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MCP39F511N
Power Monitor
Demonstration Board
User's Guide

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Object of Declaration: MCP39F511N Power Monitor Demonstration Board

EU Declaration of Conformity

Manufacturer: Microchip Technology Inc.
2355 W. Chandler Blvd.
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USA

This declaration of conformity is issued by the manufacturer.

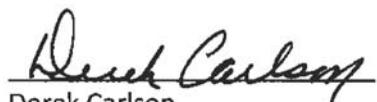
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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA


Derek Carlson
VP Development Tools

12-Sep-14
Date

MCP39F511N Power Monitor Demonstration Board User's Guide

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NOTES:

Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a “DS” number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is “DSXXXXXXA”, where “XXXXXX” is the document number and “A” is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE online help. Select the Help menu, and then Topics to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the MCP39F511N Power Monitor Demonstration Board. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Web Site
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the MCP39F511N Power Monitor Demonstration Board as a demonstration board to evaluate the MCP39F511N device. The manual layout is as follows:

- **Chapter 1. “Product Overview”** – Provides important information about the MCP39F511N Power Monitor Demonstration Board
- **Chapter 2. “Installation and Operation”** – Provides information on using the MCP39F511N Power Monitor Demonstration Board, including **Section 2.1.1 “Step 1: Wiring connections”** that describes wiring the line and load connections
- **Chapter 3. “Hardware Description”** – Provides details on the functional blocks of the power monitor, including the analog front-end design and power supply design
- **Appendix A. “Schematic and Layouts”** – Shows the schematic and layout diagrams
- **Appendix B. “Bill of Materials (BOM)”** – Lists the parts used to build the MCP39F511N Power Monitor Demonstration Board

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	<i>MPLAB® IDE User's Guide</i>
	Emphasized text	...is the <i>only</i> compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	<u>File</u> >Save
Bold characters	A dialog button	Click OK
	A tab	Click the Power tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	#define START
	Filenames	autoexec.bat
	File paths	c:\mcc18\h
	Keywords	_asm, _endasm, static
	Command-line options	-Opa+, -Opa-
	Bit values	0, 1
	Constants	0xFF, 'A'
Italic Courier New	A variable argument	<i>file.o</i> , where <i>file</i> can be any valid filename
Square brackets []	Optional arguments	mcc18 [options] <i>file</i> [options]
Curly brackets and pipe character: { }	Choice of mutually exclusive arguments; an OR selection	errorlevel {0 1}
Ellipses...	Replaces repeated text	var_name [, var_name...]
	Represents code supplied by user	void main (void) { ... }

RECOMMENDED READING

This user's guide describes how to use MCP39F511N Power Monitor Demonstration Board. Another useful document is listed below. The following Microchip document is available and recommended as a supplemental reference resource:

MCP39F511N Data Sheet – “Dual-Channel, Single-Phase Power-Monitoring IC with Calculation” (DS20005473)

This data sheet provides detailed information regarding the MCP39F511N device.

THE MICROCHIP WEB SITE

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- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, on-line discussion groups, Microchip consultant program member listing
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- Technical Support

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Technical support is available through the web site at: <http://support.microchip.com>

DOCUMENT REVISION HISTORY

Revision A (December 2015)

- Initial Release of this Document.

MCP39F511N Power Monitor Demonstration Board User's Guide

NOTES:

Chapter 1. Product Overview

1.1 INTRODUCTION

The MCP39F511N Power Monitor Demonstration Board is a fully functional dual-channel single-phase power and energy monitor. For each channel, the system calculates active power, reactive power, RMS current, RMS voltage, active energy, (both import and export), reactive energy and other typical power quantities for two separate loads, as defined in the MCP39F511N data sheet.

The MCP39F511 Power Monitor Utility software is used to calibrate and monitor the system, and can be used to create custom calibration setups. For most accuracy requirements, only a single-point calibration is needed. The energy meter software offers an automated step-by-step calibration process that can be used to quickly calibrate energy meters.

This demonstration board uses the Power Monitor Utility Software for evaluation via a USB connection to the board. A download link for this software can be found on the evaluation board's web page. For instructions on the use of this software, refer to the software's supporting documentation included within the application install package.



FIGURE 1-1: MCP39F511N Power Monitor Demonstration Board.

1.2 WHAT THE MCP39F511N POWER MONITOR DEMONSTRATION BOARD KIT INCLUDES

This MCP39F511N Power Monitor Demonstration Board kit includes:

- MCP39F511N Power Monitor Demonstration Board (ADM00706)
- AC Line Cable
- Two IEC-to-Female AC Load Cables
- Mini-USB Cable
- Important Information Sheet

Chapter 2. Installation and Operation

2.1 GETTING STARTED

To use the MCP39F511N Power Monitor Demonstration Board, follow the steps described in the sections below. The meter design uses a 5A load for calibration current and a maximum current (I_{MAX}) of 15A.

It is not recommended to put more than 15A through the AC plugs mounted on the Printed Circuit Board (PCB).

To test the calibrated meter, the following connections can be made:

2.1.1 Step 1: Wiring connections

[Figure 2-1](#) identifies the line and two load connections of the MCP39F511N Power Monitor Demonstration Board.



FIGURE 2-1: Connecting the MCP39F511N Power Monitor Demonstration Board.

2.1.2 Step 2: Connect line/load power to the meter (power the meter)

The meter will turn on when the line connection has between 90V to 220V connected. One or two loads can be connected to the meter.

