

For motor control applications

MCSXTE2BK142 Motor Control Development Board

NXP developed the MCSXTE2BK142 to provide users with a hardware platform for motor control quick prototype verification. Motor control is one of the key applications for the general-purpose automotive MCU S32K14x, and FOC is the most popular algorithm for PMSM/BLDC motor control.

KEY FEATURES

Based on NXP's S32K142 high-performance automotive-grade MCU and GD3000 gate pre-driver, the MCSXTE2BK142:

- ▶ Supports a 24 V power supply system with up to 800 W automotive BLDC/PMSM motor control system
- ▶ Is able to drive multiple types of automotive motors and tune those motors directly
- ▶ Contains a PMSM FOC based on NXP S32K142+GD3000+CAN PHY+LIN PHY
- ▶ Dual shunt and triple shunt current sample solution are implemented
- ▶ Supports multiple diagnose and protection covering UV, OV, OT, OC, short, stall detection, etc.
- ▶ Supports speed/control commands from LIN/CAN/PWM

HARDWARE SYSTEM

The MCSXTE2BK142 is designed to deliver a motor control hardware solution to support 24 V automotive systems which can be used for multiple applications, such as a cooling fan, oil pump, water pump and blower. It's an out-of-the-box evaluation board for customers in the automotive motor control market.

SET-UP AND FUNCTIONS

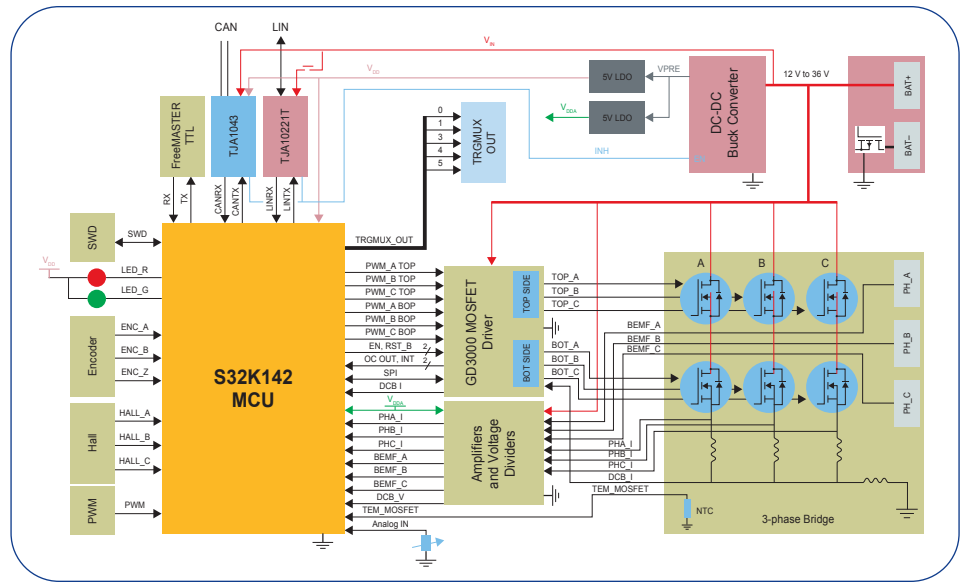
1. The 12-36 V VBAT input connects to a reverse battery protection circuit and gets output of VIN before the DC-DC converter converts that input to 7 V VPRE and we get 5 V VDD output through 2 LDO regulators.
2. The VIN directly connects to a 3-phase MOSFET high-side power stage and GD3000 pre-driver to provide power for motor control.
3. S32K142 MCU and the TJA1043 CAN transceiver use the VDD. For debug purposes, a SWD debug port is reserved for program download and debug, a TTL UART communication interface is provided for FreeMASTER/MCAT communication and a 5-pin connector is routed with TRIGMUX signal for FOC trigger monitor. Beside it are a hall sensor and an encoder interface designed for sensor-based FOC motor control, a signal conditional and PGA circuit to sample the 3-phase current and back-electromotive force for sensorless FOC.
4. One CAN bus and one LIN bus as well as a high-voltage PWM input interface are designed for external connectivity extension, such as user motor control (rotation direction, speed) command input and motor diagnostic information feedback.



