LM5141-Q1 Synchronous Buck Converter

LM3481 Boost Converter

TI reference design number: PMP20818 REV A

Buck:
Input: 13V to 50V DC
Output: 11V @ 12.5A

Boost:
Input: 12V DC
Output: 50V @ 50mA

DC – DC Test Results

Table of Contents

Created on: 4/20/2017

PMP20818 Test Results

Test Specifications

LM5141-Q1 Buck Converter

Vin min	**13V**
Vin max	**50V**
Vout	**11V**
Iout	**12.5A**

LM3481 Boost Converter

Vin	**12V**
Vout	**50V**
Iout	**50mA**

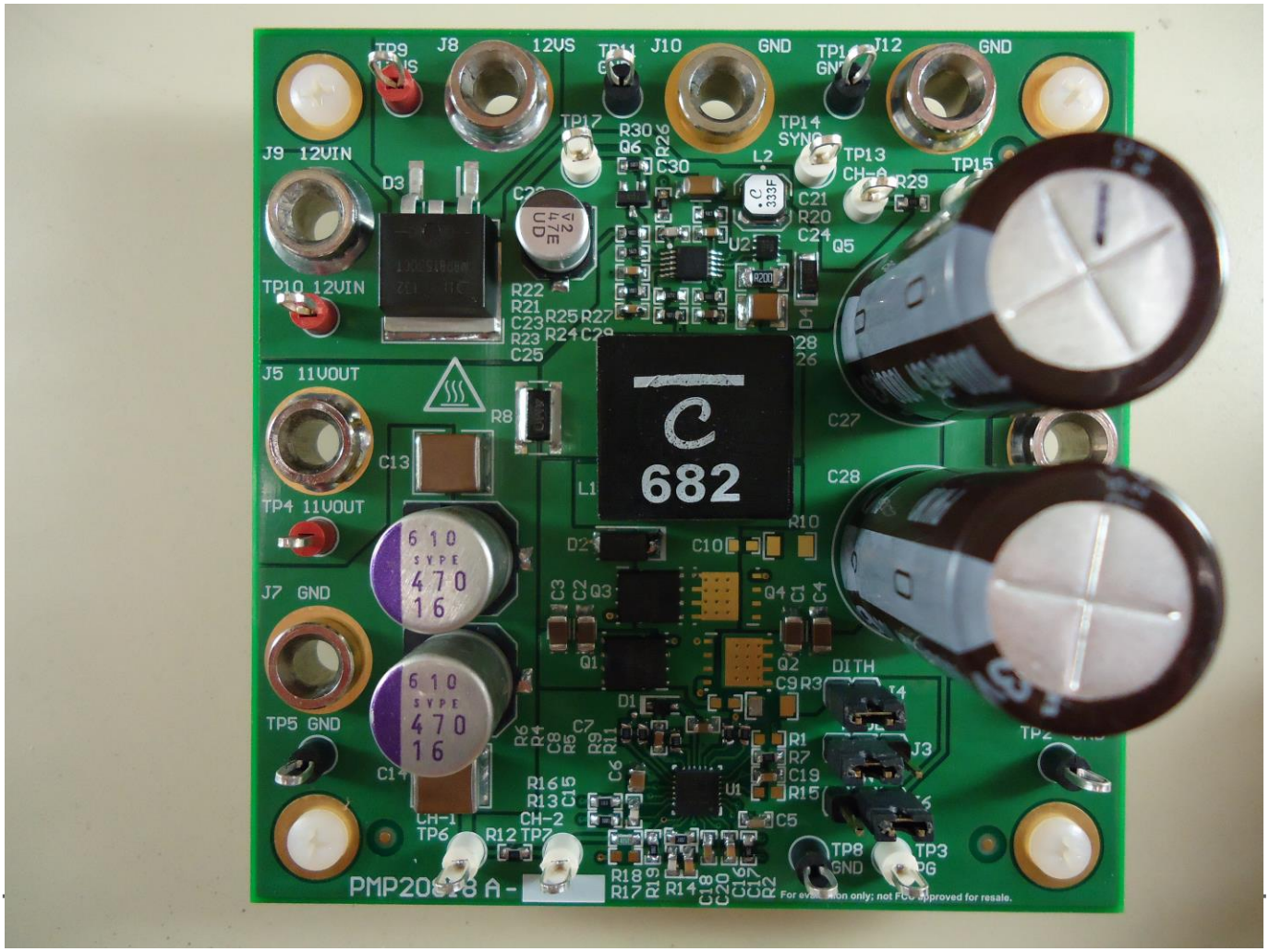
Circuit Description

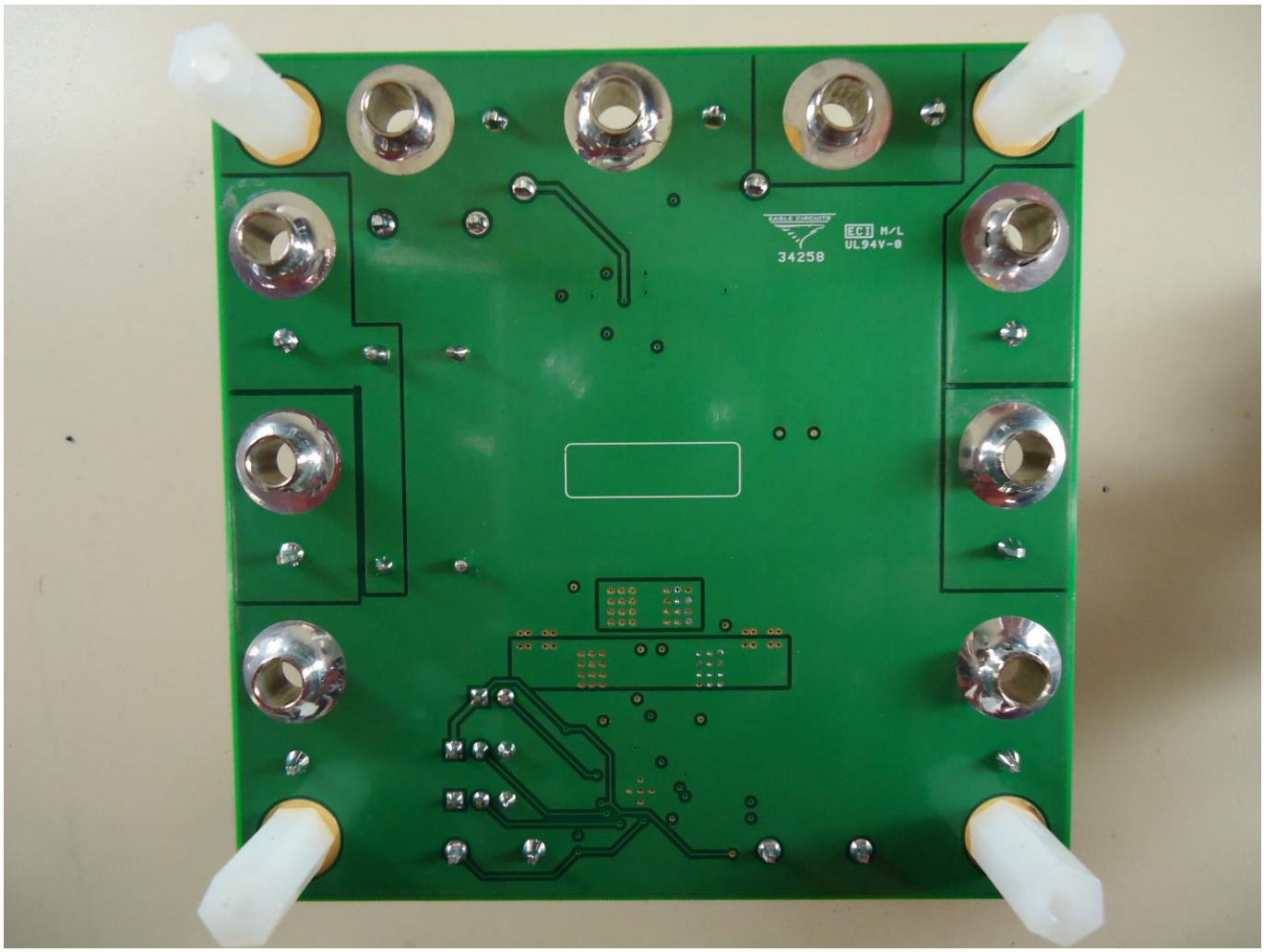
PMP20818 is a holdup circuit that uses the LM3481 non-synchronous boost and LM5141-Q1 synchronous buck controllers. When the 12V input supply is available, the buck converter is disabled, and the boost converter charges a capacitive holdup bank. In the event of a power outage, the boost converter is disabled, and the buck converter is enabled to hold up the 12V input rail for 15ms with a load of 12.5A.

For the buck only test, the boost output capacitors are jumper connected to the buck input for input filter damping.

Board Photos

The design is built on PMP20818 RevA 4-layer printed circuit board. PCB dimensions are 3.2 in. x 3.2 in.




34258
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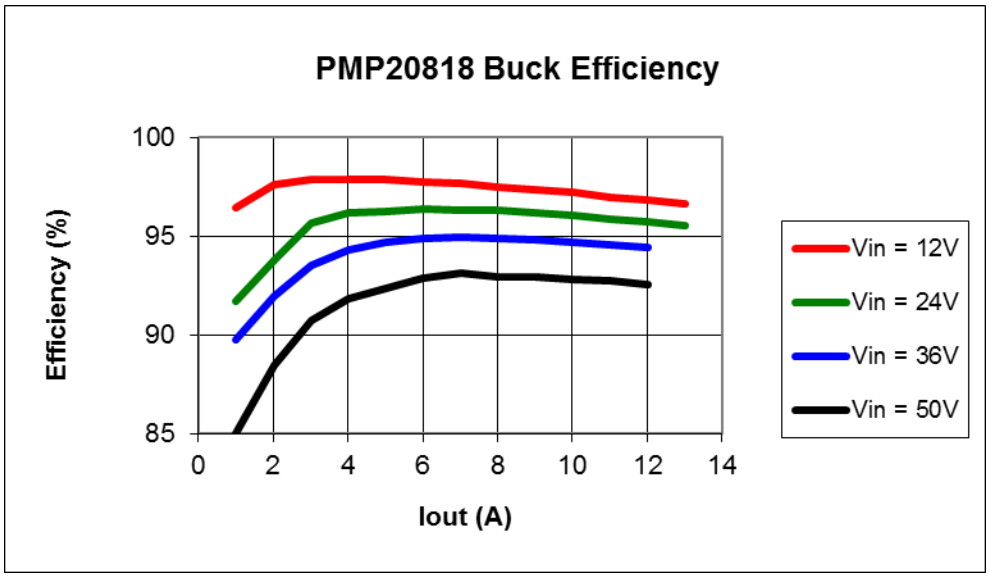
UL94V-0

