Proportional flow valves

digital, pressure compensated, direct operated, with position transducer

① Valve body
② Throttle
③ Compensator
④ Proportional solenoid
⑤ Position transducer
⑥ Integral electronics
⑦ Communication connector
⑧ Main connector
⑨ USB connector
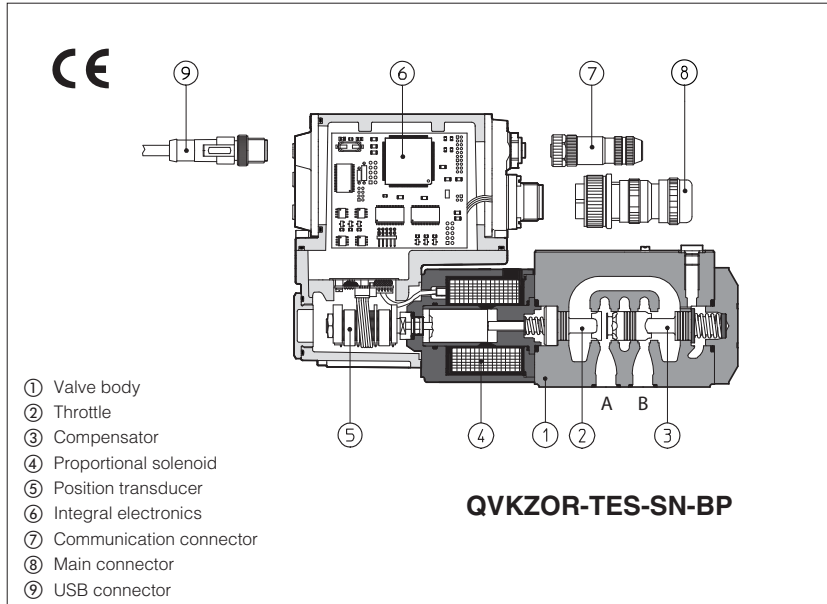
QVKZOR-TES-SN-BP

QVHZO-TEB, QVHZO-TES
QVKZOR-TEB, QVKZOR-TES

Pressure compensated proportional flow control valves, direct operated.

They are equipped with LVDT position transducer for best accuracy in flow regulations.

The integral digital electronic driver performs the valve's hydraulic regulation according to the reference signal and assures valve-to-valve interchangeability thanks to the factory presetting.

They are available in TEB basic execution with analog reference signals and USB port for software functional parameters setting or in TES full execution which includes also optional fieldbus interfaces for functional parameters setting, reference signals and real-time diagnostics.

Sizes: **06** and **10**
Max flow: up to **45** and **90 l/min**
Max pressure: **210 bar**

1 MODEL CODE

QVKZOR	- T	ES	- SN	- NP	- 10	/ 65	/ *	**	/ *

QVKZOR (block):
Pressure compensated flow control valves
QVHZO = size 06
QVKZOR = size 10

T = closed-loop one LVDT transducer

Integral digital drivers:
EB = basic **(1)**
ES = full

Alternated P/Q controls
SN = none

Fieldbus interfaces USB port always present **(1)**:
NP = Not present
BP = PROFIBUS DP   **BC** = CANopen
EH = EtherCAT   **EW** = POWERLINK

Valve size
06= ISO 4401, size 06   **10** = ISO 4401, size 10

Seals material, see sect. 5, 6:
- = NBR
PE = FKM
BT = HNBR

Series number

Electronic options, see section 10:
I = current reference input and monitor 4÷20 mA (omit for standard voltage reference input and monitor ±10 V)
F = fault signal
Q = enable signal
Z = double power supply **(2)**, enable, fault and monitor signals -12 pin connector

Max regulated flow:
QVHZO:		**QVKZOR**:	
3 =3,5l/min	**36** = 35 l/min	**65**=65 l/min
12 =12 l/min	**45** = 45 l/min	**90**=90 l/min
18 =18 l/min			

(1) TEB available only in version **SN-NP**   **(2)** double power supply only for **TES**

