



Elektrobit



UDACITY

Technical Safety Concept Lane Assistance

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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
02.04.2018	1.0	Siddarth Kothiwale	First edit

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[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 of the Technical Safety Concept

[Instructions: Answer what is the purpose of a technical safety concept?]

Answer: technical safety concept is more concrete and gets into the details of the item's technology. It involves:

- Turning functional safety requirements into technical safety requirements
- Allocating technical safety requirements to the system architecture

Inputs to the Technical Safety Concept

Functional Safety Requirements

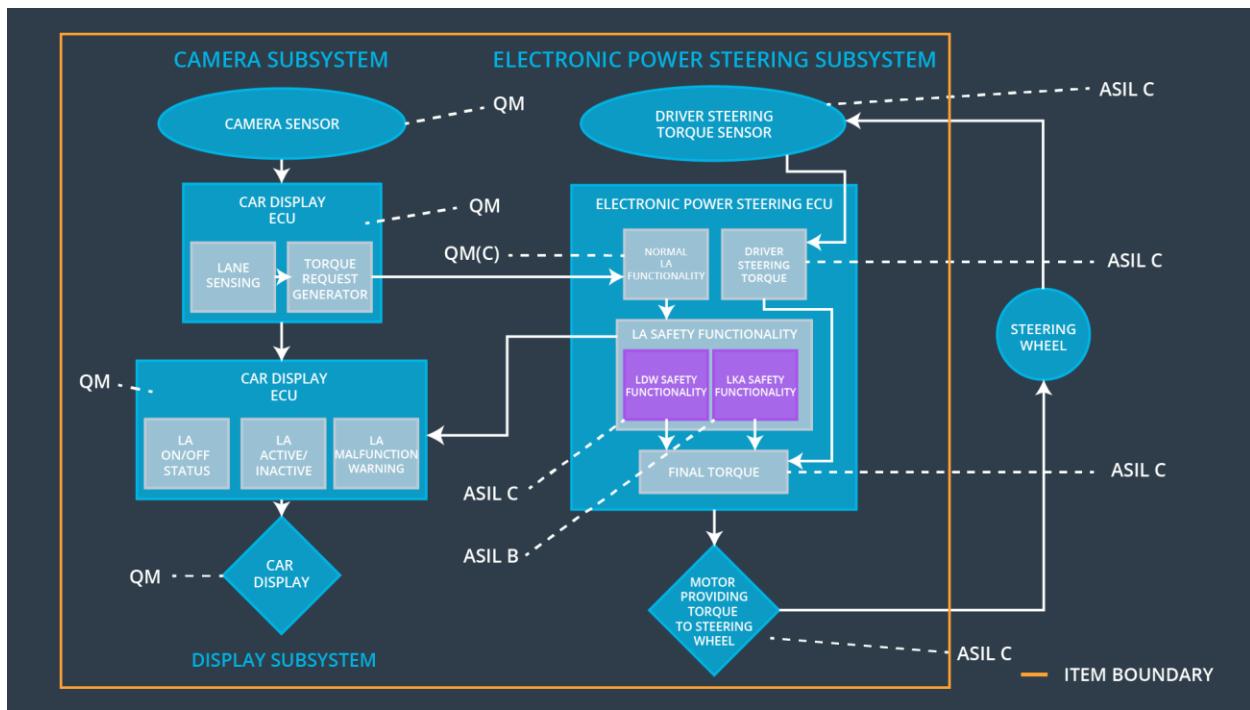
[Instructions: Provide the functional safety requirements derived in the functional safety concept]

ID	Functional Safety Requirement	A S I L	Fault Tolerant Time Interval	Safe State
Functional Safety Requirement 01-01	The lane keeping item shall ensure that the lane departure oscillating torque amplitude is below Max_Torque_Amplitude	C	50 ms	Turn off the system
Functional Safety Requirement 01-02	The lane keeping item shall ensure that the lane departure oscillating torque frequency is below Max_Torque_Frequency	C	50 ms	Turn off the system

Functional Safety Requirement 02-01	the electronic power steering ECU shall ensure that the lane keeping assistance torque is applied for only Max_Duration	B	500 ms	Turn off the system
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Refined System Architecture from Functional Safety Concept

[Instructions: Provide the refined system architecture from the functional safety concept]



Functional overview of architecture elements

[Instructions: Provide a description for each functional safety element; what is each element's purpose in the lane assistance item?]

