



MICROCHIP

MIC4606
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 MIC4606-1/2YML 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 MIC4606-1/2YML 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 MIC4606-1/2YML Evaluation Board.
- **Chapter 2. “Installation and Operation”** – Includes instructions on starting and using the MIC4606-1/2YML Evaluation Board.
- **Appendix A. “Schematic and Layouts – MIC4606-1YML”** – Shows the schematic and layout diagrams for the MIC4606-1YML Evaluation Board.
- **Appendix B. “Bill of Materials (BOM) – MIC4606-1YML-EV”** – Lists the parts used to build the MIC4606-1YML Evaluation Board.
- **Appendix C. “Schematic and Layouts – MIC4606-2YML-EV”** – Shows the schematic and layout diagrams for the MIC4606-2YML Evaluation Board.
- **Appendix D. “Bill of Materials (BOM) – MIC4606-2YML-EV”** – Lists the parts used to build the MIC4606-2YML 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	<i>MPLAB® 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 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	<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 the MIC4606-1/2YML Evaluation Board. Another useful document is listed below. The following Microchip document is available and recommended as a supplemental reference resource:

MIC4606 Data Sheet – “85V Full-Bridge MOSFET Drivers with Adaptive Dead Time and Shoot-Through Protection” (DS20005604)

THE MICROCHIP WEBSITE

Microchip provides online support via our website at www.microchip.com. This website is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the website 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
- **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

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To register, access the Microchip website at www.microchip.com, click on **Product Change Notification** and follow the registration instructions.

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- 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 website at:
<http://www.microchip.com/support>.

ORDERING INFORMATION

TABLE 1-1: ORDERING INFORMATION

Part Number	Description
MIC4606-1YML-T5	MIC4606-1YML Evaluation Board
MIC4606-2YML-T5	MIC4606-2YML Evaluation Board

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DOCUMENT REVISION HISTORY

Revision A (April 2020)

- Converted Micrel document MIC4606-2YML Evaluation Board User Guide to Microchip User's Guide template.
- Updated Gate Control on all gates with parallel OFF path utilizing serial diode and resistor.

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MIC4606-1/2YML Evaluation Board and covers the following topics:

- [MIC4606 Device Short Overview](#)
- [MIC4606-1/2YML Evaluation Board Overview](#)
- [MIC4606-1/2YML Evaluation Board Kit Contents1](#)

1.2 MIC4606 DEVICE SHORT OVERVIEW

The MIC4606 is an 85V full-bridge MOSFET driver that features adaptive dead time and shoot-through protection. The adaptive dead time circuitry actively monitors both sides of the full-bridge to minimize the time between high-side and low-side MOSFET transitions, thus maximizing power efficiency. Anti-shoot-through circuitry prevents erroneous inputs and noise from turning both MOSFETS of each side of the bridge on at the same time.

The MIC4606-1/2YML Evaluation Board also offers a wide 5.5V to 16V operating supply range to maximize system efficiency. The low 5.5V operating voltage allows longer run times in battery-powered applications. Additionally, the MIC4606's adjustable gate drive sets the gate drive voltage to VDD for optimal MOSFET $R_{DS(ON)}$, which minimizes power loss due to the MOSFET's $R_{DS(ON)}$.

1.3 MIC4606-1/2YML EVALUATION BOARD OVERVIEW

MIC4606 Device Key Features

- The adaptive dead time circuitry actively monitors both sides of the full-bridge to minimize the time between high-side and low-side MOSFET transitions, thus maximizing power efficiency. Anti-shoot-through circuitry prevents erroneous inputs and noise from turning both MOSFETS of each side of the bridge on at the same time.
- The MIC4606 also offers a wide 5.5V to 16V operating supply range to maximize system efficiency. The low 5.5V operating voltage allows longer run times in battery-powered applications.
- Additionally, the MIC4606's adjustable gate drive sets the gate drive voltage to VDD for optimal MOSFET $R_{DS(ON)}$, which minimizes power loss due to the MOSFET's $R_{DS(ON)}$.

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1.4 MIC4606-1/2YML EVALUATION BOARD KIT CONTENTS¹

The MIC4606-1/2YML Evaluation Board kit includes one the following boards:

- MIC4606-1YML Evaluation Board OR
- MIC4606-2YML Evaluation Board, and
- Important Information Sheet

Note 1: Contents will differ depending on the evaluation board purchased. The MIC4606-1/2YML Evaluation Board is available for purchase from www.microchipdirect.com.

Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MIC4606-1/2 YML Evaluation Board requires a 5.5V to 16V power supply to power the V_{DD} terminal (J1) of the MIC4606. Another supply (up to 72V) may be used to power the MOSFETs connected to the VIN terminal (J2). A pulse generator or the output of a PWM control IC may be connected to the HI and LI terminals (MIC4606-1), or PWM single input (MIC4606-2).

2.2 BOARD RATINGS

TABLE 2-1: BOARD RATINGS-PARAMETERS AND VALUES

Parameter	Value
Gate Driver Supply Voltage (V_{VDD})	5.5-16V
Board Supply Voltage (V_{VIN})	0-72V

2.3 PRECAUTIONS

Note: There is no reverse input protection on this board. When connecting the input sources, ensure that the correct polarity is observed.

Under extreme load conditions and with a high supply voltage (>48V) connected to the VIN terminal (VBUS), input transients can be quite large if long test leads are used. In such cases a 100 μ F, 100V electrolytic capacitor C4 is needed across the VIN terminals to prevent overvoltage damage to the IC. This can be removed if a clean supply voltage on VIN is always guaranteed.

2.4 GETTING STARTED

The MIC4606-1/2 YML Evaluation Board is fully assembled and tested to evaluate and demonstrate the MIC4606 85V full-bridge MOSFET driver with dead time and shoot-through protection mode.

In order to evaluate the capabilities of the MIC4606, the following five steps are required.

Note: Do not apply power until Step 5.

- 1. Connect VIN supply between the VIN and GND terminals and VDD supply between the VDD and GND terminals.**

Connect a supply between the VIN terminal (VBUS) and the GND terminal (J9), paying careful attention to polarity and supply range ($VIN \leq 72V$). Then connect a supply between the VDD terminal and the GND terminal, paying careful attention to polarity and supply range ($5.5V \leq VDD < 16V$).

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2. **Connect the TTL-compatible HI and LI inputs (MIC4606-1YML), or the PWM single input (MIC4606-2YML).**

Connect the xHI inputs (J12) and xLI inputs (J12) to a pulse generator or the output of a PWM control IC. Ensure that they are non-overlapping signals and are TTL-compatible logic-levels.

Note: The xPWM single inputs replace the xHI inputs for the MIC4606-2YML option.

3. **Monitor inputs and outputs.**

Monitor the inputs xHI and xLI or xPWM and outputs xHO and xLO with an oscilloscope.

4. **Connect motor across xHS or connect xHS to GND.**

The simplest way to observe the MIC4606 operation is to connect a motor across the xHS terminals (M1), or across either M1 terminals to GND.

5. **Turn on supplies and HI/LI inputs.**

Turn on the VDD followed by VIN. Turn on the xHI and xLI inputs (MIC4606-1YML) or PWM single inputs (MIC4606-2YML).

