ACT20X-2HAI-2SAO
2-channel HART transparent current supply isolator

Safety Manual

Weidmüller

1.1 Revision history

Version	Date	Change
00	04/2014	First Edition
01	11/2017	Product added

1.2 Validity

This manual is valid for the following product:

Device version	Type	Order number
2	ACT20X-2HAI-2SAO-S	8965440000
2	ACT20X-2HAI-2SAO-P	2456150000

1.3 Contact address

Weidmüller Interface GmbH & Co. KG
Klingenbergstraße 16
32758 Detmold
Germany

T +49 5231 14-0
F +49 5231 14-292083
www.weidmueller.com

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2. Observed standards

Standard	Description
IEC 61508	Functional safety of electrical / electronic / programmable electronic safety-related systems
IEC 61508-2:2000	Part 2: Requirements for electrical / electronic / programmable electronic safety-related systems

3. Acronyms and abbreviations

Acronym / Abbreviation	Designation	Description
Element		Term defined by IEC 61508 as “part of a subsystem comprising a single component or any group of components that performs one or more element safety functions”.
PFD	Probability of Failure on Demand	This is the likelihood of dangerous safety function failures occurring on demand.
PFH	Probability of dangerous Failure per Hour	The term “Probability” is misleading, as IEC 61508 defines a rate.
SFF	Safe Failure Fraction	Safe Failure Fraction summarizes the fraction of failures which lead to a safe state and the fraction of failures which will be detected by diagnostic measures and lead to a defined safety action.
SIF	Safety Integrity Function	Function that provides fault detection (to ensure the necessary safety integrity for the safety functions).
SIL	Safety Integrity Level	The international standard IEC 61508 specifies four discrete safety integrity levels (SIL 1 to SIL 4). Each level corresponds to a specific probability range regarding the failure of a safety function.

4. Purpose of the product

The ACT20X-2HAI-2SAO current supply isolator is a 2-channel HART transparent current supply isolator for analogue input signals. The device repeats passive and active 4...20 mA current signals from hazardous areas to non-classified areas. The device can be mounted in non-classified areas or in Zone 2 / Division 2 and receive current signals from Zone 0, 1, 2, 20, 21, 22 and mines or Class I/II/III, Division 1, Group A-G. Error events, including cable breakage, are monitored and signaled via the individual status relay.

The FDT/DTM software can be use to show the process values and alter the set point for high and low limit. The ACT20X-2HAI-2SAO has been designed, developed and certified for use in SIL applications according to the requirements of IEC 61508 individual status relay.

5. Assumptions and restrictions for use of the product

5.1 Basic safety specifications

Operational temperature range:	-20...+60 °C
Storage temperature range:	-20...+85 °C
Power supply type:	Double or reinforced
Supply voltage:	19.2...31.2 V DC
Loop supply:	15 V @ 20 mA
Max. external output supply voltage:	26 V DC
Mounting area:	Class I, Zone 2 / Division 2 or safe area
Mounting environment:	Pollution degree 2 or better, Overvoltage category II

5.2 Safety accuracy

The analogue output corresponds to the applied input within the safety accuracy.

Safety accuracy:	±2 %

5.3 Analogue output

The connected safety PLC shall be able to detect and handle the fault indications from the analogue output of the ACT20X-2HAI-2SAO current supply isolator by having a NAMUR NE43-compliant input circuit.

5.4 Failure rates

The basic failure rates from the Siemens standard SN 29500 are used as the failure rate database. Failure rates are constant; wear-out mechanisms are not included. External power supply failure rates are also not included.

5.5 Installation in hazardous areas

The IECEx installation drawing, ATEX installation drawing and FM installation drawing shall be followed, if the products are installed in or connected to hazardous areas.

5.6 Installation in SIL 3 applications

The independence of the safety functions enables the use of the two channels in a ACT20X-2HAI-2SAO HART transparent repeater device, in a SIL 3 safety function when both inputs are connected in series. The safety PLC or equivalent connected to the output shall be able to detect and handle the fault indications from both analogue outputs of the ACT20X-2HAI-2SAO repeater by having NAMUR NE43-compliant input circuits and must be able to compare the two channels.

6. Functional specification of the safety functions

Galvanic isolation of an active or passive 4...20 mA current signal from hazardous areas to an active or passive 4...20 mA output signal in non-classified areas or Zone 2 / Division 2, within the specified accuracy.

