



**PNEUMAX**



# **SUPPLY AND DISCHARGE VALVE AIRPLUS SAFELINE SERIES**

**SAFETY AND RELIABILITY**



## General

Upon implementation of the AIRPLUS size 3 series, air-treatment units, PNEUMAX develops a supply and discharge valve, with an electropneumatic control and spring-return, fitted with a diagnostic system regarding the state of the valve, with the possibility of creating a double channel to determine the system's redundancy. The valve, as a safety feature, provides the interruption of the air supply and the exhaust of the air circuit it is connected to. The version with one single channel emphasises the features of an EV 3/2 NC, monostable with electropneumatic control and spring-return, whose operation involves:

- condition of the VALVE AT REST, with a DE-ENERGISED coil; Port 1 (air supply) is not connected to Port 2 (downstream air circuit). Port 2 is discharged out of Port 3;

- condition of the VALVE ACTIVATED, with an ENERGISED coil; Port 1 (air supply) is connected to Port 2 (downstream air circuit), with Port 3 (Discharge) closed.

By de-energising the coil, the system resets the condition of VALVE AT REST by means of the return spring, which repositions the spool. Once again Port 2 (downstream air circuit), discharges via Port 3. The state of the valve is constantly monitored by a diagnostic system, using a Hall effect sensor, which reads the position of the spool and consequently takes note of the valve's position.

The sensor is in the ON position when the valve is at rest (DE-ENERGISED coil), while it is in the OFF position when the valve is activated (ENERGISED coil).

The sensor is in the OFF position under conditions of an activated valve (DE-ENERGISED coil), indicating a possible problem.

**The SAFELINE supply and discharge valve in the single version is a classified component in CATEGORY 1 according to EN ISO 13849 and is appropriate for use in safety circuits until PL=c.**

The version with a double redundant channel is made using two single solenoid valves 3/2 NC provided with diagnostics, mounted in series so that the Port 2 of the first solenoid valve is linked to the Port 1 of the second solenoid valve. It is sufficient that only one of the EV is de-energised to guarantee the discharge of the air circuit. If one of the two EV must remain blocked due to a malfunction, the other one ensures the discharge function of the pneumatic installation. Even in this case, the diagnostic system of both solenoid valves constantly monitors the state of the 2 single EV.

**The SAFELINE supply and discharge valve in the double version is a classified component in CATEGORY 4 according to EN ISO 13849 and is appropriate for use in safety circuits until PL=e.**

Both single and double solenoid valves are provided with the following certifications released by BUREAU VERITAS:

- TYPE APPROVAL certificate according to the EN ISO 13849 regulations
- certification of examination of compliance in accordance to the machinery directive 2006/42/EC

The AIRPLUS SAFELINE are solenoid valves marked as ATEX

II 3G Ex nA IIC T6 Gc (X)  
II 3D Ex tc IIIC T=80°C Dc (X) IP65

### Construction characteristics

Body	Aluminium
Solenoid Operator	Technopolymer
Rear end cap	Aluminium
Spool	Aluminium
Spool seals	Polyurethane
Piston	Aluminium
Spring	EN 10270-1 DH Steel
Electrical Interface	Male MP12 4 PIN TYPE A Connector

### Operational characteristics

Fluid	Filtered air. No lubrication needed, if applied it shall be continuous
Working temperature	-10°C ... +50°C
Working pressure, MIN	2,5 bar
Working pressure, MAX	10 bar

### ASSEMBLY AND INSTALLATION:

Undertake the installation respecting the safety requirements with regards to the system and components for hydraulic and pneumatic transmissions. Install the device as close as possible to the point of use. Its assembly is possible in any position. Pay attention to the flow direction, indicated on the main body with the labels IN and OUT. During the components discharge, high levels of noise occur. The use of a silencer on the discharge port is recommended. Ensure there is sufficient space for assembly during the installation process. Please ensure that the discharge area is always clear, and in case a silencer is used, periodically verify that it is not obstructed. It is possible to integrate and install the device in an existing AIRPLUS group or in a new installation, or else to use the device individually attaching it by aligning the assembled unit with the relevant fastening flange for the supply and discharge valve, or to use the device individually attaching it by aligning the assembled unit with the type "Y" fastening flange for the double supply and discharge valve.



