AN-2280 LMR10530 Evaluation Module

1 Introduction

The LMR10530 evaluation module is designed to provide the power supply design engineer with a fully functional regulator design using the LMR10530 3MHz switching regulator in an WSON-10 package. The evaluation module is configured to provide an output of 1.2V at up to 3A from an input voltage range of 3V to 5.5V.

The printed circuit board consists of 4 layers of copper on FR4 material. The middle layers are solid ground layers with the first middle layer having a small polygon cut out for the V_{IN} node. The intermediate ground layer helps in minimizing the AC current loop. The LMR10530 is thermally tied to the other layers by thermal vias directly underneath the device. This user's guide contains the evaluation module schematic, a quick setup procedure, and a Bill-of-Materials (BOM). For complete circuit design information, see *LMR10530 SIMPLE SWITCHER 5.5Vin, 3.0A Step-Down Voltage Regulator in WSON-10* (SNVS814).

The module has a C_{ff} capacitor footprint reserved for applications requiring higher V_{OUT}. The C_{ff} cap also helps to minimize the output voltage overshoot during sluggish startup. For suggested cap values, see the LMR10530 datasheet (SNVS814). The module also has a reserved footprint for an additional output cap, C_{o2}, for certain applications requiring more capacitance.

The performance of the evaluation board is:

- Input Range: 3 to 5.5V
- Output Voltage: 1.2V
- Output Current: 0 to 3A
- Frequency of Operation: 3000 kHz
- Board Size: 2.016 × 1.08 inches (51.2 × 27.43 mm)

2 Evaluation Board Schematic

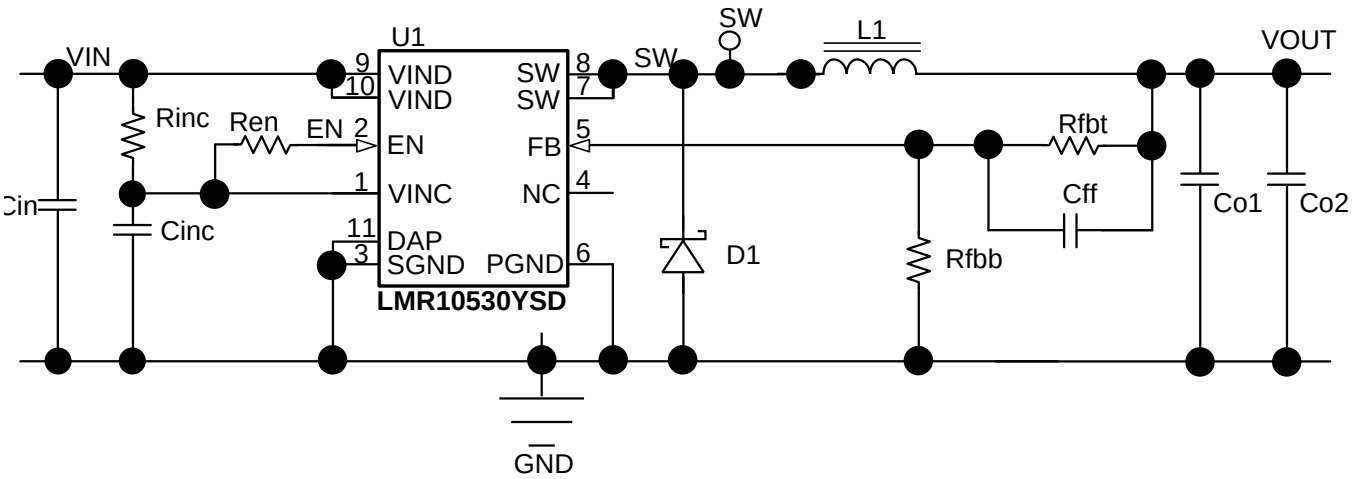


Figure 1. LMR10530 Evaluation Module Schematic

3 Powering and Loading Considerations

Read this entire section prior to attempting to power the evaluation board.