7. Functional specification of the non-safety functions

The status relay (terminal 53 and 54) and LED outputs are not suitable for use in any Safety Instrumented Function. The displayed value and any possible parameterization by the FDT/DTM software do not affect the safety function of the ACT20X-2HAI-2SAO. Also the HART transparency of the device is not a safety function.

8. Safety parameters

Configuration overview of the ACT20X-2HAI-2SAO

ID	Description
C1	Single active input and active output
C2	Single active input and passive output
C3	Single passive input and active output
C4	Single passive input and passive output
C5	Dual active input and dual active output
C6	Dual active input and dual passive output
C7	One passive input and one active input and dual active output
C8	One passive and one active input and dual passive output

Safety parameter	**Ex input SIL 2**
Proof-test interval (T_{proof}), (10 % of loop PFD)	5 years
Demand mode	High
Demand rate	(see note 1)
Mean Time To Repair (MTTR)	24 h
Hardware Fault Tolerance (HFT)	0
Component type	A
SIL capability	SIL 2
Description of the “safe state”	Output ≤ 3.6 mA or Output ≥ 21 mA

Note 1: Depends on detection time in external controller. If detection time is xx seconds, the demand rate shall be 100 times xx seconds.

ID	**PFD_{AVG}**			**PFH (see note 1)**
	T_{proof} = 1 year	**T_{proof} = 2 years**	**T_{proof} = 5 years**	
C1	1.92×10^{-4}	3.67×10^{-4}	8.92×10^{-4}	4.1×10^{-8} h^{-1}
C2	1.95×10^{-4}	3.71×10^{-4}	9.02×10^{-4}	4.1×10^{-8} h^{-1}
C3	1.91×10^{-4}	3.64×10^{-4}	8.84×10^{-4}	4.0×10^{-8} h^{-1}
C4	1.93×10^{-4}	3.68×10^{-4}	8.94×10^{-4}	4.1×10^{-8} h^{-1}

PFD_{AVG} = Average Probability of Failure on Demand

PFH = Probability of dangerous Failure per Hour

Note 1: The ACT20X-2HAI-2SAO contains no lifetime limiting components, therefore the PFH figures are valid for up to 12 years, according to IEC 61508.

Safety parameter	**Ex input SIL 3**
Proof-test interval (T_{proof}), (10 % of loop PFD)	2 years
Demand mode	High
Demand rate	(see note 1)
Mean Time To Repair (MTTR)	24 h
Hardware Fault Tolerance (HFT)	0
Component type	A (see note 2)
SIL capability	SIL 3 (see note 3)
Description of the “safe state”	Output ≤ 3.6 mA or Output ≥ 21 mA

Note 1: Depends on detection time in external controller. If detection time is xx seconds, the demand rate shall be 100 times xx seconds.

Note 2: Simple device (type A) where microprocessors and software have no effect on safety output.

Note 3: The use of ACT20X-2HAI-2SAO in SIL 3 applications requires that the connected PLC is suitable for SIL 3 applications (see chapter 5.6 "Installation in SIL 3 applications").

ID	**PFD_{AVG}**			**PFH (see note 1)**
	T_{proof} = 1 year	**T_{proof} = 2 years**	**T_{proof} = 5 years**	
C5	4.25×10^{-5}	8.04×10^{-5}	1.94×10^{-4}	1.1×10^{-8} h^{-1}
C6	4.27×10^{-5}	8.09×10^{-5}	1.95×10^{-4}	1.1×10^{-8} h^{-1}
C7	4.23×10^{-5}	8.01×10^{-5}	1.93×10^{-4}	1.1×10^{-8} h^{-1}
C8	4.26×10^{-5}	8.05×10^{-5}	1.94×10^{-4}	1.1×10^{-8} h^{-1}

PFD_{AVG} = Average Probability of Failure on Demand

PFH = Probability of dangerous Failure per Hour

Note 1: The ACT20X-2HAI-2SAO contains no lifetime limiting components, therefore the PFH figures are valid for up to 12 years, according to IEC 61508.

