



MIC24054 Evaluation Board

9A, High-Efficiency, Synchronous DC/DC
Buck Regulator with HyperLight Load®

SuperSwitcher II™

General Description

The MIC24054 DC/DC synchronous buck regulator operates over an input supply range of 4.5V to 19V and provides a regulated output at up to 9A of load current. The output voltage is adjustable down to 0.8V with a typical accuracy of $\pm 1\%$.

Micrel's HyperLight Load® architecture maintains high efficiency under light load conditions by transitioning to variable frequency, discontinuous mode operation. The Hyper Speed Control™ allows smaller output capacitance. The device operates at a switching frequency of 600kHz, which remains relatively constant with changes in input voltage and output load.

The MIC24054 uses an adaptive T_{ON} ripple control architecture. An undervoltage lockout feature is provided to ensure proper operation under power-sag conditions. An internal soft-start feature is provided to reduce the inrush current. Foldback current limit and "hiccup" mode short-circuit protection, and thermal shutdown ensures protection of the IC during fault conditions.

The HyperLight Load and Hyper Speed Control features allow ideal transition from light load to full load and vice versa. The 19V operating rating of the device provides ample design safety margin for 12V input applications.

The basic parameters of the MIC24051 evaluation board are a VIN supply of 5V to 19V, output voltage of 0.8V to 5V at 6A⁽¹⁾, and 600kHz switching frequency.

Note:

1. Refer to the temperature curves shown in [Evaluation Board Performance](#). The typical minimum input voltage to maximum output voltage conversion is limited by the maximum duty cycle.

Datasheets and support documentation are available on Micrel's web site at: www.micrel.com.

Requirements

The MIC24054 evaluation board requires only a single power supply with at least 10A current capability. The MIC24054 has internal VDD LDO so no external linear regulator is required to power the internal biasing of the IC. When $V_{IN} < 5.5V$, VDD should be tied to PVIN pins to bypass the internal linear regulator by a jumper. The output load can be either active or passive.

HyperLight Load is a registered trademark of Micrel, Inc.

Hyper Speed Control, SuperSwitcher II, and Any Capacitor are trademarks of Micrel, Inc.

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Power-Up Precautions

The evaluation board does not have reverse polarity protection. Applying a negative voltage to the VIN terminal may damage the device. The maximum VIN operating voltage of the MIC24054 evaluation board is 19V. The evaluation board has two different layout designs, one optimized for evaluation ([Figure 1](#)) and another one optimized for smaller footprint ([Figure 2](#)). The evaluation board is only populated with components shown in schematic [Figure 1](#).

Getting Started

1. VIN Supply.

Connect a supply to the VIN and GND terminals, paying careful attention to the polarity and the supply range ($5V < V_{IN} < 19V$). An ammeter may be placed between the input supply and the VIN terminal to the evaluation board. Make sure 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 V_{OUT} 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 V_{OUT} terminal. Make sure that the output voltage is monitored at the V_{OUT} terminal.

3. Enable Input.

An EN connector is provided on the evaluation board so that users can easily access the enable feature. The output of the MIC24054 turns on when VDD exceeds the UVLO threshold. The output of the MIC24054 may be turned off by shorting the EN pin to ground.

4. Turn on the Power.

Turn on VIN power supply and verify that the output voltage is regulated to 1.8V.

Ordering Information

| Part Number | Description |
|----------------|--|
| MIC24054YJL EV | 9A HLL DC/DC Buck Regulator Evaluation Board |

Output Voltage

The output voltage on the MIC24054 evaluation board is adjustable. It is set by adjusting the feedback resistors, as shown in Equation 1:

$$V_{OUT} = V_{FB} \times \left(1 + \frac{R4}{R_{BOTTOM}} \right) \quad \text{Eq. 1}$$

where $V_{FB} = 0.8V$ and R_{BOTTOM} is one of the $R5, R6, R7, R8, R9, R10, R11, R12$, which corresponds to 0.9V, 1.0V, 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, or 5V, respectively. Leaving R_{BOTTOM} open gives a 0.8V output voltage. The output voltage is set at the factory for a 1.8V output, but it can easily be changed by moving the jumper to the corresponding position to get an indicated voltage on the board. If a desired voltage is not shown on the board, it is easily changed by removing R_{BOTTOM} and replacing it with the values that yield the desired output voltage. After $R4$ is selected, R_{BOTTOM} can be calculated using Equation 2.

