

AS-i Safety Input Module for optoelectronic protective devices

User Manual



...supports the requirements for AS-i Safety up to SIL3

Subject to modifications without notice.

Generally, this manual refers to products without mentioning existing patents, utility models, or trademarks.

The absence of any such references does not indicate that a product is patent-free.

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EC Declaration of conformity

Translation of the original declaration of conformity K.A. Schmersal GmbH & Co. KG
Mödinghofe 30, 42279 Wuppertal
Germany
Internet: www.schmersal.com

We hereby certify that the hereafter described safety components both in its basic design and construction conform to the applicable European Directives.

Name of the safety component:	Safe input module
Type:	ASIM-1SI-S
Description of the safety component:	Safe AS-i input module for safety switchgear with semi-conductor outputs
Relevant EC-Directives:	2006/42/EC EC-Machinery Directive 2004/108/EC EMC-Directive
Person authorized for the compilation of the technical documentation:	Oliver Wacker Mödinghofe 30 42279 Wuppertal
Notified body for the prototype test:	TÜV NORD CERT GmbH Langemarckstraße 20 45141 Essen, Germany ID n°: 0044
Certification:	44 799 12 410213 001
Place and date of issue:	Wuppertal, September 03, 2012



1. Symbol Catalog



Information!

This symbol indicates important information.



Attention!

This symbol warns of a potential failure. Non-compliance may lead to interruptions of the device, the connected peripheral systems, or plant, potentially leading to total malfunctioning.



Warning!

This symbol warns of an imminent danger. Non-compliance may lead to personal injuries that could be fatal or result in material damages and destruction.

1.1 Abbreviations

AS-i	AS-interface (actuator sensor interface)
I/O	Input/output
EMC	Electromagnetic compliance
PELV	Protective extra-low voltage
PFD	Probability of failure on demand
SaW	Safety at Work, safety technic

2. General Remarks

Please read this chapter carefully before working with the documentation and the AS-i Safety Input Module.

2.1 Product information

This user manual is valid for the following Schmersal devices:

AS-i Safety Input Module for optoelectronic protective devices	ASIM-1SI-S
-----------------------------------------------------------------------	-------------------

2.2 Function of this manual

This manual instructs for the safe assembly, electrical installation, addressing, start-up as well as for the operation and for the maintenance of the AS-i Safety Input Module.

This manual does **not** provide instructions for operating machines, on which this module is built in. Please view the appropriate machine manual for corresponding information.



Information!

Additional information concerning the technical data as well as the parameterization of the AS-i Safety Input Module can be found in data sheet ASIM-1SI-S that can be located at <http://www.schmersal.net>.

2.3 Target group

This manual is intended for designers, developers and operators of systems that will be safeguarded by one or more AS-i Safety Input Modules. The manual is also targeted to people integrating AS-i Safety Input Modules into machinery, performing the initial start-up, or maintaining them.

2.4 AS-i specification 3.0

The AS-i 3.0 devices already fulfil the AS-i specification 3.0.

The previous specifications (2.1 and 2.0) are supported as well.

3. Safety

This chapter contains user safety information.



Warning!

Please read this chapter carefully before using the AS-i Safety Input Module in combination with other machine safeguarding components on protected machinery.

3.1 Experienced staff

The AS-i Safety Input Module for optoelectronic protective devices must only be installed, operated, and maintained by qualified staff.

Qualified is a person who

- has a suitable technical education
- has been instructed in operating the machinery and has been informed about the valid safety guidelines by the machinery operator
- has access to the user manual.

3.2 Application area of the device

The module ASIM-1SI-S is used for connecting a self tested optoelectronic protective device. Moreover, it has got two non-safety related outputs.



Attention!

Don't use the the outputs for safety related functions.



Warning!

- The module is an ESD unsecured building group. When assembling the relevant ESD preventive measures are to be kept!

3.3 Correct use

The AS-i Safety Input Module for optoelectronic protective devices must only be used as defined in chap. Application area of the device. The AS-i Safety Input Module for optoelectronic protective devices must only be used on the system, at which it was installed in accordance with this manual by adept personnel.



Information!

