

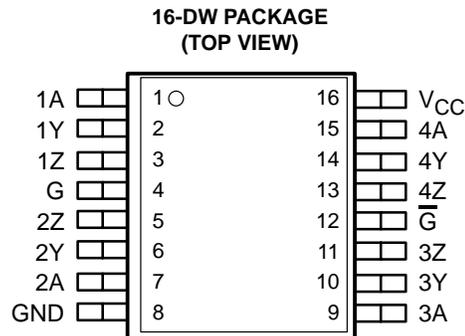
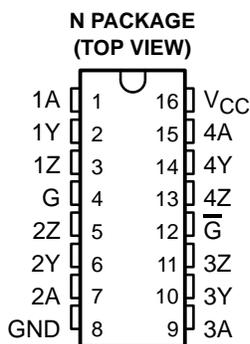
SN65LBC172A, SN75LBC172A QUADRUPLE RS-485 DIFFERENTIAL LINE DRIVERS

SLLS447B – OCTOBER 2000 – REVISED MAY 2003

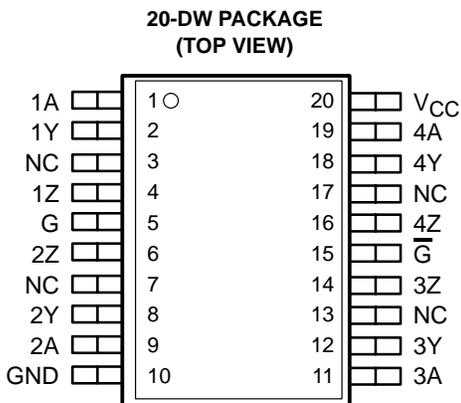
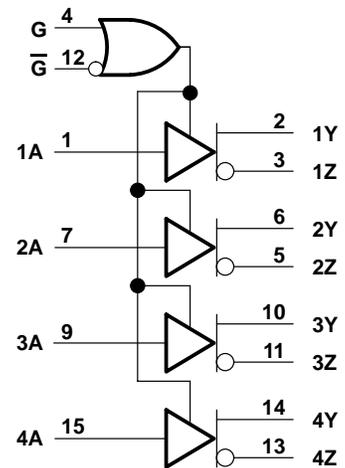
- Designed for TIA/EIA-485, TIA/EIA-422, and ISO 8482 Applications
- Signaling Rates† up to 30 Mbps
- Propagation Delay Times <11 ns
- Low Standby Power Consumption
1.5 mA Max
- Output ESD Protection Exceeds 13 kV
- Driver Positive- and Negative-Current Limiting
- Power-Up and Power-Down Glitch-Free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

description

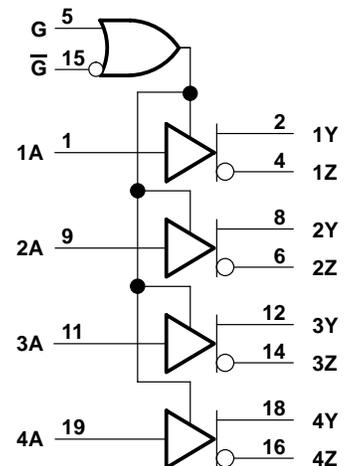
The SN65LBC172A and SN75LBC172A are quadruple differential line drivers with 3-state outputs, designed for TIA/EIA-485 (RS-485), TIA/EIA-422 (RS-422), and ISO 8482 applications.



logic diagram (positive logic)



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).

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

**TEXAS
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2001 – 2003, Texas Instruments Incorporated

SN65LBC172A, SN75LBC172A QUADRUPLE RS-485 DIFFERENTIAL LINE DRIVERS

SLLS447B – OCTOBER 2000 – REVISED MAY 2003

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 multipoint data transmission applications in noisy environments. These devices are designed using LinBiCMOS™, facilitating low power consumption and robustness.

The G and \bar{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.

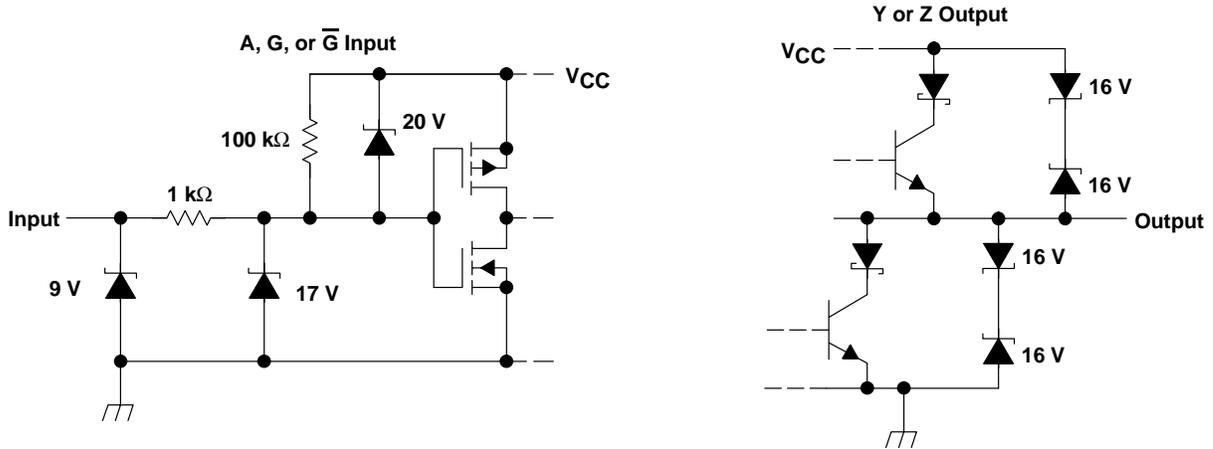
FUNCTION TABLE (EACH DRIVER)

INPUT	ENABLES		OUTPUTS	
	G	\bar{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 \bar{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	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR‡ ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ 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.

SN65LBC172A, SN75LBC172A QUADRUPLE RS-485 DIFFERENTIAL LINE DRIVERS

SLLS447B – OCTOBER 2000 – REVISED MAY 2003

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, \bar{G}	2		V_{CC}	V
Low-level input voltage, V_{IL}		0		0.8	
Output current		-60		60	mA
Operating free-air temperature, T_A	SN75LBC172A	0		70	°C
	SN65LBC172A	-40		85	

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
$ V_{OD(SS)} $	Steady-state differential output voltage magnitude‡	No load (open circuit)		3		V_{CC}	V
		$R_L = 54 \Omega$, see Figure 1		1	1.6	2.5	
		With common-mode loading, see Figure 2		1	1.6	2.5	
$\Delta V_{OD(SS)}$	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, \bar{G}		-50		50	μ A
I_{OS}	Short-circuit output current	$V_{TEST} = -7$ V to 12 V, See Figure 7	$V_I = 0$ V	-200		200	mA
I_{OZ}	High-impedance-state output current		$V_I = V_{CC}$	-50		50	
$I_{O(OFF)}$	Output current with power off		$V_{CC} = 0$ V	-10		10	
I_{CC}	Supply current		$V_I = 0$ V or V_{CC} , No load	All drivers enabled		23	
			All drivers disabled		1.5		

† 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.



