

## Operational Amplifier

### General Description

The LM48 is a general purpose operational amplifier with external frequency compensation.

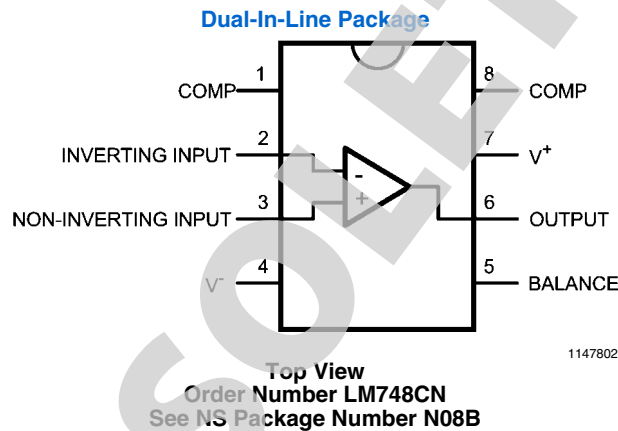
The unity-gain compensation specified makes the circuit stable for all feedback configurations, even with capacitive loads. It is possible to optimize compensation for best high frequency performance at any gain. As a comparator, the output can be clamped at any desired level to make it compatible with logic circuits.

The LM748C is specified for operation over the 0°C to +70°C temperature range.

### Features

- Frequency compensation with a single 30 pF capacitor
- Operation from  $\pm 5V$  to  $\pm 20V$
- Continuous short-circuit protection
- Operation as a comparator with differential inputs as high as  $\pm 30V$
- No latch-up when common range is exceeded
- Same pin configuration as the LM101

### Connection Diagram



**Absolute Maximum Ratings** (Note 1)

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

Supply Voltage	±22V
Power Dissipation (Note 2)	500 mW
Differential Input Voltage	±30V

Input Voltage (Note 3)	±15V
Output Short-Circuit Duration (Note 4)	
Operating Temperature Range: LM748C	0°C to +70°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	+300°C

**Electrical Characteristics** (Note 5)

Parameter	Conditions	Min	Typ	Max	Units
Input Offset Voltage	$T_A = 25^\circ\text{C}$ , $R_S \leq 10\text{ k}\Omega$		1.0	5.0	mV
Input Offset Current	$T_A = 25^\circ\text{C}$		40	200	nA
Input Bias Current	$T_A = 25^\circ\text{C}$		120	500	nA
Input Resistance	$T_A = 25^\circ\text{C}$	300	800		k $\Omega$
Supply Current	$T_A = 25^\circ\text{C}$ , $V_S = \pm 15\text{V}$		1.8	2.8	mA
Large Signal Voltage Gain	$T_A = 25^\circ\text{C}$ , $V_S = \pm 15\text{V}$ $V_{OUT} = \pm 10\text{V}$ , $R_L \geq 2\text{ k}\Omega$	50	160		V/mV
Input Offset Voltage	$R_S \leq 10\text{ k}\Omega$			6.0	mV
Average Temperature Coefficient of Input Offset Voltage	$R_S \leq 50\Omega$		3.0		$\mu\text{V}/^\circ\text{C}$
	$R_S \leq 10\text{ k}\Omega$		6.0		$\mu\text{V}/^\circ\text{C}$
Input Offset Current	$T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$			300	nA
	$T_A = -55^\circ\text{C}$ to $+125^\circ\text{C}$			500	nA
Input Bias Current	$T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$			0.8	$\mu\text{A}$
	$T_A = -55^\circ\text{C}$ to $+125^\circ\text{C}$			1.5	$\mu\text{A}$
Supply Current	$T_A = +125^\circ\text{C}$ , $V_S = \pm 15\text{V}$		1.2	2.25	mA
	$T_A = -55^\circ\text{C}$ to $+125^\circ\text{C}$		1.9	3.3	mA
Large Signal Voltage Gain	$V_S = \pm 15\text{V}$ , $V_{OUT} = \pm 10\text{V}$ $R_L \geq 2\text{ k}\Omega$	25			V/mV
Output Voltage Swing	$V_S = \pm 15\text{V}$ , $R_L = 10\text{ k}\Omega$	±12	±14		V
	$V_S = \pm 15\text{V}$ , $R_L = 2\text{ k}\Omega$	±10	±13		V
Input Voltage Range	$V_S = \pm 15\text{V}$	±12			V
Common-Mode Rejection Ratio	$R_S \leq 10\text{ k}\Omega$	70	90		dB
Supply Voltage Rejection Mode	$R_S \leq 10\text{ k}\Omega$	77	90		dB

**Note 1:** Absolute maximum ratings indicate limits beyond which damage to the device may occur. Electrical characteristic specifications do not apply when operating the device outside of its rated operating conditions.

