PMP10745
Test Report
11/25/2015

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I. Overview

The TIDA-00745 is a dual output DC/DC Buck converter power supply reference design for USB charging applications. It takes a 7V to 36V input voltage, and generates two 5V at 3A outputs with 96% peak efficiency. The reference design features two LMR23630 Buck converters to provide two very stable and well-regulated outputs. The board dimension is 66 x 58 mm (2.6 x 2.3 inch) but the solution size is 46 x 38 mm (1.8 x 1.5 inch). The reference design uses an EMI filter at the input and the board is layout-optimized for improved EMI performance, which results in compliance with the CISPR 25 Class 5 conducted emissions standard.

II. Power Specification

Input Voltage:	7V – 36V
Output:	5V @ 3A, 5V @ 3A
Total output power:	30W
Switching frequency:	400 kHz

III. Reference Board

The Board dimension of PMP10745 PCB is 66*58 mm (2.6x2.3 inch) with a solution size of 46x38 mm (1.8x1.5 inch). Four layer PCB was used for the design.

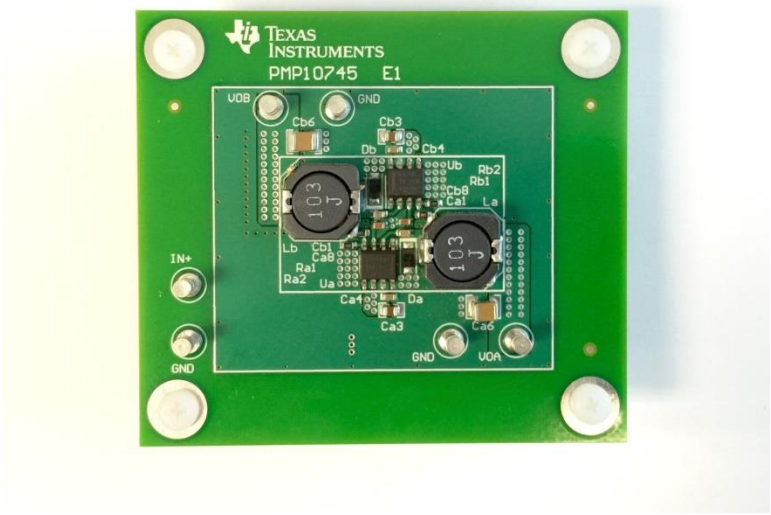

Figure 1: Reference board top view

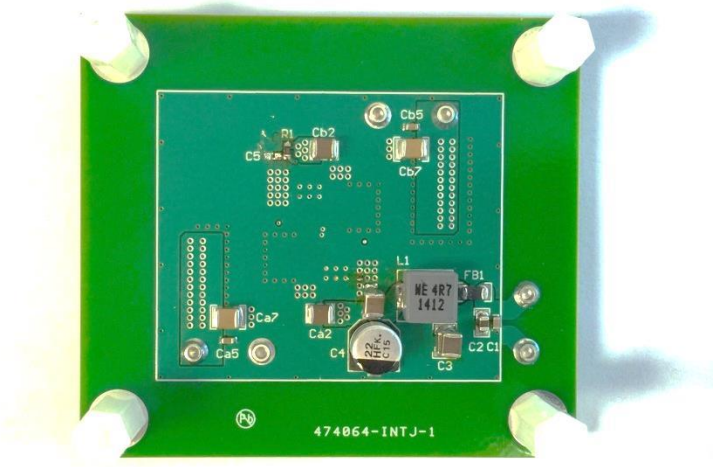

Figure 2: Reference board bottom view

IV. Efficiency

The efficiency and output regulation was measured at different input voltage conditions.

