TPS6106xEVM User's Guide

Contents

1 Introduction 1
2 Setup 1
3 Board Layout 2
4 Schematic 6

List of Figures

1 Top Assembly Layer 3
2 Top Layer Routing 4
3 Bottom Layer Routing 5
4 TPS6106xEVM Schematic 6

List of Tables

1 Device and Package Configurations 1
5 TPS6106xEVM Bill of Materials 7

1 Introduction

The Texas Instruments TPS6106xEVM evaluation module (EVM) helps designers evaluate the operation and performance of the TPS6106x family of constant current LED drivers. These devices are high-efficiency, small-size boost converters that switch at 1 MHz.

The EVM contains two independent DC/DC converters (see Table 1).

Table 1. Device and Package Configurations

Converter	IC	Package
U1	TPS61061DRB	QFN-8
U4	TPS61061YZF	CSP-8 chipscale

Converter U1 is configured to demonstrate all features of the device. Converter U4 is optimized for minimum area to demonstrate small solution size.

2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the TPS6106xEVM.

2.1 Input/Output Connector Descriptions

J1 and TP1 – Vin —is the positive connection to the corresponding converter. The leads to the input supply should be twisted and kept as short as possible to minimize EMI transmission.

J2 and TP4 – GND — is the return connection for the input power supply for the corresponding converter.

TP2 – LED Cathode — is the chipscale converter, U4, output to an external LED cathode.

TP3 – LED Anode — is the chipscale converter, U4, return from an external LED anode.

JP1 – EN — jumper enables or disables the converter. Connect the shorting jumper from the center EN pin to either the ON or OFF position.

JP2 – ILED FIXED, or DIG CTRL —jumper is used to select how the output current for converter U1 is controlled. When JP2 is in the FIXED position, jumper JP3 sets the output current HIGH (40 mA) or LOW (20 mA). When in the DIG CTRL position, pushbuttons S1 and S2 allow LED current to be stepped up or down in 1.25-mA increments between 0 mA and 40 mA.

JP3 – ILED LOW, or ILED HIGH — jumper is used with JP2 to set the LED output current. When in the ILED LOW position, converter U1 regulates FB pin to a voltage of 250 mV at pin 4. This corresponds to an LED current of 20 mA. When in the ILED HIGH position, pin 4 is regulated to 500 mV, which corresponds to an LED current of 40 mA.

JP4 – OPEN LOAD — jumper disconnects LED D5–D1 from converter U1 output. This can be used to demonstrate the converter's overvoltage protection or monitor LED current.

JP5 – BYPASS D1 — jumper bypasses LED D1 to reduce the LED load to four.

2.2 Setup

Input voltage range for both converters is 2.7 volts to 6 volts. Converter U1 load (D5–D1) is on the EVM board. Converter U4 requires an external load for proper operation.

The factory-supplied TPS61061, used for U1 and U4, can be replaced with other converters from the TPS6106x family.

2.3 Operation

For proper operation of U1, JP1 and JP2 must be configured. The recommended setting, using shorting blocks is:

JP1 to ON

JP2 to DIG CTRL

JP4 shorted

In this configuration, the unit powers up when power is applied. LED current is under the control of S1 and S2.

JP2 ILED selects how the LED D5–D1 current is set, FIXED or DIG CTRL. FIXED position places control under jumper JP3. With JP3 set to the ILED LOW position, LED current is regulated at 20 mA; in the ILED HIGH position, LED current is regulated at 40 mA. With JP2 in the DIG CTRL position S1 UP and S2 DOWN control LED current. Each pushbutton steps the current up or down ~1.25 mA per step; the range is 0 mA to 40 mA.

3 Board Layout

Board layout is critical for all high-frequency switch-mode power supplies. Figure 1, Figure 2, and Figure 3 show the board layout for the TPS6106xEVM-091 PWB. The nodes with high switching frequencies and currents are kept as short as possible to minimize trace inductance.

