

## ***PMP15019 Test Results***

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**Test Data**

**PMP15019**

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## Circuit Description

PMP15019 uses the LM5141-Q1 to evaluate the operation and performance of the LM5141-Q1 synchronous buck controller in high current applications. The PMP15019 operates over the input voltage range of 5.5V to 42 V. The maximum load current is 15A continuous, 20A transient. The LM5141-Q1 oscillator frequency is set to switch at 440 kHz to minimize the switching losses to obtain the maximum efficiency.

## Power Specification

<b>V<sub>IN</sub> Min. (Default)</b>	<b>5.5V</b>
<b>V<sub>IN</sub> Max.</b>	<b>42V</b>
<b>V<sub>OUT</sub> (Default)</b>	<b>5V (±1%)</b>
<b>I<sub>OUT</sub></b>	<b>15A, 20A transient</b>
<b>Switching Frequency (Default)</b>	<b>440 kHz</b>

## PMP15019 Board Photo (with LM5141-Q1)

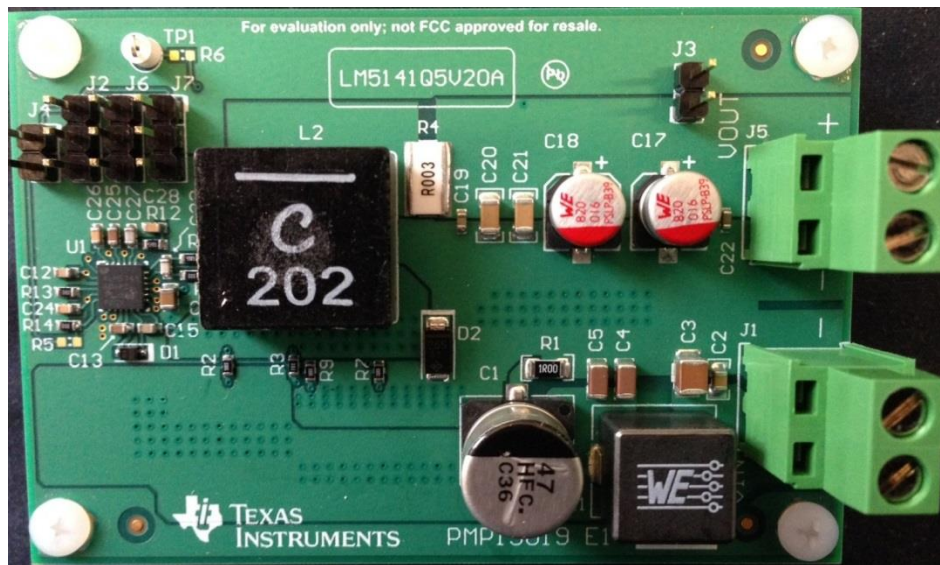


Figure 1. PMP15019 Top Side PCB, 3.0 inches X 2.0 inches

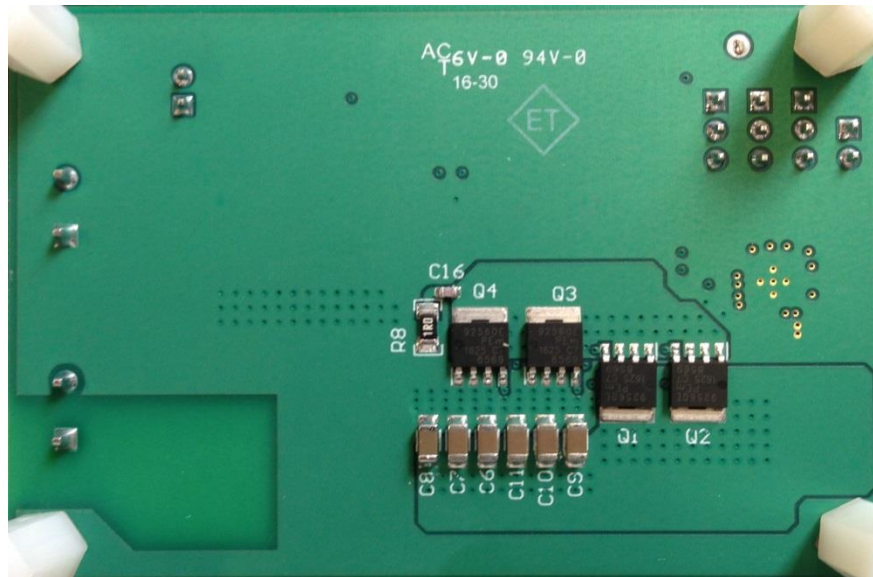


Figure 2. PMP15019 Bottom Side PCB

Thermal Image of the EVM at  $V_{IN}$  12V,  $I_{OUT}$ =15A,  $T_A$ =25°C

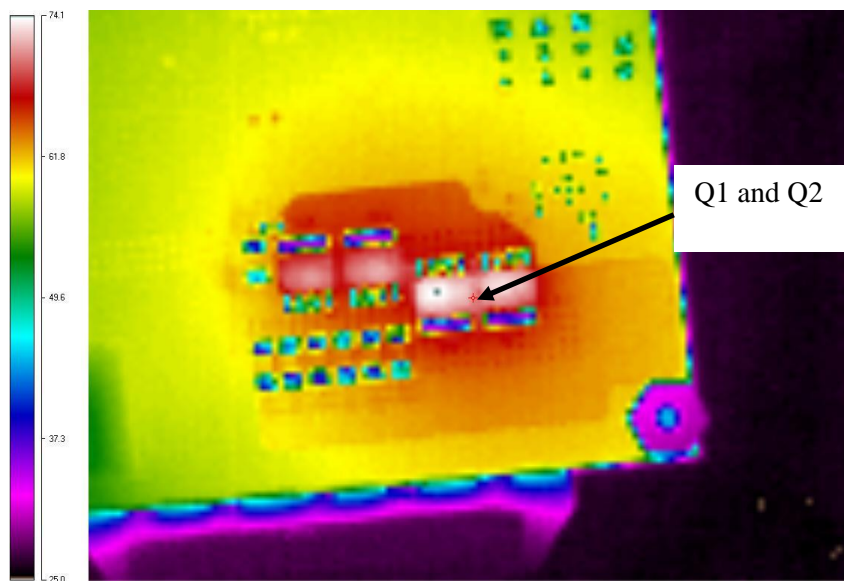


Figure 3. Bottom Side PCB

Figure 2 show the bottom side of the PCB, the case temperature of Q1 and Q2 is 74.1°C with  $V_{IN}$  12V and a 15A load.

