SBC with integrated CAN FD transceiver

Figure 1: SBCs are suitable for different applications including drones, which use increasingly embedded CAN-FD networks (Source: Microchip)

System-base chips (SBC) comprise several electronic components in order to simplify device and electronic control unit (ECU) designs. Some of them feature a CAN-FD physical medium attachment (PMA) implementation.

A CAN-FD SBC is a semiconductor that integrates a CAN-FD transceiver with power-management elements, i.e., an LDO (low-dropout) regulator or a DC/DC (direct current/direct current) converter, or both. These products reduce the number of components and save space on the printed-circuit board (PCB). Usually, energy consumption is also lower. Some CAN-SBCs implement multiple CAN-FD transceivers and additionally LIN (local interconnect network) transceivers. There is also one SBC integrating a CAN-FD stand-alone controller, too.

According to Beatrice Fankem from Texas Instruments (TI) there are three main SBC categories:

- General-purpose SBCs include transceivers (CAN HS/FD and optionally LIN) and an LDO with an output voltage to power other components in the device. This type of SBC could also include a serial peripheral interface (SPI) or pin control for feature configuration from the host controller, a base watchdog timer, and a wake pin.
- Mid-range SBCs integrate enhanced features that further reduce the board footprint. These features include multiple power elements, high-side switches, multiple wake pins, a limp pin and a configurable watchdog timer. Some will have multiple LIN or CAN transceivers or offer the option to expand the bus interface, with support for channel expansion. The power elements could be DC/DC converters with less than 250 mA of output current or LDOs that support up to 250 mA.
- Advanced SBCs offer special functionalities, which vary based on the overall system's needs. For example, an integrated CAN controller and transceivers, also known as SPI-to-CAN FD controller SBCs, enable pairing with microcontrollers that do not have integrated CAN controllers or MCUs (microcontroller units) that need an additional CAN port.

CAN-FD transceivers feature an improved symmetry compared with legacy CAN-HS (high-speed) transceivers. They can achieve higher bit rates than 1 Mbit/s. Usually, CAN-FD transceivers are suitable for bit rates of 2 Mbit/s in multi-drop networks. In point-to-point you can run them up to 5 Mbit/s depending on the symmetry features and used physical-media components such as cables and connectors as well as the topology. If you want to go beyond these limits, you need to apply CAN-SIC (signal improvement capability) transceivers. They can suppress ringing by means of a dynamic impedance adjustment.

Some CAN-FD transceivers integrated in SBCs feature a low-power mode and a selective wake-up function for partial networking. They are used mainly in automotive applications. Some CAN-FD SBCs are suitable for automotive functional safety. They provide some dedicated monitoring functions and protection features.

SBCs are used in automotive applications since several years. However, they can also be applied in industrial battery-powered systems, especially in automated-guided vehicles (AGV) and autonomous mobile ▷

robots (AMR). Typical automotive applications include body control modules, gateways, closure modules (i.e., door, roof, tailgater, and trailer), seat control modules, gear shifts, fuel pumps, HVAC (heating, ventilation, air-conditioning), wireless in-cabin charger, transfer case, NOx sensors, exhaust modules, light control modules, and water pumps. Another application field for CAN-FD SBCs are drones.

Products by Elmos

The CAN-FD SBC by Elmos integrates a DC/DC buck converter or an LDO regulator with a 3,3-V or a 5-V output and load current up to 200 mA. In the LDO version an external NMOS transistor allows to share the power dissipation between external transistor and internal LDO. All supplies are monitored and can signalize a fail event by the SPI interface. System failure can activate a fail-safe output signal for limp home support. The products provide sleep, stop, active, and fail-safe modes. The CAN FD transceiver is qualified for bit rates up to 2 Mbit/s. The SBC is capable to detect local and remote wake-up events, which can be individually enabled via SPI.

