

**Test Data
For PMP9487
09/13/2014**



Contents

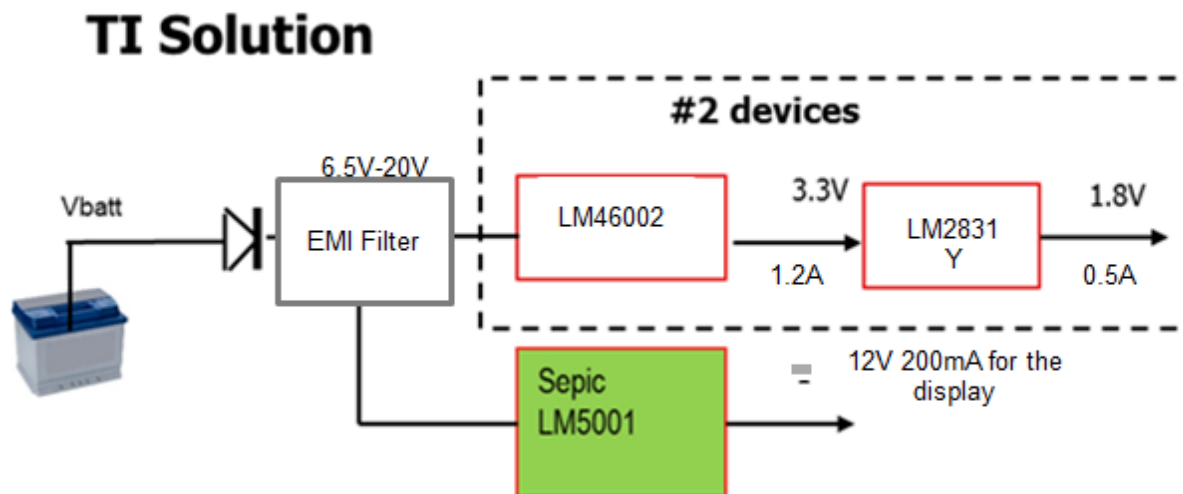
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1. Design Specifications

Vin Minimum	6.5VDC
Vin Maximum	20VDC
Vout1	12VDC
Iout 1	0.200A
Vout2	3.3VDC
Iout 2	1.30A
Vout3	1.8VDC
Iout 3	0.500A
Approximate Switching Frequency	500KHz Approx(all the converters)

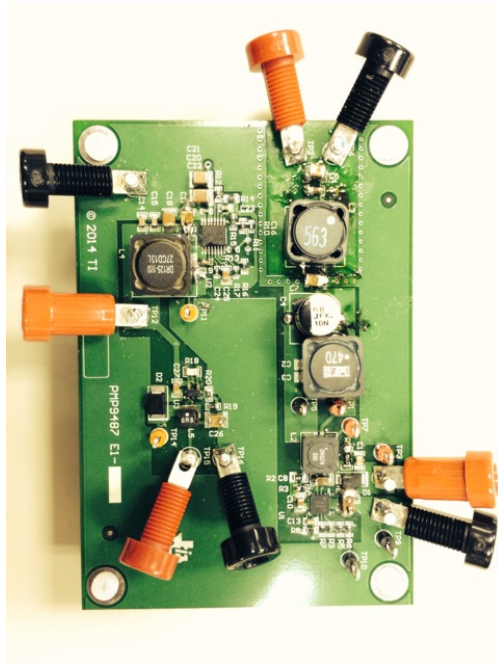
2. Circuit Description and PCB details

PMP9487 is a conducted EMI optimized (CISPR 25)8W SEPIC Converter for Wide Range Vin automotive Infotainment Cluster application using the LM5001 regulator IC(Used as SEPIC), LM46002(used as Buck) and LM2831Y regulator IC(used as Buck). The design accepts an input voltage of 6.5Vin to 20Vin and provides the outputs of 12V@250mA, 3.3V @ 1.2A and 1.8V @ 500mA. It features a small size and is an inexpensive and more efficient solution to using boost converters and linear regulators.

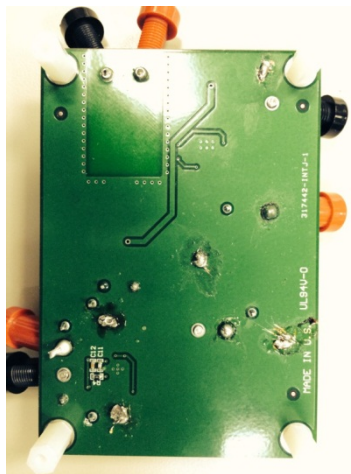


The Board dimension of PMP9487 PCB is 2750mil * 4000mil. Four layer PCB was used for the design.

3. PMP9487 Board Photos



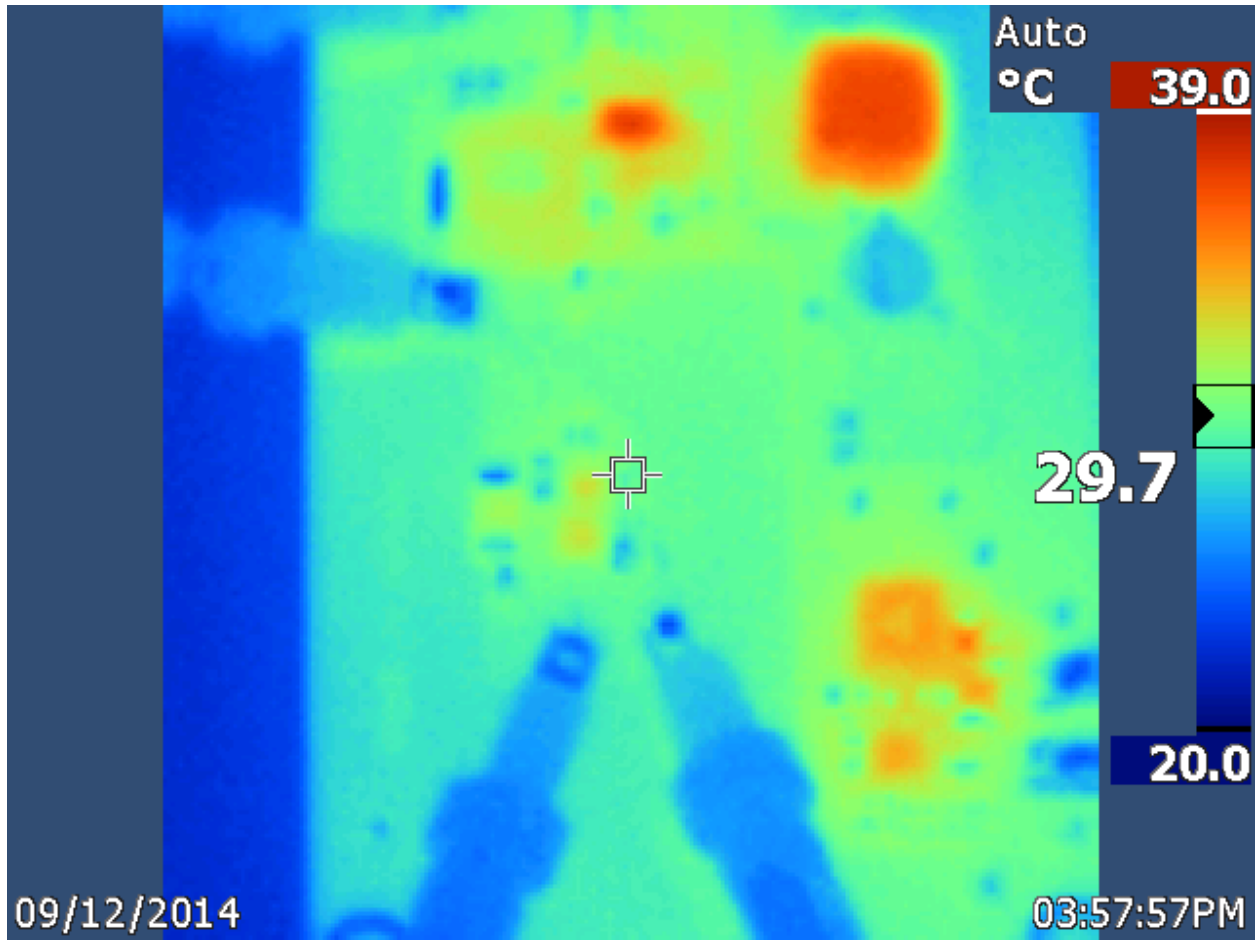
Board Photo (Top)



Board Photo (Bottom)

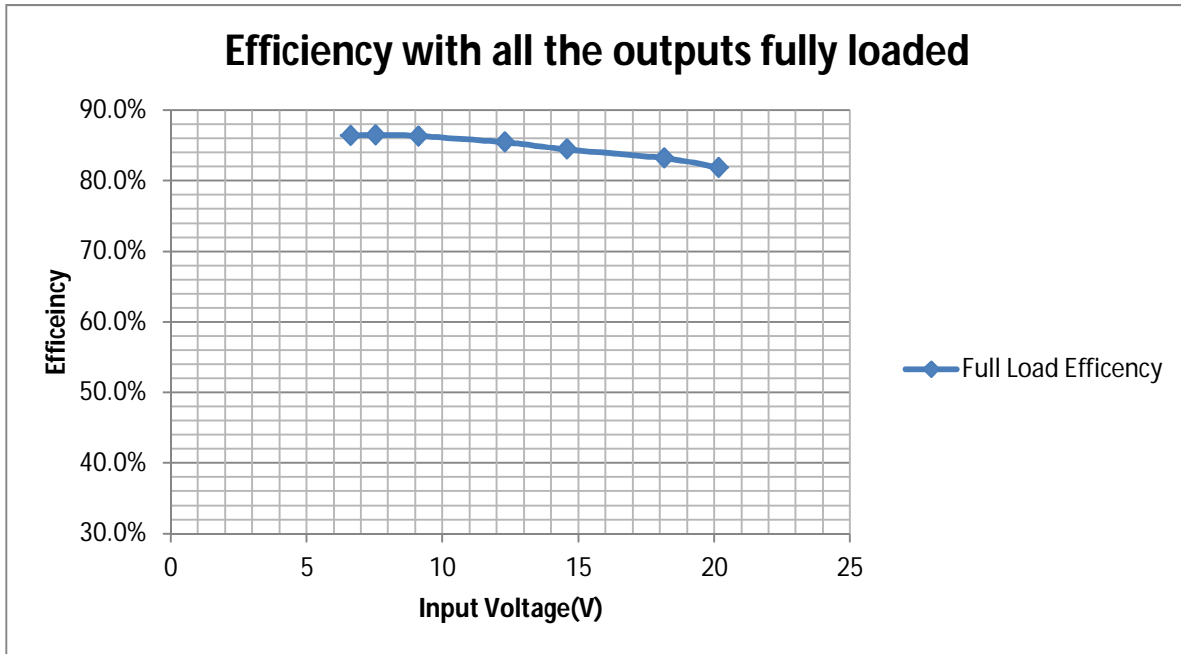
4. Thermal Data

IR thermal image taken at steady state with 14Vin and all the outputs at full load (no airflow)

