LM5121 Single-Phase Synchronous Boost Converter with Input Disconnect

TI reference design number: PMP9372 REVA1

Input: 6.4VDC to 15VDC
Output: 15.45 VDC @ 4A

DC – DC Test Results

Table of Contents

1 Test Specifications

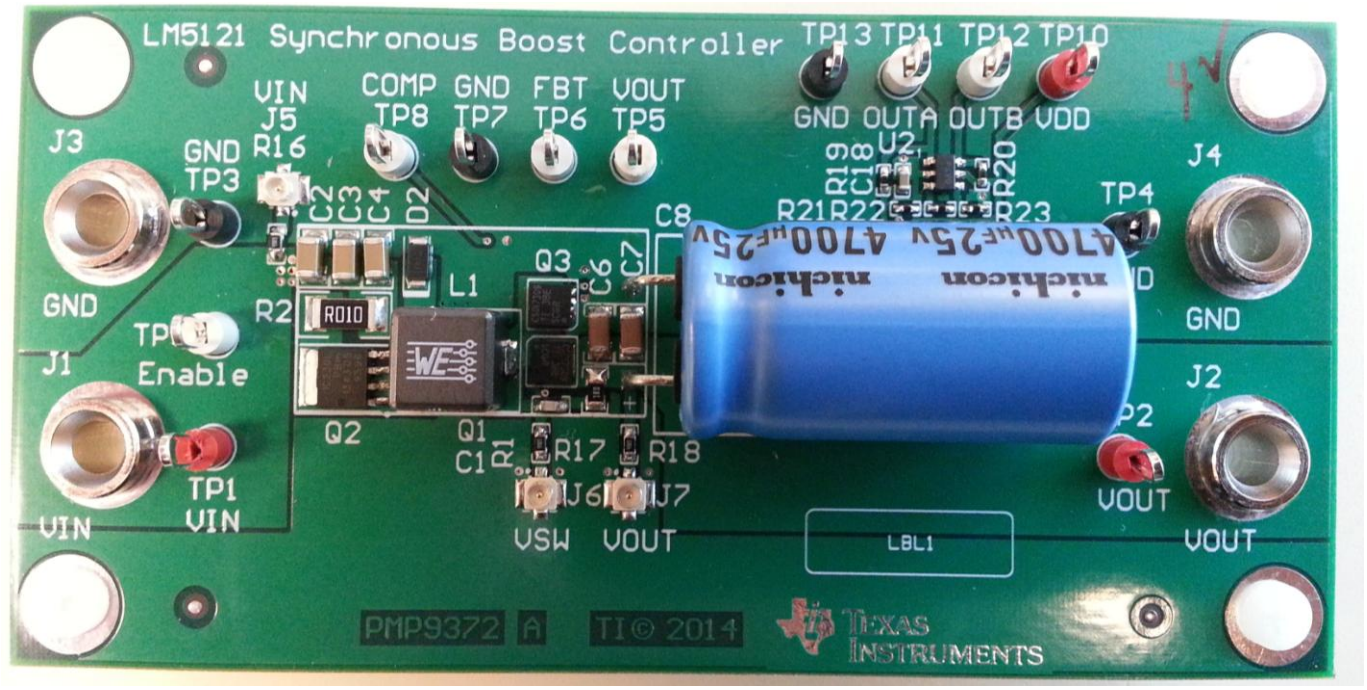
Vin Minimum	**6.4 VDC**
Vin Maximum	**15 VDC**
Vout	**15.45 VDC**
Iout	**4A Max. (2A Max. at 6.4Vin)**

