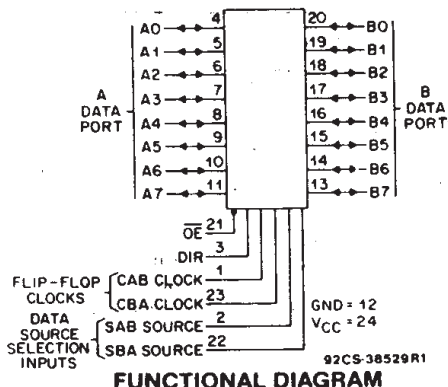


CD54/74AC646, CD54/74AC648 CD54/74ACT646, CD54/74ACT648



Data sheet acquired from Harris Semiconductor
SCHS293



Octal-Bus Transceiver/Registers, 3-State

CD54/74AC/ACT646 - Non-Inverting
CD54/74AC/ACT648 - Inverting

Type Features:

- Buffered inputs
- Typical propagation delay:
5.3 ns @ $V_{CC} = 5V, T_A = 25^\circ C, C_L = 50pF$

Family Features:

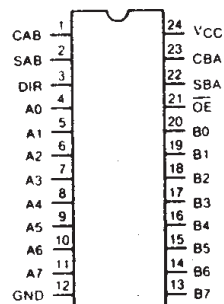
- Exceeds 2-kV ESD Protection - MIL-STD-883, Method 3015
- SCR-Latchup-resistant CMOS process and circuit design
- Speed of bipolar FAST*/AS/S with significantly reduced power consumption
- Balanced propagation delays
- AC types feature 1.5-V to 5.5-V operation and balanced noise immunity at 30% of the supply
- $\pm 24\text{-mA}$ output drive current
 - Fanout to 15 FAST* ICs
 - Drives 50-ohm transmission lines

*FAST is a Registered Trademark of Fairchild Semiconductor Corp.

The RCA CD54/74AC646 and CD54/74AC648 and the CD54/74ACT646 and CD54/74ACT648 3-state, octal-bus transceiver/registers use the RCA ADVANCED CMOS technology. The CD54/74AC648 and CD54/74ACT648 have inverting outputs. The CD54/74AC646 and CD54/74ACT646 have non-inverting outputs. These devices are bus transceivers with D-type flip-flops which act as internal storage registers on the LOW-to-HIGH transition of either CAB or CBA clock inputs. Output Enable (OE) and Direction (DIR) inputs control the transceiver functions. Data present at the high-impedance output can be stored in either register or both but only one of the two buses can be enabled as outputs at any one time. The Select controls (SAB and SBA) can multiplex stored and transparent (real time) data. The Direction control determines which data bus will receive data when the Output Enable (OE) is LOW. In the high-impedance mode (Output Enable HIGH), A data can be stored in one register and B data can be stored in the other register. The clocks are not gated with the Direction (DIR) and Output Enable (OE) terminals; data at the A or B terminals can be clocked into the storage flip-flops at any time.

The CD74AC/ACT646 and CD74AC/ACT648 are supplied in 24-lead dual-in-line narrow-body plastic packages (EN suffix) and in 24-lead dual-in-line small-outline plastic packages (M suffix). Both package types are operable over the following temperature ranges: Commercial (0 to 70°C); Industrial (-40 to +85°C); and Extended Industrial/Military (-55 to +125°C).

The CD54AC/ACT646 and CD54AC/ACT648, available in chip form (H suffix), are operable over the -55 to +125°C temperature range.



92CS-36847R1

TERMINAL ASSIGNMENT

This data sheet is applicable to the CD74AC646 and CD74ACT646. The CD54AC646, CD54/74AC648, CD54ACT646, and CD54/74ACT648 were not acquired from Harris Semiconductor.

