Test Data
For PMP10749
10/16/2015

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1. Design Specifications

Vin Minimum	**4V(Start up at 4.5V and delivers peak power at 6V)**
Vin Maximum	**36V**
Vin Nominal	**12V (automotive design)**
Vout 1 (pre boost)	**10V @ 10A (supply to dual buck controller)**
Iout 1	**6.5A**
Switching Frequency(Pre Boost)	**220 KHz**
Vout 2	**5V**
Iout 2	**10A**
Vout 3	**3.3V**
Iout 3	**10A**
Switching Frequency(Dual Buck Controller)	**2.2MHz (act as sync for Boost controller through freq divider)**
Protection	**Reverse polarity , Short Circuit protections at Outputs, Load Dump protection**

2. Circuit Description

PMP10749 is a 100W System level SMPS design for higher power automotive infotainment system.

The design has protections such as Load dump through TVS (ISO pulse testing) as well as Reverse Voltage (Innovative Smart diode with very low Iq) Protection. Further all the Controllers (boost and dual bucks) are in SYNC for EMI optimized design.

The design is divided into four major blocks:

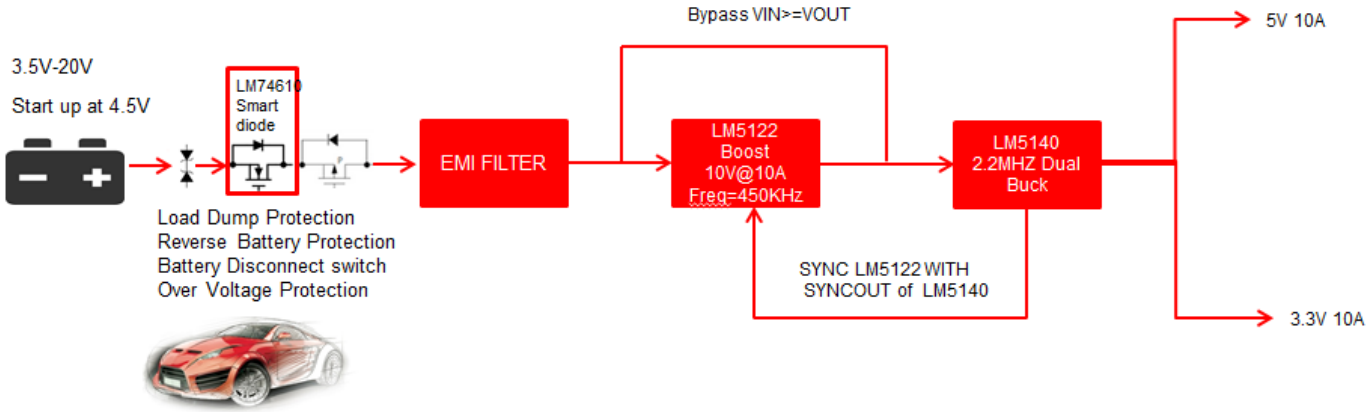
1. Protection: Reverse Battery protection through efficient smart diode and automotive transient protections through TVSs.

2. EMI Filter: 14 A Common modes choke at front end with a differential filter for Conducted EMI suppression.

3. Pre boost: Highly efficient synchronous pre boost design for 100W application. The output is maintained at 10V and when Vin > Vout , the output follows the input and true bypass operation is being achieved .

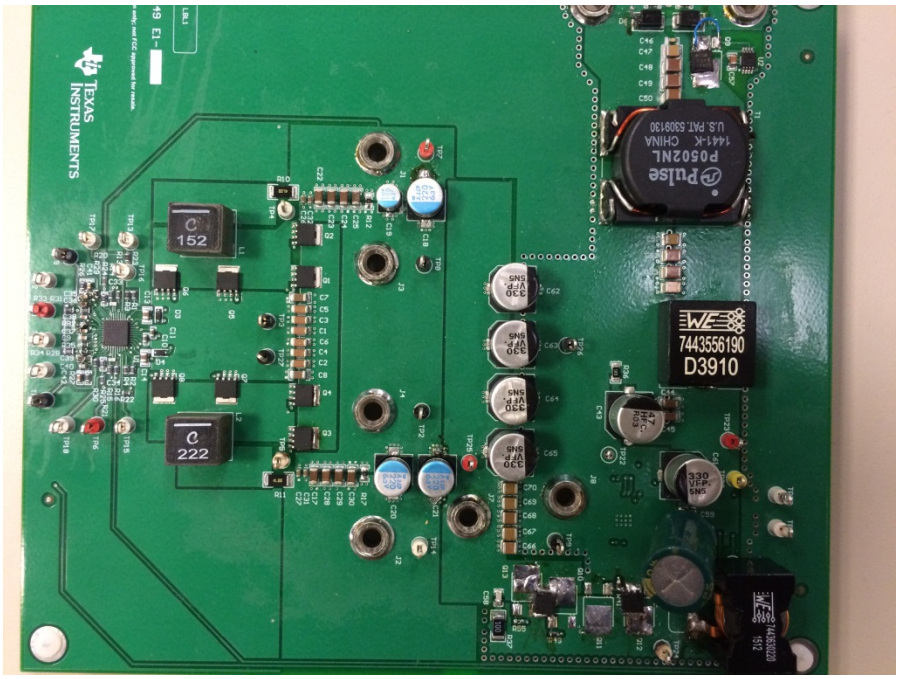
4. Dual Buck Controller: 2.2 MHZ switching for AM band avoidance as well as small size solution .Supports two output 5V@10A as well as 3.3V@10A . The Syncout of Controller is used to Sync Boost at F/10 frequency.

3. PMP10749 Block Diagram

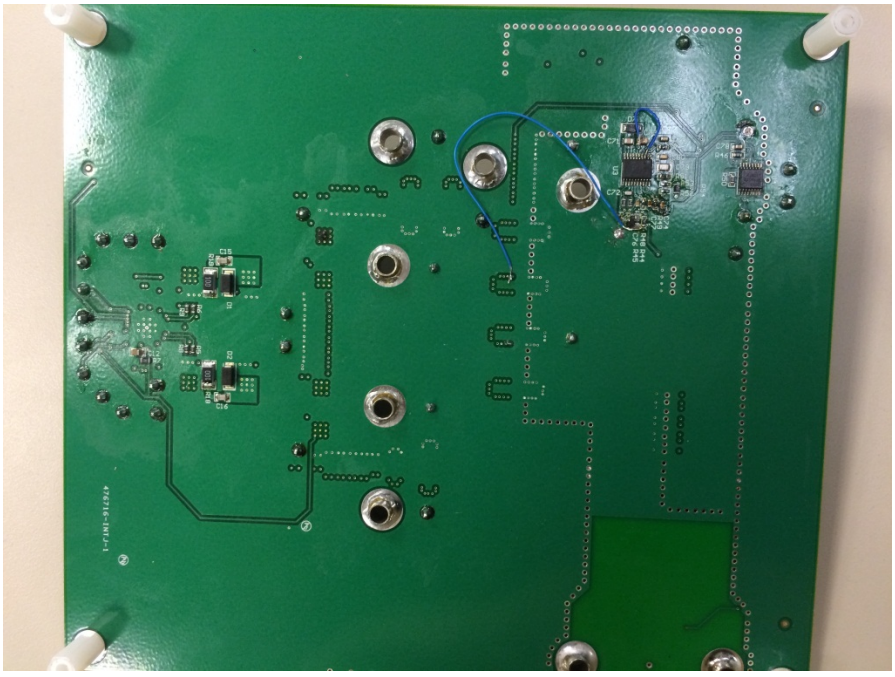


4. PMP10749 Board Photos

Board Dimensions: 6300mil *7045mi



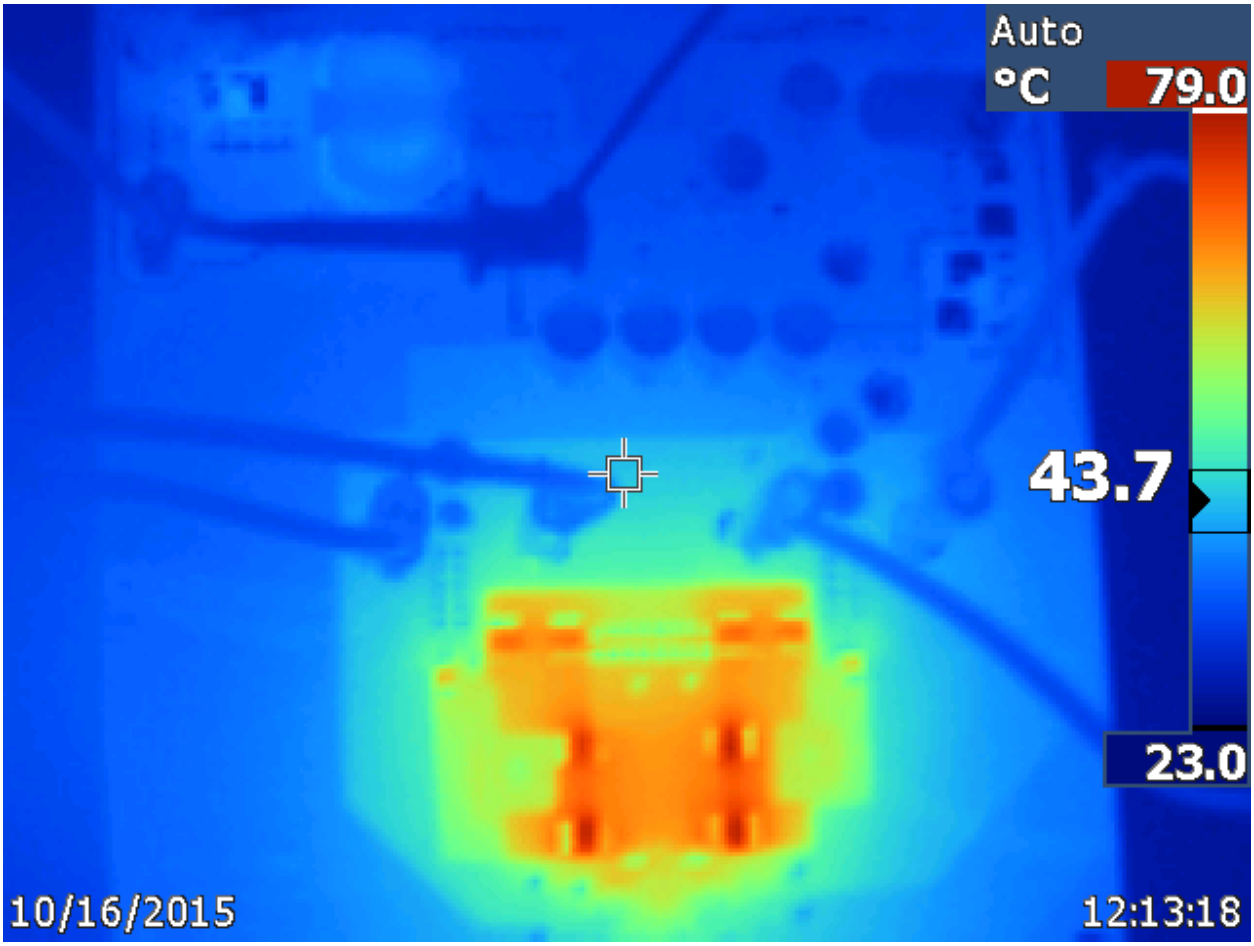
Board Photo (Top)



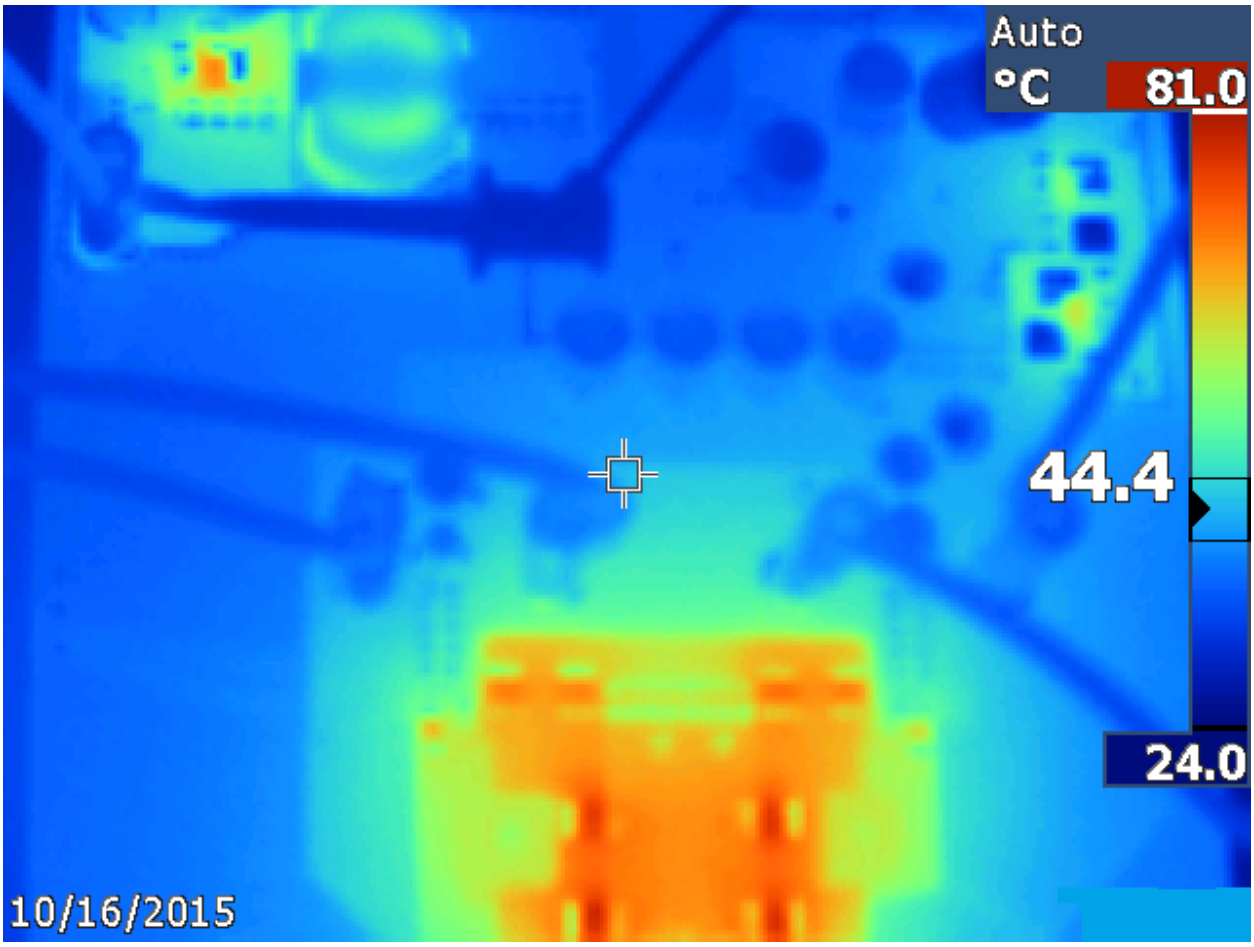
Board Photo (Bottom)

4. Thermal Data

IR thermal image taken at steady state with 12 Vin and 5V@10A and 3.3V @ 10A (Boost is Bypassed)



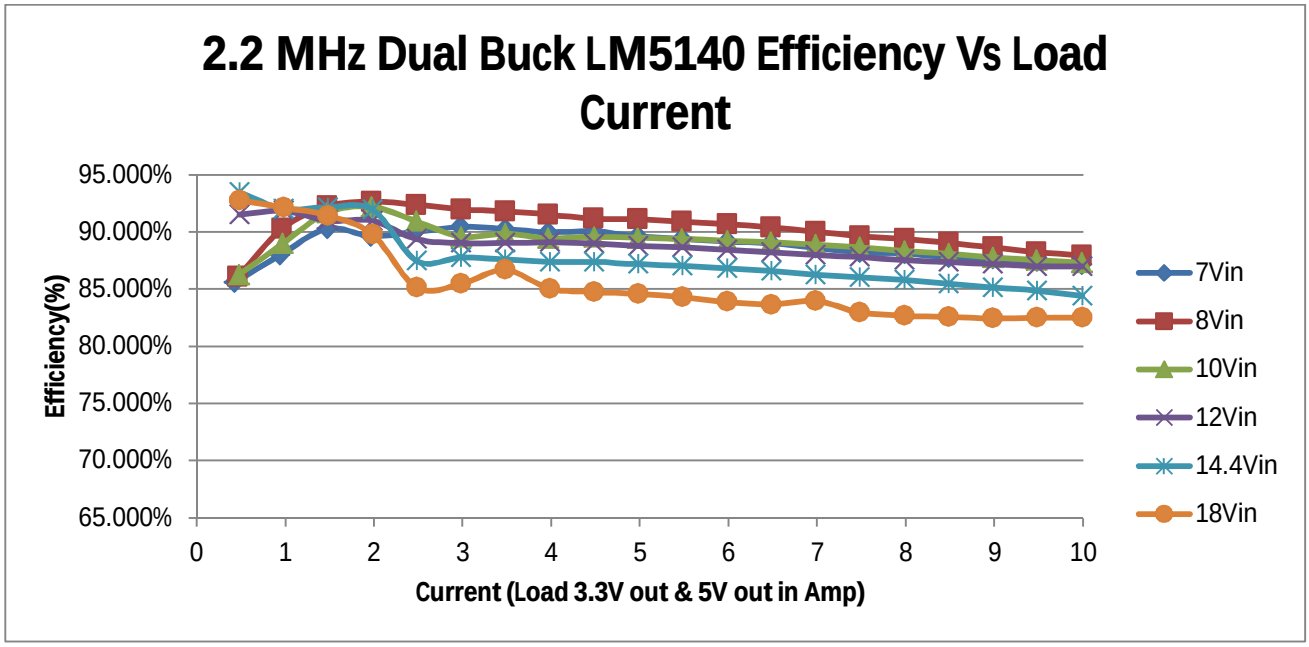
IR thermal image taken at steady state with 6 Vin and 5V@10A and 3.3V @ 10A (Boost is operational)



5. Efficiency data

5.1 Dual Buck Efficiency – LM5140 only

5.1.1 Efficiency Chart



5.1.2 Efficiency Data- Dual Buck Efficiency only

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Vout2(V)	Iout2(A)	Efficiency(%)
7	0.636	3.3555	0.5	5.031	0.424	85.600%
7	1.309	3.3555	1	5.031	0.936	88.012%
7	1.966	3.3555	1.5	5.031	1.47	90.313%
7	2.64	3.3555	2	5.031	1.96	89.674%
7	3.295	3.3555	2.5	5.031	2.46	90.028%
7	3.949	3.3555	3	5.031	2.97	90.470%
7	4.6255	3.3555	3.5	5.031	3.476	90.282%
7	5.294	3.3555	4	5.031	3.962	90.007%
7	5.96	3.3555	4.5	5.031	4.47	90.097%
7	6.658	3.3555	5	5.031	4.97	89.648%

