Product Overview

System Basis Chips (SBCs) 101 – Exploration of TI's SBC Portfolio

Introduction

TI's System Basis Chips (SBCs) integrate Controller Area Network (CAN, CAN FD, CAN SIC) or Local Interconnect Network (LIN) Transceivers with power supply components into a single package. SBCs enhance designs with additional integrated features, including a watchdog, high-side switch outputs (HSS), bus fault protection, device diagnostics and CAN or LIN transceiver channel expansion functionality. TI's SBCs are designed to fit a variety of automotive and industrial applications.

SBCs reduce the number of devices in a design by integrating several stand-alone devices into one package. Integrating multiple devices and system functions into one package improves the overall design size, the PCB layout and the system control scheme. TI's SBCs integrate wakeup functionality and low-power modes to reduce the systems power consumption, thus extending the battery life, improving efficiency, and reducing the systems' overall power dissipation.

Firstly, CAN and LIN transceivers are most often found in automotive and industrial applications. Both CAN and LIN are wired bus interfaces that communicate across multidrop nodes using differential signaling (CAN) or single-ended (LIN) cabling. Both transceiver types take information from processor A and convert to a higher voltage signal and then transmit that data on a wired bus where all bus nodes are connected and receive the signal. The receiving transceiver takes the CAN or LIN message, converts to single-ended logic signals, and sends the messages to processor B for interpretation and action.

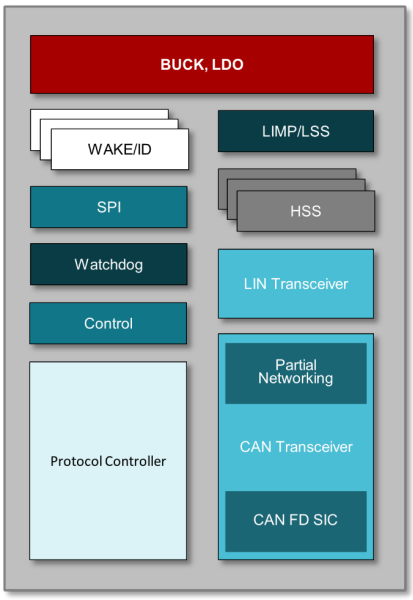

Figure 1. Generic SBC Block Diagram

Stand-alone CAN and LIN transceivers on the market are 5V or 3.3V operational and single function; while SBCs have integrated power supplies that run off 12V batter and self-supply an integrated CAN or LIN transceiver. SBCs also integrate failsafe features (Watchdog, bus fault diagnostics, thermal shutdown) to reduce the design complexity for functionally safe systems. SBCs include bus-fault protection, electrostatic discharge protection, and the functionality to select a Tx/Rx I/O voltage of 1.8V, 3.3V or 5V to interface with microcontrollers that use different I/O voltages.

For automotive and industrial design engineers, the added integration and increased reliability of SBCs enable smaller, lower-cost designs for any system that uses CAN or LIN.

The section below names and defines some of the core SBC Building Blocks.

- The first building block is the system power supply, a feature that all SBCs have integrated. The system supply block can include any number of DC/DC BUCK or LDO voltage regulators to supply the integrated CAN or LIN transceivers and provide multiple output supply rails to the MCU and other devices in the design.
- The next building block is a CAN or LIN transceiver that connects the SBC wired bus interface for communication to other nodes within the bus.
- Next building block is supervision, a block that includes a watchdog or reset pin to interrupt the microcontroller if a hardware malfunction is detected.
- Some SBCs have one or many HSS outputs for driving small loads or used for cyclic sensing wake functionality (sleep). (see Application Note: *Wake Up Methods for CAN SBCs*).
- Next is an integrated controller that takes high-voltage CAN or LIN message formats and converts them into low voltage interfaces such as SPI or I2C to communicate with other devices on the same PCB.
- Finally, the last building block is Channel Expansion, a feature specific to TI SBCs, that allows the designer to use a GPIO pin from the SBC to enable a stand-alone CAN or LIN transceiver on the PCB. This adds more CAN or LIN channels to the design while enabling better sleep and low-power mode configurations in the design. (see Application Note: *Increasing CAN/LIN Channels using Channel Expansion*)

This section reviews some of TI SBCs and highlights the primary benefits and features.

