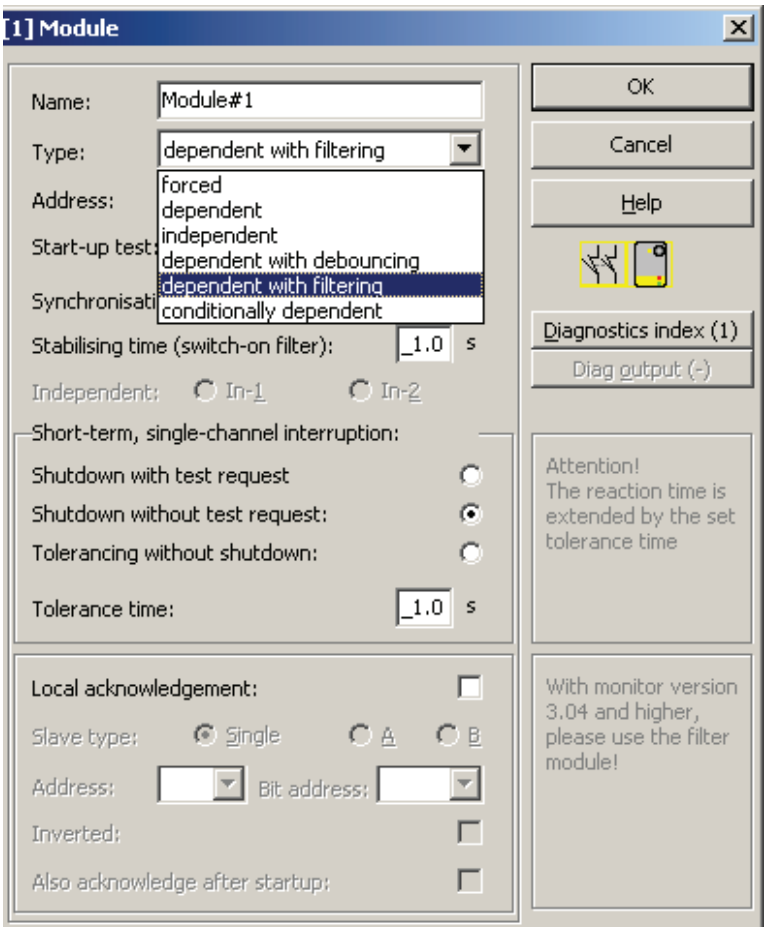
CONFIGURING A SAFE INPUT ON AS-INTERFACE SAFETY

Setting up an AS-Interface Safety at Work network is easy. In fact, putting the network together is no different for conventional (i.e., non-safe) devices than it is for safety devices. After the network has been built and modules have been addressed, the safety functions are configured in the AS-Interface safety controller (aka the SafetyMonitor.) This Technology Brief discusses the available input types selectable in the safety configuration.



AS-Interface Safety at Work has been available since 2001 and device manufacturers have learned a lot about how customers are using it. Consequently, safety input devices now have a number of different configuration parameters. Some of these parameters (dependent and dependent with debouncing) should not be used any longer and are still available

Which Types to Use?

- forced
- dependent with filtering
- conditionally dependent
- independent

This Technology Brief discusses the differences between these input types and explain their various parameters.

We will start with the **forced type**, followed by the **dependent with filtering** and **conditionally dependent types**. We will not discuss the independent type as it is used for applications with lesser safety requirements using safety products with only one contact.

Edition 06-17-2011 tdoctb0b3a_eng

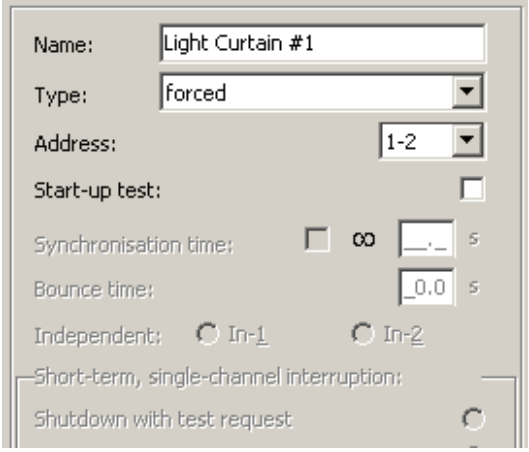
PEPPERL+FUCHS
SENSING YOUR NEEDS

THE FORCED TYPE

The forced type is by far the simplest input type as no timing parameters need to be set. But, not being able to make any adjustments means this type can be used only in special situations with very specific safety devices.

