Test Data
For PMP9486
08/22/2014

Contents

1. Design Specifications

Vin Minimum	**20VDC**
Vin Maximum	**40VDC**
Vout1	**14.5VDC**
Iout 1	**0.100A**
Vout2	**9VDC**
Iout 2	**0.100A**
Vout3	**14.5DC**
Iout 3	**0.100A**
Vout4	**9VDC**
Iout4	**0.100A**
Vout5	**10.5VDC**
Iout 5	**3mA (Just a Reference Supply)**
Approximate Switching Frequency	**300KHz Approx**

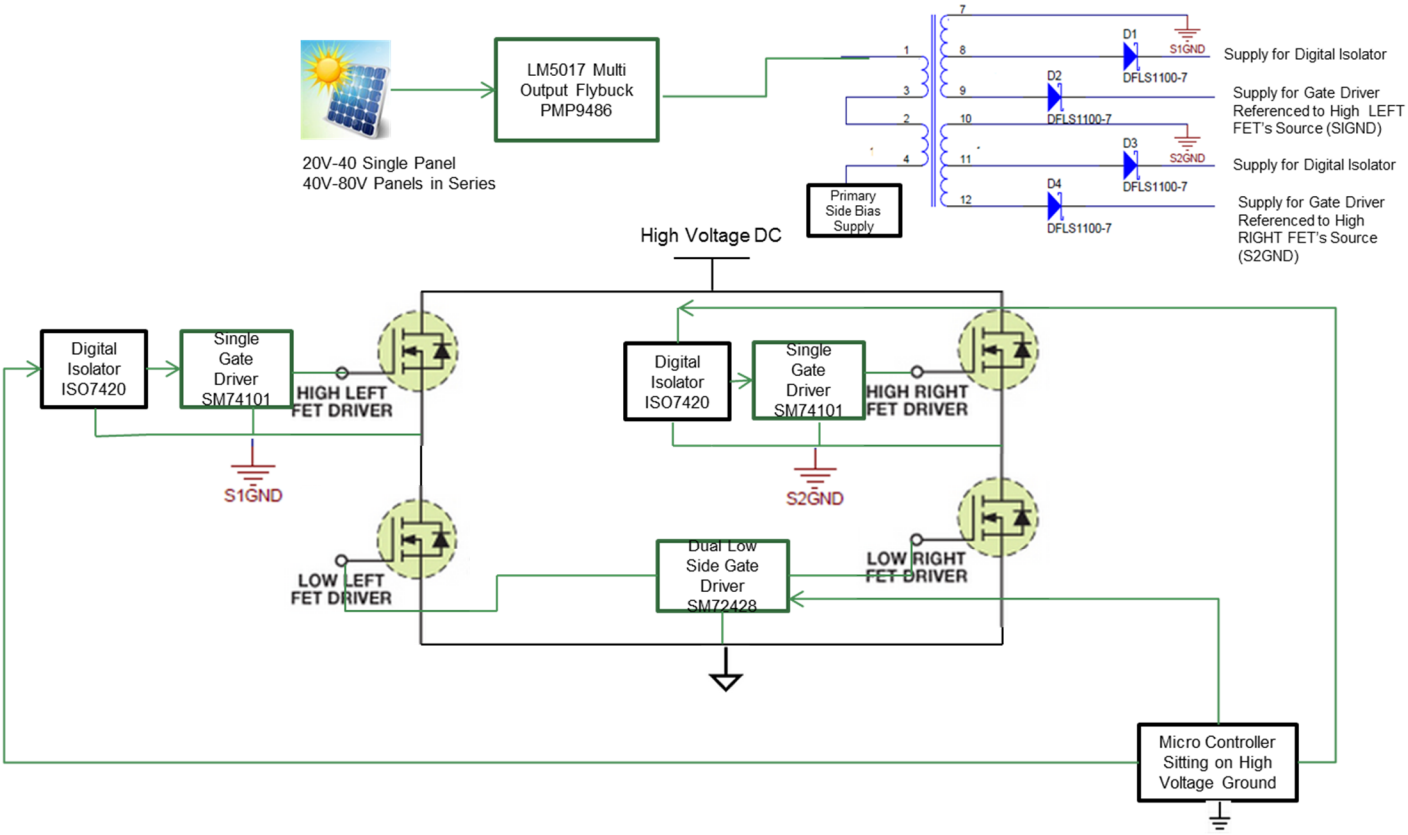
Vout 1 and Vout 2 are referenced to same Ground (GND1), Vout3 and Vout4 are referenced to same ground (GND2) . Vout5 is reference to Input Supply's Ground

2. Circuit Description and PCB details

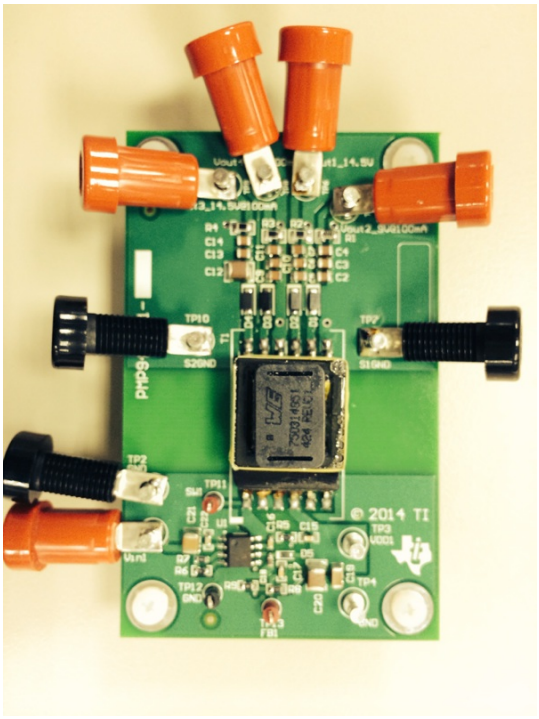
PMP9486 is a 5 output Flybuck Converter for driving Isolated Driver stages(GND wrt High Side Sources) in DC/AC section of High Frequency Commercial or residential Inverters(Ex-Solar Micro inverters) using the LM5017 regulator IC. The design accepts an input voltage of 20Vin to 40Vin DC(from Single Panel in Microinverters or 12V/24V batteries) and provides Isolated outputs of 14.5V,9V @100mA(referenced to same ground) and 14.5V,9V@100mA(referenced to same Ground). It features a small size and is an inexpensive and more efficient solution to using Flyback or Pushpull converters

The design is made by modifying the isolated Flybuck Evaluation module of LM5017 using Wruth Customized Transformer.

