MIC2800 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 website (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 MIC2800 Evaluation Board. Items discussed in this chapter include:

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

DOCUMENT LAYOUT

This document describes how to use the MIC2800 Evaluation Board as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MIC2800 Evaluation Board.
- **Chapter 2. "Installation and Operation"** – Includes instructions on installing and starting the Microchip Chip Manager application.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the MIC2800 Evaluation Board.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the MIC2800 Evaluation Board.

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) { ... }`

RECOMMENDED READING

This user's guide describes how to use the MIC2800 Evaluation Board. Another useful document is listed below. The following Microchip document is available and recommended as a supplemental reference resource:

MIC2800 Data Sheet – *"Digital Power Management IC 2 MHz, 600 mA DC/DC with Dual 300 mA/300 mA Low V_{IN} LDOs"* (DS20005839A)

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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 (November 2017)

- Initial Release of this Document.

NOTES:

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MIC2800 Evaluation Board and covers the following topics:

- MIC2800 Device Short Overview
- MIC2800 Evaluation Board Overview
- MIC2800 Evaluation Board Kit Contents

1.2 MIC2800 DEVICE SHORT OVERVIEW

1.2.1 MIC2800 Key Features

The key features of the MIC2800 include:

- 2.7V to 5.5V input voltage range
- 2 MHz DC/DC converter and two LDOs
  - LDO1 is powered from DC/DC converter for highest efficiency
  - LDO2 is powered directly from V_{IN}
- Integrated power-on reset (AND function for all outputs)
- Adjustable delay time
- LOWQ mode for DC/DC and LDOs
- 30 µA Total I_Q when in LOWQ mode
- Thermal Shutdown Protection
- Current Limit Protection
- Tiny 16-pin 3 mm x 3 mm QFN package

DC to DC Converter

- Output current to 600 mA in PWM mode
- LOWQ Mode: NO NOISE Light load mode
- 75 μV_{RMS} output noise in LOWQ mode
- 2 MHz PWM operation in normal mode
- >90% efficiency

LDOs

- LDO1: input voltage directly connected to DC/DC converter output voltage for maximum efficiency
  - Ideal for 1.8V to 1.5V conversion
  - 300 mA output current from 1.8V input
  - Output voltage down to 0.8V
- LDO2: 300 mA output current capable

1.2.2 MIC2800 Device Overview

The MIC2800 device is a high-performance power management IC, giving three output voltages with maximum efficiency. Combining a 2 MHz DC/DC converter with an LDO regulator (LDO1), the MIC2800 gives two high-efficiency outputs (DC/DC and LDO1), combined with the flexibility of a third output, a 300 mA LDO (LDO2). The MIC2800 features a LOWQ mode, reducing the total current draw in this mode to less than 30 µA. In LOWQ mode, the output noise of the DC to DC converter is 75 μV_{RMS}, significantly lower than other converters which use a PFM light load mode that can interfere with sensitive RF circuitry.

The DC to DC converter uses small values of the inductor and capacitors to reduce board space, but still retains efficiencies over 90%, at load currents up to 600 mA.

The MIC2800 is a µCap design, operating with very small ceramic output capacitors and inductors for stability, reducing required board space and component cost and it is available in fixed output voltages in the 16-pin 3 mm x 3 mm QFN lead-free package.

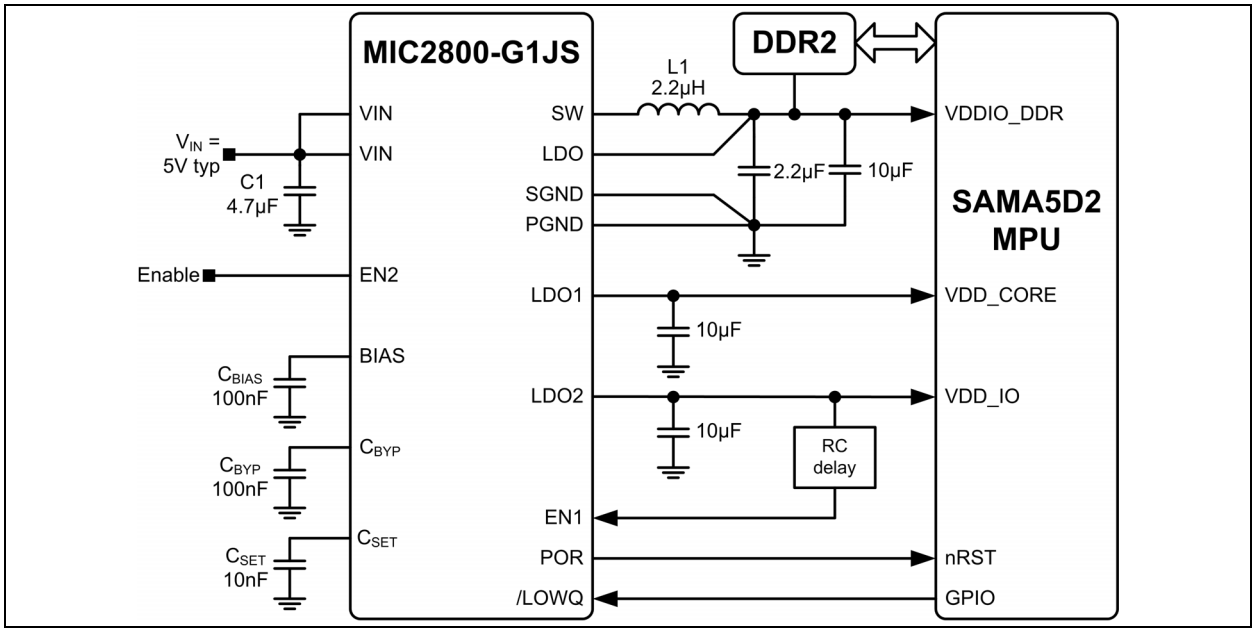


FIGURE 1-1: *MIC2800 Typical Application Circuit.*

1.3 MIC2800 EVALUATION BOARD OVERVIEW

The MIC2800 Evaluation Board has been developed to evaluate the capabilities of the MIC2800 multi-output (DC-DC and 2 x LDO) device. The board is populated with the MIC2800-G1JS device and it is set to the following voltages:

- VOUT1 (DC-DC Buck converter): 1.8V
- VOUT2 (LDO1): 1.25V
- VOUT3 (LDO2): 3.3V

The MIC2800-G1JS allows support of the SAMA5D2 family MPUs when operating off a 5V input rail. However, by populating the board with another MIC2800 IC voltage option, other power supply solutions can be demonstrated.