Thermal Image of the EVM at  $V_{IN}$  12V,  $I_{OUT}$ =15A,  $T_A$ =25°C

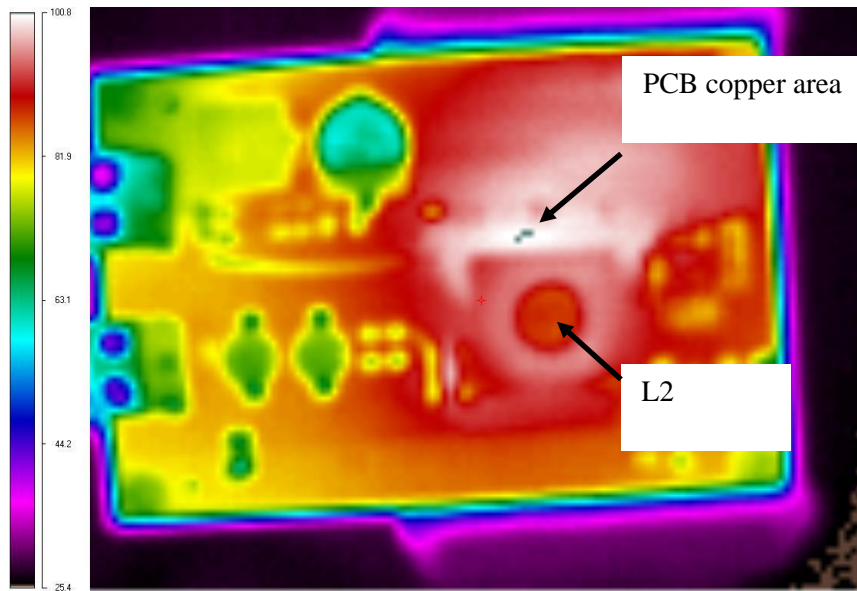
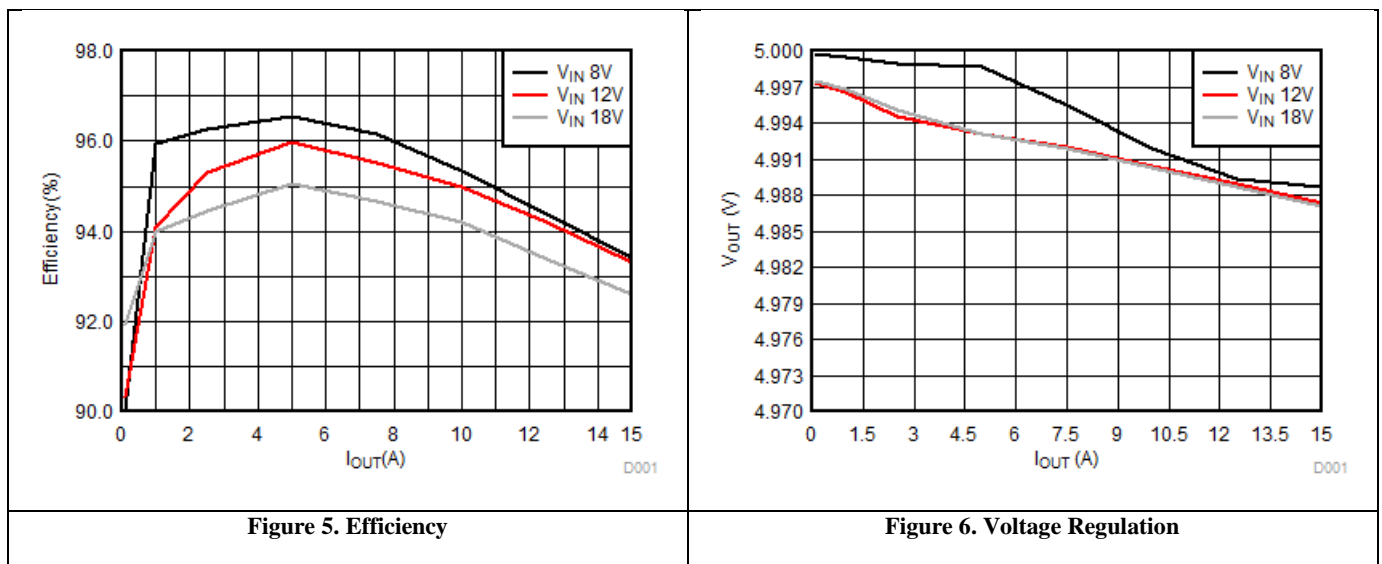


Figure 4. Top Side PCB

Figure 3 shows the top side of the PCB, the output inductor (L3) is 55°C with  $V_{IN}$  12V and a 15A load.

## PMP15019 Data



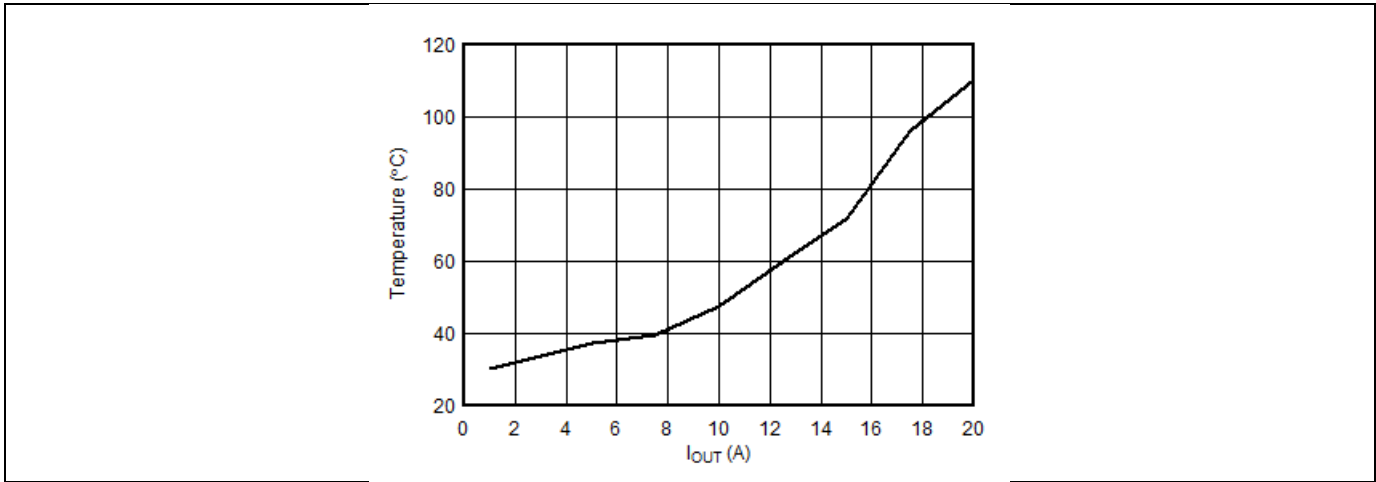


Figure 7. MOSFET (Q1 and Q2) Case Temperature °C vs I<sub>OUT</sub> V<sub>IN</sub> 12V

## Start Up

Test condition: V<sub>IN</sub> = 12V, No-load  
 C1 (Yellow) – V<sub>IN</sub>  
 C2 (Red) – V<sub>OUT</sub>  
 C3 (Blue) –Soft Start

