

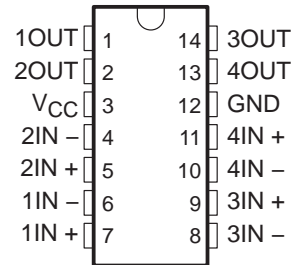
LP239, LP339, LP2901 LOW-POWER QUAD DIFFERENTIAL COMPARATORS

SLCS004B – OCTOBER 1987 – REVISED SEPTEMBER 2004

The LP239 is obsolete
and is no longer supplied.

- Wide Supply-Voltage Range . . . 3 V to 30 V
- Ultralow Power Supply Current
Drain . . . 60 μ A Typ
- Low Input Biasing Current . . . 3 nA
- Low Input Offset Current . . . ± 0.5 nA
- Low Input Offset Voltage . . . ± 2 mV
- Common-Mode Input Voltage Includes
Ground
- Output Voltage Compatible With MOS and
CMOS Logic
- High Output Sink-Current Capability
(30 mA at $V_O = 2V$)
- Power Supply Input Reverse-Voltage
Protected
- Single-Power-Supply Operation
- Pin-for-Pin Compatible With LM239, LM339,
LM2901

D OR N PACKAGE
(TOP VIEW)



description/ordering information

The LP239, LP339, LP2901 are low-power quadruple differential comparators. Each device consists of four independent voltage comparators designed specifically to operate from a single power supply and typically to draw 60- μ A drain current over a wide range of voltages. Operation from split power supplies also is possible and the ultra-low power-supply drain current is independent of the power-supply voltage.

Applications include limit comparators, simple analog-to-digital converters, pulse generators, squarewave generators, time-delay generators, voltage-controlled oscillators, multivibrators, and high-voltage logic gates. The LP239, LP339, LP2901 were designed specifically to interface with the CMOS logic family. The ultra-low power-supply current makes these products desirable in battery-powered applications.

The LP239 is characterized for operation from -25°C to 85°C . The LP339 is characterized for operation from 0°C to 70°C . The LP2901 is characterized for operation from -40°C to 85°C .

ORDERING INFORMATION

T_A	$V_{IO\text{MAX}}$ AT 25°C	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	± 5 mV	PDIP (N)	Tube of 25	LP339N	LP339N
		SOIC (D)	Tube of 50	LP339D	
			Reel of 2500	LP339DR	LP339
-40°C to 85°C	± 5 mV	PDIP (N)	Tube of 25	LP2901N	LP2901N
		SOIC (D)	Tube of 50	LP2901D	LP2901
			Reel of 2500	LP2901DR	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

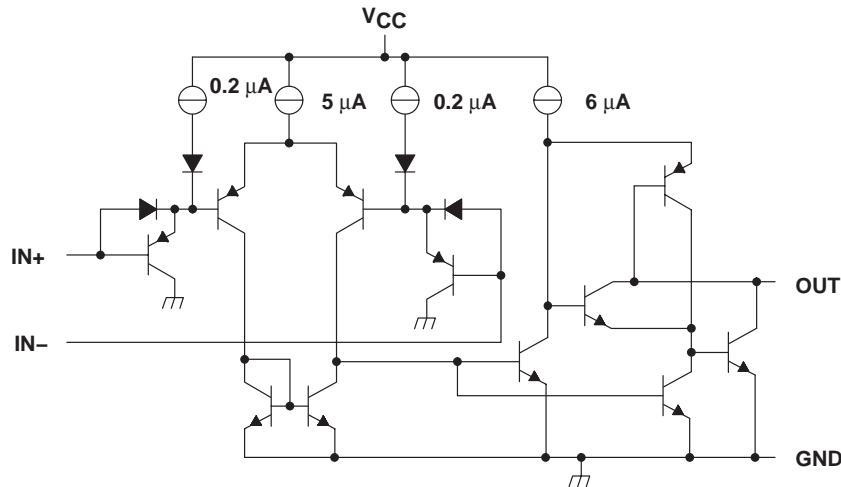
Copyright © 2004, Texas Instruments Incorporated

LP239, LP339, LP2901 LOW-POWER QUAD DIFFERENTIAL COMPARATORS

The LP239 is obsolete
and is no longer supplied.