The main devices used in the MCSXTE2BK142 are:

- ▶ S32K142 MCU: the main microcontroller with an Arm® Cortex®-M4F high-performance CPU core, 16 region MPU, 16-channel eDMA, 32 KB SRAM and 256 KB P-Flash as well as 4 KB emulated EEPROM all with ECC, 4 x 16-bit FlexTimer, PDB, TRIGMUX and 2 x 12-bit SAR ADC for motor control application
- ▶ GD3000: Three-phase field effect transistor pre-driver
- ▶ TJA1043: High-speed CAN transceiver
- ▶ TJA1021T: LIN transceiver
- ▶ N-channel TrenchMOS standard-level FET
- ▶ LDO Regulator, 300 mA, High PSRR, with 3 on/off control
- ▶ 3.5 – 60 V, 500 mA synchronous step-down voltage converter

THE HARDWARE BLOCK DIAGRAM



SOFTWARE ARCHITECTURE OVERVIEW

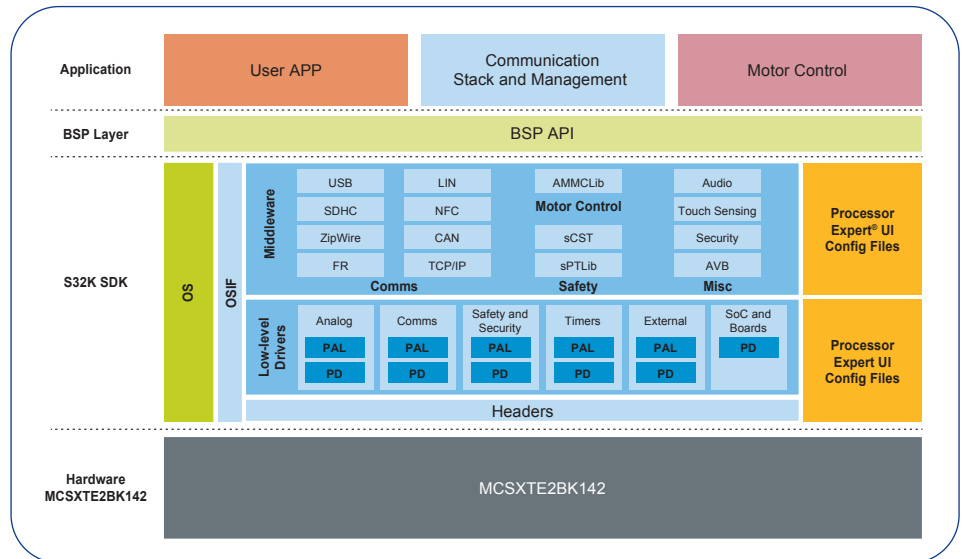
The motor control software package is developed on NXP's S32K1xx SDK RTM3.0.0 and AMMCLIB 1.1.15. In order to accelerate user application software development, it offers a BSP layer to provide API of all onboard modules. In the application layer, apart from the motor control, users can add their own application software and communication management stack.

The software package of the MCSXTE2BK142 is available to enable users to evaluate the S32K142 based motor control performance out-of-box and build their own motor control product prototype as a general motor control hardware platform.

The software package has the following features:

- ▶ Out-of-box motor control and tuning via FreeMASTER MCAT

THE SOFTWARE ARCHITECTURE



- ▶ Supports sensorless FOC PMSM/BLDC motor control
- ▶ Supports hall sensor based FOC PMSM/BLDC motor control
- ▶ Supports rich motor control diagnosis and protection: OV, UV, OC, OT, etc.
- ▶ Implements advanced motor control algorithm—like field weakening (FW) and stall detection
- ▶ Support dual-shunt and tri-shunt phase current sample
- ▶ Integrate BSP layer API of CAN, LIN and PWM communication for motor control
- ▶ Provide S32DS IDE project and makefile project to support multi-toolchain—GHS, IAR and GCC and multi-debugger—Lauterbach, U-Multilink and J-LINK debugger

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