

## 3.3V ECL Differential LVPECL/LVDS to LVTTTL/LVCMOS Translator

Check for Samples: [SN65EPT23](#)

### FEATURES

- Dual 3.3 V Differential LVPECL/LVDS to LVTTTL/LVCMOS Buffer Translator
- 24 mA LVTTTL Outputs
- Operating Range
  - $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$
  - $GND = 0 \text{ V}$
- Support for Clock Frequencies > 300 MHz
- 2.0 ns Typical Propagation Delay
- Built-in Temperature Compensation
- Drop in Compatible to MC100EPT23

### APPLICATIONS

- Data and Clock Transmission Over Backplane
- Signaling Level Conversion for Clock or Data

### DESCRIPTION

The SN65EPT23 is a low power dual LVPECL/LVDS to LVTTTL/LVCMOS translator device. The device includes circuitry to maintain inputs at  $V_{CC}/2$  when left open. The SN65EPT23 is housed in an industry standard SOIC-8 package and is also available in TSSOP-8 option.

### PINOUT ASSIGNMENT

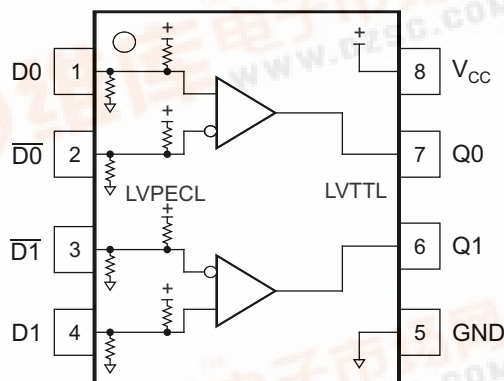


Table 1. PIN DESCRIPTION

PIN	FUNCTION
$Q_0, Q_1$	LVTTTL/LVCMOS Outputs
$D_0, \bar{D}_0, D_1, \bar{D}_1$	Differential LVPECL/LVDS/CML Inputs
$V_{CC}$	Positive Supply
GND	Ground
EP	Exposed pad must be connected to a sufficient thermal conduit. Electrically connect to the most negative supply or leave floating open.

### ORDERING INFORMATION<sup>(1)</sup>

PART NUMBER	PART MARKING	PACKAGE	LEAD FINISH
SN65EPT23D/DR	EPT23	SOIC	NiPdAu
SN65EPT23DGK/DGKR	SSTI	MSOP	NiPdAu

(1) Leadless device option not initially available; contact [TI sales representative](#) for further information.



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This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

## ABSOLUTE MAXIMUM RATINGS

PARAMETER	CONDITION	VALUE	UNIT
Absolute supply voltage, $V_{CC}$	GND = 0V	3.8	V
Absolute input voltage, $V_I$	GND = 0 and $V_I \leq V_{CC}$	0 to 3.8	V
Output current	Continuous	50	mA
	Surge	100	
Operating temperature range		–40 to 85	°C
Storage temperature range		–65 to 150	°C

## POWER DISSIPATION RATINGS

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

## THERMAL CHARACTERISTICS

PARAMETER		PACKAGE	VALUE	UNIT
$\theta_{JB}$	Junction-to Board Thermal Resistance	SOIC	79	°C/W
		MSOP	120	
$\theta_{JC}$	Junction-to Case Thermal Resistance	SOIC	98	°C/W
		MSOP	74	

## KEY ATTRIBUTES

CHARACTERISTICS	VALUE
Moisture sensitivity level	Level 1
Flammability rating (Oxygen Index: 28 to 34)	UL 94 V-0 at 0.125 in
ESD-HBM	2 kV
ESD-machine model	200 V
ESD-charge device model	2 kV
Internal pull down resistor	50 k $\Omega$
Internal pull up resistor	50 k $\Omega$
Meets or exceeds JEDEC Spec EIA/JESD78 latchup test	

**LVTTTL OUTPUT DC CHARACTERISTICS<sup>(1)</sup> ( $V_{CC} = 3.3\text{ V}$ ;  $GND = 0\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$ )<sup>(2)</sup>**

PARAMETER	CONDITION	-40°C			25°C			85°C			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$I_{OS}$	Output short circuit current	-180	-140	-50	-180	-144	-50	-180	-148	-50	mA
$V_{OH}$	Output high voltage <sup>(3)</sup>	$I_{OH} = -3.0\text{ mA}$			2.4			2.4			V
$V_{OL}$	Output low voltage	$I_{OL} = 24\text{ mA}$			0.5			0.5			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 lfm. 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) All values vary 1:1 with  $V_{CC}$ ;  $V_{CC}$  can vary  $\pm 0.3\text{ V}$
- (3) LVTTTL output  $R_L = 500\ \Omega$  to GND

