

LMR10510,LMR10515,LMR10520

Application Note 2184 LMR10510/LMR10515/LMR10520 Demo Board



Literature Number: SNVA501

LMR10510/LMR10515/ LMR10520 Demo Board

National Semiconductor
Application Note 2184
Marc Davis-Marsh
October 18, 2011



Introduction

The LMR10510/LMR10515/LMR10520 is a PWM DC/DC buck (step-down) regulator. With a switching frequency of 3MHz or 1.6MHz the overall solution size is very compact and requires a minimum number of components. The LMR10510/LMR10515/LMR10520 Demo Board is designed to provide the design engineer with a fully functional power converter to evaluate the LMR10510/LMR10515/LMR10520 series of buck regulators. The demo board comes populated with either the LMR10510Y, LMR10515Y, or LMR10520Y but can easily be modified to accommodate any of the LMR10510/LMR10515/LMR10520 regulator ICs.

Features

- 3.0V to 5.5V Input Voltage Range
- 1.8V Output Voltage (Default Setting)
- 1A/1.5A/2.0A Output Current
- Switching Frequency of 3MHz
- Small Solution Size (13 x 12mm)

Shutdown Operation

The demo board includes a pull-up resistor, R3, to enable the device once V_{IN} has exceeded 1.8V (typ). Use the EN post to disable the device by pulling this node to GND. A logic signal may be applied, to the post, to test startup and shutdown of the device.

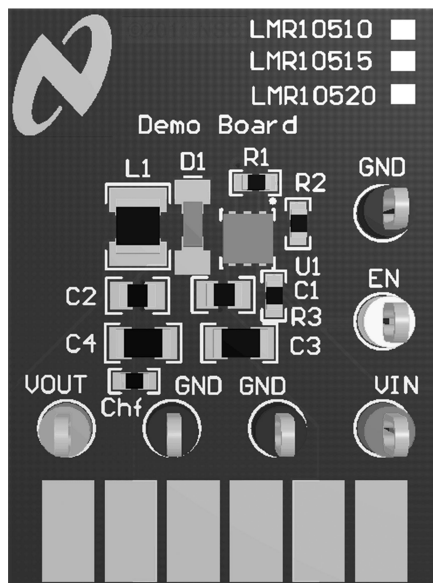
Adjusting the Output Voltage

The output voltage can be changed from 1.8V to another voltage by adjusting the feedback resistors using the following equation:

$$V_{OUT} = V_{FB}(1+(R1/R2))$$

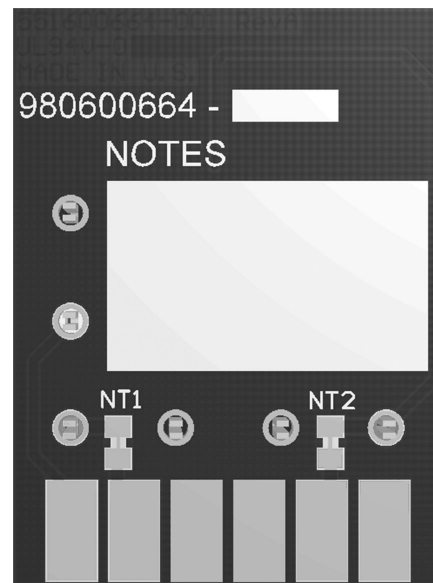
Where V_{FB} is 0.6V.

For more information on component selection and features see the LMR10510/LMR10515/LMR10520 datasheet.