3.1 Quick Start Procedure

Step 1: Set the bench power supply current limit to 3A. Set the power supply voltage to 4V. Turn off the power supply output. Connect the power supply to the LMR10530 demo board. Positive connection to V_{IN} and negative connection to GND.

Step 2: Connect a load, as high as 3A, to the V_{OUT} terminal. Positive connection to V_{OUT} and negative connection to GND.

Step 3: The EN pin should be left open for normal operation.

Step 4: Turn on the bench power supply with no load applied to the LMR10530. The V_{OUT} would be in regulation at a nominal 1.2V output.

Step 5: Slowly increase the load while monitoring the output voltage, V_{OUT} should remain in regulation as the load is increased up to 3 Amps. The LMR10530 is designed to skip some pulses at very light loads to maintain output voltage regulation. Depending on load levels, the circuit may operate in either discontinuous or continuous conduction mode.

Step 6: Slowly sweep the input voltage from 3 to 5.5V, V_{OUT} should remain in regulation with a nominal 1.2V output.

3.2 Starting Up

By default, VINC is connected to V_{IN} through a low pass filter to remove any high frequency noise present at the input. EN is connected to VINC through a 100kΩ resistor. A separate logic signal at the EN terminal can be used, if startup and shutdown need to be controlled. The EN pin is tied to V_{IN} to simplify start-up. The pull-up resistor allows the power supply design engineer to toggle EN independently, if desired, and observe the start-up behavior of the LMR10530.

3.3 Adjusting the Output Voltage

The output voltage is set using the following equation where R_{fbb} is connected between the FB pin and GND, and R_{fbt} is connected between V_{OUT} and FB.

$$V_{OUT} = V_{FB}(1 + (R_{fbt}/R_{fbb})) \quad (1)$$

The feedback voltage VFB is regulated at 0.60V typically.

Adjusting the output voltage will affect the performance of the LMR10530. In addition, output capacitors might not be rated for the new output voltage. For more information, see *LMR10530 SIMPLE SWITCHER 5.5Vin, 3.0A Step-Down Voltage Regulator in WSON-10* (SNVS814).

