LM5122 Isolated Synchronous Flyback Converter

TI reference design number: PMP10541 REV A

Input: 9V to 42V DC
Output: 5V @ 5A

DC – DC Test Results

Table of Contents

1 Test Specifications

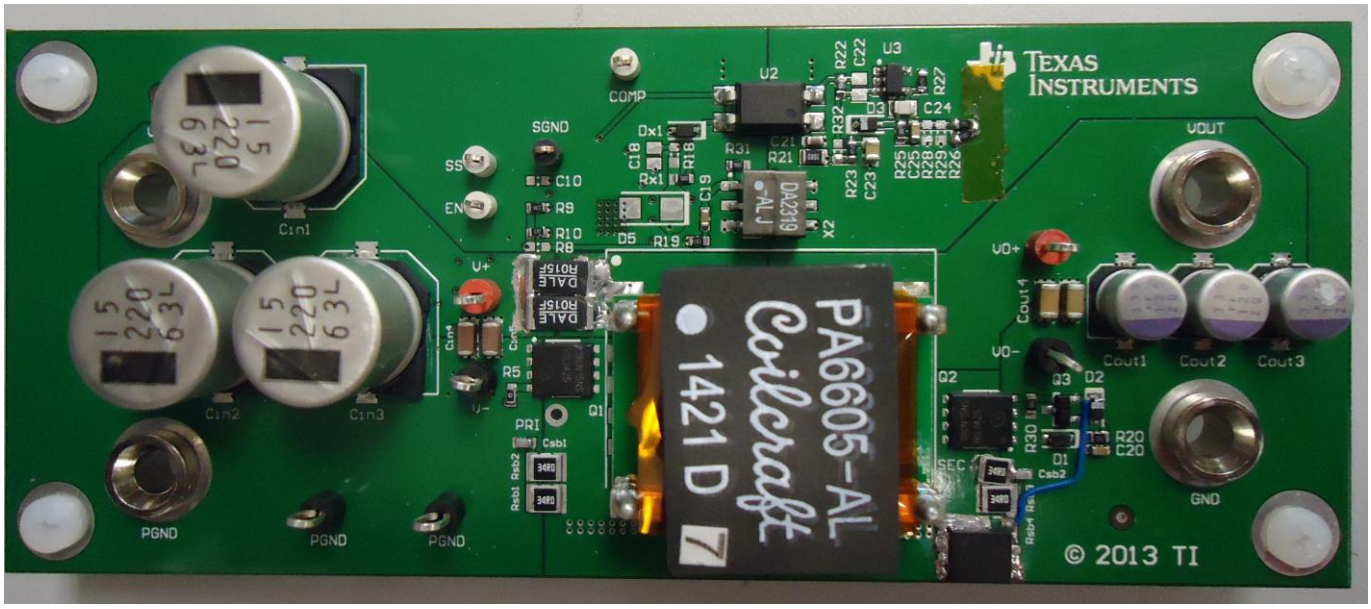
Vin min	**9V**
Vin max	**42V**
Vout	**5V**
Iout	**5A**

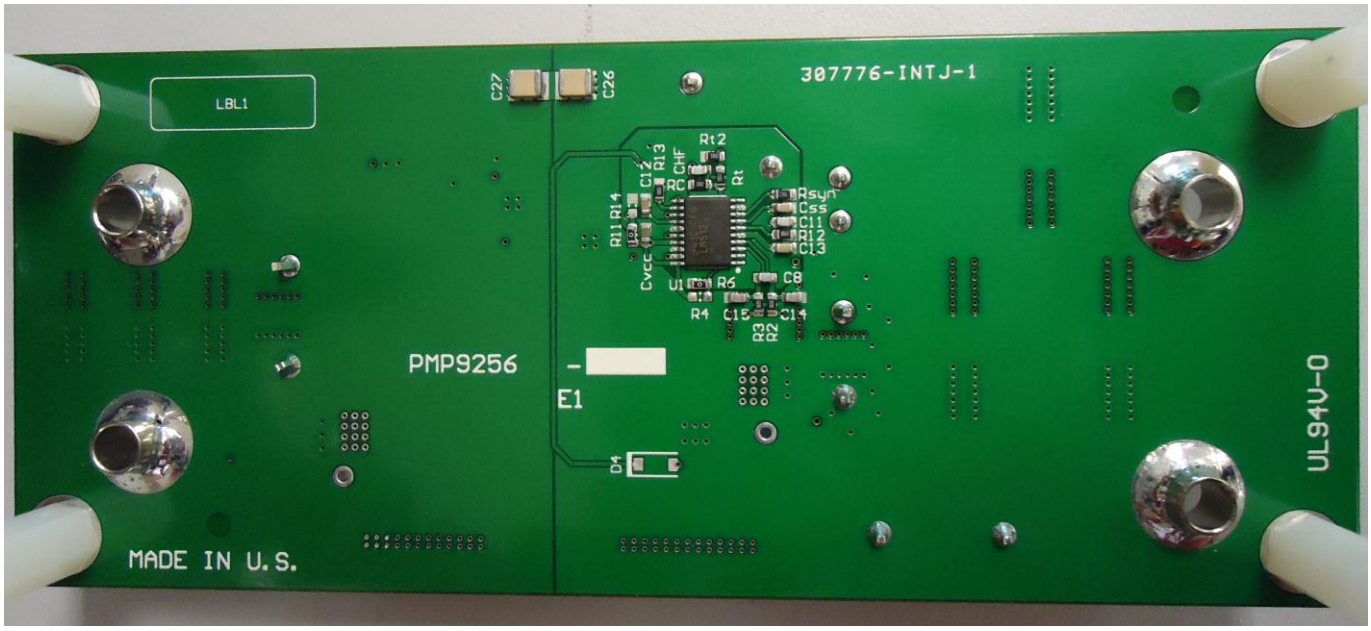
2 Circuit Description

PMP10541 is an isolated synchronous flyback converter which utilizes the LM5122 controller for industrial applications. The benefit of using a synchronous flyback is higher efficiency compared to a non-synchronous flyback. The switching frequency is set to 230 kHz for high efficiency at a nominal output power of 25W. A planar power transformer provides good coupling and thermal performance. Secondary-side gate drive is coupled from the primary through a small isolation transformer. The LMV431 shunt regulator closes the feedback loop through an optocoupler, providing tight control of the output voltage.

3 Board Photos

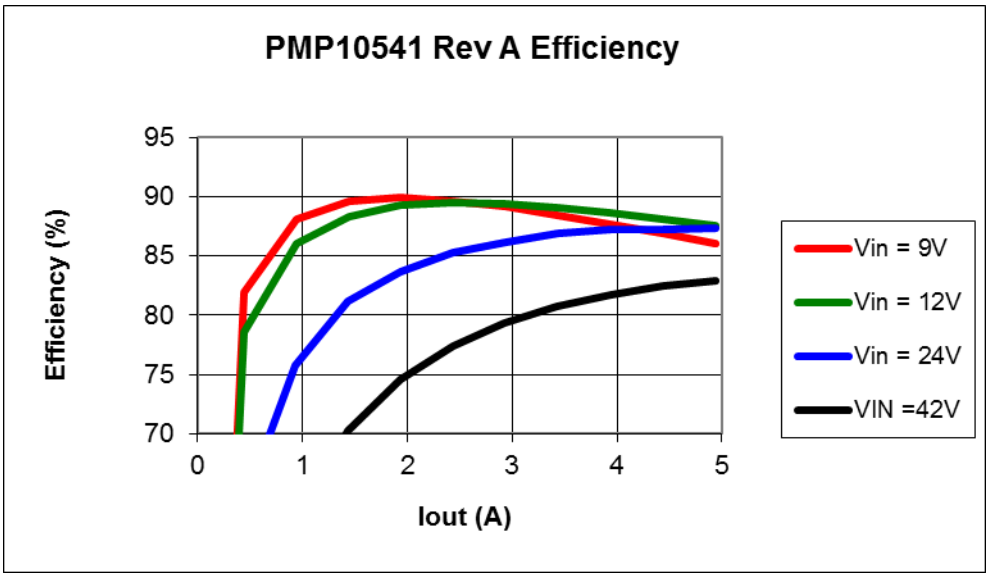
The design is built on PMP9256 printed circuit board. This is a 4-layer PCB with 1 oz. copper. PCB dimensions are 5.025 x 2.07 inch.