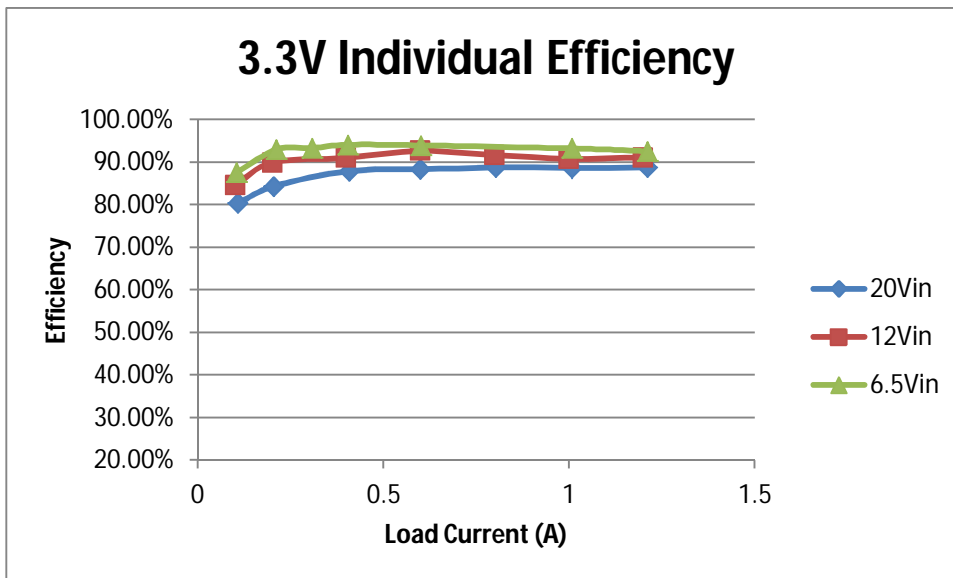


5. Efficiency

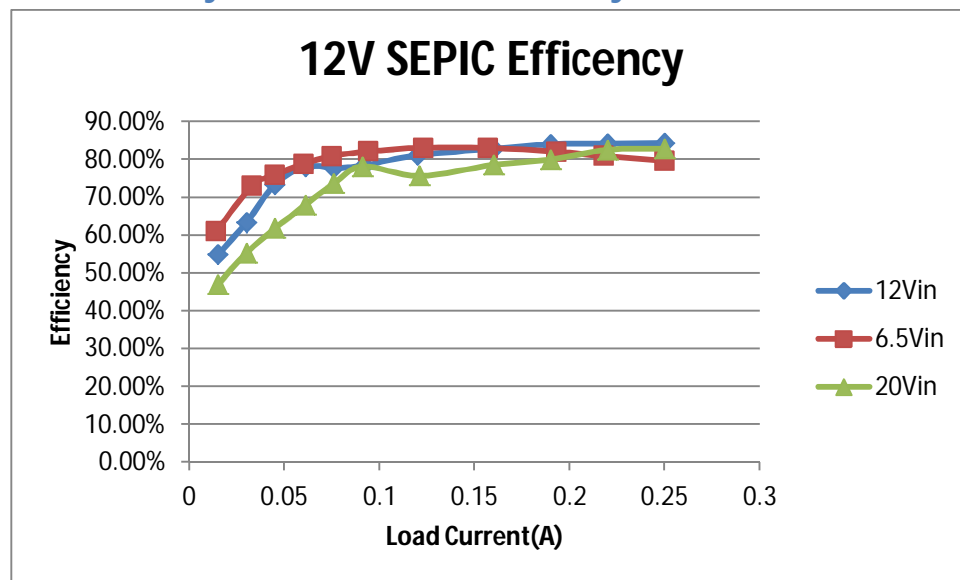
5.1 Efficiency Chart – Input Voltage Vs Efficiency with all output fully Loaded



5.2 Efficiency Chart – 3.3Vout Efficiency Vs Load Current



5.3 Efficiency Chart – 12Vout Efficiency Vs Load Current



5.3 Efficiency Data

Efficiency of total System Vs Input Voltage

Vin (V)	Iin (A)	Vout1 (V)	Iout 1(A)	Vout2 (V)	Iout 2(A)	Vout3 (V)	Iout 3(A)	Pin (W)	Pout (W)	Efficiency (%)
6.6	1.277	3.338	1.199	1.801	0.5	11.905	0.2	8.4282	7.283762	86.4%
7.54	1.116	3.338	1.199	1.801	0.5	11.905	0.2	8.41464	7.283762	86.6%
9.1063	0.926	3.338	1.199	1.801	0.5	11.905	0.2	8.432434	7.283762	86.4%
12.293	0.693	3.338	1.199	1.801	0.5	11.905	0.2	8.519049	7.283762	85.5%
14.564	0.592	3.338	1.199	1.801	0.5	11.905	0.2	8.621888	7.283762	84.5%
18.154	0.482	3.338	1.199	1.801	0.5	11.905	0.2	8.750228	7.283762	83.2%
20.158	0.441	3.338	1.199	1.801	0.5	11.905	0.2	8.889678	7.283762	81.9%

Efficiency of 3.3V Vs Load Current

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Pin(W)	Pout	Efficiency
12.244	0.359	3.339	1.2	4.395596	4.0068	91.15%
12.293	0.299	3.34	1	3.675607	3.34	90.87%
12.345	0.236	3.34	0.8	2.91342	2.672	91.71%
12.294	0.176	3.3423	0.6	2.163744	2.00538	92.68%
12.442	0.118	3.343	0.4	1.468156	1.3372	91.08%
12.184	0.061	3.343	0.2	0.743224	0.6686	89.96%
12.352	0.032	3.343	0.1	0.395264	0.3343	84.58%

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Pin(W)	Pout	Efficiency
6.692	0.0598	3.3426	0.105	0.400182	0.350973	87.70%
6.8	0.112	3.343	0.212	0.7616	0.708716	93.06%
6.8079	0.162	3.3428	0.308	1.10288	1.029582	93.35%
6.766	0.212	3.3428	0.404	1.434392	1.350491	94.15%
6.6787	0.32	3.3427	0.601	2.137184	2.008963	94.00%
6.4837	0.557	3.3422	1.008	3.611421	3.368938	93.29%
6.3775	0.685	3.3418	1.211	4.368588	4.04692	92.64%

Vin(V)	Iin(A)	Vout1(V)	Iout1(A)	Pin(W)	Pout	Efficiency
20.352	0.224	3.3409	1.212	4.558848	4.049171	88.82%
20.384	0.186	3.3411	1.007	3.791424	3.364488	88.74%
20.416	0.148	3.3419	0.803	3.021568	2.683546	88.81%
20.447	0.111	3.3422	0.6	2.269617	2.00532	88.35%
20.085	0.077	3.342	0.407	1.546545	1.360194	87.95%
20.301	0.04	3.3428	0.205	0.81204	0.685274	84.39%
20.409	0.022	3.344	0.108	0.448998	0.361152	80.44%

Efficiency of 12V Vs Load Current

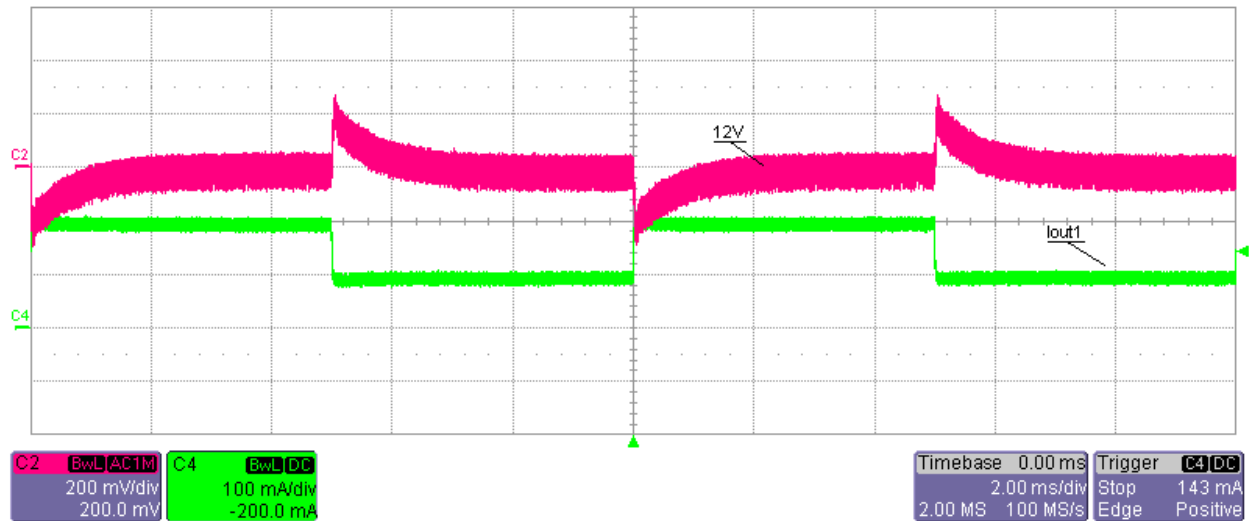
Vin(V)	Iin(A)	Iout2(A)	Vout2(V)	Pin(W)	Pout(W)	Efficiency
12.05	0.027	0.015	11.908	0.32535	0.17862	54.90%
12	0.047	0.03	11.908	0.564	0.35724	63.34%
11.96	0.061	0.045	11.908	0.72956	0.53586	73.45%
11.92	0.078	0.061	11.908	0.92976	0.726388	78.13%
11.87	0.098	0.076	11.908	1.16326	0.905008	77.80%
11.83	0.118	0.092	11.908	1.39594	1.095536	78.48%
12.06	0.146	0.12	11.908	1.76076	1.42896	81.16%
12.04	0.191	0.16	11.908	2.29964	1.90528	82.85%
12.02	0.224	0.19	11.908	2.69248	2.26252	84.03%
12.01	0.259	0.22	11.908	3.11059	2.61976	84.22%
12	0.294	0.25	11.908	3.528	2.977	84.38%

