AN-1717 LM2833X MSOP-PowerPAD Demo Board

1 Introduction

The LM2833X MSOP-PowerPAD demo board is designed to demonstrate the capabilities of the LM2833X 1.5 MHz switching regulator in an MSOP-PowerPAD-10 package.

The demo board is configured to provide an output of 1.2 V at up to 3A from an input voltage range of 3 V to 5.5 V. The board is thermally optimized with the small solution size of 1.2" X 1.1", shown in the demo board schematic in Figure 1. The output voltage can be configured to a different value by changing the ratio between R1 and R2 according to Equation 1:

$$R1 = R2 \times (V_{OUT} / VFB - 1) \quad (1)$$

The feedback voltage VFB is regulated at 0.60 V typically.

C5 on the board is reserved for two purposes given different application scenarios. First, at high V_{OUT} applications, the control loop bandwidth is not as large as at low V_{OUT}. Adding C5 at high V_{OUT} can significantly improve the load step response by boosting the loop bandwidth without significantly compromising phase margin. Secondly, it also helps to minimize output voltage overshoot during sluggish startup, short circuit release, and recovery from thermal shutdown, since it creates a feed-forward path between V_{OUT} and VFB, thus speeding up Gm-amplifier recovery. In practice, for a few kΩ of voltage divider bottom resistor R2, a 47nF ceramic capacitor is usually a good choice for C5. Note for applications where $_{VOUT}$ is close to VFB, since R1 is small, the effectiveness of adding C5 becomes decreasingly appreciable. Therefore, other measures need to be taken to achieve the desired performance. For example, to minimize output overshoot during slow startup at high V_{OUT}, an alternative approach is to apply a separate signal at the EN terminal after V_{IN} is fully established.

Another component that is not populated on the board is C4, which is reserved for applications where a large output capacitor is desired.

Table 1 lists the bill of materials (BOM) on this demo board. The measured performance characteristics and layout of this board are also included below.

All trademarks are the property of their respective owners.

Copyright © 2008–2013, Texas Instruments Incorporated

2 Powering up the Board

Powering up the LM2833X MSOP-PowerPAD demo board is a single-step procedure, simply by applying a DC voltage of 3 V to 5.5 V to V_{IN} and GND terminals. By default, V_{INC} is connected to V_{IN} through a low pass filter to remove any high frequency noise present at the input. EN is connected to V_{INC} through a 100 kΩ resistor. A separate logic signal at the EN terminal can be used, if startup and shutdown need to be controlled. A load can be connected between V_{OUT} and GND terminals before or after the board is powered up. At V_{OUT} of 1.2 V, the internal soft-start circuit can bring up V_{OUT} smoothly regardless of load or input voltage.

The LM2833X is designed to skip some pulses at very light loads to maintain output voltage regulation. Depending on load levels, the circuit may operate in either discontinuous or continuous conduction mode.

