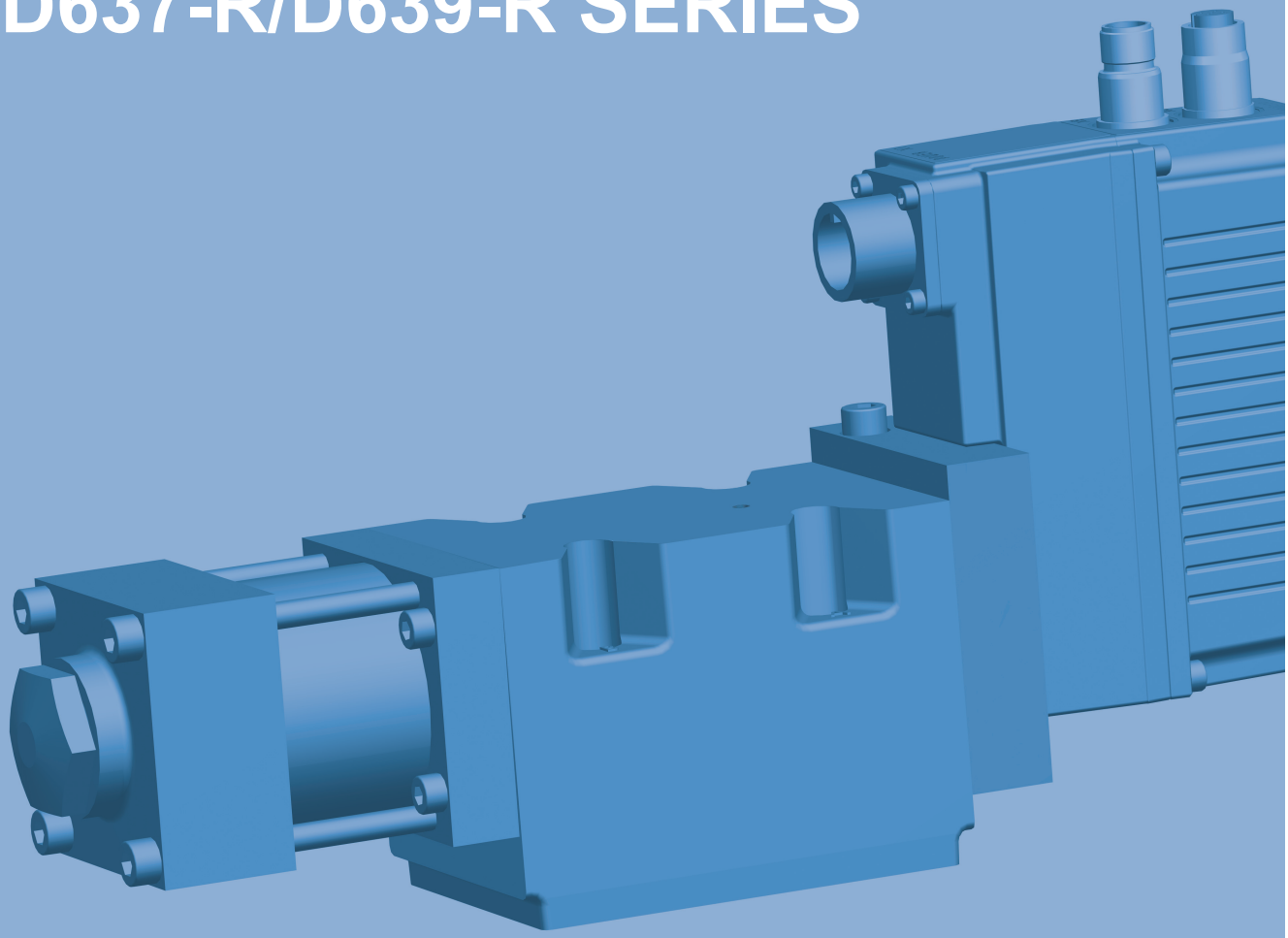
USER MANUAL

D637-R/D639-R SERIES



DIRECT DRIVE SERVOVALVES WITH
INTEGRATED DIGITAL ELECTRONICS
AND OPTIONAL FIELD BUS INTERFACE

Translation of the Original User Manual
(CA61892-001; Version 1.0, 08/09)

WHAT MOVES YOUR WORLD

MOOG

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For your notes.

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1 General Information

1.1 Notes on the user manual

Notes on the user manual

This user manual applies only to the standard models of D637-R/D639-R series valves. It contains the most important information for ensuring proper and correct operation of the valves.
⇨ Chapter "2.1 Intended operation", page 5
⇨ Chapter "2.2 Handling in accordance with safety requirements", page 6

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

The contents of this user manual and the application-relevant product-related hardware and software documentation 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.
⇨ Chapter "1.1.2 Completeness", page 1
⇨ Chapter "2.3 Responsibilities", page 7
⇨ Chapter "2.4 Selection and qualification of personnel", page 8
⇨ Chapter "2.2 Handling in accordance with safety requirements", page 6

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. 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.

1.1.1 Validity and subject to change without notice

Validity of the user manual and subject to change without notice

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 reasons being given.

1.1.2 Completeness

Completeness of the user manual

This user manual is only complete in conjunction with the application-relevant product-related hardware and software documentation.
Available documents:
⇨ Chapter "1.2 Supplementing documents", page 3

1.1.3 Storage location

Storage location for the user manual

This user manual, together with all the application-relevant product-related hardware and software documentation, must be located in the near vicinity of the valve or superordinated machine and must be accessible at all times.

1.1.4 Typographical conventions

Typographical conventions

DANGER 	**Identifies safety instructions which are intended to warn of immediately imminent danger to life and limb or serious damage to property.** **Failure to comply with these safety instructions will inevitably result in fatalities, serious personal injuries (crippling/disablement) or serious damage to property!**
WARNING 	**Identifies safety instructions which are intended to warn of possible danger to life and limb or possible serious damage to property.** Failure to comply with these safety instructions may result in fatalities, serious personal injuries (crippling/disablement) or serious damage to property!
CAUTION 	Identifies safety instructions which are intended to warn of minor personal injuries or minor damage to property. Failure to comply with these safety instructions may result in minor personal injuries or minor damage to property.
	Identifies important notes/information
• or –	Identifies listings.
⇨	Identifies references to another chapter, another page, table or illustration in the user manual.
"…"	Identifies chapter headings or document titles, which are referenced.
Blue text	Identifies hyperlinks in the PDF file.
1., 2., …	Identifies steps in a procedure which must be performed in consecutive order.
'…'	Identifies parameters of the valve software (e.g., 'Node-Id') or the valve state (e.g., 'ACTIVE').
→	Identifies the direction of the valve opening (e.g., P→T).

1.2 Supplementing documents

The supplementing documents mentioned here are not included in the valves' scope of delivery. They are available as accessories.
⇨ Chapter "13.1 Accessories", page 105

The PDF files of the supplementing documents can be downloaded from the following link:
http://www.moog.com/industrial/literature

Supplementing documents

The following supplementing documents are available:

- Application notes "Technical Note TN 353"
  Protective grounding and electrical shielding of hydraulic valves with integrated electronics
- Application notes "Technical Note TN 494"
  Maximum permissible lengths of electric cables for the connection of hydraulic valves with integrated electronics
- Catalog "D637-R/D639-R"

1.3 Manufacturer's declaration

Manufacturer's declaration

The valves comply with the standards specified in the associated manufacturer's declaration.
The valves comply with the requirements of the Machine Directive 98/37/EC.
Refer to the associated manufacturer's declaration for the applied standards.

Please contact us or one of our authorized service centers for the manufacturer's declaration.

1.4 Registered trademarks

Registered trademarks

Moog and Moog Authentic Repair® are registered trademarks of Moog Inc. and its subsidiaries.

Microsoft® and Windows® are either registered trademarks or trademarks of the Microsoft® Corporation in the USA and/or other countries.

All the product and company names mentioned in this user manual are possibly registered 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.

1.5 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.

Exclusion of warranty and liability

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 or handling of the valves by non-qualified personnel
  ⇨ Chapter "2.4 Selection and qualification of personnel", page 8
- Non-intended operation
  ⇨ Chapter "2.1 Intended operation", page 5
- Handling not in accordance with safety requirements
  ⇨ Chapter "2.2 Handling in accordance with safety requirements", page 6
- Omission of the application-relevant occupational safety and health measures
  ⇨ Chapter "2.6 Occupational safety and health", page 9
- Failure to observe this user manual or the application-relevant product-related hardware and software documentation
- Failure to observe the application-relevant safety standards of the manufacturer and the operator of the machine
- Failure to observe the latest versions of the relevant national and international regulations, standards and guidelines (such as e.g., the EU Machinery Directive, the regulations of the trade association and of TÜV or VDE) in 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
  ⇨ Chapter "2.9 Pressure limitation", page 10
- Failure to comply with the preconditions for satisfying the EMC protection requirements
  ⇨ Chapter "4.4.1 Electromagnetic compatibility (EMC)", page 47
- 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
  ⇨ Chapter "2.5 Structural modifications", page 8
  ⇨ Chapter "11 Service", page 93
- 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, mounting, 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
  ⇨ Chapter "4 Technical Data", page 43
- Improper storage, transportation, mounting, 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
  ⇨ Chapter "13 Accessories and Spare Parts", page 105
- Catastrophes caused by foreign objects or force majeure

2 Safety

2.1 Intended operation

Intended operation

WARNING

The valves may be operated exclusively within the framework of the data and applications specified in the user manual.
Any other or more extensive use is not permitted.

WARNING

Use of the valves in potentially explosive environments is not permitted.

The valves may only be operated as a component part of a superordinated 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, electrical and hydraulic connection, start-up, configuration, operation, cleaning and maintenance.

The valves may only be started up when the following is ensured:

- The superordinated machine with all its installed components complies with the latest versions of the relevant national and international regulations, standards and guidelines (such as e.g., the EU Machinery Directive, the regulations of the trade association and of TÜV or VDE).
- The valves and all other installed components are in a technically fault-free and operationally reliable state.
- No signals which can lead to uncontrolled movements 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
  ⇨ Chapter "2.2 Handling in accordance with safety requirements", page 6
- Adherence to all inspection and maintenance instructions of the manufacturer and the operator of the machine
- Observation of all application-relevant product-related hardware and software documentation
- Observation of all application-relevant safety standards of the manufacturer and the operator of the machine
- Observation of all the latest versions of the application-relevant national and international regulations, standards and guidelines (such as e.g., the EU Machinery Directive, the regulations of the trade association and of TÜV or VDE)

2.2 Handling in accordance with safety requirements

WARNING

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.

WARNING

As in any electronic control system, also the failure of certain valve components can lead to an uncontrolled and/or unpredictable operational sequence. All types of failure on system level must be taken into consideration and appropriate protective measures must be taken.
The use of automatic control technology in a machine calls for special measures.
If automatic control technology is to be used, the user should, in addition to all potentially available standards or guidelines on safety-engineering installations, consult the manufacturers of the components used in great depth.

Handling in accordance with safety requirements

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 safety instructions in the user manual
- All safety instructions in the application-relevant product-related hardware and software documentation
- All safety instructions in the application-relevant safety standards of the manufacturer and the operator of the machine
- All relevant national and international safety and accident prevention regulations, standards and guidelines, such as e.g., the safety regulations of the trade association, of TÜV or VDE, in particular the following standards pertaining to the safety of machinery:
  - DIN EN ISO 12100
  - DIN EN 982
  - DIN EN 563
  - EN 60204

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

2.3 Responsibilities

Responsibility of the manufacturer and the operator of the machine

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 application-relevant product-related hardware and software documentation.
The manufacturer and the operator of the machine are particularly responsible for ensuring the following:

- Selection and training of personnel
  ⇨ Chapter "2.4 Selection and qualification of personnel", page 8
- Intended operation
  ⇨ Chapter "2.1 Intended operation", page 5
- Handling in accordance with safety requirements
  ⇨ Chapter "2.2 Handling in accordance with safety requirements", page 6
- Taking and monitoring of the application-relevant occupational safety and health measures
  ⇨ Chapter "2.6 Occupational safety and health", page 9
- Observation of all application-relevant safety standards of the manufacturer and the operator of the machine
- Observation of the latest versions of the relevant national and international regulations, standards and guidelines (such as e.g., the EU Machinery Directive, the regulations of the trade association and of TÜV or VDE) in 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
  ⇨ Chapter "2.9 Pressure limitation", page 10
- Compliance with the preconditions for satisfying the EMC protection requirements
  ⇨ Chapter "4.4.1 Electromagnetic compatibility (EMC)", page 47
- Use of the valves in a technically faultless and operationally safe state
- Prevention of unauthorized or improperly performed structural modifications, repairs or maintenance
  ⇨ Chapter "2.5 Structural modifications", page 8
  ⇨ Chapter "11 Service", page 93
- Definition and observation of the application-specific inspection and maintenance instructions
- Adherence to all technical data relating to the storage, transportation, mounting, 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
  ⇨ Chapter "4 Technical Data", page 43
- Proper storage, transportation, mounting, 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
  ⇨ Chapter "13 Accessories and Spare Parts", page 105
- Handy and accessible storage of this user manual and of the application-relevant product-related hardware and software documentation
  ⇨ Chapter "1.1.3 Storage location", page 1

2.4 Selection and qualification of personnel

WARNING

Only properly qualified and authorized users may work with and on the valves.

Selection and qualification of personnel

Qualified users

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 which they are exposed to 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.

2.5 Structural modifications

WARNING

In the interests of avoiding damage to the valves or accessories, structural modifications, on account of the complexity of the internal components of the valves or accessories, may only be carried out by us or one of our authorized service centers.

Structural modifications

2.6 Occupational safety and health

Occupational safety and health measures and equipment

WARNING

The magnets in the permanent magnet linear force motor create strong magnetic fields, which can have a disruptive effect on sensitive devices, such as e.g., cardiac pacemakers. The relevant safe distances appropriate for the device must be observed.

CAUTION

Depending on the application, significant levels of noise may be generated when the valves are operated.
If necessary, the manufacturer and operator of the machine must take appropriate sound insulation measures or stipulate that suitable safety equipment, such as e.g., ear protection, be worn.

CAUTION

Falling objects, such as e.g., valve, tool or accessory, can cause injury.
Suitable safety equipment, such as e.g., safety shoes, must be worn to provide protection against injury.

CAUTION

Valves and hydraulic port lines can become very hot during operation.
Suitable safety equipment, such as e.g., work gloves, must be worn to provide protection against injury before touching the valve or the connection cables during such operations as mounting, removal, electrical and hydraulic connection, troubleshooting or servicing.

CAUTION

When handling hydraulic fluids, observe the safety provisions applicable to the hydraulic fluid used.
If necessary, suitable safety equipment, such as e.g., work gloves, must be worn.

2.7 General safety instructions

General safety instructions

WARNING

Only properly qualified and authorized users may work with and on the valves.
⇨ Chapter "2.4 Selection and qualification of personnel", page 8

WARNING

Observe and adhere to the technical data and in particular the information given on the valve nameplate.
⇨ Chapter "4 Technical Data", page 43

CAUTION

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

2.8 ESD

WARNING

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

ESD

2.9 Pressure limitation

WARNING

Excessive pressure at the hydraulic ports damages the valve and can cause unsafe states in the machine and personal injury.
Pressure-limiting valves, for example, or other comparable safety devices must be installed to limit the pressure at all hydraulic ports to the specified maximum operating pressure.
Maximum operating pressure:
⇨ Chapter "4 Technical Data", page 43

Safety devices for pressure limitation

3 Product Description

3.1 Function and mode of operation

Function of the valves: throttle valves

The valves of the D637-R/D639-R series are direct drive servovalves (DDV: **D**irect **D**rive **V**alve). The valves are throttle valves for 2-, 3-, 4- or even 2x2-way applications.
The valves are suitable for electrohydraulic position, speed, pressure and force control even for high dynamic requirements. The valves control flow and/or regulate pressure.
The valves of the D637-R series can be used for flow control. The valves of the D639-R series can be used for pressure and pressure limitation control and/or flow control.
The control electronics and a pressure transducer (D639-R only) are integrated in the valve.

3.1.1 Operational modes

Depending on the model, one of the operational modes below is preset in the valve.
Changeover between the operational modes is only possible in the D639-R series valves with pQ-control and can be accessed via the integrated service or field bus interface.

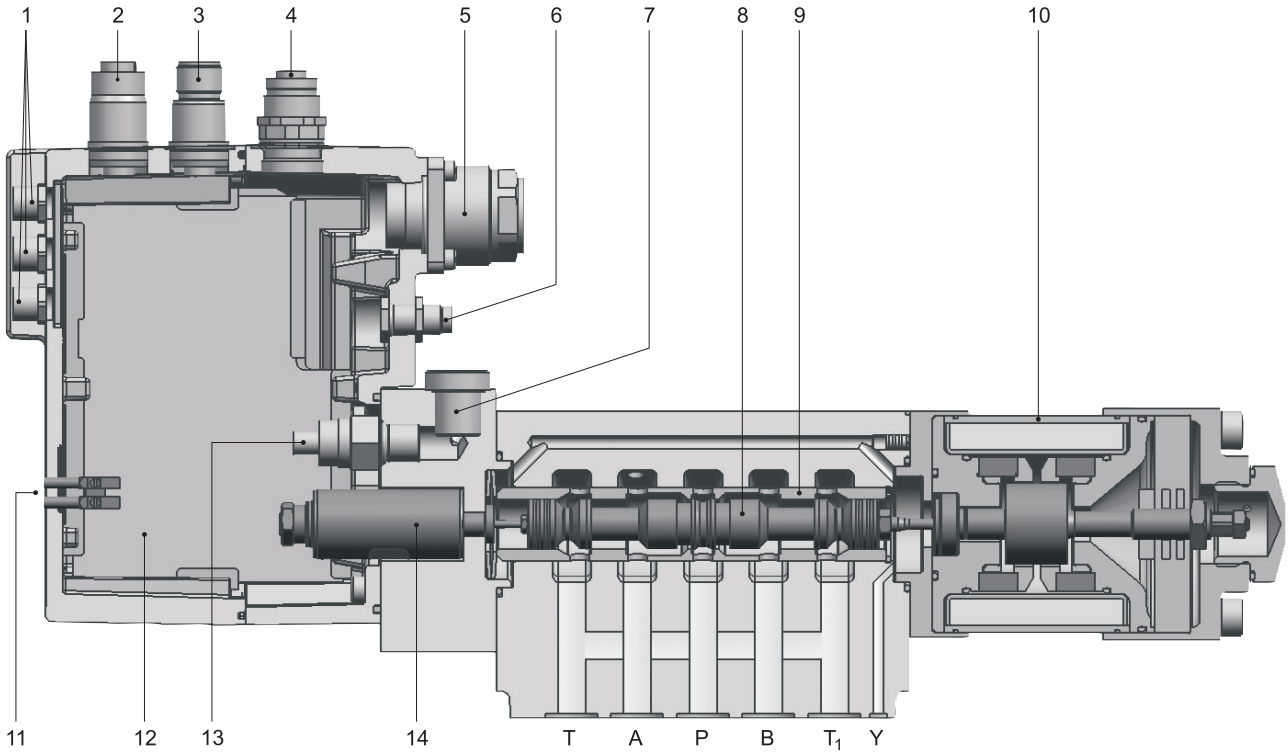
Operational modes: Q-, p-, pQ-control

Operational mode	Series D637-R	Series D639-R	
	Q	p	pQ
Flow control (Q-control) ⇨ Chapter "3.3.1.1 Flow control (Q-control)", page 24	• [1]		•
Pressure control (p-control) ⇨ Chapter "3.3.1.2 Pressure control (p-control)", page 25		• [1]	•
Flow and pressure control (pQ-control) ⇨ Chapter "3.3.1.3 Flow and pressure control (pQ-control)", page 26			• [1]

Table 1: Operational modes of the valves

[1] Operational mode preset on delivery

3.1.2 Representative depiction of the valve

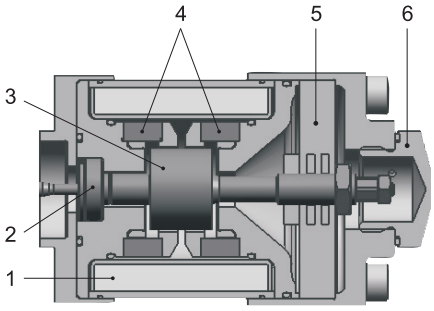


Item	Designation	Further information
1	Analog input connectors X5…X7	The analog input connectors X5…X7 are only provided on valves with axis control function (ACV).
2	Field bus connector X4	The field bus connectors X3 and X4 are only provided on valves with field bus interfaces. ⇨ Chapter "3.1.5.2 Field bus connectors X3 and X4", page 17 ⇨ Chapter "9.3.1 Configuration via the field bus interface", page 83
3	Field bus connector X3	
4	Digital signal interface connector X2	The digital signal interface connector X2 is only provided on valves with axis control function (ACV).
5	Valve connector X1	⇨ Chapter "8.3 Valve connector X1", page 69
6	Service connector X10	The service connector X10 is only provided on valves without CAN bus interfaces. ⇨ Chapter "3.1.5.3 Service connector X10", page 17 ⇨ Chapter "9.3.2 Configuration via the service interface", page 85
7	Venting screw	The venting screw is only provided on D639-R series valves. ⇨ Chapter "9.5.1 Venting", page 87
8	Spool	
9	Bushing	
10	Permanent magnet linear force motor	⇨ Chapter "3.1.3 Permanent magnet linear force motor", page 13
11	Status LEDs	The multicolor LEDs are only provided on valves with field bus interfaces. They serve to indicate the valve operating state and the network status. The number and the function of LEDs are dependent on the field bus.
12	Digital valve electronics	⇨ Chapter "3.1.4 Valve electronics and valve software", page 13
13	Position transducer (LVDT)	⇨ Chapter "3.3.1.1 Flow control (Q-control)", page 24
14	Pressure transducer	The pressure transducer is only provided on D639-R series valves. ⇨ Chapter "3.3.1.2 Pressure control (p-control)", page 25
T…Y	Ports	⇨ Chapter "7.2.2 Mounting pattern of mounting surface", page 61

Figure 1: Representative depiction of a direct drive servovalve

3.1.3 Permanent magnet linear force motor

Representative depiction of a permanent magnet linear force motor



Item	Designation
1	Coil
2	Bearing
3	Armature
4	Permanent magnets
5	Centering springs
6	Screw plug

Figure 2: Representative depiction of a permanent magnet linear force motor

Permanent magnet linear force motor

A permanent magnet linear force motor (figure 2 or item 10 in figure 1) is used to drive the valve spool (item 8 in figure 1).
In contrast to proportional-solenoid drives, the permanent magnet linear force motor can move the spool from the spring-centered center position in both working directions. This results in high actuating power for the spool simultaneously with 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 solenoids.
The linear force motor (figure 2 or item 10 in figure 1) drives the valve spool (item 8 in figure 1). The spool starting position is determined in the de-energized state by the centering springs (item 5 in figure 2). The linear force motor enables the spool to be displaced 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.