TI's general-purpose SBC TCAN11623-Q1 integrates a CAN FD transceiver, 3.3V LDO (70mA out), and a WAKE pin; while SBC TCAN11625-Q1 integrates a CAN and CAN FD transceiver, 5V LDO (100mA out), and a WAKE pin. The LDO supplies the CAN transceiver while also providing output power to small loads. The WAKE pin is a high-voltage input that is used to wake the SBC from a sleep or low-power mode. The integrated LDO in the TCAN1162x-Q1 SBC devices removes the need for a 5V or 3.3V stand-alone LDO to power a stand-alone CAN transceiver. The TCAN1162x-Q1 SBCs integrate a CAN transceiver and LDO into a one package design.

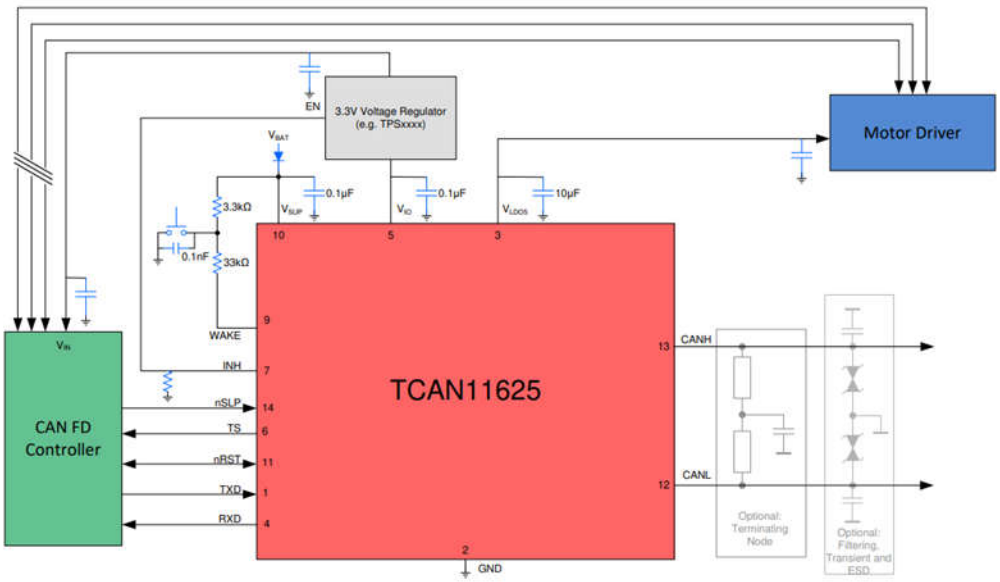

Figure 2. Simplified TCAN11625-Q1 Schematic

The TLIN1431-Q1 mid-range SBC includes a LIN transceiver, a watchdog timer, a high-side switch, a WAKE pin and an LDO (125mA). The TLIN1431-Q1 also supports channel expansion, which gives you the flexibility to expand your system by adding and controlling external LIN or CAN transceivers without having to use another general-purpose input/output from the microcontroller or processor. Figure 3 is a simplified design that uses the TLIN1431-Q1 as the main SBC interfacing with the microcontroller while the TCAN11623-Q1 is connected via channel expansion to add a CAN transceiver (channel) to the design. The channel expansion feature allows the designer to add a stand-alone CAN or LIN or even another SBC into the system design.

