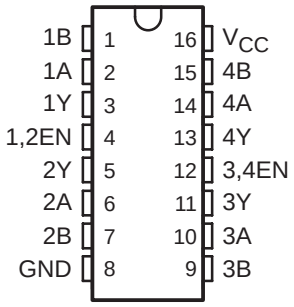
- **Designed for TIA/EIA-485, TIA/EIA-422, and ISO 8482 Applications**
- **Signaling Rate[1] Exceeding 50 Mbps**
- **Fail-Safe in Bus Short-Circuit, Open-Circuit, and Idle-Bus Conditions**
- **ESD Protection on Bus Inputs 6 kV**
- **Common-Mode Bus Input Range −7 V to 12 V**
- **Propagation Delay Times <16 ns**
- **Low Standby Power Consumption <20 μA**
- **Pin-Compatible Upgrade for MC3486, DS96F175, LTC489, and SN75175**

SN65LBC175A (Marked as 65LBC175A)
SN75LBC175A (Marked as 75LBC175A)
D or N PACKAGE
(TOP VIEW)

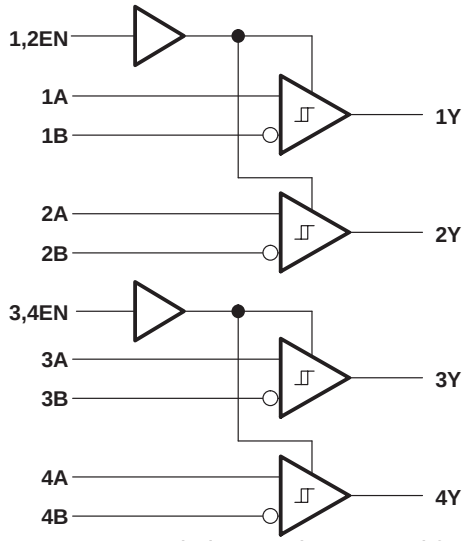


description

The SN65LBC175A and SN75LBC175A are quadruple differential line receivers with 3-state outputs, designed for TIA/EIA-485 (RS-485), TIA/EIA-422 (RS-422), and ISO 8482 (Euro RS-485) applications.

These devices are optimized for balanced multipoint bus communication at data rates up to and exceeding 50 million bits per second. The transmission media may be twisted-pair cables, printed-circuit board traces, or backplanes. The ultimate rate and distance of data transfer is dependent upon the attenuation characteristics of the media and the noise coupling to the environment.

logic diagram



Each receiver operates over a wide range of positive and negative common-mode input voltages, and features ESD protection to 6 kV, making it suitable for high-speed multipoint data transmission applications in harsh environments. These devices are designed using LinBiCMOS™, facilitating low power consumption and inherent robustness.

Two EN inputs provide pair-wise enable control, or these can be tied together externally to enable all four drivers with the same signal.

The SN75LBC175A is characterized for operation over the temperature range of 0°C to 70°C. The SN65LBC175A is characterized over the temperature range from −40°C to 85°C.

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.

[1]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.

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FUNCTION TABLE
(each receiver)

DIFFERENTIAL INPUTS A – B (V_{ID})	ENABLE EN	OUTPUT Y
$V_{ID} \le -0.2$ V	H	L
-0.2 V $< V_{ID} < -0.01$ V	H	?
-0.01 V $\le V_{ID}$	H	H
X	L	Z
X	OPEN	Z
Short circuit	H	H
Open circuit	H	H

