



## **Results of the IEC 61508 Functional Safety Assessment**

Project:

YTA710 and YTA610 Temperature Transmitter

Customer:

**Yokogawa Electric Corporation**  
Musashino-shi, Tokyo  
Japan

Contract No.: Q23/04-175

Report No.: YEC 15-12-066 R001

Version V6, Revision R11, May 24, 2023

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## Management Summary

The Functional Safety Assessment of the Yokogawa Electric Corporation

YTA710 and YTA610 Temperature Transmitter

development project, performed by *exida* consisted of the following activities:

- *exida* assessed the development process used by Yokogawa Electric Corporation through an audit and review of a detailed safety case against the *exida* certification scheme which includes the relevant requirements of IEC 61508. The assessment was executed using subsets of the IEC 61508 requirements tailored to the work scope of the development team.
- *exida* reviewed and assessed a detailed Failure Modes, Effects, and Diagnostic Analysis (FMEDA) of the devices to document the hardware architecture and failure behavior.
- *exida* reviewed field failure data to verify the accuracy of the FMEDA analysis.
- *exida* reviewed the manufacturing quality system in use at Yokogawa Electric Corporation.

The functional safety assessment was performed to the SIL 3 requirements of IEC 61508:2010. A full IEC 61508 Safety Case was created using the *exida* Safety Case tool, which also was used as the primary audit tool. Hardware and software process requirements and all associated documentation were reviewed. Environmental test reports were reviewed. The user documentation and safety manual also were reviewed.

The results of the Functional Safety Assessment can be summarized by the following statements:

**The audited development process, as tailored and implemented by the Yokogawa Electric Corporation YTA710 and YTA610 Temperature Transmitter development project, complies with the relevant safety management requirements of IEC 61508 SIL 3.**

**The assessment of the FMEDA, done to the requirements of IEC 61508, has shown that the YTA710 and YTA610 Temperature Transmitter can be used in a low demand safety related system in a manner where the  $PFD_{AVG}$  is within the allowed range for SIL 3 (HFT = 1) according to table 2 of IEC 61508-1.**

**The assessment of the FMEDA also shows that the YTA710 and YTA610 Temperature Transmitter meets the requirements for architectural constraints of an element such that it can be used to implement a SIL 2 safety function (with HFT = 0) or a SIL 3 safety function (with HFT = 1).**

**This means that the YTA710 and YTA610 Temperature Transmitter is capable for use in SIL 3 applications in Low demand mode when properly designed into a Safety Instrumented Function per the requirements in the Safety Manual and when using the versions specified in section 3.1 of this document.**

The manufacturer will be entitled to use the Functional Safety Logo.



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## 1 Purpose and Scope

This document shall describe the results of the IEC 61508 functional safety assessment of the:

- YTA710 & YTA610 Temperature Transmitter

by *exida* according to the accredited *exida* certification scheme which includes the requirements of IEC 61508: 2010.

The purpose of the assessment was to evaluate the compliance of:

- the YTA710 and YTA610 Temperature Transmitter with the technical IEC 61508-2 and -3 requirements for SIL 3 and the derived product safety property requirements

and

- the YTA710 and YTA610 Temperature Transmitter development processes, procedures and techniques as implemented for the safety-related deliveries with the managerial IEC 61508-1, -2 and -3 requirements for SIL 3.

and

- the YTA710 and YTA610 Temperature Transmitter hardware analysis represented by the Failure Mode, Effects and Diagnostic Analysis with the relevant requirements of IEC 61508-2.

The assessment has been carried out based on the quality procedures and scope definitions of *exida*.

The results of this assessment provide the safety instrumentation engineer with the required failure data per IEC 61508 / IEC 61511 and confidence that sufficient attention has been given to systematic failures during the development process of the device.

### 1.1 Tools and Methods used for the assessment

This assessment was carried by using the *exida* Safety Case tool. The Safety Case tool contains the *exida* scheme which includes all the relevant requirements of IEC 61508.

For the fulfillment of the objectives, expectations are defined which builds the acceptance level for the assessment. The expectations are reviewed to verify that each single requirement is covered. Because of this methodology, comparable assessments in multiple projects with different assessors are achieved. The arguments for the positive judgment of the assessor are documented within this tool and summarized within this report.

All assessment steps were continuously documented by *exida* (see [R1])

## 2 Project Management

### 2.1 *exida*

*exida* is one of the world's leading accredited Certification Bodies and knowledge companies, specializing in automation system safety and availability with over 400 years of cumulative experience in functional safety. Founded by several of the world's top reliability and safety experts from assessment organizations and manufacturers, *exida* is a global company with offices around the world. *exida* offers training, coaching, project oriented system consulting services, safety lifecycle engineering tools, detailed product assurance, cyber-security and functional safety certification, and a collection of on-line safety and reliability resources. *exida* maintains a comprehensive failure rate and failure mode database on process equipment based on 250 billion hours of field failure data.

### 2.2 Roles of the parties involved

Yokogawa Electric Corporation      Manufacturer of the YTA710 & YTA610 Temperature Transmitter

*exida*      Performed the hardware assessment [R3]

*exida*      Performed the Functional Safety Assessment [R1] per the accredited *exida* scheme.

Yokogawa Electric Corporation contracted *exida* with the IEC 61508 Functional Safety Assessment of the above mentioned devices.

### 2.3 Standards / Literature used

The services delivered by *exida* were performed based on the following standards / literature.

[N1]	IEC 61508 (Parts 1 – 7): 2010	Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems
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### 2.4 Reference documents

#### 2.4.1 Documentation provided by Yokogawa Electric Corporation

Doc ID	Document Description	Project Document Name	Version	Date
D01	Quality Manual	QP-140-01-8.pdf Title: 品質マニュアルの管理手順	8	18 Jul, 2014
D02	Overall Development Process	QP172-01-6.pdf Title: 標準製品の開発管理手順	6	26 Sep, 2012
D03	Configuration Management Process	QP172-06-2.pdf Title: ソフトウェアの構成管理手順	2	1 Sep, 2009
D04	Field Failure Reporting Procedure	QP185-02-3.pdf Title: 是正処置および予防処置の管理手順	3	20 Oct, 2009

