LM5118 Buck-Boost Converter

TI reference design number: PMP7995 Rev A

Input: 5V to 60V
Output: 12V @ 2A

DC – DC Test Results

Table of Contents

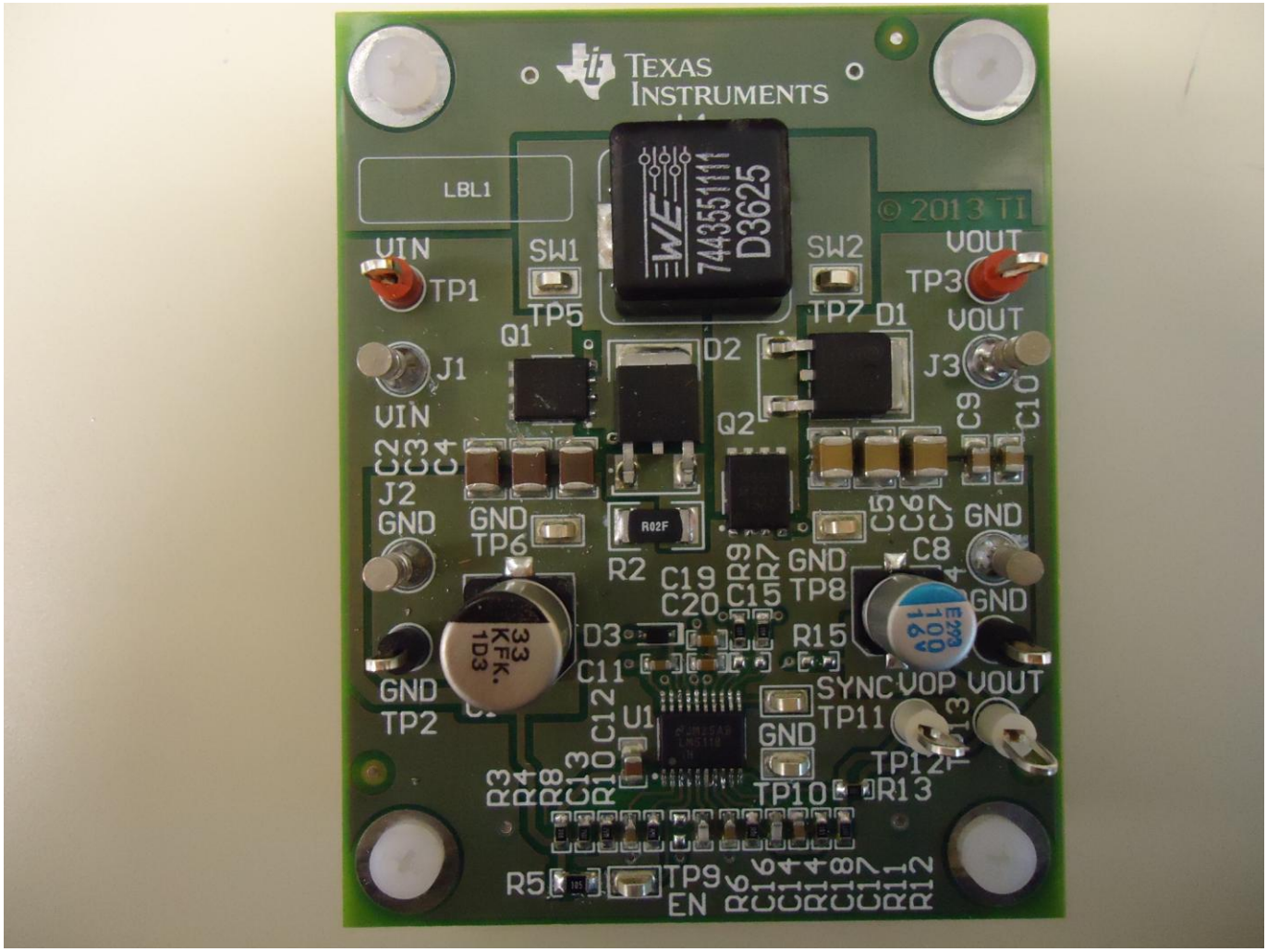
1 Circuit Description

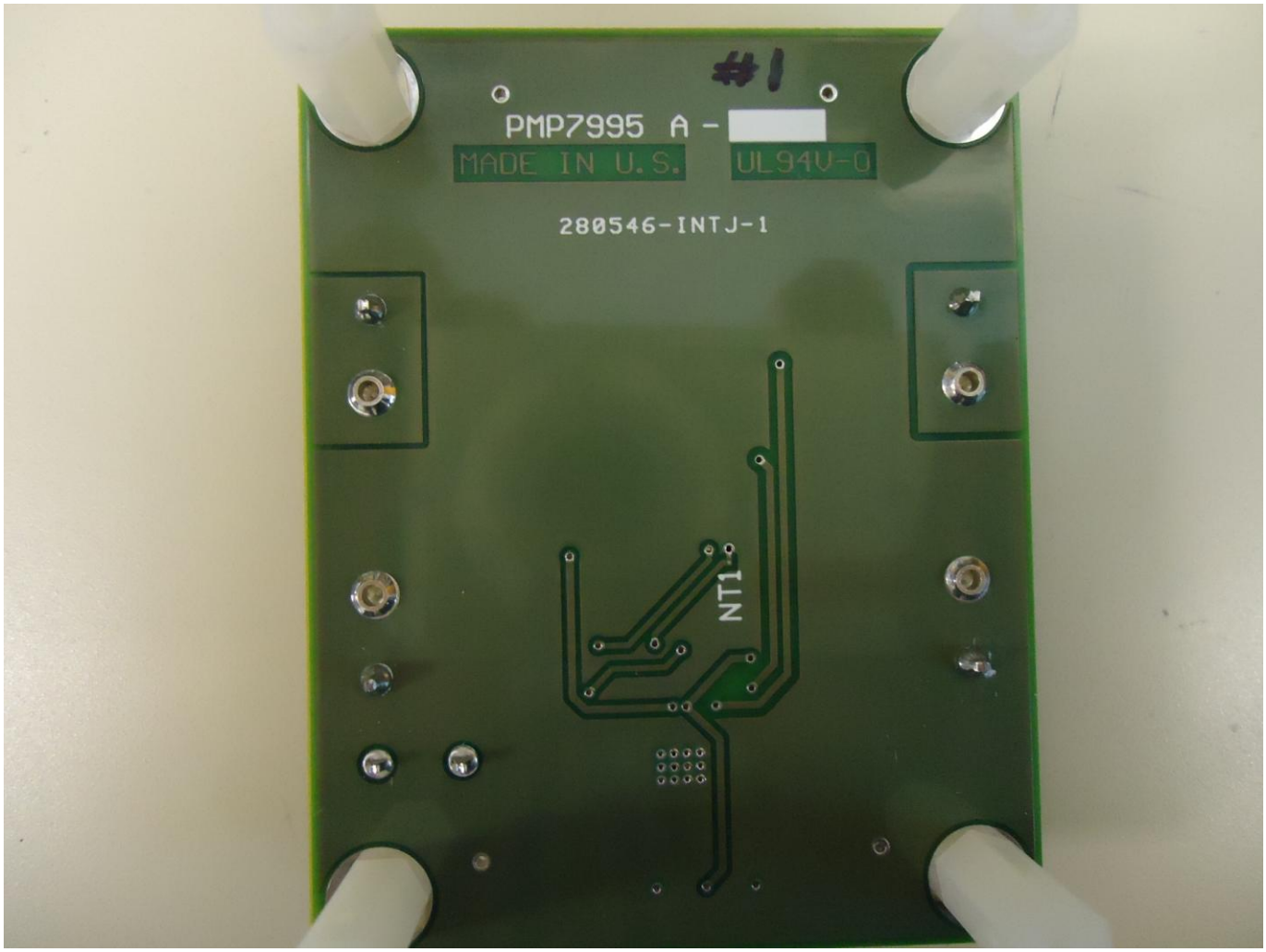
PMP7995 is a buck-boost converter rated for 12V output at 2A from an input voltage of 5V to 60V. This design uses the LM5118 buck-boost controller at a switching frequency of 300 kHz. To minimize cost the layout was done for a 2 layer printed circuit board.

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

2 Photos

The photographs below show the PMP7995 Rev A assembly. This is a 2 layer board using 1 ounce copper. The board dimensions are 2.2” x 2.8”.




