



MCP1642B/D
Two-Cell to USB Power
Evaluation Board
User's Guide

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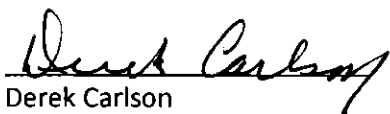
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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA


Derek Carlson
VP Development Tools

12-Sep-14
Date

NOTES:

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Preface

NOTICE TO CUSTOMERS

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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 MCP1642B/D Two-Cell to USB Power Evaluation 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 MCP1642B/D Two-Cell to USB Power Evaluation Board as a development tool. The manual layout is as follows:

- **Chapter 1. “Product Overview”** – Important information about the MCP1642B/D Two-Cell to USB Power Evaluation Board.
- **Chapter 2. “Installation and Operation”** – Includes instructions on how to get started with this user's guide and a description of the user's guide.
- **Appendix A. “Schematic and Layouts”** – Shows the schematic and layout diagrams for the MCP1642B/D Two-Cell to USB Power Evaluation Board.
- **Appendix B. “Bill of Materials (BOM)”** – Lists the parts used to build the MCP1642B/D Two-Cell to USB Power 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	<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><i>File>Save</i></u>
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 MCP1642B/D Two-Cell to USB Power Evaluation Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

- **MCP1642B/D Data Sheet – “1.8A Input Current Switch, 1 MHz Low-Voltage Start-up Synchronous Boost Regulator” (DS20005253)**
- **AN1311, Single Cell Input Boost Converter Design (DS01311)**

This application note details how to use the MCP1642B/D device in specific applications.

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- 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 (December 2014)

- Initial Release of this Document.

NOTES:

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MCP1642B/D Two-Cells to USB Power Evaluation Board and covers the following topics:

- MCP1642B/D Short Overview
- What is the MCP1642B/D Two-Cells to USB Power Evaluation Board?
- What the MCP1642B/D Two-Cells to USB Power Evaluation Board Contains

1.2 MCP1642B/D SHORT OVERVIEW

The MCP1642B/D are compact, high-efficiency, fixed-frequency, step-up DC-DC converters. These products provide an easy-to-use power supply solution, with a minimum number of external components for applications powered by one-cell, two-cell, or three-cell alkaline, Ni-Cd, Ni-MH, one-cell Li-Ion or Li-Polymer batteries.

The MCP1642B/D devices operate in Pulse-Width Modulation (PWM), at a fixed 1 MHz switching frequency, featuring Internal Compensation, Overtemperature Protection and Power Good Open-Drain Output. The device has 1.8V start-up voltage at 5V output and 1 mA load current.

There are two shutdown options for the MCP1642B/D family:

- True Output Disconnect mode (MCP1642B/D)
- Input-to-Output Bypass mode (MCP1642D)

For the fixed-output voltage option of the MCP1642B/D devices, the V_{FB} pin is not connected. The output voltage is set by an internal feedback divider. The fixed values are: 1.8V, 3.0V, 3.3V, 5.0V (see [Table 1-1](#)).

On the MCP1642B/D Two-Cells to USB Power Evaluation Board, the fixed output voltage version (MCP1642B/D-50) is used.

The goal of the MCP1642B/D Two-Cells to USB Power Evaluation Board is to demonstrate the higher output current capabilities of the MCP1642B/D, supplied from two AA batteries.

TABLE 1-1: PART NUMBER SELECTION BY SHUTDOWN OPTIONS

Part Number	True Output Disconnect	Input-to-Output Bypass
MCP1642B-ADJ (or -18; 30; 33; 50)	X	—
MCP1642D-ADJ (or -18; 30; 33; 50)	—	X