CD54/74AC646, CD54/74AC648 CD54/74ACT646, CD54/74ACT648

FUNCTION TABLE

INPUTS						DATA I/O#		OPERATION OR FUNCTION	
OE	DIR	CAB	CBA	SAB	SBA	A0 THRU A7	B0 THRU B7	646	648
X	X		X	X	X	Input	Not specified	Store A, B unspecified	Store A, B unspecified
X	X	X		X	X	Not specified	Input	Store B, A unspecified	Store B, A unspecified
H	X			X	X	Input	Input	Store A and B Data Isolation, hold storage	Store A and B Data Isolation, hold storage
L	L	X	X	X	L	Output	Input	Real-Time B Data to A Bus Stored B Data to A Bus	Real-Time \bar{B} Data to A Bus Stored \bar{B} Data to A Bus
L	L	X	H or L	X	H				
L	H	X	X	L	X	Input	Output	Real-Time A Data to B Bus Stored A Data to B Bus	Real-Time \bar{A} Data to B Bus Stored \bar{A} Data to B Bus
L	H	H or L	X	H	X				

#The data output functions may be enabled or disabled by various signals at the OE and DIR inputs. Data input functions are always enabled, i.e., data at the bus pins will be stored on every low-to-high transition on the clock inputs. To prevent excess currents in the High-Z modes, all I/O terminals should be terminated with 10 kΩ resistors.

MAXIMUM RATINGS, Absolute-Maximum Values:

- DC SUPPLY-VOLTAGE (V_{CC}) -0.5 to 6 V
- DC INPUT DIODE CURRENT, I_{IK} (for $V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V) ± 20 mA
- DC OUTPUT DIODE CURRENT, I_{OK} (for $V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V) ± 50 mA
- DC OUTPUT SOURCE OR SINK CURRENT per Output Pin, I_O (for $V_O > -0.5$ V or $V_O < V_{CC} + 0.5$ V) ± 50 mA
- DC V_{CC} OR GROUND CURRENT (I_{CC} OR I_{GND}) ± 100 mA*
- POWER DISSIPATION PER PACKAGE (P_D):
 - For $T_A = -55$ to $+100^\circ\text{C}$ (PACKAGE TYPE E) 500 mW
 - For $T_A = +100$ to $+125^\circ\text{C}$ (PACKAGE TYPE E) Derate Linearly at 8 mW/ $^\circ\text{C}$ to 300 mW
 - For $T_A = -55$ to $+70^\circ\text{C}$ (PACKAGE TYPE M) 400 mW
 - For $T_A = +70$ to $+125^\circ\text{C}$ (PACKAGE TYPE M) Derate Linearly at 6 mW/ $^\circ\text{C}$ to 70 mW
- OPERATING-TEMPERATURE RANGE (T_A) -55 to $+125^\circ\text{C}$
- STORAGE TEMPERATURE (T_{stg}) -65 to $+150^\circ\text{C}$
- LEAD TEMPERATURE (DURING SOLDERING):
 - At distance $1/16 \pm 1/32$ in. (1.59 ± 0.79 mm) from case for 10 s maximum $+265^\circ\text{C}$
 - Unit inserted into PC board min. thickness $1/16$ in. (1.59 mm) with solder contacting lead tips only $+300^\circ\text{C}$

*For up to 4 outputs per device; add ± 25 mA for each additional output.

RECOMMENDED OPERATING CONDITIONS:

For maximum reliability, normal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTICS	LIMITS		UNITS
	MIN.	MAX.	
Supply-Voltage Range, V_{CC} *: (For $T_A =$ Full Package-Temperature Range)			
AC Types	1.5	5.5	V
ACT Types	4.5	5.5	V
DC Input or Output Voltage, V_I, V_O	0	V_{CC}	V
Operating Temperature, T_A	-55	+125	$^\circ\text{C}$
Input Rise and Fall Slew Rate, dt/dv			
at 1.5 V to 3 V (AC Types)	0	50	ns/V
at 3.6 V to 5.5 V (AC Types)	0	20	ns/V
at 4.5 V to 5.5 V (ACT Types)	0	10	ns/V

*Unless otherwise specified, all voltages are referenced to ground.