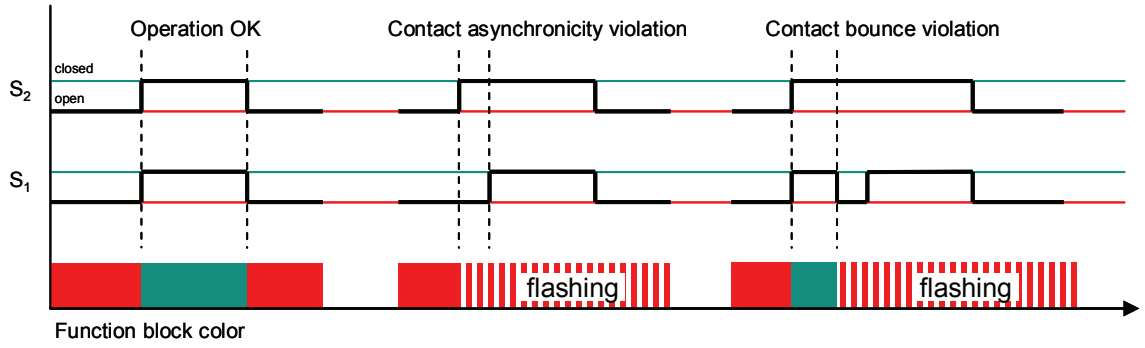
When to use

The forced input type should be used only with safe devices that have “perfect” contact behavior. Perfect contact behavior means that both contacts close and open simultaneously and never show any bounce. Clearly this limitation excludes safety devices with mechanical contacts. We strongly suggest using this input type only with safety devices utilizing electronic-safe outputs. Safety-light curtains and safety scanners come to mind. Before using this input type, check with the manufacturer of the safety device to ensure it satisfies these requirements.



Requirements

- The two safe contacts on the safety device must always open simultaneously. If the SafetyMonitor detects contact asynchronicity, the function block will go into the “error lock” state.
- The two safe contacts on the safety device must always close simultaneously. If the SafetyMonitor detects contact asynchronicity, the function block will go into the “error lock” state.
- Safety contacts must not exhibit any type of bounce.



Right: The forced input type requires perfect contact synchronicity and absolutely no bounce.

Middle and left: When the SafetyMonitor detects asynchronicity or bounce it goes into the “error lock” state (flashing red).

