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MIC2810 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 website (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 "DSXXXXXXXXA", where "XXXXXXXX" 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 online help. Select the Help menu, and then Topics, to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the MIC2810 Evaluation Board. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Website
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the MIC2810 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"** – Important information about the MIC2810 Evaluation Board.
- **Chapter 2. "Installation and Operation"** – Includes instructions on installing and starting the Microchip Chip Manager application.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the MIC2810 Evaluation Board.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the MIC2810 Evaluation Board.

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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) { ... }`

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RECOMMENDED READING

This user's guide describes how to use the MIC2810 Evaluation Board. Another useful document is listed below. The following Microchip document is available and recommended as a supplemental reference resource:

- **MIC2810 Data Sheet – *"Digital Power Management IC 2 MHz, 600 mA, DC/DC w/Dual 300 mA/300 mA Low V_{IN} LDOs"* (DS20005910)**

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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
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- 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 website at:
http://www.microchip.com/support

DOCUMENT REVISION HISTORY

Revision A (May 2018)

- Initial release of this document

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Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MIC2810 Evaluation Board and covers the following topics:

- MIC2810 Device Short Overview
- MIC2810 Evaluation Board Overview
- MIC2810 Evaluation Board Kit Contents

1.2 MIC2810 DEVICE SHORT OVERVIEW

1.2.1 MIC2810 Key Features

The key features of the MIC2810 include:

- 2.7V to 5.5V Input Voltage Range
- 2 MHz DC/DC Converter and two LDOs
- Integrated Power-On Reset (POR)
- Adjustable POR Delay Time
- LOWQ mode
  - 30 µA Total IQ when in LOWQ Mode
- DC/DC Converter
  - 2.7V to 5.5V Input Voltage Range
  - Up to 600 mA of Output Current in PWM Mode
  - LOWQ Mode: NO RIPPLE Light Load Mode
  - 53 μV_{RMS} Output Noise in LOWQ Mode
  - 2 MHz PWM Mode Operation
  - >90% Efficiency
- LDO1
  - 1.65V to 5.5V Input Voltage Range
  - 300 mA Output Current
  - Output Voltage down to 0.8V
- LDO2
  - 2.7V to 5.5V Input Voltage Range
  - 300 mA Output Current
  - Output Voltage down to 0.8V
- Thermal Shutdown Protection
- Current Limit Protection
- Simple, Leakage-Free Interfacing to Host MPU in Applications with Backup Power
- Tiny 16-pin 3 mm x 3 mm QFN package

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1.2.2 MIC2810 Device Overview

The MIC2810 device is a high-performance power management IC, integrating a 2 MHz DC/DC switcher with two 300 mA LDOs. The MIC2810 features a LOWQ mode, reducing the total current draw while in this mode to less than 30 µA. In LOWQ mode, the output noise of the DC/DC converter is 53 μV_{RMS}, significantly lower than other converters that use a PFM light load mode that can interfere with sensitive RF circuitry.

The DC-to-DC converter uses small values of the inductor and capacitors to reduce board space, but still retains high efficiency over a wide load range, while supporting load currents up to 600 mA.

The LDOs in the MIC2810 operate with very small ceramic output capacitors for stability, therefore reducing required board space and component cost.

The MIC2810 is available in various output voltage options in the 16-pin 3 mm x 3 mm QFN package.

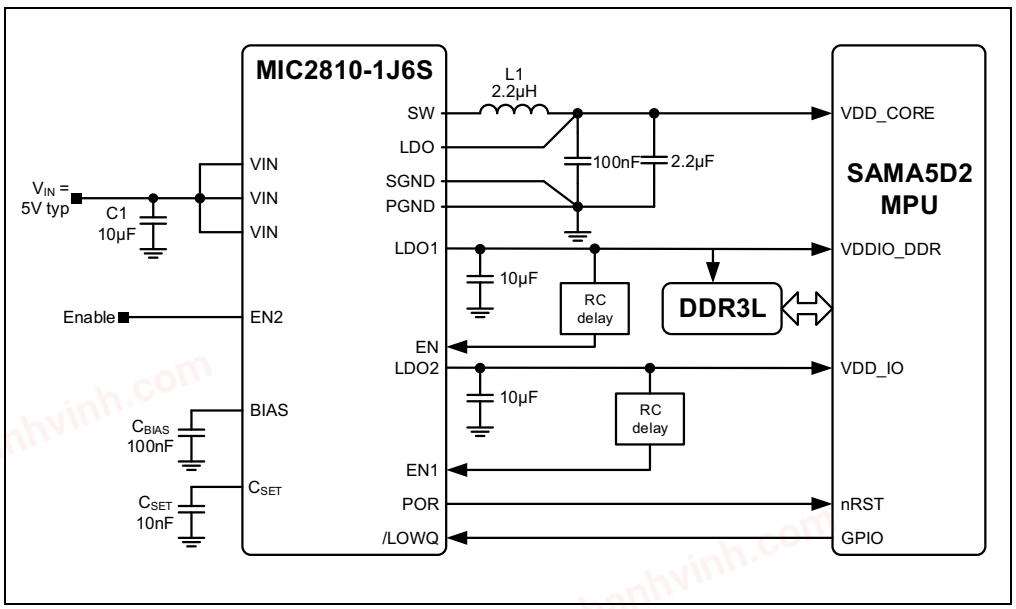


FIGURE 1-1: *MIC2810 Typical Application Circuit.*

1.3 MIC2810 EVALUATION BOARD OVERVIEW

The MIC2810 Evaluation Board has been developed to evaluate the capabilities of the MIC2810 multi-output (DC-DC and 2 x LDO) device. The board is populated with the MIC2810-1J6S device and it is set for the following voltages:

- VOUT1 (DC-DC Buck converter): 1.25V
- VOUT2 (LDO1): 1.4V
- VOUT3 (LDO2): 3.3V

Those voltages were selected to support a wide variety of MCUs with 1.25V core voltage, 1.35V (1.4 typical) DDR3L voltage and 3.3V for the I/O voltage.

The MIC2810 Evaluation Board features independent Enable connectors (EN, EN1 and EN2). To disable the regulators, a jumper must be placed on J1 (to disable the DC/DC converter), J2 (to disable LDO1) or to J3 (to disable LDO2). Since it is not recommended to leave EN pins floating, the MIC2810 Evaluation Board features 100 kΩ pull-up resistors, so the default value when the board is powered is ON.

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The MIC2810 Evaluation Board also features a LOWQ mode to switch the functionality of the DC/DC converter. When the LOWQ is logic high (>1V), the DC/DC converter works in PWM mode (normal operation mode with 600 mA output current capability). When the LOWQ is logic low (<0.2V), the DC/DC converter stops switching, the output voltage is supplied by a low noise linear regulator and the quiescent current of the device is greatly reduced. In linear (LDO) mode, the output can deliver 60 mA of current to the load.

LOWQ mode also limits the output load of both LDO1 and LDO2 to 50 mA.

To check the status of the MIC2810 outputs, Power-On Reset Output is available with a pull-up to VIN or to VOUT3 (selectable by jumper (J6)). Active low on this output indicates an under-voltage condition on either one of the three regulators.

The board can be powered from 3.6V to 5.5V. This input voltage range is determined by the 3.3V LDO2 that has a dropout voltage of maximum 300 mV over temperature. To power any of the MIC2810 devices, the minimum input voltage has to comply VOUT-LDO2 + 300mV, but no less than 2.45V.

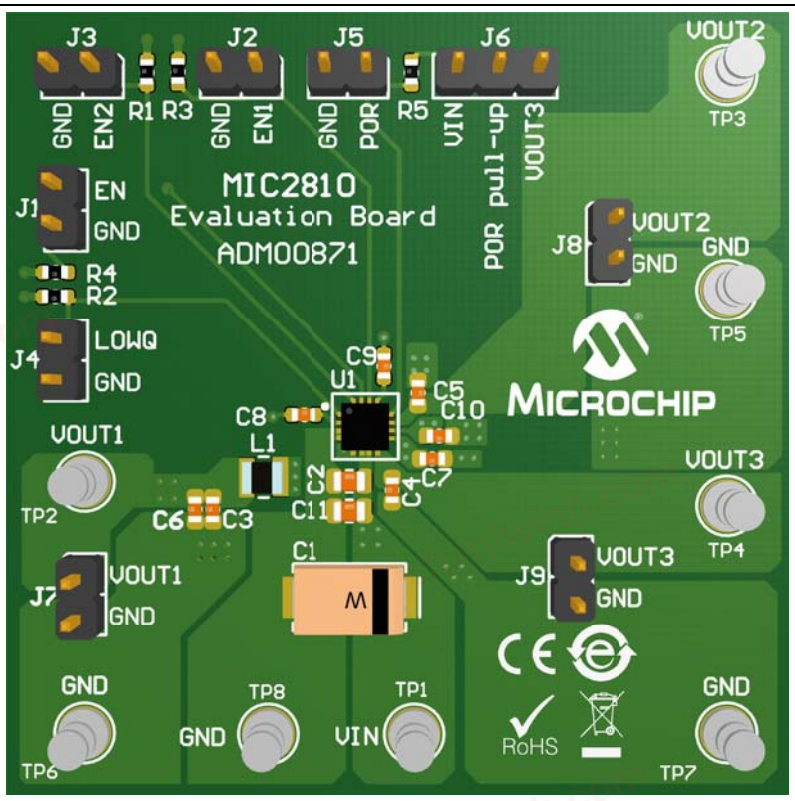


FIGURE 1-2: *MIC2810 Evaluation Board – 3D Top View.*

1.4 MIC2810 EVALUATION BOARD KIT CONTENTS

The MIC2810 Evaluation Board kit includes:

- MIC2810 DC/DC with Dual LDO PMIC Evaluation Board (ADM00871)
- Important Information Sheet

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Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MIC2810 Evaluation Board, equipped with the -1J6S version (3.3V on LDO2), can be powered from a wide voltage range, spanning from 3.6V to 5.5V, making it compatible with 5V rails and USB power.

