ISL8115DEMO1Z

Synchronous Buck Converter

AN1919
Rev 2.00
March 11, 2015

Introduction

The ISL8115DEMO1Z is a compact reference design Synchronous Buck Converter (28.19mmx16.89mm) implementing Intersil's wide input range PWM controller ISL8115. Utilizing voltage mode control with input feed-forward, the ISL8115DEMO1Z maintains a constant loop gain for optimal transient response, especially for applications with a wide input voltage range. For a more detailed description of the ISL8115 functionality, refer to the ISL8115 datasheet.

This user guide includes the test setup, typical performance waveforms, schematic, layout and bill of materials (BOM).

Specifications

TABLE 1. DEMONSTRATION BOARD ELECTRICAL SPECIFICATIONS

SPEC	DESCRIPTION	MIN	TYP	MAX	UNIT
V_{IN}	Input voltage range	16	24	36	V
V_{OUT}	Output voltage		5		V
I_{OUT}	Output rated current		10		A
I_{OC}	Overcurrent threshold		13		A
f_{SW}	Switching frequency		600		kHz
Input UVP	Rising threshold		15		V
	Falling threshold		14.2		V
η	Efficiency at 24V input full load (10A)		90.12		%

FIGURE 1. ISL8115DEMO1Z DEMONSTRATION BOARD

Key Features

- Small, compact design
- Fast transient response
  - Voltage-mode PWM leading-edge modulation with nonlinear control
  - Input voltage feed-forward
- Integrated 5V high speed 4A MOSFET gate drivers
  - Internal bootstrap diode
- Oscillator programmable from 150kHz to 1.5MHz
  - Frequency synchronization to external clock signal
- Diode emulation mode for light load efficiency improvement
- Output OVP/UVP; OCP and OTP
- Adjustable soft-start
- Prebias start-up function
- Excellent output voltage regulation
  - 0.6V ±1.0% internal reference (-40°C~+125°C)
  - 0.6V ±0.7% internal reference (-40°C~+105°C)
  - Differential voltage sensing

References

- ISL8115 datasheet

Ordering Information

PART NUMBER	DESCRIPTION
ISL8115DEMO1Z	Demonstration Board for ISL8115

Recommended Equipment

- Input power source up to 36V supply voltage with 125W power supply ability
- Electronic load with 100W power sinking ability
- Voltmeters and ammeters
- 100MHz quad-trace oscilloscope

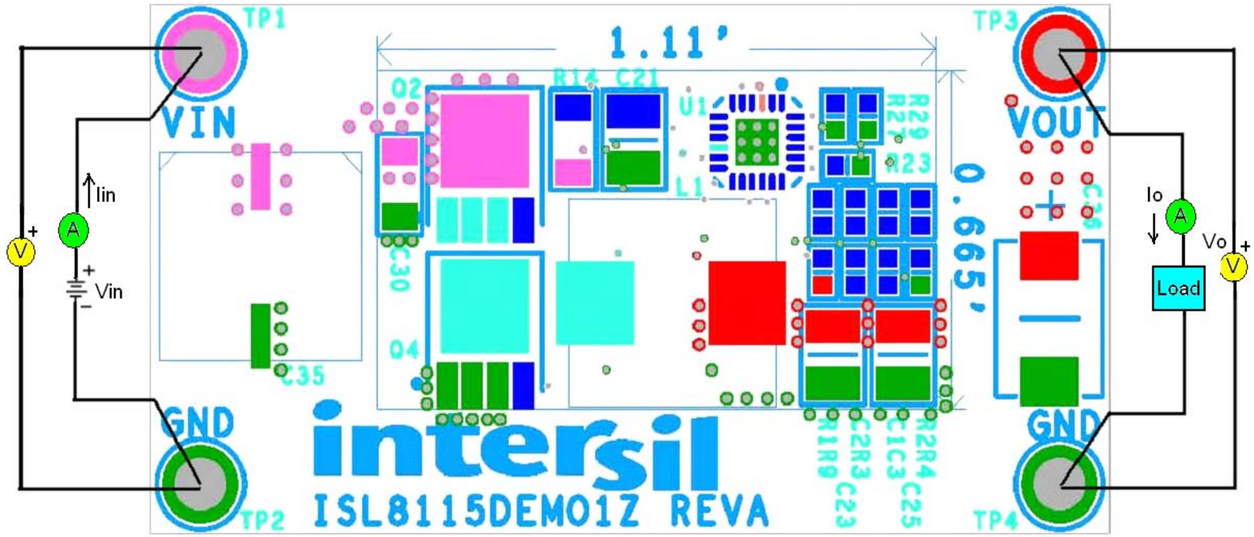


FIGURE 2. ISL8115DEMO1Z TEST SETUP

Quick Test Setup

1. Ensure that the demonstration board is correctly connected to the power supply and the electronic load prior to applying any power. Refer to Figure 2 for proper setup.
2. Set the input voltage to 24V, turn on the power supply and observe output voltage. The output voltage variation should be within 5%.
3. Adjust load current within 10A. The output voltage variation should be within 5%.
4. Use oscilloscope to observe output ripple voltage and phase node ringing. For accurate measurement, refer to Figure 3 for proper setup.

Probe Setup

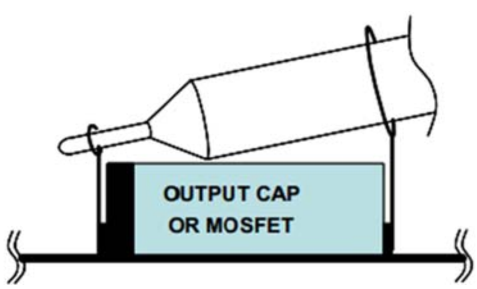


FIGURE 3. OSCILLOSCOPE PROBE SETUP

Design Guide

The ISL8115DEMO1Z is optimized for 16V to 36V input voltage range. However, the evaluation board can be modified to support multiple applications due to the customer's requirements. Refer to the ISL8115 datasheet for detailed information.

