SK-POWER-3P-LV2-MC

Motor Control Starter Kit User Guide

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Contents

1. Overview

1.1 Abstract

The SK-Power-3P-LV2-MC is an Evaluation Board for low voltage motor control applications using brushless DC or permanent magnet synchronous motors.

Software development is possible by connecting an MCU Evaluation Board such as the FM4-216-ETHERNET to the SK-Power-3P-LV2-MC via the motor drive connector (MC) X1.

1.2 Features

- Low voltage FET based inverter with gate drivers for three-phase motors up to 24V 3A
- Current measurement of all three phases and the DC link with hall-effect based current sensors
- Voltage measurement of all three phases and the power supply
- Onboard overcurrent- and overvoltage-detection with LED and DTTI signal to connected StarterKit
- Onboard temperature sensor (optional)
- Externally attachable brake resistor control for motor brake (optional)
- 34 pin MC connector with all for motor control relevant signals
- Flexible power supply options

Note:

This board must only be used for test applications in an evaluation laboratory environment.

1.3 General Description

The SK-Power-3P-LV2-MC can be directly connected to Cypress FM Family Evaluation Boards featuring a compatible 34-pin connector, such as the FM4-216-ETHERNET or SK-FM4-U-PERIPHERAL.

The board can be used for development of low voltage motor control applications in combination with a suitable MCU Evaluation Board. The MC connector combines all motor control signals e.g. PWM and phase-current measurement signals. Additionally, the connected evaluation board can be powered via the MC connector.

By connecting an unregulated DC voltage of 15-24V to the connector X7, the onboard voltage regulators can generate 12V and 5V voltage supply for gate drivers and analog circuitry. The supply for the motor DC link can be separated from X7 and supplied directly via X6 (24V max).

The board includes hall-effect based current sensors, as well as resistive dividers for phase and DC link voltage measurement. All signals are routed to the MC connector, from where they can be routed to the analogue digital converter (ADC) pins of a microcontroller unit (MCU). The onboard overcurrent- and overvoltage detection has two potentiometers to adjust the voltage and current limits suitable for the motor and application. If an overcurrent or overvoltage occurs the MCU's Dead Time Timer Interrupt (DTTI) signal deactivates the pulse width modulation (PWM) signal of the Microcontroller.

The temperature sensor located near the MOSFETs delivers a temperature proportional voltage which can be interpreted by the application.

2. Installation

Carefully remove the board from the shipping box.

First, check if there are any damages before powering up the evaluation system.

For the power supply a DC input voltage of 12V – 15V is recommended. The positive voltage (+) must be connected to the center and ground (GND) must be connected to the shield of the connector X7!

To separate the DC link input from the gate driver and analog supply, the DC link voltage (up to 24V 3A max) can be input by X6. The positive voltage (+) must be connected on Pin1 and ground (GND) must be connected to Pin2. In this configuration, a separate supply with variable current limit can be used for the motor DC link, so that the gate drivers and analog circuitry are not influenced by overcurrent events on the DC link, which might occur during development and debugging.

NOTE: To separate logic and DC link supply, jumper JP8 must be opened!

Please refer to the following chapters for details.

After power-on, the green power-on LED for VCC5V (LD3) and the green power-on LED for VCC12V (LD1) should illuminate. If the LEDs do not light, switch off the power supply and check input polarity as well as the settings of JP6, JP8, JP10, JP11 and JP12.