Top View

30171602



Bottom View

30171603

FIGURE 1. LMR10510/LMR10515/LMR10520 Demo Board

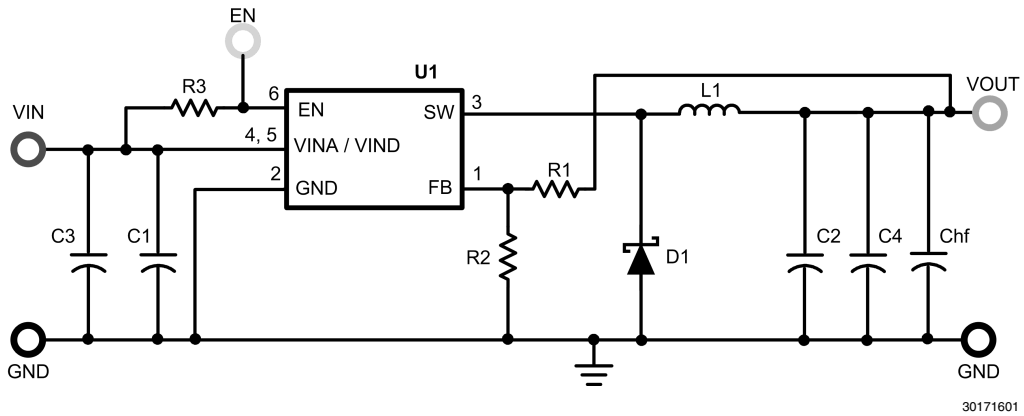


FIGURE 2. LMR10510 Demo Board Schematic

Bill of Materials LMR10510Y

Part ID	Part Value	Manufacturer	Part Number	Package Type
U1	1A Buck Regulator	National Semiconductor	LMR10510Y	LLP
C1, C2	2.2 μ F, 10V, X5R	TDK	C2012X5R1A225K	0805
C3, C4	22 μ F, 6.3V, X5R	TDK	C3216X5R0J226M	1206
Chf	22nF, 50V, X7R	Murata	GRM188R71H223KA01D	0603
D1, Catch Diode	Schottky 1.5A, 30VR	Toshiba	CRS08	SFLAT
L1	1.0 μ H, 2.05A, 45m Ω	Murata	LQH32PN1R0NN0	
R1	20.0 K Ω , 1%	Vishay	CRCW060320K0FKEA	0603
R2	10.0 K Ω , 1%	Vishay	CRCW060310K0FKEA	0603
R3	1 Meg Ω , 5%	Vishay	CRCW06031M00JNEA	0603
GND	Test Point, Black	Keystone	5011	
VIN	Test Point, Red	Keystone	5010	
VOUT	Test Point, Orange	Keystone	5013	
EN	Test Point, Yellow	Keystone	5014	

