

# 6 GENERAL INFORMATION

# INDEX

## GENERAL INFORMATION

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Table FS001-0/E

## Basics for digital proportional electrohydraulics

Digital electrohydraulics enables new functionalities within the conventional control architectures and represents the fundamental premise to realize machines with high technological contents.

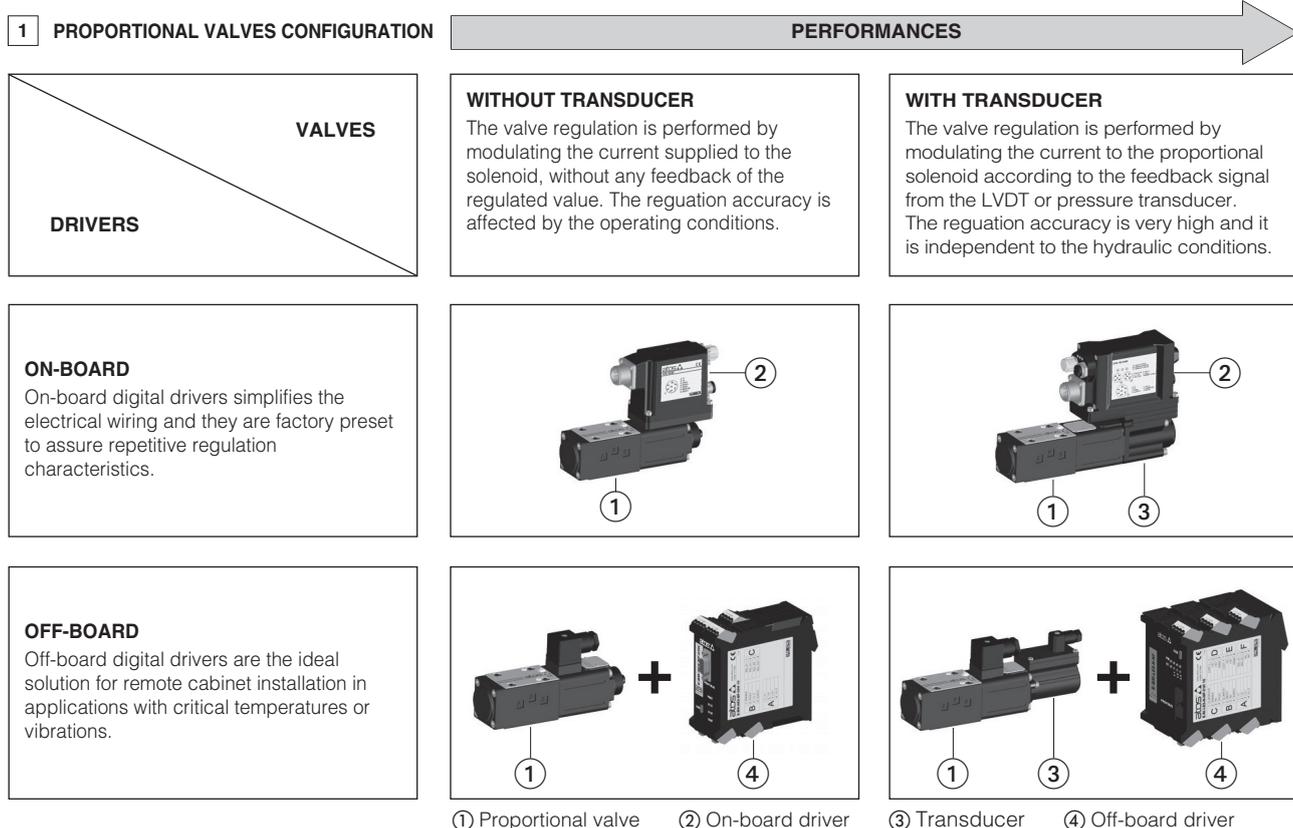
The digital electronics integrates several logic and control functions (distributed intelligence) and allows the introduction into the hydraulic system of the most modern fieldbus communication networks.

The integration of advanced digital technologies into Atos proportional valves brings important advantages and innovative features:

- better performances of electrohydraulic components: hysteresis, response time, linearity, repeatability, valve to valve reproducibility
- numerical software setting of hydraulic parameters (scale, bias, ramp, compensation of non-linearities) for full valve to valve reproducibility
- advanced diagnostics (alarms history, built-in oscilloscope function) and computer assisted maintenance
- industry 4.0 connectivity through direct interfacing with fieldbus networks

Atos digital components range includes:

- proportional valves and drivers, see sections 1 and 2
- proportional P/Q pumps, see 4.3
- axis controls and servoactuators, see section 5



**2 PROPORTIONAL VALVES CLASSIFICATION** - with on-board or off-board driver

| PERFORMANCES | Valve classification                  | Type of valve | Transducer | Hydraulic features                | Application   |
|--------------|---------------------------------------|---------------|------------|-----------------------------------|---|
|              | <b>Servoproportionals</b>             | Directional   | LVDT       | Zero spool overlap                | Actuator position and speed control<br>P/Q control                        |
|              | <b>High performance proportionals</b> | Directional   | LVDT       | Positive spool overlap            | Actuator direction and speed control<br>P/Q control                       |
|              |                                       | Flow          | LVDT       | Pressure compensated              | System flow regulation, actuator speed control                            |
|              |                                       | Pressure      | Pressure   | Relief<br>Reducing<br>Compensator | System pressure control<br>Actuator force control<br>Load sensing control |
|              | <b>Proportionals</b>                  | Directional   | None       | Positive spool overlap            | Actuator direction and speed control                                      |
|              |                                       | Flow          |            | Pressure compensated              | System flow regulation, actuator speed control                            |
|              |                                       | Pressure      |            | Relief<br>Reducing<br>Compensator | System pressure control<br>Actuator force control<br>Load sensing control |

**3** **FIELDBUS INTERFACES** - see tech table **GS510**

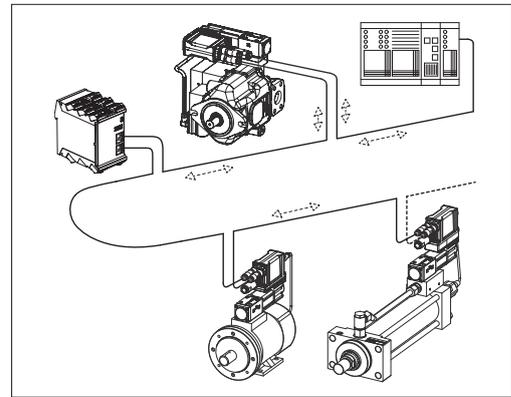
Drivers with fieldbus communication interface allow an higher level of integration with the machine automation architecture: machine central unit (fieldbus master), wired with all the controlled devices (fieldbus node).

Fieldbus available:

- BC** = CANopen      **BP** = PROFIBUS DP      **EH** = EtherCAT  
**EW** = POWERLINK    **EI** = EtherNet/IP      **EP** = PROFINET RT/IRT

Fieldbus interface allows:

- complete diagnostic of the driver status
- improved information available for machine operation
- improved accuracy and robustness of digital transmitted information
- real time modification of the valve parameters
- direct access to all driver parameters
- costs reduction due to simpler and standardized wiring solutions
- costs reduction due to fast and simple installation and maintenance



**4** **P/Q CONTROLS** - see tech table **FS500**

**4.1 P/Q controls for servoproportional and high performance directional valves**

In most of the machines functions, the typical movement of a single actuator requires direction, speed and sometime force regulations, normally performed by different type of valves.

Digital proportional valves with SP, SF, SL options add the pressure or force closed loop control to the basic directional control.

A single proportional valve with P/Q control allows to manage complex machine operations requiring high performance combined regulations (typical application: injection cycle or mould motion in plastic machinery).

The closed loop pressure or force control requires the installation in the system of one/two remote pressure transducers or a load cell, to be connected to the valve digital driver.

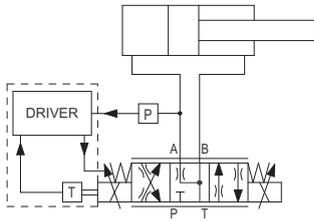
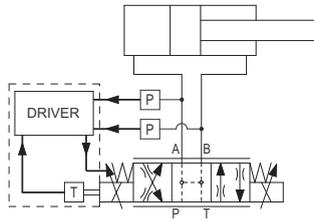
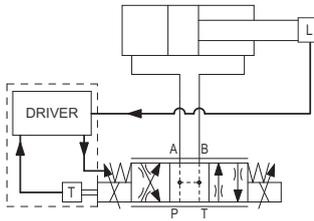
The option SP performs the closed loop pressure control on one side of the actuator by using one remote pressure transducer.

The other two options perform the closed loop force control by two remote pressure transducers (SF) or one load cell (SL).

Pressure/force and flow are regulated according to two different command signals.

The selection from pressure-force to flow control and vice versa is self performed by the digital driver through dedicated algorithm.

**P/Q control configurations**

| SP = pressure control  | SF = force control   | SL = force control  |
|--|--|---|
|                         |   |            |
| one remote pressure transducer has to be installed on the actuator's port to be controlled                 | two remote pressure transducers have to be installed on the actuator's ports; the actuator force is calculated by the pressure feedbacks (Pa - Pb) | one load cell transducer has to be installed between the actuator and the controlled load       |
|  valve spool transducer |  pressure transducer  |  load cell |

**4.2 Proportional valves with P/Q control** - with on-board or off-board driver/axis card

| Valve classification                  | Application                           |
|---------------------------------------|---------------------------------------|
| <b>Servoproportionals</b>             | SF, SL<br>SP only in 3-way connection |
| <b>High performance proportionals</b> | SP, SF, SL                            |



**4.3 P/Q controls for variable piston pumps** - see tech table **AS170**

PVPC-PERS/PES variable displacement axial piston pumps, integrate the digital combined closed loop pressure and flow control with the electronic max power limitation.

A multiple set of PID parameters can be real time selected during the axis motion via the 12 pin connector (option /S) or through the fieldbus interface, to optimize the P/Q control performances.

The PVPC-PES pumps allow the accurate and dynamic closed loop control of the delivered flow and the system pressure.



**5 AXIS CONTROLS**

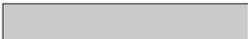
The modern architecture of industrial machinery strongly increases the demand of accuracy, repeatability and performance. This leads to the need of devices that integrate to the traditional axis positioning also the pressure/force controls.

Atos focuses the integration of axis cards functions with proportional electrohydraulics either in on-board or off-board format.

They improve motion performances, simplify the automation architecture and may be integrated in the fieldbus network.

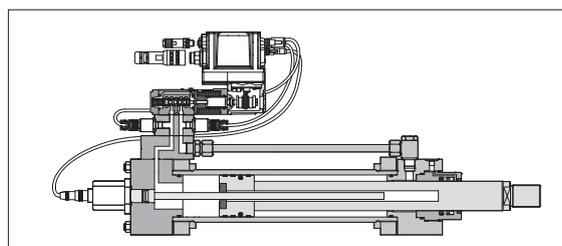
**5.1 Synthetic comparison**

| TYPE  |                          | ON BOARD AXIS CARD AND DRIVER   | AXIS CARD WITH DRIVER FUNCTION  | AXIS CARD  |
|---|--------------------------|---|---|--|
| FORMAT  |                          |  | <br>DIN-rail format | <br>DIN-rail format |
| MAIN FUNCTION                                     |                          |  | <br>DIN-rail format | <br>DIN-rail format |
| Technical table                                   |                          | <b>FS610 FS620 FS630</b>  | <b>GS330</b>  | <b>GS340</b>   |
| Valve's driver function                           |                          | ●   | ●   | n.a.   |
| Nr. of controlled axis                            |                          | 1   | 1   | 1  |
| Internal programmable cycles                      |                          | simple  | simple  | complete   |
| Graphic programming software                      |                          | ●   | ●   | ●  |
| Position control                                  |                          | ●   | ●   | ●  |
| Position transducer interface:                    | Analog                   | ●   | ●   | ●  |
|   | Digital (SSI or Encoder) | ●   | ●   | ●  |
| P/Q control                                       |                          | ●   | ●   | ●  |
| Analog transducer interface, pressure or force    |                          | 2   | 2   | 2  |
| Performance parameters setting (e.g. Dither, PID) |                          | ●   | ●   | ●  |
| Valve parameters setting (e.g. Bias, Ramp, Scale) |                          | ● factory preset  | ● factory preset  | ●  |
| Alternated control                                |                          | ●   | ●   | ●  |
| USB interface                                     |                          | ●   | ●   | ●  |
| CANopen   |                          | ●   | ●   | ●  |
| PROFIBUS DP                                       |                          | ●   | ●   | ●  |
| EtherCAT  |                          | ●   | ●   | ●  |
| POWERLINK   |                          | ●   | ●   | ●  |
| EtherNet/IP                                       |                          | ●   | ●   | ●  |
| PROFINET RT/IRT                                   |                          | ●   | ●   | ●  |
| Digital input                                     |                          | 1   | 1   | 3  |
| Digital output                                    |                          | 1   | 1   | 1  |
| Analog input reference                            |                          | 2   | 2   | 2  |
| Analog output monitor                             |                          | 2   | 2   | up to 3  |

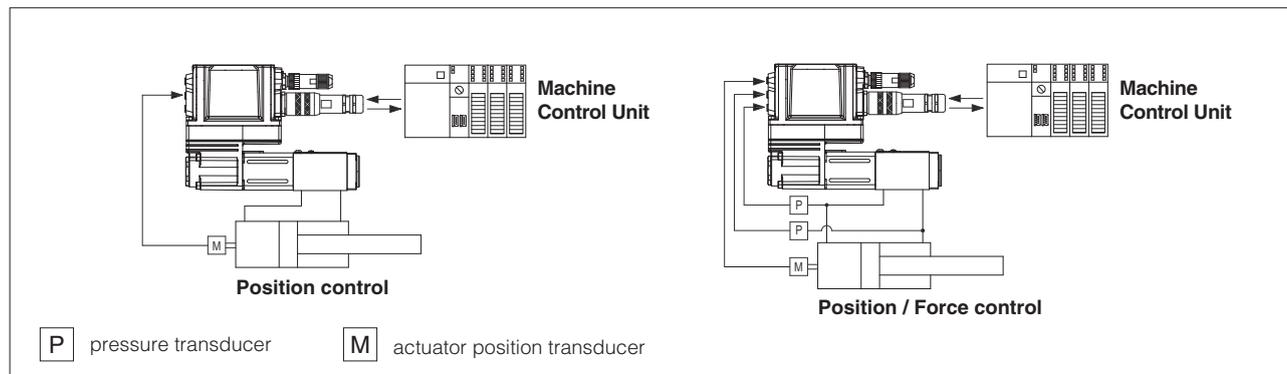
 = options

**5.2 Servoactuators - see tech table FS700**

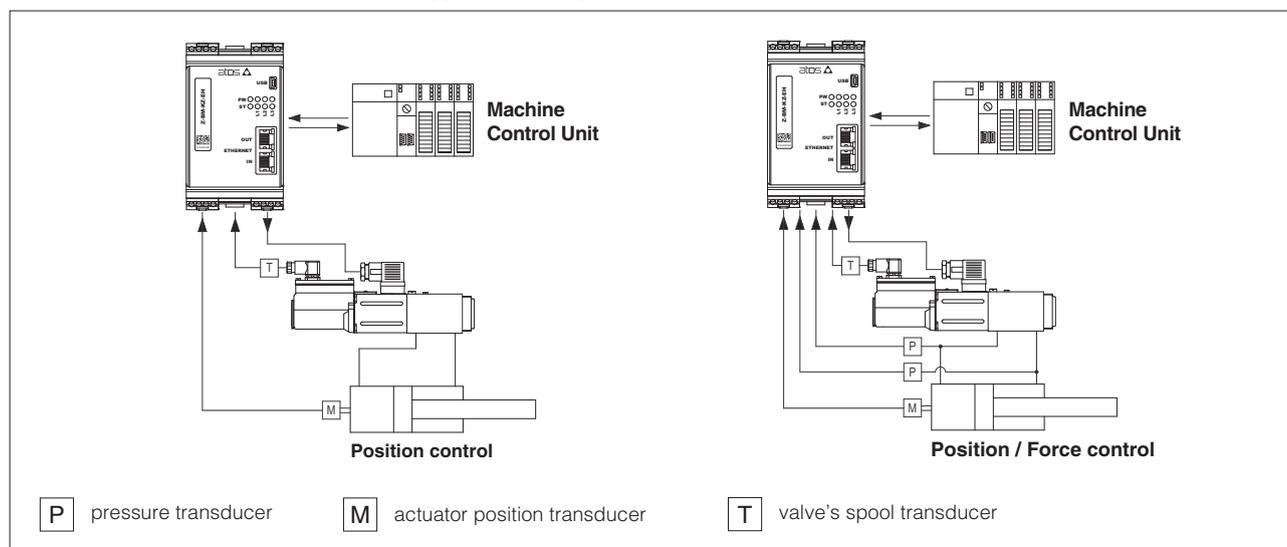
They are stand-alone units performing closed loop position plus optional alternated P/Q controls. These units are made by a servocylinder with position transducer and a servoproportional valve with on-board driver + axis card, factory assembled and tested.



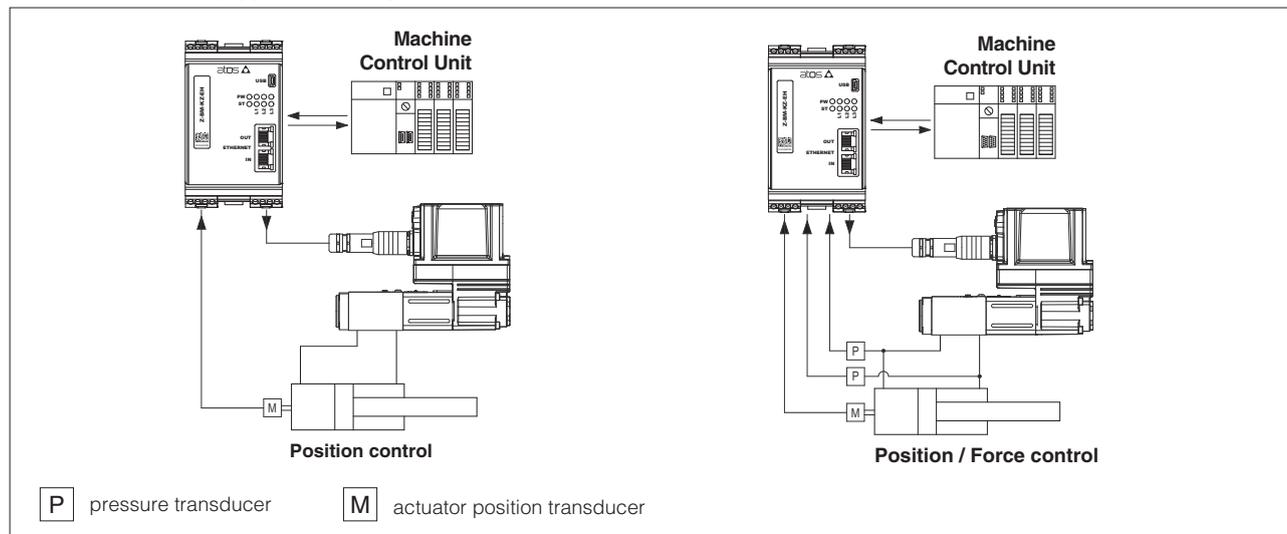
5.3 Digital servoproportionals with on-board axis card and driver, application example - see FS610, FS620, FS630



5.4 DIN-rail axis card with driver function, application example - see tech table GS330



5.5 DIN-rail axis card, application example - see tech table GS340



6 ATOS PROGRAMMING SOFTWARE - see tech table GS500

The valve functional parameters and configurations can be easily set and optimized using Atos programming software. E-SW and Z-SW software are supplied in DVD format and can be easily installed on a desktop or a notebook computer.

