

# SN54LS682, SN54LS684, SN54LS685, SN54LS687, SN54LS688, SN74LS682, SN74LS684 THRU SN74LS688 8-BIT MAGNITUDE/IDENTITY COMPARATORS

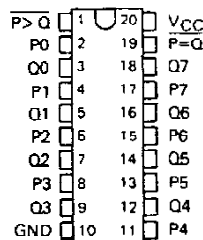
D2617, JANUARY 1981—REVISED MARCH 1988

SDLS008

- Compares Two-8-Bit Words
- Choice of Totem-Pole or Open-Collector Outputs
- Hysteresis at P and Q Inputs
- 'LS682 has 20-kΩ Pullup Resistors on the Q Inputs
- SN74LS686 and 'LS687 . . . JT and NT 24-Pin, 300-Mil Packages

SN54LS682, SN54LS684, SN54LS685 . . . J PACKAGE  
SN74LS682, SN74LS684, SN74LS685 . . . DW OR N PACKAGE

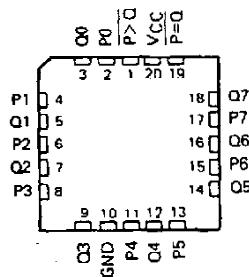
(TOP VIEW)



TYPE	P = Q	P > Q	OUTPUT ENABLE	OUTPUT CONFIGURATION	20-kΩ PULLUP
'LS682	yes	yes	no	totem-pole	yes
'LS684	yes	yes	no	totem-pole	no
'LS685	yes	yes	no	open-collector	no
SN74LS686	yes	yes	yes	totem-pole	no
'LS687	yes	yes	yes	open-collector	no
'LS688	yes	no	yes	totem-pole	no

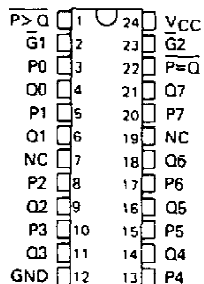
SN54LS682, SN54LS684, SN54LS685 . . . FK PACKAGE

(TOP VIEW)



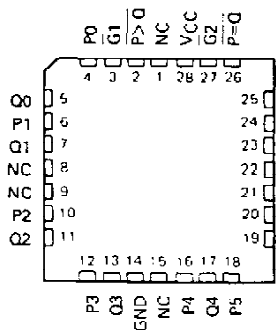
SN54LS687 . . . JT PACKAGE  
SN74LS686, SN74LS687 . . . DW OR NT PACKAGE

(TOP VIEW)



SN54LS687 . . . FK PACKAGE

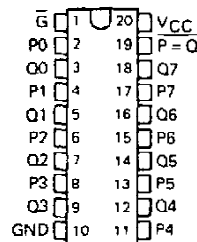
(TOP VIEW)



NC—No internal connection

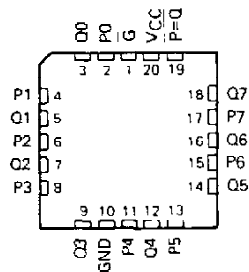
SN54LS688 . . . J PACKAGE  
SN74LS688 . . . DW OR N PACKAGE

(TOP VIEW)



SN54LS688 . . . FK PACKAGE

(TOP VIEW)



PRODUCTION DATA documents contain information 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.



POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

# SN54LS682, SN54LS684, SN54LS685, SN54LS687, SN54LS688 SN74LS682, SN74LS684 THRU SN74LS688 8-BIT MAGNITUDE/IDENTITY COMPARATORS

## description

These magnitude comparators perform comparisons of two eight-bit binary or BCD words. All types provide  $\overline{P=Q}$  outputs and all except 'LS688 provide  $\overline{P>Q}$  outputs as well. The 'LS682, 'LS684, 'LS686, and 'LS688 have totem-pole outputs, while the 'LS685 and 'LS687 have open-collector outputs. The 'LS682 features 20-k $\Omega$  pullup termination resistors on the Q inputs for analog or switch data.

FUNCTION TABLE

DATA P, Q	ENABLES		OUTPUTS	
	$\overline{G1}$ , $\overline{G1}$	$\overline{G2}$	$\overline{P=Q}$	$\overline{P>Q}$
P=Q	L	X	L	H
P>Q	X	L	H	L
P<Q	X	X	H	H
P=Q	H	X	H	H
P>Q	X	H	H	H
X	H	H	H	H

- NOTES: 1. The last three lines of the function table applies only to the devices having enable inputs, i.e., 'LS686 thru 'LS688.
2. The  $\overline{P<Q}$  function can be generated by applying the  $\overline{P=Q}$  and  $\overline{P>Q}$  outputs to a 2-input NAND gate.
3. For 'LS686 and 'LS687,  $\overline{G1}$  enables  $\overline{P=Q}$  and  $\overline{G2}$  enables  $\overline{P>Q}$ .

