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MCP1601
Evaluation Board (Rev. 1)
User's Guide

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MCP1601 Evaluation Board (Rev. 1) User 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 MCP1601 Evaluation Board (Rev. 1). Items discussed in this chapter include:

• About This Guide
• Recommended Reading
• The Microchip Web Site
• Customer Support

ABOUT THIS GUIDE

Document Layout

This document describes how to use MCP1601 Evaluation Board (Rev. 1) 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 MCP1601 Evaluation Board (Rev. 1).
• **Chapter 2: MCP1601 Evaluation Board (Rev. 1)** – Includes instructions on how to get started, as well as a description of the evaluation board.
• **Appendix A: Schematic and Layouts** – Shows the schematic and layout diagrams for the MCP1601 Evaluation Board (Rev. 1).
• **Appendix B: Bill-of-Materials** – Lists the parts used to build the MCP1601 Evaluation Board (Rev. 1).

MCP1601 Evaluation Board (Rev. 1) User's Guide

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
'b*nnnn*	A binary number where *n* is a digit	'b00100, 'b10
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier font:		
Plain Courier	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`
Italic Courier	A variable argument	`file`.o, where `file` can be any valid filename
0x*nnnn*	A hexadecimal number where *n* is a hexadecimal digit	`0xFFFF, 0x007A`
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 MCP1601 Evaluation Board (Rev. 1). Other useful documents are listed below and are available and recommended as supplemental reference resources.

MCP1601 Data Sheet (DS21896)

This data sheet provides detailed information regarding the MCP1601 product family.

Application Note 793, "Power Management in Portable Applications: Understanding the Buck Switchmode Power Converter", (DS00793)

This application note outlines a design procedure for buck regulators.

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- **General Technical Support** – Frequently Asked Questions (FAQ), technical support requests, online discussion groups, Microchip consultant program member listing
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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
- Development Systems Information Line

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

In addition, there is a Development Systems Information Line which lists the latest versions of Microchip's development systems software products. This line also provides information on how customers can receive currently available upgrade kits.

The Development Systems Information Line numbers are:

1-800-755-2345 – United States and most of Canada

1-480-792-7302 – Other International Locations

NOTES:

Chapter 1. Product Overview

1.1 INTRODUCTION

The MCP1601 Evaluation Board (Rev. 1) is designed to demonstrate the use of the MCP1601 Synchronous Buck Regulator in a step-down, inductor-based DC/DC converter application.

This document describes the capabilities of the MCP1601 Evaluation Board (Rev. 1) and how to select the desired synchronous converter operating mode, and to program the output voltage.

> **Note:** This users guide applies to the 102-00033 MCP1601 Evaluation Board (Rev. 1). There is another version of the MCP1601 evaluation board that uses a different component set and is supplied with a separate user's guide.

The MCP1601 Evaluation Board (Rev. 1) Schematic is shown is Figure 1-1.
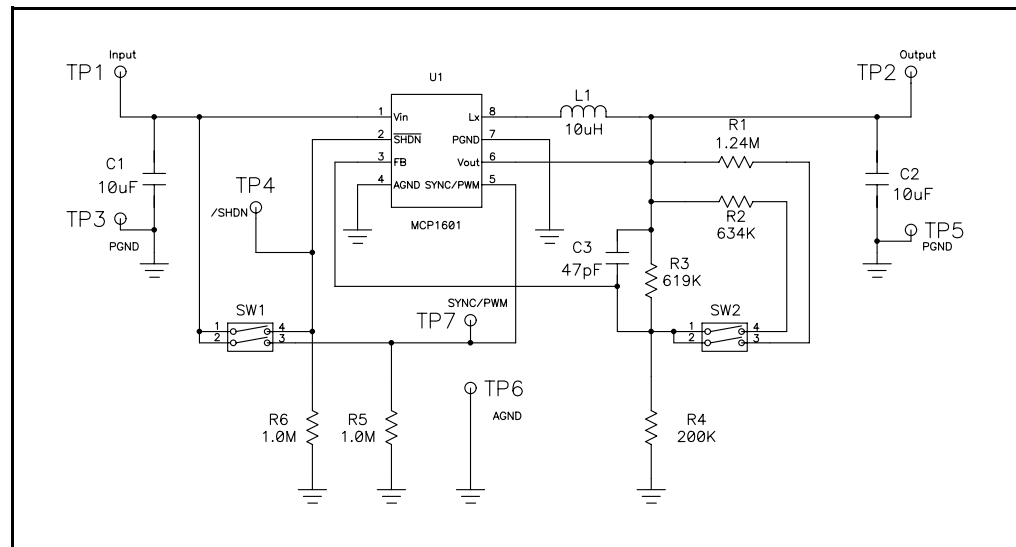
FIGURE 1-1: *MCP1601 Evaluation Board (Rev. 1) Block Diagram.*

