USER MANUAL FOR
PILOT-OPERATED
PROPORTIONAL VALVES
WITH INTEGRATED DIGITAL ELECTRONICS
D94xK SERIES

PROPORTIONAL VALVES FOR ELECTROHYDRAULIC POSITION, SPEED, PRESSURE AND FORCE CONTROL EVEN FOR HIGH DYNAMIC REQUIREMENTS
# Table of Contents

Index of Tables .......................................................................................................................... viii  
Index of figures .......................................................................................................................... x  

1 General Information ................................................................................................................... 1  
1.1 Notes on user manual ................................................................................................................. 1  
1.1.1 Subject to change without notice and validity ................................................................. 1  
1.1.2 Completeness ....................................................................................................................... 2  
1.1.3 Storage location ..................................................................................................................... 2  
1.1.4 Typographical conventions ................................................................................................ 3  
1.1.5 Structure of the warning notes ............................................................................................ 4  
1.2 Supplemental documents ........................................................................................................... 5  
1.3 Intended operation ..................................................................................................................... 5  
1.4 Selection and qualification of personnel .................................................................................... 7  
1.5 Structural modifications ............................................................................................................. 8  
1.6 Environmental protection ........................................................................................................ 9  
1.6.1 Acoustic Emissions .............................................................................................................. 9  
1.6.2 Disposal ............................................................................................................................. 9  
1.7 Responsibilities ....................................................................................................................... 10  
1.8 Warranty and liability .............................................................................................................. 11  
1.9 Declaration of conformity ....................................................................................................... 12  
1.10 Registered marks and trademarks ......................................................................................... 13  

2 Safety ........................................................................................................................................ 14  
2.1 Handling in accordance with safety requirements .................................................................. 14  
2.2 Occupational safety and health .............................................................................................. 15  
2.3 General safety instructions .................................................................................................... 16  
2.4 ESD ..................................................................................................................................... 16  
2.5 Pressure limitation ................................................................................................................. 16  

3 Product Description .................................................................................................................. 17  
3.1 Function and mode of operation ............................................................................................... 17  
3.1.1 Operational modes ............................................................................................................. 17  
3.1.2 Pilot pressure ...................................................................................................................... 18  
3.1.3 Representative depiction of the valve ................................................................................. 19  
3.1.4 Permanent magnet linear force motor .............................................................................. 21  
3.1.5 Valve electronics and valve software ............................................................................... 22  
3.1.5.1 Valve status ................................................................................................................... 23  
3.1.6 Signal interfaces ............................................................................................................... 24  
3.1.6.1 Connector X1 ............................................................................................................... 25  
3.1.6.2 Fieldbus connectors X3 and X4 .................................................................................. 25  
3.1.6.3 Service connector X10 ............................................................................................... 26  

3.2 Safety function/fail-safe .......................................................................................................... 27  
3.2.1 Mechanical fail-safe function ............................................................................................ 28  
3.2.1.1 Valves with fail-safe functions F, D and M ......................................................... 28  
3.2.1.2 Valves with fail-safe functions H and K ................................................................... 29  
3.2.1.3 Mechanical fail-safe state ....................................................................................... 29  
3.2.1.4 Fail-safe identification ............................................................................................. 29  
3.2.1.5 Spool identification ................................................................................................. 29  
3.2.2 Electrical fail-safe function .............................................................................................. 30
# Table of Contents

## 3.3 Hydraulics ................................................................. 34

- 3.3.1 Operational modes ............................................ 34
  - 3.3.1.1 Flow control (Q-control) .......................... 35
  - 3.3.1.2 Pressure control (p-control) ................. 36
  - 3.3.1.3 Flow and pressure control (pq-control) ... 37
- 3.3.2 Valve configurations and hydraulic symbols .......... 38
  - 3.3.2.1 2-way and 2/2-way operation ................. 38
  - 3.3.2.2 4-way and 3-way operation .................... 39
  - 3.3.2.3 5-way operation ................................. 40
- 3.3.3 Control type ports X and Y ................................ 41
  - 3.3.3.1 Pilot pressure port X ................................ 41
  - 3.3.3.2 Leakage port Y ........................................ 41
  - 3.3.3.3 Pilot identification .................................... 41
- 3.3.4 Electrical and hydraulic zero positions ............... 42
- 3.3.5 Notes on the pressure controller control response ... 42

## 3.4 Control ........................................................................... 43

- 3.4.1 Signal types for set-point and actual value .......... 44
  - 3.4.1.1 Signal type identification ......................... 45
  - 3.4.1.2 Flow control command inputs .................. 46
  - 3.4.1.3 Pressure control command inputs ............. 49
- 3.4.2 Analog actual value output ............................... 52
- 3.4.3 Digital enable input ......................................... 52

## 3.5 Configuration software .............................................. 53

## 3.6 Moog Valve and Pump Configuration Software .......... 54

## 3.7 Nameplate ................................................................. 54

## 4 Characteristic curves ..................................................... 55

- 4.1 Flow diagram (4-way operation) ......................... 55
- 4.2 Flow signal characteristic curve .......................... 57
- 4.3 Pressure signal characteristic curves .................... 58
  - 4.3.1 Valves with controlled spool position ............ 58
  - 4.3.2 Pressure control valves ............................... 58

## 5 Transportation and Storage ........................................ 59

- 5.1 Checking/unpacking a delivery ............................. 61
- 5.2 Scope of delivery of the valve .................. 61
- 5.3 Storage ............................................................... 62

## 6 Mounting and Connection to the Hydraulic System ...... 63

- 6.1 Dimensions (installation drawings) ....................... 64
- 6.2 Mounting surface .................................................... 64
  - 6.2.1 Surface quality ............................................ 64
  - 6.2.2 Holes in mounting surface ......................... 64
- 6.3 Mounting the valve .................................................. 65
  - 6.3.1 Tools and materials required ....................... 65
  - 6.3.2 Specification for installation screws for the valves . 65
  - 6.3.3 Procedure .................................................. 66
7 Electrical connection ................................................................. 68
  7.1 Safety instructions for installation and maintenance ...................... 68
    7.1.1 Protective grounding and electrical shielding .......................... 70
    7.1.2 Moog Valve and Pump Configuration Software ..................... 71
  7.2 Block diagram ......................................................................... 73
  7.3 Arrangement of connectors ...................................................... 74
  7.4 Connector X1 .......................................................................... 76
    7.4.1 Pin assignment of connector X1 ........................................... 76
    7.4.2 Mating connector for connector X1 ....................................... 76
    7.4.3 Power supply ...................................................................... 77
  7.5 Analog inputs/outputs ............................................................... 77
    7.5.1 Analog inputs ...................................................................... 77
      7.5.1.1 Signal types .................................................................... 78
    7.5.2 Analog outputs ..................................................................... 80
  7.6 Digital inputs/outputs .............................................................. 81
    7.6.1 Digital input ........................................................................ 81
    7.6.2 Digital outputs ..................................................................... 81
  7.7 Digital signal interface ............................................................. 82
    7.7.1 SSI transducer ..................................................................... 82
      7.7.1.1 Pin assignment SSI transducer connector X2 .................. 83
  7.8 Field bus connectors X3 and X4 ................................................ 84
    7.8.1 CAN connectors ................................................................ 84
      7.8.1.1 Technical data for the CAN bus interface ....................... 84
      7.8.1.2 Pin assignment, CAN connectors .................................... 85
    7.8.2 Profibus-DP connectors ....................................................... 85
      7.8.2.1 Technical data for the Profibus-DP interface ................. 86
      7.8.2.2 Pin assignment, Profibus-DP connectors ....................... 86
    7.8.3 EtherCAT connectors .......................................................... 87
      7.8.3.1 Technical data for the EtherCAT interface ..................... 87
      7.8.3.2 Pin assignment, EtherCAT connectors ......................... 88
  7.9 Analog input connectors X5, X6 and X7 ..................................... 89
    7.9.1 Pin assignment, analog input connectors X5, X6 and X7 .......... 89
    7.9.2 Signal types ........................................................................ 90
    7.9.3 Input resistances .................................................................. 91
  7.10 Service connector X10 ............................................................. 92
  7.11 General notes on wiring ......................................................... 94
    7.11.1 Tools and materials required .............................................. 94
    7.11.2 Procedure ......................................................................... 95
    7.11.3 Wiring of supply lines, evaluation of digital and analog signals .. 95
  7.12 Protective grounding, equipotential bonding, and shielding .......... 96
    7.12.1 Overview ........................................................................ 96
    7.12.2 Equipotential bonding and protective grounding ............... 97
      7.12.2.1 General principles ....................................................... 98
      7.12.2.2 Protective conductor ................................................... 98
      7.12.2.3 Ground loops ............................................................. 99
    7.12.3 Machines with deficient equipotential bonding .................. 100
    7.12.4 Electrical shielding .......................................................... 100
      7.12.4.1 Cables .................................................................... 100
      7.12.4.2 Connecting the shield ................................................. 101
      7.12.4.3 Insulated shielding ..................................................... 103
      7.12.4.4 Cable routing ......................................................... 104
Table of Contents

7.13 Permissible lengths for connection cables ................................................................. 104
  7.13.1 Introduction ........................................................................................................... 104
  7.13.2 Typical values for copper cables ......................................................................... 104
    7.13.2.1 Resistance of cable ..................................................................................... 104
    7.13.2.2 Capacitance of cable .................................................................................. 105
  7.13.3 24V supply cables ............................................................................................... 105
    7.13.3.1 Voltage drop per unit length ....................................................................... 106
    7.13.3.2 Examples of the voltage drop of supply cables ........................................交易平台
  7.13.4 Analog signal cables ............................................................................................. 107
  7.13.5 Digital signal cables ............................................................................................. 108
    7.13.5.1 Digital signal input cables .......................................................................... 108
    7.13.5.2 Digital signal output cables ......................................................................... 108
    7.13.5.3 Field bus cables ........................................................................................ 108

7.14 Wiring connector X1 ................................................................................................. 108
  7.14.1 Single-ended command signals ......................................................................... 109
  7.14.2 Conversion of actual value output signals \( I_{out} \) ....................................................... 110
    7.14.2.1 Valves with 7-pin connector X1 .................................................................. 110

7.15 Wiring SSI transducers (X2) .................................................................................. 111
  7.15.1 SSI master mode .................................................................................................. 111

7.16 Wiring CAN networks .............................................................................................. 112
  7.16.1 Cable lengths and cable cross sections ............................................................... 115
    7.16.1.1 Suitable cable types for CAN networks ....................................................... 115
  7.16.2 Permissible number of CAN bus nodes .............................................................. 116
  7.16.3 CAN module address (node ID) .......................................................................... 116
  7.16.4 CAN transmission rate ....................................................................................... 116

7.17 Wiring Profibus-DP networks (X3, X4) ................................................................. 117
  7.17.1 Cable lengths and cable cross sections ............................................................... 118
    7.17.1.1 Suitable cable types for Profibus-DP networks ............................................. 119
  7.17.2 Permissible number of Profibus nodes .............................................................. 119
  7.17.3 Profibus-DP module address (node ID) .............................................................. 119
  7.17.4 Profibus-DP transmission rate ............................................................................. 119

7.18 Wiring EtherCAT networks (X3, X4) .................................................................. 120
  7.18.1 Suitable cable types for EtherCAT networks .................................................... 121
  7.18.2 Permissible number of EtherCAT nodes ............................................................ 122
  7.18.3 EtherCAT module address (node ID) ................................................................. 122
  7.18.4 EtherCAT transmission rate ................................................................................ 122

7.19 Wiring analog inputs (X5, X6, X7) ...................................................................... 123

7.20 Electrical start-up ................................................................................................. 125

7.21 Electromagnetic compatibility (EMC) ................................................................. 126

7.22 Communication via the Moog Valve and Pump Configuration Software ....... 127

8 Start-up ..................................................................................................................... 129
  8.1 Preparations ............................................................................................................. 133
  8.2 Start-up of the valves ............................................................................................. 134
  8.3 Configuration of the valves .................................................................................... 135
    8.3.1 Configuration via the fieldbus interface ............................................................ 135
      8.3.1.1 Configuration with the machine controller ............................................... 135
      8.3.1.2 Configuration with the Moog Valve and Pump Configuration Software .... 136
  8.3.2 Configuration via the service interface .............................................................. 136
  8.3.3 Factory setting of the valves ............................................................................. 138
  8.3.4 Storing of parameters ....................................................................................... 138
  8.4 Filling and flushing the hydraulic system ............................................................. 139
Table of Contents

8.5 Start-up of the hydraulic system ................................................................. 140
  8.5.1 Venting .................................................................................................. 140
    8.5.1.1 Tool required ................................................................................. 141
    8.5.1.2 Venting the valve and the actuator ............................................. 141

9 Operation ........................................................................................................... 142
  9.1 Preparations for operation ........................................................................ 145
  9.2 Operation of the valve ............................................................................... 146
  9.3 Shutting down the valve ............................................................................ 147

10 Service ............................................................................................................. 149
  10.1 Removing of the valves ............................................................................ 153
    10.1.1 Tools and materials required ......................................................... 153
    10.1.2 Removing ....................................................................................... 154
  10.2 Maintenance ............................................................................................. 155
    10.2.1 Checking and replacing the port O-rings ....................................... 155
    10.2.1.1 Tools and materials required ..................................................... 155
    10.2.1.2 checking and replacing the O-rings .......................................... 155
    10.2.2 Monitoring the pressure transducer drift ........................................ 156
  10.3 Troubleshooting ....................................................................................... 156
    10.3.1 Leaks ............................................................................................... 157
      10.3.1.1 Leak at the valve connecting surface ....................................... 157
      10.3.1.2 Leak at the linear force motor screw plug ............................... 157
      10.3.1.3 Leak at the venting screw....................................................... 157
    10.3.2 No hydraulic response by the valve ............................................... 158
    10.3.3 Instability of the external control loop ........................................... 158
    10.3.4 Instability of the internal valve control loops ................................. 159
      10.3.4.1 Flow control ............................................................................ 159
      10.3.4.2 Pressure control ..................................................................... 159
  10.4 Repair ....................................................................................................... 160

11 Technical Data .............................................................................................. 162
  11.1 Nameplates .............................................................................................. 164
    11.1.1 Model number and type designation ............................................. 166
    11.1.2 LSS address .................................................................................... 173
    11.1.3 Data matrix code ........................................................................... 173
  11.2 Electromagnetic compatibility (EMC) ..................................................... 173
  11.3 Technical data D941K – ISO 4401-05/NG10 .......................................... 174
    11.3.1 Mounting surface ......................................................................... 175
      11.3.1.1 Mounting pattern of mounting surface .................................... 175
    11.3.2 Data D941K with direct-operated pilot valve D633K .................. 176
  11.4 Technical data D942K – ISO 4401-07/NG16 .......................................... 185
    11.4.1 Mounting surface ......................................................................... 186
      11.4.1.1 Mounting pattern of mounting surface ................................. 186
    11.4.2 Data D942K with direct-operated pilot valve D633K ................. 187
  11.5 Technical data D943K – ISO 4401-08/NG25 .......................................... 196
    11.5.1 Mounting surface ......................................................................... 197
      11.5.1.1 Mounting pattern of mounting surface .................................... 197
    11.5.2 Data D943K with direct-operated pilot valve D633K ................. 198
  11.6 Technical data D944K – ISO 4401-08/NG25 .......................................... 207
    11.6.1 Mounting surface ......................................................................... 208
      11.6.1.1 Mounting pattern of mounting surface .................................... 208
    11.6.2 Data D944K with direct-operated pilot valve D633K ................. 209
Index of Tables

Tab. 1: Identification, D94xK type series ........................................................................................................... 5
Tab. 2: Operational modes of the valves .............................................................................................................. 17
Tab. 3: Valve status .................................................................................................................................................. 23
Tab. 4: Existing signal interfaces ........................................................................................................................ 24
Tab. 5: Fail-safe events .......................................................................................................................................... 30
Tab. 6: Benefits of the different signal types for analog command inputs .............................................................. 44
Tab. 7: Signal types command value and spool position signal in the type designation ........................................... 45
Tab. 8: Specification for installation screws for the valves ..................................................................................... 65
Tab. 9: Allocation of interfaces to connectors ....................................................................................................... 75
Tab. 10: Technical data for the CAN bus interface .................................................................................................. 84
Tab. 11: Technical data for the Profibus-DP interface ............................................................................................ 86
Tab. 12: Technical data for the EtherCAT interface ............................................................................................... 87
Tab. 13: Input resistances X5, X6, X7 ....................................................................................................................... 91
Tab. 14: Benefits of the different signal types for analog inputs ............................................................................. 95
Tab. 15: Examples of the voltage drop of supply cables as a function of the cable length for a cable cross section of 0.75 m² ........................................................................................................................................ 106
Tab. 16: Recommendation for maximum cable lengths in CAN networks, depending on the transmission rate ................................................................................................................................................... 115
Tab. 17: Recommendation for maximum cable lengths in CAN networks, depending on the cable cross section and the number n of CAN bus nodes .................................................................................. 115
Tab. 18: Maximum permissible stub cable lengths in CAN networks ........................................................................... 115
Tab. 19: Specification of electrical data for CAN bus cables ................................................................................ 115
Tab. 20: Suitable cable types for CAN networks ........................................................................................................ 115
Tab. 21: Recommendation for maximum cable lengths in Profibus-DP networks, depending on the transmission rate ................................................................................................................................................... 118
Tab. 22: Specification of electrical data for Profibus-DP cables (as per type A) ........................................................................................................................................ 119
Tab. 23: Suitable cable types for Profibus-DP networks ............................................................................................. 119
Tab. 24: Assignment of Ethernet/EtherCAT signals with mixed connector types ...................................................... 121
Tab. 25: Overview of technical data for the series and variants ............................................................................. 162
Tab. 26: Spool type in the type designation ............................................................................................................. 166
Tab. 27: Rated flow variant in the type designation .................................................................................................. 167
Tab. 28: Pressure range identification in the type designation ....................................................................................... 167
Tab. 29: Spool variant in the type designation ........................................................................................................... 168
Tab. 30: Pilot valve variant in the type designation .................................................................................................... 168
Tab. 31: Spool position in case of failure, D94xK with pilot valve D633K ................................................................ 169
Tab. 32: Variant of pilot pressure and leakage port in the type designation ............................................................... 170
Tab. 33: Seal material variant in the type designation .............................................................................................. 170
Tab. 34: Variant of the valve connector X1 in the type designation ........................................................................ 170
| Tab. 35: Signal types command value and spool position signal in the type designation | 171 |
| Tab. 36: Variant of the fieldbus connector X3 and X4 in the type designation | 172 |
| Tab. 37: Technical data D941K with direct-operated pilot valve D633K | 176 |
| Tab. 38: Technical data D942K with direct-operated pilot valve D633K | 187 |
| Tab. 39: Technical data D943K with direct-operated pilot valve D633K | 198 |
| Tab. 40: Technical data D944K with direct-operated pilot valve D633K | 209 |
| Tab. 41: Technical data D945K with direct-operated pilot valve D633K | 220 |
| Tab. 42: Accessories and tools for all proportional valves in the D94xK type series | 232 |
| Tab. 43: Tools for valves in the D94xK type series | 234 |
| Tab. 44: Spare parts and accessories in the D941K type series with direct-operated pilot valve D633K | 234 |
| Tab. 45: Spare parts and accessories in the D942K type series with direct-operated pilot valve D633K | 235 |
| Tab. 46: Spare parts and accessories in the D943K and D944K type series with direct-operated pilot valve D633K | 235 |
| Tab. 47: Spare parts and accessories in the D945K type series with direct-operated pilot valve D633K | 236 |
| Tab. 48: Abbreviations, symbols and identification letters | 254 |
Index of figures

Fig. 1: Representative depiction of a two-stage proportional valve with directly-operated pilot valve D633K.............................................................................................................. 19
Fig. 2: Representative depiction of the permanent magnet linear motor (D633K)................................................................................................................................................... 21
Fig. 3: Flow control (Q-control) block diagram......................................................................................................................... 35
Fig. 4: Pressure control (p-control) block diagram................................................................................................................................. 36
Fig. 5: Flow and pressure control (pQ-control) block diagram........................................................................................................ 37
Fig. 6: 5-way operation with mechanical fail-safe function F (hydraulic symbol)............................................................................... 40
Fig. 7: Examples of the electrical and hydraulic zero positions of different spools in the flow signal characteristic curve .......................................................... 42
Fig. 8: Floating flow control command input ±10 V (circuit and characteristic curve).................................................................................. 46
Fig. 9: Floating flow control command input ±10 mA (circuit and characteristic curve)................................................................. 46
Fig. 10: Floating flow control command input 4–20 mA (circuit and characteristic curve)...................................................................... 47
Fig. 11: Differential flow control command input 0–10 V (circuit and characteristic curve)................................................................. 49
Fig. 12: Differential flow control command input 0–10 mA (circuit and characteristic curve).............................................................. 50
Fig. 13: Differential flow control command input 4–20 mA (circuit and characteristic curve).............................................................. 51
Fig. 14: Flow diagram (4-way operation) D941K to D945K........................................................................................................ 55
Fig. 15: Flow signal characteristic curve with equal electrical and hydraulic zero positions................................................................. 57
Fig. 16: Design for measuring the flow signal characteristic curve................................................................................................. 57
Fig. 17: Valve D941K, flow-signal characteristic................................................................................................................................. 58
Fig. 18: Pressure signal characteristic curve of the valves with controlled spool position and zero lap ................................................................................................................................. 58
Fig. 19: Design for measuring the pressure signal characteristic curve on valves with a controlled spool position (example: D941K) ................................................................................................. 58
Fig. 20: Pressure characteristic curve of the pressure control valves ................................................................................................. 58
Fig. 21: Design for measuring the pressure signal characteristic curve on pressure control valves (example: D941K)................................................................................................. 58
Fig. 22: Block diagram of the valve electronics ................................................................................................................................. 73
Fig. 23: Arrangement of connectors on the valve electronics housing (maximum equipment specification) ................................................................. 74
Fig. 24: Pin assignment connector X1 (7-pin) p/Q valves ................................................................................................................................. 76
Fig. 25: SSI transducer connector X2 ......................................................................................................................................................... 83
Fig. 26: CAN connectors X3 and X4......................................................................................................................................................... 85
Fig. 27: Profibus DP connectors X3 and X4......................................................................................................................................................... 86
Fig. 28: EtherCAT connectors X3 and X4......................................................................................................................................................... 88
Fig. 29: Analog input connectors X5, X6 and X7......................................................................................................................................................... 89
Fig. 30: Equivalent circuit diagram of analog input ......................................................................................................................................................... 91
Fig. 31: Service connector X10 (M8, 3-pin) ......................................................................................................................................................... 92
Fig. 32: Equipotential bonding and protective grounding of machines (see also EN 60204-1) and electrical shielding of our valves with integrated electronics ......................................................................................................................................................... 97
Index of figures

Fig. 33: Connecting the shield to the control cabinet's wall (detail A from Fig. 32) ................................. 101
Fig. 34: Connecting the cable shield via connector to the control cabinet's wall (detail A from Fig. 32) .................................................................................................................................................. 102
Fig. 35: Connecting the insulated shielding to the control cabinet's wall (detail A from Fig. 32) .......... 103
Fig. 36: Voltage drop on the supply cable ............................................................................................................. 106
Fig. 37: Wiring of the 7-pin connector X1 pQ valve .............................................................................................. 108
Fig. 38: Circuit for single-ended command signals .................................................................................................... 109
Fig. 39: Conversion of actual value output signals I_{out} ........................................................................................ 110
Fig. 40: Wiring diagram with SSI transducer ......................................................................................................... 111
Fig. 41: Signals between valve and a 16-bit SSI transducer (example) ................................................................. 111
Fig. 42: CAN wiring diagram ...................................................................................................................................... 113
Fig. 43: Connection of the CAN bus valve with terminal resistor ........................................................................ 113
Fig. 44: Connection of the valve to a PC via the CAN bus interface (field bus connector X3) ..................... 114
Fig. 45: Profibus-DP wiring diagram ..................................................................................................................... 118
Fig. 46: Connection valve Profibus with terminal resistor .................................................................................... 118
Fig. 47: EtherCAT wiring diagram .......................................................................................................................... 121
Fig. 48: Twisted-pair litz wires in Ethernet/EtherCAT cables with M12 connectors ...................................... 121
Fig. 49: Connecting a 2-wire transducer to analog input connectors X5, X6 or X7 .......................................... 124
Fig. 50: Connecting a 3-wire transducer to analog input connectors X5, X6 or X7 .......................................... 124
Fig. 51: Connecting a 4-wire transducer to analog input connectors X5, X6 or X7 .......................................... 124
Fig. 52: Connection of the valve to a PC via the service interface (service connector X10) ...................... 137
Fig. 53: MOOG Global Support Logo .................................................................................................................... 160
Fig. 54: Ex nameplate (example) .......................................................................................................................... 164
Fig. 55: Ex nameplate (example) .......................................................................................................................... 165
Fig. 56: Hole pattern in the mounting surface for the D941K type series (dimensions in mm) .................... 175
Fig. 57: Installation drawing for D941K (dimensions in mm) ................................................................................. 178
Fig. 58: Installation drawing for D941K (dimensions in mm) ................................................................................. 180
Fig. 59: D941K valves, flow-signal characteristics ................................................................................................. 182
Fig. 60: Step response for D941K valves, standard ............................................................................................... 183
Fig. 61: Frequency response for D941K valves, standard ........................................................................................ 183
Fig. 62: Step response for D941K valves, trimmed ................................................................................................. 184
Fig. 63: Frequency response for D941K valves, trimmed ...................................................................................... 184
Fig. 64: Hole pattern in the mounting surface for the D942K type series (dimensions in mm) .................... 186
Fig. 65: Installation drawing for D942K (dimensions in mm) ................................................................................. 189
Fig. 66: Installation drawing for D942K (dimensions in mm) ................................................................................. 191
Fig. 67: D942K valves, flow-signal characteristics ................................................................................................. 193
Fig. 68: Step response for D942K valves, standard ............................................................................................... 194
Fig. 69: Frequency response for D942K valves, standard .................................................................................... 194
Fig. 70: Step response for D942K valves, trimmed ............................................................................................... 195
Index of figures

Fig. 71: Frequency response for D942K valves, trimmed ................................................................. 195
Fig. 72: Hole pattern in the mounting surface for the D943K type series (dimensions in mm) ........ 197
Fig. 73: Installation drawing for D943K (dimensions in mm) .......................................................... 200
Fig. 74: Installation drawing for D943K (dimensions in mm) .......................................................... 202
Fig. 75: D943K valves, flow-signal characteristics .......................................................................... 204
Fig. 76: Step response for D943K valves, standard ......................................................................... 205
Fig. 77: Frequency response for D943K valves, standard ............................................................... 205
Fig. 78: Step response for D943K valves, offset .............................................................................. 206
Fig. 79: Frequency response for D943K valves, offset .................................................................. 206
Fig. 80: Hole pattern in the mounting surface for the D944K type series (dimensions in mm) ...... 208
Fig. 81: Installation drawing for D944K (dimensions in mm) ........................................................... 211
Fig. 82: Installation drawing for D944K (dimensions in mm) ........................................................... 213
Fig. 83: D944K valves, flow-signal characteristics .......................................................................... 215
Fig. 84: Step response for D944K valves, standard ....................................................................... 216
Fig. 85: Frequency response for D944K valves, standard .............................................................. 216
Fig. 86: Step response for D944K valves, trimmed .......................................................................... 217
Fig. 87: Frequency response for D944K valves, trimmed ............................................................... 217
Fig. 88: Hole pattern in the mounting surface for the D945K type series (dimensions in mm) ...... 219
Fig. 89: Installation drawing for D945K (dimensions in mm) ........................................................... 222
Fig. 90: Installation drawing for D945K (dimensions in mm) ........................................................... 224
Fig. 91: D945K valves, flow-signal characteristics, 1,000 l/min ...................................................... 226
Fig. 92: D945K valves, flow-signal characteristics, 1,500 l/min ...................................................... 227
Fig. 93: Step response for D945K valves, standard, stub shaft spool K10 ......................................... 228
Fig. 94: Frequency response for D945K valves, standard, stub shaft spool K10 ............................... 228
Fig. 95: Step response for D945K valves, trimmed, stub shaft spool K10 .......................................... 229
Fig. 96: Frequency response for D945K valves, trimmed, stub shaft spool K10 ............................... 229
Fig. 97: Step response for D945K valves, standard, stub shaft spool K15 ......................................... 230
Fig. 98: Frequency response for D945K valves, standard, stub shaft spool K15 ............................... 230
Fig. 99: Step response for D945K valves, trimmed, stub shaft spool K15 .......................................... 231
Fig. 100: Frequency response for D945K valves, trimmed, stub shaft spool K15 .............................. 231
1 General Information

1.1 Notes on user manual

This user manual refers exclusively to the standard models of the valves of the Type series D941K to D945K. It includes the most important notes in order to operate these valves properly and safely.

- Chap. "1.3 Intended operation", page 5
- Chap. "2.1 Handling in accordance with safety requirements", page 14

Special models of the valves custom-made for specific customers, such as for example valves with axis control function (ACV), are not explained in this user manual. Please contact Moog or one of its authorized service centers for information on these special models.

The contents of this user manual and the product-related hardware and software documentation relevant to the particular application must be read, understood and followed in all points by each person responsible for machine planning, assembly and operation before work with and on the valves is started. This requirement applies in particular to the safety instructions.

- Chap. "1.1.2 Completeness", page 2
- Chap. "1.4 Selection and qualification of personnel", page 7
- Chap. "1.7 Responsibilities", page 10
- Chap. "2.1 Handling in accordance with safety requirements", page 14

This user manual has been prepared with great care in compliance with the relevant regulations, state-of-the-art technology and our many years of knowledge and experience, and the full contents have been generated to the best of the authors' knowledge. However, the possibility of error remains and improvements are possible. Please feel free to submit any comments about possible errors and incomplete information to us.

- This user manual is also available in German.
- On request, translation into other languages is possible.

1.1.1 Subject to change without notice and validity

The information contained in this user manual is valid and correct at the moment of release of this version of the user manual. The version number and release date of this user manual are indicated in the footer. Changes may be made to this user manual at any time and without notice.
1.1.2 Completeness
This user manual is only complete in conjunction with the product-related hardware and software documentation required for the relevant application.
Available documentation:
a Chap. "1.2 Supplemental documents", page 5

1.1.3 Storage location
This user manual together with all the product-related hardware and software documentation relevant to the application concerned must at all times be kept close at hand to the valve or the higher-level machine.
1.1.4 Typographical conventions

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DANGER</strong></td>
<td>Warns about an imminent danger to health and life. Failure to observe this warning can cause severe injuries or even death. Make absolutely sure to heed the measures described to prevent this danger.</td>
</tr>
<tr>
<td><strong>WARNING</strong></td>
<td>Warns about a possible situation dangerous to health. Failure to observe this warning can cause severe injuries or even death. Make absolutely sure to heed the measures described to prevent this danger.</td>
</tr>
<tr>
<td><strong>CAUTION</strong></td>
<td>Warns about a possible situation dangerous to health. Failure to observe this warning can cause slight injuries. Make absolutely sure to heed the measures described to prevent this danger.</td>
</tr>
</tbody>
</table>

**Identifies important notes that contain usage tips and special useful information, but no warnings.**

- **or -** Identifies listings
- ▶ Indicates an action to be taken
- ⇔ Identifies references to another chapter, another table or figure
- "..." Denotes headings to the chapters or titles of the documents to which reference is being made
- **Blue text** Identifies hyperlinks
- 1., 2., ... Identifies steps in a procedure that must be performed in consecutive order
- '...' Identifies parameters for valve software (e.g.: 'Node ID') or the valve status (e.g.: 'ACTIVE')
1.1.5 Structure of the warning notes

In the present user manual, danger symbols draw attention to remaining dangers in the handling of valves that cannot be constructively avoided. The actions for avoiding danger described must be adhered to. The warning notes used are structured as follows:

### SIGNAL WORD

<table>
<thead>
<tr>
<th>Type of danger</th>
<th>Consequences</th>
<th>Prevention</th>
</tr>
</thead>
</table>

- **Warning symbol:** draws attention to the danger
- **Signal word:** indicates the severity of the danger
  - Meaning of the signal words:
    a Chap. "1.1.4 Typographical conventions", page 3
- **Type of danger:** names the type and source of danger
- **Consequences:** describes the consequences in case of non-observance
- **Prevention:** specifies the actions to prevent this danger.
1.2 Supplemental documents

The supplementary documents are not included in the valve scope of delivery. They are available as an accessory.

*Chap. "12 Accessories, Spare Parts, and Tools", page 232

The PDF files of the supplemental documents can be downloaded from the following link:

http://www.moog.com/industrial/literature

1.3 Intended operation

The valves may only be operated as a component part of a higher-level overall system, for example in a machine.

They may be used only as control elements to control flow and/or pressure in hydraulic circuits that regulate position, speed, pressure and power.

The valves are intended for use with mineral-oil-based hydraulic oils. Use with other media requires our prior approval.

Correct, reliable and safe operation of the valves requires qualified project planning as well as proper utilization, transportation, storage, mounting, removal, electric and hydraulic connection, start-up, configuration, operation, cleaning and maintenance.

<table>
<thead>
<tr>
<th>II 2G Ex d e IIC TX Gb</th>
<th>Temperature environment</th>
<th>Temperature hydraulic fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sealing material: FKM</td>
<td>T4 -20 °C 60 °C</td>
<td>-20 °C 80 °C</td>
</tr>
<tr>
<td></td>
<td>T5 -20 °C 55 °C</td>
<td>-20 °C 55 °C</td>
</tr>
<tr>
<td></td>
<td>T6 -20 °C 45 °C</td>
<td>-20 °C 45 °C</td>
</tr>
<tr>
<td>Sealing material: HNBR</td>
<td>T4 -20 °C 60 °C</td>
<td>-20 °C 75 °C</td>
</tr>
<tr>
<td></td>
<td>T5 -20 °C 55 °C</td>
<td>-20 °C 55 °C</td>
</tr>
<tr>
<td></td>
<td>T6 -20 °C 45 °C</td>
<td>-20 °C 45 °C</td>
</tr>
<tr>
<td>Sealing material: T-ECOPUR</td>
<td>T6 -40 °C 35 °C</td>
<td>-40 °C 35 °C</td>
</tr>
<tr>
<td>Temperature range down to -40 °C on request</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tab. 1: Identification, D94xK type series
The valves may only be started up when the following is ensured:

- The higher-level machine with all its installed components complies with the latest versions of the relevant national and international regulations, standards, and guidelines (such as, the EU Machinery Directive, ATEX directive, and the regulations of the trade association, TÜV, and VDE).

- The valves and all the other installed components are in a technically fault-free and operationally reliable state.

- No signals that can lead to uncontrolled motions in the machine are transmitted to the valves.

Intended operation also includes the following:

- Observation of this user manual

- Handling of the valves in accordance with safety requirements
  a Chap. "2.1 Handling in accordance with safety requirements", page 14

- Adherence to all the inspection and maintenance instructions of the manufacturer and the operator of the machine

- Observation of all product-related hardware and software documentation relevant to the particular application

- Observation of all safety standards of the manufacturer and the operator of the machine relevant to the application concerned

- Observation of all the latest versions of the national and international regulations, standards, and guidelines relevant to the application concerned (for example, the EU Machinery Directive, the ATEX directive, and the regulations of the trade association, TÜV, and VDE)
1.4 Selection and qualification of personnel

**CAUTION**

Danger of personal injury and damage to property!
Working with and on the valves without the required basic mechanical, hydraulic, and electrical knowledge may cause injuries or parts may be damaged.

- Only properly qualified and authorized users may work with and on the valves.
- a Chap. "1.4 Selection and qualification of personnel", page 7

Maintenance work by the user on explosion proof valves is not permitted. Intervention by third parties will invalidate the ex certification.

Qualified users are specialized personnel with the required knowledge and experience who have been trained to carry out such work. The specialized personnel must be able to recognize and avert the dangers to which they are exposed when working with and on the valves. In particular, these specialized personnel must be authorized to operate, earth/ground and mark hydraulic and electrical devices, systems and power circuits in accordance with the standards of safety engineering. Project planners must be fully conversant with automation safety concepts.

Warranty and liability claims in the event of personal injury or damage to property are among others excluded if such injury or damage is caused when the valves are worked on or handled by non-qualified personnel.

a Chap. "1.8 Warranty and liability", page 11
1.5 Structural modifications

**DANGER**

**Danger of explosion!**
To guarantee safe operation in hazardous areas:
- Structural modifications of the valves or to accessories may only be made by MOOG GmbH or by an authorized MOOG service center.
- Intervention by third parties will invalidate the Ex certification.

**CAUTION**

**Electrostatic discharge!**
To guarantee safe operation in hazardous areas.
The additional painting of our explosion-proof valves by third parties is a structural change. In case of additional painting, due to the possible accumulation of electrostatic charges, the corresponding provisions of the DIN EN 60079-0 standard must be adhered to.

**CAUTION**

**Risk of damage!**
The valves and the accessories can be damaged due to structural changes.
- Due to the complexity of the internal components, structural changes to the valves and to the accessories may only be made by us or our authorized service centers.

Warranty and liability claims for personal injury and damage to property are excluded if they are caused by unauthorized or improperly performed structural modifications or other interventions.

[Chap. “1.8 Warranty and liability”, page 11]
1.6 Environmental protection

1.6.1 Acoustic Emissions

**WARNING**

Damage to hearing!
Depending on the application, significant levels of noise may be generated when the valves are operated.
- Always protect yourself with hearing protection when working on the valves.

Generally speaking, the valves do not generate harmful acoustic emissions when they are used for their intended purpose.

1.6.2 Disposal

**WARNING**

Risk of injury!
In order to prevent injuries and other damage to health, please observe the following recommendations.
- Wear appropriate safety clothing.
- Wear protective gloves and safety glasses.
- a Chap. "2.2 Occupational safety and health", page 15

It is essential to comply with the relevant national waste disposal regulations and environmental protection provisions when disposing of valves, spare parts or accessories, packaging that is no longer needed, hydraulic fluid or auxiliary materials and substances used for cleaning!
If necessary, the items to be disposed of must be expertly dismantled into individual parts, separated into individual materials and placed in the corresponding waste system or earmarked for recycling.

The valve contains among others the following materials:

- Electronic components
- Adhesives and casting compounds
- Parts with electro-plated surfaces
- Permanent-magnet materials
- Hydraulic fluid
- Assorted metals and plastics
1.7 Responsibilities

The manufacturer and the operator of the machine are responsible for ensuring that work with and on the valves and handling of the valves is planned and performed in accordance with the directions given in this user manual and in the product-related hardware and software documentation relevant to the application concerned.

The manufacturer and the operator of the machine are in particular responsible for ensuring the following:

- Selection and training of personnel
  a Chap. "1.4 Selection and qualification of personnel", page 7
- Intended operation
  a Chap. "1.3 Intended operation", page 5
- Handling in accordance with safety requirements
  a Chap. "2.1 Handling in accordance with safety requirements", page 14
- Taking and monitoring of the occupational safety and health measures required for the particular application
  a Chap. "2.2 Occupational safety and health", page 15
- Observation of all safety standards of the manufacturer and the operator of the machine relevant to the application concerned
- Observation of the latest versions of the national and international regulations, standards, and guidelines relevant to the application concerned (for example, the EU Machinery Directive, the regulations of the trade association and of ATEX guideline, TÜV or VDE) and governing the configuration, construction, and operation of the machine with all its installed components
- Installation of suitable safety devices for limiting the pressure at the hydraulic ports
  a Chap. "2.5 Pressure limitation", page 16
- Compliance with the preconditions for satisfying the EMC protection requirements
  a Chap. "11.2 Electromagnetic compatibility (EMC)"", page 173
- Use of the valves in a technically faultless and operationally safe state
- Prevention of unauthorized or improperly performed structural modifications, repairs or maintenance
  a Chap. "1.5 Structural modifications", page 8
  a Chap. "10 Service", page 149
- Definition and observation of the application-specific inspection and maintenance instructions
- Adherence to all the technical data relating to the storage, transportation, installation, removal, connection, start-up, configuration, operation, cleaning, maintenance or elimination of any faults, in particular the ambient conditions and the data pertaining to the hydraulic fluid used
  a Chap. "11 Technical Data", page 162
- Proper storage, transportation, installation, removal, connection, start-up, configuration, operation, cleaning, maintenance, elimination of any faults or disposal
- Use of suitable and faultless accessories and of suitable and faultless spare parts
  a Chap. "12 Accessories, Spare Parts, and Tools", page 232
- Handy and accessible storage of this user manual and of the product-related hardware and software documentation relevant to the particular application
  a Chap. "1.1.3 Storage location", page 2
1.8 Warranty and liability

Our General Terms and Conditions of Sale and Payment always apply. These are made available to the buyer at the latest on conclusion of the contract. Among other things, warranty and liability claims for personal injury and damage to property are excluded if they are caused by one or more of the following:

- Work with and on the valves carried out by or the valves handled by non-qualified personnel
  a Chap. "1.4 Selection and qualification of personnel", page 7
- Non-intended operation
  a Chap. "1.3 Intended operation", page 5
- Handling not in accordance with safety requirements
  a Chap. "2.1 Handling in accordance with safety requirements", page 14
- Omission of the occupational safety and health measures required for the particular application
  a Chap. "2.2 Occupational safety and health", page 15
- Failure to observe this user manual or the product-related hardware and software documentation relevant to the particular application
- Failure to observe the safety standards of the manufacturer and the operator of the machine relevant to the application concerned
- Failure to observe the latest versions of the national and international regulations, standards, and guidelines relevant to the application concerned (for example, the EU Machinery Directive, the regulations of the trade association and of TÜV or VDE) and governing the configuration, construction, and operation of the machine with all its installed components
- Omission of suitable safety devices for limiting the pressure at the hydraulic ports
  a Chap. "2.5 Pressure limitation", page 16
- Failure to comply with the preconditions for satisfying the EMC protection requirements
  a Chap. "11.2 Electromagnetic compatibility (EMC)", page 173
- Use of the valves in a state that is not technically faultless or not operationally safe
- Unauthorized or improperly performed structural modifications, repairs or maintenance
  a Chap. "1.5 Structural modifications", page 8
  a Chap. "10 Service", page 149
- Failure to adhere to the inspection and maintenance instructions of the manufacturer and the operator of machine
- Failure to adhere to all the technical data relating to the storage, transportation, installation, removal, connection, start-up, configuration, operation, cleaning, maintenance or elimination of any faults, in particular the ambient conditions and the data pertaining to the hydraulic fluid used
  a Chap. "11 Technical Data", page 162
- Improper storage, transportation, installation, removal, connection, start-up, configuration, operation, cleaning, maintenance, elimination of any faults or disposal
- Use of unsuitable or defective accessories or of unsuitable or defective spare parts
  a Chap. "12 Accessories, Spare Parts, and Tools", page 232
- Catastrophes caused by foreign objects or force majeur
1.9 Declaration of conformity

An ATEX directive-compliant declaration of conformity for the control valves of the D94xK type series has been created and is depicted in this user manual.

MOOG GmbH
Hanns-Klemm-Str. 28
71034 Böblingen

Declaration of conformity

as defined by directive 94/9/EC (ATEX), Annex X

Herewith we declare that the

Series of Servovalves
D67xKxxxx, D94xKxxxx

(detailed model & serial number is referenced on the delivery note)

are in conformance with the provisions of the directive 94/9/EC (ATEX).

The admission of the series is registered under BVS 11 ATEX E 122 X
by DEKRA EXAM GmbH, Dinnendahlstrasse 9, 44809 Bochum, Germany
The monitoring body of the QM system is TÜV Süd (0123)

Applied harmonized standards in particular:

EN 60079-0:2009 Electrical apparatus for potentially explosive atmospheres - General requirements,
EN 60079-1:2007 Electrical apparatus for potentially explosive atmospheres - Flameproof enclosures "d",
EN 60079-7:2007 Electrical apparatus for potentially explosive atmospheres - Increased safety "e”.

Moog GmbH
Postfach 1670, D-71006 Böblingen
Phone.: 07031 622-0
Fax: 07031 622-100

Gunter Klugus
General Manager

Böblingen, 29.08.2011

Richard Kohse
Quality Manager
Representative for ATEX directive 94/9/EC
1.10 Registered marks and trademarks

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CANopen is a registered trademark of CAN in Automation (CAN).

EtherCAT is a registered trademark of Beckhoff Automation GmbH.

Profibus-DP is a registered trademark of PROFIBUS Nutzerorganisation e.V.

All the product and company names mentioned in this user manual are possibly proprietary names or trademarks of the respective manufacturers. The use of these names by third parties for their own purposes may infringe the rights of the manufacturers. The absence of the symbols ® or ™ does not indicate that the name is free from trademark protection.
2 Safety

2.1 Handling in accordance with safety requirements

It is the responsibility of the manufacturer and the operator of the machine to ensure that the valves are handled in accordance with safety requirements.

CAUTION

Danger of personal injury and damage to property due to unexpected operation!
As in any electronic control system, the failure of certain components in valves as well might lead to an uncontrolled and/or unpredictable operational sequence.

- If automatic control technology is to be used, the user should, in addition to all the potentially available standards or guidelines on safety-engineering installations, consult the manufacturers of the components used in great depth.

In order to ensure that the valves are handled in accordance with safety requirements and operated without faults, it is essential to observe the following:

- All the safety instructions in the user manual
- All the safety instructions in the product-related hardware and software documentation relevant to the particular application
- All the safety instructions in the safety standards of the manufacturer and the operator of the machine that are relevant to the application concerned
- All the relevant national and international safety and accident prevention regulations, standards, and guidelines, such as the safety regulations of the trade association, TÜV or VDE, the ATEX product directive 94/9/EC, and the ATEX operating directive 1999/92/EC; in particular, the following standards pertaining to the safety of machinery:
  - EN ISO 12100
  - EN 982
  - EN 563
  - EN 60204
  - EN 60079-0
  - EN 60079-1
  - EN 60079-7

Observing the safety instructions and the safety and accident prevention regulations, standards and guidelines will help to prevent accidents, malfunctions and damage to property!
2.2 Occupational safety and health

**DANGER**

Risk of poisoning and injury!
Contact with hydraulic fluids can damage your health (e.g. eye injuries, skin and tissue damage, poisoning in case of inhaling).
- Wear protective gloves and safety glasses.
- If nevertheless hydraulic fluid gets into your eyes or on your skin, consult a doctor immediately.
- When handling hydraulic fluids, observe the safety provisions applicable to the hydraulic fluid used.

**WARNING**

Danger of injury due to falling objects!
Falling objects, such as valves, tools, or accessories, can cause injury.
- Wear appropriate safety clothing, e.g. safety shoes.

**WARNING**

Danger of burning!
Valves and hydraulic port lines can become very hot during operation. Fingers and hands can suffer severe burn injuries when touching the valve or the connector cable.
- Allow the valve and the connector cable to cool off before contact.
- Wear appropriate safety clothing, e.g. safety gloves.

**WARNING**

Damage to hearing!
Depending on the application, significant levels of noise may be generated when the valves are operated.
- Always protect yourself with hearing protection when working on the valves.
2.3 General safety instructions

**CAUTION**

**Risk of damage!**
In order to prevent damage to the valves or to the machine, the following must be observed:
- Values specified in the technical data must be adhered to.
- Values specified on the nameplate must be adhered to.
- Chap. "11 Technical Data", page 162

This user manual and the product-related hardware and software documentation relevant to the application concerned must be inserted in the machine's operating instructions.

2.4 ESD

**CAUTION**

**Risk of damage!**
Electrical discharges can damage internal device components.
- Protect the valve, accessories and spare parts against static charging. In particular, avoid touching the connector contacts.

2.5 Pressure limitation

**WARNING**

**Danger of personal injury and damage to property!**
The operation of the valves at pressure that is too high on the hydraulic connections can cause injuries and damage to the machine.
- Pressure-limiting valves or other comparable safety devices, for example, must be installed to limit the pressure at all the hydraulic ports to the specified maximum operating pressure. Maximum operating pressure:
  - Chap. "11 Technical Data", page 162
3 Product Description

3.1 Function and mode of operation

The valves in the D941K to D945K type series are two-stage proportional valves with a direct-operated pilot valve (Fig. 1, D633K with permanent magnet linear force motor). The valves are throttle valves for 2-, 3-, 4-, 5- or even 2/2x2-way applications.

They are suitable for electrohydraulic position, speed, pressure, and force control even with high dynamic requirements. They control flow and/or control pressure.

The valve electronics with a PWM driver end stage and a 24 V direct current supply are integrated into the valve.

The digital valve electronics are installed in the electronic housing in vibration-decoupled design so that they are not sensitive to shock and vibration.

For a detailed description of how these work, see:
- a Chap. "3.1.3 Representative depiction of the valve", page 19
- a Chap. "3.3.1.1 Flow control (Q-control)", page 35

3.1.1 Operational modes

Depending on the model, one of the operational modes below is preset in the valve.

It is possible to switch between the operational modes via the integrated service or fieldbus interface.

<table>
<thead>
<tr>
<th>Operational mode</th>
<th>D94xK</th>
<th>p</th>
<th>pQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow control (Q-control)</td>
<td>• 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a Chap. &quot;3.3.1.1 Flow control (Q-control)&quot;, page 35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure control (p-control)</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>a Chap. &quot;3.3.1.2 Pressure control (p-control)&quot;, page 36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow and pressure control (pQ-control)</td>
<td>• 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a Chap. &quot;3.3.1.3 Flow and pressure control (pQ-control)&quot;, page 37</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tab. 2: Operational modes of the valves

1) Operational mode preset on delivery
3.1.2 Pilot pressure

If large flows are required with a high valve pressure difference, a correspondingly high pilot pressure must be selected to overcome the flow forces.

For reliable function of the valves, we recommend the following pilot pressure $p_x$:

For valves with stub shaft spool  $p_x \geq p_p$
For valves with standard spool  $p_x \geq 0.3 \times p_p$

whereby

$p_p =$ pressure on the P port of the valve (pressure supply)

The control pressure specified in the technical data must be adhered to.

a Chap. "11.1 Nameplates", Digit 3, pressure range identification, page 167

Hydraulic safety devices for pressure limitation

Excessive pressure at the hydraulic ports damages the valve and can cause unsafe states in the machine as well as personal injury.

Pressure-limiting valves or other comparable safety devices, for example, must be installed to limit the pressure at all the hydraulic ports to the specified maximum operating pressure.

a Chap. "2.5 Pressure limitation"
### 3.1.3 Representative depiction of the valve

![Representative depiction of the valve](image)

**Fig. 1: Representative depiction of a two-stage proportional valve with directly-operated pilot valve D633K**

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Analog input connector X5...X7</td>
<td>The analog input connectors X5…X7 are optionally available.</td>
</tr>
<tr>
<td>2</td>
<td>Connector X2 for digital signal interface</td>
<td>The X2 connector is optionally available.</td>
</tr>
<tr>
<td>3</td>
<td>Service connector X10</td>
<td>The X10 service connector is only present for valves without CAN bus interface. As standard, the X10 service connector is not approved for use in hazardous areas; however, on request it can be obtained as a version that is suitable for use in hazardous areas. Tightening torque: tighten the screw plug of the service connector with tightening torque 9.5 Nm / 7 lbf ft! a Chap. &quot;7.10 Service connector X10&quot;, page 92</td>
</tr>
<tr>
<td>4</td>
<td>Connector X1</td>
<td>a Chap. &quot;7.4 Connector X1&quot;</td>
</tr>
<tr>
<td>5</td>
<td>Pressure transducer</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Venting screw</td>
<td>a Chap. &quot;8.5.1 Venting&quot;, page 140</td>
</tr>
<tr>
<td>7</td>
<td>Pilot valve D633K</td>
<td>a Chap. &quot;3.1.4 Permanent magnet linear force motor&quot;, page 21</td>
</tr>
<tr>
<td>8</td>
<td>Main stage spool</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Ports</td>
<td>Mounting surface: Hole pattern, D941K (NG10) type series a Fig. 56, page 175 Hole pattern, D942K (NG16) type series a Fig. 64, page 186 Hole pattern, D943K (NG25) type series a Fig. 72, page 197 Hole pattern, D944K (NG25) type series a Fig. 80, page 208 Hole pattern, D945K (NG32) type series a Fig. 88, page 219</td>
</tr>
<tr>
<td>10</td>
<td>LVDT</td>
<td>a Chap. &quot;3.3.1.1 Flow control (Q-control)&quot;, page 35</td>
</tr>
<tr>
<td>Item</td>
<td>Designation</td>
<td>Additional information</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------</td>
<td>------------------------------------------------------------</td>
</tr>
<tr>
<td>11</td>
<td>Digital valve electronics</td>
<td>a Chap. &quot;3.1.5 Valve electronics and valve software&quot;, page 22</td>
</tr>
<tr>
<td>12</td>
<td>Fieldbus-X3 connector</td>
<td>The fieldbus connectors X3 and X4 are only provided on valves with fieldbus interfaces. a Chap. &quot;7.8 Field bus connectors X3 and X4&quot;, page 84</td>
</tr>
<tr>
<td>13</td>
<td>Fieldbus-X4 connector</td>
<td>a Chap. &quot;8.3.1 Configuration via the fieldbus interface&quot;, page 135</td>
</tr>
<tr>
<td>14</td>
<td>Ground terminal</td>
<td>a Chap. &quot;7.12 Protective grounding, equipotential bonding, and shielding&quot;</td>
</tr>
</tbody>
</table>
3.1.4 Permanent magnet linear force motor

A permanent magnet linear force motor is used to drive the valve spool (item 1 in Fig. 2) of the pilot valve.

In contrast to proportional-solenoid drives, the permanent magnet linear force motor can move the spool from the spring-set position in both working directions. This results in high actuating power for the spool while simultaneously providing very good static and dynamic properties.

The permanent magnet linear force motor is a differential motor excited by permanent magnets. Some of the magnetic force is already provided by the permanent magnets. The linear force motor's power demand is thus significantly lower than is the case with comparable proportional-magnet drives.

The linear force motor drives the valve's spool (item 1, Fig. 2). The spool starting position is determined in the de-energized state by the centering springs (item 5 in Fig. 2). The linear force motor enables the spool to be deflected from the starting position in both directions. Here, the actuating power of the linear force motor is proportional to the coil current.

The high forces of the linear force motor and centering springs effect precise spool movement even against flow and frictional forces.

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spool</td>
</tr>
<tr>
<td>2</td>
<td>Bearing</td>
</tr>
<tr>
<td>3</td>
<td>Permanent magnet</td>
</tr>
<tr>
<td>4</td>
<td>Coil</td>
</tr>
<tr>
<td>5</td>
<td>Centering springs</td>
</tr>
<tr>
<td>6</td>
<td>Screw plug</td>
</tr>
<tr>
<td>7</td>
<td>Armature</td>
</tr>
</tbody>
</table>
3.1.5 Valve electronics and valve software

The digital drive and control electronics are integrated in the valve. These valve electronics contain a microprocessor system that executes all the important functions via the valve software it contains. The digital electronics enable valve control that is both precise and repeatable across the full working range regardless of temperature.

The valve electronics can assume device- and drive-specific functions, such as command signal ramps or dead band compensation. This can relieve the strain on external machine control and if necessary field-bus communication.

a Chap. "3.5 Configuration software", page 53
a Chap. "8.3 Configuration of the valves", page 135
3.1.5.1 Valve status

**CAUTION**

Danger of personal injury and damage to property!
The 'NOT READY' valve status is caused only by a serious, non-rectifiable fault.

- If the 'NOT READY' valve status occurs, the valve must be sent to MOOG GmbH or an authorized MOOG service center for inspection.

The valve's device status is referred to as the valve status. The valve status can be set or interrogated via the service or fieldbus interface in the valve software. Setting and interrogation can be performed for example with the Moog Valve and Pump Configuration Software.

<table>
<thead>
<tr>
<th>Valve status</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>'ACTIVE'</td>
<td>The valve is ready for operation and is in closed-loop control operation.</td>
</tr>
<tr>
<td>'HOLD'</td>
<td>The valve is ready for operation and is in the electrical fail-safe state on account of a control command. The electrical fail-safe spool position is a closed loop parameterized setting. [a Chap. &quot;3.2.2 Electrical fail-safe function&quot;, page 30]</td>
</tr>
<tr>
<td>'FAULT HOLD'</td>
<td>The valve is ready for operation and is in the electrical fail-safe state on account of a fault reaction. The electrical fail-safe spool position is a closed loop parameterized setting. [a Chap. &quot;3.2.2 Electrical fail-safe function&quot;, page 30]</td>
</tr>
<tr>
<td>'DISABLED'</td>
<td>The valve electronics are ready for operation and the valve is in the mechanical fail-safe state on account of a control command. [a Chap. &quot;3.2.1.3 Mechanical fail-safe state&quot;, page 29] Internal parameters can be set and interrogated. The current to the permanent magnet linear force motor is switched off.</td>
</tr>
<tr>
<td>'FAULT DISABLED'</td>
<td>The valve electronics are ready for operation and the valve is in the mechanical fail-safe state on account of a fault reaction. Internal parameters can be set and interrogated. [a Chap. &quot;3.2.1.3 Mechanical fail-safe state&quot;, page 29] The current to the permanent magnet linear force motor is switched off.</td>
</tr>
<tr>
<td>'INIT'</td>
<td>The valve is switched off, is in the mechanical fail-safe state and can be configured via the service or field bus interface. [a Chap. &quot;3.2.1.3 Mechanical fail-safe state&quot;, page 29]</td>
</tr>
<tr>
<td>'NOT READY'</td>
<td>The valve is not ready for operation and is in the mechanical fail-safe state on account of a serious non-rectifiable fault. [a Chap. &quot;3.2.1.3 Mechanical fail-safe state&quot;, page 29]</td>
</tr>
</tbody>
</table>

Tab. 3: Valve status

Fail-safe states and fail-safe events:
  - [a Chap. "3.2.1.3 Mechanical fail-safe state", page 29]
  - [a Chap. "3.2.3 Fail-safe events", page 30]
  - [a Chap. "11.1 Nameplates", Digit 6, Fail-safe variant, page 169]
3.1.6 Signal interfaces

The valves have a connector, X1, with model-dependent analog and digital inputs/outputs. The connectors are an explosion-proof model.