#### WARNING!

Pay particular attention to external factors such as the nearness of live wires, magnetic fields, metallic objects providing magnetic conduction very close to the device, which may influence and disturb the diagnostic system.



#### WARNING!

The electrical connection must be made exclusively by specialized personnel, using components that have no voltage present. Only use power supplies which can guarantee a safe electrical isolation of the working voltage in accordance to IEC/EN 60204-1. Additionally, observe the requirements anticipated by the PELV circuits in accordance to IEC/EN 60204-1.

### CARE AND MAINTENANCE:



#### WARNING!

Do not connect or disconnect the device when energised! Do not open and/or disassemble the parts that are included in the energised valve. Once the power supply is disconnected, wait for a few minutes before opening or disassembling parts of the valve that result in its disassembly.

Before carrying out any operation, it is essential to remove the pneumatic and power supply to the device and wait for the residual pressure to be completely discharged. Please ensure that the discharge is always clear, and in case a silencer is used, periodically verify that it is not obstructed. Periodically remove any dust deposits from the valve using a damp cloth. Use soapy water to clean the device. Do not use corrosive or alcohol-based products.

For maintenance operations on internal components, please consult with PNEUMAX SPA.



## Regulatory Framework

The purpose of the EU's Machinery Directive is to define the health and safety requirements in the framework of designing and constructing machinery. Since 2009, the new Machinery Directive has become effective in the European Union. Member countries of the EU are required to implement this standard. The manufacturers of machinery can comply with the Machinery Directive applying the harmonised standards listed in the Official Journal of the European Union.

The design and manufacture of safety controls are developed in compliance with one of the two important harmonised standards:

<b>UNI EN ISO 13849-1</b>
Safety of machinery Safety-related parts of control systems Part 1: General design principles

<b>EN 62061</b>
Safety of machinery Functional safety of electrical, electronic and programmable control systems regarding safety

The UNI EN ISO 13849-1 standard is one of the most important harmonised standards, which has been widely used; it is intended to provide a guide to principles for design and integration of safety-related parts of the control system.

Each safety-related control system must be designed and constructed in accordance with the principles of ISO 12100 and ISO 14121 by which the possible risks are considered and assessed, in view of the intended uses and the reasonably anticipated incorrect uses.

The parts of a machinery's control system are called "Safety-related parts of control systems". Their capacity to perform a safety function under predictable conditions is assigned by means of five possible levels called "performance levels" (PL). These levels are defined in terms of probability of dangerous malfunction per hour.

PL - Performance Level	Average probability of dangerous malfunction per hour (1/h)
a	$\geq 10^{-5}$ to $< 10^{-4}$
b	$\geq 3 \times 10^{-6}$ to $< 10^{-4}$
c	$\geq 10^{-6}$ to $< 3 \times 10^{-6}$
d	$\geq 10^{-7}$ to $< 10^{-6}$
e	$\geq 10^{-8}$ to $< 10^{-10}$

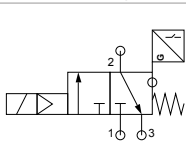
The calculated PL must be greater or equal to the necessary value, which arises from the calculation of the risk correlated to one single function and to the need to reduce it to an acceptable level.