3.4 Typical Test Setup

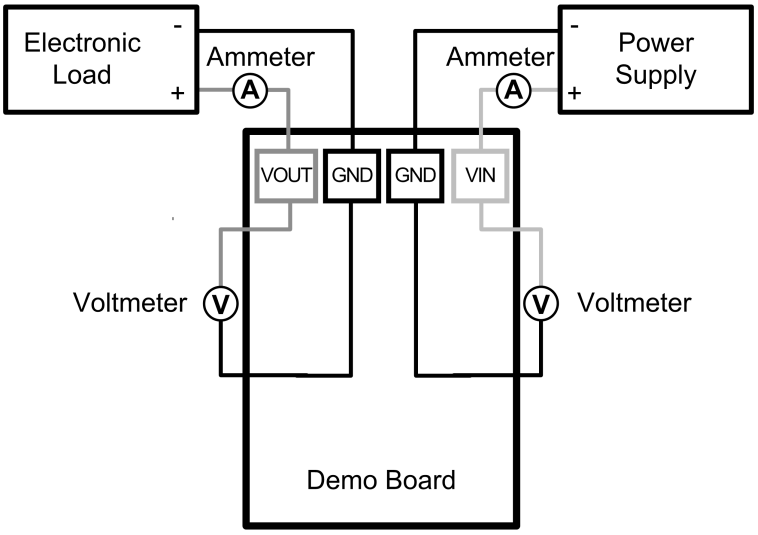


Figure 2. Efficiency Measurements

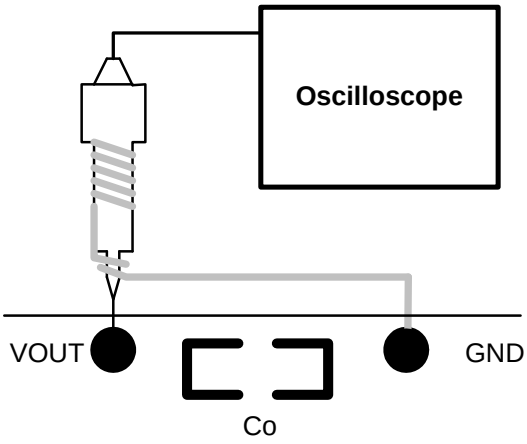