The software graphic interface is organized in pages and levels related to different specific functional groups and allows to:

- simply access all the functional parameters of Atos digital proportional valves and drivers
- numerically adapt the factory preset parameters to the application requirements
- verify the actual working conditions
- identify and quickly solve fault conditions
- store the customized setting into the valve/driver or into the PC

The software automatically recognizes the connected valve model and adapts the displayed parameters.



Table E001-10/E

## Basics for on-off solenoid directional valves

Atos solenoid valves have been designed and tested with innovative concepts to satisfy the advanced needs of modern machines: rapid or damped switching, quiet operation, reduced power absorbed, versatility, reliability and safety of use. This table gives engineers, in condensed form, a series of useful information for the choice and the use of modern solenoid valves.

### 1 DESCRIPTION OF FUNCTION

Solenoid directional valves are used for changing flow direction in hydraulic systems.

Main features are:

- 1.1 New integrated design between hydraulic and electrical parts with more compact construction and better efficiencies.
- 1.2 Wet solenoids for maximum reliability, also available in flame-proof, intrinsically safe and stainless steel execution.
- 1.3 All seals are static and all the moving parts are protected and lubricated by the fluid.
- 1.4 Smoother switching with effective regulation thanks to optional switching control devices.
- 1.5 Plastic encapsulated coils easily interchangeable and UL certified.
- 1.6 Electric or electronic connectors, depending on the application and on electric control board interface.
- 1.7 Cored oil passages with low pressure drops.
- 1.8 Interchangeable spools for various directional functions.

### 2 SOLENOID IDENTITY

According to European Convention, solenoid "A" is close to "A" port and solenoid "B" is close to "B" port of the valve body (pilot valve body for two stage valves).

### 3 SPOOLS CHARACTERISTICS

Standard interchangeable spools are available in a wide range of configurations, as indicated in table 3.

**Specific spools to reduce water hammer-shocks during switching:** variants 1/1, 4/8 and 5/1. Their special shape reduces water hammer-shocks during switching. Use of these spools is not recommended with maximum flow greater than 80% of the nominal values, because of higher pressure drops generated in the valve.

**Response times and control of switching time: direct operated solenoid valves.**

The solenoid valve response times can be controlled by the use of specific devices (option L); associated with the spools \*1 and \*8 it is possible to control smooth acceleration/deceleration of the connected actuator. The L\* devices allow an effective control of the solenoid valve switching time, slowing down the spool speed without reducing the solenoid force.

They are available in different configurations. For correct use a slight backpressure (2 bar) on solenoid valve T port is recommended. Valve response time is also influenced by operating conditions (oil characteristics and temperature), elasticity of the hydraulic circuit and by use of electronic connectors.

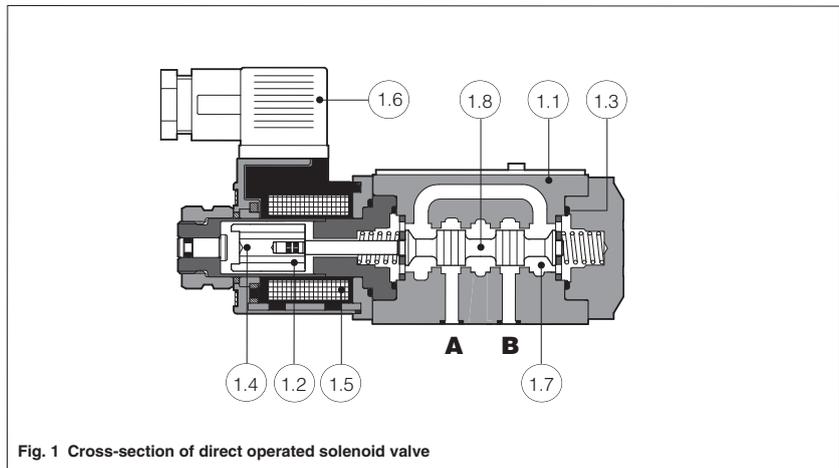


Fig. 1 Cross-section of direct operated solenoid valve

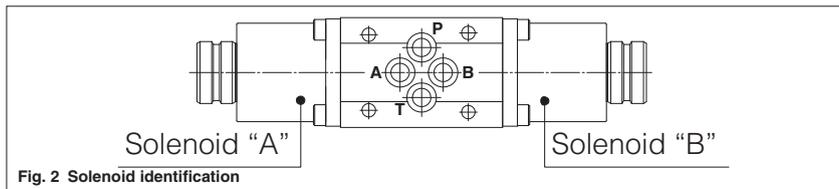


Fig. 2 Solenoid identification

| Type | Scheme | Intermediate passages |
|------|--------|-----------------------|
| 0    |        |                       |
| 1    |        |                       |
| 2    |        |                       |
| 3    |        |                       |
| 4    |        |                       |
| 5    |        |                       |
| 58   |        |                       |
| 6    |        |                       |
| 7    |        |                       |
| 8    |        |                       |
| 0/2  |        |                       |
| 1/2  |        |                       |
| 2/2  |        |                       |
| 16   |        |                       |
| 17   |        |                       |

Table 3 Basic spools, schemes and intermediate passages between central and external positions. **The spools are not available for all the directional valves. For their availability see the relevant valve table.**

**Response time and control of switching time: pilot operated solenoid valves.**

The response time of the piloted valves can be adjusted by means of the options /H (meter-out control) or /H9 (meter-in control). This options provide the installation between the main stage and the pilot valve of a modular throttle valve, type HQ-\*/U specific for fine pilot flow control. Associated with \*/1 and \*/8 spools, smooth acceleration/deceleration can be controlled on loads.

**\*P spools for direct operated solenoid valves to reduce leakage.**

They are normally used on pilot valve for pressure and directional control valves, for cartridge valves and systems with specific requirements.

Use of these spools is not recommended with maximum flow greater than 70% of the nominal values, because of the higher pressure drops generated in the valve.

Following types available: 1P, 3P, 1/2 P, 8P (for ISO size O6 valves).

**4 COIL CHARACTERISTICS**

Solenoid valves are available both with DC and AC coils.

- OI solenoids for DHI valves are available for AC and DC supply (only replacing coils)
- OE-AC and OE-DC solenoids for DHE valves are available respectively for AC and DC supply
- AE-AC and AE-DC solenoids for DKE valves are available respectively for AC and DC supply

For solenoids OE and AE, the coils of different voltages are interchangeable only for the same type of power supply AC or DC.

The DC solenoids can be also fed with AC supply, by using 669 connector.

**5 ELECTRICAL CONNECTORS TO ISO 4400 (DIN 43650)**

The cable entry on electrical plugs can be fitted at 90° intervals by reassembling the contact holder relative to the plug housing.

The cable entry is Pg. 11 suitable for cable Ø 6-10 mm.

Following types are available:

Standard connectors, IP65 protection degree (666);

Connectors with built in LED (667);

Connectors with built in rectifier bridge (669) to supply DC coils by alternating current AC.

In addition to the above DIN connectors, other type of electrical interfaces are available on request:

- Lead Wire connection
- Deutsch connector DT-04-2P (IP67)
- AMP Junior Timer connector (IP67)

**6 ELECTRONIC CONNECTORS**

**Operational principle**

E-SD to eliminate electric disturbances when solenoids are deenergized;

**7 OPERATING NOTES**

**Tightening of the fixing screws to the subplates and of the plastic coil ringnut.**

It is particularly important to check that the tightening of the fixing screws respects the torque limits indicated in table 4.

Higher values may cause anomalous deformations of the body and prevent sli-

**Table 3.2 Spools to reduce water hammer shocks associated with switching**

| Type | Scheme | Intermediate passages |
|------|--------|-----------------------|
| 0/1  |        |                       |
| 1/1  |        |                       |
| 3/1  |        |                       |
| 4/8  |        |                       |

**Table 3.3 Specific spools for special uses or in regenerative circuits**

| Type | Scheme | Intermediate passages |
|------|--------|-----------------------|
| 09   |        |                       |
| 90   |        |                       |
| 19   |        |                       |
| 91   |        |                       |
| 39   |        |                       |
| 93   |        |                       |
| 49   |        |                       |
| 94   |        |                       |

ding of the spool. 12.9 class fixing screws are recommended. The plastic coil ringnuts will be fixed on the solenoid with a torque 4Nm: this deforms properly the seals and protects against external particles and water entrance.

**Operation in circuits with flow exceeding the nominal valve flow**

In circuits with flow rates greater than the nominal values and in circuits with accumulators, where the instantaneous flow can exceed nominal values, is recommended a plug-in restrictor on P port of solenoid valve to limit the maximum flow on the valve.

Dilatation and contraction of flexible hoses subjected to variations of system pressure can generate high instantaneous flow rates.

The version indicated in fig.5 can be directly inserted into P port of the valve but also in other valve ports.

The plug-in restrictors can be ordered separately:

PLUG H-\*\* (for DH\* valves)

PLUG K-\*\* (for DKE\* valves)

\*\* the double asterisk identifies the dimension in tenths of a millimeter.

Example: PLUG H-05 = 0,5 mm diameter

**Limits on two-way and three-way operation for direct operated solenoid valves.**

When used as two-way and three-way valves with P, A or B ports blocked or not subject to flow, or with flow much lower than flow on other ports, maximum catalogue performance cannot be assured.

**Minimum pilot pressure for pilot operated solenoid valves.**

A minimum pressure value must be guaranteed for piloting the valve. This value is 8 bar. For spools with P-T connection in rest position, the option /R should be used.

**Operation combined with hydraulic cylinders with high section ratios.**

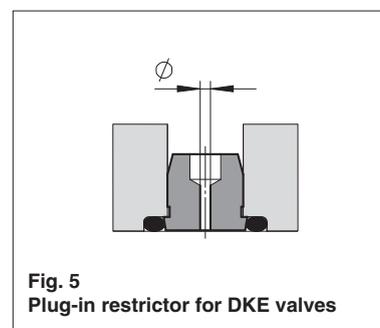
Operational limits may occur with cylinders with section ratios (piston/rod) greater than 1.25. In these cases multiplications or demultiplications of flow and pressure may disturb the correct operation of the solenoid valve.

**8 SPECIAL VERSION SOLENOID VALVES**

- for explosion-proof environments
- for intrinsically safe operation
- stainless steel execution for marine or aggressive environments or water base fluids
- for operation beyond the allowed temperature limits.

**Table 4 Recommended torque for the fixing screws**

| Valve type | Fixing screws class 12.9 | Torque        |
|------------|--------------------------|---------------|
| DH*        | M5                       | 8 Nm          |
| DKE*       | M6                       | 15 Nm         |
| DP**-2     | M10 & M6                 | 70 Nm & 15 Nm |
| DP**-4     | M12                      | 125 Nm        |
| DP**-6     | M20                      | 600 Nm        |



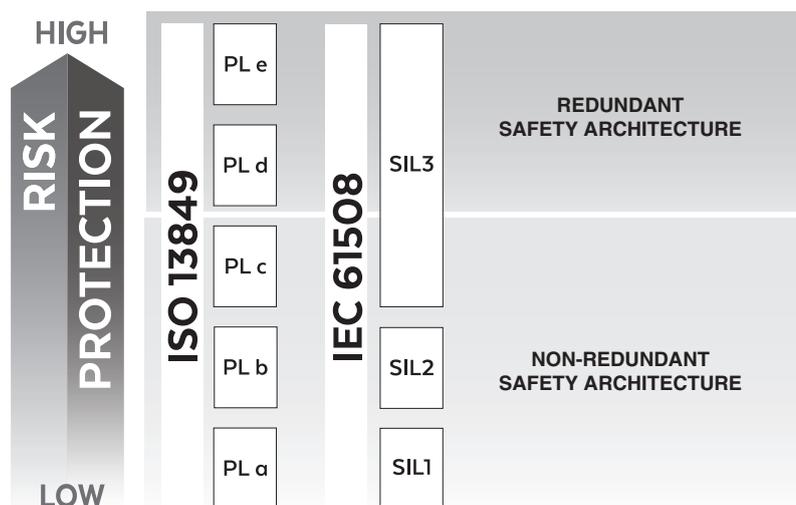
**Fig. 5 Plug-in restrictor for DKE valves**



Table Y010-0/E

## Basics for safety components

IEC 61508 Safety Integrity Level and ISO 13849 Performance Level - certified by 



Safety in engineering of modern machinery is becoming a primary issue to protect people from potential risks caused by accidental failures of machines and systems.

The **Machine Directive 2006/42/EC** with relevant norms **IEC 61508 Safety Integrity Level (SIL)** and **ISO 13849 Performance Level (PL)**, represents the framework of the functional safety, which is a key aspect in terms of general principles of prevention concerning safety of devices or systems with health implications.

It defines the safety requirements that the machine manufacturer must comply with, in order to obtain the certification and thus the possibility to apply the CE mark required to sell the machine within the European market.

Machine Directive 2006/42/EC replaces the existing 98/37/EC and it is universally applicable to machinery, safety components, and other specific equipment.

### 1 SAFETY NORMS

**IEC 61508** and relevant norms **IEC 61511** (process control system) plus **IEC 62061** (machine control systems) introduce the integrated probabilistic approach to the functional safety. They specify the Safety Integrity Levels (SIL) required to perform safety functions.

**ISO 13849** norm provides safety requirements and guidance on the principles for the design and integration of safety-related parts of control systems including the design of software.

It specifies the Performance Level (PL) required to perform safety functions.

PL: discrete value that specify the ability of safety related parts of control systems to perform a safety function under foreseeable conditions.

The requirements are classified into five Performance Levels, where **PL e** identifies the highest protection level.

### 2 CERTIFICATION



Atos safety valves (on-off and proportionals) are certified by TÜV in compliance with IEC 61508, IEC 61511, IEC 62061, ISO 13849

**The certification guarantees the valve compliance with related safety norms and it proves that all requirements have been met for the SIL and PL levels claimed for the specific valve.**

The certification also confirms the following data which can be used by the machine manufacturer for the certification of the whole system:

- the design process used by the valve manufacturer to avoid failures
- the design techniques and measures used to control failures
- the methods used to define hardware fault tolerances
- the methods used to measure the safe failure fractions
- the methods used to measure the probabilities of failure

**⚠ The use of non-certified products invests the machine manufacturer of the responsibility for validating that all above aspects have been carried out according to the applicable standards.**

Without valve's certification the machine manufacturer has to alternatively:

- collect from valve's manufacturer all the reliability data necessary to evaluate the safety level of the whole system
- consider the worst case concerning the safety level (e.g. assign to valves the lower safety level **PL a** or **SIL 1** in order to calculate system safety)

### 3 RISK ASSESSMENT

The first step for determining the necessary risk reduction is the Risk Assessment.

It is a procedure carried out to identify which risks in the machine require a mitigation by means of safety control systems (e.g. laser barriers, shut-off valves, enabling devices, etc). Each of these control systems become a Safety Function.

At that point the safety functions must be defined and satisfied by the machine design (see 3.1).

**⚠ It is the responsibility of the machine manufacturer to ensure that all safety requirements are satisfied and to conduct a documented risk assessment to ensure that all potential machine hazards are covered.**

**3.1 Machine Manufacturer**

With the name of "Machine Manufacturers" are identified OEMs or end users who manufacture machinery for their own needs or everybody who performs "significant modifications" as:

- change the machine function
- change the machine application area
- change the equipment
- change the machine performance

If changing any of the above parameters results in either change of intended use or change of safety system or safety component, a machine modification should be treated as "significant".

Example:

Adding air-gun pneumatic connection = NOT significant modification

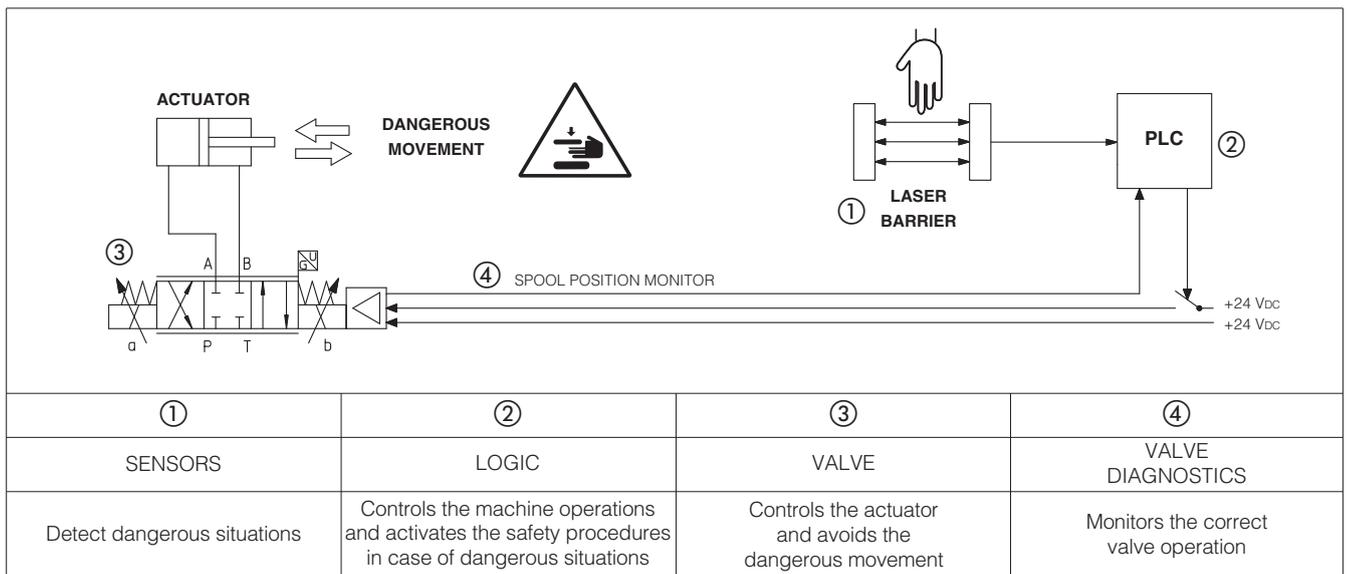
Adding hydraulic accumulator to increase the speed and improve cycle time of the machine = significant modification

**4 SAFETY RELATED PARTS**

They are parts of machine control systems performing safety functions, allowing the system to achieve or maintain a safe status.