2 HYDRAULIC SYMBOLS

2 way connection   **3 way** connection
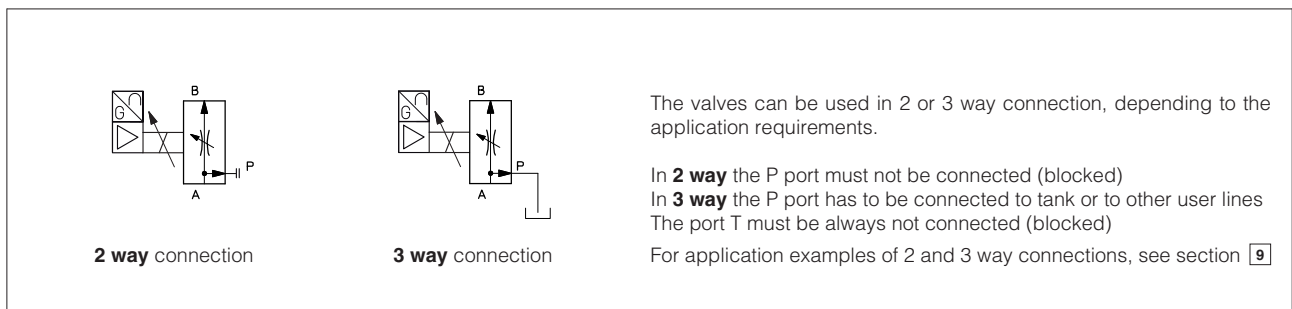
The valves can be used in 2 or 3 way connection, depending to the application requirements.

In **2 way** the P port must not be connected (blocked)
In **3 way** the P port has to be connected to tank or to other user lines
The port T must be always not connected (blocked)

For application examples of 2 and 3 way connections, see section 9

GENERAL NOTES

QVHZO-TEB, TES and QVKZOR-TEB, TES proportional valves are CE marked according to the applicable Directives (e.g. Immunity/Emission EMC Directive and Low Voltage Directive). Installation, wirings and start-up procedures must be performed according to the general prescriptions shown in table F003 and in the installation notes supplied with relevant components. The electrical signals of the valve (e.g. monitor signals) must not be directly used to activate safety functions or components, as prescribed by the European standards (Safety requirements of fluid technology systems and components-hydraulics, EN-982).

FIELDBUS - only for **TES**

Fieldbus allows valve direct communication with machine control unit for digital reference, valve diagnostics and settings. These execution allow to operate the valves through fieldbus or analog signals available on the main connector. For detailed information about fieldbus features and specification see tech table **GS510**.

MAIN CHARACTERISTICS - based on mineral oil ISO VG 46 at 50 °C

Assembly position	Any position
Subplate surface finishing	Roughness index, Ra 0,4 flatness ratio 0,01/100 (ISO 1101)
MTTFd valves according to EN ISO 13849	150 years, see technical table P007
Ambient temperature range	**standard** = -20°C ÷ +60°C
	/BT option = -40°C ÷ +60°C
Storage temperature range	**Standard** = -20°C ÷ +70°C
	/BT option = -40°C ÷ +60°C
Coil resistance R at 20°C	**QVHZO** = 3 ÷ 3,3 Ω **QVKZOR** = 3,8 ÷ 4,1 Ω
Max. solenoid current	**QVHZO** = 2,6 A **QVKZOR** = 3 A
Max. power	50 Watt
Insulation class	H (180°) Due to the occuring surface temperatures of the solenoid coils, the European standards ISO 13732-1 and EN982 must be taken into account
Protection degree to DIN EN60529	IP66/67 with mating connector
Tropicalization	Tropical coating on electronics PCB
Duty factor	Continuous rating (ED=100%)
EMC, climate and mechanical load	See technical table G004
Communication interface	USB Atos ASCII coding	CANopen EN50325-4 + DS408	PROFIBUS DP EN50170-2/IEC61158	EtherCAT, POWERLINK IEC 61158
Communication physical layer	not insulated USB 2.0 + USB OTG	optical insulated CAN ISO11898	optical insulated RS485	Fast Ethernet, insulated 100 Base TX