1.2   WHAT IS THE MCP1601 EVALUATION BOARD (REV. 1)?

The MCP1601 is a 500 mA synchronous buck regulator. Both the high-side buck P-channel and the low-side N-channel switches are integrated within the device. The integrated synchronous switch makes the MCP1601 very efficient, even when converting unregulated input voltages to low-voltage, fixed outputs. This evaluation board is designed for a wide range of output voltages and currents. For specific applications, smaller inductors, shielded inductors, tantalum capacitors and different output voltage settings can improve the total DC/DC converter performance and cost.

1.3   WHAT THE MCP1601 EVALUATION BOARD (REV. 1) KIT INCLUDES

This MCP1601 Evaluation Board (Rev. 1) Kit includes:

• The MCP1601 Evaluation Board (Rev. 1) (102-00033)
• MCP1601 Evaluation Board (Rev. 1) User's Guide (DS51511)
• MCP1601 Data Sheet (DS21762)

Chapter 2. MCP1601 Evaluation Board (Rev. 1)

2.1 INTRODUCTION

This chapter provides detailed information illustrating how to apply input power, connect load, select output voltage set points and select the operating mode for the MCP1601 Evaluation Board (Rev. 1). Board test point descriptions are also provided.

2.2 FEATURES

The MCP1601 device can operate in three different modes of operation to optimize the efficiency of the voltage conversion. The three operating modes are:

• Automatic switching from PFM mode to PWM mode, and back
• Synchronization to external oscillator
• Fixed-frequency forced PWM mode

The MCP1601 output voltage is adjustable and is set by two external divider resistors. A two-position switch is used on the MCP1601 Evaluation Board (Rev. 1) to change the resistance of the external divider and adjust the output voltage to four different settings. These output voltage settings are: 1.8V, 2.05V, 2.45V and 3.28V.

2.3 GETTING STARTED

2.3.1 Applying Power to the Board

Two surface-mount test points are used to apply power to the MCP1601 Evaluation Board (Rev. 1). For proper operation, the input voltage range is $2.7V < +V_{IN} < +5.5V$ for all operating conditions. The MCP1601 has an internal Undervoltage Lockout (UVLO) that will prevent the board from operating when the input voltage is below the specified 2.7V minimum.

1. Connect the positive side of the external power supply (+) to the $+V_{IN}$ test point.
2. Connect the negative side (GND) of the external power supply to the P_{GND} test point, located to the left of the $+V_{IN}$ test point.

2.3.2 Connecting a Load to the Board

To connect an external load to the board, the $+V_{OUT}$ and P_{GND} test points are used.

1. Connect the positive side of the load to the $+V_{OUT}$ pin and the negative or ground side of the load to the P_{GND} test point, located to the right of the $+V_{OUT}$ test point. The MCP1601 output is rated for 500 mA (maximum) continuous current. The output is protected against over current and short circuit conditions.

2.3.3 Enabling the MCP1601 - Using Switch SW$_1$, Position 1

Switch SW$_1$, position 1 is used to determine the Shutdown mode for the MCP1601 device. With switch SW$_1$, position 1 pushed to the right, the $\overline{SHDN}$ pin is pulled up and the output of the MCP1601 device is enabled. When switch SW$_1$, position 1 is to the left, the MCP1601 device is in a low quiescent current Shutdown mode and the output is disabled.

2.3.4 Selecting the Operating Mode - Using Switch SW$_1$, Position 2

The multi-function SYNC/PWM pin on the MCP1601 is used to set the operating mode of the device. The three operating modes are:

• Automatic switching from PFM mode to PWM mode, and back
• Synchronization to external oscillator
• Fixed-frequency forced PWM mode

To select automatic PFM/PWM mode:

1. Slide switch SW$_1$, position 2 to the left (or off) position. While operating in this mode, the MCP1601 device will automatically select the most efficient operating mode by approximating the load current internally.