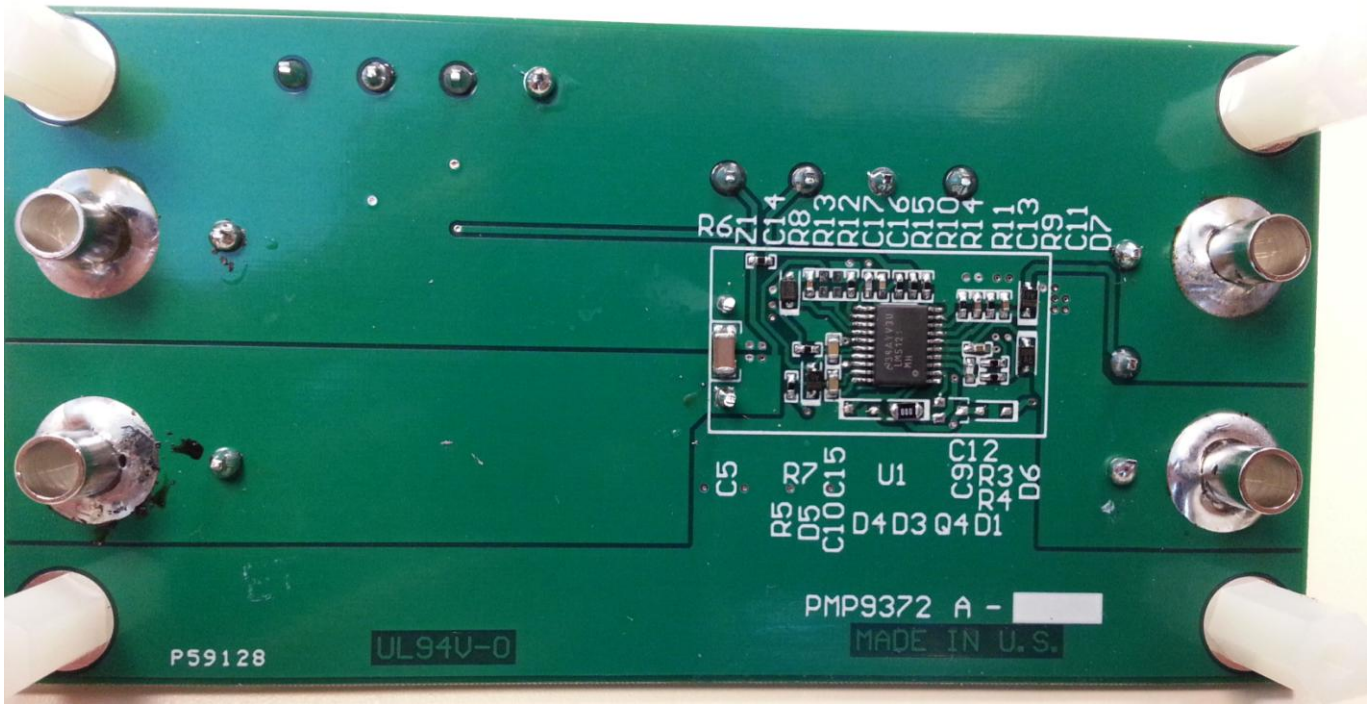
2 Circuit Description

PMP9372 is a single-phase synchronous boost converter, which utilizes the LM5121 controller. The design features inrush current limiting, input over-current disconnect, and can be set for latch-off or auto restart on fault. Inrush limiting is set to 11A nominal, which allows startup into a 4700µF output capacitor. The TPS3700DDC is used as an output voltage monitor, which provides Power Good signaling of output over-voltage and under-voltage.

3 Board Photos

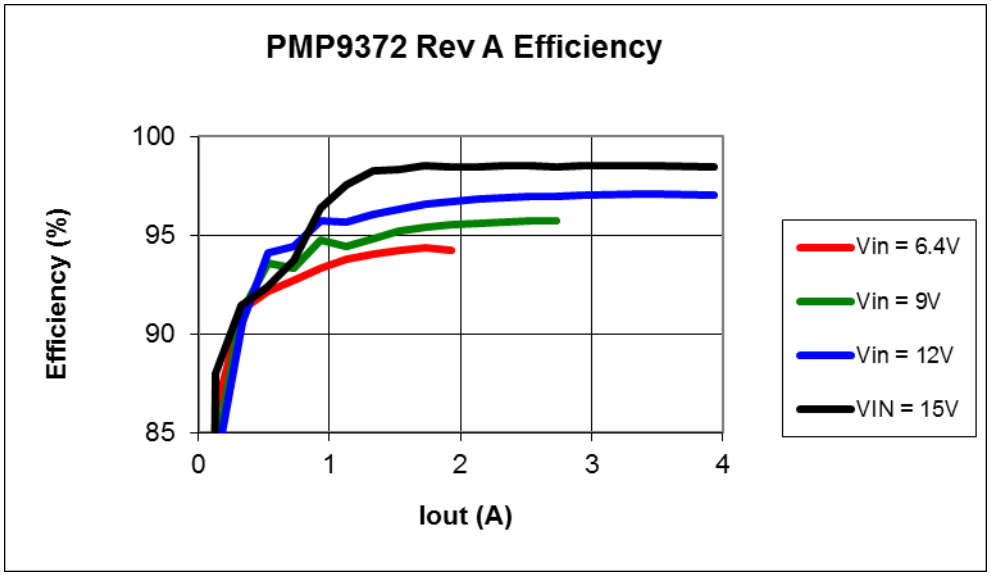
The design is built on PMP9372 Rev A printed circuit board. This is a 6-layer PCB with 1 oz. copper on the external layers and 0.5 oz. copper on all inner layers. PCB dimensions are 4.2 x 2.1 inch. The LM5121 solution size is 1.10 x 0.59 inch.





4 Efficiency

4.1 Efficiency Results



4.2 Efficiency Data

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Pdis (W)	Efficiency (%)
6.402	0.007	15.395	0.000	0.04	0.00	0.04	0.000
6.402	0.377	15.394	0.135	2.41	2.08	0.34	86.105
6.401	0.880	15.394	0.334	5.63	5.14	0.49	91.278
6.401	1.388	15.394	0.532	8.88	8.19	0.69	92.178
6.401	1.901	15.393	0.733	12.17	11.28	0.89	92.725
6.401	2.409	15.392	0.935	15.42	14.39	1.03	93.330
6.401	2.900	15.392	1.131	18.56	17.41	1.15	93.780
6.401	3.405	15.392	1.332	21.80	20.50	1.29	94.066
6.401	3.915	15.392	1.534	25.06	23.61	1.45	94.220
6.401	4.414	15.391	1.732	28.25	26.66	1.60	94.348
6.401	4.931	15.391	1.933	31.56	29.75	1.81	94.257
6.401	2.138	7.303	2.134	13.69	15.58	-1.90	113.878
6.409	2.535	5.707	2.333	16.25	13.31	2.93	81.951
6.397	2.711	5.669	2.534	17.34	14.37	2.98	82.834
6.401	2.740	5.931	2.736	17.54	16.23	1.31	92.522
6.401	2.972	5.663	2.932	19.02	16.60	2.42	87.280
6.401	3.532	5.660	3.434	22.61	19.44	3.17	85.970
6.401	4.006	5.654	3.936	25.64	22.25	3.39	86.786

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Pdis (W)	Efficiency (%)
9.000	0.007	15.397	0.000	0.06	0.00	0.06	0.000
9.000	0.267	15.396	0.131	2.40	2.02	0.39	83.932
9.000	0.622	15.396	0.331	5.60	5.10	0.50	91.034
9.000	0.969	15.395	0.530	8.72	8.16	0.56	93.560
9.000	1.338	15.395	0.730	12.04	11.24	0.80	93.326
9.000	1.682	15.395	0.932	15.14	14.35	0.79	94.782
9.000	2.048	15.394	1.131	18.43	17.41	1.02	94.459
9.000	2.399	15.394	1.330	21.59	20.47	1.12	94.827
9.000	2.749	15.394	1.530	24.74	23.55	1.19	95.198
9.000	3.100	15.394	1.729	27.90	26.62	1.28	95.399
9.000	3.458	15.394	1.931	31.12	29.73	1.40	95.514
8.999	3.815	15.394	2.132	34.33	32.82	1.51	95.598
9.000	4.170	15.394	2.332	37.53	35.90	1.63	95.654
9.000	4.527	15.394	2.533	40.74	38.99	1.75	95.705
8.999	4.881	15.394	2.732	43.92	42.06	1.87	95.748
9.000	3.024	8.263	2.929	27.22	24.20	3.01	88.927
9.000	3.469	8.259	3.430	31.22	28.33	2.89	90.735
9.000	4.000	8.254	3.934	36.00	32.47	3.53	90.198

