



# **MCP1612 Evaluation Board User's Guide**

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## Preface

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### 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 MCP1612 Evaluation Board. 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 the MCP1612 Evaluation Board. The manual layout is as follows:

- **Chapter 1: Installation and Operation** – Describes how to use the various features of the MCP1612 Evaluation Board.
- **Appendix A: Schematic and Layouts** – Shows the schematic and Printed Circuit Board (PCB) layout diagrams for the MCP1612 Evaluation Board.
- **Appendix B: Bill-of-Materials** – Shows the parts used to build the MCP1612 Evaluation Board.

# MCP1612 Evaluation Board User's Guide

## 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</i></u> >Save                                    |
| Bold characters                                  | A dialog button  | Click <b>OK</b>   |
|  | A tab  | Click the <b>Power</b> tab                                  |
| 'bnnnn'  | A binary number where <i>n</i> is a digit                  | 'b00100, 'b10   |
| Text in angle brackets < >                       | A key on the keyboard                                      | Press <Enter>, <F1>   |
| <b>Courier font:</b>                             |  |   |
| 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  | <i>file.o</i> , where <i>file</i> can be any valid filename |
| 0xnnnn   | A hexadecimal number where <i>n</i> is a hexadecimal digit | 0xFFFF, 0x007A  |
| 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)<br>{ ...<br>}                              |

## RECOMMENDED READING

The following Microchip documents are available and recommended as supplemental reference resources.

### **MCP1612 Data Sheet, "Single 1A, 1.4 MHz Synchronous Buck Regulator", DS21921**

The data sheet provides detailed information regarding the MCP1612 buck regulator.

## 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:

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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

## REVISION HISTORY

### Revision A (January 2005)

- Initial Release of this Document.

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## Chapter 1. Installation and Operation

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### 1.1 INTRODUCTION

The MCP1612 is a 1A, 1.4 MHz, fully integrated buck regulator. The output voltage is selectable from 0.8V to  $V_{IN}$  by use of an external resistor divider. It is available in both the 8L-MSOP and 8L-DFN packages.

The MCP1612 Evaluation Board contains two independent buck regulators featuring the 8L-MSOP and the 8L-DFN packages. The output voltage is set to one of eight different preset values (four per regulator circuit) by use of a two-position DIP switch. Each regulator circuit can supply an output current of 0 to 1A.

### 1.2 EVALUATION BOARD DESCRIPTION

The MCP1612 Evaluation Board consists of two separate 0 to 1A buck regulator circuits. One circuit (CKT<sub>1</sub>) features the 8L-MSOP package, while the other circuit (CKT<sub>2</sub>) features the 8L-DFN package. Each circuit has four different preset output voltage ( $V_{OUT}$ ) settings.

The settings for  $V_{OUT}$  on CKT<sub>1</sub> are 0.8V, 1.0V, 1.2V, and 1.4V. Refer to **Section 1.3.1 “CKT<sub>1</sub> Operation”** for an explanation detailing how to set  $V_{OUT}$ . The input voltage ( $V_{IN}$ ) of CKT<sub>1</sub> can be 2.7V to 5.5V for any setting of  $V_{OUT}$ .

The settings for  $V_{OUT}$  on CKT<sub>2</sub> are 0.8V, 1.7V, 2.4V, and 3.3V. Refer to **Section 1.3.2 “CKT<sub>2</sub> Operation”** for an explanation detailing how to set  $V_{OUT}$ . Since the MCP1612 is a buck regulator,  $V_{OUT}$  has to be lower than  $V_{IN}$ . Therefore, it is recommended that  $V_{IN}$  for CKT<sub>2</sub> be greater than  $V_{OUT}$  plus 500 mV to 5.5V to ensure proper operation.