*Chap. “3.1.6.1 Connector X1”, page 25*

Pin assignment of the connector X1:

*Chap. “7.4.1 Pin assignment of connector X1”, page 76*

**WARNING**

**Danger of explosion!**

To guarantee safe operation in a hazardous area:

- For mounting and removal of the explosion-proof connectors as well as operation of the valve, the notes and instructions in the "Explosion-proof connectors eXLink, CEAG" operating instructions must absolutely be adhered to.

Depending on the model, the valves can also have an isolated field bus interface (connectors X3 and X4) and/or a service interface (service connector X10).

*Chap. “3.1.6.2 Fieldbus connectors X3 and X4”, page 25*

*Chap. “3.1.6.3 Service connector X10”, page 26*

For the standard model of the valve, the service interface is not suitable for use in hazardous areas. On request, the service interface is available in an explosion-proof model.

<table>
<thead>
<tr>
<th>Interfaces</th>
<th>Connector X1</th>
<th>Field bus connectors X3 and X4</th>
<th>Service connector X10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valves without field bus interface</td>
<td>•</td>
<td>-</td>
<td>•¹</td>
</tr>
<tr>
<td>Valves with CAN bus interface</td>
<td>•</td>
<td>•¹</td>
<td>-</td>
</tr>
<tr>
<td>Valves with Profibus interface</td>
<td>•</td>
<td>•</td>
<td>•¹</td>
</tr>
<tr>
<td>Valves with EtherCAT interface</td>
<td>•</td>
<td>•</td>
<td>•¹</td>
</tr>
</tbody>
</table>

Tab. 4: Existing signal interfaces

¹ The valves can be started up and configured via the CAN bus or service interface with the Moog Valve and Pump Configuration Software.

*Chap. “8.3.1.2 Configuration with the Moog Valve and Pump Configuration Software”, page 136*

It is necessary when ordering the valve to establish whether a field bus interface is to be integrated and if necessary one of the above-mentioned field bus interfaces is to be selected.
3.1.6.1 Connector X1

Valves without field bus interfaces must be commanded with an analog signal(s) via connector X1.

Valves with field bus interfaces can be controlled either with analog command signals via connector X1 or with digital signals via the field bus interface (connectors X3 and X4).

Different signal types for analog command inputs for flow control can, depending on the model, be selected in the valve.

The valves have an analog actual value output:

The valves have a digital enable input.

Pin assignment of connector X1:

3.1.6.2 Fieldbus connectors X3 and X4

Valves with field bus interfaces are started up, activated, monitored and configured via the field bus interface (connectors X3 and X4).

To reduce the amount of wiring, the field bus interface is provided with two connectors on the valve. The valves can thus be directly looped into the field bus, i.e. without the use of external T-pieces.

Valves with CAN bus interfaces can be started up and configured via the CAN bus interface (field bus connector X3) with the Moog Valve and Pump Configuration Software.

Plug assignment of the field bus connectors X3 and X4:
3.1.6.3 Service connector X10

Valves without CAN bus interfaces can be started up and configured via the service interface (service connector-X10) with the Moog Valve and Pump Configuration Software.

a Chap. "8.3.2 Configuration via the service interface", page 136

**WARNING**

Danger of explosion!
To guarantee safe operation in hazardous areas, the following points must be heeded:

- In its standard model with screw plug, the service connector X10 is not approved for use in hazardous areas.
- For mounting of the screw plug of the service connector X10, it must be observed that the gasket and the threads of the screw plug as well as the threads in the electronic housing of the valve are not damaged.
- In case of damage to the screw plug for the service connector X10 or the threads in the electronic housing, the valve must not be operated.
- Tightening torque screw plug:
  a Chap. "3.1.3 Representative depiction of the valve", page 19

For the standard model of the valve, the service interface is not suitable for use in hazardous areas. On request, the service interface is available in an explosion-proof model.
3.2 Safety function/fail-safe

CAUTION

Risk of injury!
In order to prevent injuries and other damage to health during safety-critical operation, please observe the following recommendations.

 fail-safe functions

The valve fail-safe functions increase the safety for the user if, for example the valve supply voltage fails or the pilot pressure $p_X$ drops.

There are two different fail-safe functions: mechanical/hydraulic and electrical.

 fail-safe events

The valve can be rendered in the fail-safe state by different events.

 fail-safe state

The valve must be restarted after it has adopted the fail-safe state.

The valve can be rendered in the fail-safe state by different events.

fail-safe state

The mechanical/hydraulic valve fail-safe state is denoted by the fact that the spool of the main stage is in a defined spring-determined position.

fail-safe state

The electrical valve fail-safe state is denoted by the fact that the valve is in the 'HOLD' or 'FAULT HOLD' valve status and a preset command signal is corrected by suitable positioning of the main stage spool.

It is essential to ensure at the machine end that these fail-safe states result in a safe state in the machine.

The valve must be restarted after it has adopted the fail-safe state.
3.2.1 Mechanical fail-safe function

The valves in the D67XK series are offered with various fail-safe functions. The behavior of the valve in the fail-safe function depends on the fail-safe function selected, the pilot valve, as well as the respective status of pilot pressure and control pressure of the 4/2-way valve.

The fail-safe function must be specified when the valve is ordered. To see which fail-safe function is integrated into the valve, see the 6th place in the type designation.

The following fail-safe functions are available:

- Fail-safe function F
- Fail-safe function D
- Fail-safe function H
- Fail-safe function K

3.2.1.1 Valves with fail-safe functions F, D and M

In the case of the fail-safe functions F, D and M, the mechanical setting of the linear force motor or corresponding centering springs at the factory establishes which position the spool assumes in the mechanical fail-safe state.

Position of main stage spool: a Tab. 3, page 23

The installation drawing/dimensions of the valves are type-dependent
a Chap. "11 Technical Data", page 162

Hydraulic symbols:
a Chap. "3.3.2 Valve configurations and hydraulic symbols", page 38
3.2.1.2 Valves with fail-safe functions H and K

The valves with fail-safe function H and K with 4/2-way seat valves are called fail-safe valves.

For applications with proportional valves, for which certain safety specifications apply to prevent danger to man and machine, it must be possible to assume a corresponding spool setting for a safe state. Therefore, a fail-safe model is available for the multi-stage proportional valves.

After external triggering, this fail-safe function applies a defined spool setting: safe middle position or open position A→T or B→T.

For fail-safe valves in the D94xK series, both control spaces of the main stage are short-circuited hydraulically via a 4/2-way valve to move the spool of the main stage to the safe middle position. The spring-set force moves the spool into the safe fail-safe position.

For fail-safe valves it is possible to monitor whether the main spool is in the safe position:

Installation drawing/dimensions:
a Chap. "11 Technical Data", page 162

Hydraulic symbols:
a Chap. "3.3.2 Valve configurations and hydraulic symbols", page 38

3.2.1.3 Mechanical fail-safe state

The valve is in the mechanical fail-safe state when the main stage spool is in a defined spring-determined position.

The spool positions of the main stage in case of failure of the valve electronics or of the control pressure of the 4/2-way valve are described in the tables about the fail-safe function in the technical data.
a Tab. 31, page 169

Type designation:
a Chap. "11.1 Nameplates", Digit 6, Fail-safe variant, page 169

All other combinations of pressure and supply voltage give rise to an undefined main stage spool position.

3.2.1.4 Fail-safe identification

The fail-safe identification, i.e. the 6th position in the valve type designation of the proportional or servo valve, indicates which mechanical fail-safe function is integrated in the valve.

Type designation:
a Chap. "11.1 Nameplates", Digit 6, Fail-safe variant, page 169

3.2.1.5 Spool identification

The spool identification, i.e. the 4th position in the valve type designation, indicates which spool version is integrated in the valve.

Type designation:
a Chap. "11.1 Nameplates", Digit 4, Spool, page 168
3.2.2 Electrical fail-safe function

After adopting the 'HOLD' or 'FAULT HOLD' valve status, the valve is in the electrical fail-safe state and a preset command signal is corrected by suitable positioning of the main stage spool.

The command signal can be set or interrogated via the service or field bus interface in the valve software. Setting and interrogation can be performed for example with the Moog Valve and Pump Configuration Software.

Command signals that may be applied from an external source via the field bus interface or the analog inputs are ignored in the 'HOLD' and 'FAULT HOLD' valve states.

3.2.3 Fail-safe events

### CAUTION

Danger of personal injury and damage to property!
The 'NOT READY' valve status is caused only by a serious, non-rectifiable fault.

- If the 'NOT READY' valve status occurs, the valve must be sent to MOOG GmbH or an authorized MOOG service center for inspection.

The valve is rendered in the fail-safe state in response to the fail-safe events set out below.
The valve must be restarted after it has adopted the fail-safe state.

a Chap. "3.2.4 Restarting the valve", page 33

<table>
<thead>
<tr>
<th>Fail-safe event</th>
<th>Fail-safe state</th>
<th>Cause of adoption of fail-safe state</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mechan.</td>
<td>Elect.</td>
</tr>
<tr>
<td>Shutdown/failure of the supply voltage</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td>Signals on the enable input of the X1 connector (not possible for p/Q function)</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td>Drop in the pilot pressure pX</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td>Adoption by valve of valve status</td>
<td>'HOLD'</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>'FAULT HOLD'</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>'DISABLED'</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>'FAULT DISABLED'</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>'INIT'</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>'NOT READY'</td>
<td>•</td>
</tr>
</tbody>
</table>

Tab. 5: Fail-safe events
3.2.3.1 Shutdown/failure of the supply voltage

**CAUTION**

Risk of damage!
After the supply voltage to the valve is shut down, fails or drops below 18 V, the linear force motor is no longer activated by the valve electronics.
- The cause of the fault must be determined on the machine side and if necessary, eliminated.

The valves with fail-safe functions F and D are rendered in the mechanical fail-safe state when the supply voltage is shut down or fails.

With the pilot pressure applied, the mechanical setting of the pilot valve defines which end face of the main stage spool is pressurized with pilot pressure and thus which position the spool assumes in the hydraulic fail-safe state.

Position of main stage spool:
a Tab. 31, page 169

3.2.3.2 Signals at the enable input

Switching of the valve to fail-safe state can also be triggered by a corresponding signal at the enable input of connector X1. Signals lower than 6.5 V at the enable input switch the valve to fail-safe state.

(Not for valves with pQ control.)

Pin assignment of connector X1:
a Chap. "7.4.1 Pin assignment of connector X1", page 76

3.2.3.3 Drop in the pilot pressure \( p_X \)

After the pilot pressure \( p_X \) has dropped below\(^1\) (depressurized), the main stage spool is pushed by the spring restoring force into the defined spring-determined center position denoting the mechanical fail-safe state of the valves.

Position of main stage spool:
a Tab. 31, page 169

---

\(^1\) Pilot pressure values:
a Chap. "11.1 Nameplates", Digit 3, pressure range identification, page 167
a Chap. "11.1 Nameplates", Digit 6, Fail-safe variant, page 169
3.2.3.4 Settable fault reaction

**CAUTION**

Danger of personal injury and damage to property!
The 'NOT READY' valve status is caused only by a serious, non-rectifiable fault.
- If the 'NOT READY' valve status occurs, the valve must be sent to MOOG GmbH or an authorized MOOG service center for inspection.

**Mechanical fail-safe state due to fault reaction**
Adoption by the valve of the 'FAULT DISABLED' valve status and thus of the mechanical fail-safe state can be triggered by different events, such as e.g. the supply voltage dropping below 18 V.
It is possible to set in the valve software the event(s) for which the valve is rendered in the 'FAULT DISABLED' valve status.
The setting can be made or interrogated via the service or fieldbus interface in the valve software. Setting and interrogation can be performed for example with the Moog Valve and Pump Configuration Software.
a Chap. "3.6 Moog Valve and Pump Configuration Software", page 54
The transition of the valve into the 'NOT READY' valve status and therefore into the mechanical fail-safe state is caused by a serious, non-rectifiable fault.

**Electrical fail-safe state due to fault reaction**
The transition of the valve into the 'FAULT HOLD' valve status and therefore into the electrical fail-safe state can be initiated by different events, such as e.g. a fault in the electric cable.
It is possible to set in the valve software the event(s) for which the valve is rendered in the 'FAULT HOLD' valve status.
The valve state can be set or interrogated via the service or fieldbus interface in the valve software. Setting and interrogation can be performed for example with the Moog Valve and Pump Configuration Software.
a Chap. "3.6 Moog Valve and Pump Configuration Software", page 54

3.2.3.5 Control commands
The transition of the valve into the 'HOLD', 'DISABLED' and 'INIT' valve states can be initiated by a control command.
3.2.4 Restarting the valve

### WARNING

Danger of injury due to unexpected machine movements!
In order to avoid injuries and other risks to health on start-up of the valve after a transition into the fail-safe state, please follow the following instructions.
- The cause of the fault must be determined on the machine side and if necessary, eliminated.
- It is necessary to ensure that restarting the valve does not give rise to unintentional or dangerous states in the machine.

**After shutdown/failure of the supply voltage:**
After the transition of the valve into a fail-safe state on account of a shut-down/failure of the supply voltage to the valve, it will be necessary to restart the valve by applying the supply voltage in accordance with the technical data. If necessary, the valve must be returned to the 'ACTIVE' valve status.

**After application of an enable signal lower than 6.5 V:**
After the transition of the valve into a fail-safe state on account of the application of an enable signal lower than 6.5 V, it will be necessary to restart the valve by applying an enable signal between 8.5 V and 32 V.

**After a drop in the pilot pressure $p_X$:**
After the valve has adopted the fail-safe state on account of a drop in the pilot pressure $p_X$, it will be necessary to restart the valve by applying a higher pilot pressure.

Pilot pressure values:
- Chap. "11.1 Nameplates", Digit 3, pressure range identification, page 167
- Chap. "11.1 Nameplates", Digit 6, Fail-safe variant, page 169

**After transition of the valve into the 'FAULT DISABLED' or 'FAULT HOLD' valve status:**
After transition of the valve into the fail-safe state on account of a transition into the 'FAULT DISABLED' or 'FAULT HOLD' valve status, it can be restarted as follows:
- Acknowledge the fault via the service or field bus interface and return the valve to the 'ACTIVE' valve status.
- Set the supply voltage for at least 1 second under defined conditions to zero and then restore the supply voltage in accordance with the technical data. If necessary, the valve must be returned to the 'ACTIVE' valve status.

**After transition of the valve into the 'HOLD', 'DISABLED' or 'INIT' valve status:**
After the transition of the valve into the fail-safe state on account of adoption of the 'DISABLED' or 'INIT' valve status, it can be restarted as follows:
- Return the valve to the 'ACTIVE' valve status.
- Apply an enable signal less than 6.5 V, then apply an enable signal between 8.5 V and 32 V and return the valve to the 'ACTIVE' valve status.
- For valves without fieldbus interface: set the supply voltage for at least 1 second under defined conditions to zero and then restore the supply voltage in accordance with the technical data.
3.3 Hydraulics

CAUTION

Danger of personal injury and damage to property due to spraying fluids!
In order to ensure proper operation of the valves and of the machine, the following must be observed:
- The correct configuration of the valve with regard to flow and pressure is required.

3.3.1 Operational modes

Possible operational modes of the different Series: a Tab. 2, page 17
3.3.1.1 Flow control (Q-control)

In this operational mode the position of the main stage spool is controlled. The predefined command signal corresponds to a particular spool position. The position of the spool is proportional to the control signal.

The command signal (command position for the main stage spool) is transmitted to the valve electronics. The actual spool position is measured with a position transducer (LVDT) and transmitted to the valve electronics. Deviations between the predefined command position and the measured actual position of the spool are corrected. The valve electronics activate the pilot valve, which positions the spool accordingly. This process sets a specific flow.

The position command can be influenced by means of parameters in the valve software (e.g., linearization, ramping, dead band, sectionally defined amplification, correction of the zero position).

The parameters can be set or interrogated via the service or field bus interface in the valve software. Setting and interrogation can be performed for example with the Moog Valve and Pump Configuration Software.

The flow rate to be set depends not only on the position of the spool, but also on the pressure difference $\Delta p$ at the individual control lands.

a Chap. "3.5 Configuration software", page 53
a Chap. "4.1 Flow diagram (4-way operation)", page 55

Characteristic curves
a Chap. "11 Technical Data", page 162
3.3.1.2 Pressure control (p-control)

Faultless valve functioning for pressure control is only guaranteed if the control loop is stable and the pressure in port T is lower than the pressure to be controlled.

In this operational mode the pressure in port A is controlled. The predefined command signal corresponds to a particular pressure in port A.

The command signal (command pressure for port A) is transmitted to the valve electronics. The pressure in port A is measured with a pressure transducer and transmitted to the valve electronics as the actual pressure. Deviations between the predefined command pressure and the pressure measured in port A are corrected. The valve electronics drive the linear force motor, which positions the spool accordingly. This process sets a specific flow, which results in a pressure change in port A. The controlled pressure follows the command signal proportionally.

The pressure command can be influenced by means of parameters in the valve software (e.g., ramps, scaling, limitation).

The pressure controller is designed as an extended PID controller. The parameters of the PID controller and of the integrated pressure transducer can be set or interrogated via the service or field bus interface in the valve software. Setting and interrogation can be performed for example with the Moog Valve and Pump Configuration Software.

[Fig. 4: Pressure control (p-control) block diagram]

In this operational mode the pressure in port A is controlled. The predefined command signal corresponds to a particular pressure in port A.

The command signal (command pressure for port A) is transmitted to the valve electronics. The pressure in port A is measured with a pressure transducer and transmitted to the valve electronics as the actual pressure. Deviations between the predefined command pressure and the pressure measured in port A are corrected. The valve electronics drive the linear force motor, which positions the spool accordingly. This process sets a specific flow, which results in a pressure change in port A. The controlled pressure follows the command signal proportionally.

The pressure command can be influenced by means of parameters in the valve software (e.g., ramps, scaling, limitation).

The pressure controller is designed as an extended PID controller. The parameters of the PID controller and of the integrated pressure transducer can be set or interrogated via the service or field bus interface in the valve software. Setting and interrogation can be performed for example with the Moog Valve and Pump Configuration Software.

[a Chap. "3.3.5 Notes on the pressure controller control response", page 42]
[a Chap. "3.5 Configuration software", page 53]
[a Chap. "3.6 Moog Valve and Pump Configuration Software", page 54]
High pressure peaks in the hydraulic system can result in a drift of the valve’s internal pressure transducer. To monitor any possible drift of the valve’s pressure transducer, we recommend that the pressure transducer be checked 3, 6 and 12 months after the valve is started up and thereafter at intervals of 6 months. This can be conducted for example using comparison measurements with a calibrated pressure gauge. If necessary, the internal pressure transducer must be recalibrated. The pressure transducer can be influenced by means of parameters in the valve software. The parameters can be set or interrogated via the service or field bus interface in the valve software. Setting and interrogation can be performed for example with the Moog Valve and Pump Configuration Software.

3.3.1.3 Flow and pressure control (pQ-control)

This operational mode is a combination of flow and pressure control, where both command signals, i.e. the command position for the spool and the command pressure for port A, must be provided.

In pQ-control the position command calculated by the pressure controller is compared with the position command applied from an external source. The smaller of the two command signals is forwarded to the position control loop.
The following combinations are for example possible:

- Flow control with superimposed pressure limitation control
- Forced changeover from one operational mode to the other

### 3.3.2 Valve configurations and hydraulic symbols

Depending on the model, the following valve configurations are possible:

- 2-way operation
  - a Chap. "3.3.2.1 2-way and 2/2-way operation", page 38
- 3-way operation
  - a Chap. "3.3.2.2 4-way and 3-way operation", page 39
- 4-way operation
  - a Chap. "3.3.2.2 4-way and 3-way operation", page 39
- 5-way operation
  - a Chap. "3.3.2.3 5-way operation", page 40
- 2/2-way operation
  - a Chap. "3.3.2.1 2-way and 2/2-way operation", page 38

### 3.3.2.1 2-way and 2/2-way operation

Hydraulic symbols of the valves D941K to D945K:
- a Chap. " Technical data for D941K to D945K, overview", page 162

Fail-safe functions:
- a Chap. "3.2.1.1 Valves with fail-safe functions F, D and M", page 28

With 2-way and 2/2x2-way operation the valves can be used to control the flow in one direction (used as throttle valves).

With 2/2x2-way operation the valve can be used in 2-way applications for greater flows.

It is necessary to connect ports P with B and A with T externally for this purpose.
- a Chap. " Technical data for D941K to D945K, overview", page 162

The flow directions that are depicted under "Way functions and hydraulic symbols" in the technical data of the corresponding valve must be adhered to.

For the 2/2-way function, the connections X and Y must always be closed.
- a Chap. "3.3.3.1 Pilot pressure port X", page 41
- a Chap. "3.3.3.2 Leakage port Y", page 41
3.3.2.2 4-way and 3-way operation

Hydraulic symbols of the valves D941K to D945K:
a Chap. "Technical data for D941K to D945K, overview", page 162

Fail-safe functions:
a Chap. "3.2.1.1 Valves with fail-safe functions F, D and M", page 28
a Chap. "3.2.1.2 Valves with fail-safe functions H and K", page 29

With 4-way operation the valves can be used to control the flow in ports A and B (used as throttle valves).

Port A or B must be closed in order to obtain 3-way operation.

The flow directions that are depicted under "Way functions and hydraulic symbols" in the technical data of the corresponding valve must be adhered to.

For D941 valves with a 4-way design and with $Q_N > 60 \text{ l/min}$, the second tank port $T_1$ is required.

Information about whether the valve is delivered with externally or internally-connected leakage connection $Y$ and whether leakage connection $Y$ must be used:
a Chap. "3.3.3.2 Leakage port Y", page 41
3.3.2.3 5-way operation

![Diagram of 5-way operation](image)

**5-way operation (fail-safe function F)**

Fig. 6: 5-way operation with mechanical fail-safe function F (hydraulic symbol)

Hydraulic symbols of the D941K valve:
a Chap. "11.3 Technical data D941K – ISO 4401-05/NG10", page 174

Fail-safe functions:
a Chap. "3.2.1.1 Valves with fail-safe functions F, D and M", page 28
a Chap. "3.2.1.2 Valves with fail-safe functions H and K", page 29

The streaming directions that are depicted under "Way functions and hydraulic symbols" in the technical data of the corresponding valve must be adhered to.
Information about whether the valve is delivered with externally or internally-connected leakage connection Y and whether leakage connection Y must be used:
a Chap. "3.3.3.2 Leakage port Y", page 41

**CAUTION**

Danger of personal injury and damage to property!
For the D941K valves in the 5-way version type B80..., T₁ becomes P₁
3.3.3 Control type ports X and Y

3.3.3.1 Pilot pressure port X

If the system pressure is subject to heavy fluctuations, external actuation via pilot pressure port X delivers better control precision.

The valve can be supplied with either an externally or an internally connected pilot pressure port X.
When the valve is ordered, it is specified how this connection is made.
Whether the pilot pressure connection X is used can be read from the 7th digit of the variant designation.
a Chap. "11.1 Nameplates", Digit 7, Hydraulic control type, Pilot pressure port X and leakage port Y, page 170

3.3.3.2 Leakage port Y

The leakage port Y is present in all series of the D94xK type series; it must be used in the following cases:
• always with 2/2x2-way operation
• if high pressure peaks occur in the tank connection T (e.g. caused by other switchable valves in the hydraulic circuit) - without use of the leakage connection Y, they will cause damage to the valve.
The maximum permissible values are specified under "Hydraulic data" in the technical data for the corresponding valve:
a Chap. "Technical data for D941K to D945K, overview", page 162

The valve can be supplied with either an externally or an internally connected pilot pressure port Y.
When the valve is ordered, it is specified how this connection is made.
Whether the pilot pressure connection Y is used can be read from the 7th digit of the variant designation.
a Chap. "11.1 Nameplates", Digit 7, Hydraulic control type, Pilot pressure port X and leakage port Y, page 170

3.3.3.3 Pilot identification

The pilot identification, i.e. the 7th position in the valve type designation, indicates whether pilot pressure port X and leakage port Y are internally or externally connected.

Type designation:
a Chap. "11.1 Nameplates", Digit 7, Hydraulic control type, Pilot pressure port X and leakage port Y, page 170
3.3.4 Electrical and hydraulic zero positions

The hydraulic zero position of the spool is not necessarily identical to the electrical zero position.

The electrical zero position of the spool is set if the command signal input for the spool position is equal to zero. The hydraulic zero position is the position of the spool in which the pressures, when the spool is symmetrical, are equal in the two sealed control ports. The hydraulic zero position is model-dependent.

Fig. 7: Examples of the electrical and hydraulic zero positions of different spools in the flow signal characteristic curve

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electrical zero position of the spool</td>
</tr>
<tr>
<td>2</td>
<td>Hydraulic zero position of the spool</td>
</tr>
<tr>
<td>3</td>
<td>Spool overlap</td>
</tr>
</tbody>
</table>

3.3.5 Notes on the pressure controller control response

The controlled system is essentially influenced by:

- Rated flow $Q_N$
- Actual pressure difference $\Delta p$ per control land
- Load stiffness
- The fluid volume connected with port A and to be controlled

Depending on differences in machine construction (such as volume, pipework, branching, accumulators.), different pressure controller configurations may be required in pressure control.

The pressure controller configurations can be set or interrogated via the service or field bus interface in the valve software.

Setting and interrogation can be performed for example with the Moog Valve and Pump Configuration Software.

Up to 16 pressure controller configurations can be stored and activated during operation.

a Chap. "3.6 Moog Valve and Pump Configuration Software", page 54
3.4 Control

Valves without field bus interfaces must be commanded with an analog signal(s) via connector X1.
Valves with field bus interfaces can be controlled either with analog command signals via connector X1 or with digital signals via the field bus interface (connectors X3 and X4).

☞ Chap. "3.1.6 Signal interfaces", page 24
a Chap. "3.4.1 Signal types for set-point and actual value", page 44

DANGER

 Danger!
Danger due to electric shock.
▷ Only use SELV/PELV power supplies to supply the valve.
3.4.1 Signal types for set-point and actual value

Valves without field bus interfaces must be commanded with an analog signal(s) via connector X1. Depending on the variant, various signal types can be configured for the analog flow function input signal (input) and for the analog spool position signal (actual value output) applied to the X1 connector.

The signal type can be set via the service or fieldbus interface in the valve software. Setting and interrogation can be performed for example with the Moog Valve and Pump Configuration Software.

<table>
<thead>
<tr>
<th>Signal types for command signal</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>±10 V</td>
<td>Simple measurement of the signal, e.g. with an oscilloscope</td>
</tr>
<tr>
<td>±10 mA</td>
<td>In contrast to the 4–20 mA signal type, less power is required with low command signals;</td>
</tr>
<tr>
<td>4 to 20 mA</td>
<td>Detection of fault in the electrical line and large transmission lengths are possible</td>
</tr>
</tbody>
</table>

It is necessary when ordering the valve to establish which signal type for the analog command inputs is to be set in the valve on delivery. Which signal type has been set in the valve on delivery can be ascertained from the signal type identification, i.e. the 10th position in the type designation.

All current and voltage inputs are floating but can be connected to ground (single-ended) by means of external wiring.

Basically, activation of the command inputs with differential signals is to be preferred. If the command signal cannot be transmitted differentially, the reference point of the command input at the valve must be connected to ground (GND).

Because current inputs have a lower input resistance than voltage inputs and are therefore less prone to interference, a current signal is preferable to a voltage signal.

Pin assignment of connector X1:

Configuration: a Chap. "8.3 Configuration of the valves", page 135
3.4.1.1 Signal type identification

The signal type identification, i.e. the 10th position in the valve type designation, indicates which signal type for the command inputs is set in the valve when it is delivered.

The signal type of the command signal input applies in combination with the signal type of the spool position signal (actual value output).

The analog command signal $I_{in}$ or $U_{in}$ is the flow command value input. The stroke position signal (actual output value) $I_{out}$ or $U_{out}$ is proportional to the mechanical position of the spool.

The type designation and the signal type indicate the valve's delivery status. By changing the valve configuration, it is possible to change the valve in such a way that it no longer conforms to this status. Which signal type is currently set can be ascertained for example with the Moog Valve and Pump Configuration Software.

Type designation:

<table>
<thead>
<tr>
<th>Version</th>
<th>Command signals for 100 % spool stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Command signal (X1, input contacts 1 and 2)</td>
</tr>
<tr>
<td>D</td>
<td>$\pm 10$ V</td>
</tr>
<tr>
<td>E</td>
<td>4–20 mA</td>
</tr>
<tr>
<td>M</td>
<td>$\pm 10$ V</td>
</tr>
<tr>
<td>X</td>
<td>$\pm 10$ mA</td>
</tr>
<tr>
<td>9</td>
<td>Fieldbus</td>
</tr>
<tr>
<td>Y</td>
<td>Others on request.</td>
</tr>
</tbody>
</table>

Tab. 7: Signal types command value and spool position signal in the type designation

The analog command signal $I_{in}$ or $U_{in}$ is the flow command value input. The stroke position signal (actual output value) $I_{out}$ or $U_{out}$ is proportional to the mechanical position of the spool.

a Chap. "7 Electrical connection", page 68

a Chap. "11.1 Nameplates", Digit 10, Command signal for 100 % spool stroke, page 170

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3.4.1.2 Flow control command inputs

Signal type for the command input: ±10 mA

If there is no differential command input source available, the reference point of the command inputs must be connected to 0 V of the command input source (GND).

The operating direction of the command signal can be altered by modifying the parameters of the valve software.

DANGER

Danger of personal injury and damage to property!
The potential difference of each input to GND must be between -15 V and 32 V.
- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.

If there is no differential command input source available, the reference point of the command inputs must be connected to 0 V of the command input source (GND).

Signal type for the command input: ±10 V

The spool stroke is proportional to the input voltage \( U_{in} \).

- \( U_{in} = 10 \) V 100 % spool stroke, valve opening: P\( \rightarrow \)A and B\( \rightarrow \)T
- \( U_{in} = 0 \) V Spool in electrical zero position
- \( U_{in} = -10 \) V 100 % spool stroke, valve opening: P\( \rightarrow \)B and A\( \rightarrow \)T

Spool stroke [%] Command signal [V]

If there is no differential command input source available, the reference point of the command inputs must be connected to 0 V of the command input source (GND).

The operating direction of the command signal can be altered by modifying the parameters of the valve software.

Signal type for the command input: ±10 V

The spool stroke is proportional to the input current \( I_{in} \).

- \( I_{in} = 10 \) mA 100 % spool stroke, valve opening: P\( \rightarrow \)A and B\( \rightarrow \)T
- \( I_{in} = 0 \) mA Spool in electrical zero position
- \( I_{in} = -10 \) mA 100 % spool stroke, valve opening: P\( \rightarrow \)B and A\( \rightarrow \)T

Spool stroke [%] Command signal [mA]
If there is no floating command input source available, the reference point of the command inputs must be connected to 0 V of the command input source (GND).

The operating direction of the command signal can be altered by modifying the parameters of the valve software.

**Signal type for the command input: 4–20 mA**

The spool stroke is proportional to the input current $I_{in}$.

- $I_{in} = 20$ mA: 100 % spool stroke, valve opening: P→A and B→T
- $I_{in} = 12$ mA: Spool in electrical zero position
- $I_{in} = 4$ mA: 100 % spool stroke, valve opening: P→B and A→T

---

**Risk of valve electronic damage!**
The input current $I_{in}$ of the command inputs with current input signal must be between -25 mA and 25 mA! Voltage levels in excess of 5 V may cause the destruction of the integrated valve electronics.
- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.

---

**Danger of personal injury and damage to property!**
The potential difference of each input to GND must be between -15 V and 32 V.
- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.

---

CAUTION

Risk of valve electronic damage!
The input current $I_{in}$ of the command inputs with current input signal must be between -25 mA and 25 mA! Voltage levels in excess of 5 V may cause the destruction of the integrated valve electronics.
- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.
CAUTION

Danger of personal injury and damage to property!
In the signal range 4–20 mA command signals $I_{in} < 3$ mA (e.g. due to a faulty electric cable) indicate a fault.
- The valve response to this fault can be set and activated via the service or fieldbus interface in the valve software. Setting and activation can be performed for example with the Moog Valve and Pump Configuration Software.
- Examine the connection cables for defects.

CAUTION

Danger of personal injury and damage to property!
The potential difference of each input to GND must be between -15 V and 32 V.
- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.

If there is no floating command input source available, the reference point of the command inputs must be connected to 0 V of the command input source (GND). The operating direction of the command signal can be altered by modifying the parameters of the valve software.
### 3.4.1.3 pressure control command inputs

**Signal type for the command input: 0–10 V**

![Differential pressure control command input 0–10 V](image)

In the case of this signal type, the input is configured as a differential voltage input with a 0–10 V input range.

The pressure in control port A is proportional to the input voltage \( U_{in} \).

\[
\begin{align*}
U_{in} = 10 \text{ V} & \quad 100 \% \text{ pressure in control port A} \\
U_{in} = 0 \text{ V} & \quad 0 \% \text{ pressure in control port A}
\end{align*}
\]

The differential input resistance \( R_{In} \) is 20 kΩ.

The input resistance referenced to supply zero is approx. 150 kΩ.

---

**CAUTION**

Danger of personal injury and damage to property!

The potential difference of each input to GND must be between -15 V and 32 V.

- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.

If there is no differential command input source available, the reference point of the command inputs must be connected to 0 V of the command input source (GND).
Signal type for the command input: 0–10 mA

In the case of this signal type, the input is configured as a differential voltage input with a 0–10 mA input range.
The input current to be measured $I_{in}$ is directed via the two input pins to an internal shunt.
The pressure in control port A is proportional to the input current $I_{in}$.

- $I_{in} = 10 \text{ mA}$ 100 % pressure in control port A
- $I_{in} = 0 \text{ mA}$ 0 % pressure in control port A

The differential input resistance $R_{in}$ is 200 $\Omega$.
The input resistance referenced to GND is approx. 150 k$\Omega$.

**CAUTION**

Danger of personal injury and damage to property!
The potential difference of each input to GND must be between -15 V and 32 V.
- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.

**CAUTION**

Risk of valve electronic damage!
The input current must be between -25 mA and 25 mA. Input currents outside this permissible range will destroy the input.
- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.

If there is no differential command input source available, the reference point of the command inputs must be connected to 0 V of the command input source (GND).
Signal type for the command input: 4–20 mA

In the case of this signal type, the input is configured as a differential voltage input with a 4–20 V input range.
The input current to be measured $I_{in}$ is directed via the two input pins to an internal shunt.
The pressure in control port A is proportional to the input current $I_{in}$.

- $I_{in} = 20\ mA$ 100 % pressure in control port A
- $I_{in} = 4\ mA$ 0 % pressure in control port A

The differential input resistance $R_{in}$ is 200 $\Omega$.
The input resistance referenced to GND is approx. 150 $k\Omega$.

**CAUTION**

**Danger of personal injury and damage to property!**
In the signal range 4–20 mA command signals $I_{in} < 3\ mA$ (e.g. due to a faulty electric cable) indicate a fault.

- The valve response to this fault can be set and activated via the service or fieldbus interface in the valve software.
- Setting and activation can be performed for example with the Moog Valve and Pump Configuration Software.
- Examine the connection cables for defects.

**CAUTION**

**Danger of personal injury and damage to property!**
For the floating analog inputs of connector X1, the potential difference (referenced to supply zero) must be between -15 V and 32 V.

- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.

**CAUTION**

**Risk of valve electronic damage!**
The input current must be between -25 mA and 25 mA. Input currents outside this permissible range will destroy the input.

- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.
3.4.2 Analog actual value output

The valves have an analog actual value output:
The stroke position signal $I_{out}$ or $U_{out}$ (X1, contact 4) specifies the measured actual value of the position of the spool in the flow function.
The reference point for the analog output is GND (X1, contact 7).

The entire spool stroke corresponds to 4 to 20 mA or 2 to 10 V.

- $I_{out} = 20$ mA $U_{out} = 10$ V 100 % spool stroke, Valve opening: P→A and B→T
- $I_{out} = 12$ mA $U_{out} = 6$ V Spool in electrical zero position
- $I_{out} = 4$ mA $U_{out} = 2$ V 100 % spool stroke, Valve opening: P→B and A→T

External detection of electrical cable faults can be realized with the 4–20 mA and 2-10 V analog spool position signal.

$I_{out} = 0$ mA or $U_{out} = 0$ V suggests a cable break.

The actual value output 4–20 mA and 2–10 V is short-circuit-proof.

Signal types command signal and spool position signal in the type designation:
a Tab. 7, page 45
Pin assignment of connector X1:
a Chap. "7.4.1 Pin assignment of connector X1", page 76
Conversion of actual value output signals $I_{out}$ from 4–20 mA into 2–10 V:
a Chap. "7.14.2 Conversion of actual value output signals $I_{out}$", page 110

The 4–20 mA output can be transformed using this switch into 2–10 V or the valve can be ordered directly with a 2–10 V output.

3.4.3 Digital enable input

The valves have a digital enable input.

Switching of the valve to standby or fail-safe state can also be triggered by corresponding signals at the enable input of connector X1:
- Signals between 8.5 V and 32 V based on GND at the enable input switch the valve to standby.
- Signals lower than 6.5 V at the enable input switch the valve to fail-safe state.

Pin assignment of connector X1:
a Chap. "7.4.1 Pin assignment of connector X1", page 76
Fail-safe state of the valves:
a Chap. "3.2 Safety function/fail-safe", page 27
3.5 Configuration software

By changing the configuration of the software in the valve, the functionality of the valve can be influenced using the external configuration software.

CAUTION

Risk of personal injuries!
In case of malfunctions of the valve due to incorrectly-configured software, there is a danger due to uncontrolled movements of the higher-level machine and destruction in the area around the higher-level machine.

- When changing the configuration of the valve, make sure that the functionality of the valve matches that described in the operating instructions and the planned functionality.

The valve software is an integral part of the valve and cannot be altered, copied or replaced by the user.

Many of the functions made available by the valve software can be configured by the user by modifying parameters. For this purpose, the desired parameters must be transferred to the valve via the service or field bus interface. Parameters can basically be modified by each fieldbus node, for example also by the machine controller.

- If the valve is incorporated in a fieldbus, the parameters can be transferred to the valve each time the system is powered up. This ensures that the valve always receives the correct configuration of the valve software.

The Moog Valve and Pump Configuration Software is available as an accessory to simplify start-up, diagnosis and configuration of the valves.

a Chap. "3.6 Moog Valve and Pump Configuration Software", page 54
3.6 Moog Valve and Pump Configuration Software

The Moog Valve and Pump Configuration Software is a Microsoft® Windows® application enabling fast and convenient start-up, diagnosis and configuration of the valves.

The Moog Valve and Pump Configuration Software communicates with the valves via the service or CAN bus interface. A PC with a suitable interface card is required for this purposes.

The Moog Valve and Pump Configuration Software offers the following functions:

- Transfer of data between PC and valves
- Storage of the current valve settings on the PC
- Activation of the valves with graphic software control elements
- Graphic representation of status information, command signals and actual values as well as characteristic curves for the valves
- Recording and visualization of the system parameters with the integrated data logger and the integrated oscilloscope function

The Moog Valve and Pump Configuration Software is available as an accessory.

3.7 Nameplate

See "Technical data":
- a Chap. "11.1 Nameplates", page 164
- a Chap. "11.1.1 Model number and type designation", page 166
- a Chap. "11.1.2 LSS address", page 173
- a Chap. "11.1.3 Data matrix code", page 173
4 Characteristic curves

All characteristic curves are type-specific.
Flow rate characteristic curves, step response and frequency response characteristic curves:
a Chap. "11 Technical Data", page 162

4.1 Flow diagram (4-way operation)

Fig. 14: Flow diagram (4-way operation) D941K to D945K

Nominal pressure drop \( \Delta p_N \) = 10 bar (145 psi)
e.g. \( \Delta p_N = 5 \text{ bar (72.5 psi)} \) per control land

Q\(_{\text{max}}\) = 3600 l/min (0.3/0.5 gpm) (40 gpm)
Q\(_{\text{max}}\) = 1500 l/min (0.3/0.5 gpm) (40 gpm)
Q\(_{\text{max}}\) = 600 l/min (0.3/0.5 gpm) (40 gpm)
Q\(_{\text{max}}\) = 180 l/min

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The flow rate to be set depends not only on the position of the spool, but also on the pressure difference $\Delta p$ at the individual control lands.

A flow control command signal of 100% produces with a rated pressure difference of $\Delta p_N = 5$ bar (72.5 psi) per control land the rated flow $Q_N$. If the pressure difference is altered, so the flow $Q$ also changes with a constant command signal in accordance with the following formula:

$$ Q = Q_N \cdot \sqrt[4]{\frac{\Delta p}{\Delta p_N}} $$

- $Q$ [l/min]: actual flow
- $Q_N$ [l/min]: rated flow
- $\Delta p$ [bar/psi]: Actual pressure difference per control land
- $\Delta p_N$ [bar/psi]: Rated pressure difference $\Delta p_N = 5$ bar (72.5 psi) per control land

To avoid cavitation, the flow speed of the actual flow $Q$ calculated in this way at ports (P, A, B, X, Y and T) must not be too great.

The actual flow $Q$ calculated thus must not exceed a mean flow velocity of 30 m/s (96.54 ft/s) at ports P, A, B, X, Y and T.
4.2 Flow signal characteristic curve

The flow-signal characteristic curves are type-specific.

As an example, a linear characteristic curve of a D941K (cf. Fig. 17, P30) is depicted here.

![Flow signal characteristic curve](image1)

Fig. 15: Flow signal characteristic curve with equal electrical and hydraulic zero positions

![Design for measuring the flow signal characteristic curve](image2)

Fig. 16: Design for measuring the flow signal characteristic curve

![Valve D941K, flow-signal characteristic](image3)

Fig. 17: Valve D941K, flow-signal characteristic
4.3 Pressure signal characteristic curves 1)

4.3.1 Valves with controlled spool position

Fig. 18: Pressure signal characteristic curve of the valves with controlled spool position and zero lap

Fig. 19: Design for measuring the pressure signal characteristic curve on valves with a controlled spool position (example: D941K)

4.3.2 Pressure control valves

Fig. 20: Pressure characteristic curve of the pressure control valves

Fig. 21: Design for measuring the pressure signal characteristic curve on pressure control valves (example: D941K)

1) Typical characteristic curve
   (measured at operating pressure $p_P = 140$ bar, viscosity of the hydraulic fluid $\nu = 32$ mm$^2$/s and temperature of the hydraulic fluid $T = 40$ °C)
5 Transportation and Storage

WARNING

Danger of property damage!
In order to ensure perfect, reliable, and safe operation of the valves, heed the following:

- The valves must be protected in particular to prevent entry of dust and moisture.
- The permissible ambient conditions for the valves must be maintained at all times also in the case of transportation and storage.

[Chap. "11 Technical Data", page 162]

WARNING

Danger of explosion!
During transport and storage, cables on the valve, cable glands, screw plugs, and plug connectors must not be damaged.

- The valve must not be started up with damaged cables, connectors or screw plugs, and it must be sent to us or to one of our authorized service centers immediately.

CAUTION

Risk of injury!
To prevent injuries or other damaging influences on health, suitable protective measures must be taken if necessary prior to and when carrying out any work on the valves or the machine, such as mounting or removing, electrical or hydraulic connection, troubleshooting or servicing, and when handling the valves, accessories, tools or hydraulic fluids.

[Chap. "2.2 Occupational safety and health", page 15]

CAUTION

Risk of damage due to dirt and moisture!
This is the only way of adequately protecting the valves against the penetration of dirt and moisture and protecting the gaskets/seals against the effects of ozone and UV.

- The valves must not be transported or stored without their shipping plate fitted.
- The valve shipping plate may only be removed from the valve hydraulic ports directly prior to mounting and must be reinstalled directly after the valve has been removed.
- The shipping plate and the associated fastening elements (screws and nuts) must be kept for later use, e.g. during transportation.
CAUTION

Risk of damage due to condensation!
Due to temperature fluctuations during transport and storage of the valves, humidity may condense.
- Wait with the start-up of the valves until the valves have reached the ambient temperature

CAUTION

Risk of damage!
The plugs, connectors, and connection cables of the valves may not be used for other purposes, such as for stepping on or as transport holders.

CAUTION

Danger of personal injury and damage to property!
Warranty and liability claims for personal injury and damage to property are excluded if they are caused by valves, spare parts or accessories having been stored or transported outside their original packaging.
- Store and transport valves, spare parts, and accessories only in properly-sealed original packaging.
  - a Chap. "1.8 Warranty and liability", page 11.

CAUTION

Risk of damage!
Improper handling during transport or storage of the valves, spare parts, and accessories can cause damage to the original packaging and to the contents.
- After transporting or storing valves, spare parts and accessories, check the original packaging and contents for possible damage.
- Do not start up the system if the packaging or contents show signs of damage. In this case, notify us or the supplier responsible immediately.
- In the event of transportation damage, store the damaged packaging so that if necessary damages can be claimed from the transport contractor.
5.1 Checking/unpacking a delivery

**Procedure:**

1. Check whether the packaging is damaged.
2. Remove packaging.
3. Keep damaged packaging so that damage claims can be lodged against the transport company.
   We recommend that you keep the original packaging for later transportation or storage operations.
4. Dispose of packaging material that is no longer needed according to the local specific disposal regulations and environmental protection provisions.
5. Check whether the contents of the packaging are damaged.
6. In case of damaged packaging or damaged content, inform us and the responsible supplier immediately.
7. Check whether the delivery matches the order and the delivery note.
8. In case of incorrect or incomplete delivery, inform us or the responsible supplier immediately.

5.2 Scope of delivery of the valve

The scope of delivery of the valve consists of:

- Valve with mounted oilproof shipping plate at the hydraulic port
- For D941K:
  - 6 O-rings ID 12.4 x dia. 1.8 [mm] (0.49 x 0.07 in)
    (0.61 x 0.07 in) for ports A, B, P, T1 and X
  - 1 O-ring ID 15.6 x dia. 1.8 [mm] (0.61 x 0.07 in)
    for port Y
- For D942K:
  - 4 O-rings ID 21.89 x dia. 2.6 [mm] (0.86 x 0.10 in)
    (0.61 x 0.07 in) for ports A, B, P and T
  - 2 O-rings ID 10.82 x dia. 1.8 [mm] (0.43 x 0.07 in)
    for ports X and Y
- For D943K and D944K:
  - 4 O-rings ID 34.60 x dia. 2.6 [mm] (1.36 x 0.10 in)
    (0.61 x 0.07 in) for ports A, B, P and T
  - 2 O-rings ID 20.92 x dia. 2.6 [mm] (0.82 x 0.10 in)
    for ports X and Y
- For D945K:
  - 4 O-rings ID 53.60 x dia. 3.5 [mm] (2.11 x 0.14 in)
    (0.61 x 0.07 in) for ports A, B, P and T
  - 2 O-rings ID 14.00 x dia. 1.8 [mm] (0.55 x 0.07 in)
    for ports X and Y
- User manual D94xK type series
5.3 Storage

The following effects may occur in the course of long-term storage:

- Gasket/seal materials become brittle, possibly resulting in leaks
- Hydraulic fluid becomes gummy, possibly resulting in friction.

In order to avoid possible resulting impairments or damage, we recommend that the valve, after a period of storage or operation of more than 5 years, be inspected by us or one of our authorized service centers.
6 Mounting and Connection to the Hydraulic System

**DANGER**

Danger of injury due to electric voltage and unexpected movements!

Work on machines that are not shut down presents a danger to life and limb. Work such as mounting or removal, electrical or hydraulic connection, troubleshooting or servicing may only be performed on machines and valves that are shut down.

- Make sure to shut the machine down and switch it off.
- Make sure that the drive motor cannot be switched on.
- For this purpose, switch off the supply voltage as well as that of connected peripherals, such as externally powered transducers or programming units.
- Make sure that all power-transmitting components and connections (electrical and hydraulic) are switched off according to the manufacturer's instructions and secured against switching on again. If possible, remove the main fuse from the machine.
- Make sure that the machine is completely depressurized.

**DANGER**

Danger of poisoning and injury due to hydraulic fluid squirting out under pressure!

Contact with hydraulic fluids can damage your health (e.g. eye injuries, skin and tissue damage, poisoning in case of inhaling).

- Wear protective gloves and safety glasses.
- If hydraulic fluid gets into your eyes or on your skin, consult a doctor immediately.
- When handling hydraulic fluids, observe the safety provisions applicable to the hydraulic fluid used.

**WARNING**

Danger of explosion!

For mounting and connection to the hydraulic system, cables on the valve, cable glands, screw plugs, and plug connectors may not be damaged.

- The valve must not be started up with damaged cables, connectors or screw plugs, and it must be sent to us or to one of our authorized service centers immediately.

**CAUTION**

Risk of injury!

To prevent injuries or other damaging influences on health, suitable protective measures must be taken if necessary prior to and when carrying out any work on the valves or the machine, such as mounting or removing, electrical or hydraulic connection, troubleshooting or servicing, and when handling the valves, accessories, tools or hydraulic fluids.

- a Chap. "2.2 Occupational safety and health", page 15
6.1 Dimensions (installation drawings)

The dimensions of the valves depend on the series

a Chap. "11 Technical Data", page 162

6.2 Mounting surface

6.2.1 Surface quality

Evenness as per EN ISO 1302:  
< 0.01 mm (400 µin) over 100 mm (3.94 in)

Average roughness $R_a$ according to EN ISO 1302:  
< 0.8 µm (30 µin)

6.2.2 Holes in mounting surface

The details for the mounting surface depend on the series.

Holes in the mounting surfaces:

a Chap. "11 Technical Data", page 162
6.3 Mounting the valve

6.3.1 Tools and materials required

The following tools and materials are required for mounting the valves:

- For removing the shipping plate:
  Wrench for hexagon socket head cap screws or regular screwdriver (only valve D941K) and, if necessary, wrench

- For mounting the valve
  Torque wrench for hexagon socket head cap screws

- Installation screws

- Replacement for O-rings of ports to be replaced if necessary.

The installation screws and the O-rings to be replaced if necessary are not included in the scope of delivery for the valves. They are available as an accessory.  

- The wrench sizes of the hexagon socket cap head screws for mounting are type series-specific.
- Details about the screws and their tightening torque:
  a Tab. 8, page 65

The fastening screws for the transport plates are type-specific.
- Details about fastening screws and their tightening torque:

6.3.2 Specification for installation screws for the valves

<table>
<thead>
<tr>
<th></th>
<th>Hexagon socket head cap screws as per EN ISO 4762</th>
<th>Number required</th>
<th>Width across flats/ Tightening torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>D941K NG10</td>
<td>M6x40</td>
<td>4</td>
<td>WAF 5 11 Nm (8 lbf ft) ± 10 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D942K NG16</td>
<td>M6x55, M10x60</td>
<td>2, 4</td>
<td>WAF 5 11 Nm (8 lbf ft) ± 10 % WAF 8 54 Nm (40 lbf ft) ± 10 %</td>
</tr>
<tr>
<td>D943K and D944K NG25</td>
<td>M12x75</td>
<td>6</td>
<td>WAF 10 94 Nm (69 lbf ft) ± 10 %</td>
</tr>
<tr>
<td>D945K NG32</td>
<td>M20x90</td>
<td>6</td>
<td>WAF 17 460 Nm (339 lbf ft) ± 10 %</td>
</tr>
</tbody>
</table>

Tab. 8: Specification for installation screws for the valves
6.3.3 Procedure

CAUTION

Danger of personal injury and damage to property!
The shipping plate attachment screws must not under any circumstances be used to mount the valve.
- Use only the installation screws specified here for mounting the valve.
- The fastening of the valve with unsuitable screws can be destroyed under pressure.

CAUTION

Risk of damage due to dirt and moisture!
This is the only way of adequately protecting the valves against the penetration of dirt and moisture and protecting the gaskets/seals against the effects of ozone and UV.
- The valves must not be transported or stored without their shipping plate fitted.
- The valve shipping plate may only be removed from the valve hydraulic ports directly prior to mounting and must be reinstalled directly after the valve has been removed.
- The shipping plate and the associated fastening elements (screws and nuts) must be kept for later use, e.g. during transportation.

CAUTION

Danger of explosion and risk of damage due to overheating!
In order to prevent overheating of the valves.
- Mount the valves so that good ventilation is ensured.
- The maximum permissible temperatures of the respective temperature classes and the maximum permissible ambient temperature as well as the maximum permissible temperature of the hydraulic fluid may not be exceeded.
  a Chap. "1.3 Intended operation", page 5

CAUTION

Risk of damage!
Vibrations and shocks can damage the valve.
- Do not mount the valve directly on machine parts that are exposed to strong vibrations or sudden movement.
- On units that are moved in jerks and jolts, the movement direction of the spool should not be the same as the movement direction of the unit.a Chap. "11 Technical Data", page 162
Mounting and Connection to the Hydraulic System

Mounting the valve

**Procedure for mounting the valve:**

1. Clean the valve mounting and connecting surfaces. Check and if necessary correct the evenness and roughness of the mounting surface.
   - a Chap. "6.2.1 Surface quality", page 64

2. Remove the shipping plate from the valve's hydraulic port. The shipping plate and the associated fastening elements (screws and nuts) must be kept for later use, e.g. during transportation.

3. Check that O-rings in the valve ports (P, A, B, X, Y and T) are present and for elasticity, integrity and correct seating. If necessary, install O-rings, replace or correct the seating.

4. Paying attention to the mounting pattern, place the valve on the mounting surface and align with the mounting bores.

5. Secure the valve. To do so, tighten the installation screws (hexagon socket head cap screws) free from distortion in diagonal sequence. Tightening torque:
   - a Tab. 8, page 65

Due to the significant weight of the D945K valve, special measures must be taken during mounting and removal. There are two eye bolts screwed into the D945K valve for lifting and transport. Threaded holes are provided in the D943K and D944K valves, into which the eye bolts for lifting and transport can be screwed.
7 Electrical connection

7.1 Safety instructions for installation and maintenance

**DANGER**

**Danger of explosion!**
An explosion can be triggered by sparks when switching on the machine.

- Open connectors for the interface must absolutely be covered before start-up.
- The eXLink connectors from CEAG must be mounted according to the instructions in the operating instructions for the eXLink connectors.
- In the standard model with a screw plug, the service connector X10 is not permitted for use in a hazardous area.
- The service connector X10 in the standard model M8, 3-pin must be sealed with the original screw plug belonging to the valve before start-up.
- When mounting the screw plug for the service connector X10, make sure that the seal and the thread of the screw plug as well as the thread in the electronic housing of the valve are not damaged.
- In case of damage to the screw plug for the service connector X10 or the threads in the electronic housing, the valve must not be operated.
- Tightening torque for screw plug: a Chap. "3.1.3 Representative depiction of the valve", page 19

**WARNING**

**Danger of explosion!**
For the electrical connection of the valve, cables, cable glands, screw plugs, and connectors must not be damaged.

- The valve must not be started up with damaged cables, connectors or screw plugs, and it must be sent to us or to one of our authorized service centers immediately.

**WARNING**

**Danger of explosion!**
To guarantee safe operation in hazardous areas:

- The signal interfaces of the valve are implemented with explosion-proof connectors.
- For mounting and removal of the connectors as well as operation of the valve, the notes and instructions in the "Explosion-proof connectors eXLink, CEAG" operating instructions must absolutely be adhered to.
CAUTION

Danger of personal injury and damage to property from interchanged connections!
Interchanging connections causes unforeseeable movements of the machine and thus corresponding risks to people and equipment.
- When starting up valves on the field bus for the first time, we recommend that the component be operated in a depressurized state.
- Before connecting valves to the field bus, it is essential to complete the electrical and if necessary hydraulic connection of the component properly as described in the user manual.

CAUTION

Danger of personal and property damage due to defective accessories and defective spare parts!
Unsuitable or defective accessories or unsuitable or defective spare parts may cause damage, malfunctions or failure of the valve or the machine.
- Use only original accessories and original spare parts.

CAUTION

Danger of personal injury and damage to property!
Improperly laid connection cables can cause damage, malfunctions or failure of valves or the machine.
- Do not lay valve connection cables in the immediate vicinity of high-voltage cables or together with cables that switch inductive or capacitive loads.

CAUTION

Danger of personal injury and damage to property!
For the floating analog inputs of connector X1, the potential difference (referenced to supply zero) must be between -15 V and 32 V.
- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.

CAUTION

Danger of personal injury and damage to property!
In the signal range 4–20 mA input currents < 3 mA can cause faulty reactions with digital valves.
- Examine the connection cables for defects.
7.1.1 Protective grounding and electrical shielding

CAUTION

Risk of valve electronic damage!
In the signal range 4–20 mA command signals Iin < 3 mA (e.g. due to a faulty electric cable) indicate a fault.
- The valve response to this fault can be set and activated via the service or field bus interface in the valve software.
- Setting and activation can be performed with the Moog Valve and Pump Configuration Software, for example.
- Examine the connection cables for defects.

CAUTION

Risk of valve electronic damage!
The input current must be between -25 mA and 25 mA. Input currents outside this permissible range will destroy the input.
- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.

The valves described here must only be operated with external fuse protection. The information about the external fuse protection of the valves is included in Chapter 11.3 to 11.7.
a Tab. 37, page 176
a Tab. 38, page 187
a Tab. 39, page 198
a Tab. 40, page 209
a Tab. 41, page 220

DANGER

Danger of explosion in case of unsafe operation!
In order to create as small a potential difference in the machine as possible and guarantee safe operation of the machine, the equipotential bonding and protective conductor system for a machine in which the valves are to be used must be constructed according to EN 60204-1.
- Connect all elements of the machine to each other via equipotential bonding conductors.
- Connect all elements of the machine that have exposed metal surfaces to the protective conductor rail via protective conductors and equipotential bonding conductors.
- Connect all the protective conductors and the equipotential bonding conductor in the main cabinet via the protective conductor rail to the protective earth (PE) terminal.
7.1.2 Moog Valve and Pump Configuration Software

**CAUTION**

Danger of personal injury and damage to property!
Improper handling of the Moog Valve and Pump Configuration Software causes malfunctions and thus corresponding risks to people and equipment.
- For safety reasons, the Moog Valve and Pump Configuration Software must not be used inside a machine for visualization purposes or as an operator terminal.

**CAUTION**

Danger of personal injury and damage to property!
It is not permitted to operate the Moog Valve and Pump Configuration Software on a fieldbus while the machine is running. It is only permitted to activate valves via the Moog Valve and Pump Configuration Software if this does not cause any dangerous states in the machine and in its surroundings.
CAUTION

Danger of personal injury and damage to property!
Activating valves via the Moog Valve and Pump Configuration Software within a network can give rise to unforeseeable events if field bus communication takes place simultaneously between the machine control or other bus nodes!
- Deactivate the field bus communication for machine control and other bus nodes.

