SIRIUS 3RA6 with AS-i Mounting Module for Local Safety Shutdown at Level SIL 1 acc. to IEC 62061 / PL c acc. to EN ISO 13849-1:2006

SIRIUS

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Question

How can I use the local inputs of the 3RA6 AS-i mounting module?

What safety category can be achieved with the local inputs of the AS-i mounting module?

Answer

With the help of a position switch you can monitor, for example, the status of a flap.

SIL 1 according to IEC 62061 or PL c according to EN ISO 13849-1:2006 (in the following ISO 13849-1) can be realized.

Table of Contents

1 Introduction

Based on the functional safety standards IEC 62061 and ISO 13849-1 it is possible to perform a qualitative and quantitative assessment of safety functions with non-safety-related (standard) components.

Examples of such non-safety-related (standard) components are the switching and protection devices of the SIRIUS Innovation series.

These devices are frequently used in applications aimed at the protection of assets.

This FAQ describes how a position switch with a positively-opening contact is monitored by using the local input, so as to initiate the safe shutdown of the AS-i mounting module of the 3RA6 at level SIL 1 according to IEC 62061 or PL c according ISO 13849-1 or category 2 according to EN 954-1. Operation of the position switch will cause the 3RA6 compact feeder to disconnect. In this example a drive unit will be shut down. Opening of the protective flap results in a safety-related shutdown of the drive via the local inputs on the AS-i mounting module of the compact feeder. The feedback information from the motor starter profile is analyzed via AS-i in the SIMATIC S7 CPU in a non-safety-related cyclic manner. When the flap is closed again, the compact feeder registers the "closed" condition of the position switch and the compact feeder can be activated again.

1.1 Notes regarding the S7 program

- The feedback information from the motor starter profile is analyzed at cyclic intervals via AS-i in the SIMATIC S7 CPU.
- When the position switch has been operated, the compact feeder will start again only after a positive edge has been transmitted to the output D0. This implies that the ON command must be reset after or during operation of the position switch. Then it can be set again to initiate the compact feeder.
- Logic assignment of process data and process images

| Compact feeder status	Inputs				Output
	D0	D1	D2	D3	D0
	Compact feeder ready for operation	Motor ON	Group fault	General warning	Motor
Normal mode	X				
AUX Power deactivated, undervoltage, overvoltage			X		
Output (Motor ON) set via master	X	X			X
Overload	X		X	X	
Limit switch open	X		X		

1.2   Customer benefits

- Mechanical access protection can be realized without extra hardware requirements, since safe shutdown is effected via the AS-i mounting module with local inputs
- Quick disconnection independently of bus and PLC cycle times
- Application changes to the technical safety equipment can be realized without requiring extensive retrofitting with extra safety technology
- Saves time and money through quick installation and commissioning and easy wiring
- Extremely durable, maintenance-free, robust and reliable
- Easy to retrofit and locally restricted "safety – control range"

