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## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

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**MICROCHIP**

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**MCP39F501  
Power Monitor  
Demonstration Board  
User's Guide**

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ISBN: 978-1-62077-874-6

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**Object of Declaration: MCP39F501 Power Monitor Demonstration Board User's Guide**

EU Declaration of Conformity


This declaration of conformity is issued by the manufacturer.

The development/evaluation tool is designed to be used for research and development in a laboratory environment. This development/evaluation tool is not intended to be a finished appliance, nor is it intended for incorporation into finished appliances that are made commercially available as single functional units to end users. This development/evaluation tool complies with EU EMC Directive 2004/108/EC and as supported by the European Commission's Guide for the EMC Directive 2004/108/EC (8<sup>th</sup> February 2010).

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



Derek Carlson

VP Development Tools



Date

# MCP39F501 Power Monitor Demonstration Board User's Guide

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# MCP39F501 POWER MONITOR DEMONSTRATION BOARD USER'S GUIDE

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# MCP39F501 POWER MONITOR DEMONSTRATION BOARD USER'S GUIDE

## 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](http://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 “DSXXXXA”, where “XXXX” 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 MCP39F501 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 MCP39F501 Power Monitor Demonstration Board as a demonstration board to evaluate the MCP39F501 device. The manual layout is as follows:

- **Chapter 1. “Product Overview”** – Provides important information about the MCP39F501 Power Monitor Demonstration Board
- **Chapter 2. “Installation and Operation”** – Provides information on using the MCP39F501 Power Monitor Demonstration Board, including **Section 2.1.3 “Step 3: Connect the USB cable to a PC with the installed “MCP39F501 Power Monitor Utility” software”** that describes wiring the line and load connections
- **Chapter 3. “Hardware Description”** – Provides details on the function 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 MCP39F501 Power Monitor Demonstration Board



# MCP39F501 Power Monitor Demonstration Board User's Guide

## CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

### DOCUMENTATION CONVENTIONS

Description	Represents	Examples
<b>Arial font:</b>		
Italic characters	Referenced books	<i>MPLAB<sup>®</sup> 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><i>File&gt;Save</i></u>
Bold characters	A dialog button	Click <b>OK</b>
	A tab	Click the <b>Power</b> 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>
<b>Courier New font:</b>		
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 MCP39F501 Power Monitor Demonstration Board. Another useful documents is listed below. The following Microchip document is available and recommended as a supplemental reference resource.

**MCP39F501 Data Sheet – “Single Phase Energy and Power Monitoring IC with Calculation” (DS20005256)**

This data sheet provides detailed information regarding the MCP39F501 device.

## THE MICROCHIP WEB SITE

Microchip provides online support via our web site at [www.microchip.com](http://www.microchip.com). This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

- **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, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

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- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

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

## DOCUMENT REVISION HISTORY

**Revision A (February 2014)**

- Initial Release of this Document.

# MCP39F501 Power Monitor Demonstration Board User's Guide

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## Chapter 1. Product Overview

### 1.1 INTRODUCTION

The MCP39F501 Power Monitor Demonstration Board is a fully functional single-phase power monitor. This low-cost design does not use any transformers and requires few external components. The system calculates active power, reactive power, RMS current, RMS voltage and other typical power quantities, as defined in the MCP39F501 data sheet.

The Microchip Energy Meter 1-Phase software is used to calibrate and monitor the system, and can be used to create custom calibration setups. For some accuracy requirements, only a single-point calibration may be 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 MCP39F501 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:** MCP39F501 Power Monitor Demonstration Board.

## 1.2 WHAT THE MCP39F501 POWER MONITOR DEMONSTRATION BOARD KIT INCLUDES

This MCP39F501 Power Monitor Demonstration Board kit includes:

- MCP39F501 Power Monitor Demonstration Board (ARD00455)
- Important Information Sheet
- Mini USB cable
- AC Line cable
- AC Load cable
- Plastic enclosure

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## **Chapter 2. Installation and Operation**

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### **2.1 GETTING STARTED**

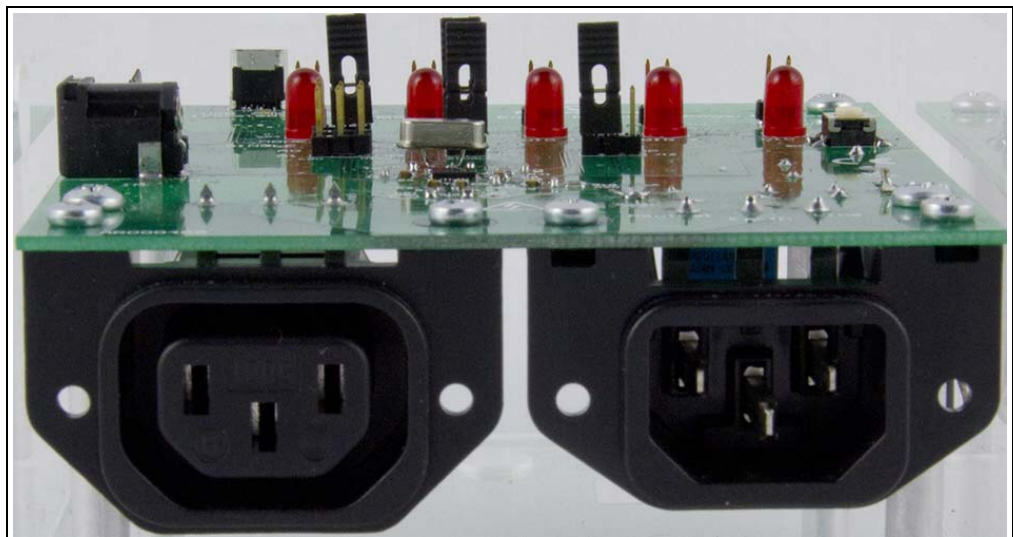
To use the MCP39F501 Power Monitor Demonstration Board, follow the steps described in the sections below. The meter design uses a 5A load for calibration current and a maximum current ( $I_{MAX}$ ) of 15A.