#1
PMP7995 A -
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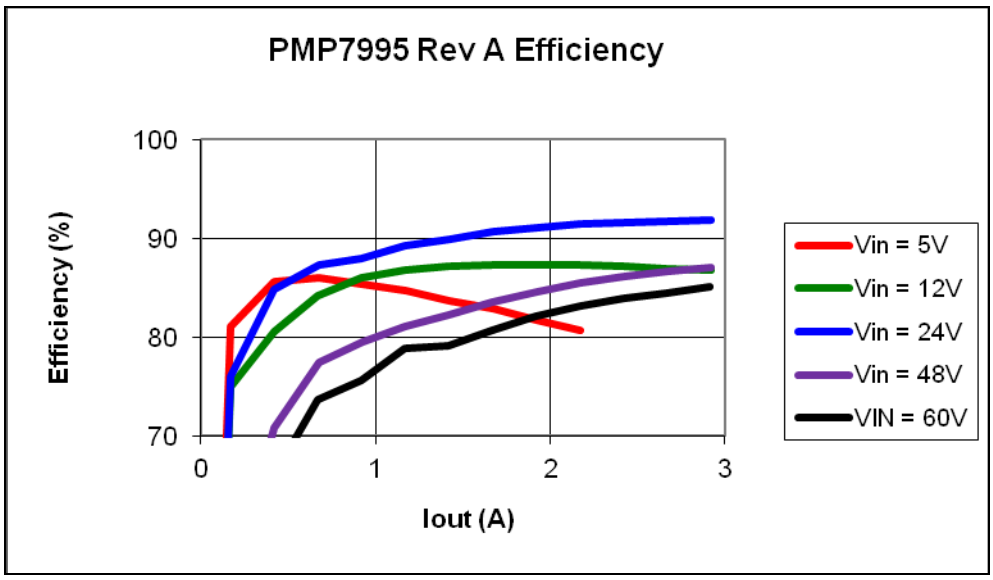
UL94V-0
280546-INTJ-1
NT1

3 Efficiency

The efficiency data is shown in the tables and graph below.



Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
5.003	0.032	11.844	0.000	0.000	0.16	0.00	0.16
5.003	0.502	11.844	0.172	81.113	2.51	2.04	0.47
5.003	1.169	11.844	0.423	85.663	5.85	5.01	0.84
5.003	1.856	11.845	0.674	85.978	9.29	7.98	1.30
5.003	2.561	11.845	0.924	85.421	12.81	10.94	1.87
5.003	3.280	11.845	1.173	84.670	16.41	13.89	2.52
5.002	4.022	11.845	1.422	83.724	20.12	16.84	3.27
5.002	4.778	11.845	1.672	82.867	23.90	19.80	4.09
5.002	5.567	11.846	1.922	81.764	27.85	22.77	5.08
5.001	6.375	11.846	2.170	80.630	31.88	25.71	6.18
5.003	0.260	0.035	0.924	2.486	1.30	0.03	1.27
5.003	0.260	0.035	0.924	2.486	1.30	0.03	1.27
5.003	0.261	0.035	0.924	2.477	1.31	0.03	1.27

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
12.001	0.026	11.858	0.000	0.000	0.31	0.00	0.31
12.001	0.224	11.859	0.170	74.995	2.69	2.02	0.67
12.001	0.515	11.859	0.420	80.588	6.18	4.98	1.20
12.001	0.788	11.858	0.671	84.138	9.46	7.96	1.50
12.000	1.057	11.858	0.920	86.009	12.68	10.91	1.77
12.000	1.332	11.858	1.170	86.798	15.98	13.87	2.11
12.000	1.610	11.859	1.420	87.162	19.32	16.84	2.48
12.000	1.890	11.859	1.670	87.322	22.68	19.80	2.88
12.000	2.174	11.859	1.921	87.324	26.09	22.78	3.31
12.000	2.460	11.859	2.172	87.255	29.52	25.76	3.76

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12.000	2.746	11.859	2.422	87.165	32.95	28.72	4.23
12.000	3.036	11.859	2.672	86.976	36.43	31.69	4.74
12.000	3.326	11.859	2.920	86.762	39.91	34.63	5.28

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
24.007	0.009	11.860	0.000	0.000	0.22	0.00	0.22
24.007	0.113	11.861	0.174	76.077	2.71	2.06	0.65
24.007	0.247	11.861	0.424	84.811	5.93	5.03	0.90
24.007	0.382	11.861	0.675	87.302	9.17	8.01	1.16
24.006	0.518	11.859	0.922	87.928	12.44	10.93	1.50
24.007	0.649	11.859	1.172	89.206	15.58	13.90	1.68
24.007	0.781	11.859	1.422	89.941	18.75	16.86	1.89
24.006	0.911	11.859	1.672	90.666	21.87	19.83	2.04
24.006	1.042	11.859	1.922	91.120	25.01	22.79	2.22
24.006	1.174	11.859	2.172	91.394	28.18	25.76	2.43
24.006	1.306	11.859	2.422	91.613	31.35	28.72	2.63
24.006	1.438	11.859	2.671	91.758	34.52	31.68	2.85
24.006	1.570	11.859	2.920	91.878	37.69	34.63	3.06

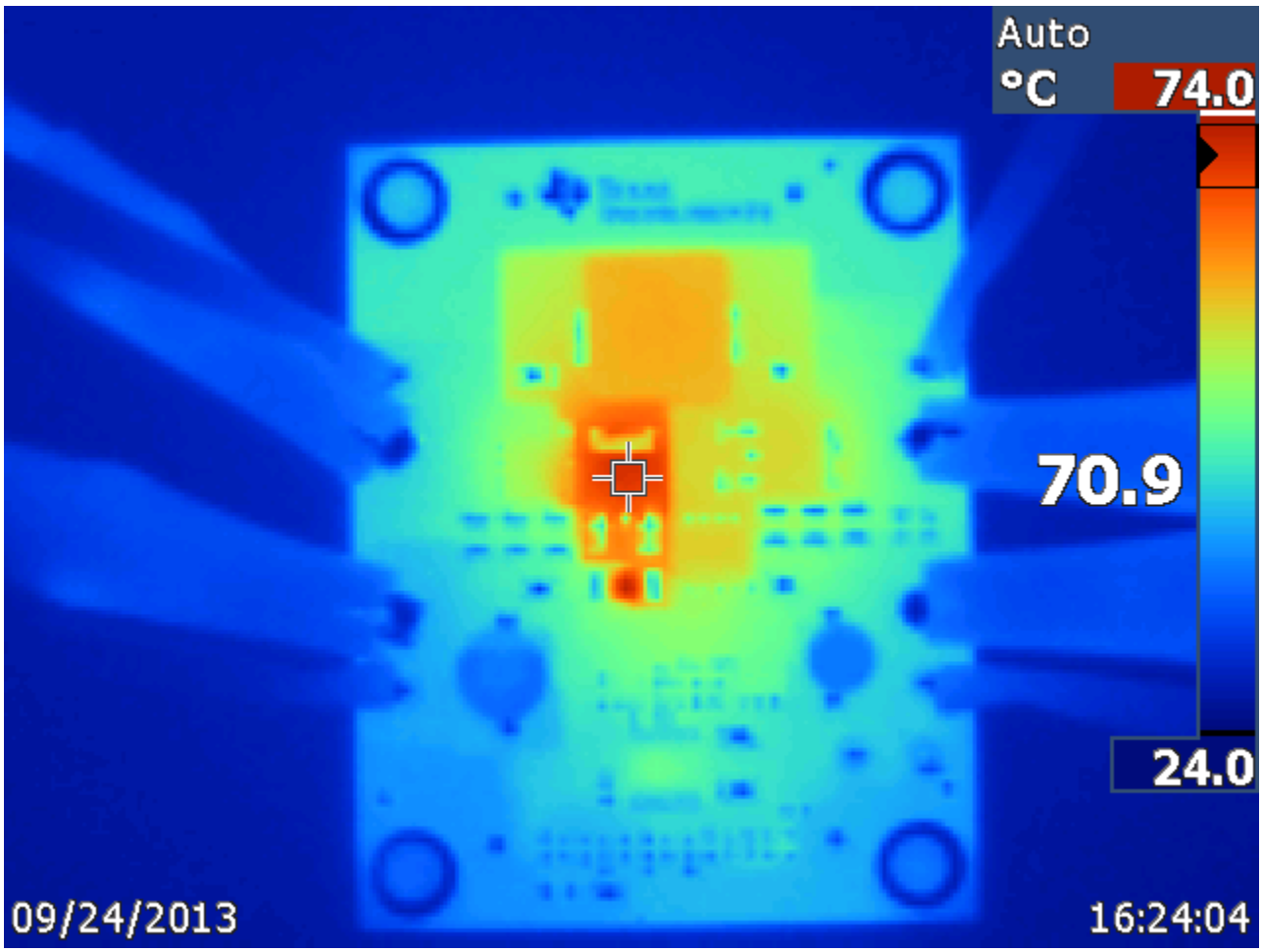
Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
48.019	0.008	11.864	0.000	0.000	0.38	0.00	0.38
48.019	0.078	11.866	0.173	54.808	3.75	2.05	1.69
48.019	0.148	11.866	0.424	70.794	7.11	5.03	2.08
48.019	0.215	11.867	0.674	77.473	10.32	8.00	2.33
48.019	0.287	11.867	0.924	79.564	13.78	10.97	2.82
48.019	0.357	11.867	1.172	81.131	17.14	13.91	3.23
48.019	0.427	11.865	1.421	82.228	20.50	16.86	3.64
48.018	0.494	11.865	1.670	83.532	23.72	19.81	3.91
48.018	0.561	11.865	1.921	84.611	26.94	22.79	4.15
48.018	0.627	11.865	2.170	85.518	30.11	25.75	4.36
48.018	0.695	11.865	2.421	86.074	33.37	28.73	4.65
48.018	0.762	11.865	2.672	86.645	36.59	31.70	4.89
48.017	0.829	11.865	2.919	87.007	39.81	34.63	5.17

