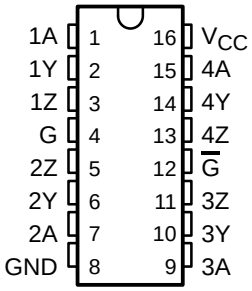
- **Designed for TIA/EIA-485, TIA/EIA-422, and ISO 8482 Applications**
- **Signaling Rates† up to 30 Mbps**
- **Propagation Delay Times <11 ns**
- **Low Standby Power Consumption 1.5 mA Max**
- **Output ESD Protection Exceeds 13 kV**
- **Driver Positive- and Negative-Current Limiting**
- **Power-Up and Power-Down Glitch-Free for Live Insertion Applications**
- **Thermal Shutdown Protection**
- **Industry Standard Pin-Out, Compatible With SN75172, AM26LS31, DS96172, LTC486, and MAX3045**

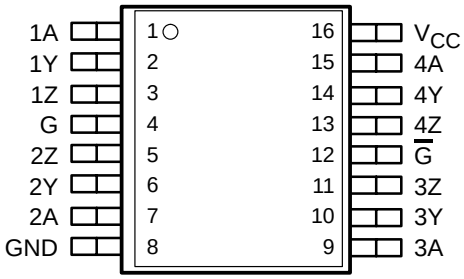
description

The SN65LBC172A and SN75LBC172A are quadruple differential line drivers with 3-state outputs, designed for TIA/EIA-485 (RS-485), TIA/EIA-422 (RS-422), and ISO 8482 applications.

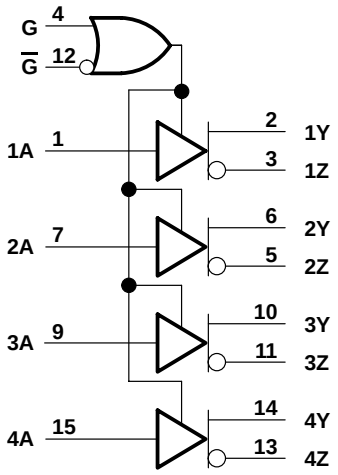
N PACKAGE
(TOP VIEW)



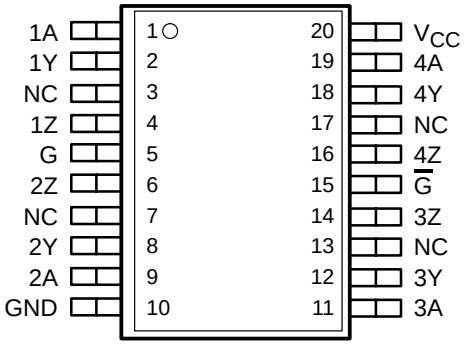
16-DW PACKAGE
(TOP VIEW)



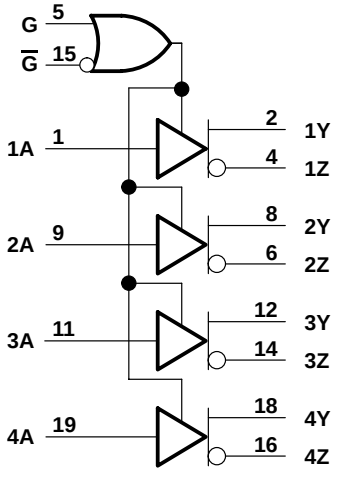
logic diagram (positive logic)



20-DW PACKAGE
(TOP VIEW)



logic diagram (positive logic)



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.

LinBiCMOS is a trademark of Texas Instruments.

†The signaling rate of a line is the number of voltage transitions that are made per second expressed in the units bps (bits per second).

description (continued)

These devices are optimized for balanced multipoint bus transmission at signalling rates up to 30 million bits per second. The transmission media may be printed-circuit board traces, backplanes, or cables. The ultimate rate and distance of data transfer is dependent upon the attenuation characteristics of the media and the noise coupling to the environment.

Each driver features current limiting and thermal-shutdown circuitry making it suitable for high-speed mulitpoint data transmission applications in noisy environments. These devices are designed using LinBiCMOS™, facilitating low power consumption and robustness.

The G and $\overline{G}$ inputs provide driver enable control using either positive or negative logic. When disabled or powered off, the driver outputs present a high-impedance to the bus for reduced system loading.

The SN75LBC172A is characterized for operation over the temperature range of 0°C to 70°C. The SN65LBC172A is characterized over the temperature range from –40°C to 85°C.

AVAILABLE OPTIONS

T_A	PACKAGE		
	16-PIN PLASTIC SMALL OUTLINE† (JEDEC MS-013)	**20-PIN PLASTIC SMALL OUTLINE† (JEDEC MS-013)**	**16-PIN PLASTIC THROUGH-HOLE (JEDEC MS-001)**
0°C to 70°C	SN75LBC172A16DW	SN75LBC172ADW	SN75LBC172AN
	Marked as 75LBC172A		
–40°C to 85°C	SN65LBC172A16DW	SN65LBC172ADW	SN65LBC172AN
	Marked as 65LBC172A		