If used in a way differing from this description or if the device has been changed in any way – even during installation – any warranty claims with respect to Schmersal are invalid.

3.4 Disposal



Information!

Electronic waste is hazardous waste. Please comply with all local ordinances when disposing this product!

The device does not contain batteries that need to be removed before disposing it.

4. Product Description

This chapter is intended to inform the reader about the special characteristics of the AS-i Safety Input Module for optoelectronic protective devices. It describes the design and the functionality of the devices.



Warning!

This chapter must be read before installation and operation of the device in conjunction with other safety components on protected machinery.

4.1 AS-i Safety at Work

AS-i Safety at Work combines safe and non-safe data on a bus system. The classification AS-i Safety at Work identifies the safe data transfer that enables the integration of safety procedures in an AS-i network.

The components of AS-i Safety at Work conform to EN 50295 and are compatible with all other AS-i components. Therefore, existing AS-i applications can easily be extended with safety-relevant functions.

AS-i Safety at Work always requires a Safety Monitor (as a stand-alone device or integrated into a Gateway), that evaluates the safe signals on the bus, and a safe AS-Interface bus connection, that enables the transfer of safe signals from safety-relevant components (AS-i SaW input).

Additionally, decentralized safe AS-I SaW outputs can be added. Controlled by the Safety Monitor these outputs can be used to safely switch off safe actuators.

Several Safety Monitors and safe input and output slaves can be used on an AS-i system. At the same time, the Safety Monitors can be parameterized and, thus, be checked through AS-i and the configuration software.



Information!

By utilizing AS-i Safety at Work safety requirements up to category 4 according to EN 954-1 and additionally performance level "e" according to EN 13 849 as well as SIL 3 according to EN 62 061 can be satisfied.

In order to satisfy the requirements of these safety categories, all peripheral components, for instance the Safety Monitors, all safe bus connections, and all connected sensors must satisfy these standards.

4.1.1 Special characteristics of the AS-i Safety Input Module for optoelectronic protective devices

The module ASIM-1SI-S is a 1I/2O safety input slave.

Further characteristics:

- 2/1 safety inputs with 2 channels for floating contacts
- 2 standard semiconductor outputs
- the two input channels are monitored concerning cross-connection against each other
- supports AS-i Safety applications up to category 4/SIL3
- optical indication of inputs/outputs via LEDs

Product Description

- outputs are short-circuit, overload and pole protected
- the outputs and the sensors are powered galvanically isolated out of separate 24 V
- integrated watchdog function for non-safe outputs (depending on parameter)
- connection for an address programming device (handheld)

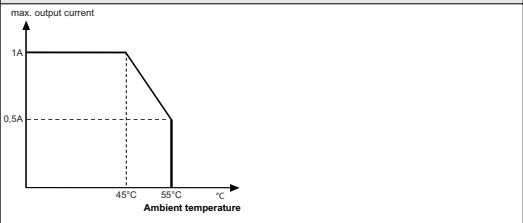
Product Description
4.2 Technical data

Article no.	ASIM-1SI-C / ASIM-1SI-S
Connection	
Connection	COMBICON
Length of connector cable	I/O: max. 15 m
AS-i	
Voltage	22 ... 31,6V
AUX	
Voltage	24V (20 ... 30V DC) (PELV)
Output	
Number	2, electronic, short-circuit-protected
Power supply of outputs	out of AUX voltage
Display	
LED AUX (green)	24V DC AUX on
LED OUT (yellow)	2x outputs
Environment	
Applied standards	EN ISO 13849-2:2008 EN 61 000-6-2, EN 61 000-6-4 EN 62 061:2005 SIL3 EN 954-1 cat 4 EN 50 295
Protection category EN 60 529	IP20 (only suitable for use in electrical operating rooms / control cabinets with IP 54 minimum protection rating)
Allowable shock and vibration stress	≤ 15 g, T ≤ 11 ms 10 ... 55 Hz, 0,5 mm amplitude
Dimensions (W / H / D in mm)	22,5 / 99,6 / 50,5