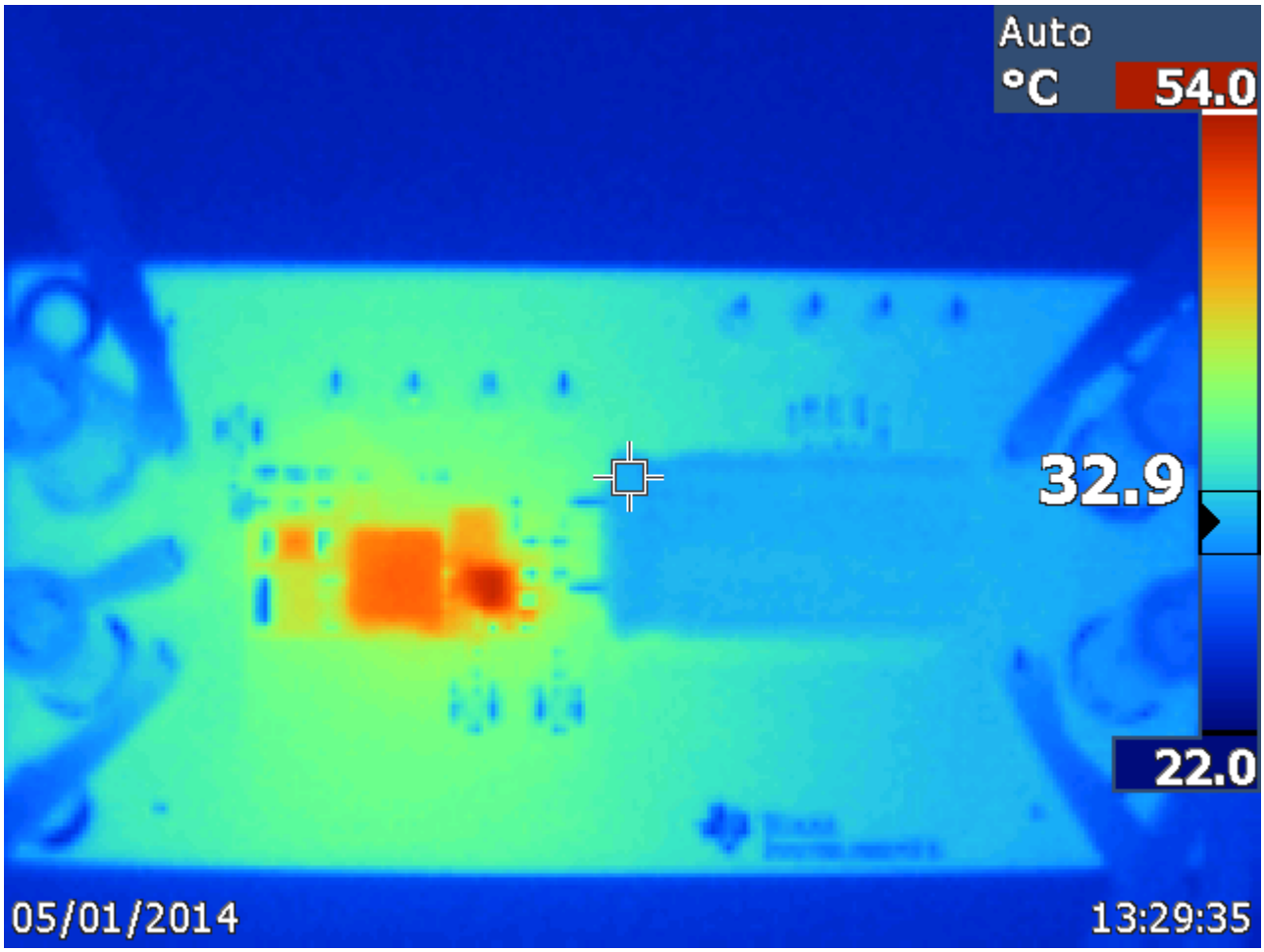
PMP9372 Test Results

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Pdis (W)	Efficiency (%)
12.000	0.006	15.395	0.000	0.07	0.00	0.07	0.000
12.000	0.202	15.395	0.131	2.42	2.02	0.41	83.199
12.000	0.470	15.395	0.332	5.64	5.11	0.53	90.623
12.000	0.721	15.395	0.529	8.65	8.14	0.51	94.128
12.000	0.993	15.394	0.731	11.92	11.25	0.66	94.436
12.000	1.248	15.395	0.931	14.98	14.33	0.64	95.705
12.000	1.513	15.394	1.128	18.16	17.36	0.79	95.640
12.000	1.775	15.394	1.329	21.30	20.46	0.84	96.050
12.000	2.040	15.394	1.532	24.48	23.58	0.90	96.338
12.000	2.298	15.394	1.730	27.58	26.63	0.94	96.575
12.000	2.559	15.394	1.929	30.71	29.70	1.01	96.701
12.000	2.824	15.394	2.131	33.89	32.80	1.08	96.803
12.000	3.084	15.393	2.330	37.01	35.87	1.14	96.913
12.000	3.345	15.393	2.528	40.14	38.91	1.23	96.944
12.000	3.610	15.393	2.729	43.32	42.01	1.31	96.970
12.000	3.872	15.393	2.929	46.46	45.09	1.38	97.034
12.000	4.530	15.393	3.428	54.36	52.77	1.59	97.070
12.000	5.192	15.393	3.928	62.30	60.46	1.84	97.046

