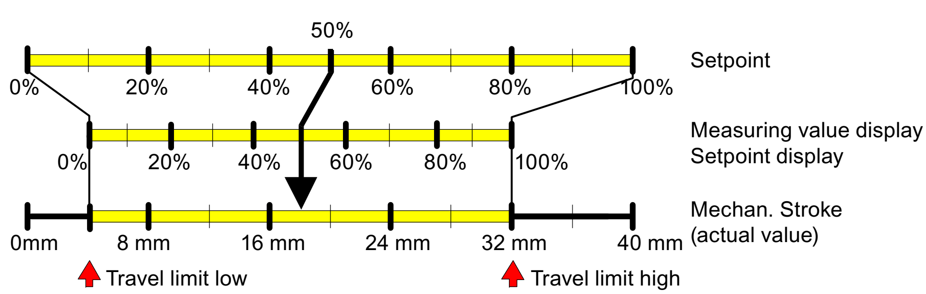


Figure 8-5 Example: YNRM = FLoW with YA = 10 % and YE = 80 %

See also

'39.YCLS' Tight closing/fast closing with manipulated variable (Page 163)

8.4.2.10 '38.YDIR' Direction of manipulated variable for display and position feedback

Possible settings:	• riSE • FALL
Purpose:	This parameter is used to set the direction of action of the display and the position feedback. The direction is rising or falling.
Factory setting:	riSE

8.4.2.11 '39.YCLS' Tight closing/fast closing with manipulated variable

Possible settings:	no	None
	uP	Tight closing Up
	do	Tight closing Down
	uP do	Tight closing Up and Down
	Fu	Fast closing Up
	Fd	Fast closing Down
	Fu Fd	Fast closing Up and Down
	uP Fd	Tight closing Up and fast closing Down
	Fu do	Fast closing Up and tight closing Down

Purpose:

This parameter is used to drive the control valve to the endstops. If the parameter is not activated, the control valve controls the two endstops which were determined during the initialization.

With tight closing, the control valve requires longer to leave the endstops. With fast closing, the endstops of the control valve are left immediately.

The tight closing and fast closing functions are activated on one side or for both endstops. Parameter 'YCLS' becomes effective if the effective setpoint:

- Is at or below the value set in the "40.YCDO' Value for tight closing/fast closing Down (Page 164)' parameter.
- Is at or above the value set in the "41.YCUP' Value for tight closing/fast closing Up (Page 164)' parameter.

Factory setting: no

See the figure in the description of the '37.YNRM' Standardization of manipulated variable (Page 161) parameter and the figure in the description of the '13.SL0' ... '33.SL20' Setpoint turning point (Page 159) parameters.

Note

Activated tight closing/fast closing function

If the function is activated, then the monitoring of control deviation is turned off in the respective overflow direction for the "49.\\LIM' Response threshold of fault message 'Control deviation' (Page 169)' parameter. The following applies: 'YCDO: < 0 %' and 'YCUP: > 100 %'. This functionality is especially advantageous for valves with lining. For long-term monitoring of the positions of the endstops, we recommend that you activate the 'F.ϟZERO' and 'G.ϟOPEN' parameters.

8.4.2.12 '40.YCDO' Value for tight closing/fast closing Down

Requirement:	'39.YCLS' Tight closing/fast closing with manipulated variable (Page 163) Parameter is set to 'do', 'uP do', 'Fd', 'Fu Fd', 'uP Fd' or 'Fu do'
Adjustment range:	0.0 ... 100.0
Purpose:	Use the 'YCDO' parameter to set the value as of which the "Tight closing/fast closing Down" function is activated. If the effective setpoint is at or below the value set here, the actuator moves in tight closing Down or fast closing Down.
Factory setting:	0.5

Note

The value in the 'YCDO' parameter is always smaller than that in 'YCUP'. The tight closing/fast closing function has a fixed hysteresis of 1%. The 'YCDO' parameter is relative to the mechanical stops. The 'YCDO' is independent of the values set in the '7.SDIR' Setpoint direction (Page 157) and '38.YDIR' Direction of manipulated variable for display and position feedback (Page 163) parameters.

8.4.2.13 '41.YCUP' Value for tight closing/fast closing Up

Requirement:	'39.YCLS' Tight closing/fast closing with manipulated variable (Page 163) Parameter is set to 'do', 'uP do', 'Fd', 'Fu Fd', 'uP Fd' or 'Fu do'
Adjustment range:	0.0 ... 100.0
Purpose:	Use the 'YCUP' parameter to set the value as of which the tight closing Up or fast closing Up is activated. If the effective setpoint is at or above the value set here, the actuator moves in tight closing Up or fast closing Up.
Factory setting:	99.5

Note

The value in the 'YCDO' parameter is always smaller than that in 'YCUP'. The tight closing/fast closing function has a fixed hysteresis of 1%. The 'YCUP' parameter is relative to the mechanical stops. The 'YCUP' is independent of the values set in the '7.SDIR' Setpoint direction (Page 157) and '38.YDIR' Direction of manipulated variable for display and position feedback (Page 163) parameters.

8.4.2.14 '42.DI1' / '43.DI2' Function digital input

Setting option

- Digital input DI1

NO contact	**NC contact**
OFF	OFF
on	-on
bloc1	-uP
bloc2	-doWn
uP	-StoP
doWn	-PST
StoP	
PST	

- Digital input DI2

NO contact	**NC contact**
OFF	OFF
on	-on
uP	-uP
doWn	-doWn
StoP	-StoP
PST	-PST

Purpose:

These parameters determine the function of the digital inputs. The possible functions are described below. The direction of action can be adapted to a normally closed or normally open mode.

- DI1 or DI2 = On or -On
  Digital messages from I/O devices, e.g. from pressure or temperature switches, are read out over the communication interface or result in a response from the fault message output through an OR logic operation with other messages.
- DI1 = bLoc1
  Use this parameter value to interlock the "Configuration" mode against adjustment. The lock is performed e.g. with a jumper between terminals 9 and 10.
- DI1 = bLoc2
  If the DI1 digital input has been activated, 'Manual' mode is blocked in addition to "Configuration" mode.

- DI1 or DI2 =
  Contact uP or doWn closes or
  Contact -uP or -doWn opens
  If the digital input is activated, the actuator uses the value defined by the "'35.YA' Start of manipulated variable limit / '36.YE' End of manipulated variable limit (Page 161)" parameter for controlling in 'Automatic' mode.
- DI1 or DI2 =
  Contact StoP closes or
  Contact -StoP opens
  If the digital input is activated, control of the pneumatic block is blocked in "Automatic" mode. The actuator remains at the last position. Leakage measurements can be performed in this way without using the initialization function.
- DI1 or DI2 = PSt or -PSt
  Via digital input DI1 or DI2, a Partial Stroke Test (PST) is initiated by actuation of a NC or NO contact depending on the selection.
- DI1 or DI2 = OFF
  No function
  Special function of digital input DI1: If digital input DI1 is activated in "P-manual mode" by a jumper between terminals 9 and 10, the firmware version is displayed when the button is pressed.

If one of the above-named functions is activated with the "DI1" and "DI2" parameters simultaneously, then: "Blocking" has priority over "uP". "uP" has priority over "doWn". "doWn" has priority over "PST".

Factory setting: OFF

8.4.2.15 '44.AFCT' Alarm function

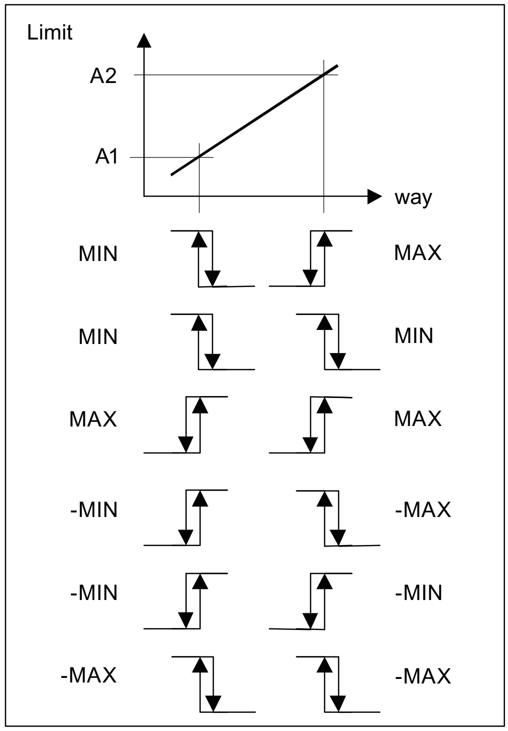
Possible settings: See corresponding representation below

Purpose: This parameter can be used to determine the value at which going above or below a given offset or angle will result in a message. The triggering of alarms (limits) is relative to the MPOS scale. The alarms are signaled via the Digital I/O Module (DIO). In addition, alarms can also be read via the communication interface.

The direction of action of the digital outputs can be adjusted from "High active" to "Low active" for the next systems.

Factory setting: OFF

Direction of action and hysteresis



	Digital I/O Module (DIO)	
Examples	A1	A2
A1 = 48	AFCT = MIN / MAX	
A2 = 52		
Way =45	**Active**	
Way =50		
Way =55		**Active**
A1 = 48	AFCT = -MIN / -MAX	
A2 = 52		
Way =45		**Active**
Way =50	Active	Active
Way =55	**Active**	
A1 = 52	AFCT = MIN / MAX	
A2 = 48		
Way =45	**Active**	
Way =50	Active	Active
Way =55		**Active**
A1 = 52	AFCT = -MIN / -MAX	
A2 = 48		
Way =45		**Active**
Way =50		
Way =55	**Active**	

Note

If extended diagnostics is activated using parameter "'52.XDIAG' Activating for extended diagnostics (Page 171)" with setting "On3", then the alarms are not output through the Digital I/O Module (DIO). Alarm A1 is output with setting "On2". However, notification via the communication interface is possible at any time.

8.4.2.16 '45.A1' / '46.A2' Response threshold of alarm

Adjustment range: 0.0 ... 100.0

Purpose: These parameters are used to specify when an alarm should be displayed. The response thresholds of the alarms (in percent) refer to the MPOS scale in the '37.YNRM' Standardization of manipulated variable (Page 161) parameter. The MPOS scale corresponds to the mechanical travel.

Depending on the setting of the alarm function in the '44.AFCT' Alarm function (Page 166) parameter, the alarm is triggered upon an upward violation (Max) or downward violation (Min) of this response threshold.

Factory setting: With 'A1': 10.0 With 'A2': 90.0

8.4.2.17 '47.\\FCT' Function of the fault message output

Requirement: At least one of the following modules is fitted

- Digital I/O Module (DIO)
- Inductive Limit Switches (ILS)
- Mechanic Limit Switches (MLS)

Possible settings:

Normal direction of action	Inverted direction of action
• ϟ	• -ϟ
• ϟnA	• -ϟnA
• ϟnAb	• -ϟnAb

Purpose: The fault message in the form of monitoring of control deviation over time is also triggered by the following events:

- Power failure
- Processor fault
- Actuator fault
- Process valve fault
- Supply pressure PZ is out of specification

Additional error messages are also output if the '52.XDIAG (Page 171)' parameter is activated.

The fault message cannot be switched off, but it can be suppressed (factory setting) when you exit 'Automatic' mode. Set the 'ϟFCT' parameter to 'ϟnA' to also generate a fault message here.

You also have an option to "or" the fault message with the status of the digital inputs. To do this, first set the '42.DI1' / '43.DI2' Function digital input (Page 165) parameter to 'on' or '-on'. Subsequently set the 'ϟFCT' parameter to 'ϟnAb'.

If you want the fault message to be output with inverse direction of action, select the '-ϟ' setting.

Factory setting: ϟ

8.4.2.18 '48.\\TIM' Monitoring period for setting of fault message 'Control deviation'

Possible settings:	• Auto • 0 ... 100
Purpose:	Use this '48.ϟTIM' application parameter to set the time in seconds within which the positioner must reach the compensated state. The corresponding response threshold is specified in the parameter. When the configured time is exceeded, the fault message output is set.
Factory setting:	Auto

Note

Activated tight closing/fast closing function

If the function is activated, the monitoring of control deviation is switched off in the respective overrun direction for the '49.ϟLIM' application parameter. The following applies: 'YCDO: < 0%' and 'YCUP: > 100%'. This functionality is especially advantageous for valves with lining. For long-term monitoring of the end positions, we recommend that you activate the 'F.ϟZERO' and 'G.ϟOPEN' diagnostic parameters.

More information is available in the Diagnostics Manual.

8.4.2.19 '49.\\LIM' Response threshold of fault message 'Control deviation'

Possible settings:	• Auto • 0 ... 100
Purpose:	This '49.ϟLIM' application parameter is used to set a value for the permissible size of the control deviation to trigger a fault message. The value is given in percent. If the '48.ϟTIM' and '49.ϟLIM' parameters are set to 'Auto', then the fault message is set if the slow step zone is not reached within a certain period of time. Within 5 to 95% of the actuator travel, this time is twice the initialization travel time, and ten times the initialization travel time outside of 10 to 90%.
Factory setting:	Auto

Note

Activated tight closing/fast closing function

If the function is activated, the monitoring of control deviation is switched off in the respective overrun direction for the '49.ϟLIM' application parameter. The following applies: 'YCDO: < 0%' and 'YCUP: > 100%'. This functionality is especially advantageous for valves with lining. For long-term monitoring of the end positions, we recommend that you activate the 'F.ϟZERO' and 'G.ϟOPEN' diagnostic parameters.

More information is available in the Diagnostics Manual.

8.4.2.20 '50.PRST' Preset (HART/FF)

Possible settings:
- ALL
- Init
- PArA
- diAg

Purpose:

Use this parameter to restore the factory settings for most parameters. The following parameter groups are available:
- ALL: Reset all parameters together which can be reset by 'Init', 'PArA' and 'diAg'.
- Init: Reset initialization parameters '1.YFCT' to '5.INITM'.
- PArA: Reset application parameters '6.SCUR' Current range of setpoint (Page 156) to '49.\\LIM' Response threshold of fault message 'Control deviation' (Page 169).
- diAg: Resetting the extended diagnostic parameters A to U as well as parameter '52.XDIAG' Activating for extended diagnostics (Page 171).

An overview of the parameters and factory settings can be found in section Parameter assignment (Page 145).

In order to select one of the parameter groups listed above, repeatedly press the ▽ button until the desired setting is output in the display. Start the function by keeping the △ button pressed until 'oCAY' is output in the display. The values of the parameter group are now the factory settings.

Description:

If you wish to use a previously initialized positioner on a different control valve, set the parameters to the factory settings prior to a new initialization. To do this, use the 'ALL' or 'Init' setting.

Factory setting: ALL

8.4.2.21 '51.PNEUM' Pneumatics type

Requirement:	FIP	You have a positioner with the "Fail in place" function with order suffix -Z, order code F01.
	booSt	You operate the positioner with a booster.
Possible settings:	Std	Standard pneumatic block
	FIP	Fail in Place pneumatic block
	booSt	Operation with boosters

Purpose:

Start the function by pressing the △ button for at least 5 seconds. The display shows 'WAit' during these 5 seconds. Set the desired function after 5 seconds.

Std	Setting for a standard pneumatic block.

FIP	If you order a positioner for Fail in Place applications, the position is then equipped with a special pneumatic block. The "PNEUM" parameter is preset to "FIP". The parameter must be set to "FIP" again when the electronics are re-placed.
booSt	Use this function if you operate the positioner with a booster. This function then shows the actuator overshoot. You can find a description of how to operate the booster under Booster (Page 293).

8.4.2.22 '52.XDIAG' Activating for extended diagnostics

This parameter is used to activate extended diagnostics. This also determines the maintenance level to be reported. The maintenance levels according to increasing importance are: Maintenance required, maintenance demanded and maintenance alarm.

Note

Activation of extended diagnostics

Extended diagnostics are deactivated in the factory setting: The "52.XDIAG" parameter is set to "Off".

The extended diagnostics are activated and the diagnostic parameters can be shown on the display only after changing the parameter to "On1", "On2" or "On3".

After changing the parameter "52.XDIAG" from "Off" to "On1", "On2" or "On3", the process diagnostics are also visible and can be activated individually. The setting applies to all process diagnostics. More information is available in the Diagnostics Manual.

Table 8-1 Application parameter "52.XDIAG"

Setting	Description
Off	• The display of the process diagnostics are deactivated. • The messages are deactivated.
On1	• The process diagnostics are displayed. • 1-stage message for all process diagnostics: The **threshold 3 messages** are activated. • If threshold 3 is exceeded: – A specific process diagnostics message is shown on the display. – With the optional Digital I/O Module (DIO): The "Fault message output" is activated.

Setting	Description
On2	• The process diagnostics are displayed. • 2-stage message for all process diagnostics: **Threshold 2 messages** and **threshold 3 messages** are activated. • If threshold 2 is exceeded: – A specific process diagnostics message is shown on the display. – With the optional Digital I/O Module (DIO): The digital output "DO2" is activated. • If threshold 3 is exceeded: – The threshold 2 message is **not** generated. – A specific process diagnostics message is shown on the display. – With the optional Digital I/O Module (DIO): The "Fault message output" is activated. The digital output "DO2" is deactivated.
On3	• The process diagnostics are displayed. • 3-stage message for all process diagnostics: **Threshold 1 messages, threshold 2 messages** and **threshold 3 messages** are activated. • If threshold 1 is exceeded: – A specific process diagnostics message is shown on the display. – With the optional Digital I/O Module (DIO): The digital output "DO1" is activated. • If threshold 2 is exceeded: – The threshold 1 message is **not** generated. – A specific process diagnostics message is shown on the display. – With the optional Digital I/O Module (DIO): The digital output "DO2" is activated. The digital output "DO1" is deactivated. • If threshold 3 is exceeded: – The threshold 1 message and the threshold 2 message are **not** generated. – A specific process diagnostics message is shown on the display. – With the optional Digital I/O Module (DIO): The "Fault message output" is activated. The digital outputs "DO1" and "DO2" are deactivated.

Note

Resetting messages after successful maintenance

If a high or low threshold is violated, the positioner generates a message in the form of an error code and a bar in the display. The message disappears automatically after successful maintenance. Depending on the application, the message is displayed for several hours until the message disappears. The message disappears immediately if you perform one or more of the following tasks:

- Deactivate the monitoring.
- Re-initialize the high and low stops of the device.
- Reset the counter.
- Reset the threshold.

With extended diagnostics, the threshold of the message is displayed using bars ① in addition to the error code ②. These bars ① and the error code ② are shown in the display as follows:

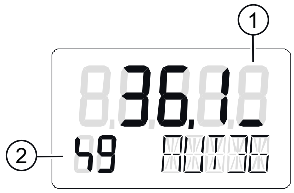


Figure 8-6 Display of a threshold 1 message: 1 bar means maintenance level "Maintenance required"

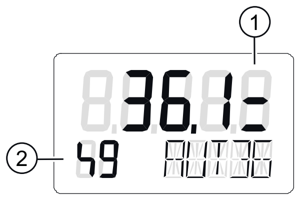


Figure 8-7 Display of a threshold 2 message: 2 bars means maintenance level "Maintenance demanded"

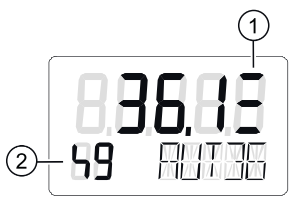


Figure 8-8 Display of a threshold 3 error message: 3 bars means maintenance level "Maintenance alarm"

See also

Display messages with error code (Page 209)

8.5 Diagnostic values

8.5.1 Displaying diagnostic values

Open Diagnostics mode

- Press the 3 buttons on the display simultaneously for at least 2 seconds.
  ⇒ "Diagnostics" mode is active.
  Diagnostic value shown in the display:

  – The top line shows the value, e.g. "107".
    For values greater than 99 999, the display switches to exponential format. Example: The value "1 234 567" is shown as "1.23E6".
  – The bottom line shows the number of the diagnostic value, e.g. "1", and the short name of the diagnostic value, e.g. "STRKS".

Displaying diagnostic values

The diagnostic values are shown on the display in ascending or descending order.

- In ascending order: Press the button.
  ⇒ The next highest diagnostic value is displayed.
- Descending order: Hold down the button and press the button at the same time.
  ⇒ The next lower diagnostic value is displayed.

Set diagnostic value to zero

Requirement

The diagnostic value can be reset.

Procedure

1. Select the desired diagnostic value.
2. Press the button for at least 5 seconds.
   ⇒ The "rESEt" display changes to "0". The value is set to zero.

Exit Diagnostics mode

- Press the button for at least 2 seconds.

8.5.2 Diagnostic values overview

Diagnostic value	Short designation	Unit	More information
100% strokes	1.STRKS	-	→ Diagnostics Manual
Direction change	2.CHDIR	-	
Fault messages	3.ϟCNT	-	
Alarm 1	4.A1CNT	-	
Alarm 2	5.A2CNT	-	
Operating hours	6.HOURS	h (hours)	
Operating hours, resettable	7.HOURR	h (hours)	
Determined actuator travel	8.WAY	• Angle in ° • Stroke in mm	
Travel time UP (direction 100% position)	9.TUP	s (seconds)	
Travel time DOWN (direction 0% position)	10.TDOWN		
Leakage test	11.LEAK	%/minute	
PST status / Measured time	12.PST	• - • s (seconds)	
Time since last Partial Stroke Test	13.PRPST	Days	
Time until next Partial Stroke Test	14.NXPST		
Dynamic control valve behavior	15.DEVI	%	
Pneumatic leakage	16.ONLK		
Stiction (slipstick effect)	17.STIC		
Endstop 0% position	18.ZERO		
Endstop 100% position	19.OPEN		
Average value of position	20.PAVG		
Position of lower endstop (0% position)	21.P0	%	Diagnostic value "Manipulated variable lower endstop (0% position)" (21.P0) (Page 177)
Position of upper endstop (100% position)	22.P100		Diagnostic value "Manipulated variable upper endstop (100% position)" (22.P100) (Page 179)
Pulse length UP (direction 100% position)	23.IMPUP	ms (milliseconds)	Diagnostic values "Pulse length UP" (23.IMPUP) / "Pulse length DOWN" (24.IMPDN) (Page 181)
Pulse length DOWN (direction 0% position)	24.IMPDN		
Pulse interval	25.PAUTP	ms (milliseconds)	Diagnostic value "Pulse interval" (25.PAUTP) (Page 182)
Deadband UP (direction 100% position)	26.DBUP	%	→ Diagnostics Manual
Deadband DOWN (direction 0% position)	27.DBDN		
Slow step zone UP (direction 100% position)	28.SSUP	%	Diagnostic values "Slow step zone UP" (28.SSUP) / "Slow step zone up DOWN" (29.SSDN) (Page 182)
Slow step zone DOWN (direction 0% position)	29.SSDN		

Diagnostic value	Short designa-tion	Unit	More information
Current temperature	30.TEMP	• °C • °F	→ Diagnostics Manual
Minimum temperature (min/max pointer)	31.TMIN		
Maximum temperature (min/max pointer)	32.TMAX		
Number of operating hours in temperature range 1 ... 9	33.T1 ... 41.T9	h (hours)	
Switching cycles of pneumatic block, valve 1	42.VENT1		
Switching cycles of pneumatic block, valve 2	43.VENT2		
Switching cycles of pneumatic block, valve 1, resettable	44.VEN1R	-	
Switching cycles of pneumatic block, valve 2, resettable	45.VEN2R		
Save maintenance information	46.STORE	-	
Prediction UP (direction 100% position)	47.PRUP		Diagnostic values "Prediction UP" (47.PRUP) / "Prediction DOWN" (48.PRDN) (Page 183)
Prediction DOWN (direction 0% position)	48.PRDN		
Operating hours in the travel range WT00 ... WT95	49.WT00 ... 56.WT95	h (hours)	→ Diagnostics Manual
Length of the leakage compensation pulses	57.LCPUL	ms (milliseconds)	
Period of the leakage compensation pulses	58.LCPER	s (seconds)	
Setpoint current	59.mA	mA	
Supply pressure PZ	60.PZ	• bar • MPa • psi	
Actuating pressure Y1	61.P1		
Actuating pressure Y2	62.P2		
Maximum supply pressure PZ, resettable	63.PZMAX		
Violations of lower limit PZ, resettable	64.N_MIN	-	
Violations of upper limit PZ, resettable	65.N_MAX	-	
Violations of limit Y1, resettable	66.N1MAX	-	
+/- Leakage at Y1	67.LMY1	• bar/min • MPa/min • psi/min	
+/- Leakage at Y2	68.LMY2		
Maximum positive leakage at Y1	69.LMUY1		
Maximum positive leakage at Y2	70.LMUY2		
Maximum negative leakage at Y1	71.LMDY1		
Maximum negative leakage at Y2	72.LMDY2		
Procedure for adjustment of electronics	73.RPL_E	-	Diagnostic value "Procedure for ad-justment of electronics" (73.RPL_E) (Page 185)
Position adjustment when replacing the posi-tioner	74.TRIM	%	Diagnostic value "Position adjust-ment" (74.TRIM) (Page 186)

8.5.3 Diagnostic values for commissioning and initialization

8.5.3.1 Diagnostic value "Manipulated variable lower endstop (0% position)" (21.P0)

Diagnostic value	**Lower endstop manipulated variable (0% position)** **Short designation: 21.P0**	
Function 1	The diagnostic value shows the status or the measured value/potentiometer value determined by the position detection system during automatic initialization at the upper endstop of the process valve (0% position), e.g. "7.4". With manual initialization, the value corresponds to the manually approached lower end position.	
Function 2	Synchronize 0% position.	
Requirement	The positioner is initialized.	
Display options	NO	It is currently not possible to adjust the 0% position. Initialization of the positioner is required.
	0.0 ... 100.0	
Unit	%	

Synchronize 0% position

The positioner is not usually initialized under process conditions. During operation, the endstop may change due to temperature changes and the resulting thermal expansion of the material.

If the process diagnostics "Monitoring 0% endstop" (F.\ZERO) is activated, the set thresholds may be exceeded due to thermal expansion. As a result, error messages are displayed.

Recommendation:

After the thermal expansion has fully affected the valve, compare the "21.P0" diagnostic value with the changed position of the lower endstop (0% position).

Requirements

- The positioner is in "Manual (MAN)" or "Automatic (AUT)" mode.
- The current position of the actuator is within the range -10% to +10% of the lower endstop.

Procedure for "Manual (MAN)" mode

1. Use the △ and ▽ buttons to move the actuator to the position that is to be adopted as the new 0% position.
2. Switch the positioner to "Diagnostics" mode by pressing the 3 buttons on the display ✋ ▽ △ simultaneously for at least 2 seconds.
3. Select the diagnostic value "21.P0".

4. Apply the current position by pressing the button for at least 5 seconds.
⇒ After 5 seconds, "0.0" appears in the display: This means that the current position has been adopted as the new 0% position.
⇒ After releasing the button, the corresponding value of the position detection system is displayed, e.g. "7.4".
5. Switch the positioner to "Manual (MAN)" mode by pressing the button for at least 2 seconds.

Procedure for "Automatic (AUT)" mode

1. Ensure that the actuator is at the position that is to be adopted as the new 0% position.
2. Switch the positioner to "Diagnostics" mode by pressing the 3 buttons on the display simultaneously for at least 2 seconds.
3. Select the diagnostic value "21.P0".
4. Apply the current position by pressing the button for at least 5 seconds.
⇒ After 5 seconds, "0.0" appears in the display: This means that the current position has been adopted as the new 0% position.
⇒ After releasing the button, the corresponding value of the position detection system is displayed, e.g. "7.4".
5. Switch the positioner to "Automatic (AUT)" mode by pressing the button for at least 2 seconds.

8.5.3.2 Diagnostic value "Manipulated variable upper endstop (100% position)" (22.P100)

Diagnostic value	**Upper endstop manipulated variable (100% position)** **Short designation: 22.P100**	
Function 1	The diagnostic value shows the status or the measured value/potentiometer value determined by the position detection system during automatic initialization at the upper endstop of the process valve (100% position), e.g. 87.5". With manual initialization, the value corresponds to the manually approached upper end position.	
Function 2	Adjust 100% position.	
Requirement	The positioner is initialized.	
Display options	NO	It is currently not possible to adjust the 100% position. Initialization of the positioner is required.
	0.0 ... 100.0	
Unit	%	

Adjust 100% position

The positioner is not usually initialized under process conditions. During operation, the endstop may change due to temperature changes and the resulting thermal expansion of the material.

If the process diagnostics "Monitoring 100% endstop" (G.\OPEN) is activated, the set thresholds may be exceeded due to thermal expansion. As a result, error messages are displayed.

Recommendation:

After the thermal expansion has fully affected the valve, compare the "22.P100" diagnostic value with the changed position of the upper endstop (100% position).

Requirements

- The positioner is in "Manual (MAN)" or "Automatic (AUT)" mode.
- The current position of the actuator is within the range -10% to +10% of the upper endstop.

Procedure for "Manual (MAN)" mode

1. Use the and buttons to move the actuator to the position that is to be adopted as the new 100% position.
2. Switch the positioner to "Diagnostics" mode by pressing the 3 buttons on the display simultaneously for at least 2 seconds.
3. Select the diagnostic value "22.P100".
4. Apply the current position by pressing the button for at least 5 seconds.
   ⇒ After 5 seconds, "0.0" appears in the display: This means that the current position has been adopted as the new 100% position.
   ⇒ After releasing the button, the corresponding value of the position detection system is displayed, e.g. "87.4".
5. Switch the positioner to "Manual (MAN)" mode by pressing the button for at least 2 seconds.

Procedure for "Automatic (AUT)" mode

1. Ensure that the actuator is at the position that is to be adopted as the new 100% position.
2. Switch the positioner to "Diagnostics" mode by pressing the 3 buttons on the display simultaneously for at least 2 seconds.
3. Select the diagnostic value "22.P100".
4. Apply the current position by pressing the button for at least 5 seconds.
   ⇒ After 5 seconds, "0.0" appears in the display: This means that the current position has been adopted as the new 100% position.
   ⇒ After releasing the button, the corresponding value of the position detection system is displayed, e.g. "87.4".
5. Switch the positioner to "Automatic (AUT)" mode by pressing the button for at least 2 seconds.

8.5.3.3 Diagnostic values "Pulse length UP" (23.IMPUP) / "Pulse length DOWN" (24.IMPDN)

Diagnostic values	**Pulse length UP (direction 100% position)** **Short designation: 23.IMPUP**
	Pulse length DOWN (direction 0% position) **Short designation: 24.IMPDN**
Function	The smallest possible pulse lengths that can be used to move the actuator are determined during the initialization. The pulse lengths are determined separately for the UP direction (direction 100% position) and the DOWN direction (direction 100% position) and displayed in these diagnostic values.
Note	The optimum value depends in particular on the volume of the actuator. The values can be adapted if needed: • Low values lead to small actuating pulses and frequent activation of the actuator. • Large values are advantageous for large actuator volumes.
Setting range	6 ... 160
Factory setting	6
Unit	ms (milliseconds)

Change pulse length

Note

Pulse length

- There is no movement if the values are too small.
- High values also lead to large movements with small actuators.

1. Switch the positioner to "Diagnostics" mode by pressing the 3 buttons on the display simultaneously for at least 2 seconds.
2. Select the diagnostic value.
3. Activate the setting function by pressing the or button for at least 5 seconds.
4. Set the diagnostic values to the desired values.
5. Switch the positioner to "Manual (MAN)" or "Automatic (AUT)" mode by pressing the button for at least 2 seconds.

8.5.3.4 Diagnostic value "Pulse interval" (25.PAUTP)

Diagnostic value	**Pulse interval** **Short designation: 25.PAUTP**
Function	The diagnostic value defines the time between the pulses in milliseconds.
Notes	• The diagnostic value can be changed manually. This can improve the control quality in applications with stiction (slipstick effect). • The set value is not changed when the positioner is initialized.
Setting range	2 ... 320
Factory setting	28
Unit	ms (milliseconds)

Change pulse interval

1. Switch the positioner to "Diagnostics" mode by pressing the 3 buttons on the display simultaneously for at least 2 seconds.
2. Select the diagnostic value.
3. Activate the setting function by pressing the or button for at least 5 seconds.
4. Set the diagnostic value to the desired value.
5. Switch the positioner to "Manual (MAN)" or "Automatic (AUT)" mode by pressing the button for at least 2 seconds.

8.5.3.5 Diagnostic values "Slow step zone UP" (28.SSUP) / "Slow step zone up DOWN" (29.SSDN)

Diagnostic values	**Slow step zone UP (direction 100% position)** **Short designation: 28.SSUP**
	Slow step zone DOWN (direction 0% position) **Short designation: 29.SSDN**
Function	The diagnostic values define the size of the slow step zones as a percentage. The slow step zone is the area of mean control deviation.
Notes	The values are taken into account for the initialization. The values can be adapted if needed. • A low value means: High actuating speeds are achieved even with small setpoint changes. • A high value means: Overshoot is reduced in the event of large setpoint changes. • If the system deviation is greater than the value of the slow step zone, the pneumatic outputs are permanently activated. • If the system deviation is less than the value of the slow step zone, the pneumatic outputs are clock controlled. The clock pulse length is proportional to the size of the system deviation. Pneumatic outputs: • Single-acting: Output Y1 • Double-acting: Outputs Y1 and Y2

Diagnostic values	**Slow step zone UP (direction 100% position)** **Short designation: 28.SSUP** **Slow step zone DOWN (direction 0% position)** **Short designation: 29.SSDN**
Setting range	0.1 ... 100.0
Factory setting	10.0
Unit	%

Change the size of the slow step zone

> **NOTICE**
>
> **Overshoots or too low speeds of shifting**
>
> Values too small for the slow step zones can cause overshooting.
> - Enter a higher value.
>
> Values too high for the slow step zones lead to slow actuating speeds close to the compensated state.
> - Enter a smaller value.

1. Switch the positioner to "Diagnostics" mode by pressing the 3 buttons on the display simultaneously for at least 2 seconds.
2. Select the diagnostic value.
3. Activate the setting function by pressing the or button for at least 5 seconds.
4. Set the diagnostic values to the desired values.
5. Switch the positioner to "Manual (MAN)" or "Automatic (AUT)" mode by pressing the button for at least 2 seconds.

8.5.3.6 Diagnostic values "Prediction UP" (47.PRUP) / "Prediction DOWN" (48.PRDN)

Diagnostic values	**Prediction UP (direction 100% position)** **Short designation: 47.PRUP** **Prediction DOWN (direction 0% position)** **Short designation: 48.PRDN**
Function	The diagnostic values show the predictions of the positioner for the upward movement (direction 100% position) and the downward movement (direction 0% position) The diagnostic values act as damping factors to set the control dynamics.
Notes	The values are taken into account for the initialization. The values can be adapted if needed. Changes in the diagnostic values have the following effect: • Small values result in quick adjustments with overshoots. • Large values result in slow adjustments without overshoots.

