

# SN54LS240, SN54LS241, SN54LS244, SN54S240, SN54S241, SN54S244, SN74LS240, SN74LS241, SN74LS244, SN74S240, SN74S241, SN74S244 OCTAL BUFFERS AND LINE DRIVERS WITH 3-STATE OUTPUTS

SDLS144

APRIL 1985—REVISED MARCH 1988

- 3-State Outputs Drive Bus Lines or Buffer Memory Address Registers
- PNP Inputs Reduce D-C Loading
- Hysteresis at Inputs Improves Noise Margins

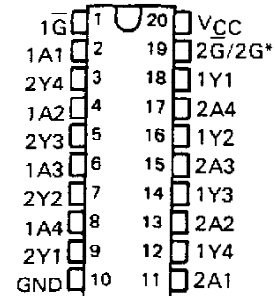
## description

These octal buffers and line drivers are designed specifically to improve both the performance and density of three-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters. The designer has a choice of selected combinations of inverting and noninverting outputs, symmetrical  $\bar{G}$  (active-low output control) inputs, and complementary  $\bar{G}$  and  $\bar{G}$  inputs. These devices feature high fan-out, improved fan-in, and 400-mV noise-margin. The SN74LS' and SN74S' can be used to drive terminated lines down to 133 ohms.

The SN54' family is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74' family is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

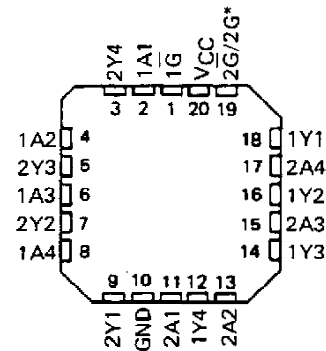
SN54LS', SN54S' ... J OR W PACKAGE  
SN74LS', SN74S' ... DW OR N PACKAGE

(TOP VIEW)



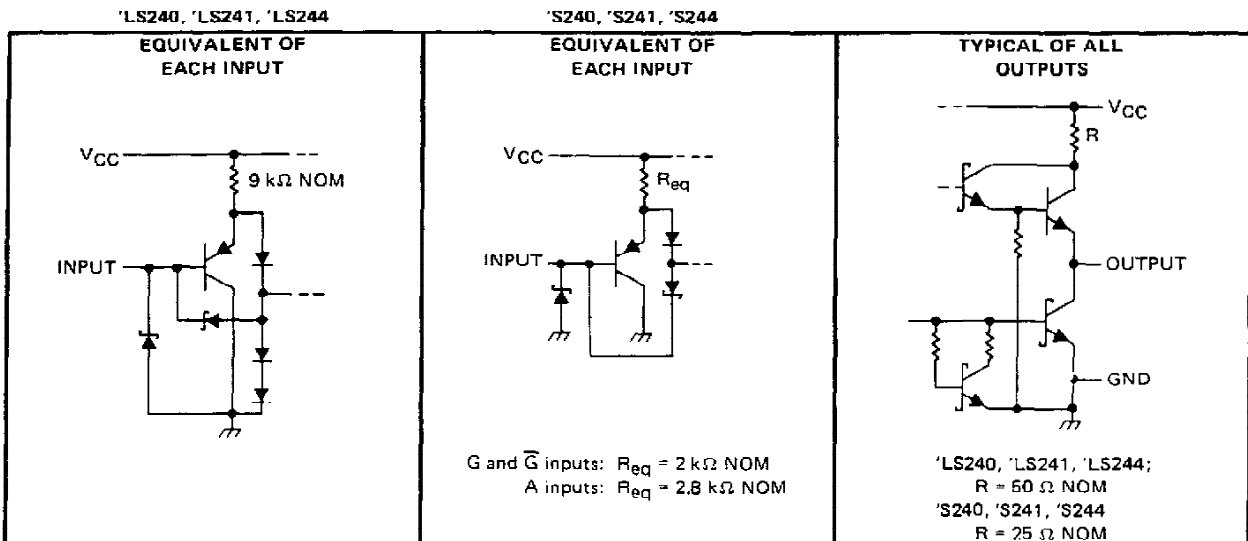
SN54LS', SN54S' ... FK PACKAGE

(TOP VIEW)



\*2G for 'LS241 and 'S241 or 2G for all other drivers.