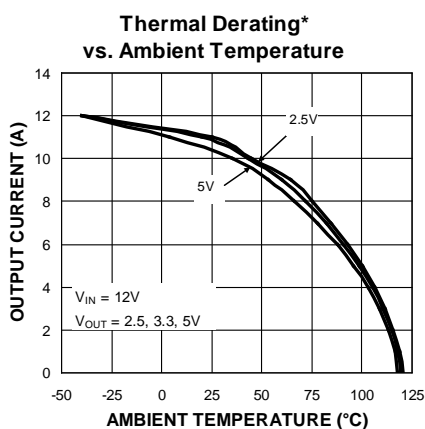
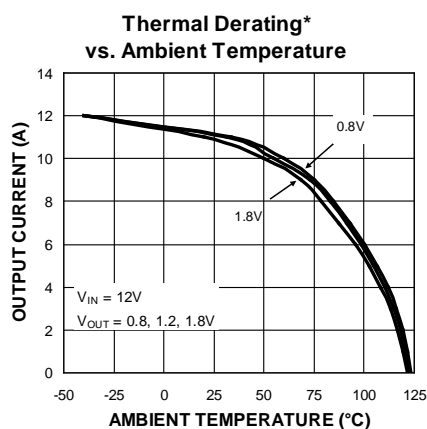
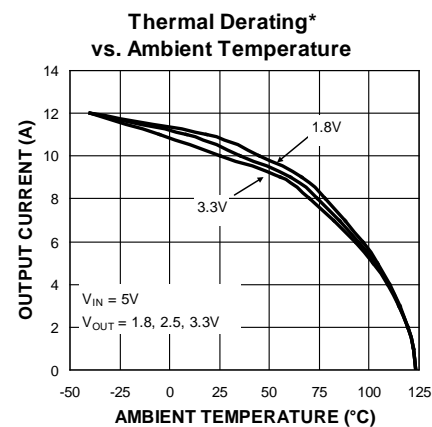
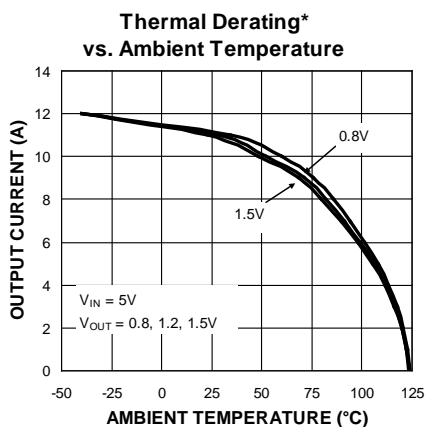
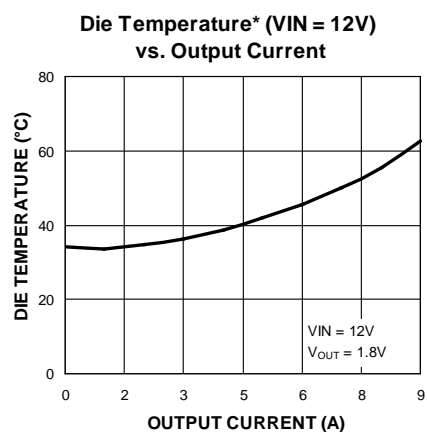
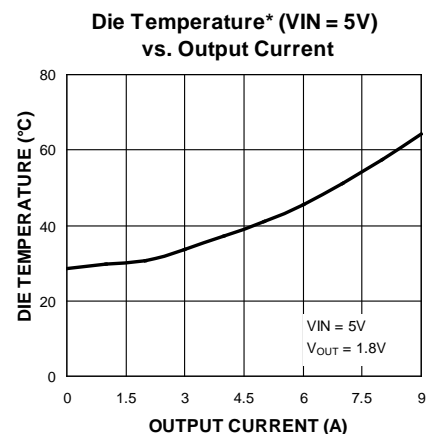
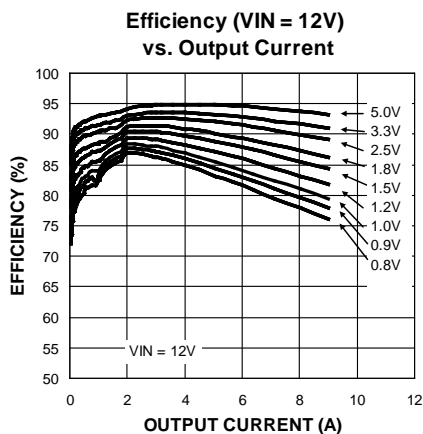
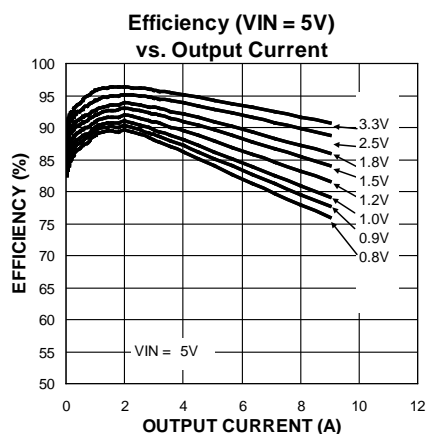
$$R_{BOTTOM} = \frac{R4 \times V_{FB}}{V_{OUT} - V_{FB}} \quad \text{Eq. 2}$$