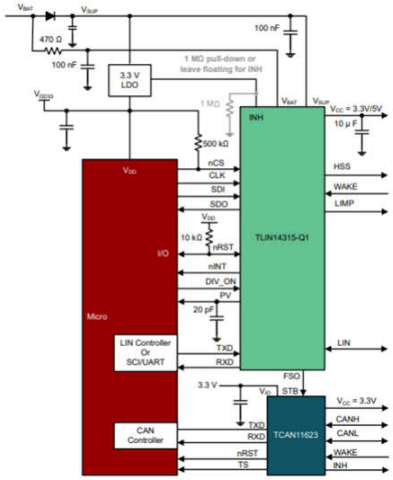

Figure 3. Simplified TLIN1431-Q1 Schematic with Channel Expansion to the TCAN11623-Q1

The TCAN2451-Q1 mid-range SBC includes a CAN transceiver that supports CAN FD, CAN SIC and Partial Networking, a DC/DC BUCK regulator (1A), an LDO (200mA), a Watchdog, 4 WAKE pins and 4 high-side switches (100mA each). TCAN2451-Q1 connects to the processor or microcontroller via SPI and has an integrated EEPROM to store device specific configurations. This mid-range SBC device provides the designer with more output current than the general-purpose SBCs. The increased output is used to power larger processors, sensors, or other devices in the system that require more power than what the general-purpose SBCs can support. TCAN2451-Q1 integrates Partial Networking and 4 WAKE pins to support several system wake-up methods. This device also has 4 high-side switch outputs for driving small loads or configuring cyclic sensing wake functionality.

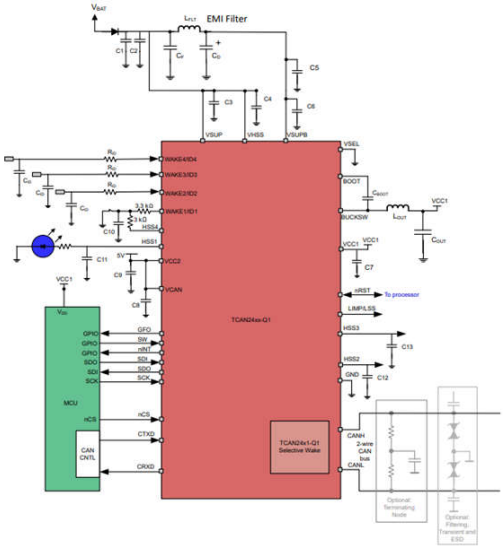

Figure 4. Simplified TCAN2451-Q1 Schematic

Another one of TI's mid-range SBCs is TCAN2857-Q1. This device integrates a CAN transceiver that supports CAN FD, CAN SIC and Partial Networking as well as a LIN transceiver. Having both CAN and LIN integrated allows the designer to connect one processor or microcontroller to one SBC to communicate on both the CAN and LIN bus. TCAN2857-Q1 has 3 integrated LDOs (350mA external PNP, 250mA and 200mA) for system power rails. TCAN2857-Q1 also has a Watchdog, 3 WAKE pins and 4 high-side switches (100mA each) and an integrated EEPROM to store device specific configurations. System designers can use this SBC to future proof designs to support both the CAN and LIN bus communication with 3 power rails and control logic to plan for simple to complex designs using one SBC.