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
60.025	0.008	11.867	0.000	0.000	0.48	0.00	0.48
60.024	0.069	11.870	0.172	49.295	4.14	2.04	2.10
60.024	0.126	11.870	0.421	66.075	7.56	5.00	2.57
60.024	0.180	11.871	0.671	73.725	10.80	7.97	2.84
60.024	0.241	11.870	0.921	75.573	14.47	10.93	3.53
60.024	0.294	11.871	1.172	78.839	17.65	13.91	3.73
60.024	0.355	11.869	1.421	79.151	21.31	16.87	4.44
60.023	0.409	11.868	1.669	80.685	24.55	19.81	4.74
60.023	0.462	11.868	1.918	82.086	27.73	22.76	4.97
60.023	0.516	11.868	2.169	83.113	30.97	25.74	5.23
60.023	0.570	11.868	2.418	83.877	34.21	28.70	5.52
60.022	0.624	11.868	2.666	84.478	37.45	31.64	5.81
60.022	0.678	11.868	2.916	85.040	40.69	34.61	6.09

4 Thermal Test

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

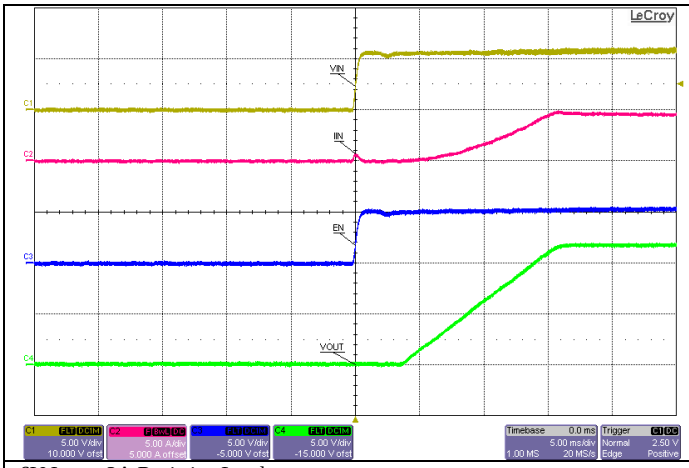
4.1 12V Input, 2A Load, No Airflow



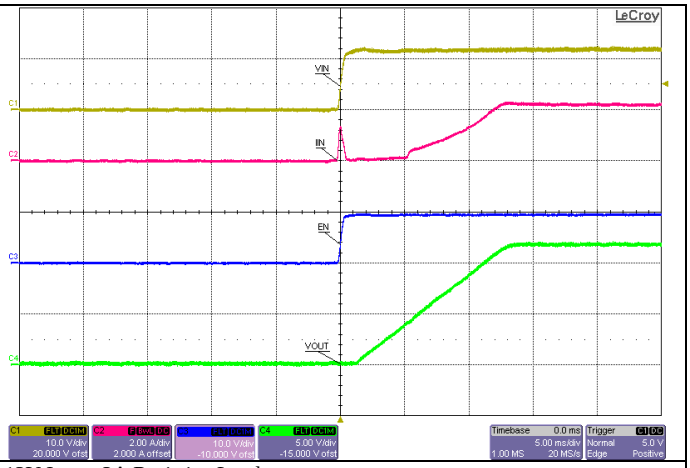
5 Startup Behavior

5.1 Turn-on from Vin

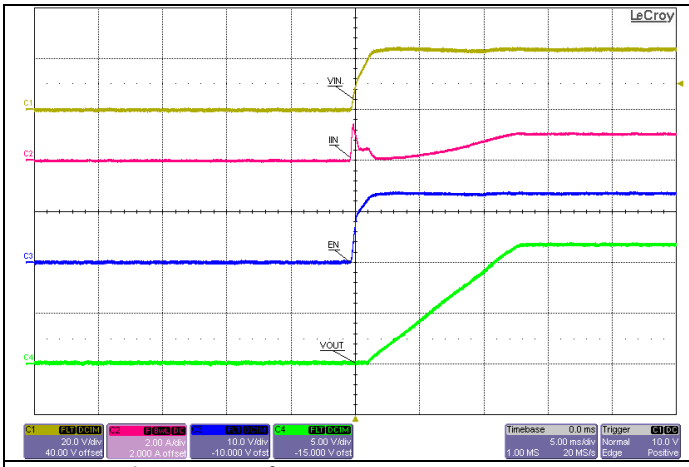
The output voltage is well controlled at turn-on from Vin, showing no evidence of over-shoot.