**LVPECL INPUT DC CHARACTERISTICS<sup>(1)</sup> ( $V_{CC} = 3.3\text{ V}$ ;  $GND = 0.0\text{ V}$ )<sup>(2)</sup>**

PARAMETER		-40°C			25°C			85°C			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$I_{CCH}$	Power supply current (Outputs set to high)	15 25			15 25			15 25			mA
$I_{CCL}$	Power supply current (Outputs set to low)	15 25			15 25			15 25			mA
$V_{IH}$	Input high voltage	2075 2420			2075 2420			2075 2420			mV
$V_{IL}$	Input low voltage	1355 1675			1355 1675			1355 1675			mV
$V_{IHCMR}$	Input high voltage common mode range (Differential) <sup>(3)</sup>	1.2 3.3			1.2 3.3			1.2 3.3			V
$I_{IH}$	Input high current	150			150			150			$\mu\text{A}$
$I_{IL}$	Input low current	-150			-150			-150 0.5			$\mu\text{A}$

- (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 lfm. 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) Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{CC}$  can vary  $\pm 0.3\text{ V}$ .
- (3)  $V_{IHCMR}$  min varies 1:1 with GND,  $V_{IHCMR}$  max varies 1:1 with  $V_{CC}$ .  $V_{IHCMR}$  is referenced to most positive side of differential signal

**AC CHARACTERISTICS<sup>(1)</sup> ( $V_{CC} = 3.0\text{ V}$  to  $3.6\text{ V}$ ;  $GND = 0.0\text{ V}$ )<sup>(2)</sup> <sup>(3)</sup>**

PARAMETER		-40°C			25°C			85°C			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$f_{MAX}$	Max switching frequency <sup>(4)</sup> (Figure 1–Figure 3)	300			300			300			MHz
$t_{PLH} / t_{PHL}$	Propagation delay low to high; output at 1.5V	1.1	1.3	1.9	1.1	1.3	1.9	1.1	1.3	1.9	ns
$T_{SK++}$	Output to output skew++	110			110			110			ps
$T_{SK-}$	Output to output skew- -	110			110			110			ps
$T_{SKPP}$	Part to part skew <sup>(5)</sup>	400			400			400			ps
$t_{JITTER}$	Random clock jitter (RMS) <sup>(6)</sup>	10			10			10			ps
$V_{PP}$	Input voltage swing <sup>(7)</sup>	150 1200			150 1200			150 1200			mV
$t_r / t_f$	Output rise/fall times (0.8 V – 2.0 V)	250	560	800	250	580	800	250	600	800	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 lfm. 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) Input parameters vary 1:1 with  $V_{CC}$ .  $V_{CC}$  can vary  $\pm 0.3\text{ V}$ .
- (3) TTL output  $R_L = 500\ \Omega$  to GND and  $C_L = 20\text{ pF}$  to GND see Figure 4.
- (4)  $F_{max}$  assures for functionality only;  $V_{OL}$  and  $V_{OH}$  levels are assured at DC only
- (5) Skews are measured between outputs under identical conditions.
- (6) Measured with  $V_{ID} = 1.5\text{ V}_{PP}$  at  $V_{CM} = 2.0\text{ V}$  and  $1.2\text{ V}$
- (7) 200 mV input assured full logic swing at the output.

