

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]**

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| --- | --- | --- | --- |
| Date | Version | Editor | Description |
| 20/10/2018 | 1 | Omar | First attempt |
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# 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**](https://support.google.com/docs/answer/116338?co=GENIE.Platform%3DDesktop&hl=en)**, you can use headings for each section and then go to Insert > Table of Contents.** [**Microsoft Word**](https://support.microsoft.com/en-us/help/285059/how-to-create-a-table-of-contents-by-marking-text-in-word) **has similar capabilities]**

[Document history](#_1t3h5sf)

[Table of Contents](#_ktt3lgighckp)

[Purpose of the Technical Safety Concept](#_fulgh8sf1ocg)

[Inputs to the Technical Safety Concept](#_757cx6xm46zb)

[Functional Safety Requirements](#_2f9rjqxbsp2)

[Refined System Architecture from Functional Safety Concept](#_qp3s9pvua9mt)

[Functional overview of architecture elements](#_cqb49updinx4)

[Technical Safety Concept](#_mx8us8onanqo)

[Technical Safety Requirements](#_lnxjuovv6kca)

[Refinement of the System Architecture](#_74udkdvf7nod)

[Allocation of Technical Safety Requirements to Architecture Elements](#_g2lqf7kmbspk)

[Warning and Degradation Concept](#_4w6r8buy4lrp)

# Purpose of the Technical Safety Concept

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

# the technical safety concept defines how the subsystem interact at the message level describes how the ECUs communicate with each other.

# Inputs to the Technical Safety Concept

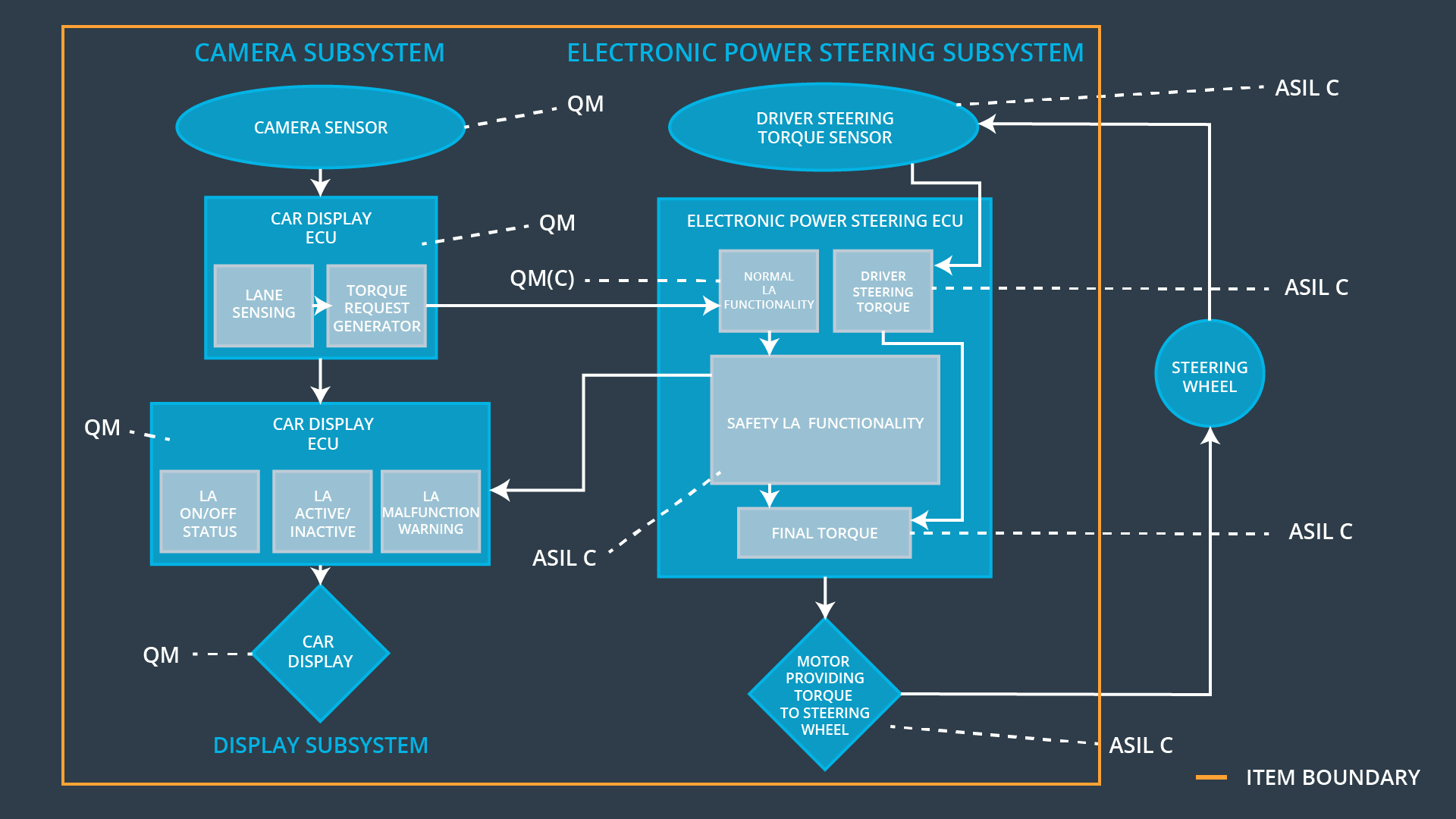
## Functional Safety Requirements

**[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 lane keeping item shall ensure that the lane departure oscillating torque amplitude is below Max\_Torque\_Amplitude | C | 50 ms | Lane departure warning torque request amplitude shall be set to zero |
| 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 | Lane departure warning torque request amplitude shall be set to zero |
| 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 | lane keeping assistance function shall be time limited and the additional steering torque shall end after a given timer interval so that the driver can not misuse the system for autonomous driving |

