

Quick Start Guide

MCSXTE2BK142 Motor Control Development Board

32K scalable family of AEC-Q100 qualified 32-bit Arm® Cortex®-M4F and Cortex-M0+ based MCUs targeted for general-purpose automotive and high-reliability industrial applications



GET TO KNOW THE MCSXTE2BK142 MOTOR CONTROL DEVELOPMENT BOARD

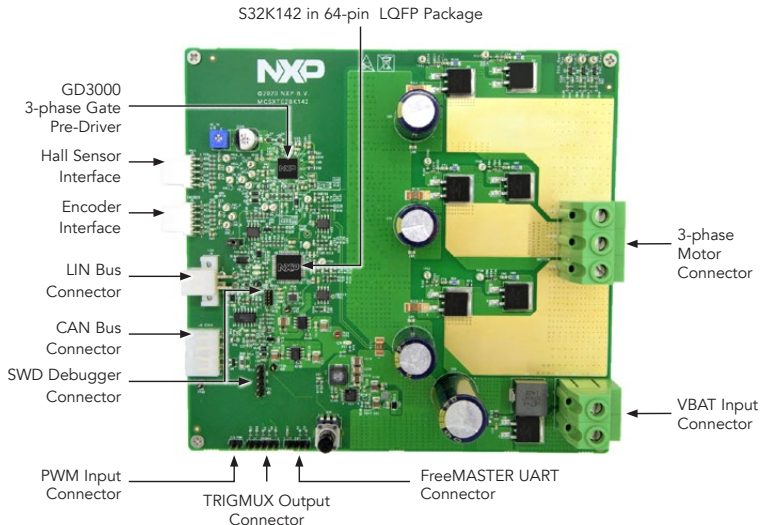


Figure 1: MCSXTE2BK142 connectors

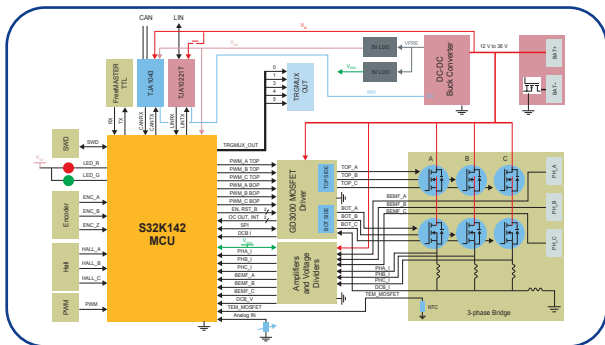


Figure 2: MCSXTE2BK142 system block diagram

THE MCSXTE2BK142 HARDWARE SYSTEM

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 the 3-phase MOSFET high-side power stage and GD3000 pre-driver to provide power for motor control.
3. S32K142 MCU and the J1A1043 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 there 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.

MCSXTE2BK142 FEATURES

- Supports 24 V power supply system with up to 800 W automotive BLDC/PMSM motor control system
- Able to drive multiple types of automotive motors and tune those motors directly
- PMSM FOC based on NXP S32K142+GD3000+CAN PHY+LIN PHY
- Dual shunt and triple shunt current sample solutions are implemented
- Supports multiple diagnose and protection covering UV, OV, OT, OC, short, stall detection, etc.
- Supports speed/control commands from LIN/CAN/PWM
- Out-of-box motor control and tuning via FreeMASTER MCA
- Supports sensorless FOC PMSM/BLDC motor control
- Supports hall/encoder sensor based FOC PMSM/BLDC motor control
- Implements advanced motor control algorithm—like field weakening (FW) and stall detection
- Provides S32DS IDE project and makefile project to support multi-toolchain—**GHS**, **IAR** and **GCC** and multi-debugger—**Lauterbach**, **U-Multilink** and **J-LINK** debugger

STEP-BY-STEP INSTRUCTIONS

All documents (Fact Sheet, Quick Start Guide, Software User Manual, Hardware User Manual) of MCSXTE2BK142 are available on: nxp.com/MCSXTE2BK142. Before starting, download and install the following **software**:

- **S32 Design Studio for Arm® 2018.R1**
- **FreeMASTER 2.5 or newer**

STEP-BY-STEP INSTRUCTIONS CONTINUED

1 Download Software



Download installation software and documentation at nxp.com/MCSXTE2BK142.

2 Connect Your PMSM Motor

Connect your PMSM motor with the MCSXTE2BK142 via **J11**. Connect your hall sensor or encoder with **J5** and **J6** if your motor has and wants to assess the sensor FOC motor control.

3 Connect Debugger and Power on the Board

Connect debugger (PEMicro U-Multilink/J-LINK) with the board via **J4/J3**, provide 12V/24V DC power supply to board, then **D13** green LED will be on.

4 Import and Build the Demo

Import the selected demo project from the **NXP\MC_DevKits\MCSXTE2BK142\sw** folder into S32DS for Arm® IDE, clean and build the project. You can also use other toolchains, such as IAR, GHS to compile the project via makefile, for details please refer to the software user guide.

STEP-BY-STEP INSTRUCTIONS CONTINUED

5 Download and Debug the Project

Launch the debug target in debug configuration according the actual debugger you are using, download the compile result into the board and enjoy the debug.

6 Tuning your Motor via MCAT

Using a USB-to-UART converter to connect the board with your laptop via **J2**, open the MCAT — **S32K_PMSM_Sensorless.pmp** under sub-folder — **FreeMASTER_control** with **FreeMASTER**, connect to start tuning your motor.