LM5141-Q1 Synchronous Buck Converter

1 Efficiency

1.1 Output Efficiency Results



1.2 Output Efficiency Data

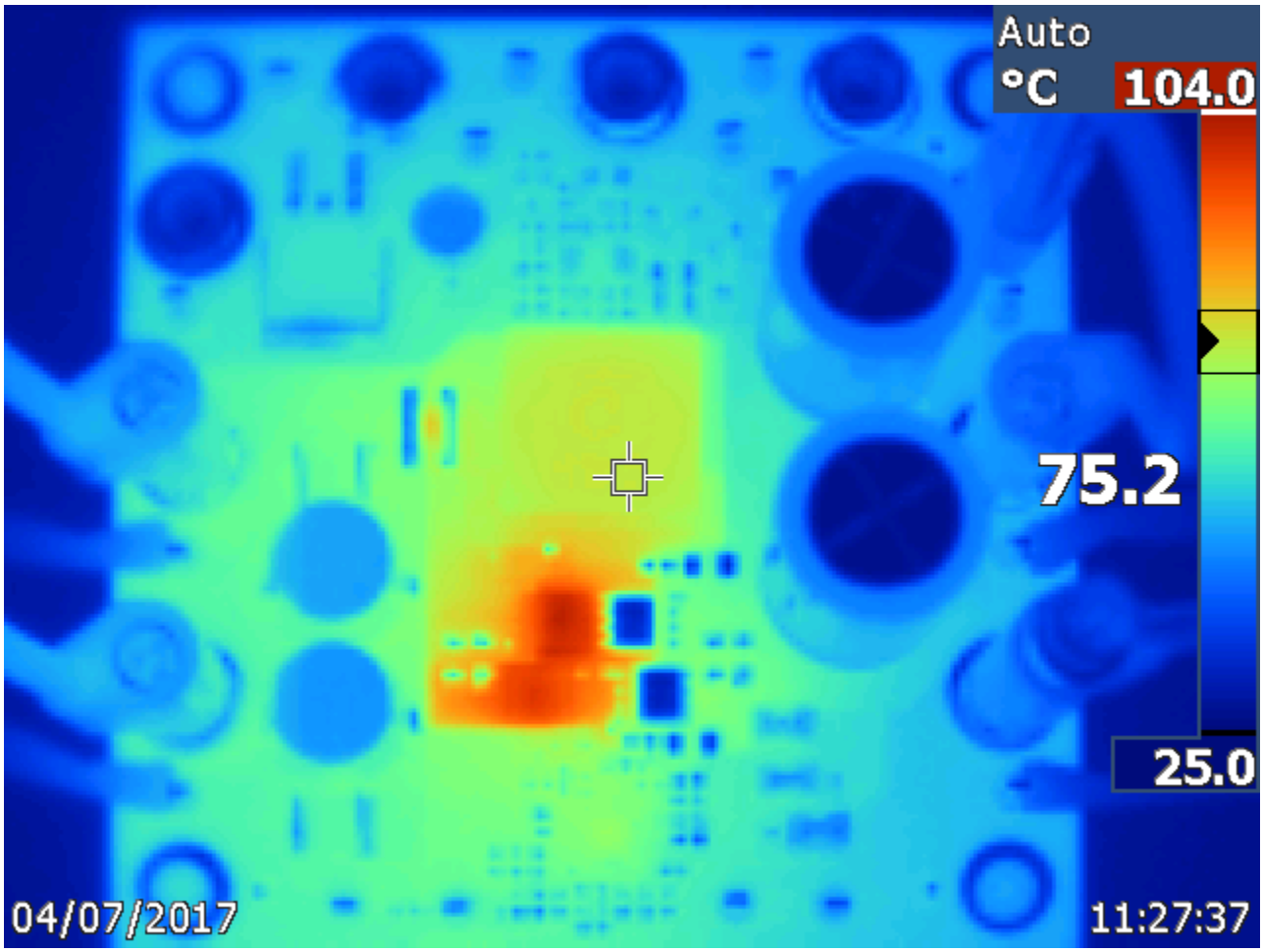
Vin(V)	Iin(A)	Vout(V)	Iout(A)	Pin(W)	Pout(W)	Loss(W)	Efficiency
12.0061	0.0060	11.1736	-0.0040	0.072	-0.045	0.117	-62.04
12.0057	0.9560	11.1221	0.9920	11.477	11.033	0.444	96.13
12.0054	1.9220	11.1231	2.0220	23.074	22.491	0.584	97.47
12.0053	2.8620	11.1264	3.0200	34.359	33.602	0.757	97.80
12.0053	3.8060	11.1202	4.0200	45.692	44.703	0.989	97.84
12.0054	4.7500	11.1101	5.0200	57.026	55.772	1.253	97.80
12.0050	5.7000	11.1072	6.0180	68.429	66.843	1.585	97.68
12.0050	6.6560	11.1118	7.0200	79.906	78.005	1.901	97.62
12.0049	7.6200	11.1153	8.0200	91.477	89.145	2.333	97.45
12.0050	8.5820	11.1126	9.0200	103.027	100.236	2.792	97.29
12.0050	9.5440	11.1042	10.0200	114.576	111.264	3.312	97.11
12.0048	10.5100	11.0967	11.0200	126.170	122.286	3.885	96.92
12.0047	11.4840	11.0962	12.0200	137.861	133.377	4.485	96.75
11.9407	11.3500	9.9131	13.0200	135.527	129.069	6.458	95.24
11.9931	2.4080	2.6056	7.0320	28.879	18.322	10.557	63.44
24.0137	0.0060	11.1547	-0.0040	0.144	-0.045	0.189	-30.97

24.0024	0.5020	11.1424	0.9920	12.049	11.053	0.996	91.73
24.0105	0.9900	11.1082	2.0200	23.770	22.439	1.332	94.40
24.0123	1.4600	11.1103	3.0180	35.058	33.531	1.527	95.64
24.0115	1.9360	11.1243	4.0200	46.486	44.720	1.767	96.20
24.0102	2.4160	11.1279	5.0200	58.009	55.862	2.147	96.30
24.0088	2.8920	11.1216	6.0200	69.433	66.952	2.481	96.43
24.0070	3.3720	11.1073	7.0200	80.951	77.973	2.978	96.32
24.0058	3.8500	11.0915	8.0200	92.422	88.954	3.468	96.25
24.0036	4.3300	11.0799	9.0200	103.935	99.941	3.995	96.16
24.0011	4.8140	11.0758	10.0200	115.541	110.980	4.562	96.05
23.9985	5.3040	11.0777	11.0200	127.288	122.076	5.212	95.91
23.9959	5.7980	11.0822	12.0180	139.128	133.186	5.942	95.73
23.9931	6.2960	11.0852	13.0200	151.061	144.329	6.732	95.54
23.9848	0.6840	1.6339	5.2160	16.406	8.522	7.883	51.95
36.0102	0.0060	11.1581	-0.0040	0.216	-0.045	0.261	-20.66
36.0046	0.3420	11.1335	0.9940	12.314	11.067	1.247	89.87
36.0091	0.6760	11.1022	2.0180	24.342	22.404	1.938	92.04
36.0074	0.9940	11.1008	3.0180	35.791	33.502	2.289	93.60
36.0056	1.3140	11.1135	4.0200	47.311	44.676	2.635	94.43
36.0033	1.6380	11.1244	5.0200	58.973	55.844	3.129	94.69
36.0000	1.9600	11.1256	6.0180	70.560	66.954	3.606	94.89
35.9966	2.2820	11.1164	7.0180	82.144	78.015	4.129	94.97
35.9926	2.6040	11.1026	8.0180	93.725	89.020	4.704	94.98
35.9880	2.9280	11.0892	9.0180	105.373	100.002	5.371	94.90
35.9828	3.2560	11.0787	10.0200	117.160	111.009	6.151	94.75
35.9775	3.5840	11.0725	11.0180	128.943	121.997	6.947	94.61
35.9715	3.9180	11.0714	12.0180	140.936	133.056	7.881	94.41
35.9654	0.4260	1.8534	4.7920	15.321	8.881	6.440	57.97
35.9763	0.3460	1.7033	3.6420	12.448	6.203	6.244	49.83
50.0184	0.0080	11.1474	-0.0040	0.400	-0.045	0.445	-11.14
50.0159	0.2620	11.1433	0.9940	13.104	11.076	2.028	84.53
50.0158	0.5060	11.1068	2.0200	25.308	22.436	2.872	88.65
50.0125	0.7380	11.1080	3.0180	36.909	33.524	3.385	90.83
50.0084	0.9740	11.1230	4.0200	48.708	44.714	3.994	91.80
50.0030	1.2080	11.1304	5.0200	60.404	55.874	4.529	92.50
49.9963	1.4440	11.1270	6.0180	72.195	66.962	5.233	92.75
49.9890	1.6780	11.1125	7.0180	83.881	77.988	5.894	92.97
49.9804	1.9120	11.0957	8.0180	95.562	88.966	6.597	93.10
49.9708	2.1500	11.0857	9.0180	107.437	99.971	7.467	93.05

49.9615	2.3920	11.0838	10.0180	119.508	111.038	8.470	92.91
49.9514	2.6360	11.0882	11.0180	131.672	122.169	9.503	92.78
49.9410	2.8820	11.0957	12.0160	143.930	133.326	10.604	92.63
49.9314	3.1300	11.1016	13.0160	156.285	144.499	11.787	92.46
49.9738	0.4380	1.9598	5.3960	21.889	10.575	11.314	48.31