Vin(V)	Iin(A)	Iout2(A)	Vout2(V)	Pin(W)	Pout(W)	Efficiency
6.66	0.041	0.014	11.908	0.27306	0.166712	61.05%
6.56	0.082	0.033	11.908	0.53792	0.392964	73.05%
6.72	0.105	0.045	11.908	0.7056	0.53586	75.94%
6.71	0.135	0.06	11.908	0.90585	0.71448	78.87%
6.69	0.165	0.075	11.908	1.10385	0.8931	80.91%
6.68	0.204	0.094	11.908	1.36272	1.119352	82.14%
6.65	0.265	0.123	11.908	1.76225	1.464684	83.11%
6.62	0.34	0.157	11.908	2.2508	1.869556	83.06%
6.59	0.425	0.193	11.908	2.80075	2.298244	82.06%
6.57	0.488	0.218	11.908	3.20616	2.595944	80.97%
6.53	0.572	0.25	11.908	3.73516	2.977	79.70%

Vin(V)	Iin(A)	Iout2(A)	Vout2(V)	Pin(W)	Pout(W)	Efficiency
20.02	0.019	0.015	11.908	0.38038	0.17862	46.96%
20.19	0.032	0.03	11.908	0.64608	0.35724	55.29%
20.16	0.043	0.045	11.908	0.86688	0.53586	61.81%
20.14	0.053	0.061	11.908	1.06742	0.726388	68.05%
20.12	0.061	0.076	11.908	1.22732	0.905008	73.74%
20.09	0.069	0.091	11.908	1.38621	1.083628	78.17%
20.03	0.095	0.121	11.908	1.90285	1.440868	75.72%
20.21	0.12	0.16	11.908	2.4252	1.90528	78.56%
20.2	0.14	0.19	11.908	2.828	2.26252	80.00%
20.2	0.157	0.22	11.908	3.1714	2.61976	82.61%
20.19	0.178	0.25	11.908	3.59382	2.977	82.84%

6. Waveforms

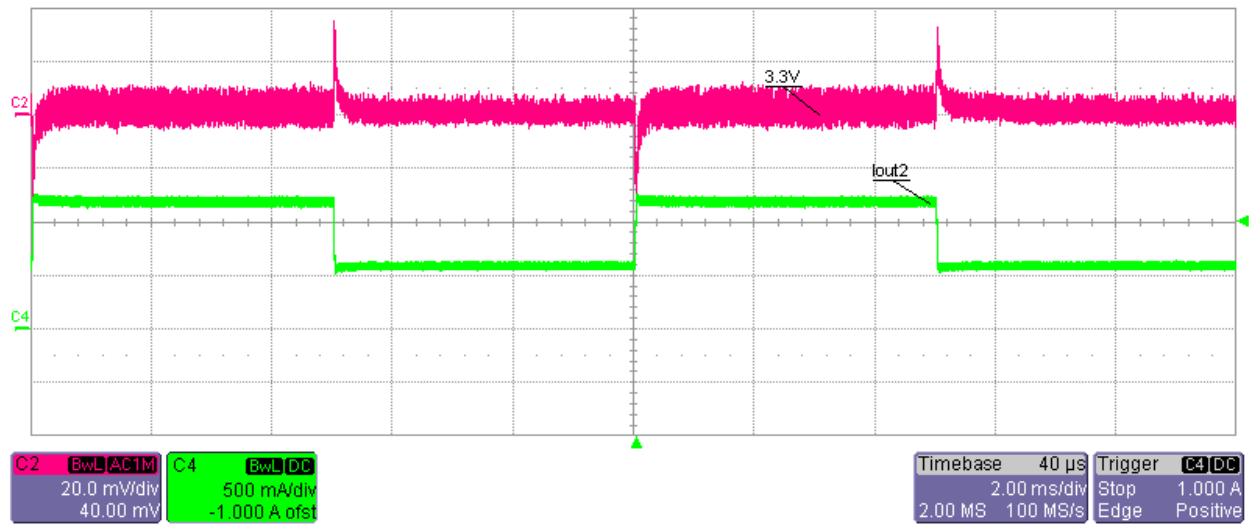
6.1 Load Transient Response



Load Transient Response at 6.5Vin and 50%-to-100% Load Step on 12V Output Vout1(Full Load were connected to all other outputs)

Ch2 – Vout1 (AC coupled)

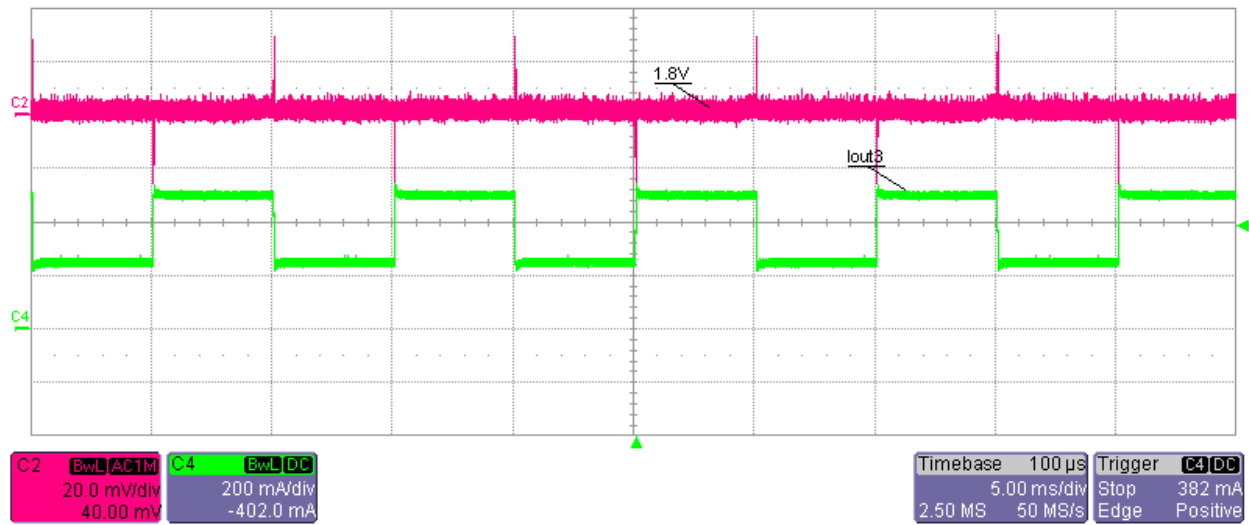
Ch4- lout 1



Load Transient Response at 6.5Vin and 50%-to-100% Load Step on 3.3V Output Vout2 (Full Load were connected to all other outputs)

Ch2 – Vout2 (AC coupled)

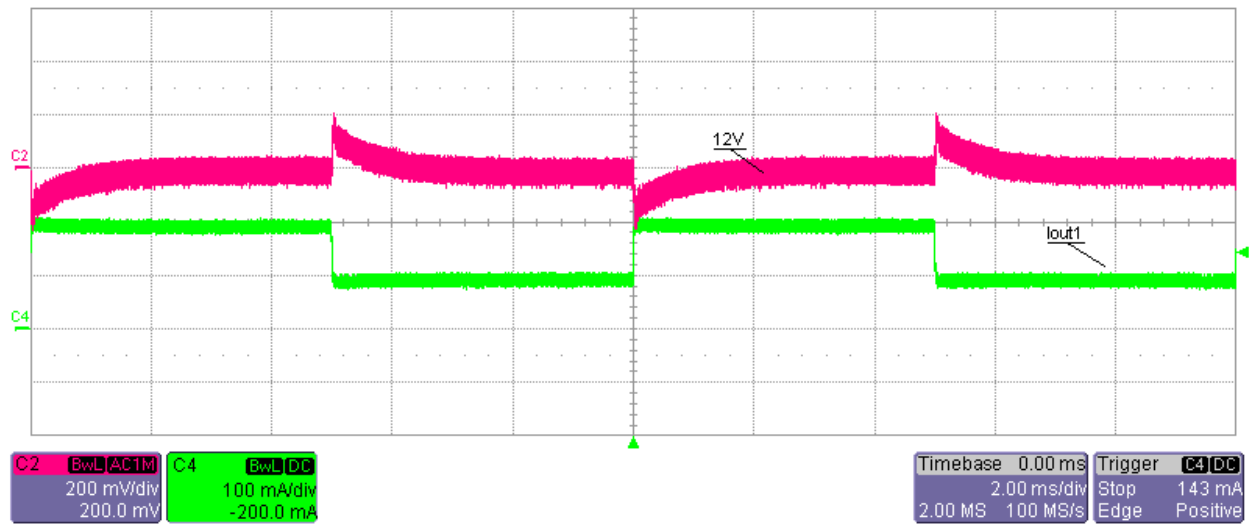
Ch4- Iout 2



Load Transient Response at 6.5V_{in} and 50%-to-100% Load Step on 1.8V Output Vout3(Full Load were connected to all other outputs)

Ch2 – Vout3 (AC coupled)

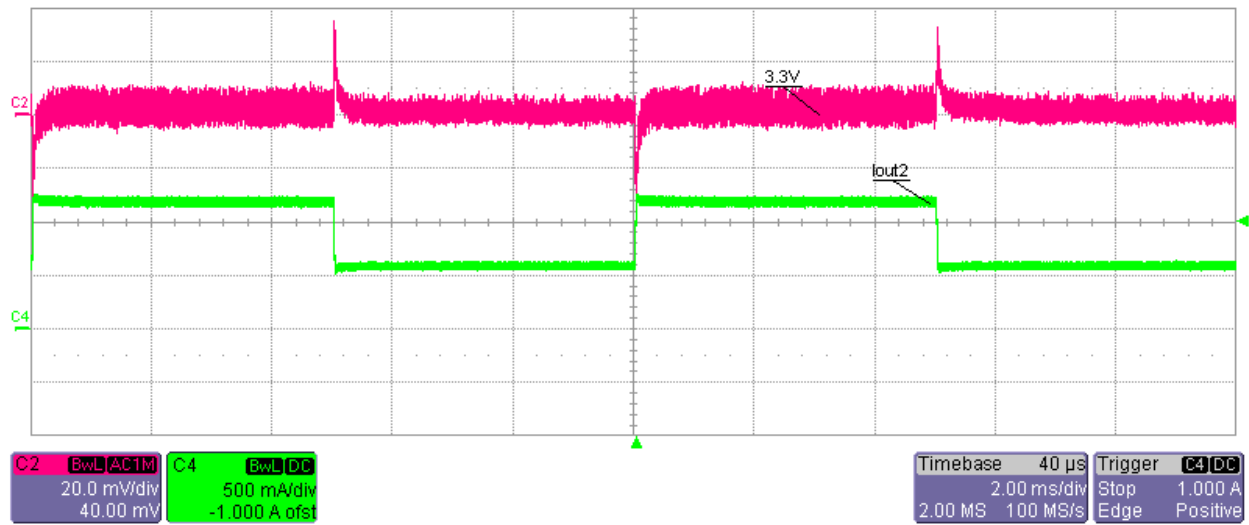
Ch4- Iout 3



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

Ch2 – Vout1 (AC coupled)