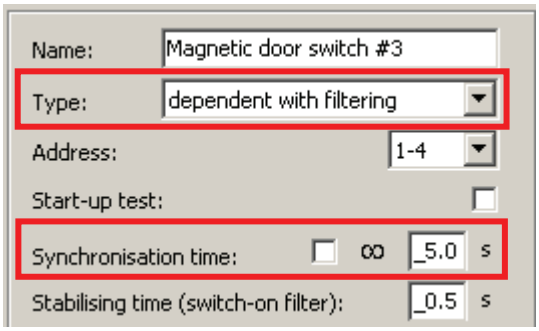
Edition 06-17-2011 tdoctb0b3a_eng

PEPPERL+FUCHS
SENSING YOUR NEEDS

THE DEPENDENT WITH FILTERING TYPE

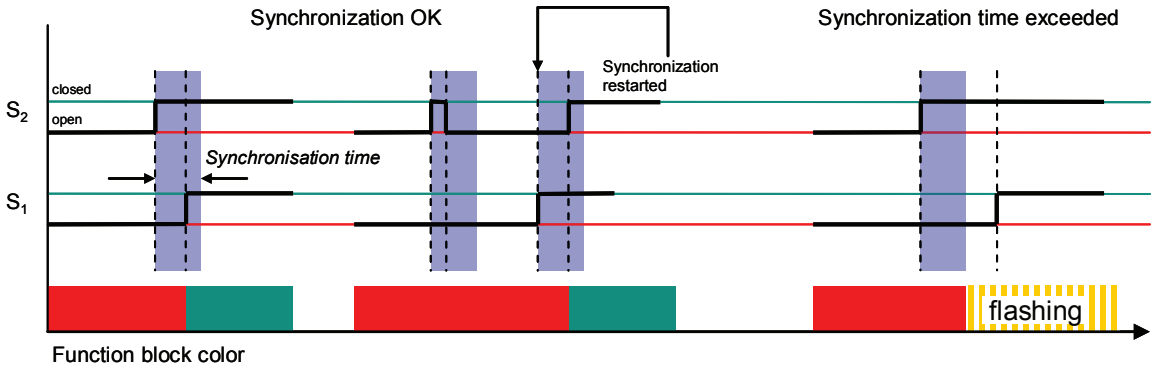
Since most safety devices utilize mechanical contacts they are less than perfect, showing bounce and contact asynchronicity. This inconsistency makes it necessary to provide an input type that can correct for this behavior. (Contact bounce will be dealt with on the next page.)

During the startup phase the two safe contacts transition from the safe (open) state to the released (closed) state. In the case of an e-stop, this transition corresponds to the e-stop being pulled out. When talking about a magnetic door switch, it refers to the time when the door is being closed. The synchronization time parameter identifies how the two safe contacts close with respect to each other.



Requirements

- The two safe contacts of the safety device must close within the Synchronization time.
- If Infinite Synchronization time is selected, closure of the second contact can occur anytime.
  Note: Conventional safety relays behave this way.



Right: As soon as one contact closes, the synchronization time starts. The second contact must also close before the synchronization time expires.

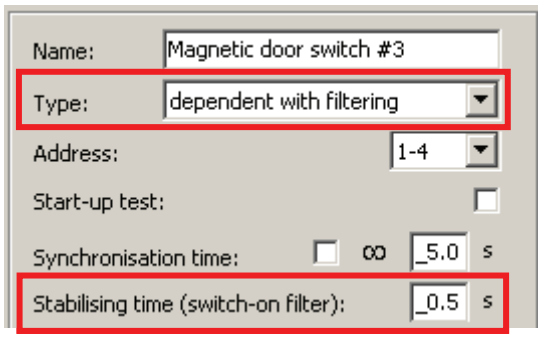
Left: If the contacts do not close, the function block goes into the “test input” state (yellow flashing).

Middle: If the first contact opens again before the synchronization time expires, the startup process resets and the synchronization timer restarts when the next contact closes.

Edition 06-17-2011 tdoctb0b3a_eng

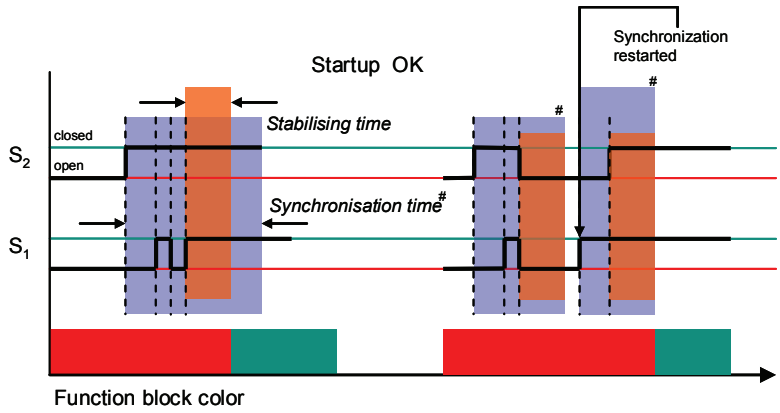
AS-INTERFACE SAFETY AT WORK FILTERING FUNCTION:

Once a mechanical contact closes, it is quite likely to bounce open again. Contact bounce is common to nearly all mechanical safety devices including magnetic and key-operated door switches, e-stops and mechanical safety limit switches. The stabilising time (switch-on filter) corrects for contact bounce during the startup phase.



