



1.0 Design Specifications

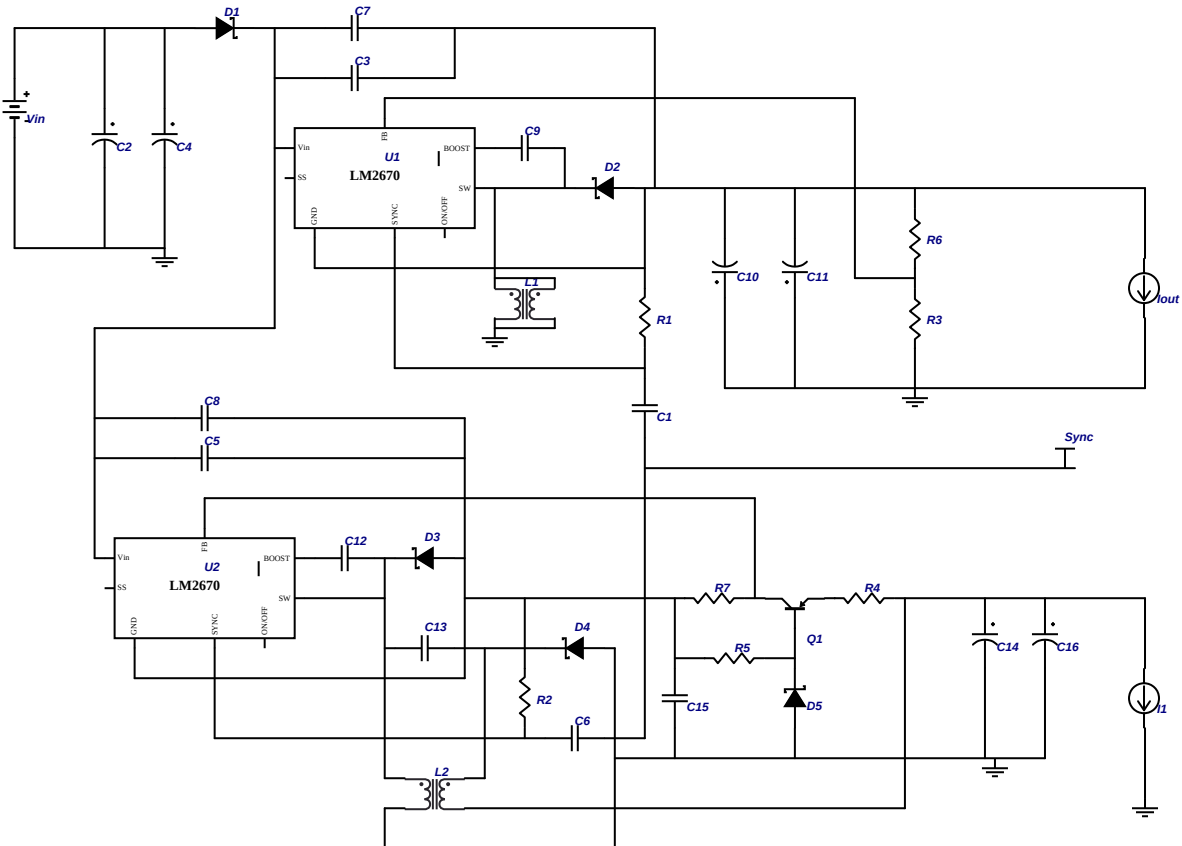
Inputs	Outputs #1	Outputs #2
VinMin=11	Vout1=-7.44	Vout2=7.44
VinMax=16	Iout1=2.0	Iout2=2.0