2 Setup and Wiring

2.1 Hardware setup – overview
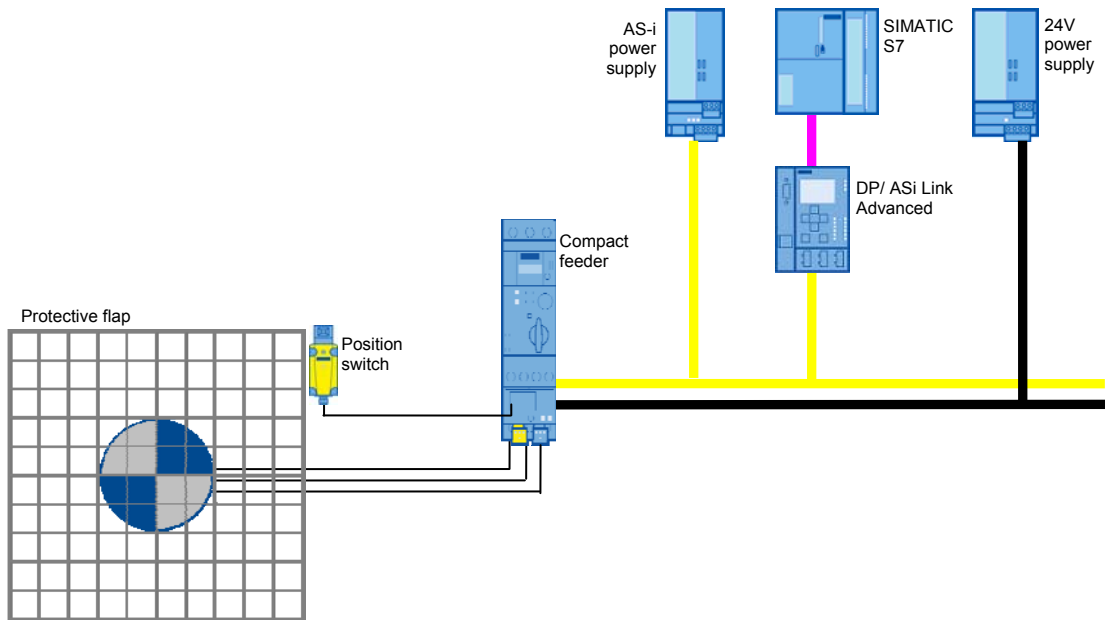
2.2 Wiring of the hardware components
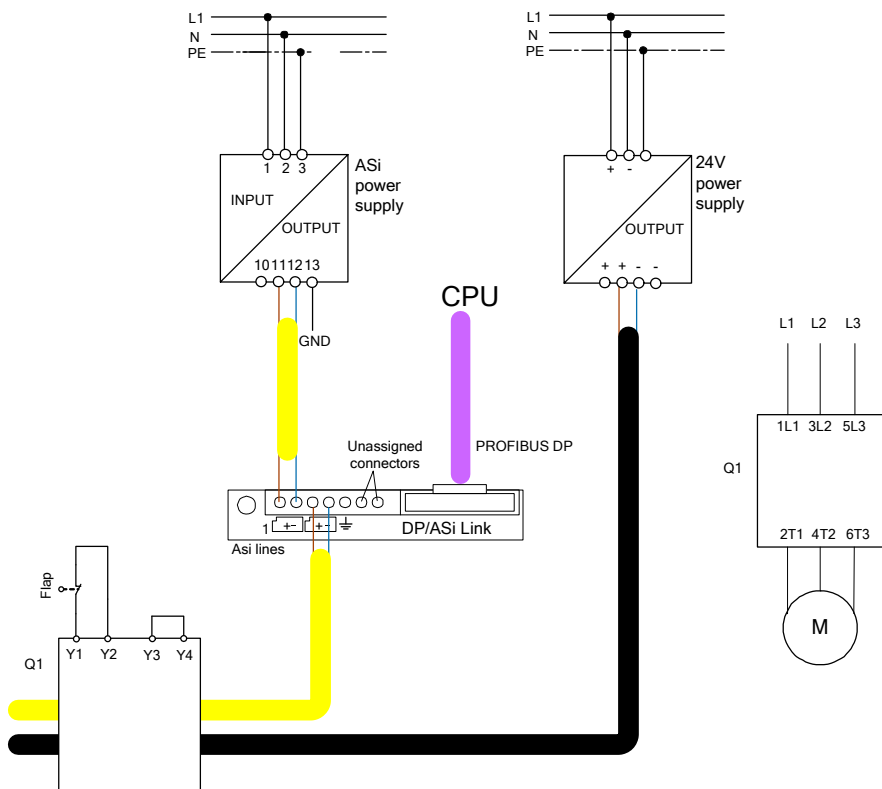
3 Evaluation according to IEC 62061 and ISO 13849-1

3.1 Safety function

Further considerations are based on the following safety function:

safety function	
SF 1	The motor must be switched off when the protective door is opened.

The safety function listed above is evaluated below according to the two standards IEC 62061 und ISO 13849-1.

3.2 Evaluation according to IEC 62061

Parameters for the calculation of PFH_D for
"Detection" (position switch) and "Responding" (Compact Feeder)

Parameter	Value	Reason	Definition
B10 position switch Compact Feeder	$1 * 10^6$ $3 * 10^6$	Manufacturer specifications	Siemens
Ratio of **Dangerous Failures** position switch Compact Feeder	 0,2 0,5	Manufacturer specifications (20%) (50%)	
T1 Useful life time	175.200h (20Jahre)	Manufacturer specifications	
C Number of actuations of position switch Number of actuations of Compact Feeder	1/ h 1 / h	Assumptions: Actuated once per hour. Actuation takes place every day of the year (365 days). The Compact Starter is always energized and is only operated during opening the flap / protective door.	User
DC Diagnostic Coverage	0 (0%)	No fault reaction is initiated. (Worst case).	