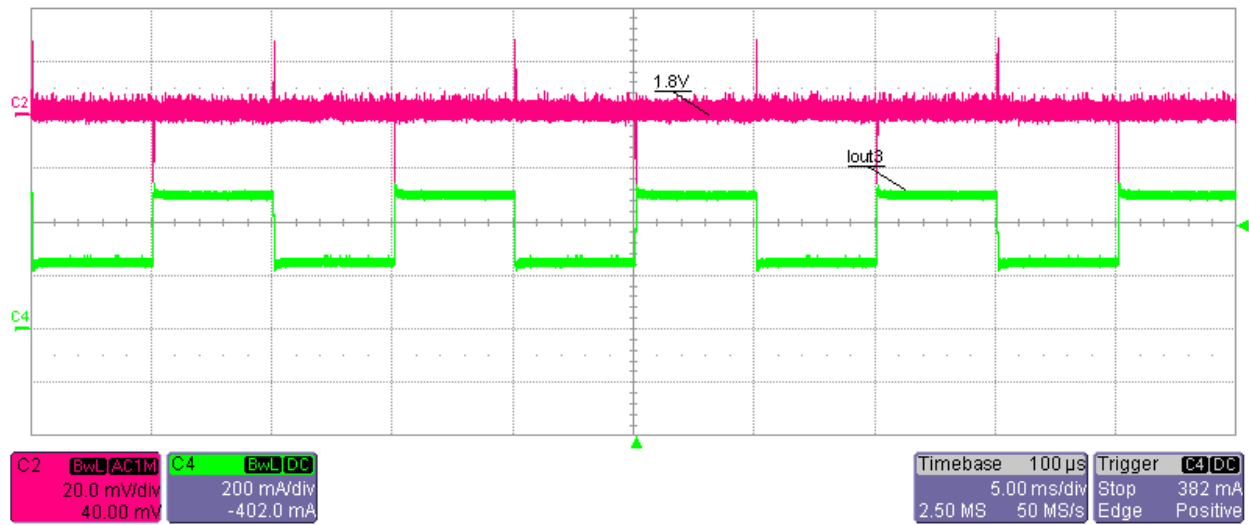
Ch4- lout 1



Load Transient Response at 12Vin and 50%-to-100% Load Step on 3.3V Output Vout2 (Full Load were connected to all other outputs)

Ch2 – Vout2 (AC coupled)

Ch4- lout 2

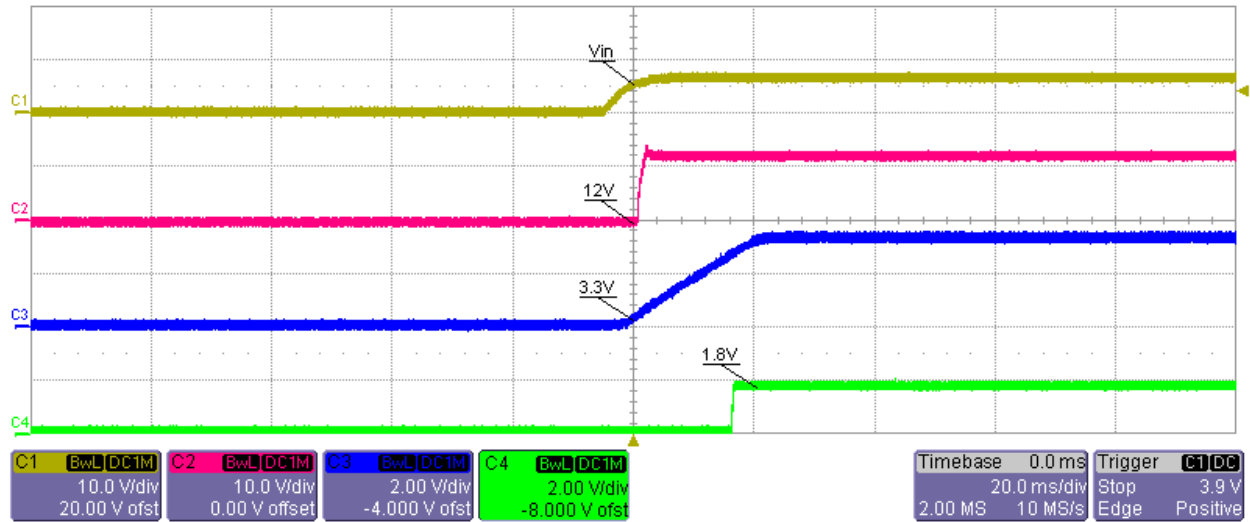


Load Transient Response at 12Vin and 50%-to-100% Load Step on 1.8V Output Vout3(Full Load were connected to all other outputs)

Ch2 – Vout3 (AC coupled)

Ch4- Iout 3

6.2 Startup



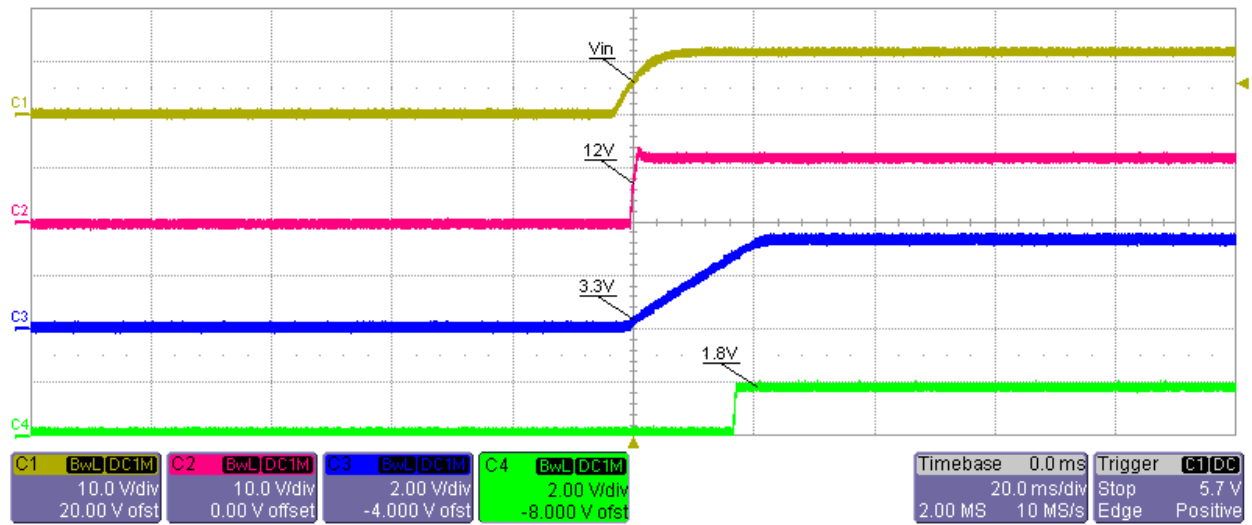
Startup into full Load (all the output was connected to full Load) at 6.5 Vin

Ch1-Vin

Ch2-Vout 1

Ch3-Vout 2

Ch4-Vout3



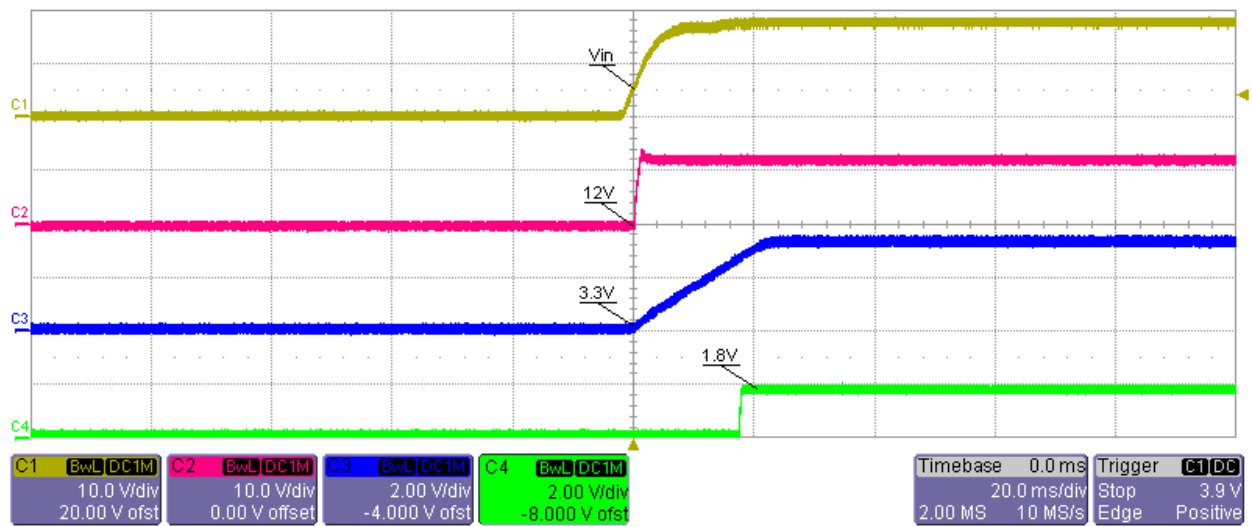
Startup into full Load (all the output was connected to full Load) at 12 Vin