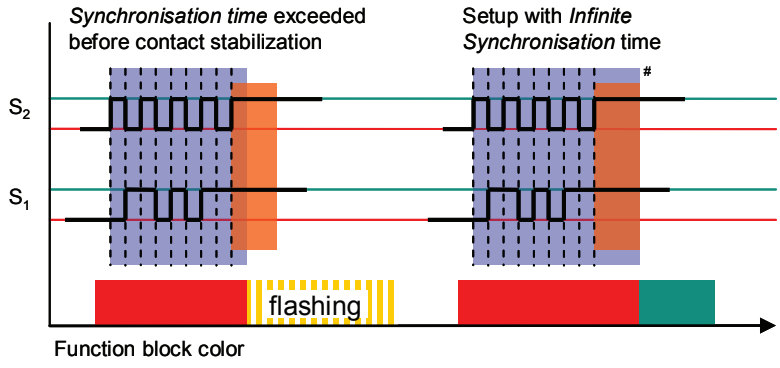
Startup Requirements

- Both contacts must close within the Synchronisation time.
- Within the Synchronisation time, both contacts must remain closed for the Stabilising time.
- If both contacts are open for the Stabilising time, the Synchronisation time restarts with the next closed contact.



Left: As soon as one contact closes, the Synchronisation time starts. The second contact must also close before Synchronisation time expires. Additionally, both contacts must remain closed for the Stabilising time.

Right: If both contacts are open for the duration of Stabilising time the Synchronisation time restarts with the next contact closure.



Left: If a set of bouncing contacts does not stabilize within the Synchronisation time, the function block goes into the “test input” state (yellow flashing).

Right: Selecting Infinite Synchronisation time allows the contacts to open/close without time limit. Once they have stabilized, the function block goes into the “started” state (solid green).

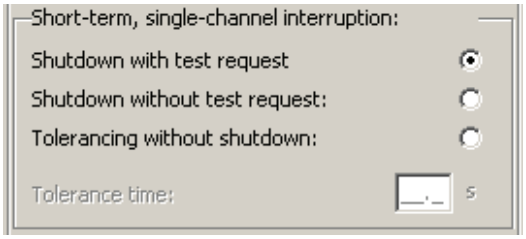
Edition 06-17-2011 tdoctb0b3a_eng

PEPPERL+FUCHS
SENSING YOUR NEEDS

After the function block starts (solid green), its behavior in situations where one contact opens for a brief moment can be controlled by selecting one of the three radio buttons. The three cases will be discussed separately.

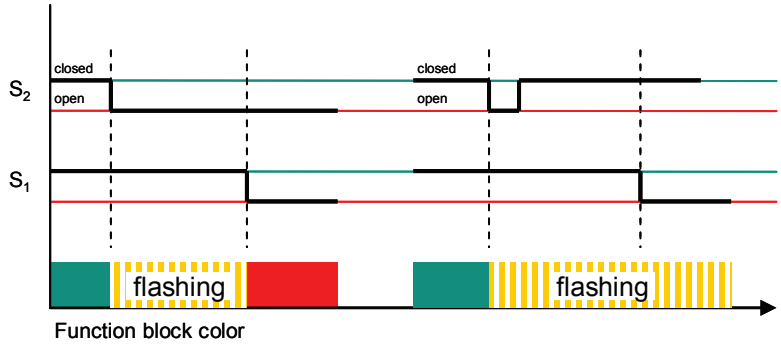
STARTUP WITH TEST REQUEST

This is the easiest of the three options as it does not offer any additional parameters.



Operating conditions

- As soon as any one of the two contacts of the safety device opens up for any amount of time, the function block shuts down.
- As long as only one contact of the safety device is open – thus waiting for the second contact to also open up – the function block is in the “test input” state (flashing yellow) and cannot be restarted.
- Restarting is only possible after “testing,” i.e., opening both contacts simultaneously.