SLCS004B – OCTOBER 1987 – REVISED SEPTEMBER 2004

schematic diagram (each comparator)



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, V_{CC} (see Note 1)	36 V
Differential input voltage, V_{ID} (see Note 2)	± 36 V
Input voltage range, V_I (either input)	-0.3 V to 36 V
Input current, $V_I \leq -0.3$ V (see Note 3)	-50 mA
Duration of output short-circuit to ground (see Note 4)	Unlimited
Continuous total dissipation (see Note 5)	See Dissipation Rating Table
Operating free-air temperature range, T_A : LP239	-25°C to 85°C
LP339	0°C to 70°C
LP2901	-40°C to 85°C
Package thermal impedance, θ_{JA} (see Notes 6 and 7): D package	86°C/W
N package	80°C/W
Operating virtual junction temperature, T_J	150°C
Lead temperature range 1,6 mm (1/16 inch) from case for 60 seconds: J package	300°C
Storage temperature range, T_{stg}	-65°C to 150°C

† Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the recommended operating conditions is not implied.

Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES:
- All voltage values, except differential voltages, are with respect to the network ground.
 - Differential voltages are at IN+ with respect to IN-.
 - This input current only exists when the voltage at any of the inputs is driven negative. The current flows through the collector-base junction of the input clamping device. In addition to the clamping device action, there is lateral n-p-n parasitic transistor action. This action is not destructive, and normal output states are reestablished when the input voltage returns to a value more positive than -0.3 V at $T_A = 25^\circ\text{C}$.
 - Short circuits between outputs to V_{CC} can cause excessive heating and eventual destruction.
 - If the output transistors are allowed to saturate, the low-bias dissipation and the on-off characteristics of the outputs keep the dissipation very small (usually less than 100 mW).
 - Maximum power dissipation is a function of $T_J(\text{max})$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can impact reliability.
 - The package thermal impedance is calculated in accordance with JESD 51-7.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING
J	1025 mW	8.2 mW/°C	656 mW	533 mW



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

LP239, LP339, LP2901 LOW-POWER QUAD DIFFERENTIAL COMPARATORS

The LP239 is obsolete
and is no longer supplied.

SLCS004B – OCTOBER 1987 – REVISED SEPTEMBER 2004

recommended operating conditions

		LP239		LP339		LP2901		UNIT	
		MIN	MAX	MIN	MAX	MIN	MAX		
V_{CC}	Supply voltage	3	30	3	30	3	30	V	
V_{IC}	Common-mode input voltage	$V_{CC} = 5\text{ V}$	0	3	0	3	0	3	V
		$V_{CC} = 30\text{ V}$	0	28	0	28	0	28	V
V_I	Input voltage	$V_{CC} = 5\text{ V}$	0	3	0	3	0	3	V
		$V_{CC} = 30\text{ V}$	0	28	0	28	0	28	V
T_A	Operating free-air temperature	-25	85	0	70	-40	85	°C	

electrical characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS		T_A^\dagger	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	$V_{CC} = 5\text{ V to } 30\text{ V}$, $R_S = 0$,	$V_O = 2\text{ V}$, See Note 6	25°C	±2	±5	mV
				Full range		±9	
I_{IO}	Input offset current			25°C	±0.5	±5	nA
				Full range	±1	±15	
I_{IB}	Input bias current	See Note 7		25°C	-2.5	-25	nA
				Full range	-4	-40	
V_{ICR}	Common-mode input voltage range	Single supply		25°C	0 to $V_{CC} - 1.5$		V
				Full range	0 to $V_{CC} - 2$		
A_{VD}	Large-signal differential voltage amplification	$V_{CC} = 15\text{ V}$,	$R_L = 15\text{ k}\Omega$		500		V/mV
	Output sink current	$V_{I-} = 1\text{ V}$, $V_{I+} = 0$	$V_O = 2\text{ V}$, See Note 8	25°C	20	30	mA
				Full range	15		
			$V_O = 0.4\text{ V}$	25°C	0.2	0.7	
	Output leakage current	$V_{I+} = 1\text{ V}$, $V_{I-} = 0$	$V_O = 5\text{ V}$	25°C	0.1		nA
				Full range		1	µA
			$V_O = 30\text{ V}$				
V_{ID}	Differential input voltage	$V_I \leq 0$ (or V_{CC-} on split supplies)				36	V
I_{CC}	Supply current	$R_L = \infty$ all comparators			60	100	µA

† Full range is -25°C to 85°C for the LP239, 0°C to 70°C for the LP339, and -40°C to 85°C for the LP2901.

NOTES: 8. V_{IO} is measured over the full common-mode input voltage range.

9. Because of the p-n-p input stage, the direction of the current is out of the device. This current essentially is constant (i.e., independent of the output state). No loading change exists on the reference or input lines as long as the common-mode input voltage range is not exceeded.