Valve model		QVHZO					QVKZOR	
Max regulated flow [l/min]	3,5	12	18	35	45	65	90
Min regulated flow **(1)** [cm³/min]	15	20	30	50	60	85	100
Regulating Δp [bar]	4 - 6		10 - 12		15	6 - 8	10 - 12
Max flow on port A [l/min]	50				60	70	100
Max pressure [bar]	210					210	
Response time 0÷100% step signal **(2)** [ms]	25					35	
Hysteresis [% of the regulated max flow]	≤ 0,5					≤ 0,5	
Linearity [% of the regulated max flow]	≤ 0,5					≤ 0,5	
Repeatability [% of the regulated max flow]	≤ 0,1					≤ 0,1	
Thermal drift	zero point displacement < 1% at ΔT = 40°C						

Notes: Above performance data refer to valves coupled with Atos electronic drivers, see sections.
(1) For different Δp, the max flow is in accordance to the diagrams in section 8.2
(2) Referred to spool in neutral position and 50°C oil temperature.
(3) 0-100% step signal

SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C
	FKM seals (/PE option) = -20°C ÷ +80°C
	HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	20÷100 mm²/s - max allowed range 15 ÷ 380 mm²/s
Fluid contamination class	ISO 4406 class 20/18/15 NAS 1638 class 9, in line filters of 10 μm (β10 ≥75 recommended)

| **Hydraulic fluid**	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

Valve model	**TEB**	**TES**
Drivers model	E-RI-TEB-N	E-RI-TES-N
Type	Digital	
Format	Integral to valve	
Data sheet	GS208	GS210

Note: for main and communication connector see sections 12 , 13

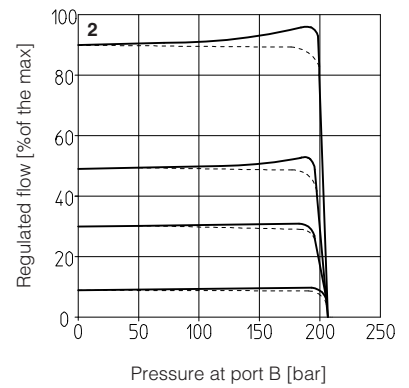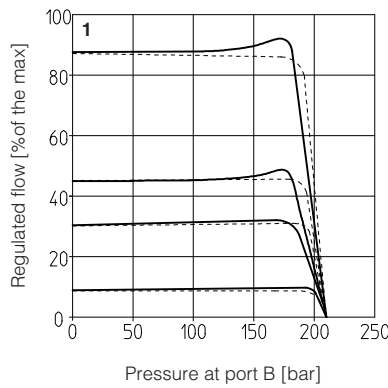| 8 | DIAGRAMS - based on mineral oil ISO VG 46 at 50 °C |

8.1 Regulation diagrams

1 = QVHZO-*-06/**3**
2 = QVHZO-*-06/**12**
3 = QVHZO-*-06/**18**
4 = QVHZO-*-06/**36**
5 = QVHZO-*-06/**45**
6 = QVKZOR-*-10/**65**
7 = QVKZOR-*-10/**90**
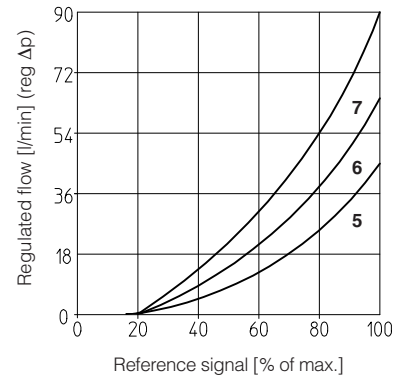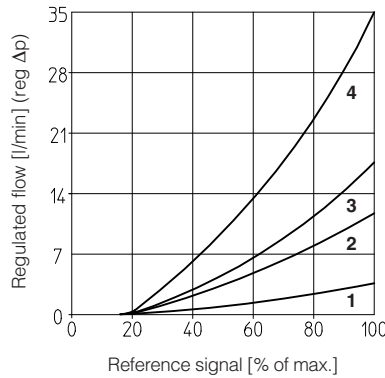
8.2 Regulated flow/outlet pressure diagrams
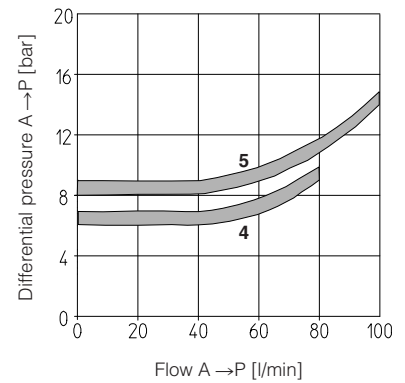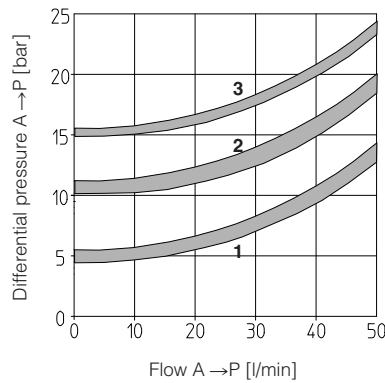with inlet pressure = 210 bar

