

Quick Start Guide

# MCSPT1AK144

S32K144 Development Kit for 3-Phase PMSM  
and BLDC Motor Control

## Quick Start Guide

# S32K144 DEVELOPMENT KIT FOR 3-PHASE PMSM AND BLDC MOTOR CONTROL

40 W PM Motor  
Part Number: 45ZWN24-40

DEVKIT-MOTORDG Board  
Part Number: DEVKIT-MOTORDG

S32K144 Evaluation Board  
Part Number: S32K144EVB-Q100

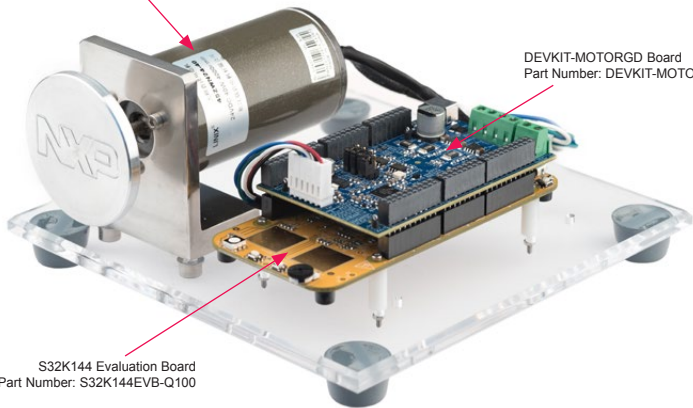


Figure 1: S32K144 development kit for 3-phase PMSM and BLDC motor control

## GET TO KNOW THE S32K144EVb

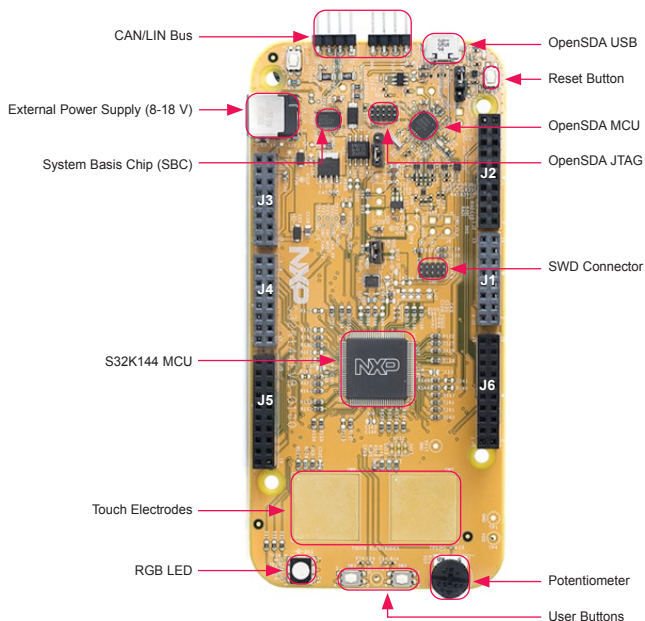


Figure 2: S32K144 evaluation board

## Quick Start Guide

### GET TO KNOW DEVKIT-MOTORGD

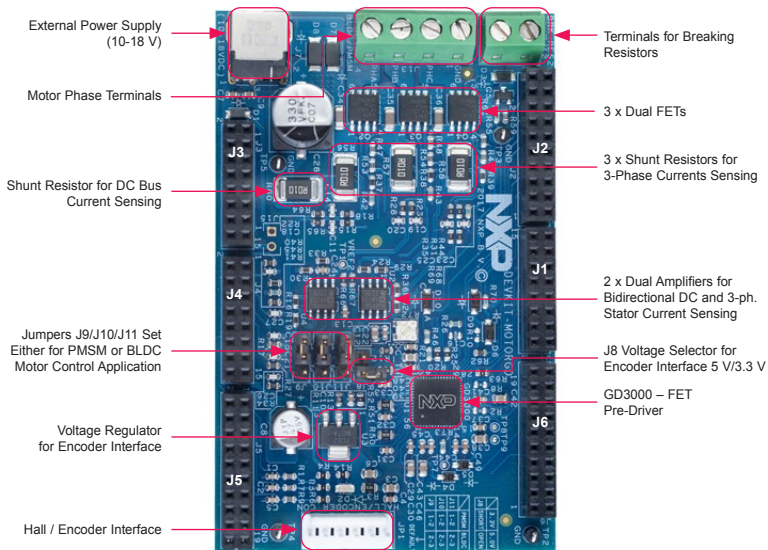
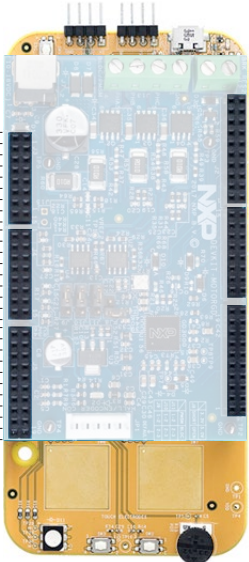


Figure 3: DEVKIT-MOTORGD board

## HEADER/PINOUT FOR PMSM MOTOR CONTROL

S32K144EVB controls DEVKIT-MOTORGD through inner pins of the I/O headers. Inner pins of the I/O headers are Arduino compatible. Pins in red are configurable, this is the pin configuration for **PMSM** motor control (see jumper options on page 11).



DKT-MOTORGD	S32K144EVB	PIN
VDC (10-18 V)	VIN (5-12 V)	J3-01
MCU_VCC (5 V)	IOREF (5 V)	J3-03
NC	RESET	J3-05
NC	3V3	J3-07
NC	5 V	J3-09
GND	GND	J3-11
GND	GND	J3-13
