MIC2132 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 MIC2132 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 MIC2132 Evaluation Board as a development. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MIC2132 Evaluation Board.
- **Chapter 2. "Installation and Operation"** – Includes instructions on installing and using the MIC2132 Evaluation Board.
- **Appendix A. "Schematics and Layouts"** – Shows the schematic and layout diagrams for the MIC2132 Evaluation Board.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the MIC2132 Evaluation Board.
- **Appendix C. "Board Waveforms and Performance Curves"** – Shows the behavior and performance of the MIC2132 Evaluation Board in numbers.

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 the MIC2132 Evaluation Board, EV66F86A. Another useful document is listed below. The following Microchip document is available and recommended as a supplemental reference resource.

- **MIC2132 Data Sheet – *"75V"* (DS20006654).**

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

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:
https://www.microchip.com/support.

DOCUMENT REVISION HISTORY

Revision A (November 2022)

- Initial release of this document.

NOTES:

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MIC2132 Evaluation Board and covers the following:

- MIC2132 Device Overview
- MIC2132 Device Key Features
- MIC2132 Evaluation Board Kit Contents

1.2 MIC2132 DEVICE OVERVIEW

The MIC2132 is a constant on-time, dual phase synchronous buck controller featuring a unique adaptive on-time control architecture with a stackable feature of up to eight phases. The MIC2132 operates over an input supply range from 4.5V to 75V and can be used to supply up to 50A of output current/phase. The output voltage is adjustable down to 0.6V with an ensured accuracy of ±1%. The device operates with a programmable switching frequency from 100 kHz to 800 kHz per phase.

The MIC2132 is available in a 32-pin 5 mm x 5 mm VQFN package, with a -40°C to +125°C junction operating temperature range.

1.3 MIC2132 DEVICE KEY FEATURES

- Input Voltage Range: 4.5V to 75V
- Adjustable Output from 0.6V to 32V
- Adaptive Constant on Time Control
  - High Delta V Operation
  - Any Capacitor™ Stable
- 0.6V Internal Reference with ±1% Accuracy
- Operates in CCM, Stackable for Multiphase Operation Up to Eight Phases
- Ripple Injection from Third Node which Allows Greater than 50% Duty Cycles
- Accurate Current Balancing Between Phases
- Accurate Phasing Between Phases which are Always 180° Out of Phase
- 100 kHz to 800 kHz Switching Frequency per Phase
- High Voltage Internal 5V LDO for Single Supply Operation
- Secondary LDO to Improve System Efficiency
- Supports Start Up to Pre-bias Output
- Remote Sense Amplifier for Tight Output Regulation
- Supports Adaptive Voltage Positioning (AVP) or Droop
- Precision Enable Function for Low Stand-by Current
- External Programmable Soft Start to Reduce Inrush Current
- Programmable Current Limit and Hiccup Short Circuit Protection
- Thermal Shut Down with Hysteresis
- Die Temperature Sense on MIC2132
- Compact Size: 5 x 5 mm 32-pin QFN
- -40°C to +125°C Junction Temperature Range

1.4 MIC2132 EVALUATION BOARD KIT CONTENTS

The MIC2132 Evaluation Board kit includes the following items:

- MIC2132 Evaluation Board PCB
- Important Information Sheet
- China RoHS Declaration

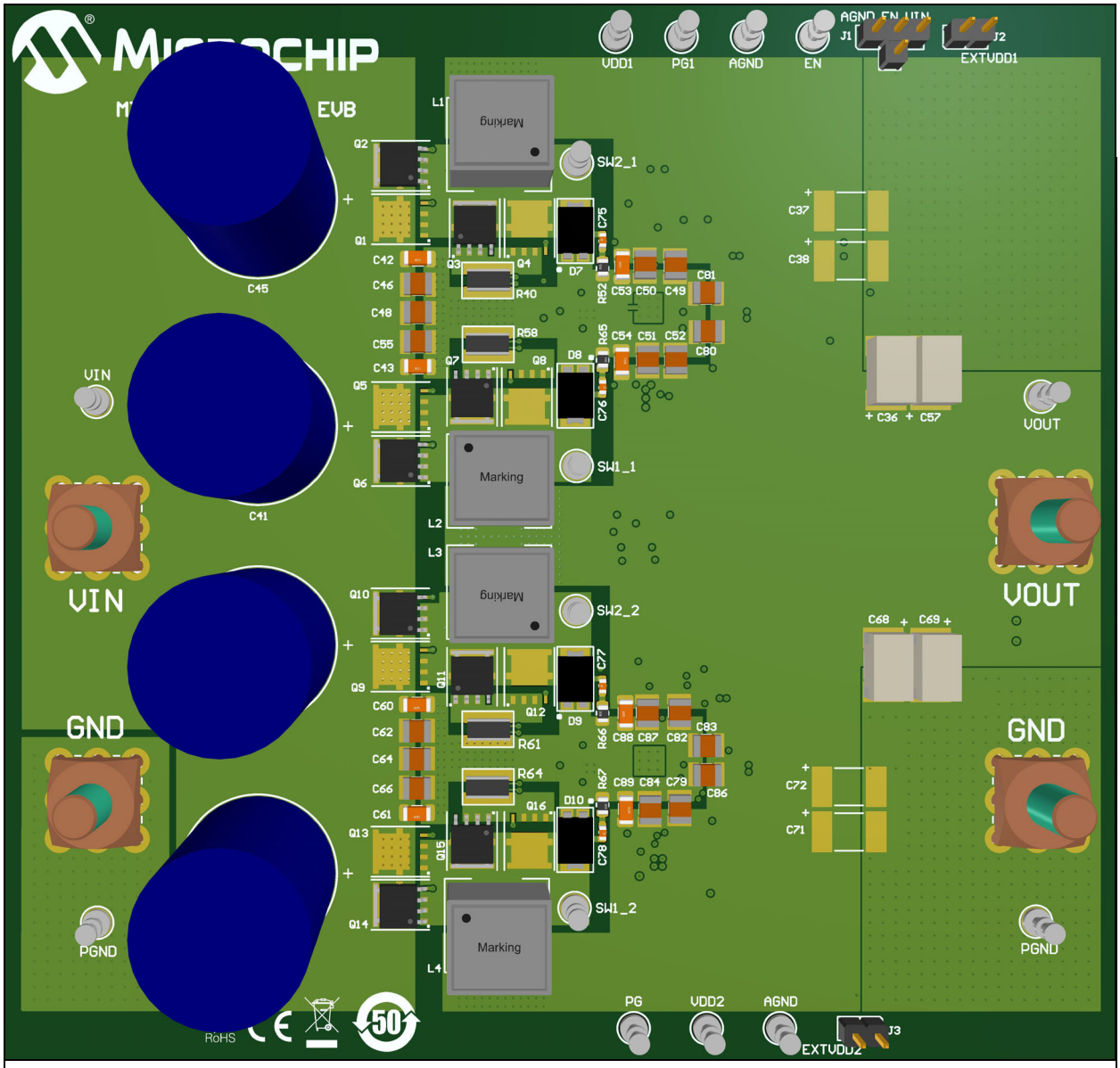


FIGURE 1-1: *Typical MIC2132 Evaluation Board, EV66F86A (Top 3D View).*

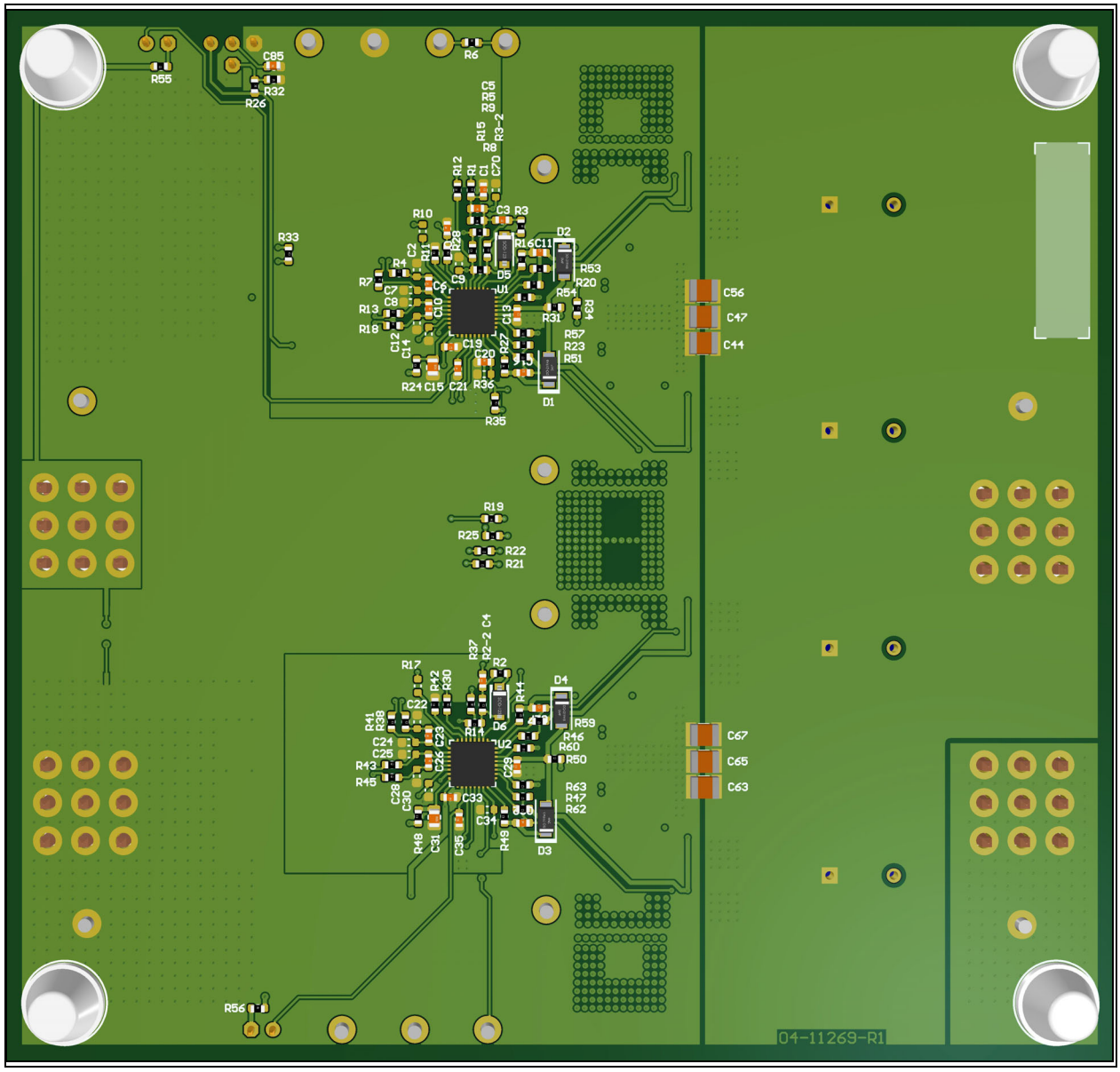


FIGURE 1-2: *Typical MIC2132 Evaluation Board, EV66F86A (Bottom 3D View).*

NOTES:

Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MIC2132 Evaluation Board is fully assembled and tested to evaluate and demonstrate the MIC2132 capabilities. The board uses 2 MIC2132 in a 4 phase topology and can deliver an adjustable output voltage between 0.6V and 32V, with a maximum current of 40A when it's supplied with 10-75V input voltage. However, the board is tunned and optimized for 12V input (±20%) and 5V/40A output.

2.1.1 Powering the MIC2132 Evaluation Board

The board is connected directly to a variable DC power supply that can deliver 10V to 75V DC and an output capability of at least 17A (for 12V input). The load could either be a power resistor or an electronic load.

