Test Data
For PMP9495
03/09/2015

Contents

1. Design Specifications

Vin Minimum	6
Vin Maximum	33VDC
Vout1	9V-13.4V
Iout 1(to be used as Constant Voltage Output)	5A
Fast Charge Current (For Battery Charger)	5.5A
LED Drive Current	5.5A
Approximate Switching Frequency	300 KHz Approx

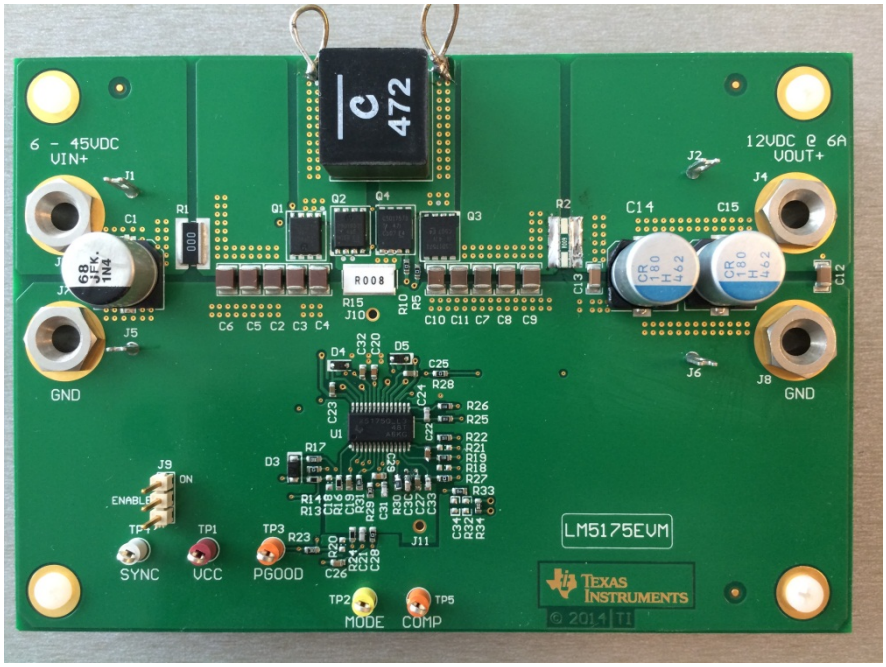
2. Circuit Description and PCB details

PMP9495 is a 72 W four Switch Buck –Boost Design utilizing best in Class Buck Boost Converter LM5175. The design accepts a very Wide input voltage of 6Vin to 33Vin and provides the outputs of 13.4V@5 A for Constant Voltage Output Application, 9V-13.4V @ 5.5A for CC/CV Battery Charger application, and 5.5 A for Constant Current LED Drive application. It features an inexpensive and more efficient solution to using discrete Buck and boost converters.

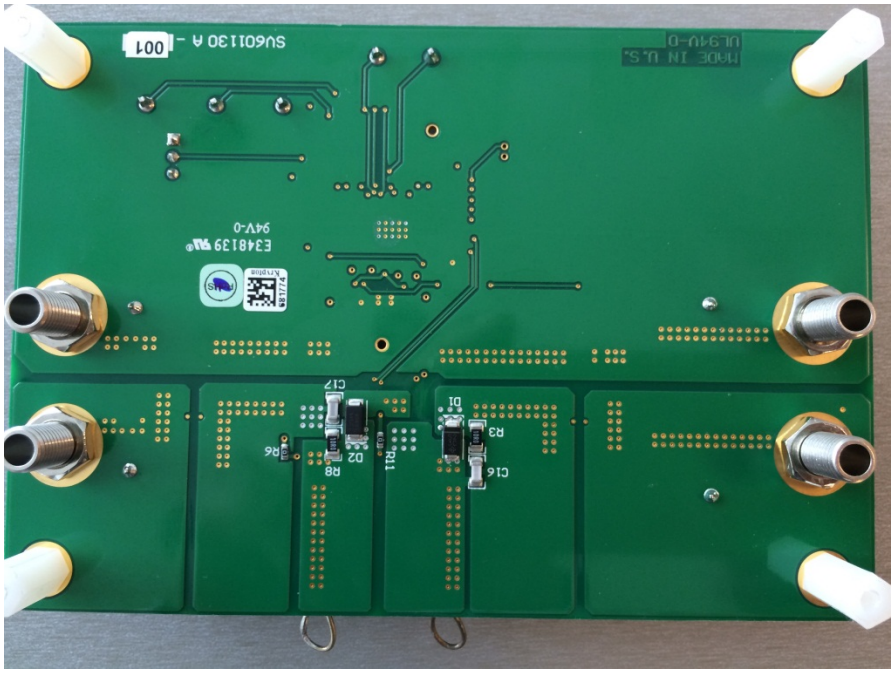
The average current regulation loop at the output is used for Battery Charging profiling with no external circuit being involved.

The Board dimension of PMP9495 PCB is 5000 mil * 3450 mil. Four layer PCB was used for the design.

3. PMP9495 Board Photos



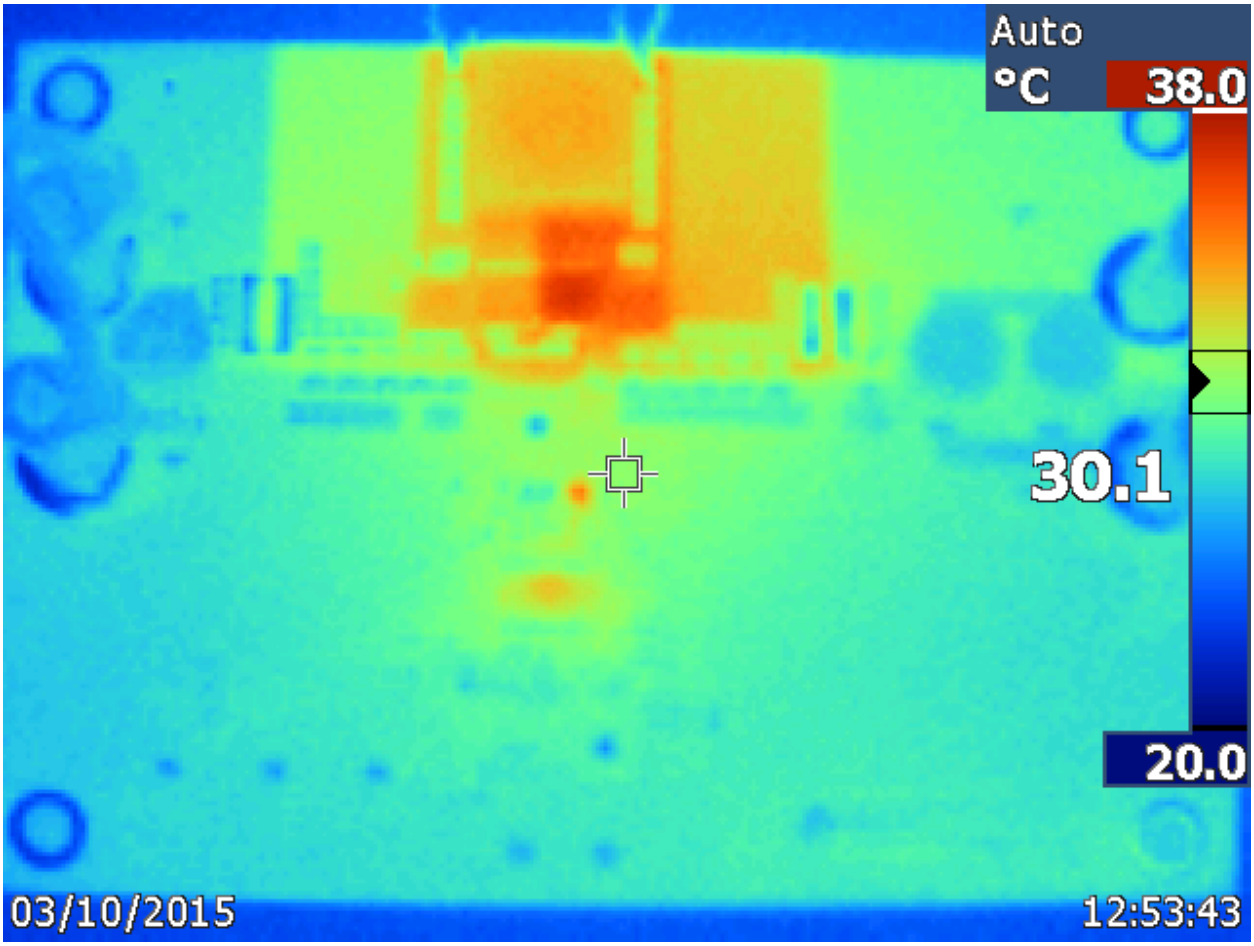
Board Photo (Top)