Element	Description
Camera Sensor	To sense or record the video of road
Camera Sensor ECU - Lane Sensing	To sense the lanes from the video
Camera Sensor ECU - Torque request generator	To generate torque request in case the car leaves the road
Car Display	To display the warnings
Car Display ECU - Lane Assistance On/Off Status	To issue a message to display to show on/off status
Car Display ECU - Lane Assistant Active/Inactive	To issue a message to display to show active/inactive
Car Display ECU - Lane Assistance malfunction warning	To issue a message to display to show malfunction warning
Driver Steering Torque Sensor	To sense the torque at the steering wheel (may be the driver is providing some torque)
Electronic Power Steering (EPS) ECU - Driver Steering Torque	To calculate the amount of torque that needs to be applied taking into account the torque applied by driver
EPS ECU - Normal Lane Assistance Functionality	To steer by correct amount to keep the car in the lane
EPS ECU - Lane Departure Warning Safety Functionality	To provide a vibration to steering wheel to warn the driver and to see that the frequency and the amplitude is below the specified limit.
EPS ECU - Lane Keeping Assistant Safety Functionality	To see that the car remains in the lane and the system shuts down after the specified amount of time.

EPS ECU - Final Torque	To apply a final torque taking into account the functional safety concepts
Motor	To apply the required torque to the steering wheel

Technical Safety Concept

Technical Safety Requirements

[Instructions: Fill in the technical safety requirements for the lane departure warning first functional safety requirement. We have provided the associated functional safety requirement in the first table below. Hint: The technical safety requirements were discussed in the lesson videos. The architecture allocation column should contain element names such as LDW Safety block, Data Transmission Integrity Check, etc. Allocating the technical safety requirements to the "EPS ECU" does not provide enough detail for a technical safety concept.]

Lane Departure Warning (LDW) Requirements:

Functional Safety Requirement 01-01 with its associated system elements

(derived in the functional safety concept)

ID	Functional Safety Requirement	Electronic Power Steering ECU	Camera ECU	Car Display ECU
Functional	The lane keeping item shall	X		

Safety Requirement 01-01	ensure that the lane departure oscillating torque amplitude is below Max_Torque_Amplitude			
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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 'LDW_Torque_Request' sent to the 'Final electronic power steering Torque' component is below 'Max_Torque_Amplitude.'	C	50 ms	LDW Safety	LDW torque request amplitude should be set to zero
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	50 ms	LDW Safety	LDW torque request amplitude should be set to zero
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 request amplitude should 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	LDW Safety	LDW torque request amplitude should 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 should be set to zero
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[Instructions: Fill in the technical safety requirements for the lane departure warning second functional safety requirement. We have provided the associated functional safety requirement in the table below. Hint: Most of the technical safety requirements will be the same. At least one technical safety requirement will have to be slightly modified because we are talking about frequency instead of amplitude. These requirements were not given in the lessons]

Functional Safety Requirement 01-2 with its associated system elements
(derived in the functional safety concept)

ID	Functional Safety Requirement	Electronic Power Steering ECU	Camera ECU	Car Display ECU
Functional Safety Requirement 01-02	The lane keeping item shall ensure that the lane departure oscillating torque frequency is below Max_Torque_Frequency	X		

Technical Safety Requirements related to Functional Safety Requirement 01-02 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 'LDW_Torque_Request' sent to the 'Final electronic power steering Torque' component is below 'Max_Torque_Frequency.'	C	50 ms	LDW Safety	LDW torque request frequency should be set to zero
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	50 ms	LDW Safety	LDW torque request frequency should be set to zero
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 request frequency should 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	LDW Safety	LDW torque request frequency should 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 frequency should be set to zero

Lane Departure Warning (LDW) Verification and Validation Acceptance Criteria:

[OPTIONAL: For each technical safety requirement, identify both the verification and validation acceptance criteria. "Validation" asks whether or not you chose the appropriate parameters. "Verification" involves testing to make sure the vehicle behaves as expected when the parameter value is crossed. There is not necessarily one right answer. Look at your verification and validation acceptance criteria from the functional safety concept for inspiration.]

Lane Keeping Assistance (LKA) Requirements:

[Instructions: Fill in the technical safety requirements for the lane keeping assistance functional safety requirement 02-01. We have provided the associated functional safety requirement in the table below. Hint: You can reuse the technical safety requirements from functional safety requirement 01-01. But you need to change the language because we are now looking at a different system. The ASIL and Fault Tolerant Time Interval are different as well.]

Functional Safety Requirement 02-1 with its associated system elements
(derived in the functional safety concept)

ID	Functional Safety Requirement	Electronic Power Steering ECU	Camera ECU	Car Display ECU
Functional Safety Requirement 02-01	The lane keeping item shall ensure that the lane keeping assistance torque is applied for only Max_Duration	X		

Technical Safety Requirements related to Functional Safety Requirement 02-01 are:

ID	Technical Safety Requirement	A S I L	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety	The LKA safety component shall ensure that the torque is applied	B	500 ms	LKA Safety	LKA torque request