2.1.3 Step 3: Connect the USB cable to a PC with the installed MCP39F511N Power Monitor Utility software

Select the appropriate COM port. If the meter is connected correctly, the connection status in the bottom left corner of the software will display “Meter Connected”. If no meter is found, the status will be “Meter Disconnected”. Check that the correct COM port was selected and try again. Press the **Start** Icon to begin showing output data and UART transmission between the PC and the MCP39F511N.

Chapter 3. Hardware Description

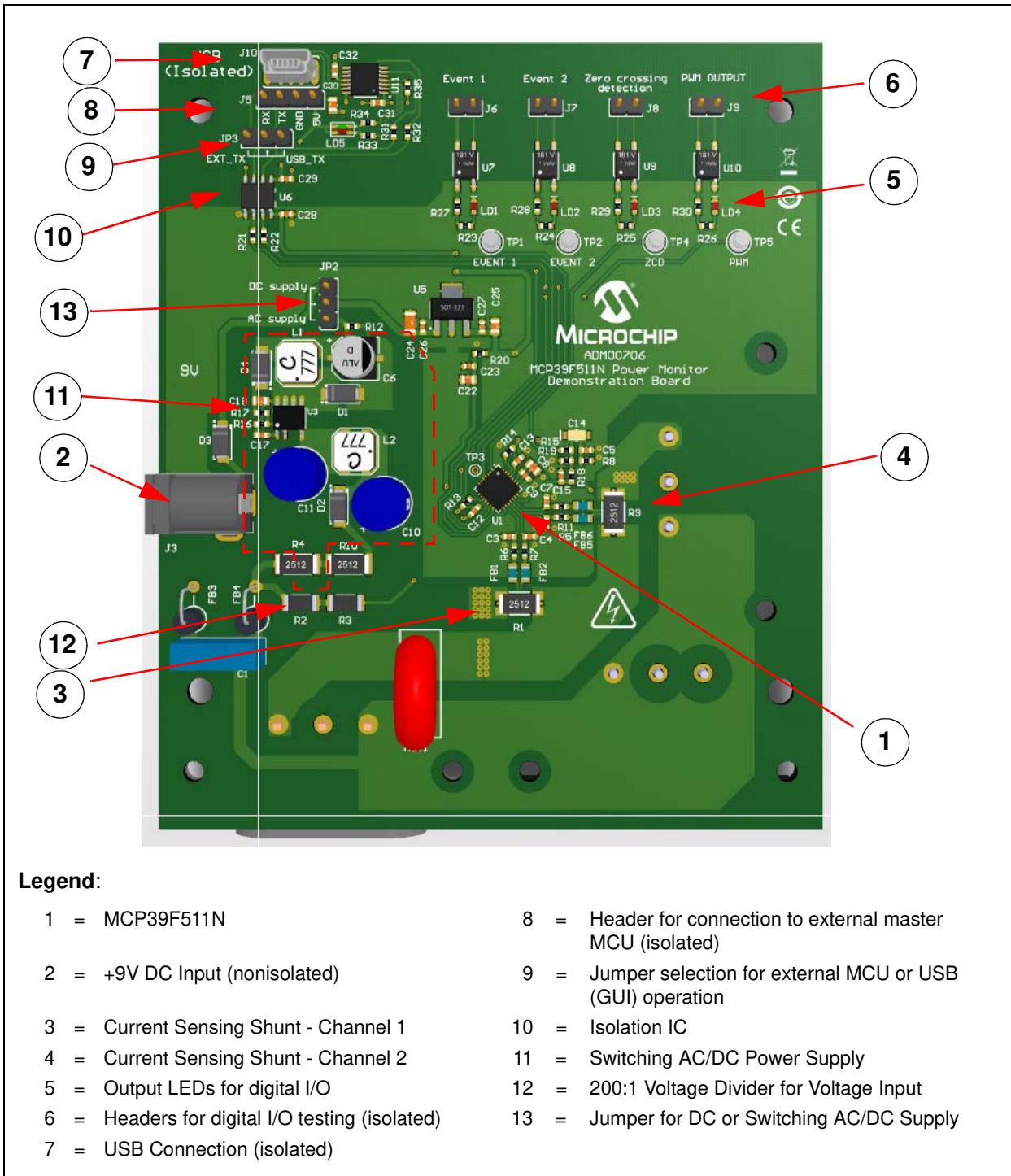


FIGURE 3-1: MCP39F511N Power Monitor Demonstration Board Top View.