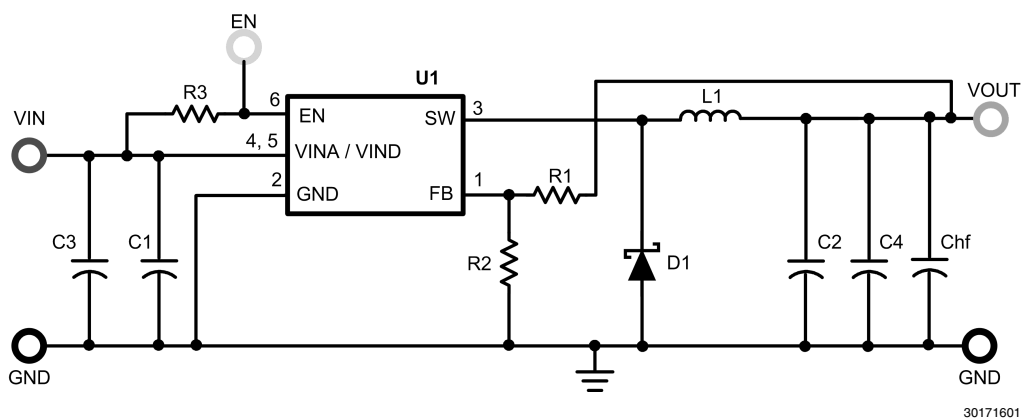


FIGURE 3. LMR10515 Demo Board Schematic

Bill of Materials LMR10515Y

Part ID	Part Value	Manufacturer	Part Number	Package Type
U1	1.5A Buck Regulator	National Semiconductor	LMR10515Y	LLP
C1, C2	2.2 μ F, 10V, X5R	TDK	C2012X5R1A225K	0805
C3, C4	22 μ F, 6.3V, X5R	TDK	C3216X5R0J226M	1206
Chf	22nF, 50V, X7R	Murata	GRM188R71H223KA01D	0603
D1, Catch Diode	Schottky 1.5A, 30VR	Toshiba	CRS08	SFLAT
L1	1.0 μ H, 2.05A, 45m Ω	Murata	LQH32PN1R0NN0	
R1	20.0 K Ω , 1%	Vishay	CRCW060320K0FKEA	0603
R2	10.0 K Ω , 1%	Vishay	CRCW060310K0FKEA	0603
R3	1 Meg Ω , 5%	Vishay	CRCW06031M00JNEA	0603
GND	Test Point, Black	Keystone	5011	
VIN	Test Point, Red	Keystone	5010	
VOUT	Test Point, Orange	Keystone	5013	
EN	Test Point, Yellow	Keystone	5014	

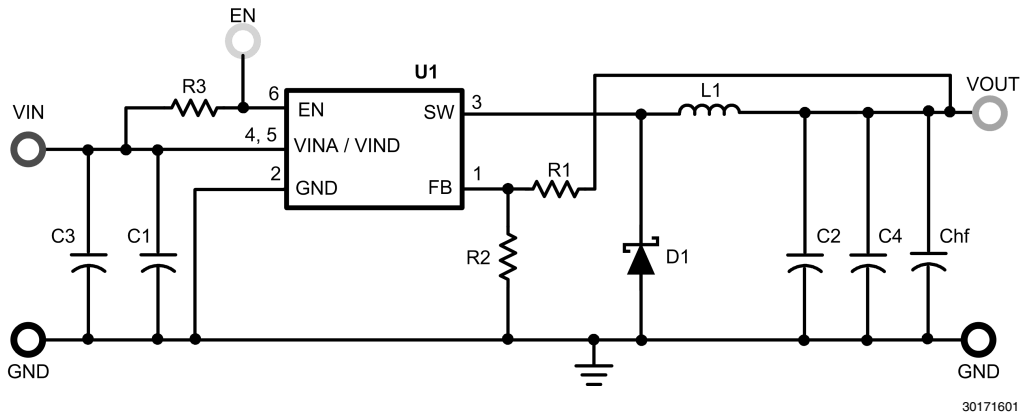


FIGURE 4. LMR10520 Demo Board Schematic

Bill of Materials LMR10520Y

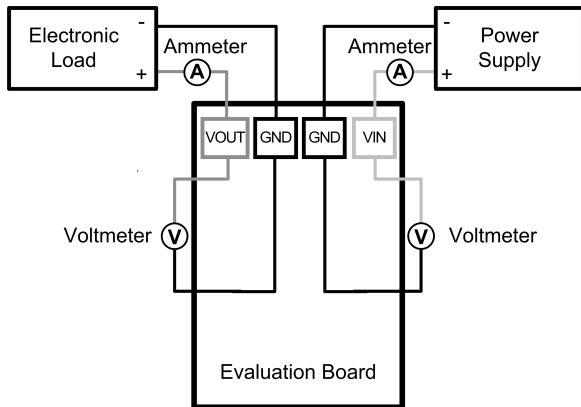
Part ID	Part Value	Manufacturer	Part Number	Package Type
U1	2A Buck Regulator	National Semiconductor	LMR10520Y	LLP
C1, C2	2.2 μ F, 10V, X5R	TDK	C2012X5R1A225K	0805
C3, C4	22 μ F, 6.3V, X5R	TDK	C3216X5R0J226M	1206
Chf	22nF, 50V, X7R	Murata	GRM188R71H223KA01D	0603
D1, Catch Diode	Schottky 2A, 30V	Toshiba	CMS06	MFLAT
L1	1.0 μ H, 2.45A, 30m Ω	Murata	LQH44PN1R0NP0L	
R1	20.0 K Ω , 1%	Vishay	CRCW060320K0FKEA	0603
R2	10.0 K Ω , 1%	Vishay	CRCW060310K0FKEA	0603
R3	1 Meg Ω , 5%	Vishay	CRCW06031M00JNEA	0603
GND	Test Point, Black	Keystone	5011	
VIN	Test Point, Red	Keystone	5010	
VOUT	Test Point, Orange	Keystone	5013	
EN	Test Point, Yellow	Keystone	5014	