VDC (10-18 V)	VIN (10-18 V)	J3-15
DCBI	ADC1_SE6	J4-01
DCBV	ADC1_SE7	J4-03
PHK_1	ADC0_SE4	J4-08
PHB_1	ADC1_SE18	J4-07
PHC_1	ADC0_SE2	J4-09
NC	PTC0	J4-11
NC	PTE2	J4-13
NC	PTE6	J4-15
ENC_A	FTM2_QD_PHA	J5-01
ENC_B	FTM2_QD_PHB	J5-03
INDEX	PTA1	J5-05
NC	PTA3	J5-07
NC	PTA7	J5-09
NC	PTB13	J5-11
NC	PTC1	J5-13
NC	PTC2	J5-15
NC	NC	J5-17
NC	NC	J5-19
IN	S32K144EVB	DKT-MOTORGD
2-19	PTE10	GD_INT
2-17	PTE11	OC_OUT
2-15	ASEF	NC
2-13	GND	GND
2-11	LPSPID_SCK	SPI_SCLK
2-09	LPSPID_SIN	SPI_MISO
2-07	LPSPID_SOUT	SPI_MOSI
2-05	PTB5	SPI_CS_B
2-03	PTD14	BRAKE_PWM
2-01	PTD13	NC
1-15	FTM3_CH5	PWMC_LS
1-13	FTM3_CH4	PWMC_HS
1-11	FTM3_CH3	PWMB_LS
1-09	FTM3_CH2	PWMB_HS
1-07	FTM3_CH1	PWMA_LS
1-05	FTM3_CH0	PWMA_HS
1-03	PTA3	GD_RST
1-01	PTA2	GD_EN
8-19	PTD0	NC
8-17	PTD2	NC
8-15	PTD9	NC
8-13	PTD8	NC
8-11	PTC8	NC
5-09	PTC9	NC
5-07	PTD17	NC
6-05	PTE12	NC
8-03	PTA8	NC
8-01	PTA9	NC

Figure 4: S32K144EVB + DEVKIT-MOTORGD pin assignment

### HEADER/PINOUT FOR BLDC MOTOR CONTROL

S32K144EVB controls DEVKIT-MOTORGD through inner pins of the I/O headers. Inner pins of the I/O headers are Arduino compatible. Pins in red are configurable, this is the pin configuration for **BLDC** motor control (see jumper options on page 11).

