MC56F8006 Controller Daughter Board for BLDC/PMSM Motor Control Drive

Users Manual

MC56F8006DBUM

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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)
01/2009	0	Initial release	N/A

Chapter 1
Board Overview

1.1 MC56F8006 Controller Daughter Board for BLDC/PMSM Motor Control Drive Outline

Freescale's MC56F8006 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. MC56F8006 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 MC56F8006 Controller Daughter Board

1.3 Setup Guide

Setup and connections for the MC56F8006 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 2.2.1 Configuration Header J1 and 2.2.2 ADC Configuration Headers J5, J6.

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

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.

1.4 Board Description

The Controller Daughter Board is populated with an MC56F8013 or MC56F8023 digital signal controller (DSC). All the necessary signals are available on two 20-pin Rib-cage connectors, J6 and J7. Headers J1, J2, J4, and J5 are configuration headers and are used for board configuration. For more details, see 2.2.1 Configuration Header J1 and 2.2.2 ADC Configuration Headers J5, J6. JTAG header J3 is used for uploading the program onto the controller.

Board schematic is available in Appendix A. MC56F8006 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:

- Configuration header J1
- ADC configuration headers J5, J6
- JTAG header J2
- Two 20-pin daughter board connectors J3, J4

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 J3 and J4. Table 2-5 and Table 2-6 show the signal descriptions. Several configuration headers are used because the MC56F8006 controller in the LQFP32 package doesn't have enough pins.

2.2 Signal Descriptions

Pin descriptions are identified in this subsection.

2.2.1 Configuration Header J1

Configuration header J1 serves for connecting the ENCODER Index/Hall sensor phase C signal or the RxD signal for SCI communication to the controller GPIOB6 pin. Table 2-1 shows the jumper settings for the selected function.

Table 2-1 Configuration Header J1

Pins shorted	Signal Name	Description
1–2	ENC_Index	ENCODER Index or Hall sensors Phase C input
2–3	RxD	RxD signal for SCI communication

2.2.2 ADC Configuration Headers J5, J6

Table 2-2 and Table 2-3 show the ADC Configuration Headers pin description. Header J5 selects, if the BEMF voltages or phase currents are routed to the controller ADC inputs. Header J6 selects, if the DC-bus current or phase currents are routed to the controller ADC input.

Table 2-2 ADC Configuration Header J5 — Signal Descriptions

Header #	Pins shorted	Signal Name	Description
5	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.
	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.
	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.

Table 2-3 ADC Configuration Header J6 — Signal Descriptions

Header #	Pins shorted	Signal Name	Description
6	1–2	I_sense_DCB	Analog-sense signal that measures current in phase DC-bus.
	2–3	I_sense_A	Analog-sense signal that measures current in phase A.

2.2.3 JTAG Header J3

This serves for updating the software for the MC56F8006 controller. Signals are described in Table 2-4.

Table 2-4 JTAG Header J2 — Signal Descriptions

Pin #	Signal Name	Description
1	TDI	Test data input signal
2	GND	Digital ground
3	TDO	Test data output signal
4	GND	Digital ground
5	TCK	Test clock input signal
6	GND	Digital ground

Table 2-4 JTAG Header J2 — Signal Descriptions (Continued)

Pin #	Signal Name	Description
7	No Connect	
8	No Connect	
9	/RESET	$\overline{\text{RESET}}$ signal
10	TMS	Test mode select input signal
11	+3.3V	Digital +3.3 V power supply
12	No Connect	
13	No Connect	
14	No Connect	

2.2.4 Daughter Board Connectors J3 and J4

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 2-5 and Table 2-6 contain the lists of signal descriptions for connectors J6 and J7.