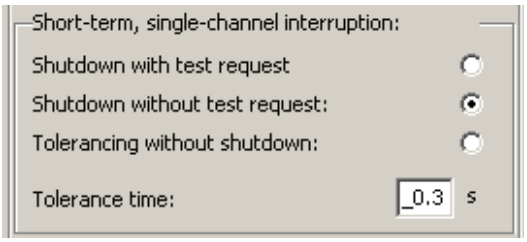
Left: As soon as one contact opens, the function block shuts down. Since a re-start is only possible after both contacts are open, the function block is in the “test input” state (yellow flashing) until both contacts are open.

Right: If a safe contact opens and then recloses again, the function block will not restart but instead stay in the “test input” state (yellow flashing) until both contacts are open. A short contact bounce could be the reason.

Edition 06-17-2011 tdoctb0b3a_eng

AS-INTERFACE SAFETY AT WORK FILTERING FUNCTION:

In situations where a single contact can open up for a brief moment, the Short-Term, single-channel interruption options provide additional flexibility.

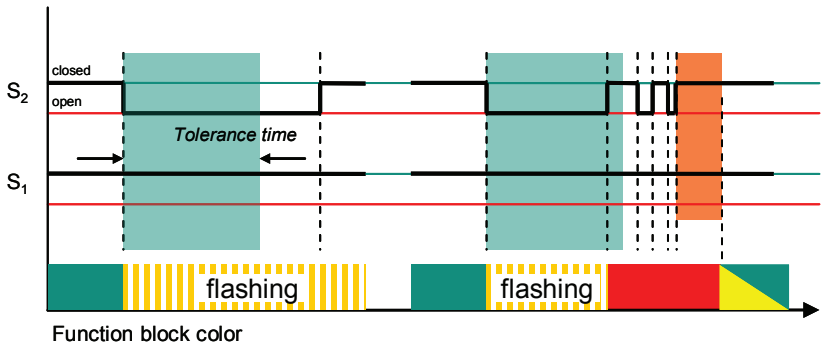


SHUTDOWN WITHOUT TEST REQUEST

A Tolerance time is set. As long as the single contact is open for less than the Tolerance time, the function block will not demand “testing.”

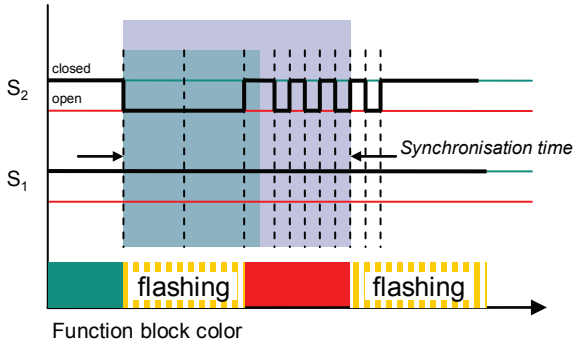
Operating conditions

- As soon as one of the two contacts of the safety device opens up for any amount of time, the function block shuts down.
- If a single contact opens for a time longer than the Tolerance time, the function block is in the “test input” state (flashing yellow) and cannot be restarted. Restarting is only possible after “testing”, i.e. opening both contacts simultaneously.
- If a single contact opens for a time shorter than the Tolerance time, the function shuts down and can restart once the stabilizing condition has been satisfied. If Local acknowledgement is selected, restarting will wait until the Local acknowledgement condition is met.



Left: If the single-channel interruption is longer than the Tolerance time, “testing” must be performed.

Right: If the single-channel interruption is shorter than Tolerance time, the release circuit can restart after both contacts have stabilized. If configured, the Local acknowledgement condition must be met.

