SN65EPT22 3.3 V Dual LVTTL/LVCMOS to Differential LVPECL Buffer

1 Features

- Dual 3.3V LVTTL to LVPECL Buffer
- Operating Range
  - LVPECL V_{CC} = 3.0 V to 3.6 V With GND = 0 V
- Support for Clock Frequencies to 2.0 GHz (typ)
- 420 ps Typical Propagation Delay
- Deterministic HIGH Output Value for Open Input Conditions
- Built-in Temperature Compensation
- Drop in Compatible to MC100ELT23
- PNP Single Ended Inputs for Minimal Loading

2 Applications

- Data and Clock Transmission Over Backplane
- Signaling Level Conversion

3 Description

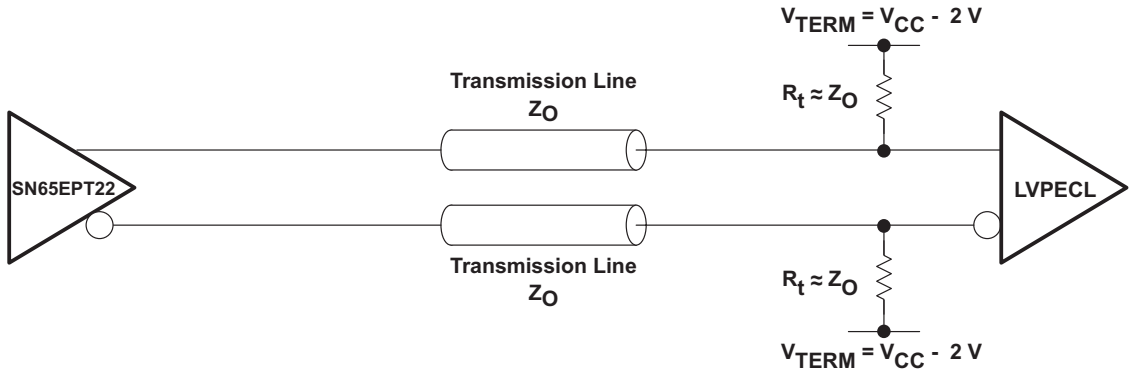
The SN65EPT22 is a low power dual LVTTL to LVPECL translator device. The device includes circuitry to maintain known logic HIGH level when inputs are in open condition. The SN65EPT22 is housed in an industry standard SOIC-8 package and is also available in TSSOP-8 package option.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
SN65EPT22	SOIC (8)	4.90mm x 3.91mm
	VSSOP (8)	3.00mm x 3.00mm

(1) For all available packages, see the orderable addendum at the end of the datasheet.

4 Simplified Schematic



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5 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision A (November 2010) to Revision B **Page**

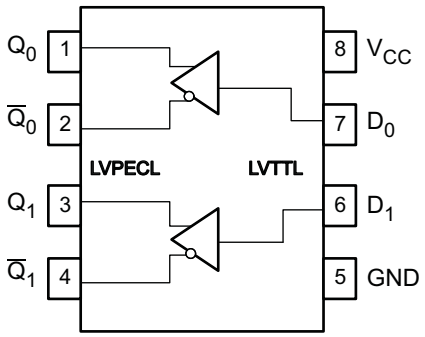
- Deleted the Ordering Information table ... 1
- Added the Device Information table ... 1
- Added the Simplified Schematic ... 1
- Added the Handling Ratings ... 3
- Added the Device and Documentation Support and Mechanical, Packaging, and Orderable Information ... 8

Changes from Original (November 2010) to Revision A **Page**

- Changed SN65EPT22 to EPT22 (2 places) in Ordering Information Table under Part Marking column ... 1

6 Pin Configuration and Functions

Top View



Pin Functions

PIN	FUNCTION
D_0, D_1	LVTTL data inputs
Q_0, $\overline{Q}_0$, Q_1, $\overline{Q}_1$	LVPECL outputs
V_{CC}	Positive supply
GND	Ground

7 Specifications

7.1 Absolute Maximum Ratings(1)

PARAMETER	CONDITION	MIN	MAX	UNIT
Absolute supply voltage, V_{CC}			6	V
Absolute input voltage, VI	GND = 0 and VI ≤ V_{CC}	0	6	V
Supply voltage LVPEL			3.3	V
Output current	Continuous		50	mA
	Surge		100	
Operating temperature range		–40	85	°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.

