



Elektrobit



UDACITY

# Technical Safety Concept Lane Assistance

Document Version: [Version]

Template Version 1.0, Released on 2017-06-21



# Document history

Date	Version	Editor	Description
25-May-2018	1.0	Nishant Katariya	Initial Draft

## Table of Contents

[Document history](#)

[Table of Contents](#)

[Purpose of the Technical Safety Concept](#)

[Inputs to the Technical Safety Concept](#)

[Functional Safety Requirements](#)

[Refined System Architecture from Functional Safety Concept](#)

[Functional overview of architecture elements](#)

[Technical Safety Concept](#)

[Technical Safety Requirements](#)

[Refinement of the System Architecture](#)

[Allocation of Technical Safety Requirements to Architecture Elements](#)

[Warning and Degradation Concept](#)

## Purpose of the Technical Safety Concept

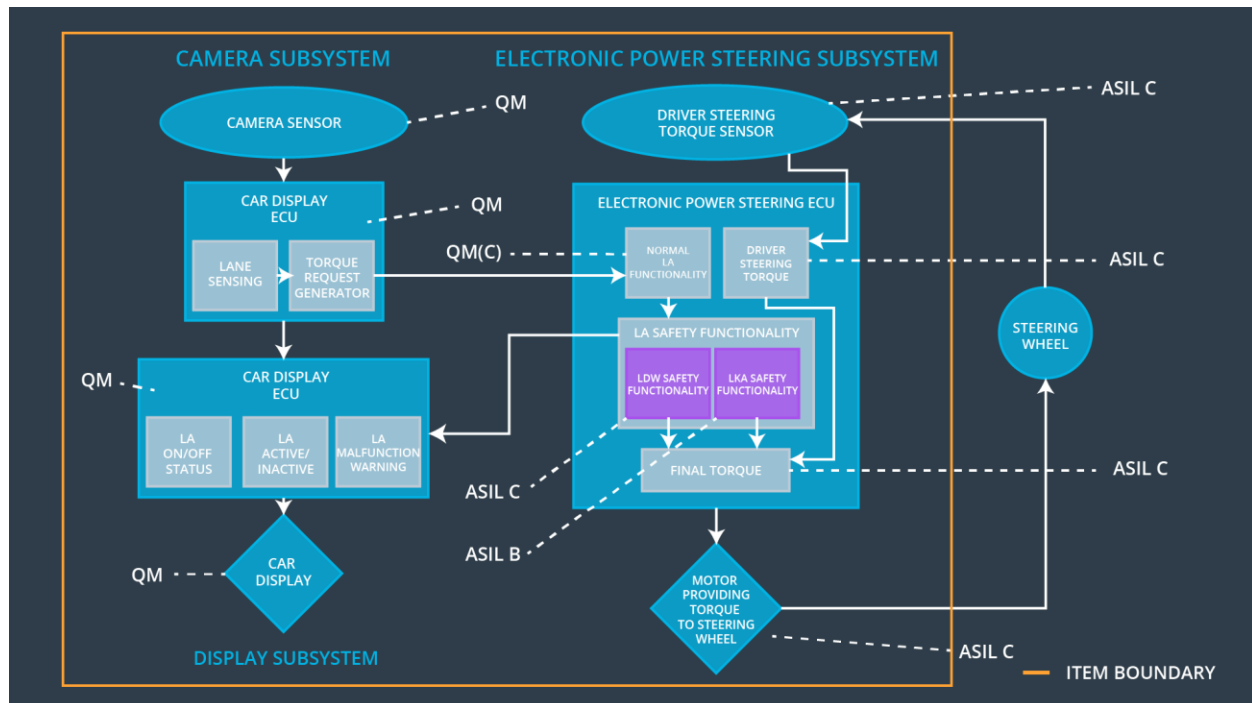
[Instructions: Answer what is the purpose of a technical safety concept?]

# Inputs to the Technical Safety Concept

## Functional Safety Requirements

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	50ms	Steering torque Amplitude is below Max_Torque_Amplitude
Functional Safety Requirement 01-02	The lane keeping item shall ensure that the lane departure oscillating torque frequency is below Max_Torque_Frequency	C	50ms	Oscillation frequency is below Max_Torque_Frequency.
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	500ms	Lane Assistance Functionality is Off

## Refined System Architecture from Functional Safety Concept



## Functional overview of architecture elements

Element	Description
Camera Sensor	Camera sensor perceives the vehicle leaving the lane; it sends the signal to the Electronic power steering system request to turn/vibrate the steering wheel. ECU (Electronic Control Unit) is a microcomputer that contains software and hardware specific to vehicle's functionality.
Camera Sensor ECU - Lane Sensing	Camera Sensor ECU has software block to detect lanes either using deep learning algorithm or sing image processing
Camera Sensor ECU - Torque request generator	Camera Sensor ECU has software block which generate torque request which will be sent to EPS ECU.
Car Display	Displays the warning and status of the system on Display
Car Display ECU - Lane Assistance	A Status light for showing the status on/off of LA

On/Off Status	
Car Display ECU - Lane Assistant Active/Inactive	A Status light for showing the status Active/Inactive of LA
Car Display ECU - Lane Assistance malfunction warning	A Warning light for showing malfunction in LA system
Driver Steering Torque Sensor	It senses how much steering force is applied by the driver.
Electronic Power Steering (EPS) ECU - Driver Steering Torque	ECU Block to process sensor measurement (Steering torque applied by driver)
EPS ECU - Normal Lane Assistance Functionality	Receives torque request from Camera sensor ECU and transfer it to safety lane assistance functionality
EPS ECU - Lane Departure Warning Safety Functionality	Checks malfunction of LDW and translates torque requests into final torque output.
EPS ECU - Lane Keeping Assistant Safety Functionality	Checks malfunction of LKA and translates torque requests into final torque output.
EPS ECU - Final Torque	Combine torque from LDW and LKA and send them to motor
Motor	It is actuator to generate torque and rotate the steering wheel