<b>S1 Slight danger</b>	<b>F1</b> Occasional danger and brief exposure	<b>P1</b> - possibly avoidable danger <b>P2</b> - largely unavoidable danger	<b>PL= a</b> <b>PL= b</b>
	<b>F2</b> Frequent danger and long exposure	<b>P1</b> - possibly avoidable danger <b>P2</b> - largely unavoidable danger	
<b>S2 Serious danger</b>	<b>F1</b> Occasional danger and brief exposure	<b>P1</b> - possibly avoidable danger <b>P2</b> - largely unavoidable danger	<b>PL= c</b> <b>PL= d</b>
	<b>F2</b> Frequent danger and long exposure	<b>P1</b> - possibly avoidable danger <b>P2</b> - largely unavoidable danger	

# Supply and Discharge Valve

## Single (VS)

**Pneumatic symbol**



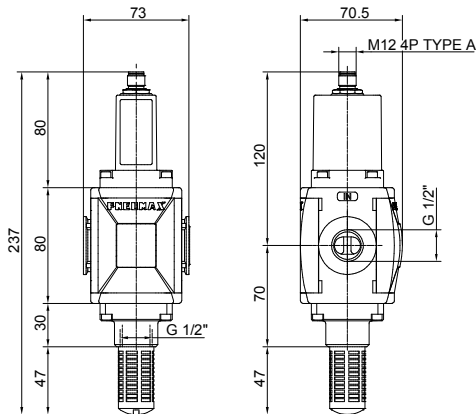
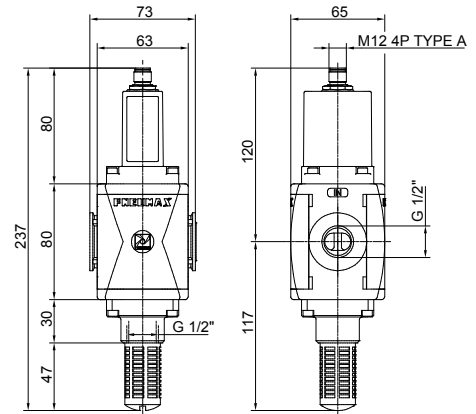
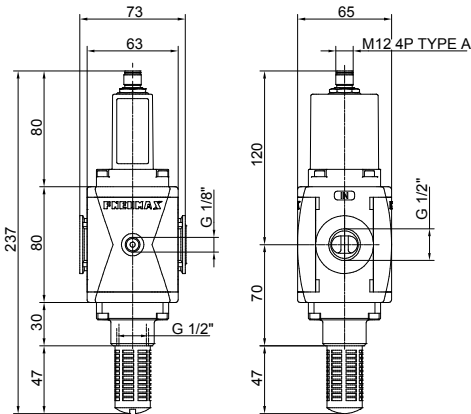
ATEX CE