7.2 Handling Ratings

			MIN	MAX	UNIT
T_{stg}	Storage temperature range		–65	150	°C
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins(1)	–4	4	kV
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins(2)	–2	2	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

7.3 Power Dissipation Ratings

PACKAGE	CIRCUIT BOARD MODEL	POWER RATING T_A < 25°C (mW)	THERMAL RESISTANCE, JUNCTION TO AMBIENT NO AIRFLOW	DERATING FACTOR T_A > 25°C (mW/°C)	POWER RATING T_A = 85°C (mW)
D	Low-K	719	139	7	288
	High-K	840	119	8	336
DGK	Low-K	469	213	5	188
	High-K	527	189	5	211

7.4 Thermal Information

THERMAL METRIC(1)		D	DGK	UNIT
		8 PINS	8 PINS	
$R_{\theta JB}$	Junction-to-board thermal resistance	79	120	°C/W
$R_{\theta JC}$	Junction-to-case thermal resistance	98	74	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953.

7.5 Key Attributes

CHARACTERISTICS	VALUE
Moisture sensitivity level	Lead free package
SOIC-8	Level 1
VSSOP-8	Level 3
Flammability rating (Oxygen Index: 28 to 34)	UL 94 V-0 at 0.125 in
Meets or exceeds JEDEC Spec EIA/JESD78 latchup test	

7.6 TTL Input DC Characteristics(1)

(V_{CC} = 3.3 V, GND = 0, T_A = –40°C to 85°C)

CHARACTERISTIC		CONDITION	MIN	TYP	MAX	UNIT
I_{IH}	Input HIGH current	V_{IN} = 2.7 V			20	µA
I_{IHH}	Input HIGH current max	V_{IN} = V_{CC}			100	µA
I_{IL}	Input LOW current	V_{IN} = 0.5 V			–0.6	mA
V_{IK}	Input clamp voltage	I_{IN} = –18 mA			–1	V
V_{IH}	Input high voltage		2.0			V
V_{IL}	Input low voltage				0.8	V

(1) Device will meet the specifications after thermal balance has been established when mounted in a socket or printed circuit board with maintained transverse airflow greater than 500 lfpm. Electrical parameters are assured only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

7.7 PECL Output DC Characteristics[1]

(V_{CC} = 3.3 V; GND = 0.0V) [2]

CHARACTERISTIC		–40°C			25°C			85°C			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
I_{CC}	Power supply current		39	45		42	47		45	50	mA
V_{OH}	Output HIGH voltage [3]	2155	2224	2405	2155	2224	2405	2155	2224	2405	mV
V_{OL}	Output LOW voltage[3]	1355	1441	1605	1355	1438	1605	1355	1435	1605	mV

(1) Device will meet the specifications after thermal balance has been established when mounted in a socket or printed circuit board with maintained transverse airflow greater than 500 lfpm. Electrical parameters are assured only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.
(2) Output parameters vary 1:1 with V_{CC}
(3) All loading with 50Ω to V_{CC} –2.0V

7.8 AC Characteristics [1]

(V_{CC} = 3.0 V to 3.6 V; GND = 0 V)[2]

CHARACTERISTIC		–40°C			25°C			85°C			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
f_{MAX}	Max switching frequency[3], see Figure 5		2.1			2.0			2.0		GHz
t_{PLH} / t_{PHL}	Propagation delay to differential output	230		550	230		550	230		550	ps
t_{SKEW}	Within device skew[4]		25	50		25	50		25	50	ps
	Device to device skew[5]		100	200		100	200		100	200	ps
t_{JITTER}	Random clock jitter (RMS)		0.2	0.8		0.2	0.8		0.2	0.8	ps
t_r / t_f	Output rise/fall times (20%–80%)	150		300	150		300	150		300	ps

(1) Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm. Electrical parameters are assured only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.
(2) Measured using a 2.4 V source, 50% duty cycle clock source. All loading with 50 Ω to VCC – 2.0 V.
(3) Maximum switching frequency measured at output amplitude of 300 mV_{pp}.
(4) Skew is measured between outputs under identical transitions and conditions on any one device.
(5) Device−to−Device Skew for identical transitions at identical VCC levels.

