

## 8-BIT UNIVERSAL BUS TRANSCEIVER AND TWO 1-BIT BUS TRANSCEIVERS WITH SPLIT LVTTL PORT, FEEDBACK PATH, AND 3-STATE OUTPUTS

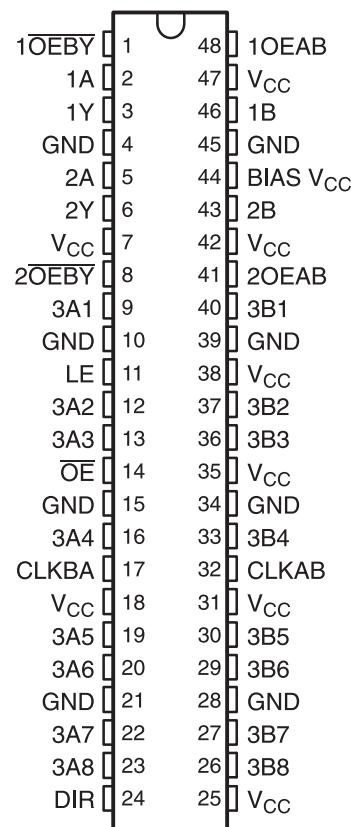
Check for Samples: [SN74VMEH22501A](#)

### FEATURES

- Member of the Texas Instruments Widebus™ Family
- UBT™ Transceiver Combines D-Type Latches and D-Type Flip-Flops for Operation in Transparent, Latched, or Clocked Modes
- OEC™ Circuitry Improves Signal Integrity and Reduces Electromagnetic Interference (EMI)
- Compliant With VME64, 2eVME, and 2eSST Protocols
- Bus Transceiver Split LVTTL Port Provides a Feedback Path for Control and Diagnostics Monitoring
- I/O Interfaces Are 5-V Tolerant
- B-Port Outputs (–48 mA/64 mA)
- Y and A-Port Outputs (–12 mA/12 mA)
- $I_{off}$ , Power-Up 3-State, and BIAS  $V_{CC}$  Support Live Insertion
- Bus Hold on 3A-Port Data Inputs
- 26- $\Omega$  Equivalent Series Resistor on 3A Ports and Y Outputs
- Flow-Through Architecture Facilitates Printed Circuit Board Layout
- Distributed  $V_{CC}$  and GND Pins Minimize High-Speed Switching Noise
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II

- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

DGG OR DGV PACKAGE  
(TOP VIEW)



### DESCRIPTION/ORDERING INFORMATION

The SN74VMEH22501A 8-bit universal bus transceiver has two integral 1-bit three-wire bus transceivers and is designed for 3.3-V  $V_{CC}$  operation with 5-V tolerant inputs. The UBT™ transceiver allows transparent, latched, and flip-flop modes of data transfer, and the separate LVTTL input and outputs on the bus transceivers provide a feedback path for control and diagnostics monitoring. This device provides a high-speed interface between cards operating at LVTTL logic levels and VME64, VME64x, or VME320<sup>(1)</sup> backplane topologies.

The SN74VMEH22501A is pin-for-pin compatible to the SN74VMEH22501 (TI literature number [SCES357](#)), but operates at a wider operating temperature (–40°C to 85°C) range.

(1) VME320 is a patented backplane construction by Arizona Digital, Inc.



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.

## DESCRIPTION/ORDERING INFORMATION (CONTINUED)

High-speed backplane operation is a direct result of the improved OEC™ circuitry and high drive that has been designed and tested into the VME64x backplane model. The B-port I/Os are optimized for driving large capacitive loads and include pseudo-ETL input thresholds ( $\frac{1}{2} V_{CC} \pm 50$  mV) for increased noise immunity. These specifications support the 2eVME protocols in VME64x (ANSI/VITA 1.1) and 2eSST protocols in VITA 1.5. With proper design of a 21-slot VME system, a designer can achieve 320-Mbyte transfer rates on linear backplanes and, possibly, 1-Gbyte transfer rates on the VME320 backplane.

All inputs and outputs are 5-V tolerant and are compatible with TTL and 5-V CMOS inputs.

Active bus-hold circuitry holds unused or undriven 3A-port inputs at a valid logic state. Bus-hold circuitry is not provided on 1A or 2A inputs, any B-port input, or any control input. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

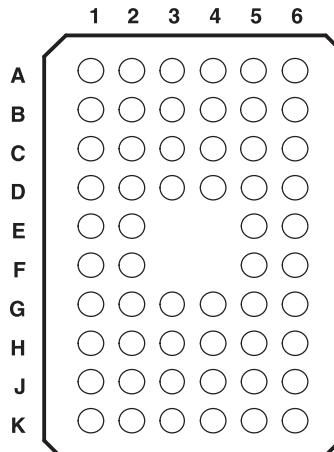
This device is fully specified for live-insertion applications using  $I_{off}$ , power-up 3-state, and BIAS  $V_{CC}$ . The  $I_{off}$  circuitry prevents damaging current to backflow through the device when it is powered off/on. The power-up 3-state circuitry places the outputs in the high-impedance state during power up and power down, which prevents driver conflict. The BIAS  $V_{CC}$  circuitry precharges and preconditions the B-port input/output connections, preventing disturbance of active data on the backplane during card insertion or removal, and permits true live-insertion capability.

When  $V_{CC}$  is between 0 and 1.5 V, the device is in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 1.5 V, output-enable (OE and OE<sub>BY</sub>) inputs should be tied to  $V_{CC}$  through a pullup resistor and output-enable (OE<sub>AB</sub>) inputs should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the drive capability of the device connected to this input.

### ORDERING INFORMATION

T <sub>A</sub>	PACKAGE <sup>(1)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	BGA MicroStar™ Junior – ZQL	Tape and reel	SN74VMEH22501AZQLR	VK501A
	TSSOP – DGG	Tape and reel	SN74VMEH22501ADGGR	VMEH22501A
	TVSOP – DGV	Tape and reel	SN74VMEH22501ADGVR	VK501A
	VFBGA – GQL	Tape and reel	SN74VMEH22501AGQLR	VK501A

(1) Package drawings, thermal data, and symbolization are available at [www.ti.com/sc/packaging](http://www.ti.com/sc/packaging).

**GQL OR ZQL PACKAGE  
(TOP VIEW)**

**TERMINAL ASSIGNMENTS<sup>(1)</sup>**

	1	2	3	4	5	6
<b>A</b>	1 $\overline{OE}$ BY	NC	NC	NC	NC	1OEAB
<b>B</b>	1Y	1A	GND	GND	$V_{CC}$	1B
<b>C</b>	2Y	2A	$V_{CC}$	$V_{CC}$	BIAS $V_{CC}$	2B
<b>D</b>	3A1	2 $\overline{OE}$ BY	GND	GND	2OEAB	3B1
<b>E</b>	3A2	LE			$V_{CC}$	3B2
<b>F</b>	3A3	$\overline{OE}$			$V_{CC}$	3B3
<b>G</b>	3A4	CLKBA	GND	GND	CLKAB	3B4
<b>H</b>	3A5	3A6	$V_{CC}$	$V_{CC}$	3B6	3B5
<b>J</b>	3A7	3A8	GND	GND	3B8	3B7
<b>K</b>	DIR	NC	NC	NC	NC	$V_{CC}$

(1) NC - No internal connection

## FUNCTIONAL DESCRIPTION

The SN74VMEH22501A is a high-drive (–48/64 mA), 8-bit UBT transceiver containing D-type latches and D-type flip-flops for data-path operation in transparent, latched, or flip-flop modes. Data transmission is true logic. The device is uniquely partitioned as 8-bit UBT transceivers with two integrated 1-bit three-wire bus transceivers.

### Functional Description for Two 1-Bit Bus Transceivers

The OEAB inputs control the activity of the 1B or 2B port. When OEAB is high, the B-port outputs are active. When OEAB is low, the B-port outputs are disabled.

Separate 1A and 2A inputs and 1Y and 2Y outputs provide a feedback path for control and diagnostics monitoring. The OEBY inputs control the 1Y or 2Y outputs. When OEBY is low, the Y outputs are active. When OEBY is high, the Y outputs are disabled.

The OEBY and OEAB inputs can be tied together to form a simple direction control where an input high yields A data to B bus and an input low yields B data to Y bus.

1-BIT BUS TRANSCEIVER FUNCTION TABLE

INPUTS		OUTPUT	MODE
OEAB	OEBY		
L	H	Z	Isolation
H	H	A data to B bus	True driver
L	L	B data to Y bus	True driver
H	L	A data to B bus, B data to Y bus	True driver with feedback path

### Functional Description for 8-Bit UBT Transceiver

The 3A and 3B data flow in each direction is controlled by the OE and direction-control (DIR) inputs. When OE is low, all 3A- or 3B-port outputs are active. When OE is high, all 3A- or 3B-port outputs are in the high-impedance state.

FUNCTION TABLE

INPUTS		OUTPUT
OE	DIR	
H	X	Z
L	H	3A data to 3B bus
L	L	3B data to 3A bus

The UBT transceiver functions are controlled by latch-enable (LE) and clock (CLKAB and CLKBA) inputs. For 3A-to-3B data flow, the UBT operates in the transparent mode when LE is high. When LE is low, the 3A data is latched if CLKAB is held at a high or low logic level. If LE is low, the 3A data is stored in the latch/flip-flop on the low-to-high transition of CLKAB.

The UBT transceiver data flow for 3B to 3A is similar to that of 3A to 3B, but uses CLKBA.

**Table 1. UBT TRANSCEIVER FUNCTION TABLE<sup>(1)</sup>**

INPUTS				OUTPUT 3B	MODE
OE	LE	CLKAB	3A		
H	X	X	X	Z	Isolation
L	L	H	X	$B_0$ <sup>(2)</sup>	Latched storage of 3A data
L	L	L	X	$B_0$ <sup>(3)</sup>	
L	H	X	L	L	True transparent
L	H	X	H	H	
L	L	↑	L	L	Clocked storage of 3A data
L	L	↑	H	H	

(1) 3A-to-3B data flow is shown; 3B-to-3A data flow is similar, but uses CLKBA.

