

Software Safety Requirements and Architecture

Lane Assistance

**Document Version: [Version]**

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# Document history

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| 24/5/2018 | 1.0 | Vivek Pathak | First Attempt |
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# Purpose

The purpose of this document is to capture the software safety requirements for all technical safety requirements from technical safety concepts as it test how much the software is robust and real time functionality can happen related discussion to it. This will help easy software designs which will design safety hazards.

# Inputs to the Software Requirements and Architecture Document

## Technical safety requirements

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

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| **ID** | **Technical Safety Requirement** | **ASIL** | **Fault Tolerant Time Interval** | **Architecture Allocation** | **Safe State** |
| Technical  Safety  Requirement  01 | The Lane Departure Warning 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 | Lane Departure |
| Technical  Safety  Requirement  02 | When the Lane Departure Warning is deactivated, the ‘LDW Safety’ software module shall send a signal to the Car Display ECU to turn on a warning signal. | C | 50 ms | LDW Safety | Lane Departure Warning torque to zero. |
| Technical  Safety  Requirement  03 | When a failure is detected by the Lane Departure Warning functionality, it shall deactivate the Lane Departure Warning feature and set ‘LDW\_Torque\_Request’ to zero. | C | 50 ms | LDW Safety | Lane Departure Warning torque 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 | Lane Departure Warning torque to zero. |
| Technical  Safety  Requirement  05 | Memory test shall be conducted at start up of the EPS ECU to check for any memory problems | A | Ignition cycle | Data Transmission Integrity Check | Lane Departure Warning torque to zero. |

## Refined Architecture Diagram from the Technical Safety Concept

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# Software Requirements

**Lane Departure Warning (LDW) Amplitude Malfunction Software Requirements:**

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| **ID** | **Technical Safety Requirement** | **ASIL** | **Fault Tolerant Time Interval** | **Allocation to Architecture** | **Safe State** |
| Technical  Safety  Requirement  01 | The Lane Departure Warning 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 | Lane Departure Warning torque to zero. |

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| ID | Software Safety Requirement | ASIL | Allocation Software Elements | Safe State |
| Software  Safety  Requirement  01 | The input signal ‘Primary\_LDW\_Torq\_Req’ shall be read and pre-processed to determine the torque request coming from the ‘Basic/Main LAFunctionality’ SW Component. Signal ‘processed\_LDW\_Torq\_Req’ shall be generated at the end of the processing. | C | LDW\_SAGETY\_INPUT\_PROCESSING | N/A |
| Software Safety Requirement 02 | In case the ‘processed\_LDW\_Torq\_Req’ signal has a value greater than ‘Max\_Torque\_Amplitude\_LDW’ (maximum allowed safe torque), the torque signal ‘limited\_LDW\_Torq\_Req’ shall be set to zero, else ‘limited\_LDW\_Torq\_Req’ shall take the value of ‘processed\_LDW\_Torq\_Req’ | C | TORQUE\_LIMITER | ‘limited\_LDW\_Torq\_Req’ = 0 (Nm=Newton-meter) |
| Software Safety Requirement 03 | The ‘limited\_LDW\_Torq\_Req’ shall be transformed into a signal ‘LDW\_Torq\_Req’ which is suitable to be transmitted outside the LDW Safety component (‘LDW Safety’) to the ‘Final EPS Torque’ component. | C | LDW\_SAFETY\_OUTPUT\_GENERATOR | LDW\_Torq\_Req = 0 (Nm) |

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| **ID** | **Technical Safety Requirement** | **ASIL** | **Fault Tolerant Time Interval** | **Allocation to Architecture** | **Safe State** |
| Technical  Safety  Requirement  02 | Validity and integrity of data transmission for LDW\_Torque\_Req shall be insured . | C | 50 ms | Data transmission integrity check | NA |

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| **ID** | **Software Safety Requirement** | **ASIL** | **Allocation Software Elements** | **Safe State** |
| Software Safety Requirement 02-01 | Any data to be transmitted outside the LDQ Safety component (‘LDW Safety’) including ‘LDW\_Torque\_Req’ and ‘activation\_status’ shall be protected by an End-2-End protection mechanism. | C | E2C Calc | LDW\_Torq\_Req = 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 | E2E Calc | LDW\_Torq\_Req = 0 (Nm) |