Board Photo (Bottom)

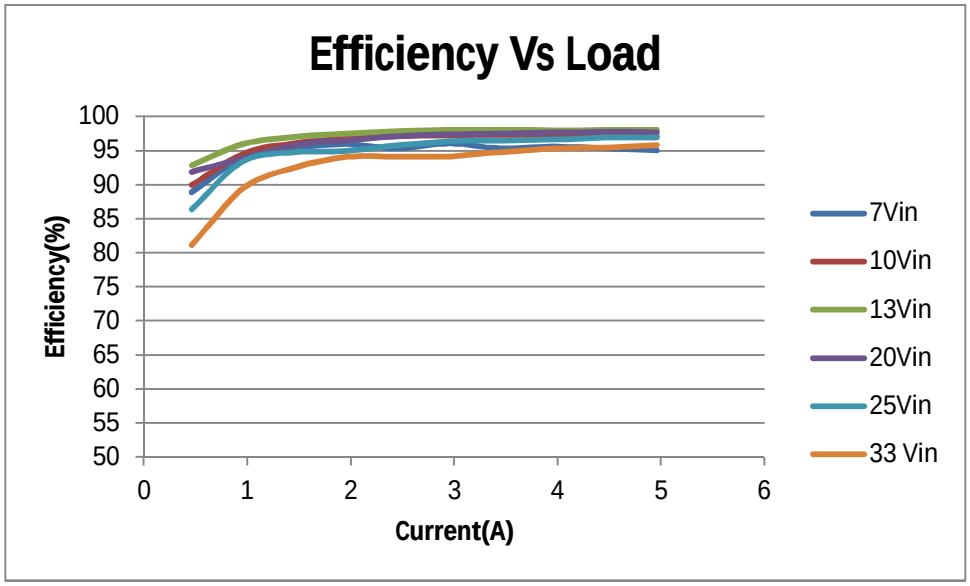
4. Thermal Data

IR thermal image taken at steady state with 10 Vin and the 13V output at full load (5.5A in CC mode)



5. Efficiency

5.1 Efficiency Chart – Constant Voltage Output



5.2 Efficiency Data

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
==========				
7.003	0.11	13.405	0	0
7.003	0.99	13.405	0.46	88.942
7.003	1.955	13.407	0.96	94.01
7.003	2.93	13.408	1.46	95.404
7.003	3.91	13.41	1.96	95.99
7.003	4.9	13.412	2.44	95.368
7.003	5.9	13.414	2.96	96.098
7.003	6.91	13.416	3.44	95.372
7.003	7.935	13.418	3.96	95.621
7.003	8.96	13.42	4.46	95.388
7.003	10	13.422	4.96	95.064

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
==========				
10.003	0.065	13.402	0	0
10.003	0.685	13.403	0.46	89.979
10.003	1.36	13.404	0.96	94.588
10.003	2.035	13.406	1.46	96.152
10.003	2.715	13.408	1.96	96.765
10.002	3.395	13.409	2.46	97.142
10.003	4.08	13.411	2.96	97.266
10.002	4.765	13.412	3.46	97.369
10.002	5.46	13.413	3.96	97.262
10.002	6.155	13.415	4.46	97.188
10.002	6.85	13.416	4.96	97.124

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
==========				
13.004	0.04	13.394	0	0
13.004	0.51	13.396	0.46	92.915
13.004	1.03	13.398	0.96	96.028
13.003	1.55	13.4	1.46	97.069
13.003	2.07	13.401	1.96	97.584
13.004	2.59	13.403	2.46	97.895
13.003	3.11	13.404	2.96	98.112
13.003	3.635	13.406	3.46	98.136
13.003	4.165	13.407	3.96	98.032
13.003	4.69	13.408	4.46	98.058
13.003	5.215	13.409	4.96	98.08

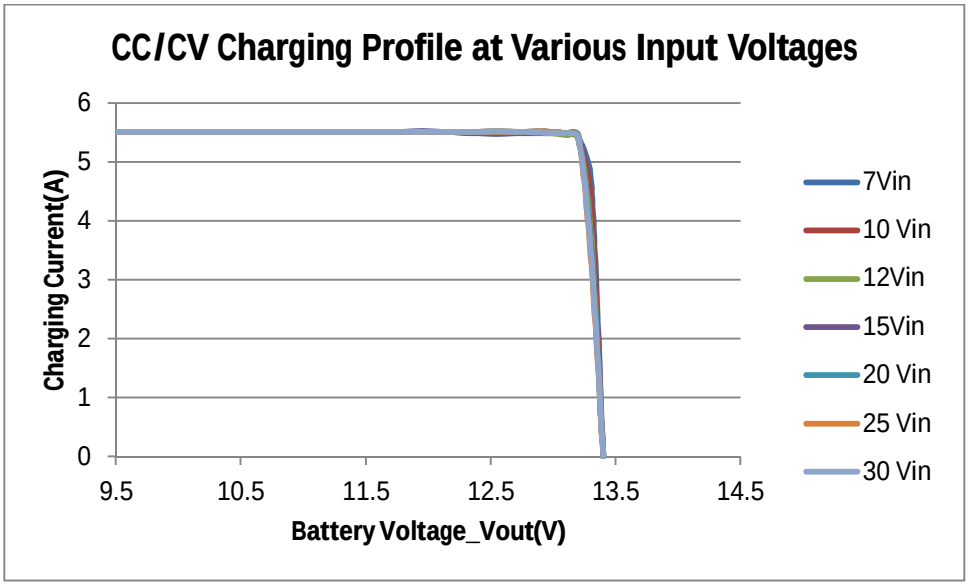
Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
==========				
20.01	0.03	13.394	0	0
20.01	0.335	13.395	0.46	91.92
20.01	0.335	13.395	0.46	91.92
20.01	1.02	13.398	1.46	95.84
20.01	1.36	13.399	1.96	96.503
20.01	1.695	13.4	2.46	97.19
20.009	2.035	13.401	2.96	97.418
20.009	2.375	13.403	3.46	97.586
20.009	2.715	13.404	3.96	97.709
20.009	3.055	13.405	4.46	97.806
20.009	3.4	13.406	4.96	97.741