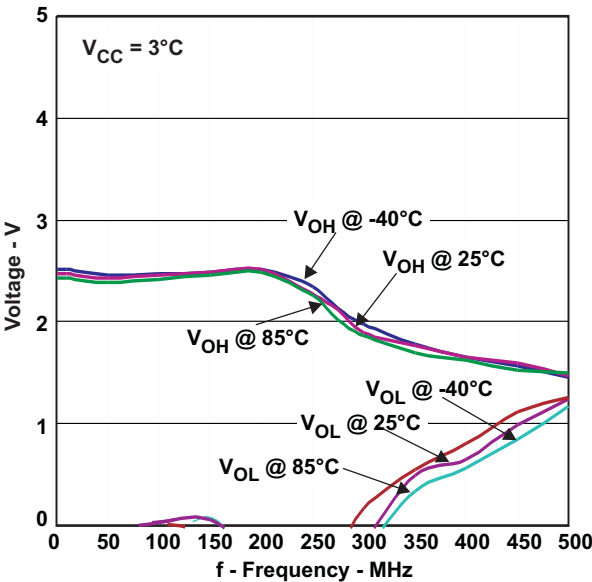


Figure 1. Maximum Switching Frequency  $V_{CC} = 3.0\text{ V}$

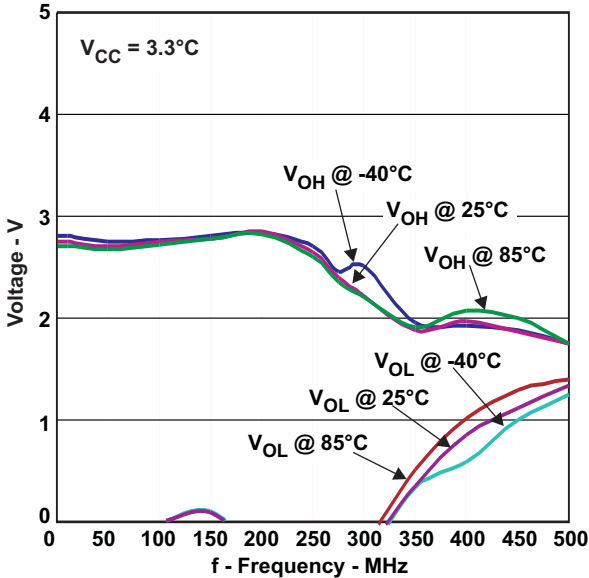


Figure 2. Maximum Switching Frequency  $V_{CC} = 3.3\text{ V}$

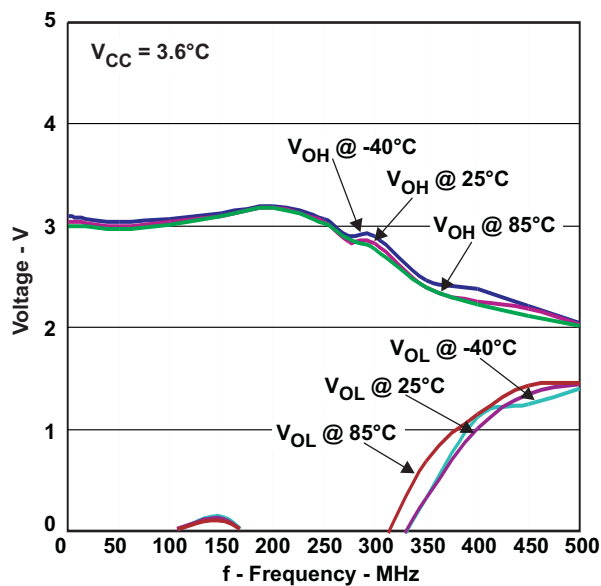


Figure 3. Maximum Switching Frequency  $V_{CC} = 3.6\text{ V}$

### Typical Output Loading Used for Device Evaluation

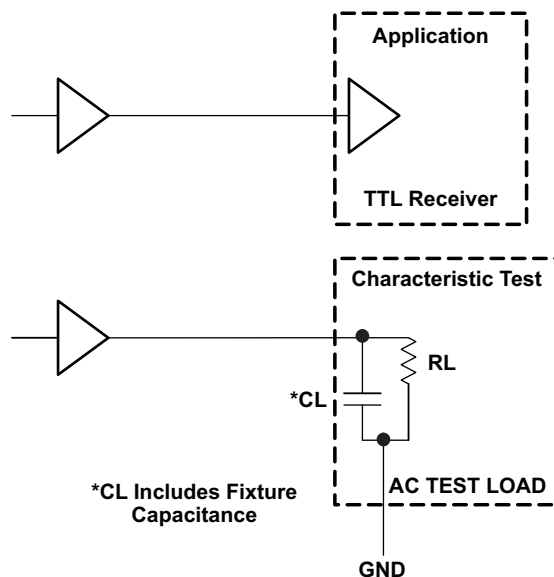


Figure 4. TTL Output Loading Used for Device Evaluation

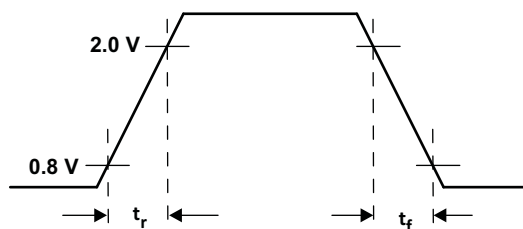


Figure 5. Output Rise and Fall Times

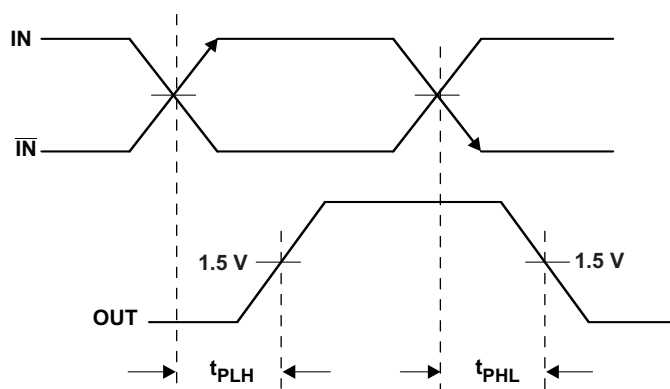


Figure 6. Output Propagation Delay

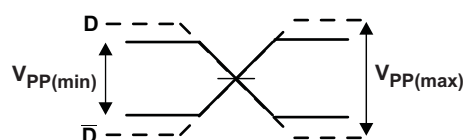


Figure 7. Input Voltage Swing