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

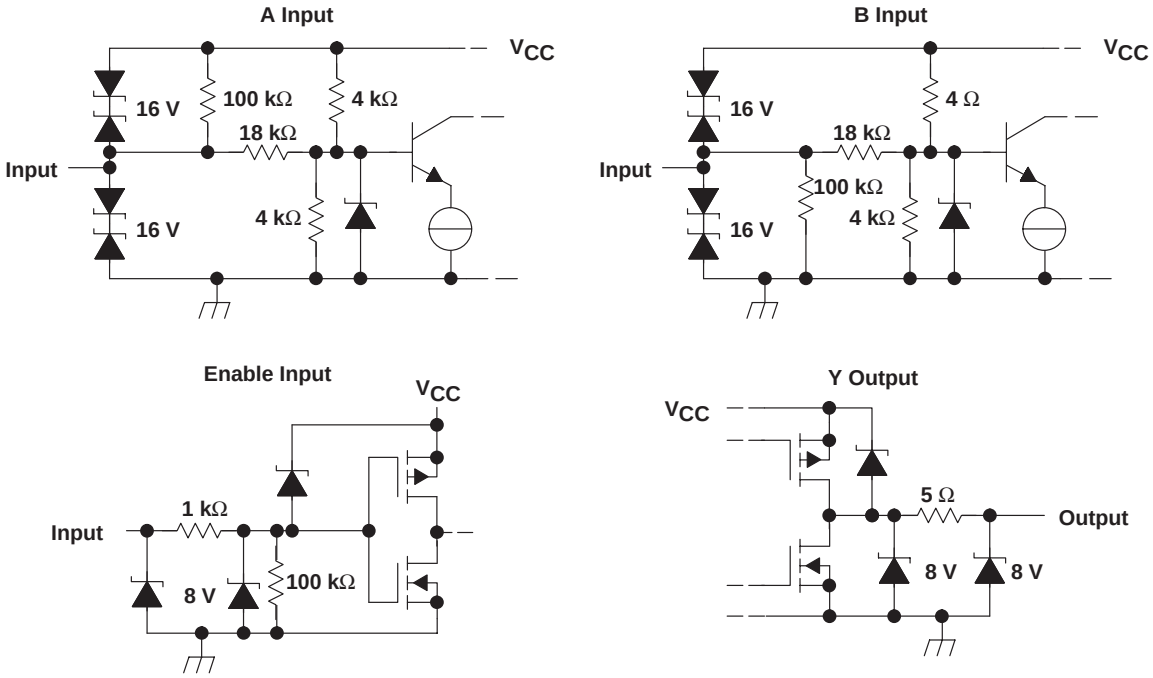
AVAILABLE OPTIONS

T_A	PACKAGE	
	PLASTIC SMALL OUTLINE† (JEDEC MS-012)	PLASTIC DUAL-IN-LINE (JEDEC MS-001)
0°C to 70°C	SN75LBC175AD	SN75LBC175AN
−40°C to 85°C	SN65LBC175AD	SN65LBC175AN

† Add an R suffix for taped and reeled

† For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.

equivalent input and output schematic diagrams



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

Supply voltage range, V_{CC} (see Note 1) . . . . . −0.3 V to 6 V
Voltage range at any bus input (steady state), A and B . . . . . −10 V to 15 V
Voltage range at any bus input (transient pulse through 100 Ω, see Figure 5) . . . . . −30 V to 30 V
Voltage input range at 1,2EN and 3,4EN, V_I . . . . . −0.5 V to V_{CC} + 0.5 V
Receiver output current, I_O . . . . . ±10 mA
Electrostatic discharge:
Human body model (see Note 2): A and B to GND . . . . . 6 kV
All pins . . . . . 5 kV
Charged-device model (see Note 3): All pins . . . . . 2 kV
Continuous power dissipation . . . . . See Power Dissipation Rating Table

† 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, and are steady-state (unless otherwise specified).
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	$T_A \le 25°C$ POWER RATING	DERATING FACTOR† ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING
D	1080 mW	8.7 mW/°C	690 mW	560 mW
N	1150 mW	9.2 mW/°C	736 mW	598 mW

† This is the inverse of the junction-to-ambient thermal resistance when board-mounted and 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	A, B	−7		12	V
High-level input voltage, V_{IH}	EN	2		V_{CC}	V
Low-level input voltage, V_{IL}	EN	0		0.8	V
Output current	Y	−8		8	mA
Operating free-air temperature, T_A	SN75LBC175A	0		70	°C
	SN65LBC175A	−40		85	°C

electrical characteristics over recommended operating conditions

PARAMETER			TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_{IT+}	Positive-going differential input voltage threshold		−7 V ≤ V_{CM} ≤ 12 V (V_{CM} = (V_A + V_B) / 2)			−80	−10	mV
V_{IT-}	Negative-going differential input voltage threshold				−200	−120		
V_{HYS}	Hysteresis voltage (V_{IT+} − V_{IT-})					−40		mV
V_{IK}	Input clamp voltage		I_I = −18 mA		−1.5	−0.8		V
V_{OH}	High-level output voltage		V_{ID} = 200 mV, I_{OH} = −8 mA	See Figure 1	2.7	4.8		V
V_{OL}	Low-level output voltage		V_{ID} = −200 mV, I_{OL} = 8 mA			0.2	0.4	
I_{OZ}	High-impedance-state output current		V_O = 0 V to V_{CC}		−1		1	µA
I_I	Line input current		Other input at 0 V, V_{CC} = 0 V or 5 V	V_I = 12 V			0.9	mA
				V_I = −7 V	−0.7			
I_{IH}	High-level input current	Enable inputs					100	µA
I_{IL}	Low-level input current	Enable inputs			−100			µA
R_I	Input resistance		A, B		12			kΩ
I_{CC}	Supply current		V_{ID} = 5 V	1,2EN, 3,4EN at 0 V			20	mA
			No load	1,2EN, 3,4EN at V_{CC}		11	16	mA

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

switching characteristics over recommended operating conditions

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
t_r	Output rise time	V_{ID} = −3 V to 3 V, See Figure 2		2	4	ns
t_f	Output fall time			2	4	ns
t_{PLH}	Propagation delay time, low-to-high level output		9	12	16	ns
t_{PHL}	Propagation delay time, high-to-low level output		9	12	16	ns
t_{PZH}	Propagation delay time, high-impedance to high-level output	See Figure 3		27	38	ns
t_{PHZ}	Propagation delay time, high-level to high-impedance output			7	16	ns
t_{PZL}	Propagation delay time, high-impedance to low level output	See Figure 4		29	38	ns
t_{PLZ}	Propagation delay time, low-level to high-impedance output			12	16	ns
$t_{sk(p)}$	Pulse skew (| (t_{PLH} − t_{PHL}) |)			0.2	1	ns
$t_{sk(o)}$	Output skew (see Note 4)				2	ns
$t_{sk(pp)}$	Part-to-part skew (see Note 5)				2	ns

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

NOTES: 4. Outputs 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.

