

# LM5020 Design Document

National Semiconductor  
LM5020  
June 2006



## 1.0 Design Specifications

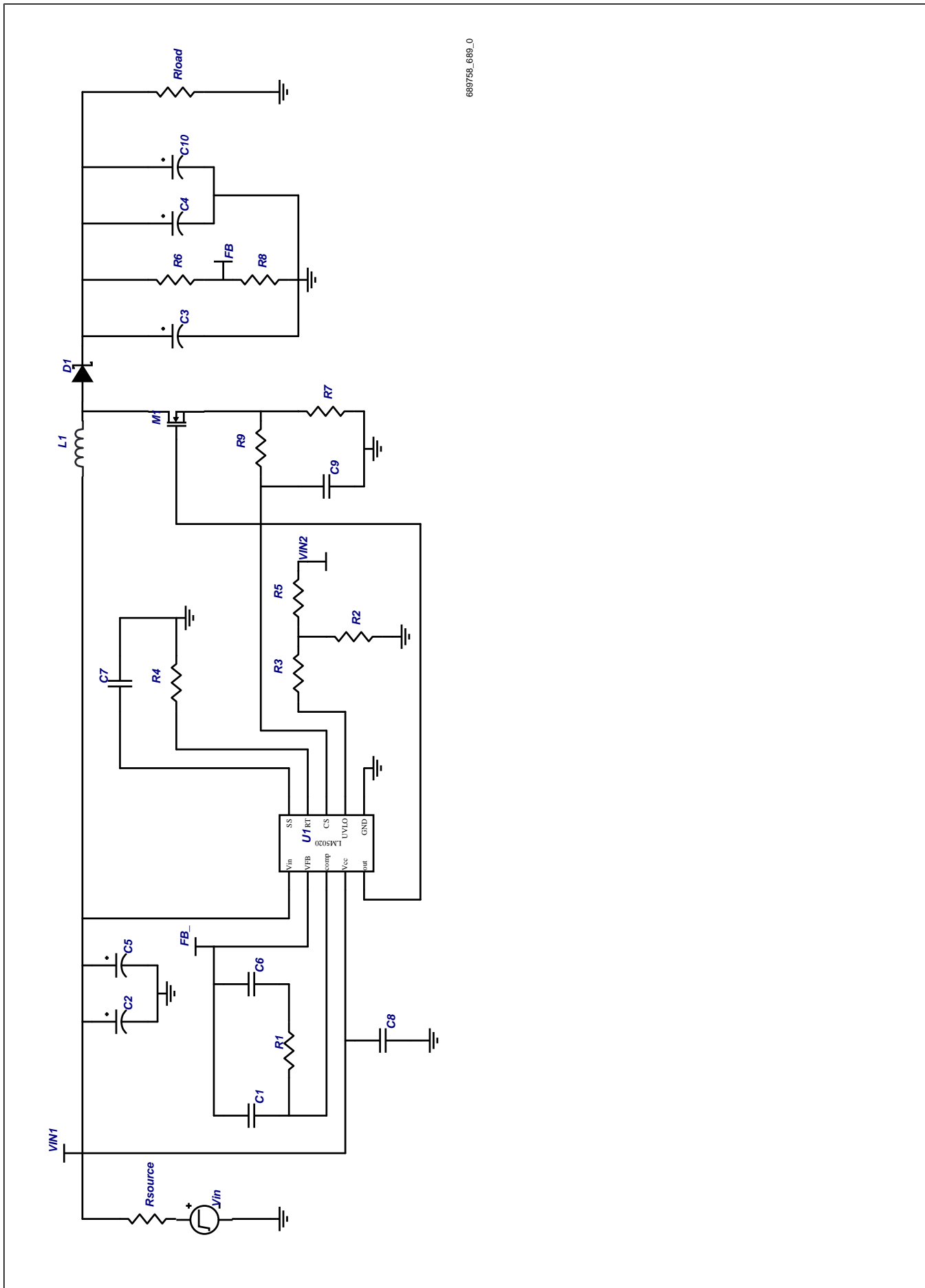
Inputs	Outputs #1
VinMin=12	Vout1=26
VinMax=12	Iout1=1.5