(2) Output level before the indicated steady-state input conditions were established, provided that CLKAB was high before LE went low

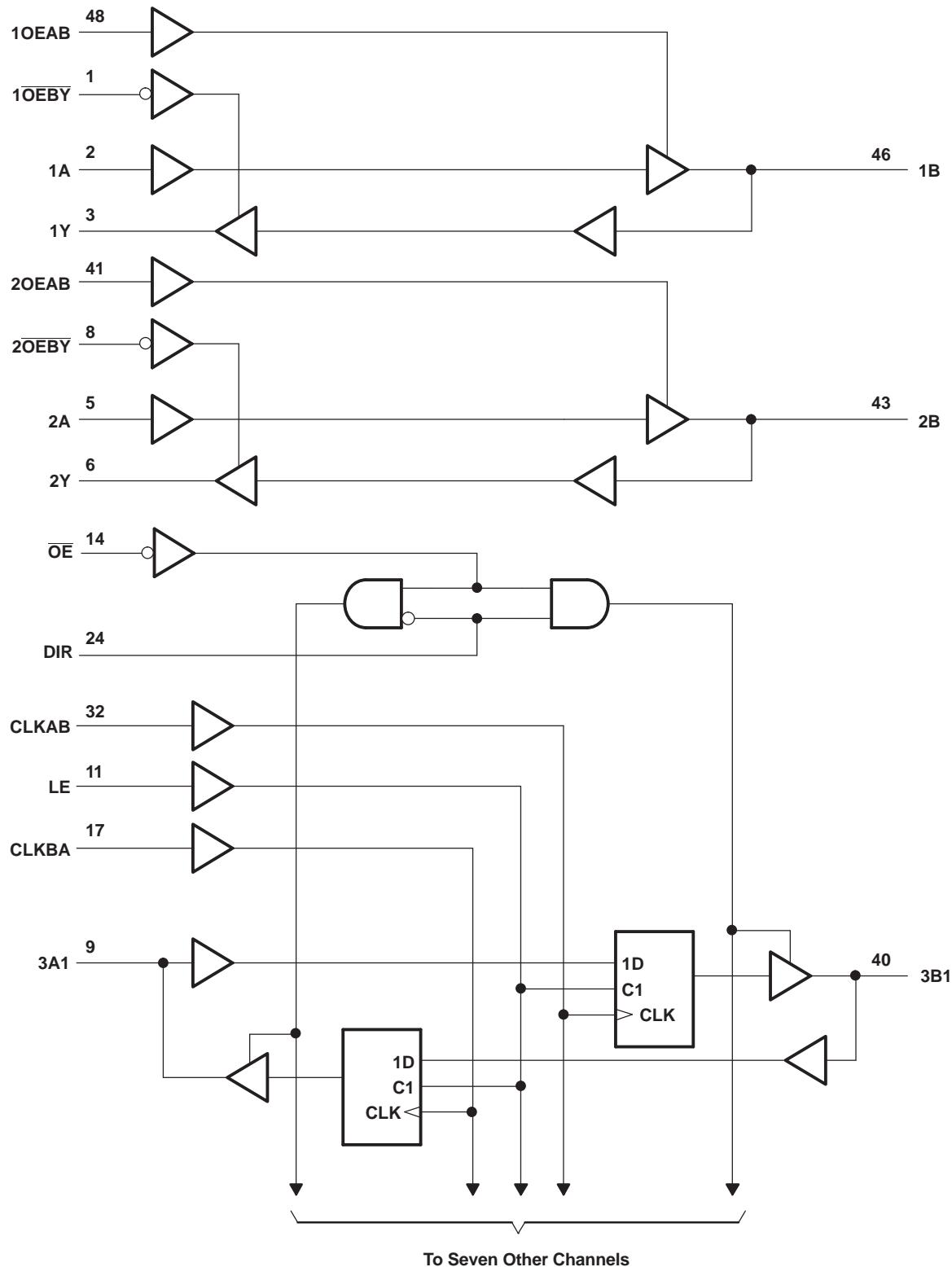
(3) Output level before the indicated steady-state input conditions were established

The UBT transceiver can replace any of the functions shown in [Table 2](#).

**Table 2. SN74VMEH22501A UBT Transceiver Replacement Functions**

FUNCTION	8 BIT
Transceiver	'245, '623, '645
Buffer/driver	'241, '244, '541
Latched transceiver	'543
Latch	'373, '573
Registered transceiver	'646, '652
Flip-flop	'374, '574
SN74VMEH22501A UBT transceiver replaces all above functions	

## LOGIC DIAGRAM (POSITIVE LOGIC)



Pin numbers shown are for the DGG and DGV packages.

## Absolute Maximum Ratings<sup>(1)</sup>

over operating free-air temperature range (unless otherwise noted)

		MIN	MAX	UNIT
$V_{CC}$ , BIAS $V_{CC}$	Supply voltage range	-0.5	4.6	V
$V_I$	Input voltage range <sup>(2)</sup>	-0.5	7	V
$V_O$	Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup>	-0.5	7	V
$V_O$	Voltage range applied to any output in the high or low state <sup>(2)</sup>	3A port or Y output	-0.5	$V_{CC} + 0.5$
		B port	-0.5	4.6
$I_O$	Output current in the low state	3A port or Y output	50	mA
		B port	100	
$I_O$	Output current in the high state	3A port or Y output	-50	mA
		B port	-100	
$I_{IK}$	Input clamp current	$V_I < 0$	-50	mA
$I_{OK}$	Output clamp current	$V_O < 0$ or $V_O > V_{CC}$ , B port	-50	mA
$\theta_{JA}$	Package thermal impedance <sup>(3)</sup>	DGG package	70	°C/W
		DGV package	58	
		GQL/ZQL package	42	
$T_{stg}$	Storage temperature range	-65	150	°C

(1) 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 under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

(3) The package thermal impedance is calculated in accordance with JESD 51-7.

## Recommended Operating Conditions<sup>(1) (2)</sup>

		MIN	NOM	MAX	UNIT
$V_{CC}$ , BIAS $V_{CC}$	Supply voltage	3.15	3.3	3.45	V
$V_I$	Input voltage	Control inputs or A port	$V_{CC}$	5.5	V
		B port	$V_{CC}$	5.5	
$V_{IH}$	High-level input voltage	Control inputs or A port	2		V
		B port	$0.5 V_{CC} + 50$ mV		
$V_{IL}$	Low-level input voltage	Control inputs or A port		0.8	V
		B port		$0.5 V_{CC} - 50$ mV	
$I_{IK}$	Input clamp current			-18	mA
$I_{OH}$	High-level output current	3A port and Y output		-12	mA
		B port		-48	
$I_{OL}$	Low-level output current	3A port and Y output		12	mA
		B port		64	
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled		10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up ramp rate		20		μs/V
$T_A$	Operating free-air temperature	-40		85	°C

(1) All unused control inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

(2) Proper connection sequence for use of the B-port I/O precharge feature is GND and BIAS  $V_{CC} = 3.3$  V first, I/O second, and  $V_{CC} = 3.3$  V last, because the BIAS  $V_{CC}$  precharge circuitry is disabled when any  $V_{CC}$  pin is connected. The control inputs can be connected at any time, but normally are connected during the I/O stage. If B-port precharge is not required, any connection sequence is acceptable, but generally, GND is connected first.

## Electrical Characteristics

over recommended operating free-air temperature range for A and B ports (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP <sup>(1)</sup>	MAX	UNIT	
$V_{IK}$		$V_{CC} = 3.15$ V,		$I_I = -18$ mA		-1.2		
$V_{OH}$	3A port, any B ports, and Y outputs	$V_{CC} = 3.15$ V to 3.45 V,		$I_{OH} = -100$ $\mu$ A	$V_{CC} - 0.2$		V	
	3A port and Y outputs	$V_{CC} = 3.15$ V		$I_{OH} = -6$ mA	2.4			
				$I_{OH} = -12$ mA	2			
	Any B port	$V_{CC} = 3.15$ V		$I_{OH} = -24$ mA	2.4			
$V_{OL}$	3A port, any B ports, and Y outputs	$V_{CC} = 3.15$ V to 3.45 V,		$I_{OL} = 100$ $\mu$ A	0.2		V	
	3A port and Y outputs	$V_{CC} = 3.15$ V		$I_{OL} = 6$ mA	0.55			
				$I_{OL} = 12$ mA	0.8			
				$I_{OL} = 24$ mA	0.4			
	Any B port	$V_{CC} = 3.15$ V		$I_{OL} = 48$ mA	0.55			
				$I_{OL} = 64$ mA	0.6			
$I_I$	Control inputs, 1A and 2A	$V_{CC} = 3.45$ V,		$V_I = V_{CC}$ or GND	$\pm 1$		$\mu$ A	
		$V_{CC} = 0$ or 3.45 V,		$V_I = 5.5$ V	5			
$I_{OZH}$ <sup>(2)</sup>	3A port, any B port, and Y outputs	$V_{CC} = 3.45$ V,		$V_O = V_{CC}$ or 5.5 V	5		$\mu$ A	
$I_{OZL}$ <sup>(2)</sup>	3A port and Y outputs	$V_{CC} = 3.45$ V,		$V_O = \text{GND}$	-5		$\mu$ A	
	Any B port				-20			
$I_{off}$	$V_{CC} = 0$ , BIAS $V_{CC} = 0$ ,		$V_I$ or $V_O = 0$ to 5.5 V		$\pm 10$		$\mu$ A	
$I_{BHL}$ <sup>(3)</sup>	3A port	$V_{CC} = 3.15$ V,		$V_I = 0.8$ V	75		$\mu$ A	
$I_{BHH}$ <sup>(4)</sup>	3A port	$V_{CC} = 3.15$ V,		$V_I = 2$ V	-75		$\mu$ A	
$I_{BHLO}$ <sup>(5)</sup>	3A port	$V_{CC} = 3.45$ V,		$V_I = 0$ to $V_{CC}$	500		$\mu$ A	
$I_{BHHO}$ <sup>(6)</sup>	3A port	$V_{CC} = 3.45$ V,		$V_I = 0$ to $V_{CC}$	-500		$\mu$ A	
$I_{OZ(PU/PD)}$ <sup>(7)</sup>	$V_{CC} \leq 1.5$ V, $V_O = 0.5$ V to $V_{CC}$ , $V_I = \text{GND}$ or $V_{CC}$ , $\overline{OE}$ = don't care			$\pm 10$		$\mu$ A		
$I_{CC}$	$V_{CC} = 3.45$ V, $I_O = 0$ , $V_I = V_{CC}$ or GND		Outputs high		30		mA	
			Outputs low		30			
			Outputs disabled		30			
$I_{CCD}$	$V_{CC} = 3.45$ V, $I_O = 0$ , $V_I = V_{CC}$ or GND, One data input switching at one-half clock frequency, 50% duty cycle		Outputs enabled		76		$\mu$ A/ clock MHz/ input	
			Outputs disabled		19			
$\Delta I_{CC}$ <sup>(8)</sup>	$V_{CC} = 3.15$ V to 3.45 V, One input at $V_{CC} - 0.6$ V, Other inputs at $V_{CC}$ or GND			750		$\mu$ A		

- (1) All typical values are at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$ .
- (2) For I/O ports, the parameters  $I_{OZH}$  and  $I_{OZL}$  include the input leakage current.
- (3) The bus-hold circuit can sink at least the minimum low sustaining current at  $V_{IL}$  max.  $I_{BHL}$  should be measured after lowering  $V_{IN}$  to GND, then raising it to  $V_{IL}$  max.
- (4) The bus-hold circuit can source at least the minimum high sustaining current at  $V_{IH}$  min.  $I_{BHH}$  should be measured after raising  $V_{IN}$  to  $V_{CC}$ , then lowering it to  $V_{IH}$  min.
- (5) An external driver must source at least  $I_{BHLO}$  to switch this node from low to high.
- (6) An external driver must sink at least  $I_{BHHO}$  to switch this node from high to low.
- (7) High-impedance state during power up or power down
- (8) This is the increase in supply current for each input that is at the specified TTL voltage level, rather than  $V_{CC}$  or GND.