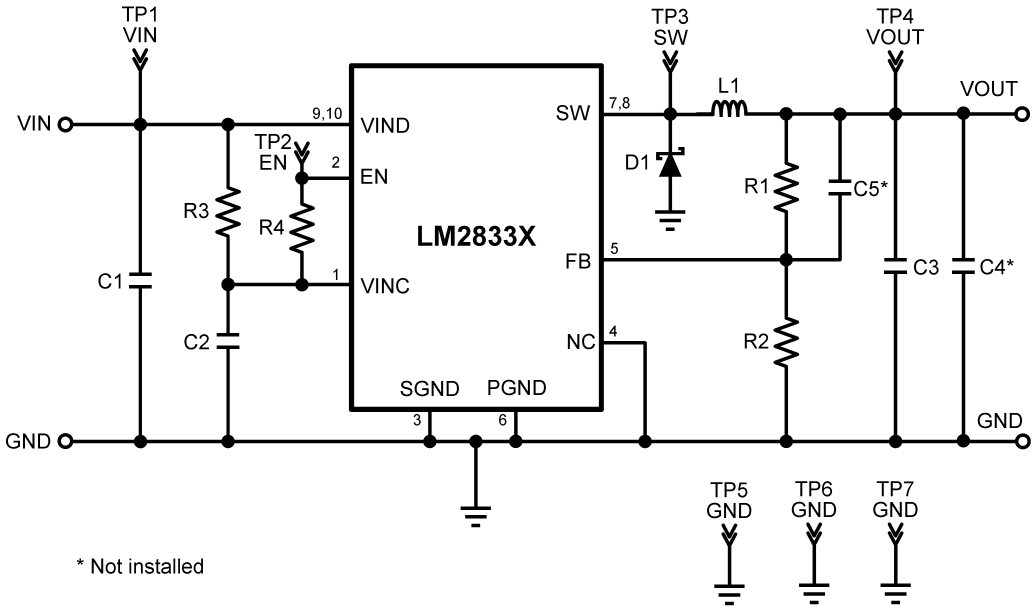
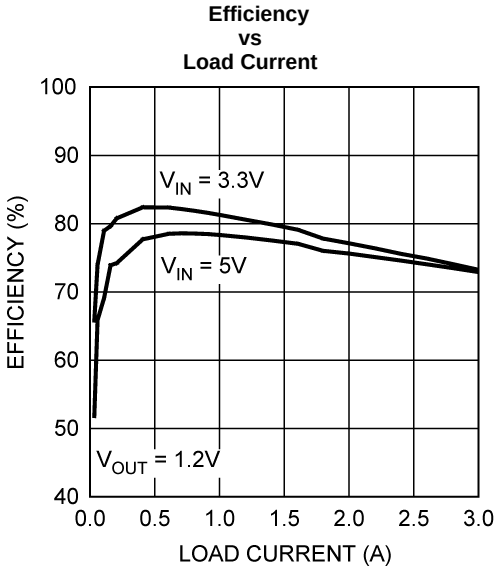
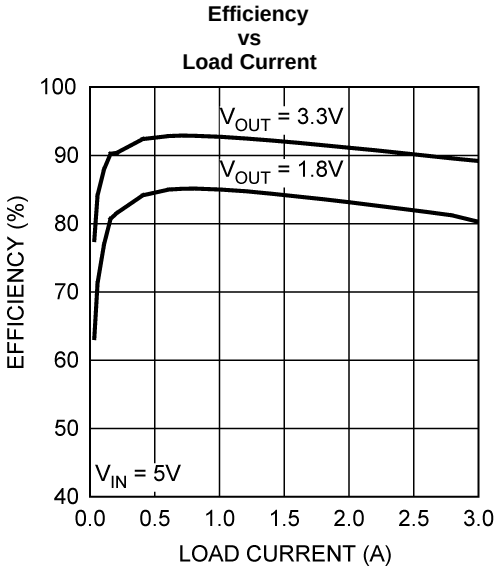


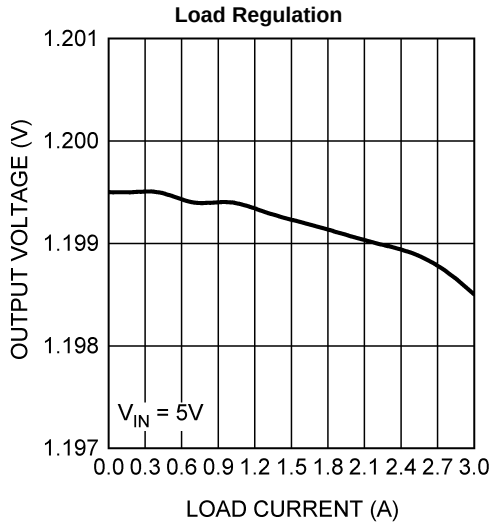
Figure 1. LM2833X MSOP-PowerPAD Demo Board Schematic

