Gasoline Technology Car II

New benchmark on fuel efficiency
“The second-generation Gasoline Technology Car demonstrates the huge potential of a mild hybrid when the 48 V electrical system, the internal combustion engine and the operating strategies are optimized holistically as a complete system.”

José Avila, Member of the Executive Board of Continental and President of the Powertrain Division

“The GTC II, just like the GTC I, is a milestone in terms of the successful integration of highly efficient hybrid operating strategies in a manual-transmission vehicle. The GTC II’s electronic clutch supports functions such as electric launch, electric stop-go operation and energy recuperation at speeds almost down to standstill.”

Dr.-Ing. Peter Gutzmer, Member of the Schaeffler Executive Board responsible for Research & Development

“The Ford Focus with its 1.0-liter Ecoboost engine, which has won multiple International Engine of the Year awards, provides an excellent starting point for a hybrid vehicle, showing the potential that hybridization offers even for an engine that starts from such a high baseline. When integrating the GTC II concept, the focus was therefore on overall powertrain optimization.”

Carsten Weber, Manager Engine & Powertrain Systems Research & Advanced Engineering, Ford Europe
Gasoline Technology Car II

New benchmark on fuel efficiency
Presented at the Vienna Motor Symposium in 2014, the first-generation Gasoline Technology Car (GTC I) stole the show with a 17% improvement in New European Driving Cycle (NEDC) fuel efficiency compared with the reference model, and CO₂ emissions of just under 95 g/km. The already highly efficient Ford Focus reference model was equipped with a turbocharged 3-cylinder 1-liter gasoline engine (GTDI) and 12 V start-stop system. Now the project partners Continental and Schaeffler, in close cooperation with Ford, present the second-generation Gasoline Technology Car (GTC II): The GTC II showcases the potential of intelligent, latest-generation 48 V hybridization in its most highly advanced form. The GTC II promises an improvement of about 25% on the NEDC fuel consumption compared to the reference vehicle. The most obvious difference between the GTC II and the GTC I is the highly efficient integration of the electric motor between the internal combustion engine and the transmission in the second-generation model (“48 V P2 Architecture”).
Gasoline Technology Car I

Features

› Ford Focus, equipped with a turbocharged 3-cylinder 1-liter gasoline engine (GTDI)
› No geometrical changes on the engine
› Continental Fuel Injection System
› 48 V P0 Architecture: Belt-driven Starter Generator (BSG) in front of the combustion engine
› Euro 6c
› CO₂ emission = 95g/km
Gasoline Technology Car II

Features

- Ford Focus 1,0L 3cyl Eco-Boost, increased compression ratio CR=12, modified intake camshaft, RAAX™ Turbocharger
- Continental Fuel Injection System
- 48 V P2 Architecture: Belt-driven Starter Generator (BSG) between combustion engine and transmission
- Euro 6c
- CO₂ emission target < 85 g/km
The GTC II’s electric motor is integrated in the drive train by means of a belt that runs between the internal combustion engine and the transmission. Two clutches, one upstream and one downstream of the belt, allow the internal combustion engine (ICE) to be completely decoupled when required. The electric motor can then power the vehicle independently of the ICE.

As a result, the GTC II supports both constant-speed electric coasting at low load, as well as electric launch, for example in stop-start driving.
Vehicle Architecture

At a Glance

RAAX™ Turbocharger A/C-Compressor

48 V Inverter

Electrical Water Pump

E-Machine

HMI

DMF – Dual Mass Flywheel

LIVC – Late Intake Valve Closing

ECU – Electronic Control Unit

12 V Battery 48 V Battery

DC/DC Converter

ECU (Hybrid Operation Strategy)

Starter

48 V Inverter 48 V E-Machine

Decoupling Tensioner

Clutch CO

Belt

Bearings

Clutch C1

Clutch Actuators

P2 Hybrid Module

A/C-Compressor

Electrical Vacuum Pump

Smart Coolant Pump

RAAX™ Turbocharger

Electrically Heated Catalyst

DMF

Thermo Management Module

ECU – Electronic Control Unit

HMI – Human Machine Interface

DMF – Dual Mass Flywheel

LIVC – Late Intake Valve Closing
Vehicle Components

At a Glance

- Engine Management System (EMS) 3
- Thermal Management
- Hybridization
- Combustion Optimization and Exhaust After-treatment
48 V PO Architecture (GTC I)

Overview of Driving Modes

C = Combustion Engine  D = Dual Mass Flywheel  E = Electrical Machine  T = Transmission
48 V P2 Architecture (GTC II)
Overview of Driving Modes

- **Electrical Driving**
- **Recuperation**
- **Traction Mode**
- **Electrical Vehicle Air Conditioning**
- **Boost**
- **Coasting**

- **A = Air Conditioning Compressor**
- **C = Combustion Engine**
- **D = Dual Mass Flywheel**
- **E = Electrical Machine**
- **T = Transmission**
48 V Hybrid Module

In Detail

48 V E-Motor with Power Electronics
Decoupling Tensioner
Clutch System with Damper
Belt
AC-Compressor
Benefits

48 V Hybrid Module

› Disconnects crankshaft to reduce losses during electric driving, recuperation and sailing

› Enabler for pure e-drive with a 48 V System

› Enabler for air conditioning during standstill (ICE off)

› Modular approach for e-motor incl. power electronics

› Deletion of Front End Accessory Drive (FEAD) belt drive
CO₂ Reduction Potential
Simulated Overall Savings

New European Driving Cycle (NEDC)

Worldwide Harmonized Light-Duty Vehicles Test Procedure (WLTP)

LIVC = Late Intake Valve Closing
Summary

› More than 25% CO₂ and fuel reduction compared to the reference vehicle (NEDC)

› High-volume segment solution: Milestone in terms of the successful integration of highly efficient hybrid operating strategies in a manual-transmission vehicle

› Innovative 48 V P2 Architecture – the electric motor is integrated between the internal combustion engine and the transmission

› New fuel saving functions: The electric motor can power the vehicle independently of the ICE. As a result, the GTC II supports both constant-speed electric sailing at low load, as well as electric launch, for example in stop-start driving

› The absence of any engine braking effect in deceleration phases means that more kinetic energy is available for recuperation

› First practical application for 48 V Electrically Heated Catalyst: GTC II complies with the strict requirements of emissions standard Euro 6c (2017/2018)
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