7	7.3425	3.3555	5.5	5.031	5.47	89.450%
7	8.0425	3.3555	6	5.031	5.98	89.202%
7	8.725	3.3555	6.5	5.031	6.476	89.057%
7	9.4455	3.3555	7	5.031	6.98	88.636%
7	10.165	3.3555	7.5	5.031	7.48	88.255%
7	10.858	3.3555	8	5.031	7.98	88.140%
7	11.5805	3.3555	8.5	5.031	8.48	87.813%
7	12.2825	3.3555	9	5.031	8.98	87.672%
7	12.995	3.3555	9.5	5.031	9.48	87.474%
7	13.7285	3.3555	10	5.031	9.98	87.164%

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Vout2(V)	Iout2(A)	Efficiency(%)
8	0.5795	3.3555	0.5	5.031	0.46	86.109%
8	1.133	3.3555	1	5.031	0.96	90.305%
8	1.6835	3.3555	1.5	5.031	1.47	92.284%
8	2.242	3.3555	2	5.031	1.97	92.674%
8	2.8155	3.3555	2.5	5.031	2.47	92.414%
8	3.404	3.3555	3	5.031	2.98	92.020%
8	3.978	3.3555	3.5	5.031	3.476	91.855%
8	4.554	3.3555	4	5.031	3.962	91.554%
8	5.1515	3.3555	4.5	5.031	4.47	91.207%
8	5.7305	3.3555	5	5.031	4.97	91.139%
8	6.3185	3.3555	5.5	5.031	5.47	90.953%
8	6.919	3.3555	6	5.031	5.98	90.726%
8	7.518	3.3555	6.5	5.031	6.476	90.435%
8	8.1345	3.3555	7	5.031	6.98	90.056%
8	8.755	3.3555	7.5	5.031	7.48	89.660%
8	9.3645	3.3555	8	5.031	7.98	89.422%
8	9.99	3.3555	8.5	5.031	8.48	89.070%
8	10.626	3.3555	9	5.031	8.98	88.672%
8	11.2625	3.3555	9.5	5.031	9.472	88.270%
8	11.9015	3.3555	10	5.031	9.98	87.977%

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Vout2(V)	Iout2(A)	Efficiency(%)
10	0.4685	3.3555	0.5	5.031	0.47	86.282%
10	0.923	3.3555	1	5.031	0.966	89.008%
10	1.355	3.3555	1.5	5.031	1.47	91.726%
10	1.802	3.3555	2	5.031	1.97	92.242%
10	2.288	3.3555	2.5	5.031	2.47	90.976%
10	2.7965	3.3555	3	5.031	2.98	89.608%
10	3.2525	3.3555	3.5	5.031	3.476	89.875%
10	3.728	3.3555	4	5.031	3.962	89.471%
10	4.2	3.3555	4.5	5.031	4.478	89.592%
10	4.668	3.3555	5	5.031	4.97	89.506%
10	5.1415	3.3555	5.5	5.031	5.47	89.419%
10	5.625	3.3555	6	5.031	5.98	89.277%
10	6.102	3.3555	6.5	5.031	6.476	89.137%
10	6.59	3.3555	7	5.031	6.98	88.930%
10	7.0815	3.3555	7.5	5.031	7.48	88.679%
10	7.583	3.3555	8	5.031	7.98	88.344%
10	8.079	3.3555	8.5	5.031	8.48	88.111%
10	8.584	3.3555	9	5.031	8.98	87.812%
10	9.081	3.3555	9.5	5.031	9.472	87.579%
10	9.59	3.3555	10	5.031	9.98	87.346%

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Vout2(V)	Iout2(A)	Efficiency(%)
12	0.3725	3.3555	0.5	5.031	0.48	91.558%
12	0.7515	3.3555	1	5.031	0.98	91.882%
12	1.1425	3.3555	1.5	5.031	1.48	91.022%
12	1.5265	3.3555	2	5.031	1.98	91.016%
12	1.945	3.3555	2.5	5.031	2.48	89.399%
12	2.3445	3.3555	3	5.031	2.98	89.070%
12	2.735	3.3555	3.5	5.031	3.476	89.068%
12	3.1275	3.3555	4	5.031	3.98	89.116%
12	3.5225	3.3555	4.5	5.031	4.48	89.043%
12	3.925	3.3555	5	5.031	4.98	88.815%
12	4.3255	3.3555	5.5	5.031	5.48	88.670%
12	4.7315	3.3555	6	5.031	5.98	88.447%
12	5.137	3.3555	6.5	5.031	6.48	88.268%
12	5.5485	3.3555	7	5.031	6.98	88.019%

12	5.9585	3.3555	7.5	5.031	7.48	87.827%
12	6.376	3.3555	8	5.031	7.98	87.557%
12	6.788	3.3555	8.5	5.031	8.484	87.415%
12	7.202	3.3555	9	5.031	8.98	87.219%
12	7.6195	3.3555	9.5	5.031	9.48	87.026%
12	8.0285	3.3555	10	5.031	9.99	86.997%

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Vout2(V)	Iout2(A)	Efficiency(%)
14.4	0.304	3.3555	0.5	5.031	0.48	93.490%
14.4	0.625	3.3555	1	5.031	0.98	92.065%
14.4	0.94	3.3555	1.5	5.031	1.48	92.192%
14.4	1.2585	3.3555	2	5.031	1.98	91.999%
14.4	1.656	3.3555	2.5	5.031	2.48	87.500%
14.4	1.982	3.3555	3	5.031	2.98	87.800%
14.4	2.3165	3.3555	3.5	5.031	3.476	87.632%
14.4	2.657	3.3555	4	5.031	3.98	87.414%
14.4	2.99	3.3555	4.5	5.031	4.48	87.418%
14.4	3.331	3.3555	5	5.031	4.98	87.211%
14.4	3.67	3.3555	5.5	5.031	5.48	87.090%
14.4	4.015	3.3555	6	5.031	5.98	86.859%
14.4	4.3635	3.3555	6.5	5.031	6.48	86.595%
14.4	4.7165	3.3555	7	5.031	6.98	86.288%
14.4	5.068	3.3555	7.5	5.031	7.48	86.049%
14.4	5.421	3.3555	8	5.031	7.98	85.818%
14.4	5.7825	3.3555	8.5	5.031	8.48	85.489%
14.4	6.1475	3.3555	9	5.031	8.98	85.150%
14.4	6.5085	3.3555	9.5	5.031	9.48	84.901%
14.4	6.893	3.3555	10	5.031	9.99	84.440%

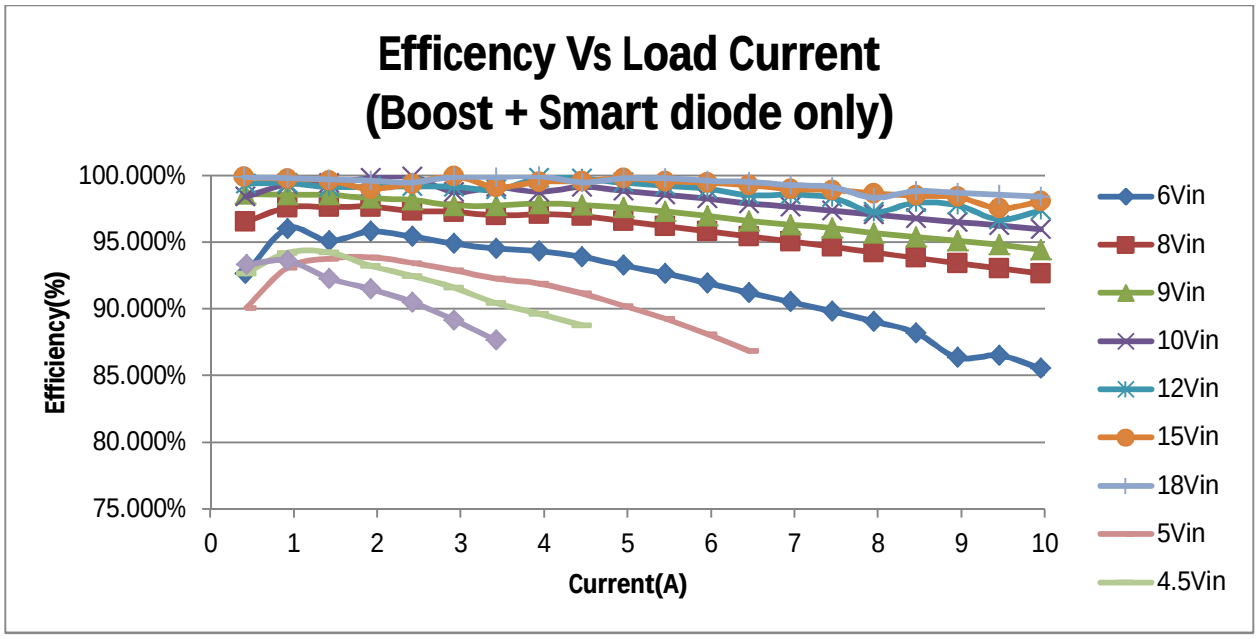
Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Vout2(V)	Iout2(A)	Efficiency(%)
18	0.245	3.3555	0.5	5.031	0.48	92.803%
18	0.4995	3.3555	1	5.031	0.98	92.157%
18	0.758	3.3555	1.5	5.031	1.48	91.462%
18	1.0315	3.3555	2	5.031	1.98	89.796%
18	1.361	3.3555	2.5	5.031	2.48	85.173%

18	1.6285	3.3555	3	5.031	2.98	85.487%
18	1.8725	3.3555	3.5	5.031	3.476	86.729%
18	2.184	3.3555	4	5.031	3.98	85.077%
18	2.4665	3.3555	4.5	5.031	4.48	84.777%
18	2.7465	3.3555	5	5.031	4.98	84.617%
18	3.033	3.3555	5.5	5.031	5.48	84.304%
18	3.3245	3.3555	6	5.031	5.98	83.920%
18	3.613	3.3555	6.5	5.031	6.48	83.666%
18	3.876	3.3555	7	5.031	6.98	84.000%
18	4.204	3.3555	7.5	5.031	7.48	82.987%
18	4.5	3.3555	8	5.031	7.98	82.705%
18	4.7875	3.3555	8.5	5.031	8.48	82.605%
18	5.078	3.3555	9	5.031	8.98	82.467%
18	5.3575	3.3555	9.5	5.031	9.48	82.513%
18	5.6435	3.3555	10	5.031	9.99	82.509%

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Vout2(V)	Iout2(A)	Efficiency(%)
32	0.1725	3.3555	0.5	5.031	0.5	75.965%
32	0.3335	3.3555	1	5.031	1	78.584%
32	0.5455	3.3555	1.5	5.031	1.5	72.065%
32	0.715	3.3555	2	5.031	2	73.309%
32	0.8845	3.3555	2.5	5.031	2.5	74.075%
32	1.06	3.3555	3	5.031	3	74.173%
32	1.2505	3.3555	3.5	5.031	3.5	73.353%
32	1.434	3.3555	4	5.031	4	73.104%
32	1.6205	3.3555	4.5	5.031	4.5	72.777%
32	1.8145	3.3555	5	5.031	5	72.218%
32	2.008	3.3555	5.5	5.031	5.5	71.784%
32	2.208	3.3555	6	5.031	6	71.217%
32	2.4165	3.3555	6.5	5.031	6.5	70.495%
32	2.63	3.3555	7	5.031	7	69.755%
32	2.8545	3.3555	7.5	5.031	7.5	68.859%
32	2.9765	3.3555	8	5.031	8	70.439%
32	3.113	3.3555	8.5	5.031	8.5	71.560%
32	3.3505	3.3555	9	5.031	9	70.399%
32	3.612	3.3555	9.5	5.031	9.5	68.930%
32	3.8	3.3555	10	5.031	10	68.968%

5.2 Boost efficiency – LM5122 only

5.2.1 Efficiency Chart



5.2.2 Efficiency Data- Boost Efficiency only

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
6.003	0.75	9.933	0.42	92.662%
6.003	1.585	9.933	0.92	96.044%
6.003	2.47	9.932	1.42	95.117%
6.003	3.315	9.932	1.92	95.827%
6.003	4.195	9.932	2.42	95.445%
6.003	5.09	9.932	2.92	94.915%
6.003	5.985	9.932	3.42	94.543%
6.003	6.91	9.932	3.94	94.338%
6.003	7.84	9.932	4.45	93.910%
6.003	8.78	9.932	4.95	93.278%
6.003	9.73	9.932	5.45	92.673%
6.003	10.705	9.932	5.95	91.960%

6.003	11.695	9.932	6.45	91.249%
6.003	12.7	9.932	6.95	90.542%
6.003	13.72	9.932	7.45	89.840%
6.002	14.77	9.932	7.95	89.069%
6.003	15.845	9.932	8.45	88.233%
6.003	17.145	9.932	8.95	86.368%
6.003	18.07	9.932	9.45	86.525%
6.002	19.245	9.932	9.95	85.555%

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
8.002	0.54	9.933	0.42	96.547%
8.002	1.17	9.933	0.92	97.608%
8.002	1.805	9.933	1.42	97.655%
8.002	2.44	9.933	1.92	97.677%
8.002	3.085	9.932	2.42	97.364%
8.002	3.725	9.933	2.92	97.306%
8.002	4.375	9.932	3.42	97.026%
8.002	5.035	9.932	3.94	97.126%
8.002	5.695	9.932	4.45	96.985%
8.002	6.36	9.932	4.95	96.602%
8.002	7.03	9.932	5.45	96.223%
8.002	7.705	9.932	5.95	95.848%
8.002	8.385	9.932	6.45	95.476%
8.002	9.075	9.932	6.95	95.055%
8.002	9.765	9.932	7.45	94.694%
8.002	10.47	9.932	7.95	94.245%
8.002	11.175	9.932	8.45	93.853%
8.002	11.885	9.931	8.95	93.458%
8.002	12.6	9.931	9.45	93.080%
8.002	13.325	9.931	9.95	92.672%

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
9.002	0.47	9.933	0.42	98.604%
9.001	1.03	9.933	0.92	98.569%
9.001	1.59	9.933	1.42	98.556%
9.001	2.155	9.933	1.92	98.320%
9.001	2.72	9.933	2.42	98.183%
9.002	3.295	9.932	2.92	97.774%
9.001	3.86	9.932	3.42	97.765%
9.001	4.44	9.932	3.94	97.917%
9.001	5.02	9.932	4.45	97.814%
9.001	5.595	9.932	4.95	97.623%
9.001	6.18	9.932	5.45	97.309%
9.001	6.77	9.932	5.95	96.978%
9.001	7.365	9.932	6.45	96.635%
9.001	7.96	9.932	6.95	96.342%
9.001	8.555	9.932	7.45	96.091%
9.001	9.165	9.931	7.95	95.705%
9.001	9.77	9.931	8.45	95.425%
9.001	10.38	9.931	8.95	95.132%
9.001	10.995	9.931	9.45	94.828%
9.001	11.62	9.931	9.95	94.475%

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
10.003	0.426	9.988	0.42	98.444%
10.003	0.923	9.97	0.92	99.346%
10.003	1.4205	9.951	1.42	99.445%
10.003	1.91	9.932	1.92	99.810%
10.003	2.405	9.932	2.42	99.909%
10.003	2.935	9.932	2.92	98.783%
10.003	3.425	9.932	3.42	99.145%
10.003	3.96	9.932	3.94	98.789%
10.003	4.455	9.932	4.45	99.179%
10.003	4.97	9.932	4.95	98.891%
10.003	5.49	9.932	5.45	98.567%
10.003	6.01	9.932	5.95	98.299%
10.003	6.54	9.932	6.45	97.924%
10.003	7.065	9.932	6.95	97.674%

10.003	7.595	9.932	7.45	97.395%
10.003	8.13	9.932	7.95	97.092%
10.003	8.665	9.931	8.45	96.817%
10.003	9.205	9.931	8.95	96.530%
10.003	9.745	9.931	9.45	96.275%
10.003	10.29	9.931	9.95	96.000%

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
12.002	0.426	11.987	0.424	99.406%
12.002	0.9225	11.969	0.92	99.455%
12.002	1.426	11.95	1.42	99.148%
12.002	1.9245	11.932	1.92	99.184%
12.002	2.4215	11.913	2.42	99.197%
12.002	2.918	11.895	2.92	99.176%
12.002	3.42	11.876	3.42	98.950%
12.002	3.9	11.858	3.94	99.814%
12.002	4.4	11.84	4.45	99.771%
12.002	4.9	11.82	4.95	99.489%
12.002	5.4	11.802	5.45	99.244%
12.002	5.9	11.784	5.95	99.016%
12.002	6.4	11.737	6.45	98.556%
12.002	6.9	11.746	6.95	98.576%
12.002	7.4	11.728	7.45	98.377%
12.002	7.9	11.603	7.95	97.287%
12.002	8.4	11.69	8.45	97.980%
12.002	8.9	11.671	8.95	97.788%
12.002	9.4	11.547	9.45	96.721%
12.002	9.9	11.632	9.95	97.407%

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
15.008	0.4	14.993	0.4	99.900%
15.008	0.92	14.975	0.92	99.780%
15.008	1.42	14.956	1.42	99.654%
15.008	1.93	14.938	1.92	99.018%
15.008	2.42	14.92	2.42	99.414%
15.008	2.9	14.902	2.92	99.978%
15.008	3.395	14.772	3.42	99.152%
15.008	3.92	14.865	3.94	99.553%
15.008	4.42	14.847	4.45	99.599%
15.008	4.9	14.828	4.95	99.809%
15.008	5.4	14.81	5.45	99.594%
15.008	5.895	14.791	5.95	99.474%
15.008	6.395	14.773	6.45	99.281%
15.008	6.9	14.754	6.95	99.020%
15.008	7.395	14.735	7.45	98.911%
15.008	7.9	14.717	7.95	98.682%
15.008	8.4	14.697	8.45	98.511%
15.008	8.895	14.679	8.95	98.413%
15.008	9.395	14.556	9.45	97.556%
15.008	9.895	14.64	9.95	98.090%

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
18.011	0.4	17.996	0.4	99.917%
18.011	0.92	17.978	0.92	99.817%
18.011	1.42	17.959	1.42	99.711%
18.011	1.92	17.941	1.92	99.611%
18.011	2.42	17.923	2.42	99.511%
18.011	2.905	17.905	2.92	99.925%
18.011	3.4	17.886	3.42	99.890%
18.011	3.91	17.868	3.94	99.967%
18.011	4.405	17.741	4.45	99.507%
18.011	4.91	17.831	4.95	99.807%
18.011	5.4	17.813	5.45	99.816%
18.011	5.9	17.794	5.95	99.632%
18.011	6.395	17.776	6.45	99.544%
18.011	6.9	17.757	6.95	99.304%