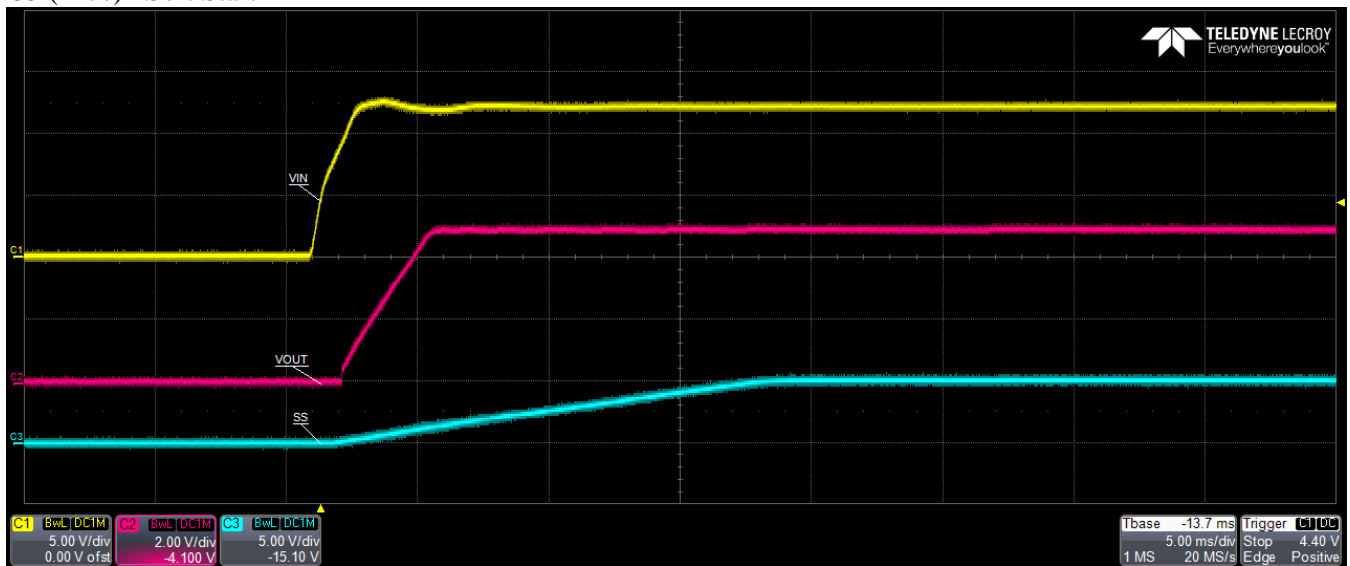


Figure 8. Startup at No Load

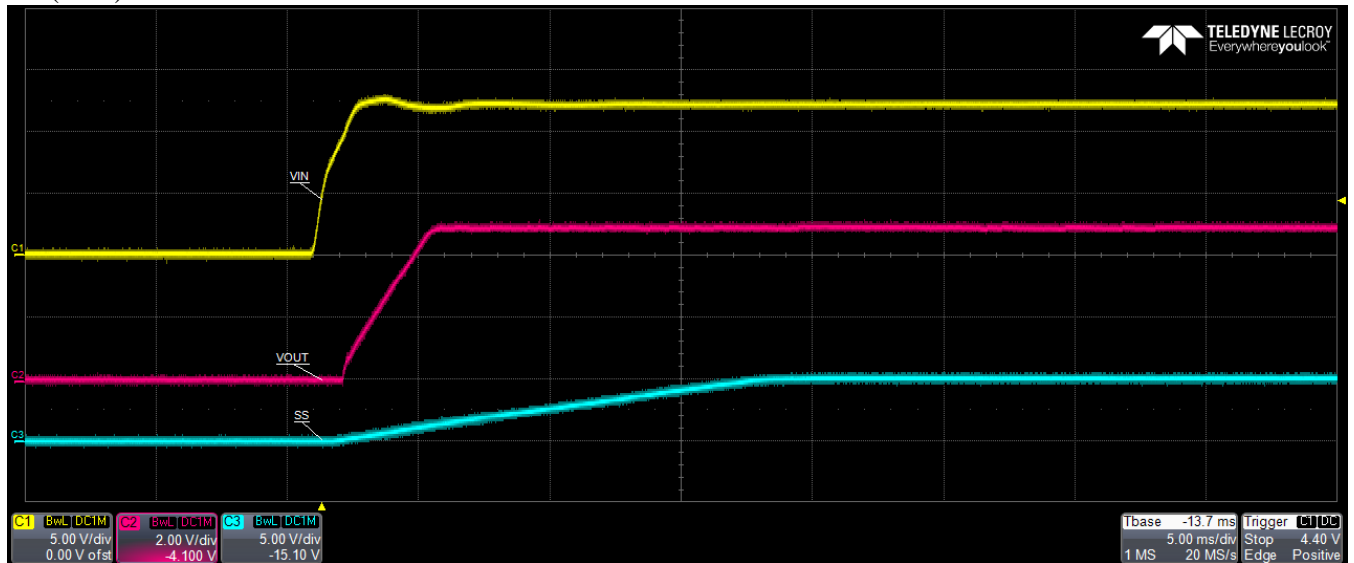
Figure 8 shows the no-load startup waveform, the start-up is monotonic with no output overshoot.

Test condition:  $V_{IN} = 12V$ , Maximum Load (15A)

C1 (Yellow) –  $V_{IN}$

C2 (Red) –  $V_{OUT}$

C3 (Blue) – Soft Start



**Figure 9. Startup at Full load**

Figure 8 shows the full load start-up, the start-up is monotonic with no output overshoot.

## Load Transients

### Load Step (1.5A-13.5A), $0.6A/\mu s$

Test condition:  $V_{IN} = 12V$

CH2 (Red)-  $V_{OUT}$  (AC coupled);  $\Delta V_{SEC} = 400mV$  peak to peak

CH4 (Green) -  $I_{OUT}$



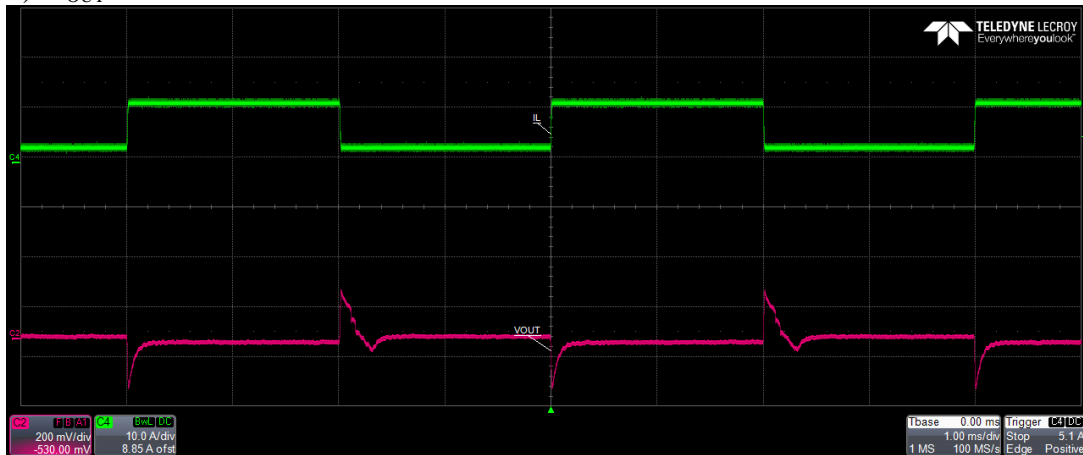
**Figure 10. Load Step Response 1.5A-13.5A**