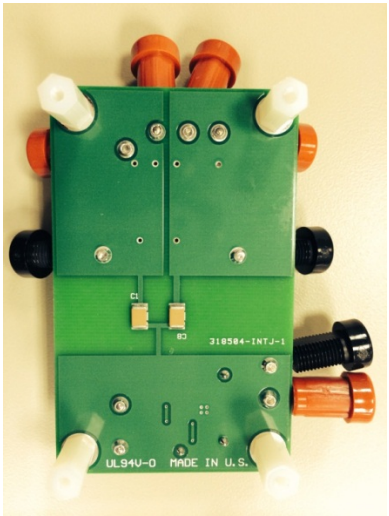
3. PMP9486 Block Diagram –Application in MicroInverters



4. PMP9486 Board Photos

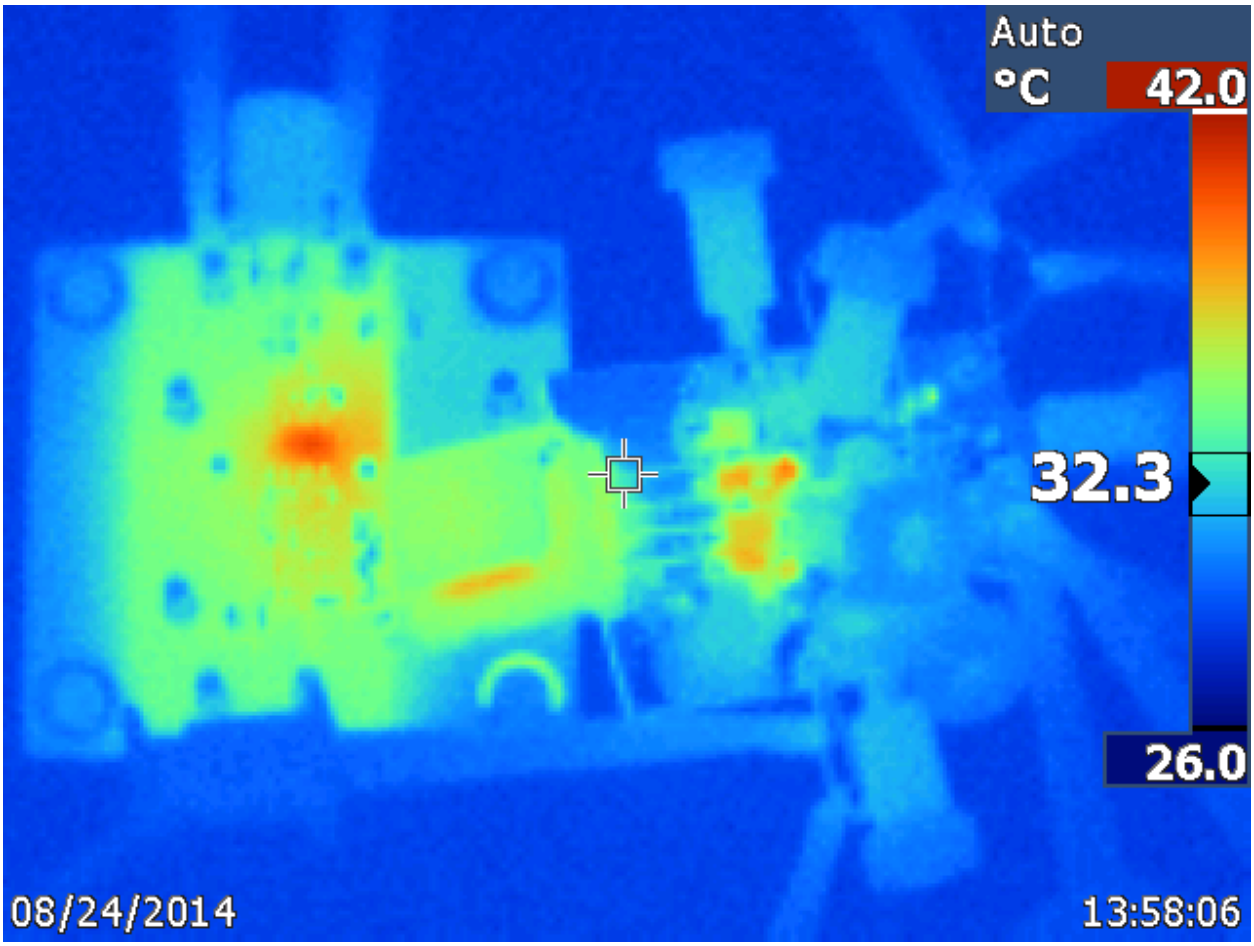


Board Photo (Top)



Board Photo (Bottom)

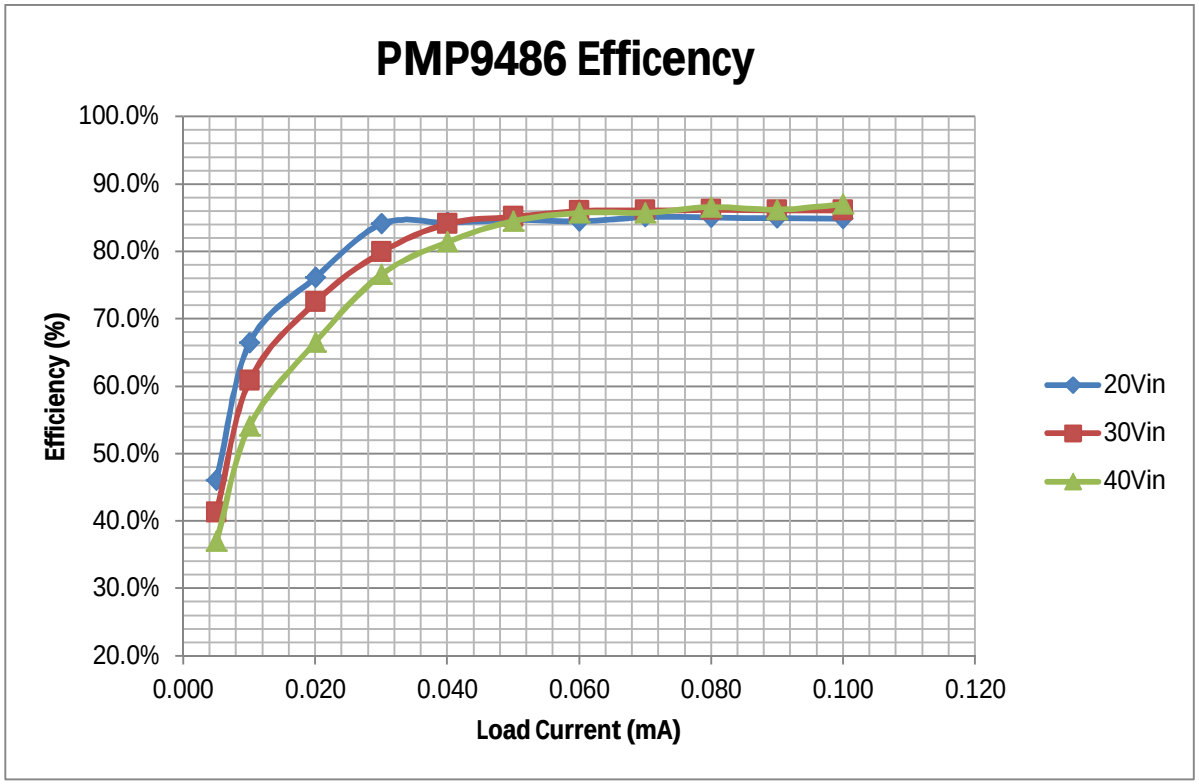
5. Thermal Data



IR thermal image taken at steady state with 30Vin and 150mA load (no airflow)