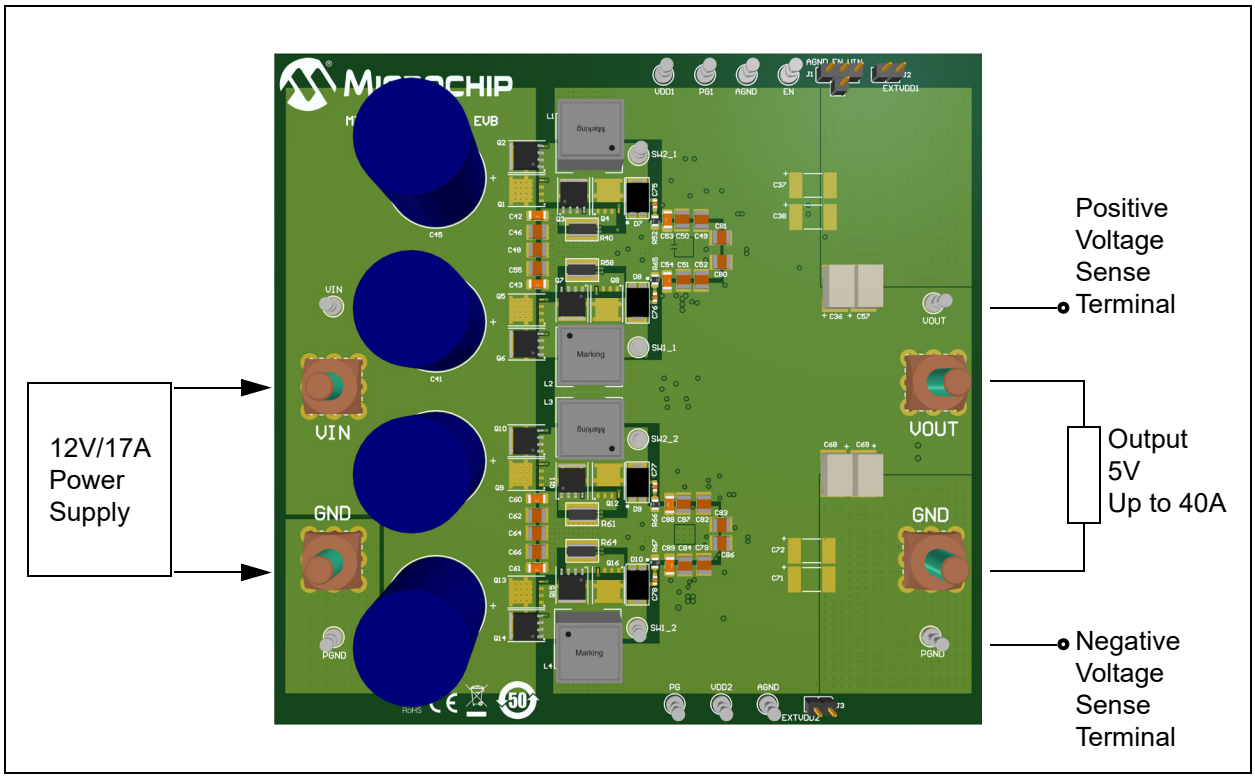


FIGURE 2-1: *MIC2132 Evaluation Board Connection Diagram.*

2.2 SETUP AND CONFIGURATION

The output voltage delivered by the MIC2132 Evaluation Board is set to 5V. To enable the IC, a jumper on J1 must be placed vertically, between J1-2 and J1-3 (to pull the enable to VIN) or between J1-2 and J4 (in order to pull the enable to the voltage divider, in this case ½ VIN). MIC2132 also features an internal high voltage LDO. To bypass this LDO, jumpers can be plugged on J2 (EXTVDD1 for U1) and J3 (EXTVDD2 for U2), but only if the board output voltage is greater than 4.7V. If the internal high voltage LDO is to be used, the jumpers should left unconnected. EXTVDD can also be connected to an external voltage from 4.7V up to 13V through the provided test pins – EXTVDD1 (for U1) and EXTVDD2 (for U2).

EXAMPLE 2-1: CALCULATION OF R_{ILIM} FOR BOTTOM RESISTOR CURRENT SENSING

$$I_{LIM} = \frac{0.3V - (0.25 \times V_{ILIM})}{R_{sns}} \quad (1)$$

$$V_{ILIM} = 1.2V - (4 \times R_{sns} \times I_{LIM}) \quad (2)$$

For I_{LIM} = 10A per phase, R_{sns} = 10 mΩ at 25°C, using equation (2)
V_{ILIM} = 1.2V – (4 × 10 mΩ × 10A) = 0.8V.

To obtain 0.8V on the I_{LIM} pin, which has a 10 µA constant-current source over a constant temperature, a programming equivalent resistor R_{ILIM} = 0.8V/10 µA = 80 kΩ, is required.

EXAMPLE 2-2: CALCULATION OF THE FEEDBACK DIVIDER FOR 5V

$$R_{FB(BOT)} = \frac{R_{FB(TOP)}}{\frac{V_{OUT}}{V_{REF}} - 1} \quad (3)$$

For V_{OUT} = 5V having $R_{FB(TOP)}$ = 20 kΩ and V_{REF} = 0.6V, using equation (3)
$R_{FB(BOT)}$ = 20 kΩ/(5V/0.6V – 1) = 2.72 kΩ.

Due to tolerances, a 2.4 kΩ and 300Ω resistor in series give a calculated output voltage of 5V.

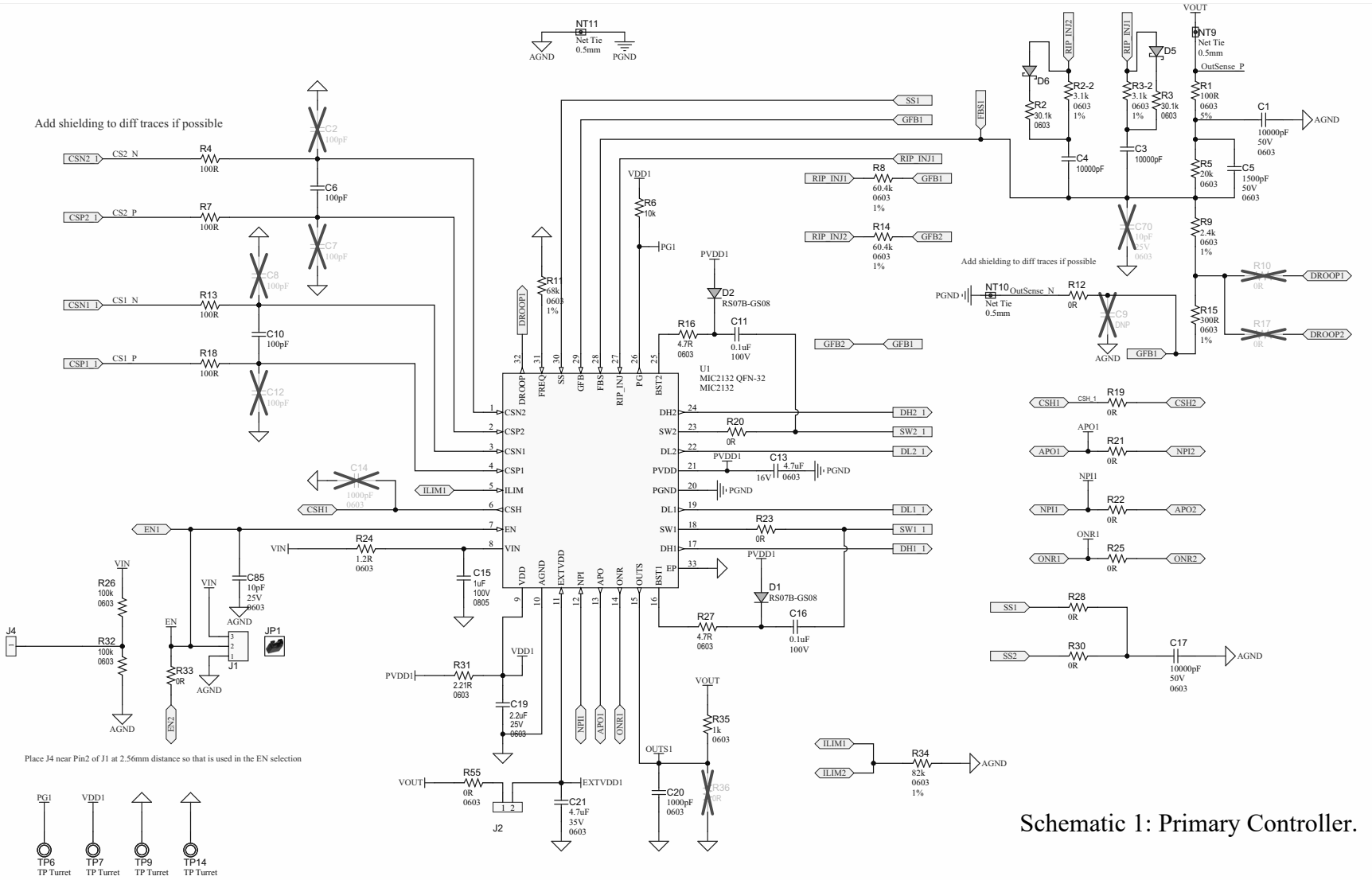
Appendix A. Schematics and Layouts

A.1 INTRODUCTION

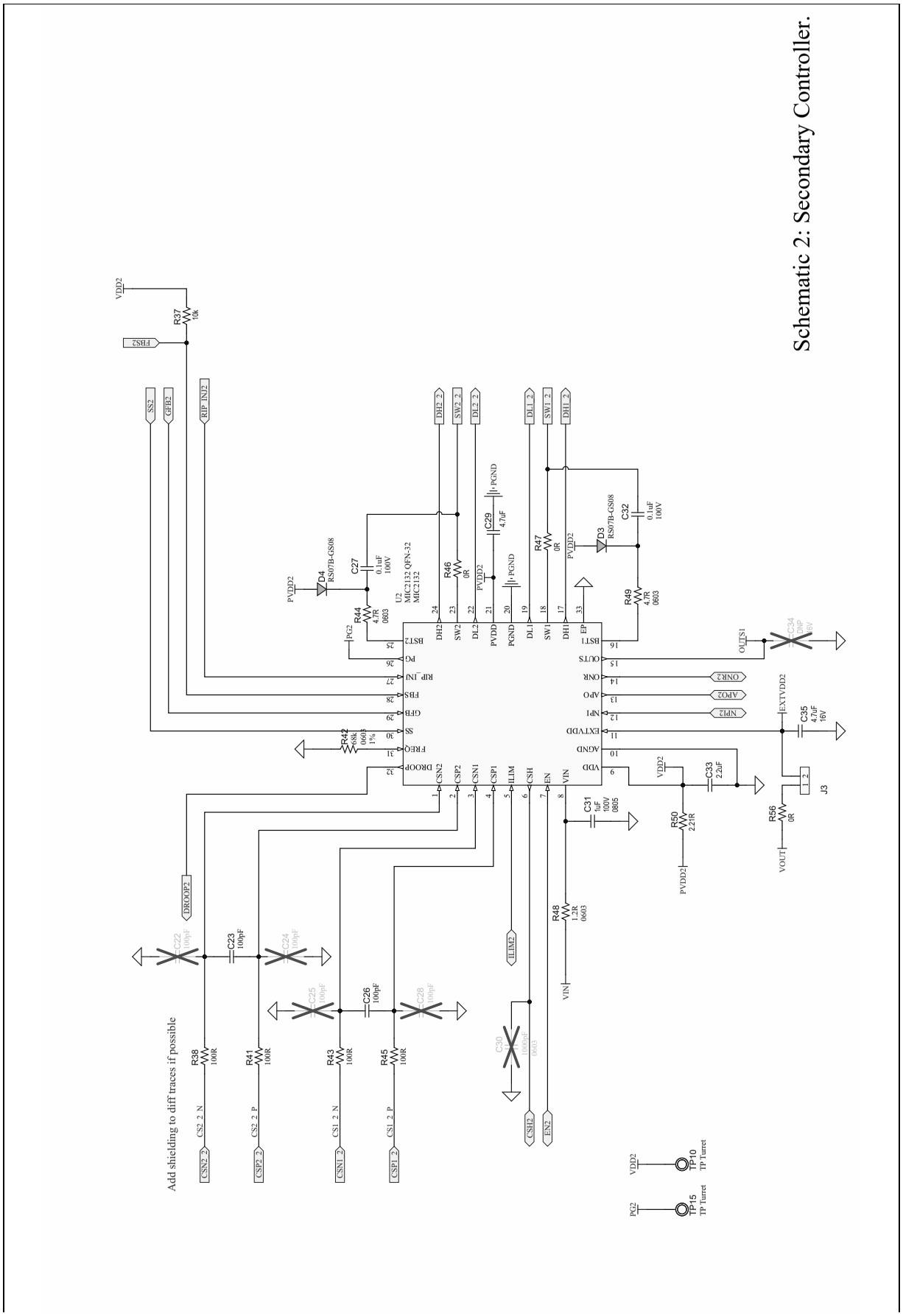
This appendix contains the schematics and layouts of the MIC2132 Evaluation Board:

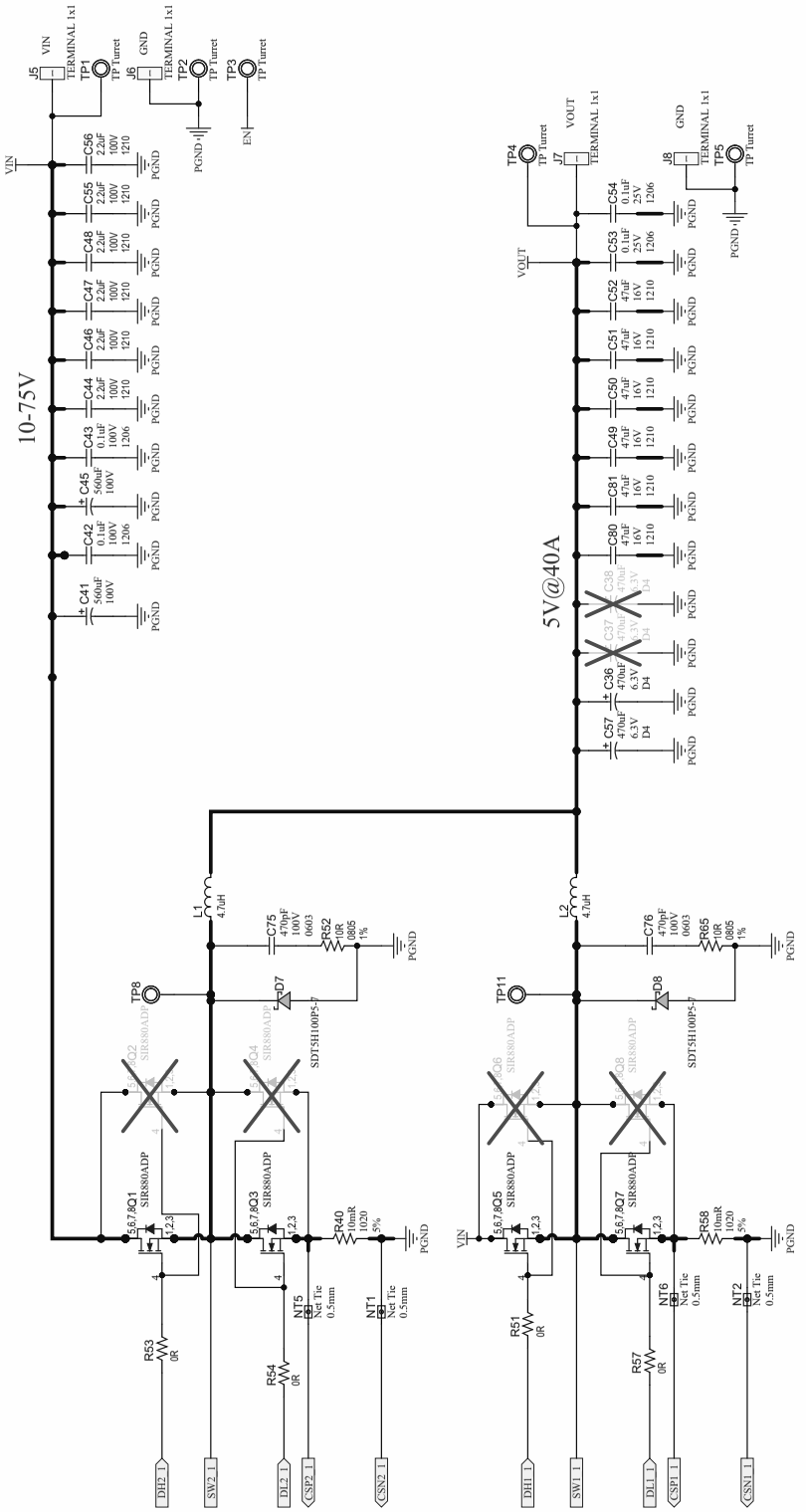
- EV66F86A Board – Schematics
- EV66F86A Board – Top Silk
- EV66F86A Board – Top Copper and Silk
- EV66F86A Board – Top Copper
- EV66F86A Board – Inner 1 Copper
- EV66F86A Board – Inner 2 Copper
- EV66F86A Board – Inner 3 Copper
- EV66F86A Board – Inner 4 Copper
- EV66F86A Board – Bottom Silk
- EV66F86A Board – Bottom Copper and Silk
- EV66F86A Board – Bottom Copper

A.2 EV66F86A BOARD – SCHEMATICS

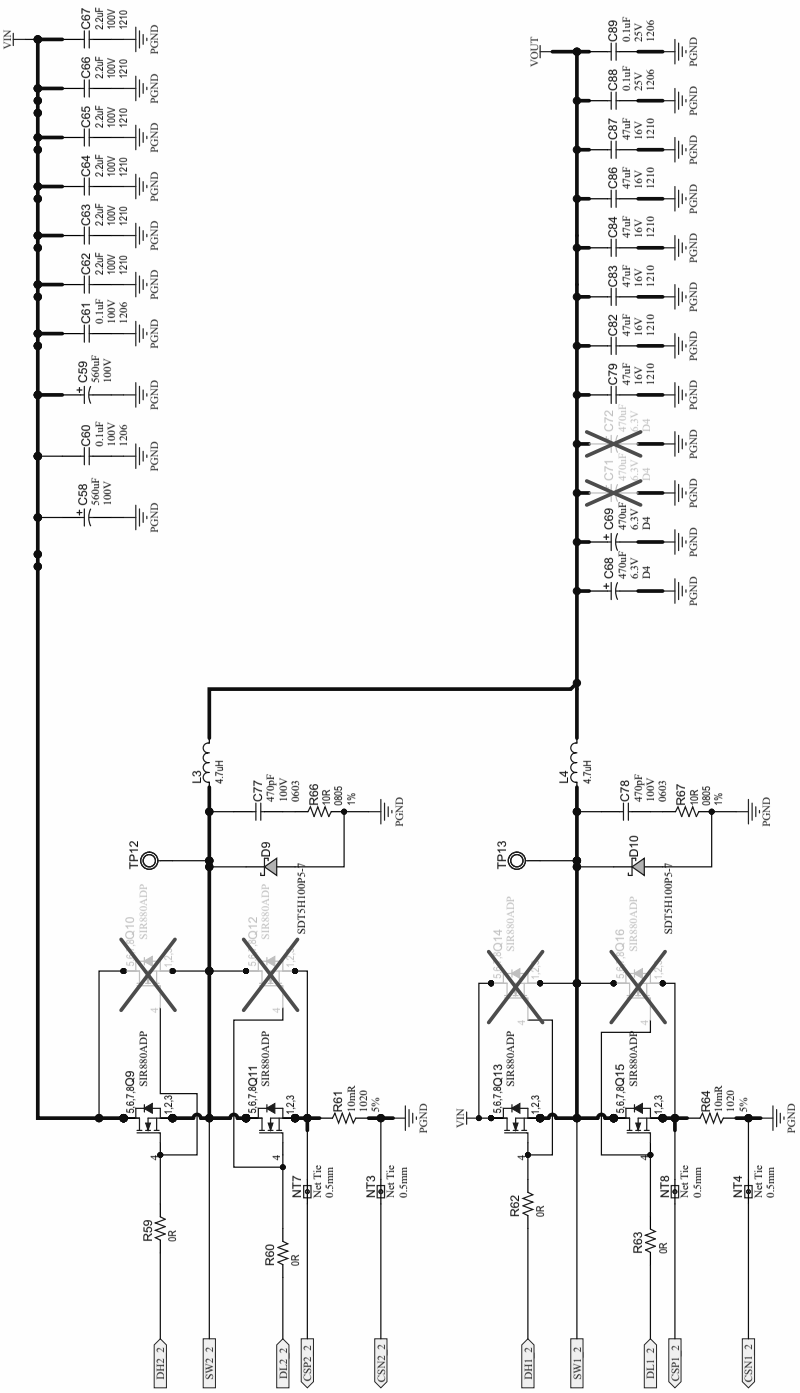


Schematic 1: Primary Controller.


Schematic 2: Secondary Controller.
Add shielding to diff traces if possible
U2
MIC2132 QFN-32
MIC2132
VDD2
R37
10k
FBS2
SS2
GFB2
RIP_IND2
DH2_2
SW2_2
DL2_2
DL1_2
SW1_2
DH1_2
D4
RS07B-GS08
D3
RS07B-GS08
C27
0.1uF
100V
C29
4.7uF
C32
0.1uF
100V
R44
4.7R
0603
R46
0R
R47
0R
R49
4.7R
0603
PVDD2
PGND
PG2
BST2
PG
RIP_IND
FBS
GFB
SS
FREQ
DROOP
CSN2
CSP2
CSN1
CSP1
ILIM
CSH
EN
VIN
BST1
DH1
SW1
DL1
PVDD
PGND
DH2
SW2
DL2
EP
OUTS
ONR
APO
NP1
EXTVDD
AGND
VDD
OUTS1
ONR2
APO2
NP12
EXTVDD2
C34
DNP
16V
C35
4.7uF
16V
R42
68k
0603
1%
C33
2.2uF
VDD2
C31
1uF
100V
0805
R50
2.21R
R56
0R
VOUT
J3
DROOP2
C22
100pF
C23
100pF
C24
100pF
C25
100pF
C26
100pF
C28
100pF
C30
100pF
0603
R48
1.2R
0603
ILIM2
CSH2
EN2
R38
100R
R41
100R
R43
100R
R45
100R
CS2_2_N
CS2_2_P
CS1_2_N
CS1_2_P
CSN2_2
CSP2_2
CSN1_2
CSP1_2
TP10
TP Turret
TP15
TP Turret

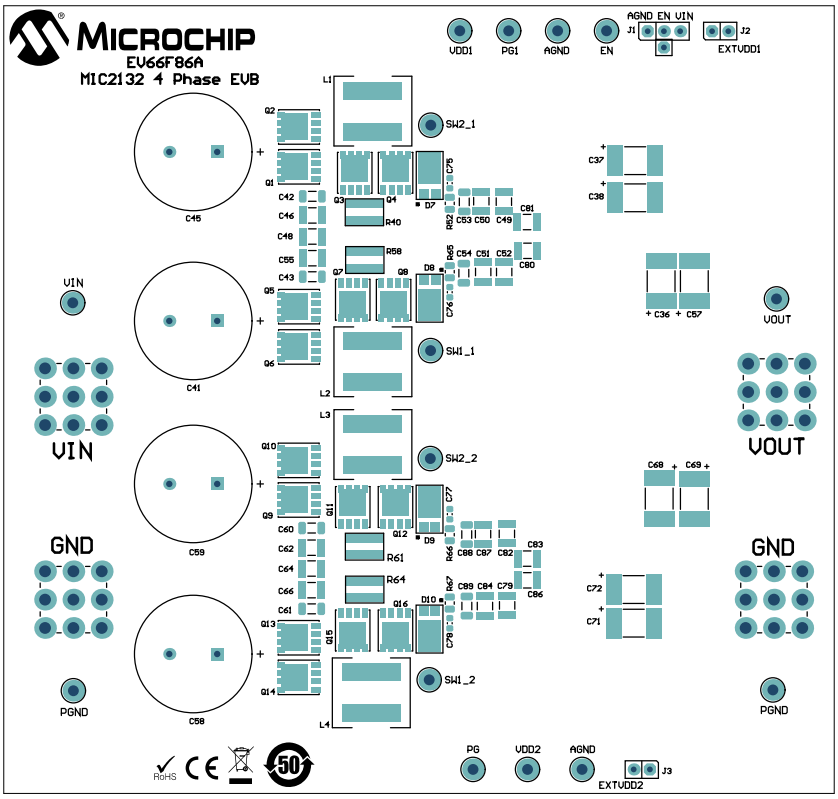


Schematic 3: Power Phases 1-2.

