MCP1603
Tiny Reference Design

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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 MCP1603 Tiny Reference Design. 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 MCP1603 Tiny Reference Design 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 MCP1603 Tiny Reference Design
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to get started with this reference design board and a description of the reference design board operation.
- **Appendix A. "Schematics and Layouts"** – Shows the schematic and layout diagrams for the MCP1603 Tiny Reference Design.
- **Appendix B. "Bill of Materials (BOM)"** - Lists the parts used to build the MCP1603 Tiny Reference Design.

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 MCP1603 Tiny Reference Design. Other useful documents are listed below. The following Microchip document is available and recommended as supplemental reference resources:

- **MCP1603 Data Sheet, *"2.0 MHz, 500 mA Synchronous Buck Regulator"*, DS22042**
- **AN793 - *"Power Management in Portable Applications: Understanding the Buck Switchmode Power Converter"*, DS00793**
- ***MCP1603 Buck Converter Evaluation Board User's Guide*, DS51652**

THE MICROCHIP WEB SITE

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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
- **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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- 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 (October 2008)

- Initial Release of this Document.

NOTES:

Chapter 1. Product Overview

1.1 INTRODUCTION

Step-down converter choices include a variety of linear and switching regulators. The MCP1603 500 mA synchronous buck regulator provides a low profile, cost effective, and efficient solution for devices like cellular telephones, USB-powered devices and hand held instruments. The device provides a solution with minimal board space because of the high-frequency operation, which reduces the size requirements of the external inductor and capacitor and the 1 mm maximum height TSOT package. The MCP1603 switches at a fixed frequency of 2.0 MHz when operating at a heavy load. This provides a low-noise, small size solution. When operating at light loads, the MCP1603 automatically changes operation to a pulse frequency modulation (PFM) mode to minimize quiescent current drawn from the input source. No intervention is necessary for smooth transition from one mode to another.

This chapter covers the following topics:

- What is the MCP1603 Tiny Reference Design?
- What the MCP1603 Tiny Reference Design Kit includes?

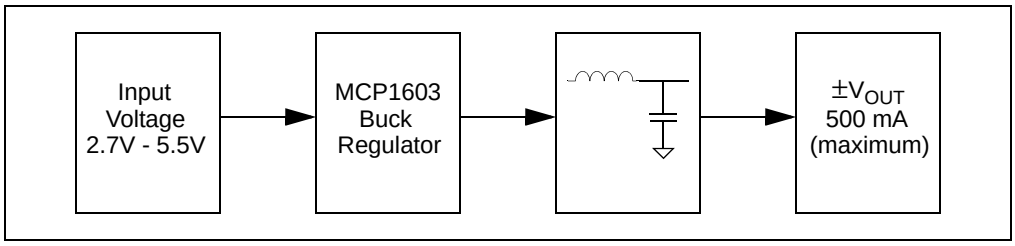


FIGURE 1-1: *MCP1603 Tiny Reference Design Block Diagram.*

1.2 WHAT IS THE MCP1603 TINY REFERENCE DESIGN BOARD?

The MCP1603 Tiny Reference Design demonstrates the use of Microchip's MCP1603 device in a step-down application. The evaluation board is a fully functional platform to evaluate the MCP1603 buck regulator over the input voltage, output voltage and current range of the device. The evaluation board is designed to show off one of the main advantages of MCP1603 - its small size.

Test points are provided to allow easy connection of the input voltage source and the output load.