The MIC2800 Evaluation Board features independent Enable connectors (EN1 and EN2). To disable the regulators, a jumper must be placed on J1 (to disable the DC/DC converter and LDO1) or to J2 (to disable LDO2). Since it is not recommended to leave EN pins floating, the MIC2800 Evaluation Board features 100 kΩ pull-up resistors, so the default value when the board is powered is ON.

The MIC2800 Evaluation Board also features a $\overline{\text{LOWQ}}$ pin to switch the functionality of the DC/DC converter. When the $\overline{\text{LOWQ}}$ is logic high (>1V), the DC/DC converter works in PWM mode (normal operation mode with 600 mA output current capability). When the $\overline{\text{LOWQ}}$ is logic low (<0.2V), the DC/DC converter stops switching, the output voltage is supplied by a low noise linear regulator and the quiescent current of the device is greatly reduced. In linear (LDO) mode, the DC/DC converter output can deliver 60 mA of current to the load from the LDO pin.

The $\overline{\text{LOWQ}}$ mode also limits the output load of both LDO1 and LDO2 to 10 mA

To check the status of the MIC2800 outputs, Power-on Reset Output is available with a pull-up to V_{IN} or to VOUT3. Active low on this output indicates an undervoltage condition on either one of the three regulators.

The board can be powered from 3.6V to 5.5V. This input voltage range is determined by the 3.3V LDO2 that has a dropout voltage of maxim 300 mV overtemperature. If another version of the MIC2800 is placed on the board, the minimum input voltage must comply to $V_{OUTLDO2}$ + 300 mV.