Test Setup

Demonstration Board Quick Setup Procedures

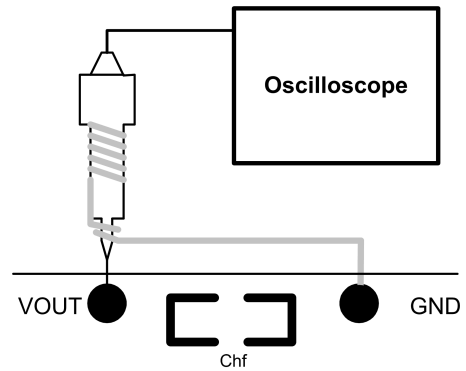
Step	Description	Notes
1	Connect a power supply to VIN terminals	V_{IN} range: 3V to 5.5V
2	Connect a load to VOUT terminals	I_{OUT} range: 0A to 1A / 1.5A / 2.0A
3	EN should be left floating for normal operation. Short this to ground to shutdown the part	
4	Apply $V_{IN} = 5V$, with 0A load applied, check V_{OUT} with a voltmeter	Nominal 1.8V
5	Apply a 1A / 1.5A / 2.0A load and check V_{OUT}	Nominal 1.8V

Efficiency Measurements



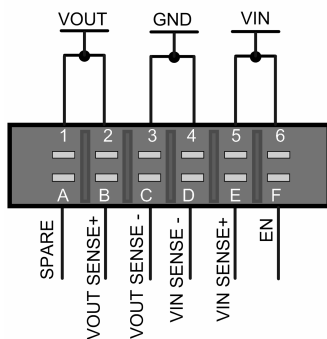
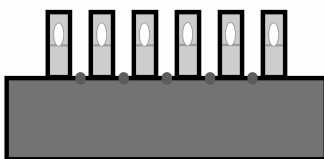
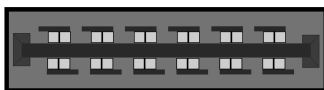
30171604