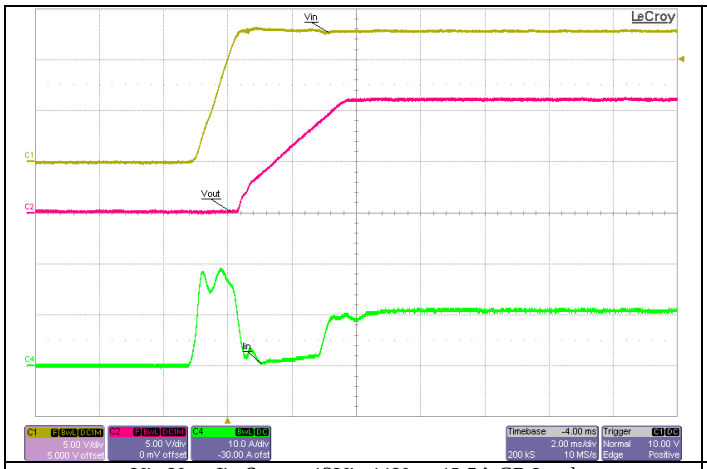
2 Thermal

2.1 24V Input, 11V Output at 13A Load

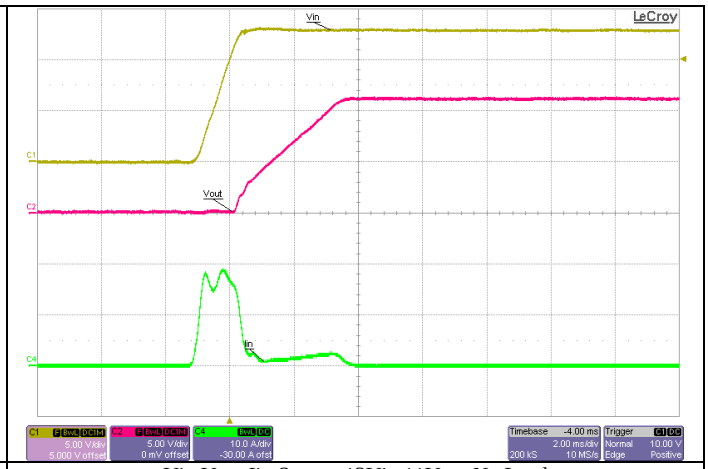


3 Startup

3.1 Startup from 13V Input

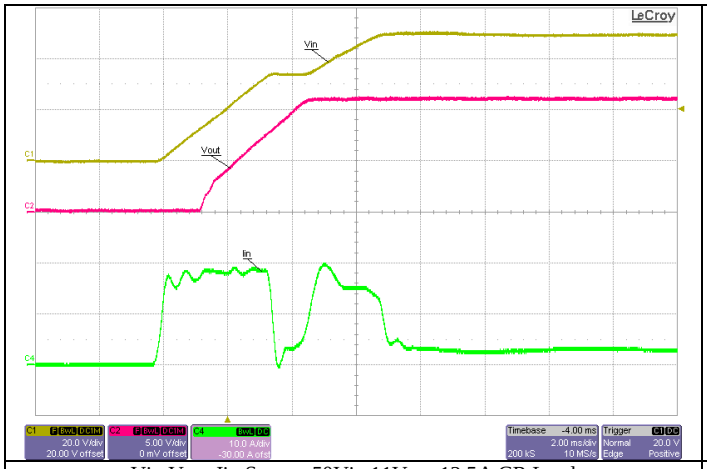


Vin Vout Iin Startup 13Vin 11Vout 12.5A CR Load

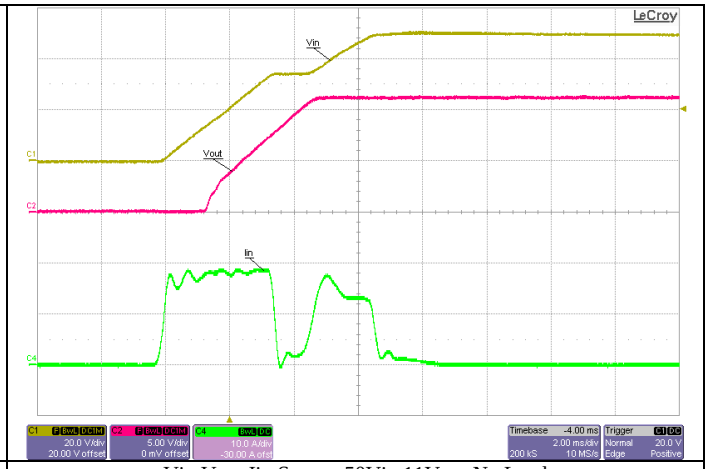


Vin Vout Iin Startup 13Vin 11Vout No Load

3.2 Startup from 50V Input



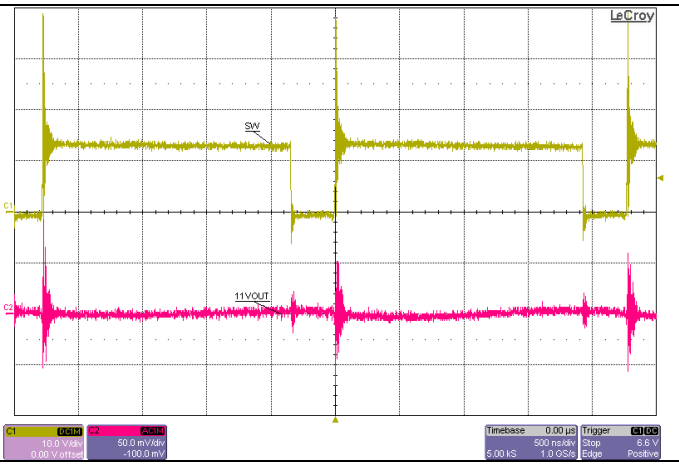
Vin Vout Iin Startup 50Vin 11Vout 12.5A CR Load



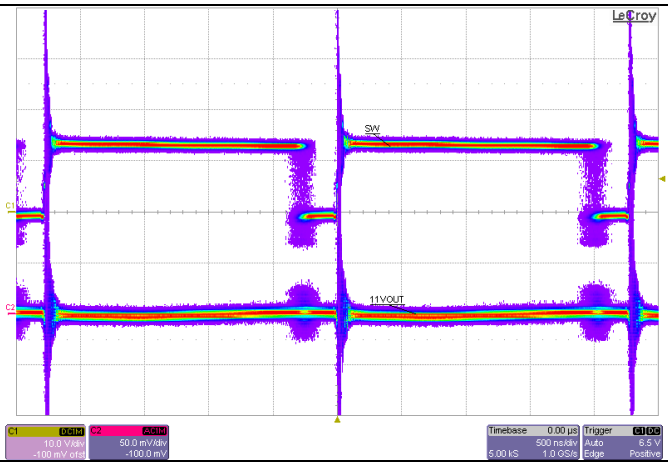
Vin Vout Iin Startup 50Vin 11Vout No Load

4 Switch Node and Output Ripple Waveform

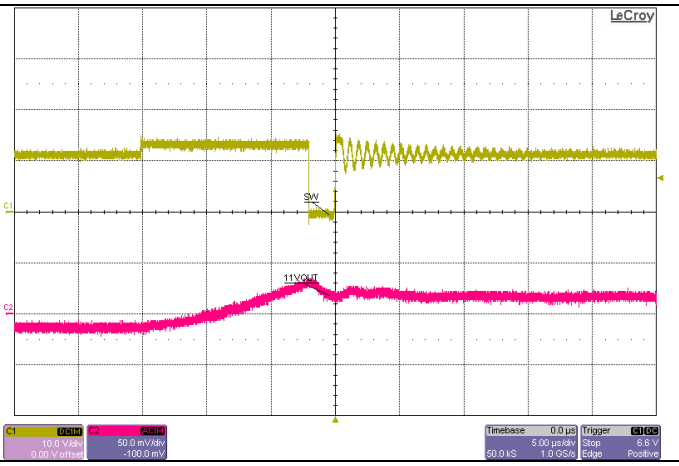
4.1 13V Input



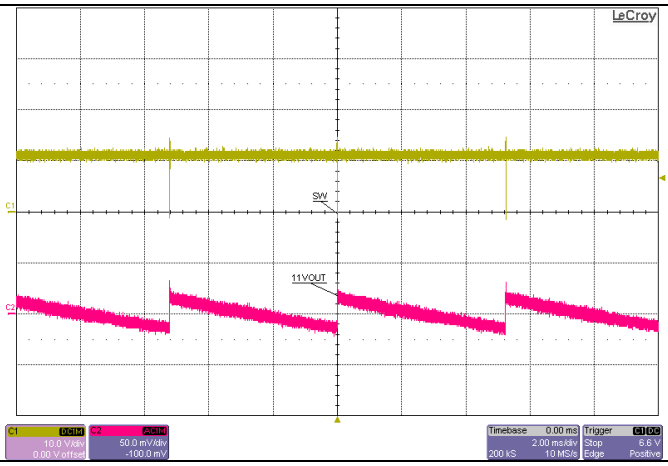
SW VOUT 13Vin 11Vout 12.5A CC Load



SW VOUT 13Vin 11Vout 12.5A CC Load (persistence on)