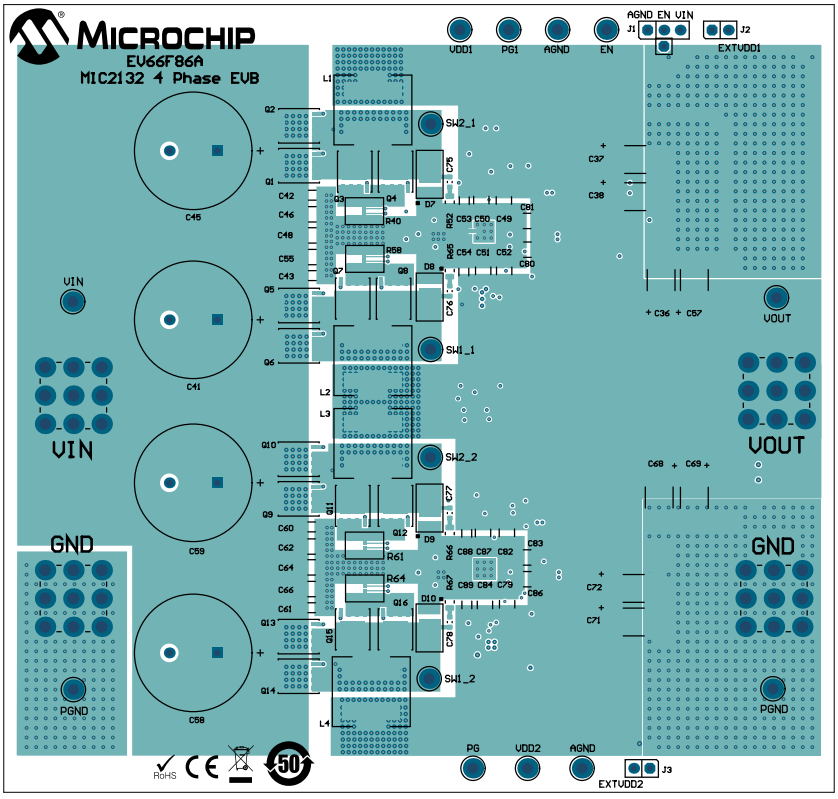


Schematic 4: Power Phases 3-4.

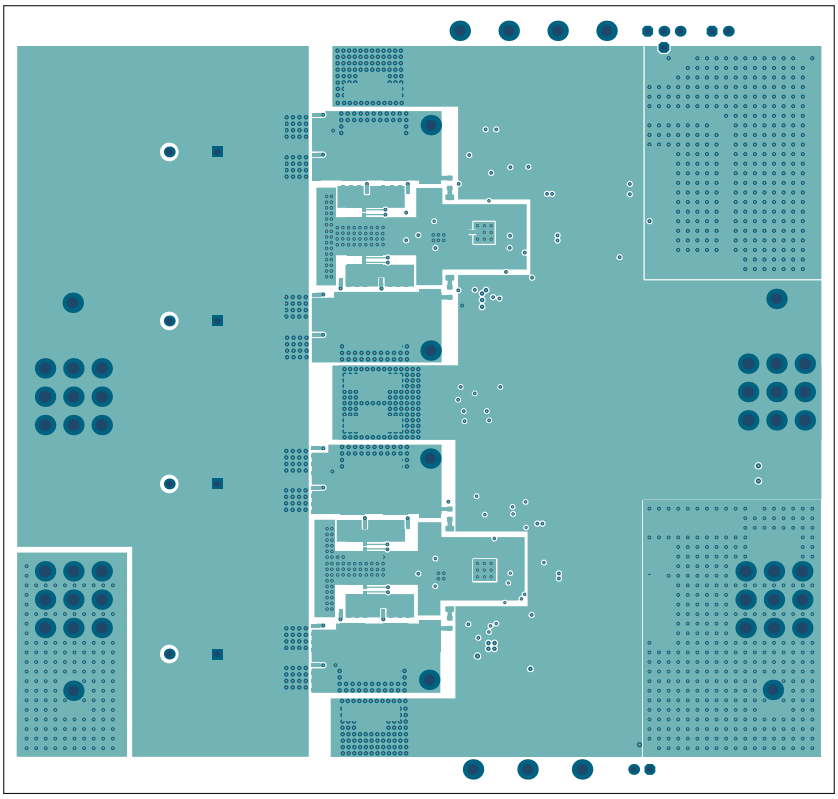
A.3 EV66F86A BOARD – TOP SILK



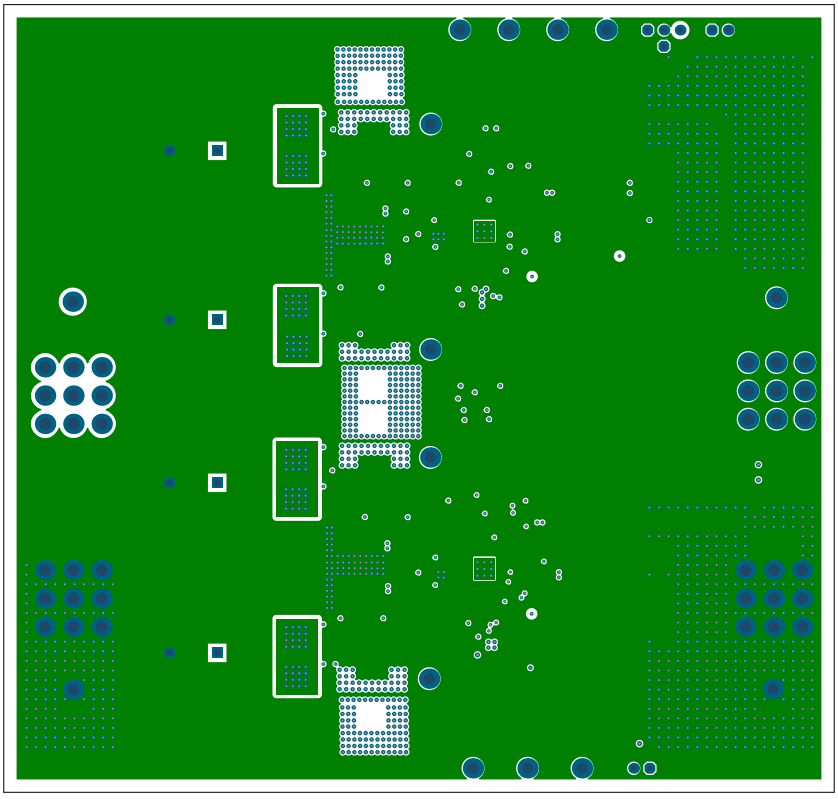
A.4 EV66F86A BOARD – TOP COPPER AND SILK