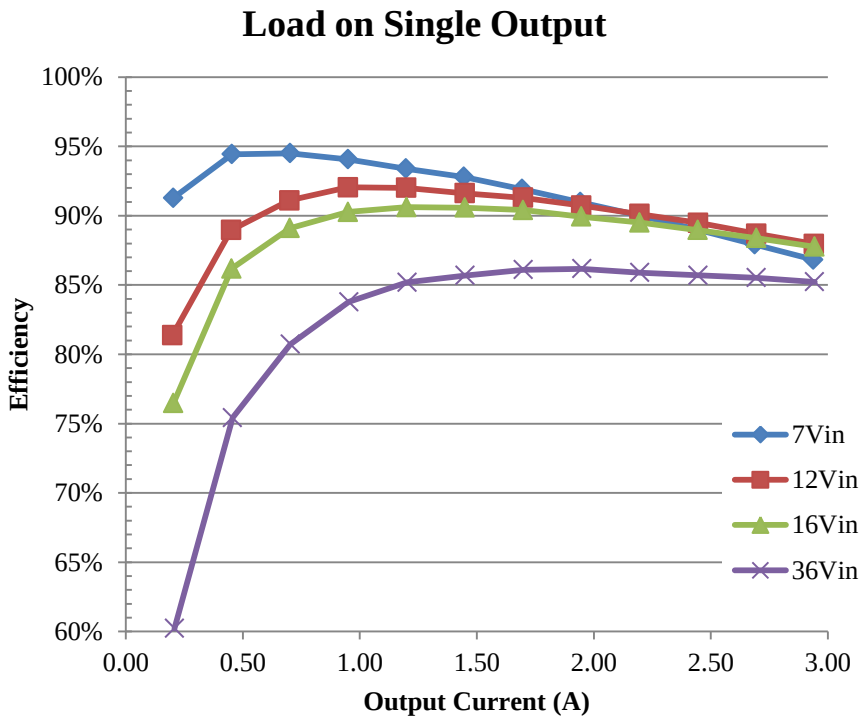

Figure 3: Power efficiency loaded on single output

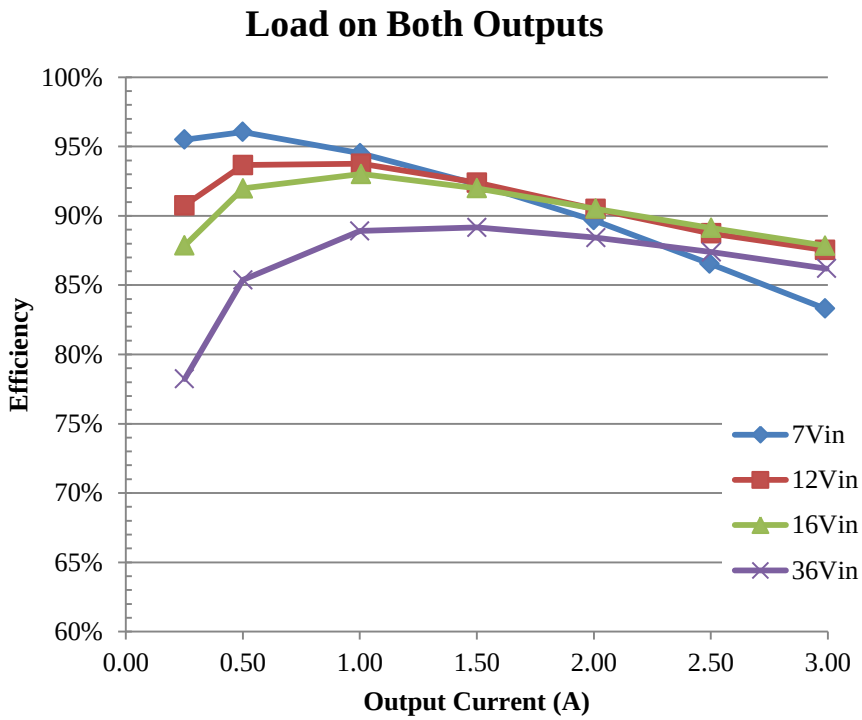

Figure 4: Power efficiency loaded on both outputs

V. Thermal

The thermal image was taken at 25°C room temperature, no air flow. The board was operating at 12V input, 2.5A load on both outputs.

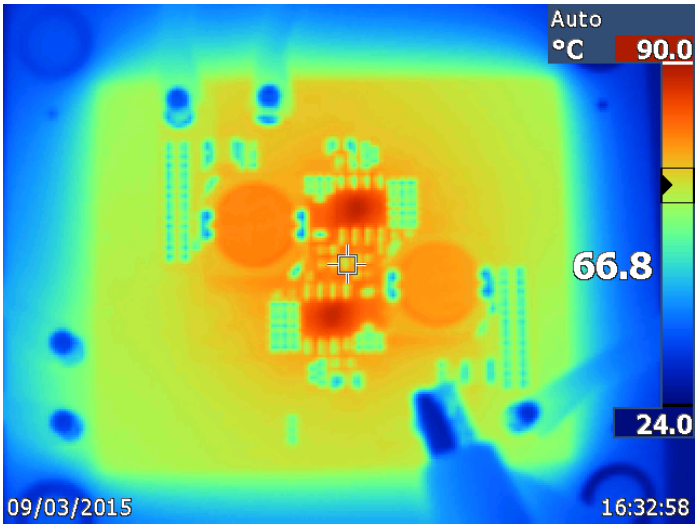

Figure 5: Thermal image from top view

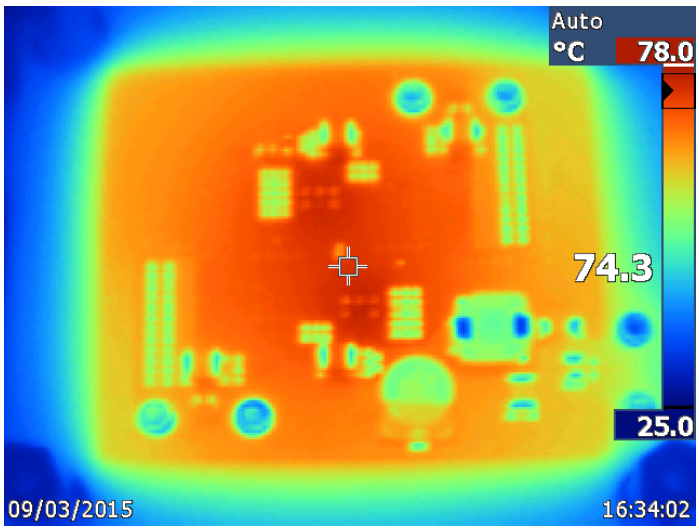

Figure 6: Thermal image from bottom view

VI. Conducted EMI

The conducted emissions were tested under the CISPR 25 standards. The input voltage at the board was set at 13V. The resistor load was soldered on the output terminals of the test board as the 3A load. The frequency band examined spans from 150 kHz to 108 MHz covering the AM, FM radio bands, VHF band, and TV band specified in the CISPR 25. The scan results (Figure 7, Figure 8,) show the EMI noise using peak detector (yellow) and average detector (blue) in the spectrum analyzer. The limit lines in red are the Class 5 limits for conducted disturbances at different frequency bands specified in the standard, and the peak limits are the higher ones than the average limits. It can be seen that, with the input filter, the peak/average noise is lower than the corresponding peak/average limits in the scan results. Therefore, the reference board is in compliance with the CISPR 25 Class 5 conducted emissions standard.