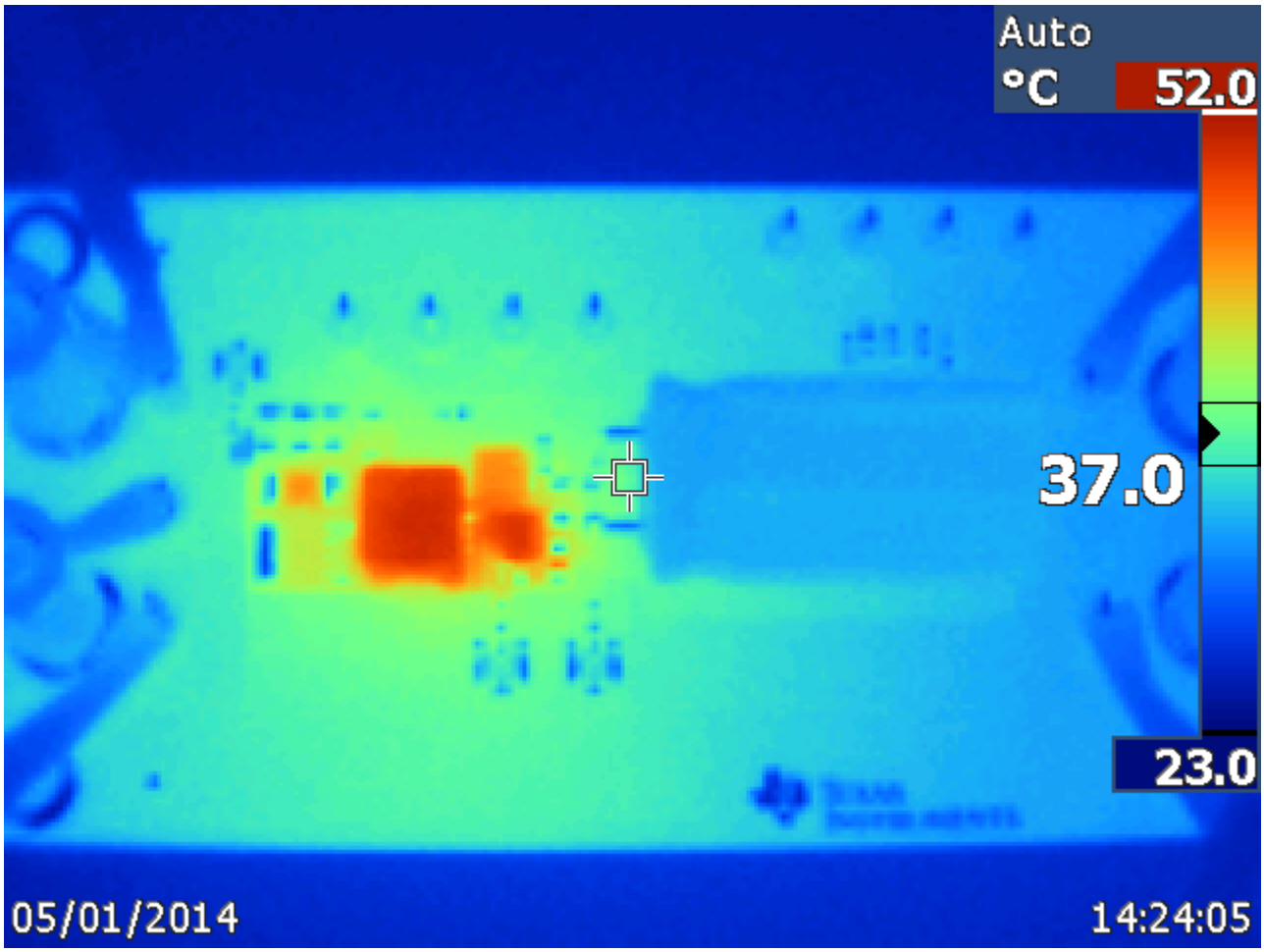
Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Pdis (W)	Efficiency (%)
15.006	0.006	15.395	0.000	0.09	0.00	0.09	0.000
15.006	0.148	15.395	0.127	2.22	1.96	0.27	88.035
15.006	0.368	15.395	0.328	5.52	5.05	0.47	91.441
15.006	0.583	15.395	0.525	8.75	8.08	0.67	92.386
15.006	0.796	15.395	0.727	11.94	11.19	0.75	93.699
15.006	0.990	15.395	0.930	14.86	14.32	0.54	96.375
15.006	1.186	15.395	1.128	17.80	17.37	0.43	97.575
15.006	1.388	15.395	1.329	20.83	20.46	0.37	98.231
15.006	1.597	15.395	1.531	23.96	23.57	0.39	98.352
15.006	1.800	15.395	1.728	27.01	26.60	0.41	98.489
15.006	2.011	15.395	1.930	30.18	29.71	0.46	98.460
15.006	2.220	15.395	2.130	33.31	32.79	0.52	98.433
15.006	2.428	15.395	2.331	36.43	35.89	0.55	98.494
15.006	2.635	15.395	2.530	39.54	38.95	0.59	98.504
15.006	2.845	15.395	2.730	42.69	42.03	0.66	98.445
15.006	3.051	15.395	2.930	45.78	45.11	0.68	98.524
15.005	3.571	15.394	3.430	53.58	52.80	0.78	98.542
15.005	4.098	15.394	3.933	61.49	60.54	0.95	98.462