10. The output sink current is a function of the output voltage. These devices have a bimodal output section that allows them to sink (via a Darlington connection) large currents at output voltages greater than 1.5 V, and smaller currents at output voltages less than 1.5 V.

switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, R_L connected to 5 V through 5.1 kΩ

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Large-signal response time	TTL logic swing, $V_{Ref} = 1.4\text{ V}$		1.3		µs
Response time			8		



APPLICATION INFORMATION

Figure 1 shows the basic configuration for using the LP239, LP339, or LP2901 comparator. Figure 2 shows the diagram for using one of these comparators as a CMOS driver.

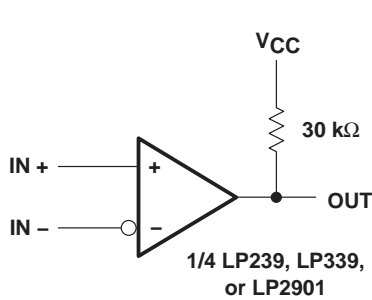


Figure 1. Basic Comparator

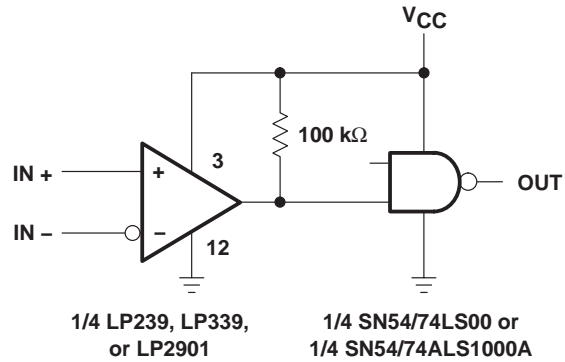


Figure 2. CMOS Driver

All pins of any unused comparators should be grounded. The bias network of the LP239, LP339, and LP2901 establishes a drain current that is independent of the magnitude of the power-supply voltage over the range of 2 V to 30 V. It usually is necessary to use a bypass capacitor across the power supply line.

The differential input voltage may be larger than V_{CC} without damaging the device. Protection should be provided to prevent the input voltages from going negative by more than -0.3 V. The output section has two distinct modes of operation: a Darlington mode and ground-emitter mode. This unique drive circuit permits the device to sink 30 mA at $V_O = 2$ V in the Darlington mode and 700 μ A at $V_O = 0.4$ V in the ground-emitter mode. Figure 3 is a simplified schematic diagram of the output section. The output section is configured in a Darlington connection (ignoring Q3). If the output voltage is held high enough (above 1 V), Q1 is not saturated and the output current is limited only by the product of the h_{FE} of Q1, the h_{FE} of Q2, and I1 and the 60- Ω saturation resistance of Q2. The devices are capable of driving LEDs, relays, etc. in this mode while maintaining an ultra-low power-supply current of 60 μ A, typically.

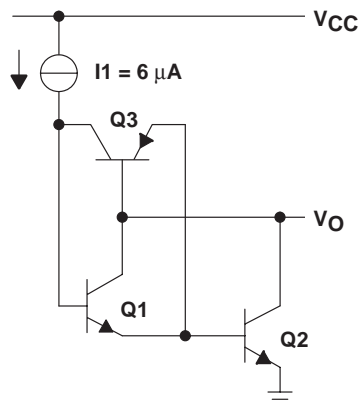


Figure 3. Output-Section Schematic Diagram

The LP239 is obsolete
and is no longer supplied.

APPLICATION INFORMATION

Without transistor Q3, if the output voltage were allowed to drop below 0.8 V, transistor Q1 would saturate, and the output current would drop to zero. The circuit would be unable to pull low current loads down to ground or the negative supply, if used. Transistor Q3 has been included to bypass transistor Q1 under these conditions and apply the current I_1 directly to the base of Q2. The output sink current now is approximately I_1 times the h_{FE} of Q2 (700 μ A at $V_O = 0.4$ V). The output of the devices exhibits a bimodal characteristic, with a smooth transition between modes.

In both cases, the output is an uncommitted collector. Several outputs can be tied together to provide a dot logic function. An output pullup resistor can be connected to any available power-supply voltage within the permitted power-supply range, and there is no restriction on this voltage, based on the magnitude of the voltage that is supplied to V_{CC} of the package.

