



S32K344 Brushless Direct Current and Permanent Magnet Synchronous Motor Control Development Kit

MCSPTE1AK344

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The MCSPTE1AK344 is a development kit engineered for brushless direct current (BLDC) motor control, targeting heating, ventilation and air conditioning (HVAC) or electric pumps, and 3-phase permanent magnet synchronous motor (PMSM) control, targeting active suspension, electric powertrain, eTurbo or belt start generator.

Based on the 32-bit Arm® Cortex®-M7 S32K3 microcontroller and the GD3000 pre-driver, the MCSPTE1AK344 enables rapid prototyping and evaluation of BLDC and PMSM control applications without having to wait for the final hardware design.

The MCSPTE1AK344 application software leverages the Automotive Math and Motor Control Library (AMMCLib) set plus Real-Time Drivers (RTD) software package to provide a complete reference implementation for both 3-phase BLDC and PMSM motor control.

The RTD software allows building motor control applications for both AUTOSAR® and non-AUTOSAR environments.

The diagram illustrates the system architecture for the S32K344, showing the integration of various components for motor control:

- Real-Time Drivers for S32K3** and **Automotive Math and Motor Control Library Set for S32K3** provide the core control logic.
- FreeMASTER** is used for development and debugging via **LPUART**.
- Start/Stop** and **Fault** inputs are managed through **SIUL** and **LPSPI**.
- The **GD3000** 3-Phase Low-Voltage Power Stage is connected to a **U_Dc bus** and a **BLDC** motor.
- RTD Drivers** are connected to the **eMIOS + LCU** and **TRGMUX** blocks.
- Application Control** manages the **Required Speed (RPM)** and **Required Current Limit**.
- The **Speed PI Controller** and **Current Limitation PI Controller** process the required inputs to generate a **Duty Cycle**.
- Speed, Current Calculation** block receives **Actual Speed (RPM)** and **Actual Motor Current** to provide feedback.
- Zero Cross Detection** and **Zero-Crossing Period** are used for sensorless control.
- Hall Period** is used for Hall sensor-based control.
- ADC** and **TRGMUX** blocks interface with the **BLDC** motor's **Bemf** and **Hall** signals.
- Legend:**
 - Blue line: Sensorless
 - Orange line: Hall sensor

The diagram illustrates the S32K344 Reference Design architecture, showing the integration of various hardware and software components for motor control.

Hardware Components:

- 3-Phase Low-Voltage Power Stage:** Includes a PMSM motor, a 3-phase inverter, and a DC bus (U_{Dc} bus) connected to a V_{dc} source.
- GD3000:** The main microcontroller unit, interfaced with the power stage and various peripheral drivers.
- Real-Time Drivers for S32K3:** Includes Automotive Math and Motor Control Library Set for S32K3.
- FreeMASTER:** A software tool for real-time monitoring and control.
- RTD Drivers:** Multiple Real-Time Digital (RTD) drivers connected to the GD3000 via LPUART, SIUL, and LPSPI.
- ADC:** Analog-to-Digital Converter for sensor feedback.
- TRGMUX:** Triangular Wave Generator Multiplexer for PWM generation.
- BCTU:** Back-EMF and Current Tracking Unit.
- Angle Tracking Observer:** Used for sensorless motor control.
- Current Sensing Processing:** Processes current sensor data for feedback.
- DC_{bus} Ripple Compensation:** Compensates for DC bus voltage ripples.
- Back-EMF & Angle Tracking Observer:** Estimates back-EMF and rotor position for sensorless control.
- Forward Park Transformation:** Converts d-q currents to alpha-beta currents.
- Forward Clark Transformation:** Converts alpha-beta currents to a-b-c currents.

Control Loops and Signal Flow:

- Speed Loop & FW (Field Weakening):** Receives speed feedback (Speed_{RM}) and generates a speed reference (Is_{d_req}).
- Current Loop:** Receives current feedback (Is_d, Is_q) and generates current references (Is_d, Is_q).
- PWM Modulation:** Generates PWM signals (Us_{alpha_comp}, Us_{beta_comp}) for the inverter.
- Inverse Park Transformation:** Converts d-q currents to alpha-beta currents (Is_{alpha}, Is_{beta}).
- Sw Switch:** Represents the 3-phase inverter switching.
- DC_{bus} Ripple Compensation:** Compensates for DC bus voltage ripples.
- Current Sensing Processing:** Processes current sensor data (Is_a, Is_b, Is_c) for feedback.
- Angle Tracking Observer:** Estimates rotor position (Theta_{enc}) for sensorless control.
- Back-EMF & Angle Tracking Observer:** Estimates back-EMF (Theta_{enc_fit}) and rotor position (Omega_{enc_filt}) for sensorless control.
- Forward Park Transformation:** Converts d-q currents to alpha-beta currents (Is_{alpha}, Is_{beta}).
- Forward Clark Transformation:** Converts alpha-beta currents to a-b-c currents (Is_a, Is_b, Is_c).

Legend:

- Blue line: Sensorless
- Orange line: Encoder sensor

S32K344

View additional information for [S32K344 Brushless Direct Current and Permanent Magnet Synchronous Motor Control Development Kit](#).

Note: The information on this document is subject to change without notice.

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