



Confirmation

Manufacturer: Siemens AG

Product category: Fail-safe function blocks for storage and retrieval machines

Type: Software library „ASRM_Failsafe_TS1500_V20“
 F_SAFE_POS, F_SLP_MONITOR,
 F_ENDZONE, F_BRAKE_TEST,
 F_LOAD_MONITOR, F_SBR_MONITOR,
 F_MIN_MAX, F_INTERPOLATION,
 LFAddDInt, LFSubDInt, LFMulDInt, LFDivDInt,
 LFAddInt, LFSubInt, LFMullInt, LFDivInt

Application: Control and monitoring of storage and retrieval machines in conjunction with the safety-related automation systems SIMATIC STEP 7 Safety Advanced of the company Siemens AG

TÜV Equipment: 2645430

TÜV report no.: e-f-2039-01-16 dated 2016-03-01

Test regulations: DIN EN 528: 2008-02
 DIN EN ISO 13849-1: 2008-12
 DIN EN ISO 13849-2: 2013-02
 DIN EN 62061: 2013-09

Result: The function blocks meet the applicable requirements as set out in the product and application standards. The applicable requirements are described in specifications and in the functional requirements outlined in the Manual. In line with the requirements, no retroactive effect was detected on the protection system which, depending on the type of the plant, must be composed of the blocks to control and monitor the storage and retrieval machines. The conditions set out in the Test Report and in the relevant Manual shall be observed and adhered to.

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 and Building Services
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Regensburg, 2016-03-01

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Inspection report

ASRM Safety Library



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TÜV Equipment: 2645430
TÜV Report No. e-t-2039-01-16

Testing body: TÜV SÜD Industrie Service GmbH
Department of Electrical Engineering and Building Services
Regensburg Branch

Subject of the test: Fail-safe function blocks for controlling and monitoring rail dependent storage and retrieval equipment

F_SAFE_POS, F_SLP_MONITOR, F_ENDZONE,
F_BRAKE_TEST, F_LOAD_MONITOR, F_SBR_MONITOR,
F_MIN_MAX, F_INTERPOLATION, LFAddDInt, LFSubDInt,
LFMulDInt, LFDivDInt, LFAddInt, LFSubInt, LFMulInt, LFDivInt

Expert: Dipl.-Ing. (FH) Thomas Maget

Period of testing: 2016-02-08 – 2016-03-01

Evaluation criteria: DIN EN 528: 2009-02
DIN EN ISO 13849-1: 2008-12
DIN EN ISO 13849-2: 2013-02
DIN EN 62061: 2013-09

Results of the test: See section 7

Regensburg, 2016-03-01

Regensburg Branch
Department of Electrical Engineering
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1 Purpose and scope of testing

On behalf of Siemens AG, the fail-safe function blocks for controlling and monitoring rail dependent storage and retrieval equipment were subjected to a safety test on the basis of the test requirements set out in Section 2.

The aim of the evaluation was to determine whether the requirements set out in the specification documents are satisfied.

2 Evaluation criteria

The test was carried out on the basis of the standards and technical regulations listed below in combination with the corresponding instructions from the safety manual of the safety automation system.

- /G1/ DIN EN 528: 2008-02 " Rail dependent storage and retrieval equipment – Safety requirements"
- /G2/ DIN EN ISO 13849-1: 2008-12 "Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design"
- /G3/ DIN EN ISO 13849-2: 2013-02 "Safety of machinery - Safety-related parts of control systems - Part 2: Validation"
- /G4/ DIN EN 62061: 2013-09 "Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems"

3 Test documents

The following documents were used for testing:

