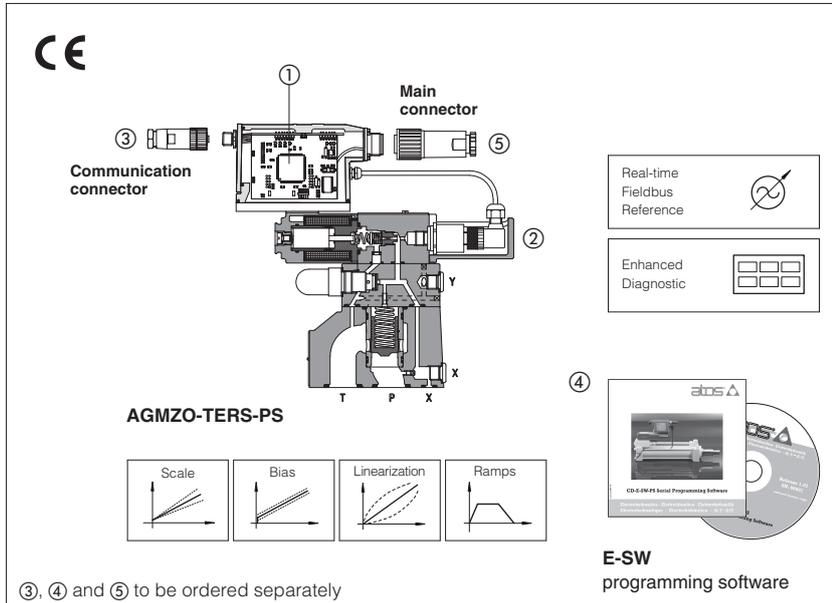# Digital electronic drivers type E-RI-TERS, E-RI-AERS

integral-to-valve format, for proportional valves with one integral or remote pressure transducer



**Main connector**

**Communication connector**

Real-time Fieldbus Reference

Enhanced Diagnostic

**AGMZO-TERS-PS**

| Scale | Bias | Linearization | Ramps |
|---|---|---|---|

③, ④ and ⑤ to be ordered separately

**E-SW** programming software

CD-E-SW-PS Serial Programming Software

These integral digital drivers ① supply and control, in closed loop, the regulated pressure of direct and pilot operated proportional valves according to the electronic reference input signal.

E-RI-TERS execution operates direct and pilot operated relief/reducing control valves with one integral pressure transducer ②.

E-RI-AERS execution operates direct and pilot operated relief/reducing control valves with one remote pressure transducer.

Digital communication interface ③ allows to program the drivers with the Atos PC software ④.