## PACKAGING INFORMATION

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SN65EPT23D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65EPT23DGK	ACTIVE	MSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65EPT23DGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65EPT23DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

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**TAPE AND REEL INFORMATION**



\*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
SN65EPT23DGKR	MSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
SN65EPT23DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1



## TAPE AND REEL BOX DIMENSIONS

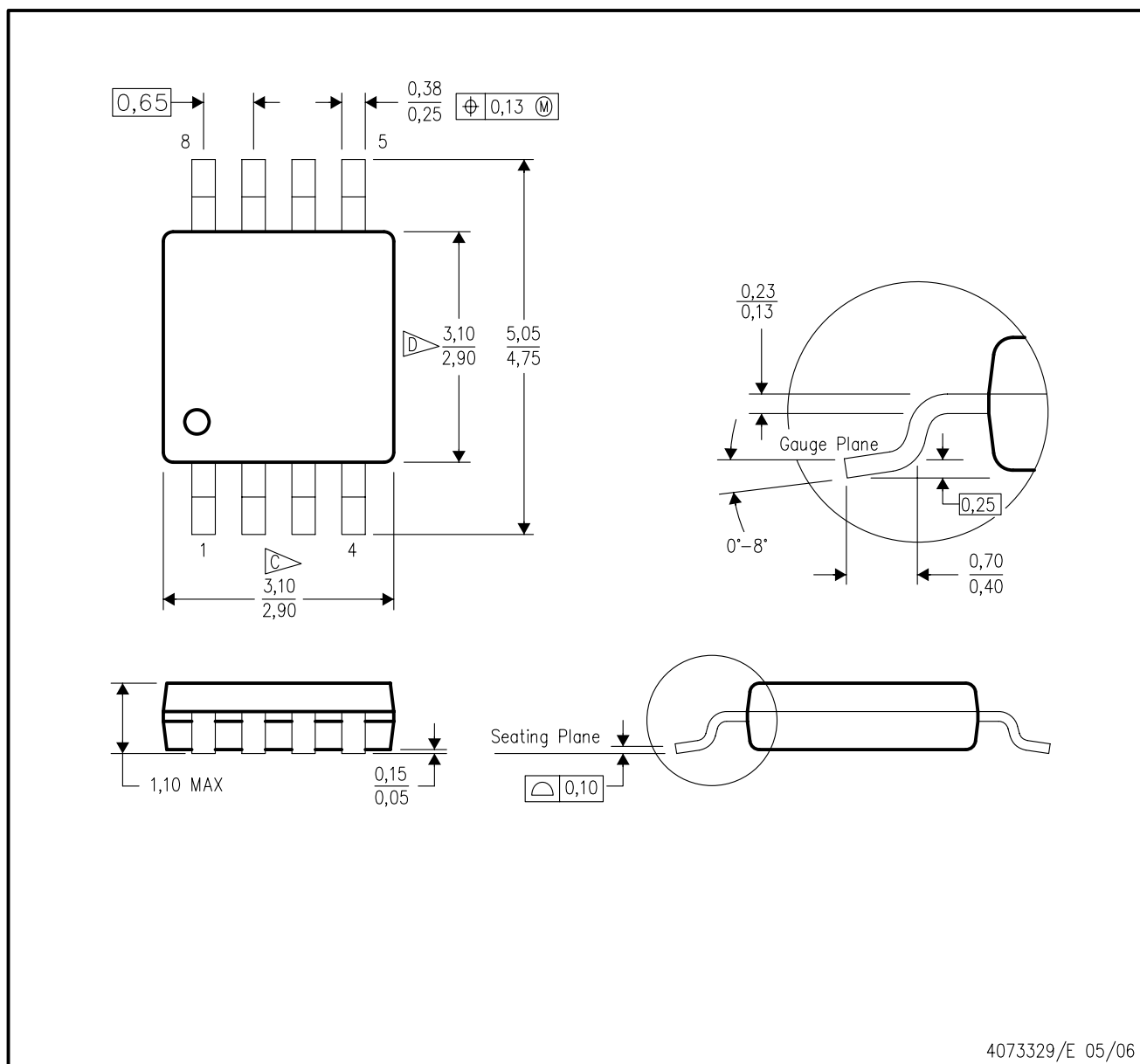


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65EPT23DGKR	MSOP	DGK	8	2500	346.0	346.0	29.0
SN65EPT23DR	SOIC	D	8	2500	346.0	346.0	29.0