II 3G Ex nA IIC T6 Gc (X)  
II 3D Ex tc IIIC T=80°C Dc (X) IP65

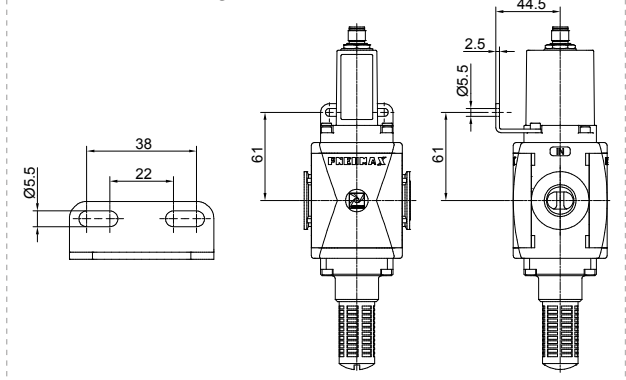
**Electrical Connection**



PIN	DESCRIPTION
1	+24 VDC (Sensor)
2	+24 VDC (EV)
3	GND (Sensor +EV)
4	SENSOR OUTPUT



**Dimensions with fixing bracket mounted**



Electrical Features		Technical Features		Ordering code
Electrical Connection	Male M12 4 PIN TYPE A Connector	Connections	G1/2" UNI-ISO 228/1	<b>N173BVS</b>
Coil Features	24VDC, 1 Watt	Fluid	Filtered air. No lubrication needed, if applied it shall be continuous	VERSIONS
Suppressor diode for coil reverse voltage spike	Present	Function	3/2 NC monostable	= Standard* (without connections)
Supply Voltage Allowance	-5% ... +10%	Working Pressure, MIN	2,5 bar	<b>M</b> = Incorporated pressure gauge
<b>Electrical features of sensor</b>		Working Pressure, MAX	10 bar	<b>W</b> = Incorporated pressure gauge (Right-Left)
Sensor Features	10 ... 30V DC	Working Temperature	-10°C ... +50°C	<b>G</b> = G1/8" pressure gauge Connection
Operating Principle	Hall effect	Flow rate at 6bar Δp1 (from 1 to 2)	3500 NL/min	FIXING
Contact Type	N.O.	Flow rate at 6bar Δp1 (from 2 to 3)	2000 NL/min	= Without fixing *
Output Type	PNP	Flow rate at 6bar (from 2 to 3) with free discharge	3800 NL/min	<b>F</b> 01 = Fixing bracket mounted (Left-Right)
Permanent Maximum Current	100 mA	Type of Installation	In-line	02 = Fixing bracket mounted (Right-Left)
Permanent Maximum Power	3 Watt	Mounting Position	Indifferent	*no additional letter required
Voltage Drop, MAX	2 V	Noise Level	90 dB	
<b>Safety features</b>		Response time according to ISO 12238, activation time (ms)	36 ms	
Regulatory Compliance	EN ISO 13849-1	Response time according to ISO 12238, deactivation time (ms)	76 ms	
Safety Function Fulfilled	Interruption of supply and unloading of the downstream pneumatic circuit	IP Rating	IP65 (with connector installed)	
Performance Level (PL)	Up to c			
UNI EN ISO 13849 Category	Up to 1			
Safety Integrity Level (SIL) EN 62061	Up to 1			
B10d**	7.000.000 cycles			
CE Marking	In accordance with the EC Machinery Directive, annex V			

\*\*Reliability and lifetime of pneumatic valves assessed in accordance with ISO 19973-2, Pneumatic fluid power - Assessment of component reliability by testing - Part 2: Directional control valves.

## Example of a safety system by means of a Single valve

**Please note: the safety valve is not sufficient alone to guarantee the safety function. Its setup requires the use of a monitoring device.**

In this setup, the SIEMENS® 3SK1112-1BB40 monitoring device has been indicated, activated by an S2 start / reset pushbutton, blocked by an S1 emergency shutdown key.

Said monitoring device, by means of the readings of the sensor placed inside the valve (reading made by means of the K1 relay), operates the activation of the valve itself. The monitoring device transmits the safety status as an output.