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
==========				
25.007	0.04	13.391	0	0
25.007	0.285	13.392	0.46	86.436
25.007	0.55	13.394	0.96	93.488
25.007	0.825	13.395	1.46	94.794
25.007	1.105	13.395	1.96	95.011
25.007	1.375	13.395	2.46	95.833
25.007	1.645	13.396	2.96	96.392
25.007	1.92	13.398	3.46	96.55
25.007	2.195	13.399	3.96	96.665
25.007	2.465	13.4	4.46	96.953
25.006	2.74	13.401	4.96	97.012

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
==========				
33.014	0.045	13.394	0	0
33.014	0.23	13.394	0.46	81.141
33.014	0.435	13.395	0.96	89.542
33.014	0.64	13.396	1.46	92.566
33.014	0.845	13.396	1.96	94.119
33.014	1.06	13.396	2.46	94.169
33.014	1.275	13.395	2.96	94.195
33.014	1.48	13.395	3.46	94.855
33.014	1.685	13.396	3.96	95.361
33.013	1.895	13.396	4.46	95.503
33.013	2.1	13.397	4.96	95.848

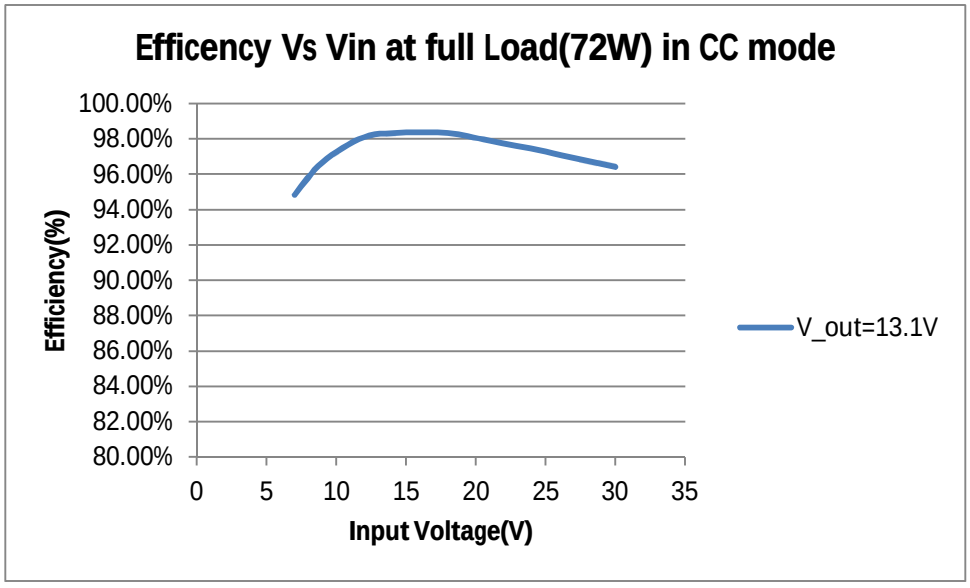
6. Battery Charging CC/CV profile and Efficiency data in CC mode .

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



Vin (V)	Vout(V)	Charging Current(A)		Vin (V)	Vout(V)	Charging Current(A)
12	9.5	5.52		20	9.5	5.52
12	9.8	5.52		20	9.8	5.52
12	10.1	5.52		20	10.1	5.52
12	10.4	5.52		20	10.4	5.52
12	10.7	5.52		20	10.7	5.52
12	11.1	5.52		20	11.1	5.52
12	11.5	5.52		20	11.5	5.52
12	11.8	5.52		20	11.8	5.52
12	12.1	5.52		20	12.1	5.52
12	12.4	5.52		20	12.4	5.52
12	12.7	5.52		20	12.7	5.52
12	13	5.49		20	13	5.52
12	13.1	5.46		20	13.1	5.49
12	13.2	5.42		20	13.2	5.46
12	13.3	3.84		20	13.3	3.6
12	13.4	0		20	13.4	0

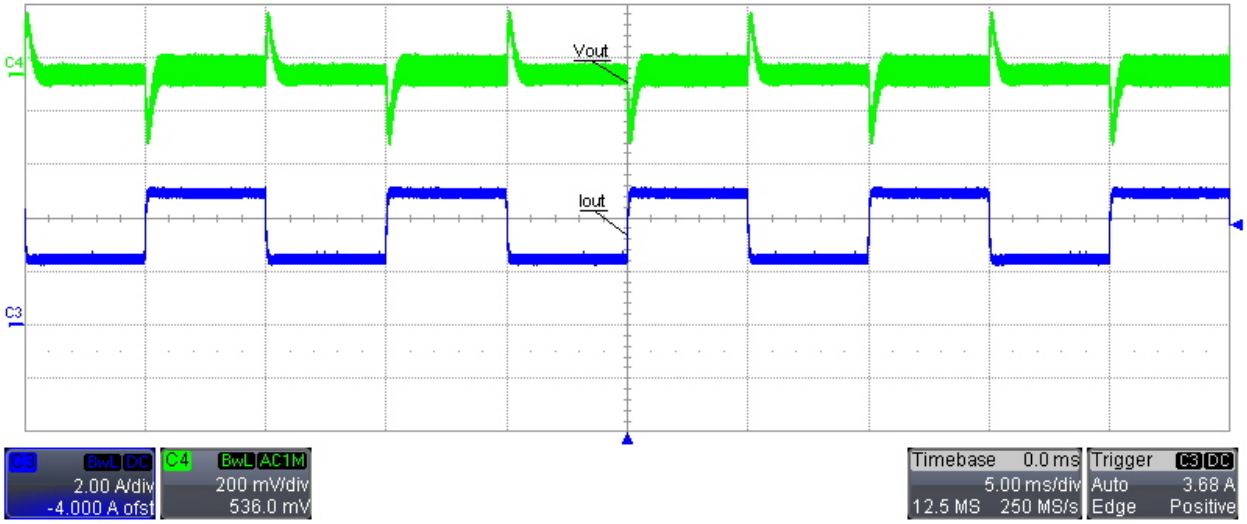
Vin (V)	Vout(V)	Charging Current(A)		Vin (V)	Vout(V)	Charging Current(A)
15	9.5	5.52		25	9.5	5.52
15	9.8	5.52		25	9.8	5.52
15	10.1	5.52		25	10.1	5.52
15	10.4	5.52		25	10.4	5.52
15	10.7	5.52		25	10.7	5.52
15	11.1	5.52		25	11.1	5.52
15	11.5	5.52		25	11.5	5.52
15	11.8	5.52		25	11.8	5.52
15	12.1	5.52		25	12.1	5.52
15	12.4	5.49		25	12.4	5.52
15	12.7	5.49		25	12.7	5.52
15	13	5.49		25	13	5.52
15	13.1	5.49		25	13.1	5.49
15	13.2	5.42		25	13.2	5.43
15	13.3	3.64		25	13.3	3.4
15	13.4	0		25	13.4	0
Vin (V)	Vout(V)	Charging Current(A)		Vin (V)	Vout(V)	Charging Current(A)
30	9.5	5.52		10	9.5	5.52
30	9.8	5.52		10	9.8	5.52
30	10.1	5.52		10	10.1	5.52
30	10.4	5.52		10	10.4	5.52
30	10.7	5.52		10	10.7	5.52
30	11.1	5.52		10	11.1	5.52
30	11.5	5.52		10	11.5	5.52
30	11.8	5.52		10	11.8	5.52
30	12.1	5.52		10	12.1	5.52
30	12.4	5.52		10	12.4	5.52
30	12.7	5.52		10	12.7	5.52
30	13	5.49		10	13	5.49
30	13.1	5.49		10	13.1	5.49
30	13.2	5.42		10	13.2	5.42
30	13.3	3.5		10	13.3	4.38
30	13.4	0		10	13.4	0



Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
==========				
7	10.86	13.157	5.48	94.84%
9	8.3	13.157	5.49	96.70%
12	6.135	13.157	5.49	98.11%
15	4.922	13.157	5.52	98.37%
18	4.103	13.157	5.52	98.34%
21	3.532	13.157	5.52	97.92%
25	2.986	13.157	5.52	97.29%
30	2.506	13.157	5.51	96.43%

7 Waveforms – Constant Voltage Output

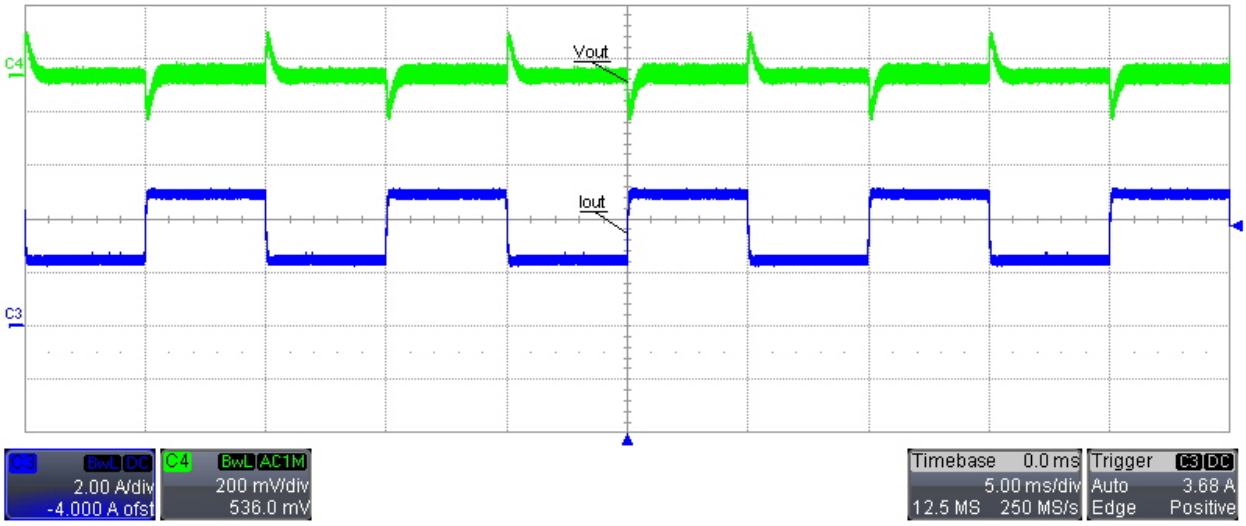
7.1 Load Transient Response



Load Transient Response at 7 Vin and 50%-to-100% (2.5A-to-5A) Load Step on 13.4V Output Voltage

Ch4 – Vout1 (AC coupled)

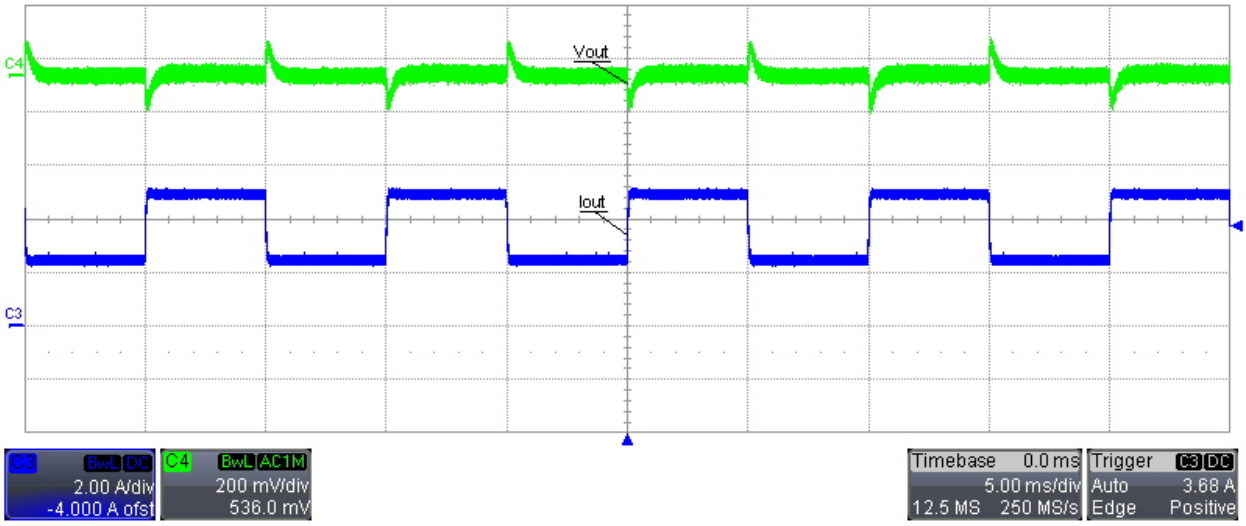
Ch3 - Iout 1



Load Transient Response at 13 Vin and 50%-to-100% (2.5A-to-5A) Load Step on 13.4V Output Voltage

Ch4 – Vout1 (AC coupled)

Ch3 - Iout 1

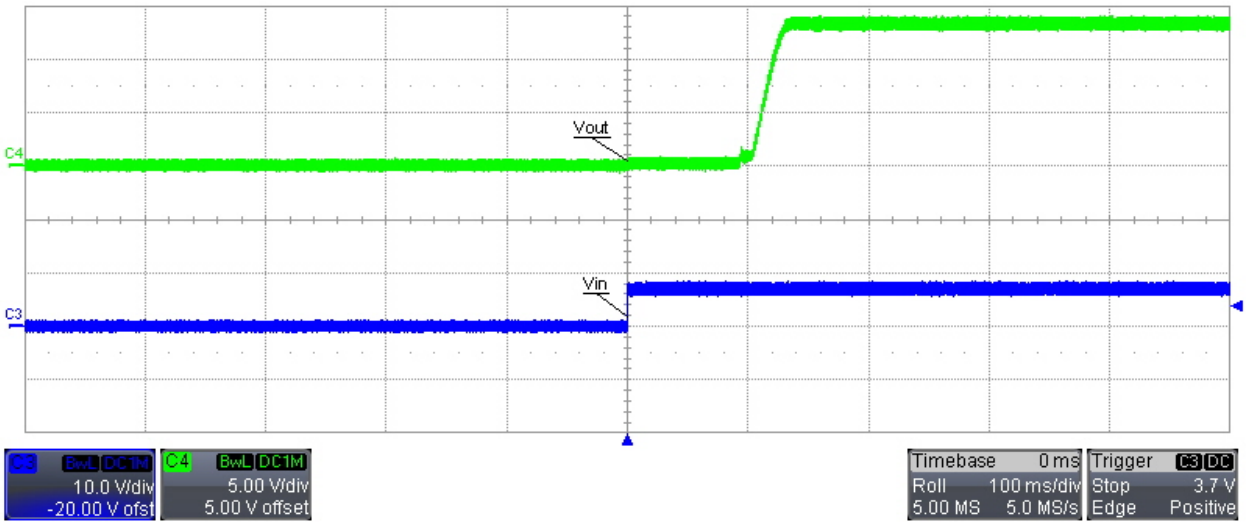


Load Transient Response at 25 Vin and 50%-to-100% (2.5A-to-5A) Load Step on 13.4V Output Voltage