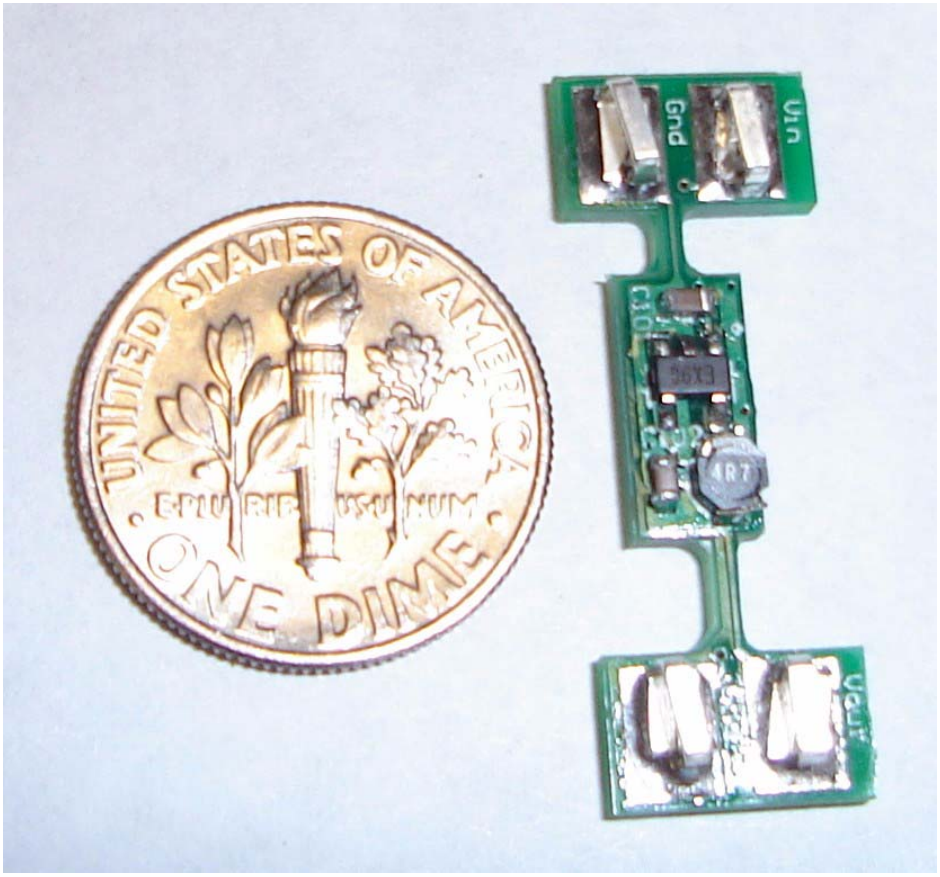


FIGURE 1-2: *MCP1603 Tiny Reference Design Board Size.*

1.3 WHAT THE MCP1603 TINY REFERENCE DESIGN BOARD KIT INCLUDES?

This MCP1603 Tiny Reference Design kit includes:

- Three separate MCP1603 Tiny Reference Design boards with the following output voltage options:
  - Fixed 3.3V using the MCP1603T-330I/OS
  - Fixed 1.8V using the MCP1603T-180I/OS
  - Fixed 1.2V using the MCP1603T-120I/OS
- Analog and Interface Products Demonstration Boards CD-ROM
  - MCP1603 Tiny Reference Design (DS51750)

Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MCP1603 Tiny Reference Design is designed to demonstrate Microchip's MCP1603 in a fixed output voltage configuration. The board is designed to demonstrate how to generate both positive and negative rails using the MCP1603. The MCP1603 is a 500 mA synchronous buck regulator that features both Pulse Frequency Modulation (PFM) and Pulse Width Modulation (PWM). The PFM mode is used at light loads to improve system efficiency while the 2.0 MHz PWM mode is entered at heavy loads. The transition between PFM and PWM modes automatically occurs without any external intervention. The MCP1603 is available in both adjustable parts that require an external divider to set the output voltage and fixed output voltage parts. The high switching speed and TSOT package (1 mm maximum height) make the MCP1603 ideal for space constrained applications that require an efficient stepped down voltage.

2.2 FEATURES

The MCP1603 Tiny Reference Design has the following features:

- Ultra compact size and low profile 500 mA converter design
- Wide Input voltage range from 2.7V to 5.5V
- Fixed output voltages: 3.3V, 1.2V, 1.8V as well as -1.2V and -1.8V (from 3.3V supply)
- Test points for connecting input voltage source and external load

2.3 GETTING STARTED

The MCP1603 Tiny Reference Design is fully assembled and tested for evaluating the MCP1603 device. The board requires the use of an external input voltage source of 2.7V to 5.5V and an external load capable of 500 mA.

2.3.1 Power Input and Output Connection

Powering the MCP1603 Tiny Reference Design (Positive Output Voltage Configuration)

1. Connect the positive side of the input source (+) to V_{IN}.
2. Connect the negative or return side (-) of input source to GND. Refer to Figure 2-1. The input voltage must be within the range of 2.7V to 5.5V.

