DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board User's Guide

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12-Sep-14
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DN2470 BASED LINEAR REGULATOR INPUT VOLTAGE RANGE EXTENDER EVALUATION BOARD USER'S GUIDE

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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 "DSXXXXXXXXA", where "XXXXXXXX" 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 DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board User's Guide. 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 DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board User's Guide as a development tool.

- **Chapter 1. "Product Overview"** – Important information about the DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board User's Guide.
- **Chapter 2. "Installation and Operation"** – This chapter includes a detailed description of each function of the demonstration board and instructions on how to use the board.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board User's Guide.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board User's Guide.
- **Appendix C. "DN2470 Characterization Plots"** – Describes the various plots and waveforms for the DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board User's Guide.

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* 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	*File>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	*`file`*`.o`, where *`file`* can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options]` *`file`* `[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) { ... }`

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RECOMMENDED READING

This user's guide describes how to use the DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board User's Guide. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

DN2470 Data Sheet – "*N-Channel, Depletion-Mode, Vertical DMOS FET*" (DS20005410)

MCP1754 Data Sheet – *"150 mA,16V, High-Performance LDO"* (DS20002276)

MCP1755 Data Sheet – *"300 mA,16V, High-Performance LDO"* (DS25160)

MCP1790 Data Sheet – *"70 mA, High Voltage Regulator"* (DS20002075)

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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
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- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

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

DOCUMENT REVISION HISTORY

Revision A (March 2016)

- Initial release of this document.

DN2470 BASED LINEAR REGULATOR INPUT VOLTAGE RANGE EXTENDER EVALUATION BOARD USER'S GUIDE

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board and covers the following topics:

- DN2470 Device Overview
- What is the DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board?
- What the DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board Kit Contains

1.2 DN2470 DEVICE OVERVIEW

The DN2470 is a low-threshold depletion-mode (normally-on) vertical FET. Vertical DMOS FETs are suited for a wide range of switching and amplifying applications where high breakdown voltage, high input impedance, low input capacitance and fast switching speeds are required.

The DN2470 has a 700V voltage breakdown with a 42 ohms drain-to-source On-state resistance and 500 mA saturated drain-to-source current when operating over typical conditions. The device is packaged in a TO-252 (D-PAK) and it is designed to operate in a temperature range of -55°C to +150°C (refer to the DN2470 data sheet for more information).

1.3 WHAT IS THE DN2470 BASED LINEAR REGULATOR INPUT VOLTAGE RANGE EXTENDER EVALUATION BOARD?

The DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board presents the universal off-line linear regulation using the 700V depletion-mode FET DN2470. The board features off-line regulation using three different selectable LDOs: MCP1754, MCP1755 and MCP1790, offered in various package options. The evaluation board operates with 50 Hz 230 VAC or 60 Hz 120 VAC AC lines and sources 10 mA typical output current (LDO's output current).

Figure 1-1 presents the evaluation board block diagram.

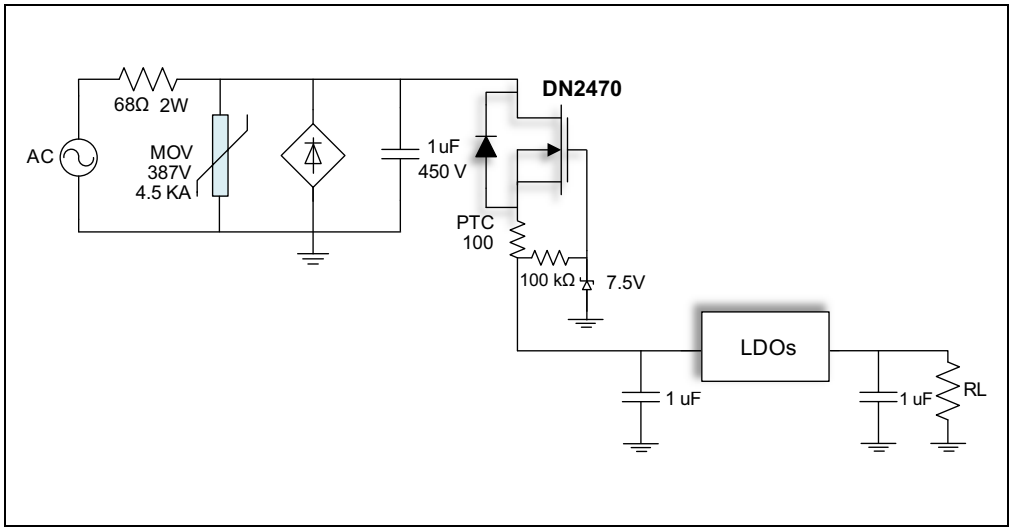

FIGURE 1-1: *DN2470 Evaluation Board Block Diagram.*

1.3.1 Evaluation Board Features

- 120 and 230 VAC Off-line Regulation
- Typical Output Current of 10 mA
- Maximum Output Current Thermally Limited
- Transient Survivability of 2.5 kV
- Overtemperature Protection; Typically +105°C
- Output Voltage Range of 3-5V
- Three Different Selectable LDOs:
  - MCP1754 (3.3V)
  - MCP1755 (5.0V)
  - MCP1790 (3.0V)

