



Software Safety Requirements and Architecture

Lane Assistance

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Document history

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Date	Version	Editor	Description
27/12/2018	1.0	Manjunath Gasthi	Initial version

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]

[Document history](#)

[Table of Contents](#)

[Purpose](#)

[Inputs to the Software Requirements and Architecture Document](#)

[Technical safety requirements](#)

[Refined Architecture Diagram from the Technical Safety Concept](#)

Purpose

This document identify requirements for the software components at component level to identify potential problems on software design and architecture that could lead to a violation of safety goals. These Requirements are more detail oriented than the technical safety concept requirements.

Inputs to the Software Requirements and Architecture Document

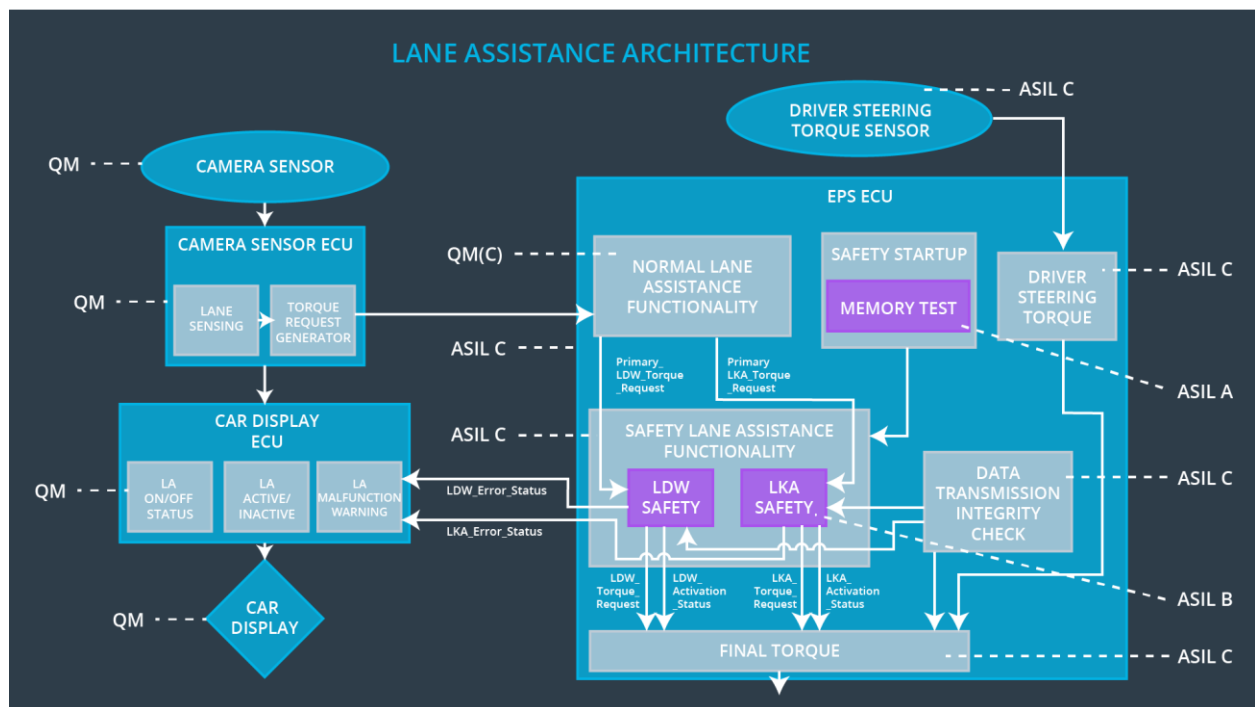
Technical safety requirements

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 electronically power steering Torque' component is below 'Max_Torque_Amplitude'.	C	50 mS	LDW Safety	LDW Torque Request Amplitude shall be set to zero.
Technical Safety Requirement 02	When the Lane Departure Warning is deactivated, the 'LDW Safety' software module shall send a signal to the Car Display ECU to turn on a warning signal.	C	50 mS	LDW Safety	LDW Torque Request Amplitude shall be set to zero.
Technical Safety Requirement	As soon as a failure is detected by the LDW function, it shall deactivate	C	50 mS	LDW Safety	LDW Torque Request Amplitude

03	the LDW feature and the 'LDW_Torque_Request' shall be set to zero.				shall be set to zero.
Technical Safety Requirement 04	The validity and integrity of the data transmission for 'LDW_Torque_Request' signal shall be ensured.	C	50 mS	Data Transmission Integrity Check	LDW Torque Request Amplitude shall be set to zero.
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 Torque Request Amplitude shall be set to zero.

Refined Architecture Diagram from the Technical Safety Concept



Software Requirements

Lane Departure Warning (LDW) Amplitude Malfunction Software Requirements:

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	50 mS	LDW Safety	LDW torque output is set to zero.

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 preprocessed 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_PROCESSING	N/A
Software	In case the		TORQUE_LIMITER	"limited_LDW_

Safety Requirement 01-02	<p>“processed_LDW_Torq_Req” signal has a value greater than</p> <p>“Max_Torque_Amplitude_LDW” (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”</p>			Torq_Req” = 0 (Nm=Newtonmeter)
Software Safety Requirement 01-03	<p>The “limited_LDW_Torq_Req” shall be transformed into a signal “LDW_Torq_Req” which is suitable to be transmitted outside of the LDW Safety component (“LDW Safety”) to the “Final EPS Torque” component. Also see Software Safety Requirement 01-01 and Software Safety Requirement 02-02.</p>	C	LDW_SAFETY_OUTPUT_GENERATOR	LDW_Torq_Req = 0 (Nm)

ID	Technical Safety Requirement	A S I L	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety Requirement 02	When the Lane Departure Warning is deactivated, the 'LDW Safety' software module shall send a signal to the Car Display ECU to turn on a warning signal.	C	50 mS	LDW Safety	LDW torque output is set to zero.

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" (see Software Safety Requirement 01-01-03-02) 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	A S I L	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	50 mS	LDW Safety	LDW torque output is set to zero.

ID	Software Safety Requirement	A S I L	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	LDW_Torq_Req = 0
Software Safety Requirement 03-04	In case an error is detected by any of the software elements, it shall set the value of its corresponding torque to 0 so that "LDW_Torq_Req" is set to 0	C	All	N/A

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)
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ID	Technical Safety Requirement	A S I L	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety Requirement 04	The validity and integrity of the data transmission for 'LDW_Torque_Request' signal shall be ensured.	C	50 mS	LDW Safety	LDW torque output is set to zero.

ID	Software Safety Requirement	A S I L	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 displayECU.	C	LDW_SAFETY_ACTIVATION, CarDisplay 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	Memory Test	LDW torque output is set to zero.

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	MEMORYTEST	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	A	MEMORYTEST	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	MEMORYTEST	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

