



**LM5122 Boost Converter
with
LM5050-1 Reverse Battery Protection**

TI reference design number: PMP7936 Rev A

**Input: 4.5V – 42V
Output: 13.8V @ 10A**

DC – DC Test Results

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PMP7936 Rev A Test Results

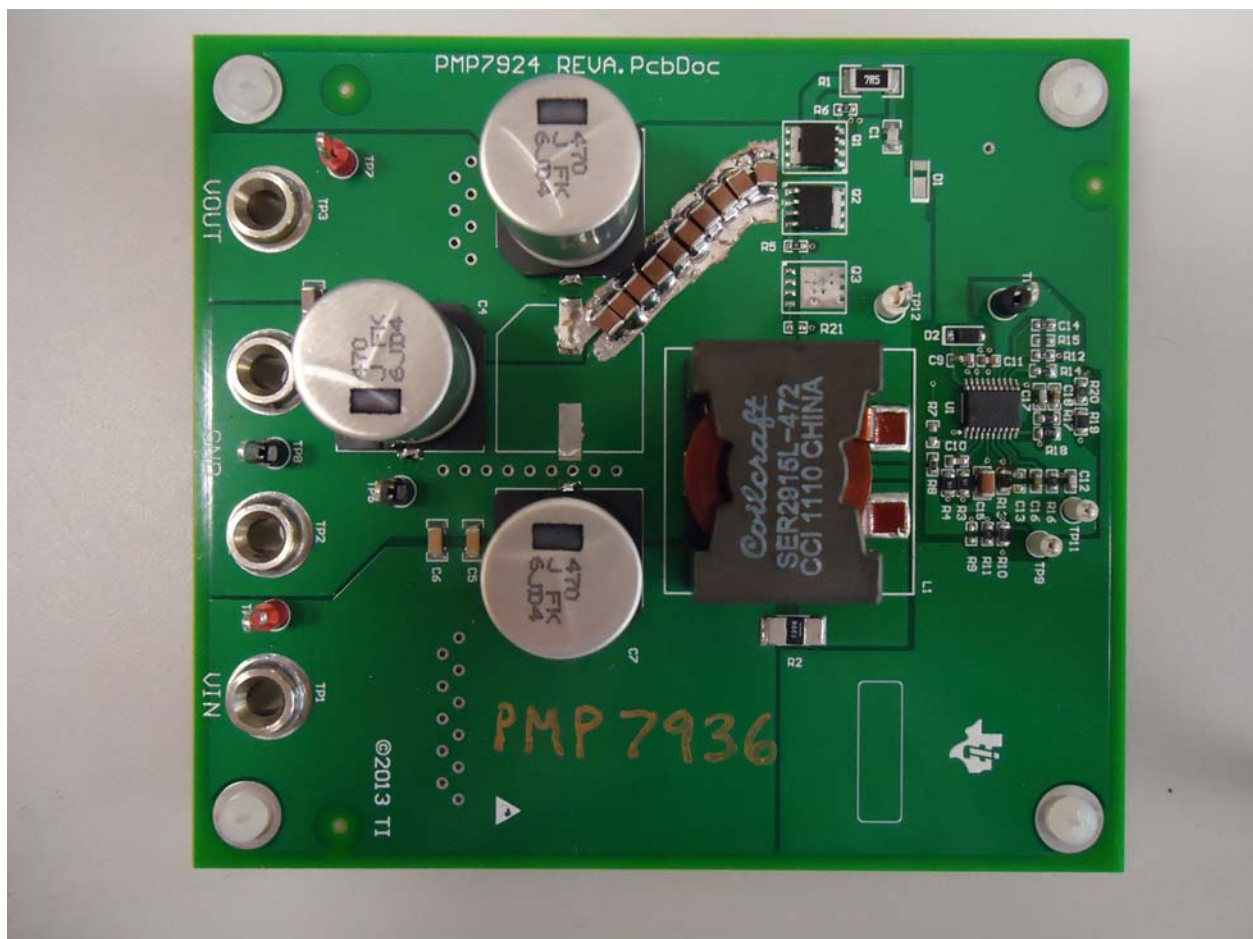
1 Circuit Description

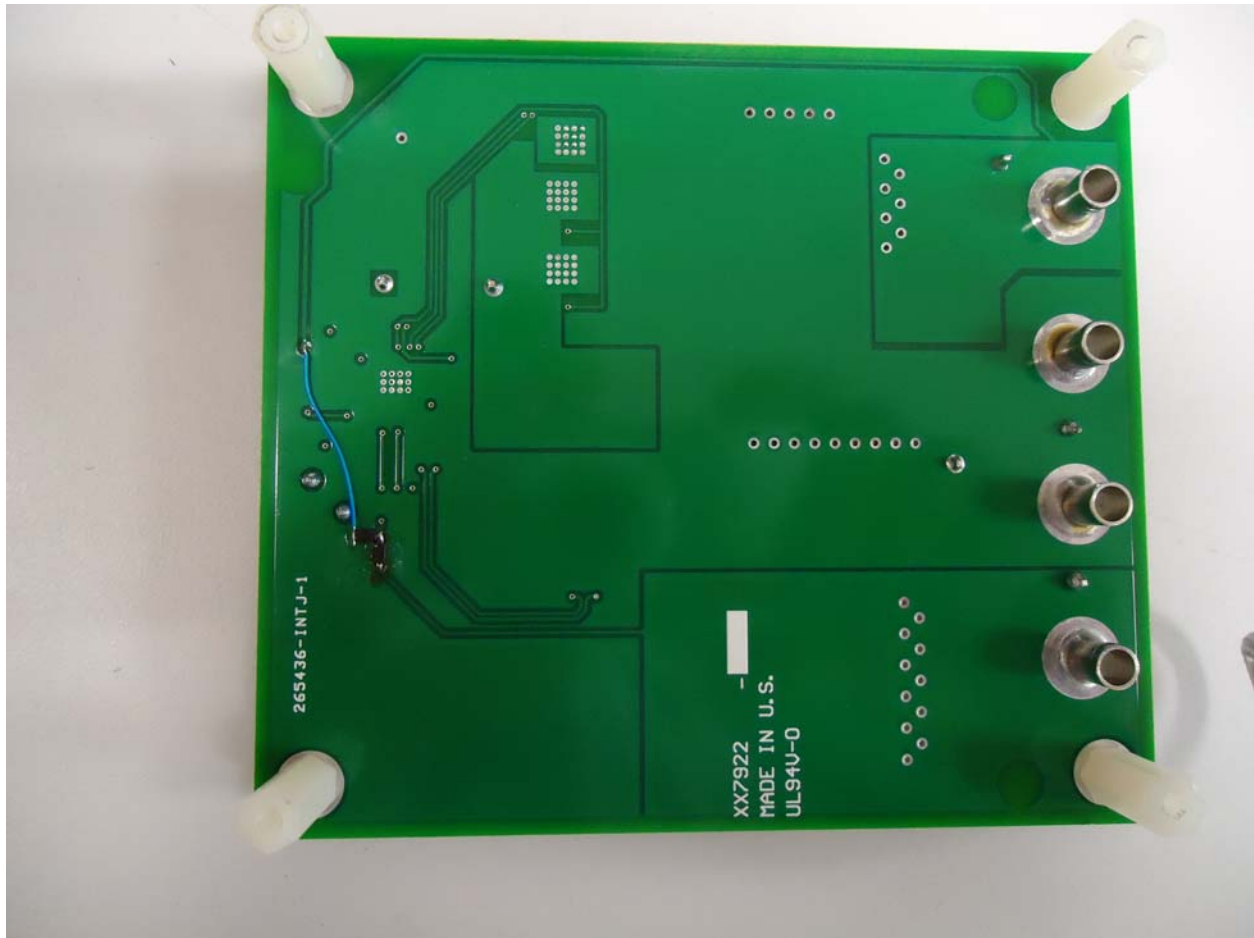
PMP7936 is a boost converter capable of 138W output power and targeted for automotive applications. This design uses the LM5122 synchronous boost current-mode PWM controller. The circuit will start at a minimum input of 6.5V and has an operating input voltage range of 4.5V to 42V. The output is 13.8V at 8A continuous, 10A peak. The LM5122 incorporates bypass mode operation, so that when $V_{IN} > 13.8V$, V_{OUT} is approximately equal to V_{IN} . Reverse battery protection is provided by the LM5050-1 high side OR-ing FET controller.

All tests were performed at room temperature on an open bench.

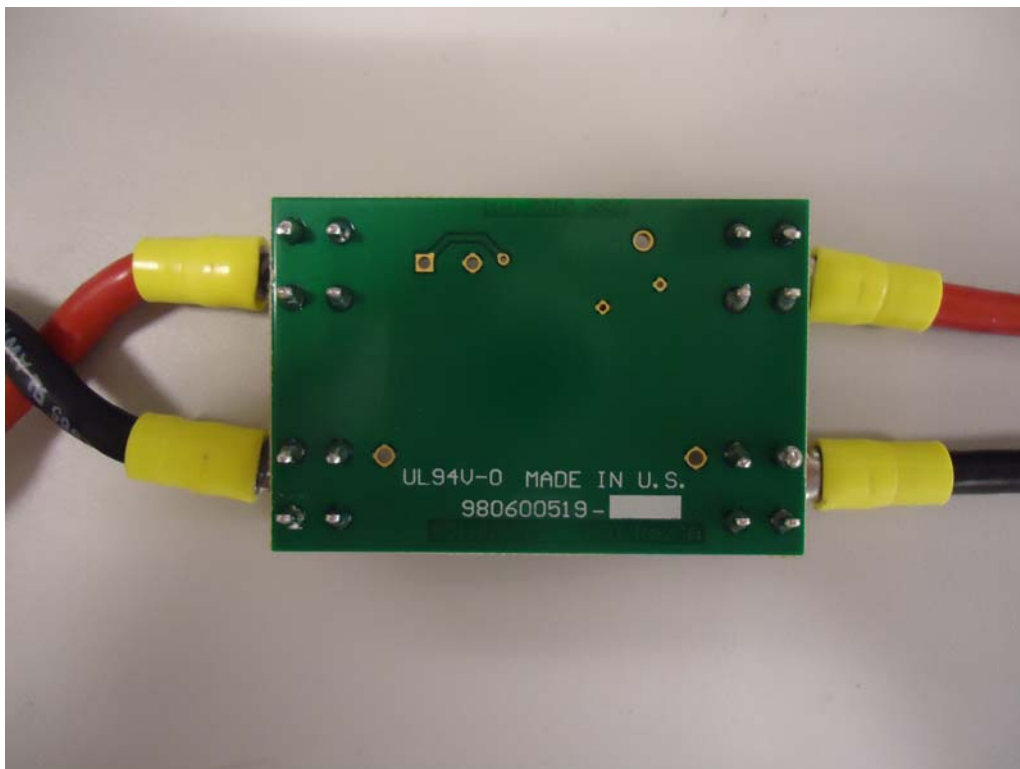
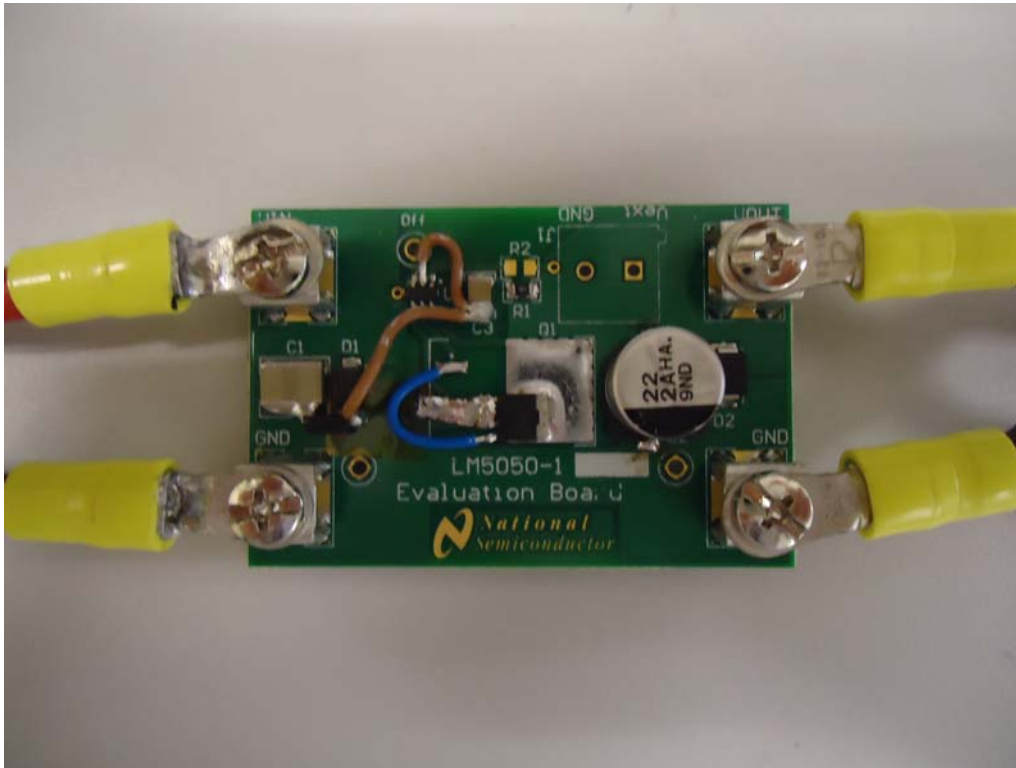
2 Photos

The LM5122 boost circuit was built on PMP7924 Rev A printed circuit board. This is a four layer board with overall dimensions of 4.31 inches x 3.85 inches.