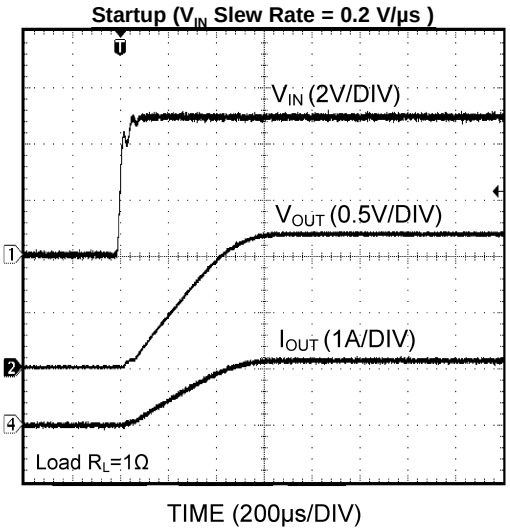
Copyright © 2008–2013, Texas Instruments Incorporated

3 Typical Performance Characteristics



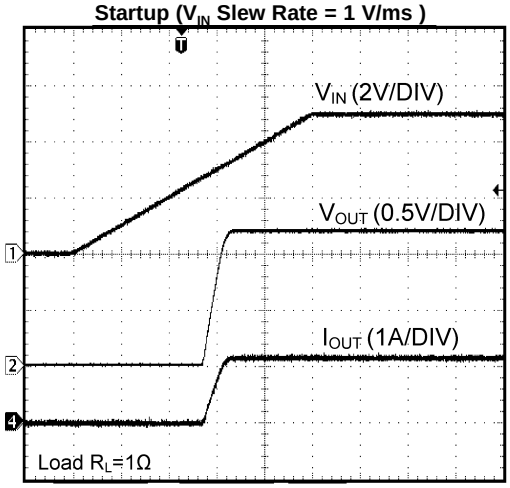






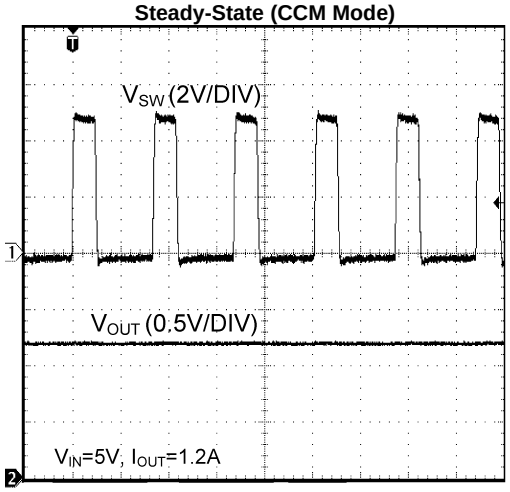
Copyright © 2008–2013, Texas Instruments Incorporated

Startup (V_{IN} Slew Rate = 1 V/ms)



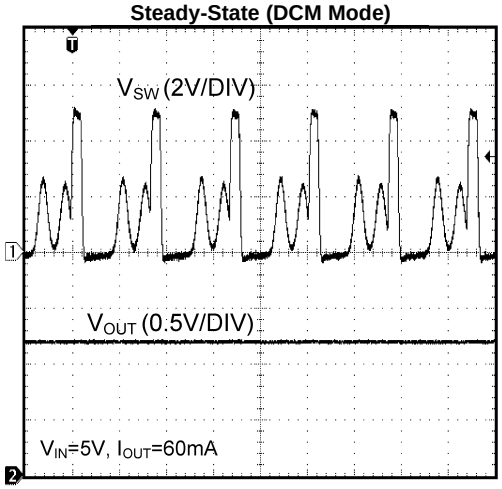
TIME (1ms/DIV)

Steady-State (CCM Mode)