Diagnostic values	Prediction UP (direction 100% position) Short designation: 47.PRUP
	Prediction DOWN (direction 0% position) Short designation: 48.PRDN
Setting range	1 ... 40
Factory setting	1

Change the diagnostic value

1. Switch the positioner to "Diagnostics" mode by pressing the 3 buttons on the display simultaneously for at least 2 seconds.
2. Select the diagnostic value.
3. Activate the setting function by pressing the or button for at least 5 seconds.
4. Set the diagnostic values to the desired values.
5. Switch the positioner to "Manual (MAN)" or "Automatic (AUT)" mode by pressing the button for at least 2 seconds.

8.5.3.7 Diagnostic value "Procedure for adjustment of electronics" (73.RPL_E)

Diagnostic value	**Procedure for adjustment of electronics** **Short designation: 73.RPL_E**
Function	The diagnostic value provides a step-by-step procedure for improving linearity of a positioner with linear actuator.
Requirement	The positioner has firmware version 5.04 or higher.

Adjust the electronics

1. Switch the positioner to "Manual (MAN)" mode.
2. Press the or buttons until the lever of the mounting kit is in the horizontal position as far as possible.
3. Switch the positioner to "Diagnostics" mode by pressing the 3 buttons on the display simultaneously for at least 2 seconds.
4. Select the diagnostic value "73.RPL_EL".
   ⇒ "SEt" is shown in the display.
5. Start the adjustment by keeping the button pressed.
   ⇒ After 5 seconds, "oCAY" is displayed. The adjustment is complete.
6. Exit "Diagnostics" mode by keeping the button pressed for at least 2 seconds.
7. Switch the positioner to "Configure" mode by pressing the button on the display for at least 5 seconds.
8. Start the initialization of the positioner.
9. Switch the positioner to "Automatic (AUT)" mode by pressing the button for at least 2 seconds.

8.5.3.8 Diagnostic value "Position adjustment" (74.TRIM)

Diagnostic value	**Position adjustment** **Short designation: 74.TRIM**
Function	The diagnostic value is used to compare the position of the new positioner with the position of the previous positioner.
Note	Procedure for replacing the positioner → Replacing the positioner with communication (Page 138)
Requirement	The positioner has firmware version 5.04 or higher.
Setting range	-10.0 ... 110.0
Unit	%

Set the position of the new, replaced positioner

1. Switch the positioner to "Diagnostics" mode by pressing the 3 buttons on the display simultaneously for at least 2 seconds.
2. Select the diagnostic value "74.TRIM".
3. Activate the setting function by pressing the or button for at least 5 seconds.
4. Use the or buttons to set the diagnostic value to the noted actual position value of the previous positioner.
5. Acknowledge the position with the button.
   ⇒ The position is immediately adjusted.
6. Switch the positioner to "Manual (MAN)" or "Automatic (AUT)" mode by pressing the button for at least 2 seconds.

8.6 Overview of the assignment of the HART variables

Dynamic variables for device revision 6, as of firmware 5.01.xx HART 7

For positioners with HART communication, the variables PV, SV, TV and QV are assigned as follows:

Variable	Meaning	Physical variable
HART Primary Variable (PV)	Primary variable	W (setpoint) in %
HART Secondary Variable (SV)	1st secondary variable	X (actual value) in %
HART Tertiary Variable (TV)	2nd secondary variable	Xd (control deviation) in %
HART Quaternary Variable (QV)	3rd secondary variable	t (temperature) in °C

Additional physical variables for Device Revision 8, as of firmware 5.03.xx HART 7

Starting with Device Revision 8, the following additional physical variables are available for the SV, TV and QV variables:

- W (setpoint) in %
- X (actual value on the LUI) in %
- Xd (control deviation) in %
- t (temperature) in °C or °F
- X (internal actual value) in %
- C (coded status of digital inputs and alarm outputs) in °C
- PZ (supply pressure PZ) in bar/MPa/psi
- Y1 (actuating pressure Y1 connection) in bar/MPa/psi
- Y2 (actuating pressure Y2 connection) in bar/MPa/psi

Functional safety 9

9.1 Range of applications for functional safety

The positioner is suitable for use on valves that satisfy the special requirements in terms of functional safety up to SIL 2 in accordance with IEC 61508 or IEC 61511. The 6DR5.1.-0....-....-Z C20 versions are available for this.

These are single-acting positioners for mounting on pneumatic actuators with spring return.

The positioner automatically depressurizes the actuator on demand or in case of faults. The actuator brings the process valve to the specified safety position in this way.

This positioner meets the following requirement:

- Functional safety up to SIL 2 in accordance with IEC 61508 or IEC 61511 for safe venting

See also

Functional safety in process instrumentation (http://www.siemens.com/SIL)

9.2 Safety function

Depressurizing of the connected actuator is the safety function for the SIPART PS2 positioner. The built-in spring brings the process valve to the required safety position. Depending on the direction of action of this spring, the process valve is completely opened or closed.

The positioner starts the depressurizing process of the connected pneumatic actuator at the latest 100 ms after the request. The progress of the depressurizing process depends on the connections and properties of the pneumatic actuator.

This safety function can be triggered by:

- With 2-wire connection: a signal source with 0 mA.
- With 3/4-wire connection: a power supply source with 0 V.

The safety function is not affected by other device functions, particularly the microcontroller, software and communication interface. With respect to this safety function, the positioner must therefore be considered as a type A subsystem in accordance with IEC 61508-2.

Situations in which it is not possible to depressurize the actuator on demand or in the case of a fault represent hazardous failure.

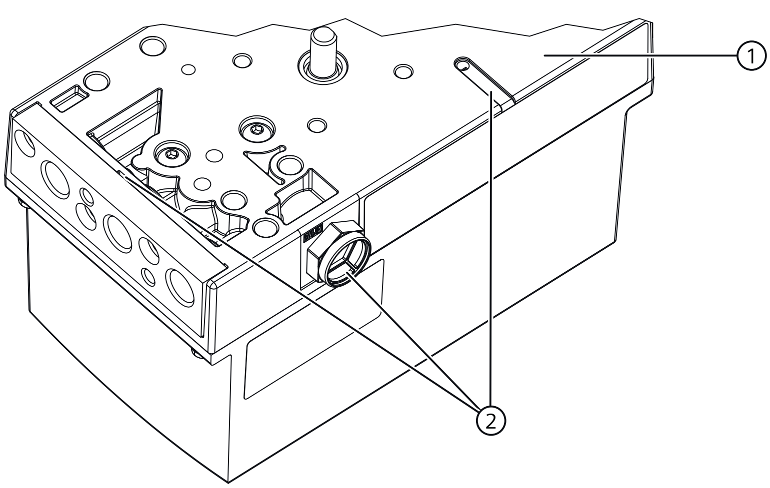
⚠ **WARNING**
Disregarding conditions for fulfilling the safety function
Disregarding conditions can result in a malfunction of the process system or application, for example, process pressure too high, maximum level exceeded.
The mandatory settings and conditions are listed in sections "Settings (Page 193)" and "Safety characteristics (Page 194)".
• These conditions must be met in order to fulfill the safety function.

The pneumatic block of the positioner pressurizes and depressurizes the actuator. The characteristic service life of the pneumatic block depends on the load. The average service life is approx. 200 million switching cycles. The number of actuation processes for the switching cycles is shown in the local display or via HART communication in the diagnostic values "42.VENT1" and "43.VENT2".

See also

Diagnostic values overview (Page 175)

NOTICE
Freezing of the exhaust air outlets
When devices of the type 6DR5..0/1/2/3 are used, the exhaust air outlets ② may freeze. The function of the device is impaired.
• Do **not** install the positioner with the base plate ① pointing up.



① Base plate

② Exhaust air outlets

Figure 9-1 Exhaust air outlets, base plate

Safety-instrumented system in single-channel operation (SIL 2)

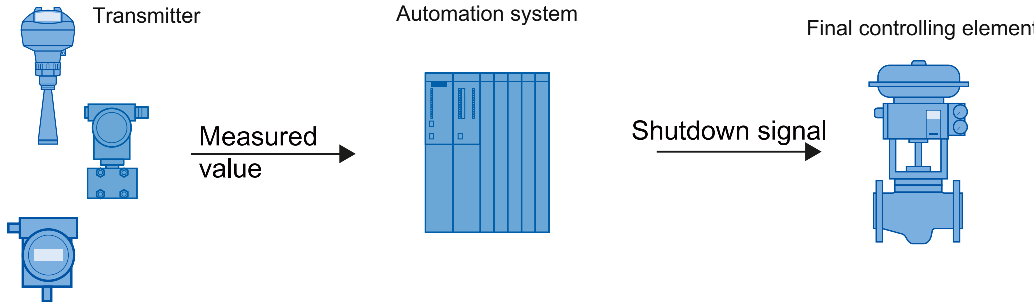


Figure 9-2 Safety-instrumented system in single-channel operation

The combination of transmitter, automation system and final controlling element forms a safety-instrumented system that performs a safety function.

The transmitter generates a process-related measured value that is transferred to the automation system. The automation system monitors this measured value. If the measured value violates the high or low limit, the automation system generates a shutdown signal for the connected final controlling element, which switches the corresponding process valve to the specified safety position.

9.3 Type A - Safety Integrity Level (SIL)

The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL) from SIL 1 to SIL 4. Each level corresponds to a range of probability for failure of a safety function.

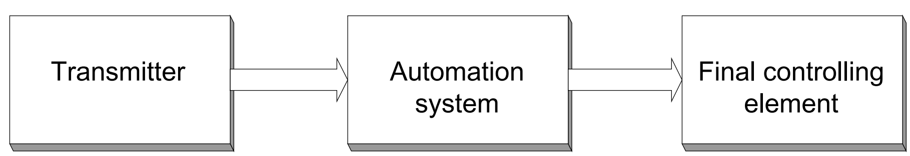
Description

The following table shows the dependency of the SIL on the "average probability of dangerous failure of a safety function of the entire safety-instrumented system" (PFD_{AVG}). "Low demand mode" is examined. The safety function is required a maximum of once per year on average.

Table 9-1 Safety Integrity Level

SIL	Interval
4	$10^{-5} \leq PFD_{AVG} < 10^{-4}$
3	$10^{-4} \leq PFD_{AVG} < 10^{-3}$
2	$10^{-3} \leq PFD_{AVG} < 10^{-2}$
1	$10^{-2} \leq PFD_{AVG} < 10^{-1}$

The "average probability of dangerous failure of the entire safety-related system" (PFD_{AVG}) is normally split between the following three components:



PFDAVG-Part < 35 % < 15 % < 50%

Figure 9-3 PFD distribution

The following table shows the achievable Safety Integrity Level (SIL) for the entire safety-related system for type A devices depending on the safe failure fraction (SFF) and the hardware fault tolerance (HFT).

- Type A devices include analog transmitters and solenoid valves **without** complex components, e.g. microprocessors (see also IEC 61508, Section 2).
- The specific values for your device are listed in the manufacturer's declaration of the device (SIL Declaration of Conformity, Functional Safety according to IEC 61508 and IEC 61511): Certificates (http://www.siemens.com/processinstrumentation/certificates).

SFF	HFT for type A devices		
	0	1	2
< 60%	SIL 1	SIL 2	SIL 3
60 to 90%	SIL 2	SIL 3	SIL 4
90 to 99%	SIL 3	SIL 4	SIL 4
> 99%	SIL 3	SIL 4	SIL 4

9.4 Settings

No special parameter settings are required for the safety function.

Protection against configuration changes

You should attach the enclosure cover so that the device is protected against unwanted and unauthorized changes/operation.

Checking the safety function

Prerequisite for checking the safety function

- Positioner is in operation.
- The actuator belonging to the positioner is **not** in the safety position.

Procedure

1. On the positioner, switch the signal source to 0 mA or the power supply source to 0 V.
2. Reduce the supply pressure (PZ) to one-third of the maximum supply pressure.
3. Always carry out the validation of the safety function with positioner, actuator and process valve under operating conditions.

Result

The actuator brings the process valve to the specified safety position.

See also

Safety function (Page 189)

9.5 Safety characteristics

The safety characteristics necessary for use of the system are listed in the SIL declaration of conformity. These values apply under the following conditions:

- The positioner is only used in applications with low demand rate for the "Low demand mode".
- The positioner is blocked against unwanted and unauthorized changes/operation.
- The signal source with 0 mA or the power supply source with 0 V for the SIPART PS2 positioner is generated by a safe system that fulfills SIL 2 for single-channel operation.
- The connected actuator must be single-acting and return the process valve to the safe end position by spring force in the following scenarios:
  - With an actuating pressure (Y1 connection) up to one-third of the maximum available supply pressure (PZ connection)
- The air outlet does not contain any additional cross-sectional contractions leading to an increased dynamic pressure. In particular, a silencer is only allowed if icing or other contamination is ruled out.
- The restrictor in the Y1 circuit may not be completely closed during operation.
- According to ISO 8573-1, the air quality is Class 3 maximum and free of oil, water and dirt.
- The average temperature viewed over a long period is 40 °C.
- Fault rates are calculated on the basis of a mean time to repair (MTTR) of 8 hours.
- In case of a fault, the pneumatic outlet of the positioner is depressurized. A spring in the pneumatic actuator must move the process valve to the pre-defined, safe end position.
- A dangerous failure of the positioner is one in which the pressure outlet is not depressurized or the safety position is not reached when the signal source is 0 mA or the power supply source is 0 V.

See also

Settings (Page 193)

9.6 Maintenance/check

Interval

We recommend that the functioning of the positioner is checked at regular intervals of one year.

Checking the safety function

Check the safety function as detailed in chapter "Settings (Page 193)"

Checking safety

Verify the safety function of the entire safety circuit on a regular basis in accordance with IEC 61508/61511. The test intervals are determined in the course of calculations for each safety circuit of a system (PFD_{AVG}).

Service and maintenance 10

10.1 Basic safety instructions

10.1.1 Maintenance

The device is maintenance-free. However, a periodic inspection according to pertinent directives and regulations must be carried out.

An inspection can include:

- Ambient conditions
- Seal integrity of the process connections, cable entries, and cover
- Reliability of power supply, lightning protection, and grounds

⚠ WARNING
Dust layers above 5 mm
Risk of explosion in hazardous areas.
Device may overheat due to dust build up. • Remove dust layers in excess of 5 mm.

⚠ CAUTION
Releasing button lock
Improper modification of parameters could influence process safety. • Make sure that only authorized personnel may cancel the button locking of devices for safety-related applications.

NOTICE
Penetration of moisture into the device
Damage to device. • Make sure when carrying out cleaning and maintenance work that no moisture penetrates the inside of the device.

10.2 Cleaning

The positioner is maintenance-free to a large extent. Screens are installed in the pneumatic connections of the positioners to protect them from rough dirt particles. If there are dirt particles in the supply air (PZ), they damage the screens and hamper the function of the positioner. Clean the screens as described in the following two chapters.

Cleaning the enclosure

- Clean the outside of the enclosure with the inscriptions and the display window using a cloth moistened with water or a mild detergent.
- Do not use any aggressive cleansing agents or solvents, e.g. acetone. Plastic parts or the painted surface could be damaged. The inscriptions could become unreadable.

WARNING

Electrostatic charge

Risk of explosion in hazardous areas if electrostatic charges develop, for example, when cleaning plastic surfaces with a dry cloth.

- Prevent electrostatic charging in hazardous areas.

10.2.1 Positioners 6DR5..0, 6DR5..3 and 6DR5..5

Procedure for removal and cleaning of the sieves

1. Switch off the supply pressure PZ.
2. Remove the pneumatic connecting cables.
3. Unscrew the cover.
   This step is not required for the 6DR5..5 enclosure.
4. Remove the three screws on the pneumatic terminal strip.
5. Remove the sieves and O-rings behind the terminal strip.
6. Clean the sieves, e.g. using compressed air.

Procedure for installation of the sieves

⚠ CAUTION
Damage to the polycarbonate enclosure 6DR5..0
• The enclosure is damaged due to screwing in the self-tapping screws improperly.
• Ensure that the available thread pitches are used.
• Turn the screws anticlockwise until they engage noticeably in the thread pitch.
• Tighten the self-tapping screws only after they have engaged.

1. Insert the sieves into the recesses of the enclosure.
2. Place the O-rings on the sieves.
3. Insert the pneumatic terminal strip.
4. Tighten the three screws. Note: With the polycarbonate enclosure, the screws are self-tapping.
5. Screw down the cover.
   This step is not required for the 6DR5..5 enclosure.
6. Connect the pneumatic connecting cables again.

10.2.2 Positioners 6DR5..1, 6DR5..2 and 6DR5..6

Removal, cleaning and installation of the screens

1. Switch off the supply pressure PZ.
2. Remove the pneumatic connecting cables.
3. Remove the metal screen from the bores carefully.
4. Clean the metal screens, e.g. using compressed air.
5. Insert the screens.
6. Connect the pneumatic connecting cables again.

10.3 Maintenance and repair work

Send defective devices to the repairs department, together with information on the malfunction and the cause of the malfunction. When ordering replacement devices, please provide the serial number of the original device. You can find the serial number on the nameplate.

⚠ WARNING
Impermissible repair of the device
• Repair must be carried out by Siemens authorized personnel only.

WARNING

Maintenance during continued operation in a hazardous area

There is a risk of explosion when carrying out repairs and maintenance on the device in a hazardous area.

- Isolate the device from power.

- or -

- Ensure that the atmosphere is explosion-free (hot work permit).

WARNING

Impermissible accessories and spare parts

Risk of explosion in areas subject to explosion hazard.

- Only use original accessories or original spare parts.
- Observe all relevant installation and safety instructions described in the instructions for the device or enclosed with the accessory or spare part.

WARNING

Improper connection after maintenance

Risk of explosion in areas subject to explosion hazard.

- Connect the device correctly after maintenance.
- Close the device after maintenance work.

Refer to Electrical wiring (Page 81).

10.4 Replacing electronics

Condition

- You are familiar with the general procedure described in the section "Installing option modules (Page 46)".

Procedure

Note

Possible movement of the actuator

When the electronics are being replaced, the actuator can be unintentionally depressurized.

- Observe the procedure described below.

Removing

1. Switch off the supply pressure PZ and depressurize the actuator.
2. Open the positioner as in the description depending on the device version:
   – Opening the positioner (Page 47)
3. Remove the ribbon cables and the electrical connections from the electronics.
4. Remove the two fixing screws of the electronics.
5. Remove the electronics.
6. Place the new electronics onto the four holders of the adapter.

Installation

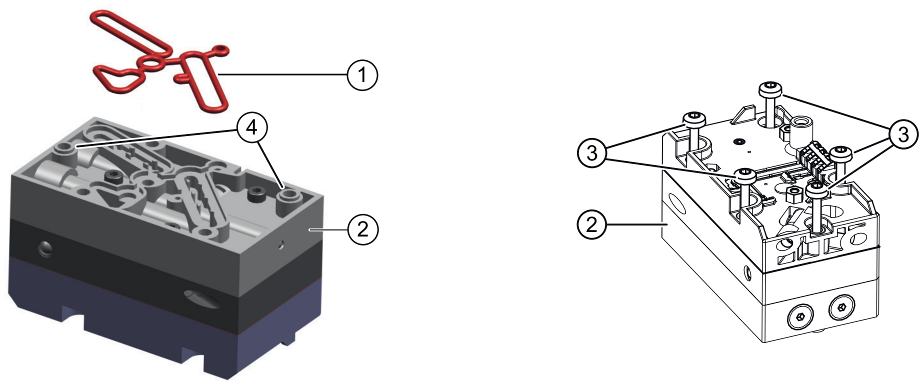
1. Screw in the two fixing screws of the electronics.
2. Tighten the screws.
3. Connect the ribbon cables and the electrical connections.
4. Close the positioner as in the description depending on the device version:
   – Closing the positioner (Page 70)
5. For a positioner with order option -Z F01 "Fail in Place", adjust the parameter "PNEUM" from "Std" to "FIP".
6. For a positioner with linear actuator, adjust the electronics with the "73. RPL_E" parameter.
7. Switch on the supply pressure PZ.
8. Initialize the positioner as described in the "Commissioning" section.

10.5 Replacing the pneumatic block

Requirement

- You are familiar with the general procedure described in the section "Installing option modules (Page 46)".

Procedure



① Cord seal
② Pneumatic block
③ Mounting screws
④ Centering elements

Figure 10-1 Pneumatic block

Removing

1. Switch off the supply pressure PZ and depressurize the actuator.
2. Open the positioner as in the description depending on the device version:
   – Opening the positioner (Page 47)
3. Remove the ribbon cable from the electronics.
4. Remove the two fixing screws of the electronics.
5. Remove the electronics.
6. Unscrew the fixing screws ③ of the pneumatic block ②.
   4 screws for single-acting pneumatic block. 5 screws for double-acting pneumatic block.
7. Remove the pneumatic block ② and the cord seal ①.
8. Blow any dirt off the surface on which the pneumatic block was placed.

Installation

1. Insert the new cord seal ① into the new pneumatic block ②.
2. Press the cord seal ① evenly into the groove on the pneumatic block ②.
3. Place the new pneumatic block on the base plate.
   Make sure that the pneumatic block engages with the centering elements ④ on the base plate.
4. Screw the supplied fixing screws ③ into the pneumatic block.

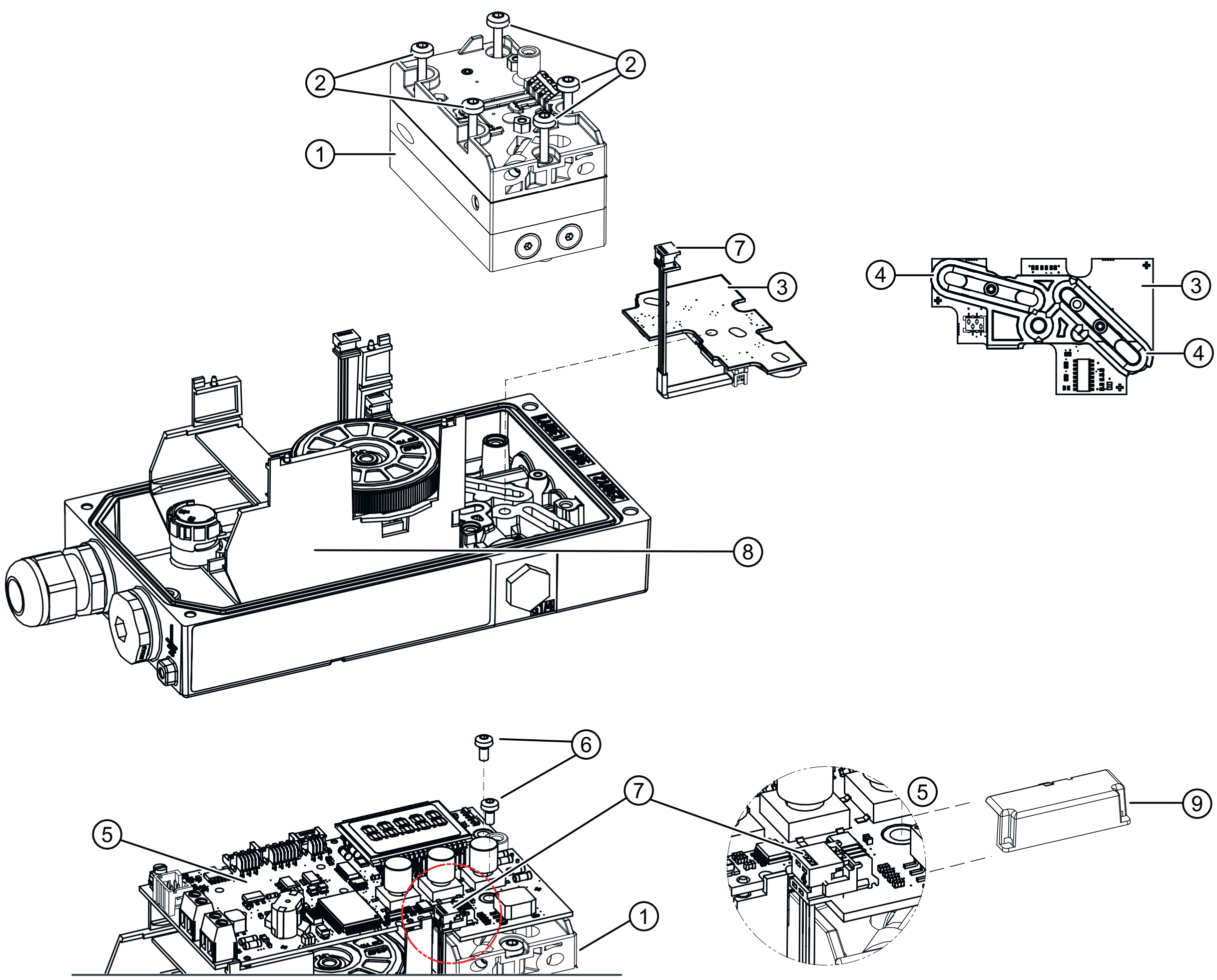
5. Tighten the fixing screws with a torque of 1.1 Nm.
6. Place the electronics onto the four holders of the adapter.
7. Screw in the two fixing screws of the electronics.
8. Tighten the fixing screws.
9. Close the positioner as in the description depending on the device version:
   – Closing the positioner (Page 70)
10. For a positioner with order option -Z F01 "Fail in Place", adjust the parameter '51.PNEUM' Pneumatics type (Page 170) from "Std" to "FIP".
11. Switch on the supply pressure PZ.
12. Initialize the positioner as described in section "Commissioning (Page 107)".

10.6 Replace the pressure sensor module

Requirement

- You have a positioner with a built-in pressure sensor module, order suffix -Z P01 or -Z P02.
- You are familiar with the procedure described in section "Replacing the pneumatic block (Page 202)".

Overview screen



①	Pneumatic block	⑥	Fixing screws electronics
②	Mounting screws	⑦	Ribbon cable, covered with plastic cap ⑨
③	Pressure sensor module	⑧	Adapter
④	Cord seal	⑨	Plastic cap
⑤	Electronics		

Figure 10-2 Pressure sensor, schematic diagram

Procedure

Removing

1. Switch off the supply pressure PZ and depressurize the actuator.
2. Open the positioner as described in section "Opening the positioner (Page 47)".
3. Remove the plastic cap ⑨.
4. Remove the ribbon cable ⑦ and all other ribbon cables from the electronics ⑤.
5. Remove the two fixing screws ⑥ of the electronics.
6. Remove the electronics ⑤.
7. Unscrew the fixing screws ② of the pneumatic block ①.
   4 screws for single-acting pneumatic block. 5 screws for double-acting pneumatic block.
8. Remove the pneumatic block ①.
   Make sure that the cord seal ④ of the pneumatic block is in the pneumatic block.

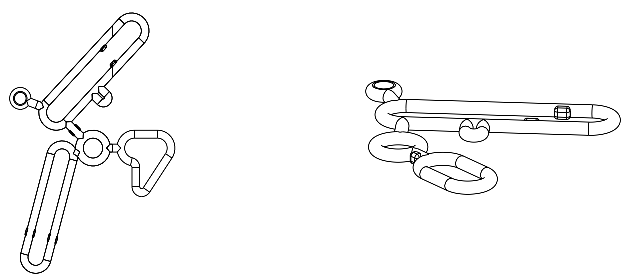


Figure 10-3 Cord seals of the pneumatic block; double-acting (left), single-acting (right)

9. Blow any dirt off the surface on which the pneumatic block was placed.
10. Remove the pressure sensor module ③ and the cord seal ④ of the pressure sensor module.

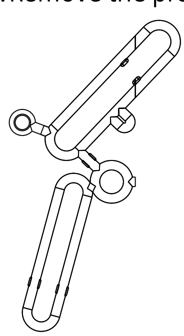


Figure 10-4 Cord seal of the pressure sensor

Installation

1. Insert the new cord seal ④ into the new pressure sensor module ③.
2. Press the cord seal ④ into the groove on the pressure sensor module ③ on all sides.
3. Place the pressure sensor module ③ on the baseplate.

4. Place the pneumatic block ① on the pressure sensor module ③.
   – Make sure that the cord seal ④ of the pneumatic block is in the pneumatic block.
   – Make sure that the pneumatic block engages with the centering elements (④) (Page 202) on the base plate.
5. Screw the fixing screws ② into the pneumatic block ①.
6. Tighten the fixing screws ② with a torque of 1.1 Nm.
7. Place the electronics ⑤ onto the four holders of the adapter ⑧.
8. Screw in the two fixing screws ⑥ of the electronics.
9. Tighten the fixing screws ⑥.
10. Insert the ribbon cable ⑦ and all other ribbon cables onto the electronics ⑤.
11. Place the plastic cap ⑨.
12. Close the positioner as described in section "Closing the positioner (Page 70)".
13. For a positioner with order option -Z F01 "Fail in Place", adjust the parameter '51.PNEUM' Pneumatics type (Page 170) from "Std" to "FIP".
14. Switch on the supply pressure PZ.
15. Initialize the positioner as described in section "Commissioning (Page 107)".

Result

The pressure sensor module is ready to use again.

10.7 Return procedure

To return a product to Siemens, see Return document (http://www.siemens.com/processinstrumentation/returngoodsnote).

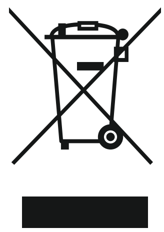
Contact your Siemens representative to clarify if a product is repairable, and how to return it. They can also help with quick repair processing, a repair cost estimate, or a repair report/cause of failure report.

NOTICE
Decontamination The product may have to be decontaminated before it is returned. Your Siemens contact person will let you know for which products this is required.

See also

Decontamination declaration (http://www.siemens.com/sc/declarationofdecontamination)

10.8 Disposal



Devices described in this manual should be recycled. They may not be disposed of in the municipal waste disposal services according to the Directive 2012/19/EC on waste electronic and electrical equipment (WEEE).

Devices can be returned to the supplier within the EC and UK, or to a locally approved disposal service for eco-friendly recycling. Observe the specific regulations valid in your country.

Further information about devices containing batteries can be found at: Information on battery/product return (WEEE) (https://support.industry.siemens.com/cs/document/109479891/)

Diagnostics and troubleshooting 11

11.1 Display messages with error code

Indication on the display

Example for error code 4

If threshold 1 is exceeded	If threshold 2 is exceeded	If threshold 3 is exceeded:
 ① 1 bar ② Error code	 ① 2 bars ② Error code	 ① 3 bars ② Error code

The error code ② is shown on the display in the 2nd line on the left.

ϟ Error symbol
The error symbol is only displayed before the 1-digit error codes 1 ... 9.

Error code in the display	Meaning/Cause		Remedy
ϟ1	Meaning	Control deviation: Actual value response has exceeded values for "48.TIM" and "49.LIM". Possible causes: • Supply pressure PZ missing • Actuator fault • Process valve fault, e.g. blockage	Error message disappears if the control deviation falls below the response threshold
	Number of thresholds	1	
	Description	In "Automatic (AUT)" mode, the deviation between the setpoint and actual value is continuously monitored. Depending on the setting of the application parameters "48.TIM Monitoring period for setting of fault message control deviation" and "49.LIM Response threshold for fault message control deviation", the fault message is activated if the control deviation remains. This monitoring function is always active.	

Error code in the display	Meaning/Cause		Remedy
ϟ2	Meaning	The positioner is not in "Automatic" mode. Possible causes: • The positioner is configured. • The positioner is in "Manual (MAN)" mode.	• Switch the positioner to "Automatic (AUT)" mode.
	Number of thresholds	1	
	Requirement	Application parameter "47.ϟFCT" - Funktion des Störmeldeausgangs ist eingestellt auf "ϟnA" or "ϟnAb"	
	Description	If the positioner is not in the "Automatic (AUT)" mode, an error message is generated if the parameter "47.ϟ FCT" is set accordingly. In this way, the control system is warned, for example, if the positioner has been switched to "Manual (MAN)" or "Configure" mode.	
ϟ3	Meaning	Digital input DI1 or DI2 active. Possible causes: The contact connected to the digital input has been activated, e.g. by the switch for monitoring of the packing glands, a temperature switch or a limit switch, e.g. for pressure.	Error message disappears when the digital input is no longer activated.
	Number of thresholds	1	
	Requirement	Application parameter "47.ϟFCT" = ϟnAB and digital function "42.DI1" or "43.DI2" to "On"	
	Description	If the digital input is activated, an error message is generated if the application parameters "47.ϟFCT" and "DI1" are set accordingly. Configure the digital input DI2 on the digital I/O module (DIO) in the same way.	
ϟ4	Meaning	Limit for number of total strokes exceeded. The total path covered by the actuator exceeds one of the configured thresholds.	Error message disappears when the stroke counter is reset or the thresholds are increased. More information → Diagnostics Manual
	Number of thresholds	3	
	Requirement	Process diagnostics "Monitoring number of total strokes" (L.\STRK) is activated.	
	Description	The diagnostic value "1.STRKS" is constantly compared with the thresholds that are determined from the "L1.LIMIT" to "L4.FACT3" parameters. If the thresholds are exceeded, the fault message output or the digital outputs A1 and A2 respond, depending on the setting of the extended diagnostics .	

Error code in the display	Meaning/Cause		Remedy
ϟ5	Meaning	The number of changes of direction exceeds one of the configured thresholds.	Error message disappears when the counter for change of direction is reset or the thresholds are increased. More information → Diagnostics Manual
	Number of thresholds	3	
	Requirement	Process diagnostics "Monitoring number of direction changes" (O.\DCHG) is activated.	
	Description	The diagnostic value "Number of changes in direction (2 CHDIR)" is constantly compared with the thresholds that are determined from the "O1.LIMIT" to "O4.FACT3" parameters. If the thresholds are exceeded, the fault message output or the digital outputs A1 and A2 respond, depending on the setting of the extended diagnostics .	
ϟ6	Meaning	Lower endstop limit (position 0%) exceeded. Possible causes: • Wear on the process valve • Deposits or foreign bodies in the process valve • Friction clutch misaligned • Mechanical readjustment of the position feedback	Error message disappears when the deviation falls below the limit or the positioner has been initialized again. Even the deactivation of monitoring ("F.\ZERO" = "OFF") may trigger an error message. More information → Diagnostics Manual
	Number of thresholds	3	
	Requirements	• The "Monitoring 0% endstop" (F.\ZERO) process diagnostics are activated. • The application parameter "39.YCLS" is set to one of the following values: "do", "uP do", "Fd", "Fu Fd", "uP Fd", "Fu do"..	
	Description	This function can be used to detect the errors in the process valve. Monitoring is always performed whenever the process valve is in the "Tight closing/Fast closing Down" position. The current position is compared with the position that was determined as the lower endstop at the time of initialization. Example: A value of 3% is set. The position is normally adopted for "Tight closing/Fast closing Down". A fault is reported if a value > 3% or < -3% is determined instead. The error message remains activated until either subsequent monitoring remains within the tolerance or a re-initialization is performed. This monitoring function does not deliver any utilizable results if the endstops were not determined automatically at the time of initialization, but the limits were set manually (manual initialization, "5.INITM"). If the thresholds are exceeded, the fault message output or the digital outputs A1 and A2 respond, depending on the setting of the extended diagnostics .	

