Test Data
For PMP9492
12/21/2014

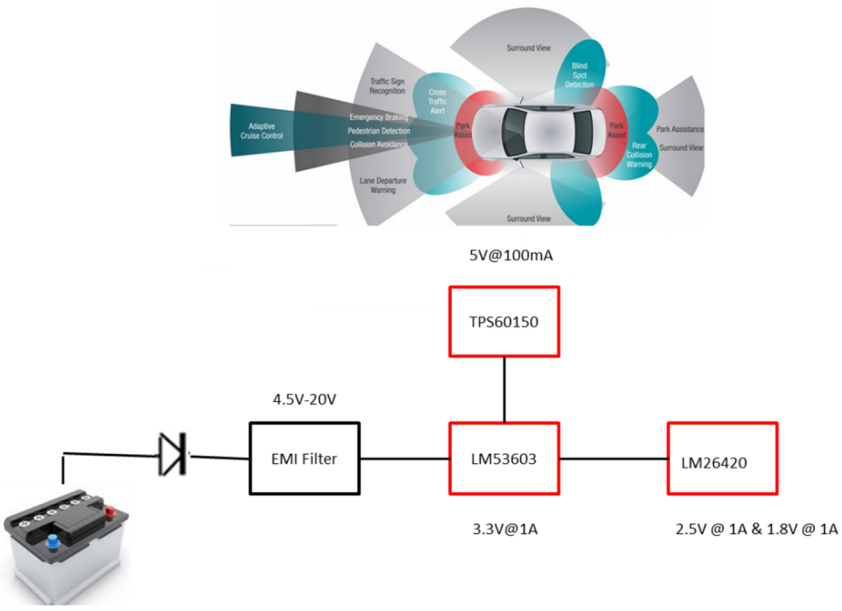
Contents

1. Design Specifications

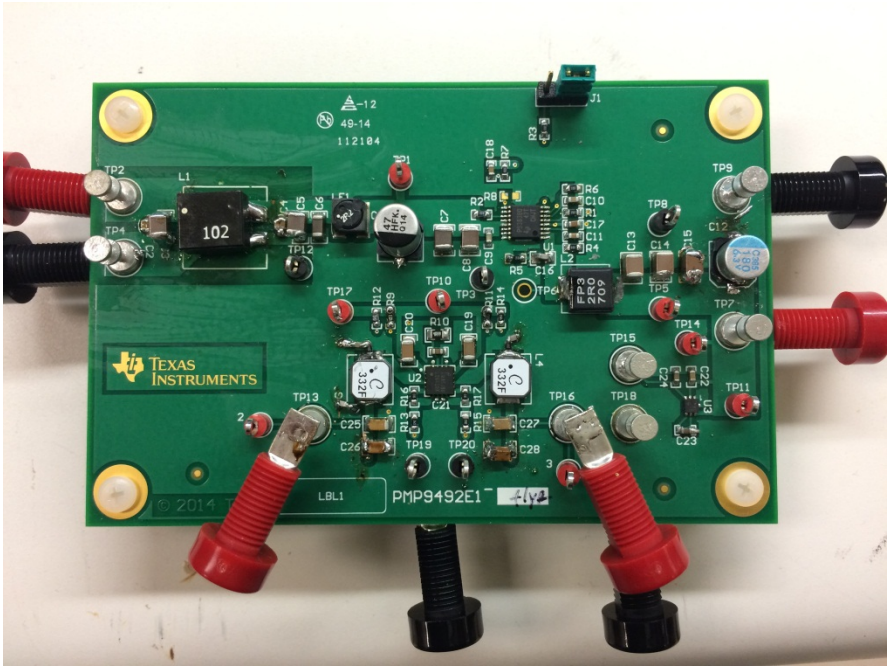
Vin Minimum	**4.5VDC**
Vin Maximum	**20VDC**
Vout1	**3.3VDC**
Iout 1	**1.0A**
Vout2	**2.5VDC**
Iout 2	**1.0A**
Vout3	**1.8VDC**
Iout 3	**1.0A**
Vout4	**5**
Iout 4	**0.1A**
Approximate Switching Frequency	**2.1MHz for Vout1,2&3 and 1.5MHz for Vout4**

2. Circuit Description and PCB details

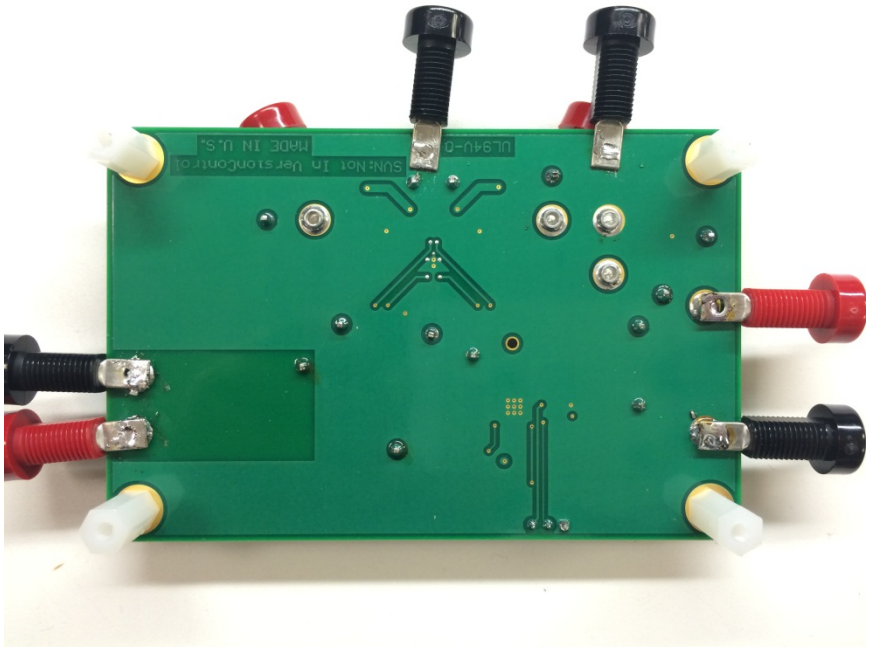
PMP9492 is a conducted EMI optimized (CISPR 25 Class 5)9 W Multi output Design for Wide Range Vin automotive ADAS application that supports Cold –Cranking Conditions . The design uses LM53603 regulator IC (Used as Buck), LM26420 (used as dual Buck) and TPS60150 regulator IC (used as Charge pump for 5V output). The design accepts an input voltage of 4.5Vin to 20Vin and provides the outputs of 3.3V@1.0A, 2.5V @ 1.0A , 1.8V @ 1.0A and 5V@ 100mA . It features a small size and is an inexpensive and more efficient solution customized for ADAS and other Automotive related applications. The Board dimension of PMP9492 PCB is 2600mil * 4000mil. Four layer PCB was used for the design.



3. PMP9492 Board Photos



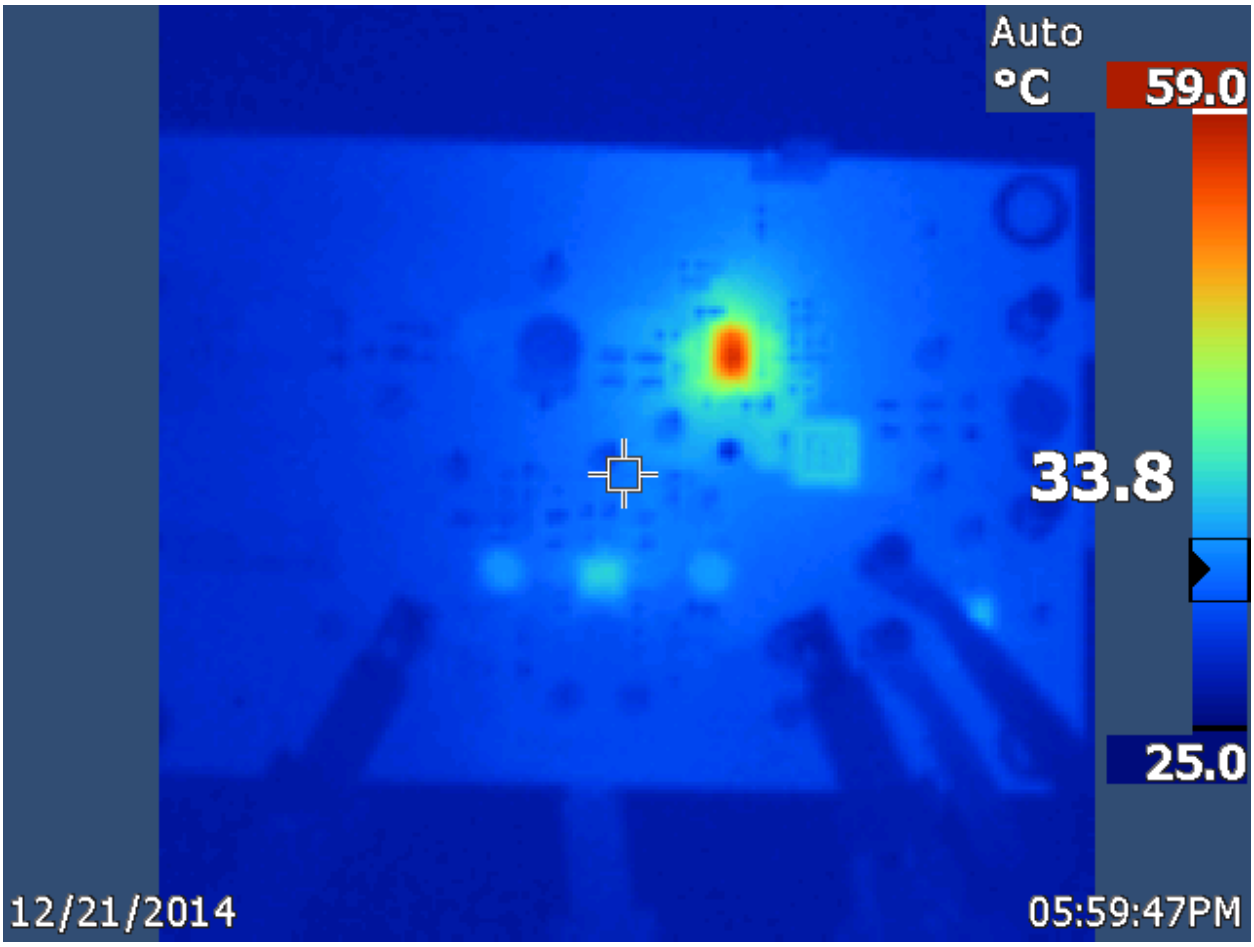
Board Photo (Top)



