Test Data
For PMP9491
01/19/2015

Table of Contents

1. Design Specifications

Vin Minimum	**3.5V**
Vin Maximum	**10V**
Vin Nominal	**3.6V or 7.2V (Depending on Single or Dual Li ion Battery)**
Vout	**12VDC**
Iout	**2.5A**
Switching Frequency(SMPS)	**300KHz**
Audio Amplifier Total Power	**30W**
Audio Amp Output	**15W +15W Stereo(on 4 ohm BTL) or 30W Woofer (on 2 ohm PBTL)**
Audio Amp Input	**Stereo Inputs. Processing for Woofer Amp Built-in**
Li ion Battery Charger –Charge Current	**2A max (Adjustable through Resistance)**
Li ion Battery Charger –Input Current Limit	**2A**

2. Circuit Description

PMP9491 is a 30W Audio Boom Box Design which can be used in 15W +15W Stereo or 30W Woofer Applications. The design is broadly divided into four main stages:

1. Single-Phase Non Synchronous Boost Converter using the LM3481 controller IC. The design accepts an input voltage of 3.3Vin to 10Vin (7.2 VIN Nominal) and provides an output of 12V capable of supplying 2.5A of continuous current to the load.

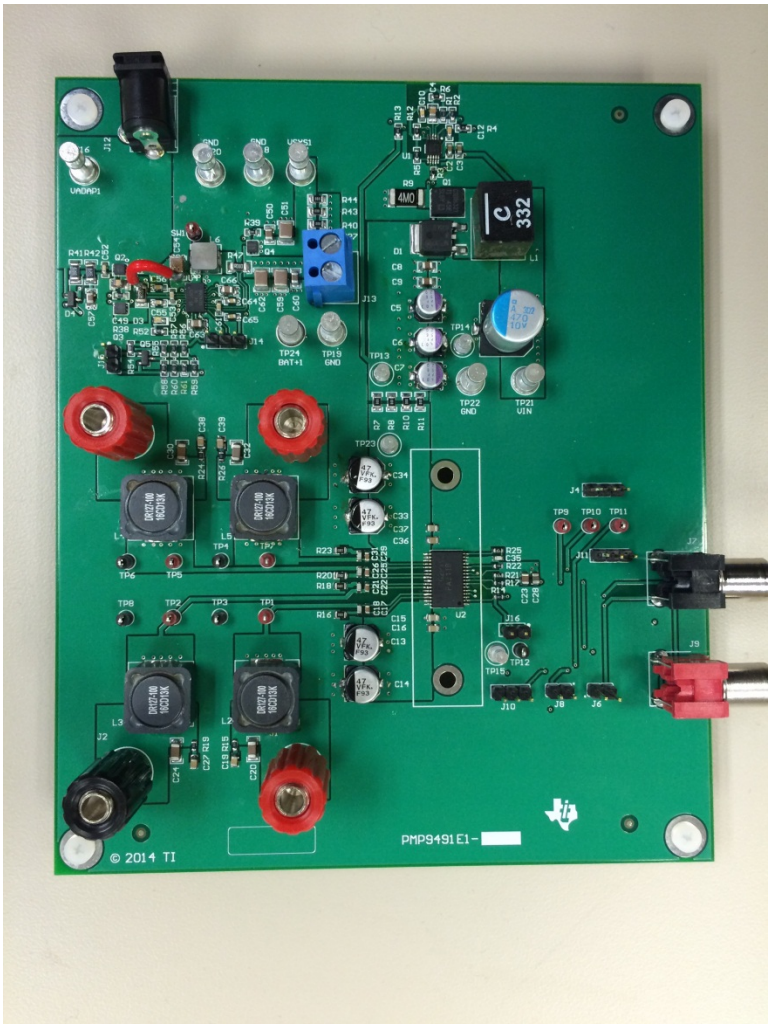
2. 15W + 15W Stereo Audio Amplifier with TPA3130D2 Class D device.

3. BQ24133- Switch-Mode Li-Ion and Li-Polymer Stand-Alone Battery Charger with Integrated MOSFETs and Power Path Selector capable of Charging 1-3 Cells at 2A.

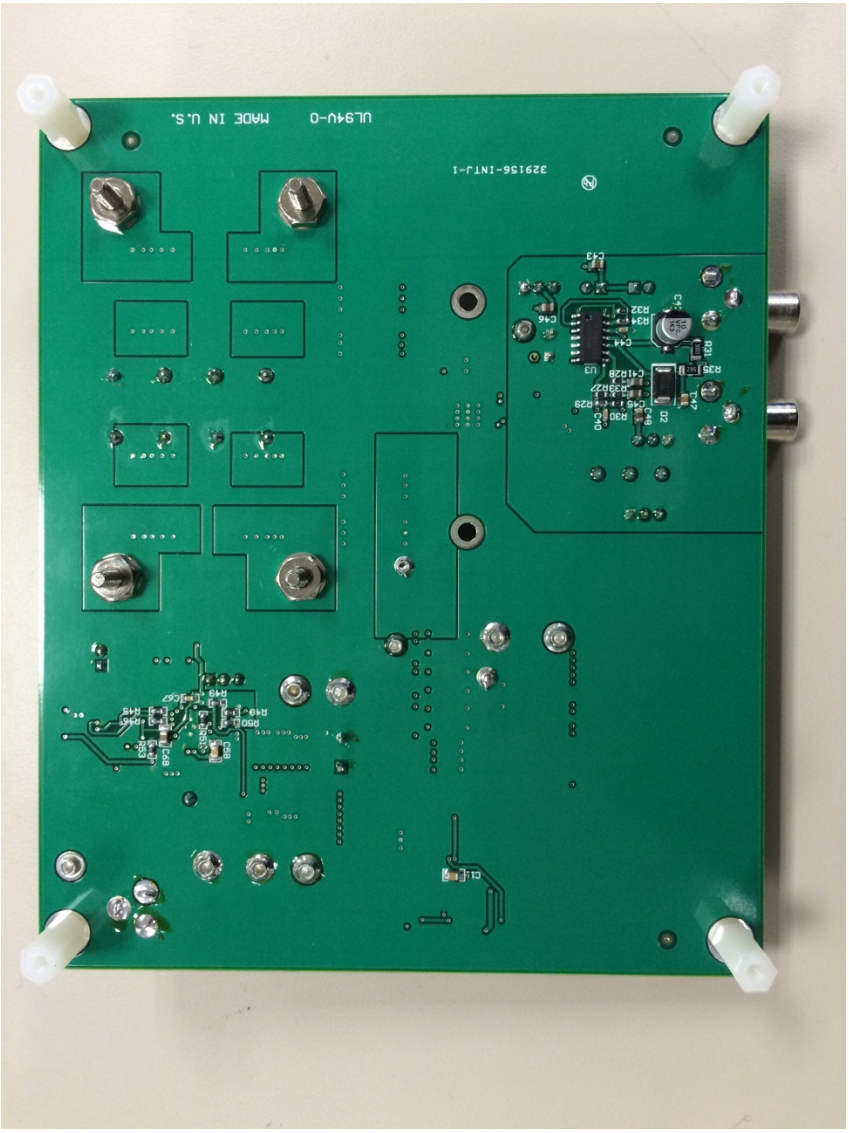
4. Stereo Inputs to Woofer Bass Input Conversion.

3. PMP9491 Board Photos

Board Dimensions: 5750mil *4970mil



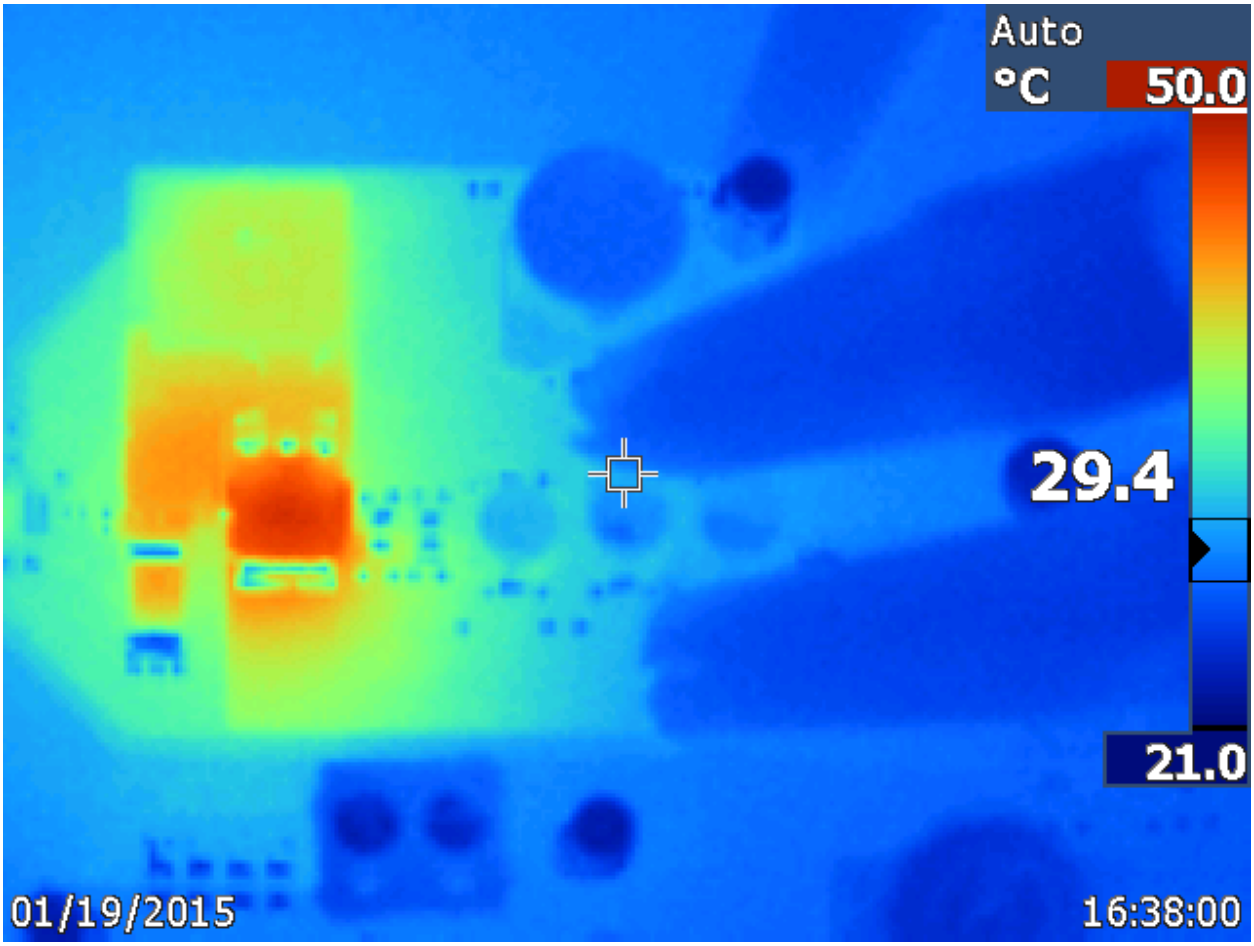
Board Photo (Top)