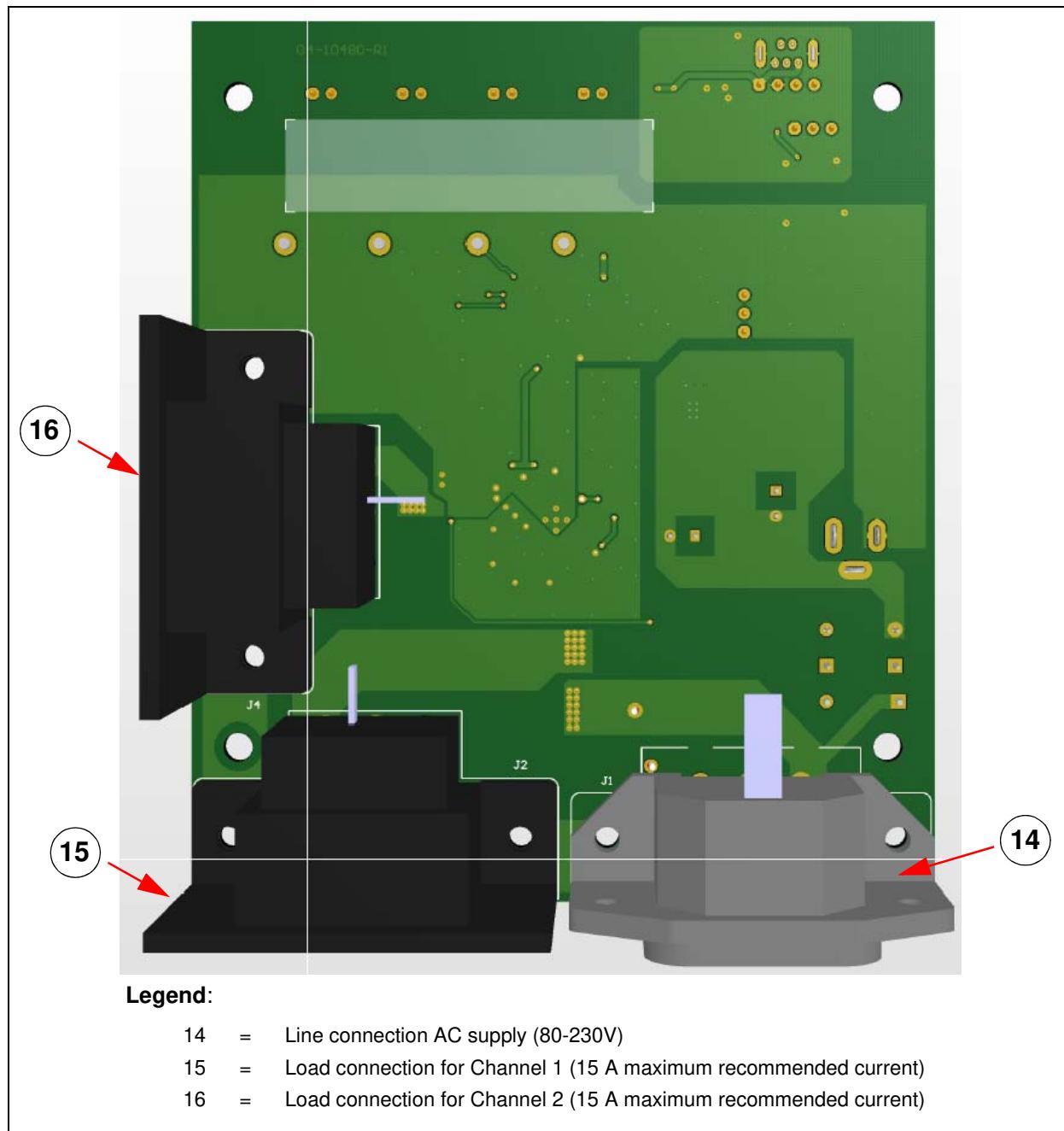


FIGURE 3-2: MCP39F511N Power Monitor Demonstration Board Bottom View.

3.1 INPUT AND ANALOG FRONT END

The MCP39F511N Power Monitor Demonstration Board will operate from 80V to 230V. At the bottom of the main board, there are the high-voltage line and neutral connections. The shunts sit on the neutral or low-side of a two-wire system. The board comes populated with two surface mount 2 mΩ shunts.

The line side of the two-wire system goes into a resistive divider on the voltage channel input, along with a DC offset added from V_{DD} . Anti-aliasing low-pass filters are included. The voltage channel uses two 499 kΩ resistors and the additional components to achieve a divider ratio of approximately 236:1. For a line voltage of 236 V_{RMS}, the channel 1 input signal size will be 1 V_{RMS} with a DC offset voltage of $DV_{DD}/2$ per the schematic snippet below.

