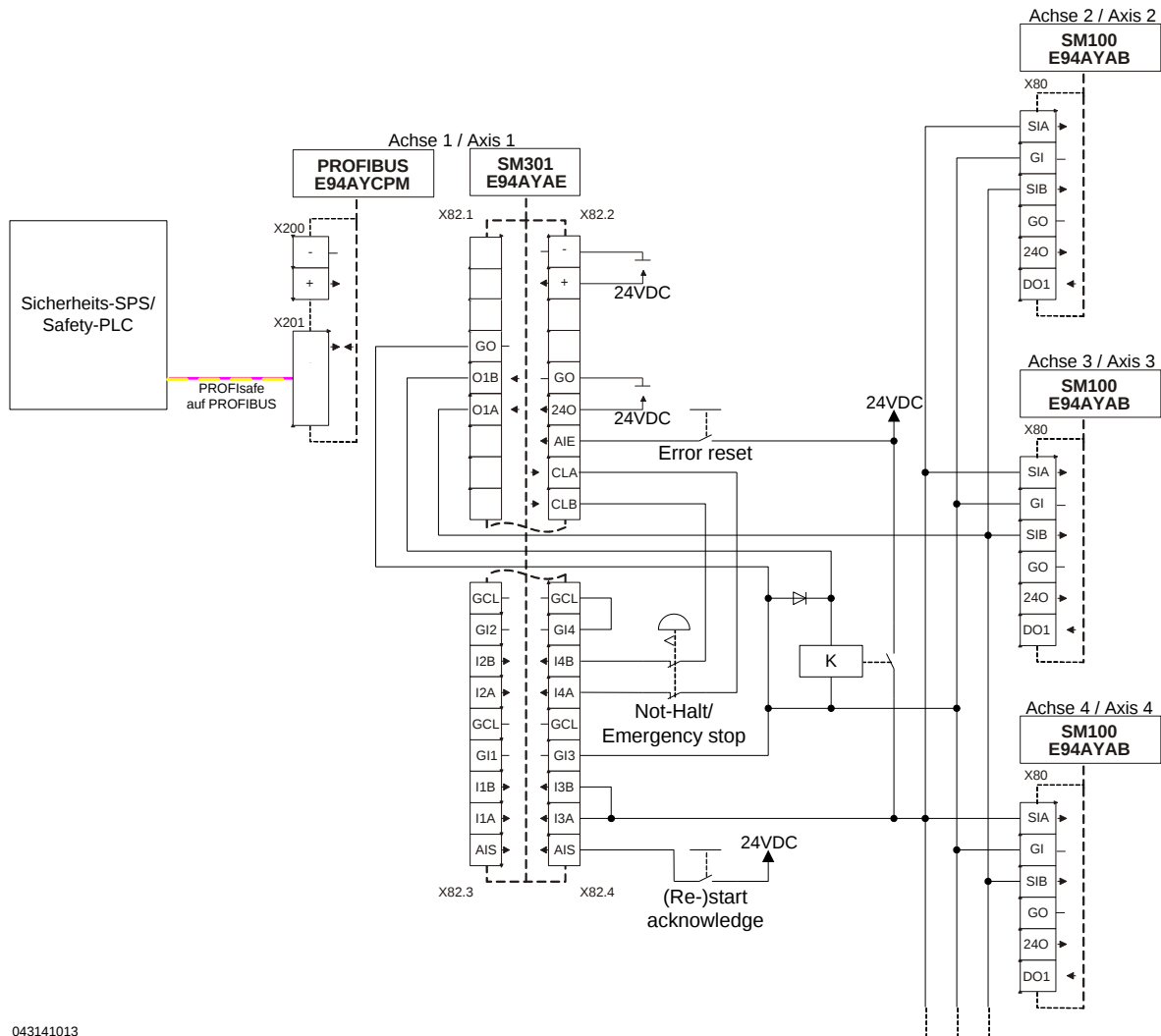


9400 with SM301
Safe torque off and SM301 controls 17 SM100
using an auxiliary relay
SM301 is connected to the safety PLC via PROFIsafe
(architecture according to PL e of EN ISO 13849-1)

Connection diagram (extract):



043141013

When the safety function is requested, the motors are stopped according to stop category 0 of EN 60204-1.

When the emergency stop is activated, the STO function is activated via PROFIsafe in the SM301. The switch state of the auxiliary relay K is safely transmitted to the safety PLC and there compared with the expected value.

Since the SM100 does not contribute to the probability of failure on demand (PFD) and to the probability of failure per hour (PFH), the feedback DO1 need not be used. All safety-relevant errors that can occur in the SM100 result in the safe state. Faults have been excluded for protected cables (according to DIN EN ISO 13849-2:2008-09 and DIN EN 61800-5-2:2008-04). This applies to cables which are protected by a cable duct and installed inside the control cabinet.

