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Z8FMC16100 Series Motor Control Development Kit

User Manual

UM019206-1011

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Revision History

Each instance in the Revision History table below reflects a change to this document from its previous version. For more details, click the appropriate links in the table.

Date	Revision Level	Description	Page No
Oct 2011	06	Corrected erroneous kit references; updated Figure 3.	All, 6
Aug 2011	05	Updated schematic diagram in Figure 7 to Rev C per CR#13164.	16
Feb 2008	04	Updated Zilog logo, Zilog text, and Foreword section.	All
Nov 2006	03	Corrected Vcc_33V to Vcc_3.3V.	All
Jul 2005	02	Updated MCU description.	4
Jun 2005	01	Original issue.	

Table of Contents

Introduction

Zilog's Z8FMC16100 Series Motor Control Development Kit helps you to develop motor control applications using Zilog's 32-LQFP Z8FMC16100 Motor Control MCU. This development kit provides an application-specific platform for creating a design based on the Z8FMC16100 Series microcontroller, and features a Motor Control Motor Driver System (MC MDS) Module mounted on a 3-Phase Motor Control Application Board. A 24VDC, 3200RPM 3-phase motor is included with the kit.

Kit Features

The key features of the Z8FMC16100 Series Motor Control Development Kit include:

- MC MDS Module
- 3-Phase Motor Control Application Board
- USB Smart Cable with opto-isolator
- 3-phase 24VDC, 30W, 3200RPM motor with spade connectors and Internal Hall Sensors (powered by external adjustable 24VDC supply not included in kit)
- Universal 5VDC power supply
- Motor Control Software and Documentation CD-ROM

For Z8FMC16100 Series Motor Control Development Kit installation and setup instructions, refer to Z8FMC16100 Series Motor Control Development Kit Quick Start Guide (QS0054).

Development Kit Block Diagram

Figure 1 displays a block diagram of the Z8FMC16100 Series Motor Control Development Kit.

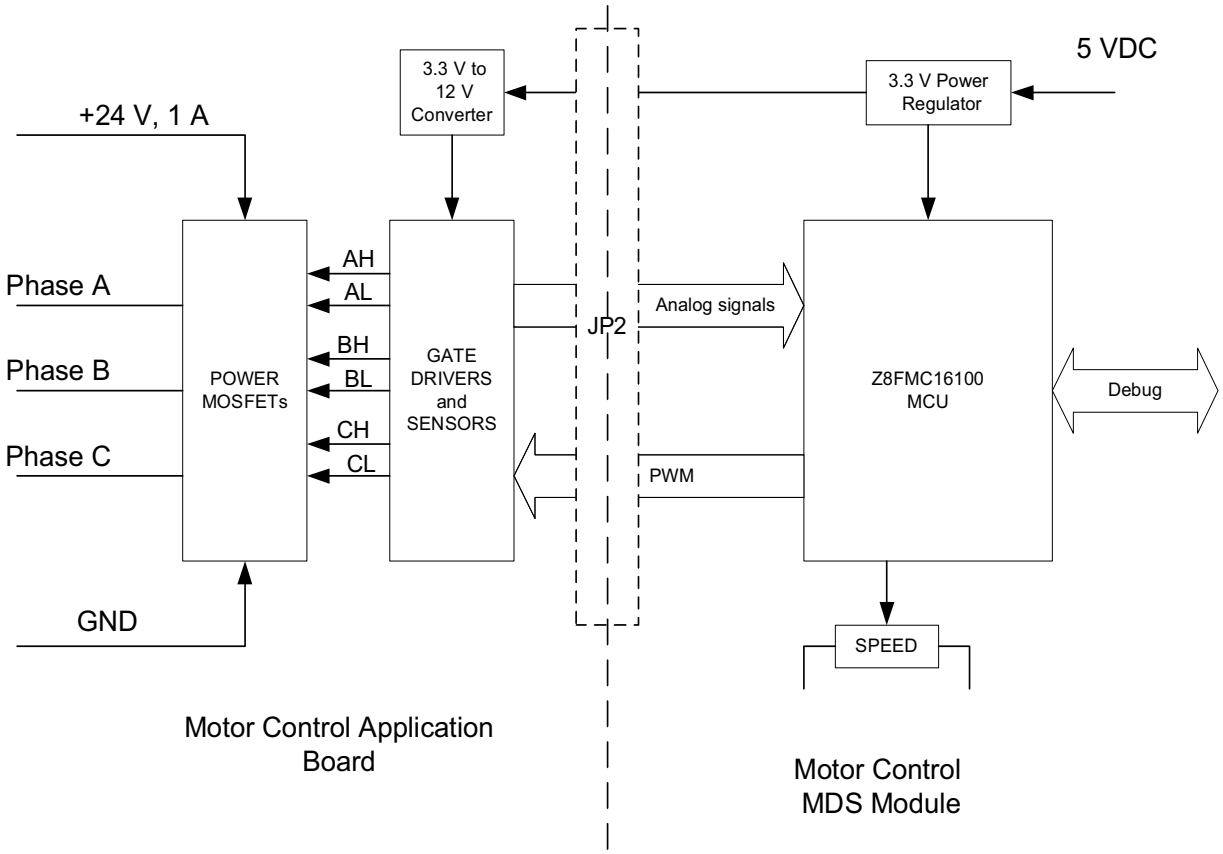

Figure 1. Z8FMC16100 Series Motor Control Development Kit Block Diagram

MC MDS Module Description

The MC MDS Module consists of a Z8FMC16100 MCU and circuitry that interfaces the chip to an external development PC running the Zilog Developer Studio II Integrated Development Environment (ZDSII IDE) and to the 3-Phase Motor Control Application Board. It also provides a prototype area for use. A diagram of the MC MDS Module is shown in Figure 2.