2.0 Design Description

Two LM2670-ADJ regulator ICs are used to architect two Buck-Boost inverter circuits: one (U1) that inverts the input voltage to create a negative output voltage, and the other (U2) that also inverts the input voltage yet re-inverts the signal through a coupled inductor arrangement to create a re-inverted positive version of the same voltage. The inverter circuits charge their inductors, L1 and L2. During the off-time of the switch the discharge of the inductor pulls current in the negative direction to ground. The U1 based inverter is able to program its output voltage between -5V and -13V by adjusting the voltage divider resistors R6 and R3. With the component

values in this design the output voltage is set to -7.44V. The U2 based inverter uses the L2 secondary winding to invert the inverted signal so that the positive voltage tracks the negative voltage. The second output is programmed through the current sensed across R7 by the current source circuit formed by Q1. Capacitors C3 & C7 and C8 & C5 are used for inverter stabilization. Output capacitors, C10 & C11 and C14 & C16 respectively, charge to the required output voltage and serve to shunt ripple currents to ground. The LM2670 is a PWM regulator with internal FET switch and compensation circuitry. These two features minimize the number of external components, thus making the design inexpensive.

3.0 Schematic



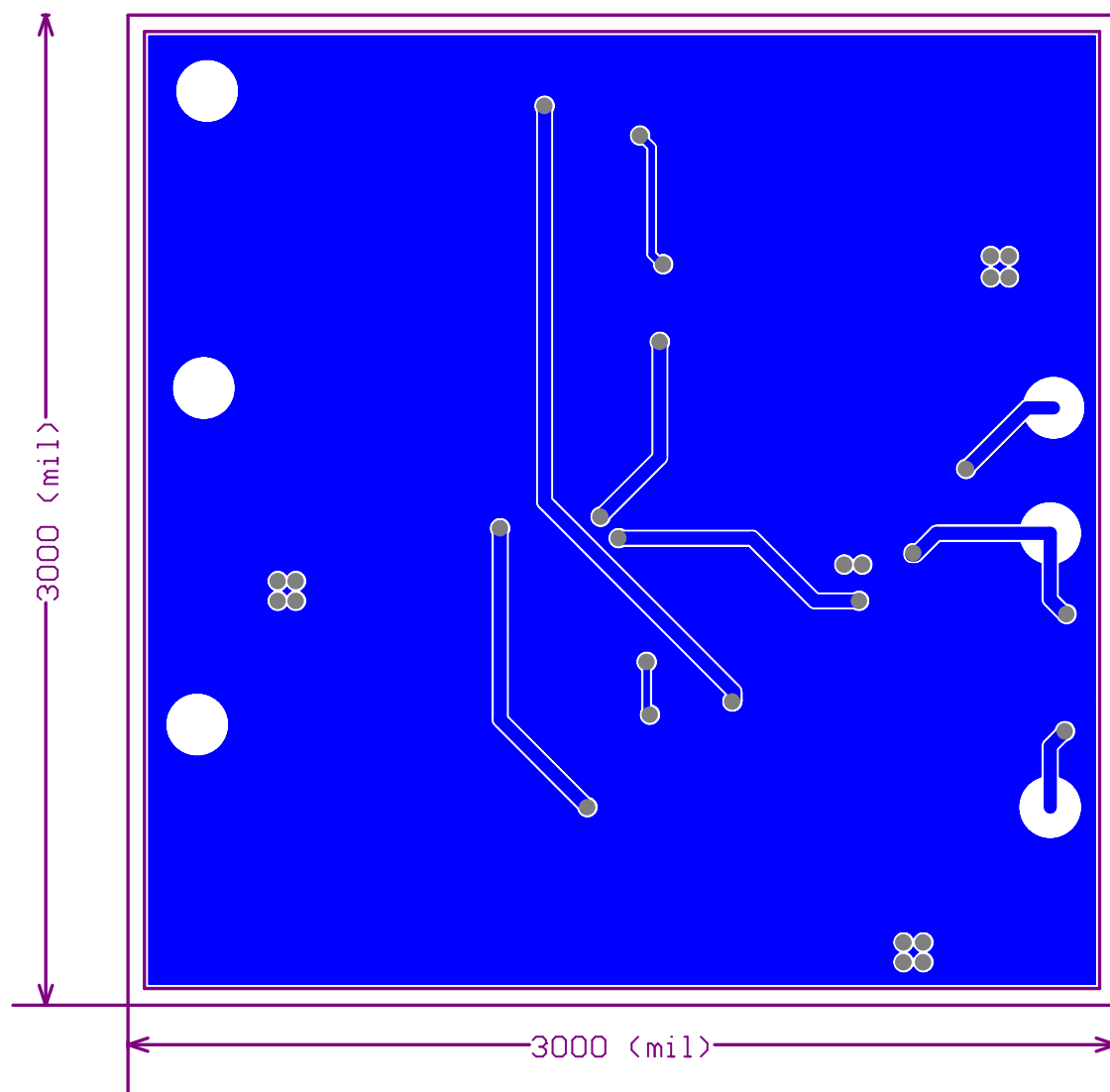
689758_859_0

FIGURE 1. Example Schematic Showing Connection for all Components.

4.0 Bill Of Materials

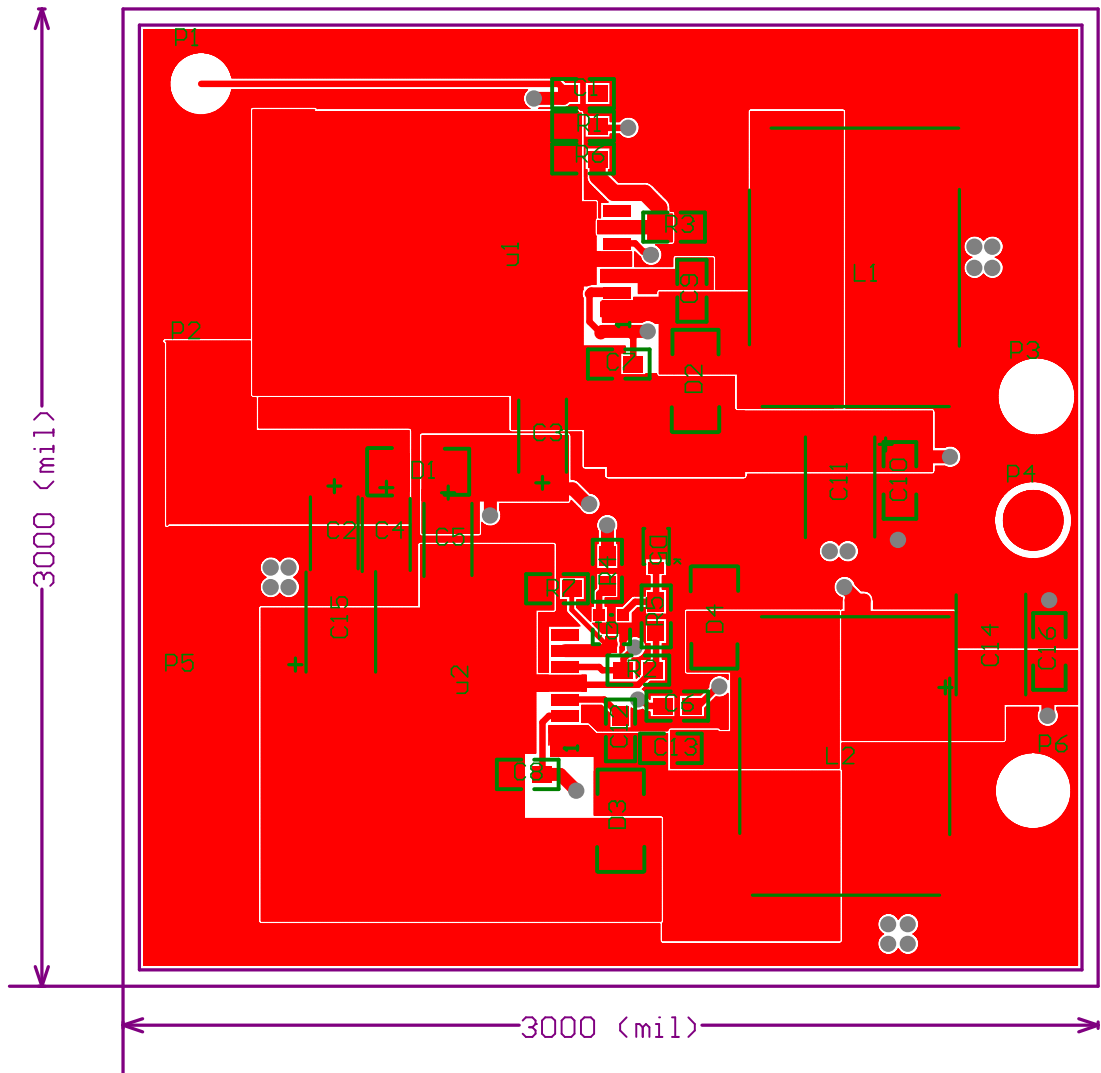
Part	Manufacturer	Part#	Attributes
C1	Vishay	VJ0805A100KXXAT	100p F
C10	TDK	C4532X7R1E106M	10u F
C11	Vishay	595D157X_020R2T	150u F
C12	Vishay	VJ0805Y103KXXAT	0.01u F