6V Input, 2A Resistive Load



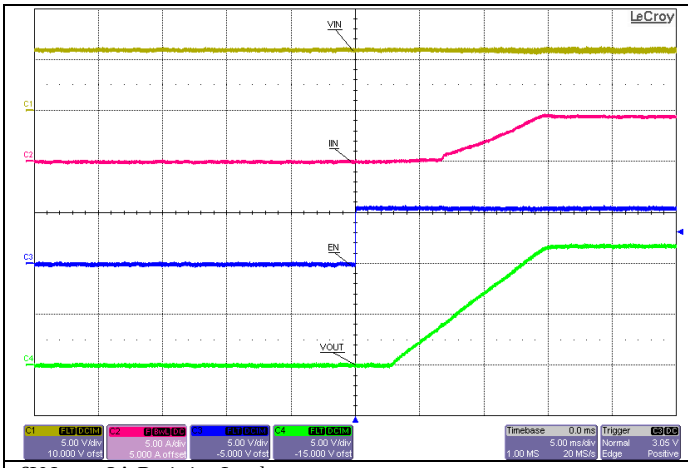
12V Input, 2A Resistive Load



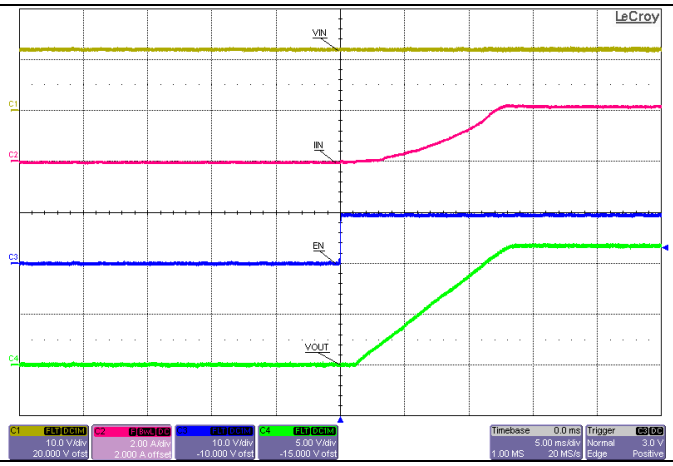
24V Input, 2A Resistive Load

5.2 Turn-on from EN

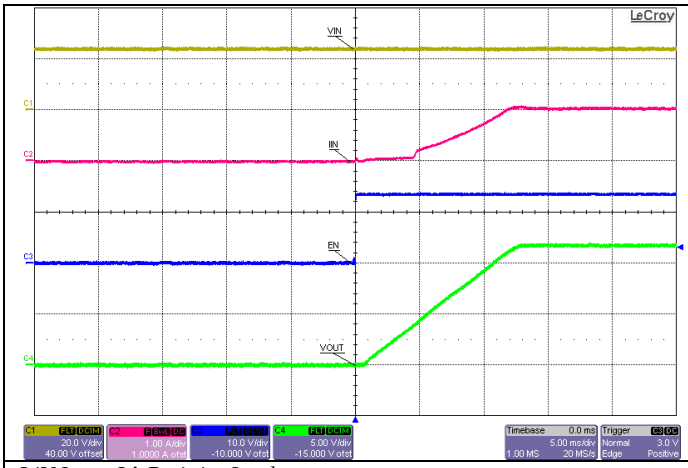
The output voltage is well controlled at turn-on from enable, showing no evidence of over-shoot.



6V Input, 2A Resistive Load



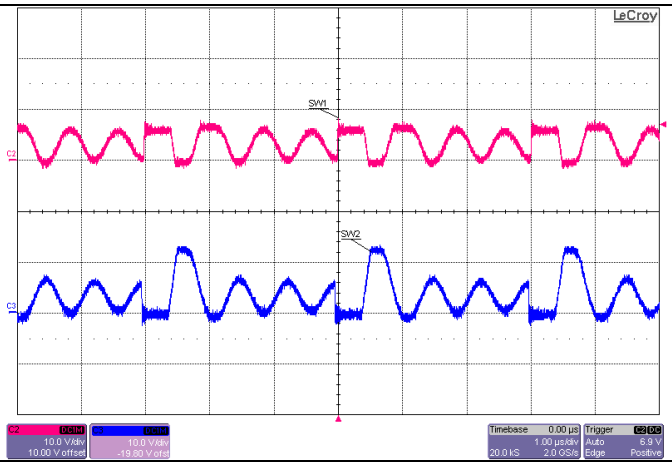
12V Input, 2A Resistive Load



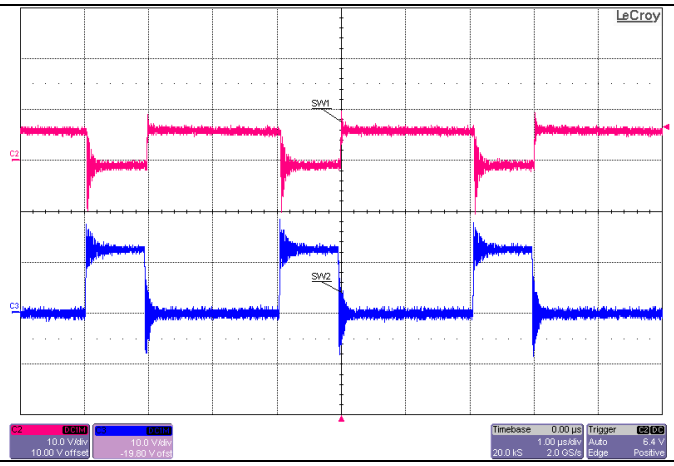
24V Input, 2A Resistive Load

6 Switching Behavior

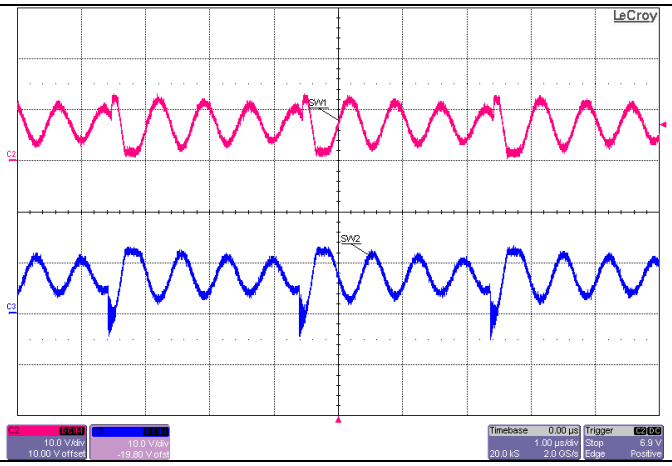
6.1 Switching at No Load and Full Load



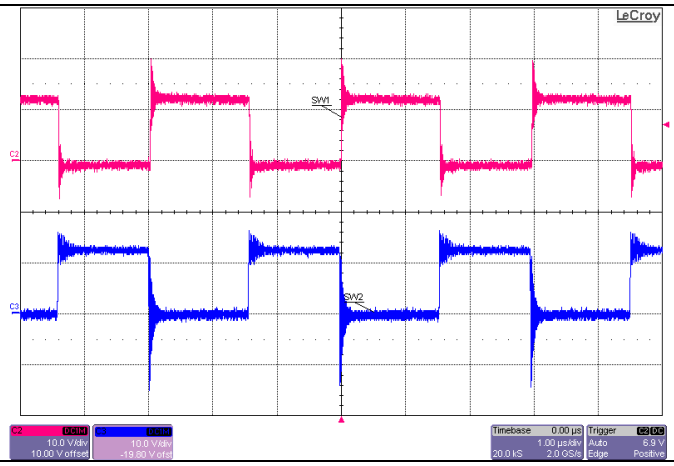
6V Input, No Load



6V Input, 2A Load



12V Input, No Load



12V Input, 2A Load

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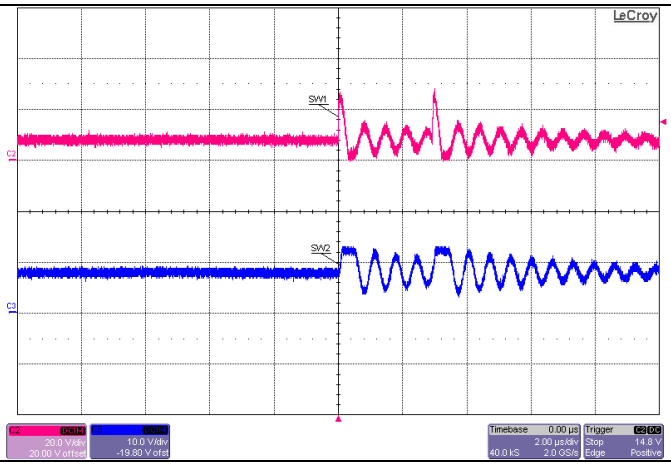
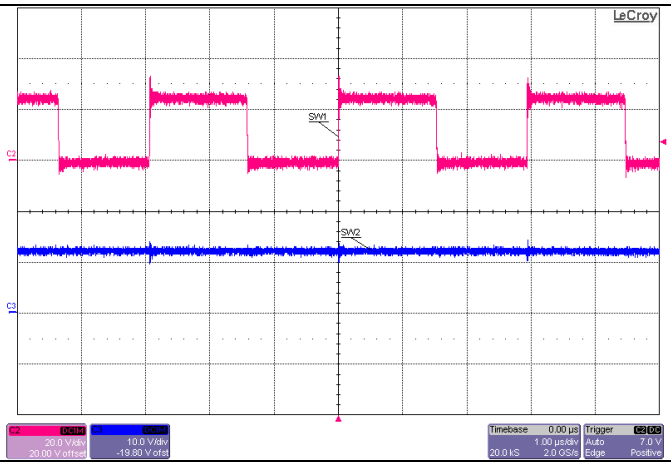
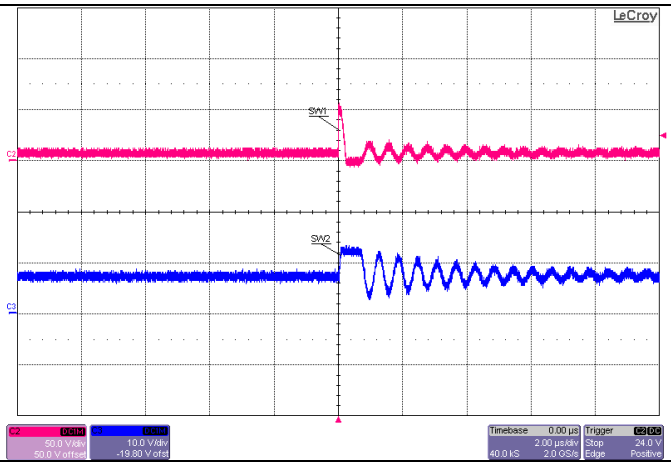


