MCP16321 Evaluation Board User's Guide

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MCP16321 EVALUATION 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) 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 MCP16321 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 MCP16321 Evaluation Board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MCP16321 Evaluation Board.
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to get started with the MCP16321 Evaluation Board and a description of the user's guide.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the MCP16321 Evaluation Board.
- **Appendix B. "Bill of Materials"** – Lists the parts used to build the MCP16321 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 MCP16321 Evaluation Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

- **MCP16321/2 Data Sheet – *"24V Input, 1A/2A Output, High Efficiency Synchronous Buck Regulator with Power Good Indication"* (DS22285)**

THE MICROCHIP WEB SITE

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- **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
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- **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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Users of Microchip products can receive assistance through several channels:

- 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 (November 2011)

- Initial Release of this Document.

NOTES:

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MCP16321 Evaluation Board and covers the following topics:

- MCP16321 Short Overview
- What is the MCP16321 Evaluation Board?
- MCP16321 Evaluation Board kit contents

1.2 MCP16321 SHORT OVERVIEW

The MCP16321 is a highly integrated, 1A output current capable, high-efficiency, fixed frequency, synchronous, step-down DC-DC converter in a popular 3 mm x 3 mm 16-lead QFN package that operates from input voltage sources up to 24V. Integrated features include a low resistance high-side switch, low resistance low-side switch, 1.0 Mhz fixed-frequency peak-current mode control, internal compensation, power good output, peak current limit, V_{OUT} overvoltage and overtemperature protection. Minimal external components are necessary to develop a complete step-down DC-DC converter power supply. The MCP16321 draws less than 10 µA while disabled.

High converter efficiency is achieved by integrating the current limited, low resistance, high-speed N-Channel MOSFETs and associated drive circuitry. Incorporating both the upper and lower switches reduces the need for external components. High switching frequency minimizes the size of external filtering components resulting in an overall small solution size.

The MCP16321 can supply 1A of continuous current while regulating the output voltage from 0.9V to 5V. An integrated high performance peak-current mode architecture keeps the output voltage tightly regulated, even during input voltage steps and output current transient conditions that are common in power systems.

The evaluation board is populated with the adjustable version of the MCP16321; V_{OUT} is set to 3.0V using an external resistor divider. The evaluation board was developed to accommodate the MCP16321 fixed output voltage options.