Figure 3. Voltage Ripple Measurements

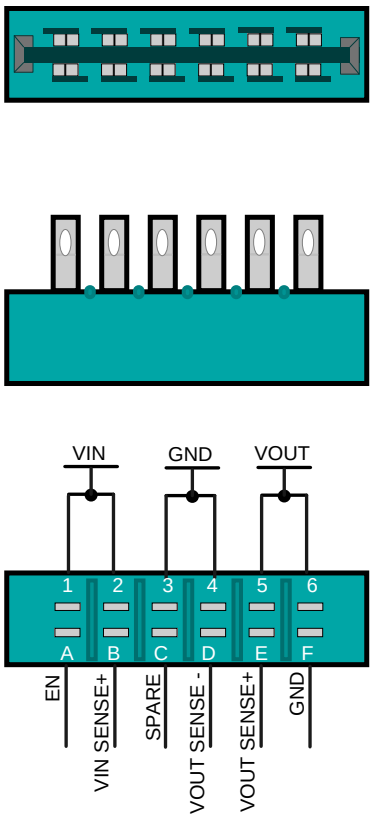


Figure 4. Edge Connector Schematic

4 Board Images

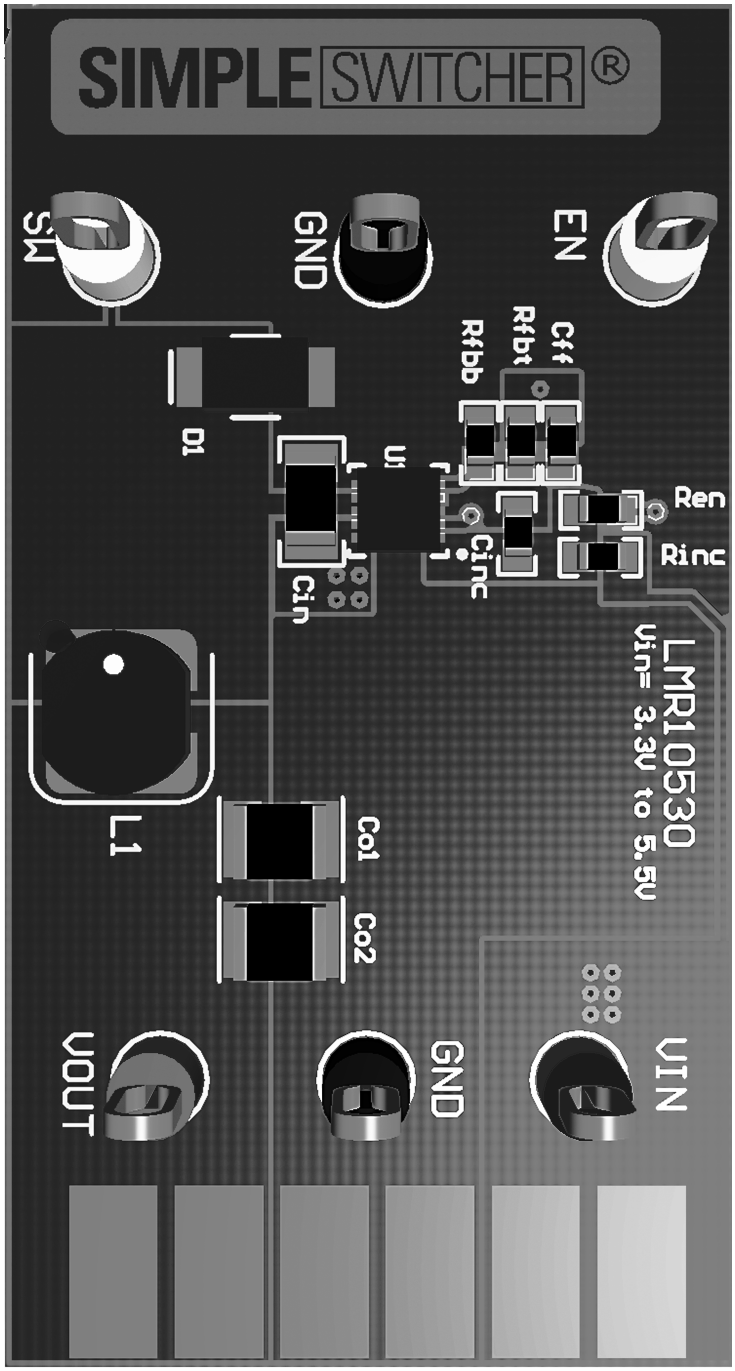


Figure 5. Top Side

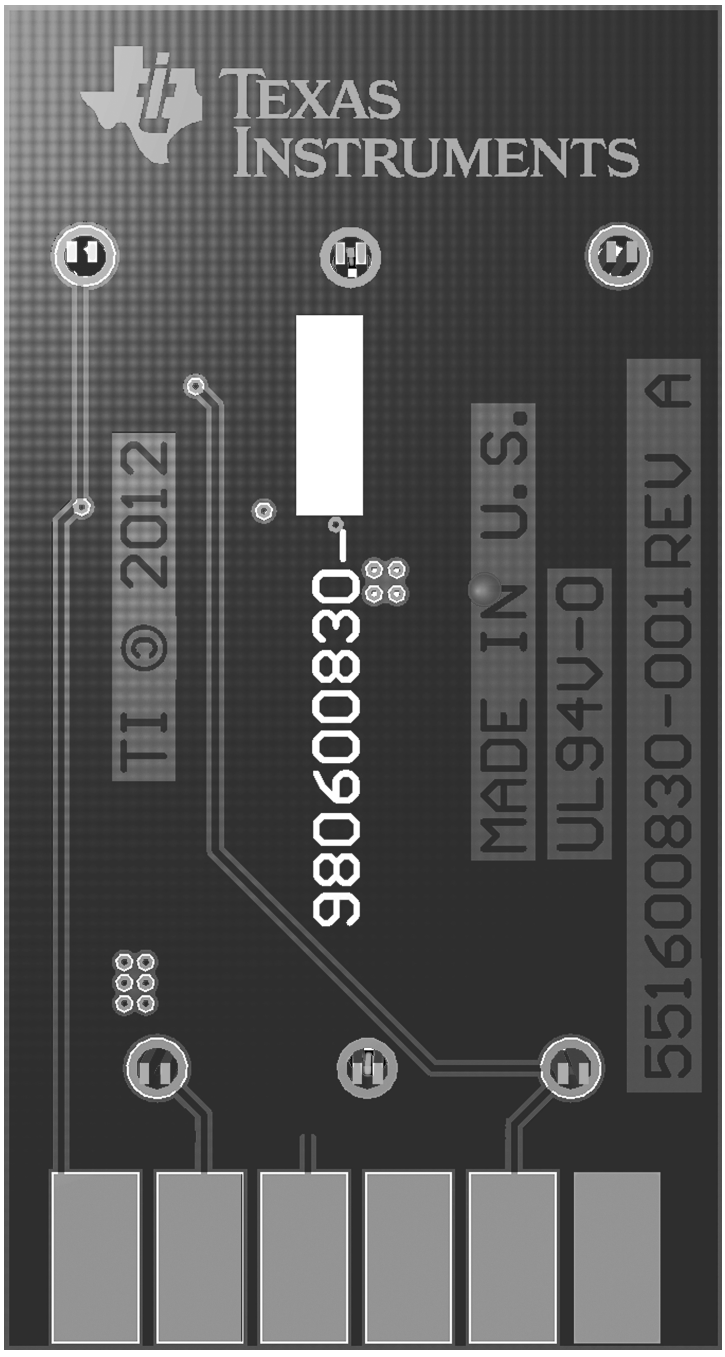
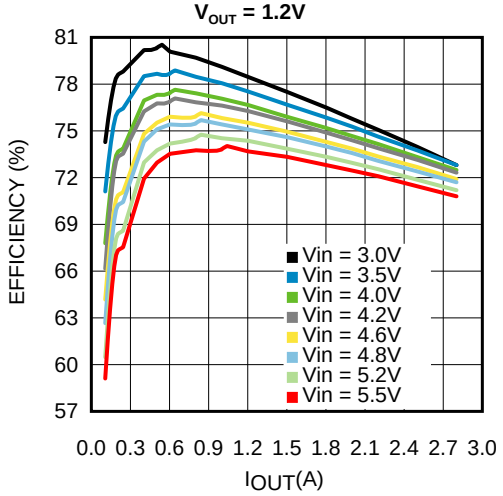