5. 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

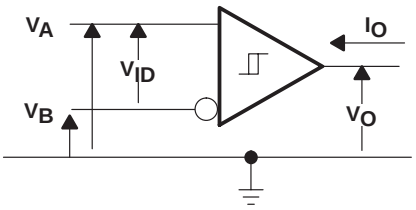
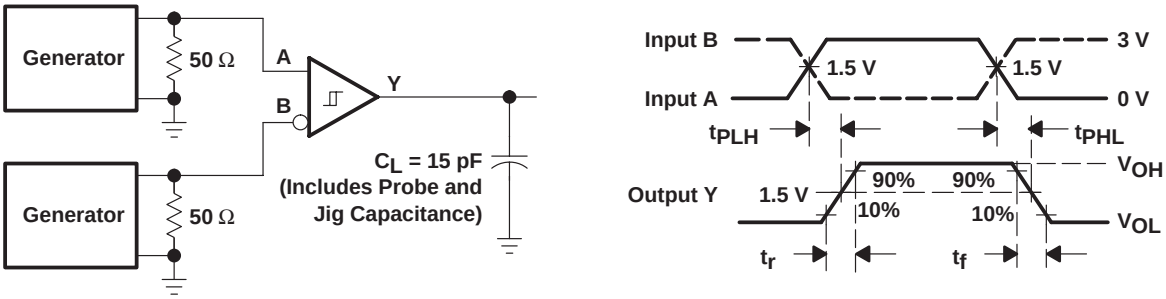
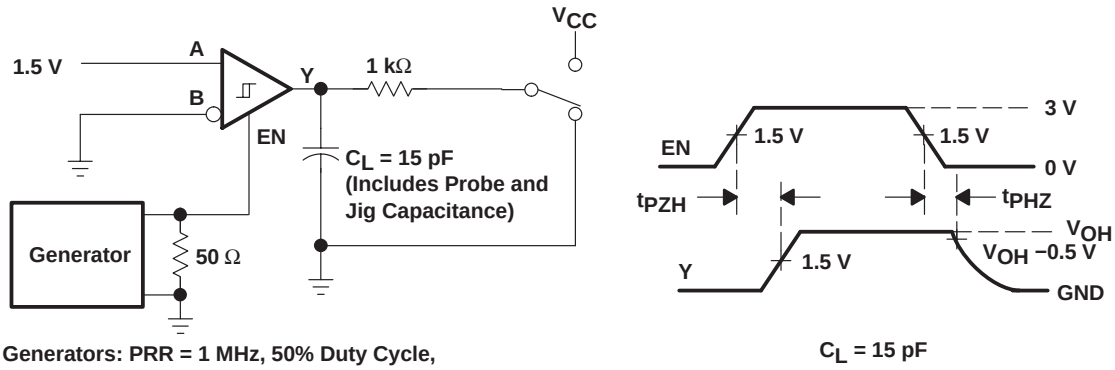


