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Chips Merge CAN And Power Management Functions To Support Power-Saving Partial Networking In Vehicles

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You don't have to be a smart phone designer to realize the value of power management and simply turning off unnecessary power consuming loads to extend battery life. With automobiles, power management is more subtle and even more important. More-efficient power conversion techniques are just one of the many options carmakers can consider.

In electric vehicles, reduced power consumption gets benefits similar to the smart phone—longer customer use between charges—but running out of energy has far more severe consequences. In the vast majority of vehicles that rely on fossil fuels for propulsion, vehicle loads impact vehicle fuel consumption and emissions. A rule of thumb[1] estimate indicates reducing a car's power consumption by 10 A reduces CO_2 emissions by about 3.5 g/km. Another rule of thumb[2] shows how the driver's wallet is directly impacted. Fuel economy decreases by 0.1 to 0.2 liters per 100 km by a 100 W increase in average electrical power consumption.

Automakers have significantly improved fuel economy over the past decade, in spite of an average electrical power consumption quadrupling[1] to 3 kW today. According to Strategy Analytics Global Automotive Practice,[3] the electronics control units (ECUs) per vehicle for vehicles of all size continue to increase. Table 1 shows upper and mid-range vehicle data. In today's networked vehicle, these modules all connect to the vehicle's primary Controller Area Network (CAN) either directly or through other networks.

Table 1. ECUs per vehicle (source: Strategy Analytics.)

Vehicle Class	Model Year	
	2013	2018
Upper Max	100	110
Upper Avg	76	80
Mid. Max.	52	60
Mid Avg.	33	38

Reducing Power Consumption

More-efficient LED lighting, motors and power conversion as well as simply turning off unnecessary loads are among the electrical/electronic solutions to reduce power consumption. Addressing the last item shows a radical departure in system thinking that carmakers and their suppliers have pursued. The solution involves selective CAN communications or "partial networking."

The partial networking standard development effort of the SWITCH work group, which stands for Selective Wake-up and Interoperable Transceiver in CAN High Speed, was supported by several semiconductor suppliers and European carmakers. The standard is now at the International Standards Organization (ISO). The draft for the ISO 16845-2,[4] which defines the conformance tests according to the ISO 11898-6[5] for partial networking is still under development. However, semiconductor suppliers have introduced products that provide partial networking capabilities.

As explained in "Partial Networking for CAN bus systems: Any saved gram CO_2/km is essential to meet stricter EU regulations,"[1] an ECU waiting for a CAN communication consumes about 2 W but many are not used as much as 95% of the travel time. Partial networking enables "selective wake-up" and "selective sleep" functionality. The technique is implemented in conjunction with a system basis chip (SBC) that includes low drop out (LDO) voltage regulators and/or a dc-dc converter for powering a microcontroller (MCU) and other system loads.

NXP was the first semiconductor supplier to offer an SBC for partial networking applications. "The UJA1168 is a System Basis Chip combining the power supply of an ECU with a CAN Transceiver, which is able to support enhanced ECU power management through CAN partial networking," says Toni Versluijs, vice president & general manager, PL In Vehicle Networking Business Unit, NXP Semiconductors.

The chip allows the detection of any relevant CAN telegram without the need for complex re-synchronization to CAN traffic. This results in a very fast and reliable reaction time with respect to power management functions (specifically: wake-up on CAN traffic) in ECUs compared to other implementations. The UJA1168 offers a 5-V/100-mA microcontroller supply.

"Not all OEMs can make immediate use of partial networking, since the network and ECU architectures need adjustments and new functional clustering to achieve the maximum benefit," observes Versluijs.

As the first supplier to market, NXP has attracted attention from tier one suppliers and carmakers. "Several automotive tier ones have already designed in and use the NXP UJA1168 for different modules for those OEMs," says Versluijs. This includes the UJA1168TK, a version in a very small leadless package that allows significant board space saving.

Other semiconductor members of the SWITCH work group have also introduced SBCs to implement partial networking. ST Microelectronics L99PM72PXP[6] integrates both high-speed CAN (HS-CAN) and LIN physical layers to support partial networking. The IC includes two 5-V regulators. Fred Rennig, technical marketing engineer for STMicroelectronics notes, "These SBCs provide the power supply for the MCU in the system and via a second LDO the supply for additional sensors." Fig. 1 shows a door application of the SBC with partial networking.