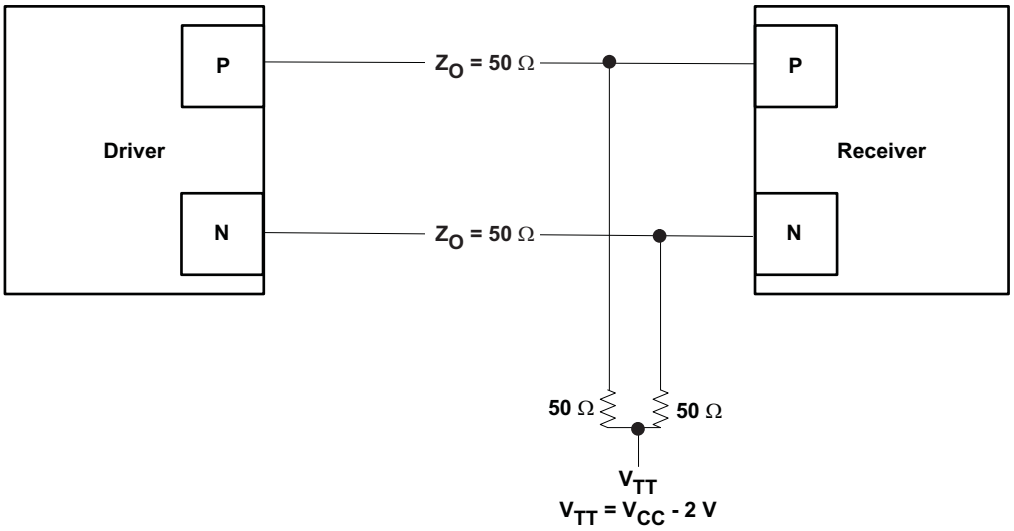


Figure 1. Termination for Output Driver

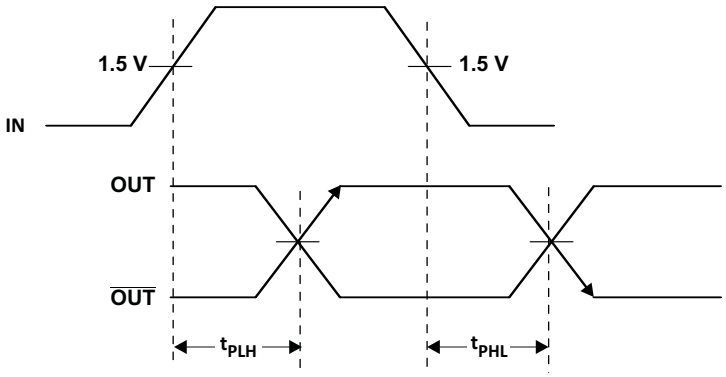


Figure 2. Output Propagation Delay

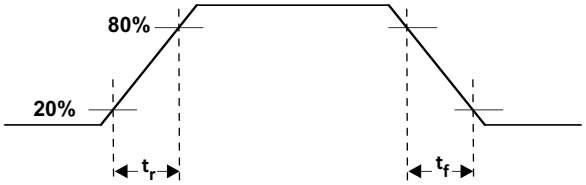


Figure 3. Output Rise and Fall Times

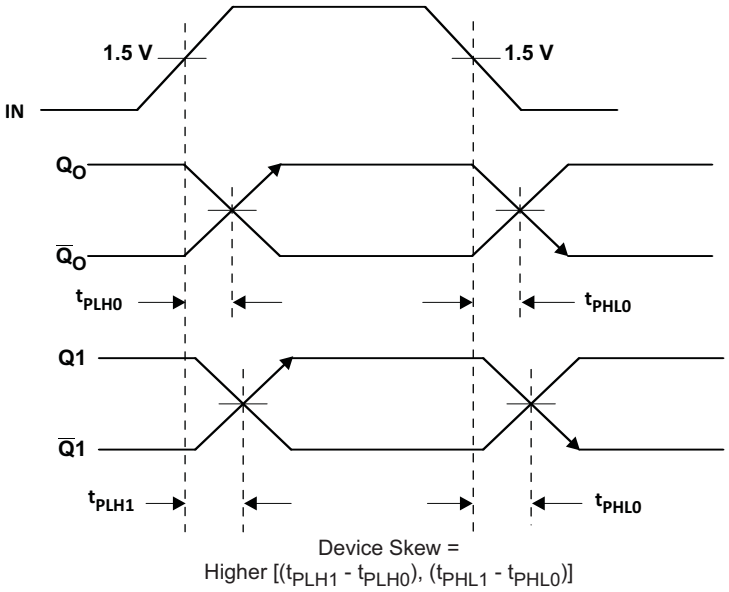


Figure 4. Device Skew

7.9 Typical Characteristics

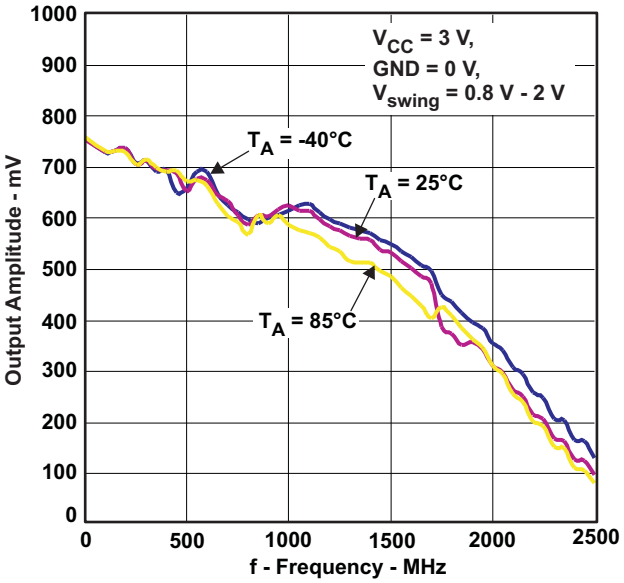


Figure 5. Output Amplitude versus Frequency

8 Device and Documentation Support

8.1 Trademarks

All trademarks are the property of their respective owners.

