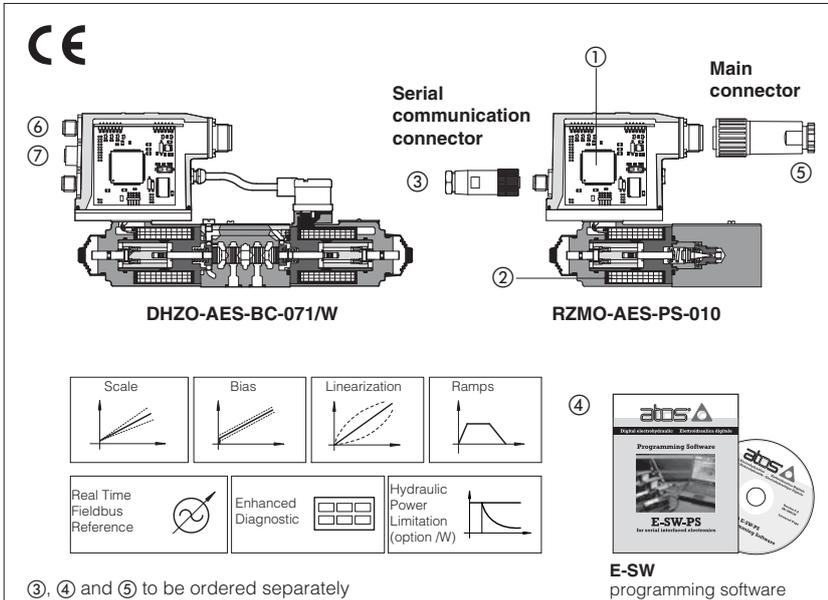


# Digital electronic drivers type E-RI-AES

integral-to-valve format, for proportional valves without transducer



E-RI-AES integral digital drivers ① supply and control the current to the solenoid of Atos proportional valves without transducer, according to the electronic reference input signal. The solenoid ② proportionally transforms the current into a force, acting on the valve spool or poppet, against a reacting spring, thus providing the valve's hydraulic regulation.

E-RI-AES can drive one single or one double solenoid proportional valve. The electronic main connector is fully interchangeable with the analog drivers one. The serial communication port ③ is always present for configuration, monitoring and firmware updating of the driver through Atos PC software ④.

Optional fieldbus communication interfaces (CANopen or PROFIBUS DP) are available to command the valves directly from the machine control unit.

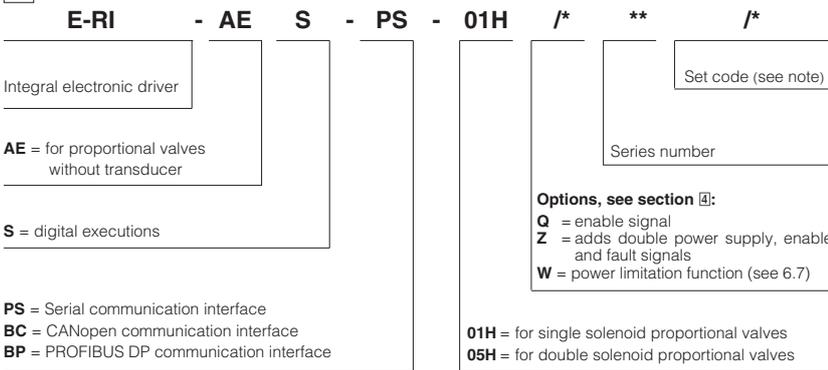
**Electrical Features:**

- Functional parameters are factory preset for best performances
- Standard 7 pin main connector ⑤ for power supply, analog input reference and monitor signals
- /Q option 7 pin main connector for enable signal
- /Z option 12 pin main connector for additional double power supply, enable and fault signals
- 5 pin connector for serial communication interface
- 5 pin connector ⑥ for fieldbus communication interface, at choice: -BC or -BP
- /W option 5 pin connector ⑦ for external pressure transducer
- Electrical protection against reverse polarity of power supply
- IP67 protection degree
- CE mark to EMC directive