2.2 GETTING STARTED

To power up the MIC2810 Evaluation Board, the following steps must be completed:

1. Connect an external supply between V_{IN} and GND terminals. Pay attention to the polarity.
2. With the output of the power supply disabled, set its voltage to the desired input test voltage ($3.6V \le V_{IN} \le 5.5V$). An ammeter may be placed between the input supply and the V_{IN} terminals. Be sure to monitor the supply voltage at the V_{IN} terminal, as the ammeter and/or power lead resistance can reduce the voltage supplied to the device.
3. Connect a load between either the VOUT1 and GND, VOUT2 and GND or VOUT3 and GND terminals. The load can be either passive (resistive) or active (electronic load). Some electronic loads can sink the programmed current starting from very low output voltage levels during startup. For a more realistic startup behavior evaluation, a resistive load or constant resistance is recommended. An ammeter may be placed between the load and the output terminals. Ensure the output voltage is monitored at the VOUT1, VOUT2 or VOUT3 terminals. To obtain the best output voltage regulation measurement and low noise, measure with a ground spring on the output capacitor, correspondent to the desired output.
4. The MIC2810 Evaluation Board has pull-up resistors from each EN pin to V_{IN}. By default, the output voltage will be enabled when the input supply of >2.7V is applied. To disable the device, apply a voltage of 0V to the EN terminals or place a jumper on J1, J2 or J3.
5. Power-on-Reset (POR) test point is provided to monitor the POR function (J5). The POR flag has programmable delay set by the capacitor placed on CSET pin to ground. The logic High level is determined by the placement of J6. The pull-up can be either to VIN or to VOUT3 (LDO2 output). If left floating, the POR voltage will not reflect the condition of the MIC2810.
6. It is recommended to populate C1 with a 47 µF electrolytic capacitor rated at 10V minimum if long power wires are used for V_{IN}, as the inductance associated with long wires on the board input may cause voltage spikes at load stepping or start-up into heavy load. If the spikes exceed the 6V absolute maximum input voltage rating, the MIC2810 may fail.

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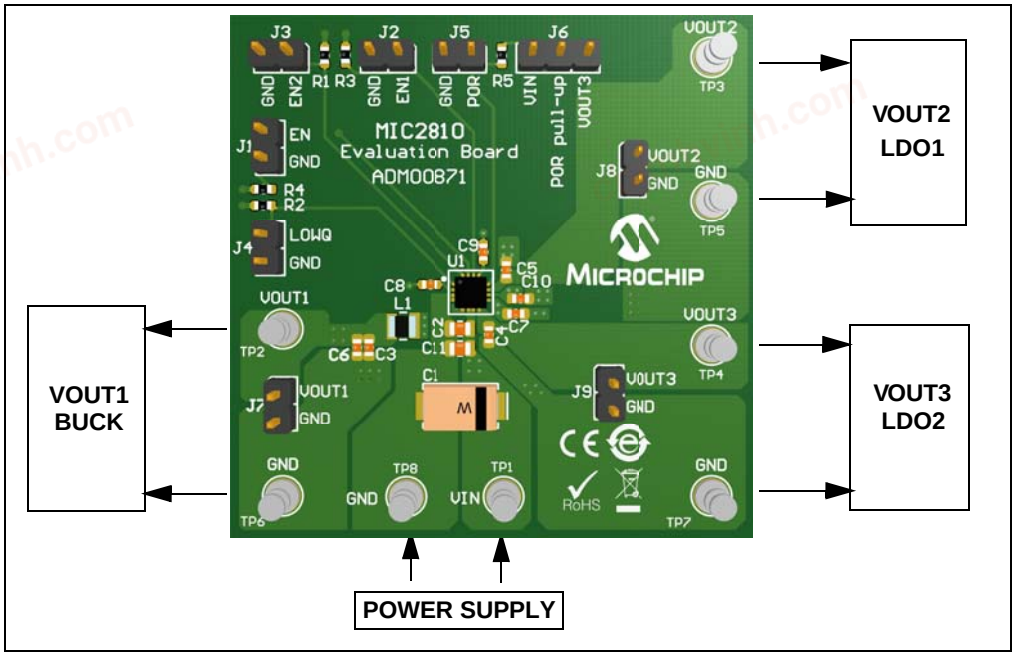


FIGURE 2-1: *MIC2810 Evaluation Board – Test Points Description.*

2.3 EVALUATION BOARD DESCRIPTION

2.3.1 Power-on Reset Pull-up Resistor

The MIC2810 Evaluation Board offers the possibility of connecting the POR pin to either V_{IN} or VOUT3 (LDO2, 3.3V) by using J6. This provides the flexibility for direct interfacing with 3.3V systems or directly to V_{IN} when the 3.3V rail is disabled.

2.3.2 Power-on Reset Capacitor (C9)

The MIC2810 has a programmable POR delay set by connecting a capacitor to the CSET pin. This pin is a current source output that charges a capacitor that sets the delay time for the POR output, from low to high. The current source of 1.25 µA charges a capacitor up from 0V. When the capacitor reaches 1.25V, the output of the POR is allowed to go high. The delay time in microseconds is equal to the C_{SET} capacitor in picofarads (Equation 2-1).

