Test Data
For PMP9490
02/25/2015

Contents

1. Design Specifications

Vin Minimum	9.5VDC
Vin Maximum	20VDC
Vout1	10.8V -15V
Iout 1(to be used as Constant Voltage Output)	15A
Fast Charge Current (For Battery Charger)	12.5A(14.7V as Battery termination Voltage)
LED Drive Current	12.5A(at multiple strings of either 3 or 4 or 5 LEDs in Parallel)
Approximate Switching Frequency	140 KHz Approx

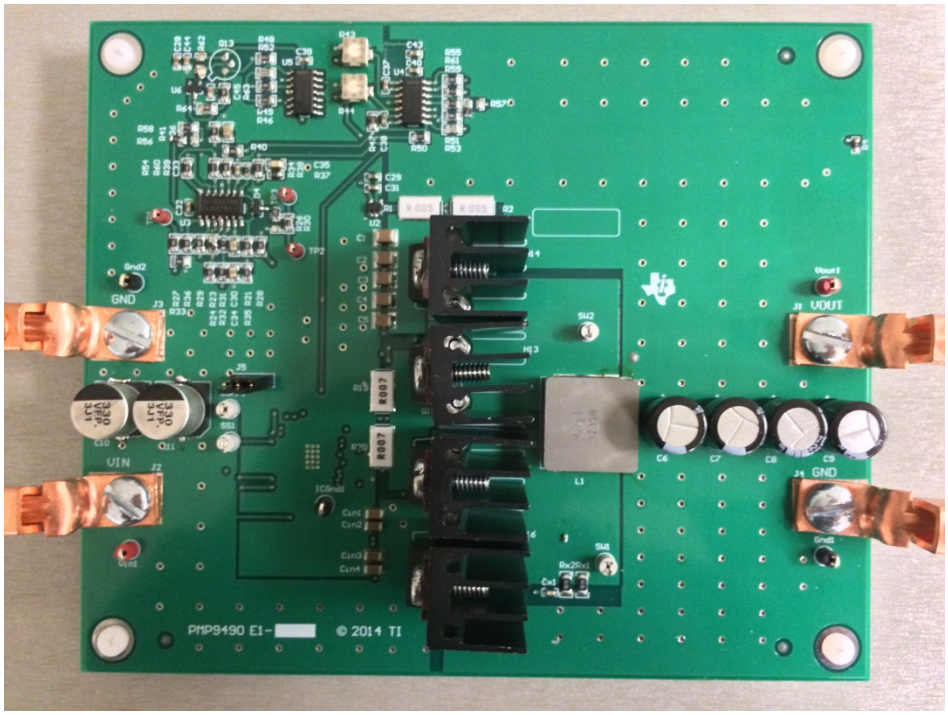
2. Circuit Description and PCB details

PMP9490 is a 225W four Switch Buck –Boost Design utilizing best in Class Synchronous Buck Boost Converter LM5175. The design accepts an input voltage of 9.5Vin to 20Vin and provides the outputs of 15V@15 A for Constant Voltage Output Application(as Voltage stabilizer or as Power amplifier SMPS) , 10.8V to 15V@12.5A for CC/CV Battery Charger application, and 12.5 A for Constant Current LED Drive application. It features an inexpensive and more efficient solution to using discrete Buck and boost converters.

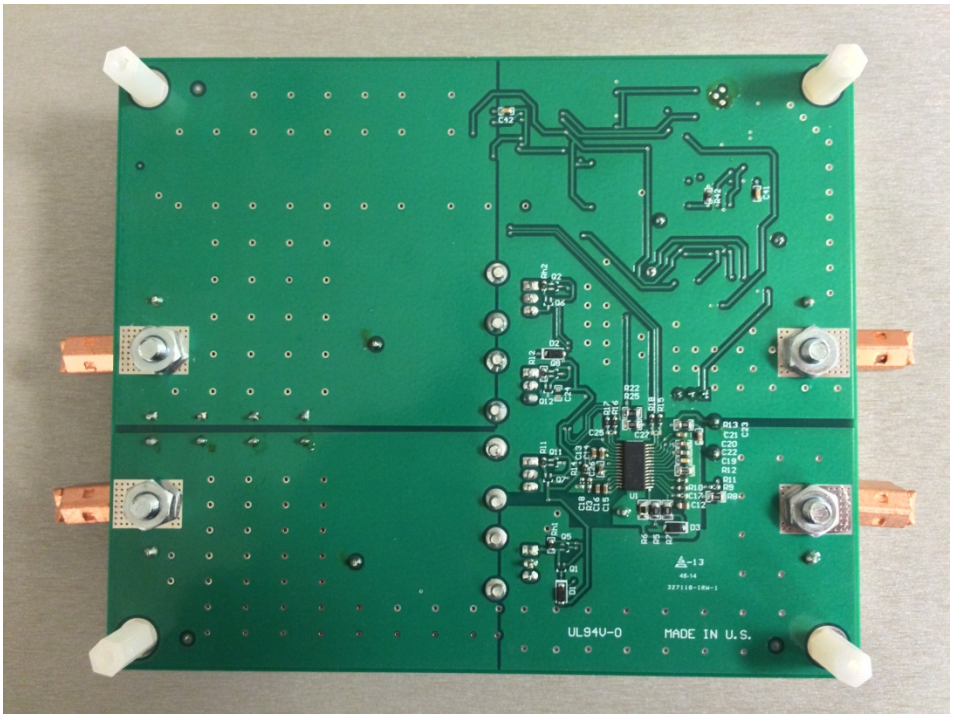
The average current regulation loop of the IC at the output is used for Battery Charging profiling with no external circuit being involved.

The Board dimension of PMP9490 PCB is 5905mil * 5255mil. Four layer PCB was used for the design.