These parts consist of either hardware or software and stand-alone or integrated components of the machine control system.

Safety-related parts incorporate the entire effective chain of a safety function provided by control unit, valves, sensors and actuator.



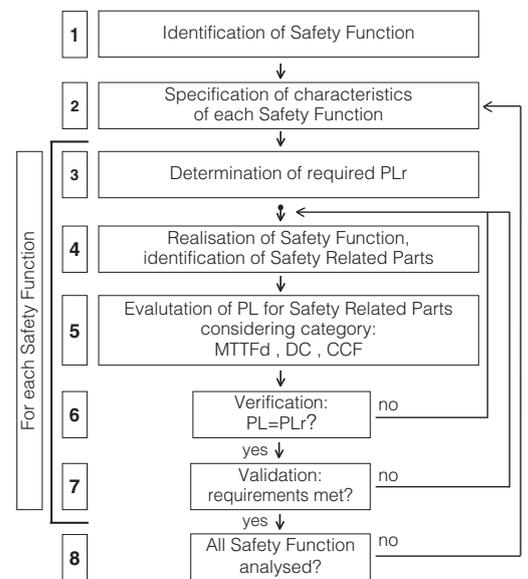
**5 SAFETY ANALYSIS**

The second step after the identification of the risk is the Safety Analysis.

The process for the design of the safety-related parts of control systems, is iterative.

The aside scheme shows the one used by EN ISO 13849-1:

- The first step consists in the identification of the Safety Functions.
- Any characteristics of all safety functions must be described and documented.
- The Performance Level required (PLr) by each safety function must be defined. ISO13849-1 uses a path like the one shown in section 5.1.
- The machine manufacturer must design a system to protect the operator, granting a Performance Level (PL) equal or higher than the Performance Level required (PLr). The Performance Level (PL) must be defined considering following parameters:
  - MTTFd, reliability of safety system – see section 5.2
  - DC, capability to detect faults – see section 5.3
  - CCF, vulnerability of the system to failures – see section 5.4
  - architecture categories of the safety system – see section 6

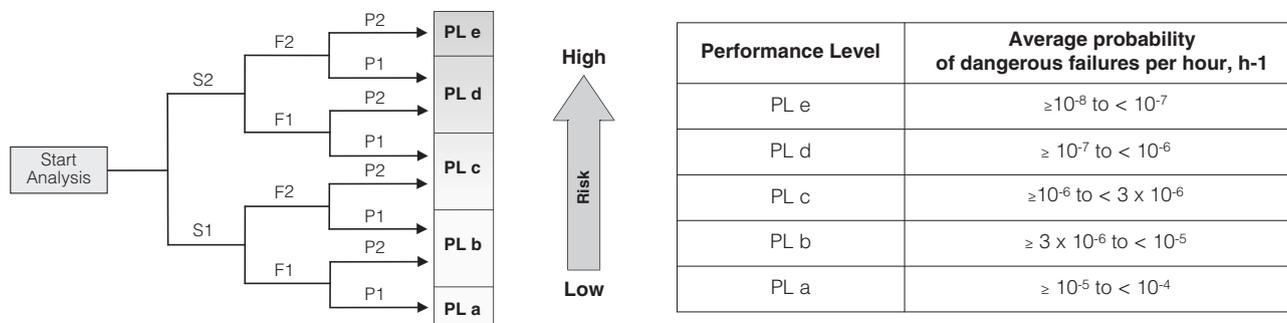


**5.1 Performance Level required - PLr**

The determination of PLr for ISO 13849-1 is carried out analysing the following parameters:

- Severity of harm:  
S1 = slight  
S2 = serious
- Frequency and duration of exposure to the hazard:  
F1 = not often  
F2 = frequent
- Possibility of avoiding the hazard or limiting the harm:  
P1 = possible  
P2 = rarely possible

Each of five performance levels corresponds to a further parameter scale, based on the probability of a dangerous failure per hour.



**5.2 Mean Time to Failure dangerous - MTTFd**

The achievement of a specific PL or SIL relies on the reliability of the system. The reliability is quantified by Mean Time to Failure dangerous (MTTFd) which is measured in hours. The MTTFd should be determined from the component manufacturer’s data.

**5.2 Diagnostic Coverage - DC**

The Diagnostic Coverage (DC) is a measure of how effectively the potential dangerous failures can be detected by the monitoring system. EN ISO 13849-1 suggests how to define DC. Diagnostic Coverage is defined as the measure of the effectiveness of diagnostics: it is determined as the ratio between the failure rate of detected dangerous failures and the failure rate of total dangerous failures;

- DC = 0%** no dangerous faults are detected
- DC = 100%** most of dangerous faults are detected (it is impossible to reach a DC = 100% because diagnostics are not considered to be completely reliable)

**Diagnostic Coverage categories:**

| Category | Range          |
|----------|----------------|
| None     | DC < 60%       |
| Low      | 60% ≤ DC < 90% |
| Medium   | 90% ≤ DC < 99% |
| High     | DC ≥ 99%       |

**5.3 Common Cause Failure - CCF**

The CCF value is a parameter for evaluating the measures against the common cause failure. It is a failure in redundant systems where two or more channels fail at the same time in consequence of a single common cause. The redundancy can be compromised if both channels fail simultaneously due to the same cause. EN ISO 13849-1 provides a score for CCF, which is used to determine the Performance Level (PL).

For this score, EN ISO13849-1 defines a checklist of seven important countermeasures:

- The signal paths of different channels are physically separated (score = 15 points)
- Diversity in the technology, the design or the physical principles of the channels (score = 20 points)
- Protection against possible overloading (15 points) and the use of well-tried components [which are those components which have been widely used or made and verified for safety related application (score = 5 points)]
- Failure mode and effects analysis during development for the identification of potential common cause failures (score = 5 points)
- Training of designer/service personnel in CCF and its avoidance (score = 5 points)
- Protection against common failures caused by contamination (fluid filtration) and electromagnetic interference for electrical parts(score = 25 points)
- Protection about common cause failures caused by unfavorable environmental conditions (score = 10 points)

For architecture categories 2, 3 and 4 a minimum score of 65 points is required (see section 6).

**Note:** CCF always depends on the system and application.

## 6 ARCHITECTURE CATEGORIES

SIL and PL levels depend not only on the characteristics of the single component but also on the architecture of the hydraulic system and of the signals diagnostic.

Architecture categories help to define the probability of failure and the PL of the safety related parts of a control system in relation to their resistance to faults and their subsequent behavior in the fault condition

There are five architecture categories, identified as : **B, 1, 2, 3, 4**

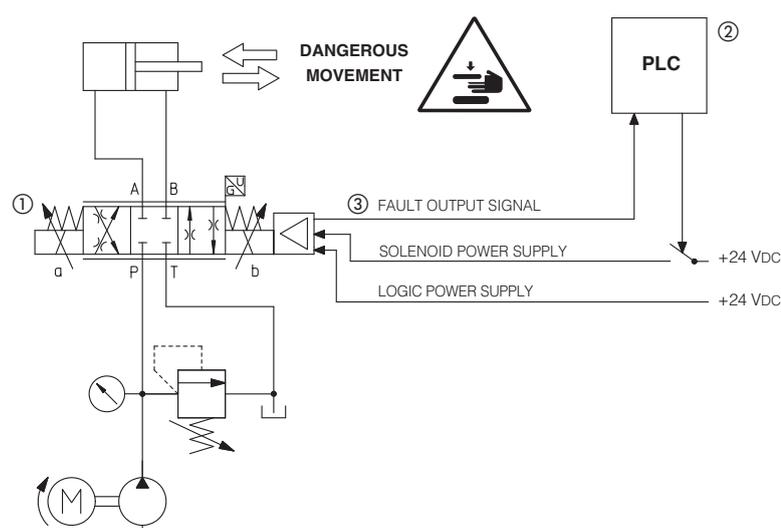
The higher is the number, the higher is the complexity of the safety system and the higher is the achieved Performance Level PL.

### 6.1 Architecture categories B and 1

In categories B and 1, the resistance to faults is mainly achieved by the selection of proper components. They are not-redundant architecture so the occurrence of a failure may lead to the loss of the safety function.

Category 1 has a greater resistance than category B because of the use of special components and principles which are considered well-tried and tested in a safety system.

#### Example of architecture category 1



**Safety function** = to prevent the dangerous cylinder movement in a certain phase of the cycle or in emergency

The safety function is achieved by disabling the current to the solenoids of safety proportional valve so that the spool is moved by the springs to the rest position with positive overlap.

Through the continuous monitoring of the valve's spool position, the machine PLC verifies if the "safe condition" is fully accomplished.

**⚠ The safety function is not performed in case of valve ① failure**  
**Fault tolerance HFT = 0**

① Digital proportional valve with double power supply - option /U (i.e. DHZO-TES-SN-NP-07\*-L5 /U)

② Machine PLC supervising the safety function

③ Fault output signal used for safety diagnostics

### 6.2 Architecture - category 2

In category 2 all of the requirements of architecture B and 1 are combined. In addition, the system is monitored to intercept faults affecting the safety function.

These monitors are made at regular intervals, e.g. at startup or before the next demand on the safety function.

By using an appropriate selection of test intervals, a suitable risk reduction can be obtained.

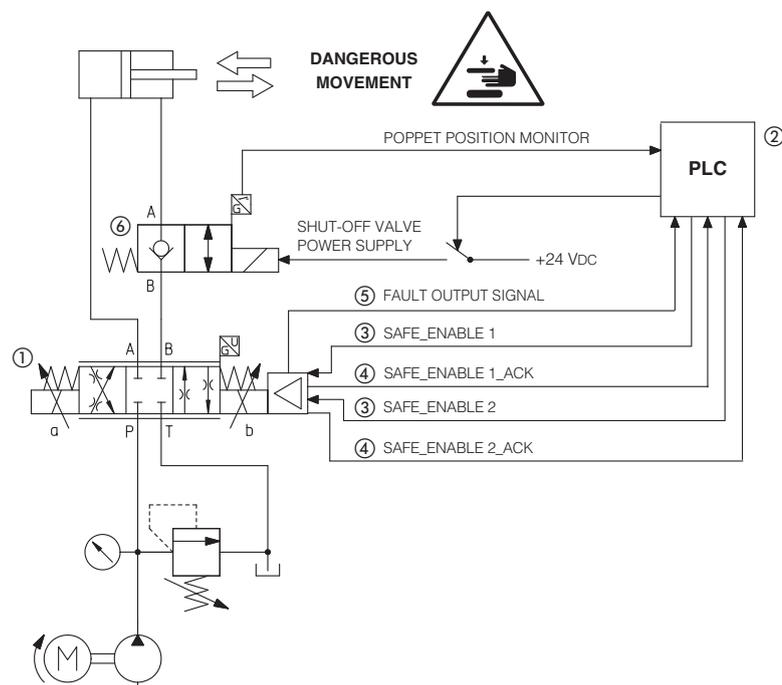
### 6.3 Architecture categories 3 and 4

In categories 3 and 4, the occurrence of a single fault does not result in the loss of the safety function.

In category 4 such faults are detected automatically.

Accumulation of faults will not lead to a loss of the safety function.

#### Example of architecture category 4



**Safety function** = to prevent the dangerous cylinder movement in a certain phase of the cycle or in emergency

In this example a safety shut-off valve with poppet position switch has been added to the safety proportional valves to grant a **redundant safety architecture**.

The safety function is performed by disabling the current to the solenoid of safety proportional valve and safety shut-off valve so that the spool is moved by the springs to the rest position with positive overlap.

The safety condition is confirmed by:

- SAFE\_ENABLE\_ACK status = 24 VDC
- shut-off valve poppet position monitor signals

**⚠ The safety function is performed even in case of failure of one valve, ① or ⑥**  
**Fault tolerance HFT = 1**

① Digital proportional valve - option /K  
(i.e. DHZO-TES-SN-NP-07\*-L5 /K)

② Machine PLC supervising the safety function

③ Signals used to enable/disable the current to the valve's solenoids

④ Signals confirming the valve safe status

⑤ Fault output signal used for safety diagnostics

⑥ Safety shut-off valve with poppet position monitor (i.e. JO-DL /FV)

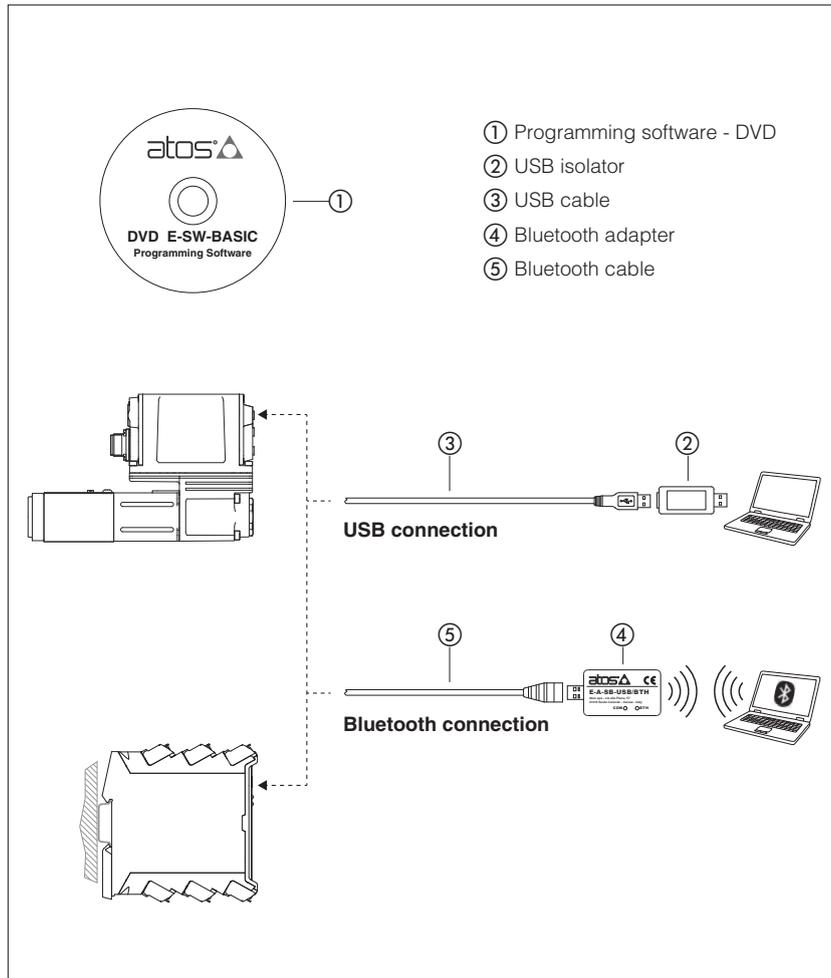




Table **GS500-7/E**

# Programming tools for digital electronics

Atos PC software, USB adapters, cables and terminators



The E-SW and Z-SW programming software are supplied in DVD format and can be easily installed on a desktop or a notebook computer. The intuitive graphic interface allows:

- set up valve's functional parameters
- verify the actual working conditions
- identify and quickly solve fault conditions
- adapt the factory preset parameters to the application requirements
- store the customized setting into the valve
- archive the customized setting into the PC

The graphic interface is organized in pages related to different specific groups of functions and parameters.

The software automatically recognizes the connected valve model and adapts the displayed parameter groups, according to the selected access level.

The software is available in different versions according to the driver and axis card communication interfacing.

Fieldbus communication software includes also dedicated manuals and configuration files for user self management of the Atos electronics, using a fieldbus master.

**Features:**

- automatic valve recognition
- multilevel graphic interface
- numeric parameters settings (scale, bias, ramp, linearization, dither, etc.)
- real-time parameters modification
- diagnostic and monitor signals
- preset data storing into the digital driver and axis card
- internal oscilloscope function
- internal database of customized preset

**DVD contents:**

- software installer
- user and fieldbus communication manuals
- fieldbus configuration files

**1 PROGRAMMING SOFTWARE**

Valve functional parameters can be easily set up with Atos E-SW and Z-SW programming software using proper connection to the digital driver/axis card.

|  |   |              |   |   |   |  |
|--|---|--------------|---|---|---|--|
| <b>E - SW</b>  | - | <b>BASIC</b> | / | *   | - | *  |
| E-SW= for valve drivers  |   |              |   |   |   | Supplies:<br>- = first supply<br>N = next supply |
| Supported valve drivers communication:   |   |              |   |   |   |  |
| <b>BASIC</b> = NP (USB) PS (Serial) IR (Infrared)  |   |              |   |   |   |  |
| <b>FIELDBUS</b> = BC (CANopen) BP (PROFIBUS DP) EH (EtherCAT)<br>EW (POWERLINK) EI (EtherNet/IP) EP (PROFINET) |   |              |   |   |   |  |
|  |   |              |   | Option:   |   |  |
|  |   |              |   | <b>PQ</b> = for valve drivers with alternated P/Q controls SP, SF, SL |   |  |

**Notes:** E-SW-FIELDBUS supports also valve drivers without fieldbus communication;  
E-SW-\*/PQ supports also valve drivers without P/Q control

|  |   |             |   |  |
|--|---|-------------|---|--|
| <b>Z - SW</b>  | - | <b>FULL</b> | - | *  |
| Z-SW= for axis cards   |   |             |   |  |
| Supported axis cards communication:  |   |             |   |  |
| <b>FULL</b> = NP (USB) PS (Serial)<br>BC (CANopen) BP (PROFIBUS DP) EH (EtherCAT)<br>EW (POWERLINK) EI (EtherNet/IP) EP (PROFINET) |   |             |   |  |
|  |   |             |   | Supplies:<br>- = first supply<br>N = next supply |

**1.1 Programming software versions**

Different software versions are available according to the valve drivers and axis cards type to be connected and communication interface.

**Note:** the E-SW and Z-SW software are supplied in DVD format; E-SW-BASIC software can be free downloaded from the Atos website

Free programming software, web download:

**E-SW-BASIC** Software can be downloaded upon web registration at [www.atos.com](http://www.atos.com); service and DVD not included.  
Upon web registration user receive via email the Activation Code (software free license) and login data to access Atos Download Area.  
The software remains active for 10 days from the installation date and then it stops until the user inputs the Activation Code.

DVD first supply of programming software, to be ordered separately:

**E-SW-BASIC** Software has to be activated via web registration at [www.atos.com](http://www.atos.com); 1 year service included.  
**E-SW-BASIC/PQ** Upon web registration user receive via email the Activation Code (software license) and login data to access personal Atos Download Area.  
**E-SW-FIELDBUS**  
**E-SW-FIELDBUS/PQ** The software remains active for 10 days from the installation date  
**Z-SW-FULL** and then it stops until the user inputs the Activation Code.

