High-Performance, Multi-Mode, Step-Down Controller

MIC2111B Evaluation Board

General Description

The MIC2111B is a programmable-frequency, valley-current/voltage-mode PWM controller that provides the control and protection features necessary for power devices and drivers that use current-sensing across the inductor. The MIC2111B provides a single tri-state PWM logic signal to DrMOS modules to realize low output voltage, high current power supply. The device has precision enable and power good (PG) functions for the sequencing of multiple power supplies. In addition, the solution is compatible with intelligent power stages in a high-current, step-down DC/DC converter.

The MIC2111B evaluation board operates over an input supply range of 5.5V to 16V and provides a regulated output at up to 20A of load current. The output voltage is adjustable down to 0.6V with a typical accuracy of ±1%. The evaluation board operates at a switching frequency of 500kHz, in valley current mode.

The MIC2111B utilizes a programmable control architecture. The MIC2111B evaluation board is configured for valley current mode control. An undervoltage lockout feature is provided to ensure proper operation under power sag conditions. An adjustable soft-start feature is provided to reduce inrush current. An adjustable current-limit is provided. “Hiccup” mode short-circuit protection and thermal shutdown ensures protection of the IC during fault conditions.

The basic parameters of the evaluation board are:

- V_{IN} supply: 5.5V to 16V
- Output: 1.2V at 20A
- 500kHz switching frequency (Adjustable from 200kHz to 2MHz)
- Control mode: Valley current mode (Adjustable to voltage mode)

The customer can configure the MIC2111B evaluation board to operate in voltage mode through the following jumper selections.

Control Mode	P1	P2
Valley Current Mode	Pins 1-2	Pins 1-2
Voltage Mode	Pins 2-3	OPEN

For information about compensation component selection, see the MIC2111 datasheet on Micrel’s website at: www.micrel.com.

Requirements

The MIC2111B evaluation board requires only a single power supply with at least 10A current capability. The MIC2111B has an on-board 5V LDO to power the internal biasing of the MIC2111B IC and DrMOS gate drive supply.

Power-up Precautions

The evaluation board does not have reverse polarity protection. Applying a negative voltage to the VIN terminal may damage the device. In addition, the maximum V_{IN} operating voltage of the MIC2111B evaluation board is 16V.

Ordering Information

Part Number	Description
MIC2111BYMT	MIC2111B Evaluation Board

Getting Started

1. **Connect a supply to the VIN and GND terminals.**

   Pay careful attention to the polarity and the supply range (5.5V < V_{IN} < 16V). An ammeter may be placed between the input supply and the VIN terminal to the evaluation board. Ensure that the supply voltage is monitored at the VIN terminal. The ammeter and/or power lead resistance can reduce the voltage supplied to the input. Do not apply power until Step 4.

2. **Connect the load to the VOUT and ground terminals.**

   The load can be either passive (resistive) or active (as in an electronic load). An ammeter can be placed between the load and the VOUT terminal. Ensure that the output voltage is monitored at the VOUT terminal.

3. **Enable input.**

   An EN connector is provided on the evaluation board for users to easily access the enable feature. The output of the MIC2111B turns on when V_{CC} exceeds the UVLO threshold. The output of the MIC2111B evaluation board may be turned off by shorting the EN pin to ground.

4. **Turn on the power.**

   Turn on the VIN power supply and verify that the output voltage is regulated to 1.2V.

Evaluation Board Description

Output Voltage

The output voltage on the MIC2111B evaluation board is adjustable. It is set by adjusting the feedback resistors and using the following equation.

$$VOUT = VFB\ x\ \left(1 + \frac{R14}{R11}\right) \quad \text{Eq. 1}$$

where V_{FB} = 0.6V and R11 is 4.99kΩ for a 1.2V output voltage. Leaving R11 open gives a 0.6V output voltage. The output can be adjusted from 0.6V to 3.46V by changing the value of R11 according to the equation above.

