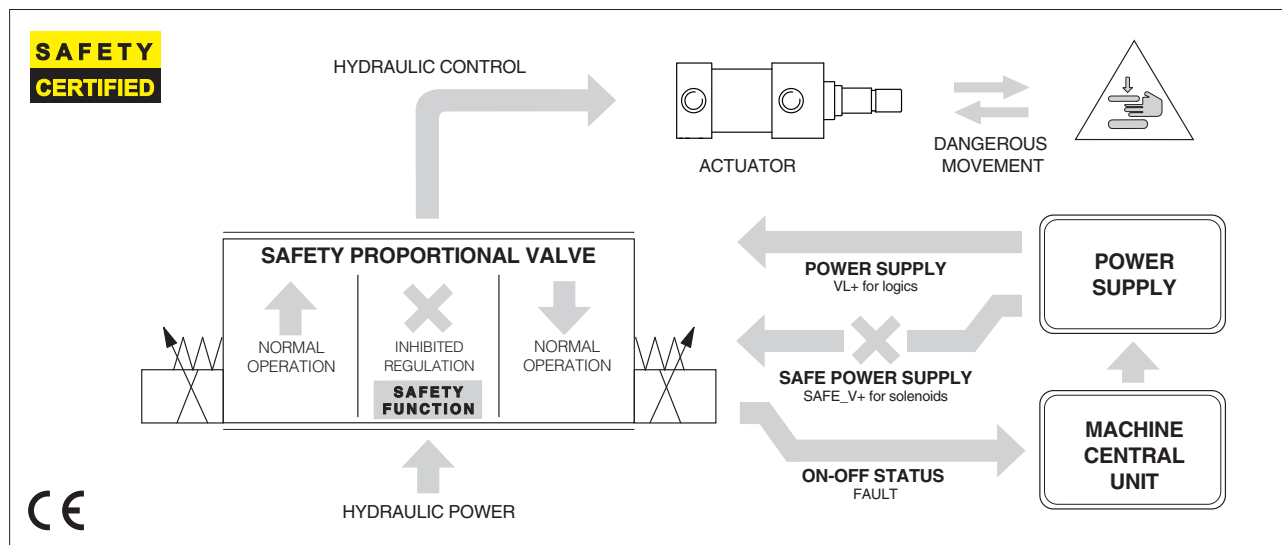


# Safety proportional valves with double power supply

directional valves with on-board driver and LVDT transducer

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



## 1 GENERAL DESCRIPTION

Safety proportional valves with double power supply are identified by option /U and are intended for use in hydraulic circuits of machines which must comply with safety requirements of Machine Directive 2006/42/EC.

They are designed to perform **Safety Functions**, in addition to the standard control of direction, speed, pressure/force or position of hydraulic actuators, depending to the valve features.

The Safety Function is operated to reduce the potential dangerous risks which may happen in a specific phase of the machine cycle. It is activated by the machine central unit (PLC) which inhibits the regulation of proportional valve /U by removing the safe power supply to the valve solenoids in case of emergency or for specific requirements along the working cycle.

Upon solenoid power supply interruption, the valve driver remains active thanks to the separated power supply for logics, thus providing fault signal and communication to the machine central unit (PLC) which manages these information as diagnostic signals.

Safety proportional valves with option /U are certified by TÜV in compliance with IEC 61508 and ISO 13849

## 2 CERTIFICATION

IEC 61508, IEC 61511, IEC 62061	max SIL3	See technical table Y010 for details about SIL, PL and safety architectures
ISO 13849	category 1, PL c for non-redundant safety architecture category 4, PL e for redundant safety architecture	

## 3 VALVES RANGE

Option /U is available for high performance proportional directional valves and servoproportional valves with TES/LES on-board digital driver or TEZ/LEZ axis controller.

It adds the safety functions to standard control of direction, speed, pressure/force (for SP, SF, SL version) and position (for TEZ, LEZ versions).

Valve's performance characteristics and overall dimensions remains unchanged as per standard valve models, refer to specific FS\*\* technical tables.