TABLE 2. 12V APPLICATION

V_{IN}	R_{35}
12V	71.5k

Quick modify to 12V input application, Table 2 can be followed. Some other modifications need to be made at the same time if best performance is expected.

Output Voltage Adjustment

The output voltage can be set by the resistors R_4 and R_1. In order to keep the existing compensation parameters unchanged, adjust R_4 to set the output voltage by the following Equation 1:

$$R_4 = \frac{0.6V \times R_1}{V_{OUT} - 0.6V} \quad \text{(EQ. 1)}$$

The VMON monitors the output for UVP and OVP, the resistor divider value of R_{11}/R_8 should be the same with the R_1/R_4.

Synchronization

The ISL8115DEMOZ board can be synchronized with an external clock. Applying a clock signal (10% to 90% duty cycle) in the range of 150kHz to 1.5MHz to the FSET pin makes the internal frequency synchronized with the external clock. Please remove R_{27} when the synchronized function is implemented.

Typical Performance Curves

Unless otherwise specified, the input voltage is 28V.

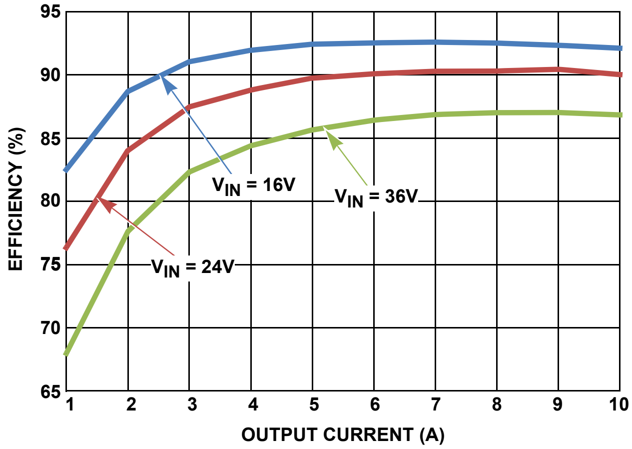


FIGURE 4. EFFICIENCY vs LOAD CURRENT AT CCM MODE

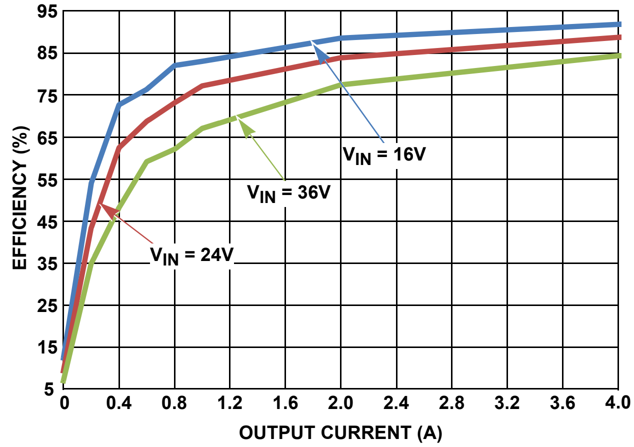


FIGURE 5. EFFICIENCY vs LOAD CURRENT AT DEM MODE

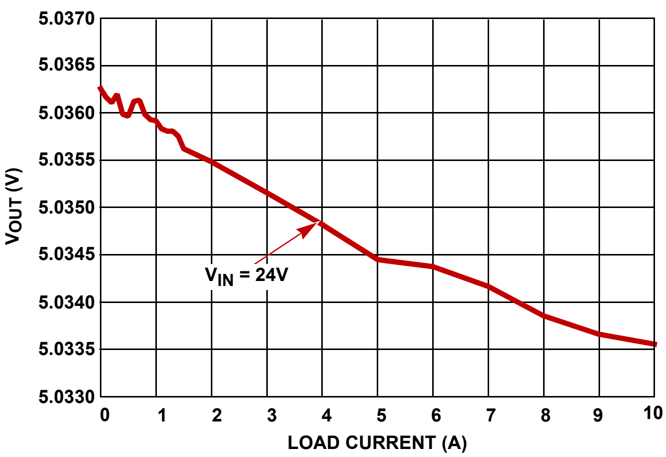


FIGURE 6. V_{OUT} LOAD REGULATION AT CCM MODE

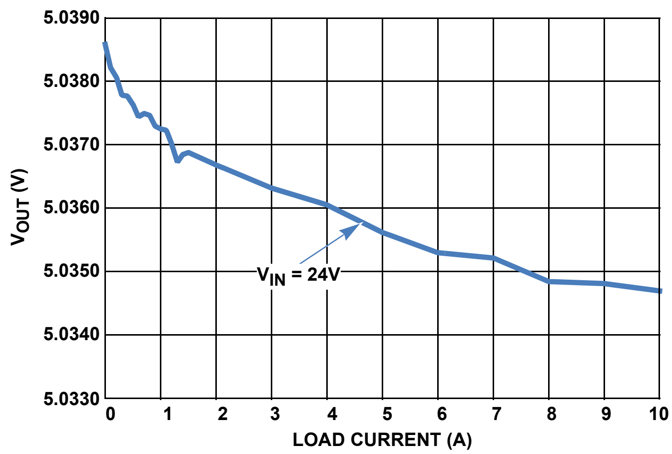


FIGURE 7. V_{OUT} LOAD REGULATION AT DEM MODE

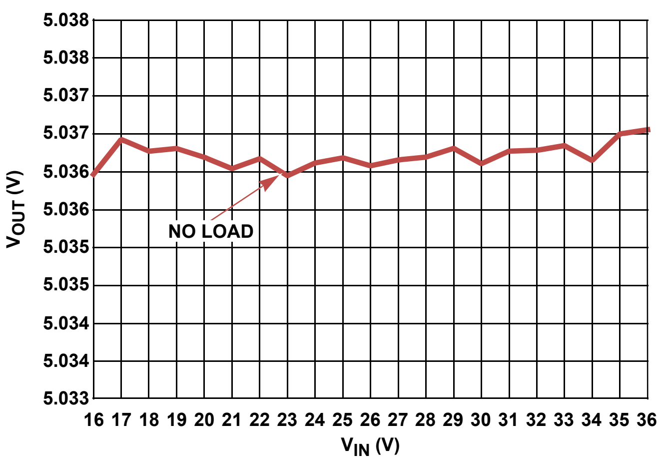


FIGURE 8. LINE REGULATION AT NO LOAD CCM MODE

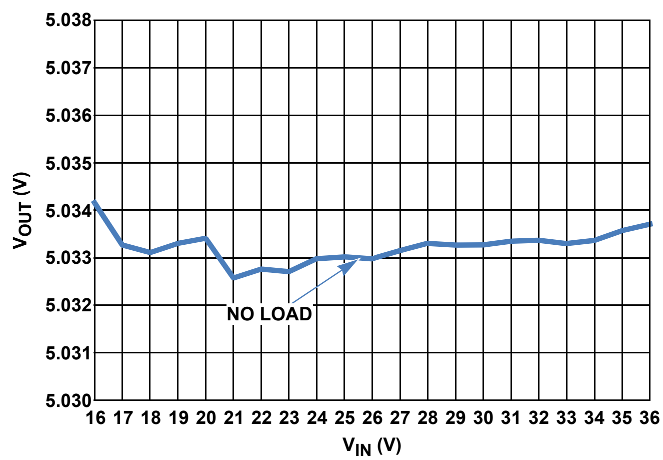


FIGURE 9. LINE REGULATION AT NO LOAD DEM MODE

Typical Performance Curves Unless otherwise specified, the input voltage is 28V. (Continued)