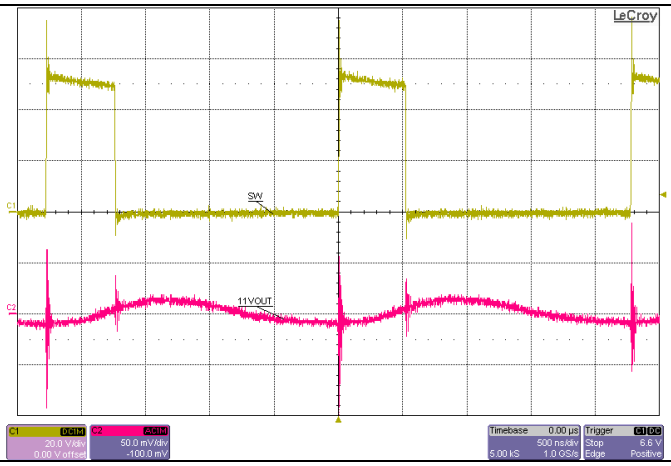


SW VOUT 13Vin 11Vout No Load Zoomed In

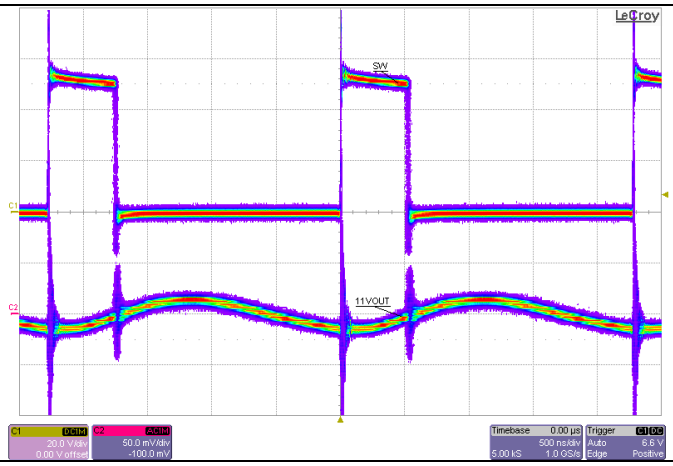


SW VOUT 13Vin 11Vout No Load Zoomed Out

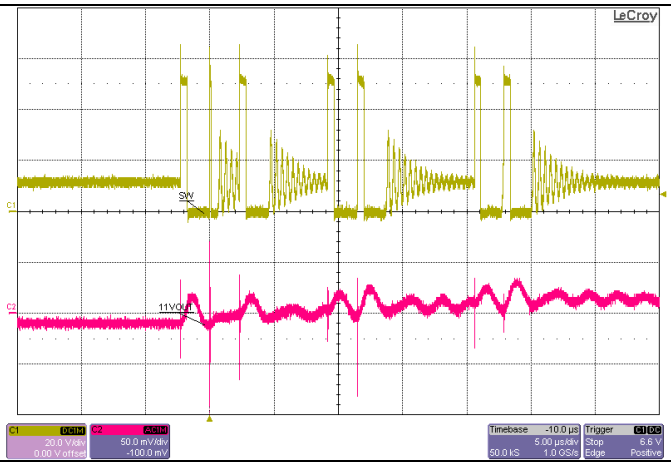
4.2 50V Input



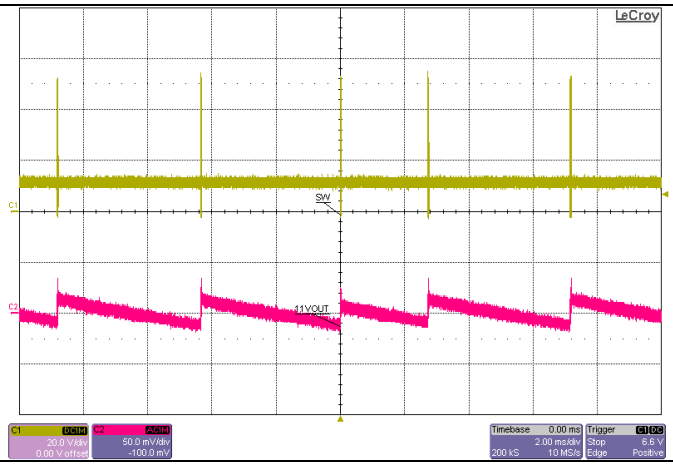
SW VOUT 50Vin 11Vout 12.5A CC



SW VOUT 50Vin 11Vout 12.5A CC Load (persistence on)



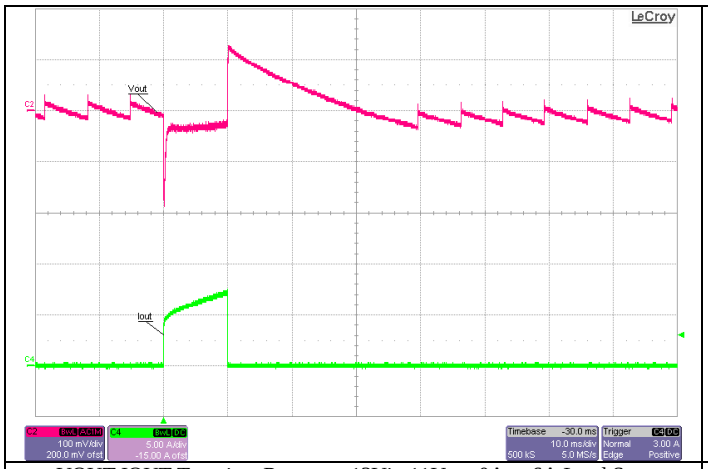
SW VOUT 50Vin 11Vout No Load Zoomed In



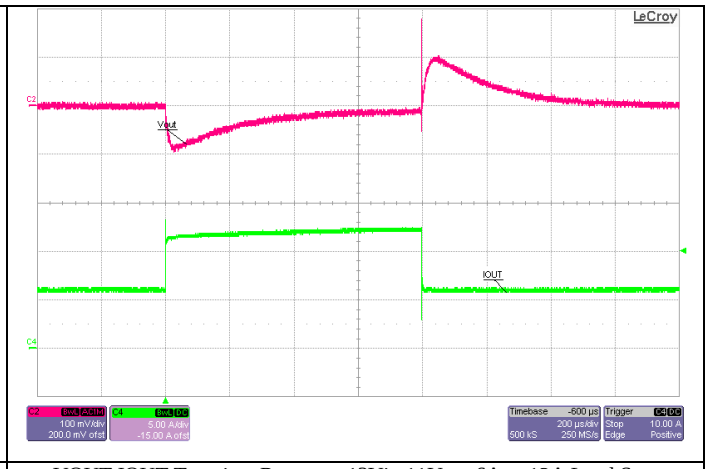
SW VOUT 50Vin 11Vout No Load Zoomed Out

5 Load Transient Response

5.1 13V Input

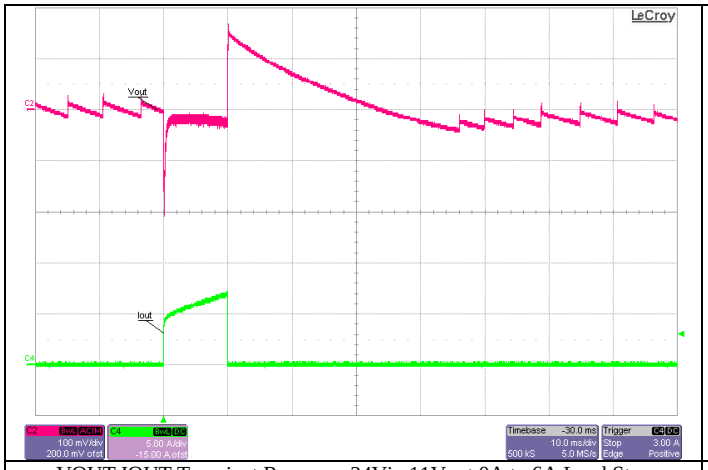


VOUT IOUT Transient Response 13Vin 11Vout 0A to 6A Load Step

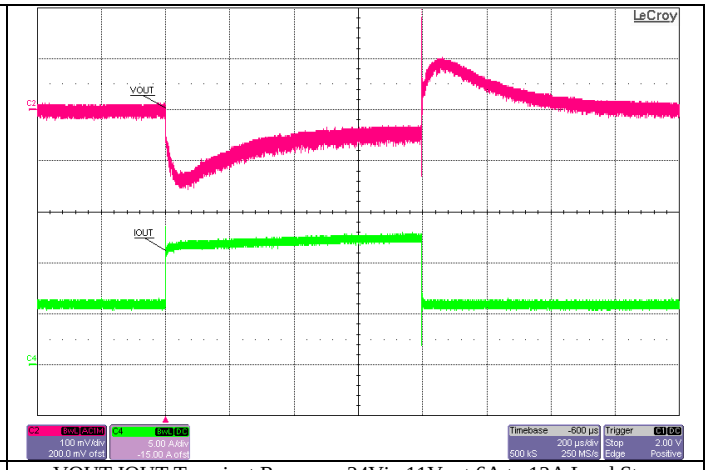


VOUT IOUT Transient Response 13Vin 11Vout 6A to 12A Load Step

5.2 24V Input

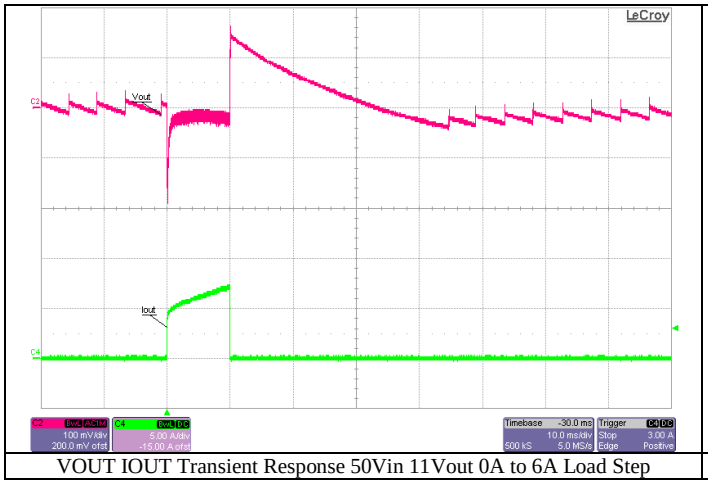


VOUT IOUT Transient Response 24Vin 11Vout 0A to 6A Load Step

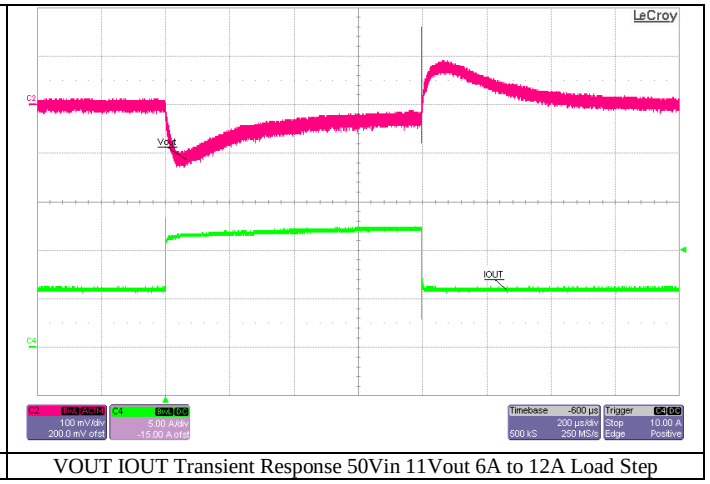


VOUT IOUT Transient Response 24Vin 11Vout 6A to 12A Load Step

5.3 50V Input



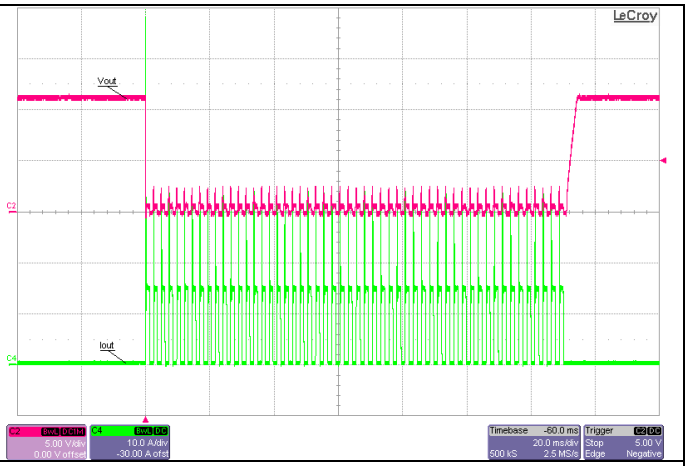
VOUT IOUT Transient Response 50Vin 11Vout 0A to 6A Load Step