- /U1/ Management of Functional Safety, Development Process for Safety-Relevant Systems, Process Description, Version A2 dated 17.04.2014
- /U2/ FSM/Validation Plan, Version E2 dated 14.10.2015
- /U3/ FSM/Validation Planning Review Report, Version E2 dated 14.10.2015
- /U4/ Safety Requirements Specification, Version E2 dated 16.10.2015
- /U5/ Specification Review Report, Version C2 dated 16.10.2015
- /U6/ Safety Assessment Report I, Version B2 dated 20.11.2015
- /U7/ Functional Design Specification, Version G2 dated 10.11.2015
- /U8/ Safety Requirements Tracking List, Version D2 dated 10.11.2015
- /U9/ Detail Design Specification, F_SAFE_POS, Version H2 dated 19.11.2015
- /U10/ Detail Design Specification, F_SLP_MONITOR, Version F2 dated 19.11.2015
- /U11/ Detail Design Specification, F_ENDZONE, Version F2 dated 19.11.2015
- /U12/ Detail Design Specification, F_BRAKE_TEST, Version F2 dated 19.11.2015
- /U13/ Detail Design Specification, F_LOAD_MONITOR, Version F2 dated 19.11.2015
- /U14/ Detail Design Specification, F_SBR_MONITOR, Version G2 dated 19.11.2015
- /U15/ Detail Design Specification, F_MIN_MAX, Version E2 dated 19.11.2015
- /U16/ Detail Design Specification, F_INTERPOLATION, Version A2 dated 19.11.2015
- /U17/ Detail Design Specification, F_MATH_FUNCTIONS, Version A2 dated 19.11.2015
- /U18/ Safety Assessment Report II, Version B2 dated 20.11.2015
- /U19/ Release of Software dated 15.02.2016, including program print-outs (PDF) of the function in Safety Advanced
- /U20/ Module Test Specification, F_SAFE_POS, Version B2 dated 08.12.2015
- /U21/ Module Test Specification, F_SLP_MONITOR, Version B2 dated 08.12.2015
- /U22/ Module Test Specification, F_ENDZONE, Version B2 dated 08.12.2015
- /U23/ Module Test Specification, F_BRAKE_TEST, Version B2 dated 08.12.2015
- /U24/ Module Test Specification, F_LOAD_MONITOR, Version B2 dated 08.12.2015
- /U25/ Module Test Specification, F_SBR_MONITOR, Version B2 dated 08.12.2015
- /U26/ Module Test Specification, F_MIN_MAX, Version B2 dated 08.12.2015
- /U27/ Module Test Specification, F_INTERPOLATION, Version A2 dated 08.12.2015
- /U28/ Module Test Specification, F_MATH_FUNCTIONS, Version A2 dated 08.12.2015

- /U29/ Module Test Report, F_SAFE_POS, Version C2 dated 15.02.2016
- /U30/ Module Test Report, F_SLP_MONITOR, Version B2 dated 08.01.2016
- /U31/ Module Test Report, F_ENDZONE, Version B2 dated 08.01.2016
- /U32/ Module Test Report, F_BRAKE_TEST, Version B2 dated 08.01.2016
- /U33/ Module Test Report, F_LOAD_MONITOR, Version B2 dated 08.01.2016
- /U34/ Module Test Report, F_SBR_MONITOR, Version B2 dated 08.01.2016
- /U35/ Module Test Report, F_MIN_MAX, Version B2 dated 08.01.2016
- /U36/ Module Test Report, F_INTERPOLATION, Version A2 dated 08.01.2016
- /U37/ Module Test Report, F_MATH_FUNCTIONS, Version A2 dated 08.01.2016
- /U38/ Manual, Fail-Safe Function Blocks for Rack Serving Units, TIA Safety Advanced with S7-1500F, dated 02/2016, Version v2.0
- /U39/ Release of Manual, Version v2.0 dated 15.02.2016
- /U40/ Factory Acceptance Test Specification, Version B2 dated 29.01.2016
- /U41/ Factory Acceptance Test Report, Version B2 dated 16.02.2016
- /U42/ Program printout (PDF) of the test project for the factory acceptance test, overall failsafe signature 227976F4, time of translation 16.02.2016 11:11:56
- /U43/ Safety Assessment Report III, Version B2 dated 18.02.2016
- /U44/ Safety Assessment Report IV, Version B2 dated 18.02.2016
- /U45/ Modification Request Tracking List dated 15.02.2016
- /U46/ Modification Note MOD-0001 dated 08.10.2015
- /U47/ Modification Note MOD-0002 dated 15.02.2016

4 Description of the item for testing

The item for testing described in this document comprises the software function blocks listed below from software library "ASRM_Failsafe_TS1500_V20".

F_SAFE_POS	Formation of a safe actual position and speed value
F_SLP_MONITOR	Safe position monitoring at the end of the travel route
F_ENDZONE	Safe position monitoring and safe speed profile at the end of the travel route
F_BRAKE_TEST	Safe brake test combined with drive function "SBT"
F_LOAD_MONITOR	Overload and slack rope detection
F_SBR_MONITOR	Monitoring a braking ramp
F_MIN_MAX	Minimum/Maximum value selection
F_INTERPOLATION	Calculation of the envelope curve for function block F_ENDZONE
LFAddInt	Intercept an overflow in the double integer number range during an addition
LFSubInt	Intercept an overflow in the double integer number range during a subtraction
LFMulInt	Intercept an overflow in the double integer number range during a multiplication
LFDivInt	Intercept an overflow in the double integer number range during a division
LFAddInt	Intercept an overflow in the integer number range during an addition
LFSubInt	Intercept an overflow in the integer number range during a subtraction
LFMulInt	Intercept an overflow in the integer number range during a multiplication
LFDivInt	Intercept an overflow in the integer number range during a division

The function blocks can be used in a system to control and monitor rail dependent storage and retrieval equipment. They form the safety functions pursuant to DIN EN 528 and are designed to simplify the programming, function testing and final acceptance of the software for the specific application.

