MC9S08MP16 Controller Daughter Board for BLDC/PMSM Motor Control Drive

Users Manual

LVBLDCMP16DBUM

Rev. 0
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MC9S08MP16 Controller Daughter Board for BLDC/PMSM Motor Control Drive

Users Manual

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The following revision history table summarizes changes contained in this document. For your convenience, the page number designators have been linked to the appropriate location.

Revision History

Date	Revision Level	Description	Page Number(s)
06/2009	0	Initial release	N/A

Chapter 1
Board Overview

1.1 MC9S08MP16 Controller Daughter Board for BLDC/PMSM Motor Control Drive Outline

Freescale's MC9S08MP16 Controller Daughter Board for BLDC/PMSM Motor Control Drive together with a 3-Phase BLDC/PMSM Motor Control Drive board create a single unit for developing BLDC/PMSM motor-control applications.

The daughter board is connected via two connectors to the 3-Phase BLDC/PMSM Motor Control Drive board. All necessary signals are available to allow a variety of algorithms to control the 3-Phase PMSM and BLDC motors.

Figure 1-1 is an illustration of the controller daughter board.

1.2 About this Manual

Key items are in the following locations in this manual:

- Setup instructions — 1.3 Setup Guide
- Schematics — Appendix A. MC9S08MP16 Controller Daughter Board for BLDC/PMSM Motor Control Drive Schematics
- Pin assignments — Chapter 2 Pin Description
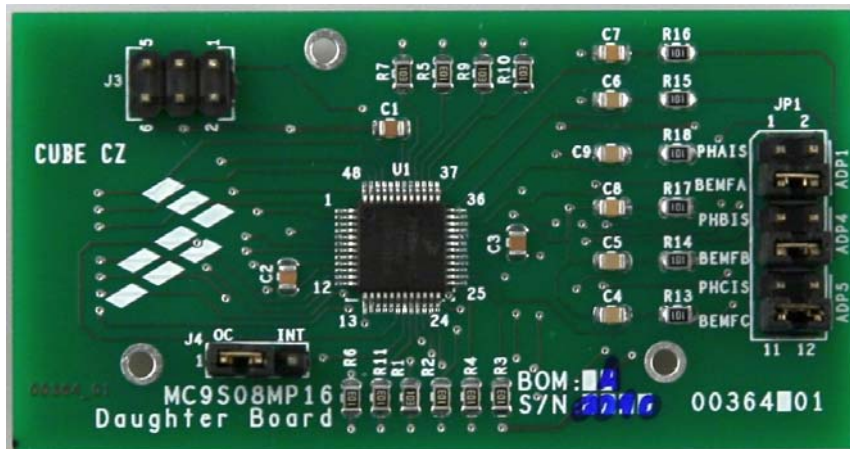- Pin-by-pin description — 2.2 Signal Descriptions

Figure 1-1 MC9S08MP16 Controller Daughter Board

1.3 Setup Guide

Setup and connections for the MC9S08MP16 Controller Daughter Board for BLDC/PMSM Motor Control Drive are straightforward. The controller daughter board plugs into the main board via two 20-pin daughter board connectors. The system can be powered by a 12 to 24 V DC power supply. For safety reasons, and ease of making measurements, use a regulated DC supply. Limit power supply to under five amps.

Place jumpers to route the required signals to the controller. For jumper settings, visit chapter 2.2.4 ADC Configuration Header JP1.

A step-by-step setup procedure for the main board is available in the *3-Phase BLDC/PMSM Motor Control Drive Users Manual* LVMCDBLDCPMSMUG.

<div style="text-align:center">

WARNING
Check the power supply voltage before plugging in the Controller Daughter Board. If an input voltage higher than 24 V is applied, the controller daughter board can be damaged.

</div>

1.4 Board Description

The Controller Daughter Board is populated with an MC9S08MP16 8-bit HCS08 controller. All the necessary signals are available on two 20-pin Rib-cage connectors, J1 and J2. BDM header J3 is used for program upload onto the controller. Headers J4 and JP1 are configuration headers and are used for board configuration. For more details, look into 2.2.3 Configuration Header J4 and 2.2.4 ADC Configuration Header JP1.

Board schematic is available in Appendix A. MC9S08MP16 Controller Daughter Board for BLDC/PMSM Motor Control Drive Schematics.