<table>
<tr><th>Error code in the display</th><th colspan="2">Meaning/Cause</th><th>Remedy</th></tr>
<tr><td rowspan="4">ϟ7</td><td>Meaning</td><td>Upper endstop limit (position 100%) exceeded.
Possible causes:
• Wear on the process valve
• Deposits or foreign bodies in the process valve
• Friction clutch misaligned
• Mechanical readjustment of the position feedback</td><td rowspan="4">Error message disappears when the deviation falls below the limit or the positioner has been initialized again.
Even the deactivation of monitoring ("G.\OPEN" = "OFF") may trigger an error message.
More information → Diagnostics Manual</td></tr>
<tr><td>Number of thresholds</td><td>3</td></tr>
<tr><td>Requirements</td><td>• The "100% endstop monitoring" process diagnostics (G.\OPEN) is activated.
• The application parameter "39.YCLS" is set to one of the following values: "uP", "uP do", "Fu", "Fu Fd", "uP Fd", "Fu do"..</td></tr>
<tr><td>Description</td><td>This function can be used to detect the errors in the process valve.
Monitoring is always performed whenever the process valve is in the "Tight closing/Fast closing Up" position.
The current position is compared with the position that was determined as the upper endstop at the time of initialization.
Example: A value of 3% is set. The position is normally adopted for "Tight closing/Fast closing Up". A fault is reported if a value > 3% or < -3% is determined instead.
The error message remains activated until either subsequent monitoring remains within the tolerance or a re-initialization is performed.
This monitoring function does not deliver any utilizable results if the endstops were not determined automatically at the time of initialization, but the limits were set manually (manual initialization, "5.INITM").
If the thresholds are exceeded, the fault message output or the digital outputs A1 and A2 respond, depending on the setting of the extended diagnostics .</td></tr>
</table>

Error code in the display	Meaning/Cause		Remedy
ϟ8	Meaning	Deadband limit exceeded. Possible causes: • Increased packing glands friction • Mechanical play in position detection • Leakage	Error message disappears when the limit is undershot again. More information → Diagnostics Manual
	Number of thresholds	1	
	Requirements	• Process diagnostics "Deadband monitoring" (E.\DEBA) is activated. • The application parameter "34.DEBA" is set to "Auto".	
	Description	If the deadband increases disproportionately during operation when the deadband is automatically adjusted, this indicates a fault in the system. A limit can therefore be entered for this value ("E1.LEVL3", threshold for deadband monitoring). An fault message output is activated when this value is exceeded.	

<table>
<tr><th>Error code in the display</th><th colspan="2">Meaning/Cause</th><th>Remedy</th></tr>
<tr><td rowspan="13">ϟ9</td><td colspan="3">Partial Stroke Test (PST) (without pressure sensors)</td></tr>
<tr><td rowspan="2">Meaning</td><td>Case 1: PST exceeds the threshold of the reference stroke time.
Possible cause: Process valve is stuck or rusted. Increased stiction.</td><td rowspan="5">Error message disappears when ...
Case 1: ... a PST is successfully performed within the reference stroke time or the function is deactivated.
Case 2: ... the actuator moves within the range of the PST start tolerance. Or: ... the PST start tolerance is increased until the actuator (PST start position) is within the PST start tolerance.
• Restart PST.
More information → Diagnostics Manual</td></tr>
<tr><td>Case 2: Start position of the PST outside the start tolerance
Process valve is in the safety position.</td></tr>
<tr><td>Number of thresholds</td><td>3 (with Case 1)</td></tr>
<tr><td>Requirement</td><td>Process diagnostics "Partial Stroke Test" (A.\PST) is activated.</td></tr>
<tr><td>Description</td><td>The error message appears if one of the 3 thresholds of the PST resulting from the reference stroke time is exceeded. The severity of the error message can be recognized by the number of bars on the display. At the same time, the error message is output via the fault message output or the digital outputs A1 and A2 in accordance with the extended diagnostics setting.
This error message also appears when a manual or cyclic PST is initiated and the test cannot be started because the process valve is not within the start tolerance.</td></tr>
<tr><td colspan="3">Partial Stroke Test (pressure sensor-supported, option -Z P02)</td></tr>
<tr><td>Meaning</td><td>PST failed.
Possible causes:
• Unexpectedly large step height detected during execution.
• Lower limit of the internal breakout pressure violated.
• Lower limit of the internal rupture pressure violated.
• End position not reached.
• Return position not reached.</td><td rowspan="3">Error message disappears when the next execution of the PST is successful.
More information → Diagnostics Manual</td></tr>
<tr><td>Requirements</td><td>• Process diagnostics "Partial Stroke Test" (A.\PST) is activated.
• "Pressure monitoring" (U.\PRES) is activated.</td></tr>
<tr><td>Description</td><td>When performing a PST reference run via "AY.PSTIN", no error message is generated. The error message is output for errors that occur during the execution of a manual or cyclically triggered PST. If the preconditions are not met, e.g. the start position is outside the start tolerance, no error message is output.</td></tr>
</table>

Error code in the display	Meaning/Cause		Remedy
10	Meaning	Deviation from expected dynamic control valve behavior Possible causes: • Actuator fault • Process valve fault • Process valve stuck • Increased stiction • Failure of the supply pressure PZ PZ	Error message disappears when the deviation falls below the limit or the process diagnostics are deactivated. More information → Diagnostics Manual
	Number of thresholds	3	
	Requirement	The process diagnostics "Monitoring of dynamic control valve behavior" (b.\DEVI) is activated.	
	Description	Monitoring of dynamic control valve behavior compares the currently determined control behavior with the expected control behavior. The deviation is compared with the configured thresholds.	
11	Meaning	Pneumatic leakage of valve	Error message disappears when the valve leakage has been remedied or the process diagnostics are deactivated. More information → Diagnostics Manual
	Number of thresholds	3	
	Requirement	The process diagnostics "Monitoring of pneumatic leakage" (C.\LEAK) is activated.	
	Description	The diagnostics compare the expected air consumption with the actual air consumption when the actuator is moving.	
12	Meaning	Limit for jerky changes in the process valve position exceeded. Possible cause: Increased stiction: The process valve now jerks and no longer moves smoothly.	Error message disappears if the limit is no longer exceeded or the process diagnostics are deactivated. More information → Diagnostics Manual
	Number of thresholds	3	
	Requirement	The process diagnostics "Monitoring of stiction (slip-stick effect)" (d.\STIC) is activated.	
	Description	Process diagnostics continuously monitor the stiction of the valve. In the event of setpoint changes, jerky changes in the process valve position, so-called slip jumps, indicate excessive stiction.	
13	Meaning	Threshold below the lower limit temperature. Possible cause: Ambient temperature too low.	Error message disappears when the temperature no longer falls below the lower limit temperature thresholds or the process diagnostics are deactivated. More information → Diagnostics Manual
	Number of thresholds	3	
	Requirement	Process diagnostics "Monitoring of lower limit temperature" (H.\TMIN) is activated.	
	Description	Process diagnostics continuously monitor the lower limit temperature of the positioner.	

Error code in the display	Meaning/Cause		Remedy
14	Meaning	Threshold of the upper limit temperature exceeded. Possible cause: Ambient temperature too high.	Error message disappears when the temperature no longer exceeds the upper limit temperature thresholds or the process diagnostics are deactivated. More information → Diagnostics Manual
	Number of thresholds	3	
	Parameter setting	Process diagnostics "Monitoring of lower limit temperature" (H.\TMIN) is activated.	
	Description	The process diagnostics continuously monitor the upper limit temperature of the positioner.	
15	Meaning	Position average value deviates from the reference value. Possible cause: In the last comparison interval, the process valve characteristic was changed so significantly that a deviating average value of position was calculated.	The error message disappears when the result of an average position value calculation following a comparison interval is again within the thresholds with respect to the reference value, or if the process diagnostics are deactivated. More information → Diagnostics Manual
	Number of thresholds	3	
	Requirement	The process diagnostics "Monitoring of average position value" (P.\PAVG) is deactivated.	
	Description	Process diagnostics monitors the pipes for blockages or leakage during a continuous process. During diagnostics, the current average position value of the valve is compared with the reference average value.	

Error codes that are displayed when pressure monitoring is activated

Error code in the display	Meaning/Cause		Remedy
16	Meaning	The parameter values of the Partial Stroke Test (PST) are not configured correctly. The error message is shown on the display, but is not reported via the fault message output. Possible causes: • PST (without pressure sensors): The combination of the parameter values "A1.STPOS", "A3.STRKH" and "A4.STRKD" is not plausible. • PST (pressure sensor-supported, option -Z P02): Plausibility check of the configuration parameters not successful.	PST (without pressure sensors): • The "A1.STPOS", "A3.STRKH" and "A4.STRKD" parameters can be configured plausibly. PST (pressure sensor-suppor-ted): • Execute stroke direction from high pressure level to low pressure level. For double-acting actuators, the pressure difference P2 minus P1 is relevant. • Configure parameters "A1.STPOS", "A2.STTOL", "Ad.ENPOS" to meet one of the following conditions that is appropriate: – At higher pressure levels at the 100% position: A1.STPOS - A2.STTOL > Ad.ENPOS + 5 % – At higher pressure levels at the 0% position: A1.STPOS + A2.STTOL < Ad.ENPOS - 5 % More information → Diagnostics Manual
	Number of thresholds	1	
	Requirements	• Process diagnostics "Partial Stroke Test" (A.\PST) is activated. • PST only (pressure sensor-supported, option -Z P02): "Pressure monitoring" (U.\PRES) is activated.	
99999 **17**	Meaning / Possi-ble cause	• The pressure sensor module is overloaded or defec-tive. • An electrical connection was terminated.	• Set pressure monitoring (U.\PRES) to "OFF" and re-start the positioner. • Replace pressure sensor module (Page 204). More information → Diagnostics Manual
	Number of thresholds	1	
	Requirement	"Pressure monitoring" (U.\PRES) is activated.	
18	Meaning	Supply pressure PZ falls below the configured lower lim-it (U5.PZMLL).	• Increase supply pressure PZ until the upper lim-it (U5.PZMLL) plus hysteresis "U2.P_HYS" is violated. More information → Diagnostics Manual
	Number of thresholds	1	
	Requirement	"Pressure monitoring" (U.\PRES) is activated.	

Error code in the display	Meaning/Cause		Remedy
19	Meaning/Cause	Supply pressure PZ is outside the positioner specification of 1.4 bar to 7.0 bar	• Adjust supply pressure PZ until the device-specific limits of 1.4 to 7 bar +/- hysteresis (U2.P_HYS) are adhered to. More information → Diagnostics Manual
	Number of thresholds	1	
	Requirement	"Pressure monitoring" (U.\PRES) is activated.	
20	Meaning	Supply pressure exceeds the configured upper limit (U6.PZMUL).	• Reduce supply pressure PZ until it falls below the limit (U6.PZMUL) minus hysteresis (U2.P_HYS). More information → Diagnostics Manual
	Number of thresholds	1	
	Requirement	"Pressure monitoring" (U.\PRES) is activated.	
21	Meaning	The actuating pressure at Y1 exceeds the configured limit (U7.PCL).	• Check to determine why the actuating pressure was exceeded. • Reduce the actuating pressure by moving the positioner in the opposite direction. More information → Diagnostics Manual
	Number of thresholds	1	
	Requirement	"Pressure monitoring" (U.\PRES) is activated.	
21 HoLD	Meaning	The positioner is set to "Hold position" if the "U3.PFRLL" or "U4.PFRUL" parameter is set to "HoLd" is set.	• Increase or reduce supply pressure PZ according to error code "18" or "20".
		The actuating pressure at Y1 exceeds the configured limit (U7.PCL).	• Check to determine why the actuating pressure was exceeded. • Reduce the actuating pressure by moving the positioner in the opposite direction.
22	Meaning	Pressure increase or leakage at Y1 (single-acting) or Y2 (double-acting) exceeds the configured limit (U8.LRL).	• Find and eliminate the cause of the pressure increase / leakage. • Reset diagnostic values "69.LMUY1", "70.LMUY2", "71.LMDY1" and "72.LMDY2". • Reset the "U8.LRL" limit to "0". More information → Diagnostics Manual
	Number of thresholds	1	
	Requirement	"Pressure monitoring" (U.\PRES) is activated.	

Error codes that are displayed after an internal check of the electronics

Error code in the display	Meaning/Cause	Remedy
23	Initialization data contains errors.	• Initialize the positioner. If the error persists, the device electronics of the positioner may have a defect. • Replace electronics.
24	Calibration data for position detection contains errors.	• Replace electronics.

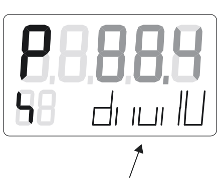
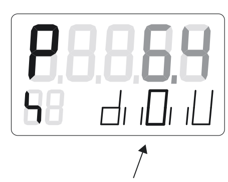
11.2 Display messages

Indication on the display

Example message "RUN 3"

Display of the messages in the table:

nn	Stands for variable numeric values.
ϟ	Error symbol
/	Slash: The texts to the left and right of the slash are shown alternately on the display.

Message in the display	Meaning/Cause	Remedy
AUTnn	Automatic mode, nn = setpoint	-
CPU **Start**	Message after application of electrical auxiliary power	• Wait.
CPU **test**	"CPU test" flashes approx. every 2 seconds. Pneumatic block does not switch. Possible cause: • Water in the pneumatic block, e.g. due to wet compressed air	• At an early stage, this fault can be rectified with subsequent operation using dry air. • If necessary, dry the positioner in a temperature cabinet at 50 to 70 °C. • Otherwise: Repair
P nn.n ϟ **d u U** 	Message during initialization in RUN 2. The bar graph display of the zero point is outside the tolerance band.	1. Set between "P 4.0" and "P 9.9" (>0<) using friction clutch.  2. Continue using △ or ▽ button.
Error **SLnn**	Possible message when exiting "Configure" mode: Monotony interruption of the free characteristic on the setpoint turning point "n"	• Correct the value.
EXSTP	Actuator was stopped by the digital input.	-
EX UP	Actuator is moved to the upper endstop by the digital input.	-
EXDWN	Actuator is moved to the lower endstop by the digital input.	-
EXPST	Partial Stroke Test was activated, e.g. by the digital input.	More information → Diagnostics Manual

Message in the display	Meaning/Cause	Remedy
nn.n **FINSH**	Initialization was successfully completed, with display of the actuator travel or the actuator angle.	1. Briefly acknowledge using button. 2. Leave configuration level with a long press of the button.
FST	Full Stroke Test is running.	More information → Diagnostics Manual
HTnn	Setpoint specification via HART	• Do not specify the setpoint via HART anymore or restart device.
HW / ERROR	Fault in the hardware.	• Replace electronics.
INPST	Cyclic Partial Stroke Test.	More information → Diagnostics Manual
LEAKR	A leakage test started via communication is running.	-
MANnn	Manual mode (nn = setpoint)	• Switch to automatic mode with the button.
nn.n **%MIN**	Value and unit of the result after the leakage test	• Rectify the leakage if the value is too large. • Continue using button.
MSRT	Multi Step Response Test is running.	More information → Diagnostics Manual
nnn.n	Actual position [in %] for initialized positioner. Flashing decimal point shows communication with a class 2 master.	-
n.nn.nn **-nn**	Message when exiting "Configure" mode: Firmware revision of the positioner, e.g. "5.03.00-28"	• Wait.
NOINI	Positioner is not initialized.	• Initialize the positioner.
d **NOZZL** U **NOZZL**	Drive is stopped: The initialization was interrupted using the "-" button when the actuation speed display was active.	1. The travel time can be changed by adjusting the restrictor(s). 2. Redetermine the positioning speed using the button. 3. Continue using button.
ok	Manual initialization: The permissible measuring range of end positions reached.	• Acknowledge using button. The remaining steps "RUN 1" to "FINSH" run automatically.
oFL / 127.9	Display range exceeded. Possible causes: • Friction clutch misaligned • Transmission ratio selector set wrong. • Positioner was installed on a different actuator without being re-initialized.	• Adjust friction clutch such that the actual value display remains within 0.0 to 100.0 when moving the actuator. • Set transmission ratio selector. • Restore factory setting with application parameter "50.PRST Preset" and perform initialization.
P---	Message before or during initialization. Possible causes: • Measuring range exceeded. • The potentiometer is in the inactive zone. • Transmission ratio selector or effective lever arm are not adapted to the travel.	• Switch the transmission ratio selector to "90°", especially in the case of part-turn actuators. • Adjust the effective lever length of linear actuators as per the measuring range.
Pnnn.n	Potentiometer voltage when the positioner is not initialized (P-manual mode): Actual position in % of measuring range.	• Check whether the complete actuator travel can be covered using the and buttons and that "P---" is never displayed. • Initialize the positioner.

Message in the display	Meaning/Cause	Remedy
RANGE	Only with manual initialization: The position of the endstop or the measuring span is beyond the permissible measuring range.	• Approach a different position of the stop using the or button and acknowledge using the button. • Move the friction clutch until "ok" is displayed, and then acknowledge with the button. • Terminate the initialization using the button, switch to the P-manual mode, and correct the actuator travel and the position detection.
P nn.n **RUN 1**	Initialization has been started, RUN 1 is active: Determining the direction of action.	• Wait.
P nn.n **RUN 1 / ERROR**	Error during initialization in RUN 1: Positioner remains in "RUN 1". Possible causes: • Initialization started from the end position • The response time of a maximum of 1 minute was not observed • Insufficient supply of compressed air. • Supply pressure PZ not connected or supply pressure PZ too low. • Compressed air line blocked, e.g. solenoid valve • Restrictor(s) closed. • Actuator does not move freely. • Position sensor not connected before starting the device.	• A waiting time of up to 1 minute is required • Do not start initialization from the end position. • Ensure supply pressure PZ. • Free up blocked lines. • Eliminate cause. • Restart the positioner. • Repeat initialization.
P nn.n **RUN 2**	Initialization RUN 2 is active: Travel control and determination of the endstops	• Wait.
P nn.n **RUN 2 / ERROR**	Error during initialization in RUN 2: Positioner remains in RUN 2. Possible causes: • Transmission ratio selector switch, "2.YAGL" initialization parameter and travel range do not match. • Incorrectly set stroke on the lever • Pneumatic block does not switch.	• Check the setting for initialization parameters "2.YAGL" and "3.YWAY". • Check the stroke setting on the lever.
P nn.n **RUN 3**	Initialization RUN 3 is active: Determination and display of the travel times	• Wait.
P nn.n **RUN 3 / ERROR**	Error during initialization in the RUN 3: Positioner remains in "RUN 3". Possible cause: • Actuator travel time is too high	• Open the restrictor completely and/or set supply pressure PZ to the highest permissible value. • Use a booster if required.
P nn.n **RUN 4**	Initialization RUN 4 is active: Determining the minimum positioning increment length	• Wait.

Message in the display	Meaning/Cause	Remedy
P nn.n **RUN 5**	Initialization RUN 5 is active: Optimization of the transient response	• Wait until "FINSH" is displayed. Initialization was completed successfully. • For option -Z P02: Wait.
P nn.n **RUN 5 / ERROR**	Mechanical play in the positioner - actuator - valve	• Part-turn actuator: Check for firm seating of set screw on coupling wheel. • Linear actuator: Check for firm seating of lever on positioner shaft. • Correct mechanical play between the actuator and the control valve.
	Diagnostic value "9.TUP" or "10.TDOWN" < 1.5 s	• Adjust the travel speed to > 1.5 s with the internal restrictors. • Initialization parameter "1.YFCT" on a actuator with an inverse direction of action, e.g. from "turn" to "-turn".
P nn.n **RUN 6**	Initialization RUN 6 is active: Determining Valve Signature	• Wait until "FINSH" is displayed. Initialization was completed successfully.
tESt / nn.n **LEAKG**	Leakage test for initialization active; "+" button was pressed during the actuation speed display.	• Wait for 1 minute.
VS-ER	Error during initialization in RUN 6: Valve Signature (VS) could not be recorded successfully. Possible causes: • Start/end position or return position not reached. • Pressure sensor module defective.	• Check supply pressure PZ. • Check whether application ranges are adhered to. • Check the pressure sensor module: Check the diagnostic values "60.PZ", "61.P1" and "62.P2" for plausibility.
SRT	Step Response Test is running.	More information → Diagnostics Manual
ϟ **U-d <**	Error during initialization in RUN 2: Adjustment of the electronics not yet completed for a positioner with linear actuator.	With internal wear-free, non-contacting position detection: • Calibrate the electronics using the diagnostic value "73.RPL_E".
	Error during initialization in RUN 2: "Up-Down" measuring span was undershot.	With potentiometer, friction clutch and linear actuator: 1. Increase the effective lever length or switch the transmission ratio selector to 33°. 2. Briefly acknowledge using button. 3. Restart initialization.
U nn.n **d- ->U**	Initialization RUN 3 is active: Determination and display of the travel time "Up"	• Wait until initialization continues in RUN 4. • To change the travel time, interrupt the initialization with the button. • Activate the leakage test using the button.
d nn.n **U- ->d**	Initialization RUN 3 is active: Determination and display of the travel time "Down"	

Message in the display	Meaning/Cause	Remedy
ㄣ**UP >**	Message during initialization. Measuring range upper endstop exceeded (> 97%) or inactive zone of the potentiometer transversed.	With potentiometer, friction clutch and linear actuator: 1. Increase the effective lever length or switch the transmission ratio selector to 90°. 2. Briefly acknowledge using ☜ button. 3. Restart initialization. With potentiometer, friction clutch and part-turn actuator: 1. Set the friction clutch to "P < 97". 2. Briefly acknowledge using ☜ button. 3. Restart initialization. With internal wear-free, non-contacting position detection: • Calibrate the electronics using the diagnostic value "73.RPL_E".
P nn.n ㄣ**90_95**	Message during initialization. Measuring range upper endstop exceeded (> 97%)	Only for part-turn actuators: 1. Use the △ or ▽ button to move it in the range of 90 to 95%. 2. Briefly acknowledge using ☜ button.
VPT	Valve Performance Test is running.	More information → Diagnostics Manual
VS	Valve Signature Test is running.	More information → Diagnostics Manual
VS-ER	Error during initialization in RUN 6: Valve Signature (VS) could not be recorded successfully. Possible causes: • Start/end position or return position not reached. • Actuator does not move or no pressure change detected. • Pressure sensor module defective.	• Check whether the pressure sensor module provides plausible pressure values: → Diagnostic values "60.PZ", "61.P1", "62.P2". • Check supply pressure PZ. • Check drive. • Check whether application ranges are adhered to. • Restart initialization. • Contact support.
YEND1	Only with manual initialization: The 1st position of the endstop can be approached.	1. Approach 1st position of the endstop with the △ or ▽ button. 2. Acknowledge using ☜ button.
YEND2	Only with manual initialization: The 2nd position of the endstop can be approached.	1. Approach 2nd position of the endstop with the △ or ▽ button. 2. Acknowledge using ☜ button.

See also

Display (Page 95)

Replace the pressure sensor module (Page 204)

11.3 Troubleshooting

Error	Meaning/Cause	Remedy
Actuator does not move.	Compressed air < 1.4 bar	• Set the supply pressure PZ to > 1.4 bar.
Direction of action incorrectly determined, e.g. direction "Valve open and Valve closed" is incorrect.	-	• Set the "1.YFCT" parameter on an actuator with inverse direction of action, e.g. from "turn" to "-turn".
Pneumatic block does not switch.	Water in the pneumatic block, e.g. due to wet compressed air	• At an early stage, this fault can be rectified with subsequent operation using dry compressed air. • If necessary, dry the positioner in a temperature cabinet at 50 to 70 °C. • Otherwise: Repair
In the manual and automatic modes, the actuator cannot be moved or can be moved only in one direction.	Moisture in the pneumatic block	
Pneumatic block does not switch. No click can be heard when the △ or ▽ button is pressed in "Manual (MAN)" mode.	The screw between the cover and the pneumatic block is not tightened or the cover is jammed.	• Tighten the screw. • Clear the jam.
	Dirt in the pneumatic block	• Repair or new device. • Clean or replace the integrated fine sieves.
	Deposits can form on contacts between the electronics plate and pneumatic block due to continuous stress and strong vibrations.	• Clean all contact surfaces with denatured alcohol. • If needed, bend the pneumatic block contact springs slightly.
Pneumatic block does not switch. A soft click can be heard when the △ or ▽ button is pressed in "Manual (MAN)" mode.	The restrictors on the pneumatic block are closed.	• Open the restrictor screw by turning it counter-clockwise.
	Dirt in the pneumatic block	• Repair or new device. • Clean or replace the integrated fine sieves.
The pneumatic block continually switches in stationary automatic mode (constant setpoint) and in "Manual (MAN)" mode.	Pneumatic leakage in the positioner - actuator system.	• Start the leakage test in "RUN 3" during initialization. • Rectify leakage in the actuator and/or feed line. • In case of an intact actuator and tight feed line: Repair or new device
	Dirt in the pneumatic block	• Repair or new device. • Clean or replace the integrated fine sieves.

Error	Meaning/Cause	Remedy
The pneumatic block continually switches and the actuator oscillates around an average value in stationary automatic mode (constant setpoint) and in "Manual (MAN)" mode.	Stiction of the packing glands of the valve or actuator is too high.	• Reduce stiction or increase deadband of positioner (parameter "dEbA") until the oscillation stops.
	Looseness (play) in the positioner/ actuator/control valve system	• Part-turn actuator: Check for firm seating of set screw on coupling wheel. • Linear actuator: Check for firm seating of lever on positioner shaft. • Correct any other play between the actuator and the control valve.
	Actuator too fast	• Increase travel times using restrictor screws. • If fast travel time is required: Increase the deadband ("dEbA" parameter) until the oscillation stops.
Positioner does not "move" control valve to the endstop (at 20 mA).	Supply pressure is too low. Load on the feeding controller or system output is too low.	• Increase supply pressure. • Interconnect load transformer. • Select 3-/4-wire operation.
Zero point displaces sporadically (> 3%).	Impact or shock loads result in accelerations so high that the friction clutch moves, e.g. due to "vapor shocks" in vapor lines.	• Rectify the causes for shock loads. • Re-initialize the positioner.
The device function has completely failed. No representation on the display either.	Electrical auxiliary power is not adequate.	• Check the electrical auxiliary power.
	In case of very high continuous loads due to vibrations/oscillations: • Screws of the electrical connection terminals may come loose. • Electrical connection terminals and/or electronic components can be shaken loose.	• Tighten the screws and secure with sealing wax. • Repair • For prevention: Install the positioner on damping pads.

Technical specifications 12

12.1 HART operating conditions

Rated conditions	
Ambient conditions	For use indoors and outdoors.
Ambient temperature	In hazardous areas, observe the maximum permissible ambient temperature corresponding to the temperature class.
• Permissible ambient temperature for operation [1)2)]	-30 ... +80 °C (-22 ... +176°F)
• Maximum permissible height above sea level	Up to 2 000 m above sea level
• Relative humidity	0 ... 100%
Degree of pollution	4
Overvoltage category	II
Degree of protection of enclosure	
• According to IEC 60529	IP66
• According to NEMA 250	Type 4X
Vibration resistance	
• Harmonic oscillations (sine) according to IEC 60068-2-6	3,5 mm (0.14"), 2 ... 27 Hz, 3 cycles/axis
	98,1 m/s² (321.84 ft/s²), 27 ... 300 Hz, 3 cycles/axis
• Bump (half-sine) according to IEC 60068-2-27	150 m/s² (492 ft/s²), 6 ms, 1 000 shocks/axis
• Noise (controlled digitally) according to IEC 60068-2-64	10 ... 200 Hz; 1 (m/s²)²/Hz (3.28 (ft/s²)²/Hz)
	200 ... 500 Hz; 0,3 (m/s²)²/Hz (0.98 (ft/s²)²/Hz)
	4 hours/axis
• Recommended range of continuous operation of the entire control valve	≤ 30 m/s² (98.4 ft/s²) without resonance rise
Climate class	According to IEC/EN 60721-3
• Storage	1K23, -40 ... +80 °C (-40 ... +176 °F)
• Transport	2K12, -40 ... +80 °C (-40 ... +176 °F)
Recommended storage duration [3)]	12 months
Expected service life	15 years

1) At ≤ -10 °C (≤ 14°F), the refresh rate of the display is limited

2) The following applies to order suffix (order code) **-Z M40**: -40 ... +80 °C (-40 ... +176°F)

3) At storage temperature -40 ... +80 °C

See also

Proper mounting (Page 33)

12.2 Pneumatic data for all device versions

Pneumatic data	
Auxiliary power (air supply)	Compressed air, carbon dioxide (CO_2), nitrogen (N), noble gases or cleaned natural gas
• Pressure [1)]	1.4 ... 7 bar (20.3 ... 101.5 psi)
Air quality to ISO 8573-1	
• Solid particulate size and density	Class 3
• Pressure dew point	Class 3 (min. 20 K (36 °F) below ambient temperature)
• Oil content	Class 3
Unrestricted flow (DIN 1945)	
• Pressurize actuator [2)]	
2 bar; 0.1 KV (29 psi; 0.116 CV)	4.1 Nm³/h (2.6 scfm)
4 bar; 0.1 KV (58 psi; 0.116 CV)	7.1 Nm³/h (4.4 scfm)
6 bar; 0.1 KV (87 psi; 0.116 CV)	9.8 Nm³/h (6.1 scfm)
• Depressurize actuator for all versions except fail in place [2)]	
2 bar; 0.2 KV (29 psi; 0.232 CV)	8.2 Nm³/h (5.1 scfm)
4 bar; 0.2 KV (58 psi; 0.232 CV)	13.7 Nm³/h (8.5 scfm)
6 bar; 0.2 KV (87 psi; 0.232 CV)	19.2 Nm³/h (12.0 scfm)
• Depressurize actuator for fail in place version	
2 bar; 0.1 KV (29 psi; 0.116 CV)	4.3 Nm³/h (2.7 scfm)
4 bar; 0.1 KV (58 psi; 0.116 CV)	7.3 Nm³/h (4.5 scfm)
6 bar; 0.1 KV (87 psi; 0.116 CV)	9.8 Nm³/h (6.1 scfm)
Valve leakage	$< 6 \cdot 10^{-4}$ Nm³/h ($3.7 \cdot 10^{-4}$ scfm)
Throttle ratio	Adjustable up to ∞: 1
Typical auxiliary power consumption in the controlled state	0.01 Nm³/h (0.006 scfm)
Sound pressure level	$L_{A\,eq} < 75$ dB $L_{A\,max} < 80$ dB
Sound pressure with installed booster [3)]	$L_{Aeq} < 95.2$ dB $L_{A\,max} < 98.5$ dB

[1)] The following applies to fail in place double acting: 3 ... 7 bar (43.5 ... 101.5 psi)
[2)] When using device versions Ex d (6DR5..5-... and 6DR5..6-...), values are reduced by approximately 20%.
[3)] Read the warning notice "Increased sound pressure level (Page 107)".

See also

Basic safety instructions (Page 107)

12.3 Construction for all device versions

Construction		
How does it work?		
• Range of stroke (linear actuator)	3 to 130 mm (0.12 to 5.12")	
• Angle of rotation (part-turn actuator)	30° ... 100°	• Devices with transmission ratio selector
	15° ... 160°	• Devices with internal non-contacting position detection
Mounting method		
• On the linear actuator	Using mounting kit 6DR4004-8V and, where necessary, an additional lever arm 6DR4004-8L on actuators according to IEC 60534-6-1 (NAMUR) with a fin, columns, or a plane surface.	
• On the part-turn actuator	Using mounting kit 6DR4004-8D or TGX:16300-1556 on actuators with mounting plane according to VDI/VDE 3845 and IEC 60534-6-2: The required mount must be provided on the actuator-side.	
Weight, positioner without option modules or accessories		
• 6DR5..0 Glass-fiber reinforced polycarbonate enclosure	Approx. 0.9 kg (1.98 lb)	
• 6DR5.11 aluminum enclosure, only single-acting	Approx. 1.3 kg (2.86 lb)	
• 6DR5..2 stainless steel enclosure	Approx. 3.9 kg (8.6 lb)	
• 6DR5..3 aluminum enclosure	Approx. 1.6 kg (3.53 lb)	
• 6DR5..5 aluminum enclosure, flameproof, rugged	Approx. 5.2 kg (11.46 lb)	
• 6DR5..6 stainless steel enclosure, flameproof, rugged	Approx. 8.4 kg (18.5 lb)	
Material		
• Enclosure		
6DR5..0 polycarbonate	Glass-fiber reinforced polycarbonate (PC)	
6DR5.11 aluminum, only single-acting	GD AlSi12	
6DR5..2 stainless steel	Austenitic stainless steel 316Cb, mat. No. 1.4581	
6DR5..3 aluminum	GD AlSi12	
6DR5..5 aluminum, flameproof, rugged	GK AlSi12	
6DR5..6 stainless steel enclosure, flameproof, rugged	Austenitic stainless steel 316L, mat. No. 1.4409	
• Pressure gauge block	Aluminum AlMgSi, anodized or stainless steel 316	
Versions		
• In the polycarbonate enclosure 6DR5..0	Single-acting and double-acting	
• In aluminum enclosure 6DR5.11	Single-acting	
• In aluminum enclosures 6DR5..3 and 6DR5..5	Single-acting and double-acting	
• In stainless steel enclosures 6DR5..2 and 6DR5..6	Single-acting and double-acting	
Tightening torques		
• Part-turn actuator fixing screws DIN 933 M6x12-A2	5 Nm (3.7 ft lb)	
• Linear actuator fixing screws DIN 933 M8x16-A2	12 Nm (8.9 ft lb)	
• Gland pneumatic G¼	15 Nm (11.1 ft lb)	

Construction	
• Pneumatic gland 1/4-18 NPT	
Without sealant	12 Nm (8.9 ft lb)
With sealant	6 Nm (4.4 ft lb)
• Cable glands	
Screw-in torque for plastic gland in all enclosures	4 Nm (3 ft lb)
Screw-in torque for cable gland made of metal/stainless steel in polycarbonate enclosure	6 Nm (4.4 ft lb)
Screw-in torque for metal/stainless steel glands in aluminum/stainless steel enclosure	6 Nm (4.4 ft lb)
Screw-in torque for NPT adapter made of metal/stainless steel in polycarbonate enclosure	8 Nm (5.9 ft lb)
Screw-in torque for NPT adapter made of metal/stainless steel in aluminum/stainless steel enclosure	15 Nm (11.1 ft lb)
Screw-in torque for NPT gland in the NPT adapter NOTE: To avoid damage to the device, the NPT adapter must be held in place while the NPT gland is screwed into the NPT adapter.	68 Nm (50 ft lb)
Tightening torque for union nut made of plastic	2.5 Nm (1.8 ft lb)
Tightening torque for union nut made of metal/stainless steel	4 Nm (3 ft lb)
• Pressure gauge block fixing screws	6 Nm (4.4 ft lb)
Manometer	
• Degree of protection	
Manometer made of plastic	IP31
Manometer, steel	IP44
Manometer made of stainless steel 316	IP54
• Vibration resistance	In accordance with DIN EN 837-1
Connections, electrical	
• Screw terminals	2.5 mm^2 AWG30-14
• Cable gland	
Without Ex protection as well as with Ex i	M20 x 1.5 or 1/2-14 NPT
With explosion protection Ex d	Ex d-certified M20 x 1.5; 1/2-14 NPT or M25 x 1.5
Connections, pneumatic	Female thread G¼ or ¼-18 NPT

12.4 Controller for all device versions

Controller	
Control unit	
• Five-point controller	Adaptive
• Dead zone	
dEbA = auto	Adaptive
dEbA = 0.1 … 10 %	Can be set as fixed value
Analog-to-digital converter	
• Scanning time	10 ms
• Resolution	≤ 0,05 %
• Transmission error	≤ 0,2 %
• Temperature influence	≤ 0.1 %/10 K (≤ 0.1 %/18 °F)

12.5 Explosion protection SIPART PS2

You can find details on explosion protection in the SIPART PS2 compact operating instructions (A5E03436620) and the explosion protection certificates.