DVD next supplies of programming software, to be ordered separately:

**E-SW-BASIC-N** Only for supplies after the first; service not included, web registration not allowed.  
**E-SW-BASIC/PQ-N** Software has to be activated with Activation Code received upon first supply web registration.  
**E-SW-FIELDBUS-N**  
**E-SW-FIELDBUS/PQ-N**  
**Z-SW-FULL-N**

**Notes:** the E-SW and Z-SW software are NOT interchangeable and have to be ordered separately;  
programming software FIELDBUS and FULL can program digital electronics through USB communication port for all industrial and ex-proof versions of drivers/axis cards

**1.2 DVD contents**

Include software installer, user manuals and fieldbus configuration files:

EDS for BC - GSD for BP - XML for EH - XDD for EW - EDS for EI - GSDML for EP

**1.3 Atos Download Area**

Direct access to latest releases of programming software, manuals, USB drivers and fieldbus configuration files at [www.atos.com](http://www.atos.com)

Software and USB drivers can be easily installed following the instruction contained in the "info.txt" files.

An automatic mailing message will inform all the registered users whenever a new software upgrade is available.

**1.4 E-SW / Z-SW minimum PC requirements**

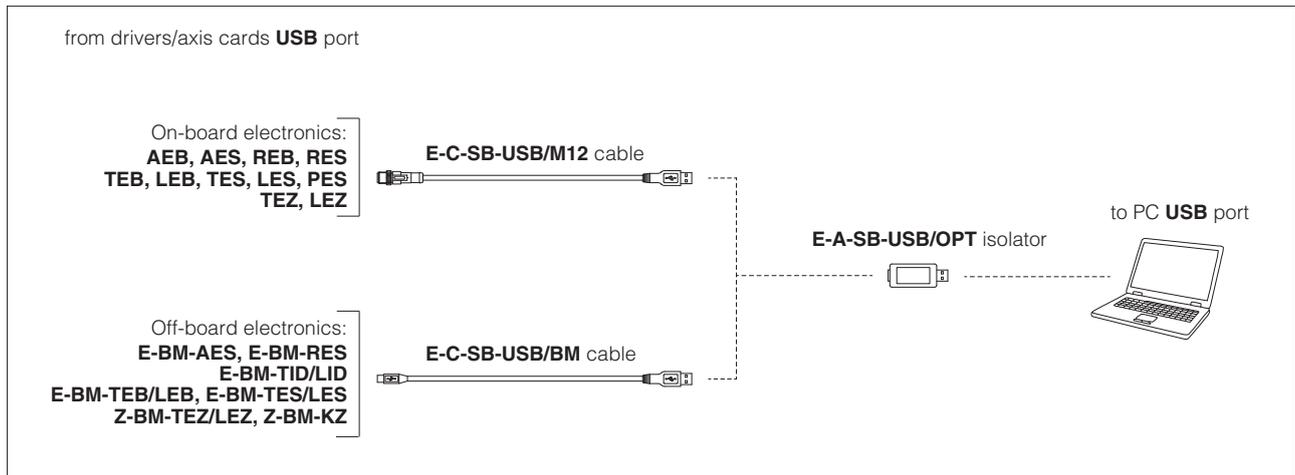
|                           |                                       |                  |  |
|---------------------------|---------------------------------------|------------------|--|
| <b>Personal Computer</b>  | Pentium® processor 1GHz or equivalent | <b>Memory</b>    | 512 MB RAM + Hard Disk with 250MB free space |
| <b>Operating System</b>   | Windows XP SP3                        | <b>Device</b>    | DVD reader                                   |
| <b>Monitor Resolution</b> | 1024 x 768                            | <b>Interface</b> | Serial RS232 port (only for PS) or USB port  |

**2 USB connection - ISOLATOR AND CABLE**

E-SW / Z-SW software permit valve's parameterization through USB port.

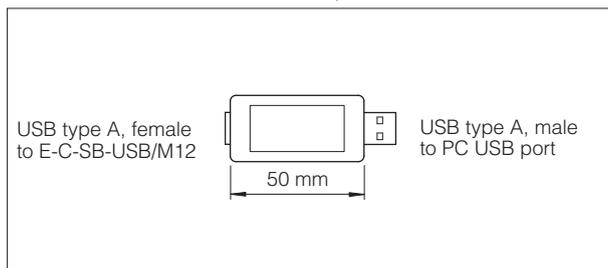
**2.1 Connection tools**

Isolator and cables shown in the image below can be ordered individually or in a single solution purchasing a dedicated kit: **E-KIT-USB**



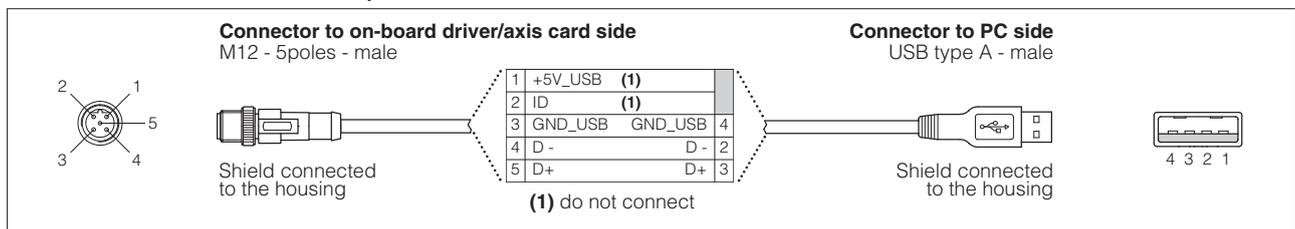
**WARNING: drivers/axis cards USB port is not isolated!** Use of USB isolator adapter is highly recommended for PC protection: wrong earthing connections may cause high potential difference between GNDs, generating high currents that could damage the PC connected to drivers/axis cards.

**2.2 E-A-SB-USB/OPT - isolator adapter**

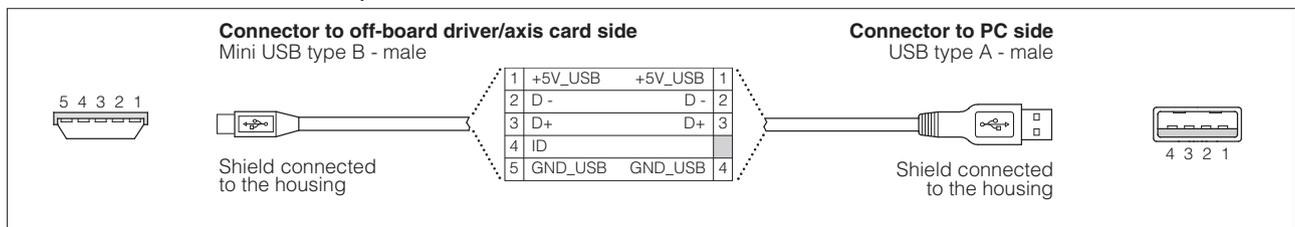


- USB 2.0 Full speed (12 MBps)
- electrical isolation 1 kV
- temperature range, -40° ÷ +50° (relative humidity 25% ÷ 75%)
- external power supply not required (power 400 mA output, 5 V ±10%)
- MTBF >1,2 million hours (MIL standard)

**2.3 E-C-SB-USB/M12 - 4 m cable - only for on-board electronics**



**2.4 E-C-SB-USB/BM - 3 m cable - only for off-board electronics**

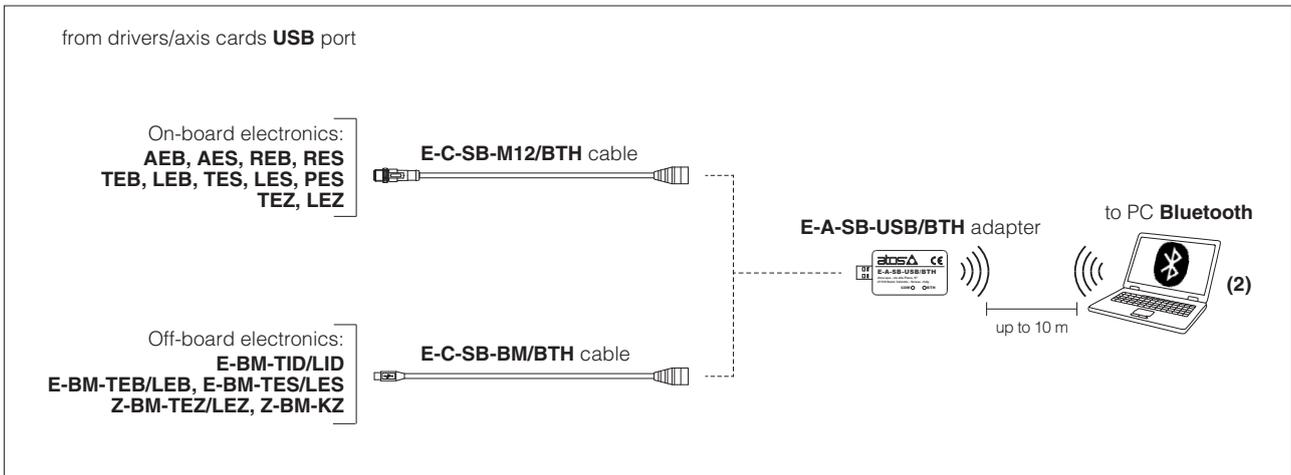


**3 BLUETOOTH connection - ADAPTER AND CABLE**

E-SW / Z-SW software permit valve's parameterization through Bluetooth (1).

**3.1 Connection tools**

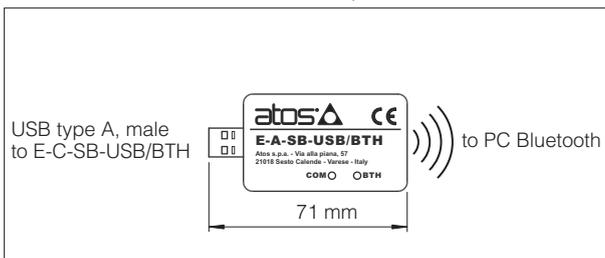
Adapter and cables shown in the image below can be ordered individually or in a single solution purchasing a dedicated kit: **E-KIT-BTH**



(1) Bluetooth adapter is not compatible with E-BM-AES and E-BM-RES drivers

(2) If PC has not built-in Bluetooth, use standard USB to Bluetooth dongle compatible with E-A-SB-USB/BTH specification (please refer to STARTUP-BTH guide)

**3.2 E-A-SB-USB/BTH - Bluetooth adapter**

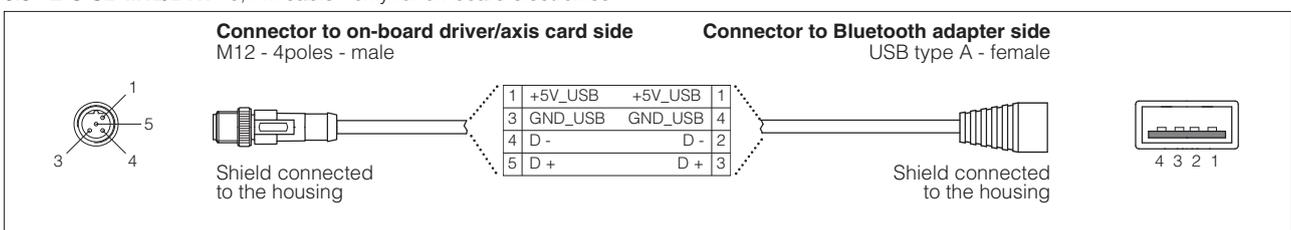


- USB male connector, type A
- type of radio interface: Bluetooth Class 2
- temperature range, -20 ÷ +70 °C (storage -40 ÷ +70 °C)
- external power supply not required (from Atos drivers/axis cards only)
- protocol: Bluetooth Classic Version 2.x , 3.x supporting Serial Port Profile
- max RF transmission power: Class 2 Output Power (+1.5 dBm typical)
- frequency: 2.402 GHz to 2.480 GHz
- LEDs indicate the actual working condition
- IP20 protection degree

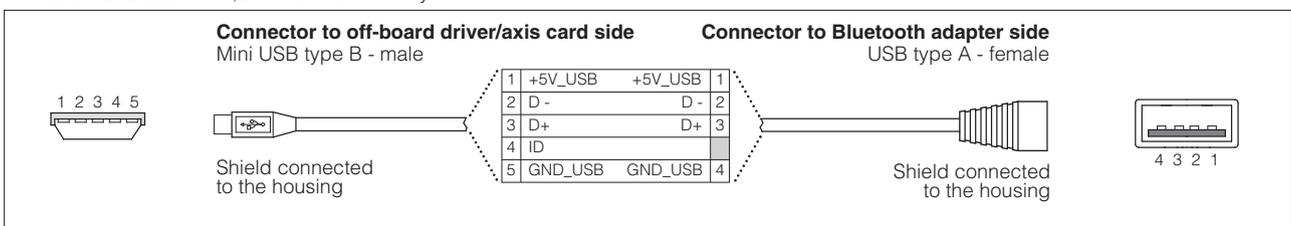
**WARNING: Bluetooth adapter is available only for Europe, USA, Canada, China, Japan, India, Korea markets!**

Bluetooth adapter is certified according to RED (Europe), FCC (USA), ISED (Canada), SRRC (China), MIC (Japan), BIS (India), KC (Korea) directives

**3.3 E-C-SB-M12/BTH - 0,4 m cable - only for on-board electronics**



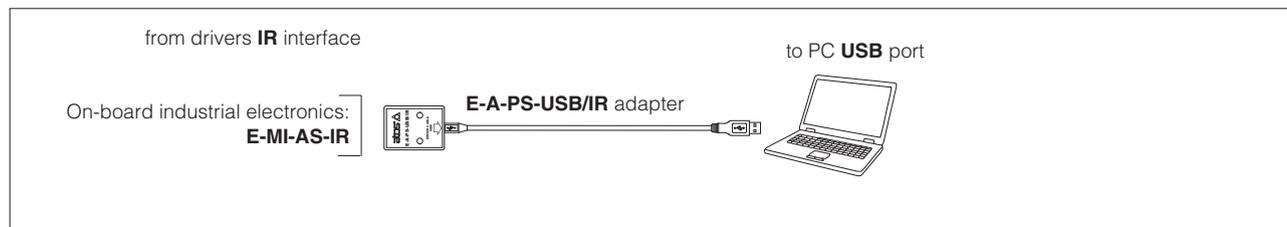
**3.4 E-C-SB-BM/BTH - 0,2 m cable OTG - only for off-board electronics**



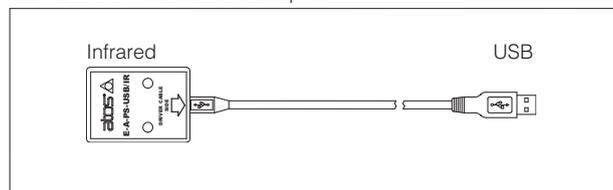
**4 IR infrared - USB COMMUNICATION ADAPTER** - only for **E-MI-AS-IR** drivers

The adapter have to be connected to the USB communication port of PC to activate the IR infrared communication interface towards Atos digital electrohydraulics.

**4.1 Connection tools**



**4.2 E-A-PS-USB/IR - 3 m adapter**

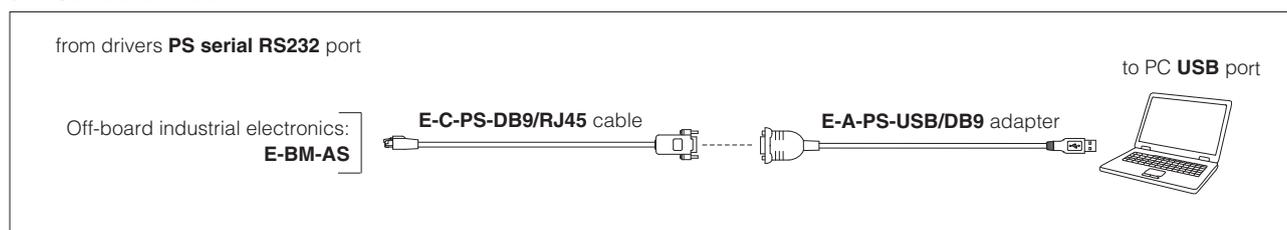


- direct infrared communication with the driver
- USB male connector, type A
- plug-in format for direct infrared connection on the driver
- transmission rate 9,6 kbit/s
- external power supply not required (USB supply)

**5 PS serial RS232 - USB COMMUNICATION ADAPTER AND CROSS CABLES** - only for **E-BM-AS** drivers

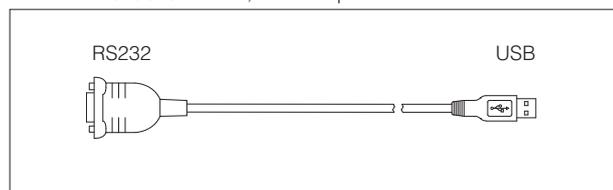
The adapter have to be connected to the USB communication port of PC to activate the PS serial RS232 communication interface towards Atos digital electrohydraulics. The cross cables connect the relevant connector of the USB adapter with the communication port of the digital drivers.

**5.1 Connection tools**



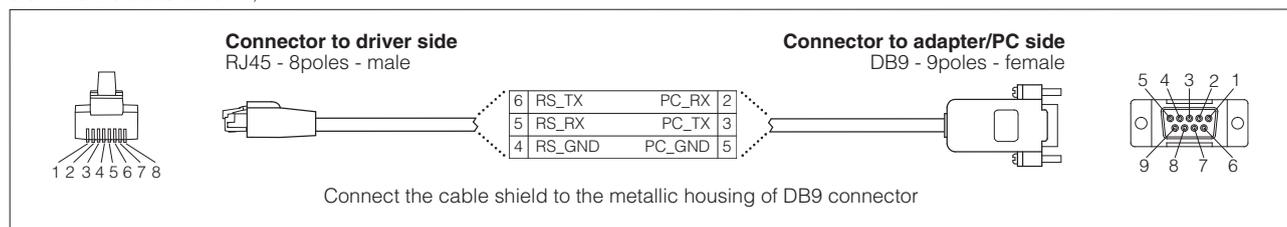
**Note:** the adapter is not required if PC is already equipped with a serial RS232 communication port

**5.2 E-A-PS-USB/DB9 - 0,45 m adapter**



- DB9 male connector according to serial RS232 specification
- USB male connector, type A
- transmission rate from 1,6 kbit/s up to 225 kbit/s
- external power supply not required (USB supply)

**5.3 E-C-PS-DB9/RJ45 - 2,5 m cable**



**6 FIELDBUS TERMINATORS** - only for **BC** and **BP**

The fieldbus terminators are required when output fieldbus connector has to be used as network end point.