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 load connections of the MCP39F501 Power Monitor Demonstration Board.



**FIGURE 2-1:** *Connecting the MCP39F501 Power Monitor Demonstration Board.*

#### **2.1.2 Step 2: Turn on line/load power to the meter (power the meter)**

The meter will turn on when the line connection has between 90V to 220V connected.

#### **2.1.3 Step 3: Connect the USB cable to a PC with the installed “MCP39F501 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.

# MCP39F501 Power Monitor Demonstration Board User's Guide

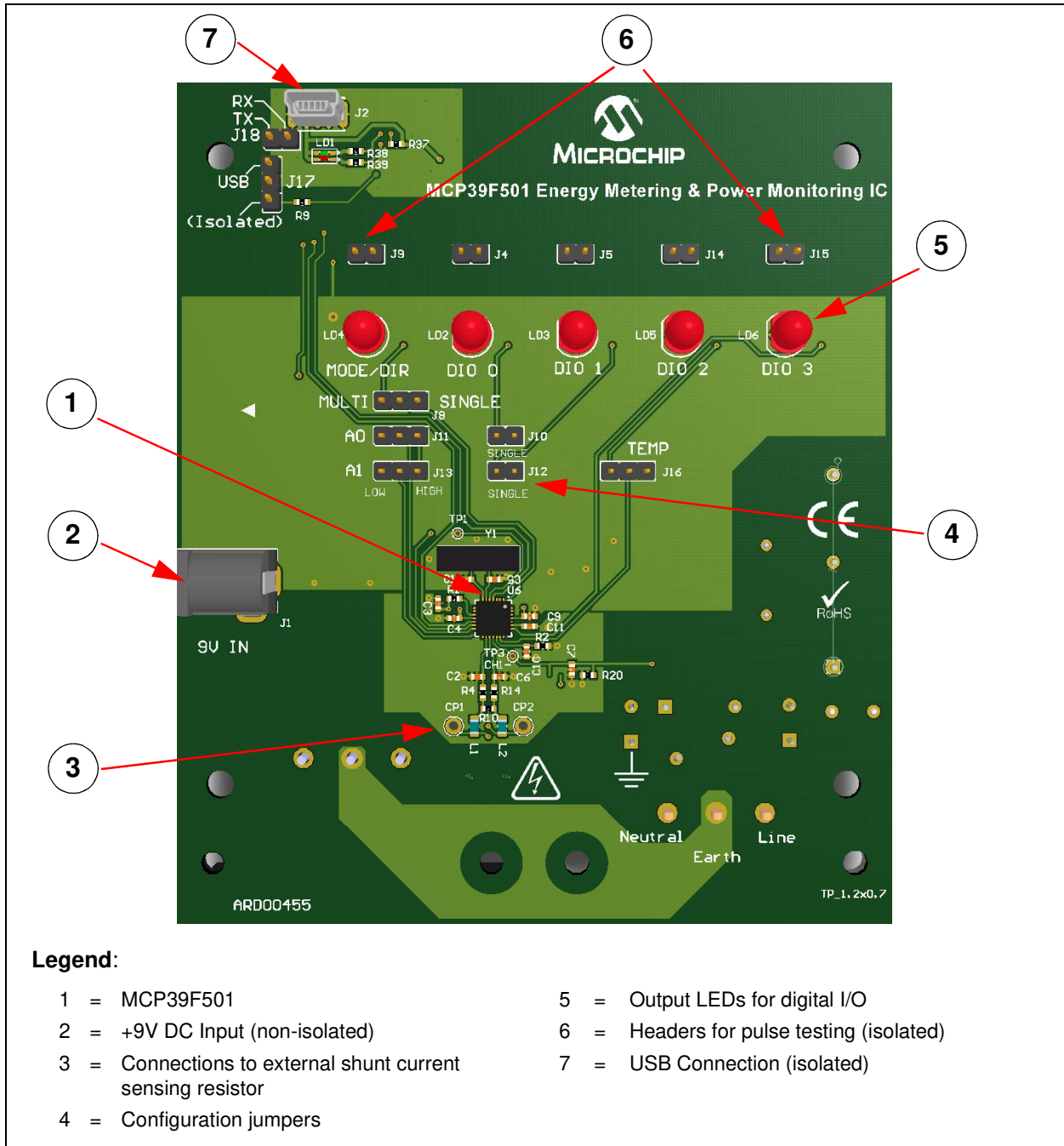
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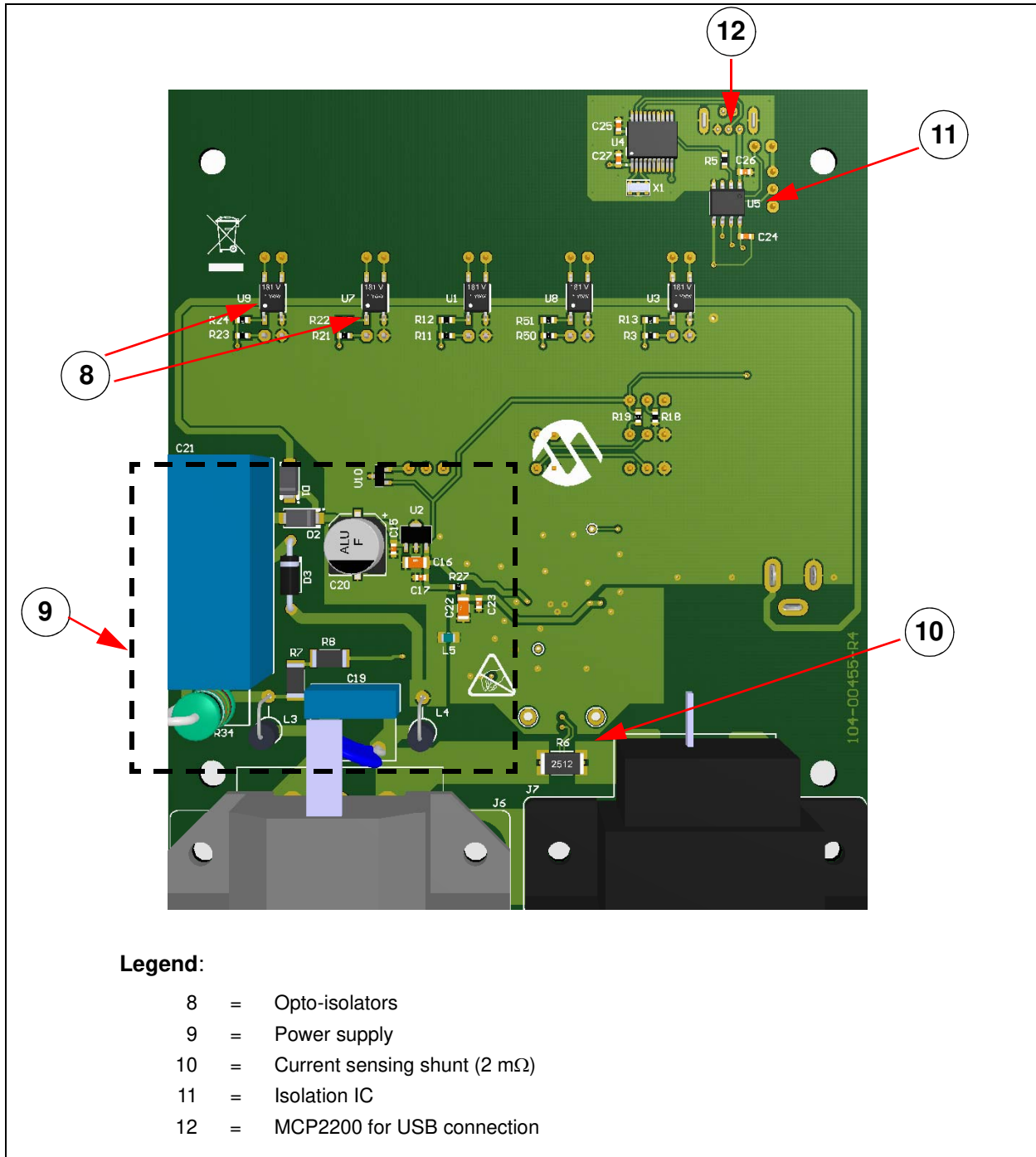
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**Chapter 3. Hardware Description**



