

General

Upon implementation of the AIRPLUS TG3 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 been 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 2 according to ISO EN 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 ISO EN 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/CE

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 M12 4 PIN TYPE A Connector |

Operational characteristics

| | |
|-----------------------|--|
| Fluid | filtered and lubricated or non-lubricated air; if lubricated it must 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:

UNI EN ISO 13849-1

Safety of machinery
Safety-related parts of control systems
Part 1: General design principles

EN 62061

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.

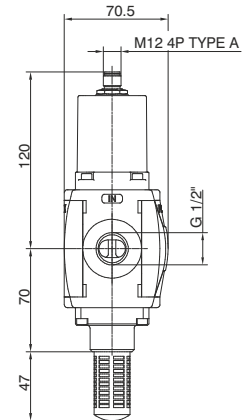
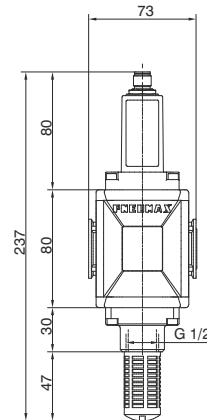
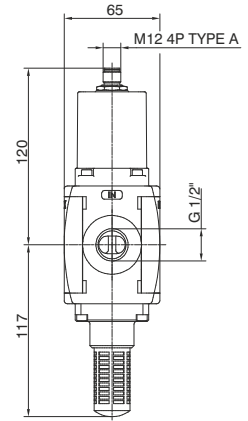
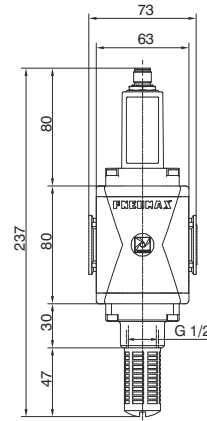
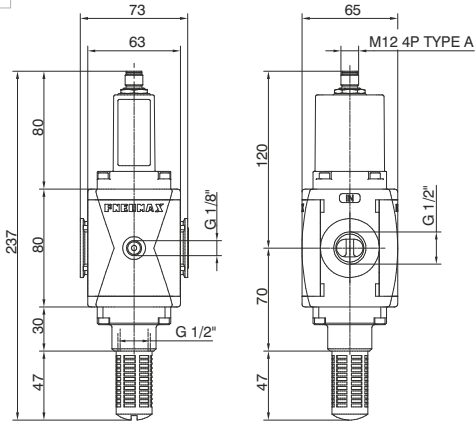
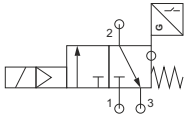
| PL – Performance Level | Average probability of dangerous malfunction per hour (1/h) |
|------------------------|---|
| a | $\geq 10^{-5}$ to $< 10^{-4}$ |
| b | $\geq 3 \times 10^{-6}$ to $< 10^{-4}$ |
| c | $\geq 10^{-6}$ to $< 3 \times 10^{-6}$ |
| d | $\geq 10^{-7}$ to $< 10^{-6}$ |
| e | $\geq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

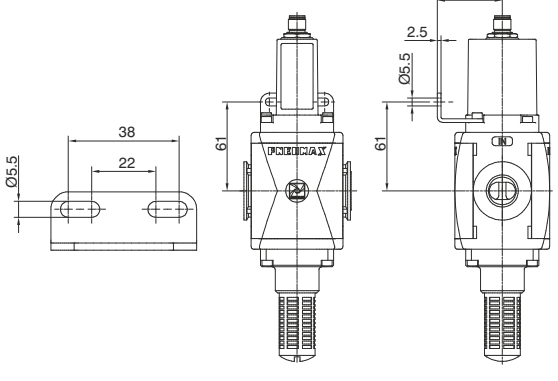
| | | | |
|--------------------------------|---|--|---------------|
| S1 Slight danger | F1 Occasional danger and brief exposure | P1 – possibly avoidable danger | PL = a |
| | F2 Frequent danger and long exposure | P2 – largely unavoidable danger | PL = b |
| S2 Serious danger | F1 Occasional danger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

