MCP1640
Synchronous Boost Converter Evaluation Board
User's Guide

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MCP1640 SYNCHRONOUS BOOST CONVERTER 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 "DSXXXXXA", where "XXXXX" 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 on-line help. Select the Help menu, and then Topics to open a list of available on-line help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the MCP1640 Synchronous Boost Converter 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 MCP1640 Synchronous Boost Converter Evaluation Board as a development tool. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MCP1640 Synchronous Boost Converter 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 MCP1640 Synchronous Boost Converter Evaluation Board.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the MCP1640 Synchronous Boost Converter 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 MCP1640 Synchronous Boost Converter Evaluation Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

- **MCP1640/B/C/D Data Sheet (DS22234)**

This data sheet provides detailed information regarding the MCP1640 device.

- **AN1311, Single Cell Input Boost Converter Design (DS01311)**

This application note details how to use the MCP1640 device in specific applications.

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- Field Application Engineer (FAE)
- Technical Support

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

DOCUMENT REVISION HISTORY

Revision A (February 2010)

- Initial Release of this Document.

MCP1640 SYNCHRONOUS BOOST CONVERTER EVALUATION BOARD USER'S GUIDE

Chapter 1. Product Overview

1.1 INTRODUCTION

The MCP1640 is a compact, high-efficiency, fixed frequency, step-up DC-DC converter. It provides 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, NiCd, NiMH, one-cell Li-Ion or Li-Polymer batteries.

The MCP1640 automatically selects the best operating mode for efficiency, Pulse Width Modulation (PWM) or Pulse Frequency (PFM); it has a low quiescent current (20 µA), a wide input voltage range (0.35 to 5.5V) and low start-up voltage (0.65V).

The MCP1640 is available in SOT-23-6 and 2x3mm-8 DFN packages.

This chapter provides an overview of the MCP1640 Boost Controller Evaluation Board and covers the following topics:

- What is the MCP1640 Synchronous Boost Converter Evaluation Board?
- Contents of the MCP1640 Synchronous Boost Converter Evaluation Board

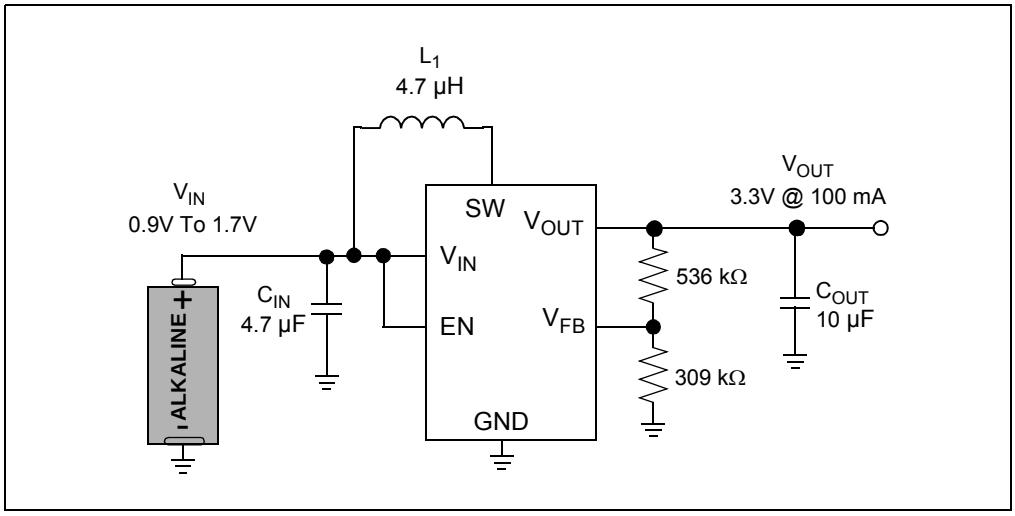


FIGURE 1-1: *Typical MCP1640 Boost Converter Single Cell Battery Input.*

1.2 WHAT IS THE MCP1640 SYNCHRONOUS BOOST CONVERTER EVALUATION BOARD?

The MCP1640 Synchronous Boost Converter Evaluation Board is used to evaluate and demonstrate Microchip Technology's MCP1640 products. This board demonstrates the MCP1640 in two boost-converter applications with multiple output voltages. It can be used to evaluate both package options (SOT-23-6 and 2x3-8 DFN). The MCP1640 Synchronous Boost Converter Evaluation Board was developed to help engineers reduce the product design cycle time.