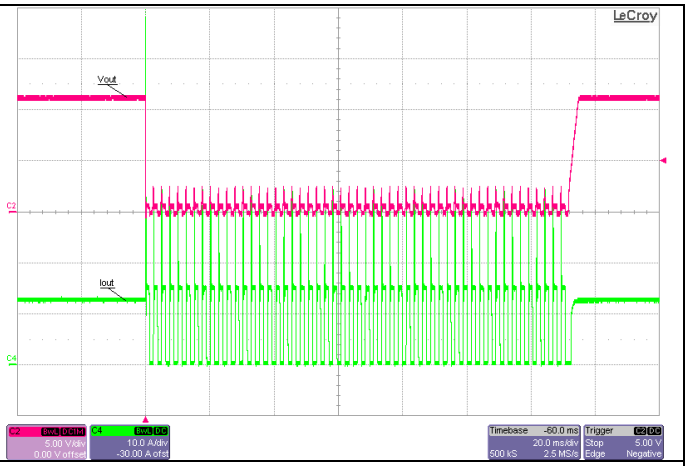
VOUT IOUT Transient Response 50Vin 11Vout 6A to 12A Load Step

6 Short Circuit Tests

6.1 13V Input Short Circuit and Recovery

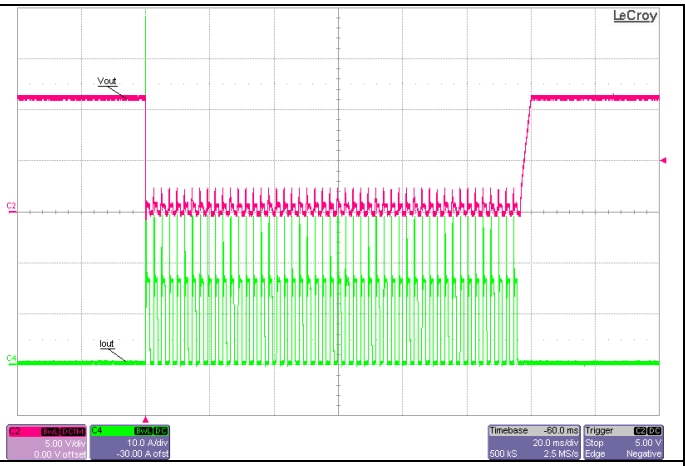


IOUT VOUT Short Circuit 13Vin 11Vout No Load

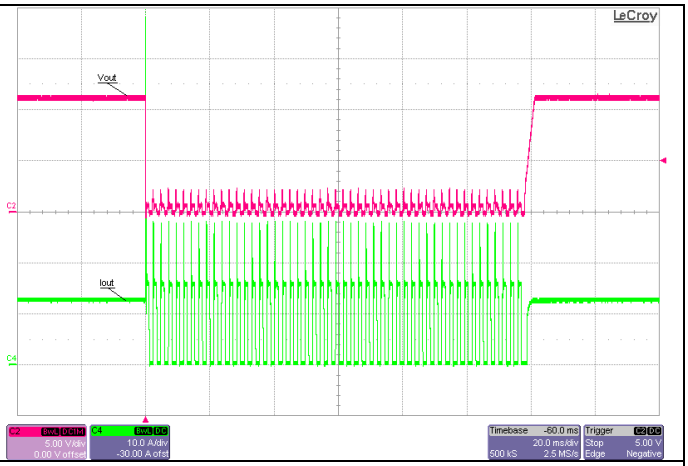


IOUT VOUT 13Vin 11Vout 12.5A CC Load

6.1 50V Input Short Circuit and Recovery



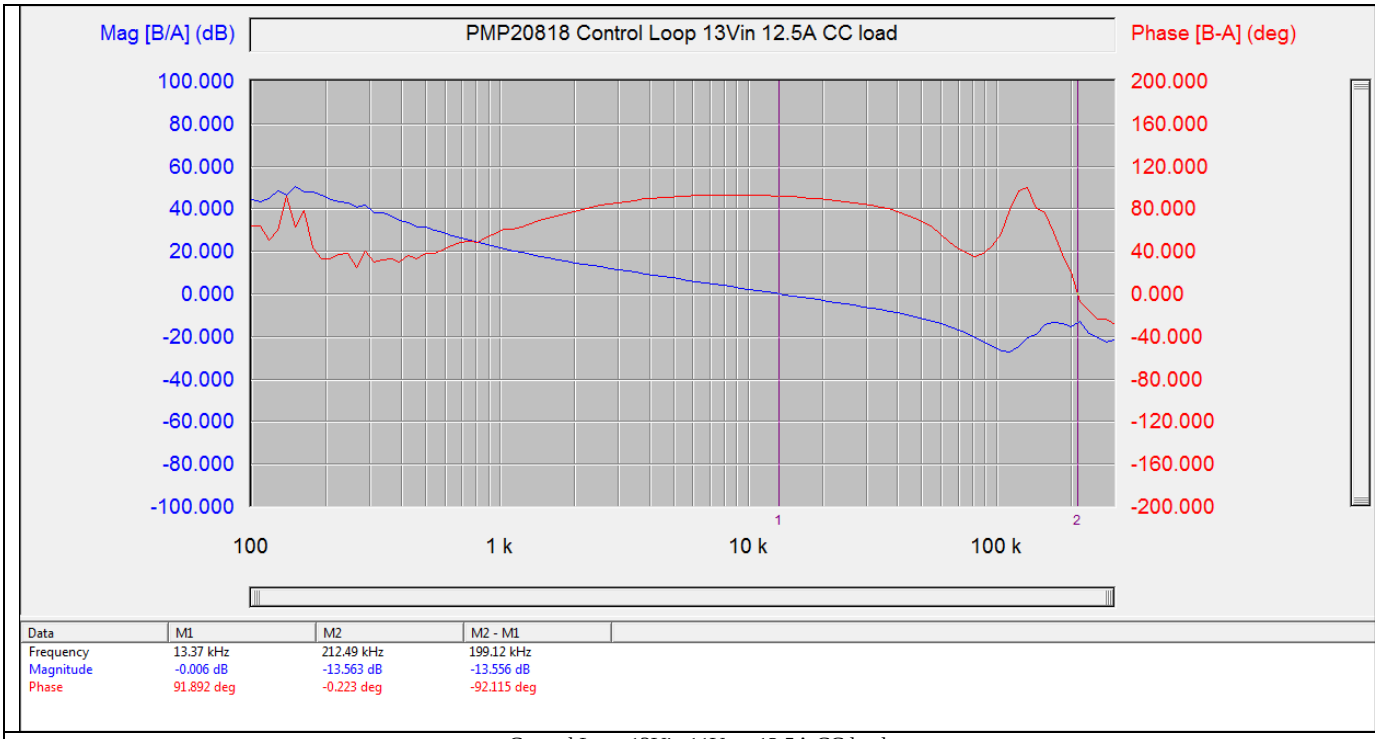
IOUT VOUT 50Vin 11Vout No Load



IOUT VOUT 50Vin 11Vout 12.5A CC Load

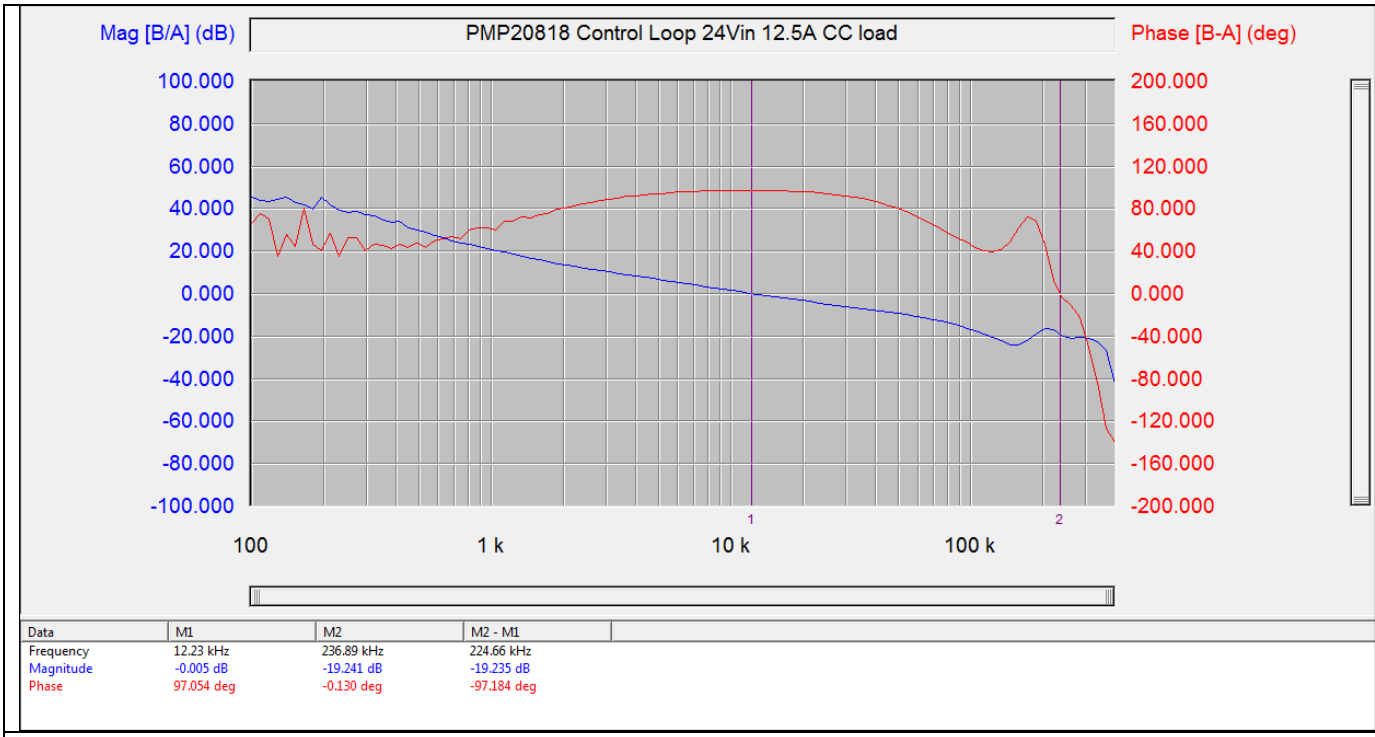
7 Frequency Response

7.1 13V Input



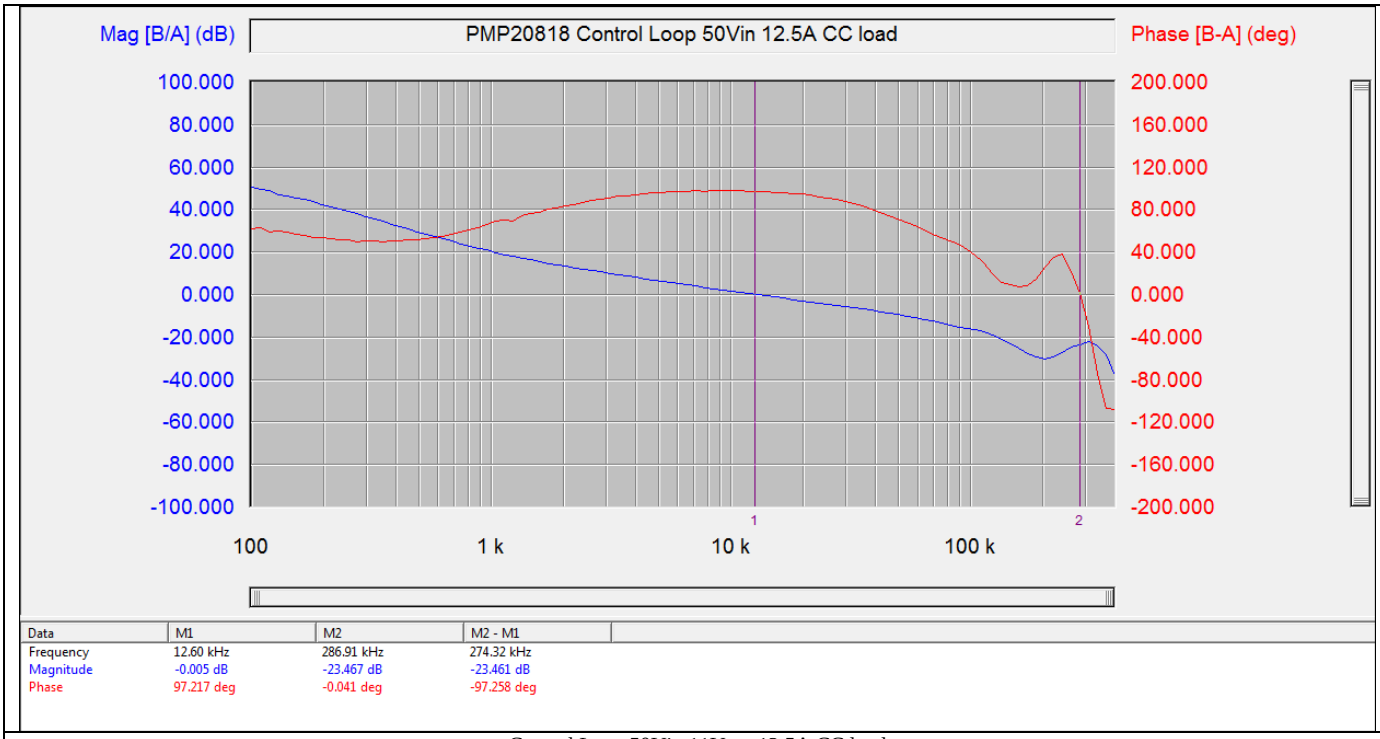
Control Loop 13Vin 11Vout 12.5A CC load

7.2 24V Input



Control Loop 24Vin 11Vout 12.5A CC load

7.3 50V Input

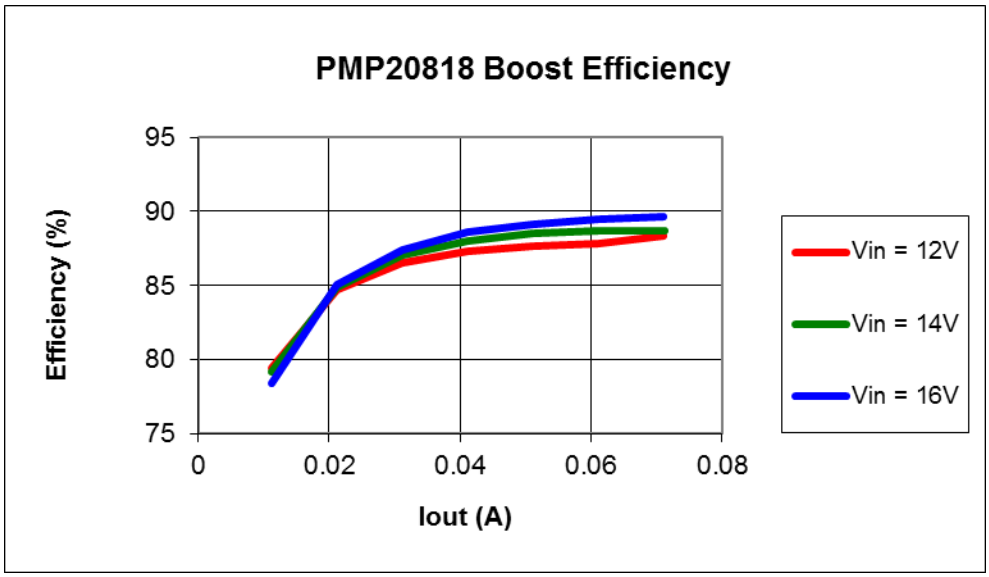


Control Loop 50Vin 11Vout 12.5A CC load

LM3481 Non-Synchronous Boost Converter

8 Efficiency

8.1 Output Efficiency Results



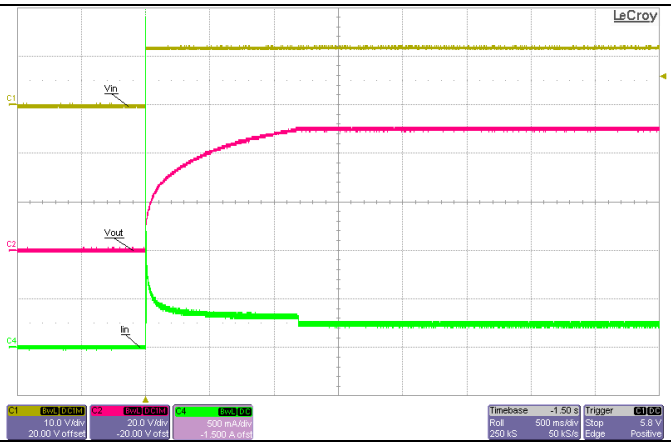
8.2 Output Efficiency Data

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Pin(W)	Pout(W)	Loss(W)	Efficiency
12.0063	0.0098	50.3251	0.0001	0.117	0.006	0.112	4.71
12.0061	0.0586	50.2423	0.0111	0.704	0.559	0.145	79.44
12.0061	0.1044	50.2177	0.0211	1.253	1.062	0.191	84.72
12.0061	0.1503	50.1994	0.0311	1.805	1.562	0.243	86.53
12.0062	0.1968	50.1827	0.0411	2.363	2.064	0.299	87.35
12.0058	0.2437	50.1682	0.0511	2.926	2.564	0.362	87.64
12.0060	0.2907	50.1543	0.0611	3.490	3.065	0.425	87.83