Ch1-Vin

Ch2-Vout 1

Ch3-Vout 2

Ch4-Vout3



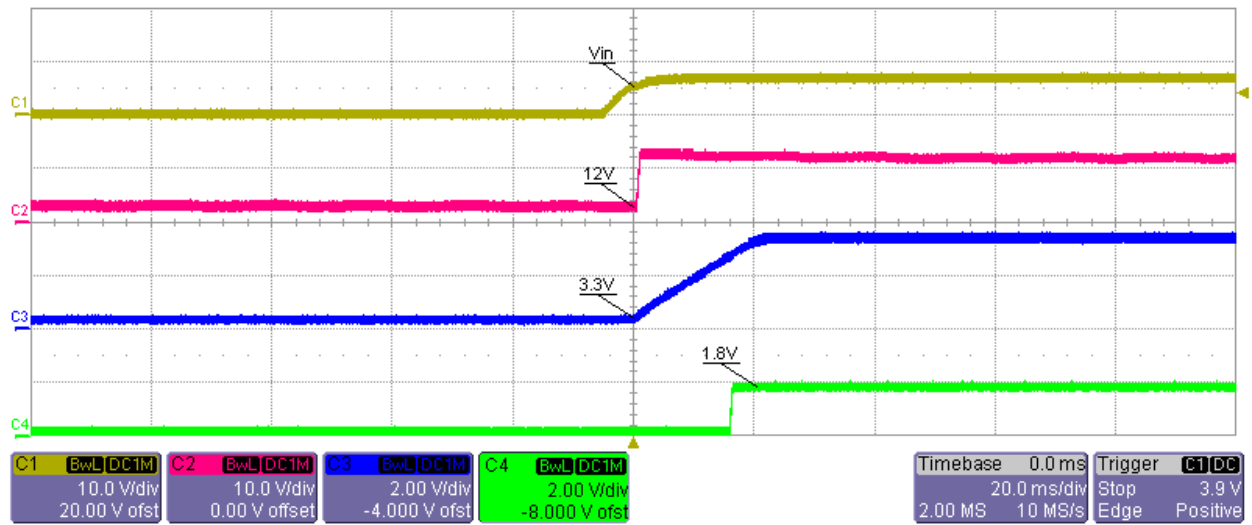
Startup into full Load (all the output was connected to full Load) at 20 Vin

Ch1-Vin

Ch2-Vout 1

Ch3-Vout 2

Ch4-Vout3



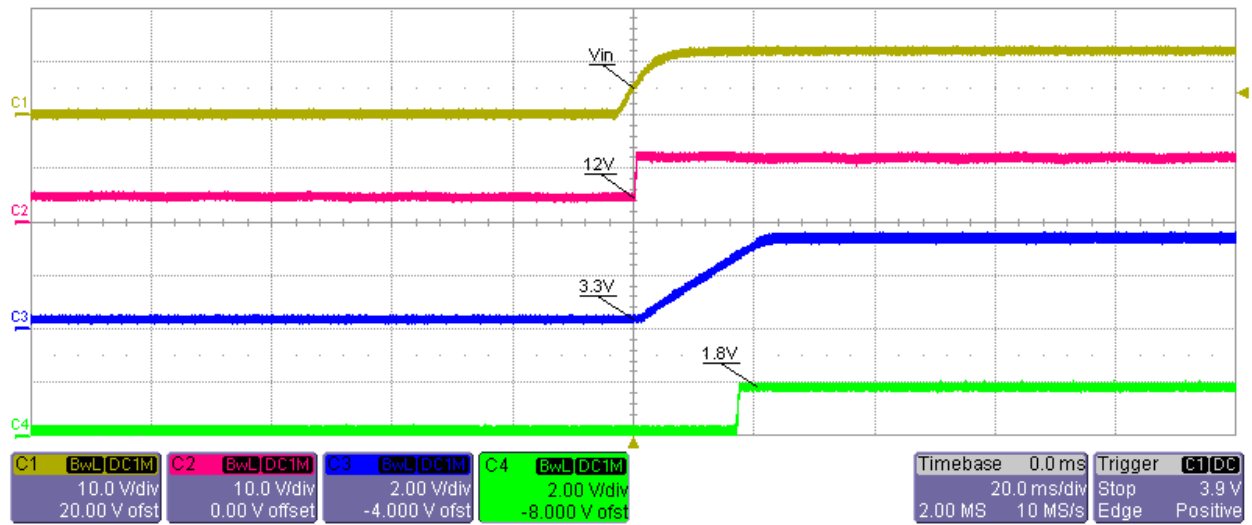
Startup into No Load (all the output was connected to No Load) at 6.5 Vin

Ch1-Vin

Ch2-Vout 1

Ch3-Vout 2

Ch4-Vout3



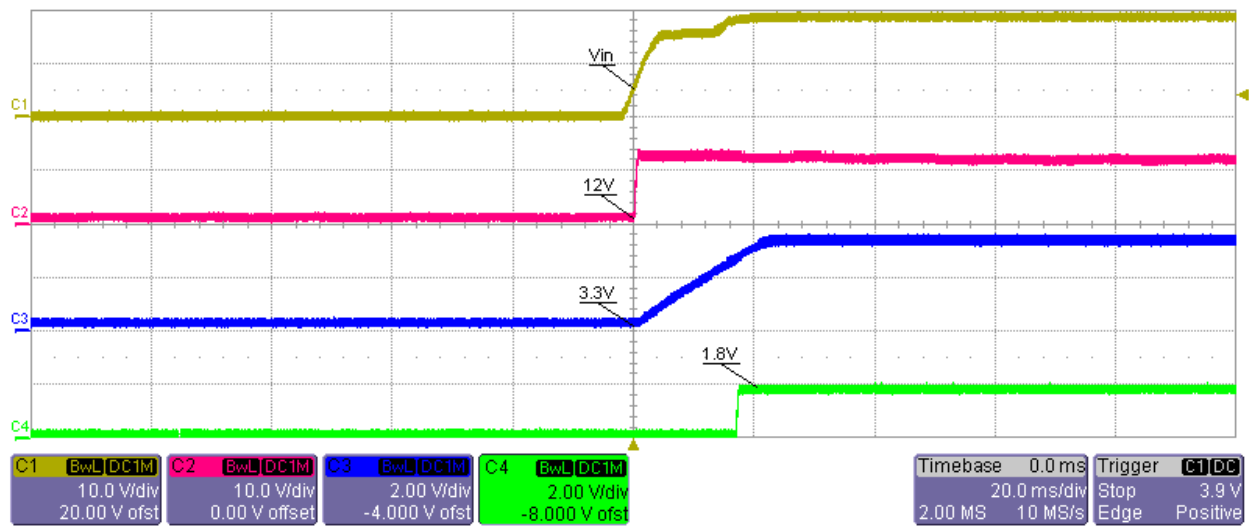
Startup into No Load (all the output was connected to No Load) at 12 Vin

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

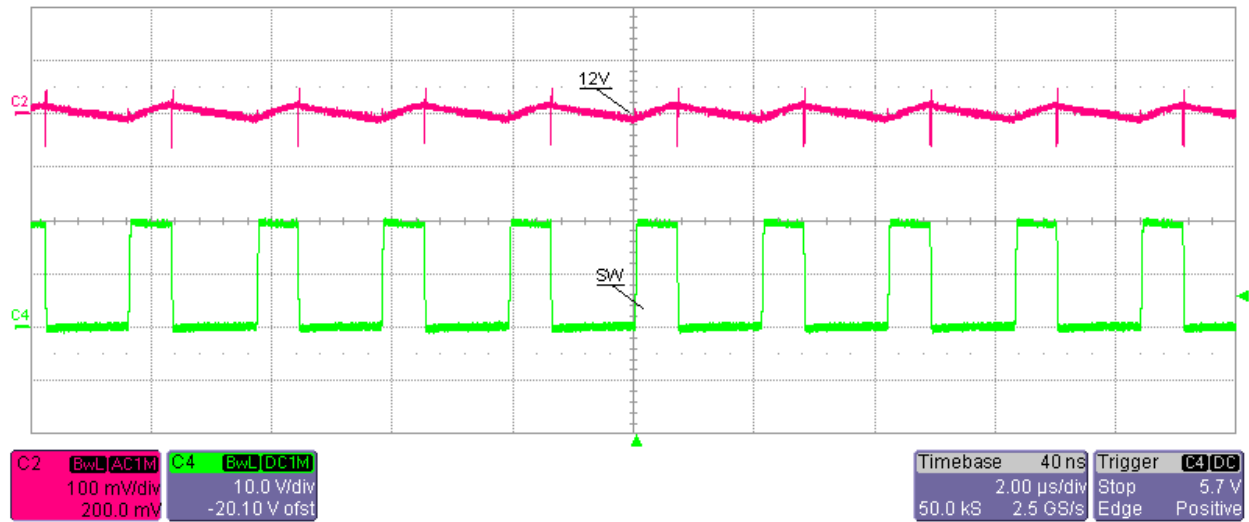
Ch1-Vin

Ch2-Vout 1

Ch3-Vout 2

Ch4-Vout3

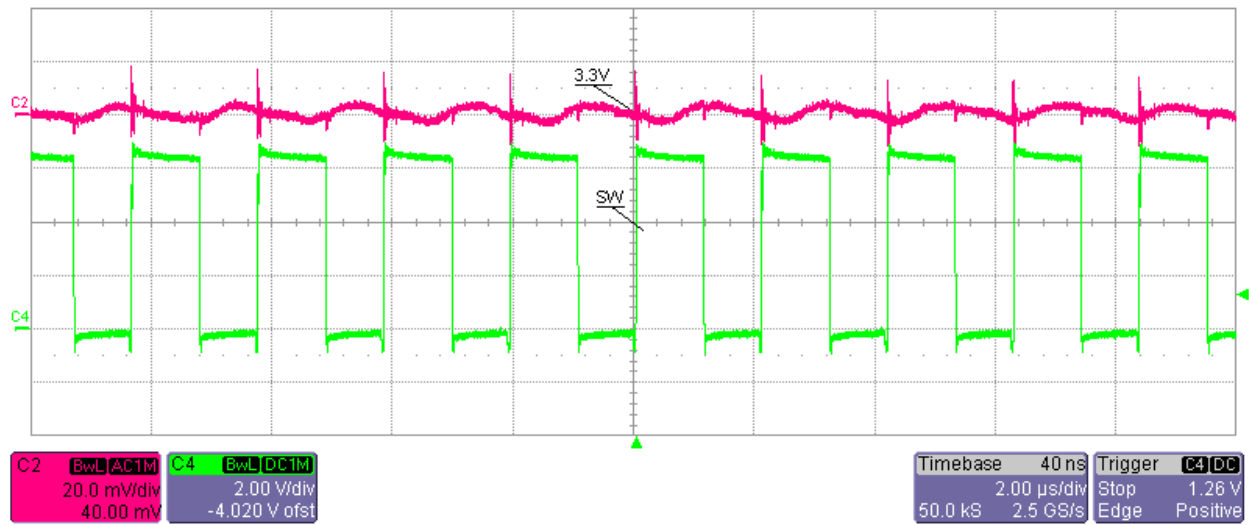
6.3 Output Voltage Ripple and Switch Node Voltage