1 = QVHZO
2 = QVKZOR

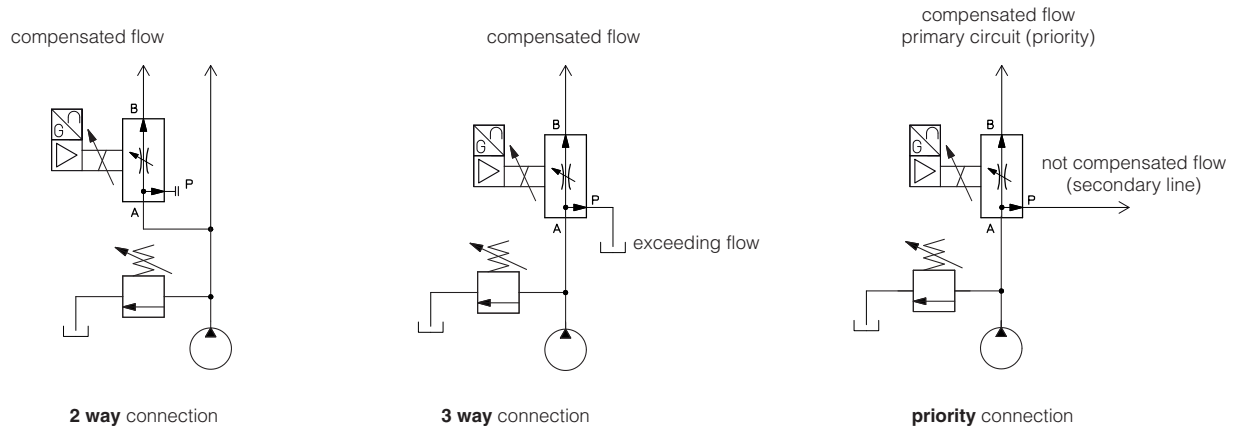Dotted line for 3-way versions

8.3 Flow A→P/Δp diagrams
3-way configuration

1 = QVHZO-*-06/**3**
    QVHZO-*-06/**12**
2 = QVHZO-*-06/**18**
    QVHZO-*-06/**36**
3 = QVHZO-*-06/**45**
4 = QVKZOR-*-10/**65**
5 = QVKZOR-*-10/**90**

compensated flow   compensated flow   compensated flow primary circuit (priority)

not compensated flow (secondary line)

exceeding flow

2 way connection   **3 way** connection   **priority** connection

2 way connection
The 2 way connection is normally used to control the flow in one part of the hydraulic circuit or to regulate the speed of a specific actuator.
The metered flow in the controlled line is kept constant, independently to the load variations
If the valve is directly installed on the pump main line, the exceeding flow is returned to tank though the pressure relief valve.

3 way connection
The 3 way connection is normally used when the valve directly controls the pump flow (main line)
The metered flow in the controlled line is kept constant, independently to the load variations
The exceeding flow (not metered by the valve) it is returned to tank trough the valve P port = T line (3rd way)

Priority connection
The priority connection guarantees the pressure compensated flow supply to the primary circuit.
The exceeding flow (not required by the primary circuit) is bypassed through the valve P port, to secondary circuit operating at lower pressure and not requiring compensated flow regulations.

