

Start - Contents Application Note

Each Safety Application Notes considers one aspect of a safety circuit. Therefore, implementing a safety circuit in a specific application always requires several documents that are linked in the application note.

Important notes

- Please unzip the zip file and save it in a folder. Some programs used cannot open files in compressed folders.
- Certain programs are required to open some files, see section
➔ “Recommendations for the required software”

Contents of the application notes

Normally contains every application note the following files:

- **Application Note (in pdf format)**
Document with the description, circuit, required features of components and product recommendations from Festo.
- **Sistema project (in Sistema format and as Sistema report in pdf format)**
Sistema project for the evaluation of the sub-circuit for the safety sub-function according to the block diagram in the application note. As a rule, this is only the safety-related output of the pneumatic safety circuit.
- **FluidDraw Project (in FluidDraw format and in pdf format)**
FluidDraw project with the subcircuit for the safety subfunction according to the description in the application note.
- **FluidDraw Translation Table DE – EN (in FluidDraw format)**
The FluidDraw project was created with a translation table in order to be able to select and display different languages (German and English). To integrate the translation table into a FluidDraw project, see ➔ “Instructions translation table for FluidDraw”.
- **FluidSim Project (in FluidSim format)**
FluidSim project with a possible electrical circuit and the pneumatic sub-circuit for the specified safety sub-functions. This project file can be used to test and explain how the circuit works using a simulation.

Date
2026-08-31

Our Reference
100501

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- **Video**

The video shows and explains the simulation of the pneumatic part of the circuit.

Recommendations for the required software

The following software is required to make full use of this application note:

- **Reader for files in pdf format**

We recommend the free ➔ [Adobe Acrobat Reader](#).

- **Sistema**

Sistema is a software assistant for the evaluation of safety circuits of machines according to the ISO 13849-1 standard. This is a software provided free of charge by the Institute for Occupational Safety and Health (IFA) ➔ [Software-Assistant SISTEMA](#).

- **FluidDraw**

- FluidDraw makes it quick and easy to create pneumatic, hydraulic, and electrical circuit diagrams. This is a paid program that can be ordered from Festo ➔ [FluidDraw 365](#).

- **FluidSim**

FluidSim can be used to simulate pneumatic, hydraulic, and electrical circuits at circuit diagram level. For the simulation of this application note, the Windows version with licenses for pneumatics and electrical engineering is required. For the licenses ➔ [FluidSim](#).

- **Video player for MP4 files**

A video player is required to play the video showing the simulation of the pneumatic circuit. The Media Player, which is suitable for playback, is normally available for Windows.

Instructions translation table for FluidDraw

The translation table can be loaded with the following steps:

1. Select the “Manage” menu
2. Select the “Translation tables” menu item
3. Select the “Open...” button
4. Select the file “... FluidDraw Translation Table DE - EN.xmltt”

5. The columns TextID, German and US-English are displayed in the “Words” table
6. The “Manage translation tables” window can be closed with the OK button
7. Select the “Project” menu
8. Select the “Language” menu item
9. Select the file “... Translation Table DE - EN.xmltt” in the “Translation table” selection list (usually the lowest file in the list)
10. Select the desired languages in the “Project / Page / Report” and “Translation language” selection lists.

Instructions for simulation with FluidSim

Functions of the components used

- S1 - ON/Reset

The machine is switched on. In the simulation the electrical supply valve Q10 is controlled so that the working pressure for the application is available. The preconditions are:

- The minimum pressure (setting 3 bar) at pressure switch B10 is exceeded.
- Emergency stop S3 is not activated.

Notes

- The safety door may be open. Background: For a safety door, the entire pneumatic system does not necessarily need to be exhausted, only the hazardous area. In the case of an emergency-stop situation, however, it must be fully exhausted.

- S2 – OFF

The machine is switched off. The electrical supply valve Q10 is de-energized so that working pressure for the application is no longer available.

- S3 – Emergency stop

An emergency stop is requested, i.e., SSC for the application and SDE for the pneumatic system. Valve K1 is no longer actuated, interrupting and exhausting the control-pressure supply to the pilot-operated check valves Q3 and Q4. As a result, they move to their normal position and interrupt the flow paths from both chambers of the pneumatic drive M1; in other words, SSC is executed.

Valves Q1, Q2, and Q10 are no longer actuated. They move to their normal positions. Q1 and Q2 execute the STO stop function and subsequently PUS once they have reached their normal positions. The SDE safety sub-function is executed for the pneumatic system by Q10. To reset the system, emergency-stop switch S3 must be closed again and pushbutton S1 (Reset) must be pressed. Normal machine operation can then be restarted using S5.