Product Description

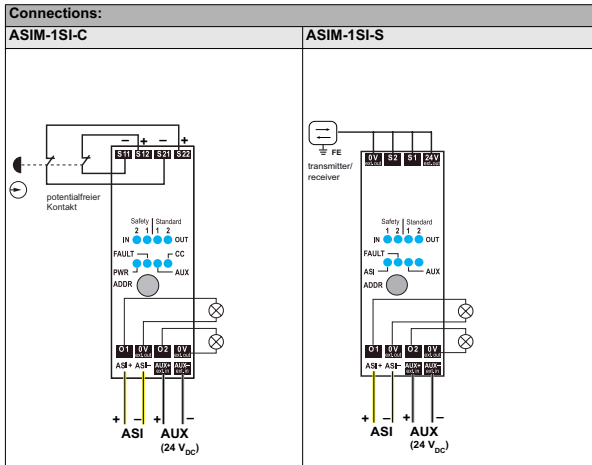
Article no.	ASIM-1SI-C	ASIM-1SI-S
AS-i		
Profile	S-7.B.0, ID1=F	S-7.B.1, ID1=F
Max. current input out of AS-i	< 80mA	60mA
AUX		
Max. current input out of AUX	1,5A at output short-circuit	4A max.
Input		
Number	2 / 1 safe inputs (2 channels) for floating contacts	2 / 1 safe inputs (2 channels) for OSSDs
Power supply of inputs	out of AS-i voltage	out of AUX voltage
Switching threshold	10mA, R < 150Ω	$V_{in} > 11V$ for High-Level, input current $\geq 2,5mA$ at 15V
Power supply for external sensor	–	1,8A out of AUX voltage
OSSD input test pulses	–	0 ... 50 Hz
OSSD input test pulse width	–	$U_{aux} \geq 21,5V = 0 \dots 1 \text{ ms}$ test pulses possible $U_{aux} \geq 17V = 0 \dots 0,8 \text{ ms}$ test pulses possible $U_{aux} < 17V = 0 \dots 0,6 \text{ ms}$
Output		
Max. output current	200mA per output	1A per output*
Display		
LED ASI (PWR) (green)	AS-i power supply on	
LED FLT / FAULT (red)	red: communication error or address is 0 red, flashing: overload, internal supply of the in-/outputs	red: AS-i communication error, slave does not participate in the normal exchange of data, e.g. slave address 0 red, flashing: overload or AUX voltage missing
LED CC (red)	cross-connection of the input lines, peripheral fault	–
LED IN (yellow)	2x safe inputs	
Environment		
Applied standards	–	EN 61 131-2
	EN ISO 13 849-1:2008/PLe Kat 4	
Operating temperature	0°C ... +70°C	0°C ... +55°C
Storage temperature	-40°C ... +85°C	

***Derating ASIM-1SI-S**



Product Description

Programming:	AS-i Bit-setting			
	D0	D1	D2	D3
	Safe input			
ASIM-1SI-C	S11 / S12		S21 / S22	
ASIM-1SI-S	S1		S2	
	Output			
ASIM-1SI-C / ASIM-1SI-S	O1	O2	not used	not used
	Parameter bit			
	P0: watchdog (0 off / 1 on), P1, P2, P3 not used			



4.3 Safety relevant data

Identification data	Value	Standard
Safety category	4	EN 954-1
Safety category	4	EN ISO EN 13 849-2: 2008
Performance level (PL)	e	EN ISO EN 13 849-1: 2008
Safety Integrity Level (SIL)	3	EN 62061
Usage time (TM) in years	20	EN ISO EN 13 849-2: 2008 EN ISO EN 13 849-1: 2008
Maximum operating time in months	12	EN 62061
PFD	8,00E ⁻⁰⁷	EN 61508
PFH _D (Probability of a dangerous failure per hour)	1,48E ⁻⁰⁹	EN 61508
	2,83E ⁻⁰⁹	EN 62061
Max. system reaction time	10 ms	EN 62061

To determine the safety characteristics (PFD and PFH), the values of all components using this function are to be considered. The ASIM-1SI-S module provides no significant contribution to the PFD or PFH values of the complete system. For the values of other components, please refer to relevant documentation.

4.4 Requirements for the voltage supply +24 V_{EXT} (AUX)



Information!