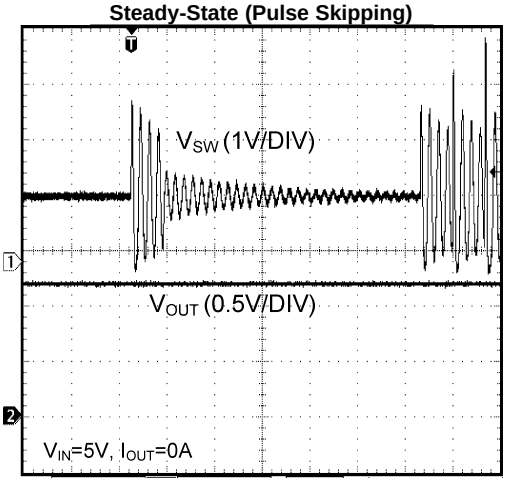
TIME (400ns/DIV)

Steady-State (DCM Mode)



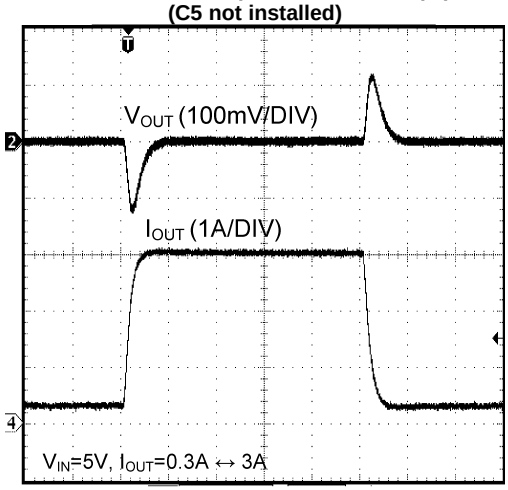
TIME (400ns/DIV)

Steady-State (Pulse Skipping)



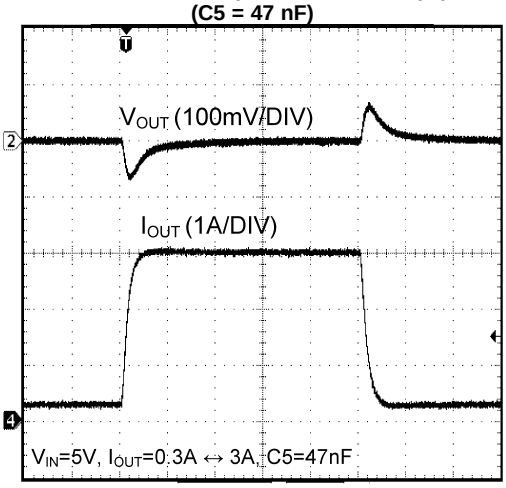
TIME (1µs/DIV)

Load Transient (Slew Rate = 0.1A/µs) (C5 not installed)



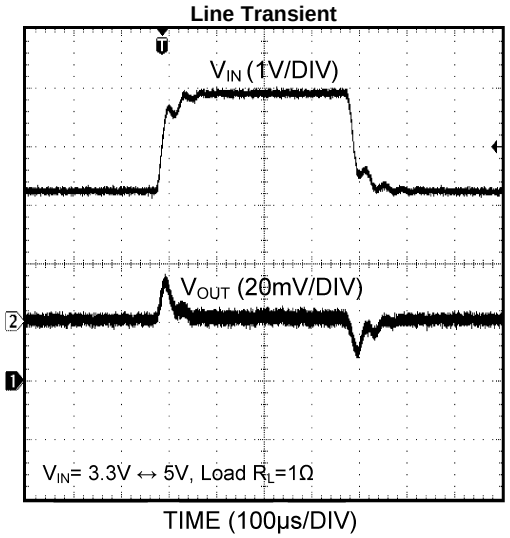
TIME (100µs/DIV)

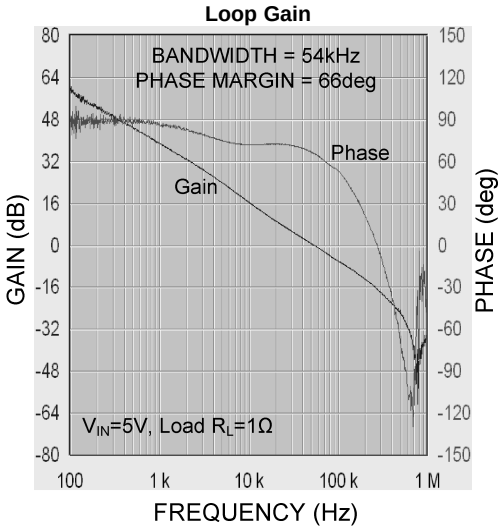
Load Transient (Slew Rate = 0.1A/µs) (C5 = 47 nF)