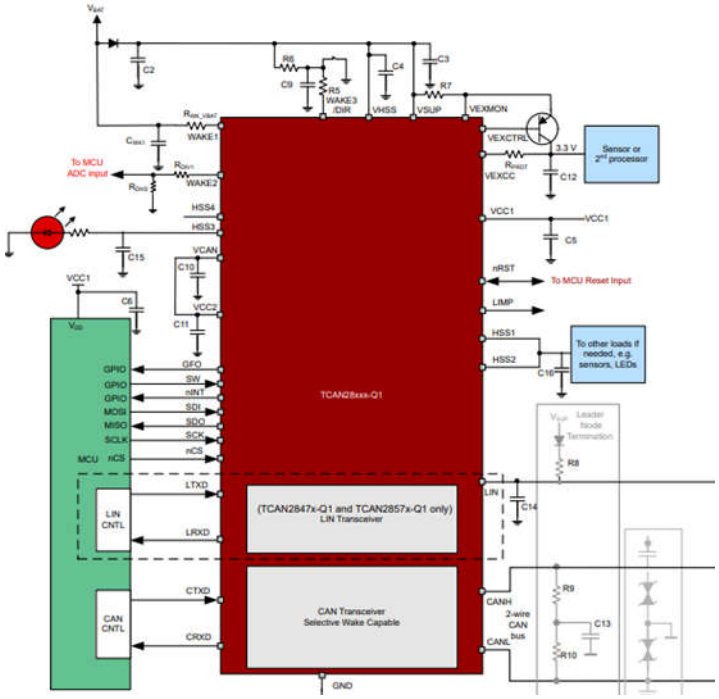

Figure 5. Simplified TCAN2857-Q1 Schematic

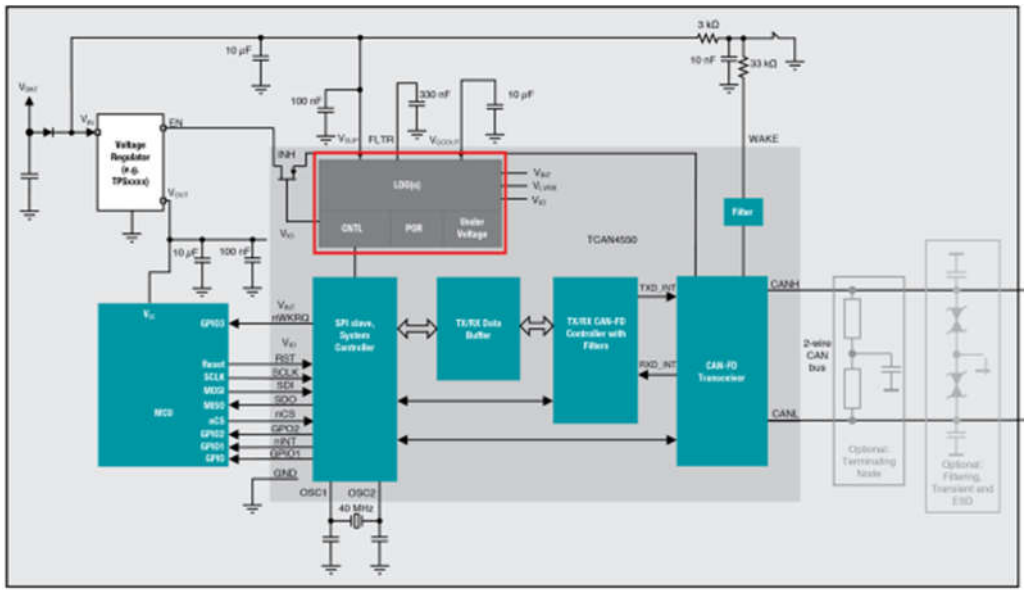

Figure 6. TCAN4550-Q1 Block Diagram: Processor Connections and Integrated LDO

The TCAN4550-Q1 advanced SBC combines both a CAN FD controller and a CAN FD transceiver into a single package. The TCAN4550-Q1 includes a local WAKE pin, a watchdog timer and an LDO (70mA) output. The TCAN4550-Q1 enables CAN communication to any processor or microcontroller that does not have an integrated CAN controller or adds an additional CAN channel for any processor or microcontroller that has used up all available CAN communication channels. TCAN4550-Q1 also allows designers to upgrade a system that only supports classical CAN to CAN FD by leveraging the CAN FD Controller in TCAN4550-Q1. Figure 6 shows a basic block diagram of the TCAN4550-Q1 and the connection to a host processor through SPI.