5 Thermal

5.1 Thermal Image at 12Vin and 4A Load

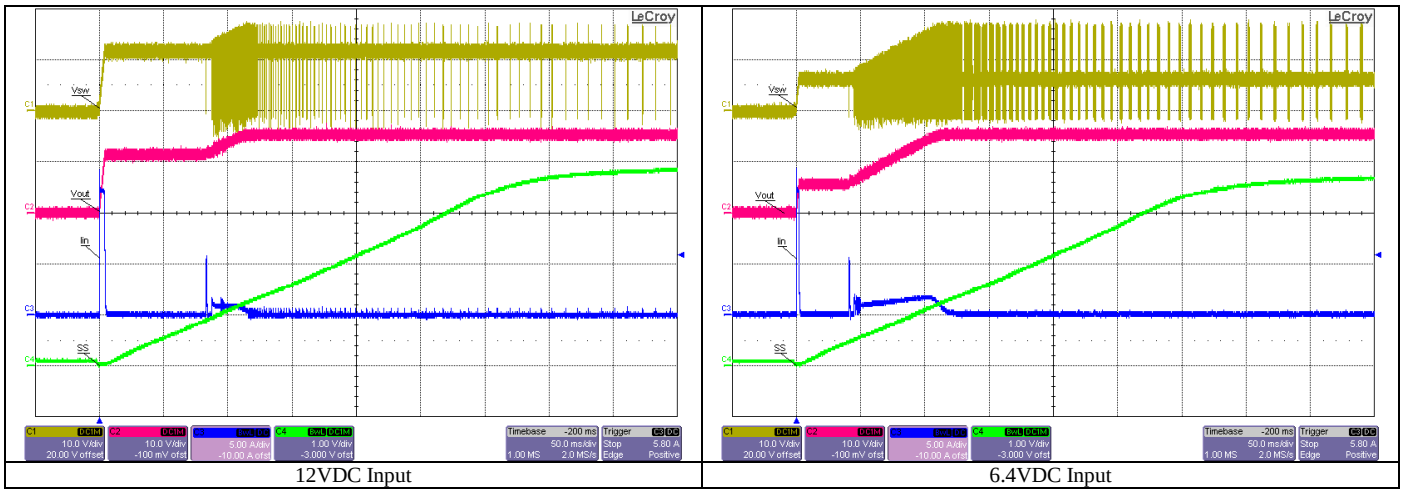


5.2 Thermal Image at 6.4Vin and 2A Load



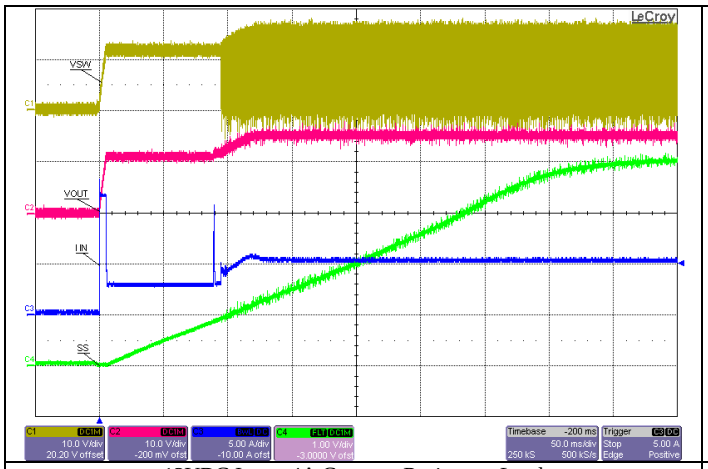
6 Startup

6.1 Startup using EN at No Load

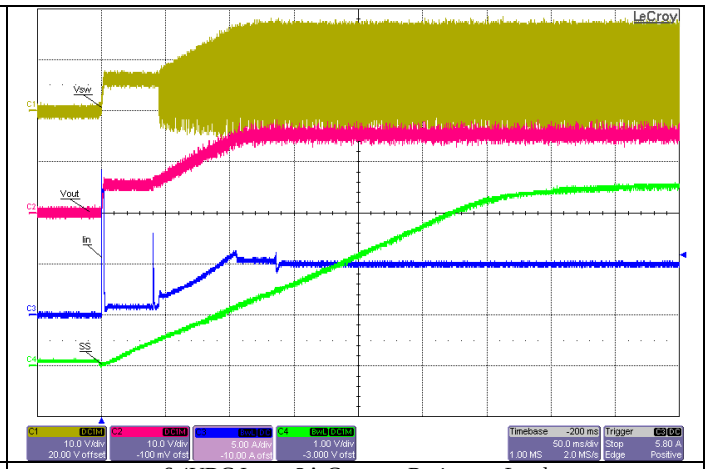


12VDC Input	6.4VDC Input

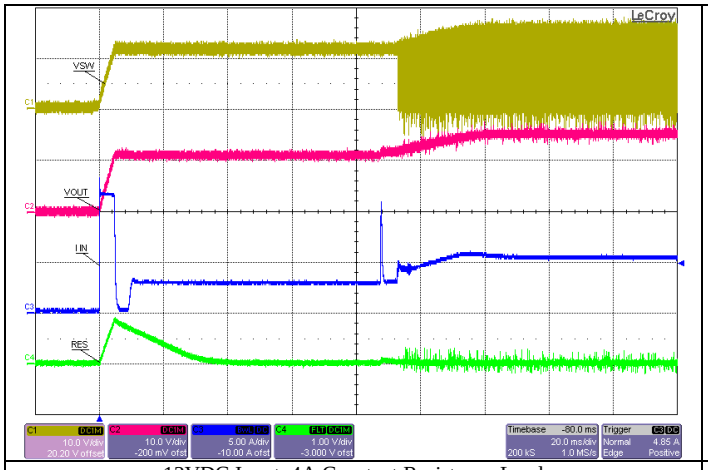
6.1 Startup Using EN at Full Load



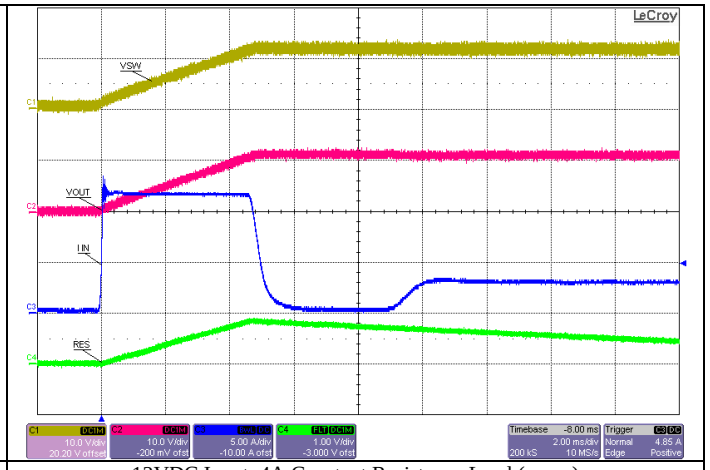
12VDC Input, 4A Constant Resistance Load