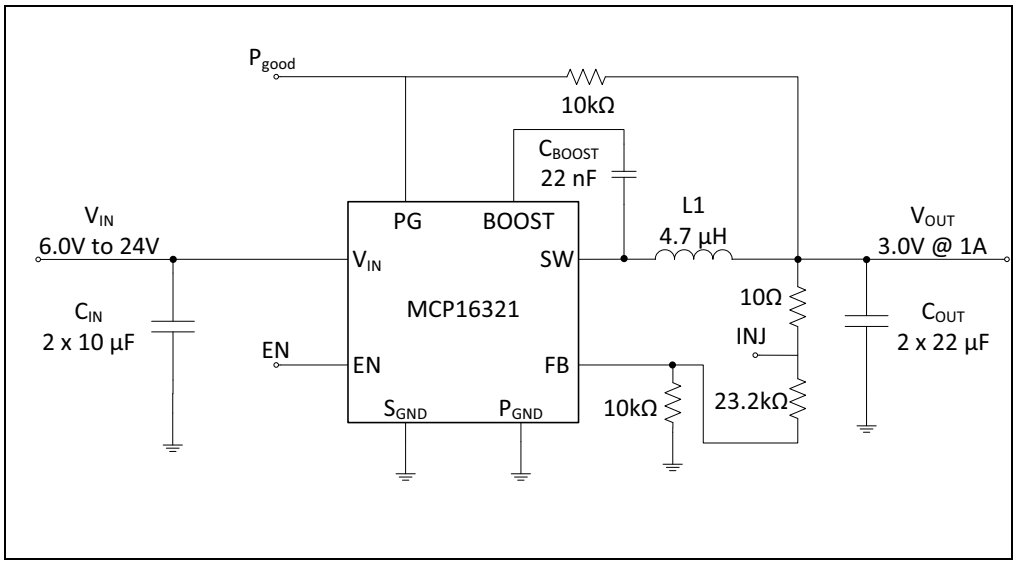


FIGURE 1-1: *Typical MCP16321 Buck Application.*

1.3 WHAT IS THE MCP16321 EVALUATION BOARD?

The MCP16321 Evaluation Board is designed to operate from a 6V to 24V input and regulate the output to 3.0V. Test points for input power and load are provided to demonstrate the capability of the MCP16321 Evaluation Board over the entire range. The MCP16321 Evaluation Board was designed using small surface-mount components to show application size for a high-voltage buck design. The board was designed to be the evaluation platform for the MCP16321 product.

1.4 MCP16321 EVALUATION BOARD KIT CONTENTS

This MCP16321 Evaluation Board kit includes the following items:

- MCP16321 Evaluation Board, 102-00414
- Important Information Sheet

Chapter 2. Installation and Operation

2.1 INTRODUCTION

2.1.1 MCP16321 Features

The MCP16321 devices have been developed to provide high input voltage, high current applications with a precisely regulated rail while operating at high efficiency.

The key features of the MCP16321 include:

- Up to 95% Typical Efficiency for 5V Output Applications
- Input Voltage Range: 6.0V to 24V
- Output Voltage Range: 0.9V to 5V set using external resistor divider
- 1.5% V_{REF} Accuracy
- Fixed Output Voltage Options 0.9V, 1.5V, 1.8V, 2.5V, 3.3V, 5V
- 2.0% V_{OUT} Accuracy
- Integrated High-Side N-Channel Switch: 180 mΩ
- Integrated Low-Side N-Channel Switch: 120 mΩ
- 1A Output Current MCP16321
- 1 MHz Fixed Frequency
- Adjustable Output Voltage
- Low Device Shutdown Current
- Peak Current Mode Control
- Internal Compensation
- Stable with Ceramic Capacitors
- Internal Soft-Start
- Cycle by Cycle Peak Current Limit
- Under Voltage Lockout (UVLO): 5.75V (typical)
- Output Overvoltage Protection
- Overtemperature Protection
- Available Package: 3 mm x 3 mm QFN-16 lead package

A high-performance peak-current mode control system is used to deliver a fast response to sudden line and load changes

2.1.1.1 MCP16321 EVALUATION BOARD FEATURES

The MCP16321 Evaluation Board is developed to demonstrate how the MCP16321 buck regulator operates over a wide input voltage and load range. Test points are provided for input and output voltage, allowing the MCP16321 Evaluation Board to be connected directly to a system. Test vias are also included to give the user easy access to the switch, power good, enable and injection nodes for easy evaluation of the device. There are also ancillary vias provided for attaching extra input and output connections. The 1A maximum continuous output current is available over the entire V_{IN} range, (6.0V to 24.0V), along with the entire adjustable output range (0.9V to 5.0V).

A copper via, labeled PGD, connected to the power good pin on the device, can be populated to monitor the power good output of the device. The power good pin is externally pulled up to V_{OUT} with a 10 kΩ resistor (R2).The power good output pin should not be pulled to a voltage higher than 6.0V.

A copper via, labeled INJ, connected between the 10Ω injection resistor (R1) and the R_{TOP} resistor can be populated to allow a convenient injection point for stability analysis.

A copper via, labeled EN, connected to the enable input on the device can be populated and used to turn the MCP16321 on and off. Turning the device ON (Enable > 2.2V) when the under-voltage lockout threshold is met (V_{IN} > 5.75V), will enable the device. This pin must be pulled low (Enable < 0.8V) to disable the device. The EN input is internally pulled high enabling the device. It is not necessary to pull the EN input high for the device to operate and regulate output voltage. The Enable input pin should not be driven to a voltage higher than 6.0V.

A copper via, labeled SW, connected to the switch node of the device can be populated to analyze the switch node of the device.

2.2 GETTING STARTED

The MCP16321 Evaluation Board is fully assembled and tested to evaluate and demonstrate the MCP16321 operational capabilities.

