

ACT20X-(2)HDI-(2)SDO NAMUR isolating switching amplifier

Safety Manual



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 products:

Device versior	Туре	Order number
2	ACT20X-HDI-SDO-S	8965360000
2	ACT20X-2HDI-2SDO-S	8965390000
2	ACT20X-HDI-SDO-P	2456070000
2	ACT20X-2HDI-2SDO-P	2456100000

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

Table of contents

1.1	Revision history
1.2	Validity
1.3	Contact address
1.5	
Table o	of contents4
2.	Observed standards6
3.	Acronyms and abbreviations7
4.	Purpose of the product8
5.	Assumptions and restrictions for use of the product9
5.1	Basic safety specifications9
5.2	Associated equipment9
5.2.	1 Transistor output
5.2.2	2 Field device
5.3	Failure rates9
5.4	Safe parameterization9
5.5	Installation in hazardous areas9
6.	Functional specification of the safety functions10
7.	Functional specification of the non-safety functions11
8.	Safety parameters12
9.	Failure category SIL 213
10.	Hardware and software configuration14
11.	Periodic proof test procedure15
12.	Procedures to repair or replace the product16
13.	Maintenance17
14.	Configuration with FDT/DTM18
14.1	Concept18
14.2	Hardware / Firmware

4

15.	Parameterization by user interface	19
16.	SIL concept for DTMs	21
16.1	Activate/deactivate safe parameterization	21
16.2	Verification procedure	24
16.3	Configuration of a SIL active product	25
16.4	Changing SIL password	26
16.5	Safety-related configuration user responsibility	27
16.6	Functional test	27
17.	Fault reaction and restart	28
18.	Connection diagram	29
18.1	Application	29
18.2	Electrical connections	30
10.2		

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		
IEC 61508-3:1998	Part 3: Software requirements		
IEC 61326-3-1:2008	Immunity requirements for 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-HDI-SDO is a one channel, the ACT20X-2HDI-2SDO is a two channel pulse isolator for transmission of signals to the safe area from NAMUR sensors and mechanical switches installed in the hazardous area.

The device can be mounted in the safe area and in Zone 2 / Division 2 and receive 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 ACT20X-(2)HDI-(2)SDO has been designed, developed and certified for use in SIL 2 applications according to the requirements of IEC 61508.

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:	19.231.2 V DC
Output pulse length, min.:	40 µs
Mounting area:	Zone 2 & Class I, Division 2 or safe area
Mounting environment:	Pollution degree 2 or better, Overvoltage category II

5.2 Associated equipment

5.2.1 Transistor output

The opto output signals are fed to SIL 2 compliant inputs of a safety PLC specified to receive a frequency of 5 kHz and a pulse length down to 40 μ s or the field device signal pulse length minus 60 μ s.

5.2.2 Field device

The field device must provide a minimum pulse length of 100 µs.

5.3 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.

5.4 Safe parameterization

The user is responsible for verifying the correctness of the configuration parameters (refer to chapter 16.5 "Safety-related configuration user responsibility" on page 27). Manual override may not be used for safety applications.

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.

6. Functional specification of the safety functions

Pulse isolator as well as supply of NAMUR sensors and mechanical switches with cable error detection installed in the hazardous area. Cable error detection only works with NAMUR sensors or with the use of external resistors R_s and R_p . (refer to chapter 18 "Connection diagram" on page 29).

10

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.

8. Safety parameters

Safety parameter	Ex output SIL2
Proof-test interval (T _{proof}), (10 % of loop PFD)	5 years
Safe Failure Fraction (SFF)	92 %
Demand response time, opto output	< 125 µs
Demand mode	High
Demand rate	1000 s
Diagnostic test interval	10 s
Mean Time To Repair (MTTR)	8 h
Hardware Fault Tolerance (HFT)	0
Component type	В
SIL capability	SIL 2
Description of the "safe state", opto output	High impedance

	PFD _{AVG}			
T _{proof} = 1 year	T _{proof} = 2 years T _{proof} = 5 years		PFH (see note 1)	
1.58 × 10 ⁻⁴	3.17 × 10 ⁻⁴	7.92 × 10 ⁻⁴	3.62 × 10 ⁻⁸ h ⁻¹	