4 Efficiency

4.1 Efficiency Results



4.2 Efficiency Data

The output current is increased above the maximum value to test current limit.

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Pdis (W)	Efficiency (%)
9.002	0.035	4.987	0.000	0.32	0.00	0.32	0.000
9.002	0.301	4.987	0.445	2.71	2.22	0.49	81.902
9.002	0.594	4.987	0.944	5.35	4.71	0.64	88.041
9.002	0.891	4.986	1.441	8.02	7.18	0.84	89.578
9.002	1.196	4.986	1.941	10.77	9.68	1.09	89.889
9.001	1.507	4.986	2.439	13.56	12.16	1.40	89.652
9.001	1.826	4.986	2.939	16.44	14.65	1.78	89.158
9.001	2.153	4.986	3.438	19.38	17.14	2.24	88.455
9.001	2.489	4.986	3.941	22.40	19.65	2.75	87.709
9.000	2.832	4.986	4.440	25.49	22.14	3.35	86.856
9.000	3.182	4.985	4.940	28.64	24.63	4.01	85.990
8.999	3.539	4.985	5.436	31.85	27.10	4.75	85.088
8.999	3.906	4.985	5.936	35.15	29.59	5.56	84.185
9.002	0.016	0.002	0.099	0.14	0.00	0.14	0.137
9.002	0.025	0.002	0.099	0.23	0.00	0.22	0.088
9.002	0.025	0.001	0.057	0.23	0.00	0.22	0.025
9.002	0.016	0.002	0.050	0.14	0.00	0.14	0.069
9.002	0.016	0.002	0.050	0.14	0.00	0.14	0.069
9.002	0.016	0.002	0.099	0.14	0.00	0.14	0.137
9.002	0.025	0.002	0.099	0.23	0.00	0.22	0.088
9.002	0.025	0.002	0.095	0.23	0.00	0.22	0.084

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Pdis (W)	Efficiency (%)
12.002	0.036	4.986	0.000	0.43	0.00	0.43	0.000
12.002	0.233	4.986	0.441	2.80	2.20	0.60	78.629
12.002	0.455	4.986	0.942	5.46	4.70	0.76	86.008
12.002	0.678	4.986	1.441	8.14	7.18	0.95	88.294
12.002	0.903	4.986	1.940	10.84	9.67	1.16	89.251
12.002	1.132	4.986	2.438	13.59	12.16	1.43	89.472
12.001	1.365	4.986	2.938	16.38	14.65	1.73	89.424
12.001	1.603	4.986	3.437	19.24	17.14	2.10	89.080
12.001	1.846	4.985	3.938	22.15	19.63	2.52	88.612
12.001	2.092	4.985	4.437	25.11	22.12	2.99	88.100
12.001	2.343	4.985	4.937	28.12	24.61	3.51	87.526
12.001	2.598	4.985	5.436	31.18	27.10	4.08	86.914
12.000	2.858	4.985	5.937	34.30	29.60	4.70	86.296
12.000	3.123	4.985	6.434	37.48	32.07	5.40	85.584
12.000	3.394	4.984	6.935	40.73	34.56	6.16	84.866
12.002	0.022	0.002	0.104	0.26	0.00	0.26	0.079
12.002	0.022	0.002	0.104	0.26	0.00	0.26	0.079
12.002	0.022	0.000	0.052	0.26	0.00	0.26	0.000
12.002	0.014	0.000	0.052	0.17	0.00	0.17	0.000
12.002	0.014	0.002	0.055	0.17	0.00	0.17	0.065
12.002	0.016	0.000	0.101	0.19	0.00	0.19	0.000

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Pdis (W)	Efficiency (%)
24.008	0.043	4.986	0.000	1.03	0.00	1.03	0.000
24.008	0.143	4.986	0.441	3.43	2.20	1.23	64.047
24.008	0.257	4.986	0.938	6.17	4.68	1.49	75.799
24.008	0.368	4.986	1.439	8.83	7.17	1.66	81.210
24.008	0.481	4.986	1.938	11.55	9.66	1.88	83.677
24.008	0.594	4.985	2.439	14.26	12.16	2.10	85.258
24.007	0.707	4.985	2.935	16.97	14.63	2.34	86.202
24.007	0.821	4.985	3.435	19.71	17.12	2.59	86.878
24.007	0.938	4.985	3.938	22.52	19.63	2.89	87.177
24.006	1.056	4.985	4.437	25.35	22.12	3.23	87.251
24.006	1.175	4.985	4.939	28.21	24.62	3.59	87.286
24.005	1.296	4.985	5.437	31.11	27.10	4.01	87.120
24.005	1.418	4.984	5.937	34.04	29.59	4.45	86.929
24.004	1.540	4.984	6.435	36.97	32.07	4.89	86.761
24.004	1.665	4.984	6.934	39.97	34.56	5.41	86.470
24.003	1.792	4.984	7.434	43.01	37.05	5.96	86.138
24.002	1.920	4.984	7.937	46.08	39.56	6.53	85.839
24.001	2.050	4.983	8.436	49.20	42.04	7.17	85.437
24.008	0.012	0.002	0.055	0.29	0.00	0.29	0.038
24.008	0.013	0.000	0.109	0.31	0.00	0.31	0.000
24.008	0.016	0.002	0.110	0.38	0.00	0.38	0.057