C13	TDK	C4532X7R1E106M	10u F
C14	Vishay	595D157X_020R2T	150u F
C15	Vishay	595D157X_020R2T	150u F
C16	TDK	C4532X7R1E106M	10u F
C2	Vishay	595D157X_020R2T	150u F, 0.14 Ohms
C3	Vishay	595D107X_020R2T	100u F, 0.14 Ohms
C5	Vishay	595D107X_020R2T	100u F, 0.14 Ohms
C6	Vishay	VJ0805A100KXXAT	100p F
C7	TDK	C3216X7R1E105K	1u F
C8	TDK	C3216X7R1E105K	1u F
C9	Vishay	VJ0805Y103KXXAT	0.01u F
D1	ONSEMI	MBRS340	0.525 V
D2	ONSEMI	MBRS340	0.525 V
D3	ONSEMI	MBRS340	0.525 V
D4	ONSEMI	MBRS340	0.525 V
D5	ONSEMI	MBR0520	0.385 V
L1	Pulse	P0403	50.5u H, 0.07389 Ohms
L2	Pulse	P0403	50.5u H, 0.07389 Ohms
Q1	ONSEMI	MMBT3906LT1	
R1	Vishay	CRCW08051001FRT6	1k Ohms
R2	Vishay	CRCW08051001FRT6	1k Ohms
R3	Vishay	CRCW08057801FRT6	7.8k Ohms
R5	Vishay	CRCW08057801FRT6	7.8k Ohms
R6	Vishay	CRCW08051501FRT6	1.5k Ohms
R7	Vishay	CRCW08051351FRT6	1.35k Ohms
U1	National Semiconductor	LM2670	
U2	National Semiconductor	LM2670	