## 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 | The camera sensor reads in images from the road |
| Camera Sensor ECU - Lane Sensing | Camera Sensor ECU - Lane Sensing it detect the lane and it give signal if there are any lane changing or the driver move out of your lane or not. |
| Camera Sensor ECU - Torque request generator | Camera Sensor ECU - Torque request generator  If the Camera Sensor ECU - Lane Sensing detect any lane changing it will make activate torque request generator which will give signal EPS subsystem to normal lane assistance functionality and the system will check if it’s safe to make lane change or the driver move out of your lane or not |
| Car Display | Car Display contain three software blocks on controls a light that tells the driver If the lane keeping item is on or off and second one will  Control a light telling the driver that the lane departure Warning is activated or in active. |
| Car Display ECU - Lane Assistance On/Off Status | Car Display ECU - Lane Assistance On/Off Status controls a light that tells the driver If the lane keeping item is on or off |
| Car Display ECU - Lane Assistant Active/Inactive | Car Display ECU - Lane Assistant Active/Inactive Control a light telling the driver that the lane departure Warning is activated or in active. |
| Car Display ECU - Lane Assistance malfunction warning | Car Display ECU - Lane Assistance malfunction warning work as follow as soon as the LDW function deactivates he LDW feature the LDW safety software block shall send a signal to the car display to turn on a warning light. |
| Driver Steering Torque Sensor | Driver Steering Torque Sensor will sense the applied steering of the diver on the steering wheels. |
| Electronic Power Steering (EPS) ECU - Driver Steering Torque | Electronic Power Steering ECU will sense how  Much the driver is turning the steering wheel and t will receive the vibrational torque request from the camera Subsystem this is where we will limit the amplitude and The frequency to be low max torque amplitude and max torque frequency. the last thing Electronic Power Steering ECU do it will add these torque request together to output a final torque to the motor that moves the steering wheel. |
| EPS ECU - Normal Lane Assistance Functionality | EPS ECU - Normal Lane Assistance Functionality it control the normal steering as long as it’s safe as it sent the data to LA functionaity |
| EPS ECU - Lane Departure Warning Safety Functionality | EPS ECU - Lane Departure Warning Safety Functionality it shall ensure that the amplitude of he LDW\_Torque\_Request sent to the Final electroics power steering Torque componet is below Max\_Torque\_Amplitude |
| EPS ECU - Lane Keeping Assistant Safety Functionality | 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 can not misuse the system for autonomous driving |
| EPS ECU - Final Torque | EPS ECU - Final Torque is the final torque that will be provided to the steering wheels |
| Motor | Motor will Providing torque to steering |

# 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 software componet | Lane departure warning torque request amplitude shall 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 software componet | Lane departure warning torque request amplitude shall 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 software componet | Lane departure warning torque request amplitude 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 | Lane departure warning 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 | Lane departure warning torque request amplitude shall be set to zero |

**[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** | **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\_Frequency. | C | 50 ms | LDW safety software componet | Lane departure warning torque request amplitude shall 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 software componet | Lane departure warning torque request amplitude shall 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 software componet | Lane departure warning torque request amplitude 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 | Lane departure warning 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 | Lane departure warning torque request amplitude shall 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** | **ASIL** | **Fault Tolerant Time Interval** | **Allocation to Architecture** | **Safe State** |
| Technical  Safety  Requirement  01 | The Lane keeping item shall ensure that the lane departure oscillating torque amplitude is below 'Max\_Torque\_Amplitude | B | 500 ms | LDW safety software componet | lane keeping assistance function shall be time limited and the additional steering torque shall end after a given timer interval so that the driver can not misuse the system for autonomous driving |
| Technical  Safety  Requirement  02 | As soon as The Lane keeping item deactivates the Lane keeping item feature, the The Lane keeping item Safety' software block shall send a signal to the car display ECU to turn on a warning light. | B | 500 ms | LDW safety software componet | lane keeping assistance function shall be time limited and the additional steering torque shall end after a given timer interval so that the driver can not misuse the system for autonomous driving |
| Technical  Safety  Requirement  03 | As soon as a failure is detected by The Lane keeping item, it shall deactivate The Lane keeping item and the 'LDW\_Torque\_Request' shall be set to zero. | B | 500 ms | LDW safety software componet | lane keeping assistance function shall be time limited and the additional steering torque shall end after a given timer interval so that the driver can not misuse the system for autonomous driving |
| Technical  Safety  Requirement  04 | The validity and integrity of the data transmission for 'LDW\_Torque\_Request' signal shall be ensured. | B | 500 ms | data transmission integrity check | lane keeping assistance function shall be time limited and the additional steering torque shall end after a given timer interval so that the driver can not misuse the system for autonomous driving |
| 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 | lane keeping assistance function shall be time limited and the additional steering torque shall end after a given timer interval so that the driver can not misuse the system for autonomous driving |

**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.]**

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## 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]**

1. LDW safety software componet
2. data transmission integrity check
3. Safety Startup

## 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 functionality | Lane Departure Warning (LDW) function shall apply an oscillating steering torque to provide the driver a haptic feedback | Yes | There is no warning |
| WDC-02 | turn off the functionality | Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane | Yes | the driver will see a warning light on the dashboard when the system malfunctions |