S32K142 I/O PIN ALLOCATION

S32K142 PERIPHERAL MODULE	MCSXTE2BK142 FUNCTION	PERIPHERAL FUNCTION	GPIO PIN
PWM	PWMA_HS_B	FTM3_CH0	PTA2
	PWMA_LS	FTM3_CH1	PTA3
	PWMB_HS_B	FTM3_CH2	PTC6
	PWMB_LS	FTM3_CH3	PTC7
	PWMC_HS_B	FTM3_CH4	PTD2
	PWMC_LS	FTM3_CH5	PTD3
SPI	GD_CS_B	LPSPiO_PCS0	PTB0
	GD_MOSI	LPSPiO_SOUT	PTB1
	GD_SCLK	LPSPiO_SCK	PTB2
	GD_MISO	LPSPiO_SIN	PTB3
CAN	CAN1_RX	CAN1_RX	PTA12
	CAN1_TX	CAN1_TX	PTA13
	CAN_EN	GPIO_O	PTD5
	CAN_STB	GPIO_O	PTD6
	CAN_ERR	GPIO_I	PTD7

S32K142 I/O PIN ALLOCATION CONTINUED

S32K142 PERIPHERAL MODULE	MCSXTE2BK142 FUNCTION	PERIPHERAL FUNCTION	GPIO PIN
ADC	PHA_I	ADC0_SE9	PTC1
	PHB_I	ADC1_SE8/ ADC0_SE8	PTB13
	PHC_I	ADC1_SE6	PTD4
	DCB_I	ADC0_SE15	PTC17
	DCB_V	ADC1_SE10	PTE2
	BEMF_A	ADC0_SE12	PTC14
	BEMF_B	ADC0_SE3	PTA7
	BEMF_C	ADC0_SE2	PTA6
	Tem_MOSFET	ADC0_SE13	PTC15
	Analog_IN	ADC0_SE14	PTC16
LIN	LIN_RX	LPUART1_RX	PTC8
	LIN_TX	LPUART1_TX	PTC9
	LIN_SLP	GPIO_O	PTE8
LPUART	FMT_RX	LPUART0_RX	PTC2
	FMT_TX	LPUART0_TX	PTC3

S32K142 I/O PIN ALLOCATION CONTINUED

S32K142 PERIPHERAL MODULE	MCSXTE2BK142 FUNCTION	PERIPHERAL FUNCTION	GPIO PIN
FTM	HALL_A	FTM0_CH1	PTD16
	HALL_B	FTM0_CH0	PTD15
	HALL_C	FTM0_CH7	PTE9
	ENC_A	FTM2_QD_PHA	PTE5
	ENC_B	FTM2_QD_PHB	PTE4
	ENC_Z	FTM1_CH1	PTD1
	PWM_IN	FTM1_CH4	PTA10
GPIO	GD_EN	GPIO_O	PTB4
	GD_RST_B	GPIO_O	PTB5
	GD_OC	GPIO_I	PTE7
	GD_INT	GPIO_I	PTB12
	LED_R	GPIO_O	PTE0
	LED_G	GPIO_O	PTE1
TRGMUX_OUT	TRGMUX_OUT1	TRGMUX_OUT1	PTD0
	TRGMUX_OUT3	TRGMUX_OUT3	PTA0
	TRGMUX_OUT4	TRGMUX_OUT4	PTE10
	TRGMUX_OUT5	TRGMUX_OUT5	PTE11

CONNECTOR SIGNALS ROUTE

CONNECTOR	PIN	FUNCTION/ SIGNAL
J1 (TRGMUX OUT)	J1-1	TRGMUX_OUT5
	J1-2	TRGMUX_OUT4
	J1-3	TRGMUX_OUT3
	J1-4	TRGMUX_OUT1
	J1-5	TRGMUX_OUT0
J2 (FreeMASTER UART TTL)	J2-1	VDD
	J2-2	GND
	J2-3	UART_TX
	J2-4	UART_RX
J3 (SWD)	J3-1	VDD
	J3-2	SWD_DIO
	J3-3	SWD_SCLK
	J3-4	GND
	J3-5	RESET_b

CONNECTOR	PIN	FUNCTION/ SIGNAL
J4 (JTAG/SWD)	J4-1	VDD
	J4-2	JTAG_TMS/ SWD_DIO
	J4-3	GND
	J4-4	JTAG_TCLK/ SWD_CLK
	J4-5	GND
	J4-6	JTAG_TDO
	J4-7	NC
	J4-8	JTAG_TDI
	J4-9	NC
	J4-10	RESET_b

CONNECTOR SIGNALS ROUTE CONTINUED

CONNECTOR	PIN	FUNCTION/ SIGNAL
J5 (Hall sensor)	J5-1	VDD
	J5-2	GND
	J5-3	HALL_C
	J5-4	HALL_B
	J5-5	HALL_A
J6 (Encoder)	J6-1	VDD
	J6-2	GND
	J6-3	ENC_C
	J6-4	ENC_B
	J6-5	ENC_A
J7 (LIN PHY power supply)	J7-1	VIN
	J7-2	VBAT of TJA1021
J8 (LIN bus)	J8-1	GND
	J8-2	GND
	J8-3	VBAT
	J8-4	LIN

CONNECTOR	PIN	FUNCTION/ SIGNAL
J9 (CAN bus)	J9-1	CAN_H
	J9-2	CAN_L
	J9-3	GND
	J9-4	NC
J10 (PWM input)	J10-1	PWM_CMD
	J10-2	GND
J11 (Motor 3-phase power output)	J11-1	PHA
	J11-2	PHB
	J11-3	PHC
J12 (VBAT input)	J12-1	VBAT-
	J12-2	VBAT+

SUPPORT

Visit www.nxp.com/support for a list of phone numbers within your region.

WARRANTY

Visit www.nxp.com/warranty for complete warranty information.



Get Started

Download installation software and documentation at nxp.com/MCSXTE2BK142.

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