For $V_{FB} = 0.8V$:

$$R_{BOTTOM} = \frac{R4 \times 0.8V}{V_{OUT} - 0.8V} \quad \text{Eq. 3}$$

Do not set the output voltage to exceed 5V because of the 6.3V rating of the output capacitor and the limitation of the line regulation. Please refer to the "Setting Output Voltage" and "Ripple Injection" subsections of the "Application Information" section of the MIC24054 datasheet for detailed information.

Evaluation Board Performance



Die Temperature* : The temperature measurement was taken at the hottest point on the MIC24054, which was case mounted on a 5 square inch, 4 layer, 0.62", FR-4 PCB with 2oz finish copper weight per layer, see the *Thermal Measurement* section of the MIC24054 datasheet. Actual results will depend upon the size of the PCB, ambient temperature and proximity to other heat emitting components.

Evaluation Board Schematic

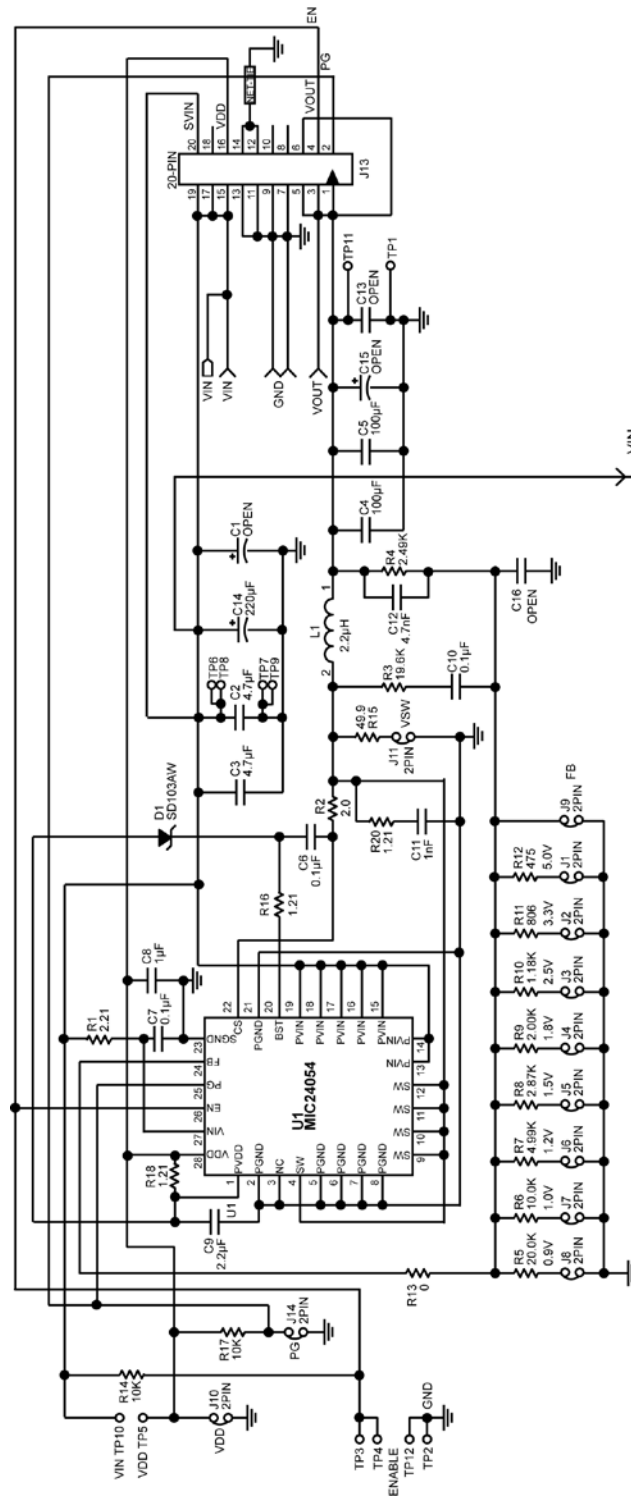


Figure 1. Schematic of MIC24054 Evaluation Board
(J11, R13, R15 are for testing purposes)

Evaluation Board Schematic (Continued)

