



Software Safety Requirements and Architecture

Lane Assistance

Document Version: [Version]
Template Version 1.0, Released on 2017-06-21



Document history

[Instructions: Fill in the date, version and description fields. You can fill out the Editor field with your name if you want to do so. Keep track of your editing as if this were a real world project.

For example, if this were your first draft or first submission, you might say version 1.0. If this is a second submission attempt, then you'd add a second line with a new date and version 2.0]

Date	Version	Editor	Description
22-11-2017	1.0	Pablo Elizalde	First draft

Table of Contents

[Instructions: We have provided a table of contents. If the table of contents is not showing up correctly in your word processor of choice, please update it. The table of contents should show each section of the document and page numbers or links. Most word processors can do this for you. In Google Docs, you can use headings for each section and then go to Insert > Table of Contents. Microsoft Word has similar capabilities]

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Purpose

[Instructions: Answer what is the purpose of this document?]

The purpose of the Software Requirements and Architecture Document is to develop requirements and metric against which the item can be verified, that will ensure its functional safety.

Inputs to the Software Requirements and Architecture Document

[Instructions:

REQUIRED:

You are only required to develop this document for the LDW (lane departure warning) amplitude malfunction. So here, provide the technical safety requirements for the LDW amplitude malfunction as well as the refined system architecture diagram from the technical safety concept.

OPTIONAL:

Expand this document to include software safety requirements for the LDW frequency malfunction as well. Go even further and document software safety requirements for the Lane Keeping Assistance (LKA) function as well.

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Technical safety requirements

Technical Safety Requirements related to Functional Safety Requirement 01-01 are:

ID	Technical Safety Requirement	ASIL	Fault Tolerant Time Interval	Architecture Allocation	Safe State
Technical Safety Requirement 01	The LDW safety component shall ensure that the amplitude of the 'LDW_Torque_Request' sent to the 'Final electronic power steering Torque' component	C	50ms	LDW Safety Functionality	LDW shall set oscillation torque to 0.

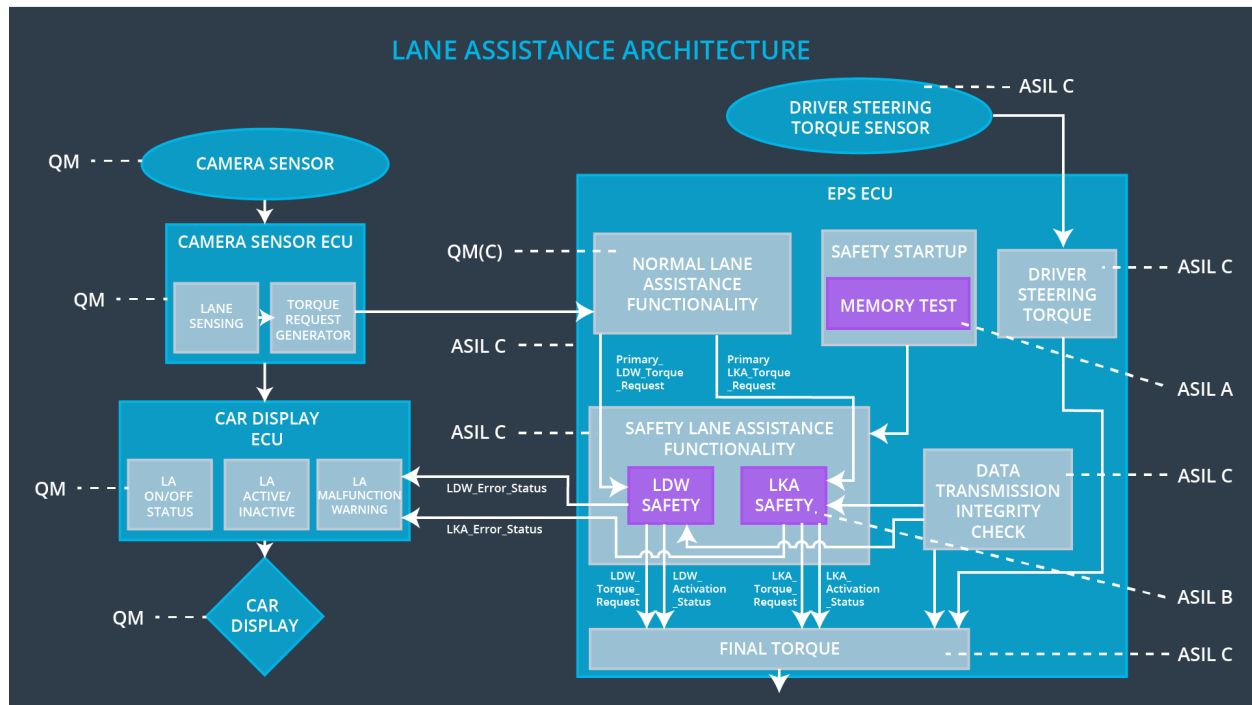
	is below 'Max_Torque_Amplitude'.				
Technical Safety Requirement 02	As soon as the LDW function deactivates the LDW feature, the 'LDW Safety' software block shall send a signal to the car display ECU to turn on a warning light.	C	50ms	LDW Safety Functionality	LDW shall set the oscillating torque to 0.
Technical Safety Requirement 03	As soon as a failure is detected by the LDW function, it shall deactivate the LDW feature and the 'LDW_Torque_Request' shall be set to zero.	C	50ms	LDW Safety Functionality	LDW shall set the oscillating torque to 0.
Technical Safety Requirement 04	The validity and integrity of the data transmission for 'LDW_Torque_Request' signal shall be ensured.	C	50ms	Data Transmission Integrity Check	LDW shall set the oscillating torque to 0.
Technical Safety Requirement 05	Memory test shall be conducted at start up of the EPS ECU to check for any faults in memory.	A	Ignition cycle	Safety startup	LDW shall set the oscillating torque to 0.