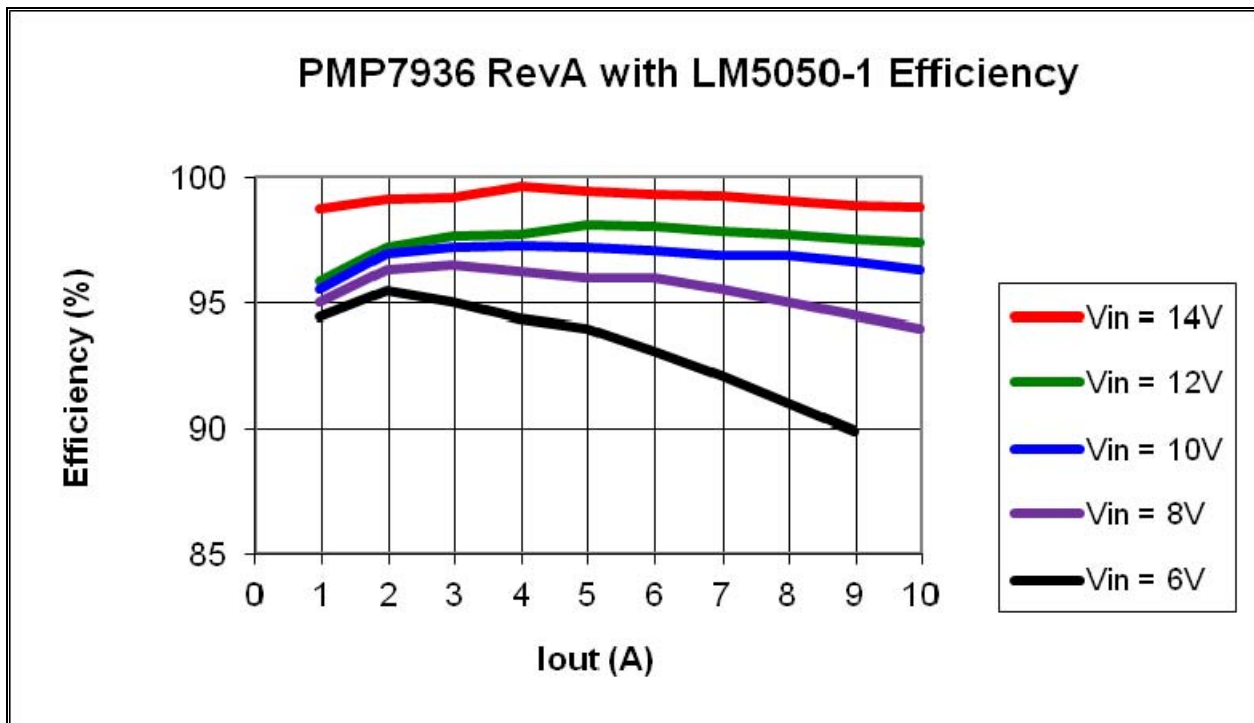
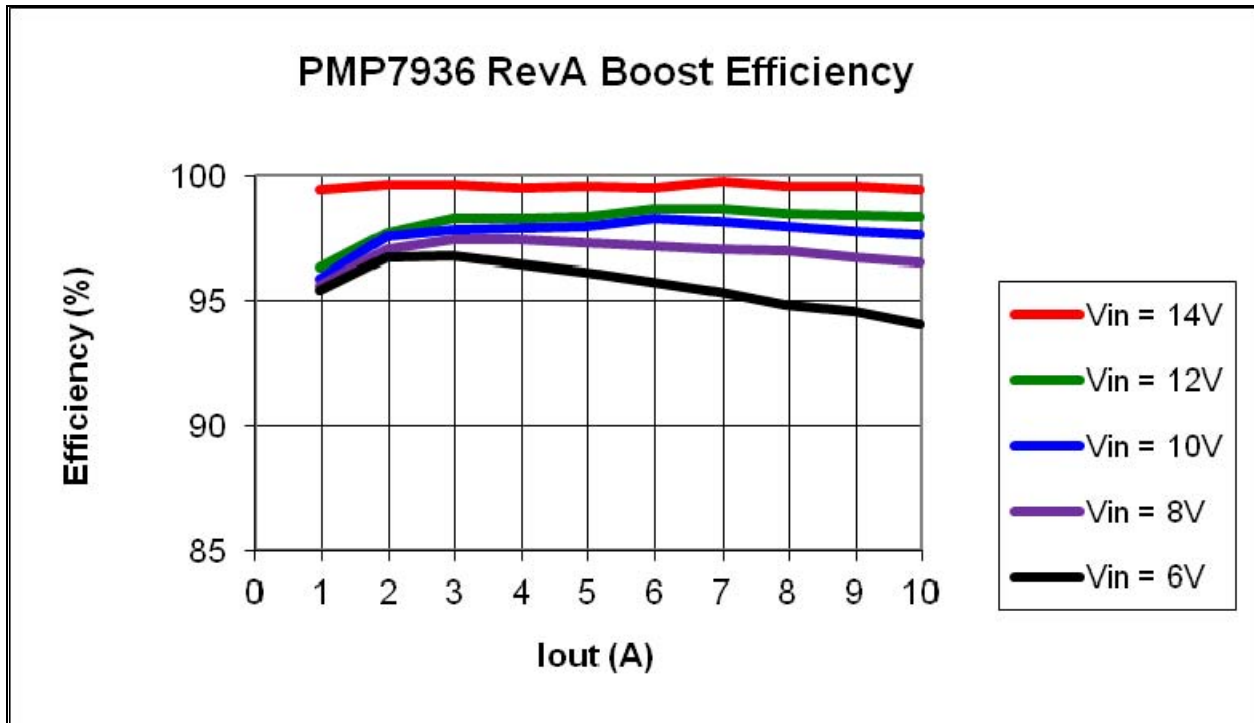


The reverse battery protection circuit was built on the LM5050-1 evaluation board. This is a two layer board with overall dimensions of 1.50 inches x 2.25 inches.



PMP7936 Rev A Test Results

3 Efficiency



3.1 LM5122 Boost Efficiency Data

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
14.005	0.005	14.005	0.000	0.000	0.07	0.00	0.07
14.005	0.965	13.996	0.960	99.418	13.51	13.44	0.08
14.005	1.965	13.986	1.960	99.610	27.52	27.41	0.11
14.005	2.965	13.976	2.960	99.625	41.52	41.37	0.16
14.005	3.970	13.966	3.960	99.470	55.60	55.31	0.29
14.005	4.965	13.956	4.960	99.550	69.53	69.22	0.31
14.005	5.965	13.946	5.960	99.495	83.54	83.12	0.42
14.005	6.965	13.936	6.980	99.722	97.54	97.27	0.27
14.005	7.970	13.926	7.980	99.561	111.62	111.13	0.49
14.005	8.965	13.916	8.980	99.531	125.55	124.97	0.59
14.005	9.965	13.906	9.980	99.443	139.56	138.78	0.78

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
12.001	0.030	13.785	0.000	0.000	0.36	0.00	0.36
12.001	1.145	13.785	0.960	96.306	13.74	13.23	0.51
12.001	2.305	13.785	1.960	97.673	27.66	27.02	0.64
12.001	3.460	13.785	2.960	98.266	41.52	40.80	0.72
12.001	4.630	13.785	3.960	98.243	55.56	54.59	0.98
12.001	5.795	13.786	4.960	98.322	69.55	68.38	1.17
12.001	6.965	13.786	5.980	98.628	83.59	82.44	1.15
12.001	8.130	13.786	6.980	98.625	97.57	96.23	1.34
12.001	9.310	13.786	7.980	98.463	111.73	110.01	1.72
12.001	10.485	13.786	8.980	98.385	125.83	123.80	2.03
12.001	11.660	13.786	9.980	98.322	139.93	137.58	2.35

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
10.002	0.040	13.785	0.000	0.000	0.40	0.00	0.40
10.002	1.380	13.785	0.960	95.876	13.80	13.23	0.57
10.002	2.770	13.785	1.960	97.521	27.71	27.02	0.69
10.002	4.170	13.785	2.960	97.831	41.71	40.80	0.90
10.002	5.575	13.785	3.960	97.897	55.76	54.59	1.17
10.003	6.980	13.785	4.960	97.927	69.82	68.37	1.45
10.003	8.390	13.786	5.980	98.231	83.93	82.44	1.48
10.002	9.805	13.786	6.980	98.120	98.07	96.23	1.84
10.003	11.230	13.786	7.980	97.933	112.33	110.01	2.32
10.002	12.660	13.786	8.980	97.767	126.63	123.80	2.83
10.003	14.090	13.786	9.980	97.617	140.94	137.58	3.36

PMP7936 Rev A Test Results

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
8.002	0.050	13.784	0.000	0.000	0.40	0.00	0.40
8.002	1.730	13.785	0.960	95.595	13.84	13.23	0.61
8.002	3.480	13.785	1.960	97.025	27.85	27.02	0.83
8.002	5.235	13.785	2.960	97.405	41.89	40.80	1.09
8.002	7.005	13.785	3.960	97.386	56.05	54.59	1.47
8.002	8.785	13.786	4.960	97.270	70.30	68.38	1.92
8.002	10.570	13.786	5.960	97.143	84.58	82.16	2.42
8.002	12.360	13.786	6.960	97.013	98.90	95.95	2.95
8.002	14.175	13.786	7.980	96.988	113.43	110.01	3.42
8.002	15.995	13.786	8.980	96.723	127.99	123.80	4.19
8.002	17.820	13.786	9.980	96.486	142.60	137.58	5.01

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
6.003	0.070	13.784	0.000	0.000	0.42	0.00	0.42
6.003	2.310	13.785	0.960	95.433	13.87	13.23	0.63
6.003	4.655	13.785	1.960	96.688	27.94	27.02	0.93
6.003	7.025	13.785	2.960	96.757	42.17	40.80	1.37
6.003	9.430	13.786	3.960	96.439	56.61	54.59	2.02
6.003	11.850	13.786	4.960	96.124	71.14	68.38	2.76
6.003	14.295	13.786	5.960	95.749	85.81	82.16	3.65
6.003	16.765	13.786	6.960	95.340	100.64	95.95	4.69
6.003	19.275	13.787	7.960	94.846	115.71	109.74	5.96
6.003	21.815	13.787	8.980	94.542	130.96	123.81	7.15
6.003	24.380	13.787	9.980	94.015	146.35	137.59	8.76

3.2 LM5122 Boost with LM5050-1 Efficiency Data

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
14.005	0.005	13.982	0.000	0.000	0.07	0.00	0.07
14.005	0.970	13.966	0.960	98.693	13.58	13.41	0.18
14.005	1.970	13.949	1.960	99.095	27.59	27.34	0.25
14.005	2.970	13.932	2.960	99.144	41.59	41.24	0.36
14.005	3.970	13.915	3.980	99.608	55.60	55.38	0.22
14.005	4.970	13.898	4.980	99.436	69.60	69.21	0.39
14.005	5.970	13.881	5.980	99.281	83.61	83.01	0.60
14.005	6.965	13.864	6.980	99.206	97.54	96.77	0.77
14.005	7.970	13.848	7.980	99.003	111.62	110.51	1.11
14.005	8.970	13.831	8.980	98.868	125.62	124.20	1.42
14.005	9.965	13.814	9.980	98.785	139.56	137.86	1.70

PMP7936 Rev A Test Results

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
12.002	0.030	13.785	0.000	0.000	0.36	0.00	0.36
12.002	1.150	13.785	0.960	95.880	13.80	13.23	0.57
12.002	2.315	13.785	1.960	97.243	27.78	27.02	0.77
12.002	3.480	13.785	2.960	97.693	41.77	40.80	0.96
12.002	4.655	13.785	3.960	97.708	55.87	54.59	1.28
12.002	5.830	13.785	4.980	98.110	69.97	68.65	1.32
12.002	7.005	13.786	5.980	98.057	84.07	82.44	1.63
12.002	8.190	13.786	6.980	97.894	98.30	96.23	2.07
12.002	9.380	13.786	7.980	97.720	112.58	110.01	2.57
12.001	10.575	13.786	8.980	97.548	126.91	123.80	3.11
12.002	11.770	13.786	9.980	97.395	141.26	137.58	3.68