Board Photo (Bottom)

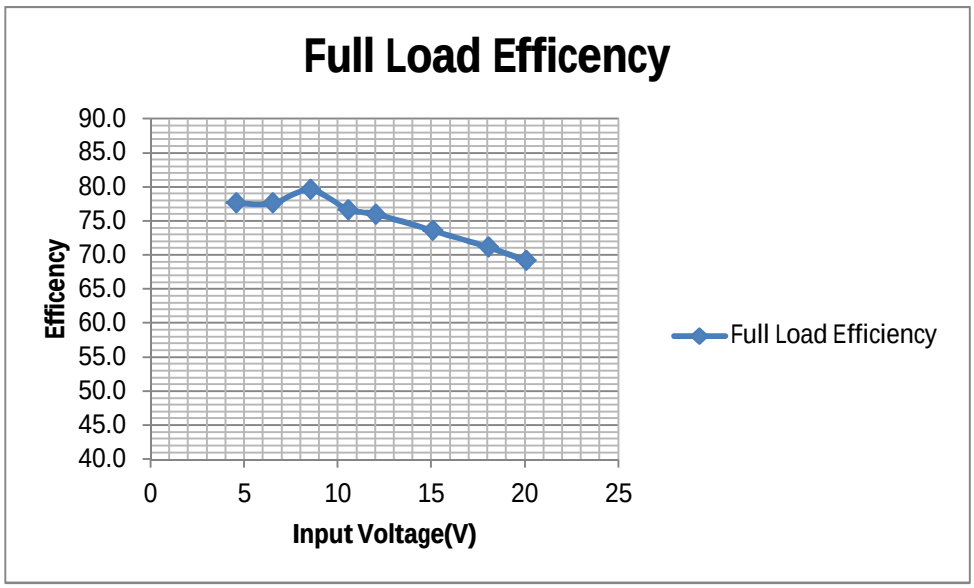
4. Thermal Data

IR thermal image taken at steady state with 12Vin and all the outputs at full load (no airflow)

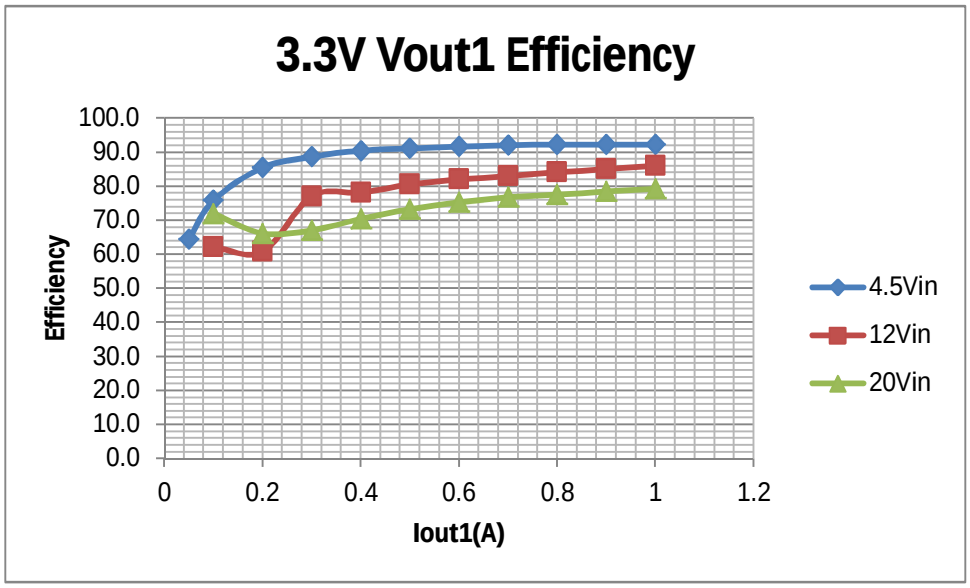


5. Efficiency

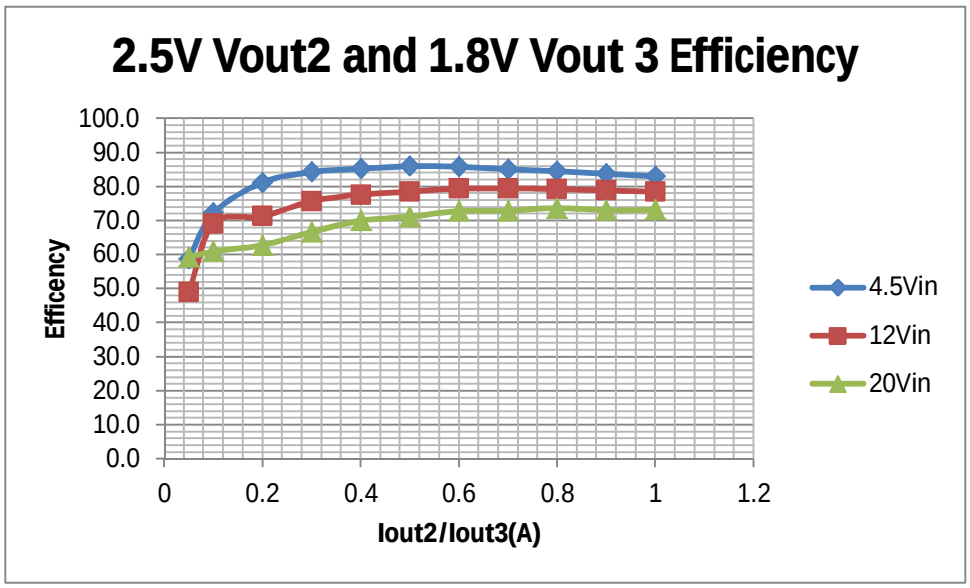
5.1 Efficiency Chart – Input Voltage Vs Efficiency with all output fully Loaded



5.2 Efficiency Chart – 3.3Vout Efficiency Vs Load Current



5.3 Efficiency Chart – 2.5V Vout2 and 1.8V Vout3 Efficiency



5.3 Efficiency Data

Efficiency of total System Vs Input Voltage

Vin (V)	Iin (A)	Vout 1(V)	Iout 1(A)	Vout 2(V)	Iout 2(A)	Vout 3(V)	Iout 3(A)	Vout 4(V)	Iout 4(A)	Pin (W)	Pout (W)	Efficiency (%)
4.566	2.28	3.31	1	2.47	1	1.8	1	5.02	0.1	10.41048	8.082	77.6
6.507	1.6	3.31	1	2.47	1	1.8	1	5.02	0.1	10.4112	8.082	77.6
8.53	1.19	3.31	1	2.47	1	1.8	1	5.02	0.1	10.1507	8.082	79.6
10.54	1	3.31	1	2.47	1	1.8	1	5.02	0.1	10.54	8.082	76.7
12.04	0.883	3.31	1	2.47	1	1.8	1	5.02	0.1	10.63132	8.082	76.0
15.058	0.729	3.31	1	2.47	1	1.8	1	5.02	0.1	10.97728	8.082	73.6
18.06	0.629	3.31	1	2.47	1	1.8	1	5.02	0.1	11.35974	8.082	71.1
20.06	0.582	3.31	1	2.47	1	1.8	1	5.02	0.1	11.67492	8.082	69.2