**Software Features:**

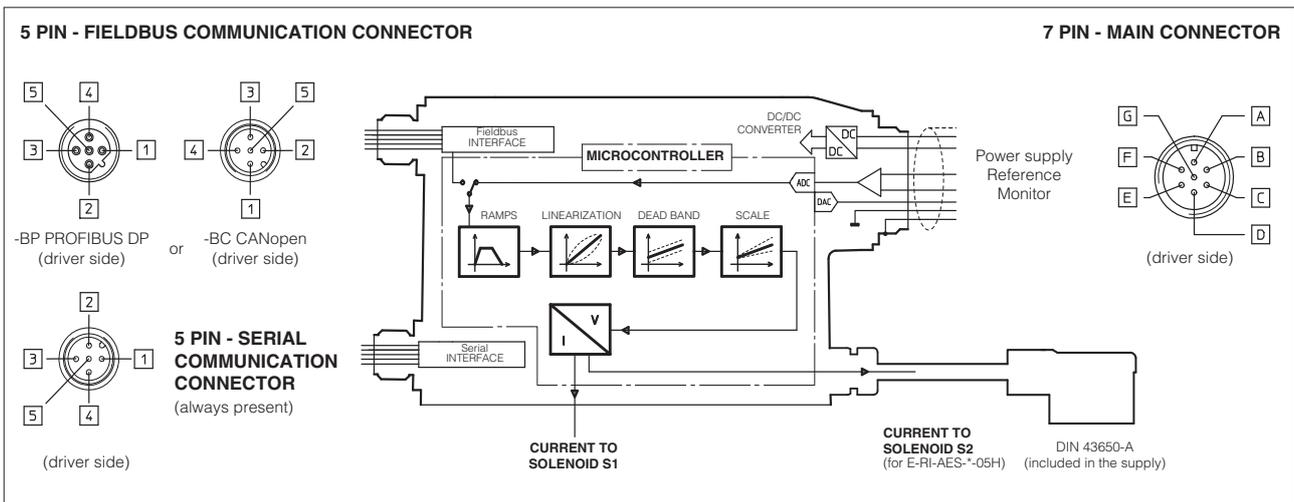
- Setting of valve's functional parameters: bias, scale, ramps, dither
- Linearization function for the hydraulic regulation
- Setting of valve's dynamic response to optimize the application performances
- Software selectable range of electronic reference analog inputs: voltage or current
- Max power limitation (/W option)
- Complete diagnostics of driver status, solenoid and fault conditions
- Intuitive graphic interface
- In field firmware update through standard serial communication
- Internal oscilloscope function