To synchronize the MCP1601 switching frequency to an external oscillator:

1. Slide switch SW$_1$, position 2 to the left. Connect the external oscillator to the SYNC/PWM test point located below and to the right of switch SW$_1$ and the A$_{GND}$ test point. See the MCP1601 datasheet (DS21762) for external clock specifications. When synchronizing to an external oscillator, the MCP1601 will operate in the Fixed-frequency mode at the same frequency as the external oscillator.

To select the Fixed-frequency mode that operates off of the 750 kHz internal oscillator:

1. Slide switch SW$_1$, position 2 to the right (or on) position. This will tie the SYNC/PWM pin high and force PWM operation from the internal oscillator, making the MCP1601 device independent of external load conditions.

2.3.5 Selecting the MCP1601 output voltage

Switch SW$_2$ is used to select the output voltage. Refer to Table 2-1 to choose one of the pre-selected output voltages.

TABLE 2-1: SWITCH SETTINGS FOR PRE-SELECTED OUTPUT VOLTAGES

SW$_2$, Position 1	SW$_2$, Position 2	V$_{OUT}$
OFF	OFF	3.28V
OFF	ON	2.45V
ON	OFF	2.05V
ON	ON	1.8

The output voltage for the MCP1601 device is determined by using the following equation.

EQUATION 2-1:

$$V_{OUT} = V_{REF}\left(1 + \frac{R_2}{R_4}\right)$$

Where:

V_{REF} = 0.8V, typical
R_4 = 200 kΩ for the evaluation board

R_2 is set by the parallel combination of R_1, R_2 and R_3

2.4   TEST POINTS

2.4.1   Shutdown ($\overline{\text{SHDN}}$)

The $\overline{\text{SHDN}}$ (or shutdown) test point can be used to either monitor the level of the shutdown pin or as an input to the shutdown pin of the MCP1601 device. With switch SW_1, position 1 in the off position, a 1 MΩ resistor will pull the pin low.

2.4.2   SYNC/PWM

The SYNC/PWM pin can be used to either monitor the level of the SYNC/PWM pin or as an input to the MCP1601 device. With switch SW_1, position 2 in the off position, a 1 MΩ resistor will pull the pin low.

To synchronize to an external oscillator:

1.   With switch SW_1, position 2 in the off position, connect the external oscillator to the SYNC/PWM test point.

2.4.3   Analog Ground (A_{GND})

The analog ground (or A_{GND}) can be used as a quiet ground connection. When using the external oscillator synchronization function, connect the return or ground of the external oscillator to the A_{GND} test point.

NOTES:

Appendix A. Schematic and Layouts

A.1   INTRODUCTION

This appendix contains the schematic and board layout diagrams for the MCP1601 Evaluation Board (Rev. 1).