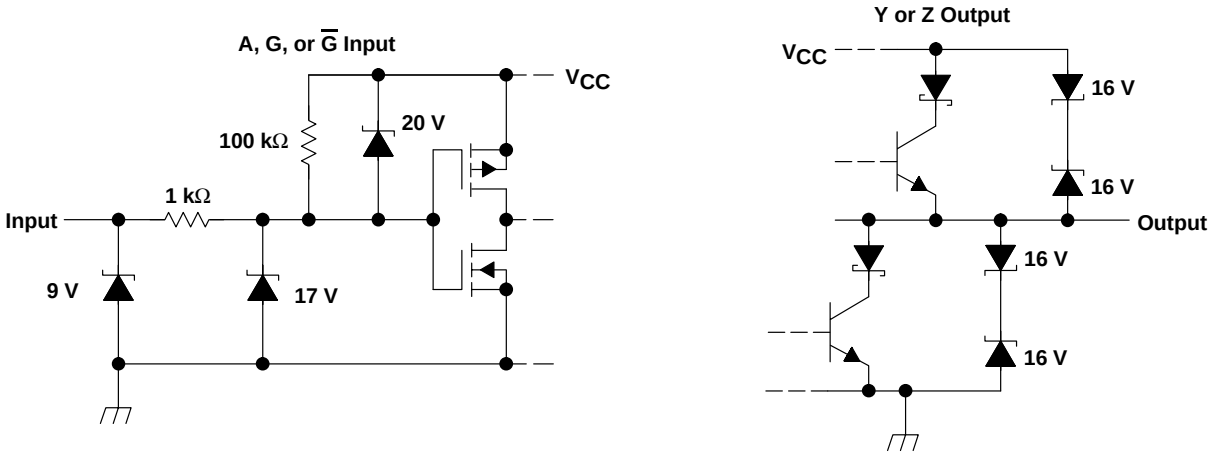
† Add R suffix for taped and reeled version.

FUNCTION TABLE (EACH DRIVER)

INPUT	ENABLES		OUTPUTS	
A	**G**	**$\overline{G}$**	**Y**	**Z**
L	H	X	L	H
L	X	L	L	H
H	H	X	H	L
H	X	L	H	L
OPEN	H	X	H	L
OPEN	X	L	H	L
H	OPEN	X	H	L
L	OPEN	X	L	H
X	L	H	Z	Z
X	L	OPEN	Z	Z

H = high level, L = low level, X = irrelevant,
Z = high impedance (off)

equivalent input and output schematic diagrams



absolute maximum ratings†

Supply voltage range, V_{CC} (see Note 1) . . . . . –0.3 V to 6 V
Output voltage range, V_O, at any bus (steady state) . . . . . –10 V to 15 V
Output voltage range, V_O, at any bus (transient pulse through 100 Ω, see Figure 8) . . . . . –30 V to 30 V
Input voltage range, V_I, at any A, G, or $\overline{G}$ terminal . . . . . –0.5 V to V_{CC} + 0.5 V
Electrostatic discharge: Human body model (see Note 2) Y, Z, and GND . . . . . 13 kV
All pins . . . . . 5 kV
Charged-device model (see Note 3) All pins . . . . . 1 kV
Storage temperature range, T_{stg} . . . . . –65°C to 150°C
Continuous power dissipation . . . . . See Dissipation Rating Table
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 260°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. All voltage values, except differential I/O bus voltages, are with respect to GND.
2. Tested in accordance with JEDEC standard 22, Test Method A114–A.
3. Tested in accordance with JEDEC standard 22, Test Method C101.

DISSIPATION RATING TABLE

PACKAGE	JEDEC BOARD MODEL	$T_A \le 25°C$ POWER RATING	DERATING FACTOR‡ ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING
16-PIN DW	Low K	1200 mW	9.6 mW/°C	769 mW	625 mW
	High K	2240 mW	17.9 mW/°C	1434 mW	1165 mW
20-PIN DW	Low K	1483 mW	11.86 mW/°C	949 mW	771 mW
	High K	2753 mW	22 mW/°C	1762 mW	1432 mW
16-PIN N	Low K	1150 mW	9.2 mW/°C	736 mW	598 mW

‡ This is the inverse of the junction-to-ambient thermal resistance when board-mounted with no air flow.

recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}		4.75	5	5.25	V
Voltage at any bus terminal	Y, Z	–7		12	V
High-level input voltage, V_{IH}	A, G, $\overline{G}$	2		V_{CC}	V
Low-level input voltage, V_{IL}	A, G, $\overline{G}$	0		0.8	V
Output current		–60		60	mA
Operating free-air temperature, T_A	SN75LBC172A	0		70	°C
	SN65LBC172A	–40		85	°C

electrical characteristics over recommended operating conditions

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_{IK}	Input clamp voltage	I_I = –18 mA		–1.5	–0.77		V
V_O	Open-circuit output voltage	Y or Z, No load		0		V_{CC}	V
$\lvert V_{OD(SS)} \rvert$	Steady-state differential output voltage magnitude‡	No load (open circuit)		3		V_{CC}	V
		R_L = 54 Ω, see Figure 1		1	1.6	2.5	V
		With common-mode loading, see Figure 2		1	1.6	2.5	V
$\Delta V_{OD(SS)}$	Change in steady-state differential output voltage between logic states	See Figure 1		–0.1		0.1	V
$V_{OC(SS)}$	Steady-state common-mode output voltage	See Figure 3		2	2.4	2.8	V
$\Delta V_{OC(SS)}$	Change in steady-state common-mode output voltage between logic states	See Figure 3		–0.02		0.02	V
I_I	Input current	A, G, $\overline{G}$		–50		50	µA
I_{OS}	Short-circuit output current	V_{TEST} = –7 V to 12 V, See Figure 7	V_I = 0 V	–200		200	mA
			V_I = V_{CC}	–200		200	mA
I_{OZ}	High-impedance-state output current		G at 0 V, $\overline{G}$ at V_{CC}	–50		50	µA
$I_{O(OFF)}$	Output current with power off		V_{CC} = 0 V	–10		10	µA
I_{CC}	Supply current	V_I = 0 V or V_{CC}, No load	All drivers enabled			23	mA
			All drivers disabled			1.5	mA

† All typical values are at V_{CC} = 5 V and 25°C.