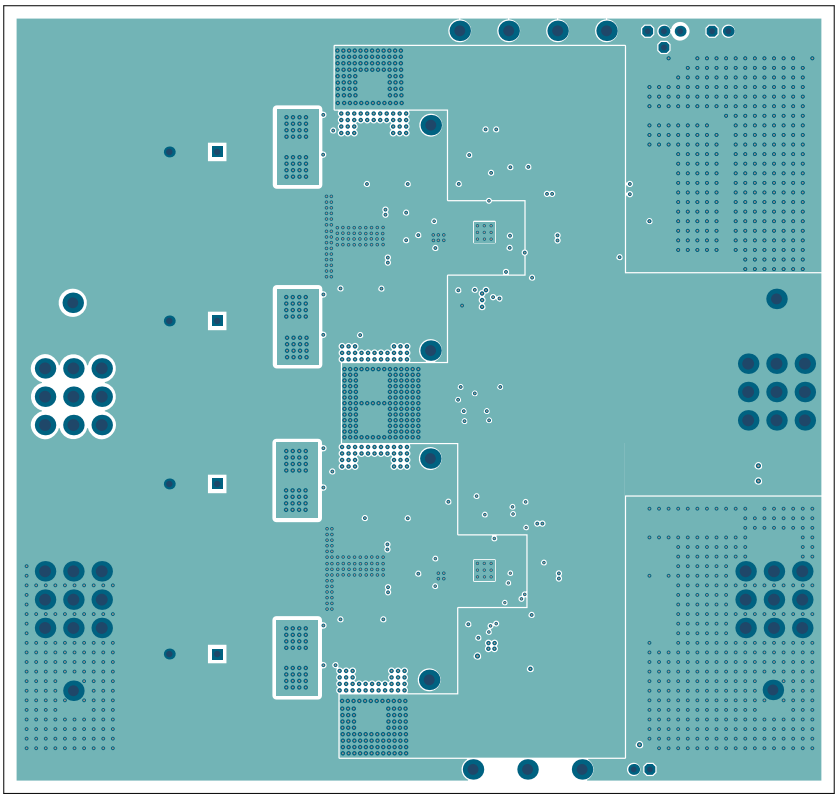
A.5 EV66F86A BOARD – TOP COPPER



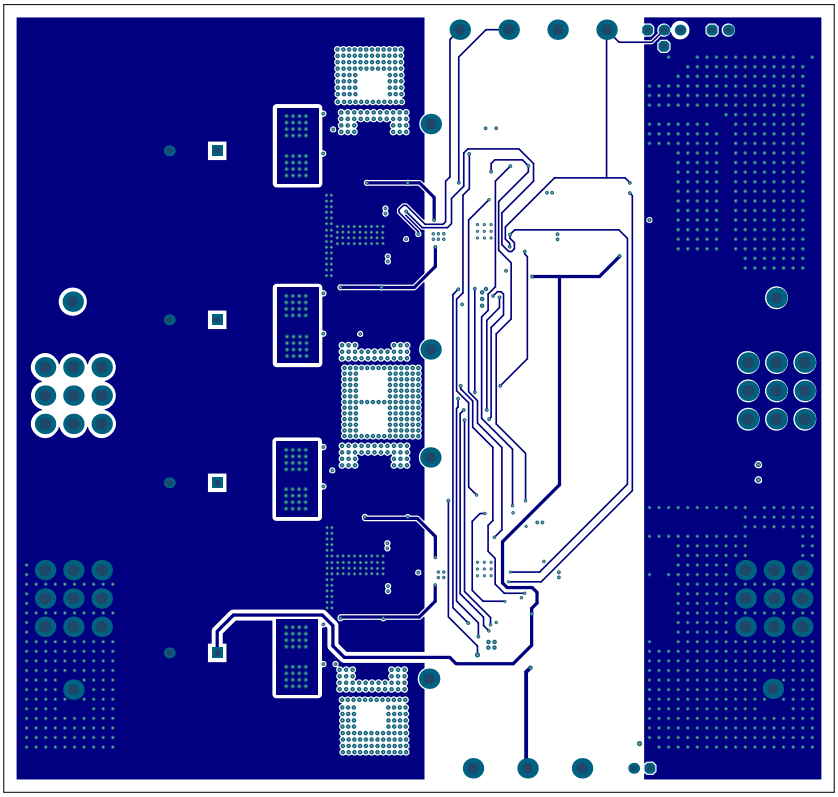
A.6 EV66F86A BOARD – INNER 1 COPPER



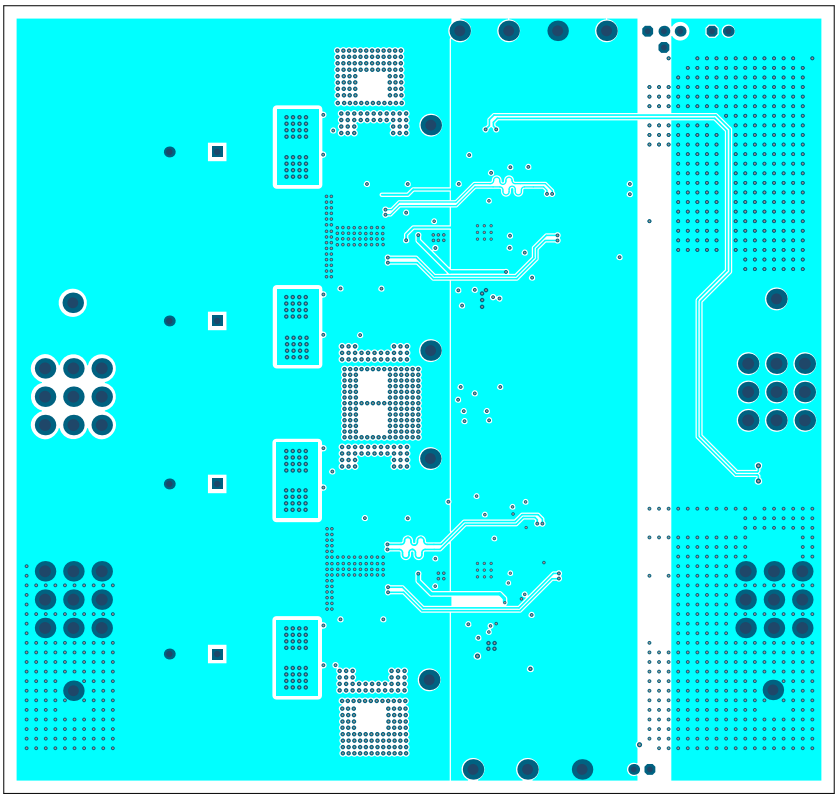
A.7 EV66F86A BOARD – INNER 2 COPPER



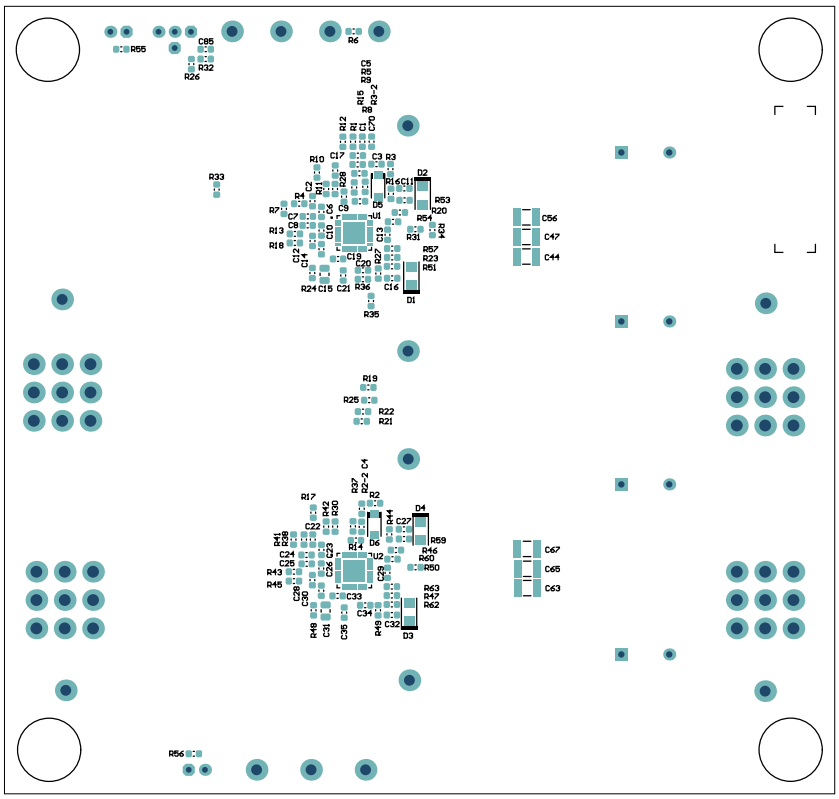
A.8 EV66F86A BOARD – INNER 3 COPPER



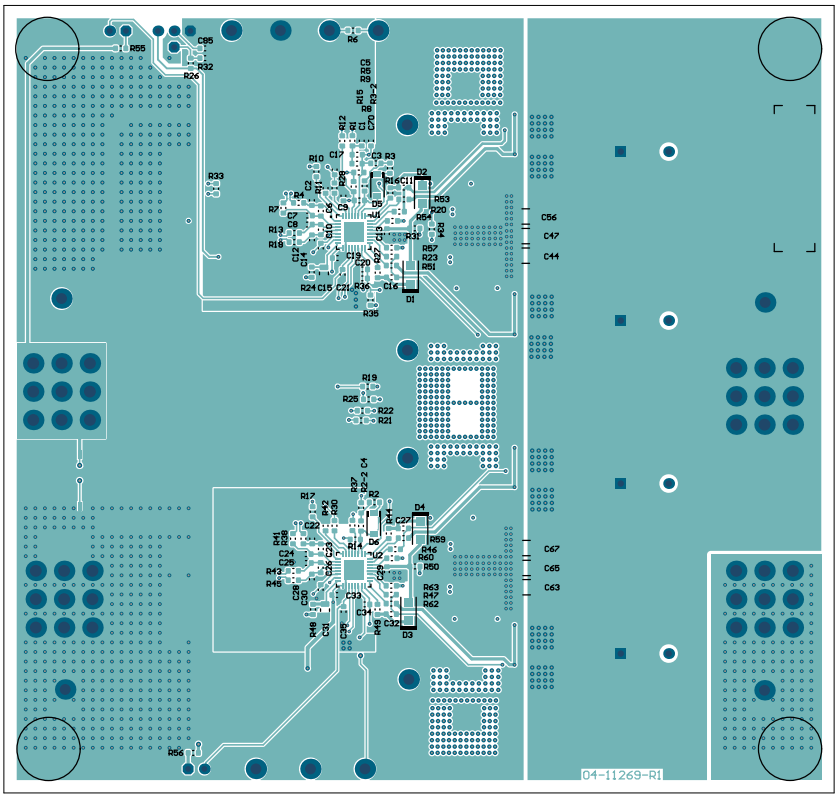
A.9 EV66F86A BOARD – INNER 4 COPPER



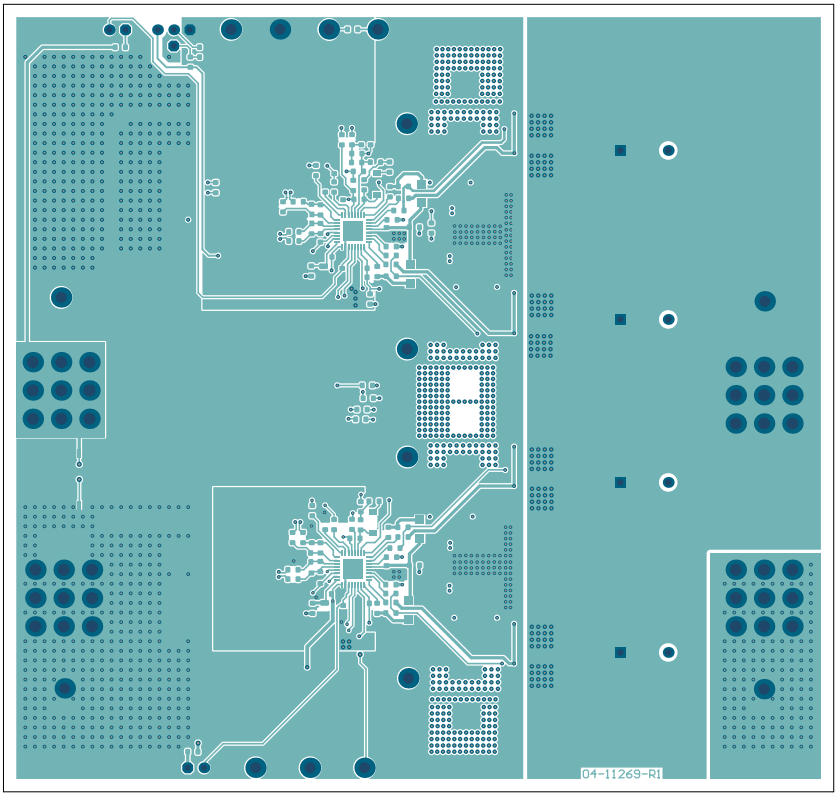
A.10 EV66F86A BOARD – BOTTOM SILK



A.11 EV66F86A BOARD – BOTTOM COPPER AND SILK



A.12 EV66F86A BOARD – BOTTOM COPPER



Appendix B. Bill of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Qty.	Reference	Description	Manufacturer	Part Number
2	C1, C17	Capacitor, ceramic, 10000pF, 50V, 10%, X7R, SMD, 0603	Wurth Elektronik	885012206089
2	C3, C4	Capacitor, ceramic, 10000pF, 25V, 5%, C0G, SMD, 0603	TDK Corporation	C1608C0G1E103J080AA
1	C5	Capacitor, ceramic, 1500pF, 50V, 10%, X7R, SMD, 0603	Wurth Elektronik	885012206084
4	C6, C10, C23, C26	Capacitor, ceramic, 100pF, 50V, 10%, X7R, SMD, 0603	Wurth Elektronik	885012206077
4	C11, C16, C27, C32	Capacitor, ceramic, 0.1uF, 100V, 10%, X7R, SMD, 0603	Wurth Elektronik	885012206120
3	C13, C29, C35	Capacitor, ceramic, 4.7uF, 16V, 10%, X5R, SMD, 0603	TDK Corporation	C1608X5R1C475K080AC
2	C15, C31	Capacitor, ceramic, 1uF, 100V, 10%, X7S, SMD, 0805	TDK Corporation	C2012X7S2A105K125AB
2	C19, C33	Capacitor, ceramic, 2.2uF, 25V, 10%, X5R, SMD, 0603	Murata Manufacturing Co., Ltd.	GRM188R61E225KA12D
1	C20	Capacitor, ceramic, 1000pF, 50V, 10%, X7R, SMD, 0603	Wurth Elektronik	885012206083
1	C21	Capacitor, ceramic, 4.7uF, 35V, 10%, X5R, SMD, 0603	Murata Manufacturing Co., Ltd.	GRM188R6YA475KE15D
4	C36, C57, C68, C69	Capacitor, tantalum, 470uF, 6.3V, 20%, 0.025Ohm, SMD, D4	Panasonic® - ECG	6TPE470M
4	C41, C45, C58, C59	Capacitor, aluminum, 560uF, 100V, 20%, TH, P7.5D18H26.5	United Chemi-Con	EKYB101ELL561MM25S
4	C42, C43, C60, C61	Capacitor, ceramic, 0.1uF, 100V, 10%, X7R, SMD, 1206	Wurth Elektronik	885012208118
12	C44, C46, C47, C48, C55, C56, C62, C63, C64, C65, C66, C67	Capacitor, ceramic, 2.2uF, 100V, 10%, X7R, SMD, 1210	KEMET	C1210C225K1RACTU
12	C49, C50, C51, C52, C79, C80, C81, C82, C83, C84, C86, C87	Capacitor, ceramic, 47uF, 16V, 20%, X5R, SMD, 1210	Wurth Elektronik	885012109011
4	C53, C54, C88, C89	Capacitor, ceramic, 0.1uF, 25V, 10%, X7R, SMD, 1206	Wurth Elektronik	885012208058
4	C75, C76, C77, C78	Capacitor, ceramic, 470pF, 100V, 5%, C0G/NP0, SMD, 0603	Wurth Elektronik	885012006083

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.