## 2.0 Design Description

The LM5020 is employed here to design a Boost power supply where the input voltage rail is stepped up to create the output voltage rail. The LM5020 is a versatile PWM controller requiring an external the FET switch which can be sized to fit the output specification. The input voltage,  $V_{in}$ , during the on-time of the switch charges the L1 inductor through the FET to ground. During the off-time of the FET switch the inductor reverses polarity to forward bias the diode D1 to charge the

output capacitors to the required output voltage and provide current to the load. The output voltage is set through the voltage divider R6 & R8 and the loop transient response is governed by the resistor capacitor circuit across the feedback pin, VFB, and the compensation pin, COMP, of the controller IC. Output capacitors (C3,C4,C10) are set to limit ripple and noise voltage while the input capacitance limits the noise ripple effects found on the input rail. The softstart ramp is optimized through C7 and the switching frequency is set via R4. Note that M1 in the schematic is shown as Q1 in the layout.

## 3.0 Schematic



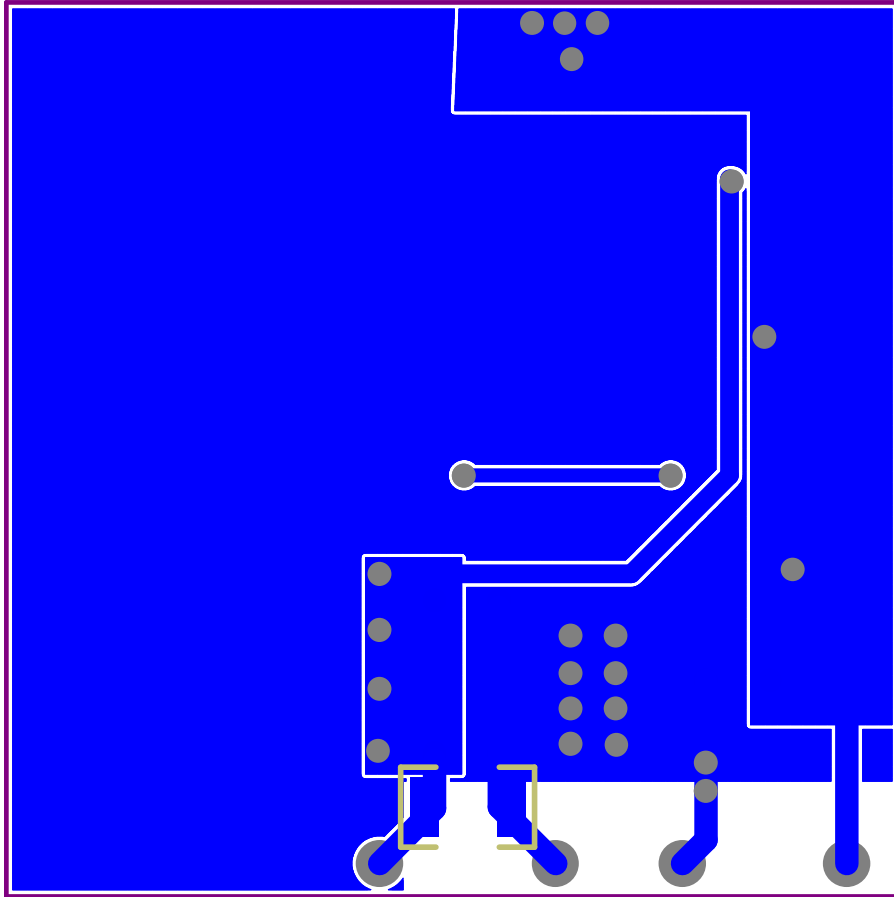
689758\_689\_0

FIGURE 1. Example Schematic Showing Connection for all Components.