‡ The minimum V_{OD} may not fully comply with TIA/EIA-485-A at operating temperatures below 0°C. System designers should take the possibly of lower output signal into account in determining the maximum signal transmission distance.

switching characteristics over recommended operating conditions

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high level output	R_L = 54 Ω, C_L = 50 pF, see Figure 4	5.5	8	11	ns
t_{PHL}	Propagation delay time, high-to-low level output		5.5	8	11	ns
t_r	Differential output voltage rise time		3	7.5	11	ns
t_f	Differential output voltage fall time		3	7.5	11	ns
$t_{sk(p)}$	Pulse skew $\lvert t_{PLH} - t_{PHL} \rvert$			0.6	2	ns
$t_{sk(o)}$	Output skew†				2	ns
$t_{sk(pp)}$	Part-to-part skew‡				3	ns
t_{PZH}	Propagation delay time, high-impedance-to-high-level output	See Figure 5			25	ns
t_{PHZ}	Propagation delay time, high-level-output-to-high impedance				25	ns
t_{PZL}	Propagation delay time, high-impedance-to-low-level output	See Figure 6			30	ns
t_{PLZ}	Propagation delay time, low-level-output-to-high impedance				20	ns

† Output skew ($t_{sk(o)}$) is the magnitude of the time delay difference between the outputs of a single device with all of the inputs connected together.
‡ Part-to-part skew ($t_{sk(pp)}$) is the magnitude of the difference in propagation delay times between any specified terminals of two devices when both devices operate with the same input signals, the same supply voltages, at the same temperature, and have identical packages and test circuits.

PARAMETER MEASUREMENT INFORMATION

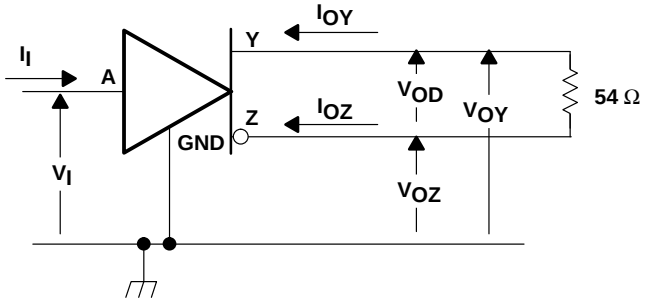


Figure 1. Test Circuit, V_{OD} Without Common-Mode Loading

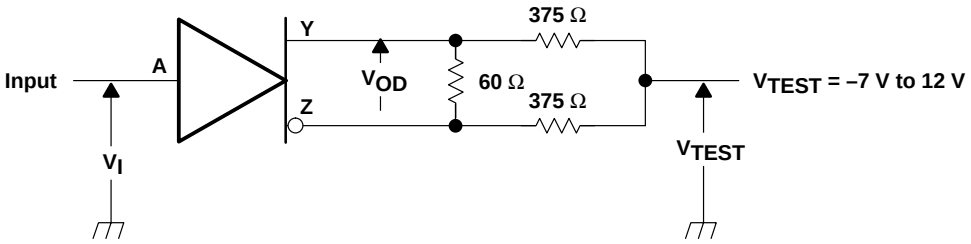
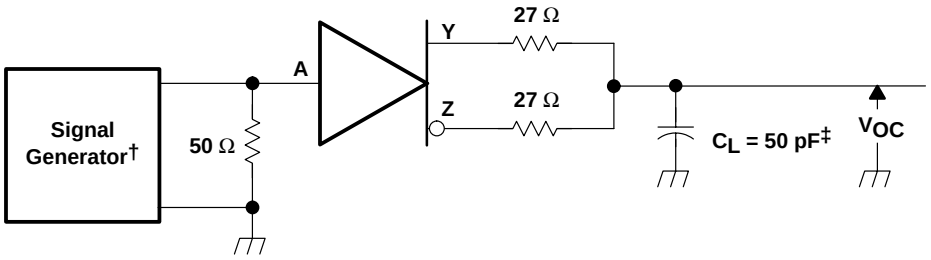


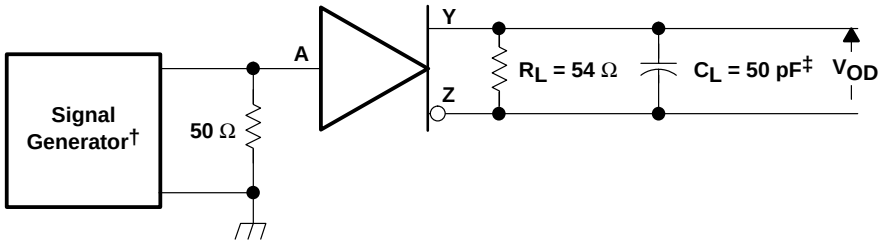
Figure 2. Test Circuit, V_{OD} With Common-Mode Loading