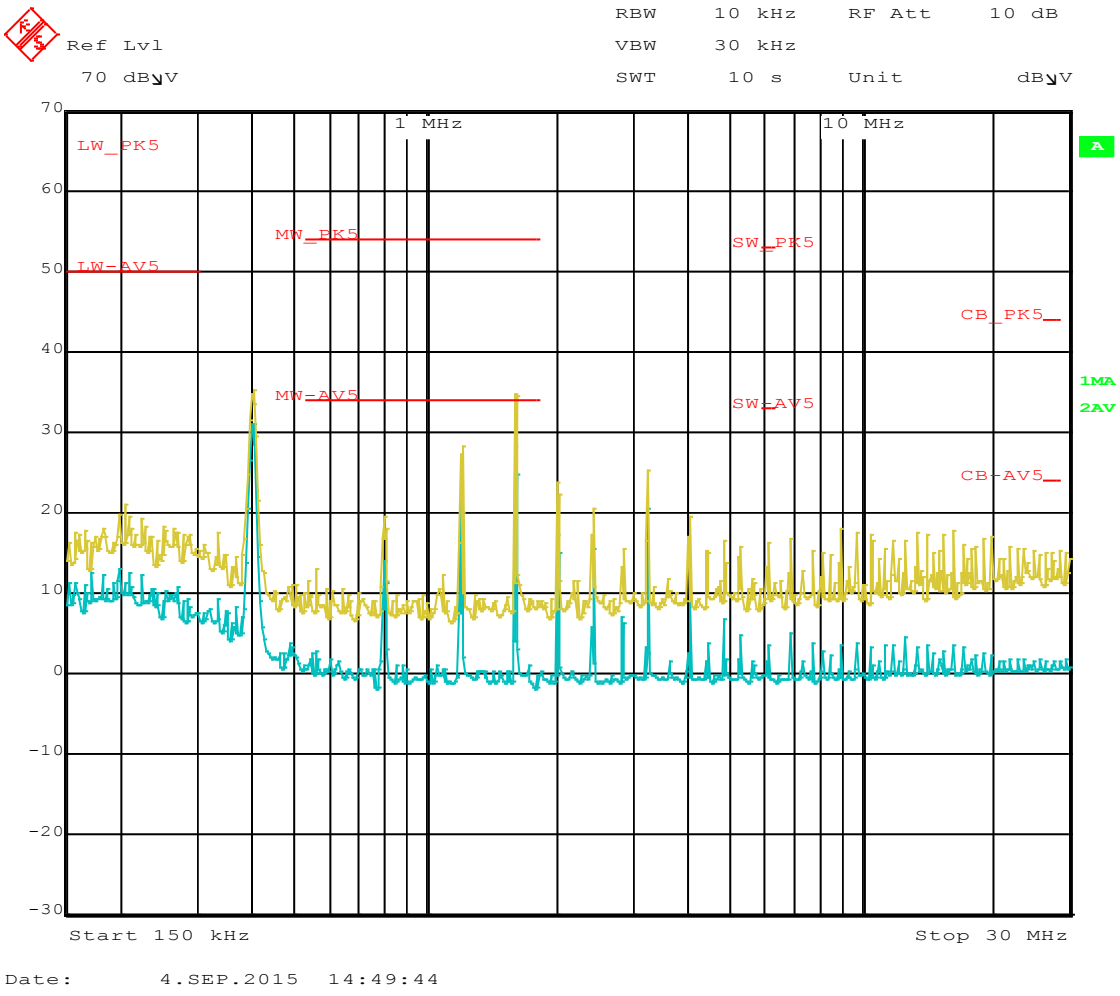

Figure 7: Conducted EMI scan, 150 kHz – 30 MHz, with the EMI filter

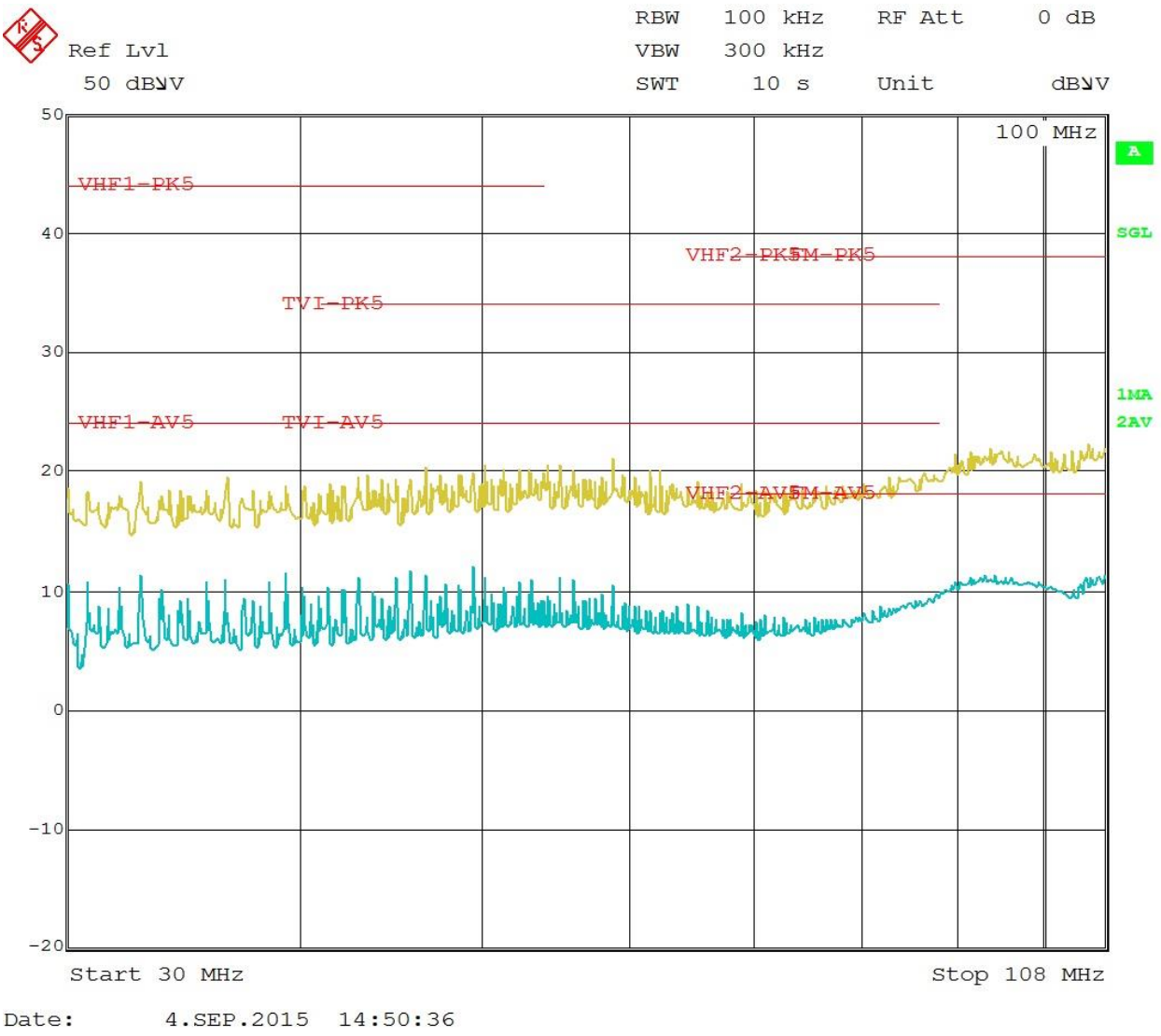

Figure 8: Conducted EMI scan, 30 MHz – 108 MHz, with the EMI filter

VII. Power Up

The reference board was tested under no load and full 3A load on both output channels at 12V input. C1 (yellow) is the input voltage, C2 (pink) is the output voltage on channel A, and C3 (blue) is the output voltage on channel B.

