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## Design of Vehicle Control Unit Based on DSP for a Parallel HEV\*

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**Abstract**—This paper presents a DSP based vehicle control unit (VCU) for hybrid electric vehicle (HEV). Digital Signal Processor (DSP) based real time controller plays a key role in HEV system operation. It provides an efficient platform to run complex optimization algorithms for energy management strategy. First, the hardware design of VCU is introduced in detail. Then software design of VCU and C code automatic generation technical based on RTW are discussed. A flexible and configurable method is described to automatically deploy the Simulink-model into the VCU. Experimental results have demonstrated the reliability of hardware design and flexibility of software design of the proposed VCU.  
**Index Terms**—hybrid electric vehicle, DSP TMS320F2812, automatic code generation

### I. INTRODUCTION

Hybrid electric vehicles have been widely studied in recent years because of their potential to significantly improve fuel economy and reduce emissions without sacrificing vehicle performance. It combines an internal combustion engine (ICE) and electric motor (EM) together with an energy storage that can each act independently or in combination. Adding an additional degree of freedom, the hybrid powertrain can improve fuel economy by operating ICE in the optimum efficiency range and by making use of regenerative braking during deceleration [1]-[2].

In the specific parallel hybrid architecture shown in figure.1, the powertrain integrates an engine, an electric traction motor/generator, an automatic clutch, and an automated manual transmission system. The motor is directly linked between the output of the master clutch and the input to the transmission. This architecture provides the

regenerative braking during deceleration and allows efficient motor assist and recharge operations by the engine [3]. Hybrid electric vehicle are composed of several subsystems,

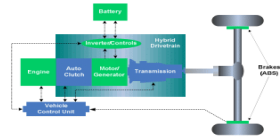


Fig. 1. Schematic of the parallel hybrid electric vehicle drivetrain.

such as vehicle control unit (VCU), engine, transmission, motor/generator and Ni-Hi battery. VCU collects signals from driver operation unit and receives relative information transferred by each subsystem controller. According to energy management strategy, VCU coordinates the operation of vehicle subsystems to achieve performance targets such as maximizing fuel economy and reducing exhaust emissions. Therefore, VCU is the kernel of hybrid electrical vehicle system. Its capability will directly affect reliability and performance of HEV.

The focus of this paper will be to describe the design of VCU for a parallel HEV. The remainder of this paper is organized as follows: Section 2 describes hardware design of VCU based on DSP TMS320F2812 in detail. The software design

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Dec. . components ud and u4 are expressed in dependence on the components of. Proceedings of the IEEE International Symposium on Industrial Electronics (Cat. . At present, 67% of all the electrical energy generated in the UK is converted radial and tangential components of the ISIE', Cholula, Puebla, Mexico; stator flux-linkage space vector i n its locus. . I X gmerdtor is u s 4 as a load.

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