18.011	7.4	17.739	7.45	99.155%
18.011	7.905	17.615	7.95	98.358%
18.011	8.4	17.701	8.45	98.864%
18.011	8.9	17.682	8.95	98.725%
18.011	9.4	17.663	9.45	98.589%
18.011	9.9	17.644	9.95	98.457%

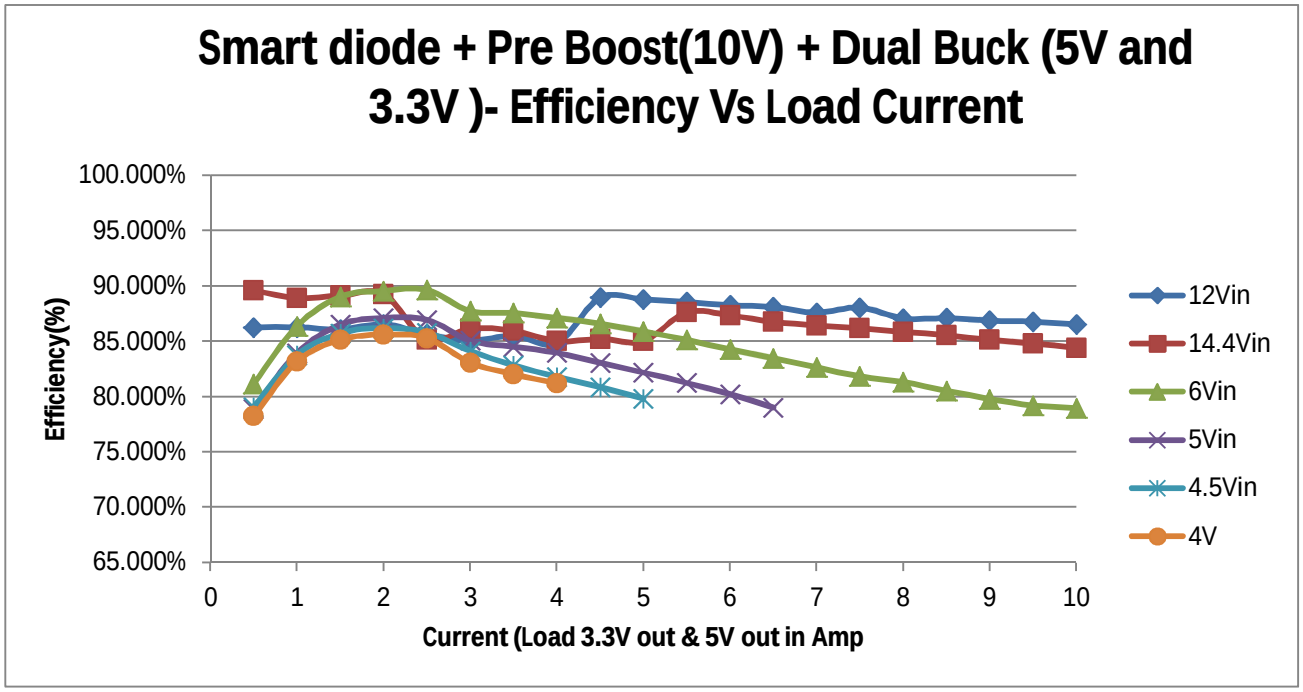
Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
5	0.948	9.933	0.43	90.109%
5	1.963	9.933	0.92	93.106%
5	3.007	9.932	1.42	93.804%
5	4.062	9.932	1.92	93.892%
5	5.143	9.932	2.42	93.469%
5	6.243	9.932	2.92	92.909%
5	7.361	9.932	3.42	92.290%
5	8.5145	9.932	3.94	91.919%
5	9.695	9.932	4.45	91.176%
5	10.895	9.932	4.95	90.249%
5	12.125	9.932	5.45	89.286%
5	13.41	9.932	5.95	88.136%
5	14.75	9.932	6.45	86.863%

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
4.5	1.024	9.932	0.43	92.681%
4.5	2.155	9.932	0.92	94.225%
4.5	3.325	9.932	1.42	94.259%
4.5	4.545	9.932	1.92	93.238%
4.5	5.7745	9.932	2.42	92.496%
4.5	7.0345	9.932	2.92	91.617%
4.5	8.345	9.932	3.42	90.453%
4.5	9.7	9.932	3.94	89.650%
4.5	11.06	9.932	4.45	88.803%

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
4	1.144	9.932	0.43	93.330%
4	2.44	9.932	0.92	93.621%
4	3.82	9.932	1.42	92.300%
4	5.21	9.932	1.92	91.504%
4	6.638	9.932	2.42	90.522%
4	8.13	9.932	2.92	89.180%
4	9.685	9.932	3.42	87.681%

5.3 Boost efficiency – System's Efficiency (Smart diode + Pre Boost + Dual Buck)

5.3.1 Efficiency Chart



5.3.2 Efficiency data- Complete system's Efficiency data

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Vout2(V)	Iout2(A)	Efficiency(%)
12	0.405	3.3555	0.5	5.031	0.5	86.281%
12	0.81	3.3555	1	5.031	1	86.281%
12	1.2175	3.3555	1.5	5.031	1.5	86.104%
12	1.615	3.3555	2	5.031	2	86.548%
12	2.04	3.3555	2.5	5.031	2.5	85.646%
12	2.465	3.3555	3	5.031	3	85.056%
12	2.86	3.3555	3.5	5.031	3.5	85.527%
12	3.295	3.3555	4	5.031	4	84.841%
12	3.535	3.3555	4.5	5.031	4.5	88.966%
12	3.935	3.3555	5	5.031	5	88.802%
12	4.3405	3.3555	5.5	5.031	5.5	88.557%
12	4.75	3.3555	6	5.031	6	88.279%
12	5.155	3.3555	6.5	5.031	6.5	88.122%
12	5.585	3.3555	7	5.031	7	87.594%
12	5.952	3.3555	7.5	5.031	7.5	88.064%
12	6.421	3.3555	8	5.031	8	87.074%
12	6.82	3.3555	8.5	5.031	8.5	87.103%
12	7.24	3.3555	9	5.031	9	86.877%
12	7.65	3.3555	9.5	5.031	9.5	86.788%
12	8.075	3.3555	10	5.031	10	86.548%

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Vout2(V)	Iout2(A)	Efficiency(%)
14.4	0.325	3.3555	0.5	5.031	0.5	89.599%
14.4	0.655	3.3555	1	5.031	1	88.915%
14.4	0.98	3.3555	1.5	5.031	1.5	89.142%
14.4	1.305	3.3555	2	5.031	2	89.256%
14.4	1.71	3.3555	2.5	5.031	2.5	85.146%
14.4	2.028	3.3555	3	5.031	3	86.153%
14.4	2.3715	3.3555	3.5	5.031	3.5	85.953%
14.4	2.74	3.3555	4	5.031	4	85.021%
14.4	3.075	3.3555	4.5	5.031	4.5	85.229%
14.4	3.425	3.3555	5	5.031	5	85.021%
14.4	3.6545	3.3555	5.5	5.031	5.5	87.650%

14.4	4.001	3.3555	6	5.031	6	87.338%
14.4	4.3635	3.3555	6.5	5.031	6.5	86.755%
14.4	4.7165	3.3555	7	5.031	7	86.436%
14.4	5.068	3.3555	7.5	5.031	7.5	86.187%
14.4	5.426	3.3555	8	5.031	8	85.867%
14.4	5.7865	3.3555	8.5	5.031	8.5	85.550%
14.4	6.157	3.3555	9	5.031	9	85.132%
14.4	6.5235	3.3555	9.5	5.031	9.5	84.813%
14.4	6.8995	3.3555	10	5.031	10	84.411%

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Vout2(V)	Iout2(A)	Efficiency(%)
6	0.861	3.3555	0.5	5.031	0.5	81.170%
6	1.618	3.3555	1	5.031	1	86.388%
6	2.3545	3.3555	1.5	5.031	1.5	89.048%
6	3.121	3.3555	2	5.031	2	89.571%
6	3.8975	3.3555	2.5	5.031	2.5	89.657%
6	4.779	3.3555	3	5.031	3	87.743%
6	5.587	3.3555	3.5	5.031	3.5	87.563%
6	6.4165	3.3555	4	5.031	4	87.135%
6	7.264	3.3555	4.5	5.031	4.5	86.590%
6	8.135	3.3555	5	5.031	5	85.910%
6	9.03	3.3555	5.5	5.031	5.5	85.134%
6	9.95	3.3555	6	5.031	6	84.286%
6	10.881	3.3555	6.5	5.031	6.5	83.498%
6	11.8385	3.3555	7	5.031	7	82.648%
6	12.81	3.3555	7.5	5.031	7.5	81.835%
6	13.7515	3.3555	8	5.031	8	81.315%
6	14.7505	3.3555	8.5	5.031	8.5	80.546%
6	15.7655	3.3555	9	5.031	9	79.793%
6	16.7655	3.3555	9.5	5.031	9.5	79.202%
6	17.705	3.3555	10	5.031	10	78.947%

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Vout2(V)	Iout2(A)	Efficiency(%)
5	1.063	3.3555	0.5	5.031	0.5	78.895%

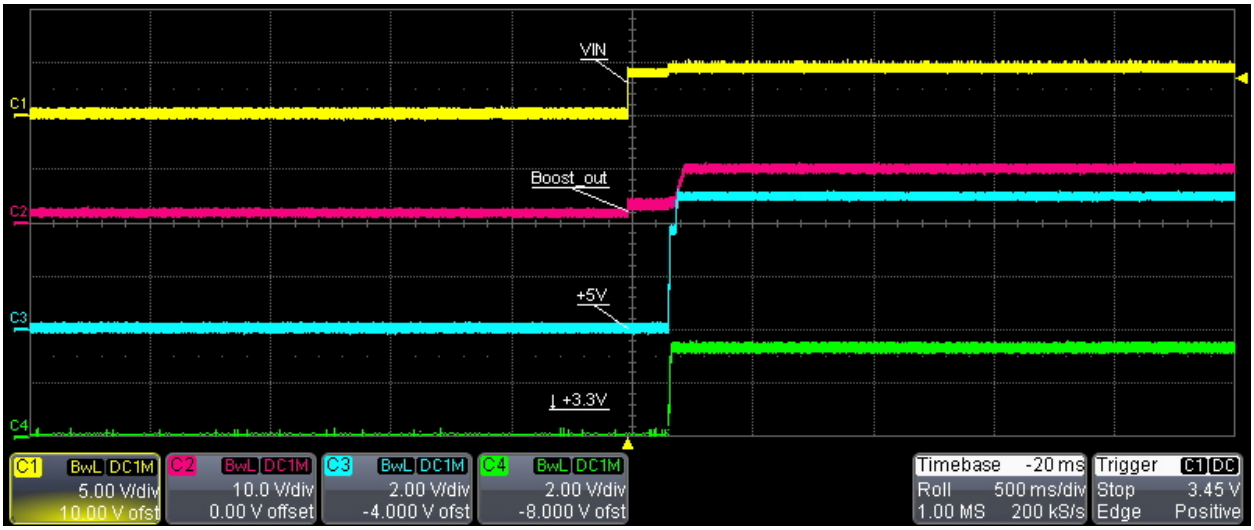
5	1.998	3.3555	1	5.031	1	83.949%
5	2.908	3.3555	1.5	5.031	1.5	86.518%
5	3.8505	3.3555	2	5.031	2	87.121%
5	4.82225	3.3555	2.5	5.031	2.5	86.956%
5	5.915	3.3555	3	5.031	3	85.070%
5	6.945	3.3555	3.5	5.031	3.5	84.529%
5	7.99	3.3555	4	5.031	4	83.970%
5	9.085	3.3555	4.5	5.031	4.5	83.080%
5	10.205	3.3555	5	5.031	5	82.180%
5	11.3535	3.3555	5.5	5.031	5.5	81.254%
5	12.541	3.3555	6	5.031	6	80.247%
5	13.795	3.3555	6.5	5.031	6.5	79.032%

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Vout2(V)	Iout2(A)	Efficiency(%)
4.5	1.178	3.3555	0.5	5.031	0.5	79.103%
4.5	2.225	3.3555	1	5.031	1	83.760%
4.5	3.26	3.3555	1.5	5.031	1.5	85.752%
4.5	4.325	3.3555	2	5.031	2	86.181%
4.5	5.43	3.3555	2.5	5.031	2.5	85.804%
4.5	6.645	3.3555	3	5.031	3	84.138%
4.5	7.875	3.3555	3.5	5.031	3.5	82.830%
4.5	9.115	3.3555	4	5.031	4	81.785%
4.5	10.37	3.3555	4.5	5.031	4.5	80.873%
4.5	11.67	3.3555	5	5.031	5	79.849%

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Vout2(V)	Iout2(A)	Efficiency(%)
4.09	1.31	3.3555	0.5	5.031	0.5	78.263%
4.09	2.4645	3.3555	1	5.031	1	83.201%
4.09	3.612	3.3555	1.5	5.031	1.5	85.153%
4.09	4.79	3.3555	2	5.031	2	85.615%
4.09	6.01	3.3555	2.5	5.031	2.5	85.295%
4.09	7.405	3.3555	3	5.031	3	83.072%
4.09	8.75	3.3555	3.5	5.031	3.5	82.020%
4.09	10.1	3.3555	4	5.031	4	81.207%

6. Waveforms

6.1 System's Startup Waveforms



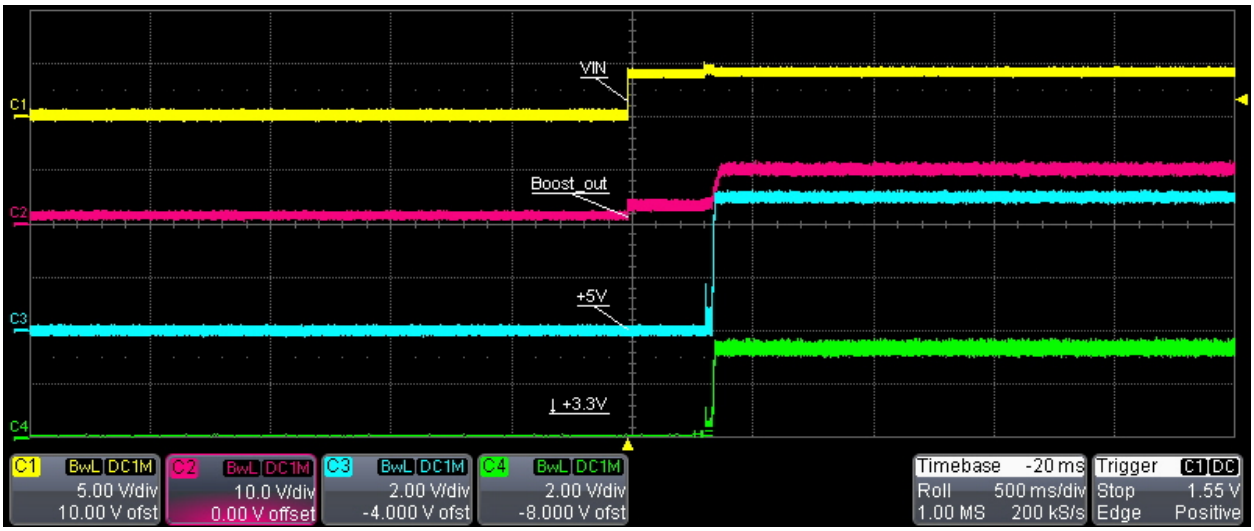
Startup into No Load at 4.5 Vin

C1- Vin

C2-Boost_Vout

C3- 5V_Buckout

C4-3.3V_Buckout



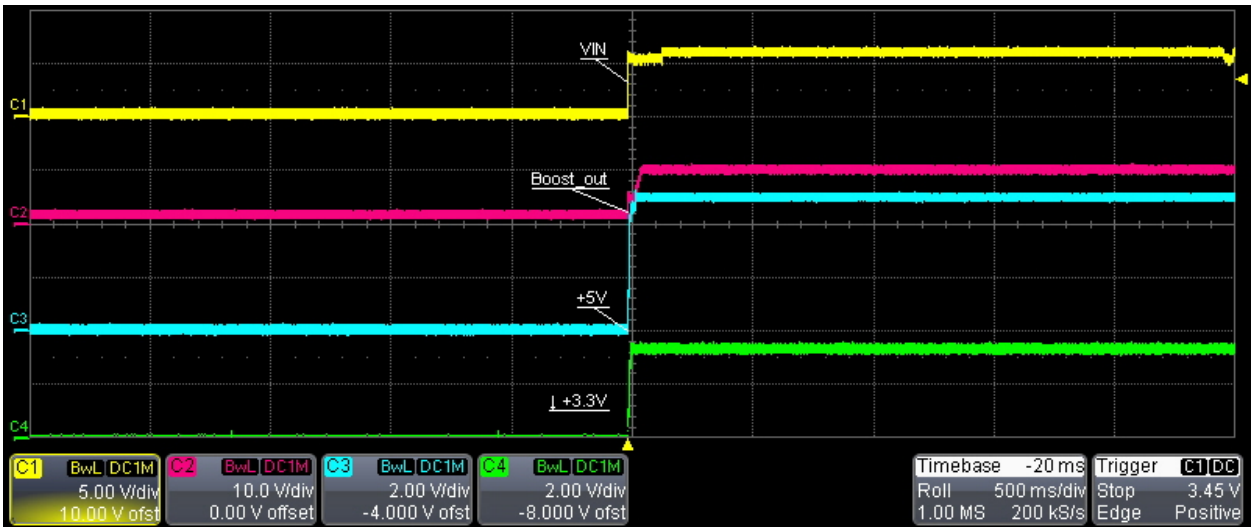
Startup into half Load(5V@4A 3.3V@4A) at 4.5 Vin