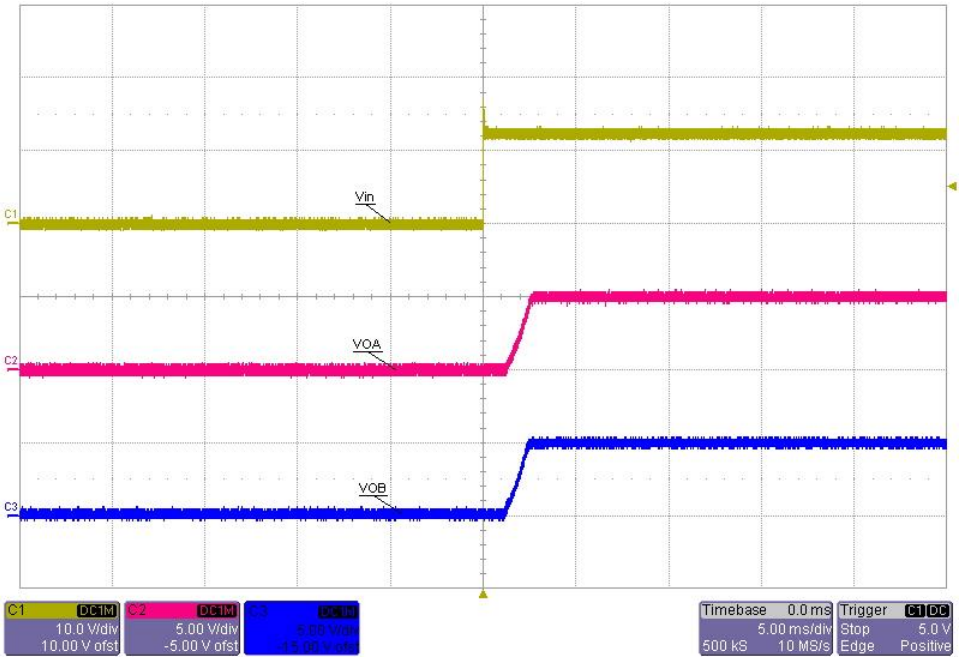

Figure 9: Power up into no load at 12V input

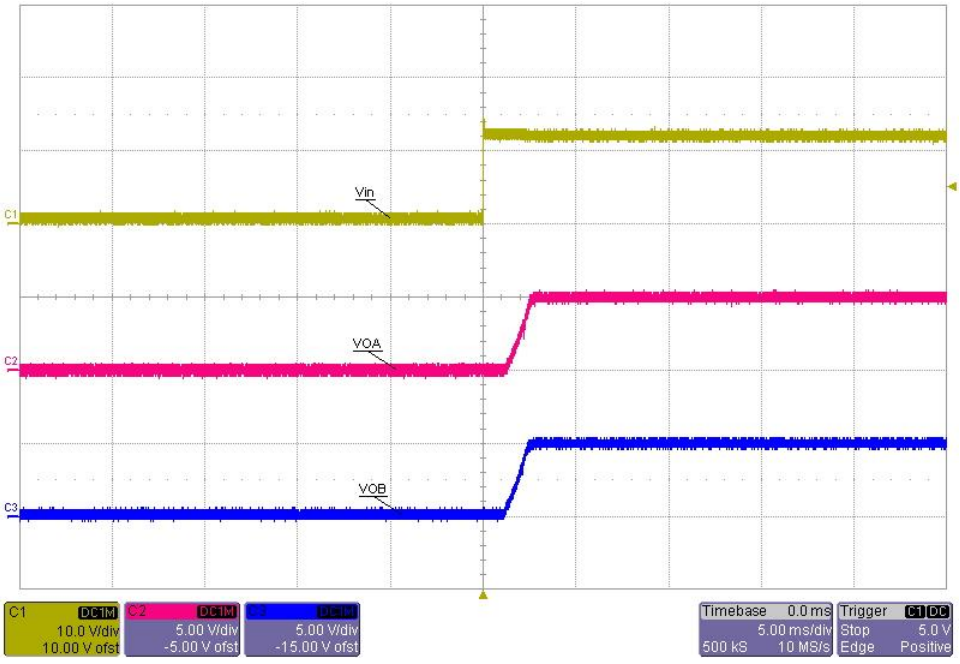

Figure 10: Power up into full 3A load on both output channels at 12V input

VIII. Switching Waveforms

The switch node voltage was measured directly from the inductor. C1 (yellow) is the switch node voltage on channel A and C2 (pink) is the switch node voltage on channel B.