3. PMP9490 Board Photos



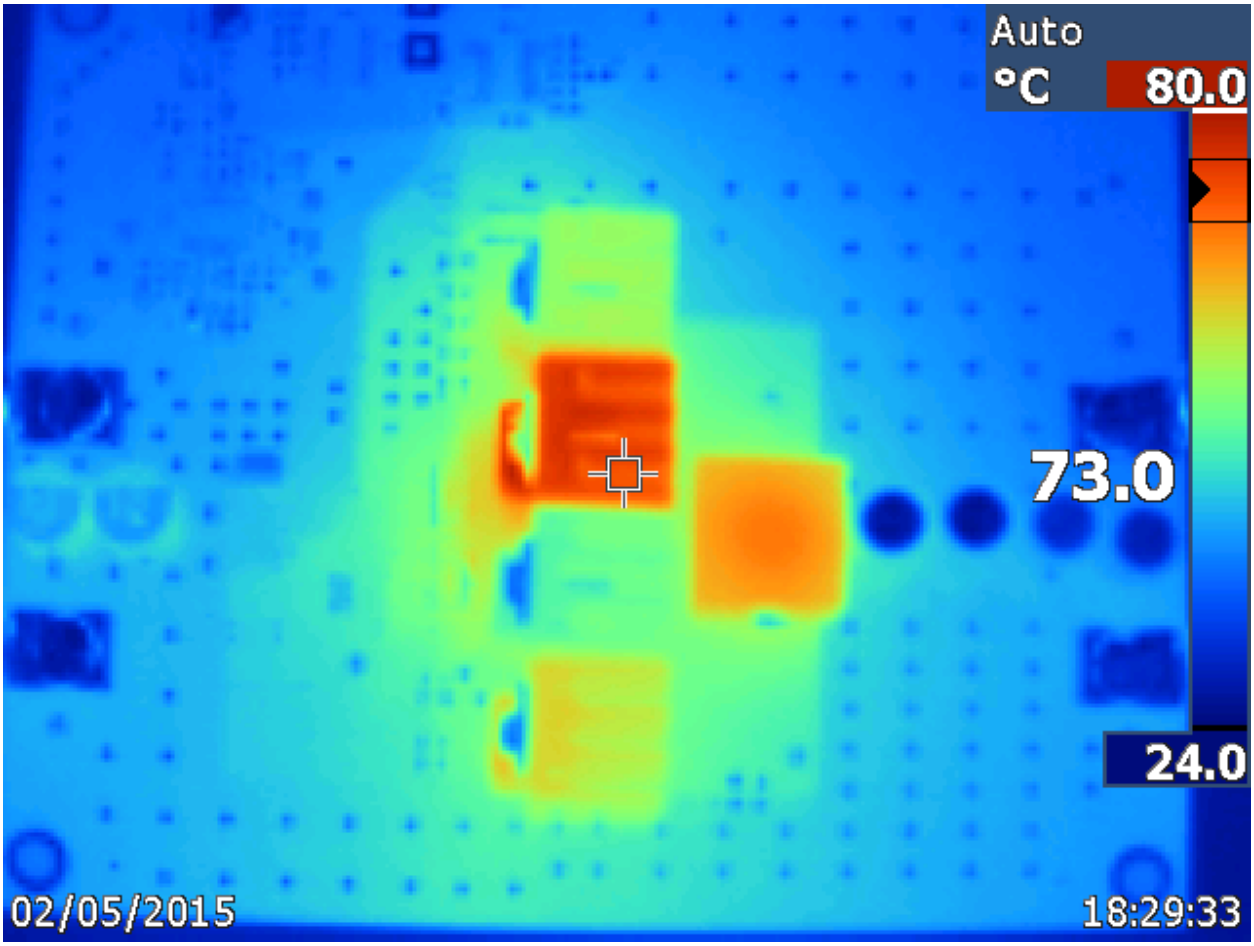
Board Photo (Top)



Board Photo (Bottom)

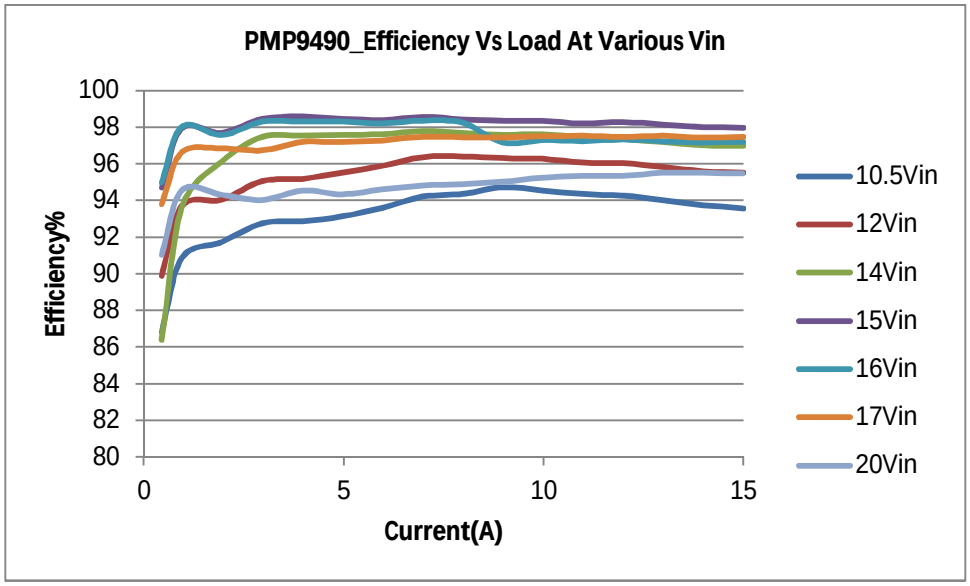
4. Thermal Data

IR thermal image taken at steady state with 10 Vin and the 14.7V output at full load (no airflow)



5. Efficiency

5.1 Efficiency Chart – Constant Voltage Output



5.2 Efficiency Data

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
==========				
10.502	0.01	14.698	0	0
10.502	0.71	14.716	0.44	86.838
10.501	1.45	14.72	0.94	90.873
10.501	2.965	14.724	1.94	91.743
10.501	4.475	14.728	2.96	92.771
10.501	5.98	14.731	3.96	92.896
10.501	7.47	14.731	4.96	93.146
10.501	8.93	14.73	5.96	93.62
10.501	10.39	14.729	6.98	94.229
10.501	11.86	14.729	7.98	94.376
10.501	13.325	14.73	9	94.743
10.501	14.775	14.732	9.96	94.572
10.501	16.295	14.733	10.96	94.366
10.501	17.83	14.735	11.98	94.281
10.501	19.37	14.736	12.98	94.036
10.501	20.925	14.738	13.98	93.767
10.501	22.5	14.739	15	93.572

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
==========				
12.001	0.005	14.703	0	0
12.001	0.6	14.713	0.44	89.905
12.001	1.23	14.715	0.94	93.706
12.001	2.53	14.722	1.94	94.066
12.001	3.82	14.725	2.96	95.075
12	5.105	14.727	3.96	95.199
12	6.37	14.725	4.96	95.547
12.001	7.625	14.724	5.96	95.899
12	8.885	14.723	6.98	96.386
12	10.155	14.724	7.98	96.42
12	11.44	14.726	8.98	96.328
12	12.695	14.727	9.96	96.285
12	14	14.728	10.96	96.083
12	15.31	14.729	11.98	96.045
12	16.625	14.731	12.98	95.844