D05	Manufacturer Qualification Procedure	SMS台帳 (Manufacturing Standard).pdf		15 Apr, 2014
D06	Part Selection Procedure	ds41102E.pdf Title: Recommended electrical parts	3	13 Apr, 2007
D07	Quality Management System (QMS) Documentation Change Procedure	QP-140-02-6E.pdf Title: Document Control Procedure	0	15 Oct, 2010
D08	Quality Management System (QMS) Documentation Change Procedure	GMj-800.pdf Title: YOKOGAWAグループ品質マネジメント基本規程	4	27 Apr, 2015
D09	Non-Conformance Reporting procedure	GMj-804.pdf Title: YOKOGAWAグループの製品不適合処理	9	27 Apr, 2015
D10	Corrective Action Procedure	QP-185-02-1E0.pdf Title: Improvement Activity Management Procedures	0	20 Apr, 2011
D11	Internal Audit Procedure	QP-150-03-6E0.pdf Title: Quality Management Audit Procedures	0	27 Apr, 2015
D12	Action Item List Tracking Procedure	QS-100-8E0.pdf Title: Quality Management Regulation	0	31 Mar, 2014
D13	Training Procedure	QP-160-02-2E.pdf Title: Competence, Training and Awareness Management Procedures	0	15 Oct, 2010
D14	Test Equipment Calibration Procedure	QP-175-03-9E0.pdf Title: Control Procedure for Measuring Equipment Traceability	0	30 Mar, 2015
D15	Management Review Process	ds10101E.pdf Title: Lifecycle management standard for products	6	28 Sep, 2012
D16	Software Development Process	QP-172-05-1E1.pdf Title: Management Procedures for Development Tools and Techniques	0	20 Apr, 2011
D17	Modification Procedure	SMM-C-088_18_設計変更作業基準.doc	18	1Jul, 2013
D18	Impact Analysis Template	SMM-C-088_18_設計変更作業基準 別紙1_設計変更計画書.xlsx	18	1Jul, 2013
D19	FSM Plan or Development Plan	STR-CMNPF_TX-AE003 YTA710製品開発計画書.pdf	0	30 March, 2016
D20	Configuration Management Plan	STR-CMNPF_TX-AE046 YTA610最終審査資料.pptx	0	9 Sep, 2016



D21	Verification Plan and Result	STR-CMNPF_TX-AE006_設計検討書.xls	5	16 May, 2016
D22	Shipment Records	YTA_Shipping and field return Data.xlsx		Jun 2016
D23	Training Record	教育記録_アナログ技術者.doc		22 May, 2016
D24	Skills Matrix	SkillMap_アナログ技術者.xlsx		13 May, 2016
D25	ISO 900x Cert or equivalent	ISO9001認証書.pdf		24 Dec, 2014
D26	List of Design Tools	STR-CMNPF_TX-NB006 YTA710ツール評価.docx	0	10 Mar, 2016
D27	Safety Requirements Specification	STR-CMNPF_TX-AC003_YTA710_Safety_Requirement_Specification.docx	0	7 Apr, 2016
D28	Safety Requirements Review	STR_CMNPF_TX-VF037_YTA710_Safety_Requirement_Specification_レビュー記録書.docx	0	7 Apr, 2016
D29	System Architecture Design Specification	STR-CMNPF_TX-NB002_YTA710アーキテクチャ.doc	0	28 Apr, 2015
D30	Schematics / Circuit Diagrams	FD1_F9221DA_REV1.pdf / FE1-F9221DA_REV1.xlsx	1	23 Sep, 2016
D31	Schematics / Circuit Diagrams	FD1-F9221AA_REV0.pdf / FE1-F9221AA_REV1.xlsx	1	26 Sep, 2016
D32	Schematics / Circuit Diagrams	FD1-F9221BA_REV1.pdf / FE1-F9221BA_REV1.xlsx	1	26 Sep, 2016
D33	Schematics / Circuit Diagrams	FD1-F9221EA_REV0 .pdf / FE1-F9221EA_REV1.xlsx	1	26 Sep, 2016
D34	Schematics / Circuit Diagrams	FD1-F9221FA_REV0.pdf / FE1-F9221FA_REV1xlsx	1	26 Sep, 2016
D35	Schematics / Circuit Diagrams	FD1-F9221GA_REV0.pdf / FE1-F9221GA_REV1.xlsx	1	26 Sep, 2016
D36	High Level Software Design Specification	STR-CMNPF_TX-NB003_YTA710_基本設計書.docx	0	15 Jul, 2015
D37	Detailed Software Design Specification	STR-CMNPF_TX-NB005_YTA710_Temp._Assy_設計書.pdf	1	11 Apr, 2016
D38	Detailed Software Design Specification	STR-CMNPF_TX-MA003_伝送器共通PFモジュール間通信仕様書_Rev1.docx	1	30 Oct, 2015

D39	Requirements Traceability Matrix	STR-CMNPF_TX-NB008_YTA710トレーサビリティマトリックス.doc	0	7 Apr, 2016
D40	Fault Injection Test Plan	YTA710 Fault_Injection_Plan_28Jan2016.xls		28 Jan, 2016
D41	Coding Standard	SDS-C-079_C/C++_コーディングルール_rev3.doc	3	11 Nov, 2014
D42	Validation Test Plan	STR-CMNPF_TX-OB007_YTA710_共通部システムテスト計画書.docx	0	12 Jan, 2016
D43	Validation Test Plan Review Record	STR-CMNPF_TX-OB004_YTA710_共通部機能仕様システムテスト計画_報告書レビュー議事録.docx	0	2 Dec, 2015
D44	EMC Test Plan	STR-CMNPF_TX-IC056_EEN404-D01_YTA710-J_EMC_TestPlan_rev0.docx	0	15 Jan, 2016
D45	Validation Test Results	STR-CMNPF_TX-OB004_YTA710_共通部機能仕様システムテスト計画_報告書.xls	0	11 Dec, 2015
D46	Validation Test Results	STR-CMNPF_TX-OB003_YTA710_Temp._Assy_テスト計画書兼報告書.pdf	1	14 Apr, 2016
D47	EMC Test Results	STR-CMNPF_TX-IC056_YTA710_EMC_テストレポート.pdf		10 Feb, 2016
D48	Fault Injection Test Results	YTA710 Fault_Injection_Plan-Result_28Jan2016.xls		28 Jan, 2016
D49	Operation / Maintenance Manual	IM01C50G01-01EN_001.pdf	1st Edition	Jun, 2016
D50	Safety Manual	Appendix A. Safety Instrumented Systems .pdf	0	6 Jul, 2016
D51	Safety Manual Review	STR-CMNPF_TX-VF057_YTA710_Safety_Manual改訂(rev1) レビュー議事録.docx	0	5 Jul, 2016

#### 2.4.1.1 Documentation provided by Yokogawa Electric Corporation for Revised Certification (Q16/08-109)

D52	Requirements Traceability Matrix	STR-CMNPF_TX-NB008_YTA710トレーサビリティマトリックス.doc	0	23 Sep, 2016
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## 2.4.1.2 Documentation provided by Yokogawa Electric Corporation for Revised Certification (Q16/12-111)