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

Qty.	Reference	Description	Manufacturer	Part Number
1	C85	Capacitor, ceramic, 10pF, 25V, 5%, NP0, SMD, 0603	Wurth Elektronik	885012006032
4	D1, D2, D3, D4	Diode, rectifier, RS07B-GS08, 100V, 500mA, SMD, DO-219AB	Vishay Semiconductor Diodes Division	RS07B-GS08
2	D5, D6	Diode, Schottky, MBR0530T1G, 430mV, 500mA, 30V, SOD-123	Diodes Incorporated®	B0530W-7-F
4	D7, D8, D9, D10	Diode, Schottky, RS07B-GS08, 100V, 5A, SMD, PowerDI-5	Diodes Incorporated	SDT5H100P5-7
1	J1	Connector, Header-2.54, male, 1x3, gold, 5.84MH, TH, vertical	Amphenol ICC (FCI)	68000-103HLF
2	J2, J3	Connector, Header-2.54, male, 1x2, gold, 5.84MH, TH, vertical	Amphenol ICC (FCI)	77311-118-02LF
1	J4	Connector, HDR-2.54, male, 1x1, gold, 5.84MH, TH, vertical	Samtec, Inc.	TSW-101-07-S-S
4	J5, J6, J7, J8	Connector, terminal, 85A, male, 1x1, shank, terminal, TH, vertical	Wurth Elektronik	74651195R
4	L1, L2, L3, L4	Inductor, 4.7uH, 27A, 20%, SMD, L11.6W10.5H8.8	Wurth Elektronik	74439369047
8	Q1, Q3, Q5, Q7, Q9, Q11, Q13, Q15	Transistor, FET, N-Channel, SIR880ADP-T1-GE3, 80V, 60A, 83W, PPAK, SO-8	Vishay Siliconix	SIR880ADP-T1-GE3
1	R1	Resistor, TKF, 100R, 5%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3GEYJ101V
2	R2-2, R3-2	Resistor, TKF, 3.1k, 1%, 1/3W, SMD, 0603	Bourns®, Inc.	CHP0603-FX-3011ELF
2	R2, R3	Resistor, TF, 30.1k, 0.1%, 1/10W, SMD, 0603	Susumu Co., LTD.	RG1608P-3012-B-T5
8	R4, R7, R13, R18, R38, R41, R43, R45	Resistor, TKF, 100R, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ3EKF1000V
1	R5	Resistor, TKF, 20k, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ3EKF2002V
2	R6, R37	Resistor, TF, 10k, 1%, 1/16W, SMD, 0603	TE Connectivity, Ltd. (previously Tyco Electronics, Ltd.)	5-1879337-9
2	R8, R14	Resistor, TKF, 60.4k, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3EKF6042V
1	R9	Resistor, TKF, 2.4k, 1%, 1/10W, SMD, 0603	Yageo Corporation	RC0603FR-072K4L
2	R11, R42	Resistor, TKF, 68k, 1%, 1/10W, SMD, 0603	Stackpole Electronics, Inc.	RMCF0603FT68K0
22	R12, R19, R20, R21, R22, R23, R25, R28, R30, R33, R46, R47, R51, R53, R54, R55, R56, R57, R59, R60, R62, R63	Resistor, TKF, 0R, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3GEY0R00V
1	R15	Resistor, TKF, 300R, 1%, 1/10W, SMD, 0603	Yageo Corporation	RC0603FR-07300RL

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.

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

Qty.	Reference	Description	Manufacturer	Part Number
4	R16, R27, R44, R49	Resistor, TKF, 4.7R, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3RQF4R7V
2	R24, R48	Resistor, TKF, 1.2R, 1%, 1/10W, AEC-Q200, SMD, 0603	Panasonic - ECG	ERJ-3RQF1R2V
2	R26, R32	Resistor, TF, 100k, 1%, 1/8W, SMD, 0603	Vishay Beyschlag	MCT06030C1003FP500
2	R31, R50	Resistor, TF, 2.21R, 0.1%, 1/16W, SMD, 0603	Stackpole Electronics, Inc.	RNCF0603BKC2R21
1	R34	Resistor, TKF, 82k, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3EKF8202V
1	R35	Resistor, TKF, 1k, 1%, 1/10W, SMD, 0603, AEC-Q200	Panasonic - ECG	ERJ3EKF1001V
4	R40, R58, R61, R64	Resistor, TKF, 10mR, 5%, 2W, SMD, 1020, AEC-Q200	Vishay/Dale	RCWE102010L0JNEA
4	R52, R65, R66, R67	Resistor, TKF, 10R, 1%, 1/8W, SMD, 0805	Vishay/Dale	CRCW080510R0FKEAC
15	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15	Connector, TP, pin, tin, TH	Harwin Plc.	H2121-01

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.

TABLE B-2: BILL OF MATERIALS (BOM) – MICROCHIP PARTS

Qty.	Reference	Description	Manufacturer	Part Number
2	U1, U2	Microchip, Analog, 75V, Dual Phase, COT, Switching, Buck Controller, MIC2132 QFN-32	Microchip Technology, Inc. and its subsidiaries	MIC2132

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.

TABLE B-3: BILL OF MATERIALS (BOM) – MECHANICAL PARTS

Qty.	Reference	Description	Manufacturer	Part Number
1	JP1	Mechanical, hardware, jumper, 2.54mm, 1x2	3M	969102-0000-DA
1	LABEL1	Label, assembly, W/rev level (small modules), per MTS-0002	—	—
4	PAD1, PAD2, PAD3, PAD4	Mechanical, hardware, rubber pad, cylindrical, 0.374" x 0.189", clear	Essentra PLC.	RBS-35
1	PCB1	Printed Circuit Board	—	04-11269-R1

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.

TABLE B-4: BILL OF MATERIALS (BOM) – DO NOT POPULATE PARTS

Qty.	Reference	Description	Manufacturer	Part Number
0	C2, C7, C8, C12, C22, C24, C25, C28	Capacitor, ceramic, 100pF, 50V, 10%, X7R, SMD, 0603	Wurth Elektronik	885012206077
0	C9	Capacitor, ceramic, 0.1uF, 100V, 10%, X7R, SMD, 0603	Murata Manufacturing Co., Ltd.	GRM188R72A104KA35D
0	C14, C30	Capacitor, ceramic, 1000pF, 50V, 10%, X7R, SMD, 0603	Wurth Elektronik	885012206083
0	C34	Capacitor, ceramic, 4.7uF, 16V, 10%, X5R, SMD, 0603	TDK Corporation	C1608X5R1C475K080AC
0	C37, C38, C71, C72	Capacitor, tantalum, 470uF, 6.3V, 20%, 0.025Ohm, SMD, D4	Panasonic - ECG	6TPE470M
0	C70	Capacitor, ceramic, 10pF, 25V, 5%, NP0, SMD, 0603	Wurth Elektronik	885012006032
0	Q2, Q4, Q6, Q8, Q10, Q12, Q14, Q16	Transistor, FET, N-Channel, SIR880ADP-T1-GE3, 80V, 60A, 83W, PPAK SO-8	Vishay Siliconix	SIR880ADP-T1-GE3
0	R10, R17, R36	Resistor, TKF, 0R, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3GEY0R00V

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.

Appendix C. Board Waveforms and Performance Curves

C.1 MAIN WAVEFORMS

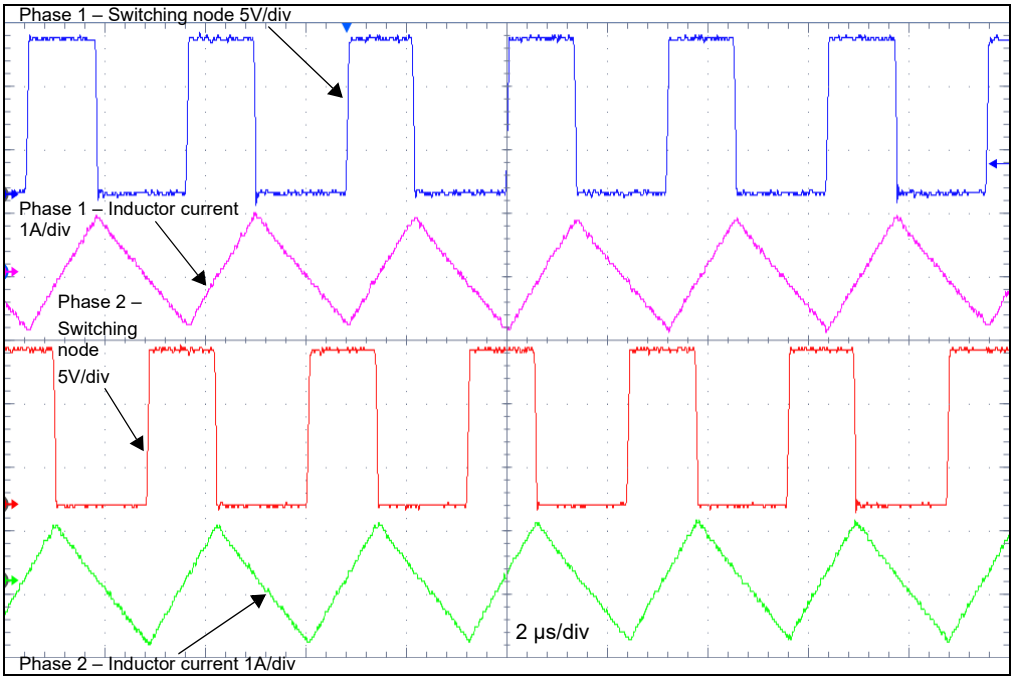


FIGURE C-1: *Switching Node Waveforms for V_{IN} 12V, V_{OUT} 5V, Phase 1 + 2, No Load.*

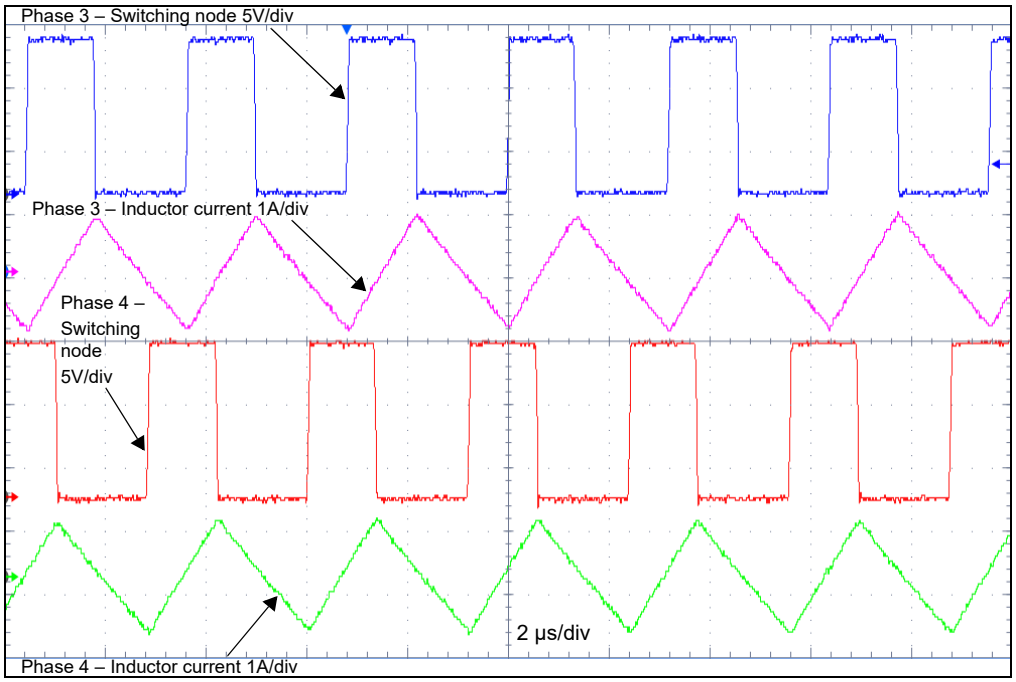


FIGURE C-2: *Switching Node Waveforms for V_{IN} 12V, V_{OUT} 5V, Phase 3 + 4, No Load.*

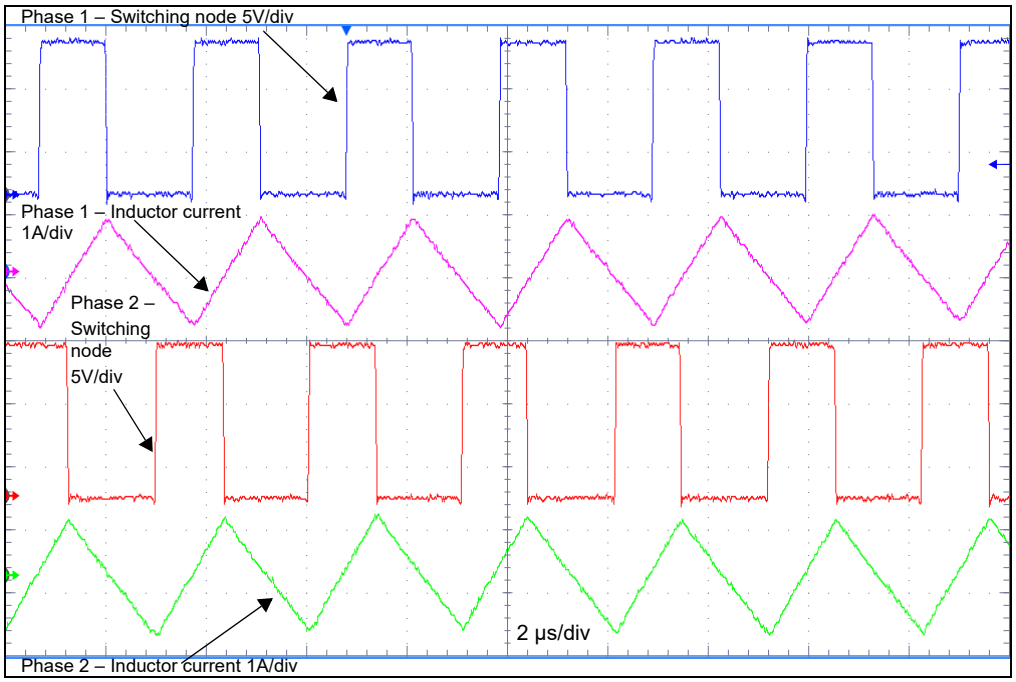


FIGURE C-3: *Switching Node Waveforms for V_{IN} 12V, V_{OUT} 5V, Phase 1 + 2, Iout 10A.*