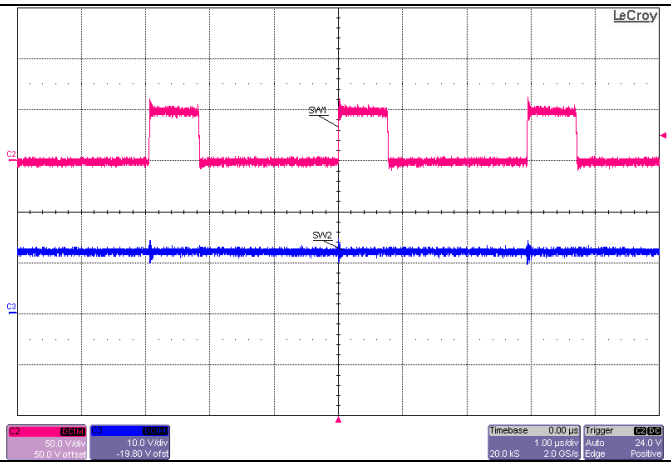
24V Input, No Load



24V Input, 2A Load



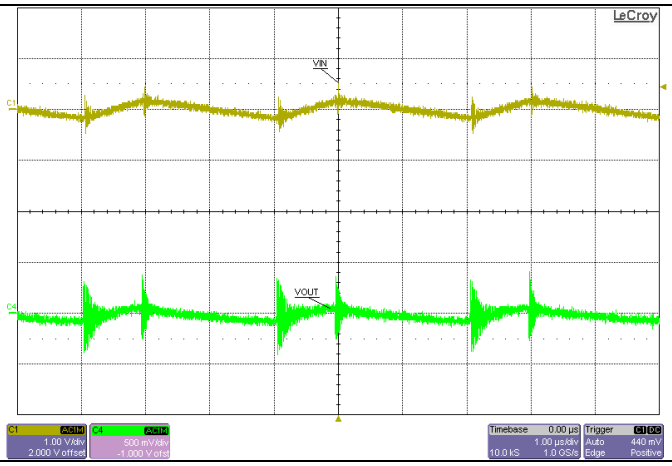
48V Input, No Load



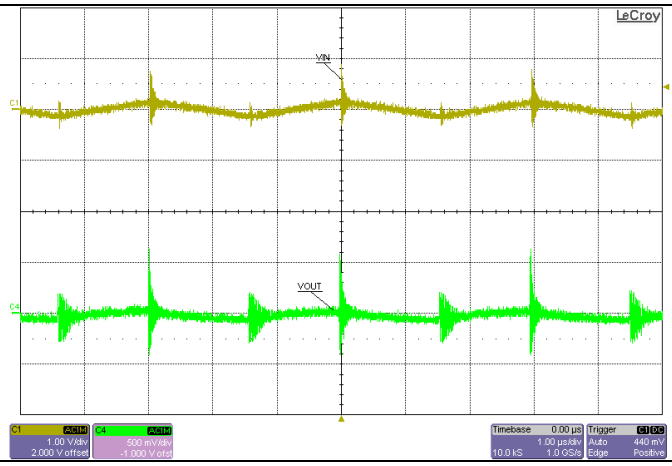
48V Input, 2A Load

7 Ripple Voltage

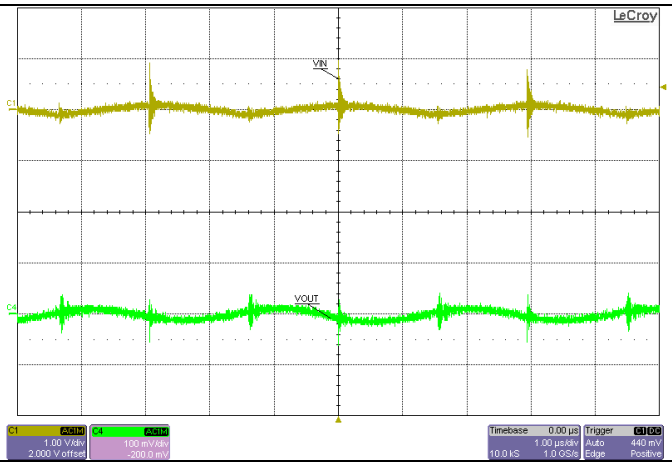
7.1 Input and Output Ripple



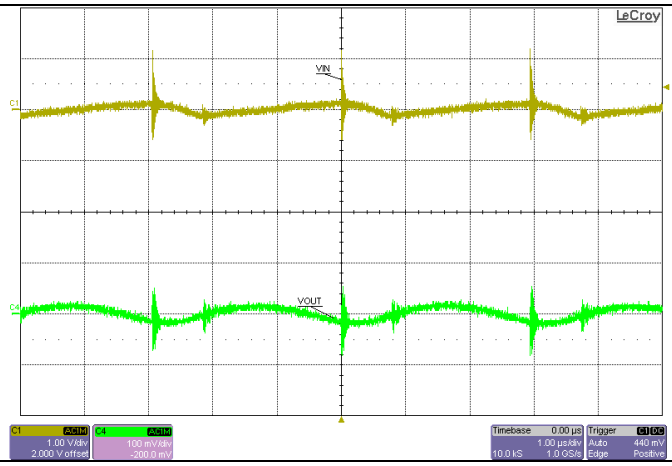
6V Input, 2A Load



12V Input, 2A Load



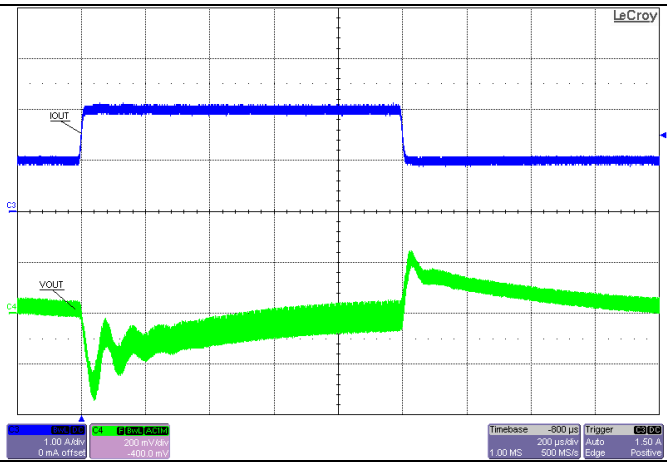
24V Input, 2A Load



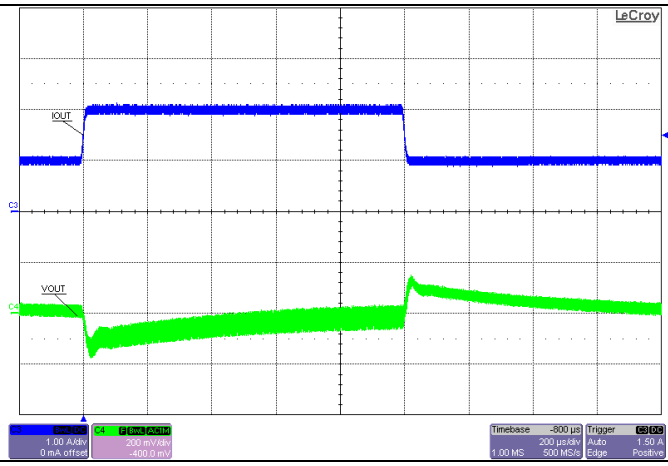
48V Input, 2A Load

8 Load Transient Response

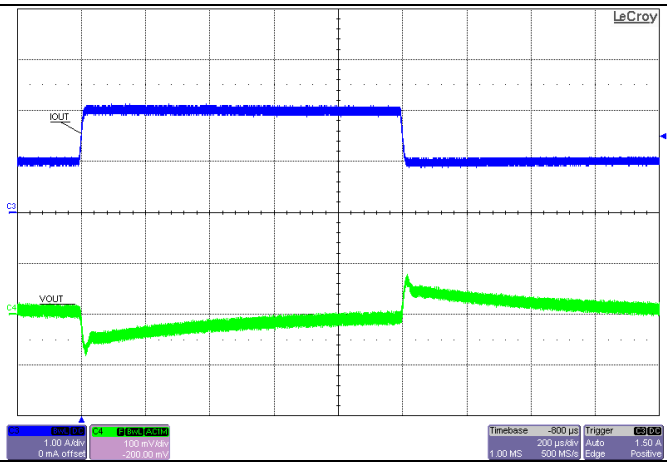
8.1 Load Transient Response, 1A to 2A Load Step