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

Pneumatic symbol

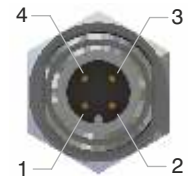


Dimensions with fixing bracket mounted



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 filtered and lubricated or non-lubricated air; if lubricated it must be continuous | |
| Coil Features | 24VDC, 1 Watt | Fluid | | |
| Suppressor diode for coil reverse voltage spike | Present | Function | 3/2 NC monostable | VERSIONS = Standard* (without connections) |
| Supply Voltage Allowance | -5% ÷ +10% | Working Pressure, MIN | 2,5 bar | M = Incorporated pressure gauge |
| Electrical features of sensor | | Working Pressure, MAX | 10 bar | W = Incorporated pressure gauge (Right-Left) |
| Sensor Features | 10 ÷ 30V DC | Working Temperature | -10°C ÷ +50°C | G = G1/8" pressure gauge Connection |
| Operating Principle | Hall effect | Flow rate at 6bar Δp1 (from 1 to 2) | 3500 NL/min | FIXINGS = Without fixing * |
| Contact Type | N.O. | Flow rate at 6bar Δp1 (from 2 to 3) | 2000 NL/min | F 01 = Fixing bracket mounted (Left-Right) |
| Output Type | PNP | Flow rate at 6bar (from 2 to 3) with free discharge | 3800 NL/min | 02 = Fixing bracket mounted (Right-Left) |
| Permanent Maximum Current | 100 mA | Type of Installation | In line | * no additional letter required |
| Permanent Maximum Power | 3 Watt | Mounting Position | Indifferent | |
| Voltage Drop, MAX | 2 V | Noise Level | 90 dB | |
| Safety features | | Response Time ON ISO 12238 | 36 ms | |
| Regulatory Compliance | EN ISO 13849-1 | Response Time OFF ISO 12238 | 76 ms | |
| Safety Function Fulfilled | Interruption of supply and unloading of the downstream pneumatic circuit | IP Rating | IP65 (with connector installed) | |
| Performance Level (PL) | c | | | |
| UNI EN 13849 Category | 2 | | | |
| Safety Integrity Level (SIL) | 1 | | | |
| PFH ₀ | 1,7*10 ⁶ | | | |
| CE Marking | In accordance with the EU Machinery Directive, annex V | | | |

3

Installation tip 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.

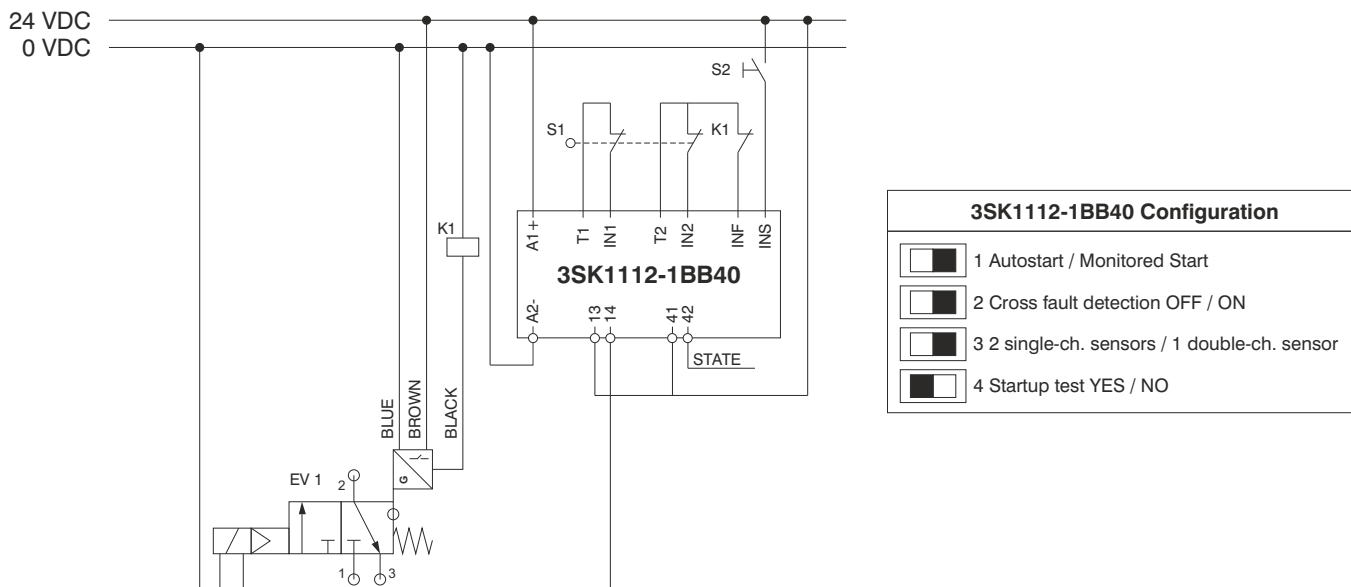
The preliminary estimate and the final verification of the achieved PL are the responsibility of the designer of the part of the system dedicated to providing the safety function.