The MCP1601 Evaluation Board (Rev. 1) is constructed using one silk-screen layer and two , 1 oz. metal wiring layers. The bottom metal wiring layer is a single ground plane routed to partition the P_{GND} high-current return pin from the small-signal A_{GND} return pin on the MCP1601 device.
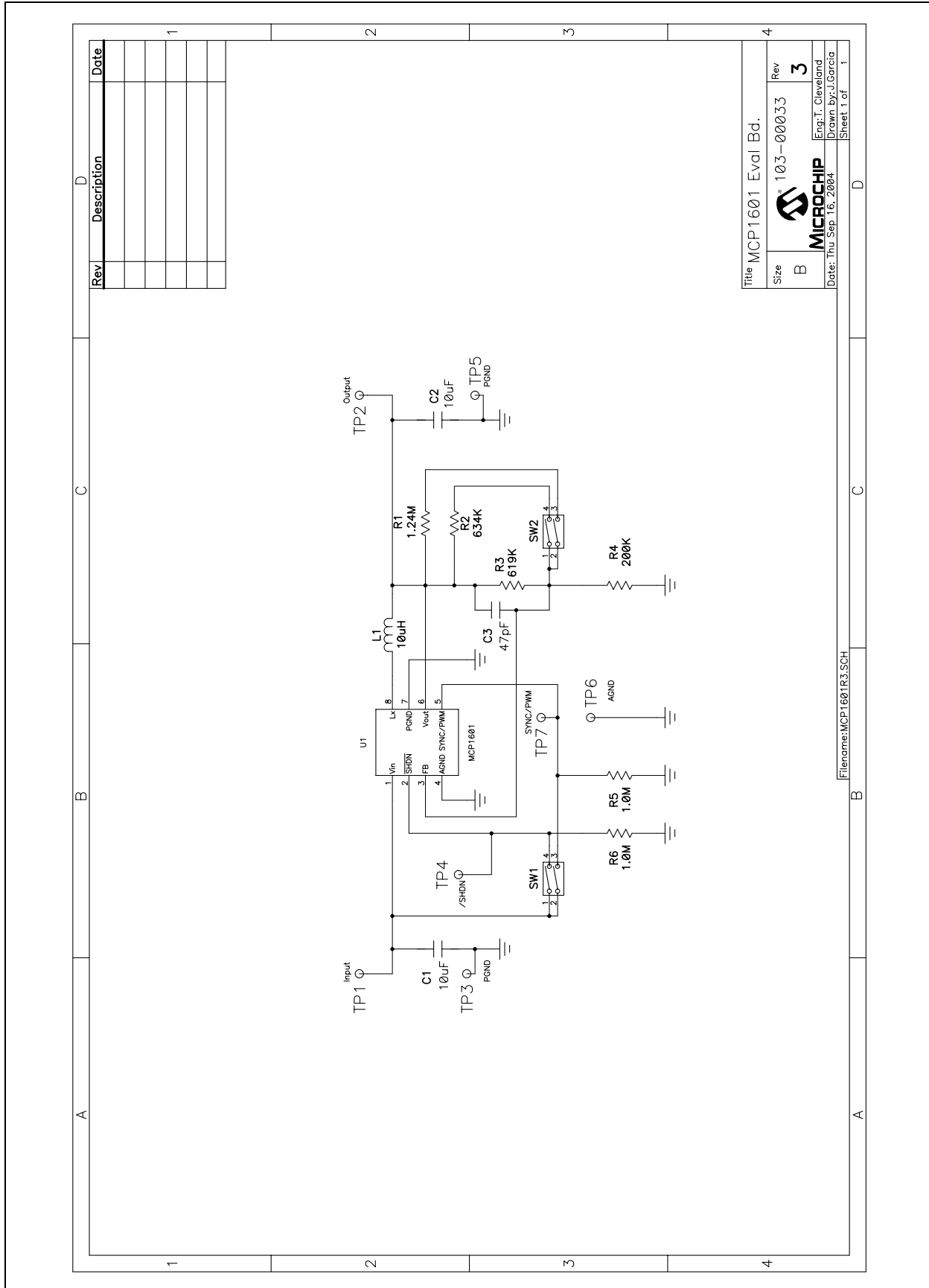
Diagrams included in this appendix:

• Board Schematic
• Top Metal Layer
• Bottom Metal Layer

A.2 BOARD SCHEMATIC

A.3   BOARD - TOP LAYER

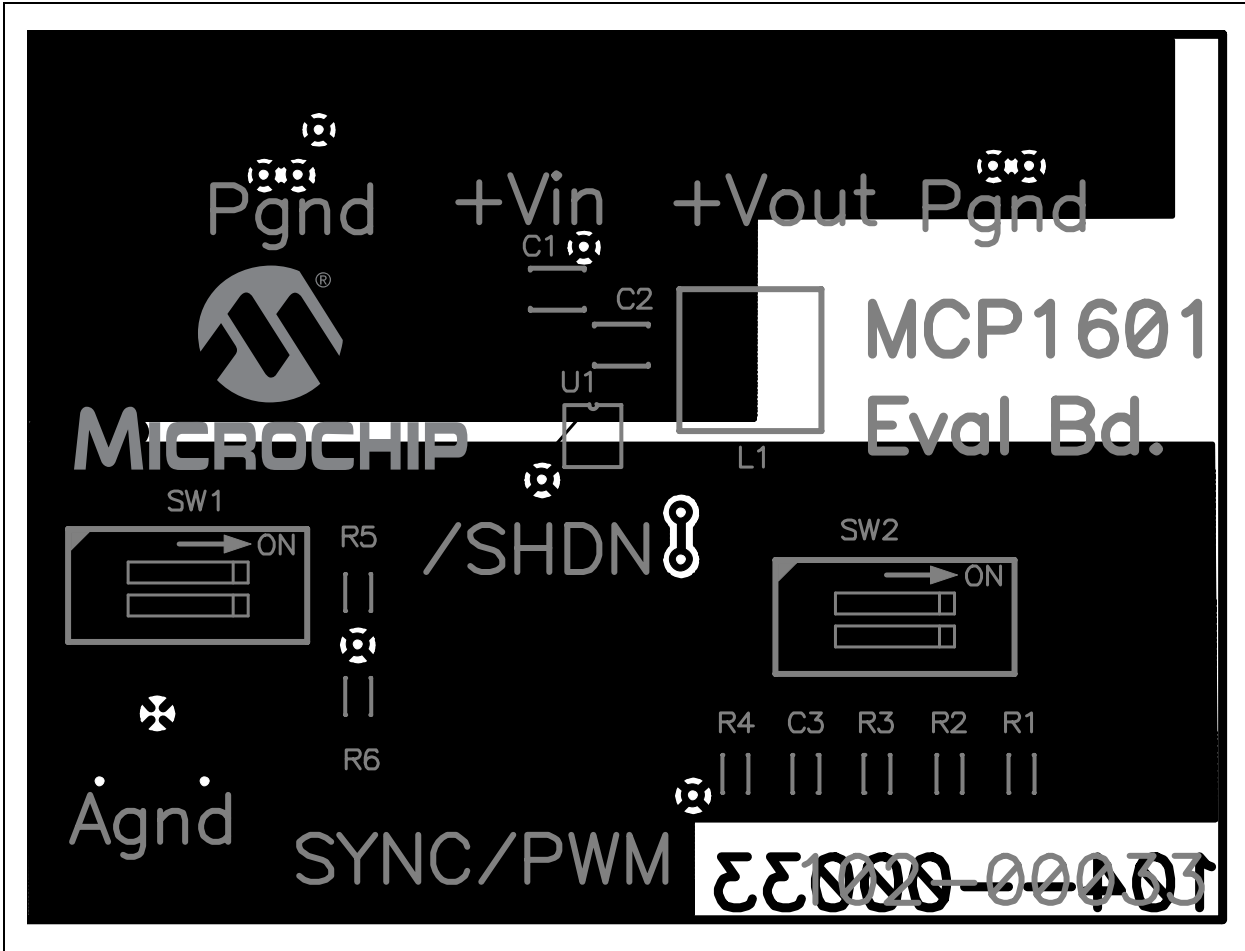# MCP1601 Evaluation Board (Rev. 1) User Guide
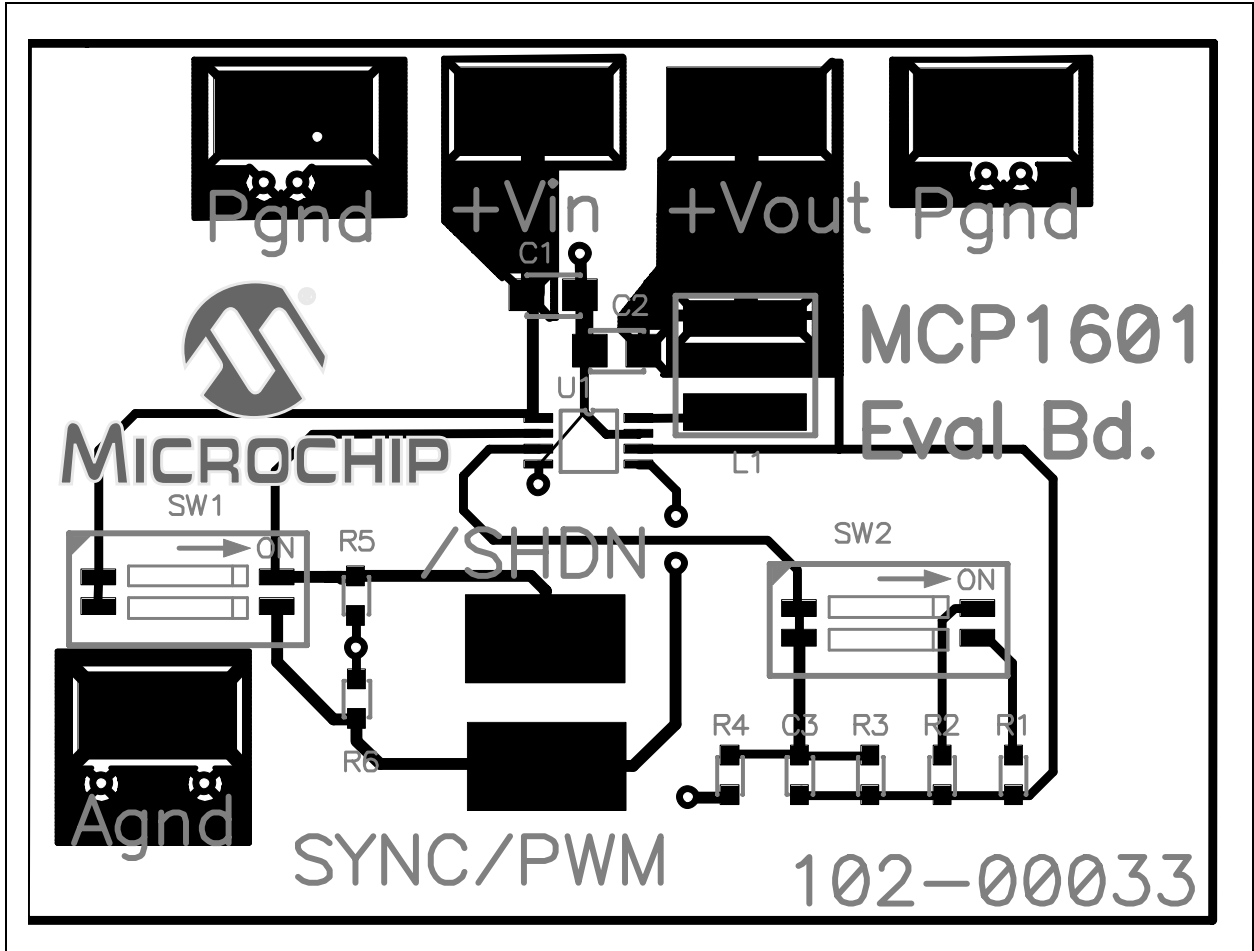
A.4   BOARD - BOTTOM LAYER