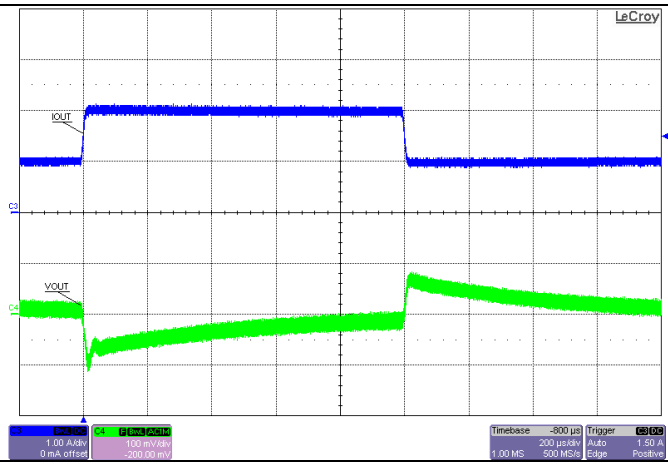
6V Input, 1A to 2A Load Step



12V Input, 1A to 2A Load Step

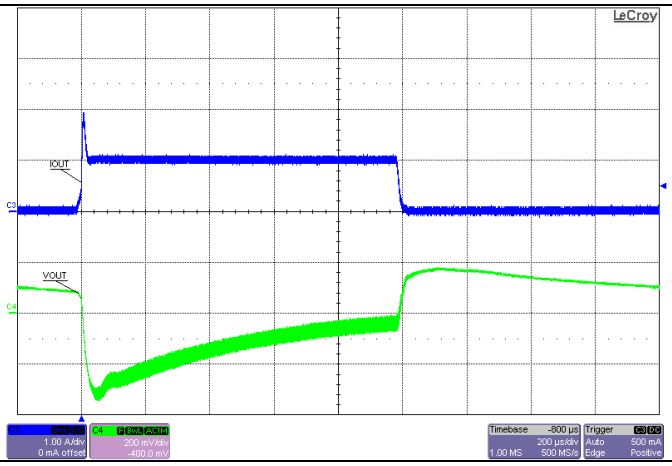


24V Input, 1A to 2A Load Step

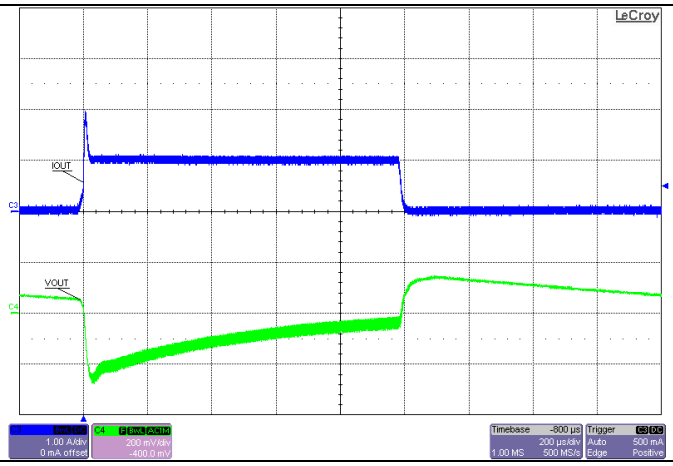


48V Input, 1A to 2A Load Step

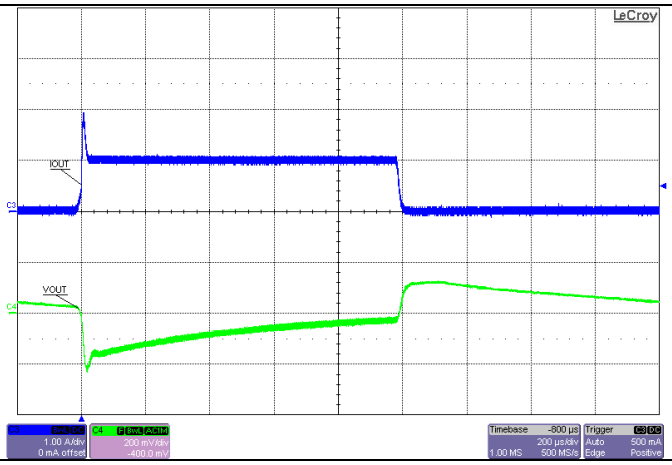
8.2 Load Transient Response, 0A to 1A Load Step