 PFD_{AVG} = Average Probability of Failure on Demand

PFH = Probability of dangerous Failure per Hour

Note 1: The ACT20X-(2)HDI-(2)SDO 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

Failure rates according to IEC 61508		
Total failure rate for dangerous detected failures (λ_{DD})	135.6 FIT	
Total failure rate for dangerous undetected failures (λ_{DU})	36.18 FIT	
Total failure rate for all safe failures (λ_{Safe})	275.5 FIT	

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

10. Hardware and software configuration

All configurations of software and hardware versions are fixed from factory and cannot be changed by enduser 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	Perform an ON / OFF signal for 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. Configuration with FDT/DTM

The pulse isolator ACT20X-(2)HDI-(2)SDO will be configured via PC according to the FDT/DTM standard.

14.1 Concept

The FDT technology standardizes the configuration and communication interfaces between different devices and connected systems, IEC 62453. Therefore the FDT provides a common environment for accessing and connecting the devices features. Any device can be configured, operated and maintained through the standardized graphical user interfaces. These functions are regardless of supplier and type of communication protocol. The FDT interface is the specification describing the standard data exchange between field devices and PC.

A device driver with full fit the FDT mandatory interfaces are called device type manager (DTM). The DTMs are classified for the ACT20X product family into two categories:

- Device DTMs which represent the ACT20X product family with its configuration components
- Communication DTMs which create the connection to the ACT20X over the CBX 200 hardware

The FDT Frame Application is the software program that implements all DTMs. The FDT Frame Application, also called FDT container, provides the DTM management, navigation, user management and common environment. The Weidmüller FDT container is called "WI-Manager".

14.2 Hardware / Firmware

The hardware of the ACT20X product family has a jack plug for the CBX 200 hardware. The CBX 200 hardware is used for the configuration via serial port and PC. The result is a point to point connection (PC to hardware).

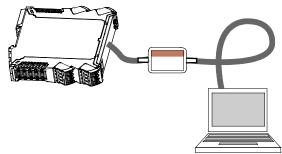


Figure 1 Point to point connection with the CBX 200 and an ACT20X device for the configuration

15. Parameterization by user interface

Configuration of the parameter via the General User interface "GUI" via the FDT / DTM software.

The parameterization according to the safety requirements is oriented towards the general using the product related DTM (Figure 2 "GUI DTM configuration (1) (example)" and Figure 3 "GUI DTM configuration (2) (example)" shows an example of a DTM).