EQUATION 2-1:

$$PORDelay(\mu s) = C_{SET}(pF)$$

2.3.3 LOWQ Mode

MIC2810 is 2 MHz 600 mA DC/DC converter with two independent integrated 300 mA LDOs. This design combines good overall efficiency with low output noise. However, the DC/DC converter is always switching in PWM mode. This means that at light load, the quiescent current is higher. To solve this, the MIC2810 features a LOWQ mode. In this mode, the DC/DC converter is disabled and the output voltage is provided by a low noise linear regulator (LDO) capable of supplying 60 mA to the load while the operating current is reduces to 38 µA. In this mode, the other linear regulators (LDO1 and LDO2) will also be internally limited to 50 mA.

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2.3.4 Output Noise and Ripple Measurements

The MIC2810 Evaluation Board is populated with headers used for measuring output noise and ripple on both the DC/DC converter and the LDOs (J7, J8 and J9). Each connector is designed to probe the output signal using the local ground as reference. This is the proper way of measuring low-amplitude ripple signals because it eliminates any noise caused by long oscilloscope ground leads or ground plane noise.

2.3.5 Board Layout Considerations

It is recommended that the GND plane between the input capacitors and the GND pins of the MIC2810 is kept as short as possible and no vias should be placed. This will improve transient response and decrease noise.

It is also recommended that a copper plane and vias are placed directly under the IC to help with cooling and shielding.

For Electro Magnetic Interference (EMI) reasons, the switching note should be kept as short as possible and can be routed on the bottom of the board.

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Appendix A. Schematic and Layouts

A.1 INTRODUCTION

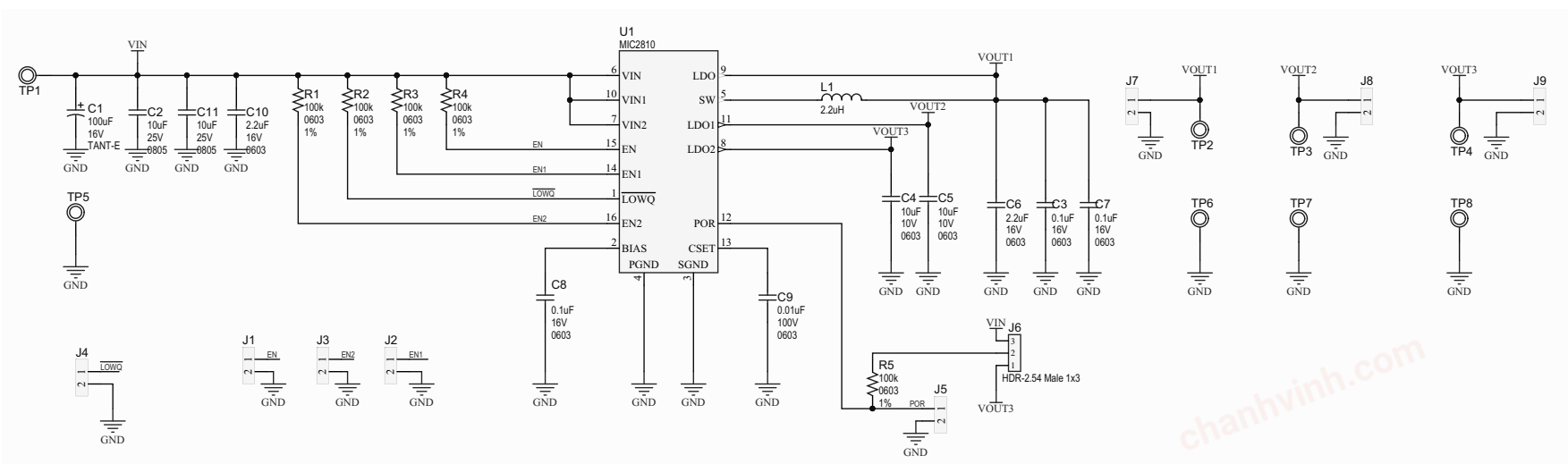
This appendix contains the following schematics and layouts for the MIC2810 Evaluation Board:

- Board – Schematic
- Board – Top Silk
- Board – Top Copper and Silk
- Board – Top Copper
- Board – Bottom Copper
- Board – Bottom Copper and Silk
- Board – Bottom Silk