## Electrical Characteristics (continued)

over recommended operating free-air temperature range for A and B ports (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
C <sub>i</sub>	1A and 2A inputs	V <sub>I</sub> = 3.15 V or 0			2.8	pF
	Control inputs				2.6	
C <sub>o</sub>	1Y or 2Y outputs	V <sub>O</sub> = 3.15 V or 0			5.6	pF
C <sub>io</sub>	3A port	V <sub>CC</sub> = 3.3 V, Any B port			7.9	pF
	Any B port				11 12.5	

## Live-Insertion Specifications

over recommended operating free-air temperature range for B port

PARAMETER		TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
I <sub>CC</sub> (BIAS V <sub>CC</sub> )	V <sub>CC</sub> = 0 to 3.15 V,	BIAS V <sub>CC</sub> = 3.15 V to 3.45 V, I <sub>O(DC)</sub> = 0			5	mA
	V <sub>CC</sub> = 3.15 V to 3.45 V <sup>(2)</sup> ,				10	μA
V <sub>O</sub>	V <sub>CC</sub> = 0,	BIAS V <sub>CC</sub> = 3.15 V to 3.45 V	1.3	1.5	1.7	V
I <sub>O</sub>	V <sub>CC</sub> = 0	V <sub>O</sub> = 0,			-20	-100
		V <sub>O</sub> = 3 V,			20	100

(1) All typical values are at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C.

(2) V<sub>CC</sub> – 0.5 V < BIAS V<sub>CC</sub>

## Timing Requirements for UBT Transceiver

over recommended operating conditions (unless otherwise noted) (see [Figure 1](#) and [Figure 2](#))

			MIN	MAX	UNIT
f <sub>clock</sub>	Clock frequency			120	MHz
t <sub>w</sub>	Pulse duration	LE high			ns
		CLK high or low			
t <sub>su</sub>	Setup time	3A before CLK↑	Data high	2.1	ns
			Data low	2.2	
		3A before LE↓	CLK high	2	
			CLK low	2	
		3B before CLK↑	Data high	2.5	ns
			Data low	2.7	
		3B before LE↓	CLK high	2	
			CLK low	2	
t <sub>h</sub>	Hold time	3A after CLK↑	Data high	0	ns
			Data low	0	
		3A after LE↓	CLK high	1	
			CLK low	1	
		3B after CLK↑	Data high	0	
			Data low	0	
		3B after LE↓	CLK high	1	
			CLK low	1	

## Switching Characteristics for Bus Transceiver Function

over recommended operating conditions (unless otherwise noted) (see [Figure 1](#) and [Figure 2](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	TYP	MAX	UNIT	
$t_{PLH}$	1A or 2A	1B or 2B	5.1	8.9		ns	
$t_{PHL}$			4.5	7.8			
$t_{PLH}$	1A or 2A	1Y or 2Y	7.2	14.5		ns	
$t_{PHL}$			6.1	13			
$t_{PZH}$	OEAB	1B or 2B	4.6	8.1		ns	
$t_{PZL}$			3.7	7.4			
$t_{PHZ}$	OEAB	1B or 2B	3.3	9.7		ns	
$t_{PLZ}$			1.8	4.8			
$t_r$	Transition time, B port (10%–90%)			4.3		ns	
$t_f$	Transition time, B port (90%–10%)			4.3		ns	
$t_{PLH}$	1B or 2B	1Y or 2Y	1.6	5.6		ns	
$t_{PHL}$			1.6	5.6			
$t_{PZH}$	$\overline{OE}BY$	1Y or 2Y	1.2	5.6		ns	
$t_{PZL}$			1.8	4.9			
$t_{PHZ}$	$\overline{OE}BY$	1Y or 2Y	1.4	5.4		ns	
$t_{PLZ}$			1.7	4.5			

## Switching Characteristics for UBT Transceiver

over recommended operating conditions (unless otherwise noted) (see [Figure 1](#) and [Figure 2](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	TYP	MAX	UNIT	
$f_{max}$			120			MHz	
$t_{PLH}$	3A	3B	5.5	9.3		ns	
$t_{PHL}$			4.7	8.3			
$t_{PLH}$	LE	3B	6	10.6		ns	
$t_{PHL}$			4.9	8.7			
$t_{PLH}$	CLKAB	3B	5.8	10.1		ns	
$t_{PHL}$			4.6	8.4			
$t_{PZH}$	$\overline{OE}$	3B	4.6	9.3		ns	
$t_{PZL}$			3.5	8.5			
$t_{PHZ}$	$\overline{OE}$	3B	4.8	9.3		ns	
$t_{PLZ}$			2.4	5.7			
$t_r$	Transition time, B port (10%–90%)			4.3		ns	
$t_f$	Transition time, B port (90%–10%)			4.3		ns	
$t_{PLH}$	3B	3A	1.7	5.9		ns	
$t_{PHL}$			1.7	5.9			
$t_{PLH}$	LE	3A	1.7	5.9		ns	
$t_{PHL}$			1.7	5.9			
$t_{PLH}$	CLKBA	3A	1.4	5.5		ns	
$t_{PHL}$			1.4	5.5			
$t_{PZH}$	$\overline{OE}$	3A	1.5	6.2		ns	
$t_{PZL}$			2.1	5.5			
$t_{PHZ}$	$\overline{OE}$	3A	1.8	6.2		ns	
$t_{PLZ}$			2.3	5.6			

## Skew Characteristics for Bus Transceiver

for specific worst-case  $V_{CC}$  and temperature within the recommended ranges of supply voltage and operating free-air temperature (see [Figure 1](#) and [Figure 2](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	MAX	UNIT
$t_{sk(LH)}$	1A or 2A	1B or 2B	0.8	ns	
$t_{sk(HL)}$			0.7		
$t_{sk(LH)}$	1B or 2B	1Y or 2Y	0.7	ns	
$t_{sk(HL)}$			0.6		
$t_{sk(t)}$ <sup>(1)</sup>	1A or 2A	1B or 2B	1.7	ns	
	1B or 2B	1Y or 2Y	1.2		
$t_{sk(pp)}$	1A or 2A	1B or 2B	2.8	ns	
	1B or 2B	1Y or 2Y	1.4		

(1)  $t_{sk(t)}$  – Output-to-output skew is defined as the absolute value of the difference between the actual propagation delay for all outputs of the same packaged device. The specifications are given for specific worst-case  $V_{CC}$  and temperature and apply to any outputs switching in opposite directions, both low to high (LH) and high to low (HL) [ $t_{sk(t)}$ ].

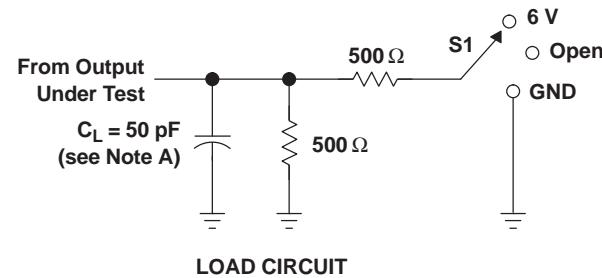
## Skew Characteristics for UBT

for specific worst-case  $V_{CC}$  and temperature within the recommended ranges of supply voltage and operating free-air temperature (see [Figure 1](#) and [Figure 2](#))

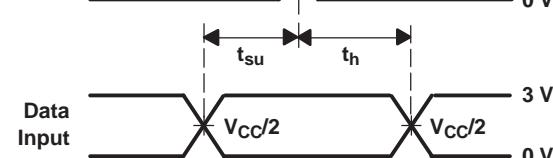
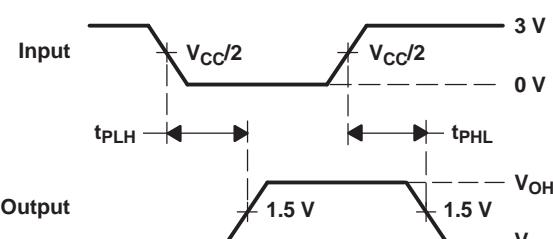
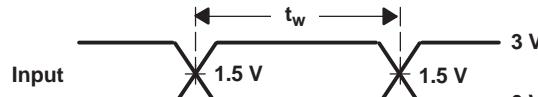
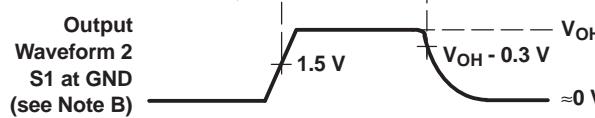
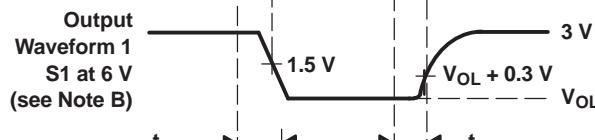
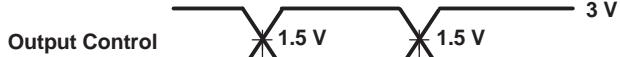
PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	MAX	UNIT
$t_{sk(LH)}$	3A	3B	1.3	ns	
$t_{sk(HL)}$			1.1		
$t_{sk(LH)}$	CLKAB	3B	0.8	ns	
$t_{sk(HL)}$			0.8		
$t_{sk(LH)}$	3B	3A	0.7	ns	
$t_{sk(HL)}$			0.6		
$t_{sk(LH)}$	CLKBA	3A	0.7	ns	
$t_{sk(HL)}$			0.6		
$t_{sk(t)}$ <sup>(1)</sup>	3A	3B	1.9	ns	
	CLKAB	3B	2.1		
	3B	3A	1.2		
	CLKBA	3A	1		
$t_{sk(pp)}$	3A	3B	2.8	ns	
	CLKAB	3B	2.7		
	3B	3A	1.3		
	CLKBA	3A	1.2		

(1)  $t_{sk(t)}$  – Output-to-output skew is defined as the absolute value of the difference between the actual propagation delay for all outputs of the same packaged device. The specifications are given for specific worst-case  $V_{CC}$  and temperature and apply to any outputs switching in opposite directions, both low to high (LH) and high to low (HL) [ $t_{sk(t)}$ ].