Figure 1. Voltage and Current Definitions



Generators: PRR = 1 MHz, 50% Duty Cycle,
t_r <6 ns, Z_O = 50 Ω

Figure 2. Switching Test Circuit and Waveforms

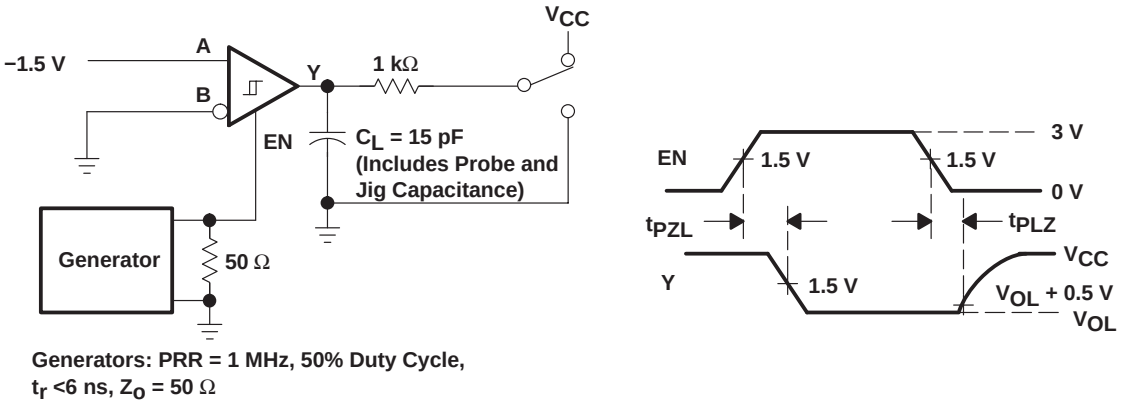


Generators: PRR = 1 MHz, 50% Duty Cycle,
t_r <6 ns, Z_O = 50 Ω

C_L = 15 pF

Figure 3. Test Circuit Waveforms, t_{PZH} and t_{PHZ}

PARAMETER MEASUREMENT INFORMATION



Generators: PRR = 1 MHz, 50% Duty Cycle,
t_r <6 ns, Z_O = 50 Ω

Figure 4. Test Circuit Waveforms, t_{PZL} and t_{PLZ}

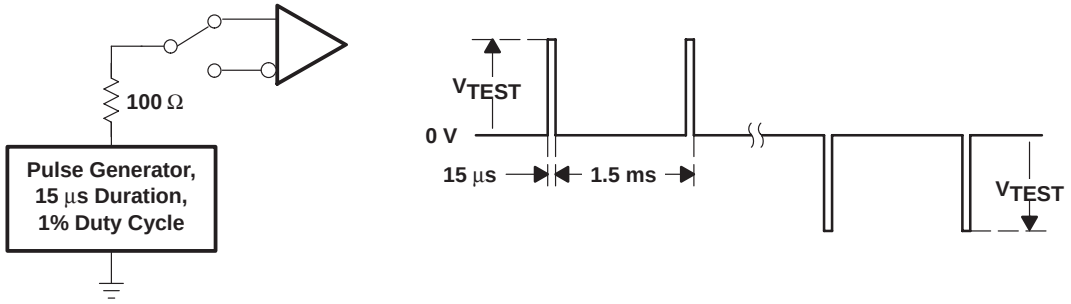


Figure 5. Test Circuit and Waveform, Transient Over-Voltage Test

TYPICAL CHARACTERISTICS

BUS INPUT CURRENT vs BUS INPUT VOLTAGE

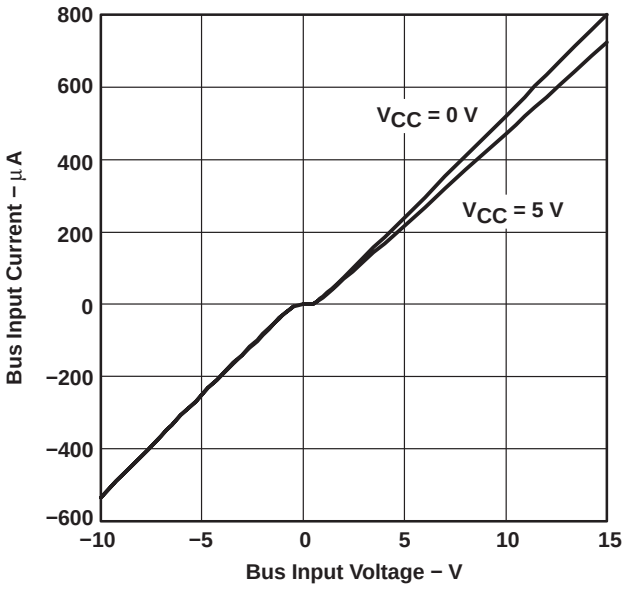


Figure 6

OUTPUT VOLTAGE vs DIFFERENTIAL INPUT VOLTAGE

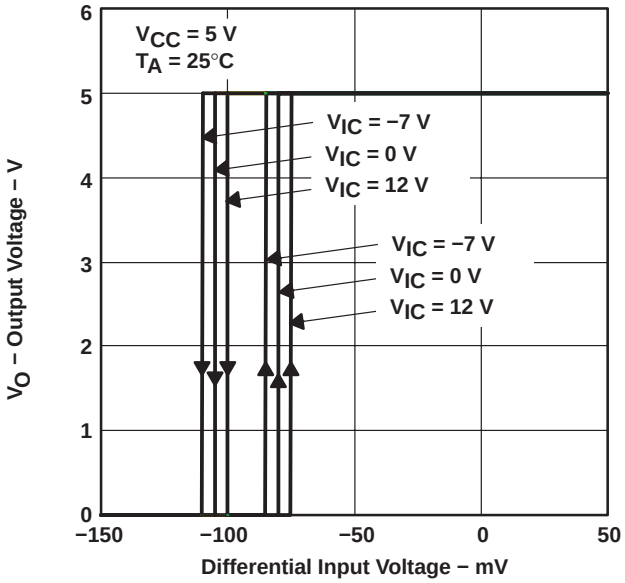


Figure 7

SUPPLY CURRENT vs SIGNALING RATE (ALL FOUR CHANNELS)