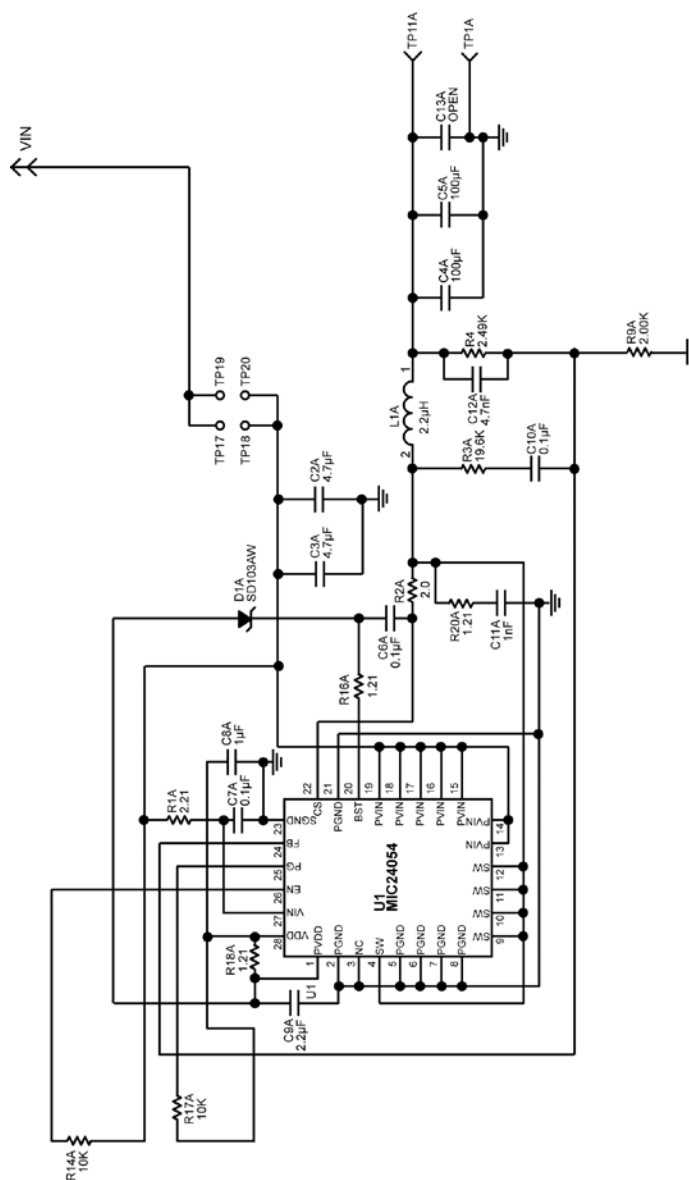


Figure 2. Schematic of MIC24054 Evaluation Board – Optimized for Smaller Footprint
(J11, R13, R15 are for testing purposes)

Bill of Materials

| Item | Part Number | Manufacturer | Description | Qty. |
|-------------|--------------------|--------------------------------|---|------|
| C1 | Open | | | |
| C2, C3 | 12103C475KAT2A | AVX ⁽¹⁾ | 4.7µF Ceramic Capacitor, X7R, Size 1210, 25V | 2 |
| | GRM32DR71E475KA61K | Murata ⁽²⁾ | | |
| | C3225X7R1E475K | TDK ⁽³⁾ | | |
| C13, C15 | Open | | | |
| C4, C5 | 12106D107MAT2A | AVX | 100µF Ceramic Capacitor, X5R, Size 1210, 6.3V | 2 |
| | GRM32ER60J107ME20L | Murata | | |
| | C3225X5R0J107M | TDK | | |
| C6, C7, C10 | 06035C104KAT2A | AVX | 0.1µF Ceramic Capacitor, X7R, Size 0603, 50V | 3 |
| | GRM188R71H104KA93D | Murata | | |
| | C1608X7R1H104K | TDK | | |
| C8 | 0603ZC105KAT2A | AVX | 1.0µF Ceramic Capacitor, X7R, Size 0603, 10V | 1 |
| | GRM188R71A105KA61D | Murata | | |
| | C1608X7R1A105K | TDK | | |
| C9 | 0603ZD225KAT2A | AVX | 2.2µF Ceramic Capacitor, X5R, Size 0603, 10V | 1 |
| | GRM188R61A225KE34D | Murata | | |