Chapter 2
Pin Description

2.1 Introduction

Inputs and outputs are located on seven connectors and headers available on the board:

- Two 20-pin daughter board connectors J1, J2
- BDM header J3
- Configuration header J4
- ADC configuration header JP1

Pin descriptions for each connector and header are identified in the following information.

Figure 2-1 shows the pin assignments for the daughter board connectors J1 and J2.

Table 2-1 and Table 2-2 show the signal descriptions. JP1 configuration header is used to share AD converter inputs for BEMF voltages and phase currents.

2.2 Signal Descriptions

Pin descriptions are identified in this subsection.

2.2.1 Daughter Board Connectors J1 and J2

Signal inputs and outputs for interconnection with the 3-Phase BLDC/PMSM LV Motor Control Drive are situated on two 20-pin connectors, located on the board's bottom-side. Figure 2-1 shows the pin assignments. This figure shows the physical layout of the connectors, assuming that the board is oriented upside down (bottom is up). Table 2-1 and Table 2-2 contain the lists of signal descriptions for connectors J1 and J2.

Table 2-1 Daughter Board Connector J1 — Signal Descriptions

Pin #	Signal Name	Description
1	GND	Digital and power ground
2	+3.3V	Digital +3.3 V power supply
3	No Connect	
4	No Connect	
5	PWM_AT	Gate-drive signal for the top half-bridge of phase A. A logic low turns on phase A's top switch.

## Table 2-1 Daughter Board Connector J1 — Signal Descriptions (Continued)

Pin #	Signal Name	Description
6	PWM_AB	Gate-drive signal for the bottom half-bridge of phase A. A logic high turns phase A's bottom switch on.
7	PWM_BT	Gate-drive signal for the top half-bridge of phase B. A logic low turns on phase B's top switch.
8	PWM_BB	Gate-drive signal for the bottom half-bridge of phase B. A logic high turns phase B's bottom switch on.
9	PWM_CT	Gate-drive signal for the top half-bridge of phase C. A logic low turns on phase C's top switch.
10	PWM_CB	Gate-drive signal for the bottom half-bridge of phase C. A logic high turns phase C's bottom switch on.
11	OC	Overcurrent signal from the 3-phase bridge driver.
12	INT	Interrupt signal from the 3-phase bridge driver.
13	TxD	TxD signal between JM60 and the Controller Daughter Board.
14	RxD	RxD signal between JM60 and the Controller Daughter Board.
15	TOGGLE_SWITCH_ON1	Toggle-switch input (switch in position ON1) on the BLDC drive.
16	TOGGLE_SWITCH_ON2	Toggle-switch input (switch in position ON2) on the BLDC drive.
17	UP_SWITCH	UP switch input.
18	DOWN_SWITCH	DOWN switch input.
19	USER_LED	USER LED signal.
20	/RESET	$\overline{\text{RESET}}$ signal.

Table 2-2 Daughter Board Connector J2 — Signal Descriptions

Pin #	Signal Name	Description
1	GNDA	Analog-power supply ground.
2	+3.3VA	Analog +3.3 V power supply.
3	I_sense_A	Analog-sense signal that measures current in phase A. It is scaled at 50 V per amp of DC-bus current.
4	I_sense_B	Analog-sense that measures current in phase B. It is scaled at 0.563 V per amp of DC-bus current.
5	I_sense_C	Analog-sense signal that measures current in phase C. It is scaled at 0.563 V per amp of DC-bus current.
6	BEMF_sense_A	Analog-sense signal that measures phase A back-EMF. It is scaled at 8.09 mV per volt of DC-bus voltage.

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Table 2-2 Daughter Board Connector J2 — Signal Descriptions (Continued)