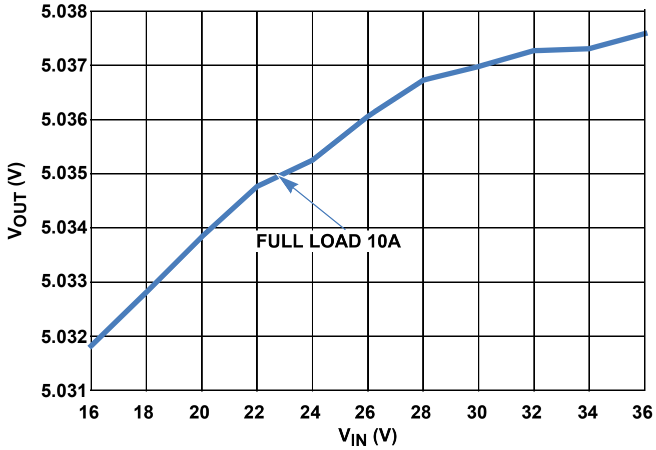


FIGURE 10. LINE REGULATION AT FULL LOAD CCM MODE

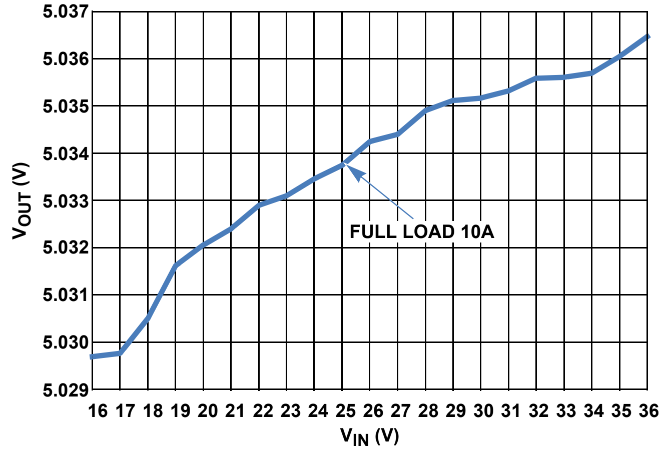


FIGURE 11. LINE REGULATION AT FULL LOAD DEM MODE

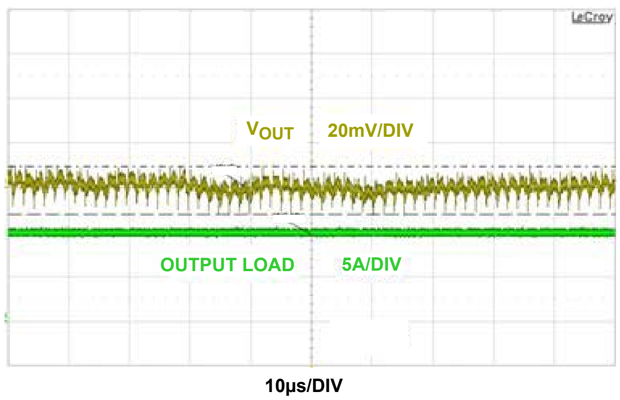


FIGURE 12. OUTPUT VOLTAGE RIPPLE AT 10A LOAD CONDITION

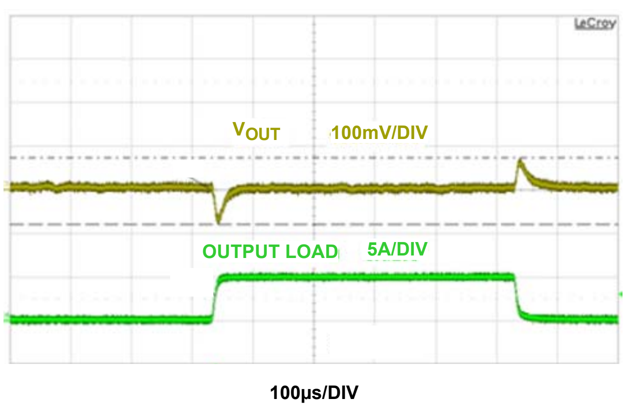


FIGURE 13. LOAD TRANSIENT 0A TO 5A; 2A/µs AT CCM

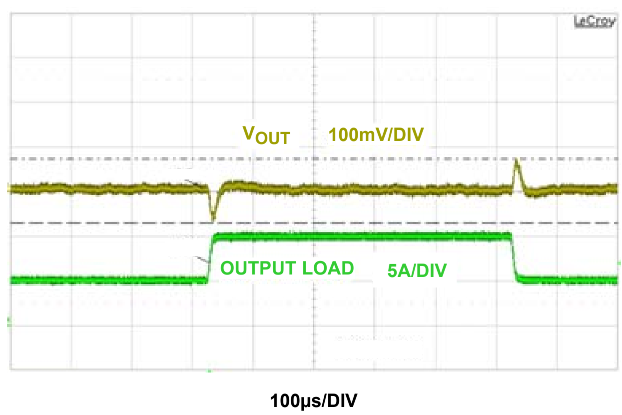
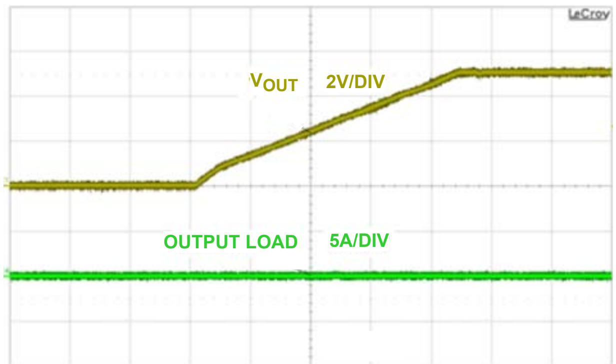


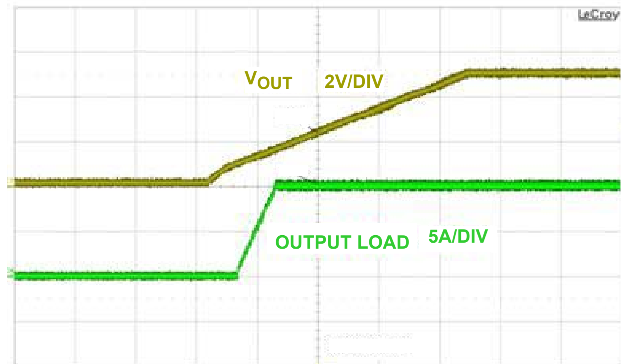
FIGURE 14. LOAD TRANSIENT 5A TO 10A; 2A/µs AT CCM

Typical Performance Curves Unless otherwise specified, the input voltage is 28V. (Continued)