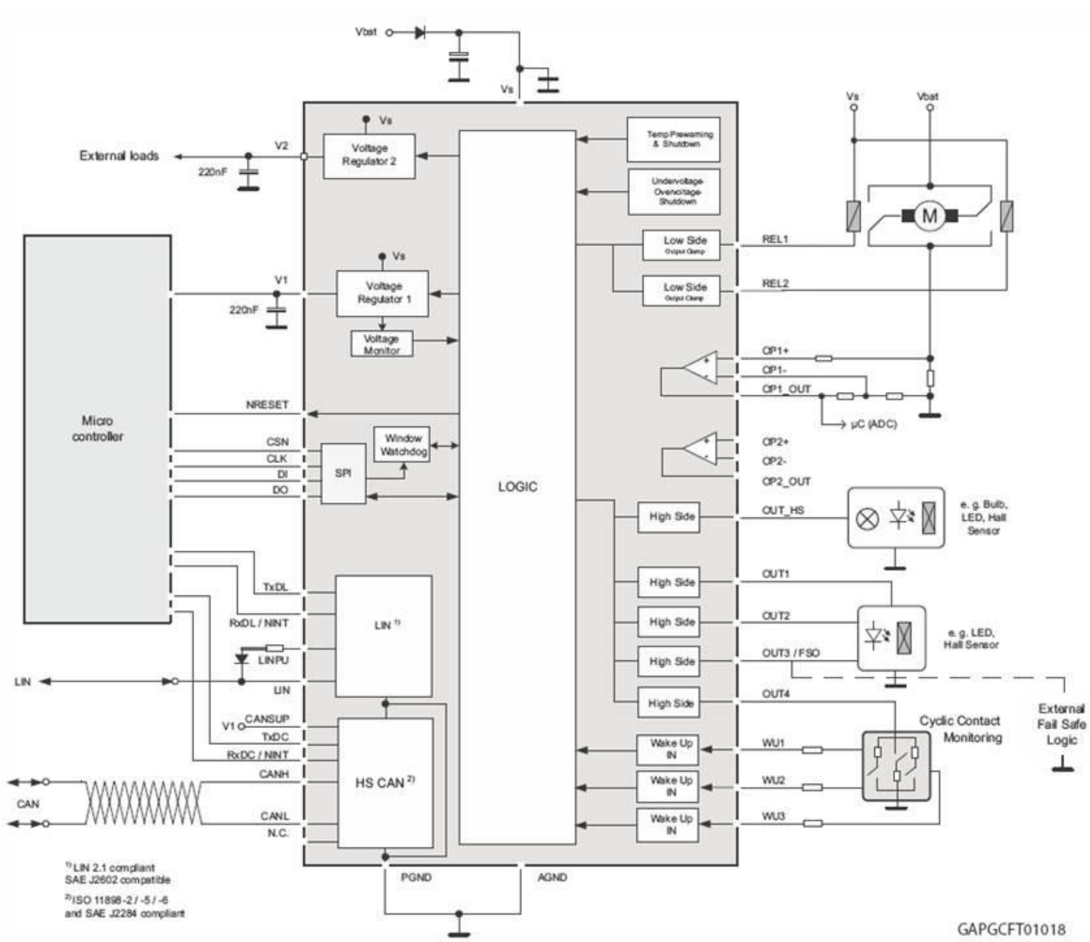

Fig. 1. Voltage Regulator 1 and Voltage Regulator 2 in STMicroelectronics L99PM72PXP are LDOs.

The Elmos E520.13[7] is a high-speed (HS)-CAN transceiver and SBC for partial networking.

An Infineon white paper[8] describes energy savings addressed by its TLE9267 system basis chip.[9] Dan Moore, segment marketing manager at Infineon, points out that one new feature (in addition to the partial networking support) is called cyclic sense. "This is a mode in which the device goes into low quiescent current mode (stop or sleep) and at specified intervals, it checks the wake up inputs for any change of state," says Moore. "If a change is detected, it signals the MCU. Compared to cyclic wake function in earlier devices this results in less frequent system 'power up'."

Body electronics SBCs may follow the lead of other vehicle system's SBCs. David Lopez, Analog Product Line manager for Freescale Semiconductor says, "For current supplies greater than 250 mA, the trend for some carmakers is to replace the LDO with dc-dc solutions to save energy consumption, reduce emissions, and achieve increased fuel economies."

Freescale's solution for functional safety requirements in safety, chassis and powertrain applications is the MC33908 SBC (Fig. 2.) This product has a flexible switch-mode power supply (SMPS) pre-regulator that allows non-inverting buck-boost or standard buck topologies. Higher power requirement systems in body electronics, such as the body control module (BCM), gateways, and some high-end HVACs may switch to dc-dc converters according to Lopez.