12	17.95	14.732	13.98	95.614
12	19.28	14.733	15	95.52

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
==========	==========	==========	==========	==========
14.004	0.065	14.712	0	0
14.004	0.535	14.712	0.44	86.401
14.004	1.055	14.712	0.94	93.604
14.004	2.12	14.713	1.94	96.142
14.004	3.19	14.713	2.96	97.488
14.004	4.265	14.713	3.96	97.55
14.003	5.34	14.714	4.96	97.6
14.003	6.415	14.715	5.96	97.631
14.003	7.5	14.716	6.98	97.805
14.003	8.585	14.717	7.98	97.692
14.003	9.67	14.718	8.98	97.606
14.003	10.725	14.719	9.96	97.616
14.003	11.82	14.72	10.96	97.472
14.002	12.935	14.721	11.98	97.373
14.002	14.04	14.722	12.98	97.204
14.002	15.15	14.723	13.98	97.029
14.001	16.255	14.716	15	96.992

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
==========	==========	==========	==========	==========
15.007	0.025	14.693	0	0
15.006	0.455	14.698	0.44	94.718
15.006	0.94	14.699	0.94	97.954
15.006	1.945	14.7	1.94	97.709
15.006	2.945	14.701	2.96	98.466
15.006	3.935	14.702	3.96	98.597
15.006	4.935	14.704	4.96	98.484
15.006	5.935	14.705	5.96	98.407
15.006	6.94	14.706	6.98	98.566
15.005	7.945	14.707	7.98	98.446
15.005	8.95	14.708	8.98	98.349
15.005	9.925	14.708	9.96	98.366
15.005	10.94	14.709	10.96	98.207
15.004	11.95	14.71	11.98	98.287

15.004	12.965	14.712	12.98	98.167
15.004	13.985	14.713	13.98	98.025
15.004	15.01	14.713	15	97.995

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
==========				
16.008	0.02	14.689	0	0
16.007	0.425	14.69	0.44	95.011
16.007	0.88	14.691	0.94	98.036
16.007	1.825	14.695	1.94	97.588
16.007	2.765	14.702	2.96	98.325
16.007	3.7	14.704	3.96	98.315
16.006	4.635	14.705	4.96	98.314
16.006	5.575	14.706	5.96	98.223
16.005	6.52	14.707	6.98	98.373
16.004	7.465	14.709	7.98	98.249
16.006	8.485	14.697	8.98	97.179
16.006	9.4	14.699	9.96	97.305
16.006	10.35	14.701	10.96	97.26
16.006	11.305	14.702	11.98	97.337
16.006	12.26	14.703	12.98	97.254
16.005	13.215	14.704	13.98	97.19
16.005	14.175	14.705	15	97.225

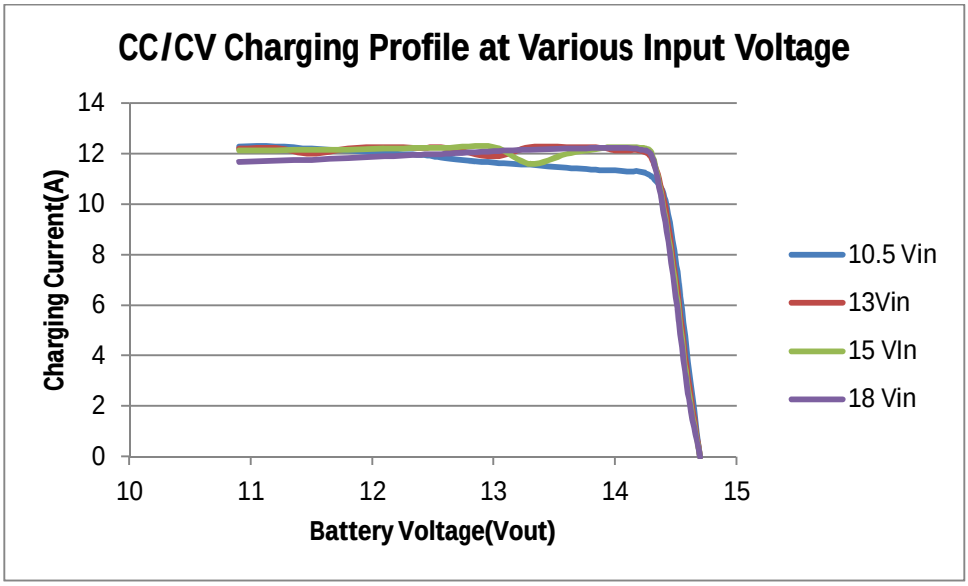
Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
==========				
17.009	0.015	14.689	0	0
17.009	0.405	14.689	0.44	93.823
17.009	0.84	14.689	0.94	96.641
17.008	1.73	14.689	1.94	96.849
17.008	2.625	14.692	2.94	96.749
17.008	3.52	14.696	3.96	97.207
17.007	4.41	14.698	4.96	97.202
17.007	5.295	14.701	5.96	97.297
17.006	6.19	14.703	6.98	97.492
17.005	7.08	14.705	7.98	97.467
17.004	7.97	14.706	8.98	97.445
17.003	8.835	14.707	9.96	97.51
17.002	9.72	14.708	10.96	97.543

17.001	10.615	14.709	11.96	97.481
16.999	11.515	14.71	12.98	97.544
16.998	12.415	14.71	13.98	97.449
16.996	13.32	14.713	15	97.486

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
==========				
20.009	0.015	14.701	0	0
20.008	0.355	14.697	0.44	91.044
20.008	0.73	14.694	0.94	94.567
20.008	1.51	14.69	1.94	94.328
20.008	2.295	14.689	2.94	94.049
20.007	3.075	14.69	3.96	94.556
20.006	3.86	14.69	4.96	94.353
20.006	4.625	14.69	5.96	94.623
20.005	5.405	14.69	6.98	94.829
20.004	6.175	14.692	7.98	94.914
20.004	6.94	14.693	8.98	95.041
20.004	7.68	14.694	9.96	95.262
20.003	8.445	14.695	10.96	95.342
20.002	9.215	14.696	11.96	95.359
20.002	9.985	14.697	12.98	95.517
20.001	10.755	14.698	13.98	95.522
20	11.53	14.7	14.98	95.493

6. Battery Charging CC/CV profile.

The CC/CV profile was tested by Sweeping Vout (using CV mode Load) between 10.8-15V at Various Input Voltage.