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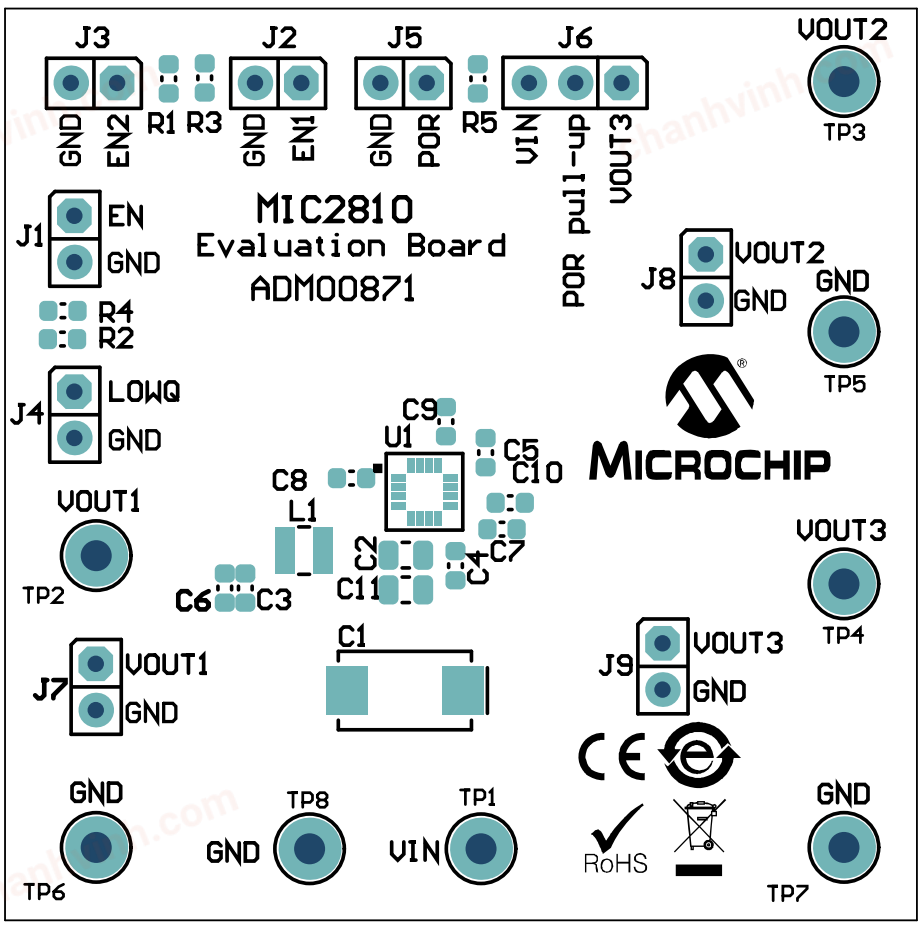
A.2 BOARD – SCHEMATIC



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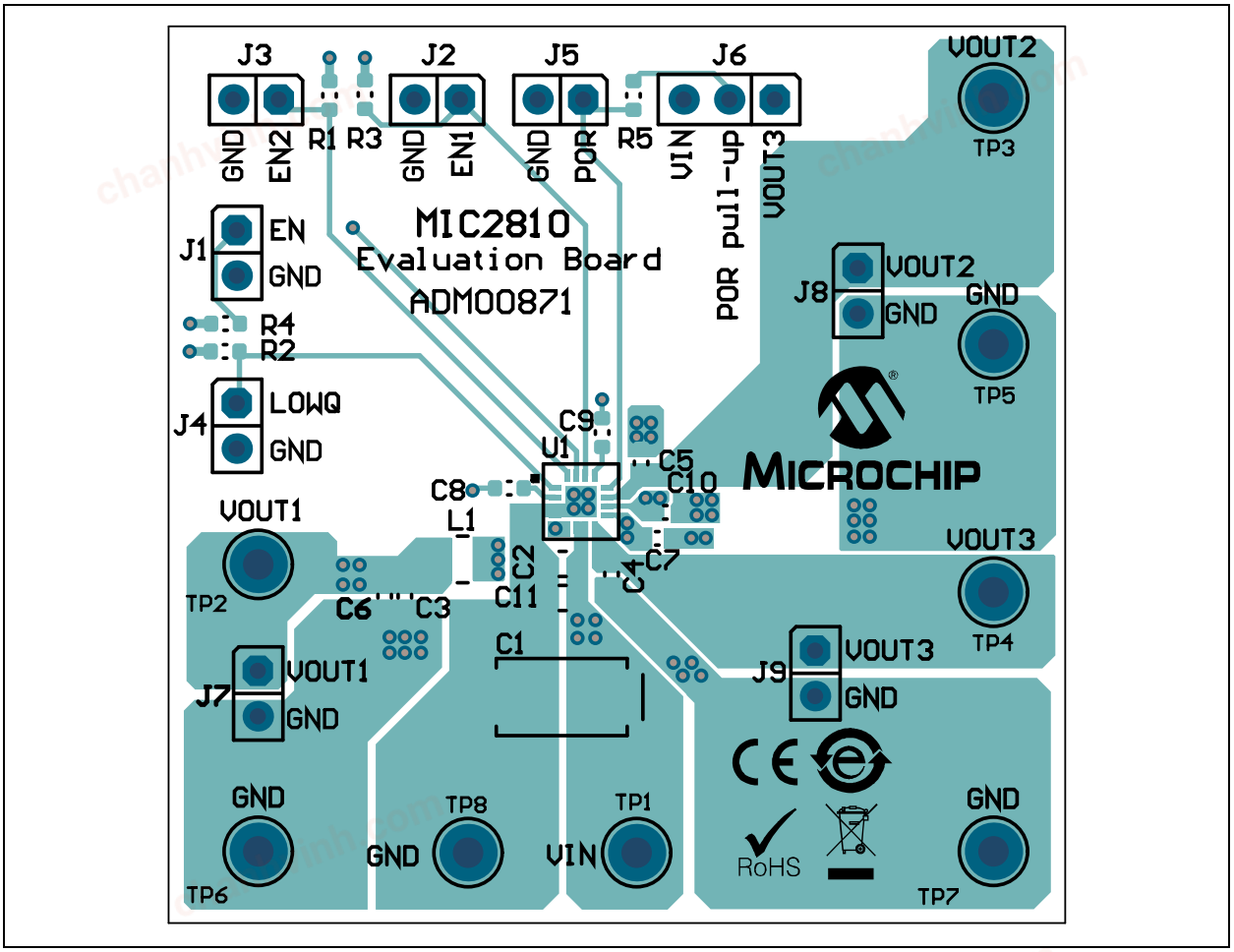
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A.3 BOARD – TOP SILK



