

AS-i Safety Relay Output Module with Diagnostic Slave

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
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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 output module

Type: ASOM-1SO-R2

Description of the safety component: Safe AS-i output module with relay enabling

Relevant EC-Directives: 2006/42/EC EC-Machinery Directive
2004/108/EC EMC-Directive

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EC-prototype test certificate: 44 205 12 410213 007

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)
AOPD	Active opto-electronic protective device
CRC	Cyclic redundancy check
I/O	Input/output
EDM	External device monitoring
EMC	Electromagnetic compliance
ESD	Electrostatic discharge
PELV	Protective extra-low voltage
PFD	Probability of failure on demand
PLC	Programmable logic control
SaW	Safety at Work, safety technic

2. General Remarks

Please read this chapter carefully before working with the documentation and the "AS-i Safety Relay Output Module with Diagnostic Slave".

2.1 Product information

This user manual is valid for the following Schmersal devices:

AS-i Safety Relay Output Module with Diagnostic Slave and 1 EDM input	ASOM-1SO-R2
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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 Output Relay.

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 Output Relay can be found in data sheet ASOM-1SO-R2 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 Output Relays. The manual is also targeted to people integrating AS-i Safety Output Relays into machinery, performing the initial start-up, or maintaining them.

2.4 AS-i specification 3.0

The "AS-i Safety Relay Output Module with Diagnostic Slave" is designed according to the AS-i specification 3.0.

Earlier specifications (2.1 and 2.0) continue to be fully supported.

3. Safety

This chapter contains user safety information.



Warning!

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

3.1 Experienced staff

The AS-i Safety Relay Output Module with Diagnostic Slave 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 ASOM-1SO-R2 is a decentralized output-module that safely controls actuators on the AS-i Safety at Work (SaW) safety bus system.

In this set-up, a Safety Monitor or a Gateway with integrated Safety Monitor, respectively, controls the ASOM-1SO-R2.

A special characteristic of this module is its two different kinds of AS-i addresses:

- Safe AS-i address
ASOM-1SO-R2 listens to the communication on the safe address and switches based on these data.
- Non-safety relevant AS-i address
The non-safety relevant AS-i address is used for diagnostic purposes and for switching under PLC control.

All SaW output modules with the same safe AS-I address switch at the same time.

The ASOM-1SO-R2 is certified according to EN 62 061, SIL 3, and EN 13 849, performance level e.

3.3 Correct use

The AS-i Safety Relay Output Module with Diagnostic Slave must only be used as defined in chap. Application area of the device. The AS-i Safety Relay Output Module with Diagnostic Slave 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 Relay Output Module with Diagnostic Slave. 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 Output Relay

- Two redundant, force-guided relays
- Two parallel, galvanically isolated contact sets
- 4 standard inputs
- External sensors supplied from AS-i
- Programming jack
- Operating mode selector switch

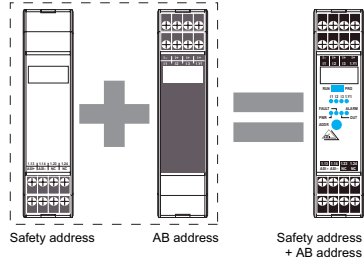
4.2 Technical Data

Article no.	ASOM-1SO-R2
Inputs	1 diagnostic + 1 EDM
Outputs	1 relay 3A, 24V, DC-13 or 3A, 230V, AC-15
AS-i profile	S.7.A.E
ID1 Code	5 _{hex} (default), value modifiable
External device monitoring (EDM)	supplied out of AS-i, approx. 24V, approx. 10 mA
Indicators	
3 x LED yellow (I1, I2, I3)	state of standard inputs I1, I2, I3
1 x LED yellow (1.Y1)	state EDM input 1.Y1
LED green (PWR)	AS-i voltage ON
LED red (FAULT)	AS-i Fault
LED yellow (OUT)	for definition see table "device color"
LED red (ALARM)	PLC indicates alarm
Operating current	< 200mA
Current supply of sensors	90mA
Operating voltage	AS-i (30V _{DC})
Voltage of insulation	≥ 6 kV
Applied standards	EN 954-1 Cat 4 IEC 61 508 SIL 3 EN 13 849-1/PLe Cat 4 EN IEC 62 061 SIL 3
Housing	Din-rail mounting
Ambient operating temperature	0°C ... +55 °C
Storage temperature	-25°C ... +85 °C
Dimensions (L / W / H in mm)	114 / 22,5 / 99
Protection class DIN EN 60 529	Housing IP20