Voltage Ripple Measurements



30171605

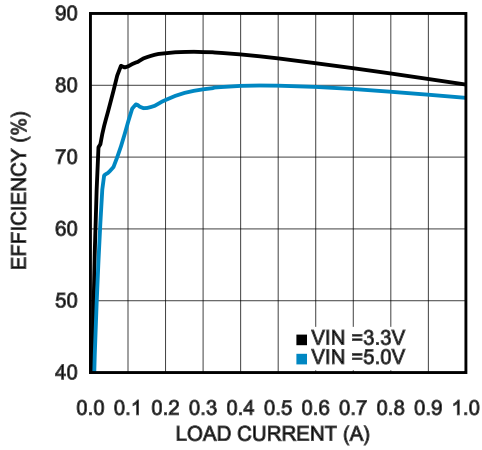
Edge Connector Schematic



30171606

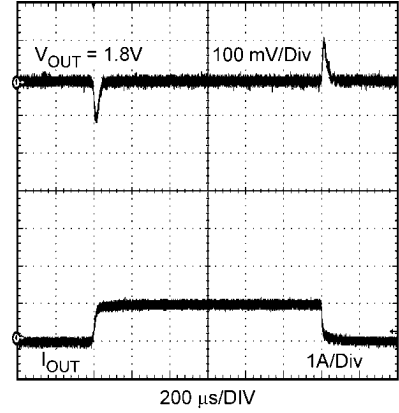
Typical Performance Characteristics

Efficiency vs. Load Current LMR10510



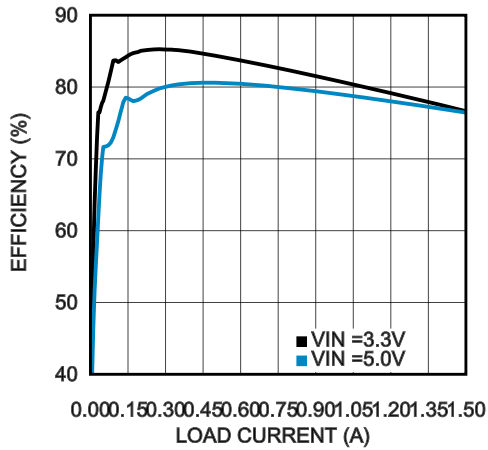
30171607

Load Transient Waveforms LMR10510



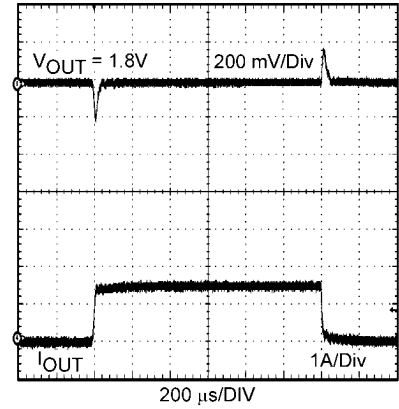
30171608

Efficiency vs. Load Current LMR10515



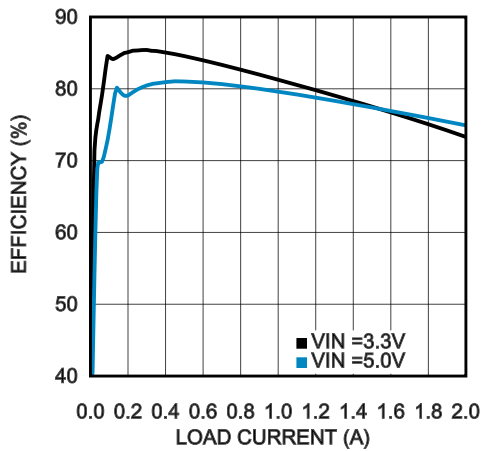
30171609

Load Transient Waveforms LMR10515



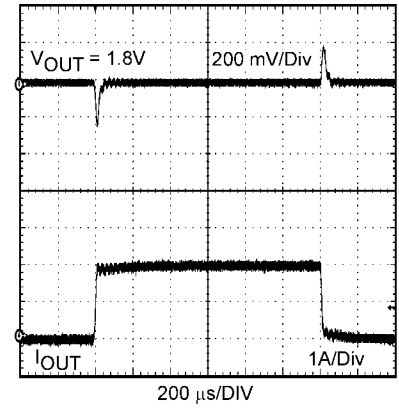
30171610

Efficiency vs. Load Current LMR10520