Drivers executions with fieldbus communication interface (CANopen or PROFIBUS DP) are available to program and command the valves directly by the machine control unit.
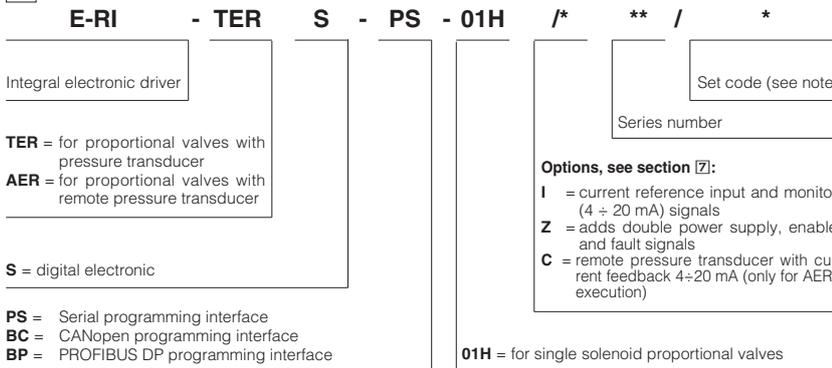
**Electrical Features:**
- Integral-to-valve digital electronic, functional parameters are factory preset for best performances
- Standard 7 pin main connector ⑤ for power supply, analog input reference and monitor signals
- /Z option 12 pin main connector for additional double power supply, enable and fault signals
- /I option for current reference and monitor signals
- /C option for current interface with remote pressure transducer
- 5 pin connector ③ for communication interface, at choice: serial -PS or fieldbus -BC and -BP
- IP67 protection degree
- CE mark to EMC and Low Voltage directives
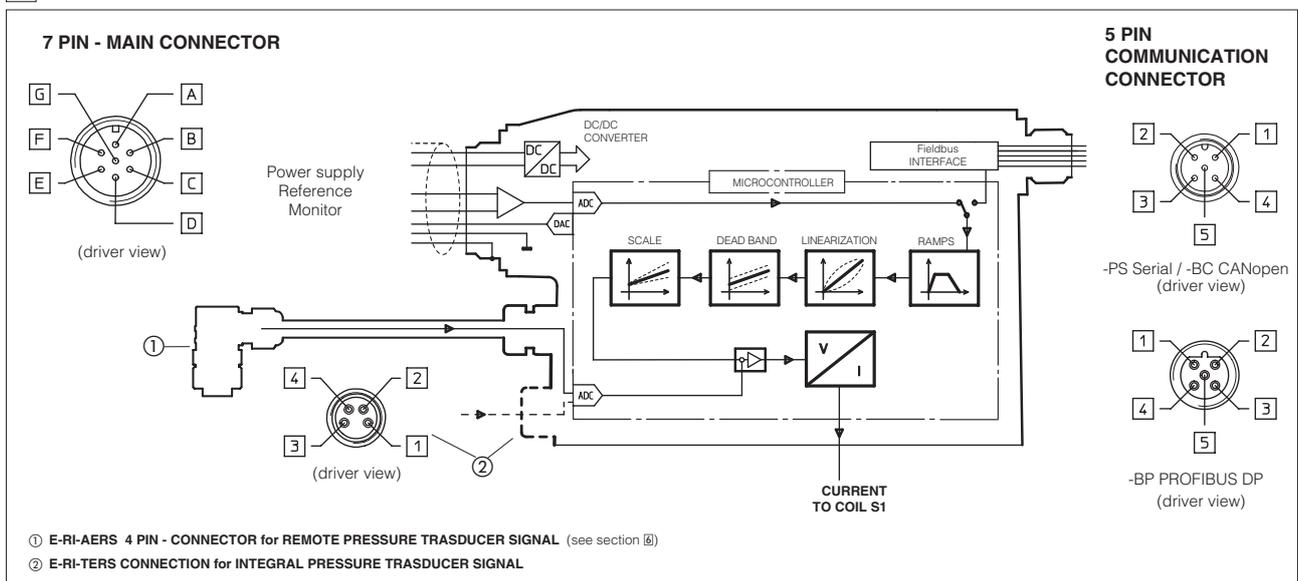
**Software Features:**
- Setting of valve's functional parameters: bias, scale, ramps, dither
- Linearization function for the hydraulic regulation
- Setting of valve's dynamic response (PID) to optimize the application performances
- Range selection for the electronic reference analog inputs: voltage or current (/I option)
- Complete diagnostics of driver status, solenoid and fault conditions
- Intuitive graphic interface

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**1  MODEL CODE**

**E-RI – TER S – PS – 01H /\* \*\* / \***

Integral electronic driver

**TER** = for proportional valves with pressure transducer
**AER** = for proportional valves with remote pressure transducer

**S** = digital electronic

**PS** = Serial programming interface
**BC** = CANopen programming interface
**BP** = PROFIBUS DP programming interface

Set code (see note)