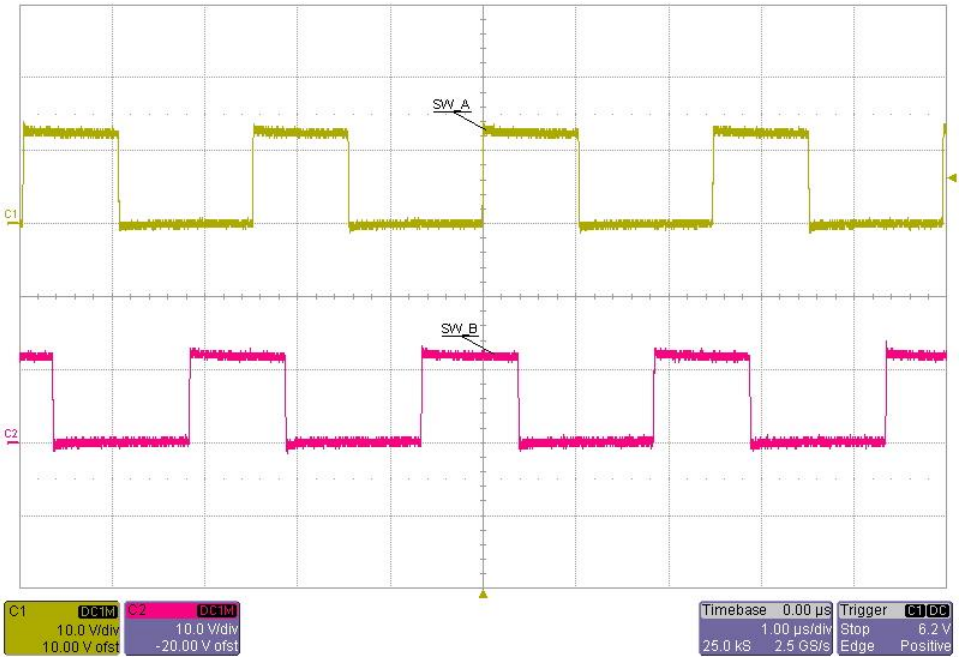

Figure 11: Switch node voltage at no load, 12V input

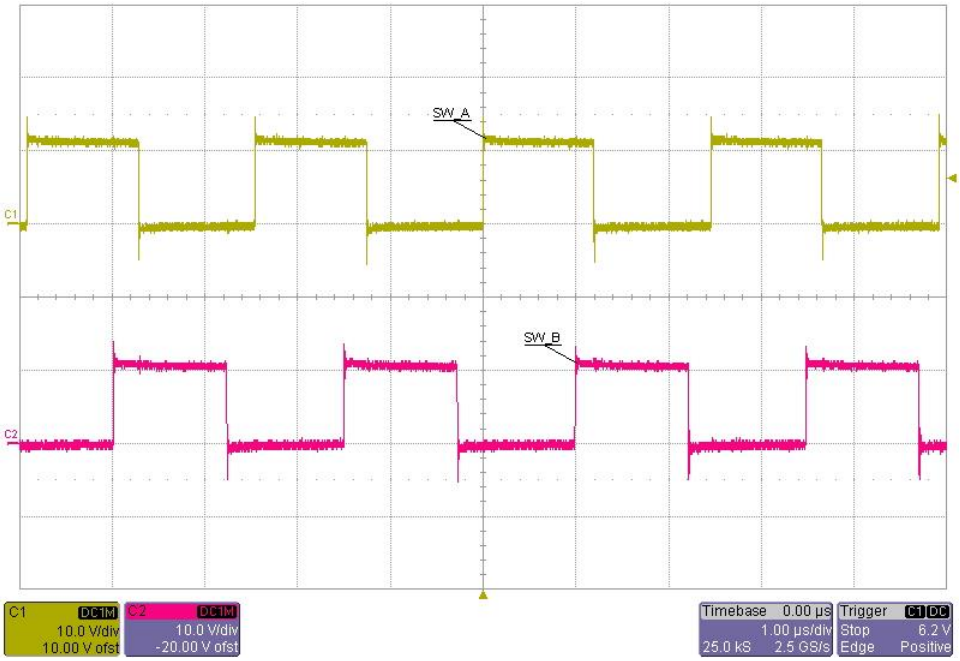

Figure 12: Switch node voltage at full 3A load on both channels, 12V input

IX. Load Transients

The load transient responses were tested by applying output load step from 50% to 100% on channel A at different input voltages. C1 (yellow) is the output current of channel A, C2 (pink) is the output voltage of channel A in AC mode, and C3 (blue) is the output voltage of channel B in AC mode.