## 4.0 Bill Of Materials

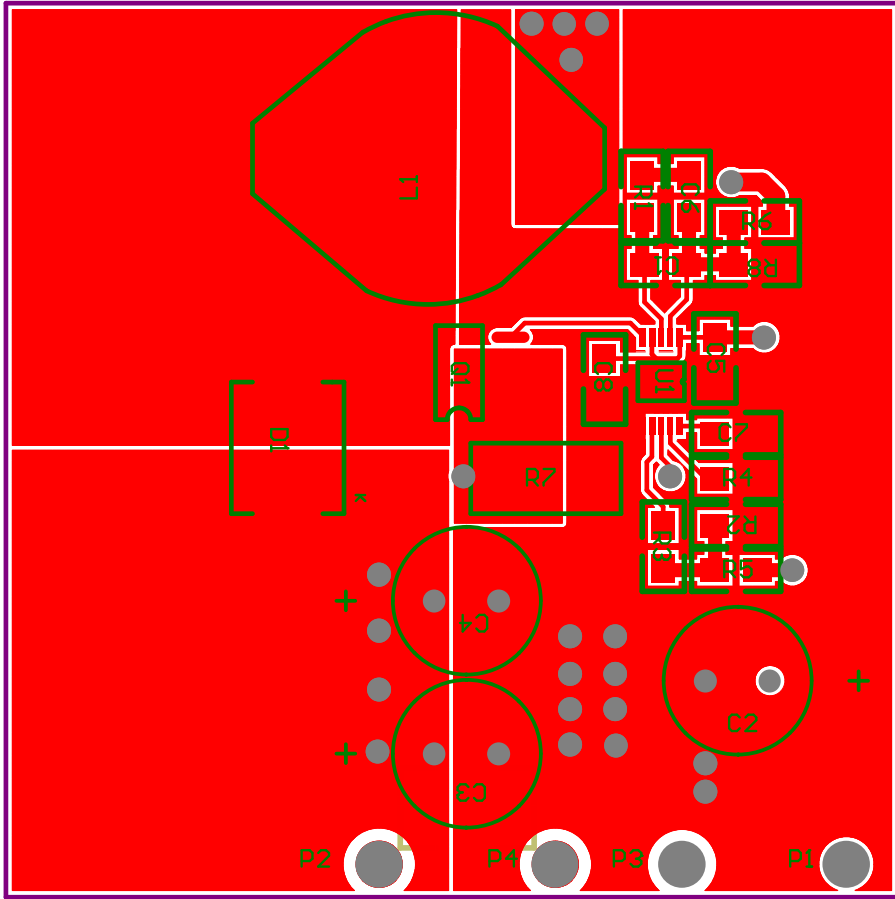
Part	Manufacturer	Part#	Attributes
C1	Vitramon	VJ0805A471KXXAT	470p F
C10	Vitramon	VJ0805Y474KXXAT	470n F
C2	Sanyo	35MV330WX	330u F, 0.044 Ohms
C3	Sanyo	35MV330WX	330u F, 0.044 Ohms
C4	Sanyo	35MV330WX	330u F, 0.044 Ohms
C5	TDK	C2012X5R1C105K	1u F
C6	Vitramon	VJ0805Y104KXXAT	100n F
C7	Vitramon	VJ0805Y103KXXAT	10n F
C8	Vitramon	VJ0805Y104KXXAT	0.1u F
C9	Vitramon	VJ0805A471KXXAT	470p F
D1	ONSEMI	MBRS360	0.74 V
L1	Coilcraft	DO5022P-223	22u H, 0.047 Ohms
M1	Vishay	SI4894DY	
R1	Dale	CRCW08051002FRT6	10k Ohms
R2	Dale	CRCW08051002FRT6	10k Ohms
R3	Dale	CRCW08052001FRT6	2k Ohms
R4	Dale	CRCW08051742FRT6	17.4k Ohms
R5	Dale	CRCW08054992FRT6	49.9k Ohms
R6	Dale	CRCW08051002FRT6	10k Ohms
R7	Dale	WSL2512 0R075 1% R86	0.075 Ohms
R8	Dale	CRCW08054990FRT6	499 Ohms
R9	Dale	CRCW08053010FRT6	301 Ohms
U1	National Semiconductor	LM5020	