Requirement 01	for only Max_Duration				should be set to zero
Technical Safety Requirement 02	As soon as the LKA function deactivates the LKA feature, the 'LKA Safety' software block shall send a signal to the car display ECU to turn on a warning light.	B	500 ms	LKA Safety	LKA torque request should be set to zero
Technical Safety Requirement 03	As soon as a failure is detected by the LKA function, it shall deactivate the LKA feature and the ' LKA _Torque_Request' shall be set to zero.	B	500 ms	LKA Safety	LKA torque request should be set to zero
Technical Safety Requirement 04	The validity and integrity of the data transmission for ' LKA _Torque_Request' signal shall be ensured.	B	500 ms	LKA Safety	LKA torque request should 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	LKA torque request should be set to zero

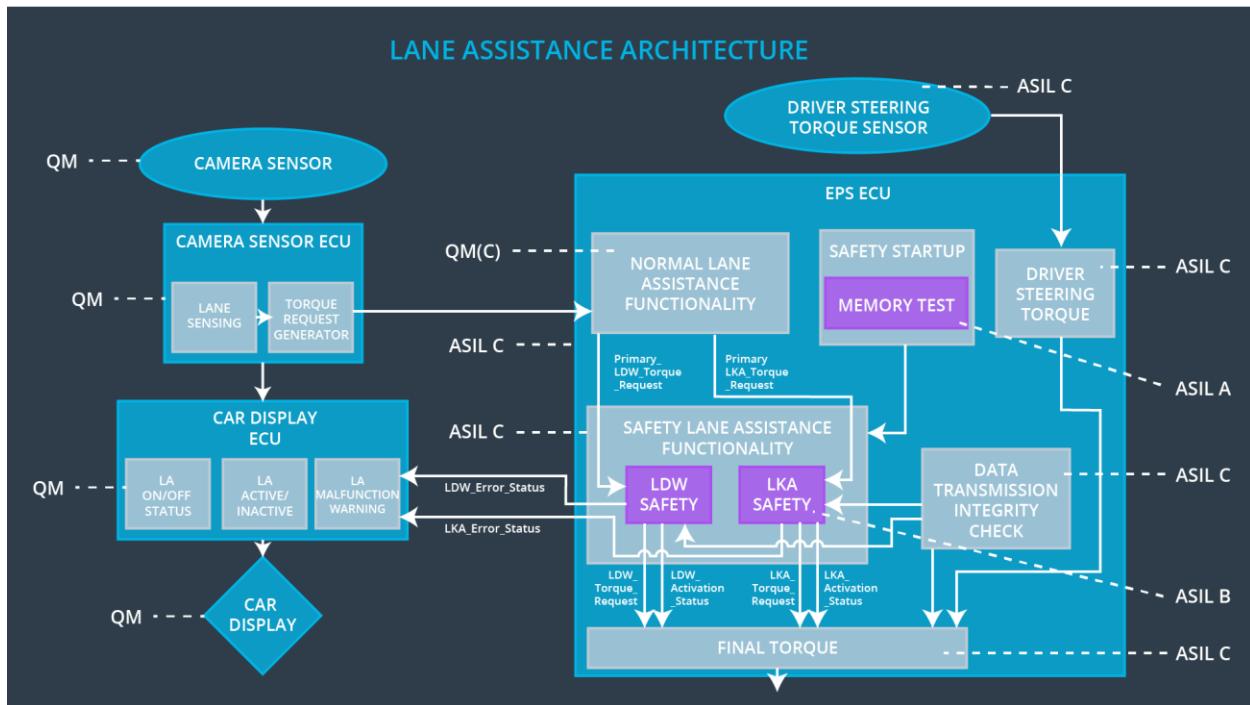
Lane Keeping Assistance (LKA) Verification and Validation Acceptance Criteria:

[OPTIONAL: For each technical safety requirement, identify both the verification and validation acceptance criteria. "Validation" asks whether or not you chose the appropriate parameters.

"Verification" involves testing to make sure the vehicle behaves as expected when the parameter value is crossed. There is not necessarily one right answer. Look at your verification and validation acceptance criteria from the functional safety concept for inspiration.]

Refinement of the System Architecture

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



Allocation of Technical Safety Requirements to Architecture Elements

[Instructions: We already included the allocation as part of the technical requirement tables. Here you can state that for this particular item, all technical safety requirements are allocated to the Electronic Power Steering ECU]

Answer: All the technical safety requirements are applied to EPS ECU

Warning and Degradation Concept

[Instructions: We've already identified that for any system malfunction, the lane assistance functions will be turned off and the driver will receive a warning light indication. The technical safety requirements have not changed how functionality will be degraded or what the warning will be.

So in this case, the warning and degradation concept is the same for the technical safety requirements as for the functional safety requirements. You can copy the functional safety warning and degradation concept here.

Oftentimes, a technical safety analysis will lead to a more detailed warning and degradation concept.]

ID	Degradation Mode	Trigger for Degradation Mode	Safe State invoked?	Driver Warning
WDC-01	Turn off the function	Amplitude> Max_Torque_Amplitude and Frequency> Max_Torque_Frequency	Yes	Warning sign in Kombi
WDC-02	Turn off the function	If LKA active for time > Max_Duration	Yes	Warning sign in Kombi