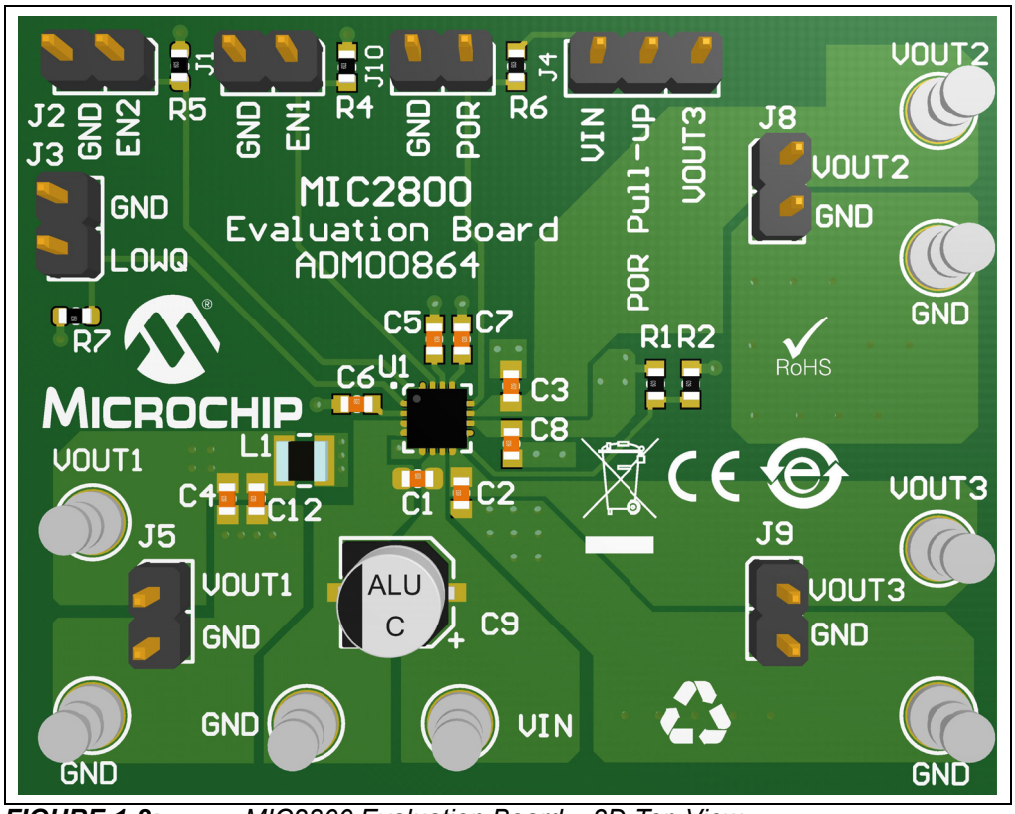


FIGURE 1-2: *MIC2800 Evaluation Board – 3D Top View.*

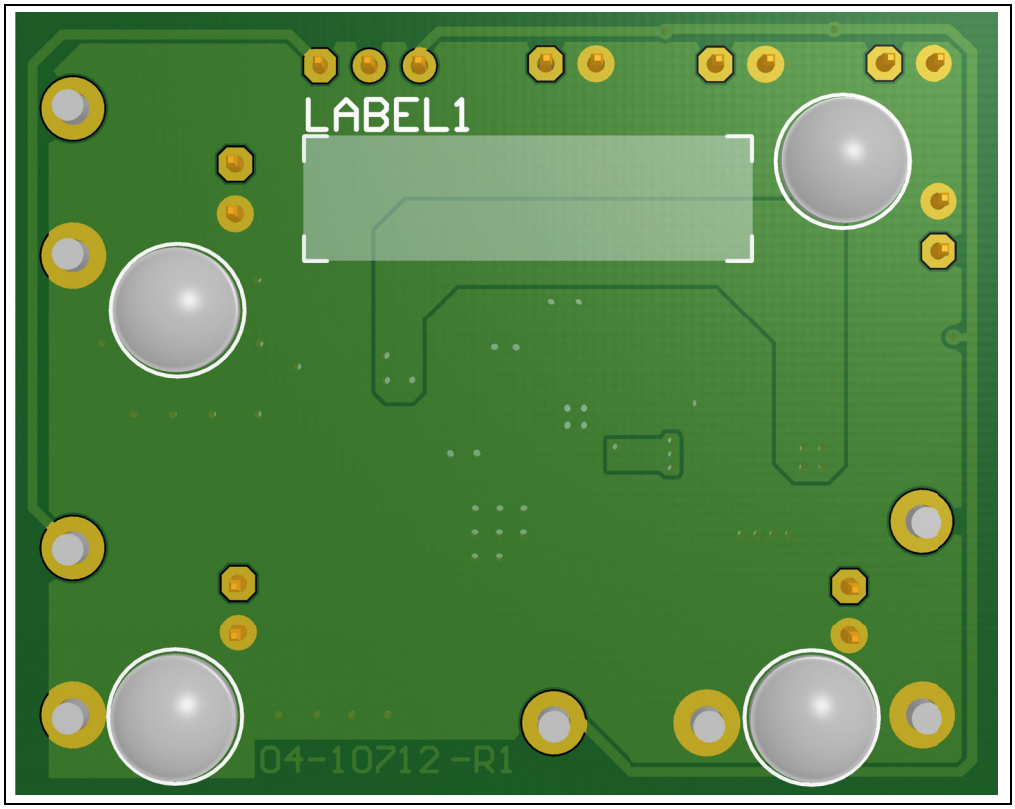


FIGURE 1-3: *MIC2800 Evaluation Board – 3D Bottom View.*

1.4 MIC2800 EVALUATION BOARD KIT CONTENTS

The MIC2800 Evaluation Board kit includes:

- MIC2800 DC/DC with Dual LDO PMIC Evaluation Board (ADM00864)
- Information Sheet

Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MIC2800 Evaluation Board can be powered from a wide voltage range, from 3.6V to 5.5V, making it compatible with 5V rails and USB power.

2.2 GETTING STARTED

To power up the MIC2800 Evaluation Board, the following steps must be completed:

1. Connect an external supply between V_{IN} and GND terminals. Pay attention to the polarity.
2. With the output of the power supply disabled, set its voltage to the desired input test voltage ($3.6V \le V_{IN} \le 5.5V$). An ammeter may be placed between the input supply and the V_{IN} terminals. Be sure to monitor the supply voltage at the V_{IN} terminal, as the ammeter and/or power lead resistance can reduce the voltage supplied to the device.
3. Connect a load between either VOUT1 and GND, VOUT2 and GND, or VOUT3 and GND. The load can be either passive (resistive) or active (electronic load). Some electronic loads can sink the programmed current starting from very low output voltage levels during startup. For a more realistic startup behavior evaluation, a resistive load or constant resistance is recommended. An ammeter may be placed between the load and the output terminals. Ensure the output voltage is monitored at the VOUT1, VOUT2 and VOUT3 terminals. To obtain the best output voltage regulation measurement and low noise, please measure with a ground spring on the output capacitor, corresponding to the desired output.
4. The MIC2800 Enable Pins (EN1, EN2) have pull-up resistors to V_{IN}. By default, the output voltage will be enabled when the input supply of >2.7V is applied. To disable the device, apply a voltage of 0V to the EN1, EN2 terminals (J1 and/or J2).
5. Power-on Reset (POR) test point is provided to monitor the POR function (J10). The power-on reset output will go high after all the output voltages have reached 96% of their nominal voltage and will go low as son as one of the output voltages go below 91% of its nominal voltage. The POR flag has programmable assertion delay set by the capacitor placed on CSET pin to ground.
6. The inductance associated with long wires between the power supply and the board input may cause voltage spikes at load stepping, start-up into heavy loads or hot wire plug conditions. If the spikes exceed 6V absolute maximum input voltage, the MIC2800 may fail. This behavior is prevented by C9 capacitor (100µF Al-Electrolytic capacitor) by absorbing voltage spikes.

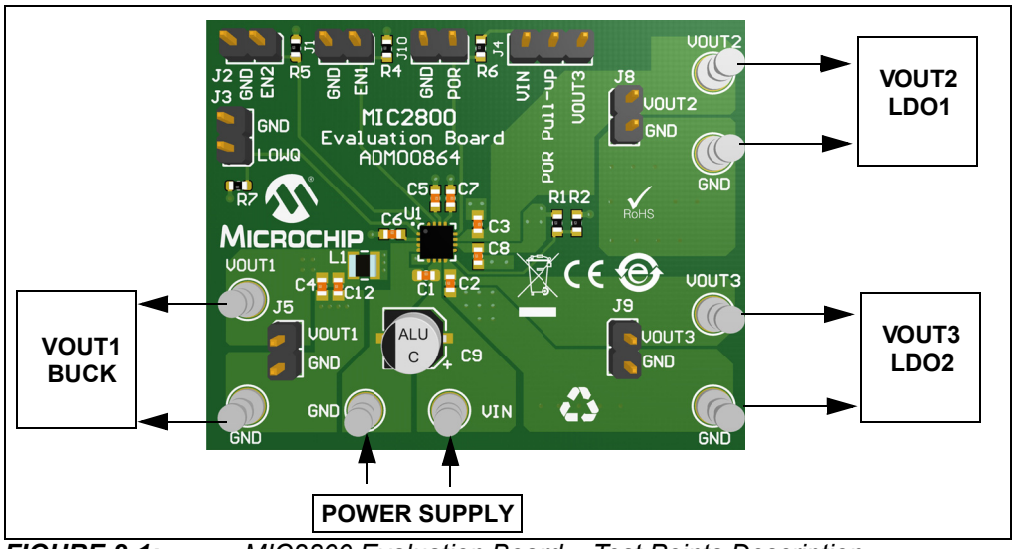


FIGURE 2-1: *MIC2800 Evaluation Board – Test Points Description.*

2.3 EVALUATION BOARD DESCRIPTION

2.3.1 Power-on Reset Pull-up Resistor

The MIC2800 Evaluation Board offers the possibility of connecting the POR pin to either V_{IN} or VOUT3 (LDO2, 3.3V) by using J4. This provides the flexibility for direct interfacing with 3.3V systems or directly to V_{IN} when the 3.3V rail is disabled.