# 5.0 Layout



PADC\_NSC0305\_lo\_1

FIGURE 2. Board's Bottom View



PADC\_NSC0305\_1e\_2

FIGURE 3. Board's Top View

### 6.0 Waveforms

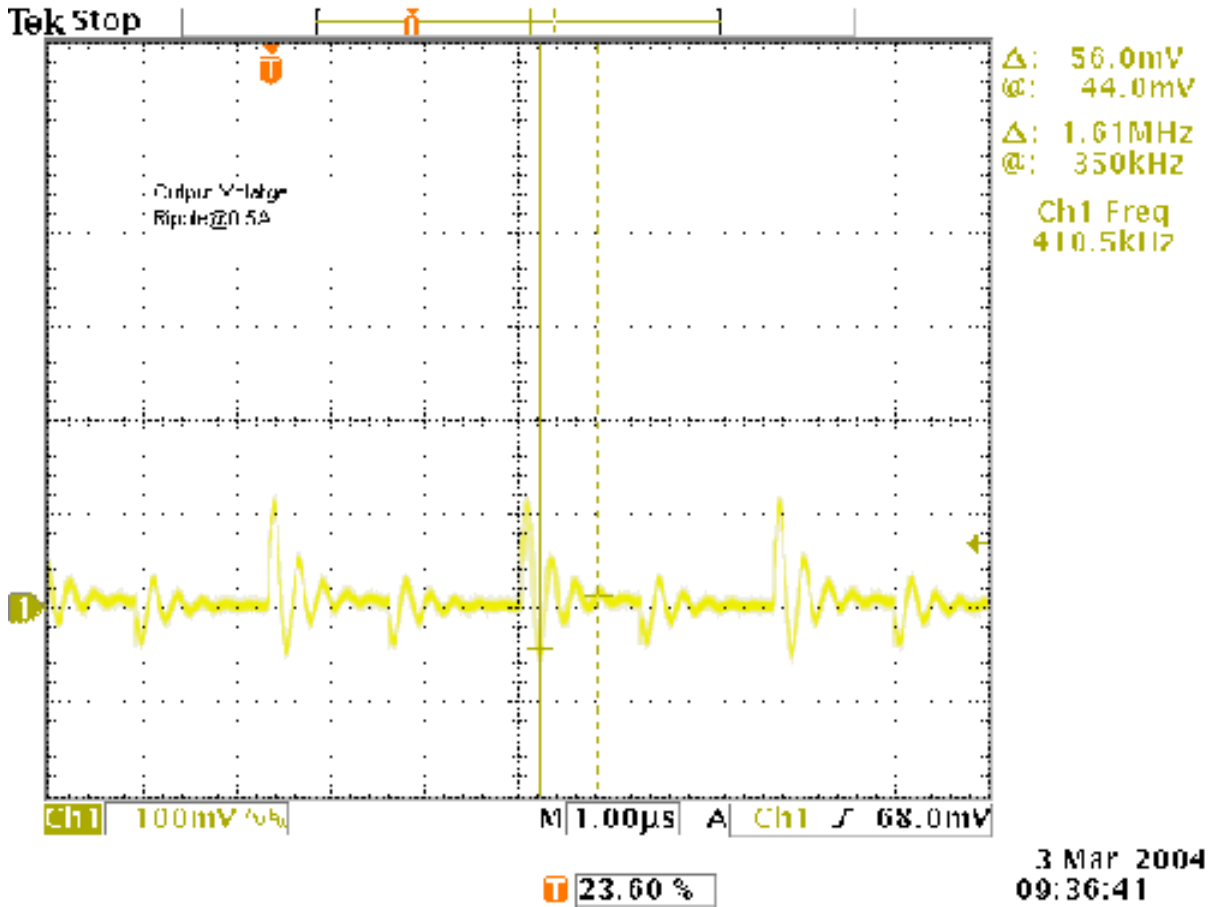


FIGURE 4. NSC0305-Output Ripple volts-0.5A load