3.1.4 Valve electronics and valve software

Integrated digital valve electronics and valve software

The digital driver and control electronics are integrated in the valve.
These valve electronics contain a microprocessor system which executes all of the important functions via the valve software it contains. The digital electronics enable the valve to be controlled across the entire working range without drift and almost regardless of temperature.
⇨ Chapter "3.5 Valve software", page 39

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

3.1.4.1 Block diagram of the valve electronics

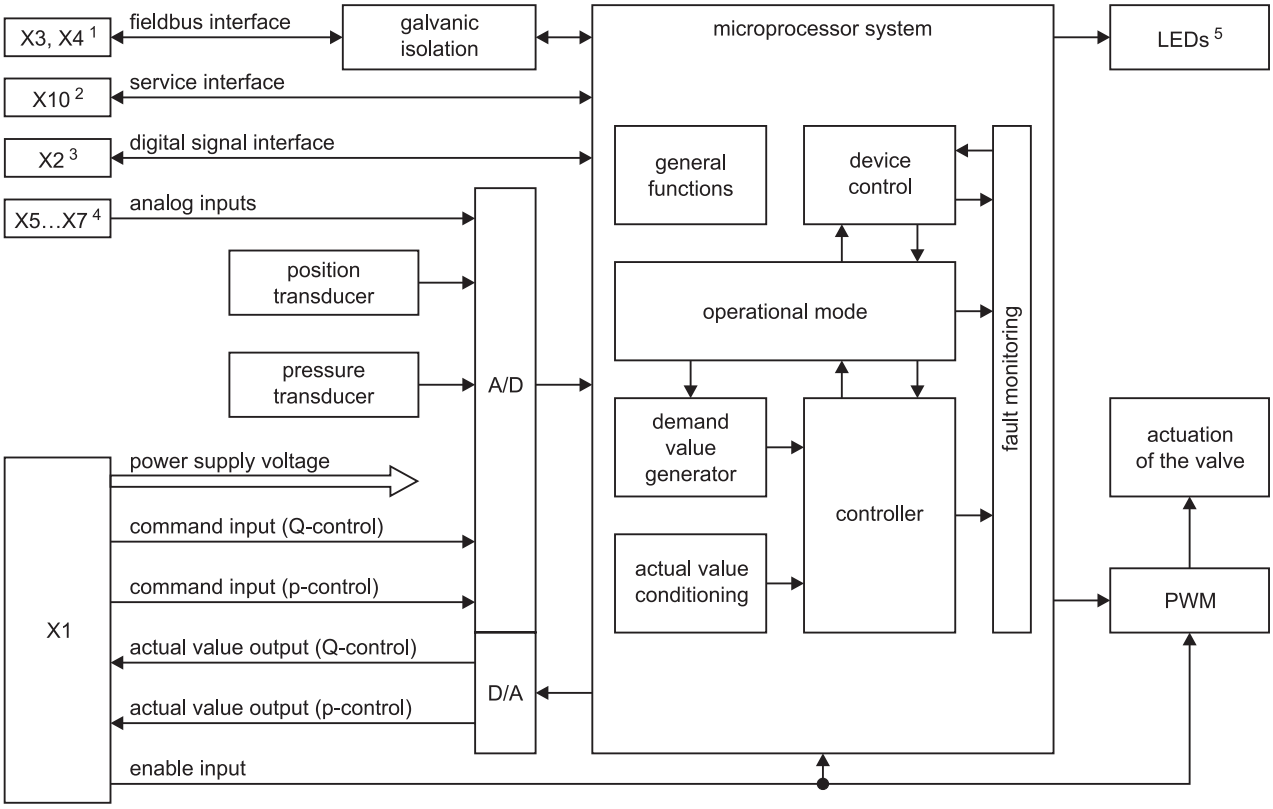


Figure 3: Block diagram of the valve electronics

[1] The field bus connectors X3 and X4 are only provided on valves with field bus interfaces.

[2] The service connector X10 is only provided on valves without CAN bus interfaces.

[3] The digital signal interface connector X2 is only provided on valves with axis control function (ACV).

[4] The analog input connectors X5…X7 are only provided on valves with axis control function (ACV).

[5] The multicolor LEDs are only provided on valves with field bus interfaces.

3.1.4.2 Valve states

WARNING

The 'NOT READY' valve state is caused only by a serious, non-rectifiable fault.
If the 'NOT READY' valve state occurs, the valve must be sent to us or one of our authorized service centers for inspection.

Valve state

The valve's device status is referred to as the valve state.
The valve state 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 Configuration Software.
⇨ Chapter "3.6 Moog Valve Configuration Software", page 39

Valve state	Explanation
'ACTIVE'	The valve is ready for operation and is in closed-loop control operation.
'HOLD'	The valve is ready for operation and is in the electrical fail-safe state on account of a control command. A preset command signal is corrected. ⇨ Chapter "3.2.2 Electrical fail-safe function", page 20
'FAULT HOLD'	The valve is ready for operation and is in the electrical fail-safe state on account of a fault reaction. A preset command signal is corrected. ⇨ Chapter "3.2.2 Electrical fail-safe function", page 20
'DISABLED'	The valve electronics are ready for operation and the valve is in the mechanical fail-safe state on account of a control command. ⇨ Chapter "3.2.1.2 Mechanical fail-safe state", page 19 Signals can be evaluated. The current to the permanent magnet linear force motor is switched off.
'FAULT DISABLED'	The valve electronics are ready for operation and the valve is in the mechanical fail-safe state on account of a fault reaction. Signals can be evaluated. ⇨ Chapter "3.2.1.2 Mechanical fail-safe state", page 19 The current to the permanent magnet linear force motor is switched off.
'INIT'	The valve is switched off, is in the mechanical fail-safe state and can be configured via the service or field bus interface. ⇨ Chapter "3.2.1.2 Mechanical fail-safe state", page 19
'NOT READY'	The valve is not ready for operation and is in the mechanical fail-safe state on account of a serious non-rectifiable fault. ⇨ Chapter "3.2.1.2 Mechanical fail-safe state", page 19

Table 2: Valve states

Fail-safe states and fail-safe events:
⇨ Chapter "3.2.1 Mechanical fail-safe function", page 18
⇨ Chapter "3.2.2 Electrical fail-safe function", page 20
⇨ Chapter "3.2.3 Fail-safe events", page 21

3.1.5 Signal interfaces

The valves are provided with a valve connector X1 with model-dependent analog and digital inputs/outputs.
⇨ Chapter "3.1.5.1 Valve connector X1", page 16
Pin assignment of valve connector X1:
⇨ Chapter "8.3 Valve connector X1", page 69

Depending on the model, the valves can also be provided with an isolated field bus interface (field bus connectors X3 and X4) and/or a service interface (service connector X10).
⇨ Chapter "3.1.5.2 Field bus connectors X3 and X4", page 17
⇨ Chapter "3.1.5.3 Service connector X10", page 17

Existing signal interfaces

	Signal interface		
	Valve connector X1	**Field bus connectors X3 and X4**	**Service connector X10**
Valves without field bus interface	•	-	• [1]
Valves with CAN bus interface	•	• [1]	-
Valves with Profibus interface	•	•	• [1]
Valves with EtherCAT interface	•	•	• [1]

Table 3: Existing signal interfaces

[1] The valves can be started up and configured via the CAN bus or service interface with the Moog Valve Configuration Software.
⇨ Chapter "9.3.1.2 Configuration with the Moog Valve Configuration Software", page 84

ⓘ 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.

3.1.5.1 Valve connector X1

Control of the valves

Valves without field bus interfaces must be controlled with analog command signals via valve connector X1.
Valves with field bus interfaces can be controlled either with analog command signals via valve connector X1 or with digital signals via the field bus interface (connectors X3 and X4).
⇨ Chapter "3.4 Control", page 30

Analog command inputs

Depending on the model, different signal types for analog command inputs for flow or pressure control can be set in the valve.
⇨ Chapter "3.4.1 Signal types for analog command inputs", page 30

Analog actual value outputs

Depending on the model, the valve can be provided with different analog actual value outputs for flow and/or pressure control.
⇨ Chapter "3.4.2 Analog actual value outputs 4–20 mA", page 38

Enable input

The valves are provided with a digital enable input.
⇨ Chapter "3.4.3 Digital enable input", page 38

Pin assignment of valve connector X1:
⇨ Chapter "8.3 Valve connector X1", page 69

3.1.5.2 Field bus connectors X3 and X4

Field bus connectors X3 and X4

Valves with field bus interfaces are started up, controlled, monitored and configured via the field bus interface (connectors X3 and X4).
⇨ Chapter "9.3.1 Configuration via the field bus interface", page 83
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 interface can be started up and configured via the CAN bus interface (field bus connector X3) with the Moog Valve Configuration Software.
⇨ Chapter "9.3.1.2 Configuration with the Moog Valve Configuration Software", page 84

3.1.5.3 Service connector X10

Service connector X10

Valves without CAN bus interface can be started up and configured via the service interface (service connector X10) with the Moog Valve Configuration Software.
⇨ Chapter "9.3.2 Configuration via the service interface", page 85

3.2 Safety function/fail-safe

WARNING

It is essential to observe the notes/information on handling in accordance with safety requirements particularly in the case of safety-critical applications.
⇨ Chapter "2.2 Handling in accordance with safety requirements", page 6

WARNING

The manufacturer and the operator of the machine are responsible for ensuring that, when the machine is configured, designed and operated with all of the installed components, the latest version of the safety standards relevant to safety-critical applications applicable to averting damage are observed.
It is vital among other things to ensure that both the individual components and the complete machine can be rendered in a safe state.

Fail-safe functions

The valve fail-safe functions increase the safety of the user if, for example, the valve supply voltage fails.
There are two different fail-safe functions: mechanical and electrical.
⇨ Chapter "3.2.1 Mechanical fail-safe function", page 18
⇨ Chapter "3.2.2 Electrical fail-safe function", page 20

The valve can be rendered in the fail-safe state by different events.
⇨ Chapter "3.2.3 Fail-safe events", page 21

Mechanical fail-safe state

The mechanical valve fail-safe state is denoted by the fact that the spool is in a defined spring-determined position.
⇨ Chapter "3.2.1.2 Mechanical fail-safe state", page 19

Electrical 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 state and a preset command signal is corrected by suitable positioning of the 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 its transition into the fail-safe state.
⇨ Chapter "3.2.4 Restarting the valve", page 23

3.2.1 Mechanical fail-safe function

Mechanical fail-safe functions

The following mechanical fail-safe functions are available:

- Fail-safe function F
- Fail-safe function D
- Fail-safe function M

It is necessary when ordering the valve to establish which mechanical fail-safe function is to be integrated in the valve.
Which mechanical fail-safe function is integrated in the valve can be ascertained from the fail-safe identification, i.e., the 6th position in the valve type designation.
⇨ Chapter "3.2.1.3 Fail-safe identification", page 19

3.2.1.1 Valves with fail-safe function F, D or M

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 spool: ⇨ Table 4, page 19

3.2.1.2 Mechanical fail-safe state

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

Position of the spool in the mechanical fail-safe state

Fail-safe function	Position of spool
F	Defined position of spool: approx. 10 % valve opening: P→B and A→T
D	Defined position of spool: approx. 10 % valve opening: P→A and B→T
M	Defined overlapped center position of spool The mechanical fail-safe function M gives rise only in conjunction with spools which have an overlap greater than ±10 %, i.e., in valves with bushing-spool identification D, to the defined overlapped center position. In the case of a smaller overlap, i.e., in valves with a different bushing-spool identification, a defined overlapped center position is not possible. ⇨ Chapter "3.2.1.4 Bushing-spool identification", page 20

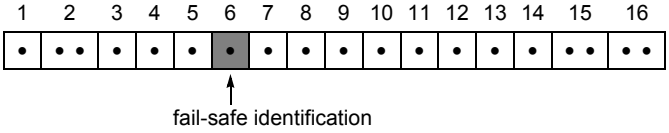
Table 4: Position of the spool in the mechanical valve fail-safe state

3.2.1.3 Fail-safe identification

Fail-safe identification

The fail-safe identification, i.e., the 6th position in the valve type designation, indicates which mechanical fail-safe function is integrated in the valve.
Type designation: ⇨ Chapter "3.7 Nameplate", page 40

Type designation:



Ident.	Fail-safe function	Further information
F	Valves with fail-safe function F	⇨ Table 4, page 19 ⇨ Chapter "3.2.1.1 Valves with fail-safe function F, D or M", page 19
D	Valves with fail-safe function D	
M	Valves with fail-safe function M	
X	Valves with special fail-safe function	

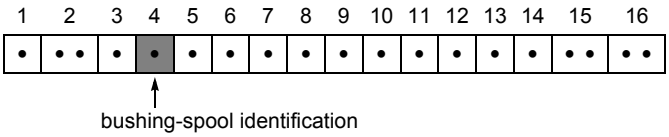
Table 5: Fail-safe identification in the type designation

3.2.1.4 Bushing-spool identification

Bushing-spool identification

The bushing-spool identification, i.e., the 4th position in the valve type designation, indicates which bushing-spool version is integrated in the valve.
Type designation: ⇨ Chapter "3.7 Nameplate", page 40

Type designation:



Ident.	Valve configuration	Bushing-spool version
O	4-way	Linear characteristic curve, zero lap
A	4-way	Linear characteristic curve, ±1.5 % to ±3 % positive overlap
D	4-way	Linear characteristic curve, ±10 % positive overlap
B	3-way	Valve opening: P→A and A→T (D639-R only)
Z	2x2-way	Valve opening: P→A and B→T (externally connect P with B and A with T), with port Y only
X		Special spool, on request

Table 6: Bushing-spool identification in the type designation

3.2.2 Electrical fail-safe function

Electrical fail-safe function and electrical fail-safe state

After transition into the 'HOLD' or 'FAULT HOLD' valve state, the valve is in the electrical fail-safe state and a preset command signal is corrected by suitable positioning of the spool.
Depending on the operational mode set, the command signal is a flow control and/or pressure control command signal.
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 Configuration Software.

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

3.2.3 Fail-safe events

WARNING

The 'NOT READY' valve state is caused only by a serious, non-rectifiable fault.
If the 'NOT READY' valve state occurs, the valve must be sent to us or one of our authorized service centers for inspection.

Fail-safe events

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 its transition into the fail-safe state.
⇨ Chapter "3.2.4 Restarting the valve", page 23

Fail-safe event		Fail-safe state: mechan.	Fail-safe state: electr.	Cause of the transition into the fail-safe state: external event	Cause of the transition into the fail-safe state: settable fault reaction	Cause of the transition into the fail-safe state: control command
Shutdown/failure of the supply voltage		•		•		
Signals at the enable input of valve connector X1		•	•	•		
Transition of the valve into the valve state	'HOLD'		•			•
	'FAULT HOLD'		•		•	
	'DISABLED'	•				•
	'FAULT DISABLED'	•			•	
	'INIT'	•				•
	'NOT READY'	•		• Serious, non-rectifiable fault		

Table 7: Fail-safe events

Valve state: ⇨ Chapter "3.1.4.2 Valve states", page 15

3.2.3.1 Shutdown/failure of the supply voltage

WARNING

After the supply voltage to the valve is shut down, fails or drops below 18 V, the linear force motor is no longer driven by the valve electronics.

Fail-safe due to shutdown/failure of the supply voltage

The valve is rendered in the mechanical fail-safe state when the supply voltage is shut down or fails.

3.2.3.2 Signals at the enable input

Fail-safe due to signals at the enable input

The transition of the valve into the fail-safe state can also be initiated by a corresponding signal at the enable input of valve connector X1. Depending on the model, signals lower than 6.5 V at the enable input render the valve in the mechanical or electrical fail-safe state.
⇨ Chapter "3.4.3 Digital enable input", page 38

Pin assignment of valve connector X1:
⇨ Chapter "8.3 Valve connector X1", page 69

3.2.3.3 Settable fault reaction

WARNING

The 'NOT READY' valve state is caused only by a serious, non-rectifiable fault.
If the 'NOT READY' valve state occurs, the valve must be sent to us or one of our authorized service centers for inspection.

Mechanical fail-safe state due to fault reaction

Mechanical fail-safe state due to fault reaction

The transition of the valve into the 'FAULT DISABLED' valve state and therefore into the mechanical fail-safe state can be initiated 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 for which the valve is rendered in the 'FAULT DISABLED' valve state.
The setting can be made 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 Configuration Software.
⇨ Chapter "3.6 Moog Valve Configuration Software", page 39

The transition of the valve into the 'NOT READY' valve state and therefore into the mechanical fail-safe state is caused by a serious, non-rectifiable fault.

Electrical fail-safe state due to fault reaction

Electrical fail-safe state due to fault reaction

The transition of the valve into the 'FAULT HOLD' valve state 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 for which the valve is rendered in the 'FAULT HOLD' valve state.
The setting can be made 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 Configuration Software.
⇨ Chapter "3.6 Moog Valve Configuration Software", page 39

3.2.3.4 Control commands

Control commands

The transition of the valve into the 'HOLD', 'DISABLED' and 'INIT' valve states can be initiated by a control command.
It is possible to set in the valve software the event for which the valve is rendered in the 'HOLD', 'DISABLED' or 'INIT' valve state.
The setting can be made 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 Configuration Software.
⇨ Chapter "3.6 Moog Valve Configuration Software", page 39

3.2.4 Restarting the valve

WARNING

Before restarting the valve after the transition of the valve into the fail-safe state, it is necessary to identify and if necessary rectify the cause of the fault at the machine end.
It is also necessary to ensure that restarting the valve does not give rise to unintentional or dangerous states in the machine.

Restarting the valve

After shutdown/failure of the supply voltage:
After the transition of the valve into the fail-safe state on account of a shutdown/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 state.

After application of an enable signal lower than 6.5 V:
After the transition of the valve into the 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 the transition of the valve into the 'FAULT DISABLED' or 'FAULT HOLD' valve state:
After the transition of the valve into the fail-safe state on account of the transition into the 'FAULT DISABLED' or 'FAULT HOLD' valve state, it can be restarted as follows:

- Acknowledge the fault via the service or field bus interface and return the valve to the 'ACTIVE' valve state.
- Set the supply voltage to zero for at least 1 second under defined conditions and then restore the supply voltage in accordance with the technical data.

After the transition of the valve into the 'HOLD', 'DISABLED' or 'INIT' valve state:
After the transition of the valve into the fail-safe state on account of the transition into the 'HOLD', 'DISABLED' or 'INIT' valve state, it can be restarted as follows:

- Return the valve to the 'ACTIVE' valve state.
- 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 state.
- Valves without field bus interface: Set the supply voltage to zero for at least 1 second under defined conditions and then restore the supply voltage in accordance with the technical data.

3.3 Hydraulics

3.3.1 Operational modes

WARNING **To ensure faultless valve operation, it is necessary to configure the valve correctly with regard to flow and pressure.**

Possible operational modes of the different series: ⇨ Table 1, page 11

3.3.1.1 Flow control (Q-control)

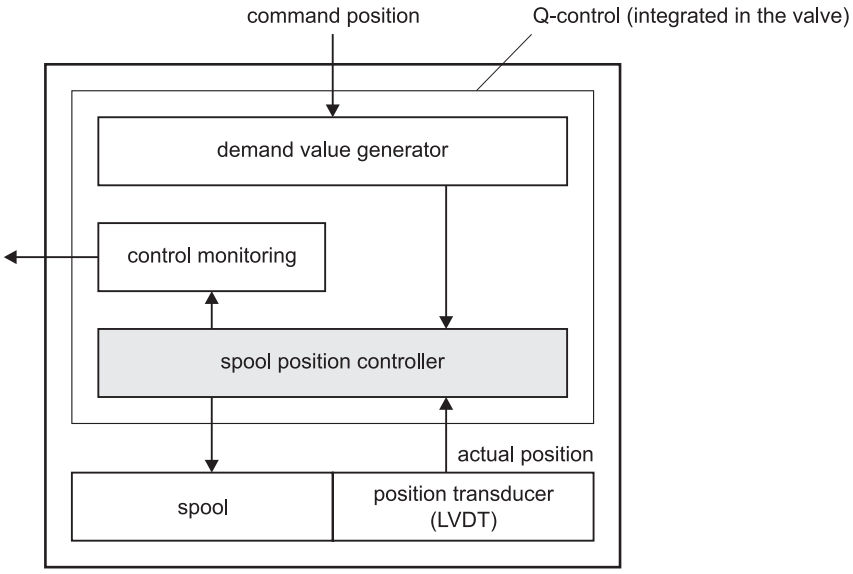


Figure 4: Flow control (Q-control) block diagram

Flow control (Q-control): Controlling the spool position

In this operational mode the position of the 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 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 transmitted command position and the measured actual position of the spool are corrected. The valve electronics drive the linear force motor, 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 Configuration Software.

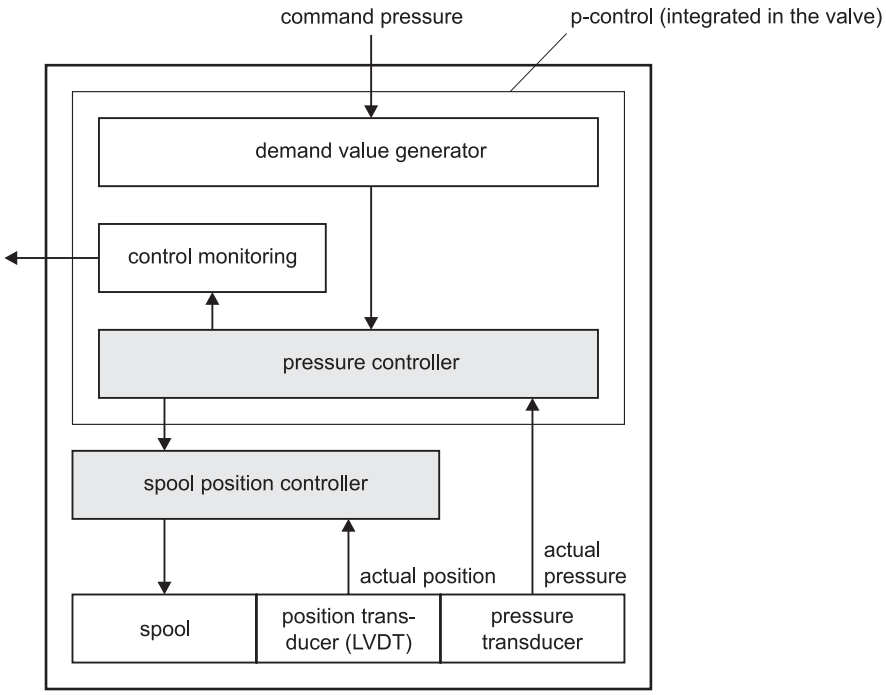
The flow that is set depends not only on the spool position but also on the pressure difference Δp at the individual control lands.

⇨ Chapter "3.5 Valve software", page 39
⇨ Chapter "5.1 Flow diagram (4-way operation)", page 49
⇨ Chapter "5.2 Flow signal characteristic curve", page 50

3.3.1.2 Pressure control (p-control)

WARNING

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.



Pressure control (p-control): controlling the pressure in port A

Figure 5: 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 Configuration Software.

⇨ Chapter "3.3.5 Notes on the pressure controller control response (D639-R)", page 29
⇨ Chapter "3.5 Valve software", page 39
⇨ Chapter "3.6 Moog Valve Configuration Software", page 39

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 gage. 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 Configuration Software.