SN65LBC172A, SN75LBC172A QUADRUPLE RS-485 DIFFERENTIAL LINE DRIVERS

SLLS447B – OCTOBER 2000 – REVISED MAY 2003

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 t _{PLH} – t _{PHL}				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.

SN65LBC172A, SN75LBC172A QUADRUPLE RS-485 DIFFERENTIAL LINE DRIVERS

SLLS447B – OCTOBER 2000 – REVISED MAY 2003

PARAMETER MEASUREMENT INFORMATION

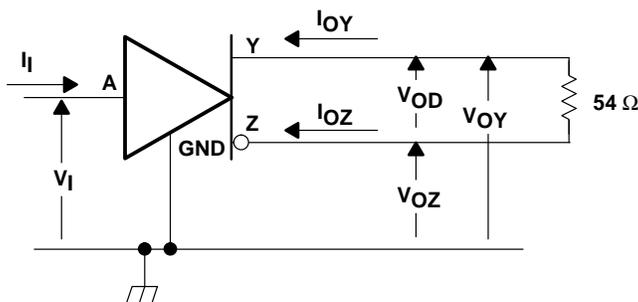


Figure 1. Test Circuit, V_{OD} Without Common-Mode Loading

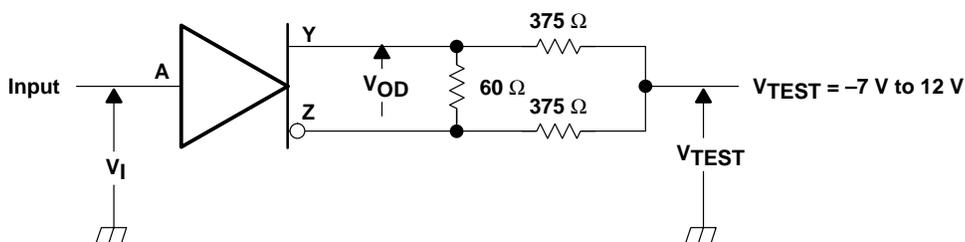
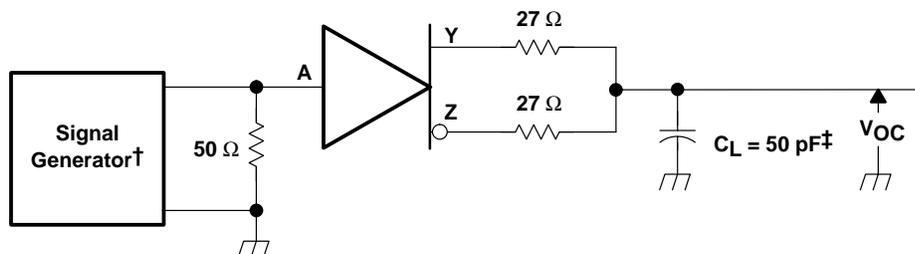


Figure 2. Test Circuit, V_{OD} With Common-Mode Loading



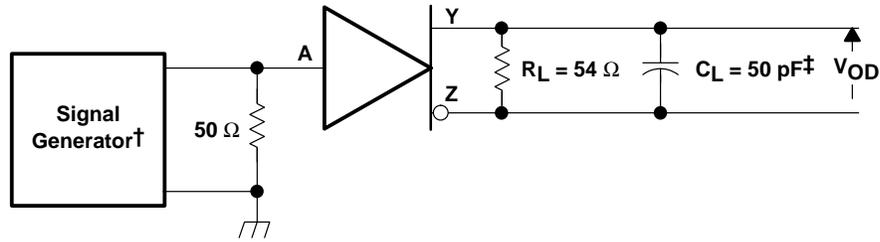
† PRR = 1 MHz, 50% duty cycle, $t_r < 6$ ns, $t_f < 6$ ns, $Z_O = 50 \Omega$

‡ Includes probe and jig capacitance

Figure 3. V_{OC} Test Circuit

SN65LBC172A, SN75LBC172A QUADRUPLE RS-485 DIFFERENTIAL LINE DRIVERS

SLLS447B – OCTOBER 2000 – REVISED MAY 2003



† PRR = 1 MHz, 50% duty cycle, $t_r < 6\ \text{ns}$, $t_f < 6\ \text{ns}$, $Z_O = 50\ \Omega$

‡ Includes probe and jig capacitance

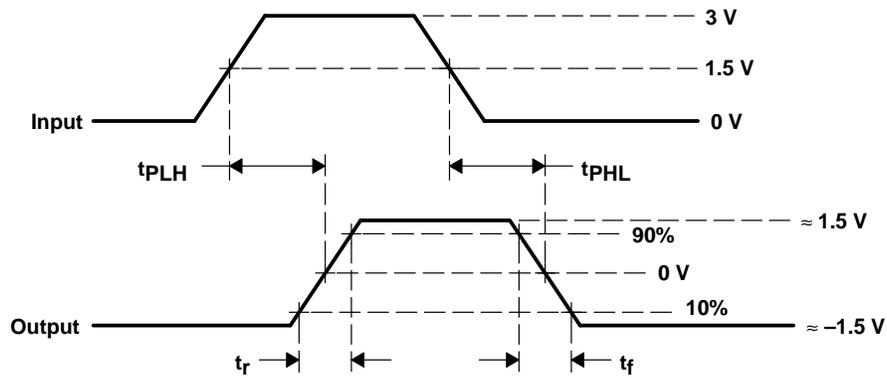
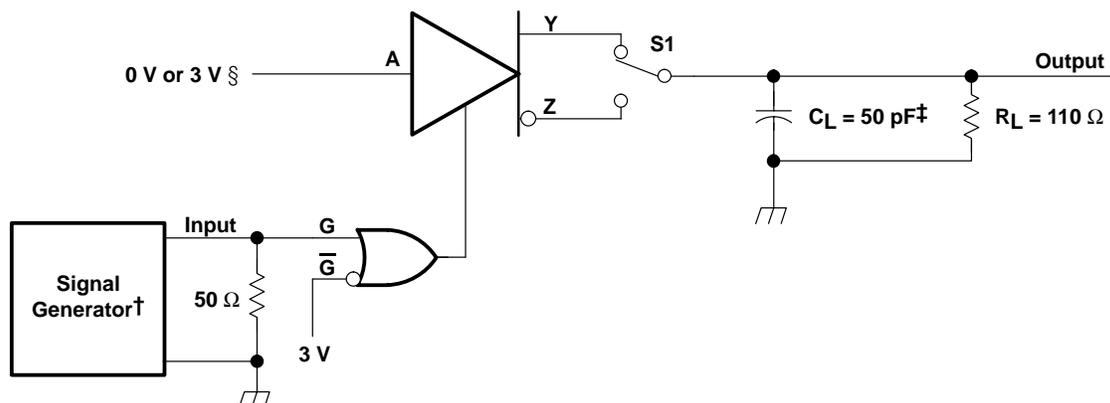