12.6 Electrical data (HART)

	Electronics without explosion protection	**Electronics with explosion protection Ex "db"**	**Electronics with explosion protection Ex "ia", "db ia"**	**Electronics with explosion protection Ex "ic", "ec", "tb"**
Current input I_W				
Rated signal range	4 … 20 mA			
Test voltage	840 V DC, 1 s			
Digital input DI1 (terminals 9/10; galvanically connected to basic device)	Suitable only for floating contact; max. contact load < 5 µA at 3 V			
2-wire connection 6DR50.. and 6DR53.. 4 … 20 mA 6DR51.. and 6DR52.. HART				
Current to maintain the auxiliary power	≥ 3.8 mA			
Required load voltage U_B (corresponds to Ω at 20 mA)				
• 6DR50.0/1/2/3				
Typical	6.36 V (= 318 Ω)	6.36 V (= 318 Ω)	7.8 V (= 390 Ω)	7.8 V (= 390 Ω)
Max.	6.53 V (= 327 Ω)	6.53 V (= 327 Ω)	8.3 V (= 415 Ω)	8.3 V (= 415 Ω)
• 6DR50.5/6				

	Electronics without explosion protection	**Electronics with explosion protection Ex "db"**	**Electronics with explosion protection Ex "ia", "db ia"**	**Electronics with explosion protection Ex "ic", "ec", "tb"**
Typical	8.25 V (= 413 Ω)	8.25 V (= 413 Ω)	7.9 V (= 395 Ω)	7.9 V (= 395 Ω)
Max.	8.8 V (= 440 Ω)	8.8 V (= 440 Ω)	8.5 V (= 425 Ω)	8.5 V (= 425 Ω)
• 6DR51.0/1/2/3				
Typical	6.6 V (= 330 Ω)	6.6 V (= 330 Ω)	-	-
Max.	6.79 V (= 340 Ω)	6.79 V (= 340 Ω)	-	-
• 6DR51.5/6				
Typical	8.75 V (= 438 Ω)	8.75 V (= 438 Ω)	8.45 V (= 423 Ω)	8.45 V (= 423 Ω)
Max.	9.3 V (= 465 Ω)	9.3 V (= 465 Ω)	9 V (= 450 Ω)	9 V (= 450 Ω)
• 6DR52..				
Typical	-	8.4 V (= 420 Ω)	8.4 V (= 420 Ω)	8.4 V (= 420 Ω)
Max.	-	9 V (= 450 Ω)	9 V (= 450 Ω)	9 V (= 450 Ω)
• 6DR53..				
Typical	7.9 V (= 395 Ω)	-	-	-
Max.	8.4 V (= 420 Ω)	-	-	-
Static destruction limit	± 40 mA	± 40 mA	-	-

3-/4-wire connection 6DR52.. HART 6DR53.. 4 ... 20 mA				
Load voltage at 20 mA				
• 6DR52..	-	-	≤ 1 V (= 50 Ω)	≤ 1 V (= 50 Ω)
• 6DR53..	≤ 0.2 V (= 10 Ω)	≤ 0.2 V (= 10 Ω)	-	-
Auxiliary power U_{Aux}	18 ... 35 V DC	18 ... 35 V DC	18 ... 30 V DC	18 ... 30 V DC
Current consumption I_{Aux}	(U_{Aux} - 7.5 V) / 2.4 kΩ [mA]			
Galvanic isolation	Between U_{Aux} and I_W	Between U_{Aux} and I_W	Between U_{Aux} and I_W (2 intrinsically safe circuits)	Between U_{Aux} and I_W

12.7 Electrical data for pressure sensor module

	Electronics without explosion protection	Electronics with explosion protection Ex "db"	Electronics with explosion protection Ex "ia", Ex "db ia"	Electronics with explosion protection Ex "ic", "ec", "tb"
Electronics for the pressure sensor module 6DR51.. -Z P01 und -Z P02 HART, non-Ex 6DR51.. -Z P01 und -Z P02 HART, Ex				
Current input I_W				
• Rated signal range	4 ... 20 mA			
• Test voltage	840 V DC, 1 s			
• Digital input DI1 (terminals 9/10; galvanically connected to basic device)	Suitable only for floating contact; max. contact load < 5 µA at 3 V			
Current to maintain the auxiliary power	≥ 3.8 mA			
Required load voltage U_B (corresponds to Ω at 20 mA)	9.4 V (= 470 Ω)	9.4 V (= 470 Ω)	9 V (= 450 Ω)	9 V (= 450 Ω)
Static destruction limit	± 30 V	± 30 V	-	-

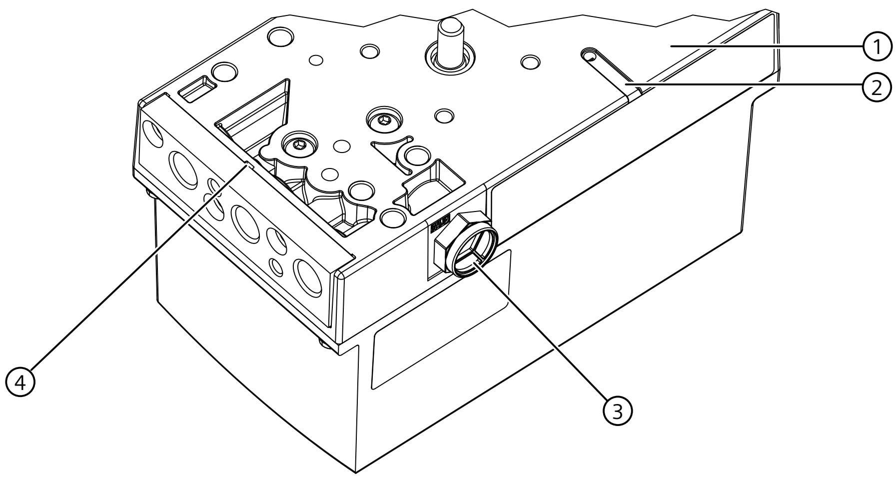
12.8 Communication (HART)

HART communication	
HART version	7
PC parameter assignment software	SIMATIC PDM; supports all device objects. The software is not included in the scope of delivery.

12.9 Technical data for natural gas as actuator medium

Introduction

For operation with natural gas, note that used natural gas escapes at the exhaust air outlets.



① Base plate
② Exhaust air outlet enclosure ventilation
③ Exhaust air outlet sound absorber
④ Exhaust air outlet near the pneumatic connections

Note

The following applies for exhaust air outlet with sound absorber ③:

The positioner is supplied as standard with a sound absorber. To provide an outlet for the exhaust air, replace the sound absorber by a G¼ pipe coupling.

The following applies for enclosure ventilation ② and control air outlet ④:

1. With the "flameproof enclosure" device version in an aluminum enclosure with order suffix -Z K50 "Operation with natural gas", you can completely collect and discharge the escaping natural gas.
2. In all other device versions, the escaping natural gas is released into the environment.

Maximum values for escaping natural gas

- The quantity of escaping natural gas is negligible during regulated operation.
- If a control deviation occurs, a maximum of 30 Nl/min of natural gas will escape at the enclosure vent ② and a maximum of 89 Nl/min at the control air outlet ④.

See also

Proper mounting (Page 33)

12.10 Option modules

12.10.1 Digital I/O Module (DIO) 6DR4004-6A / -8A

	Without explosion protection or suitable for use in Ex "db" version	With explosion protection Ex "ia", "db ia"	With explosion protection Ex "ic", "ec", "tb"
	6DR4004-8A	**6DR4004-6A**	**6DR4004-6A**
3 digital output current circuits • Digital output A1: Terminals 41 and 42 • Digital output A2: Terminals 51 and 52 • Fault message output: Terminals 31 and 32			
• Auxiliary power supply U_{Aux}	≤ 35 V and the current consumption is to be limited to < 25 mA	-	-
• Signal status			
High (not addressed)	Conductive, R = 1 kΩ, +3/-1 % *)	≥ 2.1 mA	≥ 2.1 mA
Low *) (addressed)	Deactivated, I_R < 60 µA	≤ 1.2 mA	≤ 1.2 mA
*) The status is also Low if the basic device is faulty or without a auxiliary power.	*) When using in the flameproof enclosure, the current consumption must be restricted to 10 mA per digital output.	Switching threshold for supply according to EN 60947-5-6: U_{Aux} = 8.2 V, R_i = 1 kΩ	Switching threshold for supply according to EN 60947-5-6: U_{Aux} = 8.2 V, R_i = 1 kΩ

1 digital input current circuit • Digital input DI2: Terminals 11 and 12, terminals 21 and 22 (jumper)			
• Galvanically connected with the basic device			
Signal status 0	Floating contact, open		
Signal status 1	Floating contact, closed		
Contact load	3 V, 5 µA		
• Electrically isolated from the basic device			
Signal status 0	≤ 4.5 V or open		
Signal status 1	≥ 13 V		
Internal resistance	≥ 25 kΩ		
• Static destruction limit	± 35 V	-	-
Galvanic isolation	The three digital outputs, the DI1 digital input and the basic device are galvanically isolated from each other.		
Test voltage	DC 840 V, 1 s		

12.10.2 Analog Output Module (AOM) 6DR4004-6J / -8J

	Without explosion protection or suitable for use in Ex d version	With explosion protection Ex "ia", "db ia"	With explosion protection Ex "ic", "ec", "tb"
	6DR4004-8J	**6DR4004-6J**	**6DR4004-6J**
Direct current output for position feedback			
1 current output, terminals 61 and 62	2-wire connection		
• Rated signal range	4 ... 20 mA, short-circuit proof		
• Dynamic range	3.6 ... 20.5 mA		
• Auxiliary power supply U_{Aux}	+12 ... +35 V	+12 ... +30 V	+12 ... +30 V
• External load R_B [kΩ]	≤ (U_{Aux} [V] - 12 V)/I [mA]		
• Transmission error	≤ 0.3%		
• Temperature influence	≤ 0.1%/10 K (≤ 0.1%/18 °F)		
• Resolution	≤ 0.1%		
• Residual ripple	≤ 1 %		
Galvanic isolation	Electrically isolated from the alarm option and safely isolated from the basic device		
Test voltage	DC 840 V, 1 s		

12.10.3 Inductive Limit Switches (ILS) 6DR4004-6G / -8G

	Without explosion protection	With explosion protection Ex "ia", "db ia"	With explosion protection Ex "ic", "ec", "tb"
	6DR4004-8G	**6DR4004-6G**	**6DR4004-6G**
Limit encoder with slotted initiators and fault message output			
2 slotted initiators • Digital output 1: Terminals 41 and 42 • Digital output 2: Terminals 51 and 52			
• Connection	2-wire technology in accordance with EN 60947-5-6 (NAMUR), for switching amplifiers connected on load side		
• Signal state High (not triggered)	> 2.1 mA		
• Signal state Low (triggered)	< 1.2 mA		
• 2 slotted initiators	Type SJ2-SN		
• Function	NC contact (NC, normally closed)		
1 fault message output • Digital output: Terminals 31 and 32			
• Connection	At switching amplifier in accordance with EN 60947-5-6: (NAMUR), U_{Aux} = 8.2 V, R_i = 1 kΩ).		
• Signal state High (not triggered)	R = 1.1 kΩ	> 2.1 mA	> 2.1 mA
• Signal state Low (triggered)	R = 10 kΩ	< 1.2 mA	< 1.2 mA
• Auxiliary power U_{Aux}	U_{Aux} ≤ DC 35 V I ≤ 20 mA	-	-
Galvanic isolation	The 3 outputs are galvanically isolated from the basic device.		
Test voltage	DC 840 V, 1 s		

12.10.4 Mechanic Limit Switches (MLS) 6DR4004-6K

	Without explosion protection	With explosion protection Ex "ia", "db ia"	With explosion protection Ex "ic", "tb"
Limit encoder with mechanical switching contacts			
2 limit contacts • Digital output DO1: Terminals 41 and 42 • Digital output DO2: Terminals 51 and 52			
• Max. switching current AC/DC	100 mA	-	-
• Max. switching voltage AC/DC	DC 30 V	DC 30 V	DC 30 V
1 fault message output • Digital output: Terminals 31 and 32			
• Connection	On switching amplifier according to EN 60947-5-6: (NAMUR), U_{Aux} = 8.2 V, Ri = 1 kΩ).		
• Signal state High (not triggered)	R = 1.1 kΩ	> 2.1 mA	> 2.1 mA
• Signal state Low (triggered)	R = 10 kΩ	< 1.2 mA	< 1.2 mA
• Auxiliary power	U_{Aux} ≤ DC 35 V I ≤ 20 mA	-	-
Galvanic isolation	The 3 outputs are galvanically isolated from the basic device		
Rated condition height	Max. 2 000 m above sea level. At altitudes greater than 2 000 m above sea level, use a suitable power supply.	-	-

12.10.5 Analog Input Module (AIM) 6DR4004-6F / -8F

	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec", "tb"
	6DR4004-8F	**6DR4004-6F**	**6DR4004-6F**
The Analog Input Module (AIM) 6DR4004-6F and -8F is required to connect a Non-Contacting Sensor (NCS) or Position Transmitter 6DR4004-1ES to -4ES.			
For devices without explosion protection, other types of potentiometers with resistance values between 3 and 20 KΩ can be connected.			
Signal 20 mA			
• Rated signal range	0 ... 20 mA	-	
• Internal load R_B	200 Ω	-	
• Static destruction limit	40 mA	-	
Signal 10 V			
• Rated signal range	0 ... 10 V	-	
• Internal resistance R_i	25 kΩ	-	
• Static destruction limit	20 V	-	
Supply and signal power circuits	Galvanically connected with the basic device		

12.10.6 Internal NCS module 6DR4004-5L / 6DR4004-5LE

Additional modules	Without explosion protection	With explosion protection Ex "ia", "db ia"	With explosion protection Ex "ic", "ec", "tb"
	6DR4004-5L	**6DR4004-5LE**	**6DR4004-5LE**
Linearity (after corrections made by positioner)	± 1 %		
Hysteresis	± 0.2 %		

12.10.7 Other technical specifications

Technical specifications for additional option modules and accessories is available at:

- External NCS sensors 6DR4004-6N/8N and 6DR4004-2ES (Page 271)
- Technical specifications of the external position detection system (Page 277)
- Sealing plug / thread adapter (Page 289)
- Positioner with remote electronics (Page 303)

Dimension drawings

13

13.1 Positioner in non-flameproof enclosure

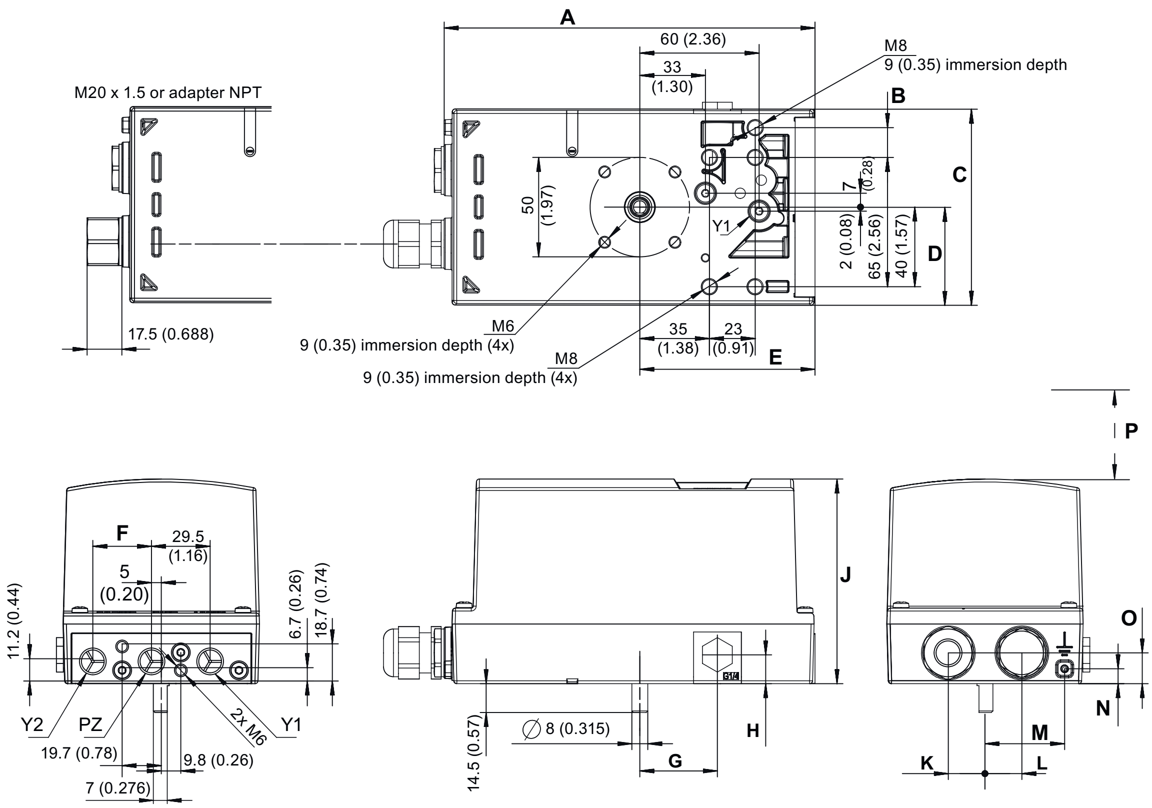


Figure 13-1 SIPART PS2, non-flameproof enclosure, dimensions in mm (inch)

	6DR5..0		6DR5..1	6DR5..2	6DR5..3	
	G¼	¼-18 NPT			G¼	¼-18 NPT
A	184.5 [7.26]	186.5 [7.34]	185 [7.28]	186.5 [7.34]	186.5 [7.34]	188.5 [7.42]
B	-	-	-	-	15 [0.59]	
C	95 [3.74]		84 [3.31]	99 [3.90]	98.6 [3.88]	
D	47.5 [1.87]		49.5 [1.95]	49.5 [1.95]	49.3 [1.94]	
E	88.5 [3.48]		88.8 [3.50]	88.5 [3.48]	88.8 [3.50]	
F 1)	29.5 [1.16]		-	29.5 [1.16]	29.5 [1.16]	
G	39 [1.54]		44 [1.73]	39 [1.54]	39 [1.54]	
H	14.5 [0.57]		16 [0.63]	16 [0.63]	14.5 [0.57]	
J	96.6 [3.80]		96.6 [3.80]	98.5 [3.88]	103 [4.06]	
K	18.5 [0.73]		22 [0.87]	18.5 [0.73]	18.5 [0.73]	
L	18.5 [0.73]		7 [0.23]	18.5 [0.73]	18.5 [0.73]	

	6DR5..0		6DR5..1	6DR5..2	6DR5..3	
	G¼	¼-18 NPT			G¼	¼-18 NPT
M	-		26.5 [1.04]	41.5 [1.53]	40 [1.57]	
N	-		7.5	7.5	7.5	
O	14.5 [0.57]		14.5 [0.57]	14.5 [0.57]	15.5 [0.61]	
P	> 150 (5.91) Adhere to this minimum clearance P for service and maintenance above the lid.					

Dimensions in mm [inch]

1) Dimension applies only to double-acting actuators.

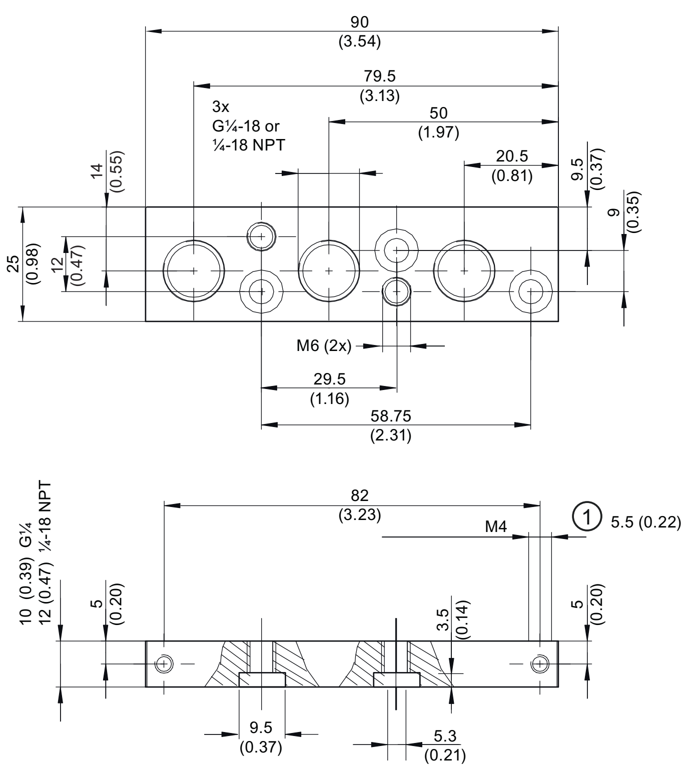
6DR5..0 Polycarbonate enclosure; dimensions with pneumatic connection G¼ or ¼-18 NPT

6DR5..1 Aluminum enclosure, single-acting

6DR5..2 Stainless steel enclosure, without inspection window

6DR5..3 Aluminum enclosure, single/double-acting; dimensions with pneumatic connection G¼ or ¼-18 NPT

13.2 Terminal strip for positioners



① Thread depth

Figure 13-2 Terminal strip, dimensions in mm (inch)

13.3 Positioner in flameproof enclosure

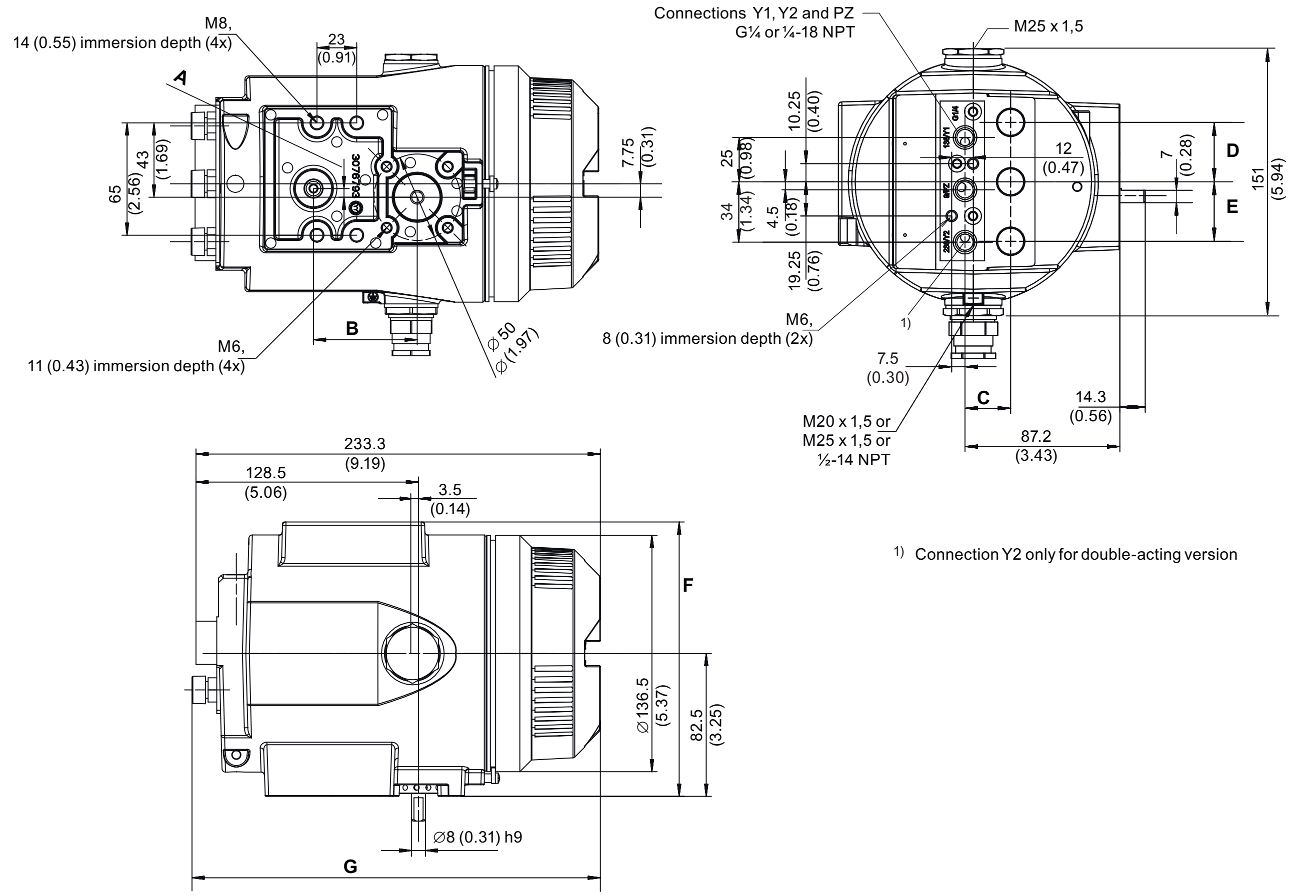


Figure 13-3 SIPART PS2, flameproof enclosure, dimensions in mm (inch)

	6DR5..5	**6DR5..6**
A	5 [0.2]	-
B	60 (2.36)	-
C	25.7 (1.01)	21.7 (0.85)
D	33.5 (1.32)	25 [0.99]
E	33.5 (1.32)	-
F	158.5 [6.24]	160 [6.3]
G	235.3 [9.26]	227.6 [8.96]

Dimensions in mm [inch]

6DR5..5 Aluminum enclosure, flameproof; dimensions with pneumatic connection G¼ or ¼-18 NPT

6DR5..6 Stainless steel enclosure, flameproof

Product documentation and support A

A.1 Technical support

Technical support

If this documentation does not completely answer your technical questions, you can enter a Support Request (http://www.siemens.com/automation/support-request).

For help creating a support request, view this video here (www.siemens.com/opensr).

Additional information on our technical support can be found at Technical Support (http://www.siemens.com/automation/csi/service).

Service & support on the Internet

In addition to our technical support, Siemens offers comprehensive online services at service & support (http://www.siemens.com/automation/serviceandsupport).

Contact

If you have further questions about the device, contact your local Siemens representative at Personal Contact (http://www.automation.siemens.com/partner).

To find the contact for your product, go to "all products and branches" and select "Products & Services > Industrial automation > Process instrumentation".

Contact address for business unit:
Siemens AG
Digital Industries
Process Automation
Östliche Rheinbrückenstr. 50
76187 Karlsruhe, Germany

A.2 Product documentation

Process instrumentation product documentation is available in the following formats:

- Certificates (http://www.siemens.com/processinstrumentation/certificates)
- Downloads (firmware, EDDs, software) (http://www.siemens.com/processinstrumentation/downloads)
- Catalog and catalog sheets (http://www.siemens.com/processinstrumentation/catalogs)
- Manuals (http://www.siemens.com/processinstrumentation/documentation)
  You have the option to show, open, save, or configure the manual.
  - "Display": Open the manual in HTML5 format
  - "Configure": Register and configure the documentation specific to your plant
  - "Download": Open or save the manual in PDF format
  - "Download as html5, only PC": Open or save the manual in the HTML5 view on your PC

You can also find manuals with the Mobile app at Industry Online Support (https://support.industry.siemens.com/cs/ww/de/sc/2067). Download the app to your mobile device and scan the device QR code.

Product documentation by serial number

Using the PIA Life Cycle Portal, you can access the serial number-specific product information including technical specifications, spare parts, calibration data, or factory certificates.

Entering a serial number

1. Open the PIA Life Cycle Portal (https://www.pia-portal.automation.siemens.com).
2. Select the desired language.
3. Enter the serial number of your device. The product documentation relevant for your device is displayed and can be downloaded.

To display factory certificates, if available, log in to the PIA Life Cycle Portal using your login or register.

Scanning a QR code

1. Scan the QR code on your device with a mobile device.
2. Click "PIA Portal".

To display factory certificates, if available, log in to the PIA Life Cycle Portal using your login or register.

Bluetooth

B

B.1 Connecting SIPART PS2 BT

NOTICE
Adherence to the degree of protection
When the SITRANS AW050 Bluetooth adapter is used with a positioner, the enclosure protection class specified on the nameplate of the positioner applies.

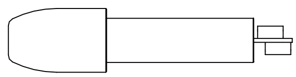
Requirements

- FW: 5.05.00 or higher
- In conjunction with the device variants:

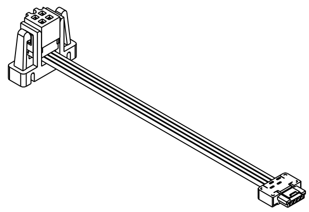
Type of protection (Ex)		**Standard enclosure**		**Flameproof enclosure 6DR5..5/6**
		Polycarbon-ate **6DR5..0**	**Aluminum 6DR5..3** **Stainless steel 6DR5..2**	
Without explosion protection		✓	✓	✓
Increased safety (Ex e), Dust ignition protection by enclosure (Ex t)	NI (Non-incendive), DIP (Dust igni-tion-proof)	-	✓	-
Increased safety (Ex e)	NI (Non-incendive)	-	✓	✓
Flameproof enclosure (Ex d), Dust ig-nition protection by enclosure (Ex t)	XP (explosion-proof), DIP (dust igni-tion-proof)	-	-	✓
Intrinsic safety "Ex i"	IS (Intrinsic Safety)	-	-	-

Mounting kit SITRANS AW050

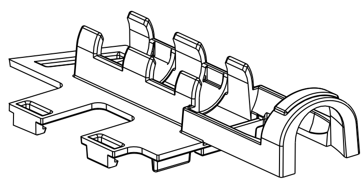
A



B



C

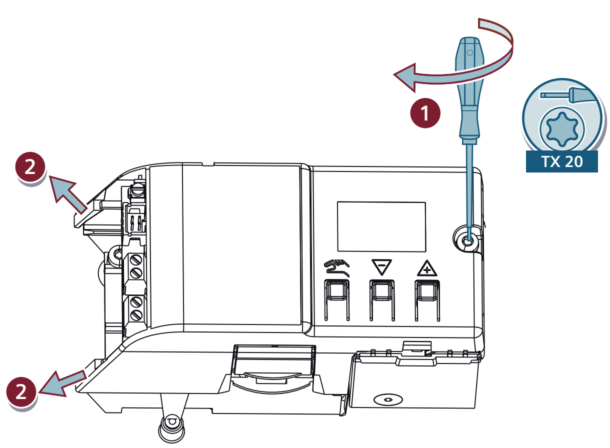


A	SITRANS AW050 Bluetooth adapter
B	1 flat ribbon cable
C	1 clamp

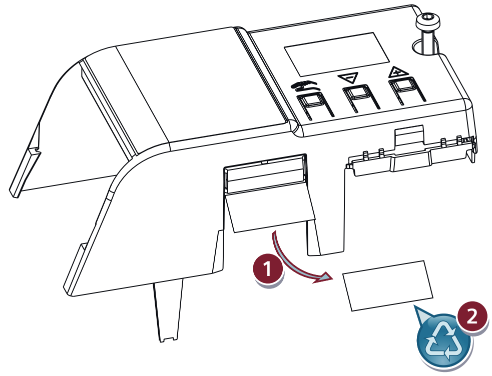
B.1.1 Procedure

Procedure

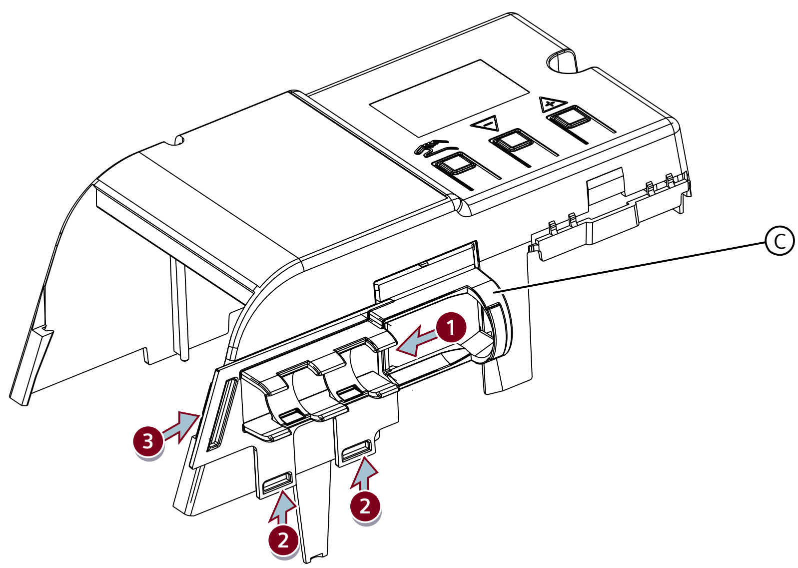
1. Open the positioner.
   Opening the positioner (Page 47)
2. Loosen the module cover.



3. If the part shown is present on the module cover, break off this part.

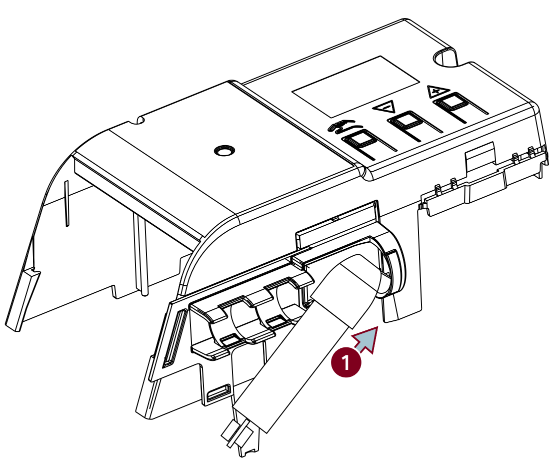


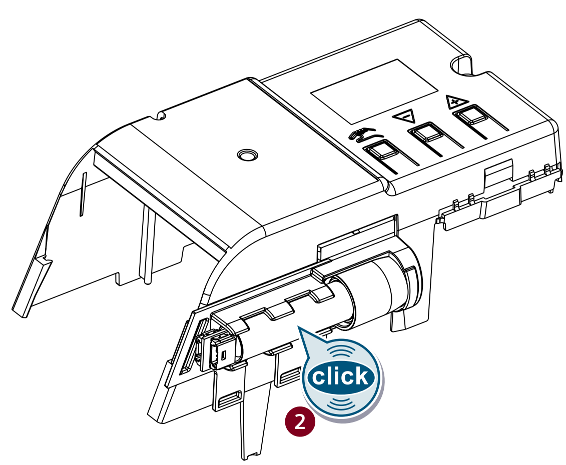
4. Engage the clip (C) on the module cover.