Ch4 – Vout1 (AC coupled)

Ch3 - Iout 1

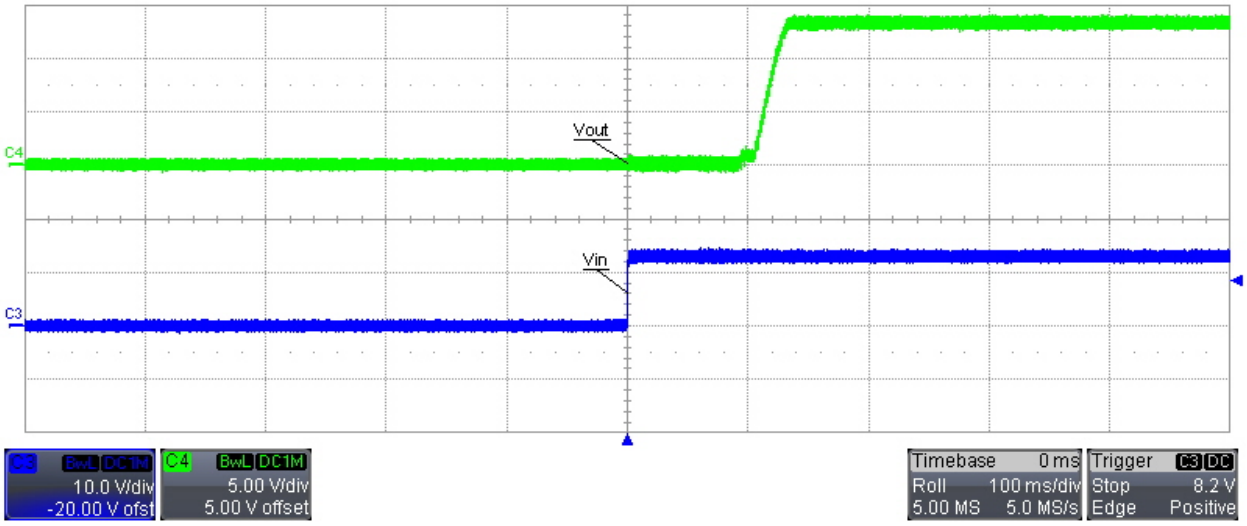
7.2 Startup



Startup into Full Load at 7 Vin (Iout=5A)

Ch3-Vin

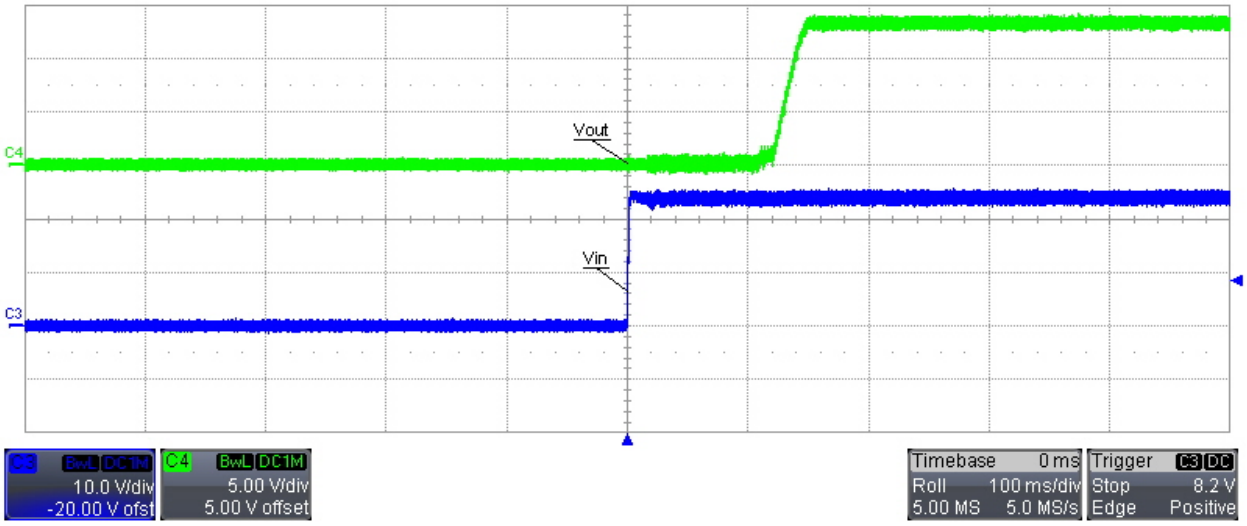
Ch4-Vout



Startup into Full Load at 13 Vin (Iout=5A)

Ch3-Vin

Ch4-Vout

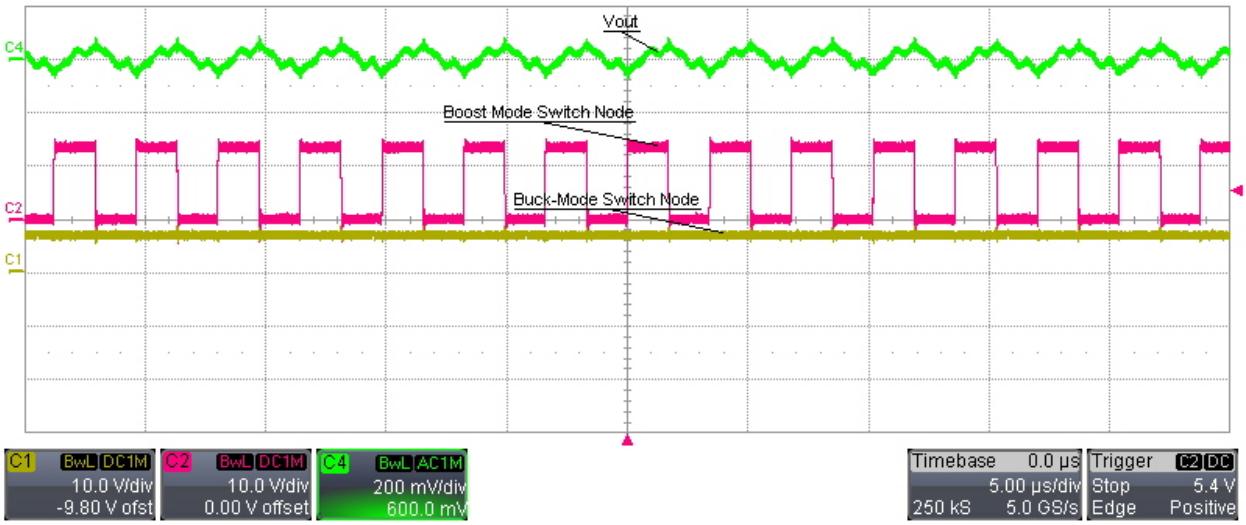


Startup into Full Load at 25 Vin (Iout=5A)