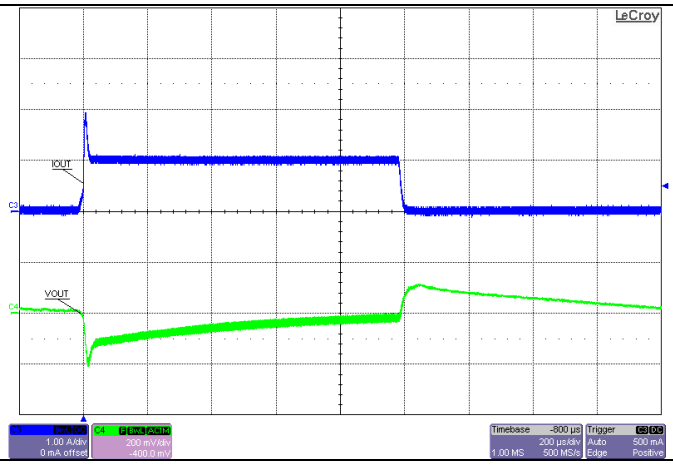
6V Input, 0A to 1A Load Step



12V Input, 0A to 1A Load Step



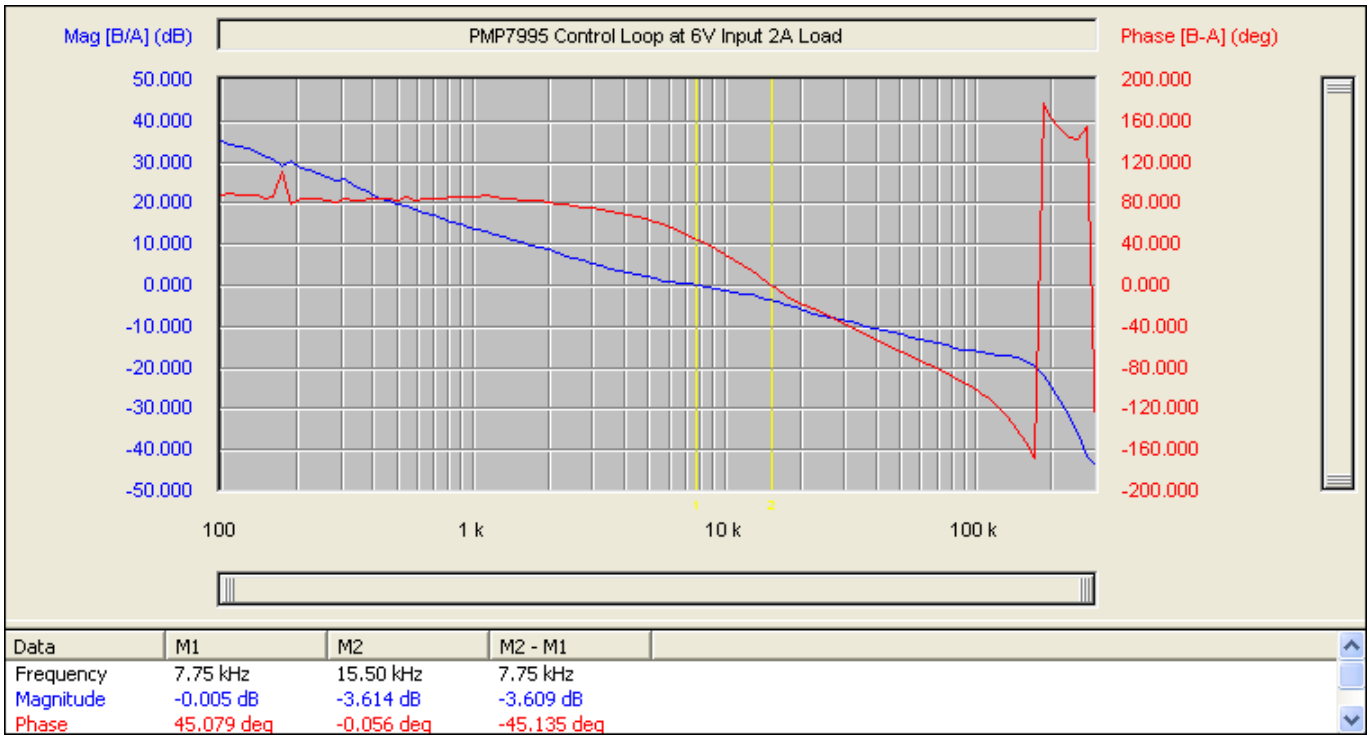
24V Input, 0A to 1A Load Step



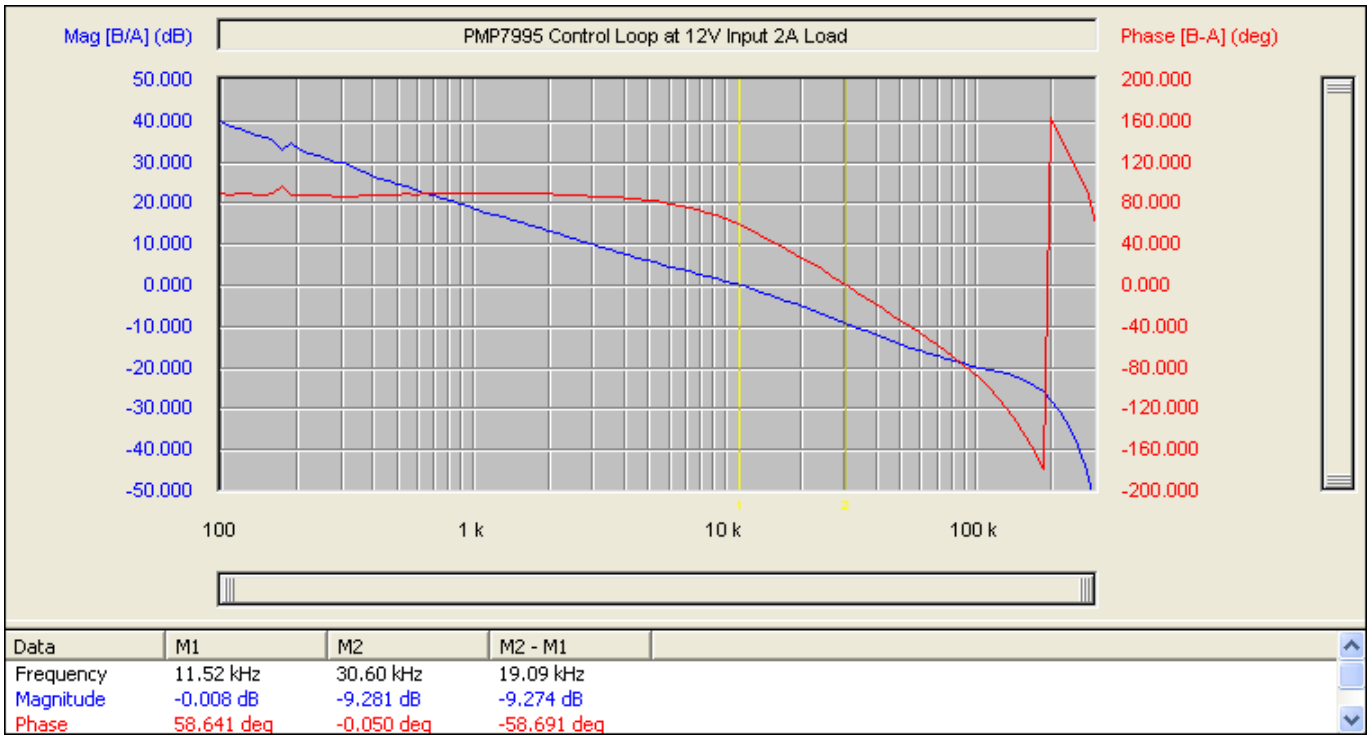
48V Input, 0A to 1A Load Step

9 Frequency Response

9.1 Frequency Response



Data	M1	M2	M2 - M1
Frequency	7.75 kHz	15.50 kHz	7.75 kHz
Magnitude	-0.005 dB	-3.614 dB	-3.609 dB
Phase	45.079 deg	-0.056 deg	-45.135 deg



Data	M1	M2	M2 - M1
Frequency	11.52 kHz	30.60 kHz	19.09 kHz
Magnitude	-0.008 dB	-9.281 dB	-9.274 dB
Phase	58.641 deg	-0.050 deg	-58.691 deg