9. Failure category SIL 2 / 3

SIL 2 failure rates according to IEC 61508	C1	C2	C3	C4
Total failure rate for dangerous detected failures (λ_{DD})	173 FIT	174 FIT	160 FIT	160 FIT
Total failure rate for dangerous undetected failures (λ_{DU})	41 FIT	41 FIT	40 FIT	41 FIT
Total failure rate for all safe failures (λ_{Safe})	177 FIT	177 FIT	164 FIT	165 FIT
Safe Failure Fraction (SFF)	89 %	89 %	89 %	88 %

FIT = 10^{-9} h^{-1} (Failure in time)

SIL 3 failure rates according to IEC 61508	C5	C6	C7	C8
Total failure rate for dangerous detected failures (λ_{DD})	377 FIT	376 FIT	363 FIT	363 FIT
Total failure rate for dangerous undetected failures (λ_{DU})	11 FIT	11 FIT	11 FIT	11 FIT
Total failure rate for all safe failures (λ_{Safe})	315 FIT	316 FIT	304 FIT	305 FIT
Safe Failure Fraction (SFF)	98 %	98 %	98 %	98 %

FIT = 10^{-9} h^{-1} (Failure in time)

10. Hardware and software configuration

All configurations of software and hardware versions are fixed from factory and cannot be changed by end-user or reseller.

This manual only covers products labeled with the product version (or range of versions) specified on the front page.

11. Periodic proof test procedure

Step	Action
1	Bypass the safety PLC or take other appropriate action to avoid a false trip.
2	Connect a simulator identical to the input setup.
3	Apply input value corresponding to 0/100 % output range to each channel.
4	Observe whether the output channel acts as expected.
5	Restore the input terminals to full operation.
6	Remove the bypass from the safety PLC or otherwise restore normal operation.

This test will detect approximately 95 % of possible “DU” (dangerous undetected) failures in the pulse isolator. The proof test is equivalent to the functional test.

12. Procedures to repair or replace the product

Any failures that are detected and that compromise functional safety should be reported to the sales department at Weidmüller Interface GmbH & Co. KG.

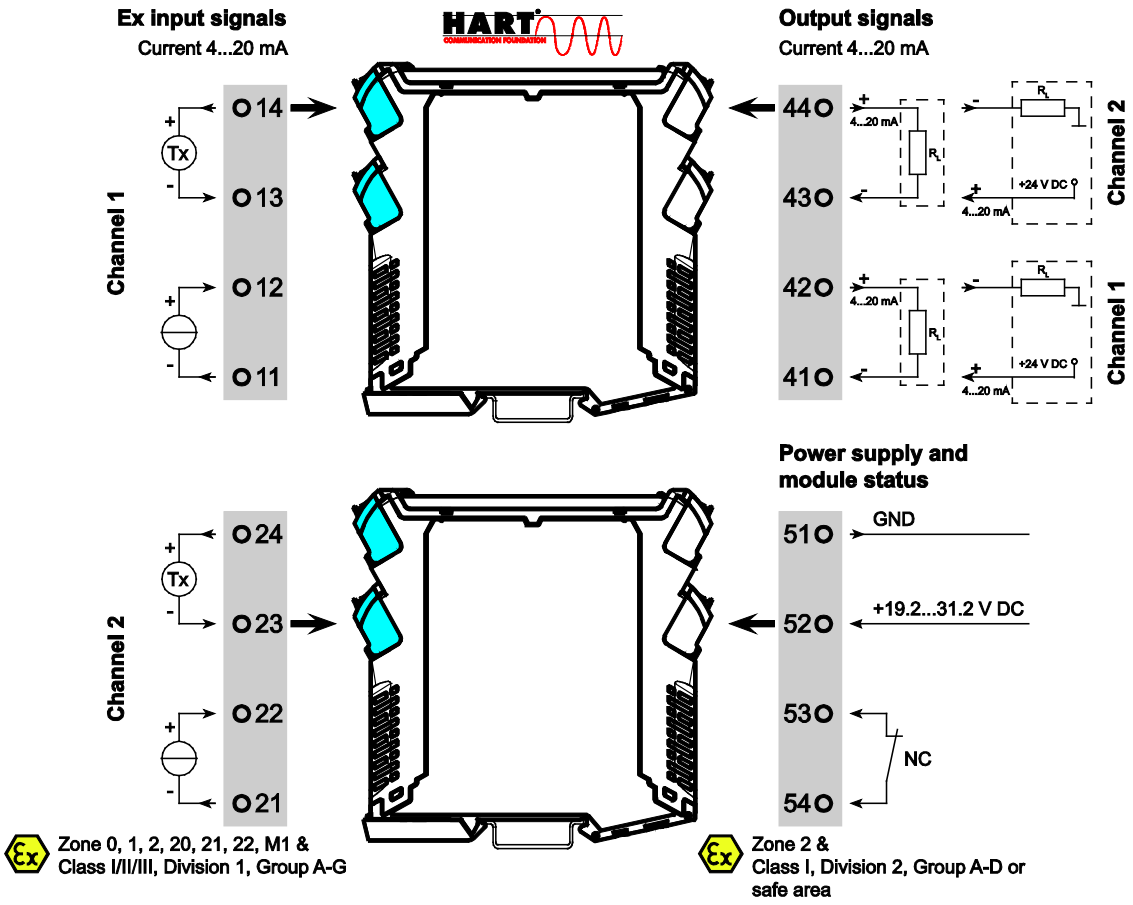
Repair of the device and replacement of circuit breakers must be done by Weidmüller Interface GmbH & Co. KG only.