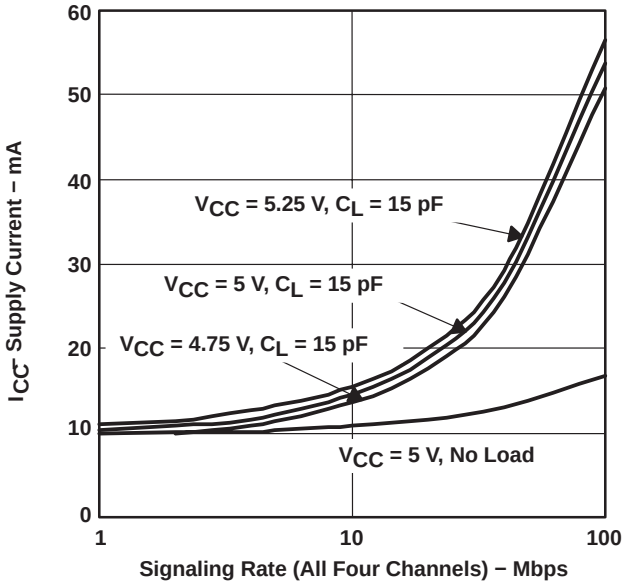


Figure 8

PROPAGATION DELAY TIME vs FREE-AIR TEMPERATURE

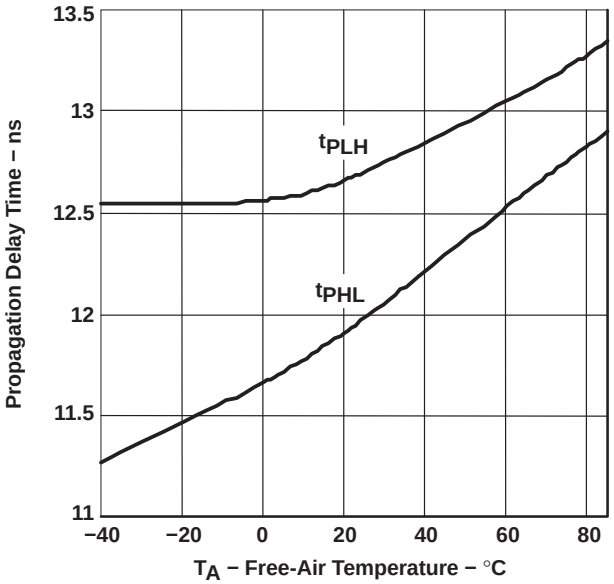


Figure 9

TYPICAL CHARACTERISTICS

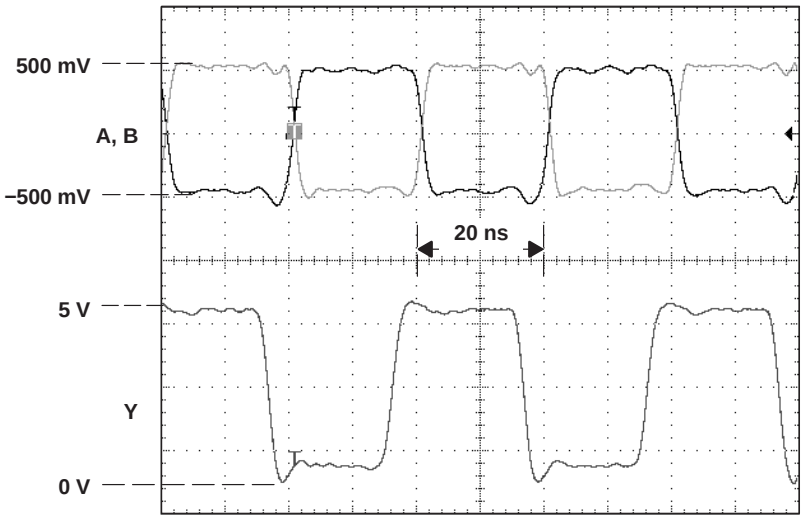


Figure 10. Receiver Inputs and Outputs, 50 Mbps Signaling Rate

APPLICATION INFORMATION

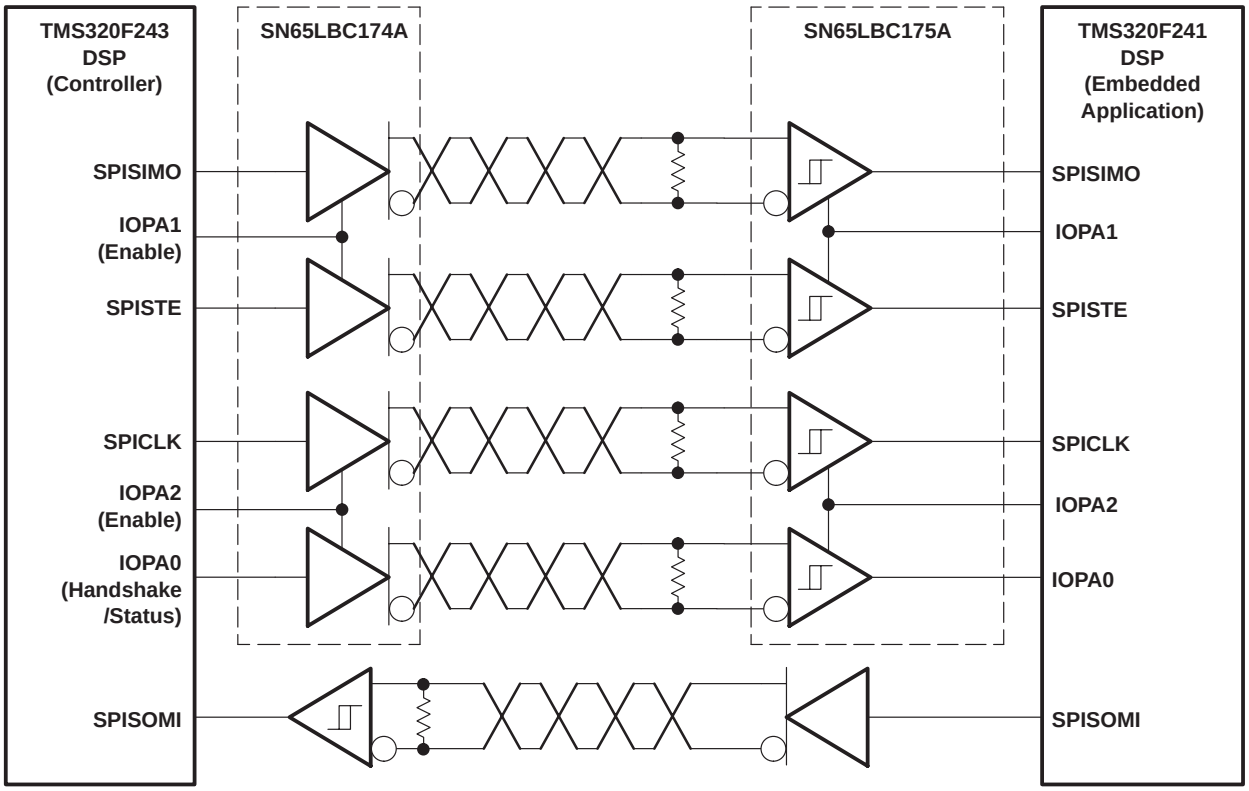


Figure 11. Typical Application Circuit, DSP-to-DSP Link via Serial Peripheral Interface

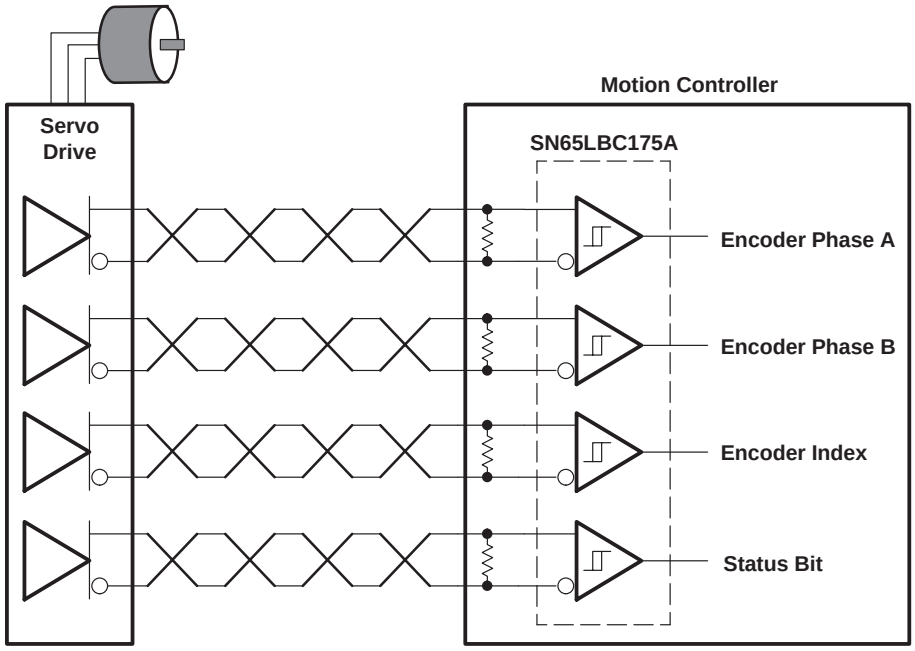


Figure 12. Typical Application Circuit, High-Speed Servomotor Encoder Interface

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
SN65LBC175AD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	65LBC175A	Samples
SN65LBC175ADG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	65LBC175A	Samples