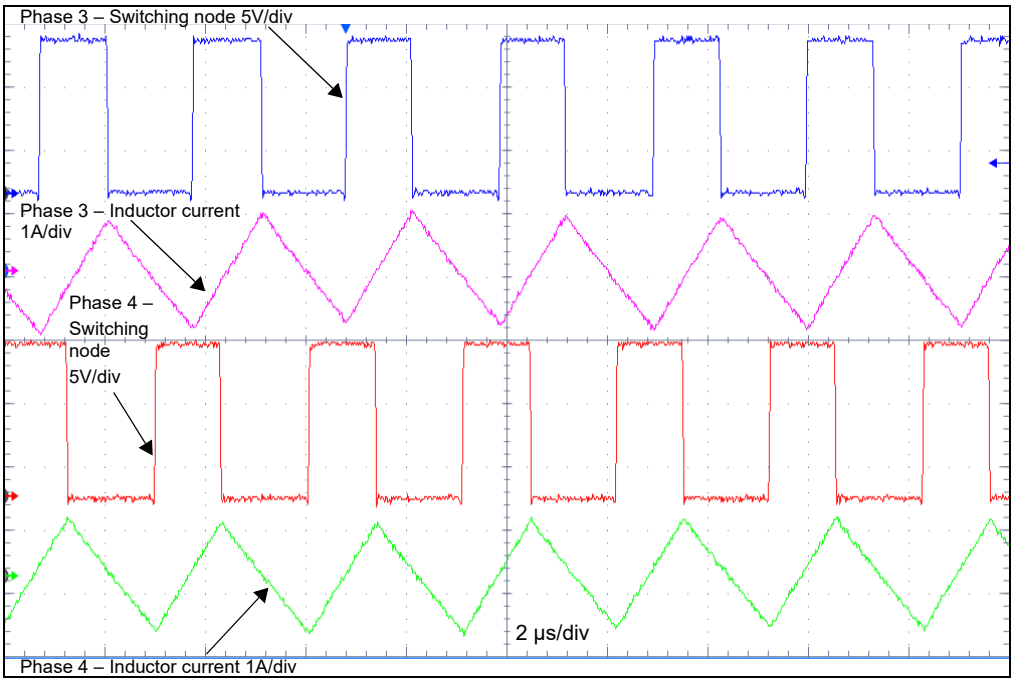


FIGURE C-4: *Switching Node Waveforms for V_{IN} 12V, V_{OUT} 5V, Phase 3 + 4, Iout 10A*

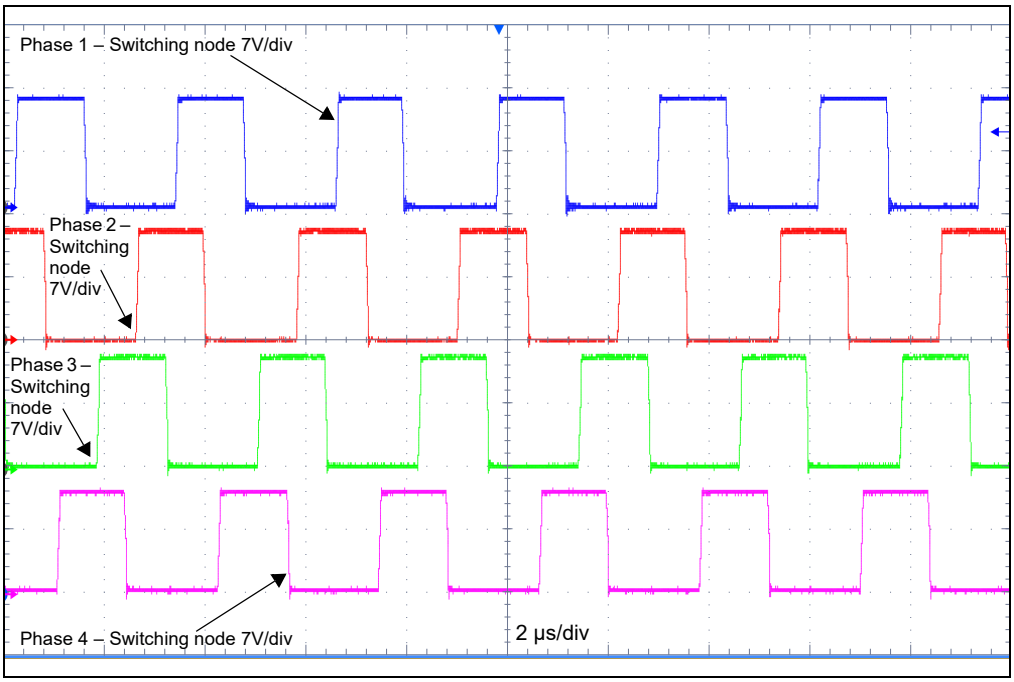


FIGURE C-5: *Switching Node Waveforms for V_{IN} 12V, V_{OUT} 5V, Phase 1 + 2 + 3 + 4, No Load.*