Information Parameters (Office) Imputs Imputs Actraits Applications Imputs Imputs according to EN 60947-5-6 Imputs Actraits Applications Imputs 05 kHz 05 kHz Actraits Applications Actraits Applications Imputs according to EN 60947-5-6 05 kHz Actraits Applications Actraits Applications Imputs according to EN 60947-5-6 05 kHz Actraits Applications Actraits Applications Imputs according to EN 60947-5-6 05 kHz Actraits Applications Actraits Applications Imputs according to EN 60947-5-6 05 kHz Actraits Applications Actraits Applications Imputs according to EN 60947-5-6 05 kHz Actraits Applications Actraits Applications Actraits Applications 05 kHz 05 kHz Actraits Applications Actraits Applications Actraits Applications according to Environs according to Environs Actraits Applications Actraits Applications Actraits Applications according to Environs according to Environs Actraits Applications Actraits Applications Actrait Applicating to Environs according to En	CBX_CH1:> ACT20X-HDI-SDO-RNO - Parameter	ize		X Device Catalogue	
Image: level, signal nom. 1kD Image: level, signal cl,ma, s6,5mA Image: level, signal nom. 15 kl Image: level, signal cl,ma, s6,5mA Image: level, signal nom. 15 kl Image: level, signal cl,ma, s6,5mA Image: level, signal nom. 15 kl Image: level, signal nom. 15 kl Image: level, signal nom. 15 kl Image: level, signal cl,ma, s6,5mA Image	KSD0/RN01	Technical characteristics Inputs NAMUR sensor Frequency range	according to EN 60947-5-6 05 kHz	B Device Types Device Vendor Device Classificati Device Classificati Device Classificati Modous over Wedous over Wedous over	ACT20X-44-0-MTCP ACT20X-24A1-23A0 ACT20X-24A1-23A0 ACT20X-24A1-23B0 ACT20X-24D1-23B0-7A0 ACT20X-24D1-23B0-7A0 ACT20X-25A1-29A0 ACT20X-25A1-29A0 ACT20X-4A1-5A0 ACT20X-4A1-5A0
Relay output Soft Area Max. voltage 250 V AC / 30 V DC Max. voltage 250 V AC / 30 V DC Max. power 500 V A / 60 W Xover 2 A AC / 2 A DC Max. power 2 V AC / 32 V DC Max. power 2 A AC / 2 A DC Max. power 2 V AC / 32 V DC Max. power 2 A AC / 0 A DC Max. power 6 4 VA / 60 W Softe area 125 V AC / 110 V DC Max. power 0,5 A AC / 0,3 A DC Max. power 0,5 A AC / 0,3 A DC Max. power 32 V AC / 32 V DC Max. power 0,5 A AC / 1 A DC Max. power 0,5 A AC / 1 A DC Max. power 0,5 A AC / 1 A DC Max. power 0,5 A AC / 1 A DC Max. power 0,5 A AC / 1 A DC Max. power 0,5 A AC / 1 A DC Max. power 0,5 A AC / 1 A DC Max. power 10 V A / 32 W Uppervalues 19,233,12 V DC MAUUS supply 8 V DC / 8 mA MAUUS supply 8 V DC / 8 mA		Resistance Trigger level, signal Trigger level, cable fault Meachanical switch with serial and parallel resistance Serial resistance	nom. 1kΩ <1,2mA, >2,1mA <0,1mA, >6,5mA nom. 750 Ω		ACT20X-HDI-SDO-RINC ACT20X-HDI-SDO-RINO ACT20X-HDI-SDO-RINO ACT20X-HDI-SAO ACT20X-HUI-SAO ACT20X-HUI-SAO-LP
Max. voltage 32 V AC / 32 V DC. Max. power 2 AC / 2 A DC. Max. power 64 VA / 60 W Safe area 125 V AC / 110 V DC. Max. voltage 125 V AC / 10 V DC. Max. voltage 62,5 V A / 32 W Zone 2 2 Max. voltage 32 V AC / 32 V DC. Max. voltage 125 V AC / 10 V DC. Max. voltage 0,5 A AC / 0,3 A DC. Max. voltage 32 V AC / 32 W Zone 2 2 Max. voltage 16 VA / 32 W Common specifications 19,231,2 V DC. Supply voltage 19 V DC / 8 mA Max. goupping 63 V DC / 8 mA		Relay output Safe Area Max. voltage Max. current Max. power	250 V AC / 30 V DC 2 A AC / 2 A DC		ACT20X-SDI-HDO-H ACT20X-SDI-HDO-L Modbus Senal Communication DT Modbus TCP Communication DTI
Safe area Max. voltage 125 V AC / 130 V DC Max. current 0,5 AA / 3,3 A DC Max. power 62,5 V A / 32 V DC Max. voltage 32 V AC / 13 A DC Max. current 0,5 AA / 1 A DC Max. current 0,5 AA / 1 A DC Max. current 0,5 AA / 1 A DC Max. current 16 VA / 32 W Common specifications Supply voltage Supply voltage 19,231,2 V DC NAMUR supply 8 V DC / 8 mA Max. consumtion 53 W (2 / 8 mA / 1 A DC)		Max. voltage Max. current Max. power	2 A AC / 2 A DC		
Hax, voltage 32 V AC / 32 V DC Max, corrent 0,5 A AC / 1 A DC Max, power 16 VA / 32 W Common specifications Supply voltage 19,231,2 V DC NAMUR supply 8 V DC / 8 mA Max, consumtion 43 W (2 / 8 mA		Safe area Max. voltage Max. current Max. power	0,5 A AC / 0,3 A DC		
Supply voltage 19,231,2 V DC NANUR supply 8 V DC / 8 mA Mex. consumminn 53 W (2 channels)		Max. voltage Max. current Max. power	0,5 A AC / 1 A DC		
		Supply voltage NAMUR supply Max. consumbon Fuse	8 V DC / 8 mA ≤3 W (2 channels)		
Isolation voltages, Test/Operation		Inouts/outputs/supply Output 1 to output 2 Status relay to supply	1,5 kV AC / 150 V AC reinforced 1,5 kV AC / 150 V AC reinforced <200 ms	-1	