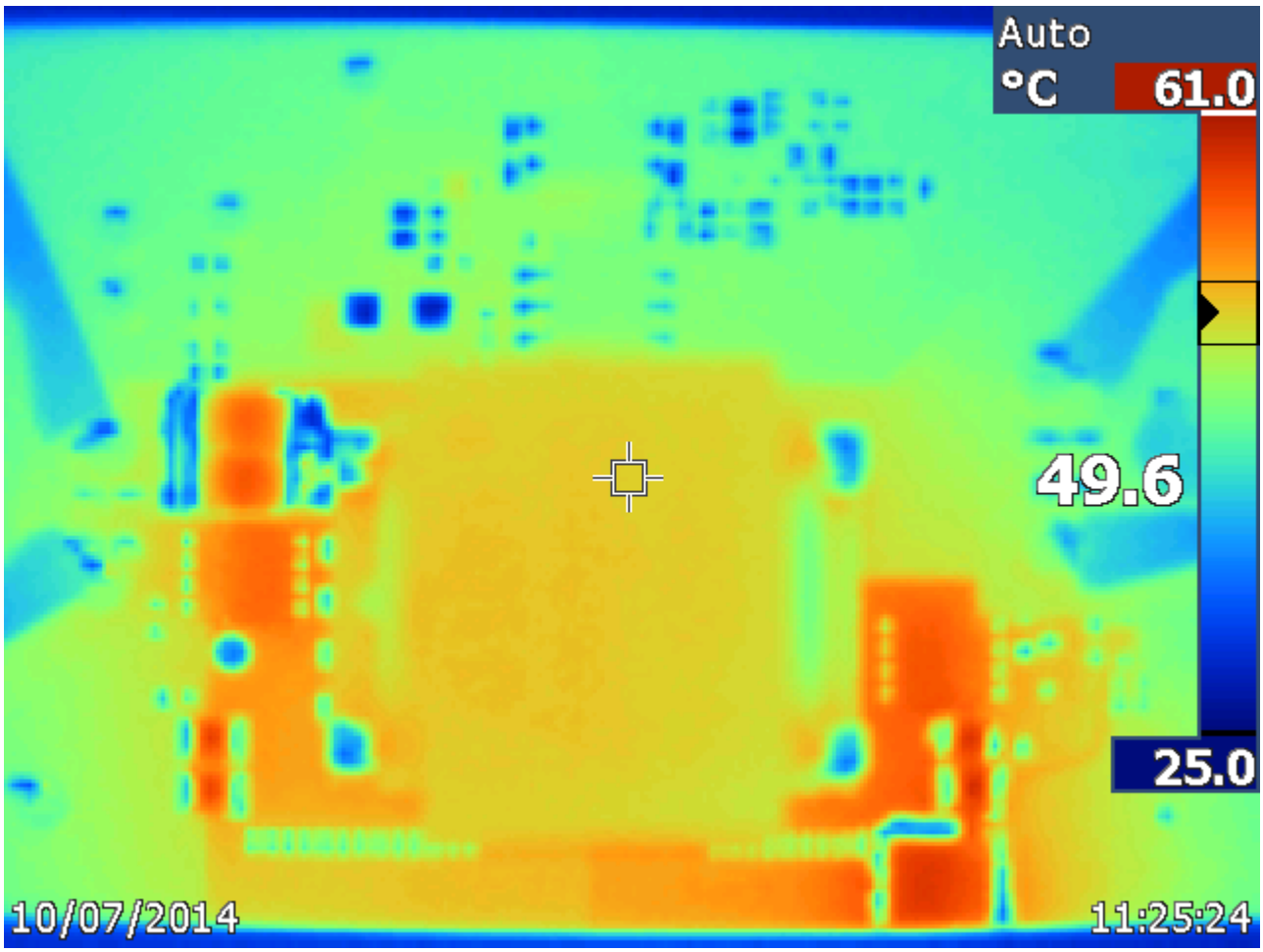
PMP10541 Test Results

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Pdis (W)	Efficiency (%)
42.016	0.055	4.985	0.000	2.31	0.00	2.31	0.000
42.016	0.109	4.985	0.437	4.58	2.18	2.40	47.567
42.016	0.178	4.985	0.935	7.48	4.66	2.82	62.322
42.016	0.242	4.985	1.433	10.17	7.14	3.02	70.256
42.016	0.308	4.985	1.935	12.94	9.65	3.29	74.539
42.016	0.373	4.984	2.433	15.67	12.13	3.55	77.374
42.015	0.438	4.984	2.930	18.40	14.60	3.80	79.354
42.015	0.504	4.984	3.430	21.18	17.10	4.08	80.730
42.015	0.571	4.984	3.933	23.99	19.60	4.39	81.707
42.015	0.638	4.984	4.434	26.81	22.10	4.71	82.442
42.014	0.706	4.984	4.935	29.66	24.60	5.07	82.921
42.014	0.774	4.984	5.433	32.52	27.08	5.44	83.269
42.013	0.842	4.983	5.931	35.37	29.55	5.82	83.545
42.013	0.911	4.983	6.429	38.27	32.04	6.24	83.701
42.013	0.981	4.983	6.927	41.21	34.52	6.70	83.750
42.012	1.051	4.983	7.425	44.15	37.00	7.16	83.794
42.012	1.123	4.983	7.928	47.18	39.51	7.67	83.734
42.011	1.195	4.982	8.428	50.20	41.99	8.21	83.637
42.011	1.268	4.982	8.928	53.27	44.48	8.79	83.498
42.010	1.341	4.982	9.427	56.34	46.97	9.37	83.367
42.009	1.415	4.982	9.925	59.44	49.45	10.00	83.183

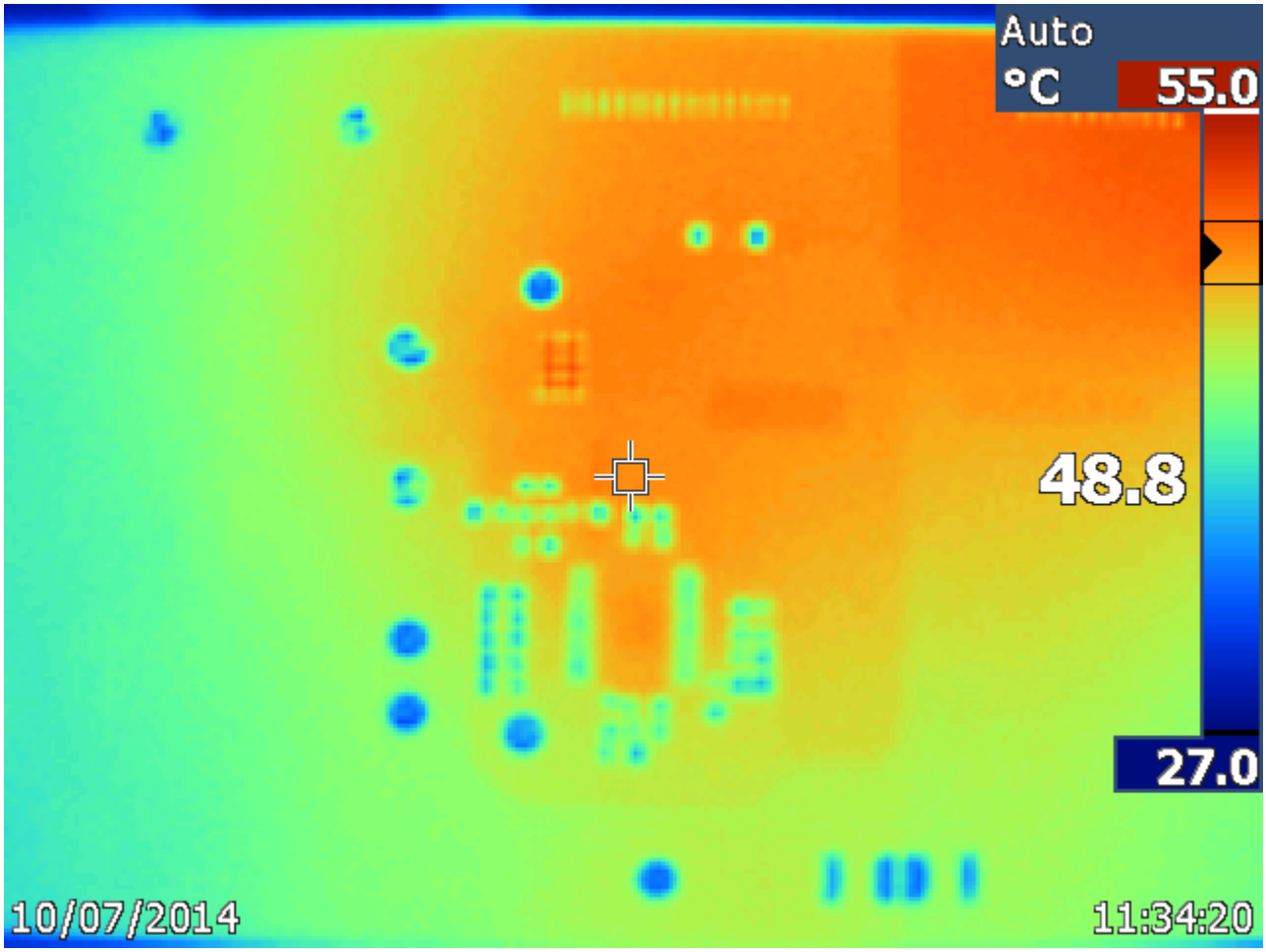
5 Thermal

12V input to 5V output at 5A load.