**1 MODEL CODE**

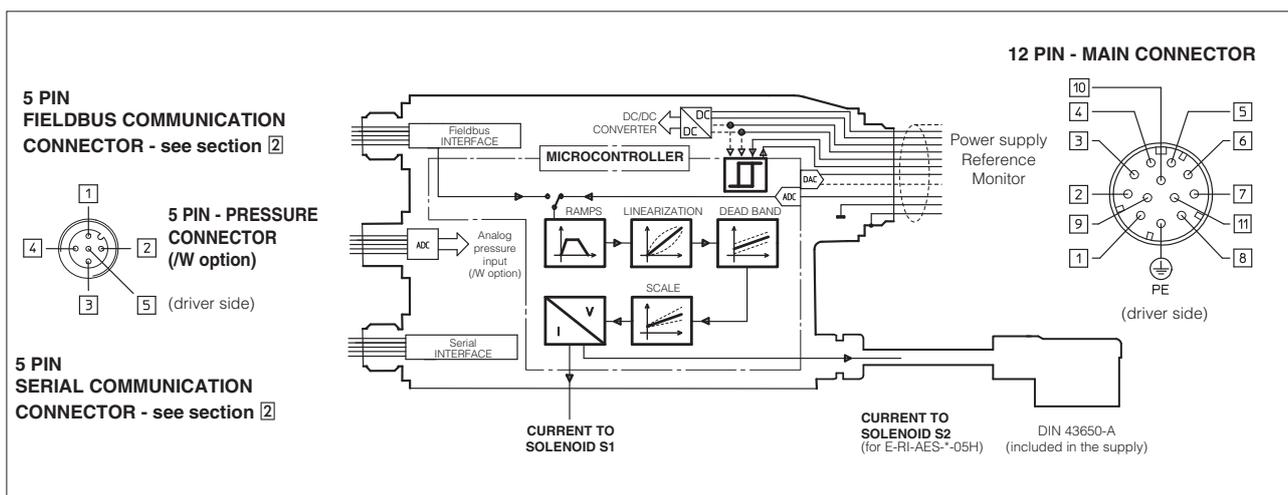


**Note:** the set code identifies the correspondance between the digital integral driver and the relevant valve; it is assigned by Atos when the driver is ordered as a spare part

**2 BLOCK DIAGRAM - Standard and /Q option**



**3 BLOCK DIAGRAM - /Z and /W options**



**4 ELECTRONIC CONNECTIONS**

**4.1 7 PIN MAIN CONNECTOR (Standard and /Q option)**

PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	V+	Power supply 24 Vdc for solenoid power stage (see 5.1)	Input - power supply
B	V0	Power supply 0 Vdc for solenoid power stage (see 5.1)	Gnd - power supply
C	AGND	Ground - signal zero for MONITOR signal (applying 24 Vdc to AGND electronics will be damaged)	Gnd - analog signal
	ENABLE	Enable (24 Vdc) or disable (0 Vdc) the driver (see 5.5) (for /Q option)	Input - on/off signal
D	INPUT+	Reference analog differential input: $\pm 10$ Vdc / $\pm 20$ mA maximum range software selectable (see 5.2) - default settings are $0 \div 10$ Vdc for two position and pressure single solenoid valves and $\pm 10$ Vdc for double solenoid valves and three position single solenoid valves	Input - analog signal
E	INPUT -		
F	MONITOR	Monitor analog output: $\pm 5$ Vdc maximum range (see 5.3)	Output - analog signal
G	EARTH	Internally connected to driver housing	

**4.2 12 PIN MAIN CONNECTOR (/Z and /W options)**

PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
1	V+	Power supply 24 Vdc for solenoid power stage (see 5.1)	Input - power supply
2	V0	Power supply 0 Vdc for solenoid power stage (see 5.1)	Gnd - power supply
3	ENABLE	Enable (24 Vdc) or disable (0 Vdc) the driver (see 5.5)	Input - on/off signal
4	INPUT+	Reference analog input: $\pm 10$ Vdc / $\pm 20$ mA maximum range software selectable (see 5.2)	Input - analog signal
5	AGND	Ground - signal zero for INPUT+ signal	Gnd - analog signal
6	MONITOR	Monitor analog output: $\pm 5$ Vdc maximum range (see 5.3)	Output - analog signal
7	NC	do not connect	
8	NC	do not connect	
	MONITOR2	2nd monitor analog output: $\pm 5$ Vdc maximum range (see 5.3) (for /W option)	Output - analog signal
9	VL+	Power supply 24 Vdc for driver logic (see 5.4)	Input - power supply
10	VL0	Power supply 0 Vdc for driver logic (see 5.4)	Gnd - power supply
11	FAULT	Driver status : Fault (0 Vdc) or normal working (24 Vdc) (see 5.6)	Output - on/off signal
PE	EARTH	Internally connected to driver housing	

**4.3 5 PIN M12 PRESSURE CONNECTOR (only for /W option)**

PIN	Input Voltage (Software selectable)	Input Current (Software selectable)
1	VT Remote transducer power supply 24 Vdc	VT Remote transducer power supply 24 Vdc
2	TR Remote transducer signal ( $0 \div 10$ Vdc) - see 5.7	TR Remote transducer signal ( $0 \div 20$ mA) - see 5.7
3	AGND signal zero for power supply and signal	NC do not connect
4	NC do not connect	NC do not connect
5	NC do not connect	NC do not connect

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

#### 4.4 5 PIN COMMUNICATION M12 CONNECTOR

PIN	Serial Communication		-BC CANopen		-BP PROFIBUS DP	
	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	

#### 5 SIGNALS SPECIFICATIONS

Atos proportional valves are CE marked according to the applicable directives (e.g. Immunity/Emission EMC 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 driver (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-982).

