



# **SOT-223-5 Voltage Regulator Evaluation Board User's Guide**

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# SOT-223-5 VOLTAGE REGULATOR 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](http://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 "DSXXXXA", where "XXXX" 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 SOT-223-5 Voltage Regulator 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 SOT-223-5 Voltage Regulator Evaluation Board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the SOT-223-5 Voltage Regulator Evaluation Board.
- **Chapter 2. "Installation and Operation"** – This chapter includes a detailed description of each function of the demo board and instructions for how to begin using the board.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the SOT-223-5 Voltage Regulator Evaluation Board.
- **Appendix B. "Bill Of Materials (BOM)"** – Lists the parts used to build the SOT-223-5 Voltage Regulator Evaluation Board.

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## CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

### DOCUMENTATION CONVENTIONS

Description	Represents	Examples
<b>Arial font:</b>		
Italic characters	Referenced books	<i>MPLAB<sup>®</sup> 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&gt;Save</i></u>
Bold characters	A dialog button	Click <b>OK</b>
	A tab	Click the <b>Power</b> 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>
<b>Courier New font:</b>		
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 SOT-223-5 Voltage Regulator Evaluation Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

**MCP1790 Data Sheet, “70 mA, High Voltage Regulator“, DS22075**

**MCP1824 Data Sheet, “300 mA, Low Voltage, Low Quiescent Current LDO Regulator“, DS22070**

**MCP1825 Data Sheet, “500 mA, Low Voltage, Low Quiescent Current LDO Regulator“, DS22056**

**MCP1826 Data Sheet, “1000 mA, Low Voltage, Low Quiescent Current LDO Regulator“, DS22057**

These datasheets provide useful information regarding voltage regulator parameters that may be validated using this evaluation board.

## THE MICROCHIP WEB SITE

Microchip provides online support via our web site at [www.microchip.com](http://www.microchip.com). This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

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

## DOCUMENT REVISION HISTORY

### Revision A (July 2008)

- Initial Release of this Document.

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## Chapter 1. Product Overview

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### 1.1 INTRODUCTION

The SOT-223-5 Voltage Regulator Evaluation Board is designed to provide functional evaluation of Microchip Voltage Regulators that utilize the SOT223-5 package and the following device pinout:

Pin 1 =  $\overline{\text{SHDN}}$

Pin 2 =  $V_{\text{IN}}$

Pin 3 = GND

Pin 4 =  $V_{\text{OUT}}$

Pin 5 = PWRGD / ADJ

The SOT-223-5 Voltage Regulator Evaluation Board does not come with a voltage regulator soldered onto the board. This allows the users to attach the voltage regulator of their choosing to the board and perform quiescent current, ground current, PSRR, and other desired tests.

The SOT-223-5 Voltage Regulator Evaluation Board is based upon a modular concept that will allow the user to plug in additional boards to increase the test capability of the voltage regulator. Planned additional modular plugin boards currently consist of an Input Voltage Linestep Board, Output Voltage Loadstep Board, and several other device packages.

### 1.2 WHAT IS THE SOT-223-5 VOLTAGE REGULATOR EVALUATION BOARD?

The SOT-223-5 Voltage Regulator Evaluation Board is designed to evaluate and test voltage regulators. By soldering the desired device to the evaluation board, the user can easily validate several parameters of the device.

#### 1.2.1 Functional Blocks

The SOT-223-5 Voltage Regulator Evaluation Board can be broken up into 6 functional blocks. The blocks are:

- Input Capacitance
- Shutdown Control
- Ground Current Measurement
- Voltage Adjust
- Power Good
- Load Resistor

#### 1.2.2 Input Capacitance

Jumper JP1 connects the input capacitance to the circuit. The input capacitor is disconnected when performing Power Supply Ripple Rejection tests. By default,  $C_1$  is populated with a 1  $\mu\text{F}$ , 50V, XR7 ceramic capacitor.

