

Enhanced Plastic 5A and 3A Low Dropout Fast Response Regulators

General Description

The LMS1585AEP and LMS1587EP are low dropout positive regulators with output load current of 5A and 3A respectively. Their low dropout voltage (1.2V) and fast transient response make them an excellent solution for low voltage microprocessor applications.

The LMS1585AEP/87EP are available in adjustable versions, which can set the output voltage with only two external resistors. In addition, they are also available in 1.5V and 3.3V fixed voltage versions (*Note 12*).

The LMS1585AEP/87EP circuits include a zener trimmed bandgap reference, current limiting and thermal shutdown.

The LMS1585AEP/87EP series are available in TO-220 and TO-263 packages.

ENHANCED PLASTIC

- Extended Temperature Performance of -40°C to 125°C
- Baseline Control - Single Fab & Assembly Site
- Process Change Notification (PCN)
- Qualification & Reliability Data
- Solder (PbSn) Lead Finish is standard
- Enhanced Diminishing Manufacturing Sources (DMS) Support

Features

- Fast transient response
- Available in Adjustable, 1.5V, and 3.3V versions
- Current limiting and thermal protection
- Line regulation 0.005% (typical)
- Load regulation 0.05% (typical)

Applications

- Low voltage logic supplies
- Selected Military Applications
- Selected Avionics Applications

Ordering Information

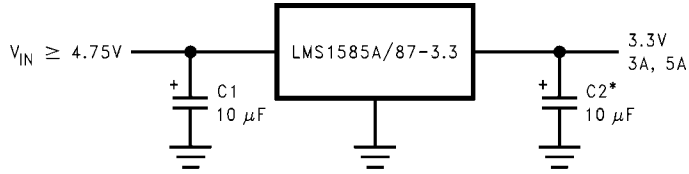
Part Number	VID Part Number	NS Package Number (<i>Note 3</i>)
LMS1585AIS33EP	V62/04639-01	TS3B
LMS1585AISADJEP	V62/04639-02	TS3B
LMS1587ISXADJEP	V62/04639-03	TS3B
(<i>Note 1, Note 2</i>)	TBD	TBD

Note 1: For the following (Enhanced Plastic) version, check for availability: LMS1585ACT3.3EP, LMS1585ACTADJEP, LMS1585AIT1.5EP, LMS1585AIT3.3EP, LMS1585AITADJEP, LMS1585ACS1.5EP, LMS1585ACS3.3EP, LMS1585ACSADJEP, LMS1585AIS1.5EP, LMS1585ACSX33EP, LMS1585CSXADJEP, LMS1585AISX15EP, LMS1585AISX33EP, LMS1585ASXADJEP, LMS1587CT1.5EP, LMS1587CT3.3EP, LMS1587CTADJEP, LMS1587IT1.5EP, LMS1587IT3.3EP, LMS1587ITADJEP, LMS1587CS1.5EP, LMS1587CS3.3EP, LMS1587CSADJEP, LMS1587IS1.5EP, LMS1587IS3.3EP, LMS1587ISADJEP, LMS1587CSX3.3EP, LMS1587CSXADJEP, LMS1587ISX1.5EP, LMS1587ISX3.3EP. Parts listed with an "X" are provided in Tape & Reel and parts without an "X" are in Rails.

Note 2: FOR ADDITIONAL ORDERING AND PRODUCT INFORMATION, PLEASE VISIT THE ENHANCED PLASTIC WEB SITE AT: www.national.com/mil