ASO-1SO-R2:

2 AS-i modules in one housing!

1 safety relay output 1 diagnostic- and 1 EDM input ASOM-1SO-R2



Product Description

Diagnostic operation ID1 = 5_{hex} (default)

Programming instructions (Bit values of inputs/outputs Diagnostic Slave)

Bit	AS-i output	Bit	AS-i input
O0	1: Alarm LED <i>on</i> 0: Alarm LED <i>off</i>	I0	Diagnostic (for definition see table device colors)
O1	Parameter P1=1 not used	I1	
	Parameter P1=0 1: output controlled by safety release 0: inhibits output on irrespective of safety release		
O2	not used	I2	
O3	inexistent	I3	1.Y1

Diagnostic (device colors)

Value	Color	Description	State change	LED "Out"
0	green	output on		on
1	green flashing	–		–
2	yellow	restart inhibit	auxiliary signal 2	1 Hz
3	yellow flashing	–		–
4	red	output off		off
5	red flashing	waiting for "reset of error condition"	auxiliary signal 1	8 Hz
6	grey	internal error, such as "fatal error"	only via "Power On" on device	all LEDs flashing
7	green/yellow	output released, but not switched on	switching-on by setting of O1	off

Programming instructions

Programming instructions Diagnostic Slave (bit values of the AS-i parameter)

Bit	P1
P1=1	safety output controlled by safety release only
P1=0	safety output controlled by output O1 in addition to safety release
Bits P0, P2, P3:	
not used	

Release		AS-i Safety Relay Output Module, safety release from the AS-i safety monitor...	
		... not received	... received
AS-i Parameter (Diagnostic Slave) changes the function of output bit O1	AS-i Parameter P1=1 (default) O1=0	safety output contact set open	safety output contact set closed
	AS-i Parameter P1=1 O1=1	safety output contact set open	safety output contact set closed
	AS-i Parameter P1=0 O1=0	safety output contact set open	safety output contact set open
	AS-i Parameter P1=0 O1=1	safety output contact set open	safety output contact set closed

3I standard inputs (instead of diagnostic) ID1=7_{hex}, or ID1=F_{hex}

Connection of sensors

Programming instructions (Bit values of inputs/outputs AB-Slave)

Bit	AS-i output	Bit	AS-i input
O0	1: Alarm LED <i>on</i> 0: Alarm LED <i>off</i>	I0	I1
O1	Parameter P1=1 not used	I1	I2
	Parameter P1=0 1: output controlled by safety release 0: inhibits output on irrespective of safety release		
O2	not used	I2	Parameter P2=0 Parameter P2=1
			I3 1: feedback for user: safety release on 0: feedback for user: safety release off
O3	inexistent	I3	1.Y1

Issue date: 30.1.2013

Product Description

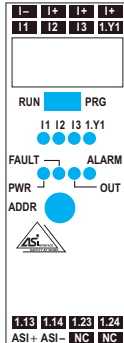
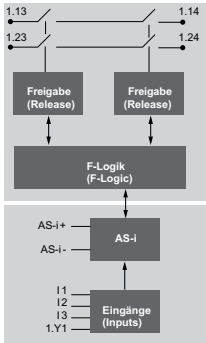
Programming instructions

Programming instructions AB slave (bit values of the AS-i parameter)