**FIGURE 3-1:** MCP39F501 Power Monitor Demonstration Board Top View – Hardware Components.

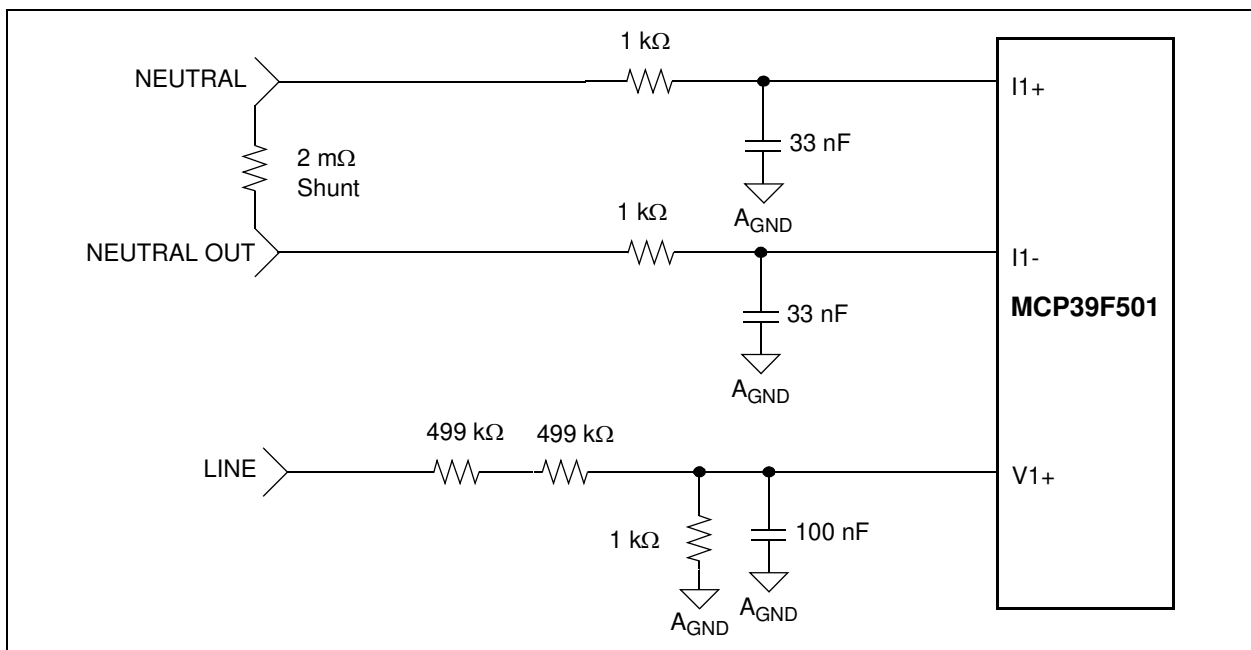


**FIGURE 3-2:** MCP39F501 Power Monitor Demonstration Board Bottom View – Hardware Components.

## 3.1 INPUT AND ANALOG FRONT END

The MCP39F501 Power Monitor Demonstration Board comes populated with components designed for 220V line voltage. However, it will work from 90V to 230V. At the bottom of the main board, there are the high-voltage line and neutral connections. There are four connections from the PCB to the meter casing. They are labeled LINE, NEUTRAL, SHUNT1 and SHUNT2. The shunt sits on the high- or line-side of a two-wire system and the meter employs a hot or “live” ground. The wires going into the shunt to SHUNT1 and SHUNT2 should be twisted together. The wires going into the LINE and NEUTRAL side of the meter should be twisted together, and also kept away from the SHUNT1 and SHUNT2 wires, if possible.

The neutral side of the two-wire system goes into a resistor divider on the voltage channel input. Anti-aliasing low-pass filters are included. The voltage channel uses two 499 k $\Omega$  resistors to achieve a divider ratio of 1000:1. For a line voltage of 230 V<sub>RMS</sub>, the channel 1 input signal size will be 230 mV<sub>RMS</sub>.

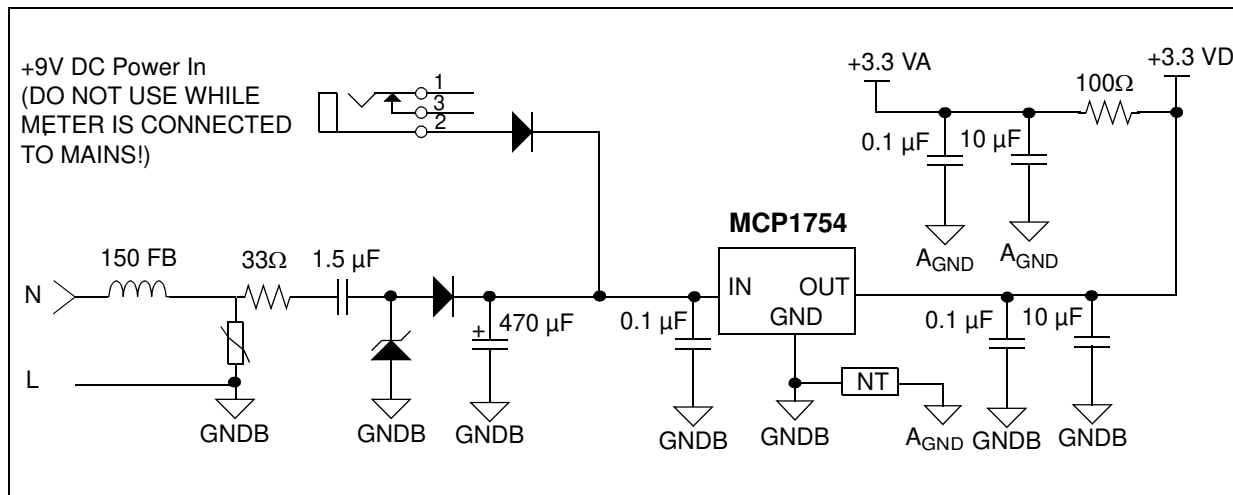


**FIGURE 3-3:** Analog Front-End Circuitry.

Note that all of the analog circuitry associated with this part of the circuit is connected to the analog ground plane (A<sub>GND</sub>).

## 3.2 POWER SUPPLY CIRCUIT

The power supply circuit for the MCP39F501 Power Monitor Demonstration Board uses a half-wave rectified signal and a +3.3V voltage regulator.