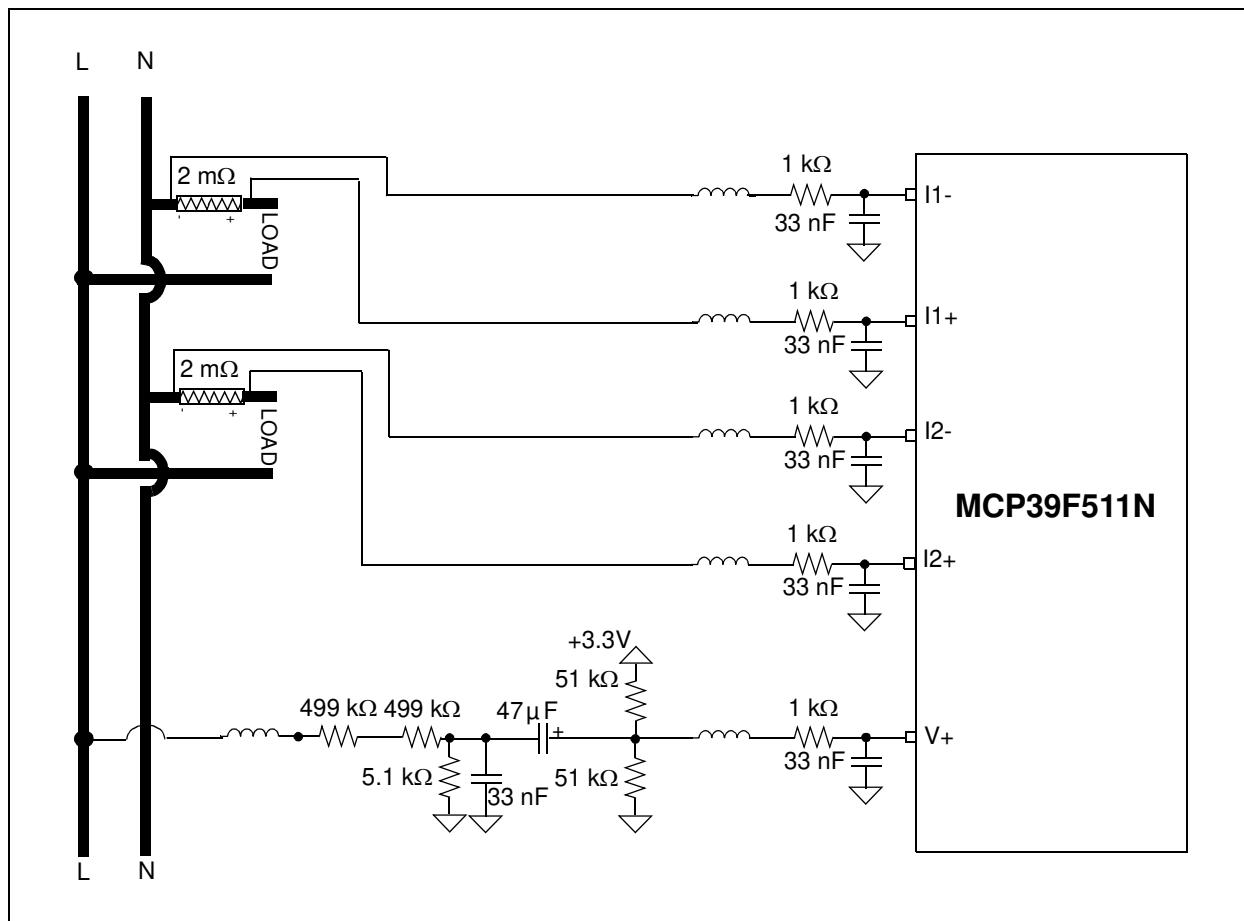


FIGURE 3-3: Analog Front-End Circuitry.

Note that all of the analog circuitry associated with this part of the circuit is connected to the analog ground plane (A_{GND}).

3.2 POWER SUPPLY CIRCUIT

The power supply circuit for the MCP39F511N Power Monitor Demonstration Board is shown in [Figure 3-4](#).