### High performance proportionals:

**DHZO-TES, DKZOR-TES** - direct, positive spool overlap - technical table **FS165**

**DPZO-TES** - piloted, positive spool overlap - technical table **FS172**

**DPZO-LES** - piloted, positive spool overlap - technical table **FS175**

### Servoproportionals:

**DHZO-TES, DKZOR-TES** - direct, zero spool overlap - technical tables **FS168**

**DPZO-LES** - piloted, zero spool overlap - technical table **FS178**

**DLHZO-TES, DLKZOR-TES** - direct, zero spool overlap - technical tables **FS180**

### Servoproportionals with TEZ/LEZ axis controller:

**DHZO-TEZ, DKZOR-TEZ** - direct, zero spool overlap - technical tables **FS620**

**DPZO-LEZ** - piloted, zero spool overlap - technical tables **FS630**

**DLHZO-TEZ, DLKZOR-TEZ** - direct, zero spool overlap - technical tables **FS610**

#### 4 FUNCTIONAL DESCRIPTION

Valves with option /U are designed to receive separated power supplies for logic VL+ and solenoids SAFE\_V+.

When the solenoid power supply SAFE\_V+ is removed, the valve's spool is moved by the spring towards the safe rest position and then the valve regulation is consequently inhibited.

The valve's diagnostics and communication remain active thanks to the logic power supply VL+ and then the valve can continuously exchange spool position and status with the machine central unit.

The time required by the valve's spool to reach the safe position is detailed in section 5

#### Safe power supply - SAFE\_V+

The SAFE\_V+ feeds only the valve solenoids. It can be removed to cut-off the current to the solenoids in order to inhibit the valve's regulation:

- inhibited regulation: SAFE\_V+ = 0 Vdc
- permitted regulation: SAFE\_V+ = 24 Vdc

For double solenoids valves the power supply SAFE\_V+ feeds both solenoids, then when it is removed the valve regulation is completely inhibited.

#### Power supply - VL+

The VL+ feeds the logic and communication functions. It must always be kept ON = 24Vdc to allow the real-time diagnostics of the valve status and spool position.

#### Fault output signal – FAULT

Fault signal is a diagnostic output which states faults or warning according to the valve status.

This signal must be monitored by the machine central unit to intercept failures which may compromise the valve safety function.

The FAULT signal is switched OFF (0 Vdc) when the internal diagnostics detects valve failures or incorrect behaviour (e.g. : spool sticking, solenoid short circuits, missing coils connection, reference signal cable broken for 4 ÷ 20 mA input, etc).

For piloted valves the FAULT signal = 0 Vdc indicates also the absence of pilot pressure.

#### 5 SWITCH-OFF TIME

The switch-off time is the time between the power supply SAFE\_V+ interruption and the achievement of the spool safety rest position. It is influenced by the working conditions like flow, pressure and fluid viscosity.

The switch-off times shown in the table are considered in the following conditions:

- max flow and max pressure values as per specific technical table of each valve model
- fluid viscosity 46 mm<sup>2</sup>/s
- fluid contamination level: ISO4406 CLASS 18/16/13

The following switch-off times can be considered as the longest ones.

For different working conditions, consult Atos technical office.

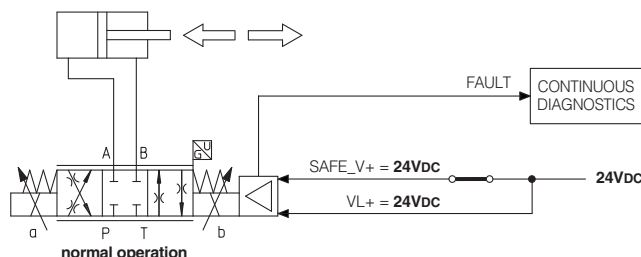
Valve model	DHZO	DKZOR	DLHZO	DLKZOR	DPZO-1	DPZO-2	DPZO-4 DPZO-4M	DPZO-6	DPZO-8
Switch-off time [ms]	50	80	40	60	180	250	300	350	400

#### 6 FUNCTIONAL EXAMPLES

The following examples show the condition of a double solenoid valve and of the controlled actuator depending to the SAFE\_ENABLE status.