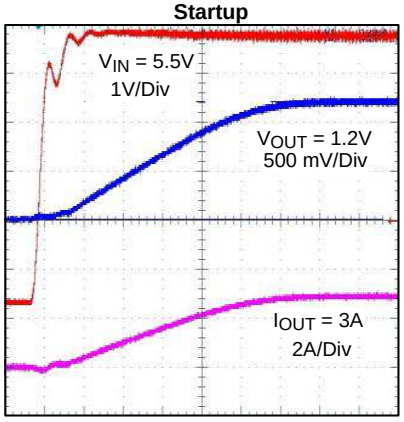
Figure 6. Bottom Side

5 Typical Performance Characteristics

Efficiency vs Load Current
V_{OUT} = 1.2V

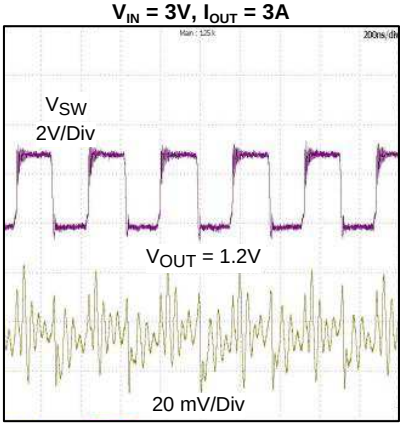


Startup



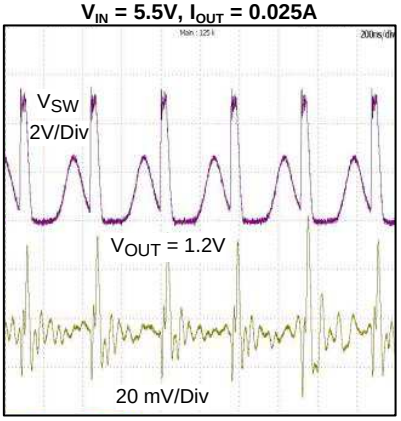
100 µs/DIV

Steady-state (CCM Mode)
V_{IN} = 3V, I_{OUT} = 3A



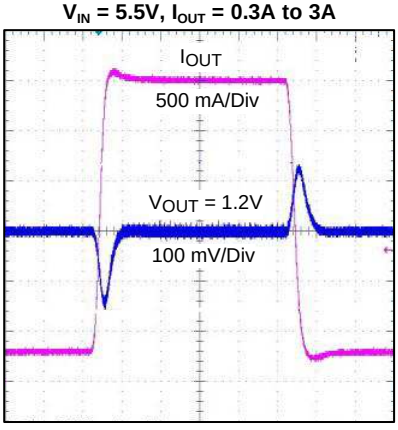
200 ns/DIV

Steady-state (DCM Mode)
V_{IN} = 5.5V, I_{OUT} = 0.025A



200 ns/DIV

Load Transient
V_{IN} = 5.5V, I_{OUT} = 0.3A to 3A



100 µs/DIV

6 Bill of Materials

Part ID	Part Value	Part Number	Manufacturer
U1	3MHz 3.0A buck regulator, WSON-10	LMR10530	Texas Instruments
L1	1.2µH, 4.6A	7447745012	Wurth Elektronik eiSos
Cin	47µF, 10V, X5R, 1206	C3216X5R0J226M	TDK
Cinc	0.22µF, 25V, X7R, 0603	06033D224KAT2A	AVX
Co1	47µF, 10V, X5R, 1210	GRM32ER61A476KE20L	Murata
D1	Schottky, 30V, 3A, 3-4E1A	CMS01	Toshiba
Rfbt	2.00kΩ, 1%, 1/8W, 0603	CRCW06032K00FKEA	Vishay
Rfbb	2.00kΩ, 1%, 1/8W, 0603	CRCW06032K00FKEA	Vishay
Rinc	10.0Ω, 1%, 1/8W, 0603	CRCW060310R0FKEA	Vishay
Ren	100kΩ, 1%, 1/8W, 0603	CRCW0603100KFKEA	Vishay
VIN	Test Point Loop	5010	Keystone
SW	Test Point Loop	5012	Keystone
GND	Test Point Loop	5011	Keystone
GND	Test Point Loop	5011	Keystone
VOUT	Test Point Loop	5013	Keystone
EN	Test Point Loop	5014	Keystone

