

IAV Control System Concept for Gaseous Fuel Drives

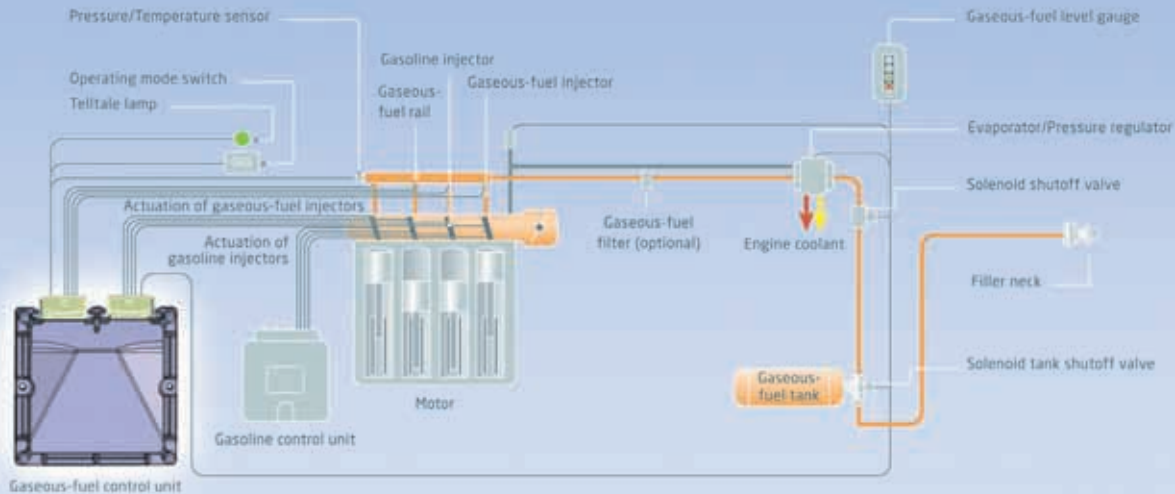
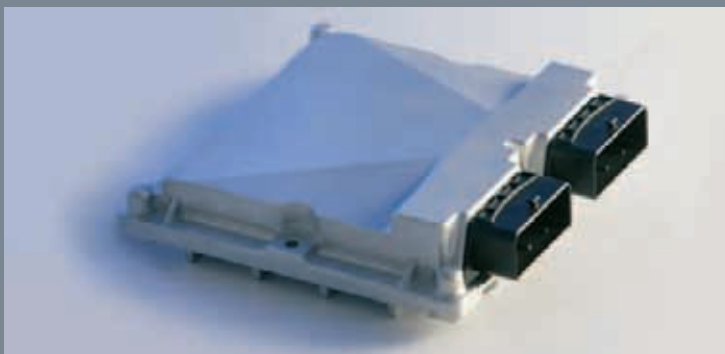


Diagram of IAV's gaseous-fuel master-sequential system

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As gasoline and diesel fuel becomes more expensive, there is a growing demand to develop alternative fuel drive systems. LPG and CNG fuels are attracting attention as near-term solutions, and IAV is one of the world's leading engineering providers of this technology. Since 1990 the company has been dedicated to developing production-ready solutions for CNG and LPG systems as well as small-volume zero-mileage conversions. As a Qualified Vehicle Modifier (QVM), IAV has comprehensive knowledge in all areas of automotive development, providing the expertise that is necessary for integrating gaseous fuel systems into existing vehicles. Based on many years of experience, IAV has consistently improved the quality, safety, efficiency and reliability of gaseous fuel powertrains by taking full account of the interfaces and influencing factors that are involved. This makes IAV one of today's leading engineering service providers in this sector.

IAV has developed a sequential control unit that works with the existing ECU to provide fast and cost-effective means of converting most existing gasoline concepts into a dual fuel, gasoline and gaseous-fuel, system. The master-sequential concept combines the use of a validated gasoline system with the added flexibility of a sequential controller. The gaseous fuel system is capable of being combined with various gas injectors, sensors, and actuators.