8.2 Electrostatic Discharge Caution

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

8.3 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

9 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN65EPT22D	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	EPT22	Samples
SN65EPT22DGK	ACTIVE	VSSOP	DGK	8	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	SIQI	Samples
SN65EPT22DGKR	ACTIVE	VSSOP	DGK	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	SIQI	Samples
SN65EPT22DR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	EPT22	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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(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.

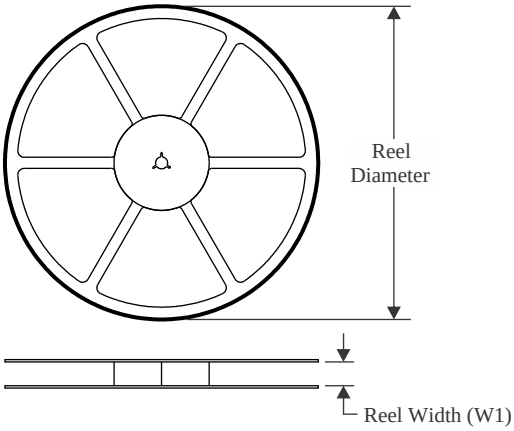
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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.

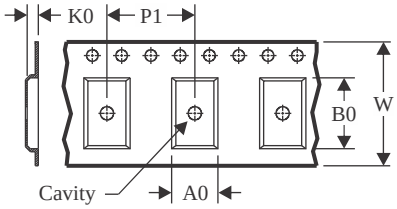
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

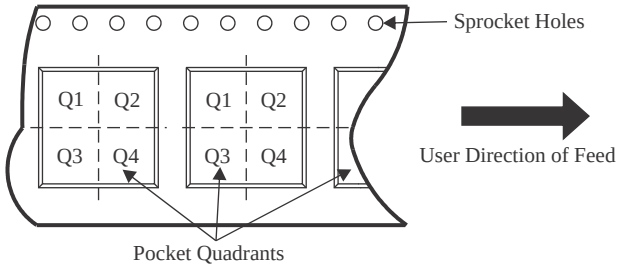


TAPE DIMENSIONS



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

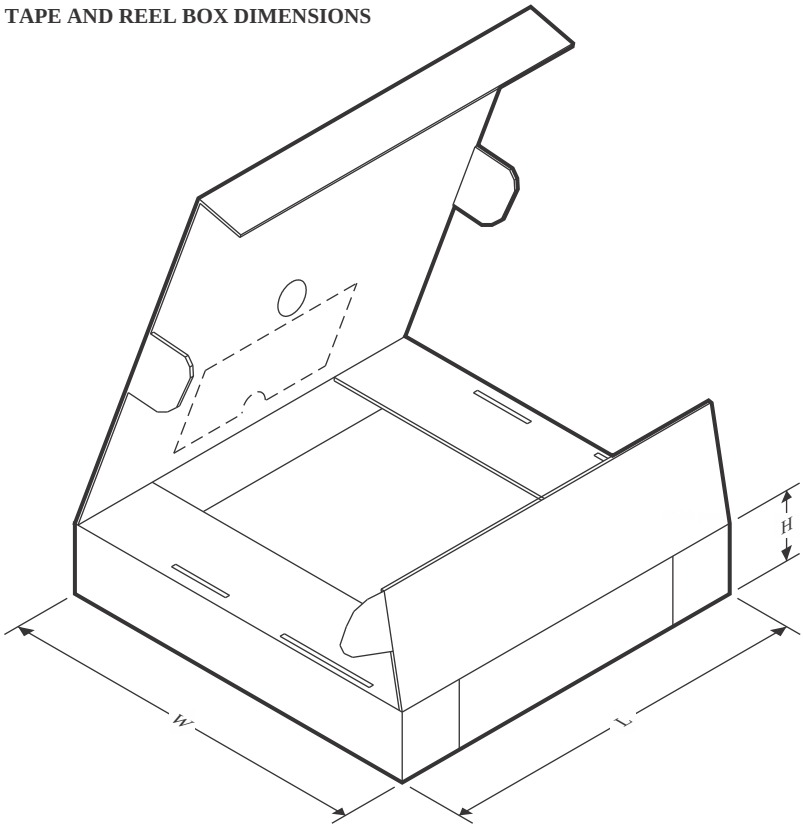
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SN65EPT22DGKR	VSSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
SN65EPT22DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