Board Photo (Bottom)

4. DC/DC Boost Test Results

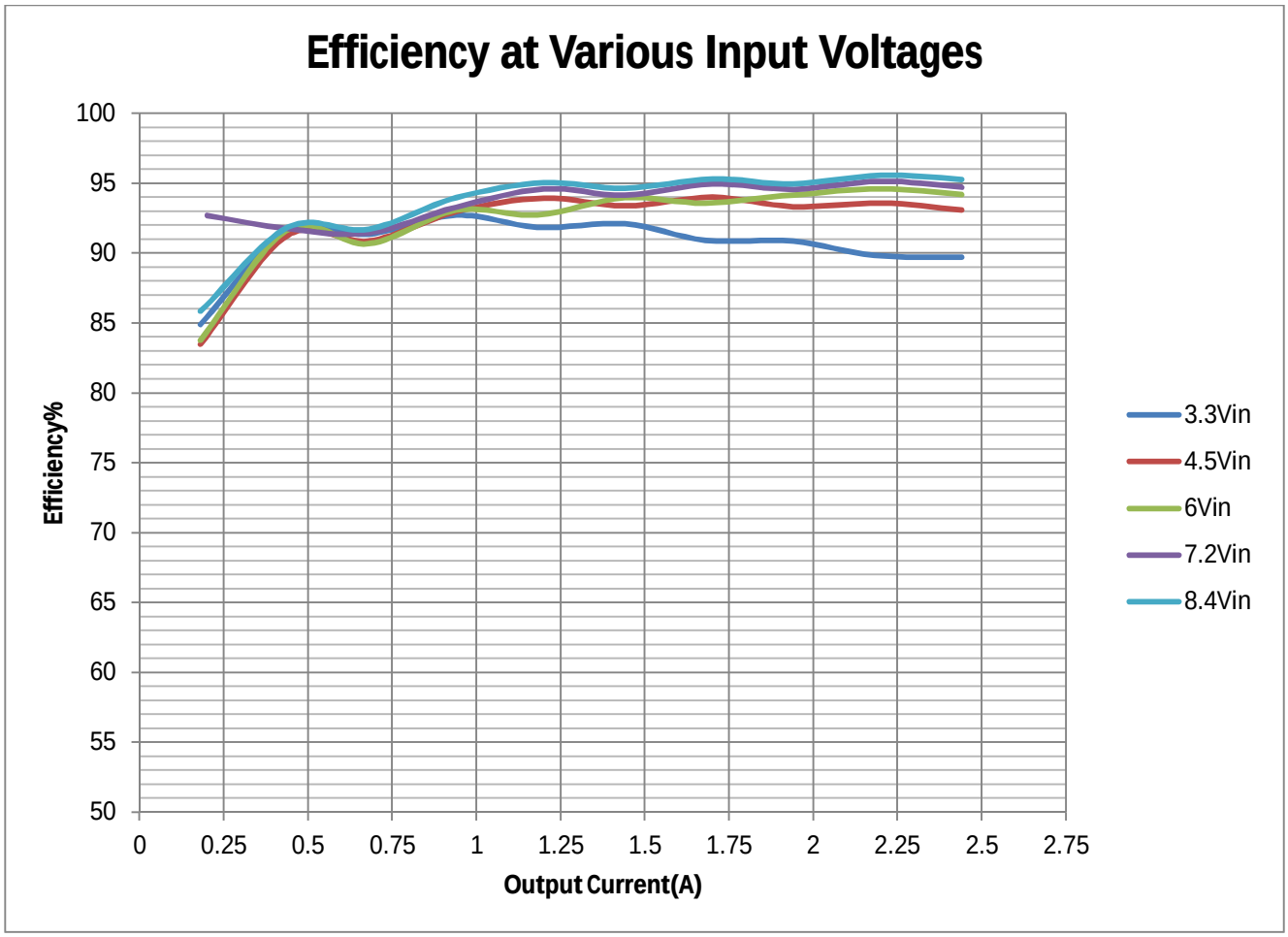
4.1 Thermal Data



IR thermal image taken at steady state with 4.8 Vin and 12V@ 2.5 A load (no airflow)-Boost only

4.2 Efficiency

4.2.1 Efficiency Chart



4.2.2 Efficiency Data

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
3.203	0.01	12.029	0	0
3.203	0.795	12.013	0.18	84.918
3.203	1.8	12.01	0.44	91.657
3.203	2.79	12.009	0.68	91.381
3.203	3.8	12.008	0.94	92.738
3.203	4.815	12.007	1.18	91.868
3.203	5.86	12.006	1.44	92.11
3.203	6.925	12.006	1.68	90.935
3.203	8	12.005	1.94	90.89
3.202	9.095	12.004	2.18	89.858
3.203	10.19	12.003	2.44	89.732

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
4.504	0.01	12.026	0	0
4.503	0.575	12.013	0.18	83.513
4.503	1.285	12.008	0.44	91.31
4.503	1.995	12.007	0.68	90.886
4.503	2.695	12.006	0.94	92.996
4.503	3.405	12.006	1.2	93.964
4.503	4.11	12.005	1.44	93.407
4.503	4.82	12.004	1.7	94.021
4.503	5.54	12.004	1.94	93.35
4.503	6.265	12.003	2.2	93.603
4.503	6.985	12.003	2.44	93.113

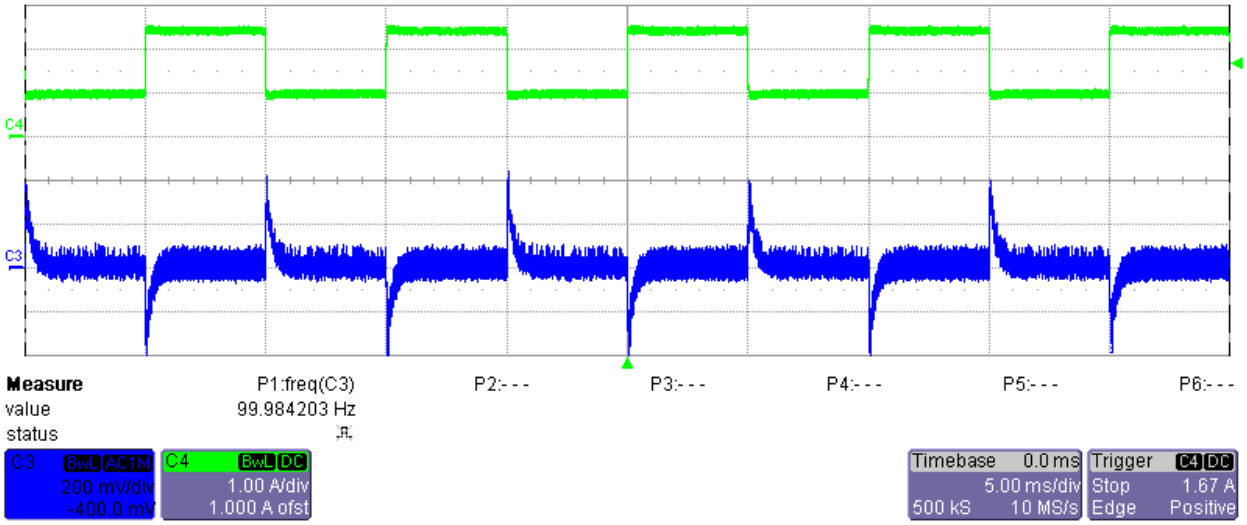
Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
6.003	0.005	12.026	0	0
6.003	0.43	12.017	0.18	83.798
6.003	0.96	12.012	0.44	91.712
6.003	1.5	12.01	0.68	90.697
6.003	2.02	12.009	0.94	93.093
6.003	2.545	12.008	1.18	92.746
6.003	3.065	12.008	1.44	93.98
6.003	3.59	12.007	1.68	93.601
6.003	4.12	12.007	1.94	94.183
6.003	4.65	12.006	2.2	94.624
6.003	5.18	12.006	2.44	94.208

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
7.202	0.005	12.025	0	0
7.201	0.36	12.018	0.2	92.719
7.202	0.8	12.015	0.44	91.756
7.202	1.24	12.013	0.68	91.471
7.202	1.68	12.011	0.94	93.314
7.202	2.115	12.01	1.2	94.615
7.202	2.55	12.01	1.44	94.17
7.202	2.985	12.009	1.7	94.964
7.202	3.42	12.009	1.94	94.587
7.201	3.855	12.008	2.2	95.165
7.201	4.295	12.008	2.44	94.734

Vin(V)	Iin(A)	Vout(V)	Iout(A)	Efficiency(%)
8.402	0.005	12.026	0	0
8.402	0.3	12.024	0.18	85.865
8.402	0.685	12.017	0.44	91.87
8.402	1.06	12.015	0.68	91.737
8.402	1.43	12.014	0.94	93.993
8.402	1.805	12.013	1.2	95.055
8.402	2.175	12.013	1.44	94.661
8.402	2.55	12.012	1.7	95.311
8.402	2.92	12.011	1.94	94.976
8.402	3.29	12.011	2.2	95.592
8.402	3.66	12.011	2.44	95.303