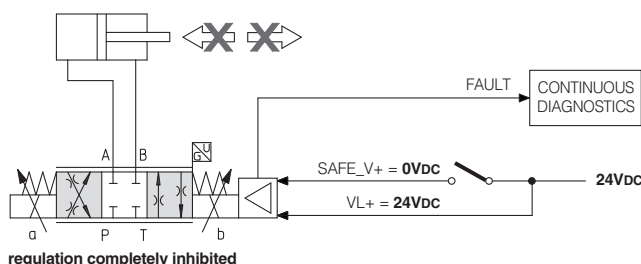
#### Valve normal operation

Safe Power Supply [Vdc]	Power Supply [VDC]
SAFE_V+	VL+
24	24



#### Valve safe operation with regulation completely inhibited

Safe Power Supply [Vdc]	Power Supply [VDC]
SAFE_V+	VL+
0	24



■ INHIBITED SPOOL POSITION  
SAFE\_V+ = 0Vdc

□ PERMITTED SPOOL POSITION  
SAFE\_V+ = 24Vdc

⊗ ⊗ INHIBITED DIRECTION

⇐ ⇨ PERMITTED DIRECTION

**7 INHIBITED / PERMITTED SPOOL POSITION**

The below tables show the inhibited / permitted spool position depending to the SAFE\_V+ status for all models of safety proportional valves.

**Note:** the inhibition of the actuator direction may be affected by other valves present in the circuit, then the whole hydraulic system where the valve /U is applied must be considered.

**7.1 High performance proportionals**

- INHIBITED SPOOL POSITION
- PERMITTED SPOOL POSITION

**DHZO-TES, DKZOR-TES - direct operated, positive spool overlap - technical table FS165**

Safe Power Supply [Vdc]	Power Supply [Vdc]	Configuration 51, 53		Configuration 71, 72, 73	
		standard	option /B	standard	option /B
SAFE_V+	VL+				
24	24				
0	24				
		①	①	①	①

**DPZO-TES - pilot operated, positive spool overlap - technical table FS172**

Safe Power Supply [Vdc]	Power Supply [Vdc]	Configuration 51, 53		Configuration 71, 72, 73	
		standard	option /B	standard	option /B
SAFE_V+	VL+				
24	24				
0	24				
		①	①	①	①

**DPZO-LES - pilot operated, positive spool overlap - technical table FS175**

Safe Power Supply [Vdc]	Power Supply [Vdc]	Configuration 71, 72, 73	
		standard	option /B
SAFE_V+	VL+		
24	24		
0	24		
		①	①

① = Spool safety rest position

## 7.2 Servoproportionals

- INHIBITED SPOOL POSITION
- PERMITTED SPOOL POSITION

### DHZO-TES/TEZ, DKZOR-TES/TEZ - direct operated, zero spool overlap - technical tables FS168, FS620

Safe Power Supply [Vdc]	Power Supply [Vdc]	Configuration 70	
		standard	option /B
SAFE_V+	VL+		
24	24		
0	24		

②
②

### DPZO-LES, DPZO-LEZ - pilot operated, zero spool overlap - technical table FS178, FS630

Safe Power Supply [Vdc]	Power Supply [Vdc]	Configuration 60		Configuration 70	
		standard	option /B	standard	option /B
SAFE_V+	VL+				
24	24				
0	24				

①
①
②
②

### DLHZO-TES/TEZ, DLKZOR-TES/TEZ - direct operated, zero spool overlap - technical tables FS180, FS610

Safe Power Supply [Vdc]	Power Supply [Vdc]	Configuration 40 with fail safe 1 or 3		Configuration 60 without fail safe	
		standard	option /B	standard	option /B
SAFE_V+	VL+				
24	24				
0	24				

①
①
①
①

① = Spool safety rest position

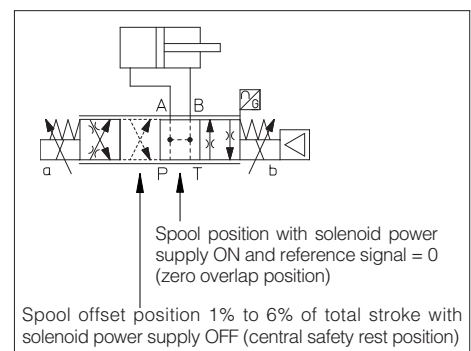
② = Spool safety rest position for valves with zero spool overlap, configuration 70 - see 7.3

### 7.3 Safety rest position - for valves with zero spool overlap, configuration 70

In absence of solenoid power supply (SAFE\_V+ = 0), the valve spool is moved by the springs force to the **safety rest position** characterized by a small offset of about 1% to 6% of the total stroke in P-B / A-T configuration.

