The Next Leap for Electronics

In today's automotive technology, there is an increasing trend of vehicles adopting the X-by-wire. This combination will have the electronics interface between high voltage electrical and low voltage digital circuits in the systems. An electrical isolation will be ideal for providing stable operation, eliminating electrical noise and interference between systems. Electrical automotive systems will be greatly helped to increase stability with the use of optical isolation devices in the automotive electronics. **Derek Chng Peng Hui, Avago Technologies, Singapore**

Hybrid-electric vehicles (HEVs) combine the benefits of gasoline engines and electric motors and can be configured to obtain different objectives, such as improved fuel economy, increased power, or additional auxiliary power for electronic devices and power tools.

HEVs have several advantages over conventional gasoline vehicles, such as regenerative braking capability that recovers energy loss from braking to slow down or stop a vehicle and generate energy back to the battery system; increased fuel efficiency by utilising the battery system to propel the vehicle at the start rather than a gasoline engine; and reduced emissions as these vehicles utilise electric and gasoline engines interchangeably in motion.

Many configurations are possible for HEVs. Essentially, a hybrid combines an energy storage system (the battery, commonly Nickel Metal Hydride, Lithium Ion and ultracapacitors for propulsion boost), a power unit (power supplies in the form of DC/DC and DC/AC inverter), and a vehicle propulsion system (electric/gasoline) Motor. A hybrid's efficiency and emissions depend on the particular combination of subsystems, how these subsystems are integrated into a complete system, and the control strategy that integrates the subsystems.

Isolation barriers between inverter and controls

Figure 1 illustrates the typical engine control system of an HEV. The controls, including a built-in AC inverter, the inverter for the motor, DC/DC converter for reducing high voltage to 12V, the battery and motor and battery electronics, are all packaged in a well ventilated assembly (usually air or water-cooled) mounted behind the rear seat of an HEV.

In the electric motor drive control module, either gate drive optocouplers (up to 2A gate drive) or intelligent power module digital optocouplers (1MBd speed) help

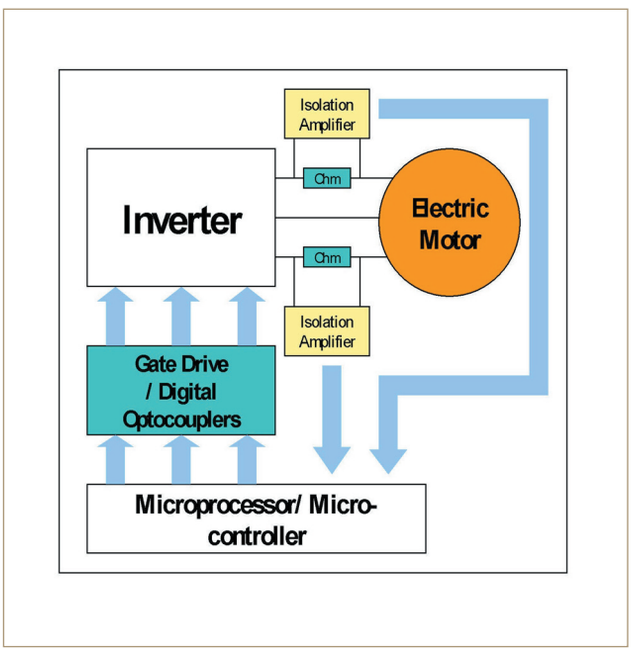

Figure 1: Electric motor drive system

interface between the motor inverter and the microcontroller system. To monitor the electric motor current, the isolation amplifier (current sensing with up to 1% gain tolerance capability) offers the best package and features to measure the current precisely. Likewise, it can also be used to monitor the car battery status providing electronic visibility of the electrical system.