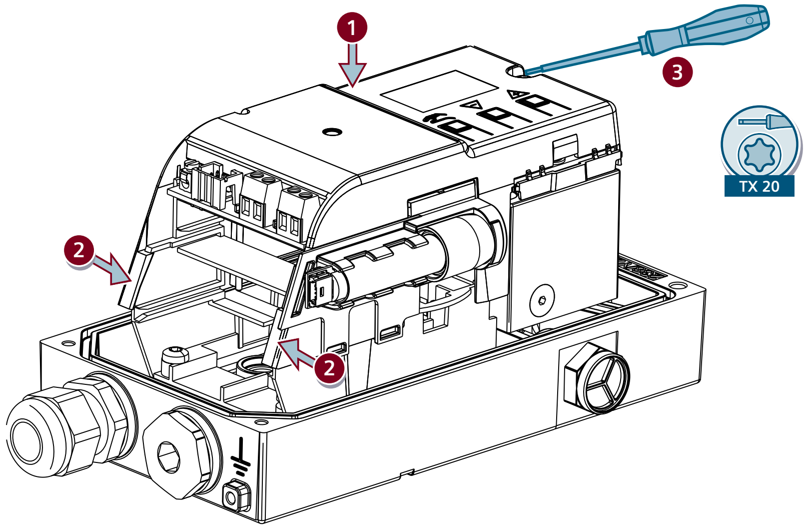
⇒ Check that the clamp is firmly seated after you hear it click into place.

5. Install the SITRANS AW050 Bluetooth adapter on the module cover.

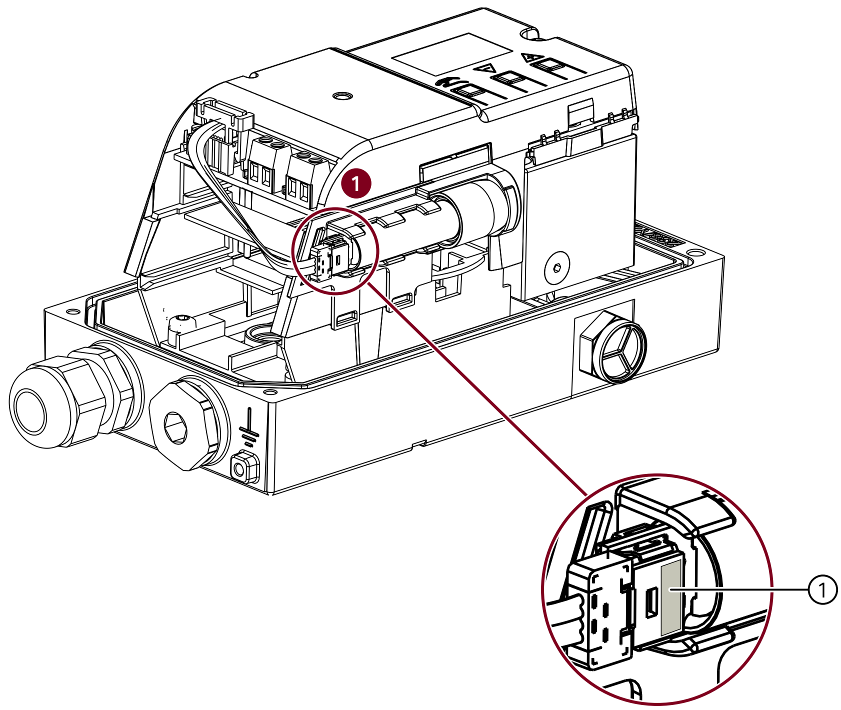


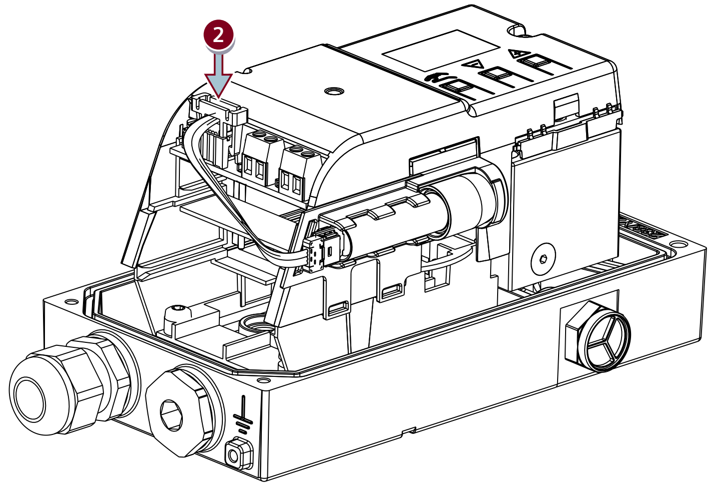


6. Install the module cover.



7. Connect the SITRANS AW050 Bluetooth adapter to the positioner using the supplied flat cable.
   The socket of the adapter is marked with a white label ①.





8. Place the lid on the positioner. Screw the lid in place.
   Closing the positioner (Page 70)

B.2 Connecting field device with SITRANS mobile IQ App

SITRANS mobile IQ is an app for mobile devices that enables authorized service technicians to monitor and configure compatible field instrumentation over a Bluetooth interface. You can find information and the app for download at: Mobile app "Industry Online Support" (https://support.industry.siemens.com/cs/ww/de/sc/2067)

Requirements for establishing the first connection

1. Field device is in operation.
2. There is a line of sight to the field device.
3. You are less than 10 meters away from the field device.
4. LED on the SITRANS AW050 Bluetooth adapter flashes every 2 seconds.

Requirements for connection setup

1. Android: "Location" access is enabled in the mobile device.
2. SITRANS mobile IQ is authorized to access the location.

Procedure

NOTICE
Unauthorized access It is your responsibility to prevent unauthorized access to the field device.

1. Start the SITRANS mobile IQ app.
   The smartphone or tablet automatically searches for Bluetooth field devices in the vicinity. The field devices found are listed. Select the desired field device in the device list.
2. Enter the default delivery password "Sitrans AW050!". The delivery password must be changed for first connection setup.
3. Assign a new password.
   – Before assigning a password, ensure that no 2 field devices with the same serial number are displayed in the selection list.
   – Assign a new password that is not the same as the default password. The new password must consist of at least 12 characters (of any type).
   – Only use passwords with a high password strength. Avoid weak passwords for example "password1", "123456789" or similar.
   – Do not use the same password for different Bluetooth field devices.
   – If the mobile end device, for example, Smartphone or tablet, has access protection, the SITRANS mobile IQ automatically saves the passwords of connected field devices. Individual, stored device passwords can be deleted in the app.

When the connection is established, the LED on the SITRANS AW050 Bluetooth adapter flashes every second.

B.3 Default password

The default delivery password must be changed for the first connection setup.

The default password is: "Sitrans AW050!".

Note that this password:

- Is used in the procedure to connect the field device with SITRANS Mobile IQ.
- Is the default used when the password is reset.

B.4 Reset Password

Procedure

1. Select "Reset password".
2. Once you have selected "Reset password", disconnect the ribbon cable between the SITRANS AW050 and the device within 60 seconds.
3. Wait for 30 seconds.
4. Insert the ribbon cable again.

The password is reset to the default password.

B.5 Security information

Security functions

- SITRANS AW050 saves important Security events like "Connection","Authentication succeeded","Authentication failed", and so on in a log.
  - To check the Security log, go to "Device settings > SITRANS AW050 > Security log" in the SITRANS mobile IQ App.
- Available firmware updates are notified and accessible in the SITRANS mobile IQ App.

B.6 Access management

The parameters are protected against changes via the "Settings > Access management" menu.

The following access levels are available:

- Read-only
  No configuration allowed. The parameter values can only be displayed. No PIN required
- User (standard)
  Allows you to configure and change all parameters.
  Preset user PIN 2457

The user PIN is deactivated on delivery.

Forget user PIN

Use the PIN recovery parameter to restore the factory setting of the user PIN.

Contact the Technical Support with the displayed Recovery ID and Electronics serial number.

Siemens Technical Support will give you a PUK (PIN Unlock Key) that you use to reset the user PIN to the factory setting 2457.

B.7 Information for radio approvals

Radio approvals	
USA Contains FCC ID: RYYEYSHJN	
Canada Contains IC: 4389B-EYSHJN	
China CMIIT ID: 2020DJ15120	
Further Radio approvals and tick marks:	European Union
	UK
	South Korea R-R-S49-SITRANS_AW050
	Australia
	Japan R 001-A10746

Canada Regulatory Information

1. This device complies with Industry Canada’s applicable licence-exempt RSSs. Operation is subject to the following two conditions:
   (1) This device may not cause interference; and
   (2) This device must accept any interference, including interference that may cause undesired operation of the device.
   Le présent appareil est conforme aux CNR d’Industrie Canada applicables aux appareils radio exempts de licence. L’exploitation est autorisée aux deux conditions suivantes :
   (1) l’appareil ne doit pas produire de brouillage;
   (2) l’utilisateur de l’appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptibled’en compromettre le fonctionnement.
2. This product is certified as type of the portable device with Industry Canada Rules. To maintain compliance with RF Exposure requirement, please use within specification of this product.
   Ce produit est certifié comme type de l'appareil portable avec Industrie Règles de Canada. Pour maintenir l'acquiescement avec exigence Expositionde RF, veuillez utiliser dans spécification de ce produit. -IC: 4389B-EYSHJN

FCC Regulatory Information

1. This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
2. CAUTION: Changes or modifications not expressly approved by the party responsible for compliance could void the use’s authority to operate the equipment.
3. This product is certified as type of the portable device with FCC Rules. To maintain compliance with RF Exposure requirement, please use within specification of this product.
4. The antenna used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
5. This module can change the output power depending on the circumstances by the application software which is developed by module installer. Any end user cannot change the output power.

South Korea-KCC Regulatory Information

이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서

가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

B.8 Technical specifications SITRANS AW050

Operating conditions and structural design	
Ambient conditions	For use indoors and outdoors.
Ambient temperature	Observe the maximum permissible ambient temperature for the field device.
• Permissible ambient temperature for operation	-40 ... +80 °C (-40 ... +176 °F)
• Relative humidity	0 ... 100%
Degree of pollution standard IEC 61010-1	2
Overvoltage category	II
Weight	60 g
Degree of protection	• Type 4X, Type 6 according to NEMA • IP66, IP68 according to IEC 60529
EMC	EN 61326
Input voltage range	2.2 ... 3.4 V DC
Maximum current consumption	2.5 mA
Material	Polycarbonate
Tightening torque cable gland	Corresponds to the specifications in the technical specifications in the Construction section
Communication, interface	Bluetooth 4.2
Range	Class 2; approx. 10 m depending on mounting position

See also

Certificates (http://www.siemens.com/processinstrumentation/certificates)

B.9 Dimension drawing of SITRANS AW050 Bluetooth adapter

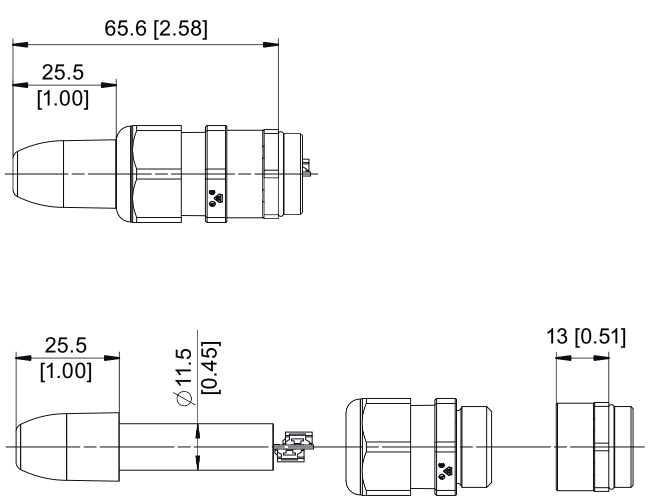


Figure B-1 Dimension drawing SITRANS AW050 Bluetooth adapter, dimensions in mm (inch)

External position detection C

C.1 Introduction

⚠ WARNING
Position Transmitter
Device versions with flameproof enclosures may only be operated with a Position Transmitter with the same type of protection.

In some cases it makes sense to mount the position detection and the controller unit separately. A separate mounting the case, for example, with continuous and strong vibrations, high or too low ambient temperatures and nuclear radiation. A universal component is available for this purpose. It is suitable for part-turn and linear actuators. You will require the following:

One of the following Position Transmitters

- Position Transmitter with Article No. 6DR4004-2ES, 3ES or 4ES
- NCS sensor for non-contacting position detection 6DR4004-6N/-8N
- Potentiometers with 3 kΩ, 5 kΩ or 10 kΩ
- Position sensor with a signal range from 0 to 20 mA
- Position sensor with a signal range from 0 to 10 V

And a positioner

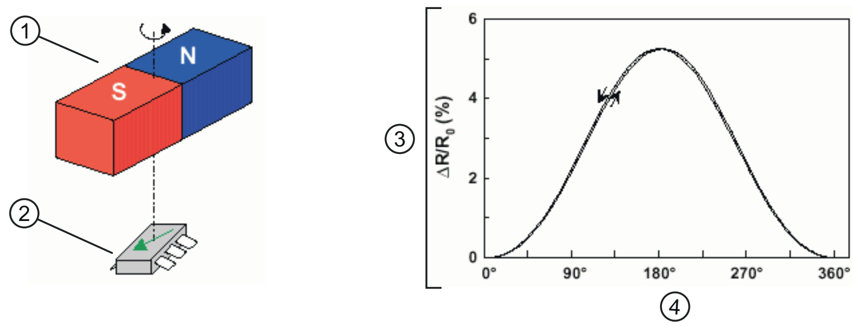
- Positioner in combination with Analog Input Module (AIM) 6DR5..0/1/2/3-0...2/3 or retrofitted as accessory 6DR4004-6F/-8F
  - An Analog Input Module (AIM) as an accessory is provided in a set along with cable clamps and M20 cable glands.

C.2 Non-Contacting Sensor

C.2.1 Mode of operation

The NCS contains a magnetic field sensor. This sensor changes its electrical resistance in response to the immediate presence of a permanent magnet. The sensor has a high signal-to-noise ratio to external magnetic fields due to the measurement method used.

The following figure shows the mode of operation with a rotating magnet.

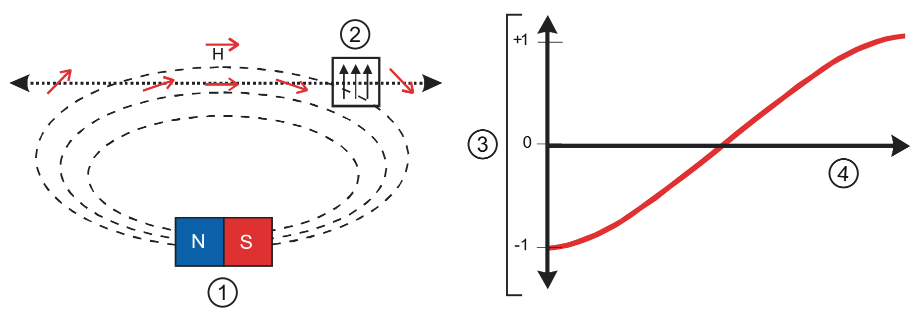


① Magnet
② Sensor
③ Resistance change
④ Angle

Figure C-1 Relative resistance change depending on the angle of the magnet

The figure shows that a circular movement of the magnet generates a sinusoidal change of the resistance. The mechanical stops of the fitting ensure that only one part (quadrant) of the sinusoidal curve is used at any one time. The principle-related non-linearity of the curve is corrected by means of software based on a curve that is stored in the positioner.

A linear movement of the magnet in the sensor range also generates a resistance change that is used to identify the position. The following figure highlights the principle:



① Magnet
② Sensor
③ Resistance change
④ Angle

Figure C-2 Resistance change depending on the position of the magnet

Non-linearity is corrected automatically in the positioner by software.

The great advantage of this principle is the absence of wear. Moreover, vibration, dampness and temperature only have a minor impact on the measurement result.

C.2.2 Mounting the NCS

Function

The positioner facilitates the separate installation of the position detection system. The stroke or rotary angle is measured directly at the actuator by means of a non-contacting sensor. It is therefore possible to install the controller unit at some distance away, e.g. on a mounting pipe or similar. The positioner is connected to the position detection system by means of an electrical cable.

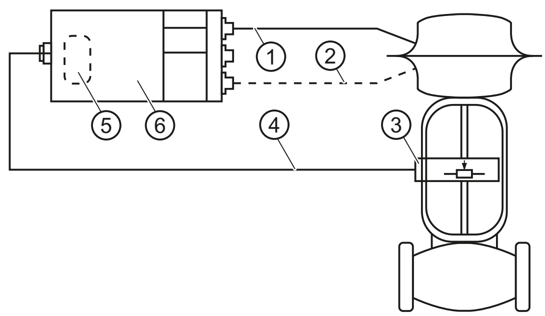
Such a separate installation is useful whenever the ambient conditions at the valve exceed the specified positioner values.

The NCS consists of a molded sensor for fixed installation and a magnet. The magnet is mounted to the spindle on linear actuators, or to the stub shaft on part-turn actuators. The sensor housing is mounted onto the console on part-turn actuators and to the bracket on linear actuators. The bracket can be a NAMUR type, or any other mounting bracket.

Auxiliary power is supplied to the NCS via the Analog Input Module (AIM) 6DR4004-6F and EMC compatibility is ensured at the same time.

You have the following options:

- To order the Analog Input Module (AIM) already installed in the positioner, Catalog FI 01
- To retrofit the Analog Input Module (AIM) in the positioner; article number 6DR4004-6F. For information on retrofitting the Analog Input Module (AIM), refer to the Installing/mounting (Page 31) section of the positioner operating instructions.



① Pneumatic line
② Pneumatic line for double-action actuators
③ Position detection system (10 kΩ potentiometer or NCS)
④ Electrical cable
⑤ Retrofittable Analog Input Module (AIM) (in the positioner)
⑥ Positioner

Figure C-3 Separate installation of the NCS and positioner

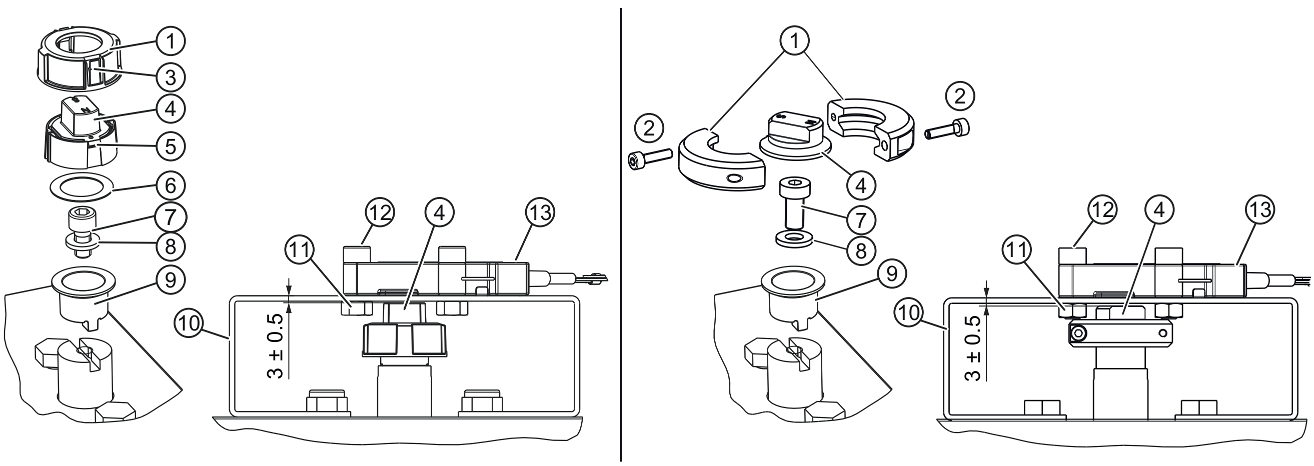
C.2.2.1 Mounting the NCS to the part-turn actuator

Requirement

1. An Analog Input Module (AIM) built into the positioner
2. A non-contacting sensor for part-turn actuators 6DR4004-.N.10 or 6DR4004-.N.40
3. A part-turn actuator with interface acc. to VDI/VDE 3845 and mounting console acc. to VDI/VDE 3845, or
   A part-turn actuator with manufacturer-specific interface

NOTICE
Incorrect mounting
A clearance of 3 mm must be maintained between the magnet and the mounting console in order to ensure correct measurement of the actuator position. The values transferred may be incorrect if this clearance is not given. • Maintain a clearance of 3 mm between the top edge of the magnet ④ and the top edge of the mounting console ⑩.

Description



①	Tensioning ring	⑧	Washer
②	Hex socket head screw size M3x12	⑨	Clamping table
③	Spring element	⑩	Mounting console
④	Magnet	⑪	Hexagon nut
⑤	Hooks	⑫	Hexagon socket screw M6x25, including washer ⑧
⑥	Plastic washer	⑬	Non Contacting Sensor (NCS)
⑦	Hex socket head screw size M6x12		

Figure C-4 Mounting on part-turn actuator with magnet holder made of glass fiber reinforced polyester (left figure) or anodized aluminum (right figure)

Procedure for the part-turn actuator to VDI/VDE 3845

1. Slide the clamping table ⑨ onto the stub shaft of the part-turn actuator.
2. Mount the clamping table ⑨ to the stub shaft using a hex socket head screw ⑦ and washer ⑧.

3. Depending on the material of the magnet holder, proceed as follows:

Magnet holder made of glass fiber reinforced polyester	Magnet holder made of anodized aluminum
1. Insert the plastic washer ⑥ into the magnet ④. 2. Fix the magnet ④ onto the clamping table ⑨. The magnet ④ can now be rotated easily on the clamping table ⑨. 3. Slide the tensioning ring ① over the magnet ④. Make sure that the spring elements ③ and the hook ⑤ on the magnet ④ are lined up above one another and that they engage. You will now have more resistance when turning the tensioning ring ① and magnet ④.	1. Place the magnet ④ onto the clamping table ⑨. 2. Secure the magnet ④ to the clamping table ⑨ by connecting the two parts of the tensioning ring ① with the two hex socket head screws ②. The magnet ④ can now be rotated easily on the clamping table ⑨. 3. Then tighten the two hex socket head screws ②. The magnet ④ can then no longer be rotated on the clamping table ⑨.

4. Screw the NCS ⑬ onto the mounting console ⑩ using the hexagon socket-head screw ⑫, hex nut ⑪ and the washer ⑧.
5. Once the NCS ⑬ is mounted, the clearance of 3 mm between the top edge of the magnet ④ and the top edge of the mounting console ⑩ is set automatically.

Procedure for part-turn actuators with manufacturer-specific interface

1. Steps 1 to 4 as above
2. Set a clearance of 3 mm between the top edge of the magnet ④ and the top edge of the mounting console ⑩. Extend the stub shaft accordingly, or insert washers underneath the NCS housing ⑬.

Reference

For information on the scope of delivery, refer to section "Scope of delivery of NCS for part-turn actuators (Page 273)".

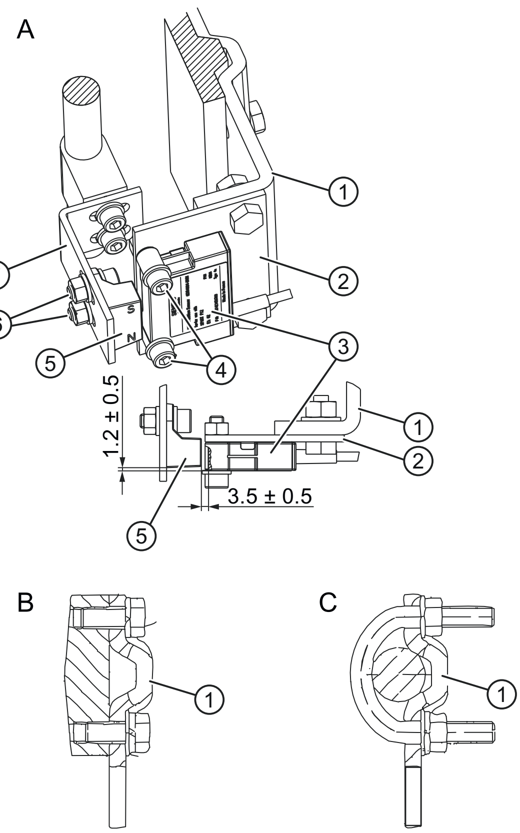
C.2.2.2 Mounting the NCS to a linear actuator up to 14 mm (0.55 inch)

Requirement

1. An Analog Input Module (AIM) built into the positioner.
2. An NCS for linear actuators up to 14 mm (0.55 inch) 6DR4004-.N.20.
3. A linear actuator with interface to NAMUR. This installation must be carried out individually. Only a NAMUR mounting bracket can be used as mounting base. The following figure shows the assembly with NAMUR mounting bracket. Or:
   A linear actuator without interface to NAMUR and individual mounting solution.

Description

The dimensions of magnet and NCS can be found under Dimensional drawing of non-contacting sensor (Page 272).



Dimensions in mm

A	Mounting on a yoke with fin	③	Non Contacting Sensor (NCS)
B	Mounting on a yoke with plane surface	④	Hex socket head screw M6x25
C	Mounting on a yoke with columns	⑤	Magnet
①	NAMUR mounting bracket IEC 60534 - not included in the scope of delivery	⑥	Hex socket head screw M6x12
②	Assembly panel for Non Contacting Sensor (NCS) - individual solution; not included in the scope of delivery	⑦	Mounting bracket for the magnet - individual solution; not included in the scope of delivery

Figure C-5 Example of the assembly on a linear actuator with a stroke up to 14 mm (0.55 inch)

Procedure

1. Produce the mounting panel ② and mounting bracket ⑦ individually.
2. Align the sensor to the center of the stroke. Observe the dimensions specified in the figure.

Reference

For information on the scope of delivery, refer to section "Scope of delivery of NCS for linear actuators up to 14 mm (0.55 inch) . (Page 273)".

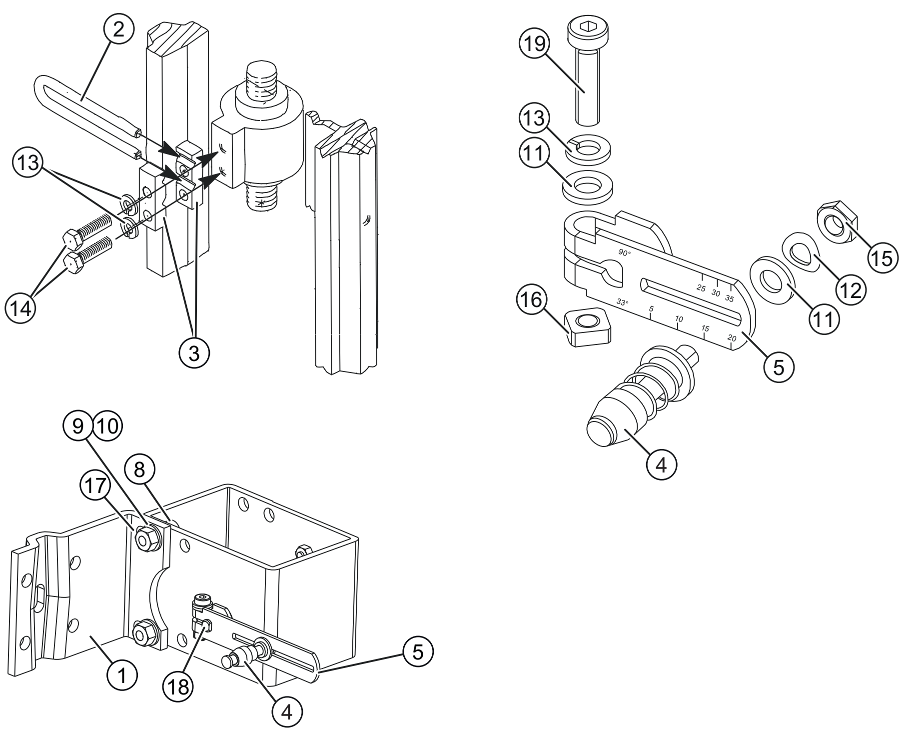
C.2.2.3 Mounting the NCS to a linear actuator > 14 mm (0.55 inch)

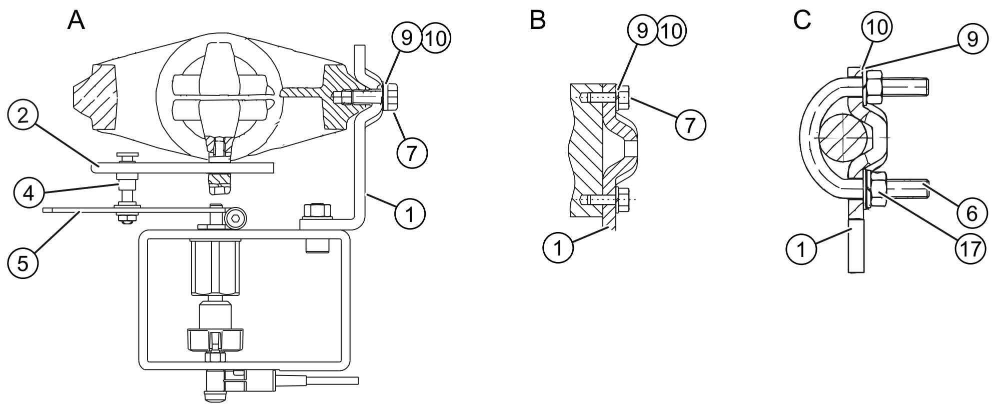
Requirement

1. An Analog Input Module (AIM) built into the positioner.
2. An NCS for linear actuators > 14 mm (0.55 inch) 6DR4004-.N.30.
3. Linear actuator with interface to NAMUR
   Item no. based on the respective stroke range: 6DR4004-8V or 6DR4004-8V + 6DR4004-8L.
   or
   linear actuator without interface to NAMUR and individual mounting solution. Item No. 6DR4004-8VK or 6DR4004-8VL can be used as individual assembly solution, depending on the stroke range.

Description

You can find the dimensions in the dimension drawing in the section "Scope of delivery of NCS for linear actuators > 14 mm (0.55 inch) . (Page 274)".





A	Mounting on a yoke with fin	⑨	Spring washer A8
B	Mounting on a yoke with plane surface	⑩	Washer B 8.4
C	Mounting on a yoke with columns	⑪	Washer B 6.4
①	NAMUR mounting bracket IEC 60534	⑫	Spring lock washer
②	Pick-up bracket	⑬	Spring washer A6
③	Clamping piece	⑭	Hexagonal screw size M6x25
④	Carrier pin	⑮	Hexagonal nut M6
⑤	Lever	⑯	Square-head nut M6
⑥	U bracket	⑰	Hexagonal nut M8
⑦	Hexagonal screw size M8x20	⑱	Shaft
⑧	Hexagonal screw size M8x16	⑲	Hex socket head screw size M6x25

Figure C-6 Mounting instructions for linear actuators with a stroke > 14 mm (0.55 inch)

Procedure

1. Mount the clamping pieces ③ to the actuator spindle using the hexagonal screw ⑭ and spring washers ⑬.
2. Slide the pick-up bracket ② into the milled recesses of the clamping pieces.
3. Set the necessary length.
4. Tighten the screws so that you can still shift the pick-up bracket ②.
5. Set the center of the pin ④ to the stroke range value specified on the actuator, or to the next higher scaling value of the lever ⑤. The actuating distance in mm will be displayed on successful initialization if you set the same value at parameter "3.YWAY" when commissioning the system.
6. Slide the lever ⑤ onto the shaft ⑱ up to the endstop.
7. Secure the lever ⑤ using the hex socket head screw ⑲.

8. Mount the bracket ① to the NCS mounting kit using:
   - Two hexagonal screws ⑧
   - Spring washer ⑨
   - Washer ⑩
   - Hexagonal nut ⑰

   The selection of the row of holes depends on the yoke width of the actuator. Make sure that the carrier pin ④ engages in the pick-up bracket ② as close as possible to the spindle over the complete stroke range. The carrier pin must not touch the clamping pieces.
9. Place the NCS mounting kit with the mounting bracket ① onto the actuator. Ensure that the carrier pin ④ is guided inside the pick-up bracket ②.
10. Tighten the pick-up bracket ② .
11. Prepare the assembly parts for the relevant actuator type for installation:
    - For mounting on yoke with fin: hexagonal screw ⑦, washer ⑩ and spring washer ⑨.
    - For mounting on a yoke with plane surface: Four hexagonal screw ⑦ with washer ⑩ and spring washer ⑨.
    - For actuator with columns: Two U brackets ⑥, four hexagonal screw ⑰ with washer ⑩ and spring washer ⑨.
12. Mount the NCS assembly kit to the yoke using the assembly parts that you prepared.

Note

Observe the height

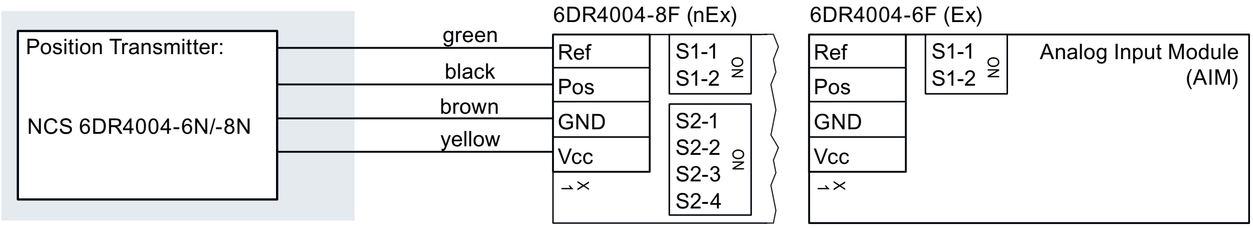
Adjust the height of the NCS assembly kit so that the lever position is in line horizontally with the stroke center. Use the lever scale on the actuator for orientation. If a symmetrical assembly is not possible, you must always ensure that the lever is in horizontal position within the range of the stroke.