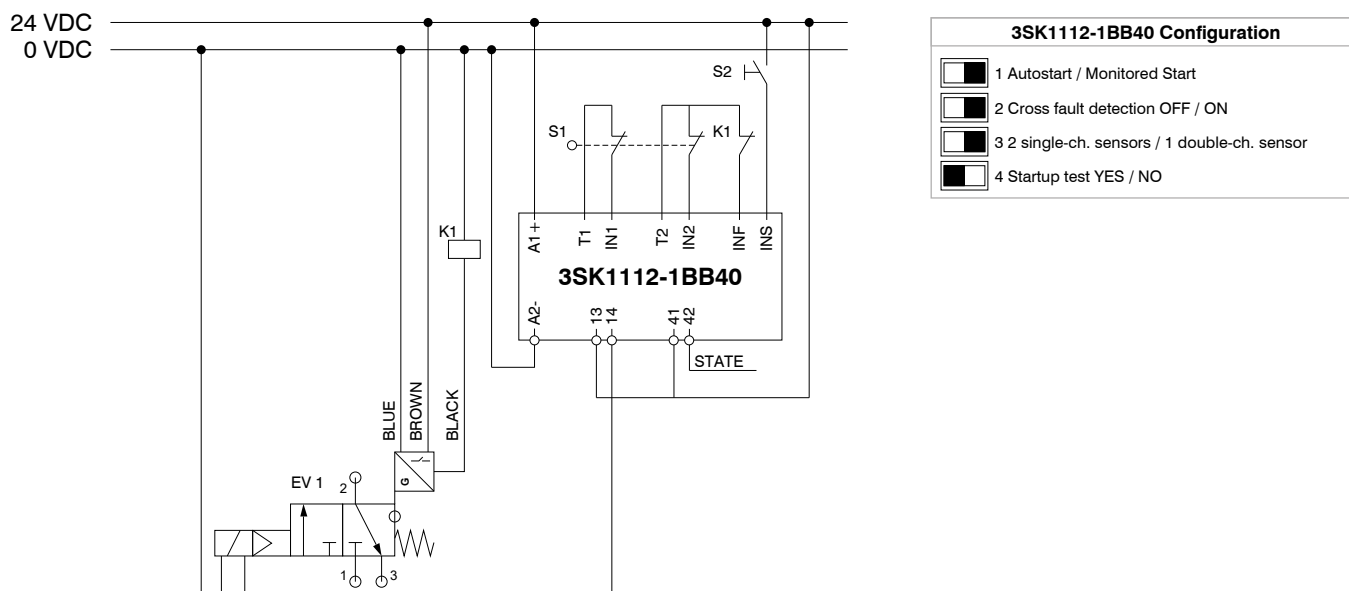
The preliminary estimate and the final verification of the achieved PL are the responsibility of the designer of the part of the system dedicated to providing the safety function.

**Note: with a single valve, it is not possible to obtain a PL greater than "c".**

### Setup suggestions

- The double stop pushbutton is connected to clamps T1-IN1 and T2-IN2 of 3SK1112-1BB40.
- The start / reset pushbutton is connected between +24 V and the INS clamp of 3SK1112-1BB40.
- The valve is supplied between 0 V (Pin 3 of the supply connector) and the 14 clamp of 3SK1112-1BB40 (Pin 2 of the supply connector).
- The HALL effect sensor is supplied between 0 V (Pin 3 of the supply connector) and 24 V (Pin 1 of the supply connector).
- The HALL effect sensor drives (Pin 4 of the supply connector) the K1 relay, whose N.A. contact will be connected between the monitoring device's clamp T2 and INF.

Provided the circuit diagram with a configuration **example**, with the configuration of 3SK1112-1BB40.

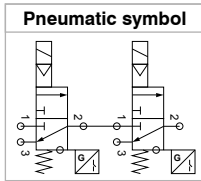


### Analysis of malfunctions

The diagnostic system (monitoring device plus sensor) has the purpose of verifying the appearance of malfunctions within the valve that undermine the safety function. In particular, (with 3SK1112-1BB40 configured as in the illustration), the K1 relay prevents resetting the system by means of S2 when the coil is de-energised, but the sensor remains in the OFF position (K1 remains de-energised).