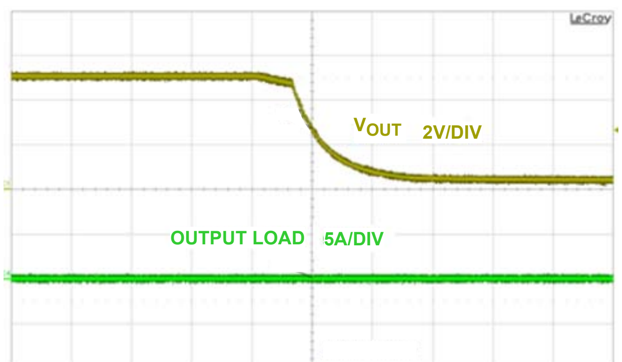
2msDIV

FIGURE 15. START-UP AT 0A LOAD CONDITION



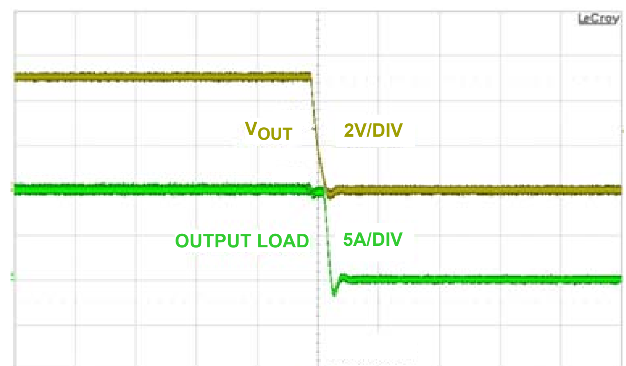
2ms/DIV

FIGURE 16. START-UP AT 10A LOAD CONDITION



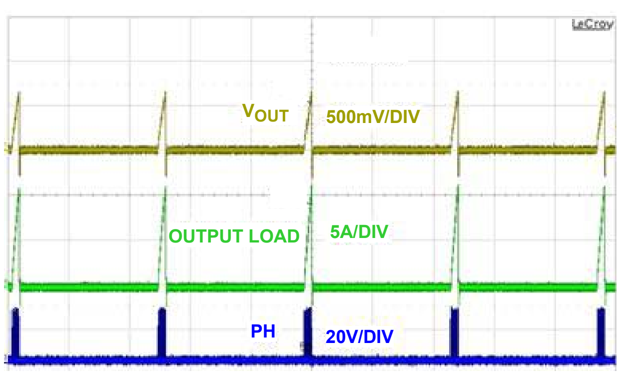
100µs/DIV

FIGURE 17. SHUTDOWN AT 0A LOAD CONDITION



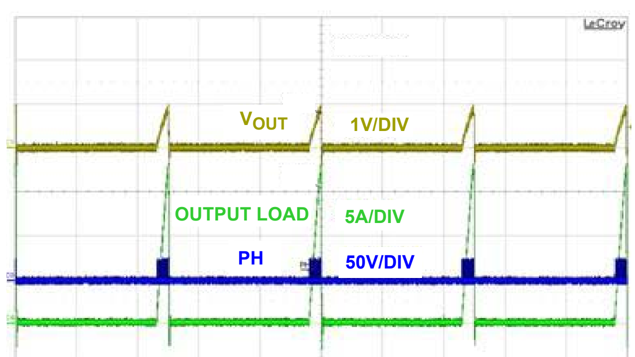
500µs/DIV

FIGURE 18. SHUTDOWN AT 10A LOAD CONDITION



5ms/DIV

FIGURE 19. OVERCURRENT PROTECTION AT 12.6A LOAD



5ms/DIV

FIGURE 20. SHORT PROTECTION

Schematic

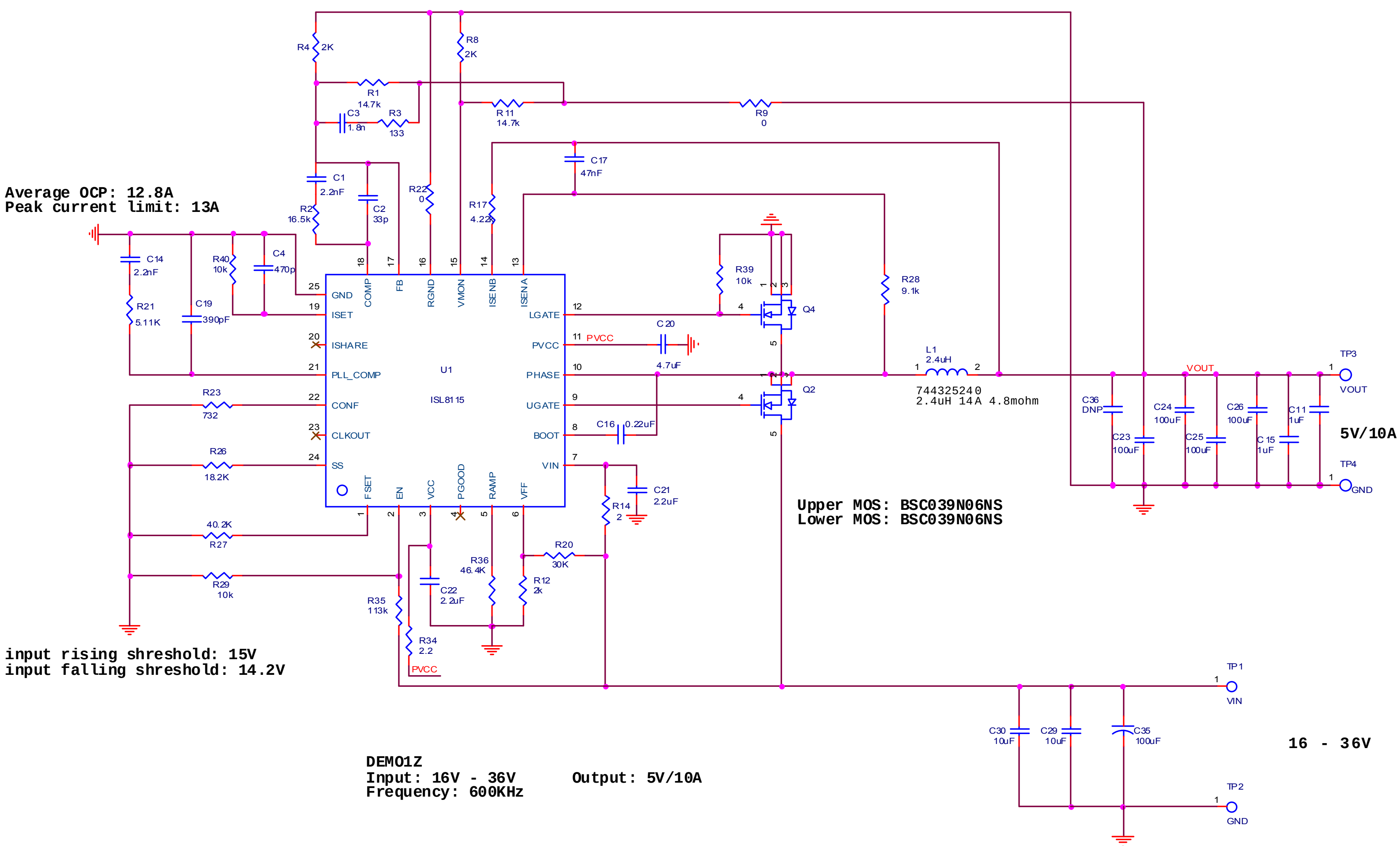


FIGURE 21. ISL8115DEMO1Z SCHEMATIC

Bill of Materials

ITEM	QTY	REFERENCE	VALUE	DESCRIPTION	MANUFACTURER	PART NUMBER
1	2	C1, C14	2.2nF	CAP CER 2200pF 25V 10% X7R 0402	Generic	Generic
2	1	C2	33pF	CAP CER 33pF 50V 5% NP0 0402	Generic	Generic
3	1	C3	1.8nF	CAP CER 1800pF 50V 10% X7R 0402	Generic	Generic
4	1	C4	470pF	CAP CER 470pF 50V 10% X7R 0402	Generic	Generic
5	2	C11, C15	1µF	CAP CER 1µF 10V 10% X5R 0603	Generic	Generic
7	1	C16	0.22µF	CAP CER 0.22µF 16V 10% X7R 0402	Generic	Generic
8	1	C17	47nF	CAP CER 0.047µF 25V 10% X7R 0402	Generic	Generic
9	1	C19	390pF	CAP CER 390pF 50V 10% X7R 0402	Generic	Generic
10	1	C20	4.7µF	CAP CER 4.7µF 6.3V 10% X5R 0805	Generic	Generic
11	1	C21	2.2µF	CAP CER 2.2µF 50V 10% X7R 1210	TDK	C3225X7R1H225K
12	1	C22	2.2µF	CAP CER 2.2µF 6.3V 20% X5R 0603	Generic	Generic