## 1.2.3 Shutdown Control

Jumper JP2 allows the user to select the Shutdown ( $\overline{\text{SHDN}}$ ) pin voltage level. The voltage level may be set to  $V_{\text{IN}}$ , GND, or open, depending on the placement of the JP2 jumper. When the jumper is not connecting pins 1 and 2, or pins 2 and 3 of JP2, the voltage level may be set by attaching a signal to TP5. This allows the user to enable, disable, or pulse the shutdown pin of the device.

The board comes with  $R_1$  populated with a 10 k $\Omega$  resistor.

## 1.2.4 Ground Current Measurement

Jumper JP3 allows measurement of ground current. When a current meter is connected to TP6 and TP7 and jumper JP3 is removed, the ground current of the device may be measured.

## 1.2.5 Voltage Adjust

For Adjustable Output Voltage devices,  $R_2$  and  $R_3$  may be populated with appropriate values to provide the desired output voltage.

The board comes with  $R_2$  populated with a 68.5 k $\Omega$  resistor.

## 1.2.6 Power-Good (PWRGD)

For devices with a Power-Good (PWRGD) output, either  $R_2$  or  $R_4$  is populated, depending on the desired pullup source voltage.

- $R_2$  selects  $V_{\text{OUT}}$  as the pull-up source voltage.
- $R_4$  selects  $V_{\text{IN}}$  as the pull-up source voltage.

The board comes with  $R_2$  populated with a 68.5 k $\Omega$  resistor.

## 1.2.7 Load Resistor

$R_5$  and  $R_6$  may be populated with the desired load resistor values for the device being evaluated. JP4 connects  $R_5$  to the device output, JP5 connects  $R_6$  to the device output.

## 1.2.8 Output Capacitor

$C_2$  may be populated with the desired output capacitance. By default,  $C_2$  is populated with a 1  $\mu\text{F}$ , 6.3V, XR7 ceramic capacitor.

## 1.2.9 Power Supply

J1 or TP1 and TP2 are connected to the user's power supply.

## 1.3 WHAT THE SOT-223-5 VOLTAGE REGULATOR EVALUATION BOARD KIT INCLUDES.

This SOT-223-5 Voltage Regulator Evaluation Board kit includes:

- SOT-223-5 Voltage Regulator Evaluation Board, 102-00198
- Microchip Analog and Interface Products Demonstration Boards CD-ROM (DS21912)
  - SOT-223-5 Voltage Regulator Evaluation Board User's Guide, (DS51751)



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## Chapter 2. Installation and Operation

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### 2.1 INTRODUCTION

The SOT-223-5 Voltage Regulator Evaluation Board is designed to be used to facilitate the evaluation of Microchip's voltage regulators or to be used as a standalone voltage regulator board. Jumpers have been placed on the board to facilitate testing of specific voltage regulator parameters. The jumpers may also be used to select pull-up and pull-down voltage levels.

The SOT-223-5 Voltage Regulator Evaluation Board kit comes with a 1  $\mu$ F ceramic input and output capacitor soldered to the board. A 10  $k\Omega$  resistor in series with the SHDN pin is also populated on the board. The PWRGD/ADJ pin has a 69.8  $k\Omega$  resistor soldered to the board. The board has four more unpopulated resistor locations that may be used for loads and voltage adjustments.

### 2.2 FEATURES

The SOT-223-5 Voltage Regulator Evaluation Board has the following features:

- Input and Output headers for future connection to Line Step and Load Step modules
- Ample testpoints to attach multimeters, power supplies, and loads
- Jumper to select ground current measurement
- Jumper to select input capacitor
- Jumper to select two different load resistors
- Jumper to select shutdown pin input:  $V_{DD}$ , GND, or use test point
- Jumper to connect input capacitor to circuit
- SMT0805 PCB footprints for user Power-Good pull-up resistor
- SMT0805 PCB footprints for user Adjustable Voltage resistor divider
- SMT0805 PCB footprints for user Bypass Capacitor

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## 2.3 GETTING STARTED

The SOT-223-5 Voltage Regulator Evaluation Board is fully assembled and tested. All that is required for operating is a user supplied voltage regulator and a supply voltage source. Some of the tests that may be completed using the SOT-223-5 Voltage Regulator Evaluation Board shall now be described.