1.4 WHAT THE DN2470 BASED LINEAR REGULATOR INPUT VOLTAGE RANGE EXTENDER EVALUATION BOARD KIT CONTAINS

The DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board kit includes:

- DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board User's Guide (ADM00682)
- Important Information Sheet

NOTES:

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Chapter 2. Installation and Operation

2.1 GETTING STARTED

The DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board is fully assembled and tested.

2.1.1 Tools Required for Operation

The tools required for operation include:

- AC Line connection or DC power supply
- An oscilloscope and/or a multimeter to observe the waveforms and measure electrical parameters

2.2 SETUP AND OPERATION PROCEDURE

To prepare the DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board for operation, the steps below must be followed carefully.

WARNING
Before beginning board setup, fully read this document, the DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board User's Guide.

CAUTION
Hazardous voltages are present when connected to AC Lines.

1. Select an LDO by placing a jumper on J3 connector. If VIN1 or VIN2 are selected, $\overline{SHDN}$ must be shorted to VIN (J5 or J7).
2. Connect a Load if needed at VOUT.
3. Connect the AC Line (120 or 230 VAC) or DC power supply to J1.

Note: Do not touch exposed areas when operating the board. Avoid touching the heat sink, the drain-exposed pad or the input resistor.

Selecting Different LDO

To select a different LDO, the AC Line or DC power supply has to be removed first.