D53	Quality Manual	QP-140-01-9E0.pdf Title: Quality Manuals Control Procedure	0	20 Jul, 2016
D54	Quality Management System (QMS) Documentation Change Procedure	GMe-800_05.pdf Title: The Principles of "Yokogawa Group Quality Management Standards"	5	13 May, 2016
D55	Modification Procedure	SMM-C-088_19_設計変更作業基準.doc	19	25 Oct, 2016
D56	Safety Requirements Specification	STR-CMNPF_TX-AC003_YTA710_YTA610_Safety_Requirement_Specification.docx	2	27 Dec, 2016
D57	Safety Requirements Review	STR-CMNPF_TX-VF109_YTA710_YTA610のSRS改訂レビュー議事録_.docx	0	27 Dec, 2016
D58	System Architecture Design Specification	STR-CMNPF_TX-NC005_YTA710_HART_システム基本部設計書_r2.docx	2	28 Dec, 2016
D59	SW HAZOP or Criticality Analysis	STR-CMNPF_TX-NB007_r1_YTA710-FMEA.xlsx	1	20 Jan, 2017
D60	Requirements Traceability Matrix	STR-CMNPF_TX-NB008_YTA710開発のトレーサビリティ報告書.doc	2	5 Feb, 2017
D61	Validation Test Plan	STR-CMNPF_TX-OC006_YTA710_Main_Assy_ROMのCRCチェックに関する検証計画報告書.xlsm	2	3 Feb, 2017
D62	Impact Analysis Record	STR-CMNPF_TX-NB011_r2_YTA710起動時ROM_CRCチェック追加による影響度分析.doc	2	20 Jan, 2017
D63	ISO 9001 Cert or equivalent	ISO9001 Certificate.pdf		1 Oct, 2016
D64	Non-conformance Reporting procedure	GMe-804_10.pdf Title: Actions for Product Nonconformity of Yokogawa Group	10	13 May, 2016
D65	FSM Plan or Development Plan	STR-CMNPF_TX-AE003_YTA710製品開発計画書.docx	3	21 Sep, 2016
D66	List of Design Tools	STR-CMNPF_TX-NB006#1_YTA710ツール評価.docx	1	25 Nov, 2016

D67	System Architecture Design Specification	STR-CMNPF_TX-NB002_YTA710アーキテクチャ.doc	1	6 Jan, 2017
D68	High Level software Design Specification	STR-CMNPF_TX-NB003_YTA710_基本設計書_1.docx	1	25 Apr, 2016
D69	Safety Manual	IM01C50T01-02EN Appendix A	3rd	

#### 2.4.1.3 Documentation provided by Yokogawa Electric Corporation for Revised Certification (Q17/12-001)

D70	STR-CMNPF-TX-ZA005	YTA710/610 のIEC 61508更新提出資料 Shipping record and field return report	0	29 Dec, 2017
D71	FCR-O-M-1004	SIL2不適合品の機能安全システムへの適用把握	0	14 Feb, 2018

#### 2.4.1.4 Documentation provided by Yokogawa Electric Corporation for Revised Certification (Q18/02-343)

D72	Shipment Records	FCR-O-A-1027 SIL2で使用しているか否かの判別確認報告書	0	27 Mar, 2017
D73	Shipment Records	FCR-O-G-1007 YTA710 サービスノート 進捗確認レビュー（第2回） 議事録	0	19 Mar, 2018
D74	Field Return Records	STR-CMNPF_TX-ZA006 YTA610, YTA710 フィールドリターン記録詳細	0	28 May, 2018
D75	Shipment Records	STR-CMNPF_TX-ZA006_出荷実績YTA610, YTA710出荷データ	0	28 May, 2018

#### 2.4.1.5 Documentation provided by Yokogawa Electric Corporation for Revised Certification (Q18/12-107)

D76	Impact Analysis Record	STR-CMNPF_TX-UA005 YTA710/610 センサバックアップ バーンアウト 調査報告書	0	13 Feb, 2019
D77	Impact Analysis Record	STR-CMNPF_TX-VF269 YTA710/610 センサバックアップ バーンアウト調査報告 /対応方針 打ち合わせ議事録	0	20 Feb, 2019
D78	Shipment Records	STR-CMNPF_TX-ZA012_YTA610_YTA710 (HART)_フィールドリターン記録詳細	1	8 Mar, 2019
D79	Field Return Records	STR-CMNPF_TX-ZA012_YTA610,YTA710 (HART)_過去1年間の出荷実績・フィールドリターン 記録	0	22 Feb, 2019

#### 2.4.1.6 Documentation provided by Yokogawa Electric Corporation for Revised Certification (Q19/03-053)

D80	Safety Requirements Specification	STR-CMNPF_TX- AC003_4_YTA710_Safety_Requirement_Specifi cation.pdf	4	24 May, 2019
D81	Safety Requirements Review	STR-CMNPF_TX- VF287_0_YTA710_610_Safety_Requirement_S pecification_レビュー議事録.pdf	0	24 May, 2019
D82	Requirements Traceability Matrix	STR-CMNPF_TX-NB010_5_YTA610トレーサビリ ティ報告書.pdf	5	11 Jun, 2019
D83	Requirements Traceability Matrix	STR-CMNPF_TX-VF293_0_YTA610_トレーサビリ ティ報告書レビュー議事録.pdf	0	11 Jun, 2019
D84	Requirements Traceability Matrix	STR-CMNPF_TX-NB008_4_YTA710トレーサビリ ティ報告書.pdf	4	24 May 2019
D85	Requirements Traceability Matrix	STR-CMNPF_TX-VF291_0_YTA710_YTA610_ト レーサビリティ報告書レビュー議事録.pdf	0	24 May, 2019
D86	Operation/Maintenance Manual	IM01C50G01-01EN_005.pdf	5	Jun, 2019
D87	Safety Manual	STR-CMNPF_TX- AC004_6_YTA710_YTA610_Safety_Manual.pdf	6	11 Jun, 2019

D88	Safety Manual Review	STR-CMNPF_TX-VF294_0_YTA710_YTA610_Safety_Manual_レビュー議事録.pdf	0	11 Jun, 2019
D89	Impact Analysis Record	STR-CMNPF_TX-NB013_Rev2_YTA710_610_ソフトウェア品質改善設計変更_影響度分析.pdf	2	24 May, 2019
D90	Impact Analysis Record	STR-CMNPF_TX-VF289_0_YTA710_610_ソフトウェア品質改善設計変更_影響度分析_レビュー議事録.pdf	0	24, May 2019
D91	Impact Analysis Record	STR-CMNPF_TX-HB043_YTA710_610のセカンドソース追加の影響度分析Rev2.pdf	2	10 Jun, 2019
D92	Impact Analysis Record	STR-CMNPF_TX-VF262_YTA710_610のセカンドソース追加レビュー議事録 Rev2.pdf	2	12 Jun, 2019
D93	ISO9001 Certificate	ISO9001_Certificate.pdf		15 Sep, 2018