**Load Step (3A-12A), 0.6A/μs**

Test condition:  $V_{IN} = 12V$

CH2 (Red)-  $V_{OUT}$  (AC coupled);  $\Delta V_{SEC} = 225mV$  peak to peak

CH4 (Green) -  $I_{OUT}$



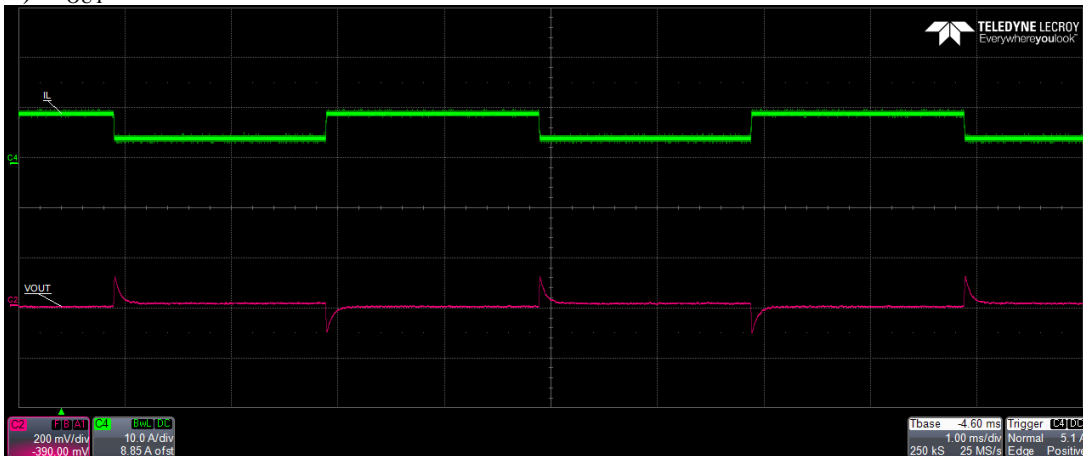
**Figure 11. Load Step Response 3A-12A**