Note 3: Refer to package details under Physical Dimensions

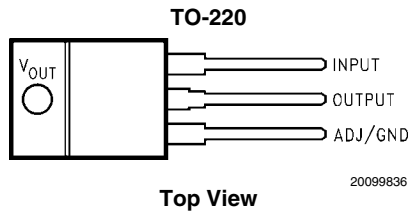
Typical Application



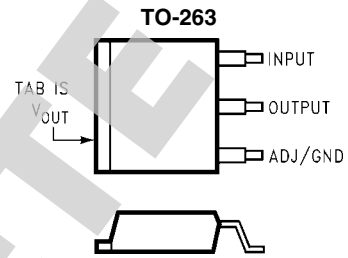
* REQUIRED FOR STABILITY

20099801

Connection Diagrams

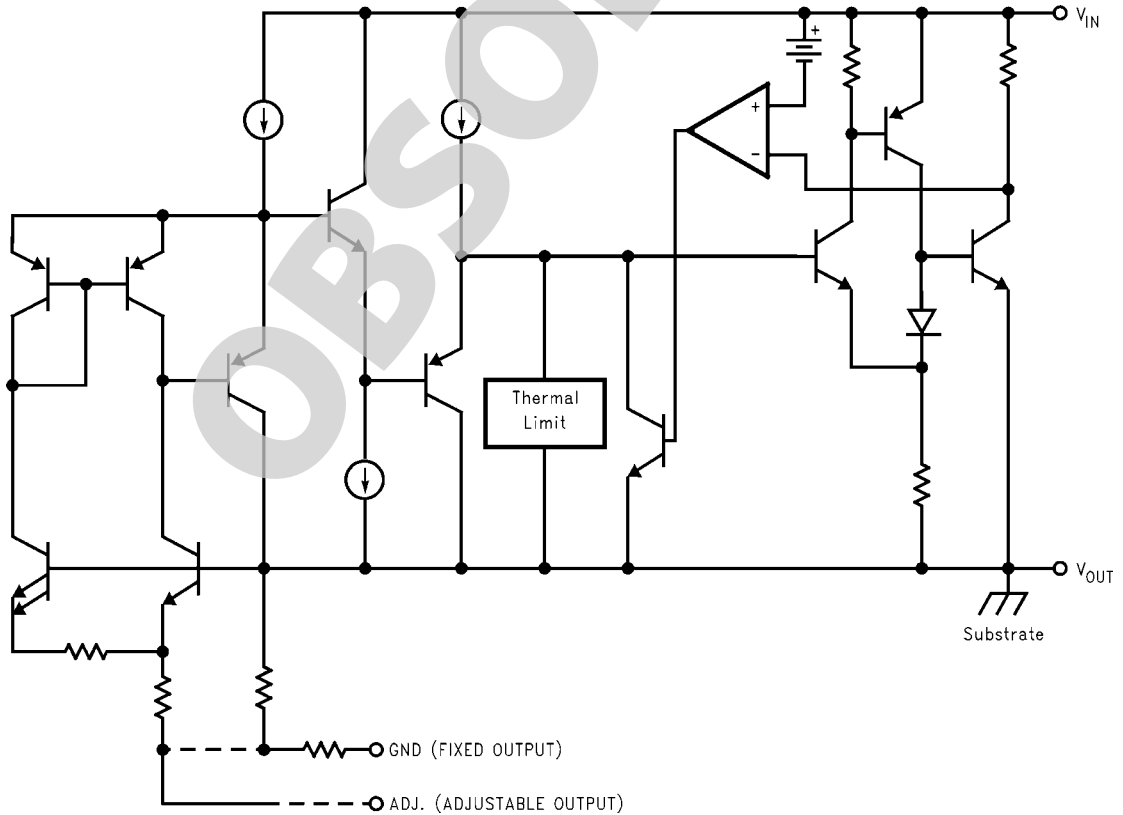


Top View



Top View

Simplified Schematic



20099814

Absolute Maximum Ratings (Note 4)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Maximum Input to Output Voltage
(V_{IN} to GND) 13V
Power Dissipation (Note 5) Internally Limited

Junction Temperature (T_J) (Note 5) 150°C
Storage Temperature Range -65°C to 150°C
Lead Temperature 260°C, 10 sec
ESD Tolerance (Note 6) 2000V

Electrical Characteristics

Typicals and limits appearing in normal type apply for $T_J = 25^\circ\text{C}$. Limits appearing in **Boldface** type apply over the entire junction temperature range for operation, 0°C to 125°C for commercial grade and -40°C to 125°C for Enhanced Plastic.