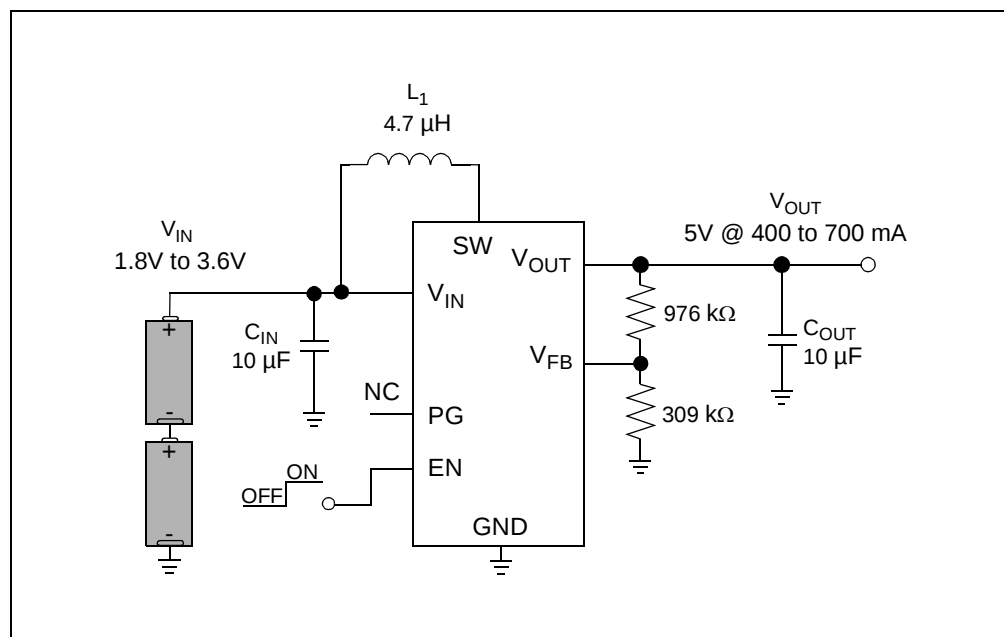


FIGURE 1-1: Typical MCP1642B/D-ADJ Boost Converter Two Cells Battery Input.

1.3 WHAT IS THE MCP1642B/D TWO-CELLS TO USB POWER EVALUATION BOARD?

The MCP1642B/D Two-Cells to USB Power Evaluation Board is used to evaluate and demonstrate Microchip Technology's MCP1642B/D/D Switching Boost Regulator. This board demonstrates the MCP1642B/D capabilities in a boost-converter application supplied from two AA batteries or from an external voltage source. A USB cable can be connected to the output of MCP1642B/D Two-Cells to USB Power Evaluation Board and used to provide power to portable electronic devices when necessary. It can be used to evaluate the MSOP-8 package. The MCP1642B/D Two-Cells to USB Power Evaluation Board was developed to help engineers reduce the product design cycle time.

On the MCP1642B/D Two-Cells to USB Power Evaluation Board, the output voltage has the value of 5.0V (the fixed value MCP1642B/D-50 device is used), resulting in a simple and compact application. The footprints for RT and RB (resistor divider connected to the FB pin) are not populated and will only be used if MCP1642B/D-ADJ, the adjustable option, will be tested.

An enable (EN Switch selection) is used to enable and disable the converter. When enabled, the MCP1642B/D will regulate the output voltage; when disabled, the MCP1642B/D will disconnect the path from input to output for "true-disconnect".

1.4 WHAT THE MCP1642B/D TWO-CELLS TO USB POWER EVALUATION BOARD CONTAINS

This MCP1642B/D Two-Cells to USB Power Evaluation Board kit includes:

- MCP1642B/D Two-Cells to USB Power Evaluation Board (ADM00556)
- Important Information Sheet

Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MCP1642B/D has been developed for applications that require higher output current capabilities (see [Figure 2-1](#)) and low output ripple. It is a compact, synchronous, fixed-frequency step-up DC-DC converter. The regulated output voltage (V_{OUT}) should be greater than the input voltage (V_{IN}). Another important feature is that the device integrates the compensation and protection circuitry, such that the final solution requires a minimum number of additional components. The device can be disabled using the EN switch. The true disconnect option, MCP1642B/D, removes the normal boost topology path from input to output.

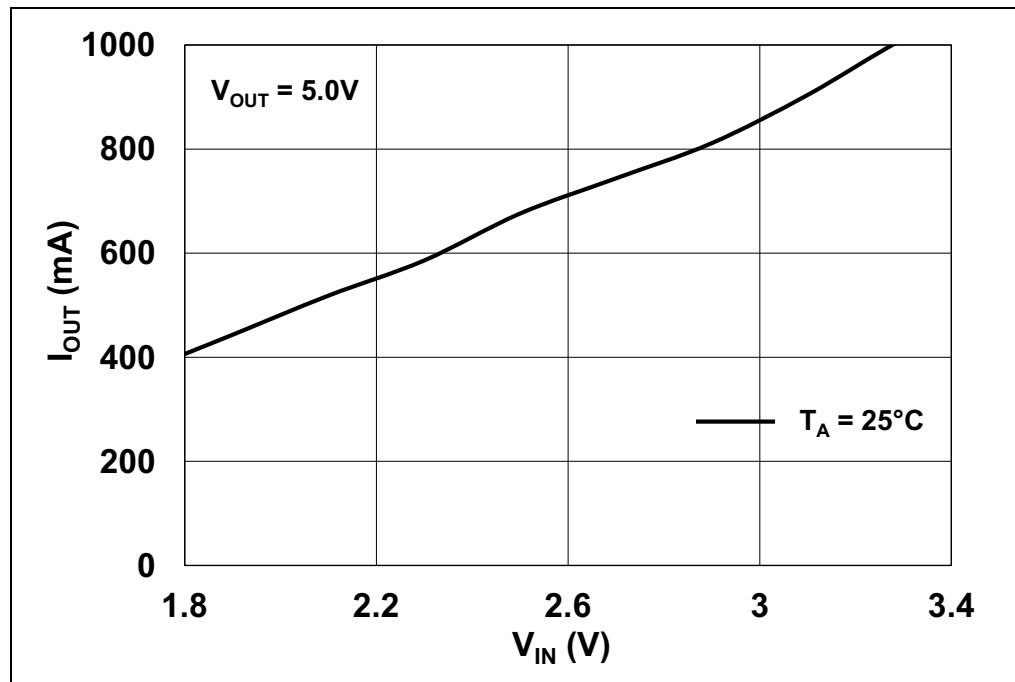


FIGURE 2-1: MCP1642B/D - 5.0 V_{OUT} Maximum I_{OUT} vs. V_{IN} Using Power Supply.