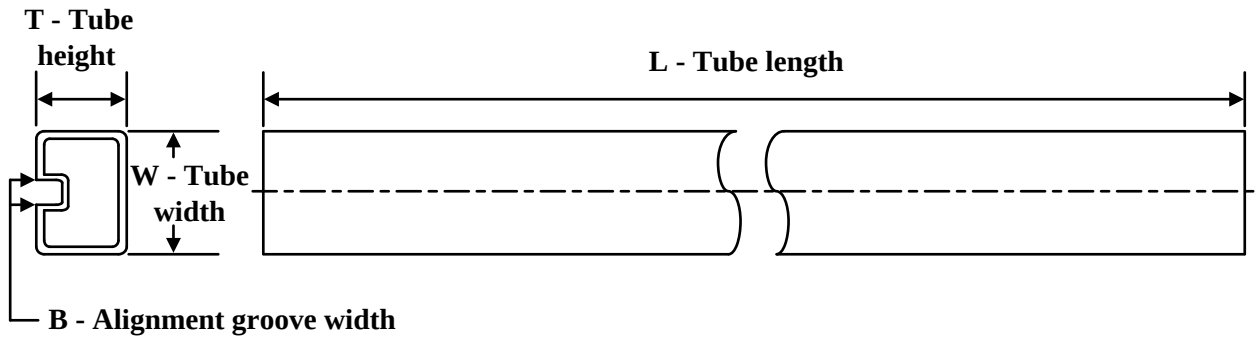
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65EPT22DGKR	VSSOP	DGK	8	2500	356.0	356.0	35.0
SN65EPT22DR	SOIC	D	8	2500	356.0	356.0	35.0

TUBE



*All dimensions are nominal

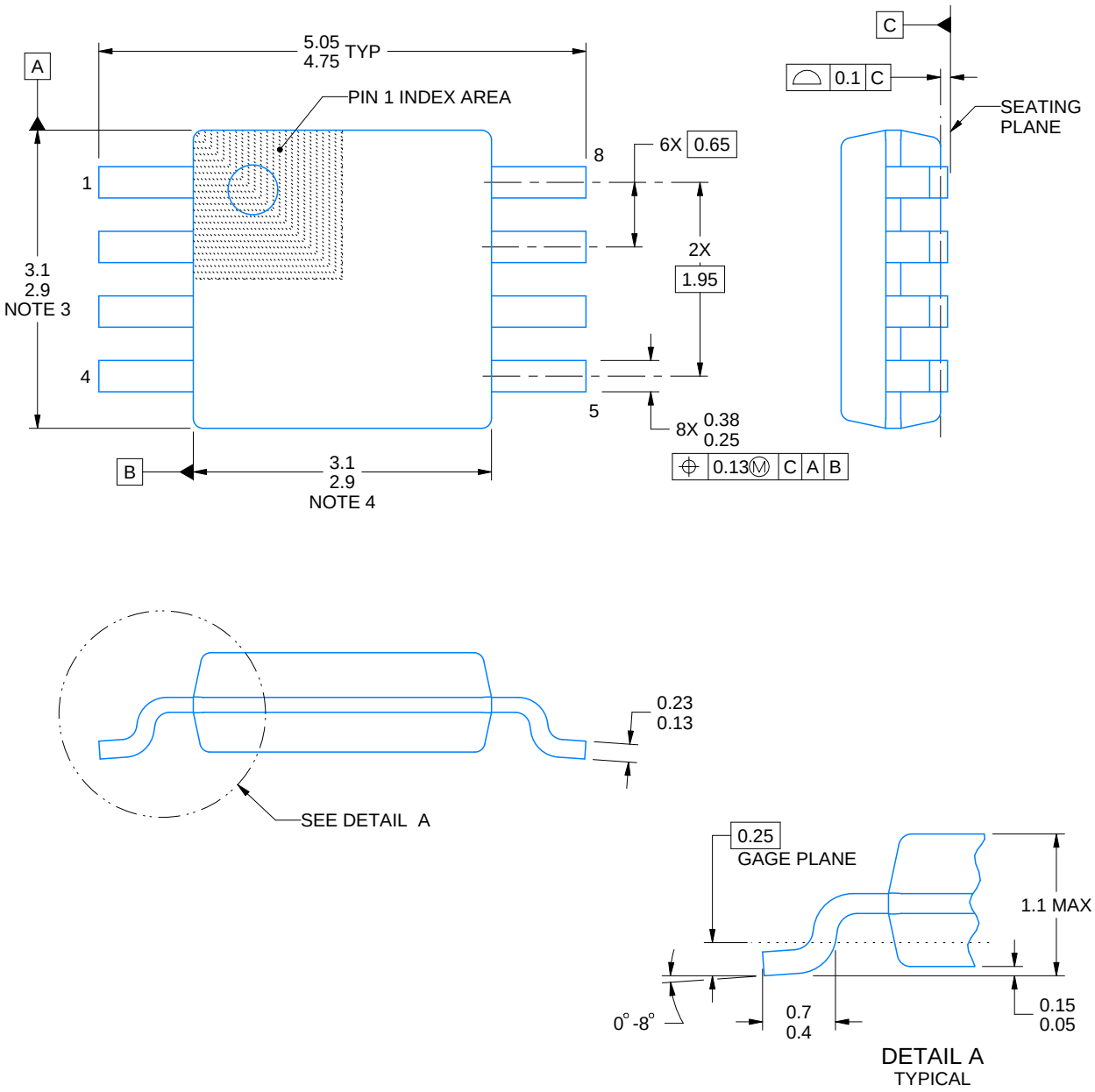
Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
SN65EPT22D	D	SOIC	8	75	506.6	8	3940	4.32
SN65EPT22DGK	DGK	VSSOP	8	80	330.2	6.6	3005	1.88