**FIGURE 3-4:** Low-Cost Power Supply Circuit.

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## **Appendix A. Schematic and Layouts**

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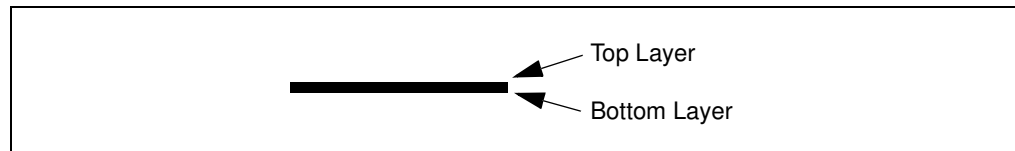
### **A.1 INTRODUCTION**

This appendix contains the following schematics and layouts for of the MCP39F501 Power Monitor Demonstration Board:

- Board – Schematic
- Board – Top Silk
- Board – Top Copper and Silk
- Board – Top Copper
- Board – Bottom Copper
- Board – Bottom Copper and Silk
- Board – Bottom Silk

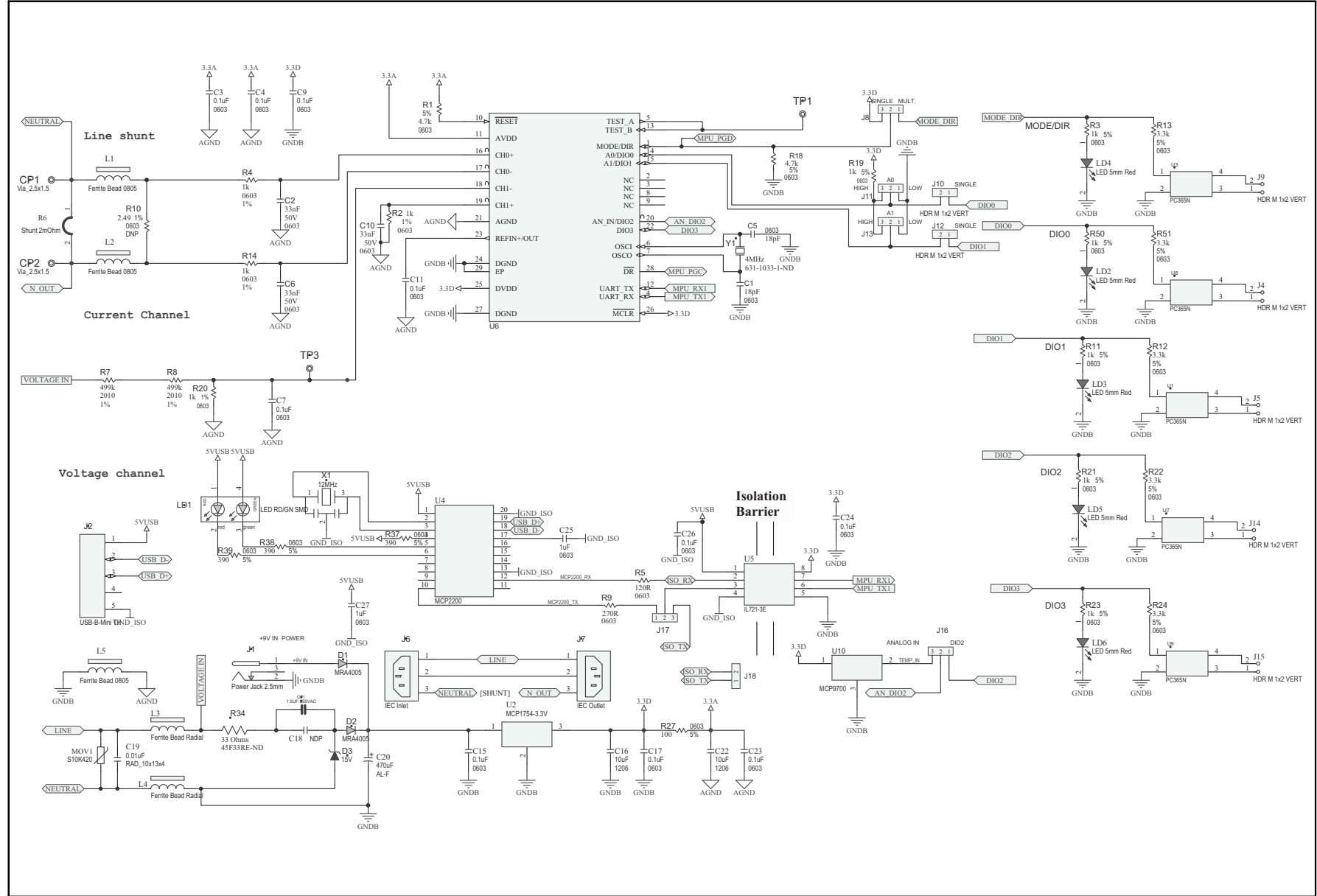
### **A.2 SCHEMATICS AND PCB LAYOUT**

The layer order is shown in Figure A-1.