Series number

Options, see section ⑦:
**I** = current reference input and monitor (4 ÷ 20 mA) signals
**Z** = adds double power supply, enable and fault signals
**C** = remote pressure transducer with current feedback 4÷20 mA (only for AERS execution)
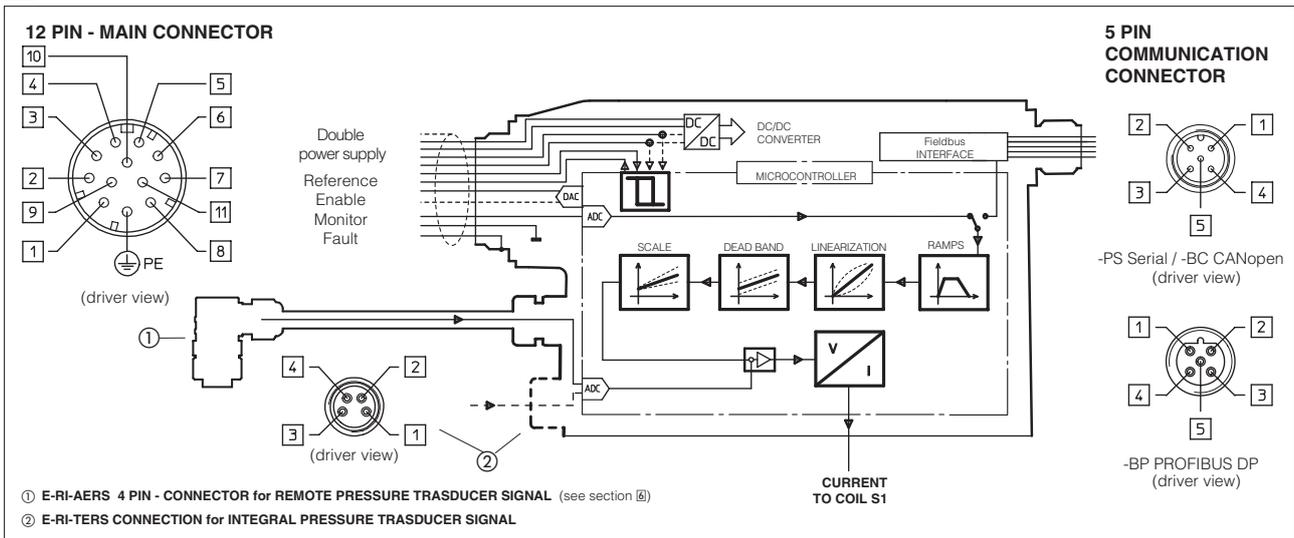
**01H** = for single solenoid proportional valves

**Note:** the set code identifies the corrispondance between the digital integral driver and the relevant valve; it is assigned by Atos when the driver is ordered as spare part.

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**2  BLOCK DIAGRAM**

**7 PIN - MAIN CONNECTOR**

**5 PIN COMMUNICATION CONNECTOR**

(driver view)

Power supply Reference Monitor

DC/DC CONVERTER

Fieldbus INTERFACE

MICROCONTROLLER

SCALE   DEAD BAND   LINEARIZATION   RAMPS

-PS Serial / -BC CANopen (driver view)

-BP PROFIBUS DP (driver view)

(driver view)

**CURRENT TO COIL S1**

① **E-RI-AERS  4 PIN - CONNECTOR for REMOTE PRESSURE TRASDUCER SIGNAL**  (see section ⑥)
② **E-RI-TERS CONNECTION for INTEGRAL PRESSURE TRASDUCER SIGNAL**

## 3  BLOCK DIAGRAM - /Z option



**12 PIN - MAIN CONNECTOR**

(driver view)

**5 PIN COMMUNICATION CONNECTOR**

-PS Serial / -BC CANopen
(driver view)

-BP PROFIBUS DP
(driver view)

Double power supply
Reference
Enable
Monitor
Fault

DC/DC CONVERTER
Fieldbus INTERFACE
MICROCONTROLLER
DAC
ADC
SCALE
DEAD BAND
LINEARIZATION
RAMPS
V / I
ADC

CURRENT TO COIL S1

(driver view)

① **E-RI-AERS  4 PIN - CONNECTOR for REMOTE PRESSURE TRASDUCER SIGNAL** (see section 6)
② **E-RI-TERS CONNECTION for INTEGRAL PRESSURE TRASDUCER SIGNAL**