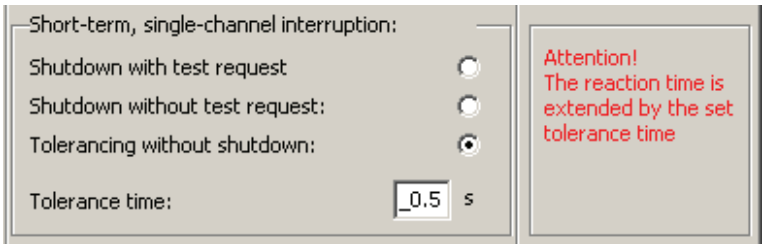


If contact bounce has not subsided and the contacts are not in the stabile condition (i.e. both contacts are continuously closed for Stabilizing time) before the Synchronisation time has expired, the function block requires “testing” (yellow flashing).

Edition 06-17-2011 tdoctb0b3a_eng

PEPPERL+FUCHS
SENSING YOUR NEEDS

It is even possible to configure the filter function such that the function block will not shut down when a short, single-channel interrupt occurs. Note that this will extend the reaction time of the system.

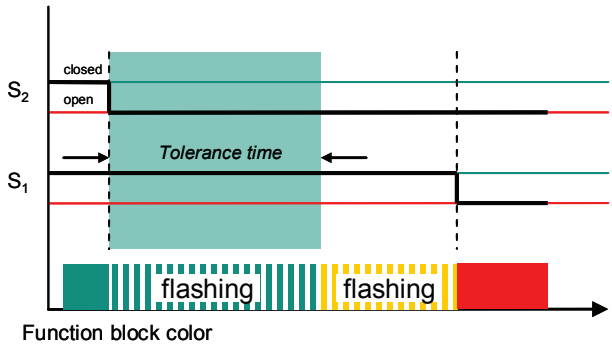


TOLERANCING WITHOUT SHUTDOWN

A single input can open up to the Tolerance time value without causing a shutdown of the function block.

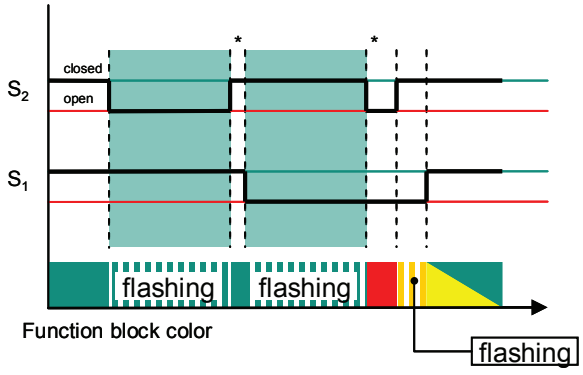
Operating conditions

- As long as a single-channel interrupt is shorter than the Tolerance time the function block remains running.
- While the single-channel is interrupted, the function block is in “delayed shutdown” mode (green flashing).
- If a single-channel interrupt lasts longer than the Tolerance time, the function block goes into the “test input” state (yellow flashing) and cannot be restarted. Restarting is only possible after “testing,” i.e., opening both contacts simultaneously.



If a single-channel interruption occurs, the function block is in “delayed shutdown” mode (green flashing). If the interruption is longer than the Tolerance time, “testing” (flashing yellow) must be performed.

The release circuit can be restarted only after both safe input contacts are open (solid red).



If contact bounce is shorter than the Tolerance time, the function block remains in the running mode (flashing green).

Should at any point during Tolerance time both safe input contacts be open, the release circuit opens and the function block is in the “shutdown” state (solid red) and can be restarted.

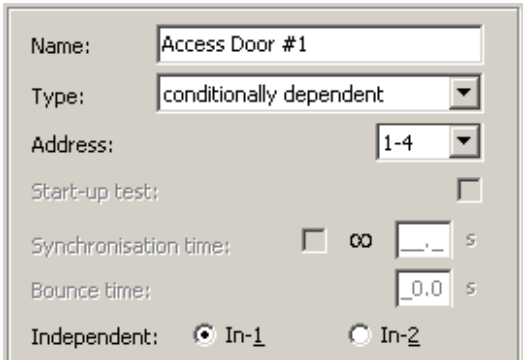
** The Tolerance time timer expires as soon as both contacts are closed again.*