TIME (100µs/DIV)

Copyright © 2008–2013, Texas Instruments Incorporated





4 Bill of Materials (BOM)

Table 1. Bill of Materials (BOM)

Part ID	Part Value	Part Number	Manufacturer
U1	1.5 MHz 3.0A buck regulator, MSOP-PowerPAD-10	LM2833	Texas Instruments
L1	1.8 µH, 3.6A, 5x5.2x2.2mm^3	LTF5022T-1R8N3R6	TDK
C1	22 µF, 6.3 V, X5R, 1206	C3216X5R0J226MT	TDK
C2	0.22 µF, 10 V, X7R, 0805	GRM216R71A224KC01D	Murata
C3	47 µF, 6.3 V, X5R, 1206	JMK316BJ476ML-T	Taiyo Yuden
C4	Open		
C5	Open		
D1	Schottky, 30 V, 3A, 3-4E1A	CMS01	Toshiba
R1	2.00 kΩ, 1%, 1/8W, 0805	CRCW08052K00FKEA	Vishay
R2	2.00 kΩ, 1%, 1/8W, 0805	CRCW08052K00FKEA	Vishay
R3	10.0 Ω, 1%, 1/8W, 0805	CRCW080510R0FKEA	Vishay
R4	100 kΩ, 1%, 1/8W, 0805	CRCW0805100KFKEA	Vishay