Ch3-Vin

Ch4-Vout

7.3 Output Voltage Ripple and Switch Node Voltage

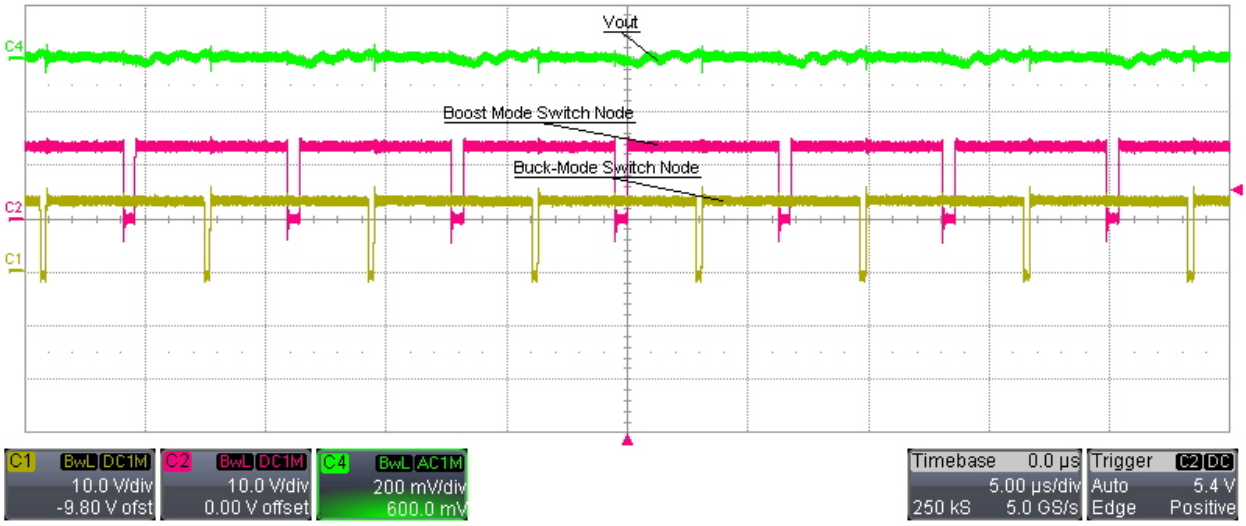


Switch Node Voltage and Output Voltage Ripple at 7 Vin and Full (5A) Load on the output.

Ch4-Output Voltage Ripple

Ch2-Boost Switch node

Ch1- Buck Switch node

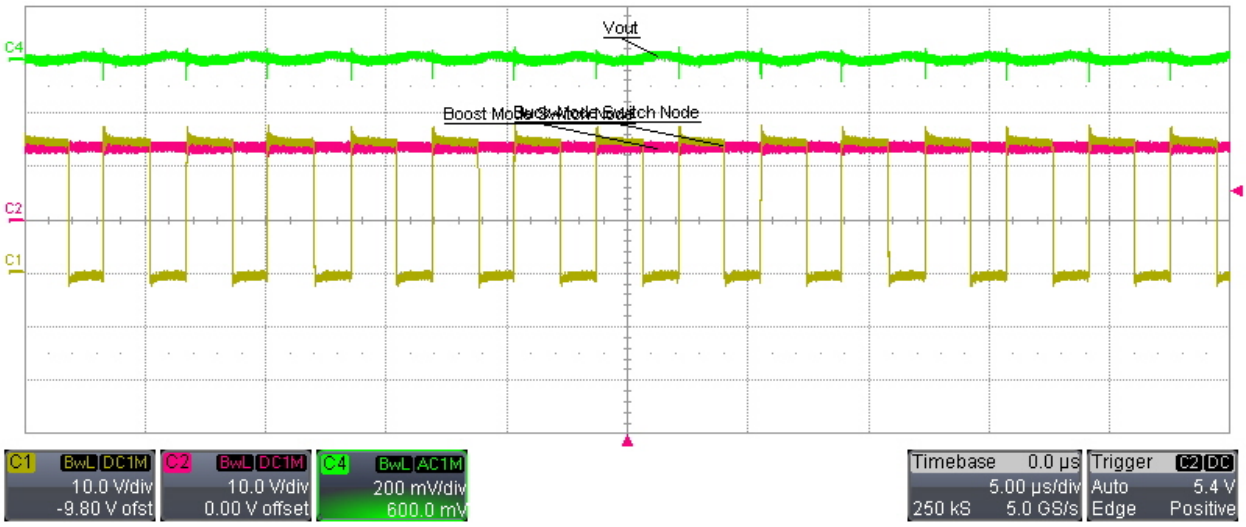


Switch Node Voltage and Output Voltage Ripple at 13 Vin and Full (5A) Load on the output.

Ch4-Output Voltage Ripple

Ch2-Boost Switch node

Ch1- Buck Switch node



Switch Node Voltage and Output Voltage Ripple at 25 Vin and Full (5A) Load on the output.

Ch4-Output Voltage Ripple

Ch2-Boost Switch node

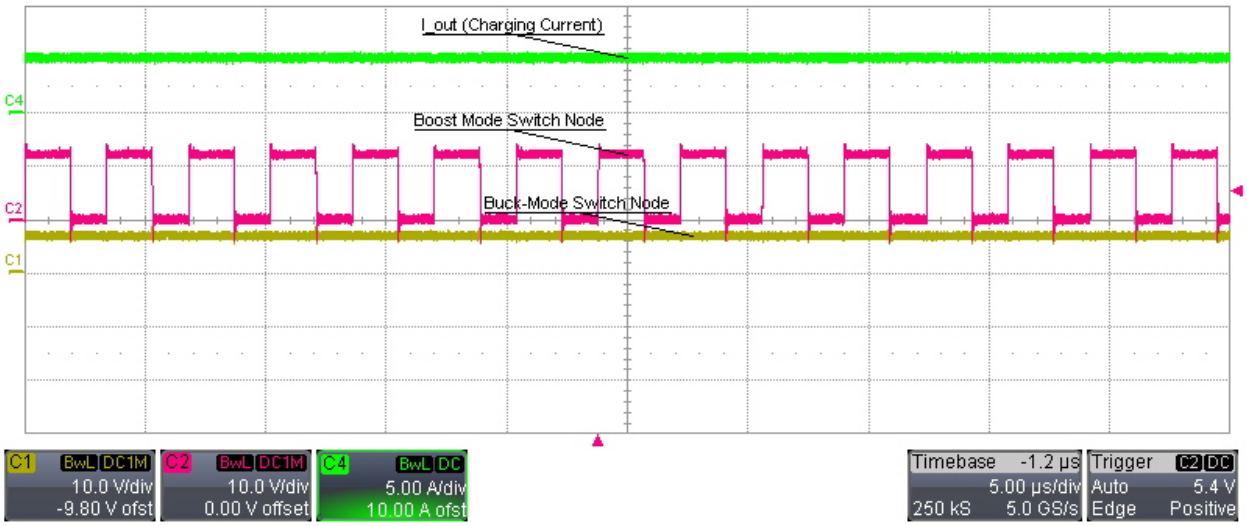
Ch1- Buck Switch node

8. CC/CV Battery Profiling /LED Driver

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=9 milliohm resistance to sense the output current such that 5.5 A output current cause the sensed voltage across the ISNS (+) and ISNS (-) pins to reach 50 mV.