Figure 2: GUI DTM configuration (1) (example)

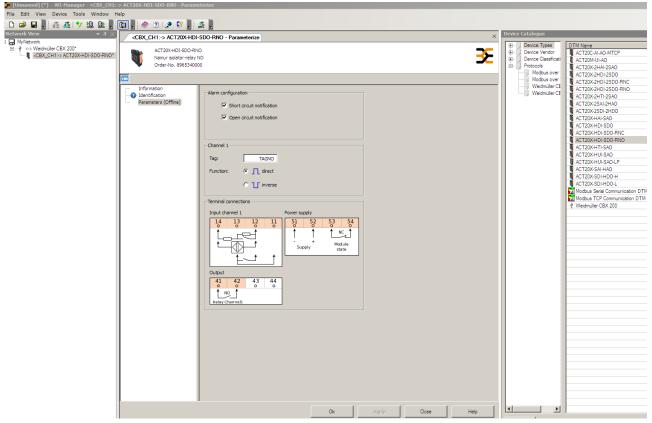
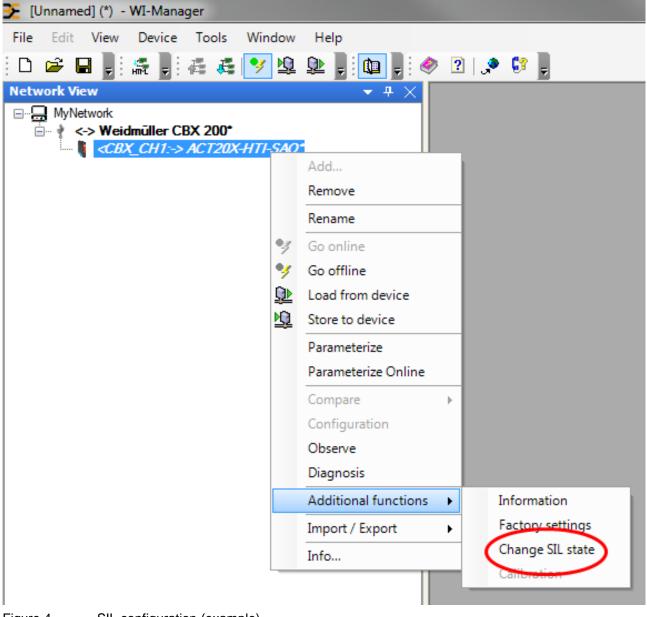


Figure 3: GUI DTM configuration (2) (example)

16. SIL concept for DTMs

16.1 Activate/deactivate safe parameterization

In online mode of the DTM the user can directly configure the device and / or the offline parameterization at the PC. For the SIL configuration the user shall shown "Change SIL state" in the additional functions of each DTM. The function is only available in online state and the hardware is verified, according Figure 4 "SIL configuration (example)".





By activate the SIL configuration all other parameter views and functions are disabled (and closed) and vice versa, according to Table 1 "Function against SIL".

Functions against SIL			
Parameter	SIL state: LOCK	SIL state: OPEN / FAIL	
Parameter Offline	Disabled	Enabled	
Parameter Online	Disabled	Enabled	
Upload	Enabled, execution follows an error message with reject the upload request	Enabled	
Download	Enabled, execution follows an error message with reject the upload request	Enabled	
Restore Factory Defaults	Disabled	Enabled	
Additional Function – Text	Change SIL state	Change SIL state	

Table 1Function against SIL

By executing the SIL function the DTM request the SIL-state and the user has to enter the password. The SIL-state and the password (enable and password) are defined in open and lock, see Figure 5 "GUI SIL configuration (OPEN) (example)" and Figure 6 "GUI SIL configuration (LOCK) (example)".