6. Efficiency

6.1 Efficiency Chart



6.2 Efficiency Data

Vin	Iin	Iout1	Vout1	Pout1	Iout2	Vout2	Pout2	Iout3	Vout3	Pout3	Iout4	Vout4	Pout4	TotalPout	Losses	Efficiency
20.88	0.025	0.005	14.989	0.07	0.005	9.270	0.05	0.005	15.106	0.08	0.005	9.321	0.05	0.24	0.285	46.1%
20.82	0.035	0.010	14.903	0.15	0.010	9.220	0.09	0.010	15.027	0.15	0.010	9.268	0.09	0.48	0.245	66.4%
20.89	0.060	0.020	14.711	0.29	0.020	9.080	0.18	0.020	14.817	0.30	0.020	9.129	0.18	0.95	0.298	76.2%
20.57	0.082	0.030	14.564	0.44	0.030	8.980	0.27	0.030	14.698	0.44	0.030	9.041	0.27	1.42	0.268	84.1%
20.45	0.109	0.040	14.473	0.58	0.040	8.910	0.36	0.040	14.628	0.59	0.040	8.970	0.36	1.88	0.350	84.3%
20.96	0.132	0.050	14.426	0.72	0.050	8.870	0.44	0.050	14.601	0.73	0.050	8.948	0.45	2.34	0.424	84.7%
20.95	0.158	0.060	14.355	0.86	0.060	8.810	0.53	0.060	14.546	0.87	0.060	8.899	0.53	2.80	0.513	84.5%
20.94	0.182	0.070	14.272	1.00	0.070	8.740	0.61	0.070	14.486	1.01	0.070	8.840	0.62	3.24	0.567	85.1%
20.93	0.207	0.080	14.189	1.14	0.080	8.680	0.69	0.080	14.418	1.15	0.080	8.790	0.70	3.69	0.646	85.1%
20.91	0.232	0.090	14.093	1.27	0.090	8.610	0.77	0.090	14.346	1.29	0.090	8.736	0.79	4.12	0.731	84.9%
20.90	0.256	0.100	13.976	1.40	0.100	8.530	0.85	0.100	14.250	1.43	0.100	8.660	0.87	4.54	0.810	84.9%

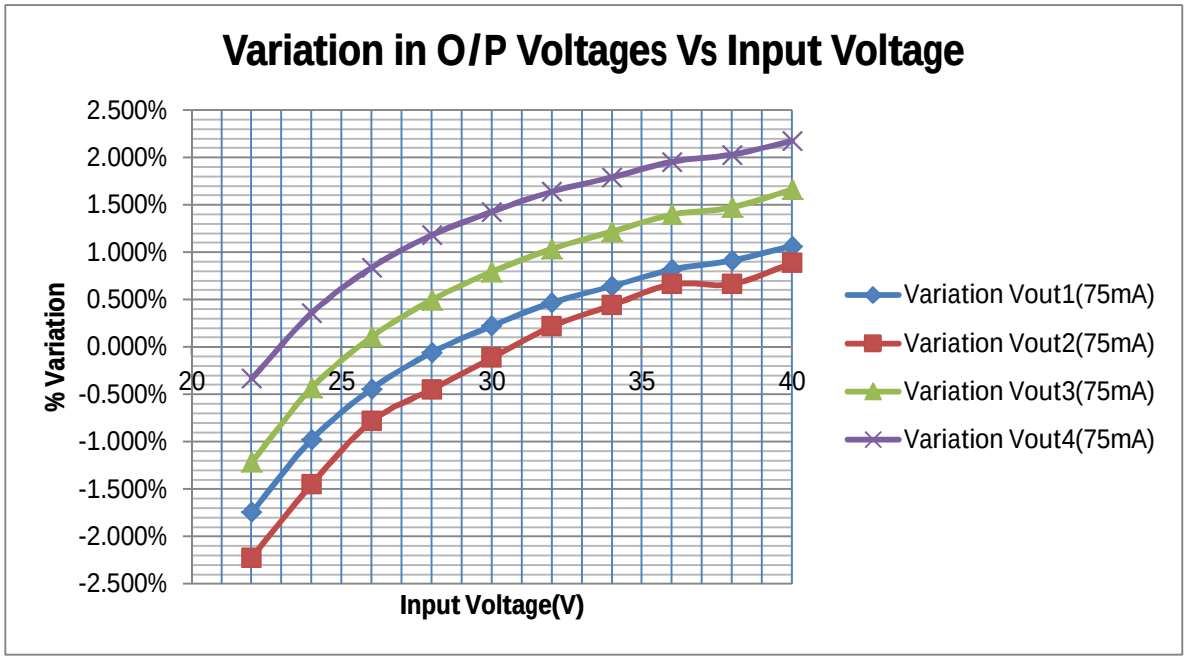
Vin	Iin	Iout1	Vout1	Pout1	Iout2	Vout2	Pout2	Iout3	Vout3	Pout3	Iout4	Vout4	Pout4	TotalPout	Losses	Efficiency
29.91	0.020	0.005	15.224	0.08	0.005	9.400	0.05	0.005	15.350	0.08	0.005	9.450	0.05	0.25	0.351	41.3%
29.87	0.027	0.010	15.095	0.15	0.010	9.340	0.09	0.010	15.224	0.15	0.010	9.380	0.09	0.49	0.316	60.8%
29.77	0.045	0.020	14.964	0.30	0.020	9.250	0.19	0.020	15.068	0.30	0.020	9.290	0.19	0.97	0.368	72.5%
29.68	0.061	0.030	14.853	0.45	0.030	9.170	0.28	0.030	14.975	0.45	0.030	9.224	0.28	1.45	0.364	79.9%
29.61	0.077	0.040	14.760	0.59	0.040	9.110	0.36	0.040	14.902	0.60	0.040	9.166	0.37	1.92	0.362	84.1%
29.52	0.095	0.050	14.714	0.74	0.050	9.070	0.45	0.050	14.863	0.74	0.050	9.129	0.46	2.39	0.416	85.2%
29.96	0.111	0.060	14.683	0.88	0.060	9.030	0.54	0.060	14.844	0.89	0.060	9.105	0.55	2.86	0.466	86.0%
29.96	0.129	0.070	14.643	1.03	0.070	9.000	0.63	0.070	14.820	1.04	0.070	9.070	0.63	3.33	0.537	86.1%
29.95	0.147	0.080	14.607	1.17	0.080	8.970	0.72	0.080	14.797	1.18	0.080	9.052	0.72	3.79	0.608	86.2%
29.94	0.165	0.090	14.564	1.31	0.090	8.930	0.80	0.090	14.772	1.33	0.090	9.025	0.81	4.26	0.684	86.2%
29.93	0.183	0.100	14.518	1.45	0.100	8.890	0.89	0.100	14.741	1.47	0.100	8.995	0.90	4.71	0.763	86.1%

Vin	Iin	Iout1	Vout1	Pout1	Iout2	Vout2	Pout2	Iout3	Vout3	Pout3	Iout4	Vout4	Pout4	TotalPout	Losses	Efficiency
39.99	0.017	0.005	15.510	0.08	0.005	9.550	0.05	0.005	15.667	0.08	0.005	9.610	0.05	0.25	0.428	37.0%
39.88	0.023	0.010	15.286	0.15	0.010	9.430	0.09	0.010	15.427	0.15	0.010	9.488	0.09	0.50	0.421	54.1%
39.81	0.037	0.020	15.106	0.30	0.020	9.330	0.19	0.020	15.211	0.30	0.020	9.379	0.19	0.98	0.492	66.6%
39.75	0.048	0.030	15.010	0.45	0.030	9.270	0.28	0.030	15.130	0.45	0.030	9.320	0.28	1.46	0.446	76.6%
39.68	0.060	0.040	14.930	0.60	0.040	9.210	0.37	0.040	15.063	0.60	0.040	9.269	0.37	1.94	0.442	81.4%
39.63	0.072	0.050	14.856	0.74	0.050	9.160	0.46	0.050	14.994	0.75	0.050	9.217	0.46	2.41	0.442	84.5%
39.56	0.085	0.060	14.803	0.89	0.060	9.120	0.55	0.060	14.952	0.90	0.060	9.179	0.55	2.88	0.480	85.7%
39.50	0.099	0.070	14.762	1.03	0.070	9.080	0.64	0.070	14.925	1.04	0.070	9.152	0.64	3.35	0.556	85.8%
39.44	0.112	0.080	14.731	1.18	0.080	9.050	0.72	0.080	14.905	1.19	0.080	9.129	0.73	3.83	0.592	86.6%
39.37	0.127	0.090	14.698	1.32	0.090	9.020	0.81	0.090	14.889	1.34	0.090	9.109	0.82	4.29	0.686	86.2%
39.95	0.137	0.100	14.675	1.47	0.100	9.000	0.90	0.100	14.877	1.49	0.100	9.092	0.91	4.76	0.709	87.1%