#### 2.4.1.7 Documentation provided by Yokogawa Electric Corporation for Revised Certification (Q20/01-064)

D94	Quality Manual	QP-140-01-10E0.pdf	0	3 Jul, 2017
D95	Overall Development Process	QP-172-01-7E0.pdf	0	3 Jul, 2017
D96	Field Failure Reporting Procedure	QP-185-02-5E0.pdf	0	27 Mar, 2019
D97	Manufacturer Qualification Procedure	MW-A01_02.pdf	2	22 Oct, 2015
D98	Quality Management System Documentation Change Procedure	GMSe-800.pdf	0	11 Jul, 2018
D99	Quality Management System Documentation Change Procedure	QP-140-02-7E0.pdf	0	3 Jul, 2017
D100	Non-Conformance Reporting Procedure	GMSe-800-01-01.pdf	0	11 Jul, 2018
D101	Corrective Action Procedure	QP-185-02-5E0.pdf	0	21 Jul, 2019

D102	Action Item List Tracking Procedure	QS-100-11E0.pdf	0	21 Aug, 2017
D103	Training Procedure	QP-160-02-3E0.pdf	0	3 Jul, 2017
D104	Test Equipment Calibration Procedure	QP-175-03-10E0.pdf	0	28 Mar, 2018
D105	Management Review Process	DS10101E.pdf	7	3 Jul, 2017
D106	Software Development Process	QP-172-05-1E2.pdf	2	3 Jul, 2017
D107	Modification Procedure	SMM-C-088_23_ja_設計変更作業基準.pdf	23	11 Jul, 2019
D108	Validation Test Plan	STR-CMNPF_TX-VF309_YTA_船級品_設計変更評価項目rev1.pdf	1	21 Jan, 2020
D109	Validation Test Plan Review Record	STR-CMNPF_TX-VF309_YTA_船級品_評価計画レビュー議事録_rev1.pdf	1	21 Jan, 2020
D110	Validation Test Results	STR-CMNPF_TX-VF330_YTA710_610_船級対応品_評価結果レビュー資料.pdf	0	17 Jan, 2020
D111	Validation Test Results Review	STR-CMNPF_TX-VF330_YTA710_610_船級対応品_評価結果レビュー議事録.pdf	0	21 Jan, 2020
D112	Safety Manual	STR-CMNPF_TX-AC004_YTA710_YTA610_Safety_Manual .pdf	7	24 Mar, 2020
D113	Safety Manual Review	STR-CMNPF_TX-VF338_The_minutes_of_review_of_Safety_Manual_20200317-0323.pdf	0	24 Mar, 2020
D114	Impact Analysis Record	STR-CMNPF_TX-HB051_YTA710_610のセカンドソース追加の影響度分析_Rev1.pdf	1	20 Jan, 2020
D115	Impact Analysis Record	STR-CMNPF_TX-HB052_YTA710_610のセカンドソース部品追加による影響度分析2.pdf	0	6 Feb, 2020

#### 2.4.1.8 Documentation provided by Yokogawa Electric Corporation for Revised Certification (Q20/03-083)

D116	Shipment Records	STR-CMNPF_TX-ZA015_YTA610,YTA710 (HART)_過去1年間の出荷実績・フィールドリターン記録.pdf	0	12 Mar, 2020
D117	Field Return Records	STR-CMNPF_TX-ZA016_YTA610,YTA710 (HART)_フィールドリターン記録詳細.pdf	0	12 Mar, 2020
D118	ISO 9001 Certificate	ISO9001_Jan2020.pdf		18 Jan, 2020
D119	High Level Software Design Specification	STR-CMNPF_TX-NB003_YTA710_YTA610_ 基本設計書_2.pdf	2	02 Apr, 2018

#### 2.4.1.9 Documentation provided by Yokogawa Electric Corporation for Revised Certification (Q21/04-012)

D120	Shipment Records	STR-CMNPF_TX-ZA020_YTA610_YTA710 (HART)_過去1年間の出荷実績・フィールドリターン記録.pdf	0	07 May, 2021
D121	Field Return Records	STR-CMNPF_TX-ZA021_YTA610_YTA710 (HART)_フィールドリターン記録詳細.pdf	0	07 May, 2021
D122	ISO 9001 Certificate	EN_ISO9001_0066454_Dec2020-UKAS.PDF		07 Dec, 2020
D123	Operation / Maintenance Manual	IM01C50G01-01EN_007.pdf	7	31 Mar, 2021
D124	Safety Manual	IM01C50T01-02EN_005.pdf (Appendix A)	5	30 Jun, 2020
D125	Safety Manual Review	STR-CMNPF_TX-VF342_The_minutes_of_review_of_Safety_Manual_20200428-0513.pdf	0	14 May, 2020
D126	Safety Manual	STR-CMNPF_TX-AC004_YTA710_YTA610_Safety_Manual_9.pdf	9	21 May, 2021
D127	Safety Manual Review	STR-CMNPF_TX-VF378_The_minutes_of_review_of_Safety_Manual_20210521.pdf	0	21 May, 2021



#### 2.4.1.10 Documentation provided by Yokogawa Electric Corporation for Revised Certification (Q22/04-004)

D128	Manufacturer Qualification Procedure	MW-A01E_3.0.pdf	3	25 Nov, 2020
D129	Shipment Records	STR-CMNPF_TX-ZA024_YTA610_YTA710 (HART)_過去1年間の出荷実績・フィールドリターン記録.pdf	0	25 Apr, 2022
D130	Field Return Records	STR-CMNPF_TX-ZA023_YTA610_YTA710 (HART)_フィールドリターン記録詳細.pdf	0	25 Apr, 2022
D131	ISO 9001 Certificate	0066454-QMS-ENGUS-UKAS.pdf		15 Sep, 2021
D132	Maintenance Manual	ManualChange21_0006_E.pdf	7	1 Jul, 2021
D133	Safety Manual	STR-CMNPF_TX-AC004_YTA710_YTA610_Safety_Manual_10.pdf	10	23 May, 2022
D134	Safety Manual Review	STR-CMNPF_TX-VF400_The_minutes_of_review_of_Safety_Manual_20220523.pdf	0	25 May, 2022

#### 2.4.1.11 Documentation provided by Yokogawa Electric Corporation for Revised Certification (Q23/04-175)

D135	Manufacturer Qualification Procedure	MW-A01E_4.0.pdf	4	9 Mar, 2023
D136	Modification Procedure	SMM-C-088_27_ja_設計変更作業基準 .pdf	27	4 Apr, 2022
D137	Modification Procedure	SMM-C-088_27_ja_別紙1_設計変更計画書.pdf	27	4 Apr, 2022
D138	Shipment Records	STR-CMNPF_TX-ZA031_YTA610_YTA710 (HART)_過去1年間の出荷実績・フィールドリターン記録.xlsx	0	21 Apr, 2023
D139	Field Return Records	STR-CMNPF_TX-ZA030_YTA610_YTA710 (HART)_フィールドリターン記録詳細.xlsx	0	21 Apr, 2023
D140	Operation / Maintenance Manual	ManualChange22-12E.pdf		1 Jul, 2022
D141	Operation / Maintenance Manual	ManualChange22_23E.pdf		31 Mar, 2023