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| **ID** | **Technical Safety Requirement** | **ASIL** | **Fault Tolerant Time Interval** | **Allocation to Architecture** | **Safe State** |
| Technical  Safety  Requirement  03 | As soon as a failure is detected by the LDW functionality, it shall deactivate the Lane Departure Warning feature and ‘LDW\_Torque\_Request’ be zero. | C | 50 ms | LDW Safety | LDW torque set to zero. |

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| **ID** | **Software Safety Requirement** | **ASIL** | **Allocation Software Elements** | **Safe State** |
| Software Safety Requirement 03-01 | Each Software shall output a signal to indicate any error which is detected by the element. Error signal = error\_status\_input (LDW\_SAFETY\_INPUT\_PROCESSING), error\_status\_torque\_limiter(TORQUE\_LIMITER), error\_status\_output\_gen(LDW\_SAFETY\_OUTPUT\_GENERATOR) | C | All | N/A |
| Software Safety Requirement 03-02 | A software element shall evaluate the error status of all other software elements and in case any one of them indicates an error, it shall deactivate the Lane Departure Warning feature (‘activation\_status’=0) | C | LDW\_SAFETY\_ACTIVATION | Lane Departure Warning function deactivated (‘activation\_status’ =0). |
| Software Safety Requirement 03-03 | In case of a no error from the software elements, the status of the Lane Departure Warning feature shall be set to activated (‘activation\_status’=1). | C | LDW\_SAFETY\_ACTIVATION | N/A |
| Software Safety Requirement 03-04 | In case an error is detected by any of the software elements, it shall set the value to its corresponding torque to zero so that ‘LDW\_Torq\_Req’ is set to zero | C | All | LDW\_Torq\_Req = 0 |
| Software Safety Requirement 03-05 | Once the Lane Departure Warning functionality has been deactivated, it shall stay deactivating until the time the ignition is switched from off to on again. | C | LDW\_SAFETY\_ACTIVATION | Lane Departure Warning function deactivated (‘activation\_status’ =0). |

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| **ID** | **Technical Safety Requirement** | **ASIL** | **Fault Tolerant Time Interval** | **Allocation to Architecture** | **Safe State** |
| 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 | Lane Departure Warning torque to zero. |

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| **ID** | **Software Safety Requirement** | **ASIL** | **Allocation Software Elements** | **Safe State** |
| Software Safety Requirement 04-01 | When the LDW function is deactivated (‘activation\_status’ set to zero), the activation status shall be sent to the Car Display ECU. | C | LDW\_SAFETY\_ACTIVATION, Car Display ECU | N/A |

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| **ID** | **Technical Safety Requirement** | **ASIL** | **Fault Tolerant Time Interval** | **Allocation to Architecture** | **Safe State** |
| Technical  Safety  Requirement  01-05 | Memory test shall be conducted at start-up of the EPS ECU to check for any memory problems | A | Ignition cycle | Data Transmission Integrity Check | Lane Departure Warning torque to zero. |

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| **ID** | **Software Safety Requirement** | **ASIL** | **Allocation Software Elements** | **Safe State** |
| Software Safety Requirement 05-01 | A CRC verification check over the software code in the Flash memory shall be done every time the ignition is switched from off to on to check for any content corruption. | A | MEMORYTEST | Activation\_status = 0 |
| Software Safety Requirement 05-02 | Standard RAM test 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 to RAM and processor vendor recommendations) | A | MEMORYTEST | Activation\_status = 0 |
| Software Safety Requirement 05-03 | The test result of the RAM or Flash memory shall be indicated to the LDW\_Safety component via the ‘test\_status’ signal. | A | MEMORYTEST | Activation\_status = 0 |
| Software Safety Requirement 05-04 | In case any fault is indicated via the ‘test\_status’ signal the INPUT\_LDW\_PROCESSING shall set an error on the error\_status\_input(=1) so that the Lane Departure Warning functionality is deactivated and the LDW\_Torque\_Req is set to zero. | A | LDW\_SFETY\_INPUT\_PROCESSING | Activation\_status = 0 |

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# Refined Architecture Diagram

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