7. Cross Regulation

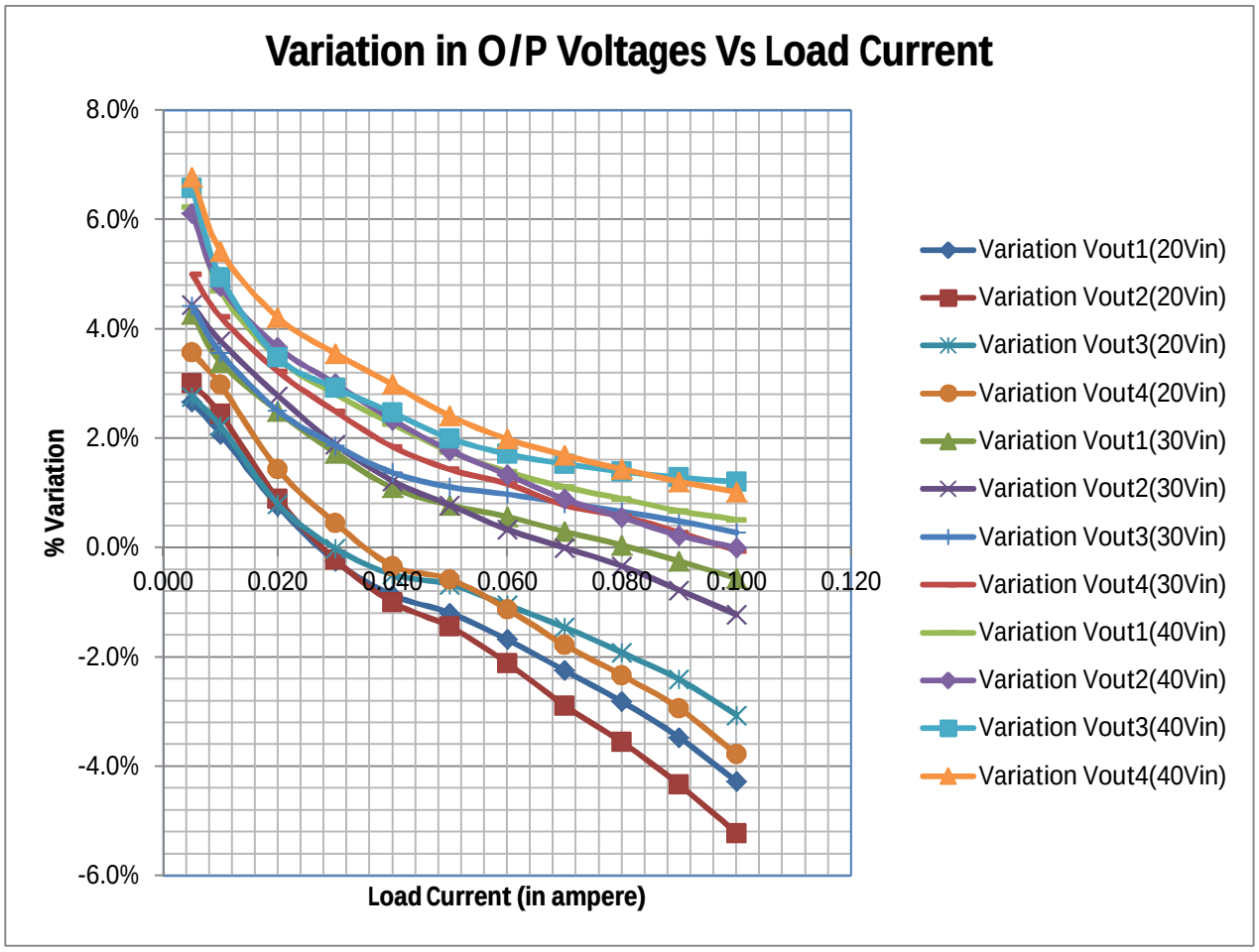
The Cross regulation was tested by Sweeping Vin(keeping Load Constant) or Output Load(Keeping Vin Constant)

7.1 Vin Sweep Response



Vin	Vout1	Vout2	Vout3	Vout4	Iout	Variation Vout 1		Variation Vout2		Variation Vout 3		Variation Vout 4
40	14.756	9.08	14.918	9.15	70mA	1.068%		0.889%		1.667%		2.178%
38	14.734	9.06	14.897	9.133	70mA	0.918%		0.667%		1.478%		2.034%
36	14.72	9.06	14.886	9.126	70mA	0.822%		0.667%		1.400%		1.959%
34	14.694	9.04	14.862	9.11	70mA	0.644%		0.444%		1.222%		1.795%
32	14.669	9.02	14.84	9.0934	70mA	0.473%		0.222%		1.038%		1.644%
30	14.633	8.99	14.809	9.0718	70mA	0.226%		-0.111%		0.798%		1.432%
28	14.592	8.96	14.773	9.045	70mA	-0.055%		-0.444%		0.500%		1.185%
26	14.536	8.93	14.723	9.01	70mA	-0.438%		-0.778%		0.111%		0.842%
24	14.458	8.87	14.653	8.9615	70mA	-0.973%		-1.444%		-0.428%		0.363%
22	14.346	8.8	14.552	8.891	70mA	-1.740%		-2.222%		-1.211%		-0.329%