## logic symbols†



†These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for DW, J, JT, N, and NT packages.

**SN54LS682, SN54LS684, SN54LS685, SN54LS687, SN54LS688,  
SN74LS682, SN74LS684 THRU SN74LS688  
8-BIT MAGNITUDE/IDENTITY COMPARATORS**

logic symbols† (continued)



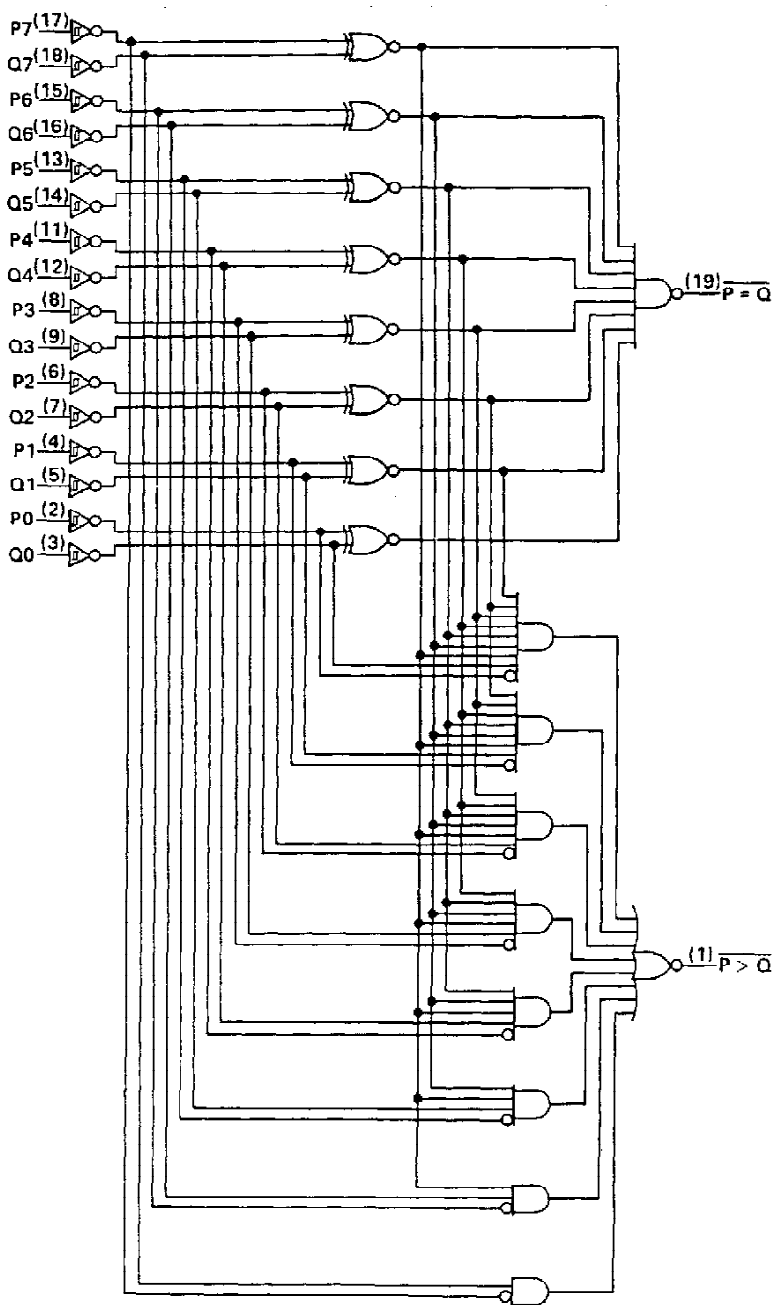
†These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for DW, J, JT, N, and NT packages.

**schematics of inputs and outputs**



**SN54LS682, SN54LS684, SN54LS685  
 SN74LS682, SN74LS684, SN74LS685  
 8-BIT MAGNITUDE/IDENTITY COMPARATORS**

LS682, LS684, LS685 logic diagram (positive logic)