## PARAMETER MEASUREMENT INFORMATION A PORT



TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	6 V
$t_{PHZ}/t_{PZH}$	GND
B-to-A Skew	Open

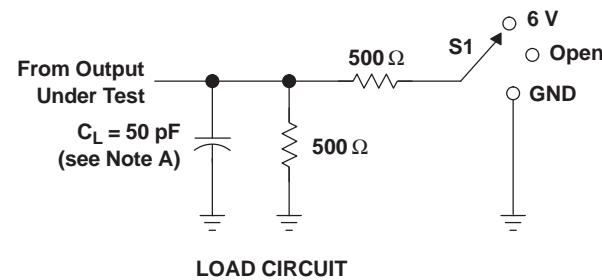
**LOAD CIRCUIT**

**VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES**

**VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTS**

**VOLTAGE WAVEFORMS  
PULSE DURATION**

**VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES  
LOW- AND HIGH-LEVEL ENABLING**

NOTES:

- $C_L$  includes probe and jig capacitance.
- Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
- All input pulses are supplied by generators having the following characteristics: PRR  $\approx 10\text{ MHz}$ ,  $Z_O = 50\Omega$ ,  $t_r \approx 2\text{ ns}$ ,  $t_f \approx 2\text{ ns}$ .
- The outputs are measured one at a time, with one transition per measurement.

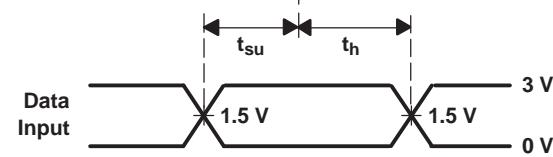
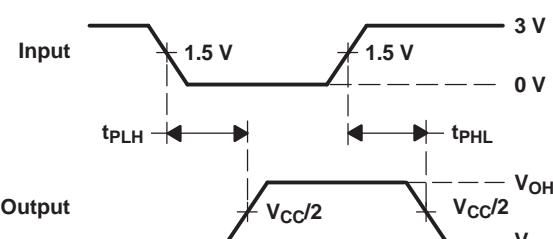
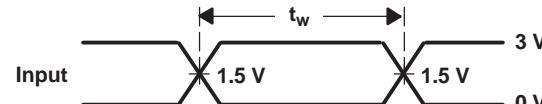
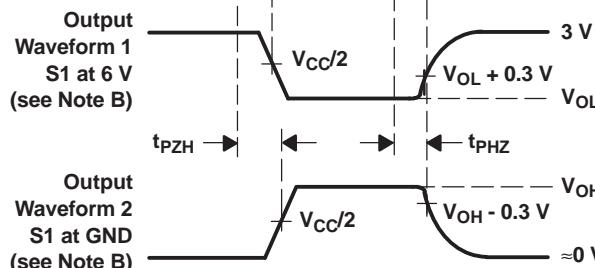
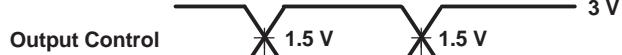
**Figure 1. Load Circuit and Voltage Waveforms**

## PARAMETER MEASUREMENT INFORMATION B PORT



TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	6 V
$t_{PHZ}/t_{PZH}$	GND
A-to-B Skew	Open

LOAD CIRCUIT

VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMESVOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTSVOLTAGE WAVEFORMS  
PULSE DURATIONVOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES  
LOW- AND HIGH-LEVEL ENABLING

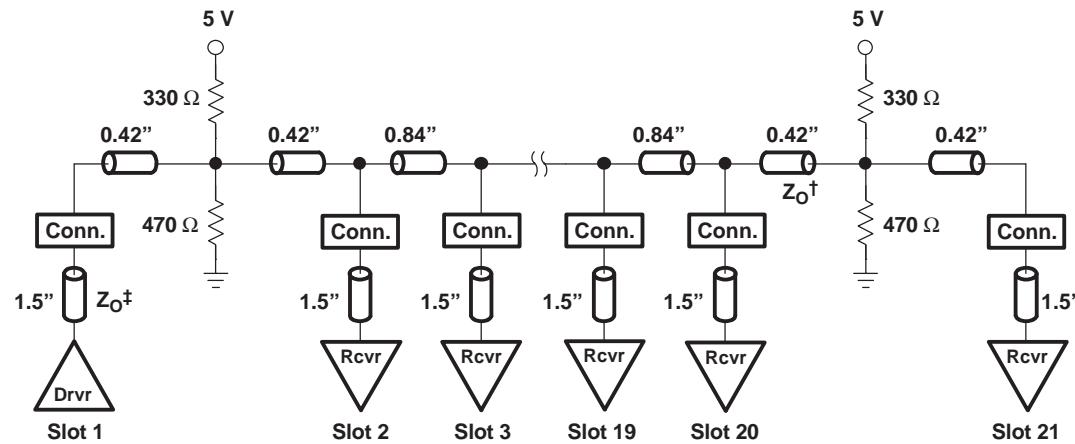
NOTES:

- $C_L$  includes probe and jig capacitance.
- Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
- All input pulses are supplied by generators having the following characteristics: PRR  $\approx 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \approx 2 \text{ ns}$ ,  $t_f \approx 2 \text{ ns}$ .
- The outputs are measured one at a time, with one transition per measurement.

Figure 2. Load Circuit and Voltage Waveforms

## Distributed-Load Backplane Switching Characteristics

The preceding switching characteristics tables show the switching characteristics of the device into the lumped load shown in the parameter measurement information (PMI) (see [Figure 1](#) and [Figure 2](#)). All logic devices currently are tested into this type of load. However, the designer's backplane application probably is a distributed load. For this reason, this device has been designed for optimum performance in the VME64x backplane as shown in [Figure 3](#).



† Unloaded backplane trace natural impedance ( $Z_0$ ) is 45  $\Omega$ . 45  $\Omega$  to 60  $\Omega$  is allowed, with 50  $\Omega$  being ideal.

‡ Card stub natural impedance ( $Z_0$ ) is 60  $\Omega$ .

**Figure 3. VME64x Backplane**

The following switching characteristics tables derived from TI-SPICE models show the switching characteristics of the device into the backplane under full and minimum loading conditions, to help the designer better understand the performance of the VME device in this typical backplane. See [www.ti.com/sc/etl](http://www.ti.com/sc/etl) for more information.

### Driver in Slot 11, With Receiver Cards in All Other Slots (Full Load)

#### Switching Characteristics for Bus Transceiver Function

over recommended operating conditions (unless otherwise noted) (see [Figure 3](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	TYP <sup>(1)</sup>	MAX	UNIT	
$t_{PLH}$	1A or 2A	1B or 2B	5.9	8.5		ns	
$t_{PHL}$			5.5	8.7			
$t_r$ <sup>(2)</sup>	Transition time, B port (10%–90%)			9	8.6	11.4	
$t_f$ <sup>(2)</sup>	Transition time, B port (90%–10%)			8.9	9	10.8	

(1) All typical values are at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$ . All values are derived from TI-SPICE models.

(2) All  $t_r$  and  $t_f$  times are taken at the first receiver.

## Switching Characteristics for UBT

over recommended operating conditions (unless otherwise noted) (see Figure 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	TYP <sup>(1)</sup>	MAX	UNIT		
$t_{PLH}$	3A	3B	6.2	8.9		ns		
$t_{PHL}$			5.6	9				
$t_{PLH}$	LE	3B	6.1	9.1		ns		
$t_{PHL}$			5.6	9				
$t_{PLH}$	CLKAB	3B	6.2	9.1		ns		
$t_{PHL}$			5.7	9				
$t_r$ <sup>(2)</sup>	Transition time, B port (10%–90%)			9	8.6	11.4	ns	
$t_f$ <sup>(2)</sup>	Transition time, B port (90%–10%)			8.9	9	10.8	ns	

(1) All typical values are at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$ . All values are derived from TI-SPICE models.

(2) All  $t_r$  and  $t_f$  times are taken at the first receiver.

## Skew Characteristics for Bus Transceiver

for specific worst-case  $V_{CC}$  and temperature within the recommended ranges of supply voltage and operating free-air temperature (see Figure 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	TYP <sup>(1)</sup>	MAX	UNIT
$t_{sk(LH)}$	1A or 2A	1B or 2B		2.5		ns
$t_{sk(HL)}$				3		
$t_{sk(t)}$ <sup>(2)</sup>	1A or 2A	1B or 2B		1		ns
$t_{sk(pp)}$	1A or 2A	1B or 2B	0.5	3.4		ns

(1) All typical values are at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$ . All values are derived from TI-SPICE models.

(2)  $t_{sk(t)}$  – Output-to-output skew is defined as the absolute value of the difference between the actual propagation delay for all outputs of the same packaged device. The specifications are given for specific worst-case  $V_{CC}$  and temperature and apply to any outputs switching in opposite directions, both low to high (LH) and high to low (HL) [ $t_{sk(t)}$ ].

## Skew Characteristics for UBT

for specific worst-case  $V_{CC}$  and temperature within the recommended ranges of supply voltage and operating free-air temperature (see Figure 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	TYP <sup>(1)</sup>	MAX	UNIT
$t_{sk(LH)}$	3A	3B		2.4		ns
$t_{sk(HL)}$				3.4		
$t_{sk(LH)}$	CLKAB	3B		2.7		ns
$t_{sk(HL)}$				3.4		
$t_{sk(t)}$ <sup>(2)</sup>	3A	3B		1		ns
	CLKAB	3B		1		
$t_{sk(pp)}$	3A	3B	0.5	3.4		ns
	CLKAB	3B	0.6	3.5		

(1) All typical values are at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$ . All values are derived from TI-SPICE models.