The output voltage should not be set in excess of 3.46V due to the need for headroom for the current sense amplifier of MIC2111B. Please refer to the Application Information section of the MIC2111 datasheet for setting the output voltage.

Oscillator Frequency

The MIC2111 has an internal oscillator by which the frequency can be set through an external resistor at the FREQ pin. The switching frequency can be programmed from 200kHz to 2MHz by using the following equation.

$$R_{FREQ} = \frac{10^{11}}{F_{SW[\Omega]}} \quad \text{Eq. 2}$$

where F_{SW} = the desired switching frequency in Hz.

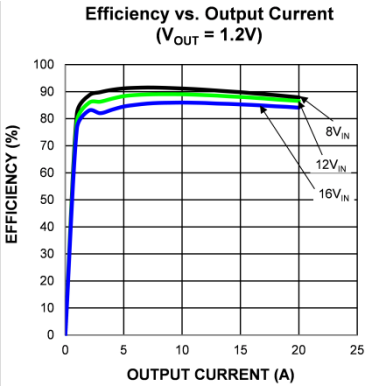
Soft-Start/Soft-Stop (SS)

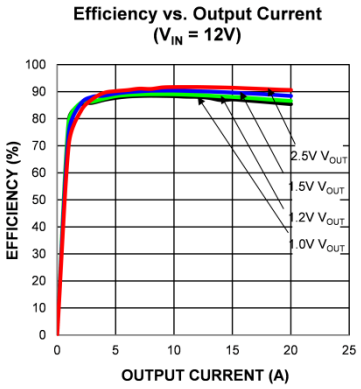
The MIC2111 has digital soft-start/soft-stop (SS) to avoid high inrush current in the input supply lines. The soft-start time can be programmed with an external resistor connected from the SS pin to GND. Table 1 illustrates resistor values and soft-start times. Soft-stop time is the same as the programmed soft-start time (contact the factory for instructions on disabling soft-stop).

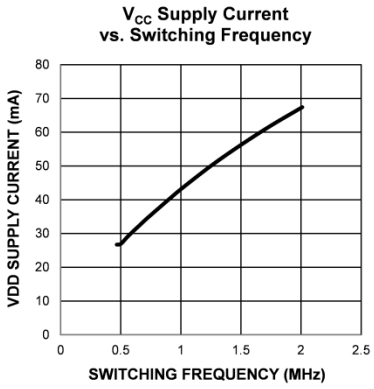
Table 1. Soft-Start Programming

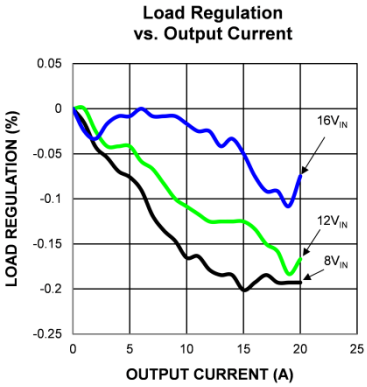
E96 Range Resistance	Soft-Start
6.19kΩ	64µs
19.1kΩ	128µs
30.9kΩ	256µs
44.2kΩ	512µs
56.2kΩ	768µs
68.1kΩ	1024µs
80.6kΩ	1536µs
93.1kΩ	2048µs
105kΩ	3072µs
118kΩ	4096µs
130kΩ	6144µs
143kΩ	8192µs
154kΩ	16384µs
169kΩ	24576µs
182kΩ	32768µs
Open	2048µs