Efficiency of 3.3V Vs Load Current

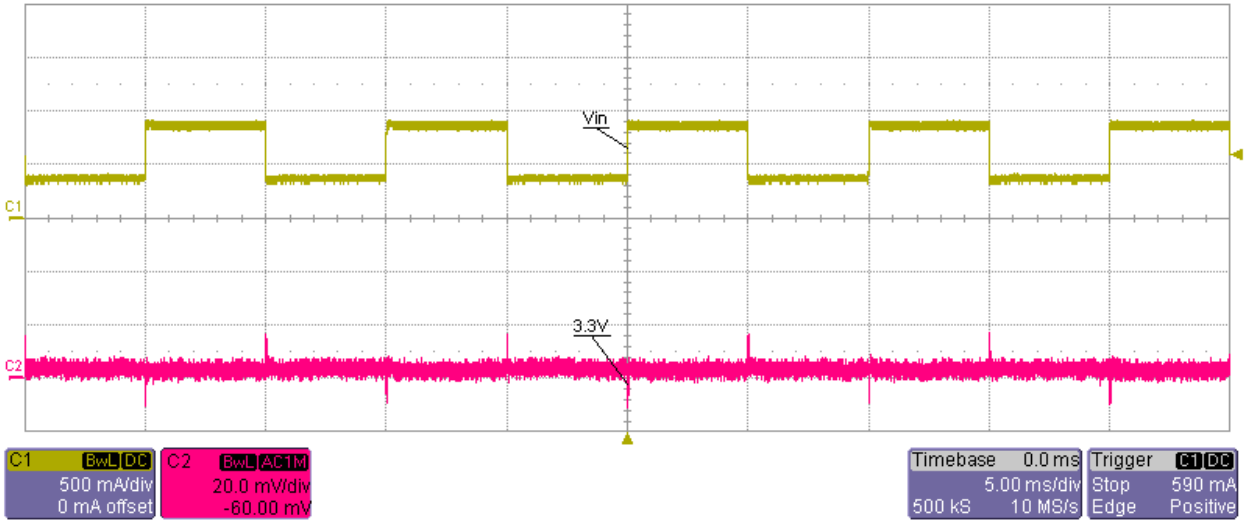
Vin (V)	Iin (A)	Vout 1(V)	Iout 1(A)	Pin (W)	Pout (W)	Efficiency (%)
4.5	0.798	3.31	1	3.591	3.31	92.2
4.51	0.716	3.31	0.9	3.22916	2.979	92.3
4.52	0.635	3.31	0.8	2.8702	2.648	92.3
4.53	0.555	3.31	0.7	2.51415	2.317	92.2
4.55	0.476	3.31	0.6	2.1658	1.986	91.7
4.55	0.399	3.31	0.5	1.81545	1.655	91.2
4.56	0.321	3.31	0.4	1.46376	1.324	90.5
4.57	0.245	3.31	0.3	1.11965	0.993	88.7
4.58	0.169	3.31	0.2	0.77402	0.662	85.5
4.59	0.095	3.31	0.1	0.43605	0.331	75.9
4.59	0.056	3.31	0.05	0.25704	0.1655	64.4
Vin (V)	**Iin (A)**	**Vout 1(V)**	**Iout 1(A)**	**Pin (W)**	**Pout (W)**	**Efficiency (%)**
12.1	0.022	3.31	0.05	0.2662	0.1655	62.2
12.1	0.045	3.31	0.1	0.5445	0.331	60.8
12.09	0.071	3.31	0.2	0.85839	0.662	77.1
12.09	0.105	3.31	0.3	1.26945	0.993	78.2
12.09	0.136	3.31	0.4	1.64424	1.324	80.5
12.08	0.167	3.31	0.5	2.01736	1.655	82.0
12.08	0.198	3.31	0.6	2.39184	1.986	83.0
12.07	0.228	3.31	0.7	2.75196	2.317	84.2
12.07	0.258	3.31	0.8	3.11406	2.648	85.0
12.07	0.287	3.31	0.9	3.46409	2.979	86.0
12.06	0.318	3.31	1	3.83508	3.31	86.3
Vin (V)	**Iin (A)**	**Vout 1(V)**	**Iout 1(A)**	**Pin (W)**	**Pout (W)**	**Efficiency (%)**
19.97	0.209	3.31	1	4.17373	3.31	79.3
19.98	0.19	3.31	0.9	3.7962	2.979	78.5
19.98	0.171	3.31	0.8	3.41658	2.648	77.5
19.98	0.151	3.31	0.7	3.01698	2.317	76.8
19.98	0.132	3.31	0.6	2.63736	1.986	75.3
19.98	0.113	3.31	0.5	2.25774	1.655	73.3
19.99	0.094	3.31	0.4	1.87906	1.324	70.5
19.99	0.074	3.31	0.3	1.47926	0.993	67.1
20	0.05	3.31	0.2	1	0.662	66.2
20	0.023	3.31	0.1	0.46	0.331	72.0
20	0.012	3.31	0.05	0.24	0.1655	69.0

Efficiency Data of 2.5V and 1.8 V

Vin (V)	Iin (A)	Vout 2(V)	Iout 2(A)	Vout 3(V)	Iout 3(A)	Pin (W)	Pout (W)	Efficiency (%)
19.96	0.292	2.47	1	1.8	1	5.82832	4.27	73.3
19.97	0.263	2.47	0.9	1.8	0.9	5.25211	3.843	73.2
19.97	0.232	2.47	0.8	1.8	0.8	4.63304	3.416	73.7
19.98	0.205	2.47	0.7	1.8	0.7	4.0959	2.989	73.0
19.98	0.176	2.47	0.6	1.8	0.6	3.51648	2.562	72.9
19.99	0.15	2.47	0.5	1.8	0.5	2.9985	2.135	71.2
19.99	0.122	2.47	0.4	1.8	0.4	2.43878	1.708	70.0
19.99	0.096	2.47	0.3	1.8	0.3	1.91904	1.281	66.8
19.99	0.068	2.47	0.2	1.8	0.2	1.35932	0.854	62.8
20	0.035	2.47	0.1	1.8	0.1	0.7	0.427	61.0
20	0.018	2.47	0.05	1.8	0.05	0.36	0.2135	59.3
Vin (V)	**Iin (A)**	**Vout 2(V)**	**Iout 2(A)**	**Vout 3(V)**	**Iout 3(A)**	**Pin (W)**	**Pout (W)**	**Efficiency (%)**
12.1	0.036	2.47	0.05	1.8	0.05	0.4356	0.2135	49.0
12.1	0.051	2.47	0.1	1.8	0.1	0.6171	0.427	69.2
12.09	0.099	2.47	0.2	1.8	0.2	1.19691	0.854	71.4
12.085	0.14	2.47	0.3	1.8	0.3	1.6919	1.281	75.7
12.08	0.182	2.47	0.4	1.8	0.4	2.19856	1.708	77.7
12.07	0.225	2.47	0.5	1.8	0.5	2.71575	2.135	78.6
12.07	0.267	2.47	0.6	1.8	0.6	3.22269	2.562	79.5
12.064	0.312	2.47	0.7	1.8	0.7	3.763968	2.989	79.4
12.057	0.357	2.47	0.8	1.8	0.8	4.304349	3.416	79.4
12.05	0.404	2.47	0.9	1.8	0.9	4.8682	3.843	78.9
12.04	0.452	2.47	1	1.8	1	5.44208	4.27	78.5
Vin (V)	**Iin (A)**	**Vout 2(V)**	**Iout 2(A)**	**Vout 3(V)**	**Iout 3(A)**	**Pin (W)**	**Pout (W)**	**Efficiency (%)**
4.45	1.155	2.47	1	1.8	1	5.13975	4.27	83.1
4.47	1.026	2.47	0.9	1.8	0.9	4.58622	3.843	83.8
4.49	0.9	2.47	0.8	1.8	0.8	4.041	3.416	84.5
4.5	0.78	2.47	0.7	1.8	0.7	3.51	2.989	85.2
4.51	0.662	2.47	0.6	1.8	0.6	2.98562	2.562	85.8
4.53	0.548	2.47	0.5	1.8	0.5	2.48244	2.135	86.0
4.55	0.44	2.47	0.4	1.8	0.4	2.002	1.708	85.3
4.56	0.333	2.47	0.3	1.8	0.3	1.51848	1.281	84.4
4.57	0.23	2.47	0.2	1.8	0.2	1.0511	0.854	81.2
4.58	0.129	2.47	0.1	1.8	0.1	0.59082	0.427	72.3
4.59	0.079	2.47	0.05	1.8	0.05	0.36261	0.2135	58.9