## 4  ELECTRONIC CONNECTIONS - 7 & 12 PIN MAIN CONNECTOR

| Standard 7pin | /Z option 12pin | SIGNAL | TECHNICAL SPECIFICATIONS | NOTES | |
|---|---|---|---|---|---|
| A | 1 | V+ | Power supply 24 $V_{DC}$ for solenoid power stage (see 7.1) | Input | - power supply |
| B | 2 | V0 | Power supply 0 $V_{DC}$ for solenoid power stage (see 7.1) | Gnd | - power supply |
| - | 3 | ENABLE | Enable (24 $V_{DC}$) or disable (0 $V_{DC}$) the driver (see 7.5) | Input | - on/off signal |
| D | 4 | INPUT+ | Reference analog input: ±10 $V_{DC}$ maximum range (4 ÷ 20 mA for /I option) - see 7.2 | Input | - analog signal |
| E | - | INPUT - | differential INPUT+ and INPUT- (for 7 pin standard execution) common mode INPUT+ referred to AGND (for 12 pin /Z option) | | |
| C | 5 | AGND | Ground :  signal zero for MONITOR signal  ( pin F of 7 pin standard or pin 6  of /Z option) signal zero for INPUT+ signal ( pin 4  of /Z option) | Gnd | - analog signal |
| F | 6 | MONITOR | Monitor analog output: ±10 $V_{DC}$ maximum range (4 ÷ 20 mA for /I option) - see 7.3 | Output | - analog signal |
| - | 7 | NC | do not connect | | |
| - | 8 | NC | do not connect | | |
| - | 9 | VL+ | Power supply 24 $V_{DC}$ for driver's logic (see 7.4) | Input | - power supply |
| - | 10 | VL0 | Power supply 0 $V_{DC}$ for driver's logic (see 7.4) | Gnd | - power supply |
| - | 11 | FAULT | Driver status : Fault  (0$V_{DC}$) or normal working (24 $V_{DC}$) (see 7.6) | Output | - on/off signal |
| G | PE | EARTH | Internally connected to driver housing | | |

**Note:** A minimum time of 270 to 590 ms have be considered between the driver energizing with the 24 $V_{DC}$ power supply and when the valve is ready to operate. During this time the current to the valve coils is switched to zero

## 5  ELECTRONIC CONNECTIONS - 5 PIN COMMUNICATION M12 CONNECTOR

| | -PS Serial | | -BC CANopen | | -BP PROFIBUS DP | |
|---|---|---|---|---|---|---|
| PIN | SIGNAL | TECHNICAL SPECIFICATION | SIGNAL | TECHNICAL SPECIFICATION | SIGNAL | TECHNICAL SPECIFICATION |
| 1 | NC | do not connect | CAN_SHLD | Shield | +5V | for termination |
| 2 | NC | do not connect | NC | do not connect | LINE-A | Bus line (high) |
| 3 | RS_GND | Signal zero data line | CAN_GND | Signal zero data line | DGND | data line and termination Signal zero |
| 4 | RS_RX | Valves receiving data line | CAN_H | Bus line (high) | LINE-B | Bus line (low) |
| 5 | RS_TX | Valves transmitting data line | CAN_L | Bus line (low) | SHIELD | |

## 6  ELECTRONIC CONNECTIONS - 4 PIN REMOTE PRESSURE TRANSDUCER M8 CONNECTOR (only for AERS)

| PIN | standard version | | /C option  (Ri = 316 W) | |
|---|---|---|---|---|
| 1 | TR | remote trasducer pressure signal (0÷+10 $V_{DC}$) | TR | remote trasducer pressure signal (4÷20 mA) |
| 2 | NC | reserved (do not connect) | NC | reserved (do not connect) |
| 3 | VT | remote transducer power supply +24 $V_{DC}$ | VT | remote transducer power supply +24 $V_{DC}$ |
| 4 | AGND | signal zero for power supply and signal | NC | reserved (do not connect) |

See tab. G465 for the pressure transducer characteristics and connections.

## 7  SIGNALS SPECIFICATIONS

Atos 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 user manuals included in the E-SW programming software.
The electrical signals of the valve (e.g. monitor signals) must not be directly used to activate safety functions, like to switch-ON/OFF the machine's safety components, as prescribed by the European standards (Safety requirements of fluid technology systems and components-hydraulics, EN-892)

### 7.1  Power supply and wirings (pin A,B / pin 1,2)

The power supply must be appropriately stabilized or rectified and filtered: apply at least a 10000 µF/40 V capacitance to single phase rectifiers or a 4700 µF/40 V capacitance to three phase rectifiers.
A safety fuse is required in series to each driver power supply: 2,5 A fuse