PACKAGE OUTLINE

DGK0008A

VSSOP - 1.1 mm max height

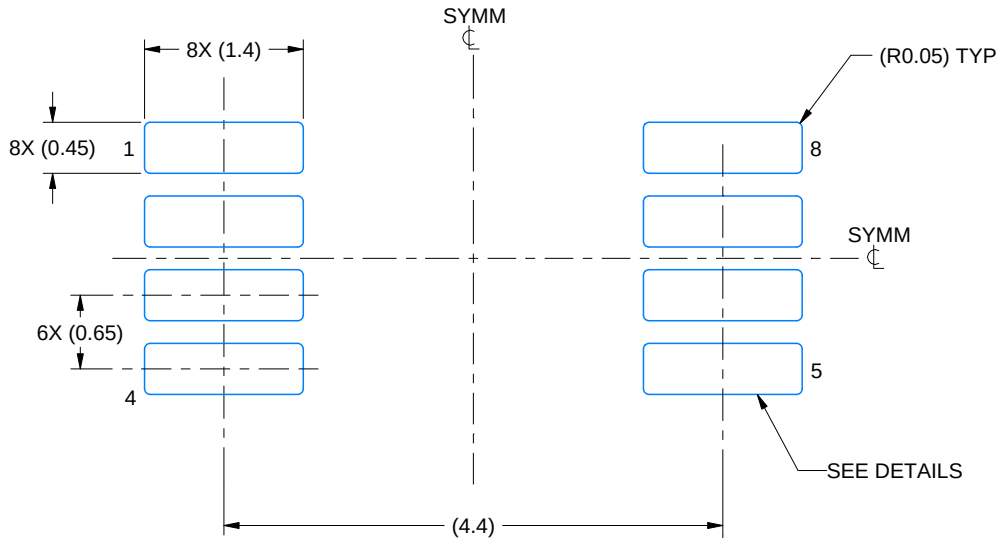
SMALL OUTLINE PACKAGE



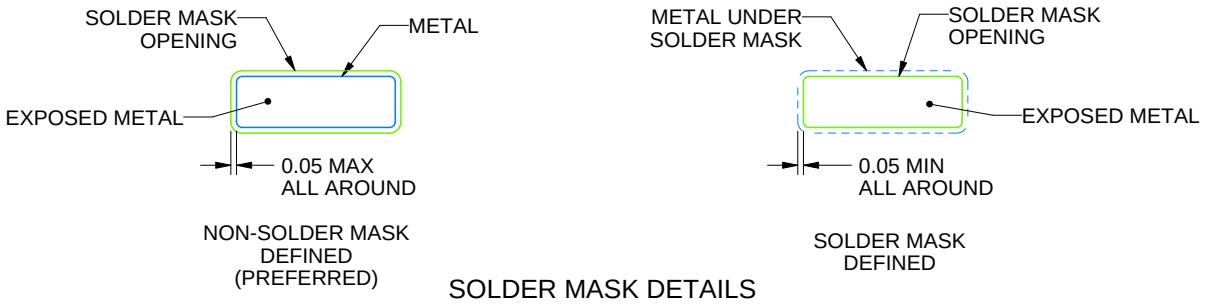
PowerPAD is a trademark of Texas Instruments.