## 2.4.2 Documentation generated by *exida*

[R1]	Safety Case WB-61508 v1.7.2e Q20-03-083 YTA 710_610 Rev8-4.xlsm	SafetyCase Workbook for YTA710 & YTA610 Temperature Transmitter (Internal document)
[R2]	YEC 15-12-066 R001 V6R11 Assessment YTA710 and YTA610.docx	Assessment Report for YTA710 & YTA610 Temperature Transmitter (this report)
[R3]	YEC 15-10-041 R001 V4R7 FMEDA YTA710 and YTA610.pdf	FMEDA report for YTA710 & YTA610 Temperature Transmitter (Updated Q22/04-004)
[R4]	2015 Q15-12-066 YTA710 PIU Spreadsheet - 02Aug2016.xls	PIU Analysis for YTA710 & YTA610 Temperature Transmitter (Internal document)
[R5]	YAS 15-12-041 R001 V1R3 Factory Assessment YTA 710.pdf	Factory Assessment for YTA710 & YTA610 Temperature Transmitter
[R6]	Q17-12-001 YTA710_610 Revised Certification PIU Spreadsheet	PIU Analysis on YTA710/610 Temperature Transmitter (Internal document)
[R7]	Q18-02-343 YTA710_610 Revised Certification PIU Spreadsheet	PIU Analysis on YTA710/610 Temperature Transmitter (Internal document)
[R8]	Q18-12-107 YTA710_610 Revised Certification PIU Spreadsheet	PIU Analysis on YTA710/610 Temperature Transmitter (Internal document)
[R9]	YCS 19-04-082 R001 V1R3 YTA610_710 Factory Assessment	YCS Factory Assessment for YTA710 & YTA610 Temperature Transmitter
[R10]	YEC20-01-064 YTA710_610 Revised Certification PIU V1R2.xlsx	PIU Analysis on YTA710/610 Temperature Transmitter (Internal document)
[R11]	YEC 20-09-140 R003 V1 R2 YTA610_710 YMG Kofu Production Assessment	YMG Kofu Production Assessment for YTA710 & YTA610 Temperature Transmitter
[R12]	YEC 21-04-012 YTA710_YTA610.xlsx	Field Failure Analysis on YTA710/610 Temperature Transmitter (Internal document)
[R13]	YEC 22-04-004 YTA710_YTA610.xlsx	Field Failure Analysis on YTA710/610 Temperature Transmitter (Internal document)
[R14]	YEC 23-04-175 YTA710_YTA610.xlsx	Field Failure Analysis on YTA710/610 Temperature Transmitter (Internal document)

## 2.5 Assessment Approach

The certification audit was closely driven by requirements of the *exida* scheme which includes

The assessment was planned by *exida* and agreed with Yokogawa Electric Corporation.

The following IEC 61508 objectives were subject to detailed auditing at Yokogawa Electric Corporation:

- FSM planning, including
  - Safety Life Cycle definition
  - Scope of the FSM activities
  - Documentation
  - Activities and Responsibilities (Training and competence)
  - Configuration management
  - Tools and languages
- Safety Requirement Specification
- Change and modification management
- Software architecture design process, techniques and documentation
- Hardware architecture design - process, techniques and documentation
- Hardware design / probabilistic modeling
- Hardware and system related V&V activities including documentation, verification
  - Integration and fault insertion test strategy
- Software and system related V&V activities including documentation, verification
- System Validation including hardware and software validation
- Hardware-related operation, installation and maintenance requirements

The project teams, not individuals were audited.

The certification audit was done in Musashino-shi, Tokyo on February 8, 2017.

### 3 Product Description

The YTA710 & YTA 610 Temperature Transmitter is a two-wire 4 – 20 mA smart device. It contains self-diagnostics and is programmed to send its output to a specified failure state, either high or low upon internal detection of a failure. For safety instrumented systems usage, it is assumed that the 4 - 20 mA output is used as the primary safety variable. The transmitter can communicate via HART communications that are superimposed on the current signal. These communications are not required for safety functionality and are considered interference free.

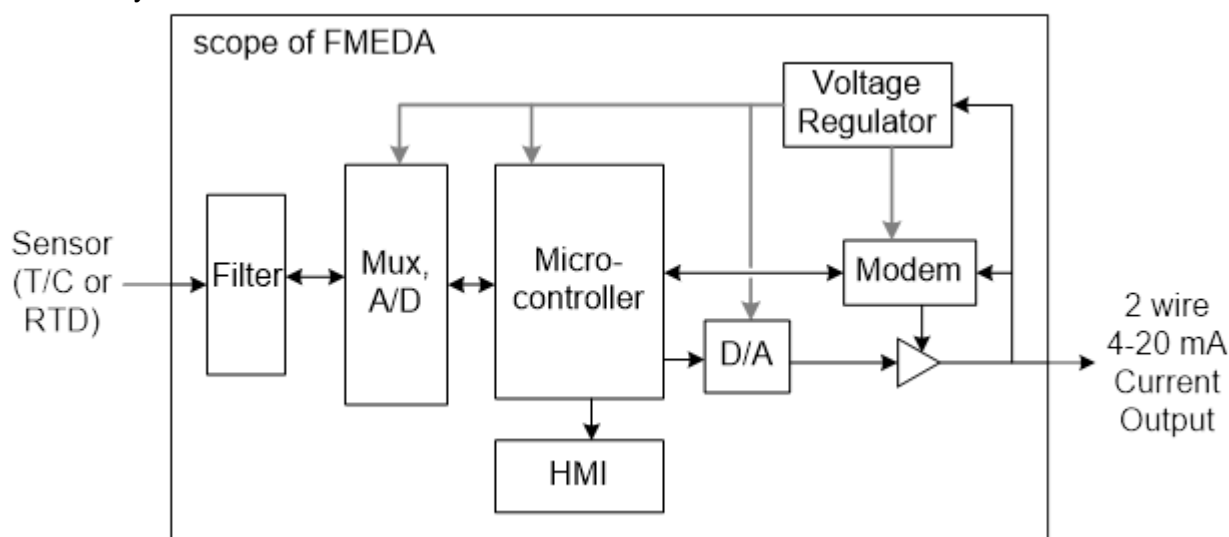


Figure 1 YTA710 & YTA 610 Temperature Transmitter, Parts included in the FMEDA

Table 1 gives an overview of the different versions that were considered in the FMEDA of the YTA710 & YTA 610 Temperature Transmitter.

**Table 1 Version Overview**

Option 1	The YTA710 & YTA 610 Temperature Transmitter, single TC configuration
Option 2	The YTA710 & YTA 610 Temperature Transmitter, single RTD configuration

The YTA710 & YTA 610 Temperature Transmitter is classified as a Type B<sup>1</sup> element according to IEC 61508, having a hardware fault tolerance of 0.

<sup>1</sup> Type B element: "Complex" element (using micro controllers or programmable logic); for details see 7.4.4.1.3 of IEC 61508-2, ed2, 2010.

