SIL Safety Manual

Manual Monitoring Safety Relay SCS 24VDC P2SIL3DSES

Weidmüller

Manufacturer

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Content

1 Scope and standards

1.1 Scope

This safety manual applies to SIL3 relays from Weidmüller's SAFESERIES for the following items produced after 11/2012:

SCS 24VDC P2SIL3DSES 1319270000

SIL3 relays in the SCS 24VDC P2SIL3DSES series from

Weidmüller Interface GmbH & Co KG
Klingenbergstraße 26
32758 Detmold
Germany

have been certified by

Certification Body TÜV NORD CERT GmbH
Notified Body 0044
Am TÜV 1
45307 Essen
Germany

according to EN 61508 SIL3. They are certified as „EC type-examination" for use in „low demand mode" and „high demand mode" systems.

Certificate Registration No:
44 207 13773717

1.2 Abbreviations

Safety Integrity Level (SIL):

Four discrete levels (SIL1 to SIL4). The higher the SIL of a safety-related system, the lower the probability that it will not perform the required safety functions.

Average Probability of Failure on Demand (PFD_{avg}):

Average probability of failure of a safety function working in low demand mode of operation.

Probability of Failure per Hour (PFH):

Average probability of failure of a safety function working in high demand or continuous mode of operation.

Safe Failure Fraction (SFF):

Percentage part of safe failures and dangerous detected failures of a safety function or a sub-system related to all failures.

Hardware Fault Tolerance (HFT):

HFT = n means, that n+1 faults could cause a loss of the safety function.

Low demand mode of operation:

Frequency of demands on a safety-related system no greater than one per year and no greater than twice the proof-test frequency.

High demand or continuous mode of operation:

Frequency of demands on a safety-related system greater than one per year or greater than twice the proof-test frequency.

Device type A (simple subsystem):

The failure modes of all constituent components are well defined and the behaviour under fault conditions can be completely determined.

FMEDA (Failure Mode, Effects and Diagnostic Analysis):

Systematic way to identify and evaluate the effects of different component failure modes, to determine what could eliminate or reduce the chance of failure, and to document a system in consideration.

Failure rates λ:

λ_{SD} Total failure rate for safe detected failures

λ_{SU} Total failure rate for safe undetected failures

λ_{DD} Total failure rate for dangerous detected failures

λ_{DU} Total failure rate for dangerous undetected failures

MTTF (Mean Time To Failure):

Mean time between two failures. MTTF is a basic measure of reliability for non-repairable systems.

Proof-test interval (T_{proof}):

Interval between periodic tests performed to detect failures in a safety-related system.

2 Device description and application

2.1 General

The safety relay in the SAFESERIES product family is certified according to DIN EN 61508 / SIL3.

It is used for safely energising (ETS = energised to safe) and de-energising (DTS = de-energised to safe) system components in process industry applications.

It also meets the requirements of EN 61508, SIL3 for a “low demand mode” and “high demand mode”.

2.2 Design and function

There are 2 separate outputs available, each with 2 contacts in a row (DTS) or parallel to each other (ETS) for safely energising and de-energising the components. In accordance with safety procedures, only one output circuit can be used at a time.

The DTS output must be equipped with an internal fuse (max. 5 A T) or an external one (max. 6.3 A T).