12.0062	0.3317	49.5003	0.0711	3.983	3.520	0.462	88.39
12.0060	0.3342	45.9299	0.0811	4.013	3.726	0.287	92.85
12.0062	0.3366	42.6058	0.0911	4.042	3.881	0.161	96.01
12.0060	0.3391	39.5768	0.1011	4.071	4.000	0.071	98.26
14.0064	0.0082	50.3275	0.0001	0.115	0.005	0.111	3.92
14.0064	0.0506	50.2502	0.0112	0.708	0.561	0.148	79.17
14.0064	0.0893	50.2250	0.0212	1.251	1.062	0.189	84.92
14.0065	0.1282	50.2072	0.0311	1.796	1.563	0.233	87.04
14.0065	0.1675	50.1919	0.0411	2.345	2.065	0.280	88.04
14.0065	0.2069	50.1775	0.0511	2.898	2.565	0.333	88.51

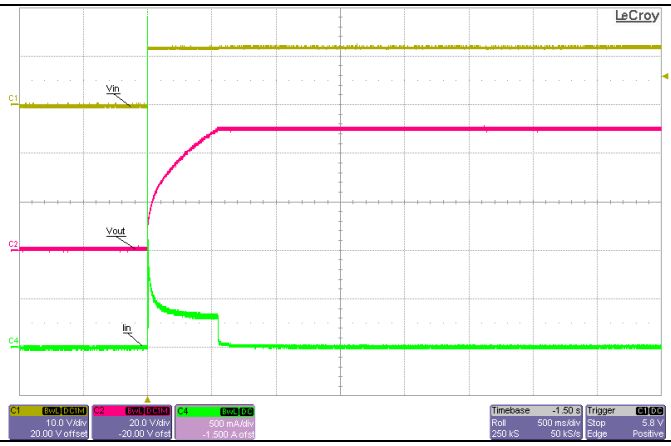
14.0064	0.2468	50.1662	0.0611	3.456	3.066	0.390	88.72
14.0064	0.2872	50.1523	0.0711	4.023	3.567	0.455	88.68
14.0064	0.2785	44.9889	0.0811	3.900	3.649	0.251	93.56
14.0063	0.2165	35.3833	0.0910	3.032	3.221	-0.189	106.22
14.0061	0.2127	29.9232	0.1010	2.979	3.023	-0.045	101.50
16.0057	0.1091	50.3270	0.0002	1.746	0.010	1.736	0.55
16.0054	0.0447	50.2556	0.0112	0.715	0.560	0.155	78.37
16.0054	0.0780	50.2314	0.0211	1.249	1.062	0.187	85.03
16.0054	0.1117	50.2135	0.0311	1.788	1.563	0.225	87.40
16.0053	0.1456	50.1994	0.0411	2.331	2.065	0.266	88.59
16.0054	0.1797	50.1862	0.0511	2.876	2.565	0.312	89.17
16.0057	0.2142	50.1744	0.0611	3.428	3.066	0.362	89.44
16.0054	0.2487	50.1645	0.0711	3.981	3.568	0.413	89.62
16.0053	0.1336	32.0426	0.0810	2.139	2.596	-0.457	121.37
16.0053	0.1423	25.9138	0.0910	2.277	2.359	-0.082	103.58
16.0052	0.1518	23.6914	0.1010	2.429	2.394	0.035	98.55