Copyright © 2008–2013, Texas Instruments Incorporated

5 Layout

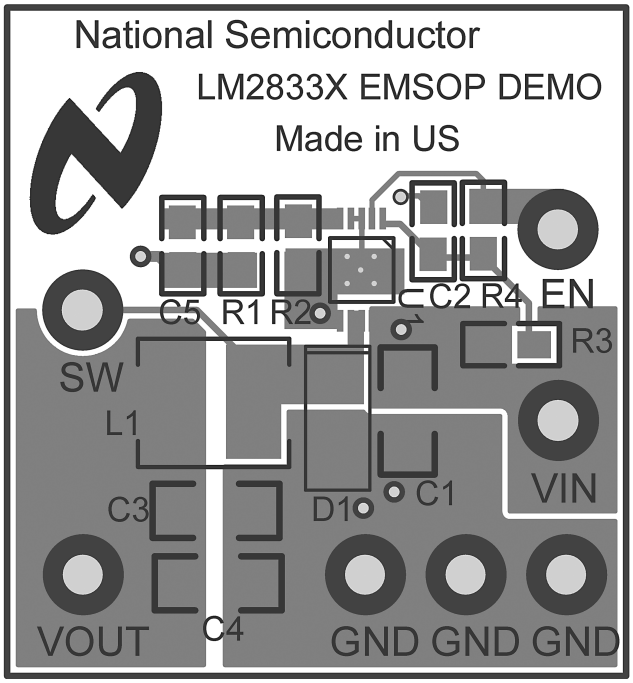


Figure 2. Top Layer and Top Overlay

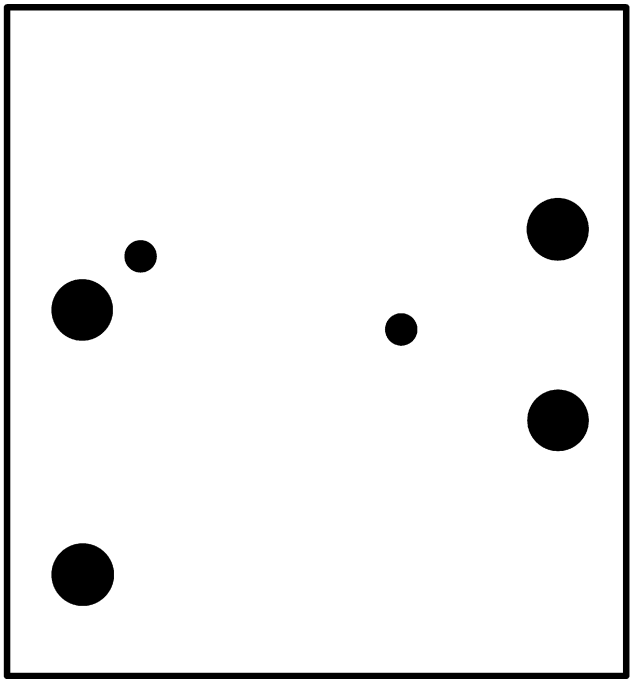


Figure 3. Internal Plane 1 (GND)

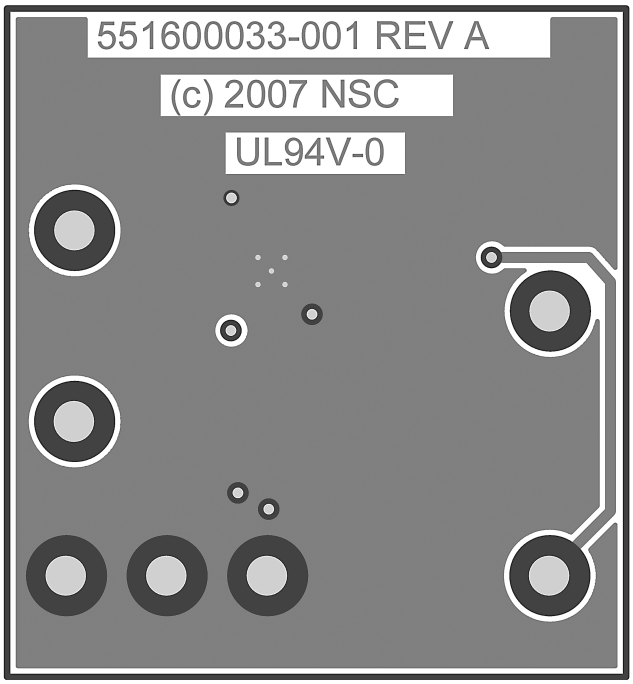


Figure 4. Bottom Layer

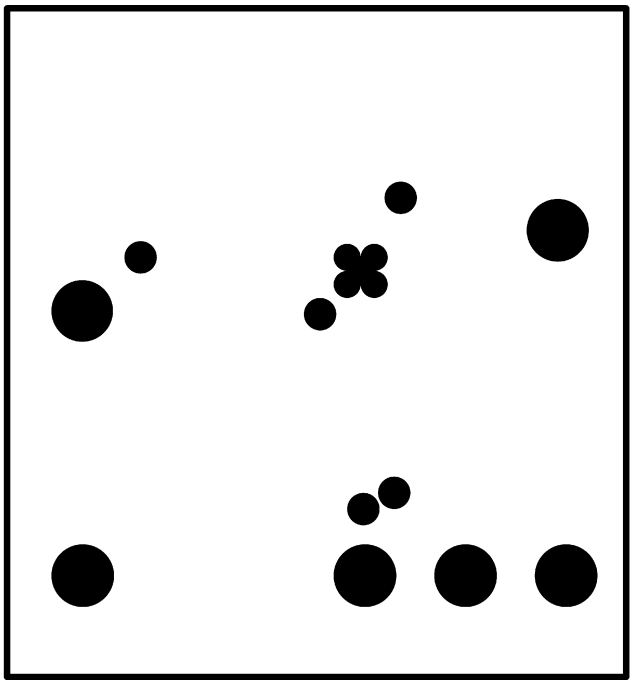


Figure 5. Internal Plane 2 (V_{IN})

Copyright © 2008–2013, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

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

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license 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 significant portions 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. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2013, Texas Instruments Incorporated