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## 1.3 HOW IT IS USED

### 1.3.1 CKT<sub>1</sub> Operation

1. Connect the 2.7V to 5.5V lab power supply to the V<sub>IN</sub> (TP1) pin and the GND (TP2) pin.

**Note:** The MCP1612 will not operate until V<sub>IN</sub> is above the 2.7V threshold.

2. Connect an electronic or resistive load between V<sub>OUT</sub> (TP4) pin and GND (TP5) pin.

**Note:** The MCP1612 is specified to deliver 0 to 1A of load current. The internal overcurrent limit is 2.3A. However, care should be taken not to exceed the 1A current rating of the part.

3. The values of V<sub>OUT</sub> are predetermined and are selectable by a two-position DIP switch (S1). Table 1-1 lists the switch settings and V<sub>OUT</sub>.

**TABLE 1-1: S1 SWITCH SETTINGS AND V<sub>OUT</sub>**

| S1, Position 1 | S1, Position 2 | V <sub>OUT</sub> |
|----------------|----------------|------------------|
| Off            | Off            | 0.8V             |
| On             | Off            | 1.0V             |
| Off            | On             | 1.2V             |
| On             | On             | 1.4V             |

4. With V<sub>IN</sub> applied, verify that V<sub>OUT</sub> agrees with the switching settings listed above.
5. A resistor pulls the shutdown (SHDN), pin up to V<sub>IN</sub>, making the circuit always enabled. The circuit can be disabled by pulling the SHDN (TP3) pin to ground.

## 1.3.2 CKT<sub>2</sub> Operation

1. Connect the 2.7V to 5.5V power supply to the V<sub>IN</sub> (TP9) pin and the GND (TP10) pin.

**Note 1:** The MCP1612 will not operate until V<sub>IN</sub> is above the 2.7V threshold.  
**2:** Since the MCP1612 is a buck regulator, V<sub>OUT</sub> has to be lower than V<sub>IN</sub>. Therefore, it is recommended to ensure proper operation that V<sub>IN</sub> be greater than V<sub>OUT</sub> plus 500 mV to 5.5V.

2. Connect an electronic or resistive load between V<sub>OUT</sub> (TP7) pin and GND (TP6) pin.

**Note:** The MCP1612 is specified to deliver 0 to 1A of load current. The internal overcurrent limit is 2.3A. However, care should be taken not to exceed the 1A current rating of the part.

3. The values of V<sub>OUT</sub> are predetermined and are selectable by a two-position DIP switch (S2). Table 1-2 lists the switch settings and V<sub>OUT</sub>.

**TABLE 1-2: S2 SWITCH SETTING AND V<sub>OUT</sub>**

| S2, Position 1 | S2, Position 2 | V <sub>OUT</sub> |
|----------------|----------------|------------------|
| Off            | Off            | 0.8V             |
| On             | Off            | 1.7V             |
| Off            | On             | 2.4V             |
| On             | On             | 3.3V             |

4. With V<sub>IN</sub> applied, verify that V<sub>OUT</sub> agrees with the switching settings listed above.
5. A resistor pulls the shutdown ( $\overline{\text{SHDN}}$ ) pin up to V<sub>IN</sub>, making the circuit always enabled. The circuit can be disabled by pulling the SHDN (TP8) pin to ground.

## 1.4 HOW IT WORKS

### 1.4.1 MCP1612 Functions

The MCP1612 is a fixed 1.4 MHz synchronous buck regulator that has integrated switching and synchronous MOSFETs. Other features integrated into the device include shutdown control, soft start, undervoltage lockout, overcurrent and overtemperature protection. The high switching frequency allows the use of a smaller inductor and filter capacitors which ultimately lead to a space-saving design. The output voltage is set by a simple resistor divider network and compensation is accomplished by a series resistor capacitor to ground.