**Load Step (5A-10A), 0.6A/μs**

Test condition:  $V_{IN} = 12V$

CH2 (Red)-  $V_{OUT}$  (AC coupled);  $\Delta V_{SEC} = 125mV$  peak to peak

CH4 (Green) -  $I_{OUT}$



**Figure 12. Transient Response 5A-10A**

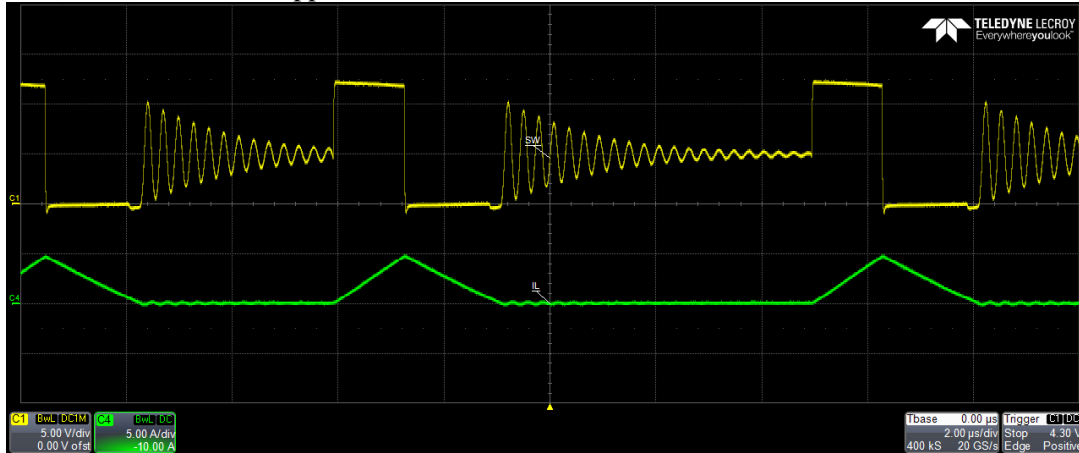


## SW Node Voltage and Inductor Ripple Current Waveforms

Test condition:  $V_{IN} = 12V$ ,  $I_{OUT} = 0.1A$

C1 (Yellow) - Switch node voltage

C4 (Green) – Inductor ripple current

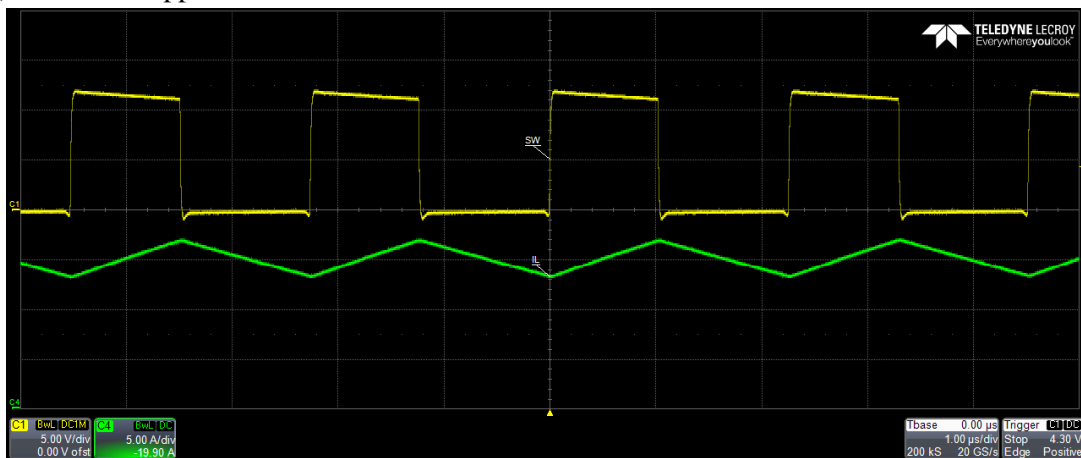


**Figure 13. Steady State at 0.1A Load**

Test condition:  $V_{IN} = 12V$ ,  $I_{OUT} = 15A$

C1 (Yellow) - Switch node voltage

C4 (Green) – Inductor ripple current



**Figure 14. Steady State 15A Load**

## Short Circuit Test

Test Conditions:  $V_{IN}=12V$

C2 (Red) -  $V_{OUT}$   
 C3 (Blue) - RES pin  
 C4 (Green) -  $I_{OUT}$

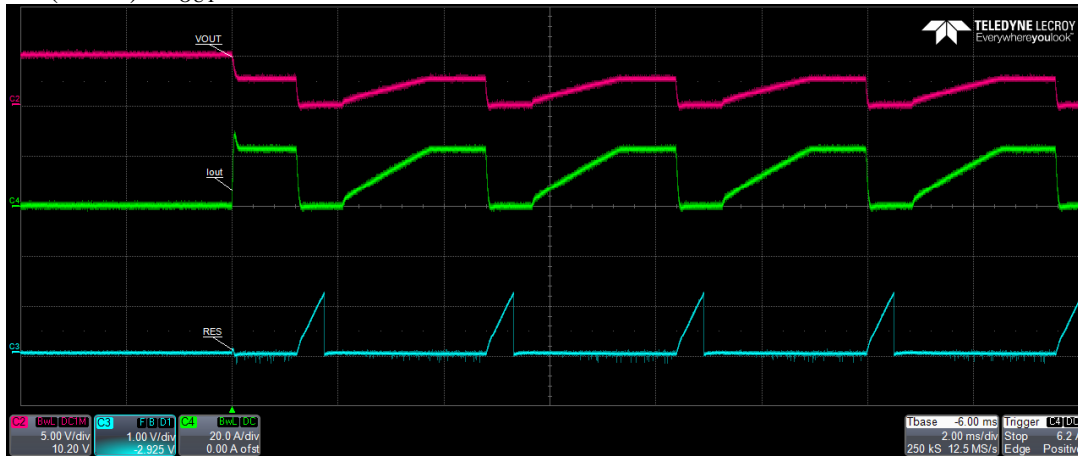


Figure 15. Overload

## Electromagnetic Interference Testing CISPR 25 Class 5

Yellow- Peak  
 Blue-Average

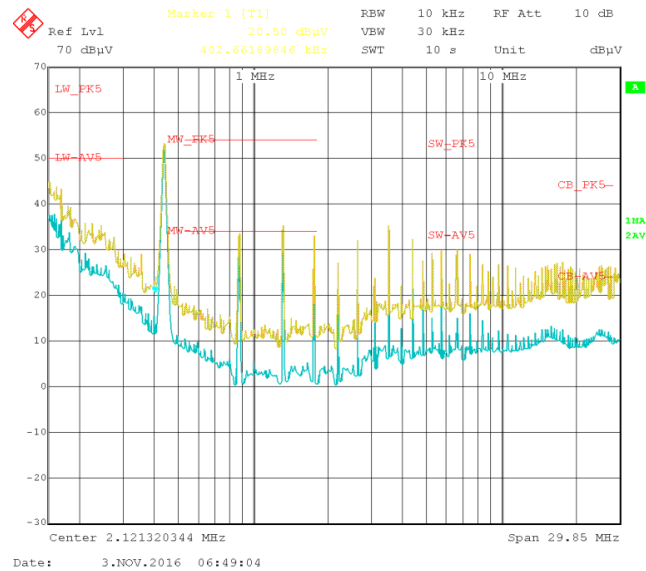


Figure 16. CISPR Class 5 Limits, 150 kHz to 30 MHz, Without Dither

Yellow- Peak  
Blue-Average

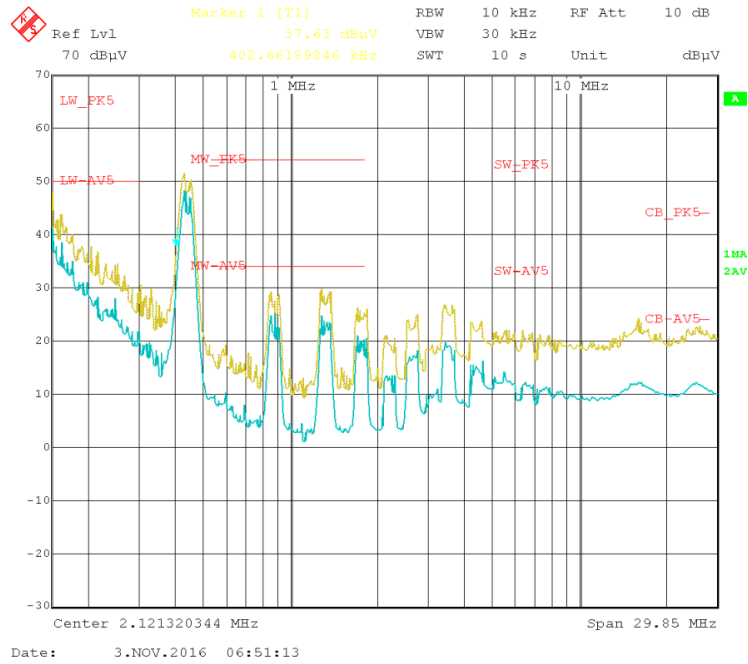


Figure 17. CISPR Class 5 Limits, 150 kHz to 30 MHz, With Dither

Using the Dither feature the 440 kHz switching frequency harmonic is reduced by 3 dB.

