



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
04/11/2018	1.0	Oyama	First Attempt
04/12/2018	2.0	Oyama	TECHNICAL SAFETY REQUIREMENTS RELATED TO FUNCTIONAL SAFETY REQUIREMENT 01-01 - TECHNICAL SAFETY REQUIREMENT02  TECHNICAL SAFETY REQUIREMENTS RELATED TO FUNCTIONAL SAFETY REQUIREMENT 01-02

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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?]

The purpose of a technical safety concept is describing what a system will do when a malfunction violates a safety goal.

## Inputs to the Technical Safety Concept

### Functional Safety Requirements

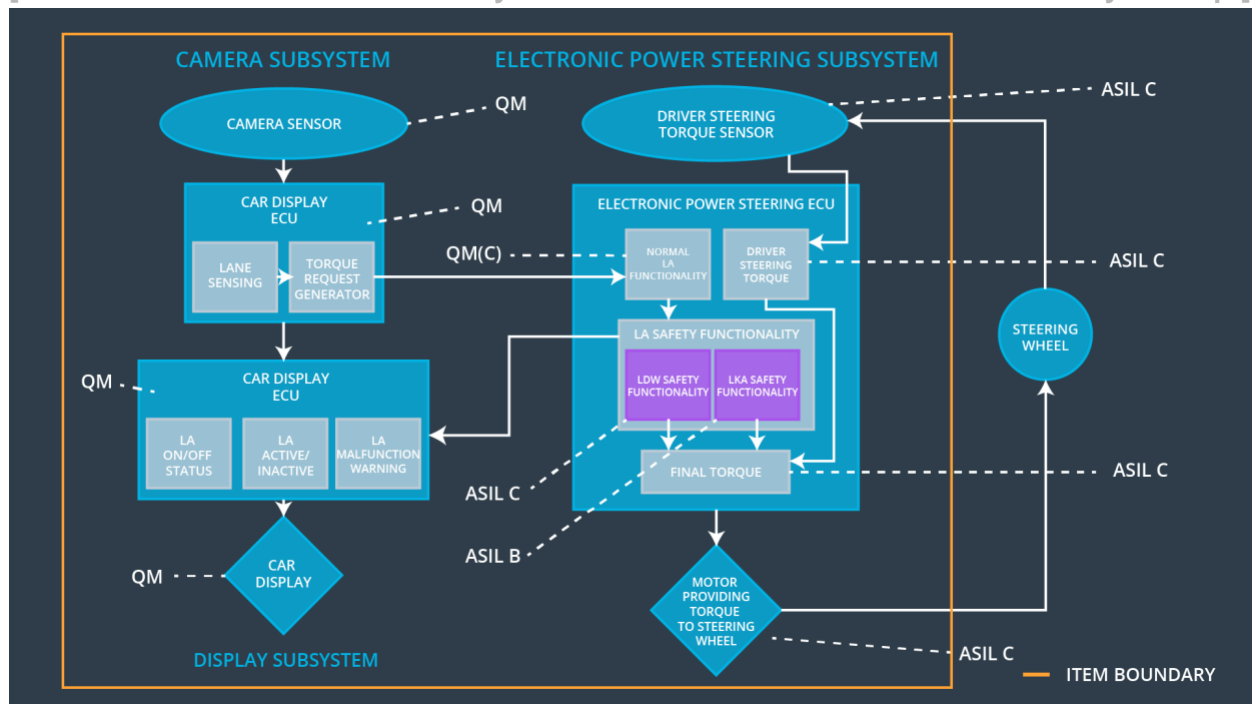
[Instructions: Provide the functional safety requirements derived in the functional safety concept ]

ID	Functional Safety Requirement	ASIL	Fault Tolerant Time Interval	Safe State
Functional Safety Requirement 01-01	The Electronic Power Steering ECU shall ensure that the oscillating torque amplitude requested by the LDW function in below Max Torque Amplitude.	C	50 ms	LDW will set the oscillating torque amplitude to 0.
Functional Safety Requirement 01-02	The Electronic Power Steering ECU shall ensure that the oscillating torque frequency requested by the LDW function in below Max Torque Frequency.	C	50 ms	LDW will set the oscillating torque frequency to 0.

Functional Safety Requirement 02-01	The lane keeping assistance function shall be time limited and the additional steering torque shall end after a given timer interval so that the driver cannot misuse the system for autonomous driving	B	500 ms	LKA will set the additional steering torque to 0.
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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	It sends a view of the road.
Camera Sensor ECU - Lane Sensing	It detects the lane lines.
Camera Sensor ECU - Torque request	It requests the vibrational torque to Electronic

generator	Power Steering ECU.
Car Display	It inform the driver the each status of the vehicle.
Car Display ECU - Lane Assistance On/Off Status	It controls a light that tells the driver if the lane keeping item is on or off.
Car Display ECU - Lane Assistant Active/Inactive	It controls a light that tells the driver if the lane departure warning is activated.
Car Display ECU - Lane Assistance malfunction warning	It controls a light that tells the driver if the lane assistance function has malfunction.
Driver Steering Torque Sensor	It measures the torque generated by the driver.
Electronic Power Steering (EPS) ECU - Driver Steering Torque	It measures the torque provided by the driver.
EPS ECU - Normal Lane Assistance Functionality	It make the additional torque request based on the driver steering torque and the torque request generator.
EPS ECU - Lane Departure Warning Safety Functionality	If the maximum amplitude or frequency is crossed, it deactivates the functionality and set the torque to 0.
EPS ECU - Lane Keeping Assistant Safety Functionality	If the maximum duration is crossed, it deactivates the functionality and set the torque to 0.
EPS ECU - Final Torque	It sends and check the final torque to the motor.
Motor	It will generate the torque physically.