**Note 2:** For operating at elevated temperatures, the device must be derated based on a maximum junction to case thermal resistance of 45°C per watt, or 150°C per watt junction to ambient. (See Curves).

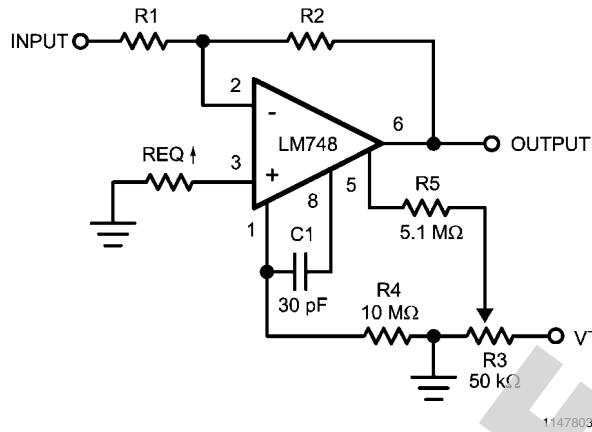
**Note 3:** For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

**Note 4:** Continuous short circuit is allowed for case temperatures to +125°C and ambient temperatures to +70°C.

**Note 5:** These specifications apply for  $\pm 5\text{V} \leq V_S \leq +15\text{V}$  and  $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$ , unless otherwise specified.

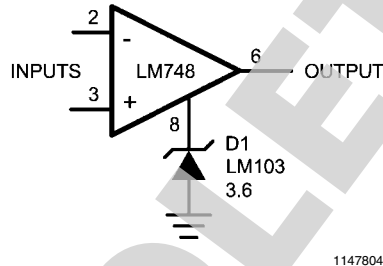
# Typical Applications

## Inverting Amplifier with Balancing Circuit

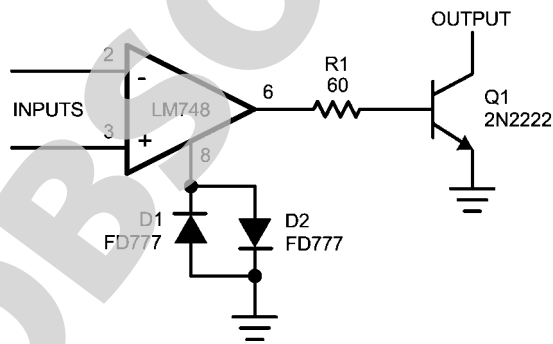


†May be zero or equal to parallel combination of R1 and R2 for minimum offset.

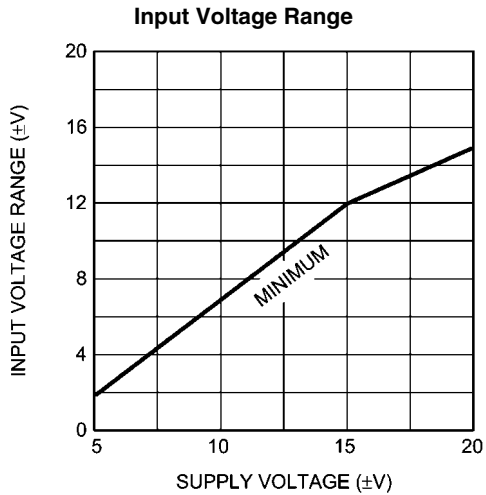
## Voltage Comparable for Driving DTL or TTL Integrated Circuits