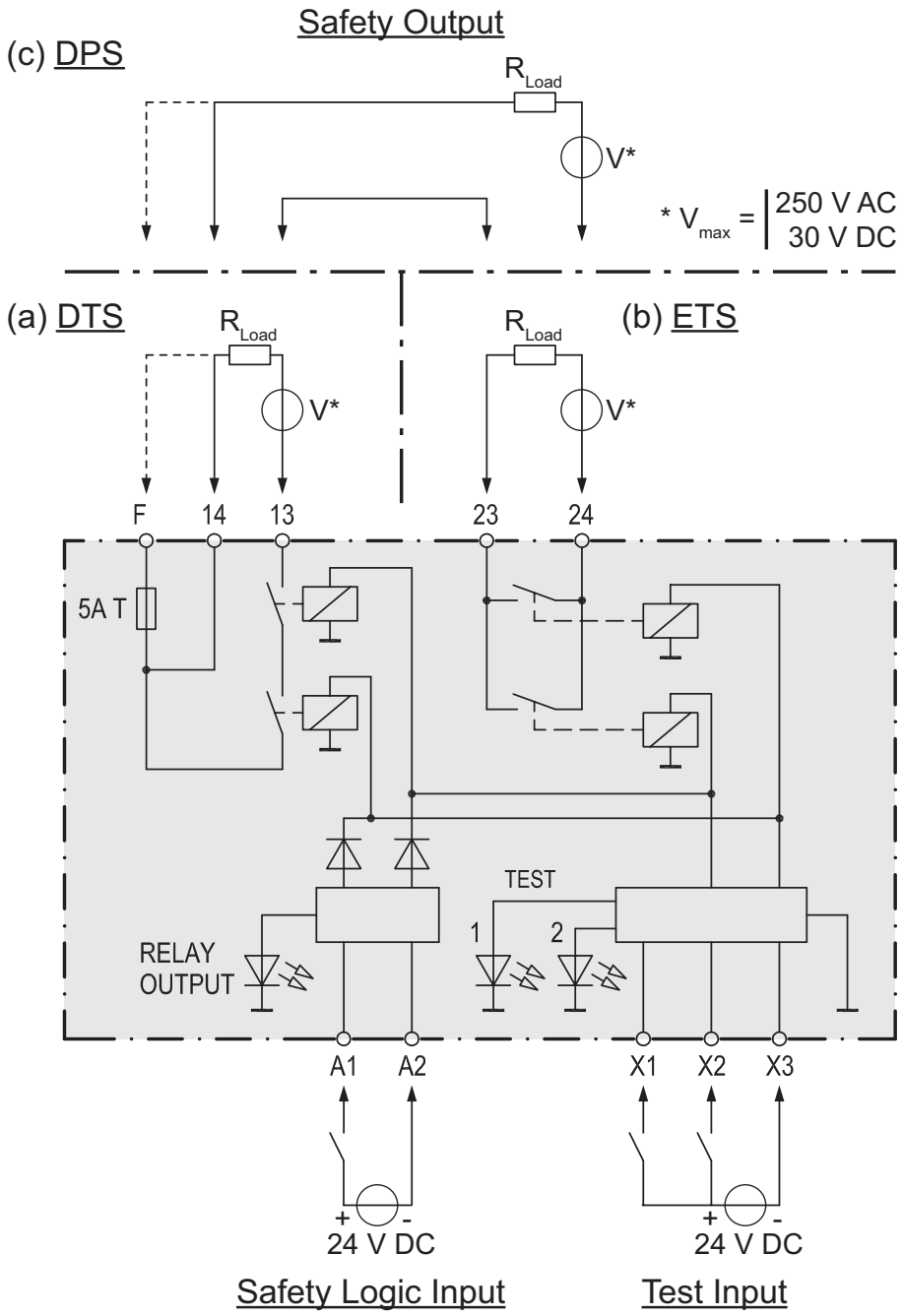
For non-safety-related applications, the two sets of contacts can be used for dual pole switching (DPS).

The safety circuit is triggered in the field by an SPS with a 24 V digital output. It is also possible to operate it on a Yokogawa “ProSafe-RS” SPS, which needs a minimum power of 35 mA @ 24 V DC -10 % on the output.

Test impulses to identify wire breaks or short circuits in the SPS named above do not influence the component.

There are 2 test inputs available for the cyclical proof test, so that the function of each individual relay contact in the built-out device can be tested.

2.3 Block diagram



3 Notes on configuring

3.1 Low demand mode of operation

The SIL3 relays from the SAFESERIES are used in low demand mode, when their demand frequency is no more than one times per year and no more than double the repeated testing frequency (refer to DIN EN 61508-4, 3.5.12).
The corresponding parameter for DTS applications is the value $PFD_{avg} = 2.11 \times 10^{-8}$, which is valid for a testing interval T_{proof} of 12 years.
The corresponding parameter for ETS applications is the value $PFD_{avg} = 1.75 \times 10^{-5}$, which is valid for a testing interval T_{proof} of 3 years.
Additional values may be found in the following table 2.