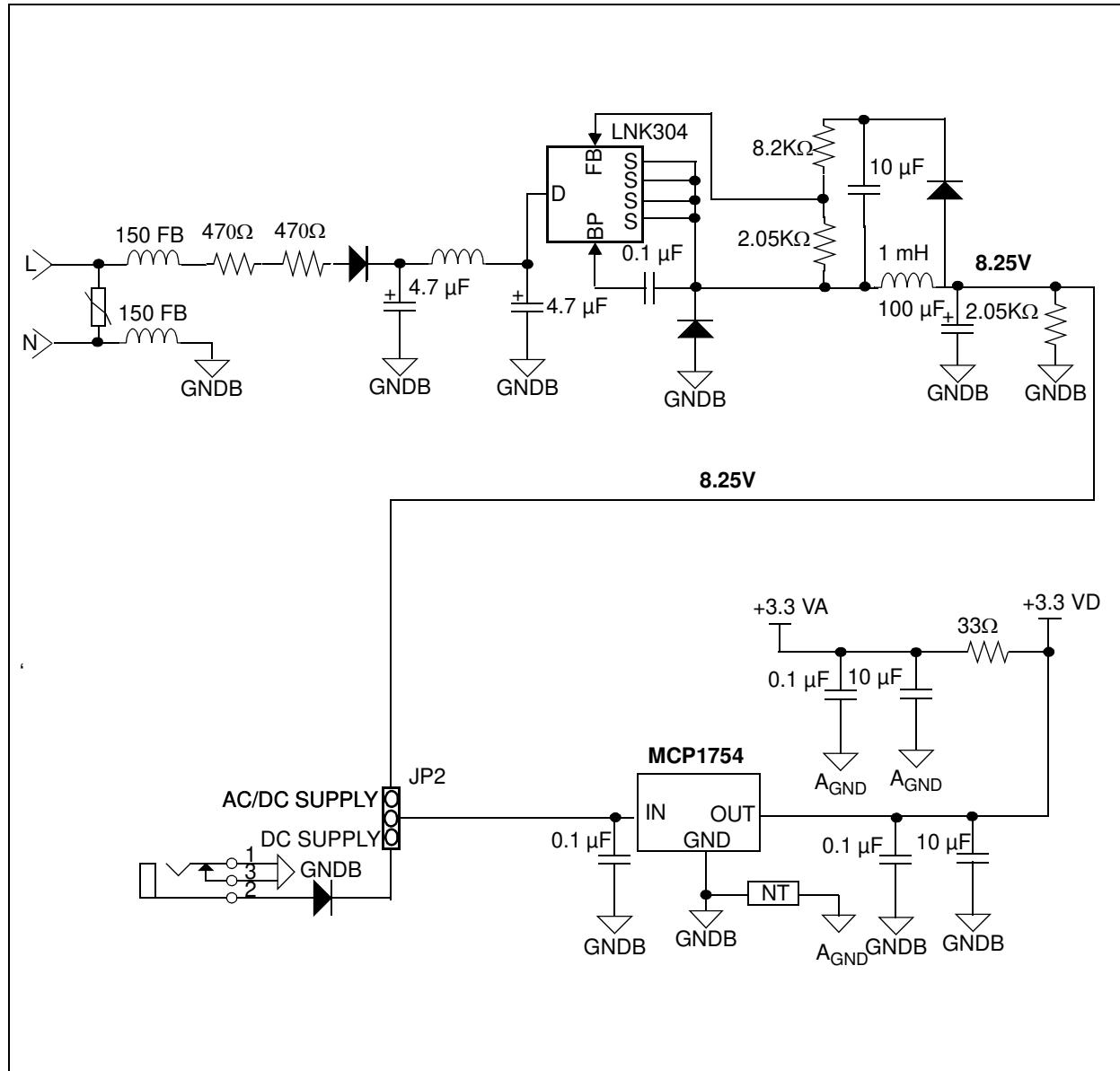


FIGURE 3-4: Power Supply Circuit with Option for AC/DC Switching Supply from Mains or DC Supply.

Appendix A. Schematic and Layouts

A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the MCP39F511N Power Monitor Demonstration Board:

- Board – Schematic
- **Board – Schematic (Continued)**
- **Board – Top Silk**
- **Board – Top Copper and Silk**
- **Board – Top Copper**
- Board – Bottom Copper
- Board – Bottom Copper and Silk
- Board – Bottom Silk

A.2 SCHEMATICS AND PCB LAYOUT

The layer order is shown in [Figure A-1](#).

