SIL Safety Manual

Manual Safety Relay SCS 24VDC P1SIL3ES LL(-T)

Weidmüller

Content

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1 Scope and definitions

1.1 Scope

This safety manual applies to the safety relays

SCS 24VDC P1SIL3ES LL	2633940000
SCS 24VDC P1SIL3ES LL-T	2634010000

from the Weidmüller SAFESERIES product family.

Manufacturer:

Weidmüller Interface GmbH & Co KG
Klingenbergstraße 26
32758 Detmold
Germany

Certification body:

TÜV NORD CERT GmbH
Zertifizierungsstelle
Maschinen
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The safety relay fulfils the safety integrity level 3 (SIL 3) for low demand mode of operation. The device is certified according to EN 61508:2010 and may bear the following TÜV certification mark.

Certificate Registration No
44 207 13773719

1.2 Terms and abbreviations

Safety Integrity Level (SIL):

Four discrete levels (SIL1 to SIL4). The higher the safety integrity level 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):

VAverage 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.

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.

Energised To Safe (ETS):

Safety-related switch-on

2 Intended use and device description

2.1 Intended use

The safety relay SCS 24VDC P1SIL3ES LL serves the purpose of safety-related switch-on of process industry systems (ETS = energised to safe).

The device fulfils the safety integrity level 3 (SIL 3) for low demand mode of operation according to EN 61508.

2.2 Device description

The input of the safety relay uses a test pulse filter and three relays connected in parallel. The relay contacts in the output are connected in parallel (see block diagram).

The load supply is connected to the L and N connection terminals.

The load is connected to connection terminals 13 and 14.

Connection terminals T1, T2 and T3 must only be used for checking the relay contacts. In order to do this, the device must be released and the test current must be limited to max. 500 mA.

The device has a diagnostic function. The diagnostic function detects the following faults in the load circuit:

– Line break

– Short circuit

– Fault in load supply

The error is output at the diagnostic output (connection terminals D21, D22) and at the alarm output (connection terminals M13, M14) and is indicated by the “ERR” status LED. The diagnostic output is a mechanical switching contact (NC contact). The alarm output is a high-active logic output.

There are three status LEDs “RLY”, “DIAG” and “ERR” on the front of the device.

The “RLY” status LED lights up yellow when the input circuit (connection terminals A1 and A2) of the device is actuated.

The status LED “RLY” does not indicate the electrical switching state at the device output.

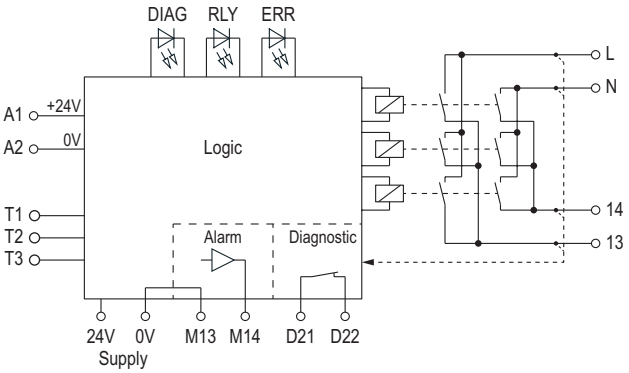
The status change at the device output is executed with a certain delay after the status LED indication has changed.

The diagnostic function of the device is not a safety function!

The “DIAG” status LED lights up green when the supply voltage (connection terminals 24V and 0V) is applied and the input circuit (connection terminals A1 and A2) of the device is not actuated.

The “ERR” status LED flashes red if the device detects a fault and the input circuit (connection terminals A1 and A2) of the device is not actuated. The switching contact at the diagnostic output opens. The alarm output changes from low level to high level.

2.3 Block diagram



3 Notes on configuration

3.1 Low demand mode of operation

The safety relay is used with a low demand rate (low demand mode) when the demand rate of the relay does not exceed 1x per year.

The associated technical parameter is the value PFD_{avg} that applies to the duration of the test interval T_{proof}.

3.2 Types of malfunctions

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

3.3 Test interval

The test interval is the period of time in which tests are conducted in full and are repeated.

Errors are detected within the framework of the proof test.

4 Commissioning and maintenance

The following operating instructions must be available for the safety relay.

Designation:	IS SCS 24VDC P1SIL3ES LL
Order number:	2689760000

It contains notes, boundary conditions and limit values that must be factored into the installation and operation of the safety relay.

