TO220-3/TO263-3 Voltage Regulator Evaluation Board User's Guide

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TO220-3/TO263-3 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) 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 TO220-3/TO263-3 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 TO220-3/TO263-3 Voltage Regulator Evaluation Board as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Contains information about the TO220-3/TO263-3 Voltage Regulator Evaluation Board.
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to get started with this evaluation board and a description of the evaluation board operation.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the TO220-3/TO263-3 Voltage Regulator Evaluation Board.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the TO220-3/TO263-3 Voltage Regulator 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 TO220-3/TO263-3 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**
- **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**
- **MCP1827 Data Sheet -** ***"1.5A, Low Voltage, Low Quiescent Current LDO Regulator"*****, DS22001**

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

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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

CUSTOMER SUPPORT

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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 (April 2009)

- Initial Release of this Document.

NOTES:

Chapter 1. Product Overview

1.1 INTRODUCTION

The TO220-3 / TO263-3 Voltage Regulator Evaluation Board is designed to provide functional evaluation of Microchip Voltage Regulators that utilize the TO220-3 and TO263-3 package and the following device pinouts:

Pin Number	U1 footprint
Pin 1	V_{IN}
Pin 2	GND
Pin 3	V_{OUT}

The TO220-3 / TO263-3 Voltage Regulator Evaluation Board does not come with a voltage regulator soldered onto the board. This allows the user to attach the voltage regulator of their choosing to the board and perform quiescent current, ground current, PSRR, and other desired tests.

The TO220-3 / TO263-3 Voltage Regulator Evaluation Board is based upon a modular concept which will allow the user to plug in additional boards to increase the test capability of the voltage regulator. Planned additional modulare plugin boards currently consist of an Input Voltage Linestep Board, Output Voltage Loadstep Board, and several other device packages.

1.2 WHAT IS THE TO220-3/TO263-3 VOLTAGE REGULATOR EVALUATION BOARD?

The TO220-3 / TO263-3 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 Funtional Blocks

The TO220-3 / TO263-3 Voltage Regulator Evaluation Board can be broken up into three functional blocks. These blocks are:

- Input Capacitance
- Ground Current Measurement
- 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 µF, 50V, XR7 ceramic capacitor.

1.2.3 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.

1.2.4 Load Resistor

R_5 may be populated with the desired load resistor value for the device being evaluated. JP4 connects R_5 to the device output. R_6 may also be populated with a load resistor. JP5 connects R_6 to the device output.

1.2.5 Output Capacitor

C_2 may be populated with the desired surface mount output capacitance. By default, C_2 is populated with a 1 µF, 6.3V, XR7 ceramic capacitor. C_3 is provided for the user to populate with a radial lead through-hole capacitor with 0.100" lead spacing.

1.2.6 Power Supply

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

1.3 WHAT THE TO220-3/TO263-3 VOLTAGE REGULATOR EVALUATION BOARD KIT INCLUDES

This TO220-3/TO263-3 Voltage Regulator Evaluation Board kit includes:

- One TO220-3/TO263-3 Voltage Regulator Evaluation Board, 102-00204
- Important Information "Read First"

Chapter 2. Installation and Operation

2.1 INTRODUCTION

The TO220-3/TO263-3 Voltage Regulator Evaluation Board is designed to be used to facilitate evaluation of Microchip's voltage regulators or to be used as a stand-alone voltage regulator board. Jumpers have been placed on the board to facilitate testing of specific voltage regulator parameters.

The TO220-3/TO263-3 Voltage Regulator Evaluation Board kit comes with a 1 uF ceramic input and output capacitor soldered to the board. The board has two unpopulated resistor locations that may be used for loads. The board also has one unpopulated output capacitor location that may be populated with a through-hole radial lead capacitor.

2.2 FEATURES

The TO220-3/TO263-3 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
- Jumpers to connect output load resistors
- Jumper to connect input capacitor to circuit
- Footprint for an additional through-hole radial lead output capacitor

2.3 GETTING STARTED

The TO220-3/TO263-3 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 TO220-3/TO263-3 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_5 and R_6.
2. Remove jumpers JP3, JP4 and JP5.
3. Connect an ammeter across testpoints TP6(+) and TP7(-). Select appropriate meter scale for device being evaluated.
4. Connect a voltmeter across testpoints TP9(+) and TP10(-).
5. Add jumper JP1.
6. Apply source voltage to testpoints TP1(+) and TP2(-).
7. Verify the voltage across testpoints TP10 and TP9 is within the expected range of the device being tested.