Products by Infineon

Infineon's CAN-FD SBC family scales from the Lite SBC to the Multi-CAN Power+ SBC. They reduce the system cost through low-component count and small footprint. The Lite SBC (TLE9461 and TLE9471) measures 8,65 mm x 6 mm; the Mid-Range+ version comes in a 7 mm x 7 mm package. It comes with two (TLE926xB) or four (TLE927xQX) integrated LIN transceivers. The Multi-CAN Power+ (TLE9278B) features up to four CAN transceivers with a switch mode power supply (SMPS) buck regulator. The 5-V or 3,3-V output supplies up to 750 mA. The chip comes in a 7 mm x 7 mm package.

All these SBC products feature optionally a low-power mode with a wake-up functionality. They are specified for bit rates up to 5 Mbit/s. The achievable bit rate depends on other electromechanical components and the chosen network topology. The products enable design flexibility and reduce software design effort through shared state machine and SPI access.

Products by Microchip

Recently, Microchip has introduced the ATA650x family of CAN-FD SBCs, integrating a 5-V LDO regulator. The products come in 8-pin (2 mm x 3 mm), 10-pin (3 mm x 3 mm), or 14-pin (4,5 mm x 3 mm) packages. To further reduce power consumption, the SBCs can disable the microcontroller supply by switching off LDOs during sleep mode. The safety features include fail safe, protection, and diagnostic functions. Designed to withstand electrostatic discharge (ESD) and equipped with electromagnetic compatibility (EMC) performance, the SBCs are suitable to operate in harsh environments. The products are AEC-Q100 qualified with a Grade 0 rating and are designed to operate in temperatures ranging from -40 °C to +150 °C.

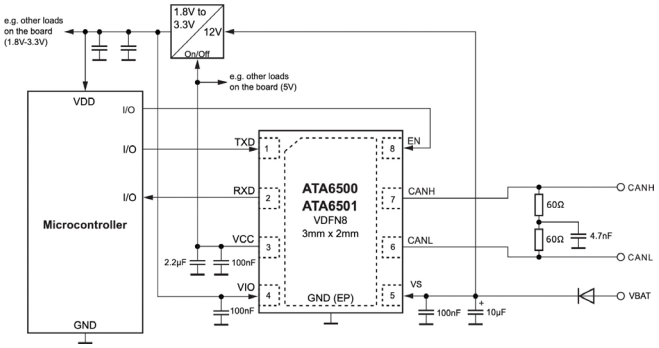

Figure 2: The shown ATA650x chip has a foot print of 3 mm x 2 mm (Source: Microchip)

"Our compact CAN-FD SBC is engineered for space-constrained applications, specifically addressing the critical need for resilience in demanding environments," said Rudy Jaramillo from Microchip. "This highly integrated solution can aid in system-level cost savings by minimizing board space requirements and helping reduce design complexities for our customers." They are available in production quantities.

Products by NXP

The FS6500 and FS4500 families integrate a CAN FD and optional LIN transceivers. The products implement safety features such as monitoring of critical analog parameters, a fail-safe state machine, and an advanced watchdog, reducing software complexity with dual-core lock-step MCUs. Additionally, the SBCs provide five configurable I/O (input/output) lines. The products support low-power functionality. There are multiple options implemented to wake up transceivers, I/O lines, and other functions. In low-power mode, a 3,3-V keep-alive memory supply is available. There is also a long duration timer, counting up to six months with a one-second resolution.

Products by Texas Instruments

The TCAN11623-Q1 general-purpose SBC integrates a CAN FD transceiver, a wake pin, and a 3-V, 70-mA LDO output, while the TCAN11625-Q1 supports a 5-V, 100-mA LDO output. The LDO powers external small loads, while an external component can use the wake pin to wake the node. The TCAN11623-Q1 family has a self-supply capability, thus removing the need for an extra voltage rail to power the SBCs.

The TCAN4550-Q1 advanced SBC combines both a CAN FD stand-alone controller and a CAN FD transceiver in a single package. It includes a local wake pin, a watchdog timer, and a 70-mA LDO output. This chip adds CAN communication to microcontrollers that don't have a CAN interface, and allows for an additional CAN channel. It also bridges the gap from CAN CC to CAN FD. This SBC is connected by means of SPI to the microcontroller. It provides additional features, including V_{IO} with 1,8-V, 3,3-V, and 5-V support, wake and inhibit functions, and a timeout watchdog that can enable processor functionality not normally available. ◀

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