6.4VDC Input, 2A Constant Resistance Load

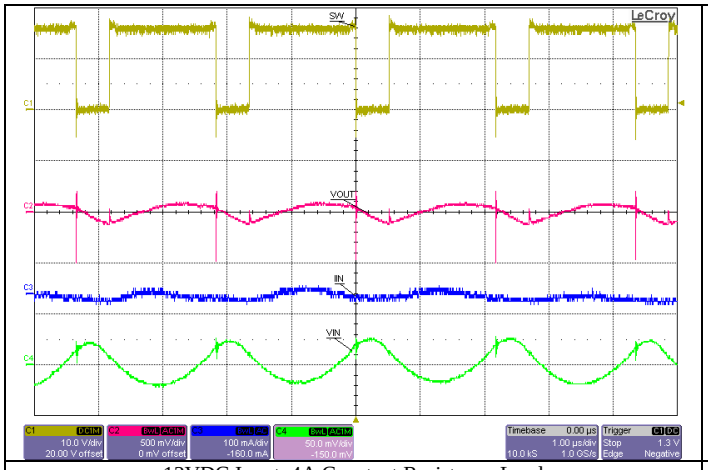


12VDC Input, 4A Constant Resistance Load

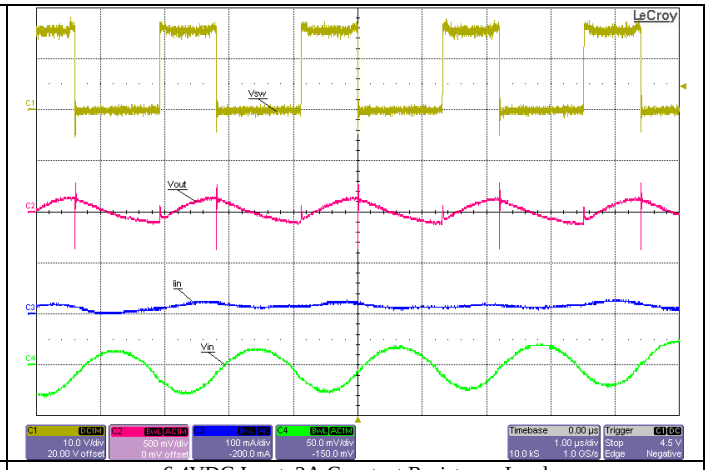


12VDC Input, 4A Constant Resistance Load (zoom)

7 Output Voltage Ripple and Switch Voltage



12VDC Input, 4A Constant Resistance Load



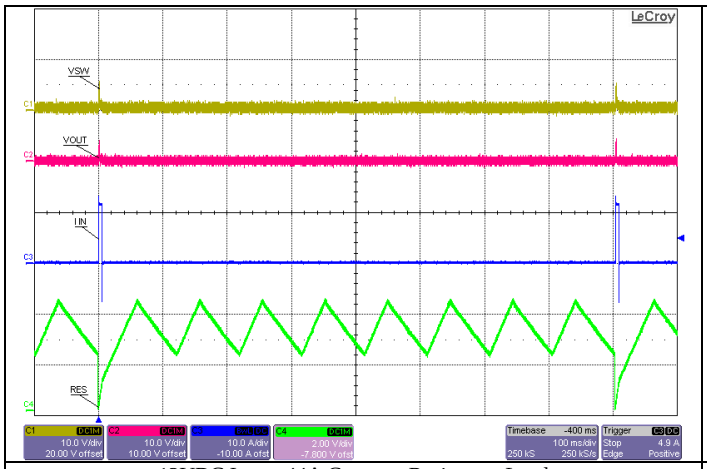
6.4VDC Input, 2A Constant Resistance Load

8 Current Limit

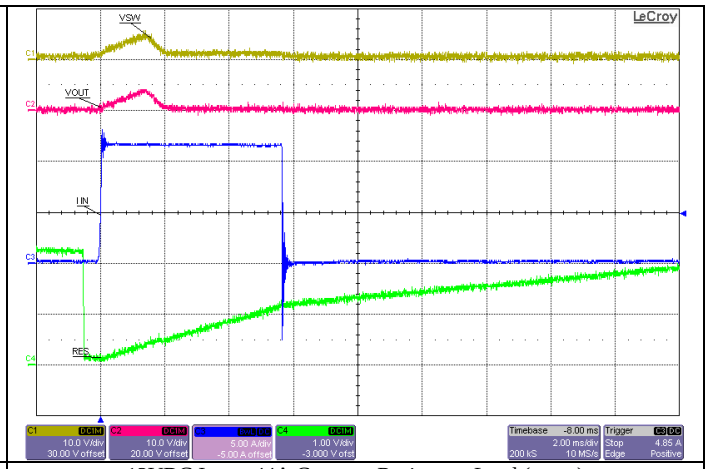
8.1 Current Limit Table

	Current Limit		Startup	
Vin (V)	Iin (A)	Iout (A)	Iin (A)	Iout (A)
12.0	5.5	4.2	5.4	4.1
11.0	5.3	3.7	5.1	3.5
10.0	5.2	3.2	4.9	3.0
9.0	5.1	2.8	4.7	2.6
8.0	5.1	2.5	4.5	2.2
7.0	5.2	2.2	4.4	1.9
6.4	5.2	2.0	4.3	1.7