7 Layout

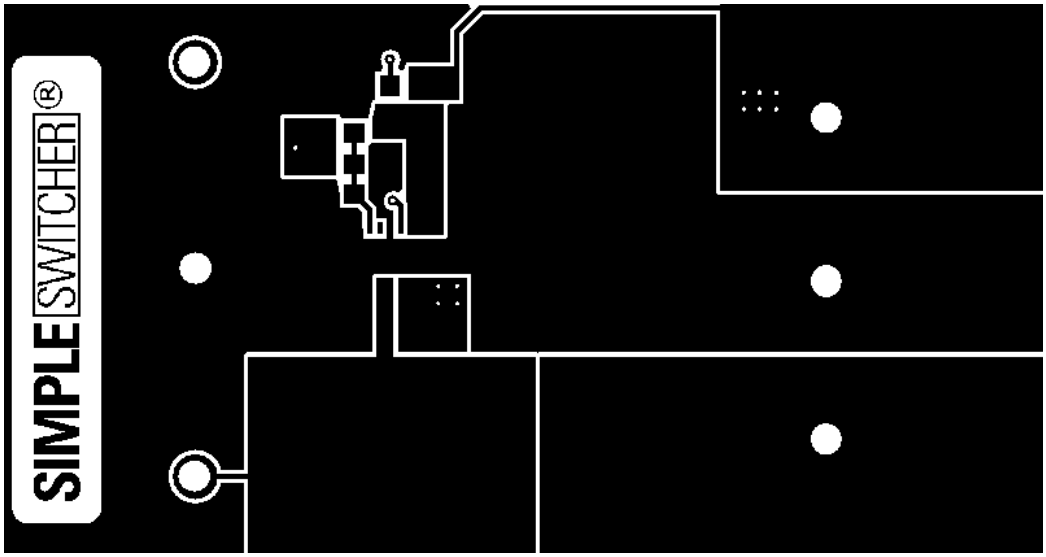


Figure 7. Top Copper

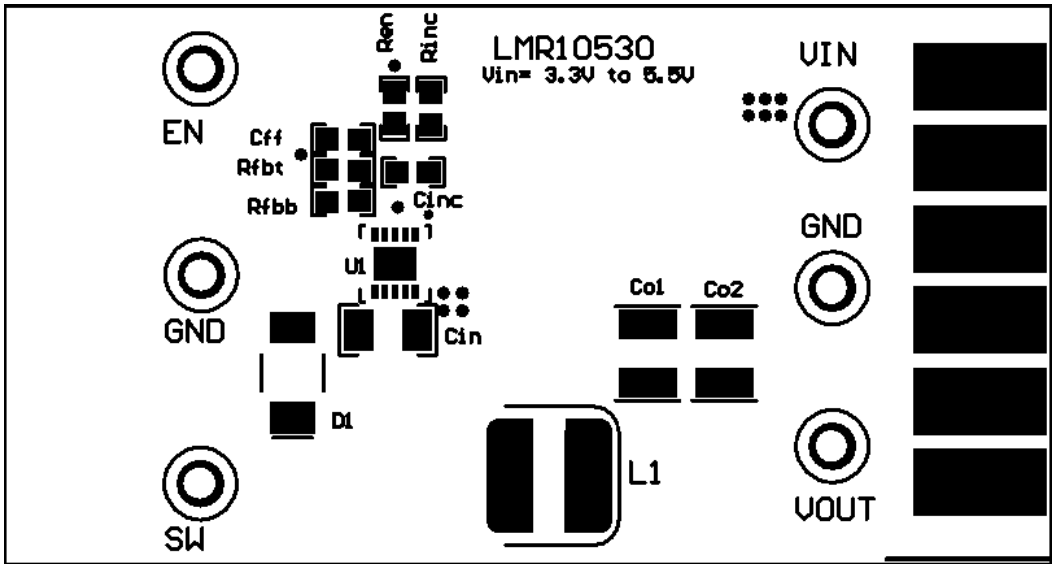


Figure 8. Top Overlay

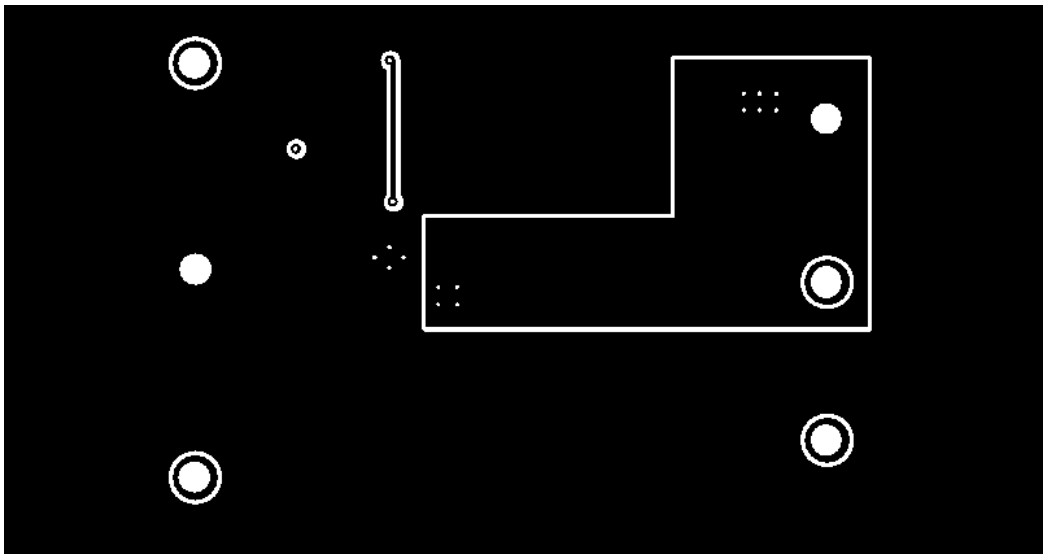


Figure 9. Internal Plane 1