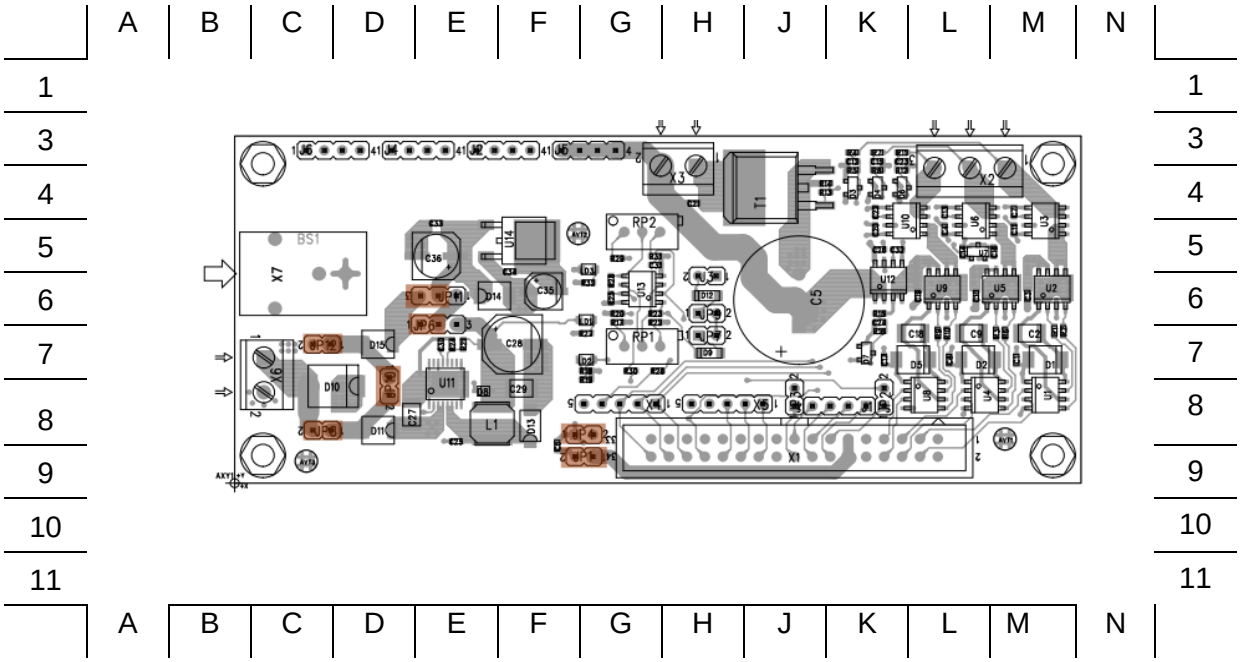
3. Default Jumper Setting

The following table shows the default jumper settings. Check these jumper settings before powering the board.

Table 1: Default jumper settings

Jumper	Description / Function	Type	Default Setting	Coordinates
JP1	VCC12V – MC Pin10,11	Jumper 2pin	closed	G9
JP2	OPT1 (Brake)	Jumper 2pin	open	K8
JP3	OPT6 (Temp)	Jumper 2pin	open	J8
JP4	GND - MC	Jumper 2pin	closed	G8
JP5	GND - PGND	Solder Jumper 2pin	closed	Bottom under connector X6
JP6	DCin = 12V / DCin > 12V	Jumper 3pin	1-2	E7
JP7	Overcurrent-DTTI	Jumper 2pin	open	H7
JP8	Vin (motor voltage) – logic power	Jumper 2pin	closed	C8
JP9	Overvoltage-DTTI	Jumper 2pin	open	H6
JP10	X6 – X7 (power supply)	Jumper 2pin	closed	D8
JP11	5V regulator input VCC12V/X7	Jumper 2pin	2-3	E6
JP12	X7 connected	Jumper 2pin	closed	C7

Figure 1: Jumper settings SK-Power-3P-LV2-MC



4. Jumpers and Switches

This chapter describes the jumpers and switches which can be modified on the StarterKit. The default settings are shown in a grey shaded area.

4.1 Power Supply (JP6, JP8, JP10, JP11, JP12)

The onboard voltage regulators provide stabilized 12V and 5V.

JP5 Connects the logic power supply ground (GND) with the power supply ground (PGND).

JP6 Connects the VCC12V power supply of the board with the attached supply of the board (connected power supply 12V) or with the output of the 12V voltage regulator.

JP8 Connects the screw connector X6 with the logic power supply of the board. The logic can be powered via X7 and the motor apart via X6 by opening this jumper.

JP10 Connects the power supply via X7 with the motor supply Vin (12V motor).

JP11 Connects the input of the 5V voltage regulator with VCC12V or with the attached supply of the board.

JP12 Connects the connector X7 with the logic power supply of the board.

Table 2: Power supply

Jumper	Setting	Description
JP5	Closed	GND connected to PGND
	Open	GND and PGND separated
JP6	1-2	Board powered with 12V supply
	2-3	Board powered with >12V supply (24V max)
JP8	Closed	Logic power is connected to motor power
	Open	Logic power and motor power separated
JP10	Closed	X7 connected to motor supply (12V motor)
	Open	X7 power not used for motor supply
JP11	1-2	VCC12V connected to input 5V regulator
	2-3	X7 power connected to input 5V regulator
JP12	Closed	X7 power connected to logic power supply
	Open	X7 disconnected from board

4.2 Overcurrent and overvoltage Detection (JP7, JP9)

The overcurrent and the overvoltage detection signals are connected via the MC connector to the DTTI pin of the microcontroller. Each of both signals can get disconnected with a jumper.

JP7 Connects the overcurrent detection to the DTTI.

JP9 Connects the overvoltage detection to the DTTI.

Table 3: Overcurrent and overvoltage detection

Jumper	Setting	Description
JP7	Open	Overcurrent detection (DTTI) is disabled
	Closed	Overcurrent detection (DTTI) is enabled
JP9	Open	Overvoltage detection (DTTI) is disabled
	Closed	Overvoltage detection (DTTI) is enabled

With the potentiometer RP1 and RP2 the barrier of overcurrent and overvoltage detection can be adjusted. RP1 is for overcurrent and RP2 for overvoltage.

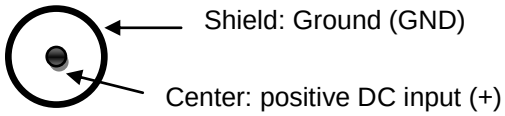
5. Connectors

5.1 Power Connectors (X6, X7)

Figure 2 shows the power connector X7. An unregulated DC power supply of 12-15V can be attached to power the board. The anode of the power connector is the center pin and the ground is connected to the shield. The board is protected against an interchange of the pins.