Bit P2	
P2=1	feedback: safety release at AS-i bit I2 / LED I3
P2=0	input I3 at AS-i bit I2
Bit P1	
P1=1	safety output controlled by safety release only
P1=0	safety output controlled by output O1 in addition to safety release
Bits P0, P3	
not used	

Release		AS-i Safety Relay Output Module, safety release from the AS-i safety monitor...	
		... not received	... received
AS-i parameter (AB slave) changes the function of output bit O1	AS-i Parameter P1=1 (default) O1=0	safety output contact set open	safety output contact set closed
	AS-i Parameter P1=1 O1=1	safety output contact set open	safety output contact set closed
	AS-i Parameter P1=0 O1=0	safety output contact set open	safety output contact set open
	AS-i Parameter P1=0 O1=1	safety output contact set open	safety output contact set closed

Operating elements and clamp assignment



Clamps/Switch	Description
I1, I2, I3	standard inputs I1, I2 and I3
1.13, 1.14	safety output contact set 1
1.23, 1.24	safety output contact set 2
I-, I+	supply voltage for inputs (out of AS-i)
1.Y1	EDM / input for electronic device monitoring
AS-i+, AS-i-	AS-i network connection
ADDR	addressing socket
PRG	protective mode not possible. Programming of safety-related AS-i address enabled
RUN	protective mode possible. Programming of non safety-related AS-i address enabled

Product Description

LEDs	State	Signal / Description
PWR (green)		no operating voltage
		operating voltage present, safety-related AS-i address and/or AS-i AB address is „0“
		operating voltage present
FAULT (red)		AS-i communication OK
		no data exchange with AB slave
OUT (yellow)		output relays contacts open
		restart inhibit, waiting for the start signal, the output relays switch-on after the start signal
		device is in unlockable error state. Waiting for "reset of error condition signal". After receiving this signal the device follows up with normal operation.
		output relays contacts closed
ALARM (red)		AS-i output bit A0 is <i>not</i> set
		AS-i output bit A0 is set
I1, I2, I3, 1.Y1 (yellow)		the corresponding input is <i>not</i> connected (mode standard inputs) or release has not been issued (I3, diagnostic mode)
		the corresponding input is connected (mode standard inputs) or release has not been issued (I3, diagnostic mode)
		(running light) switch is adjust to PRG position

LED on LED flashing LED off

	In case all LEDs are blinking simultaneously in fast rhythm a fatal error has been detected. This message is reset by a short-run disconnection of the power supply (Power On Reset).
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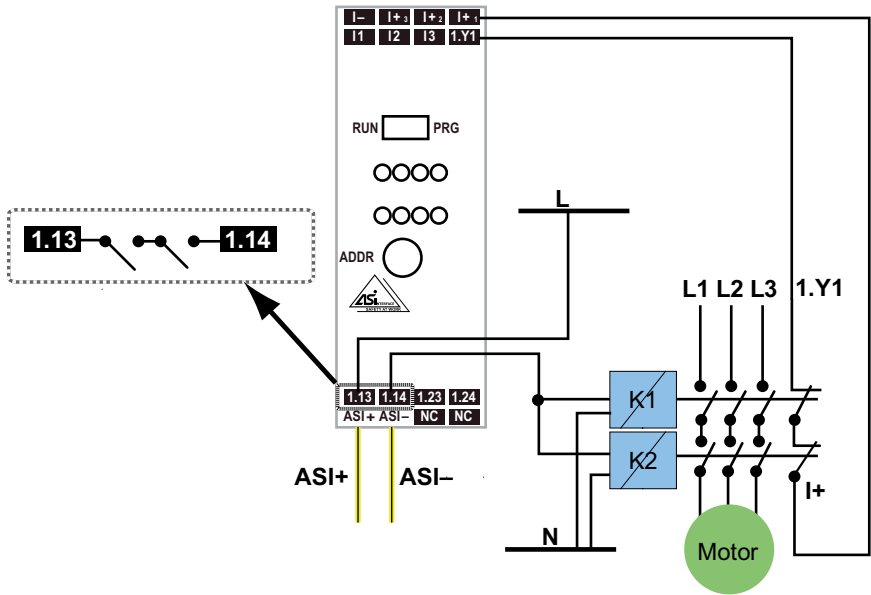
4.3 Safety relevant data