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
10.003	0.040	13.785	0.000	0.000	0.40	0.00	0.40
10.003	1.385	13.785	0.960	95.521	13.85	13.23	0.62
10.003	2.785	13.785	1.960	96.986	27.86	27.02	0.84
10.003	4.195	13.785	2.960	97.238	41.96	40.80	1.16
10.003	5.610	13.786	3.960	97.284	56.12	54.59	1.52
10.003	7.030	13.786	4.960	97.238	70.32	68.38	1.94
10.002	8.460	13.786	5.960	97.102	84.62	82.16	2.45
10.002	9.900	13.786	6.960	96.900	99.02	95.95	3.07
10.003	11.350	13.786	7.980	96.898	113.53	110.01	3.52
10.003	12.810	13.786	8.980	96.613	128.14	123.80	4.34
10.002	14.280	13.786	9.980	96.328	142.83	137.58	5.24

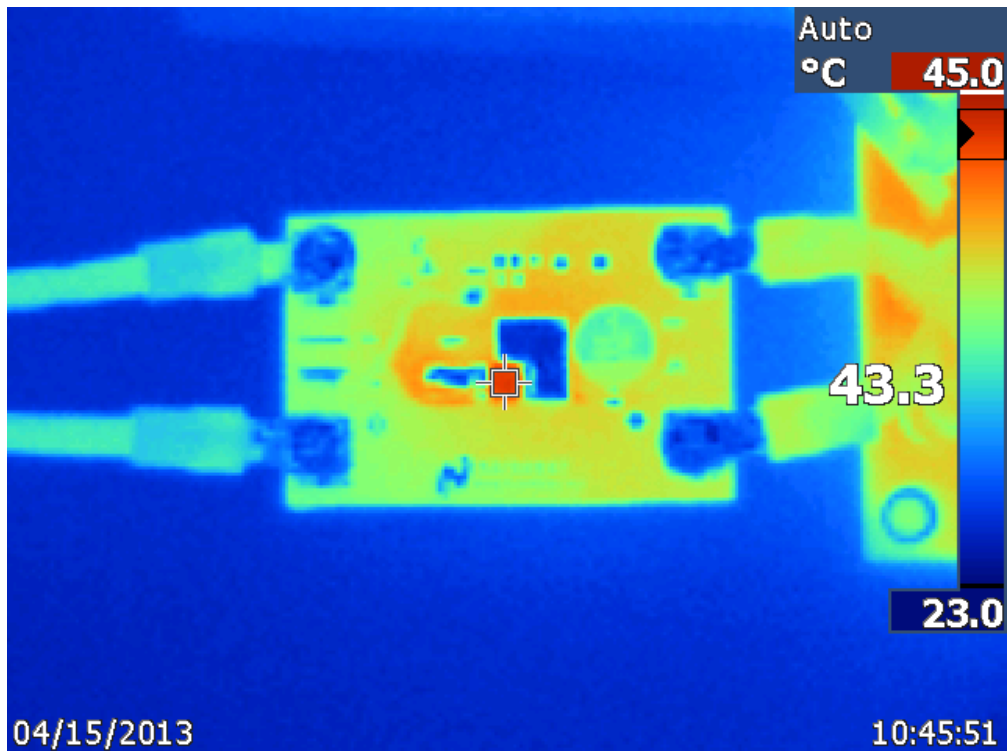
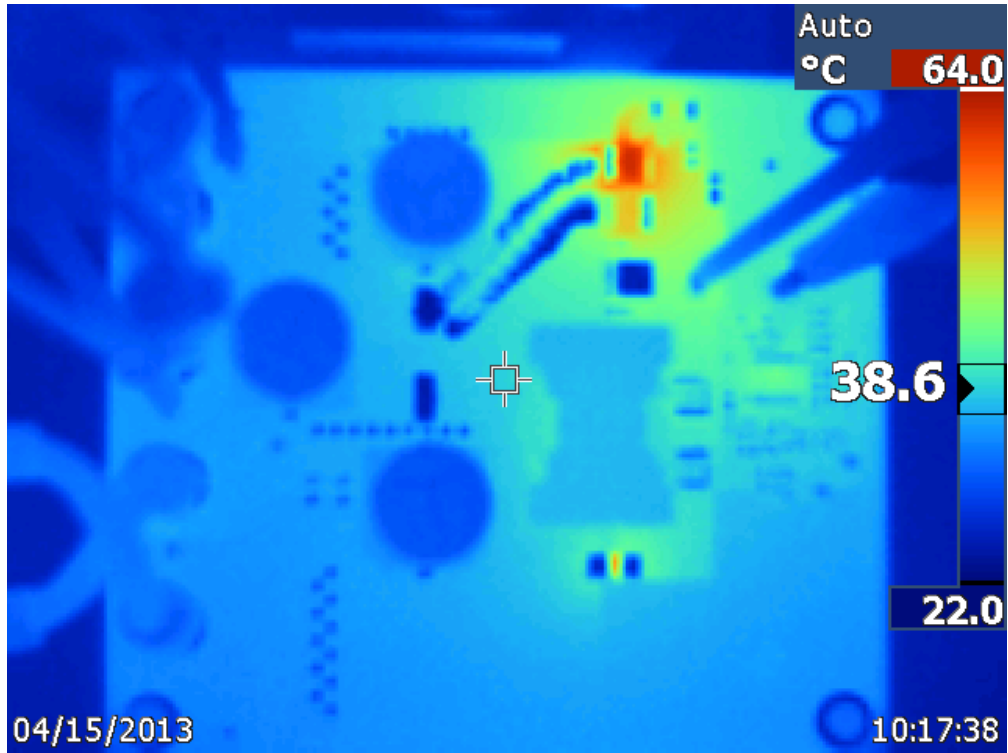
Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
8.002	0.050	13.785	0.000	0.000	0.40	0.00	0.40
8.002	1.740	13.785	0.960	95.045	13.92	13.23	0.69
8.002	3.505	13.785	1.960	96.333	28.05	27.02	1.03
8.002	5.285	13.785	2.960	96.484	42.29	40.80	1.49
8.002	7.090	13.786	3.960	96.225	56.73	54.59	2.14
8.002	8.900	13.786	4.960	96.013	71.22	68.38	2.84
8.002	10.735	13.786	5.980	95.971	85.90	82.44	3.46
8.002	12.585	13.786	6.980	95.552	100.71	96.23	4.48
8.002	14.470	13.786	7.980	95.011	115.79	110.01	5.78
8.002	16.370	13.786	8.980	94.508	130.99	123.80	7.19
8.002	18.295	13.786	9.980	93.981	146.40	137.58	8.81

PMP7936 Rev A Test Results

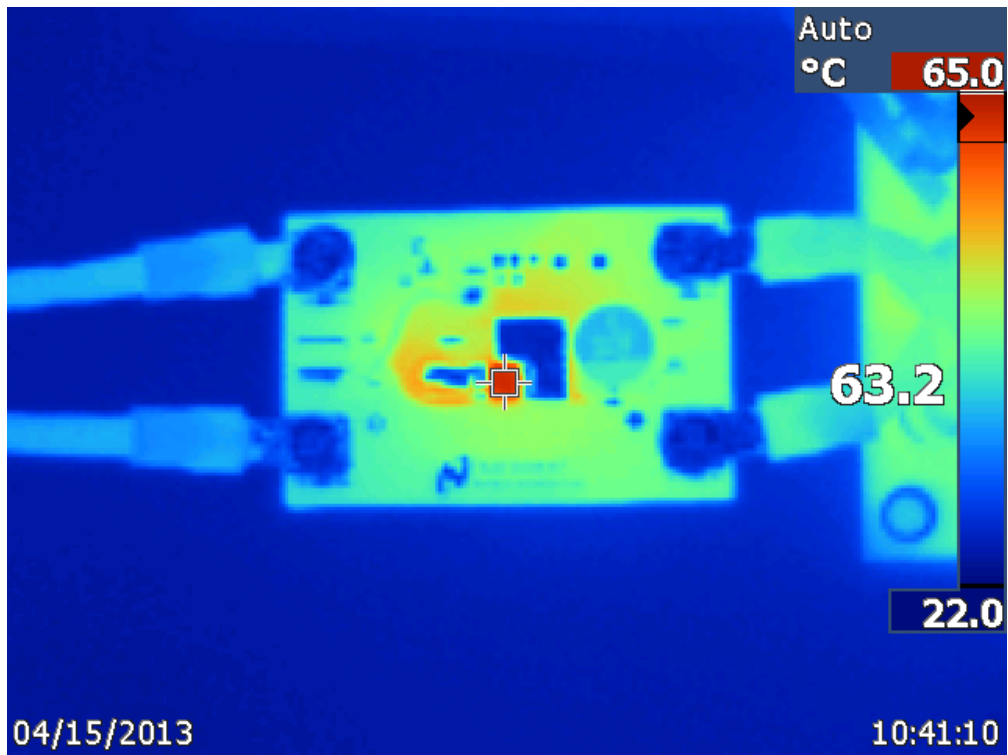
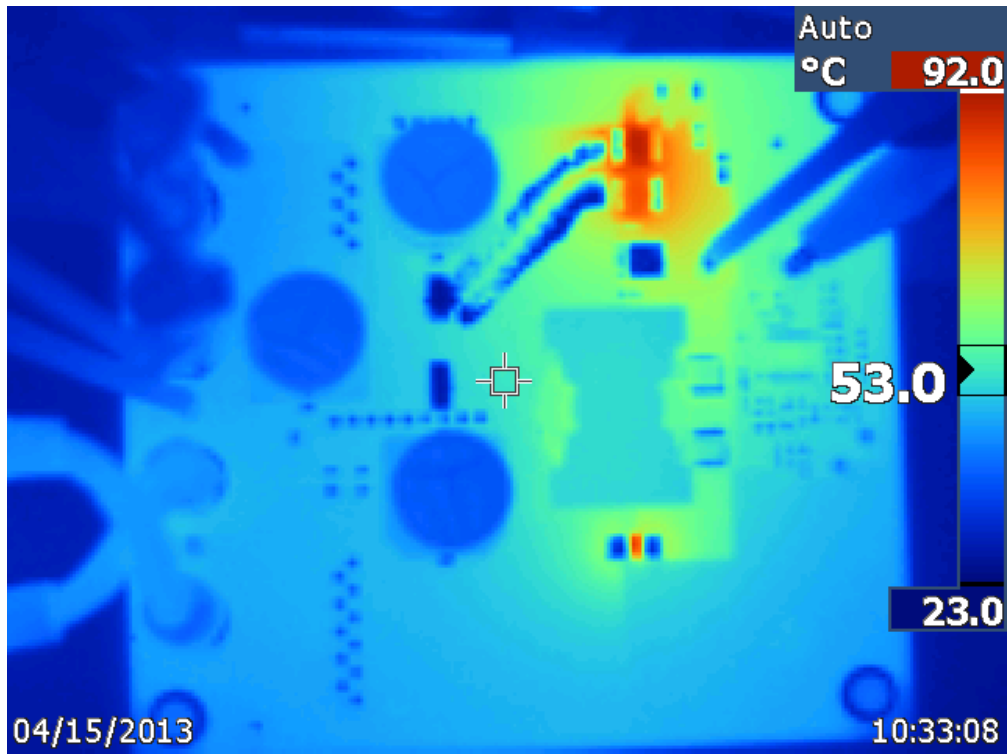
Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
6.003	0.070	13.784	0.000	0.000	0.42	0.00	0.42
6.003	2.335	13.785	0.960	94.411	14.02	13.23	0.78
6.003	4.715	13.785	1.960	95.458	28.30	27.02	1.29
6.004	7.155	13.785	2.960	94.983	42.96	40.80	2.16
6.003	9.635	13.786	3.960	94.387	57.84	54.59	3.25
6.004	12.165	13.786	4.980	93.997	73.04	68.65	4.38
6.004	14.755	13.786	5.980	93.059	88.59	82.44	6.15
6.003	17.410	13.786	6.980	92.072	104.51	96.23	8.29
6.004	20.140	13.787	7.980	90.986	120.92	110.02	10.90
6.004	22.940	13.787	8.980	89.890	137.73	123.81	13.92
6.004	9.965	5.174	9.980	86.306	59.83	51.64	8.19