Note: "x" denotes Channel A or B

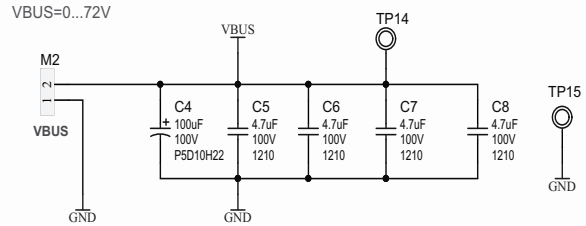
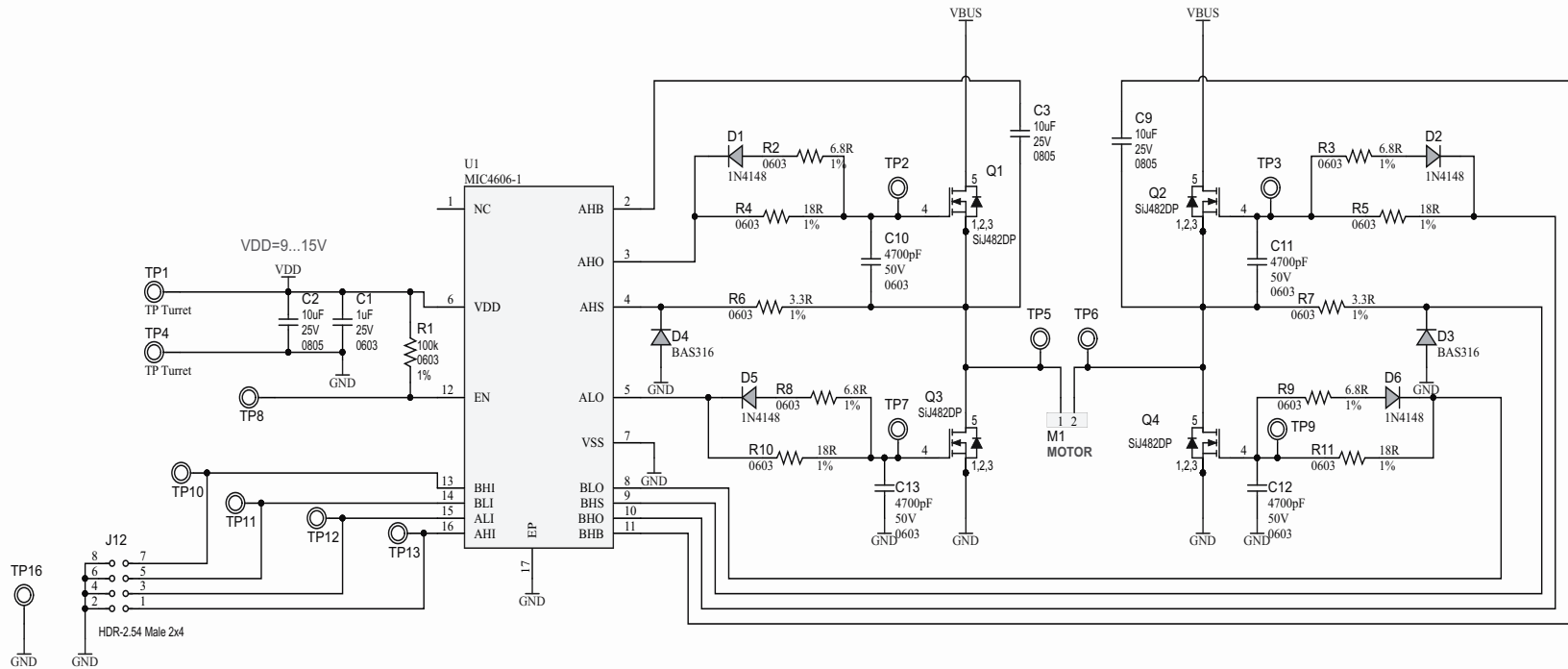
Appendix A. Schematic and Layouts – MIC4606-1YML-EV

A.1 INTRODUCTION

This appendix contains the following schematic and layouts for the MIC4606-1YML Evaluation Board:

- [MIC4606-1YML-EV Board – Schematic](#)
- [MIC4606-1YML-EV Board – Top Silk](#)
- [MIC4606-1YML-EV Board – Top Copper and Silk](#)
- [MIC4606-1YML-EV Board – Top Copper](#)
- [MIC4606-1YML-EV Board – Bottom Copper](#)
- [MIC4606-1YML-EV Board – Bottom Copper and Silk](#)
- [MIC4606-1YML-EV Board – Bottom Silk](#)