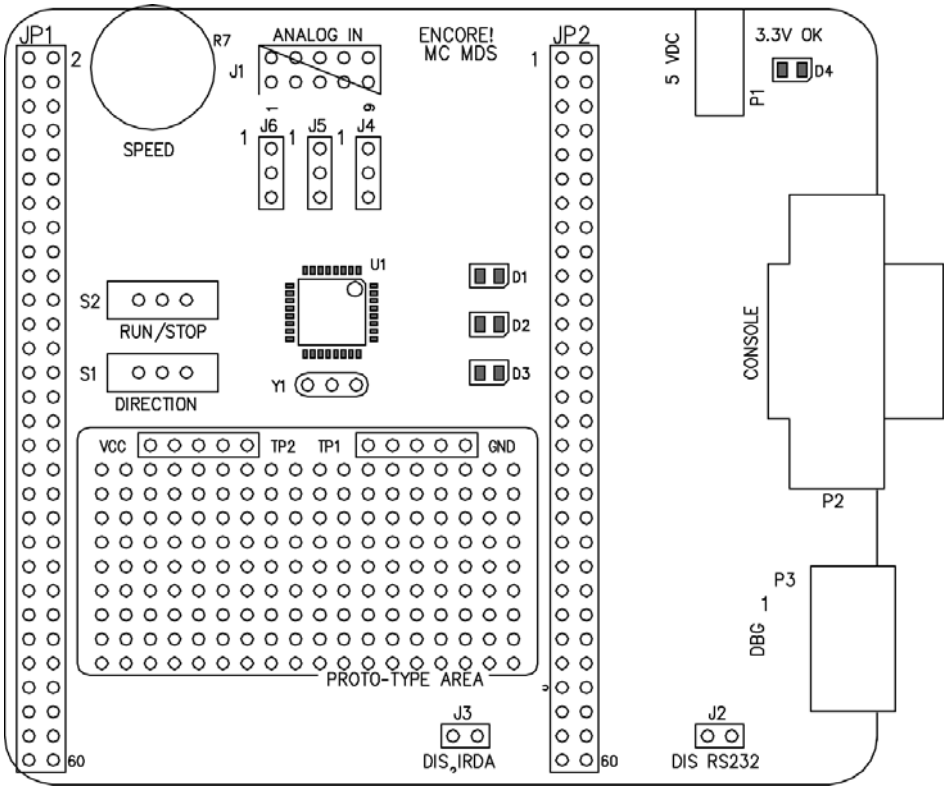

Figure 2. MC MDS Module

Features

The features of the MC MDS Module include:

- Z8FMC16100 device operating at 20MHz, with 16KB of internal Flash memory and 512B of internal register SRAM
- 20MHz ceramic resonator Y1
- Two SPDT switches, S1 and S2 (labeled DIRECTION and RUN/STOP, respectively)
- One 5K potentiometer, R7 (labeled SPEED)
- Green LED D4 (illuminates when 3.3 VDC is applied to the board)
- Three general-purpose LEDs D1, D2, and D3
- IRDA interface
- RS-232 port
- 6-pin DBG interface
- Two 60-pin headers for connecting to the 3-Phase Motor Control Application Board (JP1 and JP2; JP1 used for physical mounting only)

MCU

The Z8FMC16100 Series Flash microcontrollers, a part of the Z8 Encore! MC™ family of motor control devices are based on Zilog's advanced eZ8 8-bit CPU core. Optimized for motor control applications, these devices support the control of single and multi-phase variable-speed motors. Target applications are large appliances, small appliances, and HVAC.

The Z8FMC16100 Series Motor Control Development Kit consists of circuitry to support and present all the features of the Z8FMC16100 MCU. The key features of the Z8FMC16100 MCU include:

- 20MHz Zilog eZ8 CPU core
- 16KB Flash Program Memory
- 512B Register SRAM
- Fast 8-channel 10-bit Analog-to-Digital Converter (ADC) for current sampling and back-EMF detection
- 12-bit pulse-width modulator (PWM) module with three complementary pairs or six independent PWM outputs with dead-band generation and fault trip input
- One 16-bit timer with capture/compare/PWM capability

- One analog comparator for current limiting or over-current shutdown
- Operational Amplifier
- I^2C in MASTER, SLAVE or MULTIMASTER modes
- Serial Peripheral Interface (SPI)
- Universal Asynchronous Receiver/Transmitter (UART) with LIN interface
- IrDA interface with endec
- Internal Precision Oscillator (IPO)
- Oscillator supports either internal IPO or external crystals and ceramic resonators
- Up to 17 General-Purpose Input/Output (GPIO) pins
- Voltage Brownout/Power-On Reset (VBO/POR)
- Watchdog Timer (WDT) with internal RC oscillator
- Single-pin on-chip debugger
- In-circuit serial programming
- Operation at 2.7V to 3.6V
- 32-LQFP package
- Standard temperature range: 0º to 70º (S)

For more information about the Z8FMC16100 MCU, refer to the Z8FMC16100 Series Product Specification (PS0246) or the Z8FMC16100 Series Product Brief (PB0166). Each of these documents is available in the kit CD-ROM and for download on www.zilog.com.