CD54/74AC646, CD54/74AC648 CD54/74ACT646, CD54/74ACT648

STATIC ELECTRICAL CHARACTERISTICS: AC Series

CHARACTERISTICS	TEST CONDITIONS		V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C						UNITS	
				+25		-40 to +85		-55 to +125			
				MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
High-Level Input Voltage V _{IH}			1.5	1.2	—	1.2	—	1.2	—	V	
			3	2.1	—	2.1	—	2.1	—		
			5.5	3.85	—	3.85	—	3.85	—		
Low-Level Input Voltage V _{IL}			1.5	—	0.3	—	0.3	—	0.3	V	
			3	—	0.9	—	0.9	—	0.9		
			5.5	—	1.65	—	1.65	—	1.65		
High-Level Output Voltage V _{OH}	V _{IH} or V _{IL}	#, * {	-0.05	1.5	1.4	—	1.4	—	1.4	—	V
			-0.05	3	2.9	—	2.9	—	2.9	—	
			-0.05	4.5	4.4	—	4.4	—	4.4	—	
			-4	3	2.58	—	2.48	—	2.4	—	
			-24	4.5	3.94	—	3.8	—	3.7	—	
			-75	5.5	—	—	3.85	—	—	—	
			-50	5.5	—	—	—	—	3.85	—	
Low-Level Output Voltage V _{OL}	V _{IH} or V _{IL}	#, * {	0.05	1.5	—	0.1	—	0.1	—	0.1	V
			0.05	3	—	0.1	—	0.1	—	0.1	
			0.05	4.5	—	0.1	—	0.1	—	0.1	
			12	3	—	0.36	—	0.44	—	0.5	
			24	4.5	—	0.36	—	0.44	—	0.5	
			75	5.5	—	—	—	1.65	—	—	
			50	5.5	—	—	—	—	—	1.65	
Input Leakage Current I _I	V _{CC} or GND		5.5	—	±0.1	—	±1	—	±1	μA	
3-State Leakage Current I _{OZ}	V _{IH} or V _{IL} V _O = V _{CC} or GND		5.5	—	±0.5	—	±5	—	±10	μA	
Quiescent Supply Current, MSI I _{CC}	V _{CC} or GND	0	5.5	—	8	—	80	—	160	μA	

#Test one output at a time for a 1-second maximum duration. Measurement is made by forcing current and measuring voltage to minimize power dissipation.

*Test verifies a minimum 50-ohm transmission-line-drive capability at +85°C, 75 ohms at +125°C.

Technical Data

CD54/74AC646, CD54/74AC648 CD54/74ACT646, CD54/74ACT648

STATIC ELECTRICAL CHARACTERISTICS: ACT Series

CHARACTERISTICS	TEST CONDITIONS		V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C						UNITS	
				+25		-40 to +85		-55 to +125			
				MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
High-Level Input Voltage	V _{IH}		4.5 to 5.5	2	—	2	—	2	—	V	
Low-Level Input Voltage	V _{IL}		4.5 to 5.5	—	0.8	—	0.8	—	0.8	V	
High-Level Output Voltage	V _{OIH}	V _{IH} or V _{IL} #,*	-0.05	4.5	4.4	—	4.4	—	4.4	—	V
			-24	4.5	3.94	—	3.8	—	3.7	—	
			-75	5.5	—	—	3.85	—	—	—	
			-50	5.5	—	—	—	—	3.85	—	
Low-Level Output Voltage	V _{OIL}	V _{IH} or V _{IL} #,*	0.05	4.5	—	0.1	—	0.1	—	0.1	V
			24	4.5	—	0.36	—	0.44	—	0.5	
			75	5.5	—	—	—	1.65	—	—	
			50	5.5	—	—	—	—	—	1.65	
Input Leakage Current	I _i	V _{CC} or GND	5.5	—	±0.1	—	±1	—	±1	μA	
3-State Leakage Current	I _{oz}	V _{IH} or V _{IL} V _O = V _{CC} or GND	5.5	—	±0.5	—	±5	—	±10	μA	
Quiescent Supply Current, MSI	I _{CC}	V _{CC} or GND	0	5.5	—	8	—	80	—	160	μA
Additional Quiescent Supply Current per Input Pin TTL Inputs High 1 Unit Load	ΔI _{CC}	V _{CC} -2.1	4.5 to 5.5	—	2.4	—	2.8	—	3	mA	

9

#Test one output at a time for a 1-second maximum duration. Measurement is made by forcing current and measuring voltage to minimize power dissipation.