† PRR = 1 MHz, 50% duty cycle, t_r < 6 ns, t_f < 6 ns, Z_O = 50 Ω

‡ Includes probe and jig capacitance

Figure 3. V_{OC} Test Circuit



† PRR = 1 MHz, 50% duty cycle, t_r < 6 ns, t_f < 6 ns, Z_O = 50 Ω

‡ Includes probe and jig capacitance

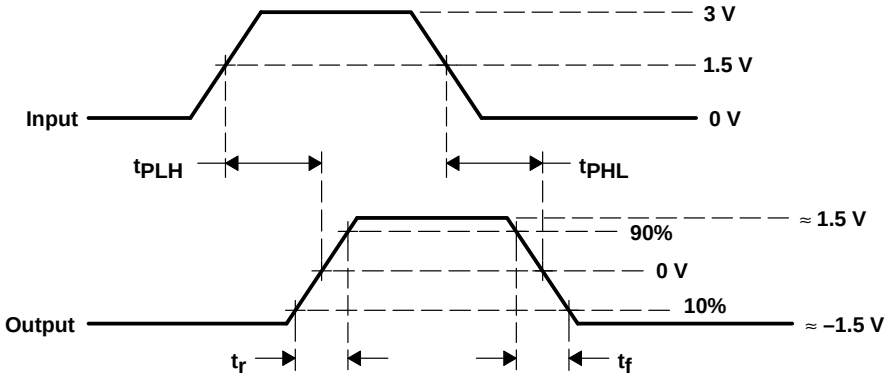
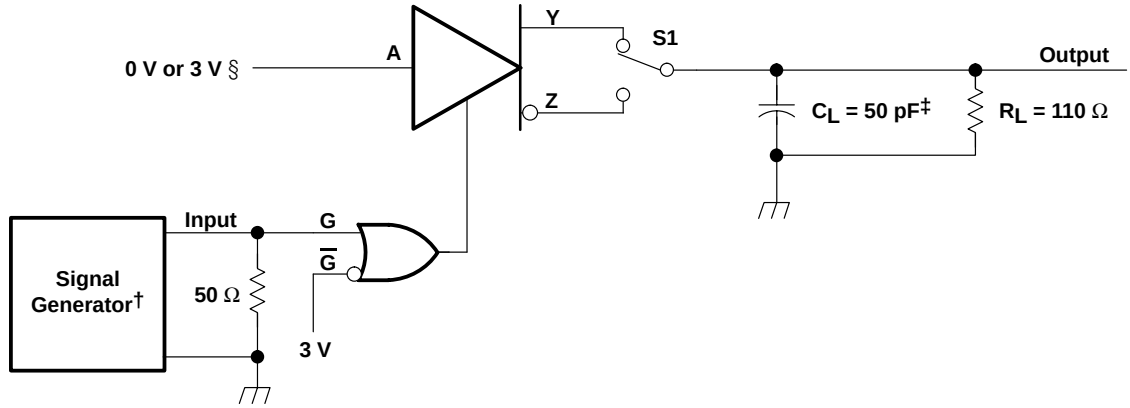


Figure 4. Output Switching Test Circuit and Waveforms

PARAMETER MEASUREMENT INFORMATION



† PRR = 1 MHz, 50% duty cycle, t_r < 6 ns, t_f < 6 ns, Z_O = 50 Ω
‡ Includes probe and jig capacitance
§ 3-V if testing Y output, 0 V if testing Z output

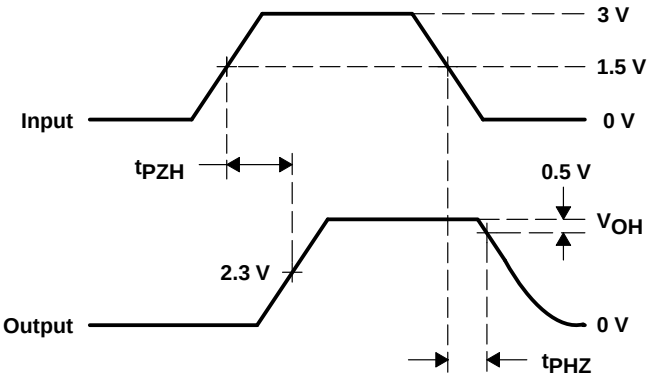
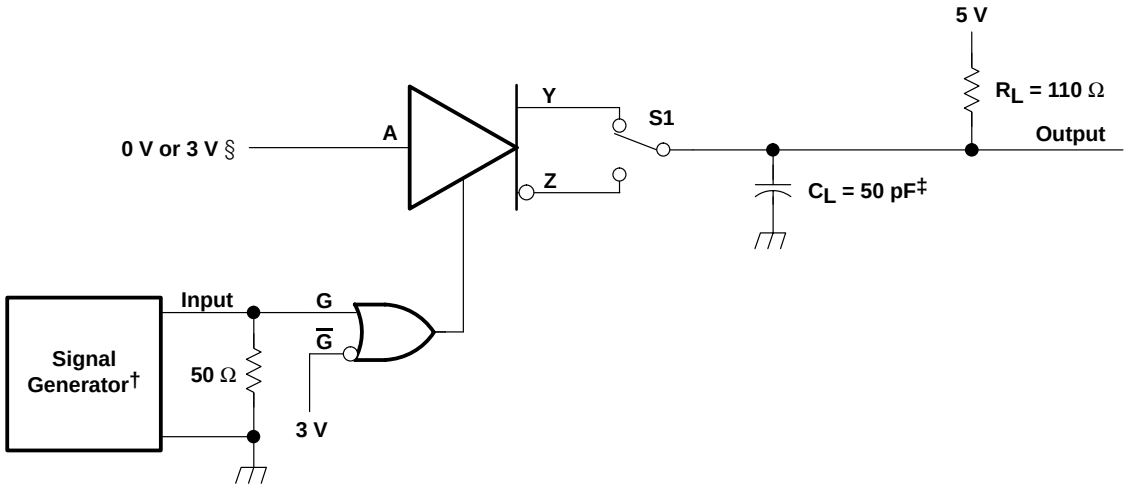