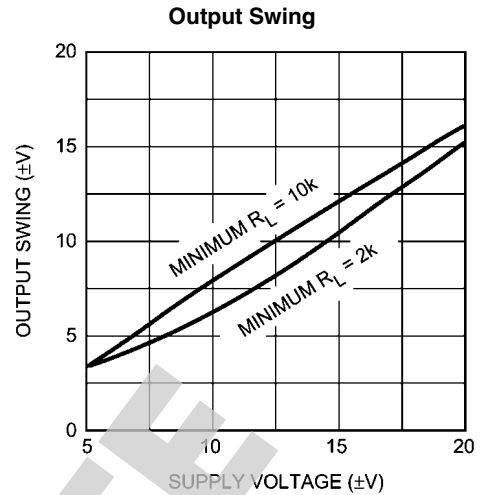
## Voltage Comparable for Driving RTL Logic or High Current Driver



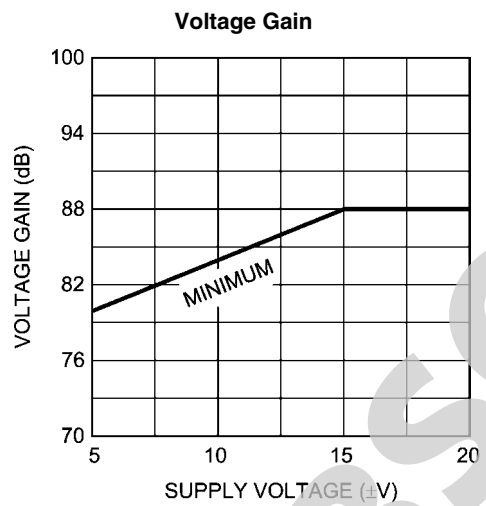
## Guaranteed Performance Characteristics (Note 5)