The safety relay must be checked for proper functioning prior to commissioning and after every change in wiring, see chapter 5.1 „Functional testing“.

5 Proof test

The purpose of the proof test is to detect any dangerous faults that cannot be detected by means of self-diagnostics. Therefore, the functionality of the safety relay must be tested in appropriate intervals.

The selection of the type and intervals of the tests is the responsibility of the operator. The test intervals are, among other factors, determined by the calculation of each individual safety circuit in a system (PFD values).

Testing must be carried out in such a way that proper functionality of the safety function is proven during interaction of all components.

5.1 Functional testing

A1, A2 = Ammeter
V1, V2, V3 = Voltmeter
Voltage source U_{input} = U_{output} = 24 V DC
S1, S2 = Switch

Dimensioning recommendation:
Load resistance R_L = 2200 Ω

The following table describes the step-by-step functional test of the safety circuit (relays 1 to 3).

SCS 24VDC P1SIL3ES LL (2633940000)

Test step	U_{input}	U_{output}	S1	T1	T2	T3	LED ERR	LED RLY	LED DIAG	V1	V2	A1	A2	V3
Check that all output contacts open when safety relay is not energised.														
Step 1	off	24 V	open	NC	NC	NC	off	off	off	0 V	0 V	0 mA	0 mA	0 V
Apply 24 V on connection terminal A1 and check that 24 V is present on connection terminal T1, T2 and T3 (steps 2, 3 , 4).														
Step 2	24 V	off	closed	S2 open	NC	NC	off	yellow	off	24 V	24 V	≈ 58 mA	0 mA	0 V
Step 3	24 V	off	closed	NC	S2 open	NC	off	yellow	off	24 V	24 V	≈ 58 mA	0 mA	0 V
Step 4	24 V	off	closed	NC	NC	S2 open	off	yellow	off	24 V	24 V	≈ 58 mA	0 mA	0 V
Apply 24 V on connection terminal T1 and check that load is energised. Repeat for connection terminal T2 and T3 (steps 5, 6, 7).														
Step 5	24 V	24 V	open	S2 closed	NC	NC	off	off	off	24 V	24 V	0 mA	≈ 17 mA	24 V
Step 6	24 V	24 V	open	NC	S2 closed	NC	off	off	off	24 V	24 V	0 mA	≈ 17 mA	24 V
Step 7	24 V	24 V	open	NC	NC	S2 closed	off	off	off	24 V	24 V	0 mA	≈ 17 mA	24 V

NC = not connected

SCS 24VDC P1SIL3ES LL-T (2634010000)

Test step	U_{input}	U_{output}	S1	T1	T2	T3	LED ERR	LED RLY	LED DIAG	V1	V2	A1	A2	V3
Check that all output contacts open when safety relay is not energised.														
Step 1	off	24 V	open	NC	NC	NC	off	off	off	0 V	0 V	0 mA	0 mA	0 V
Apply 24 V on connection terminal A1 and check that 24 V is present on connection terminal T1, T2 and T3 (steps 2, 3 , 4).														
Step 2	24 V	off	closed	S2 open	NC	NC	off	yellow	off	24 V	24 V	≈ 72 mA	0 mA	0 V
Step 3	24 V	off	closed	NC	S2 open	NC	off	yellow	off	24 V	24 V	≈ 72 mA	0 mA	0 V
Step 4	24 V	off	closed	NC	NC	S2 open	off	yellow	off	24 V	24 V	≈ 72 mA	0 mA	0 V
Apply 24 V on connection terminal T1 and check that load is energised. Repeat for connection terminal T2 and T3 (steps 5, 6, 7).														
Step 5	24 V	24 V	open	S2 closed	NC	NC	off	off	off	24 V	24 V	0 mA	≈ 21 mA	24 V
Step 6	24 V	24 V	open	NC	S2 closed	NC	off	off	off	24 V	24 V	0 mA	≈ 21 mA	24 V
Step 7	24 V	24 V	open	NC	NC	S2 closed	off	off	off	24 V	24 V	0 mA	≈ 21 mA	24 V

NC = not connected

6 Technical safety values

Safety basic data	
Safety category	SIL 3
Safety standard	EN 61508
Device type	A
HFT	2
T_{proof} in years	12

The safety parameters can be found in the TÜV certificate with the registration number 44 207 13773719. The certificate is available for download at www.weidmueller.com.

www.weidmueller.com

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