Figure 5. Enable Timing Test Circuit and Waveforms, t_{PZH} and t_{PHZ}

PARAMETER MEASUREMENT INFORMATION



† PRR = 1 MHz, 50% duty cycle, t_r < 6 ns, t_f < 6 ns, Z_O = 50 Ω
‡ Includes probe and jig capacitance
§ 3-V if testing Y output, 0 V if testing Z output

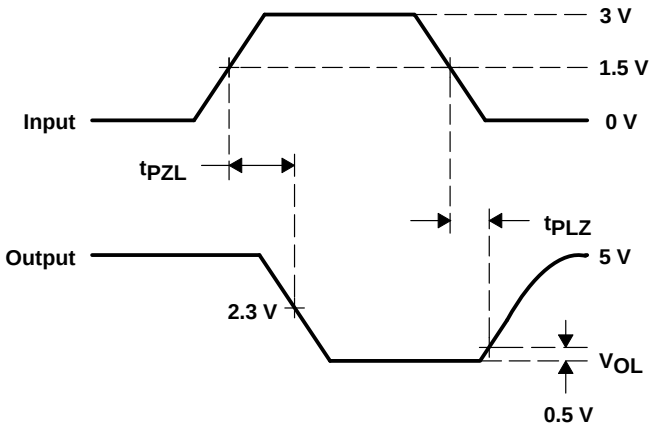


Figure 6. Enable Timing Test Circuit and Waveforms, t_{PZL} and t_{PLZ}

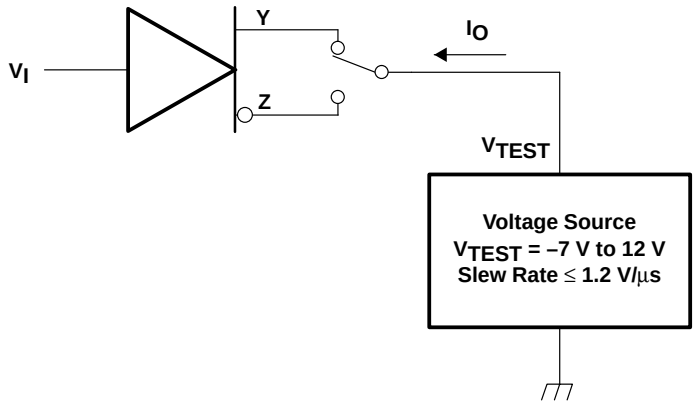