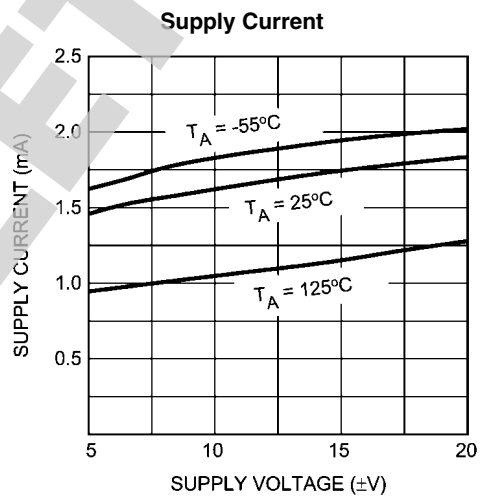
1147808



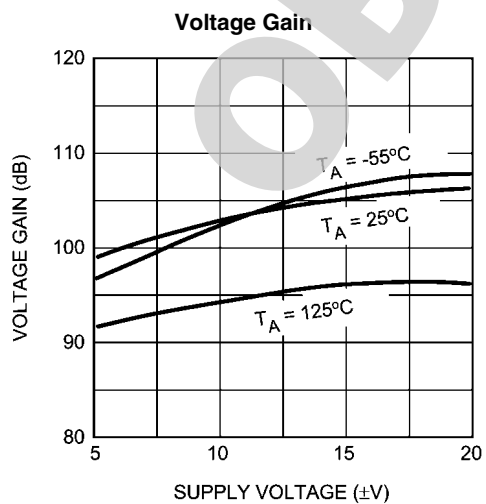
1147809



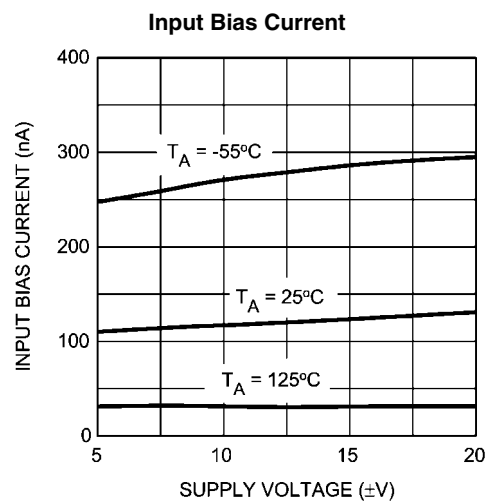
1147810



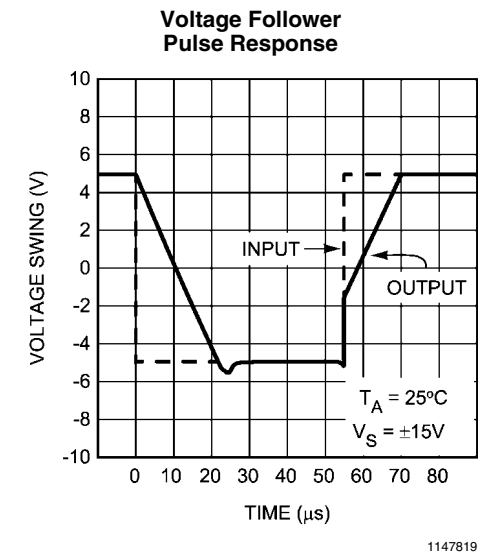
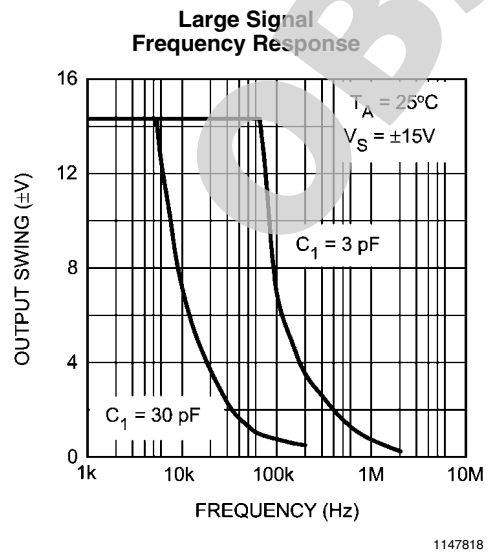
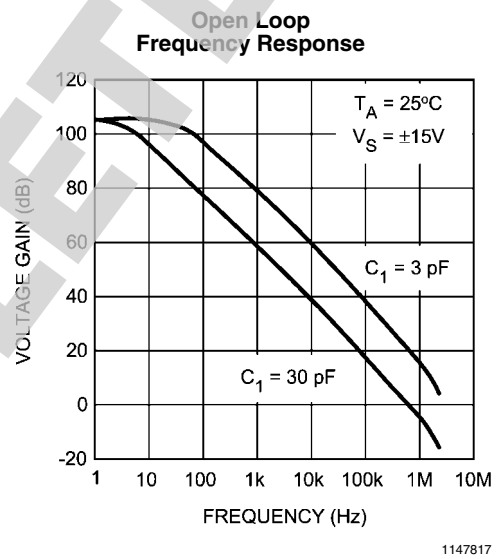
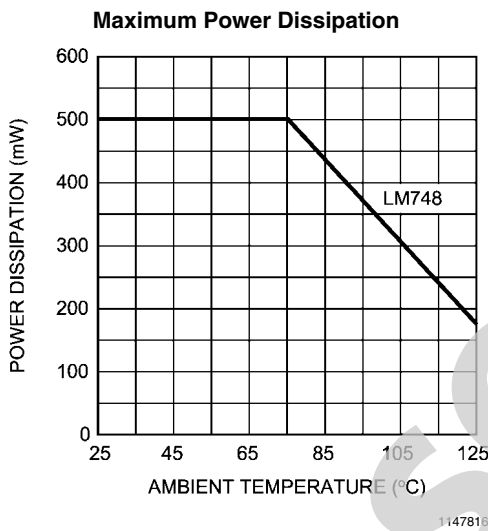
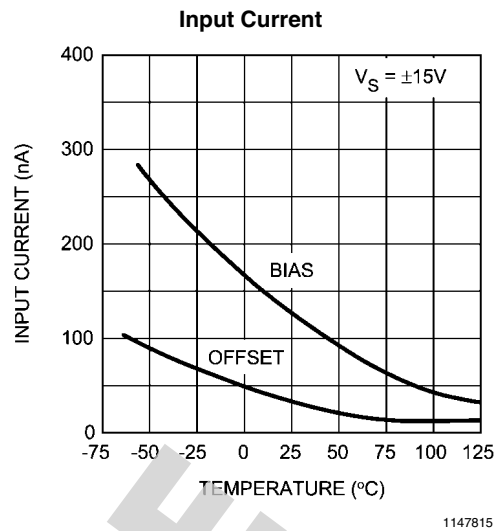
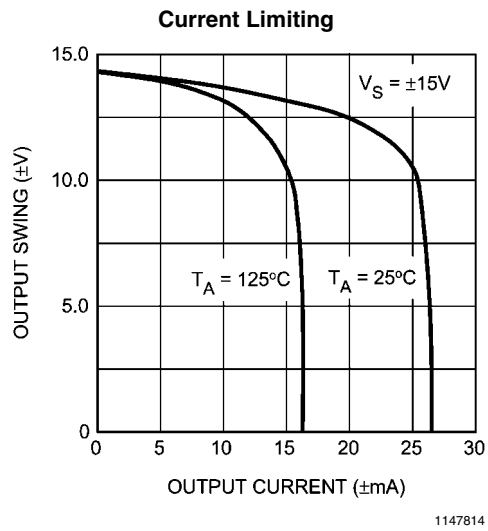
1147811