Connector JP2

Connector JP2 is a 60-pin header that connects I/O from the Z8FMC16100 MCU to the 3-Phase Motor Control Application Board. Figure 3 displays the pin layout. Table 1 on page 7 identifies the signals and their functions.

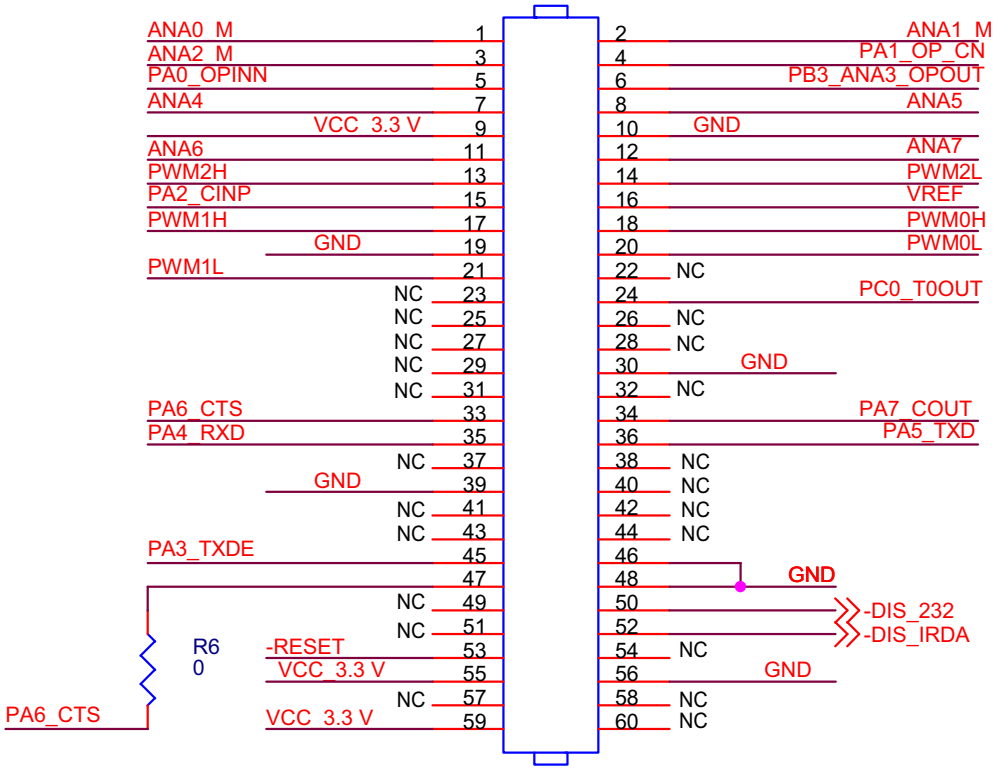

Figure 3. MC MDS Board Connector JP2

Table 1. Connector JP2 Signal Descriptions

Signal	Pin Number	Direction (with respect to MCU)	Description
General-Purpose I/O			
PA1_OP_CN PA0_OPINN PA2_CINP PA6_CTS PA7_COUT PA4_RXD PA5_TXD PA3_TXDE	4 5 15 33 34 35 36 45	I/O	Port A[7:0]. Used for general-purpose I/O.
ANA0_M ANA1_M ANA2_M PB3_ANA3_OPOUT ANA4 ANA5 ANA6 ANA7	1 2 3 6 7 8 11 12	I/O	Port B[7:0]. Used for general-purpose I/O.
PC0_T0OUT	24	I/O	Port C[0]. Used for general-purpose I/O.
Pulse-Width Modulator for Motor Control			
PWM2H PWM1H PWM0H	13 17 18	O	PWM High output.
PWM2L PWM0L PWM1L	14 20 21	O	PWM Low output.
$\overline{\text{PA7\_COUT}}$ $\overline{\text{RESET}}$	34 53	I	PWM FAULT condition input. $\overline{\text{FAULT0/RESET}}$ is active Low, FAULT1/PA7_COUT is active High.
Timers			
PC0_T0OUT PA7_COUT	24 34	O	General-Purpose Timer Outputs.
ANA0_M ANA1_M ANA2_M	1 2 3	I	General-Purpose Timer Inputs—Used as capture, gating and counter inputs.

Table 1. Connector JP2 Signal Descriptions (Continued)

Signal	Pin Number	Direction (with respect to MCU)	Description
UART Controller			
PA5_TXD	36	O	Transmit Data—This signal is the transmit output from the UART and IrDA.
PA4_RXD	35	I	Receive Data—This signal is the receiver input for the UART and IrDA.
PA6_CTS	33	I	Clear To Send signal from the receiving device that is ready to receive data.
PA3_TXDE	45	O	Driver Enable—This signal allows automatic control of external RS-485 drivers. The DE signal ensures that an external RS-485 driver is enabled when data is transmitted by the UART.
Analog			
ANA0_M ANA1_M ANA2_M PB3_ANA3_OPOUT ANA4 ANA5 ANA6 ANA7	1 2 3 6 7 8 11 12	I	Analog Input. These signals are inputs to the ADC.
PA2_CINP	15	I	Comparator positive input.
ANA4	7	I	Comparator negative input.
PA7_COUT	34	O	Comparator output.
PA1_OP_CN	4	I	Operational amplifier positive input.
PA0_OPINN	5	I	Operational amplifier negative input.
PB3_ANA3_OPOUT	6	O	Operational amplifier output.
RESET-PWM Fault			
$\overline{\text{RESET}}$/$\overline{\text{FAULT0}}$	53	I/O	$\overline{\text{RESET}}$ input pin generates a Reset or PWM fault when asserted (driven Low). The function selection is determined by the FLTSEL bit of the User Options Bits at MCU Program Memory Address 0001h, and the FAULTSEL bit in the MCU Reset Status and Control Register.
Power Supply			
VCC_3.3 V	9, 55, 59		3.3VDC Power.
GND	10, 19, 30, 39, 46, 48, 56		Ground.