2.1.1 Battery Considerations

When considering a power solution for a design, the battery needs to be carefully selected. Alkaline batteries are a commonly available option that deliver good performance in a variety of applications. Energizer® Ultimate Lithium batteries are an alternative power solution that provides superior performance high drains and allows designers to utilize the full power range of the MCP1642B/D without sacrificing size or runtime.

Energizer Ultimate Lithium batteries utilize a primary cell chemistry that contains higher energy than alkaline batteries, and has much better high-drain performance. Ultimate Lithium batteries produce a high, flat voltage profile that enables them to provide a high -energy capacity even at high drains. Additionally, Ultimate Lithium batteries have a very low internal resistance, allowing them to maintain a high voltage at very high loads.

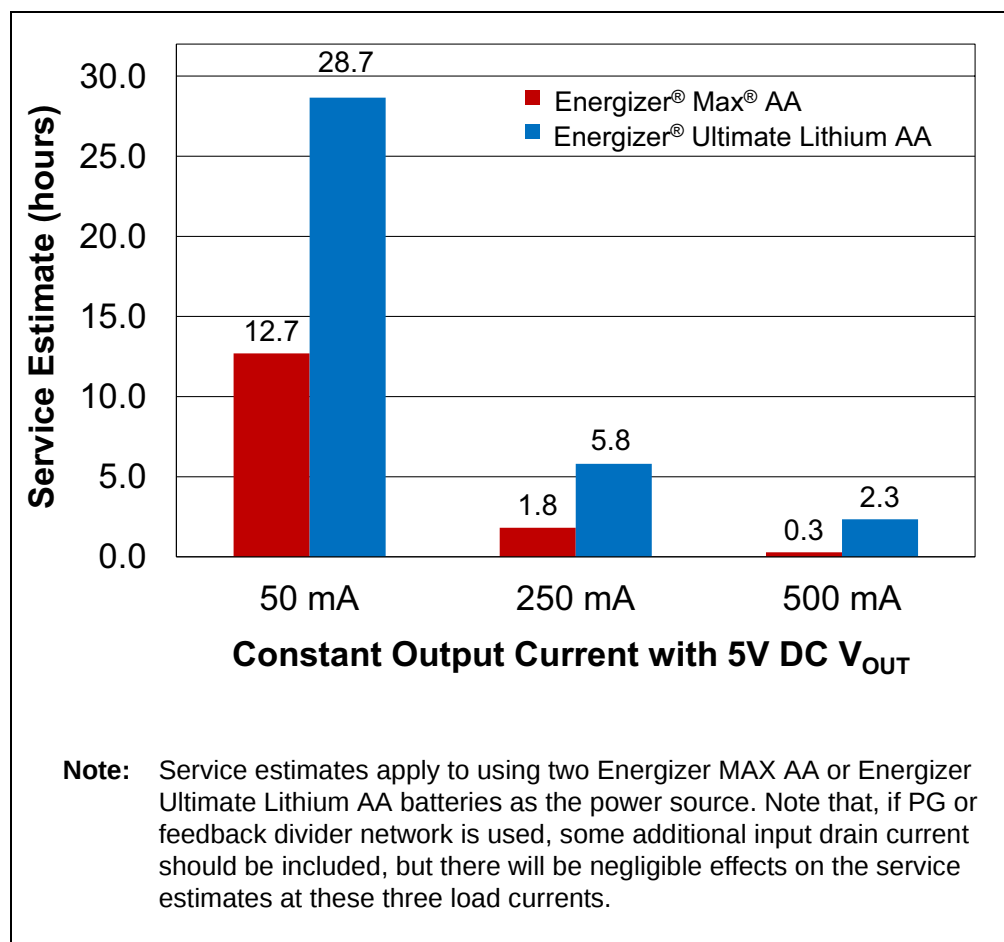


FIGURE 2-2: MCP1642B/D Run Time Estimate Using Two Energizer MAX AA or Energizer Ultimate Lithium at Different Loads.