4 Thermal

4.1 Thermal at 11V Input – 10A Load

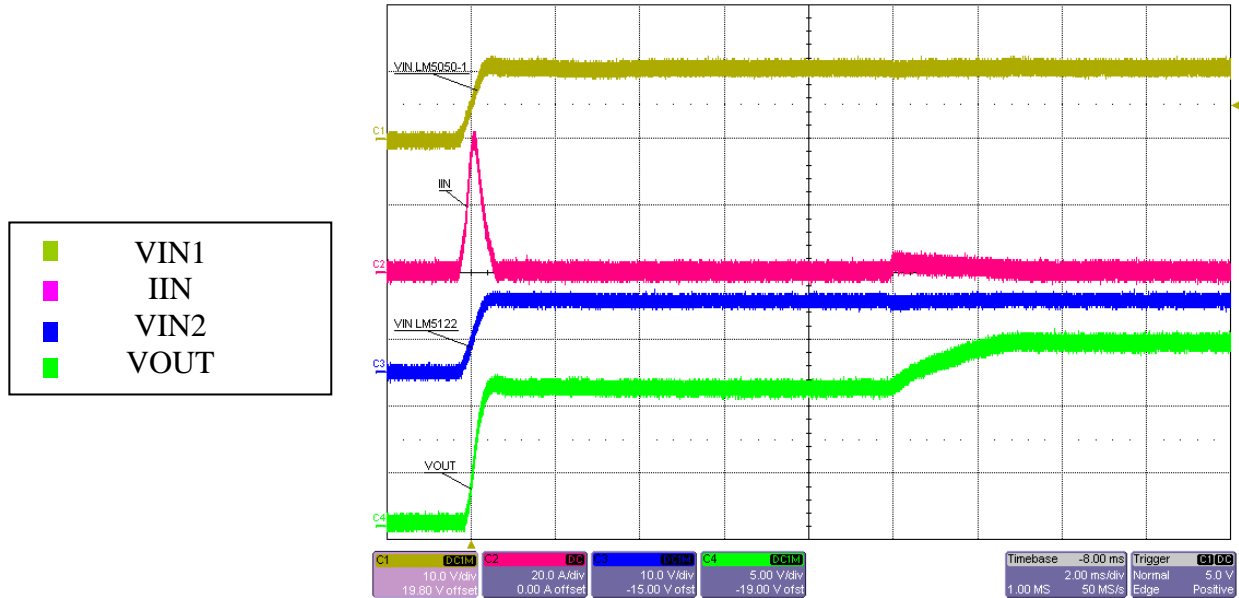


4.2 Thermal at 6V Input – 8A Load

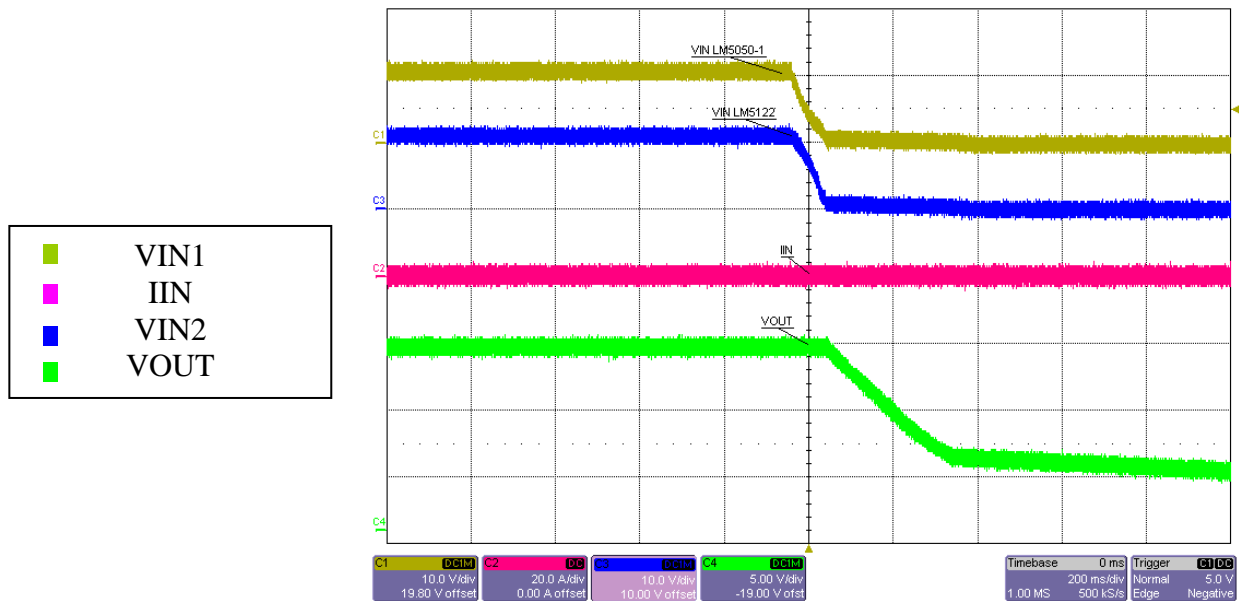


5 Power Up and Power Down

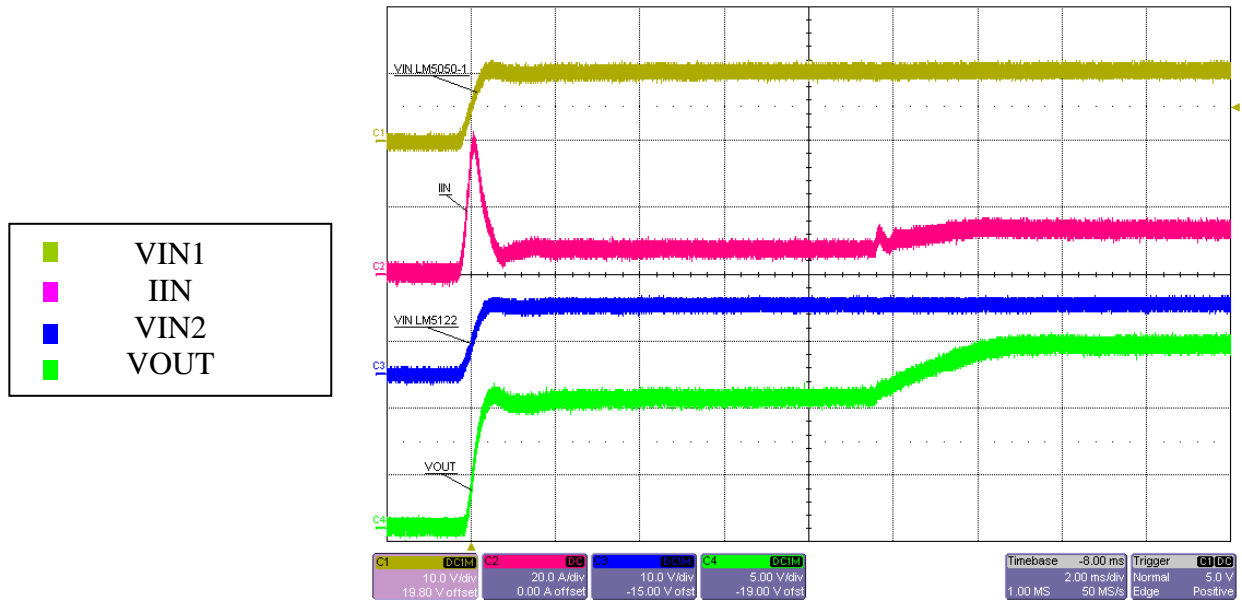
5.1 Power Up at 11V Input – No Load



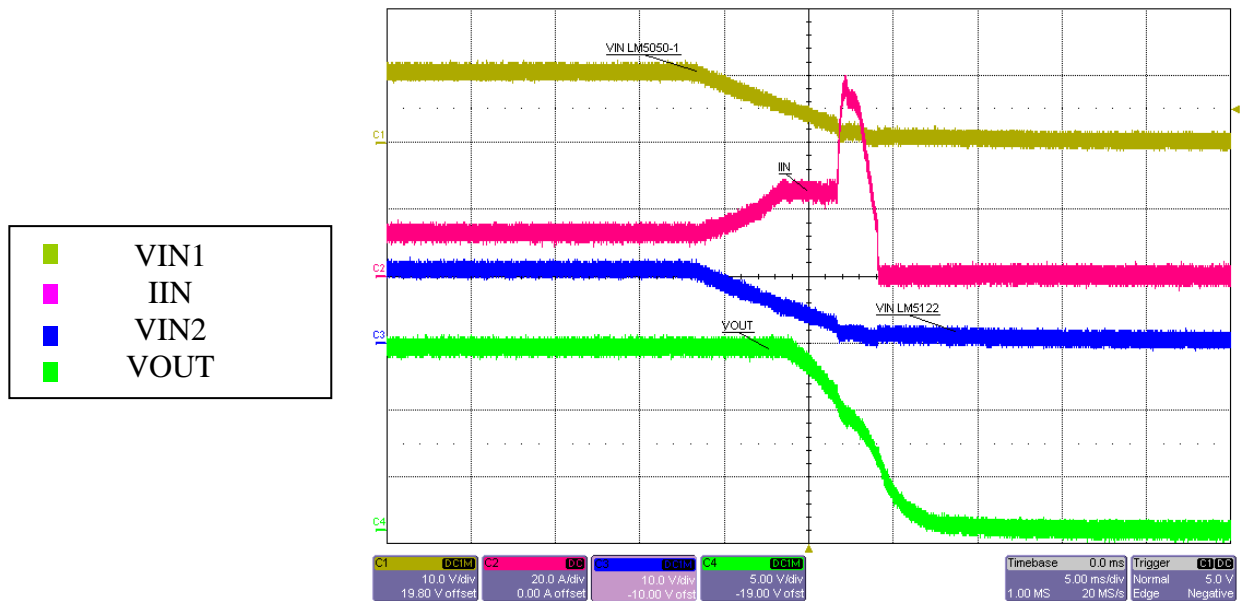
5.2 Power Down at 11V Input – No Load



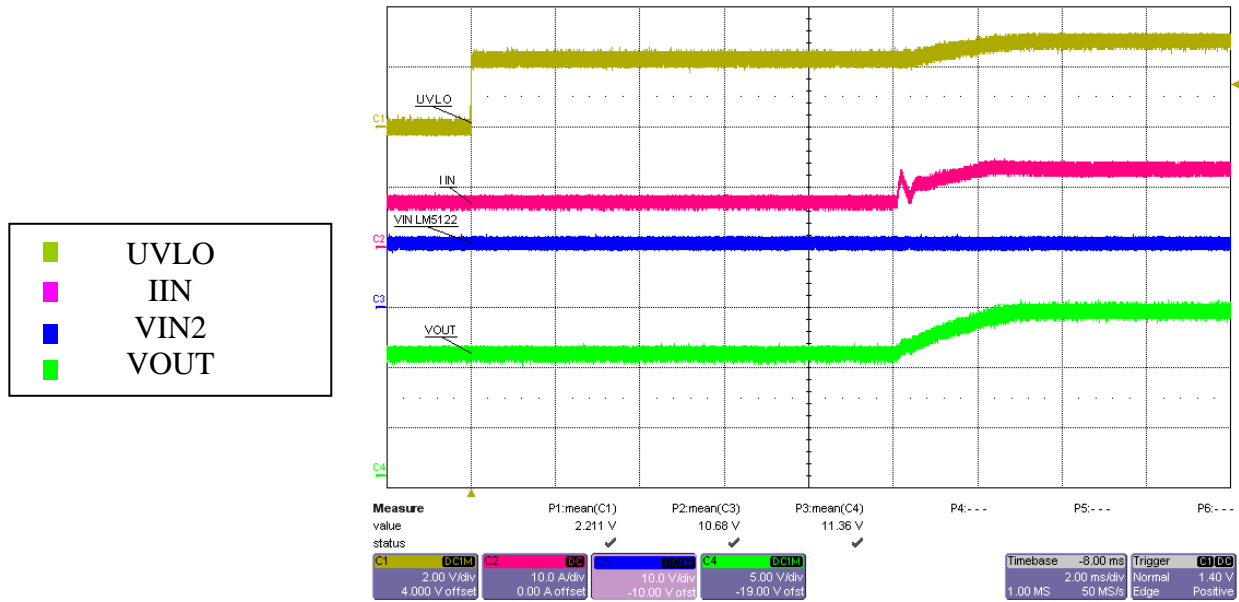
5.3 Power Up at 11V Input – 10A Load



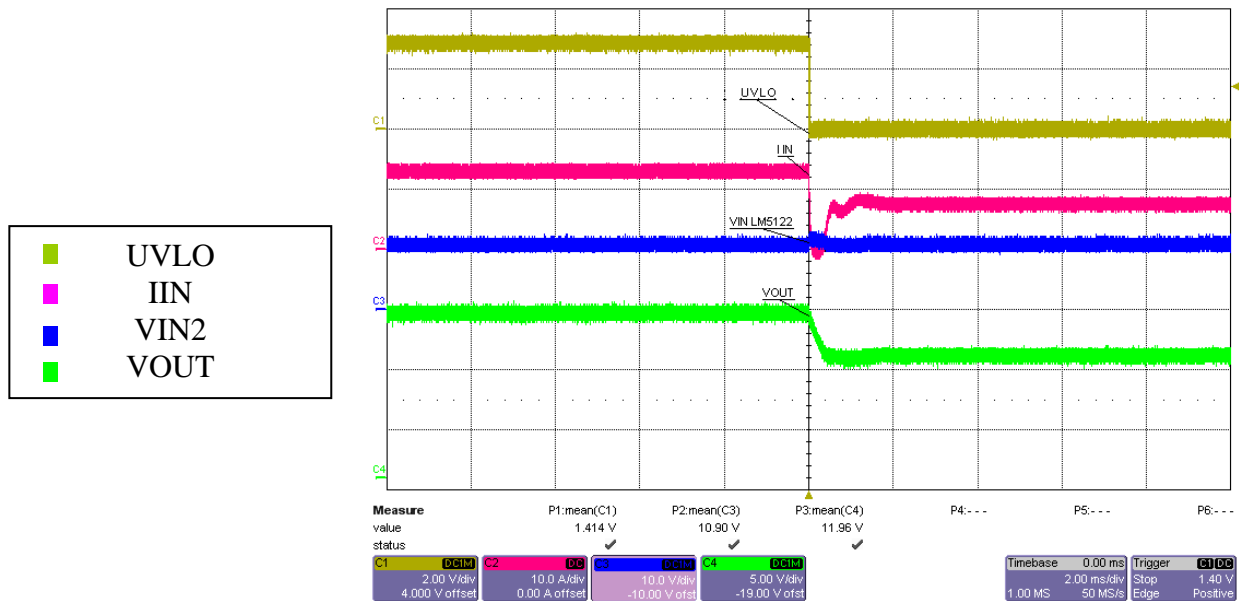
5.4 Power Down at 11V Input – 10A Load



5.5 Turn On from UVLO at 11V Input – 10A Load

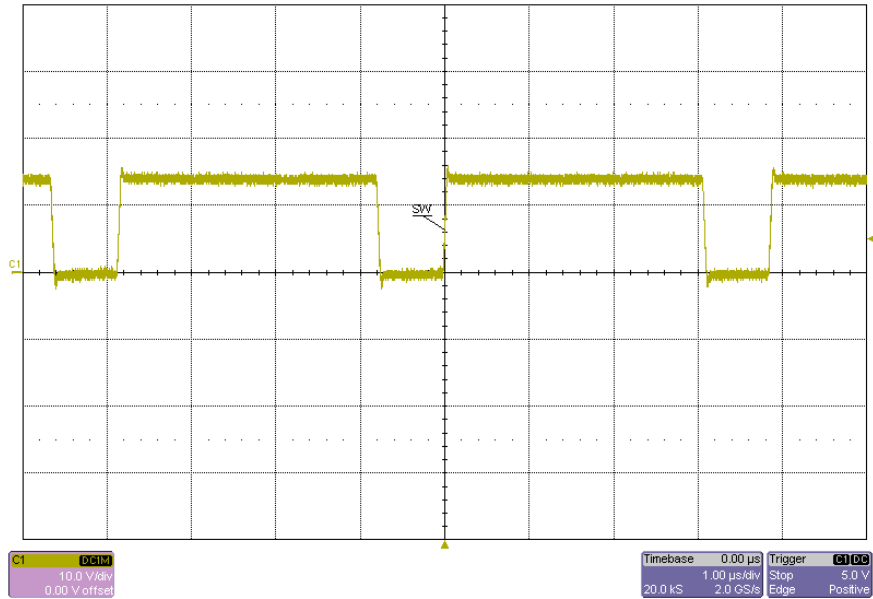