10   **ELECTRONIC OPTIONS**

Standard driver execution provides on the 7 pin main connector:

Power supply   - 24 V_{DC} must be appropriately stabilized or rectified and filtered; **2,5 A** fuse time lag is required in series to each driver power supply. Apply at least a 10000 µF/40 V capacitance to single phase rectifiers or a 4700 µF/40 V capacitance to three phase rectifiers

Reference input signal - analog differential input with ±10 V_{DC} nominal range (pin D, E), proportional to desired valve spool position

Monitor output signal - analog output signal proportional to the actual valve's spool position with ±10V_{DC} nominal range

Note: a minimum booting time between 400 and 800 ms has be considered from the driver energizing with the 24 V_{DC} power supply before the valve has been ready to operate. During this time the current to the valve coils is switched to zero.

10.1 Option /F
It provides a Fault output signal in place of the Monitor output signal, to indicate fault conditions of the driver (cable interruption of spool transducers or reference signal - for /I option): Fault presence corresponds to 0 V_{DC}, normal working corresponds to 24 V_{DC}

10.2 Option /I
It provides 4 ÷ 20 mA current reference and monitor signals, instead of the standard 0 ÷ +10V.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 V or ±20 mA.
It is normally used in case of long distance between the machine control unit and the valve or where the reference signal can be affected by electrical noise; the valve functioning is disabled in case of reference signal cable breakage.

10.3 Option /Q
To enable the driver, supply 24 V_{DC} on pin C referred to pin B: Enable input signal allows to enable/disable the current supply to the solenoid, without removing the electrical power supply to the driver; it is used to maintain active the communication and the other driver functions when the valve has to be disabled. This condition does not comply with European Norms EN13849-1 (ex EN954-1).

10.4 Option /Z
It provides, on the 12 pin main connector, the following additional features:

Enable Input Signal
To enable the driver, supply 24 V_{DC} on pin 3 referred to pin 2: when the Enable signal is set to zero the valve functioning is disabled (zero current to the solenoid) but the driver current output stage is still active.

Fault Output Signal
Fault output signal indicates fault conditions of the driver (solenoid short circuits/not connected, reference signal cable broken for 4÷20mA input, etc.). Fault presence corresponds to 0 V_{DC}, normal working corresponds to 24V_{DC} (pin 11 referred to pin 2): Fault status is not affected by the Enable input signal

Power supply for driver's logics and communication - only for **TES**
Separate power supply (pin 9,10) allow to cut solenoid power supply (pin 1,2) while maintaining active diagnostics, USB and fieldbus communication.
A safety fuse is required in series to each driver power supply: 500 mA fast fuse.

10.5 Possible combined options
/FI, /IQ and **/IZ**

11 ELECTRONIC CONNECTIONS AND LEDS

11.1 Main connector signals - 7 pin - standard, /F and /Q options Ⓐ1

PIN	Standard	/Q	/F	TECHNICAL SPECIFICATIONS	NOTES
A	V+			Power supply 24 V_{DC} Rectified and filtered: V_{RMS} = 20 ÷ 32 V_{MAX} (ripple max 10 % V_{PP})	Input - power supply
B	V0			Power supply 0 V_{DC}	Gnd - power supply
C	AGND		AGND	Analog ground	Gnd - analog signal
		ENABLE		Enable (24 V_{DC}) or disable (0 V_{DC}) the valve, referred to V0	Input - on/off signal
D	Q_INPUT+			Flow reference input signal: ±10 V_{DC} / ±20 mA maximum range	Input - analog signal
				Defaults are 0 ÷ +10 V_{DC} for standard and 4 ÷ 20 mA for /I option	Software selectable
E	INPUT-			Negative reference input signal for Q_INPUT+	Input - analog signal
F	Q_MONITOR referred to:			Flow monitor output signal: ±10 V_{DC} / ±20 mA maximum range	Output - analog signal
	AGND	V0		Defaults are 0 ÷ +10 V_{DC} for standard and 4 ÷ 20 mA for /I option	Software selectable
			FAULT	Fault (0 V_{DC}) or normal working (24 V_{DC})	Output - on/off signal
G	EARTH			Internally connected to the driver housing	