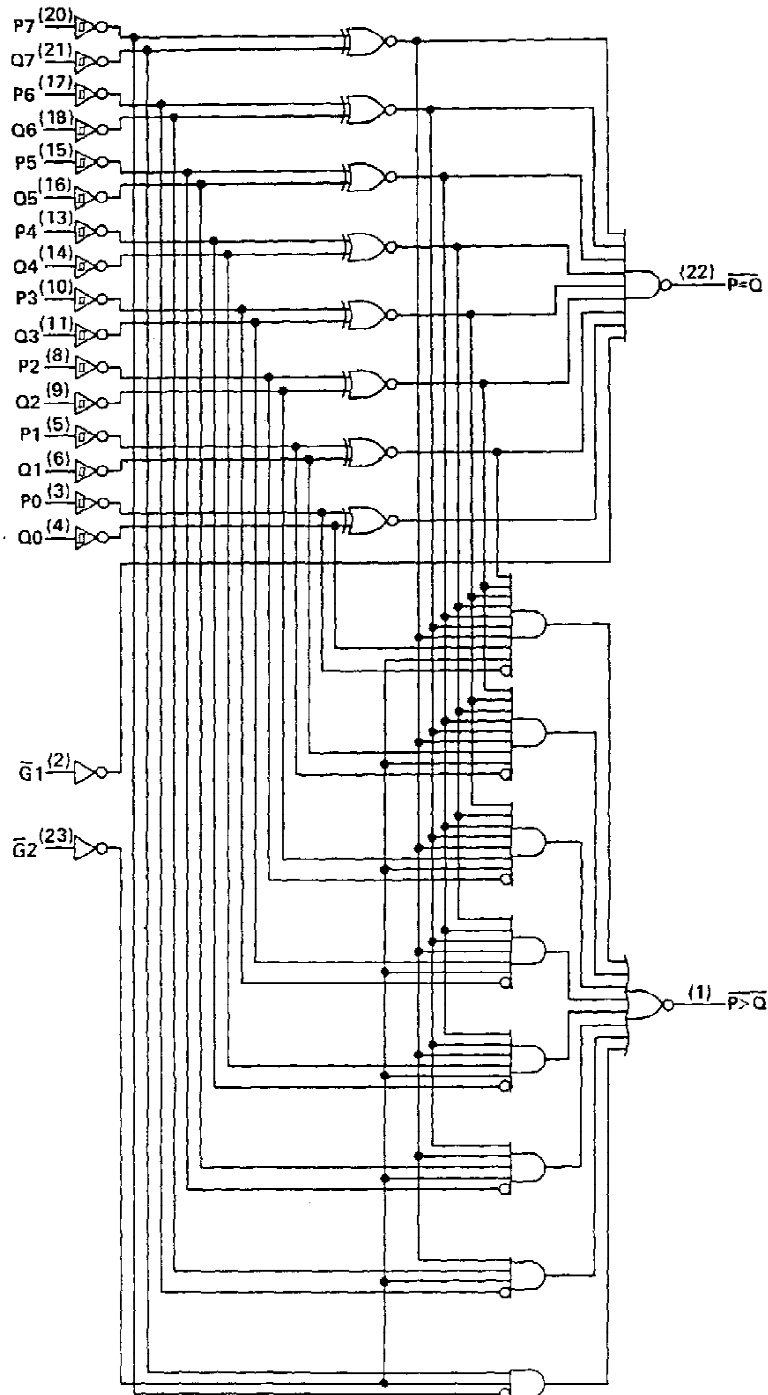
Pin numbers shown are for DW, J, and N packages.

**TEXAS**   
**INSTRUMENTS**

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

**SN54LS687**  
**SN74LS686, SN74LS687**  
**8-BIT MAGNITUDE/IDENTITY COMPARATORS**

'LS686, 'LS687 logic diagram (positive logic)



Pin numbers shown are for DW, JT, and NT packages.

  
**TEXAS**  
**INSTRUMENTS**

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

**SN54LS682, SN54LS684, SN54LS685, SN54LS687, SN54LS688  
SN74LS682, SN74LS684 THRU SN74LS688  
8-BIT IDENTITY COMPARATORS**

'LS688 logic diagram (positive logic)



Pin numbers shown are for DW, J, and N packages.

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

Supply voltage, $V_{CC}$ (see Note 1) .....	7 V
Input voltage: Q inputs of 'LS682 .....	5.5 V
All other inputs .....	7 V
Off-state output voltage: 'LS685, 'LS687 .....	7 V
Operating free-air temperature range:	
SN54LS682, SN54LS684, SN54LS685, SN54LS687, SN54LS688 .....	-55 °C to 125 °C
SN74LS682, SN74LS684 thru SN74LS688 .....	0 °C to 70 °C
Storage temperature range .....	-65 °C to 150 °C

NOTE 1: Voltage values are with respect to network ground terminal.



POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

**SN54LS682, SN54LS684, SN54LS688  
SN74LS682, SN74LS684, SN74LS686, SN74LS688  
8-BIT MAGNITUDE/IDENTITY COMPARATORS WITH TOTEM-POLE OUTPUTS**

**recommended operating conditions**

	SN54LS'			SN74LS'			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, $V_{CC}$	4.5	5	5.5	4.85	5	5.25	V
High-level output current, $I_{OH}$			-400			-400	$\mu$ A
Low-level output current, $I_{OL}$			12			24	mA
Operating free-air temperature, $T_A$	-55		125	0		70	$^{\circ}$ C

**electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)**

PARAMETER		TEST CONDITIONS†	SN54LS'			SN74LS'			UNIT
			MIN	TYP‡	MAX	MIN	TYP‡	MAX	
$V_{IH}$	High-level input voltage		2			2			V
$V_{IL}$	Low-level input voltage				0.7			0.8	V
$V_{T+} - V_{T-}$	Hysteresis	P or Q inputs		0.4			0.4		V
$V_{IK}$	Input clamp voltage	$V_{CC} = \text{MIN}$			-1.5			-1.5	V
$V_{OH}$	High-level output voltage	$V_{CC} = \text{MIN}$ , $V_{IH} = 2 \text{ V}$ , $V_{IL} = V_{IL\text{max}}$ , $I_{OH} = -400 \mu\text{A}$	2.5			2.7			V
$V_{OL}$	Low-level output voltage	$V_{CC} = \text{MIN}$ , $V_{IH} = 2 \text{ V}$ , $V_{IL} = V_{IL\text{max}}$	$I_{OL} = 12 \text{ mA}$	0.25	0.4	0.25	0.4		V
			$I_{OL} = 24 \text{ mA}$			0.35	0.5		
$I_I$	Input current at maximum input voltage	Q inputs, 'LS682	$V_{CC} = \text{MAX}$ , $V_I = 5.5 \text{ V}$					0.1	mA
		All other inputs	$V_{CC} = \text{MAX}$ , $V_I = 7 \text{ V}$					0.1	
$I_{IH}$	High-level input current		$V_{CC} = \text{MAX}$ , $V_I = 2.7 \text{ V}$		20		20		$\mu$ A
$I_{IL}$	Low-level input current	Q inputs, 'LS682	$V_{CC} = \text{MAX}$ , $V_I = 0.4 \text{ V}$		-0.4		-0.4		mA
		All other inputs			-0.2		-0.2		
$I_{OS}^{\S}$	Short-circuit output current		$V_{CC} = \text{MAX}$ , $V_O = 0$	-20	-100	-20	-100		mA
$I_{CC}$	Supply current	'LS682	$V_{CC} = \text{MAX}$ , See Note 1	42	70	42	70		mA
		'LS684		40	65	40	65		
		'LS686		44	75	44	75		
		'LS688		40	65	40	65		

† For conditions shown as MIN or MAX, use the appropriate values specified under recommended operating conditions.

‡ All typical values are at  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^{\circ}\text{C}$ .

§ Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

NOTE 1:  $I_{CC}$  is measured with any  $\bar{Q}$  inputs grounded, all other inputs at 4.5 V, and all outputs open.

TEXAS  
INSTRUMENTS

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

**SN54LS682, SN54LS684, SN54LS688**  
**SN74LS682, SN74LS684, SN74LS686, SN74LS688**  
**8-BIT MAGNITUDE/IDENTITY COMPARATORS WITH TOTEM-POLE OUTPUTS**

switching characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER†	FROM (INPUTS)	TO (OUTPUT)	TEST CONDITIONS	'LS682		'LS684		'LS686		'LS688		UNIT
				MIN	TYP MAX	MIN	TYP MAX	MIN	TYP MAX	MIN	TYP MAX	
$t_{PLH}$	P	$\overline{P=Q}$	$R_L = 667\ \Omega$ , $C_L = 45\ \text{pF}$ , All other inputs low, See Note 2	13	25	15	25	13	25	12	18	ns
$t_{PHL}$				15	25	17	25	20	30	17	23	
$t_{PLH}$	Q	$\overline{P=Q}$		14	25	16	25	13	25	12	18	ns
$t_{PHL}$				15	25	15	25	21	30	17	23	
$t_{PLH}$	$\overline{Q}, \overline{Q}1$	$\overline{P=Q}$						11	20	12	18	ns
$t_{PHL}$								19	30	13	20	
$t_{PLH}$	P	$\overline{P>Q}$			20	30	22	30	19	30		ns
$t_{PHL}$					15	30	17	30	15	30		
$t_{PLH}$	Q	$\overline{P>Q}$			21	30	24	30	18	30		ns
$t_{PHL}$					19	30	20	30	19	30		
$t_{PLH}$	$\overline{Q}2$	$\overline{P>Q}$							21	30		ns
$t_{PHL}$									16	25		

† $t_{PLH}$  = propagation delay time, low-to-high-level outputs;  $t_{PHL}$  = propagation delay time, high-to-low-level output.  
 NOTE 2: Load circuits and voltage waveforms are shown in Section 1.