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X

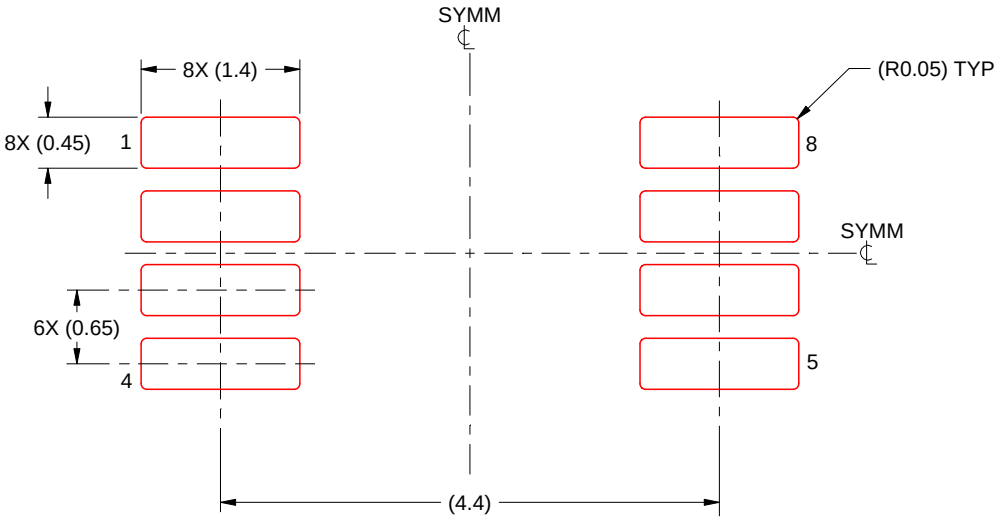


SOLDER MASK DETAILS

4214862/A 04/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
9. Size of metal pad may vary due to creepage requirement.

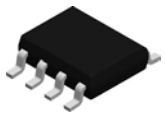


SOLDER PASTE EXAMPLE
SCALE: 15X

4214862/A 04/2023

NOTES: (continued)

11. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
12. Board assembly site may have different recommendations for stencil design.