13	4	C23, C24, C25, C26	100µF	CAP CER 100µF 6.3V 20% X5R 1210	TDK	C3225X5R0J107M250AC
14	2	C29, C30	10µF	CAP CER 10µF 50V 10% X5R 1206	TDK	C3216X5R1H106K160AB
15	1	C35	100µF	CAP ALUM 100µF 50V 20% SMD	Nichicon	PCV1H101MCL2GS
16	1	C36	DNP	CAP 220µF 6.3V	Panasonic	6TPF220M5L
17	1	L1	2.4µH	INDUCTOR POWER 2.4µH 31.5A SMD	WE-Midcom	744325240
18	2	Q2, Q4	BSC039N06NS	MOSFET N-CH 60V 19A TDSON-8	Infineon	BSC039N06NS
19	2	R1, R11	14.7k	RES 14.7kΩ 1/16W 1% 0402 SMD	Generic	Generic
20	1	R2	16.5k	RES 16.5kΩ 1/16W 1% 0402 SMD	Generic	Generic
21	1	R3	133	RES 133Ω 1/16W 1% 0402 SMD	Generic	Generic
22	3	R4, R8, R12	2k	RES 2.00kΩ 1/16W 1% 0402 SMD	Generic	Generic
23	2	R9, R22	0	RES 0.0Ω 1/16W JUMP 0402 SMD	Generic	Generic
24	1	R14	2	RES 2.00Ω 1/4W 1% 1206 SMD	Generic	Generic
25	1	R17	4.22k	RES 4.22kΩ 1/16W 1% 0402 SMD	Generic	Generic
26	1	R20	30k	RES 30kΩ 1/16W 1% 0402 SMD	Generic	Generic
27	1	R21	5.11k	RES 5.11kΩ 1/16W 1% 0402 SMD	Generic	Generic
28	1	R23	732	RES 732Ω 1/16W 1% 0402 SMD	Generic	Generic
29	1	R26	18.2k	RES 18.2kΩ 1/16W 1% 0402 SMD	Generic	Generic
30	1	R27	40.2k	RES 40.2kΩ 1/16W 1% 0402 SMD	Generic	Generic
31	1	R28	9.1k	RES 9.1kΩ 1/16W 1% 0402 SMD	Generic	Generic
32	3	R29, R39, R40	10k	RES 10kΩ 1/16W 1% 0402 SMD	Generic	Generic
33	1	R34	2.2	RES 2.2Ω 1/16W 1% 0402 SMD	Generic	Generic
34	1	R35	113k	RES 113kΩ 1/16W 1% 0402 SMD	Generic	Generic