CAUTION

Danger of personal injury and damage to property!
Messages from the Moog Valve and Pump Configuration Software can also be received by other bus nodes. This may trigger unforeseeable events.
- Deactivate the field bus communication for machine control and other bus nodes.

CAUTION

Danger of personal injury and damage to property!
If danger-free operation of the valves via the Moog Valve and Pump Configuration Software can also not be ensured with deactivated field bus communication to the machine control and other bus nodes, the following must be heeded:
- The valves may only communicate with the Moog Valve and Pump Configuration Software in a depressurized state and via a direct connection (point-to-point).

CAUTION

Data loss!
Data exchange between the valve electronics and the Moog Valve and Pump Configuration Software may be disrupted if other fieldbus nodes (e.g., a controller) are accessing the valve electronics at the same time.
- Deactivate the field bus communication for machine control.
7.2 Block diagram

* Depending on the model, the valves can have different electrical connections.
7.3 Arrangement of connectors

The depiction of the electronics housing is exemplary for all sizes.

<table>
<thead>
<tr>
<th>Connector</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>Connectors, analog signals and supply voltage</td>
<td>a Chap. &quot;7.4 Connector X1&quot;, page 76</td>
</tr>
<tr>
<td>X2</td>
<td>Connector, optional digital signal interface</td>
<td>a Chap. &quot;7.7 Digital signal interface&quot;, page 82</td>
</tr>
<tr>
<td>X3</td>
<td>Connectors, analog signals</td>
<td>a Chap. &quot;7.9 Analog input connectors X5, X6 and X7&quot;, page 89</td>
</tr>
<tr>
<td>X4</td>
<td>Connectors, analog signals</td>
<td>a Chap. &quot;7.10 Service connector X10&quot;, page 92</td>
</tr>
<tr>
<td>X5</td>
<td>The fieldbus connectors X3 and X4 are only provided on valves with fieldbus interfaces.</td>
<td>a Chap. &quot;7.8 Field bus connectors X3 and X4&quot;, page 84</td>
</tr>
<tr>
<td>X6</td>
<td>The X10 service connector is only present for valves without CAN bus interface. By default, the X10 service connector is not approved for use in hazardous area, however on request it is available for use in hazardous area.</td>
<td>a Chap. &quot;7.10 Service connector X10&quot;, page 92</td>
</tr>
</tbody>
</table>

As standard, the electrical connection for the pilot valve is established by means of permanent cabling using explosion-proof cable entries.

If this cabling needs to be replaced during service work, there is the option of using cables with explosion-proof connectors. For this purpose, please select the letter R as character 5 in the type designation (see Chapter 13 "Ordering Information"). | a Chap. "13 Ordering Information", page 237 |
Allocation of interfaces to connectors

The valve electronics are equipped with connectors that are designated X1 through X10. The table below shows which interfaces are accommodated in the different connectors.

<table>
<thead>
<tr>
<th>Interface type</th>
<th>Interface</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog input</td>
<td>Analog input 0</td>
<td>X1</td>
</tr>
<tr>
<td></td>
<td>Analog input 2</td>
<td>X5</td>
</tr>
<tr>
<td></td>
<td>Analog input 3</td>
<td>X6</td>
</tr>
<tr>
<td></td>
<td>Analog input 4</td>
<td>X7</td>
</tr>
<tr>
<td>Analog output</td>
<td>Analog output 0</td>
<td>X1</td>
</tr>
<tr>
<td>Digital input</td>
<td>Digital input 0</td>
<td>X1</td>
</tr>
<tr>
<td>Digital output</td>
<td>Digital output 0</td>
<td>X1</td>
</tr>
<tr>
<td>Digital signal interface</td>
<td>SSI transducer</td>
<td>X2</td>
</tr>
<tr>
<td>Field bus interface</td>
<td>CANopen, Profibus-DP, EtherCAT</td>
<td>X3, X4</td>
</tr>
<tr>
<td>Service interface</td>
<td></td>
<td>X10</td>
</tr>
</tbody>
</table>

Tab. 9: Allocation of interfaces to connectors

The availability of the interface depends on the model.
7.4 Connector X1

Service connector X1 is designed in accordance with EN 175201-804 and is available in the following versions:

- 7-pin connector with protective conductor contact

7.4.1 Pin assignment of connector X1

![Assignment of service connector X1 (7-pin)](image)

View of male receptacle X1 on the valve (internal thread, pin contacts)

<table>
<thead>
<tr>
<th>Contact</th>
<th>Assignment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Analog input 0</td>
<td>Current or voltage input referenced to pin 2, setpoint Q</td>
</tr>
<tr>
<td>2</td>
<td>Reference point for analog input 0 and input 1</td>
<td>Reference point for pins 1 and 3</td>
</tr>
<tr>
<td>3</td>
<td>Analog input 1</td>
<td>Current or voltage input referenced to pin 2, setpoint p</td>
</tr>
<tr>
<td>4</td>
<td>Analog output 0</td>
<td>4–20 mA or 2–10 V referenced to GND, actual value Q</td>
</tr>
<tr>
<td>5</td>
<td>Analog output 1</td>
<td>4–20 mA or 2–10 V referenced to GND, actual value p</td>
</tr>
<tr>
<td>6</td>
<td>supply voltage</td>
<td>Nominal 24 V (18–23 V) DC based on GND</td>
</tr>
<tr>
<td>7</td>
<td>GND, supply zero or signal zero</td>
<td>GND</td>
</tr>
</tbody>
</table>

a Chap. "7.14 Wiring connector X1", page 108

7.4.2 Mating connector for connector X1

The mating connector for the 7-pin connector X1 is available as an accessory.

- a Chap. "12.1 Accessories for valves in the D94xK type series", page 232
- a Chap. "7.13 Permissible lengths for connection cables", page 104

Mating connector for connector X1
7.4.3 Power supply

**CAUTION**

**Risk of personal injury due to insufficient electrical safety**
The insulating elements used are designed for the safety extra low voltage range. The circuits of the field bus connections, if provided, are only functionally isolated from other connected circuits.

Compliance with the safety regulations requires that the equipment be isolated from the mains system in accordance with EN 61558-1 and EN 61558-2-6 and that all voltages be limited in accordance with EN 60204-1.

- Nominal signal: see nameplate.
- Only use SELV/PELV power supplies

---

**CAUTION**

**Risk of EMC damage!**
Improper electrical connections can damage the valve electronics and destroy the field bus communication.

- Make the electrical connection so that it is EMC-appropriate.

The supply voltage must be nominally 24 V (18–32 V) DC referenced to supply zero. Supply voltages of less than 18 V are detected by the valve electronics as undervoltage.

The valve electronics are protected against polarity reversal of the connections.

The power consumption of the valves varies from model to model.

7.5 Analog inputs/outputs

The analog inputs/outputs are available on service connector X1 and analog inputs optionally on connectors X5, X6, and X7. The analog inputs can measure both current and voltage.

7.5.1 Analog inputs

All current and voltage inputs are differential, but can be connected to ground (single-ended) by means of external wiring. The analog inputs of connector X1 have a resolution of 12 bits.

7.5.1.1 Signal types

The analog inputs on service connector X1 are available in the following versions:

- ±10 V
- 0–10 V
- ±10 mA
- 0–10 mA
- 4–20 mA

Which signal type is set for the analog inputs on delivery depends on the valve model. The signal types can be configured via the firmware.

Detailed information can be found in the "Firmware" User Manual.

**Signal type for the analog input: ±10 V**

In the case of this signal type, the input is configured as a differential voltage input with a ±10 V input range.

- The differential input resistance is 20 kΩ.
- The input resistance referenced to supply zero is approx. 150 kΩ.
- The potential difference of each input to supply zero must be between -15 V and 32 V.

If there is no differential analog source available, the reference point of the analog input (pin 5) must be connected to 0 V of the analog source.

**Signal type for the analog input: 0–10 V**

In the case of this signal type, the input is configured as a differential voltage input with a 0–10 V input range.

- The differential input resistance is 20 kΩ.
- The input resistance referenced to supply zero is approx. 150 kΩ.
- The potential difference of each input to supply zero must be between -15 V and 32 V.

If there is no differential analog source available, the reference point of the analog input (pin 5) must be connected to 0 V of the analog source.
Signal type for the analog input: ±10 mA

With this signal type, the input current to be measured is directed via the two input pins to an internal shunt.

The differential input resistance is 200 kΩ.

The input resistance referenced to supply zero is approx. 150 kΩ.

**CAUTION**

Risk of valve electronic damage!
The input current must be between -25 mA and 25 mA. Input currents outside this permissible range will destroy the input.

- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.

The potential difference of each input to supply zero must be between -15 V and 32 V.

If there is no floating analog source available, the reference point of the analog input (pin 5) must be connected to 0 V of the analog source.

Signal type for the analog input: 0–10 mA

With this signal type, the input current to be measured is directed via the two input pins to an internal shunt.

The differential input resistance is 200 kΩ.

The input resistance referenced to supply zero is approx. 150 kΩ.

**CAUTION**

Risk of valve electronic damage!
The input current must be between -25 mA and 25 mA. Input currents outside this permissible range will destroy the input.

- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.

The potential difference of each input to supply zero must be between -15 V and 32 V.

If there is no floating analog source available, the reference point of the analog input (pin 5) must be connected to 0 V of the analog source.
Signal type for the analog input: 4–20 mA

With this signal type, the input current to be measured is directed via the two input pins to an internal shunt.

The differential input resistance is 200 kΩ.

The input resistance referenced to supply zero is approx. 150 kΩ.

CAUTION

Risk of valve electronic damage!

The input current must be between -25 mA and 25 mA. Input currents outside this permissible range will destroy the input.

- Only use SELV/PELV power supplies.
- Heed the correct dimensioning of the cables.

The potential difference of each input to supply zero must be between -15 V and 32 V.

If there is no floating analog source available, the reference point of the analog input (pin 5) must be connected to 0 V of the analog source.

In the 4–20 mA signal range signals of I_{In} < 3 mA (e.g. due to a defective electric cable) signify a fault, which can be evaluated by the valve software. The monitoring must be activated in the valve software.

7.5.2 Analog outputs

Analog outputs 4–20 mA

The reference point for the 4–20 mA analog outputs is supply zero.

The load impedance must be in the range of 0–500 Ω.

Cable break detection of the connected cable can be effected with the 4–20 mA analog outputs.

The 4–20 mA analog outputs are short-circuit protected.

a Chap. "7.14.2.1 Valves with 7-pin connector X1", page 110

Analog outputs 2–10 V

The reference point for the 2–10 V analog outputs is supply zero.

The internal resistance is 500 Ω.

Cable break detection of the connected cable can be effected with the 2–10 V analog outputs.

Voltage drops in the supply cable to the valve electronics can result in deviations from the actual value. Therefore, this variant is not recommended.


Recommendation: Use a 4–20 mA analog output and terminate directly at the measurement input with 500 Ω. This way you get a 2-10V output without the disadvantages mentioned above.

a Chap. "7.14.2 Conversion of actual value output signals I_{out}", page 110
7 Electrical connection

Digital inputs/outputs

The digital inputs/outputs are available on service connector X1 depending on the model. The digital input serves as the enable input. Depending on the configuration, the digital output indicates specific events, such as for example the occurrence of a fault.

7.6 Digital inputs/outputs

7.6.1 Digital input

Digital enable input

Signals between 8.5 V and 32 V supply voltage referenced to supply zero at the enable input are identified as an enable signal.

Signals of less than 6.5 V at the enable input are identified as enable not issued. The electrical output stage is deactivated if no enable is issued or, depending on the versions, set to "HOLD".

This input is also used to acknowledge a valve fault state via an analog signal.

The input current of the digital enable input is 2.3 mA when connected to 24 V.

Detailed information can be found in the "Firmware pQ" user manual.

7.6.2 Digital outputs

The digital outputs are short-circuit protected and switch off in the event of overload. After a period of cooling down, the digital output switches itself back on. Overload means a current load greater than 1.5 A. However, the total current consumption of the valve must be limited by a fuse.

High Supply voltage connected.
Low Supply voltage disconnected (10 kΩ to supply zero).
7.7 Digital signal interface

The digital signal interface is available on connector X2. A digital transducer can be connected to this signal interface.

Connector X2 is available in the following versions:

- 7-pin SSI transducer connector X2
  
  a Chap. "7.7.1 SSI transducer", page 82

7.7.1 SSI transducer

This digital signal interface is suitable in accordance with EIA 422 for connecting e.g. position transducers or rotary transducers with an SSI interface.

The following transducer types are supported:

- Coded with binary code
- Coded with Gray Code

The digital signal interface must be configured.

---

Recommended cable types

Use exclusively shielded cables with copper braiding shielding with min. 80% overlap. Copper conductors with a cross section of at least 0.25 mm². Use cables with twisted-pair conductors in environments with high background noise levels.

Cable break monitoring

Inputs CLK and DATA of the digital signal interfaces are monitored for cable break – regardless of which transducer type is connected. The status of cable break monitoring can be read out via field bus. The reaction to a cable break is configurable.

---

Detailed information can be found in the "Firmware" User Manual.
7.7.1.1 Pin assignment SSI transducer connector X2

![View of SSI encoder female receptacle X2 on valve (external thread, socket contacts)](image)

<table>
<thead>
<tr>
<th>Contact</th>
<th>Assignment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CLK+</td>
<td>Clock pulse output</td>
</tr>
<tr>
<td>2</td>
<td>CLK-</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>DATA+</td>
<td>Data input for transducer data</td>
</tr>
<tr>
<td>4</td>
<td>DATA-</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>SensorSup</td>
<td>Supply voltage to SSI transducer 24 V / 5 V / 0 V (configurable; see &quot;Firmware&quot; User Manual)  $I_{max} = 300$ mA</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td>Supply zero</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>not used</td>
</tr>
</tbody>
</table>

**Power supply to the transducer**

Power is supplied to the transducer via pin 5 on connector X2.

There is joint fusing of this power supply for X2, X5, X6 and X7. The entire supply current may not exceed the following value:  $I_{max} (X2+X5+X6+X7) = 300$ mA

The 24 V or 5 V supply voltage is configurable (see "Firmware" User Manual). An external power supply to the transducer is also possible. However, the 0 V transducer supply must be connected to supply zero.

The supply voltage is cut off in the event of a possible short circuit in the supply voltage to the transducer. A fault reaction can be configured (see "Firmware" User Manual). The voltage is available again as soon as the short circuit has been eliminated.
7.8 Field bus connectors X3 and X4

Fieldbus connectors X3 and X4 are available in the following versions:

- 4-pin CAN connector
  a Chap. "7.8.1 CAN connectors", page 84
- 4-pin Profibus-DP connector
  a Chap. "7.8.2 Profibus-DP connectors", page 85
- 4-pin EtherCAT connector
  a Chap. "7.8.3 EtherCAT connectors", page 87

7.8.1 CAN connectors

The CAN bus has the following features:

- Multi-master system: Each node can transmit and receive
- Topology: Line structure with short stub lines
- Network expansion and transmission rates:
  25 m at 1 Mbit/s to 5,000 m at 25 kbit/s
- Addressing type: Message-orientated via identifiers
  Priority assignment of messages possible via identifiers
- Security: Hamming distance = 6, i.e. up to 5 individual errors per message are detected
- Physical bus: ISO 11898
- Max. nodes: 127 (via repeater)

7.8.1.1 Technical data for the CAN bus interface

<table>
<thead>
<tr>
<th>EMC protection requirements</th>
<th>Immunity to interference as per EN 61000-6-2 (evaluation criterion-A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Emitted interference as per EN 61000-6-4</td>
</tr>
<tr>
<td>Connectors X3 and X4</td>
<td>In each case a 4-pin plug connector with socket connectors (eXLink plug connector Fa. CEAG, coding 1h)</td>
</tr>
<tr>
<td></td>
<td>a Chap. &quot;7.8.1.2 Pin assignment, CAN connectors&quot;, page 85</td>
</tr>
<tr>
<td>Physical</td>
<td>ISO 11898 CAN-HIGH SPEED</td>
</tr>
<tr>
<td>Maximum voltage capacity</td>
<td>±40 V long-term (between CAN_H and CAN_L)</td>
</tr>
<tr>
<td></td>
<td>±500 V long-term referenced to supply zero (optical isolation)</td>
</tr>
<tr>
<td></td>
<td>±2.5 ESD (classification A: Human Body Model, C = 100 pF, R = 1.5 kΩ)</td>
</tr>
<tr>
<td>Maximum permissible number of CAN bus nodes</td>
<td>32 or 110</td>
</tr>
<tr>
<td></td>
<td>a Chap. &quot;7.16.2 Permissible number of CAN bus nodes&quot;, page 116</td>
</tr>
</tbody>
</table>

Tab. 10: Technical data for the CAN bus interface
7.8.1.2 Pin assignment, CAN connectors

<table>
<thead>
<tr>
<th>Contact</th>
<th>Assignment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CAN_V+</td>
<td>Not connected in the valve</td>
</tr>
<tr>
<td>2</td>
<td>CAN_GND</td>
<td>CAN terminal resistor</td>
</tr>
<tr>
<td>3</td>
<td>CAN_H</td>
<td>Transceiver H</td>
</tr>
<tr>
<td>4</td>
<td>CAN_L</td>
<td>Transceiver L</td>
</tr>
<tr>
<td>5</td>
<td>CAN_SHLD</td>
<td>Shield (applied on the control cabinet side)</td>
</tr>
</tbody>
</table>

Fig. 26: CAN connectors X3 and X4

View of CAN female receptacle X3 and X4 on valve
(external thread, socket contacts)

**CAUTION**

Danger of property damage due to improper plug connection!
In order to avoid damage to the explosion proof connector:
  - Heed the notes and instructions in the "Ex connector eXLink" operating instructions.

7.8.2 Profibus-DP connectors

The Profibus-DP has the following features:

- Standardized in accordance with EN 61158-2 (type 3)
- Multi-master system:
  Masters share access time and initiate communication.
  Slaves react only on request.
- Topology: Line structure with short stub lines
- Network expansion and transmission rates:
  100 m at 12 Mbit/s to 1,200 m at 9.6 kbit/s per segment
  Use of repeaters possible
- Addressing type: address-oriented
  Priority/cycle time assignment of messages via master configuration
- Physical bus: RS 485 according to TIA/EIA-485-A
  Max. nodes: 127
7.8.2.1 Technical data for the Profibus-DP interface

<table>
<thead>
<tr>
<th>EMC protection requirements</th>
<th>Immunity to interference as per EN 61000-6-2 (evaluation criterion-A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Emitted interference as per EN 61000-6-4</td>
</tr>
<tr>
<td>Connectors X3 and X4</td>
<td>In each case a 4-pin plug connector with socket connectors (eXLink plug connector Fa. CEAG, coding 5h) a Chap. “7.8.2.2 Pin assignment, Profibus-DP connectors”, page 86</td>
</tr>
<tr>
<td>Physical</td>
<td>Conformity as per test specification &quot;PROFIBUS slaves Version 2.0 of the PNO, Order-No: 2.032&quot;</td>
</tr>
<tr>
<td>Maximum voltage capacity</td>
<td>-9 V to 14 V (long-term) from signal cable to Profi GND ±500 V long-term referenced to supply zero (optical isolation) ±40 V with a pulse of 15 µs via a resistance of 100 Ω with an edge duration &lt; 100 ns.</td>
</tr>
<tr>
<td>Maximum permissible number of Profibus-DP nodes</td>
<td>32 bus nodes without repeater With repeater up to 126 nodes</td>
</tr>
</tbody>
</table>

Tab. 11: Technical data for the Profibus-DP interface

7.8.2.2 Pin assignment, Profibus-DP connectors

![Profibus DP connectors X3 and X4](image)

View of Profibus-DP female receptacle X3 and X4 on valve (external thread, socket contacts)

<table>
<thead>
<tr>
<th>Contact</th>
<th>Assignment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Profibus V+</td>
<td>Terminal resistors for RXD/TXD-P</td>
</tr>
<tr>
<td>2</td>
<td>Profibus A</td>
<td>RXD/TXD-N</td>
</tr>
<tr>
<td>3</td>
<td>Profibus A</td>
<td>Terminal resistors for RXD/TXD-N</td>
</tr>
<tr>
<td>4</td>
<td>Profibus B</td>
<td>RXD/TXD-P</td>
</tr>
<tr>
<td>5</td>
<td>Shield</td>
<td>Positioned on control cabinet side</td>
</tr>
</tbody>
</table>

Fig. 27: Profibus DP connectors X3 and X4

**CAUTION**

Danger of property damage due to improper plug connection!
In order to avoid damage to the explosion proof connector:
- Heed the notes and instructions in the "Ex connector eXLink" operating instructions.
7 Electrical connection

Field bus connectors X3 and X4

7.8.3 EtherCAT connectors

The EtherCAT bus has the following features:

- Standardized in accordance with IEC 62407
- Single-master system:
  The master initiates communication. Slaves react only on request.
- Topology:
  Line, star, tree and ring structure based on the daisy chain principle
- Network expansion and transmission rates:
  100 m between two nodes at 100 Mbit/s
- Addressing type: Address-orientated, one telegram for all nodes
- Physical bus: Fast Ethernet
- Max. nodes: 65,535

7.8.3.1 Technical data for the EtherCAT interface

<table>
<thead>
<tr>
<th>EMC protection requirements</th>
<th>Immunity to interference as per EN 61000-6-2 (evaluation criterion-A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connectors X3 and X4</td>
<td>In each case a 4-pin plug connector with socket connectors (eXLink plug connector Fa. CEAG, coding 5h)</td>
</tr>
<tr>
<td></td>
<td>a Chap. &quot;7.8.3.2 Pin assignment, EtherCAT connectors&quot;, page 88</td>
</tr>
<tr>
<td>Physical</td>
<td>4-core, paired cable as per CAT 5 for 100-Base-TX transmission</td>
</tr>
<tr>
<td></td>
<td>Network topology: Tree and line</td>
</tr>
<tr>
<td></td>
<td>Termination: device-internal</td>
</tr>
<tr>
<td></td>
<td>Transmission rate: 100 Mbit/s</td>
</tr>
<tr>
<td></td>
<td>As per EN 61158-2 Type 12 EtherCAT, &quot;PHYSICAL LAYER SPECIFICATION AND SERVICE DEFINITION&quot; and ISO/IEC 8802-3 100 Base-TX (IEEE 802.3 Section 24)</td>
</tr>
<tr>
<td>Maximum voltage capacity</td>
<td>±500 V long-term referenced to supply zero (optical isolation)</td>
</tr>
<tr>
<td>Maximum permissible number of EtherCAT bus nodes</td>
<td>65,536</td>
</tr>
<tr>
<td></td>
<td>The maximum number of nodes in a field bus line is 216.</td>
</tr>
</tbody>
</table>

Tab. 12: Technical data for the EtherCAT interface
7.8.3.2 Pin assignment, EtherCAT connectors

Contact | Assignment | Description |
---------|------------|-------------|
1        | TX+        | Transmit    |
2        | RX+        | Receive     |
3        | TX-        | Transmit    |
4        | RX-        | Receive     |

**CAUTION**

Danger of property damage due to improper plug connection!
In order to avoid damage to the explosion proof connector:
- Heed the notes and instructions in the "Ex connector eXLink" operating instructions.

To connect the valves to an EtherCAT network, we recommend molded cord sets with an integral straight mating connector.

a Chap. "7.18 Wiring EtherCAT networks (X3, X4)", page 120
7.9 Analog input connectors X5, X6 and X7

The analog inputs of connectors X5, X6 and X7 have a resolution of 14 bits.

7.9.1 Pin assignment, analog input connectors X5, X6 and X7

<table>
<thead>
<tr>
<th>Contact</th>
<th>Assignment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Transducer supply</td>
<td>+24 V, (I_{\text{max}} (X2+X5+X6+X7) = 300 \text{ mA}) referenced to pin 3</td>
</tr>
<tr>
<td>2</td>
<td>Reference point of analog input</td>
<td>Reference point for pin 4</td>
</tr>
<tr>
<td>3</td>
<td>Transducer supply 0 V</td>
<td>Supply zero</td>
</tr>
<tr>
<td>4</td>
<td>Analog input</td>
<td>Current or voltage input referenced to pin 2</td>
</tr>
</tbody>
</table>

Fig. 29: Analog input connectors X5, X6 and X7

a Chap. "7.19 Wiring analog inputs (X5, X6, X7)", page 123

Power supply to the transducer

The transducer is supplied with power via pin 1 of connectors X5, X6 and X7. There is joint fusing of this power supply for X2, X5, X6 and X7. The entire supply current may not exceed the following value: \(I_{\text{max}} (X2+X5+X6+X7) = 300 \text{ mA}\)

An external power supply to the transducer is also possible. However, the 0 V transducer supply must be connected to supply zero. An interruption of the transducer supply current can be identified as a cable break (see "Firmware" User Manual).

The supply voltage is cut off in the event of a possible short circuit in the supply voltage to the transducer. A fault reaction can be configured (see "Firmware" User Manual). The voltage is available again as soon as the short circuit has been eliminated.
7 Electrical connection

7.9.2 Signal types

The analog inputs are available in the following versions:

- ±10 V
- 0–10 V
- 0–10 mA
- 4–20 mA

The inputs can be operated in each case differentially or single-ended (one input cable referenced to supply zero).

Which signal type is set for the analog inputs on delivery depends on the valve model. The signal types can be configured via the firmware.

Detailed information can be found in the "Firmware" User Manual.

Signal type for the analog input: ±10 V

In the case of this signal type, the input is configured as either a differential or a single-ended voltage input with a ±10 V input range.

The potential difference of each input to supply zero must be between -15 V and 32 V.

If there is no differential analog source available, the reference point of the analog input (pin 2) must be connected to 0 V of the analog source.

Signal type for the analog input: 0–10 V

For this signal type, the input is either configured as a differential or as a single-ended voltage input with 0–10 V input range.

The potential difference of each input to supply zero must be between -15 V and 32 V.

If there is no differential analog source available, the reference point of the analog input (pin 2) must be connected to 0 V of the analog source.

Signal type for the analog input: 0–10 mA

In the case of this signal type, the input is configured as either a differential or a single-ended current input with a 0–10 mA input range.

The analog input is deactivated in the event of an excessively high input current.

The potential difference of each input to supply zero must be between -15 V and 32 V.

If there is no floating analog source available, the reference point of the analog input (pin 2) must be connected to 0 V of the analog source.
**Signal type for the analog input: 4–20 mA**

In the case of this signal type, the input is configured as either a differential or a single-ended current input with a 4–20 mA input range. The analog input is deactivated in the event of an excessively high input current.

The potential difference of each input to supply zero must be between -15 V and 32 V.

If there is no floating analog source available, the reference point of the analog input (pin 2) must be connected to 0 V of the analog source.

In the 4–20 mA signal range signals of \( I_{in} < 3 \text{ mA} \) (e.g. due to a defective electric cable) signify a fault, which can be evaluated by the valve software. The monitoring must be activated in the valve software.

### 7.9.3 Input resistances

The input resistances of the analog inputs are dependent on the set signal type and the version.

<table>
<thead>
<tr>
<th>Signal type</th>
<th>Version</th>
<th>( R_0 )</th>
<th>( R_1 )</th>
<th>( R_2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>Differential</td>
<td>200 kΩ</td>
<td>250 kΩ</td>
<td>10 kΩ</td>
</tr>
<tr>
<td>±10 V; 0–10 V</td>
<td>Single-ended</td>
<td>200 kΩ</td>
<td>250 kΩ</td>
<td>&lt; 12 Ω</td>
</tr>
<tr>
<td>Current</td>
<td>Differential</td>
<td>240 Ω</td>
<td>100 kΩ</td>
<td>10 kΩ</td>
</tr>
<tr>
<td>0–10 mA; 4–20 mA</td>
<td>Single-ended</td>
<td>252 Ω</td>
<td>100 kΩ</td>
<td>&lt; 12 Ω</td>
</tr>
</tbody>
</table>

Tab. 13: Input resistances X5, X6, X7

---

**Analog input: 4–20 mA**

**Input resistances**

**Fig. 30:** Equivalent circuit diagram of analog input
7.10 Service connector X10

This interface serves to connect diagnostic and start-up tools and is available on connector X10.

View of service connector X10; sunk in electronic housing
(external thread, pin contacts)

<table>
<thead>
<tr>
<th>Contact</th>
<th>Assignment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CAN_H</td>
<td>Transceiver H</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Not assigned</td>
</tr>
<tr>
<td>4</td>
<td>CAN_L</td>
<td>Transceiver L</td>
</tr>
</tbody>
</table>

Fig. 31: Service connector X10 (M8, 3-pin)

Valves without CAN bus interfaces can be started up and configured via the service interface (service connector X10) with the Moog Valve and Pump Configuration Software.

**WARNING**

**Danger of explosion!**

To guarantee safe operation in hazardous area:

- In its standard model with screw plug, the service connector X10 is not permitted for use in a hazardous area.
- For mounting of the screw plug of the service connector X10, it must be observed that the gasket and the threads of the screw plug as well as the threads in the electronic housing of the valve are not damaged.
- If there is damage to the screw plug of the service connector or the thread in the electronic housing, the valve must not be operated in hazardous areas.
- Tightening torque screw plug:
  a Chap. "3.1.3 Representative depiction of the valve", page 19
DANGER

Danger of explosion!
An explosion can be triggered by sparks when switching on the machine.
- Open connectors for the interface must absolutely be covered before start-up.
- The eXLink connectors from CEAG must be mounted according to the instructions in the operating instructions for the eXLink connectors.
- In the standard model with a screw plug, the service connector X10 is not permitted for use in a hazardous area.
- The service connector X10 in the standard model M8, 3-pin must be sealed with the original screw plug belonging to the valve before start-up.
- When mounting the screw plug for the service connector X10, make sure that the seal and the thread of the screw plug as well as the thread in the electronic housing of the valve are not damaged.
- In case of damage to the screw plug for the service connector X10 or the threads in the electronic housing, the valve must not be operated.
- Tightening torque for screw plug:
a Chap. "3.1.3 Representative depiction of the valve", page 19

For the standard model of the valve, the service interface is not suitable for use in hazardous areas. On request, the service interface is available in an explosion-proof model.
7.11 General notes on wiring

### DANGER

**Danger of explosion!**
An explosion can be triggered by sparks when switching on the machine.
- Open connectors for the interface must absolutely be covered before start-up.
- The eXLink connectors from CEAG must be mounted according to the instructions in the operating instructions for the eXLink connectors.
- In the standard model with a screw plug, the service connector X10 is not permitted for use in a hazardous area.
- The service connector X10 in the standard model M8, 3-pin must be sealed with the original screw plug belonging to the valve before start-up.
- When mounting the screw plug for the service connector X10, make sure that the seal and the thread of the screw plug as well as the thread in the electronic housing of the valve are not damaged.
- In case of damage to the screw plug for the service connector X10 or the threads in the electronic housing, the valve must not be operated.
- Tightening torque for screw plug:
  
  a Chap. "3.1.3 Representative depiction of the valve", page 19

### WARNING

**Danger of explosion!**
To guarantee safe operation in hazardous areas:
- The signal interfaces of the valve are implemented with explosion-proof connectors.
- For mounting and removal of the connectors as well as operation of the valve, the notes and instructions in the "Explosion-proof connectors eXLink, CEAG" operating instructions must absolutely be adhered to.

### CAUTION

**Danger of property damage due to improper plug connection!**
In order to avoid damage to the explosion proof connector:
- Heed the notes and instructions in the "Ex connector eXLink" operating instructions.
The following are required for electrically connecting the valves:

- Mating connector for connector X1 (7-pin)
- Connection cables for mating connector
- Crimping tool for mating connector with corresponding crimping insert
- Installation tool

The above-mentioned connectors, cables and tools are not included in the valve scope of delivery. They are supplied separately.

**7.11.2 Procedure**

Procedure for electrically connecting the valve:

1. Conduct electrical connection in accordance with the pin assignment.
   - a Chap. “7.4 Connector X1”, page 76
2. Establish equipotential bonding, protective grounding and electrical shielding.
   - a Chap. “7.12 Protective grounding, equipotential bonding, and shielding”, page 96
   - a Chap. “7.13 Permissible lengths for connection cables”, page 104
3. Valves with field bus interface: wire field bus.
   - a Chap. “7.16 Wiring CAN networks”, page 112
   - a Chap. “7.17 Wiring Profibus-DP networks (X3, X4)”, page 117
4. Check whether all the connectors and if necessary the service connector to which no mating connector is attached are covered with a suitable dust protection cap.
5. If necessary, put a dust protection cap on.

Make sure to heed the instructions and notes in the eXLink plug connector operating instructions from CEAG.

**7.11.3 Wiring of supply lines, evaluation of digital and analog signals**

Activation of the analog inputs with differential signals is to be preferred. If the signal cannot be transmitted differentially, the reference point of the input at the valve must be connected to ground (supply zero).


Because current inputs have a lower input resistance than voltage inputs and are thus immune to interference, activation with a current signal is to be preferred to activation with a voltage signal.

<table>
<thead>
<tr>
<th>Signal type</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>±10 V or 0–10 V</td>
<td>Simple measurement of the signal, e.g. with an oscilloscope.</td>
</tr>
<tr>
<td>±10 mA or 0–10 mA</td>
<td>Large transmission lengths are possible.</td>
</tr>
<tr>
<td>4–20 mA</td>
<td>Detection of faults in the electrical line and large transmission lengths are possible.</td>
</tr>
</tbody>
</table>

Tab. 14: Benefits of the different signal types for analog inputs
7.12 Protective grounding, equipotential bonding, and shielding

7.12.1 Overview

The valves with integrated electronics are equipped with a protective conductor connection (⋯) in the connector or on the valve body in accordance with the requirements of the standard EN 60204.

This chapter contains guidelines on protective grounding and electrical shielding of cables in applications in which the valves with integrated electronics are used.

**CAUTION**

Danger of personal injury and damage to property!
Improper protective grounding and shielding, as well as improper equipotential bonding, can cause damage, malfunctions or failures of the valve or the machine.

- The valves should only be used in such machines and plants that comply with the requirements of the standard EN 60204-1 and this chapter.

**CAUTION**

Risk of personal injury due to insufficient electrical safety
Compliance with the safety regulations requires that the equipment be isolated from the mains system in accordance with EN 61558-1 and EN 61558-2-6 and that all voltages be limited in accordance with EN 60204-1.

- Only use SELV/PELV power supplies!
7.12.2 Equipotential bonding and protective grounding

- The purpose of equipotential bonding is to establish as small a potential difference as possible within the machine.
- Protective grounding serves to maintain safety while the machine is in operation.
- The term protective earth or PE designates only a single point within the machine: the connection point of the external protective conductor. All additional connections to ground (接地) are established via protective and equipotential bonding conductors.

Fig. 32: Equipotential bonding and protective grounding of machines (see also EN 60204-1) and electrical shielding of our valves with integrated electronics
7.12.2.1 General principles

DANGER

Danger of explosion in case of unsafe operation!

In order to create as small a potential difference in the machine as possible and guarantee safe operation of the machine, the equipotential bonding and protective conductor system for a machine in which the valves are to be used must be constructed according to EN 60204-1.

- Connect all elements of the machine to each other via equipotential bonding conductors.
- Connect all elements of the machine that have exposed metal surfaces to the protective conductor rail via protective conductors and equipotential bonding conductors.
- Connect all the protective conductors and the equipotential bonding conductor in the main cabinet via the protective conductor rail to the protective earth (PE) terminal.

Observe the following points when performing equipotential bonding and protective grounding:

- Connect all elements of the machine to each other via equipotential bonding conductors.
- Connect all elements of the machine that have exposed metal surfaces via protective conductors to the protective conductor rail.
- Connect all the protective conductors and the equipotential bonding conductor in the main cabinet via the protective conductor rail to the protective earth (PE) terminal.

The cross section of the protective conductor is specified in EN 60204-1, Section 8. The following cross section have proven successful for equipotential bonding conductors:
- up to 200 m cable length: 16 mm²
- up to 200 m cable length: 25 mm²

The potential difference between any two points within the machine should not be more than 7 V peak (7 V).

- Connect the electrical shielding and the electrical ground of the electronics chassis point-to-point to the protective conductor rail.
- Before releasing a machine for normal operation, always check that all equipotential bonding and protective conductors are in proper working order in accordance with EN 60204-1, section 18.

7.12.2.2 Protective conductor

The valves must essentially only be operated with safe power supplies (SELV/PELV). No dangerous voltages are generated in the valve. Therefore, no protective conductor must be connected.

DANGER

Danger to life!

People can be injured and property damaged through the operation of the valve with an unsafe power supply.

- Only use SELV/PELV power supplies in accordance with EN 60204.
7.12.2.3 Ground loops

If a valve is connected to protective earth (PE) both via the equipotential bonding system and via the valve protective conductor, a compensating current can split in the resulting ground loop. This current can cause serious malfunctions in the machine.

Observe the following points in order to minimize as much as possible malfunctions caused by a ground loop:

- Route the valve supply and signal cables as closely as possible to the equipotential bonding conductor.
  
  [Chap. "7.12.3 Machines with deficient equipotential bonding", page 100]

- The impedance of the equipotential bonding system should be less than 10% of the impedance of the shielding of the lines.
7.12.3 Machines with deficient equipotential bonding

**DANGER**

Danger to life due to electric shock!
Very strong current can flow via the shield connection of the valve.
- Extreme caution is required since for some industrial applications, no good equipotential bonding can be implemented.
- An effective equipotential bonding system must be set up in compliance with EN 60204-1, Section 8.

7.12.4 Electrical shielding

An effectively shielded machine is, to a high degree, immune to external interference sources. Furthermore, the interference emitted by the machine is reduced considerably by effective shielding.

A functioning equipotential bonding system provides the basis for an effectively shielded machine. To ensure that the cables are effectively shielded, it is essential to satisfy the general requirements with regard to equipotential bonding and protective grounding.

**Requirements of cables**

- Only use shielded cables.
- The cable shield should be made of copper braiding with a minimum 80 % coverage.
- The individual conductors must be made of copper and have a minimum cross section of 0.2 mm² in accordance with EN 60204-1.
- Use cables with twisted pair conductors in environments with high background noise levels.
- The protective conductor should be guided within the cable shield.

**Deficient equipotential bonding**

- An effective equipotential bonding system provides the basis for an effectively shielded machine. To ensure that the cables are effectively shielded, it is essential to satisfy the general requirements with regard to equipotential bonding and protective grounding.

**Electrical shielding**

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**Requirements of cables**

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- The cable shield should be made of copper braiding with a minimum 80 % coverage.
- The individual conductors must be made of copper and have a minimum cross section of 0.2 mm² in accordance with EN 60204-1.
- Use cables with twisted pair conductors in environments with high background noise levels.
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**Deficient equipotential bonding**

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**Electrical shielding**

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- Only use shielded cables.
- The cable shield should be made of copper braiding with a minimum 80 % coverage.
- The individual conductors must be made of copper and have a minimum cross section of 0.2 mm² in accordance with EN 60204-1.
- Use cables with twisted pair conductors in environments with high background noise levels.
- The protective conductor should be guided within the cable shield.
7.12.4.2 Connecting the shield

When connecting the shielding, only connectors in the accessories for valves in the D67xK series may be used.

**Connection on the valve side**

Connect the cable shield conductively to the metal shell of the connector.

**Connection on control cabinet side**

Connection on the control cabinet side can be completed with either lead-through cables or connectors.

**Cable leadthrough**

Observe the following points when connecting the shield on the control cabinet side:

- Connect the control cabinet's wall conductively to the protective conductor rail (☞).
  
  [Fig. 32, page 97](#)

- Connect the cable shield correctly (flat, conductively) to the control cabinet's wall.

![Diagram of connecting shield on control cabinet side](image)

**WARNING**

**Danger due to electric shock!**

The shield of the cable must be laid correctly in order to prevent faults in the machine and injuries to people.

- Do NOT connect the shield of the cable with the electronics chassis.

- Lead the cable shield without interruption through the wall of the EMC-compliant control cabinet as closely as possible to the electronics chassis, e.g. by means of a cable gland.
Plug connection

Observe the following points when connecting the shield on the control cabinet side:

- Connect the control cabinet's wall conductively to the protective conductor rail (②).
  - Fig. 32, page 97
- Connect the shield of the cable coming from the valve to the housing of the removable connector.
  - The housing of the connector permanently mounted in the control cabinet must demonstrate a good-conducting connection with the wall of the control cabinet.
- Connect the connector mounted in the wall of the control cabinet to the shield inside the cabinet.

![Diagram showing the connection process](image)

Fig. 34: Connecting the cable shield via connector to the control cabinet's wall (detail A from Fig. 32)

- Lead the shield inside the control cabinet as closely as possible to the electronics chassis.

**WARNING**

Danger due to electric shock!
The shield of the cable must be laid correctly in order to prevent faults in the machine and injuries to people.

- Do NOT connect the shield of the cable with the electronics chassis.
7.12.4.3 Insulated shielding

If connecting the shield to both ends of the cable is not desirable, such as in a machine with deficient equipotential bonding, insulated shielding may be required. However, this is normally only necessary if it is not possible to establish a good equipotential bonding system.

Observe the following points when connecting insulated shielding:

- Use metal shell connectors with a leading protective earth contact-( средства ) in accordance with EN 60204-1.
- Connect the cable shield conductively to the metal shell of the connector.
- Connect the control cabinet's wall conductively to the protective conductor rail ( средства ).
  a Fig. 32, page 97
- Connect the cable shield via a capacitor (e.g. 10 nF / 100 VDC ceramic capacitor) to the control cabinet's wall.

![Diagram of connecting insulated shielding to the control cabinet's wall](image)

- Install a separate shield connected to the control cabinet's wall inside the control cabinet. Route this shield as closely as possible to the electronics chassis.

**WARNING**

**Danger due to electric shock!**  
The shield of the cable must be laid correctly in order to prevent faults in the machine and injuries to people.  
- Do NOT connect the shield of the cable with the electronics chassis.
7.12.4.4 Cable routing

The routing of the cable inside a machine must comply with the following general guidelines:

- Route supply and signal cables in separate cable conduits.
- In order to minimize malfunctions caused by a ground loop, route the valve connection cables as closely as possible to the equipotential bonding conductor. 
  a Chap. "7.12.2.3 Ground loops", page 99
- Do not route cable conduits near strong electromagnetic interference sources, such as electric motors or transformers.
- If the cable routing cannot eliminate the risk of lightning strokes completely, suitable protective measures must be taken, as described in EN 60204-1.

7.13 Permissible lengths for connection cables

7.13.1 Introduction

The valves with integrated electronics are supplied via 24 V supply cables and controlled via analog or field bus cables.

This section of the chapter is intended to serve as a guide to dimensioning and configuring supply and signal cables in order to guarantee adequate supply voltage and signal quality for all the permissible valve operating states.

The maximum permissible length of supply and signal cables is limited by the resistance and the capacitance per unit length of the cables.

7.13.2 Typical values for copper cables

The typical values specified here are used in the example calculations in the following sections.

7.13.2.1 Resistance of cable

The typical resistance $R_{typ}$ of a copper cable of length $l$ is calculated as follows:

$$ R_{typ} = \frac{\rho_{Cu}}{q_{typ}} \cdot l = 23.73 \frac{\text{m} \cdot \Omega}{\text{m}} \cdot l $$

$q_{typ} = 0.25 \text{ mm}^2$  Typical cross section used for connection cables

$\rho_{Cu} = 0.0178 \frac{\text{mm}^2}{\text{m}}$  Resistivity of copper at 20 °C
7.13.2.2 Capacitance of cable
The typical capacitance per unit length of copper cables is 50 pF/m.
The typical capacitance \( C_{\text{typ}} \) of a copper cable of length \( l \) is calculated as follows:

\[
C_{\text{typ}} = \frac{50 \, \text{pF}}{\text{m}} \cdot l
\]

7.13.3 24V supply cables
The maximum permissible length \( l_{\text{max}} \) of the supply cable is calculated as follows:

\[
l_{\text{max}} = \frac{U_{\text{dr, max}}}{\left( \frac{U_{\text{ab}}}{l} \right)_{\text{typ}}}
\]

\[
U_{\text{dr, max}} = l_{\text{max}} \cdot \left( \frac{U_{\text{ab}}}{l} \right)_{\text{typ}}
\]

- \( U_{\text{min}} = 18 \, \text{V} \) Lowest permissible supply voltage for valve
- \( U_{\text{dr, max}} = 6 \, \text{V} \) Maximum permissible voltage drop over the supply cable
  \( U_{\text{dr, max}} = 24 \, \text{V} - U_{\text{min}} \)

- \( \left( \frac{U_{\text{ab}}}{l} \right)_{\text{typ}} \) voltage drop per unit length

A Chap. "7.13.3.1 Voltage drop per unit length", page 106

This calculation does not take into account a possible reduction of the power supply output voltage on account of the connected load. Nor does it take into account any voltage dips that can occur at the moment when additional loads are connected.
7.13.3.1 Voltage drop per unit length

Fig. 36: Voltage drop on the supply cable

The voltage drop per unit length over the forward and return lines of the supply cable is calculated as follows:

\[
\left( \frac{U_{ab}}{I} \right)_{\text{typ}} = 2 \cdot I_{\text{max}} \cdot \left( \frac{R_{\text{typ}}}{I} \right) = 2 \cdot I_{\text{max}} \cdot 23.73 \frac{\text{m}\Omega}{\text{m}}
\]

- \( I_{\text{max}} \): Maximum current consumption of valve (see product-specific valve user manual)
- \( R_{\text{typ}} \): Typical resistance of the cable
- \( l \): Length of the supply cable

7.13.3.2 Examples of the voltage drop of supply cables

<table>
<thead>
<tr>
<th>Valve series</th>
<th>Max. current consumption ( I_{\text{max}} )</th>
<th>Voltage drop ( \left( \frac{U_{ab}}{l} \right)_{\text{typ}} )</th>
<th>Max. permissible cable length ( \lambda_{\text{max}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>D67xK + D94xK</td>
<td>350 mA</td>
<td>17 mV/m</td>
<td>364 m</td>
</tr>
</tbody>
</table>

Tab. 15: Examples of the voltage drop of supply cables as a function of the cable length for a cable cross section of 0.75 m²
7.13.4 Analog signal cables

Influence of resistance R

The influence of the resistance R of the cable used on the maximum cable length \(l_{\text{max}}\) for signal cables is very low, as the currents flowing through signal cables are very low.

**Example:**
For a cable length \(l\) of 428 m the resistance \(R\) according to the formula below is only \(10\ \Omega\).

\[
R = \frac{\rho_{\text{Cu}}}{\eta_{\text{typ}}} \cdot l = 23.73 \ \frac{\text{m}}{\text{m}} \cdot 428 \text{ m} = 10 \ \Omega
\]

Influence of capacitance per unit length

The influence of the capacitance per unit length of the cable used on the maximum cable length \(l_{\text{max}}\) for signal cables is considerably greater.

The capacitance \(C\) that increases with the cable length forms with the input resistance \(R\) of an analog input a high pass of the first order, which can couple high-frequency interference for example at signal inputs. The limit frequency \(f_l\) of the high pass is calculated as follows:

\[
f_g = \frac{1}{2 \cdot \pi \cdot R \cdot C}
\]

The longer the cable, the lower the limit frequency \(f_l\) of the high pass.

**Example:**
A cable length \(l\) of 10 m and a typical analog input resistance \(R\) of 10 k\(\Omega\) produce according to the formula below a limit frequency \(f_l\) of 32 kHz.

\[
\begin{align*}
\frac{1}{2 \cdot \pi \cdot R \cdot C} &= \frac{1}{2 \cdot \pi \cdot 10 \ \text{k}\Omega \cdot 50 \ \frac{\text{pF}}{\text{m}} \cdot 10 \text{ m}} \\
\end{align*}
\]

\[
f_g = 32 \text{ kHz}
\]

Recommendations

With a differential voltage command signal and a cable length \(l\) of 10 m the EMC test was conducted in accordance with **EN 61000-6-2**. The interference on the spool position during the interference (electromagnetic coupling, transient) was below 1 %. This can worsen as the cable is lengthened.

Experience shows that with cable lengths over 15 m a current input should be used, as here the input resistance is smaller by a factor of 50. The limit frequency \(f_l\) of the high pass also increases by the same factor, and with it the input becomes more immune to interference.

Furthermore, the voltage drop on the cable does not have an effect in the event of a current command signal.

A differential input is always to be recommended, regardless of whether a voltage or current signal is used as the command signal, since interference coupled on the two input cables is subtracted to virtually zero.
7.13.5 Digital signal cables

7.13.5.1 Digital signal input cables
Digital signal input cables, such as enable, are more non-critical with regard to their cable lengths, because the currents are low (< 20 mA) and a greater noise level distance is easier to maintain, since only two states/levels must be differentiated.

7.13.5.2 Digital signal output cables
With digital signal output cables, such as monitoring and standby, currents up to 1.5 A are encountered. In these cases, the voltage drop over longer cables can no longer be neglected. Thus, these cables are subject to the same requirements as supply cables.

7.13.5.3 Field bus cables
In the case of digital field bus cables, the maximum possible cable lengths are very different. For the most part the cable ends are terminated with low resistance (power adaptation) in order to avoid signal reflections, which permits longer cable lengths. The maximum possible cable lengths are laid down in the standards of the relevant field buses and depend among other things on the transmission rate used.

7.14 Wiring connector X1

Fig. 37: Wiring of the 7-pin connector X1 pQ valve
7.14.1 Single-ended command signals

Basically, activation of the command inputs with differential signals is to be preferred. If the command signal cannot be transmitted differentially, the reference point of the command input at the valve must be connected to ground (GND).

Fig. 38: Circuit for single-ended command signals

If the command inputs are connected to ground (single-ended), the connection cable must be as short as possible and have an appropriately large cross section in order to keep the voltage drop as low as possible.

The voltage drop on the forward and return lines is generated by the supply current $I_{\text{supply}}$ of the valve electronics power circuit. It is proportional to the length of the connection cable and varies according to the valve status.

Maximum permissible cable lengths:

- Chap. "7.13 Permissible lengths for connection cables", page 104

The voltage drop $U_{\text{cable}}$ on the return line and the resulting potential shift of ground (supply zero) results in not the command signal $U_{\text{comm}}$, but rather the input voltage $U_{\text{in}}$ being applied at the command input in accordance with the following equation:

$$U_{\text{in}} = U_{\text{comm}} - U_{\text{cable}}$$

In the case of command signal sources with impressed current $I_{\text{comm}}$, the potential shift of ground (supply zero) has no effect on the signal. However, changes in the voltage drop resulting from the valve's varying current consumption must be corrected by the command signal source. If current control does not follow the voltage change in terms of time, the command signal at the valve input may also be affected here.

- Input voltage $U_{\text{in}} = U_{\text{comm}} - U_{\text{cable}}$

- Command signal sources with impressed current $I_{\text{comm}}$

The function of single-ended command inputs is identical to the function of differential command inputs.
### 7.14.2 Conversion of actual value output signals \( I_{\text{out}} \)

The actual value output signals \( I_{\text{out}} \) 4–20 mA can be converted into \( U_{\text{out}} \) 2–10 V in accordance with the following circuit.

#### 7.14.2.1 Valves with 7-pin connector X1

![Conversion circuit diagram](image)

**Fig. 39: Conversion of actual value output signals \( I_{\text{out}} \)
(for valves with 7-pin connector X1)**

Conversion of actual value output signals \( I_{\text{out}} \)
4–20 mA into 2–10 V
7.15 Wiring SSI transducers (X2)

An SSI transducer delivers an absolute position or angle signal, which can be read in via the digital signal interface.

7.15.1 SSI master mode

In SSI master mode the integrated electronics generate internally the SSI clock signal (CLK) with settable frequencies in the range between 78 kHz and 5 MHz.

Detailed information can be found in the "Firmware" User Manual.

In the rest state the clock signal is at 1. The first falling edge of the clock signal signals to the SSI transducer to maintain its current value. The following rising edge of the clock signal starts the data transmission of the SSI transducer. The output starts with the highest-value bit (MSB). After a complete data record has been transmitted, the SSI transducer holds the data signal at 0 until it is ready for a new transmission. The switching back of the data signal to 1 simultaneously satisfies the start condition for the SSI interface for triggering a new read-in cycle.

Fig. 40: Wiring diagram with SSI transducer

Fig. 41: Signals between valve and a 16-bit SSI transducer (example)

The signal levels conform to the standard EIA-422.

SSI transducers can be used with either Gray codes or binary coded data. A maximum of 32 bits is possible.

Detailed information can be found in the "Firmware" User Manual.
7.16 Wiring CAN networks

The valves are equipped with an electrically isolated CAN interface depending on the model. The CAN interface is supplied internally.

Procedure for connecting the valve to the CAN bus

<table>
<thead>
<tr>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Establish the electrical connection to the CAN bus.</td>
</tr>
<tr>
<td>2. Set the module address.</td>
</tr>
<tr>
<td>3. Set the transmission rate.</td>
</tr>
<tr>
<td>4. Check the configuration of the valve software and the controller settings.</td>
</tr>
</tbody>
</table>

Observe the following points when wiring CAN networks:

- All cables, connectors and terminal resistors used in CAN networks should comply with ISO 11898.
- Correct version of protective grounding and electrical shielding.
- Use shielded cables with four cores (twisted pair) and surge impedance of 120 Ω (CAN_H, CAN_L, CAN_GND and CAN_SHLD grounded).
- A CAN bus cable must not branch but short stub cables with T-connectors are permitted.
- Stub cables must be as short as possible.
- Maximum stub cable length: 115
- The cable between CAN_L and CAN_H at both CAN bus cable ends must be ended by a terminal resistor of 120 Ω ± 10 %.
- Reference potential CAN_GND and CAN_SHLD may be connected to protective earth/ground (PE) at one point only (on a connector with terminal resistor, for example).
- A terminal resistor can be omitted if the valve-internal terminal resistor (deactivated as standard) is activated (for configuration, see "Firmware" User Manual).
- The transmission rate must be adapted to the CAN bus cable length.

CAUTION

Danger of personal injury and damage to property!
Failure to heed safety instructions causes malfunctions and thus corresponding risks to people and equipment.
- Please heed all the safety instructions prior to and during start-up.

1. Establish the electrical connection to the CAN bus.
   a Chap. "7.8.1 CAN connectors", page 84
2. Set the module address.
   a Chap. "7.16.3 CAN module address (node ID)", page 116
3. Set the transmission rate.
   a Chap. "7.16.4 CAN transmission rate", page 116
4. Check the configuration of the valve software and the controller settings.
• The maximum permissible number of CAN bus nodes in the CAN network must not be exceeded.
  a Chap. “7.16.2 Permissible number of CAN bus nodes”, page 116
• Do not lay CAN Bus cables in the immediate vicinity of disturbance sources. If interference sources cannot be avoided, use double-shielded cables.

Fig. 42: CAN wiring diagram

In the customer-side eXLink connector, a bridge must be set internally between pin 3 and pin 2 if the terminal resistor should be switched. The looping through of a supply voltage is not possible with this type of terminal resistor.

Fig. 43: Connection of the CAN bus valve with terminal resistor

For CAN bus nodes without a galvanically isolated CAN bus interface, CAN_GND is generally connected to supply voltage GND inside the device. In these cases, the power supply connection cable must be grounded at the same point inside the machine as the CAN_GND connection cable. Maximum interference immunity is achieved in extensive CAN networks by using solely CAN bus nodes with galvanically isolated CAN bus interface. If it is not possible to dispense with CAN bus nodes without galvanically isolated CAN bus interface, arrange these nodes in the immediate vicinity of the central ground point. The cable length to this central ground point is to be kept as short as possible. It is particularly important in this respect to ensure that the equipotential bonding line is properly dimensioned!
Fig. 44: Connection of the valve to a PC via the CAN bus interface (field bus connector X3)

**DANGER**

**Danger of explosion!**

To guarantee safe operation in a hazardous area:

- In its standard model with screw plug, the service connector X10 is not permitted for use in a hazardous area.
- For mounting of the screw plug of the service connector X10, it must be observed that the gasket and the threads of the screw plug as well as the threads in the electronic housing of the valve are not damaged.
- If there is damage to the screw plug of the service connector or the thread in the electronic housing, the valve must not be operated in hazardous areas.
- Tightening torque screw plug: a Chap. "3.1.3 Representative depiction of the valve", page 19

The use of the service interface in the standard version is only permitted outside the hazardous areas.
7.16.1 Cable lengths and cable cross sections

<table>
<thead>
<tr>
<th>Transmission rate</th>
<th>Maximum cable length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 kbit/s</td>
<td>25 m</td>
</tr>
<tr>
<td>800 kbit/s</td>
<td>50 m</td>
</tr>
<tr>
<td>500 kbit/s</td>
<td>100 m</td>
</tr>
<tr>
<td>250 kbit/s</td>
<td>250 m</td>
</tr>
<tr>
<td>125 kbit/s</td>
<td>500 m</td>
</tr>
<tr>
<td>100 kbit/s</td>
<td>650 m</td>
</tr>
<tr>
<td>50 kbit/s</td>
<td>1000 m</td>
</tr>
<tr>
<td>20 kbit/s</td>
<td>2500 m</td>
</tr>
</tbody>
</table>

Tab. 16: Recommendation for maximum cable lengths in CAN networks, depending on the transmission rate

<table>
<thead>
<tr>
<th>Cable cross section</th>
<th>Maximum cable length for n CAN bus nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 32</td>
</tr>
<tr>
<td>0.25 mm²</td>
<td>200 m</td>
</tr>
<tr>
<td>0.50 mm²</td>
<td>360 m</td>
</tr>
<tr>
<td>0.75 mm²</td>
<td>550 m</td>
</tr>
</tbody>
</table>

Tab. 17: Recommendation for maximum cable lengths in CAN networks, depending on the cable cross section and the number n of CAN bus nodes

<table>
<thead>
<tr>
<th>Transmission rate</th>
<th>Maximum stub cable length</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 kbit/s</td>
<td>2 m</td>
<td>20 m</td>
</tr>
<tr>
<td>500 kbit/s</td>
<td>6 m</td>
<td>39 m</td>
</tr>
<tr>
<td>250 kbit/s</td>
<td>6 m</td>
<td>78 m</td>
</tr>
<tr>
<td>125 kbit/s</td>
<td>6 m</td>
<td>156 m</td>
</tr>
</tbody>
</table>

Tab. 18: Maximum permissible stub cable lengths in CAN networks

7.16.1.1 Suitable cable types for CAN networks

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surge impedance</td>
<td>120  Ω</td>
</tr>
</tbody>
</table>

Tab. 19: Specification of electrical data for CAN bus cables

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Cable type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web:</td>
<td><a href="http://www.draka-mog.com">http://www.draka-mog.com</a></td>
</tr>
<tr>
<td>Draka</td>
<td>ToughCAT7 Mud Protected</td>
</tr>
</tbody>
</table>

Tab. 20: Suitable cable types for CAN networks
7.16.2 Permissible number of CAN bus nodes

The CAN bus interface for the valve electronics supports integration in CAN networks with up to 110 CAN bus nodes. However, the maximum permissible number of CAN bus nodes can be restricted by other nodes with an older CAN bus driver to 32.