The TPS6106x family of converters are high efficiency but do dissipate power. The QFN package has an exposed thermal pad to enhance thermal performance. This must be soldered to a substantial thermal plane.

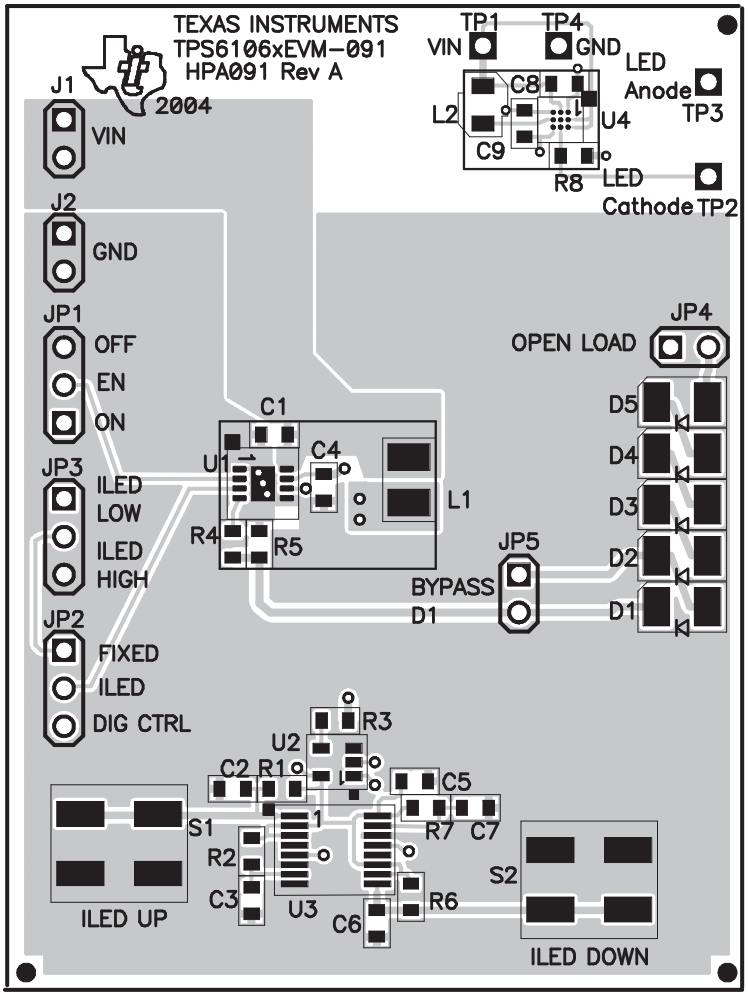

Figure 1. Top Assembly Layer

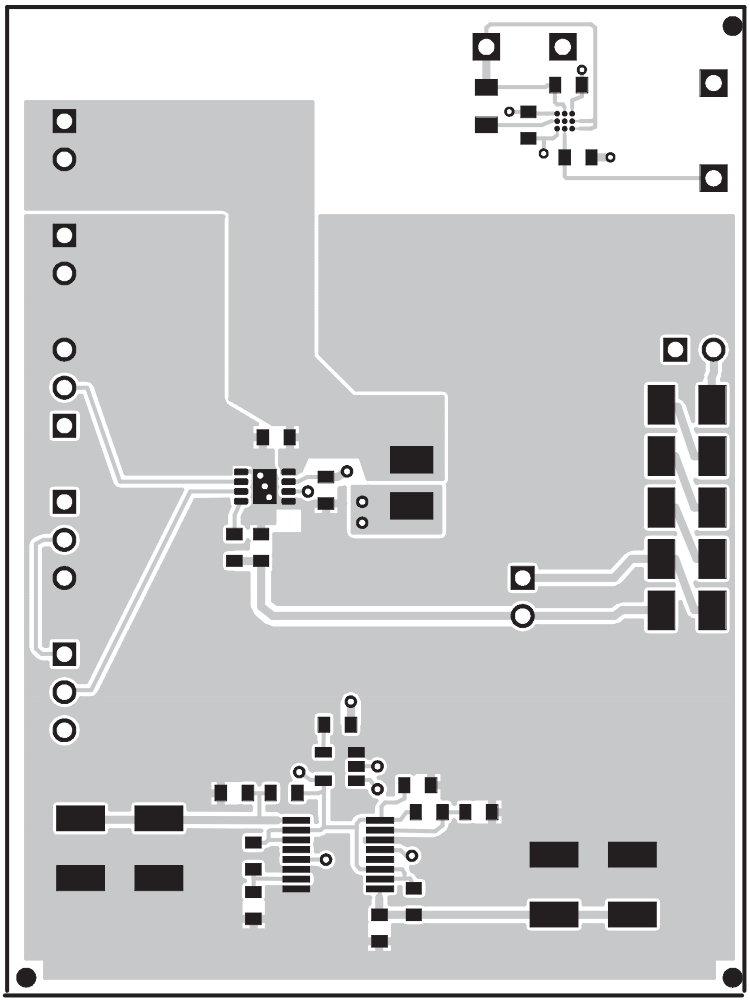

Figure 2. Top Layer Routing

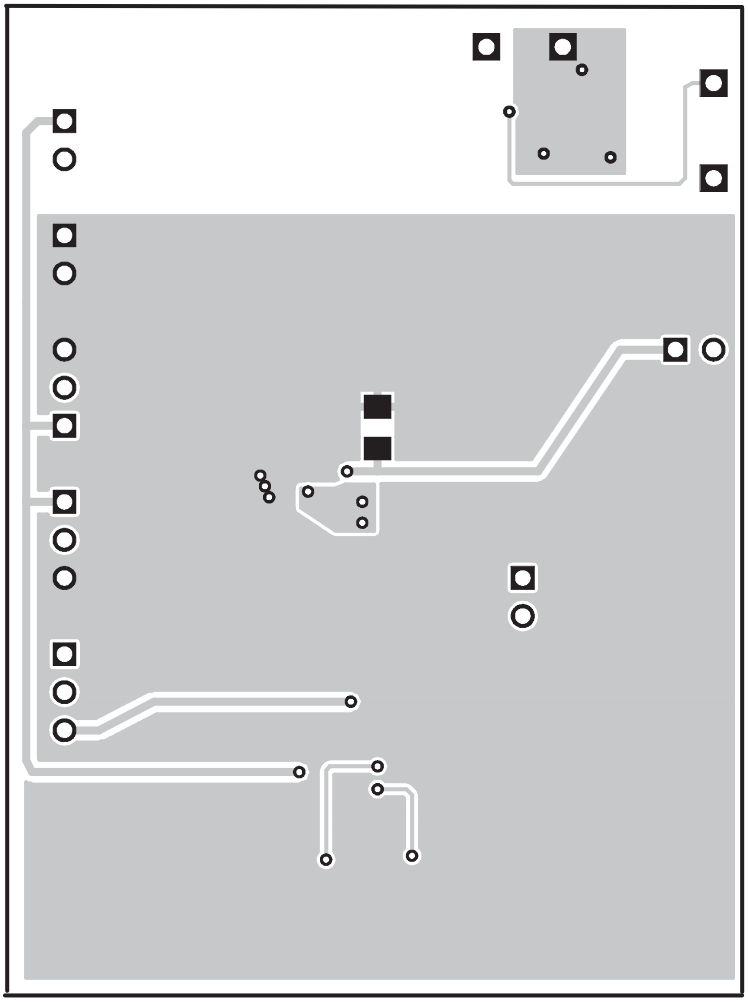

Figure 3. Bottom Layer Routing

4 Schematic

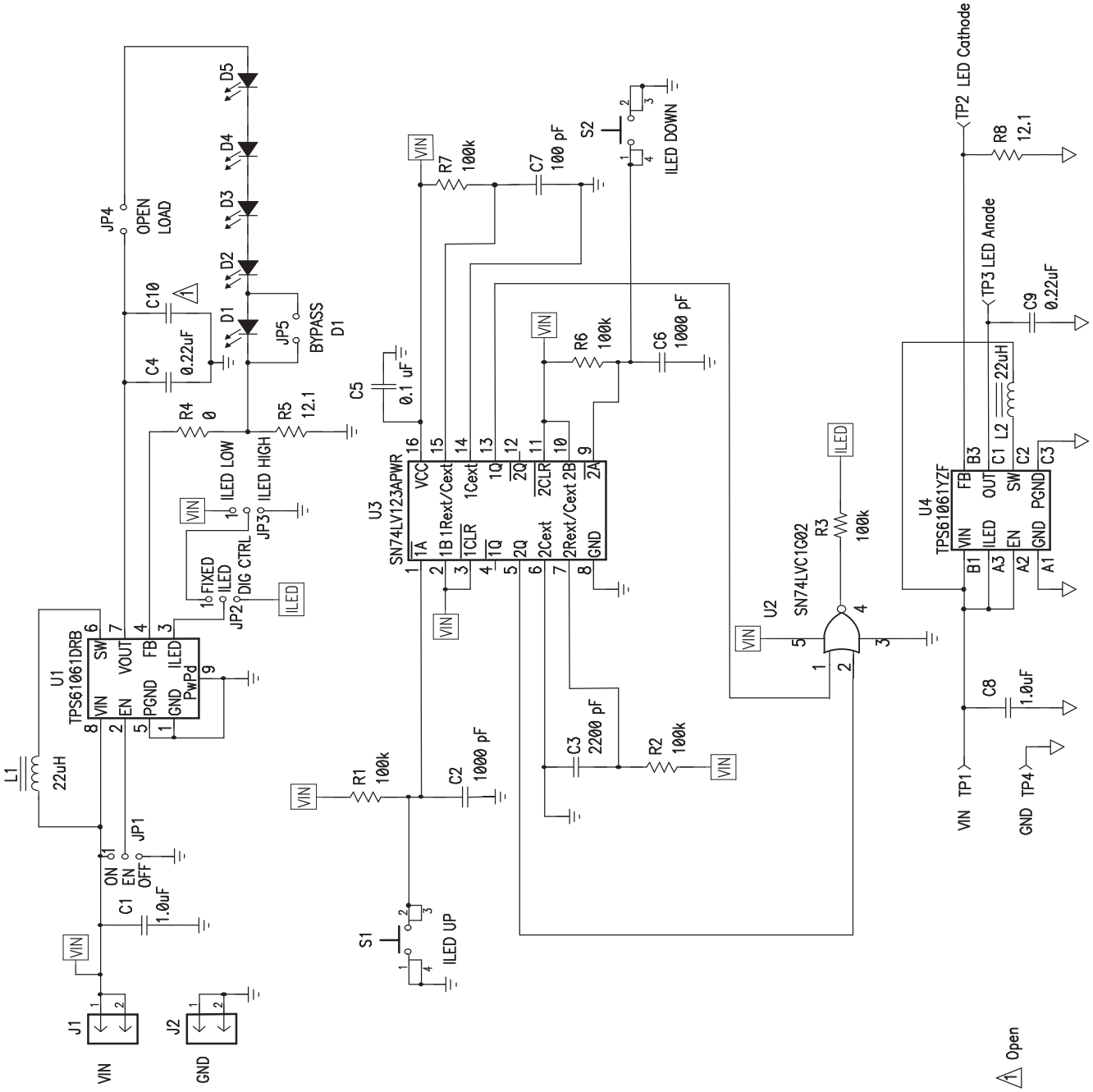

Figure 4. TPS6106xEVM Schematic

Table 5. TPS6106xEVM Bill of Materials

COUNT	Ref Des	DESCRIPTION	SIZE	MFR	PART NUMBER
2	C1, C8	Capacitor, ceramic, 1-µF, 16-V, X7R, 10%	603	TDK	C1608X7R1C105KT
0	C10	Capacitor, ceramic, xxx-µF, vv-V	1206		
2	C2, C6	Capacitor, ceramic, 1000-pF, 50-V, X7R, 10%	603	TDK	C1608X7R1H102K
1	C3	Capacitor, ceramic, 2200-pF, 50-V, X7R, 10%	603	TDK	C1608X7R1H222K