Symbol	Parameter	Conditions	Min (Note 8)	Typ (Note 7)	Max (Note 8)	Units
V_{REF}	Reference Voltage	LMS1585A-ADJEP $V_{IN}-V_{OUT} = 3V, I_{OUT} = 10mA$ $10mA \leq I_{OUT} \leq 5A, 1.5V \leq V_{IN}-V_{OUT} \leq 5.75V$	1.238	1.25	1.262	V
			1.225	1.250	1.275	V
V_{OUT}	Output Voltage	LMS1587-ADJEP $10mA \leq I_{OUT} \leq 3A, 1.5V \leq V_{IN}-V_{OUT} \leq 5.75V$	1.225	1.250	1.275	V
		LMS1585A-1.5EP $I_{OUT} = 0mA, V_{IN} = 5V$ $0 \leq I_{OUT} \leq 5A, 3V \leq V_{IN} \leq 7V$	1.485	1.500	1.515	V
ΔV_{OUT}	Line Regulation (Note 9)	LMS1585A-3.3EP $I_{OUT} = 0mA, V_{IN} = 5V$ $0 \leq I_{OUT} \leq 5A, 4.75V \leq V_{IN} \leq 7V$	3.267	3.300	3.333	V
			3.235	3.300	3.365	V
		LMS1587-1.5EP $V_{IN} = 5V, I_{OUT} = 0mA, T_J = 25^\circ\text{C}$ $0 \leq I_{OUT} \leq 3A, 3V \leq V_{IN} \leq 7V$	1.485	1.500	1.515	V
			1.470	1.500	1.530	V
ΔV_{OUT}	Load Regulation (Note 9)	LMS1587-3.3EP $0 \leq I_{OUT} \leq 3A, 4.75V \leq V_{IN} \leq 7V$	3.235	3.300	3.365	V
		LMS1585AEP/87-ADJEP $I_{OUT} = 10mA, 2.75V \leq V_{IN} \leq 7V$		0.005	0.2	%
		LMS1585AEP/87-3.3EP $I_{OUT} = 0mA, 4.75V \leq V_{IN} \leq 7V$		0.005	0.2	%
ΔV_{OUT}	Load Regulation (Note 9)	LMS1585AEP/87-1.5EP $I_{OUT} = 0mA, 3V \leq V_{IN} \leq 7V$		0.005	0.2	%
		LMS1585A-ADJEP $V_{IN}-V_{OUT} = 3V, 10mA \leq I_{OUT} \leq 5A$		0.05	0.5	%
		LMS1585A-1.5EP/LMS1585A-3.3EP $V_{IN} = 5V, 0 \leq I_{OUT} \leq 5A$		0.05	0.5	%
		LMS1587-ADJEP $V_{IN}-V_{OUT} = 3V, 10mA \leq I_{OUT} \leq 3A$		0.05	0.5	%
$V_{IN}-V_{OUT}$	Dropout Voltage	LMS1587-1.5EP/LMS1587-3.3EP $V_{IN} = 5V, 0 \leq I_{OUT} \leq 3A$		0.05	0.5	%
		LMS1585A-ADJEP/LMS1587-ADJEP $\Delta V_{REF} = 1\%, I_{OUT} = 3A$		1.15	1.3	V
		LMS1585A-3.3EP/LMS1587-3.3EP/ LMS1585A-1.5EP/LMS1587-1.5EP $\Delta V_{OUT} = 1\%, I_{OUT} = 3A$		1.15	1.3	V
		LMS1585A-ADJEP $\Delta V_{REF} = 1\%, I_{OUT} = 5A$		1.2	1.4	V
$V_{IN}-V_{OUT}$	Dropout Voltage	LMS1585A-1.5EP/LMS1585A-3.3EP $\Delta V_{OUT} = 1\%, I_{OUT} = 5A$		1.2	1.4	V
				1.2	1.4	V

Symbol	Parameter	Conditions	Min (Note 8)	Typ (Note 7)	Max (Note 8)	Units
I _{LIMIT}	Current Limit	LMS1585A-ADJEP/LMS1585A-3.3EP/ LMS1585A-1.5EP V _{IN} -V _{OUT} = 5.5V	5.0	6.6		A
		LMS1587-ADJEP/LMS1587-3.3EP/ LMS1587-1.5EP V _{IN} -V _{OUT} = 5.5V	3.1	4.3		A
	Minimum Load Current (Note 10)	LMS1585AEP/87-ADJEP 1.5V ≤ V _{IN} -V _{OUT} ≤ 5.75V		2.0	10.0	mA
	Quiescent Current	LMS1585A-3.3EP/LMS1587-3.3EP/ LMS1585A-1.5EP/LMS1587-1.5EP V _{IN} = 5V		7.0	13.0	mA
	Thermal Regulation	T _A = 25°C, 30ms Pulse		0.003		%/W
	Ripple Rejection	LMS1585A-ADJEP f _{RIPPLE} = 120Hz, V _{IN} -V _{OUT} = 3V, I _{OUT} = 5A, C _{OUT} = 25μF Tantalum		72		dB
		LMS1585A-1.5EP f _{RIPPLE} = 120Hz, C _{OUT} = 25μF Tantalum, I _{OUT} = 5A, V _{IN} = 4.5V	60	72		dB
		LMS1585A-3.3EP f _{RIPPLE} = 120Hz, C _{OUT} = 25μF Tantalum, I _{OUT} = 5A, V _{IN} = 6.3V		72		dB
		LMS1587-ADJEP f _{RIPPLE} = 120Hz, V _{IN} -V _{OUT} = 3V, I _{OUT} = 3A C _{OUT} = 25μF Tantalum		72		dB
		LMS1587-1.5EP f _{RIPPLE} = 120Hz, C _{OUT} = 25μF Tantalum, I _{OUT} = 3A, V _{IN} = 4.5V	60	72		dB
		LMS1587-3.3EP f _{RIPPLE} = 120Hz, C _{OUT} = 25μF Tantalum, I _{OUT} = 3A, V _{IN} = 6.3V		72		dB
		Adjust Pin Current			55	120
Adjust Pin Current	10mA ≤ I _{OUT} ≤ I _{FULLLOAD} , 1.5V ≤ V _{IN} -V _{OUT} ≤ 5.75V (Note 11)			0.2		μA
	Temperature Stability			0.5		%
	Long Term Stability	T _A = 125°C, 1000Hrs		0.03		%
	RMS Output Noise (% of V _{OUT})	10Hz ≤ f ≤ 10kHz		0.003		%
	Thermal Resistance Junction-to-Case	3-Lead TO-263: Control/Output Section 3-Lead TO-220: Control/Output Section			0.65/2.7 0.65/2.7	°C/W °C/W