5.1 Top – Power Components

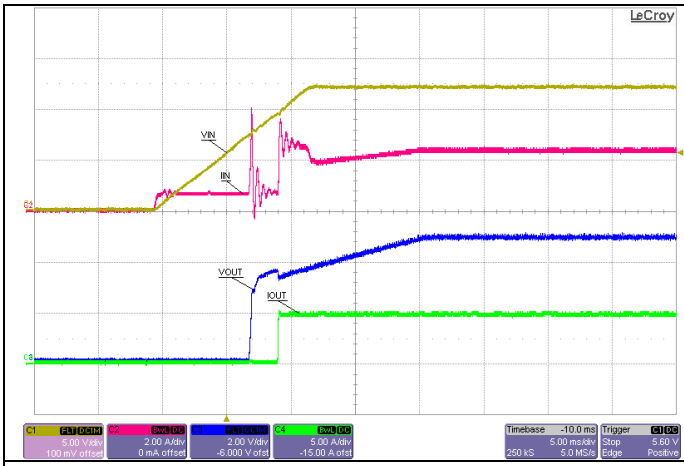


5.2 Bottom - Controller

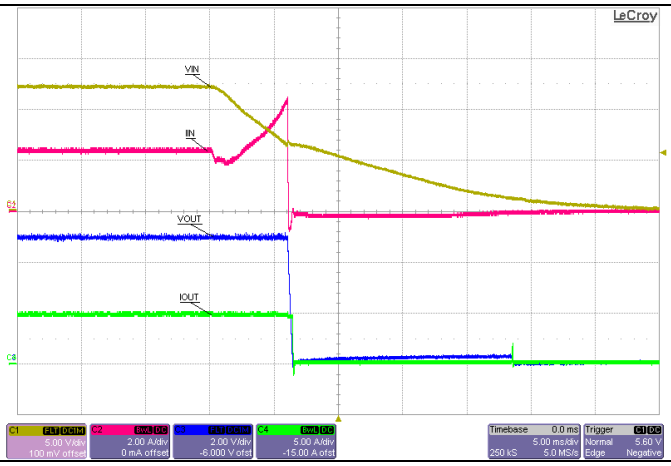


6 Startup and Shut Down

6.1 Startup and Shut Down at 12V Input



VIN IIN VOUT IOUT Startup 12Vin 5Vout 5A CC Load



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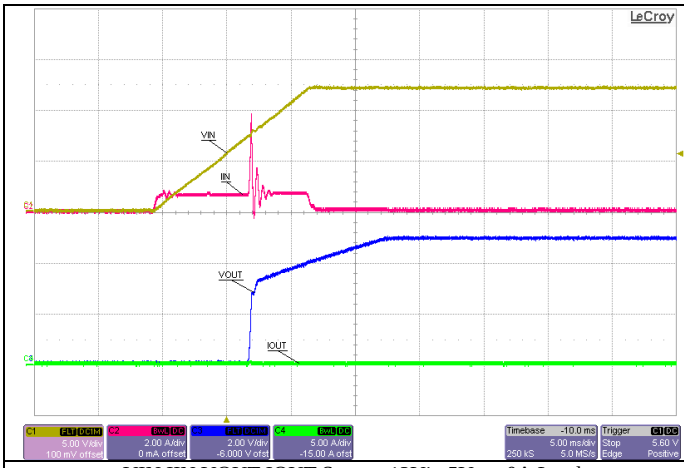
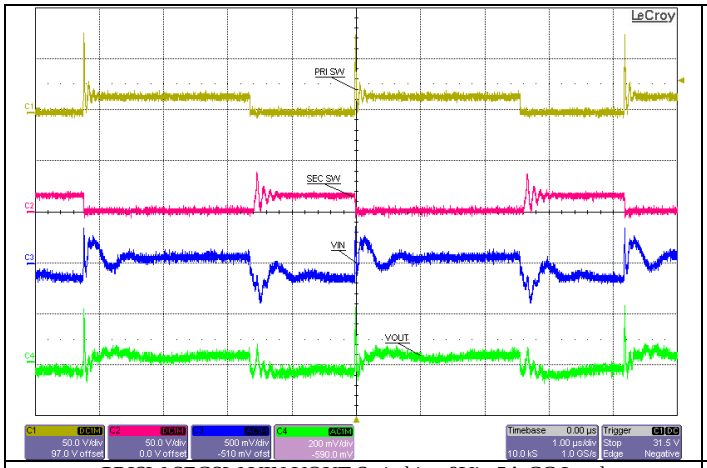


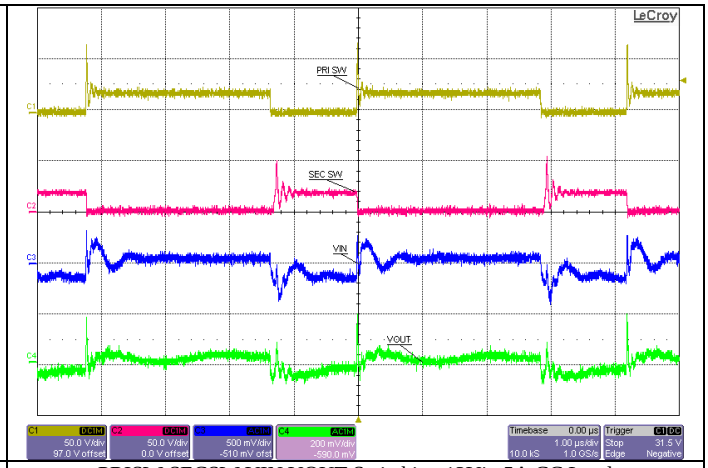
VIN IIN VOUT IOUT Startup 12Vin 5Vout 0A Load

7 Switching and Ripple Voltage

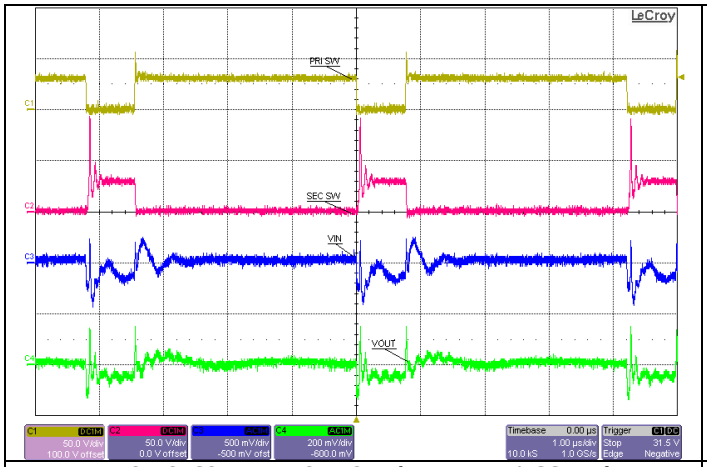
7.1 Switching and Ripple Voltage



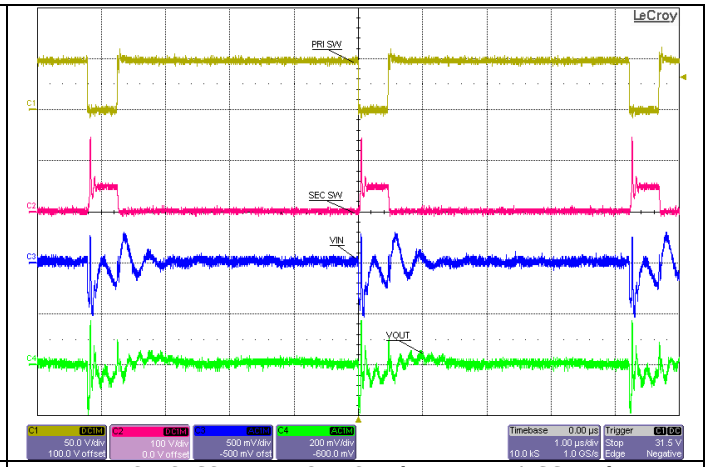
PRISW SECSW VIN VOUT Switching 9Vin 5A CC Load