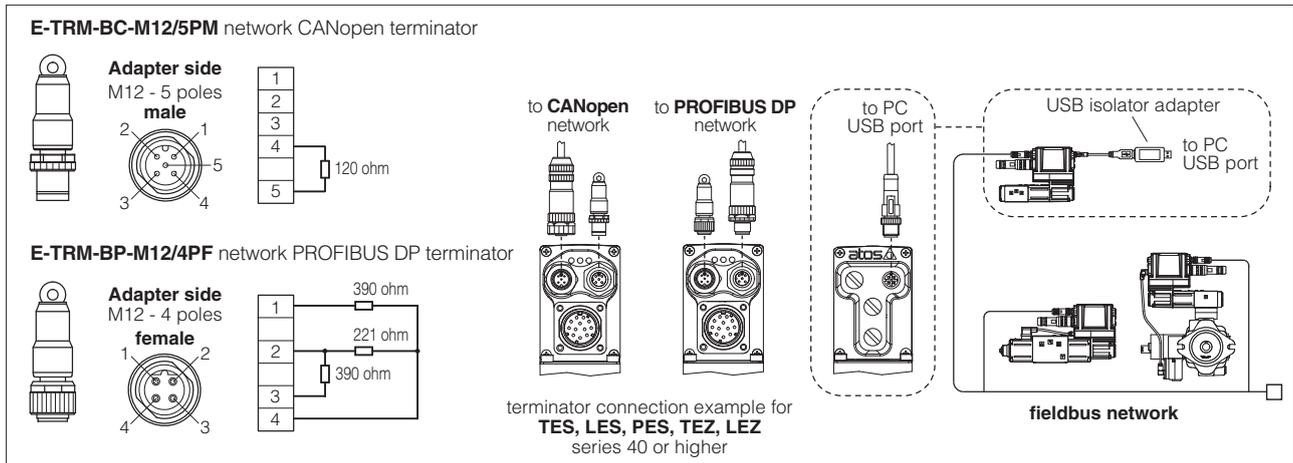
**Note:** fieldbus terminators not available for ex-proof electronics

|  |   |           |   |  |   |   |
|--|---|-----------|---|--|---|---|
| <b>E - TRM</b>   | - | <b>BC</b> | - | <b>M12</b>   | / | <b>5PM</b>  |
| Terminator   |   |           |   |  |   | Connector:<br><b>5PM</b> = to BC executions (1)<br><b>4PF</b> = to BP executions (1)<br><b>DB9</b> = to DB9 connector, cable side (2) |
| Fieldbus interfaces:<br><b>BC</b> = CANopen<br><b>BP</b> = PROFIBUS DP |   |           |   | Connector:<br><b>M12</b> = from M12 output fieldbus connector (1)<br><b>DB9</b> = from DB9 connector, adapter side (2) |   |   |

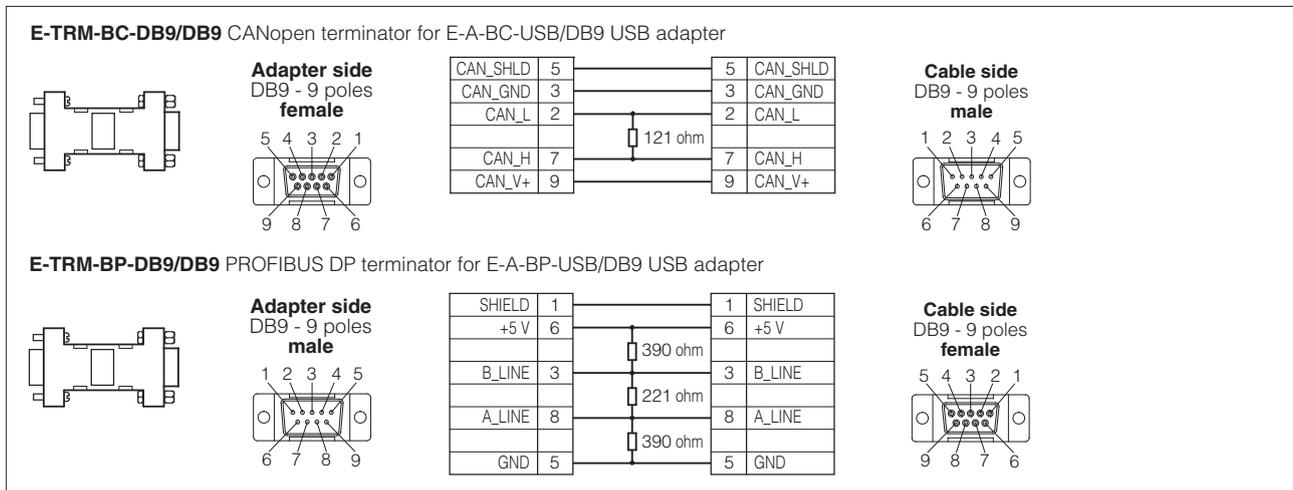
(1) for on-board TES, LES, PES, TEZ, LEZ series 40 or higher

(2) for off-board E-BM-AES, E-BM-RES, E-BM-TID/LID, E-BM-TEB/LEB, E-BM-TES/LES, Z-BM-TEZ/LEZ, Z-BM-KZ

**6.1 M12 terminators**



**6.2 DB9 terminators**



**7 FIRMWARE UPDATE**

It is possible to update the firmware of the following digital drivers and axis cards, using proper USB communication port. The firmware update is allowed starting from electronics series listed into the table or higher series:

**Industrial electronics**

|                              |                              |                              |                              |                                  |                                  |
|------------------------------|------------------------------|------------------------------|------------------------------|----------------------------------|----------------------------------|
| E-RI-AEB s10<br>E-RI-AES s40 | E-RI-REB s10<br>E-RI-RES s10 | E-RI-TEB s10<br>E-RI-LEB s10 | E-RI-TES s40<br>E-RI-LES s40 | E-RI-TES-S s40<br>E-RI-LES-S s40 | E-RI-PES-S s40                   |
| E-BM-AES s10                 | E-BM-RES s10                 | E-BM-TID s10<br>E-BM-LID s10 | E-BM-TEB s10<br>E-BM-LEB s10 | E-BM-TES s10<br>E-BM-LES s10     | E-BM-TES-S s10<br>E-BM-LES-S s10 |
| Z-RI-TEZ s40<br>Z-RI-LEZ s40 | Z-BM-KZ s10                  | Z-BM-TEZ s10<br>Z-BM-LEZ s10 |                              |                                  |                                  |

**Ex-proof electronics**

|                              |                                  |                              |                                  |
|------------------------------|----------------------------------|------------------------------|----------------------------------|
| E-RA-AES s40                 | E-RA-RES s40                     | E-RA-TES s40<br>E-RA-LES s40 | E-RA-TES-S s40<br>E-RA-LES-S s40 |
| Z-RA-TEZ s40<br>Z-RA-LEZ s40 | Z-RA-TEZ-S s40<br>Z-RA-LEZ-S s40 |                              |                                  |

**8 RECOMMENDED TOOLS SELECTION****8.1 Industrial and ex-proof electronics**

|  | Model Code                                     | Series       | Software         | Cable           | USB Adapter    | Terminator |
|--|--|--------------|------------------|-----------------|----------------|------------|
| <b>IR</b>                                    | E-MI-AS-IR                                     | 11           |                  |                 | E-A-PS-USB/IR  |            |
| <b>PS</b>                                    | E-BM-AS  | 10 or higher |                  | E-C-PS-DB9/RJ45 | E-A-PS-USB/DB9 |            |
| <b>NP</b>                                    | E-BM-AES, E-BM-RES                             | 10 or higher | E-SW-BASIC       | E-C-SB-USB/BM   | E-A-SB-USB/OPT |            |
|  | E-BM-TID, E-BM-LID (1)                         | 10 or higher |                  |                 |                |            |
|  | E-BM-TEB, E-BM-LEB, E-BM-TES, E-BM-LES (1)     | 10 or higher |                  |                 |                |            |
|  | AEB, REB (1)                                   | 10 or higher |                  |                 |                |            |
|  | TEB, LEB (1)                                   | 10 or higher | E-SW-BASIC/PQ    | E-C-SB-USB/M12  |                |            |
|  | TES, LES (1)                                   | 40 or higher |                  |                 |                |            |
|  | TES, LES, PES with SP, SF, SL options (1)      | 40 or higher |                  |                 |                |            |
|  | E-BM-TES, E-BM-LES with SP, SF, SL options (1) | 10 or higher |                  |                 |                |            |
| TEZ, LEZ (1)                                 | 40 or higher                                   | Z-SW-FULL    | E-C-SB-USB/M12   |                 |                |            |
| Z-BM-KZ, Z-BM-TEZ, Z-BM-LEZ (1)              | 10 or higher                                   |              |                  | E-C-SB-USB/BM   |                |            |
| <b>BP<br/>BC<br/>EH</b>                      | E-BM-AES, E-BM-RES                             | 10 or higher | E-SW-FIELDBUS    | E-C-SB-USB/BM   | E-A-SB-USB/OPT |            |
|  | RES (1)  | 10 or higher |                  | E-C-SB-USB/M12  |                |            |
|  | AES (1)  | 40 or higher |                  |                 |                |            |
| <b>BC<br/>BP<br/>EH<br/>EW<br/>EI<br/>EP</b> | E-BM-TES, E-BM-LES (1)                         | 10 or higher | E-SW-FIELDBUS    | E-C-SB-USB/BM   | E-A-SB-USB/OPT |            |
|  | TES, LES (1)                                   | 40 or higher |                  | E-C-SB-USB/M12  |                |            |
|  | E-BM-TES, E-BM-LES with SP, SF, SL options (1) | 10 or higher | E-SW-FIELDBUS/PQ | E-C-SB-USB/BM   |                |            |
|  | TES, LES, PES with SP, SF, SL options (1)      | 40 or higher |                  | E-C-SB-USB/M12  |                |            |
|  | TEZ, LEZ (1)                                   | 40 or higher | Z-SW-FULL        | E-C-SB-USB/M12  |                |            |
|  | Z-BM-KZ, Z-BM-TEZ, Z-BM-LEZ (1)                | 10 or higher |                  | E-C-SB-USB/BM   |                |            |

(1) Drivers and axis cards compatible with Bluetooth adapter E-A-SB-USB/BTH (see 3.1)

**8.2 Obsolete industrial electronics**

|           | Model Code                            | Series       | Software         | Cable          | USB Adapter    | Terminator |                |                |                  |
|-----------|---------------------------------------|--------------|------------------|----------------|----------------|------------|----------------|----------------|------------------|
| <b>IR</b> | E-MI-AS-IR                            | 10           | E-SW-IR          |                | E-A-PS-USB/IR  |            |                |                |                  |
| <b>PS</b> | AES                                   | 30           | E-SW-BASIC       | E-C-PS-DB9/M12 | E-A-PS-USB/DB9 |            |                |                |                  |
|           | AERS, TERS, TES, LES                  | 31           |                  |                |                |            |                |                |                  |
|           | TES, LES, PES with SP, SF, SL options | 31           | E-SW-BASIC/PQ    |                |                |            |                |                |                  |
|           | TEZ, LEZ                              | 10           | Z-SW-FULL        |                |                |            |                |                |                  |
|           | Z-ME-KZ-PS                            | 10 or higher |                  |                |                |            | E-C-PS-DB9/DB9 |                |                  |
| <b>BP</b> | AES                                   | 30           | E-SW-FIELDBUS    | E-C-PS-DB9/M12 | E-A-PS-USB/DB9 |            |                |                |                  |
|           | AERS, TERS, TES, LES                  | 31           |                  |                |                |            |                |                |                  |
|           | TES, LES, PES with SP, SF, SL options | 31           | E-SW-FIELDBUS/PQ |                |                |            | E-C-BP-DB9/M12 | E-A-BP-USB/DB9 | E-TRM-BP-DB9/DB9 |
|           | TEZ, LEZ                              | 10           | Z-SW-FULL        |                |                |            | E-C-PS-DB9/DB9 |                |                  |
|           | Z-ME-KZ-PS/BP                         | 10 or higher |                  |                |                |            |                |                |                  |
| <b>BC</b> | AES                                   | 30           | E-SW-FIELDBUS    | E-C-PS-DB9/M12 | E-A-PS-USB/DB9 |            |                |                |                  |
|           | AERS, TERS, TES, LES                  | 31           |                  |                |                |            |                |                |                  |
|           | TES, LES, PES with SP, SF, SL options | 31           | E-SW-FIELDBUS/PQ |                |                |            | E-C-BC-DB9/M12 | E-A-BC-USB/DB9 | E-TRM-BC-DB9/DB9 |
|           | TEZ, LEZ                              | 10           | Z-SW-FULL        |                |                |            |                |                |                  |
| <b>EH</b> | AES                                   | 30           | E-SW-FIELDBUS    | E-C-PS-DB9/M12 | E-A-PS-USB/DB9 |            |                |                |                  |

**8.3 Obsolete ex-proof electronics**

|           | Model Code           | Series | Software      | Cable         | USB Adapter    | Terminator       |
|-----------|----------------------|--------|---------------|---------------|----------------|------------------|
| <b>PS</b> | AES                  | 30     | E-SW-BASIC    | E-C-PS-DB9/M8 | E-A-PS-USB/DB9 |                  |
|           | AERS, TERS, TES, LES | 31     |               |               |                |                  |
| <b>BP</b> | AES                  | 30     | E-SW-FIELDBUS | E-C-PS-DB9/M8 | E-A-PS-USB/DB9 |                  |
|           | AERS, TERS, TES, LES | 31     |               | E-C-BP-DB9/RA | E-A-BP-USB/DB9 | E-TRM-BP-DB9/DB9 |
| <b>BC</b> | AES                  | 30     |               | E-C-PS-DB9/M8 | E-A-PS-USB/DB9 |                  |
|           | AERS, TERS, TES, LES | 31     |               | E-C-BC-DB9/RA | E-A-BC-USB/DB9 | E-TRM-BC-DB9/DB9 |



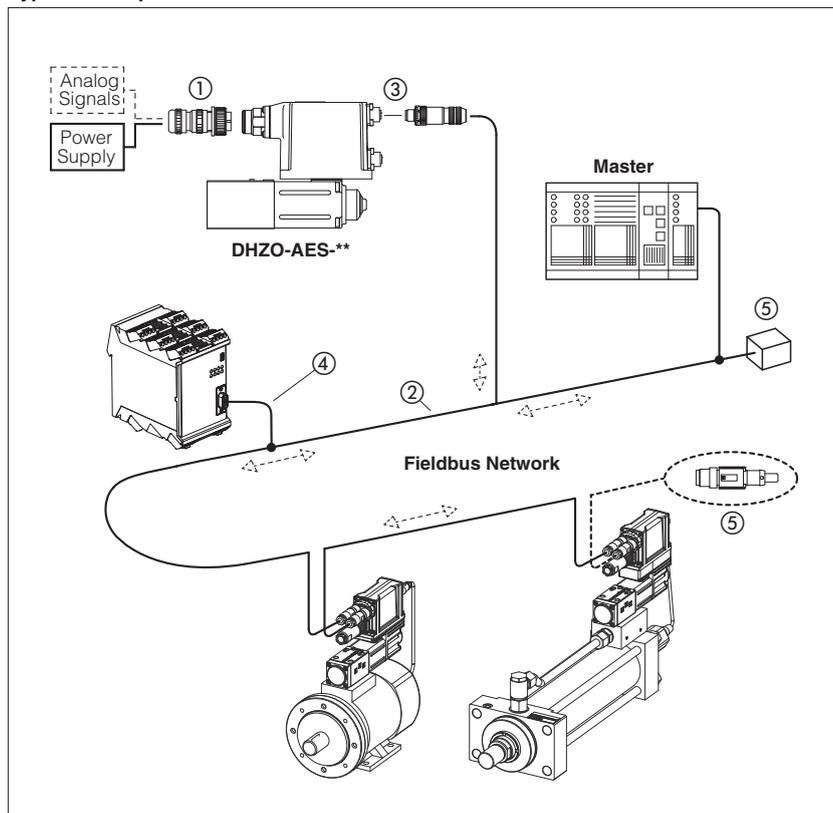


Table **GS510-5/E**

## Fieldbus features

BC (CANopen), BP (PROFIBUS DP), EH (EtherCAT),  
EW (POWERLINK), EI (EtherNet/IP), EP (PROFINET RT/IRT)

### Typical CANopen or PROFIBUS DP fieldbus network



Fieldbus communication interfaces are available for digital proportional drivers and controllers, granting several plus:

- more information available for machine operation to enhance its performances
- improved accuracy and robustness of digital transmitted information
- costs reduction due to simpler and standardized wiring solutions
- costs reduction due to fast and simple installation and maintenance
- direct integration into machine's communication networks

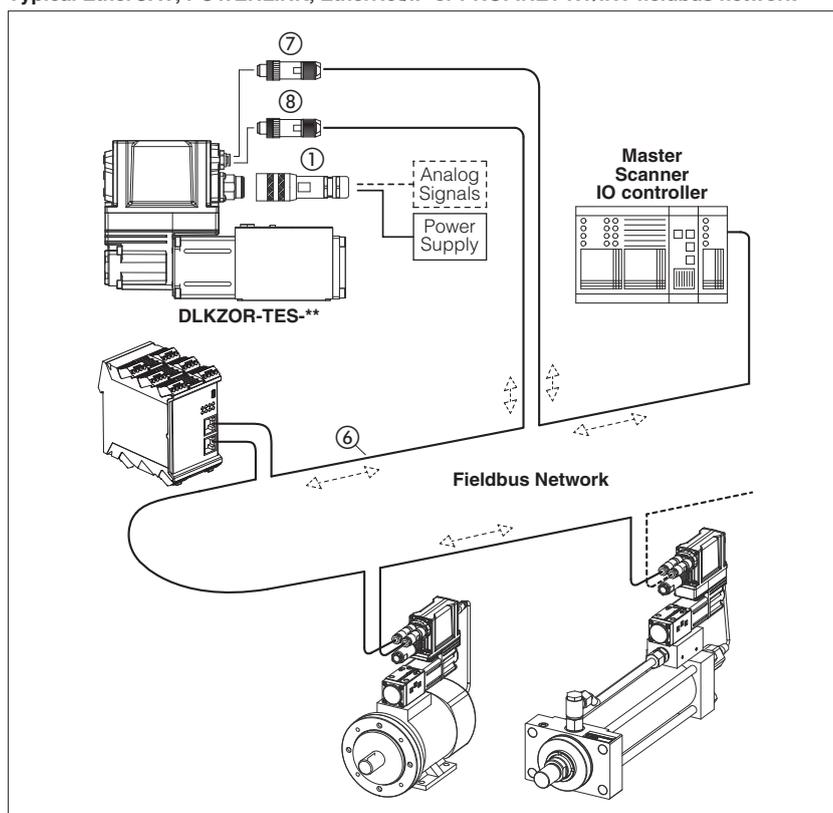
These executions allow to operate proportional valves and pumps through fieldbus or using the analog signals on main connector ①.

### Fieldbus distributed-control

Fieldbus communication allows to share all the available information of the digital drivers and controllers (reference, monitor, etc).

This distributed-control design allows to implement powerful machines functionalities for tuning, diagnostic, maintenance, etc.

### Typical EtherCAT, POWERLINK, EtherNet/IP or PROFINET RT/IRT fieldbus network



**CANopen and PROFIBUS DP** networks consist of a common cable (2 twisted wire, ②) for digital communication: several devices (node ③) can be connected to this main cable by means of short cable branches ④.