Switch Node Voltage and Output Voltage Ripple at 6.5 Vin and Full Load on all the outputs (Vripple < 50mVp-p)

Ch2-Vout1 (AC Coupled)

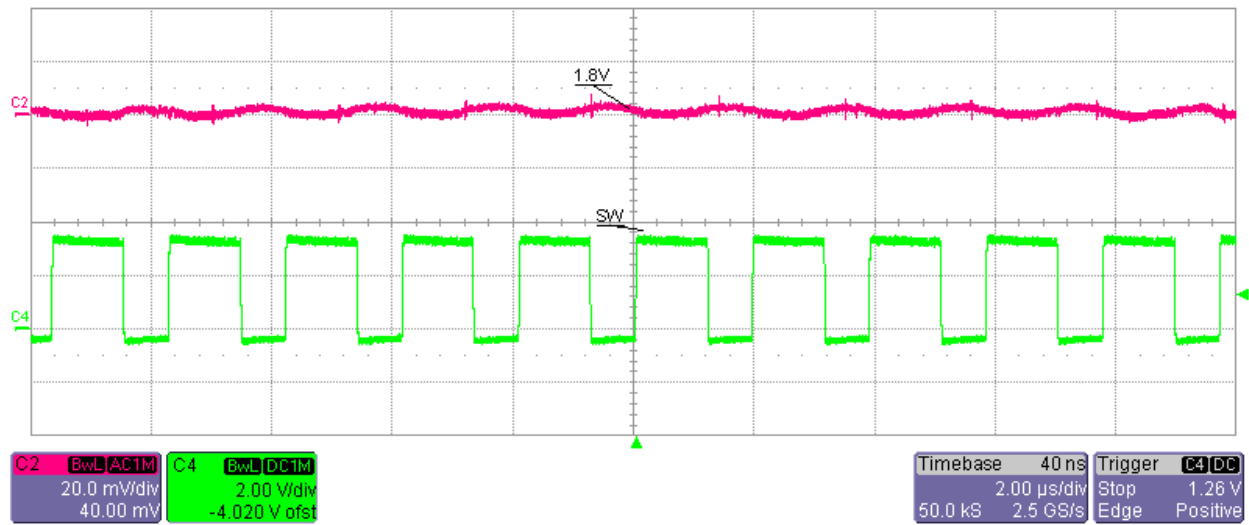
Ch4-Switching Waveform



Switch Node Voltage and Output Voltage Ripple at 6.5 Vin and Full Load on all the outputs (Vripple < 20mVp-p)

Ch2-Vout2 (AC Coupled)

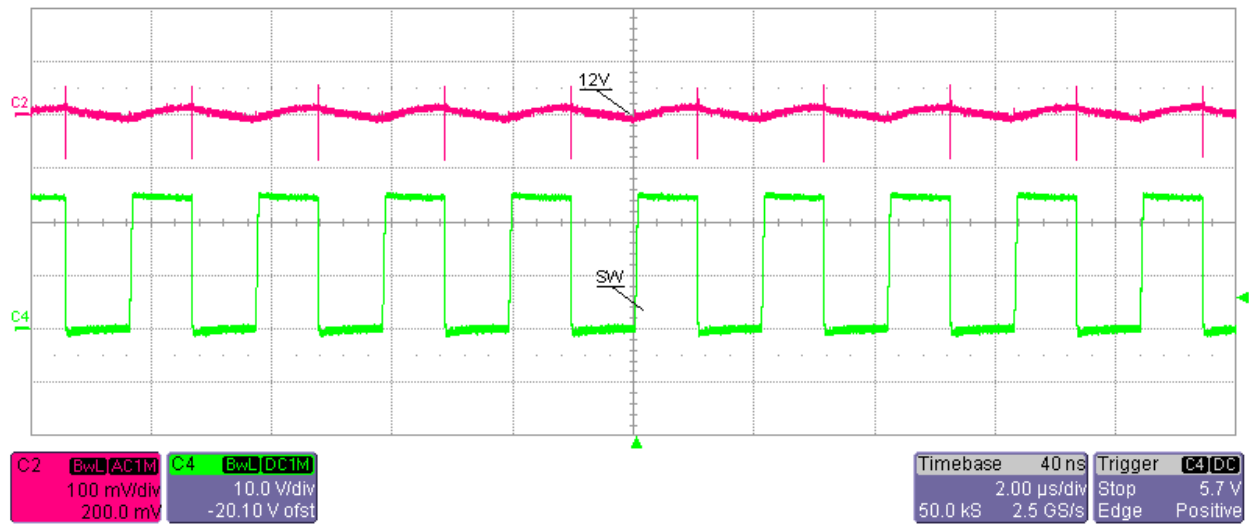
Ch4-Switching Waveform



Switch Node Voltage and Output Voltage Ripple at 6.5 Vin and Full Load on all the outputs (Vripple < 10mVp-p)

Ch2-Vout3 (AC Coupled)

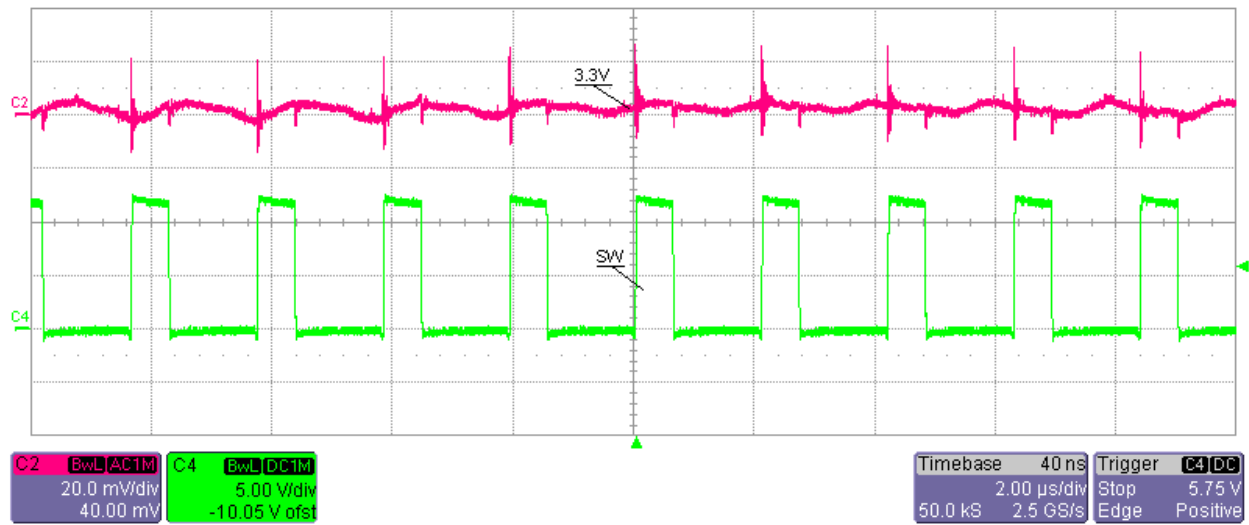
Ch4-Switching Waveform



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

Ch2-Vout1 (AC Coupled)

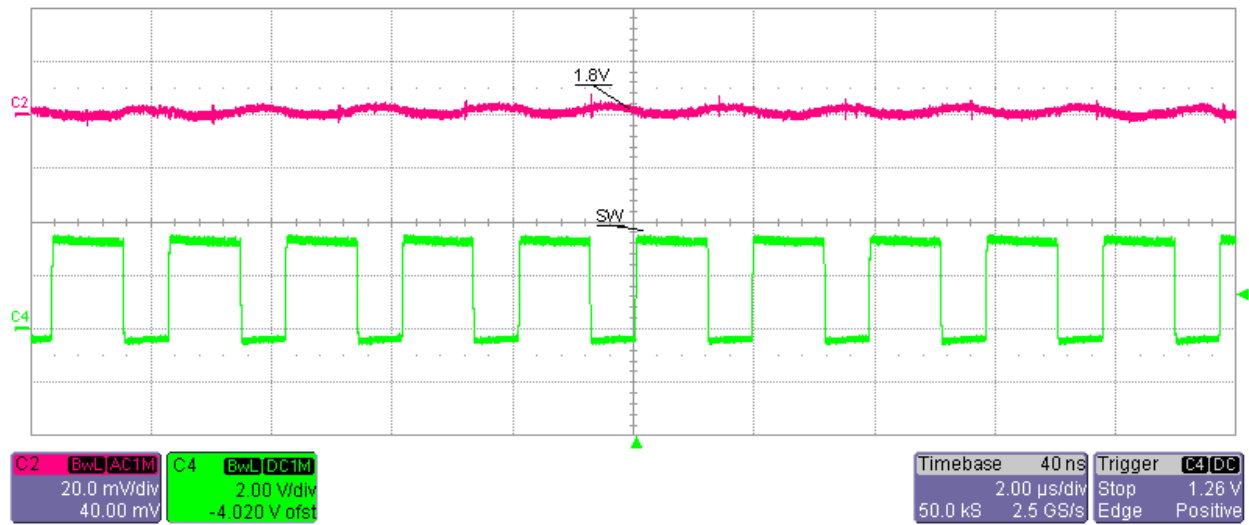
Ch4-Switching Waveform



Switch Node Voltage and Output Voltage Ripple at 12 Vin and Full Load on all the outputs (Vripple < 20mVp-p)

Ch2-Vout2 (AC Coupled)

