Functional Safety Information

TPS3704x-Q1
Functional Safety Report

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Trademarks

1 Purpose of the Functional Safety Report

The purpose of the Functional Safety Report is to summarize the results from analysis and documentation involved in the development of this project and to determine the results are sufficient to claim compliance to the identified functional safety standards. This high level overview is intended to be used by customers as a part of their safety case with respect to the TPS3704x-Q1.

2 Summary of Assessment

This functional safety assessment has shown the Texas Instruments TPS3704x-Q1 project to be satisfactorily compliant with the relevant sections of functional safety standard ISO-26262 up to ASIL-A and IEC61508 up to SIL-1 requirements.

The tailored development process used for this development, SafeTI Functional Safety Hardware, complies with the relevant requirements for functional safety management.

The work products developed for this project are sufficient to prove that this development process was followed and that the project complies with the relevant sections of ISO 26262 and IEC 61508.

The FMEDA analysis shown that the SPFM, LFM, and PMHF are within the limits required by ISO 26262-5 Tables 5, 6, and 7 to achieve ASIL-A and IEC 61508-2 tables 2 and 3 to achieve SIL-1.

The TPS3704x-Q1 passes the assessment. This assessment applies to all part numbers as given in the device naming convention figure.For non automotive grade parts remove the -Q1 from the part number.