The two endpoints of the main cable must be terminated with specific devices (terminator, ⑤) to dissipate the communication signal's energy thus preventing interferences and degradations of fieldbus transmission.

**EtherCAT, POWERLINK, EtherNet/IP and PROFINET RT/IRT** networks consist in a Ethernet common cable (4 twisted wire, ⑥) for digital communication. All slave, adapter and IO device have always the double connector for signal input ⑦ and signal output ⑧.

The main Ethernet cable starting from the master, scanner and IO controller has to be connected to the slave, adapter and IO device input connector.

The slave, adapter and IO device output connector has to be connected to the next slave, adapter and IO device input connector.

**1 CANopen features for digital drivers and controllers in BC execution****Physical**

|                     |  |
|---------------------|--|
| Serial input format | Industrial field-bus with optical insulation type CAN-Bus ISO11898 |
| Transmission rate   | Transmission rates from 10 Kbit/s to 1 Mbit/s                      |
| Max node            | 32 per segment without repeater; 127 per segment with repeater     |

**Communication Protocol**

|                 |   |
|-----------------|---|
| Data Link Layer | DS301 V4.2.0 - based on CAN standard frame with 11-bit identifier |
| Device Profile  | DS408 - Fluid Power Technology (EN50325-4)                        |
| Device type     | Slave   |

**Startup and configuration (as per DS301+DSP305)**

|                  |   |
|------------------|---|
| Boot up process  | Minimum boot-up   |
| Node setting     | LSS (Layer Setting Services)<br>SDO<br>E-SW-FIELDBUS and Z-SW-FULL programming software |
| Baudrate setting | LSS (Layer Setting Services), SDO   |
| Baudrate         | 10 / 20 / 50 (default) / 125 / 250 / 500 / 1000Kbit/s                                   |

**Fieldbus communication diagnostic (as per DS301)**

|               |                            |
|---------------|----------------------------|
| Device Error  | Emergency                  |
| Network Error | Node Guarding<br>Heartbeat |

**Real-time communication (as per DS301 + DS408)**

|               |  |
|---------------|--|
| RPDO          | 4 mappable PDOs to the drivers:<br>AES, BM-AES, TES, BM-TEZ, LES, BM-LES, RES, BM-RES, PES<br><br>4 mappable PDOs to the controllers:<br>TEZ, BM-TEZ, LEZ, BM-LEZ, BM-KZ     |
| TPDO          | 4 mappable PDOs from the drivers:<br>AES, BM-AES, TES, BM-TEZ, LES, BM-LES, RES, BM-RES, PES<br><br>4 mappable PDOs from the controllers:<br>TEZ, BM-TEZ, LEZ, BM-LEZ, BM-KZ |
| R(T)PDO types | Event Triggered, Remotely requested, Sync(cyclic) and Sync(acyclic)  |

**Non real-time communication (as per DS301 + DS408)**

|     |                             |
|-----|-----------------------------|
| SDO | 1 SDO (1 Server + 1 Client) |
|-----|-----------------------------|

**Standard references****ISO 11898**

Road Vehicles – Interchange of digital information controller area network (CAN) for High-speed communication

**EN50325-4**

Industrial communication subsystem based on ISO 11898 (CAN) for controller device interfaces

**CiA DS301**

CANopen – Application Layer and Communication Profile for Industrial Systems

**CiA DR303-1**

Cabling and connector pin assignment

**CiA DSP305**

CANopen – Layer Setting Services and Protocol

**CiA DS408**

CANopen – Device Profile for Proportional Hydraulic Valves v 1.5.2

**Programming interface**

E-SW-FIELDBUS and Z-SW-FULL software using proper cable/adaptor (see tech table **GS500**) or CANopen master device

**Configuration file**

EDS (Electronic Data Sheet), enclosed in programming software DVD E-SW-FIELDBUS and Z-SW-FULL

**Manuals**

E-MAN-S-BC and STARTUP-FIELDBUS, enclosed in programming software DVD E-SW-FIELDBUS  
Z-MAN-S-BC and STARTUP-FULL, enclosed in programming software DVD Z-SW-FULL

**2 PROFIBUS DP features for digital drivers and controllers in BP execution****Physical**

|                     |  |
|---------------------|--|
| Serial input format | Industrial field-bus with optical insulation type PROFIBUS-DP RS485<br>European fieldbus standard (lev.1 – EN50170-part 2) |
| Transmission rate   | Transmission rates from 9,6 Kbit/s to 12 Mbit/s  |
| Max node            | 32 per segment without repeater; 126 node with repeater  |

**Communication Protocol**

|                 |  |
|-----------------|--|
| Data Link Layer | PROFIBUS DPV0 - IEC 61158 (type 3)             |
| Device Profile  | PROFIBUS-DP Profile for Fluid Power Technology |
| Device type     | Slave  |

**Startup and configuration**

|                  |   |
|------------------|---|
| Boot up process  | SAP 61 for sending parameter setting data<br>SAP 62 for checking configuration data |
| Node setting     | SAP 55<br>E-SW-FIELDBUS and Z-SW-FULL programming software                          |
| Baudrate setting | Automatic   |
| Baudrate         | 9,6 / 19,2 / 45,45 / 93,75 / 187,5 / 500 / 1500 / 3000 / 6000 / 12000 Kbit/s        |

**Fieldbus communication diagnostic**

|              |        |
|--------------|--------|
| Device error | SAP 60 |
|--------------|--------|

**Real-time communication**

|     |  |
|-----|--|
| PZD | Process data area of PPO telegram by Data Exchange, default SAP:<br>cyclic transmission of standard Profibus frame |
|-----|--|

**Standard electronics - drivers**

*PPO type 3, 113, 213, 230 for:*

AES, BM-AES, TES, BM-TEZ, LES, BM-LES, RES, BM-RES

*PPO type 5, 115, 214, 240 for:*

TES, BM-TEZ, LES, BM-LES, PES with alternated P/Q control

**Note:** PPO type 213, 230, 214, 240 are customizable by user

**Standard electronics - controllers**

*PPO type 1, 111, 121, 123 for:*

TEZ, BM-TEZ, LEZ, BM-LEZ, BM-KZ

*PPO type 1, 101, 103, 111, 121, 123, 223, 227 for:*

TEZ, BM-TEZ, LEZ, BM-LEZ, BM-KZ with alternated P/Q control

**Note:** PPO type 223, 227 are customizable by user

|             |                           |
|-------------|---------------------------|
| Cyclic mode | standard, sync and freeze |
|-------------|---------------------------|

**Non real-time communication**

|     |   |
|-----|---|
| PKW | Parameter data area of PPO telegram by Data Exchange, default SAP:<br>acyclic transmission of standard Profibus frame |
|-----|---|

**Standard references**

*PROFIBUS profile*

PROFIBUS Profile,  
Fluid Power Technology,  
Edition Oct. 2001

*VDMA profile*

Fluid Power Technology,  
Proportional Valves and  
Hydrostatic Transmissions, ver 1.1

**Programming interface**

E-SW-FIELDBUS and Z-SW-FULL software using proper cable/adapter (see tech table **GS500**) or PROFIBUS DP master device

**Configuration file**

GSD (General Station Description) enclosed in programming software DVD E-SW-FIELDBUS and Z-SW-FULL

**Manuals**

E-MAN-S-BP and STARTUP-FIELDBUS, enclosed in programming software DVD E-SW-FIELDBUS

Z-MAN-S-BP and STARTUP-FULL, enclosed in programming software DVD Z-SW-FULL

**3 EtherCAT features for digital drivers and controllers in EH execution****Physical**

|                     |   |
|---------------------|---|
| Serial input format | Industrial fieldbus type Fast Ethernet galvanically insulated IEC 61158-2 |
| Transmission rate   | 2 x 100 Mbit/s (Fast Ethernet, Full-Duplex)                               |
| Max node            | 65535 slaves  |
| Ethernet Standard   | ISO/IEC 8802-3 frame format   |
| EtherType           | 0x88A4 according to IEEE 802.3  |
| Cable length        | 0,2 - 100m (between two slave devices)                                    |
| Cable type          | CAT5 (4 wire twisted pair) according with T568B                           |
| Network topology    | Line, tree and star   |
| Termination         | Device internally   |

**Communication Protocol**

|                    |   |
|--------------------|---|
| Data Link Layer    | EtherCAT use Standard Ethernet Frames:<br>ISO/IEC 8802-3 + IEC 61784-2                                    |
| Device Profile     | CANopen over EtherCAT (CoE) DS408 - Fluid Power Technology<br>EN 50325-4                                  |
| Device type        | Slave   |
| Supported protocol | CANopen SDO Mailbox-Interface "CoE"<br>Network Management<br>PDO<br>PDO Watchdog<br>Cycle time min 1 msec |

**Startup and configuration (as per DS301+DSP305)**

|              |   |
|--------------|---|
| Node setting | Automatic position addressing<br>Device node addressing |
| Baudrate     | 100 Mbit/s (Automatic)                                  |

**Fieldbus communication diagnostic (as per DS301)**

|              |           |
|--------------|-----------|
| Device Error | Emergency |
|--------------|-----------|

**Real-time communication (as per DS301 + DS408)**

|               |   |
|---------------|---|
| RPDO          | 4 PDOs messages to the driver and controller (up to 32 byte for each PDO)   |
| TPDO          | 4 PDOs messages from the driver and controller (up to 32 byte for each PDO) |
| R(T)PDO types | Remotely requested  |

**Non real-time communication (as per DS301 + DS408)**

|     |                             |
|-----|-----------------------------|
| SDO | 1 SDO (1 Server + 1 Client) |
|-----|-----------------------------|

**Standard references****ISO 11898**

Road Vehicles – Interchange of digital information controller area network (CAN) for High-speed communication

**EN 50325-4**

Industrial communication subsystem based on ISO 11898 (CAN) for controller device interfaces

**CiA DS301**

CANopen – Application Layer and Communication Profile for Industrial Systems

**CiA DSP305**

CANopen – Layer Setting Services and Protocol

**CiA DS408**

CANopen – Device Profile for Proportional Hydraulic Valves v 1.5.1

**IEC 61076-2-101**

Connectors for electronic equipment  
- Product Requirements -  
Part 2-101: Circular connectors  
- Detail specification for M12 connectors with screw-locking

**IEC 61158-2**

Industrial communication networks  
- Fieldbus specification -  
Part 2: Physical layer specification and service definition

**IEC 61784-2**

Industrial communication networks  
- Profiles -  
Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3

**Programming interface**

E-SW-FIELDBUS and Z-SW-FULL software using proper cable/adaptor (see tech table **GS500**) or EtherCAT master device

**Configuration file**

XML (Extensible Markup Language) enclosed in programming software DVD E-SW-FIELDBUS and Z-SW-FULL

**Manuals**

E-MAN-S-EH and STARTUP-FIELDBUS, enclosed in programming software DVD E-SW-FIELDBUS  
Z-MAN-S-EH and STARTUP-FULL, enclosed in programming software DVD Z-SW-FULL

**4 POWERLINK features for digital drivers and controllers in EW execution****Physical**

|                     |  |
|---------------------|--|
| Serial input format | Industrial fieldbus type Fast Ethernet galvanically insulated IEC 61158-2  |
| Transmission rate   | 2 x 100 Mbit/s (Fast Ethernet, Half-Duplex)  |
| Max node            | 239 slaves   |
| Ethernet Standard   | ISO/IEC 8802-3 frame format  |
| EtherType           | 0x88AB according to IEEE 802.3   |
| Integrated Hub      |  |
| Cable length        | 0,2 - 100m (between two slave devices)   |
| Cable type          | CAT5 (4 wire twisted pair) according with T568B  |
| Network topology    | Line, tree, star, daisy chain, ring structure or any combination of these topologies   |
| Ethernet Hub        | Integrated with 2 ports:<br>- one led for Link/Activity indicator (on each port)<br>- one bicolor led Status/Error indicator |

**Communication Protocol**

|                 |  |
|-----------------|--|
| Data Link Layer | POWERLINK use Standard Ethernet Frames:<br>ISO/IEC 8802-3 + IEC 61784-2  |
| Comm. Profile   | EPSP DS 301 v1.2   |
| Device Profile  | CANopen over Ethernet based on DS408 - Fluid Power Technology  |
| Device type     | Slave - supported features:<br>- Ethernet POWERLINK v2.0<br>- Ring Redundancy<br>- Support PollResponse Chaining<br>- Support Multiplexing<br>- Cycle time min 200 µsec<br>- SDO Multiple Parameter Read/Write |

**Startup and configuration (as per EPSP DS301 + EPSP DS 302-A/B/C/D/E)**

|              |  |
|--------------|--|
| Node setting | E-SW-FIELDBUS and Z-SW-FULL programming software |
| Baudrate     | 100 Mbit/s (Automatic)                           |

**Fieldbus communication diagnostic**

Custom parameters mappable on TPDO for emergency diagnosis

**Real-time communication (as per EPSP DS301 + DS408)**

|      |   |
|------|---|
| RPDO | 1 PDO message to the driver<br>(max number of of mapping parameters is Device specific)   |
| TPDO | 1 PDO message from the driver<br>(max number of of mapping parameters is Device specific) |

**Standard references**

**EPSP DS301**  
Ethernet POWERLINK  
Communication Profile Specification v 1.2

**EPSP DS302-A/B/C/D/E**  
Ethernet POWERLINK  
Part A: High Availability v1.1  
Part B: Multiple ASnd v1.0  
Part C: PollResponse Chaining v1.0  
Part D: Multiple PReq/Pres v1.0  
Part E: Dynamic Node Allocation v1.0

**EPSP DS311**  
Ethernet POWERLINK  
XML Device Description v 1.0

**CiA DS408**  
CANopen – Device Profile for Proportional Hydraulic Valves v 1.5.1

**IEC 61076-2-101**  
Connectors for electronic equipment  
- Product Requirements -  
Part 2-101: Circular connectors  
- Detail specification for M12 connectors with screw-locking

**IEC 61158-2**  
Industrial communication networks  
- Fieldbus specification -  
Part 2: Physical layer specification and service definition

**IEC 61784-2**  
Industrial communication networks  
- Profiles -  
Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3

**IEC 61784-3**  
Industrial communication networks  
- Profiles -  
Part 3: Functional safety fieldbuses -  
General rules and profile definitions

**IEC 61158-300/400/500/600**  
Industrial communication networks  
- Fieldbus specifications -  
Part 300: Data Link Layer service definition  
Part 400: Data Link Layer protocol specification  
Part 500: Application Layer service definition  
Part 600: Application Layer protocol specification

**ISO 15745-1**  
Industrial automation systems and integration - Open systems application integration framework -  
Part 1: Generic reference description

**Programming interface**

E-SW-FIELDBUS and Z-SW-FULL software using proper cable/adapter (see tech table **GS500**) or POWERLINK master device

**Configuration file**

XDD (XML Device Description) enclosed in programming software DVD E-SW-FIELDBUS and Z-SW-FULL

**Manuals**

E-MAN-S-EW and STARTUP-FIELDBUS, enclosed in programming software DVD E-SW-FIELDBUS  
Z-MAN-S-EW and STARTUP-FULL, enclosed in programming software DVD Z-SW-FULL

**5 EtherNet/IP features for digital drivers and controllers in EI execution****Physical**

|                   |  |
|-------------------|--|
| Ethernet Standard | ISO/IEC 8802-3 frame format  |
| EtherType         | 0x08E1 according to IEEE 802.3   |
| Transmission rate | 10/100 Mbit Full/Half-Duplex   |
| Integrated        | 2-port switch  |
| Cable length      | max 100m   |
| Cable type        | CAT5 (4 wire twisted pair) according with T568B  |
| Network topology  | Device Level Ring (DLR), linear, star structure  |
| Ethernet switch   | integrated with two ports  |
| Led indicator     | 2 led for Link/Activity indicator (on each port) and<br>1 bicolor led for Status/Error indicator |

**Communication Protocol**

ODVA CIP Object Model

ODVA CIP Object library for Generic Device Profile

- Identity Object (0x01)
- Message Router Object (0x02)
- Assembly Object (0x04)
- Connection Manager Object (0x06)
- Parameter Object (0x0F)
- DLR Object (0x47)
- QoS Object (0x48h)
- Port Object (0xF4)
- TCP/IP Object (0xF5)
- Ethernet Link Object (0xF6)

Valve parameters accessible via Vendor Specific Object 0xA2

IP address setting (range 0.0.0.0 - 255.255.255.255):

- TCP/IP Object (0xF5)
- DHCP
- Auxiliary USB communication + Atos Software

I/O Adapter and Explicit Message Server device type

Cyclic data transmission via Implicit Messages (transport class 1)

- Minimum RPI for Implicit Messages 1ms
- Total number of supported class 1 connections: 4
- Up to 5 parameters and 20 bytes for each connection
- Trigger types: Cyclic CoS

Acyclic data transmission via Connected and Unconnected Explicit Messages (transport class 3)

- Minimum RPI for Explicit Messages 100ms
- No. of simultaneous Class 3 connections: 6

**Standard references****IEC 61918**

Industrial communication networks  
- Installation of communication networks  
in industrial premises

**IEC 61076-2-101**

Connectors for electronic equipment  
- Product Requirements -  
Part 2-101: Circular connectors  
- Detail specification for M12 connectors  
with screw-locking

**IEC 61158-1**

Industrial communication networks  
- Fieldbus specification -  
Part 1: Overview and guidance for the  
IEC 61158 and IEC 61784 series

**IEC 61158-2**

Industrial communication networks  
- Fieldbus specification -  
Part 2: Physical layer specification and  
service definition

**IEC 61784-1**

Industrial communication networks  
- Profiles -  
Part 1: Fieldbus profile

**IEC 61784-2**

Industrial communication networks  
- Profiles -  
Part 2: Additional fieldbus profiles for real-  
time networks based on ISO/IEC 8802-3

**IEC 61784-3**

Industrial communication networks  
- Profiles -  
Part 3: Functional safety fieldbuses -  
General rules and profile definitions

**IEC 61784-5-2**

Industrial communication networks  
- Profiles -  
Part 5-2: Installation of fieldbuses -  
Installation profiles for CPF 2

**ISO 15745-4**

Industrial automation systems and  
integration - Open systems application  
integration framework -  
Part 4: Reference description for Ethernet-  
based control systems

**Programming interface**

E-SW-FIELDBUS and Z-SW-FULL software using proper cable/adaptor (see tech table **GS500**) or EtherNet/IP scanner device

**Configuration file**

EDS (Electronic Data Sheet) enclosed in programming software DVD E-SW-FIELDBUS and Z-SW-FULL

**Manuals**

E-MAN-S-EI and STARTUP-FIELDBUS, enclosed in programming software DVD E-SW-FIELDBUS