A maximum of 127 nodes can be operated in a CAN network thanks to the use of repeaters. However, it is necessary to bear in mind here the additionally inserted signal propagation time, which limits the maximum expansion of the CAN network.

7.16.3 CAN module address (node ID)

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Danger due to malfunctions!</strong></td>
</tr>
<tr>
<td>A multiple use of module addresses causes malfunctions and thus corresponding dangers to people and equipment.</td>
</tr>
<tr>
<td>▶ Each module address may only be used once within a CAN bus network.</td>
</tr>
</tbody>
</table>

The factory setting for the module address of the valve electronics is 127. The module address can be changed with the LSS services (Layer Setting Services) via the CAN bus. If there are no additional nodes present on the CAN bus, it is possible to set the node ID via the LSS Service Switch Mode Global. To change the module address of the valve electronics with a CAN bus network, it is essential to address the valve electronics unambiguously via the LSS address. The node ID is then set via the LSS Service Switch Mode Selective. It is also possible to configure the module address via service interface X10.

The module address of the valve electronics can also be altered with the Moog Valve and Pump Configuration Software.

7.16.4 CAN transmission rate

The transmission rate must be set to the same value for all the CAN bus nodes within a CAN bus network. The factory setting for the transmission rate is 500 kbit/s. The transmission rate can be changed with the LSS services (Layer Setting Services) via the CAN bus. The transmission rate of the valves/pumps can also be altered with the Moog Valve and Pump Configuration Software.
7.17 Wiring Profibus-DP networks (X3, X4)

The valves are equipped with an electrically isolated Profibus-DP interface depending on the model. The Profibus-DP interface is supplied internally.

Procedure for connecting the valves to the Profibus-DP

**CAUTION**

Danger of personal injury and damage to property!
Failure to heed safety instructions causes malfunctions and thus corresponding risks to people and equipment.
- Please heed all the safety instructions prior to and during start-up.

1. Establish the electrical connection to the Profibus-DP.
   a Chap. “7.8.2 Profibus-DP connectors”, page 85

2. Set the module address.
   a Chap. “7.17.3 Profibus-DP module address (node ID)”, page 119

3. Check the configuration of the valve software and the controller settings.

Observe the following points when wiring Profibus-DP networks:

- It is recommended to use 2-core Profibus cables so as to prevent the power supply to the terminal resistors from being connected in parallel.
- The specification EN 61158-2 describes two cable types. Type B can be used with limitation.
- Stub cables must be as short as possible.
- Avoid stub cables in the case of transmission rates in excess of 1,500 kbit/s.
- If stub cables are used, do not use any terminal resistors in this branch.
- The stub cable length in the case of transmission rates in excess of 1,500 kbit/s should not exceed 6.6 m in total.
7 Electrical connection

Wiring Profibus-DP networks (X3, X4)

Wiring diagram of the Profibus-DP networks

Fig. 45: Profibus-DP wiring diagram

Customer-side connection of Profibus to the valve if terminal resistor is required

Fig. 46: Connection valve Profibus with terminal resistor

7.17.1 Cable lengths and cable cross sections

<table>
<thead>
<tr>
<th>Transmission rate</th>
<th>Maximum cable length without repeaters</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.000 kbit/s</td>
<td>100 m</td>
</tr>
<tr>
<td>1,500 kbit/s</td>
<td>200 m</td>
</tr>
<tr>
<td>500 kbit/s</td>
<td>400 m</td>
</tr>
<tr>
<td>187.5 kbit/s</td>
<td>1,000 m</td>
</tr>
<tr>
<td>93.75 kbit/s</td>
<td>1,200 m</td>
</tr>
<tr>
<td>45.45 kbit/s</td>
<td>1,200 m</td>
</tr>
<tr>
<td>19.2 kbit/s</td>
<td>1,200 m</td>
</tr>
<tr>
<td>9.6 kbit/s</td>
<td>1,200 m</td>
</tr>
</tbody>
</table>

Tab. 21: Recommendation for maximum cable lengths in Profibus-DP networks, depending on the transmission rate
7.17.1.1 Suitable cable types for Profibus-DP networks

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic cable impedance (Ω)</td>
<td>135 to 165 at 3 to 20 MHz</td>
</tr>
<tr>
<td>Effective capacitance (pF/m)</td>
<td>&lt; 30</td>
</tr>
<tr>
<td>Loop impedance (Ω/km)</td>
<td>&lt; 110</td>
</tr>
<tr>
<td>Cable diameter (mm)</td>
<td>&gt; 0.64</td>
</tr>
<tr>
<td>Cable cross section (mm²)</td>
<td>&gt; 0.34</td>
</tr>
</tbody>
</table>

Tab. 22: Specification of electrical data for Profibus-DP cables (as per type A)

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Cable type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web: <a href="http://www.drakamog.com">http://www.drakamog.com</a></td>
<td>Draka ToughCAT7 Mud Protected</td>
</tr>
</tbody>
</table>

Tab. 23: Suitable cable types for Profibus-DP networks

7.17.2 Permissible number of Profibus nodes

The Profibus-DP interface of the valve electronics supports integration into Profibus-DP networks with up to 32 Profibus nodes.

A maximum of 126 nodes can be operated in a Profibus-DP network with the use of repeaters.

7.17.3 Profibus-DP module address (node ID)

**CAUTION**

Danger due to malfunctions!
A multiple use of module addresses causes malfunctions and thus corresponding dangers to people and equipment.
- Each module address may only be used once within a Profibus DP network.

The module address can be configured by sending a Set_Slave_Add telegram from a controller. There is also the option of configuring the module address by writing to the Profibus module identifier.

It is also possible to configure the module address via service interface X10.

The factory setting for the module address of the valve electronics is 126.

The module address of the valve electronics can also be altered with the Moog Valve and Pump Configuration Software.

7.17.4 Profibus-DP transmission rate

The valve electronics are automatically set to the transmission rate specified by the Profibus master. It is not possible, nor is it necessary, to configure the transmission rate on the slave side.
7.18 Wiring EtherCAT networks (X3, X4)

The valves are equipped with an electrically isolated EtherCAT interface depending on the model. The EtherCAT interface is supplied internally.

**Procedure for connecting the valves to the EtherCAT bus**

1. Establish the electrical connection to the EtherCAT bus.
   - a Chap. "7.8.3 EtherCAT connectors", page 87

2. Optional: Set the module address.
   - a Chap. "7.18.3 EtherCAT module address (node ID)", page 122

3. Check the configuration of the valve software and the controller settings, in particular the command signal source.
   - Detailed information can be found in the "Firmware" User Manual.

**Observe the following points when wiring EtherCAT networks:**

- All cables must be designed as shielded cables with twisted-pair litz wires as per ISO/IEC 8802-3 100 Base-TX and CAT 5 as per ANSI/TIA/EIA-568-B.1.
- The cable length between two nodes must not exceed 100 m as per ISO/IEC 8802-3 100 Base-TX.
- The maximum permissible number of EtherCAT nodes must not exceed 65,536.
- The cable between the nodes must not branch.
- An external cable termination (terminal resistor) as in CAN or Profibus-DP networks is not necessary.

---

**CAUTION**

Danger of personal injury and damage to property!
Failure to heed safety instructions causes malfunctions and thus corresponding risks to people and equipment.
- Please heed all the safety instructions prior to and during start-up.

**Notice**

Danger of personal injury and damage to property!
Failure to heed safety instructions causes malfunctions and thus corresponding risks to people and equipment.
- Please heed all the safety instructions prior to and during start-up.
Wiring diagram of the EtherCAT network

An RJ45 connector is usually used on the controller side. The colors of the litz wires are standardized in accordance with IEEE 802.3 for Ethernet.

<table>
<thead>
<tr>
<th>Signal</th>
<th>X3, X4</th>
<th>Litz wire</th>
<th>RJ45</th>
<th>Litz wire (RJ45, 4-core cable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TX+</td>
<td>1</td>
<td>orange</td>
<td>1</td>
<td>orange/white (yellow/white)</td>
</tr>
<tr>
<td>RX+</td>
<td>2</td>
<td>blue</td>
<td>3</td>
<td>green/white</td>
</tr>
<tr>
<td>TX-</td>
<td>3</td>
<td>white (shielded with orange)</td>
<td>2</td>
<td>orange</td>
</tr>
<tr>
<td>RX-</td>
<td>4</td>
<td>white (shielded with blue)</td>
<td>3</td>
<td>green</td>
</tr>
</tbody>
</table>

Tab. 24: Assignment of Ethernet/EtherCAT signals with mixed connector types

### 7.18.1 Suitable cable types for EtherCAT networks

CAT 5 cable according to ANSI/TIA/EIA-568-B.1. e.g. Draka ToghCAT7 Mud Protected
7.18.2 Permissible number of EtherCAT nodes

The EtherCAT interface of the valve electronics supports integration into EtherCAT networks with up to 65,535 EtherCAT nodes.
The maximum number of nodes in a field bus line is 216.
The number of nodes determines the signal propagation time of the data packets and the resulting possible cycle times.

7.18.3 EtherCAT module address (node ID)

**CAUTION**

Danger due to malfunctions!
A multiple use of module addresses causes malfunctions and thus corresponding dangers to people and equipment.
- Each module address may only be used once within an EtherCAT network.

EtherCAT nodes can be addressed using the physical position within the network. This procedure is known as auto-increment addressing.

If position-independent addressing is preferred, a static module address can also be allocated. This addressing type is known as fixed node addressing.

**Auto-increment addressing**

Each EtherCAT node is identified using the physical position within the network segment. For this purpose, each EtherCAT node increments a 16-bit address field within a telegram, which is sent through the entire network. The advantage of this mechanism lies in the fact that no module address has to be set manually for the field bus nodes.

**Fixed node addressing**

With fixed node addressing a node is addressed via the so-called Configured Station Alias. This address can be configured by the network master in the Slave Information Interface (SII).

There is also the option of configuring the module address by writing to the EtherCAT module identifier.

The advantage of fixed node addressing over auto-increment addressing lies in the fact that the nodes can still be addressed at the same address even after the network topology has been changed or after nodes have been added or removed.

The factory setting for the module address of the valve electronics is 0.

It is also possible to configure the module address via service interface X10.

- The module address of the valve electronics can also be altered with the Moog Valve and Pump Configuration Software.

7.18.4 EtherCAT transmission rate

EtherCAT works with a fixed transmission rate of 100 Mbit/s.
7.19 Wiring analog inputs (X5, X6, X7)

The signal connectors X5, X6, and X7 are wired the same in the valve. On pin 1, a supply voltage of 24 V DC is made available by the valve in order to supply sensors.

There is joint fusing of this power supply for X2, X5, X6 and X7. The entire supply current may not exceed the following value:

$$I_{\text{max}} (X2+X5+X6+X7) = 300 \text{ mA}$$

An external power supply to the transducer is also possible. However, the 0 V transducer supply must be connected to supply zero. An interruption of the transducer supply current can be identified as a cable break (see "Firmware" User Manual).

The supply voltage is cut off in the event of a possible short circuit in the supply voltage to the transducer. A fault reaction can be configured (see "Firmware" User Manual). The voltage is available again as soon as the short circuit has been eliminated.

The supply current for each transducer is monitored for the purpose of detecting cable breaks. Supply currents under 1 mA can trigger a configurable fault reaction.

2/3/4-wire transducers with a voltage or current output can be connected to X5, X6 and X7. Each input can be individually adapted.
2-wire transducers

2-wire transducers can only be operated in the signal type for the 0–10 mA or 4–20 mA analog input in the single-ended version.

Wiring the 2-wire transducer

3-wire transducers

3-wire transducers can only be operated in the single-ended version.

Wiring the 3-wire transducer

4-wire transducers

4-wire transducers should be operated in the differential version.

Wiring the 4-wire transducer
7.20 Electrical start-up

**DANGER**

**Danger of explosion!**

An explosion can be triggered by sparks when switching on the machine.

- Open connectors for the interface must absolutely be covered before start-up.
- The eXLink connectors from CEAG must be mounted according to the instructions in the operating instructions for the eXLink connectors.
- In the standard model with a screw plug, the service connector X10 is not permitted for use in a hazardous area.
- The service connector X10 in the standard model M8, 3-pin must be sealed with the original screw plug belonging to the valve before start-up.
- When mounting the screw plug for the service connector X10, make sure that the seal and the thread of the screw plug as well as the thread in the electronic housing of the valve are not damaged.
- In case of damage to the screw plug for the service connector X10 or the threads in the electronic housing, the valve must not be operated.
- Tightening torque for screw plug: a Chap. "3.1.3 Representative depiction of the valve", page 19

**WARNING**

**Danger of explosion!**

To guarantee safe operation in hazardous areas:

- The signal interfaces of the valve are implemented with explosion-proof connectors.
- For mounting and removal of the connectors as well as operation of the valve, the notes and instructions in the "Explosion-proof connectors eXLink, CEAG" operating instructions must absolutely be adhered to.

**WARNING**

**Danger of explosion!**

For electrical start-up, cables on the valve, cable glands, screw plugs, and connectors must not be damaged.

- The valve must not be started up with damaged cables, connectors or screw plugs, and it must be sent to us or to one of our authorized service centers immediately.

For the standard model of the valve, the service interface is not suitable for use in hazardous areas. On request, the service interface is available in an explosion-proof model.
7.21 Electromagnetic compatibility (EMC)

The machine manufacturer is responsible for complying with the EMC Directive. The valves fulfill the EMC protective requirements for immunity to interference as per EN 61000-6-2: (assessment criterion A) and for interference emissions according to EN 61000-6-4.

The following technical requirements must be in place so that the EMC protection requirements can be satisfied:

- Use of the mating connectors recommended for the valves.
  a Chap. "12.1 Accessories for valves in the D94xK type series", page 232
- Adequate shielding.
- Correct execution of equipotential bonding system, protective grounding and electrical shielding.
  a Chap. "7.12 Protective grounding, equipotential bonding, and shielding", page 96
7.22 Communication via the Moog Valve and Pump Configuration Software

**CAUTION**

Danger of personal injury and damage to property!
Improper handling of the Moog Valve and Pump Configuration Software causes malfunctions and thus corresponding risks to people and equipment.
- For safety reasons, the Moog Valve and Pump Configuration Software must not be used inside a machine for visualization purposes or as an operator terminal.

**CAUTION**

Danger of personal injury and damage to property!
It is not permitted to operate the Moog Valve and Pump Configuration Software on a fieldbus while the machine is running. It is only permitted to activate valves via the Moog Valve and Pump Configuration Software if this does not cause any dangerous states in the machine and in its surroundings.

**CAUTION**

Danger of personal injury and damage to property!
Activating valves via the Moog Valve and Pump Configuration Software within a network can give rise to unforeseeable events if field bus communication takes place simultaneously between the machine control or other bus nodes.
- Deactivate the field bus communication for machine control and other bus nodes.

**CAUTION**

Danger of personal injury and damage to property!
Messages from the Moog Valve and Pump Configuration Software can also be received by other bus nodes. This may trigger unforeseeable events.
- Deactivate the field bus communication for machine control and other bus nodes.

**CAUTION**

Danger of personal injury and damage to property!
If danger-free operation of the valves via the Moog Valve and Pump Configuration Software can also not be ensured with deactivated field bus communication to the machine control and other bus nodes, the following must be heeded:
- The valves may only communicate with the Moog Valve and Pump Configuration Software in a depressurized state and via a direct connection (point-to-point).
Operating the Moog Valve and Pump Configuration Software

Possible faults

If the Moog Valve and Pump Configuration Software is operated within a CAN network with machine fieldbus communication running, the following faults may occur:

- Data exchange with the valve may be disrupted if another device (such as a controller) accesses the valve simultaneously.
- Node guarding may be activated only if no other field bus node is monitoring the valves via this service.
- Field bus telegrams can also be received by other field bus nodes. This may trigger off unforeseeable events!

To establish a direct connection between Moog Valve and Pump Configuration Software and valve, detach the field bus cable from the valve and connect the valve directly to the USB CAN interface of the service PC. A 120 Ω ± 10 % terminal resistor is required here.

The configuration/start-up cable not included in the scope of delivery already features a terminal resistor. This configuration/start-up cable can only be used outside of hazardous areas. The cable can only be used in connection with the M8-M12 adapter and thus only on the service connector X10.

a Chap. "12.1 Accessories for valves in the D94xK type series", page 232
8 Start-up

Safety instructions:

DANGER

Danger to life!
Operating machines with damaged or defective components or with a leaking hydraulic system is dangerous and not permitted.

▲ Before starting up or operating the valves, check the higher-level machine including all its installed components for damage and defects.
▲ Pay particular attention here to higher-level and hydraulic safety devices such as, for example, EMERGENCY STOP switches and pressure-limiting valves.
▲ Report damage or defects to the relevant department immediately. If necessary, shut down the machine immediately and secure it.
▲ Rectify any leaks immediately in accordance with this user manual, paying particular attention to the notes/instructions on handling in accordance with safety requirements.
  ◦ Chap. "2.1 Handling in accordance with safety requirements", page 14
  ◦ Chap. "10.3 Troubleshooting", page 156

DANGER

Danger of explosion!
To guarantee safe operation in a hazardous area:

▲ In its standard model with screw plug, the service connector X10 is not permitted for use in a hazardous area.
▲ For mounting of the screw plug of the service connector X10, it must be observed that the gasket and the threads of the screw plug as well as the threads in the electronic housing of the valve are not damaged.
▲ If there is damage to the screw plug of the service connector or the thread in the electronic housing, the valve must not be operated in hazardous areas.
▲ Tightening torque screw plug:
  a Chap. "3.1.3 Representative depiction of the valve", page 19

DANGER

Danger of explosion!
To guarantee safe operation in a hazardous area:

▲ The signal interfaces of the valve are implemented with explosion-proof connectors.
▲ For mounting and removal of the connectors as well as operation of the valve, the notes and instructions in the "Explosion-proof connectors eXLink, CEAG" operating instructions must absolutely be adhered to.
▲ The eXLink operating instructions from CEAG are in the Appendix to this user manual.
DANGER

Danger of poisoning and injury due to hydraulic fluid squirting out under pressure!
Contact with hydraulic fluids can damage your health (e.g. eye injuries, skin and tissue damage, poisoning in case of inhaling).
- Wear protective gloves and safety glasses.
- If hydraulic fluid gets into your eyes or on your skin, consult a doctor immediately.
- When handling hydraulic fluids, observe the safety provisions applicable to the hydraulic fluid used.

DANGER

Danger of injury due to electric voltage and unexpected movements!
Work on machines that are not shut down presents a danger to life and limb. Work such as mounting or removal, electrical or hydraulic connection, troubleshooting or servicing may only be performed on machines and valves that are shut down.
- Make sure to shut the machine down and switch it off.
- Make sure that the drive motor cannot be switched on.
- For this purpose, switch off the supply voltage as well as that of connected peripherals, such as externally powered transducers or programming units.
- Make sure that all power-transmitting components and connections (electrical and hydraulic) are switched off according to the manufacturer's instructions and secured against switching on again. If possible, remove the main fuse from the machine.
- Make sure that the machine is completely depressurized.

DANGER

Danger of explosion!
Open connectors for the interface must absolutely be covered before start-up.
- The interfaces must be sealed with the original screw plug belonging to the valve.

DANGER

Danger of explosion!
The unsafe operation of the valves is dangerous.
- Only operate the valve when it is in a safe and functional state.
- At least once per shift, check valve for damage visible from the outside and defects such as leakage or damaged cables or connectors.
- The cable glands must be checked at regularly-prescribed intervals. For details, see standard EN 60079-17.
- Report changes, including to the operating behavior, damage, and defects to the responsible department immediately. If necessary, shut down the machine immediately and secure it.
  - Chap. "2.1 Handling in accordance with safety requirements", page 14
  - Chap. "10.3 Troubleshooting", page 156
DANGER

**Danger of explosion!**
An explosion can be triggered by sparks when switching on the machine.
- Open connectors for the interface must absolutely be covered before start-up.
- The eXLink connectors from CEAG must be mounted according to the instructions in the operating instructions for the eXLink connectors.
- In the standard model with a screw plug, the service connector X10 is not permitted for use in a hazardous area.
- The service connector X10 in the standard model M8, 3-pin must be sealed with the original screw plug belonging to the valve before start-up.
- When mounting the screw plug for the service connector X10, make sure that the seal and the thread of the screw plug as well as the thread in the electronic housing of the valve are not damaged.
- In case of damage to the screw plug for the service connector X10 or the threads in the electronic housing, the valve must not be operated.
- Tightening torque for screw plug:
  - a Chap. "3.1.3 Representative depiction of the valve", page 19

WARNING

**Danger of explosion!**
For electrical start-up, cables on the valve, cable glands, screw plugs, and connectors must not be damaged.
- The valve must not be started up with damaged cables, connectors or screw plugs, and it must be sent to us or to one of our authorized service centers immediately.

WARNING

**Danger of personal injury and damage to property!**
The operation of the valves at pressure that is too high on the hydraulic connections can cause injuries and damage to the machine.
- Pressure-limiting valves or other comparable safety devices, for example, must be installed to limit the pressure at all the hydraulic ports to the specified maximum operating pressure. Maximum operating pressure:
  - a Chap. "11 Technical Data", page 162

WARNING

**Risk of injury!**
To prevent injuries or other damaging influences on health, suitable protective measures must be taken if necessary prior to and when carrying out any work on the valves or the machine, such as mounting or removing, electrical or hydraulic connection, troubleshooting or servicing, and when handling the valves, accessories, tools or hydraulic fluids.
- a Chap. "2.2 Occupational safety and health", page 15
**CAUTION**

Danger of personal injury and damage to property!
If the configuration of the valves is changed, valve functions may be changed in such a way as to cause damage, malfunction or failure of the valve or machine.
- Changing the valve configuration during operation is only permissible if this does not cause any dangerous states in the machine or its surroundings.

**CAUTION**

Danger of personal injury and damage to property!
Working with and on the valves without the required basic mechanical, hydraulic, and electrical knowledge may cause injuries or parts may be damaged.
- Only properly qualified and authorized users may work with and on the valves.
- a Chap. “1.4 Selection and qualification of personnel”, page 7

**CAUTION**

Risk of damage due to dirt and moisture!
This is the only way of adequately protecting the valves against the penetration of dirt and moisture and protecting the gaskets/seals against the effects of ozone and UV.
- The valves must not be transported or stored without their shipping plate fitted.
- The valve shipping plate may only be removed from the valve hydraulic ports directly prior to mounting and must be reinstalled directly after the valve has been removed.
- The shipping plate and the associated fastening elements (screws and nuts) must be kept for later use, e.g. during transportation.
8.1 Preparations

The valves may only be started up when the following is ensured:

- The higher-level machine with all its installed components complies with the latest versions of the relevant national and international regulations, standards, and guidelines (such as the EU Machinery Directive, the ATEX directive, and the regulations of the trade association and of TÜV or VDE).
- The valves and all the other installed components are in a technically fault-free and operationally reliable state.
- No signals that can lead to uncontrolled motions in the machine are transmitted to the valves.

a Chap. "1.3 Intended operation", page 5
8.2 Start-up of the valves

Procedure:

1. Make sure that all the machine components, connections, and ports conform to the specifications of the machine manufacturer and operator.

2. Prepare the hydraulic system.
   a Chap. "8.4 Filling and flushing the hydraulic system", page 139

3. Establish the valve hydraulic connection.
   a Chap. "6.3 Mounting the valve", page 65

4. Establish the valve electrical connection.
   a Chap. "7.11 General notes on wiring", page 94

5. Valves with field bus interface:
   Connect the valve to the field bus.

6. Make sure that all the mechanical and electrical connections and hydraulic ports are correctly established. The eXLink operating instructions from CEAG are in the Appendix to this user manual.

7. Make sure that the valve is correctly configured, or carry out configuration.
   a Chap. "3.5 Configuration software", page 53
   a Chap. "8.3 Configuration of the valves", page 135

8. Start-up of the hydraulic system.
   a Chap. "8.5 Start-up of the hydraulic system", page 140

9. If necessary, correct the zero position parameters in the valve software. The parameters can be set or interrogated via the service or field bus interface in the valve software. Setting and interrogation can be performed for example with the Moog Valve and Pump Configuration Software.
   For additional information, see User Manual Firmware.

Monitoring the pressure transducer drift

High pressure peaks in the hydraulic system can result in a drift of the valve's internal pressure transducer. To monitor any possible drift of the valve's pressure transducer, we recommend that the pressure transducer be checked 3, 6 and 12 months after the valve is started up and thereafter at intervals of 6 months. This can be conducted for example using comparison measurements with a calibrated pressure gauge. If necessary, the internal pressure transducer must be recalibrated. The pressure transducer can be influenced by means of parameters in the valve software. The parameters can be set or interrogated via the service or field bus interface in the valve software. Setting and interrogation can be performed for example with the Moog Valve and Pump Configuration Software.
8.3 Configuration of the valves

CAUTION

Danger of personal injury and damage to property!
If the configuration of the valves is changed, valve functions may be changed in such a way as to cause damage, malfunction or failure of the valve or machine.
- Changing the valve configuration during operation is only permissible if this does not cause any dangerous states in the machine or its surroundings.

CAUTION

Danger of personal injury and damage to property!
The selected settings must be documented after the configuration of the valves has been altered.
The settings can be documented for example with the Moog Valve and Pump Configuration Software.
- After a valve has been repaired or replaced, the user must transfer the settings again to the repaired or new valve because repaired or replacement valves are like new valves delivered with factory settings.
- a Chap. "8.3.3 Factory setting of the valves", page 138
- a Chap. "10.4 Repair", page 160

The Moog Valve and Pump Configuration Software is available as an accessory to simplify start-up, diagnosis and configuration of the valves.
a Chap. "3.6 Moog Valve and Pump Configuration Software", page 54

8.3.1 Configuration via the fieldbus interface

Valves with field bus interfaces are started up, activated, monitored and configured via the field bus interface (connectors X3 and X4).

8.3.1.1 Configuration with the machine controller

To be able to configure the valves with the machine controller, it is necessary to connect the valve to the machine controller via the field bus.
8.3.1.2 Configuration with the Moog Valve and Pump Configuration Software

The Moog Valve and Pump Configuration Software communicates with the valves via the CAN interface. The CAN bus interface is either on the service interface X10 or available on the CAN field bus interface X3 and X4.

a Chap. "7.22 Communication via the Moog Valve and Pump Configuration Software", page 127

8.3.2 Configuration via the service interface

**DANGER**

Danger of explosion!
To guarantee safe operation in a hazardous area:
- In its standard model with screw plug, the service connector X10 is not permitted for use in a hazardous area.
- For mounting of the screw plug of the service connector X10, it must be observed that the gasket and the threads of the screw plug as well as the threads in the electronic housing of the valve are not damaged.
- If there is damage to the screw plug of the service connector or the thread in the electronic housing, the valve must not be operated in hazardous areas.
- Tightening torque screw plug:
  a Chap. "3.1.3 Representative depiction of the valve", page 19

For the standard model of the valve, the service interface is not suitable for use in hazardous areas. On request, the service interface is available in an explosion-proof model.

Valves without CAN bus interfaces can be started up and configured via the service interface (service connector-X10) with the Moog Valve and Pump Configuration Software.

a Chap. "3.6 Moog Valve and Pump Configuration Software", page 54
The following are required to be able to configure the valves with the Moog Valve and Pump Configuration Software via the service interface (service connector X10):

- USB start-up module, not approved for use in hazardous areas
- Configuration/start-up cable
- Adapter for service connector X10, not approved for use in hazardous areas
- PC with installed Moog Valve and Pump Configuration Software

USB starting-up module, configuration/start-up cable, adapter and Moog Valve and Pump Configuration Software are available as accessories.

a Chap. "12.1 Accessories for valves in the D94xK type series", page 232

To be able to configure the valves via the service interface, it is necessary to connect the valve as follows to the PC with installed Moog Valve and Pump Configuration Software:

![Connection diagram](image)

Fig. 52: Connection of the valve to a PC via the service interface (service connector X10)
8.3.3 Factory setting of the valves

The valve is delivered from the factory with preset parameters. This presetting corresponds to the factory setting of the valves. Depending on the valve type and model, it may be necessary to adapt the parameters to the respective application. If the valve is to be incorporated in a field bus, it may also be necessary to adapt the communication parameters.

Please contact Moog or one of its authorized service centers for information on the factory setting parameters.

8.3.4 Storing of parameters

Modified parameters are initially stored in the volatile memory of the valve electronics microprocessor system, i.e. they are lost if the power supply is interrupted. When the power supply is restored, the parameters that were stored last are again available.

The microprocessor system also has a non-volatile memory. In order to store the modified parameters in this memory, it is necessary to send a memory command to the valve. If the power supply is interrupted, the modified valve configuration will again be available after the supply is restored.
8.4 Filling and flushing the hydraulic system

**WARNING**

Risk of injury!
In order to prevent injuries and other damage to health when flushing the hydraulic system, please observe the following notes.

- The manufacturer and operator of the machine are responsible for ensuring that, in safety-critical applications, the latest versions of the relevant safety standards, which are designed to prevent damage, are observed.
- Among other things, it is vital to ensure that both the individual components and the entire machine can be put into a safe state.
- If a switching valve is fitted to flush the hydraulic system, this must not cause any dangerous states in the machine.

**Procedure:**

1. Depressurize the hydraulic system.
2. Fill the hydraulic system in accordance with the instructions of the manufacturer and the operator of the machine. Because new hydraulic fluid is unfiltered, the hydraulic system must be filled via a fill filter with a filter fineness of at least \( \beta_{10} \geq 75 \) (10 \( \mu \text{m} \) absolute).
3. Replace existing filter elements with flushing elements in accordance with the instructions of the manufacturer and the operator of the machine.
4. Remove the proportional valve.
   - a Chap. "10.1 Removing of the valves", page 153
5. Instead of the proportional valve, you must install a flushing plate or, if allowed by the hydraulic system, a switching valve.

   Use the flushing plate to flush lines P and T. The switching valve can also be used to flush the actuator with lines A and B.

   The flushing plates are not included in the valve scope of delivery. They are available as an accessory.
   - a Chap. "12.1 Accessories for valves in the D94xK type series", page 232
6. Carefully flush the hydraulic system in accordance with the instructions of the manufacturer and the operator of the machine. Observe the following when doing so:
   - In order to obtain the best possible flushing effect, make sure the hydraulic fluid reaches operating temperature.
   - Observe the minimum flushing time $t$:
     \[ t = 5 \cdot \frac{V}{Q} \text{ [h]} \]
     
     $V$ [l] : Tank capacity
     $Q$ [l/min] : Pump delivery
   - End the flushing process when at least the cleanliness class as specified in the technical data (in accordance with ISO 4406) is achieved:
     18/15/12

7. Depressurize the hydraulic system.

8. Replace flushing elements with suitable filter elements in accordance with the instructions of the manufacturer and the operator of the machine.

9. Remove the flushing plate or switching valve.

10. Mount the proportional valve.
    a Chap. "6.3 Mounting the valve", page 65

8.5 Start-up of the hydraulic system

**Procedure:**

1. Start up the hydraulic system in accordance with the instructions of the manufacturer and the operator of the machine.

2. Vent the hydraulic system in accordance with the instructions of the manufacturer and the operator of the machine.

3. Vent the valve. It may be necessary to repeat the procedure.

4. Check the hydraulic system for external leaks.

8.5.1 Venting

**CAUTION**

Risk of damage!
Air trapped in the hydraulic system, particularly in the case of high pressure peaks in the system, can cause a diesel effect. If the trapped air bubbles are compressed very quickly and thus heated, this can cause the mixture to self-ignite. This gives rise to a very high increase in pressure and temperature locally, which in turn can result in damage in the hydraulic system, e.g. to gaskets or components, causing the oil to age more quickly.

- In order to avoid diesel effects, the hydraulic system must be ventilated.
8.5.1.1 Tool required

The following tool is required for venting the valve:
- Torque wrench for 5 WAF hexagon socket screws

8.5.1.2 Venting the valve and the actuator

**WARNING**

Risk of injury!
In order to prevent injuries and other damage to health when venting the hydraulic system, please observe the following notes.
- The manufacturer and operator of the machine are responsible for making sure that for safety-critical use, relevant safety standards in the latest version, which serve to avoid damage, are heeded.
- Among other things, it is vital to ensure that both the individual components and the entire machine can be put into a safe state.
- The valve and actuator may only be vented at a low system pressure of max. 10 bar (145 psi).

**Procedure:**

1. A low system pressure of max. 10 bar (145 psi) must be applied.
2. Input valve command signals so that the pressure-controlled port is pressurized with system pressure.
3. Carefully open the venting screw by approx. one revolution. Position of the venting screw: a Fig. 1, page 19
4. Wait until no additional air escapes or until the escaping hydraulic fluid contains no additional air bubbles.
5. If necessary, tighten venting screw with torque wrench for hexagon socket head cap screws WS 5. Tightening torque of the venting screw: 15 Nm. Higher tightening torques can result in the destruction of the sealing ring for the venting screw.
6. Remove the escaped hydraulic fluid.
7. If the actuator is higher than the valve, the actuator must likewise be vented at the highest point.
9 Operation

**DANGER**

**Danger to life!**
Operating machines with damaged or defective components or with a leaking hydraulic system is dangerous and not permitted.
- Before starting up or operating the valves, check the higher-level machine including all its installed components for damage and defects.
- Pay particular attention here to higher-level and hydraulic safety devices such as, for example, EMERGENCY STOP switches and pressure-limiting valves.
- Report damage or defects to the relevant department immediately. If necessary, shut down the machine immediately and secure it.
- Rectify any leaks immediately in accordance with this user manual, paying particular attention to the notes/instructions on handling in accordance with safety requirements.
  - Chap. "2.1 Handling in accordance with safety requirements", page 14
  - Chap. "10.3 Troubleshooting", page 156

**DANGER**

**Danger of personal injury and damage to property!**
Failure to heed the eXLink operating instructions from CEAG can cause bodily injuries and property damage.
- Follow the eXLink operating instructions from CEAG in the Appendix to this user manual.
- Handle all ex-proof connectors according to the notes and instructions in the eXLink operating instructions from CEAG

**DANGER**

**Danger of injury due to electric voltage and unexpected movements!**
Work on machines that are not shut down presents a danger to life and limb. Work such as mounting or removal, electrical or hydraulic connection, troubleshooting or servicing may only be performed on machines and valves that are shut down.
- Make sure to shut the machine down and switch it off.
- Make sure that the drive motor cannot be switched on.
- For this purpose, switch off the supply voltage as well as that of connected peripherals, such as externally powered transducers or programming units.
- Make sure that all power-transmitting components and connections (electrical and hydraulic) are switched off according to the manufacturer's instructions and secured against switching on again. If possible, remove the main fuse from the machine.
- Make sure that the machine is completely depressurized.
DANGER

Danger of explosion!
The unsafe operation of the valves is dangerous.

- Only operate the valve when it is in a safe and functional state.
- At least once per shift, check valve for damage visible from the outside and defects such as leakage or damaged cables or connectors.
- The cable glands must be checked at regularly-prescribed intervals. For details, see standard EN 60079-17.
- Report changes, including to the operating behavior, damage, and defects to the responsible department immediately. If necessary, shut down the machine immediately and secure it.
  - ↩ Chap. "2.1 Handling in accordance with safety requirements", page 14
  - ↩ Chap. "10.3 Troubleshooting", page 156

DANGER

Danger of explosion!
The unsafe operation of the valves is dangerous.

- Open connectors for the interfaces must absolutely be covered before start-up.
- The eXLink connectors from CEAG must be mounted correctly according to the instructions in the "Ex plug connector eXLink" operating instructions. Here the instructions and notes in the operating instructions for the connectors must be heeded.
- Only use the service connector X10 in the M8 mode., 3-pin outside the hazardous area.
- The service connector X10 in the standard model M8, 3-pin must be sealed with the original screw plug belonging to the valve before start-up.
- For a configuration of the valve within the hazardous area, on request there is the X10 interface with an appropriate Ex-protected plug connector.

DANGER

Danger of explosion due to impermissible heating up of the valve!
As a result of insufficient ventilation of the valve or deposits on the valve, the impermissible heating up of the valve can be such that the maximum temperatures of the certified temperature classes are exceeded.

- The valves must be checked regularly, cleaned if necessary. Deposits on the valve must be removed.
- If necessary inform the responsible person immediately and remove the valve from electrical and hydraulic operation.
WARNING

Danger of explosion!
During operation, cables on the valve, cable glands, screw plugs, and connectors must not be damaged.
- The valve must not be started up with damaged cables, connectors or screw plugs, and it must be sent to us or to one of our authorized service centers immediately.

WARNING

Risk of injury!
To prevent injuries or other damaging influences on health, suitable protective measures must be taken if necessary prior to and when carrying out any work on the valves or the machine, such as mounting or removing, electrical or hydraulic connection, troubleshooting or servicing, and when handling the valves, accessories, tools or hydraulic fluids.
- a Chap. "2.2 Occupational safety and health", page 15

CAUTION

Danger of personal injury and damage to property!
To avoid damage or leaks, the following tasks must be performed at regular intervals in accordance with the instructions of the manufacturer and the operator of the machine:
- Checking the valve and the hydraulic system for externally identifiable damage and defects.
- Checking for loose plugs/connectors.
- Checking the cleanliness level of the hydraulic fluid.
- Checking the port O-rings for elasticity, integrity and correct seating.
- a Chap. "10.2.1 Checking and replacing the port O-rings", page 155

CAUTION

Danger of personal injury and damage to property!
If the configuration of the valves is changed, valve functions may be changed in such a way as to cause damage, malfunction or failure of the valve or machine.
- Changing the valve configuration during operation is only permissible if this does not cause any dangerous states in the machine or its surroundings.

CAUTION

Danger of personal injury and damage to property!
It is not permitted to operate the Moog Valve and Pump Configuration Software on a fieldbus while the machine is running. It is only permitted to activate valves via the Moog Valve and Pump Configuration Software if this does not cause any dangerous states in the machine and in its surroundings.
9.1 Preparations for operation

The valves may only be operated as a component part of a higher-level overall system, for example in a machine.

a Chap. "1.3 Intended operation", page 5

The following must be completed before the valve is operated:

• Qualified project planning
• Correct start-up and configuration of the valve
  a Chap. "8 Start-up", page 129
9.2 Operation of the valve

The valve is activated via signals that it receives from the machine controller. Direct interventions by the user on the valve during normal operation are not necessary.

The device may only be operated in a safe and functional state. At least once per shift, check valve for damage visible from the outside and defects such as leakage or damaged cables or connectors. Report changes, including to the operating behavior to the responsible department immediately.

If necessary, shut the system down immediately and secure it!

If necessary, shut the system down immediately and secure it!

Eliminate the fault immediately.

The valve has no controls, such as e.g. switches or buttons, which must be actuated.

Switching of the valve to standby or fail-safe state can also be triggered by corresponding signals at the enable input of connector X1:

- Signals between 8.5 V and 32 V based on GND at the enable input switch the valve to standby.
- Signals lower than 6.5 V at the enable input switch the valve to fail-safe state.

High pressure peaks in the hydraulic system can result in a drift of the valve's internal pressure transducer. To monitor any possible drift of the valve's pressure transducer, we recommend that the pressure transducer be checked 3, 6 and 12 months after the valve is started up and thereafter at intervals of 6 months. This can be conducted for example using comparison measurements with a calibrated pressure gauge. If necessary, the internal pressure transducer must be recalibrated.

The pressure transducer can be influenced by means of parameters in the valve software. The parameters can be set or interrogated via the service or field bus interface in the valve software. Setting and interrogation can be performed for example with the Moog Valve and Pump Configuration Software.

Information on maintenance:

Information on correcting possible faults:

Monitoring the pressure transducer drift
9.3 Shutting down the valve

DANGER

Danger to life!
Hydraulic pressure and electrical supply voltage are still normally applied after the valve has been shut down. The machine is not automatically put out of operation when the valve is shut down.

DANGER

Danger of poisoning and injury due to hydraulic fluid squirting out under pressure!
Contact with hydraulic fluids can damage your health (e.g. eye injuries, skin and tissue damage, poisoning in case of inhaling).
- Wear protective gloves and safety glasses.
- If hydraulic fluid gets into your eyes or on your skin, consult a doctor immediately.
- When handling hydraulic fluids, observe the safety provisions applicable to the hydraulic fluid used.

DANGER

Danger of injury due to electric voltage and unexpected movements!
Work on machines that are not shut down presents a danger to life and limb. Work such as mounting or removal, electrical or hydraulic connection, troubleshooting or servicing may only be performed on machines and valves that are shut down.
- Make sure to shut the machine down and switch it off.
- Make sure that the drive motor cannot be switched on.
- For this purpose, switch off the supply voltage as well as that of connected peripherals, such as externally powered transducers or programming units.
- Make sure that all power-transmitting components and connections (electrical and hydraulic) are switched off according to the manufacturer's instructions and secured against switching on again. If possible, remove the main fuse from the machine.
- Make sure that the machine is completely depressurized.
The valve can be shut down as follows:

- Switching off of the supply voltage
- Adoption by the valve of the 'DISABLED' and 'INIT' valve states
- Signal < 6.5 V at the enable input of connector X1 (valve-dependent)

If necessary, the valve must be restarted after it has been shut down or has entered the fail-safe state.

a Chap. "3.2.3 Fail-safe events", page 30

a Chap. "3.2.4 Restarting the valve", page 33
DANGER

Danger to life!
Operating machines with damaged or defective components or with a leaking hydraulic system is dangerous and not permitted.

- Before starting up or operating the valves, check the higher-level machine including all its installed components for damage and defects.
- Pay particular attention here to higher-level and hydraulic safety devices such as, for example, EMERGENCY STOP switches and pressure-limiting valves.
- Report damage or defects to the relevant department immediately. If necessary, shut down the machine immediately and secure it.
- Rectify any leaks immediately in accordance with this user manual, paying particular attention to the notes/instructions on handling in accordance with safety requirements.

☞ Chap. "2.1 Handling in accordance with safety requirements", page 14
☞ Chap. "10.3 Troubleshooting", page 156

DANGER

Danger of explosion!
To guarantee safe operation in a hazardous area:

- The signal interfaces of the valve are implemented with explosion-proof connectors.
- For mounting and removal of the connectors as well as operation of the valve, the notes and instructions in the "Explosion-proof connectors eXLink, CEAG" operating instructions must absolutely be adhered to.
- The eXLink operating instructions from CEAG are in the Appendix to this user manual.

DANGER

Danger of poisoning and injury due to hydraulic fluid squirting out under pressure!
Contact with hydraulic fluids can damage your health (e.g. eye injuries, skin and tissue damage, poisoning in case of inhaling).

- Wear protective gloves and safety glasses.
- If hydraulic fluid gets into your eyes or on your skin, consult a doctor immediately.
- When handling hydraulic fluids, observe the safety provisions applicable to the hydraulic fluid used.
DANGER

Danger of explosion due to impermissible heating up of the valve!
As a result of insufficient ventilation of the valve or deposits on the valve, the impermissible heating up of the valve can be such that the maximum temperatures of the certified temperature classes are exceeded.
- The valves must be checked regularly, cleaned if necessary. Deposits on the valve must be removed.
- If necessary inform the responsible person immediately and remove the valve from electrical and hydraulic operation.

DANGER

Danger of injury due to electric voltage and unexpected movements!
Work on machines that are not shut down presents a danger to life and limb. Work such as mounting or removal, electrical or hydraulic connection, troubleshooting or servicing may only be performed on machines and valves that are shut down.
- Make sure to shut the machine down and switch it off.
- Make sure that the drive motor cannot be switched on.
- For this purpose, switch off the supply voltage as well as that of connected peripherals, such as externally powered transducers or programming units.
- Make sure that all power-transmitting components and connections (electrical and hydraulic) are switched off according to the manufacturer's instructions and secured against switching on again. If possible, remove the main fuse from the machine.
- Make sure that the machine is completely depressurized.

DANGER

Danger of explosion!
To guarantee safe operation in a hazardous area:
- In its standard model with screw plug, the service connector X10 is not permitted for use in a hazardous area.
- For mounting of the screw plug of the service connector X10, it must be observed that the gasket and the threads of the screw plug as well as the threads in the electronic housing of the valve are not damaged.
- If there is damage to the screw plug of the service connector or the thread in the electronic housing, the valve must not be operated in hazardous areas.
- Tightening torque screw plug: a Chap. "3.1.3 Representative depiction of the valve", page 19
DANGER

Danger of explosion!
The unsafe operation of the valves is dangerous.

- Only operate the valve when it is in a safe and functional state.
- At least once per shift, check valve for damage visible from the outside and defects such as leakage or damaged cables or connectors.
- The cable glands must be checked at regularly-prescribed intervals. For details, see standard EN 60079-17.
- Report changes, including to the operating behavior, damage, and defects to the responsible department immediately. If necessary, shut down the machine immediately and secure it.

- Chap. "2.1 Handling in accordance with safety requirements", page 14
- Chap. "10.3 Troubleshooting", page 156

WARNING

Risk of injury!
To prevent injuries or other damaging influences on health, suitable protective measures must be taken if necessary prior to and when carrying out any work on the valves or the machine, such as mounting or removing, electrical or hydraulic connection, troubleshooting or servicing, and when handling the valves, accessories, tools or hydraulic fluids.

- Chap. "2.2 Occupational safety and health", page 15

WARNING

Danger of explosion!
During shut-down, cables on the valve, cable glands, screw plugs, and connectors must not be damaged.

- The valve must not be started up with damaged cables, connectors or screw plugs, and it must be sent to us or to one of our authorized service centers immediately.

CAUTION

Danger of personal and property damage due to defective accessories and defective spare parts!
Unsuitable or defective accessories or unsuitable or defective spare parts may cause damage, malfunctions or failure of the valve or the machine.

- Use only original accessories and original spare parts.
- Chap. "12 Accessories, Spare Parts, and Tools", page 232
- Warranty and liability claims for personal injury and damage to property are among other things excluded if they are caused by the use of unsuitable or defective accessories or unsuitable or defective spare parts.

- Chap. "1.8 Warranty and liability", page 11
CAUTION

Risk of damage!
The plugs, connectors, and connection cables of the valves may not be used for other purposes, such as for stepping on or as transport holders.

CAUTION

Danger of personal injury and damage to property!
Working with and on the valves without the required basic mechanical, hydraulic, and electrical knowledge may cause injuries or parts may be damaged.
- Only properly qualified and authorized users may work with and on the valves.
- a Chap. "1.4 Selection and qualification of personnel", page 7

CAUTION

Risk of damage!
In order to prevent damage to the valves or to the accessories:
- The plugs, connectors, and connection cables of the valves may not be used for other purposes, such as for stepping on or as transport holders.
- Due to the complexity of the internal components of the valves and of accessories, only we or our authorized service centers may make repairs and perform maintenance work other than that explained in this user manual.
- Warranty and liability claims for personal injury and damage to property are excluded among other things if they are caused by unauthorized repairs or other unauthorized interventions.
- Chap. "1.8 Warranty and liability", page 11
- Structural changes to or opening of explosion-proof valves are not permitted since these invalidate the ex certification.
10.1 Removing of the valves

10.1.1 Tools and materials required

The following tools and materials are required for removing the valves:

- For removing and mounting the valve
  Torque wrench for hexagon socket head cap screws
- Replacement for O-rings of ports to be replaced if necessary
- A shipping plate and the associated attachment elements
- For mounting the shipping plate
  Wrench for hexagon socket head cap screws or regular screwdriver (only valve D941K) and, if necessary, wrench

**CAUTION**

Danger of personal injury and damage to property!
Failure to heed the eXLink operating instructions from CEAG can cause bodily injuries and property damage.

- Follow the eXLink operating instructions from CEAG in the Appendix to this user manual.
- Handle all ex-protected connectors according to the notes and instructions in the eXLink operating instructions from CEAG

Structural changes to or opening of explosion-proof valves are not permitted since these invalidate the ex certification.

The installation screws and the O-rings to be replaced if necessary are not included in the scope of delivery for the valves. They are available as an accessory.

- The wrench sizes of the hexagon socket cap head screws for mounting are type series-specific.
- Details about the screws and their tightening torque:
  - a Tab. 8, page 65

The fastening screws for the transport plates are type-specific.

Details about fastening screws and their tightening torque:

10.1.2 Removing

**CAUTION**

**Risk of damage due to dirt and moisture!**
This is the only way of adequately protecting the valves against the penetration of dirt and moisture and protecting the gaskets/seals against the effects of ozone and UV.
- The valves must not be transported or stored without their shipping plate fitted.
- The valve shipping plate may only be removed from the valve hydraulic ports directly prior to mounting and must be reinstalled directly after the valve has been removed.
- The shipping plate and the associated fastening elements (screws and nuts) must be kept for later use, e.g. during transportation.

**Procedure:**

1. Shut down and switch off the machine and put it into a de-energized and depressurized state.

   For the removal of the ex-protected connectors, the notes and instructions for the eXLink operating instructions of CEAG must be heeded. The eXLink operating instructions from CEAG are in the Appendix to this user manual.

2. Disconnect the connectors of the Ex-protected connectors.

3. Release the valve’s installation screws.

4. Remove the valve from the mounting surface.

5. Check that O-rings in the valve ports (P, A, B, X, Y and T) are present and for elasticity, integrity and correct seating.

6. Replace hardened and damaged O-rings with new O-rings.

7. Attach the shipping plate to the valve's hydraulic ports.
   - The tightening torque of the attachment screws for the shipping plate is series-specific.
   - Benchmark value: 30% of the value that is specified in table "Specification for installation screws for the valves"
     **a Tab. 8, page 65**

8. If the valve is not to be immediately reused or is to be serviced: keep valve in original packaging.
   **a Chap. "5 Transportation and Storage", page 59**

9. If necessary, seal the ports of the hydraulic system to prevent the hydraulic fluid from being contaminated.
10.2 Maintenance

Changes in temperature, effects of the hydraulic fluid, such as, pressure peaks, and similar influences can, depending on the application, expose the gasket/seal materials to different levels of wear, and this in turn may cause leaks.

In order to avoid possible resulting impairments or damage, we recommend that the valve, after a period of storage or operation of more than 5 years, be inspected by us or one of our authorized service centers.

Maintenance work by the user on explosion proof valves is not permitted. Intervention by third parties will invalidate the ex certification.

If the valve is exposed to high loads, it may be necessary to reduce the check/inspection interval to suit the application.

10.2.1 Checking and replacing the port O-rings

10.2.1.1 Tools and materials required

The following are required for checking and replacing the port O-rings:

- For removing and mounting the valve
  Torque wrench for hexagon socket head cap screws
- Replacement for O-rings of ports to be replaced if necessary
  a Chap. "12 Accessories, Spare Parts, and Tools", page 232

The installation screws and the O-rings to be replaced if necessary are not included in the scope of delivery for the valves. They are available as an accessory.

The wrench sizes of the hexagon socket cap head screws for mounting are type series-specific.

Details about the screws and their tightening torque:
  a Tab. 8, page 65

10.2.1.2 checking and replacing the O-rings

Procedure:

1. Remove the valve.
   a Chap. "10.1 Removing of the valves", page 153
2. Check that O-rings in the valve ports (P, A, B, and T, etc.) are present and for elasticity, integrity and correct seating.
3. Replace hardened and damaged O-rings with new O-rings.
4. Remount the valve.
   a Chap. "6.3 Mounting the valve", page 65

Maintenance work by the user on explosion proof valves is not permitted. Intervention by third parties will invalidate the ex certification.

If the valve is exposed to high loads, it may be necessary to reduce the check/inspection interval to suit the application.
10.2.2 Monitoring the pressure transducer drift

High pressure peaks in the hydraulic system can result in a drift of the valve's internal pressure transducer. To monitor any possible drift of the valve's pressure transducer, we recommend that the pressure transducer be checked 3, 6 and 12 months after the valve is started up and thereafter at intervals of 6 months. This can be conducted for example using comparison measurements with a calibrated pressure gauge. If necessary, the internal pressure transducer must be recalibrated. The pressure transducer can be influenced by means of parameters in the valve software. The parameters can be set or interrogated via the service or field bus interface in the valve software. Setting and interrogation can be performed for example with the Moog Valve and Pump Configuration Software.

10.3 Troubleshooting

The following faults may occur:

- Leak at the valve connecting surface
  - Chap. "10.3.1.1 Leak at the valve connecting surface", page 157
- Leak at the linear force motor screw plug
  - Chap. "10.3.1.2 Leak at the linear force motor screw plug", page 157
- No hydraulic response by the valve
  - Chap. "10.3.2 No hydraulic response by the valve", page 158
- Instability of the control loops
  - Chap. "10.3.3 Instability of the external control loop", page 158
  - Chap. "10.3.4 Instability of the internal valve control loops", page 159

If the fault cannot be corrected by means of the measures set out below, please contact us or one of our authorized service centers.

After correcting the fault, if necessary reinstall and restart the valve.
- Chap. "6.3 Mounting the valve", page 65
- Chap. "3.2.4 Restarting the valve", page 33
10.3.1 Leaks

10.3.1.1 Leak at the valve connecting surface

Measures:

- Check that O-rings in the valve ports (P, A, B, X, Y and T) are present and for elasticity, integrity and correct seating.
  If necessary, install O-rings, replace or correct the seating.
- Check the valve's mounting and connecting surfaces, the valve and the hydraulic system for damage, contamination and evenness.
- Check installation screws for secure and correct seating.
  Re-tighten screws if necessary with the Torque wrench for hexagon socket head cap screws.

The wrench sizes of the hexagon socket cap head screws for mounting are type series-specific.
Details about fastening screws and their tightening torque:
Tab. 8, page 65

10.3.1.2 Leak at the linear force motor screw plug

**CAUTION**

- In the event of a leak at the linear force motor screw plug, have the valve check by Moog or one of its authorized service centers.

10.3.1.3 Leak at the venting screw

Measures:

- Check that the sealing ring on the venting screw is present and for elasticity, integrity and correct seating.
  If necessary, install the sealing ring, replace or correct the seating.
  If necessary, use a new screw.
- Check the venting screws for secure and correct seating.
  If necessary, tighten screws with torque wrench for hexagon socket head cap screws WS 5.
  Tightening torque of the venting screw: 6 Nm.
  Higher tightening torques can result in the destruction of the sealing ring for the venting screw.
- Check the valve's mounting and connecting surfaces, the valve and the hydraulic system for damage, contamination and evenness.
10.3.2 No hydraulic response by the valve

**DANGER**

Danger to life!

Touching electrically live parts can cause electric shock.
- Touching electrically live parts must therefore be avoided.

**Measures:**

- Check whether all the machine components, connections, and ports conform to the specifications of the manufacturer and operator.
  To do so, on the valves compare the data on the nameplate with the specifications. (The details on the type plate correspond to the performance requirements ordered. They may have changed due to configuration.)

- Check whether the hydraulic installation is correct and whether all the hydraulic ports are correctly established.

- Check whether hydraulic pressure is present.

- Check whether the hydraulic supply to the pilot stage is present or correctly configured (pilot mode: external or internal).

- Check whether the supply voltage is present.

- Check whether the connectors are correctly attached and non-corroded.

- Check whether there is a command signal failure or a faulty electric cable.

- Check whether the command signal is analog or applied via the field bus interface (depending on the model).

- Check whether the valve is in a fault state.
  If necessary, correct the fault and then cancel the fault via the fieldbus or reset the valve by switching the supply voltage off and then on again.

  **Typical fault causes:**
  - Supply voltage dips below 18 V
    Electrical data: a Chap. "11 Technical Data", page 162
  - Control error (for example, due to the spool sticking, which can be caused for instance by contamination)
    - No command signal (e.g., due to open circuit)

- Check whether the enable signal is applied. If there is no enable, the valve cannot be rendered in the 'ACTIVE' valve status.

- Check whether the configuration of the internal valve software is correct.

10.3.3 Instability of the external control loop

**Measures:**

- Check whether the system pressure is stable.
  If necessary, reduce control loop gain.

- Check whether the internal valve control loops are stable.
  a Chap. "10.3.4 Instability of the internal valve control loops", page 159

- Check whether the controlled system was modified.
10.3.4 Instability of the internal valve control loops

10.3.4.1 Flow control

**Measures:**
- Check whether the signal quality of the command signals is sufficient.
- Check whether the system and pilot pressures are stable.
- Check whether the quality and purity of the hydraulic fluid used conforms to the specifications of the manufacturer and the operator of the machine.
- Check whether the valve is operational. To do so, perform a comparison of the command/actual value signals.

10.3.4.2 Pressure control

**Measures:**
- Check whether the signal quality of the command signals is sufficient.
- Check whether the system pressure is stable.
- Check whether the system and pilot pressures are stable.
- Vent the valve or the hydraulic system. 
  a Chap. "8.5.1 Venting", page 140
- Optimize the control loop gain of the pressure controller by adapting the parameters (P, I, D, etc.).
  a Chap. "3.3.5 Notes on the pressure controller control response", page 42
- Check whether the quality and purity of the hydraulic fluid used conforms to the specifications of the manufacturer and the operator of the machine.
- Check whether the valve is operational. To do so, switch to flow control (Q-control) via the integrated service or field bus interface and perform a comparison of the command and actual value signals.
- Check whether the pressure controlled system has been modified.
- Check whether the pressure in T is below the pressure to be controlled.
10.4 Repair

CAUTION

Danger of personal injury and damage to property!
Repaired valves or replacement valves are, like new valves, delivered with the factory settings. In the event of a repair job for defective valves, we and our authorized service centers shall not accept liability for software and data installed by the customer.

- Check the valves for correct mechanical design and correct configuration before start-up.