2.2.1 Power Input and Output Connection

2.2.1.1 POWERING THE MCP16321 EVALUATION BOARD

The MCP16321 Evaluation Board is fully assembled, tested and ready to begin evaluation. Apply positive input voltage to the V_{IN} terminal and its return to the GND terminal. The maximum input voltage should not exceed 24V. An electronic load or resistive load can be used for evaluation, or the intended system load can be connected. Electronic loads attempt to sink current at 0V during startup; a resistive load or constant resistance is recommended for startup evaluation. Connect the positive voltage terminal of the load to the V_{OUT} terminal on the demo board and connect the negative or return side of the load to the GND terminal.

2.2.1.2 BOARD TESTING

To test the board:

1. Apply greater than 6V to the input for proper operation; no minimum load is required to regulate the output to 3.0V.
2. The EN input is internally pulled up to a low voltage internal source enabling the device. To disable the device, the EN input can be pulled below 0.8V.
3. The measured output voltage should be 3.0.V typical. Adjusting the input voltage and load should not cause the output to vary significantly over the operating range of the converter.

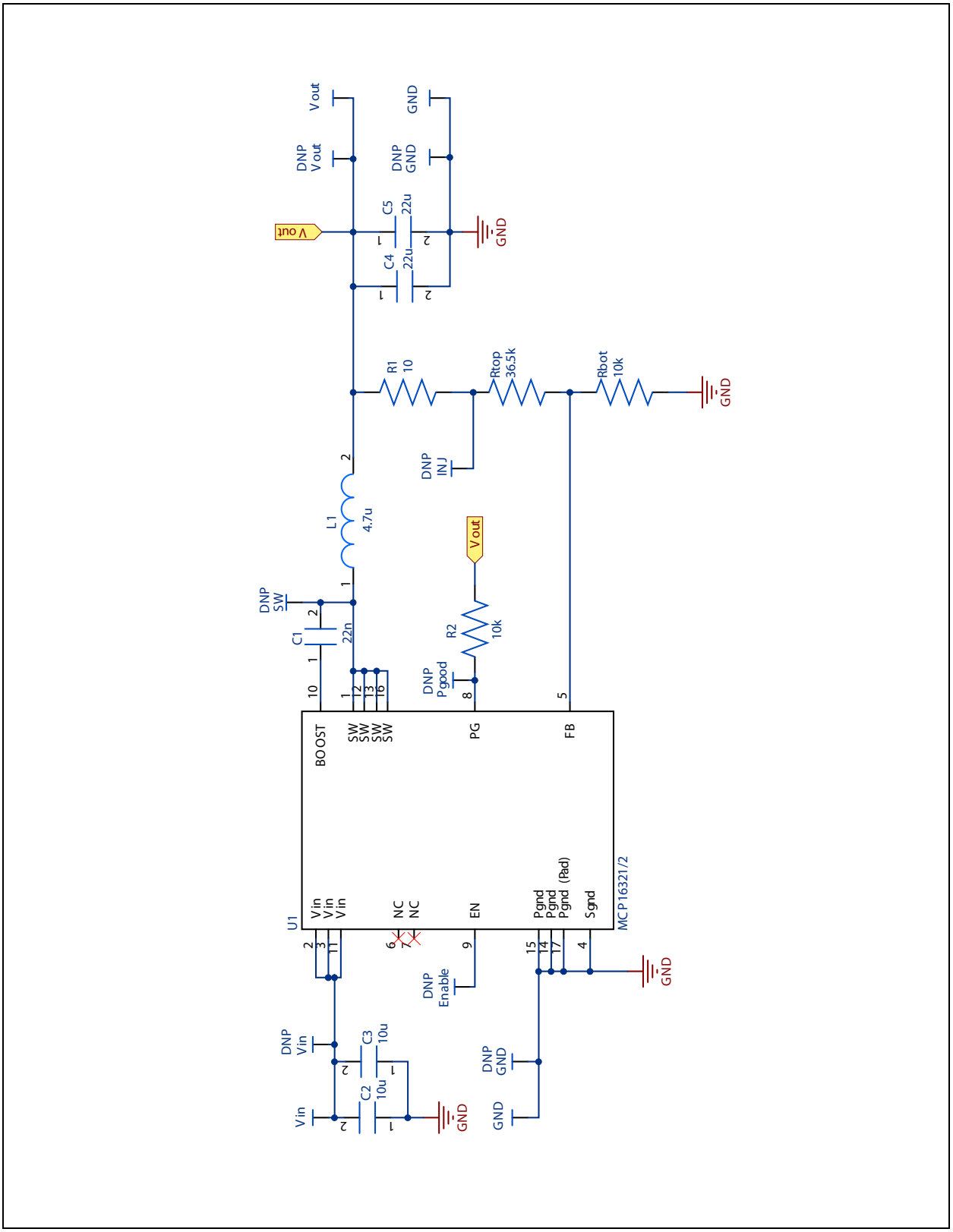
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