SN65LBC175ADR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	65LBC175A	Samples
SN65LBC175AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 85	65LBC175A	Samples
SN75LBC175AD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	75LBC175A	Samples
SN75LBC175ADG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	75LBC175A	Samples
SN75LBC175ADR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	75LBC175A	Samples
SN75LBC175ADRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	75LBC175A	Samples
SN75LBC175AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	75LBC175A	Samples

(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.

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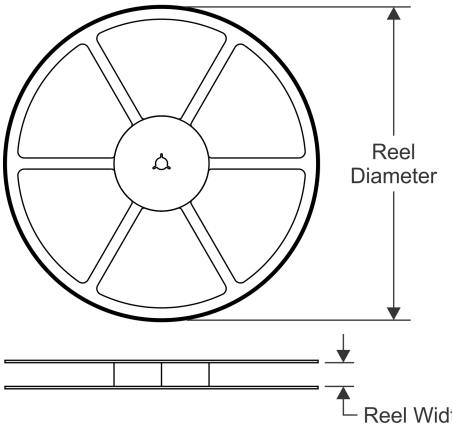
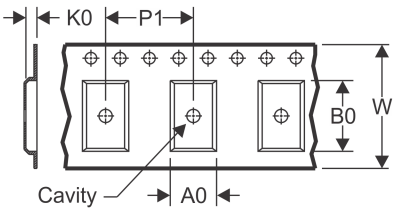
TAPE AND REEL INFORMATION