8.2 Short Circuit Test

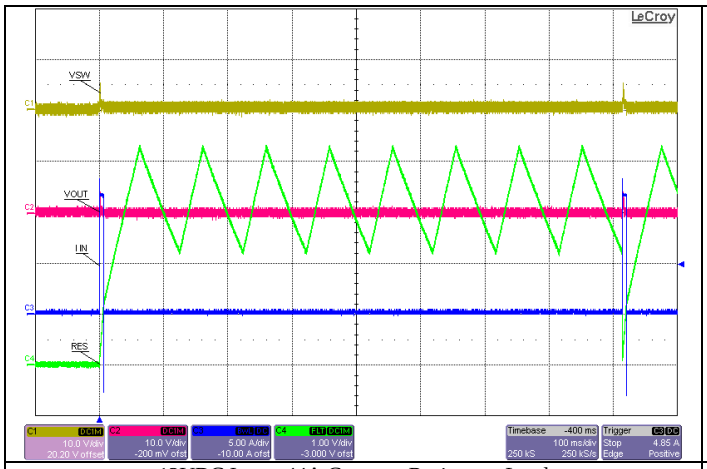


12VDC Input, 44A Constant Resistance Load

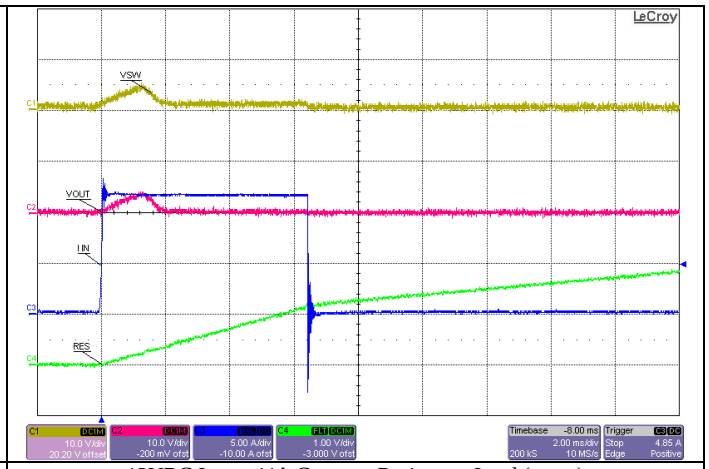


12VDC Input, 44A Constant Resistance Load (zoom)

8.3 Startup into Short Circuit

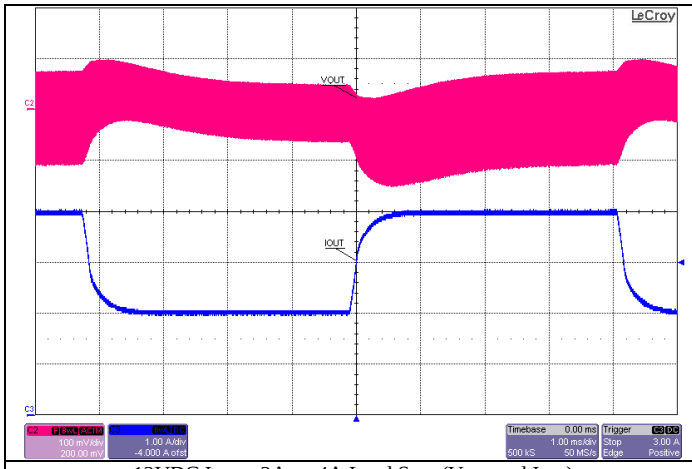


12VDC Input, 44A Constant Resistance Load

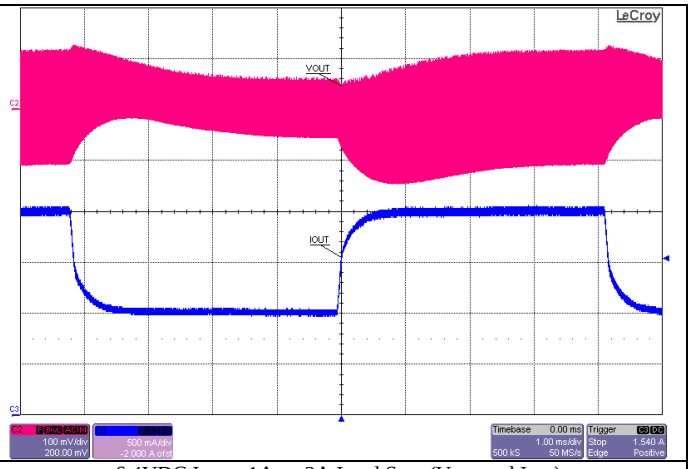


12VDC Input, 44A Constant Resistance Load (zoom)

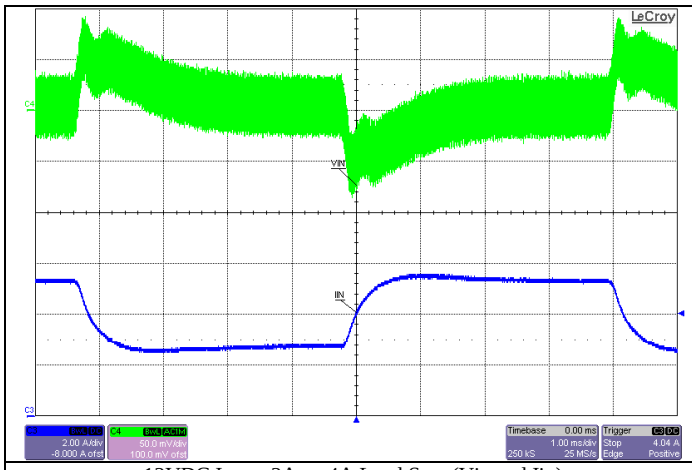
9 Load Transient Response



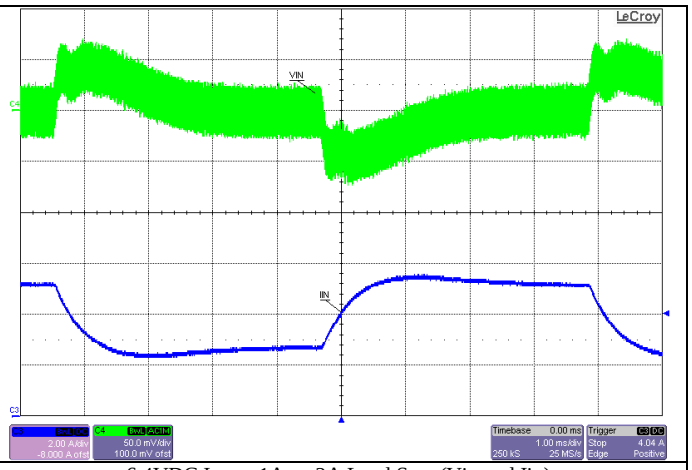
12VDC Input, 2A-to-4A Load Step (Vout and Iout)