C1- Vin

C2-Boost_Vout

C3- 5V_Buckout

C4-3.3V_Buckout



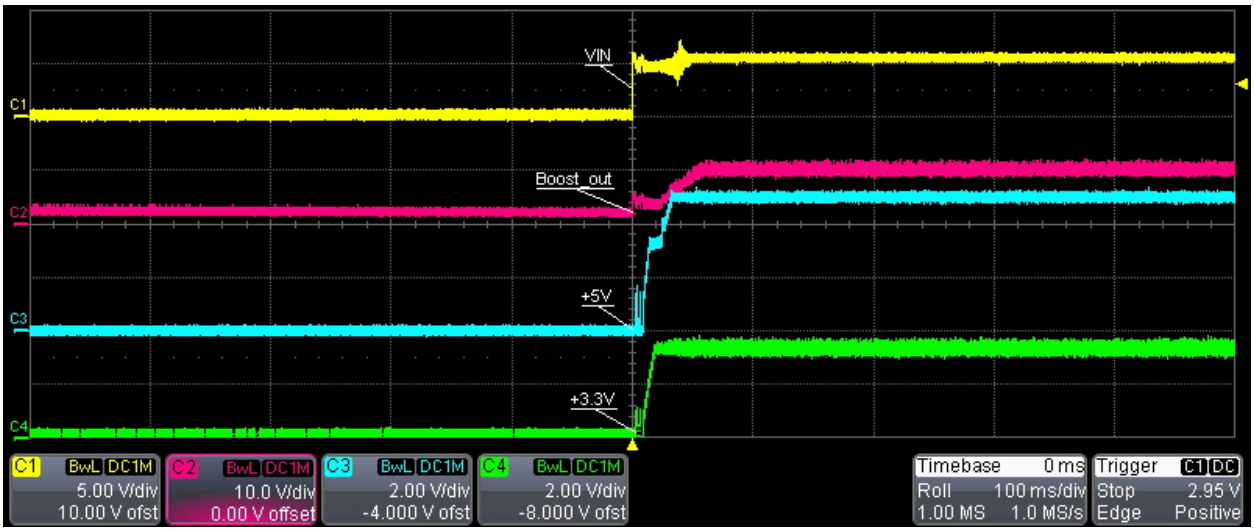
Startup into No Load at 6 Vin

C1- Vin

C2-Boost_Vout

C3- 5V_Buckout

C4-3.3V_Buckout



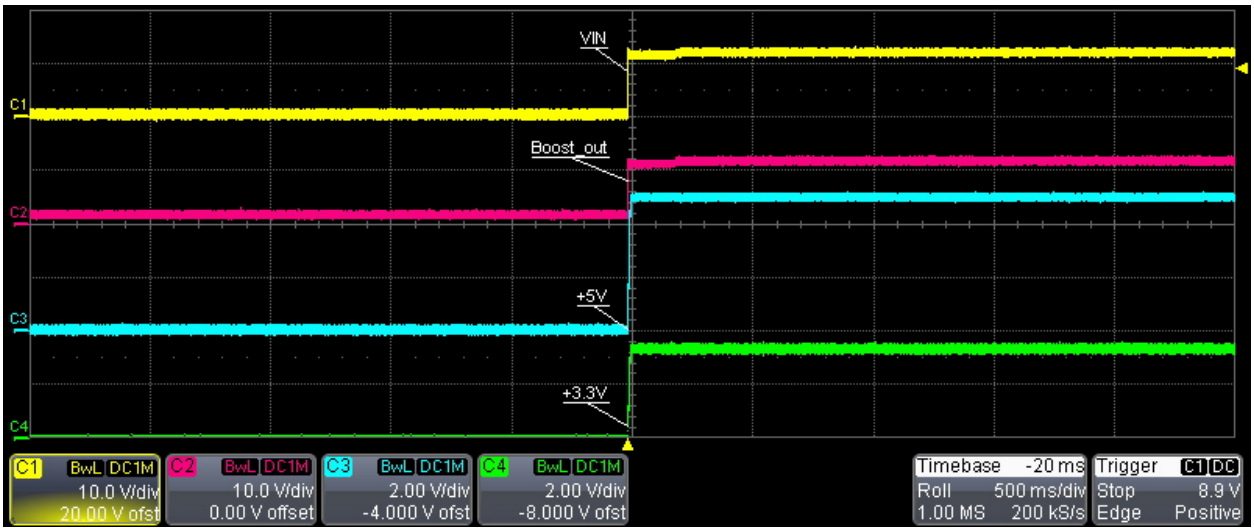
Startup into Full Load(5V@10A 3.3V@10A) at 6 Vin

C1- Vin

C2-Boost_Vout

C3- 5V_Buckout

C4-3.3V_Buckout



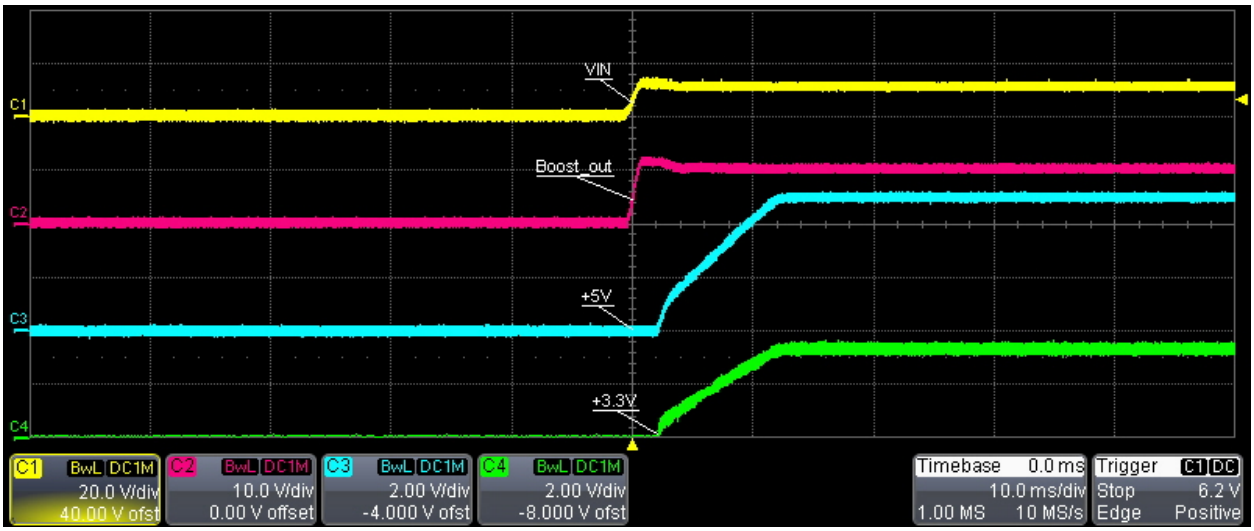
Startup into No Load at 12Vin

C1- Vin

C2-Boost_Vout

C3- 5V_Buckout

C4-3.3V_Buckout



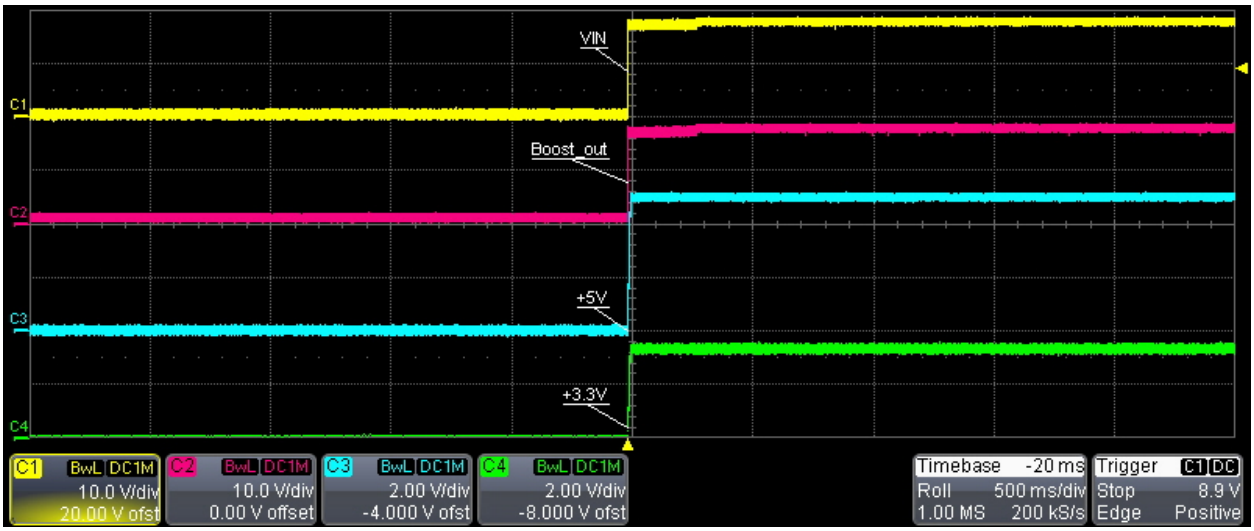
Startup into Full Load(5V@10A 3.3V@10A) at 12 Vin

C1- Vin

C2-Boost_Vout

C3- 5V_Buckout

C4-3.3V_Buckout



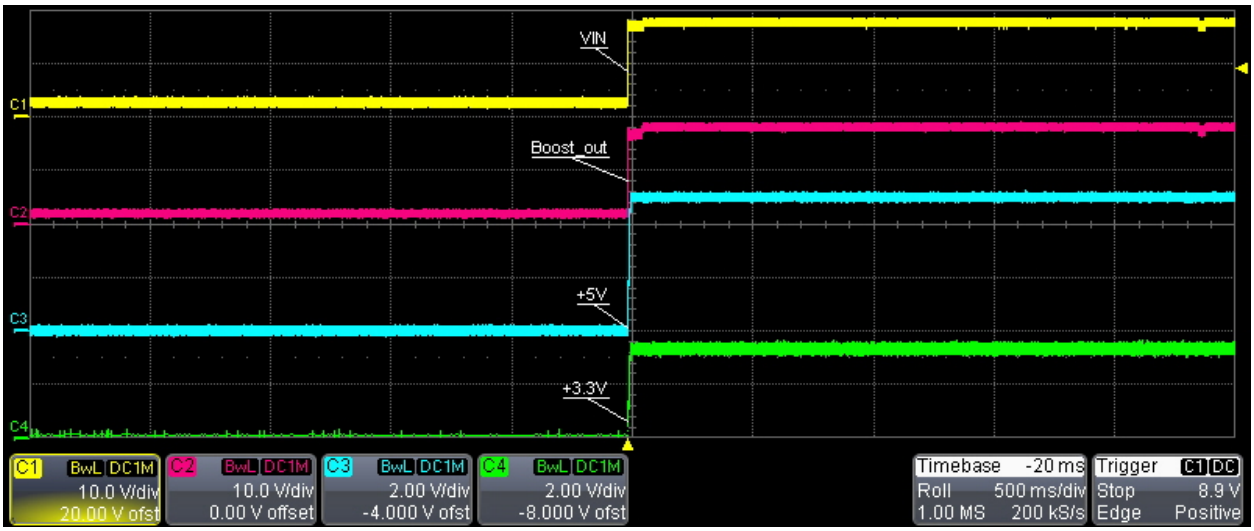
Startup into No Load at 18 Vin

C1- Vin

C2-Boost_Vout

C3- 5V_Buckout

C4-3.3V_Buckout



Startup into Full Load(5V@10A 3.3V@10A) at 18 Vin

C1- Vin

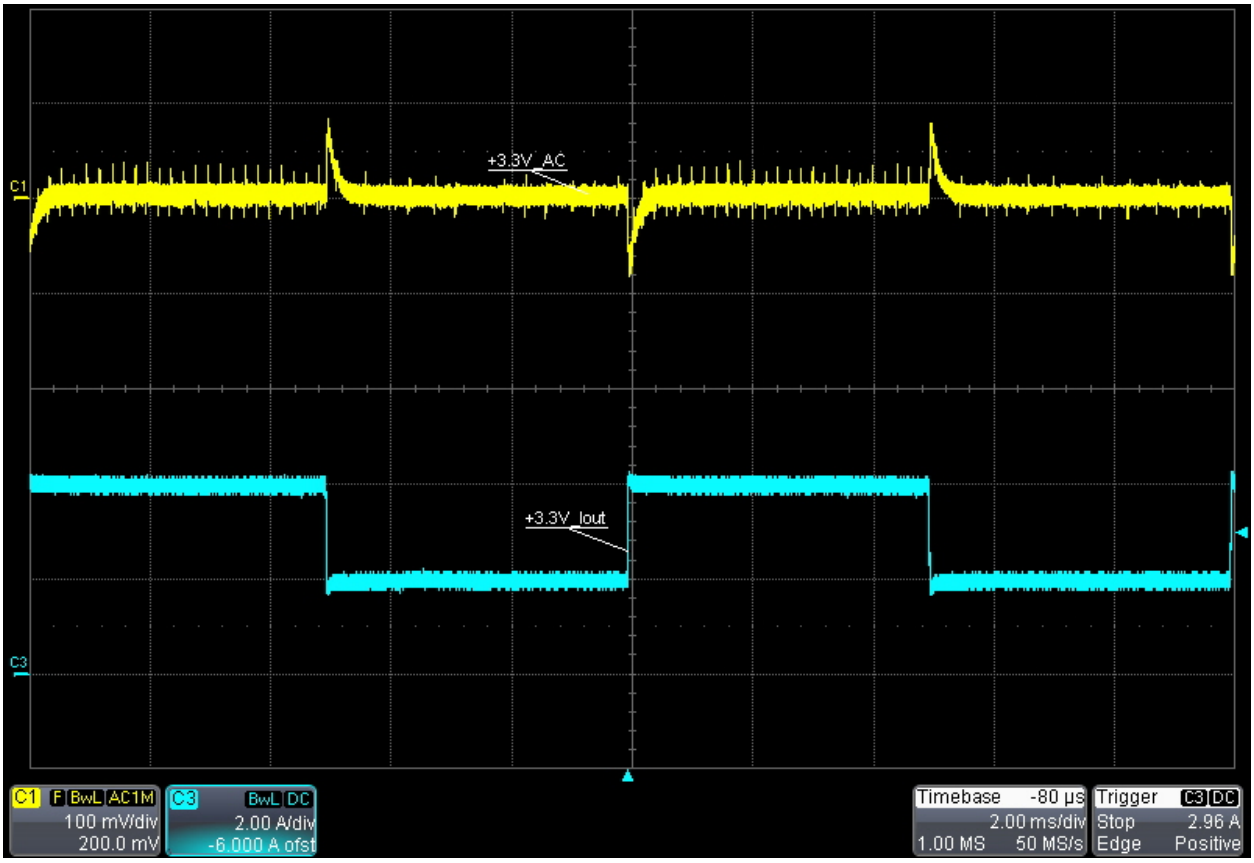
C2-Boost_Vout

C3- 5V_Buckout

C4-3.3V_Buckout

6.2 System's Transient performance

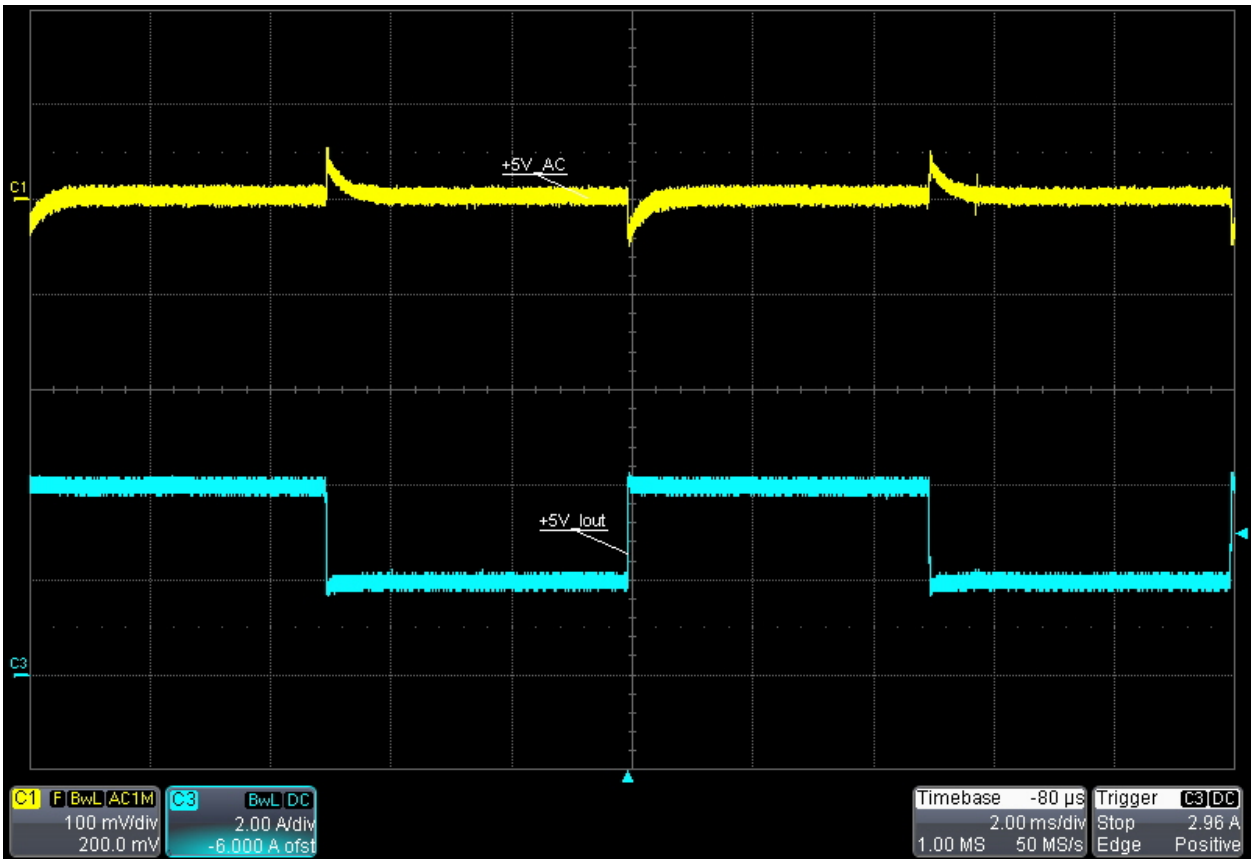
6.2.1 Dual Buck – Transient performance



Transient performance of 3.3V_Buck at Low Vin (4V) and 2A to 4A Current transient (No Load on Other buck output)