REEL DIMENSIONS

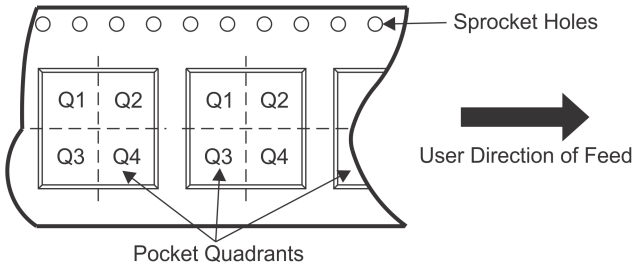


TAPE DIMENSIONS



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

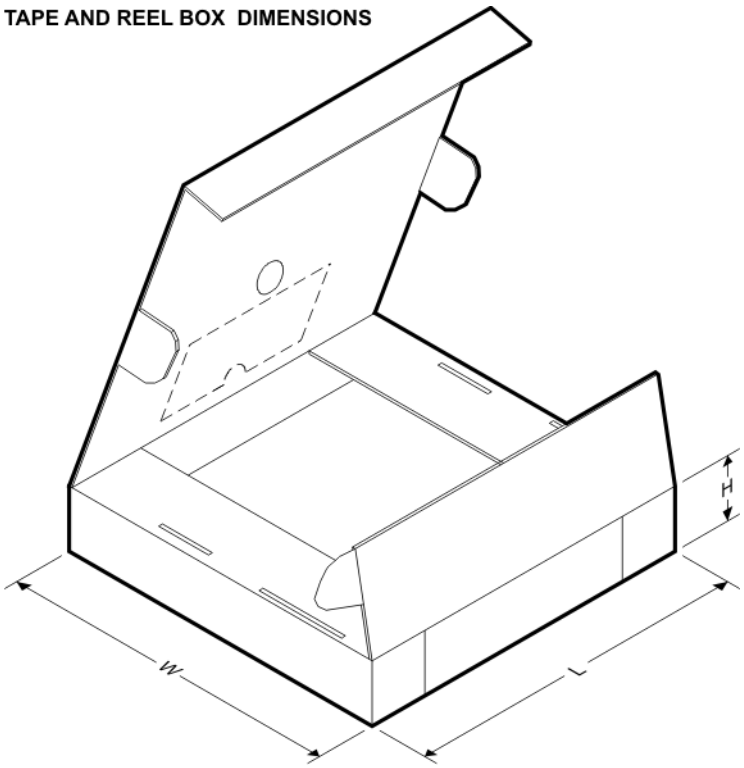
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SN65LBC175ADR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN75LBC175ADR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1

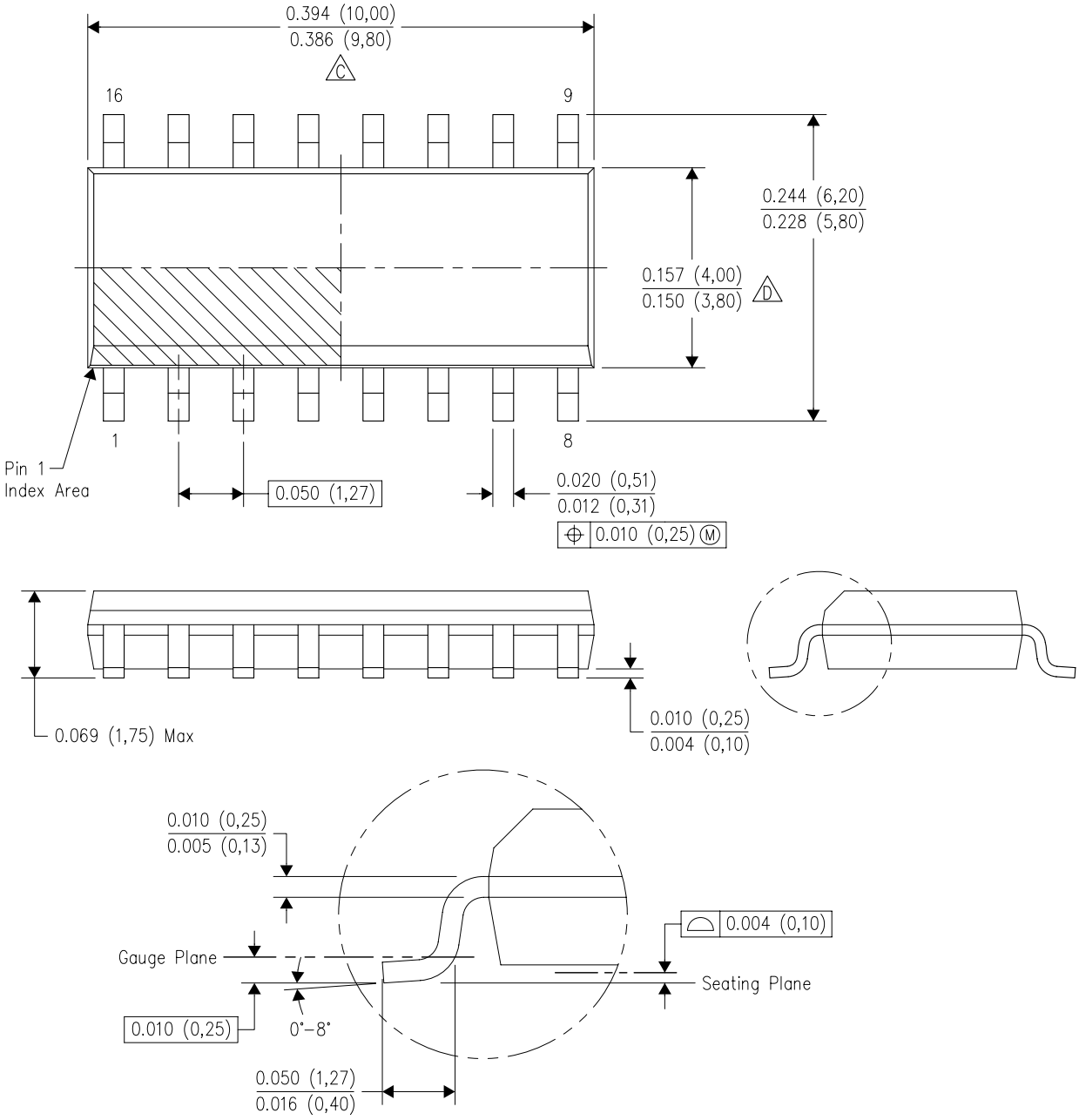
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