Identification data	Value	Standard
Safety category	4	EN 954-1
Safety category	4	EN 13849-1:2006/PLe Cat 4
Performance level (PL)	e	
Safety Integrity Level (SIL)	3	IEC 61508
Usage time (TM) in years	20	EN 13849-1:2006/PLe Cat 4
Maximum operating time in month	12	IEC 61508
PFD ¹	$2 \cdot 10^{-5}$	IEC 61508 EN 62061
PFH _D ¹ (Probability of a dangerous failure per hour)	$3,3 \cdot 10^{-9}$	IEC 61508 EN 62061
Max. system reaction time in milliseconds	50	IEC 61508

Tab. 4-1.

1.) The PFD and PFH D values stated here are related to the maximum operating time of 12 month and a maximum usage time of 20 years according to EN ISO 13849-1.
The relay's maximum switch time (including the occurrence of errors) is 50 ms starting at the time the code sequence is present until the switch-off of the relay. Additionally, the response time of the monitor and the inputs must be included.

4.4 Connecting a safety contactor



5. Maintenance

5.1 Controlling safe shutdowns

The plant safety engineer is responsible for verifying that the AS-i Safety Relay Output Module with Diagnostic Slave 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!**

Check the maximum activated time and the total operating time. These values depend on the PFD value chosen for the total failure probability. Please refer to the information in chap. Safety relevant data.

After reaching the projected maximum operating time (three, six, or 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. Address Assignment

The device offers two different types of AS-i addresses:

The safety relevant (single) AS-i address is the target address for the device through which it receives the signal for the safe release of the output. This address is not used for communication; the device only uses it to listen to ongoing communications.

This address can only be programmed if the switch is set to PRG.

The device uses the non-safety relevant (A/B) AS-i address to communicate with the master in order to exchange diagnostics data (I1 ...I3, 1.Y1) and control signals (Alarm LED).

This address can only be programmed if the switch is set to RUN.

6.1 Programming of the safety relevant AS-i address

1. Set device switch to PRG.
2. Set desired address by using the hand-held addressing device or AS-i Master.
3. Check programmed address by using the hand-held addressing device or AS-i Master.
4. Check slave's ID code by using the hand-held addressing device or AS-i Master. The code should be set to "F".
5. Check slave's ID1 code by using the hand-held addressing device or AS-i Master. Code should be the same as the tens-digit of the address.
6. Check slave's ID2 code by using the hand-held addressing device or AS-i Master. The code should be the same as the ones-digit of the address.
7. Check slave's IO code by using the hand-held addressing device or AS-i Master. The code should be "7".
8. If the settings in steps 3 to 7 were correct continue with step 9. Otherwise repeat, starting with step 1.
9. Set the switch on the device to RUN.



Warning!

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

6.2 Programming of the non-safety relevant AS-i address

This address can be programmed by using the hand-held addressing device or AS-i Master when the switch is set to RUN.

7. Safety Requirements

- The device uses two redundant, force-guided relays.
- The module recognizes if one of the relays does not switch (for instance if the contacts are welded).
- The contact sets 1.13/1.23 and 1.14/1.24 use the same relay; they do not operate independently.
- The contacts 1.13, 1.23, 1.14, 1.24 are potential-free. A cross-short check is not available.
- If the device is set up to control two independent safety contactors, connected in series, the connection between the safety contactors and the device must never be subjected to another potential as this could result in the inadvertent activation of the safety contactors.
- Input 1.Y1, just like inputs I1... I3, is a standard AS-i input.