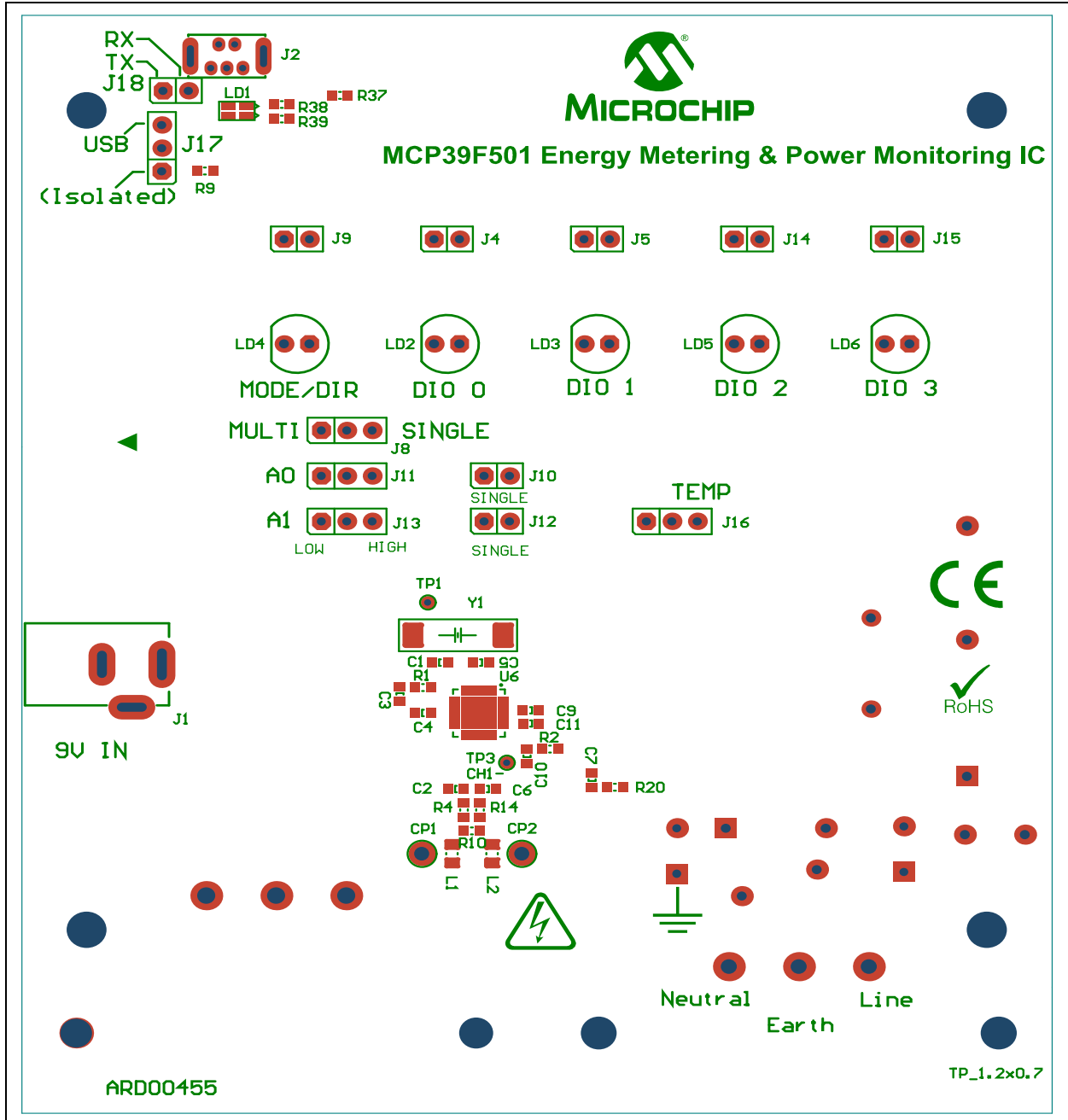


**FIGURE A-1:** *Layer Order.*

### A.3 BOARD – SCHEMATIC

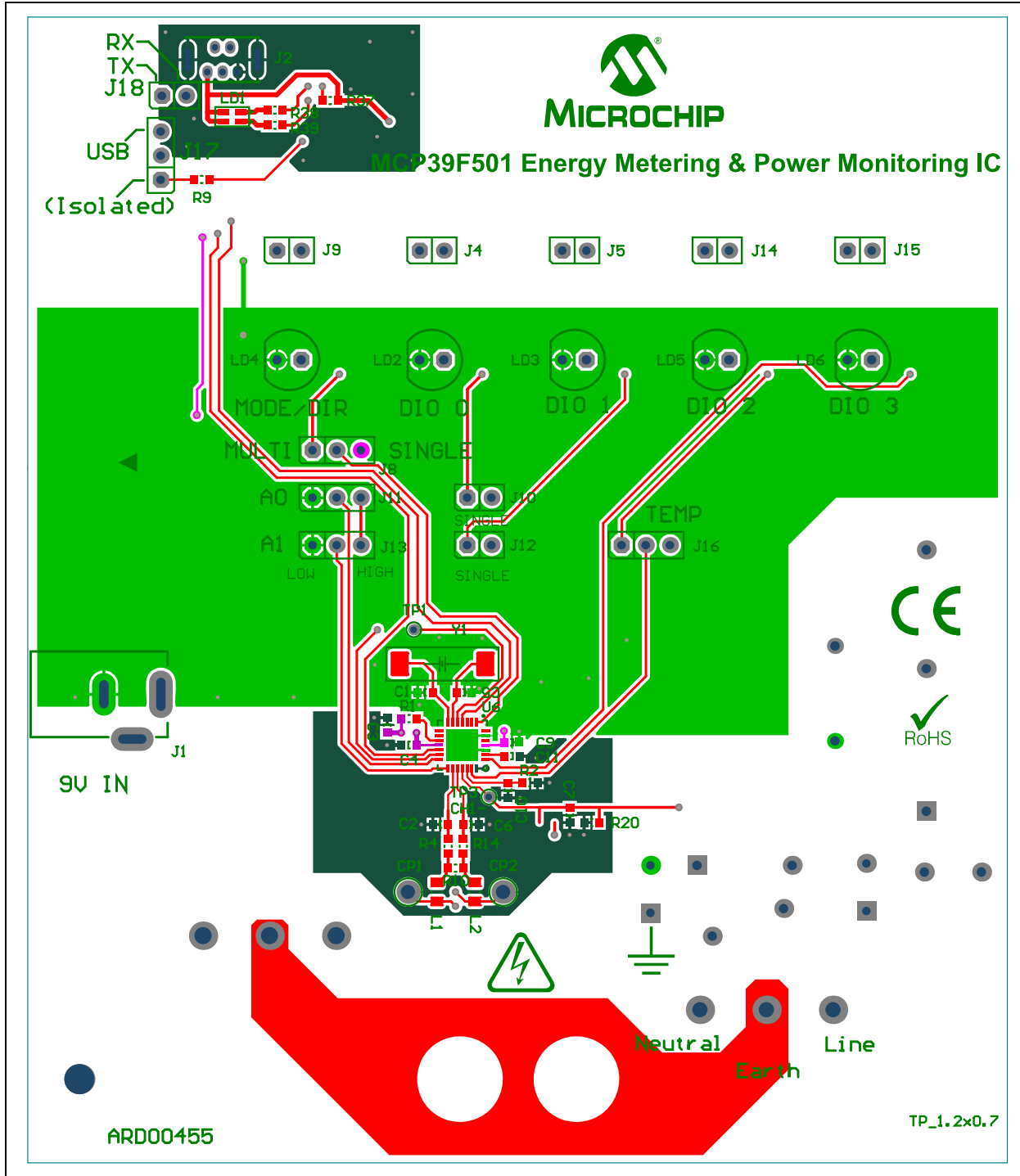