Table 2-5 Daughter Board Connector J3 — Signal Descriptions

Pin #	Signal Name	Description
1	GND	Digital and power ground
2	+3.3V	Digital +3.3 V power supply
3	NC	
4	NC	
5	PWM_AT	Gate-drive signal for the top half-bridge of phase A. A logic low turns on phase A's top switch.
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

Table 2-5 Daughter Board Connector J3 — Signal Descriptions (Continued)

Pin #	Signal Name	Description
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 2-6 Daughter Board Connector J4 — 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.
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 bus voltage. It is scaled at 8.09 V per volt of DC-bus voltage.
11	I_sense_DCB	Analog-sense signal that measures bus current. It is scaled at 8.09 V per amp of DC-bus current.
12	ENC_PhaseA	Encoder or Hall sensor Phase A input pin logic

Table 2-6 Daughter Board Connector J4 — Signal Descriptions (Continued)

Pin #	Signal Name	Description
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

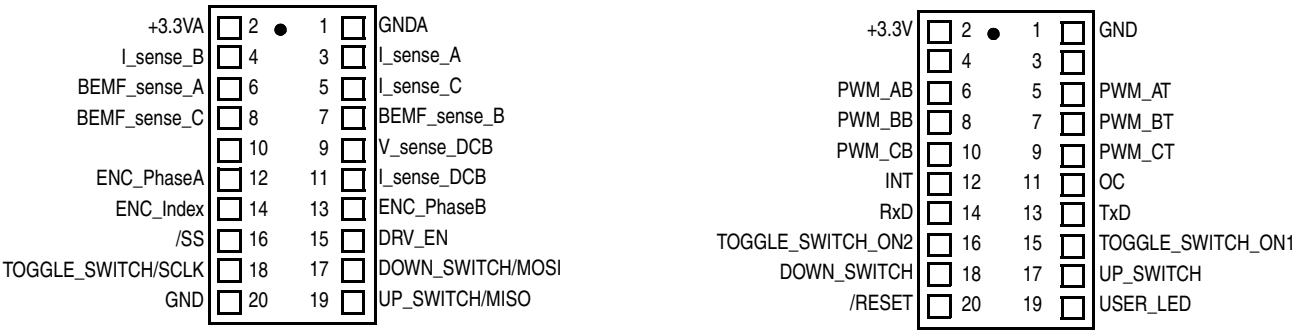

Figure 2-1 J3 and J4 Connector Physical View on Daughter Board

Appendix A.
MC56F8006 Controller Daughter Board for BLDC/PMSM Motor Control Drive Schematics

