Stand-by transceiver with fail-safe features

Atmel has launched a series of high-speed transceiver chips for CAN FD networks, which optionally provide low-power capability. The fail-safe features include over-temperature protection.

The AEC-Q100-qualified ATA6560 and ATA6561 transceiver chips are suitable for bit-rates up to 5 Mbit/s. The ATA6561 offers a direct interface to MCUs with 3-V to 5-V supply voltages. Various operating modes together with dedicated fail-safe features make the chips suitable for next generation in-vehicle networks, especially for CAN FD nodes requiring a low-power mode. The products are available in SO8 and DFN8 packages with wettable flanks for automated optical solder inspection. The specified temperature range is -40 °C to +150 °C. “Our new family of CAN transceivers enables our OEMs to bring improved connectivity with higher speed in their automobile with overall lower power,” explained Claus Mochel, Atmel Marketing Director for Automotive High Voltage Products. “We are continuing to expand our automotive product portfolio to give our customers the right mix of products to help shorten their design cycle and bring next-generation designs faster to market.”

Operating modes include an unpowered mode

Both transceivers support a normal, a stand-by, and an unpowered mode. The ATA6560 additionally provides a silent mode. In the unpowered mode, the chips are completely disengaged. In the normal mode, the driver stage is active and drives data from the TXD input to the CAN bus lines. The high-speed comparator (HSC) converts the analog data on the bus lines into digital data, which is output to the RXD pin. The bus biasing is set to VCC/2 and the under-voltage monitoring of the power supply is active. The slope of the output signals is controlled and optimized in such a way that it leads to a low electromagnetic emission.

In the stand-by mode, the transceiver cannot transmit or correctly receive data via the CAN bus lines. The transmitter and the HSC are switched off in order to reduce power consumption and only the low-power wake-up comparator (WUC) monitors the bus lines for a valid wake-up signal. A signal change on the bus from recessive to dominant followed by a dominant state longer than twake switches the RXD pin to low in order to signal a wake-up request to the connected micro-controller. In the stand-by mode, the bus lines are biased to ground, in order to reduce the current consumption to a minimum. When the transceiver signals a wake-up request to the micro-controller, a transition to normal mode is not triggered until the micro-controller sets the related signal. A bus dominant time-out timer prevents the transceiver from generating a permanent wake-up request. The ATA6560 additionally causes a quiescent current from VIO to GND by means of an internal pull-up resistor when the silent mode is activated.

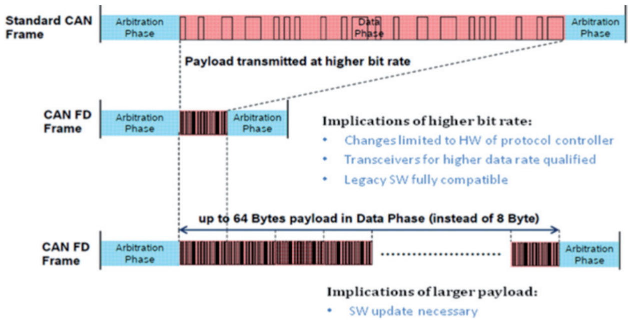

Figure 1: Operating modes of the ATA656X series (Source: Bosch)

The silent mode, only available on the ATA6560, can be used to test the connection of the bus medium, for example. In this mode the transceiver can still receive data, but the transmitter is disabled. The bus pins are released to a recessive state. All other transceiver functions, including the HSC, continue to operate as they do in normal mode. The silent mode can also be used to prevent a faulty CAN controller from disrupting the entire network communication.

Fail-safe features include under-voltage detection

The transceivers feature several fail-safe functions, in order to improve the robustness of the communication. This includes the TXD dominant time-out function. The related timer is started when the TXD pin is set to low. If the low state persists for longer than 0,8 ms, the transmitter is disabled, releasing the bus lines to recessive state. This function prevents the bus lines from being permanently driven to dominant state. The timer is reset when the TXD pin is set to high.