## A.4 BOARD – TOP SILK

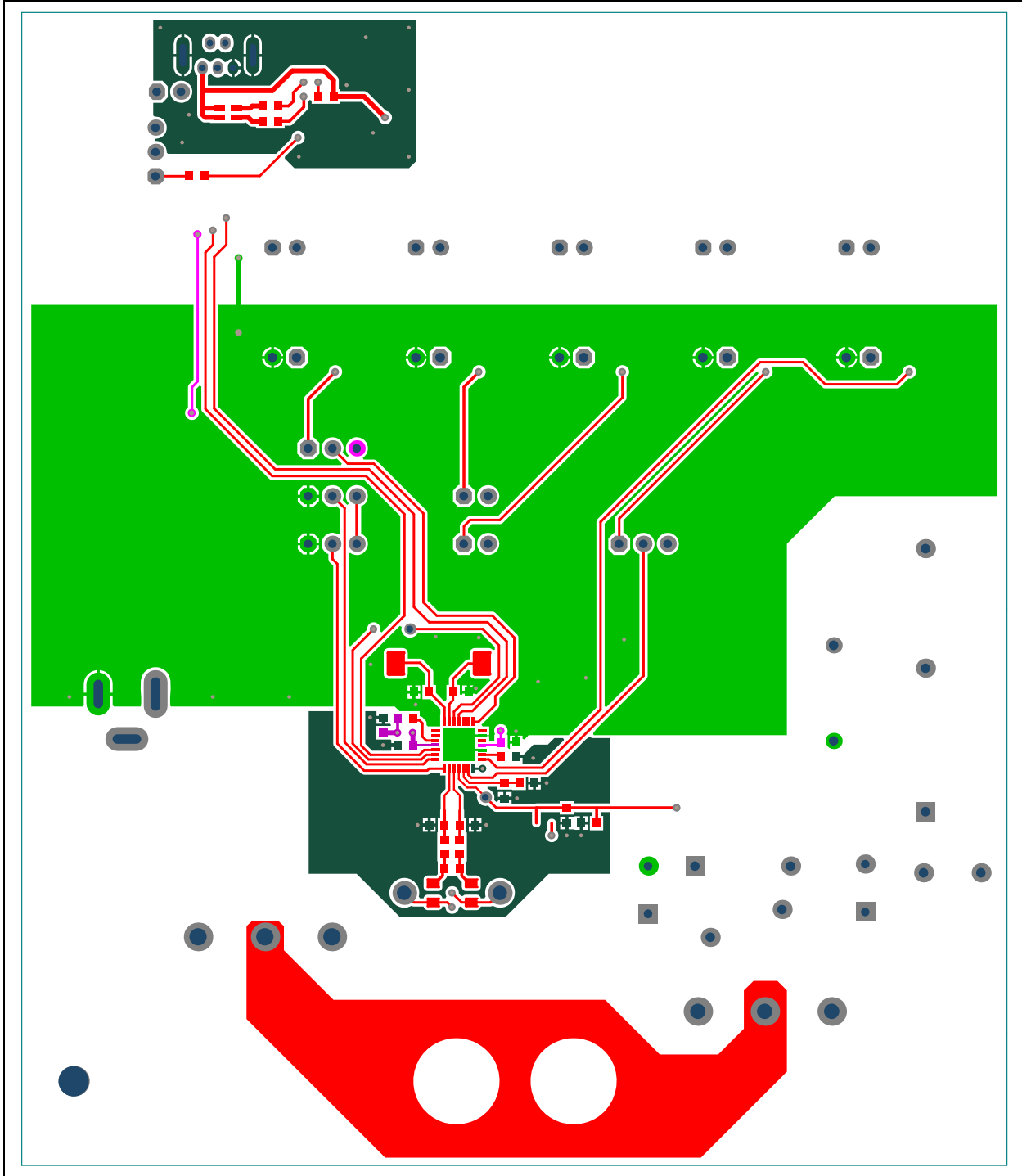




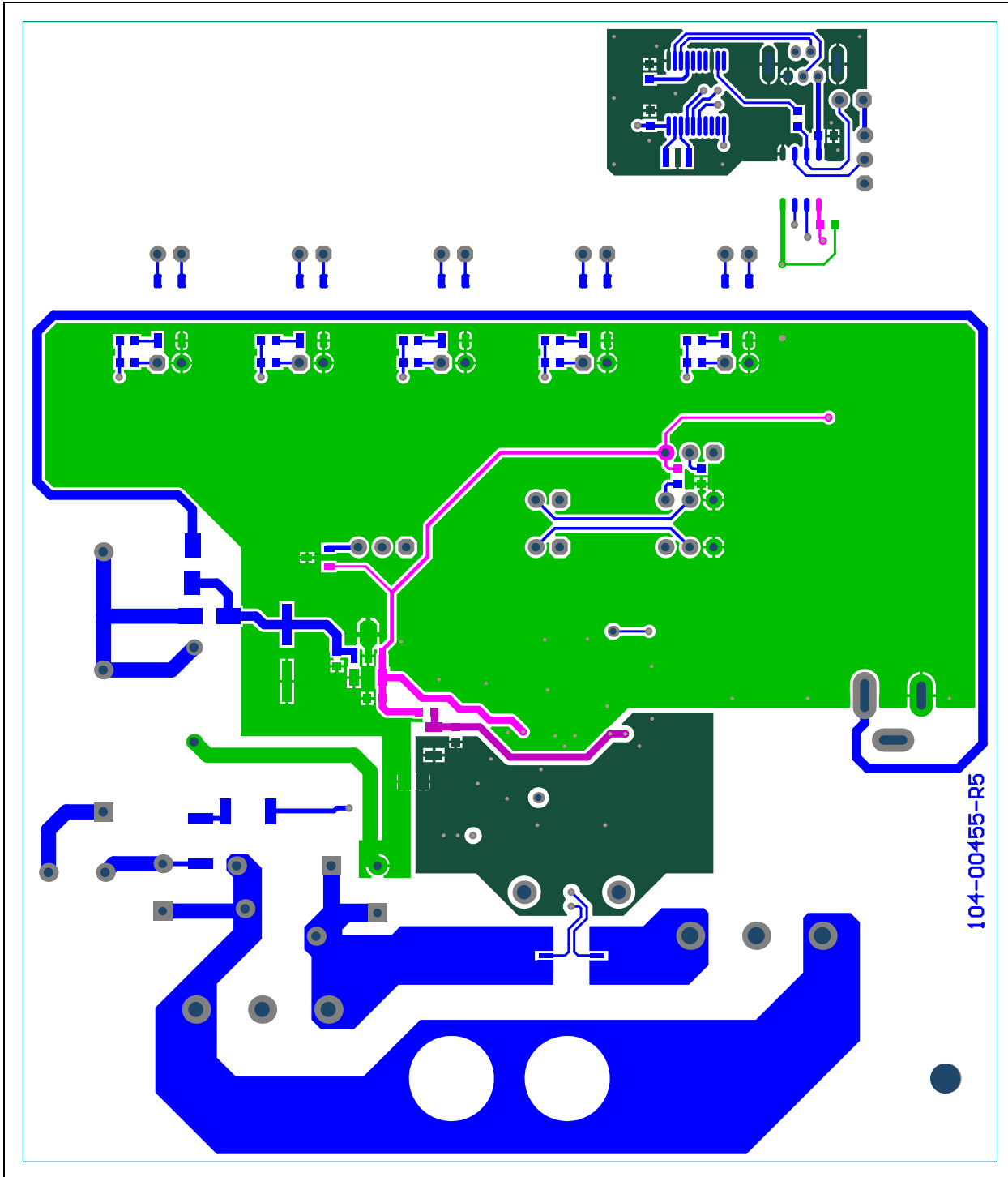
## A.5 BOARD – TOP COPPER AND SILK



## A.6 BOARD – TOP COPPER



## A.7 BOARD – BOTTOM COPPER



## A.8 BOARD – BOTTOM COPPER AND SILK