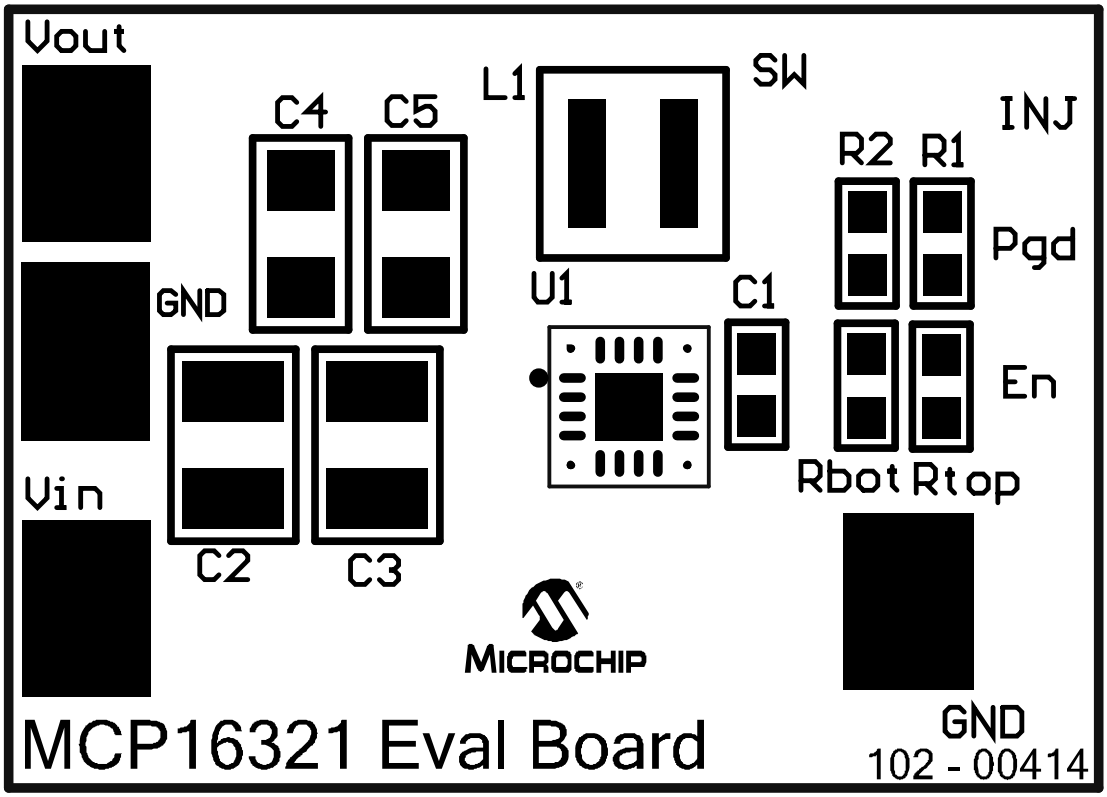
This appendix contains the following schematics and layouts for the MCP16321 Evaluation Board:

- Board – Schematic
- Board – Top Layer
- Board – Top Copper Layer
- Board – Bottom Copper Layer