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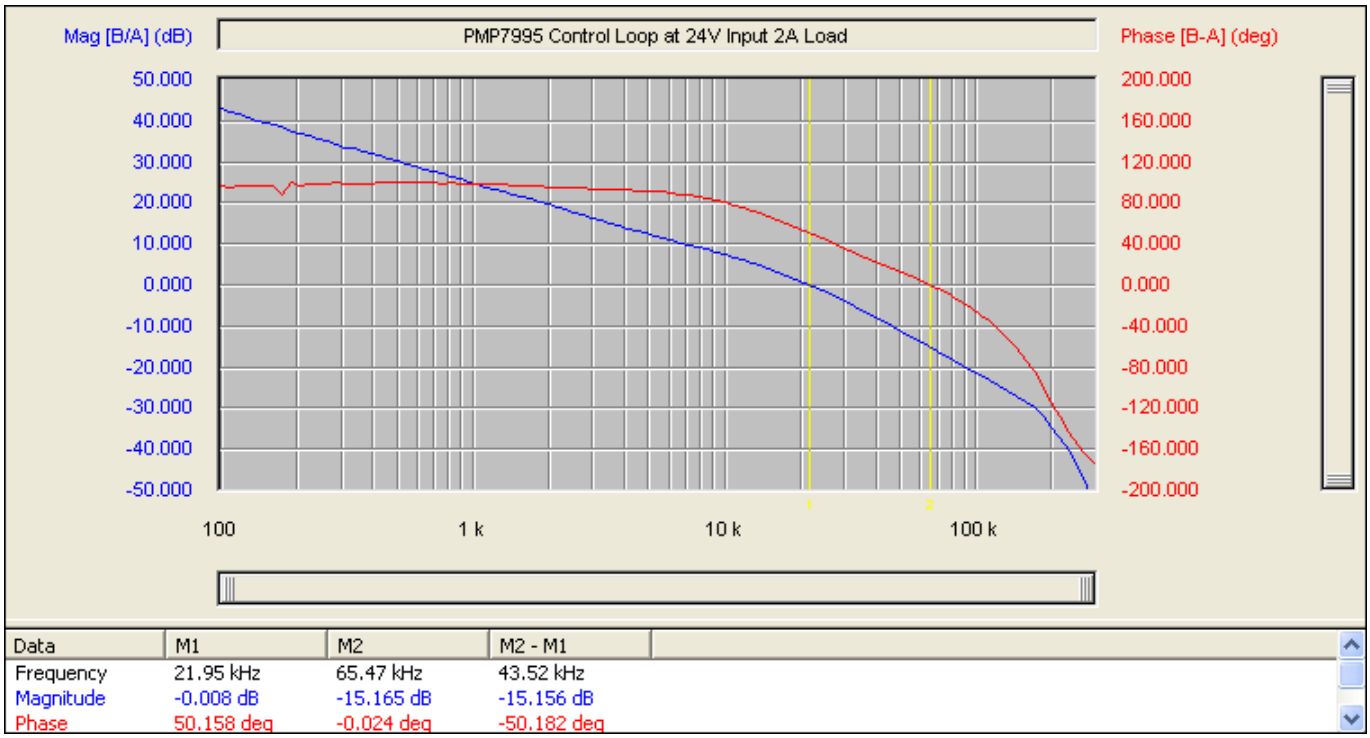
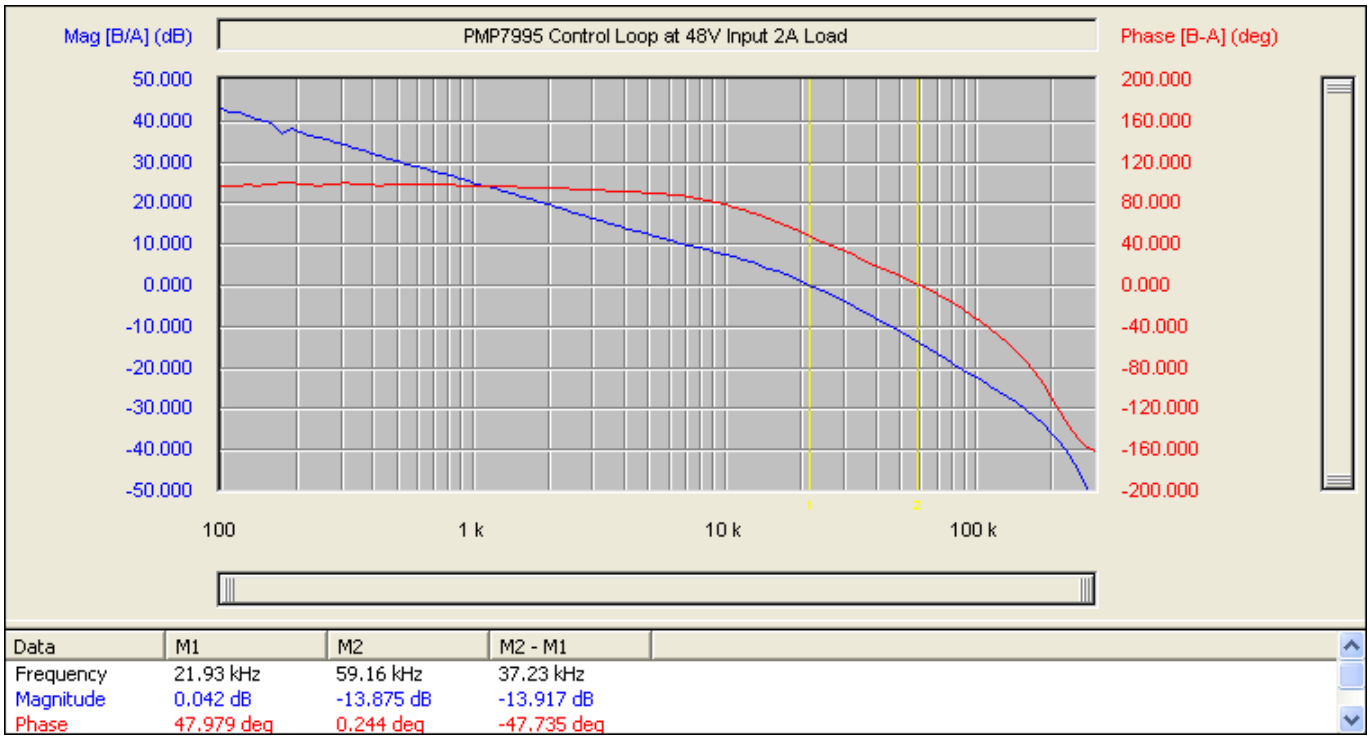


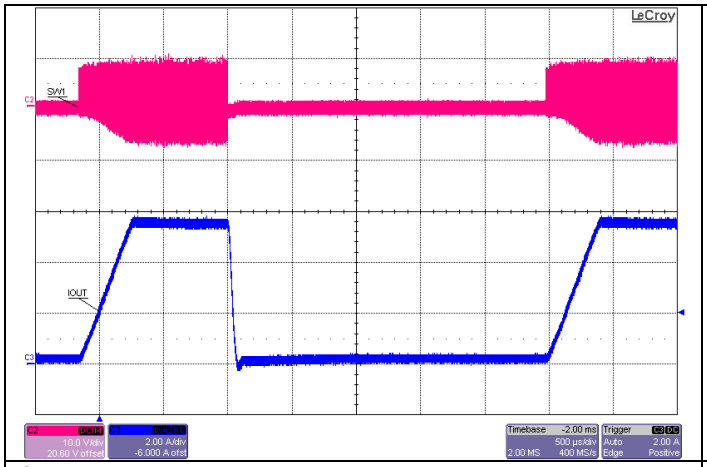
Data	M1	M2	M2 - M1
Frequency	21.95 kHz	65.47 kHz	43.52 kHz
Magnitude	-0.008 dB	-15.165 dB	-15.156 dB
Phase	50.158 deg	-0.024 deg	-50.182 deg



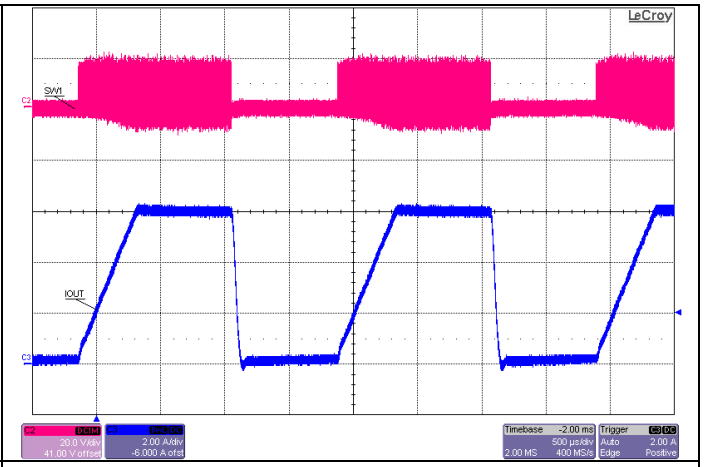
Data	M1	M2	M2 - M1
Frequency	21.93 kHz	59.16 kHz	37.23 kHz
Magnitude	0.042 dB	-13.875 dB	-13.917 dB
Phase	47.979 deg	0.244 deg	-47.735 deg

10 Over-Current Protection

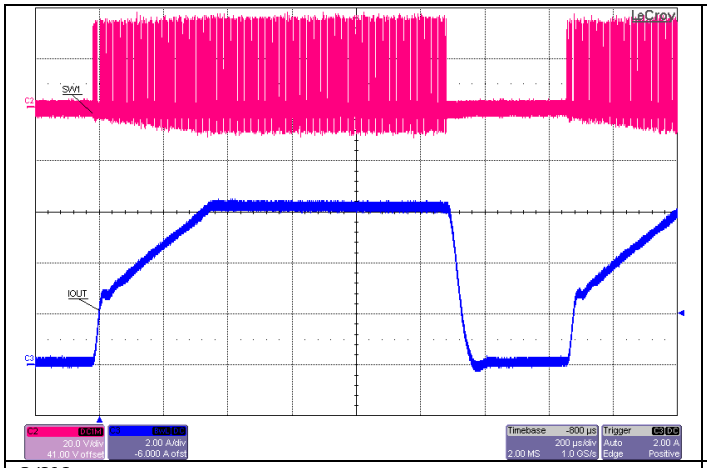
10.1 Output Short Circuit Protection



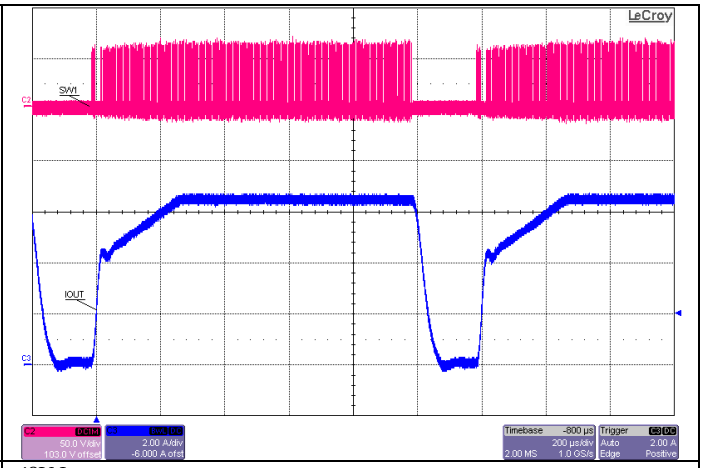
6V Input



12V Input



24V Input



48V Input

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