Figure 7. Test Circuit, Short-Circuit Output Current

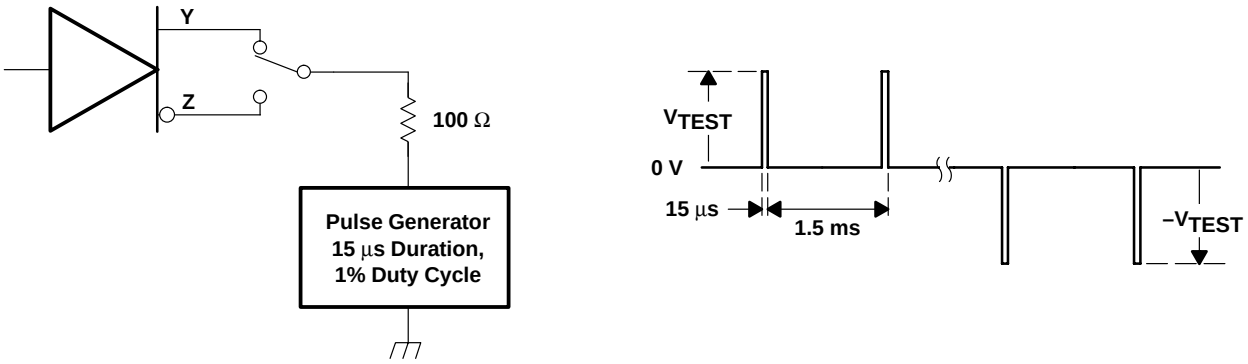


Figure 8. Test Circuit and Waveform, Transient Over-Voltage

TYPICAL CHARACTERISTICS

DIFFERENTIAL OUTPUT VOLTAGE vs OUTPUT CURRENT

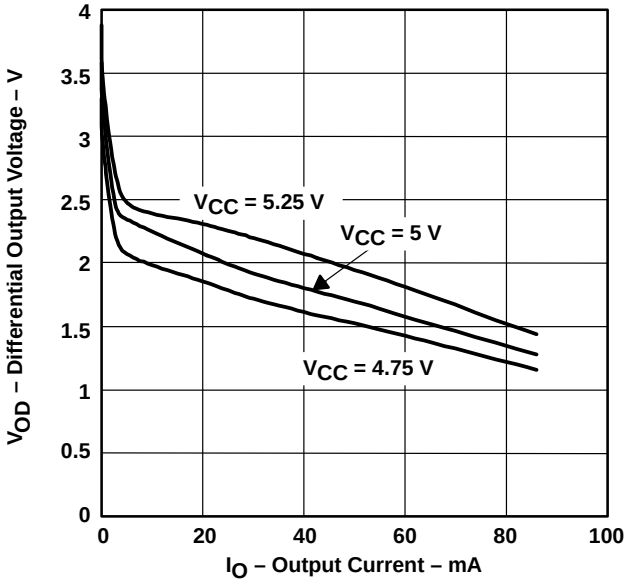


Figure 9

DIFFERENTIAL OUTPUT VOLTAGE vs FREE-AIR TEMPERATURE

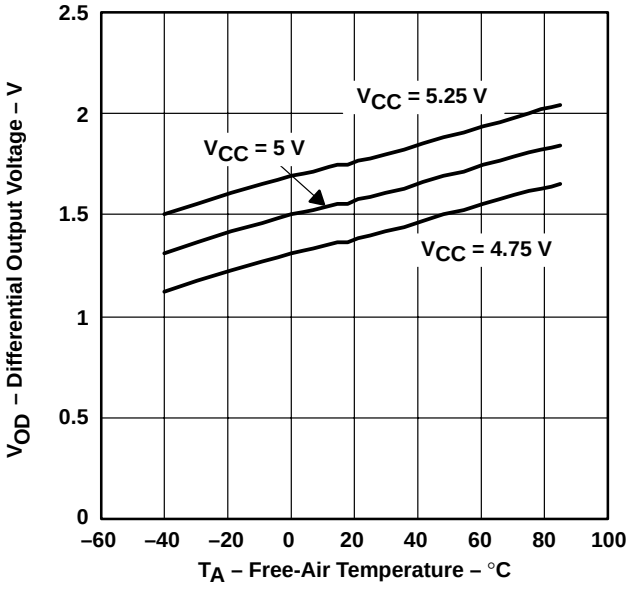


Figure 10