(2)  $t_{sk(t)}$  – Output-to-output skew is defined as the absolute value of the difference between the actual propagation delay for all outputs of the same packaged device. The specifications are given for specific worst-case  $V_{CC}$  and temperature and apply to any outputs switching in opposite directions, both low to high (LH) and high to low (HL) [ $t_{sk(t)}$ ].

## Driver in Slot 1, With One Receiver in Slot 21 (Minimum Load)

### Switching Characteristics for Bus Transceiver Function

over recommended operating conditions (unless otherwise noted) (see Figure 3)

## Switching Characteristics for Bus Transceiver Function (continued)

over recommended operating conditions (unless otherwise noted) (see [Figure 3](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	TYP <sup>(1)</sup>	MAX	UNIT	
$t_{PLH}$	1A or 2A	1B or 2B	5.5	7.4		ns	
$t_{PHL}$			5.3	7.4			
$t_r$ <sup>(2)</sup>	Transition time, B port (10%–90%)		3.9	3.4	4.4	ns	
$t_f$ <sup>(2)</sup>	Transition time, B port (90%–10%)		3.7	3.4	4.8	ns	

(1) All typical values are at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$ . All values are derived from TI-SPICE models.  
(2) All  $t_r$  and  $t_f$  times are taken at the first receiver.

## Switching Characteristics for UBT

over recommended operating conditions (unless otherwise noted) (see [Figure 3](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	TYP <sup>(1)</sup>	MAX	UNIT	
$t_{PLH}$	3A	3B	5.8	7.9		ns	
$t_{PHL}$			5.5	7.7			
$t_{PLH}$	LE	3B	5.9	8		ns	
$t_{PHL}$			5.5	7.8			
$t_{PLH}$	CLKAB	3B	5.9	8.1		ns	
$t_{PHL}$			5.5	7.7			
$t_r$ <sup>(2)</sup>	Transition time, B port (10%–90%)		3.9	3.4	4.4	ns	
$t_f$ <sup>(2)</sup>	Transition time, B port (90%–10%)		3.7	3.4	4.8	ns	

(1) All typical values are at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$ . All values are derived from TI-SPICE models.  
(2) All  $t_r$  and  $t_f$  times are taken at the first receiver.

## Skew Characteristics for Bus Transceiver

for specific worst-case  $V_{CC}$  and temperature within the recommended ranges of supply voltage and operating free-air temperature (see [Figure 3](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	TYP <sup>(1)</sup>	MAX	UNIT
$t_{sk(LH)}$	1A or 2A	1B or 2B		1.7		ns
$t_{sk(HL)}$				2.1		
$t_{sk(t)}$ <sup>(2)</sup>	1A or 2A	1B or 2B		1		ns
$t_{sk(pp)}$	1A or 2A	1B or 2B	0.2	2.1		ns

(1) All typical values are at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$ . All values are derived from TI-SPICE models.  
(2)  $t_{sk(t)}$  – Output-to-output skew is defined as the absolute value of the difference between the actual propagation delay for all outputs of the same packaged device. The specifications are given for specific worst-case  $V_{CC}$  and temperature and apply to any outputs switching in opposite directions, both low to high (LH) and high to low (HL) [ $t_{sk(t)}$ ].

## Skew Characteristics for UBT

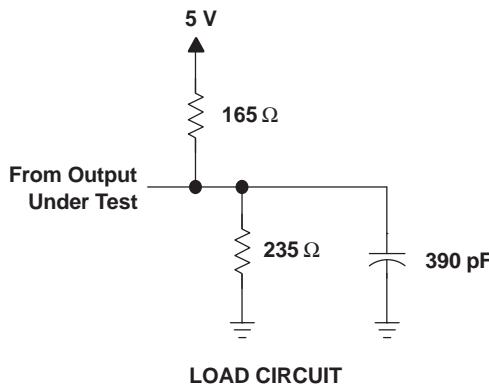
for specific worst-case  $V_{CC}$  and temperature within the recommended ranges of supply voltage and operating free-air temperature (see [Figure 3](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	TYP <sup>(1)</sup>	MAX	UNIT
$t_{sk(LH)}$	3A	3B		2		ns
$t_{sk(HL)}$				2.3		
$t_{sk(LH)}$	CLKAB	3B		2.1		ns
$t_{sk(HL)}$				2.4		
$t_{sk(t)}$ <sup>(2)</sup>	3A	3B		1		ns
	CLKAB	3B		1		
$t_{sk(pp)}$	3A	3B	0.2	2.5		ns
	CLKAB	3B	0.2	2.9		

(1) All typical values are at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$ . All values are derived from TI-SPICE models.

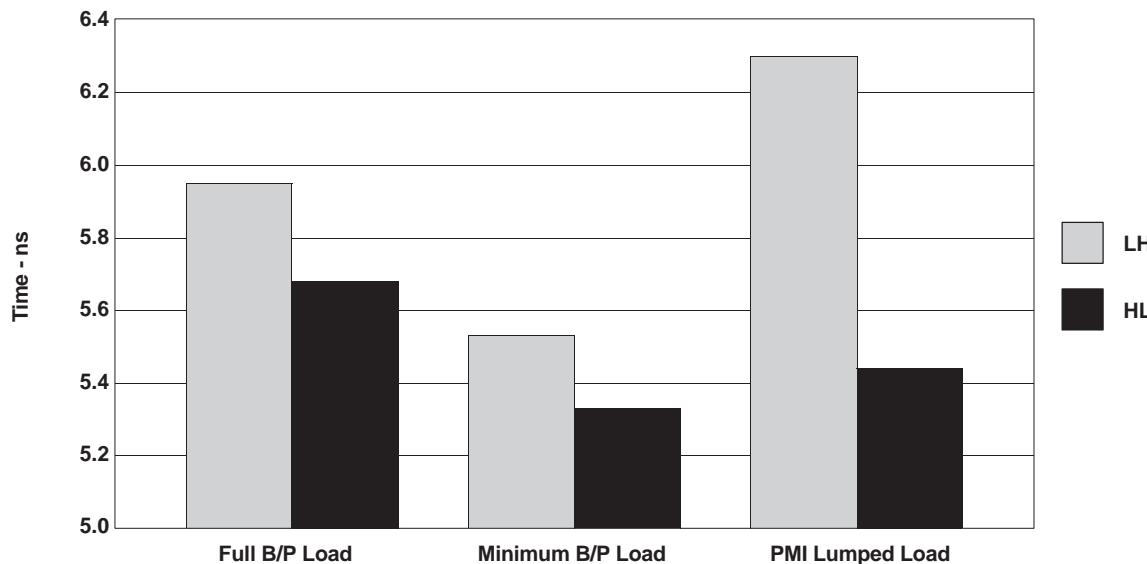
(2)  $t_{sk(t)}$  – Output-to-output skew is defined as the absolute value of the difference between the actual propagation delay for all outputs of the same packaged device. The specifications are given for specific worst-case  $V_{CC}$  and temperature and apply to any outputs switching in opposite directions, both low to high (LH) and high to low (HL) [ $t_{sk(t)}$ ].

By simulating the performance of the device using the VME64x backplane (see [Figure 3](#)), the maximum peak current in or out of the B-port output, as the devices switch from one logic state to another, was found to be equivalent to driving the lumped load shown in [Figure 4](#).

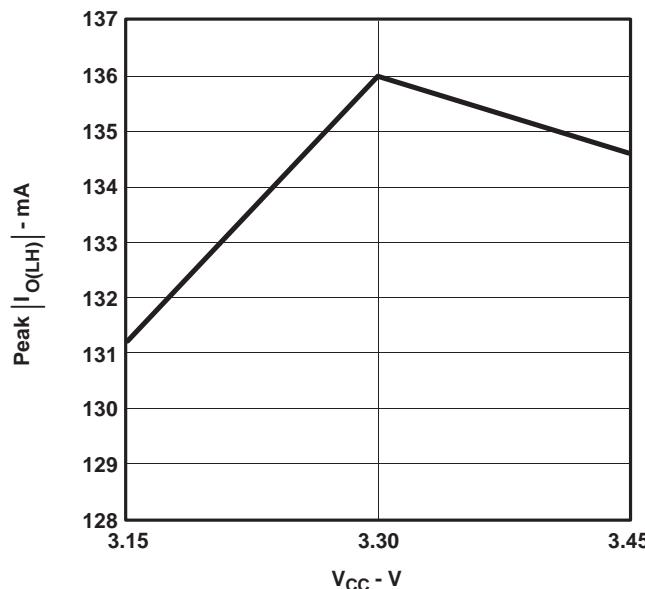
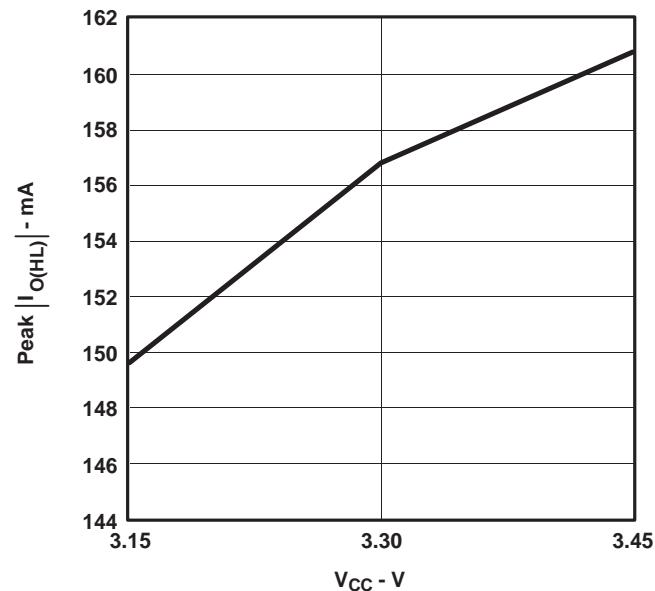


**Figure 4. Equivalent AC Peak Output-Current Lumped Load**

In general, the rise- and fall-time distribution is shown in [Figure 5](#). Since VME devices were designed for use into distributed loads like the VME64x backplane (B/P), there are significant differences between low-to-high (LH) and high-to-low (HL) values in the lumped load shown in the PMI (see [Figure 1](#) and [Figure 2](#)).