6. Waveforms

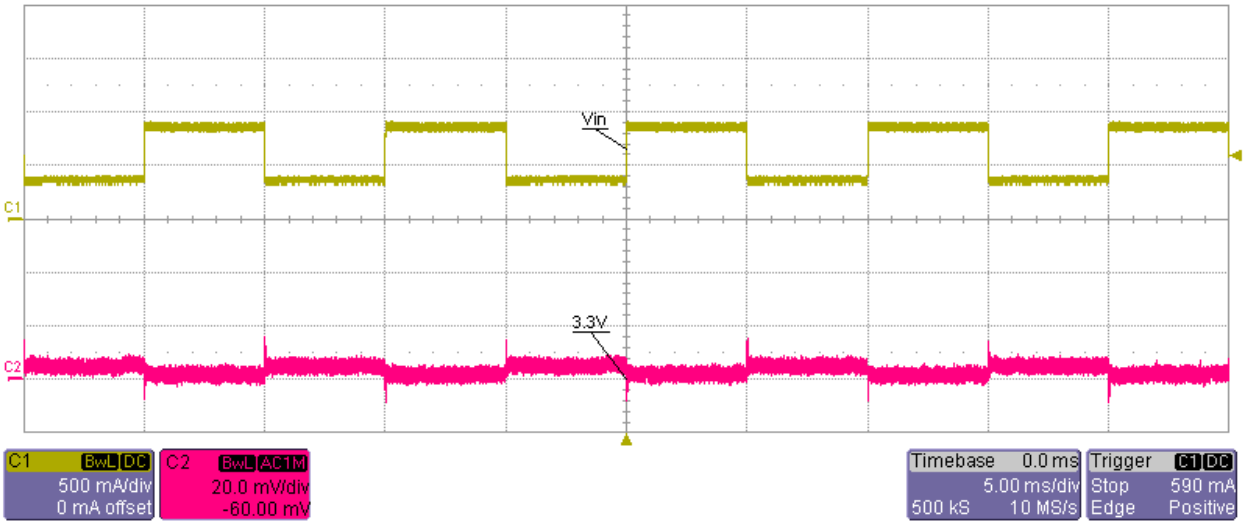
6.1 Load Transient Response



Load Transient Response at 4.5Vin and 50%-to-100% Load Step(0.5A-1A) on 3.3V Output Vout1(Full Load were connected to all other outputs)

Ch2 – Vout1 (AC coupled)

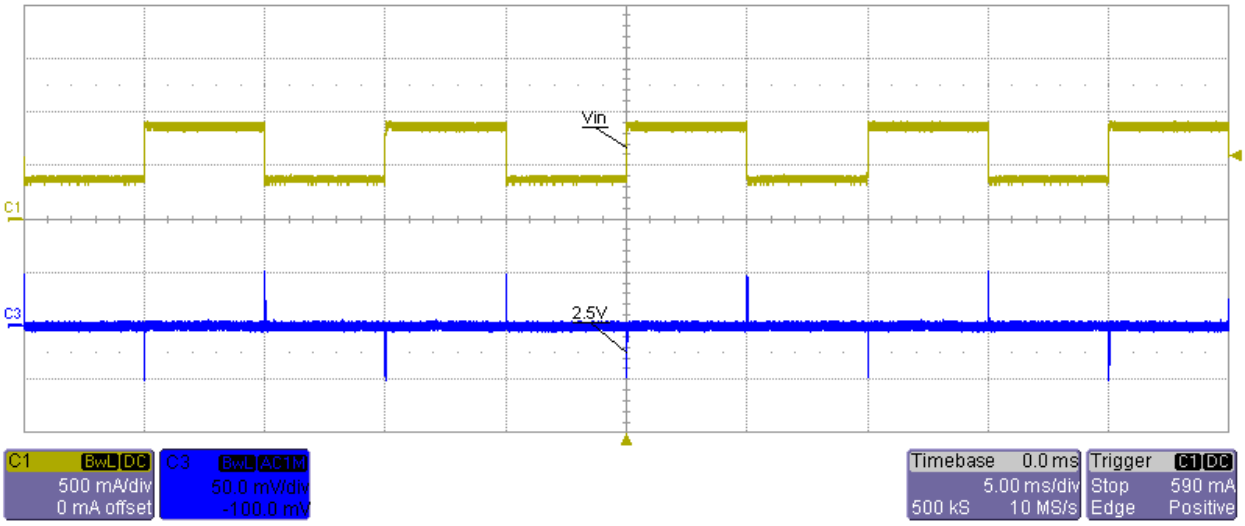
Ch1- Iout 1



Load Transient Response at 12 Vin and 50%-to-100% Load Step(0.5A-1A) on 3.3V Output Vout1(Full Load were connected to all other outputs)

Ch2 – Vout1 (AC coupled)

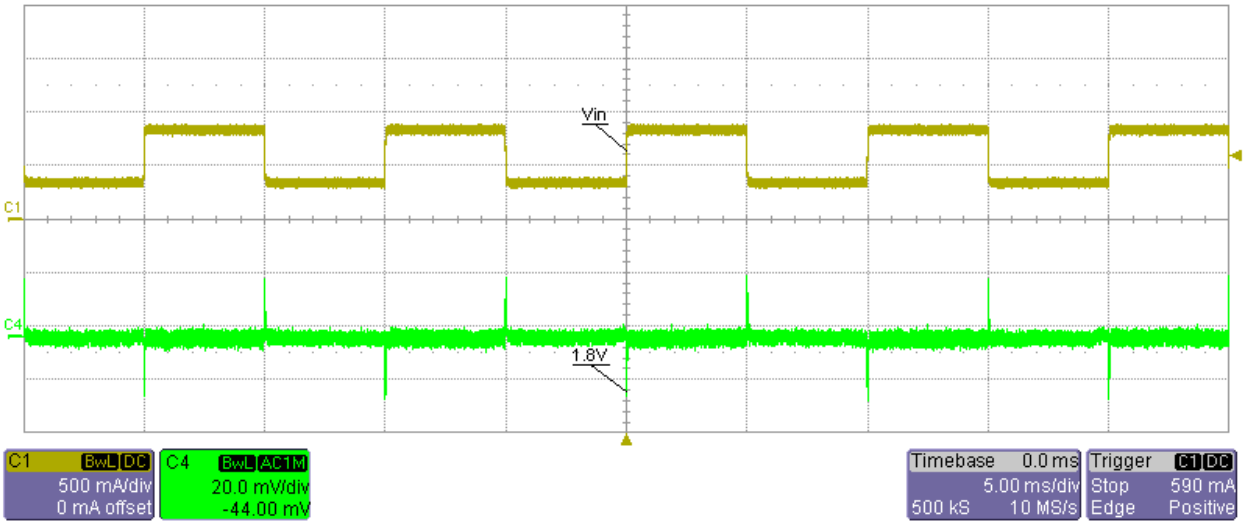
Ch1- Iout 1



Load Transient Response at 4.5 Vin and 50%-to-100% Load Step(0.5A-1A) on 2.5V Output Vout2(Full Load were connected to all other outputs)

Ch3 – Vout2 (AC coupled)

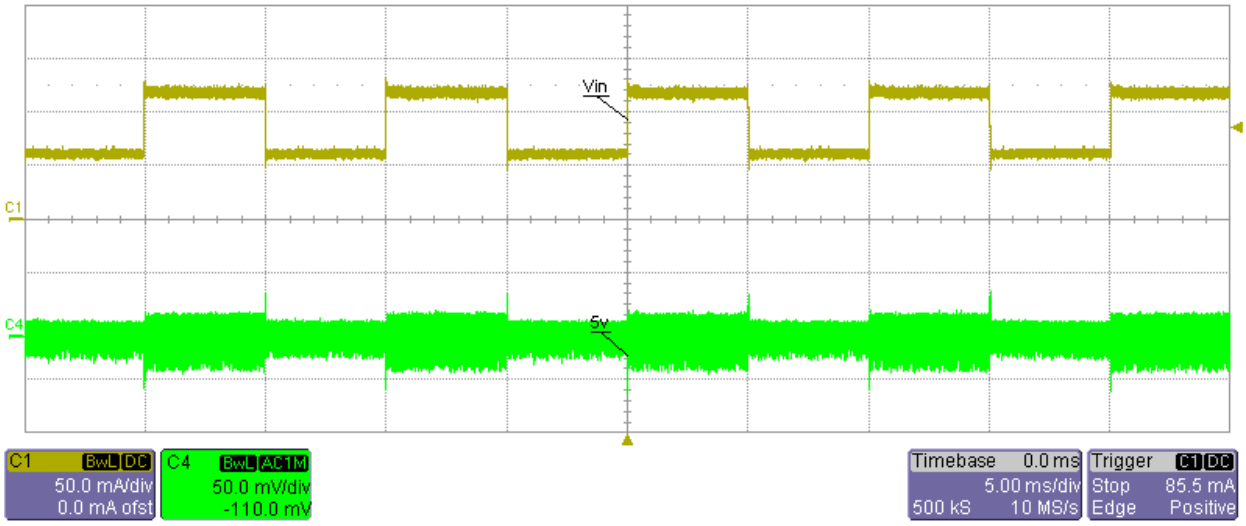
Ch1- Iout2



Load Transient Response at 4.5 Vin and 50%-to-100% Load Step(0.5A-1A) on 1.8V Output Vout3(Full Load were connected to all other outputs)