Assembly Drawing

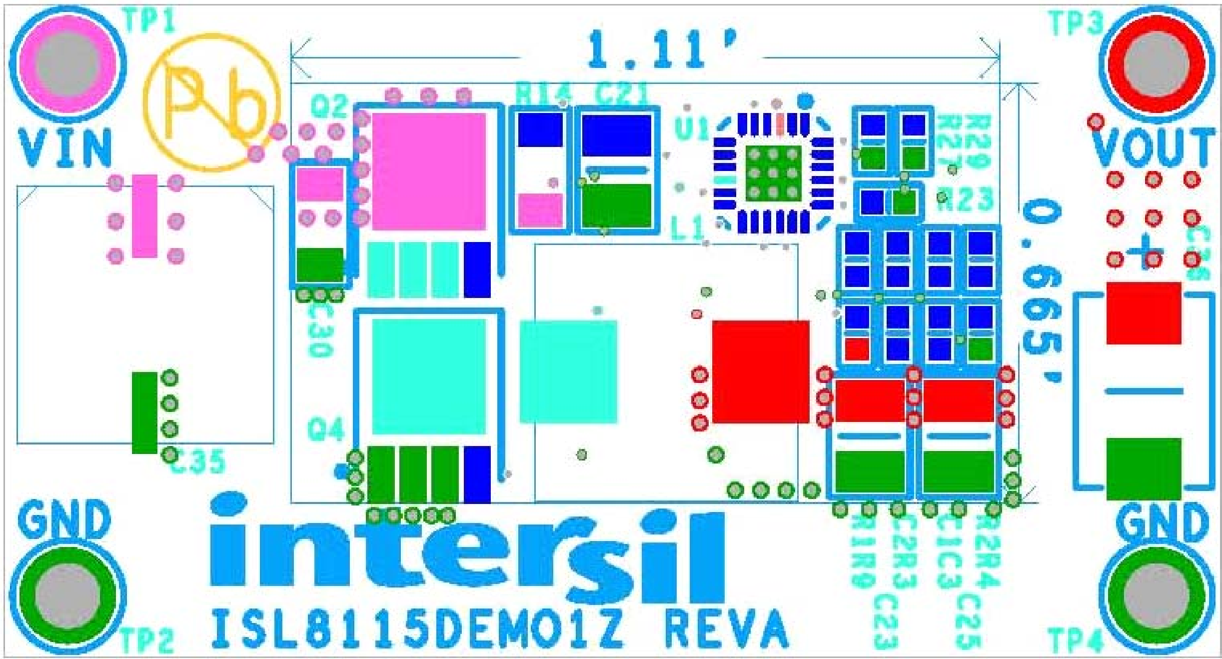


FIGURE 22. TOP

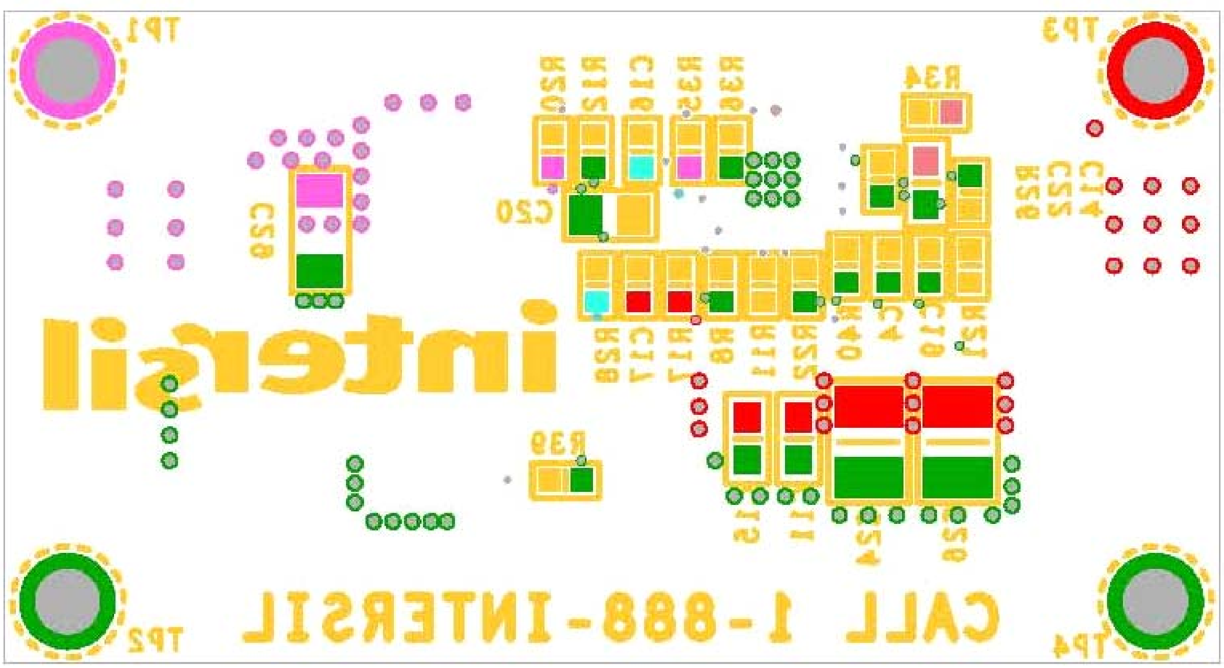


FIGURE 23. BOTTOM

PCB Layout