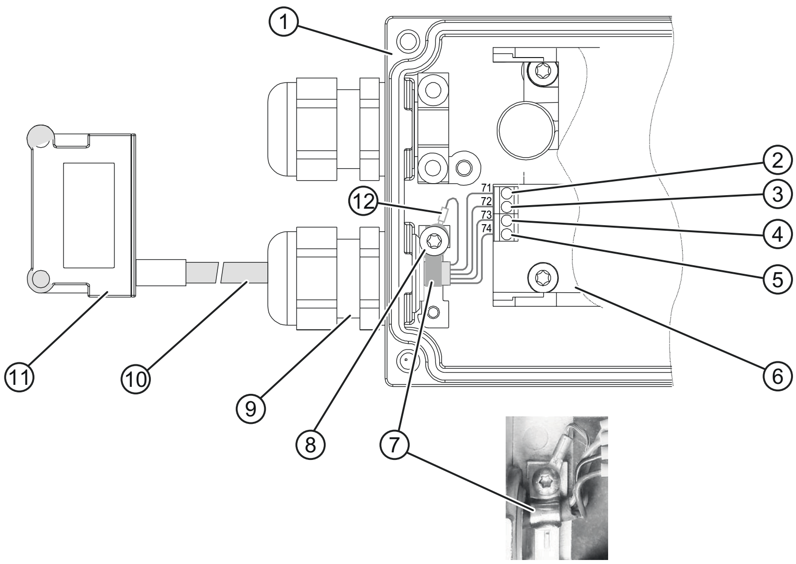
C.2.3 Connecting NCS to Analog Input Module (AIM)

Requirement

You need the Analog Input Module (AIM), article number 6DR4004-6F or -8F, for the electrical connection of the accessory part "NCS sensor for non-contacting position measurement" to the positioner. The positioner supplies auxiliary power to the NCS sensor via the option module.

Wiring diagram





①	Positioner (open state)	⑦	Cable clamp
②	Terminal Ref: Green	⑧	F3x8 or M3x8 screw
③	Terminal Pos: Black	⑨	Cable gland
④	Terminal GND: Brown	⑩	Four-pole NCS cable
⑤	Terminal Vcc: Yellow	⑪	Non Contacting Sensor (NCS)
⑥	Analog Input Module (AIM)	⑫	Cable shielding lug

Figure C-7 Example of connecting the NCS to the Analog Input Module (AIM)

Procedure

The NCS sensor is equipped with a shielded 4-pin cable. Connect this 4-pin cable to the positioner as follows:

1. Feed the 4-pin NCS cable ⑩ through the union nut and the cable gland. Note: The type of cable gland depends on the positioner version.
2. Tighten the cable gland ⑨.
3. Connect the 4-pin NCS cable ⑩ to the Analog Input Module (AIM) of the positioner in accordance with the wiring diagram.
4. Place the cable clamp ⑦ onto the outer insulation of the 4-pin NCS cable ⑩.
5. Use the screw ⑧ to bond the cable shielding lug ⑫ and the cable clamp ⑦ to the ground terminal of the positioner.
6. Grounding:
   The rear steel panel of the NCS sensor is inevitably bonded to the ground potential of the system when mounting on the console. This ground connection is only functional if there is a low-impedance connection to ground potential of the system. Ensure this connection by measuring the resistance. If necessary, ensure proper grounding by means of an additional cable from the NCS sensor to ground potential.

If potentiometers or external signal sources are used, configure the switch blocks in accordance with the following table:

Measuring range	Switch block 1		Switch block 2			
	S1-1	**S1-2**	**S2-1**	**S2-2**	**S2-3**	**S2-4**
6DR4004-.N/P/R (NCS)	ON	OFF	ON	OFF	OFF	OFF
6DR4004-1ES/-2ES/-3ES/-4ES	ON	OFF	ON	OFF	OFF	OFF
10 ... 20 kΩ	ON	OFF	ON	OFF	OFF	OFF
5 kΩ	OFF	ON	ON	OFF	OFF	OFF
3 kΩ	OFF	OFF	ON	OFF	OFF	OFF
20 mA	OFF	OFF	ON	OFF	ON	OFF
10 V	OFF	OFF	OFF	ON	OFF	OFF

C.2.4 Commissioning of NCS

C.2.4.1 Prerequisites / default settings

1. Supply electrical and pneumatic auxiliary power to the positioner. The top row of the display shows the current sensor voltage (0 to 100%), while the "NOINI" info flashes in the bottom row. The pneumatic actuator does not move.
2. If the positioner has already been initialized, perform a reset. Carry out the reset of parameter group "Init" in the '50.PRST' Preset (HART/FF) (Page 170) parameter.

3. Preset for part-turn actuators:
   While the process valve is closed, align the magnet so that the north pole is in the direction of the cable; "N" in position ⑦ in "Figure C-4 Mounting on part-turn actuator with magnet holder made of glass fiber reinforced polyester (left figure) or anodized aluminum (right figure) (Page 262)".
4. Monitor the display of the positioner while adjusting the actuator to its mechanical stops by means of △ and ▽ at the positioner. Verify that the displayed values never exceed the range from P2.0 to P98.0.

   Note

   This condition cannot be met with slipping flaps or linear actuators that exceed the mechanical actuation limits.

C.2.4.2 Initialization of part-turn actuators

Procedure

1. For part-turn actuators operating in standard control direction, set parameter "1.YFCT" to "ncSt", or to "-ncSt" in case of inverse control direction.
2. Launch initialization as usual with "INITA".

C.2.4.3 Initializing linear actuators with a stroke range up to 14 mm (0.55 inch)

Requirements

1. Set the "1.YFCT" parameter of the positioner to "ncSL" or - with inverse control direction - to "-ncSL".
2. Launch initialization as usual with "INITA".

C.2.4.4 Initializing linear actuators with a stroke range > 14 mm (0.55 inch)

Note

Parameter values "ncSLL" and "-ncLL" are only available for devices of the 6DR5... series and only with the firmware version > C4. Set the value to 90° on devices of the 6DR5... series with firmware version < C5 (YAGL). This setting is also necessary for devices of the 6DR4... series. Resultant non-linearity can be corrected by means of the programmable characteristic by setting the parameter value from "SFCT" to "FrEE" and adapting the interpolation points.

Requirements

1. Set the "1.YFCT" parameter of the positioner to "ncSLL" or - with inverse control direction - to "-ncLL".
2. Launch initialization as usual with "INITA".

C.2.5 External NCS sensors 6DR4004-6N/8N and 6DR4004-2ES

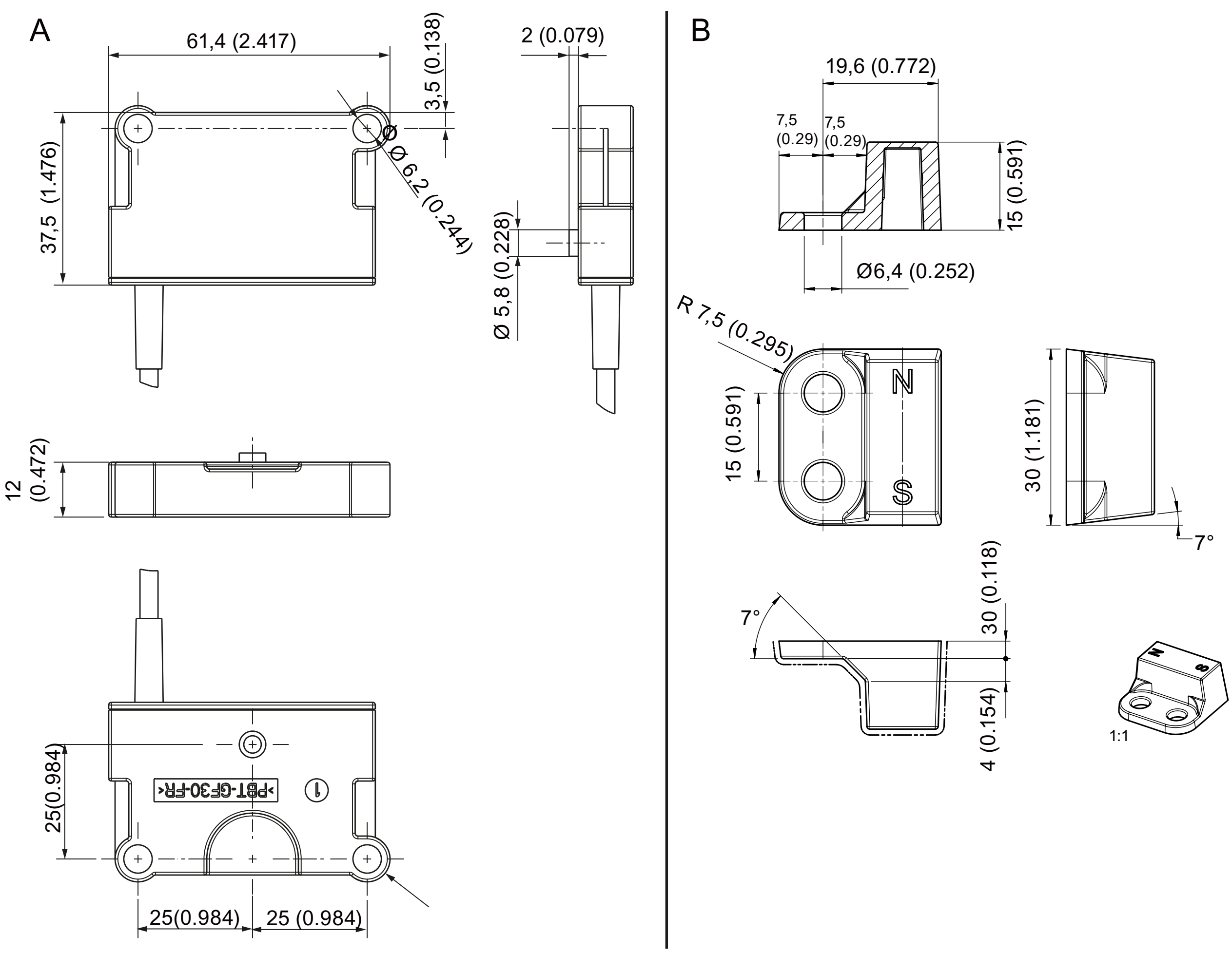
Additional modules	Without Ex protection	With Ex protection Ex "ia"	With explosion protection Ex "ic", "ec"
Travel range			
• Linear actuator 6DR4004-6/8N.20	3 to 14 mm (0.12 to 0.55")		
• Linear actuator 6DR4004-6/8N.30	10 to 130 mm (0.39 to 5.12"); up to 200 mm (7.87") on request		
• Part-turn actuator	30 to 100°		
Linearity (after corrections made by positioner)	± 1%		
Hysteresis	± 0.2%		
Temperature influence (range: rotation angle 120° or stroke 14 mm)	≤ 0.1 %/10 K (≤ 0.1 %/18 °F) for -20 to +90 °C (-4 to +194 °F) ≤ 0.2%/10 K (≤ 0.2%/18 °F) for -40 to -20 °C (-40 to -4 °F)		
Climate class	According to IEC/EN 60721-3		
• Storage	1K23, -40 ... +90 °C (-40 ... +194 °F)		
• Transport	2K12, -40 ... +90 °C (-40 ... +194 °F)		
Vibration resistance			
• Harmonic oscillations (sine) according to IEC 60068-2-6	3.5 mm (0.14"), 2 to 27 Hz, 3 cycles/axis 98.1 m/s² (321.84 ft/s²), 27 to 300 Hz, 3 cycles/axis		
• Bumping according to IEC 60068-2-29	300 m/s²(984 ft/s²), 6 ms, 4000 shocks/axis		
Torque for cable gland nut made of	Plastic	Metal	Stainless steel
	2.5 Nm (1.8 ft lb)	4.2 Nm (3.1 ft lb)	4.2 Nm (3.1 ft lb)
Torque of hexagon socket-head screw M6x12 (shaft end or mounting bracket)	4 Nm (3 ft lb)		
Torque of hexagon socket head screw M6x25 (mounting console or mounting plate)	4 Nm (3 ft lb)		
Torque of hexagon socket head screw M3x12 (clamping ring)	1 Nm (0.7 ft lb)		
Degree of protection	IP68 / type 4X		
For connecting to circuits with the following peak values	-	U_i = 5 V I_i = 160 mA P_i = 120 mW	U_i = 5 V

Additional modules	Without Ex protection	With Ex protection Ex "ia"	With explosion protection Ex "ic", "ec"
Effective internal capacitance	-	C_i = [1]	C_i = [1]
Effective internal inductance	-	L_i = [2]	L_i = [2]

[1] C_i = 110 nF + 110 nF per meter of connecting cable

[2] L_i = 270 µH + 6.53 µH per meter of connecting cable

C.2.6 Dimensional drawing of non-contacting sensor



A NCS B Magnet

Figure C-8 Dimensional drawing of the NCS and magnet, dimensions in mm (inches)

C.2.7 NCS sensor scope of delivery

C.2.7.1 Scope of delivery of NCS for part-turn actuators

6DR4004-.N.10	6DR4004-.N.40		
Quantity	**Quantity**	**Name**	**Note**
1	1	Magnet holder	
5	5	Washer	6
2	2	Hex socket head screw	M6x12
1	-	Plastic washer	
1	1	Magnet	
1	2	Tensioning ring	
4	4	Hexagon nut	M6
2	2	Hex socket head screw	M6x25
-	2	Hex socket head screw	M3x12
1	1	Non-contacting sensor	Cable lengths as ordered
1	1	Self-tapping screw for polycar-bonate enclosure	F3x8
1	1	Metric screw for metal enclo-sure	M3x8
1	1	Sealing	For cable bushings
1	1	Plugs	For closing the sealing insert
1	1	Cable clamp	
1	1	DVD	with documentation

See also

Mounting the NCS (Page 260)

C.2.7.2 Scope of delivery of NCS for linear actuators up to 14 mm (0.55 inch) .

Linear actuator with a stroke range up to 14 mm (0.55 inch) 6DR4004-.N.20		
Quantity	**Designation**	**Notes**
1	Magnet	
5	Washer	6
2	Hex socket head screw	M6x12
4	Hexagon nut	M6
2	Hex socket head screw	M6x25
1	Non-contacting sensor	Cable lengths as ordered
1	Self-tapping screw for polycar-bonate enclosure	F3x8
1	Metric screw for metal enclo-sure	M3x8

Linear actuator with a stroke range up to 14 mm (0.55 inch) 6DR4004-.N.20		
Quantity	**Designation**	**Notes**
1	Sealing	For cable bushings
1	Plugs	For closing the sealing insert
1	Cable clamp	
1	DVD	with documentation

See also

Mounting the NCS (Page 260)

C.2.7.3 Scope of delivery of NCS for linear actuators > 14 mm (0.55 inch) .

Linear actuator > 14 mm (0.55 inch) 6DR4004-.N.30		
Quantity	**Designation**	**Notes**
1	NCS assembly kit, completely assembled	Mounting by means of assembly kit for NAMUR linear actuators Mounting kit available on separate order, see 'Accessories' in Catalog FI 01.

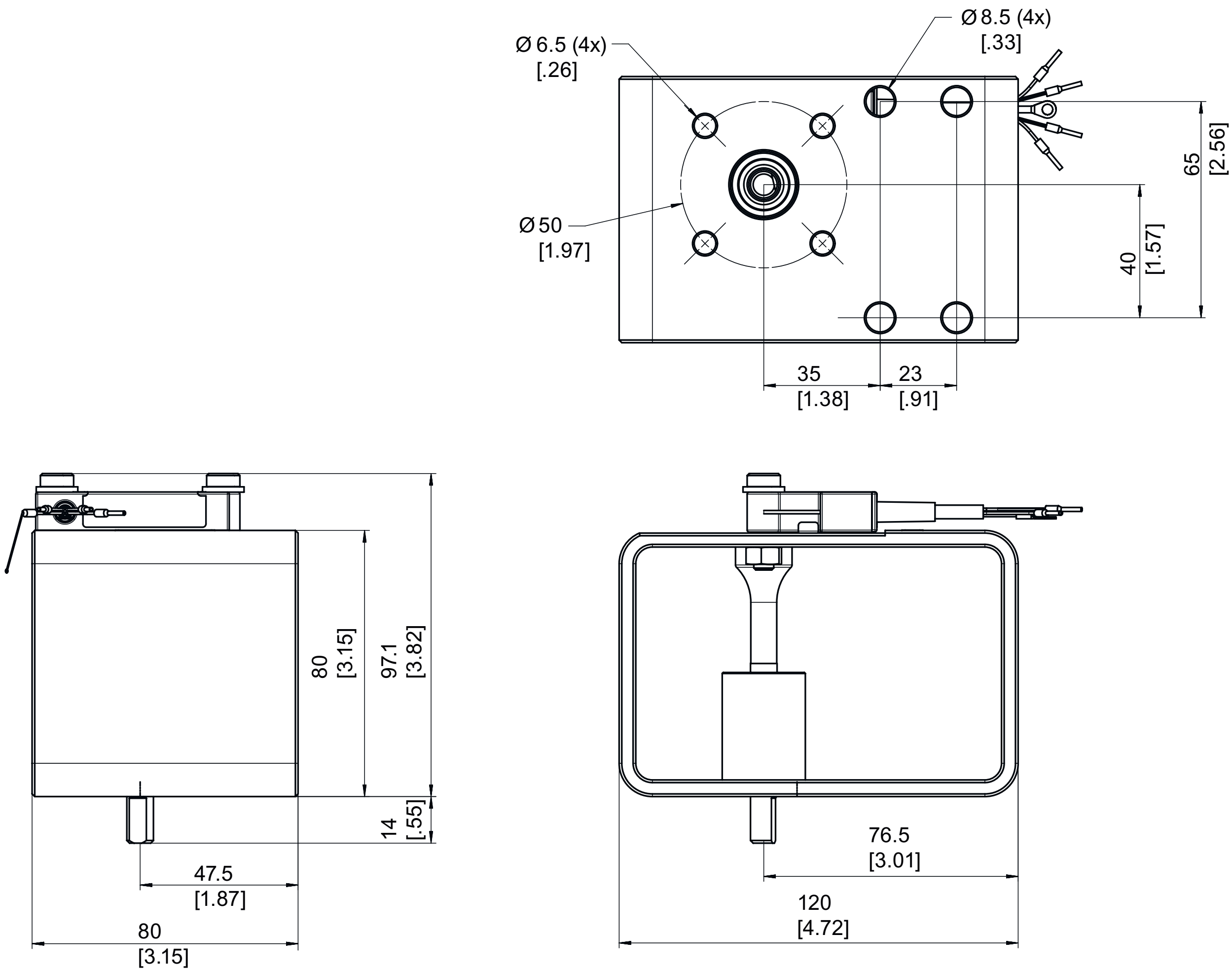


Figure C-9 Dimension drawing NCS module > 14 mm (0.55 inch)

C.3 External position detection

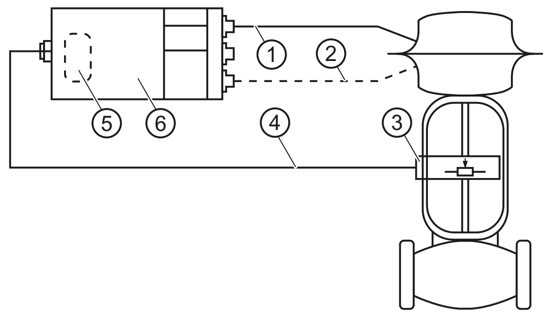
C.3.1 Mode of operation for external position detection

The Position Transmitter essentially consists of an enclosure and an internal position detection system. The position is recorded by a potentiometer or an internal NCS module, section "Mode of operation (Page 259)". The controller unit is separated from the positioner.

Such a separate installation is useful whenever the ambient conditions at the valve exceed the specified positioner values.

The Position Transmitter is secured to a console with part-turn actuators and to a mounting bracket with linear actuators, section "Mounting to linear actuator (Page 34)".

Auxiliary power is supplied to the Position Transmitter via the Analog Input Module (AIM) and EMC compatibility is ensured at the same time.



① Pneumatic line
② Pneumatic line for double-action actuators
③ Position Transmitter
④ Electrical cable
⑤ Analog Input Module (AIM) (fitted in the positioner or retrofittable)
⑥ Positioner

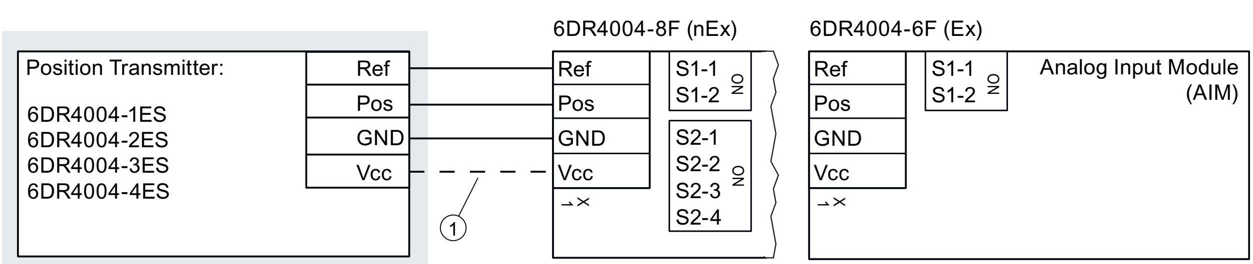
Figure C-10 Position Transmitter and positioner

C.3.2 Installation of external position detection system

Mounting of the Position Transmitter corresponds to the mounting of the positioner in a non-flameproof enclosure. Proceed as described in Section "Installing and mounting (Page 31)". The connection of the Analog Input Module (AIM) is described in the section "Analog Input Module (AIM) 6DR4004-6F / -8F (Page 86)".

C.3.3 Connecting to Analog Input Module (AIM)

Wiring diagram



① Connection of terminal Vcc is only needed for 6DR4004-2ES, -3ES and -4ES.

C.3.4 Technical specifications of the external position detection system

C.3.4.1 Rated conditions for external position detection

Rated conditions	
Ambient temperature	In hazardous areas, observe the maximum permissible ambient temperature corresponding to the temperature class.
• Permissible ambient temperature for operation	-40 ... +90 °C (-40 ... +194 °F)
Degree of protection [1)]	IP66 / Type 4X according to NEMA 250
Climate class	According to IEC/EN 60721-3
• Storage	1K23, -40 ... +90 °C (1K23, -40 ... +194 °F)
• Transport	2K12, -40 ... +90 °C (2K12, -40 ... +194 °F)
• Operation	4K26, -40 ... +90 °C (4K26, -40 ... +194 °F)

1) Impact energy max. 1 joule.

C.3.4.2 Electrical data for external position detection

External NCS sensors 6DR4004-6N / -8N

	Without explosion protection	**With explosion protection Ex "ia", "db ia", "ic"**	**With explosion protection Ex "ec"**
	6DR4004-8N	**6DR4004-6N**	**6DR4004-6N**
Travel range			
• Linear actuator 6DR4004-6/-8N.20	3 to 14 mm (0.12 to 0.55")		
• Linear actuator 6DR4004-6/-8N.30	10 to 130 mm (0.39 to 5.12"); up to 200 mm (7.87") on request		
• Part-turn actuator	30 to 100°		
Linearity (after corrections made by positioner)	± 1 %		
Hysteresis	± 0.2 %		
Temperature influence (range: rotation angle 120° or stroke 14 mm)	≤ 0.1 %/10 K (≤ 0.1 %/18 °F) for -20 to +90 °C (-4 to +194 °F) ≤ 0.2%/10 K (≤ 0.2%/18 °F) for -40 to -20 °C (-40 to -4 °F)		
Climate class	According to IEC/EN 60721-3		
• Storage	1K23, -40 ... +90 °C (-40 ... +194 °F)		
• Transport	2K12, -40 ... +90 °C (-40 ... +194 °F)		
Vibration resistance			
• Harmonic oscillations (sine) according to IEC 60068-2-6	3.5 mm (0.14"), 2 to 27 Hz, 3 cycles/axis 98.1 m/s² (321.84 ft/s²), 27 to 300 Hz, 3 cycles/axis		
• Bumping according to IEC 60068-2-29	300 m/s²(984 ft/s²), 6 ms, 4000 shocks/axis		

	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec"
	6DR4004-8N	**6DR4004-6N**	**6DR4004-6N**
Torque for cable gland nut made of	Plastic	Metal	
	2.5 Nm (1.8 ft lb)	4.2 Nm (3.1 ft lb)	
Torque of hexagon socket-head screw M6x12 (shaft end or mounting bracket)	4 Nm (3 ft lb)		
Torque of hexagon socket head screw M6x25 (mounting console or mounting plate)	4 Nm (3 ft lb)		
Torque of hexagon socket head screw M3x12 (clamping ring)	1 Nm (0.7 ft lb)		
Degree of protection	IP68 according to IEC/EN 60529; Type 4X according to NEMA 250		

Position Transmitter (Potentiometer) 6DR4004-1ES

Additional modules	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec", "tb"
Degree of protection	IP66 according to IEC/EN 60529; Type 4X according to NEMA 250	

Position Transmitter (NCS) 6DR4004-2ES

	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec", "tb"
Travel range			
• Linear actuator	3 to 14 mm (0.12 to 0.55") 10 to 130 mm (0.39 to 5.12"); up to 200 mm (7.87") on request		
• Part-turn actuator	30 to 100°		
Linearity (after corrections made by positioner)	± 1 %		
Hysteresis	± 0.2 %		
Temperature influence (range: rotation angle 120° or stroke 14 mm)	≤ 0.1 %/10 K (≤ 0.1 %/18 °F) for -20 to +90 °C (-4 to +194 °F) ≤ 0.2%/10 K (≤ 0.2%/18 °F) for -40 to -20 °C (-40 to -4 °F)		
Climate class	According to IEC/EN 60721-3		
• Storage	1K23, -40 ... +90 °C (-40 ... +194 °F)		
• Transport	2K12, -40 ... +90 °C (-40 ... +194 °F)		
Vibration resistance			
• Harmonic oscillations (sine) according to IEC 60068-2-6	3.5 mm (0.14"), 2 to 27 Hz, 3 cycles/axis 98.1 m/s² (321.84 ft/s²), 27 to 300 Hz, 3 cycles/axis		

	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec", "tb"
• Bumping according to IEC 60068-2-29	300 m/s²(984 ft/s²), 6 ms, 4000 shocks/axis		
Torque for cable gland nut made of	Plastic	Metal	
	2.5 Nm (1.8 ft lb)	4.2 Nm (3.1 ft lb)	
Torque of hexagon socket-head screw M6x12 (shaft end or mounting bracket)	4 Nm (3 ft lb)		
Torque of hexagon socket head screw M6x25 (mounting console or mounting plate)	4 Nm (3 ft lb)		
Torque of hexagon socket head screw M3x12 (clamping ring)	1 Nm (0.7 ft lb)		
Degree of protection provided by enclosure	IP66 according to IEC/EN 60529; Type 4X according to NEMA 250		

Position Transmitter (NCS, ILS) 6DR4004-3ES

	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec", "tb"
Degree of protection provided by enclosure	IP66 according to IEC/EN 60529; Type 4X according to NEMA 250		
NCS module (NCS)	**6DR4004-5L**	**6DR4004-5LE**	**6DR4004-5LE**
Inductive Limit Switches (ILS)	**6DR4004-8G**	**6DR4004-6G**	**6DR4004-6G**
2 slotted initiators • Digital output (slot-type initiators) A1: Terminals 41 and 42 • Digital output (slot-type initiators) A2: Terminals 51 and 52			
• Connection	2-wire system according to EN 60947-5-6 (NAMUR), for switching amplifier connected on load side		
• Signal state High (not triggered)	> 2.1 mA		
• Signal state Low (triggered)	< 1.2 mA		
• 2 slotted initiators	Type SJ2-SN		
• Function	NC (normally closed)		
1 fault message output • Digital output: Terminals 31 and 32			
• Connection	At switching amplifier in accordance with EN 60947-5-6: (NAMUR), U_{Aux} = 8.2 V, R_i = 1 kΩ)		
• Signal state High (not triggered)	R = 1.1 kΩ	> 2.1 mA	> 2.1 mA
• Signal state Low (triggered)	R = 10 kΩ	< 1.2 mA	< 1.2 mA
• Auxiliary power U_{Aux}	U_{Aux} ≤ DC 35 V I ≤ 20 mA	-	-

	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec", "tb"
Galvanic isolation	The 3 digital outputs are galvanically isolated from the basic unit.		
Test voltage	DC 840 V, 1 s		

Position Transmitter (NCS, MLS) 6DR4004-4ES

	Without explosion protection	With explosion protection Ex "ia", "db ia", "ic"	With explosion protection Ex "ec", "tb"
Degree of protection provided by enclosure	IP66 according to IEC/EN 60529; Type 4X according to NEMA 250		
NCS module (NCS)	**6DR4004-5L**	**6DR4004-5LE**	**6DR4004-5LE**
Mechanic Limit Switches (MLS), 6DR4004-6K			
2 limit contacts • Digital output (switching contact) A1: Terminals 41 and 42 • Digital output (switching contact) A2: Terminals 51 and 52			
• Max. switching current AC/DC	100 mA	-	-
• Max. switching voltage AC/DC	DC 30 V	DC 30 V	DC 30 V
1 fault message output • Digital output: Terminals 31 and 32			
• Connection	On switching amplifier according to EN 60947-5-6: (NAMUR), U_{Aux} = 8.2 V, Ri = 1 kΩ)		
• Signal state High (not triggered)	R = 1.1 kΩ	> 2.1 mA	> 2.1 mA
• Signal state Low (triggered)	R = 10 kΩ	< 1.2 mA	< 1.2 mA
• Auxiliary power	U_{Aux} ≤ DC 35 V I ≤ 20 mA	-	-
Galvanic isolation	The 3 digital outputs are galvanically isolated from the basic unit		
Rated condition height	Max. 2 000 m above sea level. At altitudes greater than 2 000 m above sea level, use a suitable power supply.	-	-

Internal NCS module (iNCS)

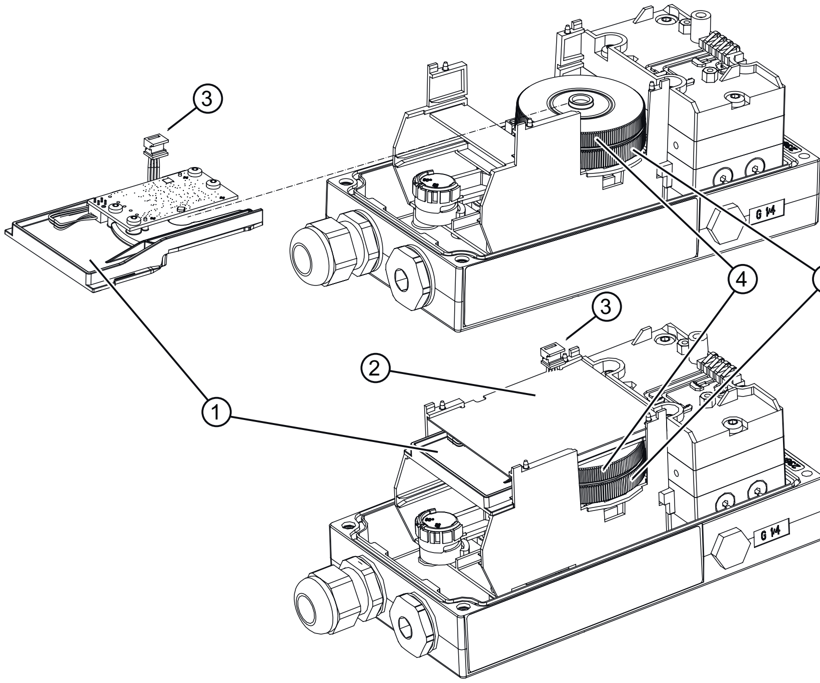
D

D.1 Internal NCS module (iNCS) 6DR4004-5L / -5LE

Function

Wear-free, non-contacting position detection

Device features



① Internal NCS module 6DR4004-5L.

② Insulating cover, yellow

③ Ribbon cable of the internal NCS module

④ Adjustment wheel of the magnet holder

⑤ Adjustment wheel for the friction clutch (without function)

Figure D-1 Installing the internal NCS module, schematic diagram

Requirement

- The slot in the adapter that is needed for the internal NCS module (iNCS) is free. The following option modules use the same slot in the adapter:
  - Digital I/O Module (DIO)
  - Inductive Limit Switches (ILS)
  - Mechanic Limit Switches (MLS)
  - Internal NCS module
- The positioner is mounted, or is to be mounted, directly on the valve using the positioner shaft.

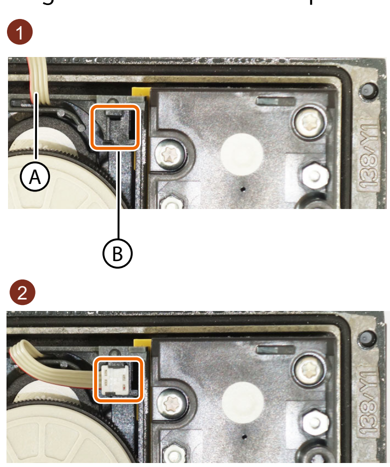
Note

The internal NCS module is not intended for the following positioner designs:

- 2-wire connection in flameproof aluminum enclosure: 6DR50.5 or 6DR51.5
- 2-wire connection in flameproof stainless steel enclosure: 6DR50.6 or 6DR51.6

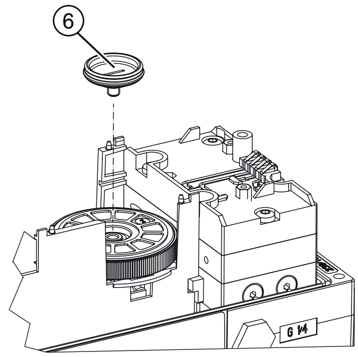
Procedure

1. Open the positioner as in the description depending on the device version:
   - Opening the positioner (Page 47)
2. Remove the ribbon cable from the electronics.
3. Remove the two fixing screws of the electronics.
4. Remove the electronics.
5. Plug the connector of the potentiometer's ribbon cable (A) onto (B) as shown in the figure:

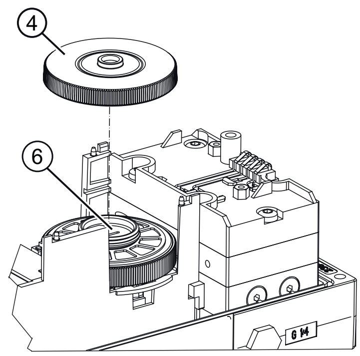


6. Screw the special screw ⑥ into the shaft of the positioner.

7. Tighten the special screw with a **torque of 2 Nm**.



8. Press the adjustment wheel of the magnet holder ④ firmly onto the special screw ⑥ of the friction clutch until you clearly hear it click into place.



Installing the internal NCS module

1. Route the ribbon cable ③ of the internal NCS module ① upwards before you slide the internal NCS module into the adapter.
2. Slide the internal NCS module ① under the electronics into the adapter until you hear it click into place.
3. An insulating cover (yellow) is required over the module. This insulating cover is supplied with the module. Place one end of the insulating cover ② under the electronics contact surface of the adapter. The recesses of the insulating cover must fit into the corresponding webs of the adapter.
4. To tighten the insulating cover, bend the walls of the adapter slightly outwards.
5. Firmly press the other end until the insulating cover is underneath the contact surface of the electronics. The recesses of the insulating cover must fit into the corresponding webs of the adapter.