### **3.1 Hardware and Software Version Numbers**

This assessment is applicable to the following hardware and software versions of YTA710 & YTA610 Temperature Transmitter:

Hardware Version: S1

Software Version: R1.03

Q19/03-053 Revised Certification is applicable to the following hardware and software version of YTA710 & YTA610 Temperature Transmitter:

Hardware Version: S1

Software Version: R1.03.01 and R1.04.01

## 4 IEC 61508 Functional Safety Assessment Scheme

*exida* assessed the development process used by Yokogawa Electric Corporation for this development project against the objectives of the *exida* certification scheme. The results of the assessment are documented in [R1].

All objectives have been successfully considered in the Yokogawa Electric Corporation development processes for the development.

*exida* assessed the set of documents against the functional safety management requirements of IEC 61508. This was done by a pre-review of the completeness of the related requirements and then a spot inspection of certain requirements, before the development audit.

The safety case demonstrated the fulfillment of the functional safety management requirements of IEC 61508-1 to 3.

The detailed development audit (see [R1]) evaluated the compliance of the processes, procedures and techniques, as implemented for the Yokogawa Electric Corporation YTA710 & YTA610 Temperature Transmitter, with IEC 61508.

The assessment was executed using the *exida* certification scheme which includes subsets of the IEC 61508 requirements tailored to the work scope of the development team.

The result of the assessment shows that the YTA710 & YTA610 Temperature Transmitter is capable for use in SIL 3 applications, when properly designed into a Safety Instrumented Function per the requirements in the Safety Manual.

### 4.1 Product Modifications

The modification process has not yet been assessed and audited, so modifications are not currently covered by this assessment. No modifications are permitted to the certified versions of the YTA710 & YTA610 Temperature Transmitter without reassessment.

As part of the *exida* scheme a surveillance audit is conducted prior to renewal of the certificate. The modification documentation listed below is submitted as part of the surveillance audit. *exida* will review the decisions made by the competent person in respect to the modifications made.

- List of all anomalies reported
- List of all modifications completed
- Safety impact analysis which shall indicate with respect to the modification:
  - The initiating problem (e.g. results of root cause analysis)
  - The effect on the product / system
  - The elements/components that are subject to the modification
  - The extent of any re-testing
- List of modified documentation
- Regression test plans

## 5 Results of the IEC 61508 Functional Safety Assessment

*exida* assessed the development process used by Yokogawa Electric Corporation during the product development against the objectives of the *exida* certification scheme which includes IEC 61508 parts 1, 2, & 3 [N1]. The development of the YTA710 & YTA610 Temperature Transmitter was done per this IEC 61508 SIL 3 compliant development process. The Safety Case was updated with project specific design documents.

### 5.1 Lifecycle Activities and Fault Avoidance Measures

Yokogawa Electric Corporation has an IEC 61508 compliant development process as assessed during the IEC 61508 certification. This compliant development process is documented in [D02], [D65] and [D95].

This functional safety assessment evaluated the compliance with IEC 61508 of the processes, procedures and techniques as implemented for the product development. The assessment was executed using the *exida* certification scheme which includes subsets of IEC 61508 requirements tailored to the SIL 3 work scope of the development team. The result of the assessment can be summarized by the following observations:

**The audited development process complies with the relevant managerial requirements of IEC 61508 SIL 3.**

#### 5.1.1 Functional Safety Management

##### FSM Planning

The functional safety management of any Yokogawa Electric Corporation Safety Instrumented Systems Product development is governed by [D02], [D65] and [D95]. This process requires that Corporation create a functional safety management plan [D65] or project plan which is specific for each development project. This plan defines all of the tasks that must be done to ensure functional safety as well as the person(s) responsible for each task. These processes and the procedures referenced herein fulfill the requirements of IEC 61058 with respect to functional safety management.

##### Version Control

All documents are under version control as required by [D07], [D54], [D98] and [D99].

##### Training, Competency recording

Competency is ensured by the creation of a competency and training matrix for the project [D13], [D23] and [D103]. The matrix lists all of those on the project who are working on any of the phases of the safety lifecycle. Specific competencies for each person are listed on the matrix which is reviewed by the project manager. Any deficiencies are then addressed by updating the matrix with required training for the project.

## **5.1.2 Safety Lifecycle and FSM Planning**

### **Assessment**

The functional safety management plan defines the safety lifecycle for this project. This includes a definition of the safety activities and documents to be created for this project. This information is communicated via these documents to the entire development team so that everyone understands the safety plan. [D02], [D65] and [D95]

The Software Development Procedure identifies the phases of the software development lifecycle and the inputs/outputs associated with each phase. [D16] and [D106]

Manufacturer has a QMS in place. The Manufacturer has been ISO 9001 certified. All sub-suppliers have been qualified through the Manufacturer Qualification procedure. [D05], [D53], [D94], [D122] and [D131]

### **Conclusion:**

The objectives of the standard are fulfilled by the Yokogawa Electric Corporation functional safety management system and new product development processes.

## **5.1.3 Documentation**

### **Assessment**

There is a document management system in place. This system controls how all safety relevant documents are changed, reviewed and approved. [D02], [D07], [D54], [D65], [D95], [D98] and [D99]

All safety related documents are met the following requirements:

- Have titles or names indicating scope of the contents
- Contain a table of contents
- Have a revision index which lists versions of the document along with a description of what changed in that version

### **Conclusion**

The objectives of the standard are fulfilled by the Yokogawa Electric Corporation functional safety management system.

## **5.1.4 Training and competence recording**

### **Assessment**

The FSM Plan lists the key people working on the project along with their roles. [D65]

A competency matrix has been created. [D23]

### **Conclusion**

The objectives of the standard are fulfilled by the Yokogawa Electric Corporation functional safety management system and internal organizational procedures.



### **5.1.5 Configuration Management**

#### **Assessment**

Formal configuration control is defined and implemented for Change Authorization, Version Control, and Configuration Identification. A documented procedure exists to ensure that only approved items are delivered to customers. Master copies of the software and all associated documentation are kept during the operational lifetime of the released software. [D20]

The configuration of the product to be certified is documented including all hardware and software versions that make up the product.

#### **Conclusion**

The objectives of the standard are fulfilled by the Yokogawa Electric Corporation organizational release procedures, functional safety management system and new product development processes.

### **5.1.6 Tools (and languages)**

#### **Assessment**

All off-line support tools have been classified as either T3 (safety critical), T2 (safety-related), or T1 (interference free). [D66]

All off-line support tools in classes T2 and T3 have a specification or product manual which clearly defines the behavior of the tool and any instructions or constraints on its use.

#### **Conclusion**

The objectives of the standard are fulfilled by the Yokogawa Electric Corporation functional safety management system.