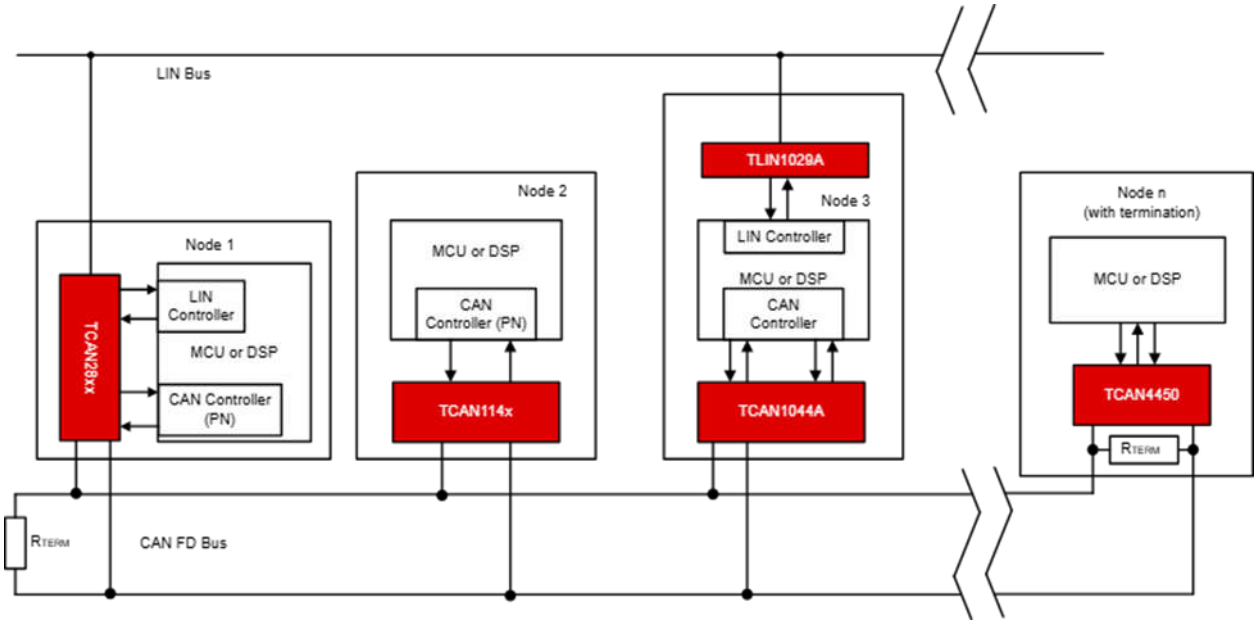

Figure 7. Simplified CAN and LIN Bus Schematic Using SBCs and Stand-Alone CAN/LIN Transceivers

Conclusion

SBCs are great for platform designs that share common power and communication requirements. A simple SBC + MCU platform design can meet the communication and power requirements for several automotive and industrial applications. Wherever bus communication (CAN or LIN) and power management are required, SBCs are a fitting and scalable design. SBC devices fit the requirements for a wide range of automotive and industrial applications. Designers can configure an individual SBC or select a family of SBCs to develop a scalable platform approach that meets the needs of multiple applications and systems.

TI has specifically designed the SBC portfolio to optimize board space, system cost, and feature integration. TI's SBCs allow designers to meet several system and power requirements by using a single SBC device or a family of SBC devices for software and hardware footprint compatibility. TI's SBC devices are highly integrated with transceivers (CAN or LIN), power outputs, and system features (Watchdog, WAKE, HSS) to support a multitude of system design requirements.

TI's SBC investments are based on market and application needs, are influenced by the latest CAN and LIN ISO standards, and are designed to meet the needs of an ever-changing environment.

Additional Considerations

- TI SBCs Selection Guide: "Featured System Basis Chips (SBCs)"
- Application Report: "Understanding LDO Performance in the TCAN4550-Q1"
- Application Note: "Wake Up Methods for CAN SBCs"
- Application Note: "Increasing CAN/LIN Channels using Channel Expansion"
- Technical Article: "Explore the Non-Speed-Related Benefits of CAN FD"
- Video Series: "CAN, LIN, & SBC Overview Videos"

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