- S4 – Safety guard door
SSC is requested for the application. Valve K1 is no longer actuated, interrupting and exhausting the control-pressure supply to the pilot-operated check valves Q3 and Q4. As a result, they move to their normal positions and interrupt the flow paths from both chambers of the pneumatic drive M1; in other words, SSC is executed.
To reset, the guard door switch S4 must be closed and the S1 (Reset) button pressed. The normal machine function can then be restarted with S5.
- S5 – Start
Pressing the start button S5 executes the normal machine function, i.e., the pneumatic drive M1 continuously extends and retracts.
- S6 – Stop
Pressing the S6 button stops the normal machine function, i.e., the pneumatic drive is functionally stopped.
- P1 - Safety request indicator
Indicator P1 shows whether a safety request is present. Before normal machine function can be continued, emergency-stop switch S3, door switch S4, and the contact of pressure switch B10 must be closed and the S1 button pressed.
- S10 - Manual on/off valve
The manual on/off valve can interrupt the compressed-air supply and exhaust the immediately downstream pneumatic system. This valve can be used to simulate a loss of pressure.
- P10, P11 – Pressure gauges
The pressure gauges can be used to monitor the supply pressure and the regulated working pressure.
- H10 – Filter
Filter with condensate drain for adequate compressed air quality.
- K10 – Pressure regulator

The pressure regulator is set to 4 bar in the simulation.

- B10 – Pressure switch

The pressure switch monitors the minimum working pressure required for the application (setting 3 bar). If the set minimum pressure is not reached, valves Q1, Q10 are no longer actuated and return to normal position. Q1 executes the STO stop function and then PUS in the valves' normal position. The safety subfunction SDE is executed for the pneumatic system.

- K1 – Control valve for pilot-operated check valves

The K1 control valve controls the two pilot-operated check valves Q3 and Q4. When a safety request is reset, the pilot-operated check valves can be actuated according to the requirements of the application. When a safety request is triggered, the control air to the pilot-operated check valves is interrupted and exhausted, causing them to move to their normal positions and block the flow paths from the chambers of the pneumatic drive.

- Q10 – Electric on/off valve

The electric on/off valve in the service unit switches the compressed air supply to the downstream pneumatic system (valve Q1, X1) on when the switch-on conditions (see S1 – ON/Reset) are met.

- X1 – Pneumatic supply

Compressed-air supply for other parts of a possible pneumatic installation.

- Q1, Q2 – Working valve

The working valves carry out the normal machine function, e.g., extending and retracting the pneumatic drive M1. If a safety request is triggered, the valves are no longer actuated, so they return to their normal position and interrupt and exhaust.

- Q3 and Q4 – Pilot-operated check valves

The K1 control valve controls the two pilot-operated check valves Q3 and Q4. When a safety demand is reset, the pilot-operated check valves can be actuated according to the requirements of the application. When a safety demand is triggered, the control air to the pilot-operated check valves is interrupted and vented, causing them to move to their normal positions and block the flow paths from the chambers of the pneumatic actuator.

- M1 – Pneumatic drive

The drive to be controlled can be any double-acting pneumatic drive, e.g., cylinders with or without piston rod, grippers.

Simulation procedure

1. Press S1: The machine is switched on, i.e., electrical supply valve Q10 is activated and applies working pressure to the pneumatic system.
2. Press S5: Machine function starts, i.e., the drive moves.
3. Activate guard door S4 – The working valves Q1 and Q2 and the control valve K1 are no longer actuated; in other words, the pilot-operated check valves move to their normal positions and execute SSC.
4. As long as guard door S4 is open, S5 may be pressed freely without causing movement.
5. Close guard door S4: The safety request from the guard door is reset. The S5 button may be pressed freely without starting movement.
6. Press S1: The safety request is acknowledged and the machine function is allowed to start.
7. Press S5: Machine function starts, i.e., the drive moves.
8. Emergency stop S3: The working valves Q1 and Q2, the control valve K1 and the valve Q10 are no longer actuated; in other words, the pilot-operated check valves move to their normal positions and execute SSC, SDE for the pneumatic system.
9. As long as emergency stop S3 is open, S5 may be pressed freely without causing movement.
10. Close emergency stop S3: The safety request caused by the emergency stop is reset. The S5 button may be pressed freely without starting movement.
11. Press S1: The safety request is acknowledged, and the machine function is allowed to start.
12. Press S5: Machine function starts, i.e., the drive moves.
13. A valve sticking can be simulated by holding the “Shift” key and then clicking with the mouse on a solenoid of valve Q1. The valve remains in the then-switched position. Release the “Shift” key.
14. Click the valve to reset the stuck condition.