Jumper and Switch Settings

The MC MDS Module has two SPDT switches (S1 and S2) and a 10KΩ potentiometer (R7) used by the development kit's preloaded demonstration software to perform the following functions:

S1, DIRECTION. Used to change the spin direction of the 3-phase motor.

S2, RUN/STOP. Used to turn the 3-phase motor ON and OFF.

R7, SPEED. Used to adjust the RPM of the 3-phase motor.

The jumpers on the MC MDS Module function as described in Table 2.

Table 2. MC MDS Module Jumper Settings

Jumper	Jumper Name	Shunt Position	Function
J2	DIS_RS232	IN	Disables the RS-232 interface.
		OUT	Enables the RS-232 interface.
J3	DIS_IRDA	IN	Disables the IRDA interface.
		OUT	Enables the IRDA interface.
J4	J4	1–2	Enables external analog input from header J1 (ANA2).
		2–3	Disables external analog input from header J1 (ANA2).
J5	J5	1–2	Enables external analog input from header J1 (ANA1).
		2–3	Disables external analog input from header J1 (ANA1).
J6	J6	1–2	Enables external analog input from header J1 (ANA0).
		2–3	Disables external analog input from header J1 (ANA0).

Physical Dimensions

The footprint of the MC MDS Module's PCB is 9.14cm x 8.12cm. When mounted on the 3-Phase Motor Control Application Board, the overall development kit height is 4.31cm.

3-Phase Motor Control Application Board

The 3-Phase Motor Control Application Board provides circuitry that drives the 3-phase 24 VDC, 3200 RPM motor included with the development kit (see Figure 4). It provides fused 24 VDC inputs for supplying external adjustable workbench power to run the motor, and interfaces the motor to the Z8FMC16100 MCU mounted on the MC MDS Module.

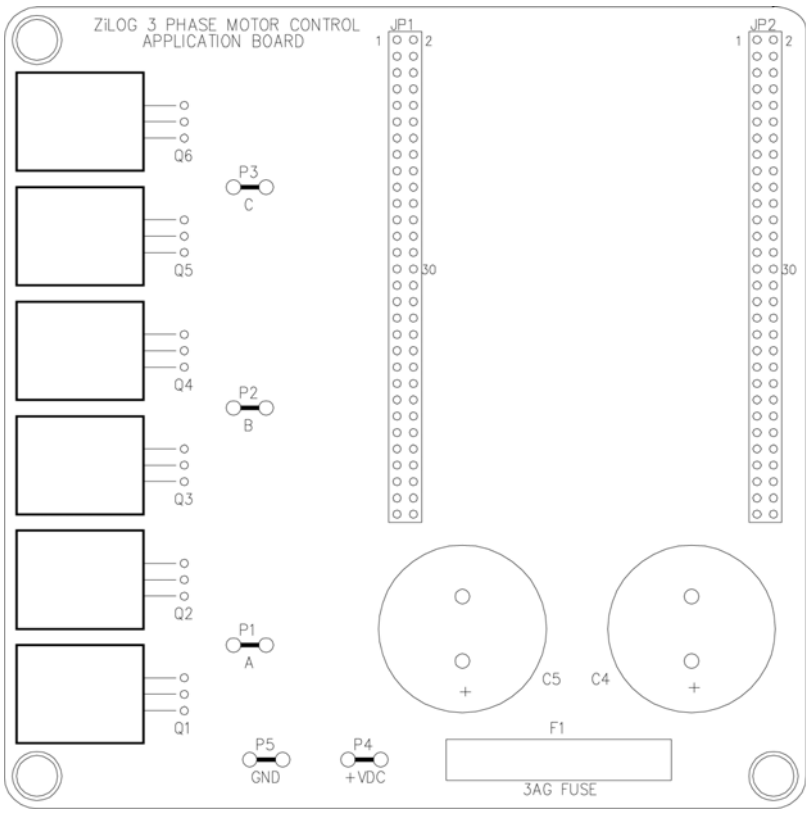

Figure 4. 3-Phase Motor Control Application Board

Features

The features of 3-Phase Motor Control Application Board include:

- Three spade lug connectors, one for each motor phase
- Dual power MOSFETs for each motor phase
- Heat-sink temperature sensor

- Spade lug connectors for power input from adjustable 24VDC power source (for connecting to the 3-phase motor)
- 5A fuse, F1
- Two 60-pin headers for connection to the MC MDS Module (JP1 and JP2; JP1 used for physical mounting only)

Power MOSFETs and Gate Drivers

Each of the phase outputs on spade lugs P1, P2 and P3 are driven by a pair of power MOSFETs, one for the high side and one for the low side. A gate driver circuit is associated with each pair of power MOSFETs.

Fused External Power Interface

An interface to an adjustable 0VDC to 24VDC workbench power supply is provided through spade lug connectors P4 (+) and P5 (–). The input power is fused through 5A 3AG fuse F1.

Physical Dimensions

The footprint of the 3-Phase Motor Control Application Board PCB is 12.44 cm x 12.44cm. With the MC MDS Module mounted on it, the overall development kit height is 4.31 cm.