### 1.4.2 Power Topology and Output Regulation

The MCP1612 is a buck regulator with integrated switching and synchronous MOSFETs. Under normal operation, current ramps up in the buck inductor when the P-channel MOSFET is on. This current is sensed and compared to the output of the error amplifier. The error amplifier output is the difference between the internal 0.8V reference and the divided down V<sub>OUT</sub>. When the sensed inductor current ramps up to the point that is equal to the amplifier error signal, the P-channel MOSFET is turned off and the N-channel synchronous MOSFET is turned on until the beginning of the next switching cycle.

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## Appendix A. Schematic and Board Layouts

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### A.1 INTRODUCTION

This appendix contains the schematic and Printed Circuit Board (PCB) layout diagrams for the MCP1612 Evaluation Board.

#### A.1.1 Highlights

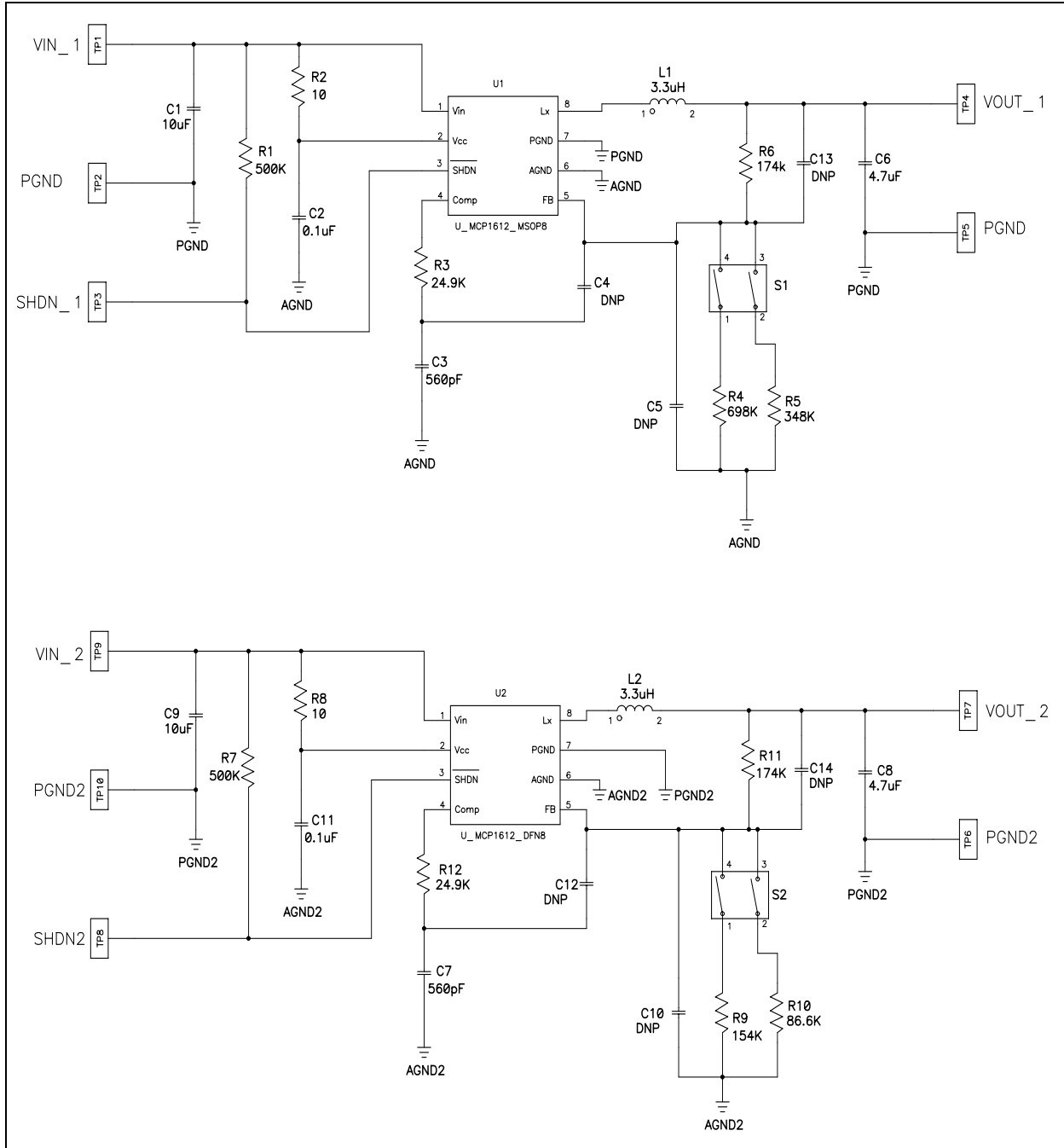
The MCP1612 Evaluation Board is constructed using a two-layer PCB. The top and bottom layers are for components and traces.