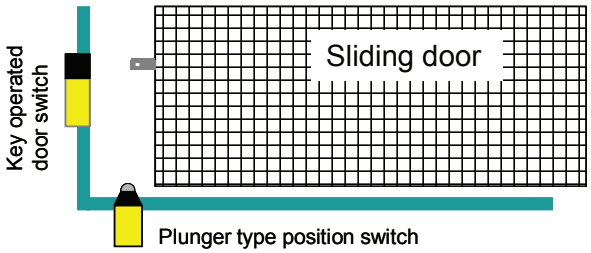
Edition 06-17-2011 tdoctb0b3a_eng

PEPPERL+FUCHS
SENSING YOUR NEEDS

THE CONDITIONALLY DEPENDENT TYPE

The conditionally dependent type is used in situations when a well-defined and reproducible timing behavior between two safe input contacts exists. What this means is best explained by looking at two examples.



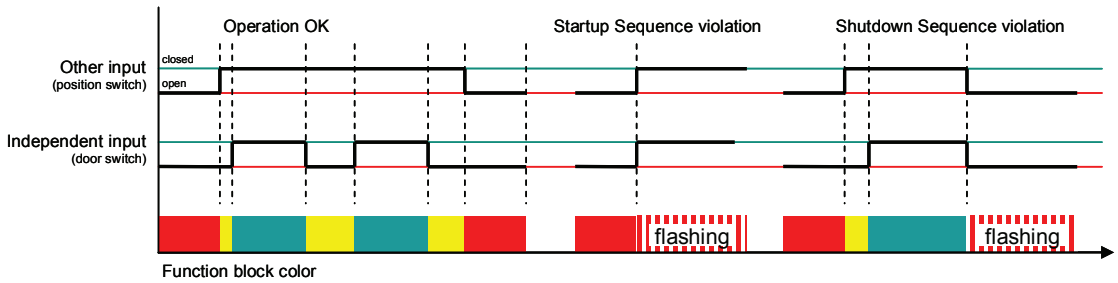


Access Door: Sliding access doors are frequently protected by two (single contact) safety switches.

When opening the door, the key-operated door switch always opens first. As the door opens farther the position switch may open too. While under normal conditions it is always possible to open the door just far enough to open the door switch, it is never possible to open the position switch only! Therefore the door switch is independent while the position switch is dependent (on the door switch).

Requirements

- During startup the dependent contact must close prior to the independent contact.
- When the independent contact opens, the function block shuts down. After closing the independent contact again, the release circuit can be restarted even if the dependent contact never opened (partially opened door).
- A violation of these conditions brings the function block into the “error lock” state (red flashing).

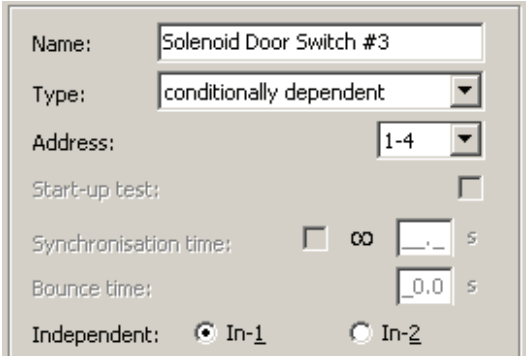


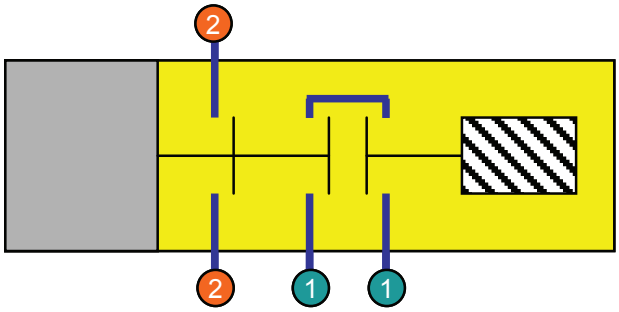
Edition 06-17-2011 tdoctb0b3a_eng

PEPPERL+FUCHS
SENSING YOUR NEEDS

THE CONDITIONALLY DEPENDENT TYPE (CONT.)