2.3.2 Power-on Reset Capacitor (C7)

The MIC2800 has a programmable POR delay set by placing a capacitor on the CSET pin. This pin is a current source output that charges a capacitor that sets the delay time for the POR output, from low to high. The current source of 1.25 µA charges a capacitor up from 0V. When the capacitor reaches 1.25V, the output of the POR is allowed to go high. The delay time in microseconds is equal to the CSET capacitor in picofarads (Equation 2-1).

EQUATION 2-1:

$$PORDelay(uS) = CSET(pF)$$

2.3.3 $\overline{\text{LOWQ}}$ Mode

MIC2800 is 2 MHz 600 mA DC/DC converter with two integrated 300 mA LDOs. This design combines good overall efficiency with low output noise. However, the DC/DC converter is always switching in PWM mode. To reduce quiescent current in light-load conditions, the MIC2800 features a $\overline{\text{LOWQ}}$ pin. In this mode, the DC/DC converter is disabled and the output voltage is provided by a low noise linear regulator (LDO) capable of supplying 60 mA to the load. In this mode, the other linear regulators (LDO1 and LDO2) will also be internally limited to 10 mA.

2.3.4 Using Fixed and Adjustable Voltage Options

The MIC2800 Evaluation Board is designed for both fixed and adjustable options. Resistors R1 and R2 are used for setting the output voltage of the adjustable option of the DC/DC converter: R1 is the top voltage divider resistor and R2 is the bottom voltage divider resistor. The feedback voltage is 0.8V (nominal) and the output voltage can be adjusted from 1V to 2V. Note that LDO1 is powered from the DC/DC converter's output, so in order for LDO1 to maintain good regulation, the DC/DC output voltage should be minimum V_{DCDC} - V_{DO}.

2.3.5 Output Noise and Ripple Measurements

The MIC2800 Evaluation Board is populated with headers used for measuring output noise and ripple on both the DC/DC converter and the LDOs (J5, J8 and J9). Each connector is designed to probe the output signal using the local ground as reference. This is the proper way of measuring low-amplitude ripple signals because it eliminates any noise caused by long oscilloscope ground leads or ground plane noise.

2.3.6 Board Layout Considerations

It is recommended that the connection between the GND pins of the MIC2800 and GND terminals of the input capacitors is kept on the TOP of the PCB and no vias should be placed between them. This will improve transient behavior and decrease noise. It is also recommended that the TOP GND plane should extend under the device for optimal noise performance.

NOTES:

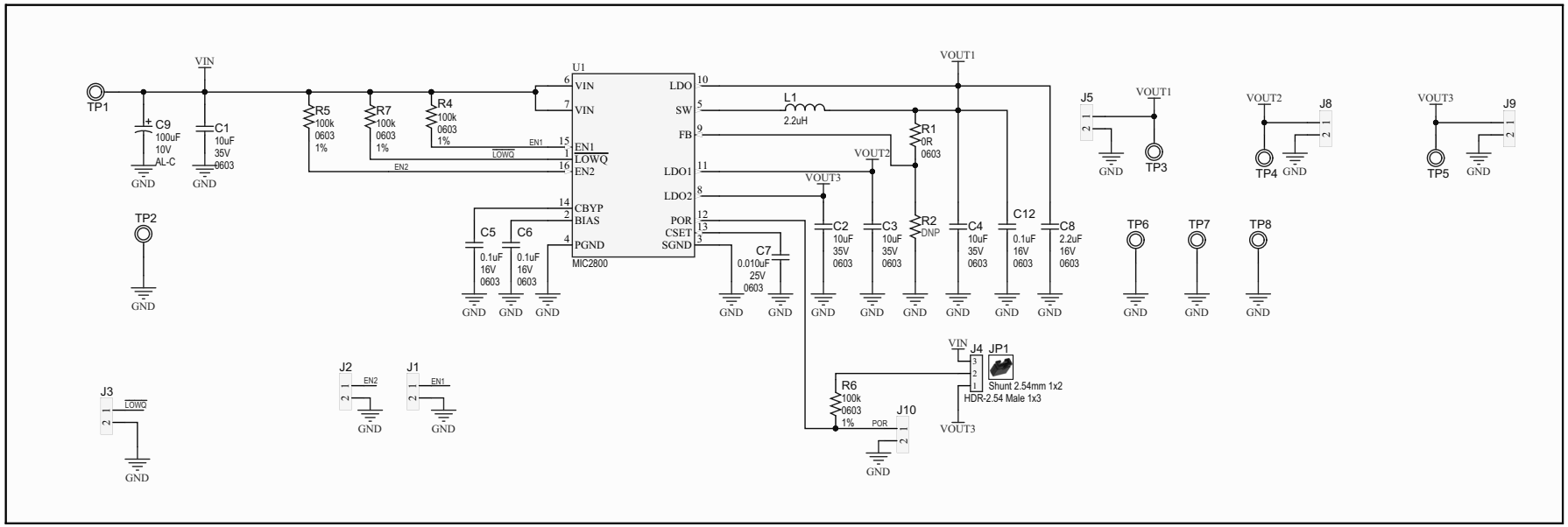
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