ZDSII

The Zilog Developer Studio II Integrated Development Environment (ZDSII IDE) is a complete stand-alone system that provides a state-of-the-art development environment. Based on the Windows® Win98SE/NT4.0-SP6/Win2000-SP2/WinXP user interfaces, ZDSII integrates a language-sensitive editor, project manager, C-Compiler, assembler, linker, librarian and source-level symbolic debugger that supports the Z8FMC16100 device.

Troubleshooting and Developer Guidelines

Overview

Before contacting Zilog Customer Support to submit a problem report, please observe the steps that follow. If there is a hardware failure, contact a local Zilog representative for assistance.

Recheck Procedures with the Quick Start Guide

Follow the procedures in the Z8FMC16100 Series Motor Control Development Kit Quick Start Guide (QS0054), and verify that the kit is set up as specified. This quick start guide is available in the Z8FMC16100 Series Motor Control Development Kit.

IrDA Port Not Working

If you plan on using the IrDA transceiver on the MC MDS Module, ensure that the hardware is set up as follows:

- DIS_IRDA jumper J3 must be OUT (shunt not installed) to enable the control gate that drives the IrDA device
- DIS_RS232 jumper J2 must be IN (shunt installed) to disable the console serial port driver

Zilog Customer Support Contact

For additional troubleshooting solutions, refer to *ZDSII Online Help*. For valuable information about customer and technical support, as well as hardware and software development tools, visit the Zilog website at www.zilog.com, where you'll also find the latest released versions of ZDSII.

Linix Motor Wiring Information

The Linix 3-phase motor included with the development kit provides three heavy-gauge wires for phase connections and five light-gauge wires used to power and access internal sensors, as indicated in Table 3.

Table 3. 3-Phase Motor Wiring Information

Wire	Description
Heavy-gauge white wire	Motor Phase A connection
Heavy-gauge blue wire	Motor Phase B connection
Heavy-gauge green wire	Motor Phase C connection
Light-gauge red wire	Sensor power V_{CC} (+)
Light-gauge black wire	Sensor power ground (-)
Light-gauge white wire	Sensor signal S_A
Light-gauge blue wire	Sensor signal S_B
Light-gauge green wire	Sensor signal S_C

Schematics

Figures 5 through 7 display schematic diagrams for the 3-Phase Motor Control Application Board.