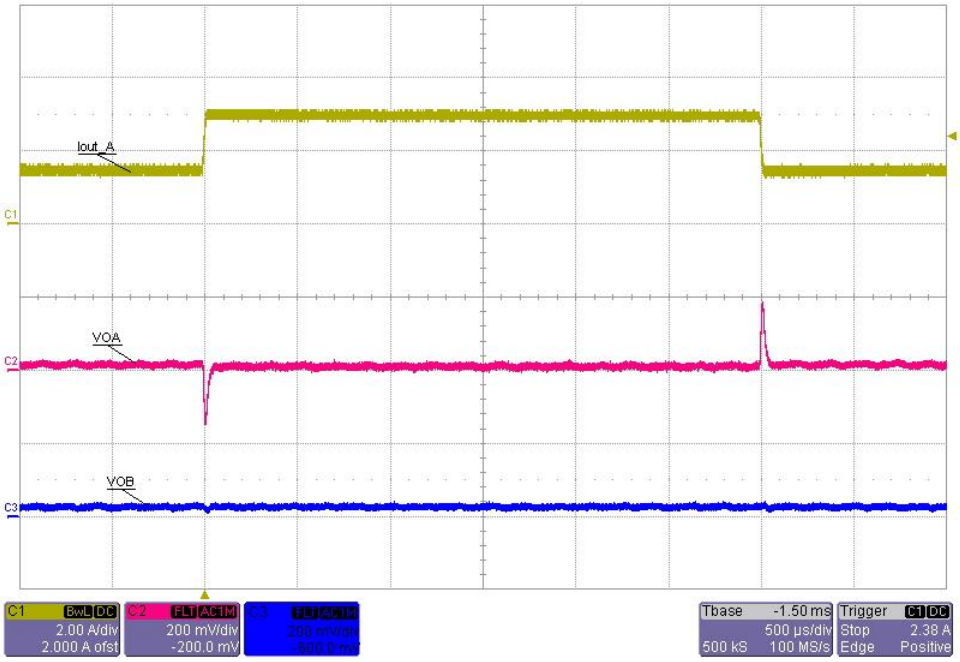

Figure 13 Output load transient response at 8V input

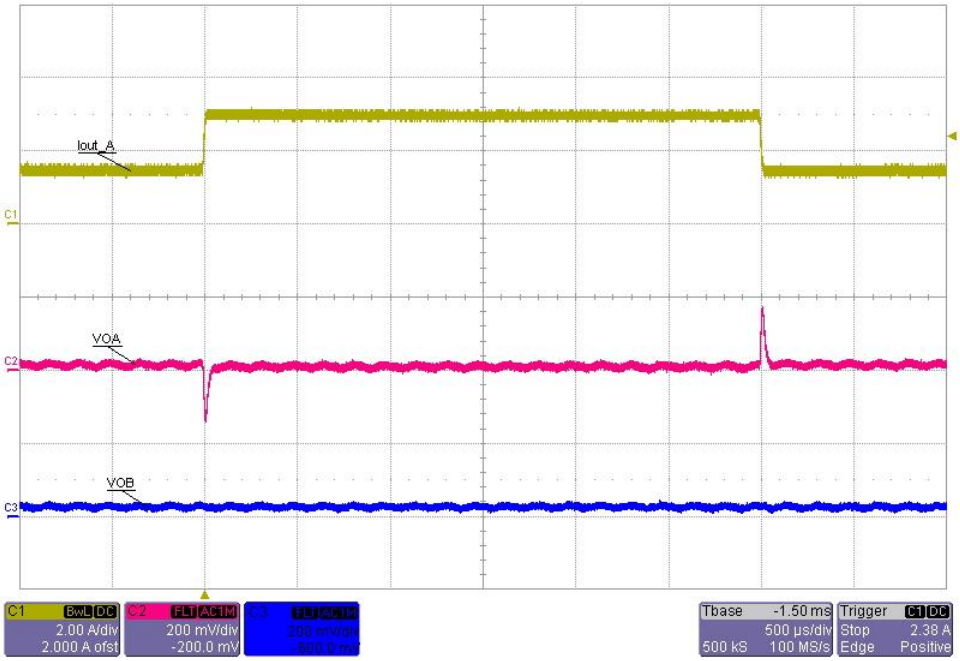

Figure 14 Output load transient response at 12V input

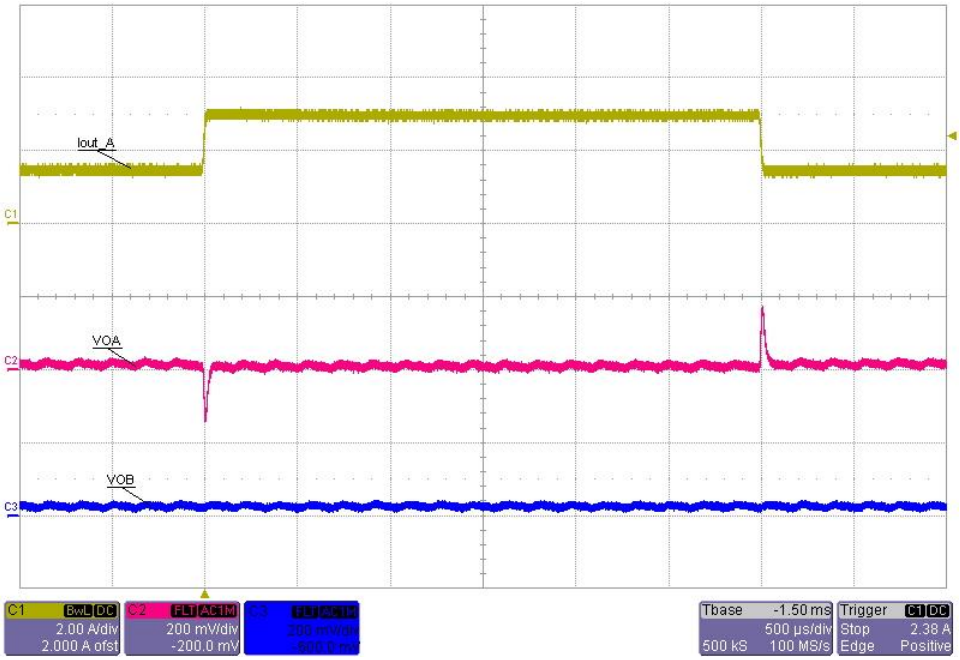

Figure 15 Output load transient response at 16V input

X. Output Voltage Ripples

The output ripples were measured directly at the output capacitors of both channels at full 3A load on both channels. C1 (yellow) is the output voltage ripple of channel A in AC mode and C2 (pink) is the output voltage ripple of channel B in AC mode.

