3 Functional Safety Processes and Advanced Driver Assistance Systems: Evolution or Revolution?

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3.1 Advanced Driver Assistance Systems @ Ford

Within the last two decades, the development of electric / electronic (E/E) systems in the automotive domain was subject to a significant change: Starting with increasing E/E content in “stand-alone features” like engine control or brake system (e.g., E-Gas or ABS) realized in one single Electronic Control Unit (ECU) with directly connected sensors, networks (like the CAN-Bus) were introduced to connect the different subsystems. Later on, distributed features were developed in which the algorithms of the realized feature are spread over several ECUs.

Key driver for this trend is the evolution of the so-called “Advanced Driver Assistance Systems (ADAS)”. These features were introduced at Ford vehicles stepwise in following generations:

This paper presents the different generations of Advanced Driver Assistance Systems brought to the market and provides an overview of the applied Functional Safety processes. It also describes the current status and provides an outlook towards the future of fully autonomous vehicles.

**ADAS generation 1**: it includes Adaptive Cruise Control (ACC) and a Pre Collision Assist function with driver warning in case of moving and stopping targets. The warning contains the estimation of driver reaction time. Different driver warning settings (early/normal/late) are available (Forward Collision Warning, FCW). The Brake system is pre-charged to achieve up to ~0.1g deceleration (Collision Mitigation by Braking, CmbB). The Emergency Brake Assist (EBA) threshold level is decreased when the radar sensor confirms the target (moving targets only).

**ADAS generation 2**: it adds Lane Assist, Light Feature & Driver Alert Systems. This includes features such as Lane Departure Warning (LDW), Lane Keeping Aid (LKA) with Camera, Auto High Beam Control (AHBC), Traffic Sign Recognition (TSR) with Camera and Driver Impairment Monitoring (DAS) based on driving behavior. Autonomous braking is done up to 0.5 g when the target is classified as a vehicle.