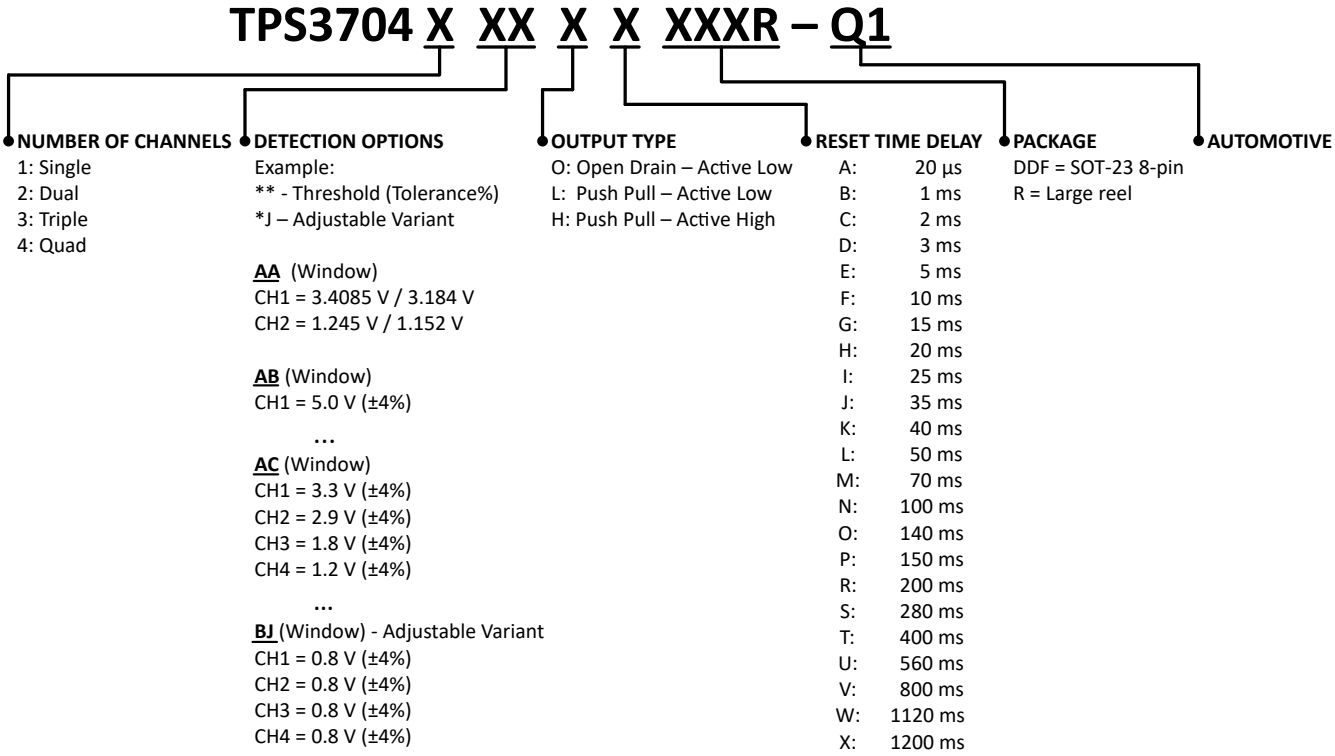

Figure 2-1. Device Naming Convention

3 Product Description

The TPS3704x is a family of quad, triple, dual, and single precision voltage supervisors where each channel has overvoltage and undervoltage detection capability. The TPS3704x features a highly accurate window threshold voltage where the upper and lower thresholds can be customized for symmetric or asymmetric tolerances. The reset signal for the TPS3704x is asserted, with a fault detection time delay (t_{PD} = 10 µs maximum), when the sense voltage is outside of the overvoltage and undervoltage thresholds.

The TPS3704x includes the resistors used to set the overvoltage and undervoltage thresholds internal to the device. These internal resistors allow for lower component counts and greatly simplifies the design because no additional margins are needed to account for the accuracy of external resistors. The level of integration in the TPS3704x enables a total small solution size for any application.

The TPS3704x is capable to monitor any voltage rail with high resolution (V_{IT} ≤ 0.8 V: 20 mV steps / V_{IT} > 0.8 V: 0.5% or 20 mV steps whichever is lower). Each channel in the TPS3704x can be configured independently as a window, OV or UV supervisor. Also, the V_{IT} threshold voltage for each channel can be asymmetric. For example, a channel that is configured as an overvoltage supervisor can be setup with a +5% tolerance whereas an undervoltage channel supervisor can be programmed with a -4% tolerance. If a window supervisor is configured, the voltage threshold tolerance can either be symmetrical or asymmetrical.

The TPS3704x includes fixed reset time delay (t_D) options ranging from 20 µs to 1200 ms and can monitor up to four channels while maintaining an ultra-low I_Q current of 15 µA (maximum).

4 Fulfillment of IEC 61508:2010 Requirements

Texas Instruments carried out this assessment with respect to relevant requirements from the IEC 61508:2010 standard.

Table 4-1. Details of IEC 61508:2010 Requirements

IEC 61508:2010	Requirement	Status	Compliance Argument	Evidence
Part 1: General Requirements	a. Documentation	Pass	All documentation follows TI Functional Safety Hardware development flow requirements. All documentation is planned in the functional safety plan. All documentation is following the TI functional safety templates.	TI Functional Safety Hardware development flow
Part 1: General Requirements	b. Management of Functional Safety	Pass	Project manager and Safety manager were appointed to this project. Functional Safety Plan was generated and necessary audits and assessments were scheduled.	Documented nomination of Functional Safety Manager
Part 1: General Requirements	c. Safety Lifecycle - Concept	Pass	Functional safety concept for the IC was developed with respect to the context of the targeted functional safety systems.	System Functional Safety Assumptions and Component Safety Requirements
Part 1: General Requirements	d. Safety Lifecycle - Overall Scope Definition	N/A	Requirements do not apply, however assumptions were made for the SEooC development.	N/A
Part 1: General Requirements	e. Safety Lifecycle - Hazard and Risk Analysis	N/A	Requirements do not apply, however assumptions were made for the SEooC development.	N/A
Part 1: General Requirements	f. Safety Lifecycle - Overall Safety Requirements	N/A	Requirements do not apply, however assumptions were made for the SEooC development.	N/A
Part 1: General Requirements	g. Safety Lifecycle - Overall Safety Requirements Allocation	Pass	Functional safety concept for the IC was developed with respect to the context of the targeted functional safety systems.	System Functional Safety Assumptions and Component Safety Requirements
Part 1: General Requirements	h. Safety Lifecycle - Overall Operation and Maintenance Planning	N/A	The requirements for overall operation and maintenance planning do not apply to this SEooC development.	N/A
Part 1: General Requirements	i. Safety Lifecycle - Overall Safety Validation Planning	Pass	These requirements were applied at the IC level, not the system level. IC functional safety requirements were planned to be validated in pre-silicon and post-silicon testing.	Validation and Characterization Plans
Part 1: General Requirements	j. Safety Lifecycle - Overall Installation and Commissioning	N/A	The requirements for overall installation and commissioning do not apply to this SEooC development.	N/A
Part 1: General Requirements	k. Safety Lifecycle - E/E/PE System Safety Requirements Specification	Pass	Functional safety concept for the IC was developed with respect to the context of the targeted functional safety systems.	Functional Safety Requirements Specification (SRS)