**Figure 5.**

Characterization-laboratory data in [Figure 6](#) and [Figure 7](#) show the absolute ac peak output current, with different supply voltages, as the devices change output logic state. A typical nominal process is shown to demonstrate the devices' peak ac output drive capability.


**Figure 6.**

**Figure 7.**

## TYPICAL CHARACTERISTICS

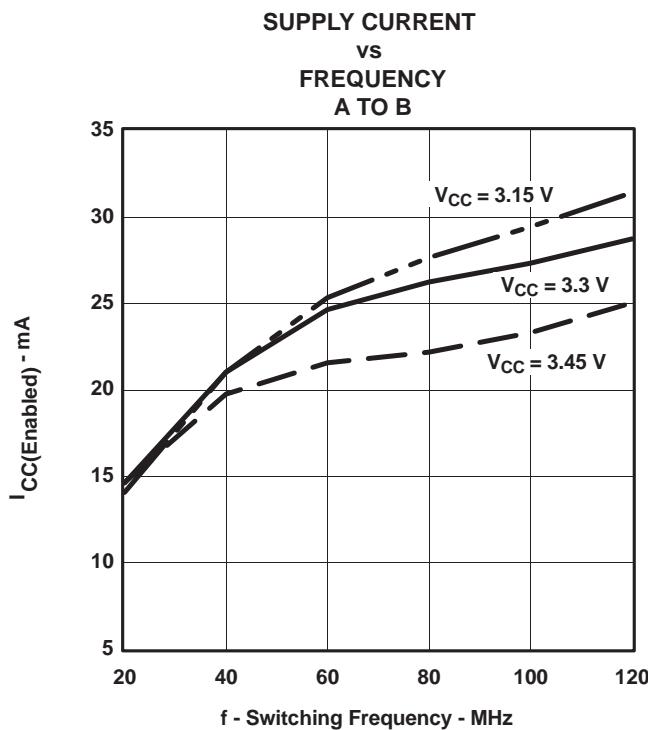


Figure 8.

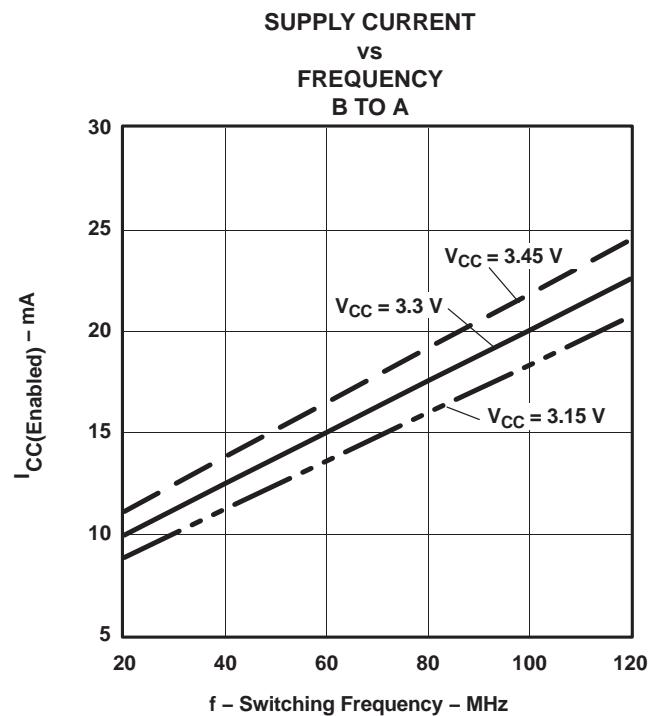
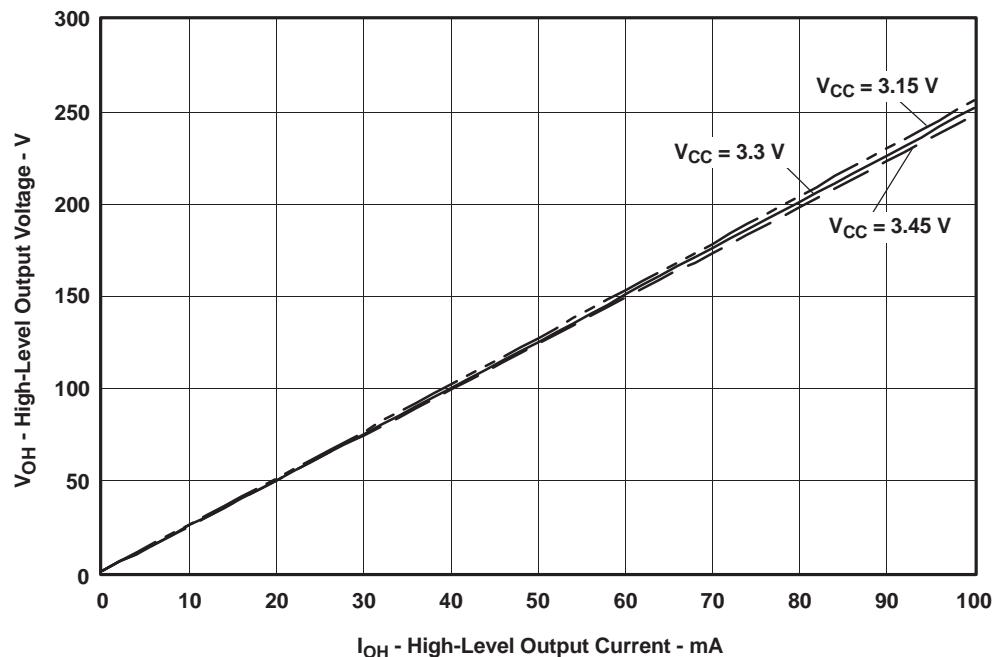
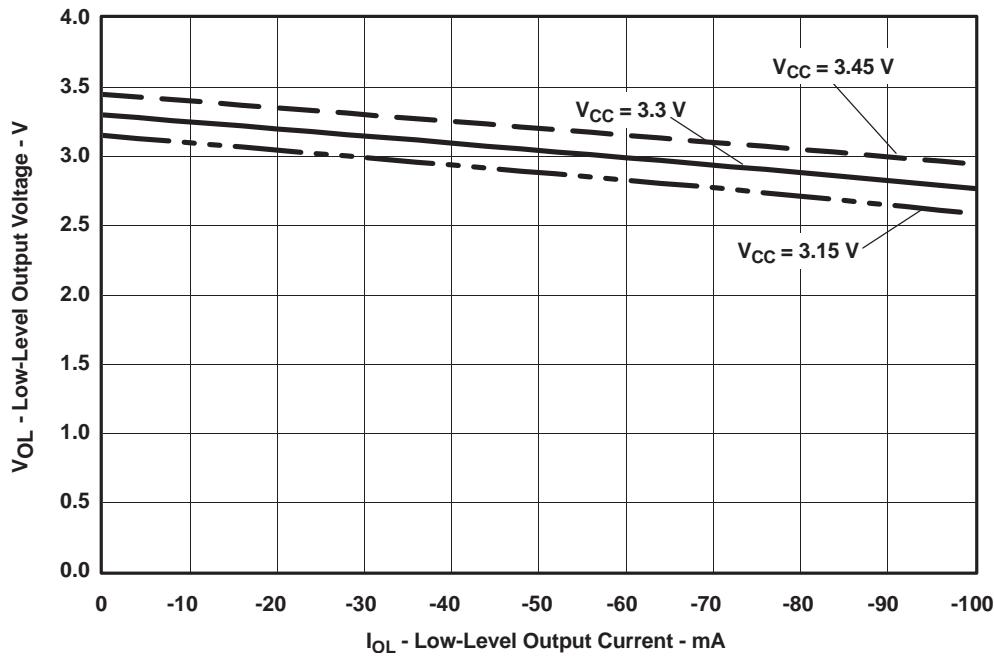


Figure 9.

**TYPICAL CHARACTERISTICS**
**HIGH-LEVEL OUTPUT VOLTAGE  
vs  
HIGH-LEVEL OUTPUT CURRENT**

**Figure 10.  $V_{OL}$  vs  $I_{OL}$** 
**LOW-LEVEL OUTPUT VOLTAGE  
vs  
LOW-LEVEL OUTPUT CURRENT**

**Figure 11.  $V_{OH}$  vs  $I_{OH}$**

## VMEbus Summary

In 1981, the VMEbus was introduced as a backplane bus architecture for industrial and commercial applications. The data-transfer protocols used to define the VMEbus came from the Motorola™ VERSA bus architecture that owed its heritage to the then recently introduced Motorola 68000 microprocessor. The VMEbus, when introduced, defined two basic data-transfer operations: single-cycle transfers consisting of an address and a data transfer, and a block transfer (BLT) consisting of an address and a sequence of data transfers. These transfers were asynchronous, using a master-slave handshake. The master puts address and data on the bus and waits for an acknowledgment. The selected slave either reads or writes data to or from the bus, then provides a data-acknowledge (DTACK\*) signal. The VMEbus system data throughput was 40 Mbyte/s. Previous to the VMEbus, it was not uncommon for the backplane buses to require elaborate calculations to determine loading and drive current for interface design. This approach made designs difficult and caused compatibility problems among manufacturers. To make interface design easier and to ensure compatibility, the developers of the VMEbus architecture defined specific delays based on a 21-slot terminated backplane and mandated the use of certain high-current TTL drivers, receivers, and transceivers.

In 1989, multiplexing block transfer (MBLT) effectively increased the number of bits from 32 to 64, thereby doubling the transfer rate. In 1995, the number of handshake edges was reduced from four to two in the double-edge transfer (2eVME) protocol, doubling the data rate again. In 1997, the VMEbus International Trade Association (VITA) established a task group to specify a synchronous protocol to increase data-transfer rates to 320 Mbyte/s, or more. The unreleased specification, VITA 1.5 [double-edge source synchronous transfer (2eSST)], is based on the asynchronous 2eVME protocol. It does not wait for acknowledgement of the data by the receiver and requires incident-wave switching. Sustained data rates of 1 Gbyte/s, more than ten times faster than traditional VME64 backplanes, are possible by taking advantage of 2eSST and the 21-slot VME320 star-configuration backplane. The VME320 backplane approximates a lumped load, allowing substantially higher-frequency operation over the VME64x distributed-load backplane. Traditional VME64 backplanes with no changes theoretically can sustain 320 Mbyte/s.