**7.2 Reference Input Signal (pin D,E / pin 4,5)**

The driver controls in closed loop the valve pressure proportionally to the external reference signal input.
The driver is designed to receive one analog reference input (pin D,E differential mode input).
The input polarity is software selectable within the ±10 V$_{DC}$ maximum range; default settings is  0 ÷ +10 V$_{DC}$ .
Driver with fieldbus interface (-BC or -BP) can be software set to receive reference value directly by the machine control unit (fieldbus master); in this case the analog reference input signal can be used for start-up and maintenance operations.
*Option /I*
The maximum range of reference input signal is software selectable among 4 ÷ 20 mA (default with cable break detection), ±10mA, ±20mA or 0 ÷ 20mA
*Option /Z*
The reference input is available in common mode (pin 4 referred to pin 5) instead of the standard differential mode

**7.3 Monitor Output Signal (pin F,C / pin 6,5)**

The driver generates an analog output signal proportional to the actual pressure of the valve (pin F/6 referred to pin C/5); the monitor output signal can be software set to show other signals available in the driver (e.g. analog reference, fieldbus reference).
The output range and polarity are software selectable within ±10 V$_{DC}$ maximum range; default settings is 0 ÷ +10 V$_{DC}$ .
*Option /I*
The maximum range of monitor output signal is 4 ÷ 20 mA

**7.4 Logic power supply (pin 9,10 - only for /Z option)**

Option /Z provides separate power supply for the solenoid (pin 1,2) and for the digital electronic circuits (pin 9,10).
Cutting solenoid power supply allows to interrupt the valve functioning but keeping energized the digital electronics thus avoiding fault conditions of the machine fieldbus controller (e.g. for emergency, as provided by the European Norms EN954-1 for components with safety class 2).
Note: pin 2 and 10 (zero Volt) are connected together inside the electronics; see 7.1 for power supplies requirements

**7.5 Enable Input Signal (pin 3,2 - only for /Z option)**

To enable the driver, supply a 24V$_{DC}$ on pin 3 referred to pin 2: when the Enable signal is set to zero the valve functioning is disabled but the driver current output stage is still active. This condition does not comply with European Norms EN954-1

**7.6 Fault Output Signal (pin 11,2 - only for /Z option)**

Fault output signal indicates fault conditions of the driver (solenoid short circuits/not connected, reference signal cable broken for 4 ÷ 20mA input, pressure transducer cable broken, etc.). Fault presence corresponds to 0 V$_{DC}$, normal working corresponds to 24 V$_{DC}$ (pin 11 referred to pin2).
Fault status is not affected by the Enable input signal

**7.7 Remote Pressure Transducer Signal (only for AERS - see section ⑥)**

Remote pressure transducer with maximum 0÷+10 V$_{DC}$ output signal can be directly connected to the driver; refer to the valve's technical table to select the transducer's maximum pressure.
*Option /C*
The maximum range of remote pressure transducer signal is software selectable among 4 ÷ 20 mA (default with cable break detection)  or  0 ÷ 20 mA

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**8  SOFTWARE TOOLS**

The driver configuration and parameters can be easily set with the Atos E-SW programming software, available in three different versions according to the driver's communication interfacing: **E-SW-PS** (Serial), **E-SW-BC** (CANopen) and **E-SW-BP** (PROFIBUS DP).
A proper connection is required between the PC and the electronic driver communication port: for a more detailed description of software interface, PC requirements, adapters, cables and terminators, please refer to technical table **G500**.
Proportional valves with fieldbus communication interface (-BC and -BP) can be directly managed by the machine control unit; it is required to implement in the machine control the standard communication as described in the user manuals supplied with the relevant programming software.

**Programming software, must be ordered separately :**
  E-SW-*    (mandatory - first supply) = Dvd including E-SW-* software installer, operator manuals, registration form for Atos digitals service
  E-SW-*-N (optional - next supplies)  = as above but not including the registration form for Atos digitals service
**USB Adapters, Cables and Terminators, can be ordered separately (see tab. G500 )**

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**9  MAIN SOFTWARE PARAMETER SETTINGS**

For a detailed descriptions of the available settings, wirings and installation procedures, please refer to the programming manuals included in the E-SW programming software (see ⑧).