The externally connectable circuits are to be separated from the net absolutely reliable!

The power supply +24 V_{EXT} may only occur via SELV or PELV networks.

4.5 Response time

The response time corresponds to the load-time in the AS-i Safety Input Module. It is the maximal (i.e. also in the case of an error) required time between the opening of the switching contacts and the operational availability in the AS-i chip of the slave.

For the computation of the safety distance of a protective device you must consider (among others) following things:

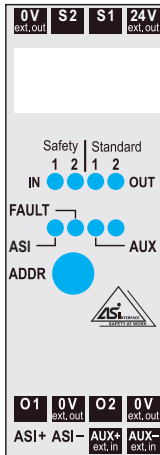
- the response time of the AS-i Safety Input Module
- the response time of the AS-i Safety Monitor
- the follow-up time of the machine or production line



Information!

Please view the appropriate manual to find information about response time of the particular devices.

4.6 Front view and connections



In 1/2

State inputs OSSD 1/2

Out 1/2

State outputs Out 1/2 // état sorties Out 1/2 // stato uscite Out 1/2

ASI (PWR)

AS-i supply power

FAULT

AS-i communication error

AUX

auxiliary voltage

S1, S2

safe input terminal

O1, O2

connection to output O1/O2

0V_{ext.out}

reference potential for the outputs and protectiv devices

24V_{ext.out}

supply voltage for electronic protectiv devices

ASI+/-

AS-i connection

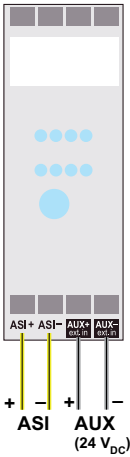
Aux+/-_{ext.in}

Supply voltage for the conventional outputs and voltage supply input for the electrical protective devices

ADDR

addressing jack

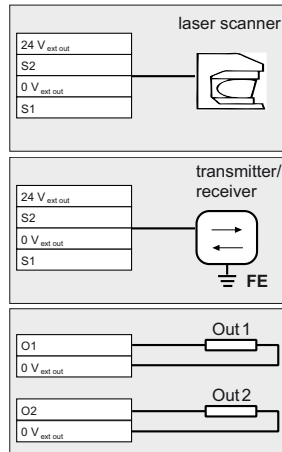
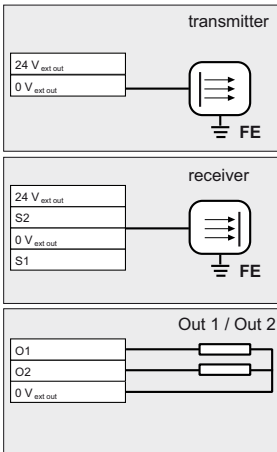
4.7 Connection to AS-i and external 24 V supply



Attention!

The AS-I power supply for the AS-I components must have isolation per IEC 60 742 and be able to handle momentary power interruptions of up to 20 ms. The power supply for the 24 V supply must also have isolation per IEC 60 742 and be able to handle momentary power interruptions of up to 20 ms. The maximum output voltage of the power supply must also be less than 42 V in case of a fault.

4.8 connection examples














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The correct safety function of the device must be verified once installed within the protected machinery!

4.9 LEDs

LEDs	Status	Signal // Description
ASI (PWR)	green	 No supply power
		 Supply power on
FAULT	red	 AS-i communication OK
		 Peripheral fault
		 AS-i communication error
AUX	green	 No auxiliary voltage
		 Auxiliary voltage OK
OUT 1, Out 2	yellow	 Output switched off
		 Output switched on
In 1, In 2		 Corresponding input not switched on
		 Corresponding input switched



LED



LED flashing



LED off

4.10 addressing with AS-i Master

⇒ addressing description is provided in the installation instruction of your AS-i master



Information!

addressing is possible also with hand addressing devices



The correct safety function of the device must be verified once installed within the protected machinery!

5. Maintenance

5.1 Controlling safe shutdowns

The plant safety engineer is responsible for verifying that the AS-i Safety Input Module for optoelectronic protective devices works correctly as part of the safety system.