Yellow- Peak  
Blue-Average

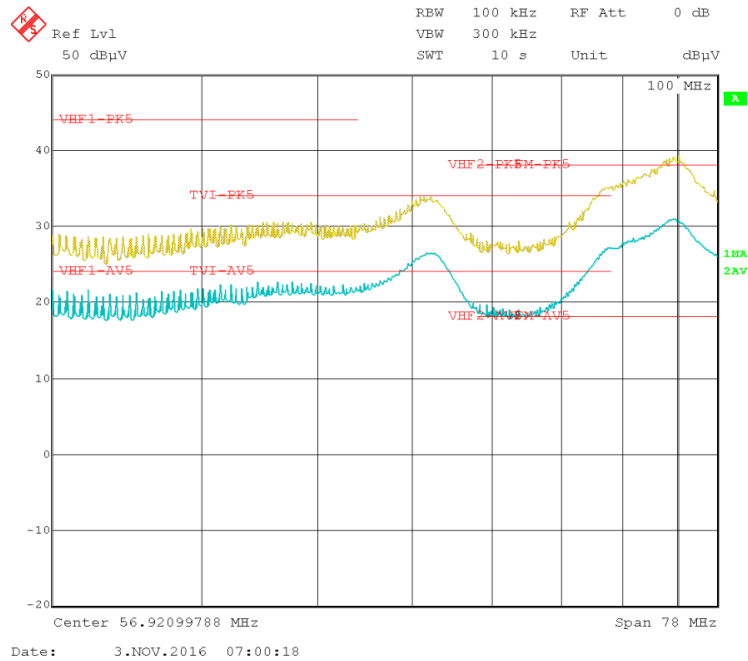


Figure 18. CISPR 25 Class 5 Limits, 30 MHz to 108MHz, Without Dither

Yellow- Peak  
Blue-Average

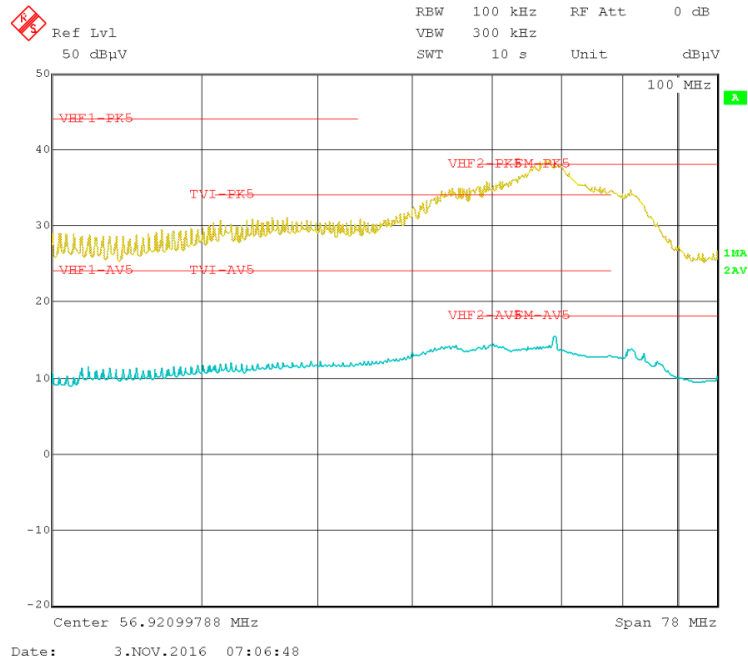


Figure 19. CISPR 25 Class 5 Limits, 30 MHz to 108MHz, With Dither

Using the Dither feature the harmonic in the 30 kHz to 108 MHz is reduced by 3 dB.

## Bode Plot

Test conditions:  $V_{IN}=12V$ ,  $V_{OUT}=5.0V$ ,  $I_{OUT}=15A$

The gain crossover frequency is 38 kHz with a phase margin of 75 degrees.