PRISW SECSW VIN VOUT Switching 12Vin 5A CC Load

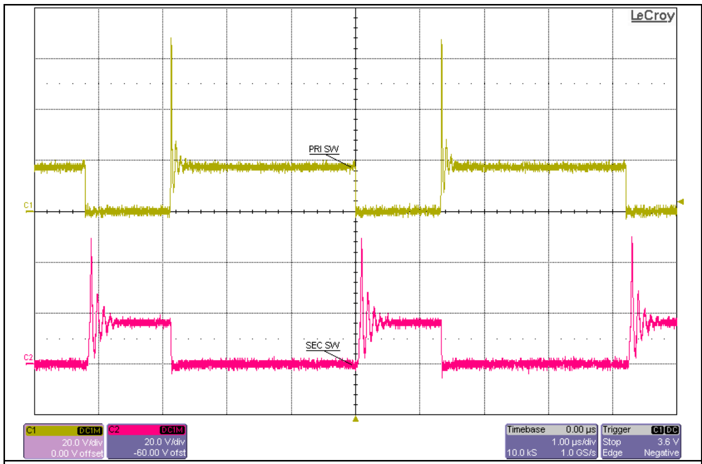


PRISW SECSW VIN VOUT Switching 24Vin 5A CC Load

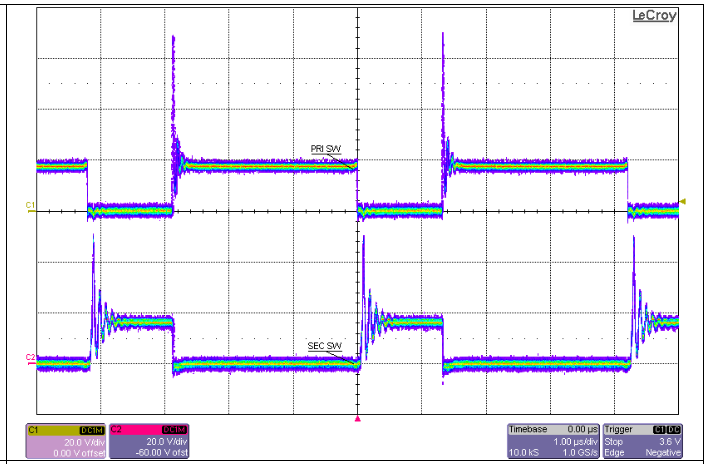


PRISW SECSW VIN VOUT Switching 42Vin 5A CC Load

7.2 Expanded Switching Voltage



PRISW SECSW Switching 12Vin 5A CC Load



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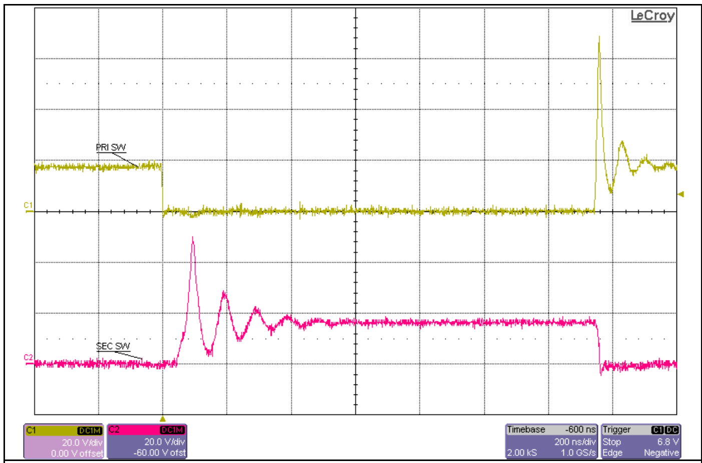

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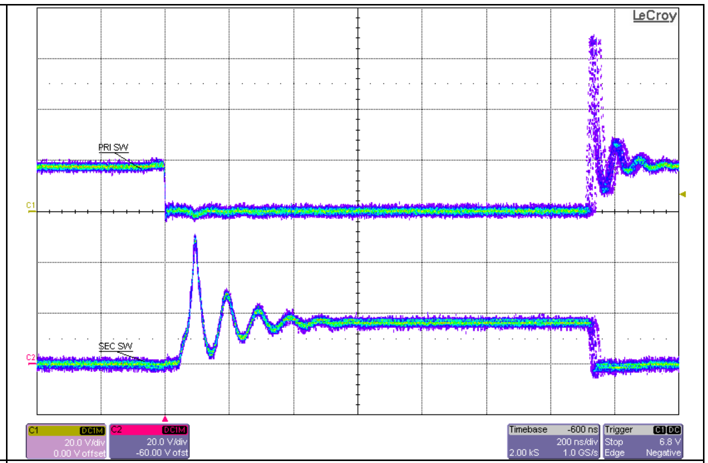

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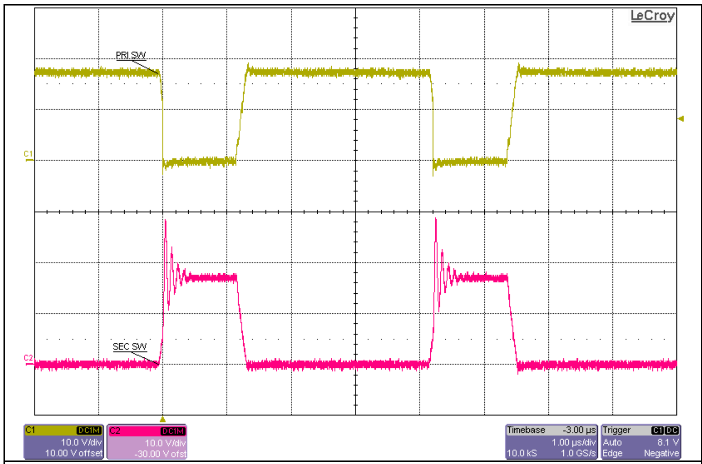
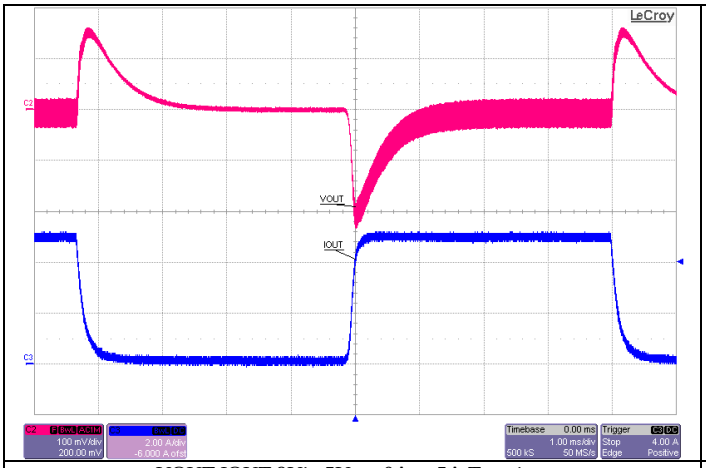