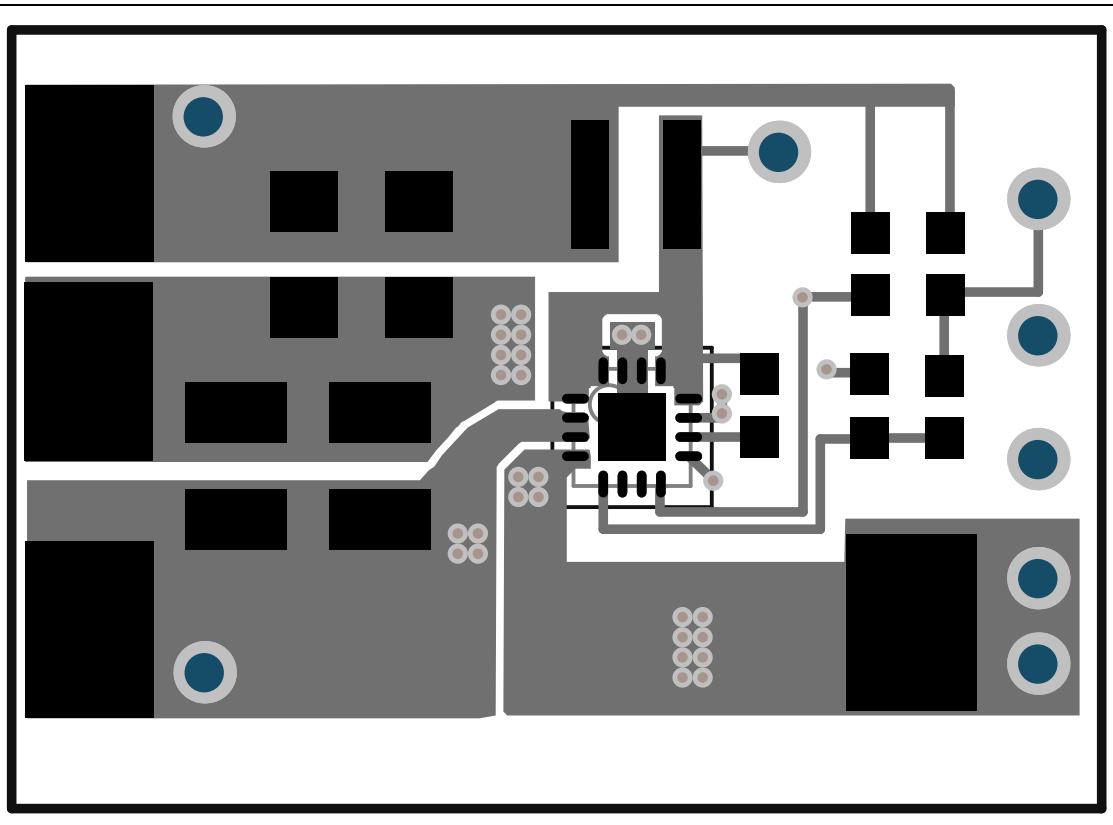
A.2 BOARD – SCHEMATIC



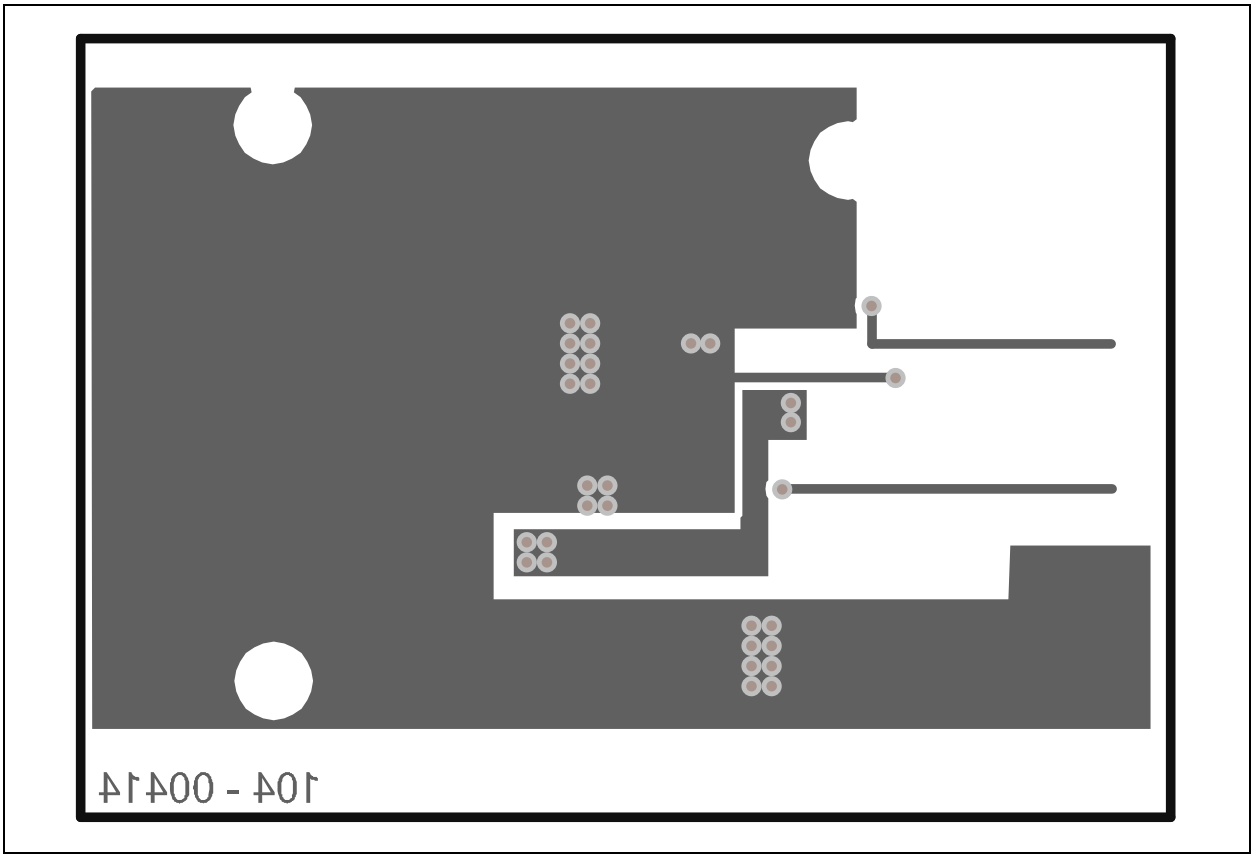
A.3 BOARD – TOP LAYER



A.4 BOARD – TOP COPPER



A.5 BOARD – BOTTOM COPPER



Appendix B. Bill of Materials

TABLE B-1: BILL OF MATERIALS (BOM)

Qty	Reference	Description	Manufacturer	Part Number
1	C1	CAP 22000pF 25V CERAMIC X7R 0603 10%	AVX Corporation	0603YC104KAT2A
2	C2, C3	CAP 10uF 35V CERAMIC X7R 1210 20%	Taiyo Yuden	GMK325AB7106MM-T
2	C4, C5	CAP 22uF 6.3V CERAMIC X7R 1206 10%	Murata	GCM31CR70J226KE23L
1	L1	XFL4020 4.7uH Shielded Power Inductor	Coilcraft	XFL4020-472MEB
1	PCB	MCP16321 6V to 24V VIN, 3.3V Printed Circuit Board	Microchip Technology Inc.	104-00414
1	R1	RES 10.0 OHM 1/10W 1% 0603 SMD	Yageo	RC0603FR-0710RL
1	R2, Rbot	RES 10.0K OHM 1/10W 1% 0603 SMD	Yageo	RC0603FR-0710KL
1	Rtop	RES 23.2K OHM 1/10W 1% 0603 SMD	Yageo	RC0603FR-0723K2L
1	U1	MCP16321 High Input Buck Converter QFN16	Microchip Technology Inc.	MCP16321
4	VIN, VOUT, GND, GND	PC TEST POINT COMPACT SMT	Keystone	5016

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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Corporate Office
2355 West Chandler Blvd.
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