A.2 MIC4606-1YML-EV BOARD – SCHEMATIC



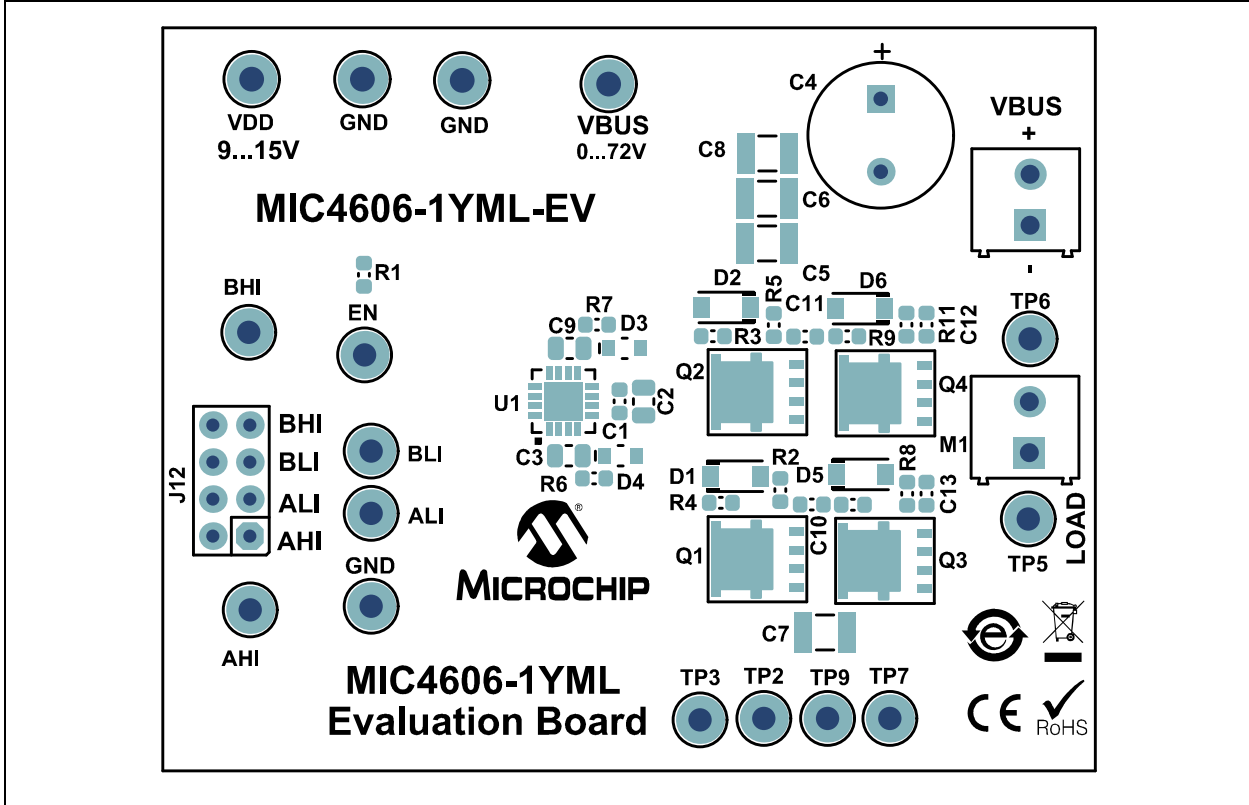
LABEL1
02- -R1
JIT

LABEL Need Help Small

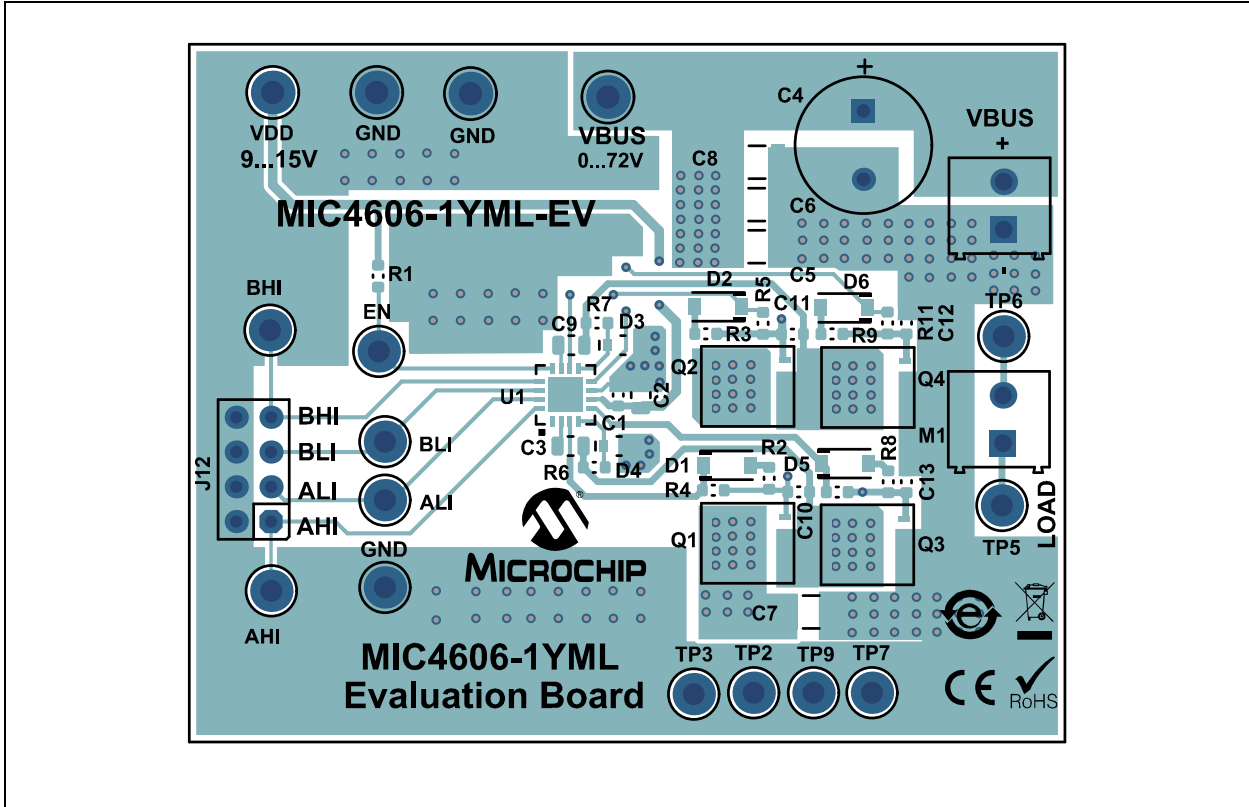
- PAD1**
Rubber Pad Cyl D7.9H5.3
- PAD2**
Rubber Pad Cyl D7.9H5.3
- PAD3**
Rubber Pad Cyl D7.9H5.3
- PAD4**
Rubber Pad Cyl D7.9H5.3