2	C4, C9	Capacitor, ceramic, 0.22-µF, 25-V, X7R, 10%	603	TDK	C1608X7R1E224K
1	C5	Capacitor, ceramic, 0.1-µF, 16-V, X7R, 10%	603	TDK	C1608X7R1C104K
1	C7	Capacitor, ceramic, 100-pF, 50-V, C0G, 5%	603	TDK	C1608C0G1H101J
5	D1–D5	Diode, LED, White, 30 mA	1210	Lumex	SML-LX2832UWC-TR
				Chicago Miniature	CMD67-21UWC
2	J1, J2	Header, 2-pin, 100-mil spacing, (36-pin strip)	0.100 X 2	Sullins	PTC36SAAN
3	JP1, JP2, JP3	Header, 3-pin, 100-mil spacing, (36-pin strip)	0.100 X 3	Sullins	PTC36SAAN
2	JP4, JP5	Header, 2-pin, 100-mil spacing, (36-pin strip)	0.100 X 2	Sullins	PTC36SAAN
1	L1	Inductor, SMT, 22-µH, 580-mA, 160-mΩ	1210	Coilcraft	ME3220-223KX
1	L2	Inductor, SMT, 22-µH, 580-mA, 800-mΩ	0.102 X 0.110	TDK	VLF3012AT-220MR33
5	R1, R2, R3, R6, R7	Resistor, chip, 100-kΩ, 1/16-W, 1%	603	Std	Std
1	R4	Resistor, chip, 0-Ω, 1/16 W, 5%	603	Std	Std
2	R5, R8	Resistor, chip, 12.1-Ω, 1/16 W, 1%	603	Std	Std