5.0 Layout



PADC_NSC0185_lo_1

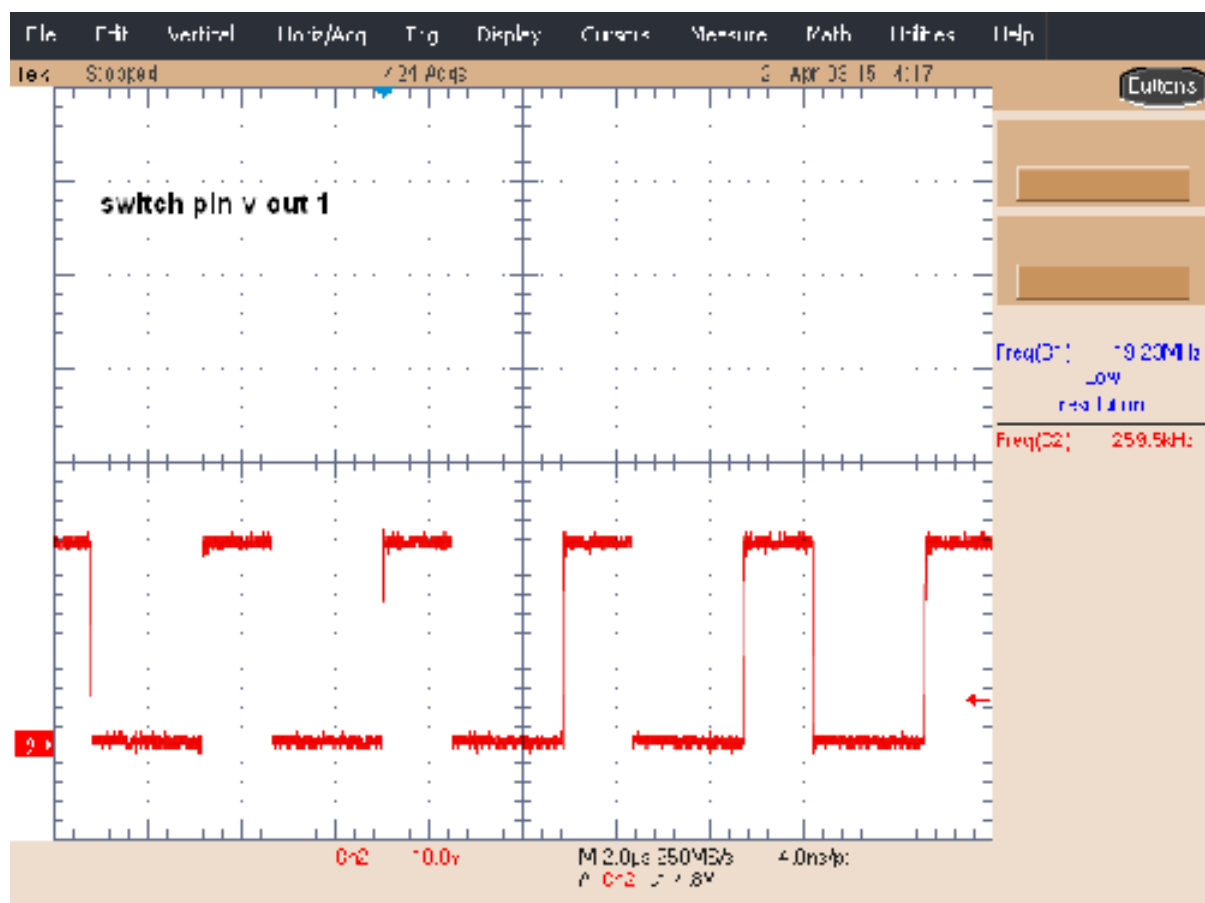
FIGURE 2. Board's Bottom View



PADC_NSC0185_i0_2

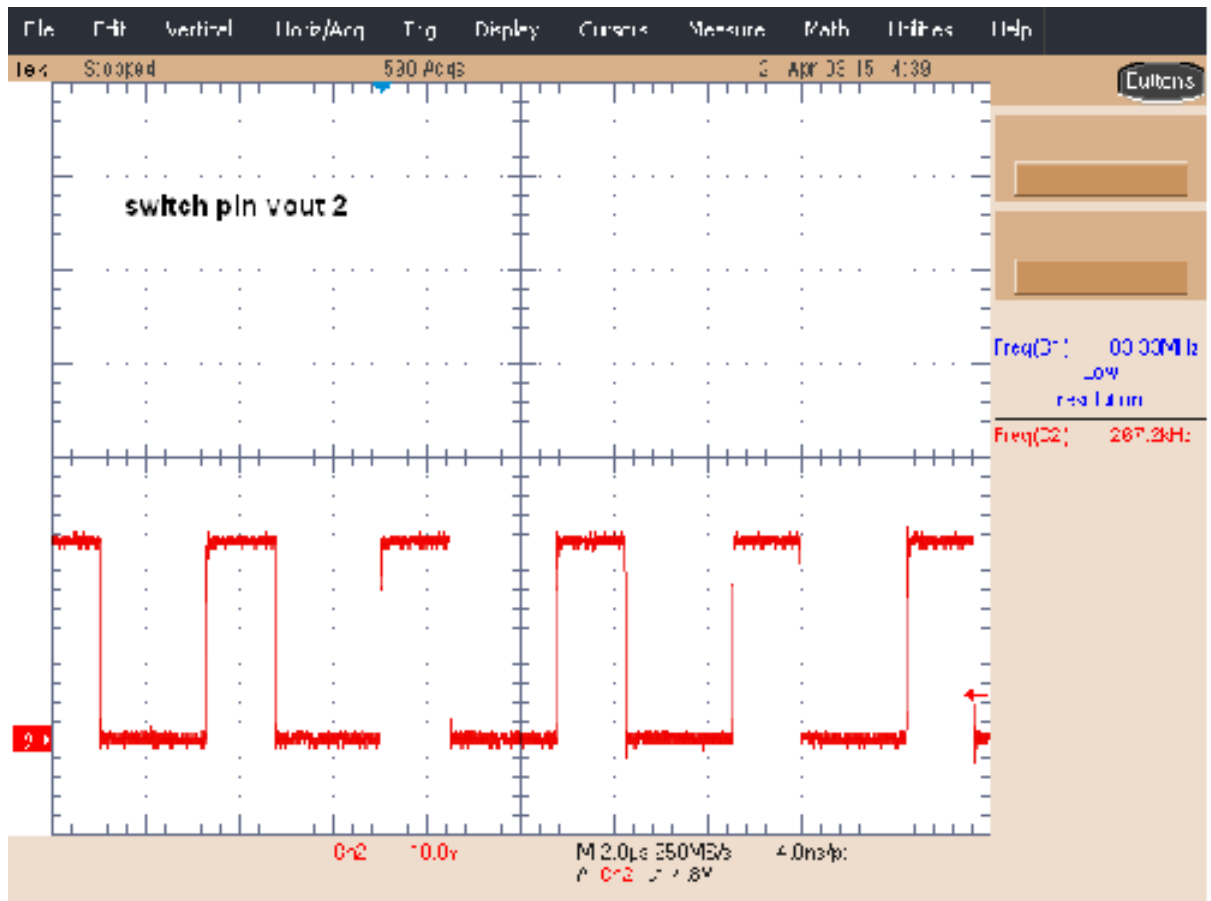
FIGURE 3. Board's Top View

6.0 Waveforms



PADC_NSC0185_wf_3

FIGURE 4. Switch pin Vout 1



PADC_NSC0185_wf_4

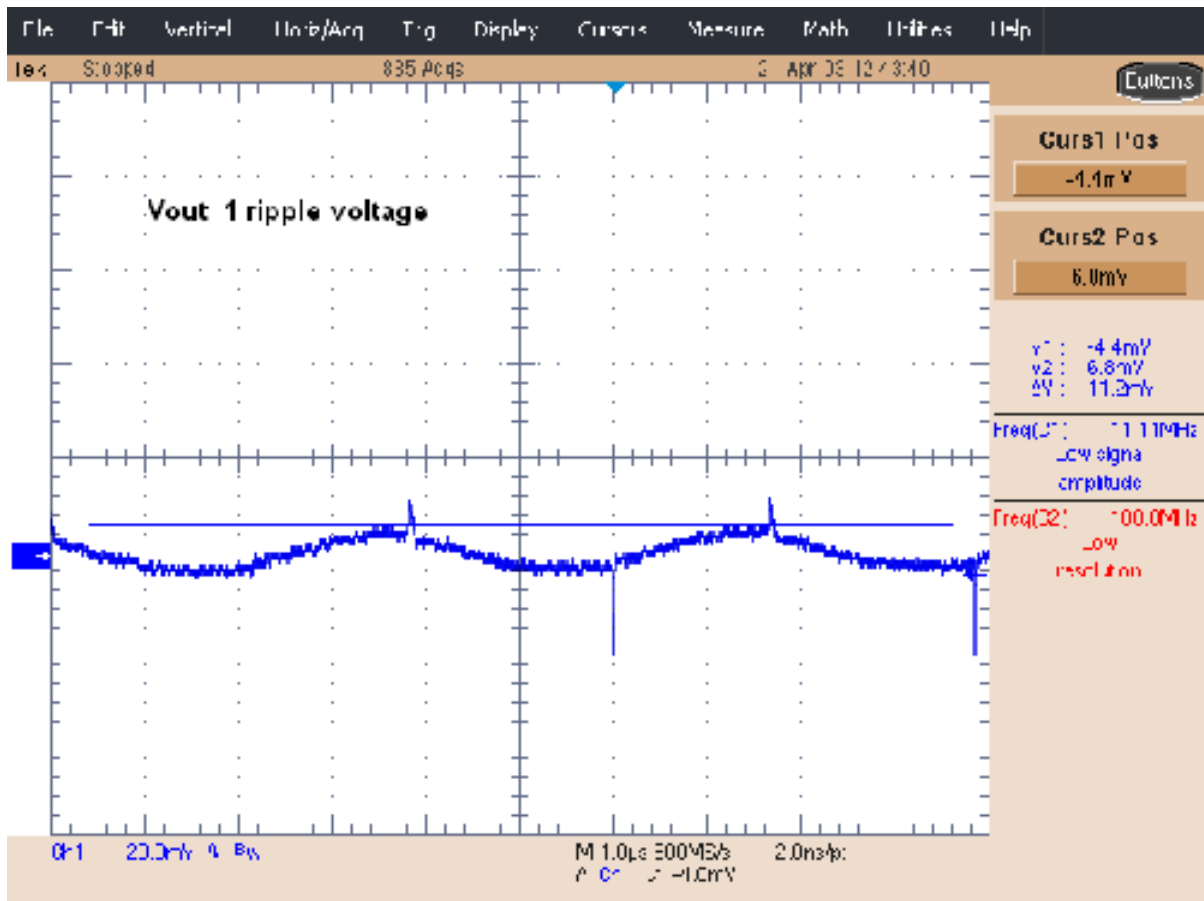
FIGURE 5. Switch pin Vout 2



PADC_NSC0185_wf_5

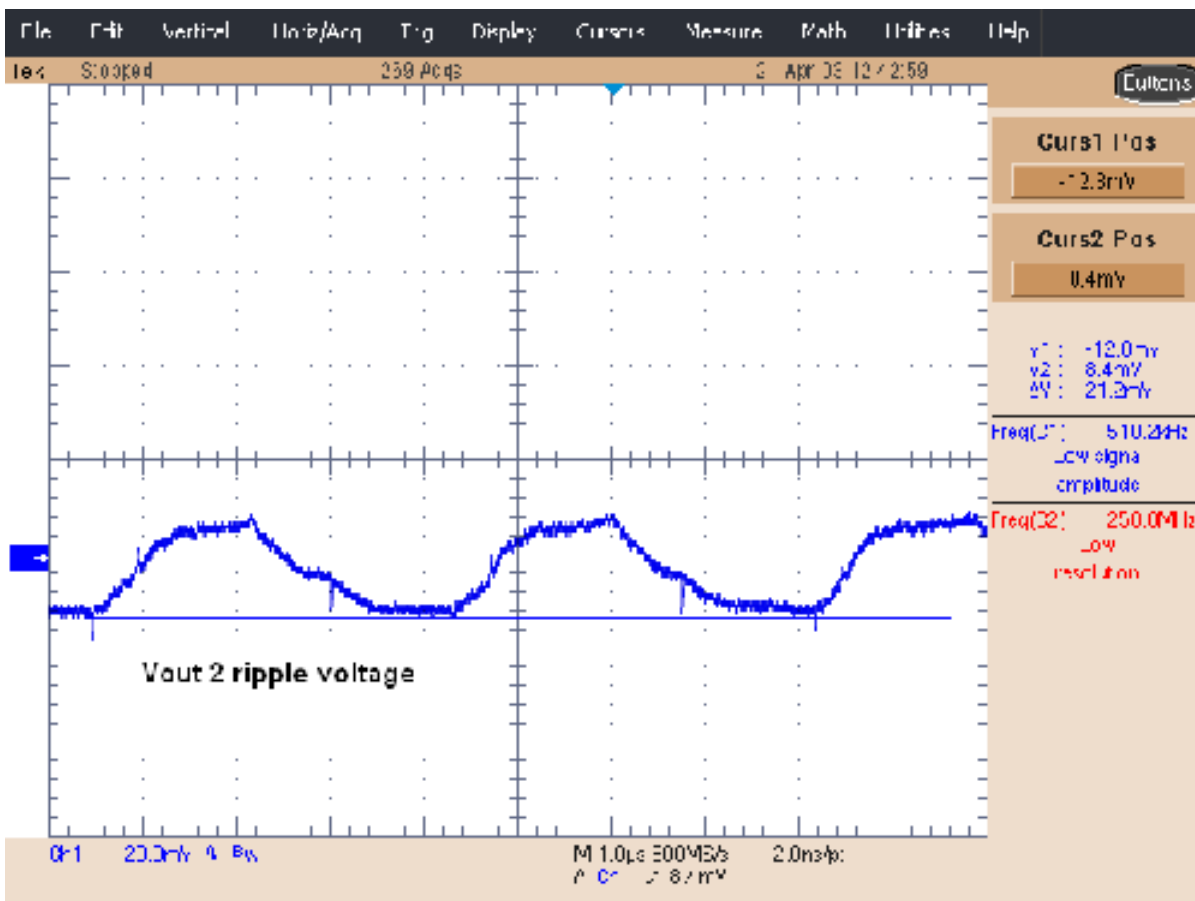
FIGURE 6. Transient Response Vout1

FIGURE 7. Transient Response Vout2



PADC_NSC0185_wf_7

FIGURE 8. Vout1 Ripple voltage



PADC_NSC0185_wf_8

FIGURE 9 Vout2 Ripple voltage

National Semiconductor's design tools attempt to recreate the performance of a substantially equivalent physical implementation of the