At least once a year it is necessary to verify the safe shutdown by initiating associated safety-related sensors or switches:

**Attention!**

Press each safety-related AS-i slave and watch the reaction of the output circuits of the AS-i Safety Monitor.

**Attention!**

After reaching the projected maximum operating time (twelve months) the entire safety system must be checked for proper operation.

After reaching the projected total usage time (20 years) the device must be checked by the manufacturer concerning its proper operation.

6. Safety Requirements

6.1 Requirements acc. to SIL3 and/or PLe

- To achieve SIL3 and PLe respectively an appropriate switch has to be connected.
- The module transmits the two channels` switching status only. The interpretation regarding synchronous run and chronological synchronism of the two channels happens inside the AS-i Safety Monitor. For this an appropriate monitoring function block must be selected. This function block must be parameterized according to the system to be monitored.

6.2 Requirements for use in a Safety Category 4 environment

Safe turn-off must be checked at regular intervals (a recommended value is 3 months).

6.3 Recommendation for improved availability of the function

The switching contacts should be turned off for at least 41 ms, since the safety monitor (depending on the set monitoring component) must recognize the INPUT OFF for a minimum number of AS-i telegrams. IF the minimum off time of 41 ms (depending on the number of slaves on the AS-i bus and the set monitoring component) is maintained, correct recognition of the input state is assured. Non-observance of this time may limit the availability of the AS-i Safety Monitor as follows:

- A setting of TWO-CHANNEL POSITIVE OPENING can cause the Safety Monitor to go into the error state; to eliminate the error state, the supply voltage for the Safety Monitor must be disconnected.
- A setting of TWO-CHANNEL DEPENDENT means the Safety Monitor allows release only after a sufficient off-time; the release can be achieved if the switching contacts are turned off for at least 41 ms .

7. SIL3 for single-channel sensor connecting

1. Overview

Intelligent, self-monitoring safety sensors can not only output their signal on two channels, but also over a single cable if certain errors are excluded.

This signal can fully meet **SIL3** requirements and should also be processed using this safety integrity level.

Here we will describe how this is accomplished and under what conditions.

2. Error Exclusion

To connect signals to **SIL3** the following errors must be excluded from the customer side:

- The switching signal is reliably generated (switching signal corresponds to **SIL3**), e.g. by means of two positive-opening relays wired in series.
- The signal line is configured such that an error exclusion can be accomplished for the cable with respect to contact with external potentials.

3. Wiring Diagram

As shown in <Wiring diagram> the output is routed to two different inputs. The clock outputs on the safety input module are not used.

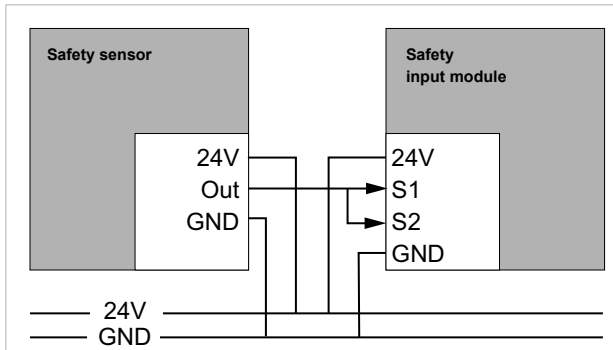


Abb. 7-1. Wiring diagram

4. AS-i Safety Monitor

In the AS-i Safety Monitor a module connected in this way must be monitored using the "2-channel positive-opening" monitoring module.

Now discrepancy times of more than 100 ms will result in an error lock.

5. Summary

When connecting according to <Wiring diagram>, for the Schmersal devices

- ASIM-1SI-S

Noting the following requirements

- The switching signal is reliably generated (switching signal corresponds to SIL3), e.g. by means of two positive-opening relays wired in series.
- The signal line is configured such that an error exclusion can be accomplished for the cable with respect to contact with external potentials.
- "2-channel positive-opening" monitoring module is used.
- Shut-off testing every 12 months

SIL3 also ensured with just a single connection cable.**Information!**

*If the switching signal meets only **SIL2**, then when connecting as described in this document an overall level of **SIL2** is achieved.*