Z-MAN-S-EI and STARTUP-FULL, enclosed in programming software DVD Z-SW-FULL

**6 PROFINET RT/IRT features for digital drivers and controllers in EP execution****Physical**

|                   |  |
|-------------------|--|
| Ethernet Standard | ISO/IEC 8802-3 frame format  |
| EtherType         | 0x8892 according to IEEE 802.3   |
| Transmission rate | 100 Mbit Full-Duplex   |
| Integrated        | 2-port switch  |
| Cable length      | max 100m   |
| Cable type        | CAT5 (4 wire twisted pair) according with T568B  |
| Network topology  | line, star, tree and ring structure  |
| Ethernet switch   | integrated with two ports  |
| Led indicator     | 2 led for Link/Activity indicator (on each port) and<br>1 bicolor led for Status/Error indicator |

**Communication Protocol**

|                 |   |
|-----------------|---|
| Data Link Layer | PROFINET use Standard Ethernet Frames:<br>ISO/IEC 8802-3 + IEC 61784-2  |
| Device type     | IO device - supported features:<br>- complies with PROFINET IO conformance Class A, B, C<br>- Acyclic parameter Channel<br>- Real Time (RT) and Isochronous Real Time (IRT) communication<br>- Up to 8 input/output parameters for real time data exchange<br>- PROFINET specific diagnostic support<br>- Media Redundancy Protocol (MRP)<br>- DCP Discovery and Configuration Protocol supported<br>- Identification & Maintenance (I&M)<br>- Cycle time min: 1 msec [RT] , 250 µsec [IRT] |

**Startup and configuration**

|                 |   |
|-----------------|---|
| Address setting | IP Address and Station Name are assigned automatically by IO controller (e.g. Discovery and Configuration Protocol) |
| Baudrate        | 100 Mbit/s (Automatic)  |

**Fieldbus communication diagnostic**

Custom parameters mappable on real time communication for emergency diagnosis

**Real-time communication**

|                |  |
|----------------|--|
| Modular config | for drivers: AES, BM-AES, TES, BM-TEZ, LEZ, BM-LEZ, RES, BM-RES, PES<br>up to 5 input parameters for real time data exchange<br>up to 5 output parameters for real time data exchange<br><br>for controllers: TEZ, BM-TEZ, LEZ, BM-LEZ, BM-KZ<br>up to 8 input parameters for real time data exchange<br>up to 8 output parameters for real time data exchange |
|----------------|--|

**Standard references****IEC 61918**

Industrial communication networks  
- Installation of communication networks in industrial premises

**IEC 61076-2-101**

Connectors for electronic equipment  
- Product Requirements -  
Part 2-101: Circular connectors  
- Detail specification for M12 connectors with screw-locking

**IEC 61158-1**

Industrial communication networks  
- Fieldbus specification -  
Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series

**IEC 61158-2**

Industrial communication networks  
- Fieldbus specification -  
Part 2: Physical layer specification and service definition

**IEC 61158-5-10**

Industrial communication networks  
- Fieldbus specification -  
Part 5-10: Application layer service definition – Type 10 elements

**IEC 61784-1**

Industrial communication networks  
- Profiles -  
Part 1: Fieldbus profile

**IEC 61784-2**

Industrial communication networks  
- Profiles -  
Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3

**IEC 61784-5-3**

Industrial communication networks  
- Profiles -  
Part 5-3: Installation of fieldbuses -  
Installation profiles for CPF 3

**Programming interface**

E-SW-FIELDBUS and Z-SW-FULL software using proper cable/adaptor (see tech table **GS500**) or PROFINET controller.

**Configuration file**

GSDML (Electronic Data Sheet) enclosed in programming software DVD E-SW-FIELDBUS and Z-SW-FULL

**Manuals**

E-MAN-S-EP and STARTUP-FIELDBUS, enclosed in programming software DVD E-SW-FIELDBUS  
Z-MAN-S-EP and STARTUP-FULL, enclosed in programming software DVD Z-SW-FULL





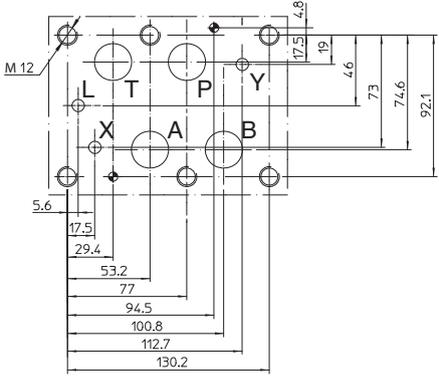
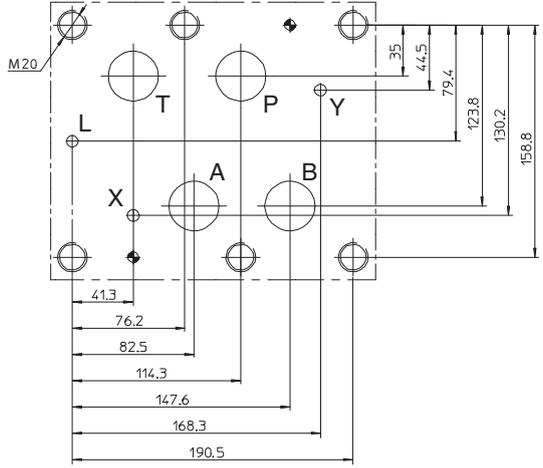
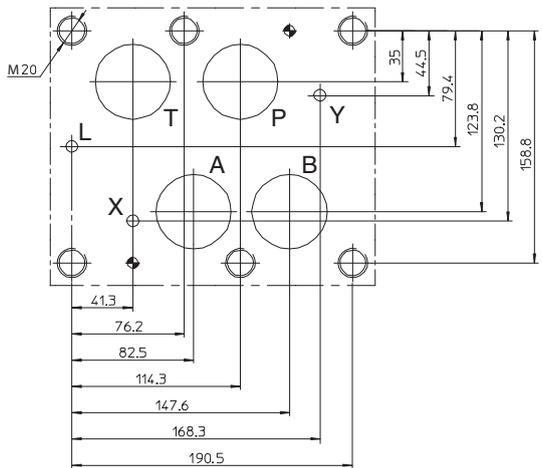
Table P005-3/E

# Mounting surfaces for electrohydraulic valves

ISO standard, for directional, pressure and flow control valves plus pressure switches

1 ISO 4401: 2005 - for directional, pressure and flow control valves

| Mounting surfaces dimensions [mm]  | ISO code / ports size [mm]  | Valve type  |   |
|--|---|---|---|
|  |   | industrial  | ex-proof  |
| <p><b>Y port only for 4401-03-03-0-05</b></p>                                  | <p><b>4401-03-02-0-05</b></p> <p>P, A, B, T = Ø 7,5 max<br/>without Y port</p>        | <p>DH*<br/>DLOH / DLOK<br/>DLEH / DLEHM<br/>QV-06<br/>RZMO<br/>RZGO<br/>DHZE / DHZO<br/>DLHZO<br/>QVH*<br/>H* (modular)</p> | <p>DHA / DHW<br/>DLAH / DLWH<br/>RZMA<br/>RZGA<br/>DHZA<br/>DLHZA<br/>QVHZA</p> |
|  | <p><b>4401-03-03-0-05</b></p> <p>P, A, B, T = Ø 7,5 max<br/>Y = Ø 3,3 max</p>         | <p>DHZO / Y<br/>DLHZO / Y</p>   | <p>DHZA / Y<br/>DLHZA / Y</p>   |
| <p><b>X and Y port only for 4401-05-05-0-05</b></p>                            | <p><b>4401-05-04-0-05</b></p> <p>P, A, B, T = Ø 11,2 max<br/>without X and Y port</p> | <p>DKE<br/>DKZOR<br/>DLKZOR<br/>QVKZOR<br/>K* (modular)</p>   | <p>DKZA<br/>DLKZA<br/>QVKZA</p>   |
|  | <p><b>4401-05-05-0-05</b></p> <p>P, A, B, T = Ø 11,2 max<br/>X, Y = Ø 6,3 max</p>     | <p>DKE/Y<br/>DKZOR / Y<br/>DLKZOR / Y<br/>DP-1*<br/>DPH-1*<br/>DPZO*-1*</p>   | <p>DKZA / Y<br/>DLKZA / Y<br/>DPHA-1* / DPHW-1<br/>DPZA*-1</p>                  |
| <p><b>4401-07-07-0-05</b></p> <p>P, A, B, T = Ø 17,5 max<br/>Y = Ø 6,3 max</p> | <p>DP-2*<br/>DPH*-2*<br/>DPZO*-2*<br/>JP*-2* (modular)</p>                            | <p>DPHA-2 / DPHW-2<br/>DPZA*-2</p>  |   |

| Mounting surfaces dimensions [mm]   | ISO code / ports size [mm]  | Valve type   |                                    |
|---|---|--|------------------------------------|
|   |   | industrial   | ex-proof                           |
|    | <p><b>4401-08-08-0-05</b></p> <p>P, A, B, T = Ø 25 max<br/>X, Y, L = Ø 11,2 max</p> | <p>DP-4*<br/>DPH*-4*<br/>DPZO*-4*<br/>JP*-3* (modular)</p> | <p>DPHA-4 / DPHW-2<br/>DPZA*-4</p> |
|   | <p><b>4401-08-08-0-05</b></p> <p>P, A, B, T = Ø 32 max<br/>X, Y, L = Ø 11,2 max</p> | <p>DPZO*-4M*</p>   | <p>DPZA*-4M*</p>                   |
|   | <p><b>4401-10-09-0-05</b></p> <p>P, A, B, T = Ø 32 max<br/>X, Y, L = Ø 11,2 max</p> | <p>DP-6*<br/>DPH*-6*<br/>DPZO*-6*</p>                      | <p>DPHA-6<br/>DPZA*-6</p>          |
|  | <p><b>4401-10-09-0-05</b></p> <p>P, A, B, T = Ø 50 max<br/>X, Y, L = Ø 11,2 max</p> | <p>DPZO*-8*</p>  | <p>-</p>                           |

2 ISO 6264: 2007 - for pressure relief valves

| Mounting surfaces dimensions [mm] | ISO code / ports size [mm]   | Valve type                    |  |
|-----------------------------------|--|-------------------------------|--|
|                                   |  | industrial                    | ex-proof   |
|                                   | <p><b>6264-06-09-1-97</b></p> <p>P, T = Ø 14,7 max<br/>X = Ø 4,8 max</p> | <p>AGAM-10<br/>AGMZO-*-10</p> | <p>AGAM-10 / AO<br/>AGAM-10 / WO<br/>AGMZA-*-10</p>  |
|                                   | <p><b>6264-08-11-1-97</b></p> <p>P, T = Ø 23,4 max<br/>X = Ø 6,3 max</p> | <p>AGAM-20<br/>AGMZO-*-20</p> | <p>AGAM -20 / AO<br/>AGAM-20 / WO<br/>AGMZA-*-20</p> |
|                                   | <p><b>6264-10-17-1-97</b></p> <p>P, T = Ø 32 max<br/>X = Ø 6,3 max</p>   | <p>AGAM-32<br/>AGMZO-*-32</p> | <p>AGAM-32 / AO<br/>AGAM-32 / WO<br/>AGMZA-*-32</p>  |

3 ISO 5781: 2000 - for pressure reducing and piloted check valves

| Mounting surfaces dimensions [mm] | ISO code / ports size [mm]  | Valve type   |                   |
|-----------------------------------|---|--|-------------------|
|                                   |   | industrial   | ex-proof          |
|                                   | <p><b>5781-06-07-0-00</b></p> <p>A, B = Ø 14,7 max<br/>X, Y = Ø 4,8 max</p> | <p>AGIS-10<br/>AGIR-10<br/>AGIU-10<br/>AGRL*-10<br/>AGRCZO*-10</p> | <p>AGRCZA*-10</p> |
|                                   | <p><b>5781-08-10-0-00</b></p> <p>A, B = Ø 23,4 max<br/>X, Y = Ø 4,8 max</p> | <p>AGIS-20<br/>AGIR-20<br/>AGIU-20<br/>AGRL*-20<br/>AGRCZO*-20</p> | <p>AGRZA*-20</p>  |
|                                   | <p><b>5781-10-13-0-00</b></p> <p>A, B = Ø 32 max<br/>X, Y = Ø 4,8 max</p>   | <p>AGIS-32<br/>AGIR-32<br/>AGIU-32<br/>AGRL*-32</p>                |                   |

4 ISO 16873: 2002 - for pressure switches

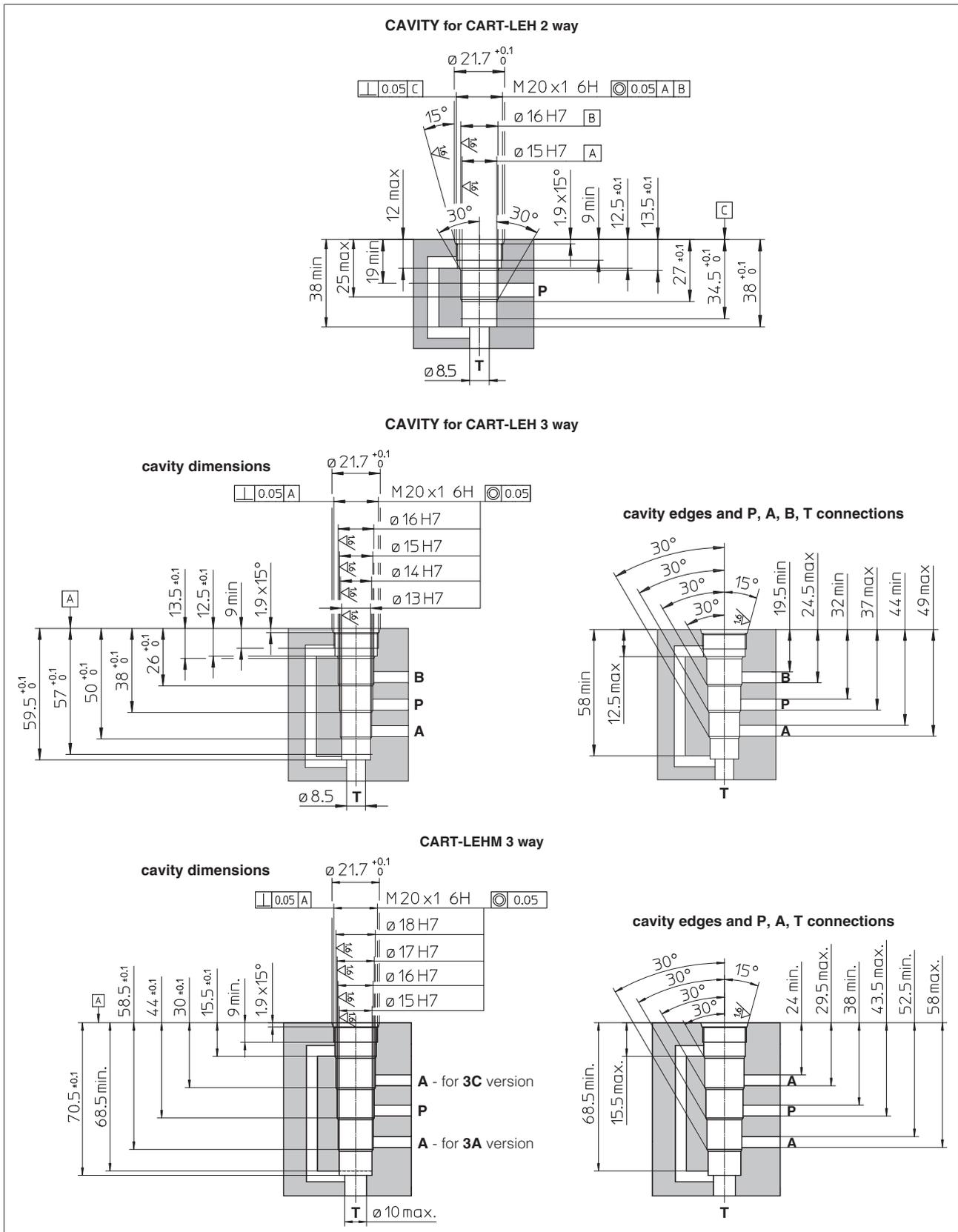
| Mounting surfaces dimensions [mm] | ISO code / ports size [mm]                        | Valve type |
|-----------------------------------|---|------------|
|                                   | <p><b>16873-01-01-0-02</b></p> <p>P = Ø 4 max</p> | <p>MAP</p> |



Table P006-3/E

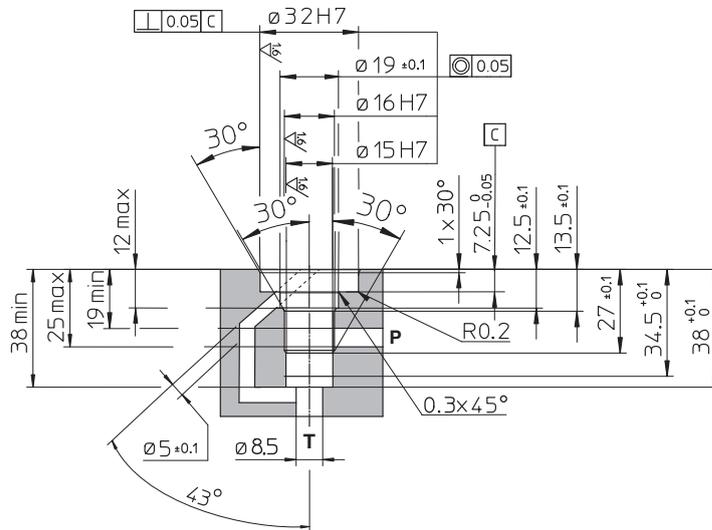
# Mounting surfaces and cavities for cartridge valves

1 CAVITIES DIMENSIONS for 2 WAY and 3 WAY CARTRIDGE VALVES type CART-LEH, CART-LEHM [mm]



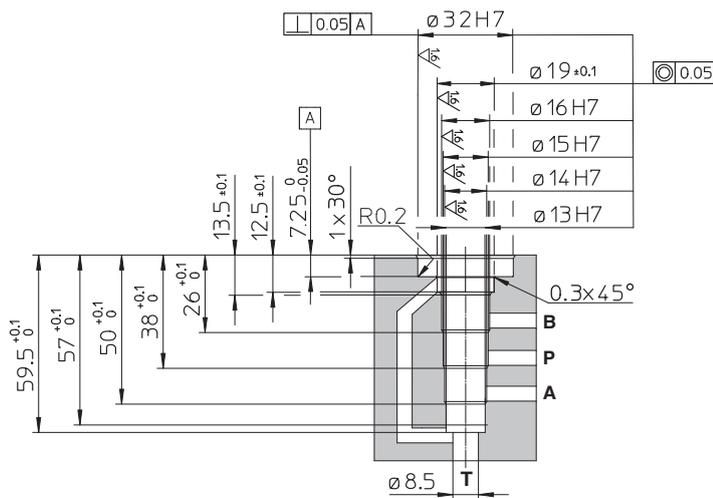
2 CAVITIES DIMENSIONS for 2 WAY and 3 WAY EX-PROOF CARTRIDGE VALVES type CART-LAH [mm]