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
LP239D	OBSOLETE	SOIC	D	14		None	Call TI	Call TI
LP239N	OBSOLETE	PDIP	N	14		None	Call TI	Call TI
LP2901D	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
LP2901DR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
LP2901N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
LP339D	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
LP339DR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
LP339N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN

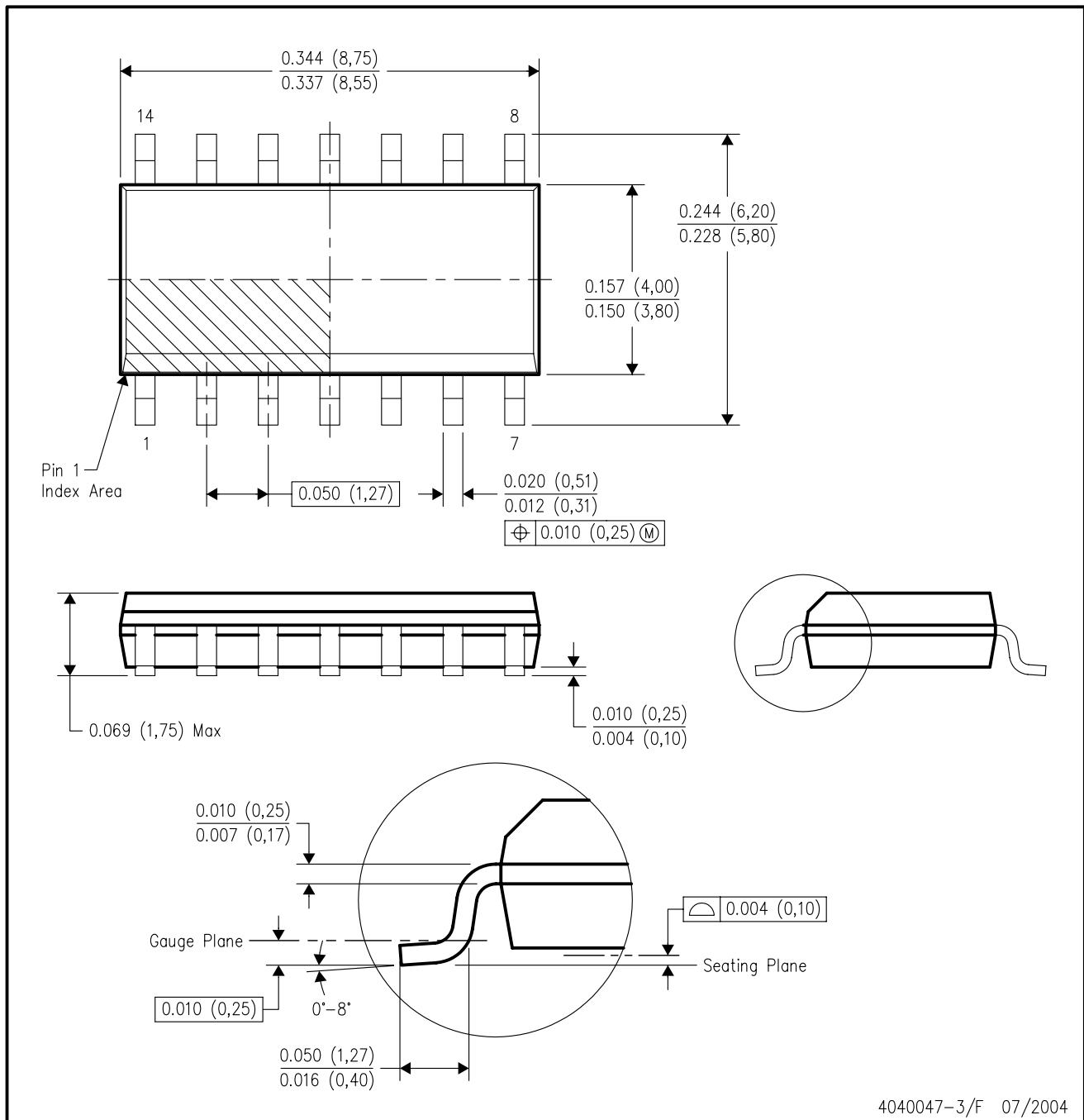


- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - $\triangle D$ The 20 pin end lead shoulder width is a vendor option, either half or full width.

4040049/E 12/2002

D (R-PDSO-G14)

PLASTIC SMALL-OUTLINE PACKAGE



4040047-3/F 07/2004

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.

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
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265

This datasheet has been download from:

www.datasheetcatalog.com

Datasheets for electronics components.