Figure 4. Output Switching Test Circuit and Waveforms

SN65LBC172A, SN75LBC172A QUADRUPLE RS-485 DIFFERENTIAL LINE DRIVERS

SLLS447B – OCTOBER 2000 – REVISED MAY 2003

PARAMETER MEASUREMENT INFORMATION



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

‡ Includes probe and jig capacitance

§ 3-V if testing Y output, 0 V if testing Z output

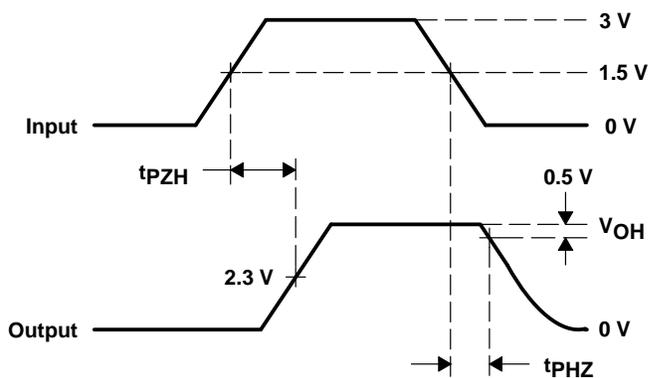
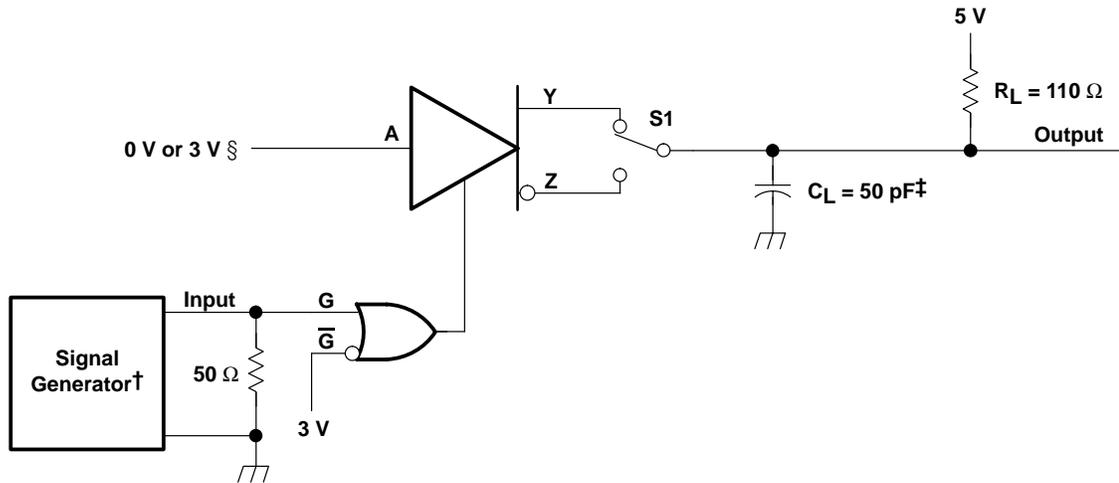