Diagrams included in this appendix:

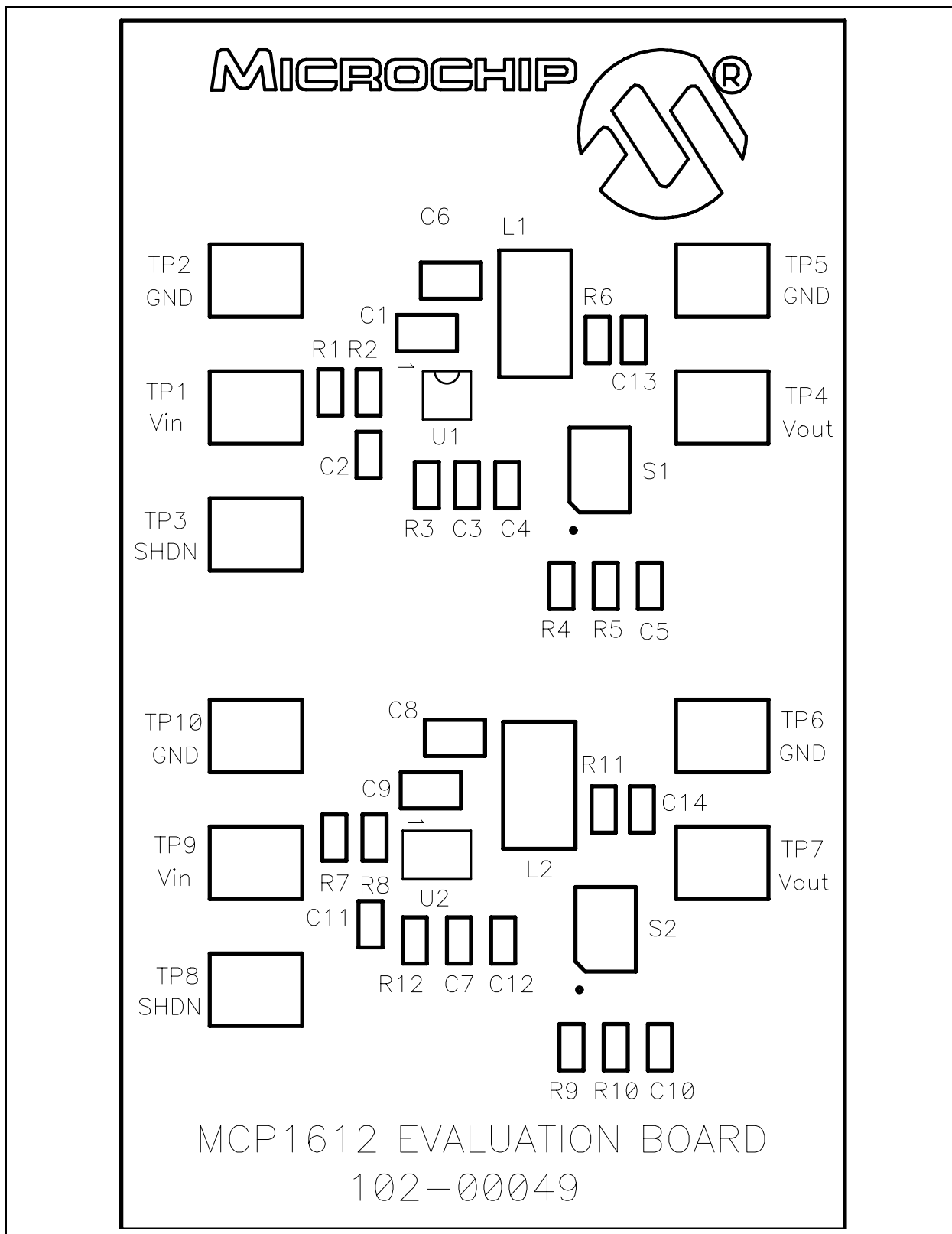
- Schematic
- Top Silk-Screen Layer
- Top Metal Layer
- Bottom Metal Layer
- Bottom Silk-Screen Layer