CAUTION

Danger of personal injury and damage to property!
If the configuration of the valves is changed, valve functions may be changed in such a way as to cause damage, malfunction or failure of the valve or machine.

- Changing the valve configuration during operation is only permissible if this does not cause any dangerous states in the machine or its surroundings.

Maintenance work by the user on explosion proof valves is not permitted. Intervention by third parties will invalidate the ex certification.

Moog Global Support™ provides professional repair and corrective maintenance services on the highest level thanks to our experienced technicians. Our customer service and our professional expertise ensure that your systems will always remain in an optimal state. Here we offer the reliability that you can only expect from leading manufacturers with worldwide branch offices.
WARNING

Risk of damage!
To guarantee safe operation in hazardous areas, the following points must be heeded:
- Maintenance work on ex-protected valves may only be performed by us or our authorized service centers.
- Intervention by third parties will invalidate the Ex certification.

Your advantages:
- Shorter downtimes, critical systems can be operated permanently with high performance
- Investment security thanks to reliability, adaptability, and guaranteed life span of our products
- Optimized corrective maintenance planning and system set-up
- Use of our flexible corrective maintenance program according to your service requirements

Our service offerings:
- Repair with original parts by trained technicians according to the latest Moog specifications
- Provision of original spare parts and products in order to avoid unplanned downtimes
- Flexible programs according to your needs for preventative corrective maintenance and set-up thanks to annual or multi-year contracts
- On-site service for start-up, set-up, and fault diagnosis
- Reliable service with equally good quantity worldwide

For additional information about **Moog Global Support™**, visit

http://www.moog.com/industrial/service

Maintenance work by the user on explosion-proof valves is not permitted. Intervention by third parties will invalidate the ex certification.

In the event of a repair job for defective valves, we and our authorized service centers reserve the right to perform a repair or, after consultation, alternatively to supply replacement valves with an identical or compatible equipment specification.
## 11 Technical Data

### CAUTION

**Risk of damage!**

In order to prevent damage to the valves or to the machine, the following must be observed:

- Values specified in the technical data must be adhered to.
- Values specified on the nameplate must be adhered to.

### CAUTION

**Risk of damage!**

In order to prevent damage to the valves or to the machine, observe the following points:

- Do not immerse the valves in liquids.

---

<table>
<thead>
<tr>
<th>Description</th>
<th>Chapter, page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nameplates</strong></td>
<td>a Chap. 11.1, page 164</td>
</tr>
<tr>
<td>Description of the functions of the valve, which are specified in the model number and type designation.</td>
<td></td>
</tr>
<tr>
<td><strong>Electromagnetic compatibility (EMC)</strong></td>
<td>a Chap. 11.2, page 173</td>
</tr>
<tr>
<td><strong>Dimensions of the connector</strong></td>
<td>a Chap. 7.3, page 74</td>
</tr>
<tr>
<td><strong>Technical data D941K – ISO 4401-05/NG10</strong></td>
<td>a Chap. 11.3, page 174</td>
</tr>
<tr>
<td>- Technical data</td>
<td></td>
</tr>
<tr>
<td>- Installation drawing/dimensions</td>
<td></td>
</tr>
<tr>
<td>- Characteristic curves</td>
<td></td>
</tr>
<tr>
<td>- Way functions and hydraulic symbols</td>
<td></td>
</tr>
<tr>
<td><strong>Two-stage digital proportional valve, D941K type series, with direct-operated pilot valve D633K</strong></td>
<td>a Chap. 11.3, page 174</td>
</tr>
<tr>
<td><strong>Technical data D942K – ISO 4401-07/NG16</strong></td>
<td>a Chap. 11.4, page 185</td>
</tr>
<tr>
<td>- Technical data</td>
<td></td>
</tr>
<tr>
<td>- Installation drawing/dimensions</td>
<td></td>
</tr>
<tr>
<td>- Characteristic curves</td>
<td></td>
</tr>
<tr>
<td>- Way functions and hydraulic symbols</td>
<td></td>
</tr>
<tr>
<td><strong>Two-stage digital proportional valve, D942K type series, with direct-operated pilot valve D633K</strong></td>
<td>a Chap. 11.4.2, page 187</td>
</tr>
</tbody>
</table>

Tab. 25: Overview of technical data for the series and variants (Part 1 of 2)
<table>
<thead>
<tr>
<th>Technical data D943K – ISO 4401-08/NG25</th>
<th>a Chap. 11.5, page 196</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Technical data</td>
<td></td>
</tr>
<tr>
<td>- Installation drawing/dimensions</td>
<td></td>
</tr>
<tr>
<td>- Characteristic curves</td>
<td></td>
</tr>
<tr>
<td>- Way functions and hydraulic symbols</td>
<td></td>
</tr>
</tbody>
</table>

Two-stage digital proportional valve, D943K type series, with direct-operated pilot valve D633K | a Chap. 11.5.2, page 198 |

<table>
<thead>
<tr>
<th>Technical data D944K – ISO 4401-08/NG25</th>
<th>a Chap. 11.6, page 207</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Technical data</td>
<td></td>
</tr>
<tr>
<td>- Installation drawing/dimensions</td>
<td></td>
</tr>
<tr>
<td>- Characteristic curves</td>
<td></td>
</tr>
<tr>
<td>- Way functions and hydraulic symbols</td>
<td></td>
</tr>
</tbody>
</table>

Two-stage digital proportional valve, D944K type series, with direct-operated pilot valve D633K | a Chap. 11.6.2, page 209 |

<table>
<thead>
<tr>
<th>Technical data D945K – ISO 4401-10/NG32</th>
<th>a Chap. 11.7, page 218</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Technical data</td>
<td></td>
</tr>
<tr>
<td>- Installation drawing/dimensions</td>
<td></td>
</tr>
<tr>
<td>- Characteristic curves</td>
<td></td>
</tr>
<tr>
<td>- Way functions and hydraulic symbols</td>
<td></td>
</tr>
</tbody>
</table>

Two-stage digital proportional valve, D945K type series, with direct-operated pilot valve D633K | a Chap. 11.7.2, page 220 |

Tab. 25: Overview of technical data for the series and variants (Part 2 of 2)
### 11.1 Nameplates

**Nameplate (example for NG10)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Model number</td>
<td>a Chap. &quot;11.1.1 Model number and type designation&quot;, page 166</td>
</tr>
<tr>
<td>2</td>
<td>Type designation</td>
<td>a Chap. &quot;1.2 Supplemental documents&quot;, page 5</td>
</tr>
<tr>
<td>3</td>
<td>Serial number</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Maximum operating pressure</td>
<td>Hydraulic data (series-specific) &lt;br&gt;a Chap. &quot;11 Technical Data&quot;, page 162 (table)</td>
</tr>
<tr>
<td>5</td>
<td>Pilot pressure</td>
<td>a Chap. &quot;3.3.3 Control type ports X and Y&quot;, page 41 &lt;br&gt;a Chap. &quot;3.3.1.1 Flow control (Q-control)&quot;, page 35</td>
</tr>
<tr>
<td>6</td>
<td>Signal type for analog command inputs</td>
<td>a Chap. &quot;3.4.1.1 Signal type identification&quot;, page 45</td>
</tr>
<tr>
<td>7</td>
<td>Supply voltage</td>
<td>see type designation: &lt;br&gt;a Chap. &quot;11.1 Nameplates&quot;, Digit 11, Supply voltage, page 171 &lt;br&gt;Pin assignment of the connector X1: &lt;br&gt;a Chap. &quot;7.4.1 Pin assignment of connector X1&quot;, page 76</td>
</tr>
<tr>
<td>8</td>
<td>Optional customer-specific designation</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Optional version identification</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Date of manufacture in MM/YY format</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>LSS address (decimal)</td>
<td>a Chap. &quot;11.1.2 LSS address&quot;, page 173</td>
</tr>
<tr>
<td>12</td>
<td>Hydraulic symbol</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Data matrix code</td>
<td>a Chap. &quot;11.1.3 Data matrix code&quot;, page 173</td>
</tr>
<tr>
<td>14</td>
<td>Designation of ports</td>
<td>(only NG10)</td>
</tr>
</tbody>
</table>

Fig. 54: Nameplate (example)
The ambient and fluid temperatures may not exceed the values of the respective temperature classes.

### Item | Designation | Additional information
---|---|---
1 | Series |
2 | Power supply |
3 | Current consumption |
4 | Temperature class | T5 |
5 | Identification |
6 | Certification |
7 | Ambient temperature | $T_A$ for temperature class from item 4 |
8 | Fluid temperature | $T_{oil}$ for temperature class from item 4 |

Fig. 55: Ex nameplate (example)
11.1.1 Model number and type designation

When ordering the valve, its functions are specified and given in model number and the type designation.

The model number is set out as follows:

```
D94x  •  •  •  •  •  •  •  •  •  •  •  •  •  •  •
```

- **Series**
- **Model**
- **Variant**

The 16-digit type designation specifies the delivery state of the valve.

By changing the valve configuration, it is possible to change the valve in such a way that it no longer conforms to this status.

Which signal type is currently set can be ascertained for example with the Moog Valve and Pump Configuration Software.

The 2nd, 15th, and 16th digit of the type designation consist of two characters. The 15th and 16th digits are specified by the factory.

```
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
```

- **Digit 1**
  - **spool type**

The 1st digit of the type designation of the valve provides information about the type of spool.

<table>
<thead>
<tr>
<th>Variant</th>
<th>Spool type</th>
<th>Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Standard spool</td>
<td>D941 to D945</td>
</tr>
<tr>
<td>B</td>
<td>Standard spool (5-way)</td>
<td>D941 (with P1 port)</td>
</tr>
</tbody>
</table>

Tab. 26: Spool type in the type designation
The 2nd digit of the type designation of the valve provides information about the rated flow $Q_N$ (at $\Delta p_N = 5$ bar (72.5 psi) per control land: tolerance $\pm 10\%$)

<table>
<thead>
<tr>
<th>Variant</th>
<th>Rated flow [l/min]</th>
<th>Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>30</td>
<td>D941K</td>
</tr>
<tr>
<td>60</td>
<td>60</td>
<td>D941K</td>
</tr>
<tr>
<td>80</td>
<td>80</td>
<td>D941K</td>
</tr>
<tr>
<td>01</td>
<td>150</td>
<td>D942K</td>
</tr>
<tr>
<td>02</td>
<td>250</td>
<td>D942K</td>
</tr>
<tr>
<td>03</td>
<td>350</td>
<td>D943K</td>
</tr>
<tr>
<td>05</td>
<td>550</td>
<td>D944K</td>
</tr>
<tr>
<td>10</td>
<td>1000</td>
<td>D945K</td>
</tr>
<tr>
<td>15</td>
<td>1500</td>
<td>D945K</td>
</tr>
</tbody>
</table>

Tab. 27: Rated flow variant in the type designation

The pressure range identification, i.e. the 3rd position in the valve type designation, indicates what maximum operating pressure is permissible in port A.

With internal control connection X, the maximum operating pressure corresponds to the maximum pilot pressure. The control parameters of the valve electronics are adjusted to the control pressure.

<table>
<thead>
<tr>
<th>Ident.</th>
<th>Maximum operating pressure in port A</th>
<th>Series D94xK</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>25 bar (363 psi)</td>
<td>p</td>
</tr>
<tr>
<td>V</td>
<td>100 bar (1,450 psi)</td>
<td>p</td>
</tr>
<tr>
<td>U</td>
<td>160 bar (2,320 psi)</td>
<td>p</td>
</tr>
<tr>
<td>T</td>
<td>250 bar (3,625 psi)</td>
<td>p</td>
</tr>
<tr>
<td>K</td>
<td>350 bar (5,075 psi)</td>
<td>p</td>
</tr>
<tr>
<td>X</td>
<td>Special version</td>
<td>p</td>
</tr>
</tbody>
</table>

Tab. 28: Pressure range identification in the type designation

The pressure controlled with a pressure command of 100 % in port A can, depending on the application, deviate from the maximum operating pressure and be set by the customer.
The 4th digit of the valve's type designation provides information about which version of the spool is integrated into the valve.

<table>
<thead>
<tr>
<th>Variant</th>
<th>Valve configuration</th>
<th>Bushing-spool version</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4-way</td>
<td>≈ zero overlap, linear characteristic curve</td>
</tr>
<tr>
<td>D</td>
<td>4-way</td>
<td>10 % positive overlap, linear characteristic curve</td>
</tr>
<tr>
<td>R</td>
<td>4-way</td>
<td>10 % positive overlap, kinked characteristic curve</td>
</tr>
<tr>
<td>Q</td>
<td>5-way</td>
<td>Valve opening: P→A and P₁→B and A→T 5 % positive overlap, linear characteristic curve (only D941K-B)</td>
</tr>
<tr>
<td>Y</td>
<td>4-way</td>
<td>≈ zero overlap, dual gain flow characteristic</td>
</tr>
<tr>
<td>Z</td>
<td>2/2-way</td>
<td>Valve opening: A→T and B→T₁ (D941K) Valve opening: P→B and T→A only with port X and Y external (D942K to D945K)</td>
</tr>
<tr>
<td>X</td>
<td>Special spool on request</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 29: Spool variant in the type designation

The 5th digit of the valve's type designation provides information about which version of the pilot valve is integrated into the valve.

<table>
<thead>
<tr>
<th>Variant</th>
<th>Pilot valve</th>
<th>Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Single-stage drive pilot valve D633K</td>
<td>D941K to D945K</td>
</tr>
</tbody>
</table>

Tab. 30: Pilot valve variant in the type designation
The 6th digit of the valve's type designation provides information about which mechanical fail-safe function is integrated into the valve.

The following table describes the spool positions of the main stage in case of failure of the valve electronics, the control pressure or the control pressure of the optional 4/2-way valve of the D94xK valve with the D633K pilot valve.

<table>
<thead>
<tr>
<th>Fail-safe Function</th>
<th>Spool position of the Main stage</th>
<th>Pilot pressure¹</th>
<th>Supply voltage of Valve Electronics</th>
<th>4/2-way seat valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>End position: P→B and A→T</td>
<td>ON:</td>
<td>off</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>undefined</td>
<td>off</td>
<td>ON:</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>End position: P→B and A→T</td>
<td>off</td>
<td>off</td>
<td>-</td>
</tr>
<tr>
<td>D</td>
<td>End position: P→A and B→T</td>
<td>ON:</td>
<td>off</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(D941K: approx. 20 % P→A and B→T)</td>
<td>off</td>
<td>ON:</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>undefined</td>
<td>off</td>
<td>ON:</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>End position: P→A and B→T</td>
<td>off</td>
<td>off</td>
<td>-</td>
</tr>
<tr>
<td>K</td>
<td>undefined</td>
<td>ON:</td>
<td>off</td>
<td>ON:</td>
</tr>
<tr>
<td></td>
<td>Defined middle position</td>
<td>off</td>
<td>ON:</td>
<td>off</td>
</tr>
<tr>
<td></td>
<td></td>
<td>off</td>
<td>ON:</td>
<td>off</td>
</tr>
<tr>
<td>H</td>
<td>End position: P→B and A→T</td>
<td>ON:</td>
<td>off</td>
<td>ON:</td>
</tr>
<tr>
<td></td>
<td>undefined</td>
<td>off</td>
<td>ON:</td>
<td>ON:</td>
</tr>
<tr>
<td></td>
<td>Defined middle position and defined P→B and A→T</td>
<td>off</td>
<td>off</td>
<td>ON:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>off</td>
<td>ON:</td>
<td>off</td>
</tr>
<tr>
<td></td>
<td></td>
<td>off</td>
<td>ON:</td>
<td>off</td>
</tr>
</tbody>
</table>

Tab. 31: Spool position in case of failure, D94xK with pilot valve D633K

All other combinations of pressure and supply voltage give rise to an undefined main stage spool position.

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User manual type series D94xK (CDS29589-de; Version -, April 2012) 169
The 7th digit in the valve type designation provides information about whether pilot pressure port X and leakage port Y are internally or externally connected in the valve.

<table>
<thead>
<tr>
<th>Variant</th>
<th>Intake X</th>
<th>Drain Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>internally</td>
<td>internally</td>
</tr>
<tr>
<td>5</td>
<td>externally</td>
<td>internally</td>
</tr>
<tr>
<td>6</td>
<td>externally</td>
<td>externally</td>
</tr>
<tr>
<td>7</td>
<td>internally</td>
<td>externally</td>
</tr>
</tbody>
</table>

Tab. 32: Variant of pilot pressure and leakage port in the type designation

For selection limitations, see the hydraulic symbols. "Valve configurations and hydraulic symbols" (series-specific) a Chap. "11 Technical Data", page 162 (table)

The 8th digit in the type designation of the valve designates the sealing material used.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>NBR</td>
<td>D941K to D944K</td>
</tr>
<tr>
<td>V</td>
<td>FKM</td>
<td>D941K to D945K</td>
</tr>
<tr>
<td>S</td>
<td>Edge seal HNBR</td>
<td>D945K</td>
</tr>
<tr>
<td>X</td>
<td>Special versions on request</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 33: Seal material variant in the type designation

The 9th digit of the valve's type designation specifies the version of the valve connector X1.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>7-pole</td>
</tr>
</tbody>
</table>

Tab. 34: Variant of the valve connector X1 in the type designation

The 10th digit of the valve's type designation provides information about which signal type is set in the valve on delivery.

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The signal type of the command signal input applies in combination with the signal type of the spool position signal (actual value output).

<table>
<thead>
<tr>
<th>Variant</th>
<th>Command signals for 100 % spool stroke</th>
<th>Stroke position signal (IOut and UOut)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>±10 V</td>
<td>2–10 V</td>
</tr>
<tr>
<td>E</td>
<td>4–20 mA</td>
<td>4–20 mA</td>
</tr>
<tr>
<td>M</td>
<td>±10 V</td>
<td>4–20 mA</td>
</tr>
<tr>
<td>X</td>
<td>±10 mA</td>
<td>4–20 mA</td>
</tr>
<tr>
<td>9</td>
<td>Fieldbus</td>
<td>Fieldbus</td>
</tr>
<tr>
<td>Y</td>
<td>Others on request.</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 35: Signal types command value and spool position signal in the type designation

The analog command signal $I_{in}$ or $U_{in}$ is the flow command value input. The stroke position signal (actual output value) $I_{out}$ or $U_{out}$ is proportional to the mechanical position of the spool.

**a Chap. "7 Electrical connection", page 68**

```
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
•••••••••••• 2 ••••••••••••
```

Digit 11
Supply voltage

The 11th digit of the type designation specifies the supply voltage:

```
2 nominal 24 V DC
```

**a Chap. "7 Electrical connection", page 68**

```
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
•••••••••••• 2 ••••••••••••
```

Digit 12

The 12th digit of the type designation is specified by the factory.

```
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
•••••••••••• 2 ••••••••••••
```

Digit 13

The 13th digit of the type designation of the valve provides information about the position of the spool with switched-off enable signal (X1).
The 14th digit of the type designation specifies whether the valve has a fieldbus interface and which is the one in question.

<table>
<thead>
<tr>
<th>Variant</th>
<th>Fieldbus connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>CAN</td>
</tr>
<tr>
<td>H</td>
<td>Profibus DP</td>
</tr>
<tr>
<td>J</td>
<td>EtherCAT</td>
</tr>
<tr>
<td>O</td>
<td>without fieldbus interface</td>
</tr>
</tbody>
</table>

Tab. 36: Variant of the fieldbus connector X3 and X4 in the type designation

The 15th and 16th digits of the type designation are specified by the factory.
11.1.2 LSS address

The decimal LSS address is set out in accordance with CiA DSP 305 as follows and serves to provide the CAN bus node with an internationally unique identification:

<table>
<thead>
<tr>
<th>LSS address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer ID</td>
</tr>
<tr>
<td>/ Product code /</td>
</tr>
</tbody>
</table>

Example:
40/43/1/4321

Even valves without CAN bus interfaces are assigned a decimal LSS address during manufacturing.

11.1.3 Data matrix code

The data matrix code is a two-dimensional code. The code on the nameplate contains a character string that is set out as follows:

<table>
<thead>
<tr>
<th>Data matrix code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model number # Optional version identification # Serial number with country identification</td>
</tr>
</tbody>
</table>

If there is no optional version identification, a blank space appears here.

Example:
D941K-215A-0001#C#D4321

11.2 Electromagnetic compatibility (EMC)

The valves in the D941K to D945K type series satisfy the EMC protection requirements for immunity to interference as per EN 61000-6-2:2005 (evaluation criterion A) and for emitted interference as per EN 61000-6-4:2005 (CAN bus and Profibus-DP) or as per EN 61000-6-3:2005 (EtherCAT).

The following technical requirements must be in place so that the EMC protection requirements can be fulfilled:

- Use of the mating connectors recommended for the valves
  a Chap. "12 Accessories, Spare Parts, and Tools", page 232
- Adequate shielding
- Version of equipotential bonding system, protective grounding, and electrical shielding.
  a Chap. "7.12.2 Equipotential bonding and protective grounding", page 97
11.3 Technical data D941K – ISO 4401-05/NG10

The technical data apply to the two-stage proportional valves in the D941K type series

- with direct-operated pilot valve D633K
  a Chap. "11.3.1 Mounting surface", page 175
  a Chap. "11.3.2 Data D941K with direct-operated pilot valve D633K", page 176
  a Chap. "Dimensions (installation drawing), with fail-safe F and D", page 178
  a Chap. "Valve configurations and hydraulic symbols", page 179
  a Chap. "11.3.2 Data D941K with direct-operated pilot valve D633K", page 176
11.3.1 Mounting surface

If the valve is mounted on the mounting surface, it projects lengthwise (x-axis) over the mounting surface.

Valve dimensions:
- Chap. "Dimensions (installation drawing), with fail-safe F and D", page 178

11.3.1.1 Mounting pattern of mounting surface

The holes in the mounting surface must correspond to ISO 4401-05-0-05.

Mounting length at least 100 mm.

- For the 5-way version type B80..., T₁ becomes P₁ (see hole pattern Fig. 56)
- For valves in the 4-way version and with Qₙ > 60 l/min and in 2/2-way version, the second tank connection T₁ is required.

The hole pattern (Fig. 56) applies to the two-stage digital proportional valve in the D941K type series with direct-operated pilot valve D633K.

![Hole pattern diagram](image)

<table>
<thead>
<tr>
<th>P</th>
<th>A</th>
<th>B</th>
<th>T</th>
<th>T₁</th>
<th>X</th>
<th>Y</th>
<th>F₁</th>
<th>F₂</th>
<th>F₃</th>
<th>F₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø 11.5 (0.45)</td>
<td>Ø 11.5 (0.45)</td>
<td>Ø 11.5 (0.45)</td>
<td>Ø 11.5 (0.45)</td>
<td>Ø 11.5 (0.45)</td>
<td>dia. 6.3 (0.25)</td>
<td>dia. 6.3 (0.25)</td>
<td>M6</td>
<td>M6</td>
<td>M6</td>
<td>M6</td>
</tr>
<tr>
<td>X 27 (1.06)</td>
<td>16.7 (0.66)</td>
<td>37.3 (1.47)</td>
<td>3.2 (0.13)</td>
<td>50.8 (2.00)</td>
<td>-8 (-0.31)</td>
<td>62 (2.44)</td>
<td>0</td>
<td>54 (2.13)</td>
<td>54 (2.13)</td>
<td>0</td>
</tr>
<tr>
<td>Y 6.3 (0.25)</td>
<td>21.4 (0.84)</td>
<td>21.4 (0.84)</td>
<td>32.5 (1.28)</td>
<td>32.5 (1.28)</td>
<td>11 (0.43)</td>
<td>11 (0.43)</td>
<td>0</td>
<td>0</td>
<td>46 (1.81)</td>
<td>46 (1.81)</td>
</tr>
</tbody>
</table>

Fig. 56: Hole pattern in the mounting surface for the D941K type series (dimensions in mm and (in))

- For maximum flow, the ports for P, T, A, and B must contrary to the standard be designed with a diameter of 11.5 mm (0.45 in).
- F₁…F₄ are holes for attachment screws in the holes of the mounting surface of the valve.
# 11.3.2 Data D941K with direct-operated pilot valve D633K

<table>
<thead>
<tr>
<th>Valve design</th>
<th>Proportional valve, two-stage, with standard spools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot valve</td>
<td>D633K</td>
</tr>
<tr>
<td>Nominal size and holes</td>
<td>NG10, holes according to ISO 4401-05-05-05-05, with T₁</td>
</tr>
<tr>
<td>Mounting position</td>
<td>In any position, fixed or movable</td>
</tr>
</tbody>
</table>
| Diameter of the ports and threads of the fastening holes | P, A, B, T, and T₁: 11.5 mm  
X and Y: 6.3 mm  
F₁ to F₄: M6  |
| Mass | approx. 13.3 kg (29.3 lb)  
Valves with fail-safe functions H and K approx. 14.5 kg (32 lb) |
| Dimensions | a "Dimensions (installation drawing), with fail-safe F and D", Seite 178 |

## General Technical data

| Ambient temperature | for transport/storage: recommended 15 °C to 25 °C  
permissible −40 °C to 80 °C  
for operation (−40 °C on request) −20 °C to 60 °C  
Depending on the certified temperature classes |
| Rel. humidity for storage | < 65 % not condensing |
| Vibration resistance | 10 g, 3 axes, Frequency: 10 to 2,000 Hz (according to EN 60068-2-6) |
| Shock resistance | 3 g, 6 directions, half-sine 3 ms (as per EN 60068-2-27) |
| Valve configurations | 5-way, 4-way, 3-way, 2/2-way and 2-way operation  
a Chap. "3.3.2 Valve configurations and hydraulic symbols", page 38 |
| Operating pressure of the pilot valve | via T or Y  
pₚ or pᵧ +10 bar  
Operating pressure range X port 10 to 350 bar  
max. pressure Y port 70 bar |
| Maximum operating pressure range of main stage | Ports P and B 350 bar  
Port A: dependent on pressure transducer max. 350 bar  
a Tab. 28, page 167  
Port T for Y internal 5 70 bar  
Port T for Y external 250 bar |
| Linearity of pressure control | < 0.5 % of the maximum operating pressure in port A  
a Chap. "11.1.1 Model number and type designation", page 166 |
| Maximum flow Qₘₐₓ | 180 l/min (48 gpm)  
a Chap. "4.1 Flow diagram (4-way operation)", page 55 |
| Rated flow Qᵣ for Δpᵣ = 5 bar per control land | 30 / 60 / 80 / 2 x 80 l/min (8 / 16 / 21 / 2 x 21 gpm)  
(depending on the series variant a Chap. "Type designation", "Digit 2, rated flow Qᵣ", Seite 167) |
| Leakage flow for 100 % jump | 1.8 l/min (0.3/0.5 gpm)  
(≈ zero overlap) |
| Pilot flow static | Pilot valve standard trimmed 0.4 l/min (0.1 gpm)  
0.4 l/min (0.1 gpm) |
| Pilot flow at 100 % | Pilot valve standard trimmed 6.0 l/min (1.6 gpm)  
6.5 l/min (1.7 gpm) |

## Permissible ambient conditions

| Hydraulic data | Mineral-oil-based hydraulic oil as per DIN 51524-1 1 to 3 and ISO 11158  
Other fluids on request |
| Permissible temperature | (−40 °C on request) −20 °C to 80 °C  
depending on the certified temperature classes |
| Viscosity | recommended 15 to 45 mm²/s  
permissible 5 to 400 mm²/s |

Tab. 37: Technical data D941K with direct-operated pilot valve D633K (Part 1 of 2)
Technical data D941K – ISO 4401-05/NG10

<table>
<thead>
<tr>
<th>Static and dynamic data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purity class, recommended (ISO 4406)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Step response time for 0 to 100 % spool stroke</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Threshold</td>
</tr>
<tr>
<td>Hysteresis</td>
</tr>
<tr>
<td>Zero shift at ( \Delta T = 55 \text{ K} )</td>
</tr>
<tr>
<td>Manufacturing tolerance</td>
</tr>
<tr>
<td>Relative duty cycle</td>
</tr>
<tr>
<td>Electrical data</td>
</tr>
<tr>
<td>Protection type</td>
</tr>
<tr>
<td>Supply voltage</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Max. current consumption static</td>
</tr>
<tr>
<td>Max. current consumption dynamic</td>
</tr>
<tr>
<td>External fuse protection for each valve</td>
</tr>
<tr>
<td>EMC protection requirements</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Connectors</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Triggering electronics</td>
</tr>
</tbody>
</table>

Tab. 37: Technical data D941K with direct-operated pilot valve D633K (Part 2 of 2)

1) The ambient temperature and the temperature of the hydraulic fluid influence the temperature of the valve electronics. In order to ensure that the electronic components integrated in the valve last as long as possible, we recommend that the hydraulic fluid be kept at as low a temperature as possible at as low an ambient temperature as possible. A reference temperature is measured in the valve electronics. Fault-free operation is guaranteed up to a reference temperature of 85 °C (185 °F). At reference temperatures over 85 °C (185 °F) a warning is output via the field bus on valves with field bus interfaces. At reference temperatures over 105 °C (221 °F) the valve electronics are deactivated; the valve adopts the 'DISABLED' valve status and thus the mechanical fail-safe state. a Chap. "3.2 Safety function/fail-safe", page 27

2) Temperature fluctuations >10 °C must be avoided during storage.

3) Transportation and storage should be as vibration- and shock-free as possible.

4) Hydraulic data was measured with control/operating pressure \( p_P = 210 \text{ bar} \), viscosity of hydraulic fluid \( \nu = 32 \text{ mm}^2/\text{s} \) and temperature of hydraulic fluid \( T = 40 \text{ °C} \). a Chap. "6 Mounting and Connection to the Hydraulic System", page 63

5) Pressure peaks up to 210 bar permissible

6) The cleanliness of the hydraulic fluid has a great effect on functional safety (reliable spool positioning, high resolution) and wear of the spool lands (pressure gain, leakage losses).
Two-stage digital proportional valve, D941K type series, with direct-operated pilot valve D633K

Dimensions (installation drawing), with fail-safe F and D

Installation space for the connectors when mounted: [Fig. 23, page 74]

*) Dimension with fixed cabling of pilot valve with explosion-proof cable glands. If the pilot valve cabling uses explosion-proof connectors, the valve installation height increases by 50 mm (1.97 in).

**) With fail-safe D
Valve configurations and hydraulic symbols

**Fail-safe function F**
5-way version

- X and Y optionally external or internal

Port \( P_1 \) required
\( P_1 \) does not correspond to ISO 4401

Port \( P_1 \) is equivalent to port \( T_1 \)

**Fail-safe function F**
4-way version

- X and Y optionally external or internal

Tank port \( T_1 \) at \( Q_N > 60 \) l/min required

**Fail-safe function M**
2/2-way version

- only X and Y external

Tank port \( T_1 \) required
Execute flow direction according to symbols.
Two-stage digital proportional valve, D941K type series, with direct-operated pilot valve D633K with fail-safe function H or K for applications with safety requirements

Dimensions (installation drawing), mechanical/hydraulic fail-safe H and K

*) Dimension with fixed cabling of pilot valve with explosion-proof cable glands. If the pilot valve cabling uses explosion-proof connectors, the valve installation height increases by 50 mm (1.97 in).

Installation space for the connectors when mounted: a Fig. 23, page 74

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nameplate</td>
<td>a Fig. 54, page 164</td>
</tr>
<tr>
<td>2</td>
<td>Ex nameplate</td>
<td>a Fig. 55, page 165</td>
</tr>
<tr>
<td>3</td>
<td>Venting screw</td>
<td>a Chap. &quot;8.5.1 Venting&quot;, page 140</td>
</tr>
</tbody>
</table>

Fig. 58: Installation drawing for D941K (dimensions in mm)
Fail-safe function H
4-way version
X and Y optionally external or internal

Fail-safe function K
2/2-way version
only X and Y external

Fail-safe function K
4-way version
X and Y optionally external or internal

defined A→T

defined middle

Execute flow direction according to symbols.
Characteristic curves, D941K valves with direct-operated pilot valve D633K

- All characteristic curves in the section "Characteristic curves, D941K valves with pilot valve D633K" are typical characteristic curves for the D941K valve with pilot valve D633K with control/operating pressure \(p_P = 210\) bar, viscosity of hydraulic fluid \(v = 32\) mm\(^2\)/s and temperature of hydraulic fluid \(T = 40^\circ\)C.
- For \(Q_N > 60\) l/min, a second tank port \(T_1\) is required.

Flow diagram (4-way operation)

Flow signal characteristic curve at rated pressure drop \(\Delta p_N = 10\) bar, that is, \(\Delta p_N = 5\) bar per control land:

- **Spool A**: zero overlap, linear characteristic curve
- **Spool D**: 10% positive overlap, linear characteristic curve
- **Spool Y**: zero overlap, dual gain flow characteristic
- **P30**: type: standard spool rated flow 30 l/min
- **P60**: type: standard spool rated flow 60 l/min
- **P80**: type: standard spool rated flow 80 l/min

Fig. 59: D941K valves, flow-signal characteristics
Step response for D941K valves with direct-operated pilot valve D633K, standard

Frequency response for D941K valves with direct-operated pilot valve D633K, standard

Fig. 60: Step response for D941K valves, standard

Fig. 61: Frequency response for D941K valves, standard
Step response for D941K valves with direct-operated pilot valve D633K, trimmed

Fig. 62: Step response for D941K valves, trimmed

Frequency response for D941K valves with direct-operated pilot valve D633K, trimmed

Fig. 63: Frequency response for D941K valves, trimmed
11.4 Technical data D942K – ISO 4401-07/NG16

The technical data applies to proportional valves in the D942K type series

- two-stage, with direct-operated pilot valve D633K
  - Chap. "11.4.1 Mounting surface", page 186
  - Chap. "11.4.2 Data D942K with direct-operated pilot valve D633K", page 187
  - Chap. " Dimensions (installation drawing), with fail-safe F and D", page 189
  - Chap. " Valve configurations and hydraulic symbols", page 190
  - Chap. " Characteristic curves, D942K valves with direct-operated pilot valve D633K", page 193
11.4.1 Mounting surface

If the valve is mounted on the mounting surface, it projects lengthwise (x-axis) over the mounting surface.

Valve dimensions:
- a Chap. "Dimensions (installation drawing), with fail-safe F and D", page 189

11.4.1.1 Mounting pattern of mounting surface

The holes in the mounting surface must correspond to ISO 4401-07-0-05.

The hole pattern (Fig. 64) applies to the digital proportional valve in the D942K type series
- two-stage, with direct-operated pilot valve D633K

<table>
<thead>
<tr>
<th>P</th>
<th>A</th>
<th>T</th>
<th>B</th>
<th>X</th>
<th>Y</th>
<th>G2</th>
<th>G2</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F2</th>
<th>F2</th>
</tr>
</thead>
<tbody>
<tr>
<td>dia. 20 (0.79)</td>
<td>dia. 20 (0.79)</td>
<td>dia. 20 (0.79)</td>
<td>dia. 6.3 (0.25)</td>
<td>dia. 6.3 (0.25)</td>
<td>dia. 4</td>
<td>dia. 4</td>
<td>M10</td>
<td>M10</td>
<td>M10</td>
<td>M10</td>
<td>M6</td>
<td>M6</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>50 (1.97)</td>
<td>34.1 (1.34)</td>
<td>18.3 (0.72)</td>
<td>65.9 (2.59)</td>
<td>76.6 (3.02)</td>
<td>88.1 (3.47)</td>
<td>76.6 (3.02)</td>
<td>18.3 (0.72)</td>
<td>0</td>
<td>101.6 (4.00)</td>
<td>101.6 (4.00)</td>
<td>0</td>
<td>34.1 (1.34)</td>
</tr>
<tr>
<td>Y</td>
<td>14.3 (0.56)</td>
<td>55.6 (2.19)</td>
<td>14.3 (0.56)</td>
<td>55.6 (2.19)</td>
<td>15.9 (0.63)</td>
<td>57.2 (2.25)</td>
<td>0</td>
<td>69.9 (2.75)</td>
<td>0</td>
<td>0</td>
<td>69.9 (2.75)</td>
<td>69.9 (2.75)</td>
<td>-1.6 (-0.06)</td>
</tr>
</tbody>
</table>

Fig. 64: Hole pattern in the mounting surface for the D942K type series (dimensions in mm and (in))

- For maximum flow, the ports for P, T, A, and B must contrary to the standard be designed with a diameter of 20 mm (0.45 in).
- F1…F4 are holes for attachment screws in the mounting surface of the valve.
- G1 and G2 are holes for accommodating the transposition-proof pins of the valve.
### 11.4.2 Data D942K with direct-operated pilot valve D633K

<table>
<thead>
<tr>
<th>Valve design</th>
<th>Proportional valve, two-stage, with standard spools</th>
<th>General Technical data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot valve</td>
<td>D633K standard or trimmed</td>
<td></td>
</tr>
<tr>
<td>Nominal size and holes</td>
<td>NG16, holes according to ISO 4401-07-0-05</td>
<td></td>
</tr>
<tr>
<td>Mounting position</td>
<td>In any position, fixed or movable</td>
<td></td>
</tr>
<tr>
<td>Diameter of the ports and threads of the fastening holes</td>
<td>P, A, T, and B 20 mm, X and Y 6.3 mm, F₁ to F₄ M10, F₁ to F₄ M10, G₁ and G₂ 4 mm</td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>approx. 18.5 kg (5.5 lb) Valves with fail-safe functions H and K approx. 20 kg (44 lb)</td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>a &quot;Dimensions (installation drawing), with fail-safe F and D&quot;, Seite 189</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>1) for transport/storage recommended 15 °C to 25 °C permissible -40 °C to 80 °C for operation (-40 °C on request) permissible -20 °C to 60 °C depending on the certified temperature classes</td>
<td>Permissible ambient conditions</td>
</tr>
<tr>
<td>Rel. humidity for storage</td>
<td>&lt; 65 % not condensing</td>
<td></td>
</tr>
<tr>
<td>Vibration resistance</td>
<td>3) 10 g, 3 axes, Frequency: 10 to 2,000 Hz (according to EN 60068-2-6)</td>
<td></td>
</tr>
<tr>
<td>Shock resistance</td>
<td>3) 50 g, 6 directions, half-sine 3 ms (as per EN 60068-2-27)</td>
<td></td>
</tr>
<tr>
<td>Valve configurations</td>
<td>4-way, 3-way, 2/2-way and 2-way operation</td>
<td></td>
</tr>
<tr>
<td>Operating pressure of the pilot valve</td>
<td>via T or Y p₁,₂ or p₃,₄ +10 bar Operating pressure range X port 10 to 350 bar max. pressure Y port 5 70 bar</td>
<td>Hydraulic data</td>
</tr>
<tr>
<td>Maximum operating pressure range of main stage</td>
<td>Ports P and B 350 bar Port A: dependent on pressure transducer max. 350 bar a Tab. 28, page 167 Port T for Y internal 5 70 bar Port T for Y external 250 bar</td>
<td></td>
</tr>
<tr>
<td>linearity of pressure control</td>
<td>&lt; 0.5 % of the maximum operating pressure in port A a Chap. &quot;11.1.1 Model number and type designation&quot;, page 166</td>
<td></td>
</tr>
<tr>
<td>Maximum flow Qₘₐₓ</td>
<td>600 l/min (158.5 gpm) a Chap. &quot;4.1 Flow diagram (4-way operation)&quot;, page 55</td>
<td></td>
</tr>
<tr>
<td>Rated flow Qᵦ for Δpᵦ = 5 bar per control land</td>
<td>150 / 250 l/min (40 / 66 gpm) (depending on the series variant a Chap. &quot; Type designation&quot;, &quot;Digit 2, rated flow Qᵦ&quot;, Seite 167)</td>
<td></td>
</tr>
<tr>
<td>Leakage flow Main stage Qₗ</td>
<td>2.5 l/min (0.3/0.5 gpm) (= zero overlap)</td>
<td></td>
</tr>
<tr>
<td>Pilot flow static</td>
<td>Pilot valve standard trimmed 0.5 l/min (0.1 gpm), 0.5 l/min (0.1 gpm)</td>
<td></td>
</tr>
<tr>
<td>Pilot flow at 100 % jump</td>
<td>Pilot valve standard trimmed 35 l/min (9.3 gpm), 26 l/min (6.9 gpm)</td>
<td></td>
</tr>
<tr>
<td>Hydraulic fluid</td>
<td>Mineral-oil-based hydraulic oil as per DIN 51524-1 1 to 3 and ISO 11158 Other fluids on request</td>
<td></td>
</tr>
<tr>
<td>Permissible temperature</td>
<td>(-40 ° on request) -20 ° to 80 ° depending on the certified temperature classes</td>
<td></td>
</tr>
<tr>
<td>Viscosity V</td>
<td>recommended permissible 15 to 45 mm²/s 5 to 400 mm²/s</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 38: Technical data D942K with direct-operated pilot valve D633K (Part 1 of 2)
Purity class\(^{5}\), 
recommended 
(ISO 4406) 

<table>
<thead>
<tr>
<th>Step response time for 0 to 100 % spool stroke</th>
<th>for functional safety</th>
<th>&lt; 18/15/12</th>
</tr>
</thead>
<tbody>
<tr>
<td>for life cycle (wear)</td>
<td>trimmed</td>
<td>&lt;17/14/11</td>
</tr>
</tbody>
</table>

Pilot valve standard 11 ms 
trimmed 13 ms 

Step response and frequency response a Seite 194 

Threshold < 0.1 % 

Hysteresis < 0.2 % 

Zero shift at \(\Delta T = 55 \) K < 1 % 

Manufacturing tolerance ±10 % 

Relative duty cycle 100 % 

Protection type IP66 with mounted mating connectors (according to EN 60529) 

Supply voltage Nominal 24 V (18 to 32 V) DC based on GND. 
Only use SELV-/PELV power supply according to EN 60204-1 

At supply voltages less than 18 V, the valve is rendered in the fail-safe state. 
a Chap. "3.2.3 Fail-safe events", page 30 

Max. current consumption static 0.3 A 

Max. current consumption dynamic 1.2 A 

External fuse protection for each valve 1.6 A slow-blowing fuse 

EMC protection requirements Immunity to interference as per EN 61000-6-2:2005 (evaluation criterion A) 

Emitted interference as per EN 61000-6-4:2005 (CAN bus and Proflbus DP) or as per EN 61000-6-3:2005 (EtherCAT) 
a Chap. "11.2 Electromagnetic compatibility (EMC)“, page 173 

Connectors a Chap. "7 Electrical connection", page 68 
a Chap. "7.4.1 Pin assignment of connector X1", page 76 

Triggering electronics Digital control electronics integrated into the valve 

Tab. 38: Technical data D942K with direct-operated pilot valve D633K (Part 2 of 2) 

1) The ambient temperature and the temperature of the hydraulic fluid influence the temperature of the valve electronics. In order to ensure that the electronic components integrated in the valve last as long as possible, we recommend that the hydraulic fluid be kept at as low a temperature as possible at as low an ambient temperature as possible. A reference temperature is measured in the valve electronics. Fault-free operation is guaranteed up to a reference temperature of 85 °C (185 °F). At reference temperatures over 85 °C (185 °F) a warning is output via the field bus on valves with field bus interfaces. At reference temperatures over 105 °C (221°F) the valve electronics are deactivated; the valve adopts the 'DISABLED' valve status and thus the mechanical fail-safe state. 
a Chap. "3.2 Safety function/fail-safe", page 27 

2) Temperature fluctuations >10 °C must be avoided during storage. 

3) Transportation and storage should be as vibration- and shock-free as possible. 

4) Hydraulic data was measured with control/operating pressure \(p_P = 210 \) bar, viscosity of hydraulic fluid \(\nu = 32 \) mm²/s and temperature of hydraulic fluid \(T = 40 \) °C. 
a Chap. "6 Mounting and Connection to the Hydraulic System", page 63 

5) The cleanliness of the hydraulic fluid has a great effect on functional safety (reliable spool positioning, high resolution) and wear of the spool lands (pressure gain, leakage losses).
Two-stage digital proportional valve, D942K type series, with direct-operated pilot valve D633K

Dimensions (installation drawing), with fail-safe F and D

---

**Item** | **Designation** | **Additional information**
--- | --- | ---
1 | Nameplate | a Fig. 54, page 164
2 | Ex nameplate | a Fig. 55, page 165
3 | Venting screw | a Chap. "8.5.1 Venting", page 140

---

Installation space for the connectors when mounted: a Fig. 23, page 74

*) Dimension with fixed cabling of pilot valve with explosion-proof cable glands. If the pilot valve cabling uses explosion-proof connectors, the valve installation height increases by 50 mm (1.97 in).
Valve configurations and hydraulic symbols

**Fail-safe function F**
4-way version
X and Y optionally external or internal

**Fail-safe function M**
2/2-way version
only X and Y external

Execute flow direction according to symbols.
Two-stage digital proportional valve, D942K type series, with direct-operated pilot valve D633K with fail-safe function H or K for applications with safety requirements

Dimensions (installation drawing), mechan./hydr. fail-safe H and K

Fig. 66: Installation drawing for D942K (dimensions in mm)

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nameplate</td>
<td>a Fig. 54, page 164</td>
</tr>
<tr>
<td>2</td>
<td>Ex nameplate</td>
<td>a Fig. 55, page 165</td>
</tr>
<tr>
<td>3</td>
<td>Venting screw</td>
<td>a Chap. &quot;8.5.1 Venting&quot;, page 140</td>
</tr>
</tbody>
</table>

Installation space for the connectors when mounted: a Fig. 23, page 74

*) Dimension with fixed cabling of pilot valve with explosion-proof cable glands. If the pilot valve cabling uses explosion-proof connectors, the valve installation height increases by 50 mm (1.97 in).
Fail-safe function H
4-way version
X and Y optionally external or internal

Fail-safe function K
4-way version
X and Y optionally external or internal

Fail-safe function K
2/2-way version
only X and Y external

defined A→T
defined middle
defined middle through mechanical stroke limitation

Execute flow direction according to symbols.
Characteristic curves, D942K valves with direct-operated pilot valve D633K

All characteristic curves in the section "Characteristic curves, D942K valves with pilot valve D633K" are typical characteristic curves for the D942K valve with pilot valve D633K with control/operating pressure \( p_P = 210 \text{ bar} \), viscosity of hydraulic fluid \( \nu = 32 \text{ mm}^2/\text{s} \) and temperature of hydraulic fluid \( T = 40 \degree \text{C} \).

Flow diagram (4-way operation)

a Chap. "4.1 Flow diagram (4-way operation)" , page 55

Flow signal characteristic curve at rated pressure drop \( \Delta p_N = 10 \text{ bar} \), that is, \( \Delta p_N = 5 \text{ bar} \) per control land:

![Flow signal characteristic curve](image)

- **Spool A**: zero overlap, linear characteristic curve
- **Spool D**: 10% positive overlap, linear characteristic curve
- **Spool Y**: zero overlap, dual gain flow characteristic
- **P01**: type: standard spool rated flow 150 l/min
- **P02**: type: standard spool rated flow 250 l/min

Fig. 67: D942K valves, flow-signal characteristics
Step response for D942K valves with direct-operated pilot valve D633K, standard

Fig. 68: Step response for D942K valves, standard

Frequency response for D942K valves with direct-operated pilot valve D633K, standard

Fig. 69: Frequency response for D942K valves, standard
Step response for D942K valves with direct-operated pilot valve D633K, trimmed

![Step response graph](image)

Fig. 70: Step response for D942K valves, trimmed

Frequency response for D942K valves with direct-operated pilot valve D633K, trimmed

![Frequency response graph](image)

Fig. 71: Frequency response for D942K valves, trimmed
11.5 Technical data D943K – ISO 4401-08/NG25

The technical data applies to proportional valves in the D943K type series

- two-stage, with direct-operated pilot valve D633K
  - Chap. "11.5.2 Data D943K with direct-operated pilot valve D633K", page 198
  - Chap. "Technical data for the mounting surface", page 197
  - Chap. "Dimensions (installation drawing), with fail-safe F and D", page 200
  - Chap. "Valve configurations and hydraulic symbols", page 201
  - Chap. "Characteristic curves, D943K valves with direct-operated pilot valve D633K", page 204
11.5.1 Mounting surface

If the valve is mounted on the mounting surface, it projects lengthwise (x-axis) over the mounting surface. Valve dimensions:

- a Chap. "Dimensions (installation drawing), with fail-safe F and D", page 200

11.5.1.1 Mounting pattern of mounting surface

The holes in the mounting surface must correspond to ISO 4401-08-08-0-05.

The hole pattern (Fig. 72) applies to the digital proportional valve in the D943K type series

- two-stage, with direct-operated pilot valve D633K

![Diagram of mounting pattern](image)

**Table 1:**

<table>
<thead>
<tr>
<th>P</th>
<th>A</th>
<th>T</th>
<th>B</th>
<th>X</th>
<th>Y</th>
<th>G₂</th>
<th>G₂</th>
<th>F₁</th>
<th>F₂</th>
<th>F₃</th>
<th>F₄</th>
<th>F₂</th>
<th>F₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>dia. 28 (1.10)</td>
<td>dia. 28 (1.10)</td>
<td>dia. 28 (1.10)</td>
<td>dia. 28 (1.10)</td>
<td>dia. 11.2 (0.44)</td>
<td>dia. 11.2 (0.44)</td>
<td>dia. 7.5 (0.30)</td>
<td>dia. 7.5 (0.30)</td>
<td>M12</td>
<td>M12</td>
<td>M12</td>
<td>M12</td>
<td>M12</td>
<td>M12</td>
</tr>
<tr>
<td>X</td>
<td>77 (3.03)</td>
<td>53.2 (2.09)</td>
<td>29.4 (1.16)</td>
<td>100.8 (3.97)</td>
<td>17.5 (0.69)</td>
<td>112.7 (4.44)</td>
<td>94.5 (3.72)</td>
<td>29.4 (1.16)</td>
<td>0</td>
<td>130.2 (5.13)</td>
<td>130.2 (5.13)</td>
<td>0</td>
<td>53.2 (2.09)</td>
</tr>
<tr>
<td>Y</td>
<td>17.5 (0.69)</td>
<td>74.6 (2.94)</td>
<td>17.5 (0.69)</td>
<td>74.6 (2.94)</td>
<td>73 (2.87)</td>
<td>19 (0.75)</td>
<td>-4.8 (-0.19)</td>
<td>92.1 (3.63)</td>
<td>0</td>
<td>0</td>
<td>92.1 (3.63)</td>
<td>92.1 (3.63)</td>
<td>0</td>
</tr>
</tbody>
</table>

Fig. 72: Hole pattern in the mounting surface for the D943K type series (dimensions in mm and (in))

- For maximum flow, the ports for P, T, A, and B must contrary to the standard be designed with a diameter of 28 mm (1.10 in).
- F₁…F₆ are holes for attachment screws in the mounting surface of the valve.
- G₁ and G₂ are holes for accommodating the transposition-proof pins of the valve.

© Moog GmbH User manual type series D94xK (CDS29589-de; Version -, April 2012) 197
## 11.5.2 Data D943K with direct-operated pilot valve D633K

<table>
<thead>
<tr>
<th>Valve design</th>
<th>Proportional valve, two-stage, with standard spools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot valve</td>
<td>D633K standard or trimmed</td>
</tr>
<tr>
<td>Nominal size and holes</td>
<td>NG25, holes according to ISO 4401-08-0-0-05</td>
</tr>
<tr>
<td>Mounting position</td>
<td>In any position, fixed or movable</td>
</tr>
</tbody>
</table>
| Diameter of the ports and threads of the fastening holes | P, A, T, B, and X 28 mm  
X and Y 11.2 mm  
F₁ to F₆  M12  
G₁ and G₂  7.5 mm  |
| Mass         | approx. 26.5 kg (5.5 lb)  
Valves with fail-safe functions H and K approx. 28 kg (61.7 lb) |
| Dimensions   | a "Dimensions (installation drawing), with fail-safe F and D", Seite 200 |
| Ambient temperature | ¹) recommended 15 °C to 25 °C  
permissible −40 °C to 80 °C  
(−40 °C on request) −20 °C to 60 °C  
depending on the certified temperature classes |
| Rel. humidity | < 65 % not condensing                               |
| Vibration resistance | ³) 10 g, 3 axes, Frequency: 10 to 2,000 Hz (according to EN 60068-2-6) |
| Shock protection | ³) 50 g, 6 directions, half-sine 3 ms (as per EN 60068-2-27) |
| Valve configurations | 4-way, 3-way, 2/2-way and 2-way operation |
| Operating pressure of the pilot valve | via T or Y \( p_{T} \) or \( p_{Y} + 10 \) bar  
max. pressure Y port ²) 70 bar |
| Maximum operating pressure range of main stage | Ports P and B 350 bar  
Port A: dependent on pressure transducer max. 350 bar  
⁴) a Tab. 28, page 167  
Port T for Y internal ⁵) 70 bar  
Port T for Y external 250 bar |
| Linearity of pressure control | < 0.5 % of the maximum operating pressure in port A  
a Chap. "11.1.1 Model number and type designation", page 166 |
| Maximum flow \( Q_{\text{max}} \) | 1500 l/min (0.3/0.5 gpm)  
a Chap. "4.1 Flow diagram (4-way operation)", page 55 |
| Rated flow \( Q_{N} \) for \( \Delta p_{N} = 5 \) bar per control land | 350 l/min (0.3/0.5 gpm) |
| Leakage flow | 3.0 l/min (0.3/0.5 gpm)  
(≈ zero overlap) |
| Pilot flow static | Pilot valve  
standard 0.5 l/min  
trimmed 0.5 l/min |
| Pilot flow at 100 % jump | Pilot valve  
standard 35 l/min  
trimmed 28 l/min |
| Hydraulic fluid | Mineral-oil-based hydraulic oil as per DIN 51524-1 1 to 3 and ISO 11158  
Other fluids on request |
| Permissible temperature | (−40 ° on request) −20 ° to 80 ° depending on the certified temperature classes |
| Viscosity \( V \) | recommended 15 to 45 mm²/s  
permissible 5 to 400 mm²/s |

Tab. 39: Technical data D943K with direct-operated pilot valve D633K (Part 1 of 2)
Purity class\(^5\), recommended (ISO 4406) | for functional safety < 18/15/12  
| for life cycle (wear) < 17/14/11  
---|---
Step response time for 0 to 100 % spool stroke | Pilot valve standard 15 ms  
| trimmed 18 ms  
Step response and frequency response \(\text{a Seite 205}\)  
---|---
Threshold | < 0.1 %  
Hysteresis | < 0.2 %  
Zero shift at \(\Delta T = 55 K\) | < 1 %  
Manufacturing tolerance | ±10 %  
Relative duty cycle | 100 %  
Protection type | IP66 with mounted mating connectors (according to EN 60529)  
Supply voltage | Nominal 24 V (18 to 32 V) DC based on GND.  
| Only use SELV-/PELV power supply according to EN 60204-1  
| At supply voltages less than 18 V, the valve is rendered in the fail-safe state.  
\(\text{a Chap. } \text{"3.2.3 Fail-safe events"}, \text{ page 30}\)  
Max. current consumption static | 0.3 A  
Max. current consumption dynamic | 1.2 A  
External fuse protection for each valve | 1.6 A slow-blowing fuse  
EMC protection requirements | Immunity to interference as per EN 61000-6-2:2005 (evaluation criterion A)  
| Emitted interference as per EN 61000-6-4:2005 (CAN bus and Proflbus DP) or as per EN 61000-6-3:2005 (EtherCAT)  
\(\text{a Chap. } \text{"11.2 Electromagnetic compatibility (EMC)"}, \text{ page 173}\)  
Connectors | a Chap. \("7 Electrical connection", page 68\)  
| a Chap. \("7.4.1 Pin assignment of connector X1", page 76\)  
Triggering electronics | Digital control electronics integrated into the valve  
---|---

Tab. 39: Technical data D943K with direct-operated pilot valve D633K (Part 2 of 2)

1) The ambient temperature and the temperature of the hydraulic fluid influence the temperature of the valve electronics. In order to ensure that the electronic components integrated in the valve last as long as possible, we recommend that the hydraulic fluid be kept at as low a temperature as possible at as low an ambient temperature as possible. A reference temperature is measured in the valve electronics. Fault-free operation is guaranteed up to a reference temperature of 85 °C (185 °F). At reference temperatures over 85 °C (185°F) a warning is output via the field bus on valves with field bus interfaces. At reference temperatures over 105 °C (221°F) the valve electronics are deactivated; the valve adopts the 'DISABLED' valve status and thus the mechanical fail-safe state.  
\(\text{a Chap. } \text{"3.2 Safety function/fail-safe"}, \text{ page 27}\)

2\) Temperature fluctuations>10 °C must be avoided during storage.

3) Transportation and storage should be as vibration- and shock-free as possible.

4) Hydraulic data was measured with control/operating pressure \(p_P = 210 \text{ bar}\), viscosity of hydraulic fluid \(\nu = 32 \text{ mm}^2/\text{s}\) and temperature of hydraulic fluid \(T = 40 \text{ °C}\).  
\(\text{a Chap. } \text{"6 Mounting and Connection to the Hydraulic System"}, \text{ page 63}\)

5) The cleanliness of the hydraulic fluid has a great effect on functional safety (reliable spool positioning, high resolution) and wear of the spool lands (pressure gain, leakage losses).
Two-stage digital proportional valve, D943K type series, with direct-operated pilot valve D633K

Dimensions (installation drawing), with fail-safe F and D

---

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nameplate</td>
<td>a Fig. 54, page 164</td>
</tr>
<tr>
<td>2</td>
<td>Ex nameplate</td>
<td>a Fig. 55, page 165</td>
</tr>
<tr>
<td>3</td>
<td>Venting screw</td>
<td>a Chap. &quot;8.5.1 Venting&quot;, page 140</td>
</tr>
</tbody>
</table>

Fig. 73: Installation drawing for D943K (dimensions in mm)

Installation space for the connectors when mounted: a Fig. 23, page 74

*) Dimension with fixed cabling of pilot valve with explosion-proof cable glands. If the pilot valve cabling uses explosion-proof connectors, the valve installation height increases by 50 mm (1.97 in).
Valve configurations and hydraulic symbols

Fail-safe function F
4-way version
X and Y optionally external or internal

Fail-safe function M
2/2-way version
only X and Y external

Execute flow direction according to symbols.
Two-stage digital proportional valve, D943K type series, with direct-operated pilot valve D633K with fail-safe function H or K for applications with safety requirements

Dimensions (installation drawing), mechan./hydr. fail-safe H and K

Fig. 74: Installation drawing for D943K (dimensions in mm)

Installation space for the connectors when mounted: a Fig. 23, page 74

*) Dimension with fixed cabling of pilot valve with explosion-proof cable glands. If the pilot valve cabling uses explosion-proof connectors, the valve installation height increases by 50 mm (1.97 in).