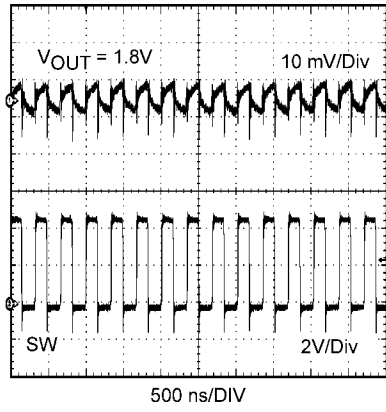
30171611

Load Transient Waveforms LMR10520



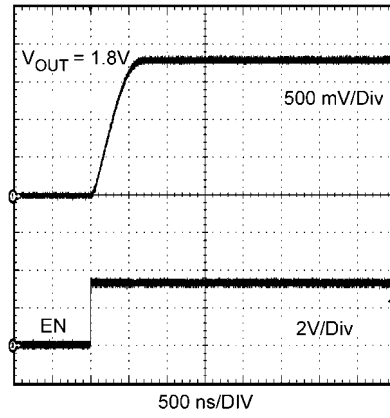
30171612

Switching Node and Output Voltage Waveforms



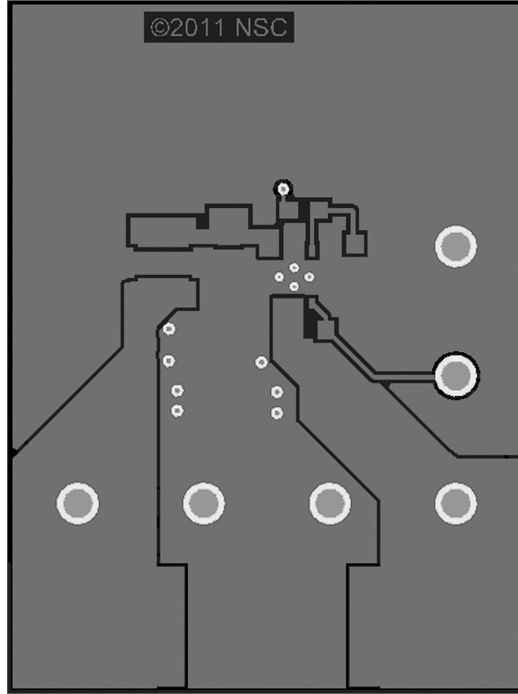
30171613

Startup Waveform



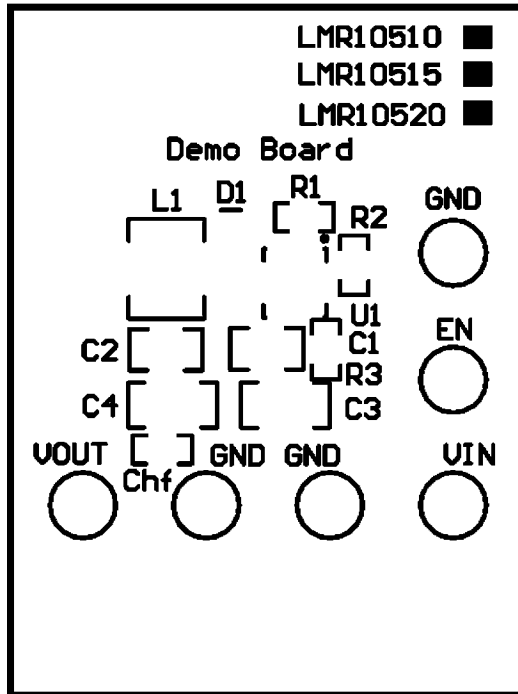
30171614

Layout



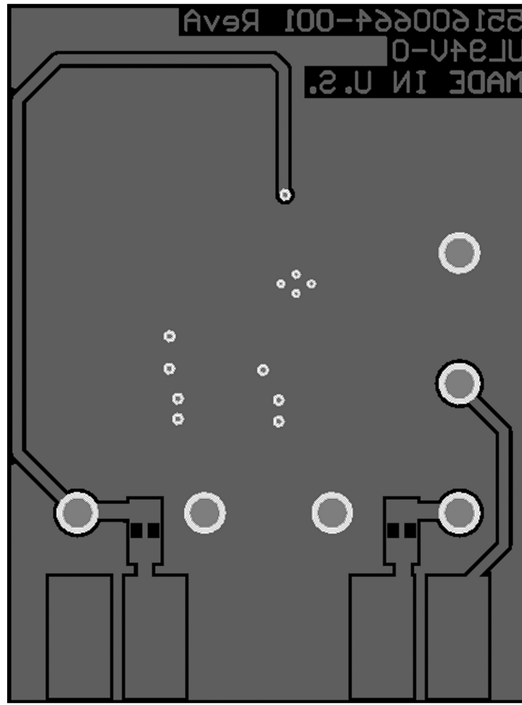
Top Layer

30171615



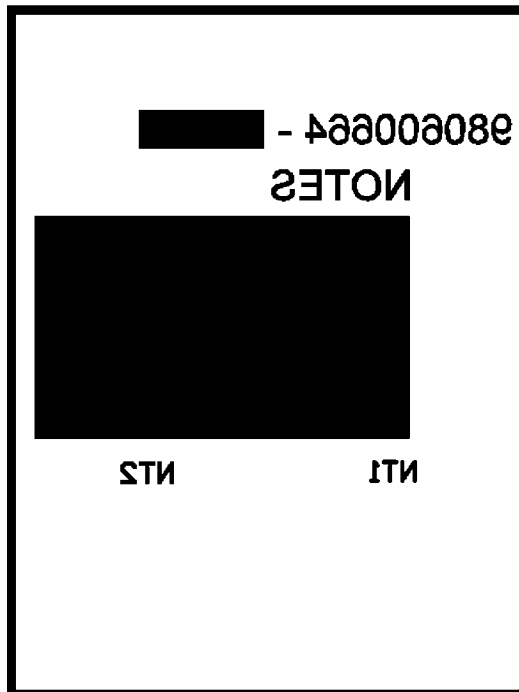
Top Overlay

30171615



Bottom Layer

30171617



Bottom Overlay

30171618

For more National Semiconductor product information and proven design tools, visit the following Web sites at:
www.national.com