At least the following automation components are required to achieve the defined safety objectives:

- Fail-safe SIMATIC S7 controller from series S7-1500F together with programming environments SIMATIC STEP 7 Professional V13 SP1 (or higher) and SIMATIC STEP 7 Safety Advanced V13 SP1 (or higher)
- SINAMICS S120 drive system with control unit CU320-2 (Firmware Version 4.6 or higher) with sensor/sensors on sensor modules SMC20/SMC30 or using DRIVE-CLiQ together with parameterisation environment SINAMICS MICROMASTER STARTER V4.4 (or higher)
- Safe PROFIBUS/PROFINET transfer (PROFIsafe telegram) between SINAMICS and F-CPU
- F-DQ module to activate the brakes
- External mechanical brake and/or motor holding brake
- Signal source for load measurement for overload/slack rope detection, for example using F-AI with a qualified sensor or two sensors which have undergone a mutual plausibility test (for example weighing cell and motor torque)

The block package covers several variants of sensor combinations. Depending on the application, both single sensor systems, consisting of a safe motor sensor with safe (form-fit) installation, and double or treble sensor systems including multiple on safe sensors may be selected.

As a result of the various sensor variants and the hardware variants resulting from this, the achieved safety integrity level/performance level of the safety functions must be established by the user. A maximum of SIL2 / PLd can be achieved using the equipment under discussion.

5 Completion of the test

In detail the following tests are carried out:

- 5.1 Evaluation of the management of functional safety
- 5.2 Test the specifications of the function blocks
- 5.3 Module tests and factory acceptance test (FAT)
- 5.4 Identification of block numbers and signatures

6 Results of the test

The completed tests provided the following results:

- 6.1 Evaluation of the management of functional safety

In terms of the system used at Siemens AG for the management of functional safety under IEC 61508-1 to -7:2011, it may be assumed that the function blocks under discussion are adequately free of systematic errors.

The appropriate certificates for use in safety applications have been issued for the automation components used (see Section 4).

The tested programming environment (STEP 7 Safety Advanced) covers the measures to avoid errors in the development of the software.

The various blocks are displayed in software modules. The software was developed on the basis of the V model in such a way that it is modular and can be tested.

The fulfilment of functionality, the process sequence and time-related information, time limits, conformity, data structure and properties of data, assumptions and dependencies for the design and testing capacity have been taken into account in terms of the various applications and are described in sufficient detail in the specification documents for the various blocks.

6.2 Test the specifications of the function blocks

The application-related evaluation of the various function blocks in terms of the evaluation criteria set out in Section 2 was conducted on the basis of the specification documents supplied to us.

6.2.1 Function block F_SAFE_POS

The test of the functionality of block F_SAFE_POS "Safe position and speed" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.2 Function block F_SLP_MONITOR

The test of the functionality of block F_SLP_MONITOR "Safe position at the end of the travel route" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.3 Function block F_ENDZONE

The test of the functionality of block F_ENDZONE "Safe position and safe speed profile at the end of the travel route" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.4 Function block F_BRAKE_TEST

The test of the functionality of block F_BRAKE_TEST "Safe brake test" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.5 Function block F_LOAD_MONITOR

The test of the functionality of block F_LOAD_MONITOR "Overload and slack rope detection" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.6 Function block F_SBR_MONITOR

The test of the functionality of block F_SBR_MONITOR "Monitoring a braking ramp" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.7 Function block F_MIN_MAX

The test of the functionality of block F_MIN_MAX "Minimum/Maximum value selection" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.8 Function block F_INTERPOLATION

The test of the functionality of block F_INTERPOLATION "Calculation of envelope curve" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.9 Function LFAAddDInt

The test of the functionality of function LFAAddDInt "Intercept an overflow in the double integer number range during an addition" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.10 Function LFSubDInt

The test of the functionality of function LFSubDInt "Intercept an overflow in the double integer number range during a subtraction" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.11 Function LFMulDInt