design. Reference designs are created using National's published specifications as well as the published specifications of other device manufacturers. While National does update this information periodically, this information may not be current at the time the reference design is built. National and/or its licensors do not warrant the accuracy or completeness of the specifications or any information contained therein. National and/or its licensors do not warrant that any designs or recommended parts will meet the specifications you entered, will be suitable for your application or fit for any particular purpose, or will operate as shown in the simulation in a physical implementation. National and/or its licensors do not warrant that the designs are production worthy. You should completely validate and test your design implementation to confirm the system functionality for your application.

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.

For the most current product information visit us at www.national.com.

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

- Life support devices or systems are devices or systems which,
 - (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
- A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

BANNED SUBSTANCE COMPLIANCE

National Semiconductor certifies that the products and packing materials meet the provisions of the Customer Products Stewardship Specification (CSP-9-111C2) and the Banned Substances and Materials of Interest Specification (CSP-9-111S2) and contain no "Banned Substances" as defined in CSP-9-111S2.

Leadfree products are RoHS compliant.



National Semiconductor Americas Customer Support Center
 Email: new.feedback@nsc.com
 Tel: 1-800-272-9959

National Semiconductor Europe Customer Support Center
 Fax: +49 (0) 180-530-85-86
 Email: europe.support@nsc.com
 Deutsch Tel: +49 (0) 69 9508 6208
 English Tel: +49 (0) 870 24 0 2171
 Français Tel: +33 (0) 1 41 91 8790

National Semiconductor Asia Pacific Customer Support Center
 Email: ap.support@nsc.com

National Semiconductor Japan Customer Support Center
 Fax: 81-3-5639-7507
 Email: jpn.feedback@nsc.com
 Tel: 81-3-5639-7560