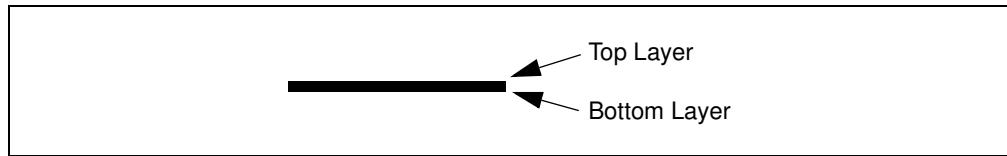
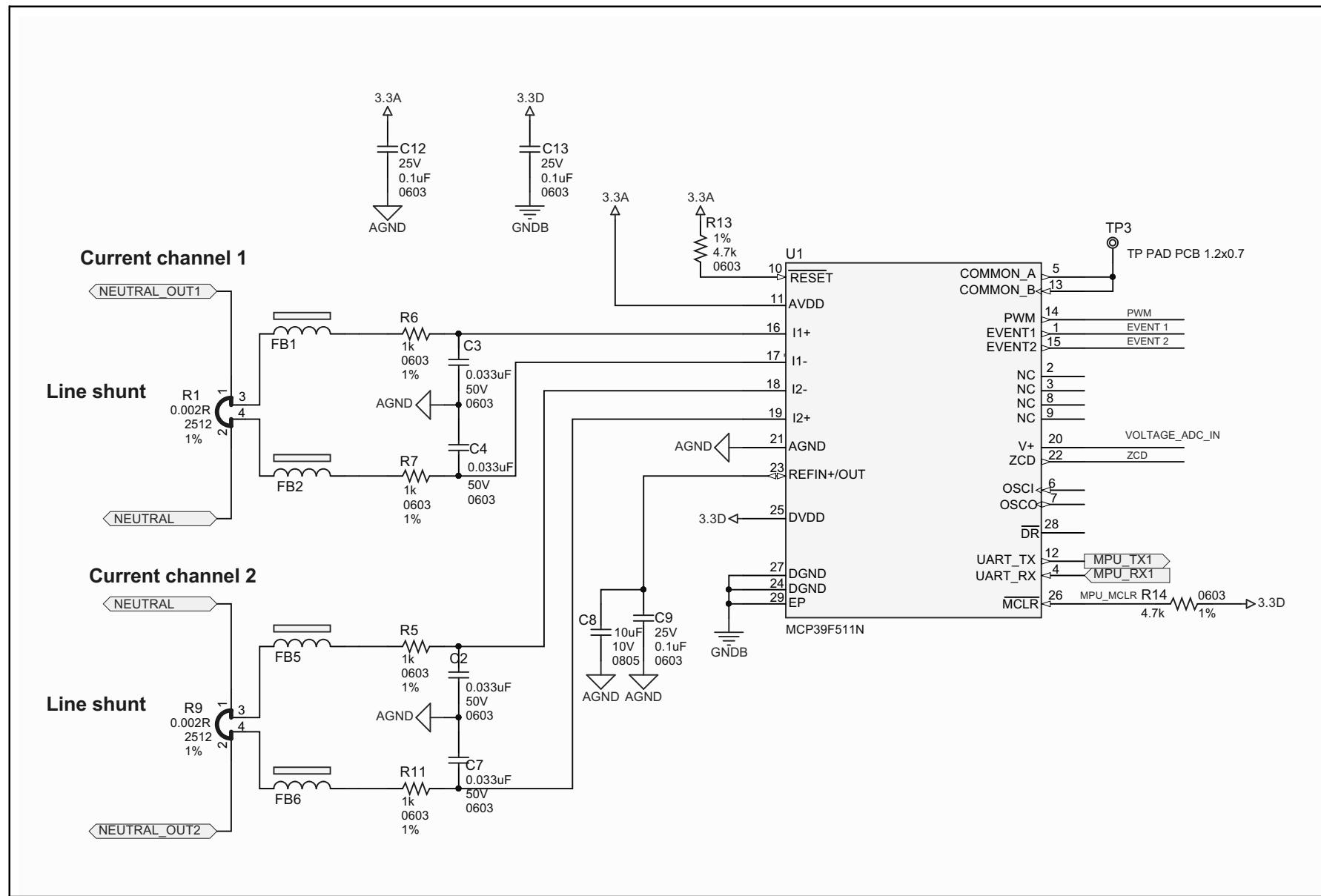
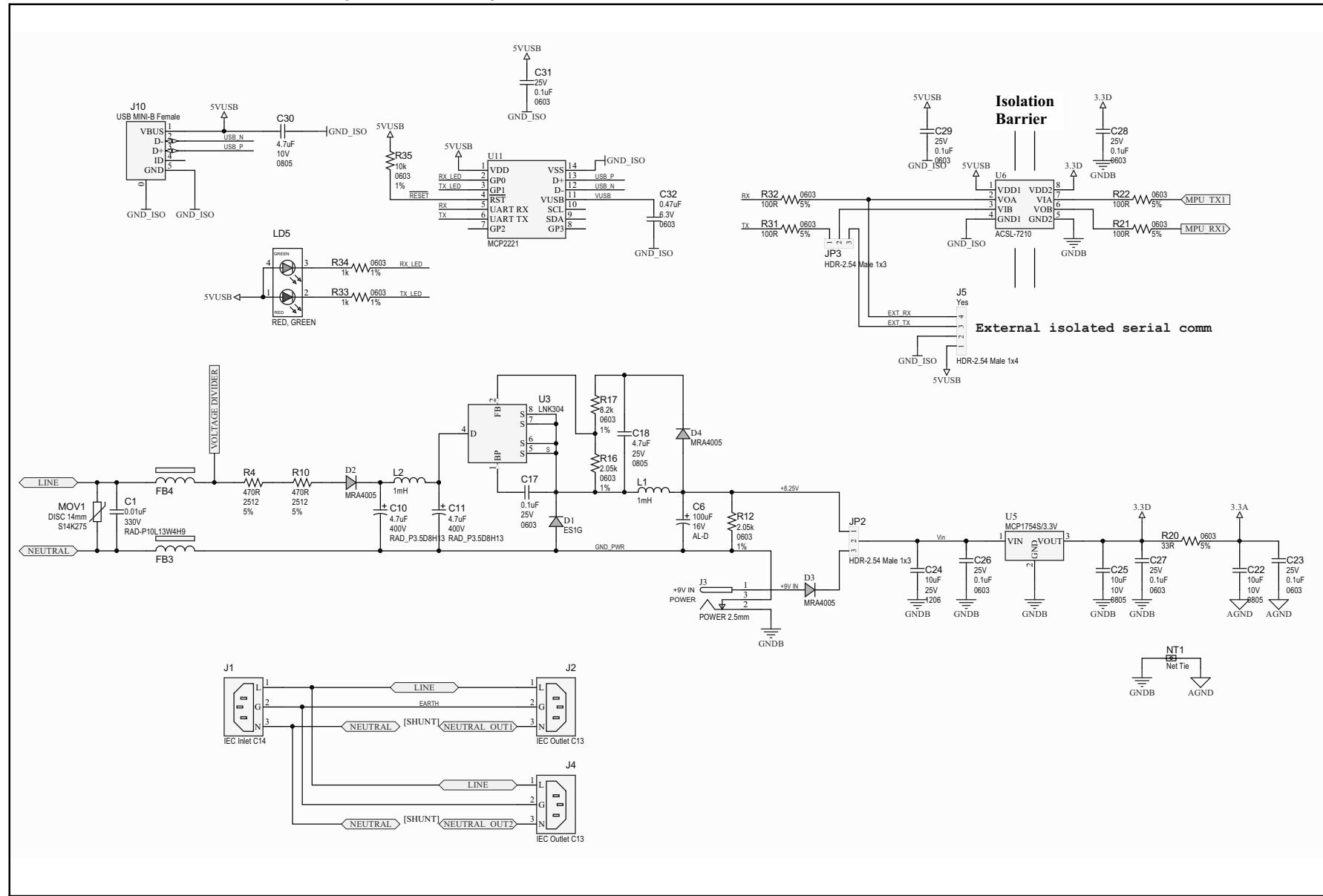


FIGURE A-1: Layer Order.