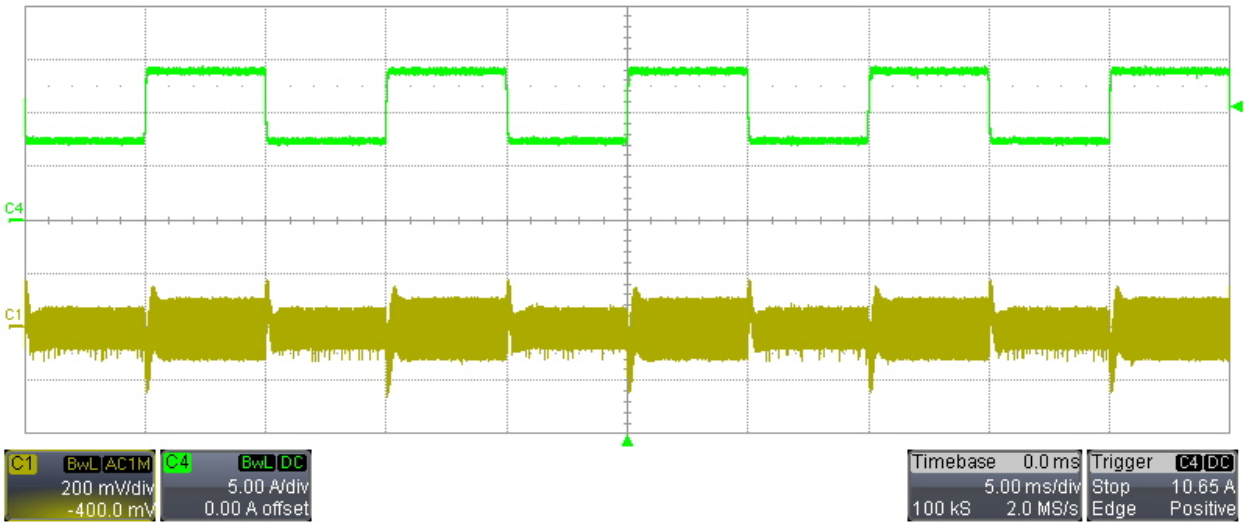


Vin	Vout	Charging Current		Vin	Vout	Charging Current
10.5	10.9	12.3		15	10.9	12.137
10.5	11.2	12.3		15	11.2	12.137
10.5	11.5	12.2		15	11.5	12.171
10.5	11.8	12.137		15	11.8	12.171
10.5	12.1	12.03		15	12.1	12.204
10.5	12.4	11.96		15	12.4	12.238
10.5	12.6	11.834		15	12.6	12.238
10.5	13	11.65		15	13	12.272
10.5	13.3	11.57		15	13.3	11.598
10.5	13.6	11.45		15	13.6	12
10.5	13.9	11.35		15	13.9	12.238
10.5	14	11.35		15	14	12.272
10.5	14.1	11.3		15	14.1	12.272
10.5	14.2	11.3		15	14.2	12.238
10.5	14.3	11.1		15	14.3	12.036
10.5	14.4	10.4		15	14.4	9.811
10.5	14.5	7.78		15	14.5	6.67
10.5	14.6	3.77		15	14.6	2.73
10.5	14.7	0		15	14.7	0

Vin	Vout	Charging Current		Vin	Vout	Charging Current
13	10.9	12.2		18	10.9	11.69
13	11.2	12.238		18	11.2	11.73
13	11.5	12		18	11.5	11.766
13	11.8	12.204		18	11.8	11.834
13	12.1	12.27		18	12.1	11.901
13	12.4	12.24		18	12.4	11.968
13	12.6	12.237		18	12.6	12
13	13	11.9		18	13	12.103
13	13.3	12.272		18	13.3	12.172
13	13.6	12.272		18	13.6	12.204
13	13.9	12.24		18	13.9	12.238
13	14	12.137		18	14	12.238
13	14.1	12.137		18	14.1	12.238
13	14.2	12.136		18	14.2	12.171
13	14.3	11.834		18	14.3	11.935
13	14.4	10.215		18	14.4	9.67
13	14.5	7.0415		18	14.5	6.33
13	14.6	3.13		18	14.6	2.5
13	14.7	0		18	14.7	0

7 Waveforms – Constant Voltage Output

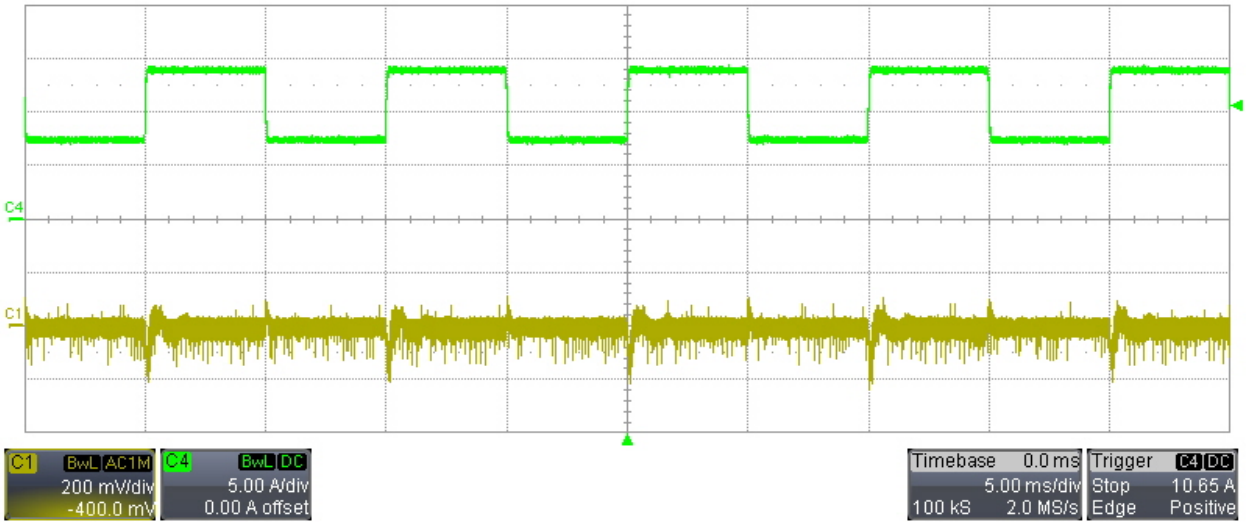
7.1 Load Transient Response



Load Transient Response at 10 Vin and 50%-to-100% (7.50A-to-15A) Load Step on 14.7V Output Voltage

Ch1 – Vout1 (AC coupled)