7.2 Output Load Sweep Response



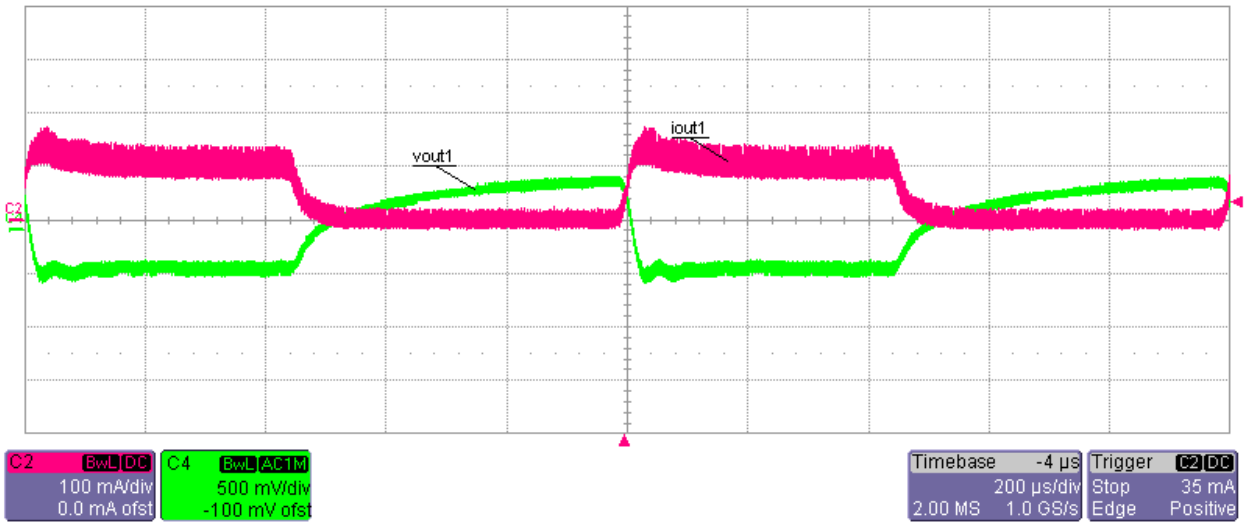
Vin	Iin	Iout1	Vout1	Pout1	Iout2	Vout2	Pout2	Iout3	Vout3	Pout3	Iout4	Vout4	Pout4	TotalPout	Losses	Efficiency	Variaont Vout1	Variaont Vout2	Varioant Vout3	Varioant Vout4
20.88	0.025	0.005	14.989	0.07	0.005	9.270	0.05	0.005	15.106	0.08	0.005	9.321	0.05	0.24	0.285	46.1%	2.7%	3.0%	2.8%	3.6%
20.82	0.035	0.010	14.903	0.15	0.010	9.220	0.09	0.010	15.027	0.15	0.010	9.268	0.09	0.48	0.245	66.4%	2.1%	2.4%	2.2%	3.0%
20.89	0.060	0.020	14.711	0.29	0.020	9.080	0.18	0.020	14.817	0.30	0.020	9.129	0.18	0.95	0.298	76.2%	0.8%	0.9%	0.8%	1.4%
20.57	0.082	0.030	14.564	0.44	0.030	8.980	0.27	0.030	14.698	0.44	0.030	9.041	0.27	1.42	0.268	84.1%	-0.2%	-0.2%	0.0%	0.5%
20.45	0.109	0.040	14.473	0.58	0.040	8.910	0.36	0.040	14.628	0.59	0.040	8.970	0.36	1.88	0.350	84.3%	-0.9%	-1.0%	-0.5%	-0.3%
20.96	0.132	0.050	14.426	0.72	0.050	8.870	0.44	0.050	14.601	0.73	0.050	8.948	0.45	2.34	0.424	84.7%	-1.2%	-1.4%	-0.7%	-0.6%
20.95	0.158	0.060	14.355	0.86	0.060	8.810	0.53	0.060	14.546	0.87	0.060	8.899	0.53	2.80	0.513	84.5%	-1.7%	-2.1%	-1.0%	-1.1%
20.94	0.182	0.070	14.272	1.00	0.070	8.740	0.61	0.070	14.486	1.01	0.070	8.840	0.62	3.24	0.567	85.1%	-2.2%	-2.9%	-1.5%	-1.8%
20.93	0.207	0.080	14.189	1.14	0.080	8.680	0.69	0.080	14.418	1.15	0.080	8.790	0.70	3.69	0.646	85.1%	-2.8%	-3.6%	-1.9%	-2.3%
20.91	0.232	0.090	14.093	1.27	0.090	8.610	0.77	0.090	14.346	1.29	0.090	8.736	0.79	4.12	0.731	84.9%	-3.5%	-4.3%	-2.4%	-2.9%
20.90	0.256	0.100	13.976	1.40	0.100	8.530	0.85	0.100	14.250	1.43	0.100	8.660	0.87	4.54	0.810	84.9%	-4.3%	-5.2%	-3.1%	-3.8%

Vin	Iin	Iout1	Vout1	Pout1	Iout2	Vout2	Pout2	Iout3	Vout3	Pout3	Iout4	Vout4	Pout4	TotalPout	Losses	Efficiency	Variaont Vout1	Variaont Vout2	Varioant Vout3	Varioant Vout4
29.91	0.020	0.005	15.224	0.08	0.005	9.400	0.05	0.005	15.350	0.08	0.005	9.450	0.05	0.25	0.351	41.3%	4.3%	4.4%	4.4%	5.0%
29.87	0.027	0.010	15.095	0.15	0.010	9.340	0.09	0.010	15.224	0.15	0.010	9.380	0.09	0.49	0.316	60.8%	3.4%	3.8%	3.6%	4.2%
29.77	0.045	0.020	14.964	0.30	0.020	9.250	0.19	0.020	15.068	0.30	0.020	9.290	0.19	0.97	0.368	72.5%	2.5%	2.8%	2.5%	3.2%
29.68	0.061	0.030	14.853	0.45	0.030	9.170	0.28	0.030	14.975	0.45	0.030	9.224	0.28	1.45	0.364	79.9%	1.7%	1.9%	1.9%	2.5%
29.61	0.077	0.040	14.760	0.59	0.040	9.110	0.36	0.040	14.902	0.60	0.040	9.166	0.37	1.92	0.362	84.1%	1.1%	1.2%	1.4%	1.8%
29.52	0.095	0.050	14.714	0.74	0.050	9.070	0.45	0.050	14.863	0.74	0.050	9.129	0.46	2.39	0.416	85.2%	0.8%	0.8%	1.1%	1.4%
29.96	0.111	0.060	14.683	0.88	0.060	9.030	0.54	0.060	14.844	0.89	0.060	9.105	0.55	2.86	0.466	86.0%	0.6%	0.3%	1.0%	1.2%
29.96	0.129	0.070	14.643	1.03	0.070	9.000	0.63	0.070	14.820	1.04	0.070	9.070	0.63	3.33	0.537	86.1%	0.3%	0.0%	0.8%	0.8%
29.95	0.147	0.080	14.607	1.17	0.080	8.970	0.72	0.080	14.797	1.18	0.080	9.052	0.72	3.79	0.608	86.2%	0.0%	-0.3%	0.7%	0.6%
29.94	0.165	0.090	14.564	1.31	0.090	8.930	0.80	0.090	14.772	1.33	0.090	9.025	0.81	4.26	0.684	86.2%	-0.2%	-0.8%	0.5%	0.3%
29.93	0.183	0.100	14.518	1.45	0.100	8.890	0.89	0.100	14.741	1.47	0.100	8.995	0.90	4.71	0.763	86.1%	-0.6%	-1.2%	0.3%	-0.1%

