



Automotive Motor Control Development Solutions

Dual 3-Phase PMSM Kit with Qorivva MPC5643L MCU

Overview

The dual 3-phase PMSM motor control development kit demonstrates the advantages of the Qorivva MPC5643L MCU for dual motor control applications using two 3-phase permanent magnet synchronous motors (PMSM) with encoder and resolver position sensors. It serves as an example of a PMSM control design using the Freescale family of automotive motor control MCUs based on Power Architecture® technology optimized for a full range of automotive applications. This application utilizes the vector control approach of the 3-phase PMSM motor and it is implemented with functions from the automotive math and motor control library set for the MPC5643L.

Target Automotive Applications

- Braking and stability control
- Electric power steering
- Active suspension
- Hybrid electric vehicles
- Transmission and gearbox

The application is designed for the MPC5643L controller board with an encoder/resolver interface and two 3-phase PMSM low-voltage power stages equipped with a 3-phase MC33937A pre-driver. Beside the main control loop, the DC-bus voltage and phase currents are monitored during the control process for overvoltage, undervoltage and overcurrent drive protection.

Freescale offers a broad portfolio of automotive MCUs, MPUs, analog integrated circuits and sensor solutions, along with extensive enablement and technical support, empowering you to create the next breakthrough automotive designs for powertrain, body, chassis and safety, infotainment and telematics, and in-vehicle networking applications.

Demo Features

- Qorivva MPC5643L controller board with a double encoder/resolver interface
- Two 3-phase BLDC/PMSM low-voltage power stages (10 A) based on a SMARTMOS MC33937A pre-driver
- Two low-voltage PMSM motors with resolver and encoder sensors
- Parameters:
 - 20 kHz PWM (50 μ s period), 100 μ s current control loop, 1 ms speed control loop
 - 10 kHz resolver excitation frequency
- Software approach optimized for portability, low maintenance cost and speed
- Application, algorithms and drivers written purely in ANSI-C
- Layered software approach
- Algorithm layer not peripheral dependent
- Field-oriented control (torque and speed) of a 3-phase PMSM motor
- Faults of DC-bus overvoltage, DC-bus undervoltage and phase overcurrent are processed
- Position sensor selection (encoder or resolver) via FreeMASTER control
- FreeMASTER visualization support



Qorivva MPC5643L MCU Features

- Up to 120 MHz PowerPC ISA dual e200z4 core, 32-bit Power Architecture CPU with 1 MB of flash and 128 KB of SRAM memory
- Dual-core safety platform targeting ISO26262 ASILD and IEC61508 SIL3 integrity levels
- Lock step or decoupled parallel mode configuration
- Floating point unit
- VLE instructions for reduced code footprint
- Freescale SafeAssure functional safety solution
- One FlexRay™, two FlexCAN and two LINFlex modules

Qorivva MPC5643L MCU Motor Control Modules

- 2x FlexPWM, four channels with four fault inputs
- 3x e-timers, including quad decode
- 2x 10-bit ADC modules with 2 x 12 channels (include four shared channels)
- Cross triggering unit with 32 input channels (eight events, 24 ADC commands)
- Fault collection unit

MC33937A Features

- Fully specified from 8 to 40 V (covers 12 and 24 V automotive systems)
- Extended operating range from 6 to 58 V (covers 12 and 42 V systems)
- Greater than 1 A gate drive capability with protection
- Protection against reverse charge injection from C_{GD} and C_{GS} of external FETs
- Dead time is programmable via the SPI port
- Simultaneous output capability enabled via safe SPI command

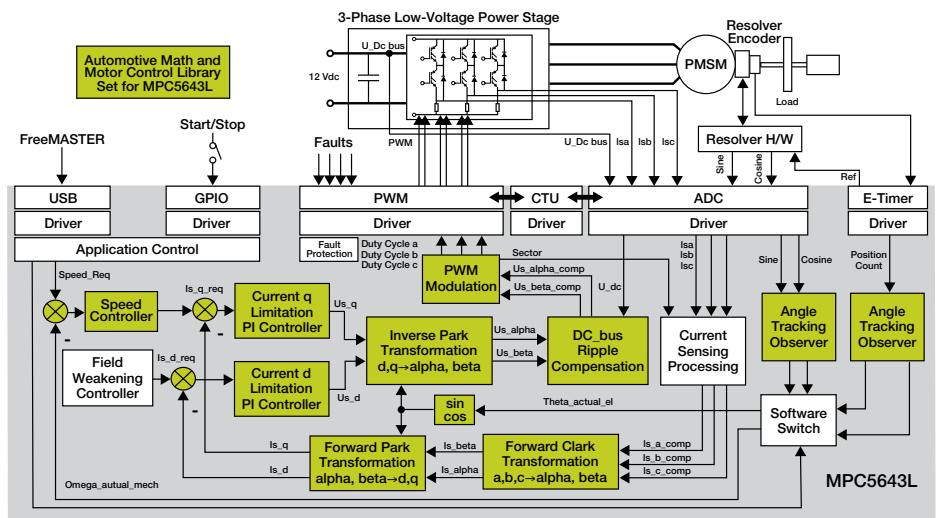
MC33905 (System Basis Chip) Features

- 5 or 3.3 V voltage regulator with current, temperature and voltage protection
- Configuration and diagnostics accessible through the SPI
- One CAN and up to two LIN transceivers
- Window watchdog, two configurable input/output pins
- Very low quiescent current in low-power modes
- Stop (Vdd On) and sleep (Vdd Off) modes

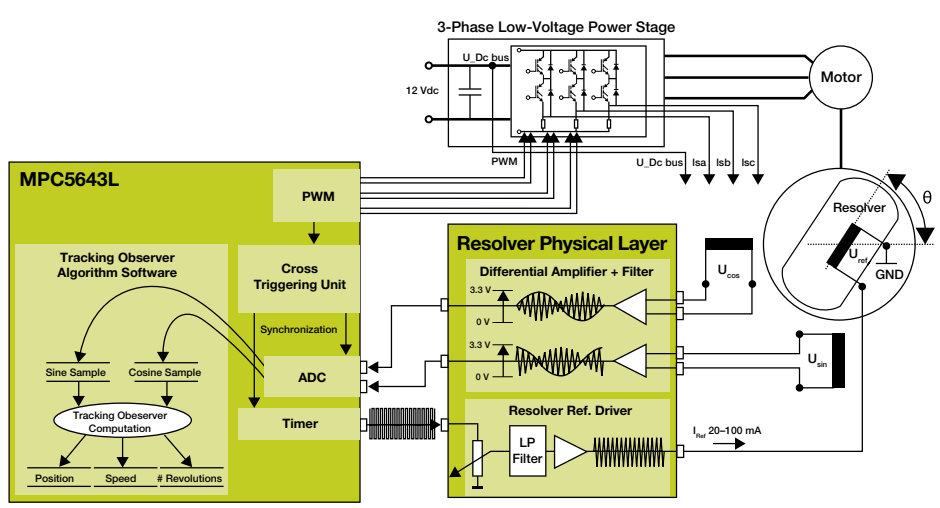
Dual 3-Phase PMSM Development Kit: Qorivva MPC5643L



Motor Control Algorithm Concept



Resolver Driver and Interface



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