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.

The circuit diagram of the **suggested** configuration is provided, along with the configuration of 3SK1112-1BB40.



Analysis of malfunctions

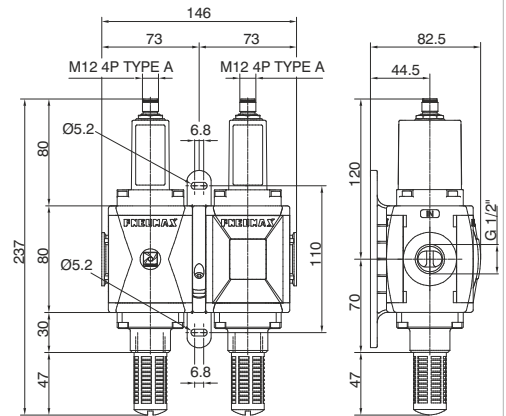
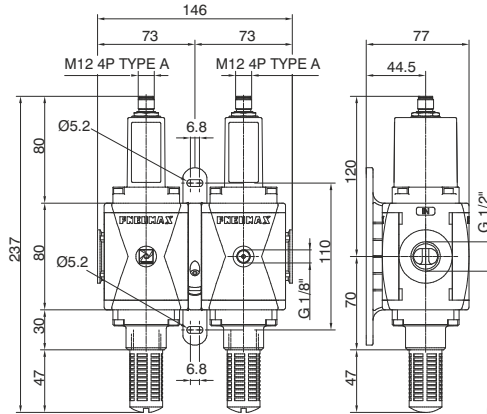
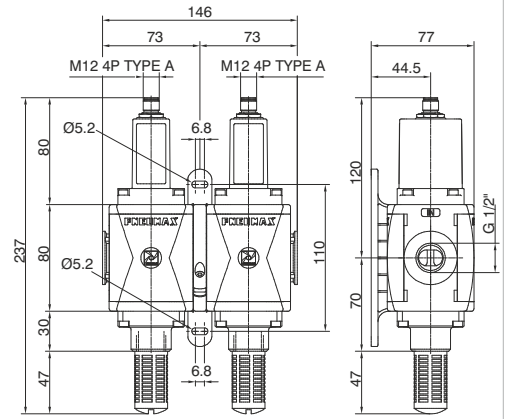
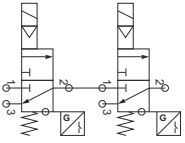
The diagnostic system (monitoring device plus sensor) has the purpose of verifying the appearance of malfunctions within the valve that undermine the safety function. In particular, (with 3SK1112-1BB40 configured as in the illustration), the K1 relay prevents resetting the system by means of S2 when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

ATEX

II 3G Ex nA IIC T6 Gc (X)