Installing the electronics and closing the positioner

1. Place the electronics onto the four holders of the adapter.
2. Screw in the two fixing screws of the electronics.
3. Tighten the screws.

4. Insert the ribbon cable connector of the internal NCS module ① onto the positioner electronics.
   Note for built-in Analog Output Module (AOM): Reestablish all electrical connections between the electronics and the option module.
5. Put on the **supplied module cover**. Make sure that no ribbon cable is pinched.

   Note

   Module cover

   Do **not** use the standard module cover. The provided module cover has a larger recess.

   ---
6. Close the positioner as in the description depending on the device version:
   – Closing the positioner (Page 70)

Result

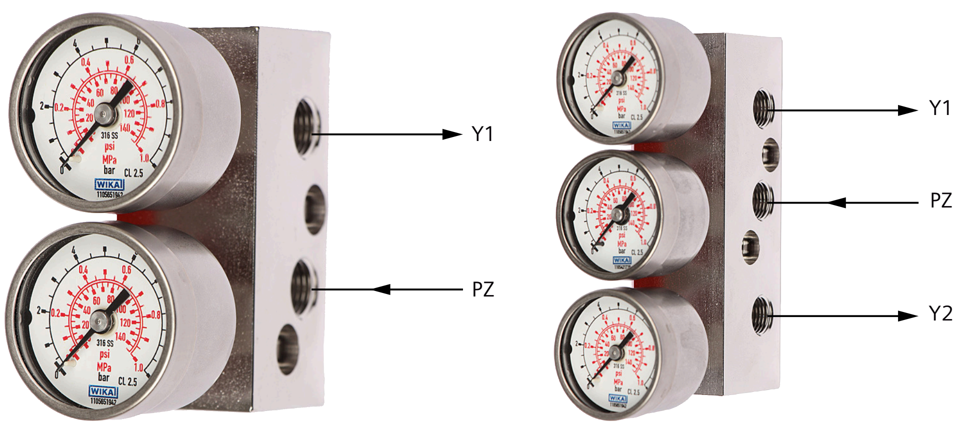
The module is installed and connected to the electronics of the positioner. Now configure the module with the parameter 1. YFCT.

Pressure gauge blocks

E

E.1 Pressure gauge block

Pressure gauge blocks that are available as accessories are illustrated below. The gauges display measured values for the actuating pressure and supply pressure. The figure to the left shows the pressure gauge block for single-acting actuators. The image to the right shows the pressure gauge block for double-acting actuators.

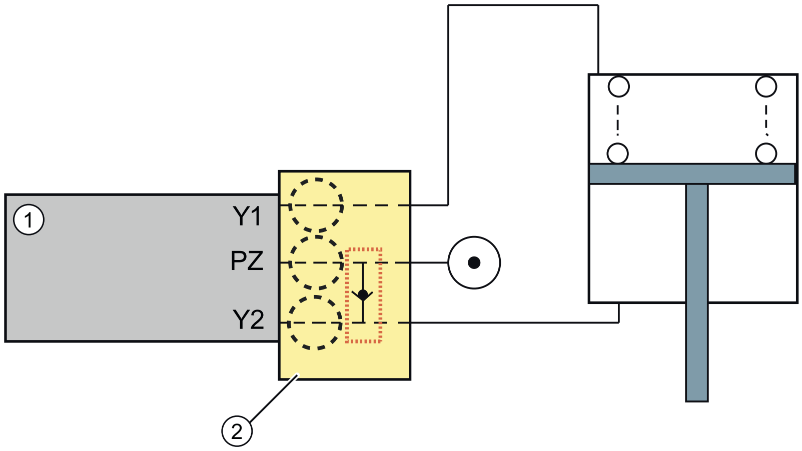


Y1	Actuating pressure
PZ	Supply pressure
Y2	Actuating pressure

Mounting

The pressure gauge block is fixed onto the lateral pneumatic connection of the positioner using the screws provided. Use the provided O-rings as sealing elements.

E.2 Venting gauge block



①	Positioner	Y1	Actuating pressure
②	Venting gauge block	PZ	Supply pressure
		Y2	Actuating pressure

Figure E-1 Mode of operation of venting gauge block

E.3 Dimension drawing of pressure gauge blocks

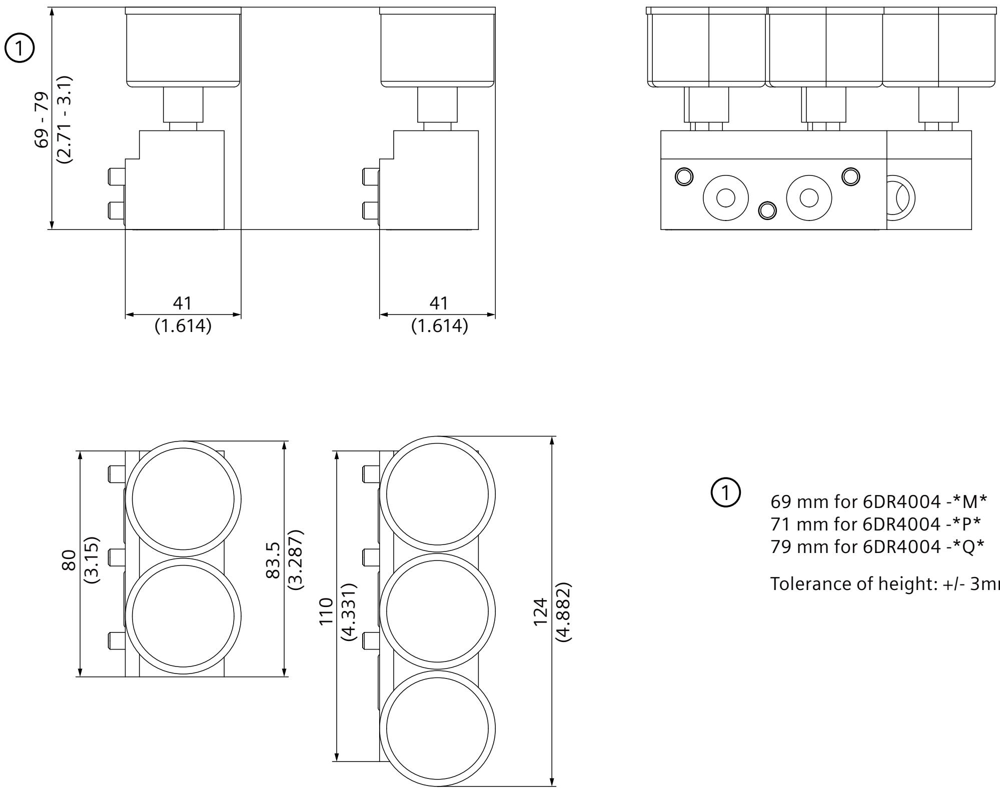


Figure E-2 Dimensions in mm [inch]

Sealing plug / thread adapter

F

F.1 Purpose

The sealing plug and the thread adapter (components) are suitable for installation in electrical equipment of flameproof enclosure "Ex db" type of protection of groups IIA, IIB and IIC as well as dust protection by enclosure "Ex tb" type of protection.

F.2 Safety instructions

WARNING

Incorrect assembly

- The component can be damaged or destroyed or its functionality impaired through incorrect assembly.
  – Mount the component using a suitable tool. Refer to the information in Chapter "Technical specifications (Page 290)", for example, torques for installation.
- For "Explosion-proof Ex d" type of protection: To ensure an engagement depth of 8 mm, the enclosure must have a wall thickness of at least 10 mm.

Improper modifications

Danger to personnel, system and environment can result from modifications and repairs of the component, particularly in hazardous areas.

- Any modification which deviates from the delivery state is not permitted.

Loss of enclosure type of protection

IP protection is not guaranteed without sealant.

- Use a suitable thread sealant.
- If you are using the component in type of protection dust protection by enclosure "Ex t", use the supplied sealing ring (①, figure in Chapter "Dimension drawings (Page 291)").

Unsuitable fluids in the environment

Danger of injury or damage to device.

Aggressive media in the environment can damage the sealing ring. Type of protection and device protection may no longer be guaranteed.

- Make sure that the sealing material is suitable for the area of use.

Note

Loss of type of protection

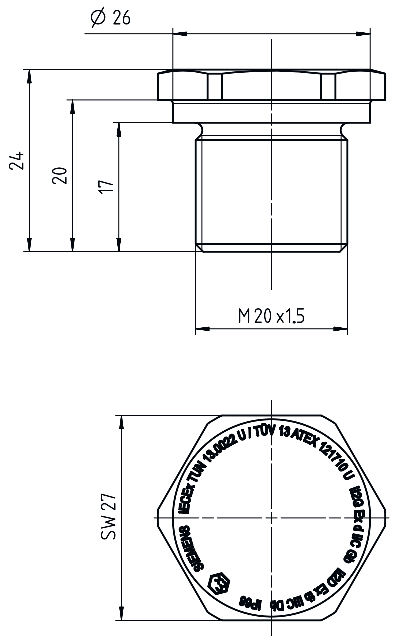
Changes in the ambient conditions can loosen the component.

- As part of the recommended maintenance intervals: Check the compression fitting for tight fit and tighten, if necessary.

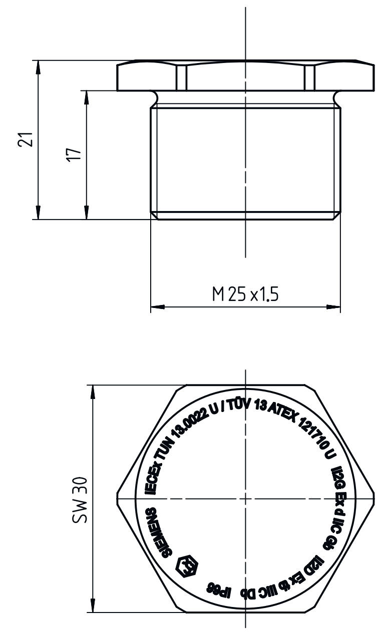
F.3 Technical specifications

Technical specifications sealing plug and thread adapter	
Sealing plug suitable for types of protection	Explosion-proof enclosure "db" of groups IIA, IIB, IIC Dust protection by enclosure "tb"
Standard compliance	The components meet Directive 2014/34/EU. They meet the requirements of standards IEC/EN 60079-0; IEC/EN 60079-1; IEC/EN 60079-31.
Explosion protection	
• Gas explosion protection	II2G Ex db IIC Gb
• Dust explosion protection	II2D Ex tb IIIC Db
Certificates	IECEx TUN 13.0022 U TÜV 13 ATEX 121710 U
Material for sealing plug / thread adapter	Stainless steel
Material for seal	AFM 30
Ambient temperature range	-40 ... +100 °C (-40 ... +212 °F) • For dust protection by enclosure "Ex t": -40 ... +90 °C (-40 ... +194 °F)
For "Ex d" type of protection: Required wall thickness for tappings	10 mm
Tightening torque	
• For thread size M20 x 1.5	40 Nm
• For thread size M25 x 1.5	55 Nm
• For thread size ½-14 NPT	95 Nm
Width A/F for thread size M20 x 1.5	27
Width A/F for thread size M25 x 1.5	30
Key size for thread size ½-14 NPT	10

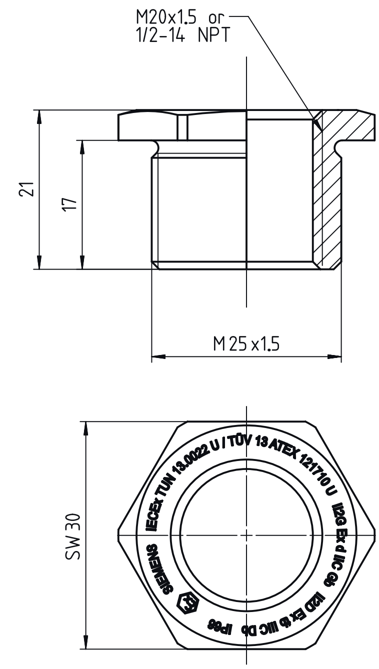
F.4 Dimension drawings



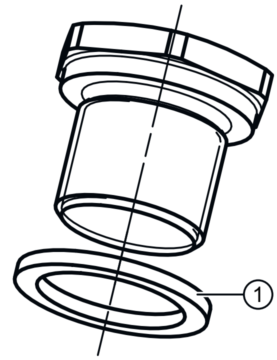
Sealing plug Ex d, M20 x 1.5, dimensions in mm



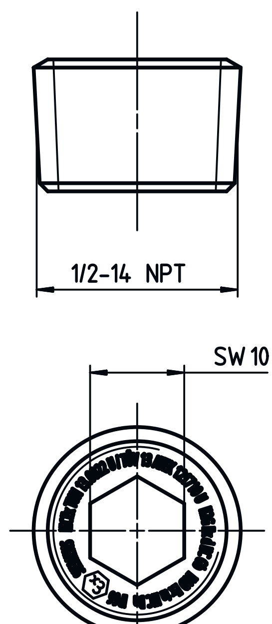
Sealing plug Ex d, M25 x 1.5, dimensions in mm



Thread adapter Ex d, M25 x 1.5 on M20 x 1.5 and M25 x 1.5 on ½-14 NPT, dimensions in mm



① Sealing ring: Use for dust protection "Ex t" type of protection.



Sealing plug Ex d ½ -14 NPT

Booster G

> **CAUTION**
>
> **Increased sound pressure level**
>
> Changes to the sound absorber of the positioner or the mounting of pneumatic components or pneumatic options on the positioner can cause a sound pressure with a level of 80 dBA to be exceeded.
>
> - Wear suitable hearing protection to protect yourself against hearing damage.

G.1 Booster introduction

In order to shorten the travel times, use a booster between the positioner and actuator.

Note

Positioner with booster, double-acting

If the supply pressure PZ fails, the booster changes the failure behavior of the positioner. The position of the valve is random.

The booster has no effect in the event of an electrical power failure.

G.2 Mounting a booster

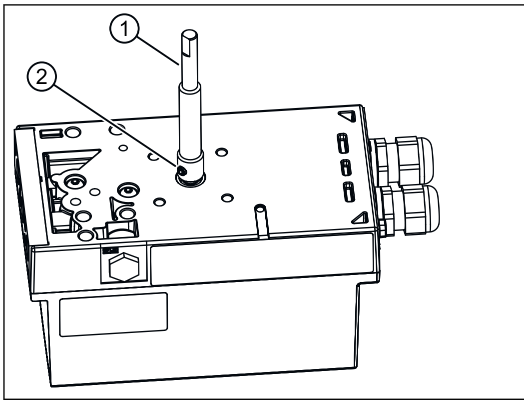
Requirement

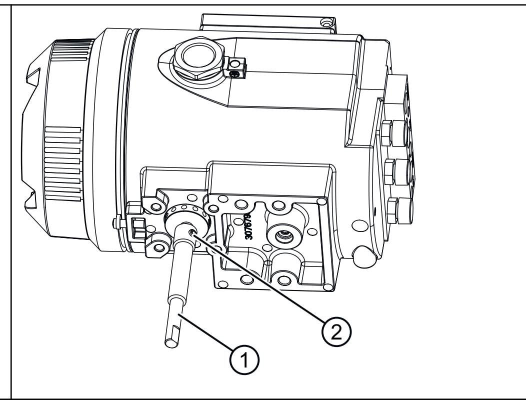
1. You are familiar with the safety instructions in section "Installing and mounting (Page 31)".
2. You have one of the following boosters:
   – With single-acting positioners, booster with the article numbers 6DR4004-1RJ, -1RK, -1RP or -1RQ
   – With double-acting positioners, booster with the article numbers 6DR4004-2RJ, -2RK, -2RP or -2RQ

A. Mount extension shaft and booster

Using the example of a single-acting positioner.

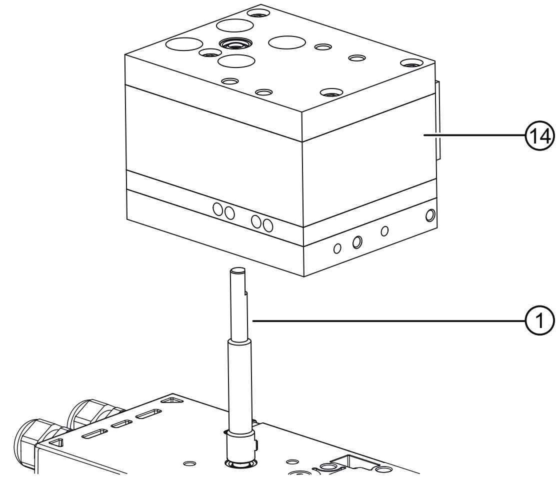
1. Plug the extension shaft ① onto the shaft of the positioner.
2. Tighten the locking screw ② at the flat end of the positioner shaft.
   Picture right: Positioner in flameproof enclosure



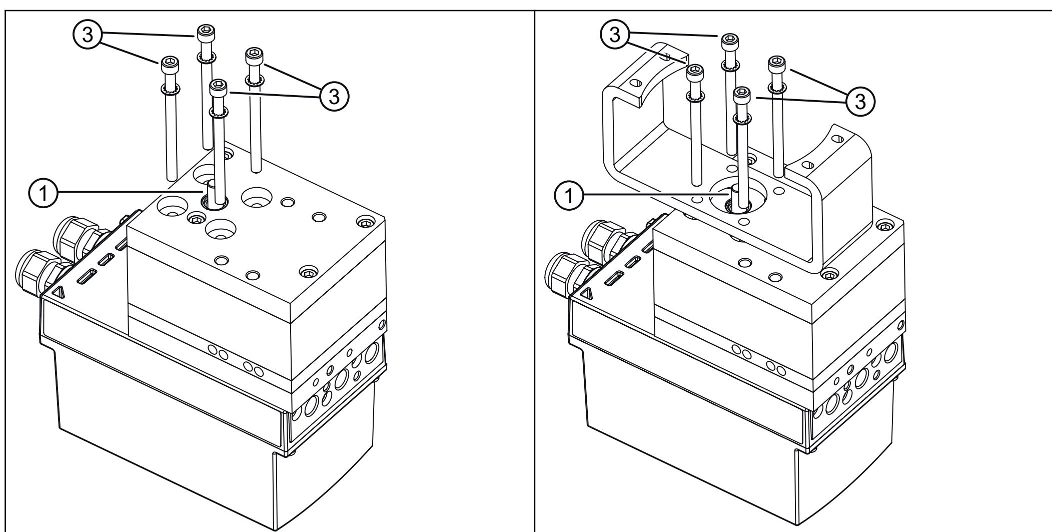


3. Check that the extension shaft ① sits properly.

4. Slide the booster ⑭ over the extension shaft ①.



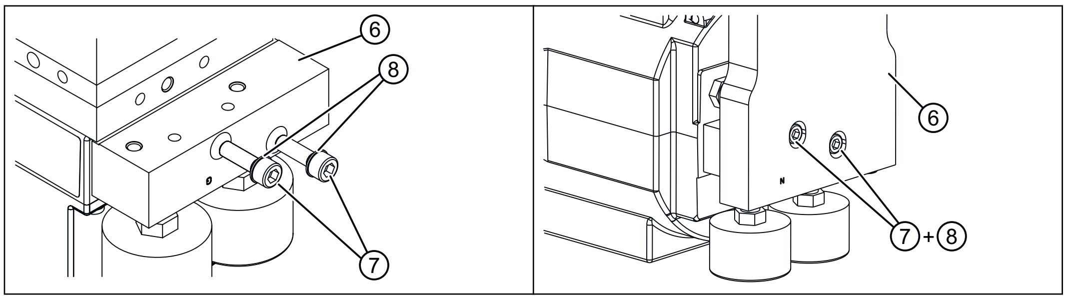
5. Fasten the booster ⑭ to the positioner with the screws ③.
   Picture left: Linear actuator. Use M6 x 85 mm screws ③
   Picture right: Part-turn actuator. Use M6 x 95 mm screws ③



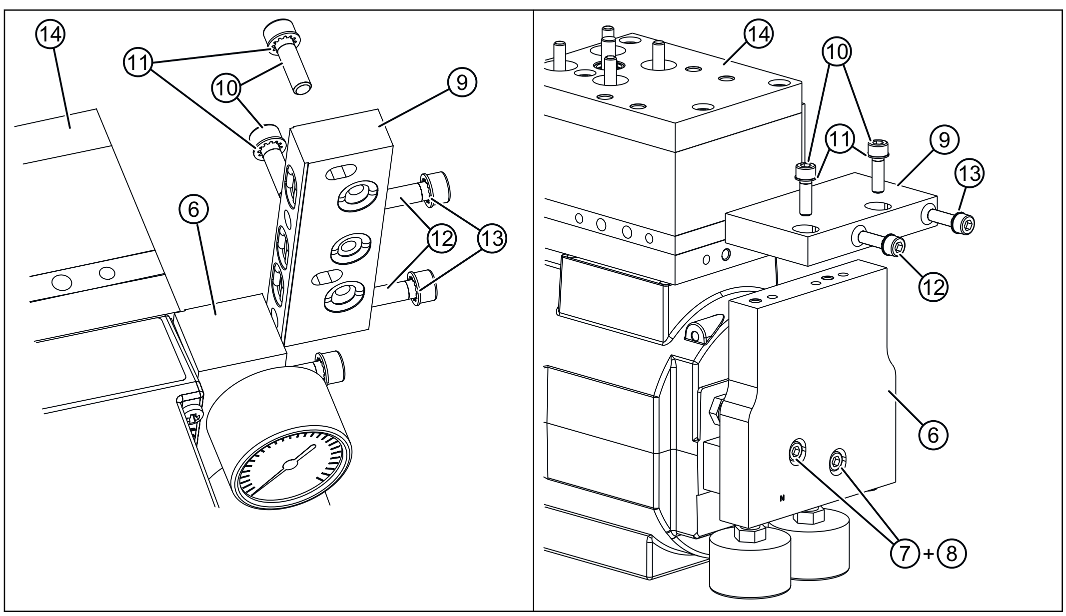
When tightening the screws, ensure that the shaft ① can be turned easily.

B. Mounting the pressure gauge and connection block

1. Check whether the O-rings are in the pressure gauge block. There are two O-rings in the single-acting version. There are three O rings in the double-acting version.
2. Fasten the **pressure gauge block** ⑥ with the screws ⑦ and lock washers ⑧. Position the screws, do **not** tighten them.

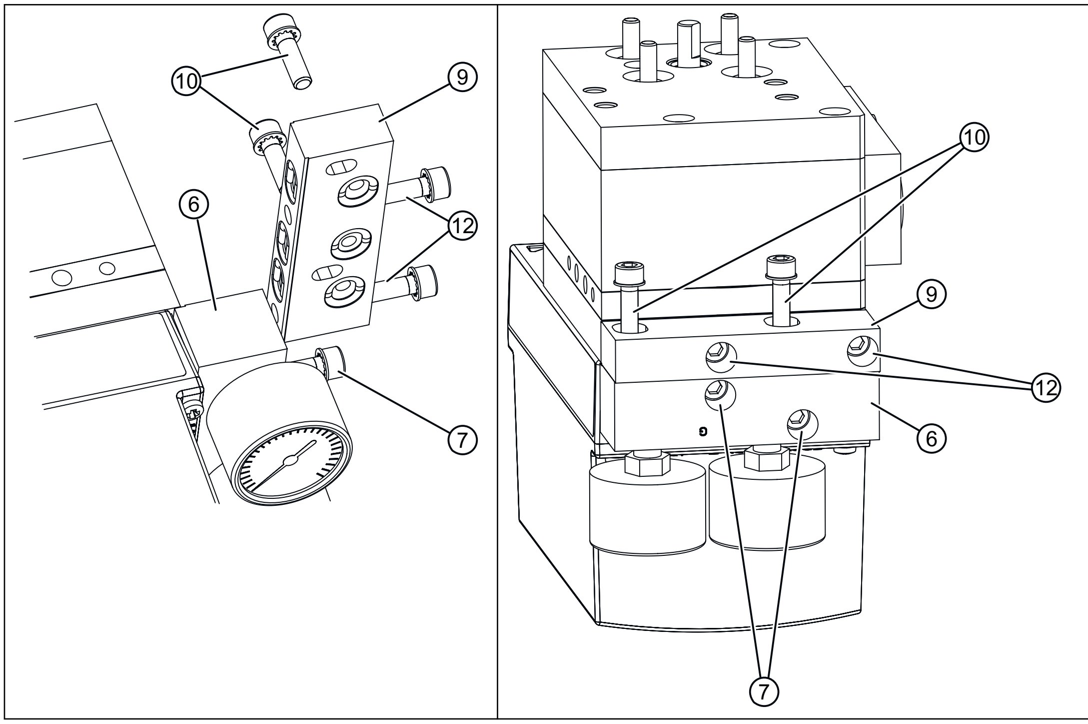


3. Fasten the connection block ⑨ with the screws ⑩, ⑫ and lock washers ⑪, ⑬. Position the screws, do **not** tighten them.



C. Tightening screws

Tighten the screws in the following order.



1. Screws ⑦ which are used to fasten the pressure gauge block ⑥ to the positioner
2. Screws ⑫ which are used to fasten the connection block ⑨ to the booster
3. Screws ⑩ which are used to fasten the connection block ⑨ to the pressure gauge block ⑥
4. Mount the positioner on the actuator as described in:
   - Mounting to linear actuator (Page 34)
   - Mounting to part-turn actuator (Page 41)
5. Use the existing interfaces on the booster.

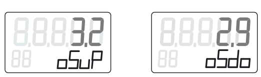
G.3 Booster commissioning

Requirement

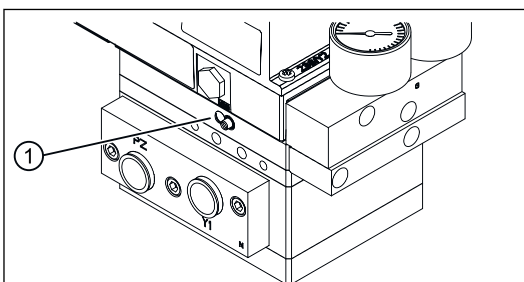
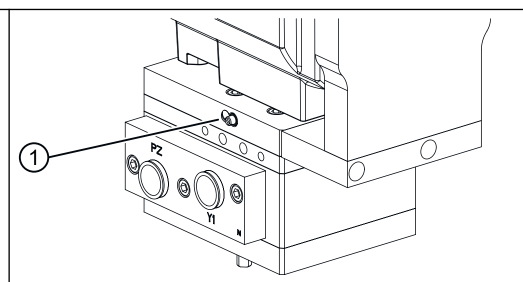
1. You operate the positioner with a booster.
2. '51.PNEUM' Pneumatics type (Page 170) parameter is set to 'booSt'.

Procedure for commissioning the booster

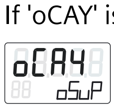
1. Check whether the restrictor(s) on the positioner are completely open. With a new positioner, the restrictors are factory-set to open. The position of the restrictors is shown in the figure in section Device components (Page 27).
2. Set '34.DEBA' Deadband of closed-loop controller (Page 160) to the largest value permissible for your process. The largest value is usually 0.5.
3. Start the automatic initialization process as described under Commissioning (Page 107).
4. With RUN 3, the initialization is stopped for five seconds. During these five seconds, start the function for setting the booster using the △ button.
   A cycle is started which continuously determines the overshoots. The values 'oSuP' and 'oSdo' are shown alternately in the display. 'oSuP' and 'oSdo' represent the values of the overshoot in % of the total stroke.

5. During the automatic initialization, adjust the booster bypass using the adjustment screw on the booster. For single-acting actuators, there is one adjustment screw; there are two adjustment screws for double-acting actuators.

	
① Booster bypass on single-acting positioner	① Booster bypass on single-acting positioner in flameproof enclosure

   If 'oCAY' is shown on the display, the overshoot is less than 3%.

6. Press the △ or ▽ button. The positioner again runs through the initialization step RUN 3, starting with determination of the travel times. The following figure schematically shows the RUN 3 sequence for the booster.
7. 'FINISH' is shown on the display when the initialization has been completed.

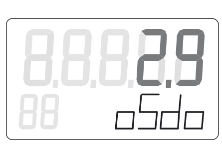
If the process value on the display does not remain stable or if a constant manipulated variable cannot be achieved for a constant setpoint, further optimization of the controller data is necessary. This is described in section Optimization of controller data (Page 102).

See also

Sequence of automatic initialization (Page 110)

G.4 RUN 3: Determination and display of travel time (leakage test)

	The travel time is determined and displayed with "down" (dxx.x) and "up" (Uxx.x). The time between 17% and 83% travel is measured. The result extrapolated for 0% to 100% travel is accepted as the diagnostic values "Travel time" (TUP, TDOWN). Stop with:	
	PNEUM	
	Std / FIP	Start leakage measurement with:
	booSt	Display of the overshoot down (3.2 oSuP), up (2.9 oSdo)

Possible messages		
Display	Meaning	Measures
Std / FIP  	Actuator does not move. The travel time cannot be changed.	Acknowledge message with: Change the travel time using the restrictor screws. Continue with:
booSt  	The overshoot is determined.	Adjust the booster bypass using the adjusting screw on the booster until the display indicates the following:  Continue with:

G.5 Booster dimension drawings

G.5.1 For positioners in non-flameproof enclosure

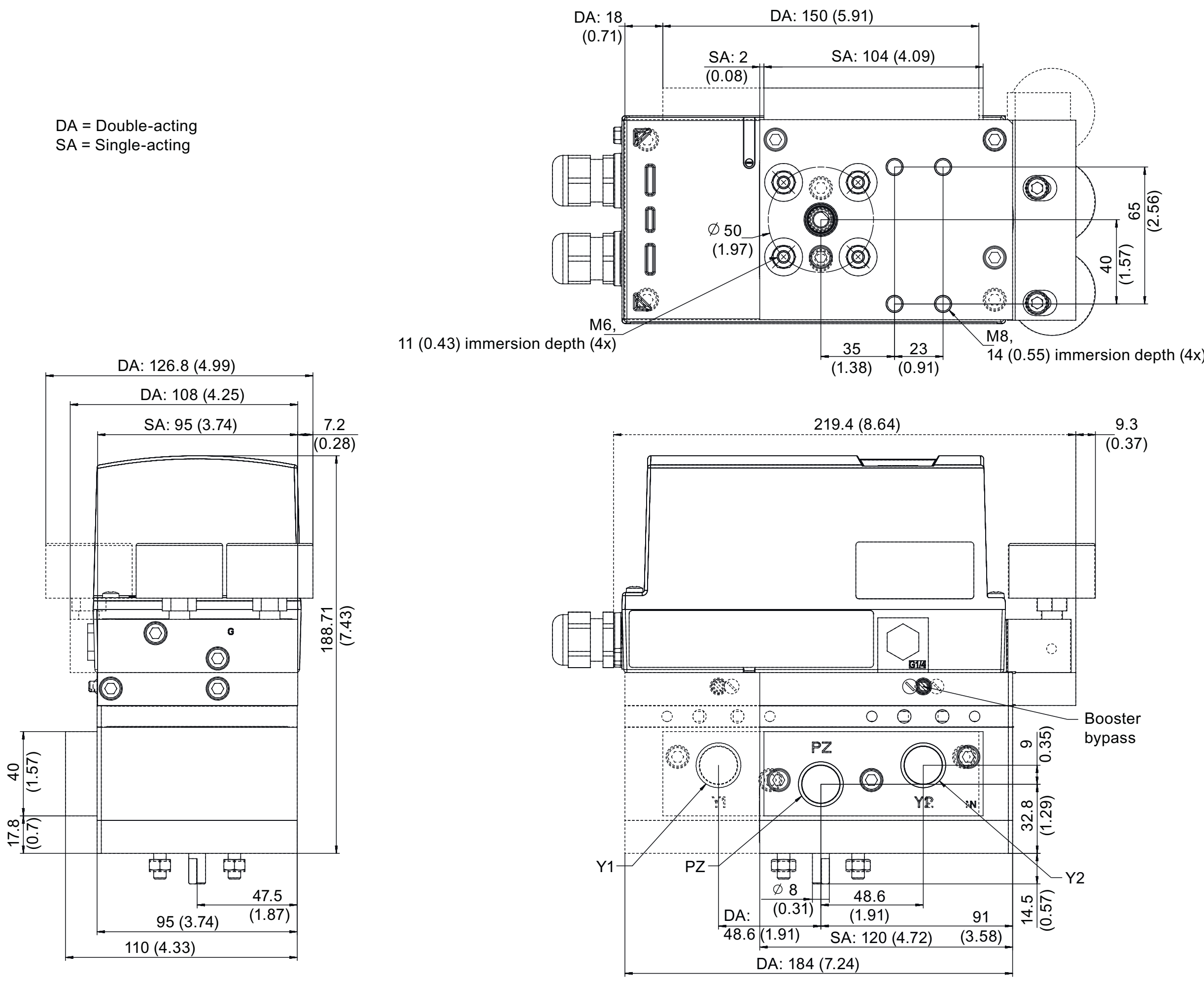


Figure G-1 Dimension drawings booster mounted on positioner, dimensions in mm (inch)

G.5.2 For positioners in flameproof enclosure

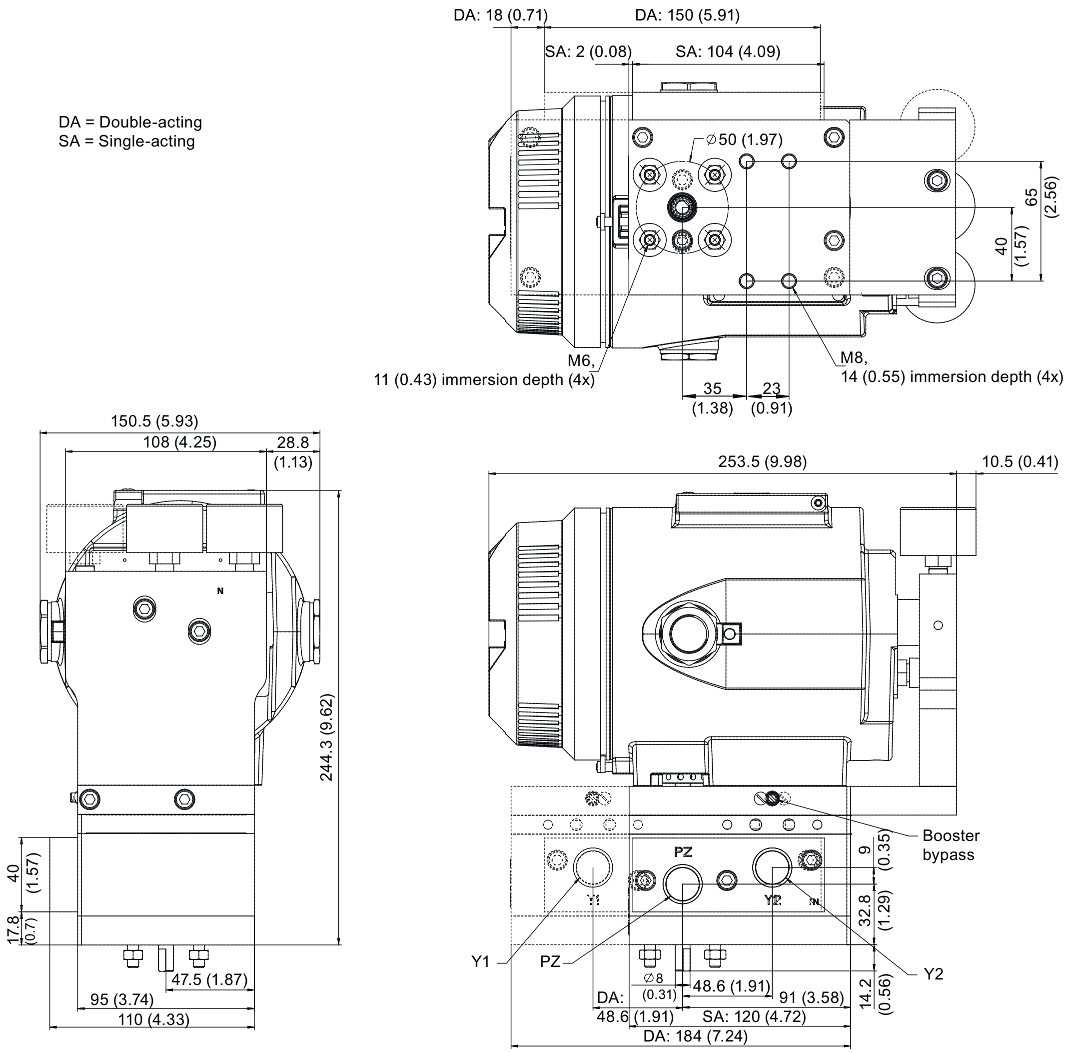


Figure G-2 Dimension drawings booster mounted on positioner in a flameproof enclosure, dimensions in mm (inch)

G.6 Technical specifications of booster

Booster	
Weight booster, single-acting	
• BOOSTER KIT for 6DR5.10 and 6DR5.13	2.9 kg (6.5 lb)
• BOOSTER KIT for 6DR5.15	3.3 kg (7.3 lb)
Weight booster, double-acting	
• BOOSTER KIT for 6DR5.20 and 6DR5.23	4.3 kg (9.4 lb)
• BOOSTER KIT for 6DR5.25	4.7 kg (10.4 lb)
Connections, pneumatic	1/2-14 NPT or G½
Air consumption	1.2 x 10^{-2} Nm^3/h (0.007 scfm)
Pressure gauge	Made of steel IP44. Scaling bar, MPa, psi
Flow capacity	Cv 2.0
Permissible ambient temperature for operation	-30 ... +80 °C (-22 ... +176 °F)

Positioner with remote electronics

H

H.1 Introduction to remote electronics

In some cases it is advisable to use the positioner separately from the electronics. The option of separating the electronics of the positioner is available for this purpose. The positioner is in a different location than the electronics. The remote electronics of the positioner allows the valves to be controlled in radiation environments, since all the highly integrated electronic components are located in an area that is protected from radiation. Highly integrated electronic components are, for example, memory blocks and microprocessor blocks.