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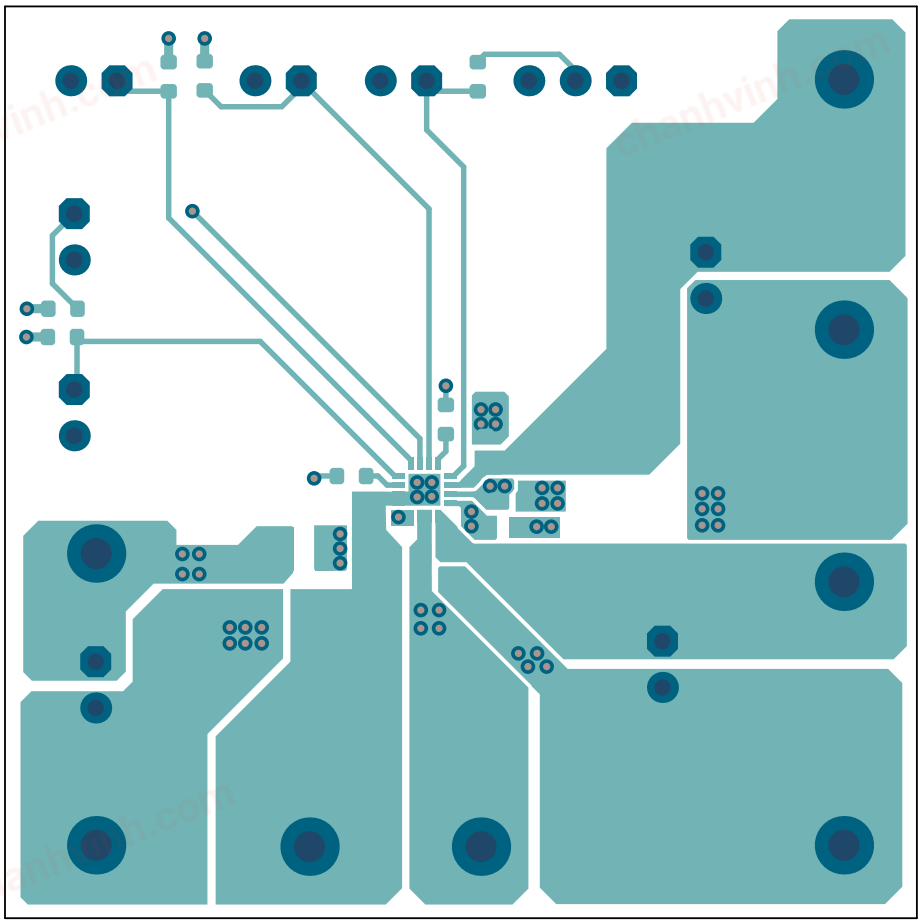
A.4 BOARD – TOP COPPER AND SILK



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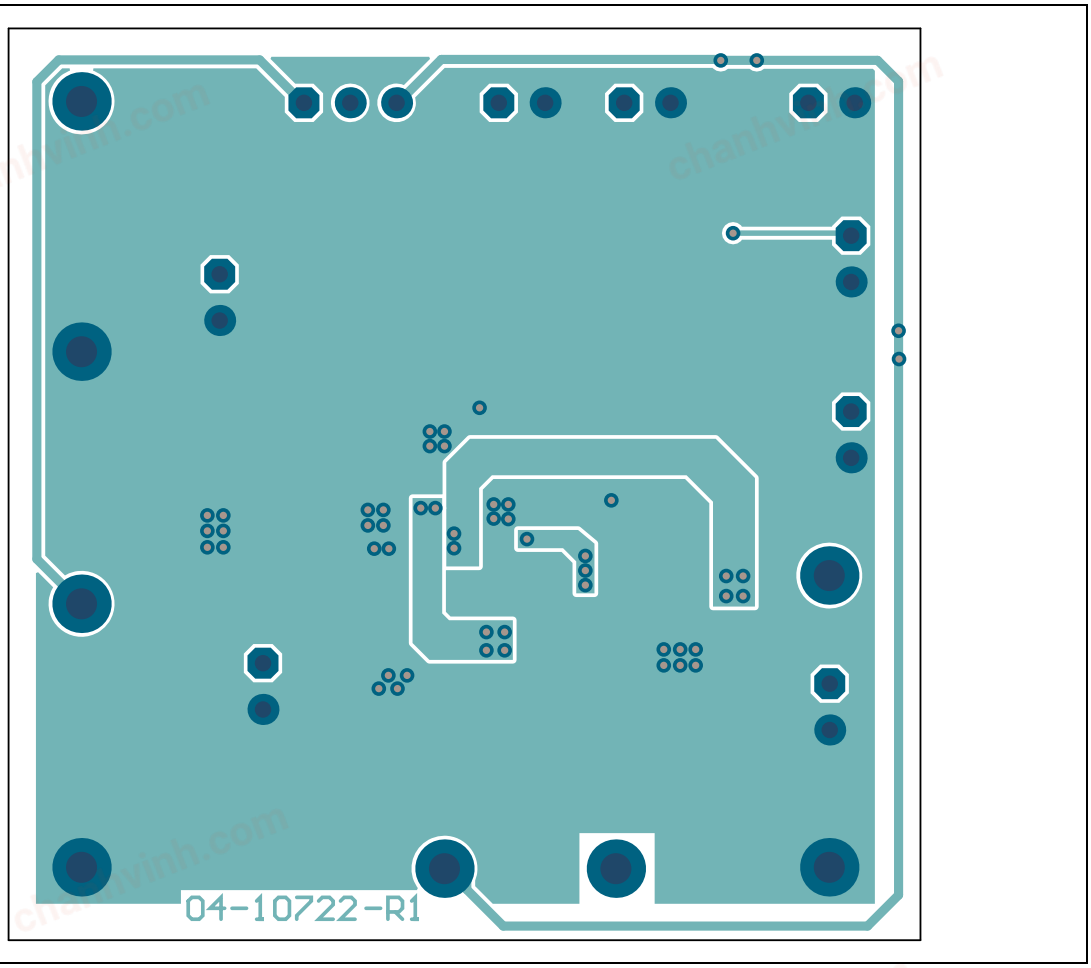
A.5 BOARD – TOP COPPER