9 Startup

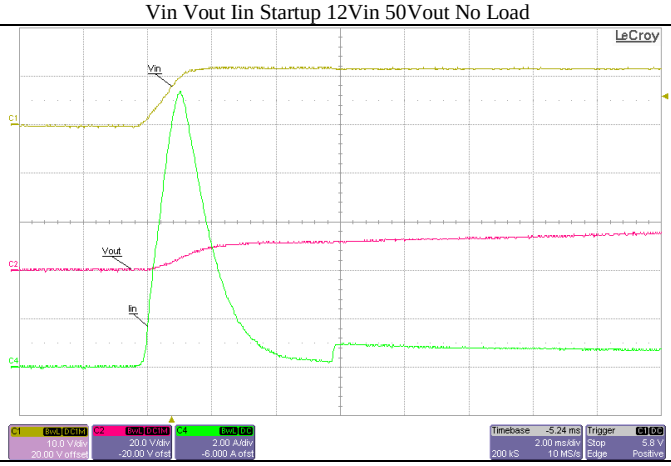
9.1 Startup from 12V Input



Vin Vout Iin Startup 12Vin 50Vout 50mA CC Load



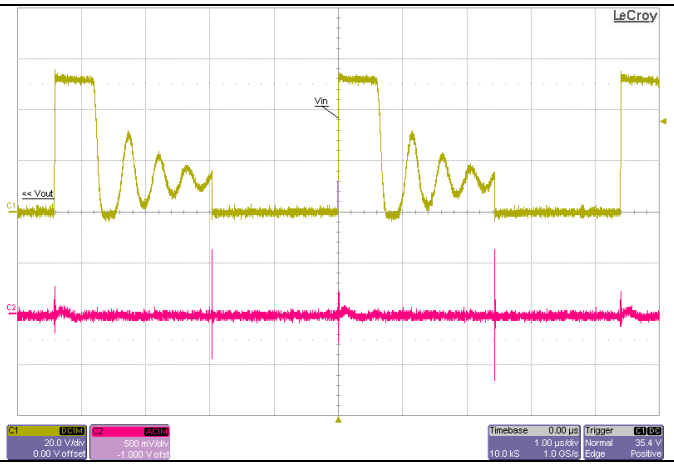
Vin Vout Iin Startup 12Vin 50Vout No Load



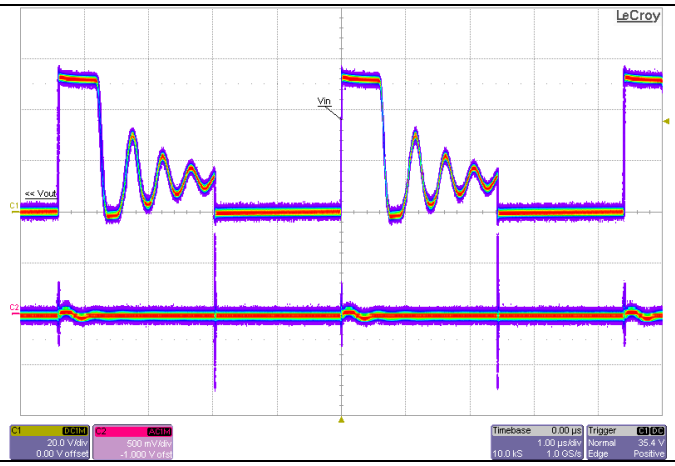
Vin Vout Iin Surge Current 12Vin 50Vout No Load

10 Switch Node and Output Ripple Waveform

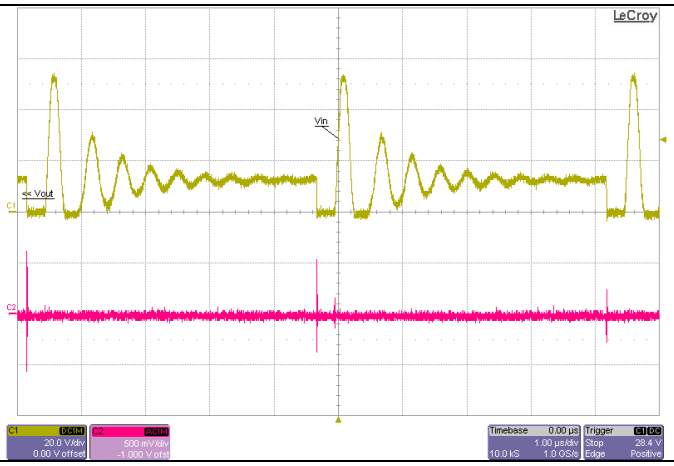
10.1 12V Input



SW VOUT 12Vin 50Vout 50mA CC Load



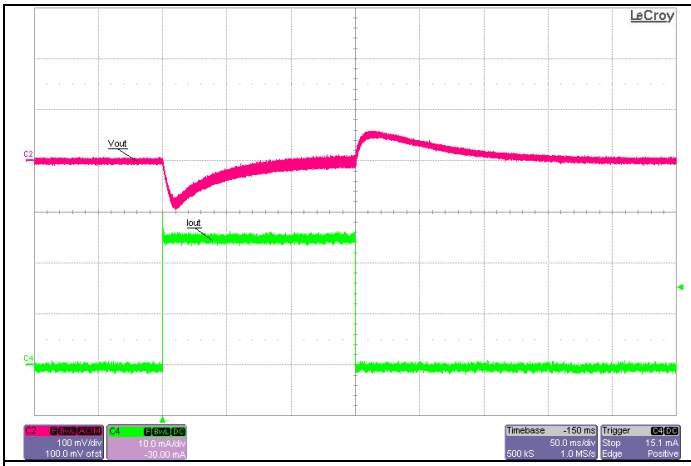
SW VOUT 12Vin 50Vout 50mA CC Load (persistence on)



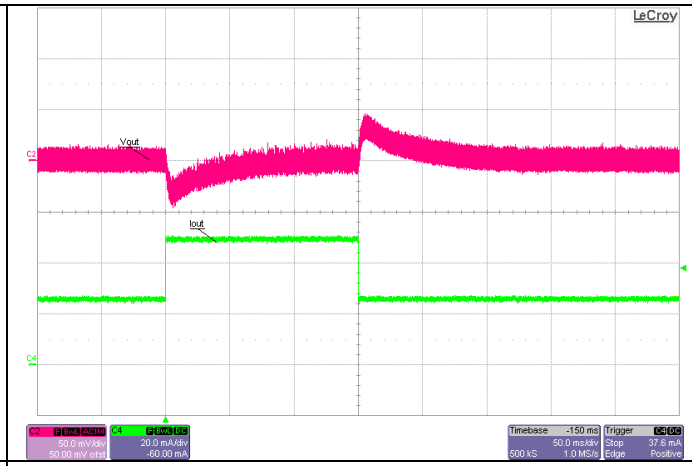
SW VOUT 12Vin 11Vout No Load

11 Load Transient Response

11.1 12V Input



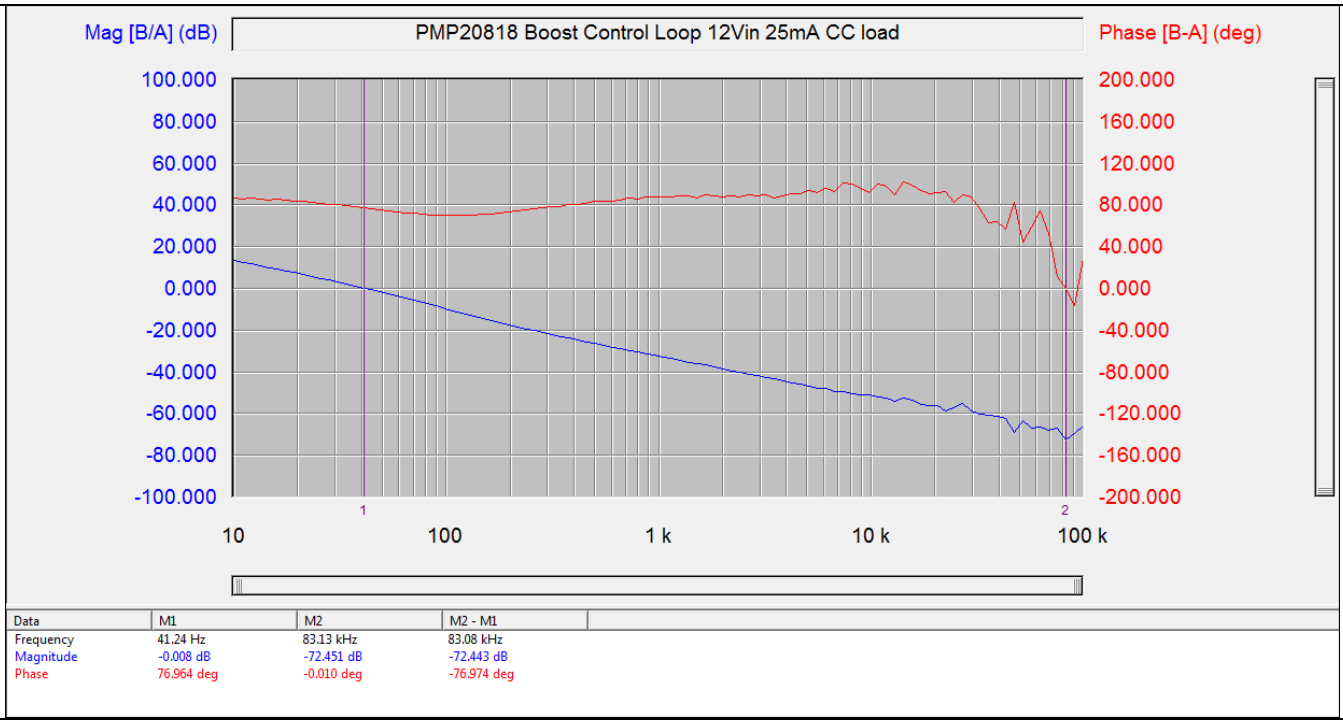
VOUT IOUT Load Transient 12Vin 0A to 25mA Load Step



