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Intake Manifold Length Effects on Turbocharged Gasoline Downsizing Engine Performance and Fuel Economy

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ABSTRACT
Downsizing of the spark ignition engine is accepted as a key contributor to reducing fuel consumption. Turbocharged engines are becoming commonplace in passenger vehicles, replacing naturally aspirated larger capacity engines. However, turbocharged engines have typically suffered from “lag” during transient operation. This perceived effect is a combination of the low speed steady state torque and a slower rate to reach maximum torque during a load step. In order to increase customer acceptance of downsized concepts it is vital that the low speed torque and transient response are optimized.

Variable Length Intake Manifolds (VLIM) have long been an established method of improving the full load performance of naturally aspirated engines. The manifold length being “tuned” to provide a high-pressure pulse at intake valve closing to maximize cylinder filling and deliver improved performance. This same approach could be applied to turbocharged engines to improve low speed torque and transient response.

This paper investigates the affects of VLIM technology applied to a 1.4-litre turbocharged gasoline direct injection engine. It demonstrates improvements in low speed torque and transient response achieved through tuning. It also investigates the tuning options available at high speed on a turbocharged engine and demonstrates the fuel consumption benefits that can be achieved through varying manifold runner length.