11.2 Main connector signal - 12 pin - /Z option Ⓐ2

PIN	TEB-SN /Z	TES-SN /Z	TECHNICAL SPECIFICATIONS	NOTES
	V+		Power supply 24 V_{DC} Rectified and filtered: V_{RMS} = 20 ÷ 32 V_{MAX} (ripple max 10 % V_{PP})	Input - power supply
1	V0		Power supply 0 V_{DC}	Gnd - power supply
2	ENABLE referred to:		Enable (24 V_{DC}) or disable (0 V_{DC}) the valve	Input - on/off signal
3	V0	VL0		
4	Q_INPUT+		Flow reference input signal: ±10 V_{DC} / ±20 mA maximum range	Input - analog signal
			Defaults are 0 ÷ +10 V_{DC} for standard and 4 ÷ 20 mA for /I option	Software selectable
5	INPUT-		Negative reference input signal for Q_INPUT+	Input - analog signal
6	Q_MONITOR referred to:		Flow monitor output signal: ±10 V_{DC} / ±20 mA maximum range	Input - analog signal
	AGND	VL0	Defaults are 0 ÷ +10 V_{DC} for standard and 4 ÷ 20 mA for /I option	Software selectable
7	AGND		Analog ground	Output - analog signal
		NC	Do not connect	Gnd - analog signal
8	R_ENABLE		Repeat enable, output repeter signal of enable input, referred to V0	
		NC	Do not connect	Output - on/off signal
9	NC		Do not connect	
		VL+	Power supply 24 V_{DC} for driver's logic and communication	Input - power supply
10	NC		Do not connect	
		VL0	Power supply 0 V_{DC} for driver's logic and communication	Gnd - power supply
11	FAULT referred to:		Fault (0 V_{DC}) or normal working (24 V_{DC})	Output - on/off signal
PE	V0	VL0		
	EARTH		Internally connected to the driver housing	

Note: do not disconnect VL0 before VL+ when the driver is connected to PC USB port

11.3 Communications connectors Ⓑ - Ⓒ

Ⓑ USB connector - M12 - 5 pin always present		
PIN	SIGNAL	TECHNICAL SPECIFICATION (1)
1	+5V_USB	Supply for external USB Flash Drive
2	ID	USB Flash Drive identification
3	GND_USB	Signal zero data line
4	D-	Data line -
5	D+	Data line +

Ⓒ1 Ⓒ2 BC fieldbus execution, connector - M12 - 5 pin		
PIN	SIGNAL	TECHNICAL SPECIFICATION (1)
1	CAN_SHLD	Shield
2	not used	Ⓒ1 - Ⓒ2 pass-through connection (2)
3	CAN_GND	Signal zero data line
4	CAN_H	Bus line (high)
5	CAN_L	Bus line (low)

Ⓒ1 Ⓒ2 BP fieldbus execution, connector - M12 - 5 pin		
PIN	SIGNAL	TECHNICAL SPECIFICATION (1)
1	+5V	Termination supply signal
2	LINE-A	Bus line (high)
3	DGND	Data line and termination signal zero
4	LINE-B	Bus line (low)
5	SHIELD	