6.4VDC Input, 1A-to-2A Load Step (Vout and Iout)

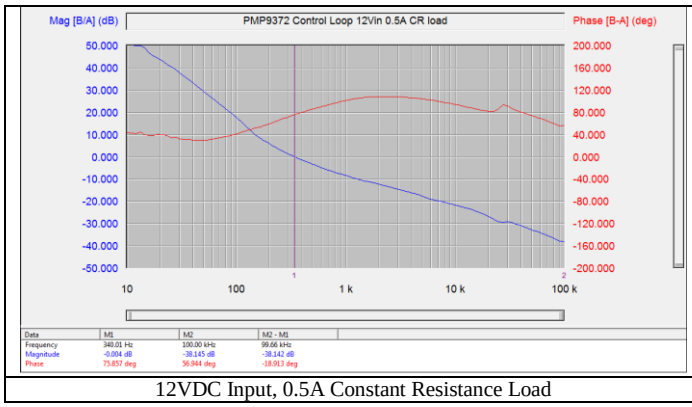


12VDC Input, 2A-to-4A Load Step (Vin and Iin)

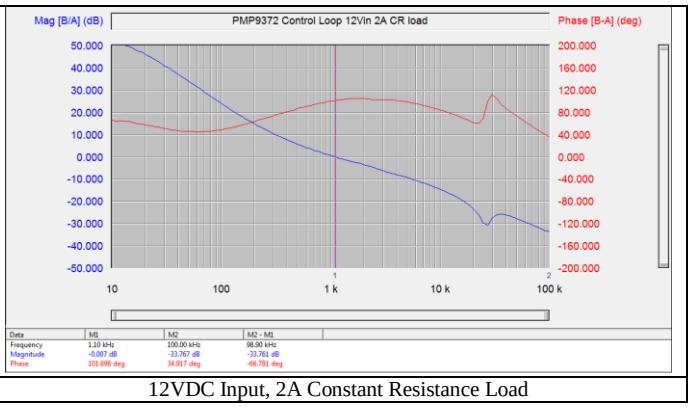


6.4VDC Input, 1A-to-2A Load Step (Vin and Iin)

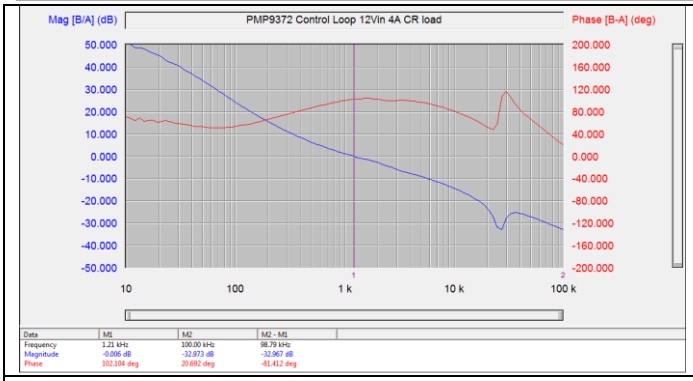
10 Control Loop Frequency Response



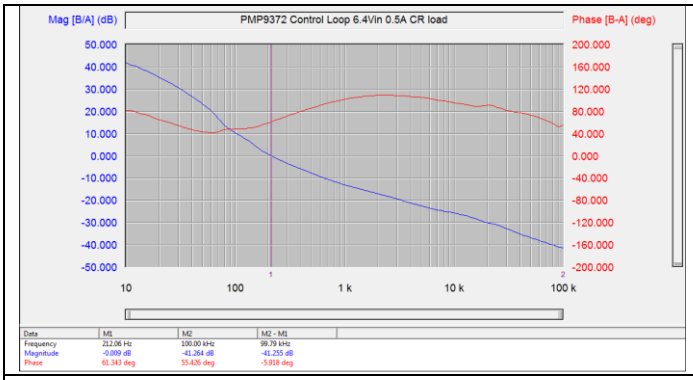
12VDC Input, 0.5A Constant Resistance Load



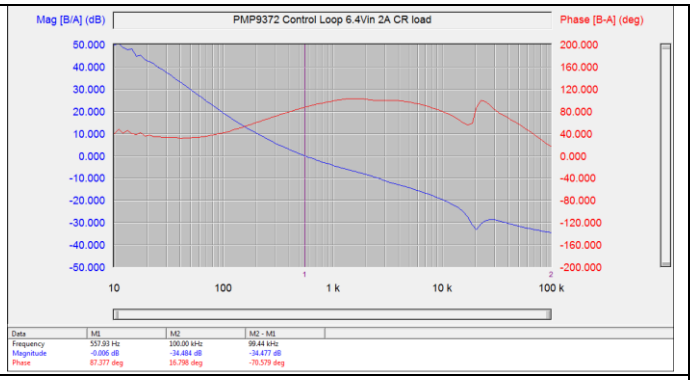
12VDC Input, 2A Constant Resistance Load



12VDC Input, 4A Constant Resistance Load



6.4VDC Input, 0.5A Constant Resistance Load



6.4VDC Input, 2A Constant Resistance Load

11 Output Over-Voltage and Under-Voltage Power Good

Condition	Voltage (V)
Under-Voltage Falling Threshold	14.22
Under-Voltage Rising Threshold	14.42
Over-Voltage Rising Threshold	16.62
Over-Voltage Falling Threshold	16.40

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