2.1.2 MCP1642B/D Two-Cells to USB Power Evaluation Board Features

The MCP1642B/D Two-Cells to USB Power Evaluation Board has the following features:

- It can be powered by two AA batteries or external power supply
- Input voltage range (V_{IN}): 1.8V to 5.5V, with $V_{IN} \leq V_{OUT}$
- Minimum start-up voltage: 1.8V at $V_{OUT} = 5.0V$ and $I_{OUT} = 1\text{ mA}$, resistive load
- Output voltage: 5.0V
- Output current: typical 700 mA @ 5V output, 2.8V input
- PWM operation
- PWM switching frequency: 1 MHz
- Power Good indicator 2 mA LED
- Enable state selectable using EN switch
- Peak input current limit of 1.8A
- Overtemperature protection (if the die temperature exceeds +150°C, with 35°C hysteresis)
- USB A output connector

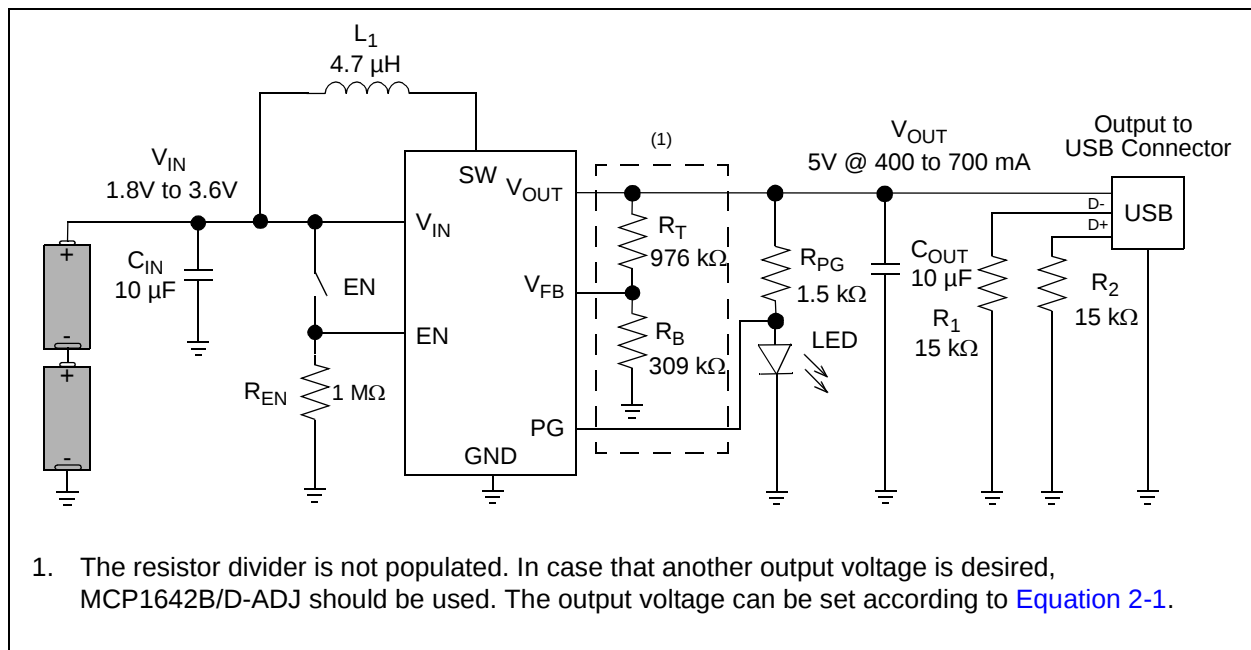


FIGURE 2-3: Two Cells to 5.0V Synchronous Boost MSOP-8 Application.

2.2 GETTING STARTED

The MCP1642B/D Two-Cells to USB Power Evaluation Board is fully assembled and tested to evaluate and demonstrate the MCP1642B/D Switching Boost Regulator in a real world application. For in-depth evaluation, this board requires the use of external laboratory supplies and load.

2.2.1 Power Input and Output Connection

2.2.1.1 POWERING MCP1642B/D TWO-CELLS TO USB POWER EVALUATION BOARD

Two AA battery holder and soldered test points are available for input voltage connections. The maximum input voltage should not exceed 5.5V. The output voltage will not remain in regulation for input voltages that are greater than or equal to the output voltage.

The MCP1642B/D Two-Cells to USB Power Evaluation Board was designed to be used in the evaluation of the device. The package selected is MSOP-8.

USB A connector or soldered test points are available to connect a load. The switch peak current limit will provide a safe maximum current value. The maximum output current for the converter will vary with input and output voltages; refer to [Figure 2-1](#) or the MCP1642B/D data sheet for more information on the maximum output current.

2.2.1.2 BOARD POWER-UP PROCEDURE:

2. Connect input supply as shown in [Figure 2-4](#) or connect two AA batteries in the battery holder on the bottom side of the board.
3. Connect system load to V_{OUT} and GND terminals; maximum load varies with input and output voltage; see the MCP1642B/D data sheet for more information on the maximum load. Typically, the MCP1642B/D can supply a 5V output with 700 mA from a 2.8V input source at room temperature. Connect the (+) side of the load to V_{OUT} and the negative (-) load to ground (GND).
4. Turn the device ON/OFF using the EN switch.
5. When EN is ON or high, the converter is enabled, the Power Good Indicator PG LED is turned ON and V_{OUT} can be measured on the V_{OUT} and GND terminals. When EN is low, the converter is disabled, the PG indicator turns OFF, and V_{OUT} is floating and is disconnected from the input.