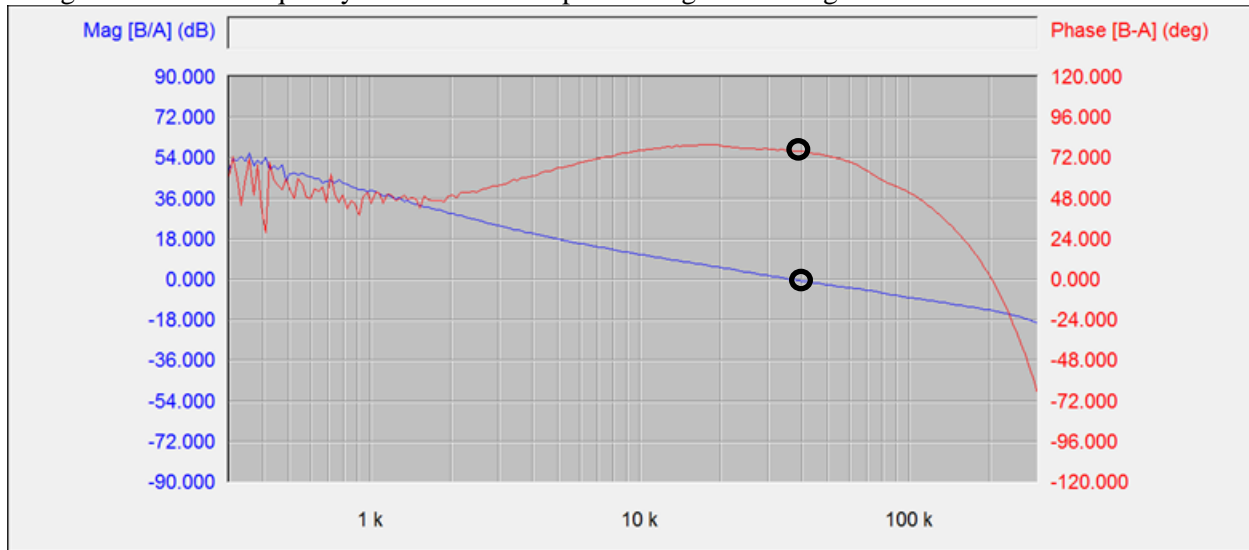


Figure 20. Bode Plot, Loop Gain and Phase

## Printed Circuit Board Layers

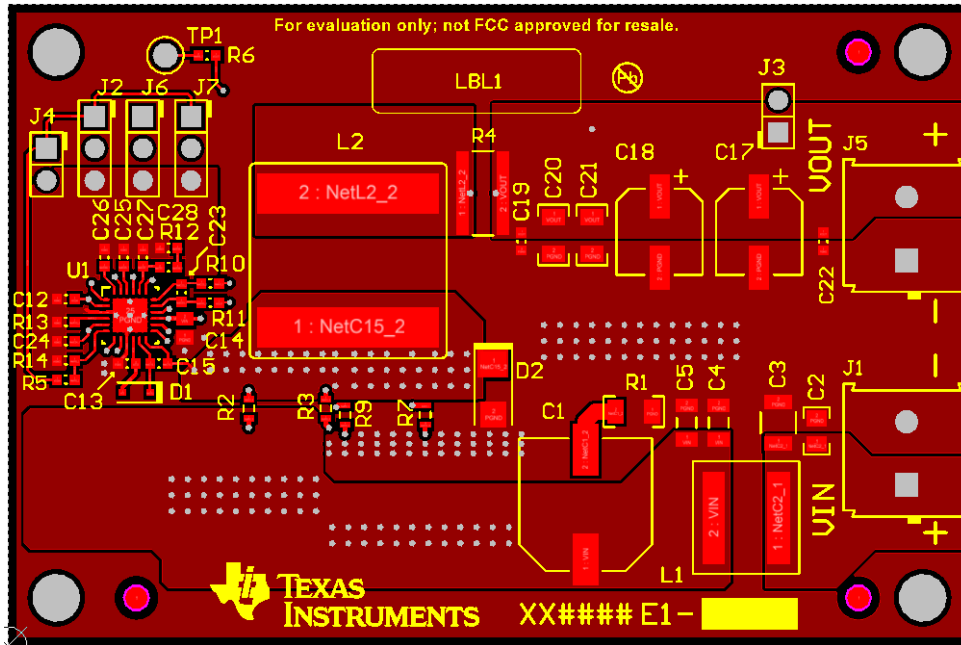


Figure 22. Top layer Assembly Drawing

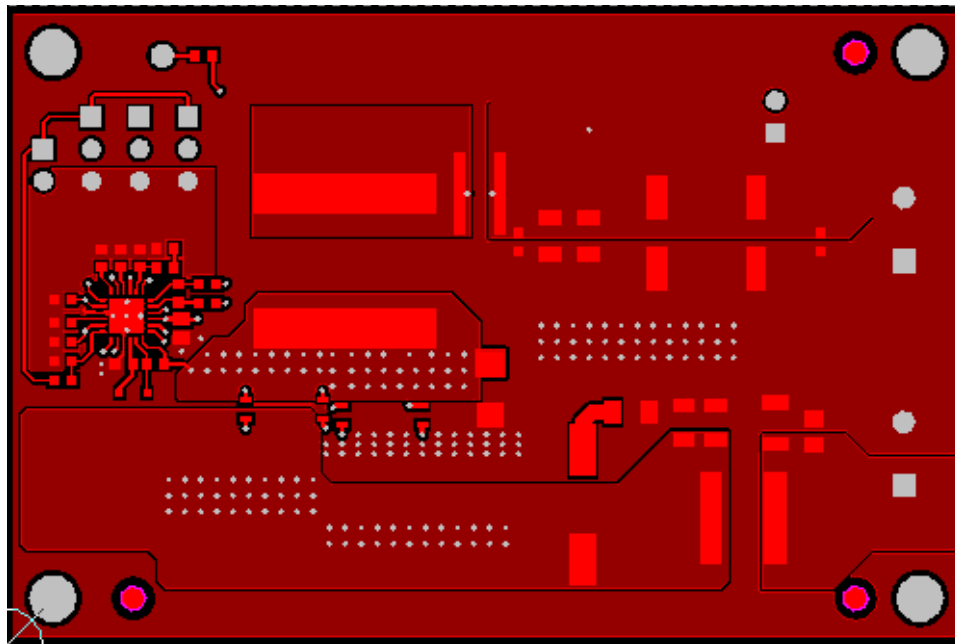


Figure 23. Top Layer Copper

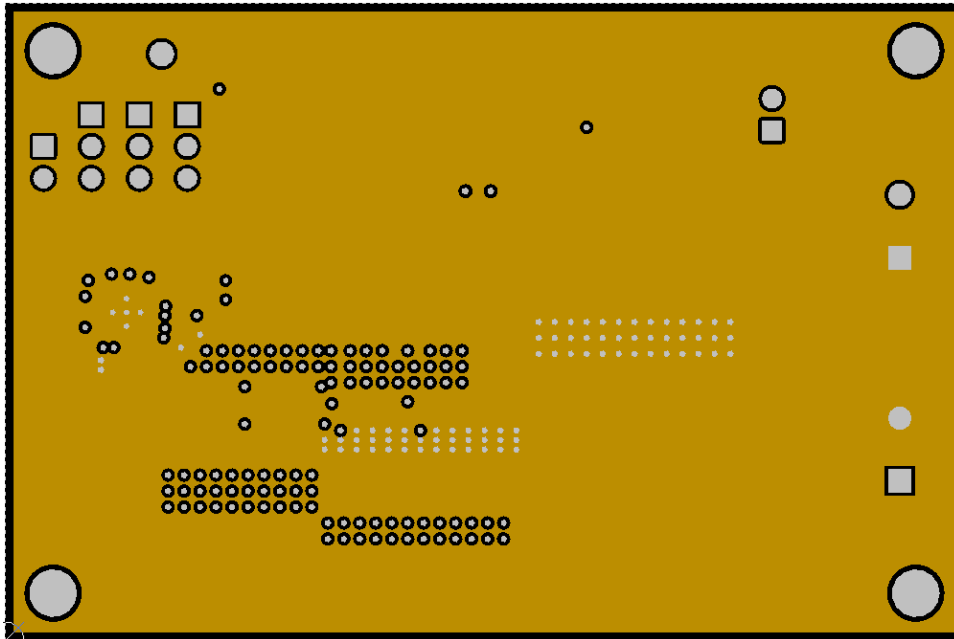


Figure 24. Layer 1 Copper

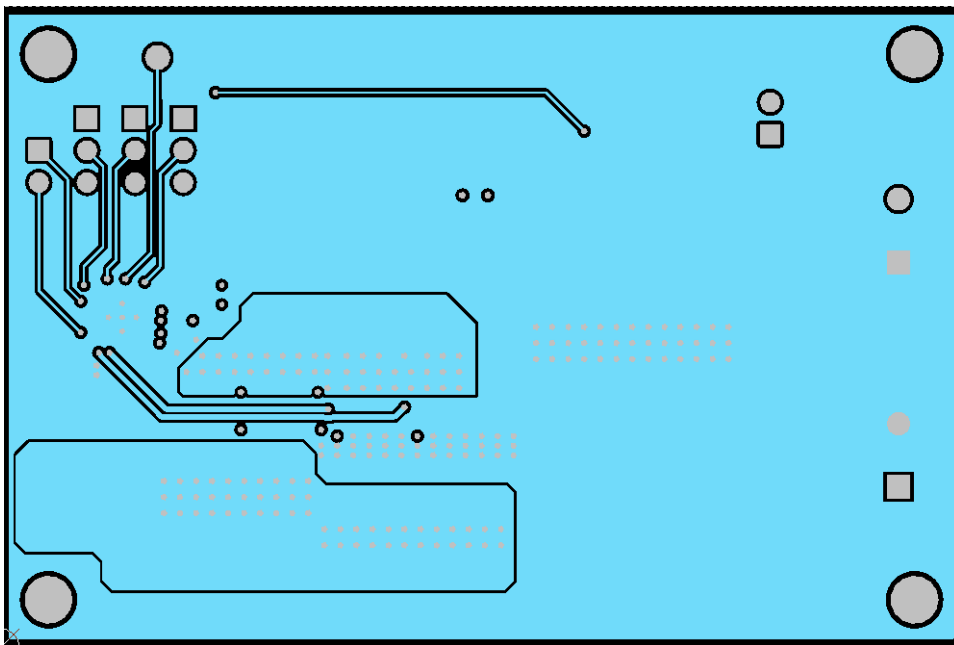


Figure 25. Layer 2 Copper