3.3.1.3 Flow and pressure control (pQ-control)

Flow and pressure control (pQ-control)

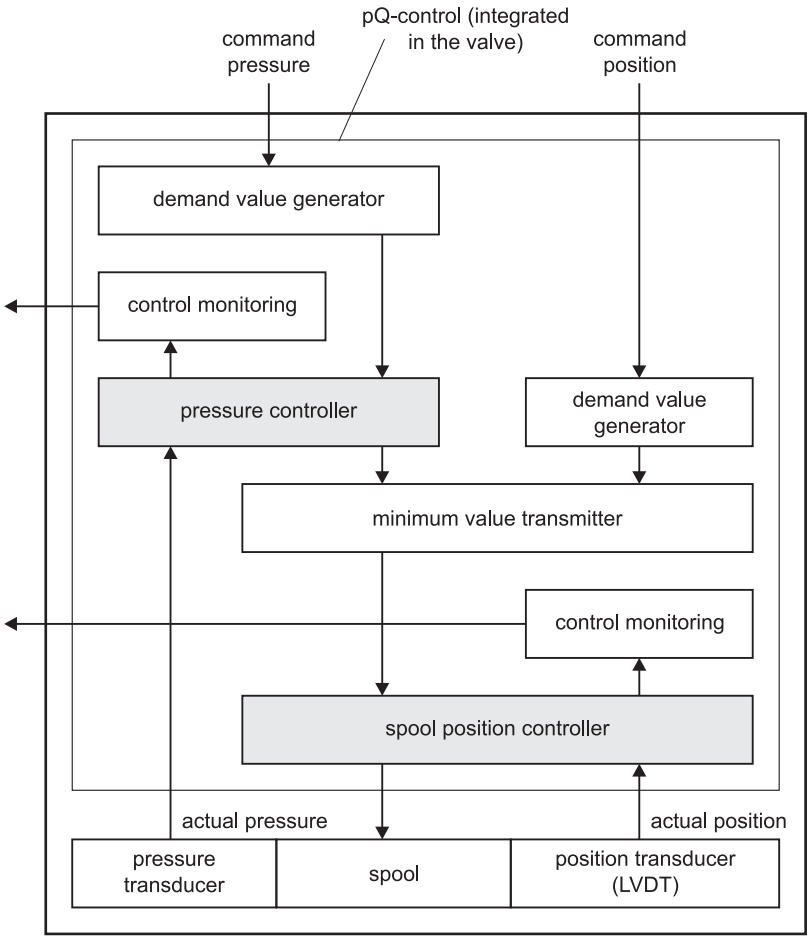


Figure 6: Flow and pressure control (pQ-control) block diagram

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

Valve configurations

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

- 2-way operation
  ⇨ Chapter "3.3.2.2 2-way and 2x2-way operation", page 28
- 3-way operation
  ⇨ Chapter "3.3.2.1 4-way and 3-way operation", page 27
- 4-way operation
  ⇨ Chapter "3.3.2.1 4-way and 3-way operation", page 27
- 2x2-way operation
  ⇨ Chapter "3.3.2.2 2-way and 2x2-way operation", page 28

3.3.2.1 4-way and 3-way operation

4-way and 3-way operation

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 blocked in order to obtain 3-way operation.

Leakage port Y must be used if the pressure in tank port T exceeds a value of 50 bar (725 psi).
⇨ Chapter "3.3.3 Leakage port Y", page 28

The valves are available with zero lap, less than ±3 % or ±10 % positive overlap.

Hydraulic symbols: 4-way and 3-way operation

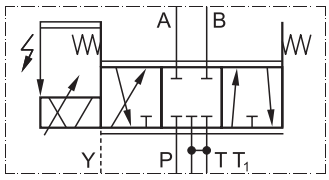


Figure 7: 4-way operation with mechanical fail-safe function M (hydraulic symbol)

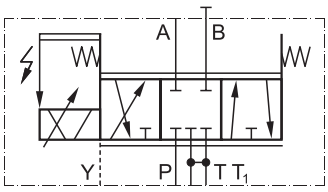


Figure 8: 3-way operation with mechanical fail-safe function M (hydraulic symbol)

⇨ Chapter "3.2.1.1 Valves with fail-safe function F, D or M", page 19

3.3.2.2 2-way and 2x2-way operation

2-way and 2x2-way operation

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

With 2x2-way operation the valve can be used in 2-way applications for greater flows.
Ports P with B and A with T must be externally connected for this purpose.
The direction of flow must be observed as per figure 10.

Leakage port Y must always be connected with 2x2-way operation.
⇨ Chapter "3.3.3 Leakage port Y", page 28

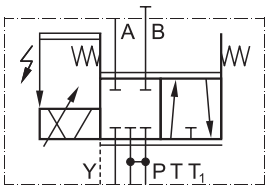


Figure 9: 2-way operation with mechanical fail-safe function M (hydraulic symbol)

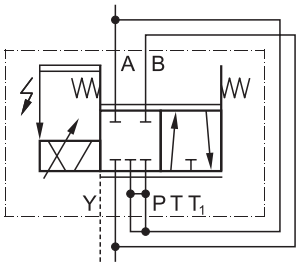


Figure 10: 2x2-way operation with mechanical fail-safe function M (hydraulic symbol)

⇨ Chapter "3.2.1.1 Valves with fail-safe function F, D or M", page 19

3.3.3 Leakage port Y

Leakage port Y

Leakage port Y must be used in the following cases:

- when the pressure p_T in tank port T is greater than 50 bar (725 psi)
- with 2x2-way operation

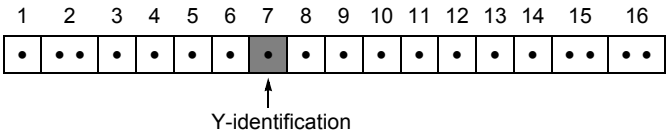
The valve can be supplied either with or without leakage port Y.
It is necessary when ordering the valve to establish whether leakage port Y is to be used.
Whether leakage port Y is used can be ascertained from the Y-identification, i.e., the 7th position in the type designation.
⇨ Chapter "3.3.3.1 Y-identification", page 28

3.3.3.1 Y-identification

Y-identification

The Y-identification, i.e., the 7th position in the valve type designation, indicates how leakage port Y is configured in the valve.
Type designation: ⇨ Chapter "3.7 Nameplate", page 40

Type designation:



Ident.	Leakage port Y	Can be used at
0	Closed, with screw plug	Pressure in tank port $p_T \leq 50$ bar (725 psi)
3	Open, with filter element	Pressure in tank port $p_T > 50$ bar (725 psi)

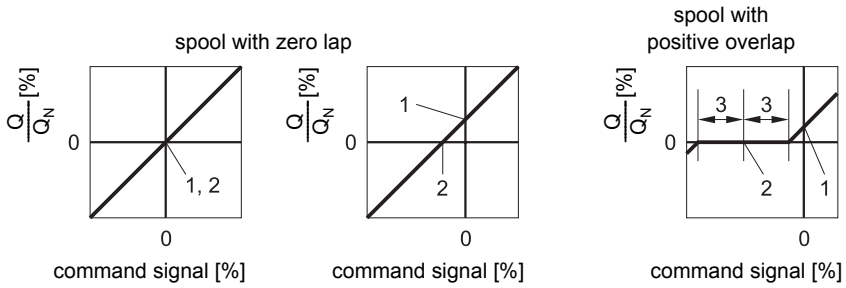
Table 8: Y-identification in the type designation

3.3.4 Electrical and hydraulic zero position

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

Electrical and hydraulic zero position of the spool

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 (when the spool is symmetrical) in which the pressures are equal in the two blocked control ports.
The hydraulic zero position is model-dependent.



Item	Designation
1	Electrical zero position of the spool
2	Hydraulic zero position of the spool
3	Spool overlap

Figure 11: Examples of the electrical and hydraulic zero position of different spools in the flow signal characteristic curve

3.3.5 Notes on the pressure controller control response (D639-R)

Notes on the pressure controller control response (D639-R)

The controlled system is essentially influenced by:

- Rated flow Q_N
- Actual pressure difference Δp per control land
- Load stiffness
- The fluid volume to be controlled in port A

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 Configuration Software.
Up to 16 pressure controller configurations can be stored and activated during operation.
⇨ Chapter "3.6 Moog Valve Configuration Software", page 39

3.4 Control

Control of the valves

Valves without field bus interfaces must be controlled with analog command signals via valve connector X1.
Valves with field bus interfaces can be controlled either with analog command signals via valve connector X1 or with digital signals via the field bus interface (connectors X3 and X4).
⇨ Chapter "3.1.5 Signal interfaces", page 16
⇨ Chapter "3.4.1 Signal types for analog command inputs", page 30

3.4.1 Signal types for analog command inputs

Analog command inputs

Valves without field bus interfaces must be controlled with analog command signals via valve connector X1.
Depending on the model, different signal types for analog command inputs for flow or pressure control can be set in the valve.
The signal type can be set via the service or field bus interface in the valve software. Setting and interrogation can be performed for example with the Moog Valve Configuration Software.
⇨ Chapter "3.6 Moog Valve Configuration Software", page 39

Advantages of the different signal types for analog command inputs

Signal types for command inputs	Advantages
±10 V or 0–10 V	Simple measurement of the signal, e.g., with an oscilloscope
±10 mA or 0–10 mA	In contrast to the 4–20 mA signal type, less power is required with low command signals; large transmission lengths are possible
4–20 mA	Detection of fault in the electric cable and large transmission lengths are possible

Table 9: Advantages of the different signal types for analog command inputs

ⓘ 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.
⇨ Chapter "3.4.1.1 Signal type identification", page 31
Which signal type is currently set can be ascertained for example with the Moog Valve Configuration Software.

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

Basically, it is preferable to use differential signals on the command inputs. If the command signal cannot be transmitted differentially, the reference point for the command input at the valve must be connected to ground (GND).
⇨ Chapter "8.3.4 Single-ended command signals", page 76

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.

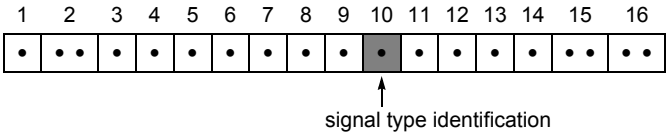
Pin assignment of valve connector X1:
⇨ Chapter "8.3 Valve connector X1", page 69

3.4.1.1 Signal type identification

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 on delivery.
Type designation: ⇨ Chapter "3.7 Nameplate", page 40

Type designation:



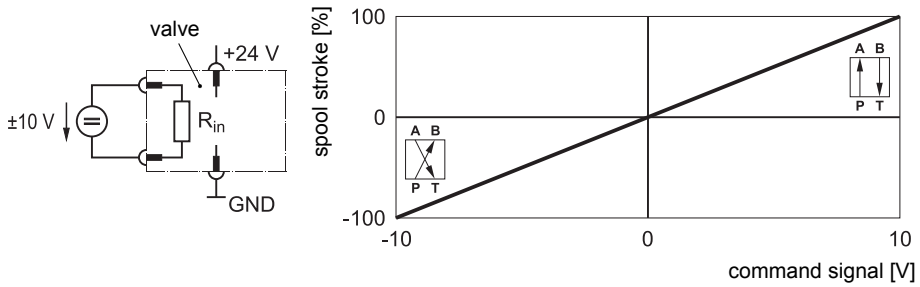
Ident.	Explanation
M	Analog command signals via differential voltage inputs: Flow control command input ±10 V and pressure control command input 0–10 V Circuit and characteristic curve: ⇨ Figure 12, page 32 and ⇨ Figure 15, page 35 Pin assignment of valve connector X1: ⇨ Figure 35, page 70 or ⇨ Figure 38, page 73
X	Analog command signals via differential current inputs: Flow control command input ±10 mA and pressure control command input 0–10 mA Circuit and characteristic curve: ⇨ Figure 13, page 33 and ⇨ Figure 16, page 36 Pin assignment of valve connector X1: ⇨ Figure 36, page 71 or ⇨ Figure 39, page 74
E	Analog command signals via differential current inputs: Flow control command input 4–20 mA and pressure control command input 4–20 mA Circuit and characteristic curve: ⇨ Figure 14, page 34 and ⇨ Figure 17, page 37 Pin assignment of valve connector X1: ⇨ Figure 37, page 72 or ⇨ Figure 40, page 75
9	Digital command signals via field bus interface

Table 10: Signal type identification in the type designation

The type designation and the signal type for analog command inputs on the nameplate 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 Configuration Software.

3.4.1.2 Flow control command inputs

Signal type for the command input: ±10 V



Differential flow control command input ±10 V

Figure 12: Differential flow control command input ±10 V (circuit and characteristic curve)

For this signal type the input is configured as a differential voltage input with an input range of ±10 V.
The spool stroke is proportional to the input voltage U_{in}.

U_{in} = 10 V	100 % spool stroke, valve opening: P→A and B→T
U_{in} = 0 V	Spool in electrical zero position
U_{in} = –10 V	100 % spool stroke, valve opening: P→B and A→T

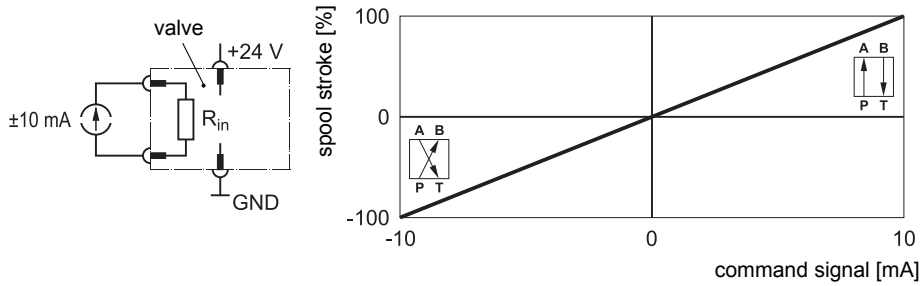
The differential input resistance R_{in} is 20 kΩ.
The input resistance referenced to GND is approximately 150 kΩ.

CAUTION

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

If there is no differential command input source available, the reference point for 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 mA



Differential flow control command input ±10 mA

Figure 13: Differential flow control command input ±10 mA (circuit and characteristic curve)

For this signal type the input is configured as a differential current input with an input range of ±10 mA.
The input current I_{in} to be measured is guided through both input pins to an internal current measuring shunt.
The spool stroke is proportional to the input current I_{in}.

I_{in} = 10 mA	100 % spool stroke, valve opening: P→A and B→T
I_{in} = 0 mA	Spool in electrical zero position
I_{in} = –10 mA	100 % spool stroke, valve opening: P→B and A→T

The differential input resistance R_{in} is 200 Ω.
The input resistance referenced to GND is approximately 150 kΩ.

CAUTION

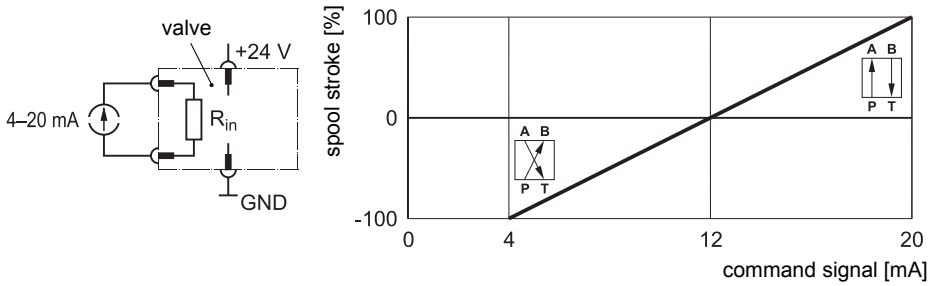
The input current I_{in} of the command inputs with current input signal must be between –25 mA and 25 mA!
Voltage levels in excess of 5 V may cause the destruction of the integrated valve electronics.

CAUTION

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

If there is no differential command input source available, the reference point for 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



Differential flow control command input 4–20 mA

Figure 14: Differential flow control command input 4–20 mA (circuit and characteristic curve)

For this signal type the input is configured as a differential current input with an input range of 4–20 mA.
The input current I_{in} to be measured is guided through both input pins to an internal current measuring shunt.
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

The differential input resistance R_{in} is 200 Ω.
The input resistance referenced to GND is approximately 150 kΩ.

CAUTION

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.

CAUTION

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 field bus interface in the valve software. Setting and activation can be performed for example with the Moog Valve Configuration Software.

CAUTION

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

If there is no differential command input source available, the reference point for 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

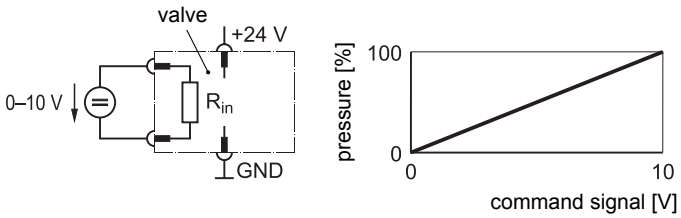


Figure 15: Differential pressure control command input 0–10 V (circuit and characteristic curve)

For this signal type the input is configured as a differential voltage input with an input range of 0–10 V.
The pressure in control port A is proportional to the input voltage U_{in}.

U_{in} = 10 V 100 % pressure in control port A

U_{in} = 0 V 0 % pressure in control port A

The differential input resistance R_{in} is 20 kΩ.
The input resistance referenced to GND is approximately 150 kΩ.

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

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

Signal type for the command input: 0–10 mA

Differential pressure control command input 0–10 mA

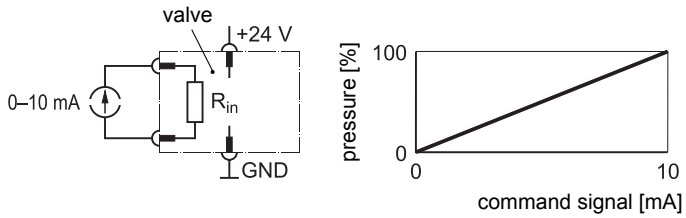


Figure 16: Differential pressure control command input 0–10 mA (circuit and characteristic curve)

For this signal type the input is configured as a differential current input with an input range of 0–10 mA.
The input current I_{in} to be measured is guided through both input pins to an internal current measuring shunt.
The pressure in control port A is proportional to the input current I_{in}.

I_{in} = 10 mA 100 % pressure in control port A

I_{in} = 0 mA 0 % pressure in control port A

The differential input resistance R_{in} is 200 Ω.
The input resistance referenced to GND is approximately 150 kΩ.

CAUTION

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.

CAUTION

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

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

Signal type for the command input: 4–20 mA

Differential pressure control command input 4–20 mA

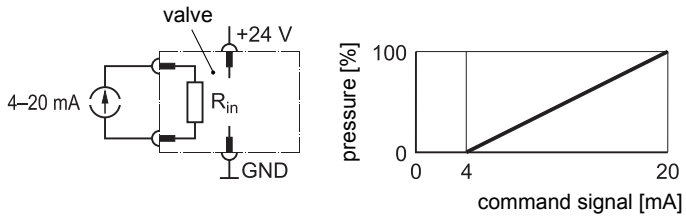


Figure 17: Differential pressure control command input 4–20 mA (circuit and characteristic curve)

For this signal type the input is configured as a differential current input with an input range of 4–20 mA.
The input current I_{in} to be measured is guided through both input pins to an internal current measuring 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 Ω.
The input resistance referenced to GND is approximately 150 kΩ.

CAUTION

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.

CAUTION

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 field bus interface in the valve software. Setting and activation can be performed for example with the Moog Valve Configuration Software.

CAUTION

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

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

3.4.2 Analog actual value outputs 4–20 mA

Analog actual value outputs

Depending on the model, the valve can be provided with different analog actual value outputs for flow and/or pressure control.

Pin assignment of valve connector X1:
⇨ Chapter "8.3 Valve connector X1", page 69

Conversion of actual value output signals I_{out} from 4–20 mA into 2–10 V:
⇨ Chapter "8.3.5 Conversion of actual value output signals I_{out}", page 77

The reference point for the 4–20 mA analog actual value outputs is GND.
The load resistance R_L must lie in the range of 0–150 Ω.

ⓘ External detection of electric cable faults can be realized with the 4–20 mA analog actual value outputs.

ⓘ The 4–20 mA actual value outputs are short-circuit protected.

3.4.2.1 Spool position actual value output

Spool position actual value output 4–20 mA

The output current I_{out} is proportional to the spool position.

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

3.4.2.2 Pressure actual value output

Pressure actual value output 4–20 mA

The output current I_{out} is proportional to the pressure in control port A.

I_{out} = 20 mA	100 % pressure in control port A
I_{out} = 4 mA	0 % pressure in control port A

3.4.3 Digital enable input

Enable input

The valves are provided with a digital enable input.
The transition of the valve into the standby state or the fail-safe state can also be initiated by corresponding signals at the enable input of valve connector X1:

- Signals between 8.5 V and 32 V referenced to GND at the enable input render the valve to standby.
- Depending on the model, signals lower than 6.5 V at the enable input render the valve in the mechanical or electrical fail-safe state.

Pin assignment of valve connector X1:
⇨ Chapter "8.3 Valve connector X1", page 69

Fail-safe state of the valves:
⇨ Chapter "3.2 Safety function/fail-safe", page 18

When connecting the digital enable input to 24 V direct voltage, the input current of the digital enable input is 2.3 mA.

3.5 Valve software

WARNING

Altering the configuration of the valve may change the function of the valve to such an extent that it will no longer function as specified in this user manual.
⇨ Chapter "9.3 Configuration of the valves", page 83

Incorrect configuration of the valves will result in danger due to:

- Uncontrolled sequences of motions
- Destruction
- Malfunction

Valve software

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

Configuration of the valves

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 be modified by a suitable field bus node, for example by the machine controller.
⇨ Chapter "9.3 Configuration of the valves", page 83

ⓘ If the valve is incorporated in a field bus, 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 Configuration Software is available as an accessory to simplify start-up, diagnosis and configuration of the valves.
⇨ Chapter "3.6 Moog Valve Configuration Software", page 39

3.6 Moog Valve Configuration Software

Moog Valve Configuration Software

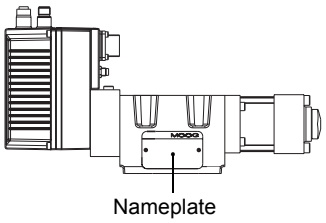
The Moog Valve Configuration Software is a Microsoft® Windows® application enabling fast and convenient start-up, diagnosis and configuration of the valves.
The Moog Valve Configuration Software communicates with the valves via the service or CAN bus interface. A PC with a suitable interface card is required for this purpose.

The Moog Valve Configuration Software offers the following functions:

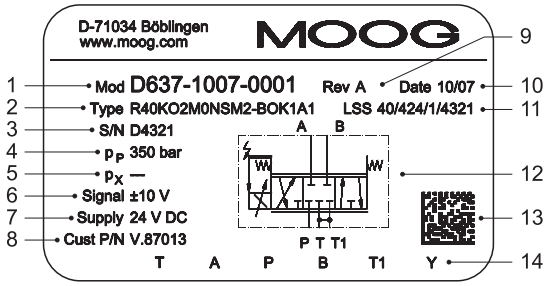
- Transfer of data between PC and valves
- Storage of the current valve settings on the PC
- Control of the valves with graphic software control elements
- Graphic representation of status information, command signals and actual values as well as characteristic curves for the valves
- Recording and visualization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

ⓘ The Moog Valve Configuration Software is available as accessories.
⇨ Chapter "13.1 Accessories", page 105

3.7 Nameplate



Nameplate



Item	Designation	Further information
1	Model number	⇨ Chapter "3.7.1 Model number", page 41
2	Type designation	Please refer to the D637-R/D639-R catalog for information on the individual positions in the type designation. ⇨ Chapter "1.2 Supplementing documents", page 3
3	Serial number	
4	Maximum operating pressure	⇨ Chapter "4.2 Hydraulic data", page 44
5	Not assigned	
6	Signal type for analog command inputs	⇨ Chapter "3.4.1 Signal types for analog command inputs", page 30
7	Supply voltage	Technical data: ⇨ Chapter "4.4 Electrical data", page 46 Pin assignment of valve valve connector X1: ⇨ Figure 38, page 73 to ⇨ Figure 40, page 75
8	Optional customer-specific designation	
9	Optional version identification	
10	Date of manufacture in MM/YY format	
11	LSS address (decimal)	⇨ Chapter "3.7.2 LSS address (Layer Setting Services)", page 41
12	Hydraulic symbol	
13	Data matrix code	⇨ Chapter "3.7.3 Data matrix code", page 41
14	Designation of ports	⇨ Chapter "7.2.2 Mounting pattern of mounting surface", page 61

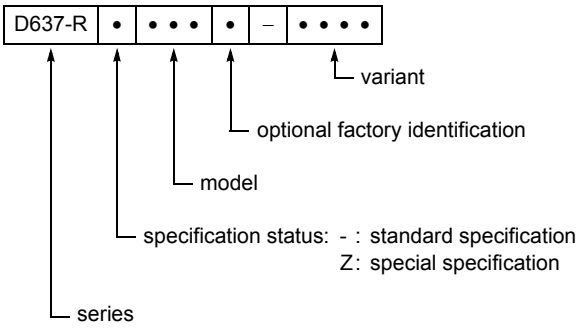
Figure 18: Nameplate (example)

ⓘ The type designation and the signal type for analog command inputs on the nameplate 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 Configuration Software.