**9.1 Scale**

Scale function allows to set the maximum valve pressure at maximum reference signal value.
This regulation allows to reduce the maximum valve regulation in front of maximum reference signal

**9.2 Bias**

Pressure proportional valves are limited in the minimum regulated pressure: the minimum pressure depends on the valve size,  the regulated flow (only for relief valves) and the T port pressure.
Desired pressure requested trough the reference signal (analog or fieldbus external input), must be greater than the minimum pressure to obtain the valve's best repeatibility and response time.
The Bias function can be set to limit internally the minimum pressure reference indipendently from the external reference value thus optimizing valve's performances.
Refer to the programming manuals for a detailed description of other software selectable Bias functions

**9.4 Ramps**

The ramp generator allows to convert sudden change of electronic reference signal into smooth time-dependent increasing/decreasing of the valve opening.
Different ramp mode can be set:
  - single ramp for any reference variation
  - two ramps for increasing and for decreasing reference variations
Ramp generator is useful for application where smooth hydraulic actuation is necessary to avoid machine vibration and shocks.
If the proportional valve is driven by a closed loop controller, the  ramps can lead to unstable behaviour, for these applications ramp function can be software disabled (default setting)

**9.5 Linearization**

Linearization function allows to set the relation between the reference input signal and the controlled valve's pressure.
Linearization is useful for applications where it is required to linearize the valve's regulation in a defined working condition

**9.6 Dither**

The dither is an high frequency modulation added to the valve's reference signal to reduce the hysteresis of the valve's regulation; in fact a small vibration in the valve's hydraulic regulation considerably reduces the mechanical friction effects (e.g. due to cylinder seals).
Dither frequency and amplitude are software selectable; the amplitude is automatically reduced at high reference values to avoid possible instability.
Lower frequency and higher amplitude reduce hysteresis but also reduce the regulation stability. In some application this can lead to vibration and noise: right setting usually depends on system setup. Dither default setting is disabled.

**9.7 Transducer Scale (for AERS)**

Transducer Scale function allows to adapt the driver to remote transducers with different  output signal range and nominal pressure

**9.1, 9.2 - Scale and Bias**
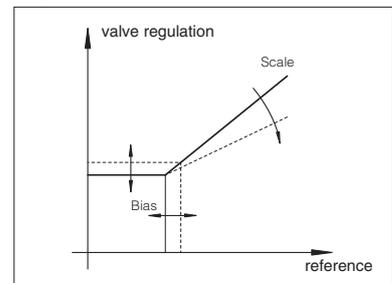


**9.4 - Ramps**



**9.5 - Linearization**

## 10 DRIVER CHARACTERISTICS

| | |
|---|---|
| Power supply (see 7.1, 7.4) | Nominal: +24 $V_{DC}$     Rectified and filtered: Vrms = 20 ÷ 32 $V_{MAX}$ (ripple max 10 % $V_{PP}$) |
| Max power consumption | 50 W |
| Reference input signal (see 7.2) | Input impedance:    voltage  Ri > 50 kΩ   ( range  ±10 $V_{DC}$ )<br>current   Ri = 316 Ω   ( range  4 ÷ 20 mA ) |
| Monitor output (see 7.3) | Output range :          voltage   ±10 $V_{DC}$ @ max 5mA<br>current   4 ÷ 20 mA @ max 500 Ω load resistance |
| Enable input  (see 7.5) | Input impedance:   Ri > 10 kΩ ;    range : 0 ÷ 5 $V_{DC}$ (ON state), 9 ÷ 24 $V_{DC}$ (OFF state), 5 ÷ 9 $V_{DC}$ (not accepted) |
| Fault output (see 7.6) | Output range :       0 ÷ +24 $V_{DC}$ ( ON state > power supply-2V ; OFF state  < 1V ) @ max 50mA |
| Alarms | Solenoid coil not connected/short circuit, cable break with current reference signal, overtemperature, under temperature,  valve pressure trasducer cable break |
| Format | Sealed box on the valve; IP67 protection degree |
| Operating temperature | -20 ÷ 50 °C  (storage -20 ÷ 70 °C) |
| Mass | approx. 480 g |
| Additional characteristics | Short circuit protection of solenoid's current supply; pressure control by P.I.D. with rapid solenoid switching |
| Electromagnetic compatibility (EMC) | Immunity: EN 50082-2; Emission: EN 50081-2 |