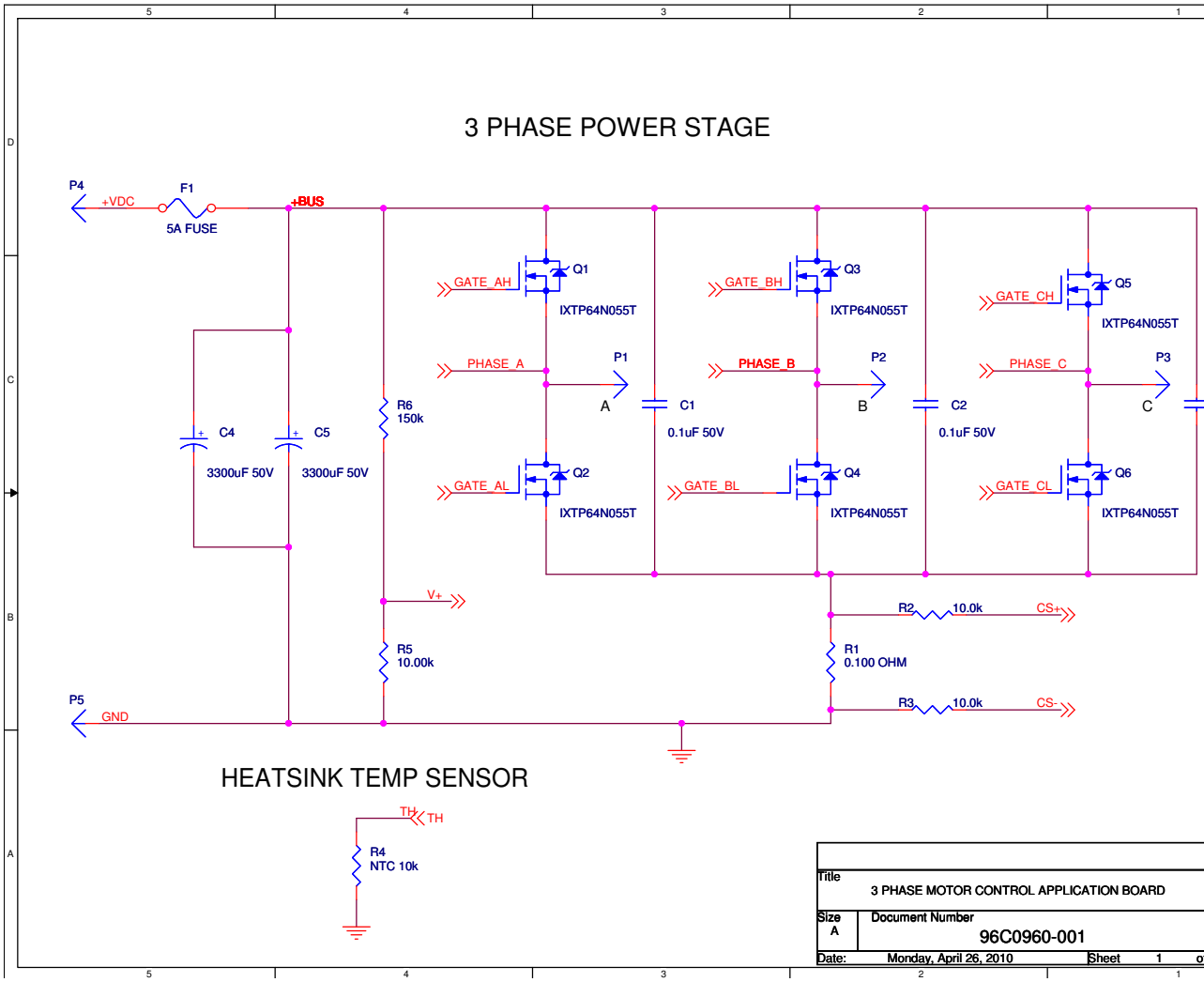

Figure 5. 3-Phase Motor Control Application Board Schematic, #1 of 3

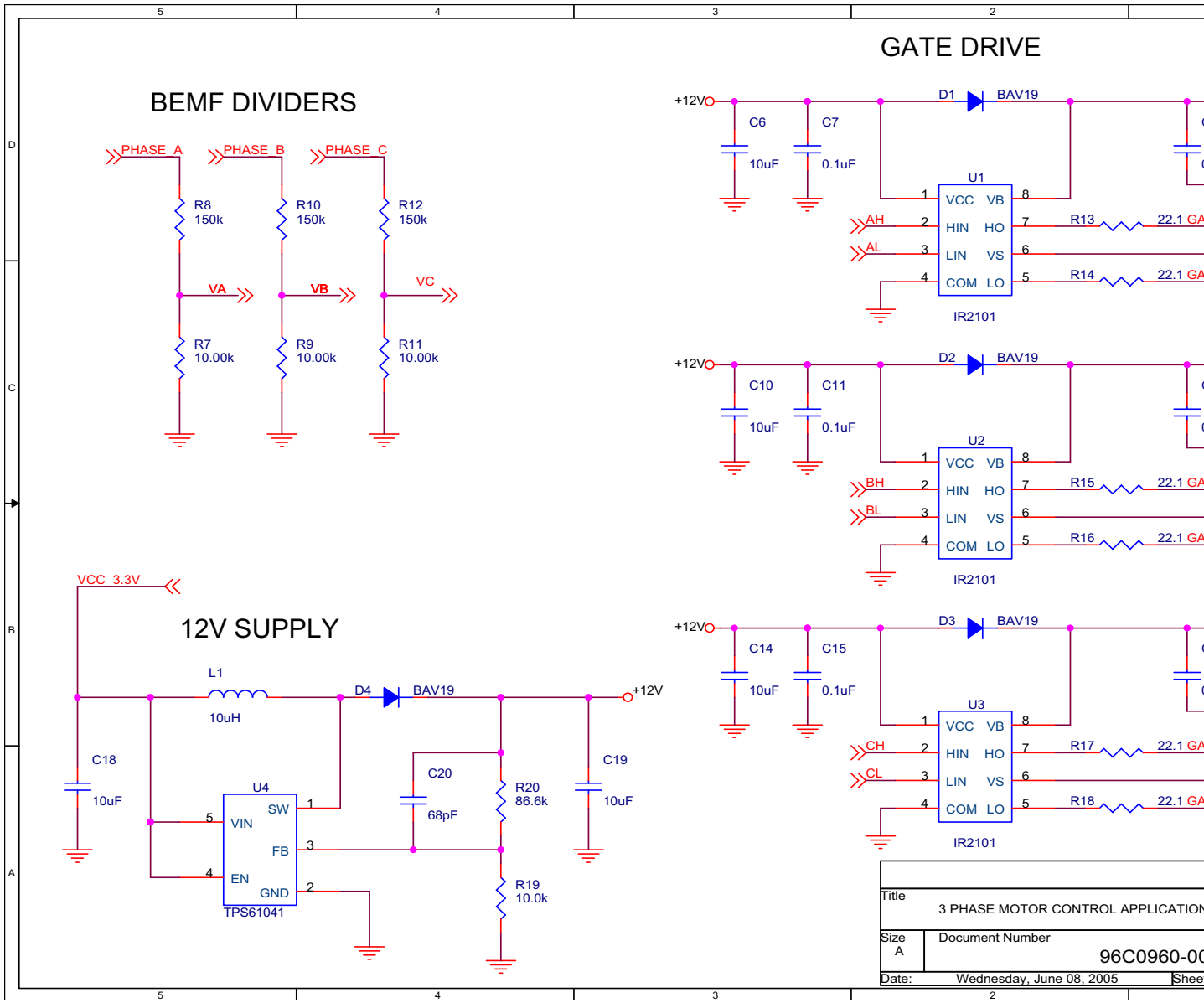

Figure 6. 