### **5.1.7 Proven In Use**

In addition to the Design Fault avoidance techniques listed above, a Proven in Use evaluation was performed on the YTA Temperature Transmitter series. Shipment records were used to determine that the YTA Temperature Transmitter series has greater than 1 billion operating hours and has demonstrated a field failure rate less than the predicted failure rates indicated in the FMEDA reports.

#### **Conclusion**

The objectives of the standard for Proven In Use for SIL 3 are fulfilled by the Yokogawa Electric Corporation field history and return procedures and supported by PIU analysis. [R4]

PIU analysis [R6] was reviewed as part of the revised certification work on Q17/12-001.

PIU analysis [R7] was reviewed as part of the revised certification work on Q18/02-343.

PIU analysis [R8] was reviewed as part of the revised certification work on Q18/12-107.

PIU analysis [R10] was reviewed as part of the revised certification work on Q20/03-083.

PIU analysis [R12] was reviewed as part of the revised certification work on Q21/04-012.

PIU analysis [R13] was reviewed as part of the revised certification work on Q22/04-004.

PIU analysis [R14] was reviewed as part of the revised certification work on Q23/04-175.

## 5.2 Safety Requirement Specification

### Objectives

The main objectives of the related IEC 61508 requirements are to:

- Specify the requirements for each E/E/PE safety-related system, in terms of the required safety functions and the required safety integrity, in order to achieve the required functional safety.

### Assessment

The SRS provides a basis for tracking the fulfillment of the requirements. All element safety functions necessary to achieve the required functional safety are specified. [D56]

The updated SRS [D80] was reviewed as part of revised certification work on Q19/03-053.

### Conclusion

The objectives of the standard are fulfilled by the Yokogawa Electric Corporation functional safety management system.

## 5.3 Change and modification management

### Objectives

The main objectives of the related IEC 61508 requirements are to:

- Ensure that the required safety integrity is maintained after corrections, enhancements or adaptations to the E/E/PE safety-related systems.

### Assessment

Modifications are initiated with an Engineering Design Change procedure [D55] and [D107]. All changes are first reviewed and analyzed for impact before being approved. Measures to verify and validate the change are developed following the normal design process.

Since this was the initial assessment of YTA710 & YTA610 Temperature Transmitter modification procedure according to IEC 61508, it was expected that modifications to the product prior the assessment did not include a functional safety impact analysis. The modification process has been revised to include a functional safety impact analysis. The initial post assessment modification to the YTA710 and YTA610 Temperature Transmitter shall be audited by *exida* to confirm that a functional safety impact analysis was performed according to Yokogawa Electric Corporation's modification procedure.

### Conclusion

The objectives of the standard are fulfilled by the Yokogawa Electric Corporation functional safety management system, change management procedures, and sustaining product procedures.

## 5.4 System Design

### Objectives

The objective of the related IEC 61508 requirements of this subclasses are to specify the design requirements for each E/E/PE safety-related system, in terms of the subsystems and elements.

## **Assessment**

The System Architecture Design describes that the behavior of the device when a fault is detected is to announce the detected fault through an external interface. [D58], [D67]

## **Conclusion**

The objectives of the standard are fulfilled by the Yokogawa Electric Corporation functional safety management system and new product development processes.

## **5.5 Software Design**

### **Objectives**

The main objectives of the related IEC 61508 requirements are to:

- Create a software architecture that fulfils the specified requirements for software safety with respect to the required safety integrity level.
- Review and evaluate the requirements placed on the software by the hardware architecture of the E/E/PE safety-related system, including the significance of E/E/PE hardware/software interactions for safety of the equipment under control.
- Design and implement software that fulfils the specified requirements for software safety with respect to the required safety integrity level, which is analyzable and verifiable, and which is capable of being safely modified.

### **Assessment**

The Software Architecture Design uses Function Block Diagrams. [D68], [D119]

The Software Architecture Design contains a description of the software architecture.

A software criticality analysis and FMEA was performed and the report lists all components along with their criticality (Safety Critical, Safety Related, or Non-Interfering) and their required Systematic Capability. [D59]

### **Conclusion**

The objectives of the standard are fulfilled by the Yokogawa Electric Corporation functional safety management system.

## **5.6 Hardware Design and Verification**

### **Objectives**

The main objectives of the related IEC 61508 requirements are to:

- Create E/E/PE safety-related systems conforming to the specification for the E/E/PES safety requirements (comprising the specification for the E/E/PES safety functions requirements and the specification for the E/E/PES safety integrity requirements).
- Ensure that the design and implementation of the E/E/PE safety-related systems meets the specified safety functions and safety integrity requirements.
- Demonstrate, for each phase of the overall, E/E/PES and software safety lifecycles (by review, analysis and/or tests), that the outputs meet in all respects the objectives and requirements specified for the phase.

- Test and evaluate the outputs of a given phase to ensure correctness and consistency with respect to the products and standards provided as input to that phase.
- Integrate and test the E/E/PE safety-related systems.

### 5.6.1 Hardware architecture design

#### Assessment

Hardware architecture design [D56], [D67] and [D80] has been partitioned into subsystems, and interfaces between subsystems are defined and documented. Design reviews [D43] and [D57] are used to discover weak design areas and make them more robust. Measures against environmental stress and over-voltage are incorporated into the design.

The FSM Plan and development process and guidelines define the required verification activities related to hardware including documentation, verification planning, test strategy and requirements tracking to validation test.

#### Conclusion

The objectives of the standard are fulfilled by the Yokogawa Electric Corporation functional safety management system and new product development processes.

### 5.6.2 Hardware Design / Probabilistic properties

#### Assessment

To evaluate the hardware design of the YTA710 & YTA610 Temperature Transmitter, a Failure Modes, Effects, and Diagnostic Analysis was performed by *exida* for each component in the system. This is documented in [R3]. The FMEDA was verified using Fault Injection Testing as part of the development, see [D48], and as part of the IEC 61508 assessment.

A Failure Modes and Effects Analysis (FMEA) is a 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 the system in consideration. An FMEDA (Failure Mode Effect and Diagnostic Analysis) is an FMEA extension. It combines standard FMEA techniques with extension to identify online diagnostics techniques and the failure modes relevant to safety instrumented system design.

From the FMEDA failure rates are derived for each important failure category.

These results must be considered in combination with  $PFD_{AVG}$  of other devices of a Safety Instrumented Function (SIF) in order to determine suitability for a specific Safety Integrity Level (SIL). The Safety Manual states that the application engineer should calculate the  $PFD_{AVG}$  for each defined safety instrumented function (SIF) to verify the design of that SIF.

#### Conclusion

The objectives of the standard are fulfilled by the Yokogawa Electric Corporation functional safety management system, FMEDA quantitative analysis, and hardware development guidelines and practices.