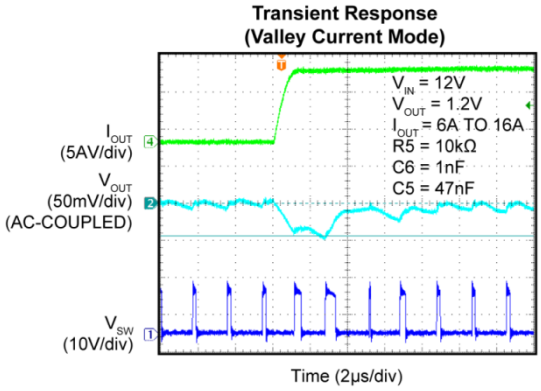
Evaluation Board Performance

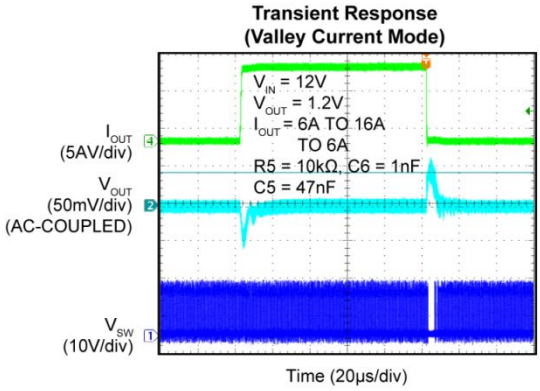


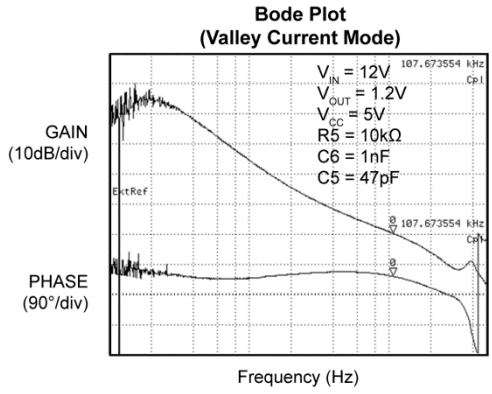


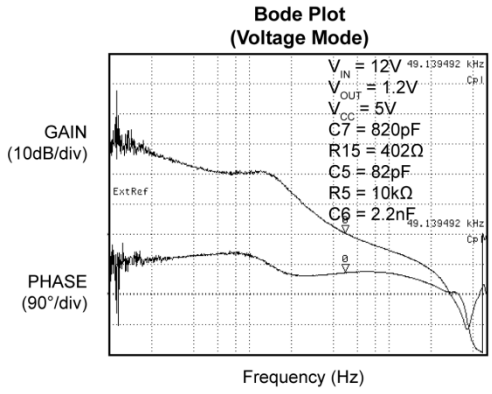




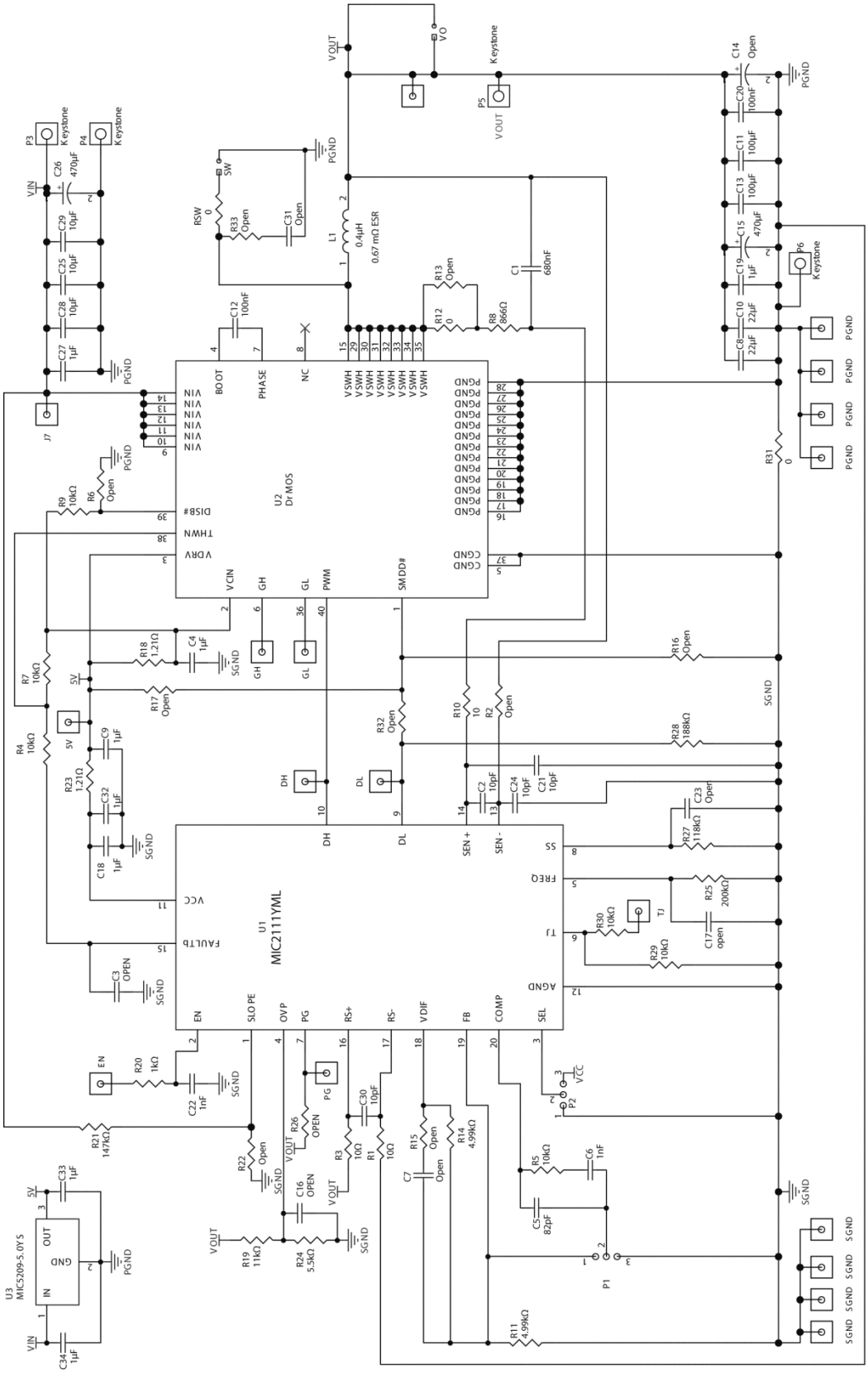








Evaluation Board Schematic



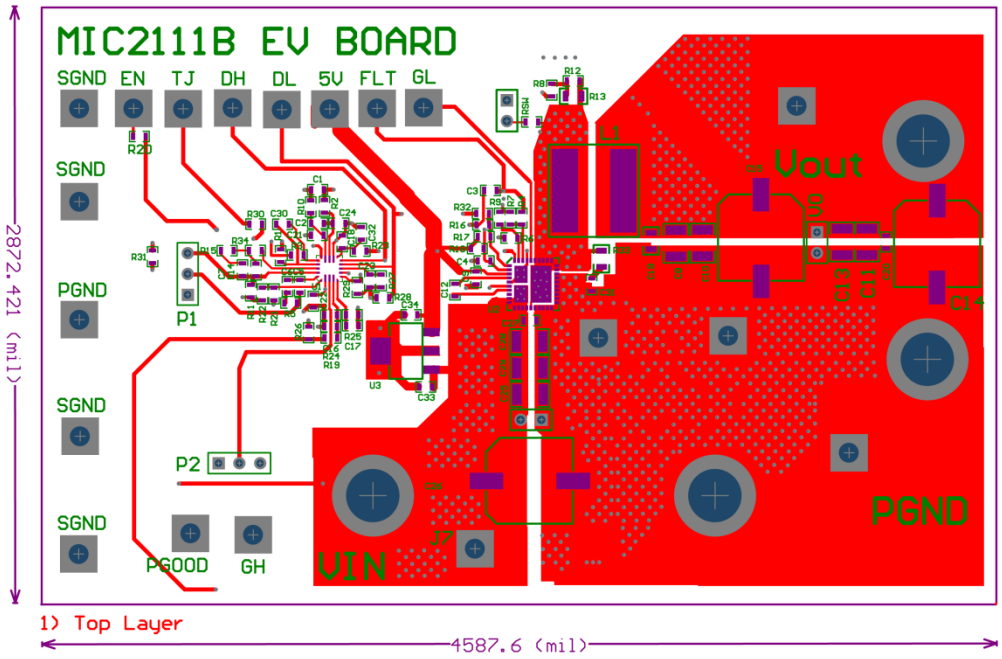
Bill of Materials

Item	Part Number	Manufacturer	Description	Qty.
C1	C1608X7R1C684K080AC	TDK[1]	0.68µF Ceramic Capacitor, X7R, 0603 Size, 16V	1
C2, C21, C24, C30	C1608C0G1H100D	TDK	10pF Ceramic Capacitor, COG, 0603 Size, 50V	4
C3, C7, C16, C17, C23,C31, R2, R6, R13, R15, R16, R17, R22, R26	OPEN			
C4, C9, C18, C19, C27,C32,C33,C34	C1608X5R1E105K	TDK	1µF Ceramic Capacitor, X5R, 0603 Size, 25V	6
C5	C1608C0G1H820J	TDK	82pF Ceramic Capacitor, COG, 0603 Size, 50V	1
C6, C22	C1608C0G1H102J	TDK	1nF Ceramic Capacitor, COG, 0603 Size, 50V	2