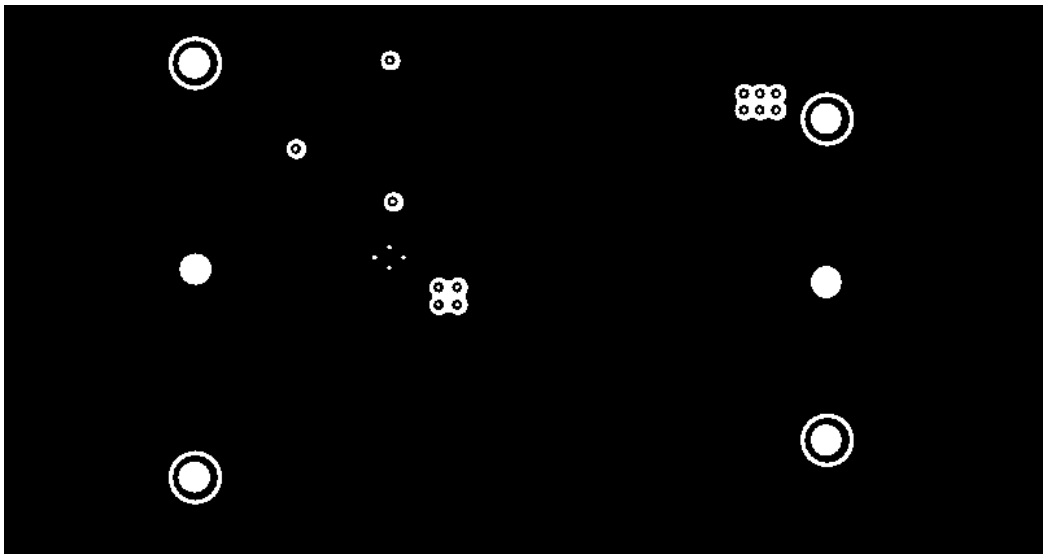


Figure 10. Internal Plane 2

Figure 11. Bottom Overlay

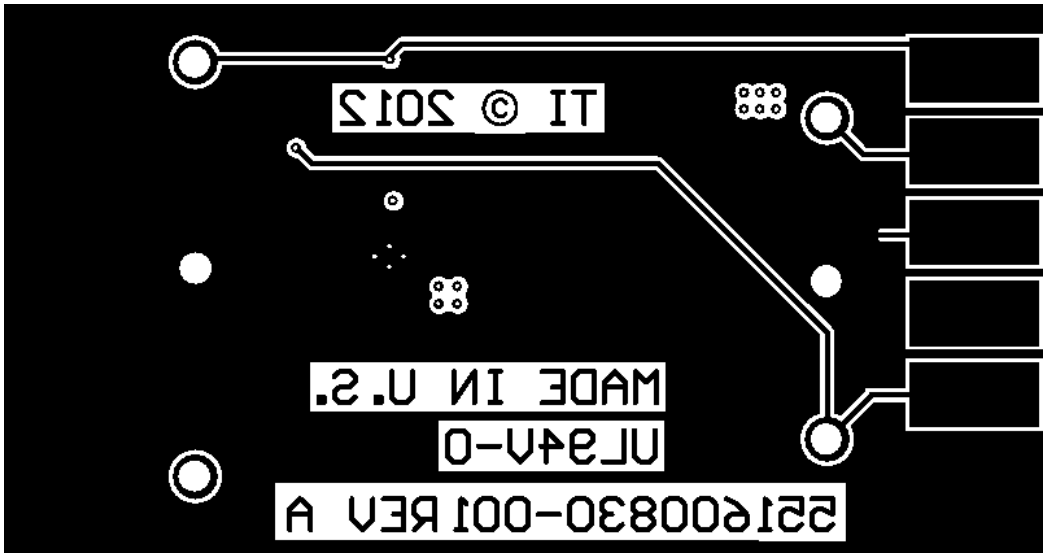


Figure 12. Bottom Copper

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