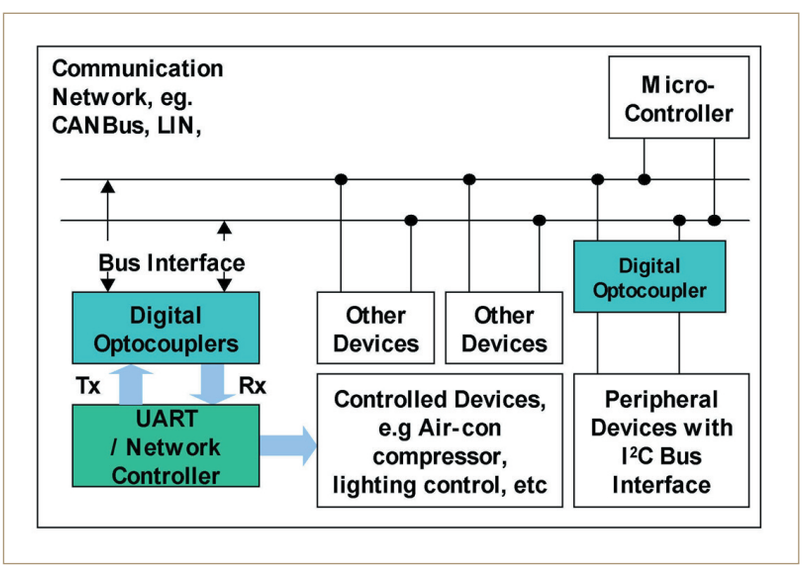

Figure 2: Car network system

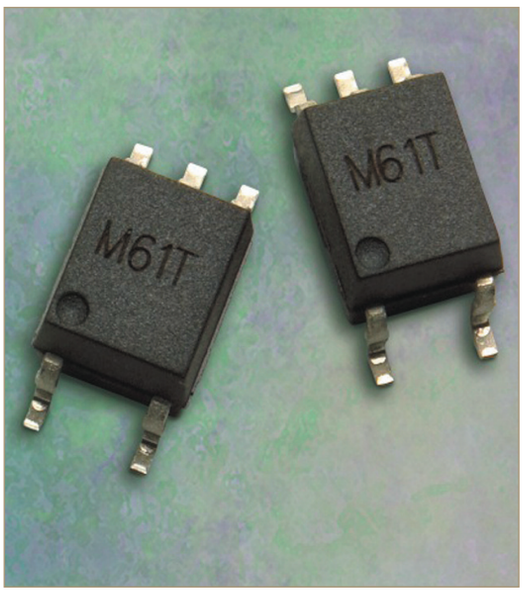

Figure 3: Due to the high number of electrical components in hybrid electric vehicles, opto-isolation products play a key role in interfacing between high and low voltage levels

In today's automotive technology, there is an increasing trend for vehicles adopting the X-by-wire (the replacement of mechanical functions in a vehicle by a combination of mechanicals, electronics, and software). This combination will have electronics interface between high voltage electrical and low voltage digital circuits in the systems. An electrical isolation will be ideal for providing stable operation, eliminate electrical noise and interference between systems.

For the communication media of the vehicles available, there are several types including LIN, CANbus, MOST and FlexRay. The most common communication protocol used by HEVs is CANbus, as it is easy to implement and only requires two wires to control the electrical system such as in the air-conditioning, power systems electronic control units, body control modules and diagnostic interfaces. CANbus was originally developed by Bosch in the 1980s for automotive applications and has since been used throughout the worldwide vehicles system, and because it has the bandwidth which can be used for real-time control, as well as data collection. The transmission speed of a CANbus is up to 1Mbps. Electrical automotive systems will be greatly helped to increase stability with the use of optical isolation devices in the automotive electronics (Figure 2).

Explosive market for electronic components

Hybrid vehicles represent an explosive market for components. To cater for the growing demands of the HEV market, Avago Technologies introduced the first automotive isolation devices ACPL-M43T (Automotive 1MBd Transistor Output High Temperature Optocouplers) in May 06, for use in the electric motor inverter and DC/DC power packs. Following the additional needs of isolation requirement in HEVs communication interfaces, Avago is introducing the automotive 10MBd Logic gate Output digital interface Optocoupler to be used in the CANBus communications network interfaces in November 06 (Figure 3).

The automotive products features double wire bonding processes for added reliability, new improved LED for high brightness with low driving current, to reduce overall power consumption and better signal coupling, improved new lead frames for better heat dissipation, and a special product lot numbering system catering to better traceability.

In addition, these products have a wide operating temperature range (-40 to 125°C) and are qualified under the AECQ100 guidelines for reliability and qualification tests that suit the automotive applications.

The outlook for hybrid vehicles is very positive for a variety of reasons. Hybrid electric vehicles market trends worldwide will be increased with the growing concern of increasing gasoline prices, as well as environmental consciousness. The rate of demand will eventually be increased significantly with conventional vehicles. HEVs will undergo many changes and improvements as the technology develops. It can easily be designed to equal or surpass the performance of conventional cars, and can meet or exceed customer expectations in the future.