Ch4 – Vout3 (AC coupled)

Ch1- Iout3

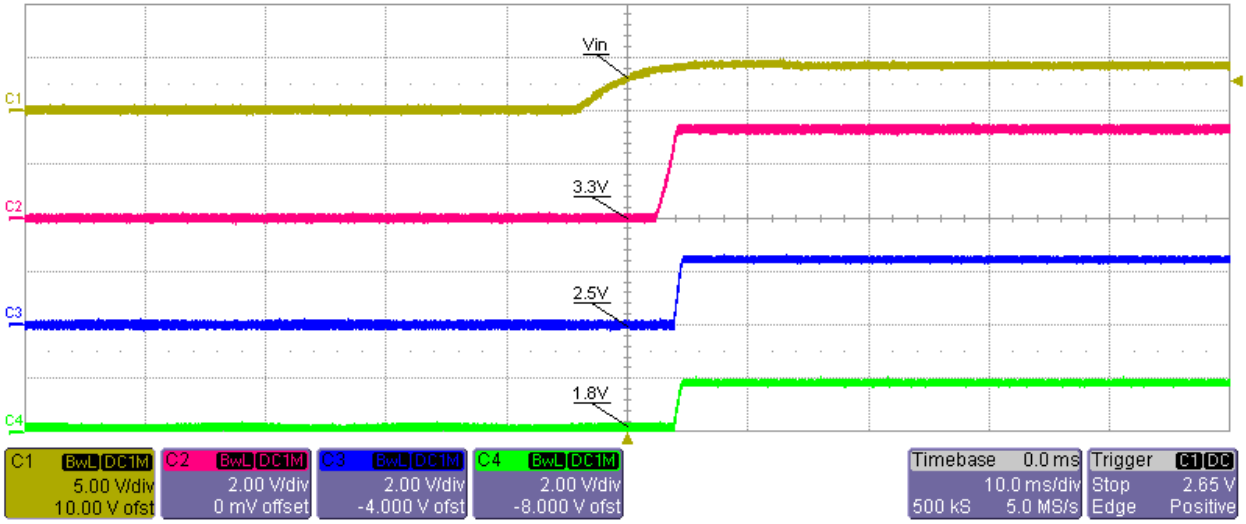


Load Transient Response at 4.5Vin and 50%-to-100% Load Step on 5V Output Vout4 (Full Load were connected to all other outputs)

Ch4 – Vout4 (AC coupled)

Ch4- Iout 4

6.2 Startup



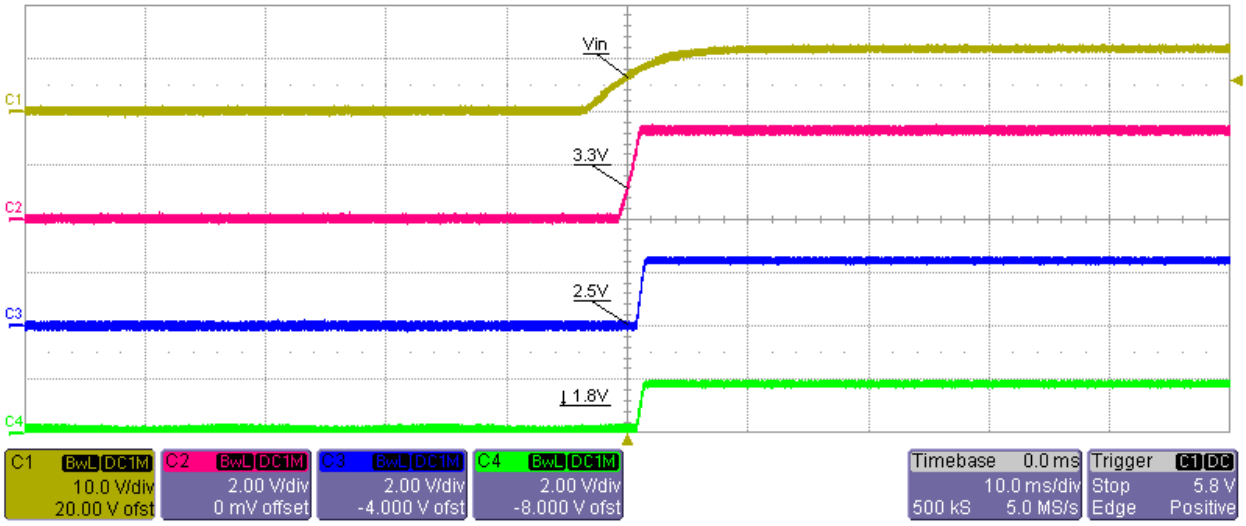
Startup into full Load (all the output was connected to full Load) at 4.5 Vin

Ch1-Vin

Ch2-Vout 1

Ch3-Vout 2

Ch4-Vout3



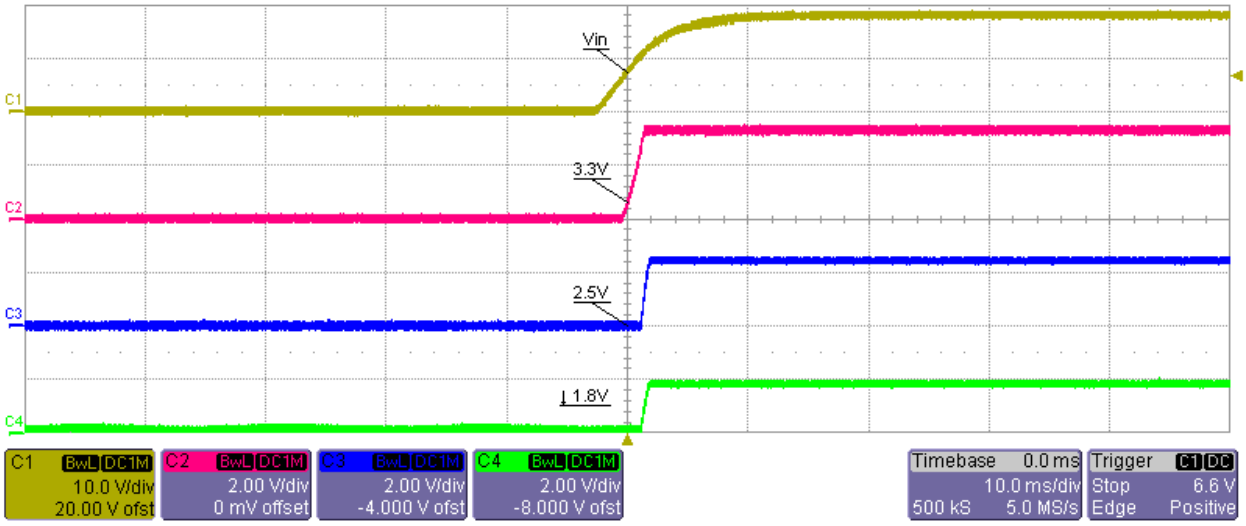
Startup into full Load (all the output was connected to full Load) at 12 Vin

Ch1-Vin

Ch2-Vout 1

Ch3-Vout 2

Ch4-Vout3



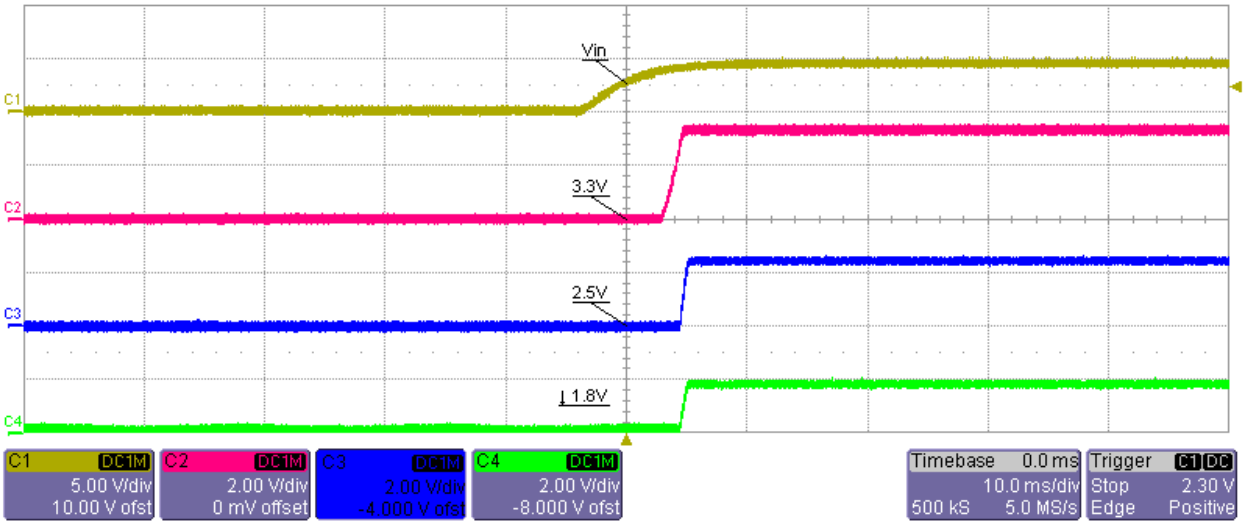
Startup into full Load (all the output was connected to full Load) at 20 Vin