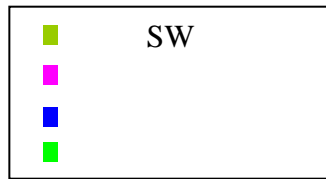


5.6 Turn Off from UVLO at 11V Input – 10A Load

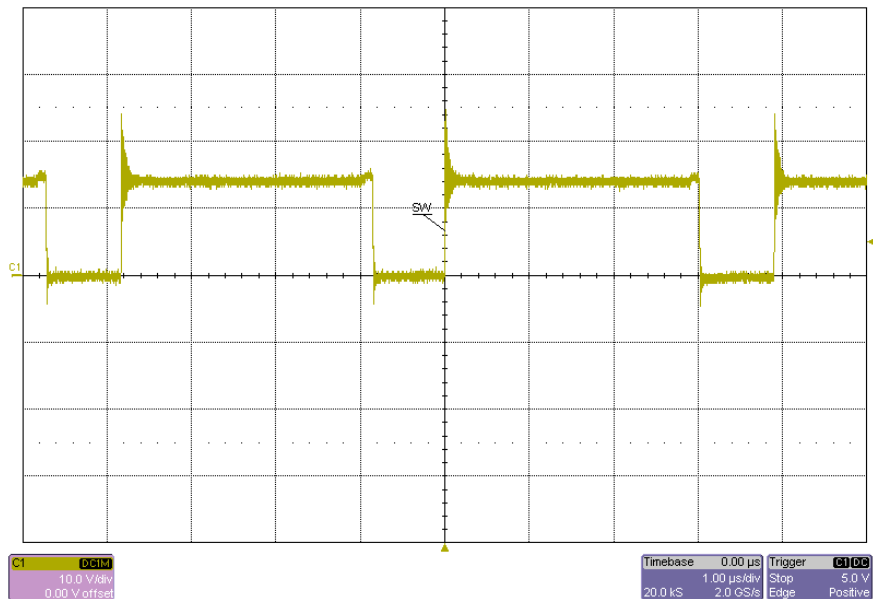
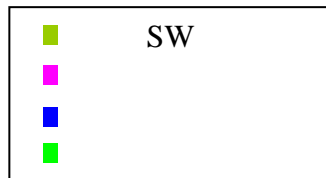


6 Switching Voltages

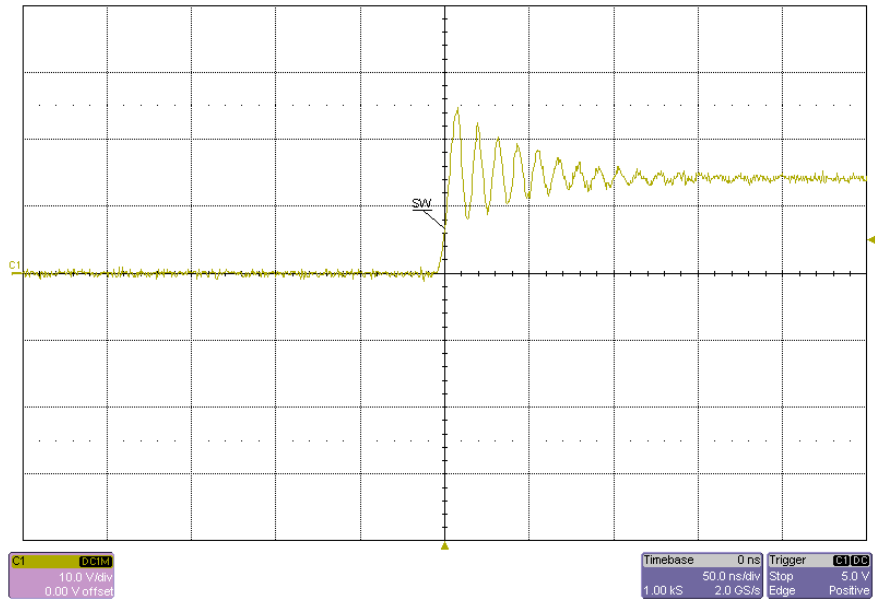
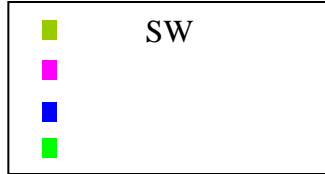
6.1 11V Input – No Load



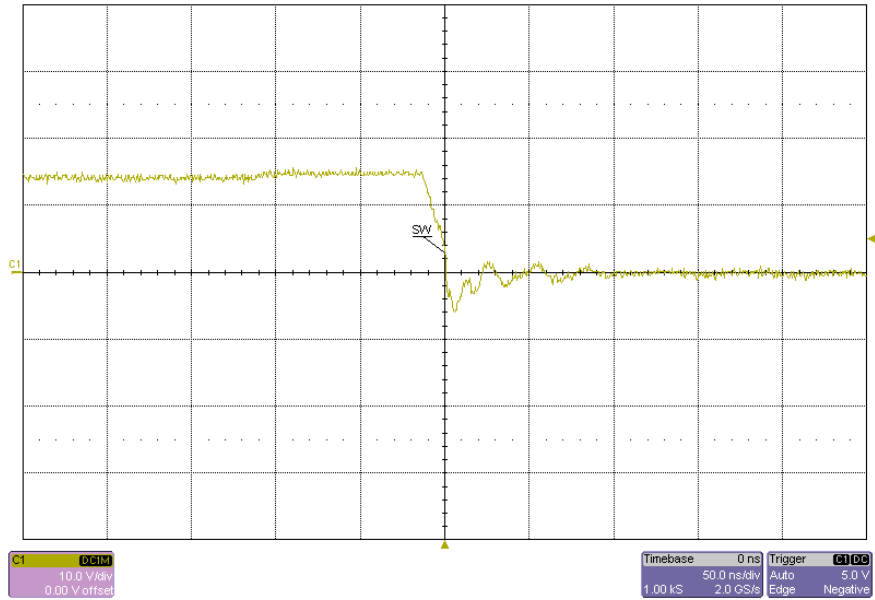
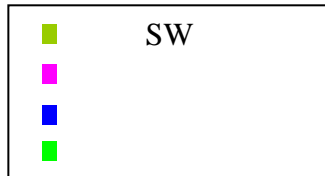
6.2 11V Input – 10A Load



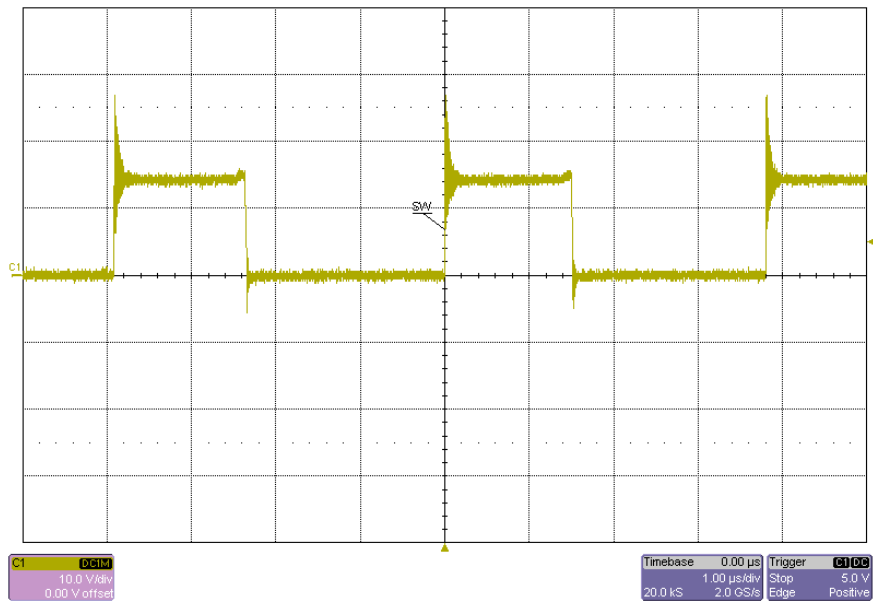
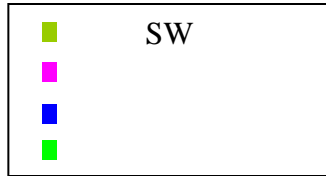
6.3 11V Input – 10A Load



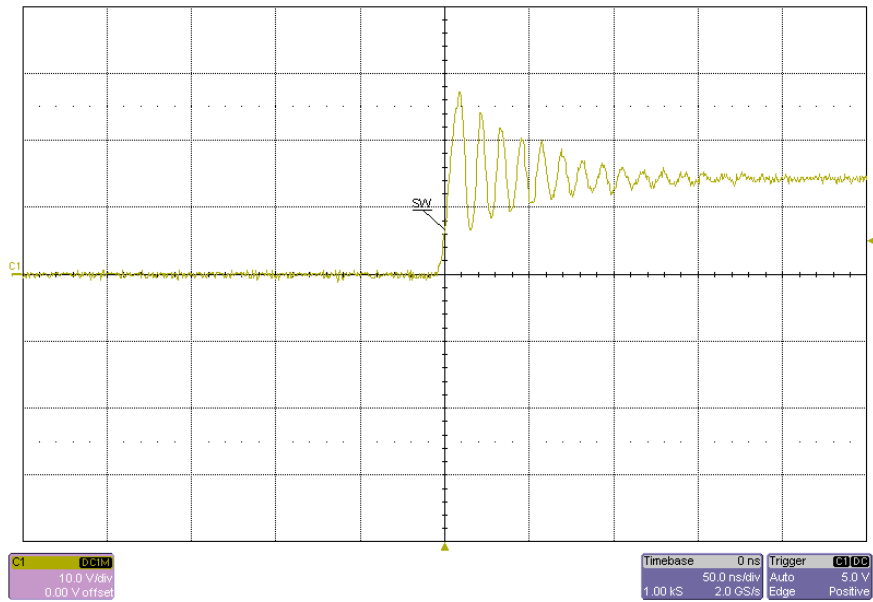
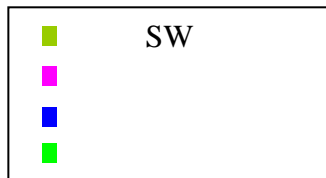
6.4 11V Input – 10A Load