| | C1608X5R1A225K | TDK | | |
| C12 | 06035C472KAZ2A | AVX | 4.7nF Ceramic Capacitor, X7R, Size 0603, 50V | 1 |
| | GRM188R71H472K | Murata | | |
| | C1608X7R1H472K | TDK | | |
| C14 | B41851F7227M | EPCOS ⁽⁴⁾ | 220µF Aluminum Capacitor, 35V | 1 |
| C11, C16 | Open | | | |
| D1 | SD103AWS | MCC ⁽⁵⁾ | 40V, 350mA, Schottky Diode, SOD323 | 1 |
| | SD103AWS-7 | Diodes Inc. ⁽⁶⁾ | | |
| | SD103AWS | Vishay ⁽⁷⁾ | | |
| L1 | HCF1305-2R2-R | Cooper Bussmann ⁽⁸⁾ | 2.2µH Inductor, 15A Saturation Current | 1 |
| R1 | CRCW06032R21FKEA | Vishay Dale | 2.21Ω Resistor, Size 0603, 1% | 1 |
| R2 | CRCW06032R00FKEA | Vishay Dale | 2.00Ω Resistor, Size 0603, 1% | 1 |
| R3 | CRCW060319K6FKEA | Vishay Dale | 19.6kΩ Resistor, Size 0603, 1% | 1 |
| R4 | CRCW06032K49FKEA | Vishay Dale | 2.49kΩ Resistor, Size 0603, 1% | 1 |
| R5 | CRCW060320K0FKEA | Vishay Dale | 20.0kΩ Resistor, Size 0603, 1% | 1 |

Notes:

1. AVX: www.avx.com.
2. Murata: www.murata.com.
3. TDK: www.tdk.com
4. EPCOS: www.epcos.com.
5. MCC: www.mccsemi.com.
6. Diode Inc.: www.diodes.com.
7. Vishay: www.vishay.com.
8. Cooper Bussmann: www.cooperbussmann.com.