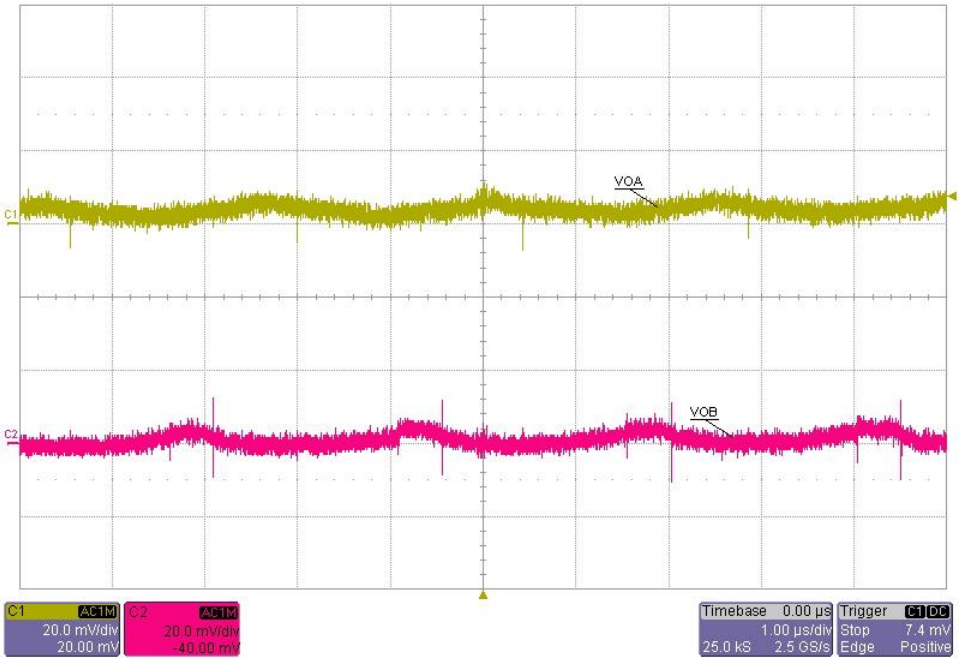

Figure 16 Output ripple at full load, 8Vin

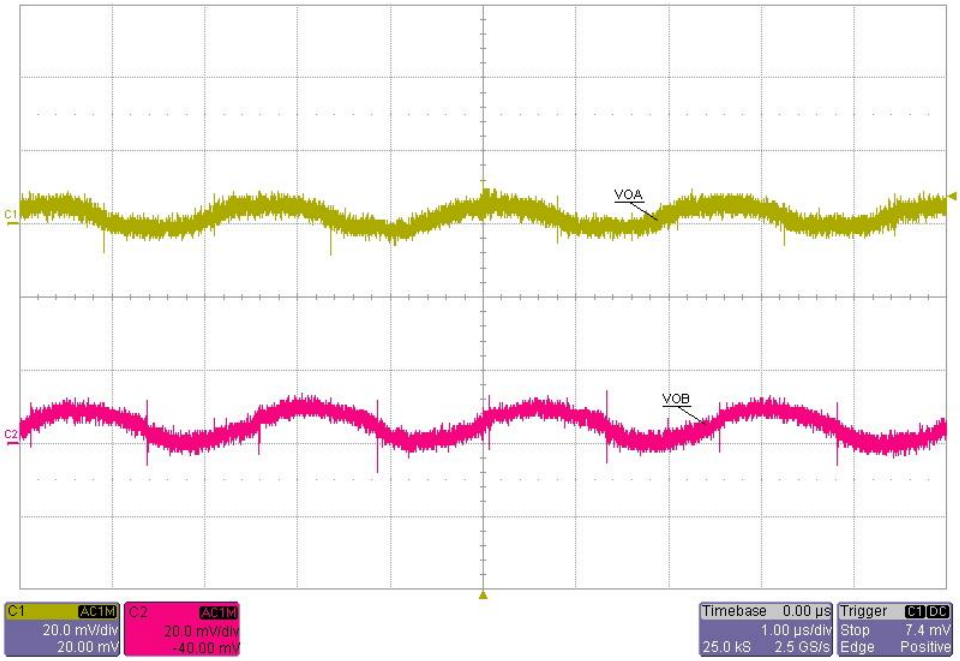

Figure 17 Output ripple at full load, 12Vin

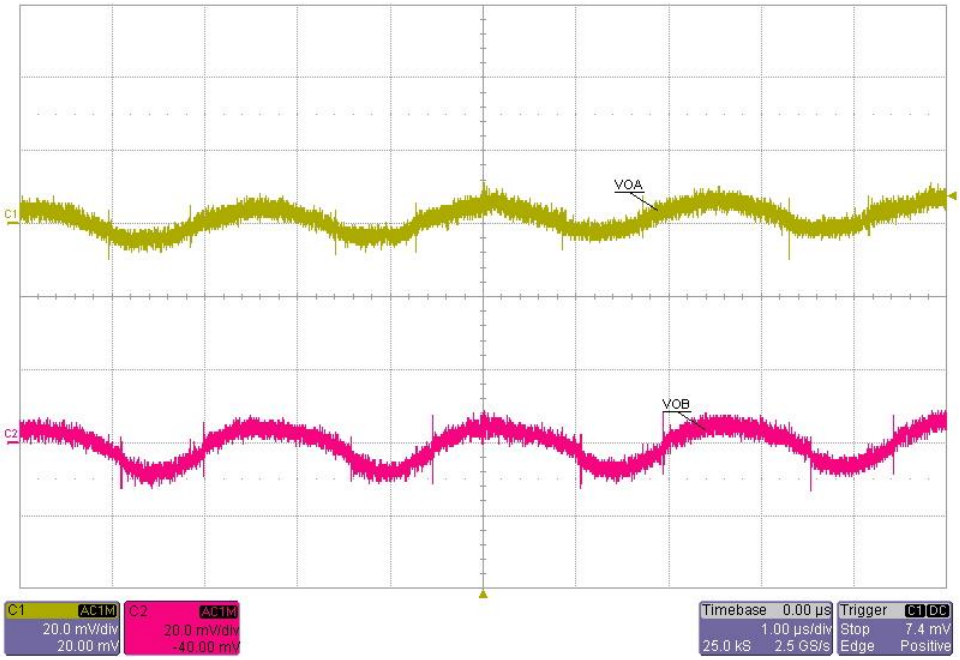

Figure 18 Output ripple at full load, 20Vin

Appendix: Efficiency Test Data

Balanced Load on 2 outputs

	Vin	Iin	Voa	Ioa	Vob	Iob	Efficiency
7Vin	6.998	0.012	5.008	0.000	4.999	0.000	0.0%
	7.000	0.376	5.008	0.251	5.000	0.251	95.5%
	7.012	0.743	5.008	0.500	4.999	0.500	96.1%
	6.999	1.515	5.007	1.001	4.998	1.002	94.5%
	6.999	2.328	5.004	1.505	4.996	1.502	92.3%
	6.999	3.185	5.001	2.001	4.993	2.001	89.7%
	7.000	4.121	4.993	2.495	4.987	2.509	86.6%
	6.999	5.125	4.989	2.989	4.983	3.005	83.3%
12Vin	11.999	0.017	5.003	0.000	4.996	0.000	0.0%
	12.000	0.231	5.008	0.251	5.000	0.251	90.8%
	11.996	0.446	5.004	0.501	4.997	0.500	93.7%
	11.996	0.894	5.000	1.006	4.994	1.006	93.8%
	11.996	1.353	4.996	1.500	4.991	1.502	92.4%
	11.995	1.844	4.990	2.008	4.987	2.005	90.5%
	11.996	2.343	4.987	2.502	4.984	2.501	88.7%
	11.999	2.846	4.992	2.989	4.985	3.005	87.5%
16Vin	15.998	0.019	5.008	0.000	5.000	0.000	0.0%
	15.998	0.179	5.008	0.251	5.000	0.251	87.9%
	15.997	0.340	5.003	0.501	4.996	0.500	92.0%
	15.997	0.676	5.000	1.006	4.994	1.006	93.0%
	15.997	1.019	4.995	1.500	4.991	1.502	92.0%
	15.997	1.382	4.991	2.008	4.987	2.005	90.5%
	15.997	1.750	4.989	2.502	4.985	2.501	89.1%
	15.997	2.126	4.986	2.988	4.983	3.005	87.8%
36Vin	35.953	0.017	5.005	0.000	4.996	0.000	0.0%
	35.944	0.089	5.005	0.251	4.996	0.251	78.2%
	35.927	0.163	5.003	0.501	4.996	0.501	85.4%
	36.076	0.312	5.001	1.000	4.994	1.000	88.9%
	36.031	0.467	4.998	1.500	4.992	1.501	89.2%
	36.003	0.629	4.993	2.009	4.988	2.000	88.4%
	35.977	0.793	4.987	2.503	4.983	2.500	87.4%
	35.948	0.963	4.981	2.995	4.977	2.996	86.2%

Single output test