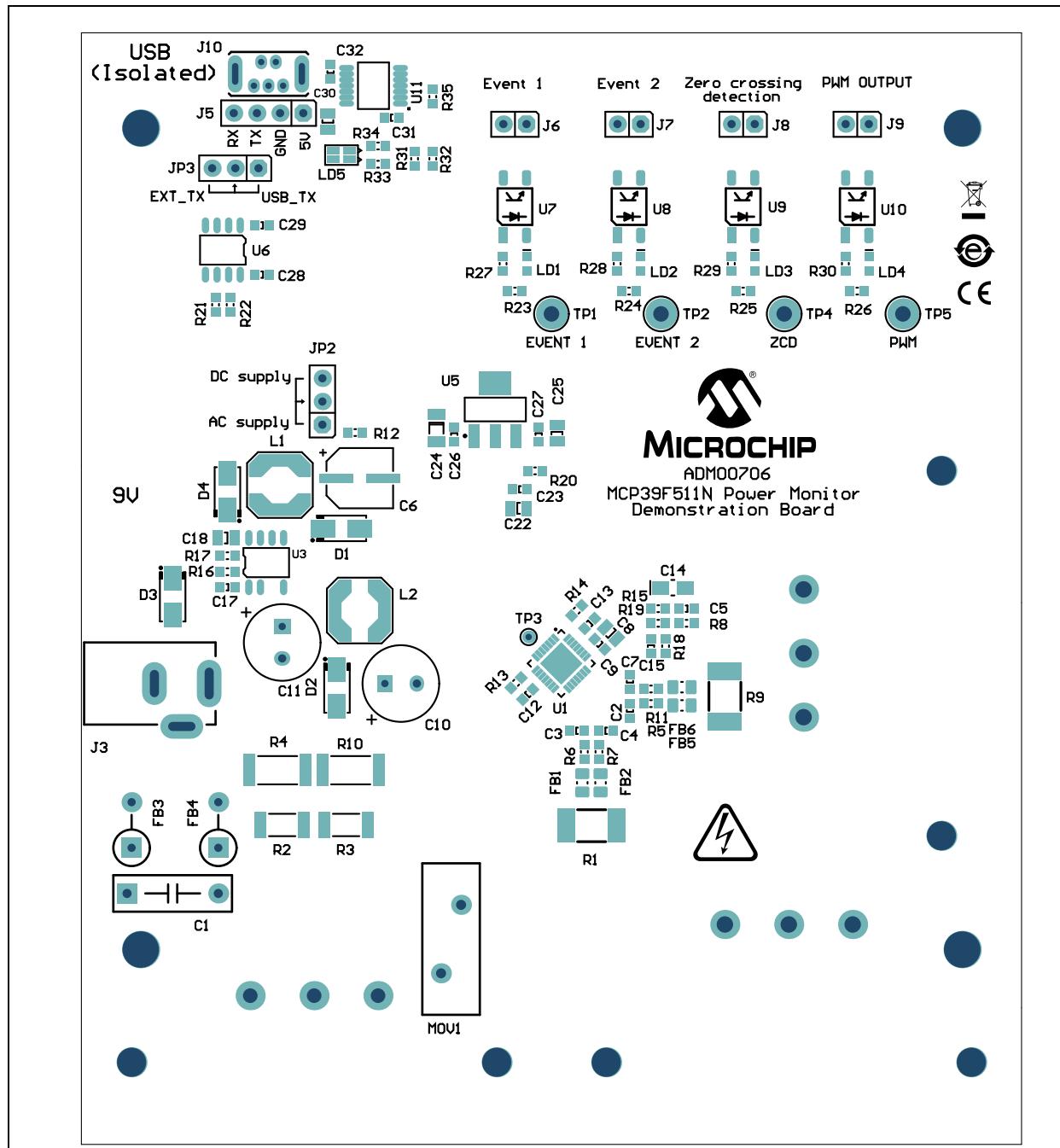
A.3 BOARD – SCHEMATIC



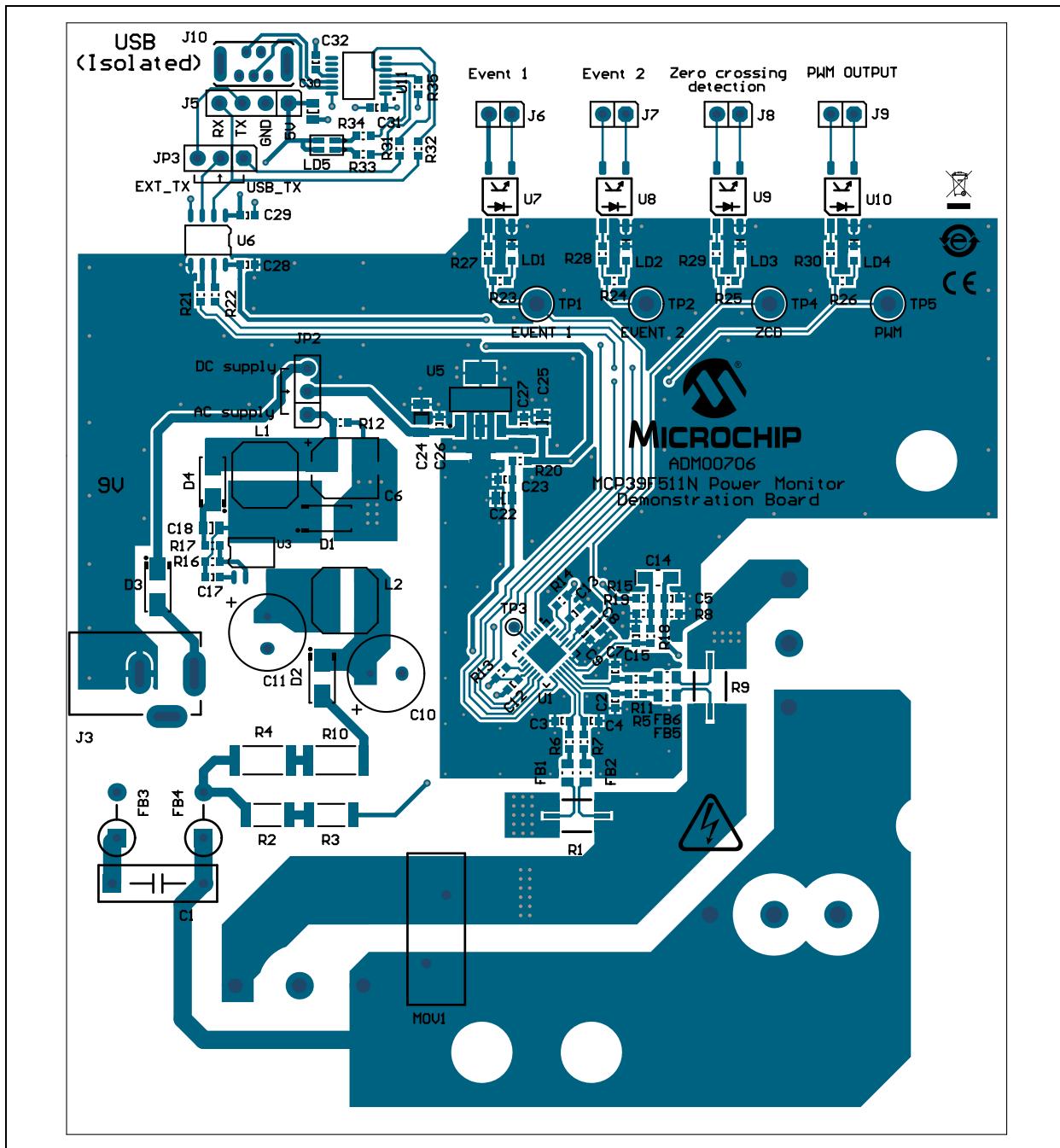
A.4 BOARD – SCHEMATIC (CONTINUED)