Figure 5. Enable Timing Test Circuit and Waveforms, t_{pZH} and t_{pHZ}

PARAMETER MEASUREMENT INFORMATION



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

‡ Includes probe and jig capacitance

§ 3-V if testing Y output, 0 V if testing Z output

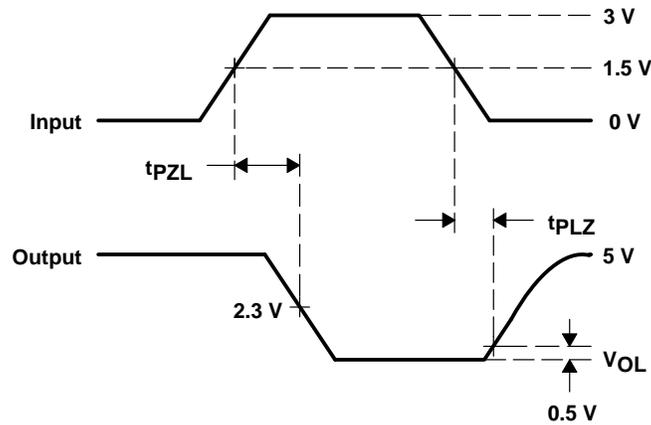


Figure 6. Enable Timing Test Circuit and Waveforms, t_{pZL} and t_{pLZ}

SN65LBC172A, SN75LBC172A QUADRUPLE RS-485 DIFFERENTIAL LINE DRIVERS

SLLS447B – OCTOBER 2000 – REVISED MAY 2003

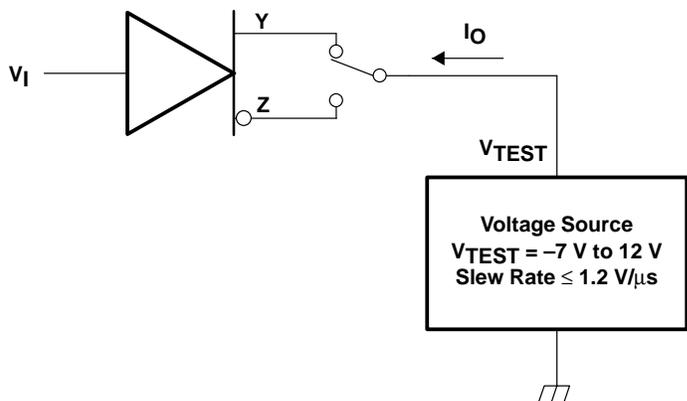


Figure 7. Test Circuit, Short-Circuit Output Current

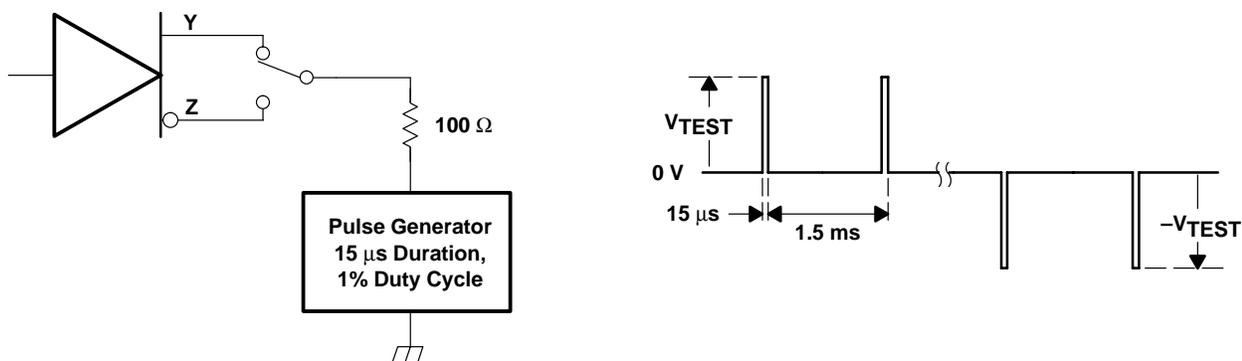


Figure 8. Test Circuit and Waveform, Transient Over-Voltage

TYPICAL CHARACTERISTICS

DIFFERENTIAL OUTPUT VOLTAGE
 vs
 OUTPUT CURRENT

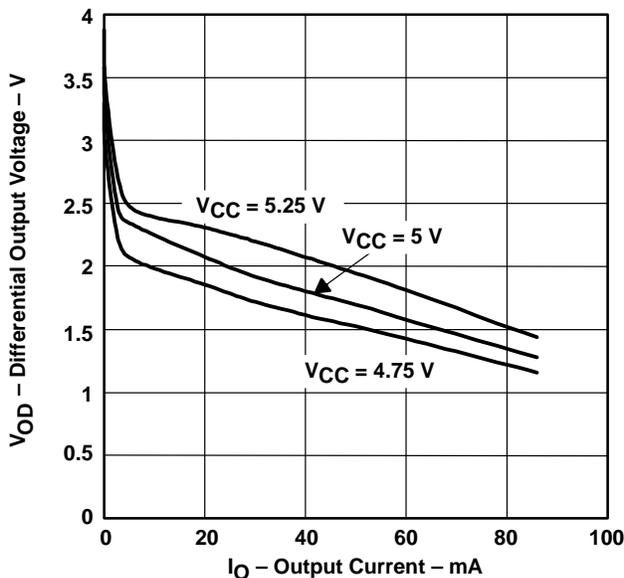


Figure 9

DIFFERENTIAL OUTPUT VOLTAGE