3-Phase Motor Control Application Board Schematic, #2 of 3

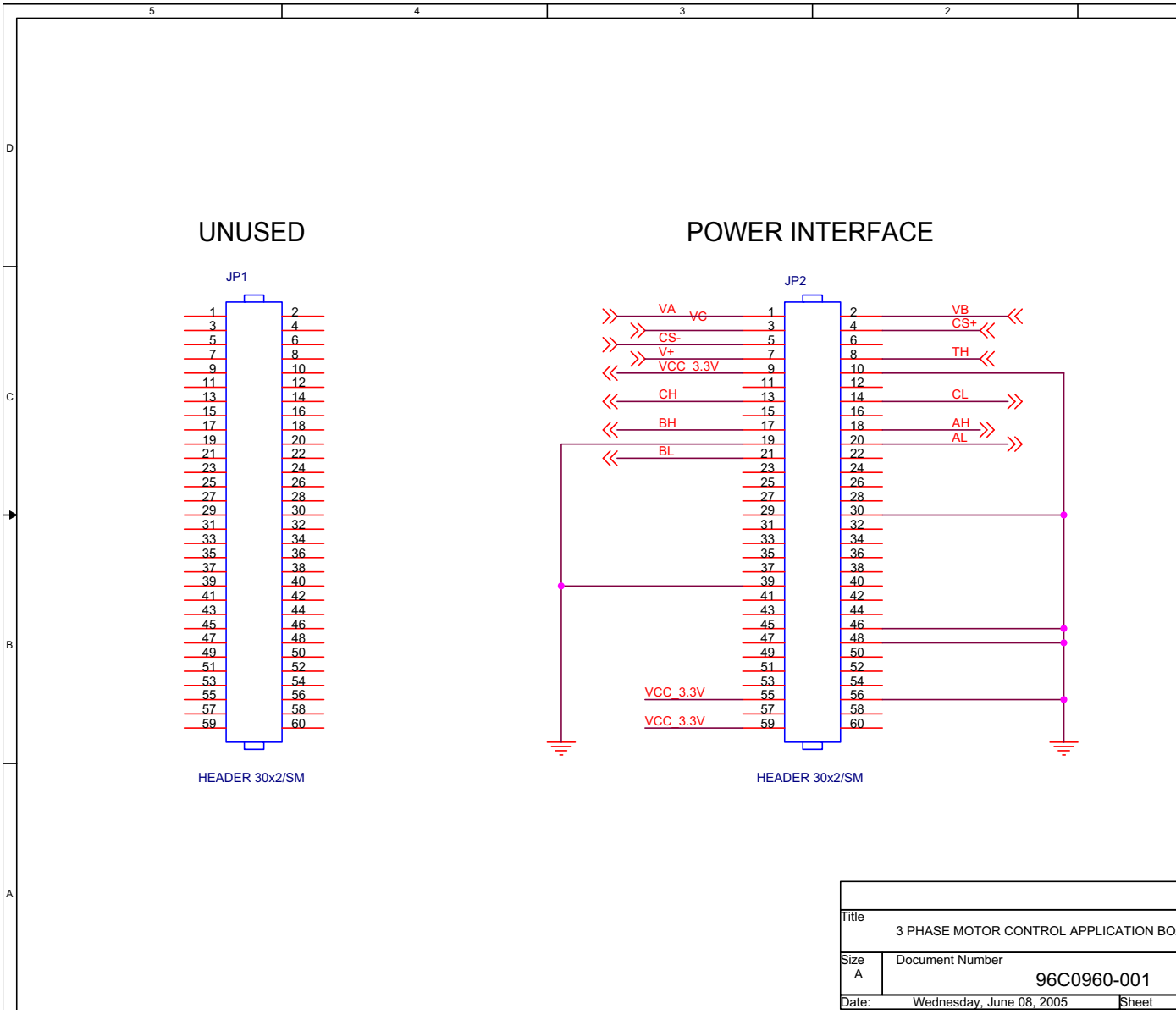

Figure 7. 3-Phase Motor Control Application Board Schematic, #3 of 3

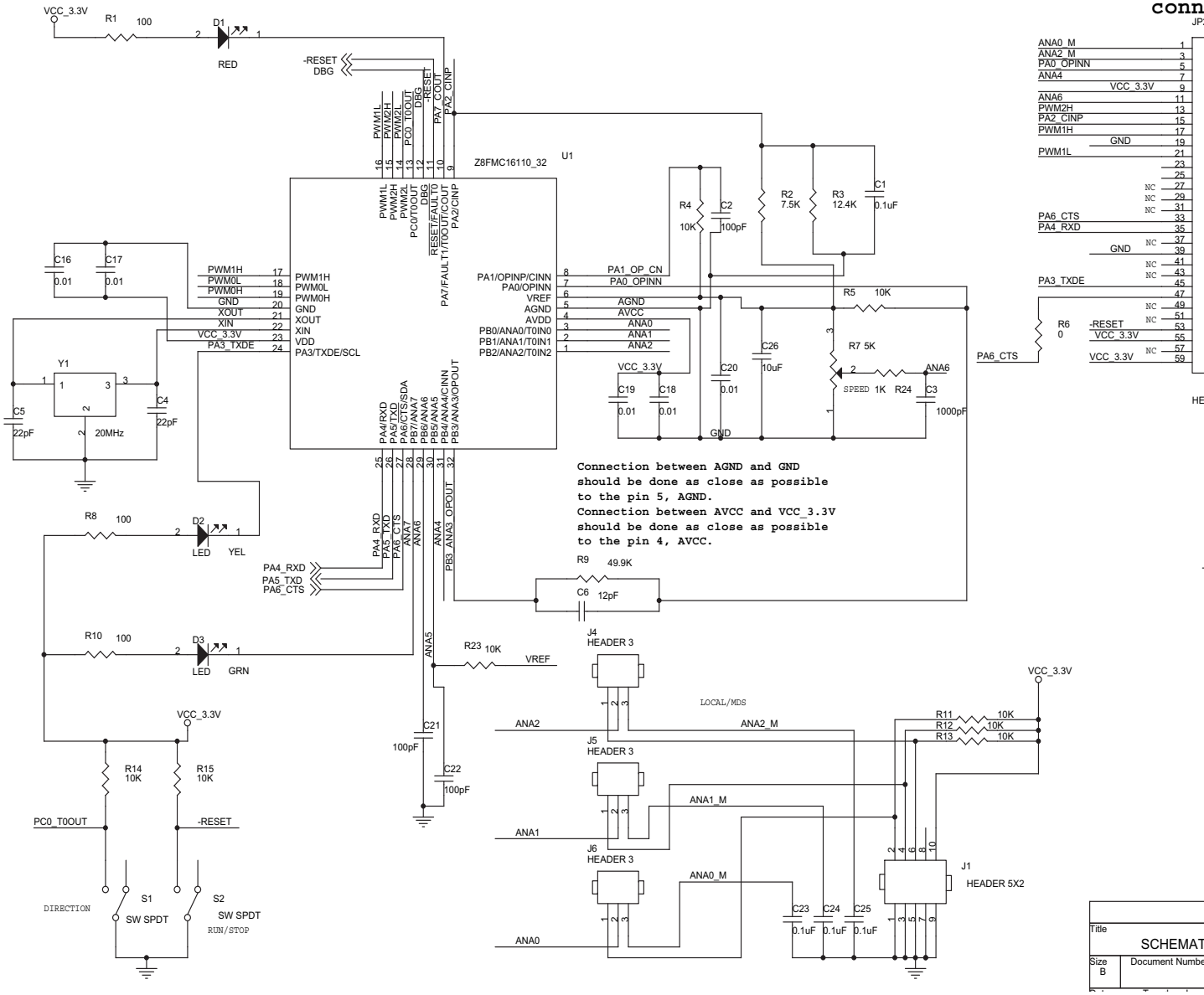