Schematic and Layouts – MIC4606-1YML-EV

A.3 MIC4606-1YML-EV BOARD – TOP SILK

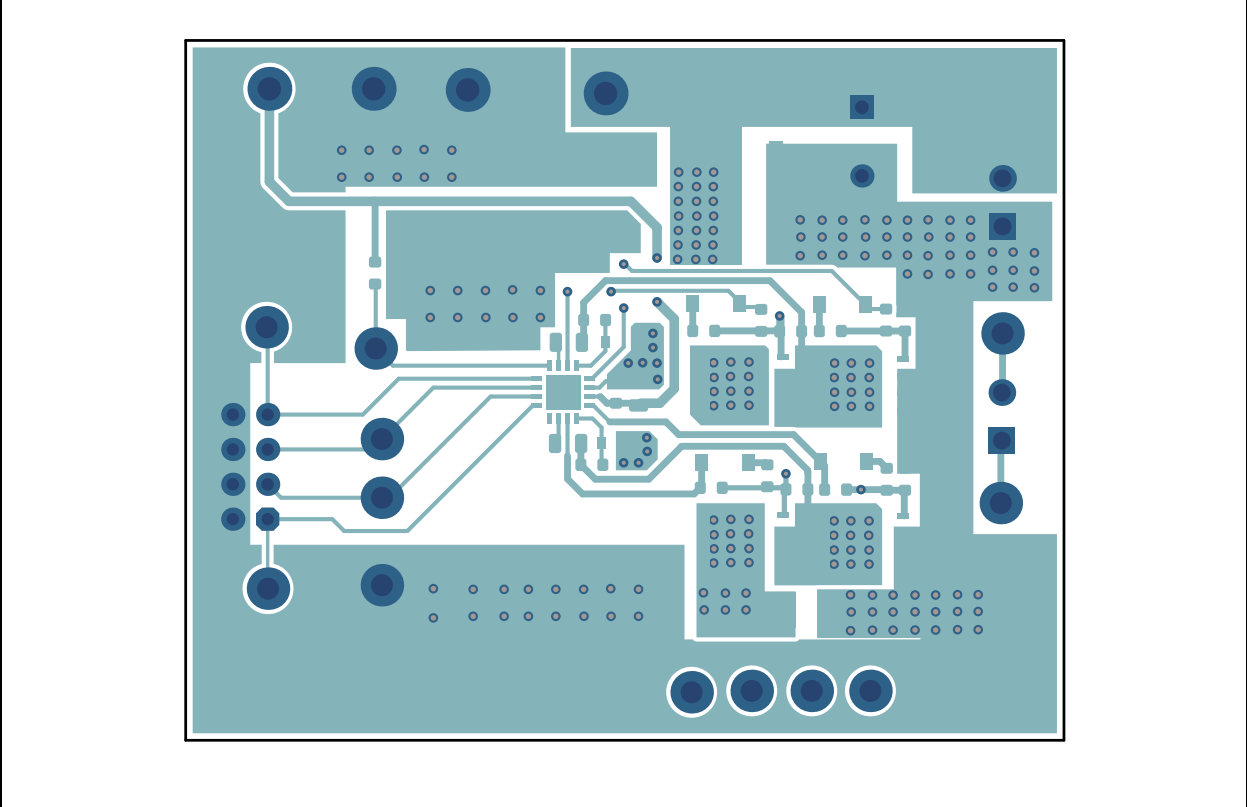


A.4 MIC4606-1YML-EV BOARD – TOP COPPER AND SILK

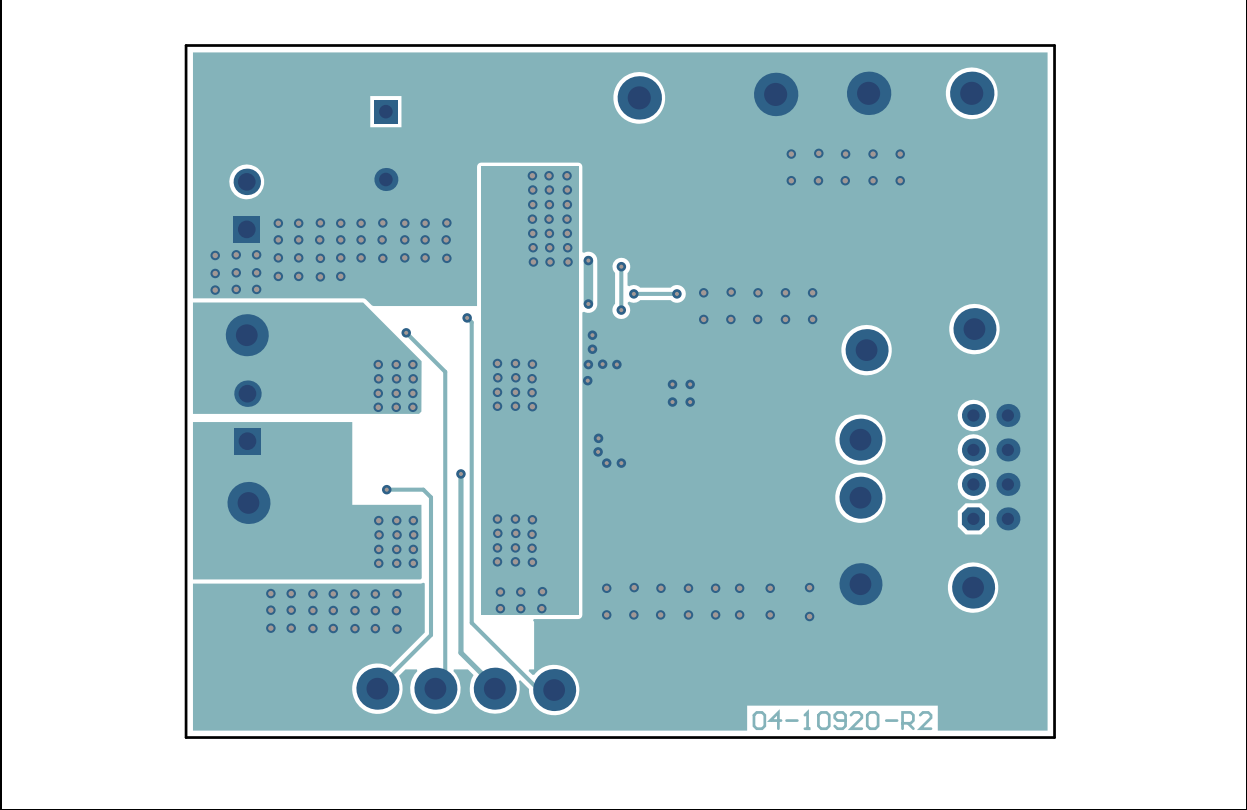


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A.5 MIC4606-1YML-EV BOARD – TOP COPPER

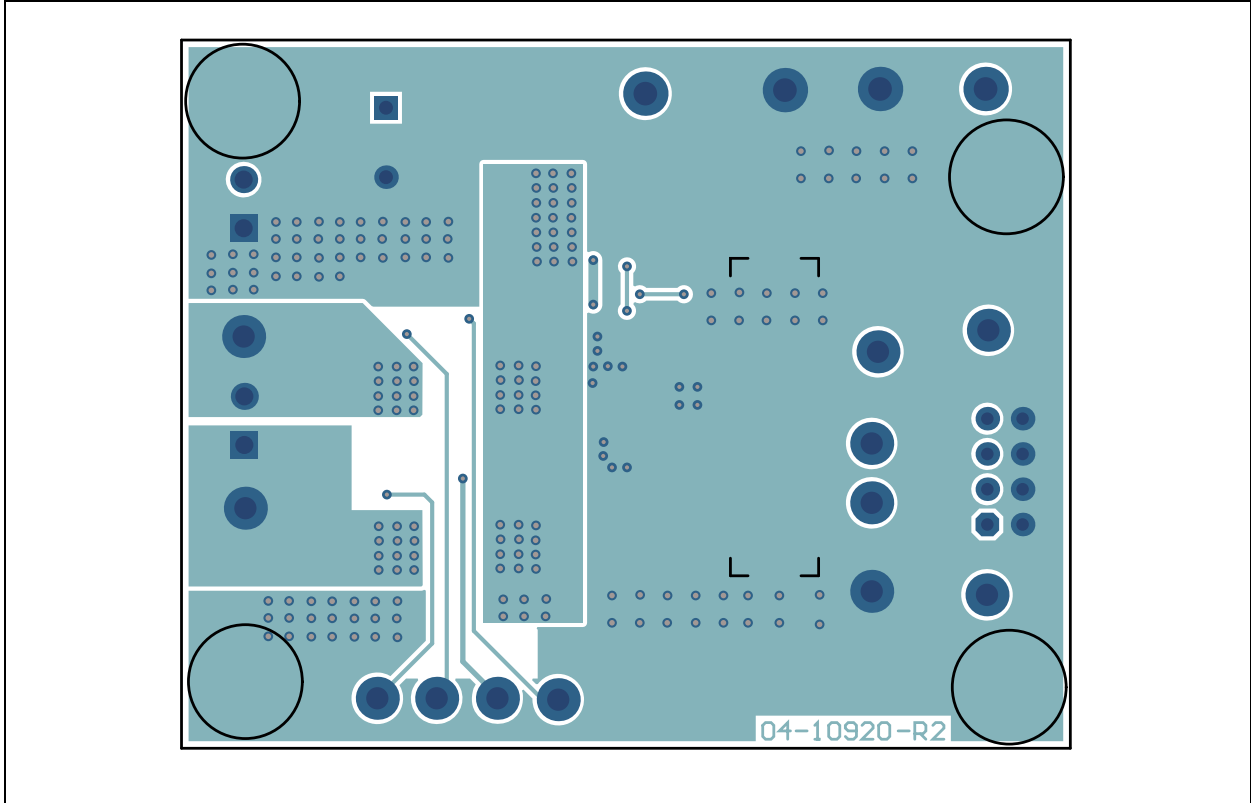


A.6 MIC4606-1YML-EV BOARD – BOTTOM COPPER

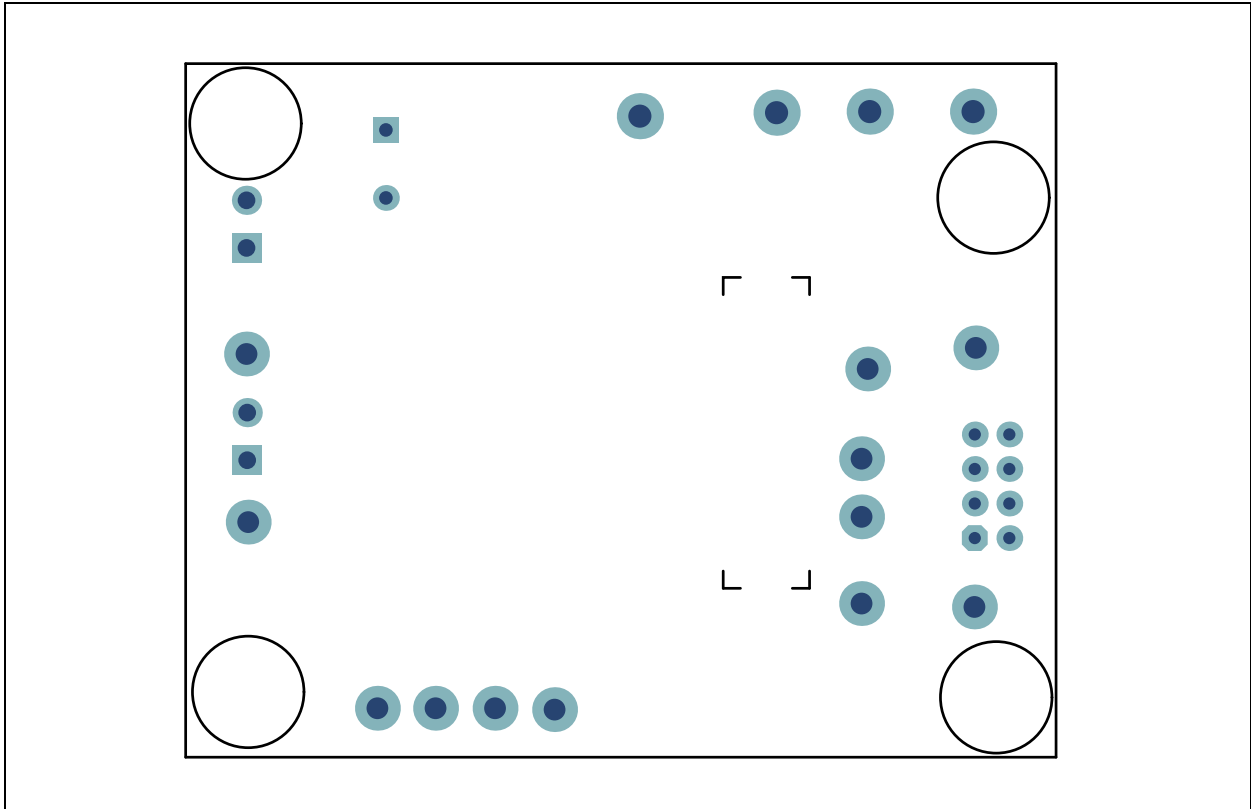


Schematic and Layouts – MIC4606-1YML-EV

A.7 MIC4606-1YML-EV BOARD – BOTTOM COPPER AND SILK



A.8 MIC4606-1YML-EV BOARD – BOTTOM SILK



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NOTES:

Appendix B. Bill of Materials (BOM) – MIC4606-1YML-EV

TABLE B-1: BILL OF MATERIALS (BOM) – MIC4606-1YML-EV EVALUATION BOARD

Qty.	Reference	Description	Manufacturer	Part Number
1	C1	Capacitor, ceramic, 1 μ F, 25V, 20%, X5R, SMD, 0603	Panasonic®	ECJ-1V41E105M
3	C2,C3,C9	Capacitor, ceramic, 10 μ F, 25V, 20%, X5R, SMD, 0805	TDK Corporation	C2012X5R1E106M085AC
1	C4	Capacitor, aluminum, 100 μ F, 100V, 20%, RAD, P5.0D10L22	TDK EPCOS	B41851A9107M000
4	C5, C6, C7, C8	Capacitor, ceramic, 4.7 μ F, 100V, 10%, X7S, SMD, 1210 AEC-Q200	Taiyo Yuden Co., Ltd.	HMK325C7475KMHPE
4	C10, C11, C12, C13	Capacitor, ceramic, 4700 pF, 50V, 10%, X7R, SMD, 0603	KEMET	C0603C472K5RACTU
4	D1, D2, D5, D6	Diode, Rectifier, 1N4148, 1.25V, 150 mA, 100V, SOD-123	MCC	1N4148W-TP
2	D3, D4	Diode, Rectifier, BAS316, 1.25V, 250 mA, 100V, SOD-323	NXP Semiconductors	BAS316115
1	J12	Connector, Header, 2.54 Male, 2x4, Gold, 5.84 MH, TH, Vertical	Würth Electronics	61300821121
1	M1, M2	Connector, Terminal, 3.5 mm, 1x2, Female, 16-24 AWG, 10A, TH, R/A	Würth Electronics	691214110002
4	PAD1, PAD2, PAD3, PAD4	Mech. HW rubber pad cylindrical. D7.9 H5.3 black	3M	70006431483
4	Q1, Q2, Q3, Q4	Transistor, FET, N-Channel, 80V, 60A, PowerPAK, SO-8L	Vishay®	SIJ482DP-T1-GE3
1	R1	Resistor, TF, 100 kW 1%, 1/8W, SMD, 0603	Vishay Beyschlag	MCT06030C1003FP500
4	R2, R3, R8, R9	Resistor, TKF, 6.8W, 1% 1/10W, SMD, 0603	Yageo Corporation	RC0603FR-076R8L

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.

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TABLE B-1: BILL OF MATERIALS (BOM) – MIC4606-1YML-EV EVALUATION BOARD
(CONTINUED)

Qty.	Reference	Description	Manufacturer	Part Number
4	TP1, TP4, TP14, TP15	Connector, TP, Pin, Tin, TH	Harwin	H2121-01
12	TP2, TP3, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP16	Connector, TP, Loop, Red, TH	Keystone Electronics Corp.	5010
1	U1	MCHP ANALOG FET DRIVER Full Bridge MIC4606-1YML-T5 QFN-16	Microchip Technology Inc.	MIC4606-1YML-T5

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.

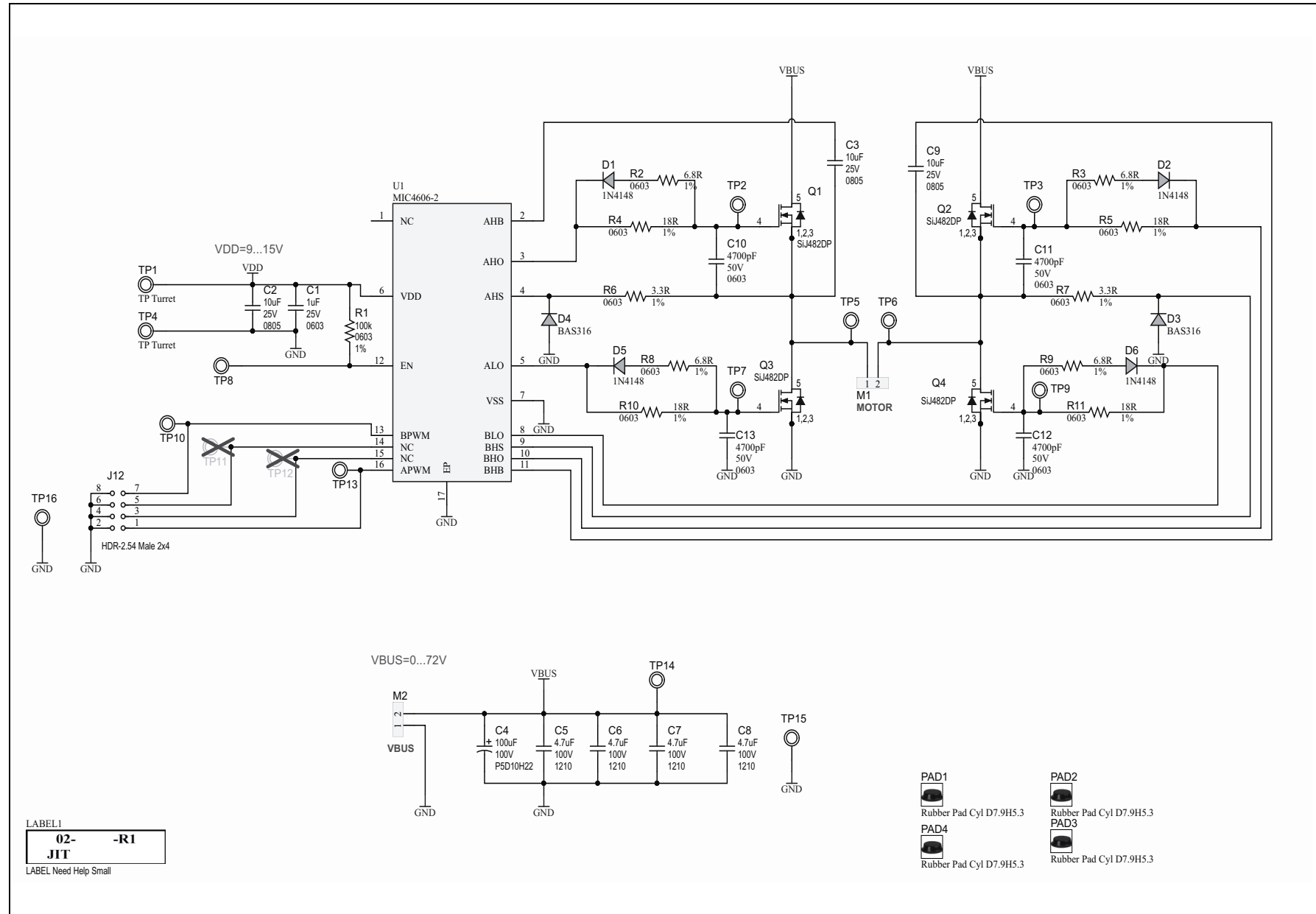
Appendix C. Schematic and Layouts – MIC4606-2YML-EV

C.1 INTRODUCTION

This appendix contains the following schematic and layouts for the MIC4606-2YML Evaluation Board:

- [MIC4606-2YML-EV Board – Schematic](#)
- [MIC4606-2YML-EV Board – Top Silk](#)
- [MIC4606-2YML-EV Board – Top Copper and Silk](#)
- [MIC4606-2YML-EV Board – Top Copper](#)
- [MIC4606-2YML-EV Board – Bottom Copper](#)
- [MIC4606-2YML-EV Board – Bottom Copper and Silk](#)
- [MIC4606-2YML-EV Board – Bottom Silk](#)