C1- 3.3V_AC coupled

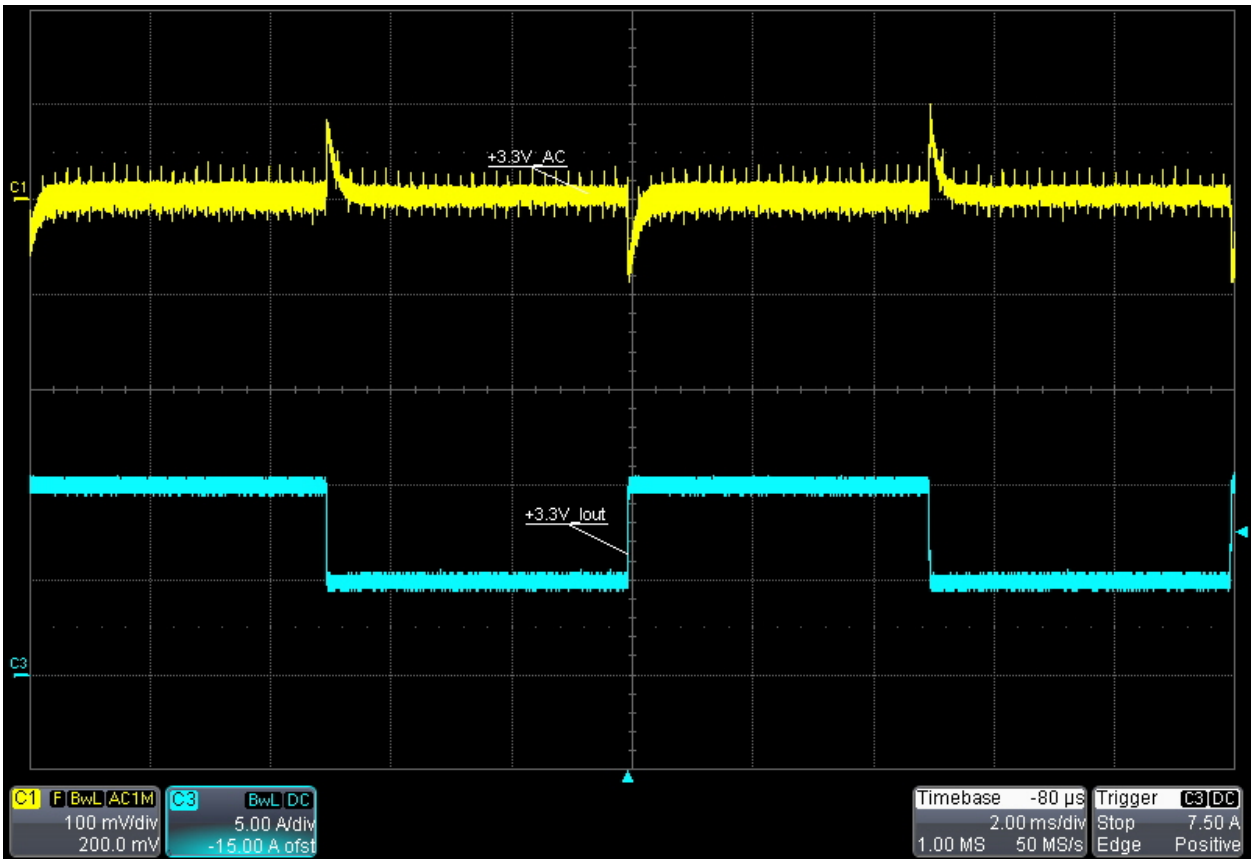
C3- 3.3V Load



Transient performance of 5V_Buck at Low Vin (4V) and 2A to 4A Current transient (No Load on other buck output)

C1- 5V_AC coupled

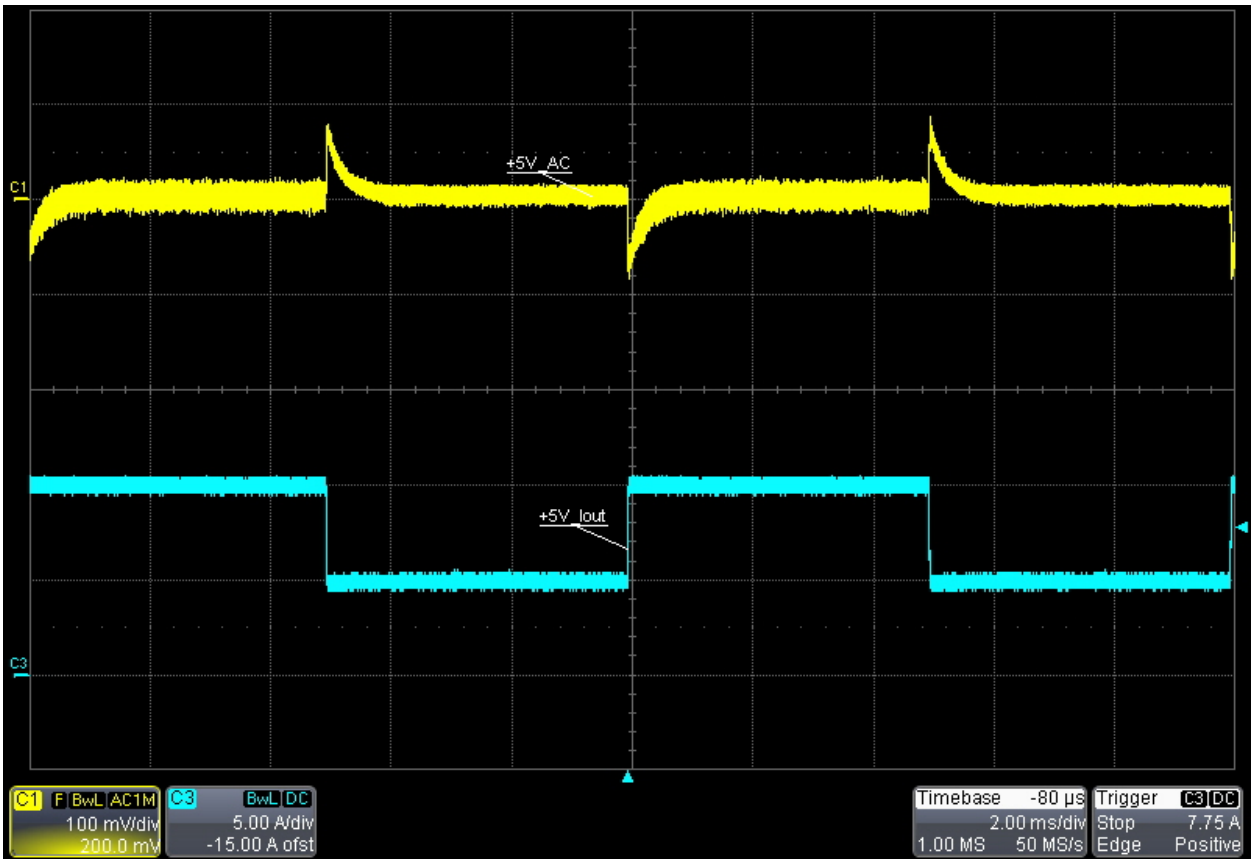
C3- 5V Load



Transient performance of 3.3V_Buck at 6Vin and 5A to 10 A Current transient (No Load on Other buck output)

C1- 3.3V_AC coupled

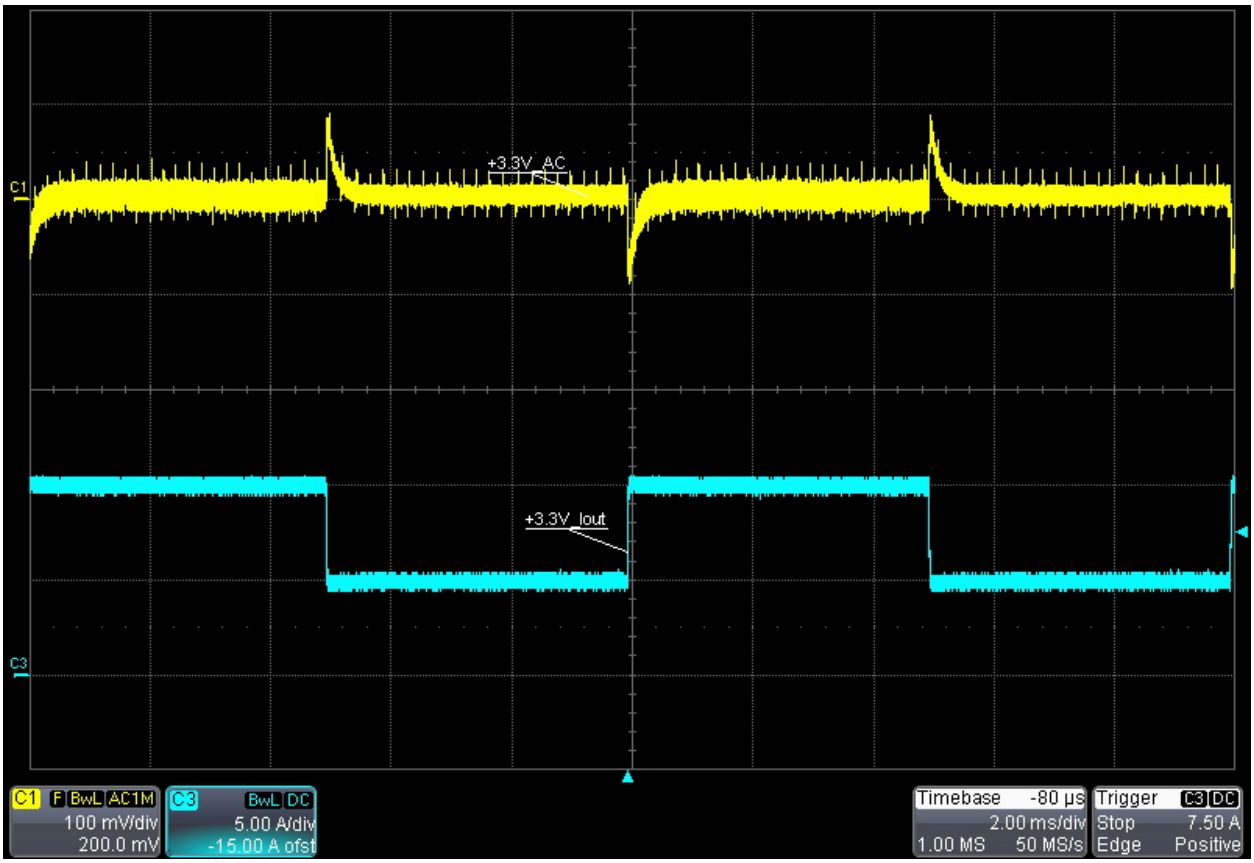
C3- 3.3V Load



Transient performance of 5V_Buck at 6Vin and 5A to 10 A Current transient (No Load on Other buck output)

C1- 5V_AC coupled

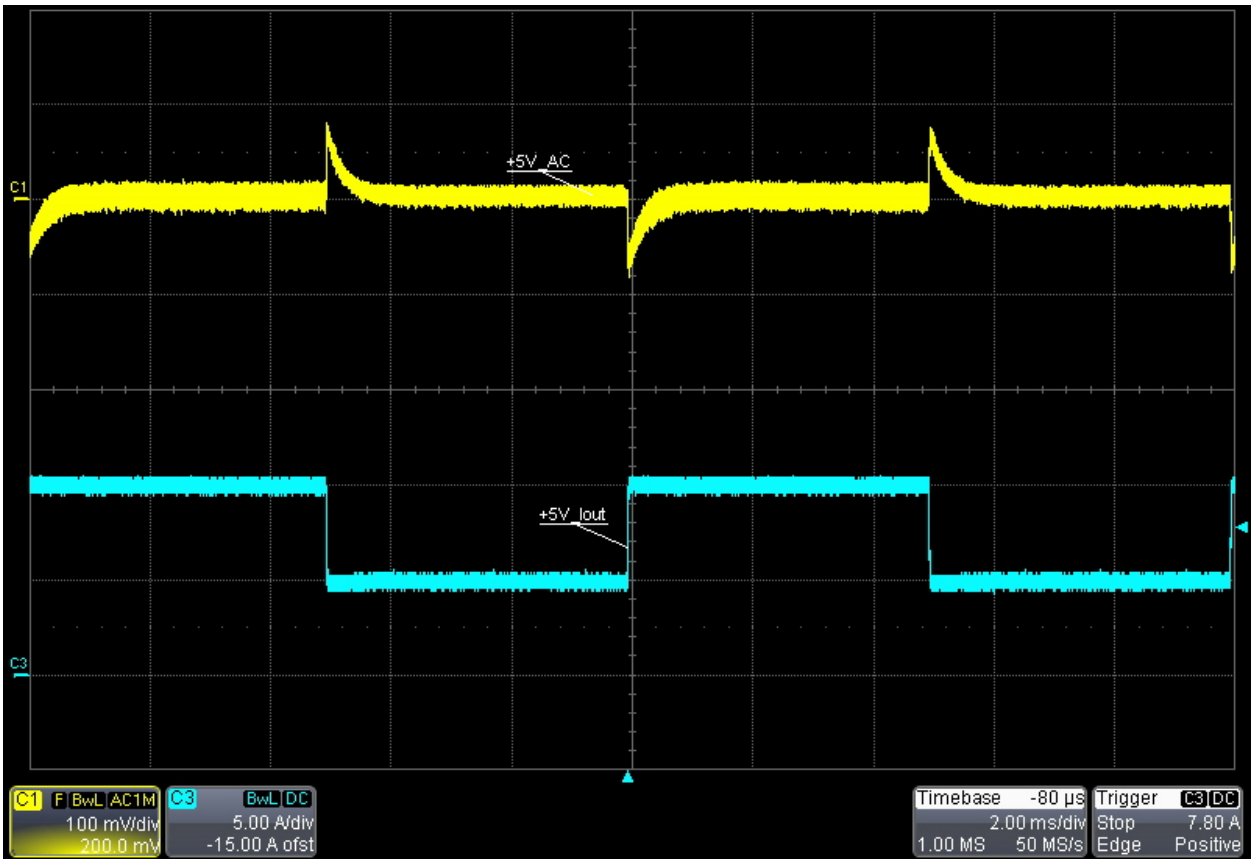
C3- 5V Load



Transient performance of 3.3V_Buck at 12Vin and 5A to 10 A Current transient (No Load on Other buck output)

C1- 3.3V_AC coupled

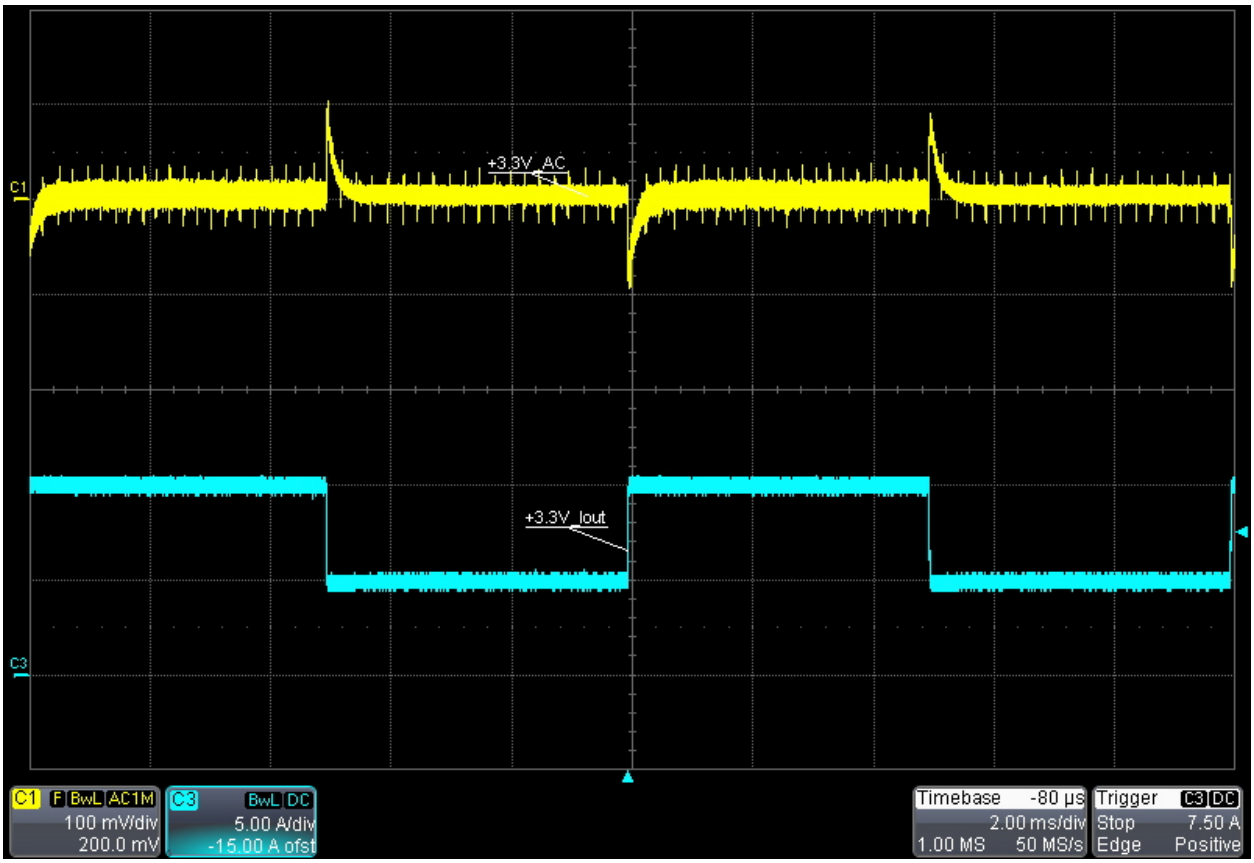
C3- 3.3V Load



Transient performance of 5V_Buck at 12 Vin and 5A to 10 A Current transient (No Load on Other buck output)

C1- 5V_AC coupled

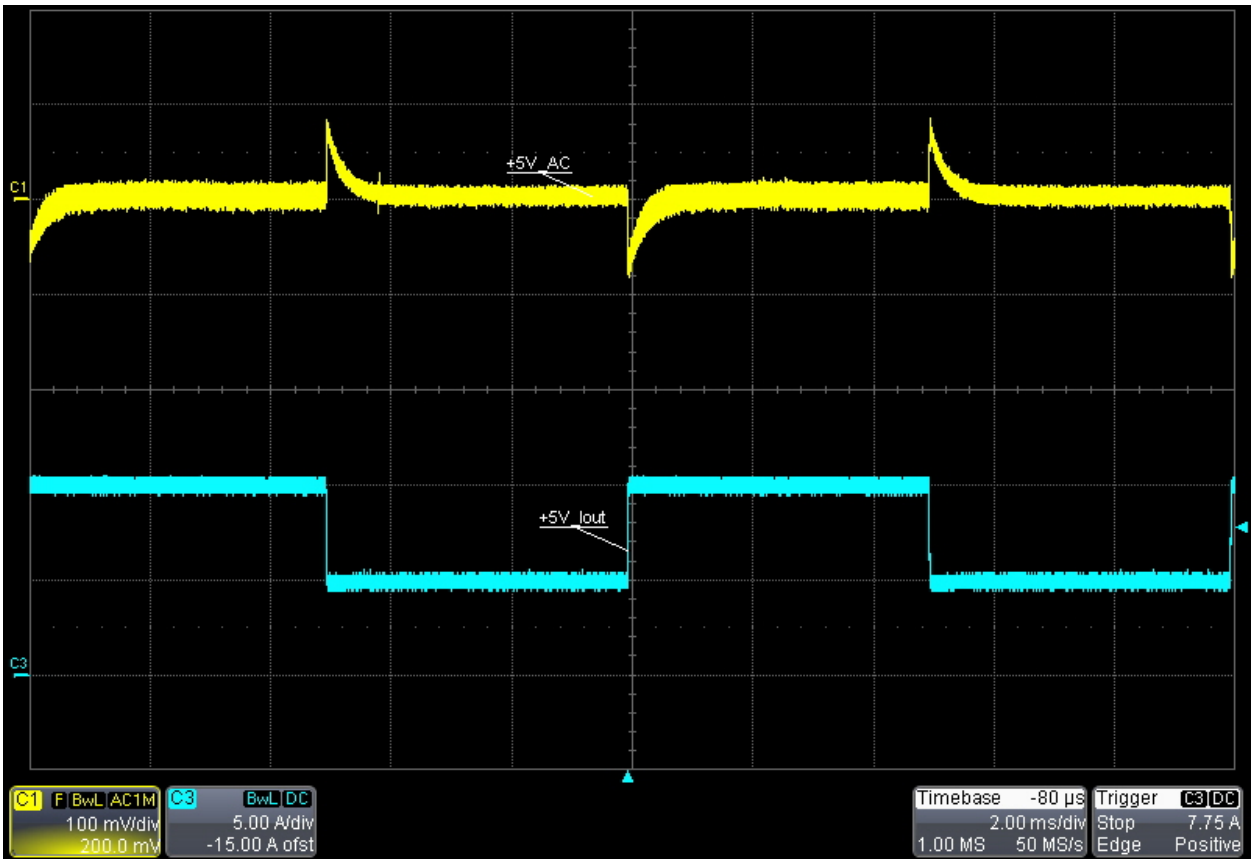
C3- 5V Load



Transient performance of 3.3V_Buck at 18Vin and 5A to 10 A Current transient (No Load on Other buck output)