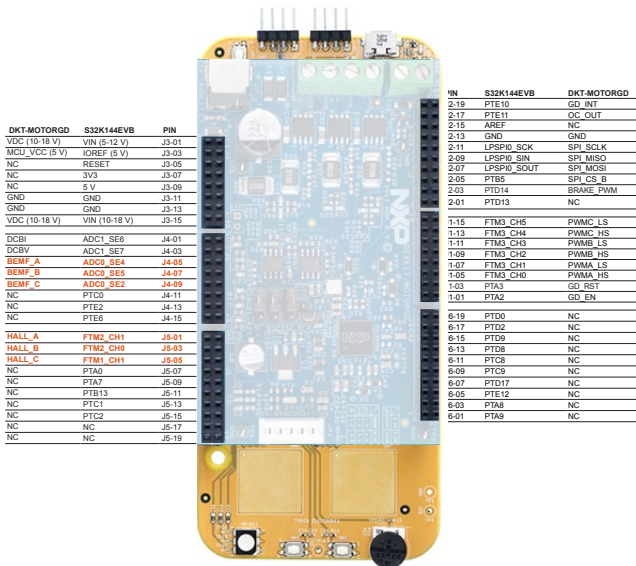


Figure 5: S32K144EVB + DEVKIT-MOTORGD pin assignment

## MCSPT1AK144 FEATURES

### Hardware

- **S32K144EVB**—S32K144 evaluation board with LIN and CAN connectivity support, OpenSDA programming/ debugging
- **DEVKIT-MOTORGD**—up to 12 V/5 A 3-phase power stage board based on SMARTMOS GD3000 pre-driver with condition monitoring and fault detection
- **Low-Cost PM Motor**—3-phase PM motor equipped with HALL sensor, 24 VDC, 4000 RPM, 40 W, 45ZWN24-40
- **USB cable**
- **12 VDC power supply**

### Software

- **Automotive Motor Control Algorithms**

— Field-oriented control (FOC) with field weakening for sinusoidal motor type (PMSM)

— Six-step commutation control for trapezoidal motor type (BLDC)

- **Evaluation version of the Automotive Math and Motor Control Library Set**

—Control algorithm built on blocks of precompiled software library

- **FreeMASTER and MCAT**

—Application tuning and variables tracking at different levels of the control structure

- **Design Studio and SDK**

—Example software created in the S32 Design Studio for Arm® built on S32 SDK software

- **SDK - Processor Expert®**

—MCU peripherals initialization generated by Processor Expert (PEX)

### STEP-BY-STEP INSTALLATION INSTRUCTIONS

#### 1 Download Software



Download installation software and documentation at [nxp.com/AutoMCDevKits](http://nxp.com/AutoMCDevKits).

#### 2 Install S32 Design Studio IDE for Arm®

Download and install S32 Design Studio IDE for Arm available at [nxp.com/S32DS-Arm](http://nxp.com/S32DS-Arm).

#### 3 Install FreeMASTER

Download and install FreeMASTER run-time debugging tool available at [nxp.com/FreeMASTER](http://nxp.com/FreeMASTER).

#### 4 Configure S32K144EVB and DEVKIT-MOTORGD boards

Ensure default S32K144EVB and DEVKIT-MOTORGD jumper options (page 11).

Place DEVKIT-MOTORGD jumpers J9, J10, J11 to position 1-2 for PMSM application or 2-3 for BLDC application (page 11).

Ensure that motor phase wires are in order: white, blue, green from phase A to phase C.

#### 5 Connect the Power Supply

Connect the 12 V power supply to the power supply terminals on DEVKIT-MOTORGD board.

Keep the DC supply voltage within the range of 8 to 18 V. The DC power supply voltage affects the maximum motor speed.

#### 6 Connect the USB Cable

Connect S32K144EVB to the PC using the USB cable. Allow the PC to automatically configure the USB drivers if needed.