## schematics of inputs and outputs



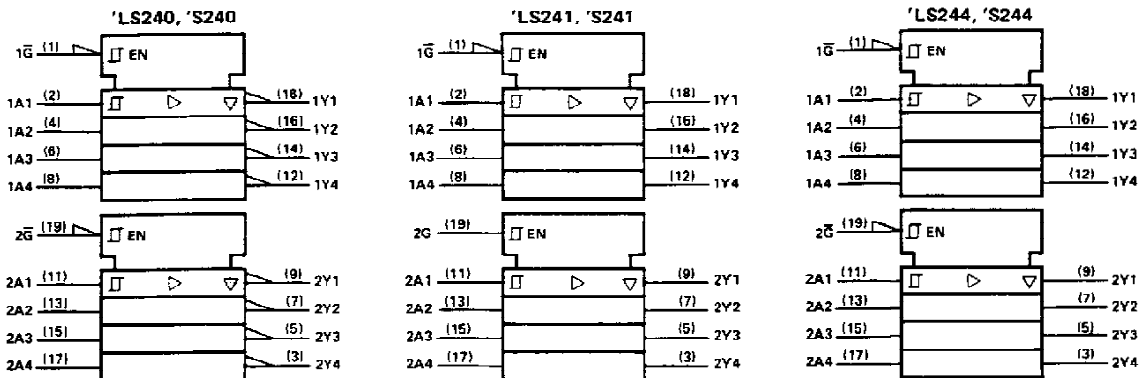
PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

TEXAS  
INSTRUMENTS

POST OFFICE BOX 656012 • DALLAS, TEXAS 75265

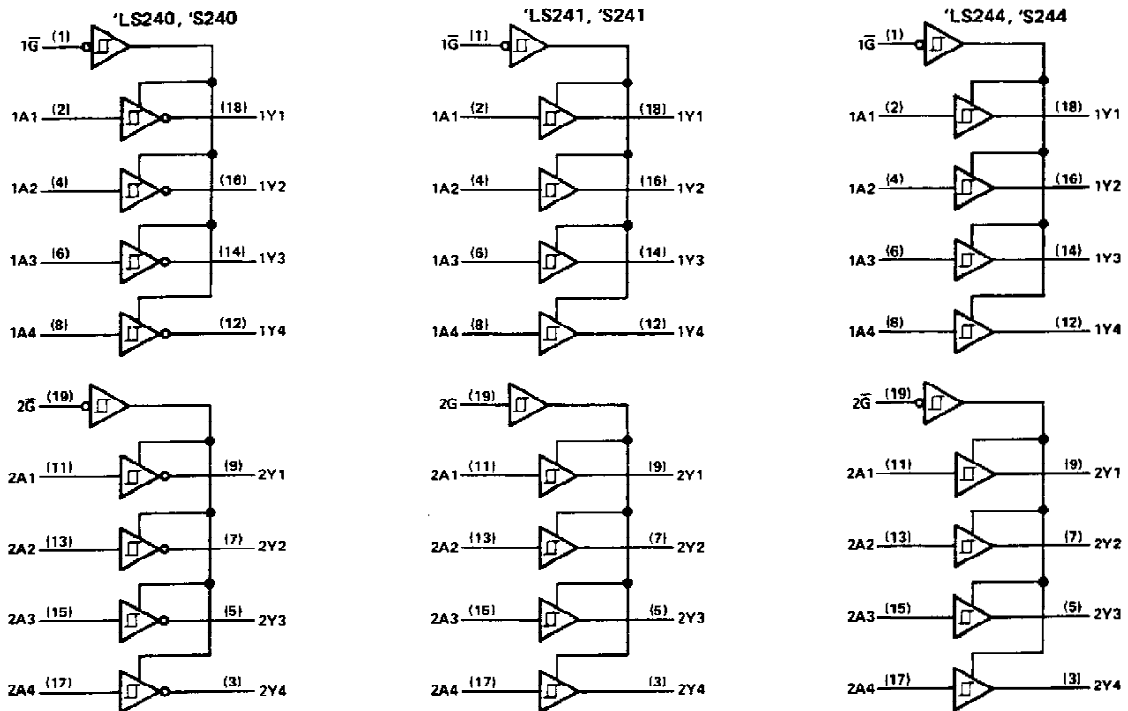
# SN54LS240, SN54LS241, SN54LS244, SN54S240, SN54S241, SN54S244, SN74SL240, SN74LS241, SN74LS244, SN74S240, SN74S241, SN74S244 OCTAL BUFFERS AND LINE DRIVERS WITH 3-STATE OUTPUTS

## logic symbols†



†These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.