C1- 3.3V_AC coupled

C3- 3.3V Load

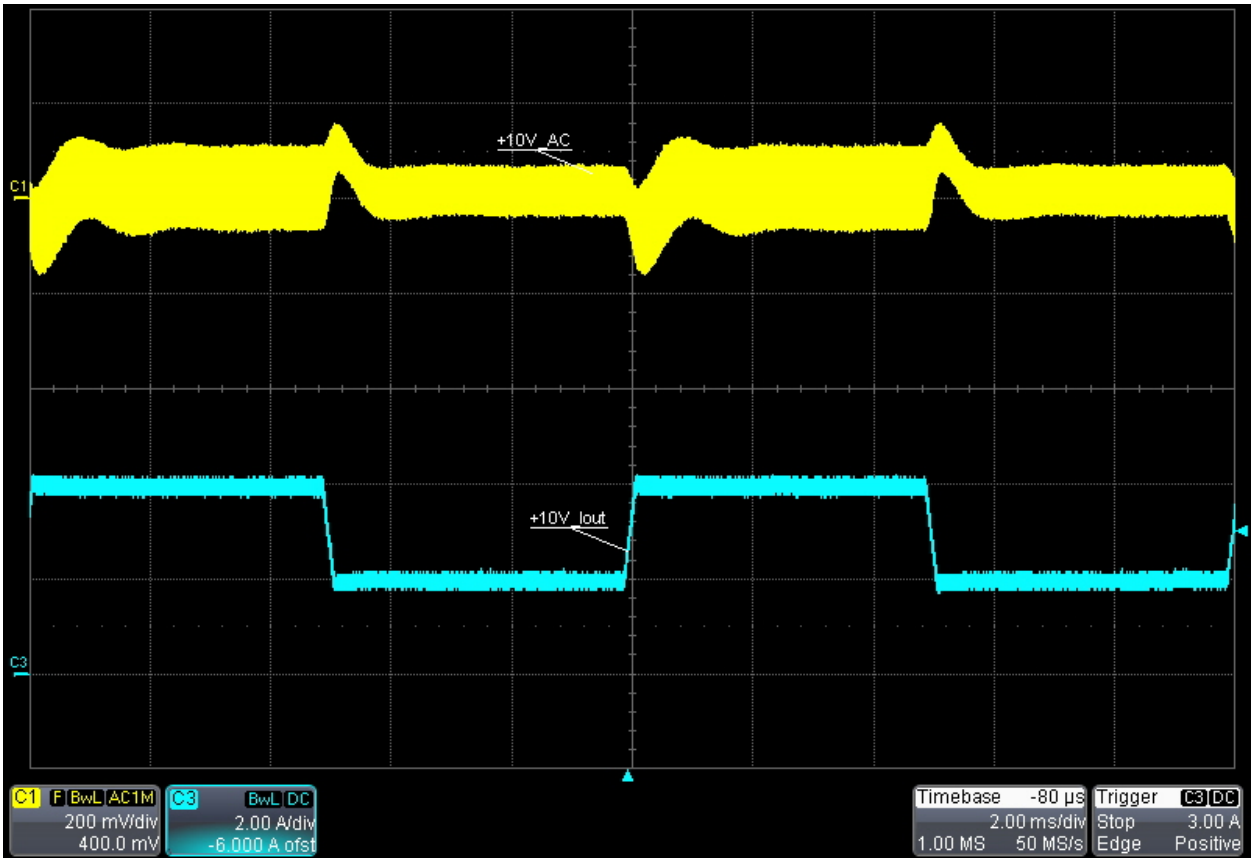


Transient performance of 3.3V_Buck at 18Vin and 5A to 10 A Current transient (No Load on Other buck output)

C1- 3.3V_AC coupled

C3- 3.3V Load

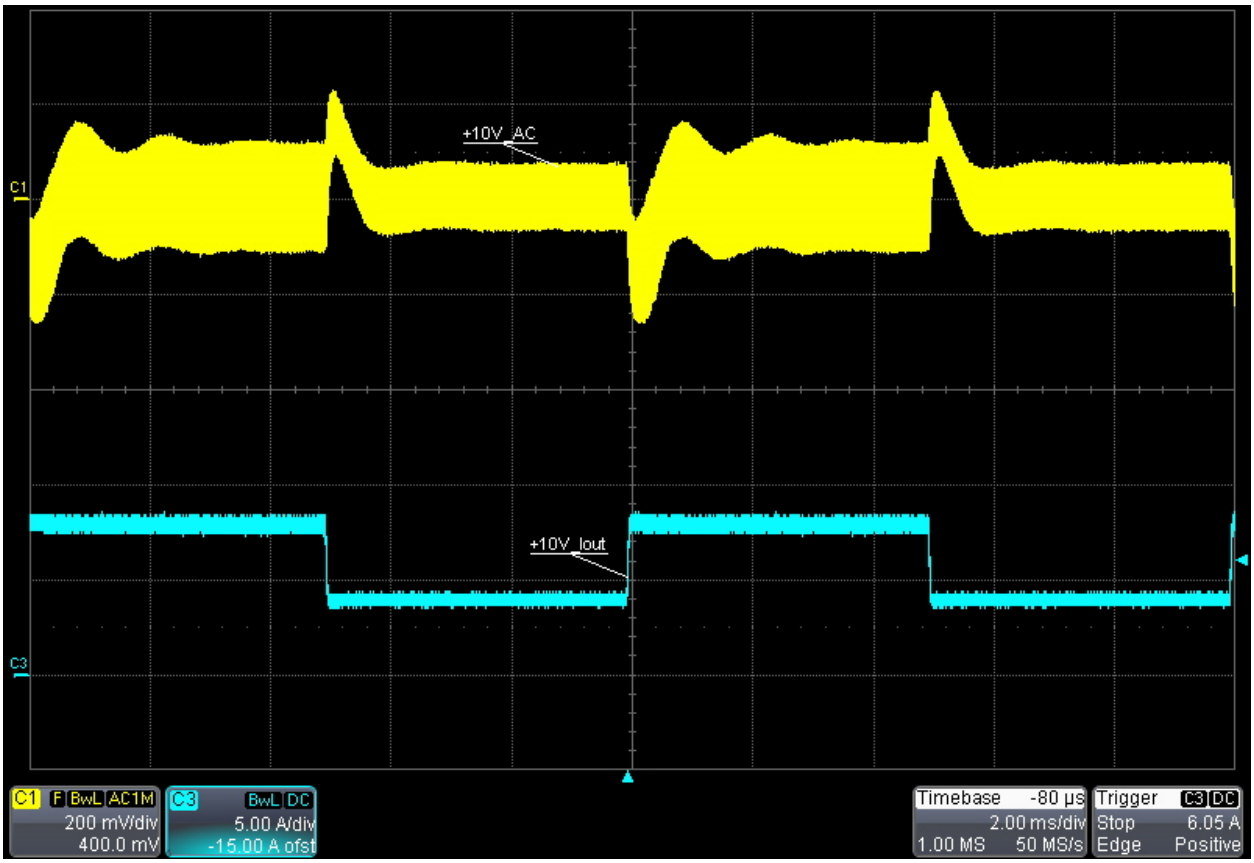
6.2.2 Pre Boost – Transient performance



Transient performance of 10V_Boost at Low Vin (4V) and 2A to 4A Current transient (Load on Boost output only)

C1- 10V_AC coupled

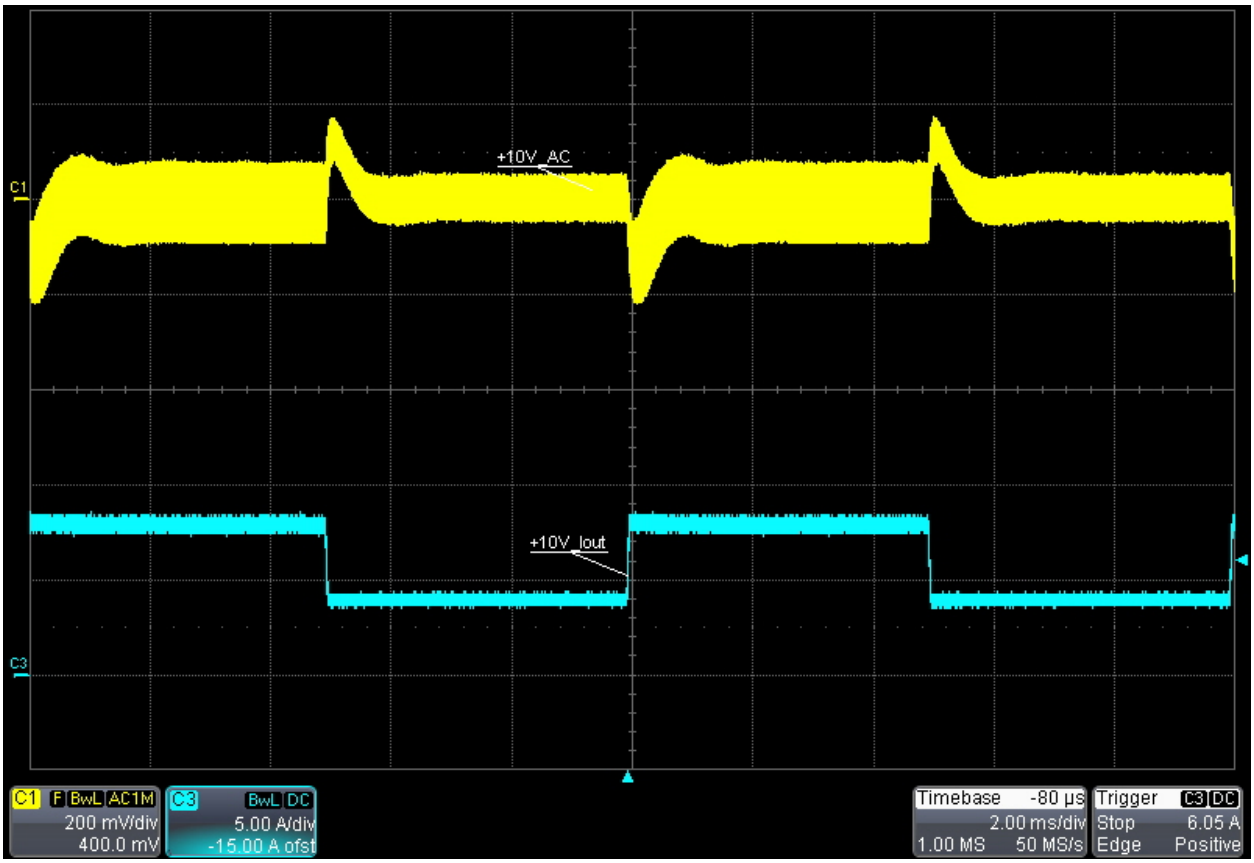
C3- 10 V Load



Transient performance of 10V_Boost at 6Vin and 4A to 8A Current transient (Load on Boost output only)

C1- 10V_AC coupled

C3- 10 V Load

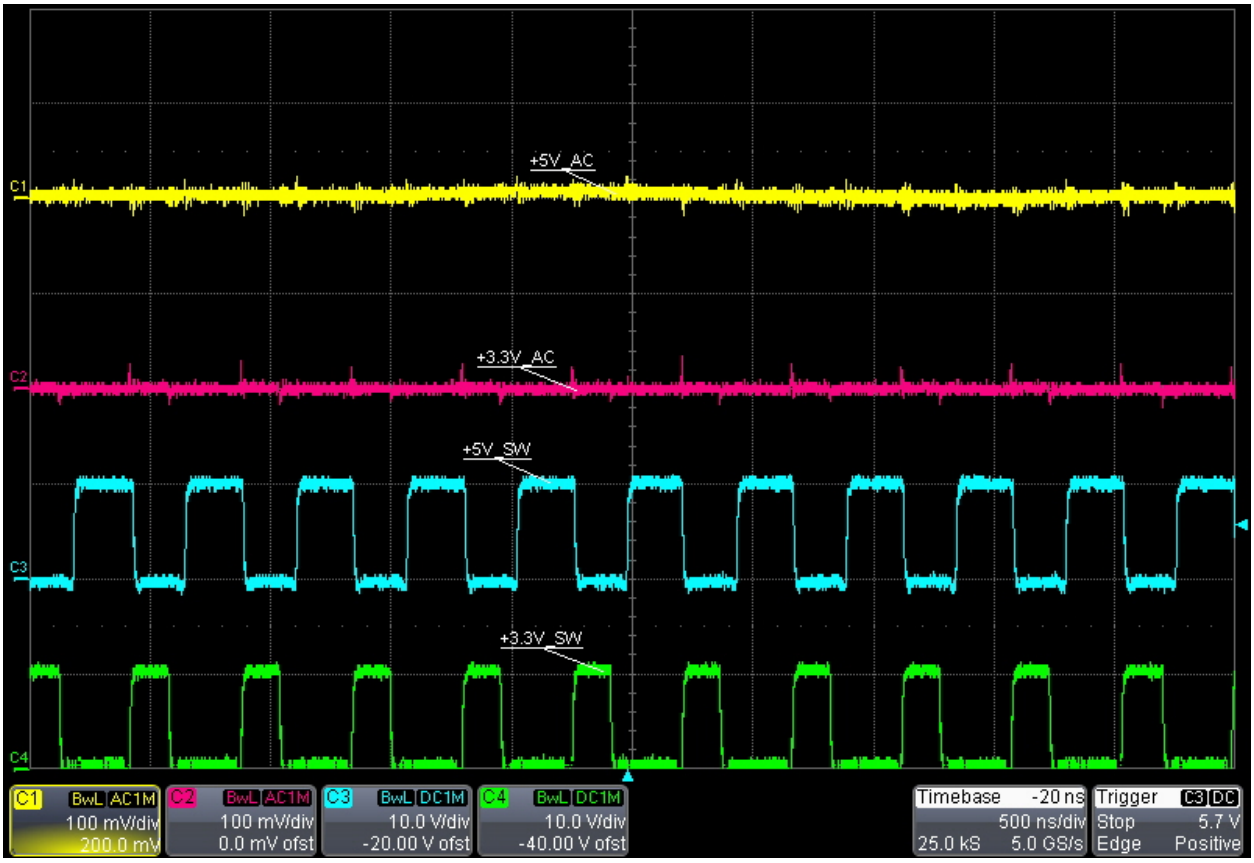


Transient performance of 10V_Boost at 8Vin and 4A to 8A Current transient (Load on Boost output only)