 vs
 FREE-AIR TEMPERATURE

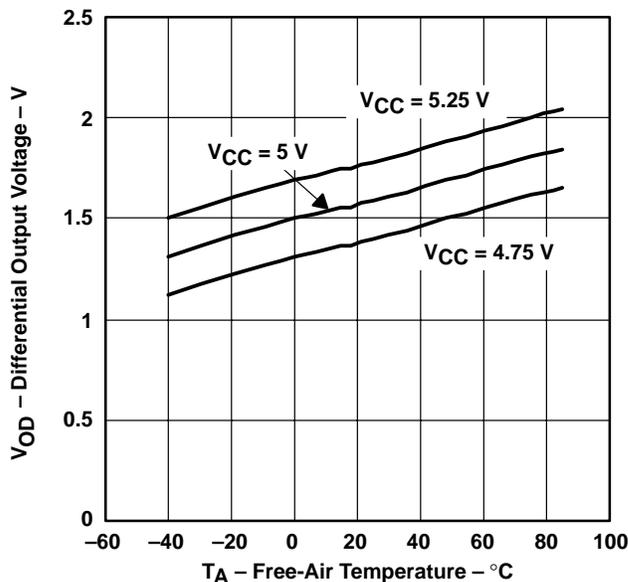


Figure 10

PROPAGATION DELAY TIME
 vs
 TEMPERATURE

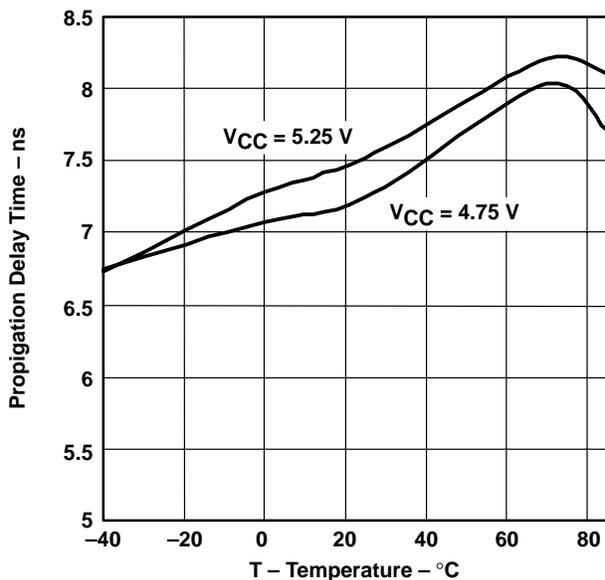


Figure 11

SUPPLY CURRENT (FOUR CHANNELS)
 vs
 SIGNALING RATE

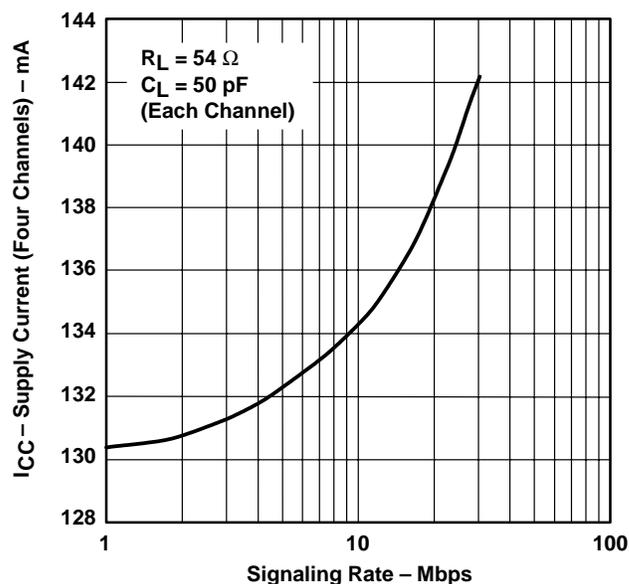


Figure 12

SN65LBC172A, SN75LBC172A QUADRUPLE RS-485 DIFFERENTIAL LINE DRIVERS

SLLS447B – OCTOBER 2000 – REVISED MAY 2003

TYPICAL CHARACTERISTICS

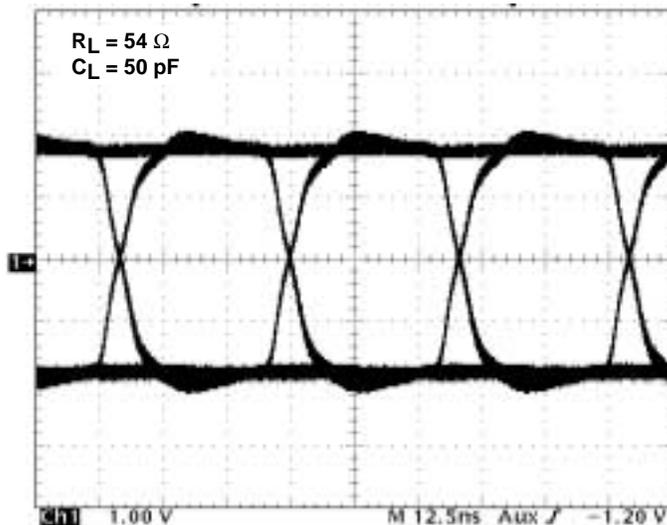


Figure 13. Eye Pattern, Pseudorandom Data at 30 Mbps

APPLICATION INFORMATION

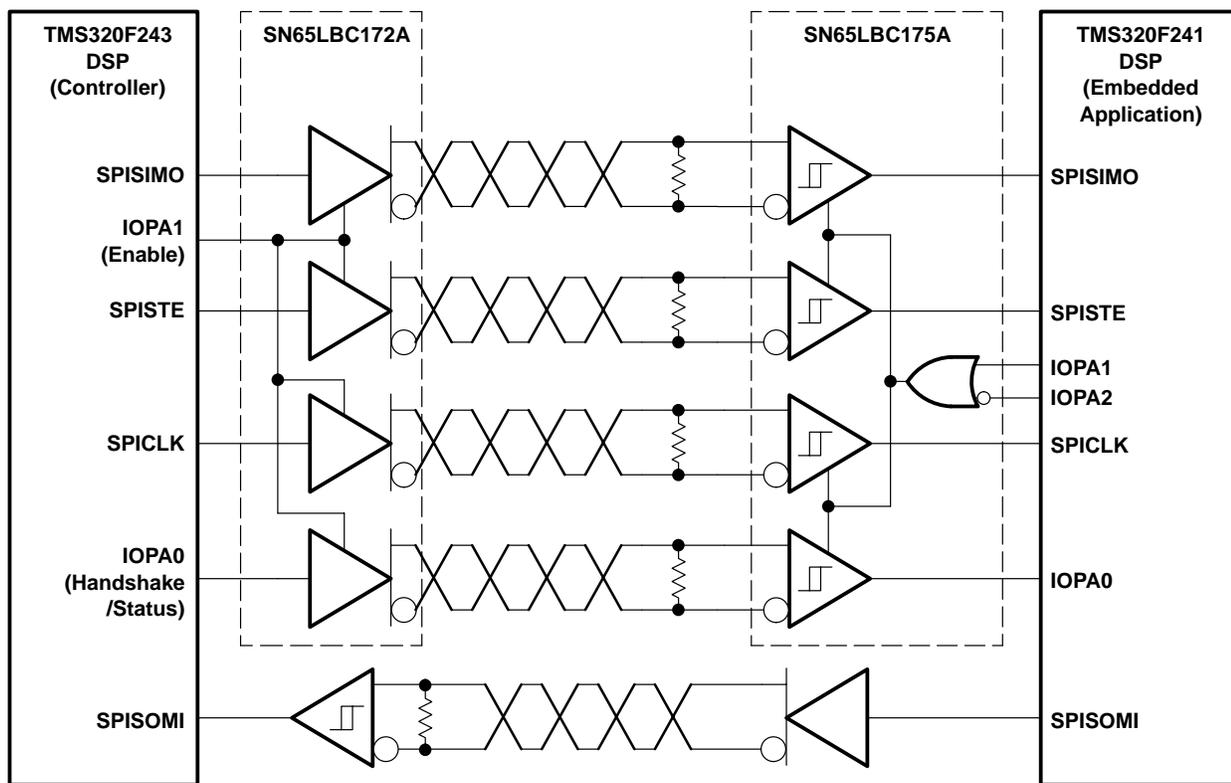


Figure 14. Typical Application Circuit, DSP-to-DSP Link via Serial Peripheral Interface

SN65LBC172A, SN75LBC172A QUADRUPLE RS-485 DIFFERENTIAL LINE DRIVERS

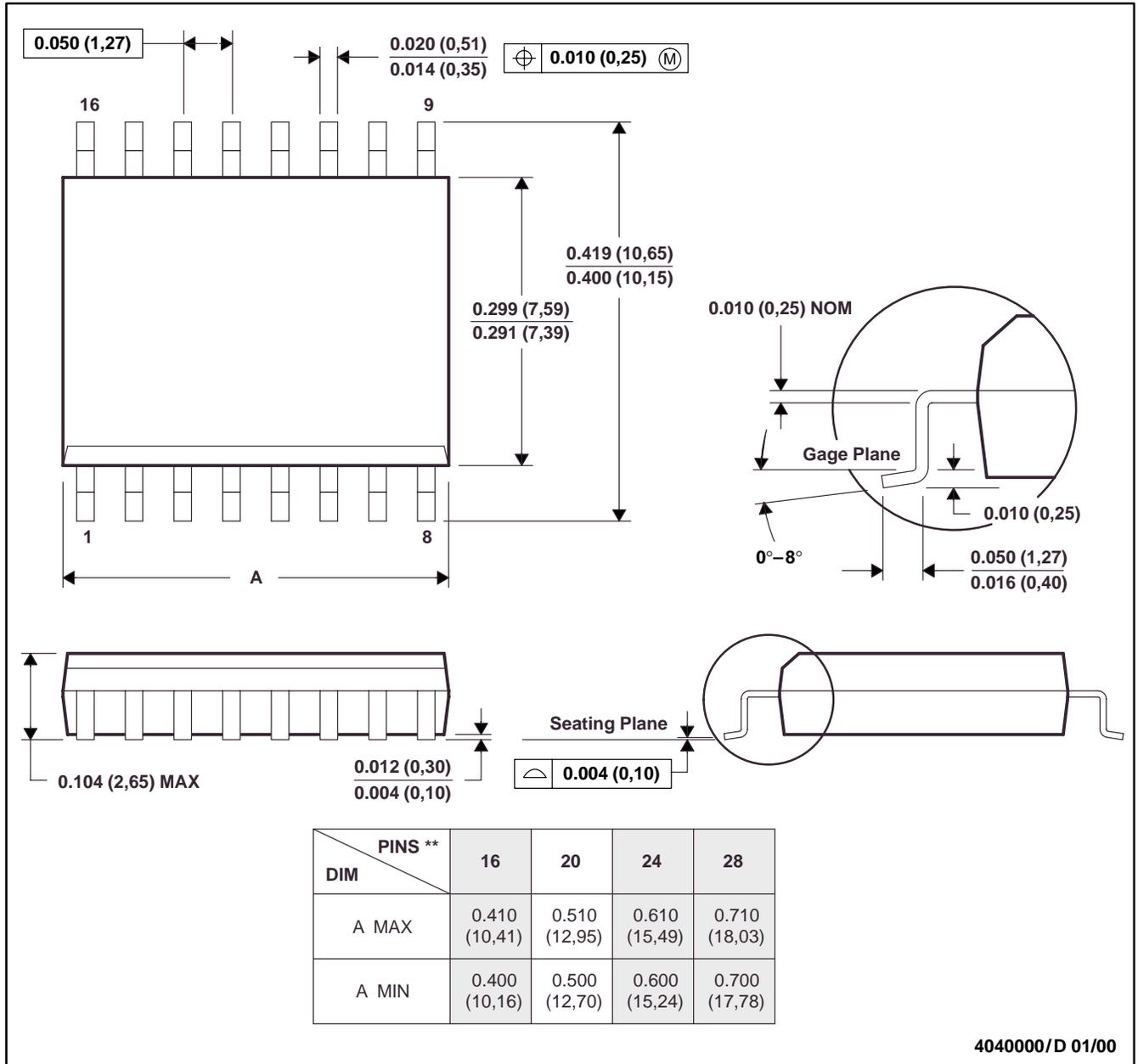
SLLS447B – OCTOBER 2000 – REVISED MAY 2003