3.7.1 Model number

Model number

The model number is set out as follows:



Example: D637-R-1007-0001

3.7.2 LSS address (Layer Setting Services)

LSS address

The decimal LSS address is set out as per CiA DSP 305 as follows and serves to provide the CAN bus node with an internationally unique identification:

40	/	product code	/	variant without leading zeros	/	serial number without country identification

manufacturer ID

⇨ Chapter "3.7.1 Model number", page 41

⇨ Figure 18, page 40, item 3

Example: 40/424/1/4321

ⓘ Even valves without CAN bus interfaces are assigned a decimal LSS address during manufacturing.

3.7.3 Data matrix code

Data matrix code

The data matrix code is a two-dimensional code. The code on the nameplate contains a character string which is set out as follows:

model number	#	optional version identification	#	serial number with country identification

⇨ Chapter "3.7.1 Model number", page 41

⇨ Figure 18, page 40, item 7

⇨ Figure 18, page 40, item 3

If there is no optional version identification, a blank space appears here.

Example: D637-R-1007-0001#A#D4321

For your notes.

4 Technical Data

WARNING **Observe and adhere to the technical data and in particular the information given on the valve nameplate.**

4.1 General technical data

WARNING **Use of the valves in potentially explosive environments is not permitted.**

CAUTION The valves must not be immersed in liquids!

General technical data

Version	Servovalve		
Mass	Approx. 7.9 kg (17.4 lb)		
Dimensions	⇨ Chapter "7.1 Dimensions (installation drawings)", page 58		
Installation position	In any position, fixed or moving; on valves with venting screws (D639-R): venting screw must point upwards ⓘ Observe the relevant safety instructions when mounting the valve. ⇨ Chapter "7 Mounting and Connection to the Hydraulic System", page 57		
Permissible ambient conditions	Ambient temperature [1]		
	For transportation/storage	Recommended	15 °C to 25 °C (59 to 77 °F) [2]
		Permissible	–40 °C to 80 °C (–40 to 176 °F) [2]
	For operation	–20 °C to 60 °C (–4 to 140 °F)	
	Rel. air humidity for storage	< 65 % not condensing	
	Vibration resistance [3]	30 g, 3 axes, frequency: 10 to 2000 Hz (as per DIN EN 60068-2-6)	
	Shock resistance [3]	50 g, 6 directions, half-sine 3 ms (as per DIN EN 60068-2-27)	

Table 11: General technical data

[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 is rendered in the 'DISABLED' valve state and therefore the mechanical fail-safe state.
⇨ Chapter "3.2 Safety function/fail-safe", page 18

[2] Temperature fluctuations > 10 °C (50 °F) must be avoided during storage.

[3] Transportation and storage should be as vibration- and shock-free as possible.

4.2 Hydraulic data

Valve construction type	Spool valve, one-stage, with bushing		
Actuation	Directly with permanent magnet linear force motor		
Pilot oil supply	None		
Nominal size and mounting pattern	NG10, mounting pattern as per ISO 4401-05-05-0-05, with or without leakage port Y ⇨ Chapter "3.3.3 Leakage port Y", page 28 ⇨ Chapter "7.2.2 Mounting pattern of mounting surface", page 61		
Diameter of ports	11.5 mm (0.45 in) ⇨ Chapter "7.2.2 Mounting pattern of mounting surface", page 61		
Sealing material	NBR, FKM, others on request		
Valve configurations	2-way, 3-way, 4-way and 2x2-way operation ⇨ Chapter "3.3.2 Valve configurations and hydraulic symbols", page 27		
Overlap	Zero lap, less than ±3 % or ±10 % positive overlap (model-dependent)		
Max. flow Q_{max}	180 l/min (48 gpm) ⇨ Chapter "5.1 Flow diagram (4-way operation)", page 49		
Rated flow Q_N	60/100 l/min (16/26 gpm) (model-dependent) (at Δp_N = 35 bar (508 psi) per control land: tolerance ±10 %)		
Max. leakage flow Q_L [1]	1.2/2 l/min (0.3/0.5 gpm) (model-dependent)		
Maximum operating pressure	Ports P and B	350 bar (5,075 psi)	
	Port A (for D637-R)	350 bar (5,075 psi)	
	Port A (for D639-R)	Dependent on pressure transducer, max. 350 bar (5,075 psi) ⇨ Chapter "4.2.1 Pressure range identification", page 45	
	Port T, T_1 without Y	50 bar (725 psi) ⇨ Chapter "3.3.3 Leakage port Y", page 28	
	Port T, T_1 with Y	350 bar (5,075 psi)	
	Port Y	Depressurized to tank	
Linearity of pressure control (D639-R only)	< 0.5 % of the maximum operating pressure in port A ⇨ Chapter "4.2.1 Pressure range identification", page 45		
Hydraulic fluid	Permissible fluids	Mineral-oil-based hydraulic oil as per DIN 51524-1 to DIN 51524-3 Other fluids on request	
	Permissible temperature [2]	–20 to 80 °C (–4 to 176 °F)	
	Viscosity ν	Recommended	15 to 100 mm²/s
		Permissible	5 to 400 mm²/s
	Cleanliness level, recommended (ISO 4406)	For functional safety	< 18/15/12
		For life cycle (wear and tear)	< 17/14/11
	ⓘ The cleanliness of the hydraulic fluid greatly influences the functional safety (safe positioning of the spool, high resolution) and the wear (control lands, pressure gain, leakage losses) of the valves. To avoid malfunctions and increased wear, we recommend that the hydraulic fluid be filtered accordingly.		

Table 12: Hydraulic data

[1] Typical values (measured at operating pressure p_P = 140 bar (2,030 psi), viscosity of hydraulic fluid ν = 32 mm²/s and temperature of hydraulic fluid T = 40 °C (104 °F))

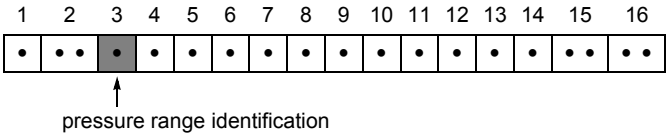
[2] The ambient temperature and the temperature of the hydraulic fluid influence the temperature of the valve electronics. In order to ensure that the electronic components integrated in the valve last as long as possible, we recommend that the hydraulic fluid be kept at as low a temperature as possible 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 is rendered in the 'DISABLED' valve state and therefore the mechanical fail-safe state.
⇨ Chapter "3.2 Safety function/fail-safe", page 18

4.2.1 Pressure range identification

Pressure range identification

The pressure range identification, i.e., the 3rd position in the valve type designation, indicates what maximum operating pressure is permissible in port A.
Type designation:⇨ Chapter "3.7 Nameplate", page 40

Type designation:



Ident.	Maximum operating pressure in port A	Series D637-R Q	Series D639-R p	Series D639-R pQ
W	25 bar (363 psi)		•	•
V	100 bar (1,450 psi)		•	•
U	160 bar (2,320 psi)		•	•
T	250 bar (3,625 psi)		•	•
K	350 bar (5,075 psi)	•	•	•
X	Special version		•	•

Table 13: 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.

4.3 Static and dynamic data

Static and dynamic data

Step response time for 0 to 100 % spool stroke[1]	15 ms (in Q-control) ⇨ Chapter "5.4 Step response and frequency response", page 52	
Hysteresis [1]	In Q-control	< 0.05 %, max. 0.1 %
	In p-control	Depending on controller optimization
Zero shift (typical)	< 1.5 % at ΔT = 55 K (in Q-control)	

Table 14: Static and dynamic data

[1] Typical values (measured at operating pressure p_P = 140 bar (2,030 psi), viscosity of hydraulic fluid ν = 32 mm²/s and temperature of hydraulic fluid T = 40 °C (104 °F))

4.4 Electrical data

Electrical data

Protection type	IP65 with mounted mating connectors or with mounted dust protection caps with sealing function (as per DIN EN 60529)	
EMC protection requirements	Immunity to interference as per DIN EN 61000-6-2:2005 (evaluation criterion A) With SELV/PELV power supply (order number: D137-003-001): immunity to interference as per DIN EN 55011:2003 Emitted interference as per DIN EN 61000-6-4:2005 (CAN bus and Profibus DP) or as per DIN EN 61000-6-3:2005 (EtherCAT) ⇨ Chapter "4.4.1 Electromagnetic compatibility (EMC)", page 47	
Supply voltage	Nominal 24 V (18–32 V) DC referenced to GND, recommended: SELV/PELV power supply as per EN 60204-1 At supply voltages less than 18 V, the valve is rendered in the fail-safe state. ⇨ Chapter "3.2.3 Fail-safe events", page 21	
External fuse protection for each valve	3.15 A slow-blowing fuse	
Duty cycle	100 %	
Valve connector X1	6+PE- or 11+PE-pin connector with pin contacts (as per DIN EN 175201-804) ⇨ Chapter "8.3 Valve connector X1", page 69	
Power consumption	P_{min} (motor in neutral position)	9.6 W at I = 0.4 A [1]
	P_{max} (at maximum flow)	67.2 W at I_{max} = 2.8 A [1] (for valves with Q_N = 60 l/min (16 gpm))
		36 W at I_{max} = 1.5 A [1] (for valves with Q_N = 100 l/min (26 gpm))
Inputs/outputs	Command input 0–10 V	R_{in} = 20 kΩ
	Command input ±10 V	R_{in} = 20 kΩ
	Command input 0–10 mA	R_{in} = 200 Ω
	Command input ±10 mA	R_{in} = 200 Ω
	Command input 4–20 mA	R_{in} = 200 Ω
	Actual value output 4–20 mA	R_L = 0–500 Ω to GND
	Enable input	Signals between 8.5 V and 32 V referenced to GND at the enable input render the valve to standby. Depending on the model, signals lower than 6.5 V at the enable input render the valve in the mechanical or electrical fail-safe state. ⇨ Chapter "3.4.3 Digital enable input", page 38

Table 15: Electrical data

[1] Current consumption I and I_{max} measured at ambient temperature T_A = 25 °C (77 °F) and supply voltage U = 24 V DC

4.4.1 Electromagnetic compatibility (EMC)

Electromagnetic compatibility (EMC)

The valves satisfy the EMC protection requirements for immunity to interference as per DIN EN 61000-6-2:2005 (evaluation criterion A).
When the SELV/PELV power supply (order number: D137-003-001) is used as power supply, the valves satisfy the EMC protection requirements for immunity to interference as per DIN EN 55011:2003.
The valves satisfy the EMC protection requirements for emitted interference as per DIN EN 61000-6-4:2005 (CAN bus and Profibus DP) or as per DIN EN 61000-6-3:2005 (EtherCAT).

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
  ⇨ Chapter "13.1 Accessories", page 105
- Adequate shielding
- Design of equipotential bonding system, protective grounding and electrical shielding as per "TN 353"

4.5 Emissions

Environmental protection: Emissions

WARNING

The magnets in the permanent magnet linear force motor create strong magnetic fields, which can have a disruptive effect on sensitive devices, such as e.g., cardiac pacemakers. The relevant safe distances appropriate for the device must be observed.

CAUTION

Depending on the application, significant levels of noise may be generated when the valves are operated.
If necessary, the manufacturer and operator of the machine must take appropriate sound insulation measures or stipulate that suitable safety equipment, such as e.g., ear protection, be worn.

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

For your notes.

5 Characteristic Curves

5.1 Flow diagram (4-way operation)

Flow diagram (4-way operation)

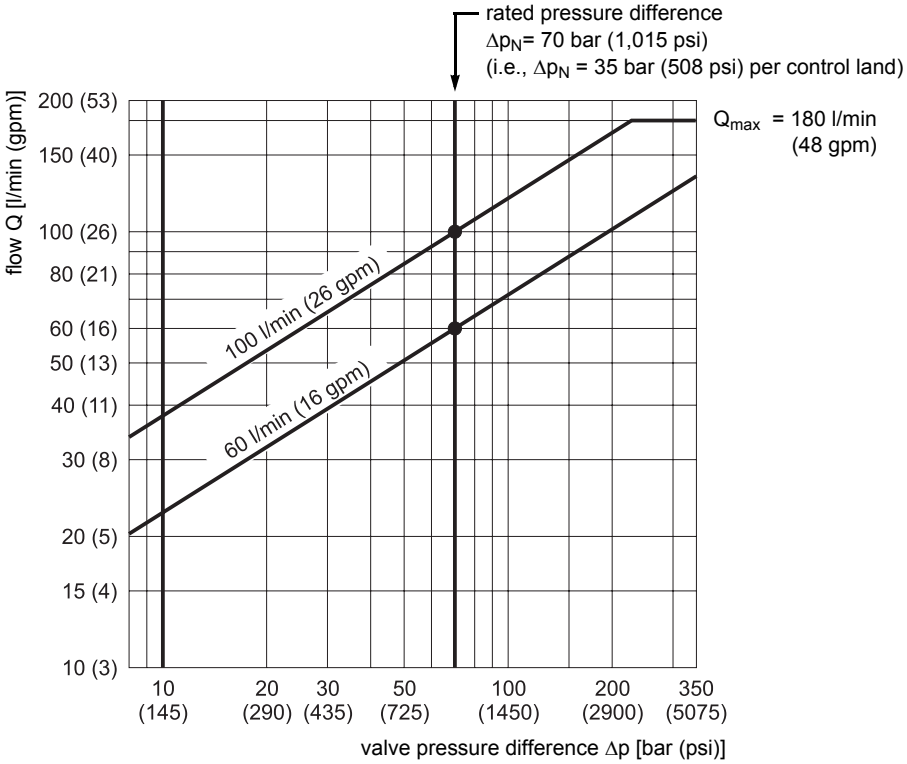


Figure 19: Flow diagram (4-way operation)

The flow that is set depends not only on the spool position but also on the pressure difference Δp at the individual control lands.

Formula for calculating the flow Q

A flow control command signal of 100 % produces with a rated pressure difference of Δp_N = 35 bar (508 psi) per control land the rated flow Q_N. If the pressure difference is altered, the flow Q also changes with a constant command signal in accordance with the following formula:

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

Q [l/min (gpm)] : actual flow
Q_N [l/min (gpm)] : rated flow
Δp [bar (psi)] : actual pressure difference per control land
Δp_N [bar (psi)] : rated pressure difference
Δp_N = 35 bar (508 psi) per control land

ⓘ To avoid cavitation, the flow speed of the actual flow Q calculated in this way at ports (A, B, P, T, etc.) must not be too great.
In typical applications the maximum permissible flow speed is 30 m/s (approx. 100 ft/s).

⇨ Chapter "3.3.1.1 Flow control (Q-control)", page 24

5.2 Flow signal characteristic curve [1]

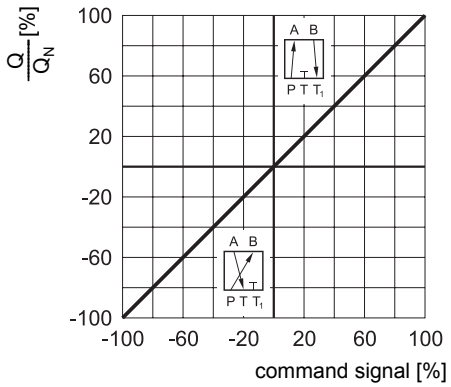


Figure 20: Flow signal characteristic curve with equal electrical and hydraulic zero position

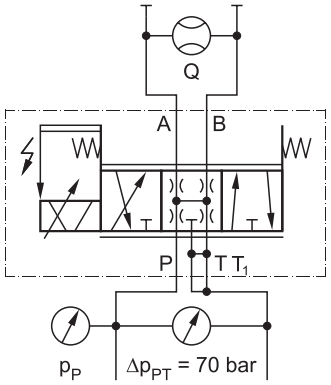


Figure 21: Setup for measuring the flow signal characteristic curve

Flow signal characteristic curve

5.3 Pressure signal characteristic curves [1]

5.3.1 Valves with controlled spool position

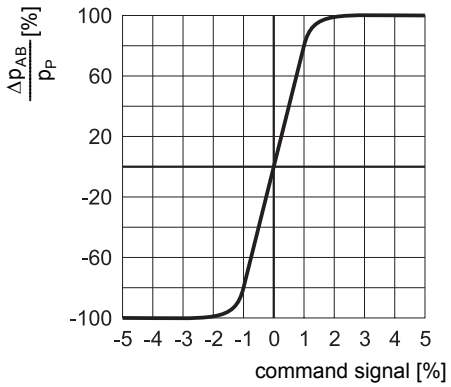


Figure 22: Pressure signal characteristic curve of the valves with controlled spool position and zero lap

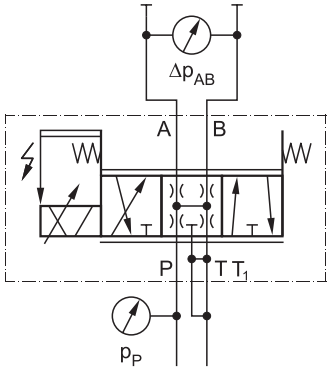


Figure 23: Setup for measuring the pressure signal characteristic curve on valves with controlled spool position

Pressure signal characteristic curve of the valves with controlled spool position and zero lap

[1] Typical characteristic curves (measured at operating pressure p_P = 140 bar (2,030 psi), viscosity of hydraulic fluid ν = 32 mm^2/s and temperature of hydraulic fluid T = 40 °C (104 °F))

5.3.2 Pressure control valves

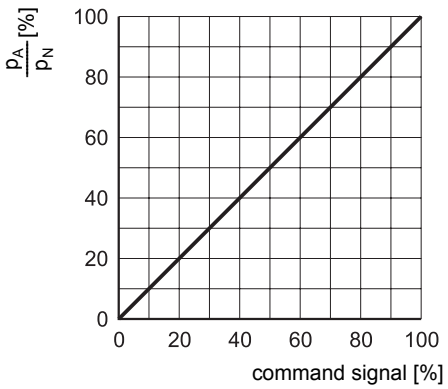


Figure 24: Pressure signal characteristic curve of the pressure control valves

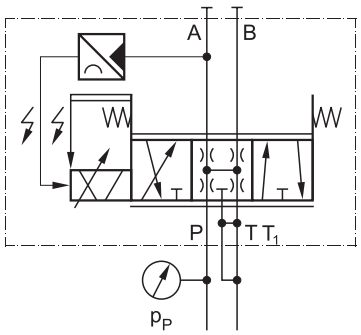


Figure 25: Setup for measuring the pressure signal characteristic curve on pressure control valves

Pressure signal characteristic curve of the pressure control valves

5.4 Step response and frequency response [1]

Step response of the spool stroke

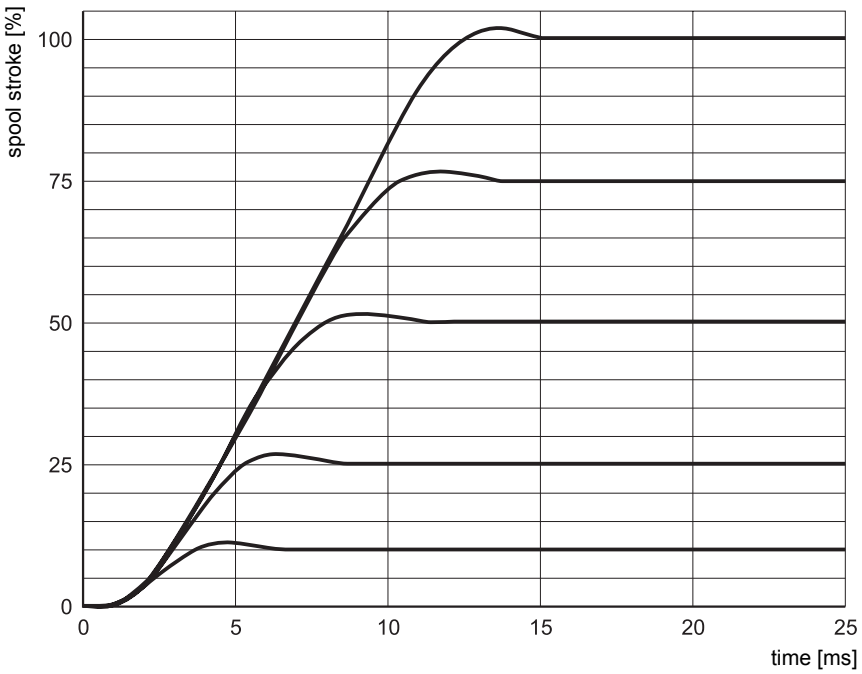


Figure 26: Step response of the spool stroke for valves with Q_N = 60 l/min (16 gpm)

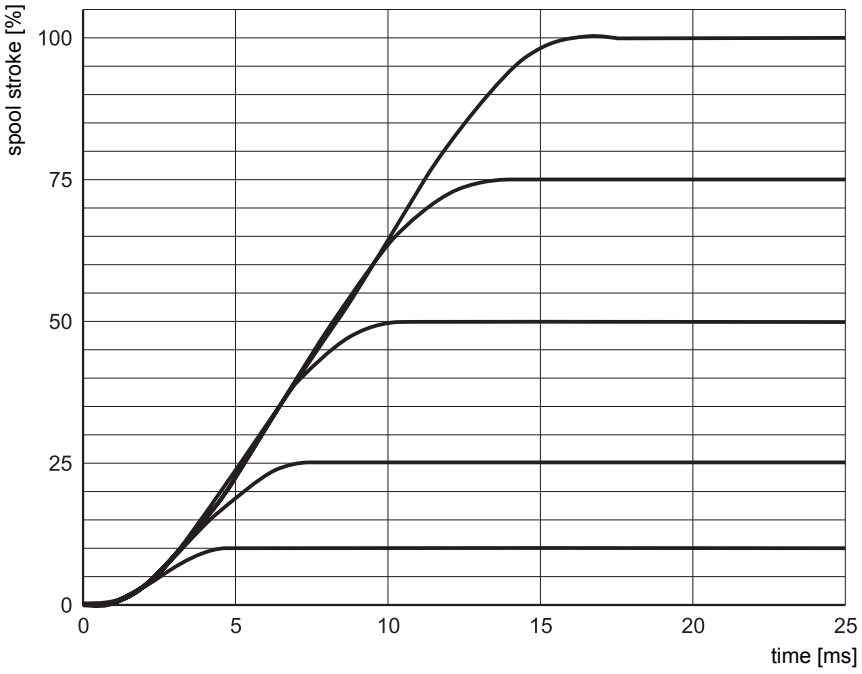


Figure 27: Step response of the spool stroke for valves with Q_N = 100 l/min (26 gpm)

[1] Typical characteristic curves (measured at operating pressure p_P = 140 bar (2,030 psi), viscosity of hydraulic fluid ν = 32 mm^2/s and temperature of hydraulic fluid T = 40 °C (104 °F))

Frequency response of the spool stroke

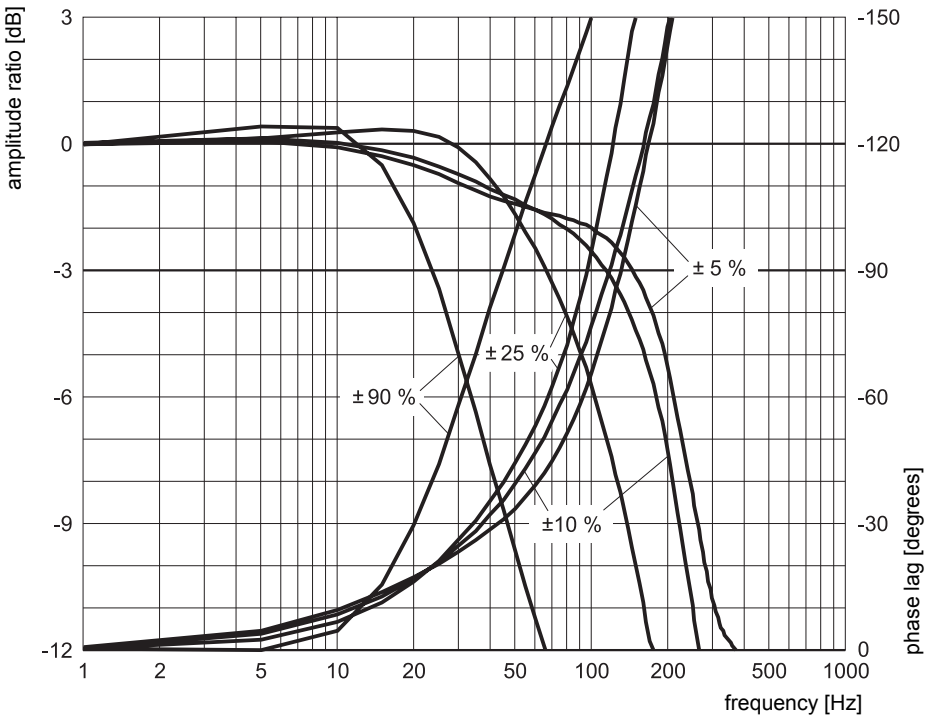


Figure 28: Frequency response of the spool stroke for valves with Q_N = 60 l/min (16 gpm)

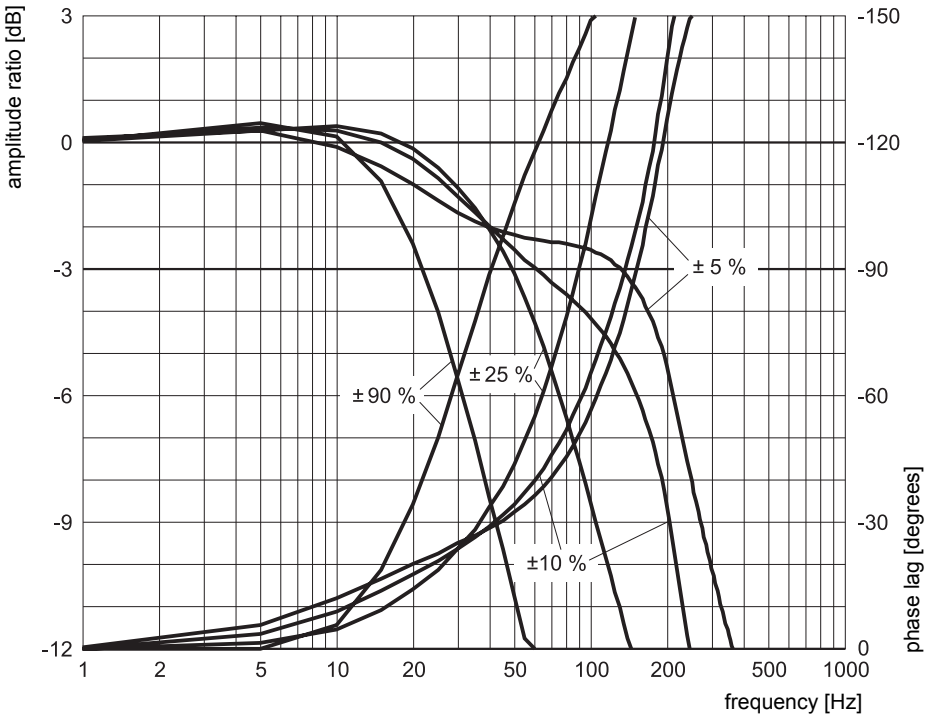


Figure 29: Frequency response of the spool stroke for valves with Q_N = 100 l/min (26 gpm)

For your notes.