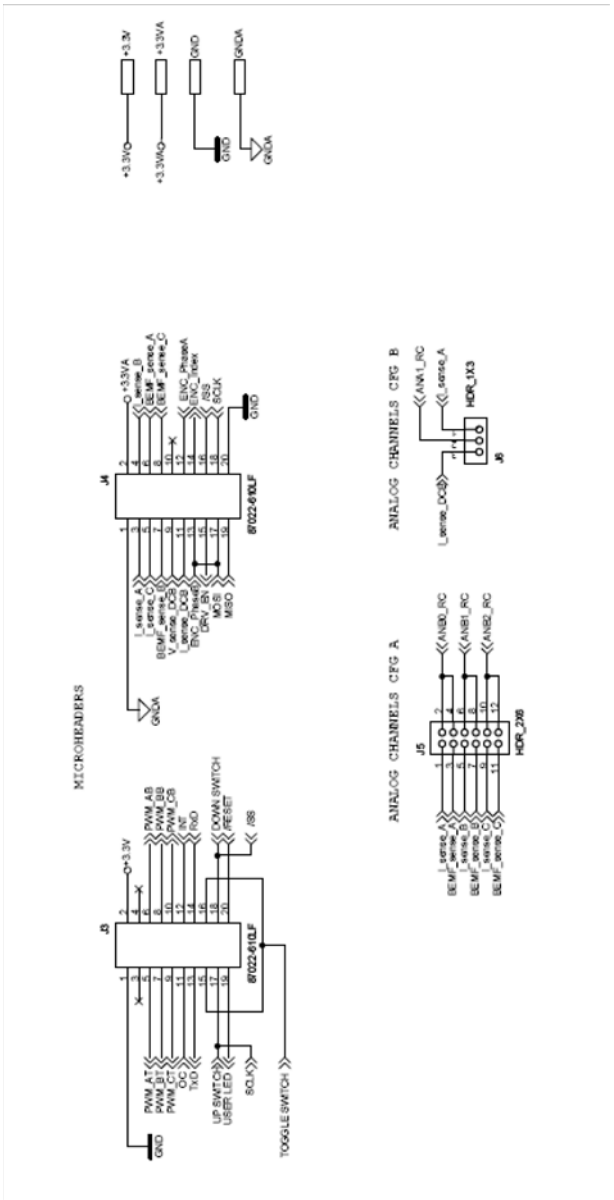

Figure A-1 Daughter Board Connectors and Headers

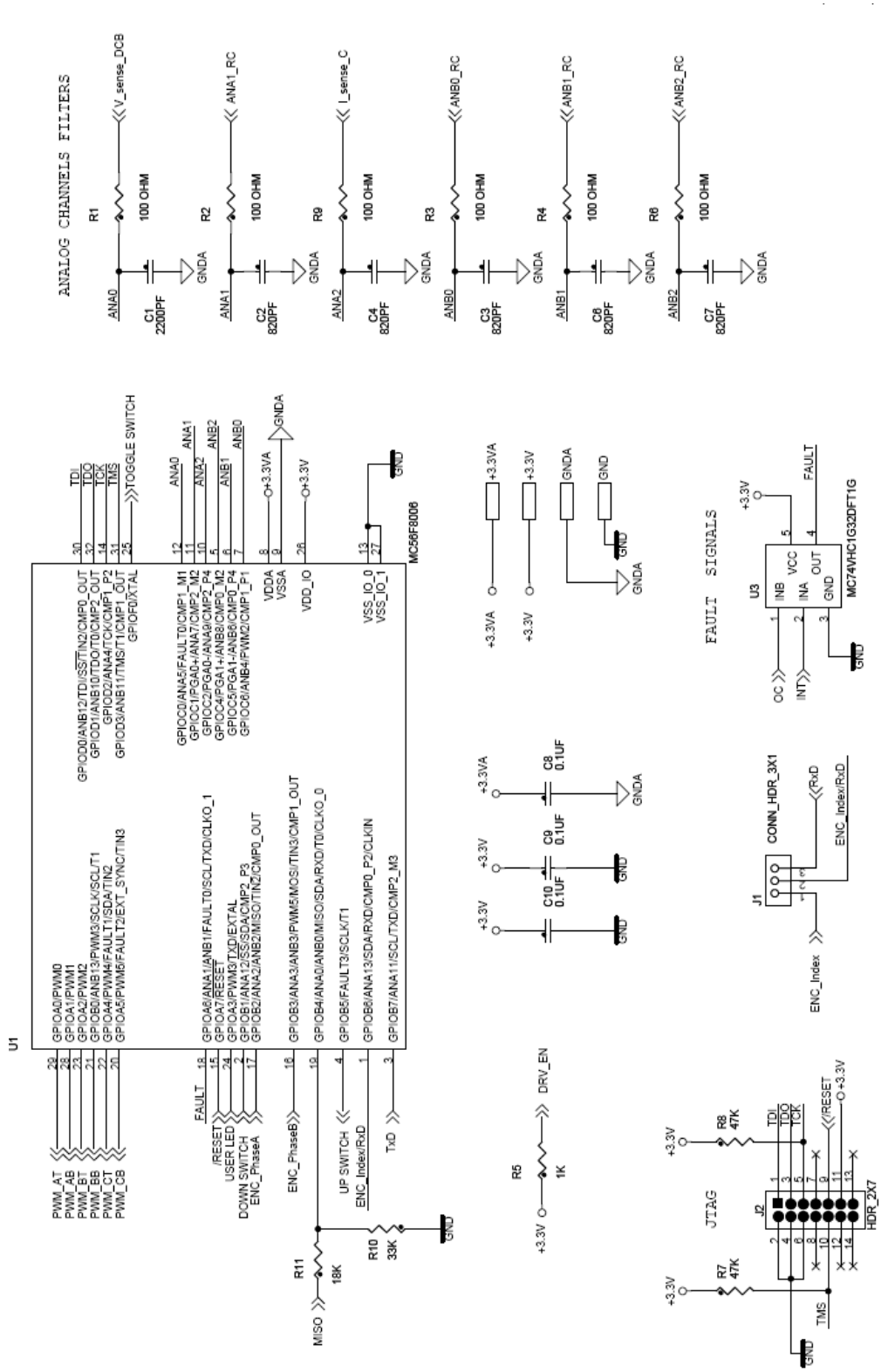

Figure A-2 Controller and Headers

Appendix B.
Bill of Materials

Table B-1 Parts List

DESIGNATORS	QUANTITY	DESCRIPTION	MANUFACTURER	PART NUMBER
C2,C2,C4,C6,C7	5	820 pF/6.3 V size 0805	ANY ACCEPTABLE	—
C1	1	2200 pF/ 6.3 V size 0805	ANY ACCEPTABLE	—
C8,C9,C10	3	100 nF/6.3 V size 0805	ANY ACCEPTABLE	—
J1,J6	2	HDR 3x1	MOLEX	09-65-2038
J2	1	HDR 2x7	TYCO ELECTRONICS	4-103322-2
J3,J4	2	87022-610	FCI	87022-610LF
J5	1	HDR 2x6	TYCO ELECTRONICS	
R1,R2,R3,R4,R6, R9	6	100 Ω Resistor 1/8 W 1 % size 0805	ANY ACCEPTABLE	—
R5	1	1 kΩ Resistor 1/8 W size 0805	ANY ACCEPTABLE	—