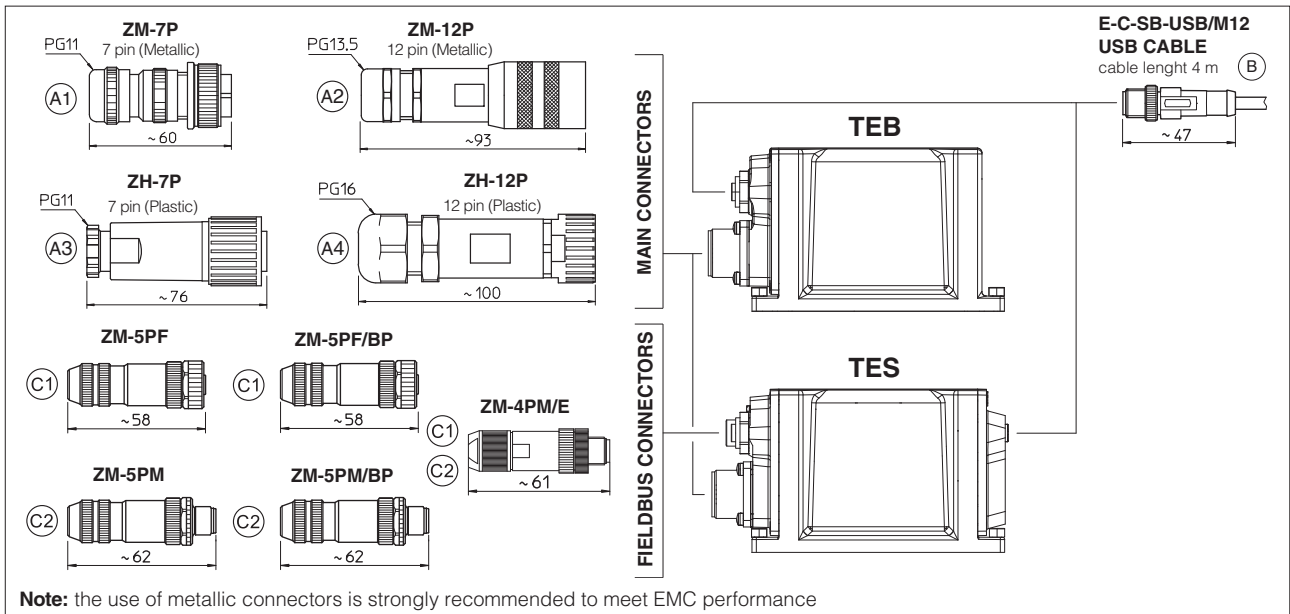| Ⓒ1 Ⓒ2 EH, EW fieldbus execution, connector - M12 - 4 pin		
PIN	SIGNAL	TECHNICAL SPECIFICATION (1)
1	TX+	Transmitter
2	RX+	Receiver
3	TX-	Transmitter
4	RX-	Receiver
	SHIELD	

Notes: (1) shield connection on connector's housing is recommended

(2): pin 2 can be fed with external +5V supply of CAN interface

11.4 Connections layout

TEB

B
A1
A2

B — USB CONNECTOR (always present)

MAIN CONNECTOR — A1 / A2

TES

C1
C2
A1
A2
B

USB CONNECTOR (always present) — B

L1 L2 L3   L — DIAGNOSTIC LED

FIELDBUS CONNECTOR — C1
FIELDBUS CONNECTOR — C2
MAIN CONNECTOR — A1 / A2

C1 — CANopen (male)
C1 — PROFIBUS DP (male)
C1 — EtherCAT POWERLINK (female - INPUT)
B — USB (female)
A1 — 7 PIN MAIN CONNECTOR (male)
A2 — 12 PIN MAIN CONNECTOR (male)

C2 — CANopen (female)
C2 — PROFIBUS DP (female)
C2 — EtherCAT POWERLINK (female - OUTPUT)

L — LED FUNCTION DESCRIPTION

	NP, BC, BP	EH, EW
L1	VALVE STATUS	LINK/ACT
L2	NETWORK STATUS	NETWORK STATUS
L3	SOLENOID STATUS	LINK/ACT

Note: connectors front view

12 CONNECTORS

A1 — **ZM-7P** PG11 7 pin (Metallic) ~60
A2 — **ZM-12P** PG13,5 12 pin (Metallic) ~93
A3 — **ZH-7P** PG11 7 pin (Plastic) ~76
A4 — **ZH-12P** PG16 12 pin (Plastic) ~100

MAIN CONNECTORS

E-C-SB-USB/M12 USB CABLE
cable lenght 4 m   B
~47

TEB

C1 — **ZM-5PF** ~58
C1 — **ZM-5PF/BP** ~58
C1 — **ZM-4PM/E** ~61
C2 — **ZM-4PM/E**

C2 — **ZM-5PM** ~62
C2 — **ZM-5PM/BP** ~62

FIELDBUS CONNECTORS

TES

Note: the use of metallic connectors is strongly recommended to meet EMC performance

13 MODEL CODES OF MAIN CONNECTORS AND COMMUNICATION CONNECTORS - to be ordered separately

VALVE VERSION	TES	TEB /Z TES /Z	BC - CANopen	BP - PROFIBUS DP	EH - EtherCat EW - POWERLINK
CONNECTOR CODE	ZM-7P (A1)	ZM-12P (A2)	ZM-5PF (C1)	ZM-5PF/BP (C1)	ZM-4PM/E (C1)
	ZH-7P (A3)	ZH-12P (A4)	ZM-5PM (C2)	ZM-5PM/BP (C2)	ZM-4PM/E (C2)
PROTECTION DEGREE	IP67				
DATA SHEET	GS208, GS210, K500				

▨ only for **TES**

14 PROGRAMMING TOOLS - see table GS500

Valve's functional parameters and configurations, can be easily set and optimized using Atos E-SW programming software connected via USB port to the digital driver. For fieldbus versions, the software permits valve's parameterization through USB port also if the driver is connected to the central machine unit via fieldbus.