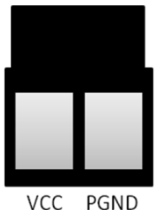
Via this connector it is possible to power the logic on the board and a small 12V DC motor.

Figure 2: Power connector **X7**



To power a DC motor up to 24V 8A a power supply attached on the screw connector X6 shown in Figure 3 is necessary. Pin1 on the left (view from the connection side) is the VCC-pin and Pin2 the ground (PGND). On the board is a shottky diode which protects the external power supply against reverse current generated by the rotation of the motor.

Figure 3: Power connector X6



5.2 Brake Resistor Connector (X3)

The brake resistor connector is a two pin screw connector. A resistor can be attached to get a braking function of the motor. This could be necessary if the connected motor works in a generator mode and a heavy load is fixed on it. By braking the motor the DC link voltage rises. The capacities have to store this voltage and can get destroyed. A brake resistor protects the capacities by turning the energy of rotation into heat. The value of the power rating depends on the DC link voltage, the possible current generated by the motor and the load and the braking cycle in which braking can occur. The braking current should not exceed 6A in average and 15A peak to limit power dissipation of T1. Additional the switching frequency for T1 should not exceed 2-3 kHz to limit switching losses, especially at higher braking currents (low resistance, high voltage). T1 can be driven at 100% duty cycle (no bootstrap circuit).

5.3 Current- and Voltage-Measurement Connector (X4, X5)

For easy measuring each current and voltage of the phases the header connectors are attached on the board. On X4 the currents and on X5 the voltages can be gripped.

Table 4: Current- and voltage-measurement connector

X4 pin	Signal	X5 pin	Signal
1	I Phase A	1	V Phase A
2	I Phase B	2	V Phase B
3	I Phase C	3	V Phase C
4	I DC Bus	4	V Bus Sense
5	GND	5	GND

5.4 Motor Drive Connector MC (X1)

By using the motor drive connector (MC) X1 a StarterKit such as the SK-91580-001-MC can be connected for automotive applications e.g. brushless DC motor control. With pin 3-8 the motor is controlled by using pulsed signals from the MCU. The currents and voltages of each phase are delivered back to the MCU via this connector. The optional pins (OPT2-5) are connected to J1 for optional applications. Additional OPT6 can be used to get information about the temperature on the power electronic and OPT1 can be used to switch on an external attached brake resistor.

Table 5: Motor drive connector

X1 pin	Signal	X1 pin	Signal
1	GND	2	GND
3	PWM1H	4	PWM1L
5	PWM2H	6	PWM2L
7	PWM3H	8	PWM3L
9	GND	10	GND
11	VCC12V	12	VCC12V
13	OPT1 (Brake)	14	OPT2
15	OPT3	16	OPT4
17	OPT5	18	OPT6 (TEMP)
19	Fault	20	DC bus voltage sense
21	Shield ground	22	Phase A voltage sense
23	Shield ground	24	Phase B voltage sense
25	Shield ground	26	Phase C voltage sense
27	Shield ground	28	DC Bus current sense

X1 pin	Signal	X1 pin	Signal
29	Shield ground	30	Phase A current sense
31	Shield ground	32	Phase B current sense
33	Shield ground	34	Phase C current sense

5.5 Motor Connector (X2)

Figure 4 shows the motor connector X2. The three phases of the motor can be attached to this connector.

Figure 4: Motor connector

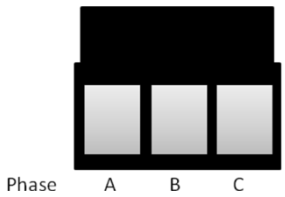


Table 6: Motor connector

X2 pin	Signal
1	Phase A
2	Phase B
3	Phase C

6. Related Products

Cypress recommends you the following product:

- FM4-216-ETHERNET Evaluation Board for Cypress FM4 Family S6E2C microcontroller series with MC connector for motor control.

7. Additional Information

For more Information on Cypress SK-POWER-3P-LV2-MC, please visit our website:
http://www.cypress.com/documentation/development-kitsboards/sk-power-3p-lv2-mc

For more Information on Cypress semiconductor products, visit the following website:
http://www.cypress.com/cypress-microcontrollers

Please contact your local support team for any technical question.

8. China RoHS Regulation

This board is compliant with China RoHS.

9. Recycling

Gültig für EU-Länder:

Gemäß der Europäischen WEEE-Richtlinie und deren Umsetzung in landesspezifische Gesetze nehmen wir dieses Gerät wieder zurück.

Valid for European Union Countries:

According to the European WEEE-Directive and its implementation into national laws we take this device back.

Revision History

Document Revision History

Document Title: SK-POWER-3P-LV2-MC Motor Control Starter Kit User Guide Document Number: 002-09749				
Revision	**ECN**	**Issue Date**	**Origin of Change**	**Description of Change**
**	–	01/17/2011	CHRH	Initial release
*A	5266035	06/15/2016	CHRH	Migrated to Cypress format