4.3 Waveforms

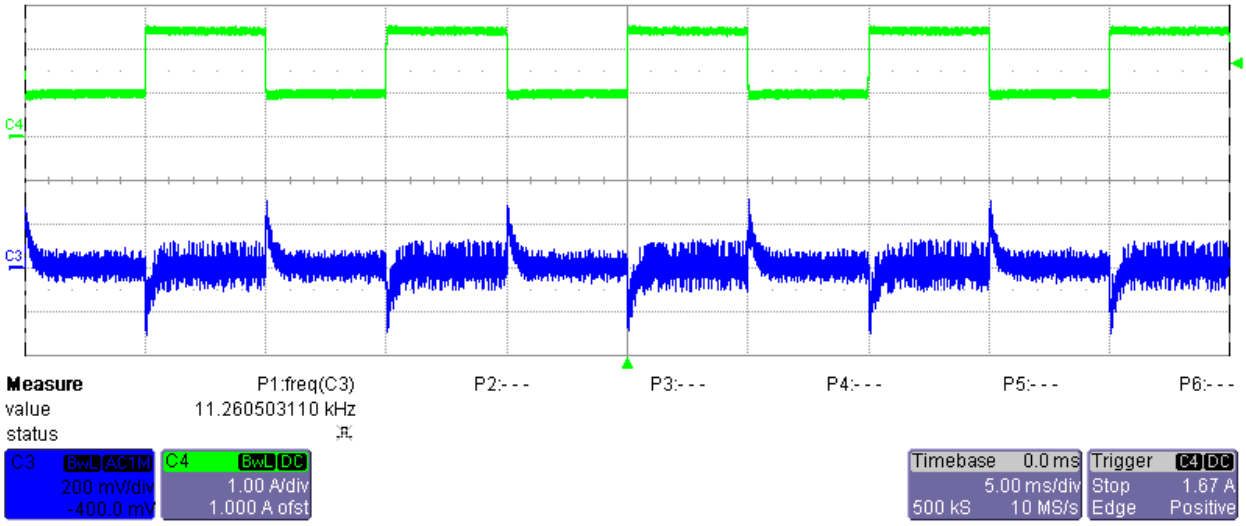
4.3.1 Load Transient Response



Load Transient Response at 3.5Vin and 40%-to-100% (1A-to-2.5A) Load Step

C4- Iout

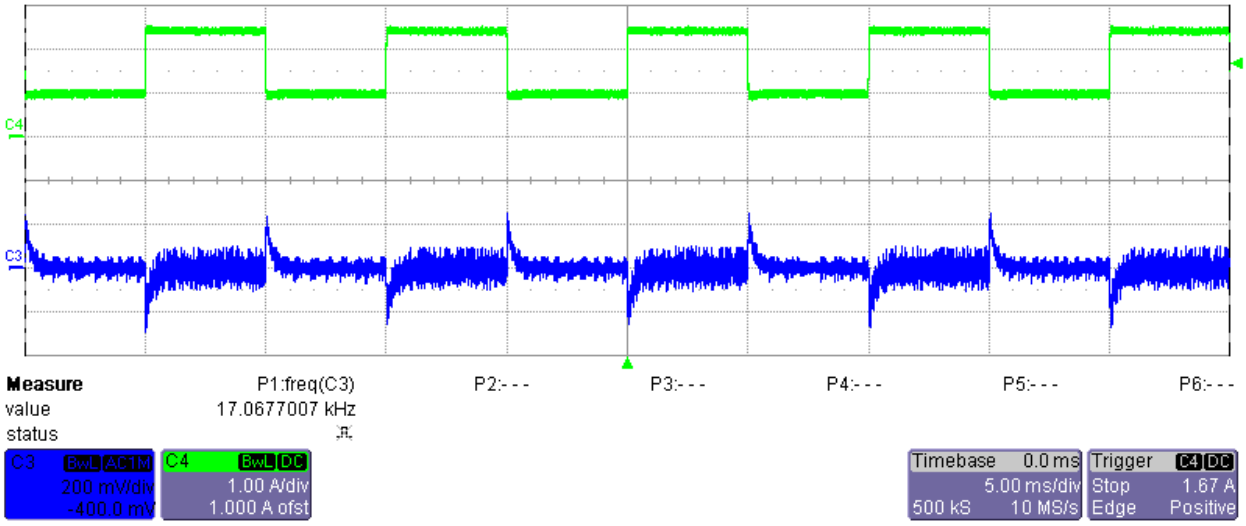
C3- Vout(AC coupled)



Load Transient Response at 6Vin and 40%-to-100% (1A-to-2.5A) Load Step

C4- Iout

C3- Vout(AC coupled)

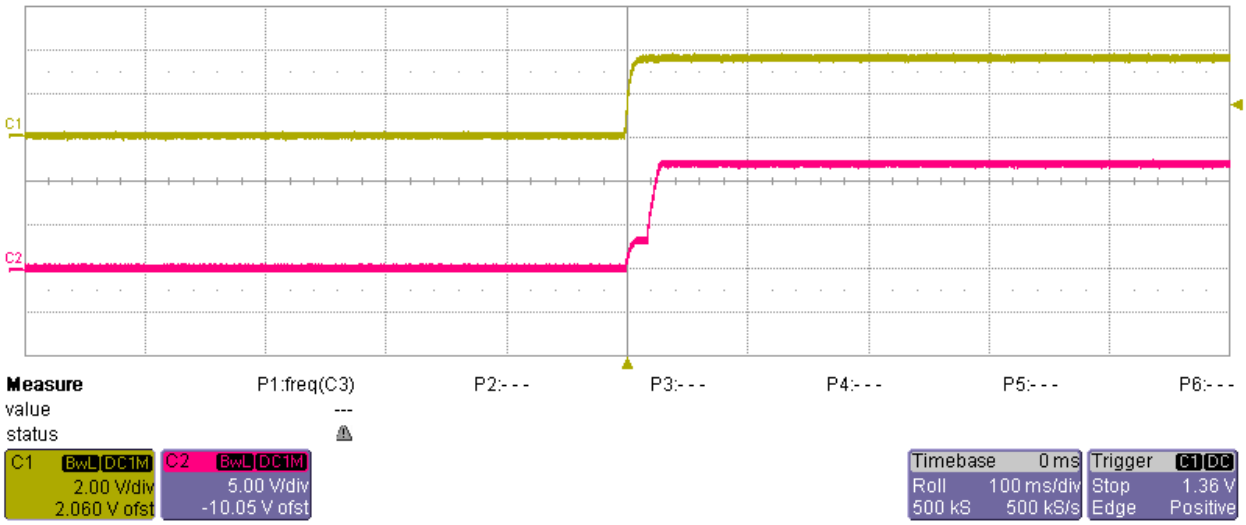


Load Transient Response at 9Vin and 40%-to-100% (1A-to-2.5A) Load Step

C4- Iout

C3- Vout(AC coupled)