Pin #	Signal Name	Description
7	BEMF_sense_B	Analog-sense signal that measures phase B back-EMF. It is scaled at 8.09 mV per volt of DC-bus voltage.
8	BEMF_sense_C	Analog-sense signal that measures phase C back-EMF. It is scaled at 8.09 mV per volt of DC-bus voltage.
9	V_sense_DCB	Analog-sense signal that measures bus voltage. It is scaled at 8.09 V per volt of DC-bus voltage.
10	V_sense_DCB/2	Analog-sense signal that measures half of bus voltage. It is scaled at 4.05 V per volt of DC-bus voltage.
11	I_sense_DCB	Analog-sense signal that measures bus current. It is scaled at 0.563 V per amp of DC-bus current.
12	ENC_PhaseA	Encoder or Hall sensor Phase A input pin logic.
13	ENC_PhaseB	Encoder or Hall sensor Phase B input pin logic.
14	ENC_Index	Encoder Index or Hall sensor Phase C input pin logic.
15	DRV_EN	3-phase bridge gate driver enable signal.
16	/SS	SPI pin chip select pin for the 3-phase bridge driver.
17	MOSI	SPI pin Master Out Slave In pin for the 3-phase bridge driver.
18	SCLK	SPI pin Clock Source pin Input for the 3-phase bridge driver.
19	MISO	SPI pin Master In Slave Out pin for the 3-phase bridge driver.
20	GND	Digital and power ground.
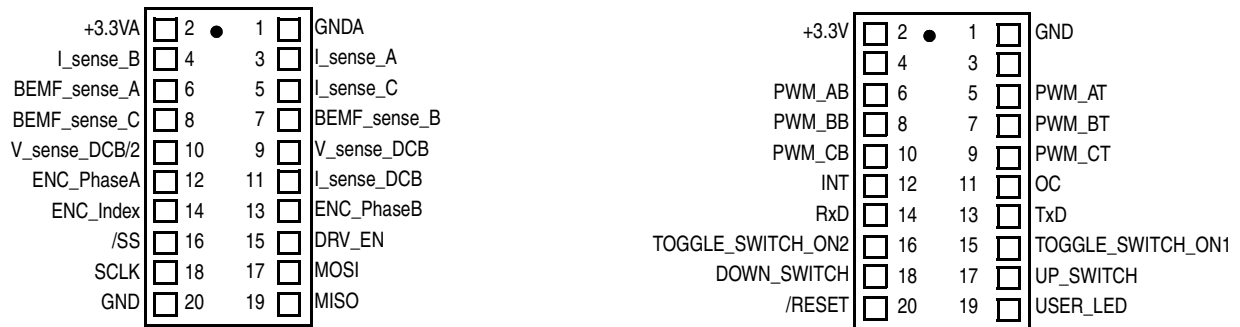
Figure 2-1 J2 and J1 Connector Physical View

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2.2.2 BDM Header J3

This serves for updating the software for the MC9S08MP16 controller. Signals are described in Table 2-3.

Table 2-3 BDM Header J3 — Signal Descriptions

Pin #	Signal Name	Description
1	BKGD/MS	Background debug pin
2	GND	Digital ground
3	No Connect	
4	/RESET	$\overline{\text{RESET}}$ signal
5	No Connect	
6	+3.3V	Digital +3.3 V power supply

2.2.3 Configuration Header J4

Configuration header J4 serves for connecting OC signal or INT signal to the controller FTM2FAULT pin. Table 2-4 shows the jumper setting for selected function.

Table 2-4 Configuration Header J4 — Signal Descriptions

Pin shorted	Signal Name	Description
1–2	OC	Overcurrent signal connected to the FTM2FAULT
2–3	INT	Interrupt signal connected to the FTM2FAULT

2.2.4 ADC Configuration Header JP1

Table 2-5 shows the ADC Configuration Headers pin description. Headers select if the BEMF voltages or phase currents are routed to the controller ADC inputs ADP1, ADP4, and ADP5.

Table 2-5 ADC Configuration Header JP1 — Signal Descriptions

ADC input	Pins shorted	Signal Name	Description
ADP1	1–2	I_sense_A	Analog-sense signal that measures current in phase A.
	3–4	BEMF_sense_A	Analog-sense signal that measures phase A back-EMF.

ADC input	Pins shorted	Signal Name	Description
ADP4	5–6	I_sense_B	Analog-sense signal that measures current in phase B.
	7–8	BEMF_sense_B	Analog-sense signal that measures phase B back-EMF.
ADP5	9–10	I_sense_C	Analog-sense signal that measures current in phase C.
	11–12	BEMF_sense_C	Analog-sense signal that measures phase C back-EMF.