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## A.2 SCHEMATIC

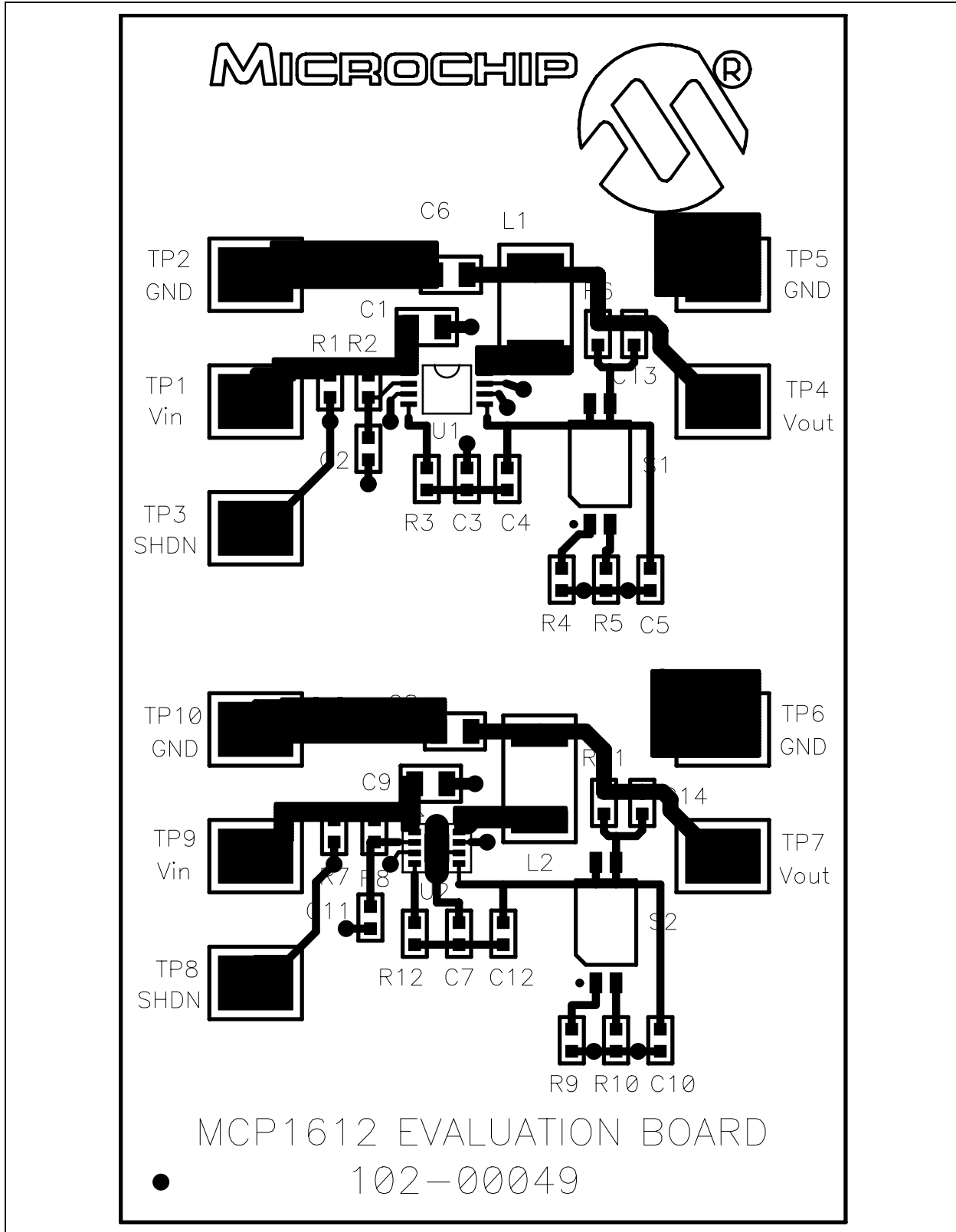