## logic diagrams (positive logic)



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

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

Supply voltage, $V_{CC}$ (see Note 1) . . . . .	7 V
Input voltage: 'LS Circuits . . . . .	7 V
'S Circuits . . . . .	5.5 V
Off-state output voltage . . . . .	5.5 V
Operating free-air temperature range: SN54LS', SN54S' Circuits . . . . .	-55° C to 125° C
SN74LS', SN74S' Circuits . . . . .	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

# SN54LS240, SN54LS241, SN54LS244, SN74LS240, SN74LS241, SN74LS244 OCTAL BUFFERS AND LINE DRIVERS WITH 3-STATE OUTPUTS

## recommended operating conditions

PARAMETER	SN54LS'			SN74LS'			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub> Supply voltage (see Note 1)	4.5	5	5.5	4.75	5	5.25	V
V <sub>IH</sub> High-level input voltage	2			2			V
V <sub>IL</sub> Low-level input voltage			0.7			0.8	V
I <sub>OH</sub> High-level output current			-12			-15	mA
I <sub>OL</sub> Low-level output current			12			24	mA
T <sub>A</sub> Operating free-air temperature	-55		125	0		70	°C

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

## 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 <sub>IK</sub>	V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 mA			-1.5			-1.5	V
Hysteresis (V <sub>T+</sub> - V <sub>T-</sub> )	V <sub>CC</sub> = MIN	0.2	0.4		0.2	0.4		V
V <sub>OH</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = MAX, I <sub>OH</sub> = -3 mA	2.4	3.4		2.4	3.4		V
	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.5 V, I <sub>OH</sub> = MAX	2			2			
V <sub>OL</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, I <sub>OL</sub> = 12 mA, V <sub>IL</sub> = MAX			0.4			0.4	V
	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, I <sub>OL</sub> = 24 mA, V <sub>IL</sub> = MAX						0.5	
I <sub>OZH</sub>	V <sub>CC</sub> = MAX, V <sub>IH</sub> = 2 V, V <sub>O</sub> = 2.7 V			20			20	μA
I <sub>OZL</sub>	V <sub>IL</sub> = MAX, V <sub>O</sub> = 0.4 V			-20			-20	
I <sub>I</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 7 V			0.1			0.1	mA
I <sub>IH</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V			20			20	μA
I <sub>IL</sub>	V <sub>CC</sub> = MAX, V <sub>IL</sub> = 0.4 V			-0.2			-0.2	mA
I <sub>OSS</sub> §	V <sub>CC</sub> = MAX	-40		-225	-40		-225	mA
I <sub>CC</sub>	V <sub>CC</sub> = MAX, Output open	Outputs high	All	17	27	17	27	mA
		Outputs low	'LS240	26	44	26	44	
		All outputs disabled	'LS241, 'LS244	27	46	27	46	
			'LS240	29	50	29	50	
'LS241, 'LS244	32	54	32	54				

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

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

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

## switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

PARAMETER	TEST CONDITIONS	'LS240			'LS241, 'LS244			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
t <sub>PLH</sub>	R <sub>L</sub> = 667 Ω, C <sub>L</sub> = 45 pF, See Note 2		9	14		12	18	ns
t <sub>PHL</sub>			12	18		12	18	ns
t <sub>PZL</sub>			20	30		20	30	ns
t <sub>PZH</sub>			15	23		15	23	ns
t <sub>PLZ</sub>	R <sub>L</sub> = 667 Ω, C <sub>L</sub> = 5 pF, See Note 2		10	20		10	20	ns
t <sub>PHZ</sub>			15	25		15	25	ns

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

  
**TEXAS**  
**INSTRUMENTS**

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

# SN54S240, SN54S241, SN54S244, SN74S240, SN74S241, SN74S244, OCTAL BUFFERS AND LINE DRIVERS WITH 3-STATE OUTPUTS

## recommended operating conditions

PARAMETER	SN54S'			SN74S'			UNIT	
	MIN	NOM	MAX	MIN	NOM	MAX		
$V_{CC}$ Supply voltage, (see Note 1)	4.5	5	5.5	4.75	5	5.25	V	
$V_{IH}$ High-level input voltage	2			2			V	
$V_{IL}$ Low-level input voltage	0.8			0.8			V	
$I_{OH}$ High-level output current	-12			-15			mA	
$I_{OL}$ Low-level output current	48			64			mA	
External resistance between any input and $V_{CC}$ or ground	40			40			k $\Omega$	
$T_A$ Operating free-air temperature (see Note 3)	-55			125			0	$^{\circ}$ C