8.1 Switch Waveforms- CC Mode

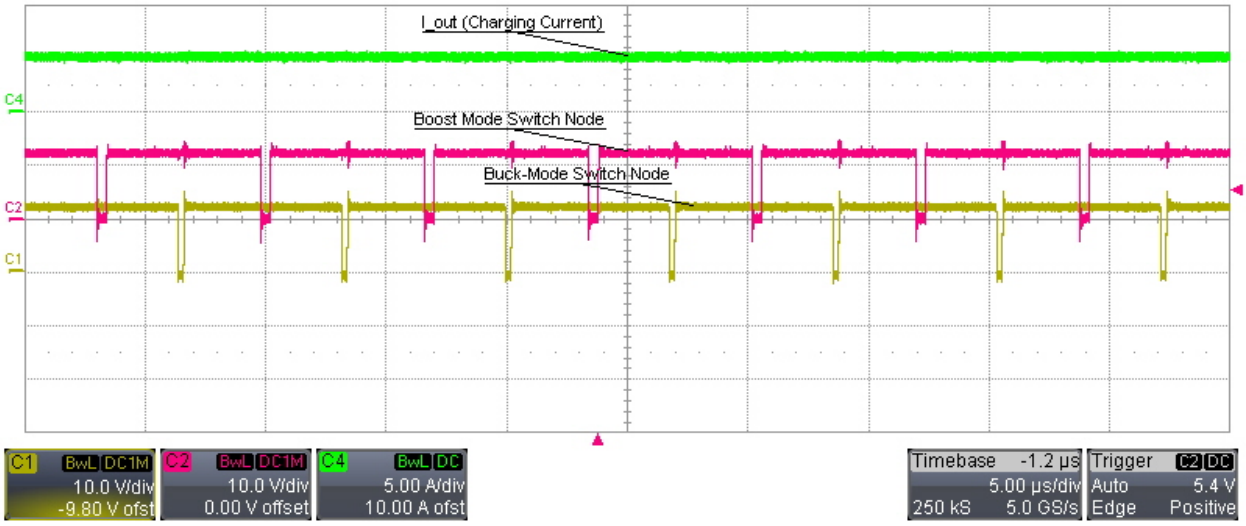


Switch Node Voltage and Charging current at 7 Vin and 12V Vout .

Ch4-Output Charging Current

Ch2-Boost Switch node

Ch1- Buck Switch node

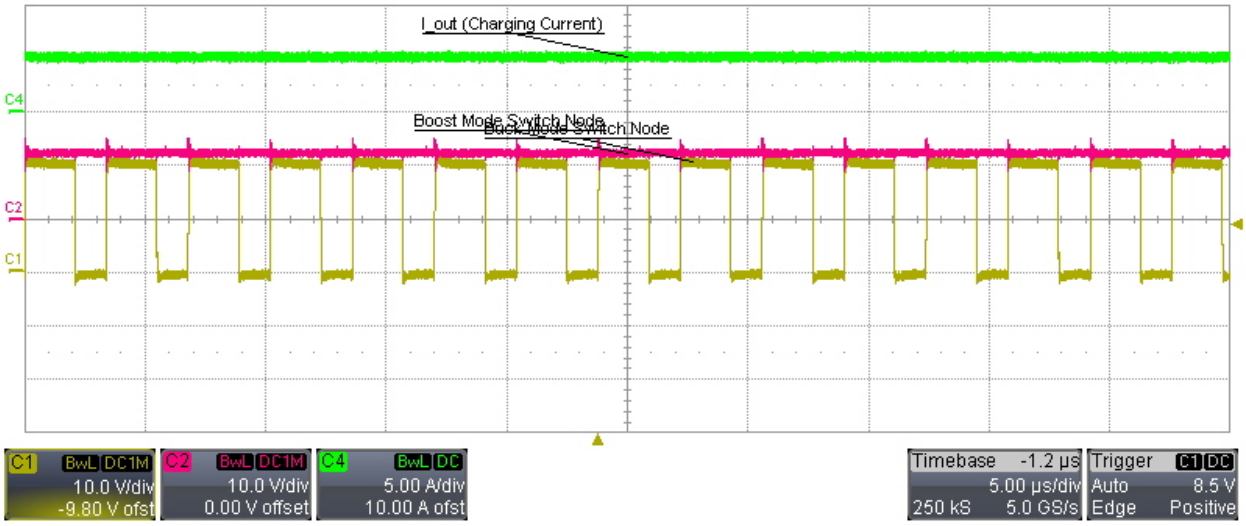


Switch Node Voltage and Charging current at 12 Vin and 12V Vout .

Ch4-Output Charging Current

Ch2-Boost Switch node

Ch1- Buck Switch node

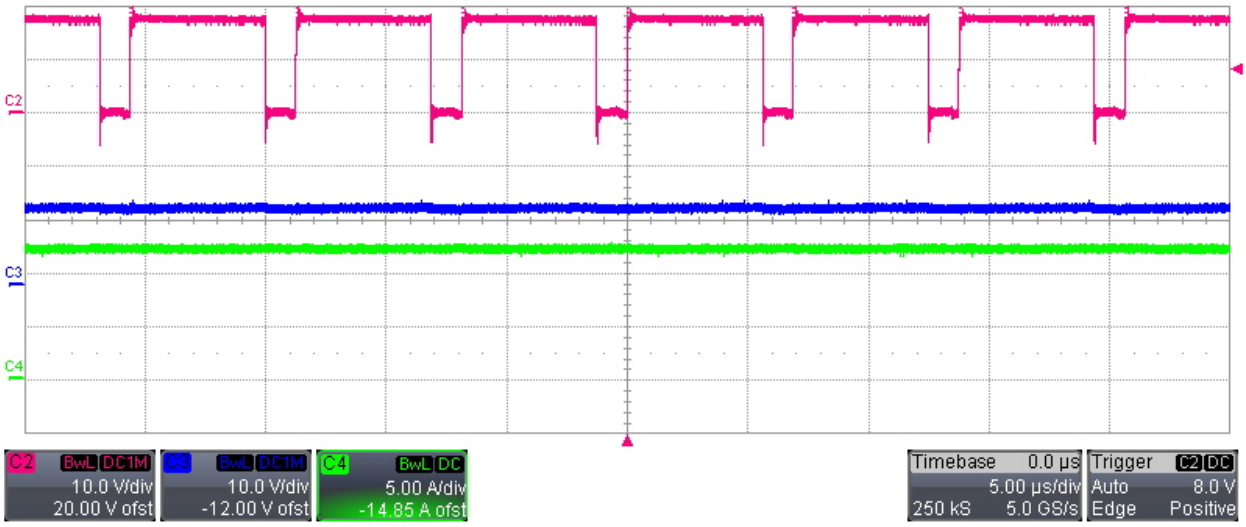


Switch Node Voltage and Charging current at 20 Vin and 12V Vout .