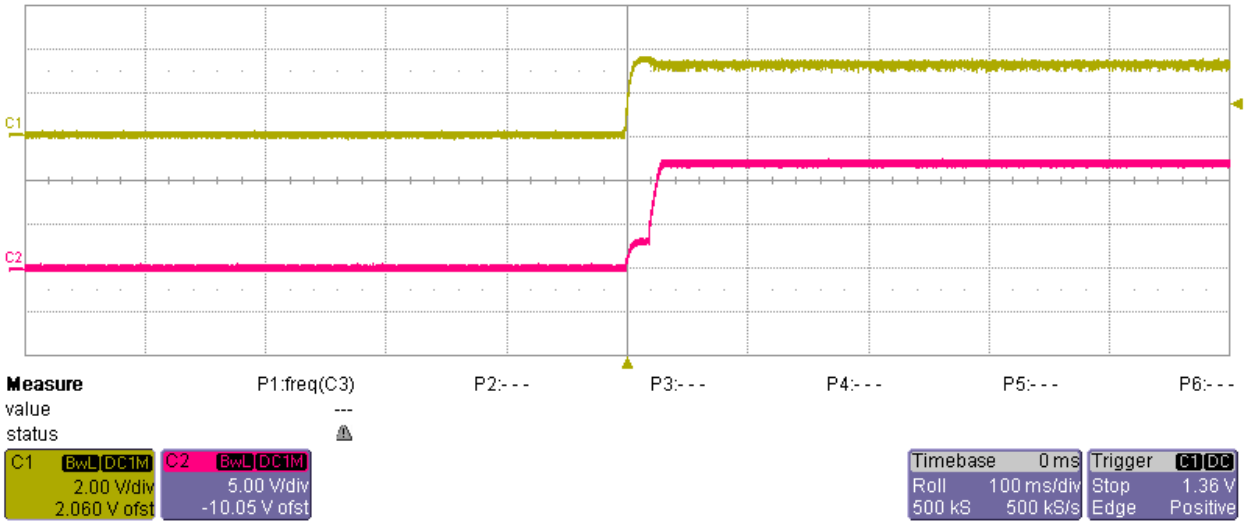
4.3.2 Startup



Startup into No Load at 3.5Vin

C1- Vin

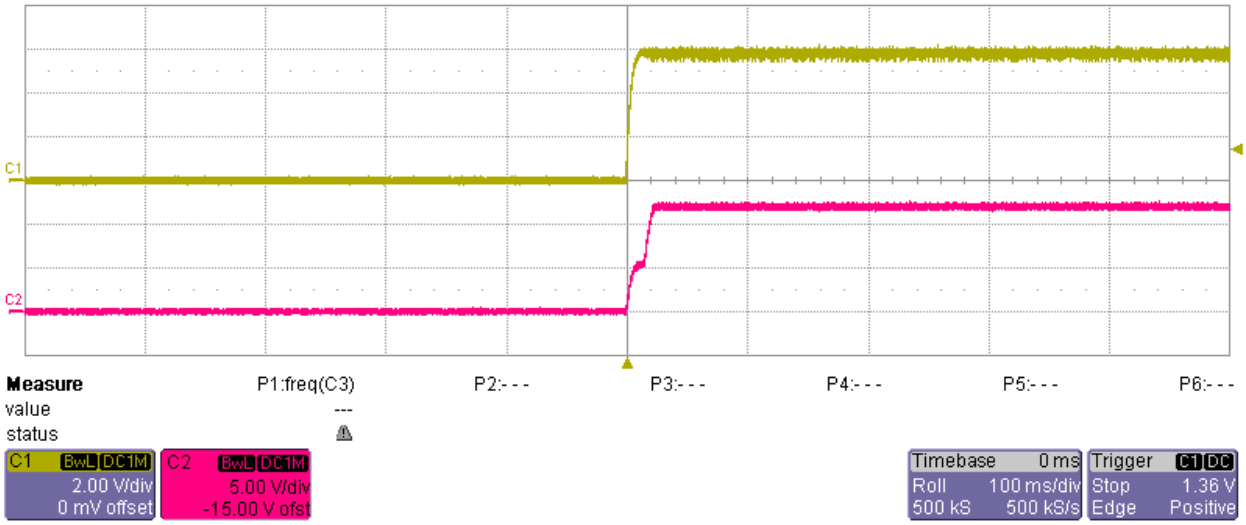
C2-Vout



Startup into Load(2.5A) at 3.5Vin

C1- Vin

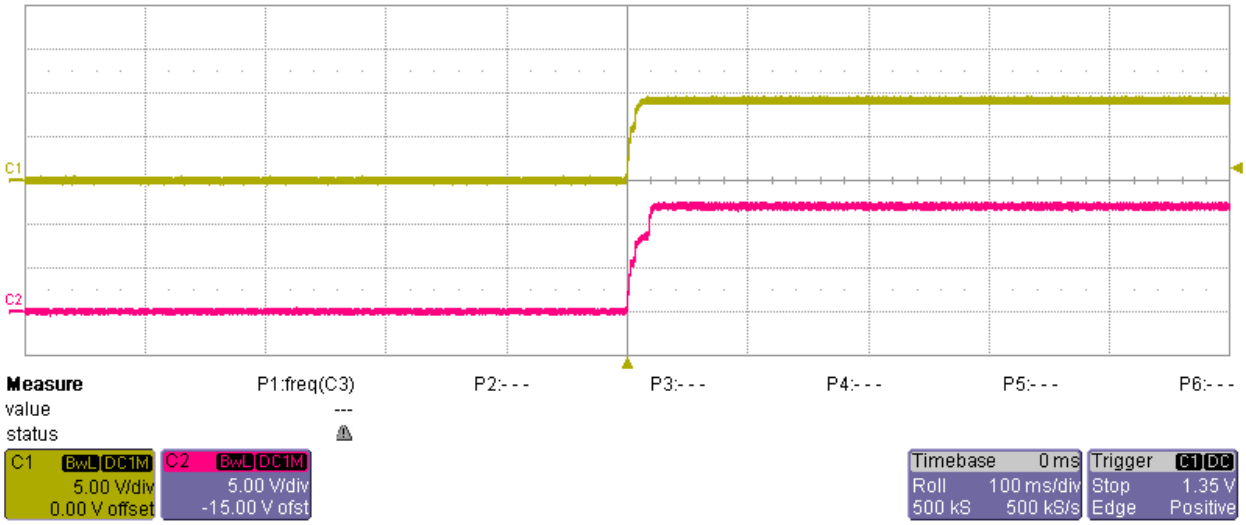
C2-Vout



Startup into No Load at 6 Vin

C1- Vin

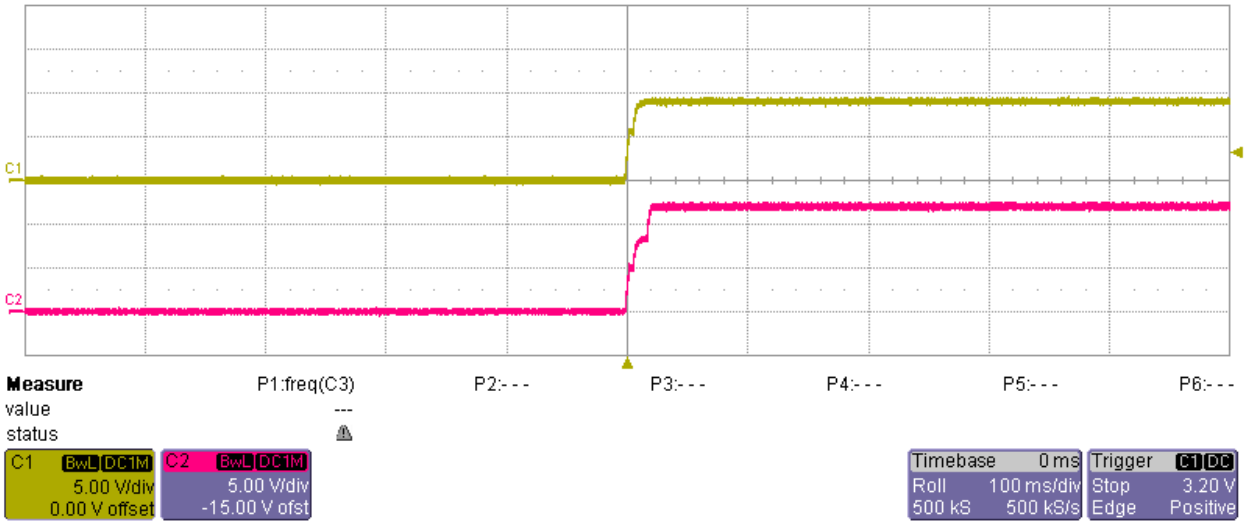
C2-Vout



Startup into No Load at 9 Vin

C1- Vin

C2-Vout

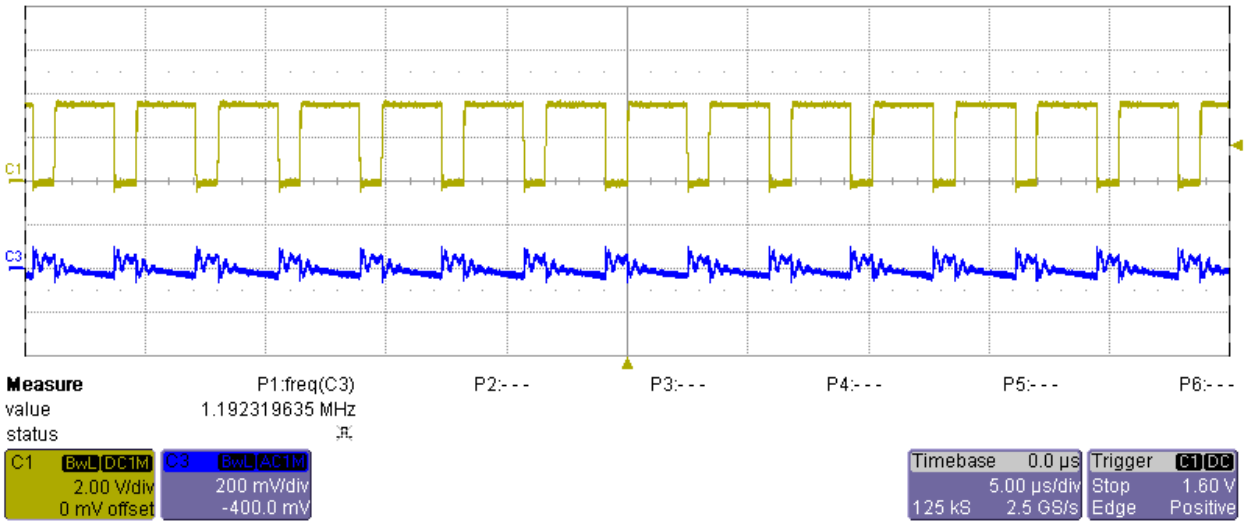


Startup into Load(2.5A) at 9 Vin

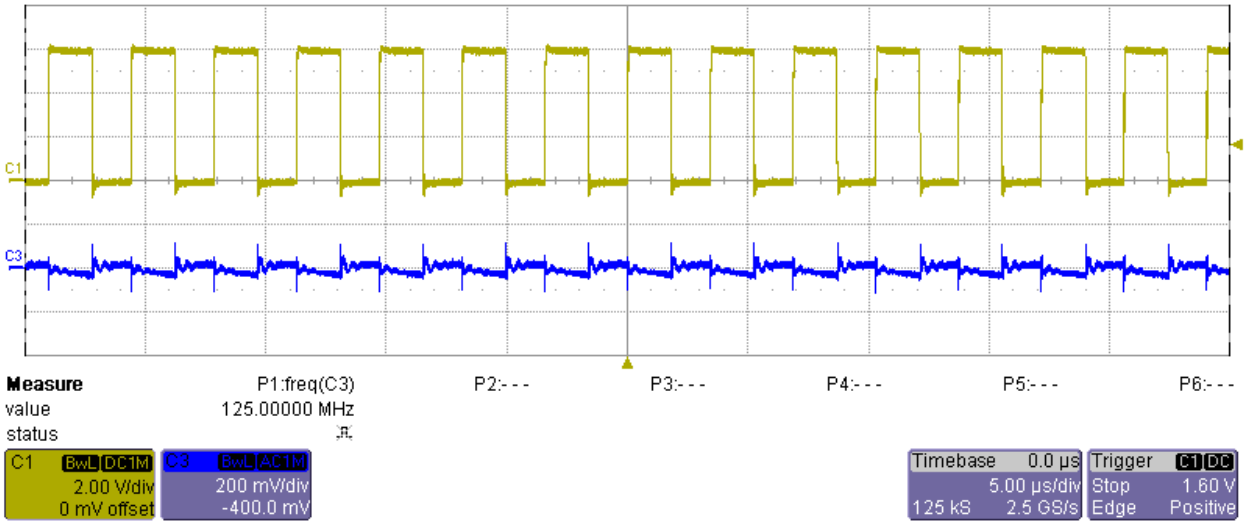
C1- Vin

C2-Vout

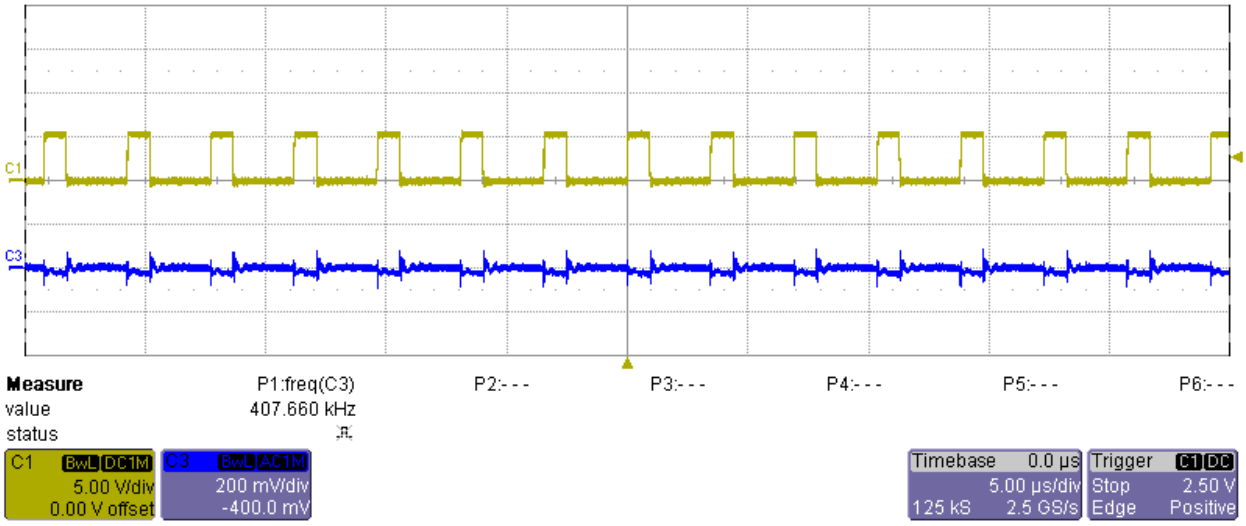
4.3.3 Output Voltage Ripple and Switch Node Voltage



