Frequently Asked Questions

Product Name: System Basis Chips (SBCs)
Date: April 2013
Application: Automotive ECUs
Datasheet: www.infineon.com/SBC
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Note: The following information is given as a hint for the implementation of the device only and shall not be regarded as a description or warranty of a certain functionality, condition or quality of the device.

General SBC Topics

Question 1:	What features are included in a System Basis Chip (SBC) and what are the benefits vs. a discrete implementation?
Answer:	The features implemented in a System Basis Chip are: - Voltage regulators (LDO and/or SMPS) - Integrated State Machine including Power Saving Modes - HS-CAN transceivers compliant to ISO 11898-1/-5/-6 - LIN Transceivers (J2602-2 and LIN2.2 – compatible with LIN1.3) - Reset, Interrupt and Watchdog (Standard/Window) - Fail Safe Outputs (FSO) also known as Limp Home Outputs - Fail Safe Input (FSI) - High voltage Wake-Up Inputs - High-Side/Low-Side Drivers - Multiple and configurable wake sources - Voltage Monitoring - General Purpose Input Outputs (GPIOs) - 16-bit Serial Peripheral Interface (SPI)
Question 2:	What is the trend in the SBC market?
Answer:	Many comfort and safety features that were in the past offered/requested only on high end cars are becoming more and more standard also for low and mid end cars. This result in a constant increase of the electronic content in the cars and, therefore, of the current consumption. At the same time there is and increased pressure on CO2 reduction, through solution to reduce the current consumption in parking and driving mode, and on standardization, reduction of components, and simplification of the electronic development. SBC supports these main trends offering: - integrated features like efficient power supplies (linear or DC/DC) - power saving modes & CAN Partial Networking (CAN FD Tolerant) - integrated safety relevant / diagnostic features - pin-to-pin and software compatible family product concepts **to reduce software and hardware development efforts and for easy scalability, i.e. optimum system costs**
Question 3:	What level of quiescent current can be achieved with an SBC and what can be the overall ECU quiescent current consumption in low-power mode?
Answer:	SBCs have different operating mode: - SBC Normal Mode: all the blocks/features are fully functional - Power Saving Modes: - SBC Stop Mode: First level current saving mode

	- SBC Sleep Mode: Second level and highest current saving mode - SBC Restart and Fail-Safe Mode: Ensuring defined software initialization and safe ECU state The quiescent current of the SBC with activated wake sources is typ. 60uA or lower in SBC Stop Mode and typ. 30uA in Sleep mode. These very low power operating modes allow to achieve overall ECU current consumption below 100uA (considering microcontrollers, transceivers and additional components in power saving mode).
Question 4:	What fail-safe/diagnostic features are implemented in an SBC?
Answer:	SBCs include the following diagnostic and fail-safe functionalities: - Fail-Safe Outputs to activate/drive directly loads when a malfunction is detected - Fail-Safe Input to monitoring the functionality of the µC - Standard/Window Watchdog to monitoring the functionality of the µC - Under- and Over-Voltage Monitoring to prevent malfunctions or damage of the µC - Over-Temperature Monitoring to early detect potential malfunctions and prevent thermal shutdown - SPI read register command to verify the correct configuration of the device and monitoring the integrity of the SPI registers - Fail-Safe operating modes to react to severe malfunctions of the ECU SBCs have up to three Fail Outputs (also called Limp-Home Outputs) to activate/drive directly loads when a malfunction is detected. An example of the usage of such an output is in Door Control Units or in the Body Control Module (BCU/BCM). If a malfunction is detected and the integrity of safe operation is not any longer guarantee, the SBC will go in Fail-Safe operating mode and will activate e.g. the front and rear lights to assure the minimum required lighting in emergency conditions. Similar concept can be applied also to other applications like front/rear wiper or window lift.
Question 5:	Are the transceivers cells (CAN & LIN) in the SBC certified and released according to the standard OEM requirements?
Answer:	Yes, Conformance Tests are performed for all transceiver cells within the product family at the company C&S release and EMC/ESD certification is performed at the IBEE institute. In addition certification for the US market is planned with the ULab institute as well as at Velio in Japan according to Toyota requirements. Device releases are initiated at all major OEMs after the devices have been qualified at Infineon Technologies.
Question 6:	Is the CAN Selective Wake or CAN Partial Networking feature implemented in the SBCs according to ISO 11898-6 standard?
Answer:	CAN partial networking is one of the features that target the reduction of the current consumption in driving mode and thus the reduction of the CO_2 emissions. The new generation of Infineon SBCs integrates this feature offering the backward compatibility with the CAN transceiver without partial networking.
Question 7:	How is the communication between microcontroller and SBC realized?
Answer:	A 16-bit SPI – standardized for Infineon SBCs - is used as communication interface between microcontroller and SBC. Through SPI, microcontroller can configure all SBC functionalities, perform diagnosis activities, i.e. check the status of the single modules inside the SBC (diagnostic), clear warning/error bits, etc. Certain critical functions, e.g. Software Development Mode access (= disabling of watchdog