6 Transportation and Storage

Safety instructions: Transportation and storage

WARNING

The permissible ambient conditions for the valves must be maintained at all times including transportation and storage.

⇨ Chapter "4 Technical Data", page 43

The valves must be protected in particular to prevent entry of dust and moisture.

Fault-free, reliable and safe operation cannot be guaranteed if the above requirements are not observed.

WARNING

The valves must not be transported or stored without their shipping plate mounted.

This is the only way of adequately protecting the valves against the ingress of dirt and moisture and protecting the seals against the effects of ozone and UV.

CAUTION

To provide protection against 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 e.g., mounting or removing, electrical or hydraulic connection, troubleshooting or servicing, and when handling the valves, accessories, tools or hydraulic fluids.

⇨ Chapter "2.6 Occupational safety and health", page 9

CAUTION

The valve shipping plate may only be removed from the valve hydraulic ports directly prior to mounting and must be re-mounted directly after the valve has been removed. This is the only way of adequately protecting the valves against the ingress of dirt and moisture and protecting the seals against the effects of ozone and UV.

The shipping plate and the associated fastening elements (screws and nuts) must be kept for later use, e.g., during transportation.

CAUTION

Do not misuse the connectors, mating connectors (plugs) and connection cables of the valves, e.g., as a tread or transport fixture.

CAUTION

To avoid condensation after the valves have been transported or stored, wait until they have reached the ambient temperature before starting up the valves.

CAUTION

To avoid damage, always transport or store valves, spare parts and accessories only in the properly sealed original packaging.

CAUTION

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, immediately notify us or the responsible supplier.

In the event of transportation damage, store the damaged packaging so that if necessary damages can be claimed from the transport contractor.

6.1 Unpacking/checking a delivery

Unpacking/checking a delivery

Procedure:

1. Check whether the packaging is damaged.
2. Remove the packaging.
3. Store the damaged packaging so that if necessary damages can be claimed from the transport contractor.
   We recommend that you also keep the undamaged original packaging for later transportation or storage operations.
4. Dispose of the packaging material no longer needed in accordance with the relevant national waste disposal regulations and environmental protection provisions.
5. Check whether the packaging contents is damaged.
6. In the event of damaged packaging or damaged contents, immediately notify us or the responsible supplier.
7. Check whether the delivery corresponds to the order and the delivery note.
8. In the event of wrong or incomplete delivery, immediately notify us or the responsible supplier.

6.2 Scope of delivery of the valve

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
- 5 O-rings ID 12.4 x Ø 1.8 [mm] (ID 0.488 x Ø 0.071 [in])
  for ports A, B, P, T and T_1
- 2 O-rings ID 15.6 x Ø 1.8 [mm] (ID 0.614 x Ø 0.071 [in])
  for port Y and O-ring recess X

6.3 Storage

Effects of long-term storage

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

- Sealing 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.

7 Mounting and Connection to the Hydraulic System

Safety instructions: Mounting and Connection to the Hydraulic System

WARNING

During operation, do not carry out any work, such as e.g., mounting or removal, electrical or hydraulic connection, troubleshooting or servicing, on the valves or the machine.
Failure to comply with this requirement results in danger due to:

- Hydraulic fluid squirting out under pressure
- Uncontrolled sequences of motions
- Destruction
- Malfunction

Before working on the valves or the machine, shut down and switch off the machine without fail and de-energize and depressurize the machine.
For this purpose, switch off the supply voltage of the valves as well as the supply voltage of the connected peripherals, such as e.g., externally powered transducers or programming units.

Secure the machine without fail against restarting.
Examples of suitable securing measures:

- Lock the main command device and remove the key
- Attach a warning sign to the master switch

WARNING

Hydraulic fluid squirting out under high pressure can cause serious personal injuries, burns and fires.
Depressurize all hydraulic lines and accumulators in the hydraulic circuit before mounting or removing, electrical or hydraulical connection, start-up, troubleshooting or servicing.

WARNING

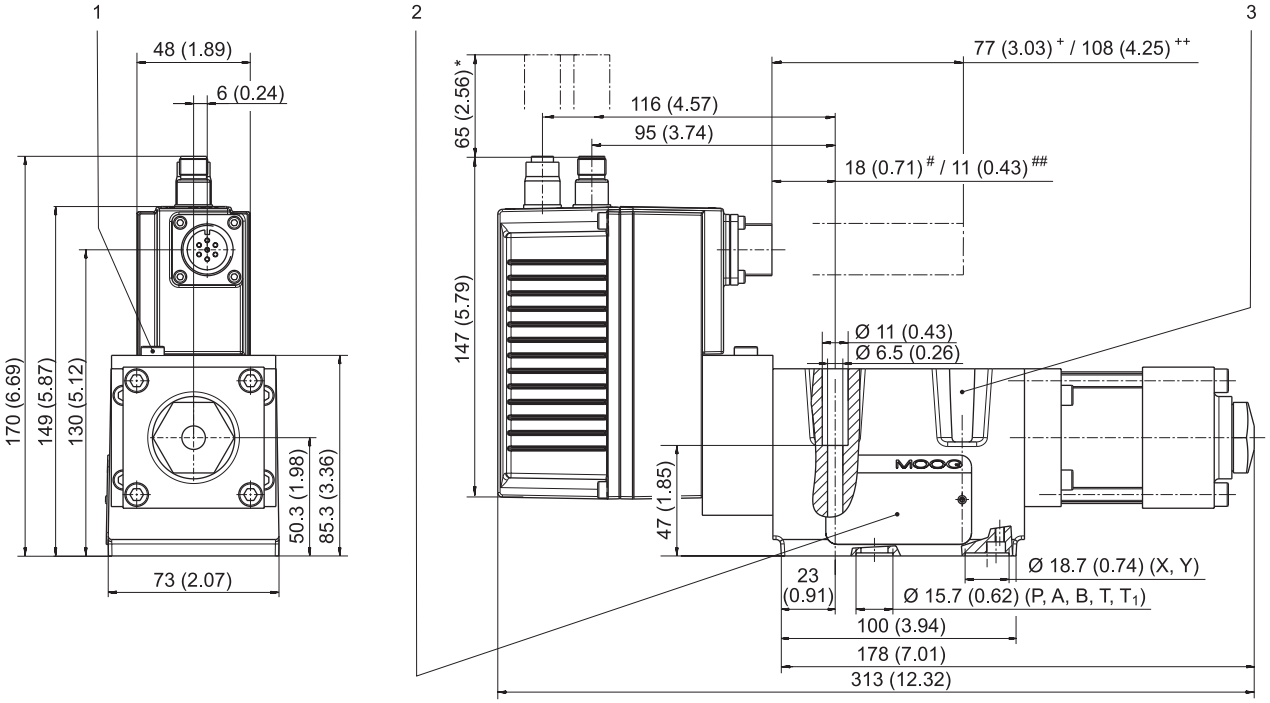
Only properly qualified and authorized users may work with and on the valves.
⇨ Chapter "2.4 Selection and qualification of personnel", page 8

CAUTION

To provide protection against 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 e.g., mounting or removing, electrical or hydraulic connection, troubleshooting or servicing, and when handling the valves, accessories, tools or hydraulic fluids.
⇨ Chapter "2.6 Occupational safety and health", page 9

7.1 Dimensions (installation drawings)

7.1.1 Valves with CAN bus interface



+ Removal room for the mating connector of the 6+PE-pin valve connector X1
⇨ Chapter "3.1.5.1 Valve connector X1", page 16

++ Removal room for the mating connector of the 11+PE-pin valve connector X1
⇨ Chapter "3.1.5.1 Valve connector X1", page 16

Dimension for the mating connector of the 6+PE-pin valve connector X1

Dimension for the mating connector of the 11+PE-pin valve connector X1

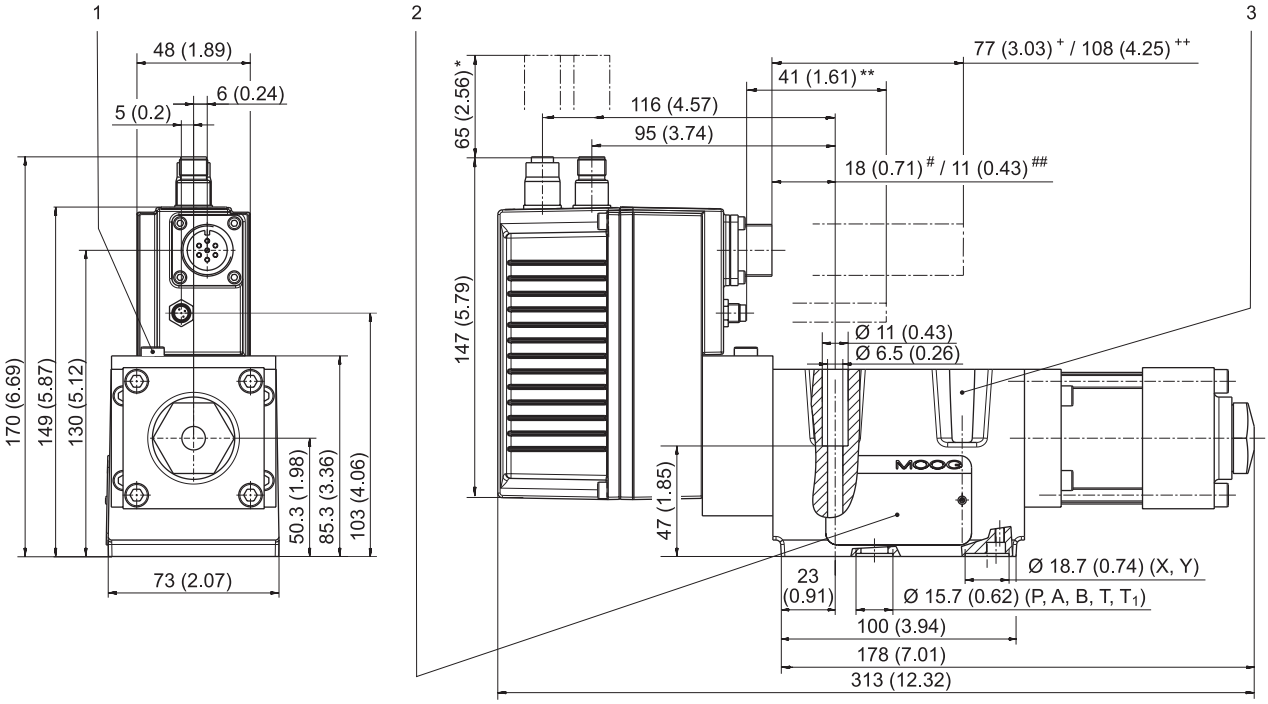
* Removal room for the mating connector of the field bus connectors X3 and X4
⇨ Chapter "3.1.5.2 Field bus connectors X3 and X4", page 17
⇨ Chapter "9.3.1 Configuration via the field bus interface", page 83

Item	Designation	Further information
1	Venting screw	The venting screw is only provided on D639-R series valves. ⇨ Chapter "9.5.1 Venting", page 87
2	Nameplate	⇨ Chapter "3.7 Nameplate", page 40
3	Installation screw or attachment screw of the shipping plate	⇨ Chapter "7.3.2 Specification for installation screws", page 62 ⇨ Chapter "7.2.2 Mounting pattern of mounting surface", page 61

Figure 30: Installation drawing for valves with CAN bus interface, dimensions in mm (inches)

Hydraulic symbols: ⇨ Chapter "3.3.2 Valve configurations and hydraulic symbols", page 27
Procedure for mounting the valve: ⇨ Chapter "7.3.3 Procedure", page 62
Position of the ports: ⇨ Chapter "7.2.2 Mounting pattern of mounting surface", page 61

7.1.2 Valves with Profibus or EtherCAT interface



+ Removal room for the mating connector of the 6+PE-pin valve connector X1
⇨ Chapter "3.1.5.1 Valve connector X1", page 16

++ Removal room for the mating connector of the 11+PE-pin valve connector X1
⇨ Chapter "3.1.5.1 Valve connector X1", page 16

Dimension for the mating connector of the 6+PE-pin valve connector X1

Dimension for the mating connector of the 11+PE-pin valve connector X1

* Removal room for the mating connector of the field bus connectors X3 and X4
⇨ Chapter "3.1.5.2 Field bus connectors X3 and X4", page 17
⇨ Chapter "9.3.1 Configuration via the field bus interface", page 83

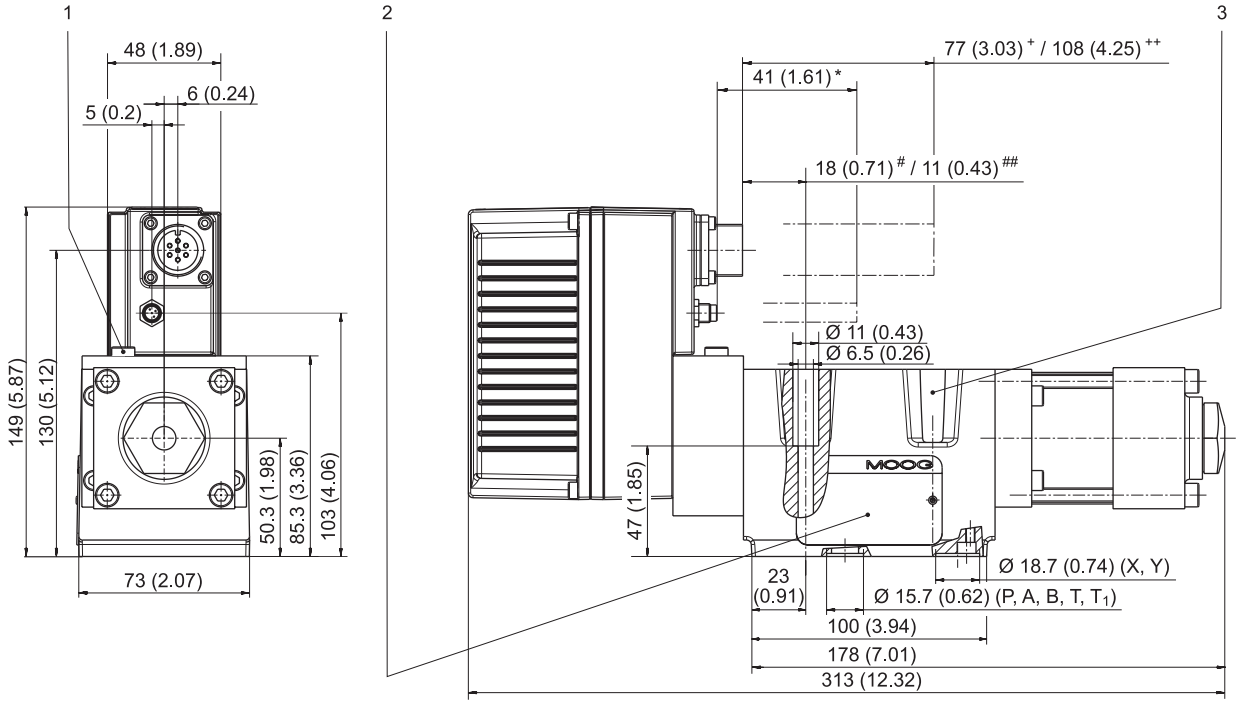
** Removal room for the adapter of the service connector X10
⇨ Chapter "3.1.5.3 Service connector X10", page 17
⇨ Chapter "9.3.2 Configuration via the service interface", page 85

Item	Designation	Further information
1	Venting screw	The venting screw is only provided on D639-R series valves. ⇨ Chapter "9.5.1 Venting", page 87
2	Nameplate	⇨ Chapter "3.7 Nameplate", page 40
3	Installation screw or attachment screw of the shipping plate	⇨ Chapter "7.3.2 Specification for installation screws", page 62 ⇨ Chapter "7.2.2 Mounting pattern of mounting surface", page 61

Figure 31: Installation drawing for valves with Profibus or EtherCAT interface, dimensions in mm (inches)

Hydraulic symbols: ⇨ Chapter "3.3.2 Valve configurations and hydraulic symbols", page 27
Procedure for mounting the valve: ⇨ Chapter "7.3.3 Procedure", page 62
Position of the ports: ⇨ Chapter "7.2.2 Mounting pattern of mounting surface", page 61

7.1.3 Valves without field bus interface



+ Removal room for the mating connector of the 6+PE-pin valve connector X1
⇨ Chapter "3.1.5.1 Valve connector X1", page 16

++ Removal room for the mating connector of the 11+PE-pin valve connector X1
⇨ Chapter "3.1.5.1 Valve connector X1", page 16

Dimension for the mating connector of the 6+PE-pin valve connector X1

Dimension for the mating connector of the 11+PE-pin valve connector X1

* Removal room for the adapter of the service connector X10
⇨ Chapter "3.1.5.3 Service connector X10", page 17
⇨ Chapter "9.3.2 Configuration via the service interface", page 85

Item	Designation	Further information
1	Venting screw	The venting screw is only provided on D639-R series valves. ⇨ Chapter "9.5.1 Venting", page 87
2	Nameplate	⇨ Chapter "3.7 Nameplate", page 40
3	Installation screw or attachment screw of the shipping plate	⇨ Chapter "7.3.2 Specification for installation screws", page 62 ⇨ Chapter "7.2.2 Mounting pattern of mounting surface", page 61

Figure 32: Installation drawing for valves without field bus interface, dimensions in mm (inches)

Hydraulic symbols: ⇨ Chapter "3.3.2 Valve configurations and hydraulic symbols", page 27
Procedure for mounting the valve: ⇨ Chapter "7.3.3 Procedure", page 62
Position of the ports: ⇨ Chapter "7.2.2 Mounting pattern of mounting surface", page 61

7.2 Mounting surface

If the valve is mounted on the mounting surface, it projects over the mounting surface.
Valve dimensions:
⇨ Chapter "7.1 Dimensions (installation drawings)", page 58

7.2.1 Surface quality

Evenness and roughness of the mounting surface

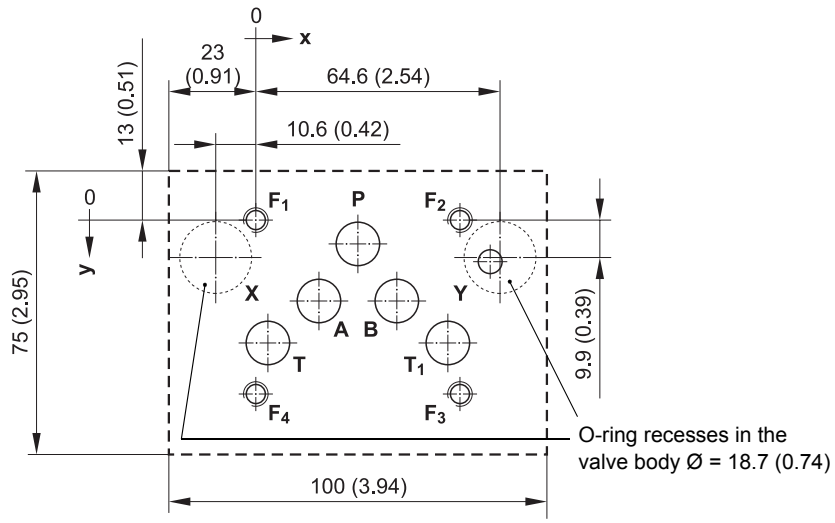
Evenness as per DIN EN ISO 1302:	< 0.01 mm (0.00039 in) over 100 mm (3.94 in)
Average surface finish R_a as per DIN EN ISO 1302:	< 0.8 µm (0.000030 in)

7.2.2 Mounting pattern of mounting surface

CAUTION

Contrary to ISO 4401-05-05-0-05 the length of the mounting surface must be at least 100 mm (3.94 in) so that the required O-ring recesses can be covered on ports X and Y.