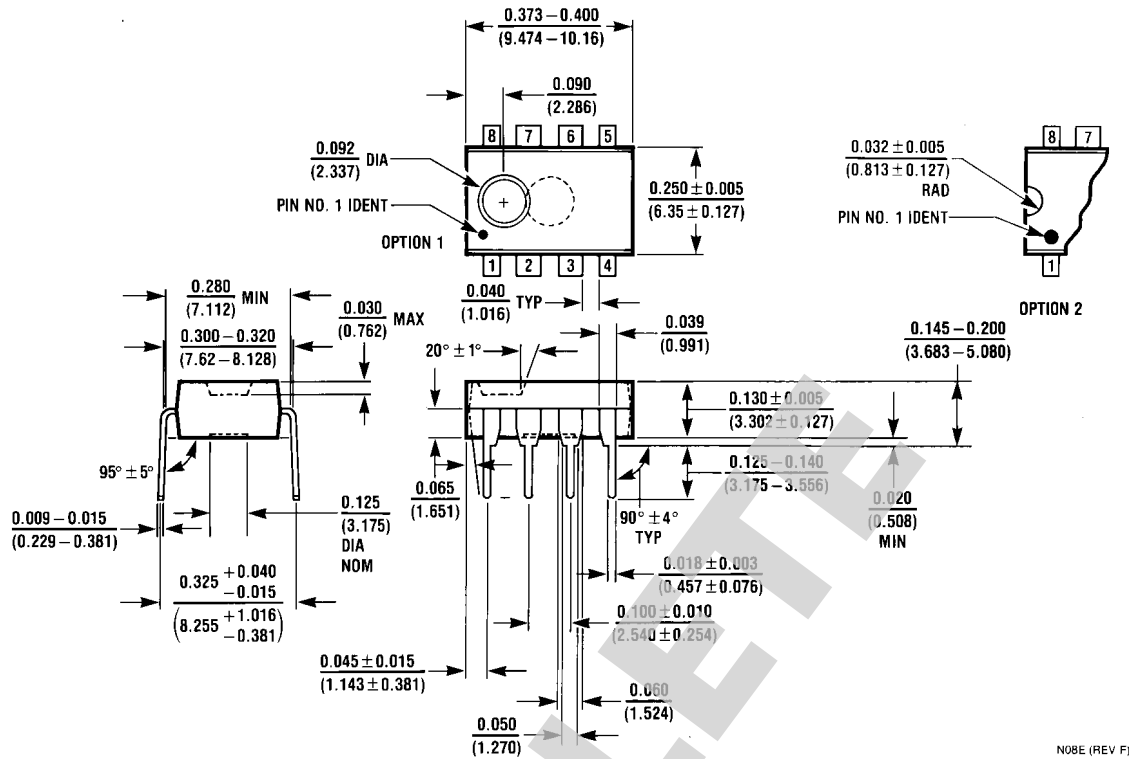
1147812



1147813



# Physical Dimensions inches (millimeters) unless otherwise noted



Dual-In-Line Package (N)  
Order Number LM748CN  
NS Package Number N08E

N08E (REV F)

## Notes

LM748

**OBSOLETE**

## Notes

For more National Semiconductor product information and proven design tools, visit the following Web sites at:  
[www.national.com](http://www.national.com)

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

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](http://www.national.com)

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

**National Semiconductor Europe Technical Support Center**  
 Email: [europe.support@nsc.com](mailto:europe.support@nsc.com)

**National Semiconductor Asia Pacific Technical Support Center**  
 Email: [ap.support@nsc.com](mailto:ap.support@nsc.com)

**National Semiconductor Japan Technical Support Center**  
 Email: [jpn.feedback@nsc.com](mailto:jpn.feedback@nsc.com)