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

3. An SN54S241J operating at free-air temperature above 116 $^{\circ}$ C requires a heat sink that provides a thermal resistance from case to free-air  $R_{\theta CA}$ , of not more than 40 $^{\circ}$ C/W.

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

PARAMETER	TEST CONDITIONS†		SN54S'			SN74S'			UNIT	
			MIN	TYP‡	MAX	MIN	TYP‡	MAX		
$V_{IK}$	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$		-1.2			-1.2			V	
Hysteresis ( $V_{T+} - V_{T-}$ )	$V_{CC} = \text{MIN}$		0.2	0.4		0.2	0.4		V	
$V_{OH}$	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OH} = -1 \text{ mA}$					2.7			V	
	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OH} = -3 \text{ mA}$		2.4	3.4		2.4	3.4			
	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.5 \text{ V}, I_{OH} = \text{MAX}$		2			2				
$V_{OL}$	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OL} = \text{MAX}$		0.55			0.55			V	
$I_{OZH}$	$V_{CC} = \text{MAX}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, V_O = 2.4 \text{ V}$		50			50			$\mu$ A	
$I_{OZL}$	$V_{CC} = \text{MAX}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, V_O = 0.5 \text{ V}$		-50			-50				
$I_I$	$V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$		1			1			mA	
$I_{IH}$	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$		50			50			$\mu$ A	
$I_{IL}$	Any A	$V_{CC} = \text{MAX}, V_I = 0.5 \text{ V}$		-400			-400			$\mu$ A
	Any G			-2			-2			mA
$I_{OS}\S$	$V_{CC} = \text{MAX}$		-50	-225		-50	-225		mA	
$I_{CC}$	Outputs high	$V_{CC} = \text{MAX},$	Outputs open	'S240	80	123	80	135	mA	
				'S241, 'S244	95	147	95	160		
	Outputs low			'S240	100	145	100	150		
				'S241, 'S244	120	170	120	180		
				Outputs disabled	'S240	100	145	100		150
'S241, 'S244	120	170	120		180					

† For conditions shown as MIN or MAX, use the appropriate value 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.



**SN54S240, SN54S241, SN54S244, SN74S240, SN74S241, SN74S244,  
OCTAL BUFFERS AND LINE DRIVERS WITH 3-STATE OUTPUTS**

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

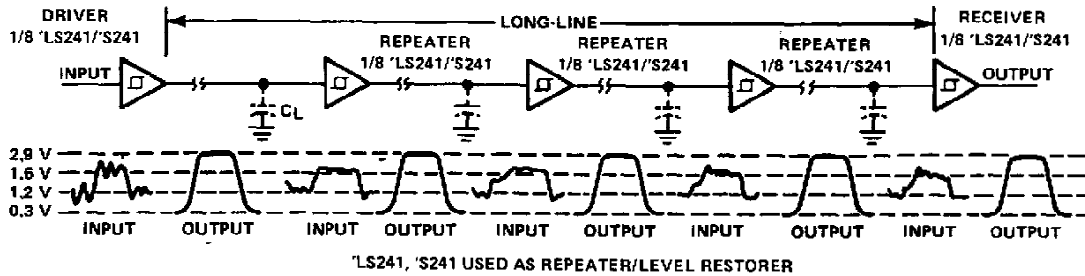
PARAMETER	TEST CONDITIONS	'S240			'S241, 'S244			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
$t_{PLH}$	$R_L = 90\ \Omega$ , See Note 4 $C_L = 50\text{ pF}$ ,	4.5		7		6	9	ns
$t_{PHL}$		4.5		7		6	9	ns
$t_{PZL}$		10		15		10	15	ns
$t_{PZH}$		6.5		10		8	12	ns
$t_{PLZ}$	$R_L = 90\ \Omega$ , See Note 4 $C_L = 5\text{ pF}$ ,	10		15		10	15	ns
$t_{PHZ}$		6		9		6	9	ns

NOTE 4: Load circuits and voltage waveforms are shown in Section 1.