3.2 High demand mode of operation

If the „low demand mode of operation” usage cannot be applied, then the SIL3 relay should be used as a safety-critical sub-system operating at high demand mode or continuous mode (DIN EN 61508-4, 3.5.12). For the demand rate and the associated PFH parameters, the values indicated in the following tables 3 and 4 apply.

Table 1

Safety basic data	
Safety category	SIL3
Safety standard	DIN EN 61508
Device type	A
HFT	1

Table 2

Safety parameters „low demand mode“						
	DTS			**ETS**		
T_{proof}	12 years			3 years		
Frequency of demands	1× per year			1× per year		
	1001D	Complete	1002D	1001D	Complete	1002D
PFD_{avg}	1.78×10^{-8}	2.11×10^{-8}	3.30×10^{-9}	1.51×10^{-5}	1.75×10^{-5}	2.37×10^{-6}
λ_{SD}	0 FIT	–	0.11 FIT	0 FIT	–	2.59 FIT
λ_{SU}	126.74 FIT	–	22 FIT	88.14 FIT	–	12.69 FIT
λ_{DD}	0.033 FIT	–	0.11 FIT	9.94 FIT	–	2.39 FIT
λ_{DU}	0.0003 FIT	–	0.001 FIT	3.43 FIT	–	9.56 FIT
SFF	> 99 %	–	> 99 %	> 96.62 %	–	79.80 %

Table 3

Safety parameters „high demand mode“ DTS						
Frequency of demands	1× per day			10× per day		
	1001D	Complete	1002D	1001D	Complete	1002D
PFH_{avg}	3.33×10^{-13}	4.37×10^{-10}	4.37×10^{-10}	4.34×10^{-9}	4.34×10^{-9}	5.04×10^{-9}
λ_{SD}	0 FIT	–	41.58 FIT	0 FIT	–	412.83 FIT
λ_{SU}	126.74 FIT	–	22.42 FIT	126.74 FIT	–	26.17 FIT
λ_{DD}	0.033 FIT	–	41.58 FIT	0.033 FIT	–	412.83 FIT
λ_{DU}	0.0003 FIT	–	0.42 FIT	0.0003 FIT	–	4.17 FIT
SFF	> 99 %	–	> 99.60 %	> 99 %	–	99.50 %

Table 4

Safety parameters „high demand mode“ ETS						
Frequency of demands	1× per day			10× per day		
	1001D	Complete	1002D	1001D	Complete	1002D
PFH_{avg}	3.43×10^{-9}	4.57×10^{-9}	1.14×10^{-9}	3.43×10^{-9}	8.48×10^{-9}	5.04×10^{-9}
λ_{SD}	0 FIT	–	44.06 FIT	0 FIT	–	415.31 FIT
λ_{SU}	88.14 FIT	–	13.11 FIT	88.14 FIT	–	16.86 FIT
λ_{DD}	9.94 FIT	–	63.86 FIT	9.94 FIT	–	435.11 FIT
λ_{DU}	3.43 FIT	–	9.978 FIT	3.43 FIT	–	13.73 FIT
SFF	96.62 %	–	92.40 %	96.62 %	–	98.40 %

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

3.3 Types of malfunctions

A safe failure is not able to render a technical safety system dangerous or non-functional. The SIL3 relay passes to a predefined safe state.

A dangerous, undetected failure has the potential to render a technical safety system dangerous or non-functional. The SIL3 relay does not pass to a predefined safe state.

3.4 Test intervals

The test interval is the time between complete repeated tests.

The functional test is described in chapter 5.1 „Functional check“.

4 Mounting and installation

The operating instructions for the SIL3 relay with the order number

IS SCS 24VDC P2SIL3DSES 1412610000

must be made available.

The instructions, constraints and limitations contained in these instructions must be taken into consideration when installing and operating the SIL3 relay.

The SIL3 relay should be checked to see if it is functioning properly before it is first used and after any wiring change is make. Refer to chapter 5.1 „Functional check“ for more details.

The output circuit is protected with a miniature device fuse (GS fuse).

The fuse is accessible on the front side of the housing. It can be swapped out without opening the housing.