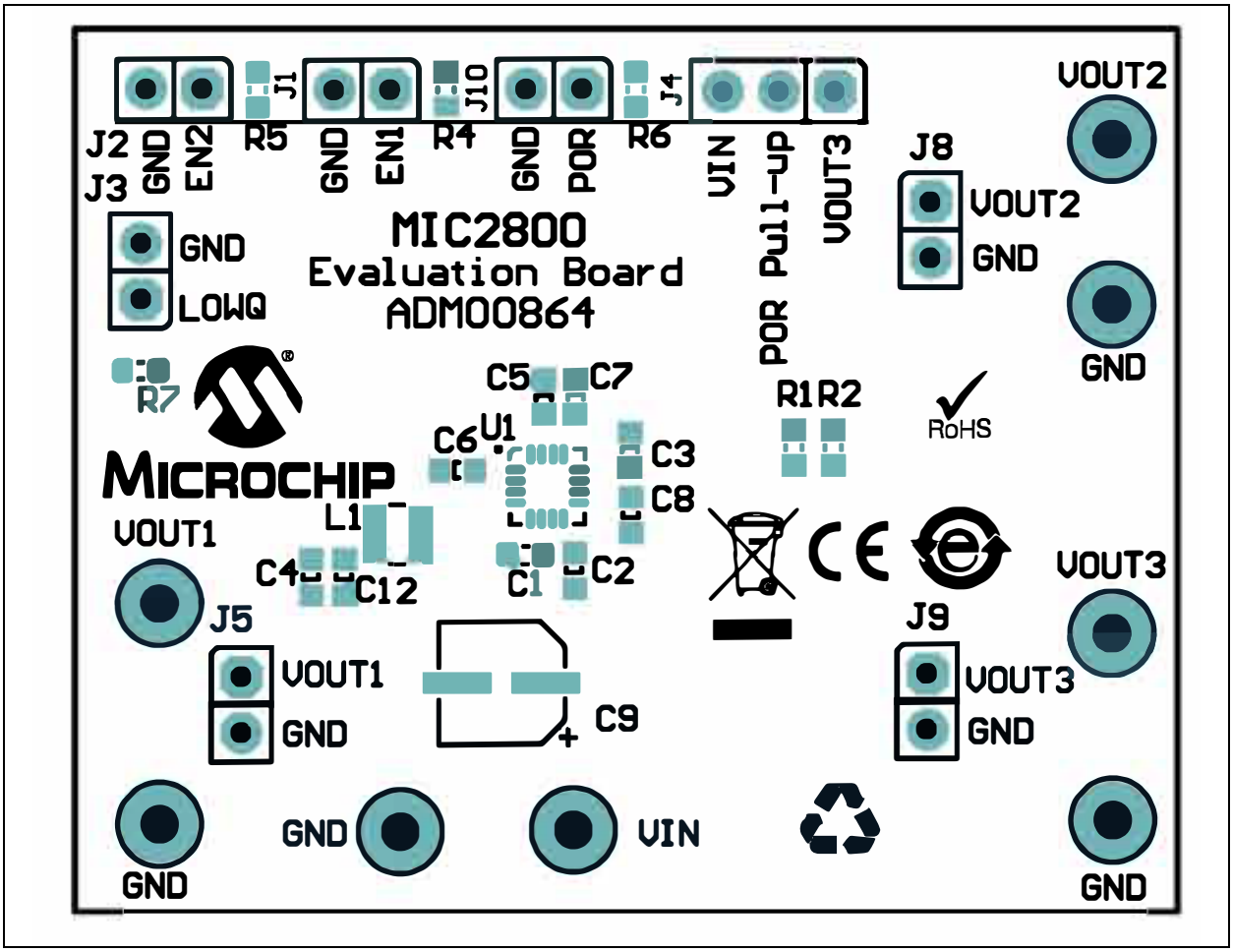
This appendix contains the following schematics and layouts for the MIC2800 Evaluation Board:

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

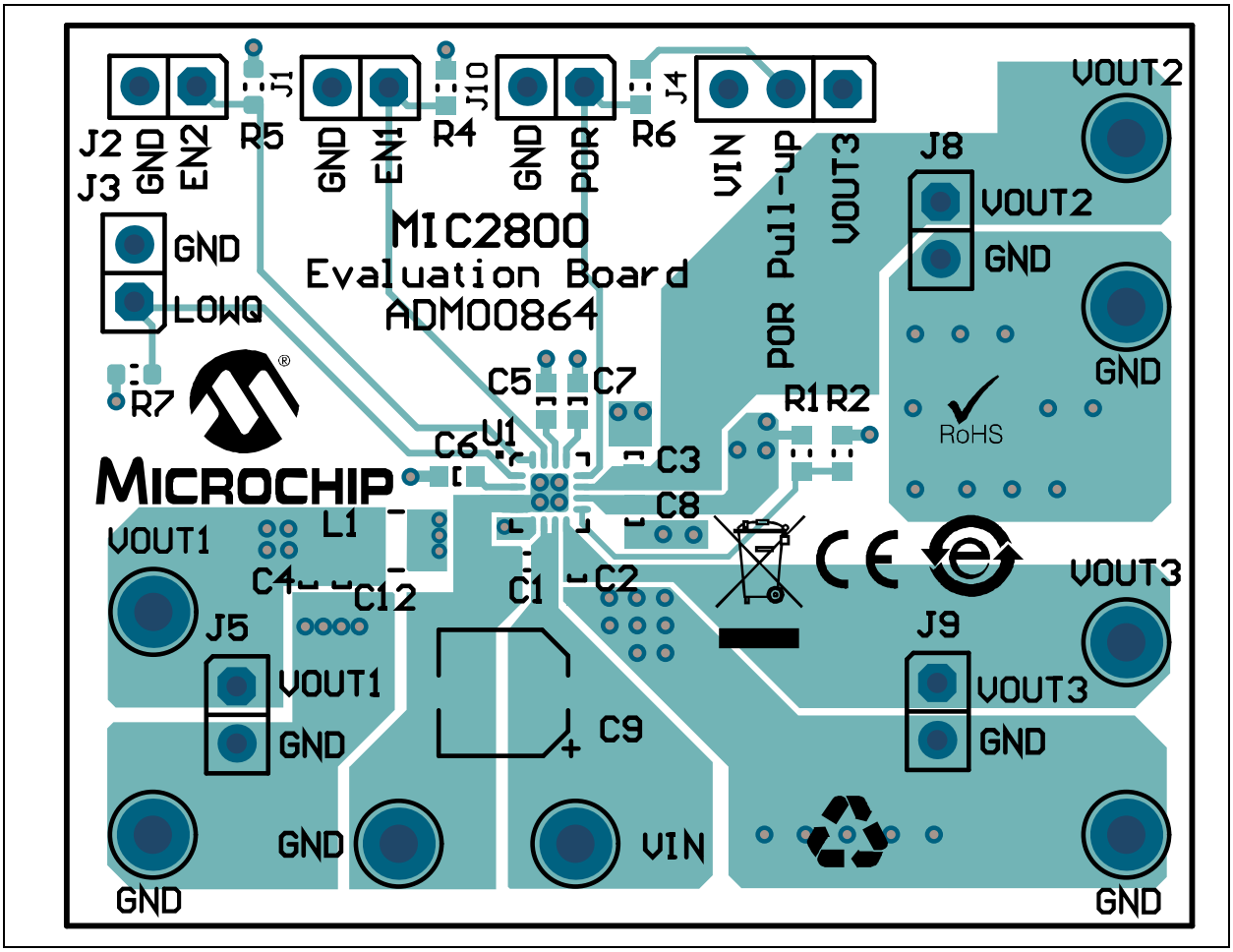
A.2 BOARD – SCHEMATIC



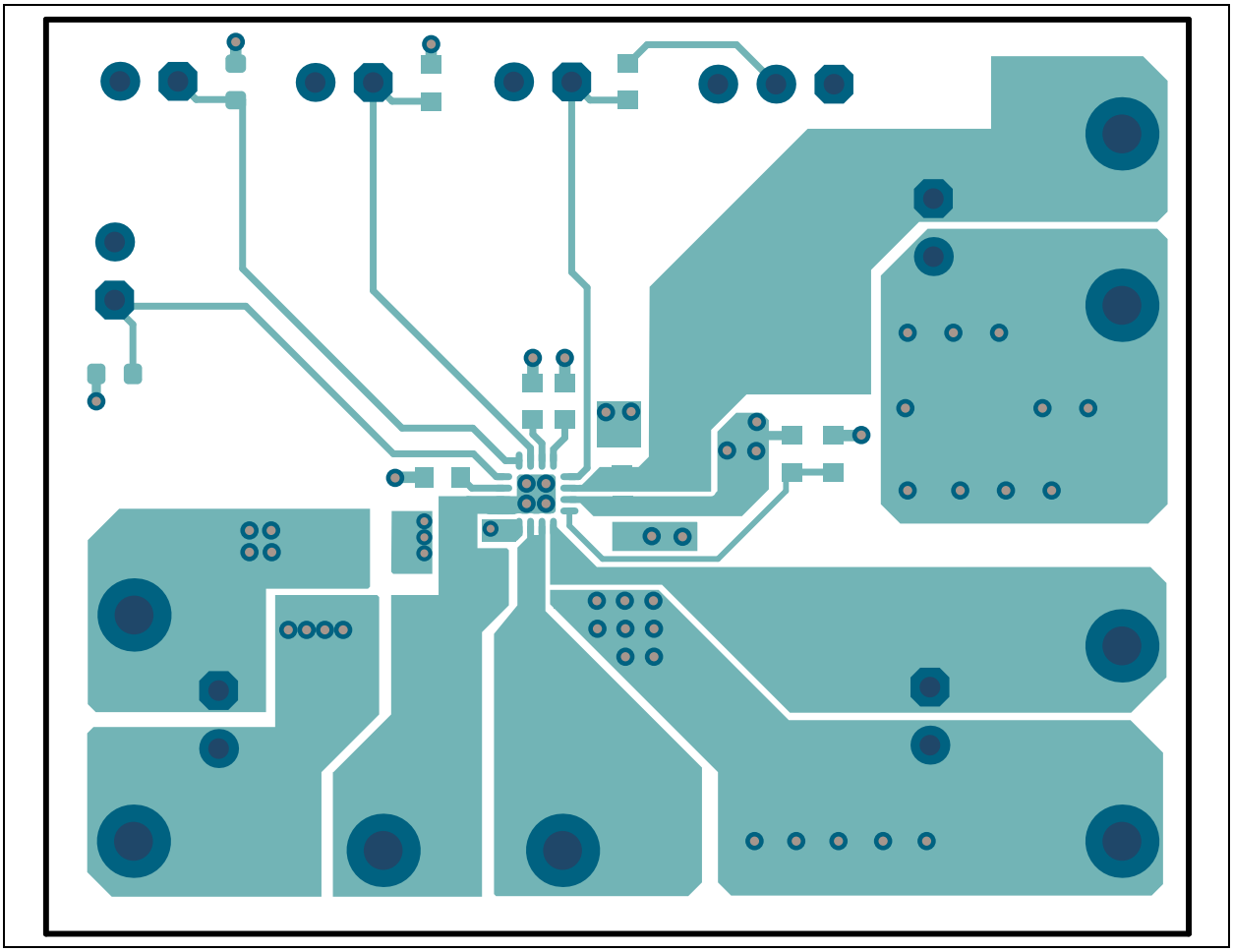
A.3 BOARD – TOP SILK



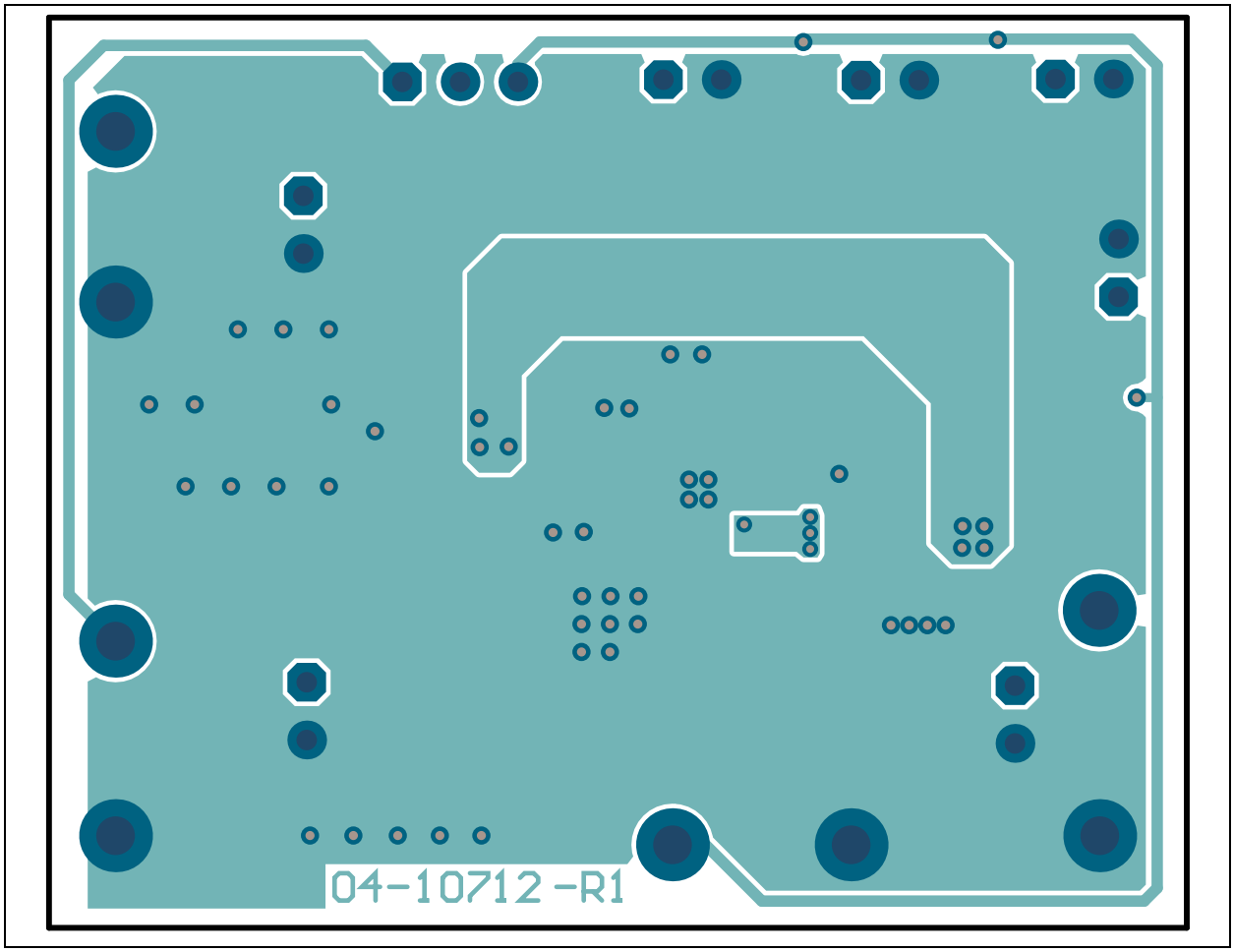
A.4 BOARD – TOP COPPER AND SILK



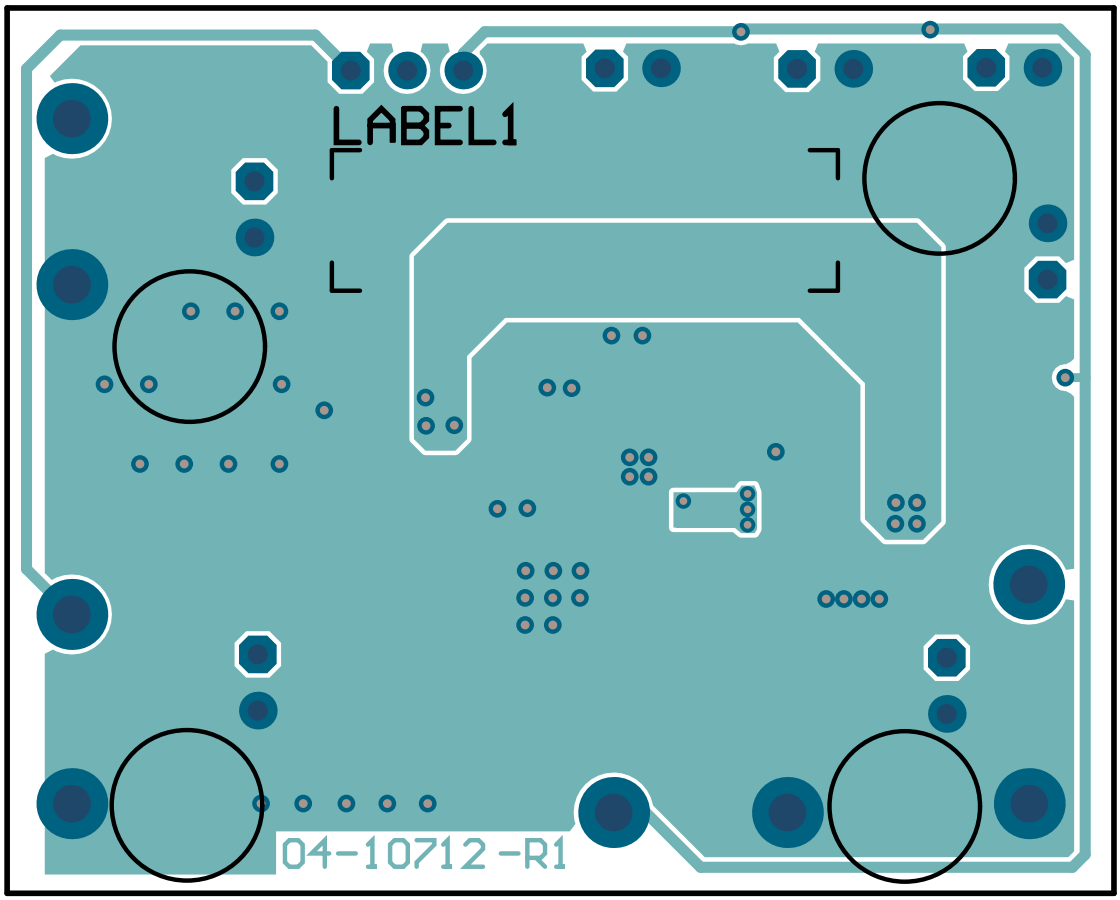
A.5 BOARD – TOP COPPER



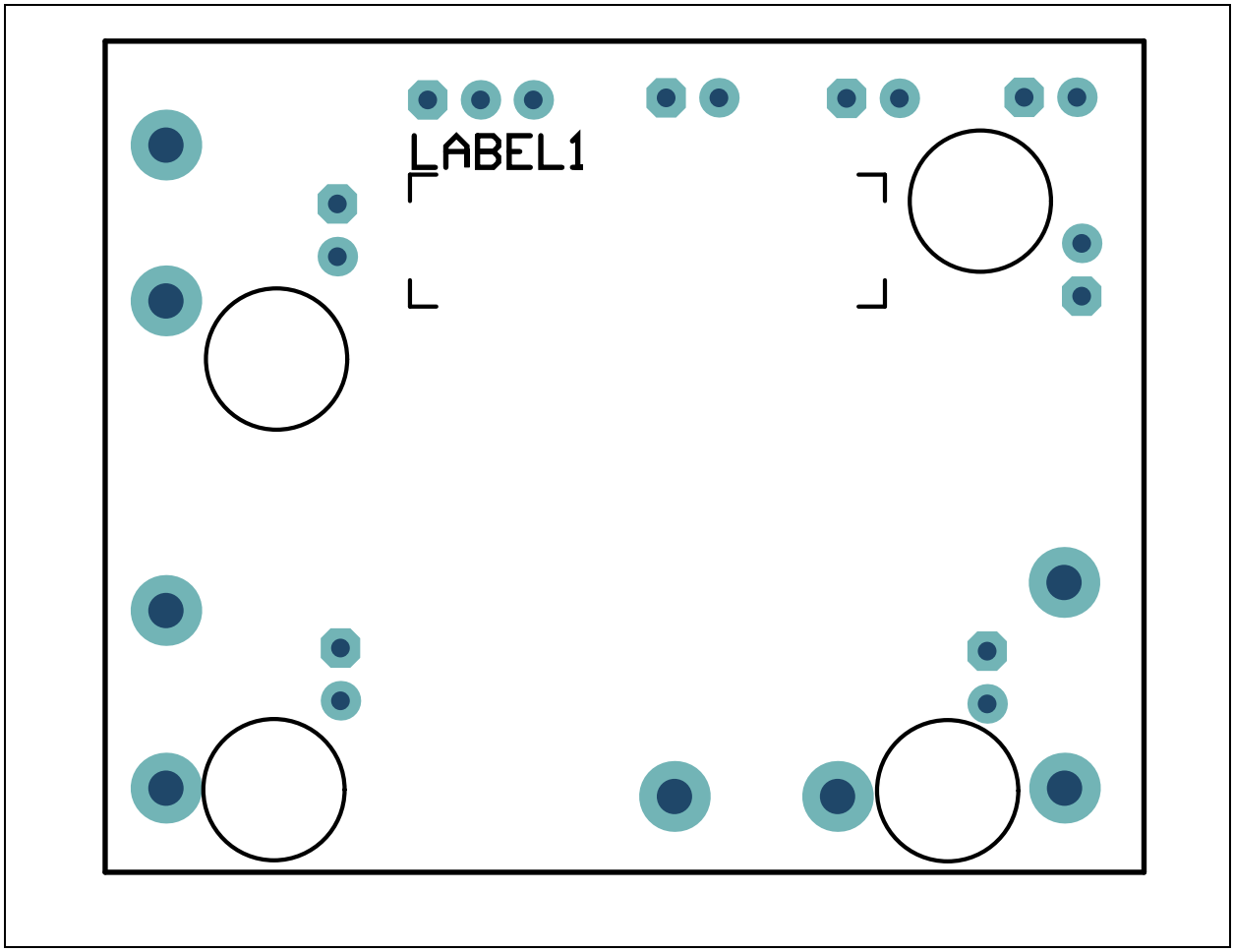
A.6 BOARD – BOTTOM COPPER



A.7 BOARD – BOTTOM COPPER AND SILK



A.8 BOARD – BOTTOM SILK



Appendix B. Bill of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Qty.	Reference	Description	Manufacturer	Part Number
4	C1, C2, C3, C4	CAP CER 10 µF 25V 20% X5R SMD 0603	Murata Electronics®	GRM188R61E106MA73D
3	C5, C6, C12	CAP CER 0.1 µF 16V 10% X7R SMD 0603	Wurth Elektronik	885012206046