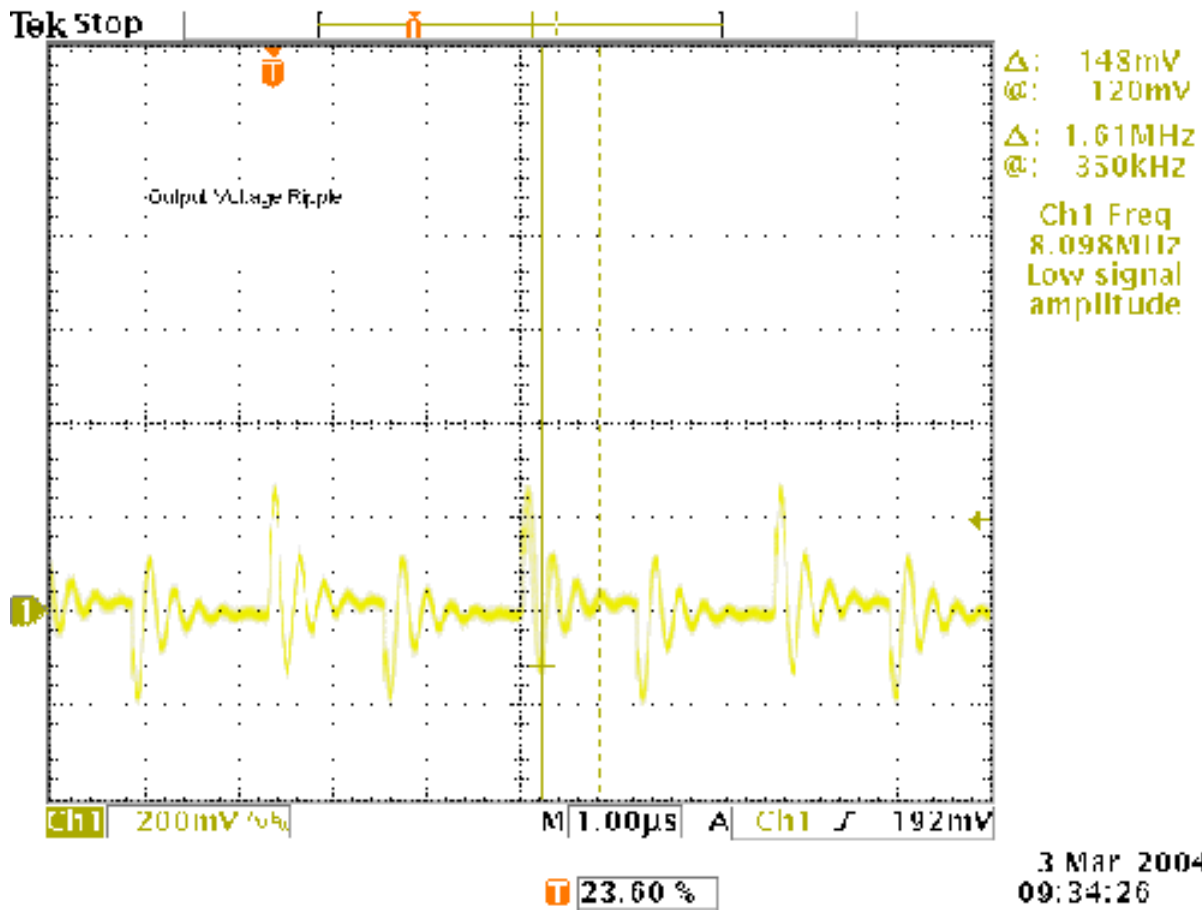


FIGURE 5. NSC0305-Output Ripple volts

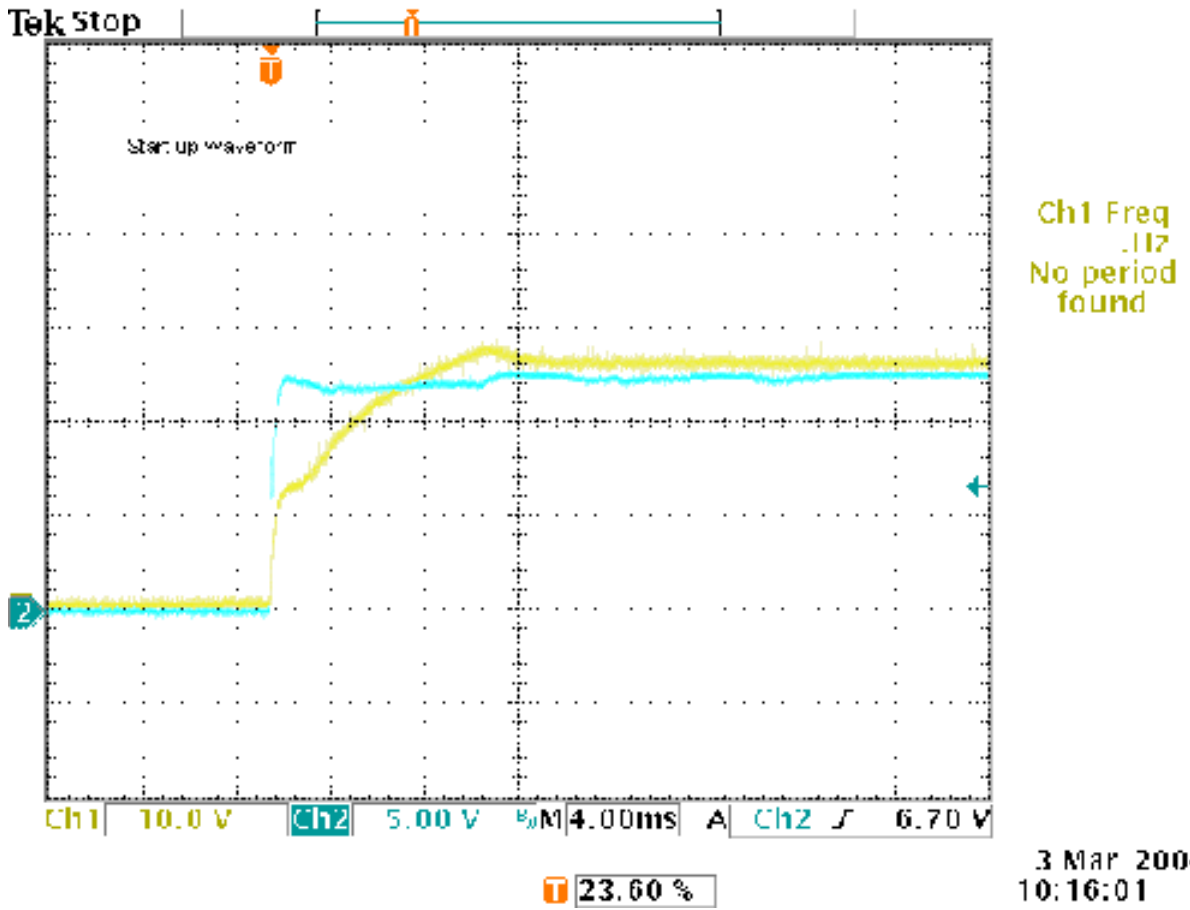


FIGURE 6. NSC0305-Start up voltages

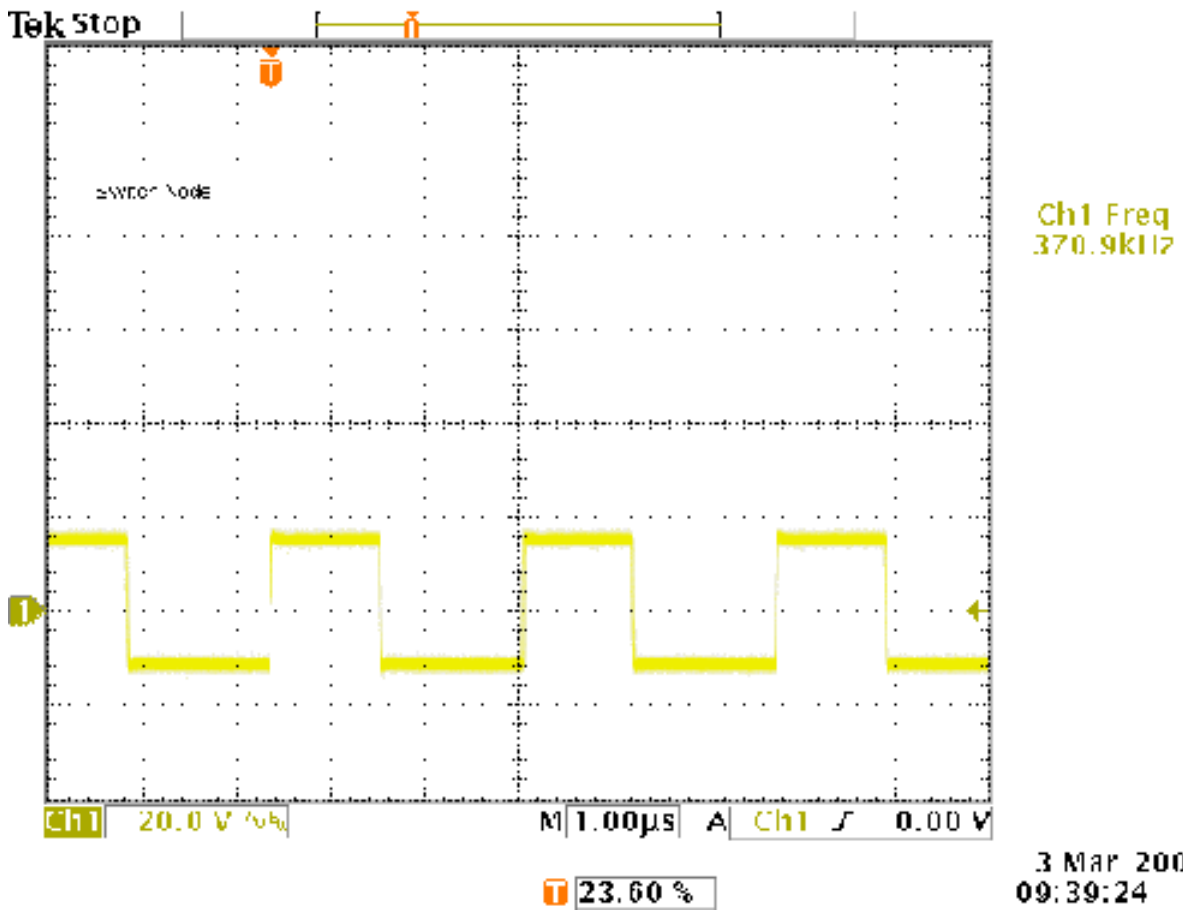