Appendix A.
MC9S08MP16 Controller Daughter Board for BLDC/PMSM Motor Control Drive Schematics
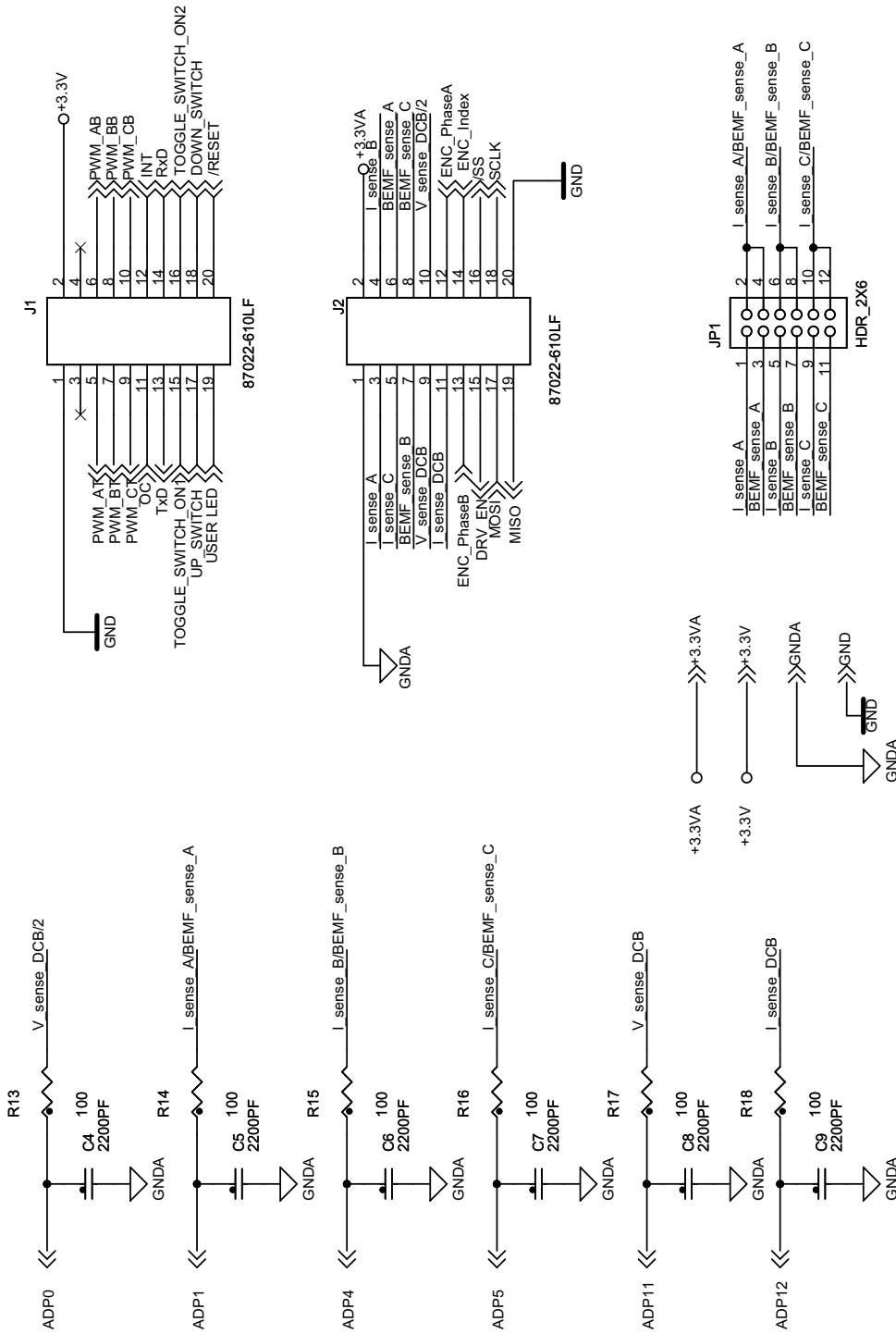
Figure A-1 Daughter Board Connectors, Filters, and ADC Configuration Header JP1
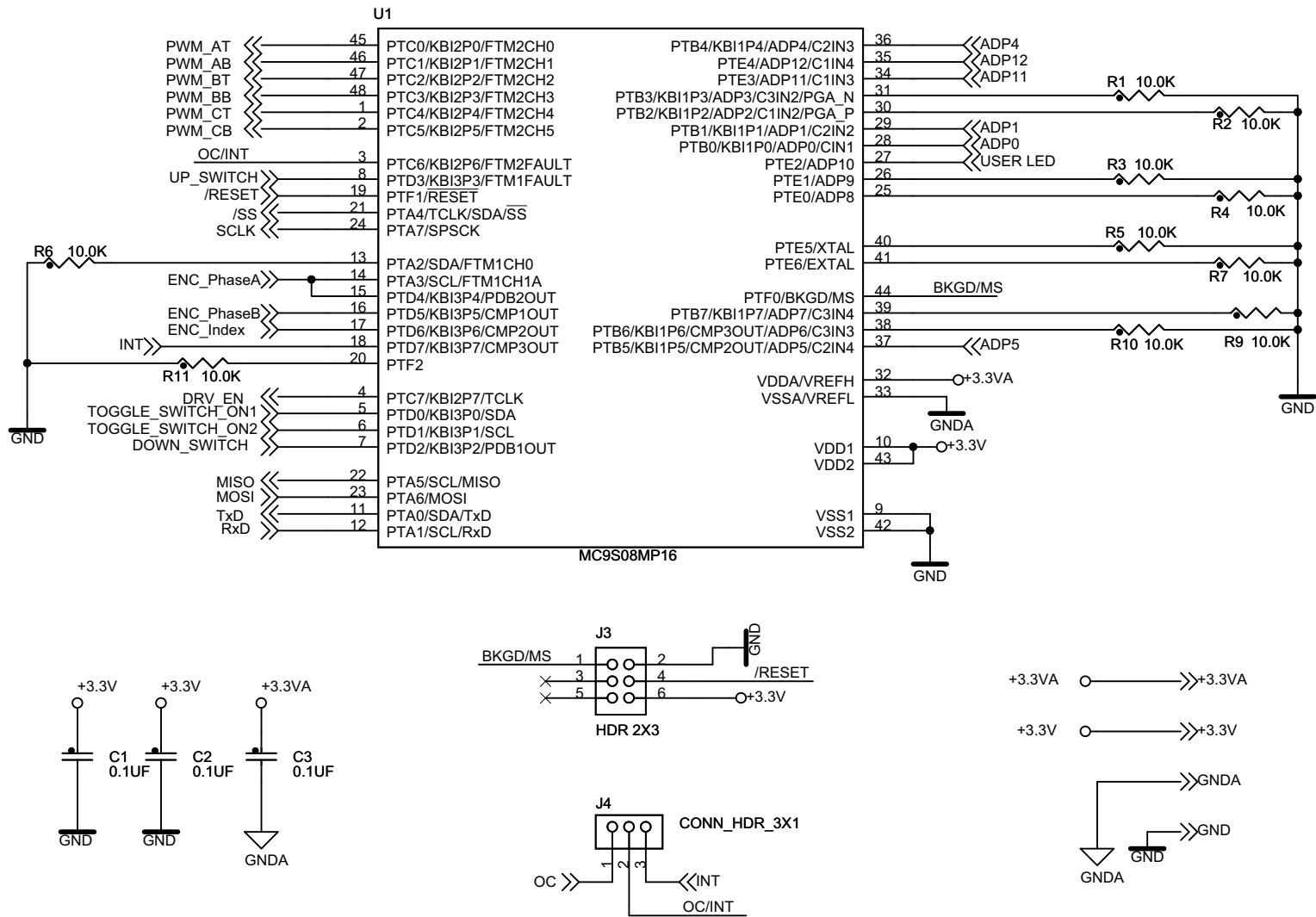
Figure A-2 Controller and Headers