C1- 10V_AC coupled

C3- 10 V Load

6.3 Dual Buck Outputs Voltage ripple

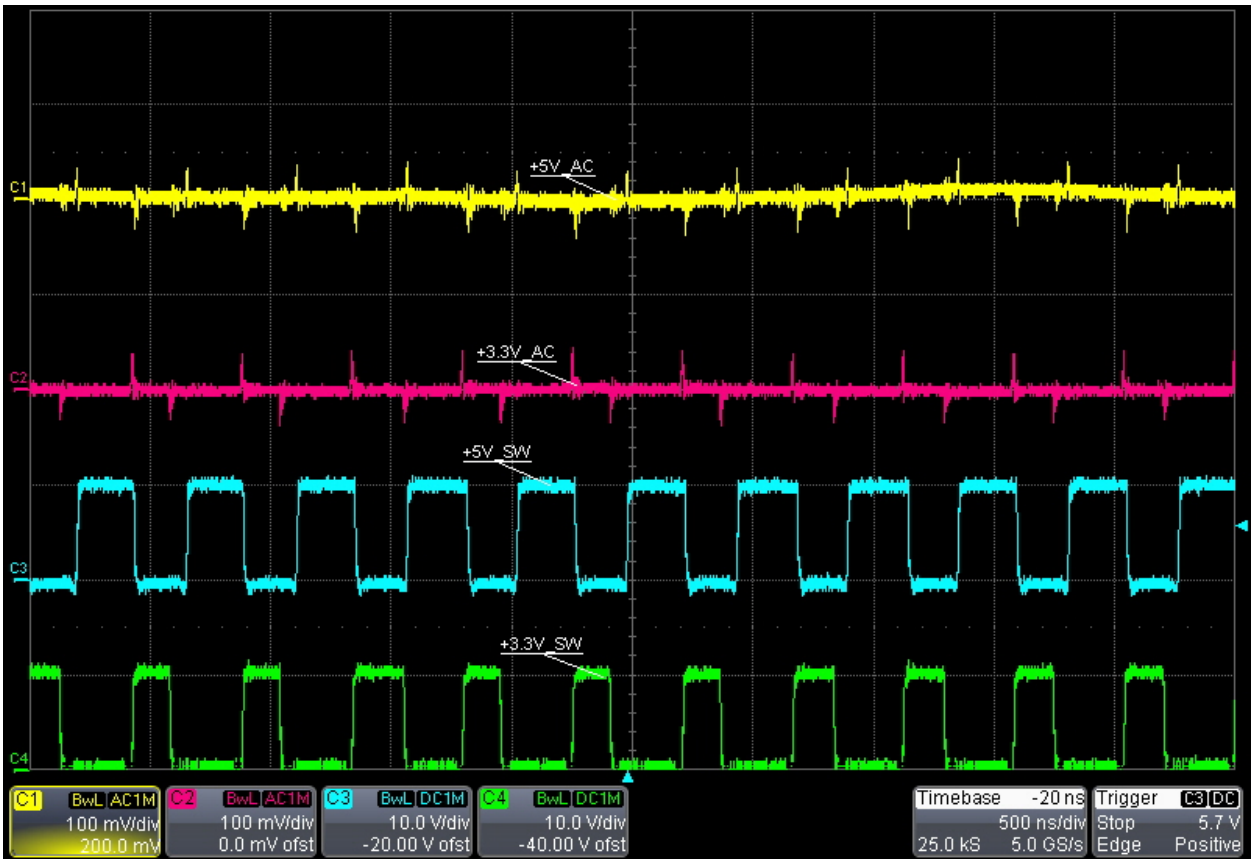


Ch1- 3.3V Ripple at 4Vin and 4A Load

Ch2- 5V Ripple at 4Vin and 4A Load

Ch3-Switch Node 5V Buck

Ch4- Switch Node 3.3V Buck

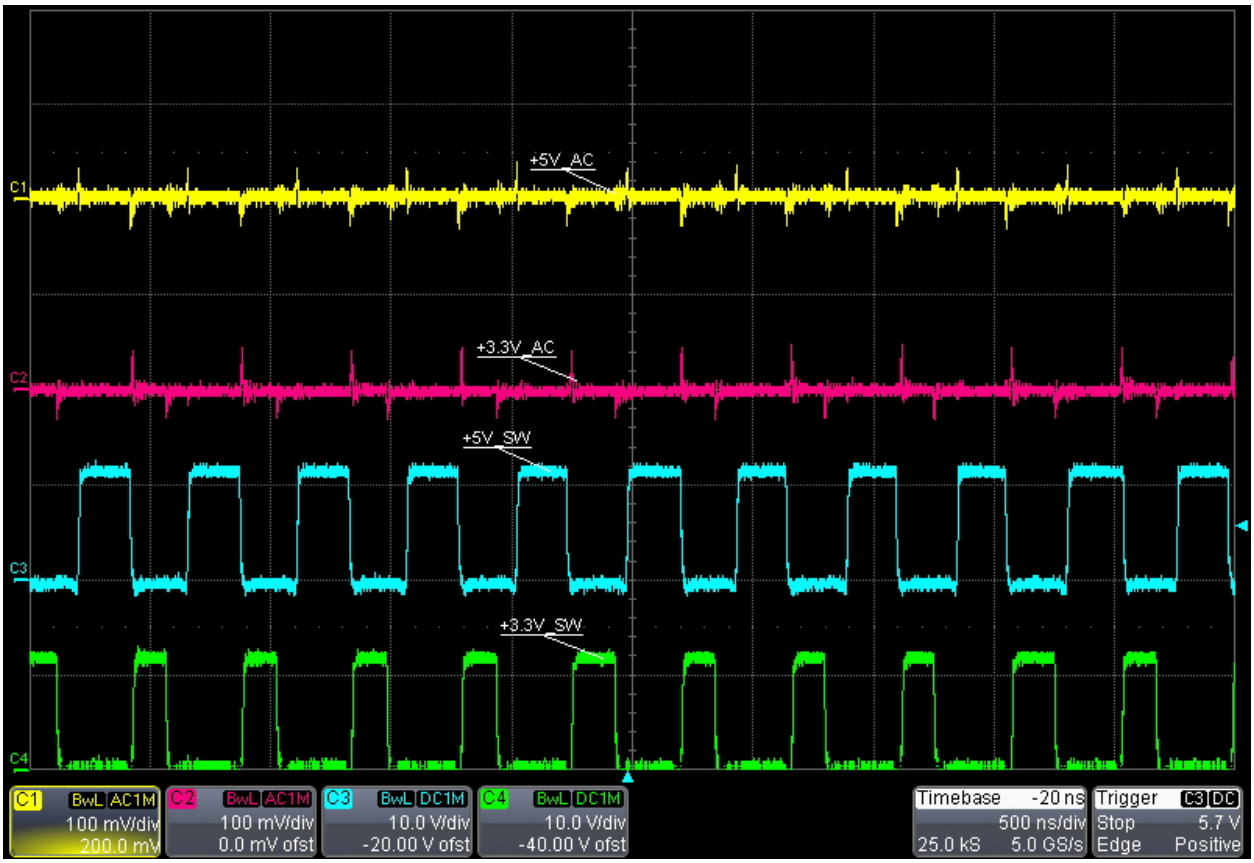


Ch1- 3.3V Ripple at 6Vin and 10A Load

Ch2- 5V Ripple at 6Vin and 10A Load

Ch3-Switch Node 5V Buck

Ch4- Switch Node 3.3V Buck



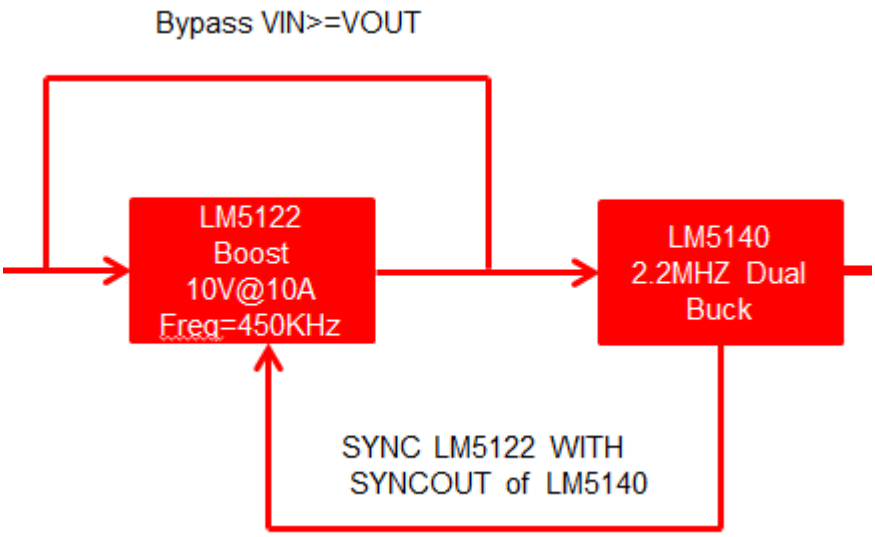
Ch1- 3.3V Ripple at 12Vin and 10A Load

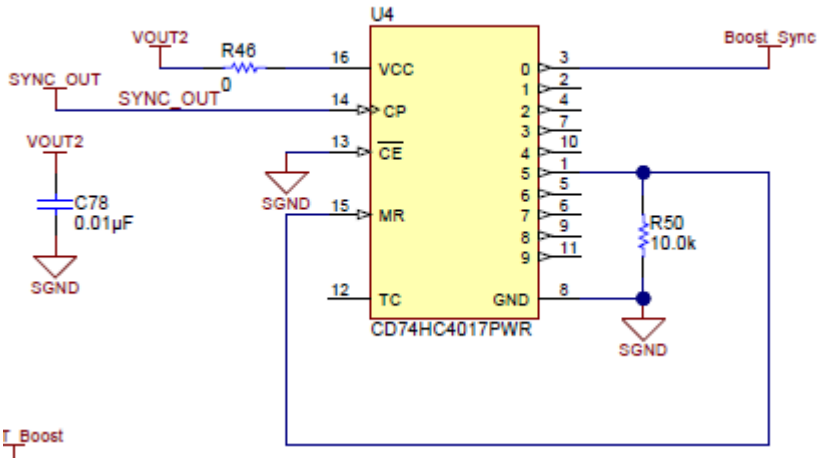
Ch2- 5V Ripple at 12 Vin and 10A Load

Ch3-Switch Node 5V Buck

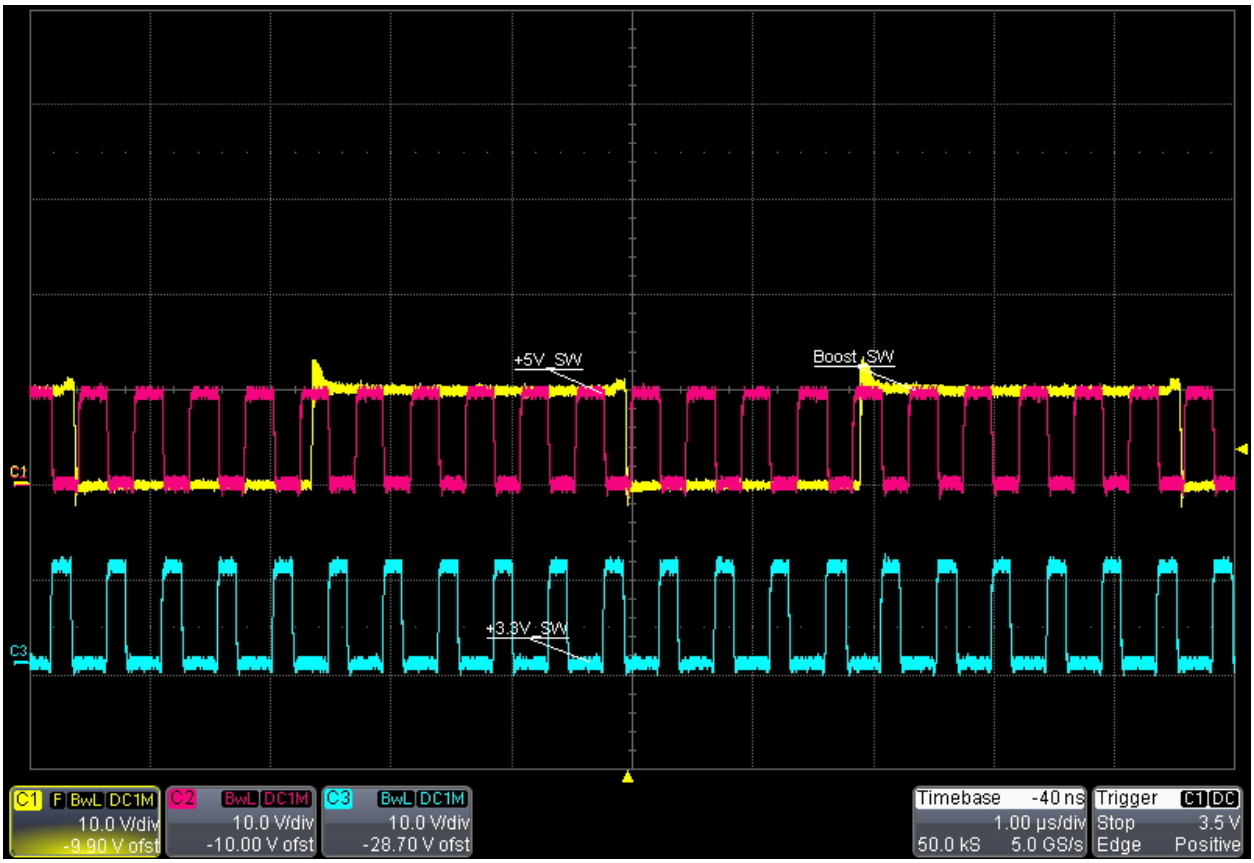
Ch4- Switch Node 3.3V Buck

7. Synchronization – Boost and Buck Controllers





Buck SYNC_OUT used to synchronize Boost controller at Freq/10 (divide/5 through counter and again divide by two by internal LM5122 oscillator)

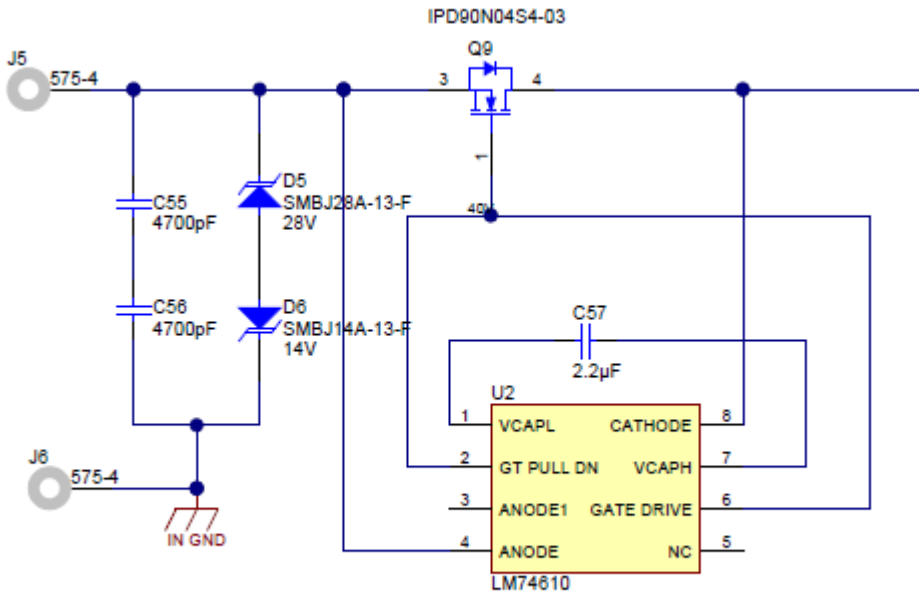


C2 – 5V Switch node at 6Vin and 10A Load

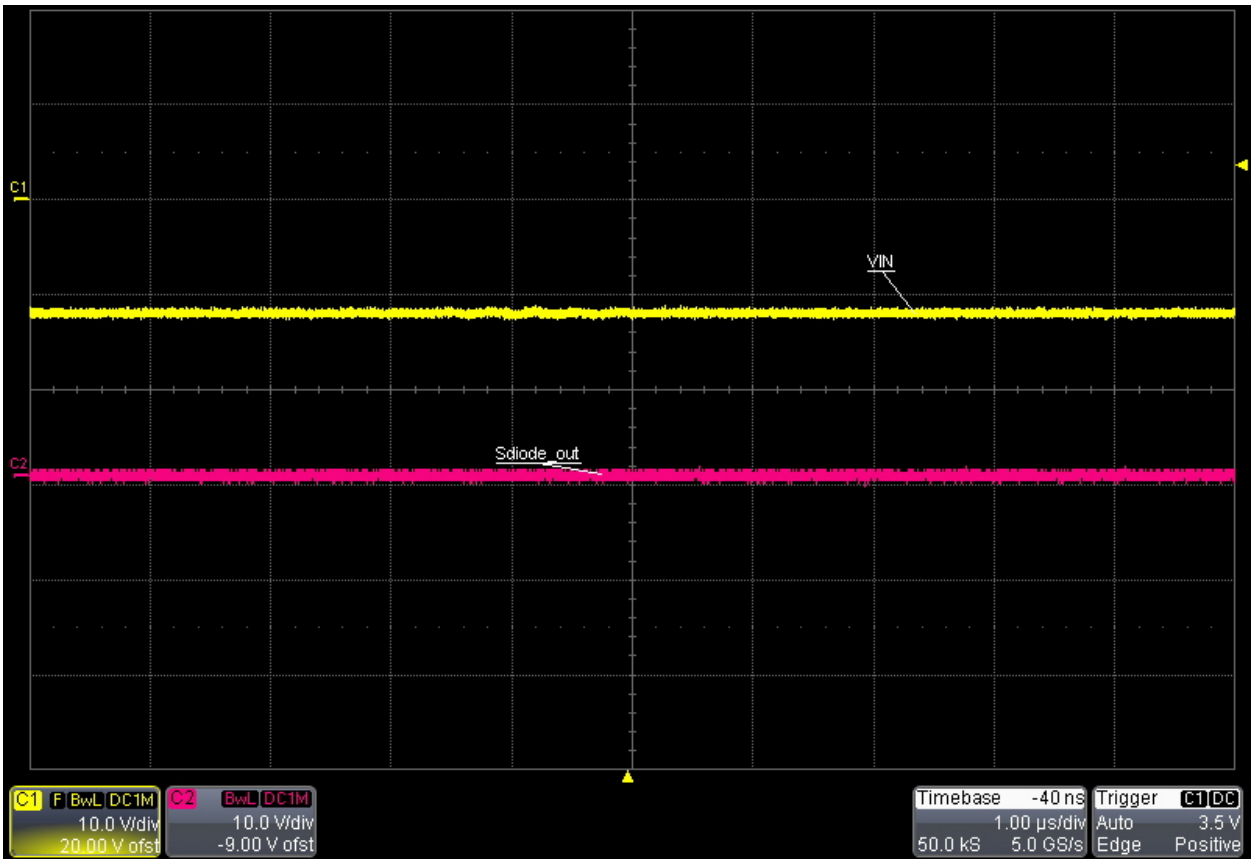
C3- 3.3V Switch node at 6Vin and 10A Load

C1- 10V Pre Boost Switch Node at 6Vin

8. Smart diode –Front End Reverse Protection

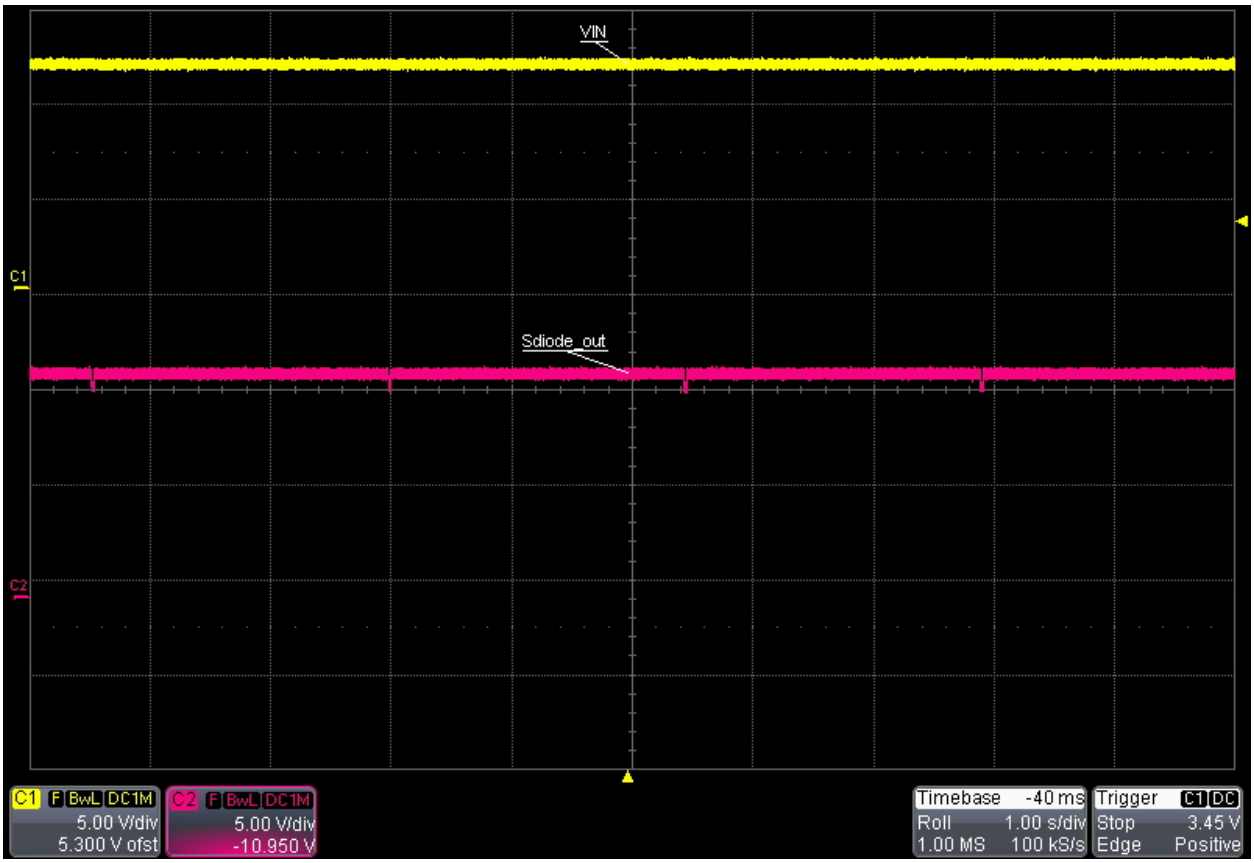


It is designed to drive an external MOSFET to emulate an ideal diode when connected in series with a power source. A unique advantage of this scheme is that it is not referenced to ground and thus has Zero Iq.