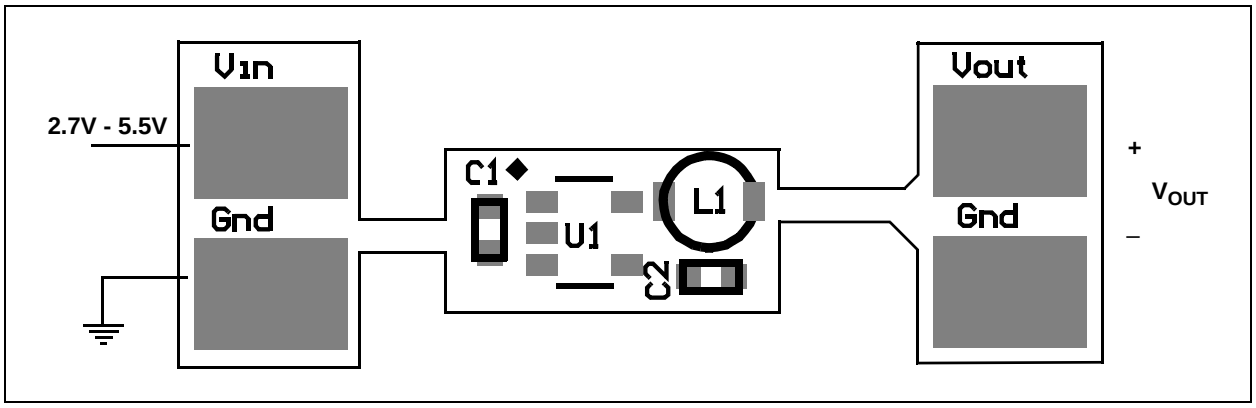


FIGURE 2-1: *Positive Output Voltage Setup Configuration Diagram.*

Powering the MCP1603 Tiny Reference Design (Negative Output Configuration

1. Connect the positive side of the input source (+) to V_{IN}.
2. Connect the negative or return side (-) of input source to V_{OUT}. Refer to Figure 2-2. In this configuration the output voltage will appear between the V_{OUT} terminal and GND terminal of the board.

Note:	For negative voltage generation the following condition must be met: V_{IN}-V_{OUT} < 5.5V. For example, if generating -1.2V output, V_{IN}-(-1.2V) < 5.5V, therefore, V_{IN} < 4.3V.

The MCP1603 device will be able to provide full load current in this configuration.

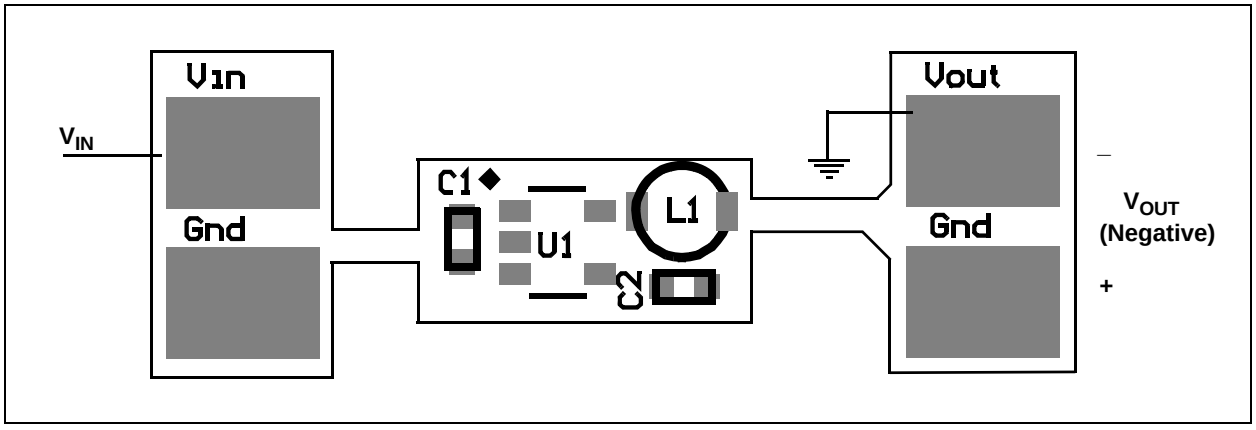


FIGURE 2-2: *Negative Output Voltage Setup Configuration Diagram.*

Applying Load to MCP1603 Tiny Reference Design Board (Positive Output Configuration)

1. Connect the positive side of the load (+) to V_{OUT}.
2. Connect the negative side of the load (-) to GND. Refer to Figure 2-1 and Figure 2-2. The maximum load current should not exceed 500 mA.