C1 - Switch Node Voltage and Ch3-Output Voltage Ripple at 3.5Vin and 2.5A Load



C1 - Switch Node Voltage and Ch3-Output Voltage Ripple at 6Vin and 2.5A Load

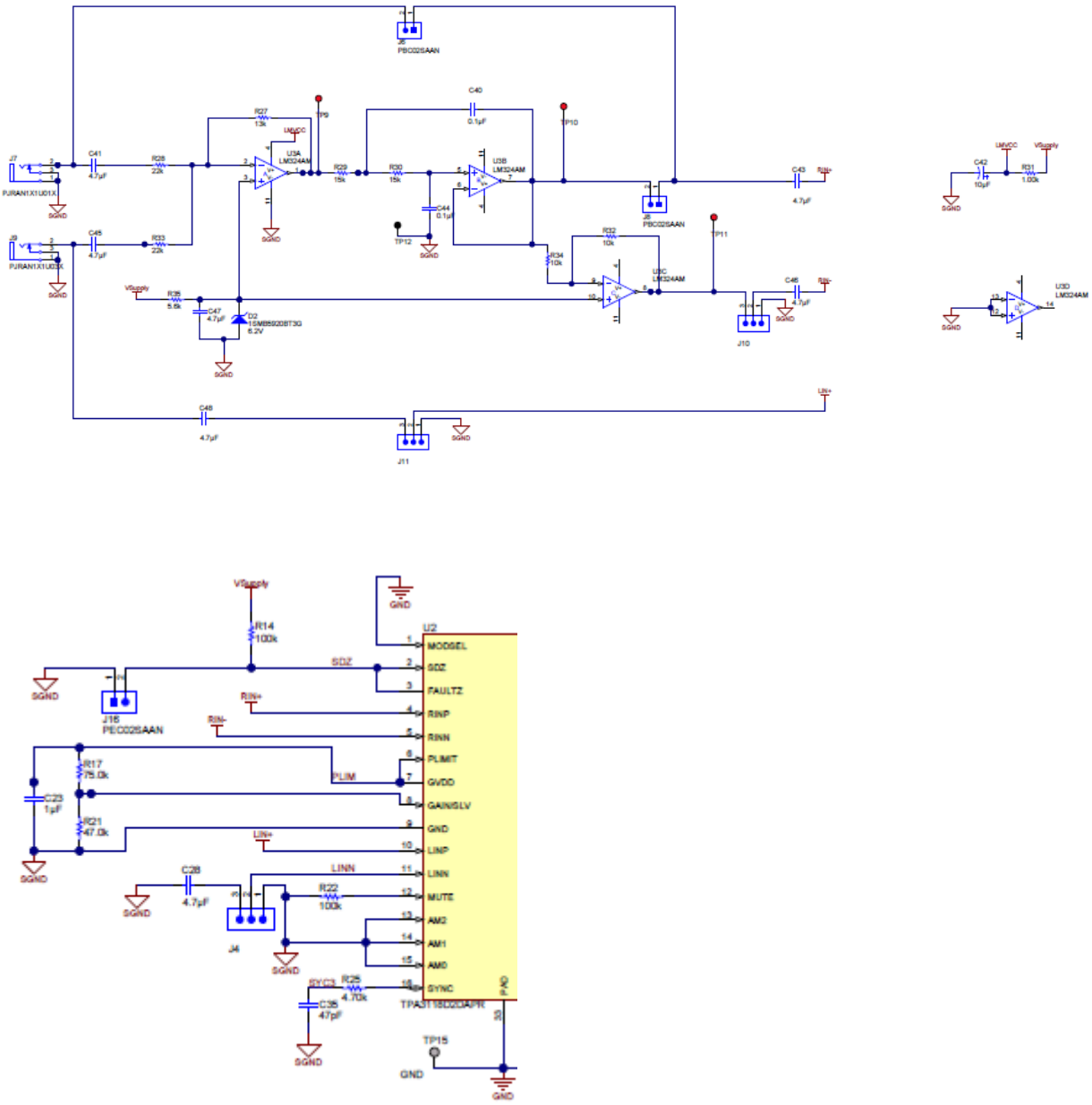


C1 - Switch Node Voltage and Ch3-Output Voltage Ripple at 9Vin and 2.5A Load

5. Audio Power Amplifier's Test Result and Jumper Connections

The entire test on Audio Amplifier was done with 5 V input on DC/DC boost converter (output 12V). The results particularly THD Vs Power reveal that Audio performance remains excellent.

5.1 Jumper Connections



BTL – Stereo Amplifier Jumpers Position:

Place jumper on J3, remove Jumper on J5, Place Jumper in Position 1-2 on J7, Place Jumper in position 2-3 on J8 and place Jumper in position 2-3 on J12.

PBTL – Woofer Amplifier Jumpers Position:

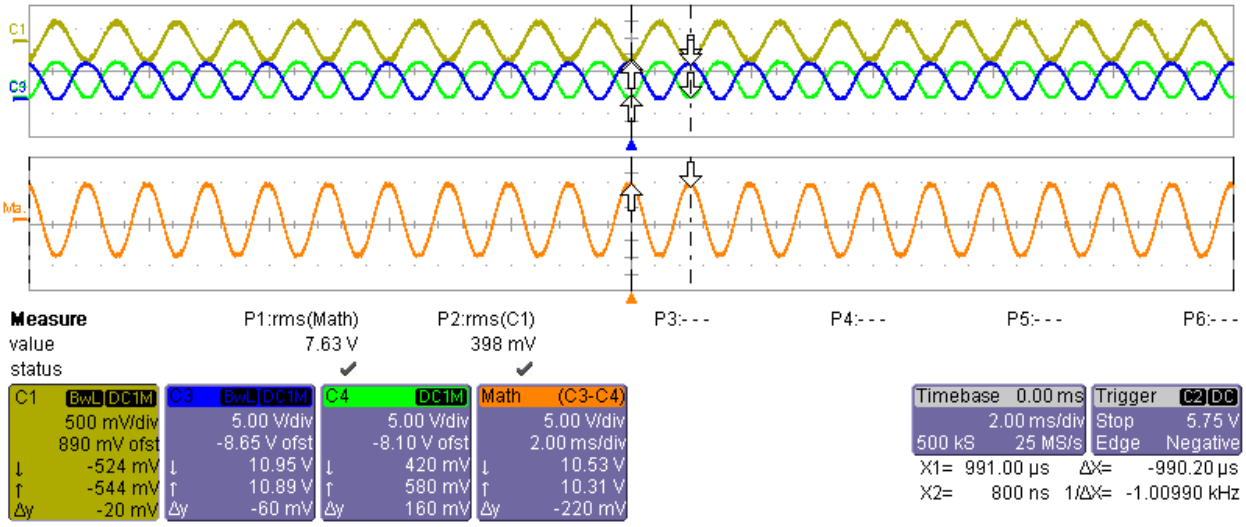
Remove jumper on J3, place Jumper on J5, Place Jumper in Position 2-3 on J7, Place Jumper in position 1-2 on J8 and place Jumper in position 1-2 on J12.

Connect J9 and J10, Connect J11 and J12 and place 2 Ohm Load across it for testing in PBTL mode

Simple Second order Low Pass Active filters is used in the design for extracting only Low frequency input for Woofer application.

5.2 BTL: Stereo Waveforms

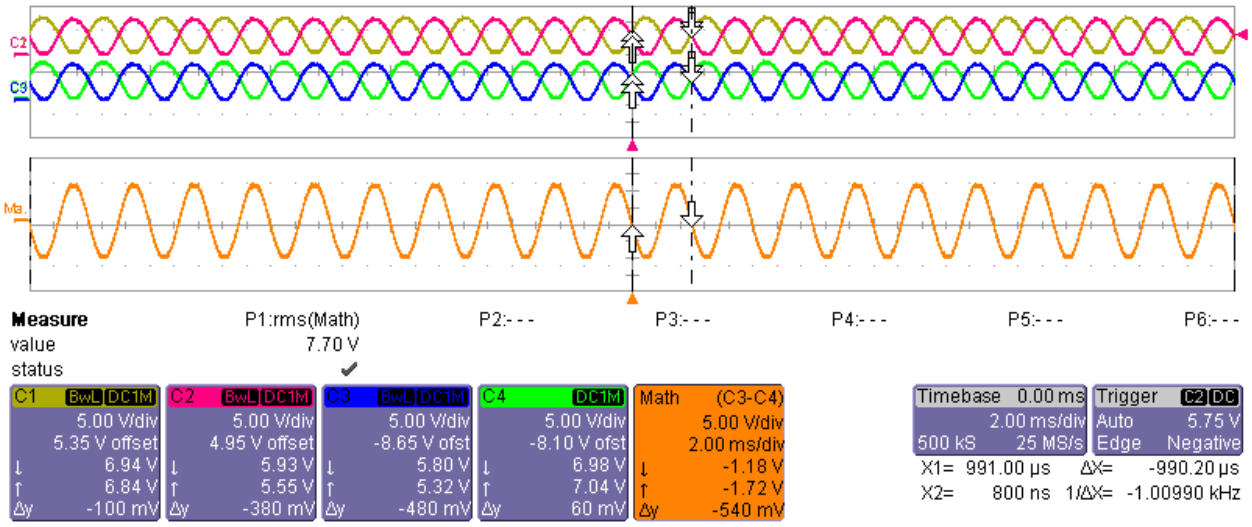
5.2.1 Input /Output Audio



CH4- Out L+ , CH3- Out L- , CH1-Input L ,Math- CH3-CH4 seen by the 4 Ohm Load

Input -400mV RMS 1 KHz Signal (Gain 26dB)