*Test verifies a minimum 50-ohm transmission-line-drive capability at +85°C. 75 ohms at +125°C.

ACT INPUT LOADING TABLE

INPUT	UNIT LOAD*
CAB, CBA	1.25
SAB, SBA	1.2
DIR	0.67
OE	1.17
An, Bn	0.4

*Unit load is ΔI_{CC} limit specified in Static Characteristics Chart, e.g., 2.4 mA max. @ 25°C.

Technical Data

CD54/74AC646, CD54/74AC648
CD54/74ACT646, CD54/74ACT648

PREREQUISITE FOR SWITCHING: AC Series

CHARACTERISTICS	SYMBOL	V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C				UNITS
			-40 to +85		-55 to +125		
			MIN.	MAX.	MIN.	MAX.	
Max. Frequency	f _{max}	1.5	11	—	10	—	MHz
		3.3*	101	—	89	—	
		5†	143	—	125	—	
Setup Time Data to Clock	t _{SU}	1.5	27	—	31	—	ns
		3.3	3.1	—	3.5	—	
		5	2.2	—	2.5	—	
Hold Time Data to Clock	t _H	1.5	2	—	2	—	ns
		3.3	2	—	2	—	
		5	2	—	2	—	
Clock Pulse Width	t _W	1.5	44	—	50	—	ns
		3.3	4.9	—	5.6	—	
		5	3.5	—	4	—	

*3.3 V: min. is @ 3 V

†5 V: min is @ 4.5 V

SWITCHING CHARACTERISTICS: AC Series; t_r, t_f = 3 ns, C_L = 50 pF

CHARACTERISTICS	SYMBOL	V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C				UNITS
			-40 to +85		-55 to +125		
			MIN.	MAX.	MIN.	MAX.	
Propagation Delays: Store A Data to B Bus Store B Data to A Bus 646	t _{PLH} t _{PHL}	1.5	—	154	—	169	ns
		3.3*	4.8	17.1	4.7	18.9	
		5†	3.5	12.3	3.4	13.5	
Store A Data to B Bus Store B Data to A Bus 648	t _{PLH} t _{PHL}	1.5	—	154	—	169	ns
		3.3	4.8	17.1	4.7	18.9	
		5	3.5	12.3	3.4	13.5	
A Data to B Bus B Data to A Bus 646	t _{PLH} t _{PHL}	1.5	—	125	—	138	ns
		3.3	4	14	3.9	15.4	
		5	2.8	10	2.8	11	
A Data to B Bus B Data to A Bus 648	t _{PLH} t _{PHL}	1.5	—	125	—	138	ns
		3.3	4	14	3.9	15.4	
		5	2.8	10	2.8	11	
Select to Data 646	t _{PLH} t _{PHL}	1.5	—	136	—	150	ns
		3.3	4.3	15.3	4.2	16.8	
		5	3.1	10.9	3	12	
Select to Data 648	t _{PLH} t _{PHL}	1.5	—	136	—	150	ns
		3.3	4.3	15.3	4.2	16.8	
		5	3.1	10.9	3	12	
3-State Enabling/ Disabling Time Bus to Output or Register to Output	t _{PZL} t _{PZH} t _{PLZ} t _{PHZ}	1.5	—	154	—	169	ns
		3.3	5.2	18.4	5.1	20.2	
		5	3.5	12.3	3.4	13.5	
Power Dissipation Capacitance	C _{PD} §	—	150 Typ.		150 Typ.		pF
Min. (Valley) During Switching of Other Outputs (Output Under Test Not Switching)	V _{OH} V _{OHV} See Fig. 1	5	4 Typ. @ 25°C				V
Max. (Peak) During Switching of Other Outputs (Output Under Test Not Switching)	V _{OL} V _{OLP} See Fig. 1	5	1 Typ. @ 25°C				V
Input Capacitance	C _I	—	—	10	—	10	pF
3-State Output Capacitance	C _O	—	—	15	—	15	pF

*3.3 V: min. is @ 3.6 V
max. is @ 3 V

†5 V: min. is @ 5.5 V
max. is @ 4.5 V

§C_{PD} is used to determine the dynamic power consumption, per package.

$$P_D = V_{CC}^2 C_{PD} f_i + \sum (V_{CC}^2 C_L f_o)$$

where f_i = input frequency
f_o = output frequency
C_L = output load capacitance
V_{CC} = supply voltage.

