

Dynamic Downsizing Demonstrator Vehicle

Ben Hibberd, Mike Bassett, Jonathan Hall & Stephen Borman
MAHLE Powertrain Limited, Northampton, UK.

Abstract

Gasoline engine downsizing is already established as a proven technology to reduce automotive fleet CO₂ emissions by as much as 25 %. Further benefits are possible through more aggressive downsizing, however, the trade-off between the CO₂ reduction achieved and vehicle drive-ability limits the level of engine downsizing currently adopted.

This paper will present results from a 48 V mild hybrid engine demonstrator, featuring an eSupercharger, belt driven torque assist and regenerative capability. Performance measurements will be presented from an advanced stage of engine testing, using a 1.2 litre, 3-cylinder, engine fitted with an advanced twin boost system.

The original cutting-edge MAHLE downsizing engine still has higher BMEP levels than any gasoline engine currently in series production. This engine has now been re-configured to enable a very high specific power output to be achieved, in excess of 160 kW/litre, whilst retaining excellent drivability and fuel economy. Of key importance is a cost effective, efficient and flexible boosting system. An eSupercharger, operating at 48 V, enables the transient response and low speed torque to be more than recovered, enabling both very high specific output and specific torque characteristic with excellent transient response and drivability characteristics.

In this application the eSupercharger is no longer simply a transient device, but also a key contributor to the steady state engine performance. It is therefore essential to the concept that there is a means for supplying the eSupercharger with uninterrupted electrical power, if the steady-state torque output of the engine is to be maintained. The demonstrator vehicle features a 48 V belt integrated starter alternator (BiSG) and an advanced lead acid battery pack.

This paper will demonstrate eSupercharging as a technology enabler for extreme engine downsizing, and will discuss the compatibility with 48 V micro-hybridisation, for further CO₂ emissions reduction. The energy management, and power flow, for controlling battery state of charge, minimising CO₂ and maintaining good transient response will be presented and discussed.