Three common output voltages can be selected: 2.0V, 3.3V and 5.0V. The output voltage can be changed with a mini-dip switch that changes the external resistor divider.

An enable (EN Switch selection) is used to enable and disable the MCP1640. When enabled, the MCP1640 will regulate the output voltage; when disabled, the MCP1640 disconnects the path from input to output for "true-disconnect".

Additional, MCP1640 options provide continuous switching and input to output bypass. For more information on these options, refer to the MCP1640/B/C/D datasheet.

1.3 CONTENTS OF THE MCP1640 SYNCHRONOUS BOOST CONVERTER EVALUATION BOARD

This MCP1640 Synchronous Boost Converter Evaluation Board kit includes:

- One MCP1640 Synchronous Boost Converter Evaluation Board unit, 102-00283
- Important Information "Read First"

Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MCP1640 is a compact, high-efficiency, fixed frequency, synchronous step-up dc-dc converter. It provides an easy-to-use power supply solution for applications powered by one-cell, two-cell, or three-cell alkaline, NiCd, NiMH, one-cell Li-Ion or Li-Polymer batteries in addition to distributed 3.3V to 5.0V applications.

The MCP1640 is capable of regulating the output voltage over a wide 2.0V to 5.5V range and typically can deliver over 100 mA of load current at 3.3V output when supplied from a single 1.2V cell. The input voltage range is 0.35V to 5.5V with a low 0.65V start-up voltage. The regulated output voltage, V_{OUT} should be greater than or equal to the input voltage, V_{IN}. Additional device features are: automatic PWM / PFM transition to optimize efficiency, low device quiescent current (20 µA in PFM mode and 1 µA in stand-by mode), multiple and selectable, logic controlled shutdown states (true load disconnect or "bypass", output connected to input), low noise and discontinuous current anti-ring control.