Mounting pattern of mounting surface



	P	A	T	T_1 optional	B	F_1	F_2	F_3	F_4	X	Y
	Ø 11.2 (0.44)	Ø 11.2 (0.44)	Ø 11.2 (0.44)	Ø 11.2 (0.44)	Ø 11.2 (0.44)	M6	M6	M6	M6	-	Ø 6.3 (0.25)
x	27 (1.06)	16.7 (0.66)	3.2 (0.13)	50.8 (2.00)	37.3 (1.47)	0	54 (2.13)	54 (2.13)	0	-	62 (2.44)
y	6.3 (0.25)	21.4 (0.84)	32.5 (1.28)	32.5 (1.28)	21.4 (0.84)	0	0	46 (1.81)	46 (1.81)	-	11 (0.43)

Figure 33: Mounting pattern of mounting surface as per ISO 4401-05-05-0-05, dimensions in mm (inches)

7.3 Mounting the valves

7.3.1 Tools and materials required

Tools and materials required for mounting the valves

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

- Flat-bladed screwdriver 8x1.6 [mm] and if necessary open-ended wrench WAF 10
  (for removing the shipping plate)
- Torque wrench for hexagon socket head cap screws WAF 5
  (for mounting the valve)
- Installation screws
  ⇨ Chapter "7.3.2 Specification for installation screws", page 62
- If necessary, spare port O-rings
  ⇨ Chapter "13.2 Spare parts", page 107

ⓘ The installation screws and spare O-rings are not included in the valves' scope of delivery. They are available as accessories.
⇨ Chapter "13.1 Accessories", page 105

7.3.2 Specification for installation screws

Specification for installation screws

Hexagon socket head cap screws as per DIN EN ISO 4762	Quality class	Number required	Tightening torque
M6x60	10.9	4	11 Nm (8.1 lbf ft) ± 10 %

Table 16: Specification for installation screws

7.3.3 Procedure

Safety instructions: Mounting the valves

WARNING

Use the installation screws specified here for mounting the valve. The shipping plate attachment screws must not under any circumstances be used to mount the valve. Secure valve mounting cannot be guaranteed in such a case.
Specification for installation screws: ⇨ Table 16, page 62

CAUTION

The valve shipping plate may only be removed from the valve hydraulic ports directly prior to mounting and must be remounted directly after the valve has been removed. This is the only way of adequately protecting the valves against the ingress of dirt and moisture and protecting the seals against the effects of ozone and UV.
The shipping plate and the associated fastening elements (screws and nuts) must be kept for later use, e.g., during transportation.

CAUTION

To prevent the valve from overheating, mount the valve so as to ensure adequate ventilation.
Do not mount the valve directly on machine parts which 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.

CAUTION

Mount the valves with venting screw (D639-R) in such a way that they can be vented. In order to allow air that may be contained in the valve to escape after the venting screw is opened, make sure the venting screw points upwards.
⇨ Chapter "9.5.1 Venting", page 87
Position of the venting screw: ⇨ Figure 1, page 12

CAUTION

The valve connecting surface and the mounting surface must be free of residues and dirt when the valve is about to be mounted.
Use a clean, soft and fluff-free cloth to clean the connecting and mounting surfaces. Do not use cleaning wool. Do not use any cleaning agents or methods which could attack the surfaces or the O-rings mechanically or chemically.

Procedure:

Procedure for mounting the valves

1. Clean the valve connecting surface and the mounting surface.
   Check and if necessary correct the evenness and roughness of the mounting surface.
   ⇨ Chapter "7.2.1 Surface quality", page 61
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 for presence, elasticity, integrity and correct seating of the O-rings in the valve ports (A, B, P, T, etc.).
   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 it 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: 11 Nm (8.1 lbf ft) ± 10 %
   ⇨ Chapter "7.3.2 Specification for installation screws", page 62

For your notes.

8 Electrical Connection

Safety instructions: Electrical Connection

WARNING

During operation, do not carry out any work, such as e.g., mounting or removal, electrical or hydraulic connection, troubleshooting or servicing, on the valves or the machine.
Failure to comply with this requirement results in danger due to:

- Hydraulic fluid squirting out under pressure
- Uncontrolled sequences of motions
- Destruction
- Malfunction

Before working on the valves or the machine, shut down and switch off the machine without fail and de-energize and depressurize the machine.
For this purpose, switch off the supply voltage of the valves as well as the supply voltage of the connected peripherals, such as e.g., externally powered transducers or programming units.

Secure the machine without fail against restarting.
Examples of suitable securing measures:

- Lock the main command device and remove the key
- Attach a warning sign to the master switch

WARNING

Hydraulic fluid squirting out under high pressure can cause serious personal injuries, burns and fires.
Depressurize all hydraulic lines and accumulators in the hydraulic circuit before mounting or removing, electrical or hydraulical connection, start-up, troubleshooting or servicing.

WARNING

Only properly qualified and authorized users may work with and on the valves.
⇨ Chapter "2.4 Selection and qualification of personnel", page 8

WARNING

Touching electrically live parts exposes the user/operator to the risk of:

- Electric shock
- Uncontrolled sequences of motions
- Destruction
- Malfunction

Touching electrically live parts must therefore be avoided!

CAUTION

To provide protection against 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 e.g., mounting or removing, electrical or hydraulic connection, troubleshooting or servicing, and when handling the valves, accessories, tools or hydraulic fluids.
⇨ Chapter "2.6 Occupational safety and health", page 9

CAUTION

Do not misuse the connectors, mating connectors (plugs) and connection cables of the valves, e.g., as a tread or transport fixture.

CAUTION

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

The protective earth connection is connected to the valve electronics housing or valve body.
The insulation materials employed are designed for use in the safety extra-low-voltage range.
The circuits of the field bus connections, if provided, are only functionally galvanically isolated from the other connected circuits.
To comply with safety regulations requires isolation from the mains as per EN 61558-1 and EN 61558-2-6 and limiting all voltages as per EN 60204-1.
We recommend using SELV/PELV power supplies.
Electrical connections must be conducted in compliance with EMC requirements.

CAUTION

Dirt or moisture can get into the valve through open connectors, i.e., if no mating connector is attached, which may result in damage to the valve.
Open connectors must be covered and sealed.
The plastic dust protection cap which is attached to service connector X10 on delivery is suitable for use as sealing cover.
The plastic dust protection caps which are attached to field bus connectors X3 and X4 on delivery are not suitable for use as sealing covers.
Suitable metallic dust protection caps for field bus connectors X3 and X4 are available as accessories.
⇨ Chapter "13.1 Accessories", page 105

8.1 Wiring

8.1.1 Tools and materials required

Tools and materials required for electrically connecting the valves

The following are required for electrically connecting the valves:

- Mating connector of valve connector X1
  (6+PE- or 11+PE-pin depending on model)
- Connection cables for mating connector
- Crimping tool for mating connector
- Installation tool
- Tool insert for crimping tool

The above-mentioned connectors, cables and tools are not included in the valves' scope of delivery. They are available separately.
⇨ Chapter "13 Accessories and Spare Parts", page 105

8.1.2 Electrical connection of the valves

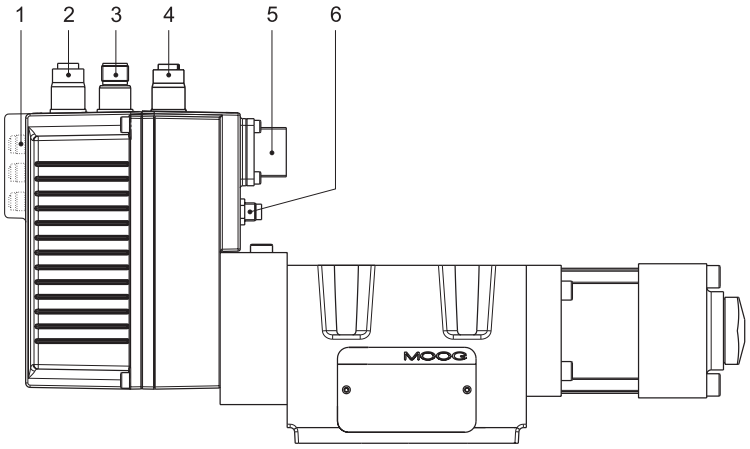
Procedure for electrically connecting the valves

Procedure:

1. Conduct electrical connection in accordance with the pin assignment.
   ⇨ Chapter "8.3 Valve connector X1", page 69
2. Establish equipotential bonding, protective grounding and shielding as per "TN 353" and "TN 494".
3. For valves with field bus interface: carry out field bus wiring.
4. Check whether all of the connectors to which no mating connector is attached are covered with a suitable dust protection cap.
   If necessary, attach a dust protection cap.

8.2 Arrangement of the connectors

Arrangement of the connectors on the valve electronics housing



Item	X	Further information
1	X5…X7	The analog input connectors X5…X7 are only provided on valves with axis control function (ACV).
2	X4	The field bus connectors X3 and X4 are only provided on valves with field bus interfaces. ⇨ Chapter "3.1.5.2 Field bus connectors X3 and X4", page 17 ⇨ Chapter "9.3.1 Configuration via the field bus interface", page 83
3	X3	
4	X2	The digital signal interface connector X2 is only provided on valves with axis control function (ACV).
5	X1	⇨ Chapter "3.1.5.1 Valve connector X1", page 16
6	X10	The service connector X10 is only provided on valves without CAN bus interfaces. ⇨ Chapter "3.1.5.3 Service connector X10", page 17 ⇨ Chapter "9.3.2 Configuration via the service interface", page 85

Figure 34: Arrangement of the connectors on the valve electronics housing (maximum equipment specification)

8.3 Valve connector X1

Valve connector X1

CAUTION

At the differential command inputs (pins D and E for 6+PE or pins 4, 5 and 7 for 11+PE) the potential difference (measured to pin B for 6+PE or pin 10 for 11+PE) must be between –15 V and 32 V.

CAUTION

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.

CAUTION

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 field bus interface in the valve software. Setting and activation can be performed for example with the Moog Valve Configuration Software.

Detailed information on the individual command inputs:
⇨ Chapter "3.4.1 Signal types for analog command inputs", page 30

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

Basically, it is preferable to use differential signals on the command inputs. If the command signal cannot be transmitted differentially, the reference point for the command input at the valve must be connected to ground (GND).
⇨ Chapter "8.3.4 Single-ended command signals", page 76

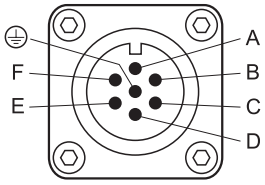
8.3.1 Mating connector of valve connector X1

Mating connector of valve connector X1

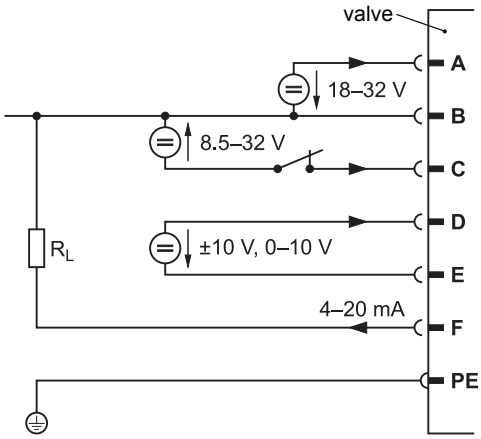
The mating connector of valve connector X1 is available as accessories.
⇨ Chapter "13.1 Accessories", page 105

8.3.2 Pin assignment of the 6+PE-pin valve connector X1

8.3.2.1 Differential voltage inputs ±10 V and 0–10 V



view of valve connector X1

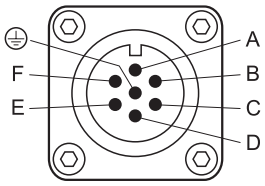


6+PE-pin valve connector X1 of valves with differential voltage inputs ±10 V and 0–10 V (signal type identification: M)

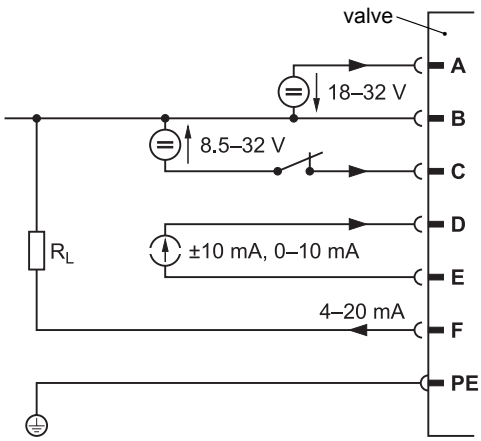
Pin	Assignment	Description
A	Supply voltage	Nominal 24 V (18–32 V) DC referenced to GND
B	GND	Supply zero or signal zero
C	Enable input	8.5–32 V referenced to GND: valve on standby < 6.5 V referenced to GND: fail-safe state of the valve ⇨ Chapter "3.4.3 Digital enable input", page 38
D	Command input	U_{in} = ±10 V or U_{in} = 0–10 V R_{in} = 20 kΩ
E	Reference point for the command input	
F	Actual value output	I_{out} = 4–20 mA referenced to GND (I_{out} is proportional to the spool position or the controlled pressure (for D639-R); the output is short-circuit protected); R_L = 0–500 Ω to GND ⇨ Chapter "8.3.5 Conversion of actual value output signals I_{out}", page 77
PE ⏚	Protective earth contact	Leading contact Connect protective grounding as per "TN 353"

Figure 35: 6+PE-pin valve connector X1 of valves with differential voltage inputs ±10 V and 0–10 V (circuit and pin assignment)

8.3.2.2 Differential current inputs ±10 mA and 0–10 mA



view of valve connector X1

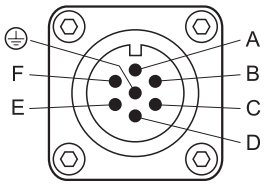


6+PE-pin valve connector X1 of valves with differential current inputs ±10 mA and 0–10 mA (signal type identification: X)

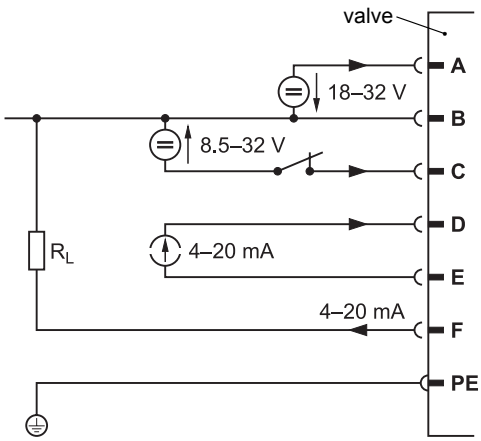
Pin	Assignment	Description
A	Supply voltage	Nominal 24 V (18–32 V) DC referenced to GND
B	GND	Supply zero or signal zero
C	Enable input	8.5–32 V referenced to GND: valve on standby < 6.5 V referenced to GND: fail-safe state of the valve ⇨ Chapter "3.4.3 Digital enable input", page 38
D	Command input	I_{in} = ±10 mA or I_{in} = 0–10 mA R_{in} = 200 Ω
E	Reference point for the command input	
F	Actual value output	I_{out} = 4–20 mA referenced to GND (I_{out} is proportional to the spool position or the controlled pressure (for D639-R); the output is short-circuit protected); R_L = 0–500 Ω to GND ⇨ Chapter "8.3.5 Conversion of actual value output signals I_{out}", page 77
PE ⏚	Protective earth contact	Leading contact Connect protective grounding as per "TN 353"

Figure 36: 6+PE-pin valve connector X1 of valves with differential current inputs ±10 mA and 0–10 mA (circuit and pin assignment)

8.3.2.3 Differential current inputs 4–20 mA



view of valve connector X1



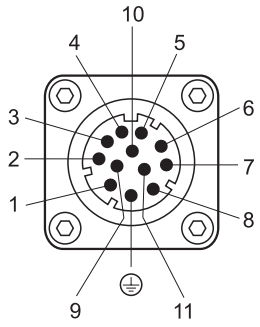
6+PE-pin valve connector X1 of valves with differential current inputs 4–20 mA (signal type identification: E)

Pin	Assignment	Description
A	Supply voltage	Nominal 24 V (18–32 V) DC referenced to GND
B	GND	Supply zero or signal zero
C	Enable input	8.5–32 V referenced to GND: valve on standby < 6.5 V referenced to GND: fail-safe state of the valve ⇨ Chapter "3.4.3 Digital enable input", page 38
D	Command input	I_{in} = 4–20 mA R_{in} = 200 Ω
E	Reference point for the command input	
F	Actual value output	I_{out} = 4–20 mA referenced to GND (I_{out} is proportional to the spool position or the controlled pressure (for D639-R); the output is short-circuit protected); R_L = 0–500 Ω to GND ⇨ Chapter "8.3.5 Conversion of actual value output signals I_{out}", page 77
PE ⏚	Protective earth contact	Leading contact Connect protective grounding as per "TN 353"

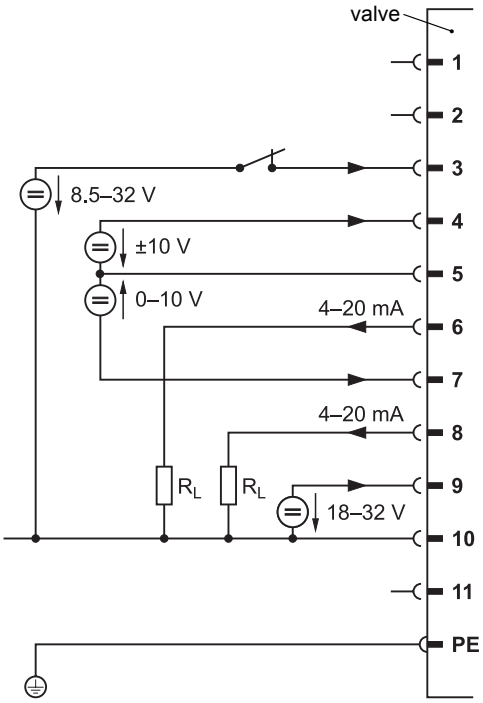
Figure 37: 6+PE-pin valve connector X1 of valves with differential current inputs 4–20 mA (circuit and pin assignment)

8.3.3 Pin assignment of the 11+PE-pin valve connector X1

8.3.3.1 Differential voltage inputs ±10 V and 0–10 V



view of valve connector X1

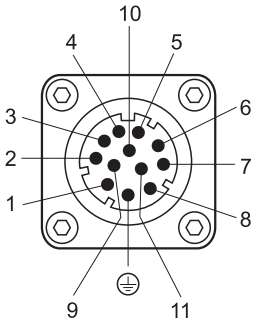


11+PE-pin valve connector X1 of valves with differential voltage inputs ±10 V and 0–10 V (signal type identification: M)

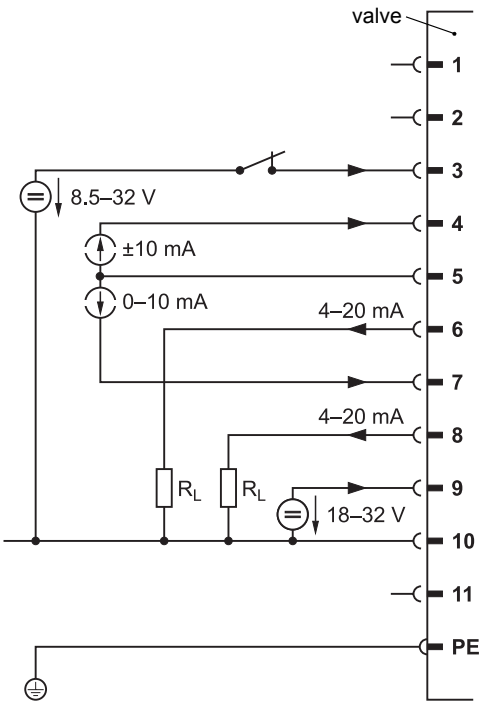
Pin	Assignment	Description
1	Not assigned	
2	Not assigned	
3	Enable input	8.5–32 V referenced to GND: valve on standby < 6.5 V referenced to GND: fail-safe state of the valve ⇨ Chapter "3.4.3 Digital enable input", page 38
4	Flow control command input	U_{in} = ±10 V (pin 5 is reference point for pins 4 and 7) R_{in} = 20 kΩ
5	Reference point for command inputs	Reference point for pins 4 and 7
6	Spool position actual value output	I_{out} = 4–20 mA referenced to GND (I_{out} is proportional to the spool position; the output is short-circuit protected); R_L = 0–500 Ω to GND ⇨ Chapter "8.3.5 Conversion of actual value output signals I_{out}", page 77
7	Pressure control command input	U_{in} = 0–10 V (pin 5 is reference point for pins 4 and 7) R_{in} = 20 kΩ
8	Pressure actual value output	I_{out} = 4–20 mA referenced to GND (I_{out} is proportional to the controlled pressure; the output is short-circuit protected); R_L = 0–500 Ω to GND ⇨ Chapter "8.3.5 Conversion of actual value output signals I_{out}", page 77
9	Supply voltage	Nominal 24 V (18–32 V) DC referenced to GND
10	GND	Supply zero or signal zero
11	Not assigned	No function! Do not connect!
PE ⏚	Protective earth contact	Leading contact Connect protective grounding as per "TN 353"

Figure 38: 11+PE-pin valve connector X1 of valves with differential voltage inputs ±10 V and 0–10 V (circuit and pin assignment)

8.3.3.2 Differential current inputs ±10 mA and 0–10 mA



view of valve connector X1

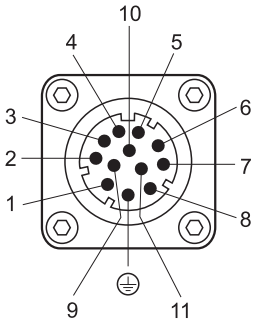


11+PE-pin valve connector X1 of valves with differential current inputs ±10 mA and 0–10 mA (signal type identification: X)

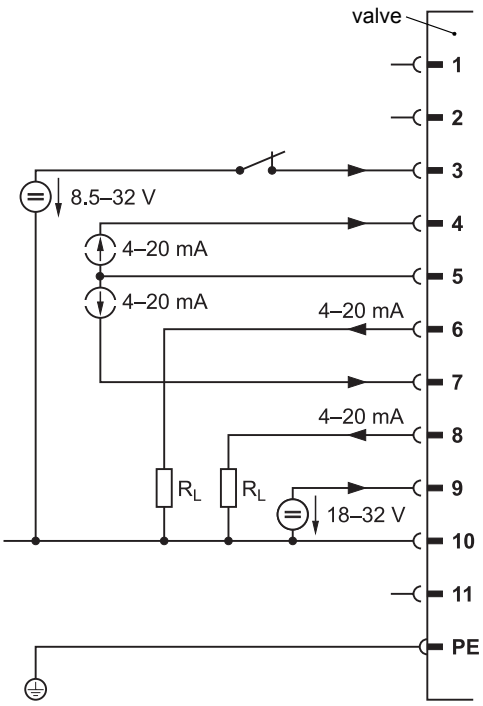
Pin	Assignment	Description
1	Not assigned	
2	Not assigned	
3	Enable input	8.5–32 V referenced to GND: valve on standby < 6.5 V referenced to GND: fail-safe state of the valve ⇨ Chapter "3.4.3 Digital enable input", page 38
4	Flow control command input	I_{in} = ±10 mA (pin 5 is common feedback for pins 4 and 7) R_{in} = 200 Ω
5	Reference point for command inputs	Common feedback for pins 4 and 7
6	Spool position actual value output	I_{out} = 4–20 mA referenced to GND (I_{out} is proportional to the spool position; the output is short-circuit protected); R_L = 0–500 Ω to GND ⇨ Chapter "8.3.5 Conversion of actual value output signals I_{out}", page 77
7	Pressure control command input	I_{in} = 0–10 mA (pin 5 is common feedback for pins 4 and 7) R_{in} = 200 Ω
8	Pressure actual value output	I_{out} = 4–20 mA referenced to GND (I_{out} is proportional to the controlled pressure; the output is short-circuit protected); R_L = 0–500 Ω to GND ⇨ Chapter "8.3.5 Conversion of actual value output signals I_{out}", page 77
9	Supply voltage	Nominal 24 V (18–32 V) DC referenced to GND
10	GND	Supply zero or signal zero
11	Not assigned	No function! Do not connect!
PE ⏚	Protective earth contact	Leading contact Connect protective grounding as per "TN 353"

Figure 39: 11+PE-pin valve connector X1 of valves with differential current inputs ±10 mA and 0–10 mA (circuit and pin assignment)

8.3.3.3 Differential current inputs 4–20 mA



view of valve connector X1



11+PE-pin valve connector X1 of valves with differential current inputs 4–20 mA (signal type identification: E)

Pin	Assignment	Description
1	Not assigned	
2	Not assigned	
3	Enable input	8.5–32 V referenced to GND: valve on standby < 6.5 V referenced to GND: fail-safe state of the valve ⇨ Chapter "3.4.3 Digital enable input", page 38
4	Flow control command input	I_{in} = 4–20 mA (pin 5 is common feedback for pins 4 and 7) R_{in} = 200 Ω
5	Reference point for command inputs	Common feedback for pins 4 and 7
6	Spool position actual value output	I_{out} = 4–20 mA referenced to GND (I_{out} is proportional to the spool position; the output is short-circuit protected); R_L = 0–500 Ω to GND ⇨ Chapter "8.3.5 Conversion of actual value output signals I_{out}", page 77
7	Pressure control command input	I_{in} = 4–20 mA (pin 5 is common feedback for pins 4 and 7) R_{in} = 200 Ω
8	Pressure actual value output	I_{out} = 4–20 mA referenced to GND (I_{out} is proportional to the controlled pressure; the output is short-circuit protected); R_L = 0–500 Ω to GND ⇨ Chapter "8.3.5 Conversion of actual value output signals I_{out}", page 77
9	Supply voltage	Nominal 24 V (18–32 V) DC referenced to GND
10	GND	Supply zero or signal zero
11	Not assigned	No function! Do not connect!
PE ⏚	Protective earth contact	Leading contact Connect protective grounding as per "TN 353"

Figure 40: 11+PE-pin valve connector X1 of valves with differential current inputs 4–20 mA (circuit and pin assignment)

8.3.4 Single-ended command signals

Basically, it is preferable to use differential signals on the command inputs. If the command signal cannot be transmitted differentially, the reference point for the command input at the valve must be connected to ground (GND).