**SN54LS685, SN54LS687**  
**SN74LS685, SN74LS687, SN74LS688**

**8-BIT MAGNITUDE/IDENTITY COMPARATORS WITH TOTEM-POLE OUTPUTS**

**recommended operating conditions**

	SN54LS <sup>†</sup>			SN74LS <sup>†</sup>			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, $V_{CC}$	4.5	5	5.5	4.85	5	5.25	V
High-level output current, $I_{OH}$			5.5			5.5	V
Low-level output current, $I_{OL}$			12			24	mA
Operating free-air temperature, $T_A$	-55		125	0		70	°C

**electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)**

PARAMETER		TEST CONDITIONS <sup>†</sup>	SN54LS <sup>†</sup>			SN74LS <sup>†</sup>			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IH}$	High-level input voltage		2			2			V	
$V_{IL}$	Low-level input voltage				0.7			0.8	V	
$V_{T+} - V_{T-}$	Hysteresis	P or Q inputs	0.4			0.4			V	
$V_{IK}$	Input clamp voltage	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$			-1.5			-1.5	V	
$I_{OH}$	High-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{ILmax}, V_{OH} = 5.5 \text{ V}$			250			100	$\mu\text{A}$	
$V_{OL}$	Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{ILmax}$	$I_{OL} = 12 \text{ mA}$		0.25	0.4	$I_{OL} = 12 \text{ mA}$		0.25	0.4
			$I_{OL} = 24 \text{ mA}$				$I_{OL} = 24 \text{ mA}$		0.35	0.5
$I_I$		$V_{CC} = \text{MAX}, V_I = 7 \text{ V}$			0.1			0.1	mA	
$I_{IH}$	High-level input current	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$			20			20	$\mu\text{A}$	
$I_{IL}$	Low-level input current	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$			-0.2			-0.2	mA	
$I_{CC}$	Supply current	$V_{CC} = \text{MAX},$ See Note 1	'LS685		40	65	'LS687		40	65
			'LS687		44	75	'LS687		44	75

<sup>†</sup>For conditions shown as MIN or MAX, use the appropriate values specified under recommended operating conditions.

<sup>‡</sup>All typical values are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ .

NOTE 1:  $I_{CC}$  is measure with any  $\bar{Q}$  inputs grounded, all other inputs at 4.5 V, and all outputs open.



**SN54LS685, SN54LS687**  
**SN74LS685, SN74LS687**  
**8-BIT MAGNITUDE/IDENTITY COMPARATORS WITH OPEN-COLLECTOR OUTPUTS**

switching characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS685			'LS687			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
$t_{PLH}$	P	$\overline{P=Q}$	$R_L = 667\ \Omega$ , $C_L = 45\ \text{pF}$ , All other inputs low, See Note 2	30	45		24	35	ns	
$t_{PHL}$				19	35		20	30		
$t_{PLH}$	Q	$\overline{P=Q}$		24	45		24	35	ns	
$t_{PHL}$				23	35		20	30		
$t_{PLH}$	$\overline{Q}, \overline{Q1}$	$\overline{P=Q}$					21	35	ns	
$t_{PHL}$							18	30		
$t_{PLH}$	P	$\overline{P>Q}$			32	45		24	35	ns
$t_{PHL}$					16	35		16	30	
$t_{PLH}$	Q	$\overline{P>Q}$			30	45		24	35	ns
$t_{PHL}$					20	35		16	30	
$t_{PLH}$	$\overline{Q2}$	$\overline{P>Q}$				24	35	ns		
$t_{PHL}$						15	30			

$t_{PLH}$  = propagation delay time, low-to-high-level outputs;  $t_{PHL}$  = propagation delay time, high-to-low-level output.  
 NOTE 2: Load circuits and voltage waveforms are shown in Section 1.



## IMPORTANT NOTICE

Texas Instruments (TI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

TI warrants performance of its semiconductor products and related software to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Certain applications using semiconductor products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications").

TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS.

Inclusion of TI products in such applications is understood to be fully at the risk of the customer. Use of TI products in such applications requires the written approval of an appropriate TI officer. Questions concerning potential risk applications should be directed to TI through a local SC sales office.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor does TI 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 of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used.

## **IMPORTANT NOTICE**

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

**CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.**

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. 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 of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.