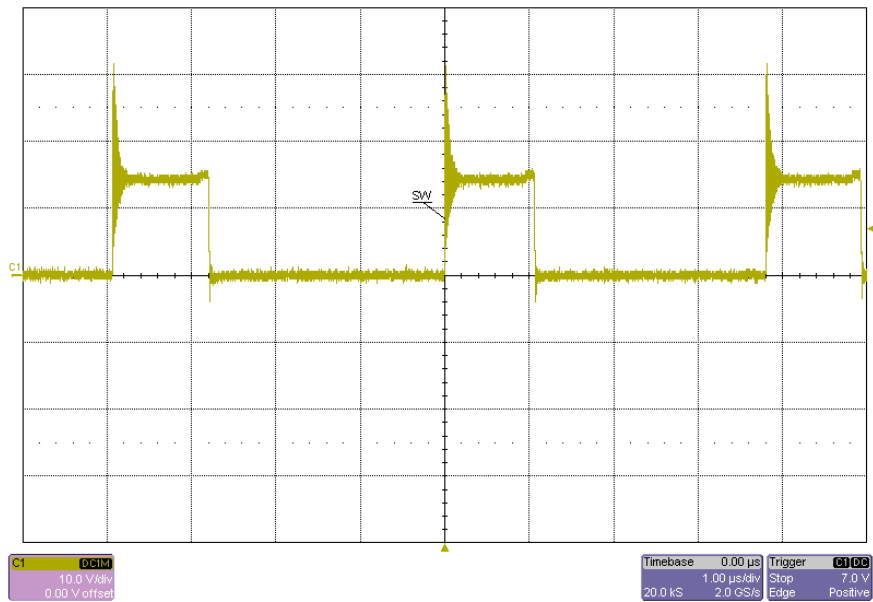
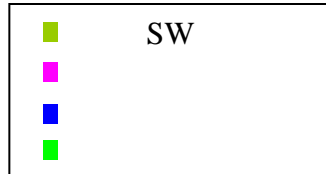
6.5 6V Input – 8A Load



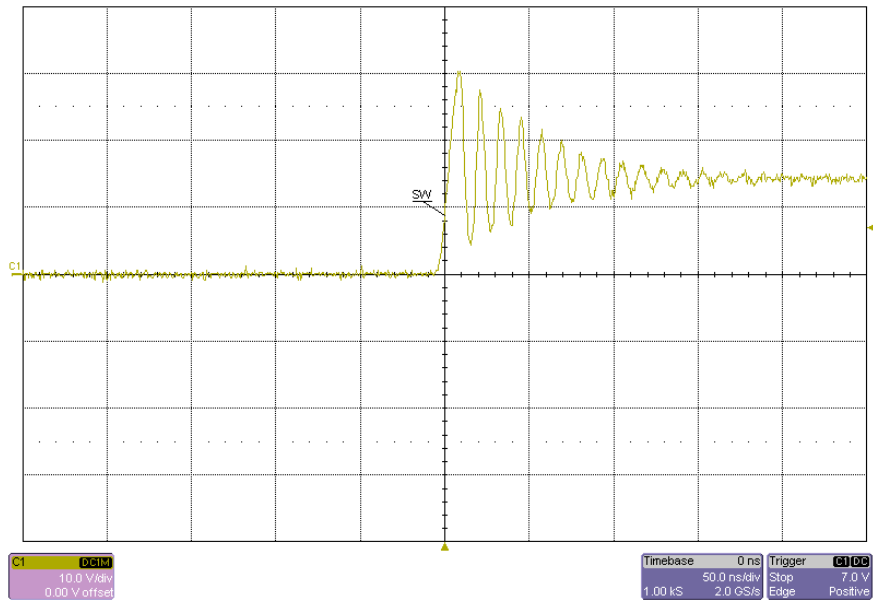
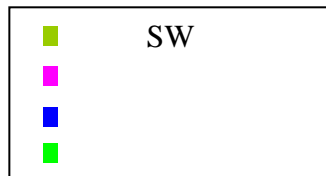
6.6 6V Input – 8A Load



6.7 4.5V Input – 7A Load

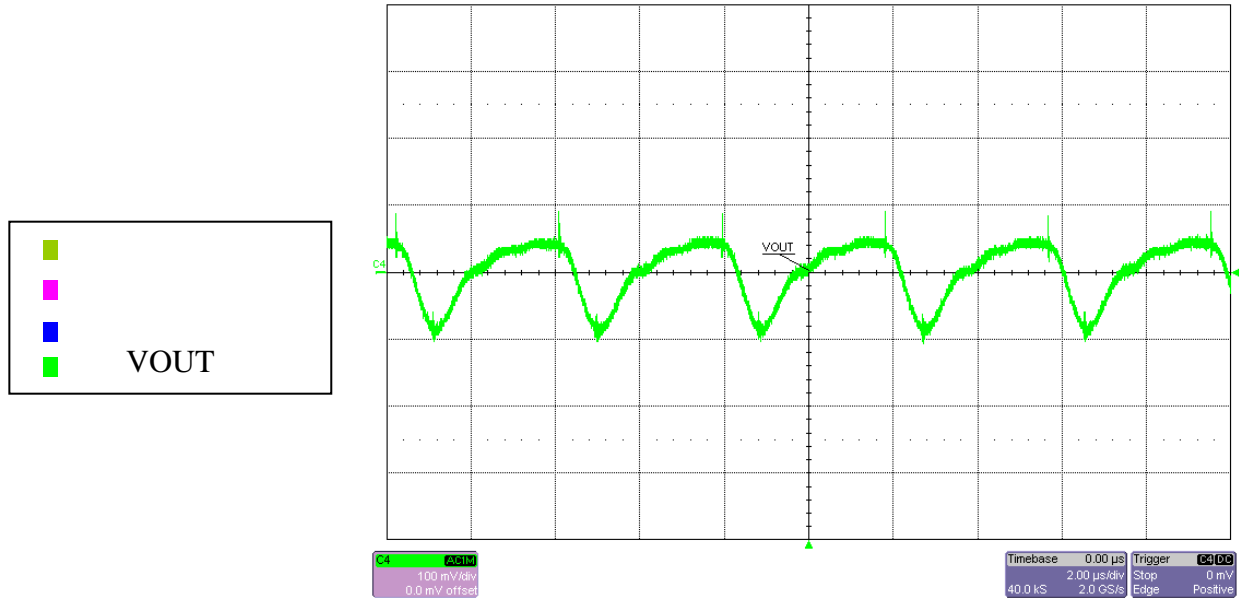


6.8 4.5V Input – 7A Load

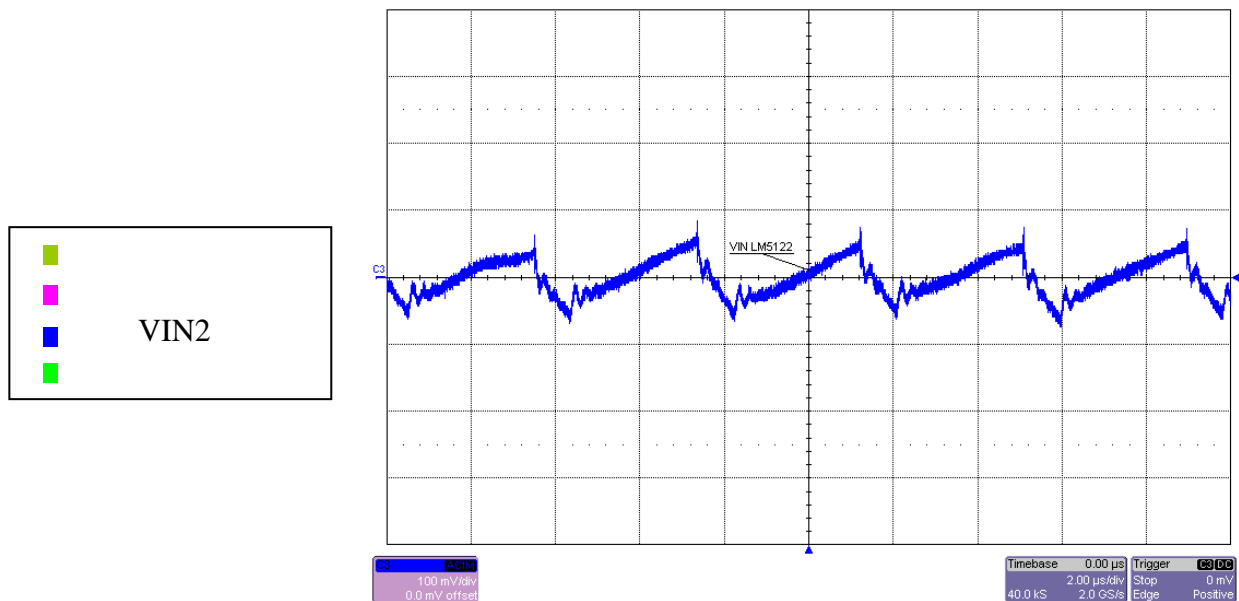


7 Ripple Voltages

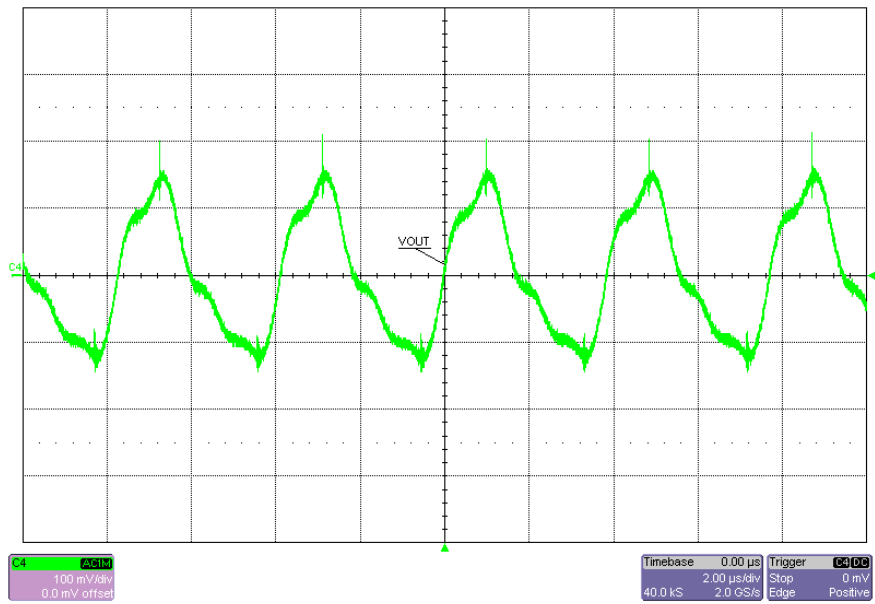
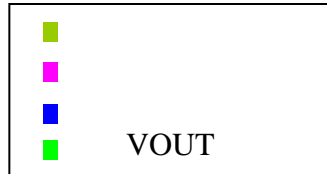
7.1 11V Input – 10A Load