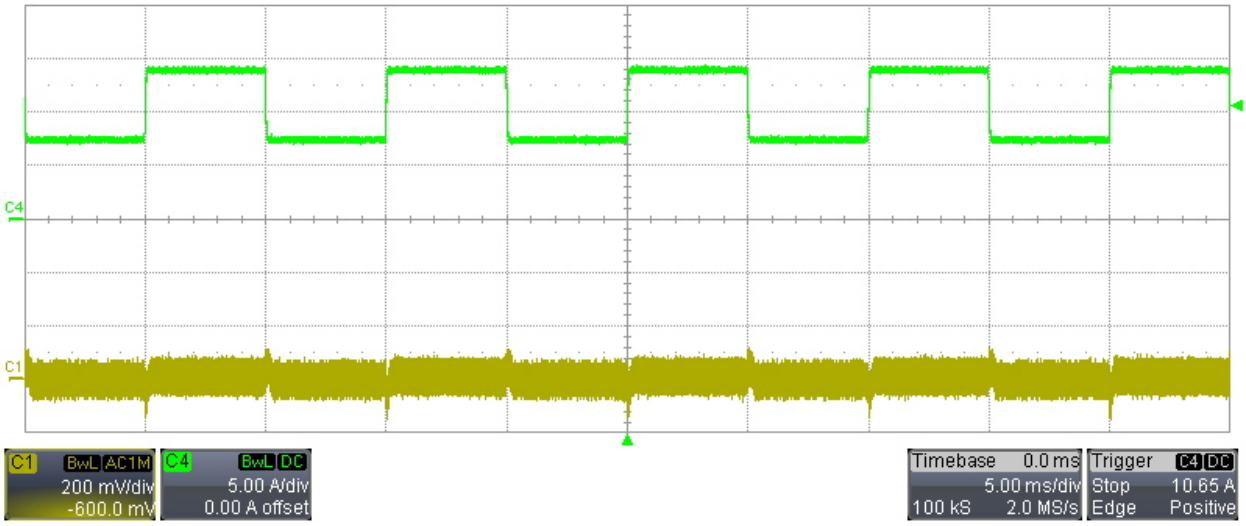
Ch4 - Iout 1



Load Transient Response at 15 Vin and 50%-to-100% (7.50A-to-15A) Load Step on 14.7V Output Voltage

Ch1 – Vout1 (AC coupled)

Ch4 - Iout 1

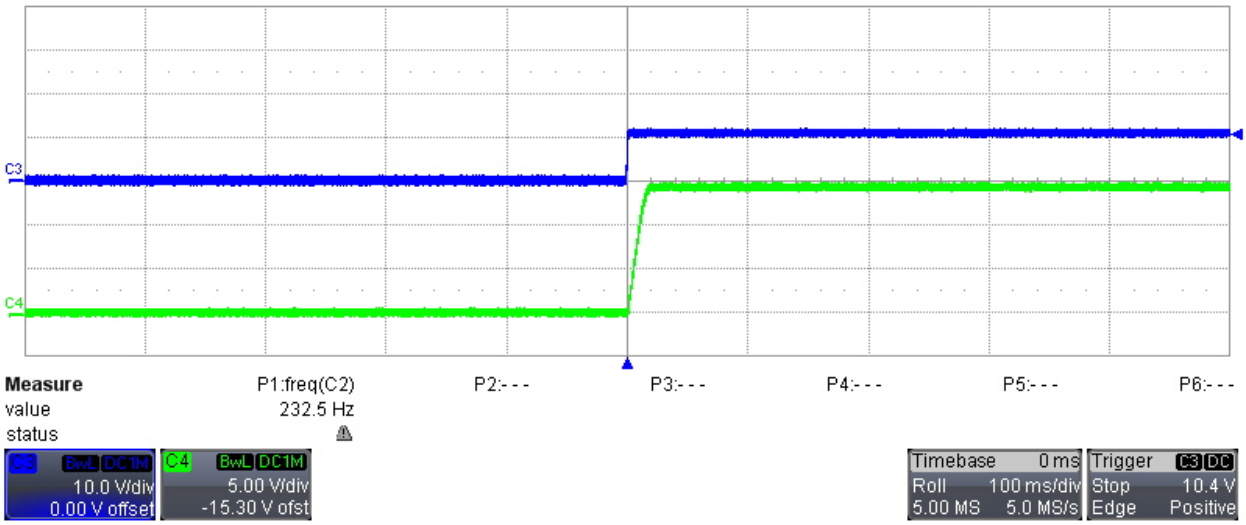


Load Transient Response at 20 Vin and 50%-to-100% (7.50A-to-15A) Load Step on 14.7V Output Voltage

Ch1 – Vout1 (AC coupled)