CD54/74AC646, CD54/74AC648 CD54/74ACT646, CD54/74ACT648

PREREQUISITE FOR SWITCHING: ACT Series

CHARACTERISTICS	SYMBOL	V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C				UNITS
			-40 to +85		-55 to +125		
			MIN.	MAX.	MIN.	MAX.	
Max. Frequency	f _{max}	5*	125	—	110	—	MHz
Setup Time Data to Clock	t _{SU}	5	2.2	—	2.5	—	ns
Hold Time Data to Clock	t _H	5	2	—	2	—	ns
Clock Pulse Width	t _w	5	3.9	—	4.5	—	ns

*5 V: min. is @ 4.5 V

SWITCHING CHARACTERISTICS: ACT Series; t_r, t_f = 3 ns, C_L = 50 pF

CHARACTERISTICS	SYMBOL	V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C				UNITS
			-40 to +85		-55 to +125		
			MIN.	MAX.	MIN.	MAX.	
Propagation Delays: Store A Data to B Bus Store B Data to A Bus 646	t _{PLH} t _{PHL}	5*	4	14.1	3.9	15.5	ns
Store \bar{A} Data to B Bus Store \bar{B} Data to A Bus 648	t _{PLH} t _{PHL}	5	4	14.1	3.9	15.5	ns
A Data to B Bus B Data to A Bus 646	t _{PLH} t _{PHL}	5	3.2	11.4	3.1	12.5	ns
\bar{A} Data to B Bus \bar{B} Data to A Bus 648	t _{PLH} t _{PHL}	5	3.2	11.4	3.1	12.5	ns
Select to Data 646	t _{PLH} t _{PHL}	5	3.7	13.2	3.6	14.5	ns
Select to Data 648	t _{PLH} t _{PHL}	5	4	14.1	3.9	15.5	ns
3-State Enabling/ Disabling Time Bus to Output or Register to Output	t _{PZL} t _{PZH} t _{PLZ} t _{PHZ}	5	4	14.1	3.9	15.5	ns
Power Dissipation Capacitance	C _{PD} §	—	150 Typ.		150 Typ.		pF
Min. (Valley) During Switching of Other Outputs (Output Under Test Not Switching)	V _{OH} V _{OHV} See Fig. 1	5	4 Typ. @ 25°C				V
Max. (Peak) During Switching of Other Outputs (Output Under Test Not Switching)	V _{OL} V _{OLP} See Fig. 1	5	1 Typ. @ 25°C				V
Input Capacitance	C _I	—	—	10	—	10	pF
3-State Output Capacitance	C _O	—	—	15	—	15	pF

9

*5 V: min. is @ 5.5 V
max. is @ 4.5 V

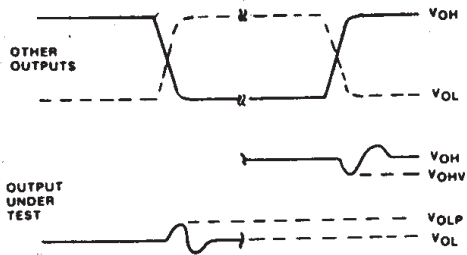
§C_{PD} is used to determine the dynamic power consumption, per package.

$$P_D = C_{PD} V_{CC}^2 f_i + \sum (C_L V_{CC}^2 f_o) + V_{CC} \Delta I_{CC}$$

f_i = input frequency
 f_o = output frequency
 C_L = output load capacitance
 V_{CC} = supply voltage.