| Communication interface | -PS Serial | -BC CANopen - see tab. G510 | -BP PROFIBUS - see tab. G510 |
|---|---|---|---|
| Physical Layer<br>Protocol | serial RS232C<br>Atos ASCII coding | optical insulated CAN ISO11898<br>CANopen EN50325-4 + DS408 | optical insulated RS485<br>PROFIBUS DP EN50170-2/IEC61158 |
| Recommended wiring cable | LiYCY shielded cables:      0,5 mm$^2$ for length up to 40m [1,5 mm$^2$ for power supply and solenoid] | | |

## 11 MAIN CONNECTOR CHARACTERISTICS  (to be ordered separately)

| CODE | SP-ZH-7P | SP-ZM-7P | SP-ZH-12P |
|---|---|---|---|
| Type | Female straight circular socket plug 7pin | Female straight circular socket plug 7pin | Female straight circular socket plug 12pin |
| Standard | DIN 43563-BF6-3-PG11 | According to MIL-C-5015 G | DIN 43651 |
| Material | Plastic reinforced with fiber glass | Aluminium alloy with cadmiun plating | Plastic reinforced with fiber glass |
| Cable gland | PG11 | PG11 | PG16 |
| Cable | LiYCY 7x 0,75 mm$^2$ max 20 m<br>7 x 1 mm$^2$ max 40 m | LiYCY 7x 0,75 mm$^2$ max 20 m<br>7 x 1 mm$^2$ max 40 m | LiCY 10 x 0,14 mm$^2$ (signal)<br>LiYY 3 x 1 mm$^2$ (alimentation) |
| Connection type | to solder | to solder | to crimp |
| Protection (DIN 40050) | IP 67 | IP 67 | IP 65 |

## 12 COMMUNICATION CONNECTOR CHARACTERISTICS  (to be ordered separately)
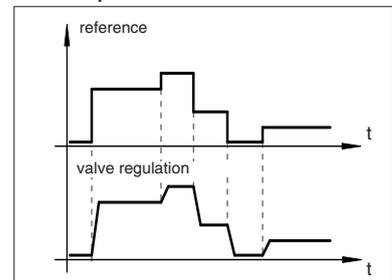
| | -PS Serial Connector | -BC CANopen Connector | -BP PROFIBUS DP Connector |
|---|---|---|---|
| CODE | SP-ZH-5P | SP-ZH-5P | SP-ZH-5P/BP |
| Type | Female straight circular socket plug 5 pin | Female straight circular socket plug 5 pin | Male straight circular socket plug 5 pin |
| Standard | M12 – IEC 60947-5-2 | M12 – IEC 60947-5-2 | M12 – IEC 60947-5-2 |
| Material | Plastic | Plastic | Plastic |
| Cable gland | PG9 | PG9 | PG9 |
| Cable | LiYCY 5x0,25 mm$^2$ shielded | CANBus Standard (301 DSP) | PROFIBUS DP Standard |
| Connection type | screw terminal | screw terminal | screw terminal |
| Protection (DIN 40050) | IP 67 | IP 67 | IP 67 |

## 13 REMOTE PRESSURE TRANSDUCER CONNECTOR CHARACTERISTICS  (to be ordered separately)

| CODE | SP-ZH-4P-M8/5 |
|---|---|
| Type | Male straight circular socket plug 4 pin |
| Standard | M8 – IEC 60947-5-2 |
| Material | Plastic |
| Cable gland | Connector moulded on cable 5 m lenght |
| Cable | 4x 0,25 mm$^2$ |
| Connection type | cable |
| Protection (DIN 40050) | IP 67 |

## 14 OVERALL DIMENSIONS [mm]



① cable gland connection for integral pressure transducer (only TERS)     ③ 5 pin connector M12 for communication interfaces -PS or -BC
② 4 pin connector M8 for remote pressure transducer (only AERS)          ④ 5 pin connector M12 for communication interface -BP