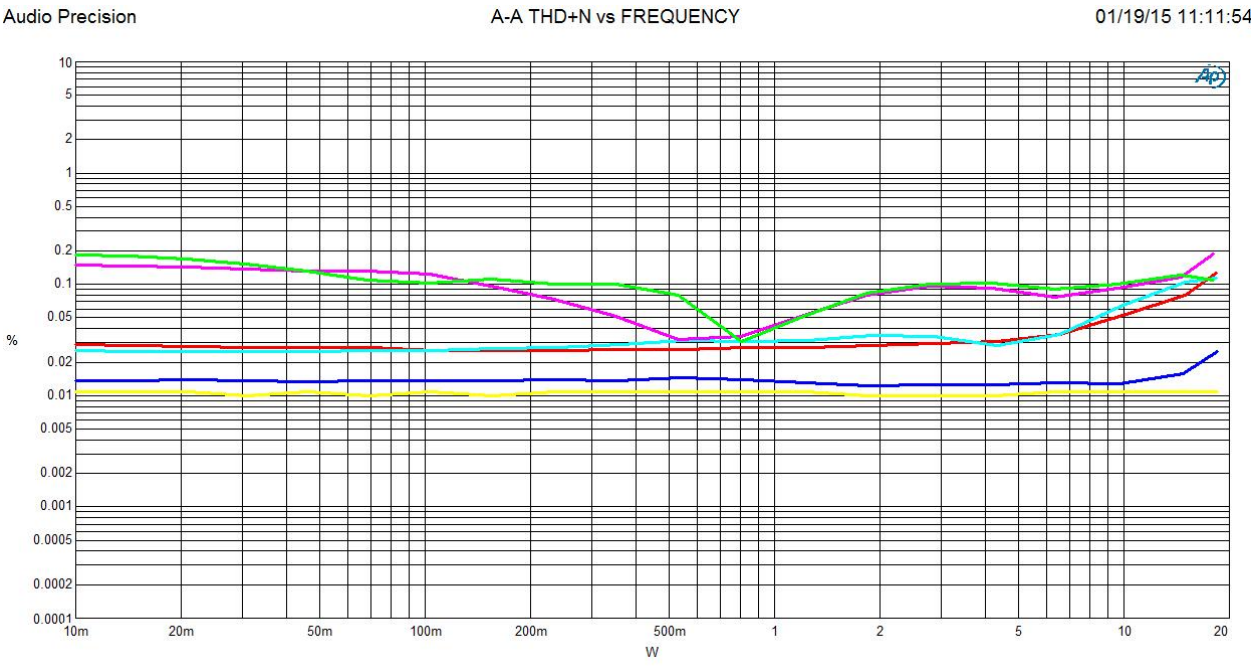
5.2.2 All output Audio Signals



CH1- Out L+ , CH2- Out L- , CH3- Out R+, CH4- Out R- , Math- CH3-CH4 seen by the 4 Ohm Load

Input -400mV RMS 1 KHz Signal (Gain-26 dB)

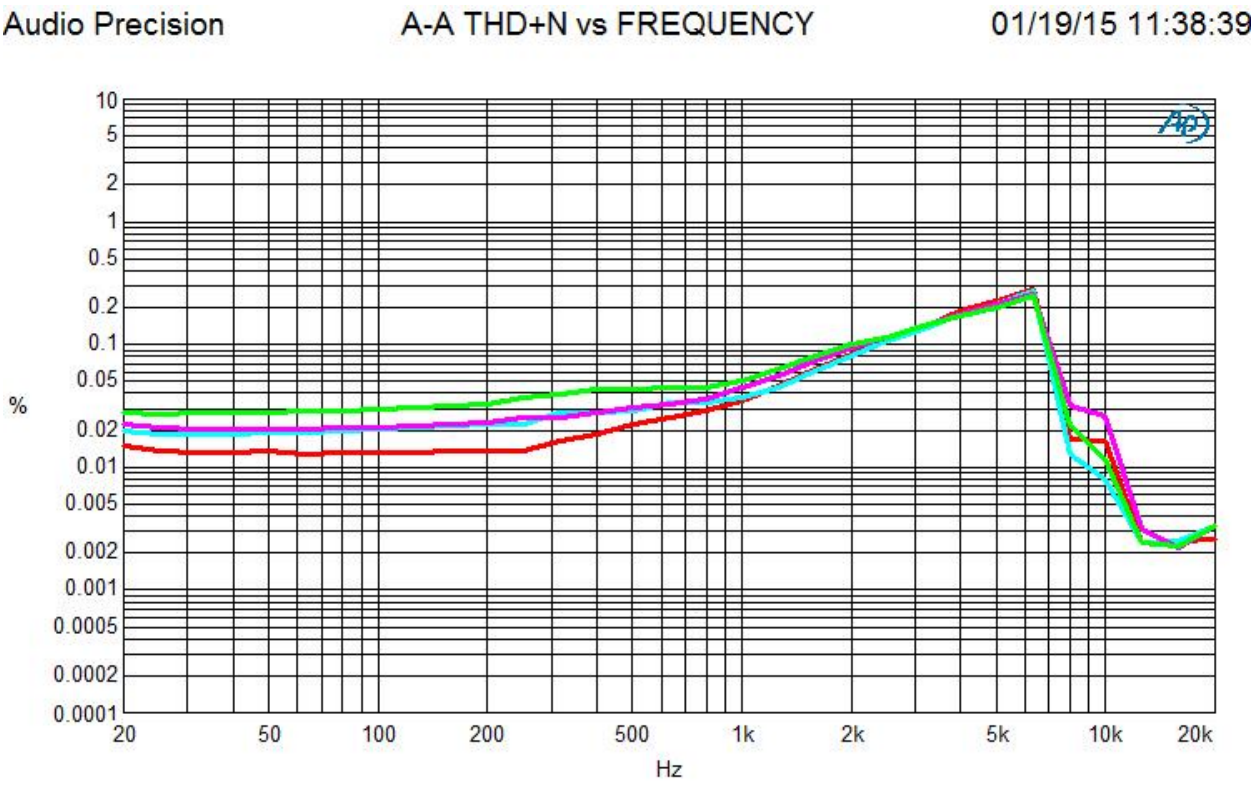
5.2.3 THD Vs Power: BTL mode



Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Red	Solid	3	Anlr.THD+N Ratio	Left	1KHz Right Channel
1	3	Cyan	Solid	3	Anlr.THD+N Ratio	Left	1 KHz Left Channel
2	1	Magenta	Solid	3	Anlr.THD+N Ratio	Left	6 KHz Right Channel
2	3	Green	Solid	3	Anlr.THD+N Ratio	Left	6 KHz Left Channel
3	1	Blue	Solid	3	Anlr.THD+N Ratio	Left	18 KHz Right Channel
3	3	Yellow	Solid	3	Anlr.THD+N Ratio	Left	18 KHz Left Channel

last.at27

5.2.4 THD Vs Frequency: BTL mode

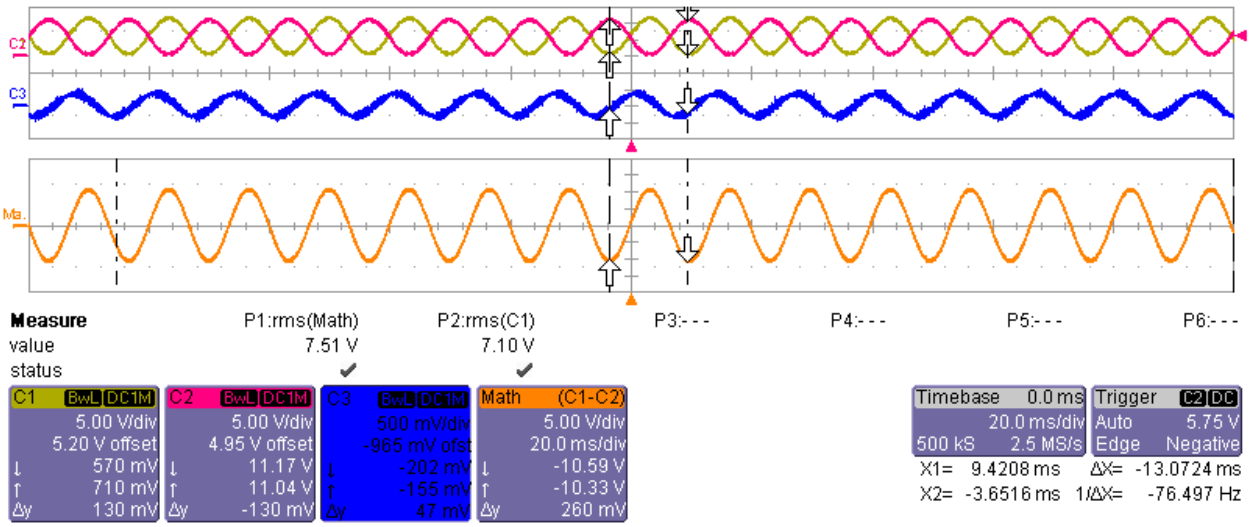


Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Red	Solid	3	Anlr.THD+N Ratio	Left	THDVsFreq 5W Right Channel
1	2	Cyan	Solid	3	Anlr.THD+N Ratio	Left	THDVsFreq 5W Left Channel
2	1	Magenta	Solid	3	Anlr.THD+N Ratio	Left	THDVsFreq 13W Right Channel
2	2	Green	Solid	3	Anlr.THD+N Ratio	Left	THDVsFreq 13W Left Channel