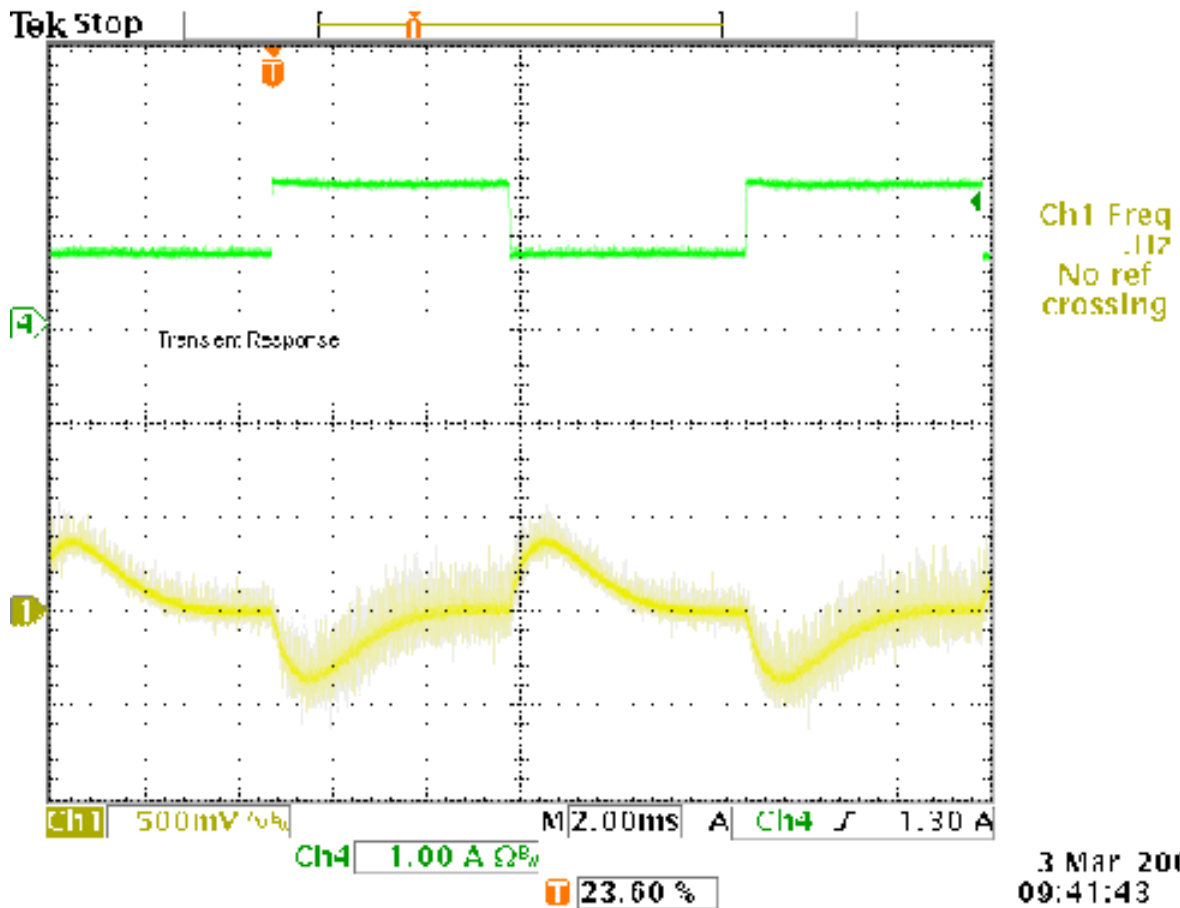


FIGURE 7. NSC0305-Switch node



PADC\_NSC0305\_wf\_7

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](http://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:

1. 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.
2. 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](mailto: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](mailto: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](mailto:ap.support@nsc.com)

**National Semiconductor Japan Customer Support Center**  
 Fax: 81-3-5639-7507  
 Email: [jpn.feedback@nsc.com](mailto:jpn.feedback@nsc.com)  
 Tel: 81-3-5639-7560