CD54/74AC646, CD54/74AC648 CD54/74ACT646, CD54/74ACT648

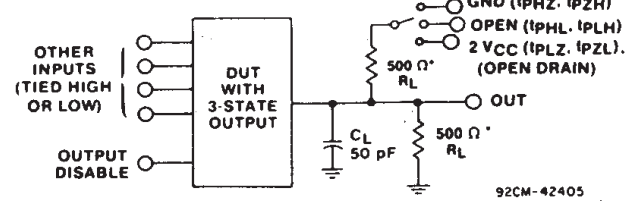
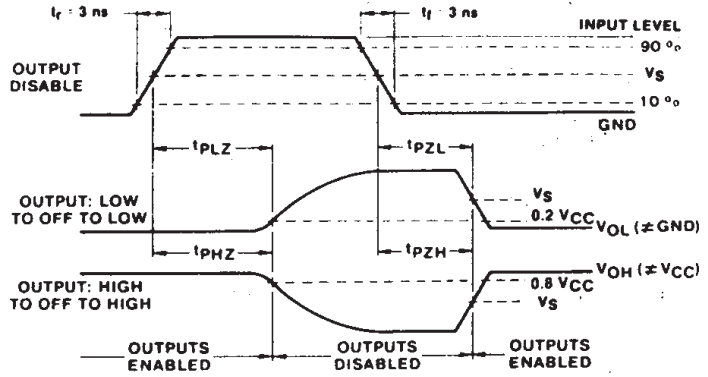
PARAMETER MEASUREMENT INFORMATION



- NOTES:
1. V_{OHV} AND V_{OLP} ARE MEASURED WITH RESPECT TO A GROUND REFERENCE NEAR THE OUTPUT UNDER TEST.
 2. INPUT PULSES HAVE THE FOLLOWING CHARACTERISTICS:
 $PRR \leq 1 \text{ MHz}$, $t_r = 3 \text{ ns}$, $t_f = 3 \text{ ns}$, SKEW 1 ns.
 3. R.F. FIXTURE WITH 700-MHz DESIGN RULES REQUIRED. IC SHOULD BE SOLDERED INTO TEST BOARD AND BYPASSED WITH $0.1 \mu\text{F}$ CAPACITOR. SCOPE AND PROBES REQUIRE 700-MHz BANDWIDTH.

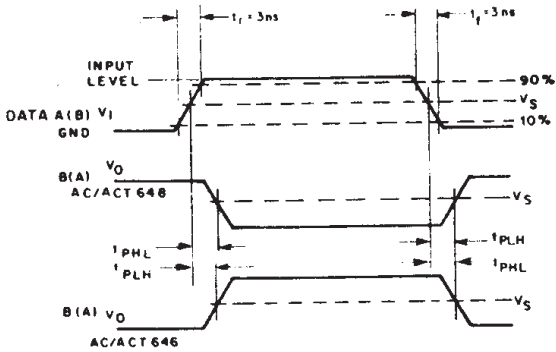
92CS-42406

Fig. 1 - Simultaneous switching transient waveforms.



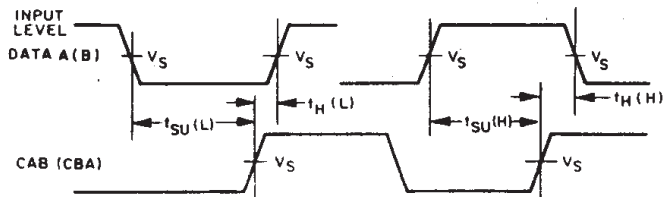
*FOR AC SERIES ONLY: WHEN $V_{CC} = 1.5 \text{ V}$, $R_L = 1 \text{ k}\Omega$

Fig. 2 - Three-state propagation delay waveforms and test circuit.



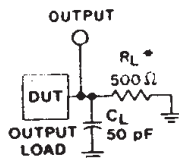
92CS-42618

Fig. 3 - Propagation delay times.



92CS-38405RI

Fig. 4 - Data setup and hold times.



*FOR AC SERIES ONLY: WHEN $V_{CC} = 1.5 \text{ V}$, $R_L = 1 \text{ k}\Omega$

92CS-42389

Fig. 5 - Test circuit.

	CD54/74AC	CD54/74ACT
Input Level	V_{CC}	3 V
Input Switching Voltage, V_S	0.5 V_{CC}	1.5 V
Output Switching Voltage, V_S	0.5 V_{CC}	0.5 V_{CC}

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.