Vin	Iin	Iout1	Vout1	Pout1	Iout2	Vout2	Pout2	Iout3	Vout3	Pout3	Iout4	Vout4	Pout4	TotalPout	Losses	Efficiency	Variaont Vout1	Variaont Vout2	Varioant Vout3	Varioant Vout4
39.99	0.017	0.005	15.510	0.08	0.005	9.550	0.05	0.005	15.667	0.08	0.005	9.610	0.05	0.25	0.428	37.0%	6.2%	6.1%	6.6%	6.8%
39.88	0.023	0.010	15.286	0.15	0.010	9.430	0.09	0.010	15.427	0.15	0.010	9.488	0.09	0.50	0.421	54.1%	4.7%	4.8%	4.9%	5.4%
39.81	0.037	0.020	15.106	0.30	0.020	9.330	0.19	0.020	15.211	0.30	0.020	9.379	0.19	0.98	0.492	66.6%	3.5%	3.7%	3.5%	4.2%
39.75	0.048	0.030	15.010	0.45	0.030	9.270	0.28	0.030	15.130	0.45	0.030	9.320	0.28	1.46	0.446	76.6%	2.8%	3.0%	2.9%	3.6%
39.68	0.060	0.040	14.930	0.60	0.040	9.210	0.37	0.040	15.063	0.60	0.040	9.269	0.37	1.94	0.442	81.4%	2.3%	2.3%	2.5%	3.0%
39.63	0.072	0.050	14.856	0.74	0.050	9.160	0.46	0.050	14.994	0.75	0.050	9.217	0.46	2.41	0.442	84.5%	1.8%	1.8%	2.0%	2.4%
39.56	0.085	0.060	14.803	0.89	0.060	9.120	0.55	0.060	14.952	0.90	0.060	9.179	0.55	2.88	0.480	85.7%	1.4%	1.3%	1.7%	2.0%
39.50	0.099	0.070	14.762	1.03	0.070	9.080	0.64	0.070	14.925	1.04	0.070	9.152	0.64	3.35	0.556	85.8%	1.1%	0.9%	1.5%	1.7%
39.44	0.112	0.080	14.731	1.18	0.080	9.050	0.72	0.080	14.905	1.19	0.080	9.129	0.73	3.83	0.592	86.6%	0.9%	0.6%	1.4%	1.4%
39.37	0.127	0.090	14.698	1.32	0.090	9.020	0.81	0.090	14.889	1.34	0.090	9.109	0.82	4.29	0.686	86.2%	0.7%	0.2%	1.3%	1.2%
39.95	0.137	0.100	14.675	1.47	0.100	9.000	0.90	0.100	14.877	1.49	0.100	9.092	0.91	4.76	0.709	87.1%	0.5%	0.0%	1.2%	1.0%

8 Waveforms

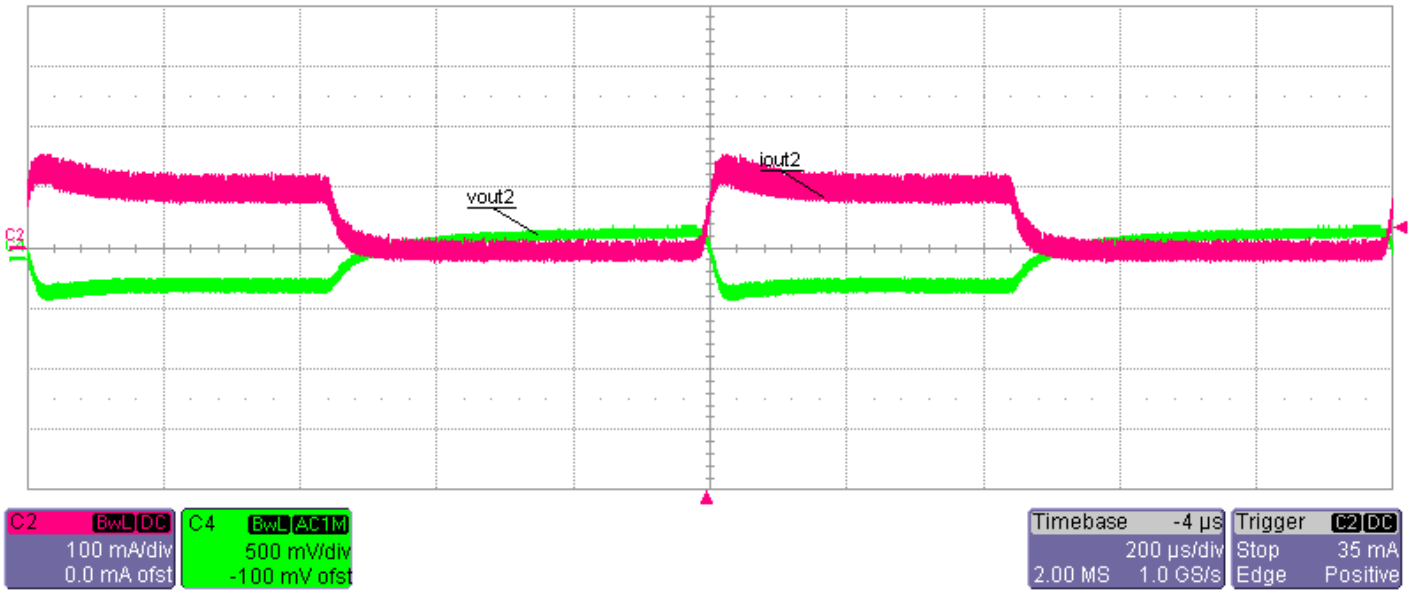
8.1 Load Transient Response



Load Transient Response at 20Vin and 0%-to-100% (0mA-to-100mA) Load Step on 14.5V Output Vout1(Load were no connected to any other outputs)

Ch4 – Vout1 (AC coupled)

Ch2- Iout 1

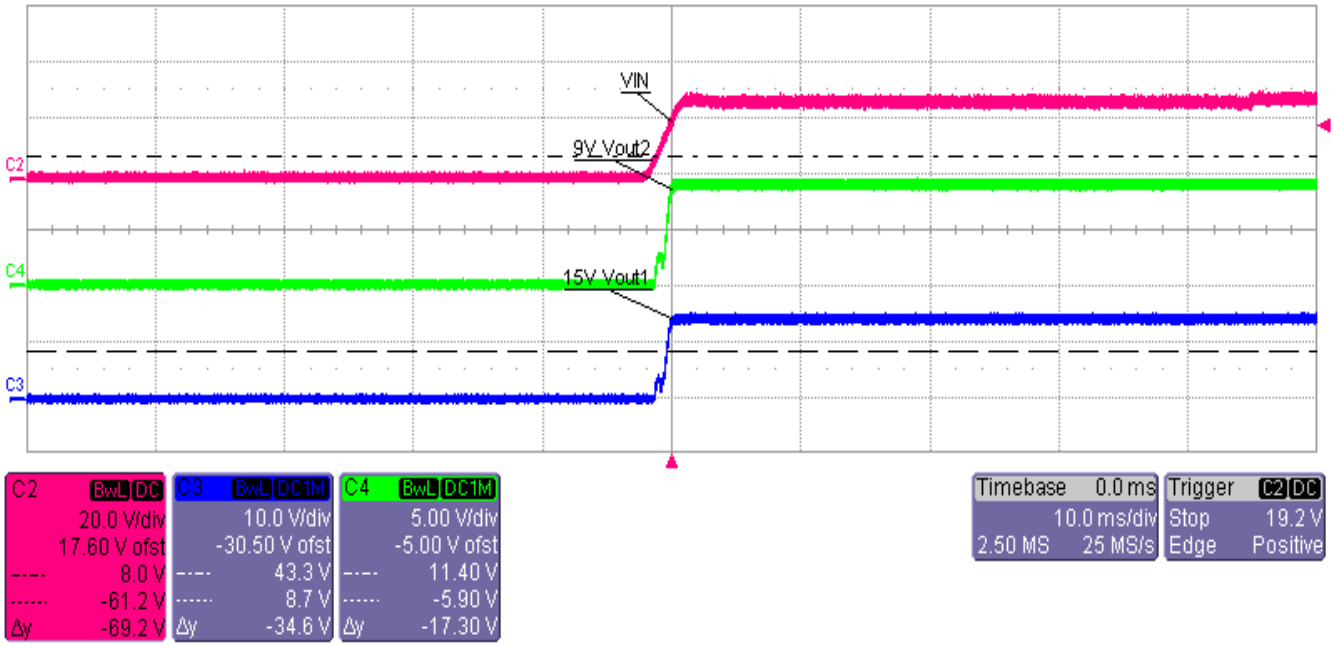


Load Transient Response at 20Vin and 0%-to-100% (0mA-to-100mA) Load Step on 9V Output Vout2(Load were no connected to any other outputs)