### 2.3.1 Ground Current and Quiescent Current

When measuring ground current, jumper JP3 should be removed, otherwise leave jumper JP3 on. To measure ground current, perform the following steps.

1. Add desired load resistors to R<sub>5</sub> and R<sub>6</sub>.
2. Remove jumpers JP3, JP4, and JP5.
3. Connect an Ampere Meter across test points TP6(+) and TP7(-). Select the appropriate meter scale for the device being evaluated.
4. Connect a voltmeter across testpoints TP9(+) and TP10(-).
5. Add jumper JP1.
6. Add jumper JP2 to pins 1 and 2.
7. Apply source voltage to test points TP1(+) and TP2(-).
8. Verify the voltage across test points TP6 and TP7 is within the expected range of the device being tested.
9. Read the Ground Current directly from the ampere meter connected to test points TP6 and TP7.
10. Vary the input voltage to obtain data for ground current versus input voltage. With no load attached to the output of the voltage regulator, the measured **ground current** is also called the **quiescent current** of the regulator.
11. Add a load selection jumper, JP4 or JP5.
12. Read the Ground Current directly from the ampere meter connected to test points TP6 and TP7.
13. The data collected will be the **ground current** versus load current.

### 2.3.2 Adjustable Output Voltage

The output voltage of some adjustable voltage regulators may be adjusted by selecting appropriate resistor divider values connected to the Adjust (ADJ) pin. R<sub>2</sub> and R<sub>3</sub> pads are available to be used as voltage divider.

### 2.3.3 Shutdown Input Selection

The Shutdown ( $\overline{\text{SHDN}}$ ) input selection may be set to  $V_{\text{IN}}$ , GND, or a user supplied voltage using test point TP5. To select  $V_{\text{IN}}$  as the  $\overline{\text{SHDN}}$  voltage, place a jumper across pins JP2-1 and JP2-2. To select GND as the  $\overline{\text{SHDN}}$  voltage, place a jumper across pins JP2 and JP3. To select a user specified input such as a function generator, remove the jumper from JP2 and connect the external voltage source positive lead (+) to test point TP5 and the negative lead (-) to test point TP4.

## 2.3.4 Power-Good (PWRGD)

The Power-Good (PWRGD) output pin has the ability to be pulled up to either  $V_{IN}$  or  $V_{OUT}$ . Populating  $R_2$  (and removing  $R_4$ ) with the desired pull-up resistor causes PWRGD to be pulled up to  $V_{OUT}$ . Populating  $R_4$  (and removing  $R_2$ ) with the desired pull-up resistor causes PWRGD to be pulled up to  $V_{IN}$ .

When PWRGD is pulled up to  $V_{OUT}$ , the device current will be minimal when  $\overline{SHDN}$  is active. When PWRGD is pulled up to  $V_{IN}$ , the device current will be higher when  $\overline{SHDN}$  is active, because the current will flow through  $R_4$  and the PWRGD pin to ground. When low operating currents are critical, PWRGD should be pulled up to  $V_{OUT}$ . That will keep current consumption at a minimum when  $\overline{SHDN}$  is active because the output voltage will be low.

## 2.3.5 Load Resistance

$R_5$  and  $R_6$  are used to set desired load values. One choice is to set  $R_5$  to the minimum current desired for testing.  $R_6$  would then be set to a value desired for specific tests. Either value may be selected by adding the respective jumpers.