PROPAGATION DELAY TIME vs TEMPERATURE

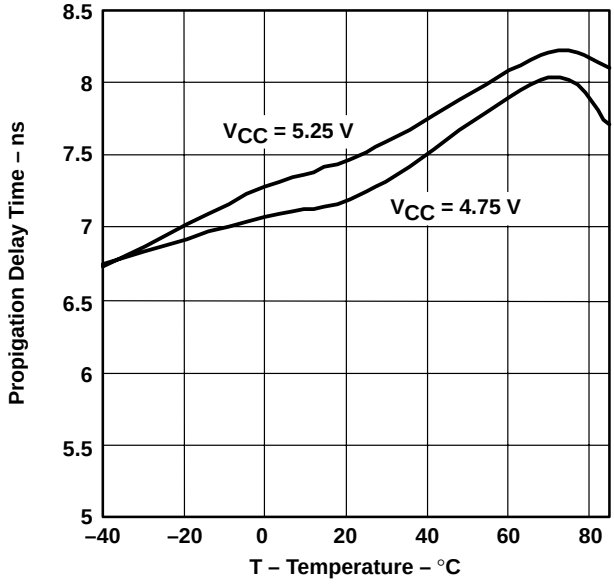


Figure 11

SUPPLY CURRENT (FOUR CHANNELS) vs SIGNALING RATE

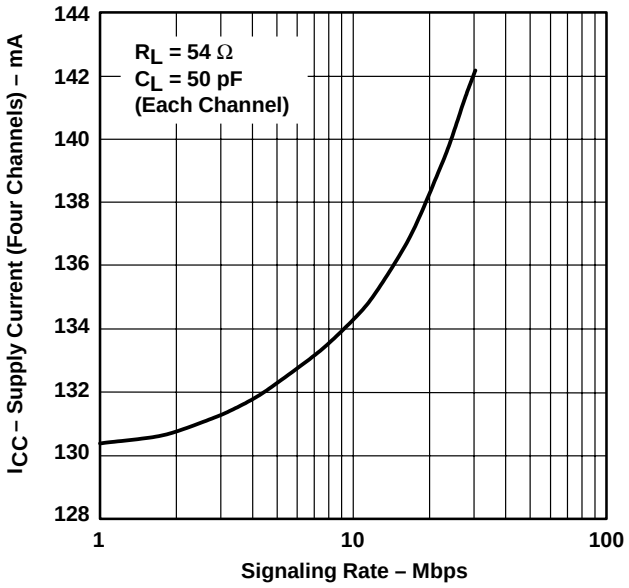


Figure 12

TYPICAL CHARACTERISTICS

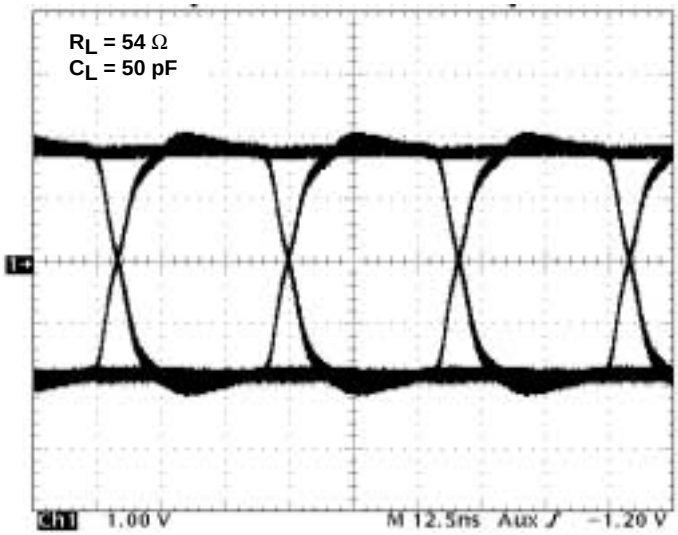


Figure 13. Eye Pattern, Pseudorandom Data at 30 Mbps

APPLICATION INFORMATION

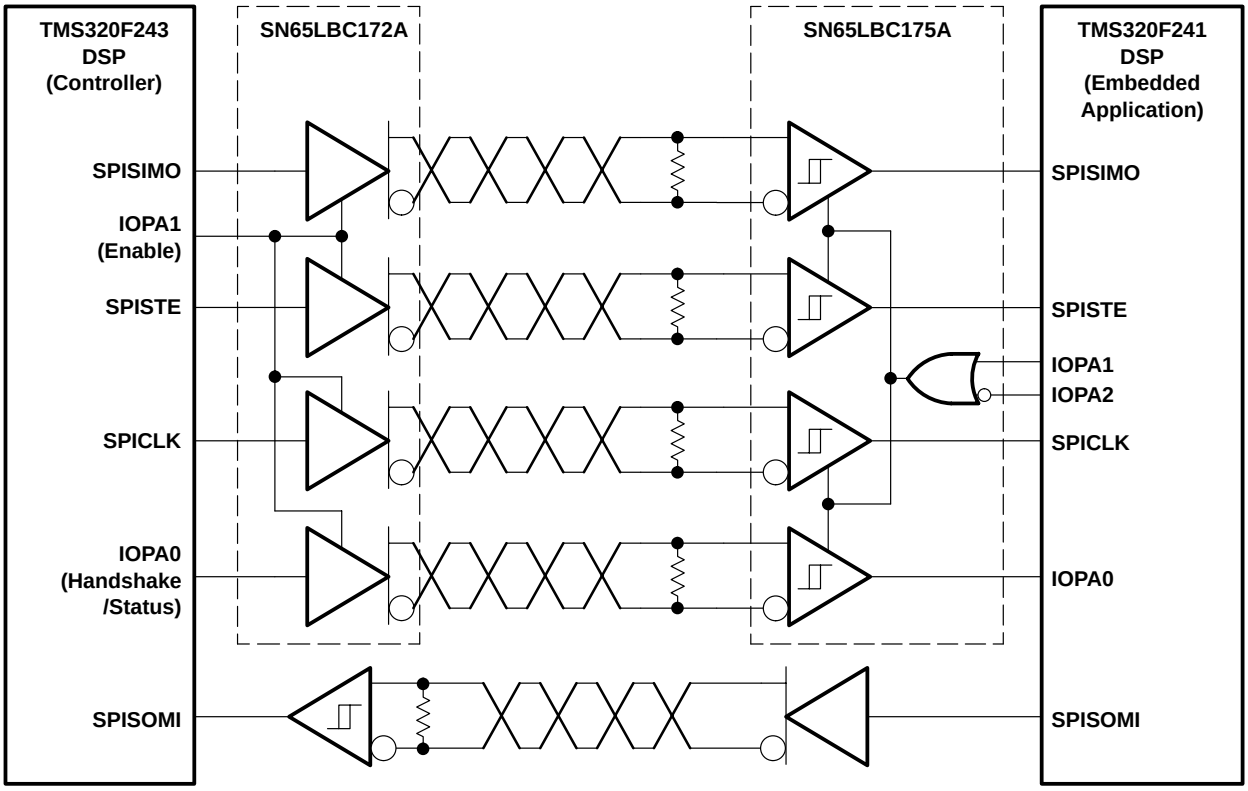
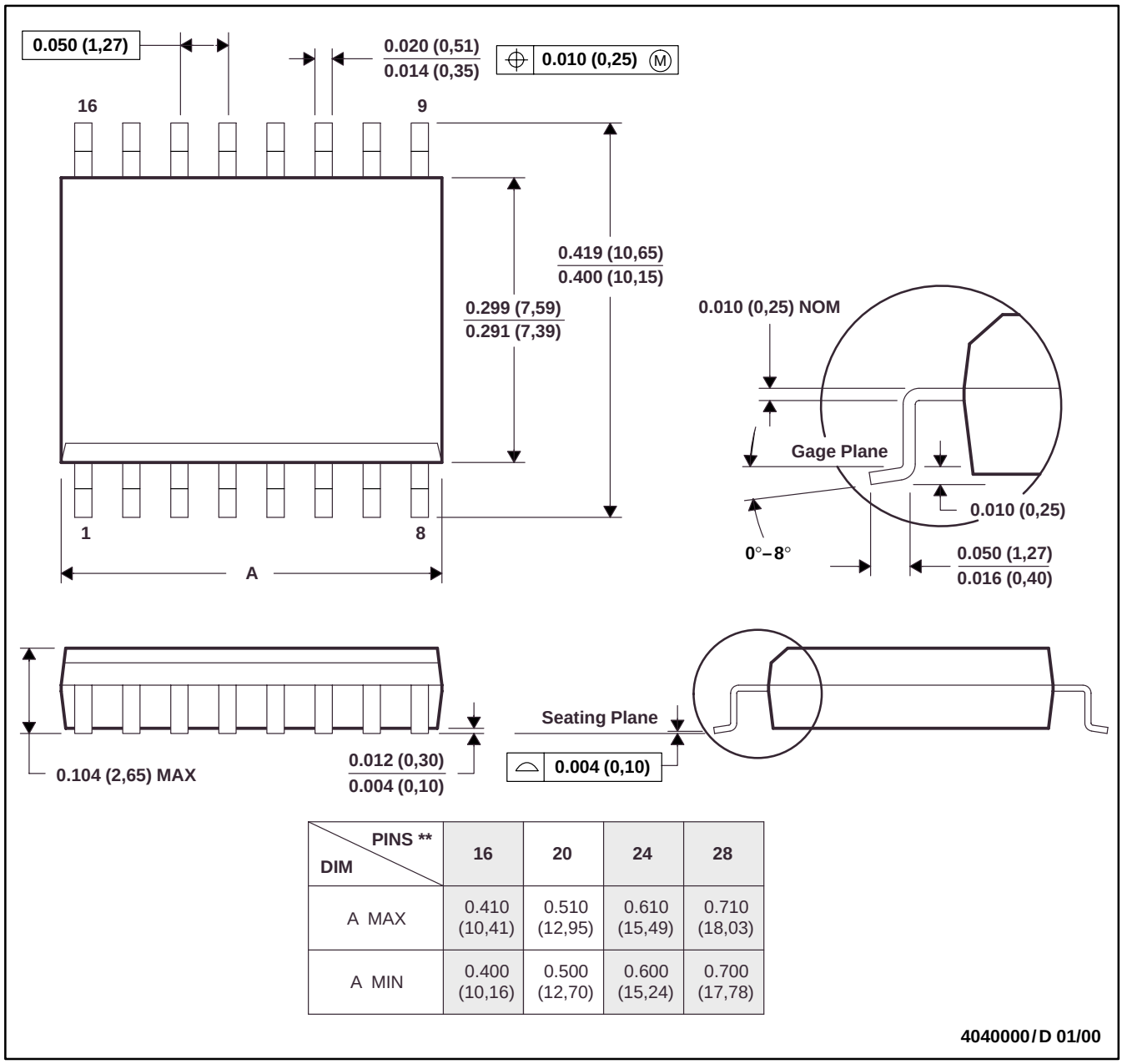