## 6 Software Verification

### Objectives

The main objectives of the related IEC 61508 requirements are to:

- To the extent required by the safety integrity level, test and evaluate the outputs from a given software safety lifecycle phase to ensure correctness and consistency with respect to the outputs and standards provided as input to that phase.
- Verify that the requirements for software safety (in terms of the required software safety functions and the software safety integrity) have been achieved.
- Integrate the software onto the target programmable electronic hardware. Combine the software and hardware in the safety-related programmable electronics to ensure their compatibility and to meet the requirements of the intended safety integrity level.
- 

### Assessment results

The Software Architecture Design uses semi-formal methods, such as Function Block Diagram and Data Flow Diagrams. Various design specifications represent software design sections. These designs were subject to review. [D37], [D38]

### Conclusion:

The objectives of the standard are fulfilled by the Yokogawa Electric Corporation functional safety management system, software development process, and new product development processes.

## 6.1 Safety Validation

### Objectives

- Ensure that the design and implementation of the E/E/PE safety-related systems meets the specified safety functions and safety integrity requirements.
- Plan the validation of the safety of the E/E/PE safety-related systems.
- Validate that the E/E/PE safety-related systems meet, in all respects, the requirements for safety in terms of the required safety functions and the safety integrity.
- Ensure that the integrated system complies with the specified requirements for software safety at the intended safety integrity level.

### Assessment

Test results are documented including reference to the test case and test plan version being executed [D42], [D45], [D46], [D61] and [D108]. Test plan reviews were documented. [D43], [D61] and [D109]

Calibration information is documented in the test results.

Test failures are documented in the test results with references to the change request made for the fix.

### Conclusion

The objectives of the standard are fulfilled by the Yokogawa Electric Corporation functional safety management system, software development process, and new product development processes.

## **6.2 Safety Manual**

### **Objectives**

- Develop procedures to ensure that the required functional safety of the E/E/PE safety-related systems is maintained during operation and maintenance.

### **Assessment**

The Safety Manual is provided and identifies and describes the functions of the product. The functions are clearly described, including a description of the input and output interfaces. When internal faults are detected, their effect on the device output is clearly described. [D51], [D69], [D87], [D112], [D124], [D126] and [D133]

The Safety Manual gives guidance on recommended periodic proof test activities for the product, including listing any tools necessary for proof testing.

All routine maintenance tools and activities required to maintain safety are identified and described in the Safety Manual.

### **Conclusion**

The objectives of the standard are fulfilled by the Yokogawa Electric Corporation functional safety management system and the safety manual.

## 7 Terms and Definitions

Fault tolerance	Ability of a functional unit to continue to perform a required function in the presence of faults or errors (IEC 61508-4, 3.6.3)
FIT	Failure In Time ( $1 \times 10^{-9}$ failures per hour)
FMEDA	Failure Mode Effect and Diagnostic Analysis
HFT	Hardware Fault Tolerance
PFD <sub>AVG</sub>	Average Probability of Failure on Demand
PFH	Probability of dangerous Failure per Hour
SFF	Safe Failure Fraction - Summarizes the fraction of failures, which lead to a safe state and the fraction of failures which will be detected by diagnostic measures and lead to a defined safety action.
SIF	Safety Instrumented Function
SIL	Safety Integrity Level
SIS	Safety Instrumented System – Implementation of one or more Safety Instrumented Functions. A SIS is composed of any combination of sensor(s), logic solver(s), and final element(s).
HART	Highway Addressable Remote Transducer
AI	Analog Input
AO	Analog Output
DI	Digital Input
DO	Digital Output
Type B element	“Complex” element (using complex components such as micro controllers or programmable logic); for details see 7.4.4.1.3 of IEC 61508-2

## 8 Status of the document

### 8.1 Liability

*exida* prepares reports based on methods advocated in International standards. Failure rates are obtained from a collection of industrial databases. *exida* accepts no liability whatsoever for the use of these numbers or for the correctness of the standards on which the general calculation methods are based.

### 8.2 Releases

Version History:

V6 R11:	Kiyoshi Takai, Revised Certification on Q23/04-175, May 24, 2023
V6 R10:	Kiyoshi Takai, Review Updated Safety Manual, May 30, 2022
V6 R9:	Kiyoshi Takai, Revised Certification on Q22/04-004, May 19, 2022
V6 R8:	Kiyoshi Takai, Reviewed Updated Safety Manual, May 27, 2021
V6 R7:	Kiyoshi Takai, Revised Certification on Q21/04-012, May 14, 2021
V6 R6:	Kiyoshi Takai, Correct after customer review, November 27, 2020
V6 R5:	Kiyoshi Takai, YMG Kofu Production Assessment added, November 21, 2020
V6 R4:	Kiyoshi Takai, Correct after customer review, April 28, 2020
V6 R3:	Kiyoshi Takai, Revised Certification on Q20/03-083, April 23, 2020
V6 R2:	Kiyoshi Takai, Correct after customer review, April 15, 2020
V6 R1:	Kiyoshi Takai, Revised Certification as modification of specification on Q20/01-064, April 10, 2020
V5 R1:	Kiyoshi Takai, Revised Certification on Q19/03-053, June 18, 2019
V4 R3:	Kiyoshi Takai, Correct after customer review, March 27, 2019
V4 R2:	Kiyoshi Takai, Revised Certification on Q18/12-107 and correct report Number, March 22, 20
V4 R1:	Kiyoshi Takai, Revised Certification on Q18/02-343, April 4, 2018
V3 R2:	Kiyoshi Takai, correct after costumer review, February 20, 2018
V3 R1:	Kiyoshi Takai, Revised Certification on Q17/12-001, February 19, 2018
V2 R4:	Kiyoshi Takai, corrected referred documents. February 23, 2017
V2 R3:	Kiyoshi Takai, corrected document rev etc. by customer review, February 21, 2017; added documents to sections 2.4.3 [D64]-[D69]
V2 R2:	Kiyoshi Takai, Revised Certificate, February 16, 2017 added documents to sections 2.4.3 [D52]-[D63]. 2.4.4 [R4]: added, [R3]: modified
V2 R1:	Kiyoshi Takai, documents changed by customer, December 19, 2016; added documents to sections 2.4.2 [D53]. 2.4.1 [D30] [D31]: modified
V1 R2:	Kiyoshi Takai, Corrected FMEDA report number, August 30, 2016
V1 R1:	Kiyoshi Takai, First Release, August 26, 2016
V1 R0:	Kiyoshi Takai, Draft for customer Review, August 24, 2016
V0 R0:	Kiyoshi Takai, Draft for internal Review, August 17, 2016



Authors: Kiyoshi Takai

Review: John Yozallinas  
Kaoru Sonoda on V5 R1, V6 R1 to V6 R11

Release status: Release to Customer

### 8.3 Future Enhancements

At request of client.

### 8.4 Release Signatures

A handwritten signature in black ink that reads "Kiyoshi Takai".

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Kiyoshi Takai, Evaluating Assessor

A handwritten signature in black ink that reads "John C Yozallinas".

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John Yozallinas, Certifying Assessor

A handwritten signature in black ink that appears to read "Kaoru".

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Kaoru Sonoda, Certifying Assessor