Note 4: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.

Note 5: The maximum power dissipation is a function of T_{J(max)}, θ_{JA}, and T_A. The maximum allowable power dissipation at any ambient temperature is P_D = (T_{J(max)} - T_A) / θ_{JA}. All numbers apply for packages soldered directly into a PC board.

Note 6: For testing purposes, ESD was applied using human body model, 1.5kΩ in series with 100pF.

Note 7: Typical Values represent the most likely parametric norm.

Note 8: All limits are guaranteed by testing or statistical analysis.

Note 9: Load and line regulation are measured at constant junction temperature, and are guaranteed up to the maximum power dissipation of 30W. Power dissipation is determined by the input/output differential and the output current. Guaranteed maximum power dissipation will not be available over the full input/output range.

Note 10: The minimum output current required to maintain regulation.

Note 11: I_{FULLLOAD} is 5A for LMS1585AEP and 3A for LMS1587EP.

Note 12: Consult factory for other fixed voltage options.

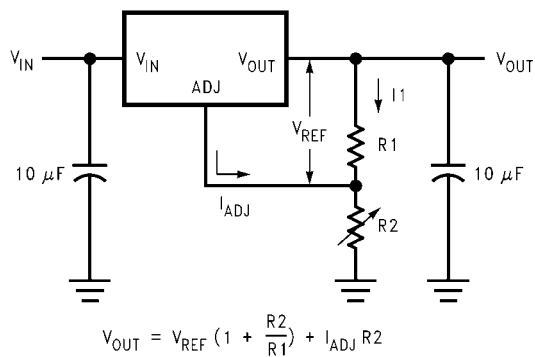
Application Note

Output Voltage

The adjustable version develops at 1.25V reference voltage, (V_{REF}), between the output and the adjust terminal. As shown in *Figure 1*, this voltage is applied across resistor R1 to generate a constant current I1. This constant current then flows through R2. The resulting voltage drop across R2 adds to the reference voltage to sets the desired output voltage.

The current I_{ADJ} from the adjustment terminal introduces an output error. But since it is small (120 μ A max), it becomes negligible when R1 is in the 100 Ω range.

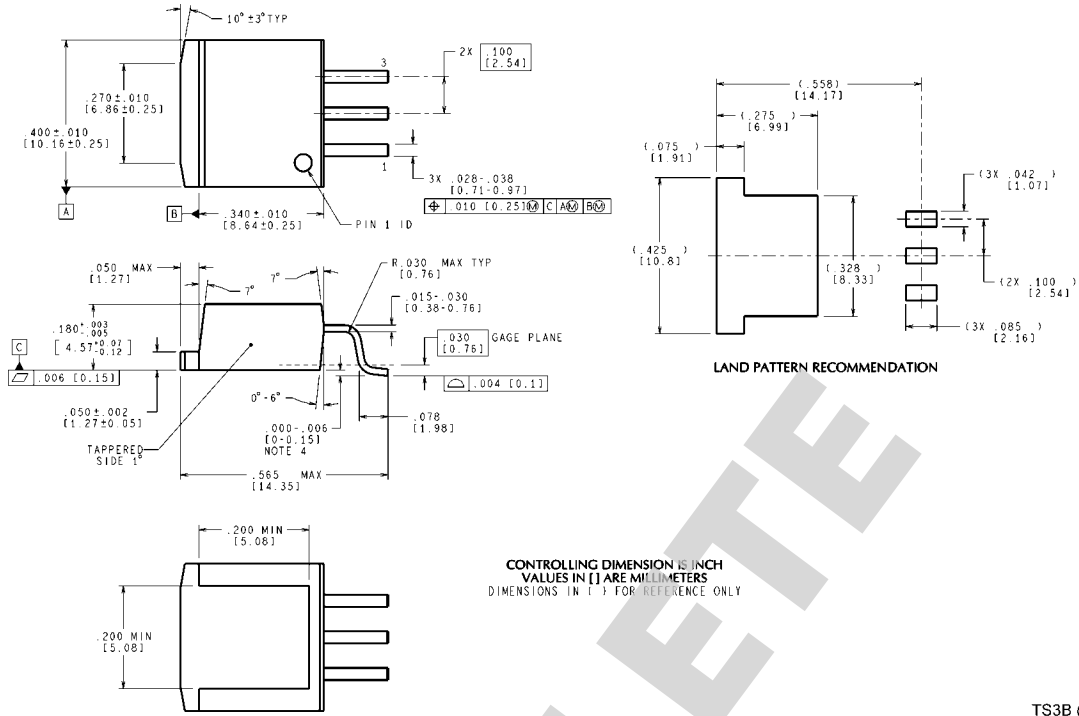
For fixed voltage devices, R1 and R2 are integrated inside the devices.