C1- Vin at -12V

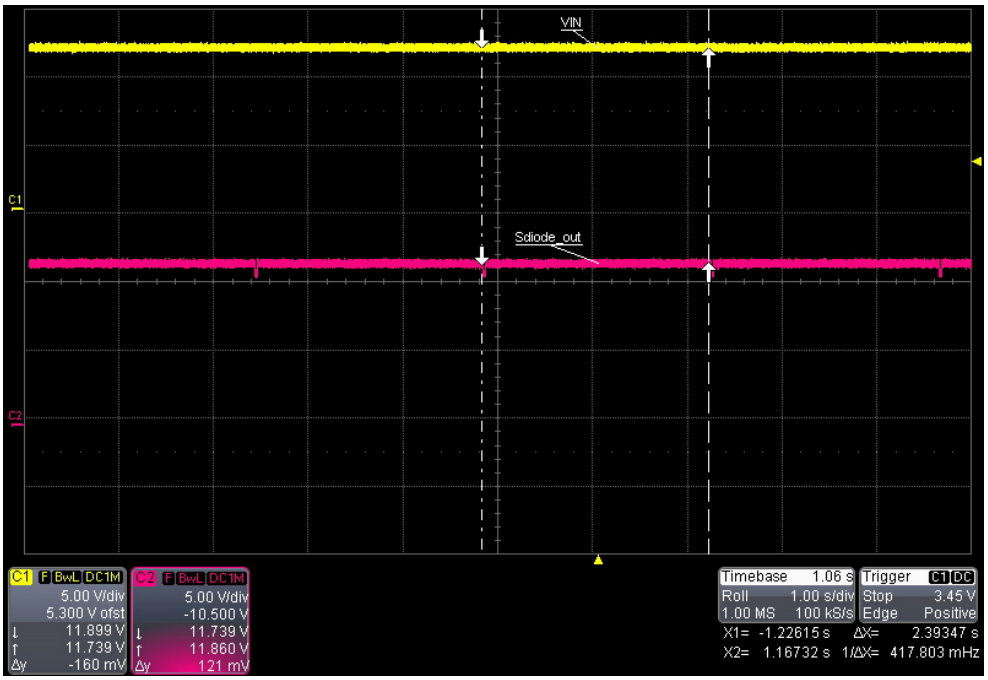
C2- Smart diode output



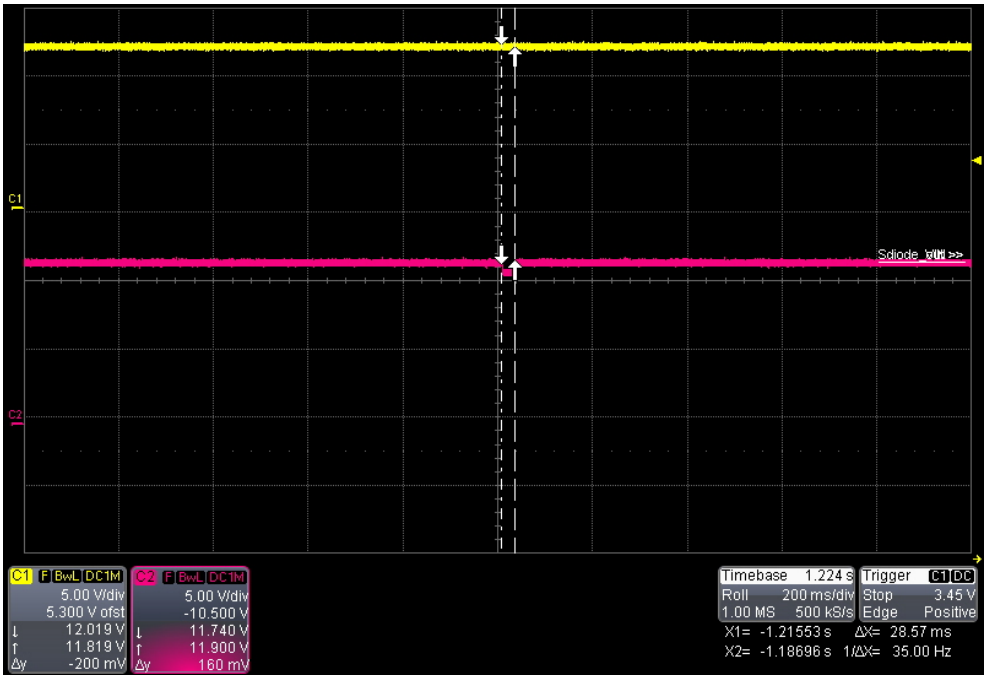
C1- Vin at 12V

C2- Smart diode output

The voltage across the MOSFET source and drain is constantly monitored by the LM74610-Q1 Anode and Cathode pins. An internal charge pump is used to provide the GATE drive for the external MOSFET. The forward conduction is through the MOSFET 98% of the time. The forward conduction is through the MOSFET body diode for 2% of time when energy is stored in an external charge pump capacitor Vcap



After every 2.4 sec Body diode conducts.



30mes is the diode conduction time.

Suppose Rdson of FET is 3.5 mohm and Body diode drop being 0.75V than total loss across the FET being = $\left(\frac{FET\ Conduction\ time}{Total\ Time}\right) I^2 RLoss + \left(\frac{diode\ conduction\ time}{Total\ time}\right) Body\ Diode\ V * I\ Loss$

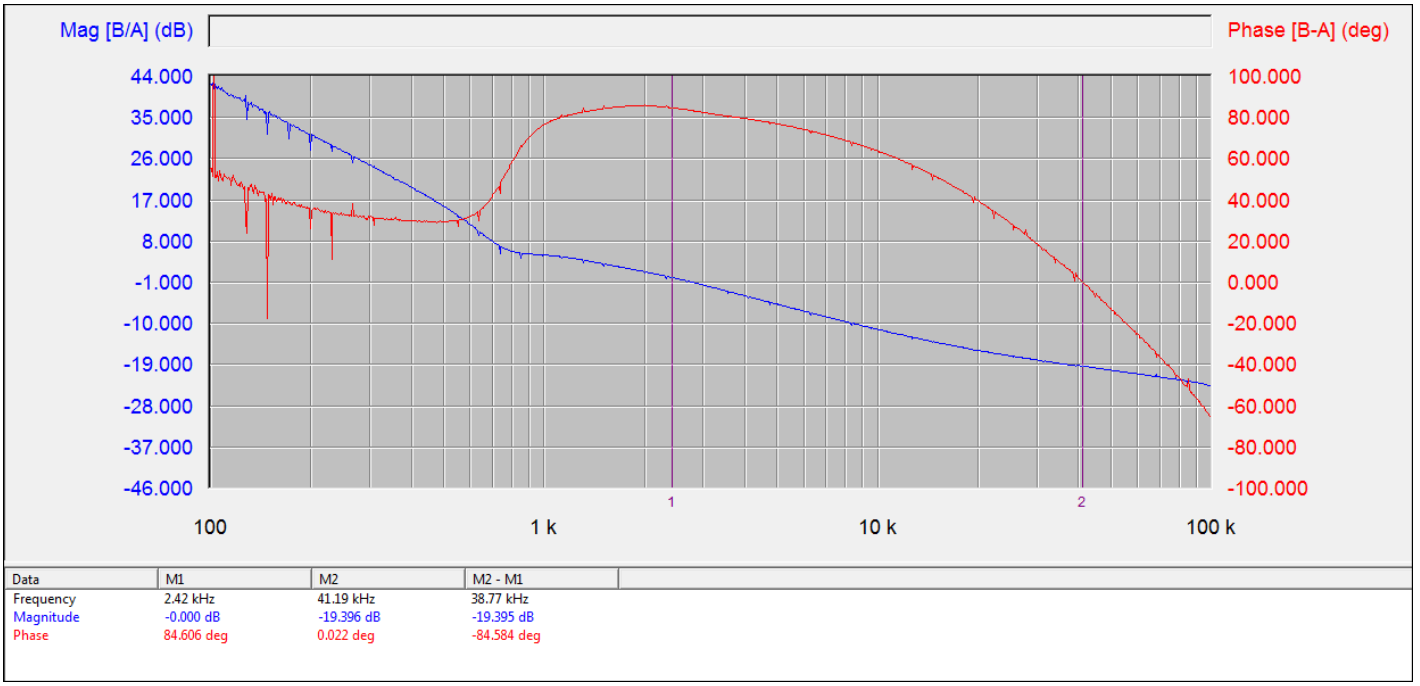
Supposing 10A of input current, Losses across FET = 0.346 + 0.09375=0.439W

FET Conduction Time = 2.375 Sec Diode Conduction Time= 0.030 Sec Total Time = 2.4Sec .

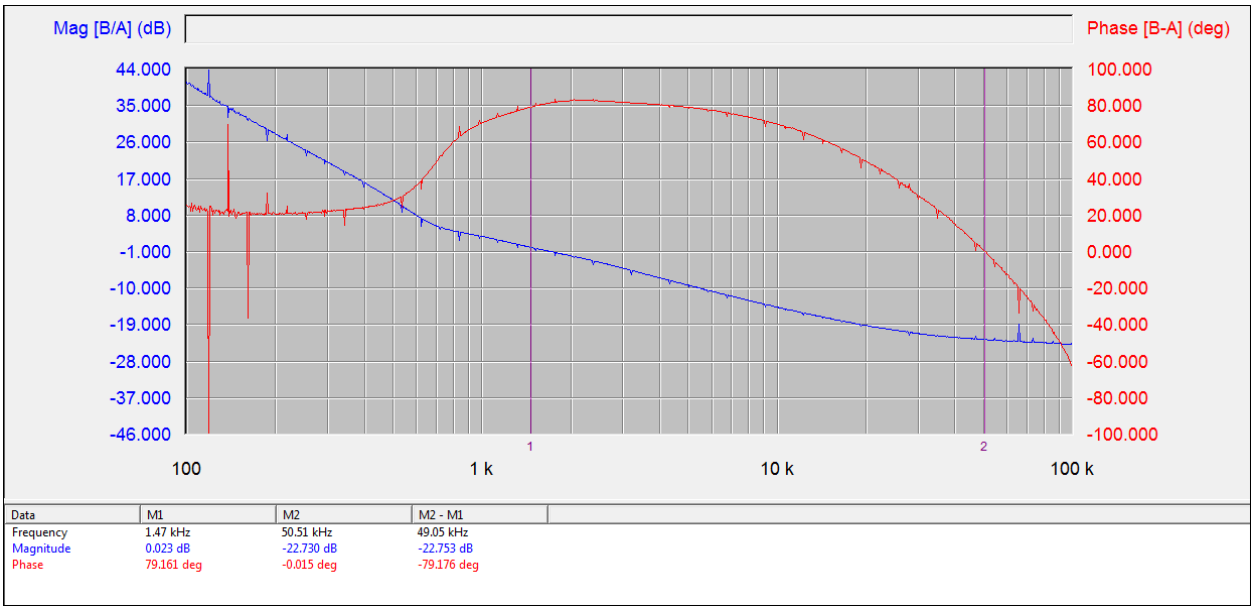
Losses if diode would have used = $Diode\ V * I\ Loss$= 7.5W

9. Loop Stability

9.1 Boost Control Loop Stability



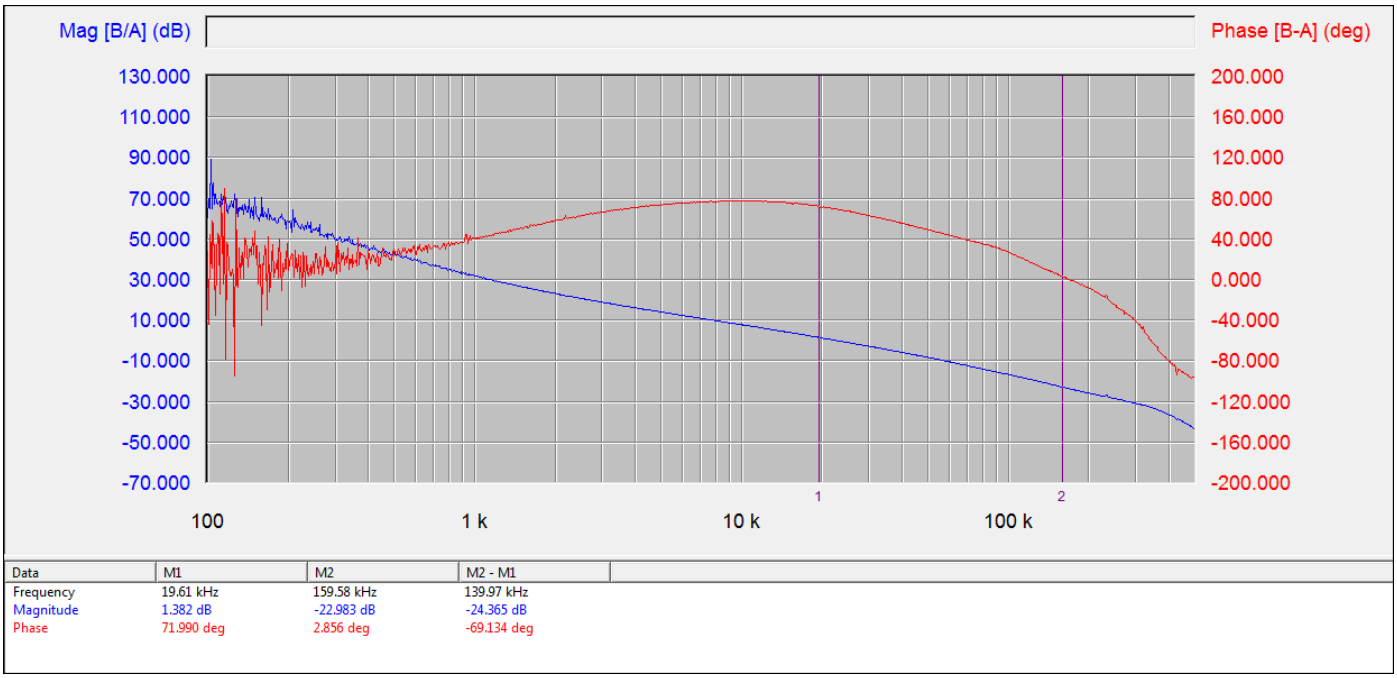
Loop Measurement for Boost Controller at 6Vin and 10V @ 8A out



Loop Measurement for Boost Controller at 4.5Vin and 10V @ 4.5A out

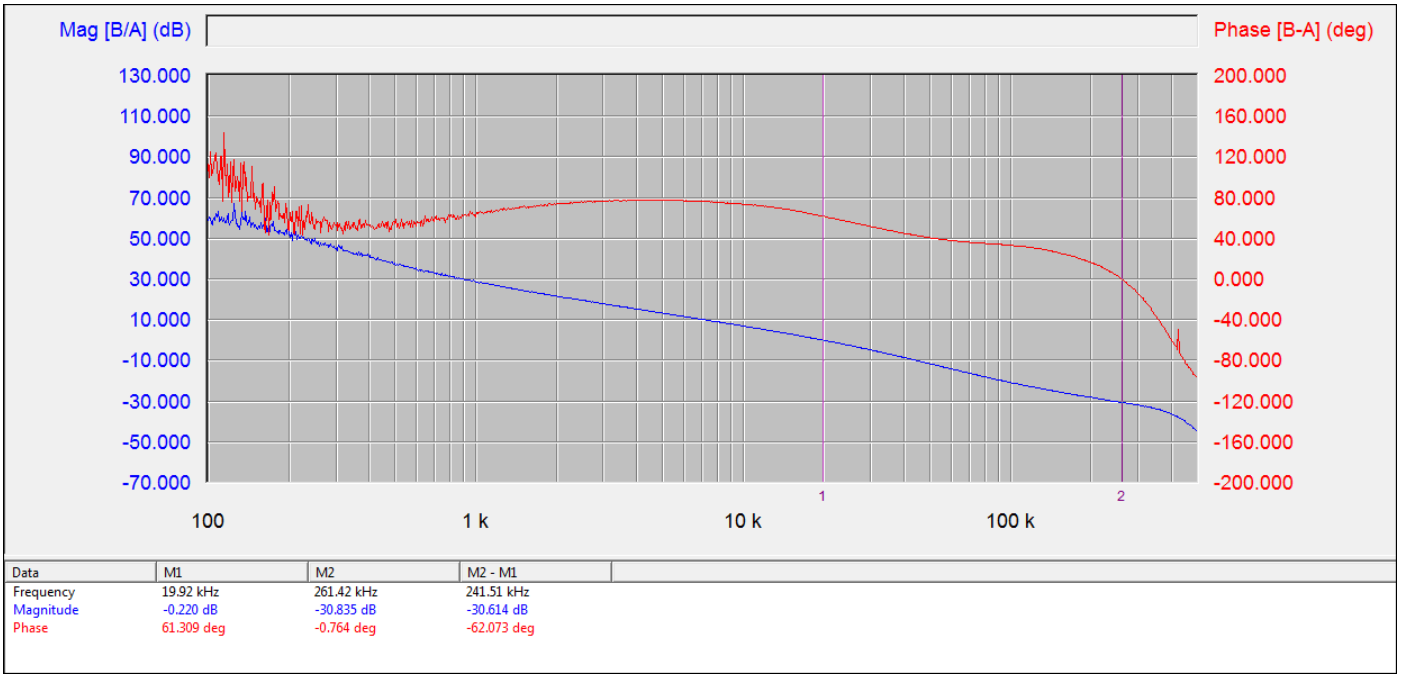
9.2 Dual Buck Controller outputs –Loop Stability

9.2.1 3.3V Buck Output



Loop Measurement for 3.3V Buck Controller at 14.4Vin and 3.3V @ 10 A out

9.2.2 5V Buck Output



Loop Measurement for 5V Buck Controller at 14.4Vin and 5V @ 10 A out

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