Pull-up resistors for the TXD, STBY, and NSIL pins ensure a safe, defined state in case the pins are left floating. Pull-up currents flow in these pins in all states, meaning all pins should be in high state during stand-by mode to minimize power consumption. If VCC and VIO drop below the under-voltage level, the transceiver switches off. The low-power WUC is only switched off during under-voltage. In stand-by mode, the wake-up time-out timer is started when the bus changes from the recessive to the dominant state. If the dominant state persists for a specified time (see above), the RXD pin is switched to high. This prevents a permanent clamping to dominant state, due to a short-circuit or a failure in one of the other nodes, which would cause a permanent wake-up request. The bus wake-up time-out timer is reset when the bus changes from dominant to recessive state. ▷

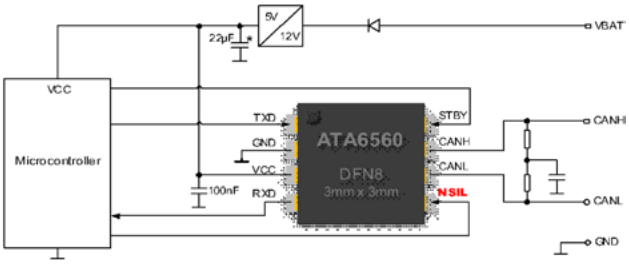

Figure 2: Typical application circuitry using the ATA6560 (Source: Atmel)

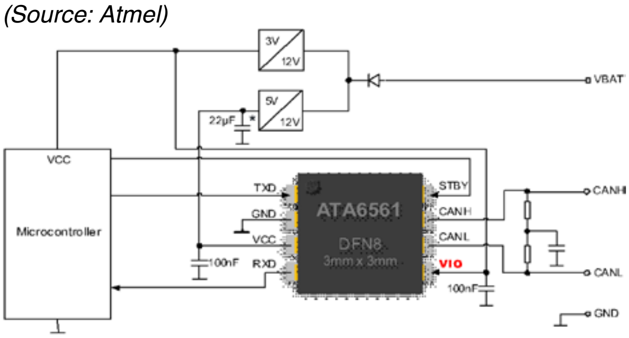

Figure 3: Typical application circuitry using the ATA6561 (Source: Atmel)

The output drivers are protected against over-temperature conditions. If the junction temperature exceeds the specified shutdown value (150 °C), the output drivers are disabled until the junction temperature drops and the TXD pin is at a high level again. The TXD condition ensures that output driver oscillations due to temperature drifts are avoided. Additionally, a short-circuit protection of the bus pins against GND and positive supply voltages is provided. A current-limiting circuit protects the transceiver from damage. If the transceiver heats up due to a continuous short between the bus-lines, the internal over-temperature protection switches the transmitter off.

The RXD recessive clamping function prevents the transceiver from sending data on the bus if its RXD line is clamped to high. If the RXD pin cannot signalize a dominant bus condition (because it was shorted to VCC) the transmitter is disabled to avoid possible data collisions on the bus. In normal and silent mode, the chips permanently compare the state of the HSC with the state of the RXD pin. If the HSC indicates a dominant state for more than 90 ns without the RXD pin doing the same, a recessive clamping situation is detected and the transceiver is forced into silent mode. This mode is released by either entering stand-by or unpowered mode or if the RXD pin shows a dominant level again.

Following transceivers will support partial networking

Atmel considers supporting partial networking as defined in ISO 11898-6 in future transceiver products. With this feature it will be possible to wake up CAN nodes individually. Transceivers with this selective wake-up capability need to partly implement the CAN protocol. A conformance test plan is being internationally standardized for partial networking transceivers (ISO 16845-6). The ISO standards for CAN high-speed transceivers (ISO 11898-2, ISO 11898-5, and ISO 11898-6) are currently under review and will be merged into one single document. *Holger Zeltwanger*