Refined Architecture Diagram from the Technical Safety Concept

[Instructions:

REQUIRED: Provide the refined system architecture diagram from the technical safety concept

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Software Requirements

Lane Departure Warning (LDW) Amplitude Malfunction Software Requirements:

[Instructions: Fill in the software safety requirements for the LDW amplitude malfunction technical safety requirements. We have provided the associated technical safety requirements. Hint: The software safety requirements were discussed in the text from the software and hardware lesson.]

OPTIONAL:

CHALLENGE ONE

Develop software safety requirements for the Lane Departure Warning (LDW) frequency function and modify the system architecture as needed.

CHALLENGE TWO

Develop software safety requirements for the Lane Keeping Assistance (LKA) function and modify the system architecture as needed.

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ID	Technical Safety Requirement	A S I L	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety Requirement 01	The LDW safety component shall ensure that the amplitude of the LDW_Torque_Request sent to the Final Electronic Power Steering Torque component is below Max_Torque_Amplitude	C	50ms	LDW Safety Functionality	LDW shall set the oscillating torque to 0.

ID	Software Safety Requirement	A S I L	Allocation Software Elements	Safe State
Software Safety Requirement 01-01	The input signal "Primary_LDW_Torq_Req" shall be read and pre-processed to determine the torque request coming from the "Basic/Main LAF functionality" SW Component. Signal "processed_LDW_Torq_Req" shall be generated at the end of the processing.	C	LDW_SAFETY_INPUT_P ROCESSING	N/A
Software Safety Requirement 01-02	In case the "processed_LDW_Torq_Req" signal has a value greater than "Max_Torque_Amplitude_LD W" (maximum allowed safe torque), the torque signal "limited_LDW_Torq_Req" shall be set to 0, else "limited_LDW_Torq_Req" shall take the value of "processed_LDW_Torq_Req".	C	TORQUE_LIMITER	"limited_LDW_T orq_Req" = 0(Nm=Newton- meter)
Software Safety Requirement	The "limited_LDW_Torq_Req" shall be transformed into a signal "LDW_Torq_Req" which is	C	LDW_SAFETY_OUTPUT _GENERATOR	LDW_Torq_Req = 0 (Nm)

01-03	suitable to be transmitted outside of the LDW Safety component ("LDW Safety") to the "Final EPS Torque" component. Also see SofSafReq02-01 andSofSafReq02-02			
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ID	Technical Safety Requirement	A S I L	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety Requirement 02	The validity and integrity of the data transmission for LDW_Torque_Request signal shall be ensured	C	50ms	Data Transmission Integrity Check	N/A