Solenoid door switch: Solenoid door switches are frequently constructed such that the solenoid is connected in series with one of the safe contacts operated by the key.

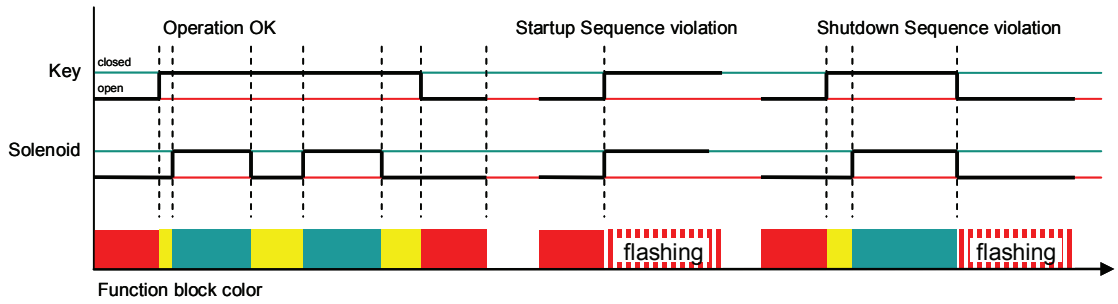




In this example, releasing the latch will open contact 1. Once that is done the key can be removed, which action opens contact 2. Since the key cannot be removed while being latched by the solenoid, contact 1 is independent and contact 2 is dependent.

Requirements

- The PLC must hold the solenoid in the unlatched position while the key is not in the switch (door open).
- When the key is in the switch (door closed), the solenoid can be put in the latched position by the PLC. This action restarts the function block.
- A violation of these conditions brings the function block into the “error lock” state (red flashing).



Edition 06-17-2011 tdoctb0b3a_eng

SUGGESTED USAGE

With these options, how does one decide which configuration of the safe input function block should be used? The following suggestions can serve as starting settings and work in many instances. Due to the safe nature of the applications, the selected configuration and parameters must always be verified by the responsible safety engineer.

Safe Device	Input Function	Details
Safety light curtain (electronic output)	forced	
Safety scanner (electronic output)	forced	
E-stop	dependent with filtering	*Synchronisation time* 500 ms *Stabilising time* 200 ms Shutdown with test request
Key operated door switch (non-latching)	dependent with filtering	*Synchronisation time* 500 ms *Stabilising time* 200 ms Shutdown with test request
Key operated door switch (latching)	conditionally dependent	
Magnetic door switches (limited door bounce)	dependent with filtering	*Synchronisation time* ∞ *Stabilising time* 500 ms Shutdown without test request *Tolerance time* 100 ms
Magnetic door switches (significant door bounce)	dependent with filtering	*Synchronisation time* ∞ *Stabilising time* 500 ms Tolerancing without shutdown *Tolerance time* 100 ms(#)
RFID door switch	dependent with filtering	*Synchronisation time* 500 ms *Stabilising time* 100 ms Shutdown with test request

#) This setting increases the reaction time of the system by 100 ms.

Contact
Pepperl+Fuchs GmbH
Lilienthalstraße 200
68307 Mannheim · Germany
Tel. +49 621 776-4411 · Fax +49 621 776-27-4411
E-mail: fa-info@de.pepperl-fuchs.com

Worldwide Headquarters
Pepperl+Fuchs GmbH · Mannheim · Germany
E-Mail: fa-info@pepperl-fuchs.com

USA Headquarters
Pepperl+Fuchs Inc. · Twinsburg · USA
E-Mail: fa-info@us.pepperl-fuchs.com

Asia Pacific Headquarters
Pepperl+Fuchs Pte Ltd · Singapore
E-Mail: fa-info@sg.pepperl-fuchs.com

PEPPERL+FUCHS
SENSING YOUR NEEDS

Edition 06-17-2011 tdoctb0b3a_eng