20099872

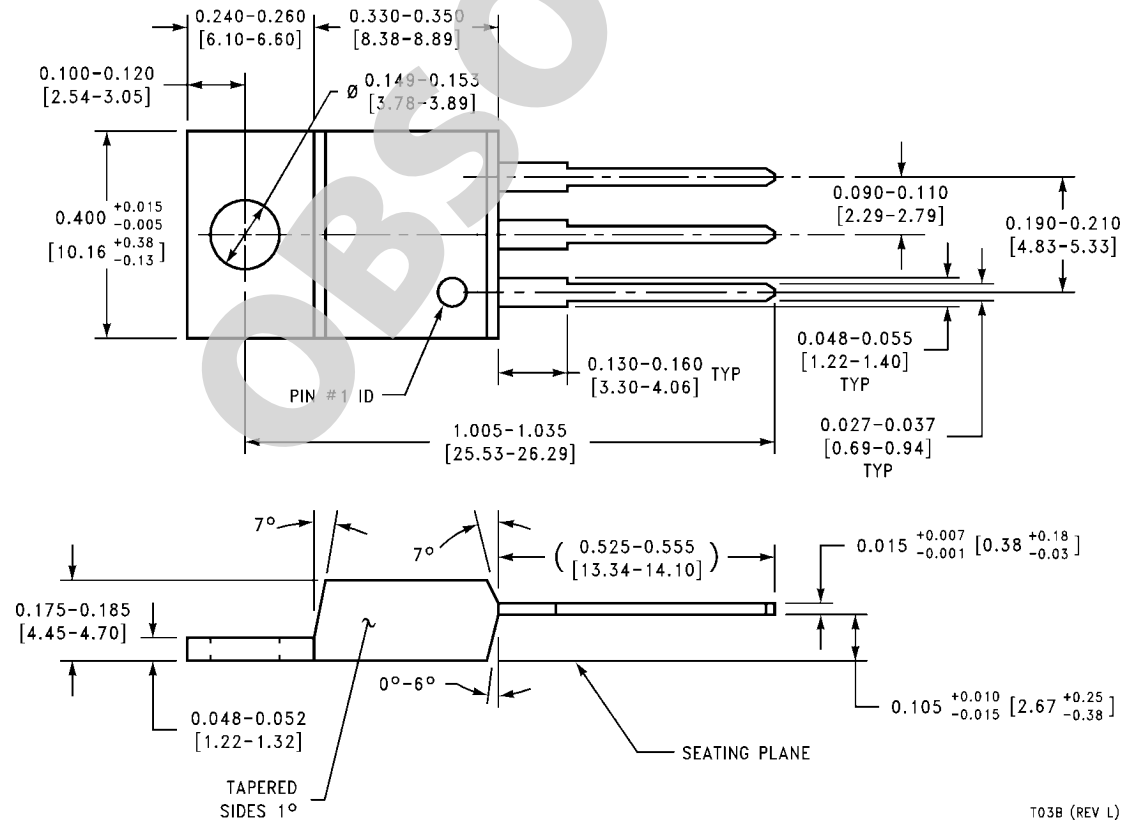
FIGURE 1. Basic Adjustable Regulator

Physical Dimensions inches (millimeters) unless otherwise noted



3-Pin TO-263
NS Package Number TS3B

TS3B (Rev F)



3-Pin TO-220
NS Package Number T03B

T03B (REV L)

Notes

OBSOLETE

Notes

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