Table 4-1. Details of IEC 61508:2010 Requirements (continued)

IEC 61508:2010	Requirement	Status	Compliance Argument	Evidence
Part 1: General Requirements	l. Safety Lifecycle - E/E/PE Safety-Related Systems: Realization	Pass	IC functional safety requirements were realized in the product design.	Design Specification
Part 1: General Requirements	m. Safety Lifecycle - Other Risk Reduction Measures: Specification and Realization	N/A	The requirements for other risk reduction measures do not apply to this SEooC development.	N/A
Part 1: General Requirements	n. Safety Lifecycle - Overall Installation and Commissioning	N/A	The requirements for overall installation and commissioning do not apply to this SEooC development.	N/A
Part 1: General Requirements	o. Safety Lifecycle - Overall Safety Validation	Pass	These requirements were applied at the IC level, not the system level. IC functional safety requirements were planned to be validated in pre-silicon and post-silicon testing.	Validation and Characterization Plans
Part 1: General Requirements	p. Safety Lifecycle - Overall Operation, Maintenance and Repair	N/A	The requirements for overall operation, maintenance and repair do not apply to this SEooC development.	N/A
Part 1: General Requirements	q. Safety Lifecycle - Overall Modification and Retrofit	N/A	The requirements for overall modification and retrofit do not apply to this SEooC development.	N/A
Part 1: General Requirements	r. Safety Lifecycle - Decommissioning or Disposal	N/A	The requirements for decommissioning or disposal do not apply to this SEooC development.	N/A
Part 1: General Requirements	s. Verification	Pass	These requirements were applied at the IC level, not the system level. IC functional safety activities have been verified by persons of appropriate independence.	Verification Plans and Reports for each safety work product per Safety Plan
Part 1: General Requirements	t. Functional Safety Assessment	Pass	Refer to section 2 for a summary of the functional safety assessment.	Functional Safety Assessment
Part 2: Requirements for E/E/PE Safety-Related Systems	a. E/E/PE System Design Requirements Specification	Pass	These requirements were applied at the IC level, not the system level. IC functional safety requirements were generated from system assumptions.	System Functional Safety Assumptions and Requirements, SRS
Part 2: Requirements for E/E/PE Safety-Related Systems	b. E/E/PE System Safety Validation Planning	Pass	These requirements were applied at the IC level, not the system level. IC functional safety requirements were planned to be validated in pre-silicon and post-silicon testing.	Validation and Characterization Plans
Part 2: Requirements for E/E/PE Safety-Related Systems	c. E/E/PE System Design & Developments Including ASICs & Software	Pass	These requirements were applied at the IC level, not the system level. IC functional safety requirements were realized in the product design.	Design Specification
Part 2: Requirements for E/E/PE Safety-Related Systems	d. E/E/PE System Integration	N/A	The requirements for system integration do not apply to this SEooC development.	N/A

Table 4-1. Details of IEC 61508:2010 Requirements (continued)