##### 5.1 Power supply and wirings (V+ and V0)

The power supply must be appropriately stabilized or rectified and filtered: apply at least a 10000  $\mu$ F/40 V capacitance to single phase rectifiers or a 4700  $\mu$ F/40 V capacitance to three phase rectifiers.

A safety fuse is required in series to each driver power supply: 2,5 A fuse.

Note: pin 2 and 10 (zero Volt) are connected together inside the electronics.

##### 5.2 Reference Input Signal (INPUT+ and INPUT-)

The driver controls in closed loop the current to the valve proportionally to the external reference input signal.

The driver is designed to receive one analog reference input (INPUT+, INPUT- differential mode input).

The input range and polarity are software selectable among voltage ( $0 \div \pm 10$  Vdc) and current ( $4 \div 20$  mA with cable break detection or  $\pm 20$  mA); default settings are  $0 \div 10$  Vdc for two position and pressure single solenoid valves and  $\pm 10$  Vdc for double solenoid valves and three position single solenoid valves (see valve's tech. table). Other ranges can be set by software.

Drivers with fieldbus interface (-BC or -BP) can be software set to receive reference value directly from the machine control unit (fieldbus master); in this case the analog reference input signal can be used for start-up and maintenance operations.

###### Option /Z and Option /W

The reference input is available in common mode (INPUT+ referred to AGND) instead of the standard differential mode

##### 5.3 Monitor Output Signals (MONITOR and MONITOR2 - only for /W option)

The driver generates an analog output signal (MONITOR) to monitor the actual valve's coil current referred to AGND for standard version or to V0 for /Q option; the monitor output signal can be software set to show other signals available in the driver (e.g. analog reference, fieldbus reference).

The output maximum range is  $\pm 5$  Vdc :  $0 \div 5$  Vdc for two position and pressure single solenoid valves and  $\pm 5$  Vdc for double solenoid valves and three position single solenoid valves (see valve's tech. table).

###### Option /W

The driver generates a second analog output signal (MONITOR2) to monitor the actual system pressure referred to AGND. The output maximum range is  $\pm 5$  Vdc; default setting is  $0 \div 5$  Vdc

##### 5.4 Logic power supply (VL+ and VL0 - for /Z and /W options)

Separate power supply for the solenoid and for the digital electronic circuits (pin 9,10).

Cutting solenoid power supply (pin 1,2) allows to interrupt the valve functioning but keeping energized the digital electronics thus avoiding fault conditions of the machine fieldbus controller. This condition allows to realize safety systems in compliance with European Norms EN13849-1 (ex EN954-1).

A safety fuse is required in series to each driver power supply: 500 mA fast fuse.

Note: pin 2 and 10 (zero Volt) are connected together inside the electronics.

##### 5.5 Enable Input Signal (ENABLE - for /Q, /Z and /W options)

To enable the driver, supply 24 Vdc on pin 3 (pin C) referred to pin 2 (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 active the communication and the other driver functions when the valve must be disabled for safety reasons. This condition does not comply with European Norms EN13849-1 (ex EN954-1).

##### 5.6 Fault Output Signal (FAULT - for /Z and /W options)

Fault output signal indicates fault conditions of the driver (solenoid short circuits/not connected, reference signal cable broken for  $4 \div 20$  mA input, etc.).

Fault presence corresponds to 0 Vdc, normal working corresponds to 24 Vdc (pin 11 referred to pin2).

Fault status is not affected by the Enable input signal.

##### 5.7 Pressure Transducer Input signal (TR - only for /W options)

When hydraulic power limitation is active (see 6.7), input signal TR must be connected to an external pressure transducer installed on the hydraulic system. The inputs signals are software selectable as voltage or current (default  $0 \div 10$  Vdc). Voltage selection: the maximum range of external pressure transducer signal is software selectable within  $0 \div 10$  Vdc. Current selection: the maximum range of external pressure transducer signal is software selectable among  $4 \div 20$  mA (default with cable break detection) or  $0 \div 20$  mA.