Circuit for single-ended command signals

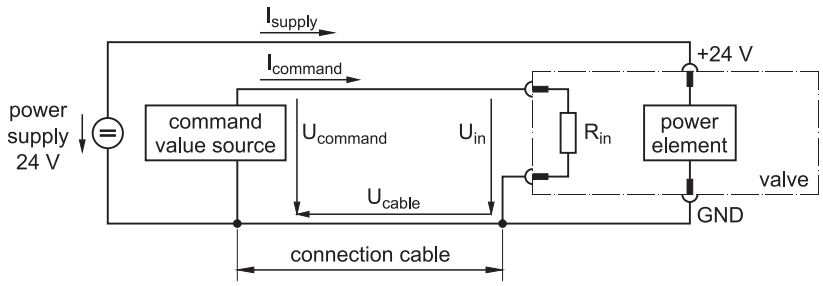


Figure 41: Circuit for single-ended command signals

Single-ended connection of the command inputs

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_{supply} of the valve electronics power element. It is proportional to the length of the connection cable and varies according to the valve status.

ⓘ Please refer to "TN 494" for detailed information on maximum permissible cable lengths.

Input voltage $U_{in} = U_{command} – U_{cable}$

The voltage drop U_{cable} on the return line results in a potential shift of ground (GND). Thus, the input voltage U_{in} is applied at the command input and not the command signal $U_{command}$. The input voltage U_{in} is calculated in accordance with the following formula:

$$U_{in} = U_{command} – U_{cable}$$

Command signal sources with impressed current $I_{command}$

In the case of command signal sources with impressed current $I_{command}$, the potential shift of ground (GND) 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.

ⓘ The function of single-ended command inputs is identical to the function of differential command inputs.
⇨ Chapter "3.4.1.2 Flow control command inputs", page 32
⇨ Chapter "3.4.1.3 Pressure control command inputs", page 35

8.3.5 Conversion of actual value output signals I_{out}

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

Conversion of actual value output signals I_{out} (4–20 mA) into 2–10 V

8.3.5.1 Valves with 6+PE-pin valve connector X1

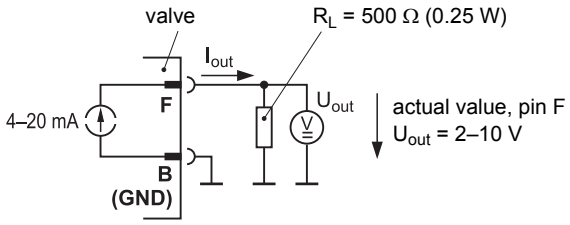


Figure 42: Circuit for converting the actual value output signals I_{out} (for valves with 6+PE-pin valve connector X1)

8.3.5.2 Valves with 11+PE-pin valve connector X1

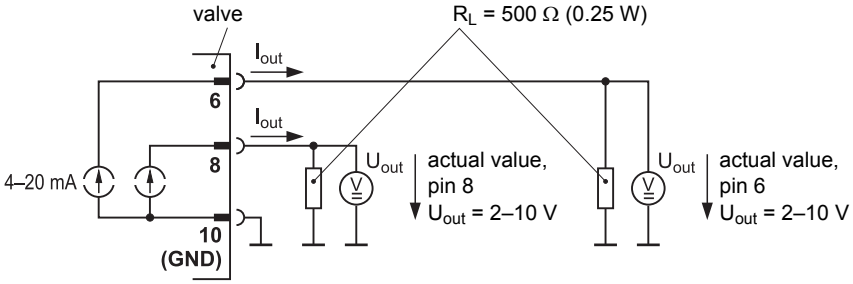


Figure 43: Circuit for converting the actual value output signals I_{out} (for valves with 11+PE-pin valve connector X1)

For your notes.

9 Start-up

Safety instructions: Start-up

WARNING

During operation, do not carry out any work, such as e.g., mounting or removal, electrical or hydraulic connection, troubleshooting or servicing, on the valves or the machine.
Failure to comply with this requirement results in danger due to:

- Hydraulic fluid squirting out under pressure
- Uncontrolled sequences of motions
- Destruction
- Malfunction

Before working on the valves or the machine, shut down and switch off the machine without fail and de-energize and depressurize the machine.
For this purpose, switch off the supply voltage of the valves as well as the supply voltage of the connected peripherals, such as e.g., externally powered transducers or programming units.

Secure the machine without fail against restarting.
Examples of suitable securing measures:

- Lock the main command device and remove the key
- Attach a warning sign to the master switch

DANGER

Operating machines with damaged or defective components or with a leaking hydraulic system is dangerous and not permitted.

Before starting up or operating the valve, check the superordinated machine including all its installed components for damage and defects.
Pay particular attention here to superordinated and hydraulic safety devices, such as e.g., EMERGENCY STOP pushbuttons and pressure-limiting valves.

In addition, to avoid damage or leaks, perform the following tasks 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.
  ⇨ Chapter "11.2.1 Checking and replacing the port O-rings", page 96

Report damage or defects to the relevant department immediately. If necessary, shut down and secure the machine immediately. Rectify any leaks immediately in accordance with this user manual, paying particular attention to the notes/instructions on handling in accordance with safety requirements.
⇨ Chapter "2.2 Handling in accordance with safety requirements", page 6
⇨ Chapter "11.3 Troubleshooting", page 97

WARNING

Hydraulic fluid squirting out under high pressure can cause serious personal injuries, burns and fires.
Depressurize all hydraulic lines and accumulators in the hydraulic circuit before mounting or removing, electrical or hydraulical connection, start-up, troubleshooting or servicing.

WARNING

Only properly qualified and authorized users may work with and on the valves.
⇨ Chapter "2.4 Selection and qualification of personnel", page 8

WARNING

Excessive pressure at the hydraulic ports damages the valve and can cause unsafe states in the machine and personal injury.
Pressure-limiting valves, for example, or other comparable safety devices must be installed to limit the pressure at all hydraulic ports to the specified maximum operating pressure.
Maximum operating pressure:
⇨ Chapter "4 Technical Data", page 43

WARNING

Prior to start-up, the valves must be checked for correct mechanical design and correct configuration. Altering the configuration of the valve may change the function of the valve to such an extent that it will no longer function as specified in this user manual.
⇨ Chapter "9.3 Configuration of the valves", page 83

Incorrect configuration of the valves will result in danger due to:

- Uncontrolled sequences of motions
- Destruction
- Malfunction

CAUTION

The valve shipping plate may only be removed from the valve hydraulic ports directly prior to mounting and must be remounted directly after the valve has been removed. This is the only way of adequately protecting the valves against the ingress of dirt and moisture and protecting the seals against the effects of ozone and UV.
The shipping plate and the associated fastening elements (screws and nuts) must be kept for later use, e.g., during transportation.

CAUTION

Do not misuse the connectors, mating connectors (plugs) and connection cables of the valves, e.g., as a tread or transport fixture.

CAUTION

Dirt or moisture can get into the valve through open connectors, i.e., if no mating connector is attached, which may result in damage to the valve.
Open connectors must be covered and sealed.
The plastic dust protection cap which is attached to service connector X10 on delivery is suitable for use as sealing cover.
The plastic dust protection caps which are attached to field bus connectors X3 and X4 on delivery are not suitable for use as sealing covers.
Suitable metallic dust protection caps for field bus connectors X3 and X4 are available as accessories.
⇨ Chapter "13.1 Accessories", page 105

CAUTION

To provide protection against 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 e.g., mounting or removing, electrical or hydraulic connection, troubleshooting or servicing, and when handling the valves, accessories, tools or hydraulic fluids.
⇨ Chapter "2.6 Occupational safety and health", page 9

9.1 Preparations

Preparations for start-up

The valves may only be started up when the following is ensured:

- The superordinated machine with all its installed components complies with the latest versions of the relevant national and international regulations, standards and guidelines (such as e.g., the EU Machinery Directive, the regulations of the trade association and of TÜV or VDE).
- The valves and all other installed components are in a technically fault-free and operationally reliable state.
- No signals which can lead to uncontrolled movements in the machine are transmitted to the valves.

⇨ Chapter "2.1 Intended operation", page 5

9.2 Start-up of the valves

Procedure:

Procedure for start-up

1. Make sure that all of the machine components, connections and ports conform to the specifications of the machine manufacturer and operator.
2. Prepare the hydraulic system.
   ⇨ Chapter "9.4 Filling and flushing the hydraulic system", page 86
3. Establish the valve hydraulic connection.
   ⇨ Chapter "7.3 Mounting the valves", page 62
4. Establish the valve electrical connection.
   ⇨ Chapter "8 Electrical Connection", page 65
5. For valves with field bus interface:
   Connect the valve to the field bus.
6. Make sure that all of the mechanical, electrical and hydraulic connections are correctly established.
7. Make sure that the valve is correctly configured or carry out configuration.
   ⇨ Chapter "3.5 Valve software", page 39
   ⇨ Chapter "9.3 Configuration of the valves", page 83
8. Start-up of the hydraulic system.
   ⇨ Chapter "9.5 Start-up of the hydraulic system", page 87
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 Configuration Software.

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 gage. 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 Configuration Software.

9.3 Configuration of the valves

Safety instructions: Configuration of the valves

WARNING

Altering the configuration of the valve may change the function of the valve to such an extent that it will no longer function as specified in this user manual.

Incorrect configuration of the valves will result in danger due to:

- Uncontrolled sequences of motions
- Destruction
- Malfunction

WARNING

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 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.
⇨ Chapter "9.3.3 Factory setting of the valves", page 85
⇨ Chapter "11.4 Repair", page 101

The Moog Valve Configuration Software is available as an accessory to simplify start-up, diagnosis and configuration of the valves.
⇨ Chapter "3.6 Moog Valve Configuration Software", page 39

9.3.1 Configuration via the field bus interface

Configuration of the valves via the field bus interface

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

9.3.1.1 Configuration with the machine controller

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.

9.3.1.2 Configuration with the Moog Valve Configuration Software

Configuration with the Moog Valve Configuration Software

Valves with CAN bus interface can be started up and configured via the CAN bus interface (field bus connector X3) with the Moog Valve Configuration Software.
⇨ Chapter "3.6 Moog Valve Configuration Software", page 39

The following are required to be able to configure the valves with the Moog Valve Configuration Software via the CAN bus interface (field bus connector X3):

- USB start-up module
- Configuration/start-up cable
- PC with installed Moog Valve Configuration Software

USB start-up module, configuration/start-up cable and Moog Valve Configuration Software are available as accessories.
⇨ Chapter "13.1 Accessories", page 105

To be able to configure the valves via the CAN bus interface, it is necessary to connect the valve as follows to the PC with installed Moog Valve Configuration Software:

Connection of the valve to a PC via the CAN bus interface (X3)

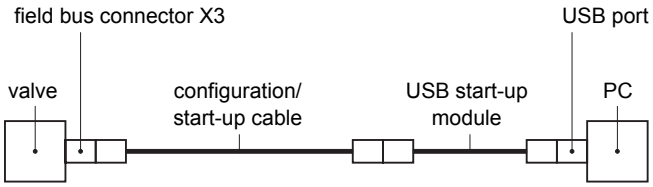


Figure 44: Connection of the valve to a PC via the CAN bus interface (field bus connector X3)

9.3.2 Configuration via the service interface

Configuration of the valves via the service interface

Valves without CAN bus interface can be started up and configured via the service interface (service connector X10) with the Moog Valve Configuration Software.
⇨ Chapter "3.6 Moog Valve Configuration Software", page 39

The following are required to be able to configure the valves with the Moog Valve Configuration Software via the service interface (service connector X10):

- USB start-up module
- Configuration/start-up cable
- Adapter for service connector X10
- PC with installed Moog Valve Configuration Software

ⓘ USB start-up module, configuration/start-up cable, adapter and Moog Valve Configuration Software are available as accessories.
⇨ Chapter "13.1 Accessories", page 105

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 Configuration Software:

Connection of the valve to a PC via the service interface (X10)

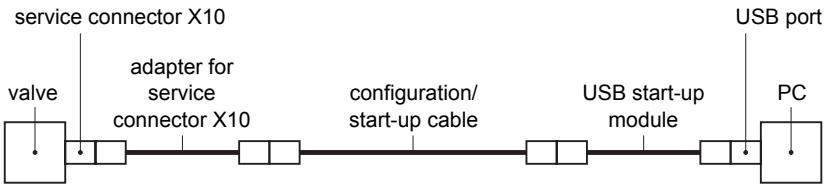


Figure 45: Connection of the valve to a PC via the service interface (service connector X10)

9.3.3 Factory setting of the valves

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 for the pressure controller 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 us or one of our authorized service centers for information on the factory setting parameters.

9.3.4 Storing of parameters

Volatile memory

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 which were stored last are again available.

Non-volatile memory

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.

9.4 Filling and flushing the hydraulic system

WARNING

If a switching valve is fitted to flush the hydraulic system, this must not cause any potentially dangerous states in the machine.

Procedure:

Procedure for filling and flushing the hydraulic system

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 contaminated, the hydraulic system must be filled via a filling filter with a filter fineness of at least $\beta_{10} \geq 75$ (10 µm (0.00039 in) 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 servovalve.
   ⇨ Chapter "11.1 Removing the valves", page 95
5. Instead of the servovalve, 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 valves' scope of delivery.
   They are available as accessories.
   ⇨ Chapter "13.1 Accessories", page 105
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:

     $$t = 5 \cdot \frac{V}{Q} \quad [h]$$

     V [l] : tank capacity
     Q [l/min] : pump delivery

   – End the flushing process when at least the cleanliness level 18/15/12 as specified in ISO 4406 is achieved.
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 servovalve.
    ⇨ Chapter "7.3 Mounting the valves", page 62

9.5 Start-up of the hydraulic system

Procedure:

Procedure for start-up of the hydraulic system

1. Start up the hydraulic system in accordance with the instructions of the manufacturer and the operator of the machine.
2. For valves with field bus interface: Check the status LEDs after switching on the operating voltage.
3. Vent the hydraulic system in accordance with the instructions of the manufacturer and the operator of the machine.
4. Vent the valve (D639-R only).
   ⇨ Chapter "9.5.1 Venting", page 87
   It may be necessary to repeat the procedure.
5. Check the hydraulic system for external leaks.

9.5.1 Venting

CAUTION

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 causes a very high increase in pressure and temperature locally, which in turn can result in damage in the hydraulic system, e.g., to seals or components, causing the oil to age more quickly.
To avoid diesel effects, it is essential to vent the hydraulic system and the valve.

9.5.1.1 Tool required

The following tool is required for venting the valve:

Tool required for venting the valves

- Torque wrench for hexagon socket head cap screws WAF 5

9.5.1.2 Venting the valve and the actuator

WARNING

The valve and actuator may only be vented at a low system pressure of max. 10 bar (145 psi).
Risk of injury!

Procedure:

Procedure for venting the valve and the actuator

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: ⇨ Figure 1, page 12
4. Wait until no further air escapes or until the escaping hydraulic fluid contains no further air bubbles.
5. Retighten the venting screw with the torque wrench for WAF 5 hexagon socket head cap screws.
   Tightening torque of the venting screw: 15 Nm (11.1 lbf ft).
   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.

10 Operation

Safety instructions: Operation

WARNING

During operation, do not carry out any work, such as e.g., mounting or removal, electrical or hydraulic connection, troubleshooting or servicing, on the valves or the machine.
Failure to comply with this requirement results in danger due to:

- Hydraulic fluid squirting out under pressure
- Uncontrolled sequences of motions
- Destruction
- Malfunction

Before working on the valves or the machine, shut down and switch off the machine without fail and de-energize and depressurize the machine.
For this purpose, switch off the supply voltage of the valves as well as the supply voltage of the connected peripherals, such as e.g., externally powered transducers or programming units.

Secure the machine without fail against restarting.
Examples of suitable securing measures:

- Lock the main command device and remove the key
- Attach a warning sign to the master switch

DANGER

Operating machines with damaged or defective components or with a leaking hydraulic system is dangerous and not permitted.

Before starting up or operating the valve, check the superordinated machine including all its installed components for damage and defects.
Pay particular attention here to superordinated and hydraulic safety devices, such as e.g., EMERGENCY STOP pushbuttons and pressure-limiting valves.

In addition, to avoid damage or leaks, perform the following tasks 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.
  ⇨ Chapter "11.2.1 Checking and replacing the port O-rings", page 96

Report damage or defects to the relevant department immediately. If necessary, shut down and secure the machine immediately. Rectify any leaks immediately in accordance with this user manual, paying particular attention to the notes/instructions on handling in accordance with safety requirements.
⇨ Chapter "2.2 Handling in accordance with safety requirements", page 6
⇨ Chapter "11.3 Troubleshooting", page 97

WARNING

Only properly qualified and authorized users may work with and on the valves.
⇨ Chapter "2.4 Selection and qualification of personnel", page 8

WARNING

Observe and adhere to the technical data and in particular the information given on the valve nameplate.
⇨ Chapter "4 Technical Data", page 43

WARNING

It is only permitted to alter the valve configuration during operation if this does not cause any dangerous states in the machine and in its surroundings.
Altering the configuration of the valve may change the function of the valve to such an extent that it will no longer function as specified in this user manual.
⇨ Chapter "9.3 Configuration of the valves", page 83

Incorrect configuration of the valves will result in danger due to:

- Uncontrolled sequences of motions
- Destruction
- Malfunction

WARNING

It is only permitted to control the valves via the Moog Valve Configuration Software if this does not cause any dangerous states in the machine and in its surroundings.
It is not permitted to operate the Moog Valve Configuration Software on a field bus while the field bus is communicating with the machine.

CAUTION

To provide protection against 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 e.g., mounting or removing, electrical or hydraulic connection, troubleshooting or servicing, and when handling the valves, accessories, tools or hydraulic fluids.
⇨ Chapter "2.6 Occupational safety and health", page 9

CAUTION

Dirt or moisture can get into the valve through open connectors, i.e., if no mating connector is attached, which may result in damage to the valve.
Open connectors must be covered and sealed.
The plastic dust protection cap which is attached to service connector X10 on delivery is suitable for use as sealing cover.
The plastic dust protection caps which are attached to field bus connectors X3 and X4 on delivery are not suitable for use as sealing covers.
Suitable metallic dust protection caps for field bus connectors X3 and X4 are available as accessories.
⇨ Chapter "13.1 Accessories", page 105

10.1 Preparations for operation

Preparations for valve operation

The valves may only be operated as a component part of a superordinated overall system, for example in a machine.
⇨ Chapter "2.1 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
  ⇨ Chapter "9 Start-up", page 79

10.2 Operation of the valve

Operation of the valve: Control via signals from the machine controller

The valve is controlled via signals which it receives from the machine controller.
Direct interventions by the user on the valve during normal operation are not necessary.
The valve has no controls, such as e.g., switches or buttons, which must be actuated.

The transition of the valve into the standby state or the fail-safe state can also be initiated by corresponding signals at the enable input of valve connector X1:

- Signals between 8.5 V and 32 V referenced to GND at the enable input render the valve to standby.
- Depending on the model, signals lower than 6.5 V at the enable input render the valve in the mechanical or electrical fail-safe state.

⇨ Chapter "3.4.3 Digital enable input", page 38

On valves with field bus interfaces the valve operating state and the network status are indicated via the status LEDs on the valve electronics housing.

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 gage. 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 Configuration Software.

Information on maintenance:
⇨ Chapter "11.2 Maintenance", page 96

Information on correcting possible faults:
⇨ Chapter "11.3 Troubleshooting", page 97

10.3 Shutting down the valve

DANGER

Safety instructions: Shutting down the valve

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.
During operation, do not carry out any work, such as e.g., mounting or removal, electrical or hydraulic connection, troubleshooting or servicing, on the valves or the machine.
Failure to comply with this requirement results in danger due to:

- Hydraulic fluid squirting out under pressure
- Uncontrolled sequences of motions
- Destruction
- Malfunction

Before working on the valves or the machine, shut down and switch off the machine without fail and de-energize and depressurize the machine.
For this purpose, switch off the supply voltage of the valves as well as the supply voltage of the connected peripherals, such as e.g., externally powered transducers or programming units.

Secure the machine without fail against restarting.
Examples of suitable securing measures:

- Lock the main command device and remove the key
- Attach a warning sign to the master switch

Shutting down the valve

The valve can be shut down as follows:

- Switching off the supply voltage
- Transition of the valve into the 'DISABLED' and 'INIT' valve states
- Signal at the enable input of valve connector X1

⇨ Chapter "3.2.3 Fail-safe events", page 21

If necessary, the valve must be restarted after it has been shut down or after its transition into the fail-safe state.
⇨ Chapter "3.2.4 Restarting the valve", page 23

11 Service

Safety instructions: Service

WARNING

During operation, do not carry out any work, such as e.g., mounting or removal, electrical or hydraulic connection, troubleshooting or servicing, on the valves or the machine.
Failure to comply with this requirement results in danger due to:

- Hydraulic fluid squirting out under pressure
- Uncontrolled sequences of motions
- Destruction
- Malfunction

Before working on the valves or the machine, shut down and switch off the machine without fail and de-energize and depressurize the machine.
For this purpose, switch off the supply voltage of the valves as well as the supply voltage of the connected peripherals, such as e.g., externally powered transducers or programming units.

Secure the machine without fail against restarting.
Examples of suitable securing measures:

- Lock the main command device and remove the key
- Attach a warning sign to the master switch

DANGER

Operating machines with damaged or defective components or with a leaking hydraulic system is dangerous and not permitted.

Before starting up or operating the valve, check the superordinated machine including all its installed components for damage and defects.
Pay particular attention here to superordinated and hydraulic safety devices, such as e.g., EMERGENCY STOP pushbuttons and pressure-limiting valves.

In addition, to avoid damage or leaks, perform the following tasks 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.
  ⇨ Chapter "11.2.1 Checking and replacing the port O-rings", page 96

Report damage or defects to the relevant department immediately. If necessary, shut down and secure the machine immediately. Rectify any leaks immediately in accordance with this user manual, paying particular attention to the notes/instructions on handling in accordance with safety requirements.
⇨ Chapter "2.2 Handling in accordance with safety requirements", page 6
⇨ Chapter "11.3 Troubleshooting", page 97

WARNING

Hydraulic fluid squirting out under high pressure can cause serious personal injuries, burns and fires.
Depressurize all hydraulic lines and accumulators in the hydraulic circuit before mounting or removing, electrical or hydraulical connection, start-up, troubleshooting or servicing.

WARNING

Only properly qualified and authorized users may work with and on the valves.
⇨ Chapter "2.4 Selection and qualification of personnel", page 8

WARNING

In the interests of avoiding damage to the valves or accessories, repairs/corrective maintenance and other maintenance/servicing work explained in this user manual, on account of the complexity of the internal components of the valves or accessories, may only be carried out by us or by our authorized service centers.