1	C7	CAP CER 0.010 µF 25V 10% X7R SMD 0603	Yageo Corporation	CC0603KRX7R8BB103
1	C8	CAP CER 2.2 µF 10V 10% X7R SMD 0603	Murata Electronics®	GRM188R71A225KE15D
7	J1, J2, J3, J5, J8, J9, J10	CON HDR-2.54 Male 1x2 Gold 5.84MH TH VERT	FCI	77311-118-02LF
1	J4	CON HDR-2.54 Male 1x3 Gold 5.84MH TH VERT	FCI	68000-103HLF
	JP1	MECH HW JUMPER 2.54mm 1x2 GOLD	Wurth Elektronik	60900213421
1	L1	INDUCTOR 2.2 µH 1.3A 20% SMD 1008	TDK Corporation	MLP2520H2R2MT0S1
1	PCB	MIC2800 Evaluation Board – Printed Circuit Board	Microchip Technology Inc.	**04-10712-R1**
1	R1	RES TKF 0R 1/10W SMD 0603	Panasonic® - ECG	ERJ-3GSY0R00V
4	R4, R5, R6, R7	RES TF 100 kΩ 1% 1/8W SMD 0603	Vishay Intertechnology, Inc.	MCT06030C1003FP500
8	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8	CON TP PIN Tin TH	Harwin Plc.	H2121-01
1	C9	CAP ALU 100uF 10V 20% SMD C	Panasonic® - ECG	EEE-1AA101WR
1	U1	MCHP ANALOG SWITCHER Buck 1.8V to 3.3V MIC2800-G1JSYML-TR VFQFN-16	Microchip Technology Inc.	**MIC2800-G1JSYML-TR**

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:

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Malaysia - Penang
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Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

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Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
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Fax: 39-0331-466781

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Fax: 34-91-708-08-91

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UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820