## STEP-BY-STEP INSTALLATION INSTRUCTIONS CONTINUED

### 7 Select Application and MCU Programing

Select appropriate PMSM or BLDC motor control application from the installed directory NXP\MCSPT1AK144\sw.

Select one of the next two steps (8 or 9) for MCU programming.

### 8 Re-program the MCU using MSD Flash Programmer

Copy and paste or drag and drop the Motorola S-record \*.srec file from the project folder to the S32K144EVB disk drive. The software is directly programmed into the flash memory of the S32K144 MCU and executed automatically.

### 9 Reprogram the MCU using S32 Design Studio

Import the installed application software project in the S32 Design Studio for Arm®:

- Start S32 DS for Arm application.
- Click **File-Import**.

- Select **General-Existing Projects into Workspace**.
- Navigate to the installed application directory:  
**NXP\MC\_DevKits\MCSPT1AK144\sw**, choose appropriate project and click **OK**.
- Click **Finish**.
- Click **Run – Debug**.

### 10 FreeMASTER Setup

- Start the FreeMASTER application
- Open \*.pmp FreeMASTER project from the project folder **<selected project> FreeMASTER\_control** by clicking **File – Open Project**.
- Click the green **GO!** button in the FreeMASTER toolbar or press CTRL+G to enable the communication.
- Successful communication is signalized in the status bar at very bottom as “RS232 UART Communication;COMn; speed = 115200”.

### APPLICATION CONTROL

**1** Click **App Control tab** in the MCAT tool menu to display the application control page. When the power supply is connected to the DEVKIT-MOTOGD board, the application is in a **READY** state indicated by the green LED on S32K144EVB board. RGB LED also indicates:

- **READY, INIT** states lighting green LED
- **CALIB, ALIGN** states flashing green LED
- **RUN** state lighting blue LED
- **FAULT** state lighting red LED

**2** In case of pending faults, click the fault button **Clear FAULT** on the FreeMASTER MCAT Control Page, or alternatively press and hold **SW2** and **SW3** buttons on S32K144EVB board simultaneously.

**3** Start the application by pressing the **ON/OFF** button on the FreeMASTER MCAT control page or by pressing switch **SW2/SW3** on S32K144EVB to initiate clockwise/counter clockwise rotor spinning direction.

**4** Set required speed by changing the **Speed Required** variable value manually in the variable watch window, by clicking **speed gauge**, or by pressing the switch **SW2/SW3**.

**5** To stop the application, click the **ON/OFF** button on the FreeMASTER MCAT control page or press and hold **SW2** and **SW3** buttons on S32K144EVB board simultaneously.

## S32K144EVB JUMPER OPTIONS

JUMPER	OPTION	SETTING	DESCRIPTION
J104	Reset signal	1-2	Reset signal to OpenSDA, use to enter into Open SDA Bootloader mode
		2-3	Reset signal direct to the MCU, use to reset S32K144 (default)
J107	Board powering	1-2	S32K144 powered by 12 V power source (default)
		2-3	S32K144 powered by USB micro connector
J109/J108	CAN	OPEN	CAN termination resistor is disconnected
		SHORT	CAN terminator resistor is connected (default)

## DEVKIT-MOTORGD JUMPER OPTIONS

JUMPER	OPTION	SETTING	DESCRIPTION
J8	HALL/Encoder interface	Short	Voltage level for HALL/Encoder interface is 3.3 V
		Open	Voltage level for HALL/Encoder interface is 5.0 V (default)
J9/J10/J11	Motor type	1-2	Bidirectional 3-phase current sensing for PMSM FOC (sinusoidal) motor control
		2-3	3-phase back-EMF voltage sensing for BLDC six-step (trapezoidal) sensorless motor control

## SUPPORT

Visit [www.nxp.com/support](http://www.nxp.com/support) for a list of phone numbers within your region.

## WARRANTY

Visit [www.nxp.com/warranty](http://www.nxp.com/warranty) for complete warranty information.



## Get Started

Download installation software and documentation at [nxp.com/AutoMCDevKits](http://nxp.com/AutoMCDevKits).

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