BESCHEINIGUNG ◆ ATTESTATION ◆ 证明书 ◆ СВИДЕТЕЛЬСТВО ◆ CONSTANCIA ◆ ATTESTAZIONE

Industrie Service

ATTESTATION

Manufacturer:	Siemens AG
Product category:	Fail-safe function blocks for storage and retrieval machines
Type:	Software library „ASRM_Failsafe_TS1500_V21" 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
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:	2750582
TÜV report no.:	e-t-2039-01-17 dated 2017-04-07
Test regulations:	EN 528: 2008 EN ISO 13849-1: 2015 EN ISO 13849-2: 2012 EN 62061: 2015
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.

TÜV SÜD Industrie Service GmbH
Department of Electrical Engineering
and Building Services
Regensburg Branch
Head of Department

Regensburg, 2017-04-20

Christian Eberle

Supervisory Board:
Karsten Xander (Chairman)
Board of Management:
Ferdinand Neuwieser (CEO),
Dr. Ulrich Klotz, Thomas Kainz

Phone: +49 941 9910-421
Fax: +49 941 9910-470
www.tuev-sued.de/is

TÜV SÜD Industrie Service GmbH
Department of Electrical Engineering and Building Services
Friedenstrasse 6
93051 Regensburg

Inspection report
ASRM Safety Library

Industrie Service

Recipient
Siemens AG
Frauenauracher Straße 80
91056 Erlangen

Commissioner
Siemens AG
Frauenauracher Straße 80
91056 Erlangen

Location
Siemens AG
Frauenauracher Straße 80
91056 Erlangen

For questions:
Christian Eberle
Phone: 0941 9910-402
Fax: 0941 9910-470
Email: christian.eberle@tuev-sued.de
TÜV Equipment: 2750582
TÜV Report No. e-t-2039-01-17

Authenticity test using the printed QR code in conjunction with the app "TÜV SÜD Verify"

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. Univ. Matthias Graf B. Eng. Peter Michtl
Period of testing:	2017-02 – 2017-04
Evaluation criteria:	EN 528: 2008 EN ISO 13849-1: 2015 EN ISO 13849-2: 2012 EN 62061: 2015
Results of the test:	No findings were found. The Actions in section 8 must be taken into consideration.

Excerpts from this document may only be reproduced and used for advertising purposes with the express written approval of TÜV SÜD Industrie Service GmbH.

The test results refer exclusively to the units under test.

Regensburg, 2017-04-25

Regensburg Branch
Department of Electrical Engineering
and Building Services
Department Manager

Christian Eberle

The Expert

Matthias Graf

Phone: 0941 9910-402
Fax: 0941 9910-470
www.tuev-sued.de/is

TÜV SÜD Industrie Service GmbH
Department of Electrical Engineering
and Building Services
Regensburg Branch
Friedenstr.6
93051 Regensburg / GERMANY

Industrie Service

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 3.

Due to optimization of the "F_SAFE_POS" block, a revaluation of the test documents as well as a factory acceptance test (FAT) of the block was necessary.

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

2 Test documents

The following documents were used for testing:

/U01/ 20160301report rbg safety library tia from TÜV SÜD Industrie Service GmbH dated 2016-03-01

/U02/ Management of Functional Safety, Development Process for Safety-Relevant Systems, Process Description, Version B2 dated 12.01.2017

/U03/ FSM/Validation Plan, Version F2 dated 14.03.2017

/U04/ Safety Assessment Report I, Version C2 dated 22.03.2017

/U05/ Functional Design Specification, Version I2 dated 03.04.2017

/U06/ Safety Requirements Tracking List, Version F2 dated 03.04.2017

/U07/ Detail Design Specification, F_SAFE_POS, Version J2 dated 03.04.2017

/U08/ Safety Assessment Report II, Version D2 dated 03.04.2017

/U09/ Release of Software, Version REL00009 dated 04.04.2017

/U10/ Module Test Specification, F_SAFE_POS, Version D2 dated 04.04.2017

/U11/ Module Test Report, F_SAFE_POS, Version E2 dated 04.04.2017

/U12/ Manual and Release of Manual, Fail-Safe Function Blocks for Rack Serving Units, Version v2.1 dated 05.04.2017

/U13/ Factory Acceptance Test Specification, Version C2 dated 05.04.2017

/U14/ Factory Acceptance Test Report, Version C2 dated 06.04.2017

/U15/ Safety Assessment Report III, Version C2 dated 06.04.2017

/U16/ Safety Assessment Report IV, Version C2 dated 06.04.2017

/U17/ Modification Note MOD-00003 dated 07.03.2017

/U18/ Modification Note MOD-00004 dated 03.04.2017

Phone: 0941 9910-402
Fax: 0941 9910-470
www.tuev-sued.de/is

TÜV SÜD Industrie Service GmbH
Department of Electrical Engineering and Building Services
Regensburg Branch
Friedenstr. 6
93051 Regensburg / GERMANY

Industrie Service

3 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.