MECHANICAL DATA

DW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

16 PINS SHOWN



- 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

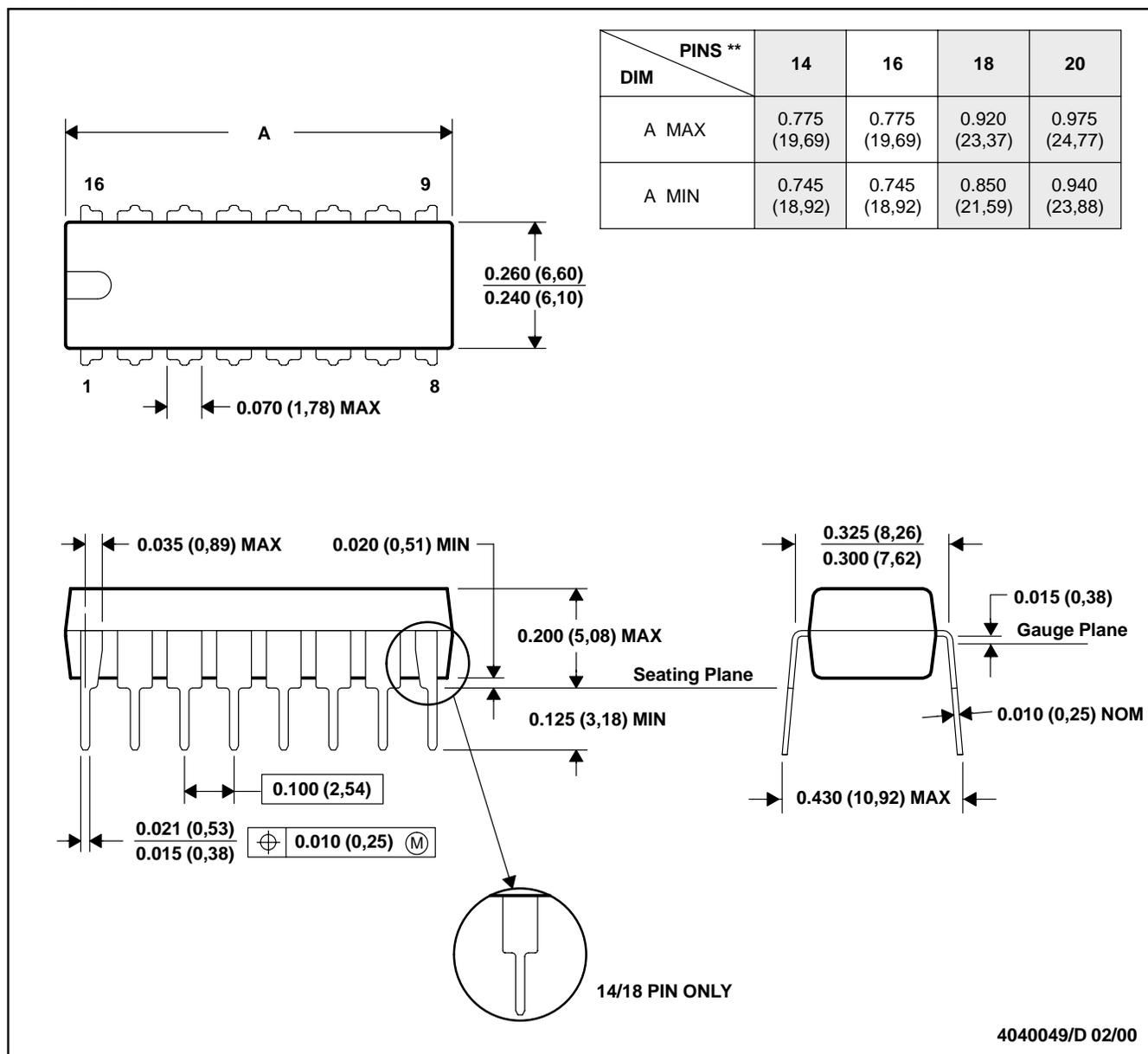
SN65LBC172A, SN75LBC172A QUADRUPLE RS-485 DIFFERENTIAL LINE DRIVERS

SLLS447B – OCTOBER 2000 – REVISED MAY 2003

MECHANICAL DATA

N (R-PDIP-T)**
16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



- 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).

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN65LBC172A16DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC172A16DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC172A16DWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC172A16DWRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC172ADW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC172ADWG4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC172ADWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC172ADWRG4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC172AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPD	N / A for Pkg Type
SN65LBC172ANE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPD	N / A for Pkg Type
SN75LBC172A16DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC172A16DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC172A16DWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC172A16DWRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC172ADW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC172ADWG4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC172ADWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC172ADWRG4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC172AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPD	N / A for Pkg Type
SN75LBC172ANE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPD	N / A for Pkg Type

⁽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.

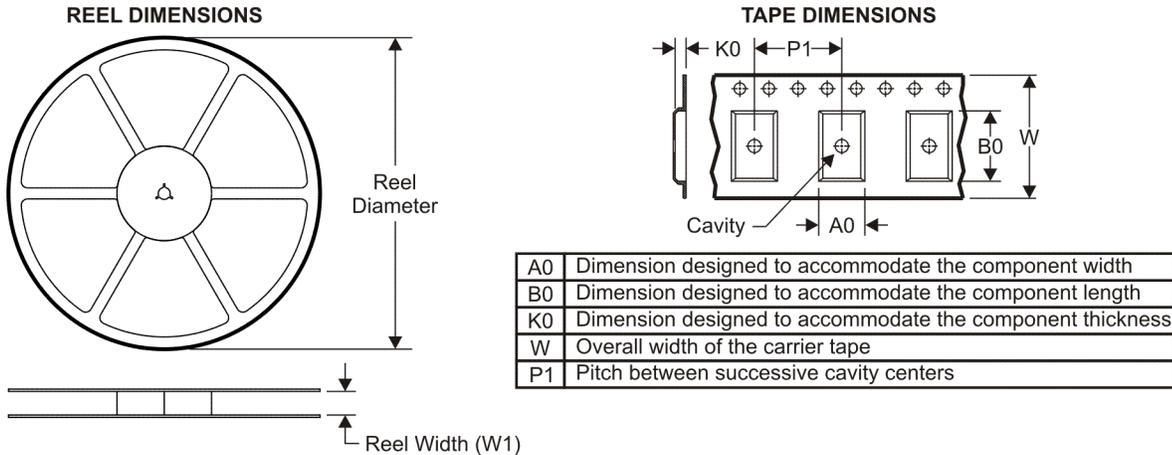
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

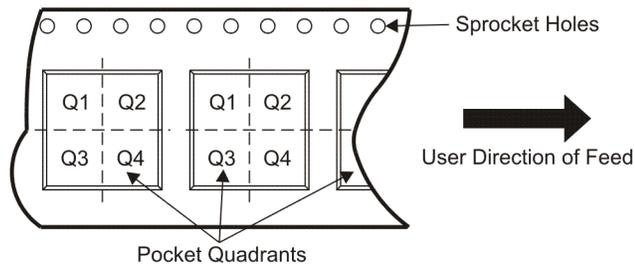
Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. 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.