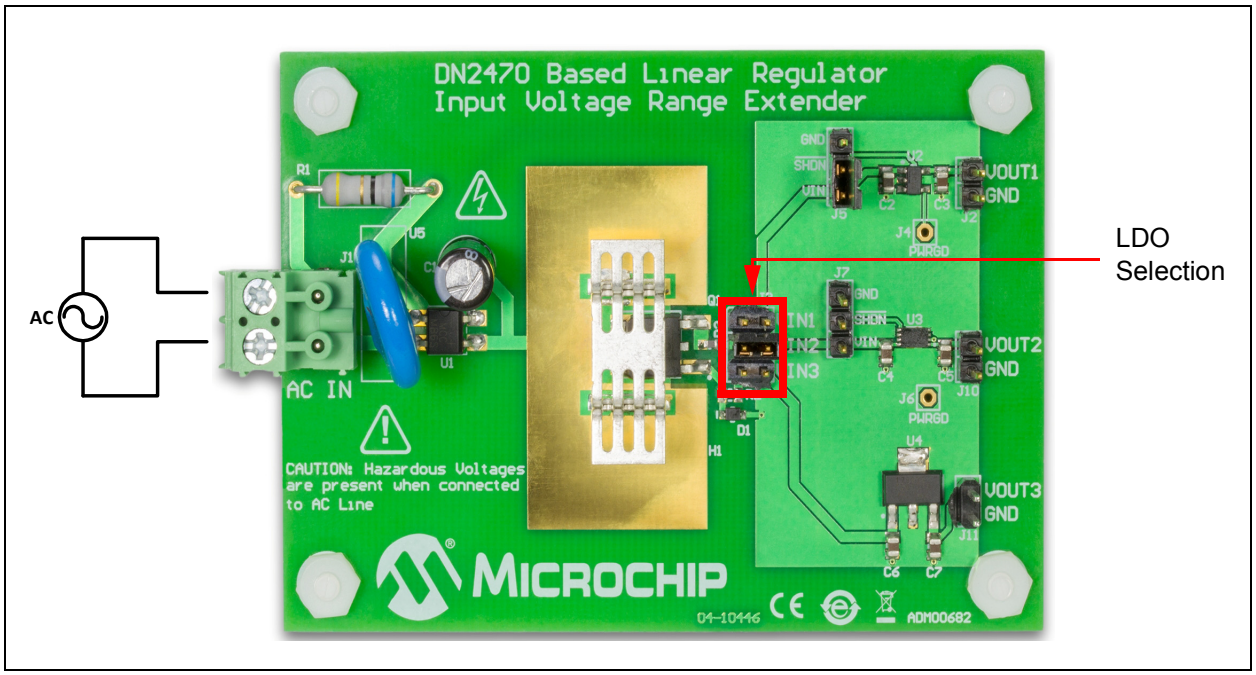

FIGURE 2-1: *DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board.*

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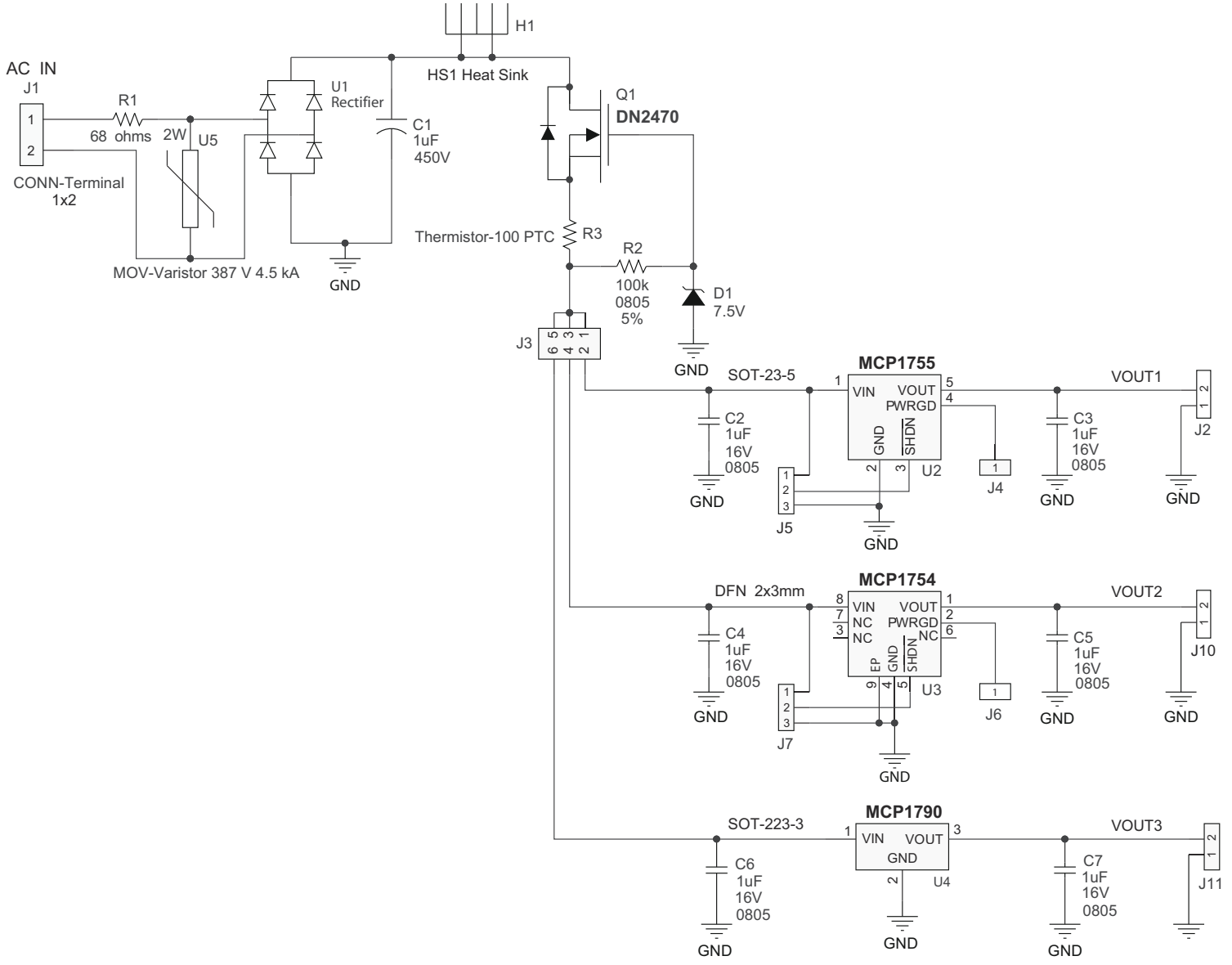
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

This appendix contains the following schematics and layouts for of the DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board:

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

A.2 BOARD – SCHEMATIC



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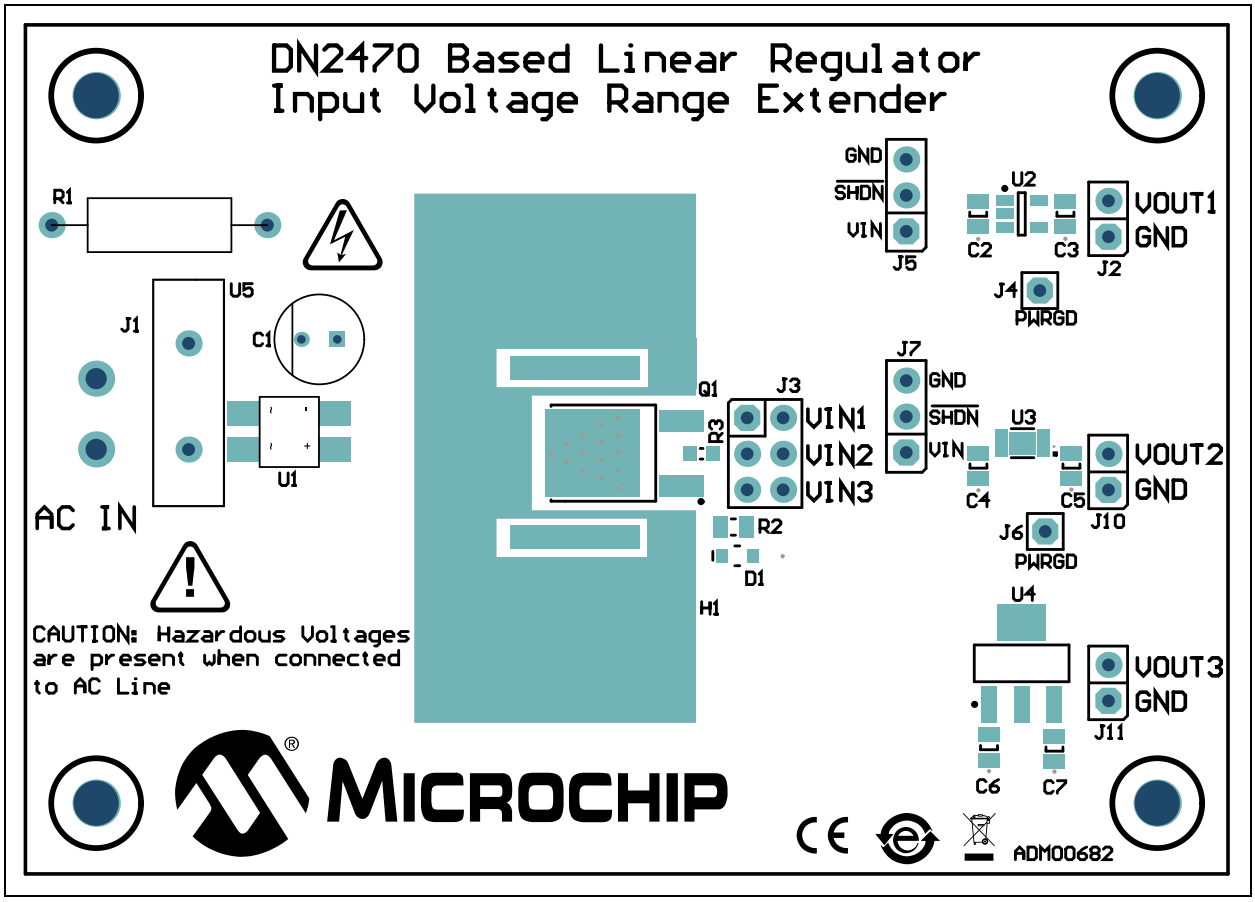
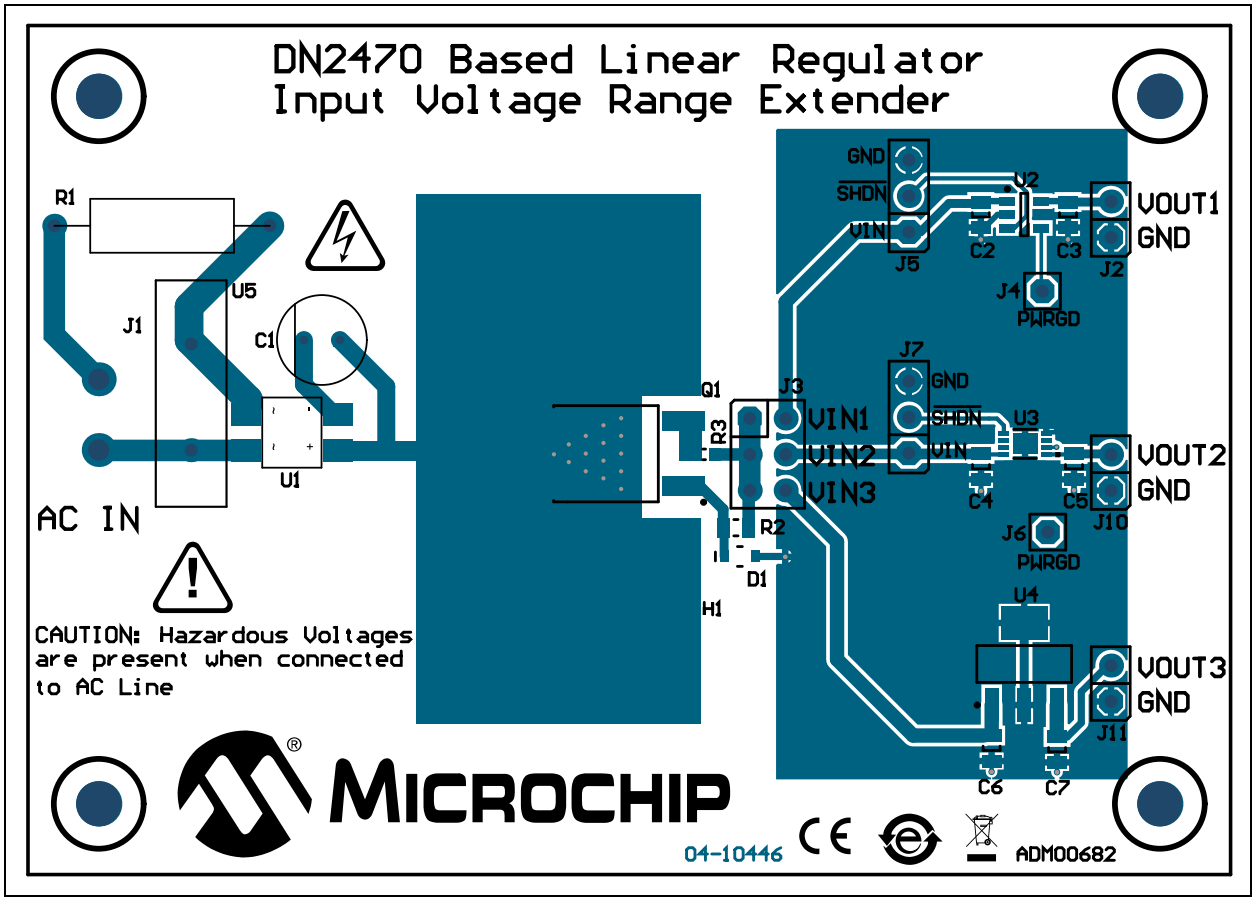
A.3 BOARD – TOP SILK