- EN 528: 2008 " Rail dependent storage and retrieval equipment – Safety requirements"
- EN ISO 13849-1: 2015 "Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design"
- EN ISO 13849-2: 2012 "Safety of machinery - Safety-related parts of control systems - Part 2: Validation"
- EN 62061: 2015 "Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems"

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_V21".

The following function block was part of the factory acceptance test (FAT) of TÜV SÜD Industrie Service GmbH dated 06.04.2017:

F_SAFE_POS	Formation of a safe actual position and speed value

The following function blocks were part of the factory acceptance test (FAT) of TÜV SÜD Industrie Service GmbH dated 16.02.2016:

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
LFAddDInt	Intercept an overflow in the double integer number range during an addition
LFSubDInt	Intercept an overflow in the double integer number range during a subtraction
LFMulDInt	Intercept an overflow in the double integer number range during a multiplication
LFDivDInt	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

Phone: 0941 9910-402
Fax: 0941 9910-470
www.tuev-sued.de/is

TÜV SÜD Industrie Service GmbH
Department of Electrical Engineering and Building Services
Regensburg Branch
Friedenstr. 6
93051 Regensburg / GERMANY

Industrie Service

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 EN 528:2008 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 V14 SP1 (or higher) and SIMATIC STEP 7 Safety Advanced V14 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.

Phone: 0941 9910-402
Fax: 0941 9910-470
www.tuev-sued.de/is

TÜV SÜD Industrie Service GmbH
Department of Electrical Engineering and Building Services
Regensburg Branch
Friedenstr. 6
93051 Regensburg / GERMANY

Industrie Service

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 taking 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 3 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 2) 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 2) 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 2) 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 2) 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 2) 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.

Phone: 0941 9910-402
Fax: 0941 9910-470
www.tuev-sued.de/is

TÜV SÜD Industrie Service GmbH
Department of Electrical Engineering and Building Services
Regensburg Branch
Friedenstr. 6
93051 Regensburg / GERMANY

Industrie Service

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 2) 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 2) 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 2) 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 LFAddDInt

The test of the functionality of function LFAddDInt "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 2) 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 2) 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 2) 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

Phone: 0941 9910-402
Fax: 0941 9910-470
www.tuev-sued.de/is

TÜV SÜD Industrie Service GmbH
Department of Electrical Engineering and Building Services
Regensburg Branch
Friedenstr. 6
93051 Regensburg / GERMANY

Industrie Service

Specification", "Functional Design Specification" and "Detail Design Specification" (see Section 2) 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 2) 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 2) 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 2) 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 2) 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 2) 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 (Mr. Thomas Maget), Department IS-EG1-RGB, the safety-relevant functions/properties of the function blocks were finally validated by means of practical tests.

Phone: 0941 9910-402
Fax: 0941 9910-470
www.tuev-sued.de/is

TÜV SÜD Industrie Service GmbH
Department of Electrical Engineering and Building Services
Regensburg Branch
Friedenstr. 6
93051 Regensburg / GERMANY

Industrie Service

For the "F_SAFE_POS" block, the entire verification and validation was repeated due to optimization measures. The final FAT by Siemens AG in presence of TÜV SÜD Industrie Service GmbH (Mr. Peter Michtl), Department IS-EG1-RGB took place on 06.04.2017.

On conclusion of the tests the overall F signature D9CBF06C dated 06.04.2017 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_V21" 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	2BE066C0
FB 201	F_SLP_MONITOR	B6974076
FB 202	F_ENDZONE	18742561
FB 203	F_BRAKE_TEST	AEF3B5CB
FB 204	F_LOAD_MONITOR	FCBB27C6
FB 207	F_SBR_MONITOR	2B05EE7D
FC 206	F_MIN_MAX	A225BBC3
FC 200	F_INTERPOLATION	2C338B83
FC 211	LFAddDInt	24EE93DA
FC 212	LFSubDInt	F7AB9793
FC 213	LFMulDInt	720E2721
FC 214	LFDivDInt	C02D0512
FC 215	LFAddInt	5C4953EC
FC 216	LFSubInt	C8E2F576
FC 217	LFMulInt	6C42D9D1
FC 218	LFDivInt	A646442B

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, LFAddDint, LFSubDInt, LFMulDInt, LFDivDInt, LFAddInt, LFSubInt, LFMulInt 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.

Phone: 0941 9910-402
Fax: 0941 9910-470
www.tuev-sued.de/is

TÜV SÜD Industrie Service GmbH
Department of Electrical Engineering and Building Services
Regensburg Branch
Friedenstr. 6
93051 Regensburg / GERMANY

Industrie Service

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 EN 528:2008 Table C2.

Phone: 0941 9910-402
Fax: 0941 9910-470
www.tuev-sued.de/is

TÜV SÜD Industrie Service GmbH
Department of Electrical Engineering and Building Services
Regensburg Branch
Friedenstr. 6
93051 Regensburg / GERMANY