The software is available in different versions according to the driver's options:

|				
E-SW-BASIC	support:	NP (USB)	PS (Serial)	IR (Infrared)
E-SW-FIELDBUS	support:	BC (CANopen)	BP (PROFIBUS DP)	EH (EtherCAT)
		EW (POWERLINK)		
E-SW-*/PQ	support:	valves with SP, SF, SL alternated control (e.g. E-SW-BASIC/PQ)		

WARNING: drivers USB port is not isolated!

The use of isolator adapter is highly recommended for PC protection (see table **GS500**)
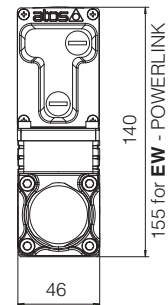
USB connection

TES

E-C-SB-USB/M12 cable

TEB

E-A-SB-USB/OPT isolator
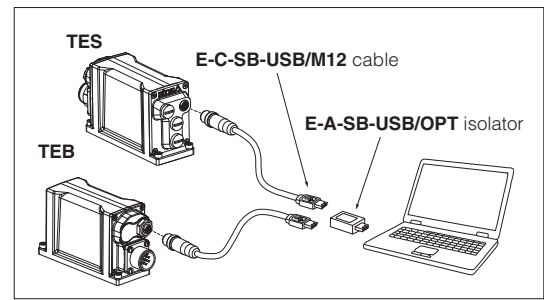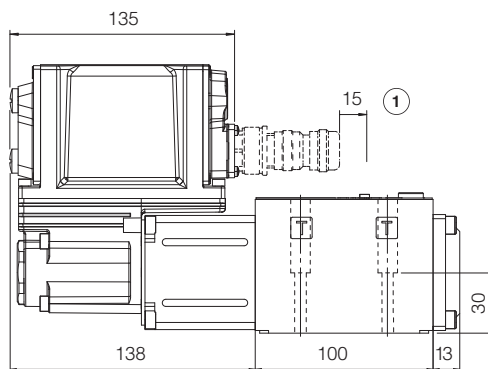
15 INSTALLATION DIMENSIONS [mm]
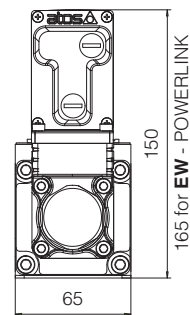
QVHZO-TEB
QVHZO-TES
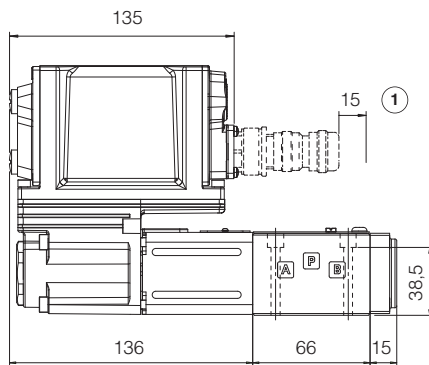
ISO 4401: 2005
Mounting surface: 4401-03-02-0-05 (see tab. P005)
Fastening bolts: 4 socket head screws M5x50 class 12.9
Tightening torque = 8 Nm
Seals: 4 OR 108;
Diameter of ports A, B, P, T: Ø 7,5 mm (max)

135

15   ①

38,5

136   66   15

Mass: 2,3 kg

140

155 for **EW** - POWERLINK

46

QVKZOR-TEB
QVKZOR-TES

ISO 4401: 2005
Mounting surface: 4401-05-04-0-05 (see tab. P005)
Fastening bolts: 4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Seals: 5 OR 2050;
Diameter of ports A, B, P, T: Ø 11,2 mm (max)

135

15   ①

30

138   100   13

Mass: 4,3 kg

150

165 for **EW** - POWERLINK

65

① = Space to remove the 7 or 12 pin main connector

Note: for main and communication connectors see section 12, 13