As an alternative, a resistor can be connected between GND and V_{OUT}. The value of this resistor must be sized such that the maximum load current does not exceed 500 mA for the selected output voltage.

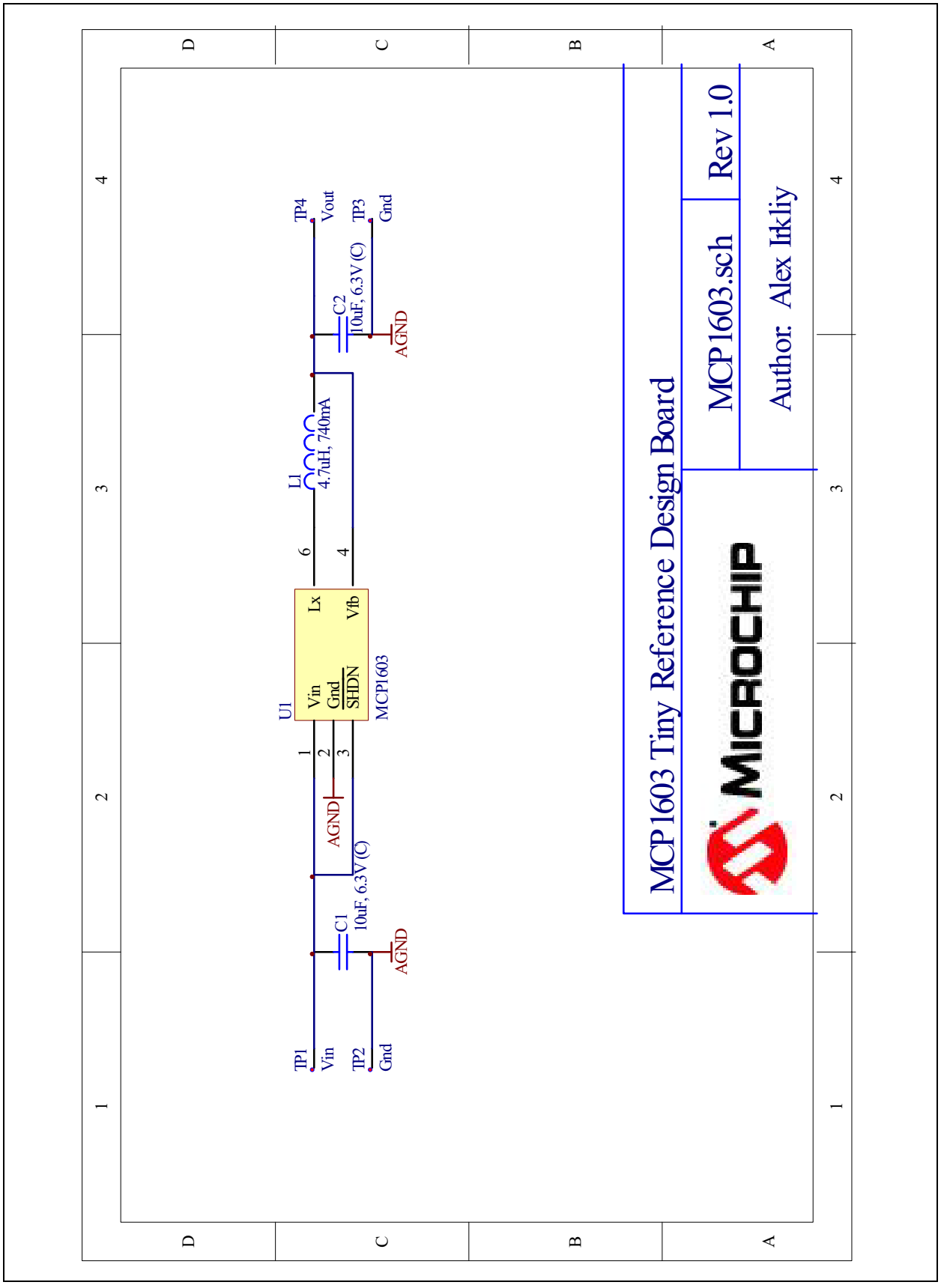
Appendix A. Schematics and Layouts

