

Automation - Functional Safety

Test Report

**Report about the test of the
safety function "Safe Torque Off" (STO)
within the DX4 series drive of
ESTUN AUTOMATION CO., LTD.**

**Report-No.: 968/FSP 1903.01/20
Date: 2020-11-04**

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within the DX4 series drive of ESTUN AUTOMATION CO., LTD.**

Report-No.:	968/FSP 1903.01/20
Date:	2020-11-04
Number of pages (excl. appendices):	7
Test object:	Drives with integrated safety function “Safe Torque Off” (STO) Types: DX4 series
Customer/Manufacturer:	ESTUN AUTOMATION CO., LTD. No .155 Jiang Jun Road South, Jiang Ning Development Zone Nanjing 211100 P.R. China
Customer-Order-No./Date:	190126662 dated 2020-09-24
Test Institute:	TÜV Rheinland Industrie Service GmbH Automation - Functional Safety (A-FS) Am Grauen Stein 51105 Köln Germany
TÜV-Quotation-No./Date:	n/a
TÜV-Order-No./Date:	268128561 dated 2020-10-12
Assessor:	Dipl.-Ing. Martin Kiontke
Test location:	see Test Institute
Test duration:	October 2020

The test results are exclusively related to the test samples.

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1. **Scope**

This test report addresses the assessment of the safety function "Safe Torque Off" (STO) within the DX4 series drives in order to add them to the existing type approval and certification of the ED3S series drives. The latter have previously been certified in accordance with the requirements for SIL 3 according to IEC 61800-5-2 and IEC 61508, SIL CL 3 according to IEC 62061, as well as for the requirements for PL e / Cat. 4 according to ISO 13849-1 [R1].

This test report bases on the inspection report 968/INS 314.00/20 [R2] and serves as the basis for the update of the EC-type examination certificate 01/205/5728.00/19 [R1].

2. **Standards forming the basis for the requirements**

- [N1] TM31_V1.0 2020
TM for Components acc. to Annex IV of the Machinery Directive
- [N2] EN 61800-5-2:2017
Adjustable speed electrical power drive systems
Part 5-2: Safety requirements -
Functional
- [N3] EN 61800-5-1:2007 + A1:2017
Adjustable speed electrical power drive systems
Part 5-1: Safety requirements -
Electrical, thermal and energy
- [N4] EN IEC 61800-3:2018
Adjustable speed electrical power drive systems
Part 3: EMC requirements and specific test methods
- [N5] EN ISO 13849-1:2015
Safety of Machinery - Safety Related Parts of Control Systems
Part 1: General principles for design
- [N6] EN 62061:2005 + AC:2010 + A1:2013 + A2:2015
Safety of machinery -
Functional safety of safety-related electrical, electronic and programmable electronic
control systems
- [N7] IEC 61508:2010, parts 1 - 7
Functional safety of electrical/electronic/programmable electronic safety-related systems
- [N8] EN 60204-1:2018 (in extracts)
Safety of machinery - Electrical equipment of machines
Part 1: General requirements
- [N9] IEC 61326-3-1:2017
Electrical equipment for measurement, control and laboratory use - EMC requirements
Part 3-1: Immunity requirements for safety-related systems and for equipment
intended to perform safety-related functions (functional safety) -
General industrial applications

The requirements of the listed standards were forming the basis for this test report so far relevant and to the extent applicable.

3. **Identification of the test object**

3.1. **Description of the device under test**

The test object is described in detail in the inspection report [R2]. The safety function "STO" within the previously certified ED3S series drives is covered by the assessment report [R1].

The DX4 drive series consist of the following product types and their revisions:

Product Types ¹⁾	Hardware Rev.	Software Rev. ²⁾
DX4-1A5AJA	V100B3-TRIO	V100B6 / CRC32: 0xB4C89B95
DX4-1A5A##-*	V100B3-TRIO	V100B6 / CRC32: 0xB4C89B95
DX4-101AJA	V100B3-TRIO	V100B6 / CRC32: 0xB4C89B95
DX4-101A##-*	V100B3-TRIO	V100B6 / CRC32: 0xB4C89B95
DX4-102AJA	V100B3-TRIO	V100B6 / CRC32: 0xB4C89B95
DX4-102A##-*	V100B3-TRIO	V100B6 / CRC32: 0xB4C89B95
DX4-104AJA	V100B3-TRIO	V100B6 / CRC32: 0xB4C89B95
DX4-104A##-*	V100B3-TRIO	V100B6 / CRC32: 0xB4C89B95
DX4-108AJA	V100B3-TRIO	V100B6 / CRC32: 0x58D75603
DX4-108A##-*	V100B3-TRIO	V100B6 / CRC32: 0x58D75603
DX4-110AJA	V100B3-TRIO	V100B6 / CRC32: 0x58D75603
DX4-110A##-*	V100B3-TRIO	V100B6 / CRC32: 0x58D75603
DX4-115AJA	V100B3-TRIO	V100B6 / CRC32: 0x58D75603
DX4-115A##-*	V100B3-TRIO	V100B6 / CRC32: 0x58D75603
DX4-120AJA	V100B3-TRIO	V100B6 / CRC32: 0x13EC7171
DX4-120A##-*	V100B3-TRIO	V100B6 / CRC32: 0x13EC7171
DX4-130AJA	V100B3-TRIO	V100B6 / CRC32: 0x13EC7171
DX4-130A##-*	V100B3-TRIO	V100B6 / CRC32: 0x13EC7171

Table 3-1: Product Type Codes and Revisions covered by the Inspection

Note ¹⁾: For type code, refer to document [D5]
 # stands for A-Z to indicate encoder software edition;
 * n/a to indicate ESTUN's general client;
 0 ... 9 or A ... Z or any other form to indicate ESTUN's specific client number.