Ch4-Switching Waveform



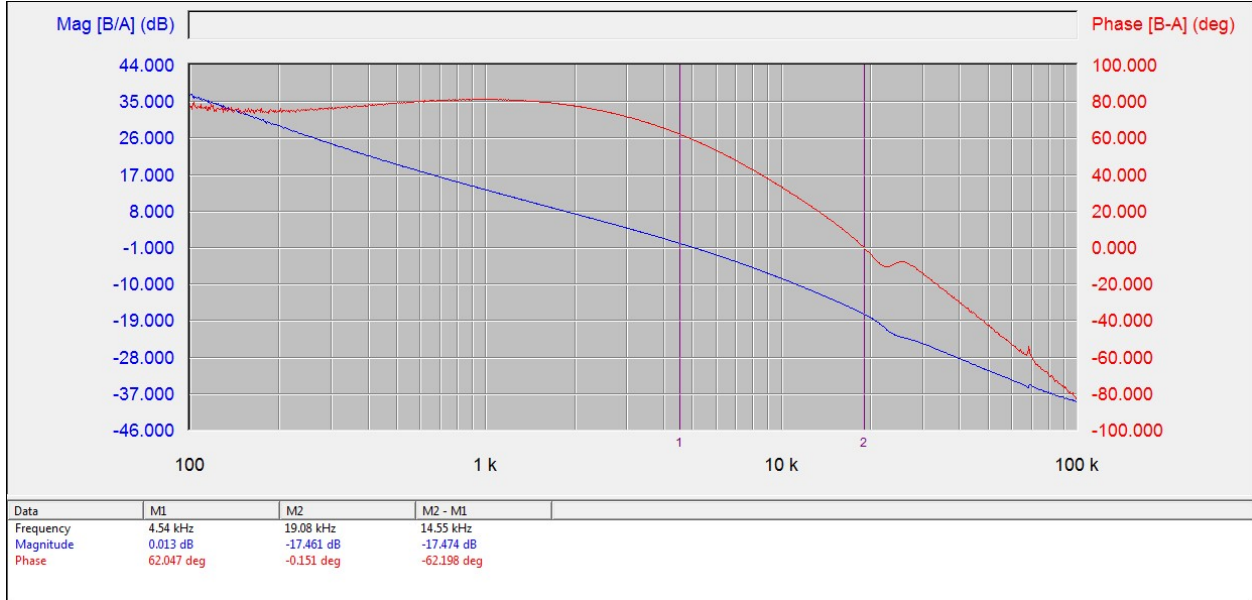
Switch Node Voltage and Output Voltage Ripple at 12 Vin and Full Load on all the outputs (Vripple < 10mVp-p)

Ch2-Vout3 (AC Coupled)

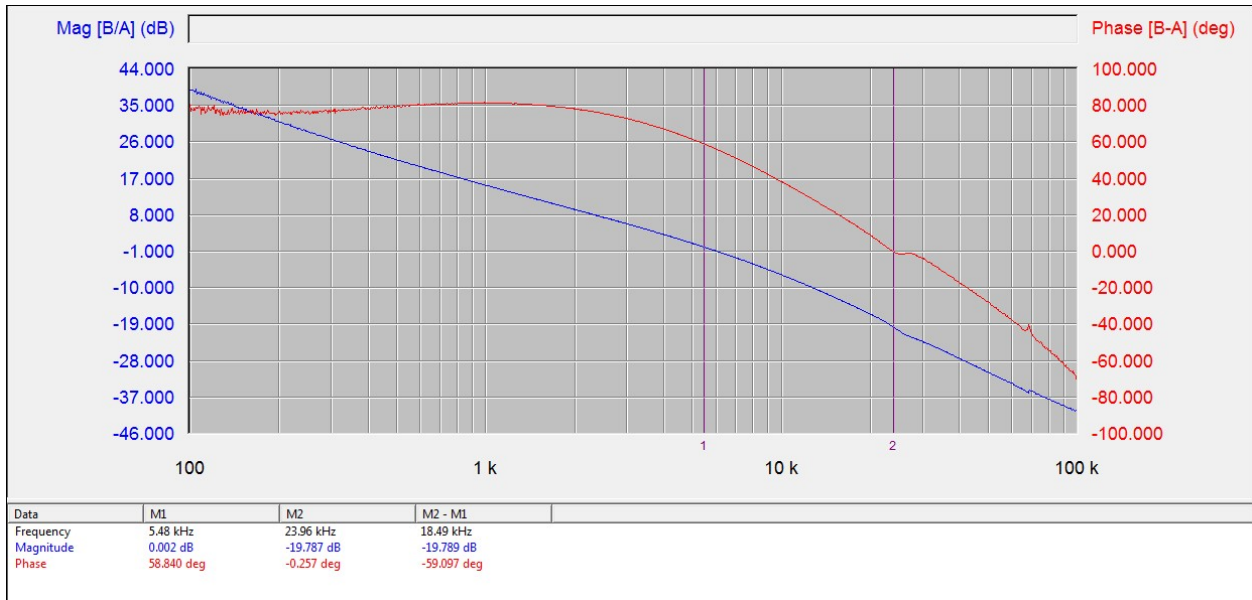
Ch4-Switching Waveform

7. Frequency Response for SEPIC 12V output

The output was loaded with 250mA .For gain/phase plot 1 , the input was 9V and for gain/phase plot 2 , the input was 12V



Gain/Phase plot 1 at $V_{in} = 9V$, $V_{out} = 12V@250mA$

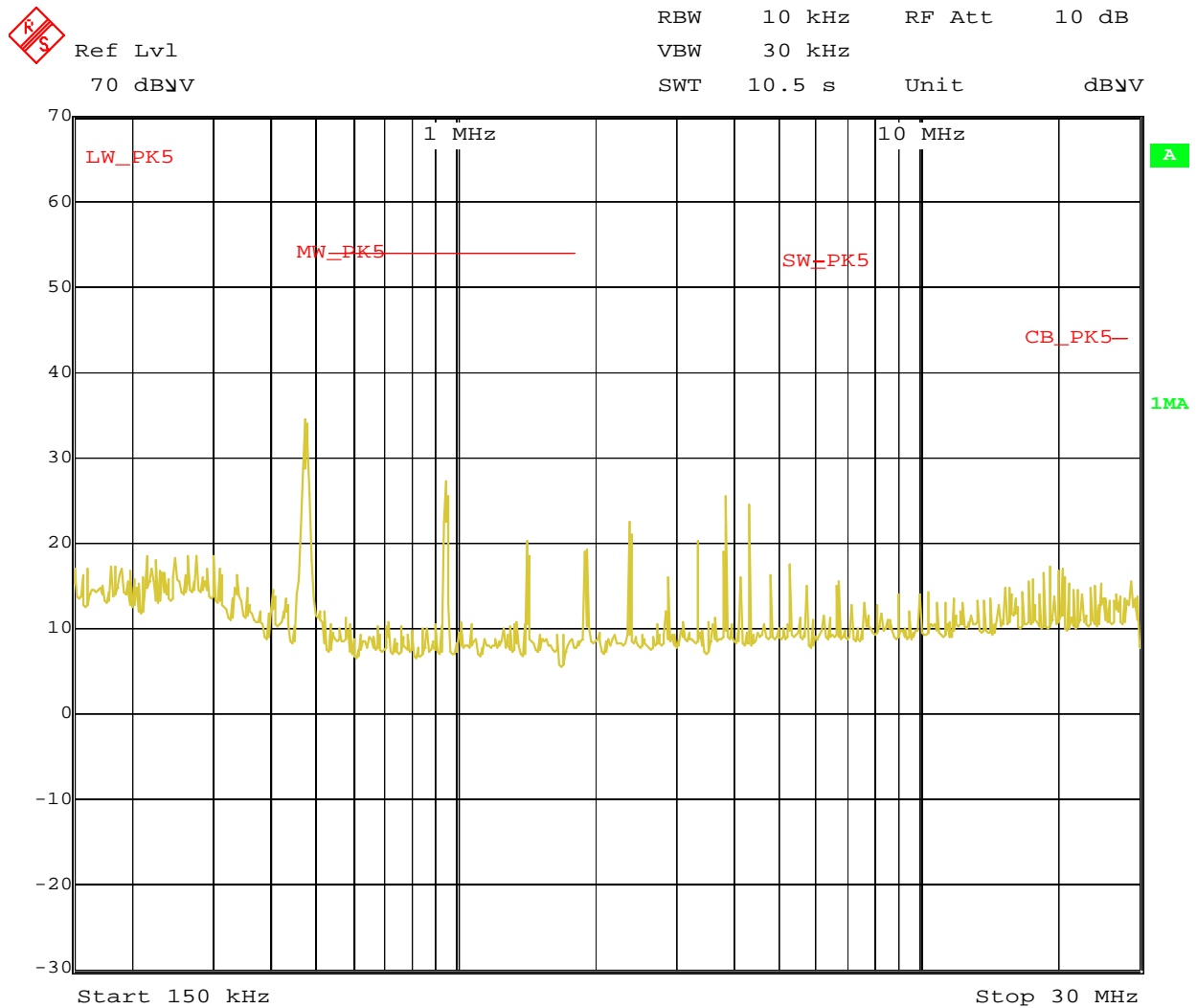


Gain/Phase plot 2 at $V_{in}=12V$, $V_{out} =12V@250mA$

8. 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 Four Figures. The first two Figure show the test result using peak detector and Average detector measurement respectively upto 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; 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.