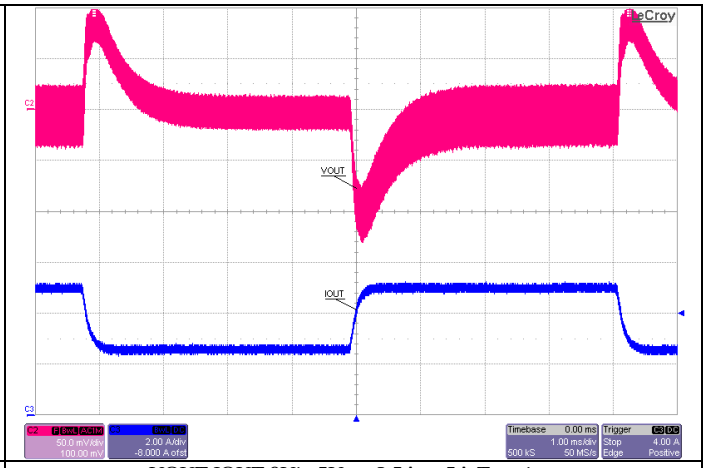
PRISW SECSW Switching 12Vin 0A Load

8 Load Transient Response

8.1 9V Input

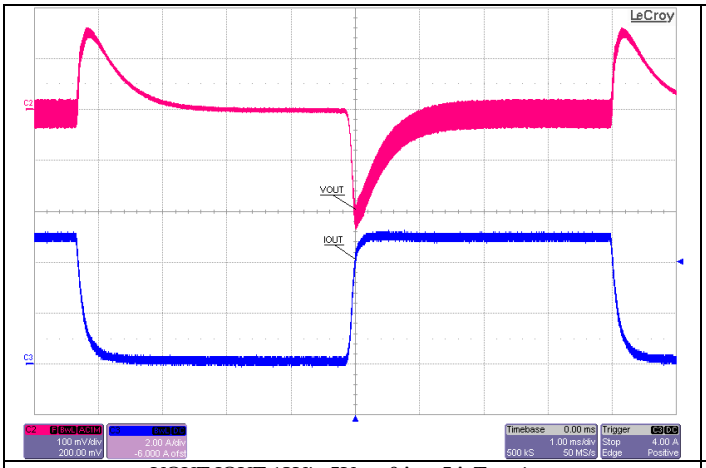


VOUT IOUT 9Vin 5Vout 0A to 5A Transient

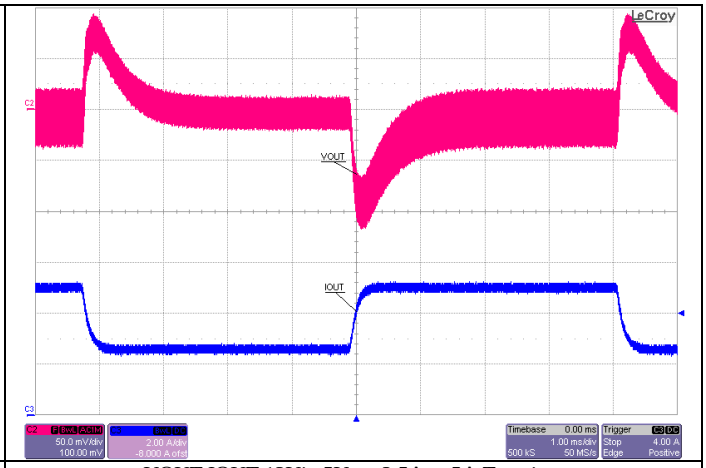


VOUT IOUT 9Vin 5Vout 2.5A to 5A Transient

8.2 12V Input

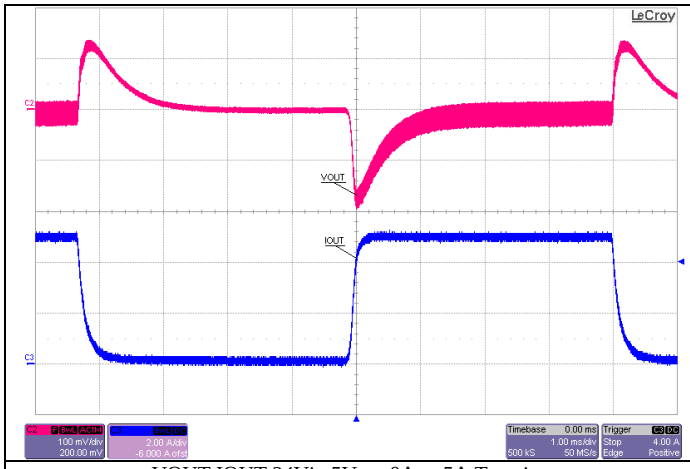


VOUT IOUT 12Vin 5Vout 0A to 5A Transient

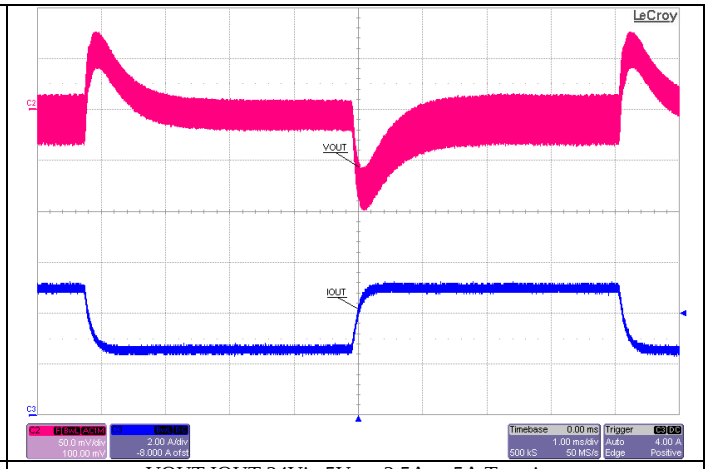


VOUT IOUT 12Vin 5Vout 2.5A to 5A Transient

8.3 24V Input

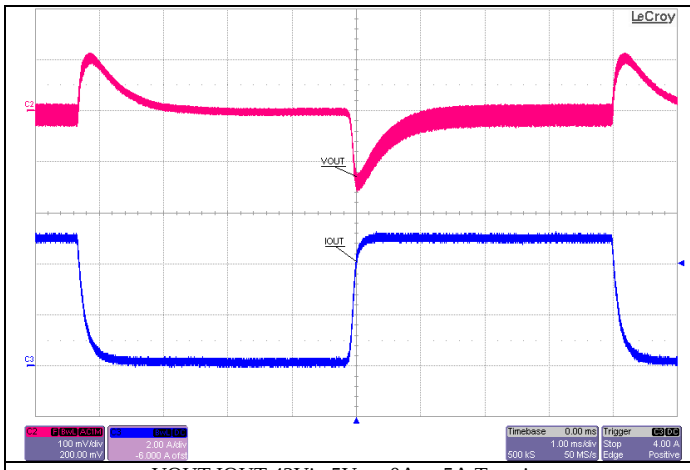


VOUT IOUT 24Vin 5Vout 0A to 5A Transient

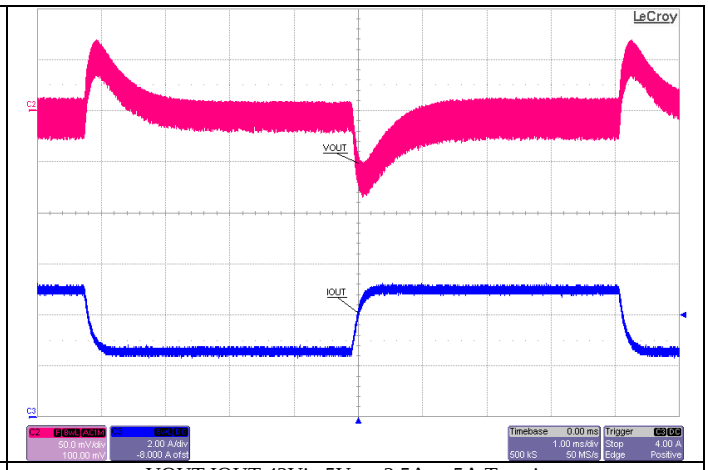


VOUT IOUT 24Vin 5Vout 2.5A to 5A Transient

8.4 42V Input



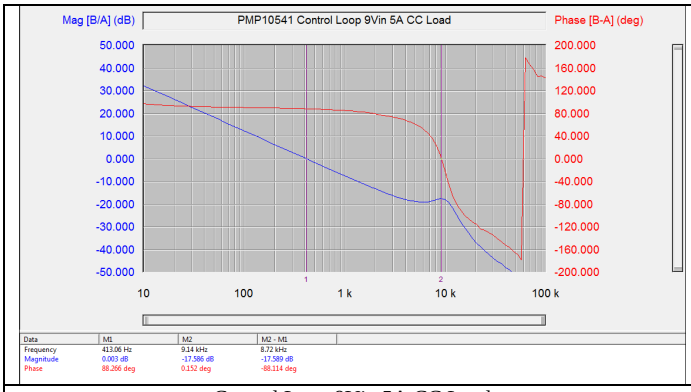
VOUT IOUT 42Vin 5Vout 0A to 5A Transient



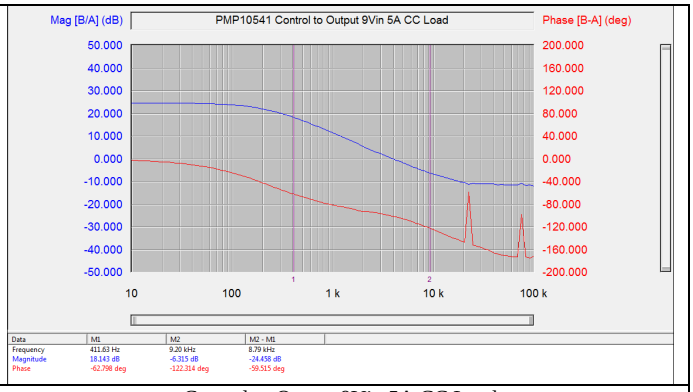
VOUT IOUT 42Vin 5Vout 2.5A to 5A Transient