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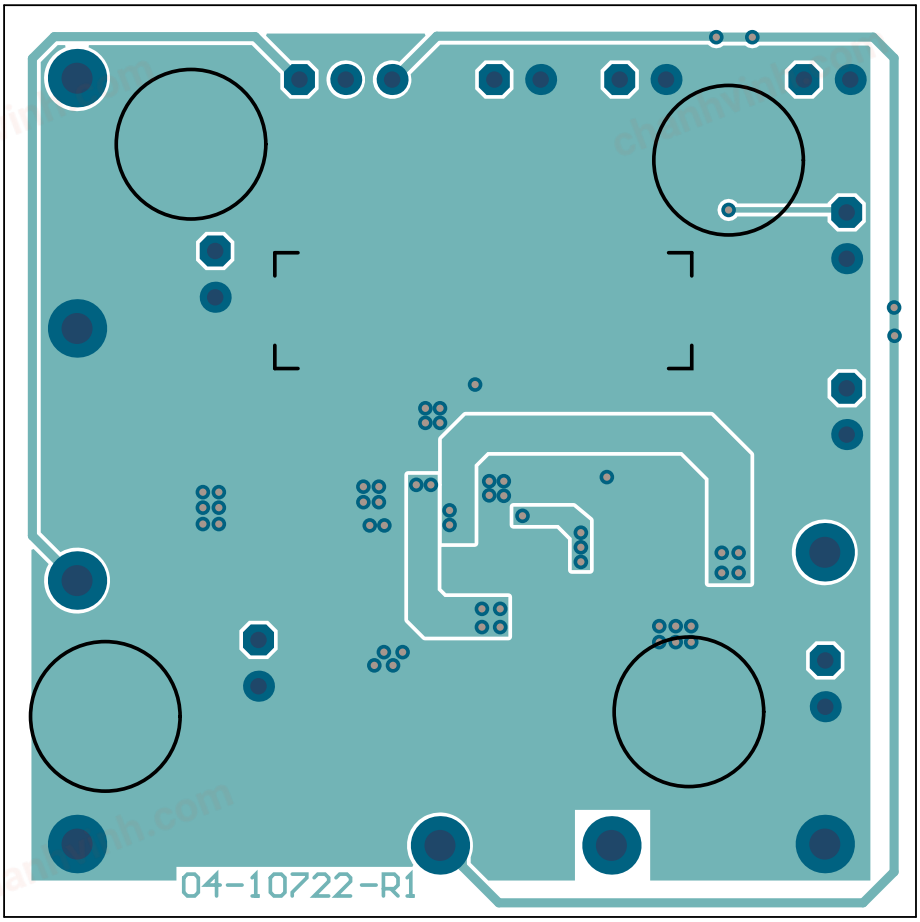
A.6 BOARD – BOTTOM COPPER