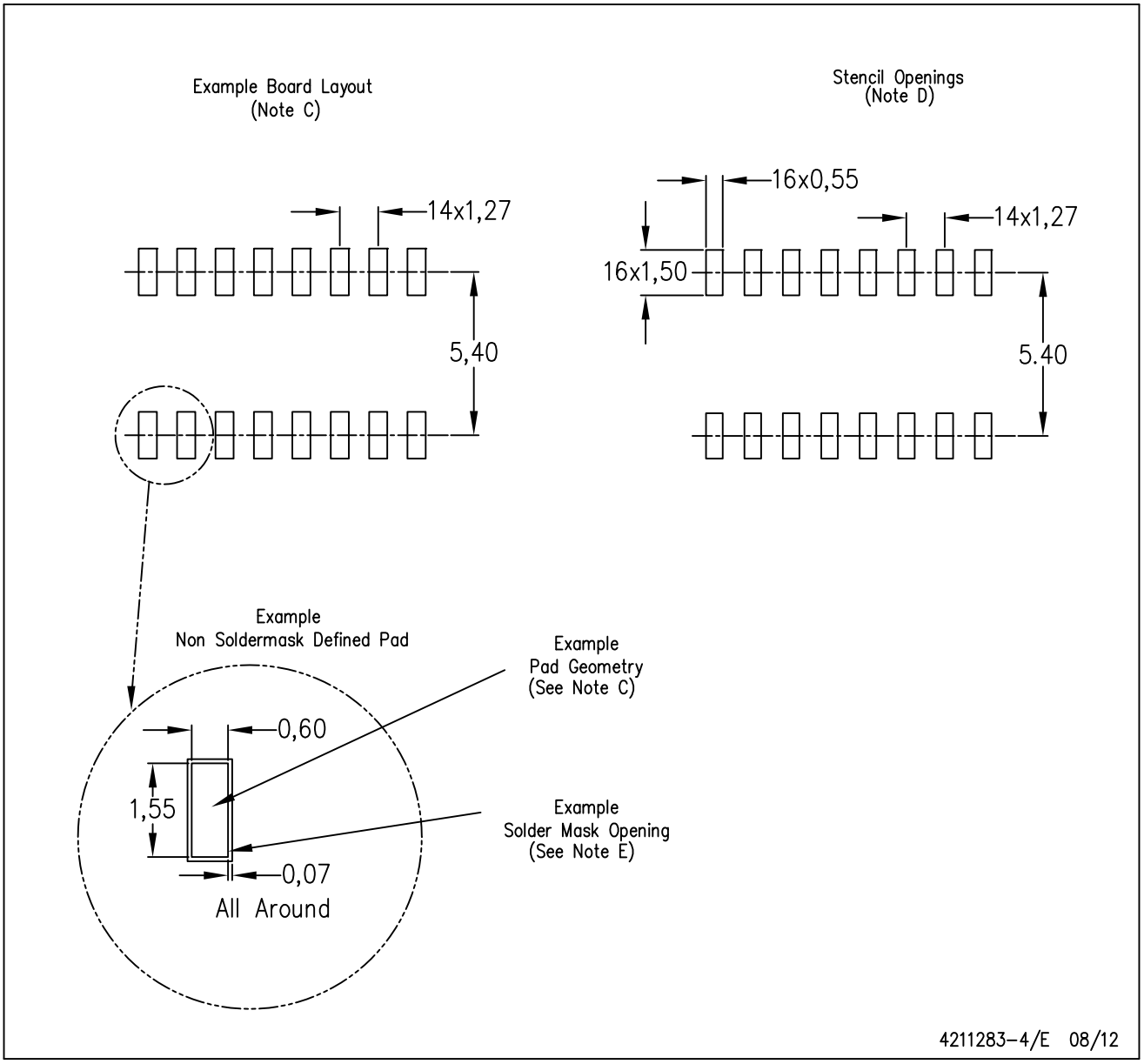
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65LBC175ADR	SOIC	D	16	2500	333.2	345.9	28.6
SN75LBC175ADR	SOIC	D	16	2500	333.2	345.9	28.6

D (R–PDSO–G16) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AC.

D (R–PDSO–G16) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC–7525 for other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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