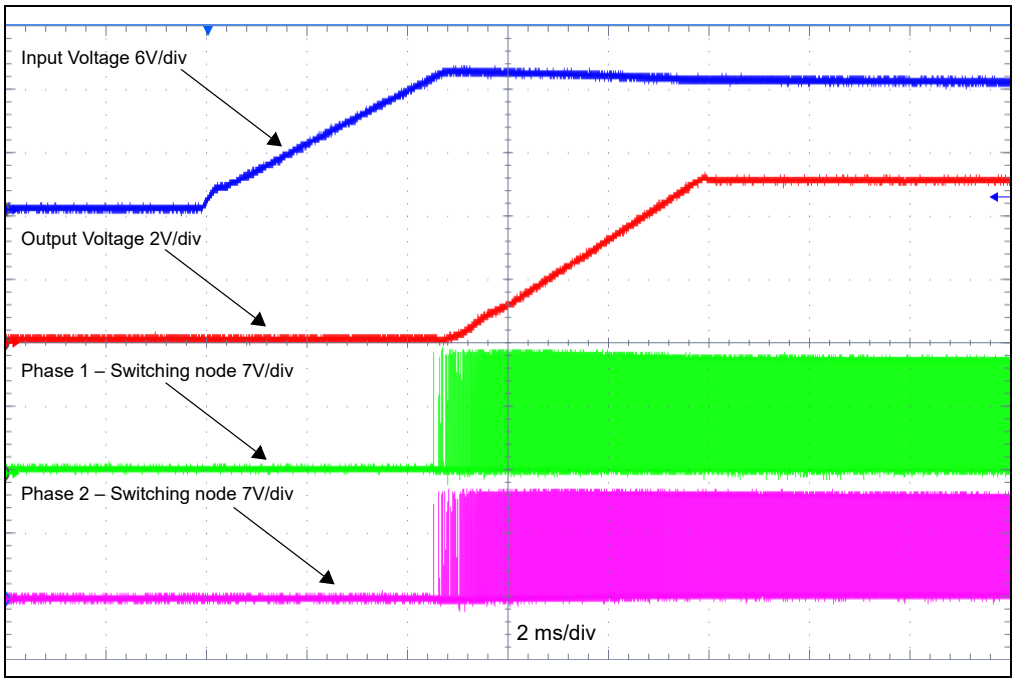


FIGURE C-6: *Soft Start Under No Load.*

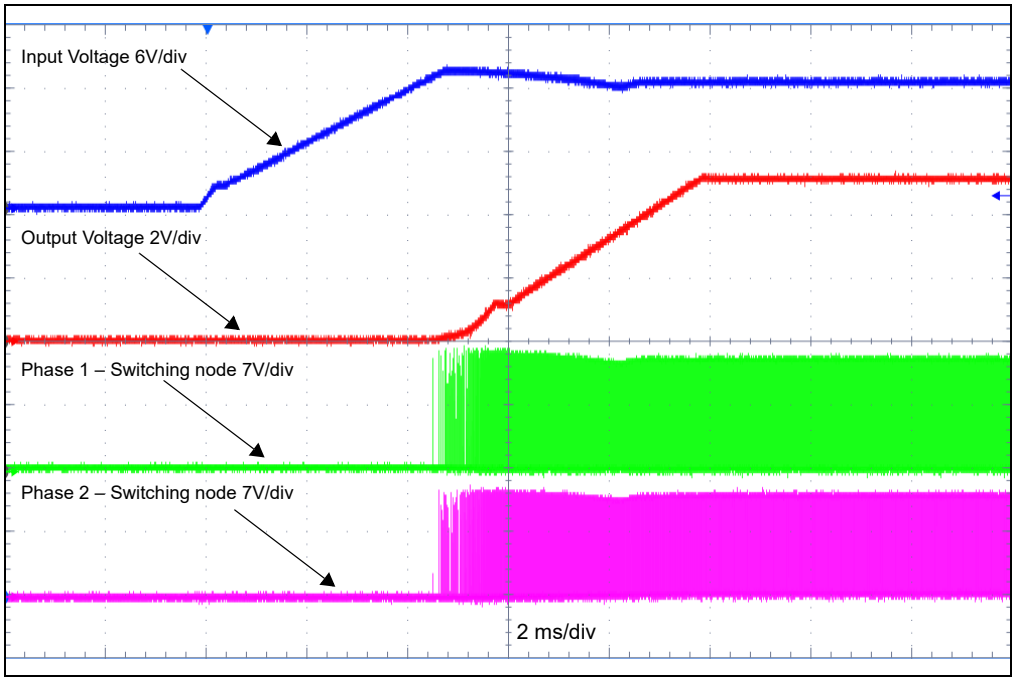


FIGURE C-7: *Start-Up Under 10A Load.*

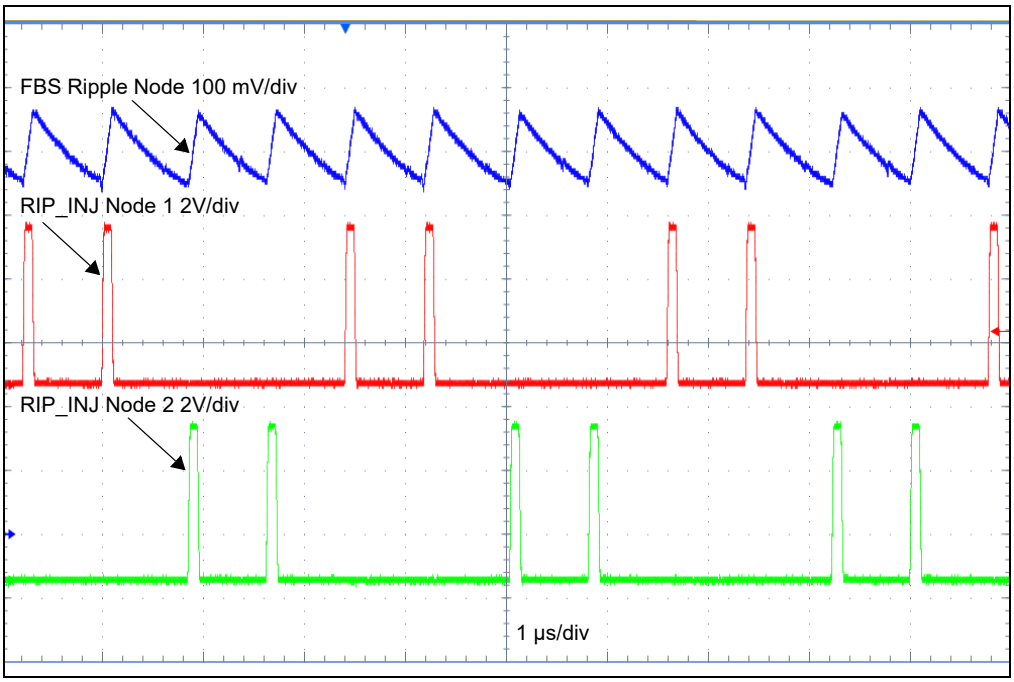


FIGURE C-8: *Ripple Injection 12 V_{IN}, 5V, No Load.*

C.2 PERFORMANCE CURVES

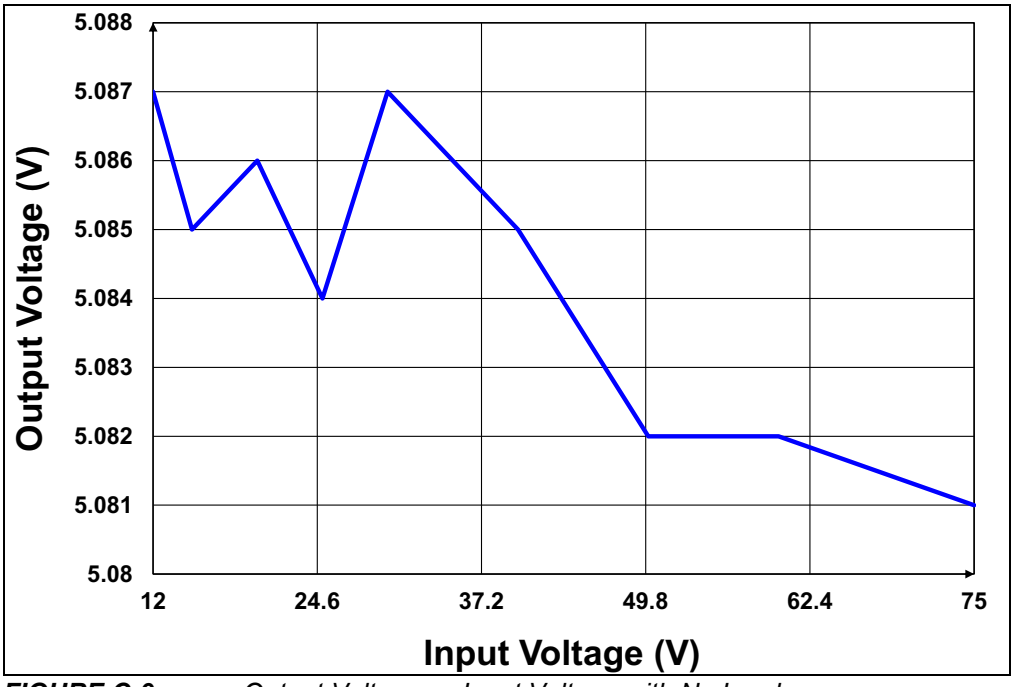


FIGURE C-9: *Output Voltage vs Input Voltage with No Load.*

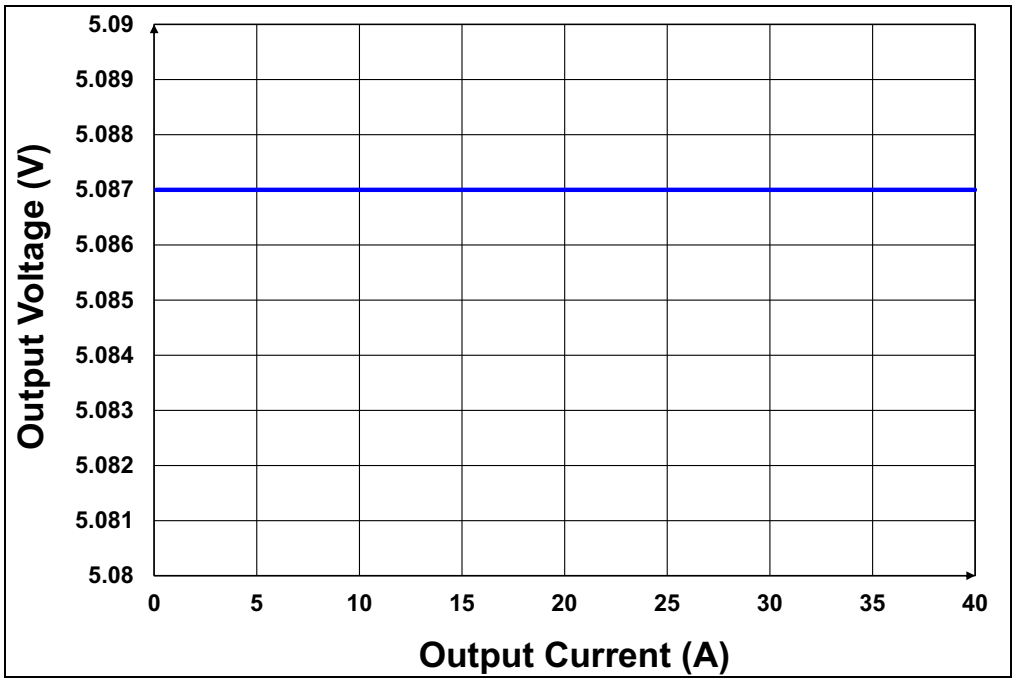


FIGURE C-10: *Output Voltage vs Output Current (V_{IN} = 12V).*

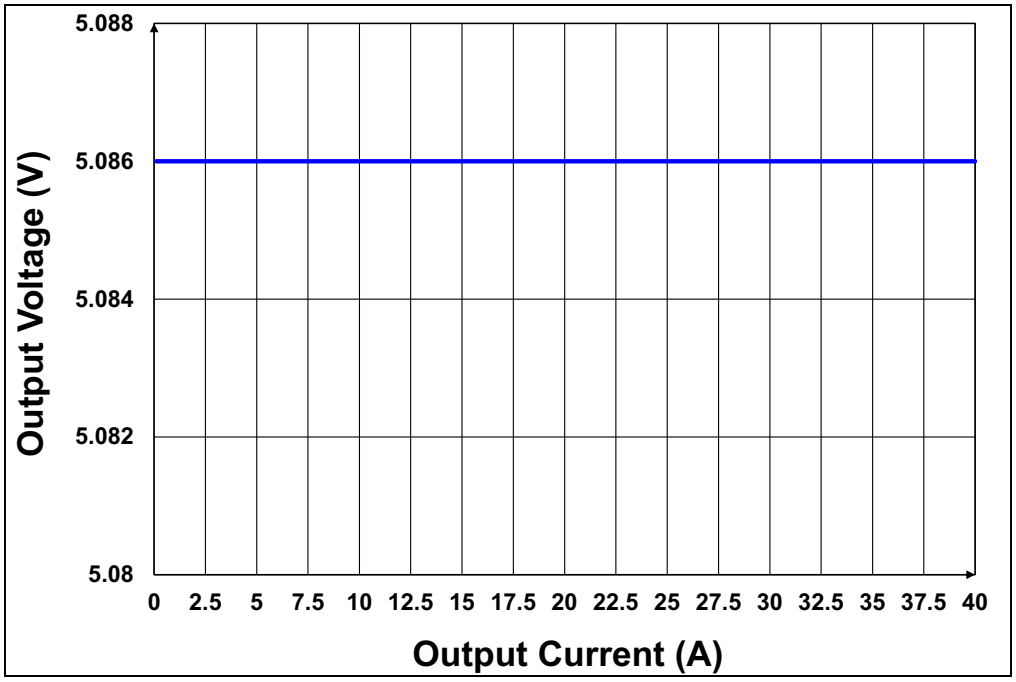


FIGURE C-11: *Output Voltage vs. Output Current (Vin = 20V).*

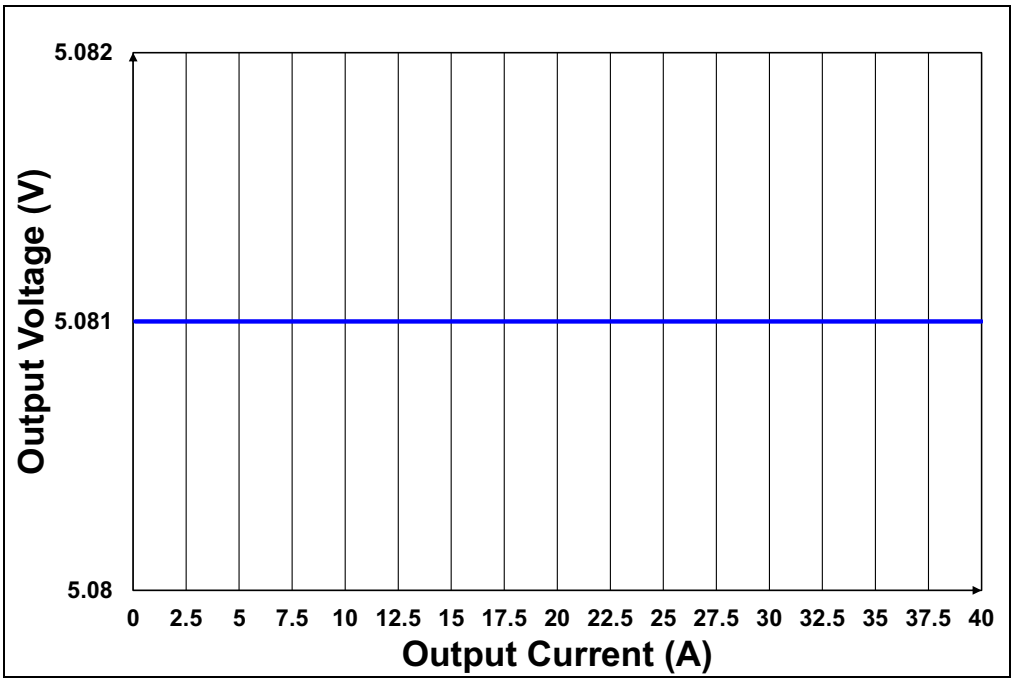


FIGURE C-12: *Output Voltage vs. Output Current (Vin = 70V).*

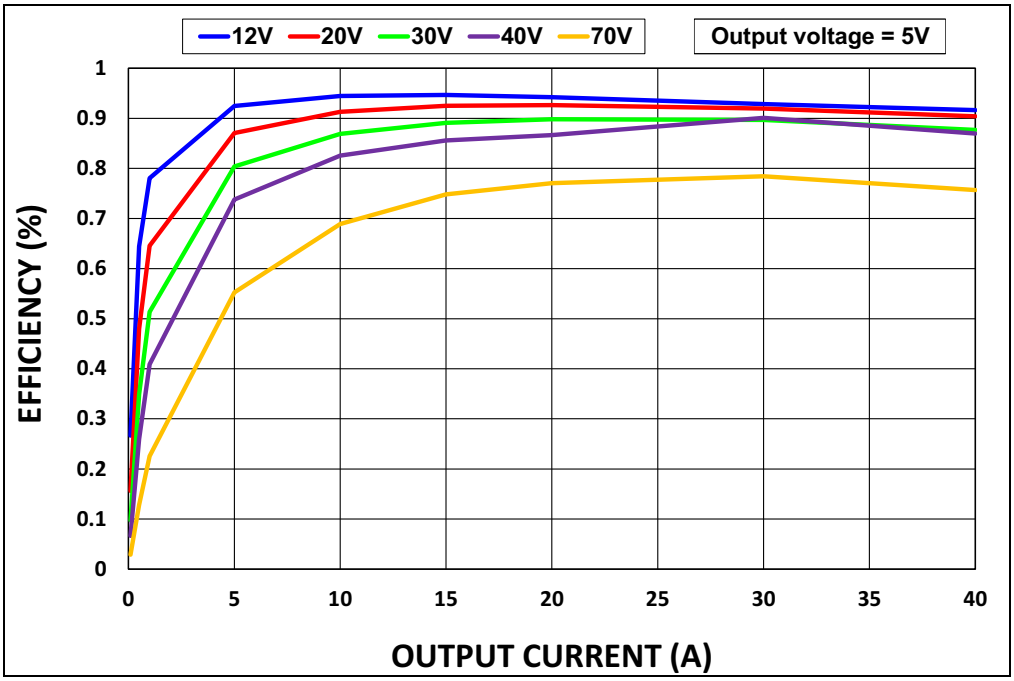


FIGURE C-13: *Efficiency vs. Output Current.*

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