This is specifically designed to avoid that in case of interruption of solenoid power supply, the actuator moves towards an undefined direction (due to the tolerances of the zero spool overlap), with potential risk of damages or personnel injury.

Thanks to the **safety rest position** the actuator movement is suddenly stopped and it is recovered at very low speed towards the direction corresponding to the P-B/ A-T connection.



## 8 ELECTRONIC CONNECTIONS

### 8.1 Main connector signals - 12 pin - options /U

PIN	TES LES	TEZ LEZ	TECHNICAL SPECIFICATIONS	NOTES
1	SAFE_V+		Safe power supply 24 Vdc for solenoid	Input - power supply
2	SAFE_V0		Safe power supply 0 Vdc for solenoid	Gnd - power supply
3	ENABLE		Enable (24 Vdc) or disable (0 Vdc) the driver, referred to VL0	Input - on/off signal
4	Q_INPUT+		Flow (spool position) reference input signal: $\pm 10$ Vdc / $\pm 20$ mA maximum range Defaults are $\pm 10$ Vdc for standard and $4 \div 20$ mA for /I option	Input - analog signal <b>Software selectable</b>
		P_INPUT+	Position reference input signal: $\pm 10$ Vdc / $\pm 20$ mA maximum range	
5	INPUT-		Negative reference input signal for Q_INPUT+, F_INPUT+ and P_INPUT+	Input - analog signal
6	Q_MONITOR		Flow (spool position) monitor output signal: $\pm 10$ Vdc / $\pm 20$ mA maximum range, referred to VL0. Defaults are $\pm 10$ Vdc for standard and $4 \div 20$ mA for /I option	Output - analog signal <b>Software selectable</b>
		P_MONITOR	Position monitor output signal: $\pm 10$ Vdc / $\pm 20$ mA maximum range, referred to VL0	
7	F_INPUT+ (1)		Pressure/force reference input signal: $\pm 10$ Vdc / $\pm 20$ mA maximum range Defaults are $\pm 10$ Vdc for standard and $4 \div 20$ mA for /I option	Input - analog signal <b>Software selectable</b>
8	F_MONITOR (1)		Pressure/force monitor output signal: $\pm 10$ Vdc / $\pm 20$ mA maximum range, referred to VL0 Defaults are $\pm 10$ Vdc for standard and $4 \div 20$ mA for /I option	Output - analog signal <b>Software selectable</b>
9	VL+		Power supply 24 Vdc for driver's logic and communication	Input - power supply
10	VL0		Power supply 0 Vdc for driver's logic and communication	Gnd - power supply
11	FAULT		Fault (0 Vdc) or normal working (24 Vdc), referred to VL0	Output - on/off signal
PE	EARTH		Internally connected to driver housing	

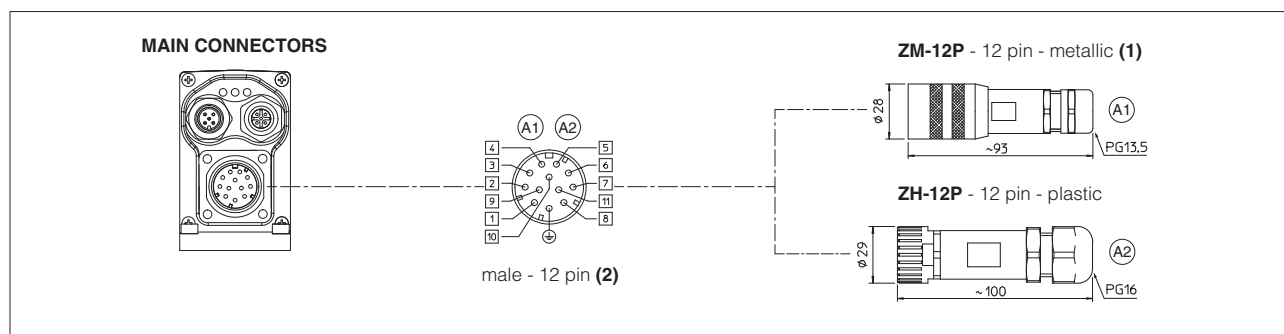
(1) Connection NOT available for TES/LES in SN execution