## 2.3.6 Line Step

Dynamic Line Step response may be evaluated by connecting an electronically switched input voltage to test points TP1(+) and TP2(-) or to connector J1. An oscilloscope is connected to TP3(Ch1 Trigger), TP9(Ch2) and TP10(GND). An appropriate load is selected using  $R_5$  and JP4 or  $R_6$  and JP5. The input voltage is then electronically switched from a low voltage to a high voltage. The corresponding voltage waveform data of the voltage regulator response is captured by the oscilloscope. Microchip will be offering a Line Step module that connects directly to connector J1. The Line Step module will be capable of switching between two voltage levels that the user supplies.

## 2.3.7 Load Step

The Dynamic Load Step response may be evaluated by connecting an electronically switched load to test points TP9(+) and TP10(-) or to connector P1. An oscilloscope is connected to the electronic load switch signal (Ch1 Trigger) and to TP9(Ch2) and TP10(Gnd). The load is then electronically switched from a high resistance to a low resistance. The corresponding voltage waveform data of the voltage regulator response is captured by the oscilloscope. Microchip will be offering a Load Step module that connects directly to connector P1. The Load Step module will have several selectable load values populated onboard to cover a wide range of loads. The load will have the ability to be electronically or manually switched.

## 2.3.8 Power Supply Rejection Ratio (PSRR)

Power Supply Rejection Ratio tests are performed by removing the input capacitor jumper, JP1, and connecting an appropriate PSRR analyzer to the SOT-223-5 Voltage Regulator Evaluation Board. The PSRR analyzer may then sweep the input voltage frequencies and record the corresponding output voltages.

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## Appendix A. Schematic and Layouts

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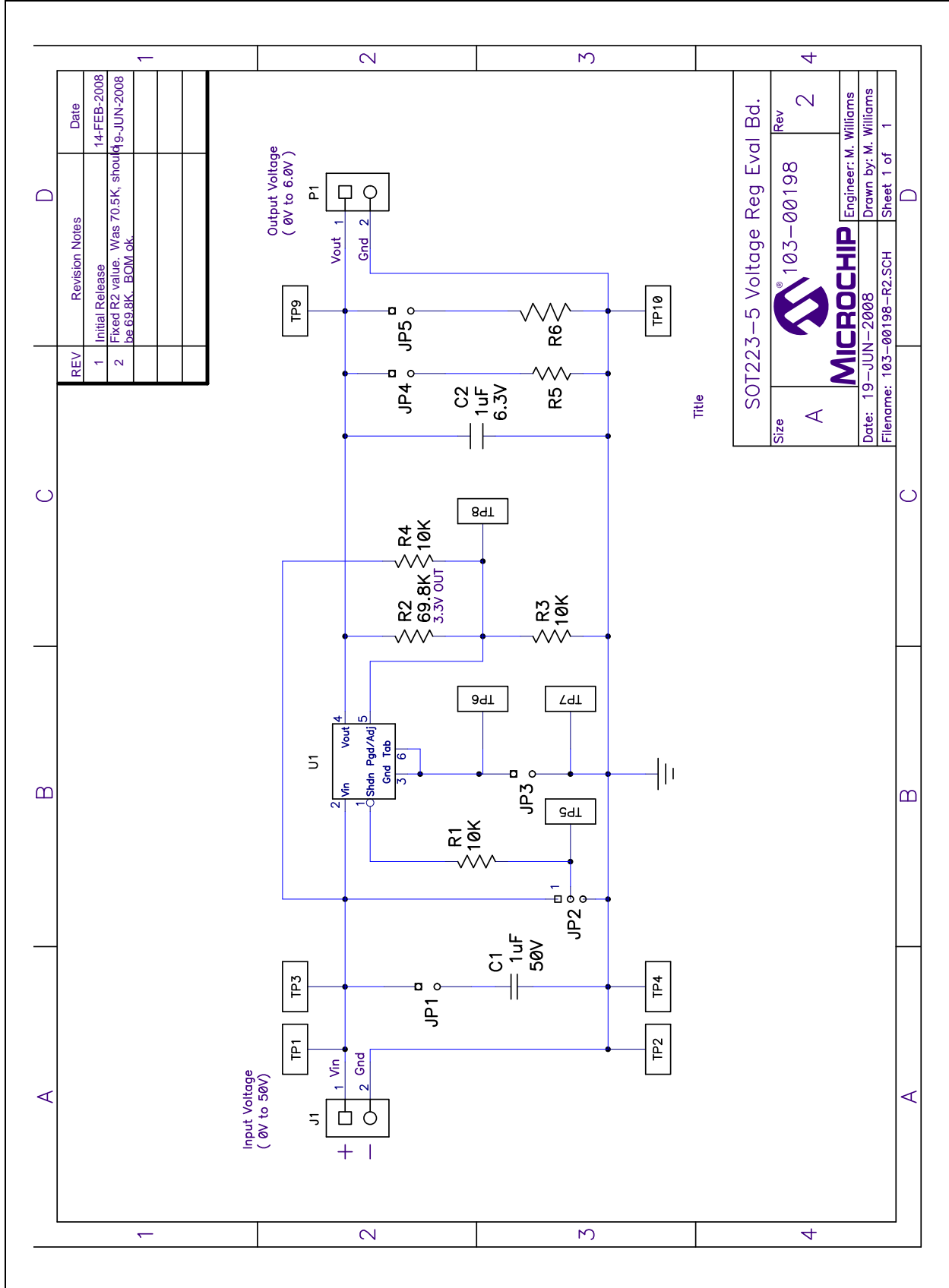
### A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the SOT-223-5 Voltage Regulator Evaluation Board:

- Board - Schematic
- Board - Top Silk
- Board - Top Solder
- Board - Bottom Solder

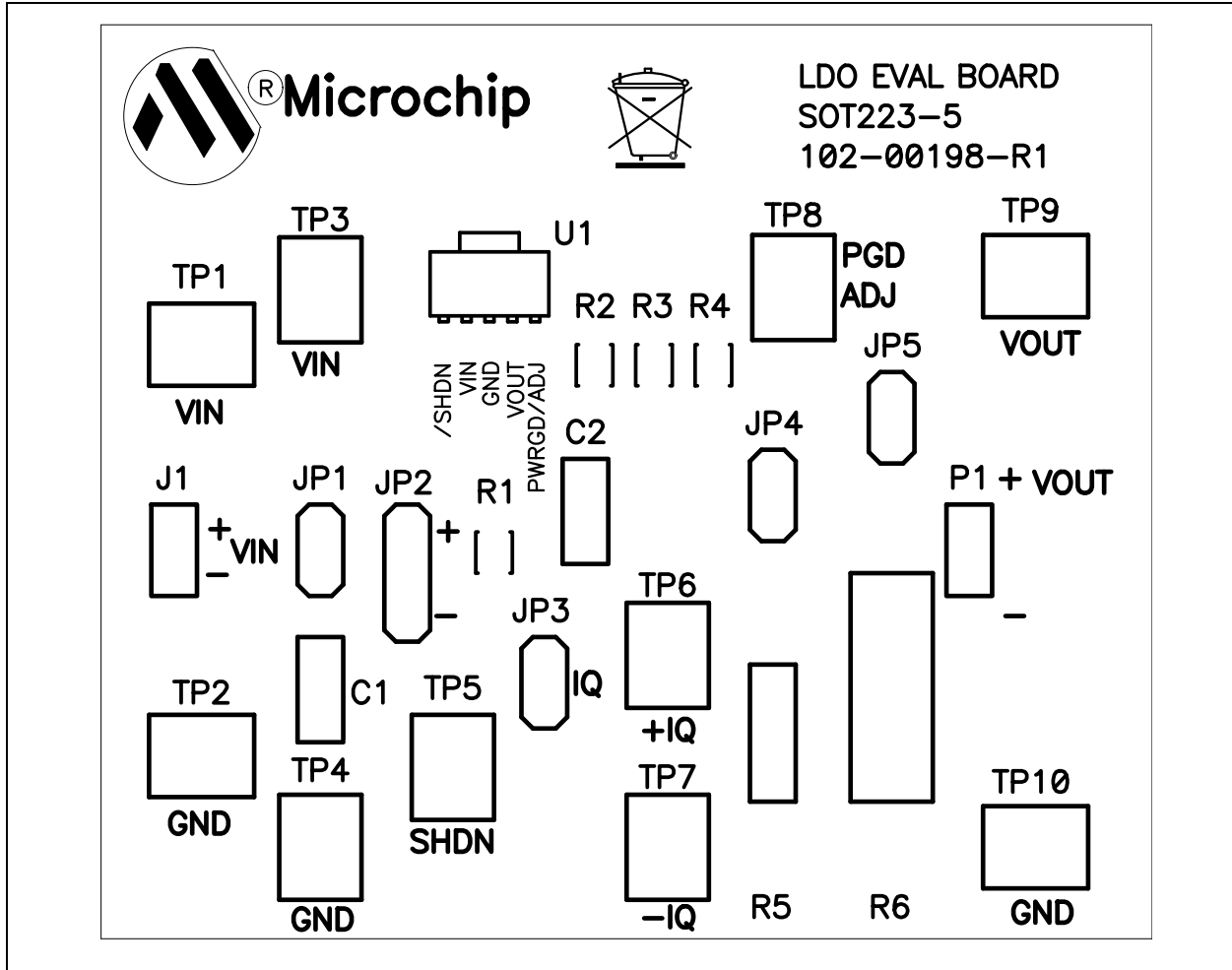
# SOT-223-5 Voltage Regulator Evaluation Board User's Guide