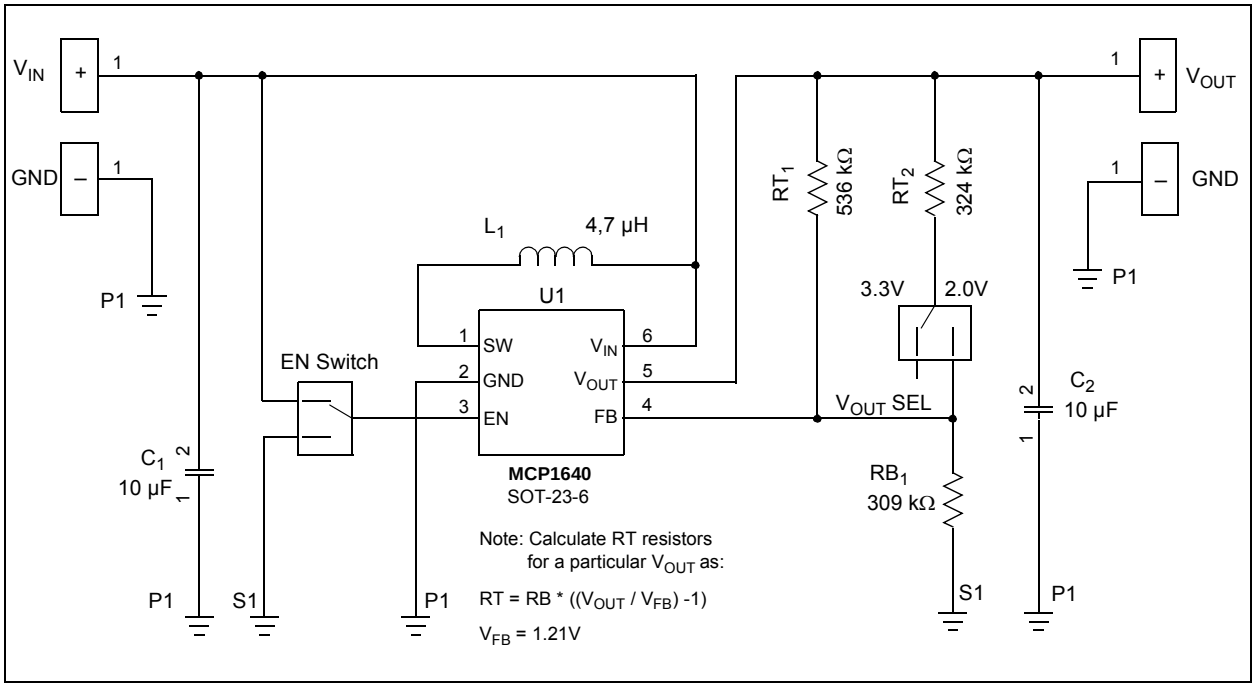


FIGURE 2-1: *MCP1640 Synchronous Boost SOT-23-6 Application.*

Two enable mode options are available: true disconnect and bypass. When disabled, the true disconnect option removes the normal boost topology path from input to output by opening the diode path using a P-Channel synchronous switch with a reversible body diode. The bypass option uses the synchronous boost converter P-Channel switch to connect the input to the output through the boost inductor while disabled providing voltage to the load, while consuming less than 1 µA of current from V_{IN}.

The MCP1640 is available in SOT-23-6 and 2x3 mm DFN-8 lead packages.

The MCP1640 Evaluation Board offers both package types in two boost-converter applications for 2.0V, 3.3V and 5.0V output voltage options that can be selected using a mini dip switch. The enable input is controlled in both boost converter applications using a mini dip switch.

2.2 FEATURES

The MCP1640 Synchronous Boost Converter Evaluation Board has the following features:

- It can be powered by one-cell, two-cell, or three-cell alkaline, NiCd, NiMH, one-cell Li-Ion or Li-Polymer batteries
- Input voltage range, V_{IN}: 0.35V to 5.5V, with $V_{IN} \leq V_{OUT}$; 1 mA load after startup
- Fixed output voltage: 2.0V or 3.3V and 3.3V or 5.0V, selected using a mini dip switch on board
- Output current: typical 100 mA @ 3.3V Output, 1.2V Input or 300 mA @ 5.0V Output, 3.3V Input
- Start-up voltage: 0.65V at V_{IN} = 1.2V, V_{OUT} = 3.3V and I_{OUT} = 1mA, resistive load
- Automatic PFM/PWM Operation
- PWM Switching Frequency = 500 kHz
- Enable state selectable using mini-dip switch on board
- Peak Input Current Limit
- Overtemperature (if the die temperature exceeds 150°C, 10°C hysteresis)

2.3 GETTING STARTED

The MCP1640 Synchronous Boost Converter Evaluation Board is fully assembled and tested to evaluate and demonstrate the MCP1640 products. This board requires the use of external lab supplies and load.

2.3.1 Power Input and Output Connection

2.3.1.1 POWERING THE MCP1640 SYNCHRONOUS BOOST CONVERTER EVALUATION BOARD

Soldered test points are available for input voltage connections. The maximum input voltage should not exceed 6.0V. The output voltage will not remain in regulation for input voltages that are greater than or equal to the output voltage.

The MC1640 Synchronous Boost Converter Evaluation Board has two independent circuit applications, one using the MCP1640 SOT-23-6 package, while the other one uses the MCP1640 DFN-8 package. The SOT-23-6 package has two output voltage settings (2.0V and 3.3V) selectable by an on board mini-dip switch. The DFN-8 package has two output voltage settings (3.3V and 5.0V) also selectable by an on board mini-dip switch.

Soldered test points are available to connect a load. The MCP1640 switch peak current limit will provide a safe maximum current value. The maximum output current for the MCP1640 will vary with input and output voltages; refer to the MCP1640 datasheet for more information on the maximum output current. As an example, the MCP1640 can typically supply a 3.3V load with 100 mA with a 1.2V input.

2.3.1.2 BOARD POWER UP PROCEDURE:

1. Connect system load to V_{OUT} and GND terminals, maximum load varies with input and output voltage; see the MCP1640 datasheet for more information on the maximum load. Typically, the MCP1640 can supply a 3.3V output with 100 mA from a 1.2V input source. Connect the (+) side of the load to V_{OUT} and the negative (-) load to ground (GND).
2. Set the desired output voltage using the V_{OUT} SEL mini dip switch.
3. Set the enable to the desired state using the EN mini dip switch.
4. When EN is set ON or high, the MCP1640 is enabled and V_{OUT} can be measured on the V_{OUT} and GND terminals. When EN is low, the MCP1640 is disabled and V_{OUT} is floating and disconnected from the input.