For the above described deployment you required the two following components:

- Component 1, consisting of the electronics in the form of a 19-inch control unit. The 19-inch control unit is installed in a control cabinet. Available in the following variants:
  - 19-inch control unit as 4 to 20 mA with 2-wire connection, Article No. A5E00151560
- Component 2 consisting of the positioner without electronics. The positioner without electronics is mounted on the valve.
  - Positioner without electronics with Position Transmitter and pneumatic unit, mounted on the valve, Article No. 6DR5910-0NG00-0AA0
    Positioner without electronics 6DR5910 (Page 312)

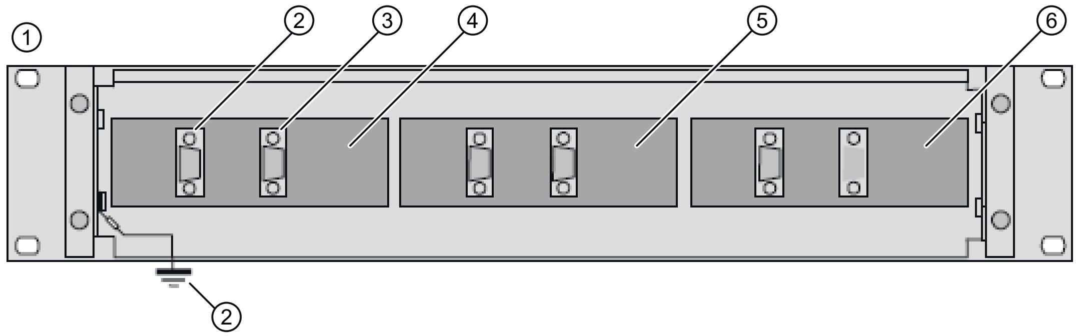
Components 1 and 2 are connected electrically to each other. The components are described below.

H.2 19-inch control unit

H.2.1 Description of 19-inch control unit 4 to 20 mA

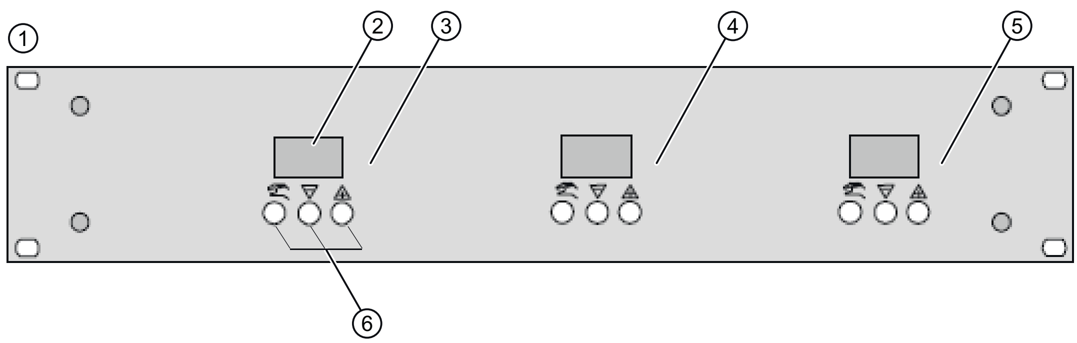
This component comprises the electronics in a 19-inch control unit in 4 to 20 mA version. Commissioning is only possible in conjunction with a positioner component 6DR5910. The 19-inch control unit has three channels and controls up to three valves.

The electronics supplies the current position of the valve in the form of a current of 4 to 20 mA, which corresponds to the position feedback.



①	19-inch control unit 4 to 20 mA	④	Channel 3
②	Sub-D 15-pin socket connector for cable to the valve	⑤	Channel 2
③	Sub-D male connector 9-pin for cable to the control system	⑥	Channel 1

Figure H-1 Device view 19-inch control unit, 4 to 20 mA, rear view



①	19-inch control unit 4 to 20 mA	④	Channel 2
③	Channel 1	⑤	Channel 3
②	Display	⑥	Input keys

Figure H-2 Device view 19-inch control unit, 4 to 20 mA, front view

H.2.2 Connecting the 19-inch control unit 4 to 20 mA

H.2.2.1 Grounding concept for 19-inch control unit 4 to 20 mA

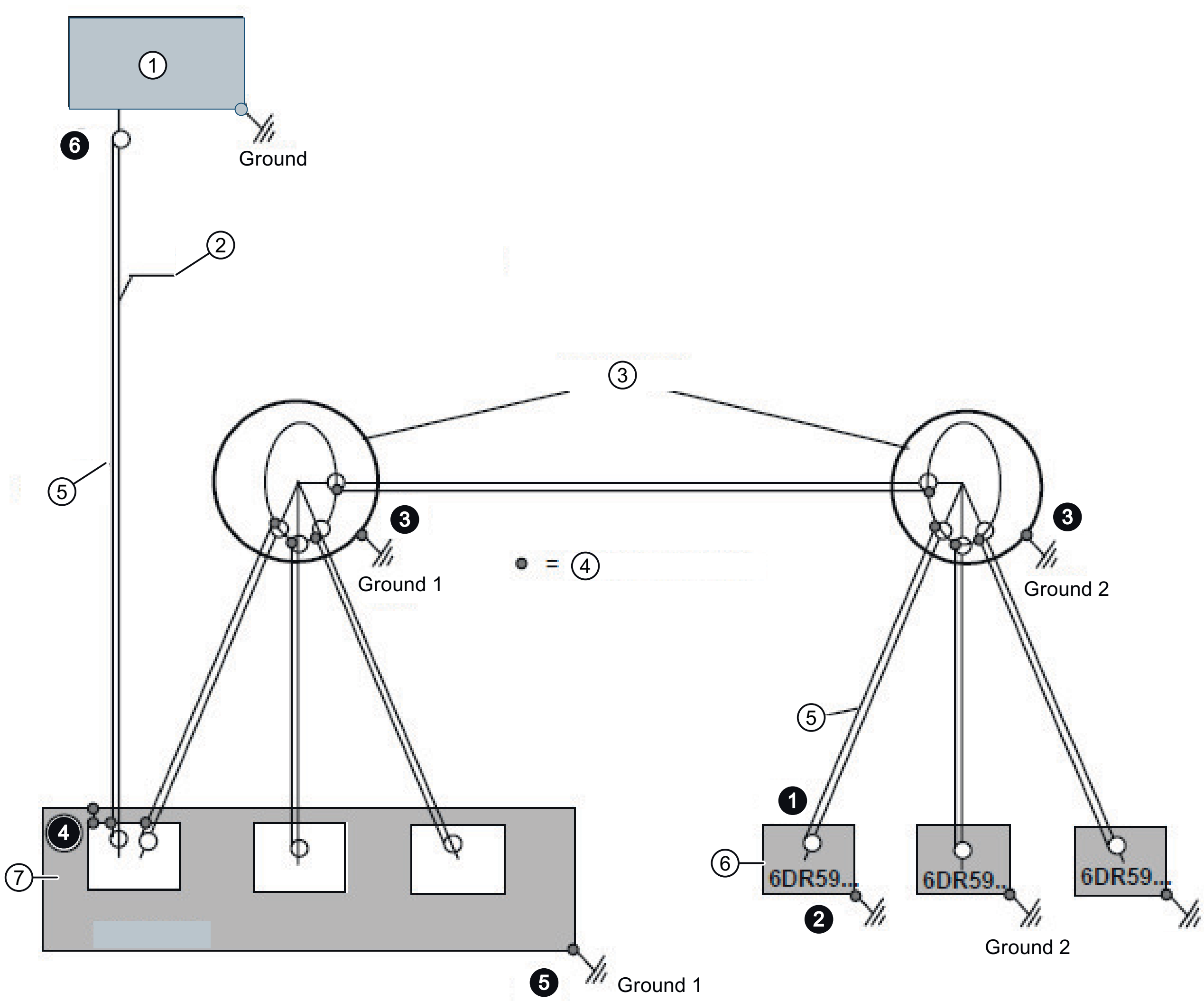
NOTICE
Interference To dissipate interference pulses the positioner components must be connected to an equipotential bonding cable (ground potential) using a low resistance. • Connect the positioner 6DR5910 according to the grounding concept described below.

Note

Properties of the cable

To avoid interference, the cable between the 19-inch control unit, positioners 6DR59.. and field distributors should have the following signal pairs (twisted pair):

- Discharge - / Discharge +
- Supply - / Supply +
- GND / POS
- V_REF GND



①	Control system	⑤	Shield
②	3 x 1 cable to the control system	⑥	Positioner 6DR5910
③	Field distributor	⑦	19-inch control unit
④	Connection point		

Ground

Figure H-3 Grounding concept for 19-inch control unit 4 to 20 mA version

Notes on the individual connection points:

❶ The cable shield is not connected to the positioner 6DR5910.

❷ The positioner 6DR5910 is connected via the mechanical assembly to Ground 2 , see Installing/mounting (Page 31). Section Basic safety instructions (Page 77) describes how to ground the enclosure.

❸ Each field distributor is grounded. The cable shields in the field distributor are not grounded. The cable shields are interconnected.

❹ The cable shields on the 19-inch control unit are connected to the field distributor.

❺ The 19-inch control unit is connected to Ground 1.

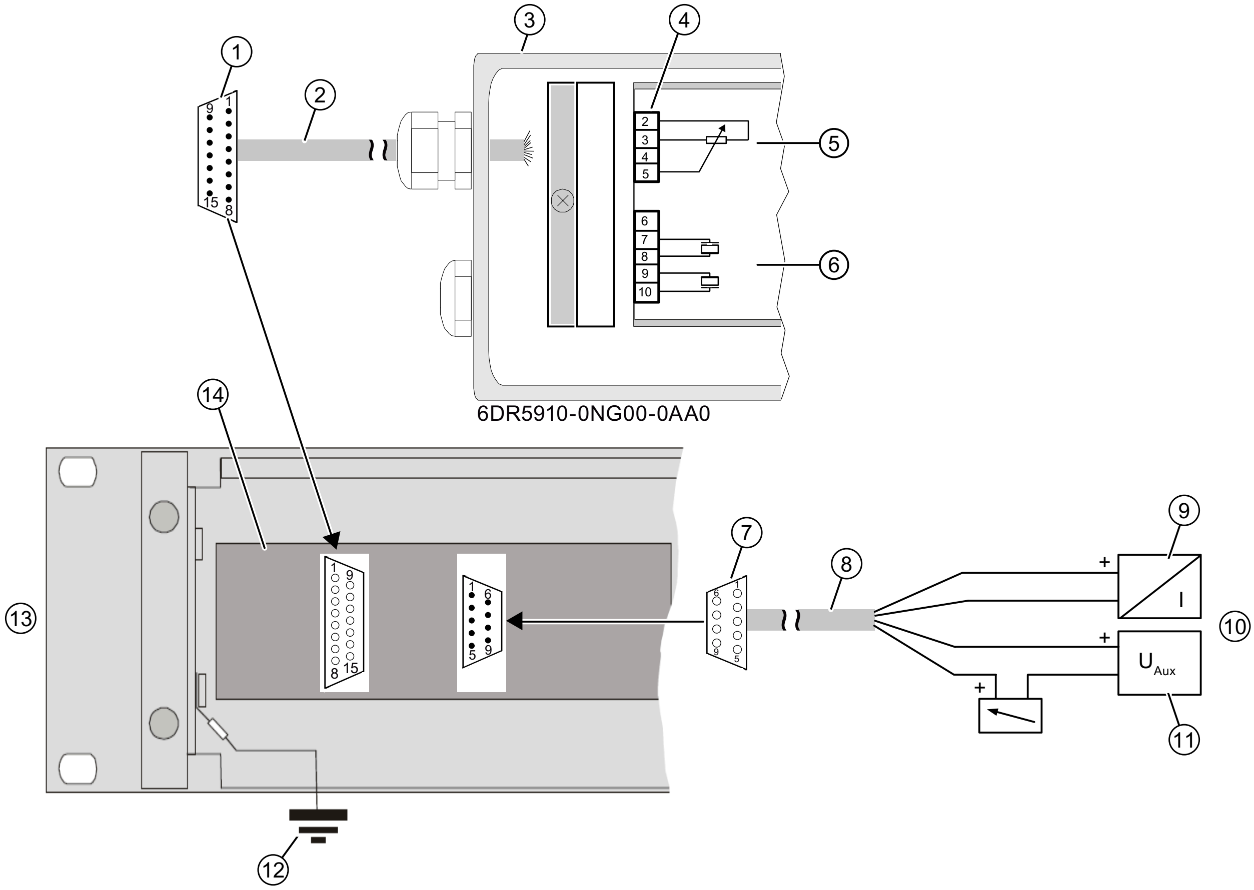
❻ The cable shields on the control system are not connected to ground.

H.2.2.2 Electrical connection of 19" slide-in module 4 to 20 mA

Requirement

You have read sections Connection (Page 77) and Grounding concept for 19-inch control unit 4 to 20 mA (Page 304).

Connecting



①	D-SUB male connector 15-pin	⑧	Cable to control system
②	Cable to the positioner 6DR5910	⑨	Signal source
③	Positioner 6DR59..	⑩	Control system
④	Connecting terminals, positioner	⑪	Auxiliary power supply U_{Aux}
⑤	Signal cables for potentiometer	⑫	Earth potential
⑥	Signal cables of pneumatic block	⑬	Electronics in 19-inch control unit 4 to 20 mA
⑦	D-SUB female connector 9-pin	⑭	Channel 1 of 3

Figure H-4 Connecting electronics electrically

Procedure

Observe the safety instructions for connection in section Basic safety instructions (Page 77).

1. Strip 5 mm of the cable shield on the cable ②.
2. Open the positioner 6DR5910. Unscrew the four fixing screws of the enclosure cover.
3. Insert the prepared cable ② through the cable entry of the positioner.
4. Tighten the cable entry.

5. Connect the wires of the cable ② to the connecting terminals ④ and to the SUB-D male connector ① according to the following table:

Connecting terminals ④ / ⑤	**Assignment**	**Assignment, male connector ①**		**Connecting terminals ④ / ⑥**	**Assignment**	**Assignment, male connector ①**
2	GND	7		6	Not assigned	-
3	Vref	6		7	Discharge +	2
4	not used	-		8	Discharge -	1
5	Vpos	4		9	Supply +	15
				10	Supply -	14

6. Connect the positioner 6DR5910 ③ to the 19-inch control unit ⑬ using the SUB-D male connector ①.
7. Connect the wires of the cable ⑧ to the signal source ⑨ and the power source ⑪ as well as the SUB-D female connector ⑦ according to the following table:

Assignment of female connector ⑦ for ⑨		**Assignment of female connector ⑦ for ⑪**	
1	Signal source +	6	-
2	Signal source -	7	-
3	-	8	U_{Aux}+
4	-	9	U_{Aux}-
5	-		

8. Connect the 19-inch control unit ⑬ to the control system ⑩ using the SUB-D female connector ⑦.

H.2.3 Technical specifications for 19-inch control unit 4 to 20 mA

You can find the valid technical specifications for the positioner in Technical specifications (Page 227). Below are the technical specifications for the 19-inch control unit 4 to 20 mA.

Rated conditions	
Degree of protection	
• Front	IP40 acc. to DIN EN 60529
• Back page	IP20 acc. to DIN EN 60529
Mounting position	Any
Vibration resistance	
• Harmonic oscillations (sine wave) according to DIN EN 60082-2-6/05.96	3.5 mm (0.14"), 5 ... 8.4 Hz, 4 cycles/axle 10 m/s² (33 ft/s²), 8.4 ... 500 Hz, 4 cycles/axle
• Oscillations (sinusoidal) according to DIN EN 60068-2-6/04.96	KWU DD 7080.9/93 KTA 3503 from 11.86
• Shock (half-sine) according to DIN EN 60068-2-27/02.2010	150 m/s² (492 ft/s²), 11 ms, 6 shocks/axle

Construction	
Weight	Approx. 1.8 kg
Material body	19-inch control unit 2 U, aluminum
Number of channels, electronics	3
Climate class	According to IEC/EN 60721-3
• Storage	-25°C to 80°C, 75% at 25°C, without condensation
• Transport	-25°C to 80°C, 75% at 25°C, without condensation
• Operation	0°C to 50°C, 75% at 25°C, without condensation

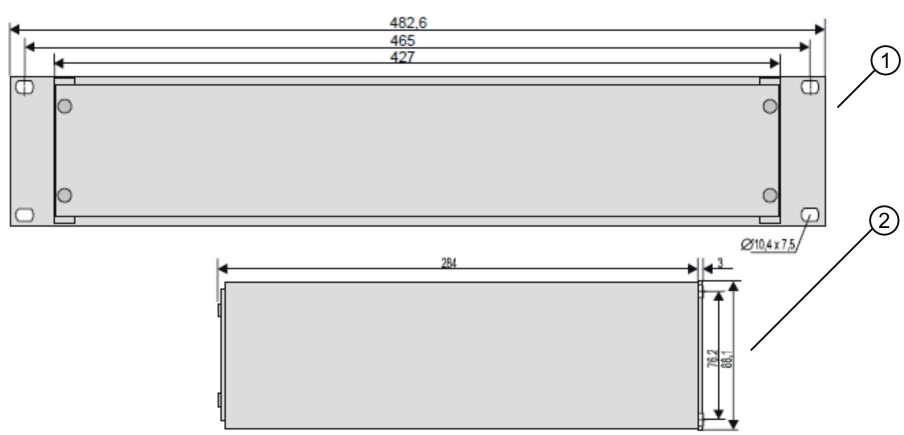
Electrical data	
Electrical connection	9-pin Sub-D plug 15-pin Sub-D female connector
Current input I_W	
• Rated signal range	4 to 20 mA
• Current to maintain the auxiliary power	≥ 3.6 mA
2-wire connection	
• Current to maintain the auxiliary power	≥ 3.6 mA
• Required load voltage U_B (corresponds to Ω at 20 mA)	6.4 V (= 320 Ω)
• Static destruction limit	± 40 mA

Technical specifications for the controller unit is available at Controller for all device versions (Page 231).
Technical specifications of the Analog Output Module (AOM) are available at Analog Output Module (AOM) 6DR4004-6J / -8J (Page 236).

H.2.4 Cable specification

Requirements	**4 to 20 mA**	**PROFIBUS PA**
Properties of the cable	• Shielded • Twisted Pair • Halogen-free	
Cable length	≤ 130 m	≤ 1 000 m
Cross-section	≥ 0.34 mm^2	≥ 0.5 mm^2
Copper resistance	≤ 57.5 Ω/km	≤ 37.5 Ω/km
Capacity wire / wire	≤ 80 nF/km	≤ 75 nF/km
Insulation resistance value	≥ 10 GΩ•cm	≥ 10 GΩ•km
Cables		
• Cable to control system	4 to 9-wire	PROFIBUS cable
• Cable to the positioner 6DR5910	8 to 15-wire	≤ 50-wire
Connection		
• Cable to control system	9-pin Sub-D female connector	Lemo FFP.2S.303.CLAC
• Cable to the positioner 6DR5910	15-pin Sub-D male connector	Burndy Connector 50p

H.2.5 Dimension drawing for 19-inch control unit 4 to 20 mA



① Rear view ② Side view

Figure H-5 19-inch control unit 4 to 20 mA, dimensions in mm

The dimensions of the positioner without electronics 6DR5910 correspond to the dimensions 6DR5..0. You can find these dimensions in the Positioner in non-flameproof enclosure (Page 241) section.

H.3 Positioner without electronics 6DR5910

This component comprises the positioner without electronics (6DR5910). Commissioning is only possible in conjunction with a electronics component in the form of a 19" slide-in module. The positioner without electronics is available in the device version in polycarbonate enclosure, single-acting.

The following section describes how you mount, connect and commission the positioner without electronics.

Installing/mounting

Mounting of this positioner without electronics corresponds to the mounting of the positioner in non-flameproof enclosure. Proceed as described in Section "Installing/mounting (Page 31)".

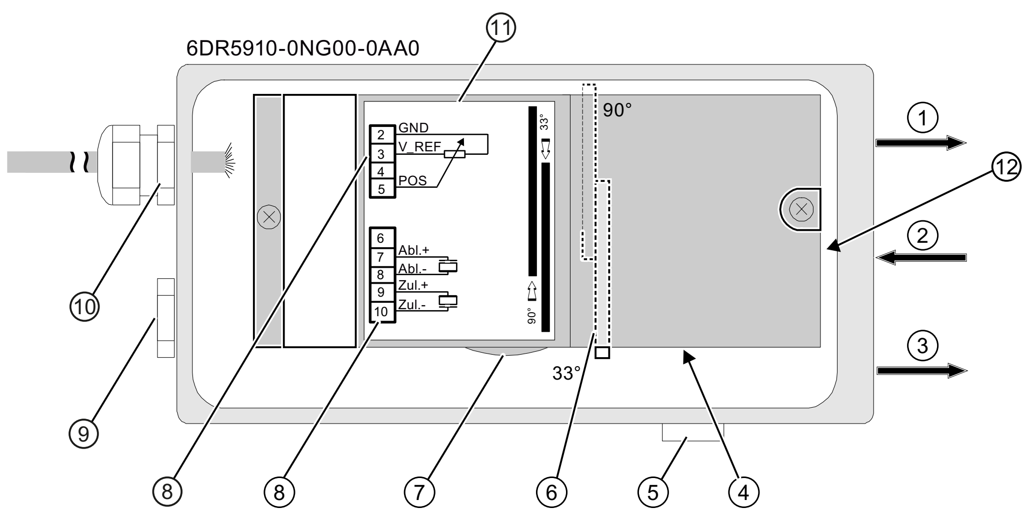
Connecting

Connect the positioner as described in Section "Positioner without electronics 6DR5910 (Page 312)". Please also observe Basic safety instructions (Page 77) for connection.

Commissioning

Commission the positioner as described in Section "Commissioning (Page 107)".

Device view of positioner 6DR5910



①	Output: Actuating pressure Y1	⑦	Friction clutch adjustment wheel
②	Input: Supply pressure PZ	⑧	Connecting terminals, positioner
③	*Output: Actuating pressure Y2 (not for 6DR59..)*	⑨	Blanking plug
④	Restrictor Y1	⑩	Cable gland
⑤	Exhaust air outlet with a sound absorber	⑪	Wiring diagram on module cover
⑥	Transmission ratio selector	⑫	Purging air selector

Abbreviations

I.1 Abbreviations for PS2 positioners

Abbreviation	Long form	Meaning
A/D	Analog-to-digital converter	-
AC	Alternating current	Alternating current
AI	Analog Input	-
AMS	Asset Management Solutions	Communication software from Emerson Process comparable with SIMATIC PDM
AO	Analog Output	-
AUT	Automatic	Operating mode
ATEX	Atmosphère explosible	Product and operation directive of European Commission for explosion protection.
CENELEC	Comité Européen de Normalisation Electrotechnique	Standards organization, responsible for European standardization in the field of electrical engineering.
CPU	Central Processing Unit	Master processor
CSA	Canadian Standard Association	Canadian standards organization
DC	Direct current	Direct current
DI	Digital Input	-
DIN	Deutsche Industrie Norm	-
DO	Digital Output	-
DTM	Device Type Manager	-
EDD	Electronic Device Description	-
Ex	Explosion protection	-
EMC	Electromagnetic compatibility	-
FDT	Field Device Tool	-
FF	FOUNDATION Fieldbus	Fieldbus of the Fieldbus Foundation
FM	Factory Mutual	American testing agency/insurance company
FW	Firmware	Device-specific software
GSD	Device master data	-
HART®	Highway Addressable Remote Transducer	Communication system for the development of industrial field busses.
IEC	International Electrotechnical Commission	International standards organization for standards in electrical engineering and electronics.
IP	International Protection Ingress Protection	International degrees of protection (long form as per DIN) Seepage protection (long form as used in US)
ISO	International Organization for Standardization	
LC	Liquid Crystal	Liquid crystal
MAN	Manual	Operating mode

Abbreviation	Long form	Meaning
NAMUR	Standards working group for measurement and control technology in the chemicals industry	Association of users in process conductor technology
µC	Microcontroller	One-Chip computer system
NCS	Non-Contacting Sensor	Sensor for non-contacting position detection
NEMA	National Electrical Manufacturers Association	US standards institution National Electrical Manufacturers Association
NPT	National Pipe Thread Taper	Pipe threading for self-sealing threads as per ANSI B.1.20.1
OPOS interface®	Open Positioner Interface	Standard interface for the connection between a positioner and a pneumatic linear or part-turn actuator
PA	Process Automation	Process automation
PDM	Process Device Manager	Siemens communication software / Engineering tool
PROFIBUS	Process Field Bus	Fieldbus
RSS feed	Rich Site Summary Feed	Shows changes in regular intervals to web sites you are subscribed to.
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik e. V.	Industrial and professional association
VDI	Verein Deutscher Ingenieure e. V.	Technical/scientific association

I.2 Abbreviations

Abbreviation	Full term in English	Meaning
FIT	Failure in Time	Frequency of failure Number of faults within 10^9 hours
HFT	Hardware Fault Tolerance	Hardware fault tolerance: Capability of a function unit to continue executing a required function in the presence of faults or deviations.
MooN	"M out of N" voting	Classification and description of the safety-instrumented system in terms of redundancy and the selection procedures used. A safety-instrumented system or part that consists of "N" independent channels. The channels are connected to each other in such a way that "M" channels are in each case sufficient for the device to perform the safety instrumented function. Example: Pressure measurement: 1oo2 architecture. A safety-instrumented system decides that a specified pressure limit has been exceeded if one out of two pressure sensors reaches this limit. In a 1oo1 architecture, there is only one pressure sensor.
MTBF	Mean Time Between Failures	Average period between two failures
MTTR	Mean Time To Restoration	Average period between the occurrence of a fault in a device or system and restoration of functionality
PFD	Probability of Dangerous Failure on Demand	Probability of dangerous failures of a safety function on demand
PFD_{AVG}	Average Probability of Dangerous Failure on Demand	Average probability of dangerous failures of a safety function on demand

Abbreviation	Full term in English	Meaning
SFF	Safe Failure Fraction	Proportion of safe failures: Proportion of failures without the potential to bring the safety-instrumented system into a dangerous or non-permissible functional status.
SIL	Safety Integrity Level	The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL 1 to SIL 4). Each level corresponds to a range of probability for failure of a safety function. The higher the Safety Integrity Level of the safety-instrumented system, the lower the probability that it will not execute the required safety functions.
SIS	Safety Instrumented System	A safety-instrumented system (SIS) executes the safety functions that are required to achieve or maintain a safe status in a system. It consists of sensors, logic unit/control system and final controlling elements.

Index

A

Actuating pressure
  Figure, 90
  Position, 27, 92
Alarm module
  see Digital I/O Module (DIO), 84
Amplifier, (See booster)
Analog Input Module (AIM)
  Retrofitting, 261
Analog Output Module
  Installation, 52
Analog Output Module (AOM), 84
Article number
  on the nameplate, 26

B

Basic electronics
  See Electronics, 27
Blanking plug
  Position, 27
Bluetooth
  Default password, 253
Bluetooth adapter
  SITRANS AW050, 248
Booster, 293

C

Cable gland
  Technical specifications, 230
Carrier pin, 118, 121, 124, 126
Catalog
  catalog sheets, 246
Certificates, 19, 246
characteristics
  Safety, 194
Cleaning, 198
Commissioning
  Automatically, 118, 123, 128, 132
  Cancel, 136
  Interrupting, 118, 123
  Manual, 120, 125, 129, 134
Compressed air, 32
Connecting
  Inductive Limit Switches (ILS), 85
  NCS sensor, 268
  Pressure sensor module, 81
Connection
  Pneumatic, 90, 115
Construction
  Technical specifications, 229, 230
Control system, 191
Customer Support, (Refer to Technical support)

D

Dead angle function, 161
Diagnostics
  Extended, 172
Diagnostics mode, 174
Digital I/O Module (DIO), 84, 88
  Installation, 50
Display
  Position, 27
Disposal, 207
Documentation
  Edition, 13
Downloads, 246
Dynamic variables, 187

E

Electronics
  Position, 27
EMC filter module
  See Analog Input Module (AIM), 88
Explosion protection, 231
Extended diagnostics, 172
External position detection system
  See Position Transmitter, 88

F

Factory setting
  Reset to ~, 118, 123, 128, 132
Fast closing, 163
Final controlling element, 191
Forget user PIN, 254
Freezing
  Exhaust air outlet, 33, 190
Friction clutch
  Set, 116

G

Gear latch, 75

H

HART
    Modem, 29
HART module, 29
HART variables, 187
Hazardous area
    Laws and directives, 19
    Qualified personnel, 22
History, 13
Hotline, (Refer to Support request)

I

I/Os
    Technical specifications, 230
iNCS
    Installation, 281
Inductive Limit Switches (ILS)
    Connecting, 85
Initialization
    Automatically, 110
    Cancel, 136
    Interrupting, 128, 132
Installation
    Analog Output Module, 52
    Digital I/O Module (DIO), 50
    Mechanic Limit Switches (MLS), 54
Insulating cover, 281
Internal NCS module
    Commissioning, 122
    Installation, 74, 281
Iy module, (See Analog Output Module (AOM))

L

Laws and directives
    Disassembly, 19
    Personel, 19
Linear actuator
    Add-on extensions, 23
    Automatic commissioning, 118, 123
    Automatic commissioning (flowchart), 111
    Manual commissioning, 120, 125
    Pneumatic connection, integrated, 90
    Single-acting, 24

M

Maintenance, 197
Manifold, 115
Manometer
    Mounting, 285
    Technical specifications, 230
Manuals, 246
Material
    Technical specifications, 229
Material adapter
    Technical specifications, 257
Mechanic Limit Switches (MLS), 109
    Installation, 54
Mechanical construction
    Technical specifications, 257
Mechanical limit switch module
    See Mechanic Limit Switches (MLS), 54, 109
Modifications
    correct usage, 21
    improper, 21
Mounting console
    Dimensions, 45
Mounting kit
    Linear actuator, 34

N

Natural gas, 234
    Operation, 109
NCS
    Installation, 74
NCS module
    Internal, 74
NCS sensor
    Connecting to Analog Input Module (AIM), 268

O

Operation
    Natural gas, 109

P

Part-turn actuator
    Automatic commissioning, 128, 132
    Automatic commissioning (flowchart), 111

Double-acting, 24
For mounting, 42
Manual commissioning, 129, 134
Password
Reset, 253
Pneumatic actuator, 28
Pneumatic block
Purging air selector, 115
Replacing, 202
Pneumatic connections, 115
Position feedback module
see Analog Output Module (AOM), 84
Positioner
Replacing, 138
Pressure gauge block, 24
Tightening torque, 230
Pressure sensor module
Connecting, 81
Purging air selector, 115

Q

Qualified personnel, 22

R

Reading initialization parameters, 138
Return procedure, 206

S

Safety position, 92
Scope of delivery, 16
Screen
Cleaning of~, 198
Sealing plug
Technical specifications, 290
Service, 245
Service and support
Internet, 245
Settings, 193
SIA module
See Inductive Limit Switches (ILS), 53, 85
SIL 2, 191
Single-channel operation, 191
SITRANS AW050
Bluetooth adapter, 248
Slot initiator, (See Inductive Limit Switches (ILS))
Supply air PZ, 194
Supply pressure
Position, 27
Support, 245
Support request, 245
System pressure, (See Supply air)

T

Technical support, 245
partner, 245
personal contact, 245
Test certificates, 19
Threaded adapter
Technical specifications, 290
Tight closing, 163
Tightening torque, 229, 257, 290
Transmission ratio selector, 75
Transmitter, 191

V

Valve block, (see Pneumatic block)
Venting gauge block, 286
Version
Technical specifications, 229

W

Warranty, 18
Weight
Technical specifications, 229
Wiring diagram
Position, 27

Y

Y1, 194