Ch4 – Vout2 (AC coupled)

Ch2- Iout 2

8.2 Startup



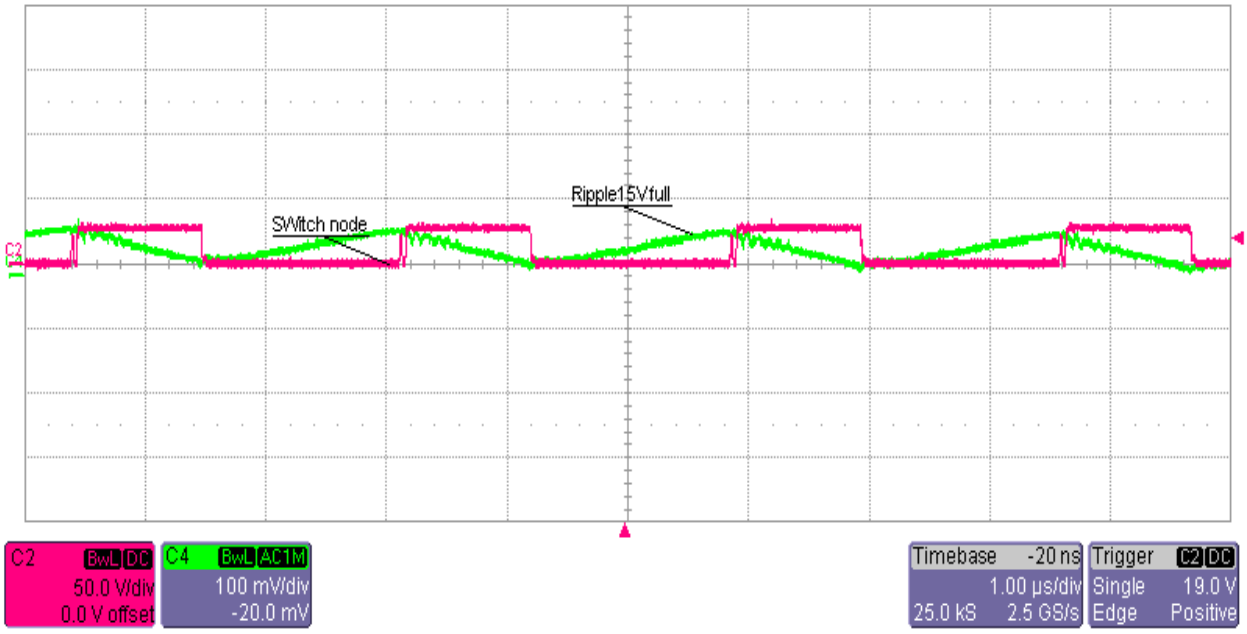
Startup into full Load (all the output was connected to 100mA) at 20 Vin

Ch2-Vin

Ch3-Vout 1

Ch4-Vout 2

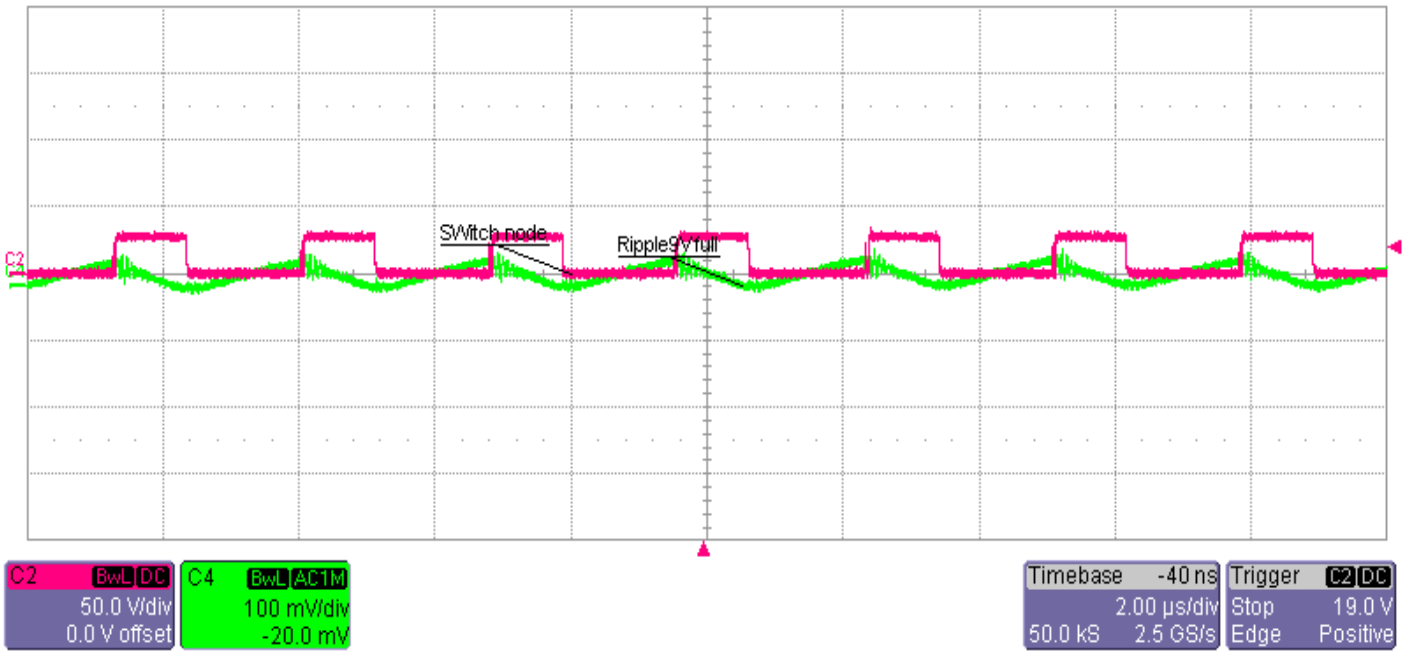
8.3 Output Voltage Ripple and Switch Node Voltage



Switch Node Voltage and Output Voltage Ripple at 20 Vin and Full (100mA) Load on all the outputs (Vripple < 60mVp-p)

Ch4-Vout1 (AC Coupled)