Figure 14. Typical Application Circuit, DSP-to-DSP Link via Serial Peripheral Interface

MECHANICAL DATA

DW (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

16 PINS SHOWN



DIM \ PINS **	16	20	24	28
A MAX	0.410 (10,41)	0.510 (12,95)	0.610 (15,49)	0.710 (18,03)
A MIN	0.400 (10,16)	0.500 (12,70)	0.600 (15,24)	0.700 (17,78)

4040000/D 01/00

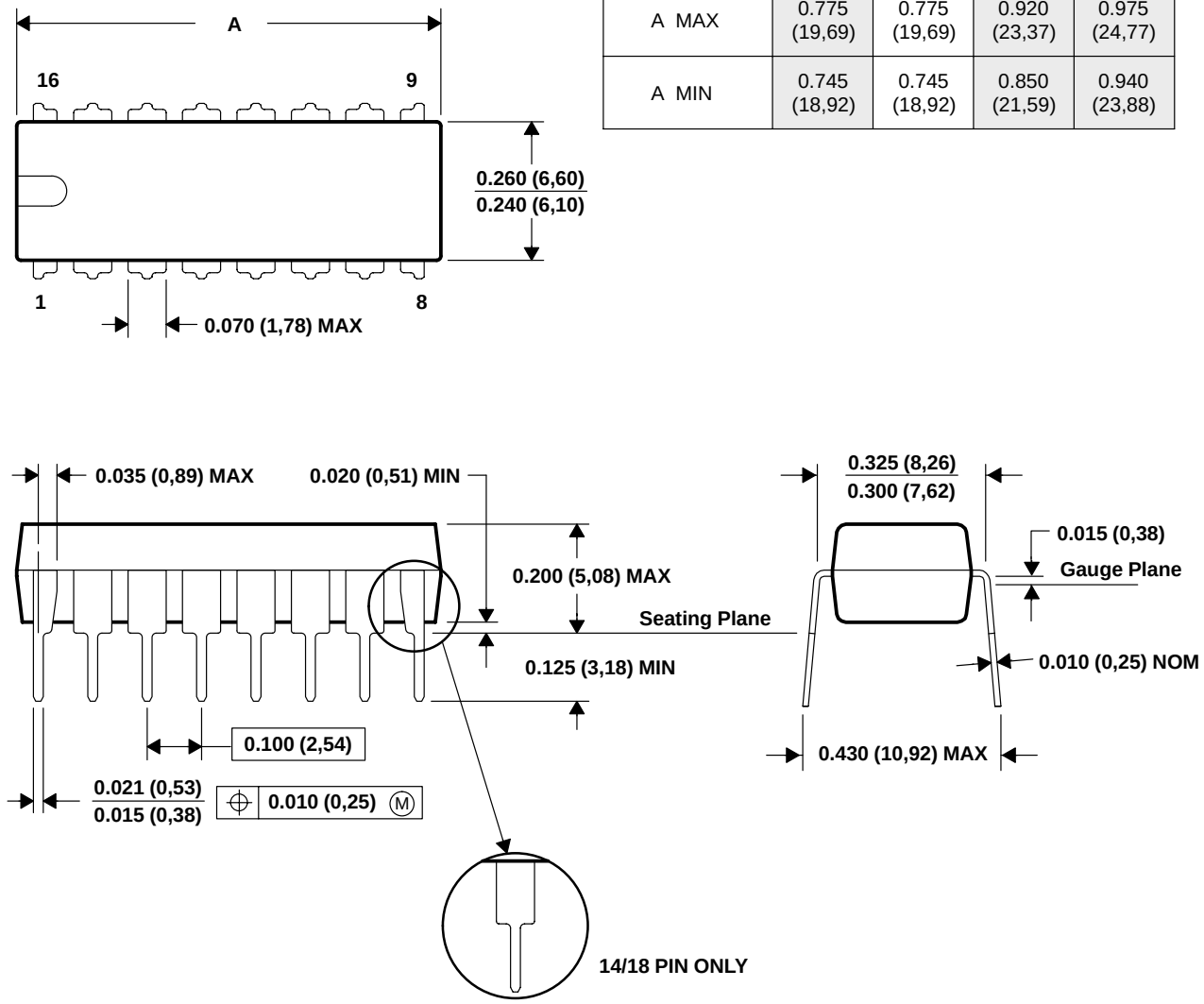
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-013

MECHANICAL DATA

N (R-PDIP-T)** **PLASTIC DUAL-IN-LINE PACKAGE**

16 PINS SHOWN

DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	0.975 (24,77)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)



NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001 (20-pin package is shorter than MS-001).

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third–party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

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

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265