Appendix B. Bill-Of-Materials (BOM)

TABLE B-1:   BILL-OF-MATERIALS

Qty	Reference	Description	Manufacturer	Part Number
1	R1	Resistor, 1.21 MΩ, 1/10W, 1%, 0603 SMD	Yageo America	9C06031A1214FKHFT
1	R2	Resistor, 634 kΩ, 1/16W, 1%, 0603 SMD	Panasonic® - ECG	ERJ-3EKF6343V
1	R3	Resistor, 619 kΩ, 1/16W, 1%, 0603 SMD	Panasonic - ECG	ERJ-3EKF6193V
1	R4	Resistor, 200 kΩ ,1/16W, 1%, 0603 SMD	Panasonic - ECG	ERJ-3EKF2003V
2	R5, R6	Resistor, 1.00 MΩ, 1/16W, 1%, 0603 SMD	Panasonic - ECG	ERJ-3EKF1004V
2	C1, C2	Capacitor, 10 µF, 6.3V, Ceramic, X5R 0805	Panasonic - ECG	ECJ-2FB0J106M
1	C3	Capacitor, CERAMIC 68 pF 50V, 0603 SMD	Panasonic - ECG	ECJ-1VC1H680J
1	L1	Inductor Power Shield, 10 µH, SMD	Coiltronics®	SD14-100
2	SW1, SW2	Switch Dip, 2pos, Half Pitch, SMT	C&K™.	TDA02H0SK1
2	PGND	Test Point Compact, SMT	Keystone Electronics®	5016
1	AGND	Test Point Compact, SMT	Keystone Electronics	5016
1	+VIN	Test Point Compact, SMT	Keystone Electronics	5016
1	+VOUT	Test Point Compact, SMT	Keystone Electronics	5016
1	SHDN	Test Point Compact, SMT	Keystone Electronics	5016
1	SYNC/PWM	Test Point Compact, SMT	Keystone Electronics	5016
4		Bumpons - Protective Products	3M®	SJ5003-0
1	U1	MCP1601 Buck Regulator	Microchip Technology Inc	MCP1601I

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