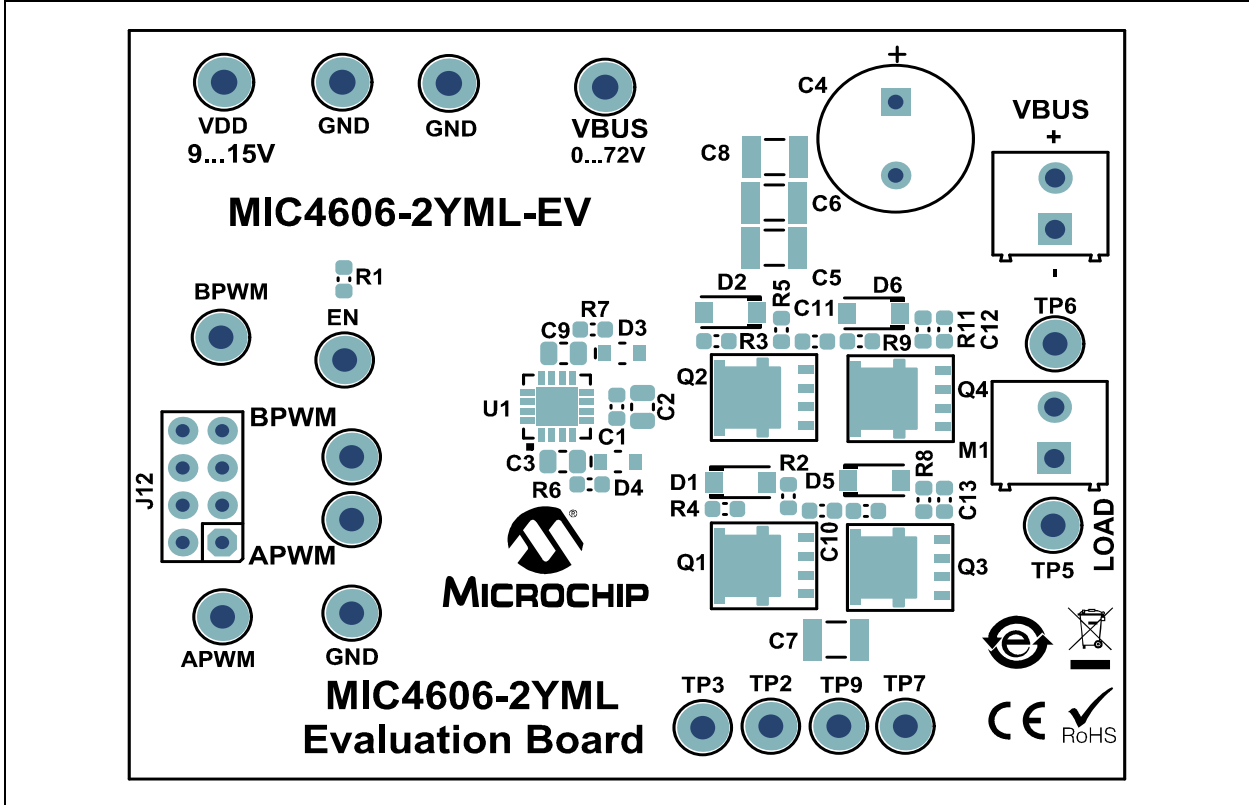
C.2 MIC4606-2YML-EV BOARD – SCHEMATIC



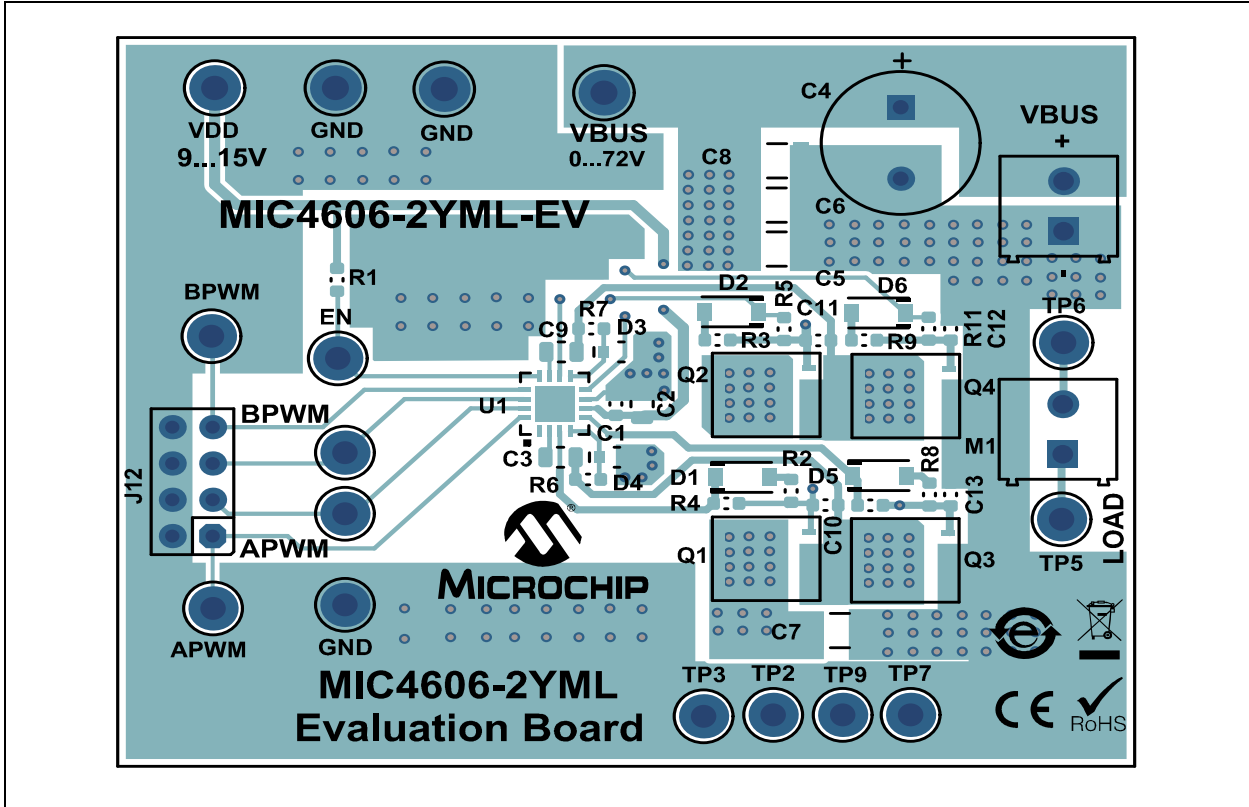
LABEL1
02- -R1
JIT
 LABEL Need Help Small