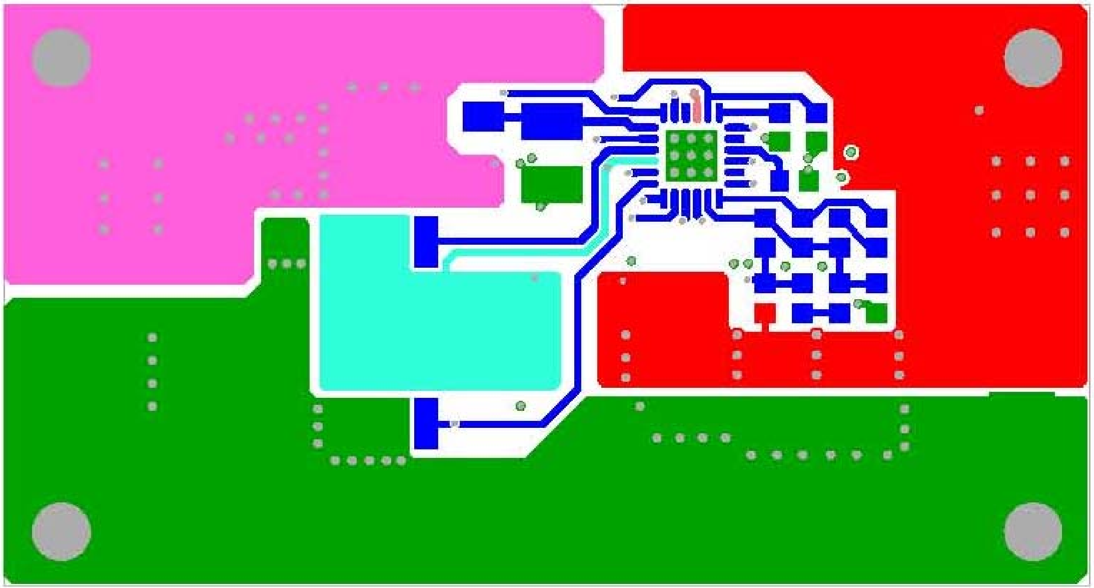


FIGURE 24. TOP LAYER

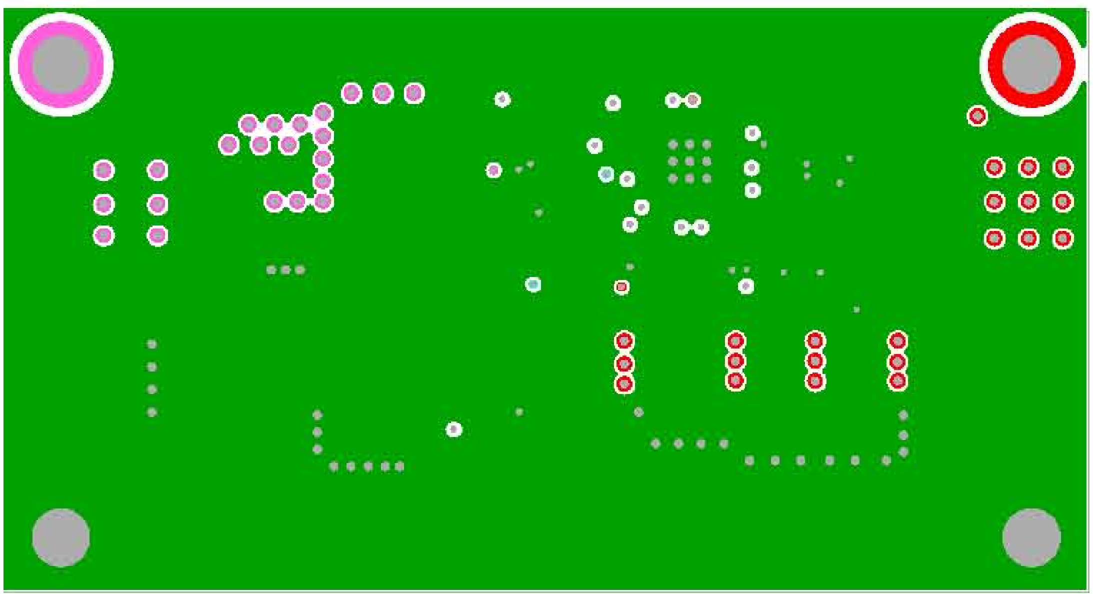


FIGURE 25. LAYER 2

PCB Layout (Continued)

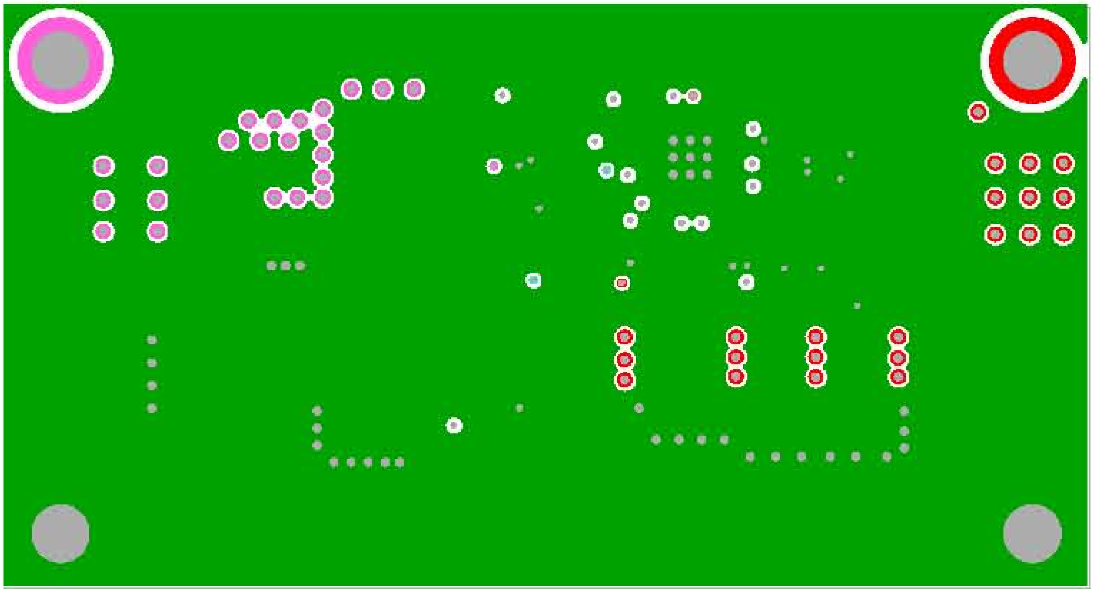