Ch4-Output Charging Current

Ch2-Boost Switch node

Ch1- Buck Switch node



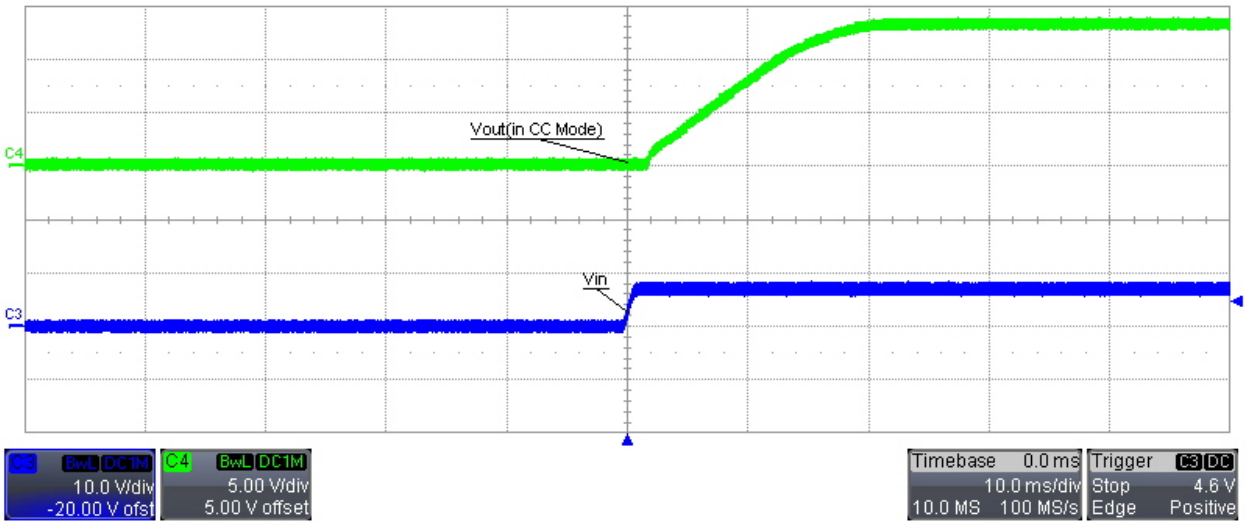
Switch Node Voltage and Charging current at 15 VIN.

Ch4-Output Charging Current

Ch3-Boost Switch node

Ch2- Buck Switch node

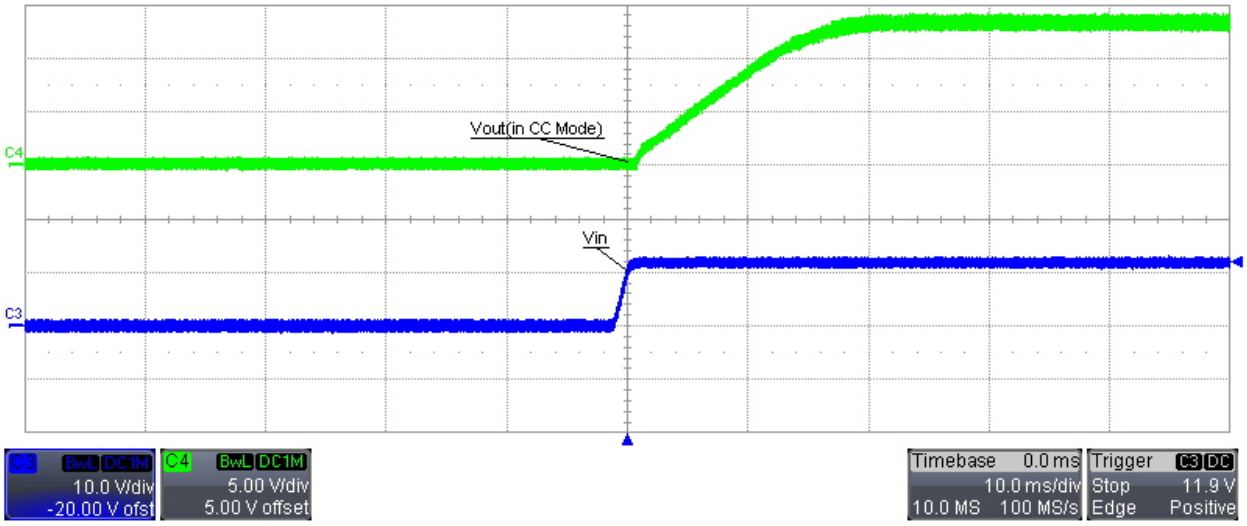
8.2 Startup- CC Mode



Startup into Full Load at 7 Vin- CC mode (Iout=5.5A)

Ch3-Vin

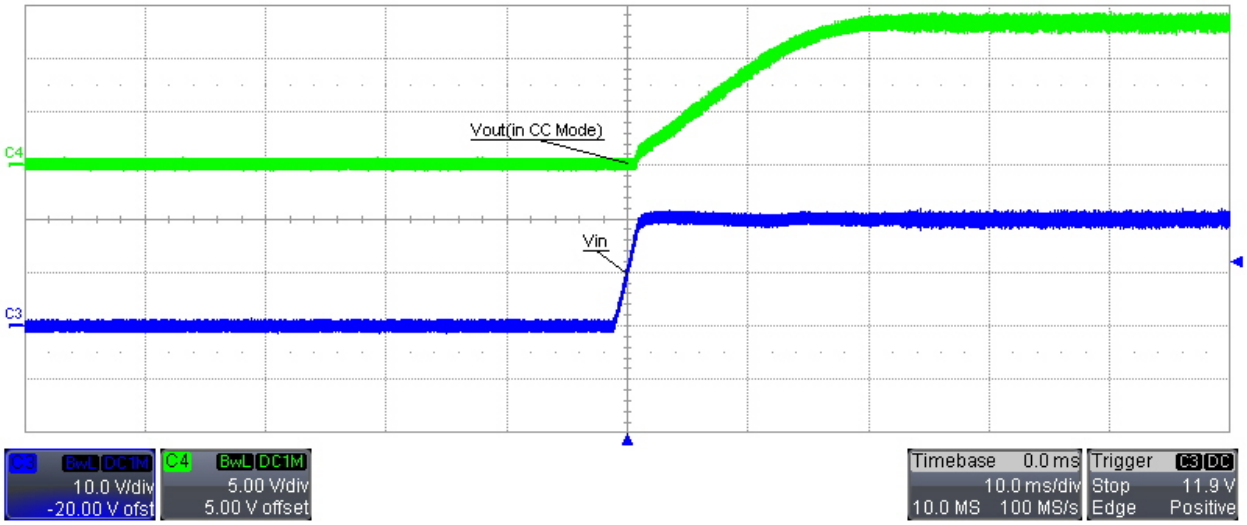
Ch4-Vout



Startup into Full Load at 12 Vin- CC mode (Iout=5.5A)

Ch3-Vin

Ch4-Vout



Startup into Full Load at 20 Vin- CC mode (Iout=5.5A)

Ch3-Vin

Ch4-Vout

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