Schematic and Layouts – MIC4606-2YML-EV

C.3 MIC4606-2YML-EV BOARD – TOP SILK

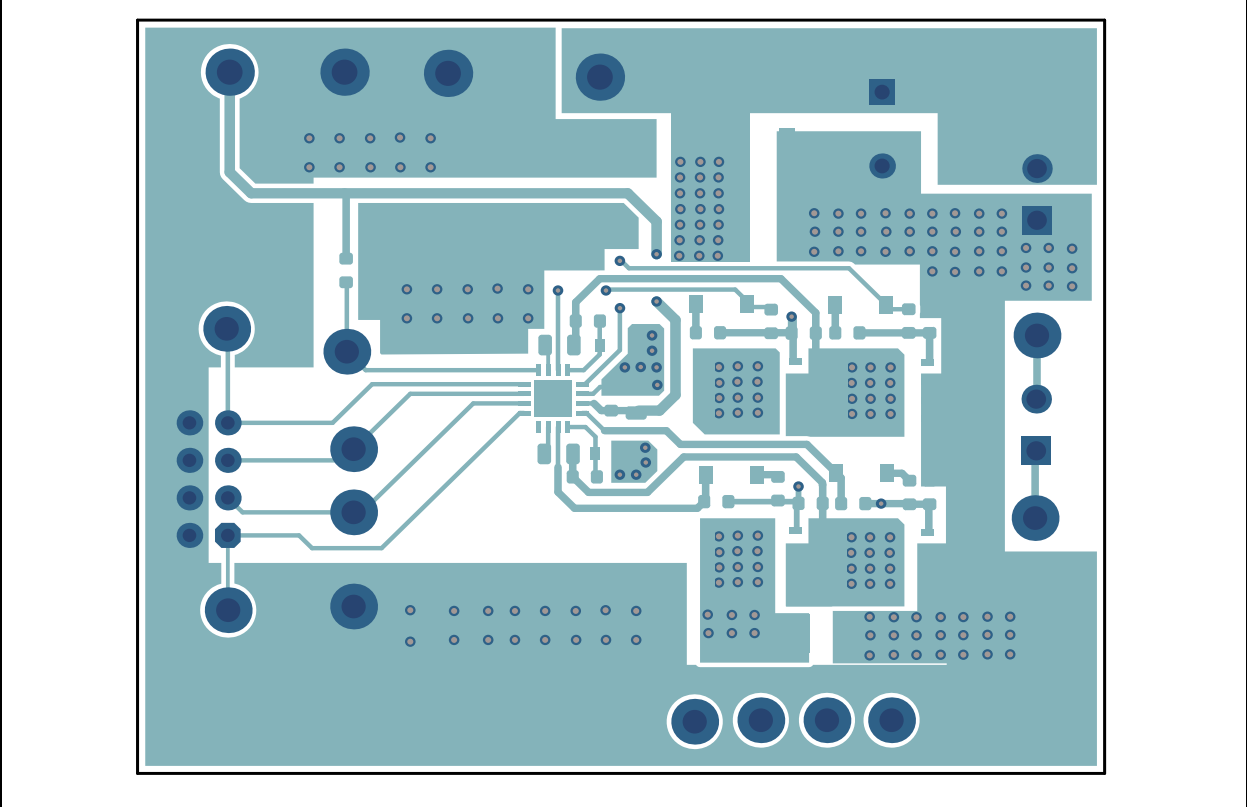


C.4 MIC4606-2YML-EV BOARD – TOP COPPER AND SILK

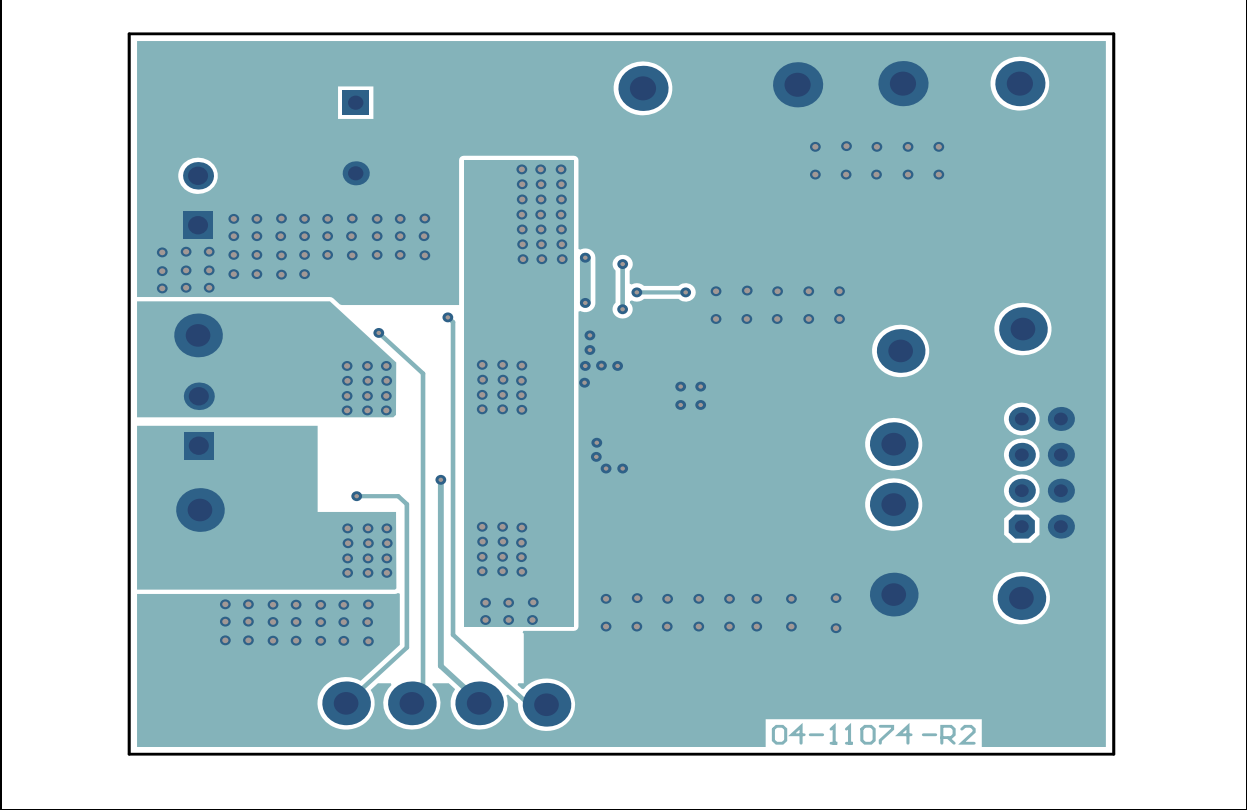


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C.5 MIC4606-2YML-EV BOARD – TOP COPPER