	for debugging purposes) or Fail-Safe behavior are hardware configured (defined voltage levels) at device power up.
Question 8:	What kinds of wake sources are available within an SBC?
Answer:	SBCs offer several standard and fully configurable wake sources: - LIN wake, if LIN transceiver is available - CAN wake, if CAN transceiver is available - Wake Inputs (incl. GPIOs if available) - Timer wakes Wake events are signaled via the INT pin in SBC Normal and Stop Mode and via a device wake-up (VCC1 ramping) in SBC Sleep Mode.
Question 9:	What VCC1 output voltage variants available?
Answer:	In automotive application, 5V is still the most used supply voltage for many devices. Nevertheless. 3.3V is becoming more and more popular, especially in the Automotive power train and safety applications. The new generation of Infineon SBCs (TLE926xQX, TLE927xQX) offers the possibility to choose product variants with 5V or 3.3V as output voltage.
Question 10:	What is the current capability of the power supplies in a SBC?
Answer:	It depends on the product and on the configuration: - Mid-Range and Drive SBC families (TLE926xQX) integrate a linear voltage regulators with maximum of 250mA output current (VCC1) and a linear voltage regulator with maximum 100mA (VCC2). Some product variants also incorporate a third voltage regulator (VCC3) with external power stage. Combining the internal linear voltage regulator VCC1 with the external power stage on VCC3, it is possible to have up to 400mA output current. A power calculation must be done taking into account the power dissipation (input/output voltage, cooling area and thermal resistance). - For high current applications it is recommended to use the DCDC regulator SBC (TLE927xQX). DCDC regulator offers a considerably higher efficiency and lower power dissipation. Therefore the usage is also recommended in all automotive applications operating at high ambient temperature (Ta>85°C). Using a buck-boost DCDC converter, is possible to guarantee the fully functioning also at a very low battery voltage (Vs<5.5V), e.g. for cranking and start-stop operation.
Question 11:	When and how is possible to disable the Fail Safe or Limp Home Outputs?
Answer:	The Limp Home Outputs can only be disabled via SPI (on TLE826x(-2)E by clearing the LH bit and on TLE926xQX/TLE927xQX by clearing the FO_ON and FAILURE bit) and after a successful watchdog trigger.
Question 12:	What is the power source for CAN and LIN when the transceivers are in wake capable mode and the SBC is in Sleep Mode?
Answer:	When the SBC is in Sleep Mode and the transceiver is in wake capable mode, only the wake receiver is active and it is supplied by VS. In these conditions the CAN and/or LIN cell is completely disabled to achieve maximum current saving. Therefore, no separate 5V supply for VCAN/VCCHSCAN is required
Question 13:	Is the CAN transceiver in TLE826x(-2)E/TLE926xQX/TLE927xQX supplied internally for

	example by VCC2?
Answer:	To allow the maximum flexibility during the ECU hardware and software development, the CAN transceiver is not connected internally to the built-in voltage regulators. The supply for the CAN transceiver needs to be connected to the Pin VCCHSCAN/VCAN (except in wake capable mode where the wake receiver is supplied internally via VS). The customer can choose if supply the CAN transceiver with VCC2, VCC1, VCC3 or an external supply. If CAN is supplied via VCC2 or VCC3, this voltage regulator, after power-up, must be activated via SPI.
Question 14:	How is possible to configure the SBC into Sleep Mode with CAN wake capable after CAN wake-up (standard CAN wake – no partial networking)?
Answer:	After a SBC wake-up due to a wake from the CAN bus, the CAN transceiver is in a woken state with following signalization: - RXD pin is set to LOW - CAN Transceiver mode will show wake capable ('01') but it actually is in the woken state, i.e. it must be rearmed prior to be wake capable again - The CAN wake-up bit is set To re-arm the CAN transceiver for wake capability again, following steps must be performed: - Clear the wake status register - Toggle the CAN Mode to either to OFF or Normal Mode - Set the CAN to wake capable Mode again - Enter SBC Sleep Mode
Question 15:	What is the minimum distance between 2 SPI commands on TLE7263E, TLE826x(-2)E, TLE926xQX and TLE927xQX?
Answer:	It is mandatory to ensure a min. High Time of CSN between two consecutive SPI commands to allow the SBC to execute the commands properly. The min. CSN high times are: - TLE7263E: 15us - TLE826x(-2)E: 10us - TLE926xQX/TLE927xQX: 3us
Question 16:	Is it possible to test quickly the watchdog in the application without waiting until the watchdog counter has an overflow and the reset is pulled (min. 10ms)?
Answer:	The watchdog can be tested quickly by simply sending to consecutive watchdog triggers via SPI. The first trigger is causing the start of a new watchdog window. The second trigger causes a trigger in the "closed window", which is not allowed and will generate a watchdog reset.
Question 17:	What happens if the CAN is set to wake capable mode and there is traffic on the CAN bus?
Answer:	The CAN will wake up immediately when a wake-up pattern (min. dominant wake-up time) is detected and the transceiver will go in a woken state. The (wake) interrupt bit for CAN wake will be set and an interrupt will be generated. Now the CAN is woken up and RXDCAN is LOW. In order to wake up again via CAN, the transceiver mode needs to be toggled (e.g. switched to CAN normal mode, or OFF, or Receive Only mode) and then back to wake capable. Interrupt bit must be cleared before going to Sleep Mode.
Question 18:	Is a pull-up resistor needed on the RxD pins of a LIN / CAN transceiver on an SBC?

Answer:	No pull-up resistor is required externally because the RXD pin has an integrated push-pull driver. An external pull-up resistor might be required for some stand-alone transceivers because they only have an open drain output stage.
Question 19:	Is it possible to use the LIN transceiver alternatively for a PWM point to point communication?
Answer:	It is possible to use the LIN transceiver for a communication to an actuator via an e.g. 10kHz PWM communication, which is not conform to the LIN protocol. Following topics need to be considered: - The communication is limited by the LIN slew rate control for 19.2kBaud and 10.4kBaud respectively (depending on the configuration). - The lowest frequency is determined by the LIN_TXD time-out period, as described in the datasheet. - It is important to note that the actuator must have the same voltage level on the LIN bus to ensure a proper communication.

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