## 6 MAIN SOFTWARE PARAMETER SETTINGS

The following is a brief description of the main settings and features of E-RI-AES drivers.

For a detailed descriptions of available settings, wirings and installation procedures, please refer to the programming manual E-MAN-RI-AES included in the E-SW-\* Dvd programming software (see section 7).

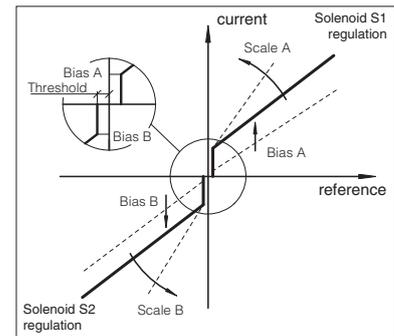
### 6.1 Scale

Scale function allows to set the maximum current supplied to the solenoid, corresponding to the max valve regulation, at maximum reference signal value.

This regulation allows to adapt the maximum current supplied from the driver to the specific nominal current of the proportional valves to which the driver is coupled; it is also useful to reduce the maximum valve regulation in front of maximum reference signal.

Two different Scale regulations are available for double solenoid valves: ScaleA for positive reference signal and ScaleB for negative reference signal.

### 6.1, 6.2 - Scale, Bias & Threshold



### 6.2 Bias and Threshold

Proportional valves may be provided with a dead band in the hydraulic regulation corresponding to their switch-off status.

This dead band discontinuity in the valve's regulation can be compensated by activating the Bias function, which adds a fixed preset Bias value to the reference signal (analog or fieldbus external input).

The Bias function is activated when the reference signal overcomes the Threshold value, preset into the driver.

The Bias setting allows to calibrate the Bias current to the specific proportional valve to which the driver is coupled.

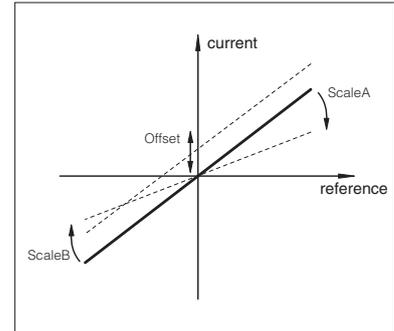
The Threshold setting is useful to avoid undesired valve regulation at zero reference signal when electric noise is present on the analog input signal: smaller threshold reduces the reference signal dead band, greater values are less affected by electric noise presence.

If fieldbus reference signal is active (see 5.2), threshold should be set to zero.

Two different Bias regulations are available for double solenoid valves: positive reference signals activate BiasA and negative reference signals activate BiasB.

Refer to the programming manuals for a detailed description of other software selectable Bias functions.

### 6.3 - Offset



### 6.3 Offset

Proportional valves may be provided with zero overlapping in the hydraulic regulation corresponding to zero reference input signal (valve's central spool position).

The Offset function allows to calibrate the Offset current, required to obtain valve's spool central position, to the specific hydraulic system setup (e.g. valve applied to cylinder with differential areas).

### 6.4 Ramps

The ramp generator allows to convert sudden change of electronic reference signal into smooth time-dependent increasing/decreasing of the current supplied to the solenoid.

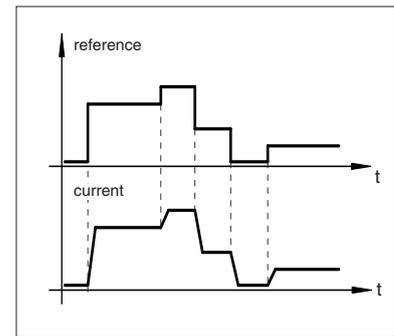
Different ramp mode can be set:

- single ramp for any reference variation
- two ramps for increasing and for decreasing reference variations
- four ramps for positive/negative signal values and increasing/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).