Evaluation Parameters

		Definition
Fault exclusion	based on the use of the local input for safety related switching off at 3RA6	Siemens

Summary

	IEC 62061			
		SIL CL		**PFH$_D$**
Detect	1	Hardware Fault Tolerance: HFT = 0 Safe Failure Fraction: SFF = 0 (0%) Use of proven components	$2,00 * 10^{-08}$	Architecture: Basic subsystem architecture A
Evaluate		Fault exclusion		
Respond	1	Hardware Fault Tolerance: HFT = 0 Safe Failure Fraction: SFF = 0 (0%) Use of proven components	$1,66 * 10^{-08}$	Architecture: Basic subsystem architecture A
Result	1	SIL CL of all tasks of the supplementary safety function is at least 1. PFH$_D$ (=$3,66 *10^{-08}$) of the entire supplementary safety function fulfills the requirements of SIL1.		

3.3 Evaluation according to ISO 13849-1

Parameters for the calculation of MTTF$_d$ for
"Detection" (position switch) and "Responding" (Compact Feeder)

Parameter	Value	Reason	Definition
B10 Position switch Compact Feeder	$1 * 10^6$ $3 * 10^6$	Manufacturer specifications	Siemens
Ratio of Dangerous Failures Position switch Compact Feeder	0,2 0,5	Manufacturer specifications (20%) (50%)	
d$_{op}$ Mean operating time in days per year	365 days per year	Assumption: Actuation takes place every day of the year (365 days).	User
h$_{op}$ Mean operating time in hours per day	24 hours per day		
t$_{cycle}$ Mean time between the start of two consecutive cycles of the component position switch Compact Feeder	1 h/cycle 1 h/cycle	Assumption: There is an interval of 1 hour between each protective door opening and Compact Feeder actuation.	

Interim results (are identical in this example for position switch and Compact Feeder):

Interim results		Reason
MTTF$_d$	high	MTTF$_d$ ≥ 30 years
DC	none	DC=0%
Measures against CCF	Not relevant	
Category	1	System behavior: A single fault can result in the loss of the safety function

Evaluation Parameter

		Definition
Fault exclusion	based on the use of the local input for safety related switching off at 3RA6	Siemens

Summary

	ISO 13849-1	
	PL	**Probability of dangerous failure per hour (PFH$_D$)**
Detect	c	$1{,}14*10^{-06}$ (from Annex K; see note)
Evaluate		Fault exclusion
Respond	c	$1{,}14*10^{-06}$ (from Annex K; see note)
Result	c	PL of all tasks of the supplementary safety function is at least c.

Note: The MTTF$_d$ for each channel is limited to max. 100 years!

3.4 Summary

	IEC 62061		ISO 13849-1	
	SIL CL	PFH$_D$	PL	Probability of dangerous failure per hour (PFH$_D$)
Detect	1	$1{,}2 * 10^{-09}$	c	$1{,}14*10^{-06}$
Evaluate	Fault exclusion		Fault exclusion	
Respond	1	$4{,}5 * 10^{-10}$	c	$1{,}14*10^{-06}$

Result	SIL1	PL c

4 Literature

4.1 Literature

The following list is by no means complete and only provides a selection of related references.

Table 4-1

	Source	Title
\1\	Brochure	**Functional safety of Machines and Systems – Easy Implementation of the European Machinery Directive** (Order no.: E20001-A230-M103-V1)
\2\	Technical book	Patrick Gehlen **Funktionale Sicherheit von Maschinen und Anlagen Umsetzung der Europäischen Maschinenrichtlinie in der Praxis** (Publicis Corporate Publishing, ISBN: 978-3-89578-366-1)

4.2 Internet links

The following list is by no means complete and only provides a selection of useful information.

Table 4-2

	Subject	Title
\1\	Reference to this document	http://support.automation.siemens.com/WW/view/en/45158046
\2\	Siemens I IA/DT Customer Support	http://support.automation.siemens.com
\3\	Safety Evaluation Tool	http://www.siemens.de/safety-evaluation-tool
\4\	Safety Integrated	http://www.siemens.com/safety-integrated