

# ON-BOARD DIAGNOSTICS MEETS AUTOSAR

As powertrains become more electric, the number of on-board diagnostics relevant Electronic Control Units (ECUs) continues to grow. Vector provides a summary of the on-board diagnostics functions integrated in the AUTOSAR basic software (BSW) and which use cases they support.

## BACKGROUND

For vehicles with combustion engines, increasingly more stringent emission limits have been set in recent years. To continue meeting these limits over years of vehicle operation, an on-board diagnostics (OBD) system must monitor components and systems to ensure fault-free operation.

Typically, three classes of ECUs are defined for each vehicle. The Master ECU takes on the role of collecting, conditioning and supplying central data and it controls warnings to the driver. Primary ECUs are ECUs that acquire local data in their fault memories and communicate with the scan tool, while Secondary ECUs only report to a Primary or Master ECU.

Functions for monitoring components and systems are subdivided into two

categories: Major Monitors are relevant for systems that have a direct effect on emission values (for example fuel and exhaust recirculation systems). Comprehensive Component Monitors check the systems that are needed for the Major Monitors or systems that affect emissions indirectly. They include functions related to battery regeneration while braking the vehicle, battery management and climate control systems.

## OBD FUNCTIONS AS PART OF THE AUTOSAR BSW

The rapid spread of electrically assisted drives leads to a growing number of Primary ECUs that have Comprehensive Component Monitor functionality.

AUTOSAR defines the OBD functions that should be implemented in the DCM (Diagnostic Communication Manager), DEM (Diagnostic Event Manager) and FIM (Function Inhibition Manager) modules. To a high degree, they reference definitions in the OBD standards and directives. The concrete implementation and configuration, for



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example calibration strategy and relation to UDS (Unified Diagnostic Services) fault memory, must be defined by software suppliers in cooperation with the OEMs.

The DCM module implements OBD-specific services, ❶. Moreover, OBD requests are either prioritised over UDS requests, or they are processed in parallel. The DEM module also contains various OBD extensions that are additional to those of UDS. They include modified error status behaviour, storing persistent DTCs, saving freeze frame data and calculating the In Use Monitor Performance Ratio (IUMPR). In combination with the FIM module, incrementing of the IUMPR counter is deactivated as soon as certain malfunctions are detected.

Production-ready OBD extensions of the DEM, DCM and FIM modules for five different automotive OEMs are already available in the AUTOSAR 3 and AUTOSAR 4 basic software from Vector.

Additional services (modes) for OBD
\$01: Request current powertrain diagnostic data
\$02: Request powertrain freeze frame data
\$03: Request emission-related DTCs
\$04: Clear/reset emission-related DTCs
\$06: Request on-board monitoring test results for specific monitored systems
\$07: Request emission-related DTCs detected during current or last completed driving cycle
\$08: Request control of on-board system, test or component
\$09: Request vehicle information
\$0A: Request emission-related DTCs with permanent status

❶ The OBD-specific extension of the DCM module contains nine additional services