Note ²⁾: Software is not considered part of the safety function "STO", but performs only part of the diagnostic function on the STO circuitry. The whole DX4 series of products use the same source code, but different frame sizes use different compiler switch options. Therefore, the CRCs for different frame sizes differ, although they have the same revision number.

3.2. Documents as a basis for the assessment

No.	Document	Rev.	Date
[D1]	Modification impact analysis report 26a_DX4_Change_Impact_Analysis_V1.2_2020-07-23.docx	1.2	2020-07-23
[D2]	EMC test report 21h_DX4_CE-EMC_test_report.pdf 21j_DX4_STO-EMC_report.pdf	-/- -/-	2020-06-08 2020-06-08
[D3]	Electrical safety and environmental test report 21i_DX4_CE-LVD_test_report.pdf	-/-	2020-06-04

No.	Document	Rev.	Date
[D4]	Safety manual 09a_DX4_SM_ESTUN_V1.3_2020-07-10.doc	1.3	2020-07-10
[D5]	Product manual or user manual 23a_DX4_PM_ESTUN_V1.1_2020-07-10.docx	1.1	2020-07-10
[D6]	Declaration of Commitment for Storage of Test Samples Declaration_of_Commitment_samples_ESTUN.pdf	-/-	2020-10-09

Table 3-2: Documents provided by the manufacturer

3.3. Documents compiled by TÜV Rheinland

The following table shows the main documents, compiled by the test laboratory:

No.	Document	Rev.	Date
[T1]	Revision List 01_205_5728_01_20_RL_2020_10_29.docx	-/-	2020-10-29
[T2]	Checklist for the acceptance of test results TP-4020_Checklist for the acceptance of external test and measurement results.docx	-/-	2020-11-04

Table 3-3: Documents compiled by TÜV Rheinland

No.	Report-No.	Date	Certificate	Date
[R1]	968/FSP 1903.00/19	2019-09-20	01/205/5728.00/19	2019-09-20
[R2]	968/INS 314.00/20	2020-08-10	-/-	-/-

Table 3-4: Previous reports and certificates

4. Tests and test results

4.1. General

The assessment/test based on the rules and regulations set out in the Test Method TM31 (referred to in Chapter 2, [N1]). The verification of the results of the inspection report [R2] which was provided by the Inspection Body, was done by means of a review. For the present assessment/test, the Test Laboratory has covered the following points:

- Verification of the Inspection Report [R2] and the modification impact analysis report [D1]
- Verification of the electromagnetic compatibility (EMC) test reports [D2]
- Verification of the environmental and electrical safety test report [D3]
- Review and Verification of the user documentation [D4], [D5]
- Review of the Declaration of Commitment [D6]

The results of the individual tests of the product are recorded in the following chapters.

4.2. Results of the functional and safety analyses

4.2.1. Verification of the Inspection Report and the modification impact analysis

According to the Inspection Report [R2], the inspection of the modification impact analysis [D1] showed that all relevant aspects concerning functional safety were taken into account. This also includes the required system integration and validation tests. To confirm this, the Test Laboratory has carried out a plausibility test of the impact analysis for the DX4 [D1].

Result: The conclusion as summarized in the inspection report [R2] and in the modification impact analysis [D1] is accepted by the Test Institute.

4.2.2. Verification of electromagnetic compatibility (EMC) tests

The review of the EMC test reports has proven that the requirements of [N4] as well as the increased immunity levels of [N2] and [N9] have been tested successfully by the accredited Test Laboratory of TÜV Rheinland (Shanghai) Co., Ltd..

Result: The required EMC testing has been passed successfully. The safety function "Safe Torque Off" (STO) within the DX4 series drives complies with the requirements of the standards as listed in chapter 2.

4.2.3. Verification of environmental (ENV) electrical safety tests

The review of the environmental test reports and for electrical safety has proven that the requirements of [N3] are met. The testing was carried out by the accredited Test Laboratory of TÜV Rheinland (Shanghai) Co., Ltd.. The modification impact analysis [D1] has shown that the shock testing as required per [N2] is not necessary.

Result: The required environmental testing and testing for electrical safety has been passed successfully. The safety function "Safe Torque Off" (STO) within the DX4 series drives complies with the requirements of the standards as listed in chapter 2.

4.2.4. Review of the user documentation

The Safety Manual [D4] and Product manual [D5] were inspected according to the applicable requirements of [N6] part 2 Annex D as documented in chapter 4.2.6 of [R]. Spot checking has been carried out by the Test Laboratory.

Result: The results of the inspection report [R2] are accepted without restrictions. The new safety manual and product manual for DX4 series drive cover all relevant aspects for a safe use of the product. All relevant information for identification and safe use is in its appropriate place.

5. Summary

The test, based on the Test Method [N1] of the Test Laboratory, concludes that the safety function "Safe Torque Off" within DX4 series drives, as specified under chapter 3.1, complies with the requirements of PL e / Cat. 4 according to EN ISO 13849-1 and SIL 3 according to EN 61800-5-2 / IEC 61508, as well as for SIL CL 3 according to EN 62061, and can be used in applications up to these safety levels. The instructions of the associated Safety Manual [D4] and Product manual [D5] provided by the manufacturer have to be considered before any safety related usage.

Since there were no changes to the previously certified ED3S series drives or the applied standards, the results documented in report [R1] remain valid.

Therefore, the issue of a joint EC-Type examination certificate for ED3S and DX4 series drives is recommended.

This assessment does not substitute the validation at application level, which is mandatory before commissioning a machine.

Cologne, 2020-11-04
TIS/A-FS/Kst. 968 ki-nie

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The expert

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