## 9 ELECTRICAL CHARACTERISTICS

SIGNALS	SPECIFICATIONS	NOTES
SAFE_V+ VL+	Nominal : +24 Vdc Rectified and filtered : $V_{RMS} = 20 \div 32 V_{MAX}$ (ripple max 10 % VPP)	Input - power supply
FAULT	ON state depends on input power supply VL+: ON state > VL+ - 2V @ max 50 mA e.g. in case of VL+ = 24V, the ON state > 22V OFF state < 1 V; External negative voltage not allowed (e.g. due to inductive loads)	Output - on/off signal

**Note:** for the electrical characteristic of all other signals, refer to the technical table of each valve model - see section 3

### 9.1 Connections layout



(1) Use of metallic connectors is strongly recommended in order to fulfill EMC requirements

(2) Pin layout always referred to driver's view

**For fieldbus and/or transducers connections, refer to specific technical tables of each valve model - see section 3**

**General tables:**

<b>Y010</b>	Basics for safety components
<b>FS001</b>	Basics for digital electrohydraulics
<b>FS500</b>	Digital proportional valves with P/Q control
<b>FS900</b>	Operating and maintenance information for proportional valves
<b>GS500</b>	Programming tools
<b>GS510</b>	Fieldbus
<b>K800</b>	Electric and electronic connectors
<b>P005</b>	Mounting surfaces for electrohydraulic valves

**Valves technical tables:**

<b>FS165</b>	DHZO-TES, DKZOR-TES, direct operated
<b>FS172</b>	DPZO-TES, pilot operated
<b>FS175</b>	DPZO-LES, pilot operated
<b>FS168</b>	DHZO-TES, DKZOR-TES, direct operated, zero spool overlap
<b>FS180</b>	DLHZO-TES, DLKZOR-TES, direct operated, sleeve execution
<b>FS178</b>	DPZO-LES, pilot operated, zero spool overlap
<b>FS610</b>	DLHZO-TEZ, DLKZOR-TEZ digital proportional valves with on-board axis card
<b>FS620</b>	DHZO-TEZ, DKZOR-TEZ digital proportional valves with on-board axis card
<b>FS630</b>	DPZO-LEZ digital proportional valves with on-board axis card

**Commissioning and troubleshooting tables:**

<b>QF300</b>	Quickstart for TES direct operated proportional valves (supplied with the valve)
<b>QF320</b>	Quickstart for TES/LES pilot operated proportional valves (supplied with the valve)

**Operating and fieldbus manuals for TES and LES:**

<b>E-MAN-RI-LES</b>	- TES and LES drivers user manual
<b>E-MAN-RI-LES-S</b>	- TES and LES drivers with P/Q control user manual
<b>E-MAN-S-BC</b>	- CANopen protocol programming manual
<b>E-MAN-S-BP</b>	- PROFIBUS DP protocol programming manual
<b>E-MAN-S-EH</b>	- EtherCAT protocol programming manual
<b>E-MAN-S-EW</b>	- POWERLINK protocol programming manual
<b>E-MAN-S-EI</b>	- EtherNet/IP protocol programming manual
<b>E-MAN-S-EP</b>	- PROFINET IRT protocol programming manual

**Operating and fieldbus manuals for TEZ and LEZ:**

<b>Z-MAN-RI-LEZ</b>	- TEZ and LEZ controllers user manual
<b>Z-MAN-RI-LEZ-S</b>	- TEZ and LEZ controllers with P/Q control user manual
<b>Z-MAN-S-BC</b>	- CANopen protocol programming manual
<b>Z-MAN-S-BP</b>	- PROFIBUS DP protocol programming manual
<b>Z-MAN-S-EH</b>	- EtherCAT protocol programming manual
<b>Z-MAN-S-EW</b>	- POWERLINK protocol programming manual
<b>Z-MAN-S-EI</b>	- EtherNet/IP protocol programming manual
<b>Z-MAN-S-EP</b>	- PROFINET IRT protocol programming manual

**SIL safety manuals for operating, installation and maintenance (on request):**

<b>TT366</b>	DHZO-TES/TEZ, DKZOR-TES/TEZ
<b>TT367</b>	DLHZO-TES/TEZ, DLKZOR-TES/TEZ
<b>TT368</b>	DPZO-TES/LES/LEZ

**TÜV certificates (on request):**

<b>C-IS-722117697-01</b>	Safety proportional valves, direct operated
<b>C-IS-722117689-01</b>	Safety proportional valves, piloted operated