13. Maintenance

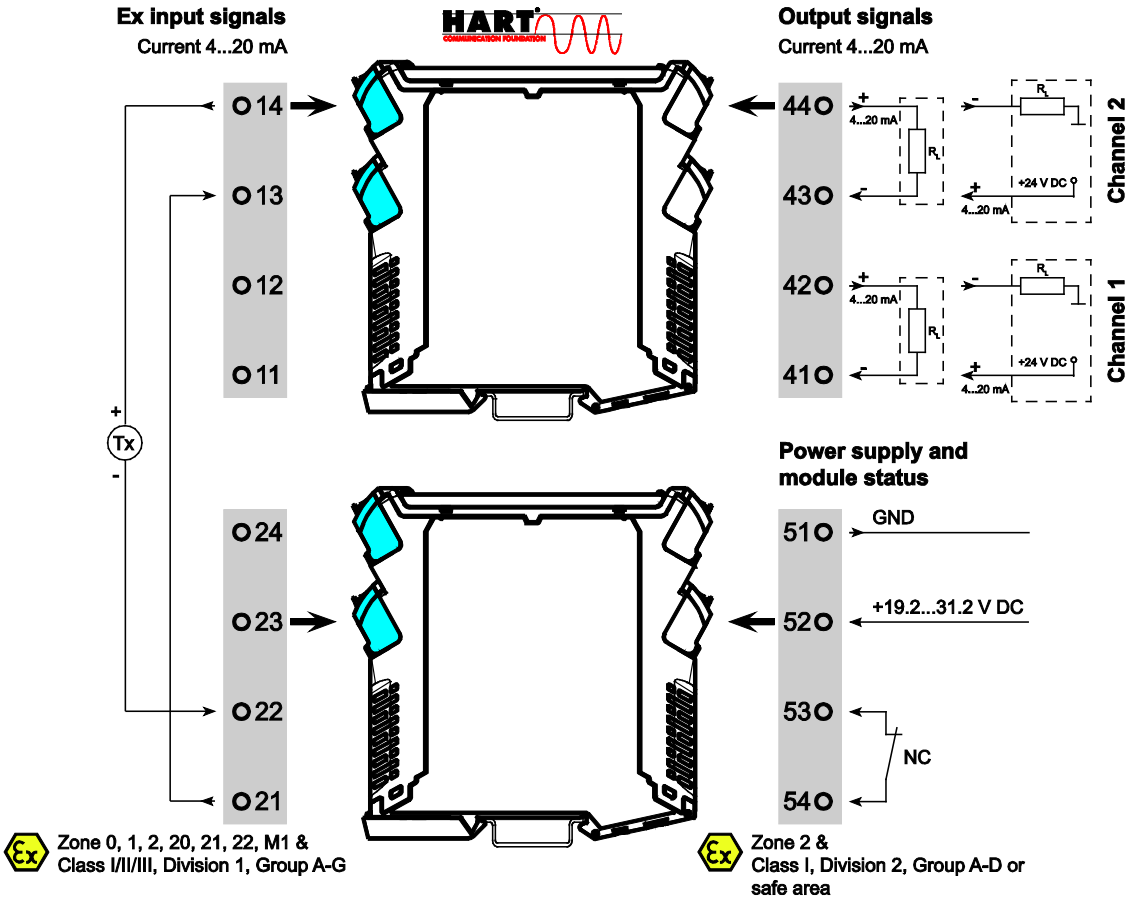
No maintenance required.