## A.2 BOARD - SCHEMATIC

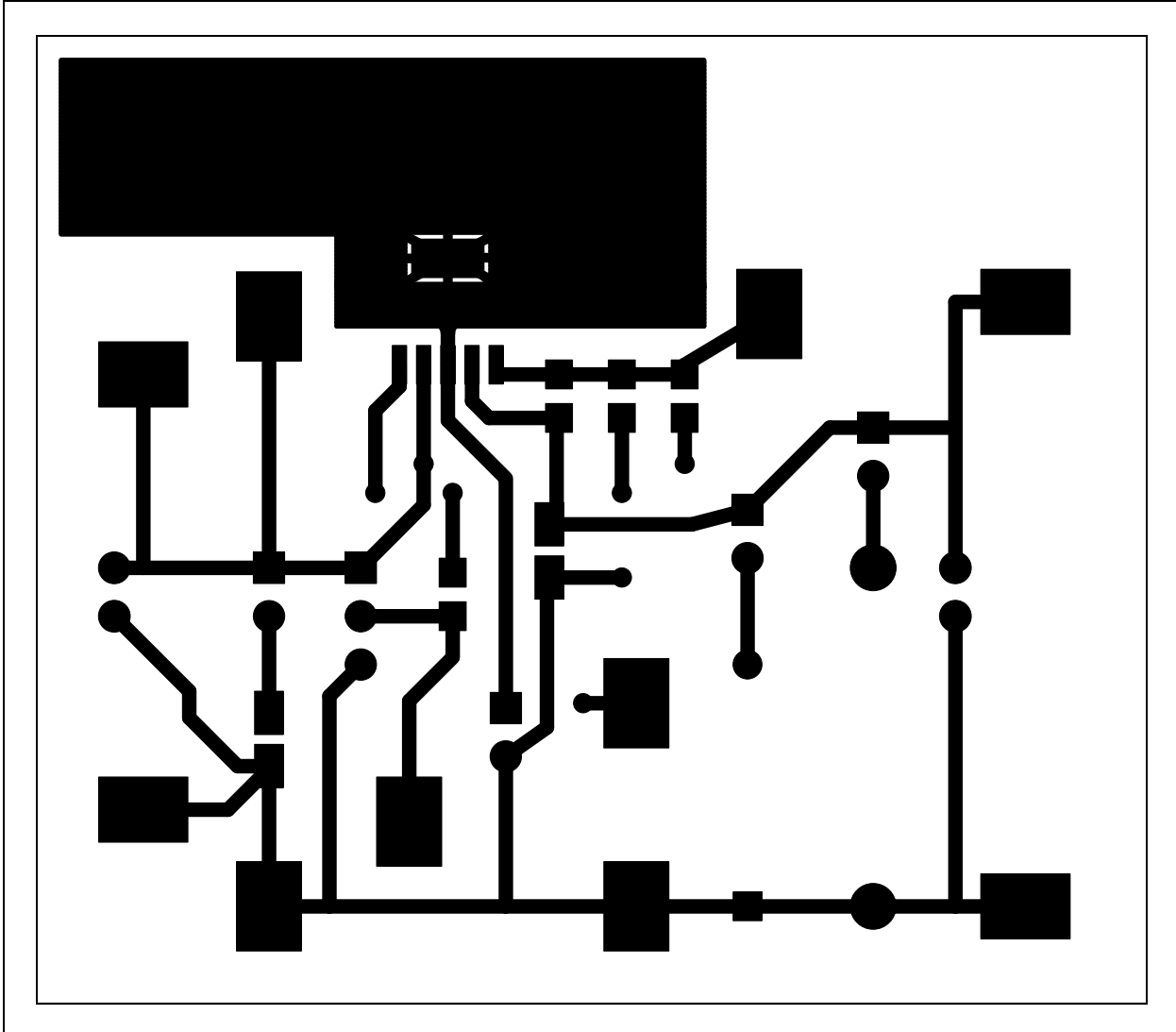




## A.3 BOARD - TOP SILKSCREEN



## A.4 BOARD - TOP SOLDER



## A.5 BOARD - BOTTOM SOLDER

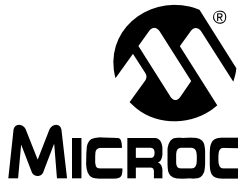


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## Appendix B. Bill Of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Qty	Reference	Description	Manufacturer	Part Number
1	C1	Capacitor, Ceramic, 1 uF, 50V, X7R, SMT 0805	Murata	GRM21BR71H105KA12L
1	C2	Capacitor, Ceramic, 1 uF, 16V, X7R, SMT 0805	Kemet <sup>®</sup> Electronics Corp	C0805C105K4RACTU
1	J1	2 pin RA header, 0.100 centers, 0.025 sq pins, 0.070 pcb to pin center height, 36 pins to a strip (yields 18 headers)	3M	929835-01-36-RK
4	JP1, JP3, JP4, JP5	2 pin header, 0.100 centers, 0.025 sq pins, 0.070 pcb to pin center height, 36 pins to a strip (yields 18 headers)	Molex <sup>®</sup> Electronics	22-28-4360
1	JP2	3 pin header, 0.100 centers, 0.025 sq pins, 0.070 pcb to pin center height, 36 pins to a strip (yields 12 headers)	Molex Electronics	22-28-4360
1	P1	RA socket, 0.100 centers, 0.025 sq pins, 0.070 pcb to pin center height	Sullins Electronics Inc.	PPPC021LGBN-RC
1	R1	10K Resistor, 1%, 1/8W, SMT 0805	Rohm CO., LTD	MCR10EZHF1002
1	PCB	Printed Circuit Board	Microchip Technology Inc.	104-00198
1	R2	69.8K Resistor, 1%, 1/8W, SMT 0805	Rohm CO., LTD	MCR10EZHF6982
10	TP1-TP10	SMT Testpoint	Keystone Electronics <sup>®</sup>	5016

**Note:** 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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