*From BLT to 2eSST – A Look at the Evolution of VMEbus Protocols* by John Rynearson, Technical Director, VITA, provides additional information on VMEbus and can be obtained at [www.vita.com](http://www.vita.com).

## Maximum Data Transfer Rates

DATE	TOPOLOGY	PROTOCOL	DATA BITS PER CYCLE	DATA TRANSFERS PER CLOCK CYCLE	PER SYSTEM (Mbyte/s)	FREQUENCY (MHz)	
						BACKPLANE	CLOCK
1981	VMEbus IEEE-1014	BLT	32	1	40	10	10
1989	VME64	MBLT	64	1	80	10	10
1995	VME64x	2eVME	64	2	160	10	20
1997	VME64x	2eSST	64	2-No Ack	160–320	10–20	20–40
1999	VME320	2eSST	64	2-No Ack	320–1000	20–62.5	40–125

## Applicability

Target applications for VME backplanes include industrial controls, telecommunications, simulation, high-energy physics, office automation, and instrumentation systems.

## PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
74VMEH22501ADGGRE4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	VMEH22501A	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74VMEH22501ADGGR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	VMEH22501A	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74VMEH22501ADGVR	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	VK501A	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74VMEH22501AGQLR	OBsolete	BGA MICROSTAR JUNIOR	GQL	56		TBD	Call TI	Call TI	-40 to 85		
SN74VMEH22501AZQLR	ACTIVE	BGA MICROSTAR JUNIOR	ZQL	56	1000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	VK501A	<span style="background-color: red; color: white; padding: 2px;">Samples</span>

(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 - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**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.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

---

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

**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.

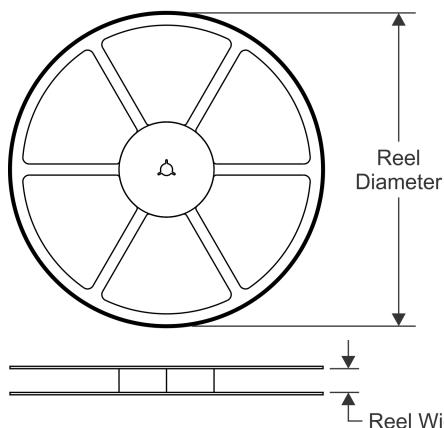
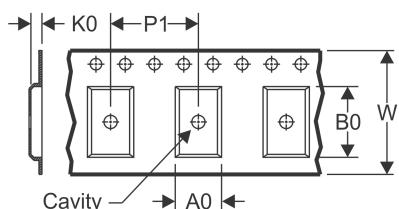
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF SN74VMEH22501A :**

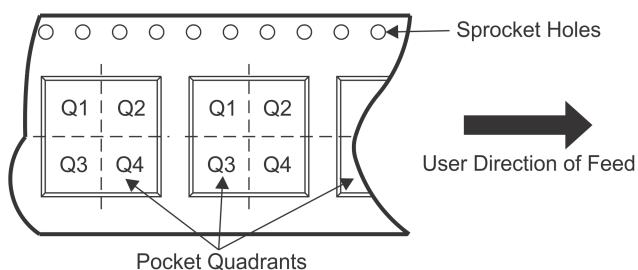
- Enhanced Product: [SN74VMEH22501A-EP](#)

NOTE: Qualified Version Definitions:

- Enhanced Product - Supports Defense, Aerospace and Medical Applications

**TAPE AND REEL INFORMATION**
**REEL DIMENSIONS**

**TAPE DIMENSIONS**


A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74VMEH22501ADGGR	TSSOP	DGG	48	2000	330.0	24.4	8.6	15.8	1.8	12.0	24.0	Q1
SN74VMEH22501ADGVR	TVSOP	DGV	48	2000	330.0	16.4	7.1	10.2	1.6	12.0	16.0	Q1
SN74VMEH22501AZQLR	BGA MI CROSTA R JUNI OR	ZQL	56	1000	330.0	16.4	4.8	7.3	1.5	8.0	16.0	Q1

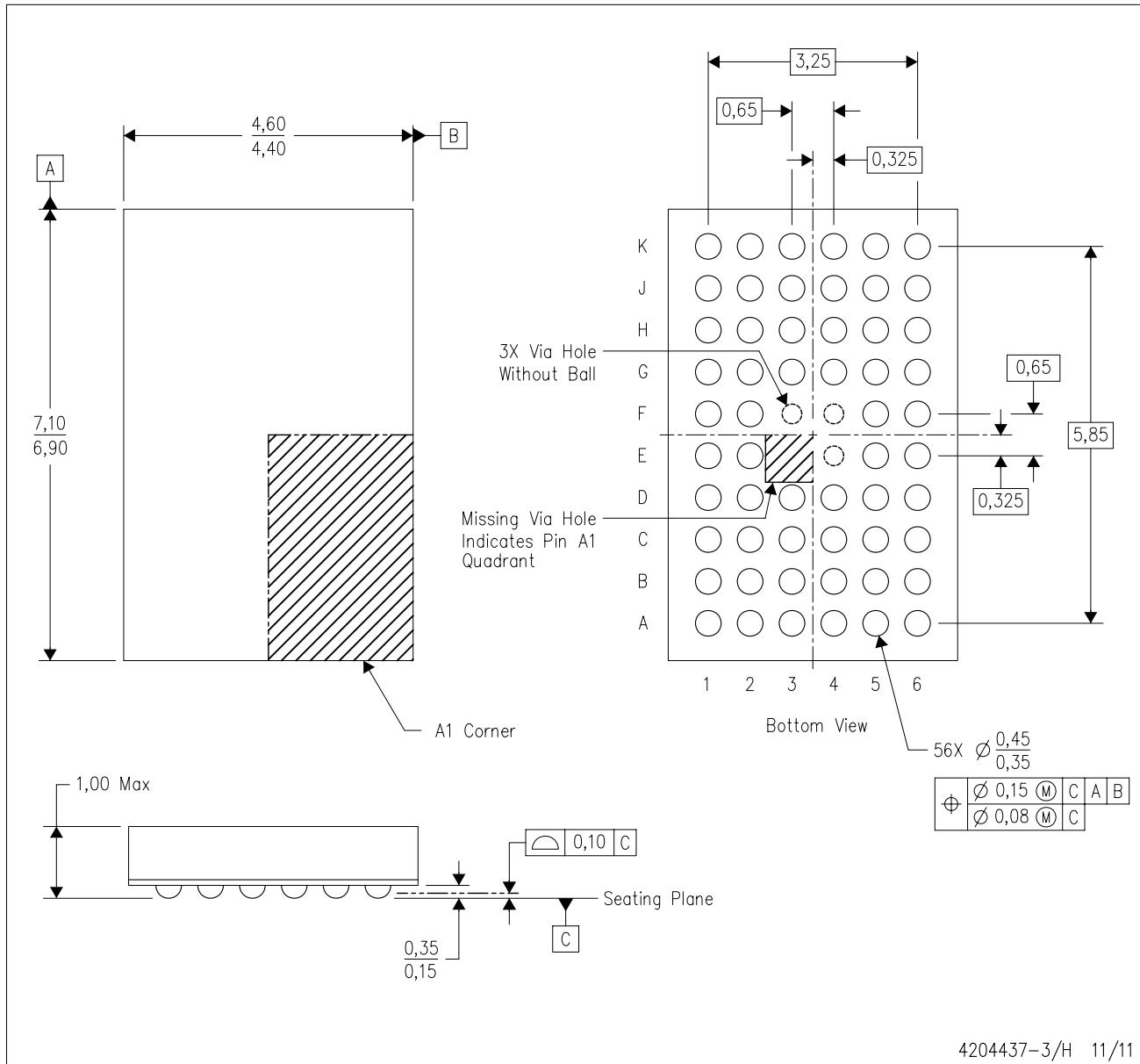
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74VMEH22501ADGGR	TSSOP	DGG	48	2000	367.0	367.0	45.0
SN74VMEH22501ADGVR	TVSOP	DGV	48	2000	367.0	367.0	38.0
SN74VMEH22501AZQLR	BGA MICROSTAR JUNIOR	ZQL	56	1000	336.6	336.6	28.6

ZQL (R-PBGA-N56)

PLASTIC BALL GRID ARRAY



4204437-3/H 11/11

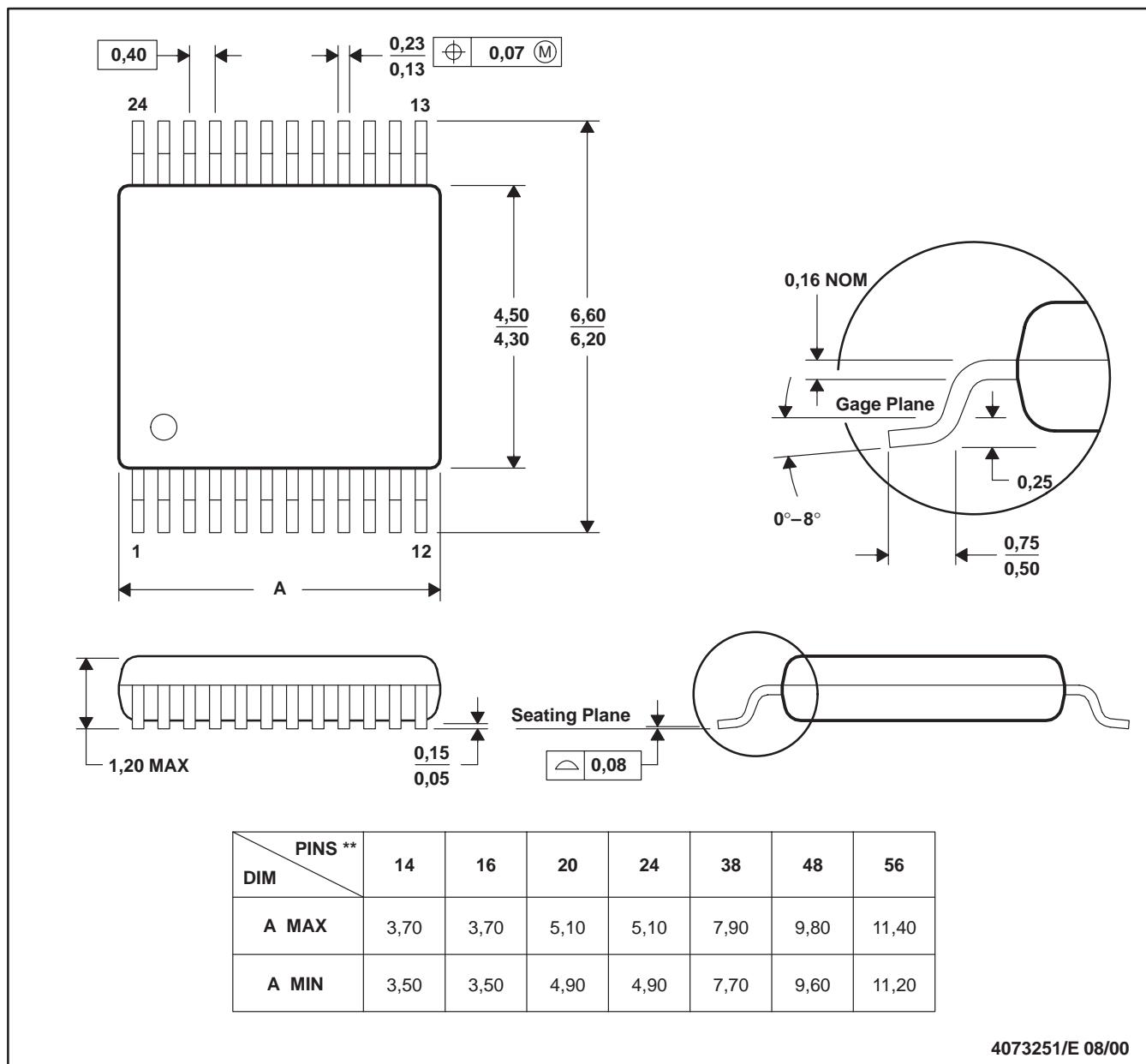
NOTES:

- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
- This drawing is subject to change without notice.
- Falls within JEDEC MO-285 variation BA-2.
- This package is Pb-free. Refer to the 56 QGL package (drawing 4200583) for tin-lead (SnPb).

## DGV (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE

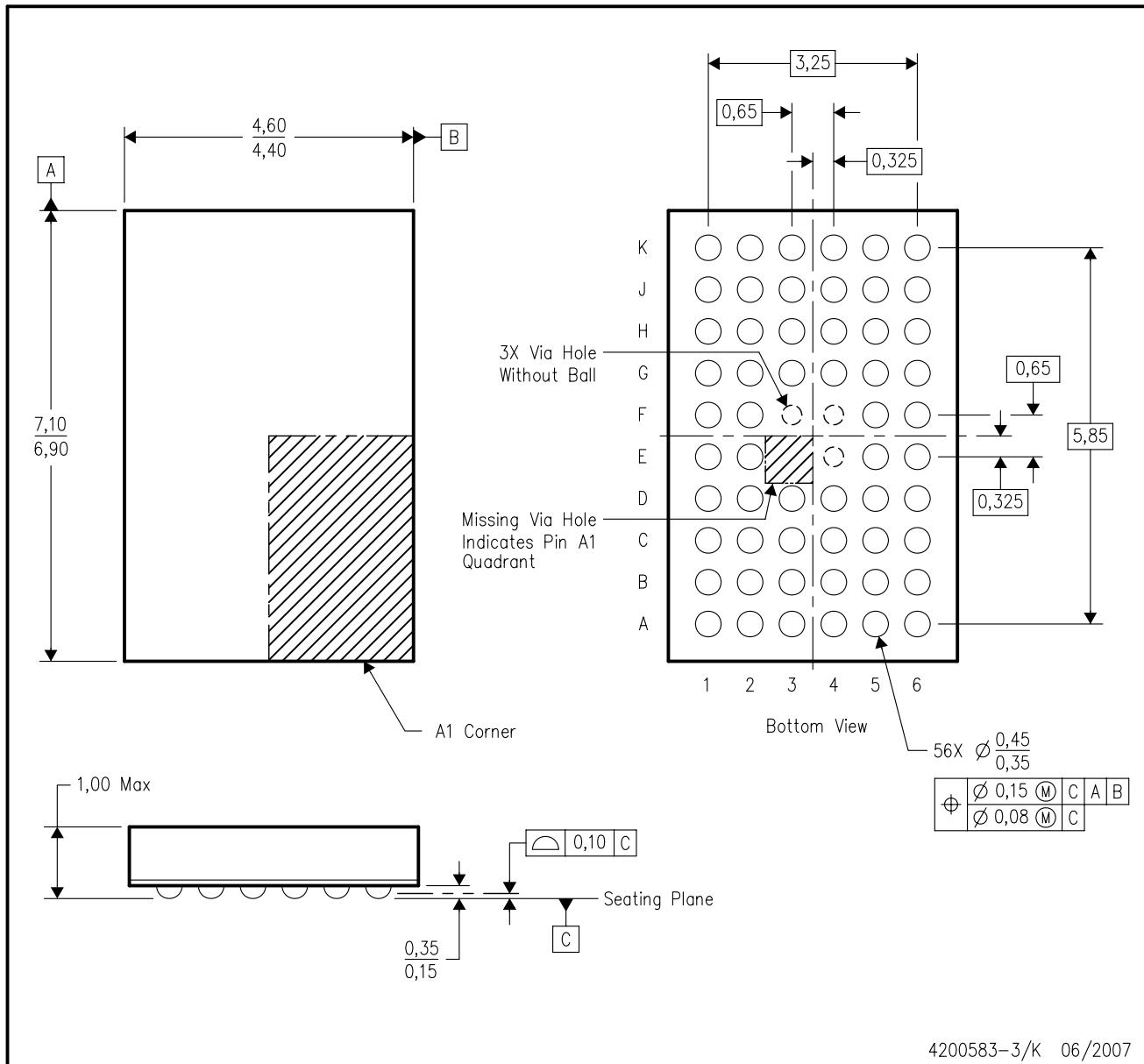
24 PINS SHOWN



NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.  
 D. Falls within JEDEC: 24/48 Pins – MO-153  
 14/16/20/56 Pins – MO-194

## GQL (R-PBGA-N56)

## PLASTIC BALL GRID ARRAY



4200583-3/K 06/2007

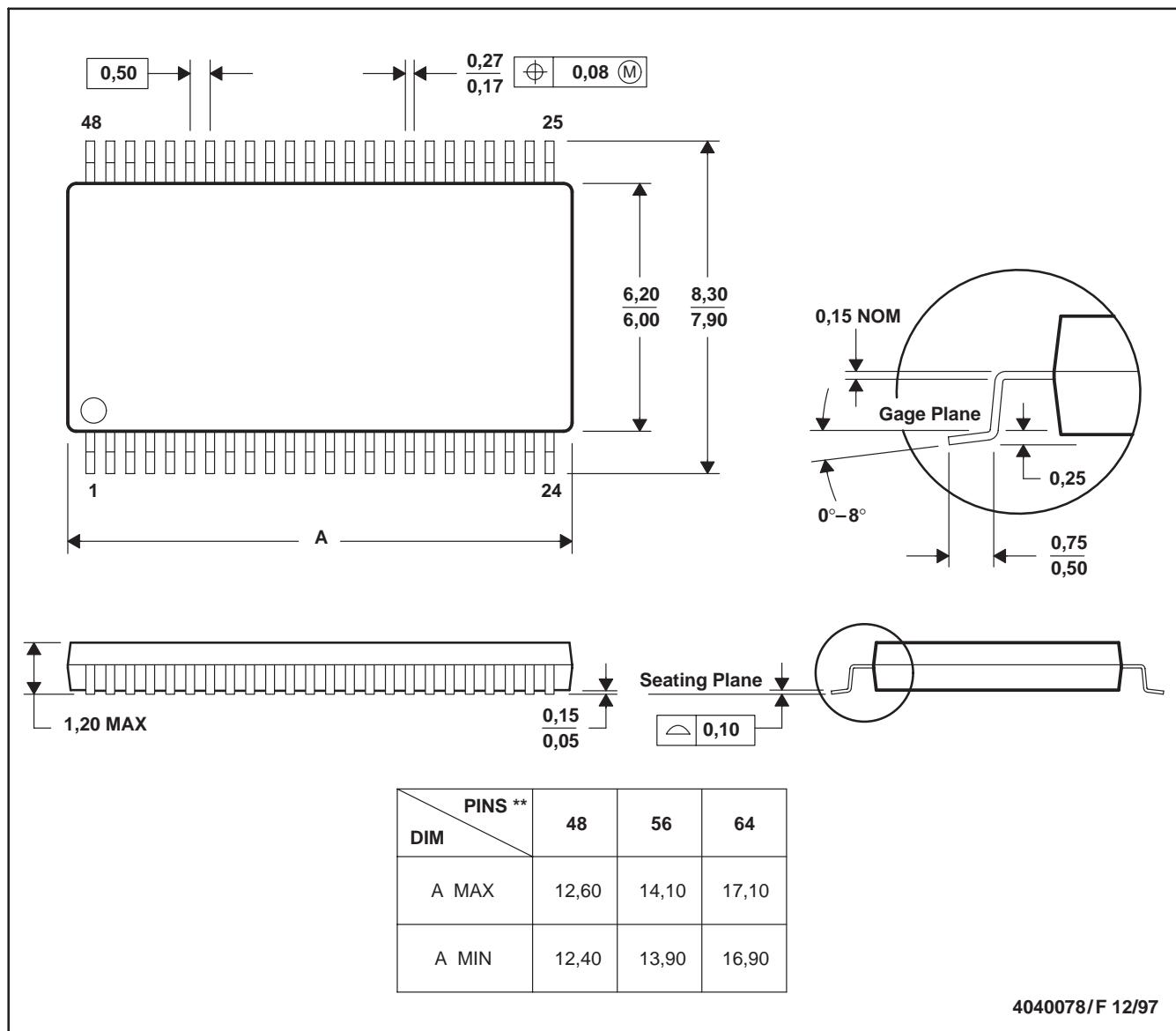
NOTES:

- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
- This drawing is subject to change without notice.
- Falls within JEDEC MO-285 variation BA-2.
- This package is tin-lead (SnPb). Refer to the 56 ZQL package (drawing 4204437) for lead-free.

DGG (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

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 relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license 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 significant portions of TI 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. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products	Applications
Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>
	<b>TI E2E Community</b>
	<a href="http://e2e.ti.com">e2e.ti.com</a>