Additional test points are available to visualize different signals (SW, PG, EN). The MCP1642B/D Two-Cells to USB Power Evaluation Board is also equipped with a USB A connector at the output. Using a USB B - micro/mini USB cable, the board can be connected to portable electronic devices and used as an alternative power supply when needed.

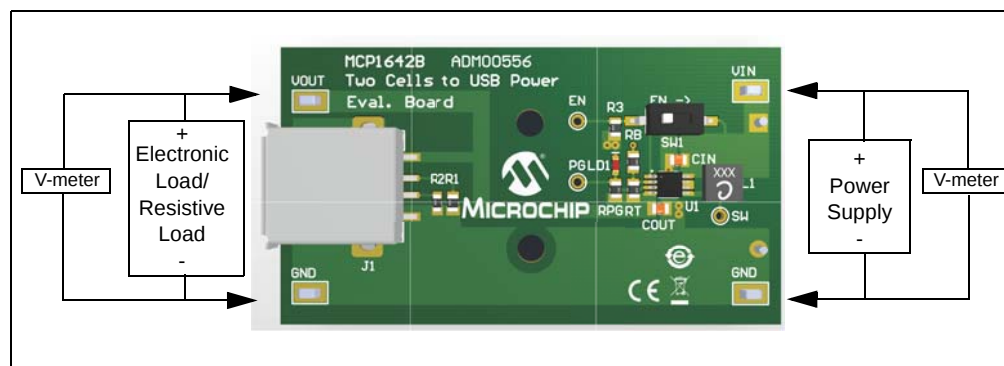


FIGURE 2-4: MCP1642B/D Two-Cells to USB Power Evaluation Board Setup.

2.2.1.3 ADJUSTABLE V_{OUT} SETTING

The board comes with the fixed output value MCP1642B/D-50 option (V_{OUT} internally set to 5.0V). If a different output voltage is desired, the MCP1642B/D-ADJ adjustable option can be used. In this case, the resistor divider consisting of R_T and R_B is used to set the converter output voltage. The value of the resistors can be calculated using [Equation 2-1](#).

EQUATION 2-1:

$$R_T = R_B \times \left[\left(\frac{V_{OUT}}{V_{FB}} \right) - 1 \right]$$

Where: $V_{FB} = 1.21V$ for MCP1642B/D-ADJ

NOTES:

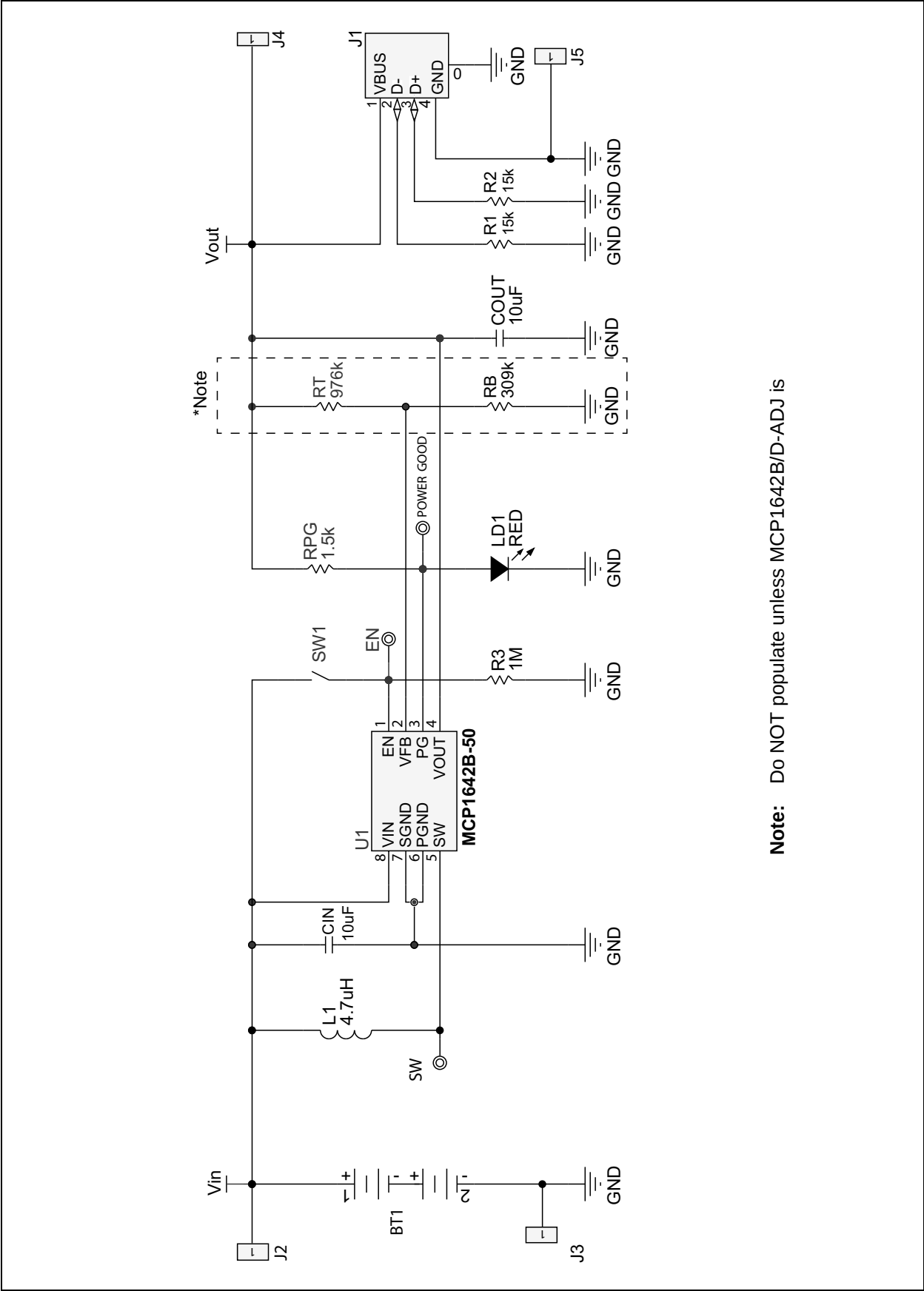
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the MCP1642B/D Two-Cell to USB Power Evaluation Board User's Guide:

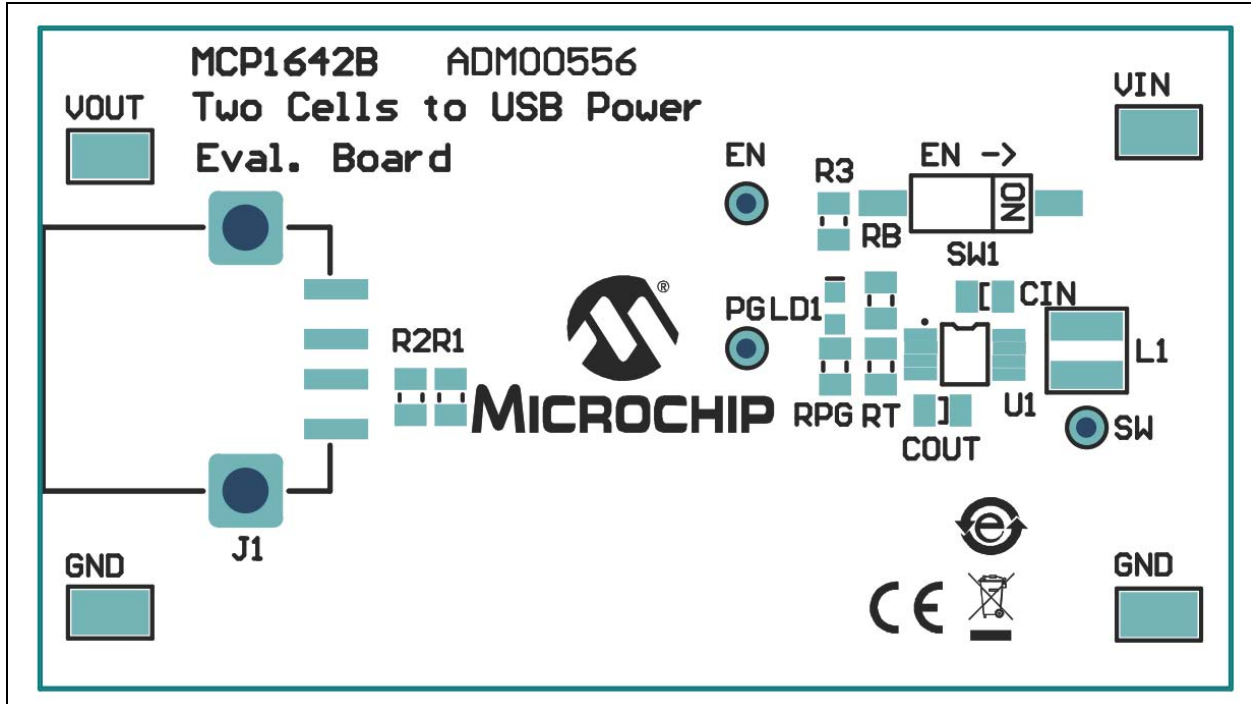
- Board – Schematic
- Board – Top Silk and Pads
- Board – Top Copper and Silk
- Board – Top Copper
- Board – Bottom Copper