## A.3 TOP SILK-SCREEN LAYER



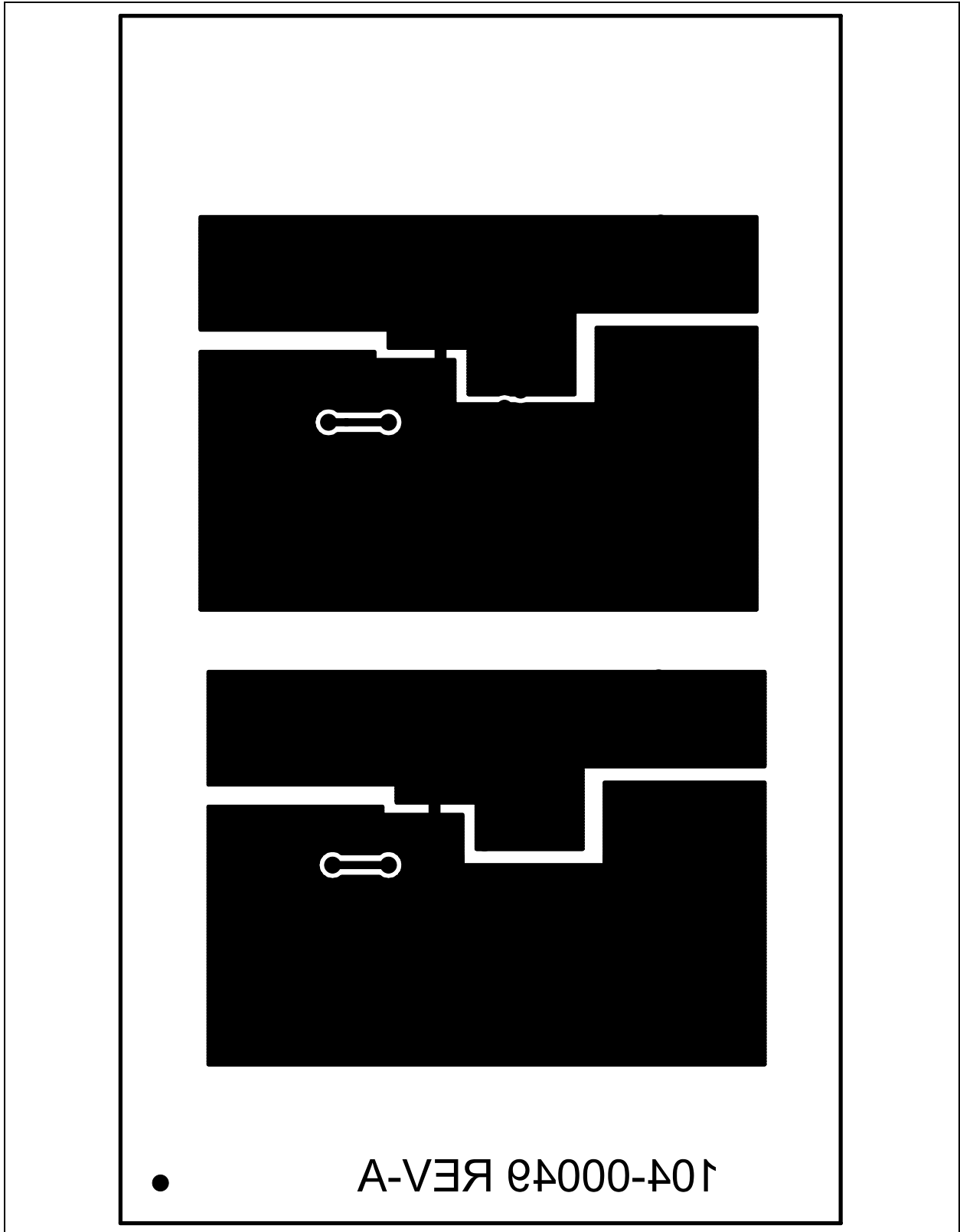
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## A.4 TOP METAL LAYER