# Supply and Discharge Valve

## Double (V2S)

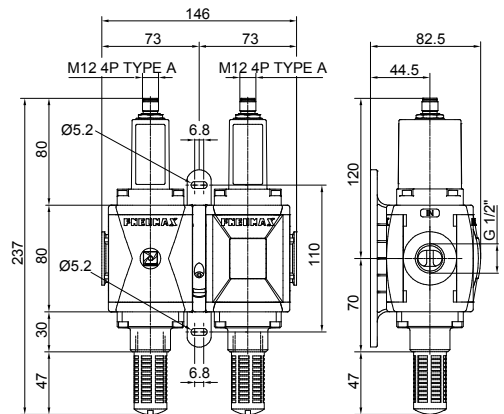
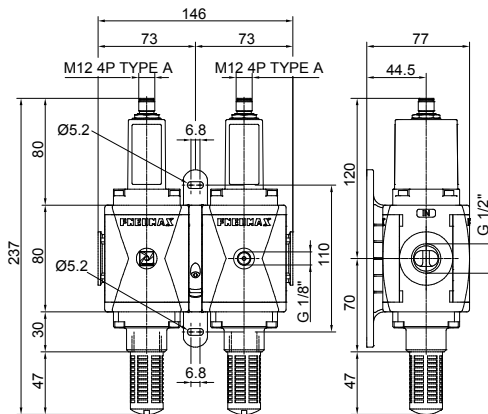
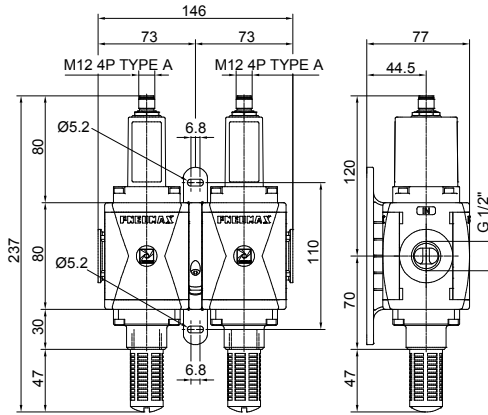


**ATEX**   
**II 3G Ex nA IIC T6 Gc (X)**  
**II 3D Ex tc IIIC T=80°C Dc (X) IP65**



**Electrical Connection**

PIN	DESCRIPTION
1	+24 VDC (Sensor)
2	+24 VDC (EV)
3	GND (Sensor +EV)
4	SENSOR OUTPUT



Electrical Features		Technical Features		Ordering code
Electrical Connection	Male M12 4 PIN TYPE A Connector	Connections	G1/2" UNI-ISO 228/1	<b>N173BV2S</b>
Coil Features	24VDC, 1 Watt + 1 Watt	Fluid	Filtered air. No lubrication needed, if applied it shall be continuous.	VERSIONS = Standard* (without connections)
Suppressor diode for coil reverse voltage spike	Present	Function	3/2 NC monostable	M= Incorporated pressure gauge G= G1/8" pressure gauge Connection
Supply Voltage Allowance	-5% ... +10%	Working Pressure, MIN	2,5 bar	FIXING X= "X" Flange Y= "Y" Flange K= "Y" Aluminium flange
<b>Electrical features of sensor</b>		Working Pressure, MAX	10 bar	FLOW RATE DIRECTION
Sensor Features	10 ... 30V DC	Flow rate at 6bar Δp1 (from 1 to 2)	2500 NL/min	= Standard* (Left-Right)*
Operating Principle	Hall effect	Flow rate at 6bar Δp1 (from 2 to 3)	2000 NL/min	W= (Right-Left)
Contact Type	N.O.	Flow rate at 6bar (from 2 to 3) with free discharge	3800 NL/min	*no additional letter required
Output Type	PNP	Type of Installation	In-line	
Permanent Maximum Current	100 mA + 100 mA	Mounting Position	Indifferent	
Permanent Maximum Power	3 Watt + 3 Watt	Noise Level	90 dB	
Voltage Drop, MAX	2 V + 2 V	Response time according to ISO 12238, activation time (ms)	68 ms	
<b>Safety features</b>		Response time according to ISO 12238, deactivation time (ms)	79 ms	
Regulatory Compliance	EN ISO 13849-1	IP Rating	IP65 (with connector installed)	
Safety Function Fulfilled	Interruption of supply and unloading of the downstream pneumatic circuit			
Performance Level (PL)	Up to e			
UNI EN ISO 13849-1 Category	Up to 4			
Safety Integrity Level (SIL) EN 62061	Up to 3			
B10d**	7.000.000 cycles			
CE Marking	In accordance with the EC Machinery Directive, annex V			

\*\*Reliability and lifetime of pneumatic valves assessed in accordance with ISO 19973-2, Pneumatic fluid power - Assessment of component reliability by testing - Part 2: Directional control valves.

## Example of a safety system by means of a Double valve

Please note: the safety valve is not sufficient alone to guarantee the safety function. Its setup requires the use of a monitoring device.