ID	Software Safety Requirement	A S I L	Allocation Software Elements	Safe State
Software Safety Requirement 02-01	Any data to be transmitted outside of the LDW Safety component ("LDW Safety")including "LDW_Torque_Req" and "activation_status" (seeSofSafReq03-02) shall be protected by an End2End(E2E)protection mechanism	C	E2ECalc	LDW_Torq_Req = 0 (Nm)
Software Safety Requirement 02-02	The E2E protection protocol shall contain and attach the control data: alive counter (SQC) and CRC to the data to be transmitted.	C	E2ECalc	LDW_Torq_Req = 0 (Nm)

ID	Technical Safety Requirement	ASIL	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety Requirement 03	As soon as a failure is detected by the LDW function, it shall deactivate the LDW feature and the LDW_Torque_Request shall be set to zero	C	50ms	LDW Safety Functionality	LDW shall set the oscillating torque to 0.

ID	Software Safety Requirement	ASIL	Allocation Software Elements	Safe State
Software Safety Requirement 03-01	Each of the SW elements shall output a signal to indicate any error which is detected by the element. Error signal = error_status_input (LDW_SAFETY_INPUT_PROCESSING), error_status_torque_limiter (TORQUE_LIMITER), error_status_output_gen (LDW_SAFETY_OUTPUT_GENERATOR)	C	All	N/A
Software Safety Requirement 03-02	A software element shall evaluate the error status of all the other software elements and in case any 1 of them indicates an error, it shall deactivate the LDW feature("activation_status"=0)	C	LDW_SAFETY_ACTIVATION	Activation_status = 0 (LDW function deactivated)
Software Safety Requirement 03-03	In case of no errors from the software elements, the status of the LDW feature shall be set to activated ("activation_status"=1)	C	LDW_SAFETY_ACTIVATION	N/A
Software Safety Requirement	In case an error is detected by any of the software elements, it shall set the value of its corresponding torque to 0 so	C	All	LDW_Torq_Req = 0

03-04	that "LDW_Torq_Req" is set to 0			
Software Safety Requirement 03-05	Once the LDW functionality has been deactivated, it shall stay deactivated till the time the ignition is switched from off to on again.	C	LDW_SAFETY_ACTIVATION	Activation_status = 0 (LDW function deactivated)

ID	Technical Safety Requirement	ASIL	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety Requirement 04	As soon as the LDW function deactivates the LDW feature, the LDW Safety software block shall send a signal to the car display ECU to turn on a warning light	C	50ms	LDW Safety	LDW shall set the oscillating torque to 0.

ID	Software Safety Requirement	ASIL	Allocation Software Elements	Safe State
Software Safety Requirement 04-01	When the LDW function is deactivated (activation_status set to 0), the activation_status shall be sent to the car display ECU.	C	LDW_SAFETY_ACTIVATION, Car Display ECU	N/A

ID	Technical Safety Requirement	A S I L	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety Requirement 05	Memory test shall be conducted at start up of the EPS ECU to check for any faults in memory	A	Ignition cycle	Safety Startup	LDW shall set the oscillating torque to 0.

ID	Software Safety Requirement	A S I L	Allocation Software Elements	Safe State
Software Safety Requirement 05-01	A CRC verification check over the software code in the Flash memory shall be done every time the ignition is switched from off to on to check for any corruption of content.	A	MEMORYTES T	Activation_status = 0
Software Safety Requirement 05-02	Standard RAM tests to check the data bus, address bus and device integrity shall be done every time the ignition is switched from off to on (E.g.walking 1s test, RAM pattern test. Refer RAM and processor vendor recommendations)	A	MEMORYTES T	Activation_status = 0
Software Safety Requirement 05-03	The test result of the RAM or Flash memory shall be indicated to the LDW_Safety component via the “test_status” signal.	A	MEMORYTES T	Activation_status = 0
Software Safety Requirement 05-04	In case any fault is indicated via the “test_status” signal the INPUT_LDW_PROCESSING shall set an error on error_status_input (=1) so that the LDW functionality is deactivated and the LDWTorque is set to 0	A	LDW_SAFETY_INPUT_PROCESSING	Activation_status = 0

Refined Architecture Diagram

[Instructions: Include the refined system architecture. Hint: The refined system architecture should include the system architecture from the end of the software and hardware lesson, including all of the ASIL labels.]