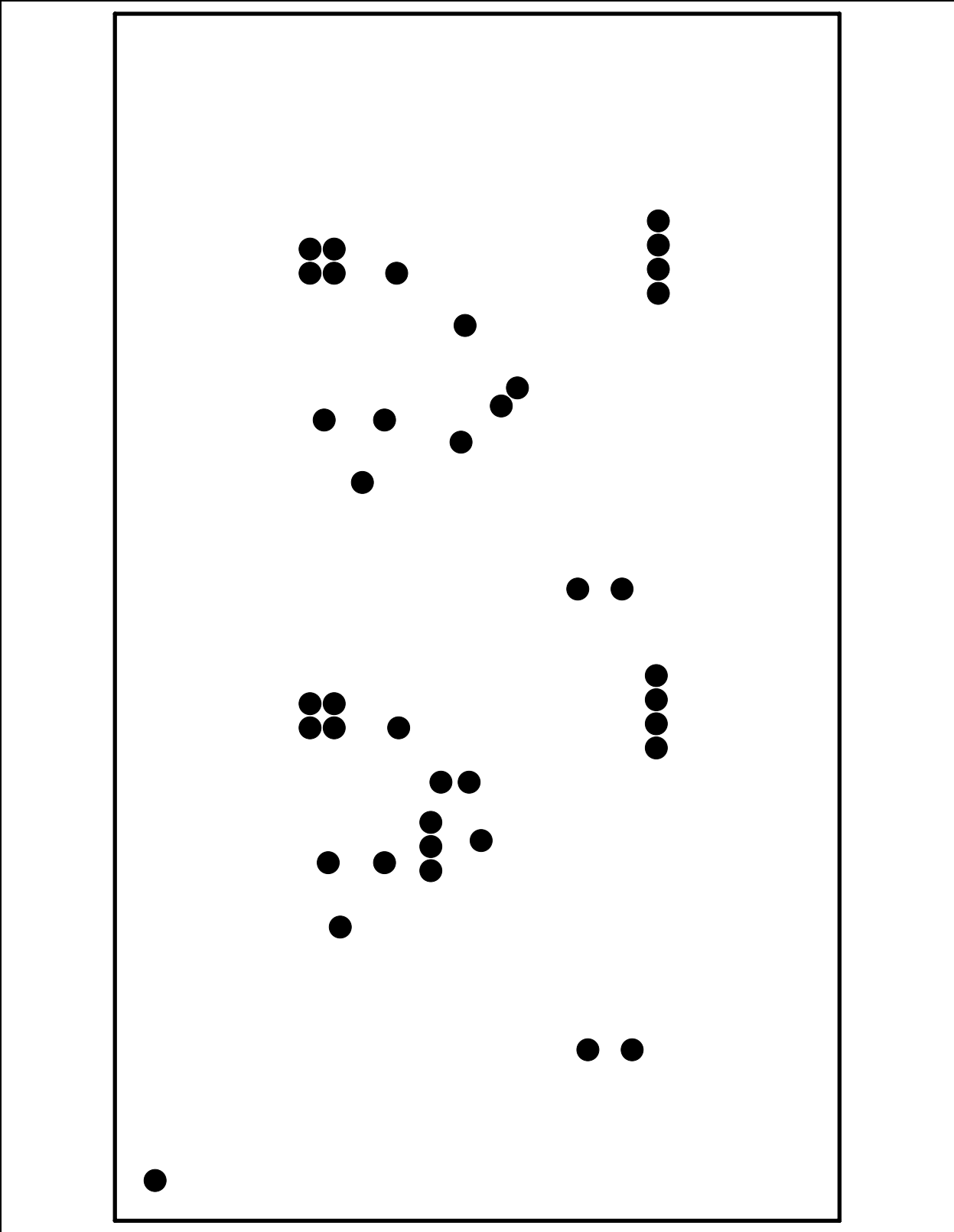


## A.5 BOTTOM METAL LAYER



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## A.6 BOTTOM SILK-SCREEN LAYER (TOP VIEW)





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## Appendix B. Bill-of-Materials (BOM)

**TABLE B-1: BILL-OF-MATERIALS (BOM)**

| Qty | Reference   | Description                      | Manufacture               | Manufacture P/N    |
|-----|---|----------------------------------|---------------------------|--------------------|
| 2   | C2, C11   | Capacitor, 0.1 $\mu$ F, 0603     | KEMET Electronics®        | C0603C104J4RACTU   |
| 2   | C6, C8  | Capacitor, 4.7 $\mu$ F, 0805     | Panasonic - ECG           | ECJ-2FB1C475K      |
| 2   | C1, C9  | Capacitor, 10 $\mu$ F, 0805      | MuRata Electronics®       | GRM21BR61A106KE19L |
| 2   | C3, C7  | Capacitor, 560 pF, 0603          | TDK Electronics Co., LTD  | C1608C0G1H561J     |
| 4   | C4, C5, C10, C12, C13, C14                        | Do Not Populate                  | –                         | –                  |
| 2   | L1, L2  | 3.3 $\mu$ H Inductor             | Coilcraft®                | DO1608C-332        |
| 1   | U2  | MCP1612 DFN                      | Microchip Technology Inc. | MCP1612-ADJI/MF    |