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nameplate</td>
<td>a Fig. 54, page 164</td>
</tr>
<tr>
<td>2</td>
<td>Ex nameplate</td>
<td>a Fig. 55, page 165</td>
</tr>
<tr>
<td>3</td>
<td>Venting screw</td>
<td>a Chap. &quot;8.5.1 Venting&quot;, page 140</td>
</tr>
</tbody>
</table>
Fail-safe function H
4-way version
X and Y optionally external or internal

Fail-safe function K
4-way version
X and Y optionally external or internal

Fail-safe function K
2/2-way version
only X and Y external

defined A → T

defined middle

defined middle through mechanical stroke limitation

Execute flow direction according to symbols.
Characteristic curves, D943K valves with direct-operated pilot valve D633K

All characteristic curves in the section "Characteristic curves, D943K valves with pilot valve D633K" are typical characteristic curves for the D943K valve with control/operating pressure $p_p = 210$ bar, viscosity of hydraulic fluid $\nu = 32$ mm²/s and temperature of hydraulic fluid $T = 40 \, ^\circ C (104 \, ^\circ F)$.

Flow diagram (4-way operation)

Flow signal characteristic curve at rated pressure drop $\Delta p_N = 10$ bar, that is, $\Delta p_N = 5$ bar per control land:

![Flow diagram](image)

**Spool A** = zero overlap, linear characteristic curve  
**Spool D** = 10% positive overlap, linear characteristic curve  
**Spool Y** = zero overlap, dual gain flow characteristic  
**L03** = type: stub shaft spool rated volume flow 350 l/min

Fig. 75: D943K valves, flow-signal characteristics
Step response for D943K valves with direct-operated pilot valve D633K, standard

![Step response graph](image)

Fig. 76: Step response for D943K valves, standard

Frequency response for D943K valves with direct-operated pilot valve D633K, standard

![Frequency response graph](image)

Fig. 77: Frequency response for D943K valves, standard
Step response for D943K valves with direct-operated pilot valve D633K, trimmed

Fig. 78: Step response for D943K valves, trimmed

Frequency response for D943K valves with direct-operated pilot valve D633K, trimmed

Fig. 79: Frequency response for D943K valves, trimmed
11.6 Technical data D944K – ISO 4401-08/NG25

The technical data apply for proportional valves in the D674K series
- two-stage, with direct-operated pilot valve D633K
  - a Chap. "11.6.2 Data D944K with direct-operated pilot valve D633K", page 209
  - a Chap. "11.6.1 Mounting surface", page 208
  - a Chap. "Dimensions (installation drawing), with fail-safe F and D", page 211
  - a Chap. "Valve configurations and hydraulic symbols", page 212
11.6.1 Mounting surface

If the valve is mounted on the mounting surface, it projects lengthwise (x-axis) over the mounting surface.

Valve dimensions:
- a Chap. "Dimensions (installation drawing), with fail-safe F and D", page 211

11.6.1.1 Mounting pattern of mounting surface

The holes in the mounting surface must correspond to ISO 4401-08-0-05.

The hole pattern (Fig. 80) applies to the digital proportional valve in the D944K type series
- two-stage, with direct-operated pilot valve D633K

![Mounting Pattern Diagram](image)

<table>
<thead>
<tr>
<th>P</th>
<th>A</th>
<th>T</th>
<th>B</th>
<th>X</th>
<th>Y</th>
<th>G2</th>
<th>G2</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F2</th>
<th>F2</th>
</tr>
</thead>
<tbody>
<tr>
<td>dia. 32 (1.26)</td>
<td>dia. 32 (1.26)</td>
<td>dia. 32 (1.26)</td>
<td>dia. 11.2 (0.44)</td>
<td>dia. 11.2 (0.44)</td>
<td>dia. 7.5 (0.30)</td>
<td>dia. 7.5 (0.30)</td>
<td>M12</td>
<td>M12</td>
<td>M12</td>
<td>M12</td>
<td>M12</td>
<td>M12</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>77 (3.03)</td>
<td>53.2 (2.09)</td>
<td>29.4 (1.16)</td>
<td>100.8 (3.97)</td>
<td>17.5 (0.69)</td>
<td>112.7 (4.44)</td>
<td>94.5 (3.72)</td>
<td>29.4 (1.16)</td>
<td>0</td>
<td>130.2 (5.13)</td>
<td>130.2 (5.13)</td>
<td>0</td>
<td>53.2 (2.09)</td>
</tr>
<tr>
<td>Y</td>
<td>17.5 (0.69)</td>
<td>74.6 (2.94)</td>
<td>17.5 (0.69)</td>
<td>74.6 (2.94)</td>
<td>73 (2.87)</td>
<td>19 (0.75)</td>
<td>-4.8 (-0.19)</td>
<td>92.1 (3.63)</td>
<td>0</td>
<td>0</td>
<td>92.1 (3.63)</td>
<td>92.1 (3.63)</td>
<td>0</td>
</tr>
</tbody>
</table>

Fig. 80: Hole pattern in the mounting surface for the D944K type series (dimensions in mm and (in))

- For maximum flow, the ports for P, T, A, and B must contrary to the standard be designed with a diameter of 32 mm (1.26 in).
- F1…F6 are holes for attachment screws in the mounting surface of the valve.
- G1 and G2 are holes for accommodating the transposition-proof pins of the valve.
### 11.6.2 Data D944K with direct-operated pilot valve D633K

<table>
<thead>
<tr>
<th>Valve design</th>
<th>Proportional valve, two-stage, with standard spools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot valve</td>
<td>D633K standard or trimmed</td>
</tr>
<tr>
<td>Nominal size and holes</td>
<td>NG25, holes according to ISO 4401-08-0-0-05</td>
</tr>
<tr>
<td>Mounting position</td>
<td>In any position, fixed or movable</td>
</tr>
</tbody>
</table>
| Diameter of the ports and threads of the fastening holes | P, A, T, B, and X 32 mm  
X and Y 11.2 mm  
F₁ to F₆  M10  
G₁ and G₂  7.5 mm |
| Mass | approx. 26.5 kg (58.4 lb)  
Valves with fail-safe functions H and K approx. 28 kg |
| Dimensions | a "Dimensions (installation drawing), with fail-safe F and D", Seite 211/ |
| Ambient temperature | for transport/storage2) recommended 15 °C to 25 °C  
permissible –40 °C to 80 °C  
for operation (–40 on request) –20 °C to 60 °C |
| Rel. humidity for storage | < 65 % not condensing |
| Vibration resistance3) | 10 g, 3 axes, Frequency: 10 to 2,000 Hz (according to EN 60068-2-6) |
| Shock resistance | 50 g, 6 directions, half-sine 3 ms (as per EN 60068-2-27) |
| Valve configurations | 4-way, 3-way, 2/2-way and 2-way operation |
| Operating pressure 4) of the pilot valve | via T or Y pₜ or pᵧ +10 bar  
Operating pressure range X port 10 to 350 bar  
max. pressure Y port 350 bar |
| Maximum operating pressure range of main stage | Ports P and B 350 bar  
Port A: dependent on pressure transducer max. 350 bar  
a Tab. 28, page 167  
Port T for Y internal 5 | 70 bar  
Port T for Y external 250 bar |
| Linearity of pressure control | < 0.5 % of the maximum operating pressure in port A  
a Chap. "11.1.1 Model number and type designation", page 166 |
| Maximum flow Qₘₐₓ | 1500 l/min (396 gpm)  
a Chap. "4.1 Flow diagram (4-way operation)", page 55 |
| Rated flow Qᵣ for Δpᵣ = 5 bar per control land | 550 l/min (145 gpm) |
| Leakage flow Qₗ | 3.0 l/min (0.79 gpm)  
(≈ zero overlap) |
| Pilot flow static | Pilot valve standard trimmed 0.5 l/min (0.1 gpm)  
0.5 l/min (0.1 gpm) |
| Pilot flow at 100 % jump | Pilot valve standard trimmed 35 l/min (9.2 gpm)  
26 l/min (6.9 gpm) |
| Hydraulic fluid | Mineral-oil-based hydraulic oil as per DIN 51524-1 1 to 3 and  
ISO 11158  
Other fluids on request |
| Permissible temperature | (–40 ° on request) –20 ° to 80 ° depending on the certified temperature classes |
| Viscosity V | recommended 15 to 45 mm²/s  
permissible 5 to 400 mm²/s |

Tab. 40: Technical data D944K with direct-operated pilot valve D633K (Part 1 of 2)
<table>
<thead>
<tr>
<th>Static and dynamic data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purity class</strong>&lt;sup&gt;5)&lt;/sup&gt;, recommended (ISO 4406)</td>
<td>for functional safety &lt;18/15/12 for life cycle (wear) &lt;17/14/11</td>
</tr>
<tr>
<td><strong>Step response time for 0 to 100 % spool stroke</strong></td>
<td>Pilot valve, standard 17 ms, trimmed 23 ms</td>
</tr>
<tr>
<td></td>
<td>Step response and frequency response a Seite 216</td>
</tr>
<tr>
<td><strong>Threshold</strong></td>
<td>&lt; 0.1 %</td>
</tr>
<tr>
<td><strong>Hysteresis</strong></td>
<td>&lt; 0.2 %</td>
</tr>
<tr>
<td><strong>Zero shift at ΔT = 55 K</strong></td>
<td>&lt; 1 %</td>
</tr>
<tr>
<td><strong>Manufacturing tolerance</strong></td>
<td>±10 %</td>
</tr>
<tr>
<td><strong>Relative duty cycle</strong></td>
<td>100 %</td>
</tr>
<tr>
<td><strong>Protection type</strong></td>
<td>IP66 with mounted mating connectors (according to EN 60529)</td>
</tr>
<tr>
<td><strong>Supply voltage</strong></td>
<td>Nominal 24 V (18 to 32 V) DC based on GND. Only use SELV-/PELV power supply according to EN 60204-1</td>
</tr>
<tr>
<td></td>
<td>At supply voltages less than 18 V, the valve is rendered in the fail-safe state. a Chap. &quot;3.2.3 Fail-safe events&quot;, page 30</td>
</tr>
<tr>
<td><strong>Max. current consumption static</strong></td>
<td>0.3 A</td>
</tr>
<tr>
<td><strong>Max. current consumption dynamic</strong></td>
<td>1.2 A</td>
</tr>
<tr>
<td><strong>External fuse protection for each valve</strong></td>
<td>1.6 A slow-blowing fuse</td>
</tr>
<tr>
<td><strong>EMC protection requirements</strong></td>
<td>Immunity to interference as per EN 61000-6-2:2005 (evaluation criterion A)</td>
</tr>
<tr>
<td></td>
<td>Emitted interference as per EN 61000-6-4:2005 (CAN bus and Probus DP) or as per EN 61000-6-3:2005 (EtherCAT) a Chap. &quot;11.2 Electromagnetic compatibility (EMC)&quot;, page 173</td>
</tr>
<tr>
<td><strong>Connectors</strong></td>
<td>a Chap. &quot;7 Electrical connection&quot;, page 68</td>
</tr>
<tr>
<td></td>
<td>a Chap. &quot;7.4.1 Pin assignment of connector X1&quot;, page 76</td>
</tr>
<tr>
<td><strong>Triggering electronics</strong></td>
<td>Digital control electronics integrated into the valve</td>
</tr>
</tbody>
</table>

Tab. 40: Technical data D944K with direct-operated pilot valve D633K (Part 2 of 2)

1) The ambient temperature and the temperature of the hydraulic fluid influence the temperature of the valve electronics. In order to ensure that the electronic components integrated in the valve last as long as possible, we recommend that the hydraulic fluid be kept at as low a temperature as possible at as low an ambient temperature as possible. A reference temperature is measured in the valve electronics. Fault-free operation is guaranteed up to a reference temperature of 85 °C (185 °F). At reference temperatures over 85 °C (185°F) a warning is output via the field bus on valves with field bus interfaces. At reference temperatures over 105 °C (221°F) the valve electronics are deactivated; the valve adopts the 'DISABLED' valve status and thus the mechanical fail-safe state. a Chap. "3.2 Safety function/fail-safe", page 27

2) **Temperature fluctuations** >10 °C must be avoided during storage.

3) Transportation and storage should be as **vibration-and shock-free** as possible.

4) **Hydraulic data** was measured with control/operating pressure pP = 210 bar, viscosity of hydraulic fluid ν = 32 mm²/s and temperature of hydraulic fluid T = 40 °C (104° F). a Chap. "6 Mounting and Connection to the Hydraulic System", page 63

5) The **cleanliness of the hydraulic fluid** has a great effect on functional safety (reliable spool positioning, high resolution) and wear of the spool lands (pressure gain, leakage losses).
Two-stage digital proportional valve, D944K type series, with direct-operated pilot valve D633K

Dimensions (installation drawing), with fail-safe F and D

Fig. 81: Installation drawing for D944K (dimensions in mm)

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nameplate</td>
<td>a Fig. 54, page 164</td>
</tr>
<tr>
<td>2</td>
<td>Ex nameplate</td>
<td>a Fig. 55, page 165</td>
</tr>
<tr>
<td>3</td>
<td>Venting screw</td>
<td>a Chap. &quot;8.5.1 Venting&quot;, page 140</td>
</tr>
</tbody>
</table>

Installation space for the connectors when mounted: a Fig. 23, page 74

*) Dimension with fixed cabling of pilot valve with explosion-proof cable glands. If the pilot valve cabling uses explosion-proof connectors, the valve installation height increases by 50 mm (1.97 in).
Valve configurations and hydraulic symbols

**Fail-safe function F**
4-way version

X and Y optionally external or internal

**Fail-safe function M**
2/2-way version

only X and Y external

Execute flow direction according to symbols.
Two-stage digital proportional valve, D944K type series, with direct-operated pilot valve D633K with fail-safe function H or K for applications with safety requirements

Dimensions (installation drawing), mechan./hydr. fail-safe H and K

Fig. 82: Installation drawing for D944K (dimensions in mm)

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nameplate</td>
<td>a Fig. 54, page 164</td>
</tr>
<tr>
<td>2</td>
<td>Ex nameplate</td>
<td>a Fig. 55, page 165</td>
</tr>
<tr>
<td>3</td>
<td>Venting screw</td>
<td>a Chap. &quot;8.5.1 Venting&quot;, page 140</td>
</tr>
</tbody>
</table>

Fig. 82: Installation drawing for D944K (dimensions in mm)

Installation space for the connectors when mounted: a Fig. 23, page 74

*) Dimension with fixed cabling of pilot valve with explosion-proof cable glands. If the pilot valve cabling uses explosion-proof connectors, the valve installation height increases by 50 mm (1.97 in).
Fail-safe function H
4-way version
X and Y optionally external or internal

Fail-safe function K
4-way version
X and Y optionally external or internal

Fail-safe function K
2/2-way version
only X and Y external

defined A→T

defined middle

defined middle through mechanical stroke limitation

Execute flow direction according to symbols.
Characteristic curves, D944K valves with direct-operated pilot valve D633K

All characteristic curves in the section "Characteristic curves, D944K valves with pilot valve D633K" are typical characteristic curves for the D944K valve with pilot valve D633K with control/operating pressure $p_P = 210$ bar, viscosity of hydraulic fluid $\nu = 32 \text{ mm}^2/\text{s}$ and temperature of hydraulic fluid $T = 40 \, ^\circ\text{C} (104 \, ^\circ\text{F})$.

Flow diagram (4-way operation)
- Chap. "4.1 Flow diagram (4-way operation)", page 55

Flow signal characteristic curve at rated pressure drop $\Delta p_N = 10$ bar, that is, $\Delta p_N = 5$ bar per control land:

- Spool A $\approx$ zero overlap, linear characteristic curve
- Spool D $\approx$ 10% positive overlap, linear characteristic curve
- Spool Y $\approx$ zero overlap, dual gain flow characteristic
- L05 type: stub shaft spool rated volume flow 550 l/min

Fig. 83: D944K valves, flow-signal characteristics
Step response for D944K valves with direct-operated pilot valve D633K, standard

Fig. 84: Step response for D944K valves, standard

Frequency response for D944K valves with direct-operated pilot valve D633K, standard

Fig. 85: Frequency response for D944K valves, standard
Step response for D944K valves with direct-operated pilot valve D633K, trimmed

Fig. 86: Step response for D944K valves, trimmed

Frequency response for D944K valves with direct-operated pilot valve D633K, trimmed

Fig. 87: Frequency response for D944K valves, trimmed
11.7 Technical data D945K – ISO 4401-10/NG32

The technical data applies to proportional valves in the D945K type series

- two-stage, with direct-operated pilot valve D633K
  - Chap. "11.7.2 Data D945K with direct-operated pilot valve D633K", page 220
  - Chap. "11.7.1 Mounting surface", page 219
  - Chap. "Dimensions (installation drawing), with fail-safe F and D", page 222
  - Chap. "Valve configurations and hydraulic symbols", page 223
  - Chap. "Characteristic curves, D945K valves with direct-operated pilot valve D633K", page 226
11.7.1 Mounting surface

If the valve is mounted on the mounting surface, it projects lengthwise (x-axis) over the mounting surface.

Valve dimensions:
- a Chap. "Dimensions (installation drawing), with fail-safe F and D", page 222

11.7.1.1 Mounting pattern of mounting surface

The holes in the mounting surface must correspond to ISO 4401-10-09-0-05.

The hole pattern (Fig. 88) applies to the digital proportional valve in the D945K type series
- two-stage, with direct-operated pilot valve D633K

![Hole pattern in the mounting surface for the D945K type series](image)

**Table 1**

<table>
<thead>
<tr>
<th>P</th>
<th>A</th>
<th>T</th>
<th>B</th>
<th>X</th>
<th>Y</th>
<th>G2</th>
<th>G2</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F5</th>
<th>F6</th>
</tr>
</thead>
<tbody>
<tr>
<td>dia. 50 (1.97)</td>
<td>dia. 50 (1.97)</td>
<td>dia. 50 (1.97)</td>
<td>dia. 50 (1.97)</td>
<td>dia. 11.2 (0.44)</td>
<td>dia. 7.5 (0.30)</td>
<td>dia. 7.5 (0.30)</td>
<td>M12</td>
<td>M12</td>
<td>M12</td>
<td>M12</td>
<td>M12</td>
<td>M12</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>114.3 (4.50)</td>
<td>82.5 (3.25)</td>
<td>41.3 (1.63)</td>
<td>147.6 (5.81)</td>
<td>41.3 (1.63)</td>
<td>168.3 (6.63)</td>
<td>147.6 (5.81)</td>
<td>41.3 (1.63)</td>
<td>0</td>
<td>190.5 (7.50)</td>
<td>190.5 (7.50)</td>
<td>0</td>
<td>76.2 (3.00)</td>
</tr>
<tr>
<td>Y</td>
<td>35 (1.38)</td>
<td>123.8 (4.87)</td>
<td>35 (1.38)</td>
<td>123.8 (4.87)</td>
<td>130.2 (5.13)</td>
<td>44.5 (1.75)</td>
<td>0</td>
<td>158.8 (6.25)</td>
<td>0</td>
<td>0</td>
<td>158.8 (6.25)</td>
<td>158.8 (6.25)</td>
<td>0</td>
</tr>
</tbody>
</table>

*Dimension not according to ISO but EN 24340. The position of the mounted safety pin is according to ISO is 138.6 mm (5.46 in) and it is drilled in the valve body in line with ISO.

Fig. 88: Hole pattern in the mounting surface for the D945K type series (dimensions in mm and (in))

- For maximum flow, the ports for P, T, A, and B must contrary to the standard be designed with a diameter of 50 mm (1.97 in).
- F1...F6 are holes for attachment screws in the mounting surface of the valve.
- G1 and G2 are holes for accommodating the transposition-proof pins of the valve.
- The position of the attached guard pin is according to DIN 24340.
  The hole G1 according to ISO is 138.6 mm (5.46 in) and is also drilled in the valve body.
11.7.2 Data D945K with direct-operated pilot valve D633K

<table>
<thead>
<tr>
<th>Valve design</th>
<th>Proportional valve, two-stage, with standard spools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot valve</td>
<td>D633K standard or trimmed</td>
</tr>
<tr>
<td>Nominal size and holes</td>
<td>NG32, holes according to ISO 4401-10-09-0-05</td>
</tr>
<tr>
<td>Mounting position</td>
<td>In any position, fixed or movable</td>
</tr>
<tr>
<td>Diameter of the ports and threads of the fastening holes</td>
<td>P, A, T, and B 50 mm</td>
</tr>
<tr>
<td></td>
<td>X and Y 11.2 mm</td>
</tr>
<tr>
<td></td>
<td>F₁ to F₆ M20</td>
</tr>
<tr>
<td></td>
<td>G₁ and G₂ 7.5 mm</td>
</tr>
<tr>
<td>Mass</td>
<td>approx. 76.5 kg (168.7 lb)</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Valves with fail-safe functions H and K approx. 78 kg</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>for transport/storage 1) recommended 15 °C to 25 °C</td>
</tr>
<tr>
<td></td>
<td>permissible −40 °C to 80 °C</td>
</tr>
<tr>
<td></td>
<td>for operation (−40 on request) −20 °C to 60 °C</td>
</tr>
<tr>
<td>Rel. humidity</td>
<td>For storage &lt; 65 % not condensing</td>
</tr>
<tr>
<td>Vibration resistance</td>
<td>3) 10 g, 3 axes, Frequency: 10 to 2,000 Hz (according to EN 60068-2-6)</td>
</tr>
<tr>
<td>Shock resistance</td>
<td>3) 50 g, 6 directions, half-sine 3 ms (as per EN 60068-2-27)</td>
</tr>
<tr>
<td>Valve configurations</td>
<td>4-way, 3-way, 2/2-way and 2-way operation</td>
</tr>
<tr>
<td>Operating pressure of the pilot valve</td>
<td>via T or Y p₀,T or p₀,Y +10 bar</td>
</tr>
<tr>
<td></td>
<td>Operating pressure range X port 10 to 350 bar</td>
</tr>
<tr>
<td></td>
<td>max. pressure Y port 5 50 bar</td>
</tr>
<tr>
<td>Maximum operating pressure range of main stage</td>
<td>Ports P and B 350 bar</td>
</tr>
<tr>
<td></td>
<td>Port A: dependent on pressure transducer max. 350 bar</td>
</tr>
<tr>
<td></td>
<td>a Tab. 28, page 167</td>
</tr>
<tr>
<td></td>
<td>Port T for Y internal 5 70 bar</td>
</tr>
<tr>
<td></td>
<td>Port T for Y external 250 bar</td>
</tr>
<tr>
<td>Linearity of pressure control</td>
<td>&lt; 0.5 % of the maximum operating pressure in port A</td>
</tr>
<tr>
<td>Maximum flow Qₘₐₓ</td>
<td>3600 l/min (951 gpm)</td>
</tr>
<tr>
<td></td>
<td>a Chap. &quot;4.1 Flow diagram (4-way operation)&quot;, page 55</td>
</tr>
<tr>
<td>Rated flow Qₚ for Δpₚ = 5 bar per control land</td>
<td>Standard</td>
</tr>
<tr>
<td></td>
<td>and trimmed 1000 / 1500 l/min (264 /396 gpm)</td>
</tr>
<tr>
<td></td>
<td>(depending on the series variant a Chap. &quot;Digit 2, rated flow Qₚ&quot;, Seite 167)</td>
</tr>
<tr>
<td>Leakage flow Main stage Qₘ</td>
<td>7.0 l/min (1.85 gpm)</td>
</tr>
<tr>
<td></td>
<td>(= zero overlap)</td>
</tr>
<tr>
<td>Pilot flow static</td>
<td>Pilot valve standard and trimmed 1.4 l/min (0.37 gpm)</td>
</tr>
<tr>
<td>Pilot flow at 100 % jump</td>
<td>Pilot valve standard trimmed 35 l/min (9.25 gpm)</td>
</tr>
<tr>
<td></td>
<td>26 l/min (6.9 gpm)</td>
</tr>
</tbody>
</table>

Hydraulic fluid

| Permissible fluids | Mineral-oil-based hydraulic oil as per DIN 51524-1 1 to 3 and ISO 11158 |
| Permissible temperature | (−40 ° on request) −20 ° to 80 ° depending on the certified temperature classes |
| Viscosity V | recommended 15 to 45 mm²/s |
| | permissible 5 to 400 mm²/s |

Tab. 41: Technical data D945K with direct-operated pilot valve D633K (Part 1 of 2)
Purity class\(^{(5)}\), recommended (ISO 4406) for functional safety <18/15/12
for life cycle (wear ) <17/14/11

| Step response time for 0 to 100 % spool stroke | standard with 1000 l/min rated flow 30 ms
| trimmed with 1000 l/min rated flow 35 ms |
| trimmed with 1500 l/min rated flow 43 ms |

Threshold

Hysteresis

Zero shift at \(\Delta T = 55 \text{ K}\)

Manufacturing tolerance \(\pm 10 \%\)

Relative duty cycle 100 \%

Protection type IP66 with mounted mating connectors (according to EN 60529)

Supply voltage Nominal 24 V (18 to 32 V) DC based on GND.
Only use SELV-/PELV power supply according to EN 60204-1
At supply voltages less than 18 V, the valve is rendered in the fail-safe state.
a Chap. "3.2.3 Fail-safe events", page 30

Max. current consumption static 0.3 A

Max. current consumption dynamic 1.2 A

External fuse protection for each valve 1.6 A slow-blowing fuse

EMC protection requirements Immunity to interference as per EN 61000-6-2:2005 (evaluation criterion A)
Emitting interference as per EN 61000-6-4:2005 (CAN bus and Profibus DP) or as per EN 61000-6-3:2005 (EtherCAT)
a Chap. "11.2 Electromagnetic compatibility (EMC)", page 173

Connectors a Chap. "7 Electrical connection", page 68
a Chap. "7.4.1 Pin assignment of connector X1", page 76

Triggering electronics integrated into the valve

Tab. 41: Technical data D945K with direct-operated pilot valve D633K (Part 2 of 2)

1) The ambient temperature and the temperature of the hydraulic fluid influence the temperature of the valve electronics. In order to ensure that the electronic components integrated in the valve last as long as possible, we recommend that the hydraulic fluid be kept at as low a temperature as possible to as low an ambient temperature as possible. A reference temperature is measured in the valve electronics. Fault-free operation is guaranteed up to a reference temperature of 85 °C (185 °F). At reference temperatures over 85 °C (185 °F) a warning is output via the field bus on valves with field bus interfaces. At reference temperatures over 105 °C (221 °F) the valve electronics are deactivated; the valve adopts the 'DISABLED' valve status and thus the mechanical fail-safe state. a Chap. "3.2 Safety function/fail-safe", page 27

2) Temperature fluctuations >10 °C must be avoided during storage.

3) Transportation and storage should be as vibration- and shock-free as possible.

4) Hydraulic data was measured with control/operating pressure \(p_p = 210 \text{ bar} \)
viscosity of hydraulic fluid \(\nu = 32 \text{ mm}^2/\text{s} \)
and temperature of hydraulic fluid \(T = 40 °\text{ C} (104 °\text{ F})\).
a Chap. "6 Mounting and Connection to the Hydraulic System", page 63

5) The cleanliness of the hydraulic fluid has a great effect on functional safety (reliable spool positioning, high resolution) and wear of the spool lands (pressure gain, leakage losses).
Two-stage digital proportional valve, D945K type series, with direct-operated pilot valve D633K

Dimensions (installation drawing), with fail-safe F and D

Fig. 89: Installation drawing for D945K (dimensions in mm)

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nameplate</td>
<td>a Fig. 54, page 164</td>
</tr>
<tr>
<td>2</td>
<td>Ex nameplate</td>
<td>a Fig. 55, page 165</td>
</tr>
<tr>
<td>3</td>
<td>Venting screw</td>
<td>a Chap. &quot;8.5.1 Venting&quot;, page 140</td>
</tr>
</tbody>
</table>

Installation space for the connectors when mounted: a Fig. 23, page 74

*) Dimension with fixed cabling of pilot valve with explosion-proof cable glands. If the pilot valve cabling uses explosion-proof connectors, the valve installation height increases by 50 mm (1.97 in).
Valve configurations and hydraulic symbols

**Fail-safe function F**
4-way version
X and Y optionally external or internal

**Fail-safe function M**
2/2-way version
only X and Y external

Execute flow direction according to symbols.
Two-stage digital proportional valve, D945K type series, with direct-operated pilot valve D633K with fail-safe function H or K for applications with safety requirements

Dimensions (installation drawing), mechan./hydr. fail-safe H and K

Installation space for the connectors when mounted: a Fig. 23, page 74

*) Dimension with fixed cabling of pilot valve with explosion-proof cable glands. If the pilot valve cabling uses explosion-proof connectors, the valve installation height increases by 50 mm (1.97 in).

Fig. 90: Installation drawing for D945K (dimensions in mm)

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nameplate</td>
<td>a Fig. 54, page 164</td>
</tr>
<tr>
<td>2</td>
<td>Ex nameplate</td>
<td>a Fig. 55, page 165</td>
</tr>
<tr>
<td>3</td>
<td>Venting screw</td>
<td>a Chap. &quot;8.5.1 Venting&quot;, page 140</td>
</tr>
</tbody>
</table>
**Fail-safe function H**
4-way version

X and Y optionally external or internal

**Fail-safe function K**
4-way version

X and Y optionally external or internal

**Fail-safe function K**
2/2-way version

only X and Y external

---

Defined middle through mechanical stroke limitation

Execute flow direction according to symbols.
Characteristic curves, D945K valves with direct-operated pilot valve D633K

All characteristic curves in the section "Characteristic curves, D945K valves with pilot valve D633K" are typical characteristic curves for the D945K valve with pilot valve D633K with control/operating pressure \( p_P = 210 \) bar, viscosity of hydraulic fluid \( \nu = 32 \text{ mm}^2/\text{s} \) and temperature of hydraulic fluid \( T = 40 \degree \text{C} \) (104 \degree \text{F}).

Flow diagram (4-way operation)

Flow diagram

Flow signal characteristic curve at rated pressure drop \( \Delta p_N = 10 \) bar, that is, \( \Delta p_N = 5 \) bar per control land:

![Flow signal characteristic curve](image)

Spool \( A \) \( \approx \) zero overlap, linear characteristic curve
Spool \( D \) 10 % positive overlap, linear characteristic curve
Spool \( V \) 20 % positive overlap, kinked characteristic curve
Spool \( Y \) \( \approx \) zero overlap, dual gain flow characteristic

P10 type: standard spool rated flow 1000 l/min

Fig. 91: D945K valves, flow-signal characteristics, 1,000 l/min
Spool A = zero overlap, linear characteristic curve
Spool D = 10% positive overlap, linear characteristic curve
Spool V = 20% positive overlap, kinked characteristic curve
Spool Y = zero overlap, dual gain flow characteristic
P15 type: standard spool rated flow 1500 l/min

Fig. 92: D945K valves, flow-signal characteristics, 1,500 l/min
Step response for D945K valves with direct-operated pilot valve D633K, standard, stub shaft spool K10

Fig. 93: Step response for D945K valves, standard, stub shaft spool K10

Frequency response for D945K valves with direct-operated pilot valve D633K, standard, stub shaft spool K10

Fig. 94: Frequency response for D945K valves, standard, stub shaft spool K10
Step response for D945K valves with direct-operated pilot valve D633K, trimmed, stub shaft spool K10

Fig. 95: Step response for D945K valves, trimmed, stub shaft spool K10

Frequency response for D945K valves with direct-operated pilot valve D633K, trimmed, stub shaft spool K10

Fig. 96: Frequency response for D945K valves, trimmed, stub shaft spool K10
Step response for D945K valves with direct-operated pilot valve D633K, standard, stub shaft spool K15

Fig. 97: Step response for D945K valves, standard, stub shaft spool K15

Frequency response for D945K valves with direct-operated pilot valve D633K, standard, stub shaft spool K15

Fig. 98: Frequency response for D945K valves, standard, stub shaft spool K15
Step response for D945K valves with direct-operated pilot valve D633K, trimmed, stub shaft spool K15

Fig. 99: Step response for D945K valves, trimmed, stub shaft spool K15

Frequency response for D945K valves with direct-operated pilot valve D633K, trimmed, stub shaft spool K15

Fig. 100: Frequency response for D945K valves, trimmed, stub shaft spool K15
12 Accessories, Spare Parts, and Tools

**CAUTION**

Danger of personal and property damage due to defective accessories and defective spare parts!

Unsuitable or defective accessories or unsuitable or defective spare parts may cause damage, malfunctions or failure of the valve or the machine.

- Use only original accessories and original spare parts.
- Warranty and liability claims for personal injury and damage to property are among other things excluded if they are caused by the use of unsuitable or defective accessories or unsuitable or defective spare parts.
- a Chap. "1.8 Warranty and liability", page 11

12.1 Accessories for valves in the D94xK type series

The accessories are Not included in scope of delivery
a Chap. "5.2 Scope of delivery of the valve", page 61

Cables of the connector cable that are not used must be insulated or insulated and placed in the control cabinet.

<table>
<thead>
<tr>
<th>Item designation</th>
<th>Number required</th>
<th>Comments</th>
<th>Item number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item name: Adapter cable M8-M12, 2 m (not approved for hazardous areas)</td>
<td>1</td>
<td></td>
<td>CA40934-001</td>
</tr>
<tr>
<td>USB start-up module (for service connector X10) not approved for use in hazardous areas</td>
<td>1</td>
<td></td>
<td>C43094-001</td>
</tr>
<tr>
<td>Configuration/start-up cable, 2 m not approved for hazardous areas</td>
<td>1</td>
<td></td>
<td>TD3999-137</td>
</tr>
<tr>
<td>SELV/PELV power pack (24 V DC, 10 A) not approved for hazardous areas</td>
<td>1</td>
<td></td>
<td>D137-003-001</td>
</tr>
<tr>
<td>Power supply cord, 2 m (not approved for hazardous areas)</td>
<td>1</td>
<td></td>
<td>B95924-002</td>
</tr>
<tr>
<td>Configuration / commissioning software (Moog Valve and Pump Configuration Software)</td>
<td>1</td>
<td></td>
<td>B99104</td>
</tr>
<tr>
<td>M8-M12 adapter cable</td>
<td>1</td>
<td></td>
<td>CA40934-001</td>
</tr>
<tr>
<td>Mating connector X1</td>
<td>1</td>
<td>Without cable, plug exlink, Fa. CEAG</td>
<td>CB22154-001</td>
</tr>
<tr>
<td>Mating connector X2</td>
<td>1</td>
<td>Without cable, plug exlink, Fa. CEAG</td>
<td>CB22150-001</td>
</tr>
<tr>
<td>Mating connector X5, X6, X7</td>
<td>3</td>
<td>Without cable, plug exlink, Fa. CEAG</td>
<td>CB22148-001</td>
</tr>
<tr>
<td>Mating connector CAN X3, X4</td>
<td>2</td>
<td>Without cable, plug exlink, Fa. CEAG</td>
<td>CB22142-001</td>
</tr>
<tr>
<td>Mating connector Profibus X3, X4</td>
<td>2</td>
<td>Without cable, plug exlink, Fa. CEAG</td>
<td>CB22145-001</td>
</tr>
<tr>
<td>Mating connector Ethercat X3, X4</td>
<td>2</td>
<td>Without cable, plug exlink, Fa. CEAG</td>
<td>CB22152-001</td>
</tr>
<tr>
<td>Connection cable X1</td>
<td>1</td>
<td>Mud-resistant cable with plug exlink, Fa. CEAG, cable length 20 m</td>
<td>CB22155-001</td>
</tr>
<tr>
<td>Connection cable X2</td>
<td>1</td>
<td>Mud-resistant cable with plug exlink, Fa. CEAG, cable length 20 m</td>
<td>CB22151-001</td>
</tr>
</tbody>
</table>

Tab. 42: Accessories and tools for all proportional valves in the D94xK type series (Part 1 of 2)
<table>
<thead>
<tr>
<th>Item designation</th>
<th>Number required</th>
<th>Comments</th>
<th>Item number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection cable CAN X3, X4</td>
<td>2</td>
<td>Mud-resistant cable with plug exlink, Fa. CEAG, cable length 20 m</td>
<td>CB22346-001</td>
</tr>
<tr>
<td>Connection cable CAN X3, X4</td>
<td>1</td>
<td>Mud-resistant cable with plug exlink, Fa. CEAG, cable length 20 m</td>
<td>CB22144-001</td>
</tr>
<tr>
<td></td>
<td>With integrated terminal resistor - this cable can only be used to connect the last valve in the fieldbus chain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection cable CAN X3, X4</td>
<td>2</td>
<td>Mud-resistant cable with plug exlink, Fa. CEAG, cable length 20 m</td>
<td>CB22143-001</td>
</tr>
<tr>
<td>Connection cable CAN X3, X4</td>
<td>1</td>
<td>Mud-resistant cable with plug exlink, Fa. CEAG, cable length 20 m</td>
<td>CB22147-001</td>
</tr>
<tr>
<td></td>
<td>With integrated terminal resistor - this cable can only be used to connect the last valve in the fieldbus chain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection cable Profibus X3, X4</td>
<td>2</td>
<td>Mud-resistant cable with plug exlink, Fa. CEAG, cable length 20 m</td>
<td>CB22146-001</td>
</tr>
<tr>
<td>Connection cable Profibus X3, X4</td>
<td>1</td>
<td>Mud-resistant cable with plug exlink, Fa. CEAG, cable length 20 m</td>
<td>CB22147-001</td>
</tr>
<tr>
<td></td>
<td>With integrated terminal resistor - this cable can only be used to connect the last valve in the fieldbus chain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection cable Ethercat X3, X4</td>
<td>2</td>
<td>Mud-resistant cable with plug exlink, Fa. CEAG, cable length 20 m</td>
<td>CB22153-001</td>
</tr>
<tr>
<td>Connection cable X5, X6, X7</td>
<td>3</td>
<td>Mud-resistant cable with plug exlink, Fa. CEAG, cable length 20 m</td>
<td>CB22149-001</td>
</tr>
<tr>
<td>Pilot valve connection cable</td>
<td>1</td>
<td>Available optionally with cable routing instead of the fixed cabling</td>
<td>CB22861-001</td>
</tr>
<tr>
<td></td>
<td>This option must be specified when the valve is ordered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present documentation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User manual type series D94xK, German</td>
<td>1</td>
<td></td>
<td>CDS29589-de</td>
</tr>
<tr>
<td>User manual type series D94xK, English</td>
<td>1</td>
<td></td>
<td>CDS29589-001</td>
</tr>
<tr>
<td>Supplemental documents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual: Moog Valve and Pump Configuration Software, German</td>
<td>1</td>
<td>Permit length of electric connection cables for valves with integrated electronics</td>
<td>CA48851</td>
</tr>
<tr>
<td>Manual: Moog Valve and Pump Configuration Software, English</td>
<td>1</td>
<td>Permit length of electric connection cables for valves with integrated electronics</td>
<td>CA58437</td>
</tr>
<tr>
<td>TN 494</td>
<td>1</td>
<td>Equipotential bonding and protective grounding of hydraulic valves with integrated electronics</td>
<td>CA58437</td>
</tr>
<tr>
<td>TN 502</td>
<td>1</td>
<td>Valves with EtherCAT interface</td>
<td>CA56678</td>
</tr>
<tr>
<td>User manual for Digital Interface Valves with EtherCAT Interface Firmware B9926-DV013-B-211</td>
<td>1</td>
<td>Valves with EtherCAT interface</td>
<td>CDS33722-en</td>
</tr>
</tbody>
</table>

Documents can be found and downloaded by specifying the item number:
For German documents, go to http://www.moog.de/german/about-moog-inc/industrial-group-literature-library/
For English documents, go to http://www.moog.com/industrial/literature

Tab. 42: Accessories and tools for all proportional valves in the D94xK type series (Part 2 of 2)
12.2 Tools for valves in the D94xK type series

<table>
<thead>
<tr>
<th>Item designation</th>
<th>Comments</th>
<th>Item number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tools for the mating connectors of the connectors</td>
<td>Crimping tool for mating connector</td>
<td>see operating instructions eXLink, CEAG</td>
</tr>
</tbody>
</table>

Tab. 43: Tools for valves in the D94xK type series

12.3 NG-dependent accessories and spare parts

The accessories are Not included in scope of delivery a Chap. "5.2 Scope of delivery of the valve", page 61

12.3.1 Proportional valves in the D941K type series

<table>
<thead>
<tr>
<th>Item designation</th>
<th>Number required</th>
<th>Comments</th>
<th>Item number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flushing plates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for ports P, A, B, T, T1, X, Y</td>
<td>1</td>
<td></td>
<td>B67728001</td>
</tr>
<tr>
<td>for ports P, T, T1 and X, Y</td>
<td>1</td>
<td></td>
<td>B67728-002</td>
</tr>
<tr>
<td>for ports P, T, T1, X, Y</td>
<td>1</td>
<td></td>
<td>B67728-003</td>
</tr>
</tbody>
</table>

| Connecting plates | | |
| Service sealing set lower level | | |
| Contains following O-rings: | | |
| for ports A, B, P, T1 and X | 6 | ID 12.4 x dia. 1.8 | NBR 85 Shore |
| [mm] | [0.49 x 0.07 in] | FKM 85 Shore | B97215-N681-10 |
| for port Y | 1 | ID 15.6 x dia. 1.8 | NBR 85 Shore |
| [mm] | [0.61 x 0.07 in] | FKM 85 Shore | B97215-V681-10 |

Tab. 44: Spare parts and accessories in the D941K type series with direct-operated pilot valve D633K
## 12.3.2 Proportional valves in the D942K type series

<table>
<thead>
<tr>
<th>Item designation</th>
<th>Number required</th>
<th>Comments</th>
<th>Item number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flushing plate</td>
<td>-76741</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecting plate</td>
<td>B97138-001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attachment screws</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>attachment screws</td>
<td>4</td>
<td>M10x60 EN ISO 4762 10.9 Tightening torque: 54 Nm (40 lbf ft) ± 10 %</td>
<td>A03665-100-060</td>
</tr>
<tr>
<td>attachment screws</td>
<td>2</td>
<td>M6x55 EN ISO 4762 10.9 Tightening torque: 11 Nm (8 lbf ft) ± 10 %</td>
<td>A03665-060-055</td>
</tr>
<tr>
<td>Service sealing set lower level</td>
<td></td>
<td>NBR 85 Shore FKM 85 Shore</td>
<td>B97215-N6X2-16 B97215-V6X2-16</td>
</tr>
<tr>
<td>Contains following O-rings:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for ports A, B, P and T</td>
<td>4</td>
<td>ID 21.89 x dia. 2.6 [mm] (0.86 x 0.10 in) NBR 85 Shore FKM 85 Shore</td>
<td>-45122-129 -42082-129</td>
</tr>
<tr>
<td>for ports X and Y</td>
<td>2</td>
<td>ID 10.82 x dia. 1.8 [mm] (0.43 x 0.07 in) NBR 85 Shore FKM 85 Shore</td>
<td>-45122-022 -42082-022</td>
</tr>
<tr>
<td>Service sealing set pilot valve or fail-safe valve</td>
<td>1</td>
<td>NBR 85 Shore FKM 85 Shore</td>
<td>B97215-N630F63 B97215-V630F63</td>
</tr>
</tbody>
</table>

Tab. 45: Spare parts and accessories in the D942K type series with direct-operated pilot valve D633K

## 12.3.3 Proportional valves in the D943K and D944K type series

<table>
<thead>
<tr>
<th>Item designation</th>
<th>Number required</th>
<th>Comments</th>
<th>Item number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flushing plate</td>
<td>-76047-001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecting plate</td>
<td>A25855-009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>attachment screws</td>
<td>6</td>
<td>M12x75 EN ISO 4762 10.9 Tightening torque: 94 Nm (69 lbf ft) ± 10 %</td>
<td>A03665-120-075</td>
</tr>
<tr>
<td>Service sealing set lower stage</td>
<td></td>
<td>NBR 85 Shore FKM 85 Shore</td>
<td>B97215-N6X4-25 B97215-V6X4-25</td>
</tr>
<tr>
<td>Contains following O-rings:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for ports A, B, P and T</td>
<td>4</td>
<td>ID 34.60 x dia. 2.6 [mm] (1.36 x 0.10 in) NBR 85 Shore FKM 85 Shore</td>
<td>-45122-113 -42082-113</td>
</tr>
<tr>
<td>for ports X and Y</td>
<td>2</td>
<td>ID 20.92 x dia. 2.6 [mm] (0.82 x 0.10 in) NBR 85 Shore FKM 85 Shore</td>
<td>-45122-195 -42082-195</td>
</tr>
<tr>
<td>Service sealing set pilot valve or fail-safe valve</td>
<td>1</td>
<td>NBR 85 Shore FKM 85 Shore</td>
<td>B97215-N630F63 B97215-V630F63</td>
</tr>
</tbody>
</table>

Tab. 46: Spare parts and accessories in the D943K and D944K type series with direct-operated pilot valve D633K
### 12.3.4 Proportional valves in the D945K type series

<table>
<thead>
<tr>
<th>Item designation</th>
<th>Number required</th>
<th>Comments</th>
<th>Item number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flushing plate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecting plate</td>
<td></td>
<td></td>
<td>A25855-001</td>
</tr>
<tr>
<td>attachment screws</td>
<td>6</td>
<td>M20x90 EN ISO 4762 10.9 Tightening torque: 460 Nm (339 lbf ft) ± 10 %</td>
<td>A03665-200-090</td>
</tr>
<tr>
<td>Service sealing set lower stage</td>
<td></td>
<td>HNBR 85 Shore FKM 85 Shore</td>
<td>B97215-S6X5-32, B97215-K6X5-32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contains following O-rings:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>for ports A, B, P and T ID 53.60 x dia. 3.5 [mm] (2.11 x 0.14 in)</td>
<td>B97217-227H, B97217-227V</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>for ports X and Y ID 14.00 x dia. 1.8 [mm] (0.55 x 0.07 in)</td>
<td>B97217-015H, B97217-015V</td>
</tr>
<tr>
<td>Service sealing set pilot valve or fail-safe valve</td>
<td>1 1</td>
<td>Set Set</td>
<td>NBR 85 Shore FKM 85 Shore</td>
</tr>
<tr>
<td>Service sealing set fail-safe adapter plate</td>
<td>1 1</td>
<td>Set Set</td>
<td>NBR 85 Shore FKM 85 Shore</td>
</tr>
</tbody>
</table>

Tab. 47: Spare parts and accessories in the D945K type series with direct-operated pilot valve D633K
## 13 Ordering Information

### Model no. (specified by factory)

<table>
<thead>
<tr>
<th>Type designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>D941 - D945 X . . . . -</td>
</tr>
</tbody>
</table>

### Specification status

<table>
<thead>
<tr>
<th>K</th>
<th>Explosion-proof mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Model variant

<table>
<thead>
<tr>
<th>Variant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

#### 1 Spool model Series

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Standard spool D941K to D944K</td>
</tr>
<tr>
<td>B</td>
<td>Standard spool (5-way) D941K (with P, connection)</td>
</tr>
<tr>
<td>K</td>
<td>Step piston D945K</td>
</tr>
</tbody>
</table>

#### 2 Rated flow \( Q_N \) (l/min)

<table>
<thead>
<tr>
<th>( \Delta p )</th>
<th>( Q_N ) (l/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 bar</td>
<td>D941K</td>
</tr>
<tr>
<td>25 bar</td>
<td>D942K</td>
</tr>
<tr>
<td>50 bar</td>
<td>D943K</td>
</tr>
<tr>
<td>75 bar</td>
<td>D944K</td>
</tr>
<tr>
<td>100 bar</td>
<td>D945K</td>
</tr>
</tbody>
</table>

#### 3 Maximum operating pressure

With internal control connection X, the max. operating pressure corresponds to the max. pilot pressure. The valve electronics are adapted to the control pressure.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>25 bar</td>
</tr>
<tr>
<td>Y</td>
<td>50 bar</td>
</tr>
<tr>
<td>Z</td>
<td>75 bar</td>
</tr>
<tr>
<td>T</td>
<td>100 bar</td>
</tr>
<tr>
<td>K</td>
<td>150 bar</td>
</tr>
</tbody>
</table>

#### 4 Spool model

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>3-way: ( P \rightarrow A, A \rightarrow T, ) Zero overlap, linear characteristic curve</td>
</tr>
<tr>
<td>U</td>
<td>5-way: ( P \rightarrow A, P \rightarrow B, A \rightarrow T, ) Zero overlap, broken characteristic curve</td>
</tr>
<tr>
<td>T</td>
<td>4-way: linear characteristic curve ( P \rightarrow A, P \rightarrow B: 20 % ) positive overlap, ( A \rightarrow T, B \rightarrow T: 15 % ) positive overlap</td>
</tr>
<tr>
<td>Z</td>
<td>2x2-way: ( A \rightarrow T, B \rightarrow T ), linear characteristic curve, closed with a (D941K) signal of 90% (can only be inserted in the bypass flow) ( P \rightarrow B, T \rightarrow A: ) only X and Y external (D942K to D945K)</td>
</tr>
</tbody>
</table>

Others on request.

#### 5 Pilot valve

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Direct-controlled pilot valve D633K, D941K ... D945K</td>
</tr>
<tr>
<td>S</td>
<td>Direct-operated pilot valve D633K, fixed cabling with ex-proof cable glands, not replaceable D941K ... D945K</td>
</tr>
</tbody>
</table>

Others on request.

#### 6 Fail-Safe-Funktion

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Middle position</td>
</tr>
<tr>
<td>F</td>
<td>( P \rightarrow B, A \rightarrow T )</td>
</tr>
<tr>
<td>D</td>
<td>( P \rightarrow A, B \rightarrow T )</td>
</tr>
<tr>
<td>K</td>
<td>Middle position</td>
</tr>
<tr>
<td>H</td>
<td>( P \rightarrow B, A \rightarrow T )</td>
</tr>
</tbody>
</table>

Others on request.
## 13 Ordering Information

### 10 Signals for 100% spool stroke

<table>
<thead>
<tr>
<th>Input signal</th>
<th>Measurement output</th>
</tr>
</thead>
<tbody>
<tr>
<td>D ±10 V</td>
<td>±2 to 10 V</td>
</tr>
<tr>
<td>E 4 to 20 mA</td>
<td>±4 to 20 mA</td>
</tr>
<tr>
<td>M ±10 V</td>
<td>±4 to 20 mA</td>
</tr>
<tr>
<td>X ±10 mA</td>
<td>±4 to 20 mA</td>
</tr>
<tr>
<td>Y Field bus</td>
<td>Field bus</td>
</tr>
<tr>
<td>A External</td>
<td></td>
</tr>
<tr>
<td>B Field bus</td>
<td></td>
</tr>
<tr>
<td>C Edge seal</td>
<td></td>
</tr>
<tr>
<td>G Others</td>
<td></td>
</tr>
</tbody>
</table>

### 13 Enable function

- **A**: When the enable signal is deactivated the spool takes up a settable controlled neutral position.
- **B**: When the enable signal is deactivated the spool takes up the defined end position A → T and B → T.
- **C**: When the enable signal is deactivated the spool takes up a settable controlled neutral position.
- **D**: When the enable signal is deactivated the spool takes up the defined end position A → T and B → T.
- **E**: Others on request.

### 12 Valve design

- **K**: Flow control with pressure limitation control above 1)
- **L**: Flow control with pressure limitation control below 1)
- **C**: Valve in bypass flow, flow control with pressure limitation control above 1)
- **M**: Pressure control in main flow 2)
- **N**: Others on request.

### 11 Electrical supply

- **2** 24 V DC

### 14 Fieldbus connectors X3, X4

- **G**: CAN
- **H**: Profinet DP
- **J**: EtherCAT
- **O**: Without fieldbus interface

### 8 Gasket material Series

- **R**: HNBR D941K to D944K
- **V**: FKM D941K to D944K
- **A**: T-ECOPUR (-40° C) D941K to D945K
- **B**: FKM44 (-40° C) D941K to D945K
- **S**: Edge seal HNBR D945K
- **T**: Others on request.

### 7 Control type

<table>
<thead>
<tr>
<th>Intake X</th>
<th>Outlet Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 internal</td>
<td>internal</td>
</tr>
<tr>
<td>5 external</td>
<td>internal</td>
</tr>
<tr>
<td>6 external</td>
<td>internal</td>
</tr>
<tr>
<td>7 internal</td>
<td>external</td>
</tr>
</tbody>
</table>

1) Only in connection with valve functionality „C1”
2) Only in connection with valve functionality „B1”
14 Keyword index

Symbols
β: filter fineness
required filter fineness for filling filter for filling the hydraulic system • 139

Δp: pressure difference
pressure difference Δp • 56

ΔpN: rated pressure difference
rated pressure difference ΔpN • 56

Numerics
2/2-way seat valve • 29
connector X9 in the block diagram of the valve/pump electronics • 73

A
A/D
A/D converter in the block diagram of the valve electronics • 22

Abbreviations
list of abbreviations • 254
A/D (analog-digital converter)
ACV (Axis Control Valve, valve with axis control functionality)
CAN (Controller Area Network)
CA (CAN in Automation e. V.)
D/A (digital-analog converter)
DIN (Deutsches Institut für Normung e. V.)
DSP (Draft Standard Proposal)
EMC (electromagnetic compatibility)
EN (European standard)
ESD (Electrostatic Discharge)
EU (European Union)
FKM (fluorocarbon rubber, material for gaskets, such as O-rings)
GND (Ground)
HNBR (Hydrogenated Nitrile Butadiene Rubber, material for gaskets, such as O-rings)
ID (Identifier)
ID (Inner Diameter, e.g. of O-rings)
IEC (International Electrotechnical Commission)
IP (International Protection)
ISM (industrial, scientific and medical, e.g. for ISM devices)
ISO (International Organization for Standardization)
LED (Light Emitting Diode)
LSS (Layer Setting Services)
LVDT (Linear Variable Differential Transformer)
NBR (Nitrile Butadiene Rubber, material for gaskets, such as O-rings)
NG (nominal size of the valve)
PC (Personal Computer)
PE (Protective Earth)
PELV (Protective Extra Low Voltage)
PID (Proportional Integral Differential, e. g. in PID controller)
PWM (Pulse Width Modulation)
SELV (Safety Extra Low Voltage)
SW (Width Across Flats for wrenches)
TN (Technical Note)
TÜV (Technischer Überwachungsverein)

USB (Universal Serial Bus)
UV (Ultraviolet)
VDE (Verband der Elektrotechnik Elektronik Informationstechnik e. V.)
VDI (Verein Deutscher Ingenieure e. V.)