IEC 61508:2010	Requirement	Status	Compliance Argument	Evidence
Part 2: Requirements for E/E/PE Safety-Related Systems	e. E/E/PE System Installation, Commissioning, Operation and Maintenance Procedures	N/A	The requirements for system installation, commissioning, operation and maintenance do not apply to this SEooC development.	N/A
Part 2: Requirements for E/E/PE Safety-Related Systems	f. E/E/PE System Safety Validation	Pass	These requirements were applied at the IC level, not the system level. IC functional safety requirements have been validated in pre-silicon and post-silicon testing.	Validation and Characterization Plans and Reports
Part 2: Requirements for E/E/PE Safety-Related Systems	g. E/E/PE System Modification	N/A	The requirements for system modification do not apply to this SEooC development.	N/A
Part 2: Requirements for E/E/PE Safety-Related Systems	h. E/E/PE System Verification	Pass	These requirements were applied at the IC level, not the system level. IC functional safety activities have been verified by persons of appropriate independence.	Verification Plans and Reports for each safety work product per Safety Plan
Part 2: Requirements for E/E/PE Safety-Related Systems	i. E/E/PE System Functional Safety Assessment	Pass	Refer to section 2 for a summary of the functional safety assessment.	Functional Safety Assessment
Part 3: Software Requirements	All sections	N/A	There are no software requirements for this SEooC development.	N/A
Part 4: Definitions and Abbreviations	No requirements in this part	N/A	There are no requirements in IEC 61508-4.	N/A
Part 5: Examples of Methods for the Determination of Safety Integrity Levels	No requirements in this part	N/A	IEC 61508-5 is an informative reference. There are no requirements in IEC 61508-5, however the analysis techniques that are recommended by this part are incorporated into the TI Functional Safety Hardware work product templates that have been used for this project.	N/A
Part 6: Guidelines on the Application of IEC 61508-2 and IEC 61508-3	No requirements in this part	N/A	IEC 61508-6 is an informative reference. There are no requirements in IEC 61508-6, however the analysis techniques that are recommended by this part are incorporated into the TI Functional Safety Hardware work product templates that have been used for this project.	N/A
Part 7: Overview of Techniques and Measures	No requirements in this part	N/A	IEC 61508-7 is an informative reference. There are no requirements in IEC 61508-7, however the analysis techniques that are recommended by this part are incorporated into the TI Functional Safety Hardware work product templates that have been used for this project.	N/A

5 Fulfillment of ISO 26262:2018 Requirements

Texas Instruments carried out this assessment with respect to relevant requirements from the ISO 26262:2011 standard.

Table 5-1. Details of ISO 26262:2018 Requirements

ISO 26262:2011	Requirement	Status	Compliance Argument	Evidence
Part 1: Vocabulary	No requirements in this part	N/A	N/A	N/A
Part 2: Management of Functional Safety	a. Safety Culture	Pass	Texas Instruments maintains worldwide corporate policies related to; product and function safety; facility and materials safety, environment & health safety, risk and insurance management and customer satisfaction thru total qualify. These policies are implemented thru requirements and specification at the business units and factory level. Continuous improvement is integral to all processes. The semiconductor group has completed TUV certification of its processes for functional safety hardware and software development.	TI Functional Safety Hardware development flow
Part 2: Management of Functional Safety	b. Competence Management	Pass	Qualification and competence for the project safety manager is review during nomination of functional safety manager. Team members are assigned by their supervisors and supervisor ensure that the persons involved in the project execution have a sufficient level of skills, competencies and qualifications corresponding to their responsibilities.	Documented Nomination of Functional Safety Manager
Part 2: Management of Functional Safety	c. Quality Management	Pass	Texas Instruments sites first achieved the International Organization for Standardization´s (ISO) Quality Management System (ISO 9001) and Environmental Management System (ISO 14001) Certifications in 1996 and have maintained compliance to the ISO requirements since that time. TI is also TS 16949 certified; an international quality system standard specifically formulated for the global automotive industry. In addition, TI sites first achieved OHSAS 18001 certification in 2007, and has achieved Sony Green Partner certification	Ti.com/Quality