last.at27

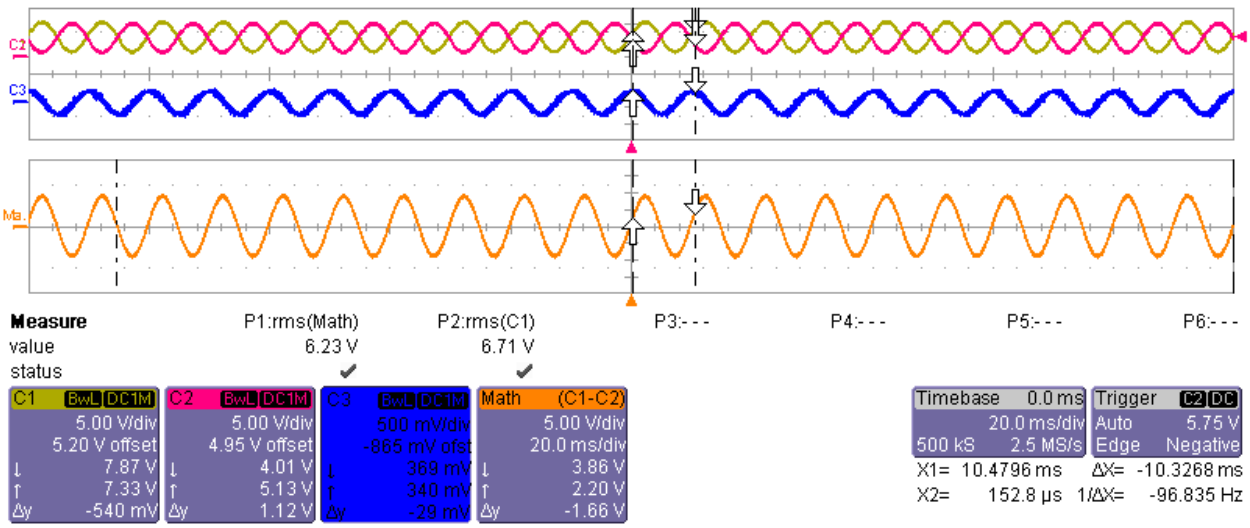
5.3 PBTL: Woofer Waveforms

5.3.1 Input /Output Audio Signals



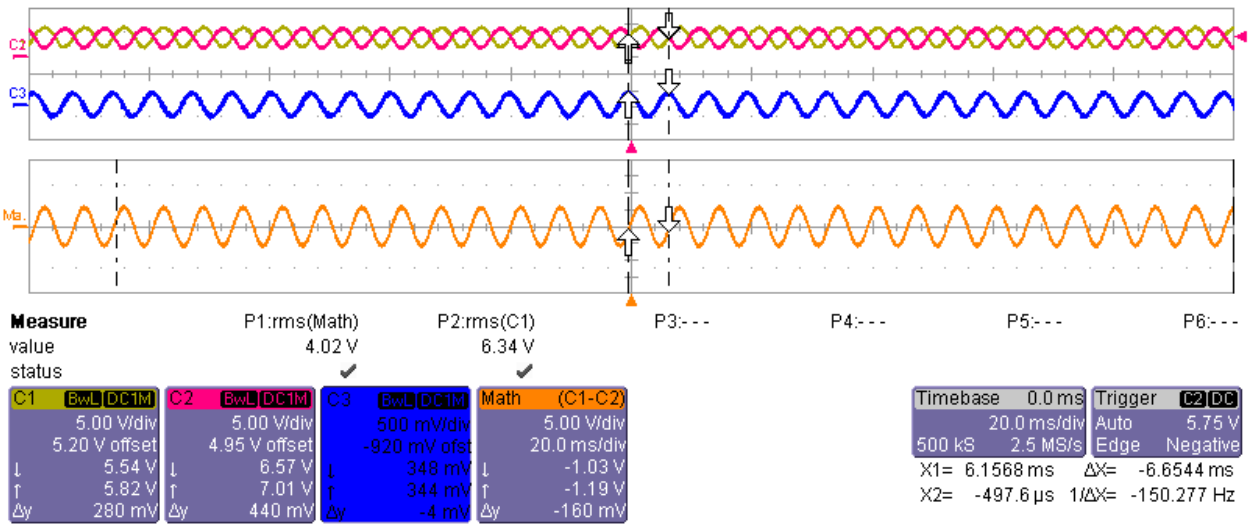
CH1- Out W+(L+ and L- Connected together) , CH2- Out W-(R+ and R- Connected together) , CH3- Input Audio Signal, Math- CH1-CH2 seen by the 2 Ohm Load

Input -300mV RMS 75Hz Signal (26dB gain)



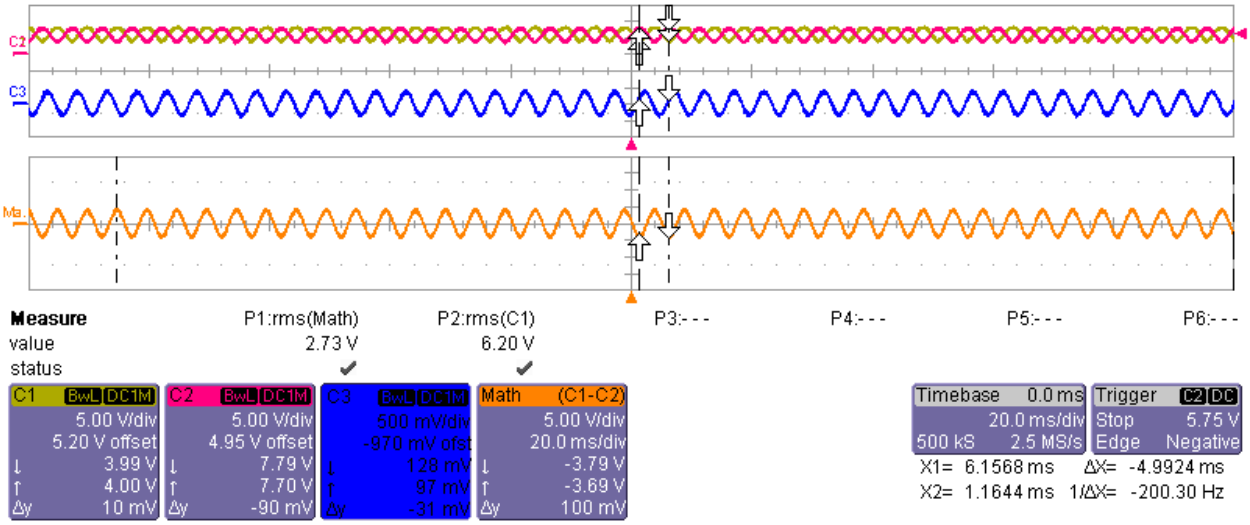
CH1- Out W+(L+ and L- Connected together) , CH2- Out W-(R+ and R- Connected together) , CH3- Input Audio Signal, Math- CH1-CH2 seen by the 2 Ohm Load

Input -300mV RMS 100Hz Signal (26dB gain)



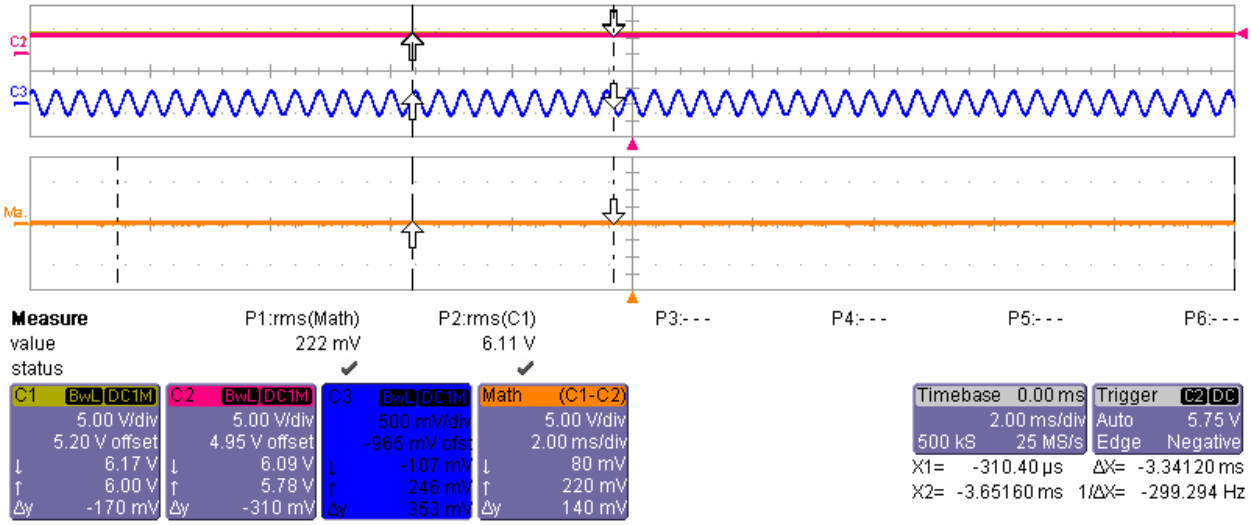
CH1- Out W+(L+ and L- Connected together) , CH2- Out W-(R+ and R- Connected together) , CH3- Input Audio Signal, Math- CH1-CH2 seen by the 2 Ohm Load

Input -300mV RMS 150Hz Signal (26dB gain)



CH1- Out W+(L+ and L- Connected together) , CH2- Out W-(R+ and R- Connected together) , CH3- Input Audio Signal, Math- CH1-CH2 seen by the 2 Ohm Load

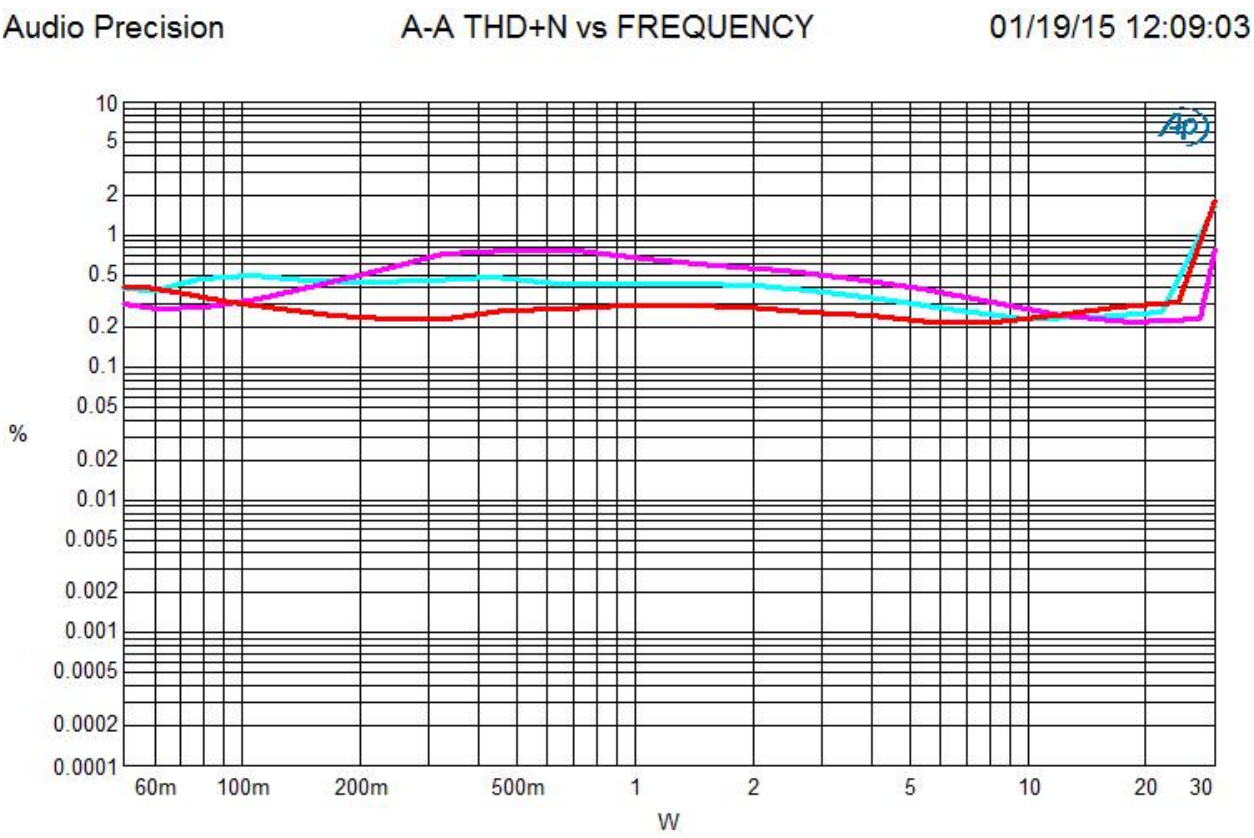
Input -300mV RMS 200 Hz Signal (26dB gain)