Ch4 - Iout 1

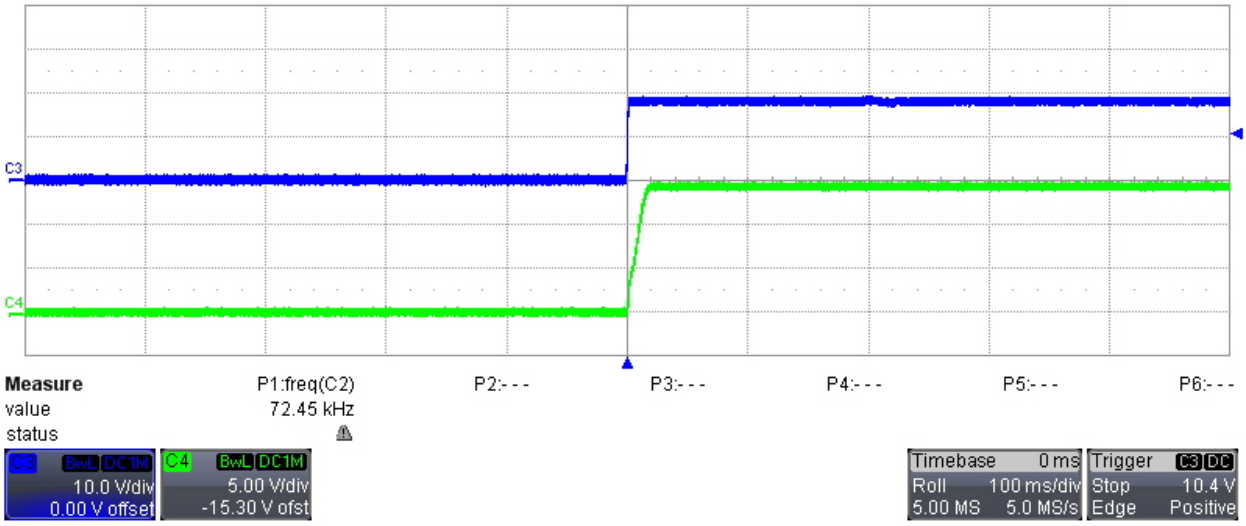
7.2 Startup



Startup into No Load at 10Vin

Ch3-Vin

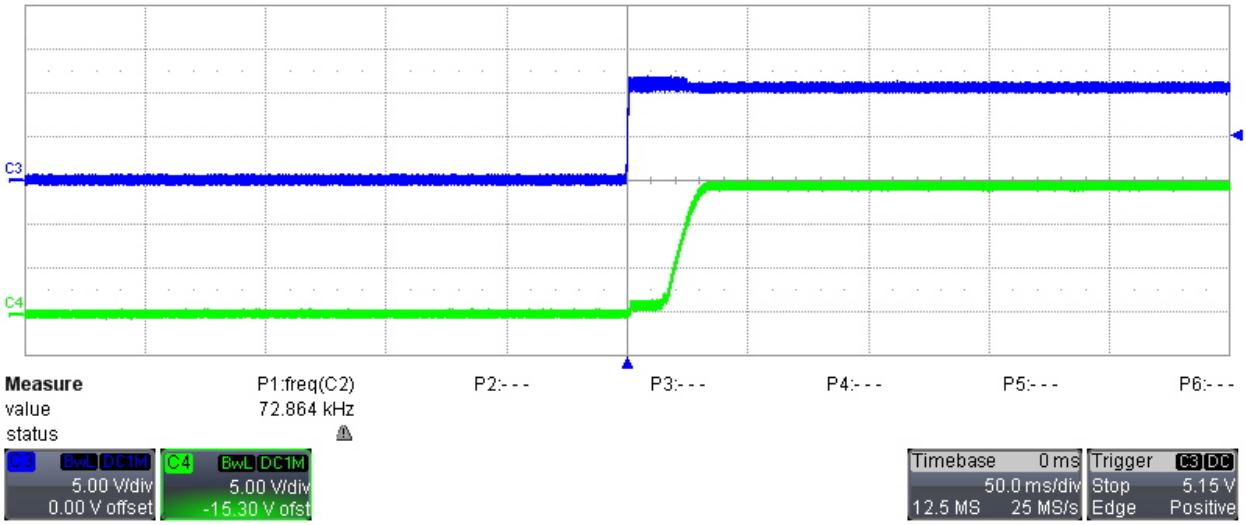
Ch4-Vout



Startup into No Load at 18 Vin

Ch3-Vin

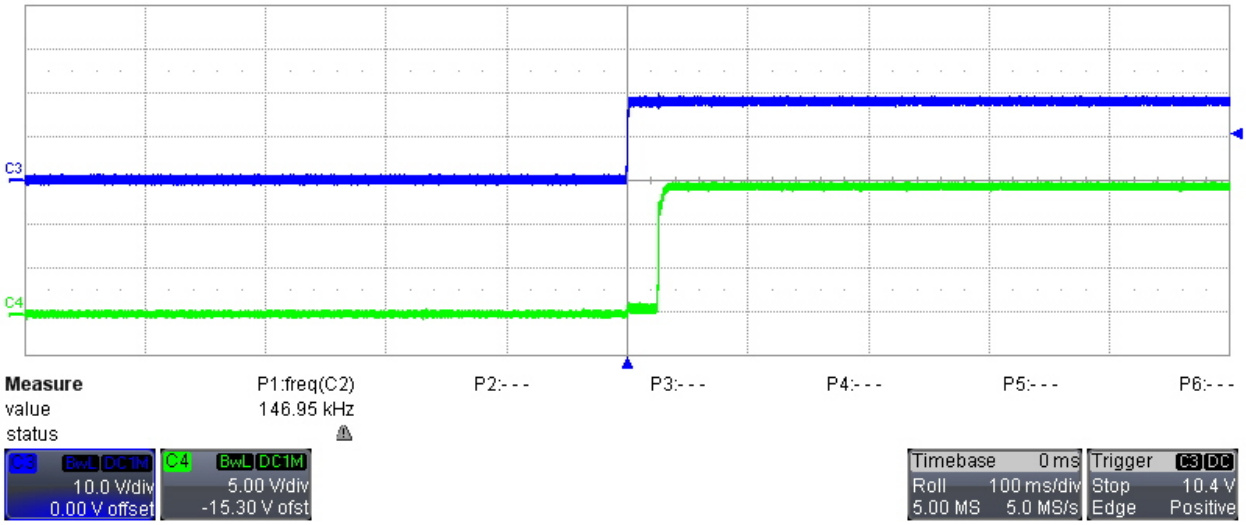
Ch4-Vout



Startup into Full Load at 10 Vin (Iout=15A)

Ch3-Vin

Ch4-Vout

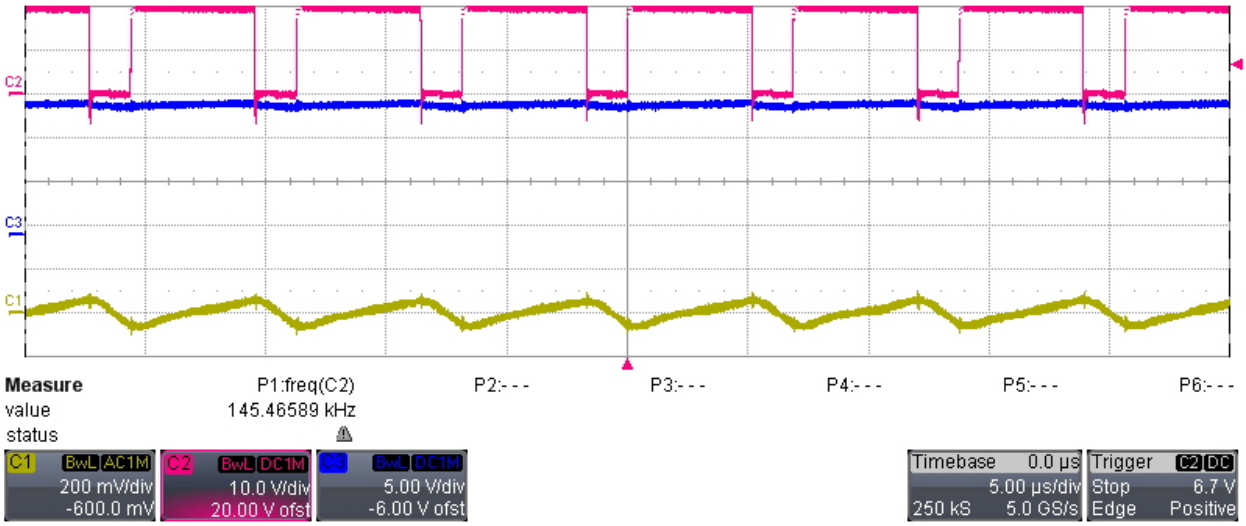


Startup into Full Load at 18 Vin (Iout=15A)