TAPE AND REEL INFORMATION



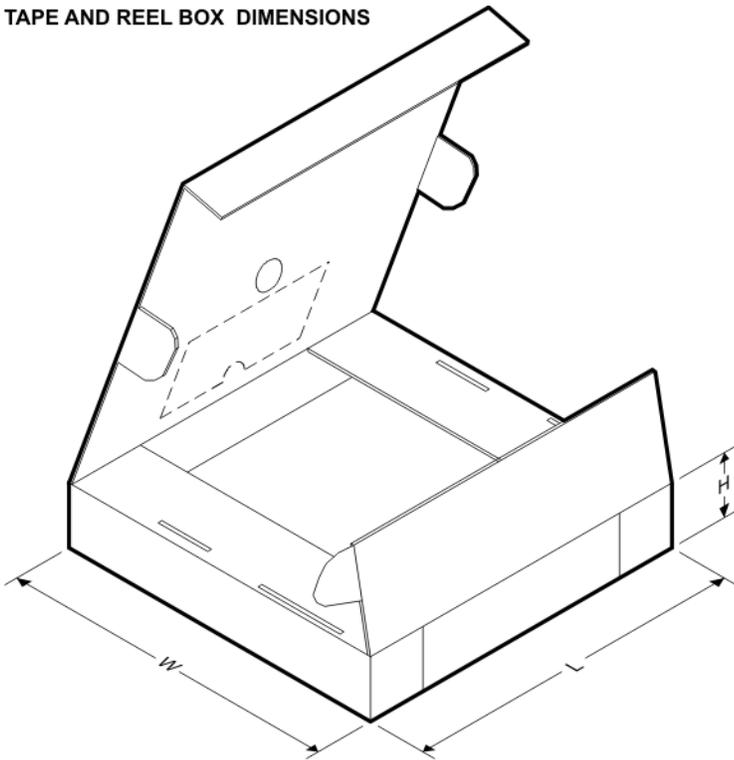
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SN65LBC172A16DWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
SN65LBC172ADWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.1	2.65	12.0	24.0	Q1
SN75LBC172A16DWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
SN75LBC172ADWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.1	2.65	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS

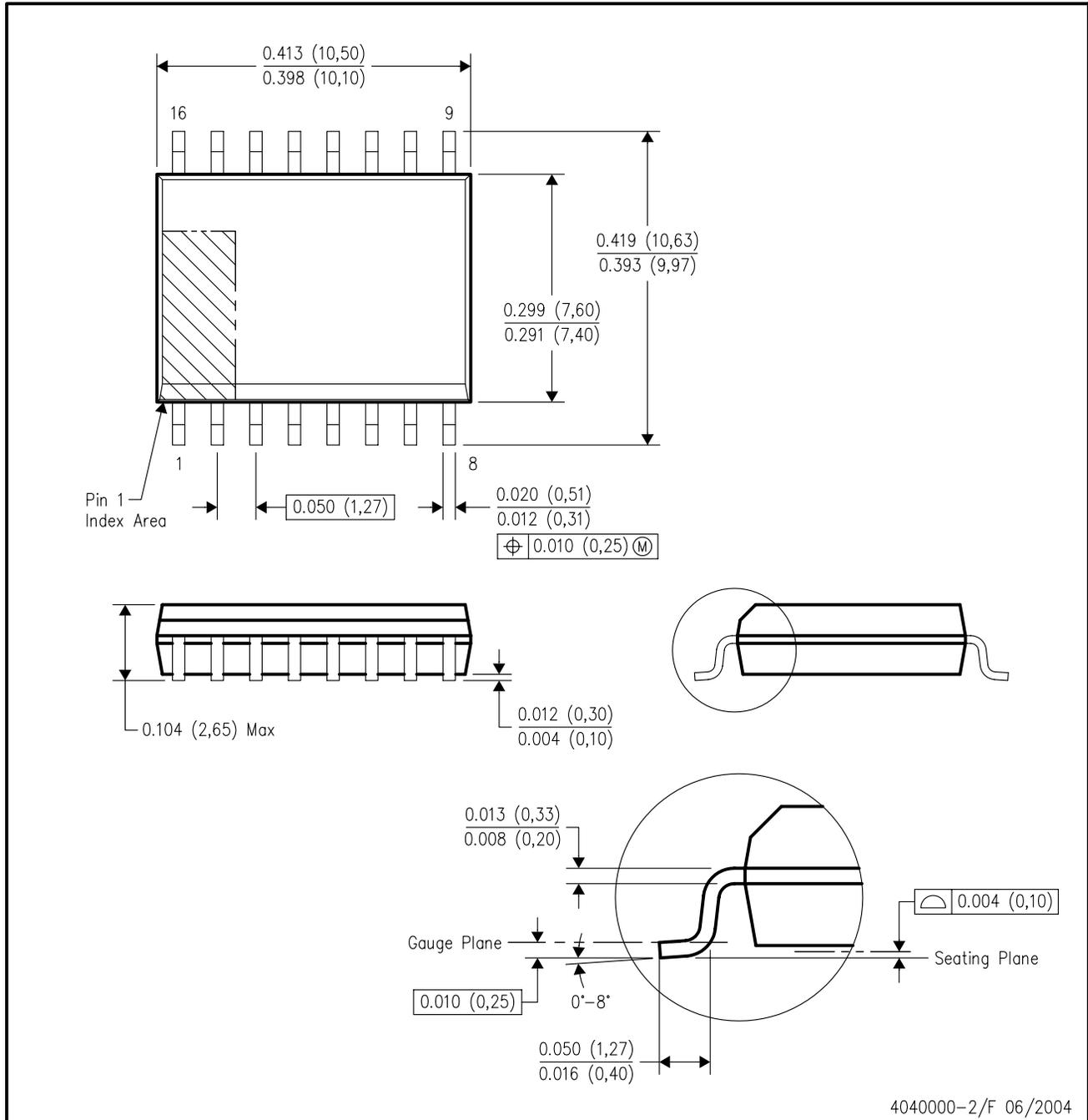


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65LBC172A16DWR	SOIC	DW	16	2000	346.0	346.0	33.0
SN65LBC172ADWR	SOIC	DW	20	2000	346.0	346.0	41.0
SN75LBC172A16DWR	SOIC	DW	16	2000	346.0	346.0	33.0
SN75LBC172ADWR	SOIC	DW	20	2000	346.0	346.0	41.0

DW (R-PDSO-G16)