Doc.-ID	201204638	Version	1.1
Date	18.07.2019	Page 1 out of 6	SM301 SM100 PROFIsafe controls SM100 PLe en.pdf

The limitation to 17 SM100 results from the maximum current of the safe output.

Symbol table in the safety PLC (section):

STO active	E	0.0	BOOL
Relay state	E	3.2	BOOL
Emergency-stop	E	3.3	BOOL
Activation SSE	A	2.7	BOOL

For detailed information on the bus connection, please see the SM301 manual.

Function block interconnection in the safety PLC (section):

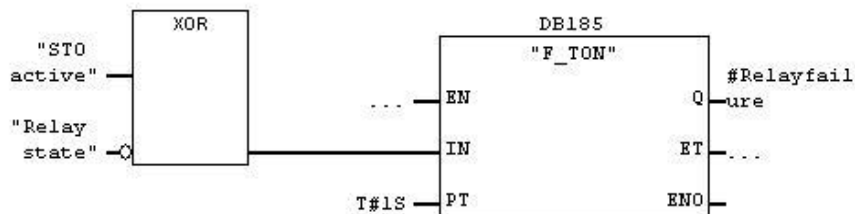
Inhalt von: 'Umgebung\Schnittstelle\TEMP'			
Name	Datentyp	Adresse	Kommentar
Relayfailure	Bool	0.0	

FB1 : Titel:

Kommentar:

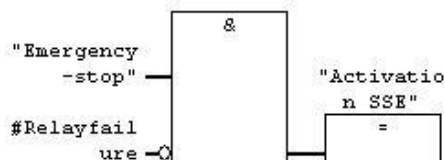
Netzwerk 1: Relay monitoring

Kommentar:



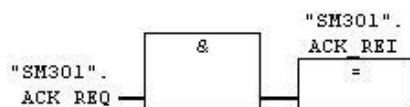
Netzwerk 2: Emergency stop

Kommentar:



Netzwerk 3: 1=ACKNOWLEDGEMENT FOR REINTEGRATION

Kommentar:



043341012

Doc.-ID	201204638	Version	1.1
Date	18.07.2019	Page 2 out of 6	SM301_SM100_PROFIsafe_controls_SM100_PLe_en.pdf

Required controller parameter settings:

General	Value	Unit
Modul-ID	x	
Safety address	x	
Encoder system	-	
Sin/cos encoder increments	-	
SD-In1		
SD-In2		
SD-In3		
SD-In3 Sensor type	Active sensor	
SD-In3 Sensor function	Free assignment	
SD-In3 Free assignment	No function	
SD-In3 Discrepancy time	10	ms
SD-In3 Input delay	x	ms
SD-In4		
SD-In4 Sensor type	Passive sensor	
SD-In4 Sensor function	Free assignment	
SD-In4 Free assignment	No function	
SD-In4 Discrepancy time	x	ms
SD-In4 Input delay	x	ms
SD-Out1		
SD-Out1 Switching condition: STO active	Negative logic	
SD-Out1 Switching condition: SS1 active	Not evaluated	
SD-Out1 Switching condition: SS2 active	Not evaluated	
SD-Out1 Switching condition: SLS1 active	Not evaluated	
SD-Out1 Switching condition: ES active	Not evaluated	
SD-Out1 Switching condition: OMS	Not evaluated	
SD-Out1 Switching condition: SOS monitored	Not evaluated	
SD-Out1 Switching condition: SLS1 monitored	Not evaluated	
SD-Out1 Switching condition: SSE active	Not evaluated	
SD-Out1 Switching condition: SD-In1 active	Not evaluated	
SD-Out1 Switching condition: SD-In2 active	Not evaluated	
SD-Out1 Switching condition: SD-In3 active	Not evaluated	
SD-Out1 Switching condition: SD-In4 active	Not evaluated	
SD-Out1 Switching condition: Error active	Not evaluated	
SD-Out1 Logic function	-	
Safe stop		
SSE: Emergency stop function	STO	
Restart - STO, SS1	Acknowledged restart	
Restart - SS2, SOS	-	
SS1, SS2: Stop time	-	ms
SOS: Tolerance window (n=0)	-	min-1
Safe speed		
Operating mode selection		
Safety bus general		
S-bus: Configuration	PROFIsafe	
S-bus: Filter control data: STO	-	

S-bus: Filter control data: SS1	-	
S-bus: Filter control data: SS2	-	
S-bus: Filter control data: SLS1	-	
S-bus: Filter control data: ES	-	
S-bus: Filter control data: OMS	-	
S-bus: Filter control data: PS_AIS	-	
S-bus: Filter control data: PS_AIE	-	
S-bus: Filter control data: SSE	Pass through	
S-bus: Filter control data: SD-Out1	-	

Parameters that are not relevant for the application example are marked with a "-".
Parameters with application-dependent setting are marked with an "x".

The above-described safe parameterisation is the version of the first software version supported.