8. Read the Ground Current directly from the ammeter connected to testpoints TP6 and TP7.
9. 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.
10. Add a load selection jumper, JP4 or JP5.
11. Read the Ground Current directly from the ammeter connected to testpoints TP6 and TP7.
12. The data collected will be the *ground current* versus load current.

2.3.2 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 their respective jumpers.

2.3.3 Line Step

Dynamic Line Step response may be evaluated by connecting an electronically switched input voltage to testpoints 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.

2.3.4 Load Step

Dynamic Load Step response may be evaluated by connecting an electronically switched load to testpoints 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.

2.3.5 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 TO220-3/TO263-3 Voltage Regulator Evaluation Board. The PSRR analyzer may then sweep the input voltage frequencies and record the corresponding output voltages.

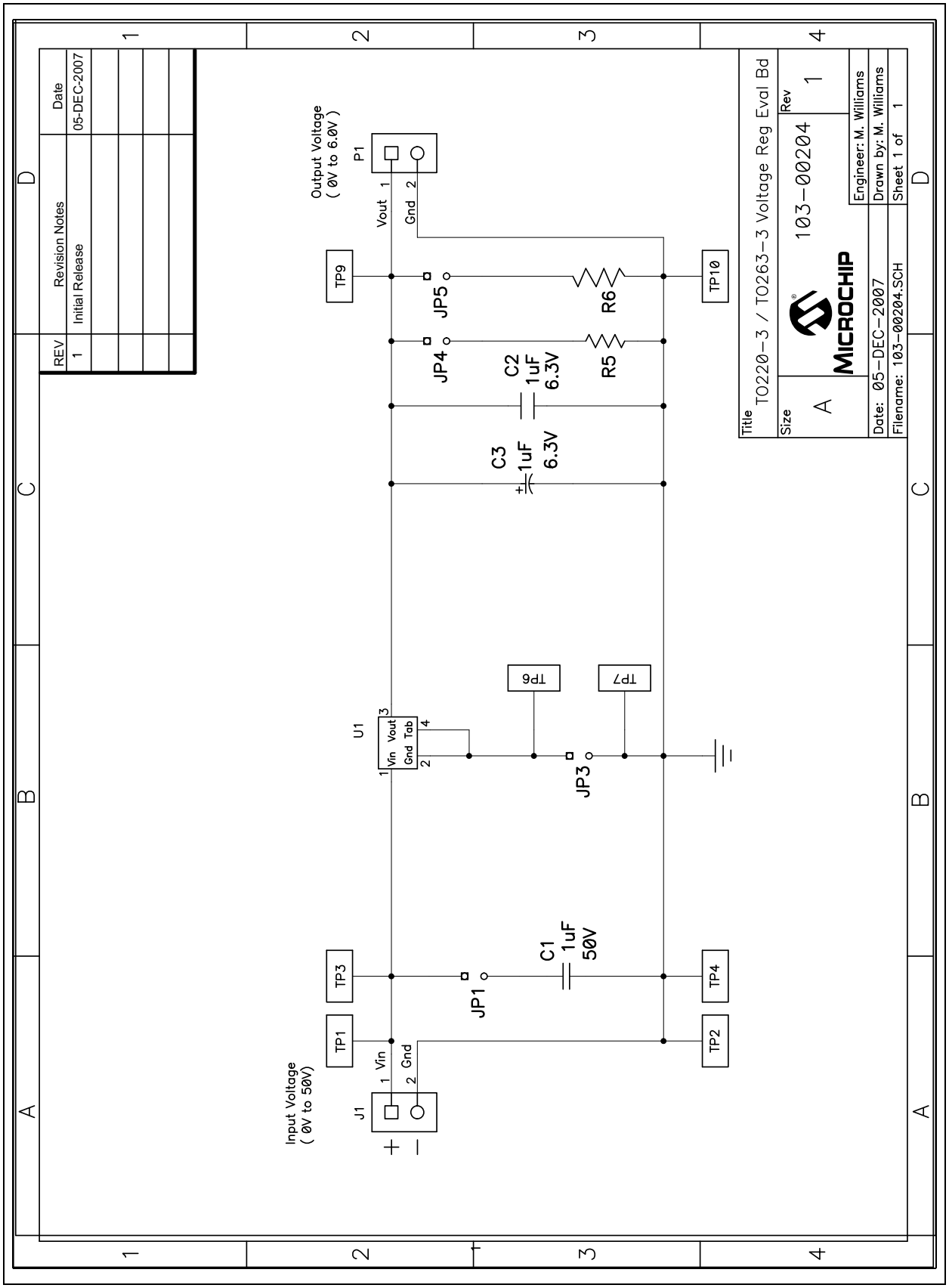
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