Capacitors C_3, C_4, C_6 and C_7 are not populated. The component pads are provided for experimental use.

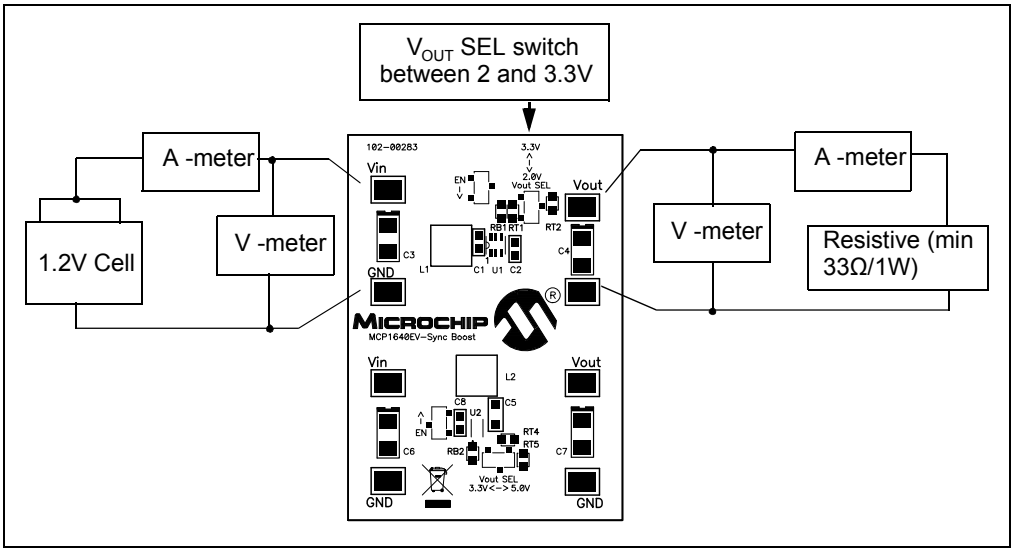


FIGURE 2-2: *MCP1640 Evaluation Board Setup.*

2.3.1.3 EN AND V_{OUT} SEL SWITCHES FUNCTION

TABLE 2-1: FUNCTION OF BOARD SWITCHES

State of Switches		V_{OUT} [V] for	
SW3 or SW4 EN Switch	**SW1 or SW2 V_{OUT} SEL Switch**	**SOT-23-6 Converter**	**2x3 mm DFN Converter**
ON	ON	2	3.3
ON	OFF	3.3	5
OFF	ON	0	0
OFF	OFF	0	0

Note that SW2 (V_{OUT} SEL) and SW4 (EN) are used for the SOT-23-6 circuit. Switches SW1 (V_{OUT} SEL) and SW3 (EN) are used for the 2x3 mm DFN-8 circuit.

2.3.1.4 ADJUSTABLE V_{OUT} SETTING

The resistor divider RT and RB are used to set the converter output voltage. By setting the V_{OUT} SEL switch in the open or OFF position, the output voltage can be calculated using the following equation:

$$RT_1 = RB_1 \times \left[\left(\frac{V_{OUT}}{V_{FB}}\right) - 1\right]$$

OR

$$RT_4 = RB_2 \times \left[\left(\frac{V_{OUT}}{V_{FB}}\right) - 1\right]$$

Where: V_{FB} = 1.21V

Note: The V_{OUT} SELL switch will not be used.