If there is a short circuit, you must make sure that the cause of the short circuit has been fixed. A functional test should be carried out after the fuse has been replaced.

5 Periodic inspections

Periodic functional inspections are used to discover non-visible and dangerous faults which cannot be detected. It is therefore important to check the functionality of the SIL3 relay with the proper frequency.

The operator must determine the type of tests and the proper time intervals. The time intervals are partly determined by the calculation of each individual safety circuit of the system (the PFD values).

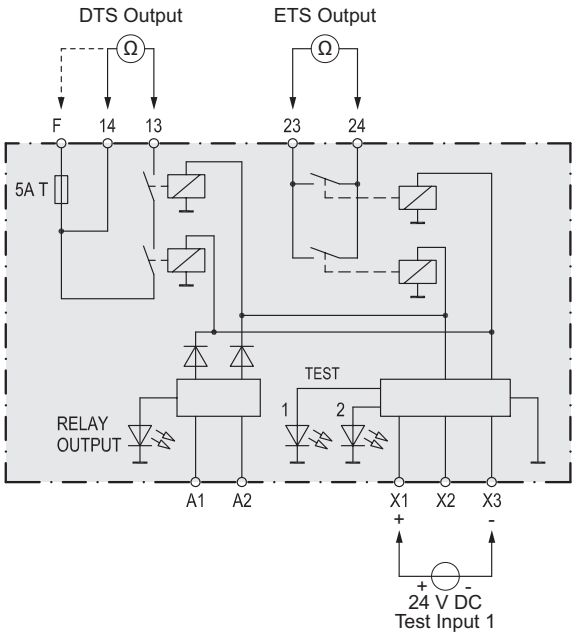
The inspections should be carried out so that the flawless operation of the safety functions in conjunction with components can be proven.

5.1 Functional check

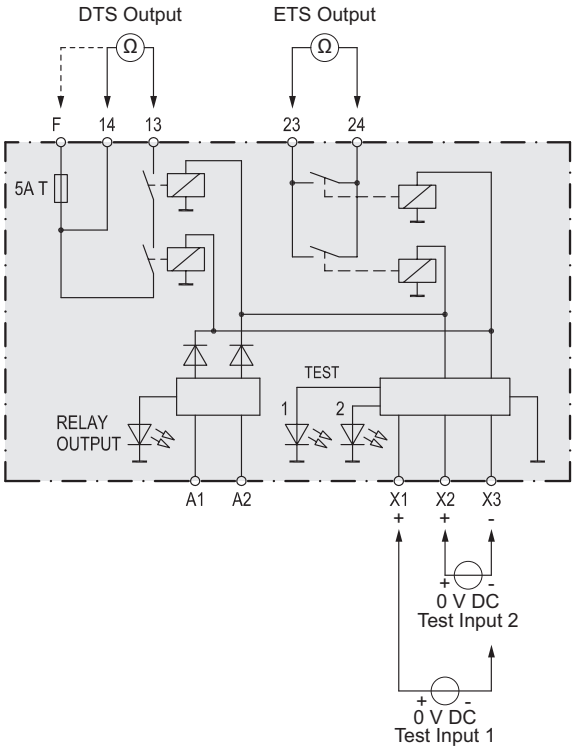
The existing relays are applied diversely (separately) and interact together with the respective switch output. For testing these relays, terminals X1, X2 and X3 are available.

The testing mode is indicated by LEDs in accordance with NAMUR NE44.