Ch1-Vin

Ch2-Vout 1

Ch3-Vout 2

Ch4-Vout3



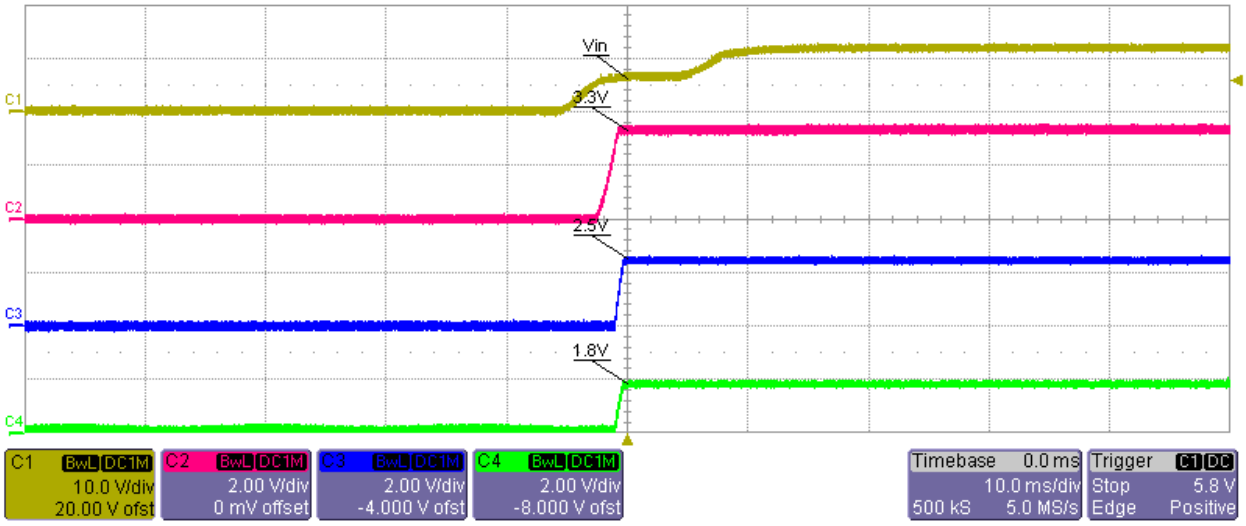
Startup into No Load (all the output was connected to No Load) at 4.5 Vin

Ch1-Vin

Ch2-Vout 1

Ch3-Vout 2

Ch4-Vout3



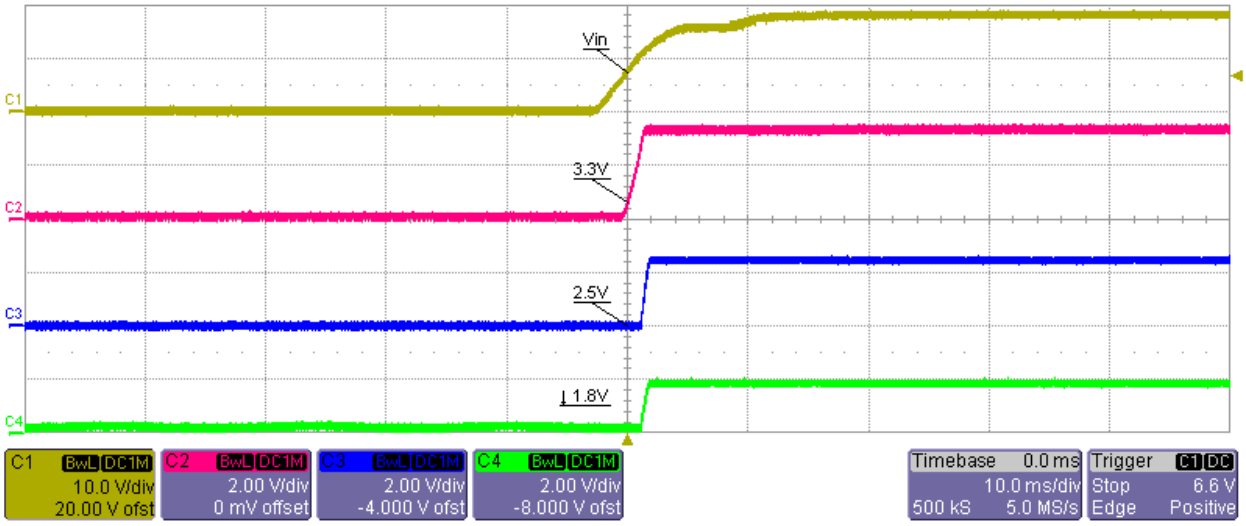
Startup into No Load (all the output was connected to No Load) at 12 Vin

Ch1-Vin

Ch2-Vout 1

Ch3-Vout 2

Ch4-Vout3



Startup into No Load (all the output was connected to No Load) at 20 Vin

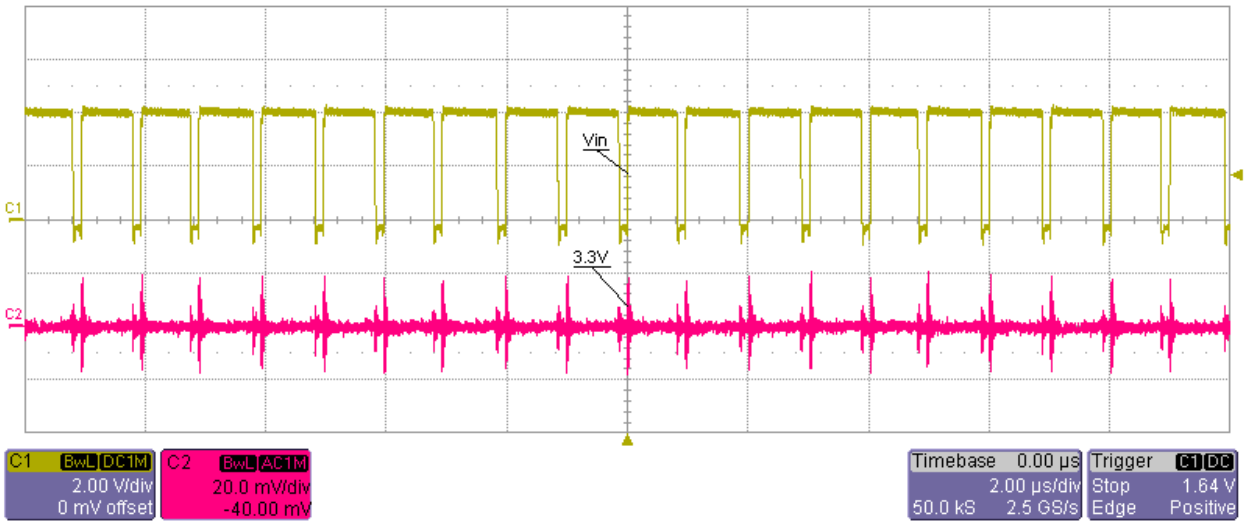
Ch1-Vin

Ch2-Vout 1

Ch3-Vout 2

Ch4-Vout3

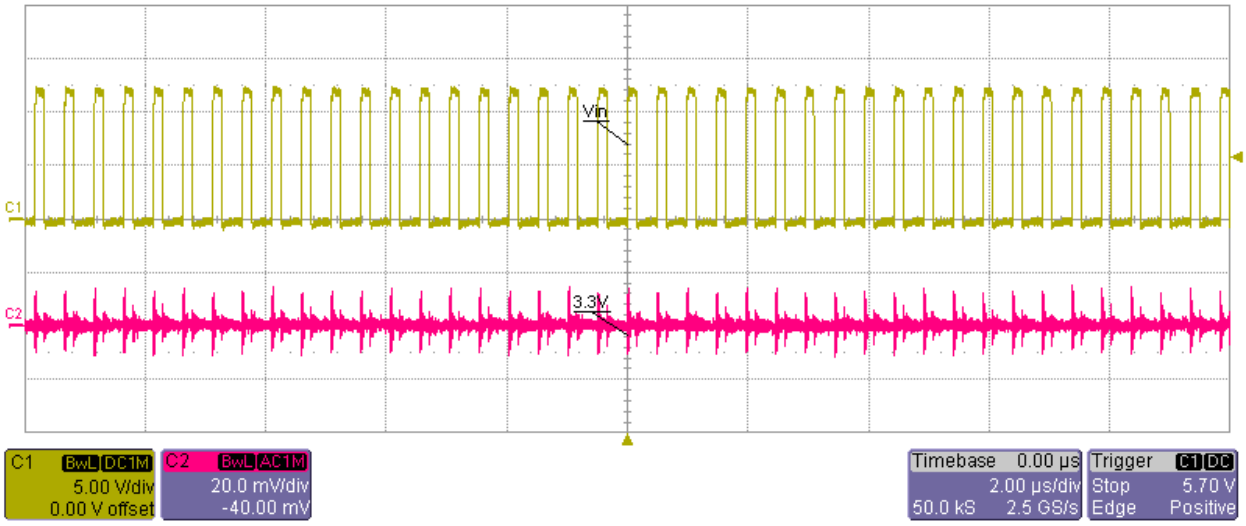
6.3 Output Voltage Ripple and Switch Node Voltage