A.2 BOARD – SCHEMATIC

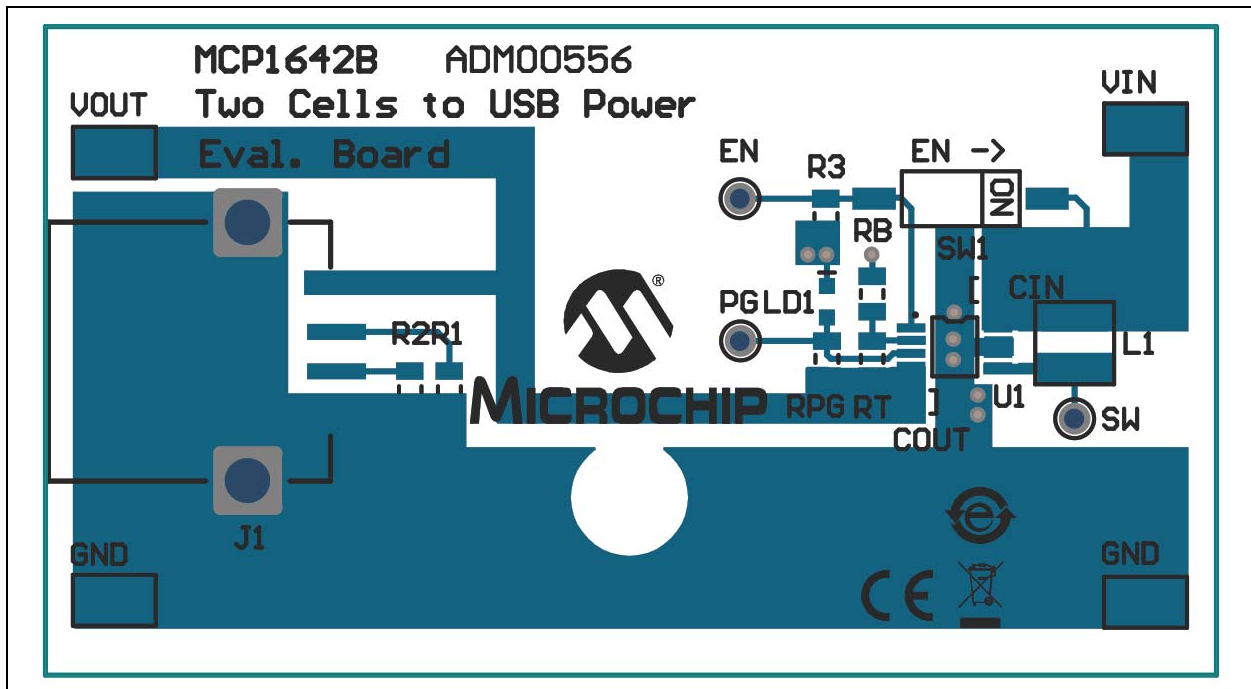


Note: Do NOT populate unless MCP1642B/D-ADJ is

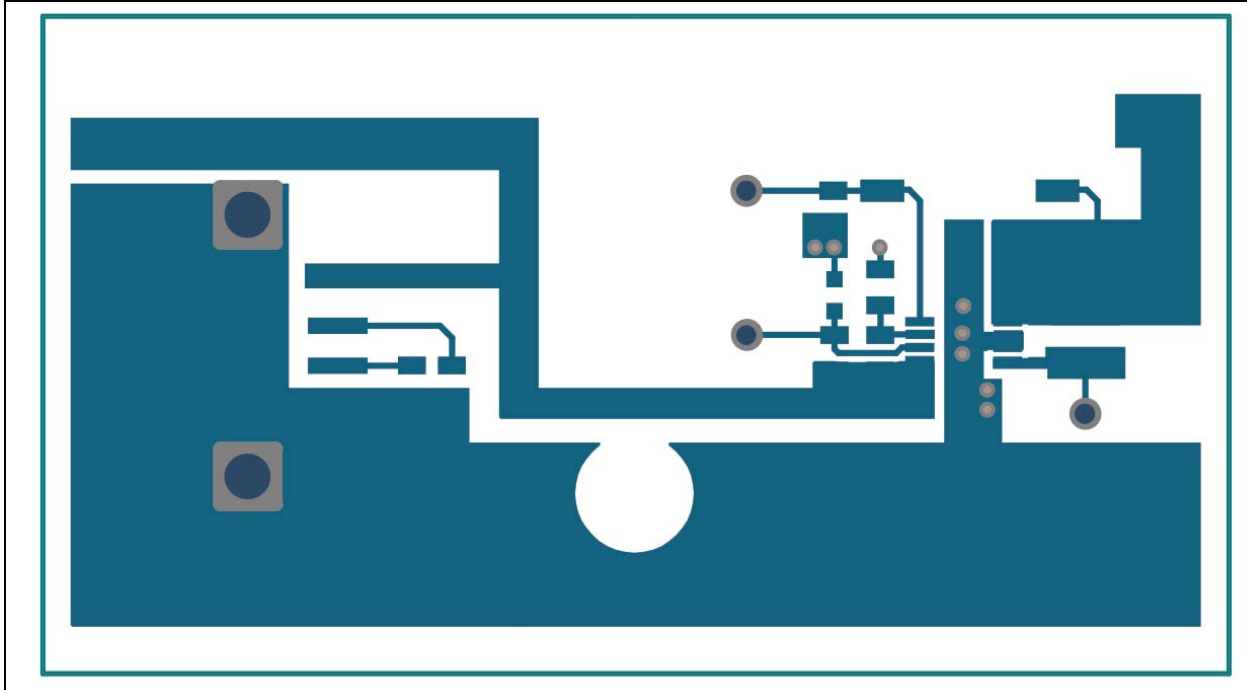
A.3 BOARD – TOP SILK AND PADS



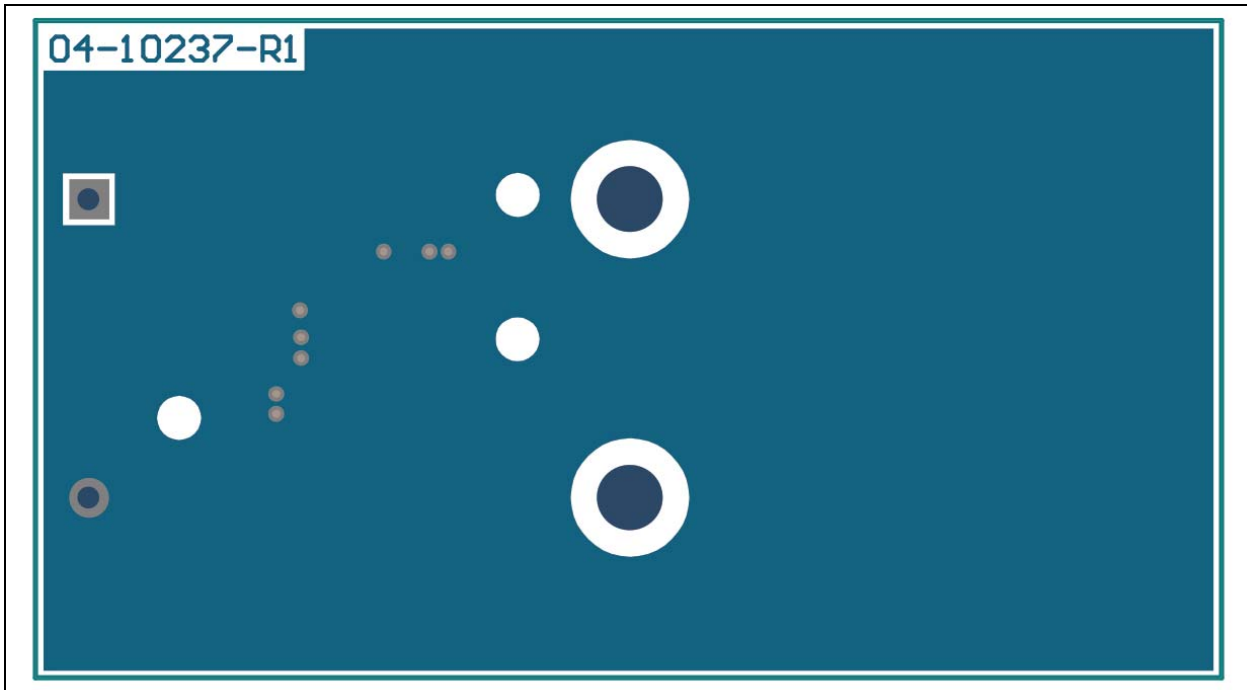
A.4 BOARD – TOP COPPER AND SILK



A.5 BOARD – TOP COPPER



A.6 BOARD – BOTTOM COPPER



Appendix B. Bill of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Qty.	Reference	Description	Manufacturer	Part Number
1	U1	IC conv. DC-DC stepup sync. MSOP-8	Microchip Technology Inc.	MCP1642B-50I/MS
1		Tape VHB white 3/4" low surface	3M	3/4-5-4932
1	BT1	Holder battery 2-cell AA PC mount	Keystone Electronics Corp.	2462
2	CIN, COUT	Cap. ceramic 10 μ F 6.3V 10% X7R SMD 0805	TDK Corporation	CGA4J1X7R0J106K125AC
1	J1	Conn. rcpt. USB Type A R/A SMD	Würth Elektronik Group	62900416021
4	J2, J3, J4, J5	Conn. TP loop tin SMD	Harwin Plc.	S1751-46R
1	L1	Inductor 4.7 μ H 2A 20% SMD XFL4020	Coilcraft	XFL4020-472MEB
1	LD1	Diode LED red 2V 30 mA SMD 0603	Würth Elektronik Group	150060RS75000
0	PCB	Printed Circuit Board – MCP1642B/D Two-Cell to USB Power Evaluation Board	Microchip Technology Inc.	104-00556
2	R1,R2	Res. 15k 1% 1/8W SMD 0805	Samsung	RC2012F153CS
1	R3	Res. 1M 1% 1/8W SMD 0805	Vishay/Dale	CRCW08051M00FKEA
1	RPG	Res. 1.5k 1% 1/8W SMD 0805	Vishay/Dale	CRCW08051K50FKEA
1	SW1	Switch spst. 24V 25 mA 418121270801 SMD	Würth Elektronik Group	418121270801
1	RB	DO NOT POPULATE Res. 309k 1% 1/8W SMD 0805	Panasonic®	ERJ-6ENF3093V
1	RT	DO NOT POPULATE Res. 976k 1% 1/8W SMD 0805	Panasonic®	ERJ-6ENF9763V

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.

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