

Freescal e Motor Control Boards

Hardware development kits provide rapid prototyping of motor control applications

Overview

Freescal e motor control development boards are intended to support the rapid evaluation and prototyping of a variety of motor control applications using Freescal e MCUs. To cover both low- and high-voltage applications Freescal e built two motor control development boards:

- Low-voltage Tower System-compatible platform
- High-voltage platform

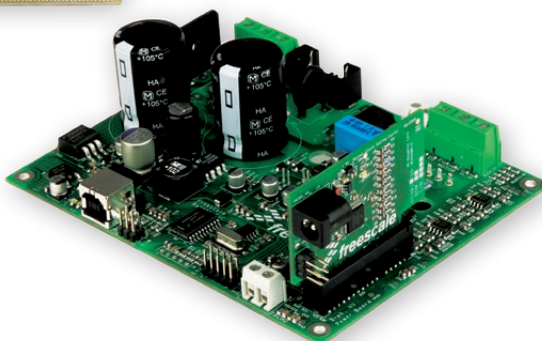
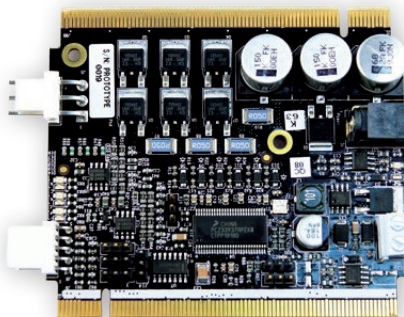
Tower System Three-Phase Low-Voltage Power Stage

The TWR-MC-LV3PH low-voltage three-phase motor control module was designed to provide a Tower System-compatible module for motor control applications. This peripheral module is interchangeable across the development platform and can be used with a variety of existing controller modules.

Three-Phase High-Voltage Power Board

High-voltage applications (supplied from mains) require a different approach of inverter board design due to safety requirements and isolation distances. The Freescal e high-voltage power board combines a three-phase inverter and power factor correction stage. The board allows development and prototyping of applications for white goods, industrial and general-purpose drives.

Figure 1: Motor Control Boards



Three-Phase Low-Voltage Tower System Board

The three-phase low-voltage control board (TWR-MC-LV3PH) is a peripheral Tower System module. With one of the available MCU Tower System modules, accommodating a selected MCU, it provides a ready-made, software-development platform for one-third horsepower offline motors. Feedback signals are provided that allow a variety of algorithms to control three-phase PMSM and BLDC motors.

The TWR-MC-LV3PH module features:

- Power supply voltage input 12 to 24 VDC, extended up to 50 V
- Output current up to 8 A
- Power supply reverse polarity protection circuitry

- Three-phase bridge inverter (six MOSFETs)
- Three-phase MOSFET gate driver with overcurrent and undervoltage protection
- Three-phase and DC bus current sensing shunts
- DC bus-voltage sensing
- Three-phase back EMF voltage sensing circuitry
- Low-voltage on-board power supplies
- Encoder/Hall sensor sensing circuitry
- Motor power and signal connectors
- User LED, power-on LED, six PWM LED diodes
- Braking resistor MOSFET

Sets of jumpers located on the board enable configuration setting of analog signals. SPI communication channel and MC33937 driver signal selectors are available through zero-ohm resistors.

The MC33937 provides overcurrent and undervoltage functions, in addition to other functions.

A filtered DC bus current signal is fed into the pre-driver current comparator input. If the current exceeds the adjustable reference value, all six transistors are switched off while a fault bit setting in the status register.

The TWR-MC-LV3PH kit contains a three-phase BLDC motor with Hall sensors LINIX 45ZWN24-40 with parameters:

- Rated voltage of 24 VDC
- Rated speed 4000 RPM
- Rated power 40 W
- Continuous current 2.34 A

The board supports Tower System standards and interface pin-out. However, not all Freescale MCUs are dedicated for motor control applications. The list of recommended Tower System MCU modules that are fully compatible from TWR-MC-LV3PH regarding number of PWMs, ADCs and timer channels is as follows:

- 8-bit
 - TWR-S08PT60
- ColdFire
 - TWR-MCF5441X
- DSC
 - TWR-56F8257
 - TWR-56F8400
- ARM core-based Kinetis MCUs
 - TWR-K40X256
 - TWR-K60N512
 - TWR-K70F120M

Three-Phase High-Voltage Power Board

The three-phase high-voltage power board is a power stage and part of the Freescale embedded motion control series of development platforms. The kit consists of the main board and a selected MCU daughter card. The interface between the card and the main power board provides a 96-pin PCI connector which accommodates all required signals for the three-phase inverter and active power factor correction stage.