🔀 [Unnamed] (*) - WI-Manager - <cbx_ch1:-> ACT20X-2HTI-2SAO - Change SIL state</cbx_ch1:->				
File Edit View Device Tools Window Help				
: D 🛩 🖬 🖕 🐗 🌉 💯 🖳 💼 👷 🥙 🛛 . 🗢 🕄 . 💭				
Network View • \mp X	<cbx_ch1:-> ACT20X-2HTI-2SAO - Change SIL state</cbx_ch1:->			
□ MyNetwork □ ∲ <-> Weidmüller CBX 200* □ ∲ < <i>CBX_CH1:-> ACT20X-2HTI-2SAO*</i>	ACT20X-2HTI-2SAO 2-Channel temperature / mA converter Order-No. 8965480000			
	SIL State SIL State: OPEN Password Enter password and press Apply to change the SIL State. Password: Confirm Password:			

Figure 5: GUI SIL configuration (OPEN) (example)

To deactivate the SIL state the user has to enter the same password and confirm it to change the SIL state from locked to open.

16.2 Verification procedure

The configuration is re-load from the device and shown in a DTM GUI (Graphical User Interface). The user interface loaded the image (as image) with the loaded configuration in the same window. The user now sees a GUI with the configuration loaded from the device, the entered configuration (device parameters) and the stored image (written parameters) as a configuration and will be prompted to check the configuration.

The GUI for SIL configuration is continues read the SIL state and shall shown the change from "OPEN" to "LOCK", see Figure 6 "GUI SIL configuration (LOCK) (example)". If the configuration is corrupted, then the devices rejected the configuration and change the state to "FAIL". After successful locking the configuration the user get a list of all parameter from the DTM and from the stored image file.

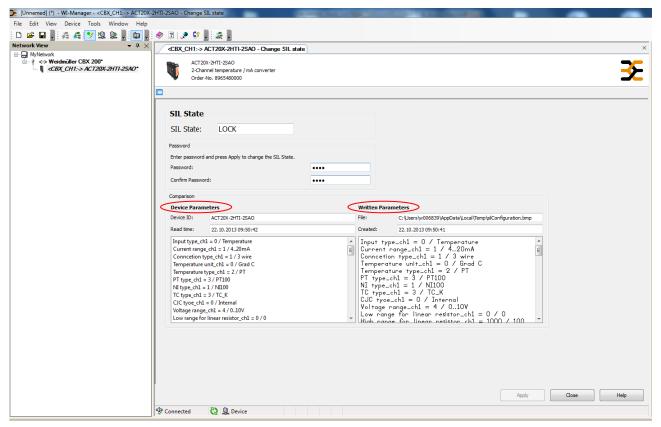


Figure 6: GUI SIL configuration (LOCK) (example)

If any parameter is found to be incorrect during verification deactivate the SIL state and go through the configuration menu and correct the parameter(s). After the correction, activate the SIL state by entering the password and confirm the password.

16.3 Configuration of a SIL active product

If the user would like to reconfigure a SIL activated product the software will show the message below.

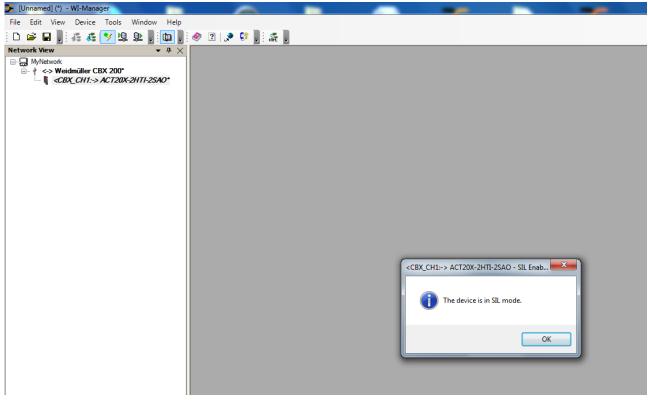


Figure 7: SIL active

To do a reconfiguration, the user needs to deactivate the SIL mode as described in chapter 16.1 "Activate/deactivate safe parameterization" on page 21. Then all parameters are available and can configure.