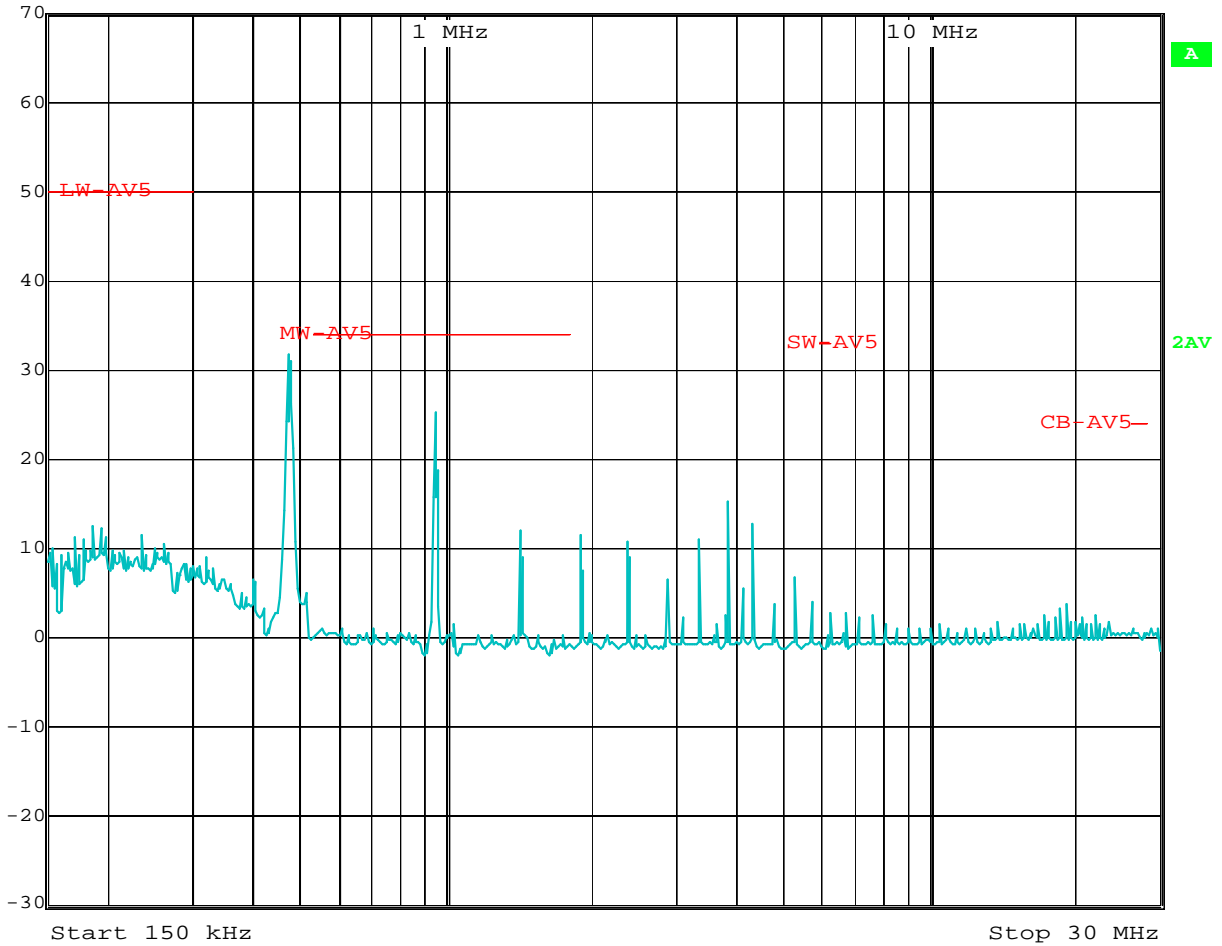
Date: 11.SEP.2014 19:03:35

Test result – Upto 30MHz Conducted Emission –Peak Detection



Ref Lvl
70 dBµV

RBW 10 kHz RF Att 10 dB
VBW 30 kHz
SWT 10.5 s Unit dBµV



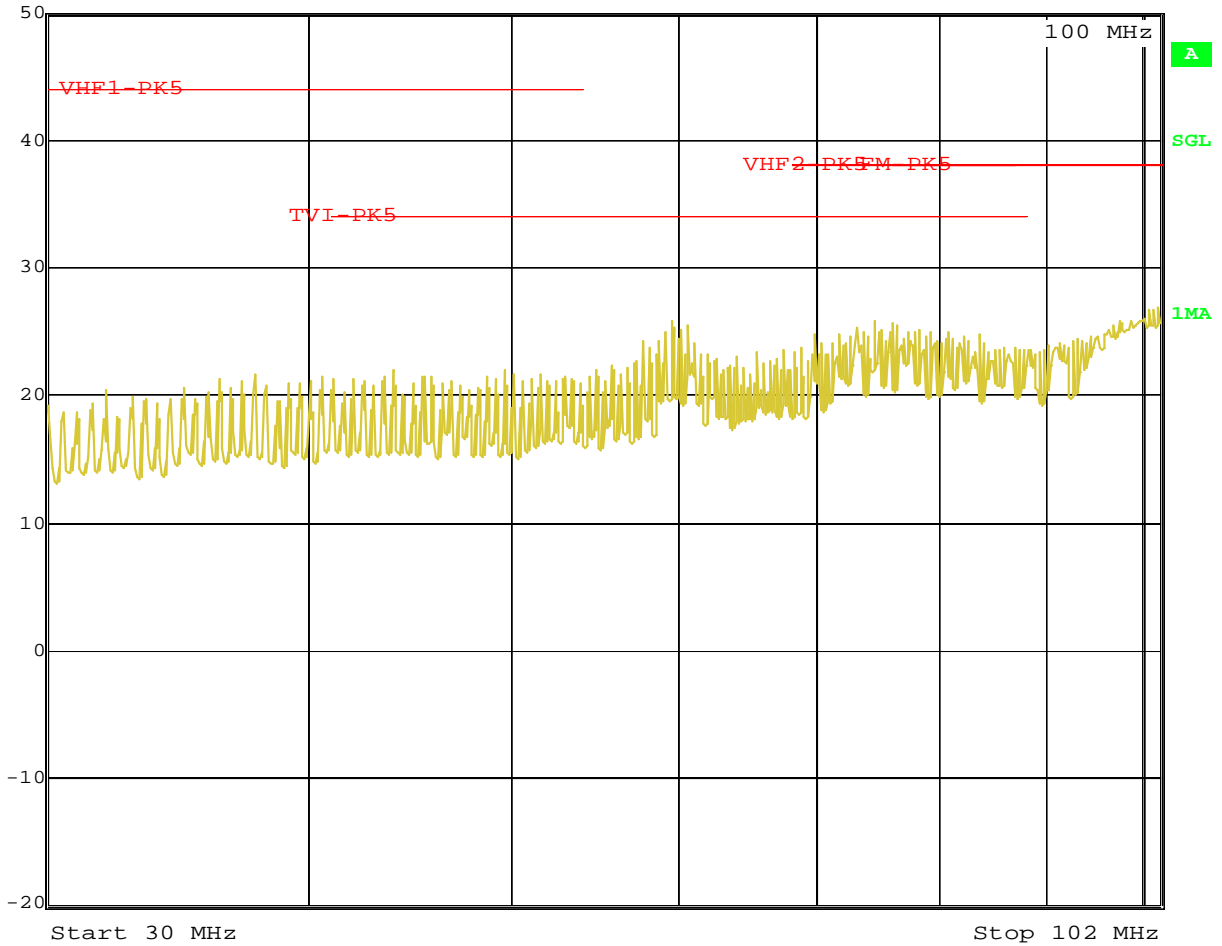
Date: 11.SEP.2014 19:07:06

Test result – Upto 30MHz Conducted Emission –AverageDetection



Ref Lvl
50 dBμV

RBW 100 kHz RF Att 0 dB
VBW 300 kHz
SWT 10 s Unit dBμV



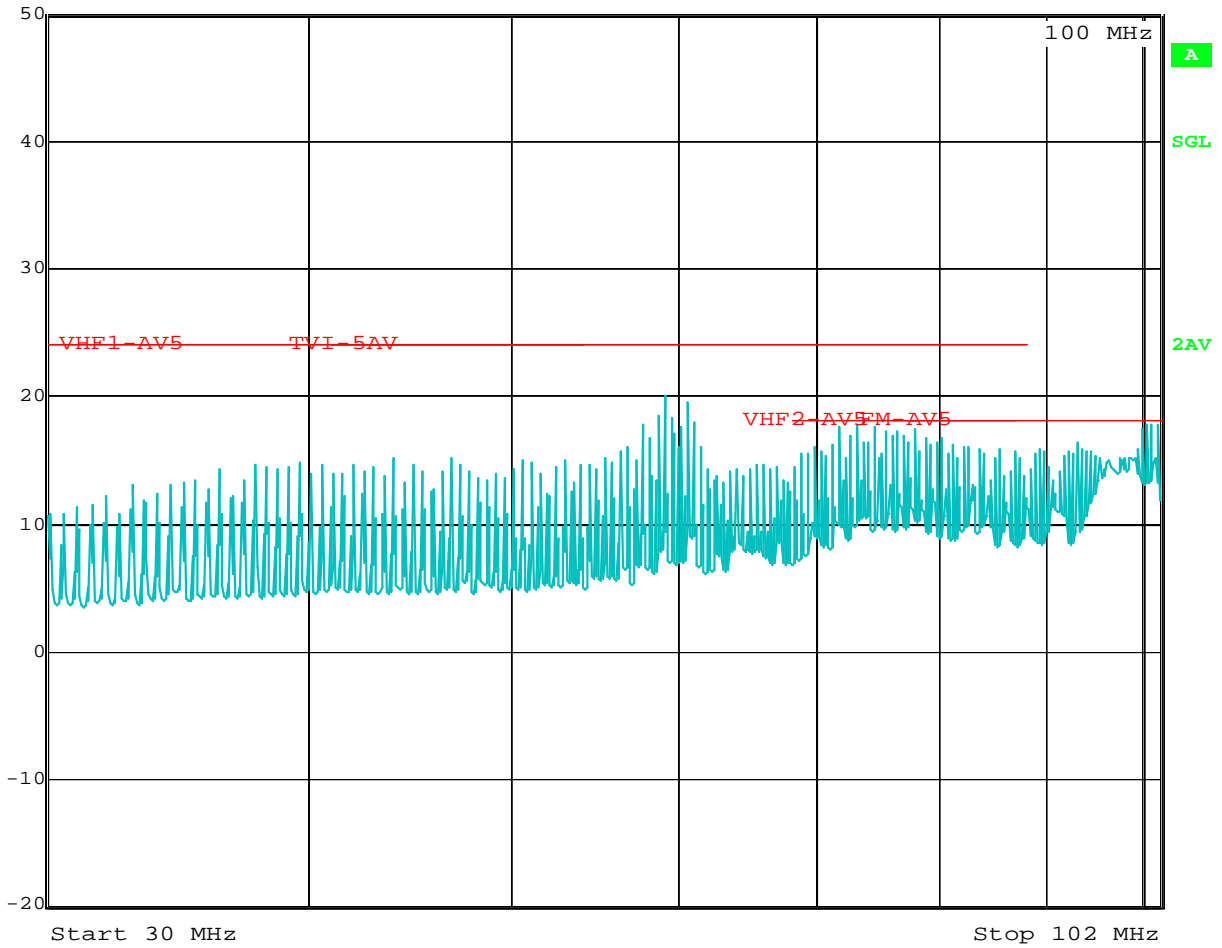
Date: 11.SEP.2014 19:14:12

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



Ref Lvl
50 dBμV

RBW 100 kHz RF Att 0 dB
VBW 300 kHz
SWT 10 s Unit dBμV



Date: 11.SEP.2014 19:12:08

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

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