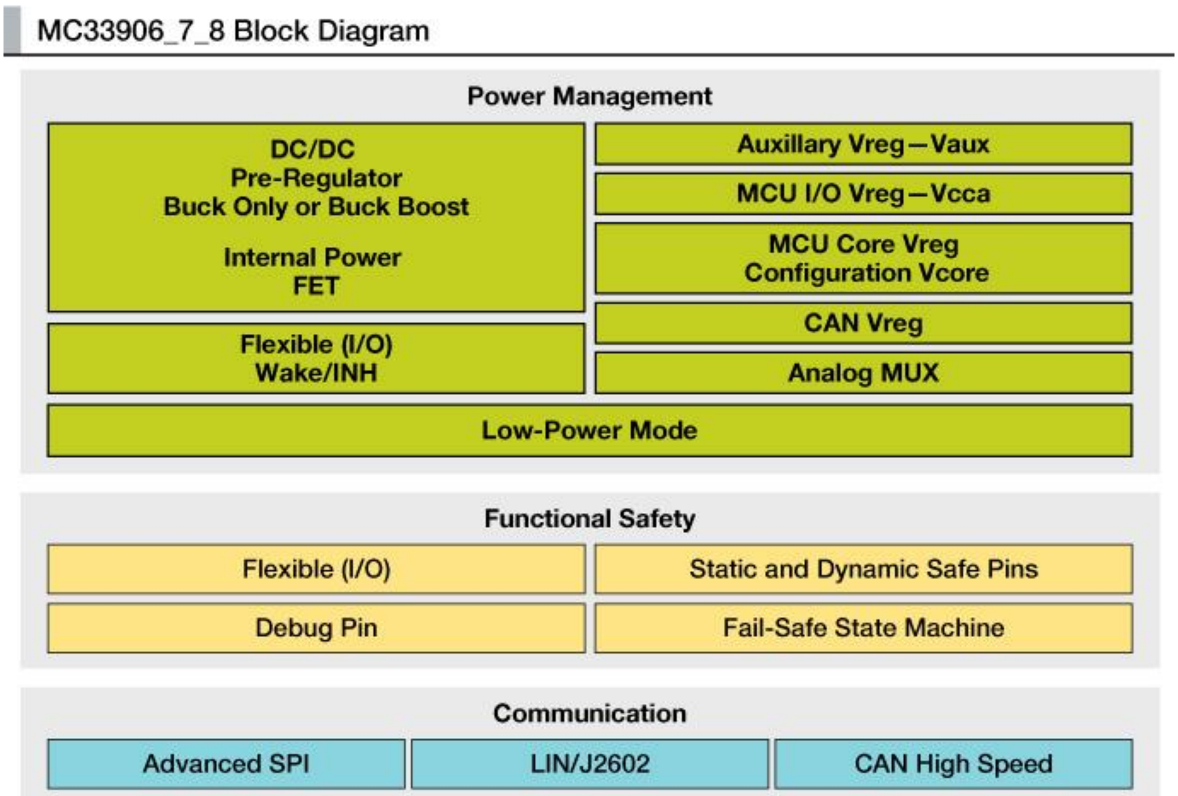

Fig. 2 Freescale's MC33906,-7 and -8 SBC for functional safety applications integrates several power management functions including a dc-dc pre-regulator.

While Audi was the main driver for partial networking, BMW and Volvo also have plans to use this technology implemented in SBCs and Volkswagen may follow Audi. With the power savings that can be realized, other carmakers will undoubtedly take advantage of partial networking and continue to look for other means to reduce power consumption as well.

References

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3. Strategy Analytics Automotive Electronics section.

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5. ISO/DIS 11898-6: Road vehicles-Controller area network (CAN)--Part 6: High-speed medium access unit with selective wake-up functionality.

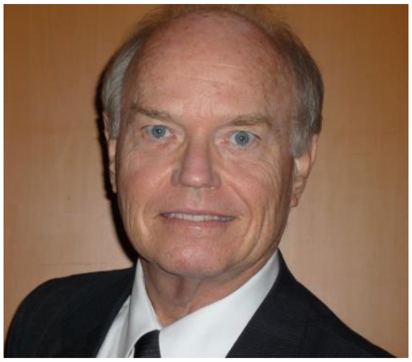
6. L99PM72PXP, Advanced power management system IC with embedded LIN and high speed CAN transceiver supporting CAN Partial Networking, product page.

7. Elmos E520.13 HS-CAN transceiver for partial networking, product page.

8. "Energy Saving in Automotive E/E Architectures" by Thomas Liebetrau, Ursula Kelling, Tobias Otter, and Magnus Hell, Infineon Technologies, December 2012.

9. Infineon's System Basis Chips (SBC) product page.

About The Author



Randy Frank has more than 30 years of industry experience in electronics and semiconductors at companies that include Chrysler, Motorola and International Rectifier, where he was involved with product engineering, marketing and applications. At American Motors, now part of the Chrysler Group LLC, he was responsible for implementing their first electronic engine control systems. Randy was the product manager for SMARTMOS ICs at Motorola, now Freescale Semiconductor, when its first power ICs were introduced. He has written on a variety of topics from power semiconductors and ICs to microcontrollers and digital signal processors. Randy is a Society of Automotive Engineers (SAE) Fellow and an IEEE Fellow. He has an MSEE, MBA and BSEE from Wayne State University in Detroit, MI.