Table 5-1. Details of ISO 26262:2018 Requirements (continued)

ISO 26262:2011	Requirement	Status	Compliance Argument	Evidence
Part 2: Management of Functional Safety	d. Tailoring of the Safety Lifecycle	Pass	Functional safety process and deliverables are tailored by TI Functional Safety Hardware flow to be applied in addition to the requirements of the Automotive IC development process. The TI Functional Safety Hardware flow has been reviewed and certified by external assessors to satisfy the requirements For ISO-26262:2018 and IEC 61508:2010.	TI Functional Safety Hardware development flow
Part 2: Management of Functional Safety	e. Safety Management	Pass	Project manager and Safety manager were appointed to this project. Functional Safety Plan was generated and necessary audits and assessments were scheduled.	Documentation of Nomination of Safety Manager
Part 2: Management of Functional Safety	f. Functional Safety Plan	Pass	A functional safety plan was generated and followed throughout the project.	Functional Safety Plan
Part 2: Management of Functional Safety	g. Confirmation Measure	Pass	An independent confirmation measure of I3 performed the appropriate reviews and audits for this project.	Documented Selection of Functional Safety Assessor, End of Phase Audits
Part 2: Management of Functional Safety	h. Safety Management After Release to Production	Pass	A process is in place for handling safety management after release for production.	Periodic Audit Report of Sustaining Operations, TI Quality Processes
Part 3: Concept Phase	a. Item Definition	N/A	Requirements do not apply, however assumptions were made for the SEooC development.	N/A
Part 3: Concept Phase	b. Initiation of the Safety Lifecycle	Pass	Most requirements do not apply, however assumptions were made for the SEooC development. Additionally, a safety plan is generated for activities in the scope of the SEooC development.	System Functional Safety Assumptions and Component Safety Requirements, Functional Safety Plan
Part 3: Concept Phase	c. Hazard Analysis and Risk Assessment	N/A	Requirements do not apply, however assumptions were made for the SEooC development.	N/A
Part 3: Concept Phase	d. Functional Safety Concept	Pass	Most requirements do not apply, however assumptions were made for the SEooC development.	System Functional Safety Assumptions and and Component Safety Requirements
Part 4: Product Development at a System Level	not applicable for a hardware component SEooC development	N/A	N/A	N/A
Part 5: Product Development at a Hardware Level	a. Initiation of Product Development at the Hardware Level	Pass	In this hardware component SEooC development, the focus of the activities are around the requirements for product development at a hardware level.	Documented Target Functional Safety Capability
Part 5: Product Development at a Hardware Level	b. Specification of Hardware Safety Requirements	Pass	Hardware safety requirements have been generated from assumptions on the intended system.	Target Functional Safety Capability, System Functional Safety Assumptions and Component Safety Requirements, SRS

Table 5-1. Details of ISO 26262:2018 Requirements (continued)