C8, C10	C3225X5R0J226M/1.60	TDK	22µF Ceramic Capacitor, X5R, 1210 Size, 6.3V	2
C11, C13	C3225X5R0J107M	TDK	100µF Ceramic Capacitor, X5R, 1210 Size, 6.3V	2
C12, C20	C1608X7R1E104K	TDK	100nF Ceramic Capacitor, X7R, 0603 Size, 25V	2
C15	6SVP470MX	Panasonic[2]	470µF OS-CON Capacitor, 6.3V	1
C25, C28, C29	C3225X5R1E106M	TDK	10µF Ceramic Capacitor, X5R, 1210 Size, 25V	2
C26	EEEFP1E471AP	Panasonic	470µF Alluminium Capacitor, 25V	1
L1	744325040	Wurth Electric[3]	0.4µH inductor, 37A saturation current	1
R1, R2, R3, R10	CRCW060310R0FKEA	Vishay Dale[4]	10Ω Resistor,0603 Size, 1%	4
R4, R5, R7, R9, R29, R30	CRCW060310K0FKEA	Vishay Dale	10kΩ Resistor,0603 Size, 1%	4
R8	CRCW0603866RFKEA	Vishay Dale	866Ω Resistor,0603 Size, 1%	1
R11, R14	CRCW06034K99FKEA	Vishay Dale	4.99kΩ Resistor,0603 Size, 1%	2
R11, R14	CRCW06034K99FKEA	Vishay Dale	4.99kΩ Resistor,0603 Size, 1%	2