Ch3-Vin

Ch4-Vout

7.3 Output Voltage Ripple and Switch Node Voltage

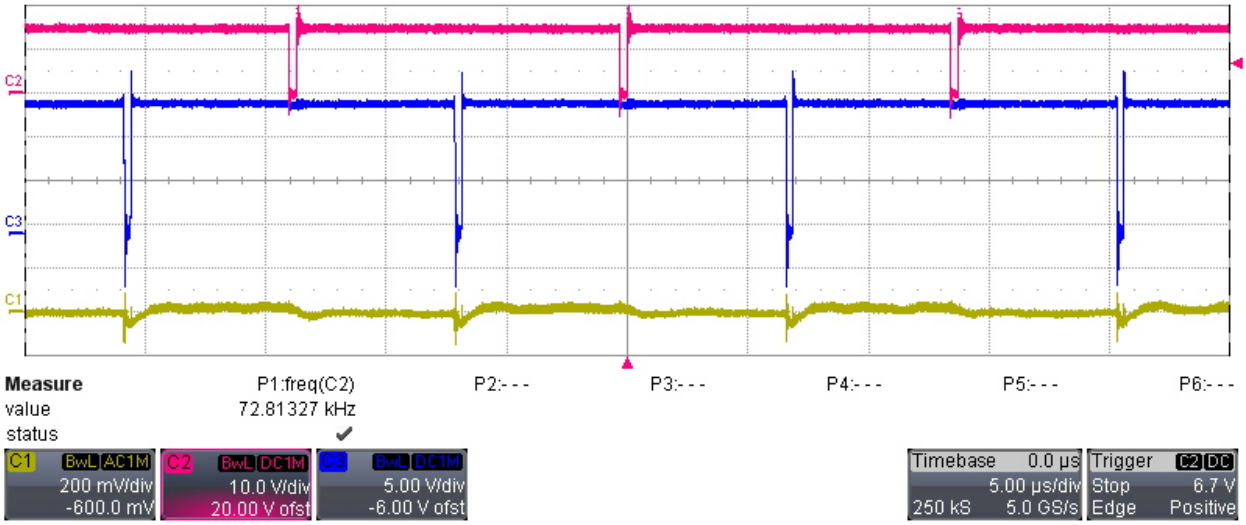


Switch Node Voltage and Output Voltage Ripple at 10.5 Vin and Full (15A) Load on the output .

Ch1-Output Voltage Ripple

Ch2-Boost Switch node

Ch3- Buck Switch node

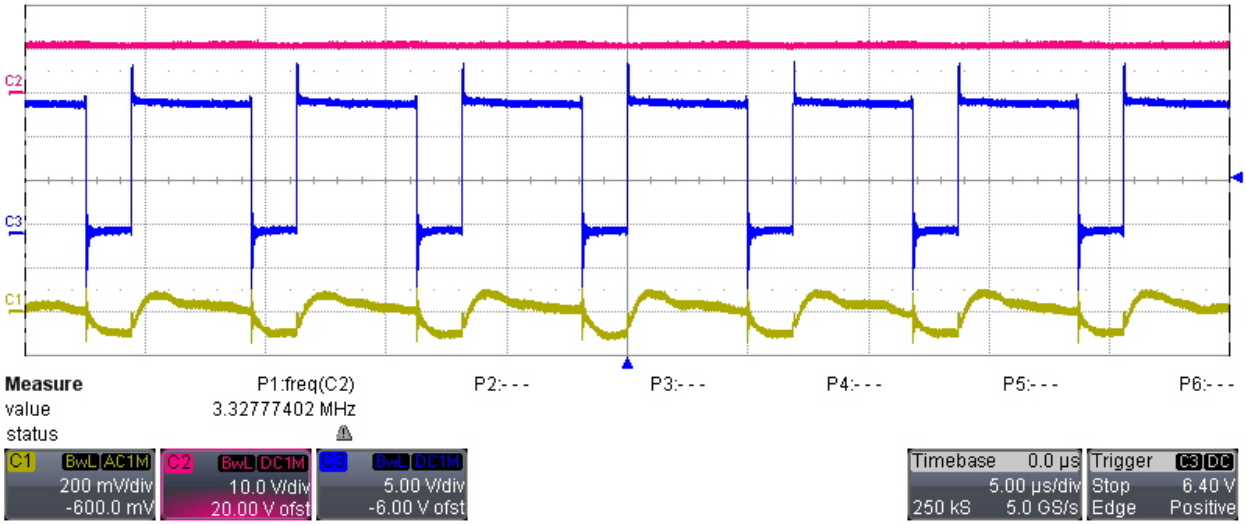


Switch Node Voltage and Output Voltage Ripple at 15 Vin and Full (15A) Load on the output .

Ch1-Output Voltage Ripple

Ch2-Boost Switch node

Ch3- Buck Switch node



Switch Node Voltage and Output Voltage Ripple at 20 Vin and Full (15A) Load on the output.

Ch1-Output Voltage Ripple

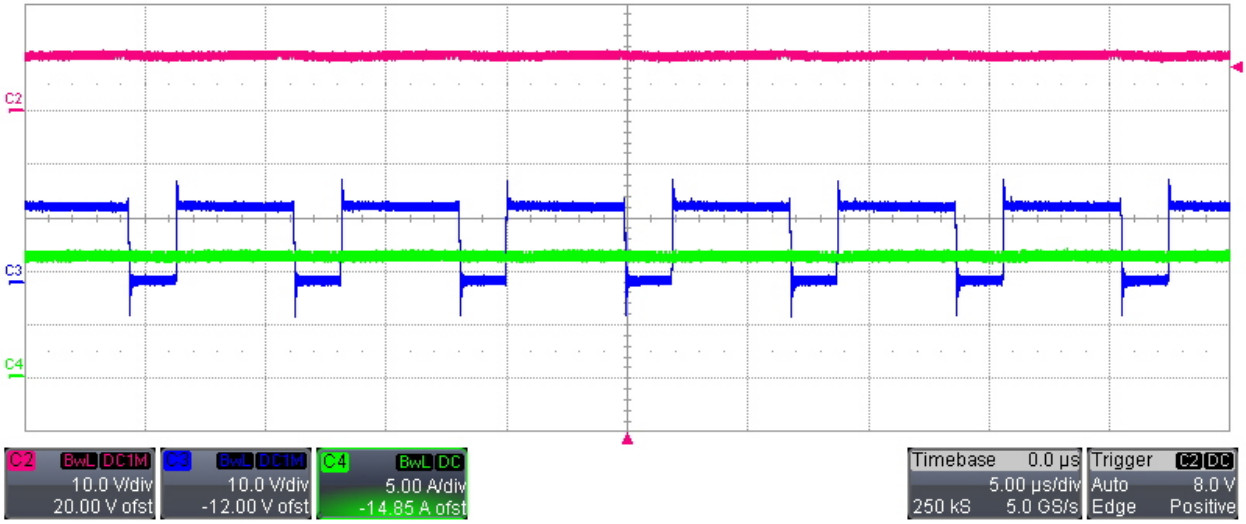
Ch2-Boost Switch node

Ch3- Buck Switch node

8. CC/CV Battery Profiling and Switch Waveforms

The CC/CV battery profiling is achieved through IC's average output Current regulation loop ie a slow Constant Current (CC) control loop becomes active and starts discharging the soft-start capacitor to regulate the drop across the output current sense Resistor.

The Current Regulation is achieved by placing R1=5milliohm parallel R2=20milliohm (resultant R is approx. 4milliohm) such that 12.5 A at the output cause the sensed voltage across the ISNS(+) and ISNS(-) pins to reach 50 mV.