	Vin	Iin	Voa	Ioa	Vob	Iob	Efficiency
7Vin	7.004	0.012	5.009	0			0.0%
	7.004	0.159	5.008	0.203			91.3%
	7.004	0.343	5.008	0.453			94.4%
	7.004	0.531	5.007	0.702			94.5%
	7.004	0.722	5.007	0.95			94.1%
	7.004	0.916	5.006	1.197			93.4%
	7.004	1.113	5.006	1.445			92.8%
	7.004	1.317	5.005	1.694			91.9%
	7.004	1.526	5.004	1.943			91.0%
	7.004	1.74	5.003	2.193			90.0%
	7.004	1.958	5.001	2.441			89.0%
	7.004	2.182	4.999	2.688			87.9%
	7.004	2.414	4.997	2.938			86.8%
12Vin	12.003	0.018	5.007	0			0.0%
	12.003	0.102	5.007	0.199			81.4%
	12.003	0.211	5.007	0.45			89.0%
	12.003	0.32	5.006	0.699			91.1%
	12.003	0.43	5.006	0.949			92.0%
	12.003	0.543	5.006	1.198			92.0%
	12.003	0.659	5.005	1.448			91.6%
	12.002	0.775	5.004	1.697			91.3%
	12.002	0.894	5.003	1.946			90.7%
	12.003	1.015	5.002	2.195			90.1%
	12.002	1.139	5.001	2.446			89.5%
	12.002	1.265	4.999	2.694			88.7%
	12.002	1.392	4.997	2.941			88.0%
16Vin	16.01	0.019	5.006	0			0.0%
	16.01	0.083	5.006	0.203			76.5%
	16.01	0.164	5.006	0.452			86.2%
	16.01	0.246	5.006	0.701			89.1%
	16.01	0.329	5.005	0.95			90.3%
	16.01	0.414	5.005	1.2			90.6%
	16.01	0.5	5.004	1.449			90.6%
	16.01	0.587	5.004	1.698			90.4%
	16.01	0.676	5.002	1.946			89.9%

	16.01	0.766	5.001	2.195	89.5%
	16.01	0.858	5	2.444	89.0%
	16.01	0.952	4.999	2.695	88.4%
	16.01	1.047	4.997	2.944	87.8%
36Vin	36.017	0.018	5.004	0	0.0%
	36.017	0.048	5.005	0.208	60.2%
	36.017	0.084	5.004	0.456	75.4%
	36.017	0.121	5.004	0.703	80.7%
	36.017	0.158	5.003	0.953	83.8%
	36.017	0.196	5.003	1.202	85.2%
	36.017	0.235	5.002	1.45	85.7%
	36.016	0.274	5.001	1.699	86.1%
	36.016	0.314	5	1.949	86.2%
	36.017	0.355	4.999	2.197	85.9%
	36.017	0.396	4.997	2.446	85.7%
	36.017	0.437	4.995	2.695	85.5%
	36.017	0.479	4.994	2.944	85.2%

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