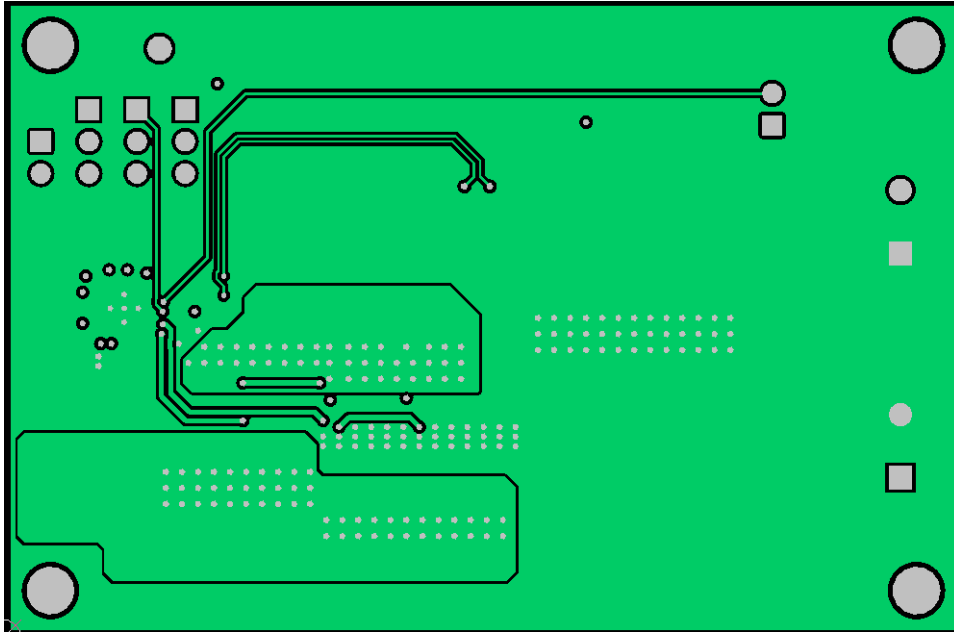


Figure 26. Layer 3 Copper

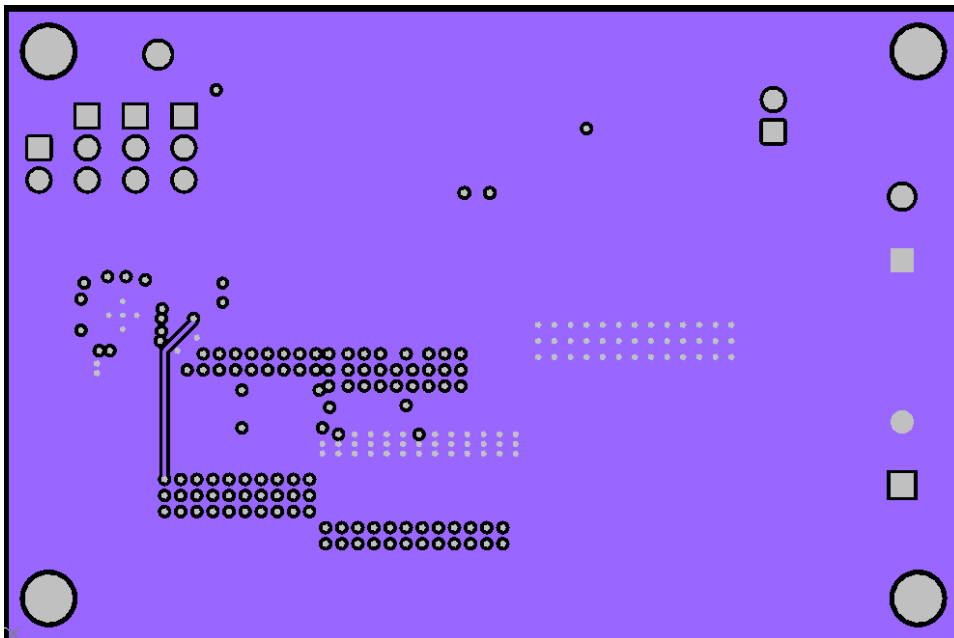


Figure 27. Layer 4 Copper



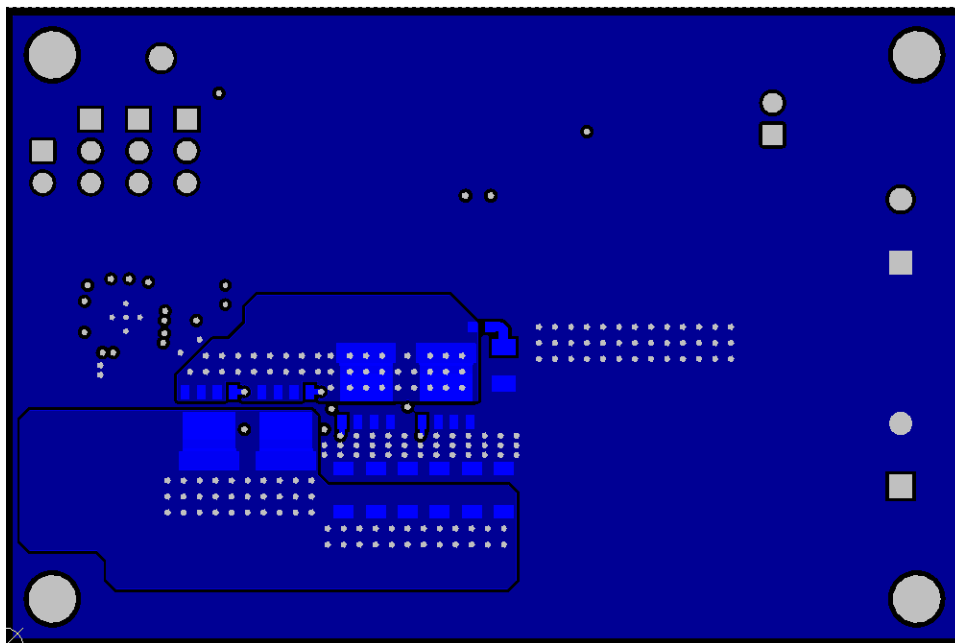


Figure 28. Bottom Layer Copper

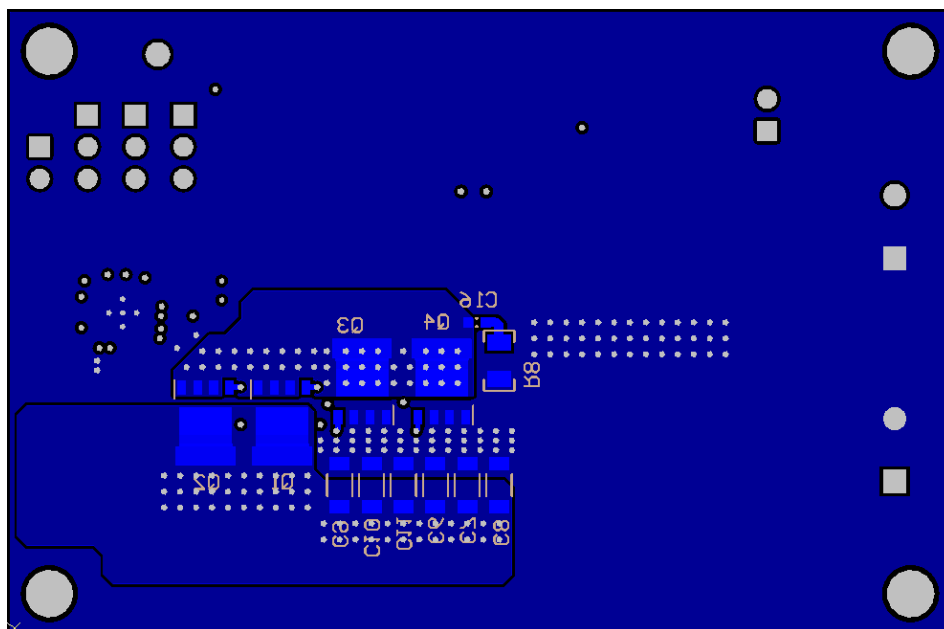


Figure 29. Bottom layer Assembly

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
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