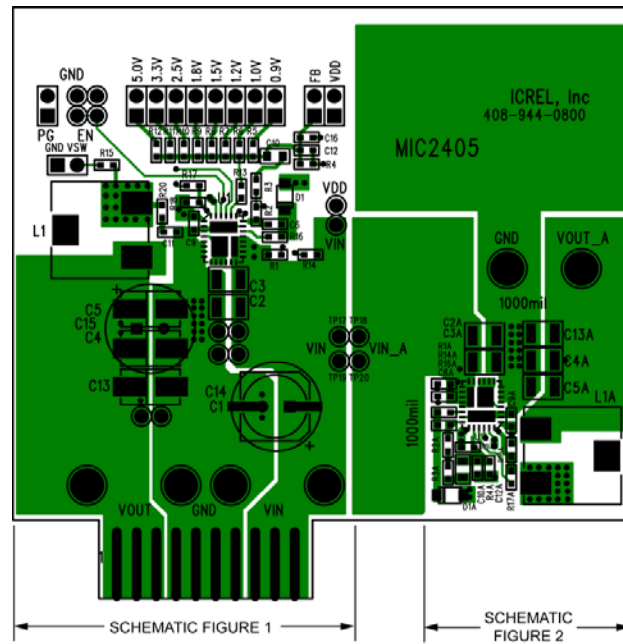
Bill of Materials (Continued)

| Item | Part Number | Manufacturer | Description | Qty. |
|---|--------------------|-----------------------------------|---|----------|
| R6, R14, R17 | CRCW060310K0FKEA | Vishay Dale | 10.0k Ω Resistor, Size 0603, 1% | 3 |
| R7 | CRCW06034K99FKEA | Vishay Dale | 4.99k Ω Resistor, Size 0603, 1% | 1 |
| R8 | CRCW06032K87FKEA | Vishay Dale | 2.87k Ω Resistor, Size 0603, 1% | 1 |
| R9 | CRCW06032K006FKEA | Vishay Dale | 2.00k Ω Resistor, Size 0603, 1% | 1 |
| R10 | CRCW06031K18FKEA | Vishay Dale | 1.18k Ω Resistor, Size 0603, 1% | 1 |
| R11 | CRCW0603806RFKEA | Vishay Dale | 806 Ω Resistor, Size 0603, 1% | 1 |
| R12 | CRCW0603475RFKEA | Vishay Dale | 475 Ω Resistor, Size 0603, 1% | 1 |
| R13 | CRCW06030000FKEA | Vishay Dale | 0 Ω Resistor, Size 0603, 5% | 1 |
| R15 | CRCW060349R9FKEA | Vishay Dale | 49.9 Ω Resistor, Size 0603, 1% | 1 |
| R16, R18 | CRCW06031R21FKEA | Vishay Dale | 1.21 Ω Resistor, Size 0603, 1% | 2 |
| R20 | Open | | | |
| All Reference designators ending with "A" | Open | | | |
| U1 | MIC24054YJL | Micrel, Inc.⁽⁹⁾ | 9A, High-Efficiency, Synchronous DC/DC Buck Regulator with HyperLight Load | 1 |