R7,R8	2	47 kΩ Resistor 1/8 W size 0805	ANY ACCEPTABLE	—
R10	1	33 kΩ Resistor 1/8 W size 0805	ANY ACCEPTABLE	—
R11	1	18 kΩ Resistor 1/8 W size 0805	ANY ACCEPTABLE	—
U1	1	digital signal controller/LQFP-32	FREESCALE SEMICONDUCTOR	MC56F8006VLC
U2	1	two-input OR gate	ON SEMICONDUCTOR	MC74VHC1G32DFT1G

Appendix C.
MC56F8006 Controller Daughter Board for BLDC/PMSM Motor Control Drive Layouts

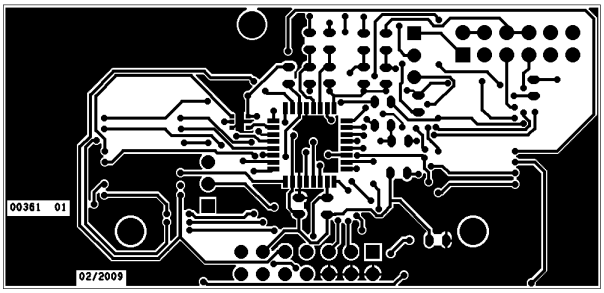

Figure C-1 Board Top Layer

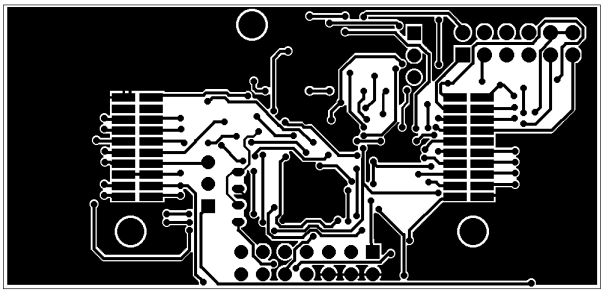

Figure C-2 Board Top Layer

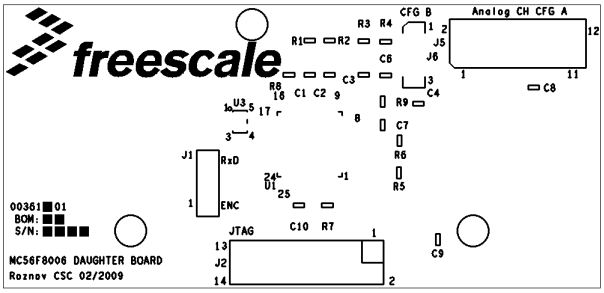

Figure C-3 Board Top Layer

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