## Technical Safety Concept

### Technical Safety Requirements

#### 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	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 shall be set 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 Torque request Amplitude shall be set 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 Torque request Amplitude shall be set 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 Torque request Amplitude shall be set 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 Torque request Amplitude shall be set to 0

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 shall be set 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 Torque request Frequency shall be set 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 Torque request Frequency shall be set 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 Torque request Frequency shall be set to 0
Technical Safety Requirement	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 request Frequency

ent 05					shall be set to 0
-----------	--	--	--	--	----------------------

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

[OPTIONAL]

## Lane Keeping Assistance (LKA) Requirements:

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	Architecture Allocation	Safe State
Technical Safety Requirement 01	The LKA safety component shall ensure that the of the 'LKA_Torque_Request' sent to the 'Final electronic power steering Torque' component for only 'Max_Duration'.	B	500 ms	LKA Safety	LKA_Activation_Status shall be set to 0
Technical Safety Requirement	As soon as the LKA function deactivates the LKA feature, the 'LKA Safety' software block	B	500 ms	LKA Safety	LKA_Activation_Status shall be set to 0

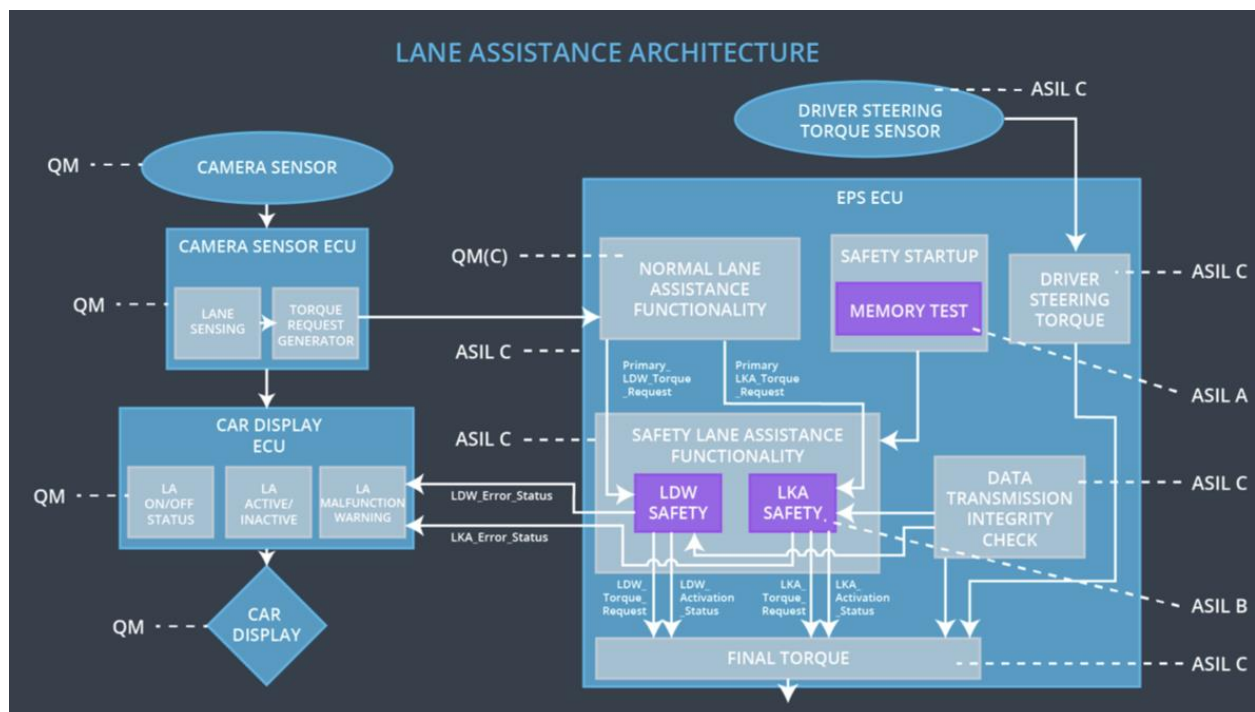


ent 02	shall send a signal to the car display ECU to turn on a warning light.				
Technical Safety Requirement 03	As soon as a failure is detected by the LKA function, it shall deactivate the LKA feature and the 'LKA_Torque_Request' shall be set to zero.	B	500 ms	LKA Safety	LKA_Activation_Status shall be set to 0
Technical Safety Requirement 04	The validity and integrity of the data transmission for 'LKA_Torque_Request' signal shall be ensured.	B	500 ms	Data Transmission Integrity Check	LKA_Activation_Status shall be set 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	LKA_Activation_Status shall be set to 0

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

[OPTIONAL]

### Refinement of the System Architecture



## Allocation of Technical Safety Requirements to Architecture Elements

All Technical safety requirements were allocated to the Electronic Power Steering ECU. For exact allocation check the technical requirements mentioned above.

### Warning and Degradation Concept

ID	Degradation Mode	Trigger for Degradation Mode	Safe State invoked?	Driver Warning
WDC-01	Turn Off LDW functionality	Malfunction_01	Yes	LDW malfunction warning on Car display
WDC-02	Turn Off LDW functionality	Malfunction_02	Yes	LDW malfunction warning on Car display
WDC-03	Turn Off LKA functionality	Malfunction_03	Yes	LKA malfunction warning on Car display