Switch Node Voltage and Output Voltage Ripple at 4.5 Vin and Full Load on all the outputs

Ch2-Vout1 (AC Coupled)

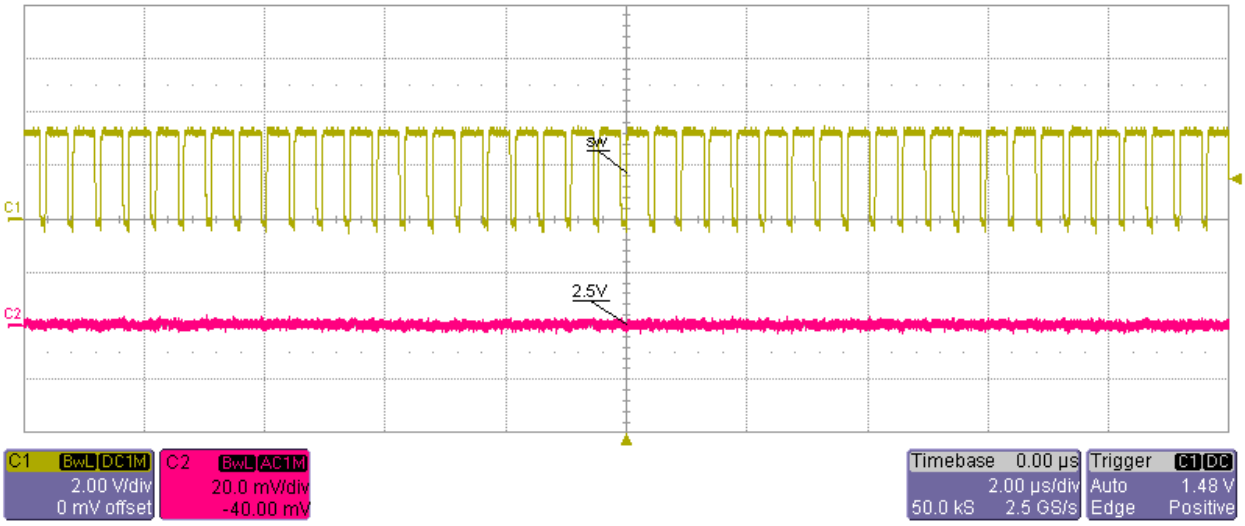
Ch1-Switching Waveform



Switch Node Voltage and Output Voltage Ripple at 12 Vin and Full Load on all the outputs

Ch2-Vout1 (AC Coupled)

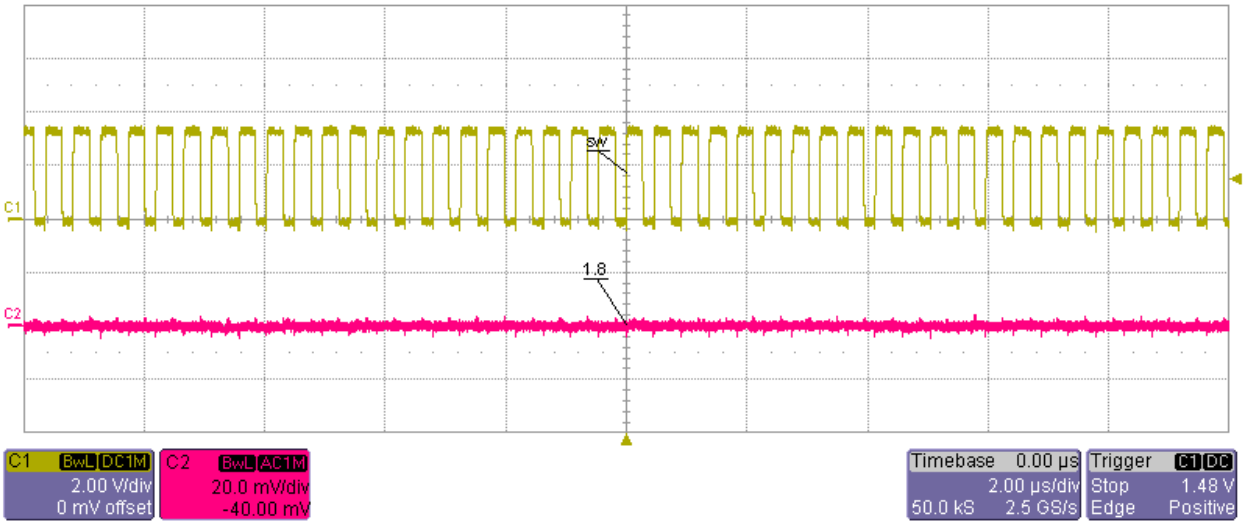
Ch1-Switching Waveform



Switch Node Voltage and Output Voltage Ripple at 12 Vin and Full Load on all the outputs (Vripple < 10mVp-p)

Ch2-Vout2 (AC Coupled)

Ch1-Switching Waveform



Switch Node Voltage and Output Voltage Ripple at 12 Vin and Full Load on all the outputs (Vripple < 60mVp-p)

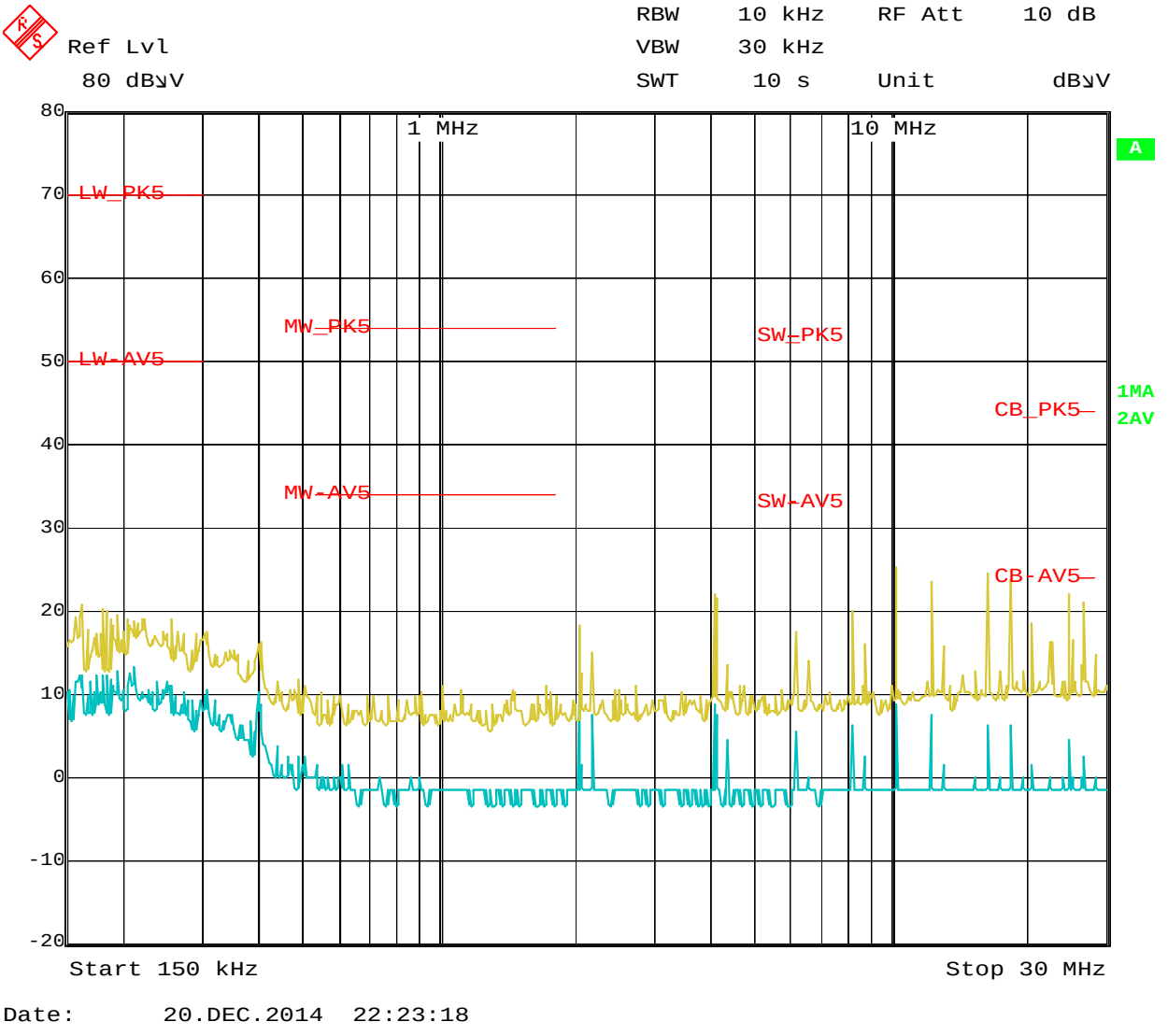
Ch2-Vout3 (AC Coupled)