Ch2-Switching Waveform

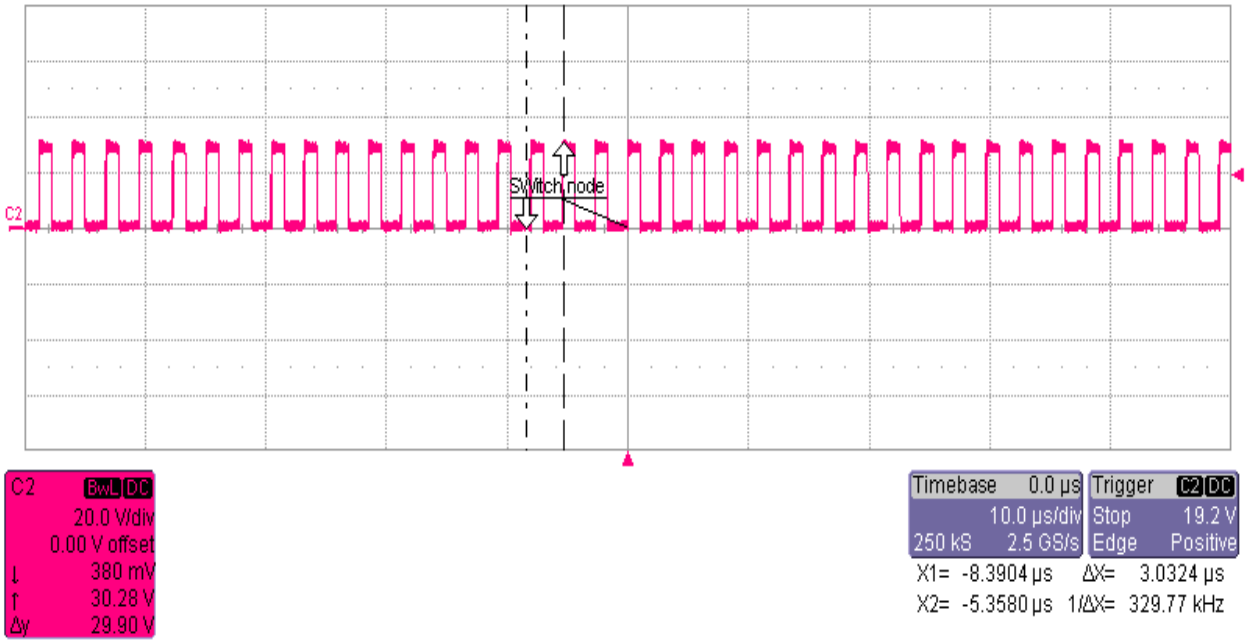


Switch Node Voltage and Output Voltage Ripple at 20 Vin and Full (100mA) Load on all the outputs (Vripple < 60mVp-p)

Ch4-Vout2 (AC Coupled)

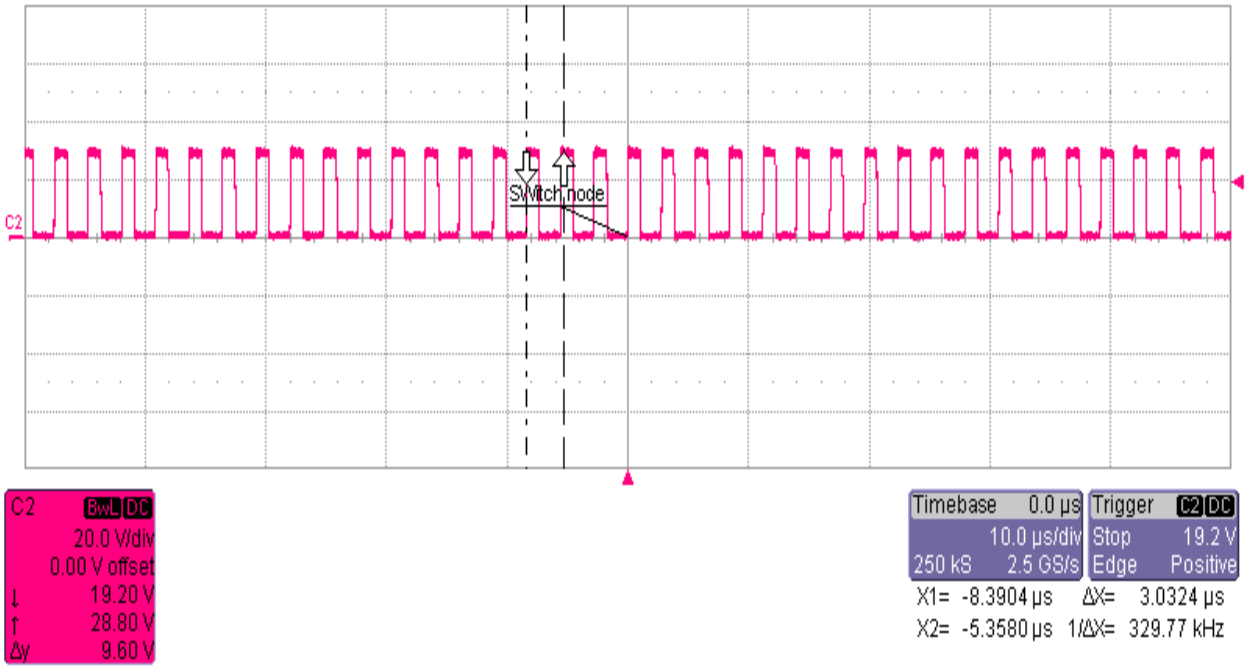
Ch2-Switching Waveform

8.4 Primary Side Switching Waveform



Switch Node Voltage(Primary side) at 30 Vin and Full (100mA) Load on all the outputs

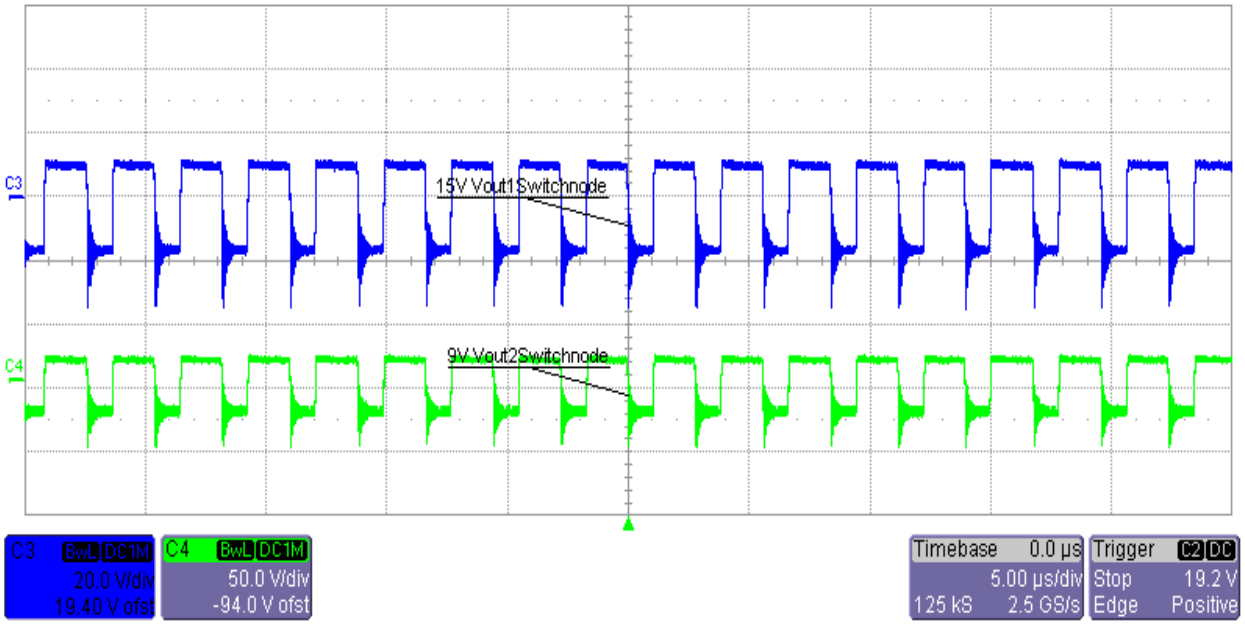
Ch2-Switching Waveform



Switch Node Voltage(Primary side) at 30 Vin and No Load on all the outputs

Ch2-Switching Waveform

8.5 Secondary Side Switching Waveform



All the outputs were loaded with 100mA and waveform was taken at Secondary switch node for Vout1 14.5V as well as Vout2 9V.

Ch3-Switching Waveform from Anode of Diode to Secondary Ground – 9V

Ch4- Switching Waveform from Anode of Diode to Secondary Ground – 14.5V

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