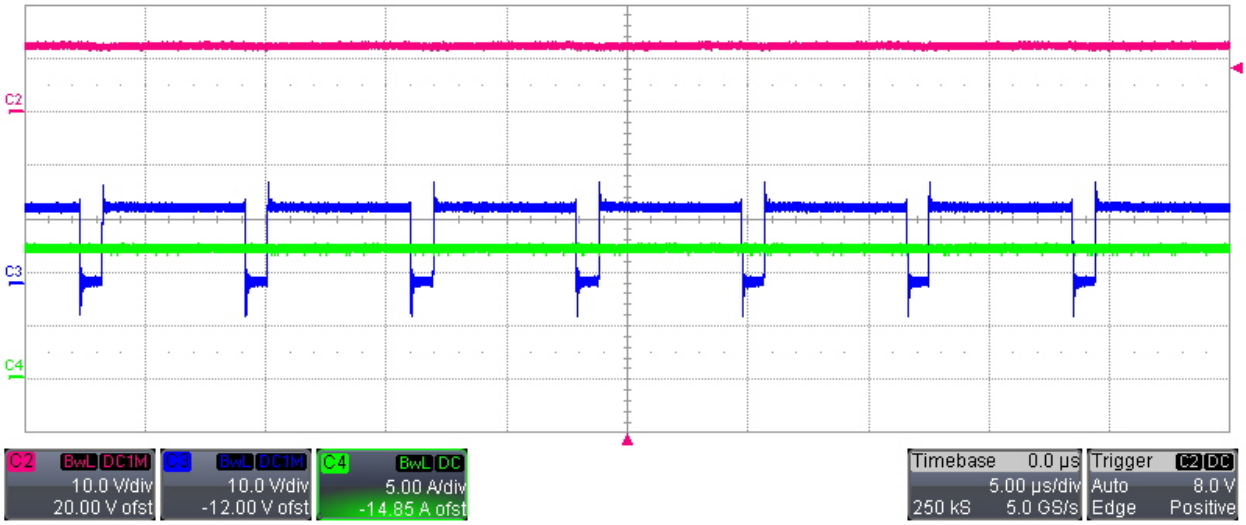


Switch Node Voltage and Charging current at 11Vin.

Ch4-Output Charging Current

Ch3-Boost Switch node

Ch2- Buck Switch node

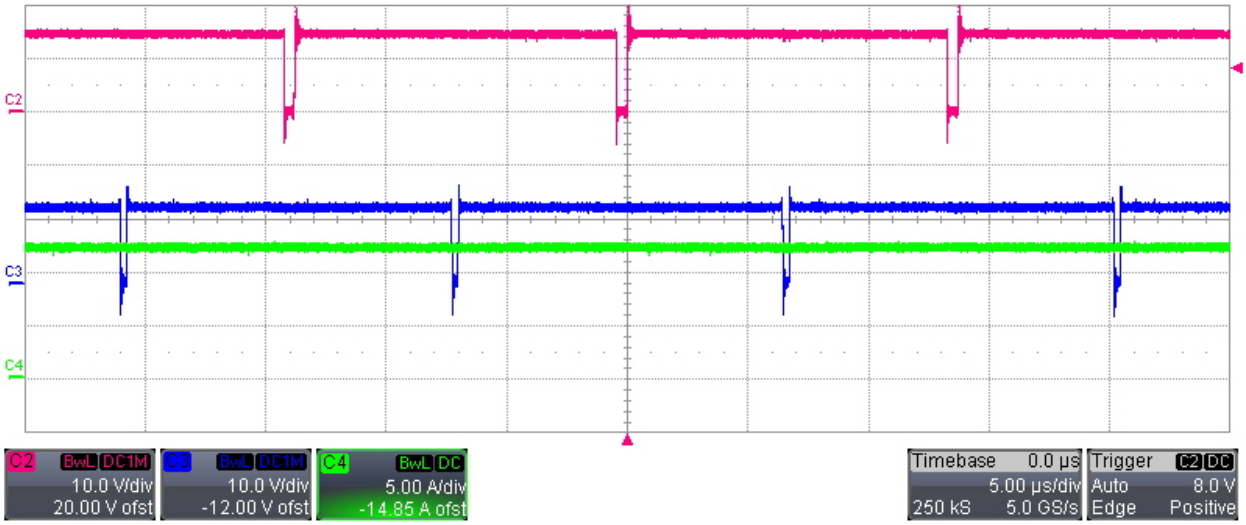


Switch Node Voltage and Charging current at 13 VIN.

Ch4-Output Charging Current

Ch3-Boost Switch node

Ch2- Buck Switch node

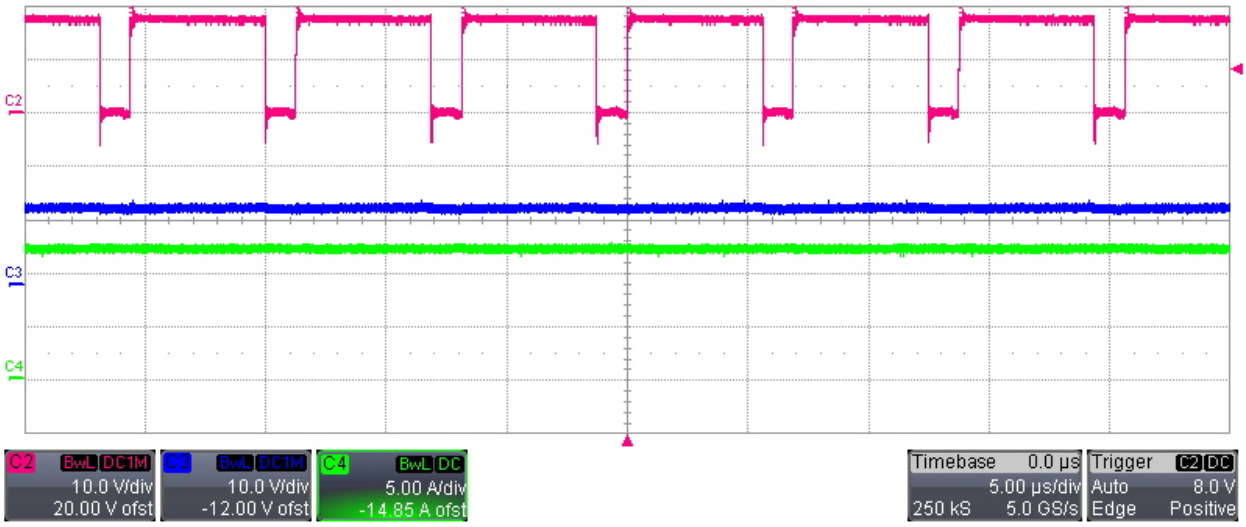


Switch Node Voltage and Charging current at 15 VIN.

Ch4-Output Charging Current

Ch3-Boost Switch node

Ch2- Buck Switch node



Switch Node Voltage and Charging current at 15 VIN.

Ch4-Output Charging Current

Ch3-Boost Switch node

Ch2- Buck Switch node

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