Safety-related parameters:



The calculations shown serve as an example of a possible determination of safety-related characteristic values.

The current suitability status and the characteristic values of the listed components must be checked by obtaining current manufacturer data on the components actually used prior to project planning.

Evaluation of the safety characteristics:

SM301 STO:

Emergency-stop switch: B10_d- value of emergency-stop switch according to table C.1 of EN ISO 13849-1: 100000

It was assumed that the system is used:

250 days / year, 16 hours / day, 2 emergency stop switch operations / day

→ resultant MTTF_d- value: 3000 years (limited to 2500 years) / DC_{avg}: 99% (direct monitoring (e.g. electrical position monitoring of control valves, electromechanical components are monitored by positive operation))

→ resultant PFH_d- value of a category 4-structure according to table K.1 (extended) of EN ISO 13849-1: $9,06 \times 10^{-10}$ 1 / hour

Since the DC of the SM301 is high, the PFH_d- value of cat. 4 is used.

(see EN ISO 13849-1:2006, chapter 6.2.7 COMMENT 2)

Safety PLC: Siemens 315F-DP: PFH_d-value: $1,54 \times 10^{-9}$ 1 / hour

PROFIsafe: PFH_d-value: $1,00 \times 10^{-9}$ 1 / hour

SM301: PFH_d-value: $8,50 \times 10^{-10}$ 1 / hour

Result: The PFH_d- value of the safety circuit is $4,30 \times 10^{-9}$ 1 / hour.

Doc.-ID	201204638	Version	1.1
Date	18.07.2019	Page 4 out of 6	SM301_SM100_PROFIsafe_controls_SM100_PLe_en.pdf

SM100 STO:

Emergency-stop switch: B10_d- value of emergency-stop switch according to table C.1 of EN ISO 13849-1: 100000

It was assumed that the system is used:

250 days / year, 16 hours / day, 2 emergency stop switch operations / day

→ resultant MTTF_d- value: 3000 years (limited to 2500 years) / DC_{avg}: 99% (direct monitoring (e.g. electrical position monitoring of control valves, electromechanical components are monitored by positive operation))

→ resultant PFH_d- value of a category 4-structure according to table K.1 (extended) of EN ISO 13849-1: $9,06 \times 10^{-10}$ 1 / hour

Since the DC of the SM301 is high, the PFH_d-value of cat. 4 is used.

(see EN ISO 13849-1:2006, chapter 6.2.7 COMMENT 2)

Safety PLC: Siemens 315F-DP: PFH_d-value: $1,54 \times 10^{-9}$ 1 / hour

PROFIsafe: PFH_d-value: $1,00 \times 10^{-9}$ 1 / hour

Switch-off - channel 1:

SM301: MTTF_d-value: 75 years

Switch-off - channel 2:

SM301: MTTF_d-value: 75 years

Auxiliary relay: B10_d- value of Wago 788-384 auxiliary relay in utilization category DC 13 with I=3A: 360000

It was assumed that the system is used:

250 days / year, 16 hours / day, 2 relay switching operations / day

→ resultant MTTF_d-value: 10800 years

→ resultant MTTF_d-value of the second channel: 74,48 years

→ resultant PFH_d- value of a category 3-structure according to table K.1 EN ISO 13849-1: $3,42 \times 10^{-8}$ 1 / hour

SM100: PFH_d- value: The SM100 does not contribute to the probability of failure on demand. Therefore, it need not be considered for the calculation.

Result: The PFH_d- value of the safety circuit is $3,76 \times 10^{-8}$ 1 / hour.

Doc.-ID	201204638	Version	1.1
Date	18.07.2019	Page 5 out of 6	SM301_SM100_PROFIsafe_controls_SM100_PLe_en.pdf

The application example is valid for:

Safety module	Type designation	From hardware version	From software version
SM100	E94AYAB	VA	-

Safety module	Type designation	From hardware version	From software version
SM301	E94AYAE	VA	1.01

Product series	Type designation	From hardware version	From software version
Servo Drives 9400	E94AxHExxxx	VA	1.49

The user must ensure that the latest application example version is used. The current application example version can be downloaded from the Application Knowledge Base.

Safety information / disclaimer:



The safety application and parameterisation notes are examples of possible subfunctions in machines.

The T10_D value according to DIN EN ISO 13849-1, Annex C.4.2 is only indicated if a B10_D value is available and the operating time is less than 20 years.

Commissioning is prohibited until the machine has been checked in accordance with the regulations set out in the relevant EU directives / national laws.

The safety instructions contained in the technical documentation must be observed.

Using the examples does not exempt the user from careful project planning. For possible damages and consequential damages Lenze assumes no liability to the extent permitted by law.

Copyright 2019 Lenze Automation GmbH

Doc.-ID	201204638	Version	1.1
Date	18.07.2019	Page 6 out of 6	SM301_SM100_PROFIsafe_controls_SM100_PLe_en.pdf