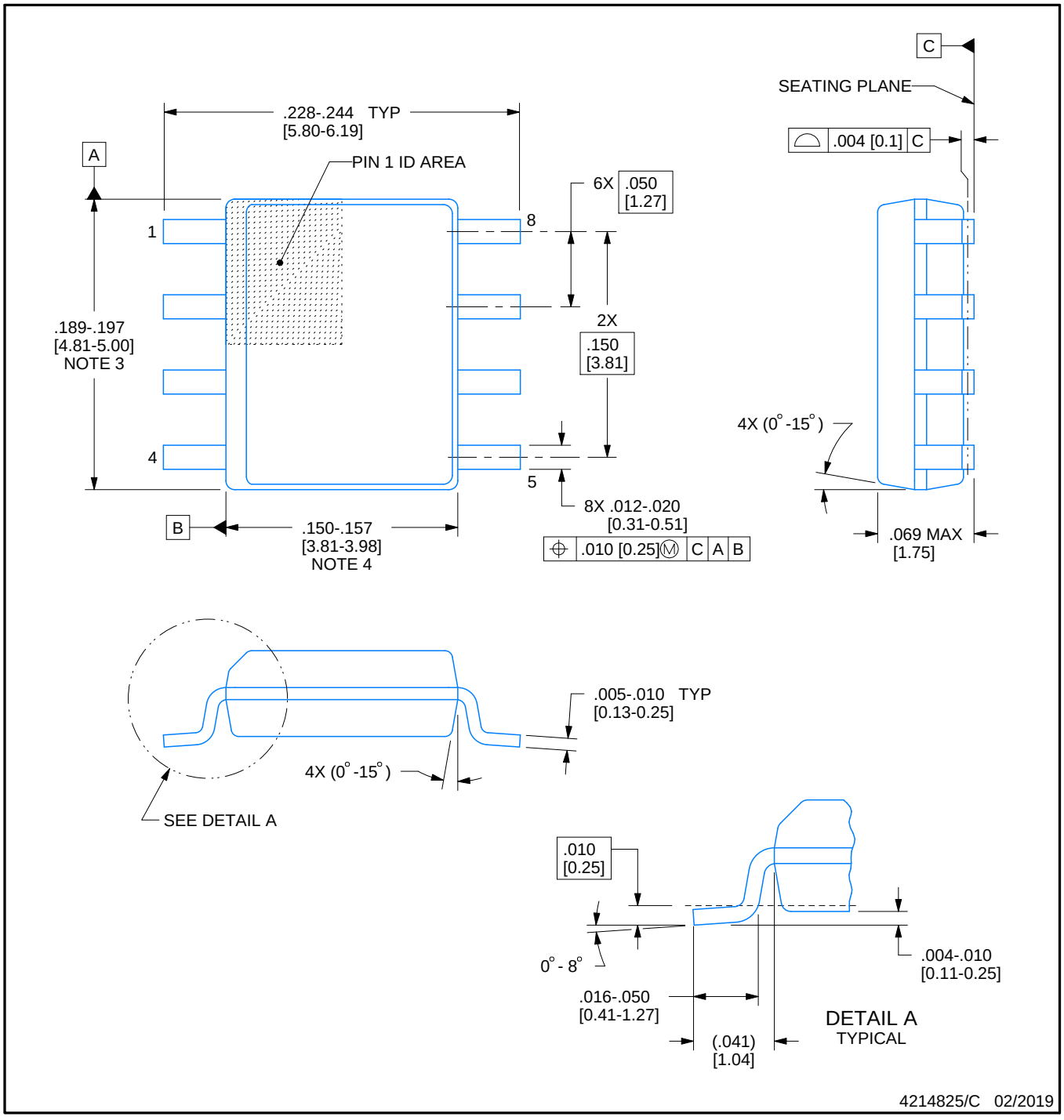


PACKAGE OUTLINE

D0008A

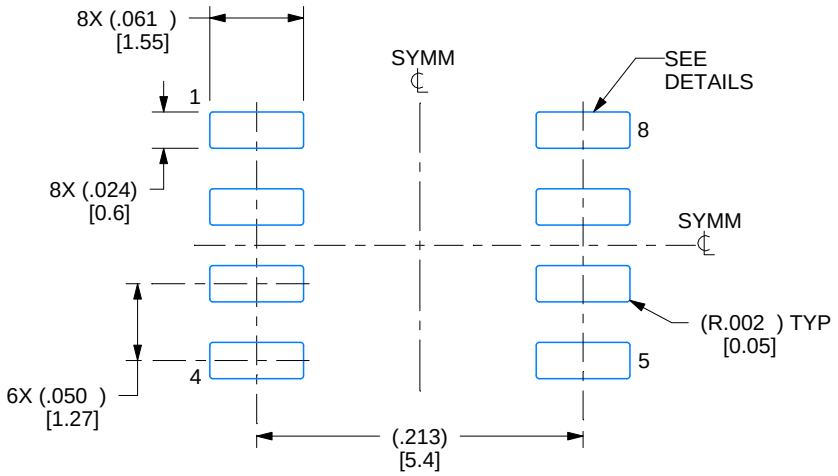
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

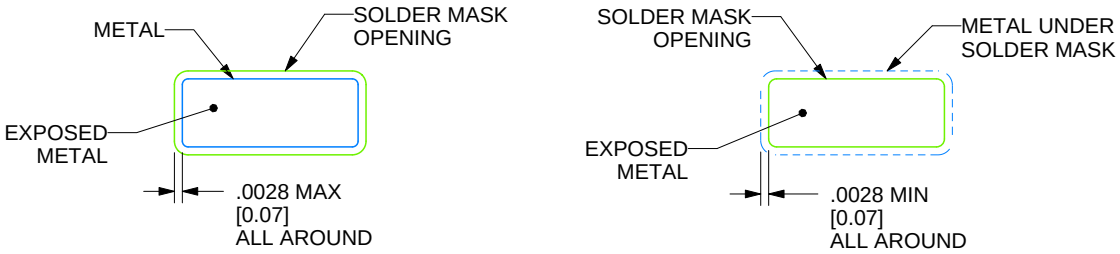


NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

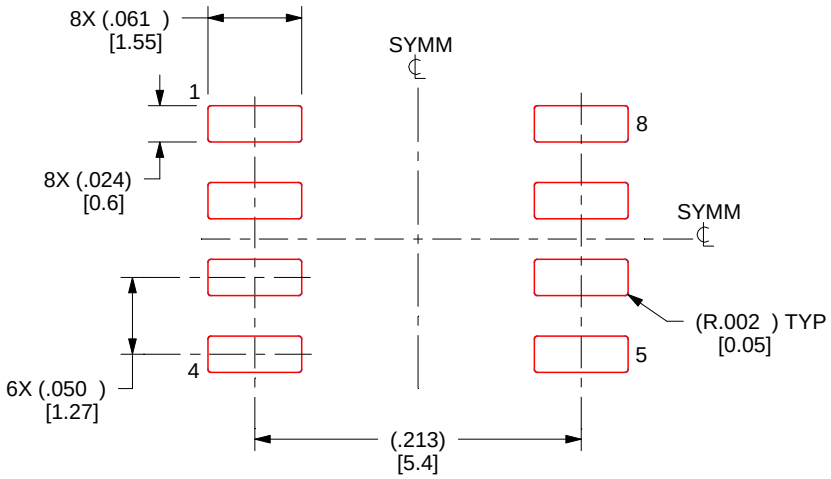
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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