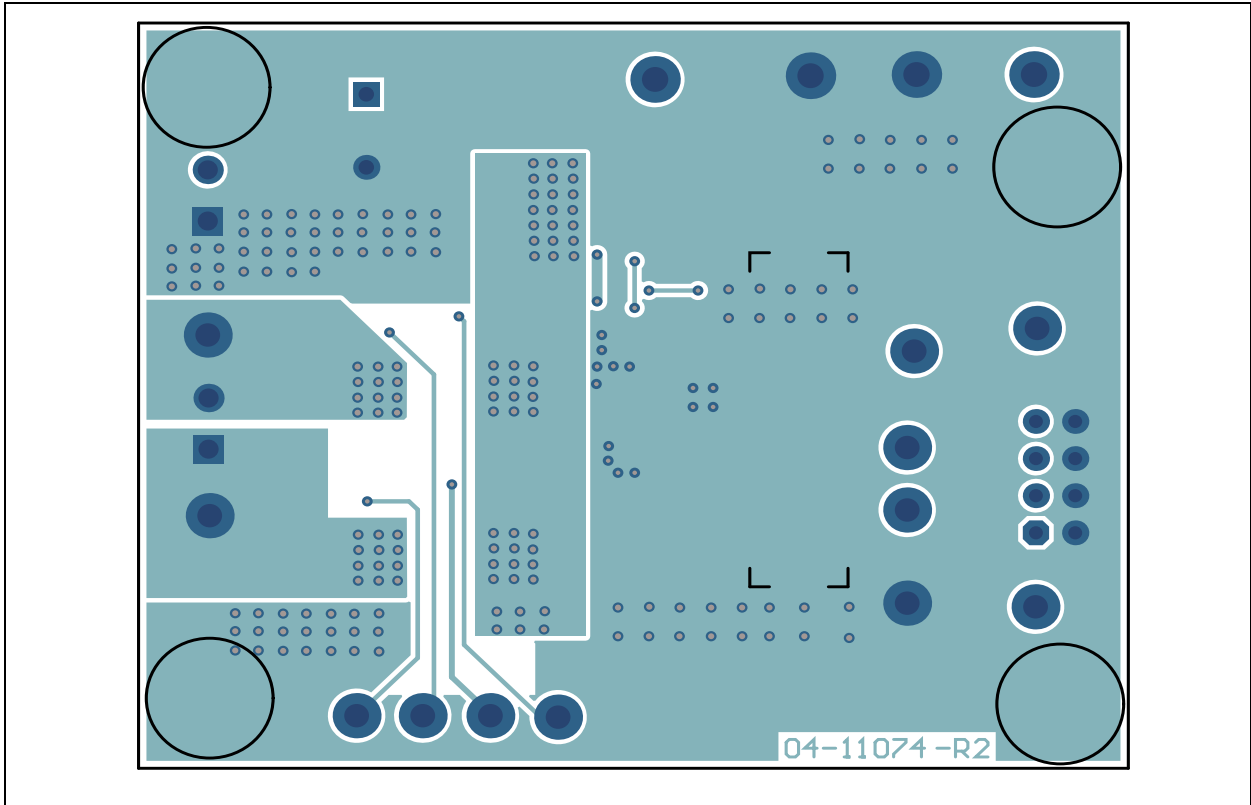


C.6 MIC4606-2YML-EV BOARD – BOTTOM COPPER

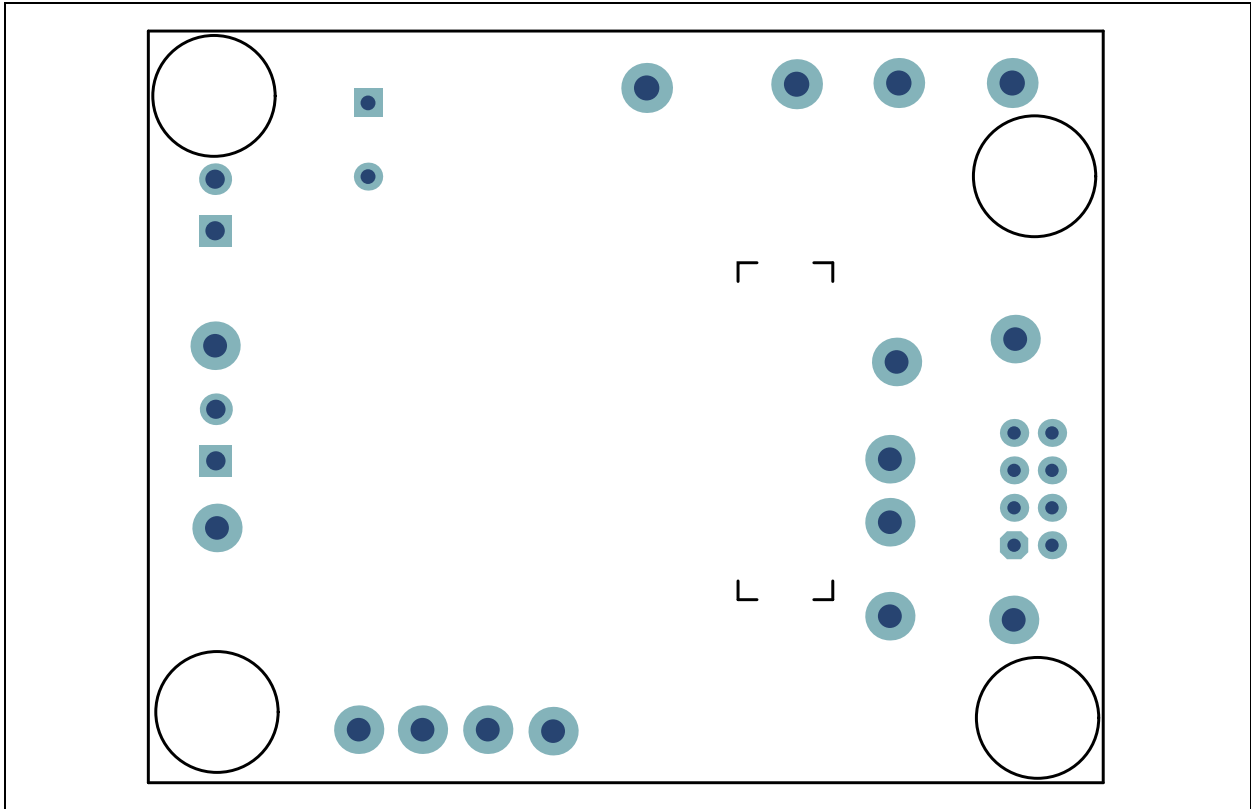


Schematic and Layouts – MIC4606-2YML-EV

C.7 MIC4606-2YML-EV BOARD – BOTTOM COPPER AND SILK



C.8 MIC4606-2YML-EV BOARD – BOTTOM SILK



MIC4606 Evaluation Board User's Guide

NOTES:

Appendix D. Bill of Materials (BOM) – MIC4606-2YML-EV

TABLE D-1: BILL OF MATERIALS (BOM) – MIC4606-2YML-EV EVALUATION BOARD

Qty.	Reference	Description	Manufacturer	Part Number
1	C1	Capacitor, ceramic, 1 μ F, 25V, 20%, X5R, SMD, 0603	Panasonic®	ECJ-1V41E105M
3	C2,C3,C9	Capacitor, ceramic, 10 μ F, 25V, 20%, X5R, SMD, 0805	TDK Corporation	C2012X5R1E106M085AC
1	C4	Capacitor, aluminum, 100 μ F, 100V, 20%, RAD, P5.0D10L22	TDK EPCOS	B41851A9107M000
4	C5, C6, C7, C8	Capacitor, ceramic, 4.7 μ F, 100V, 10%, X7S, SMD, 1210 AEC-Q200	Taiyo Yuden Co., Ltd.	HMK325C7475KMHPE
4	C10, C11, C12, C13	Capacitor, ceramic, 4700 pF, 50V, 10%, X7R, SMD, 0603	KEMET	C0603C472K5RACTU
4	D1, D2, D5, D6	Diode, Rectifier, 1N4148, 1.25V, 150 mA, 100V, SOD-123	MCC	1N4148W-TP
2	D3, D4	Diode, Rectifier, BAS316, 1.25V, 250 mA, 100V, SOD-323	NXP Semiconductors	BAS316115
1	J12	Connector, Header, 2.54 Male, 2x4, Gold, 5.84 MH, TH, Vertical	Würth Electronics	61300821121
1	M1, M2	Connector, Terminal, 3.5 mm, 1x2, Female, 16-24 AWG, 10A, TH, R/A	Würth Electronics	691214110002
4	PAD1, PAD2, PAD3, PAD4	Mech. HW rubber pad cylindrical. D7.9, H5.3, black	3M	70006431483
4	Q1, Q2, Q3, Q4	Transistor, FET, N-Channel, 80V, 60A	Vishay®	SIJ482DP-T1-GE3
1	R1	Resistor, TF, 100 kW 1%, 1/8W, SMD, 0603	Vishay Beyschlag	MCT06030C1003FP500
4	R2, R3, R8, R9	Resistor, TKF, 6.8W, 1% 1/10W, SMD, 0603	Yageo Corporation	RC0603FR-076R8L
2	R6, R7	Resistor, TKF, 3.3W, 1%, 1/10W, SMD, 0603	Panasonic	ERJ-3RQF3R3V
4	TP1, TP4, TP14, TP15	Connector, TP, Pin, Tin, TH	Harwin	H2121-01

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.

MIC4606 Evaluation Board User's Guide

TABLE D-1: BILL OF MATERIALS (BOM) – MIC4606-2YML-EV EVALUATION BOARD
(CONTINUED)

Qty.	Reference	Description	Manufacturer	Part Number
10	TP2, TP3, TP5, TP6, TP7, TP8, TP9, TP10, TP13, TP16	Connector, TP, Loop, Red, TH	Keystone Electronics Corp.	5010
0	TP11, TP12	Connector, TP, Loop, Red, TH DO NOT POPULATE	Keystone Electronics Corp.	5010
1	U1	MCHP ANALOG FET DRIVER Full Bridge MIC4606-2YML-T5 QFN-16	Microchip Technology Inc.	MIC4606-2YML-T5

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.



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