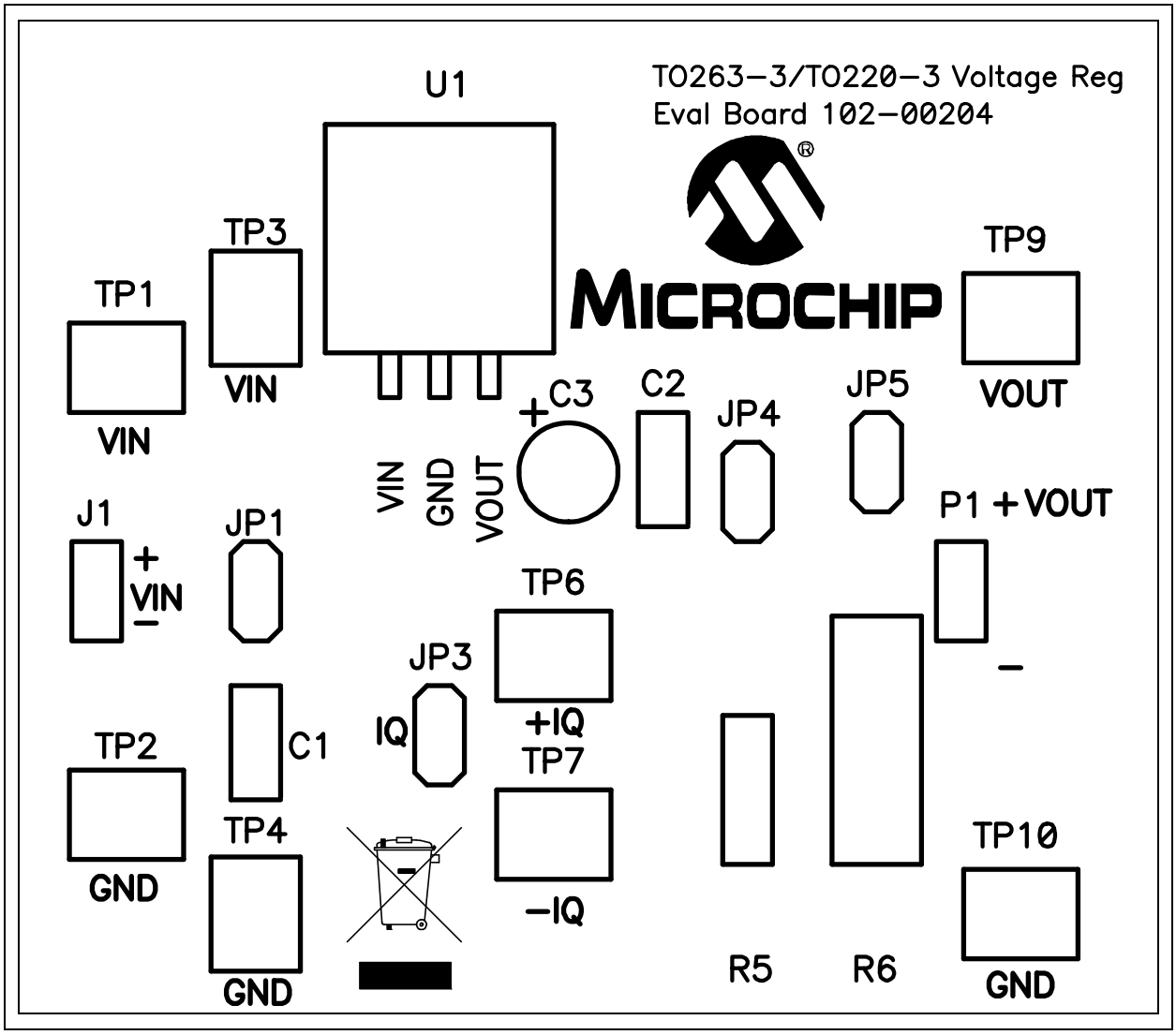
This appendix contains the following schematis and layouts for the TO220-3/TO263-3 Voltage Regulator Evaluation Board:

- Board - Schematic
- Board - Top Silk
- Board - Top Copper
- Board - Bottom Copper