A.1 INTRODUCTION AND HIGHLIGHTS

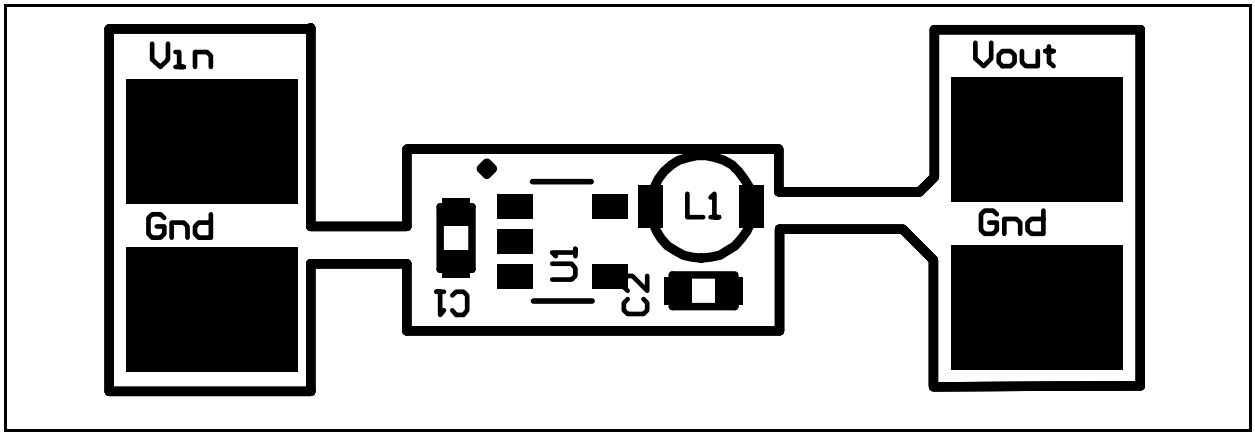
This appendix contains the following schematics and layouts for the MCP1603 Tiny Reference Design:

- Board - Schematic
- Board - Top Silk Layer
- Board - Top Metal Layer
- Board - Bottom Metal Layer