9 Control Loop Frequency Response

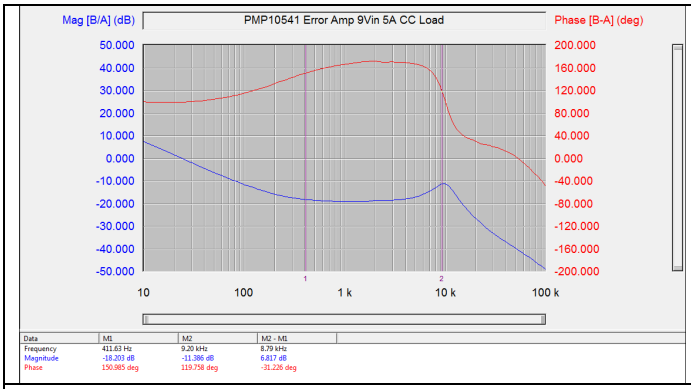
9.1 9V Input, 5A Load



Control Loop 9Vin 5A CC Load

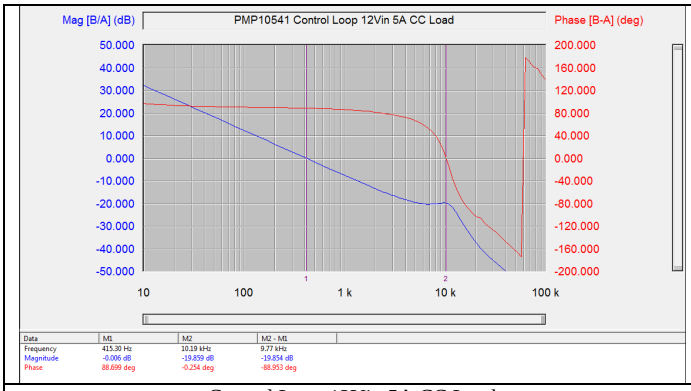


Control to Output 9Vin 5A CC Load

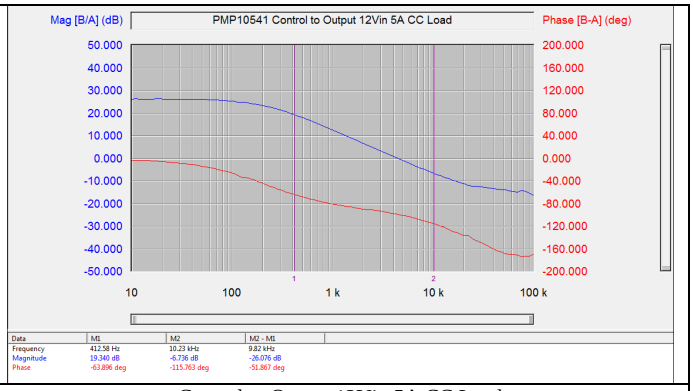


Error Amp 9Vin 5A CC Load

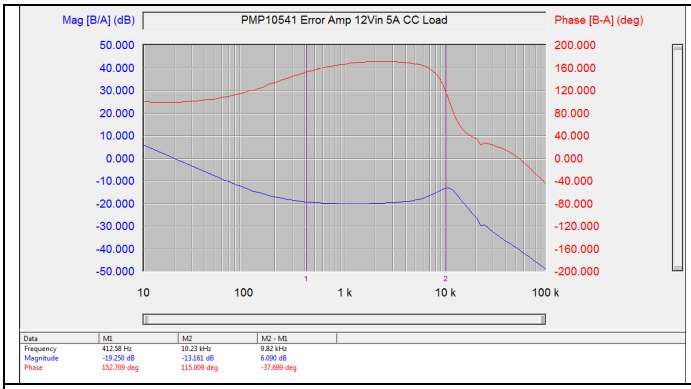
9.2 12V Input, 5A Load



Control Loop 12Vin 5A CC Load

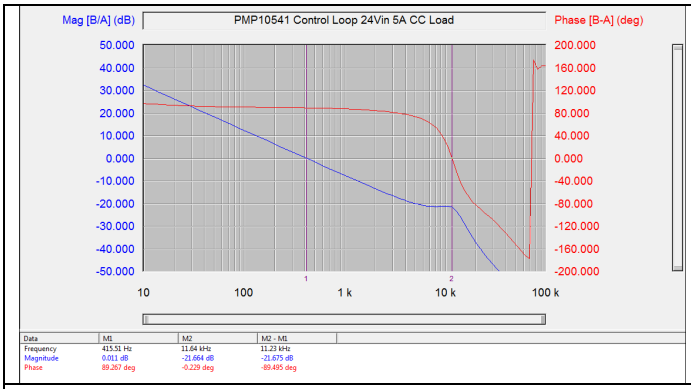


Control to Output 12Vin 5A CC Load

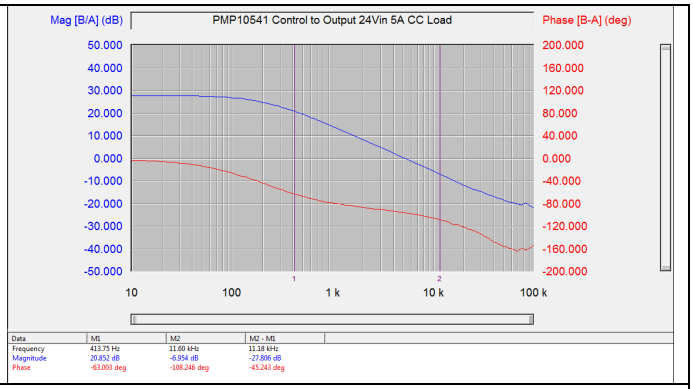


Error Amp 12Vin 5A CC Load

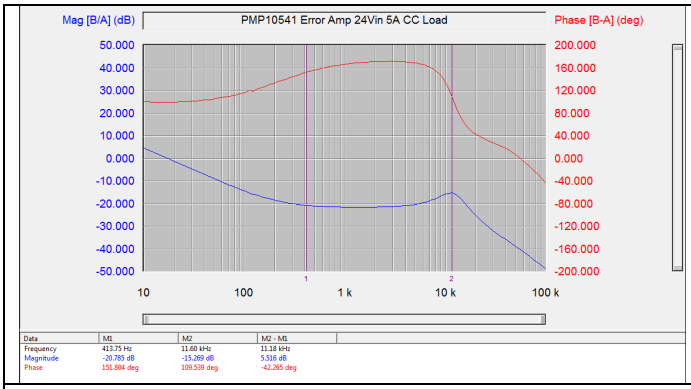
9.3 24V Input, 5A Load



Control Loop 24Vin 5A CC Load

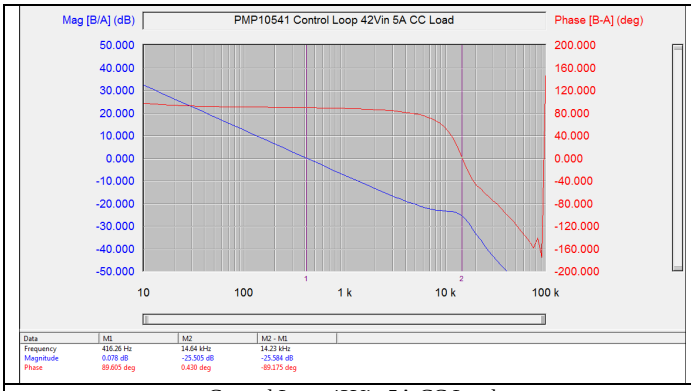


Control to Output 24Vin 5A CC Load

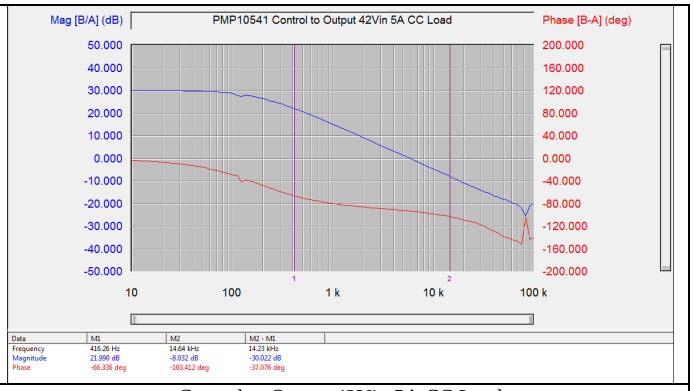


Error Amp 24Vin 5A CC Load

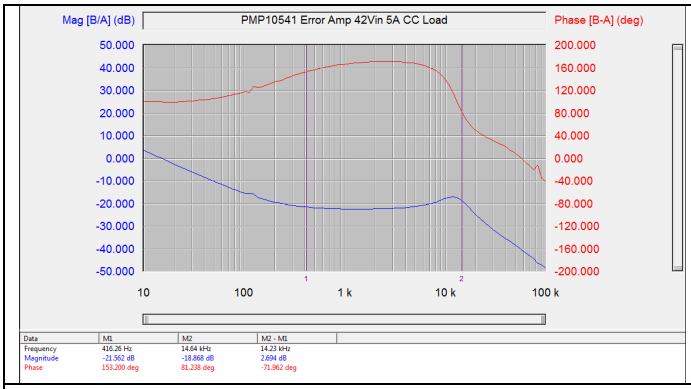
9.4 42V Input, 5A Load



Control Loop 42Vin 5A CC Load

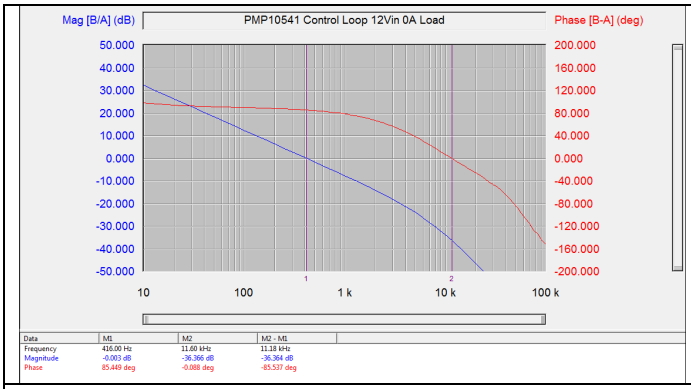