A.4 BOARD – TOP COPPER AND SILK



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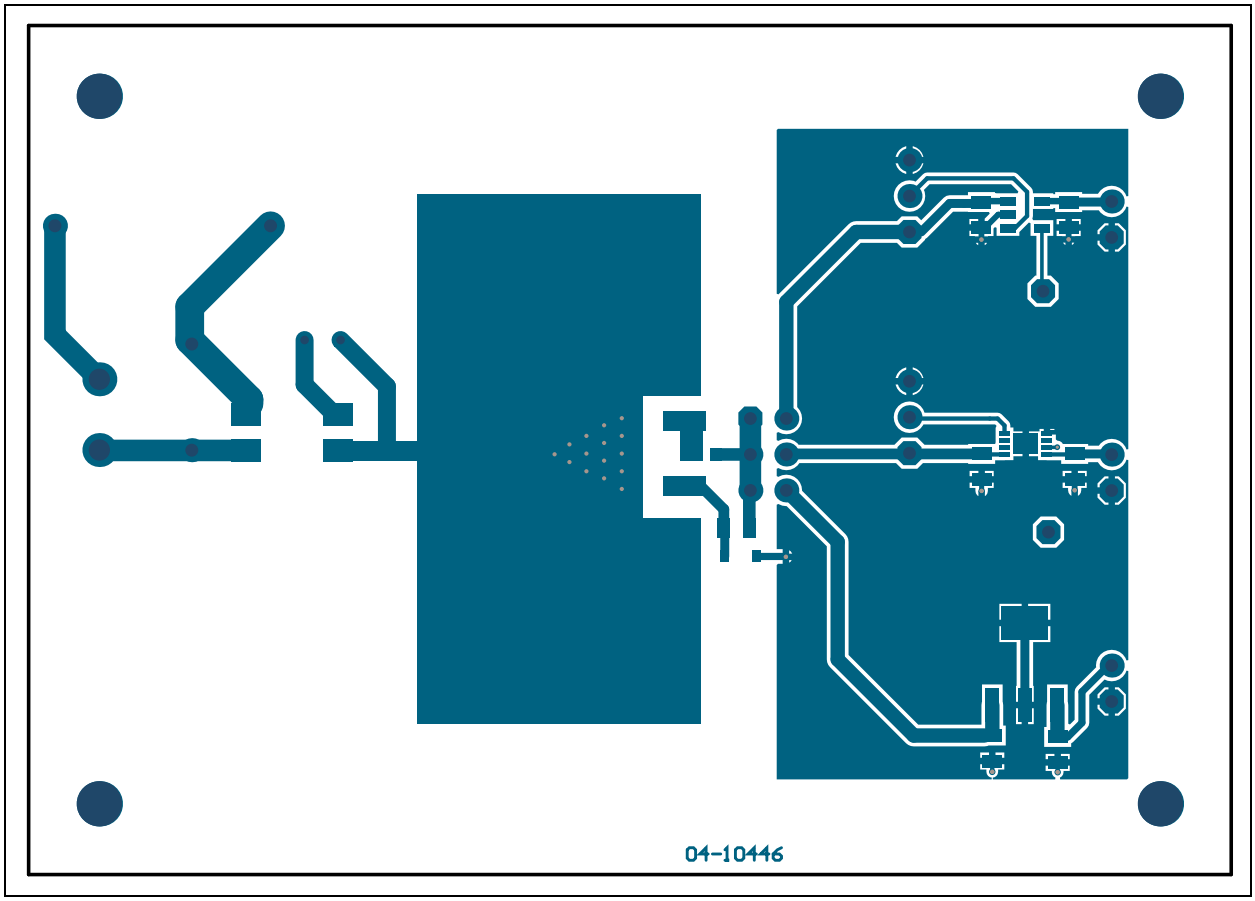
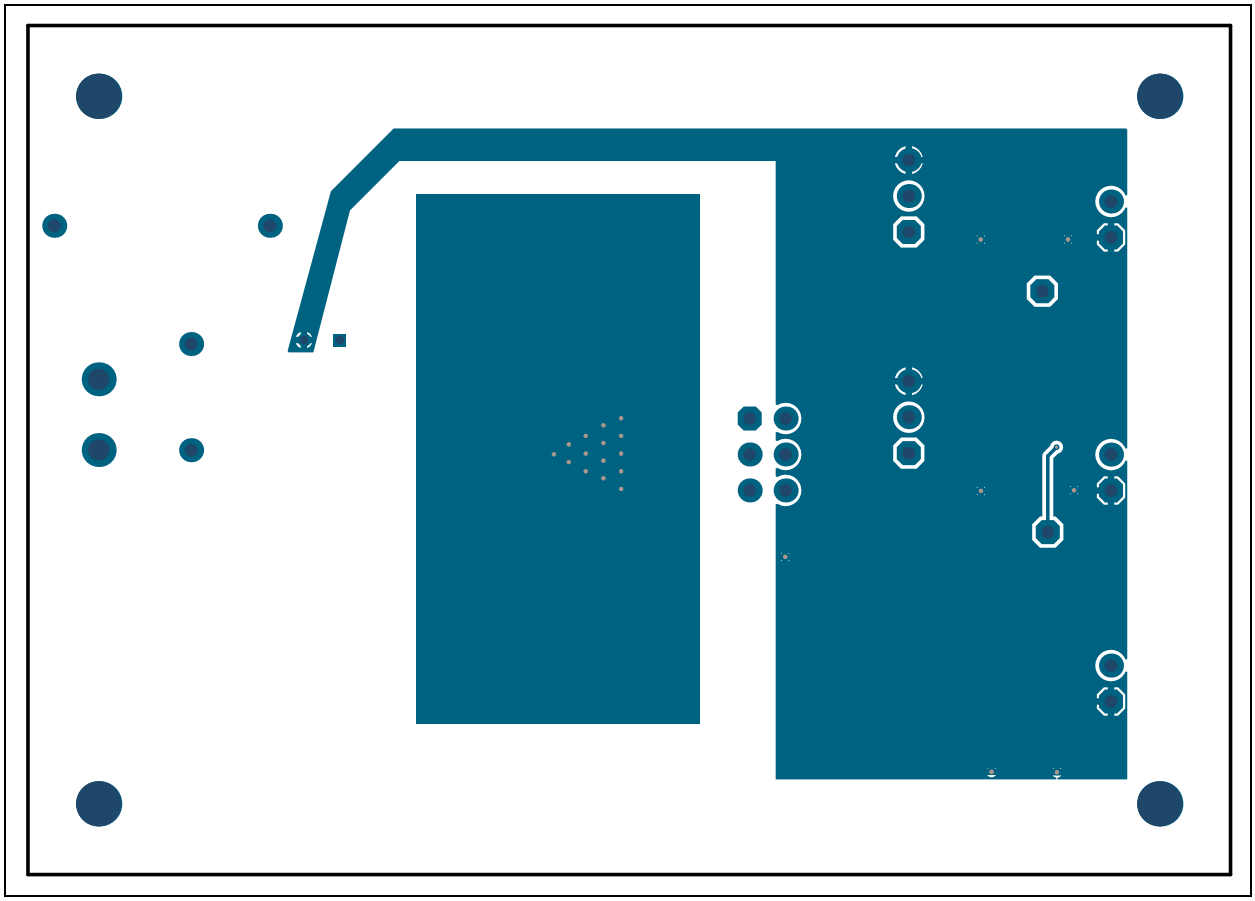
A.5 BOARD – TOP COPPER



A.6 BOARD – BOTTOM COPPER



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Appendix B. Bill of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