R12, R31, RSW	CRCW06030000Z0EA	Vishay Dale	0Ω Resistor,0603 Size, 1%	3
R18, R23	CRCW06031R21FKEA	Vishay Dale	1.21Ω Resistor,0603 Size, 1%	2
R19	CRCW060311K0FKEA	Vishay Dale	11kΩ Resistor,0603 Size, 1%	1
R20	CRCW06031K00FKEA	Vishay Dale	1kΩ Resistor,0603 Size, 1%	1
R21	CRCW0603147KFKEA	Vishay Dale	147kΩ Resistor,0603 Size, 1%	1
R24	CRCW06035K49FKEA	Vishay Dale	5.5kΩ Resistor,0603 Size, 1%	1
R25	CRCW0603200KFKEA	Vishay Dale	200kΩ Resistor,0603 Size, 1%	1
R27	CRCW0603118KFKEA	Vishay Dale	118kΩ Resistor,0603 Size, 1%	1
R28	CRCW0603188KFKEA	Vishay Dale	188kΩ Resistor,0603 Size, 1%	1
U1	**MIC2111B**	**Micrel, Inc.[5]**	**High-Performance, Multi-Mode, Step-Down Controller**	**1**
U2	SiC780ACD	Vishay	Integrated DrMOS power stage	1
U3	**MIC5209-5.0YS**	**Micrel, Inc.**	**500mA Low Noise LDO Regulator**	**1**