2	S1, S2	Switch, SPST, PB-Momentary, Sealed, Washable	0.245 X 0.251	C&K	KT11P2JM
2	TP1, TP3	Test point, red, 1-mm	0.038	Farnell	240-345
2	TP2, TP4	Test point, black, 1-mm	0.038	Farnell	240-333
1	U1	IC, constant current LED driver with digital brightness control	QFN-8P	TI	TPS61061DRB
1	U2	IC, single 2-input positive-NOR gate	SOT23-5	TI	SN74LVC1G02DBVR
1	U3	IC, dual retriggerable Monostable multivibrators with Schmitt-Trigger inputs	PW16	TI	SN74LV123APWR
1	U4	IC, constant current LED driver with digital brightness control	WCSP-9	TI	TPS6106YZF
1	--	PCB, 2.6-inch x 1.95-inch x 0.062-inch		Any	HPA091
5	--	Shunt, 100-mil, black	0.100	3M	929950-00

FCC Warning

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general customer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

EVALUATION BOARD/KIT IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive.**

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.**

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please contact the TI application engineer or visit www.ti.com/esh.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of -0.3 V to 7.0 V and the output voltage range of 0 V to 33 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 85° C. The EVM is designed to operate properly with certain components above 60° C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2007, Texas Instruments Incorporated

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 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.

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		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
RFID	www.ti-rfid.com	Telephony	www.ti.com/telephony
Low Power Wireless	www.ti.com/lpw	Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2007, Texas Instruments Incorporated