The power board is capable to control sensed or sensorless PM synchronous motors, AC induction motors and BLDC motors with the power up to 1 kW. The DC bus voltage is regulated using PFC to the value of 400 VDC which enables generation of three-phase output signals with amplitude up to 230 VAC.

The algorithms for motor control applications required apart from powerful MCUs are also motor analog signals (current, voltage) and a rotor position feedback. The motor position in case of sensorless applications is calculated using a motor model. However, the real position of the rotor is essential at least for initial application tuning. The power board contains interfaces for quadrature decoder, Hall sensors, tacho generator and optional resolver position and speed feedbacks.

The HV power board features:

- Input voltage of 85–250 VAC
- Output current up to 15 A
- Auxiliary power supplies 15 V and 5 V DC from rectified voltage
- Three-phase IGBT power module
- Analog sensing (DCB voltage, DCB current, phase currents, back EMF voltage)
- Motor speed/position sensors interface (encoder, Hall, tacho generator, resolver)

- Hardware overcurrent fault protection
- Active PFC
- Overvoltage comparator with DC-brake resistor interface
- SCI-to-USB optically isolated communication interface

The main component of three-phase inverters is the smart power module (SPM). The high-speed built-in HVIC provides optocoupler-less single supply IGBT gate driving capability that reduces the overall size of the inverter system design. Each phase current of the inverter can be monitored separately due to the divided negative DC terminal.

The platform currently supports key MCUs dedicated for motor control applications:

- MC9S08MP16
- MC56F80xx
- MC56F82xx
- MC56F84xx
- MPC564xL
- K40X256

Availability

The TWR-MC-LV3PH Tower System modules are currently available at freescale.com for direct ordering or through distributors. The kit contains three-phase BLDC motor, 24 VDC power supply and the Tower System module. The BLDC example applications are available for Kinetis MCU and DSC platforms.

The kit and application software are available at freescale.com/Tower.

The high-voltage power board will be available for ordering in 2013. Currently, the board redesign is in progress as well as mass production preparations. The MCU daughter cards will be available for both Kinetis MCU and DSC platforms.

How to Reach Us:

Home Page:

freescale.com

Motor Control

Portfolio Information:

freescale.com/motorcontrol

e-mail:

support@freescale.com

USA/Europe or Locations Not Listed:

Freescale Semiconductor
Technical Information Center, CH370
1300 N. Alma School Road
Chandler, Arizona 85224
1-800-521-6274
480-768-2130
support@freescale.com

Europe, Middle East, and Africa:

Freescale Halbleiter Deutschland GmbH
Technical Information Center
Schatzbogen 7
81829 Muenchen, Germany
+44 1296 380 456 (English)
+46 8 52200080 (English)
+49 89 92103 559 (German)
+33 1 69 35 48 48 (French)
support@freescale.com

Japan:

Freescale Semiconductor Japan Ltd.
Headquarters
ARCO Tower 15F
1-8-1, Shimo-Meguro, Meguro-ku,
Tokyo 153-0064, Japan
0120 191014
+81 3 5437 9125
support.japan@freescale.com

Asia/Pacific:

Freescale Semiconductor Hong Kong Ltd.
Technical Information Center
2 Dai King Street
Tai Po Industrial Estate,
Tai Po, N.T., Hong Kong
+800 2666 8080
support.asia@freescale.com

Information in this document is provided solely to enable system and software implementers to use Freescale Semiconductor products. There are no express or implied copyright license granted hereunder to design or fabricate any integrated circuits or integrated circuits based on the information in this document.

Freescale Semiconductor reserves the right to make changes without further notice to any products herein. Freescale Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters which may be provided in Freescale Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Freescale Semiconductor does not convey any license under its patent rights nor the rights of others. Freescale Semiconductor products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Freescale Semiconductor product could create a situation where personal injury or death may occur. Should Buyer purchase or use Freescale Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold Freescale Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Freescale Semiconductor was negligent regarding the design or manufacture of the part.