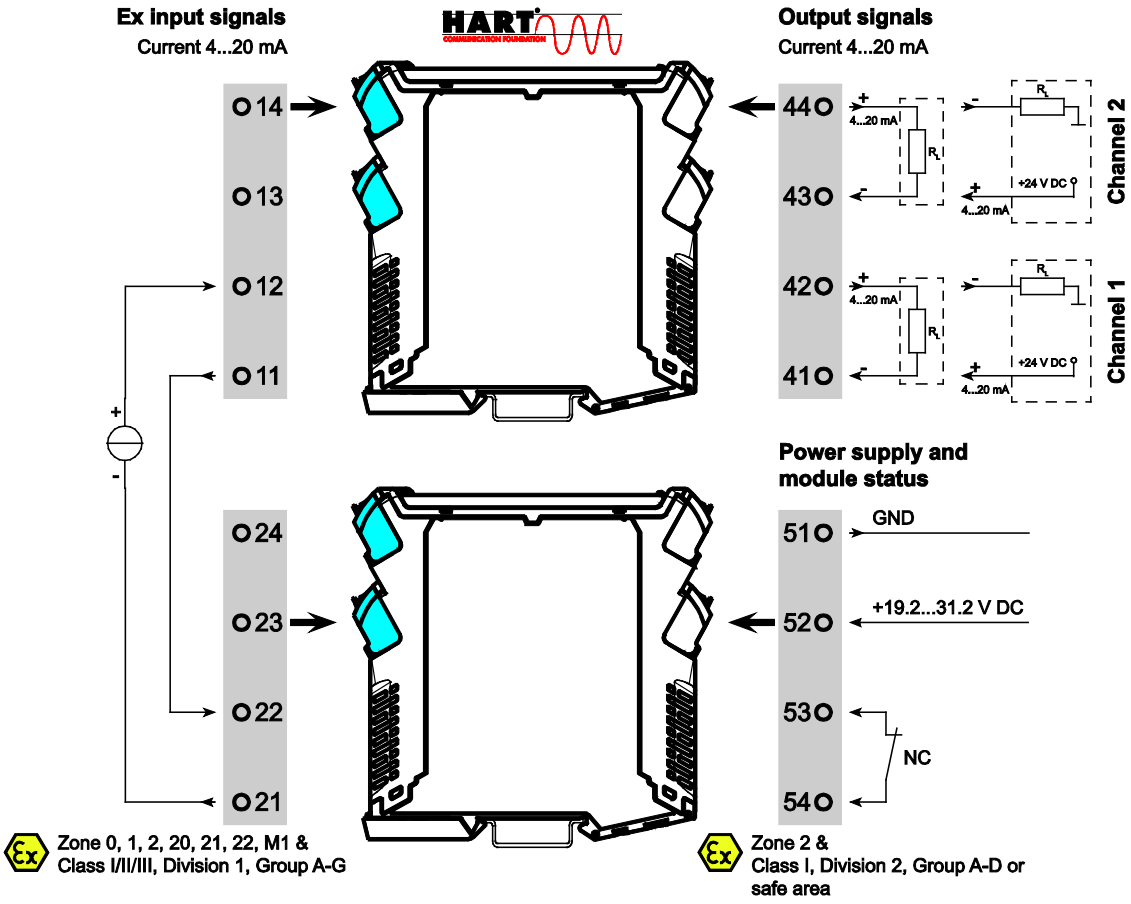
14. Connection diagram

14.1 Application, Ex inputs SIL 2



14.2 Application, Ex inputs SIL 3




Ex input signals
Current 4...20 mA
HART
Output signals
Current 4...20 mA
14
13
12
11
44
43
42
41
4...20 mA
+24 V DC
Channel 2
Channel 1
Power supply and module status
24
23
22
21
51
52
53
54
GND
+19.2...31.2 V DC
NC
Zone 0, 1, 2, 20, 21, 22, M1 &
Class I/II/III, Division 1, Group A-G
Zone 2 &
Class I, Division 2, Group A-D or
safe area

14.3 Electrical connections

Terminal	Function		Connector
11	I Passive –		Ex input channel 1
12	I Passive +		
13	I Active Return		
14	I Active Supply		
21	I Passive –		Ex input channel 2
22	I Passive +		
23	I Active Return		
24	I Active Supply		
41	Out –		output channel 1
42	Out +		
43	Out –		output channel 2
44	Out +		
51	19.2…31.2 V ⎓ 3 W	GND	power supply
52		+	
53	NC		status relay
54	COM		

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Weidmüller Interface GmbH & Co. KG
Klingenbergstraße 16
32758 Detmold
Germany
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