□	T20X-2HTI-2SAO - Change SIL state		
Network View Image: Action of the second s	2HTI-2SAO - Change SIL state 2HTI-2SAO el temperature / mA converter		
MyNetwork <th>2HTI-2SAO el temperature / mA converter</th>	2HTI-2SAO el temperature / mA converter		
CBX_CH1:-> ACT20X-2HTI-2SAO*	l temperature / mA converter		
SIL State SIL State: Password Enter password an Password: Confirm Password:	d press Apply to change the SIL State.		

Figure 8: Locked SIL state after configuration

16.4 Changing SIL password

The user can change the SIL password in the SIL "OPEN" state, when the user type a new password and confirm it. The user can choose a password between 0000 and 9999 in order to protect the device against unauthorized modifications to the configuration. The device is delivered without password.

16.5 Safety-related configuration user responsibility

Parameter	Value	Description
Function (channel 1)	Direct / Inverse	Direct / inverted channel function
Function (channel 2)	Direct / Inverse	Direct / inverted channel function
Password	09999	New password
Confirm password	Password	Confirm password

16.6 Functional test

The user is responsible to make a functional test after verification of the safety parameters. The procedure for periodic proof test, described in chapter 11 "Periodic proof test procedure" on page 15, shall be used

17. Fault reaction and restart

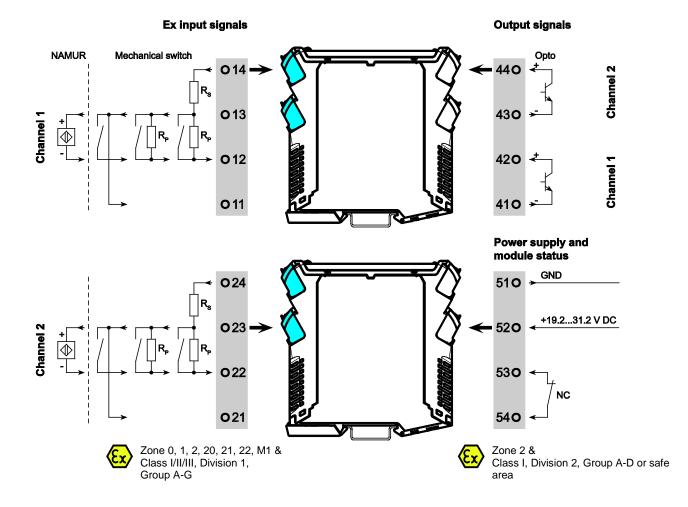
When the ACT20X-(2)HDI-(2)SDO detects a fault the output will go to Safe State, in which the opto output will go to "high impedance". If the fault is application-specific (cable error detection) the device will restart when the fault has been corrected.

For device faults there are 2 ways of bringing the module out of Safe State.

- 1. Power cycle the module.
- 2. Bring the module out of SIL mode (refer to chapter 16.1 "Activate/deactivate safe parameterization" on page 21).
- 3. Set it back to SIL mode again (refer to chapter 16.1 "Activate/deactivate safe parameterization" on page 21).

18. Connection diagram

18.1 Application



18.2 Elec	ctrical con	nections
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Terminal	Function	Connector
11	SW Sense	Ex input channel 1
12	NAMUR –	
13	SW Supply	
14	NAMUR +	
21	SW Sense	Ex input channel 2
22	NAMUR –	
23	SW Supply	
24	NAMUR +	
41	OPTO –	output channel 1
42	OPTO +	
43	OPTO –	output channel 2
44	OPTO +	
51	GND	power supply
52	+24 V DC	
53	СОМ	- status relay
54	NC	

www.weidmueller.com

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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