FIGURE 26. LAYER 3

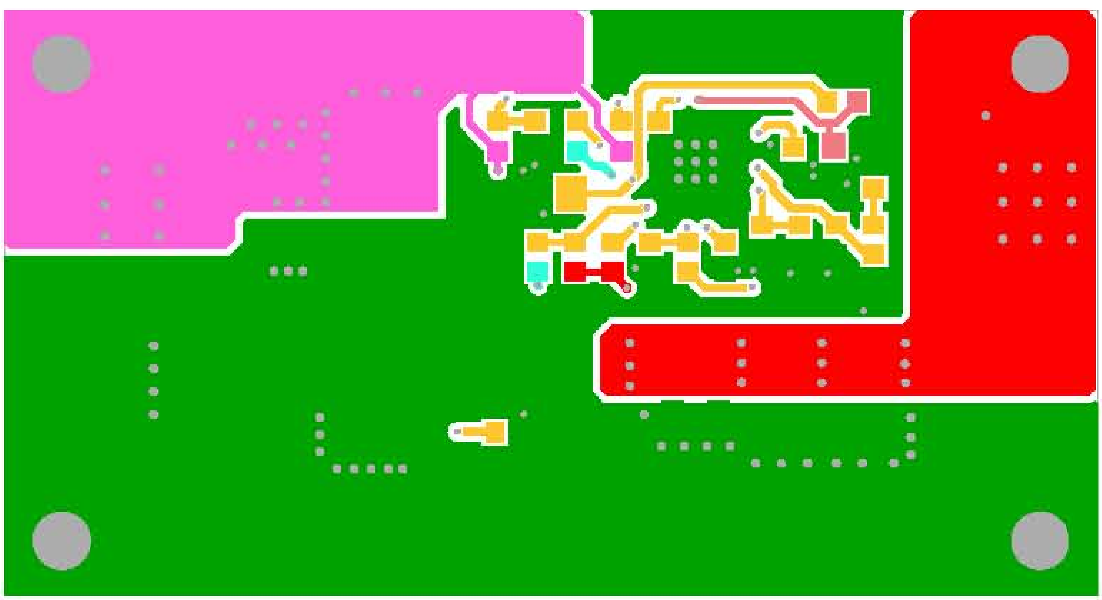


FIGURE 27. BOTTOM LAYER

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