Notes:

1. TDK: www.tdk.com.
2. Panasonic: www.industrial.panasonic.com.
3. Wurth Electronic: www.we-online.com.
4. Vishay Dale: www.vishay.com.
5. **Micrel, Inc.: www.micrel.com.**

PCB Layout Recommendations



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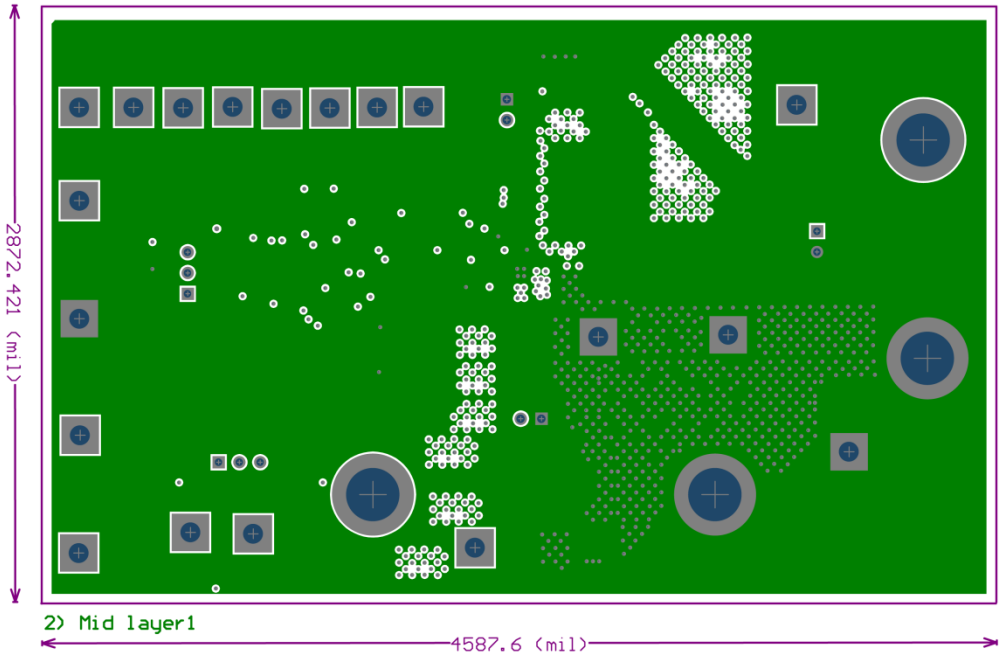
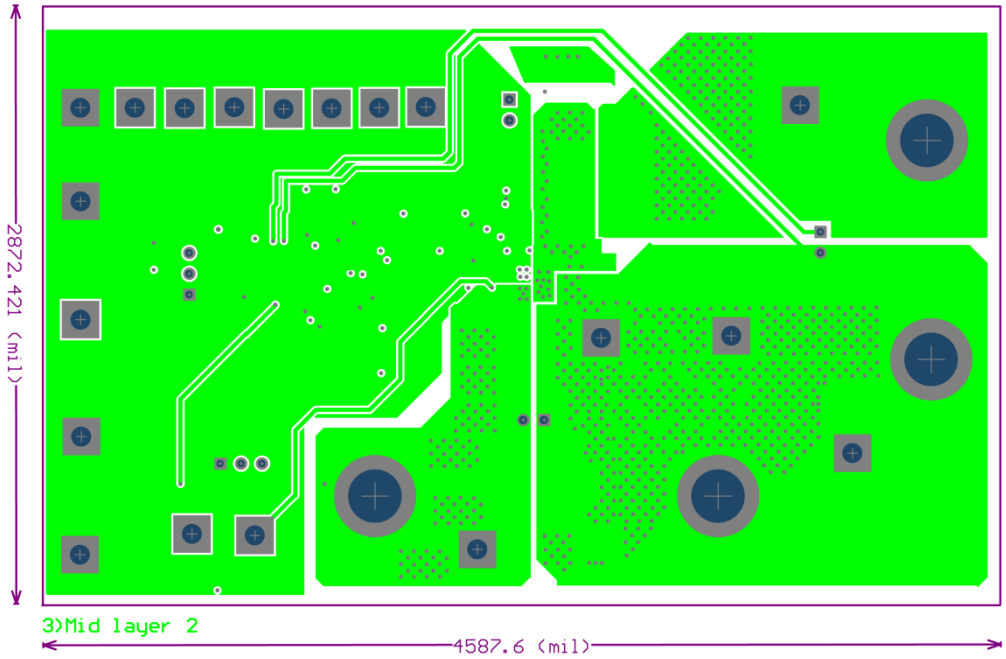