In this setup, the SIEMENS 3SK2112 monitoring device has been indicated, activated by an S2 start / reset pushbutton, blocked by an S1 emergency shutdown key. Said monitoring device, by means of the readings of the sensors placed inside the double valve, operates the activation of the valve itself. The preliminary estimate and the final verification of the achieved PL are the responsibility of the designer of the part of the system dedicated to providing the safety function.

### Setup suggestions

- The double stop pushbutton is connected to clamps T1-F-IN1 and T2-F-IN2 of 3SK2112.
- The start /reset pushbutton is connected between +24 V and the F-IN10 clamp of 3SK2112.

The double valve, for notation simplicity, is indicated as consisting of 2 valves: EV1 and Ev2

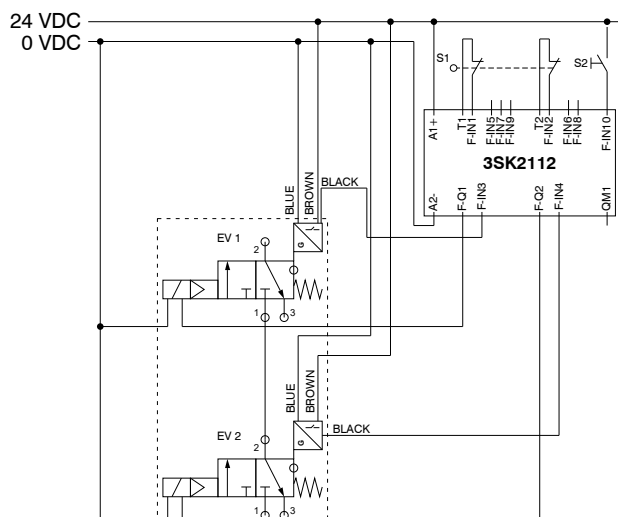
### EV1

- The valve is supplied between 0 V (Pin 3 of the supply connector) and the F-Q1 clamp of 3SK2112 (Pin 2 of the supply connector).
- The HALL effect sensor is supplied between 0 V (Pin 3 of the supply connector) and 24 V (Pin 1 of the supply connector).
- The HALL effect sensor is attached (Pin 4 of the supply connector) to the monitoring device's F-IN3 clamp.

### EV2

- The valve is supplied between 0 V (Pin 3 of the supply connector) and the F-Q2 clamp of 3SK2112 (Pin 2 of the supply connector).
- The HALL effect sensor is supplied between 0 V (Pin 3 of the supply connector) and 24 V (Pin 1 of the supply connector).
- The HALL effect sensor is attached (Pin 4 of the supply connector) to the monitoring device's F-IN4 clamp.

Provided the circuit diagram with a configuration **example**.



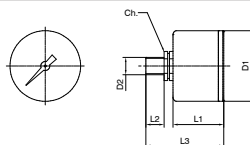
### Analysis of malfunctions

The diagnostic system (monitoring device plus sensors) has the purpose of verifying the appearance of malfunctions within the valves, which undermine the safety function. In particular, the monitoring device must be appropriately programmed to avoid the system's reset by means of S2 when both coils are de-energised and at least one sensor remains in an OFF position.

## Accessories

### Pressure gauge

Ordering code	17070V <sup>Ⓟ</sup>
VERSION	<ul style="list-style-type: none"> <li><sup>Ⓟ</sup> A= Dial Ø 40</li> <li>B= Dial Ø 50</li> </ul>
SCALE	<ul style="list-style-type: none"> <li><sup>Ⓢ</sup> A= Scale 0-4 bar</li> <li>B= Scale 0-6 bar</li> <li>C= Scale 0-12 bar</li> </ul>



### DIMENSIONS

CODE	D1	D2	L1	L2	L3	Ch
17070A...	41	Gc - 1/8"	26	10	44	14
17070B...	49	Gc - 1/8"	27	10	45	14



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