Ch1-Switching Waveform

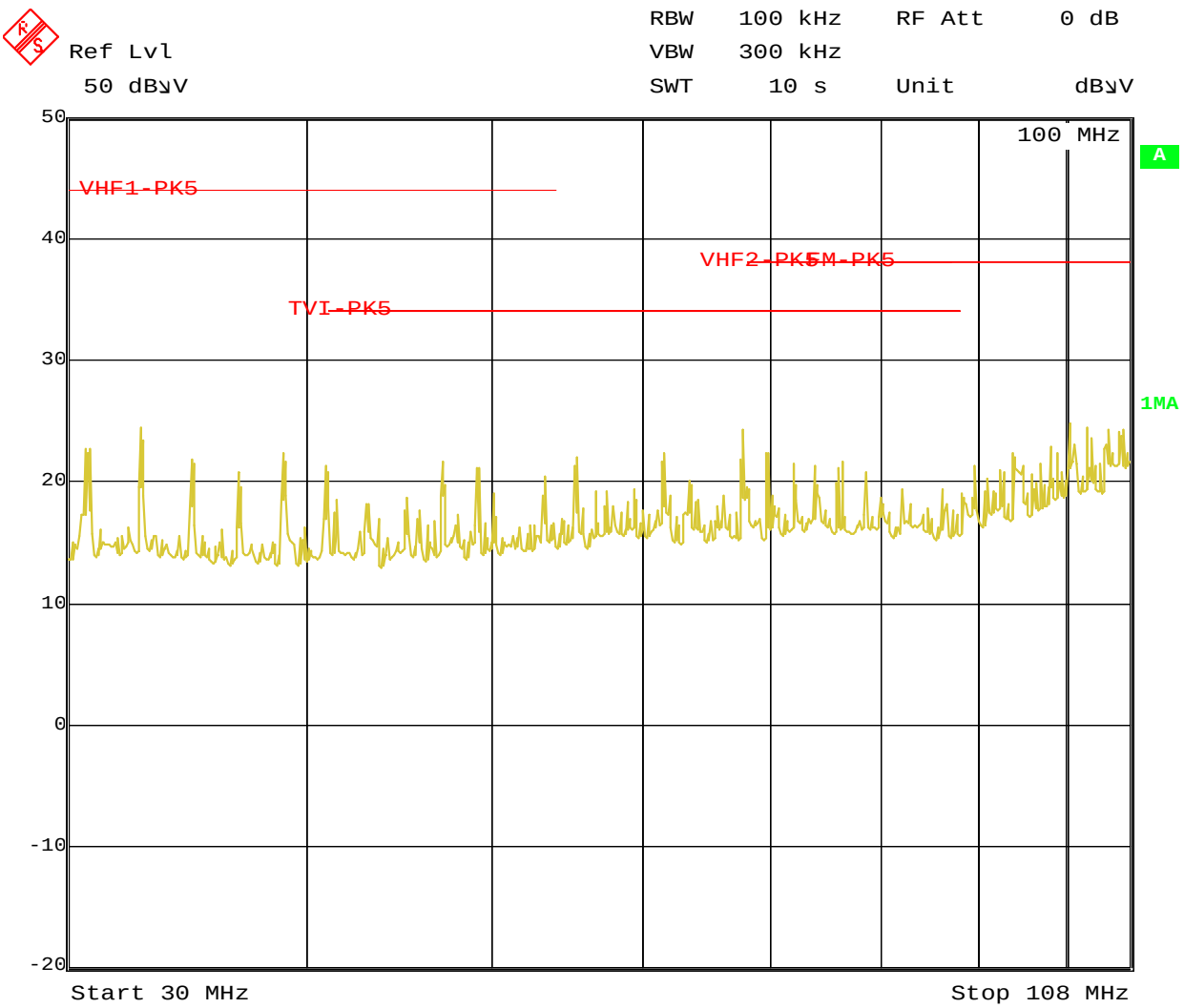
7. Conducted Emissions

The conducted emissions is tested followed the of CISPR 25 standards. The frequency band examined spans from 150 kHz to 108 MHz covering the AM, FM radio bands, VHF band, and TV band specified in the CISPR 25.

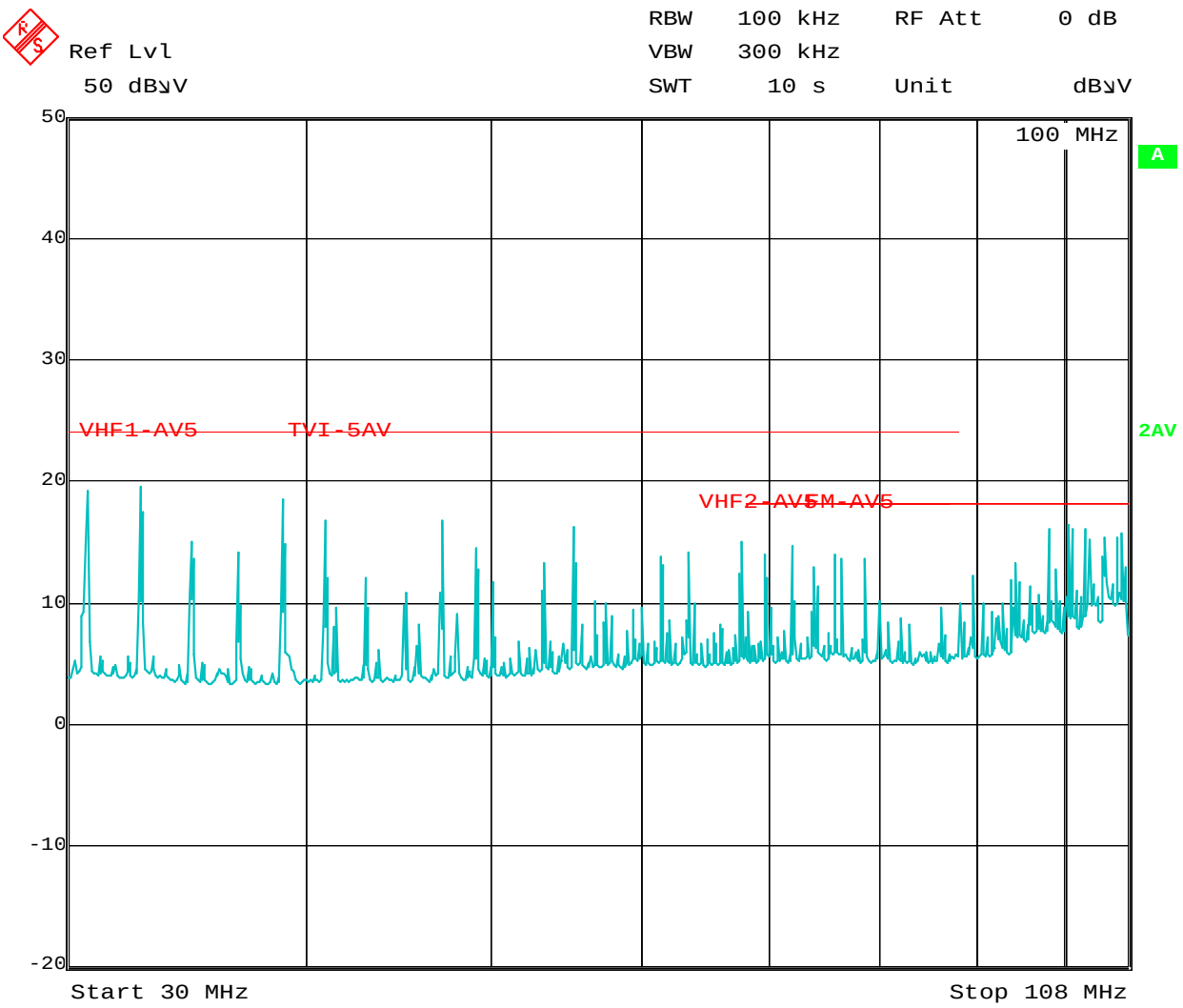
The test results are shown in below three Figures. The first Figure show the test result using peak detector and Average detector measurement up to 30MHz , and the last two Figure show the test result using average detector and Peak Detector measurement from 30MHz to 108MHz. The limit lines shown in red are the Class 5 limits for conducted disturbances specified in the CISPR 25 Class 5 ; the yellow(Peak Detector measurement) and blue(Average detector measurement) traces is the test result. It can be seen that the power supply operates quietly and the noise is below the stringent Class 5 limits too.



Test result – Upto 30MHz Conducted Emission –Peak and Average Detection



Test result –30MHz to 108MHz Conducted Emission –Peak Detection



Test result –30MHz to 108MHz Conducted Emission –Average Detection

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