CH1- Out W+(L+ and L- Connected together) , CH2- Out W-(R+ and R- Connected together) , CH3- Input Audio Signal, Math- CH1-CH2 seen by the 2 Ohm Load

Input -300mV RMS 2000 Hz Signal (out of Woofer Range)

5.3.2 THD Vs Power: PBTL into 2 Ohm



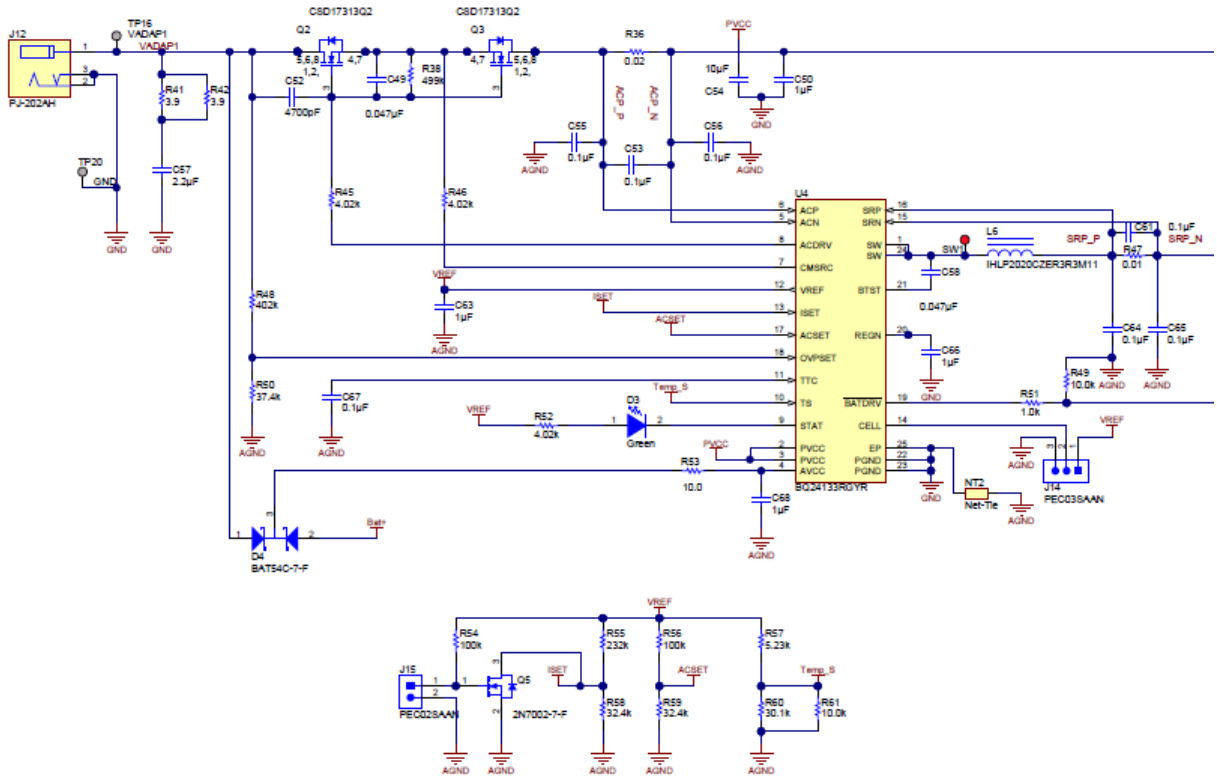
Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Red	Solid	3	Anlr.THD+N Ratio	Left	PBTL_60Hz
2	1	Cyan	Solid	3	Anlr.THD+N Ratio	Left	PBTL_85Hz
3	1	Magenta	Solid	3	Anlr.THD+N Ratio	Left	PBTL_120Hz

last.at27

6. Lithium Battery Charger's Test Result and Jumper Connections

All the testing was done with 9V adapter and 2 Cells in Series Li ion Batteries

6.1 Jumper Connections



1. Single Cell Charging – a) Connect a Jumper in position 2-3 in J14

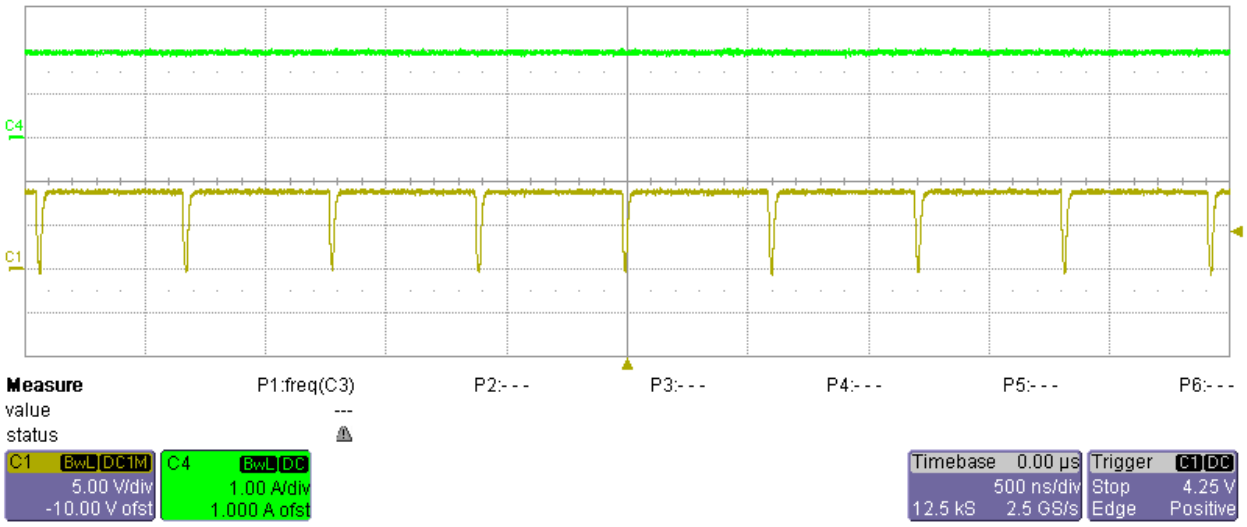
b) Remove D4 and short 1-3 position of diode + Replace R53 with 5 ohm

Dual Cells in Series Charging – a) Keep J14 Floating ie No Jumper in J14

The Default state is for 2 Cells in Series Charging with 9V Adapter.

2. Charge Enable -Put Jumper on J15 to start the Charging

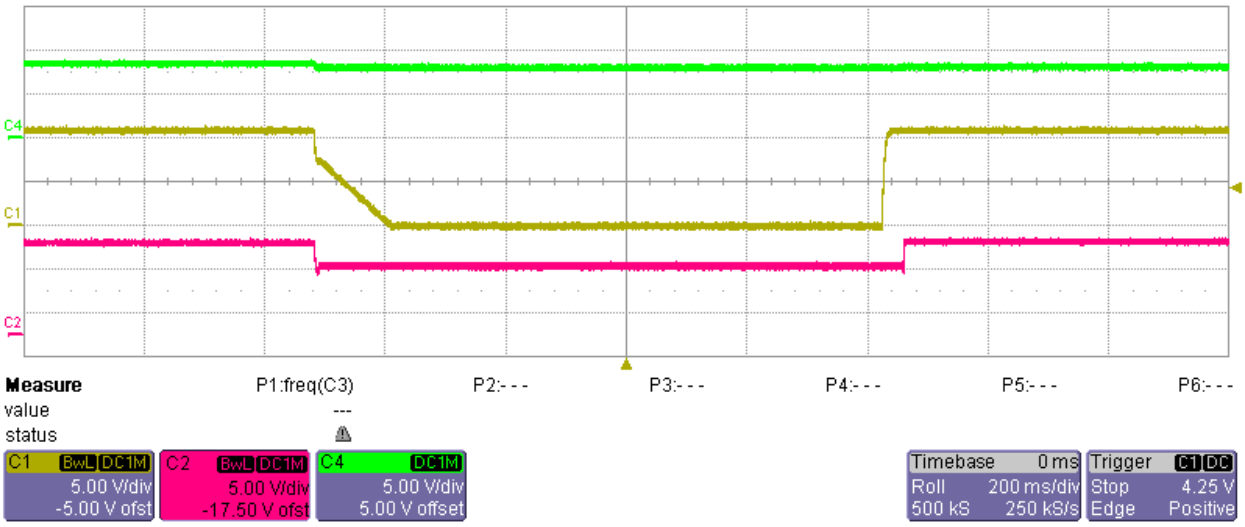
6.2 Charging Current and Switch Waveform



C4- Charging Current

C1- Switch Waveform of BQ24133 Battery Charger

6.3 Transition on Vsystem between Vinput and Battery Voltage

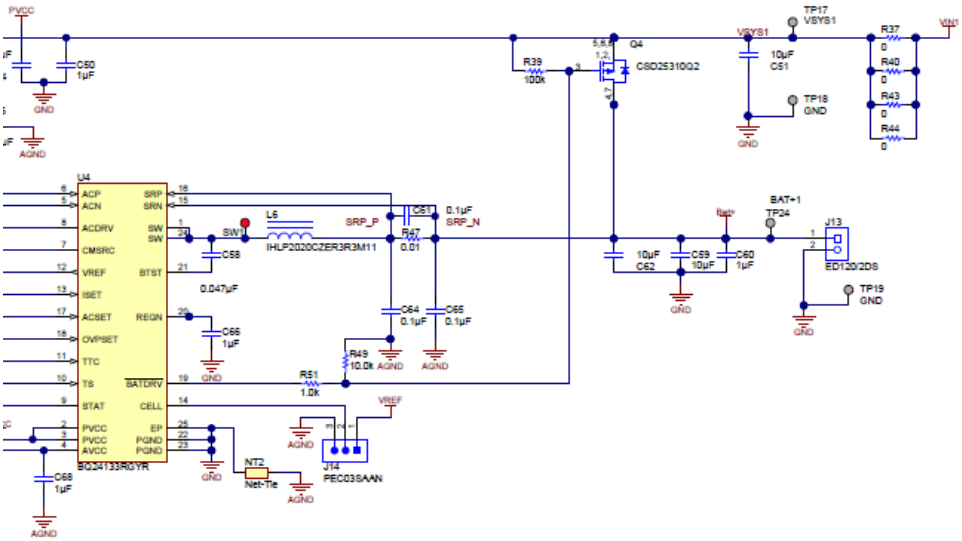


C2- Vsystem (Voltage Seen by the System)

C1- Input Voltage to the Battery Charger from Adapter

C4-Battery Voltage

When Input Voltage fails Battery Voltage took over to provide the Back up.



IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale (https:www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

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