### 6.4 - Ramps

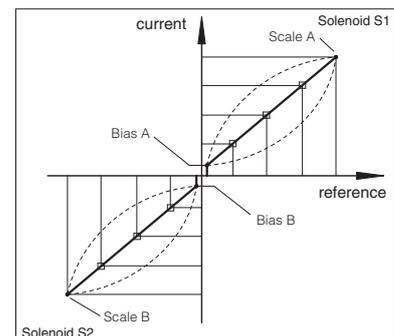


### 6.5 Linearization

Linearization function allows to set the relation between the reference input signal and the controlled valve's regulation.

Linearization is useful for applications where it is required to linearize the valve's regulation in a defined working condition.

### 6.5 - Linearization



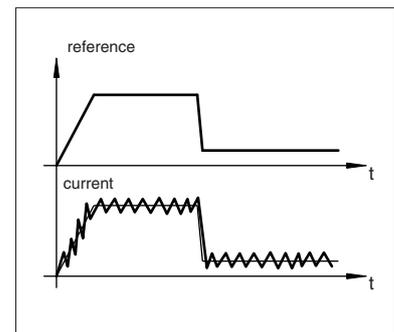
### 6.6 Variable Dither

The dither is the frequency modulation of the current supplied to the solenoid. To reduce the hysteresis should be selected a lower value of frequency, despite a lower regulation stability, because a small vibration in the valve regulating parts considerably reduces static friction effects.

To improve the regulation stability, should be selected a high value of frequency, despite a higher hysteresis. This solution in some application can lead to vibration and noise. Normally, the right setting is a compromise and depends on system setup.

E-RI-AES drivers series 30 allow to realize a variable dither frequency that linearly depends on the demanded current: variable dither frequency allows an higher degree to optimize the valve hysteresis.

### 6.6 - Variable Dither



### 6.7 Hydraulic Power Limitation (only for /W option)

E-RI-AES drivers with /W option electronically perform hydraulic power limitation on:

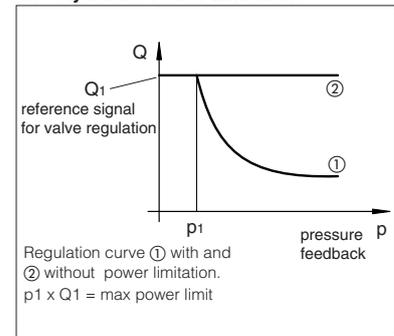
- direct and pilot operated flow control valves
- direct and pilot operated directional control valves + mechanical pressure compensator
- variable displacement pumps with proportional flow regulator (e.g. PVPC-\*-LQZ, tech.tab. A170)

The driver receives the flow reference signal by the analog external input INPUT+ (see 5.2) and a pressure transducer, installed in the hydraulic system, has to be connected to the driver's analog input TR (see 5.7).

When the actual requested hydraulic power  $p \times Q$  (TR x INPUT+) reaches the max power limit ( $p1 \times Q1$ ), internally set by software, the driver automatically reduces the flow regulation of the valve. The higher is the pressure feedback the lower is the valve's regulated flow:

$$\text{Flow regulation} = \text{Min} \left( \frac{\text{PowerLimit [sw setting]}}{\text{Transducer Pressure [TR]}} ; \text{Flow Reference [INPUT+]} \right)$$

6.7 - Hydraulic Power Limitation



## 7 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 execution: **E-SW-PS** (Serial), **E-SW-BC** (CANopen) and **E-SW-BP** (PROFIBUS DP). Programming software E-SW-BC and E-SW-BP can use also the serial communication port to program the AES series 30 integral driver of related execution. The double communications features allow to keep the driver connected to the central machine unit via fieldbus and modify the valve's parameterization through serial communication port by Atos software (features available for E-SW-BC / E-SW-BP).

For a more detailed description of software interface, PC requirements, adapters, cables and terminators, please refer to technical table **G500**.

### Programming software, must be ordered separately :

**E-SW-\*** (mandatory - first supply) = Dvd including E-SW-\* software installer and operator manuals; it allows the registration to Atos digital service

**E-SW-\*-N** (optional - next supplies) = as above but not allowing the registration to Atos digital service

On first supply of the E-SW-\* software, it is required to apply for the registration in the Atos download area : [www.download.atos.com](http://www.download.atos.com).