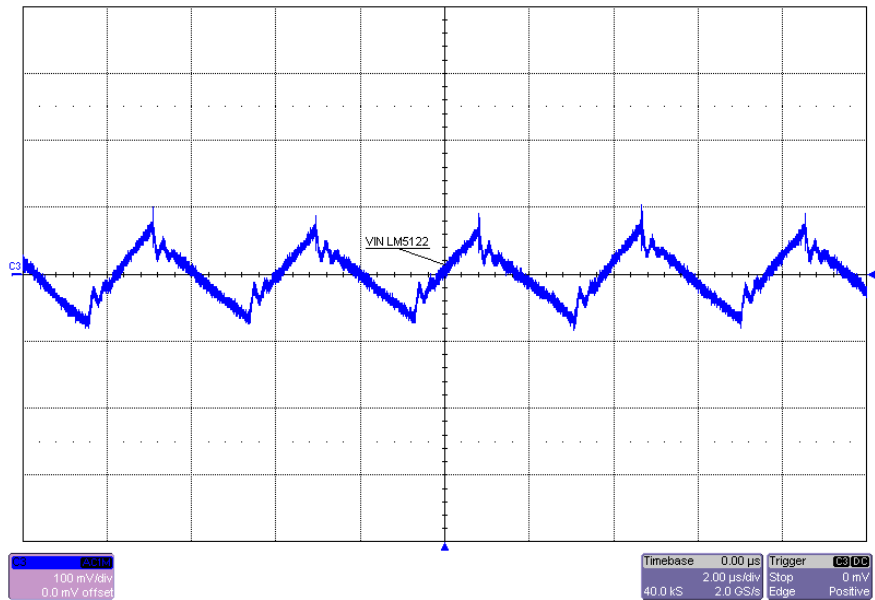
7.2 11V Input – 10A Load



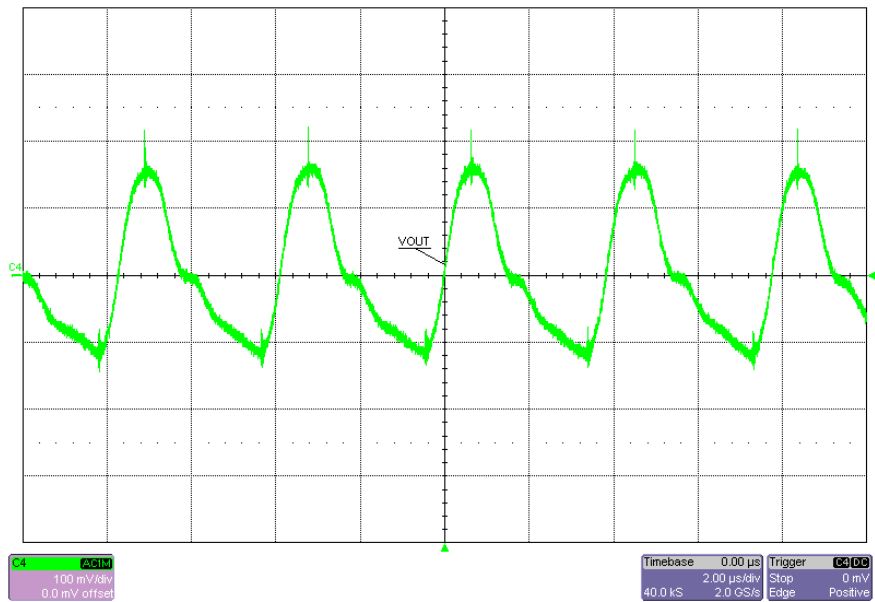
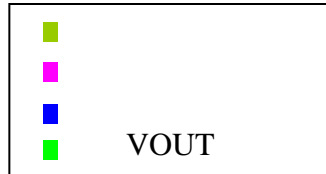
7.3 6V Input – 8A Load



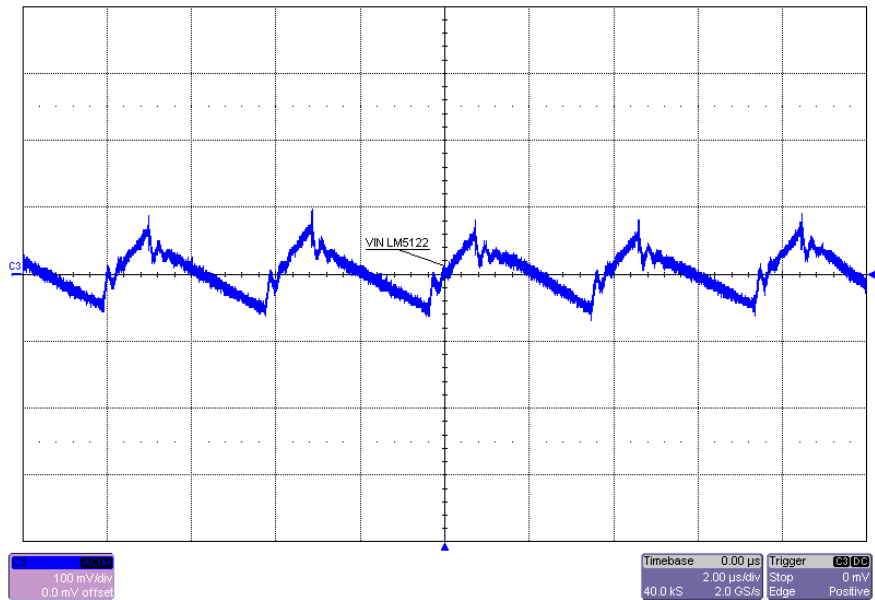
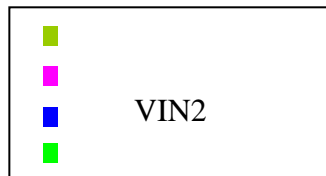
7.4 6V Input – 8A Load



7.5 4.5V Input – 7A Load



7.6 4.5V Input – 7A Load

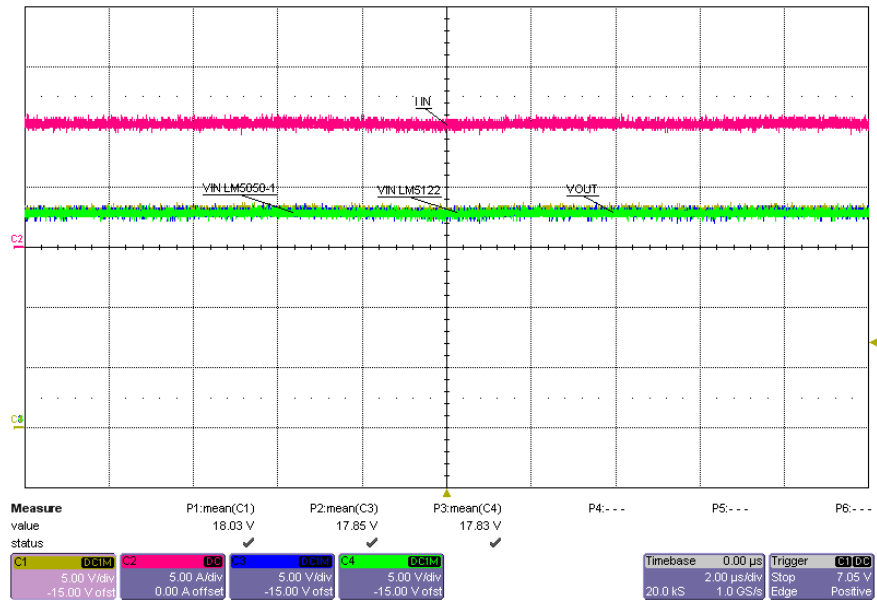


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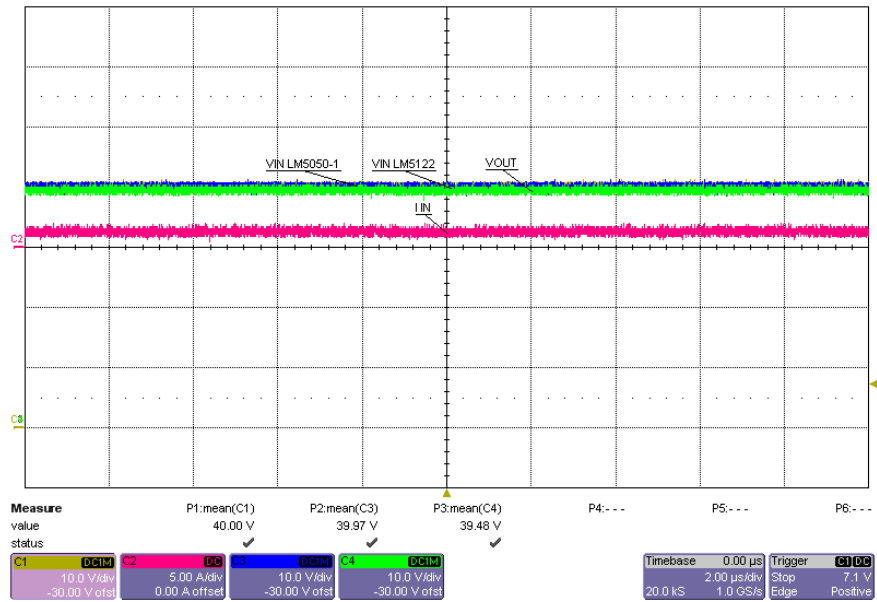
8 Bypass and Reverse

8.1 Bypass at 18V Input – 10A Load

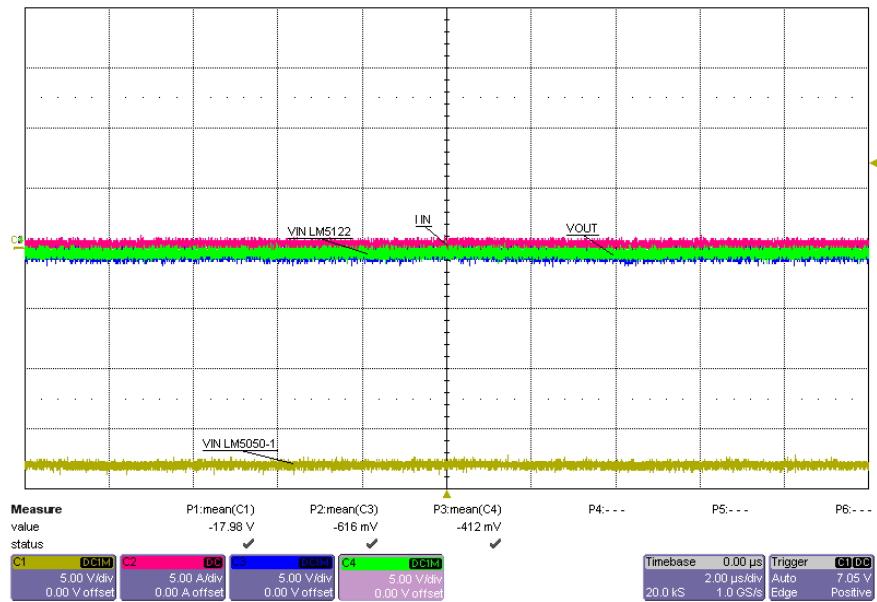
VIN LM5050-1 = 18.0V, IIN = 10A, VIN LM5122 = 17.9V, VOUT = 17.8V