| 1   | U1  | MCP1612 MSOP                     | Microchip Technology Inc. | MCP1612-ADJI/MS    |
| 2   | R2, R8  | Resistor, 10 $\Omega$ , 0603     | Yageo America             | 9C06031A10R0FKHFT  |
| 2   | R3, R12   | Resistor, 24.9 k $\Omega$ , 0603 | Yageo America             | 9C06031A2492FKHFT  |
| 1   | R10   | Resistor, 86.6 k $\Omega$ , 0603 | Yageo America             | 9C06031A8662FKHFT  |
| 1   | R9  | Resistor, 154 k $\Omega$ , 0603  | Yageo America             | 9C06031A1543FKHFT  |
| 2   | R6, R11   | Resistor, 174 k $\Omega$ , 0603  | Yageo America             | 9C06031A1743FKHFT  |
| 1   | R5  | Resistor, 348 k $\Omega$ , 0603  | Yageo America             | 9C06031A3483FKHFT  |
| 2   | R1, R7  | Resistor, 500 k $\Omega$ , 0603  | Yageo America             | 9C06031A5003FKHFT  |
| 1   | R4  | Resistor, 698 k $\Omega$ , 0603  | Yageo America             | 9C06031A6983FKHFT  |
| 2   | S1, S2  | DIP Switch                       | ITT Industries, C&K Div.  | TDA02H0SK1         |
| 10  | TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10 | SMT Test Point                   | Keystone Electronics®     | 5016               |



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## WORLDWIDE SALES AND SERVICE

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