



Software Safety Requirements and Architecture

Lane Assistance

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Document history

Date	Version	Editor	Description
24-Aug-2018	1.0	Mohamed ZIEDAN	Initial Release

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Purpose

The purpose of "Software Requirements and Architecture Document" is to develop requirement and metrics against which the item can be verified, that will insure its functional safety.

Inputs to the Software Requirements and Architecture Document

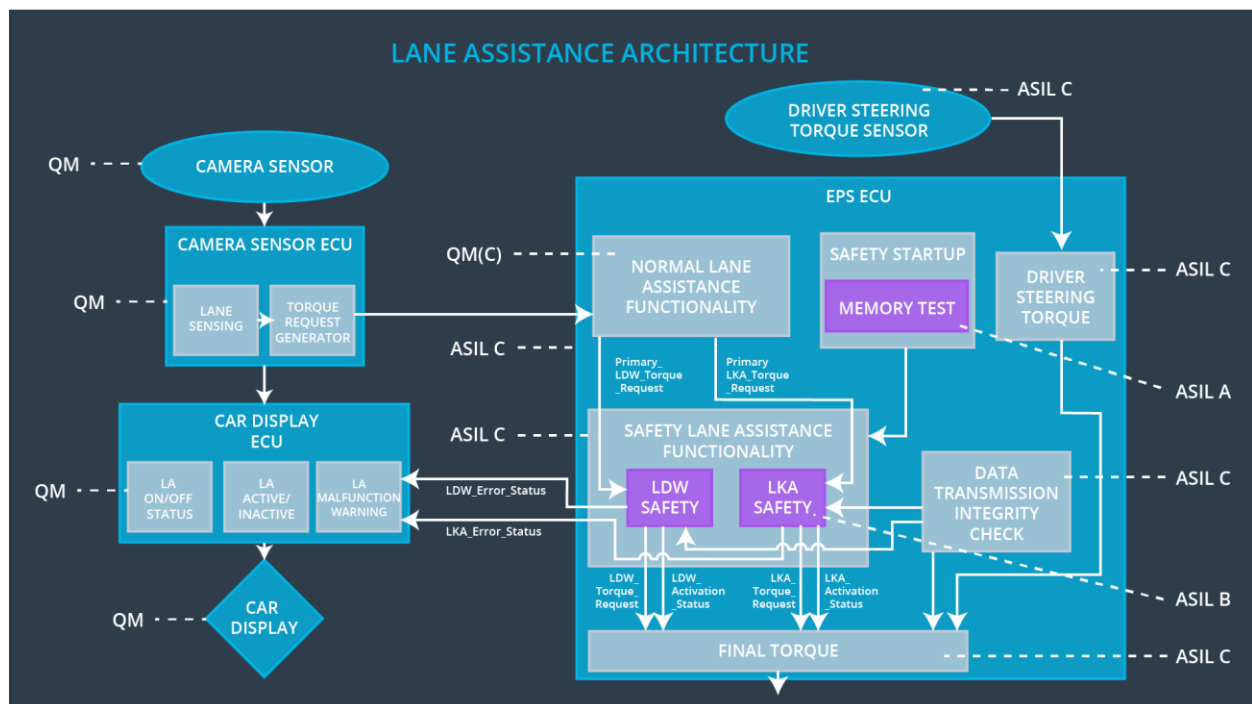
Technical safety requirements

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

ID	Technical Safety Requirement	A S I L	Fault Tolerant Time Interval	Architecture Allocation	Safe State
Technical Safety Requirement 01	The LDW safety component shall ensure that the amplitude of the ' <i>LDW_Torque_Request</i> ' sent to the 'Final electronic power steering Torque' component is below ' <i>Max_Torque_Amplitude</i> '	C	50ms	Lane Assistance Safety Functionality	Deactivate LDW
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	Deactivate LDW
Technical Safety Requirement 03	As soon as a failure is detected by the LDW function, it shall deactivate the LDW feature and the ' <i>LDW_Torque_Request</i> ' shall be set to zero	C	50ms	LDW Safety Functionality	Deactivate LDW
Technical Safety Requirement	The validity and integrity of the data transmission for ' <i>LDW_Torque_Request</i> '	C	50ms	Data Transmission Integrity	Deactivate LDW