Accessories, ordering information D94xK • 232
Acoustic emissions • 9
Acronyms • 254
Activation • 25, 43
ACV transducer connectors X2, X5…X7 in the block diagram of the valve electronics • 22

Adapter for service connector X10 • 137
Air humidity, permissible relative air humidity for storage
type series D941K • 176
type series D942K • 187
type series D943Kv • 198
type series D944K • 209
type series D945K • 220

Allocation of interfaces to connectors • 75

Ambient conditions
Permissible ambient conditions
type series D941K • 176
type series D942K • 187
type series D943K • 198
type series D944K • 209
type series D945K • 220
Potentially explosive environment • 162

Ambient temperature, permissible ambient temperature
Type series D941K • 176
Type series D942K • 187
Type series D943K • 198
Type series D944K • 209
Type series D945K • 220

Armature of the linear force motor, in the representative depiction • 21

Attachment screws
Ordering information D941K • 234
Ordering information D942K • 235
Ordering information D943K, D944K • 235
Ordering information D945K • 236

Attachment screws for the shipping plate • 66
Tightening torque (removal) • 154
Width across flats • 65, 153
Attachment screws for the shipping plate (removal) • 154

B
Block diagram of the valve/pump electronics • 73
Block diagrams
Flow control (Q-control) • 35
Valve electronics • 22

C
cT
Typical capacitance • 105

Cables
Cable length in CAN networks • 115
Cable length in Profinet networks • 118
Cable routing inside machines • 104
Calculation
maximum length • 105
typical capacitance $C_{typ}$ • 105
typical resistance $R_{typ}$ • 104
voltage drop per unit length • 106
dimensioning • 104
permissible lengths • 104–108
pin assignment of the cables for EtherCAT networks • 121
requirements • 100
suitable cables for CAN networks • 115
EtherCAT networks • 121
Profibus-DP networks • 119

CAN
CAN bus interface • 54
CAN (Controller Area Network)
literature, additional, CAN fundamentals • 256

cAN bus
general information • 84
pin assignment • 85
Technical data • 84

CAN networks
cable cross section • 115
cable length • 115
interference immunity • 113
module address • 116
number of bus nodes • 116
suitable cables • 115
transmission rate • 116
Wiring • 112–116
Procedure • 112
wiring diagram • 113

Cavitation • 56
Centering springs of the linear force motor
in the representative depiction • 21

Characteristic curves
flow diagram
type series D941K • 55
type series D942K • 55
type series D943K • 55
type series D944K • 55
type series D945K • 55
flow signal characteristic curve • 42
hydraulic zero • 42
type series D941K • 182
type series D942K • 193
type series D943K • 204
type series D944K • 215
type series D945K • 226–227

CiA
Quoted CiA standards • 173

Cleaning
disposal of auxiliary materials and substances used • 9

Cleaning connecting and mounting surfaces • 67

Cleanliness level of the hydraulic fluid • 140
type series D941K • 176
type series D942K • 187
type series D943K • 198
type series D944K • 209
type series D945K • 220

Clock pulse output (signal of SSI transducer) • 83
Command signal $U_{Command}$ of input voltage • 109
Command signals for 100% spool stroke in the type designation • 170

Command signals, single-ended • 109
configuration of the valves • 53
configuration via the field bus interface • 135
configuration via the service interface • 137
factory setting of the valves • 138

Configuration/start-up cable • 137
Ordering information D94xK • 232

Connecting plates • 234, 236
Ordering information D942K • 235
Ordering information D943K, D944K • 235

Connecting surface
cleaning • 67
trouble shooting in event of a leak • 157

Connection of the valve
carconnection to the hydraulic system • 63, 66–67
hydraulic connection • 63, 66–67

Connector
Connector X1 • 24–25, 43
in the block diagram of the valve electronics • 22
in the connector overview • 74
field bus connectors X3 and X4
in the connector overview • 74
Fieldbus connectors X3 and X4 • 24–25
dust protection caps • 130
in the block diagram of the valve electronics • 22
in the block diagram of the valve/pump electronics • 73
list of interfaces • 75
overview (arrangement of connectors on the valve electronics housing) • 74
service connector X10 • 24, 26
adapter • 137
dust protection cap • 130
in the block diagram of the valve electronics • 22
in the connector overview • 74
transducer connectors X2, X5...X7
in the block diagram of the valve electronics • 22
X1 (connector)
in the block diagram of the valve/pump electronics • 73
pin assignment • 76
X2 (digital signal interface)
in the block diagram of the valve/pump electronics • 73
X3 and X4 (field bus connectors)
in the block diagram of the valve/pump electronics • 73
X5...X7 (analog input connectors)
in the block diagram of the valve/pump electronics • 73
X8 (external LVDT connector)
in the block diagram of the valve/pump electronics • 73
X9 (2/2-way seat valve connector)
in the block diagram of the valve/pump electronics • 73
X10 (service connector)
in the block diagram of the valve/pump electronics • 73
X11 (pilot valve connector)
in the block diagram of the valve/pump electronics • 73

Connector X1 • 76
in the block diagram of the valve/pump electronics • 73
pin assignment • 76
6+PE-pin connector • 76
versions • 76
Wiring
6+PE-pin connector • 108

Connector X2
in the block diagram of the valve/pump electronics • 73
pin assignment • 83
wiring CAN networks • 112–116
cable length and cable cross section • 115
interference immunity • 113
Procedure • 112
wiring diagram • 113
wiring SSI transducers • 111
Connector X8
in the block diagram of the valve/pump electronics • 73

Connector X9
in the block diagram of the valve/pump electronics • 73
Connectors X3 and X4
in the block diagram of the valve/pump electronics • 73
pin assignment • 85–86, 88
wiring CAN networks • 112–116
cable length and cable cross section • 115
interference immunity • 113
Procedure • 112
wiring diagram • 113
wiring EtherCAT networks • 120–122
Procedure • 120
wiring diagram • 121
wiring Profinet networks • 117–119
cable length and cable cross section • 118
Procedure • 117
wiring diagram • 118
Connectors X5...X7
in the block diagram of the valve/pump electronics • 73
pin assignment • 89
Connector overview, arrangement of connectors on the valve electronics housing • 74

Connector X1 • 24–25, 43
in the block diagram of the valve electronics • 22
in the connector overview • 74

Connector X10
in the block diagram of the valve/pump electronics • 73
pin assignment • 92

Connector X11 • 92
in the block diagram of the valve/pump electronics • 73
pin assignment • 92

Control loops
trouble shooting in event of instabilities
instability of the external control loop • 158
instability of the internal valve control loops • 159

Control ports A and B
diameter:
type series D941K • 175
type series D942K • 186
type series D943K • 197
type series D944K • 208
type series D945K • 219
position in the holes in the mounting surface
type series D941K • 175
type series D942K • 186
type series D943K • 197
type series D944K • 208
type series D945K • 219

Control type hydraulic intake/drain in the type designation • 170

Conversion of actual value output signals $I_{out}$ (4–20 mA) into 2–10 V • 110

Current command signal $I_{Command}$ • 109

Cutaway drawings
Two-stage proportional valve • 19

Cutaway views
linear force motor • 21
Two-stage proportional valve • 19

D

d/D
D/A
D/A converter in the block diagram of the valve electronics • 22

Data matrix code
example • 173
on the nameplate • 164–165
structure of the data matrix code • 173

Date of manufacture on the nameplate • 164–165
diesel effect • 140
digit • 168
dimensions
type series D941K
With pilot valve D633 • 176, 180
type series D942K
With pilot valve D633 • 189, 191
type series D943K
With pilot valve D633 • 200, 202
type series D944K
With pilot valve D633 • 211, 213
type series D945K
With pilot valve D633 • 222, 224

Directives, overview of quoted directives • 262
disposal • 9
Documents, supplemental • 5
Documents, supplementing
Ordering information D94xK • 233

dust protection caps
for field bus connectors X3 and X4 • 130
for service connector X10 • 130

Duty cycle
type series D941K • 177
type series D942K • 188
type series D943K • 199
type series D944K • 210
type series D945K • 221

Electrical data
type series D941K • 177

type series D942K • 188

type series D943K • 199

type series D944K • 210

type series D945K • 221

Electrical shielding • 96–104

electrical shielding • 100
connecting the shield • 101
connection with cable leadthrough • 101
connection with plug connection • 102
insulated shielding • 103
requirement of cable routing • 104
requirement of lines • 100

Embrittlement of gaskets • 155
embrittlement of gaskets • 62

EMC
EMC protection requirements for immunity to interference and emitted interference
Technical data • 173
type series D941K • 177
type series D942K • 188
type series D943K • 199
type series D945K • 221
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

EMC standards • 173
  type series D941K • 177
  type series D942K • 188
  type series D943K • 199
  type series D944K • 210
  type series D945K • 221
requirements during start-up • 126
EMC (Electromagnetic compatibility)
  EMC Directive • 262
Emitting interference
Technical data • 173
  type series D941K • 177
  type series D942K • 188
  type series D943K • 199
  type series D944K • 210
  type series D945K • 221
Environmental protection
  acoustic emissions • 9
disposal • 9
equipotential bonding
deficient equipotential bonding • 100
electrical shielding • 100
ground loops • 99
insulated shielding in the event of deficient equipotential bonding • 103
maximum potential difference (7 V) • 98
of machines • 97
performance • 98
protective conductor • 98
cross section • 98
Equipotential bonding system, electromagnetic compatibility (EMC) • 173
ESD • 16
EtherCAT
  general information • 87
  literature, additional, EtherCAT fundamentals • 257
  maximum number of bus nodes • 87
  module address • 122
  auto-increment addressing • 122
  fixed node addressing • 122
  pin assignment of the cables for EtherCAT networks • 121
  pin assignment, connector X3 • 88
  suitable cables for EtherCAT networks • 121
  Technical data • 87
  transmission rate • 122
  wiring diagram, EtherCAT networks • 121
  wiring EtherCAT networks • 120–122
Procedure • 120
EU (European Union)
Evenness, required for mounting surface • 64
Exclusion of liability • 11
Exclusion of warranty • 11
External LVDT connector X8
  in the block diagram of the valve/pump electronics • 73
F
  limit frequency • 107
factory setting of the valves • 138
Fail-safe events • 30
  control commands • 32
drop in the pilot pressure pX • 31
  failure of the supply voltage • 31
  restarting the valve after the occurrence of
  a fail-safe event • 33
  settable fault reaction • 32
  signals at the enable input • 31
Fail-safe functions • 27
  electrical fail-safe function • 30
  hydraulic symbols • 39–40
  mechanical fail-safe functions • 28
  Valves with mechanical fail-safe function M • 28
  Valves with mechanical fail-safe function M
  hydraulic symbols • 39
  Valves with mechanical fail-safe function F and D • 28
  Valves with mechanical fail-safe function F and D
  hydraulic symbols • 40
Fail-safe states
  electrical fail-safe state • 27, 30
  mechanical fail-safe state • 27, 29
  Mechanical fail-safe state in the type designation • 169
fail-safe valves • 29
  2/2-way seat valve • 29
  hydraulic symbol • 39
Fail-safe variant, in the type designation • 169
Field bus
  connection of the valve/pump
  Safety instructions • 69
  field bus connectors X3 and X4
  in the connector overview • 74
Field bus connectors X3 and X4
  cAN bus connectors • 85
  EtherCAT connectors • 88
  general information • 84
  in the block diagram of the valve/pump electronics • 73
  Profibus-DP connectors • 86
  versions of the connectors • 84
Field bus interface
  configuration of the valves via the field bus interface • 135
Fieldbus connectors X3 and X4 • 24–25
dust protection caps • 130
in the block diagram of the valve/pump electronics • 22
Fieldbus connectors X3 and X4 in the type designation • 172
Fieldbus interface • 24
in the block diagram of the valve electronics • 22
filling filter for filling the hydraulic system
  required filter fineness βx • 139
Filling the hydraulic system • 139
filter element
  in the representative depiction of the valve • 19
Filter fineness βx
  filling filter for filling the hydraulic system • 139
Filter, filling filter for filling the hydraulic system
  required filter fineness • 139
FKM
  type series D941K • 234
type series D942K • 235
type series D943K, D944K • 235
type series D945K • 236
flow and pressure control (pQ-control) • 17
flow control (Q-control) • 17
Flow control (Q-control)
  trouble shooting in event of instability of the internal valve
  control loop • 159
flow control (Q-control) • 35
  block diagram • 35
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
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flow diagram
  type series D941K • 55
  type series D942K • 55
  type series D943K • 55
  type series D944K • 55
  type series D945K • 55
flow signal characteristic curve • 42
  hydraulic zero • 42
  type series D941K • 182
  type series D942K • 193
  type series D943K • 204
  type series D944K • 215
  type series D945K • 227
Flow speed • 56
Flow Q
  flow signal characteristic curve • 42
  type series D941K • 182
  type series D942K • 193
  type series D943K • 204
  type series D944K • 215
  type series D945K • 226–227
formula for calculation • 56
leakage flow QL
  type series D941K • 176
  type series D942K • 187
  type series D943K • 198
  type series D944K • 209
maximum flow Qmax
  type series D941K • 55, 176
  type series D942K • 55, 187
  type series D943K • 55, 198
  type series D944K • 55, 209
  type series D945K • 55, 220
rated flow QN
  Nameplate • 167
  type series D941K • 176
  type series D942K • 187
  type series D943K • 198
  type series D944K • 209
  type series D945K • 220
Flushing plate
  Ordering information D941K • 234
  Ordering information D942K • 235
  Ordering information D943K, D944K • 235
  Ordering information D945K • 236
  using when flushing the hydraulic system • 139
Formula for calculating the flow Q • 56
Formulae
  approximation formula for calculating
  the pilot pressure pX • 18
  formula for calculating the flow Q • 56
function
  linear force motor • 21
  Valves of the D94xK type series • 17
Fuse
  type series D941K • 177
  type series D942K • 188
  type series D944K • 210
  type series D945K • 221
Fuse protection, external fuse protection for each valve
  type series D941K • 177
  type series D942K • 188
  type series D943K, fuse
  type series D943K • 199
  type series D944K • 210
  type series D945K • 221
G
Gaskets
  checking and replacing the O-rings
  ports • 155
  cleaning • 67
  embrittlement • 62, 155
  Ordering information D941K • 234
  Ordering information D942K • 235
  Ordering information D943K, D944K • 235
  Ordering information D945K • 236
  Service sealing set, ordering information D941K • 234
  Service sealing set, ordering information D942K • 235
  Service sealing set, ordering information D943K, D944K • 235
  Service sealing set, ordering information D945K • 236
Ground (electrical)
  single-ended command signals • 109
  single-ended connection of the analog command
  inputs • 109
Ground (in kg)
  type series D941K • 176
  type series D942K • 187
  type series D943K • 198
  type series D944K • 209
  type series D945K • 220
Gumming of hydraulic fluid during long-term storage • 62
H
handling in accordance with safety requirements • 14, 68
Handling, in accordance with safety requirements • 14, 68
Hydraulic data
  type series D941K • 176
  type series D942K • 187
  type series D943K • 198
  type series D944K • 209
  type series D945K • 220
Hydraulic fluid
  disposal • 9
  cleanliness level • 140
  type series D941K • 176
  type series D942K • 187
  type series D943K • 198
  type series D944K • 209
  type series D945K • 220
diesel effect • 140
gumming during long-term storage • 62
  permissible fluids
  type series D941K • 176
  type series D942K • 187
  type series D943K • 198
  type series D944K • 209
  type series D945K • 220
  permissible temperature range
  type series D941K • 176
  type series D942K • 187
  type series D943K • 198
  type series D944K • 209
  type series D945K • 220
  permissible viscosity \( \nu \)
  type series D941K • 176
  type series D942K • 187
  type series D943K • 198
permissible viscosity $\nu$
type series D944K • 209
type series D945K • 220
required filter fineness $\beta_x$ for filling filter for filling the hydraulic system • 139

Hydraulic symbols • 38–40
hydraulic symbols • 39
2-way operation • 38
2x2-way operation • 38
3-way operation • 40
4-way operation • 39
fail-safe function D • 40
fail-safe function F • 40
fail-safe functions M and W • 39
fail-safe valves • 39
on the nameplate • 164–165

Hydraulic system
connection of the valve to the hydraulic system • 63, 66
filling and flushing • 139
minimum flushing time • 140
required filter fineness for filling filter • 139
preparing • 139
Start-up • 140
start-up • 139–140
venting • 140

Hysteresis
type series D941K • 177
type series D942K • 188
type series D943K • 199
type series D944K • 210
type series D945K • 221

$I_{\text{Command}}$
current command signal • 109

$I_{\text{out}}$
output current • 110

$I_{\text{Supply}}$
supply current • 109

ID (Identifier)
ID (Inner Diameter, e.g. of O-rings)
IEC (International Electrotechnical Commission)

Immunity to interference
Technical data • 173
type series D941K • 177
type series D942K • 188
type series D943K • 199
type series D944K EMC
EMC protection requirements for immunity to interference and emitted interference
type series D944K • 210
type series D945K • 221

incremental transducer
power supply • 82
reversal point of signals • 111
speed variation of signals • 111

Index of figures • x
Index of Tables • viii

Initial start-up, safety instructions • 68
Input resistances at connectors X5...X7 • 91
Input voltage $U_{\text{in}}$ • 109
Inputs, analog command inputs
$\pm 10$ mA floating • 46
$\pm 10$ V floating • 46

Inputs, analog command inputs
$0–10$ mA differential • 50
$0–10$ V differential • 49
$4–20$ mA differential • 51
$4–20$ mA floating • 47
current inputs
$\pm 10$ mA floating • 46
$0–10$ mA differential • 50
$4–20$ mA differential • 51
$4–20$ mA floating • 47
flow control command inputs
$\pm 10$ mA floating • 46
$\pm 10$ V floating • 46
$4–20$ mA floating • 47
in the block diagram of the valve electronics • 22
pressure control command inputs
$0–10$ mA differential • 50
$0–10$ V differential • 49
$4–20$ mA differential • 51
signal type on the nameplate • 164–165
voltage inputs
$\pm 10$ V floating • 46
$0–10$ V differential • 49

Inputs, analog inputs
at connectors X5...X7
$\pm 10$ V • 90
$0–10$ mA • 90
$0–10$ V • 90
$4–20$ mA • 91
benefits of the different signal types • 95
Connections • 81
in the block diagram of the valve/pump electronics • 73
maximum current for transducer supply • 123
on connector X1
$\pm 10$ mA • 79
$\pm 10$ V • 78
$0–10$ mA • 79
$0–10$ V • 78
$4–20$ mA • 80
overview of connections • 77
pin assignment X5...X7 • 89
power supply to the transducer • 89
signal types
at connectors X5...X7 • 90
evaluating the signal types • 95
on connector X1 • 78
single-ended connection • 109
Wiring • 123–125
2-wire transducer • 124
3-wire transducer • 124
4-wire transducer • 124
Connectors X5...X7 • 123–125

Inputs, command value input
signal type identification in the type designation • 45

Inputs, digital inputs
enable input • 25, 31, 52
in the block diagram of the valve electronics • 22
in the block diagram of the valve/pump electronics • 73
signals at the enable input as fail-safe events • 31
on connector X1
enable input • 81
overview of connections • 81

Instability of the control loops, trouble shooting
instability of the internal valve control loops • 159
instability of the external control loop • 158
installation drawing
  type series D941K • 176
  type series D942K • 178
  type series D943K • 189
  type series D944K • 202
  type series D943K with pilot valve D633 • 200
  type series D945K • 211
  With pilot valve D633 • 213
installation position
  type series D941K • 176
  type series D942K • 178
  type series D943K • 198
  type series D944K • 209
  type series D945K • 220
Installation screws
  required quality class • 65
  specification • 65
  tightening torque • 65
  width across flats • 65
installation screws
  width across flats • 153
Intended operation • 5
IP
  protection type
    type series D941K • 177
    type series D942K • 188
    type series D943K • 199
    type series D944K • 210
    type series D945K • 221
Item numbers
  accessories • 232

L
  \(I_{\text{max}}\)
  maximum length of the supply cable • 105
Leak, trouble shooting
  Connection surface of the valves • 157
  linear force motor screw plug • 157
  Venting screw • 157
leakage flow \(Q_L\)
  type series D941K • 176
  type series D942K • 187
  type series D943K • 198
  type series D944K • 209
  type series D945K, flow Q
    leakage flow \(Q_L\)
    type series D945K • 220
Leakage port \(Y\) • 41
  diameter
    type series D941K • 175
    type series D942K • 186
    type series D943K • 197
    type series D944K • 208
    type series D945K • 219
  position in the holes in the mounting surface
    type series D941K • 175
    type series D942K • 186
    type series D943K • 197
    type series D944K • 208
    type series D945K • 219
LED
  Status LEDs
    in the block diagram of the valve/pump electronics • 73
  status LEDs
    in the block diagram of the valve electronics • 22
    indication of operating state and network status • 146
linear force motor • 21
  Armature • 21
  Bearing • 21
  Centering springs • 21
  Coil • 21
  Cross section • 21
  Permanent magnets • 21
  representative depiction • 21
  screw plug • 21
  trouble shooting in event of a leak • 157
Literature, additional
  CAN fundamentals • 256
  directives, quoted • 262
  EtherCAT fundamentals • 257
  Fundamentals of hydraulics • 256
  Moog publications • 258
  Profinet fundamentals • 256
  standards, quoted • 258–261
Load impedance \(R_L\)
  analog actual value outputs • 110
LSS
  LSS address
    example • 173
    on the nameplate • 164–165
    structure of the LSS address • 173
LVDT (position transducer)
  in the block diagram of the valve electronics • 22
  in the block diagram of the valve/pump electronics • 73
M
  Machine controller, configuration of the valves • 135
  Maintenance
    O-ring checking and replacement
      ports • 155
  Maintenance (service) • 149
  Manufacturer's declaration • 12
  Microprocessor control
    for storing the valve software parameters • 138
    in the valve electronics • 22
    microprocessor system
      in the block diagram of the valve electronics • 22
  Minimum flushing time
    for flushing the hydraulic system • 140
  Mode of operation
    linear force motor • 21
    Valves of the D94xK type series • 17
  Model number
    on the nameplate • 164–165
    structure of the model number • 166
  Model number and type designation • 166
  Moog Valve and Pump Configuration Software
    Ordering information D94xK • 232
  Moog Valve and Pump Configuration Software
    Configuration • 135
    operation • 128
    possible faults • 128
    Safety instructions • ??–72, ??–128, ??–128
    safety instructions • 71, 127

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User manual type series D94xK (CDS29589-de; Version -, April 2012) 245
mounting • 63, 66
   installation position
      type series D941K • 176
      type series D942K • 187
      type series D943K • 198
      type series D944K • 209
      type series D945K • 220

mounting option
   type series D941K • 176
   type series D942K • 187
   type series D943K • 198
   type series D944K • 209
   type series D945K • 220

Procedure • 67
   tools and materials required • 65

mounting option
   type series D941K • 176
   type series D942K • 187
   type series D943K • 198
   type series D944K • 209
   type series D945K • 220

Mounting surface • 64
   cleaning • 67
   permissible average roughness Ra • 64
   required evenness • 64

N

ν: viscosity
   permissible viscosity ν of the hydraulic fluid
      type series D941K • 176
      type series D942K • 187
      type series D943K • 198
      type series D944K • 209
      type series D945K • 220

Nameplate • 164–165

NBR
   type series D941K • 234
   type series D942K • 235
   type series D943K, D944K • 235
   type series D945K • 236

NG
   Technical Data
      type series D941K • 176
      type series D942K • 187
      type series D943K • 198
      type series D945K • 220

Nominal size
   type series D941K • 176
   type series D942K • 187
   type series D943K • 198
   type series D944K NG
   Technical Data
      type series D944K • 209
      type series D945K • 220

Notes on user manual • 1

O

occupational safety and health
   safe distances for cardiac pacemakers and similar devices
due to magnetic fields • 15
   sound insulation measures • 15

operating pressure $P_o$
   maximum operating pressure
      type series D941K • 176
      type series D942K • 187
      type series D943K • 198
      type series D944K • 209
      type series D945K • 220
   Maximum operating pressure on the nameplate • 164–165

Operation of the valves • 142–146
   ambient conditions, permissible
      type series D941K • 176
      type series D942K • 187
      type series D943K • 198
      type series D944K • 209
      type series D945K • 220
   intended operation • 5
   necessary preparations • 145

O-rings
   checking and replacing the O-rings
   ports • 155
   cleaning • 67
   embrittlement • 62, 155
   ordering information • 235
   Ordering information D941K • 234
   Ordering information D943K, D944K • 235
   Ordering information D945K • 236
   Service sealing set, ordering information D941K • 234
   Service sealing set, ordering information D942K • 235
   Service sealing set, ordering information D943K, D944K • 235
   Service sealing set, ordering information D945K • 236

Output current $I_{out}$ • 110

Output voltage $U_{out}$ • 110

Output, analog
   spool position actual value output 4–20 mA • 52

Output, analog stroke position signal
   4–20 mA (actual value output) • 52

Outputs, analog actual value output
   in the block diagram of the valve electronics • 22

Outputs, analog actual value outputs
   conversion of $I_{out}$ (4–20 mA) into 2–10 V • 110

Outputs, analog outputs
   Connections • 81
   in the block diagram of the valve/pump electronics • 73
   on connector X1
      2–10 V • 80
      4–20 mA • 80
   overview of connections • 77

Outputs, digital outputs
   on connector X1
      Valve standby • 81
      overview of connections • 81

Outputs, spool position signal
   signal type identification in the type designation • 45
   overlap • 39, 42
   zero lap • 39, 42
**Packaging**
- disposal • 9
- storing original packaging • 60

**Part numbers**
- accessories • 232

**PC (Personal Computer)**
- Ordering information D94xK • 232

**PELV power pack**
- Ordering information D94xK • 232

**Permanent magnets of the linear force motor**
- in the representative depiction • 21

**PID (Proportional Integral Differential)**
- PID controller • 36

**Pilot flow**
- type series D941K • 176
- type series D942K • 187
- type series D943K • 198
- type series D944K • 209
- type series D945K • 220

**Pilot identification in the type designation** • 41

**Pilot identification in the type designation** • 41

**Pilot pressure port X** • 41
- diameter
  - type series D941K • 176
  - type series D942K • 187
  - type series D943K • 198
  - type series D944K • 209
  - type series D945K • 220
- position in the holes in the mounting surface
  - type series D941K • 176
  - type series D942K • 187
  - type series D943K • 198
  - type series D944K • 209
  - type series D945K • 220

**Pilot pressure \( p_X \)**
- approximation formula for calculation • 18
- drop in the pilot pressure as fail-safe event • 31
- restarting afterwards • 33
- on the nameplate • 164–165
  - type series D941K • 176
  - type series D942K, pressure \( p \) • 187
  - type series D943K • 198
  - type series D944K • 209
  - type series D945K • 220

**Pilot valve connector X11**
- in the block diagram of the valve/pump electronics • 73
- pin assignment • 92

**Pilot valve D633**
- in the representative depiction of the valve • 19
  - Technical data D941K • 176
  - Technical data D942K • 187
  - Technical data D945K • 220

**Pilot valve in the type designation** • 168
- pin assignment
  - X1 (connector) • 6+PE-pin • 76
  - X2 (digital signal interface) • SSI transducer • 83
  - X3 and X4 (field bus interface) • cAN bus • 85
  - EtherCAT • 88
  - Profibus-OP • 86
  - X5…X7 (analog input connectors) • 89

**Pin assignment**
- X10 (service connector) • 92
- X11 (pilot valve connector) • 92

**Ports**
- diameter of ports
  - type series D941K • 176
  - type series D942K • 187
  - type series D943K • 198
  - type series D944K • 209
  - type series D945K • 220
- on the nameplate • 164–165

**ports**
- O-ring checking and replacement • 155
- trouble shooting in event of leaks • 157

**Position transducer (LVDT)**
- in the block diagram of the valve electronics • 22
  - in the block diagram of the valve/pump electronics • 73

**Potentially explosive environment** • 162

**Power supply**
- Power supply
  - on the nameplate • 164–165

**Power supply**
- failure of the supply voltage • 31
  - restarting the valve afterwards • 33
- PELV power pack
  - Ordering information D94xK • 232

**Power supply**
- type series D941K • 177
  - type series D942K • 188
  - type series D943K • 199
  - type series D944K • 210
  - type series D945K • 221

**Supply voltage**
- failure of the supply voltage • 31
  - in the block diagram of the valve electronics • 22

**Power supply cord**, ordering information D94xK • 232
- requirements of supply voltage • 77
  - SELV power pack
    - type series D941K • 177
    - type series D942K • 188
    - type series D943K • 199
    - type series D944K • 210
    - type series D945K • 221

**Power supply cord**, ordering information D94xK • 232
- trouble shooting in event of instability of the internal valve control loop • 159

**Pressure control (p-control)** • 17
- trouble shooting in event of instability of the internal valve control loop • 159

**Pressure controller**
- trouble shooting in event of instability of the internal valve control loop • 159

**Pressure difference \( \Delta p \)** • 56

**Pressure limitation** • 16, 18, 131

**Pressure port P**
- diameter
  - type series D941K • 175
  - type series D942K • 186
  - type series D943K • 197
  - type series D944K • 208
  - type series D945K • 219
- position in the holes in the mounting surface
  - type series D941K • 175
  - type series D942K • 186
  - type series D943K • 197
  - type series D944K • 208
  - type series D945K • 219
Pressure transducer, internal
in the block diagram of the valve electronics • 22

Pressure \( p \)
operating pressure \( p_0 \)
maximum operating pressure
  type series D941K • 176
  type series D942K • 187
  type series D943K • 198
  type series D944K • 209
  type series D945K • 220
  Maximum operating pressure on the nameplate • 164–165
pilot pressure \( p_X \)
  approximation formula for calculation • 18
  drop in the pilot pressure • 31
  restarting afterwards • 33
  on the nameplate • 164–165
  type series D941K • 176
  type series D943K • 198
  type series D944K • 209
  type series D945K • 220

Procedure for electrically connecting valves/pumps • 95

Profibus
  literature, additional, Profibus fundamentals • 256
Profibus-DP
  maximum number of bus nodes • 86
  pin assignment • 86
  Technical data • 86

Profibus-DP networks
  general information • 85
  cable cross section • 118
  cable length • 118
  module address • 119
  suitable cables • 119
  transmission rate • 119
  Wiring • 117–119
  Procedure • 117
  wiring diagram • 118

Prohibition to duplicate - user manual • A
Prohibition to reproduce - user manual • A

protection type
  type series D941K • 177
  type series D942K • 188
  type series D943K • 199
  type series D944K • 210
  type series D945K • 221

protective conductor
  deficient equipotential bonding • 100
  ground loops • 99
  maximum potential difference (7 V) • 98
  procedure for connecting • 98
  required cross section • 98

Protective grounding • 96–104
  of machines • 97
  performance • 98

Protective grounding, electromagnetic compatibility (EMC) • 173

Pulse width modulation (PWM)
in the block diagram of the valve electronics • 22

PWM (Pulse Width Modulation)
in the block diagram of the valve electronics • 22

Q
Q_L
leakage flow
  type series D941K • 176
  type series D942K • 187
  type series D943K • 198
  type series D944K • 209
  type series D945K • 220

Q_N
rated flow
  type series D941K • 176
  type series D942K • 187
  type series D943K • 198
  type series D944K • 209
  type series D945K • 220

Rated flow, type designation • 167

Q_{max}
maximum flow
  type series D941K • 176
  type series D942K • 187
  type series D943K • 198
  type series D944K • 209
  type series D945K • 220

q_{typ}
typical cross section • 104

Qualification, requirements of the user • 7

Quality class, required for installation screws • 65

R
\rho_{Cu}
resistivity of copper • 104
R_L
load impedance \( R_L \) of the analog actual value outputs • 110
R_{typ}
typical resistance • 104
R_a
average permissible roughness \( R_a \) for mounting surface • 64

Rated flow in the type designation • 167

Rated flow \( Q_N \)
  Nameplate • 167
  type series D941K • 176
  type series D942K, flow \( Q_N \) • 187
  type series D943K • 198
  type series D944K • 209
  type series D945K • 220

Rated pressure difference \( \Delta p_N \) • 56

reference temperature of the valve electronics
  type series D941K • 176
  type series D942K • 187
  type series D943K • 198
  type series D944K • 209
  type series D945K • 220

Release date of the user manual • 1

Removal (service) • 149
Removal of the valves (service), procedure • 154
Removing • 154
Removing of the valves • 153
Repair (service) • 149, 160
Representative depictions
  linear force motor • 21
  Two-stage proportional valve with pilot valve D633 • 19
Responsibilities • 10
Responsibility of the manufacturer and the operator of the machine • 10
restarting the valve • 33
Roughness Ra, average, permissible for mounting surface • 64

Safety instructions
- general safety instructions • 16
- analog command inputs • 46–47, 49–51
- attachment elements for the shipping plate • 66
- attachment elements for the shipping plate (removal) • 154
- cleaning the valve connecting surface, mounting surface and O-rings • 67
- configuration of the valves • 135
- connection to the hydraulic system • 63, 66
- delivery of repaired valves and replacement valves with factory settings • 160
- Design of the valve with respect to flow • 34
- diesel effect • 140
- disposal • 9
- electrical and hydraulic zero positions • 42
- electrical properties • 69
- equipotential bonding • 70
- ESD • 16
- failure of the supply voltage • 31
- flushing the hydraulic system • 139
- handling in accordance with safety requirements • 14, 68
- hydraulic connection • 63, 66
- Hydraulic fluid • 63
- hydraulic fluid • 16, 129
- diesel effect • 140
- initial start-up • 68
- connection to field bus • 69
- Intended operation • 5
- isolation from the mains system • 69
- Leak on the linear motor screw plug (service) • 157
- Linear motor screw plug (service) • 157
- Maintenance (service) • 149
- Moog Valve and Pump Configuration Software • 71–72, 127–128
- mounting • 63, 66
- mounting pattern of mounting surface
  - type series D941K • 175
  - type series D942K • 186
  - type series D943K • 197
  - type series D944K • 208
  - type series D945K • 219
- occupational safety and health • 15
- safe distances for cardiac pacemakers and similar devices due to magnetic fields • 15
- sound insulation measures • 15
- open connectors • 130
- operation • 142
- power pack • 69
- pressure limitation • 16, 18, 131
- protective conductor system • 70
- Removal (service) • 149, 154

Safety notes, operation
- configuration of the valves • 144
- valve software • 144
- Safety notes, service
  - hydraulic fluid • 149
- Safety-critical applications • 27
- Scope of delivery • 61
- Screw plug on the linear force motor
  - in the representative depiction • 21
  - trouble shooting in event of a leak • 157
- Seal material
  - in the type designation • 170
- Sealing ring for venting screw
  - trouble shooting in event of a leak at the venting screw • 157
- selection and qualification of personnel • 7
  - qualified users • 7
- SELV power pack
  - type series D941K • 177
  - type series D942K • 188
  - type series D943K • 199
  - type series D944K • 210
  - type series D945K • 221
- SensorSup
  - supply voltage to the SSI transducer • 83
- Serial number on the nameplate • 164–165
- service • 149–161
- Service connector X10, configuration of the valves • 137
- Service connector X10
  - general information • 92
  - in the block diagram of the valve/pump electronics • 73
  - pin assignment • 92
- service connector X10 • 24, 26
Safety instructions
adapter • 137
dust protection cap • 130
in the block diagram of the valve electronics • 22
in the connector overview • 74
Service interface • 24
configuration of the valves via the service interface • 137
in the block diagram of the valve electronics • 22
Service sealing set, ordering information D942K • 235
Service sealing set, ordering information D943K, D944K • 235
Service sealing set, ordering information D945K • 236
Shipping plate • 59
shipping plate • 132
Attachment screws • 66
Tightening torque (removal) • 154
width across flats • 65
Attachment screws (removal) • 154
mounting • 154
removal • 67
Shock resistance
type series D941K • 176
type series D942K • 187
type series D943K • 198
type series D944K • 209
type series D945K • 220
shutting down the valve • 147
Signal cables
cable length • 108
calculation
limit frequency • 107
typical capacitance \(C_{\text{typ}}\) • 105
typical resistance \(R_{\text{typ}}\) • 104
dimensioning • 104
influence of capacitance per unit length • 107
influence of resistance • 107
limit frequency • 107
permissible lengths • 104–108
recommendations • 107
Signal interface, digital signal interface X2
in the block diagram of the valve/pump electronics • 73
SSI transducer • 83
Signal interfaces • 24
Signal type identification in the type designation • 45
Signal types for analog command inputs
on the nameplate • 164–165
Signal, differential signal
evaluation • 95
Software
Moog Valve and Pump Configuration Software
Ordering information D94xK • 232
Moog Valve and Pump Configuration Software • 54
Moog Valve and Pump Configuration Software, configuration • 135
valve software • 53
configuration of the valves • 53, 135
via the field bus interface • 135
via the service interface • 137
factory setting • 138
Microprocessor control • 22
for storing parameters • 138
sound insulation measures • 9, 15
Spool
defined spring-determined position of the spool in the mechanical fail-safe state • 29
overlap • 39, 42
Step response time for 0–100 % spool stroke
type series D941K • 177
type series D942K • 188
type series D943K • 199
type series D944K • 210
type series D945K • 221
zero lap • 39, 42
zero position (electrical and hydraulic) • 42
Spool position based on enable signal in the type designation • 171
Spool position controller
in the Q-control block diagram • 35
Spool type in the type designation • 166
Spool version in the type designation • 168
SSI transducer
cable break monitoring • 82
connection to valve/pump • 111
pin assignment • 83
power supply • 83
recommended cable types • 82
signals between valve/pump • 111
supported transducer types • 82
Wiring • 111
wiring diagram • 111
Standards
overview of quoted standards • 258–261
CiA DSP • 255, 258
DIN • 259
EN • 260
EN ISO • 261
IEC • 258
IEEE • 258
ISO • 261
ISO/DIS • 258
ISO/IEC • 258
Start-up
Hydraulic system • 140
hydraulic system • 139–140
restarting the valve • 33
valve • 129–138
start-up
EMC requirements • 126
Static and dynamic data
type series D941K • 177
type series D942K • 188
type series D943K • 199
type series D944K • 210
type series D945K • 221
Step response time for 0–100 % spool stroke
type series D941K • 177
type series D942K • 188
type series D943K • 199
type series D944K • 210
type series D945K • 221
Storage • 59, 62
ambient conditions, permissible
type series D941K • 176
type series D942K • 187
type series D943K • 198
type series D944K • 209
type series D945K • 220
Storage • 59, 62
  embrittlement of gaskets • 62
  gumming of hydraulic fluid • 62
  original packaging • 60
  storage location for user manual • 2
  user manual • 2

Structural modifications • 8
styles/spelling, used • 3
Subject to change without notice - user manual • A, 1
Supplemental documents • 5

Supply cables
calculation
  maximum length • 105
  typical capacitance Ctyp • 105
  typical resistance Rtyp • 104
  voltage drop per unit length • 106
  dimensioning • 104
  permissible lengths • 104–108

Supply current Isupply • 109
supply voltage
  in the block diagram of the valve/pump electronics • 73

Supply voltage in the type designation • 171

Symbols
  list of symbols • 254
  βx (filter fineness)
  Δp (pressure difference)
  ΔpN (rated pressure difference)
  icomm (current command signal)
  iin (input current)
  iout (output current)
  Isupply (supply current)
  l (length)
  ν (viscosity)
  p (pressure)
  pN (rated pressure)
  pP (operating pressure)
  px (pilot pressure)
  Q (flow rate of a pump)
  Q (flow)
  QL (leakage flow)
  Qmax (maximum flow)
  Qn (rated flow)
  Ra (average roughness)
  Rin (input resistance)
  rL (load impedance)
  T (Temperature)
  t (time)
  Ucat (voltage drop on the cable)
  ucomm (input voltage command signal)
  uin (input voltage)
  uout (output voltage)
  V (volume)

symbols, used • 3

T
  t (symbol for time)

Table of contents • ii
Tank port T
diameter
  type series D941K • 175
  type series D942K • 186
  type series D943K • 197
  type series D944K, tank port T
    position in the holes in the mounting surface

Throttle valve • 17

Threshold
  type series D941K • 177
  type series D942K • 188
  type series D943K • 199
  type series D944K • 209
  type series D945K • 220

Throttle valve • 17

Tools
  required for wiring valves/pumps • 94
  transducer connectors X2, X5…X7
    in the block diagram of the valve electronics • 22
Transducer interface
in the block diagram of the valve electronics  • 22
transportation  • 59
ambient conditions, permissible
type series D941K  • 176
type series D942K  • 187
type series D943K  • 198
type series D944K  • 209
type series D945K  • 220
transportation damage  • 60
Trouble shooting  • 156–159
overview of possible faults  • 156
instabilities of the control loop
external control loop  • 158
internal valve control loops  • 159
instability of the external control loop  • 158
leak at the linear force motor screw plug  • 157
Leak at the valve connecting surface  • 157
leak at the venting screw  • 157
no hydraulic response by the valve  • 158
Troubleshooting (service)  • 149
TÜV (Technischer Überwachungsverein)
Type designation
Command signals for 100 % spool stroke  • 170
Electrical supply  • 171
fail-safe identification  • 169
Fieldbus connectors X3 and X4  • 172
Gasket material  • 170
Hydraulic intake/drain  • 164–165
pilot identification  • 41
Pilot valve  • 168
Rated flow  • 167
signal type identification  • 45
Spool position based on enable signal  • 171
Spool type  • 166
Spool version  • 168
Type designation (function key)  • 166
Type designation, model number  • 166
typographical conventions  • 3

U
U_{cable}  
voltage drop on the cable  • 109
U_{command}  
command signal of input voltage  • 109
U_{dr,max}  
maximum voltage drop on the cable  • 105
U_{min}  
minimum supply voltage  • 105
U_{out}  
output voltage  • 110
U_{in}  
input voltage  • 109
USB start-up module  • 137
Ordering information D94xK  • 232
use, intended  • 5
User manual
Ordering information D94xK  • 233
prohibition to duplicate  • A
prohibition to reproduce  • A
release date  • 1
storage location  • 2
styles/spelling, used  • 3
User manual
subject to change without notice  • A, 1
symbols, used  • 3
typographical conventions  • 3
version number  • 1
Users, qualified  • 7

V
V (symbol for volume)
Valve configurations  • 38–40
2-way operation  • 38
2x2-way operation  • 38
3-way operation  • 39–40
4-way operation  • 39–40
Technical Data
type series D941K  • 176
type series D942K  • 187
type series D943K  • 198
type series D944K  • 209
type series D945K  • 220
Valve design
type series D941K  • 176
type series D942K  • 187
type series D943K  • 198
type series D944K  • 209
type series D945K  • 220
-valve electronics  • 22
block diagram  • 22
Microprocessor control  • 22
for storing the valve software parameters  • 138
reference temperature
type series D941K  • 176
type series D942K  • 187
type series D943K  • 198
type series D944K  • 209
type series D945K  • 220
-valve software  • 53
configuration of the valves  • 53
via the field bus interface  • 135
via the service interface  • 137
factory setting of the valves  • 138
Microprocessor control  • 22
for storing the valve software parameters  • 138
Valve status
‘ACTIVE’  • 23, 33
‘DISABLED’  • 23, 30, 32–33, 148
‘FAULT DISABLED’  • 23, 30, 32–33
‘FAULT HOLD’  • 23, 27, 30, 32–33
‘HOLD’  • 23, 27, 30, 32–33
‘INIT’  • 23, 30, 32–33, 148
‘NOT READY’  • 23, 30, 32
overview of the valve status  • 23
Valve/pump electronics, block diagram  • 73
VDE (Verband der Elektrotechnik Elektronik Informationstechnik e. V.)
VDI (Verein Deutscher Ingenieure e. V.)
venting
Hydraulic system  • 140
valve  • 141
Venting screw
procedure for venting the valve • 141
tightening torque • 141
trouble shooting in event of a leak • 157
width across flats • 141

Version number of the user manual • 1

Vibration resistance
type series D941K • 176
type series D942K • 187
type series D943K • 196
type series D944K • 209
type series D945K • 220

Viscosity υ of the hydraulic fluid
type series D941K • 176
type series D942K, temperature T
permissible temperature range for hydraulic fluid
type series D942K • 187
type series D943K • 196
type series D944K • 209
type series D945K • 220

Voltage drop U_Cable on the cable • 109

W

WAF
widths across flats
attachment screws for the shipping plate • 65, 153
Installation screws • 65
installation screws • 153

widths across flats
attachment screws for the shipping plate • 65, 153
Installation screws • 65
installation screws • 153

Wiring
tools and materials required • 94
X1
6+PE-pin connector • 108
X2
CAN network • 112
SSI transducer • 111
X3 and X4
CAN network • 112
EtherCAT network • 120
Profibus-DP network • 117
X5…X7 • 123
2-wire transducer • 124
3-wire transducer • 124
4-wire transducer • 124

Wrench sizes (WW)
Venting screw • 141

X

X: pilot pressure port • 41
diameter
• type series D941K • 175
type series D942K • 186
type series D943K • 197
type series D944K • 208
type series D945K • 219
position in the holes in the mounting surface
• type series D941K • 175
type series D942K • 186
type series D943K • 197
type series D944K • 208
type series D945K • 219

X: Ports
in the representative depiction of the valve • 19

Y

Y: leakage port • 41

Z

zero lap • 39, 42
Zero position of the spool
electrical zero position • 42
hydraulic zero position • 42

Zero shift
type series D941K • 177
type series D942K • 188
type series D943K • 199
type series D944K • 210
type series D945K • 221
## 15 Appendix

### 15.1 Abbreviations, symbols and identification letters

<table>
<thead>
<tr>
<th>Abbr.</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_x$</td>
<td>Symbol for filter fineness</td>
</tr>
<tr>
<td>$\Delta p$</td>
<td>Symbol for pressure difference</td>
</tr>
<tr>
<td>$\Delta p_N$</td>
<td>Symbol for rated pressure difference</td>
</tr>
<tr>
<td>$\nu$</td>
<td>Symbol for viscosity</td>
</tr>
<tr>
<td>A</td>
<td>Valve port (consumer port)</td>
</tr>
<tr>
<td>A/D</td>
<td>Analog-Digital converter</td>
</tr>
<tr>
<td>ACV</td>
<td>Axis Control Valve (valve with axis control function)</td>
</tr>
<tr>
<td>B</td>
<td>Valve port (consumer port)</td>
</tr>
<tr>
<td>CAN</td>
<td>Controller Area Network</td>
</tr>
<tr>
<td>CANopen</td>
<td>Standardized communication profile</td>
</tr>
<tr>
<td>CiA</td>
<td>CAN in Automation e. V. (International Manufacturers’ and Users’ Organization for CAN Users; <a href="http://www.can-cia.org">http://www.can-cia.org</a>)</td>
</tr>
<tr>
<td>D</td>
<td>Differential (e. g.: in PID controller)</td>
</tr>
<tr>
<td>D</td>
<td>Fail-safe function D of valve</td>
</tr>
<tr>
<td>D/A</td>
<td>Digital-Analog converter</td>
</tr>
<tr>
<td>DIN</td>
<td>Deutsches Institut für Normung e. V. (German Institute for Standardization) (<a href="http://www.din.de">http://www.din.de</a>)</td>
</tr>
<tr>
<td>DSP</td>
<td>Draft Standard Proposal</td>
</tr>
<tr>
<td>EMC</td>
<td>Electromagnetic Compatibility</td>
</tr>
<tr>
<td>EN</td>
<td>Europa-Norm (European standard)</td>
</tr>
<tr>
<td>ESD</td>
<td>Electrostatic Discharge</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>F</td>
<td>Fail-safe function F of valve</td>
</tr>
<tr>
<td>F₁...F₄</td>
<td>Bore for installation screws or attachment screws for the shipping plate in the mounting pattern of the valve mounting surface</td>
</tr>
<tr>
<td>FKM</td>
<td>Fluorocarbon rubber (material for gaskets, such as O-rings)</td>
</tr>
<tr>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>HNBR</td>
<td>Hydrogenated Nitrile Butadiene Rubber (material for gaskets, such as O-rings)</td>
</tr>
<tr>
<td>I₁</td>
<td>Integral (e. g.: in PID controller)</td>
</tr>
<tr>
<td>Iᵢn</td>
<td>Symbol for input current</td>
</tr>
<tr>
<td>Iᵢnt</td>
<td>Symbol for output current</td>
</tr>
<tr>
<td>IᵢCommand</td>
<td>Symbol for current command signal</td>
</tr>
<tr>
<td>IᵢSupply</td>
<td>Symbol for supply current</td>
</tr>
<tr>
<td>ID</td>
<td>Identifier</td>
</tr>
<tr>
<td>ID</td>
<td>Inner Diameter (e. g. on O-rings)</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electrotechnical Commission (<a href="http://www.iec.ch">http://www.iec.ch</a>)</td>
</tr>
<tr>
<td>IP</td>
<td>International Protection (IP code; degree of protection type by enclosure as per <a href="http://www.en60529">EN 60529</a>)</td>
</tr>
<tr>
<td>ISM</td>
<td>Industrial, scientific and medical (industrial, scientific, and medical, e. g. for ISM devices)</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization (<a href="http://www.iso.org">http://www.iso.org</a>)</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
</tr>
</tbody>
</table>

Tab. 48: Abbreviations, symbols and identification letters (Part 1 of 3)
<table>
<thead>
<tr>
<th>Abbr.</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSS</td>
<td>Layer Setting Services as per CiA DSP 305 (LSS offers the option of setting the node parameters, such as module address or transmission rate, of a CAN node via the CAN bus)</td>
</tr>
<tr>
<td>LVDT</td>
<td>Linear Variable Differential Transformer (position transducer; senses the position of the spool in the valve)</td>
</tr>
<tr>
<td>M</td>
<td>Fail-safe function M of valve</td>
</tr>
<tr>
<td>NBR</td>
<td>Nitrile Butadiene Rubber (material for gaskets, such as O-rings)</td>
</tr>
<tr>
<td>NG</td>
<td>Nominal size of the valve, e.g. 610</td>
</tr>
<tr>
<td>P</td>
<td>Proportional (e.g. in PID controller)</td>
</tr>
<tr>
<td>P</td>
<td>Valve port (pressure port)</td>
</tr>
<tr>
<td>P1</td>
<td>Valve port (pressure port)</td>
</tr>
<tr>
<td>P</td>
<td>Symbol for pressure (Pressure)</td>
</tr>
<tr>
<td>PN</td>
<td>Symbol for rated pressure</td>
</tr>
<tr>
<td>PP</td>
<td>Symbol for operating pressure</td>
</tr>
<tr>
<td>PX</td>
<td>Symbol for pilot pressure</td>
</tr>
<tr>
<td>PC</td>
<td>Personal Computer</td>
</tr>
<tr>
<td>PE</td>
<td>Protective Earth</td>
</tr>
<tr>
<td>PE</td>
<td>Pin of the 11+PE-pin valve connector X1</td>
</tr>
<tr>
<td>PELV</td>
<td>Protective Extra Low Voltage</td>
</tr>
<tr>
<td>PID</td>
<td>Proportional Integral Differential (e. g. in PID controller)</td>
</tr>
<tr>
<td>PWM</td>
<td>Pulse Width Modulation</td>
</tr>
<tr>
<td>Q</td>
<td>Symbol for flow</td>
</tr>
<tr>
<td>Q</td>
<td>Symbol for flow rate of a pump</td>
</tr>
<tr>
<td>QL</td>
<td>Symbol for leakage flow</td>
</tr>
<tr>
<td>Qmax</td>
<td>Symbol for maximum flow</td>
</tr>
<tr>
<td>QN</td>
<td>Symbol for rated flow</td>
</tr>
<tr>
<td>Ra</td>
<td>Symbol for average roughness</td>
</tr>
<tr>
<td>Rin</td>
<td>Symbol for input resistance</td>
</tr>
<tr>
<td>RL</td>
<td>Symbol for load impedance</td>
</tr>
<tr>
<td>SELV</td>
<td>Safety Extra Low Voltage (low voltage)</td>
</tr>
<tr>
<td>WAF</td>
<td>Width Across Flats for wrenches</td>
</tr>
<tr>
<td>T</td>
<td>Symbol for temperature</td>
</tr>
<tr>
<td>T</td>
<td>Valve port (tank port)</td>
</tr>
<tr>
<td>T1</td>
<td>Valve port (tank port)</td>
</tr>
<tr>
<td>T</td>
<td>Symbol for time</td>
</tr>
<tr>
<td>TN</td>
<td>Technical Note</td>
</tr>
<tr>
<td>TÜV</td>
<td>Technischer Überwachungsverein (German Technical Inspection Agency)</td>
</tr>
<tr>
<td>Uin</td>
<td>Symbol for input voltage</td>
</tr>
<tr>
<td>Uout</td>
<td>Symbol for output voltage</td>
</tr>
<tr>
<td>Ucomm</td>
<td>Symbol for input voltage command signal</td>
</tr>
<tr>
<td>Ucable</td>
<td>Symbol for voltage drop on the cable</td>
</tr>
<tr>
<td>USB</td>
<td>Universal Serial Bus</td>
</tr>
<tr>
<td>UV</td>
<td>Ultraviolet</td>
</tr>
<tr>
<td>V</td>
<td>Symbol for volume (such as tank capacity)</td>
</tr>
<tr>
<td>VDE</td>
<td>Verband der Elektrotechnik Elektronik Informationstechnik e. V. (German Association of Electrical Engineering, Electronics and Information Technology) (<a href="http://www.vde.de">http://www.vde.de</a>)</td>
</tr>
</tbody>
</table>

Tab. 48: Abbreviations, symbols and identification letters (Part 2 of 3)
15.2 Additional literature

15.2.1 Fundamentals of hydraulics

Findeisen, Dietmar und Findeisen, Franz:
Ölhydraulik; Springer-Verlag

Murrenhoff, Univ.-Prof. Dr.-Ing. Hubertus:
Grundlagen der Fluidtechnik - Teil 1: Hydraulik (Vorlesungsumdruck des IFAS der RWTH Aachen)
http://www.rwth-aachen.de/ifas

Murrenhoff, Univ.-Prof. Dr.-Ing. Hubertus:
Servohydraulik (Vorlesungsumdruck des IFAS der RWTH Aachen)
http://www.rwth-aachen.de/ifas

Murrenhoff, Univ.-Prof. Dr.-Ing. Hubertus:
Steuerungs- und Schaltungstechnik II (Vorlesungsumdruck des IFAS der RWTH Aachen)
http://www.rwth-aachen.de/ifas

Schäfer, Dr. Klaus D.:
Stetighydraulik - Grundlagen, Ventiltechnik, Regelkreise; Die Bibliothek der Technik, Band 215; Verlag Moderne Industrie

15.2.2 CAN fundamentals

CAN in Automation e. V.:
http://www.can-cia.org

Etschberger, Konrad (editor):
CAN - Controller-Area-Network - Grundlagen, Protokolle, Bausteine, Anwendungen; Carl Hanser Verlag

Lawrenz, Wolfhard (editor):
CAN - Controller Area Network - Grundlagen und Praxis; Hüthig Verlag

15.2.3 Profibus fundamentals

PROFIBUS Users' Organization:
http://www.profibus.com

Popp, Manfred:
PROFIBUS-DP/DPV1 - Grundlagen, Tipps und Tricks für Anwender; Hüthig Verlag
15.2.4 EtherCAT fundamentals

EtherCAT Technology Group:
http://www.ethercat.org

Additional literature:
 EtherCAT fundamentals
15 Appendix

15.2.5 Moog publications
Press releases:  
http://www.moog.com/industrial/news
Newsletters:  
http://www.moog.com/industrial/newsletter
Articles in technical journals:  
http://www.moog.com/industrial/articles
Presentations and scientific publications:  
http://www.moog.com/industrial/papers
User manual, TNs, catalogs, and similar:  
http://www.moog.com/industrial/literature

15.3 Quoted standards

15.3.1 CiA DSP
CiA DSP 305  
CiA Draft Standard Proposal: CANopen Layer Setting Services and Protocol (LSS)

15.3.2 TIA/EIA
ANSI/TIA/EIA-568-B.1  
Commercial Building Telecommunications Cabling Standard Part 1: General Requirements
EIA 422  
Electrical Characteristics of Balanced Voltage Digital Interface Circuits
TIA/EIA-485-A  
Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

15.3.3 IEC
IEC 62407  
Real-time Ethernet control automation technology (EtherCAT™)

15.3.4 IEEE
IEEE 802.3  
Carrier Sense Multiple Access with Collision Detection (CSMA/CD) - Access Method and Physical Layer

15.3.5 ISO, ISO/IEC
ISO 11898  
Road vehicles -- CAN protocol
ISO/IEC 8802-3  
Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks, specific requirements - Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications
15.3.6 DIN

DIN 51524-1
Pressure fluids; Hydraulic oils Part 1: HL hydraulic oils; Minimum requirements

DIN 51524-2
Pressure fluids; Hydraulic oils Part 2: HLP hydraulic oils; Minimum requirements

DIN 51524-3
Pressure fluids; Hydraulic oils Part 3: HVLP hydraulic oils; Minimum requirements

DIN 24340-2
Hydraulic valves; hole patterns, and connecting plates for mounting Directional Control valves
15.3.7 EN

EN 563
Safety of machinery – Temperatures of touchable surfaces – Ergonomics data to establish temperature limit values for hot surfaces

EN 982
Safety of machinery – Safety requirements for fluid power systems and their components – Hydraulics

EN 55011
Industrial, Scientific And Medical Equipment (ISM devices) – Radio-frequency Disturbance Characteristics – Limits And Methods Of Measurement

EN 60068-2-6

EN 60068-2-27

EN 60079-0
Explosive atmospheres - Part 0: Equipment - General requirements

EN 60079-1
Electrical apparatus for explosive gas atmospheres - Part 1: Flameproof enclosures "d"

EN 60079-7
Explosive atmospheres - Part 7: Equipment protection by increased safety "e"

EN 60204
Safety of machinery – Electrical equipment of machines

EN 60529
Protection types provided by enclosures (IP code)

EN 61000-6-2
Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity to interference for industrial environments

EN 61000-6-3
Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emitted interference for residential, commercial and light-industrial environments

EN 61000-6-4
Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emitted interference for industrial environments

EN 61076-2-101
Connectors for electronic equipment - Part 2-101: circular connectors - type specification for circular connector M8 with screw or snap locking and M12 with screw locking for low-voltage applications

EN 61558-1
Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests
EN 61158-2
Digital data communication in instrumentation and control – Field bus for industrial control systems

EN 61558-2-6
Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1100 V – Part 2-6: Special requirements and tests for safety transformers and power supplies that contain safety transformers

EN 175201-804
Type specification – Circular connectors – Round contacts, size diameter 1.6 mm – threaded coupling

EN 175301-803
Type specification Rectangular connectors Flat contacts, 0.8 mm (0.031 in) thickness, locking screw not detachable

15.3.8 EN ISO

EN ISO 1302
Geometrical Product Specifications (GPS) Indication of surface texture in technical product documentation

EN ISO 4762
Hexagon socket head cap screws

EN ISO 12100
Safety of machinery – Basic concepts, general principles for design

EN ISO 13849
Safety of people – Safety-related parts of controllers

EN ISO 13849-1
Safety of machinery – Safety-related parts of control systems – Part 1: General design principles

15.3.9 ISO

ISO 4401
Hydraulic fluid power – 4-port directional control valves – Mounting surfaces

ISO 4406
Hydraulic fluid power – Fluids – Method for coding level of contamination by solid particles

ISO 11158
Lubricants, industrial oils and related products (class L) – Family H (hydraulic systems) – Specifications for categories HH, HL, HM, HV and HG
15.4 Quoted directives

2006/42/EC
Directive 2006/42/EG of the European Parliament and Council for alignment of the legal and administrative provisions of the Member States for machinery

2004/108/EC
Directive 2004/108/EC concerning electromagnetic compatibility (EMC)

94/9/EC
ATEX product directive

1999/92/EC
ATEX operating directive

VDI offers numerous directives for downloading:
15.5 Explosion-proof connectors

Instructions from the company Cooper Crouse-Hinds GmbH
Betriebsanleitung
zusammen mit der ausführlichen
Die Montageanleitung darf nur
Spannungsfreiheit sicherzustellen.
am Stecker und Kupplung, ist die
Vor dem Öffnen der Druckschraube
2) Follow the instructions in the chapter ´Installation!
PTB 03 ATEX 1016 X
1) observe special requirements accd. certification
PTB 03 ATEX 1016 X
2) Follow the instructions in the chapter 'Installation'

Technische Angaben
GeräteKennzeichnung nach 94/9/EG und Norm:

1) 2 G Ex de IIC T6
2) 2 G Ex ia/b IIC T6
3) 12 D Ex ID A1 IP 68 T80°C
4) Class 1, Zone 1 Ex de IIC T6
5) Class I, Div 2; Gr. A,B,C,D
6) EG-Baumusterprüfbescheinigung: PTB 03 ATEX 1016 X
7) Zulässige Umgebungs-
temperatur: -25°C/-55°C bis +40°C
8) Bemessungsspannung: bis 250 V, 50/60 Hz
9) Bemessungstrom: max. 10 A
10) Leitungseinführung ø: Standard Optional
11) Anschlussquerschnitt: 1x0,75-1,5mm²/2,5mm²
12) Prüfdrehmomente:
EN 60068-2-6 10-150 Hz: 2g / 30 min
13) Prüfdrehmomente:
Vis de serrage -ø 7,5-11mm 3,5 Nm
Vis de serrage ø 4-7,5mm 3,5 Nm
Vis d´arrêt 1,0 Nm

t) 1) die besonderen Bedingungen gemäß Prüf.MapPath
PTB 03 ATEX 1016 X sind zu beachten.
2) Die Hinweise im Kapitel „Montage“ beachten!