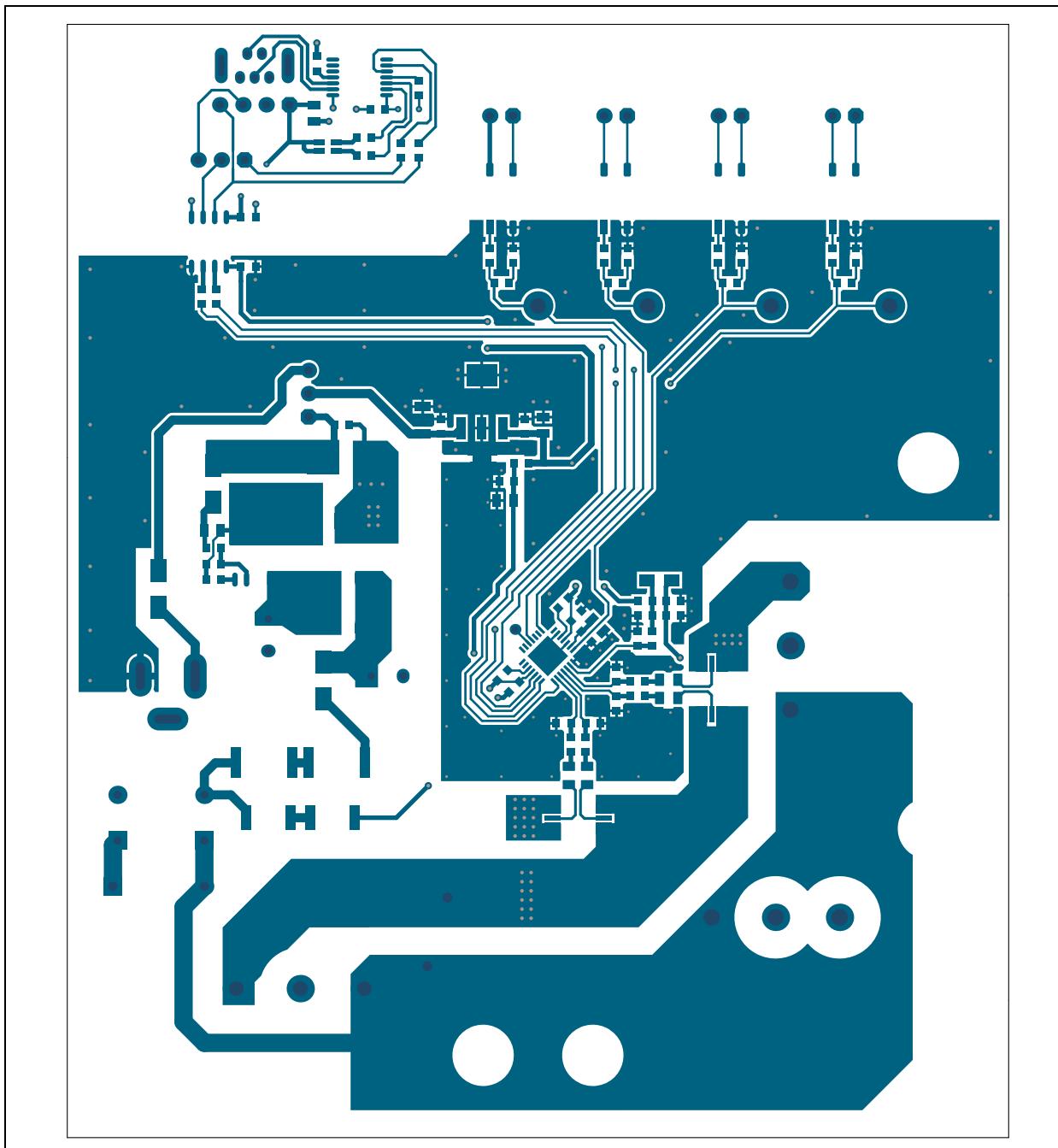
A.5 BOARD – TOP SILK



A.6 BOARD – TOP COPPER AND SILK



A.7 BOARD – TOP COPPER



A.8 BOARD – BOTTOM COPPER