Advantages of the New Gaseous-Fuel Sequential Controller

- ▶ Meets world market requirements
- ▶ Developed in compliance with German and international standards
- ▶ Provides validated systems for mass production

Open System Interfaces

- ▶ Control unit hardware can be combined with a variety of EMS components and systems
- ▶ Flexibility to select the best suited components based on function and/or cost

Fully Automated Code Generation

- ▶ Rapid adaptation of new functions
- ▶ Specific requirements can be realized short-term in high quality
- ▶ Optimized system costs and fast response to changing market requirements

Flexibly scalable hardware

- ▶ Hardware design easily tailored to various engine and vehicle related requirements
- ▶ Many hardware requirements can be met, while leaving software structures unchanged

Demand-based system integration support

- ▶ Tailored overall concept
- ▶ Calibration and validation
- ▶ Component assessment
- ▶ System development and integration
- ▶ Homologation
- ▶ Modifications to the electrical system

Compatible calibration tools

- ▶ Calibration through INCA PC interface
- ▶ Existing development environments can be used, while applying proven processes

Made in Germany

- ▶ Control unit hardware is produced in Germany
- ▶ High quality of production and validation guarantee lasting service

Outstanding value for money

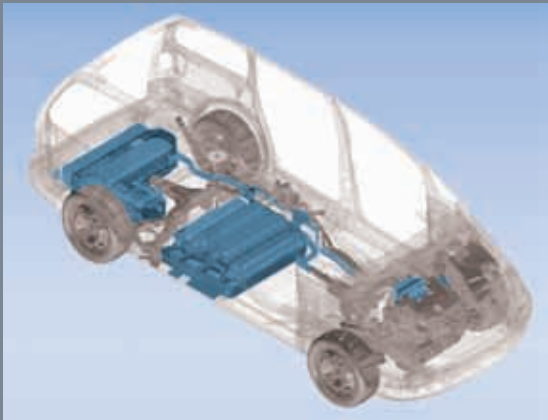
- ▶ Optimized solutions save resources, time and cost



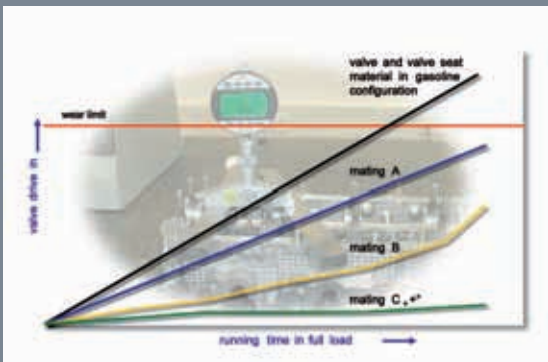
Gaseous-fuel instrumentation in OEM quality



Packaging of underfloor LPG tanks



Integrated vehicle concepts for mass production



Development to reduce valve wear in gaseous-fuel mode

Development to Start of Production (SOP) Level

IAV has proven expertise in developing gaseous-fuel vehicles to SOP level in a variety of production-ready CNG and LPG development projects. This experience includes constructing prototypes and demonstrator vehicles, as well as advance development services (particularly focusing on valvetrains). Comprehensive understanding of gaseous-fuel systems and the complex interactions involved, coupled with IAV's experience allows for the best possible solutions to avoid recall situations.

Examples of Production-Ready Development Projects

- ▶ Turn-key development of a production vehicle with bivalent CNG drive (single-controller concept from 2002)
- ▶ Development of the world's first production vehicle with liquid LPG injection (single-controller concept from 2004)

QVM (Qualified Vehicle Modifier) Conversion

With over 6,000 CNG and LPG conversions (as of 2008), IAV is Germany's No.1 vehicle modifier. Across the globe, there are over 80,000 vehicles running on IAV's gaseous-fuel systems.

Quality and Reliability

- ▶ Continuously advanced systems and components
- ▶ Optimum integration based on comprehensive base-vehicle expertise (Qualified Vehicle Modifier)
- ▶ Existing gasoline-fuel system left entirely unchanged (bivalent drive concept)

Safety

- ▶ Well documented through crash tests
- ▶ Certification of all gaseous fuel system components under ECE-R67.01 and ECE-R 110 (-40 °C), can be registered throughout Europe
- ▶ Gaseous fuel system is registered in Germany under ECE-R 115
- ▶ Constant monitoring of all emission-relevant gas components by the engine management system in both operating modes

Service

- ▶ Preparation of complete workshop service manuals
- ▶ Competent support and service
- ▶ Training of workshop personnel by experts (over 220 service points in Germany alone)
- ▶ GSP/GAP training

Made in Germany -
produced exclusively by
MGH Germany GmbH, Berlin