04	signal shall be ensured			Check	
Technical Safety Requirement 05	Memory test shall be conducted at startup of the EPS ECU to check for any faults in memory	A	ignition cycle	SAFETY STARTUP	<i>Max_Torque_Amplitude</i> is correct and Deactivate Functionality will reset Amplitude to 0

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 <i>LDW_Torque_Request</i> sent to the Final Electronic Power Steering Torque component is below <i>Max_Torque_Amplitude</i>	C	50ms	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 " <i>Primary_LDW_Torq_Req</i> " shall be read and pre-processed to determine the torque request coming from the "Basic/Main LAF functionality" SW Component. Signal " <i>processed_LDW_Torq_Req</i> " 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 " <i>processed_LDW_Torq_Req</i> " signal has a value greater than " <i>Max_Torque_Amplitude_LDW</i> " (maximum allowed safe torque), the torque signal " <i>limited_LDW_Torq_Req</i> " shall be set to 0, else " <i>limited_LDW_Torq_Req</i> " shall take the value of	C	TORQUE_LIMITER	" <i>limited_LDW_Torq_Req</i> " = 0 (Nm=Newton-meter)

	" <i>processed_LDW_Torq_Req</i> ".			
Software Safety Requirement 01-03	The " <i>limited_LDW_Torq_Req</i> " shall be transformed into a signal " <i>LDW_Torq_Req</i> " which is suitable to be transmitted outside of the LDW Safety component ("LDW Safety") to the "Final EPS Torque" component. Also see SofSafReq02-01 and SofSafReq02-02	C	LDW_SAFETY_OUTPUT_GENERATOR	<i>LDW_Torq_Req</i> = 0 (Nm)

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 <i>LDW_Torque_Request</i> 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 " <i>LDW_Torque_Req</i> " and " <i>activation_status</i> " (see SofSafReq03-02) shall be protected by an End2End(E2E) protection mechanism	C	E2ECalc	<i>LDW_Torq_Req</i> = 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	<i>LDW_Torq_Req</i> = 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 <i>LDW_Torque_Request</i> shall be set to zero	C	50ms	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 (<i>LDW_SAFETY_INPUT_PROCESSING</i>), error_status_torque_limiter (<i>TORQUE_LIMITER</i>), error_status_output_gen (<i>LDW_SAFETY_OUTPUT_GENERATOR</i>)	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 (" <i>activation_status</i> " =0)	C	<i>LDW_SAFETY_ACTIVATION</i>	<i>Activation_status</i> = 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 (" <i>activation_status</i> " =1)	C	<i>LDW_SAFETY_ACTIVATION</i>	N/A
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 " <i>LDW_Torq_Req</i> " is set to 0	C	All	<i>LDW_Torq_Req</i> = 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	<i>LDW_SAFETY_ACTIVATION</i>	<i>Activation_status</i> = 0 (LDW function deactivated)
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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 torque output is set to zero

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

ID	Technical Safety Requirement	ASIL	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety Requirement 05	Memory test shall be conducted at startup 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	ASIL	Allocation Software Elements	Safe State
Software	A CRC verification check over	A	MEMORYTES	<i>Activation_status</i> = 0

Safety Requirement 05-01	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.		T	
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	MEMORYTEST	<i>Activation_status = 0</i>
Software Safety Requirement 05-03	The test result of the RAM or Flash memory shall be indicated to the <i>LDW_Safety</i> component via the “ <i>test_status</i> ” signal	A	MEMORYTEST	<i>Activation_status = 0</i>
Software Safety Requirement 05-04	In case any fault is indicated via the “ <i>test_status</i> ” signal the INPUT_LDW_PROCESSING shall set an error on <i>error_status_input</i> (=1) so that the LDW functionality is deactivated and the LDW Torque is set to 0	A	<i>LDW_SAFETY_INPUT_PROCESSING</i>	<i>Activation_status = 0</i>

Refined Architecture Diagram