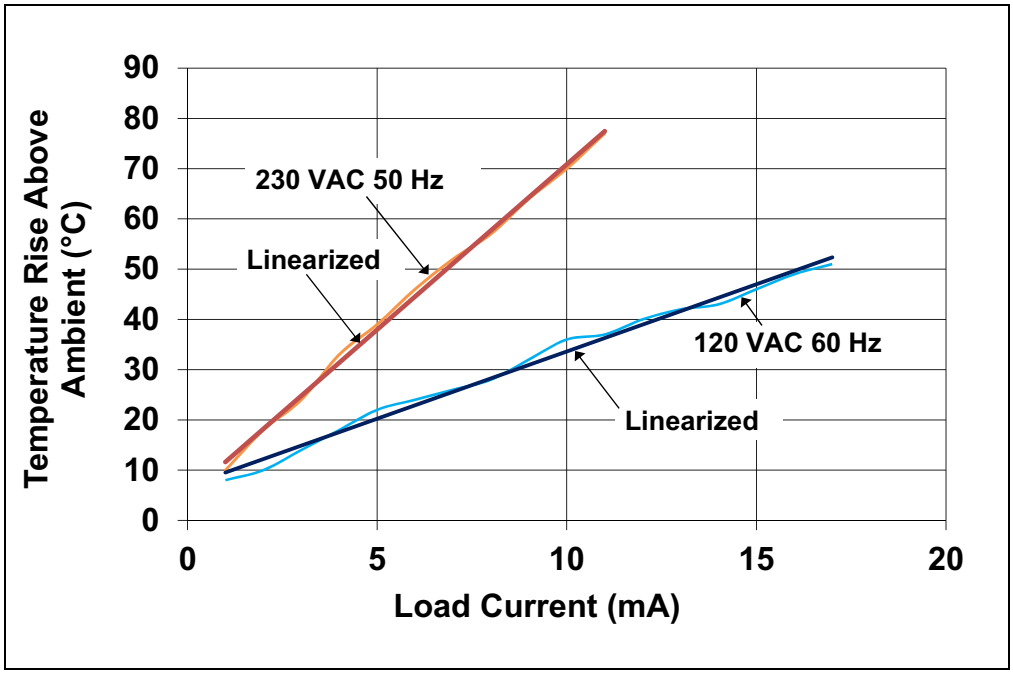
Qty.	Reference	Description	Manufacturer	Part Number
1	C1	Capacitor 1 µF 450V	Rubycon Corporation	450PX1MEFC6.3X11
6	C2, C3, C4, C5, C6, C7	Capacitor, 1 µF 16V	Kemet	C0805C105K4RACTU
1	D1	Zener Diode 7.5V	Diodes Incorporated®	BZT52C7V5S-7-F
1	H1	HS1 Heat Sink	Aavid Thermalloy	573100D00000G
1	J1	Connector Terminal 1X2	PHOENIX CONTACT	1933189
3	J2, J10, J11	2 Pos. Header Connector	Molex®	0022284020
1	J3	6 Pos. Dual Connector	Samtec Inc	TSW-103-08-L-D
2	J4, J6	1 Pos. Header Connector - NOT INSTALLED	TE Connectivity Ltd.	5-146280-1
2	J5, J7	3 Pos. Header Connector	Samtec, Inc.	TSW-103-07-T-S
4	N/A	Hex Standoff 4-40 Nylon 1/2	Keystone Electronics Corp.	4802
4	N/A	Hex Nut 1/4" Nylon	Keystone Electronics Corp.	9605
1	N/A (Mounts on J1)	Terminal Block Plug 2 Pos.	PHOENIX CONTACT	1934861
1	PCB	DN2470 Based Linear Regulator Input Voltage Range Extender Evaluation Board – Printed Circuit Board	—	04-10446
1	Q1	DN2470	Microchip Technology Inc.	**DN2470K4-G**
1	R1	68 Ohms 2W	TT Electronics Plc.	ULW2-68RJA25
1	R2	Resistor 100k	Yageo Corporation	RC0805JR-07100KL
1	R3	Thermistor-100 PTC	Murata Electronics North America, Inc.	PRG18BB101MB1RB
1	U1	Rectifier 0.5A 400V	Micro Commercial Components	MB4S-TP
1	U2	MCP1755	Microchip Techonology Inc.	**MCP1755T-3302E/OT**
1	U3	MCP1754	Microchip Techonology Inc.	**MCP1754-5002E/MC**
1	U4	MCP1790	Microchip Techonology Inc.	**MCP1790-3002E/DB**
1	U5	Varistor 387V 4.5kA -14 mm Disc	Bourns, Inc.	MOV-14D431K