VOUT IOUT Load Transient 12Vin 25mA to 50mA Load Step

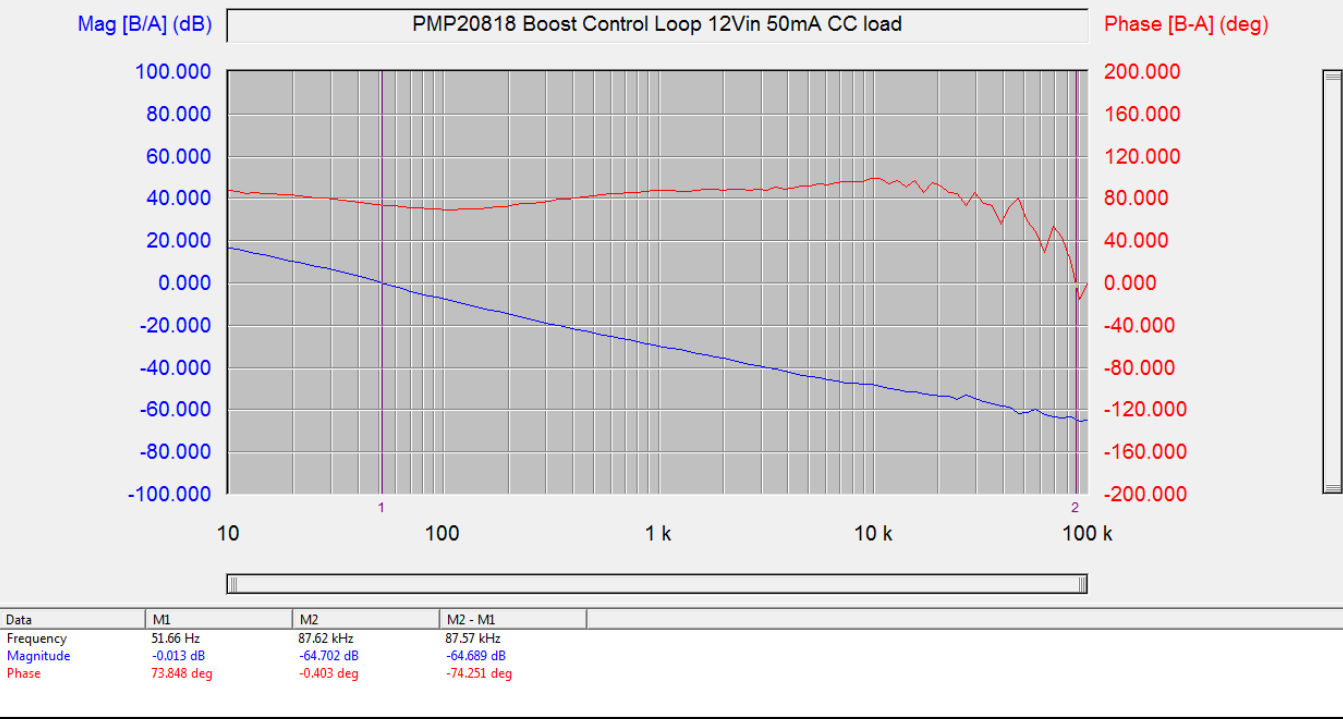
12 Frequency Response

12.1 25mA Constant Current Load



Control Loop 12Vin 50Vout 25mA CC load

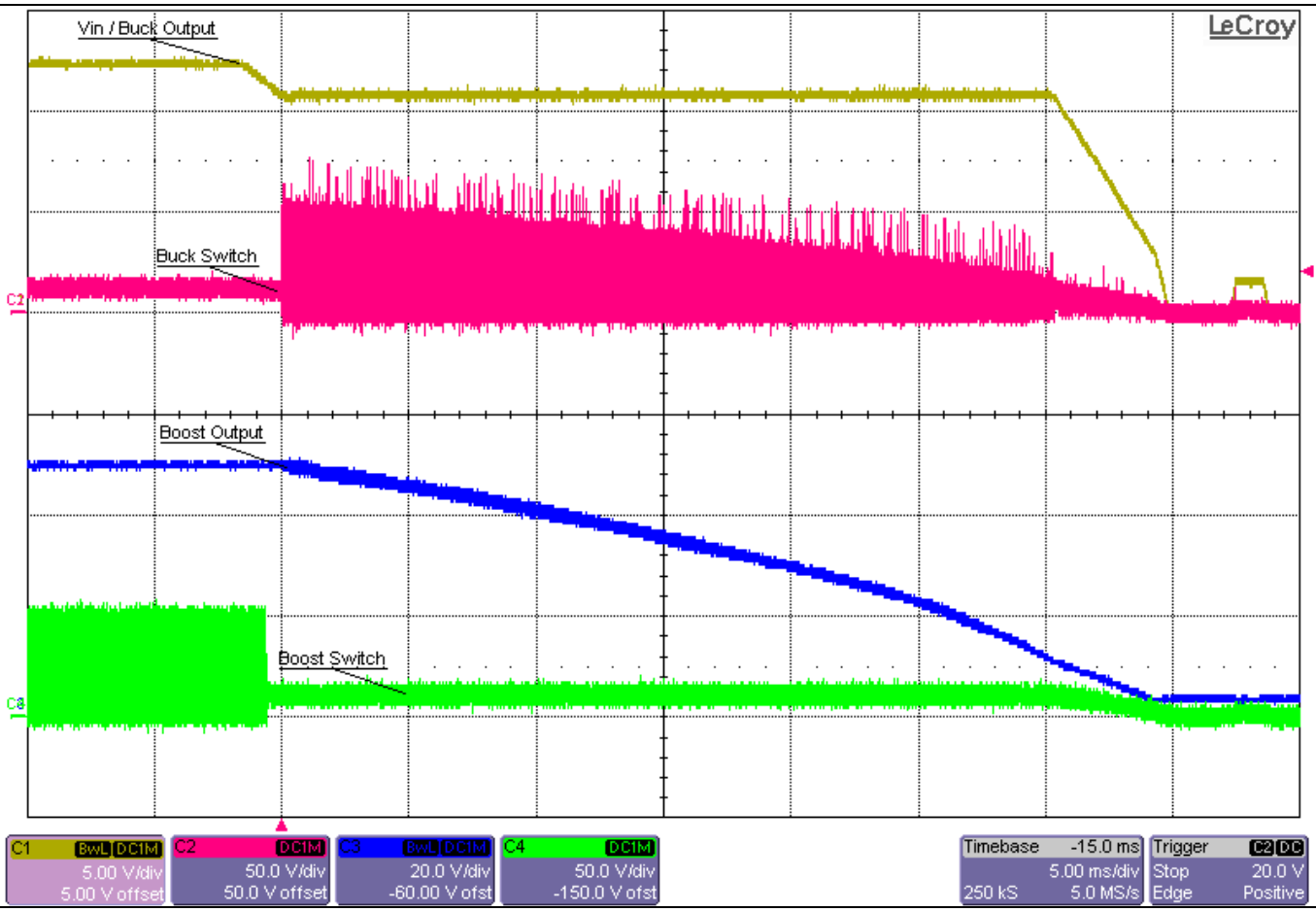
12.2 50mA Constant Current Load



Control Loop 12Vin 50Vout 50mA CC load

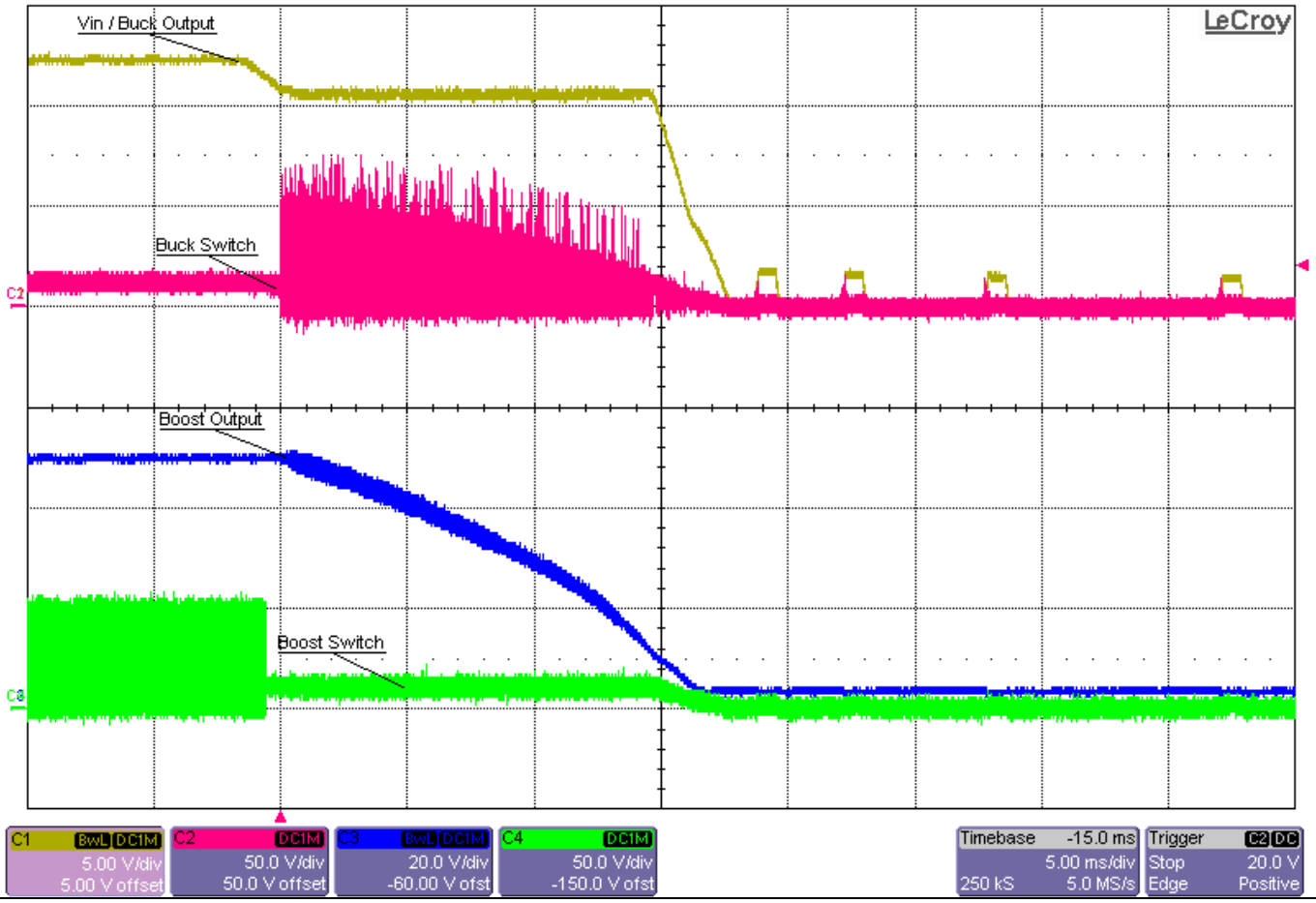
13 Hold Up Waveforms

13.1 6A Constant Current Load



Hold Up 6A CC load

13.2 12.5A Constant Current Load



Hold Up 12.5A CC load

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