CAUTION

To provide protection against 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 e.g., mounting or removing, electrical or hydraulic connection, troubleshooting or servicing, and when handling the valves, accessories, tools or hydraulic fluids.
⇨ Chapter "2.6 Occupational safety and health", page 9

CAUTION

Unsuitable or defective accessories or unsuitable or defective spare parts may cause damage, malfunctions or failure of the valve or the machine.
We recommend the use of original accessories and original spare parts.
⇨ Chapter "13 Accessories and Spare Parts", page 105

CAUTION

Do not misuse the connectors, mating connectors (plugs) and connection cables of the valves, e.g., as a tread or transport fixture.

11.1 Removing the valves

11.1.1 Tools and materials required

Tools and materials required for removing

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

- Torque wrench for hexagon socket head cap screws WAF 5
  (for removing and mounting the valve)
- If necessary, spare port O-rings
  ⇨ Chapter "13.2 Spare parts", page 107
- Shipping plate and associated fastening elements
- Flat-bladed screwdriver 8x1.6 [mm] and if necessary open-ended wrench WAF 10
  (for mounting the shipping plate)

11.1.2 Procedure

Safety instructions: Removing the valves

CAUTION

The valve shipping plate may only be removed from the valve hydraulic ports directly prior to mounting and must be re-mounted directly after the valve has been removed. This is the only way of adequately protecting the valves against the ingress of dirt and moisture and protecting the seals against the effects of ozone and UV.
The shipping plate and the associated fastening elements (screws and nuts) must be kept for later use, e.g., during transportation.

Procedure for removing the valve

Procedure:

1. Shut down and switch off the machine and place in a de-energized and depressurized state.
2. Release the valve's installation screws.
3. Remove the valve from the mounting surface.
4. Check for presence, elasticity, integrity and correct seating of the O-rings in the valve ports (A, B, P, T, etc.).
5. Replace hardened and damaged O-rings with new O-rings.
6. Mount the shipping plate to the valve's hydraulic ports.
   Tightening torque of the attachment screws:
   approx. 5 Nm (3.7 lbf ft) (hand-tight)
7. If the valve is not to be immediately reused or is to be serviced: Store the valve in its original packaging.
   ⇨ Chapter "6 Transportation and Storage", page 55
8. If necessary, block the ports of the hydraulic system to prevent the hydraulic fluid from being contaminated.

11.2 Maintenance

Embrittlement of the sealing materials

Changes in temperature, effects of the hydraulic fluid, such as e.g., pressure peaks, and similar influences can, depending on the application, expose the sealing materials to different levels of wear. 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.

If the valve is exposed to high loads, it may be necessary to reduce the check/inspection interval to suit the application.

11.2.1 Checking and replacing the port O-rings

11.2.1.1 Tools and materials required

Tools and materials required for checking and replacing the O-rings

The following are required for checking and replacing the port O-rings:

- Torque wrench for hexagon socket head cap screws WAF 5 (for removing and mounting the valve)
- If necessary, spare port O-rings
  ⇨ Chapter "13.2 Spare parts", page 107

11.2.1.2 Checking and replacing the O-rings

Procedure for checking and replacing the O-rings

Procedure:

1. Remove the valve.
   ⇨ Chapter "11.1 Removing the valves", page 95
2. Check for presence, elasticity, integrity and correct seating of the O-rings in the valve ports (A, B, P, T, etc.).
3. Replace hardened and damaged O-rings with new O-rings.
4. Remount the valve.
   ⇨ Chapter "7.3 Mounting the valves", page 62

11.2.2 Monitoring the pressure transducer drift

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 gage. 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 Configuration Software.

11.3 Troubleshooting

The following faults may occur:

Possible faults

- Leak at the valve connecting surface
  ⇨ Chapter "11.3.1.1 Leak at the valve connecting surface", page 97
- Leak at the linear force motor screw plug
  ⇨ Chapter "11.3.1.2 Leak at the linear force motor screw plug", page 97
- Leak at the venting screw
  ⇨ Chapter "11.3.1.3 Leak at the venting screw", page 98
- No hydraulic response by the valve
  ⇨ Chapter "11.3.2 No hydraulic response by the valve", page 99
- Instability of the control loops
  ⇨ Chapter "11.3.3 Instability of the external control loop", page 100
  ⇨ Chapter "11.3.4 Instability of the internal valve control loops", page 100

ⓘ If the fault cannot be corrected by means of the measures set out below, please contact us or one of our authorized service centers.

Restarting after correcting the fault

After correcting the fault, if necessary remount and restart the valve.
⇨ Chapter "7.3 Mounting the valves", page 62
⇨ Chapter "3.2.4 Restarting the valve", page 23

11.3.1 Leaks

11.3.1.1 Leak at the valve connecting surface

Measures:

Leak at the valve connecting surface

- Check for presence, elasticity, integrity and correct seating of the O-rings in the valve ports (A, B, P, T, etc.).
  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.
  Retighten screws if necessary with the torque wrench for WAF 5 hexagon socket head cap screws.
  Tightening torque of installation screws: 11 Nm (8.1 lbf ft) ± 10 %

11.3.1.2 Leak at the linear force motor screw plug

WARNING

In the event of a leak at the linear force motor screw plug, have the valve checked by us or one of our authorized service centers.

Measures:

Leak at the linear force motor screw plug

- Check ports P and T for correct connection.
- Check max. pressure in ports T and Y.
  The return pressure in T may exceed 50 bar (725 psi) only if port Y is used.

11.3.1.3 Leak at the venting screw

Leak at the venting screw

Measures:

- Check for presence, elasticity, integrity and correct seating of the sealing ring on the venting screw.
  If necessary, install the sealing ring, replace or correct the seating.
- Check the venting screws for secure and correct seating.
  Retighten the venting screw if necessary with the torque wrench for WAF 5 hexagon socket head cap screws.
  Tightening torque of the venting screw: 15 Nm (11.1 lbf ft).
  Higher tightening torques can result in the destruction of the sealing ring for the venting screw.

11.3.2 No hydraulic response by the valve

WARNING

Touching electrically live parts exposes the user/operator to the risk of:

- Electric shock
- Uncontrolled sequences of motions
- Destruction
- Malfunction

Touching electrically live parts must therefore be avoided!

No hydraulic response by the valve

Measures:

- Check whether all of the machine components, connections and ports conform to the specifications of the machine manufacturer and operator. To do so, on the valves compare the data on the nameplate with the specifications.
- Check whether the hydraulic installation is correct and whether all of the hydraulic ports are correctly established.
- Check whether the hydraulic pressure is present.
- Check whether the supply voltage is present (indicated at the status LEDs on valves with field bus interfaces).
- 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 desired signals are applied at the connector, in particular at the enable input.
- Check whether the command signal is analog or applied via the field bus interface (depending on the model).
- Check whether the valve is in the fault state (indicated at the status LEDs on valves with field bus interfaces).
  If necessary, correct the fault and then cancel the fault via the field bus or reset the valve by switching the supply voltage off and then on again.

  Typical fault causes:
  - Supply voltage drops below 18 V
    ⇨ Chapter "4.4 Electrical data", page 46
  - Maximum permissible temperature exceeded
    ⇨ Chapter "4.1 General technical data", page 43
  - Control error (e.g., 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 state.
- Check whether the configuration of the internal valve software is correct.

11.3.3 Instability of the external control loop

Instability of the external control loop

Measures:

- Check whether the external control loop is stable.
  If necessary, reduce control loop gain.
- Check whether the internal valve control loops are stable.
  ⇨ Chapter "11.3.4 Instability of the internal valve control loops", page 100
- Check whether the controlled system was modified.

11.3.4 Instability of the internal valve control loops

11.3.4.1 Flow control

Instability of the internal valve control loops: Flow control

Measures:

- Check whether the signal quality of the command signals is sufficient.
- Check whether the system pressure is stable.
- Check whether the quality and cleanliness level 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 and actual value signals.

11.3.4.2 Pressure control

Instability of the internal valve control loops: Pressure control

Measures:

- Check whether the signal quality of the command signals is sufficient.
- Check whether the system pressure is stable.
- Vent the valve or the hydraulic system.
  ⇨ Chapter "9.5.1 Venting", page 87
- Optimize the control loop gain of the pressure controller by adapting the parameters (P, I, D, etc.).
  ⇨ Chapter "3.3.5 Notes on the pressure controller control response (D639-R)", page 29
- Check whether the quality and cleanliness level 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.

11.4 Repair

WARNING

Safety instructions: Repair

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.

⇨ Chapter "9.3.3 Factory setting of the valves", page 85

Prior to start-up, the valves must be checked for correct mechanical design and correct configuration. Altering the configuration of the valve may change the function of the valve to such an extent that it will no longer function as specified in this user manual.

⇨ Chapter "9.3 Configuration of the valves", page 83

Incorrect configuration of the valves will result in danger due to:

- Uncontrolled sequences of motions
- Destruction
- Malfunction

Authentic Moog repairs

Authentic Moog repairs are performed exclusively by us or our authorized service centers. This is the only way of accessing the latest specifications required for repair work. With these specifications, the original valve performance data can be re-established and the customarily high reliability and long life cycle can be guaranteed even after repairs.

Repair quality seal

Figure 46: Repair quality seal

Our repair seal is a guarantee that an authentic Moog repair has been performed.

ⓘ 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.

11.4.1 Contact persons for repairs

Contact persons for repairs

Please refer to the following page on our internet site for contact information relating to our service centers:

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

For your notes.

12 Disposal

CAUTION

To provide protection against 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 e.g., mounting or removing, electrical or hydraulic connection, troubleshooting or servicing, and when handling the valves, accessories, tools or hydraulic fluids.
⇨ Chapter "2.6 Occupational safety and health", page 9

Environmental protection: Disposal

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

For your notes.

13 Accessories and Spare Parts

CAUTION

Unsuitable or defective accessories or unsuitable or defective spare parts may cause damage, malfunctions or failure of the valve or the machine.
We recommend the use of original accessories and original spare parts.

13.1 Accessories

The accessories are not included in the valves' scope of delivery.
⇨ Chapter "6.2 Scope of delivery of the valve", page 56

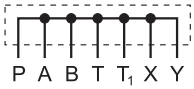
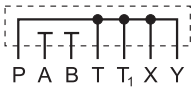
Item designation	Number required	Description	Order number
Service sealing kit (contains all the O-rings for ports A, B, P, T, T_1 and Y and O-ring recess X)	1 1	Kit NBR 90 Shore Kit FKM 90 Shore	B97215-N681-10 B97215-V681-10
Flushing plates			
for ports P, A, B, T, T_1, X, Y	1		B67728-001
for ports P, T, T_1, and X, Y	1		B67728-002
for ports P, T, T_1, X, Y	1		B67728-003
Connecting plates			On request
Installation screws	4	M6x60 hexagon socket head cap screw as per DIN EN ISO 4762, quality class: 10.9, tightening torque: 11 Nm (8.1 lbf ft) ± 10 %	A03665-060-060
Mating connector (metal), IP65			
for 6+PE-pin valve connector X1	1	As per DIN EN 175201-804 usable cable with min. Ø 8 mm (0.31 in) and max. Ø 12 mm (0.47 in)	B97007-061
for 11+PE-pin valve connector X1	1	As per DIN EN 175201-804 usable cable with min. Ø 11.5 mm (0.45 in) and max. Ø 13 mm (0.51 in)	B97067-111
Tools for the 6+PE-pin mating connectors of the valve connector X1			
Crimping tool for the mating connector	1		C21162-001
Tool insert for the crimping tool	1	For contact sizes 16 and 20	C21163-001
Installation tool	1	For contact sizes 16 and 20	C21164-001
Removal tool	1	For contact sizes 16 and 20	C21165-001
Tool kit for the 6+PE-pin mating connectors of the valve connector X1 (contains crimping tool, tool insert, installation and removal tool)	1		C21166-001
Tools for the 11+PE-pin mating connectors of the valve connector X1			
Crimping tool for the mating connector	1		B97136-001

Table 17: Accessories (part 1 of 2)

Item designation	Number required	Description	Order number
Removal tool	1		B97137-001
Tool kit for the 11+PE-pin mating connectors of the valve connector X1 (contains crimping and removal tool)	1		B97138-001
Connection cable for valve connector X1, 3 m (9.8 ft)			
with 6+PE-pin mating connector	1		C21033-003-001
with 11+PE-pin mating connector	1		C21031-003-001
Dust protection caps, IP65			
for field bus connector with external thread	1	Metal cap with O-rings	C55823-001
for field bus connector with internal thread	1	Metal cap with O-rings	CA24141-001
USB start-up module (for service connector X10)	1		C43094-001
Configuration/start-up cable, 2 m (6.5 ft)	1		TD3999-137
Adapter for service connector X10 (M8 to M12)	1		CA40934-001
SELV/PELV power supply (24 V DC, 10 A)	1		D137-003-001
Power supply cord, 2 m (6.5 ft)	1		B95924-002
Moog Valve Configuration Software	1		On request
Supplementing documents			
User manual "D637-R/D639-R series", English	1		CA61892-001
User manual "D637-R/D639-R series", German	1		CA61892-002
Application notes "Technical Note TN 353", English	1	Protective grounding and electrical shielding of hydraulic valves with integrated electronics	CA58437-001
Application notes "Technical Note TN 353", German	1	Protective grounding and electrical shielding of hydraulic valves with integrated electronics	CA58437-002
Application notes "Technical Note TN 494", English	1	Maximum permissible lengths of electric cables for the connection of hydraulic valves with integrated electronics	CA48851-001
Application notes "Technical Note TN 494", German	1	Maximum permissible lengths of electric cables for the connection of hydraulic valves with integrated electronics	CA48851-002
Catalog "D637-R/D639-R", English Catalog "D637-R/D639-R", German	1		On request

Table 17: Accessories (part 2 of 2)

The PDF files of the supplementing documents can be downloaded from the following link: http://www.moog.com/industrial/literature

13.2 Spare parts

Item designation	Number required	Description		Order number
O-rings				
for ports A, B, P, T and T_1	5	ID 12.4 x Ø 1.8 [mm] (ID 0.488 x Ø 0.071 [in])	NBR 90 Shore FKM 90 Shore	-45122-004 -42082-004
for port Y and O-ring recess X	2	ID 15.6 x Ø 1.8 [mm] (ID 0.614 x Ø 0.071 [in])	NBR 90 Shore FKM 90 Shore	-45122-011 -42082-011
Sealing ring for venting screw	1	Required only for D639-R		
			HNBR FKM	B97018-060-003 B97018-060-002
Shipping plate	1			A40508
Fastening elements for shipping plate		Do not use to mount the valve!		
Attachment screws	4	M6x55, slotted fillister head screw, tightening torque: approx. 5 Nm (3.7 lbf ft) (hand-tight)		-66119-060-055
Fastening nuts	4	M6, hexagon nut		-66118-060
Plastic dust protection cap for service connector	1			CA23105-080-010

Table 18: Spare parts

For your notes.

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

14 Index

A

B

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

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

C

D

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

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

E

F

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

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

G

H

I

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

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

L

M

N

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

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

O

P

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

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

Q

R

S

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

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

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

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

T

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

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

U

V

W

X

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

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

Y

Z

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

For your notes.

15 Appendix

15.1 Abbreviations, symbols and identification letters

Table 19: Abbreviations, symbols and identification letters

Abb.	Explanation
β_x	Symbol for filter fineness
Δp	Symbol for pressure difference
Δp_N	Symbol for rated pressure difference
ν	Symbol for viscosity
A	Valve port (control port)
A	Pin of 6+PE-pin valve connector X1
A/D	**A**nalog **d**igital converter
ACV	**A**xis **C**ontrol **V**alve (valve with axis control function)
B	Valve port (control port)
B	Pin of 6+PE-pin valve connector X1
C	Pin of 6+PE-pin valve connector X1
CAN	**C**ontroller **A**rea **N**etwork
CANopen	Standardized communication profile
CiA	**C**AN **i**n **A**utomation e. V. (international manufacturers' and users' organization for CAN users; http://www.can-cia.org)
D	**D**ifferential (e.g., in PID controller)
D	Fail-safe function **D** of valve
D	Pin of 6+PE-pin valve connector X1
D/A	**D**igital **a**nalog converter
DDV	**D**irect **D**rive **V**alve
DIN	**D**eutsches **I**nstitut für **N**ormung e. V. (German institute for standardization; http://www.din.de)
DSP	**D**raft **s**tandard **p**roposal
E	Pin of 6+PE-pin valve connector X1
EMC	**E**lectro**m**agnetic **C**ompatibility
EN	**E**uropa-**N**orm (European standard)
ESD	**E**lectro**s**tatic **d**ischarge
EU	**E**uropean **U**nion
F	Fail-safe function **F** of valve
F	Pin of 6+PE-pin valve connector X1
F_1…F_4	Bore for installation screws or attachment screws of the shipping plate in the mounting pattern of the valve mounting surface
FKM	Fluorocarbon rubber (material for seals, such as e.g., O-rings)
G	Bore for positioning pin in the mounting pattern of the valve mounting surface
GND	**G**rou**nd**
I	**I**ntegral (e.g., in PID controller)
$I_{command}$	Symbol for current command signal
I_{in}	Symbol for input current
I_{out}	Symbol for output current
I_{supply}	Symbol for supply current
ID	**Id**entifier
ID	**I**nner **d**iameter (e.g., on O-rings)
IEC	**I**nternational **E**lectrotechnical **C**ommission (http://www.iec.ch)

Table 19: Abbreviations, symbols and identification letters (part 1 of 3)

Table 19: Abbreviations, symbols and identification letters

Abb.	Explanation
IP	**I**nternational **p**rotection (IP code; degree of protection type by enclosure as per DIN EN 60529)
ISM	**I**ndustrial, **s**cientific and **m**edical (e.g., ISM equipment)
ISO	**I**nternational **O**rganization for **S**tandardization (http://www.iso.org)
LED	**L**ight **e**mitting **d**iode
LSS	**L**ayer **S**etting **S**ervices as per CiA DSP 305 (LSS offers the option of setting the node parameters, such as e.g., module address or transmission rate, of a CAN node via the CAN bus)
LVDT	**L**inear **v**ariable **d**ifferential **t**ransformer (position transducer; senses the position of the spool in the valve)
M	Fail-safe function **M** of valve
MS	**M**odule **s**tate LED
NBR	**N**itrile **b**utadiene **r**ubber (material for seals, such as e.g., O-rings)
NG	**N**enn**g**röße (nominal size), e.g., 6
NS	**N**etwork **s**tate LED
P	**P**roportional (e.g., in PID controller)
P	Valve port (pressure port)
P_{max}	Symbol for power consumption at maximum flow
P_{min}	Symbol for power consumption at motor in neutral position
p	Symbol for pressure
p_N	Symbol for rated pressure
p_P	Symbol for operating pressure
PC	**P**ersonal **c**omputer
PE	**P**rotective **e**arth
PE	Pin of 6 or 11+PE-pin valve connector X1
PELV	**P**rotective **e**xtra-**l**ow **v**oltage
PID	**P**roportional **i**ntegral **d**ifferential (e.g., in PID controller)
PWM	**P**ulse **w**idth **m**odulation
Q	Symbol for flow
Q	Symbol for delivery of a pump
Q_L	Symbol for leakage flow
Q_{max}	Symbol for maximum flow
Q_N	Symbol for rated flow
R_a	Symbol for average roughness
R_{in}	Symbol for input resistance
R_L	Symbol for load impedance
SELV	**S**afety **e**xtra-**l**ow **v**oltage
T	Symbol for temperature
T	Valve port (tank port)
t	Symbol for time
TN	**T**echnical **N**ote
TÜV	**T**echnischer **Ü**berwachungs**v**erein (German technical inspection agency)
U_{cable}	Symbol for voltage drop on the cable
$U_{command}$	Symbol for input voltage command signal
U_{in}	Symbol for input voltage
U_{out}	Symbol for output voltage
USB	**U**niversal **S**erial **B**us
UV	**U**ltra**v**iolet
V	Symbol for volume (such as e.g., tank capacity)

Table 19: Abbreviations, symbols and identification letters (part 2 of 3)

Abb.	Explanation
VDE	**V**erband **d**er **E**lektrotechnik Elektronik Informationstechnik e. V. (German association of electrical engineering, electronics and information technology; http://www.vde.de)
VDI	**V**erein **D**eutscher **I**ngenieure e. V. (association of German engineers; http://www.vdi.de)
WAF	**W**idth **a**cross **f**lats for wrenches
X	Valve port
X1…X10	Designations for the valve connectors
Y	Valve port (leakage port)

Table 19: Abbreviations, symbols and identification letters (part 3 of 3)

Table 19: Abbreviations, symbols and identification letters

15.2 Additional literature

15.2.1 CAN fundamentals

CAN in Automation e. V.:
http://www.can-cia.org

Additional literature: CAN fundamentals

15.2.2 Profibus fundamentals

PROFIBUS Users' Organization:
http://www.profibus.com

Additional literature: Profibus fundamentals

15.2.3 EtherCAT fundamentals

EtherCAT Technology Group:
http://www.ethercat.org

Additional literature: EtherCAT fundamentals

15.2.4 Moog publications

Press releases:
http://www.moog.com/industrial/news

Additional literature: Moog publications

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 manuals, 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)

Quoted standards: CiA DSP

15.3.2 DIN

Quoted standards: DIN

DIN 51524-1
Pressure fluids; Hydraulic oils: HL hydraulic oils; Minimum requirements

DIN 51524-2
Pressure fluids; Hydraulic oils: HLP hydraulic oils; Minimum requirements

DIN 51524-3
Pressure fluids; Hydraulic oils: HVLP hydraulic oils; Minimum requirements

15.3.3 DIN EN

Quoted standards: DIN EN

DIN EN 563
Safety of machinery – Temperatures of touchable surfaces – Ergonomics data to establish temperature limit values for hot surfaces

DIN EN 954-1
Safety of machinery – Safety-related parts of control systems – Part 1: General design principles

DIN EN 982
Safety of machinery – Safety requirements for fluid power systems and their components – Hydraulics

DIN EN 55011
Industrial, scientific and medical (ISM) radio-frequency equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement

DIN EN 60068-2-6
Environmental testing – Part 2: Tests; Test Fc: Vibration (sinusoidal) (IEC 60068-2-6:1995 + Corrigendum 1995)

DIN EN 60068-2-27
Environmental testing – Part 2: Tests; Test Ea and guidance: Shock (IEC 60068-2-27:1987)

DIN EN 60529
Protection types provided by enclosures (IP code)

DIN EN 61000-6-2
Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity to interference for industrial environments

DIN EN 61000-6-3
Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emitted interference for residential, commercial and light-industrial environments

DIN EN 61000-6-4
Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emitted interference for industrial environments

DIN EN 175201-804
Detail specification – Circular connectors – Round contacts, size diameter 1.6 mm (0.063 in), threaded coupling

15.3.4 DIN EN ISO

Quoted standards: DIN EN ISO

DIN EN ISO 1302
Geometrical Product Specifications (GPS) – Indication of surface texture in technical product documentation

DIN EN ISO 4762
Hexagon socket head cap screws

DIN EN ISO 12100
Safety of machinery – Basic concepts, general principles for design

15.3.5 EN

Quoted standards: EN

EN 60204
Safety of machinery – Electrical equipment of machines

EN 61558-1
Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests

EN 61558-2-6
Safety of power transformers, power supply units and similar – Part 2-6: Particular requirements for safety isolating transformers for general use

15.3.6 ISO

Quoted standards: 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

15.4 Quoted directives

Quoted directives

98/37/EC
Directive 98/37/EC of the European Parliament and Council for alignment of the legal and administrative provisions of the Member States for machinery

89/336/EEC
Directive 89/336/EEC concerning electromagnetic compatibility (EMC)

VDI offers numerous directives for downloading:
http://www.vdi-nachrichten.com/ce-richtlinien/basics/richtlinien.asp

For your notes.

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(CA61892-001; Version 1.0, 08/09)

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