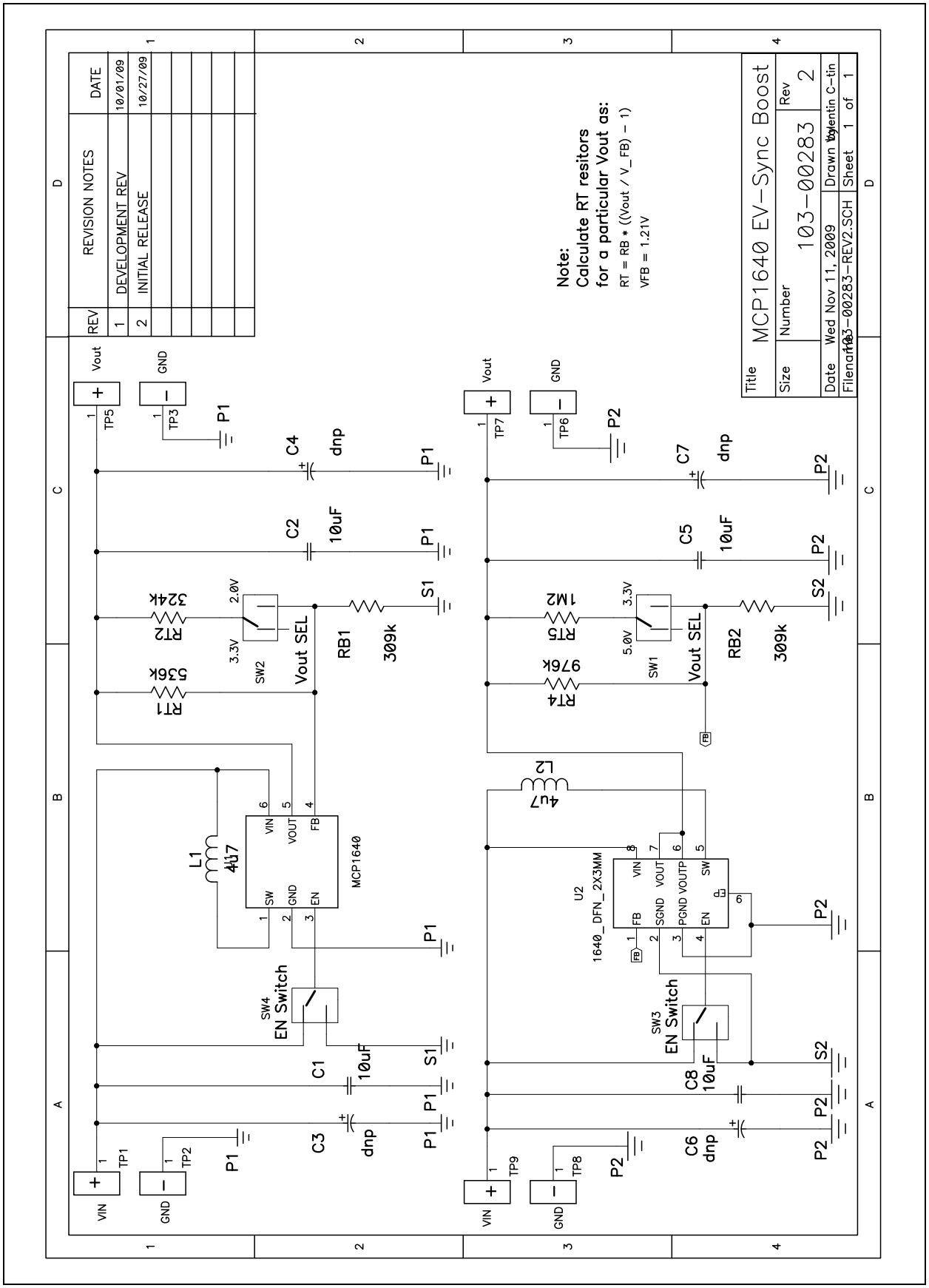
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