Sicherheitshinweise
Vor dem Öffnen der Druckschraube
am Stecker und Kupplung, ist die
Spannungsfreiheit sicherzustellen.
Die Montageanleitung darf nur
zusammen mit der ausführlichen
Betriebsanleitung „GHG5707001P0001"
(www.ceag.de erhältlich)
verwendet werden.
Die Benutzerinformationen für
„MOOG-Ventile“ sind zu beachten
Das Konfektionieren der Steck-
verbinder darf nur durch Fachkräfte
erfolgen.
Die Steckverbinder eXLink sind
def nicht für den Einsatz in der Zone 0
oder 20 geeignet. Zur Sicherstellung
des Explosionsschutzes dürfen in die
Böhrungen von druckfesten
Gehäusen nur Gerätestecker und
Flansch-steckdosen aus Metall
eingesetzt werden.
Gerätestecker und Flanschsteck-
dosen aus Metall sind durch
geeignete Maßnahmen in das
Erdpotential der Gehäuse bzw.
Geräte mit einzubeziehen.
Die unter Spannung stehenden
Steckverbinderkomponenten
müssen sofort nach dem Trennen
mit der Schutzkappe verschlossen
werden, damit die Schutzart
und damit der Explosionsschutz
sichergestellt wird.

Safety instructions
Before opening the pressure screw
on the plug and coupler, ensure that it
has been isolated from the supply.
The assembly instructions must be
used in conjunction with the detailed
operating instructions
 „GHG5707001P0001” (available from www.ceag.de).
The user information for „MOOG-
Ventile“ must to be observed
The configuration of plug and socket
systems shall only be carried out by
qualified personnel.
Plug and socket systems of the type
eXLink are not suited for use in Zone
0 or 20 areas. In order to guarantee
the explosion protection, only inlets
and flange sockets made of metal
may be fitted in the boresholes of
flammable enclosures.
The metal flange sockets and inlets
shall be incorporated in the earth
potential eyualization.
When opened, the live plug and
socket system components shall
be sealed immediately after
disconnection using the protective
cap.
Here it is necessary to ensure that it
is closed correctly, otherwise the
minimum degree of protection and
the explosion protection are no
longer guaranteed.

Instructions de sécurité
Avant de relâcher la vis de pression
sur la prise et le prolongateur,
vérifiez l’absence de tension.
Utilisez la notice de montage
uniquement en association avec les
instructions détaillées de service
“GHG5707001P0001” (disponibles
sur le site www.ceag.de ).
Les informations utilisateur pour
les „MOOG-Ventile“ doivent être
respectées
Seul un personnel qualifié est
'autorisé à effectuer le branchement
electrique des connecteurs mâles-
femelles.
Les connecteurs mâles-femelles
eXLink ne conviennent pas pour une
utilisation en zone 0 et 20. Afin de
garantir une protection
antidéflagrante, seuls des socles
connecteurs et des prises de courant,
bâtie métalliques doivent être
montés dans les évidements des
boîtiers à l’épreuve de la pression.
Les prises à bride aux métal et les
sockles connecteur aux métal
doivent être relevés au même
potentiel.
Après déconnexion, les éléments de
connexion encore sous tension
doivent immédiatement être
protégés à l’aide d’obturateurs.
# Montageanleitung / Mounting instructions / Mode d’emploi

<table>
<thead>
<tr>
<th>Kupplung</th>
<th>Coupler</th>
<th>Prolongateur</th>
</tr>
</thead>
<tbody>
<tr>
<td>(PE-Bügel, nur 4+1)</td>
<td>(PE-clamp, only with 4+1)</td>
<td>(étrier de PE, seulement 4+1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stecker</th>
<th>Plug</th>
<th>Fiche</th>
</tr>
</thead>
<tbody>
<tr>
<td>(PE-Bügel, nur 4+1)</td>
<td>(PE-clamp, only with 4+1)</td>
<td>(étrier de PE, seulement 4+1)</td>
</tr>
</tbody>
</table>

**Anschlussquerschnitt**
0,75 - 1,5mm² oder 2,5mm²

**Cross section**
0,75 - 1,5mm² or 2,5mm²

**Section de raccordement**
0,75 - 1,5mm² ou 2,5mm²

**Montageanleitung / Mounting instructions / Mode d’emploi**

**Ausführung 4-polig (3+PE)**
- ohne PE-Bügel
- mit PE-Bügel

**Version 4-pole (3+PE)**
- without PE-clamp
- with PE-clamp

**Version 4 pôles (3+PE)**
- sans l’étrier de PE

**Kupplung / Coupler / Prolongateur**

**Stecker / Plug / Fiche**

**Anschlussquerschnitt 0,75 - 1,5mm² oder 2,5mm²**

**Cross section 0.75 - 1.5mm² or 2.5mm²**

**Section de raccordement 0,75 - 1,5mm² ou 2,5mm²**

**Montageanleitung / Mounting instructions / Mode d’emploi**
Stifte / Buchsen anschließen
1. Leiter in die Anschlussöffnung der Stifte / Buchsen stecken.
2. Alle Leiter mit der Crimpzange (-→ Zubehör) ancrimpen (Fig.A).
oder
Alle Leiter mit Stiften/Buchsen verlöten und Schrumpfschlauch über jede Lötstelle ziehen.

Stecker/Kupplung montieren
- Die Isolation des Leiters muss bis an die Stifte / Buchsen heranreichen. Der Leiter darf nicht beschädigt sein.

Leiter mit Stiften / Buchsen verbinden
1. Kabel ca. 30 mm abmanteln.(Fig.1)
2. Leiter des Kabels ca. 8 mm abisolieren.

Connecting conductors to pins
- The insulation of the conductor shall reach up to the pins. The conductor must not be damaged.
1. Strip off ca. 30 mm of cable insulation.(Fig.1)
2. Strip off ca. 8 mm of insulation from cable conductors.

Crimp plugs/contacts
1. Insert conductor into the connection opening of the plug/contact pin.
2. Crimp all conductors using crimping tool (-→ Accessories) [Fig.A] or solder all conductors to plug pins/contact and pull shrink-on sleeve over each solder ring point.

Assembling plugs/coupler
- Also assemble plug/coupler pins that are not connected.
- Once they have been pressed into the plug/coupler insert, the plug pins cannot be disassembled.
1. Push pressure piece, strain relief, seal and thrust washer on to cable.
2. The plug/contact pin, Item 4, is larger in diameter. To avoid mistakes, put this into the holder first. Push all the plug pins into the hexa gonal keyways of the plug/coupler insert until they engage.
3. Push the insulating sleeve on to the plug insert.
4. Insert the plug insert with guide lug into the keyway of the plug sleeve (Fig.G).
5. Fit thrust washer, seal and strain relief.
6. Screw pressure piece tight [torque -> Technical Data]
7. Tighten locking screw (Fig. H).

Stecker/Kupplung öffnen
1. Eventuell vorhandene Schutzkappe abschrauben.
2. Arretierschraube lösen.
3. Druckstück aus Hüse herausdrehen.
4. Einsatz von vorne aus der Hüse herausdrehen.
5. Dabei Zugentlastung, Dichtung, Druckscheibe, Isolierhülse aus Hüse nach hinten heraus nehmen.
6. Farbring zur Kennzeichnung auf Hüseaufziehen.

Plug open
1. Screw down possible existing protective cap.
2. Loosen locking screw.
3. Screw out pressure piece of plug sleeve.
4. Press out from front plug insert out of plug sleeve.
5. At the same time, remove the strain relief, seal, thrust washer and insulating sleeve from the plug sleeve from the back.
6. Fit coloured ring used for marking on to6. the plug sleeve.

Ouverture de la fiche
1. Dévisser le capuchon (si monté) de la fiche.
2. Dévisser la vis d’arrêt.
3. Sortir en tournant la pièce de pression de la douille de fiche.
4. Extraire par l’avant le bloc de fiche de la douille de fiche.
5. Retirer pendant cette opération par l’arrière la décharge de tension, le joint, la rondelle de pression, la douille isolante de la douille de fiche.

Raccordement des conducteurs aux contacts mâles/ femelles
- L’isolation du conducteur doit arriver jusqu’aux contacts . Le conducteur ne doit pas être endommagé.
1. Dénuder le câble sur env. 30 mm.(Fig.1)
2. Dénuder les conducteurs du câble sur env. 8 mm.

Présertir Fiche/Prolongateur
1. Enficher le conducteur dans l’ouverture du contact mâle/femelle.
2. Pré-sertir tous les conducteurs avec la pince à sertir (-→ accessoire) (Fig.A), ou braser tous les conducteurs avec les contacts mâles/femelles et enfiler la gaine thermorétractable sur chaque brasure.

Montage de la fiche/du prolongateur
- Monter aussi les contacts mâles/femelles non raccordés.
- Les contacts mâles/femelles ne peuvent plus être démontés après avoir été pressés dans le bloc de fiche.
1. Monter la pièce de pression, la décharge de tension.
2. Le contact mâle/femelle de la position 4 a un plus gros diamètre. Pour éviter toute confusion, enficher celui-ci en premier dans son support. Enfoncer tous les contacts mâles/femelles jusqu’à l’enclenchement dans le guidage hexagonal du bloc de fiche.
3. Monter la douille isolante sur le bloc de fiche.
4. Engager le bloc de fiche avec l’ergot de guidage dans la rainure de guidage de la douille de fiche (Fig.G).
5. Monter la rondelle de pression, le joint, la décharge de tension.
6. Visser la pièce de pression (couple -> Caractéristiques techniques).
7. Visser la vis d’arrêt (Fig. H).
Manoeuvre
A/A1 Introduisez la fiche en positionnant correctement l’ergot de guidage dans la rainure de guidage correspondante du prolongateur jusqu’à la 1ère butée (B).
B 1 Ensuite, tournez la fiche d’environ 30° vers la droite jusqu’en butée de limitation.
C Assemblez la fiche et le prolongateur jusqu’en butée.
D Vissez à fond la collerette de fixation sur le connecteur enfiché.

Handling
A/A1 Insert the plug into the coupler until they reach the 1st stop. Ensure that the position of the key on the plug corresponds to that of the keyway on the coupler (B).
B 1 Then turn the plug to the right through ca. 30° until it reaches the stop.
C Insert plug into coupler until it reaches the final stop.
D Tighten the coupling nut on the connected plug and socket.

Handhabung
A/A1 Den Stecker mit der Führungsnase lagerichtig in die entsprechende Führungsnut der Kupplung bis zum 1. Anschlag einstecken (B).
B 1 Danach den Stecker um ca. 30° nach rechts bis zum Begrenzungsanschlag drehen.
C Stecker bis zum Endanschlag mit der Kupplung zusammenstecken.
D Überwurfmutter „handfest“ an der gesteckten Steckverbindung.
Conformity with standards

The plug and socket system is conform to the standards specified in the EC-Declaration of conformity and additional conform to the comparable IEC Standards IEC 60079-0, IEC 60079-1, IEC 60079-7, IEC 61241-0, IEC 61241-1.

CAN/CSA C22.2 E60079-0-02
CAN/CSA C22.2 E60079-1-02
CAN/CSA C22.2 E60079-7-2003
CAN/CSA C22.2 No 213
CAN/CSA C22.2 No 182.3 M1987
CAN/CSA C22.2 No 94.1-07
94/9 EC: Equipment and protective systems intended for use in potentially explosive atmospheres. It has been designed, manufactured and tested according to the state of the art and to DIN EN ISO 9001.
Wir / we / nous

erklären in alleiniger Verantwortung, dass die 
hereby declare in our sole responsibility, that the 
déclarnons de notre seule responsabilité, que le 

II 2 G Ex de IIC T6 // II 2 G Ex ia IIB IIC T6 
II 2 D Ex tD A21 IP66 T80°C 

auf die sich diese Erklärung bezieht, mit den folgenden Normen oder normativen Dokumenten übereinstimmen. 
which are the subject of this declaration, are in conformity with the following standards or normative documents. 
au qu elle cette déclaration se rapporte, est conforme aux normes ou aux documents normatifs suivants.

Bestimmungen der Richtlinie 
Terms of the directive 
Prescription de la directive

94/9/EG: Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen. 
94/9/EC: Equipment and protective systems intended for use in potentially explosive atmospheres.
94/9/CE: Appareils et systèmes de protection destinés à être utilisés en atmosphère explosibles.

2004/108 EG: Elektromagnetische Verträglichkeit 
2004/108 EC: Electromagnetic compatibility 
2004/108 CE: Compatibilité électromagnétique 

Eberbach, den 04.07.2008

I. R. Brandel
Leiter Labor
Head of Laboratory
Chef du dép. Laboratoire

I. V. H. Huter
Leiter Approbation
Head of Approval office 
Chef du dép. approbation

PTB 96 ATEX Q 1 - 4

Zertifizierungsstelle 
Notified Body of the certification 
Organes Notifié et Compétent

Physikalisch-Technische Bundesanstalt (0102) 
Bundesallee 100 
D-38116 Braunschweig

Konformitätsbewertungsstelle 
Notified Body to quality evaluation 
Organes d'attestation de conformité

Physikalisch-Technische Bundesanstalt (0102) 
Bundesallee 100 
D-38116 Braunschweig

Für den sicheren Betrieb des Betriebsmittels sind die Angaben der zugehörigen Betriebsanleitung zu beachten. 
For the safe use of this apparatus, the informations given in the accompanying operating instructions must be followed. 
Afin d’assurer le bon fonctionnement de nos appareils, prière de respecter les directives du mode d’emploi correspondant à ceux-ci.
eXLink 4-polig Gerätestecker, Flanschsteckdose/
4-pole Inlet, Flange/
4 la prise et le prolongateur

Technische Angaben

Gerätezeichnung nach 94/9/EG:
- II 2G Ex de IIC T6/
- II 2G Ex ia/ib IIC T6
- II 2D tD A21 IP66 T80°C

Prüfzeichen nach CSA:
Class I, Zone 1 Ex 1T6
Class I, Div 2; Gr. A,B,C,D

Zulässige Umgebungs-temperatur:
-25°C/-55°C bis +40°C

EG-Baumusterprüfung:
PTB 03 ATEX 1016 X

Bemessungsspannung:
250 V, 50/60 Hz

Bemessungstrom:
max. 10 A

Anschlussquerchnitt:
AWG 22, AWG 26

Anschlussleitung:
AWG 22/26 Metrofunk

Vibrationsfestigkeit nach EN 60068-2-6 10-150 Hz:
2g / 30 min

Prüfdruckmomente:
Antrieberabnahme: 1,0 Nm
Einbauabgewinde Steckdose, Gerätestecker: 30 Nm
Überwurfmutter: 2,5 Nm (handfest)

1) die besonderen Bedingungen gemäß Prüfschein PTB 03 ATEX 1016 X sind zu beachten.
2) Die Hinweise im Kapitel „Montage“ beachten!

Sicherheitshinweise

Vor dem Öffnen der Druckschraube am Stecker und Kupplung, ist die Spannungsfreiheit sicherzustellen.
Die Montageanleitung darf nur zusammen mit der ausführlichen Betriebsanleitung „GHG5707001P0001“ (unter www.ceag.de erhältlich) verwendet werden.
Das Konfektionieren der Steckverbinder darf nur durch Fachkräfte erfolgen.
Die Gewindebohrungen im druckfeste Gehäuse nur Gerätestecker- und Flanschsteckdosen aus Metall eingesetzt werden.
Steckverbindung nur in technisch einwandfreiem Zustand sowie bestimmungsmäßiger, sicherheits- und gefahrenbewusster Beachtung dieser Montage- und Betriebsanleitung montieren und betreiben.
Die unter Spannung stehenden Steckverbindungskomponenten müssen sofort nach dem Trennen mit der Schutzkappe verschlossen werden, damit die Schutzart und damit der Explosionsenschutz sichergestellt wird.

Technical Data

Apparatus marking acc. to 94/9/EC:
- II 2G Ex de IIC T6/
- II 2G Ex ia/ib IIC T6
- II 2D tD A21 IP66 T80°C

acc. CSA:
Class I, Zone 1 Ex 1T6
Class I, Div 2; Gr. A,B,C,D

Permissable ambient temperature:
-25°C/-55°C to +40°C

EC type examination certificate:
PTB 03 ATEX 1016 X

Rated voltage:
up to 250 V, 50/60 Hz

Rated current:
max. 10 A

Terminal cross section:
AWG 22, AWG 26

Cable:
AWG 22/26 Metrofunk

Vibration resistance acc. EN 60068-2-6 10-150 Hz:
2g / 30 min

Test torques:
Locking screw: 1,0 Nm
Screw-in thread -flange socket, inlet:
30 Nm
Coupling nut: 2,5 Nm (by hand)

1) observe special requirements accd. certification PTB 03 ATEX 1016 X.
2) Follow the instructions in the chapter „Installation“.

Safety instructions

Before opening the pressure screw on the plug and coupler, ensure that it has been isolated from the supply.
The assembly instructions must be used in conjunction with the detailed operating instructions “GHG5707001P0001” (available from www.ceag.de).
The user information for „MOOG-Ventile“ must to observed. (www.Moog.com/industrial).
The connection of plug and socket systems shall only be carried out by qualified personnel.
The threaded holes in the flameproof enclosure shall fulfill the minimum requirements of EN 60079-1.
Plug and socket systems of the type eXLink are not suited for use in zone 0 or 20 areas.
In order to guarantee the explosion protection, only inlets and flange sockets made of metal may be fitted in the boreholes of flameproof enclosures.
The metal flang sockets and inlets shall be incorporated in the earth potential equalization.
They shall be used for their intended purpose and shall be in an undamaged and perfect state.
When opened, the live plug and socket system components shall be sealed immediately after disconnection using the protective cap.
Here it is necessary to ensure that it is closed correctly, otherwise the minimum degree of protection and the explosion protection are no longer guaranteed.

Instructions de sécurité

Avant de relâcher la vis de pression sur la prise et le prolongateur, vérifiez l’absence de tension.
Utilisez la notice de montage uniquement en association avec les instructions détaillées de service “GHG5707001P0001” (disponibles sur le site www.ceag.de).
Seul un personnel qualifié est autorisé à effectuer le branchement électrique des connecteurs mâles-femelles.
Les alésages filetés du boîtier de protection ou appareil à encastrer résistant à la pression doivent satisfaire aux exigences minima de la norme EN 60079-1.
Les connecteurs mâles-femelles eXLink ne conviennent pas pour une utilisation en zone 0 et 20.
Afin de garantir une protection antidéflagrante, seuls des socles connecteurs et des prises de courant à bride métalliques doivent être montés dans les évidements des boîtiers à l’épreuve de la pression.
Les prises à bride aux métal et les socle connecteur aux métal doivent être reliés au même potentiel.
N’utilisez les prises de courant à bride et socles connecteurs qu’avec les fiches et prolongateurs correspondants et en parfait état.
Après déconnexion, les éléments de connexion encore sous tension doivent immédiatement être protégés à l’aide d’obturateurs.

Caractéristiques techniques

Marquage de l’appareil selon 94/9/CE:
- II 2G Ex de IIC T6/
- II 2G Ex ia/ib IIC T6
- II 2D tD A21 IP66 T80°C

En fonction de CSA:
Class I, Zone 1 Ex 1T6
Class I, Div 2; Gr. A,B,C,D

Température ambiante admissible:
-25°C/-55°C à +40°C

Attestation d’examen CE:
PTB 03 ATEX 1016 X

Tension nominale:
jusqu’à 250 V, 50/60 Hz

Courant nominal:
max. 10 A

Section raccordement:
AWG 22; AWG 26

Câble:
AWG 22/26 Metrofunk

Résistance aux vibrations selon EN 60068-2-6 10-150 Hz:
2g / 30 min

Couples de serrage testés:
Vis d’arrêt: 1,0 Nm
Filets de vis de prise à prouve, connecteur: 30 Nm
Ecrou (lien serré à la main): 2,5 Nm
Handhabung

A/A1  Den Stecker mit der Führungs-
   nase lagerichtig in die entsprechende
   Führungsnut der Kupplung bis zum 1.
   Anschlag einstecken (B).
B1  Danach den Stecker um ca. 30° nach
    rechts bis zum Begrenzungsanschlag
drehen.
C  Stecker bis zum Endanschlag mit der
    Kupplung zusammenstecken.
D  Die Überwurfmutter des Steckers über
    die Kupplung schieben und handfest
    festschrauben.

Handling

A/A1  Insert the plug into the coupler
   until they reach the 1st stop. Ensure
   that the position of the key on the
   plug corresponds to that of the
   keyway on the coupler (B).
B1  Then turn the plug to the right
    through ca. 30° until it reaches the
    stop.
C  Insert plug into coupler until it reaches
    the final stop.
D  Slide the coupling nut of the plug over
    the coupler and tighten well by hand

Manoeuvre

A/A1  Introduisez la fiche en
positionnant correctement l’ergot de
guidage dans la rainure de guidage
correspondante du prolongateur
jusqu’à la 1ère butée (B).
B1  Ensuite, tournez la fiche d’environ 30°
vers la droite jusqu’en butée de
limitation.
C  Assemblez la fiche et le prolongateur
jusqu’en butée.
D  Enfiler l’écrou de la prise sur le
prolongateur et bien serrer à la main.
Montage / Mounting / Montage

Gerätestecker mit Anschlussleitung
Inlet with connection leads
Socle connecteur avec lignes de raccordement

Flanschsteckdose mit Anschlussleitung
Flange socket with connection leads
Prise à bride avec lignes de raccordement

Flanschsteckdosen, oder Gerätestecker müssen durch geeignete Maßnahmen (z.B. Einkleben, Kontern (Prüfdrehmoment 30 Nm) oder Arretieren mit einem Verdrehungsschutz gegen Verdrehen oder Selbstlockern) gesichert werden.

Suitable measures shall be applied (e.g. adhesive, locking (Test torques 30 Nm) and retaining with anti-torsion protection) to safeguard screwed-in flange sockets, inlets or angle pieces against twisting or self-loosening.

Une fois vissés, les prises à brides ou socles connecteurs doivent être bloqués par un moyen approprié (par ex. collage, contre-écrou (Couples de serrage testés 30 Nm) et blocage par protection anti-torsion) pour les empêcher de tourner ou de se dévisser.

Das Gehäusevolumen bei der Auswahl des Gerätesteckers berücksichtigen.

Observe the flameproof enclosure volume when flange-socket selecting.

Observez le volume de l’enceinte antidéflagrante lors socle connecteur avec sélection.

Verdrehungsschutz - optional
Anti-torsion protection - optionally
Protection anti-torsion - facultativement
Conformity with standards

The plug and socket system is conform to the standards specified in the EC-Declaration of conformity and additional conform to the comparable IEC Standards IEC 60079-0, IEC 60079-1, IEC 60079-7, IEC 61241-0, IEC 61241-1, CAN/CSA C22.2 E60079-0-02 CAN/CSA C22.2 E60079-1-02 CAN/CSA C22.2 E60079-7-2003 CAN/CSA C22.2 No 213 CAN/CSA C22.2 No 182.3 M1987 CAN/CSA C22.2 No 94.1-07 94/9 EG: Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen. It has been designed, manufactured and tested according to the state of the art and to DIN EN ISO 9001.

Conformité avec les normes

**Technische Angaben**

GeräteKennzeichnung:

 nach 04/08: EG II 2 G Ex iaIIC T6

 nach CSA:

Class I, Zone 1 Ex de IIC T6

Class I, Div 2; Gr. A, B, C, D

EG-Baumusterprüf-

bescheinigung: PTB 06 ATEX 1031 X

Zulässige Umgebungs-

temperaturen:

-25°C to 55°C bis 40°C

Bemessungsspannung:

bis 400 V, 50/60 Hz

Bemessungsstrom:

max. 16 A

Stecker, Kupplung:

ø7-11mm ø11-15mm

Anschlusseitung:

LEONI 7x0,75mm², MUD

Anschlusquerschnitt:

1x0,75-1,5mm²

2,5mm²

Vibrationsfrequenz:

EN 60068-2-6 10-150 Hz: 2g / 30 min²

Prüfnormen:

Metal

Anreißsicherheit:

1,0 Nm

Einschraubgewinde Steck-

dose, Gerätestecker

3,5 Nm

Druckschraube:

3,5 Nm

Druckschraube:

3,5 Nm

**Technical Data**

Apparatus marking:

acc. to 04/08: EG

II 2 G Ex iaIIC T6

II 2 G Ex iaIib IIC T6

acc. CSA

Class I, Zone 1 Ex de IIC T6

Class I, Div 2; Gr. A, B, C, D

EC type examination certificate:

PTB 06 ATEX 1031 X

Permissible ambient temperature:

-25°C to 55°C to +40°C

Rated voltage:

up to 400 V, 50/60 Hz

Rated current:

max. 16 A

Cable entry:

Plug, coupler

ø7-11mm ø11-15mm

Cable:

LEONI 7x0,75mm², MUD

Terminal cross section:

1x0,75-1,5mm²

2,5mm²

Vibration resistance acc.

EN 60068-2-6 10-150 Hz: 2g / 30 min²

Test torques:

1,0 Nm

Locking screw

1,0 Nm

Screw-in thread - flange

socket, inlet

3,5 Nm

Pressure screw

3,5 Nm

Pressure screw

3,5 Nm

**Caractéristiques techniques**

Marquage de l’appareil

selon 04/08: CE

II 2 G Ex iaIIC T6

II 2 G Ex iaIib IIC T6

en fonction de CSA

Class I, Zone 1 Ex de IIC T6

Class I, Div 2; Gr. A, B, C, D

Attestation d’examen CE:

du type:

PTB 06 ATEX 1031 X

Température ambiante admissible:

-25°C to 55°C to +40°C

Tension nominale:

jusqu’à 400 V, 50/60 Hz

Courant nominal:

max. 16 A

Entrée de câble:

Standard Optional

Fiche, Prolongateur:

ø7-11mm ø11-15mm

Cable:

LEONI 7x0,75mm², MUD

Section raccordement:

1x0,75-1,5mm²

2,5mm²

Résistance aux vibrations selon

EN 60068-2-6 10-150 Hz: 2g / 30 min²

Coupled of serrage testés:

Vis d’arrêt

1,0 Nm

Filets de vis de prise à

pride, connecteur

3,5 Nm

Vis de serrage

3,5 Nm

Vis de serrage

3,5 Nm

1) die besonderen Bedingungen gemäß Prüfschein PTB 03 ATEX 1016 X sind zu beachten.

2) Die Hinweise im Kapitel „Montage“ beachten!

**Sicherheitshinweise**


Die auf den Geräten angegebene Temperaturklasse und Zündschutzart ist zu beachten. Die Steckverbindung ist nicht für den Einsatz im explosionsgefährdeten Bereich der Zone 0 und Zone 20, 21, 22 gemäß EN 60079-10 geeignet. Die Steckverbindung unter Last nur mit den Werten der technischen Daten betreiben. Trennen unter Belastung maximal bis 230 V / 400 V, 10 A möglich. Steckverbindung nur in technisch einwandfreiem Zustand sowie bestimmungs-

gemäß, sicherheits- und gefahrenbewusst unter Beachtung dieser Montage- und Betriebsanleitung montieren und betreiben.

Beachten Sie die nationalen Sicherheits-

und Unfallverhütungsvorschriften und die nachfolgenden Sicherheitshinweise in dieser Betriebsanleitung, die wie dieser Text in Kursivschrift gesetzt sind!

**Safety instructions**

Operations shall be carried out by electricians and suitably personnel trained in hazardous area with knowledge of increased safety explosion protection in accordance with IEC 60079-14.

The assembly instructions must be used in conjunction with the detailed operating instructions "GHG5707005P0001" (available from www.ceag.de).

The user information for "MOOG-Ventile" must be observed (www.Moog.com/industrial).

The temperature class and explosion group marked on the terminal boxes have to be observed.

The plug and socket system is not suitable for Zone 0 and Zone 20, 21, 22 hazardous areas according to IEC 60079-10.

The plug and socket system may only be connected or disconnected under load acc. to technical data. (230 V / 400 V max. 10 A)

These assembly and operating instructions shall be observed when installing and operating the plug and socket connector system. It shall only be used in a technically perfect state and in accordance with the intended purpose while paying attention to the particular safety and hazard aspects.

The national safety rules and regulations for the prevention of accidents, as well as the safety instructions included in these operating instructions, that, like this text, are set in italics, shall be observed!

1) Respecter les précautions particulières selon l’attestation d’examen CE de type PTB 03 ATEX 1016 X

2) Suivre les instructions du chapitre ‘Montage’!

**Consignes de sécurité**

Ce mode d’emploi s’adresse aux électриciens et personnes initiées sur base de la norme CEI 60079-14. Utilisez la notice de montage uniquement en association avec les instructions détaillées de service “GHG5707005P0001” (disponibles sur le site www.ceag.de ).


Le groupe d’explosion et la classe de température marqués sur les appareils devront être respectés.

Le connecteur n’est pas conçu pour être utilisé dans les atmosphères explosives des zones 0 et 20, 21, 22 conformément à CEI 60079-10.

 Respecter impérativement les valeurs indiquées dans les caractéristiques techniques pour les connecteurs sous charge. Ne séparer qu’à 230 V / 400 V 10 A.

Monter et utiliser le connecteur seulement s’il présente un état technique parfait, conformément à sa destination, en étant conscient des risques et des mesures de sécurité à appliquer dans le respect d’es présentes instructions de montage et de service.

Tenir compte des prescriptions nationales en matière de sécurité et de prévention des accidents ainsi que des consignes de sécurité indiquées dans ce mode d’emploi, écrites en italiques comme ce texte !
Verwendung/Eigenschaften

Die auf den Steckverbindern angegebene Temperaturklasse und Zündschutzart beachten.

Steckverbindung unter Last nur mit den Werten der Technischen Daten betreiben und trennen.


COOPER Crouse-Hinds übernimmt keine Haftung für Schäden, die aus nicht bestimmungsgemäßer Verwendung entstehen.

Use / Properties

The temperature class and type of protection stated on the apparatus shall be observed.

The plug and socket system may only be operated and disconnected under load acc. to the technical data.

The sole responsibility with respect to the suitability and proper use of the plug and socket systems with regard to the basic requirements of these instructions (see Technical Data) lies with the operator.

Plug and socket systems shall be checked in accordance with Section 6 of the named instructions, before being put into use. Modifications or changes to the design of the plug and socket systems are not permitted. Applications other than described are not permitted without COOPER CROUSE-HINDS’s prior written consent.

CCH takes no responsibility for damages caused by incorrect use.

Connection/disconnection of plug and socket

1. Der Winkel zwischen Führungsnahe und PE Stift (mit größerem Durchmesser) ergibt die Uhrzeit. (Fig. A)

2. Bis zum 1. Anschlag zusammenstecken. (Fig. C)
3. Stecker bzw. Gerätestecker gegen Kupplung bzw. Flanschsteckdose ca. 30° gegeneinander bis zum Anschlag verdrehen. (Fig. D)

5. Überwurfmutter des Steckers andrücken und festschrauben.

Disconnecting plug and socket

1. To disconnect plug and socket, carry out the above actions in the reverse order.

When opened, the live plug and socket system components shall be sealed immediately after disconnection using the protective cap.

Utilisation / Propriétés

Observez la classe de température et le type de protection indiquées sur les appareils.

Respecter impérativement les valeurs indiquées dans les caractéristiques techniques lors de l’utilisation et du débranchement du connecteur.

En cas d’utilisation non conforme de ce dispositif de connexion, par référence aux conditions de base du présent mode d’emploi (caractéristiques techniques), l’exploitant en supporterait seul la responsabilité.

Contrôler le connecteur avant la mise en service conformément aux instructions mentionnées dans la section 6.

Ne pas modifier ou transformer le connecteur.

Utiliser exclusivement des pièces d’origine du fabriquant pour les remplacements et réparations.

Toute autre utilisation s’avère non conforme.

COOPER Crouse Hinds décline toute responsabilité pour des dommages.

Branchement/Débranchement du connecteur

1. Engager dans la bonne position la fiche/le socle connecteur avec l’ergot de guidage dans la rainure de guidage correspondante du prolongateur/de la prise de courant à bride. (Fig. B)
2. Brancher les deux éléments jusqu’à la butée. (Fig. C)
3. Tourner dans des sens contraires, d’env. 30°, la fiche/le socle connecteur et le prolongateur/de la prise de courant à bride jusqu’en butée. (Fig. D)
4. Le connecteur mâle-femelle boucher tout à fait. (Fig. E)

Le branchement électrique du système de connexion est maintenant réalisé.

5. Appuyer l’écrou-raccord de la fiche et le visser.

Le vissage de l’écrou-raccord a pour effet d'établir la protection IP et la liaison mécanique. (Fig. F)

Débranchement du connecteur

1. Débrancher le connecteur dans l’ordre inverse du branchement.

Les éléments de connexion conducteurs de tension à l’état ouvert doivent être fermés avec le capuchon dès le débranchement.
Stecker/Kupplung öffnen

1. Eventuell vorhandene Schutzkappe abschrauben.
2. Arretierschraube (1) lösen.
3. Druckstück (2) aus Hülse (9) herausdrehen.
4. Einsatz (8) von vorne aus der Hülse (9) herausdrücken.
5. Dabei Zugentlastung (3), Dichtung (4), Druckscheibe (5) und Isolierhülse (6) aus Hülse (9) nach hinten heraus nehmen.
6. Farbring zur Kennzeichnung auf Hülse (9) aufziehen.

Plug open (Fig. 7.1)

1. Screw down possible existing protective cap.
2. Loosen locking screw (1).
3. Screw out pressure piece (2) of plug sleeve (9).
4. Press out from front plug insert (8) out of plug sleeve (9).
5. At the same time, remove the strain relief (3), seal (4), thrust washer (5) and insulating sleeve (6) from the plug sleeve (9) from the back.
6. Fit coloured ring used for marking on to the plug sleeve (9).

Ouverture de la fiche

1. Dévisser le capuchon (si monté) de la fiche.
2. Dévisser la vis d’arrêt (1).
3. Sortir en la tournant la pièce de pression (2) de la douille de fiche (9).
4. Extraire par l’avant le bloc de fiche (8) de la douille de fiche (9).
5. Retirer pendant cette opération par l’arrière la décharge de tension (3), le joint (4), la rondelle de pression (5), la douille isolante (6) de la douille de fiche (9).
6. Monter la bague en couleur comme repère sur la douille de fiche (9).
Leiter mit Stiften / Buchsen verbinden

⚠ Die Isolation des Leiters muss bis an die Stifte / Buchsen heranreichen. Der Leiter und die Isolation dürfen nicht beschädigt sein.

1. Kabel ca. 30 mm abmanteln.(Fig.1)
2. Leiter des Kabels ca. 8 mm abisolieren.

Stifte / Buchsen anschließen

1. Leiter in die Anschlussöffnung der Stifte / Buchsen (7) stecken.
2. Alle Leiter mit der Crimpzange (→ Zubehör) ancrimpen (Fig.2).
oder
Alle Leiter mit Stiften/Buchsen verlöten und Schrumpfschlauch über jede Lötstelle ziehen.

Stecker/Kupplung montieren

⚠ Auch Stifte/Buchsen montieren, die nicht angeschlossen sind.

⚠ Die Stifte/Buchsen sind nach dem Eindrücken in den Einsatz nicht mehr demontierbar.

Connecting conductors to pins

⚠ The insulation of the conductor shall reach up to the pins. The conductor and the isolation must not be damaged.

1. Strip off ca. 30 mm of cable insulation.(Fig.1)
2. Strip off ca. 8 mm of insulation from cable conductors.

Crimp plugs/contacts

1. Insert conductor into the connection opening of the plug/contact pin (7).
2. Crimp on all conductors using crimping tool (→ Accessories) [Fig.2] or solder all conductors to plug pins/contact and pull shrink-on sleeve over each solder ring point.

Assembling plugs/coupler

⚠ Also assemble plug/coupler pins that are not connected.

⚠ Once they have been pressed into the plug/coupler insert, the plug pins cannot be disassembled.

Raccordement des conducteurs aux contacts mâles/femelles

⚠ L'isolation du conducteur doit arriver jusqu'aux contacts. Le conducteur et l'isolation ne doit pas être endommagé.

1. Dénuder le câble sur env. 30 mm.(Fig.1)
2. Dénuder les conducteurs du câble sur env. 8 mm.

Présérer Fiche/Prolongateur

1. Enfiler le conducteur dans l’ouverture du contact mâle/femelle (7).
2. Pré-sérer tous les conducteurs avec la pince à sertir (→ accessoire) (Fig.2). ou braser tous les conducteurs avec les contacts mâles/femelles et enfiler la gaine thermorétractable sur chaque brasure.

Montage de la fiche/du prolongateur

⚠ Monter aussi les contacts mâles/femelles non raccordés.

⚠ Les contacts mâles/femelles ne peuvent plus être démontés après avoir été pressés dans le bloc de fiche.
1. Druckstück (2), Zugentlastung (3), Dichtung (4) und Druckscheibe (5) auf Kabel aufschieben.
2. Der Stift/die Buchse der Position 7 hat einen größeren Durchmesser. Diesen zuerst in seine Halterung stecken. Alle Stifte / Buchsen (7) bis zum hörbaren Einrasten in die Sechskantführung des Einsatzes (8) drücken (Fig.3).
3. Isolierhülse (6) auseinander ziehen und um die Leiter bis zum Einrasten wieder zusammendrücken (Fig.3).
4. Isolierhülse (6) auf Einsatz (8) schieben.
5. Einsatz (8) mit Führungsnase in die Führungs-nut der Hülse (10) stecken (Fig.4).
7. Druckstück (2) festschrauben (Drehmoment -> Technische Daten).
8. Arretierschraube (1) festschrauben.

**Normenkonformität**

Das Steckverbindungssystem entspricht den in der Konformitäts-erklärung aufgeführten Normen und den vergleichbaren IEC Standards
IEC 60079-0, IEC 60079-1, IEC 60079-7, IEC 61241-0, IEC 61241-1.
CAN/CSA C22.2 E60079-0-02
CAN/CSA C22.2 E60079-1-02
CAN/CSA C22.2 E60079-7-2003
CAN/CSA C22.2 No 213
CAN/CSA C22.2 No 182.3 M1987
CAN/CSA C22.2 No 94.1-07

94/9 EG: Geräte und Schutzsysteme zur bestimmungs-gemäßen Verwendung in explosionsgefährdeten Bereichen.
Das Steckverbindungssystem ist gemäß DIN EN ISO 9001 entwickelt, gefertigt und geprüft worden.

**Conformity with standards**

The plug and socket system is conform to the standards specified in the EC-Declaration of conformity and additional conform to the comparable IEC Standards
IEC 60079-0, IEC 60079-1, IEC 60079-7, IEC 61241-0, IEC 61241-1.
CAN/CSA C22.2 E60079-0-02
CAN/CSA C22.2 E60079-1-02
CAN/CSA C22.2 E60079-7-2003
CAN/CSA C22.2 No 213
CAN/CSA C22.2 No 182.3 M1987
CAN/CSA C22.2 No 94.1-07

94/9 EC: Equipment and protective systems intended for use in potentially explosive atmospheres. It has been designed, manufactured and tested according to the state of the art and to DIN EN ISO 9001.

**Conformité avec les normes**

Les boîtes à bornes sont conformes aux normes reprises dans la déclaration de conformité et supplémentaires conformes à la comparables aux IEC Standards
IEC 60079-0, IEC 60079-1, IEC 60079-7, IEC 61241-0, IEC 61241-1.
CAN/CSA C22.2 E60079-0-02
CAN/CSA C22.2 E60079-1-02
CAN/CSA C22.2 E60079-7-2003
CAN/CSA C22.2 No 213
CAN/CSA C22.2 No 182.3 M1987
CAN/CSA C22.2 No 94.1-07

94/9 CE: Appareils et systèmes de protection destinés à être utilisés en atmosphère explosive. Les boîtes à bornes ont été conçues, fabriquées et contrôlées suivant DIN EN ISO 9001.
Wir / we / nous erklären in alleiniger Verantwortung, dass die Mehrfachsteckverbindung eXLink 6-/7-polig auf die sich diese Erklärung bezieht, mit den folgenden Normen oder normativen Dokumenten übereinstimmen.

Bestimmungen der Richtlinie Terms of the directive

94/9/EG: Geräte und Schutzsysteme zur bestimmungs-gemäßen Verwendung in explosionsgefährdeten Bereichen. EN 60 079-0: 2004
94/9/EC: Equipment and protective systems intended for use in potentially explosive atmospheres. EN 60 079-1: 2004
94/9/CE: Appareils et systèmes de protection destinés à être utilisés en atmosphère explosibles. EN 60 079-7: 2004

2004/108 EC: Electromagnetic compatibility
2004/108 CE: Compatibilité électromagnétique

Für den Sicheren Betrieb des Betriebsmittels sind die Angaben der zugehörigen Betriebsanleitung zu beachten. For the safe use of this apparatus, the informations given in the accompanying operating instructions must be followed.

Afin d’assurer le bon fonctionnement de nos appareils, priére de respecter les directives du mode d’emploi correspondant à ceux-ci.
**Sicherheitshinweise**


Das Konfektionieren der Steckverbinder darf nur durch Fachkräfte erfolgen. Die auf den Geräten angegebene Temperaturklasse und Zündschutzart ist zu beachten.

Die Steckverbindung ist nicht für den Einsatz im explosionsgefährdeten Bereich der Zone 0 und Zone 20, 21, 22 gemäß EN60079-10 geeignet. Steckverbinder unter Last nur mit den Werten der Technischen Daten betreiben. Trennen unter Belastung maximal bis 230 V / 400 V , 10 A möglich.


**Technische Angaben**

Gerätenennzeichnung
- nach 94/9/EG: II 2G Ex de IIC T6/ I 2G Ex ia/ib IIC T6
- nach CSA: Class I, Zone 1 Ex de IIC T6 Class I, Zone 1 Ex ia/ib IIC T6

EG-Baumusterprüf-bescheinigung: PTB 06 ATEX 1031 X

Zulässige Umgebungs-temperatur: -25°C/-55°C bis +40°C

Bemessungsspannung: bis 400 V, 50/60 Hz

Bemessungstrom: max. 16 A

Anschlussteilung: AWG22 Metalfunken

EG-Baumusterprüfbescheinigung: AWG22, AWG26

Prüfdrehmomente:
- Antriebsdrehradius: 1,0 Nm
- Einschraubgewinde Steckdose, Gerätestecker: 30 Nm
- Überwurfmutter: 2,5 Nm (handfest)

1) die besonderen Bedingungen gemäß Prüfschein PTB 03 ATEX 1016 X sind zu beachten.

2) Die Hinweise im Kapitel „Montage“ beachten!

**Technische Daten**

Apparatus marking
- acc. 94/9/EC: II 2G Ex de IIC T6/ I 2G Ex ia/ib IIC T6
- acc. CSA: Class I, Zone 1 Ex de IIC T6 Class I, Zone 1 Ex ia/ib IIC T6

EC type examination certificate:
- PTB 06 ATEX 1031 X

Terminals:
- EN 60085-2-6: 10-150 Hz: 2g / 30 min²

Test torques
- Locking screw: 1.0 Nm
- Screw-in thread - flange: 30 Nm
- Coupling nut: 2.5 Nm (by hand)

1) observe special requirements accd. certification PTB 03 ATEX 1016 X.

2) Follow the instructions in the chapter “Installation”.

**Safety instructions**

Operations shall be carried out by electricians and suitably personnel trained in an area of hazardous work with knowledge of increased safety explosion protection in accordance with IEC 60079-14. The assembly instructions must be used in conjunction with the detailed operating instructions “GHG5707005P0011” (available from www.ceag.de).

The user information for „MOOG-Ventile“ must be observed.

The connection of plug and socket systems shall only be carried out by qualified personnel. The temperature class and explosion group marked on the terminal boxes have to be observed.

The plug and socket system is not suitable for Zone 0 and Zone 20, 21, 22 hazardous areas according with EN 60079-10. The plug and socket system may only be connected or disconnected under load acc. to technical data. (230 V / 400 V max. 10 A). The metal flange sockets and inlets shall be incorporated in the earth potential.

These assembly and operating instructions shall be observed when installing and operating the plug and socket connector system. It shall only be used in a technically perfect state and in accordance with the intended purpose while paying attention to the particular safety and hazard aspects.

The national safety rules and regulations for the prevention of accidents, as well as the safety instructions included in these operating instructions, that, like this text, are set in italics, shall be observed!

Here it is necessary to ensure that it is closed correctly, otherwise the minimum degree of protection and the explosion protection are no longer guaranteed.

**Caractéristiques techniques**

Marquage de l'appareil
- selon 94/9/CE: II 2G Ex de IIC T6/ I 2G Ex ia/ib IIC T6
- en fonction de CSA: Class I, Zone 1 Ex de IIC T6 Class I, Zone 1 Ex ia/ib IIC T6

Assiette d’examen CE
- PTB 06 ATEX 1031 X

Température ambiante admissible: -25°C/-55°C à +40°C

Tension nominale: jusqu’à 400 V, 50/60 Hz

Courant nominal: max. 16 A

Cable:
- AWG22 Metrofunk
- AWG26 Metrofunk

Section raccordement: AWG22, AWG26

Résistance aux vibrations selon
- EN 60085-2-6: 10-150 Hz: 2g / 30 min²

Couples de serrage testés
- Vis d’arrêt: 1,0 Nm
- Fils de vis de prise à pride, connecteur: 30 Nm

Ecrou(Bien serrer à la main): 2,5 Nm

1) Respecter les précautions particulières selon l'attestation d'examen CE de type PTB 03 ATEX 1016 X

2) Suivre les instructions du chapitre “Installation”.

**Consignes de sécurité**

Ce mode d’emploi s’adresse aux électriciens et personnes initiées base de la norme CEI60079-14. Utilisez la notice de montage uniquement en association avec les instructions détaillées de service “GHG5707005P0011” (disponibles sur le site www.ceag.de ).

Les informations utilisator pour les „MOOG-Ventile“ doivent être respectées.

Seul un personnel qualifié est autorisé à effectuer le branchement électrique des connecteurs mâles-femelles. Le groupe d’explosion et la classe de protection marqués sur les appareils devront être respectés.

Le connecteur n’est pas conçu pour être utilisé dans les atmosphères explosibles des zones 0 et 20, 21, 22 conformément à CEI60079-10.

Respecter impérativement les valeurs indiquées dans les caractéristiques techniques pour les connecteurs sous charge. Ne séparer qu’à 230 V / 400 V 10 A.

Les prises à bride aux métal et les socles connecteur aux métal doivent être reliés au même potentiel. Monter et utiliser le connecteur seulement s’il présente un état technique parfait, conformément à sa destination, en étant conscient des risques et des mesures de sécurité à appliquer dans le respect des présentes instructions de montage et de service.

Tenir compte des prescriptions nationales en matière de sécurité et de prévention des accidents ainsi que des consignes de sécurité indiquées dans ce mode d’emploi, écrites en italiques comme ce texte!

Après déconnexion, les éléments de connexion encore sous tension doivent être immédiatement être protégés à l’aide d’obturateurs.
Anschlussleiter von Gerätestecker/Flanschsteckdose vorbereiten

Kabel und Leiter entsprechend den Technischen Daten. 
• Bei mehr- oder feindrähtigen Leitern die Enden entsprechend den geltenden nationalen und internationalen Vorschriften behandeln (z.B. Verwenden von Adernendhülsen).
Die ordnungsgemäß abisolierten Leiter des Kabels unter Berücksichtigung einschlägiger Vorschriften anschließen.
Leiteranschluss zur Aufrechterhaltung der Zündschutzart mit besonderer Sorgfalt durchführen.

Prepare connection conductors of inlet / flange socket

Only use cables and conductors specified in the Technical Data.

With multi-wire or fine-wire connection leads, the ends of the wires shall be treated in accordance with the valid national or international regulations (e.g. the use of wire-end ferrules). The insulation of the conductor shall reach up to the plug pins. The conductor must not be damaged
The relevant regulations shall be observed to ensure that the conductors of the cable are stripped off correctly. The conductors shall be connected with due care to ensure that the degree of protection is maintained.

Branchement/Débranchement du connecteur

N’utiliser les prises de courant à bride et les socles connecteurs qu’avec des fiches et prolongateurs compatibles intacts.
Veiller à un codage identique (heure) du connecteur.
• L’angle entre l’ergot de guidage et le contact mâle PE (d’un plus grand diamètre) donne l’heure. (Fig. A)
Branchement du connecteur

1. Engager dans la bonne position la fiche/le socle connecteur avec l’ergot de guidage dans la rainure de guidage correspondante du prolongateur/de la prise de courant à bride. (Fig. B)
2. Brancher les deux éléments jusqu’à la butée 1
3. Tourner dans des sens contraires, d ’env. 30°, la fiche/le socle connecteur et le prolongateur/la prise de courant à bride jusqu’en butée. (Fig. D)
4. Le connecteur mâle-femelle boucher tout à fait.(Fig. E)

Débranchement du connecteur

1. Débrancher le connecteur dans l’ordre inverse du branchement.

Les éléments de connexion conducteurs de tension à l’état ouvert doivent être fermés avec le capuchon dès le débranchement .

Préparation conducteurs de raccordement du socle connecteur / de la prise de courant à bride

Utiliser les câbles et les conducteurs conformément aux Caractéristiques techniques.

• Avec des conducteurs multifilaires ou à fils fins, traiter les extrémités conformément aux directives nationales et internationales (par ex. en utilisant des embouts).
Raccorder les conducteurs correctement isolés du câble en respectant les directives correspondantes.
Effectuer le raccordement du conducteur avec beaucoup de soin pour garantir la protection contre les explosions.

Steckverbindung stecken/trennen

• Die Flanschsteckdosen und Gerätestecker nur mit den zugehörigen unbeschädigten Steckern und Kupplungen betreiben.

• Auf gleiche Codierung (Uhrzeit) der Steckverbindung achten.
• Der Winkel zwischen Führungsnahe und PE Stift (mit größerem Durchmesser) ergibt die Uhrzeit. (Fig. A)

Steckverbindung stecken

1. Der Stecker bzw. Gerätestecker mit der Führungsnahe lagerichtig in die entsprechende Führungsnute der Kupplung bzw. Flanschsteckdose stecken. (Fig. B)
2. Bis zum 1. Anschlag zusammenstecken. (Fig. C)
3. Stecker bzw. Gerätestecker gegen Kupplung bzw. Flanschsteckdose ca. 30° gegeneinander bis zum Anschlag verdrehen. (Fig. D)
4. Steckverbindung vollständig zusammenstecken. (Fig. E)

• Die elektrische Verbindung des Stecksystems ist jetzt hergestellt.
5. Überwurfmutter des Steckers anziehen und handfest festschrauben.

• IP Schutz und die mechanische Verbindung hergestellt. (Fig. F)

Steckverbindung trennen

1. Steckverbindung in umgekehrter Reihenfolge zum Stecken trennen.

• Bei nicht korrektem Stecken der Steckverbindungskomponenten ist der Explosionsschutz nicht mehr gewährleistet.

Connection/disconnection of plug and socket

• The flange sockets and inlets shall only be operated with the associated, undamaged plugs and couplers.

• Attention shall be paid that the coding (time setting) of the plugs and sockets is the same.

1. Insert the plug or inlet with the guide lug in the correct position into the respective keyway of the coupler or flange socket. (Fig. B)
2. Insert until 1st stop is reached. (Fig. C)
3. Turn plug or inlet through ca. 30° in relation to the coupler or flange socket until the stop is reached. (Fig. D)
4. Join plug and socket completely. (Fig. E)

The electrical connection has now been made.
5. Press the coupling nut of the plug on and screw it tight by hand.

• The IP degree of protection and the mechanical connection are established by tightening the coupling nut. (Fig. F)

Disconnecting plug and socket

1. To disconnect plug and socket, carry out the above actions in the reverse order.

When opened, the live plug and socket system components shall be sealed immediately after disconnection using the protective cap.
Gerätestecker / Flanschsteckdose einschrauben

Gerätestecker bzw. Flanschsteckdose nur in die dafür vorgesehene Gehäuse einbauen. Das Gehäusevolumen bei der Auswahl des Gerätesteckers berücksichtigen.

Die Gewindebohrungen im druckfesten Schutzgehäuse oder Einbaugeräten, müssen den Mindestanforderungen der EN 60079-1, entsprechen.


Nur die im Gerätestecker bzw. in der Flanschstechdose vorhandenen Dichteinsätze verwenden. Beim Einschrauben der Gerätestecker bzw. der Flanschsteckdosen auf die angeschlossenen Leitungen bzw. Adern achten, damit keine Beschädigung der Isolation durch das Einschrauben entsteht.

Die Einschraubkomponenten sind so fest einzuschrauben, dass eine korrekte Dichtwirkung gewährleistet ist. (Prüfdrehmoment siehe Technische Daten).

Die Gerätestecker und Flanschsteckdosen aus Metall in das Erdpotential mit einbeziehen.

Vor dem Stecken sicherstellen, dass Gerätestecker und Flanschsteckdosen nicht beschädigt sind.

2. Verdrehschutzschraube festdrehen.

Den Gerätestecker nicht durch verkleben gegen Lösen sichern, da sonst Funktionsstörungen auftreten können.

Screw in inlet / flange socket

Inlets or flange sockets shall only be built into enclosures intended for this purpose. Observe the flameproof enclosure volume when flange-socket selecting.

The threaded holes in the flameproof enclosure shall fulfil the minimum requirements of EN 60079-1.

To ensure the explosion protection, only fit inlets and flange sockets made of metal in the appropriate type of protection into the threaded holes of flameproof enclosures.

The screw-in thread must not be dirty or damaged. Only use the seal inserts provided in the inlet or flange socket.

When screwing in the inlet or flange socket, pay attention to the connected conductors to ensure that the insulation is not damaged in the process.

The screw-in components shall be tightened down in such a way that they are properly sealed (see Technical Data for test torque).

The inlets and flange sockets shall be incorporated in the earth potential.

Before use, ensure that inlets and flange sockets are not damaged.

1. Fit inlet or flange socket with anti-twist protection, (test torque -> Technical Data).
2. Tighten anti-twist screw.
3. Fit inlet or flange socket with anti-twist protection (7), (test torque -> Technical Data).

Vissage du connecteur / de la prise de courant à bride

Ne monter le socle connecteur ou la prise de courant à bride que dans les boîtiers prévus à cet effet.Observez le volume de l’enceinte antidiéflagrante lors socle connecteur avec sélection.

Les alésages filetés du boîtier de protection ou appareil à encastrer résistant à la pression doivent satisfaire aux exigences minima de la norme EN 60079-1.

Pour garantir la protection contre les explosions, n’utiliser dans les orifices des boîtiers résistant à la pression que des socles connecteurs et des prises de courant à bride en métal, présentant le type de protection contre les explosions approprié.

Les listages ne doivent pas être sales ou endommagés.

N’utiliser que les éléments d’étanchéité disponibles dans le socle connecteur ou la prise de courant à bride.

En vissant le socle connecteur ou la prise de courant à bride sur le câble ou le fil connecté, veiller à ne pas endommager l’isolation.

Les éléments de vissage doivent être visés avec un couple assurant une bonne étanchéité. (Couples de contrôle voir les Caractéristiques techniques)

Intégrer les socles connecteurs et les prises de courant à bride en métal dans le potentiomètre terrestre.

Avant la connexion, s’assurer que les socles connecteurs et les prises de courant à bride sont en bon état.

1. Visser le socle connecteur ou la prise de courant à bride avec la protection antitorison (Couples de contrôle -> Caractéristiques techniques).
2. Serrer à fond la vis de protection antitorison.
3. Bloquer le socle connecteur ou la prise de courant à bride par contre-écrou.

Ne pas coller le socle connecteur pour l’empêcher de se desserrer, cela risquerait d’entraîner des dysfonctionnements.

Das Gehäusevolumen bei der Auswahl des Gerätesteckers berücksichtigen.

Observe the flameproof enclosure volume when flange-socket selecting.

Observez le volume de l’enceinte antidiéflagrante lors socle connecteur avec sélection.

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Artikelbeschreibung</th>
<th>M25</th>
<th>SW 32</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Überwurfmutter</td>
<td>12,5</td>
<td>66</td>
</tr>
<tr>
<td>2</td>
<td>Gerätestecker-Hülse</td>
<td>12,5</td>
<td>78</td>
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<td>Anschlusskabel</td>
<td>12,5</td>
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</tr>
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<td>Gerätestecker-Einsatz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Flanschsteckhülse</td>
<td></td>
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</tr>
<tr>
<td>6</td>
<td>Flanschsteckhülse-Einsatz</td>
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</tbody>
</table>

Gerätestecker mit Anschlussleitung
Inlet with connection leads

Socle connecteuravec lignes de raccordement

Flanschsteckdose mit Anschlussleitung
Flange socket with connection leads

Prise à bride avec lignes de raccordement

V < 2000 cm³
V > 2000 cm³
Wir erklären in alleiniger Verantwortung, dass die Mehrfachsteckverbindung eXLink 6-/7-polig hierby declare in our sole responsibility, that the multiple plug and socket systems eXLink, 6-/7-pole déclarons de notre seule responsabilité, que le II 2 G Ex de IIC T6 // II 2 G Ex ia/ib IIC T6 Typ GHG 57.
auf die sich diese Erklärung bezieht, mit den folgenden Normen oder normativen Dokumenten übereinstimmen.
which are the subject of this declaration, are in conformity with the following standards or normative documents.
auquel cette déclaration se rapporte, est conforme aux normes ou aux documents normatifs suivants.

Bestimmungen der Richtlinie
Terms of the directive
Prescription de la directive

94/9/EG: Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen.
94/9/EC: Equipment and protective systems intended for use in potentially explosive atmospheres.
94/9/CE: Appareils et systèmes de protection destinés à être utilisés en atmosphère exploisable.

EN 60 079-0: 2004
EN 60 079-1: 2004
EN 60 079-7: 2004
EN 60 079-11: 2007
EN 61 984: 2001
EN 60 999-1: 2000

2004/108 EG: Elektromagnetische Verträglichkeit
2004/108 EC: Electromagnetic compatibility
2004/108 CE: Compatibilité électromagnétique

Ort und Datum
Place and date

Eberbach, den 17.09.09

Cooper Crouse-Hinds GmbH
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Für den Sicheren Betrieb des Betriebsmittels sind die Angaben der zugehörigen Betriebsanleitung zu beachten.
For the safe use of this apparatus, the informations given in the accompanying operating instructions must be followed.
Afin d’assurer le bon fonctionnement de nos appareils, priére de respecter les directives du mode d’emploi correspondant à ceux-ci.
TAKE A CLOSER LOOK.

Moog designs a range of products that complement the performance of those featured in this document. Visit our website for more information and the Moog facility nearest you.

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Pilot-operated proportional valves D941K to D945K
Version -, April 2012, CDS29589-de