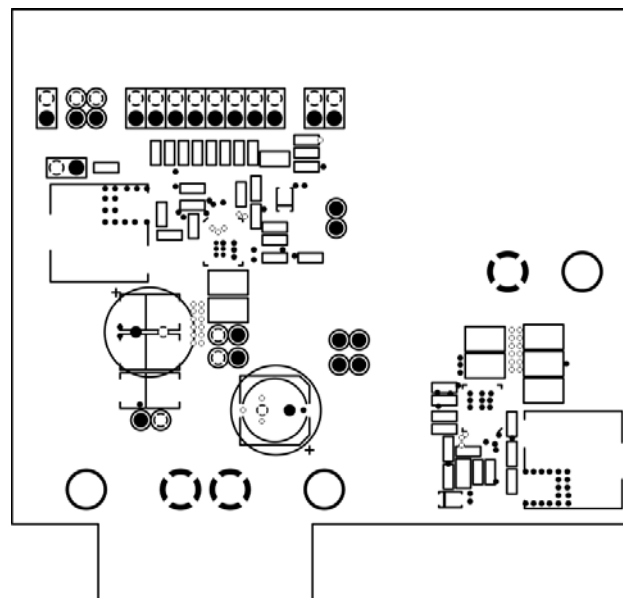
Note:

9. Micrel, Inc.: www.micrel.com.

PCB Layout Recommendations⁽¹⁾



Top Layer

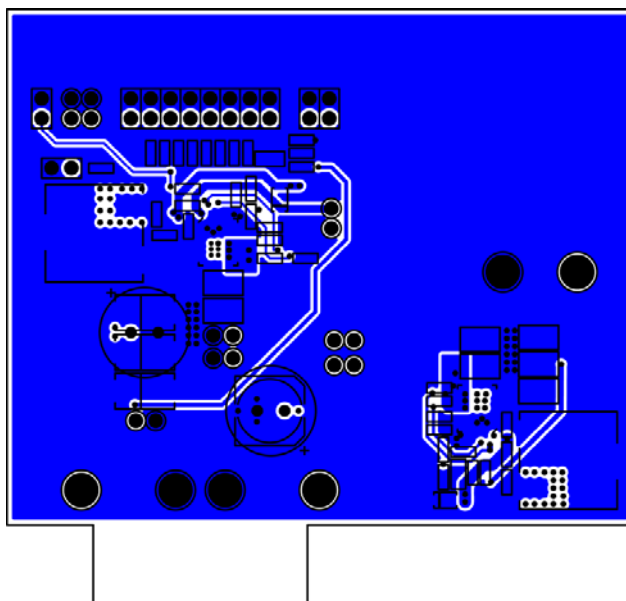


Mid-Layer 1 (Power Ground Plane)

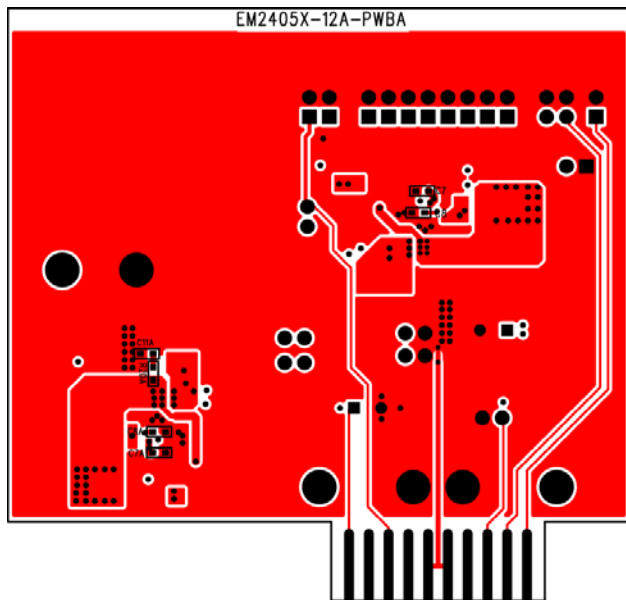
Note:

1. Refer to "PCB Layout Guideline" section for component placement and layout in MIC24054 datasheet on Micrel web page (www.micrel.com)

PCB Layout Recommendations⁽¹⁾ (Continued)



Mid-Layer 2



Bottom Layer

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