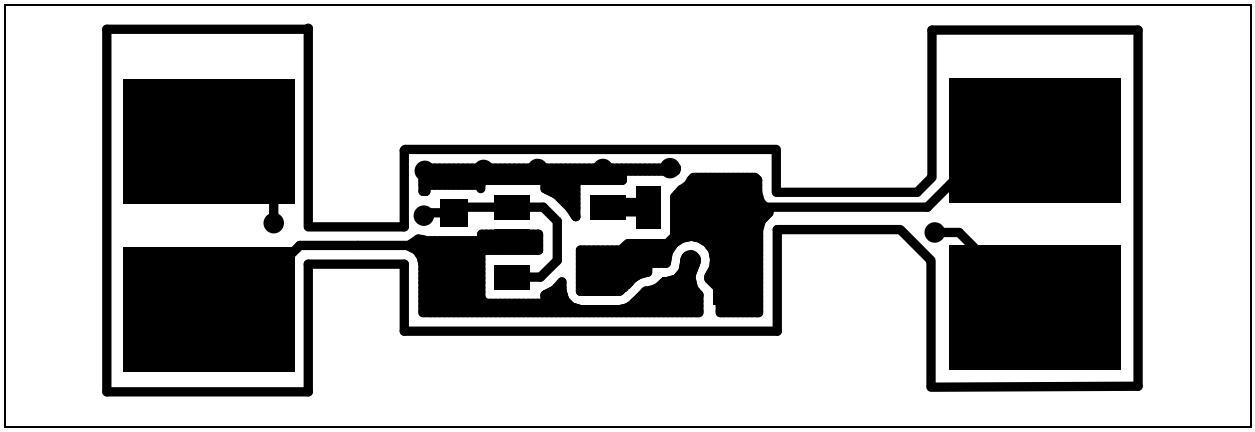
A.2 BOARD - SCHEMATIC



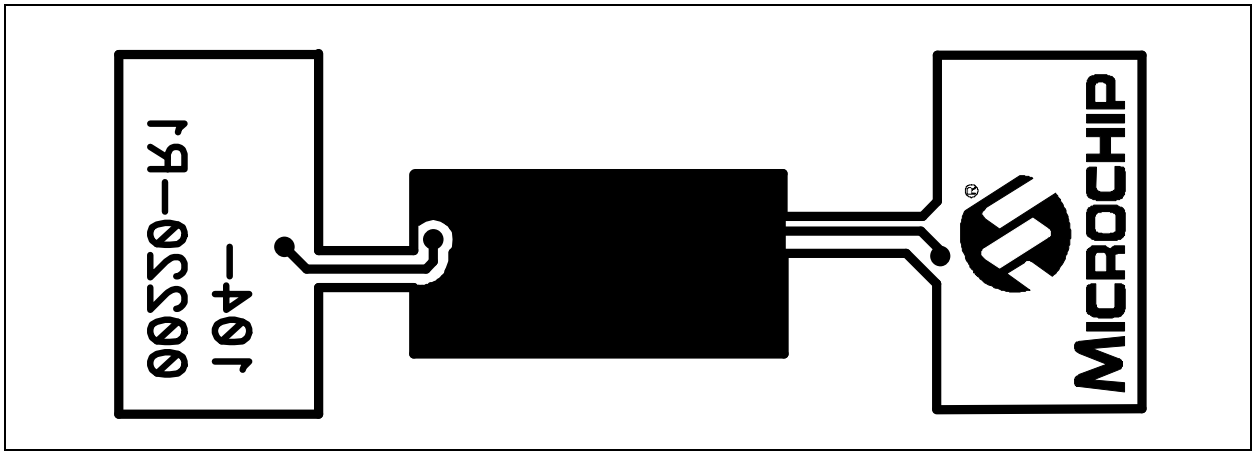
A.3 BOARD - TOP PADS AND SILK-SCREEN



A.4 BOARD - TOP PADS AND TRACE



A.5 BOARD - BOTTOM TRACE



NOTES:

Appendix B. Bill of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Qty	Designator	Description	Manufacturer	Part Number
2	C1, C2	10uF, 6.3V, 0603 Ceramic Capacitor	Panasonic® - ECG	ECJ-1VB0J106M
1	L1	4.7uH, 740mA Inductor	TDK Corporation	VLF3012AT-4R7MR74
1	PCB	RoHS Compliant Bare PCB, MCP1603 Tiny Reference Design Board	Microchip Technology Inc.	104-00220
4	TP1, TP2, TP3, TP4	PC Test Point Compact SMT	Keystone Electronics®	5016
1	U1	500 mA Synchronous Buck Regulator in SOT23-5 Package	Microchip Technology Inc.	MCP1603T-120I/OS
1	U1	500 mA Synchronous Buck Regulator in SOT23-5 Package	Microchip Technology Inc.	MCP1603T-180I/OS
1	U1	500 mA Synchronous Buck Regulator in SOT23-5 Package	Microchip Technology Inc.	MCP1603T-330I/OS

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.

WORLDWIDE SALES AND SERVICE

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Fax: 408-961-6445

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Fax: 61-2-9868-6755

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Fax: 86-25-8473-2470

China - Qingdao
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Fax: 86-532-8502-7205

China - Shanghai
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Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
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Fax: 86-755-8203-1760

China - Wuhan
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Fax: 86-27-5980-5118

China - Xiamen
Tel: 86-592-2388138
Fax: 86-592-2388130

China - Xian
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Fax: 86-29-8833-7256

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Fax: 91-80-4182-8422

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Fax: 91-11-4160-8632

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Fax: 91-20-2566-1513

Japan - Yokohama
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Fax: 81-45-471-6122

Korea - Daegu
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Fax: 82-53-744-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

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Fax: 60-3-6201-9859

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Fax: 44-118-921-5820

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