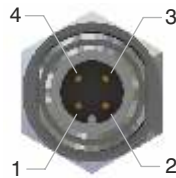
II 3D Ex tc IIIC T=80°C Dc (X) IP65

Pneumatic symbol



Electrical Connection

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



| Electrical Features | | Technical Features | |
|---|--|---|--|
| Electrical Connection | Male M12 4 PIN TYPE A Connector | Connections | G1/2" UNI-ISO 228/1 filtered and lubricated or non-lubricated air; if lubricated it must be continuous |
| Coil Features | 24VDC, 1 Watt + 1 Watt | Fluid | |
| Suppressor diode for coil reverse voltage spike | Present | Function | 3/2 NC monostable |
| Supply Voltage Allowance | -5% ÷ +10% | Working Pressure, MIN | 2,5 bar |
| | | Working Pressure, MAX | 10 bar |
| | | Working Temperature | -10°C ÷ +50°C |
| Electrical features of sensor | | Flow rate at 6bar Δp1 (from 1 to 2) | 2500 NL/min |
| Sensor Features | 10 ÷ 30V DC | Flow rate at 6bar Δp1 (from 2 to 3) | 2000 NL/min |
| Operating Principle | Hall effect | Flow rate at 6bar (from 2 to 3) with free discharge | 3800 NL/min |
| Contact Type | N.O. | Type of Installation | In line |
| Output Type | PNP | Mounting Position | Indifferent |
| Permanent Maximum Current | 100 mA + 100 mA | Noise Level | 90 dB |
| Permanent Maximum Power | 3 Watt + 3 Watt | Response Time ON ISO 12238 | 68 ms |
| Voltage Drop, MAX | 2 V + 2 V | Response Time OFF ISO 12238 | 79 ms |
| Safety features | | | |
| Regulatory Compliance | EN ISO 13849-1 | | |
| Safety Function Fulfilled | Interruption of supply and unloading of the downstream pneumatic circuit | | |
| Performance Level (PL) | e | IP Rating | IP65 (with connector installed) |
| UNI EN 13849 Category | 4 | | |
| Safety Integrity Level (SIL) | 3 | | |
| PFH ₀ | 4,7*10 ⁻⁸ | | |
| CE Marking | In accordance with the EU Machinery Directive, annex V | | |
| | | Ordering code | N173BV2S |
| | | VERSIONS | = Standard* (without connections) |
| | | M | Incorporated pressure gauge |
| | | G | G1/8" pressure gauge Connection |
| | | FIXING | |
| | | X | "X" Flange |
| | | Y | "Y" Flange |
| | | K | "Y" Aluminium flange |
| | | FLOW RATE DIRECTION | = Standard (Left-Right)* |
| | | W | (Right-Left) |
| | | * no additional letter required | |

3

Installation tip 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 provide 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

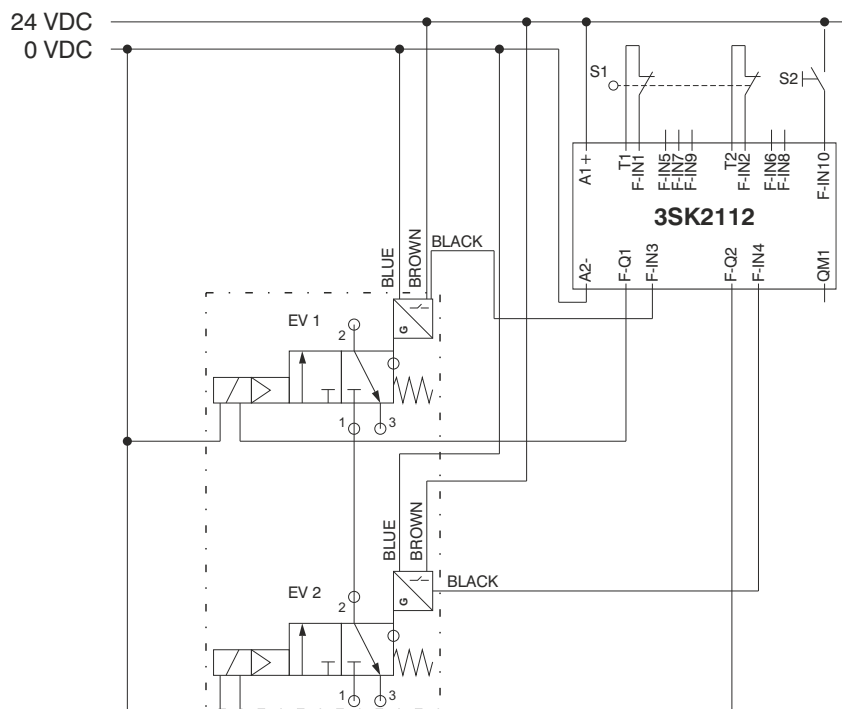
EV1

- 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.

The circuit diagram of the **suggested** configuration is provided.



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.