Figure 8. MC MDS Board Schematic, #1 of 2

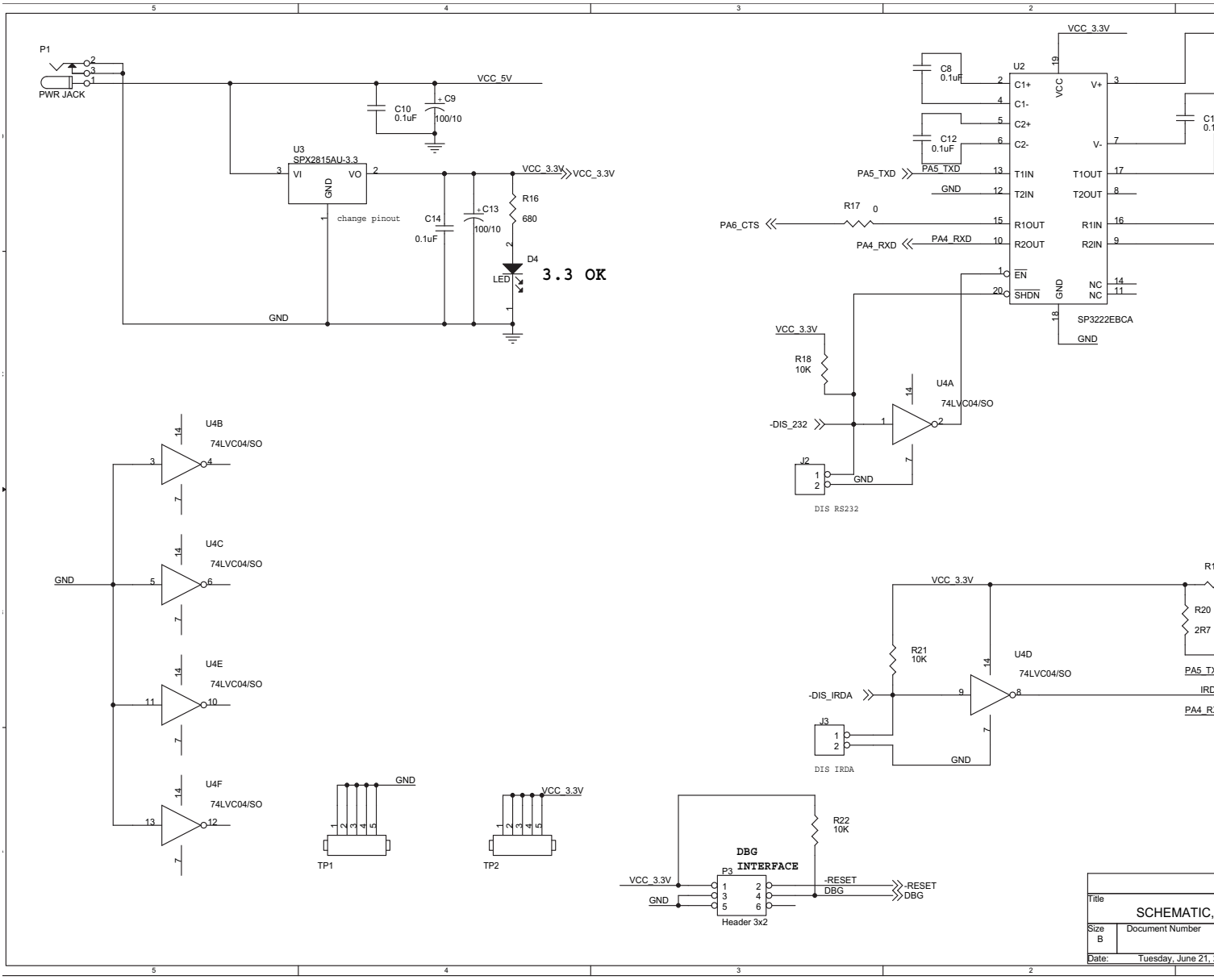

Figure 9. MC MDS Board Schematic, #2 of 2

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