Control to Output 42Vin 5A CC Load

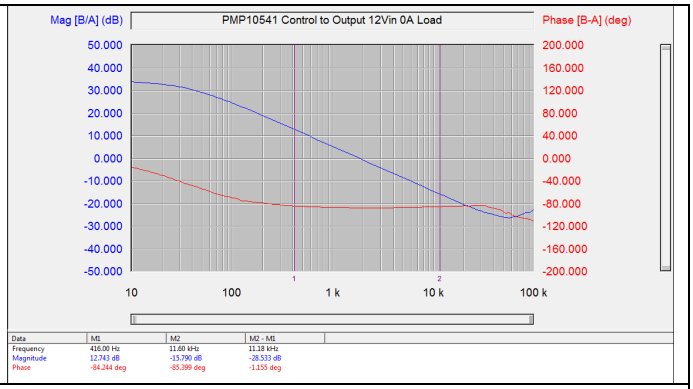


Error Amp 42Vin 5A CC Load

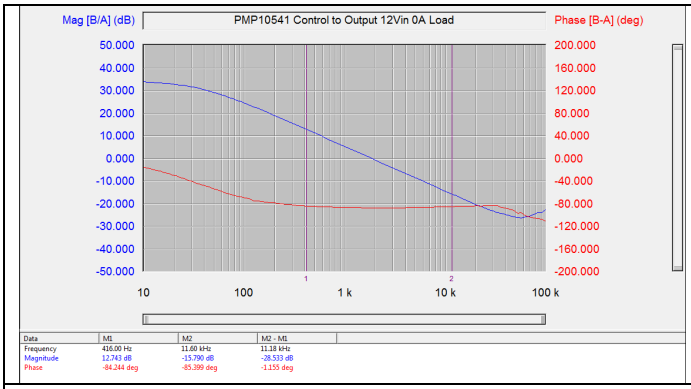
9.5 12V Input, 0A Load



Control Loop 12Vin 0A Load



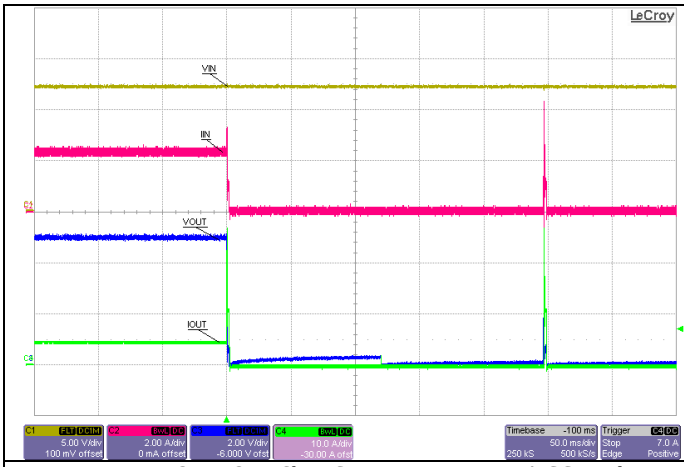
Control to Output 12Vin 0A Load



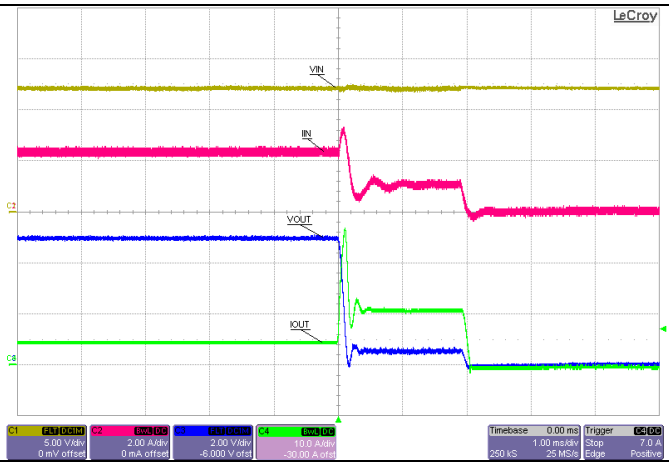
Error Amp 12Vin 0A Load

10 Short Circuit Tests

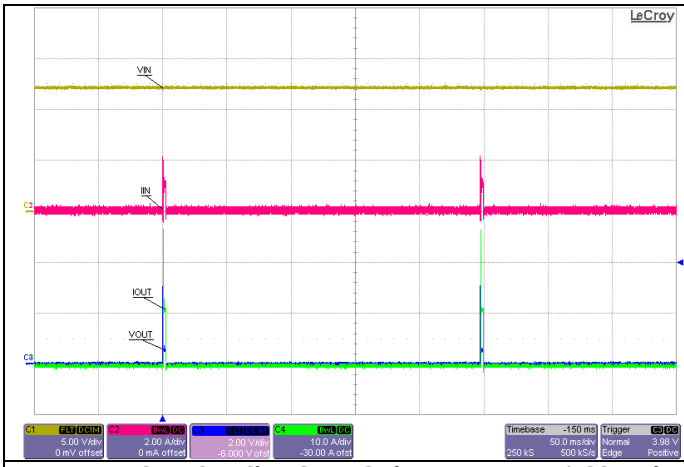
10.1 Output Short Circuit



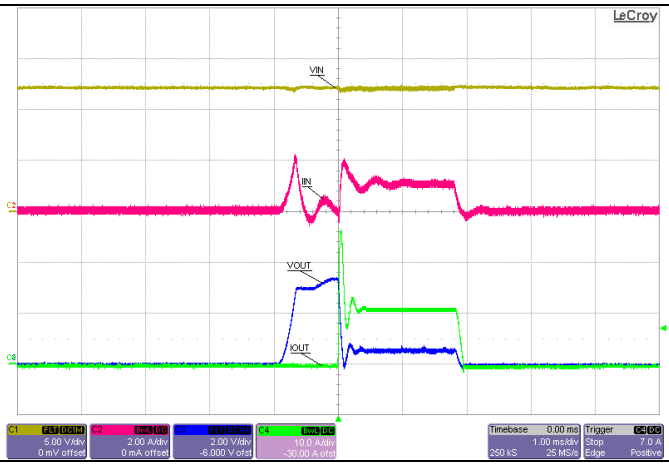
VIN IIN VOUT IOUT Short Circuit 12Vin 5Vout 5A CC Load



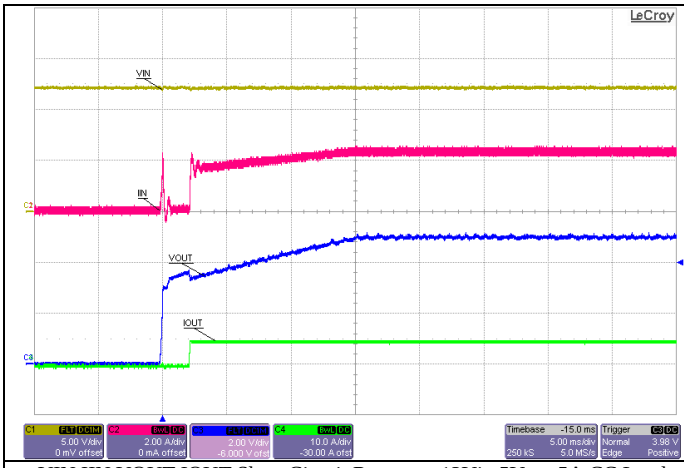
VIN IIN VOUT IOUT Short Circuit 12Vin 5Vout 5A CC Load



VIN IIN VOUT IOUT Short Circuit Cycling 12Vin 5Vout 5A CC Load



VIN IIN VOUT IOUT Short Circuit Cycling 12Vin 5Vout 5A CC Load



VIN IIN VOUT IOUT Short Circuit Recovery 12Vin 5Vout 5A CC Load

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