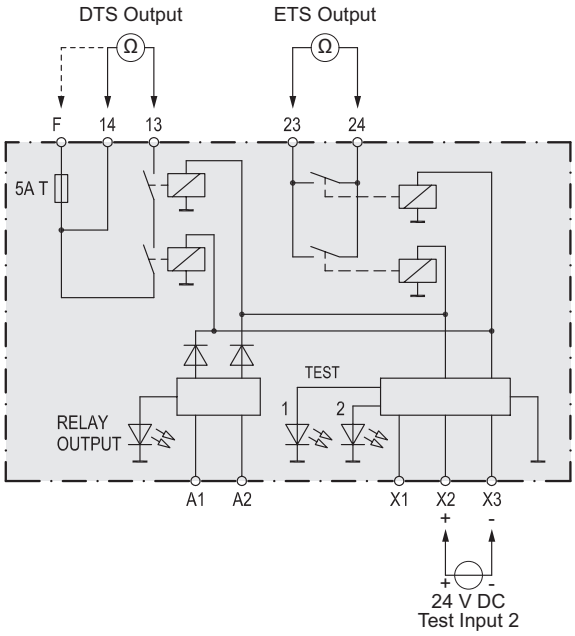
Test circuit 2



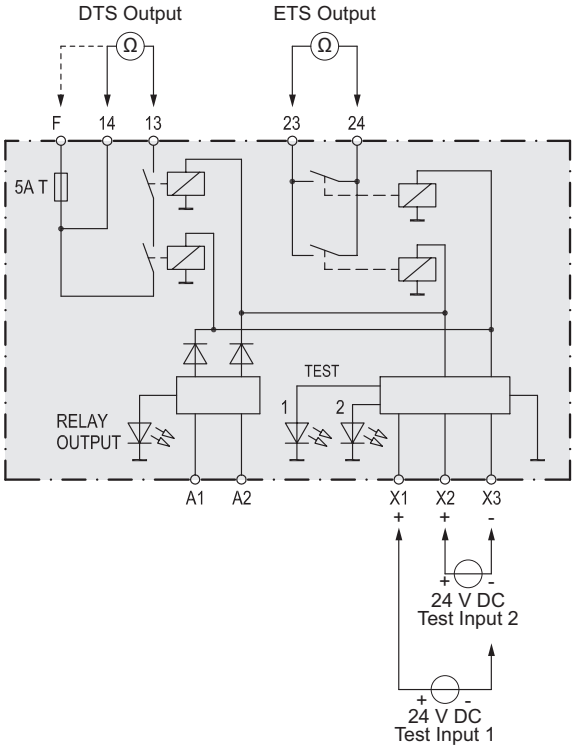
Test circuit 1



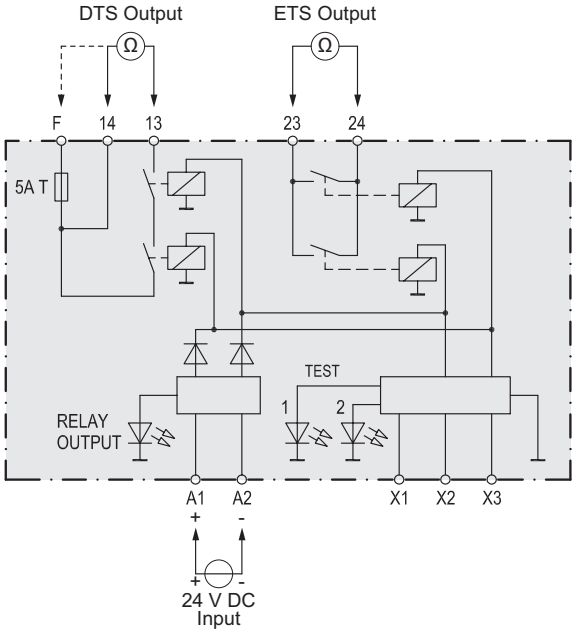
Test circuit 3



Test circuit 4



Test circuit 5



Test circuit	Input A1/A2	Test Input 1 X1/X3	Test Input 2 X2/X3	DTS-Output 13/14, 13/F	ETS-Output 23/24	LED red „TEST 1”	LED red „TEST 2”	LED yellow „RELAY OUTPUT”
1	NC	0 V DC	0 V DC	∞	∞	OFF	OFF	OFF
2	NC	24 V DC	NC	∞	0 Ω	blinking	OFF	OFF
3	NC	NC	24 V DC	∞	0 Ω	OFF	blinking	OFF
4	NC	24 V DC	24 V DC	0 Ω	0 Ω	blinking	blinking	OFF
5	24 V DC	NC	NC	0 Ω	0 Ω	OFF	OFF	ON

NC = not connected

6 Technical safety values

6.1 Assumptions

- The max. allowable ambient temperature is 50 °C.
- The environmental conditions correspond to the average industrial environment.
- The specifications in the data sheet and the operating instructions should not be exceeded.

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