ISO 26262:2011	Requirement	Status	Compliance Argument	Evidence
Part 5: Product Development at a Hardware Level	c. Hardware Design	Pass	Safety requirements have been incorporated into the design. Safety Analysis Report generated.	Design Specification
Part 5: Product Development at a Hardware Level	d. Evaluation of the Hardware Architectural Metrics	N/A	The requirements in this section are at the item level and do not apply to SEooC development. The calculations for the SEooC hardware component have been generated.	Functional Safety Analysis Report
Part 5: Product Development at a Hardware Level	e. Evaluation of Safety Goal Violations Due to Random Hardware Failures	N/A	The requirements in this section are at the item level and do not apply to SEooC development. The calculations for the SEooC hardware component have been generated.	Functional Safety Analysis Report
Part 5: Product Development at a Hardware Level	f. Hardware Integration and Testing	N/A	The requirements in this section are not applicable to SEooC development.	N/A
Part 6: Product Development at a Software Level	All sections	N/A	There are no software requirements for this SEooC development.	N/A
Part 7: Production and Operation	a. Production	Pass	Production details related to this SEooC are documented. The majority of the requirements in this section are not applicable to this SEooC development.	Production Plan
Part 7: Production and Operation	b. Operation, Service, and Decommissioning	N/A	The requirements in this section are not applicable to this SEooC development.	N/A
Part 8: Supporting Processes	a. Interfaces within distributed developments	N/A	The requirements in this section are not applicable to this SEooC development. A DIA is included in the Safety Manual for clarification of responsibilities.	N/A
Part 8: Supporting Processes	b. Specification and Management of Safety Requirements	Pass	Attention was given to safety requirements traceability throughout this project.	System Functional Safety Assumptions and Component Safety Requirements, SRS, Functional Safety Plan
Part 8: Supporting Processes	c. Configuration Management	Pass	Configuration management has been put in place for the work products created for this project.	TI Functional Safety Hardware development process, Functional Safety Plan
Part 8: Supporting Processes	d. Change Management	Pass	Change management requirements have been followed for this project and any changes that would impact safety have been addressed.	Functional Safety Plan
Part 8: Supporting Processes	e. Verification	Pass	Verification activities have been planned and executed.	Verification Plans and Reports for each safety work product per Safety Plan
Part 8: Supporting Processes	f. Documentation	Pass	This project follows TI Functional Safety Hardware documentation strategy.	TI Functional Safety Hardware development flow, Functional Safety Plan
Part 8: Supporting Processes	g. Confidence in Use of Software Tools	Pass	Software tool confidence has been documented.	Software Tool Plan

Table 5-1. Details of ISO 26262:2018 Requirements (continued)

ISO 26262:2011	Requirement	Status	Compliance Argument	Evidence
Part 8: Supporting Processes	h. Qualification of Software Components	N/A	Software components are not an aspect of this product.	N/A
Part 8: Supporting Processes	i. Qualification of Hardware Components	Pass	IC was qualified per AEC-Q100 requirements. Qualification requirements related to the applicability of the IC to be integrated into the system do not apply to SEooC development.	Qualification Plan and Report
Part 8: Supporting Processes	j. Proven in Use Argument	N/A	Proven in use argument is not claimed.	N/A
Part 9: ASIL Analysis	a. Requirements Decomposition	N/A	ASIL requirements were not decomposed.	N/A
Part 9: ASIL Analysis	b. Criteria for Coexistence of Elements	N/A	No coexisting requirements	N/A
Part 9: ASIL Analysis	c. Analysis of Dependent Failures	Pass	Dependent failure analysis was considered at the hardware component level.	Dependent Failure Analysis
Part 9: ASIL Analysis	d. Safety Analysis	Pass	FMEA, FMEDA, FIT calculations and others are included for the hardware component.	Functional Safety Analysis Report
Part 10: Guideline on ISO 26262	No requirements in this part	N/A	ISO 26262-10 is an informative reference. There are no requirements in ISO 26262-10, however the work products and analysis techniques that are recommended by this part are incorporated into the TI Functional Safety Hardware development flow and work product templates that have been used for this project.	N/A
Part 11: Guidelines on Application of ISO 26262 to semiconductors	No requirements in this part	N/A	ISO 26262-11 is an informative reference. There are no requirements in ISO 26262-11, however the work products and analysis techniques that are recommended by this part are incorporated into the TI Functional Safety Hardware development flow and work product templates that have been used for this project.	N/A
Part 12: Adaption of ISO 26262 to Motorcycles	All sections	N/A	The tables of ISO 26262-12 only apply at the system level for motorcycles, they do not apply to a hardware component SEooC. These tables are the responsibility of the system integrator if applicable.	N/A

6 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision * (April 2022) to Revision A (May 2022)	Page
• Initial Public Release	2

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