PLASTIC SMALL-OUTLINE PACKAGE

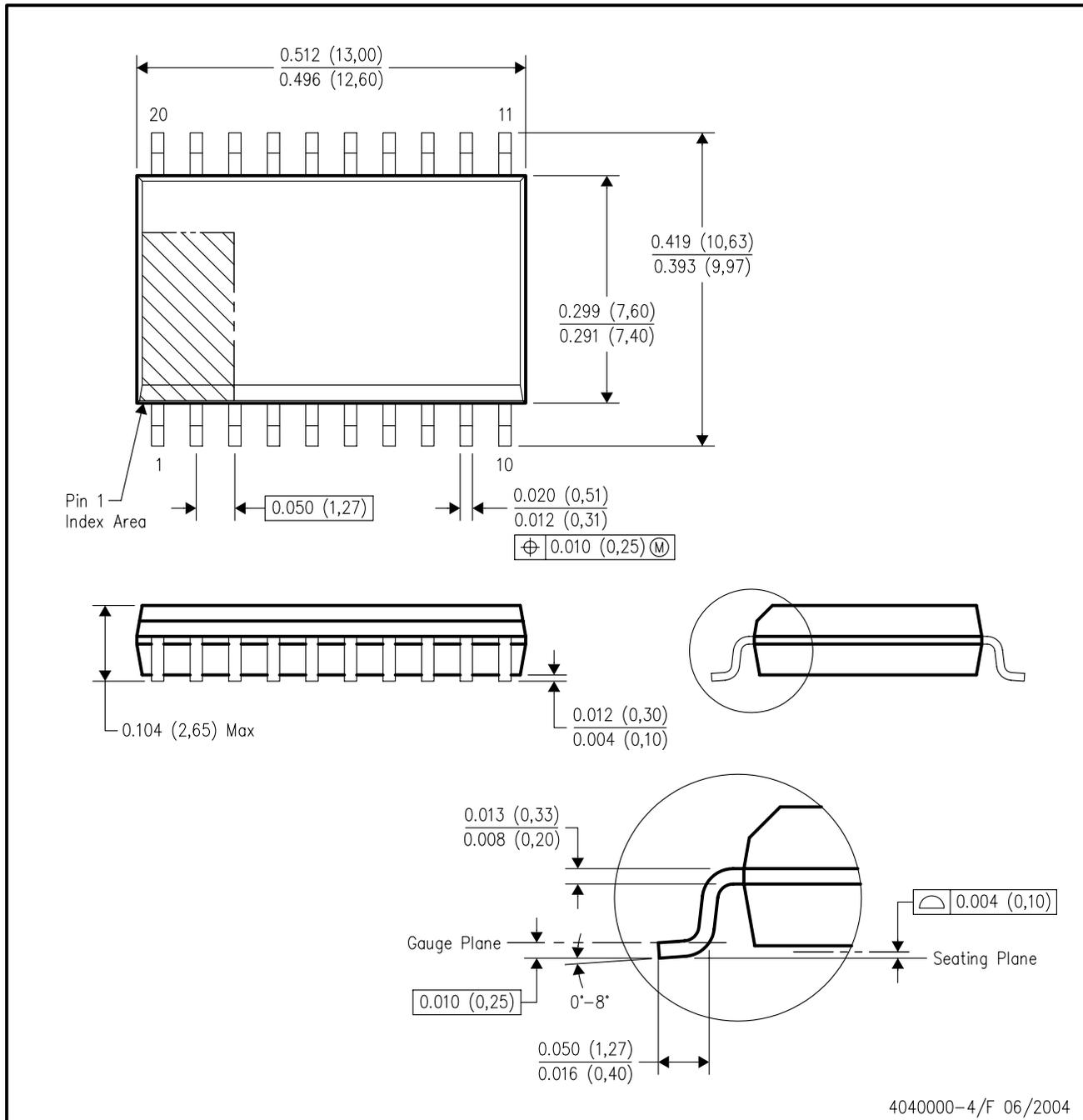


4040000-2/F 06/2004

- 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 variation AA.

DW (R-PDSO-G20)

PLASTIC SMALL-OUTLINE PACKAGE

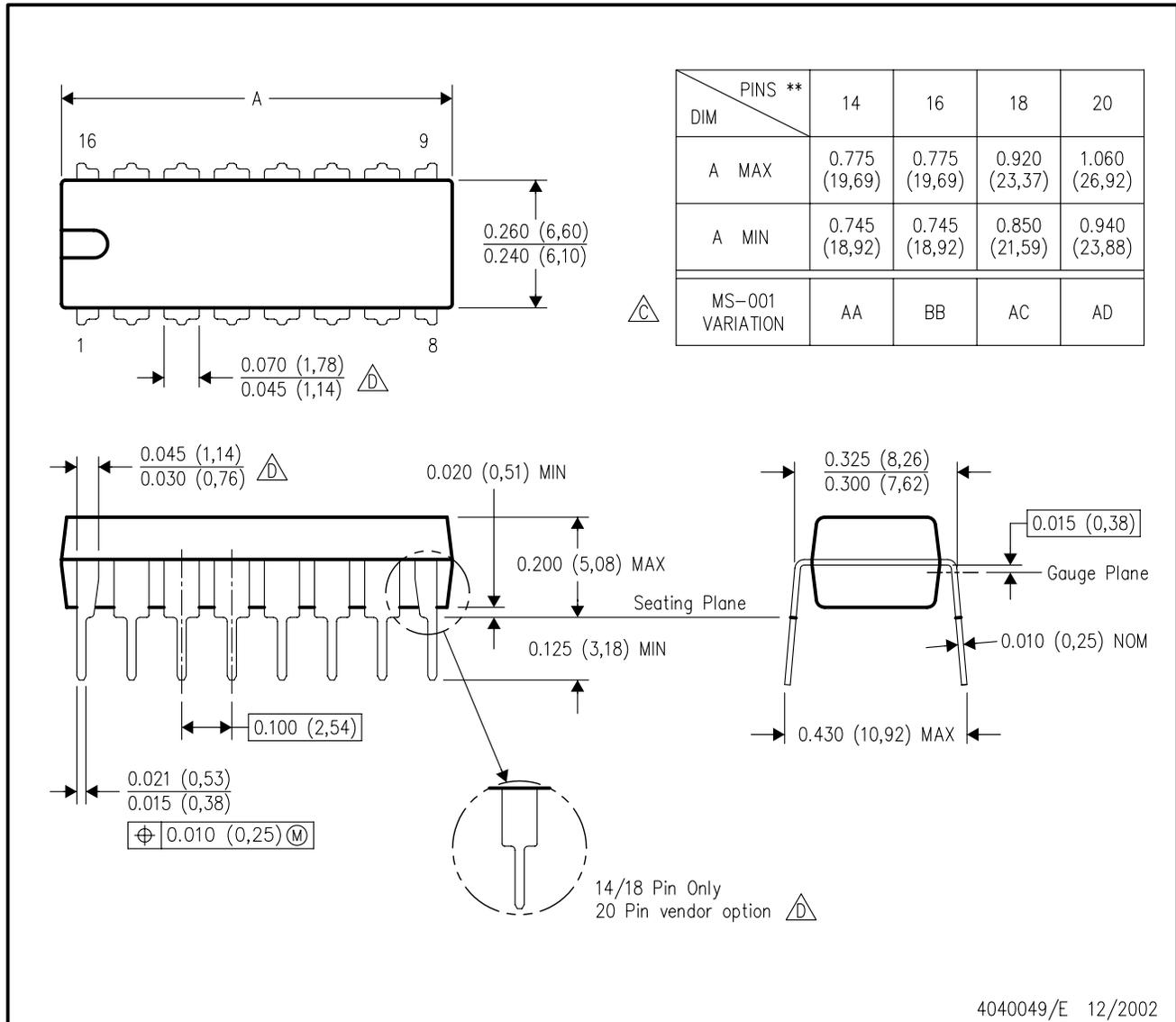


- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - D. Falls within JEDEC MS-013 variation AC.

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - $\triangle D$ The 20 pin end lead shoulder width is a vendor option, either half or full width.

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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Audio	www.ti.com/audio
Automotive	www.ti.com/automotive
Broadband	www.ti.com/broadband
Digital Control	www.ti.com/digitalcontrol
Medical	www.ti.com/medical
Military	www.ti.com/military
Optical Networking	www.ti.com/opticalnetwork
Security	www.ti.com/security
Telephony	www.ti.com/telephony
Video & Imaging	www.ti.com/video
Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2008, Texas Instruments Incorporated