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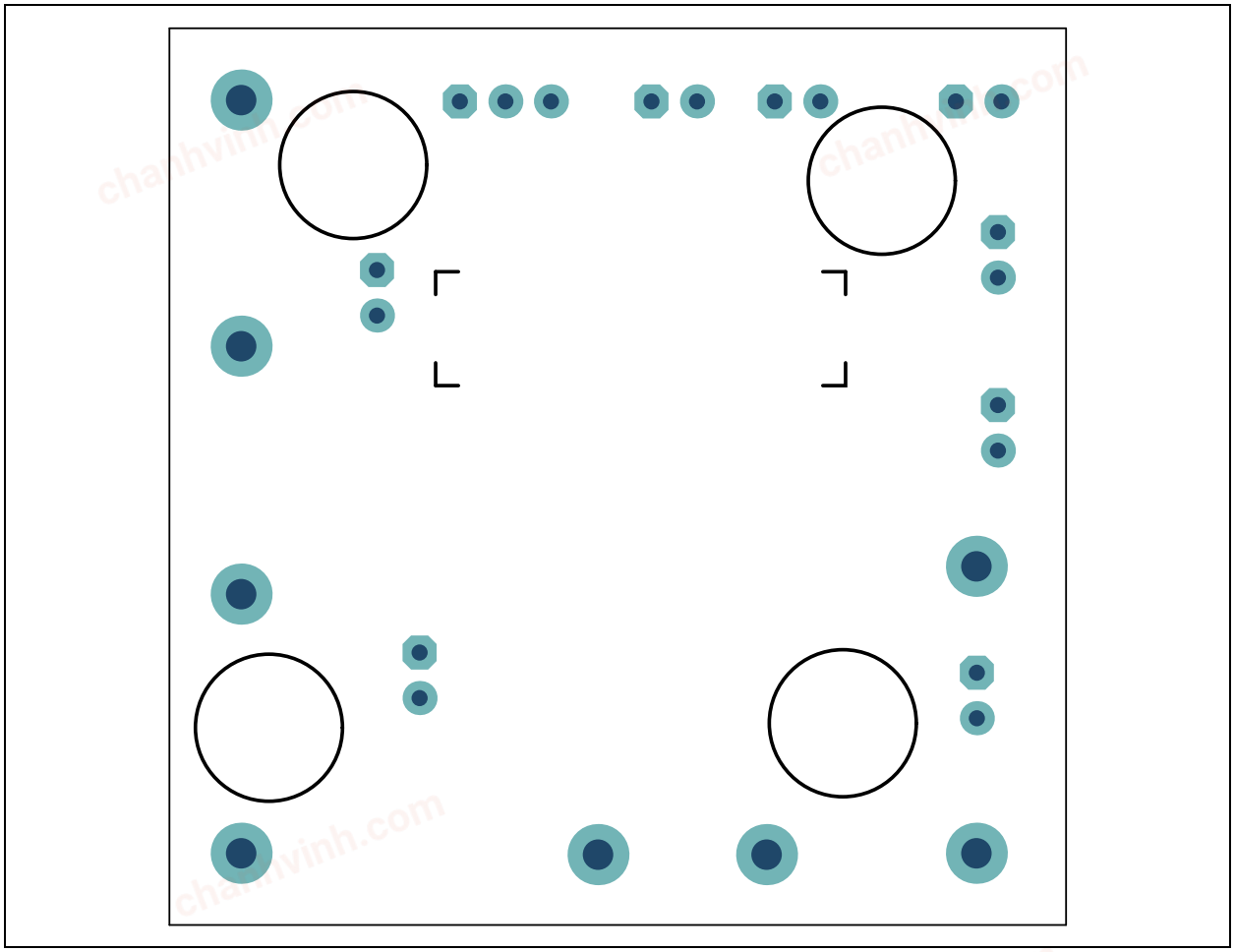
A.7 BOARD – BOTTOM COPPER AND SILK



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A.8 BOARD – BOTTOM SILK



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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 tantalum, 100 µF, 16V, 20%, 0.07Ohm, SMD, E	KEMET	T491X107M016AT
2	C2, C11	Capacitor ceramic, 10 µF, 25V, 10%, X5R, SMD, 0805	TDK Corporation	C2012X5R1E106K125AB
3	C3, C7, C8	Capacitor ceramic, 0.1 µF, 16V, 10%, X7R, SMD, 0603	Wurth Electronics Inc	885012206046
2	C4, C5	Capacitor ceramic, 10 µF, 10V, 20%, X5R, SMD, 0603	TDK Corporation	C1608X5R1A106M
2	C6, C10	Capacitor ceramic, 2.2 µF, 16V, 10%, X5R, SMD, 0603	TDK Corporation	C1608X5R1C225K
1	C9	Capacitor ceramic, 0.01 µF, 100V, 10%, X7R, SMD, 0603	TDK Corporation	C1608X7R2A103K080AA
8	J1, J2, J3, J4, J5, J7, J8, J9	Connector, HDR-2.54, male, 1x2 gold, 5.84 MH, TH, vert.	FCI	77311-118-02LF
1	J6	Connector, HDR-2.54, male, 1x3 gold, 5.84 MH, TH, vert.	FCI	68000-103HLF
1	L1	Inductor, 2.2 µH, 1.3A, 20%, SMD, 1008	TDK Corporation	MLP2520H2R2MT0S1
1	LABEL1	Label, assy. with rev. level (small modules) per MTS-0002		
4	PAD1, PAD2, PAD3, PAD4	Mechanical, HW, rubber pad cylindrical, D7.9, H5.3, black	3M	SJ61A11
1	PCB1	MIC2810 Evaluation Board – Printed Circuit Board	Microchip Technology Inc.	04-10722-R1
5	R1, R2, R3, R4, R5	Resistor, TF, 100k, 1%, 1/8W, SMD, 0603	Vishay Intertechnology, Inc.	MCT06030C1003FP500
8	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8	Connector, TP, PIN, Tin, TH	Harwin Plc.	H2121-01
1	U1	MCHP Analog switcher 1.25V/1.4V/3.3V MIC2810-1J6SYML, VFQFN-16	Microchip Technology Inc.	MIC2810-1J6SYML

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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