The test of the functionality of function LFMulDInt "Intercept an overflow in the double integer number range during a multiplication" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.12 Function LFDivDInt

The test of the functionality of function LFDivDInt "Intercept an overflow in the double integer number range during a division" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3)

showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.13 Function LFAddInt

The test of the functionality of function LFAddInt "Intercept an overflow in the integer number range during an addition" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.14 Function LFSubInt

The test of the functionality of function LFSubInt "Intercept an overflow in the integer number range during a subtraction" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.15 Function LFMulInt

The test of the functionality of function LFMulInt "Intercept an overflow in the integer number range during a multiplication" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.2.16 Function LFDivInt

The test of the functionality of function LFDivInt "Intercept an overflow in the integer number range during a division" on the basis of the documents entitled "Safety Requirements Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 3) showed that the requirements specified therein have been implemented correctly for the relevant application.

The conditions set out in Section 8 must be obeyed when using the function block.

6.3 Module tests and factory acceptance test (FAT)

The verification and validation of the requirements set out in the specification documents for the function blocks was conducted using the module tests carried out by Siemens AG. The validation documents "Module Test Specification" and "Module Test Report" (see Section 3) submitted to us verified that the requirements specified for the various function blocks had been implemented correctly.

During the factory acceptance test (FAT) on a simulation system, carried out on 16.02.2016 by Siemens AG in the presence of TÜV SÜD Industrie Service GmbH, Department IS-EG1-RGB, the safety-relevant functions/properties of the function blocks were finally validated by means of practical tests.

On conclusion of the tests the overall F signature 227976F4 dated 16.02.2016 11:11:56 (time of translation) was established for the user program of the test project.

6.4 Identification of block numbers and signatures

The function blocks are listed in software library "ASRM_Failsafe_TS1500_V20" for SIMATIC STEP 7 Safety Advanced.

The block numbers and signatures are listed below:

Block number	Block name	Block signature
FB 200	F_SAFE_POS	B1AF374D
FB 201	F_SLP_MONITOR	4306B514
FB 202	F_ENDZONE	7784F9C7
FB 203	F_BRAKE_TEST	ACB3FBA5
FB 204	F_LOAD_MONITOR	EE56B413
FB 207	F_SBR_MONITOR	94B95126
FC 206	F_MIN_MAX	088D67F5
FC 200	F_INTERPOLATION	21D8E5C4
FC 211	LFAAddDInt	68F88786
FC 212	LFSUBDInt	A2E3FC8A
FC 213	LFMULDInt	B06B3E93
FC 214	LFDIVDInt	0302D921
FC 215	LFAAddInt	D3F0DC77
FC 216	LFSUBInt	8772B769
FC 217	LFMULLInt	65F5AEC6
FC 218	LFDIVInt	64541C60

7 Report, summary

Function blocks F_SAFE_POS, F_SLP_MONITOR, F_ENDZONE, F_BRAKE_TEST, F_LOAD_MONITOR, F_SBR_MONITOR, F_MIN_MAX, F_INTERPOLATION, LFAAddDInt, LFSubDInt, LFMulDInt, LFDivDInt, LFAAddInt, LFSubInt, LFMullInt and LFDivInt satisfy the applicable requirements set out in the product and application standards.

The applicable requirements are described by the specifications and by the functional requirements set out in the manual.

A reaction on the safety system which must be formed from the blocks to suit the system type so as to control and monitor the rail dependent storage and retrieval equipment was not found.

The requirements in section 8 and in the manual must be observed and complied with.

8 Action

The following must be taken into consideration when using the function blocks.

1. The information and requirements set out in the specifications and safety manual must be observed and complied with.
2. The block signatures of the blocks used depending on the application must be validated on site.
3. The correct wiring of the blocks themselves and the wiring for the various blocks between each other must be validated on site taken into account the relevant application and system conditions. The user is responsible for the correct wiring of the blocks.
4. The type of stop reaction to be completed in the converter (STO, SS1, SOS, SS2, SDI) and the time to stand still must be defined on site on the basis of the risk assessment for the machine and taking into account the relevant application and system conditions. The user is responsible for the correct wiring of the supplied stop signal in its shut-down logic.
5. The achievable safety integrity level/performance level of all the safety functions created using the function blocks described in this document must be established by the user. The overall safety function including the peripherals (sensors and actors) must always be taken into consideration in this respect. The safety functions must meet the appropriate requirements set out in DIN EN 528 Table C2.