CAVITY for CART-LAH 2 way

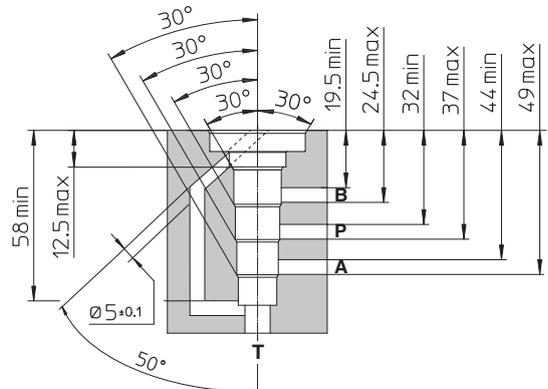


CAVITY for CART-LAH 3 way

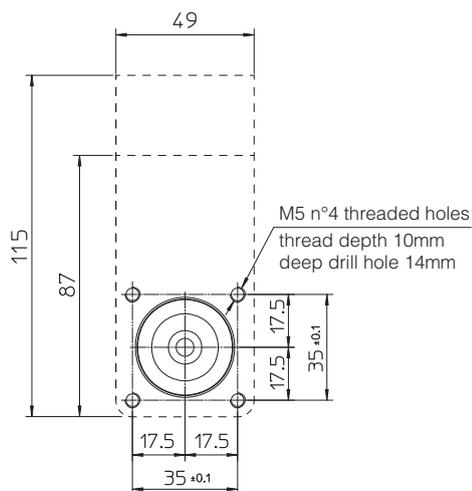
cavity dimensions



cavity edges and P, A, B, T connections



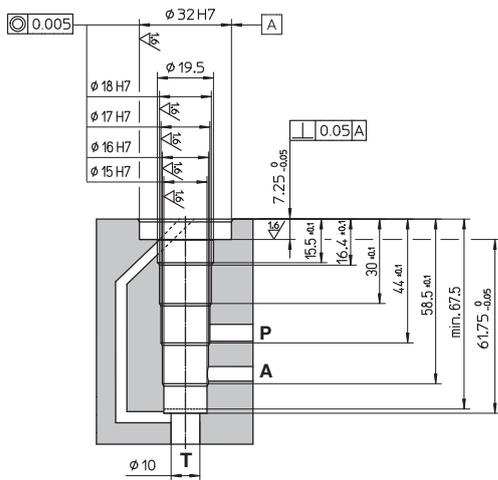
MOUNTING SURFACE for CART-LAH 2 and 3 way



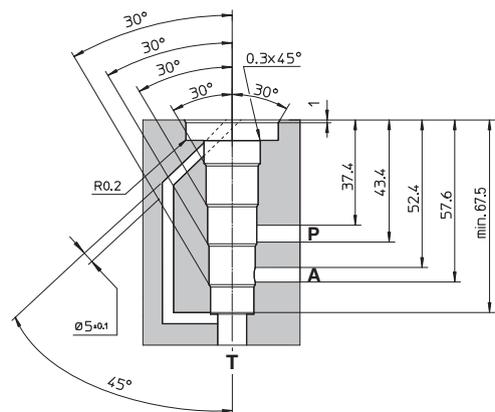
3 CAVITIES DIMENSIONS for 3 WAY EX-PROOF CARTRIDGE VALVES type CART-LAHM [mm]

CAVITY for CART-LAHM-3A

cavity dimensions

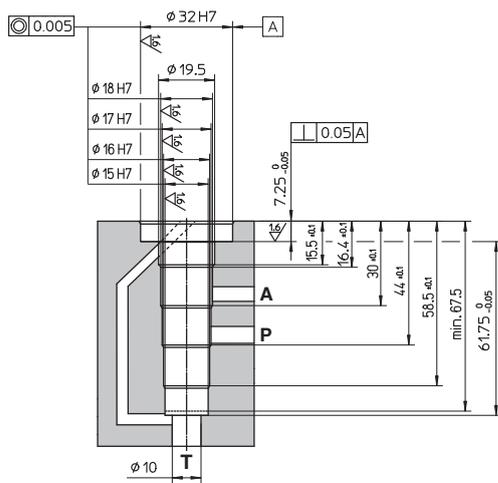


cavity edges and P, A, T connections

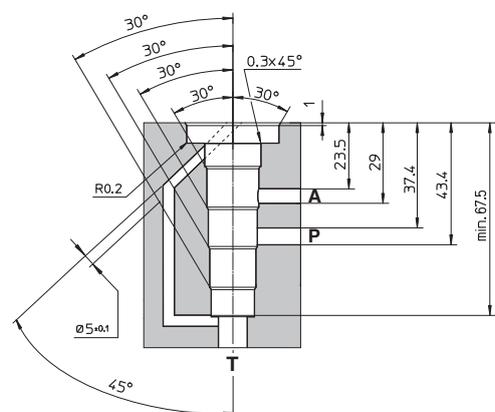


CAVITY for CART-LAHM-3C

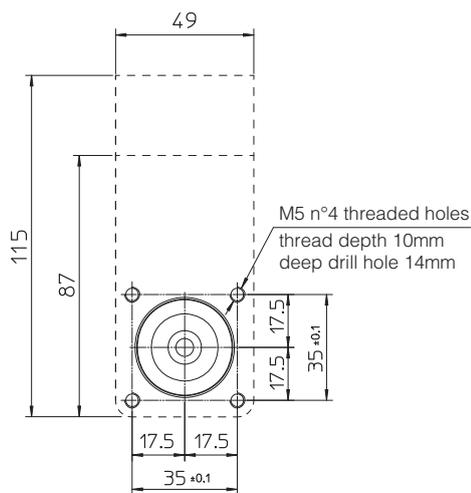
cavity dimensions



cavity edges and P, A, T connections

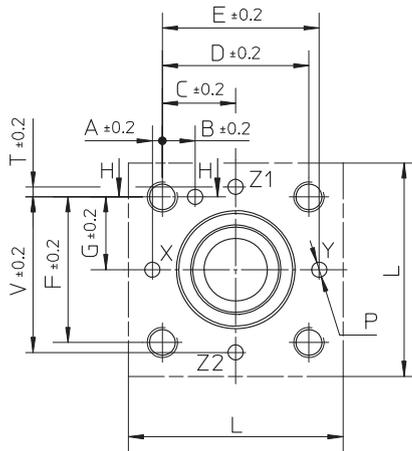


MOUNTING SURFACE for CART-LAHM 3 way



4 ISO 7368 COVER INTERFACE DIMENSIONS for 2 WAY and 3 WAY CARTRIDGE VALVES [mm]

Size from 16 to 63



VALVE TYPE

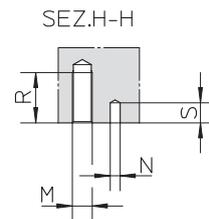
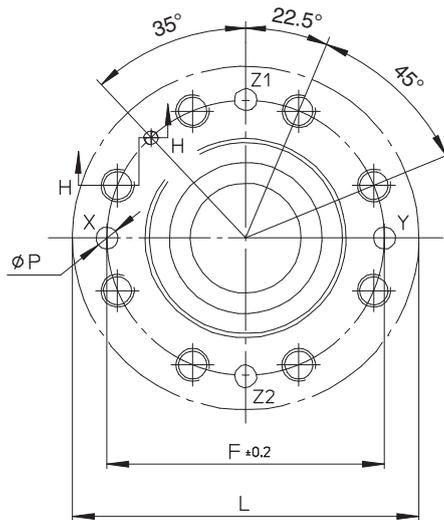
on off

- LIM
- LIR
- LIC
- LIQV
- LIDD
- LIDEW
- LIDBH
- LIDO
- LIDB
- LIDR
- LIDAS

proportional

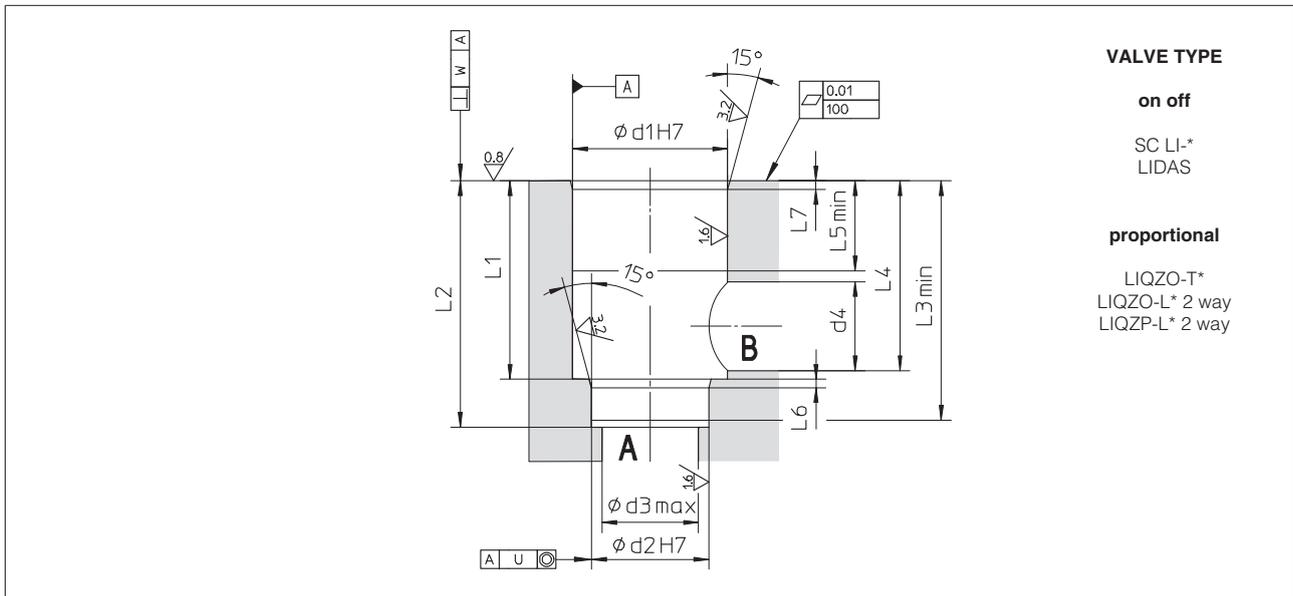
- LIQZO-T\*
- LIQZO-L\* 2 way
- LIQZO-L\* 3 way
- LIQZP-L\* 2 way
- LIQZP-L\* 3 way

Size 80 and 100



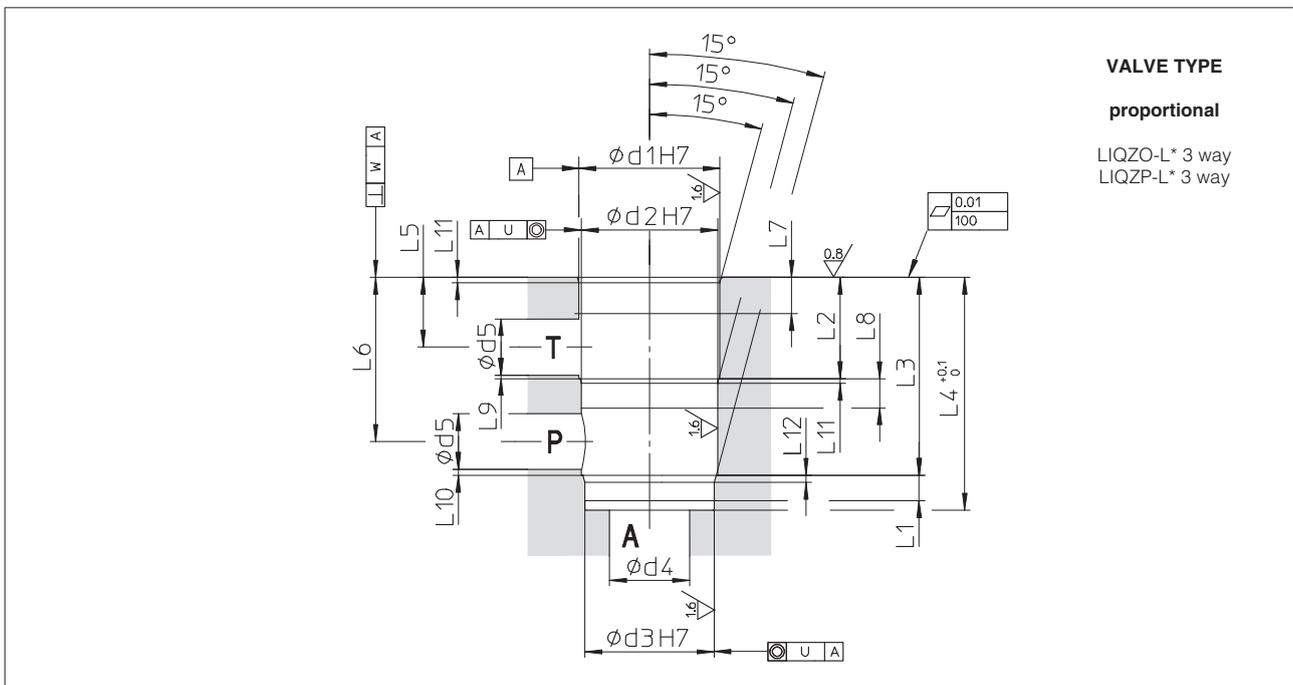
| Size | A    | B    | C    | D   | E     | F    | G    | L    | M   | ØN | P max | R  | S min | T    | V     |
|------|------|------|------|-----|-------|------|------|------|-----|----|-------|----|-------|------|-------|
| 16   | 2    | 12,5 | 23   | 46  | 48    | 46   | 23   | 65   | M8  | 4  | 4     | 20 | 6     | 2    | 48    |
| 25   | 4    | 13   | 29   | 58  | 62    | 58   | 29   | 85   | M12 | 6  | 6     | 30 | 8     | 4    | 62    |
| 32   | 6    | 18   | 35   | 70  | 76    | 70   | 35   | 102  | M16 | 6  | 8     | 38 | 8     | 6    | 76    |
| 40   | 7,5  | 19,5 | 42,5 | 85  | 92,5  | 85   | 42,5 | 125  | M20 | 6  | 10    | 46 | 8     | 7,5  | 92,5  |
| 50   | 8    | 20   | 50   | 100 | 108   | 100  | 50   | 140  | M20 | 8  | 10    | 46 | 8     | 8    | 108   |
| 63   | 12,5 | 24,5 | 62,5 | 125 | 137,5 | 125  | 62,5 | 180  | M30 | 8  | 12    | 66 | 8     | 12,5 | 137,5 |
| 80   | -    | -    | -    | -   | -     | Ø200 | -    | Ø250 | M24 | 10 | 16    | 50 | 10    | -    | -     |
| 100  | -    | -    | -    | -   | -     | Ø245 | -    | Ø300 | M30 | 10 | 20    | 63 | 10    | -    | -     |

5 ISO 7368 CAVITIES DIMENSIONS for 2 WAY CARTRIDGE VALVES [mm]



| Size | ød1 | ød2 | ød3 max | ød4 max | L1                               | L2                               | L3  | L4    | L5 | L6  | L7  | U    | W    |
|------|-----|-----|---------|---------|----------------------------------|----------------------------------|-----|-------|----|-----|-----|------|------|
| 16   | 32  | 25  | 16      | 22,5    | 43 <sup>+0.1</sup> <sub>0</sub>  | 56 <sup>+0.1</sup> <sub>0</sub>  | 54  | 42,5  | 20 | 2   | 2   | 0,03 | 0,05 |
| 25   | 45  | 34  | 25      | 27      | 58 <sup>+0.1</sup> <sub>0</sub>  | 72 <sup>+0.1</sup> <sub>0</sub>  | 70  | 57    | 30 | 2,5 | 2,5 | 0,03 | 0,05 |
| 32   | 60  | 45  | 32      | 38,5    | 70 <sup>+0.1</sup> <sub>0</sub>  | 85 <sup>+0.1</sup> <sub>0</sub>  | 83  | 68,5  | 30 | 2,5 | 2,5 | 0,03 | 0,1  |
| 40   | 75  | 55  | 40      | 54,5    | 87 <sup>+0.1</sup> <sub>0</sub>  | 105 <sup>+0.1</sup> <sub>0</sub> | 102 | 84,5  | 30 | 3   | 3   | 0,05 | 0,1  |
| 50   | 90  | 68  | 50      | 62,5    | 100 <sup>+0.1</sup> <sub>0</sub> | 122 <sup>+0.1</sup> <sub>0</sub> | 117 | 97,5  | 35 | 3   | 3   | 0,05 | 0,1  |
| 63   | 120 | 90  | 63      | 87      | 130 <sup>+0.1</sup> <sub>0</sub> | 155 <sup>+0.1</sup> <sub>0</sub> | 150 | 127   | 40 | 4   | 4   | 0,05 | 0,2  |
| 80   | 145 | 110 | 80      | 100     | 175 <sup>+0.2</sup> <sub>0</sub> | 205 <sup>+0.2</sup> <sub>0</sub> | 200 | 170,5 | 40 | 5   | 5   | 0,05 | 0,2  |
| 100  | 180 | 135 | 100     | 120     | 210 <sup>+0.2</sup> <sub>0</sub> | 245 <sup>+0.2</sup> <sub>0</sub> | 239 | 205,5 | 50 | 5   | 5   | 0,05 | 0,2  |

6 CAVITIES DIMENSIONS for 3 WAY CARTRIDGE VALVES [mm]



| Size | ød1 | ød2 | ød3 | ød4 | ød5 | L1   | L2   | L3  | L4  | L5 | L6   | L7 | L8 | L9  | L10 | L11 | L12 | U    | W    |
|------|-----|-----|-----|-----|-----|------|------|-----|-----|----|------|----|----|-----|-----|-----|-----|------|------|
| 25   | 45  | 43  | 34  | 20  | 20  | 11,5 | 56   | 89  | 103 | 45 | 78   | 25 | 15 | 1   | 1   | 2,5 | 2,5 | 0,03 | 0,05 |
| 32   | 60  | 58  | 55  | 32  | 24  | 13   | 43,5 | 85  | 100 | 30 | 70,5 | 18 | 15 | 1,5 | 2,5 | 2,5 | 2,5 | 0,03 | 0,05 |
| 40   | 75  | 73  | 55  | 40  | 30  | 15   | 54   | 105 | 125 | 36 | 87   | 21 | 18 | 3   | 3   | 3   | 3   | 0,03 | 0,05 |
| 50   | 90  | 87  | 68  | 50  | 35  | 17   | 87   | 143 | 165 | 66 | 122  | 48 | 18 | 3,5 | 3,5 | 4   | 3   | 0,05 | 0,05 |
| 63   | 120 | 116 | 90  | 63  | 48  | 20   | 85   | 165 | 195 | 57 | 137  | 33 | 28 | 4   | 4   | 4   | 4   | 0,05 | 0,05 |
| 80   | 145 | 140 | 110 | 80  | 60  | 25   | 125  | 215 | 245 | 90 | 180  | 60 | 25 | 5   | 5   | 5   | 5   | 0,05 | 0,05 |