Once the registration is completed, the password will be sent by email.

The software remains active for 10 days from the installation date and then it stops until the user inputs his password.

With the password you can also download, in your personal area, the latest releases of the Atos software, manuals, drivers and configuration files.

### USB Adapters, Cables and Terminators can be ordered separately (see tab. G500)

## 8 DRIVER CHARACTERISTICS

Power supply (*) (see 5.1, 5.4)	Nominal: +24 V <sub>DC</sub> Rectified and filtered: V <sub>rms</sub> = 21 ÷ 32 V <sub>MAX</sub> (ripple max 10 % V <sub>PP</sub> )		
Max power consumption	50 W		
Reference input signal (see 5.2)	Voltage: range ±10 V <sub>DC</sub> Current: range 4 ÷ 20 mA	Input impedance: R <sub>i</sub> > 50 kΩ Input impedance: R <sub>i</sub> = 500 Ω	
Monitor output (see 5.3)	Output range : ±5 V <sub>DC</sub> (max 5 mA)		
Enable input (see 5.5)	Range : 0 ÷ 9 V <sub>DC</sub> (OFF state), 15 ÷ 24 V <sub>DC</sub> (ON state), 9 ÷ 15 V <sub>DC</sub> (not accepted); Input impedance: R <sub>i</sub> > 37 kΩ		
Fault output (see 5.6)	Output range : 0 ÷ 24 V <sub>DC</sub> (ON state ≅ VL+ [logic power supply] ; OFF state ≅ 0 V) @ max 50 mA		
Alarms	Solenoid not connected/short circuit, cable break with current reference signal, overtemperature, under temperature, pressure transducer cable break with current signal (/W option)		
Format	Sealed box on the valve; IP67 protection degree		
Operating temperature	-20 ÷ 60 °C (storage -20 ÷ 70 °C)		
Mass	approx. 455g		
Additional characteristics	Short circuit protection of solenoid current supply; current control by P.I.D. with rapid solenoid switching		
Electromagnetic compatibility (EMC)	According to Directive 2004/108/CE (Immunity: EN 61000-6-2; Emission: EN 61000-6-3)		
Communication interface	Serial Communication	-BC CANopen - see tab. G510	-BP PROFIBUS - see tab. G510
Communication physical layer	serial RS232	optical insulated CAN ISO11898	optical insulated RS485
Communication protocol	Atos ASCII coding	CANopen EN50325-4 + DS408	PROFIBUS DP EN50170-2/IEC61158
Recommended wiring cable	LiYCY shielded cables: 0,5 mm <sup>2</sup> for length up to 40 m [1,5 mm <sup>2</sup> for power supply and solenoid]		

(\*) **Note:** Nominal data for solenoid power stage and driver logic.

**Note:** A maximum time of 380 ms (depending on communication type) have be considered between the driver energizing with the 24 VDC power supply and when the valve is ready to operate. During this time the current to the valve coils is switched to zero.

**9 CONNECTORS CHARACTERISTICS** (to be ordered separately)

**9.1 Main connector**

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 <sup>2</sup> max 20 m 7 x 1 mm <sup>2</sup> max 40 m	LiYCY 7x 0,75 mm <sup>2</sup> max 20 m 7 x 1 mm <sup>2</sup> max 40 m	LiCY 10 x 0,14 mm <sup>2</sup> (signal) LiYY 3 x 1 mm <sup>2</sup> (power supply)
Connection type	to solder	to solder	to crimp
Protection (DIN 40050)	IP 67	IP 67	IP 67

**9.2 Communication connector**

CONNECTOR TYPE	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 <sup>2</sup> 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

**9.3 Pressure connector**

CONNECTOR TYPE	/W option
CODE	SP-ZH-5PM
Type	Male straight circular socket plug 5 pin
Standard	M12 – IEC 60947-5-2
Material	Plastic
Cable gland	PG7
Cable	diameter 4 ÷ 6 mm
Connection type	screw terminal
Protection (DIN 40050)	IP 67

**10 OVERALL DIMENSIONS [mm]**