Mid Layer 1

PCB Layout Recommendations (Continued)



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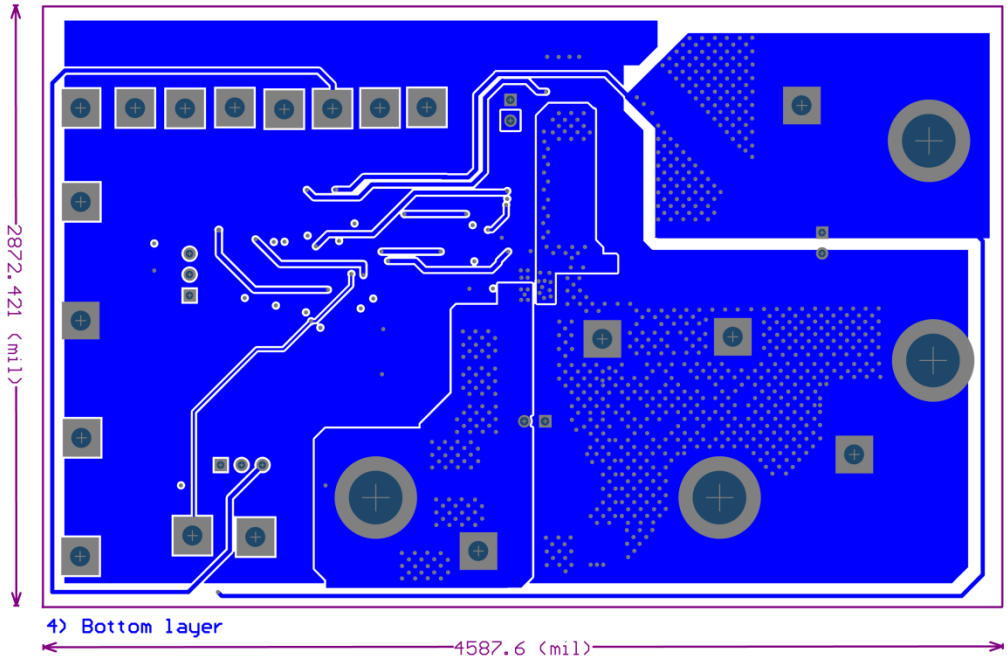

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