Note 1: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

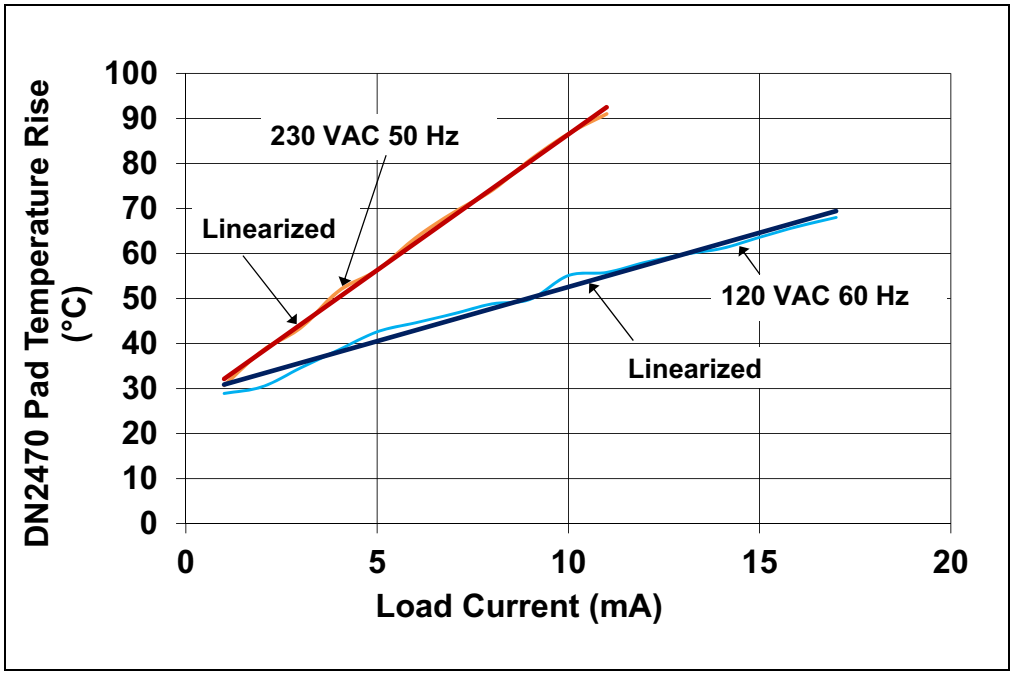
NOTES:

Appendix C. DN2470 Characterization Plots

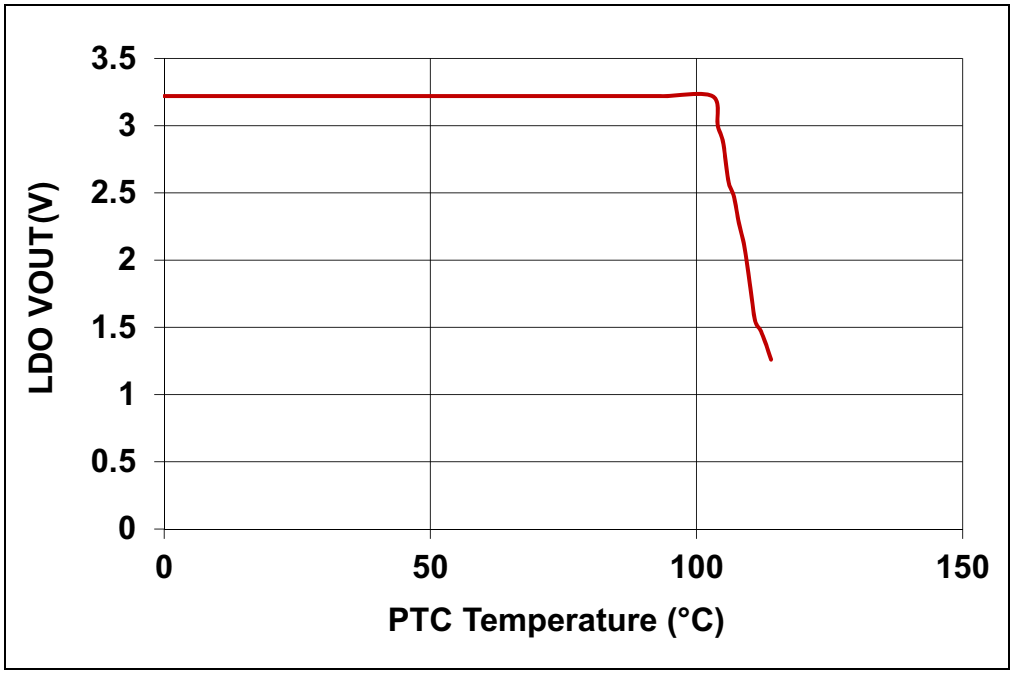
C.1 HEAT SINK



C.2 PAD TEMPERATURE



C.3 OVERTEMPERATURE PROTECTION USING PTC



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Corporate Office
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07/14/15

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