8.2 Bypass at 40V Input – 1A Load

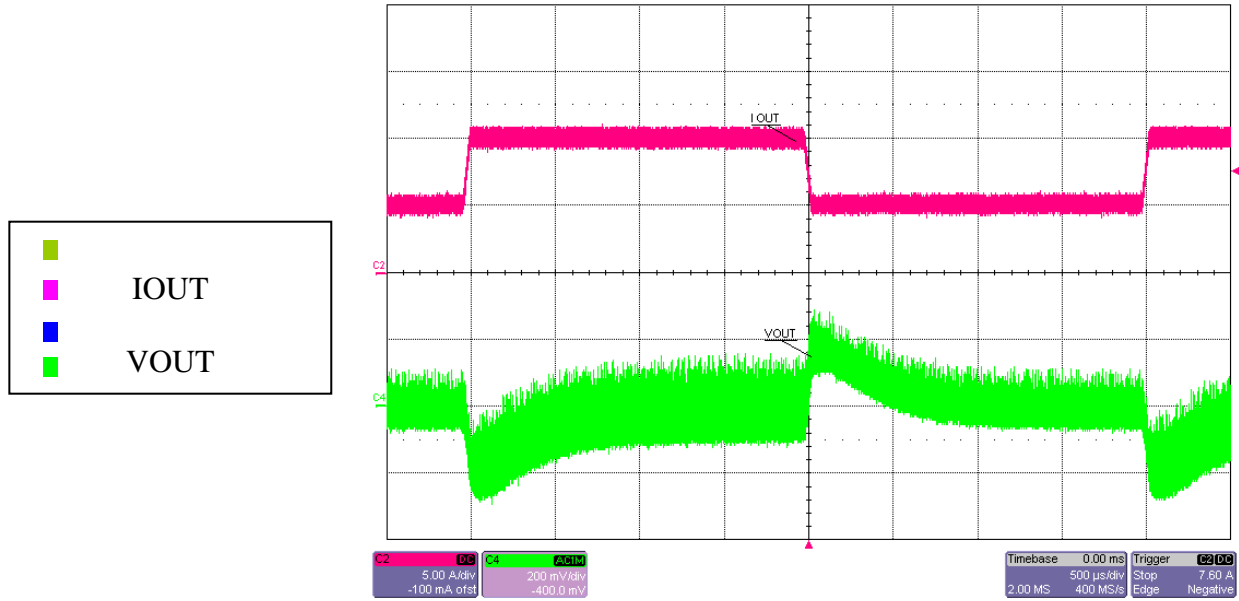


8.3 Reverse Battery Protection at -18V Input

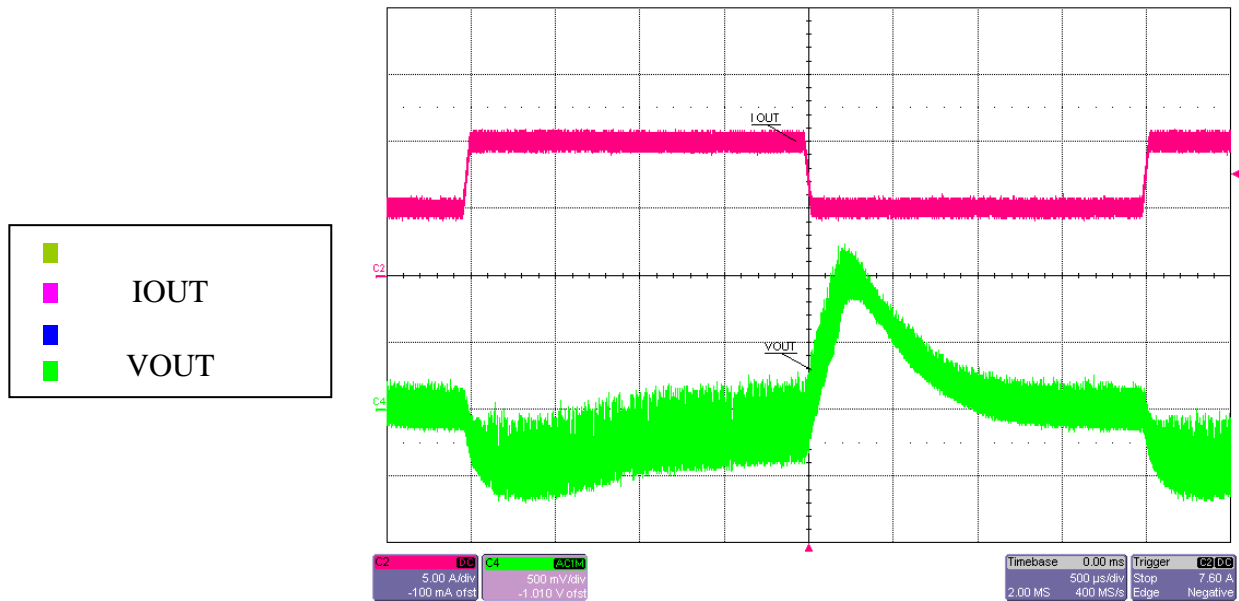


9 Transient Response

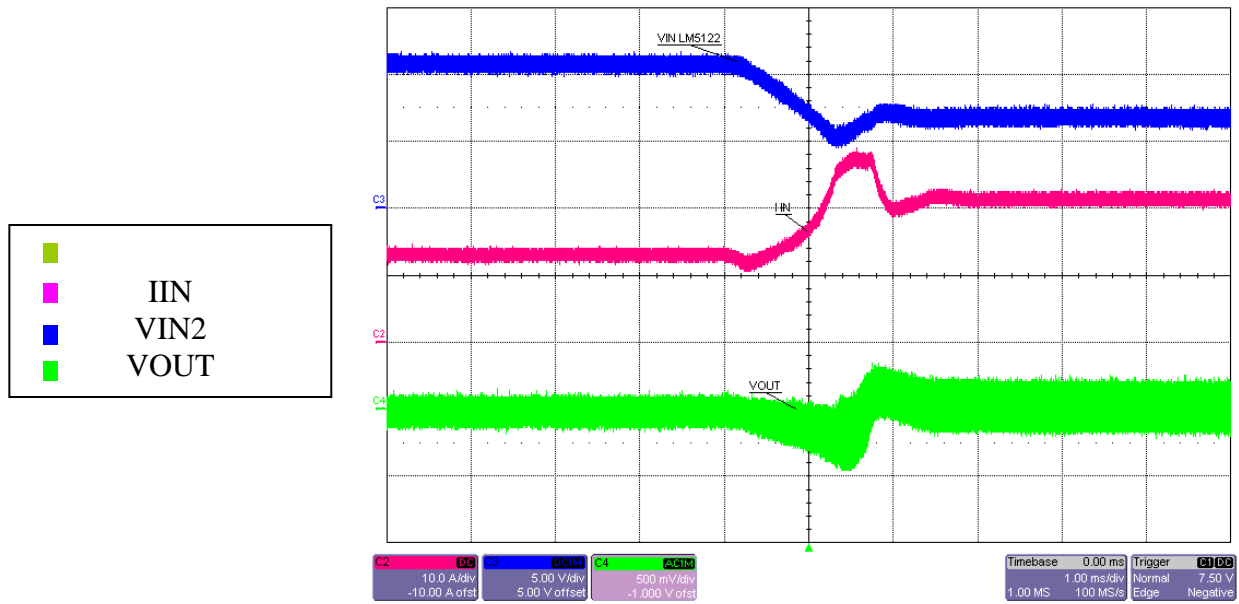
9.1 11V Input – 5A Load Step



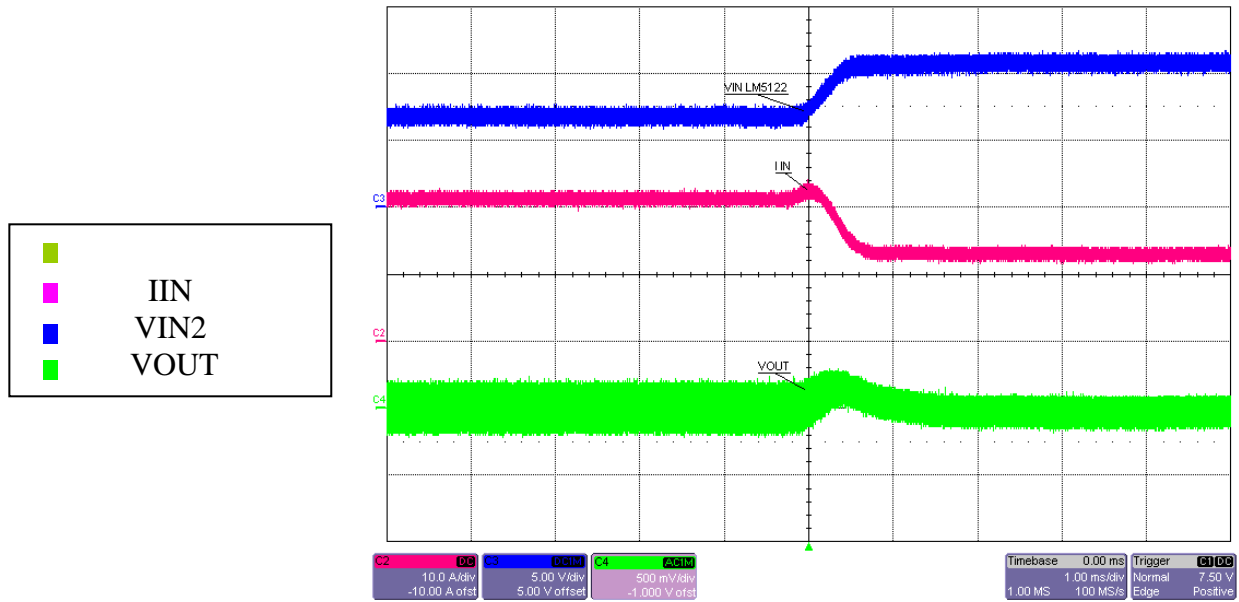
9.2 6V Input – 5A Load Step



9.3 11V to 7V Input Step – 10A Load



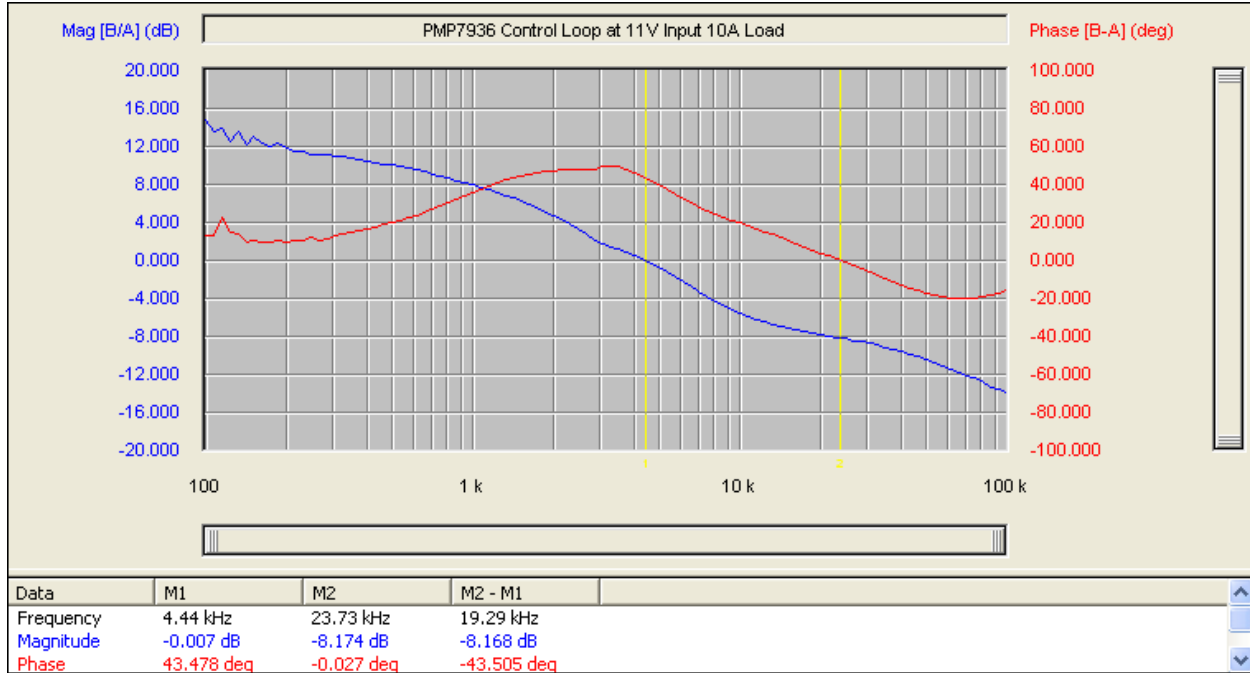
9.4 7V to 11V Input Step – 10A Load



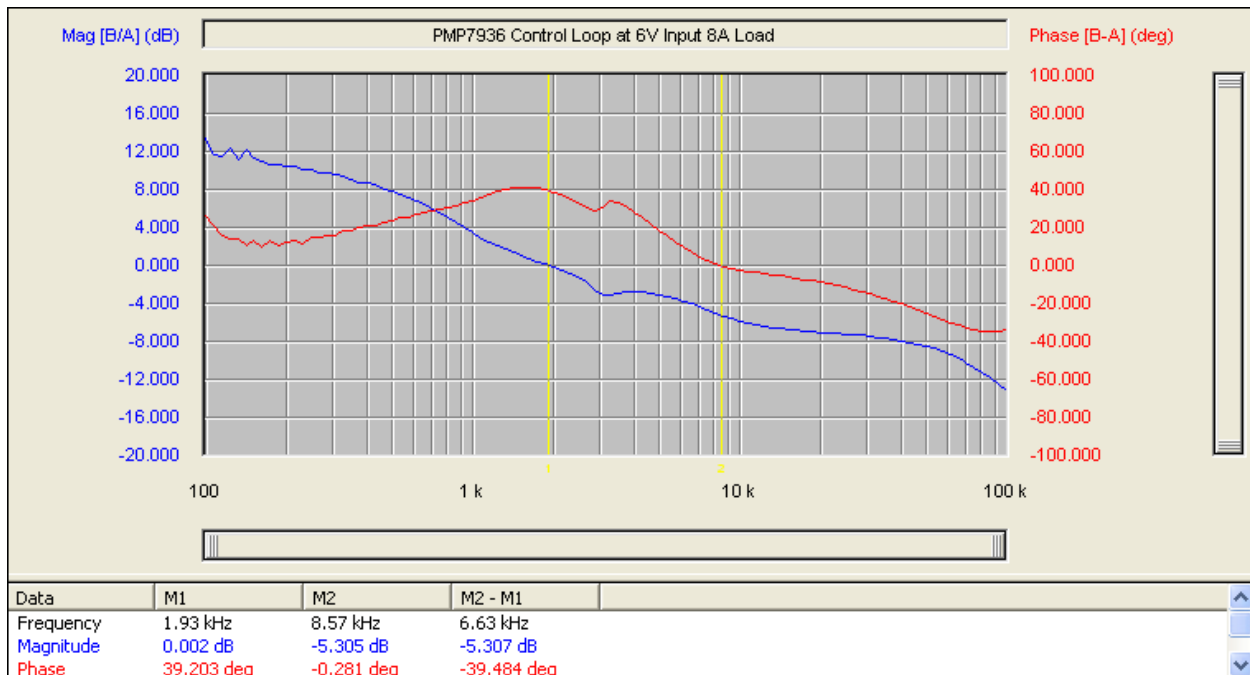
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10 Frequency Response

10.1 11V Input – 10A Load



10.2 6V Input – 8A Load



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