## 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 Safety Requirement 01-01	The lane keeping item shall ensure that the lane departure oscillating torque amplitude is below Max_Torque_Amplitude	X		

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 is below 'Max Torque Amplitude'.	C	50 ms	LDW safety	LDW set the torque request to 0.
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 set the torque request 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	50 ms	LDW safety	LDW set the torque request to 0.
Technical Safety Requirement	The validity and integrity of the data transmission for 'LDW_Torque_Request' signal	C	50 ms	Data Transmission Integrity	LDW set the torque request to 0.

ent 04	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	Memory Test	LDW set the torque request to 0.

[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 frequency 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 set the torque request to 0.
Technical	As soon as the LDW function	C	50 ms	LDW safety	LDW set

Safety Requirement 02	deactivates the LDW feature, the 'LDW Safety' software block shall send a signal to the car display ECU to turn on a warning light.				the torque request 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	50 ms	LDW safety	LDW set the torque request to 0.
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 set the torque request to 0.
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 set the torque request to 0.

#### **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:

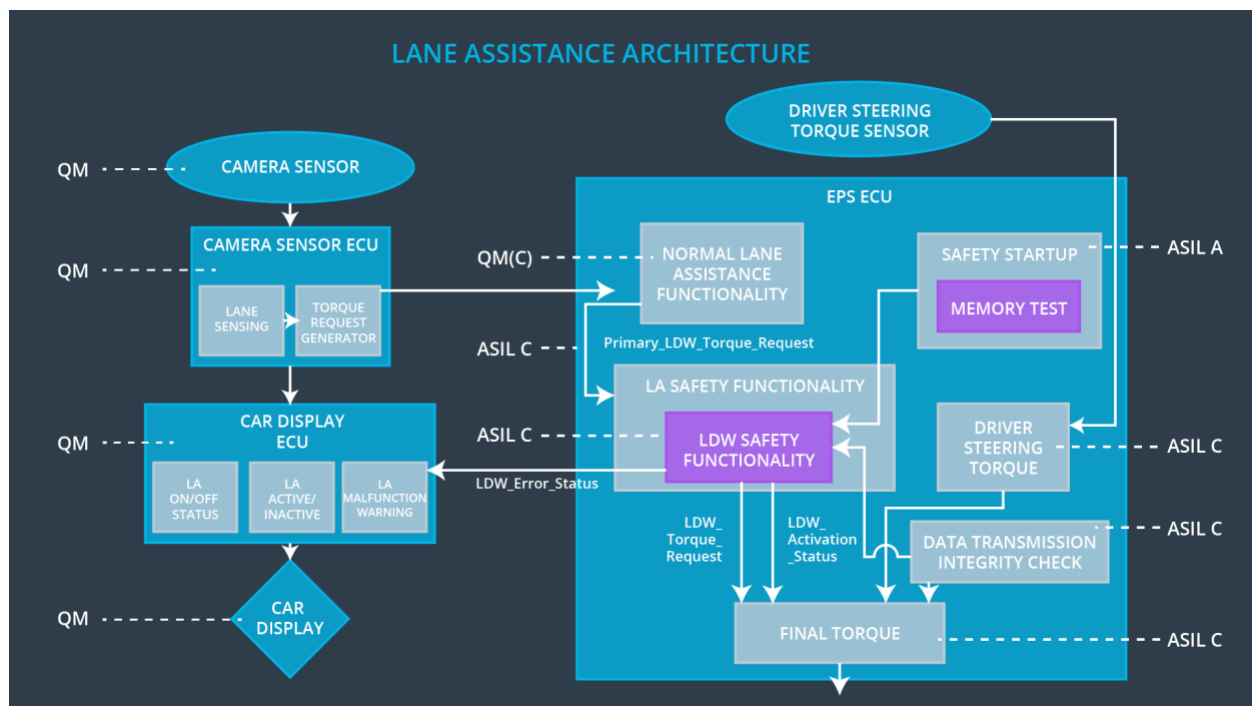
ID	Technical Safety Requirement	ASIL	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety Requirement 01	The LKA safety component shall ensure that the duration of the "LKA Torque Request" sent to the 'Final electronic power steering Torque component is below 'Max Torque duration'.	C	500 ms	LKA safety	LKA set the torque request to 0.
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.	C	500 ms	LKA safety	LKA set the torque request to 0.
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.	C	500 ms	LKA safety	LKA set the torque request to 0.
Technical Safety Requirement 04	The validity and integrity of the data transmission for 'LKA_Torque_Request' signal shall be ensured.	C	500 ms	Data Transmission Integrity Check	LKA set the torque request to 0.
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	

## 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]

The technical safety requirements will be allocated to the EPS ECU, the "LDW Safety Functionality", the "Data Transmission Integrity Check", and the "Memory Test" block.

## 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	Shut down the lane departure warning system	If the Camera Sensor fails	Yes	Make warning on the Car Display
WDC-02	Shut down the lane keeping assistance system	If the Camera Sensor fails	Yes	Make warning on the Car Display