Appendix B.
Bill of Materials

Table B-1 Parts List

DESIGNATORS	QUANTITY	DESCRIPTION	MANUFACTURER	PART NUMBER
C1-C3	2	100 nF/6.3 V size 0805	ANY ACCEPTABLE	—
C4-C9	5	100 pF/6.3 V size 0805	ANY ACCEPTABLE	—
J1, J2	2	87022-610	FCI	87022-610LF
J3	1	HDR 2x3	TYCO ELECTRONICS	1-87215-2
J4	3	HDR 1x3	TYCO ELECTRONICS	87220-3
JP1	1	HDR 2x6	TYCO ELECTRONICS	87215-3
R1-R7, R9-R11	10	10 kΩ Resistor 1/8 W size 0805	ANY ACCEPTABLE	—
R13-R18	6	100 Ω Resistor 1/8 W 1 % size 0805	ANY ACCEPTABLE	—
U1	1	8-bit HCS08 controller/LQFP-48	FREESCALE SEMICONDUCTOR	MC9S08MP16CLF

Appendix C.
MC9S08MP16 Controller Daughter Board for BLDC/PMSM Motor Control Drive Layouts

Figure C-1 Board Top Layer

Figure C-2 Board Bottom Layer

Figure C-3 Board Silkscreen Top Layer

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