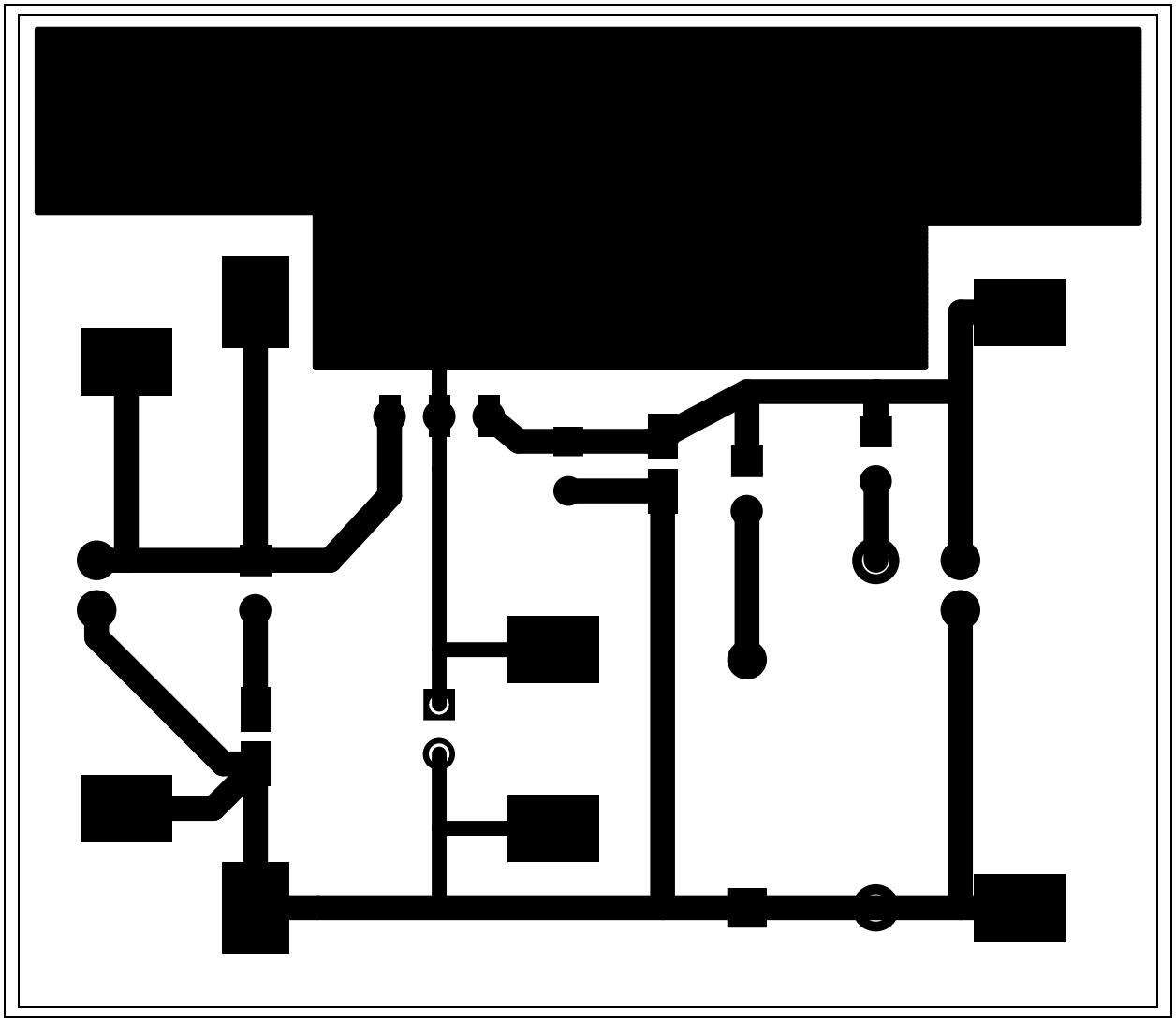
A.2 BOARD - SCHEMATIC



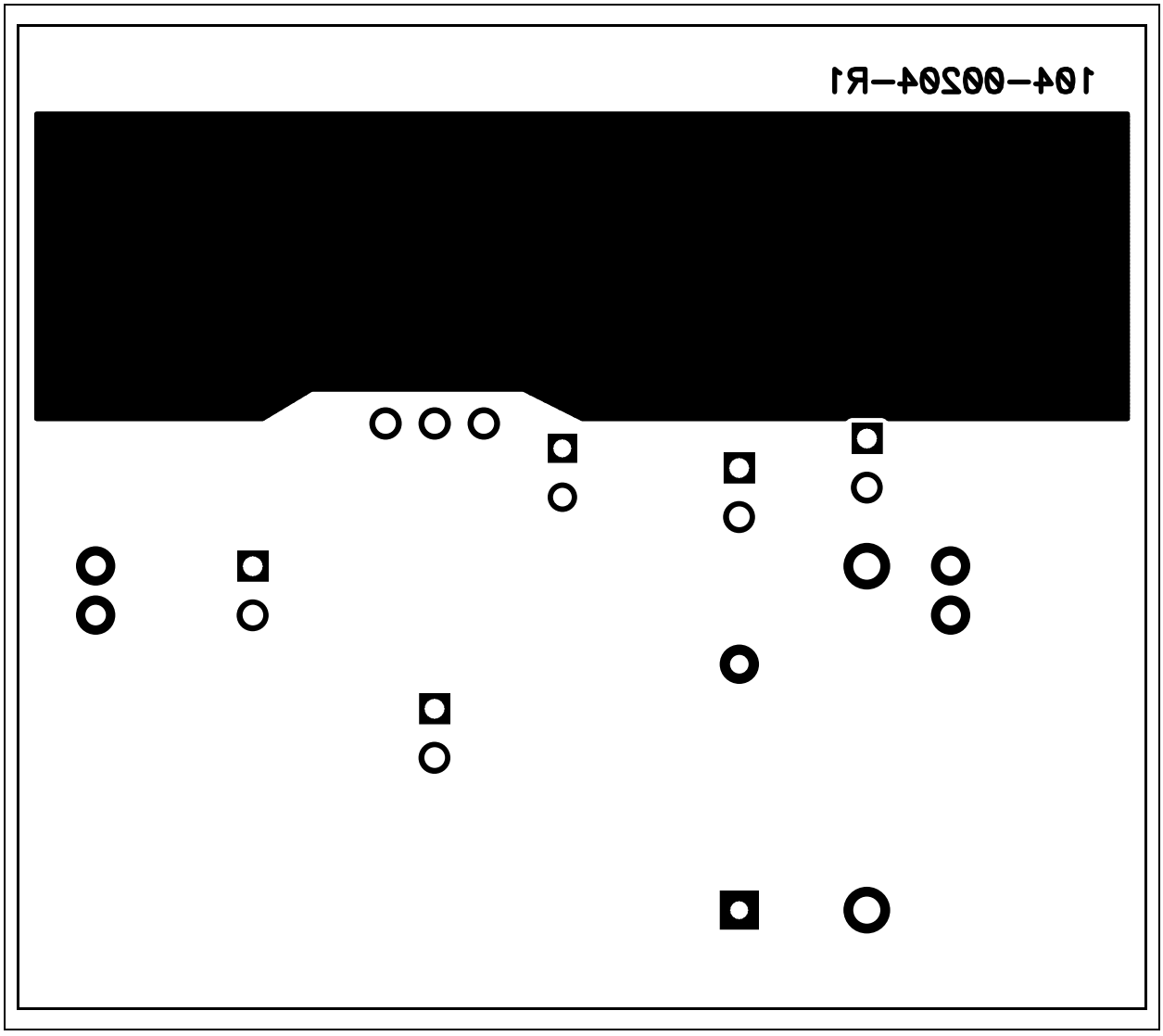
A.3 BOARD - TOP SILK



A.4 BOARD - TOP COPPER



A.5 BOARD - BOTTOM COPPER



NOTES:

Appendix B. Bill of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Qty	Reference	Description	Manufacturer	Part Number
1	C1	CAP CERAMIC 1.0 uF 50V X7R 0805	Murata Electronics®	GRM21BR71H105KA12L
1	C2	CAP CERAMIC 1.0 uF 16V X7R 0805	Kemet® Electronics	C0805C105K4RACTU
1	C3	DO NOT POPULATE	—	—
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	Molex® Electronics	22-28-4360
4	JP1, JP3, JP4, JP5	Connector, Jumper Shorting, Tin	Sullins Electronics	STC02SYAN
1	P1	RA socket, 0.100 centers, 0.025 sq pins, 0.070 pcb to pin center height	Sullins Electronics	PPPC021LGBN-RC
1	PCB	RoHS Compliant Bare PCB, TO220-3 / TO263-3 Voltage Regulator Evaluation Board	Microchip Technology Inc.	104-000204
2	R5, R6	DO NOT POPULATE	—	—
8	TP1, TP2, TP3, TP4, TP6, TP7, TP9, TP10	SMT Testpoint	Keystone Electronics®	5016
2	U1, U2	DO NOT POPULATE	—	—
4	On Each Corner	Bumpon Hemisphere, 0.44 x 0.20, Black	3M	SJ-5003 (BLACK)

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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