Products		Design Support	
Amplifiers	www.national.com/amplifiers	WEBENCH® Tools	www.national.com/webench
Audio	www.national.com/audio	App Notes	www.national.com/appnotes
Clock and Timing	www.national.com/timing	Reference Designs	www.national.com/refdesigns
Data Converters	www.national.com/adc	Samples	www.national.com/samples
Interface	www.national.com/interface	Eval Boards	www.national.com/evalboards
LVDS	www.national.com/lvds	Packaging	www.national.com/packaging
Power Management	www.national.com/power	Green Compliance	www.national.com/quality/green
Switching Regulators	www.national.com/switchers	Distributors	www.national.com/contacts
LDOs	www.national.com/ldo	Quality and Reliability	www.national.com/quality
LED Lighting	www.national.com/led	Feedback/Support	www.national.com/feedback
Voltage References	www.national.com/vref	Design Made Easy	www.national.com/easy
PowerWise® Solutions	www.national.com/powerwise	Applications & Markets	www.national.com/solutions
Serial Digital Interface (SDI)	www.national.com/sdi	Mil/Aero	www.national.com/milaero
Temperature Sensors	www.national.com/tempensors	SolarMagic™	www.national.com/solarmagic
PLL/VCO	www.national.com/wireless	PowerWise® Design University	www.national.com/training

THE CONTENTS OF THIS DOCUMENT ARE PROVIDED IN CONNECTION WITH NATIONAL SEMICONDUCTOR CORPORATION ("NATIONAL") PRODUCTS. NATIONAL MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE ACCURACY OR COMPLETENESS OF THE CONTENTS OF THIS PUBLICATION AND RESERVES THE RIGHT TO MAKE CHANGES TO SPECIFICATIONS AND PRODUCT DESCRIPTIONS AT ANY TIME WITHOUT NOTICE. NO LICENSE, WHETHER EXPRESS, IMPLIED, ARISING BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT.

TESTING AND OTHER QUALITY CONTROLS ARE USED TO THE EXTENT NATIONAL DEEMS NECESSARY TO SUPPORT NATIONAL'S PRODUCT WARRANTY. EXCEPT WHERE MANDATED BY GOVERNMENT REQUIREMENTS, TESTING OF ALL PARAMETERS OF EACH PRODUCT IS NOT NECESSARILY PERFORMED. NATIONAL ASSUMES NO LIABILITY FOR APPLICATIONS ASSISTANCE OR BUYER PRODUCT DESIGN. BUYERS ARE RESPONSIBLE FOR THEIR PRODUCTS AND APPLICATIONS USING NATIONAL COMPONENTS. PRIOR TO USING OR DISTRIBUTING ANY PRODUCTS THAT INCLUDE NATIONAL COMPONENTS, BUYERS SHOULD PROVIDE ADEQUATE DESIGN, TESTING AND OPERATING SAFEGUARDS.

EXCEPT AS PROVIDED IN NATIONAL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, NATIONAL ASSUMES NO LIABILITY WHATSOEVER, AND NATIONAL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY RELATING TO THE SALE AND/OR USE OF NATIONAL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

LIFE SUPPORT POLICY

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

Life support devices or systems are devices 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 in 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.

National Semiconductor and the National Semiconductor logo are registered trademarks of National Semiconductor Corporation. All other brand or product names may be trademarks or registered trademarks of their respective holders.

Copyright© 2011 National Semiconductor Corporation

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



**National Semiconductor
Americas Technical
Support Center**
Email: support@nsc.com
Tel: 1-800-272-9959

**National Semiconductor Europe
Technical Support Center**
Email: europe.support@nsc.com

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

**National Semiconductor Japan
Technical Support Center**
Email: jpn.feedback@nsc.com

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Mobile Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Transportation and Automotive	www.ti.com/automotive
Video and Imaging	www.ti.com/video

TI E2E Community Home Page

e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2011, Texas Instruments Incorporated