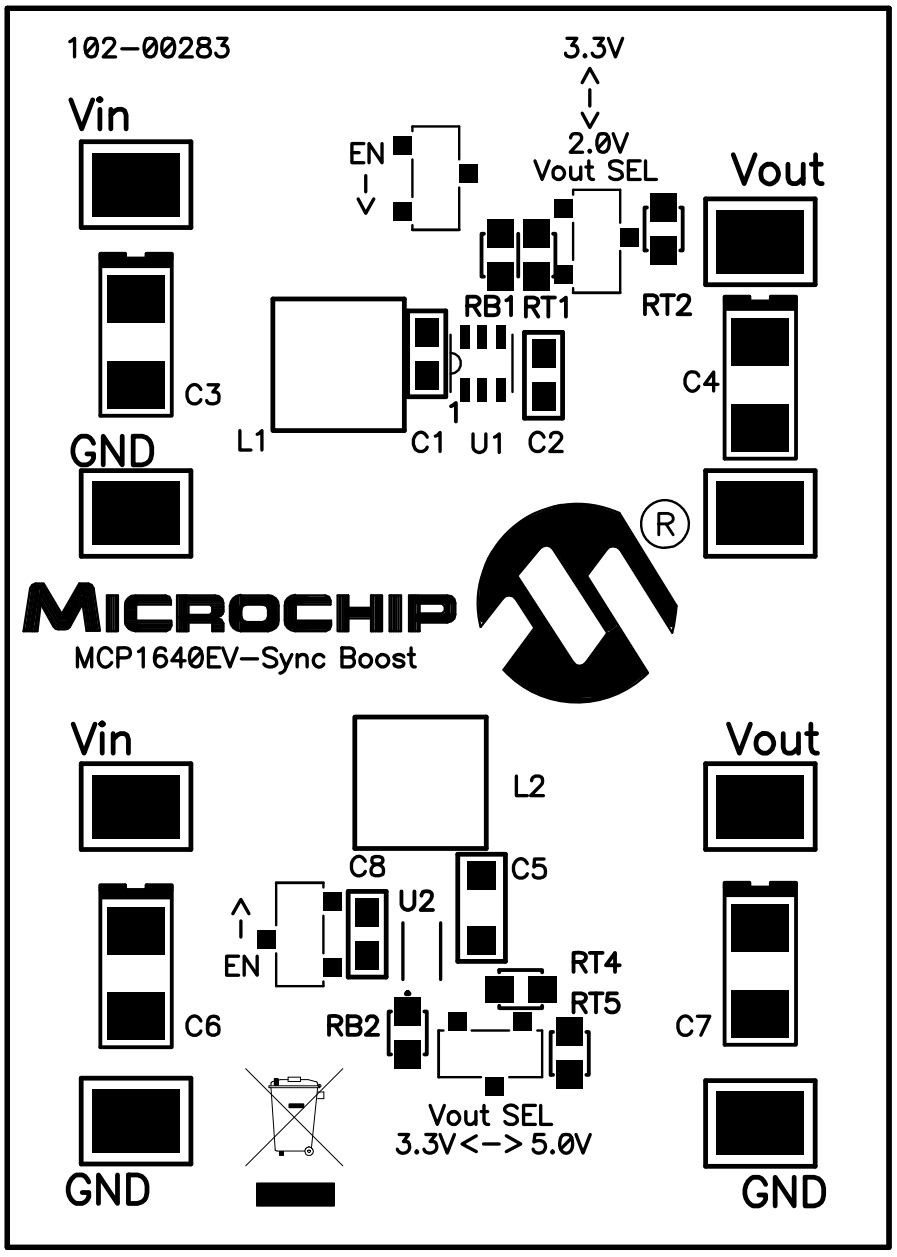
This appendix contains the following schematics and layouts for the MCP1640 Synchronous Boost Converter Evaluation Board:

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

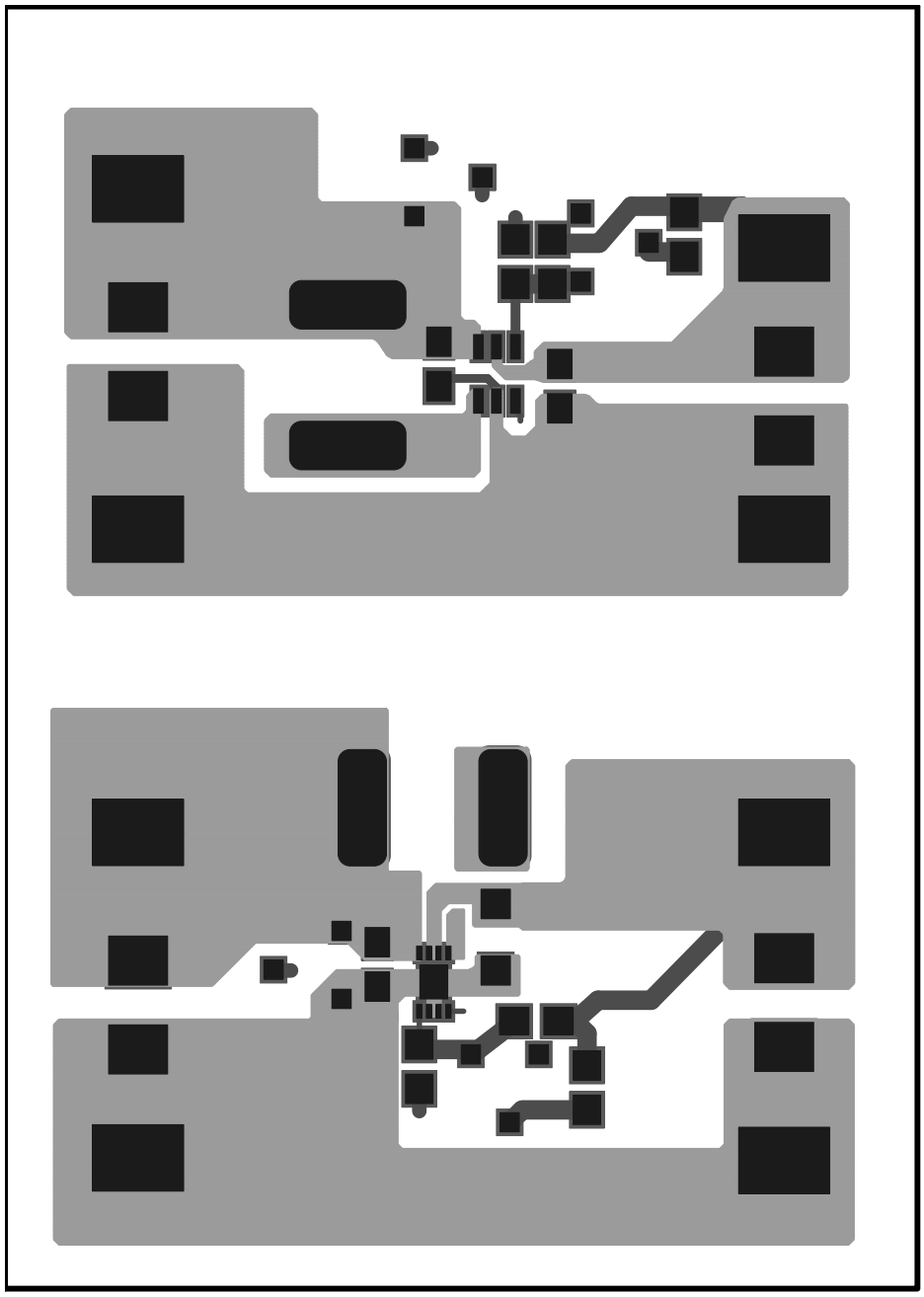
A.2 BOARD – SCHEMATIC



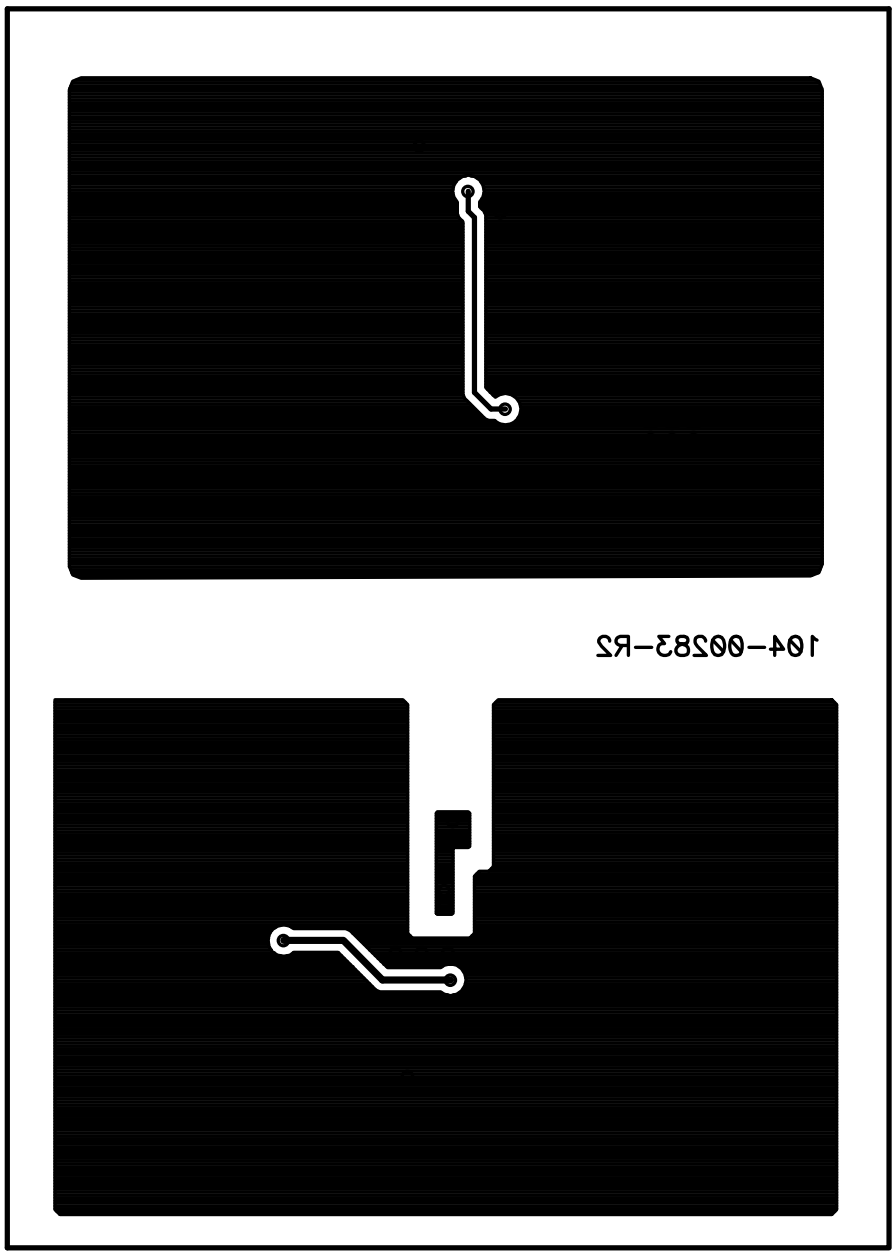
A.3 BOARD – TOP SILK AND PADS



A.4 BOARD – TOP COPPER LAYER



A.5 BOARD – BOTTOM COPPER LAYER



NOTES:

Appendix B. Bill of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Qty	Reference	Description	Manufacturer	Part Number
4	Bump	BUMPON HEMISPHERE .44X.20 WHITE	3M	SJ-5003 (WHITE)
3	C1, C2, C8	CAP CER 10UF 10V X7R 0805	Murata Electronics North America	GRM21BR71A106KE51L
0	C3, C4, C6, C7	CAP TANT LOW ESR SMD 6032-EIA / C case	—	—
1	C5	CAP CER 10UF 10V X7R 1206	Murata Electronics North America	GRM31CR71A106KA01L
2	L1, L2	INDUCTOR POWER 4.7UH 2.0A SMD	EPCOS Inc	B82462G4472M
1	PCB	RoHS Compliant Bare PCB, MCP1640 Sync Boost Converter Evaluation Board	Microchip Technology Inc.	104-00283
2	RB1, RB2	RES 309K OHM 1/8W 1% 0805 SMD	Rohm Semiconductor	MCR10EZPF3093
1	RT1	RES 536K OHM 1/8W 1% 0805 SMD	Yageo	RC0805FR-07536KL
1	RT2	RES 324K OHM 1/8W 1% 0805 SMD	Rohm Semiconductor	MCR10EZPF3243
1	RT4	RES 976K OHM 1/8W 1% 0805 SMD	Rohm Semiconductor	MCR10EZHF9763
1	RT5	RES 1.20M OHM 1/8W 1% 0805 SMD	Rohm Semiconductor	MCR10EZHF1204
4	SW1, SW2, SW3, SW4	SWITCH SLIDE SPDT SMD GULL	Copal Electronics Inc	CJS-1200TB
8	TP1, TP2, TP3, TP5, TP6, TP7, TP8, TP9	PC Test Point Compact SMT	Keystone Electronics	5016
1	U1	MCP1640 Syncronous Boost Converter - SOT23-6	Microchip Technology Inc.	MCP1640
1	U2	MCP1640 Syncronous Boost Converter – DFN2x3mm	Microchip Technology Inc.	MCP1640

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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