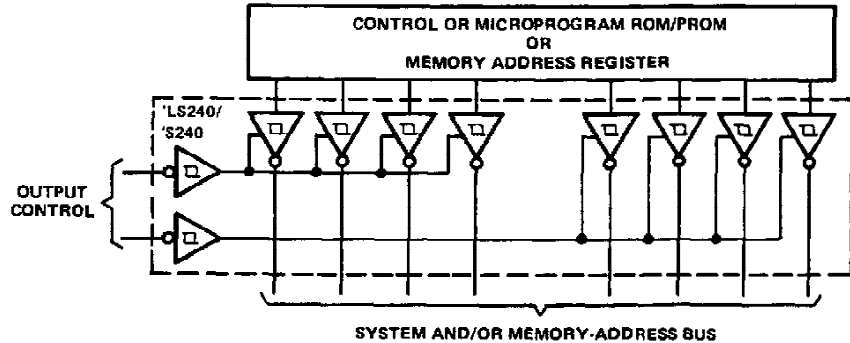
**TEXAS**  
**INSTRUMENTS**

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

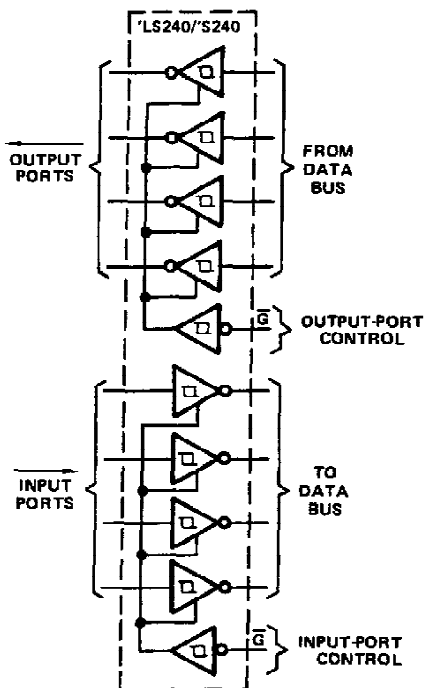
**SN54LS240, SN54LS241, SN54LS244, SN54S240, SN54S241, SN54S244,  
SN74LS240, SN74LS241, SN74LS244, SN74S240, SN74S241, SN74S244  
OCTAL BUFFERS AND LINE DRIVERS WITH 3-STATE OUTPUTS**



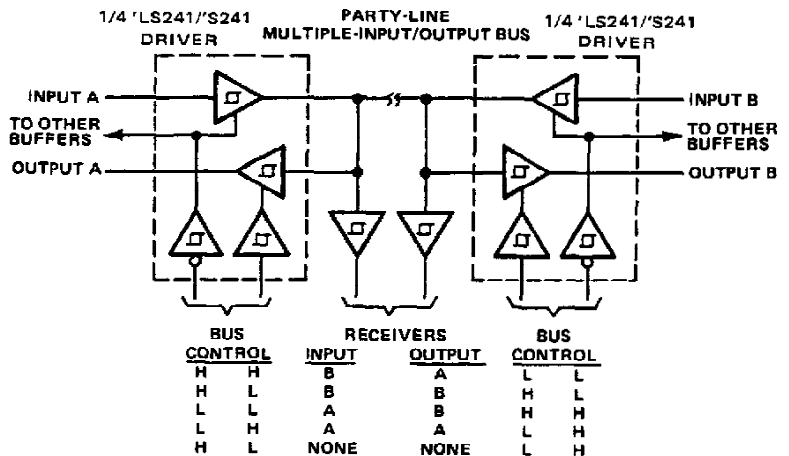
'LS241, 'S241 USED AS REPEATER/LEVEL RESTORER



'LS240/'S240 USED AS SYSTEM AND/OR MEMORY BUS DRIVER—4-BIT ORGANIZATION CAN BE APPLIED TO HANDLE BINARY OR BCD



INDEPENDENT 4-BIT BUS DRIVERS/RECEIVERS IN A SINGLE PACKAGE



PARTY-LINE BUS SYSTEM WITH MULTIPLE INPUTS, OUTPUTS, AND RECEIVERS

TEXAS  
INSTRUMENTS

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

## 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 (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.