## DGK (S-PDSO-G8)

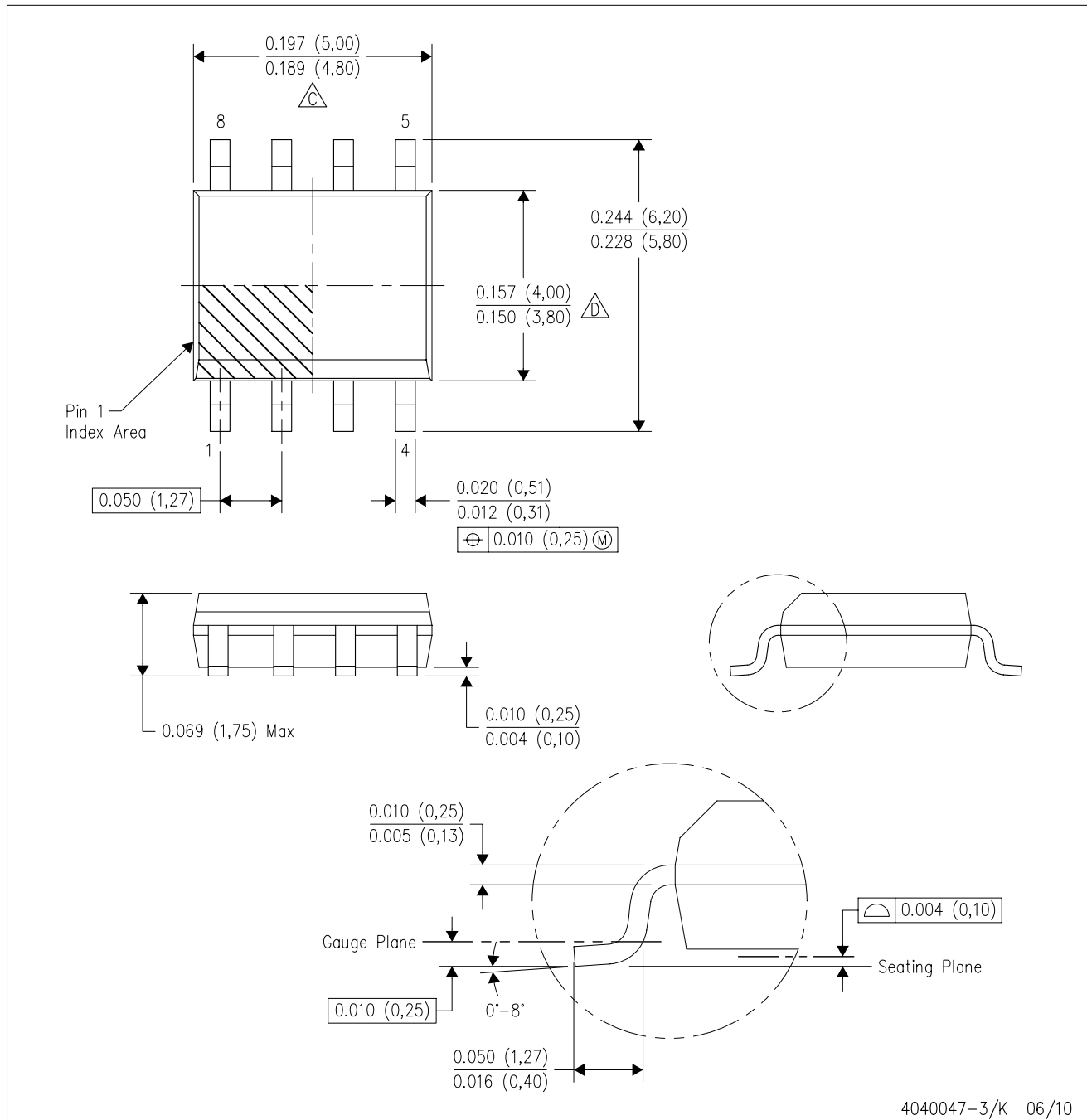
## PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in 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 0.15 per end.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
  - E. Falls within JEDEC MO-187 variation AA, except interlead flash.

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE

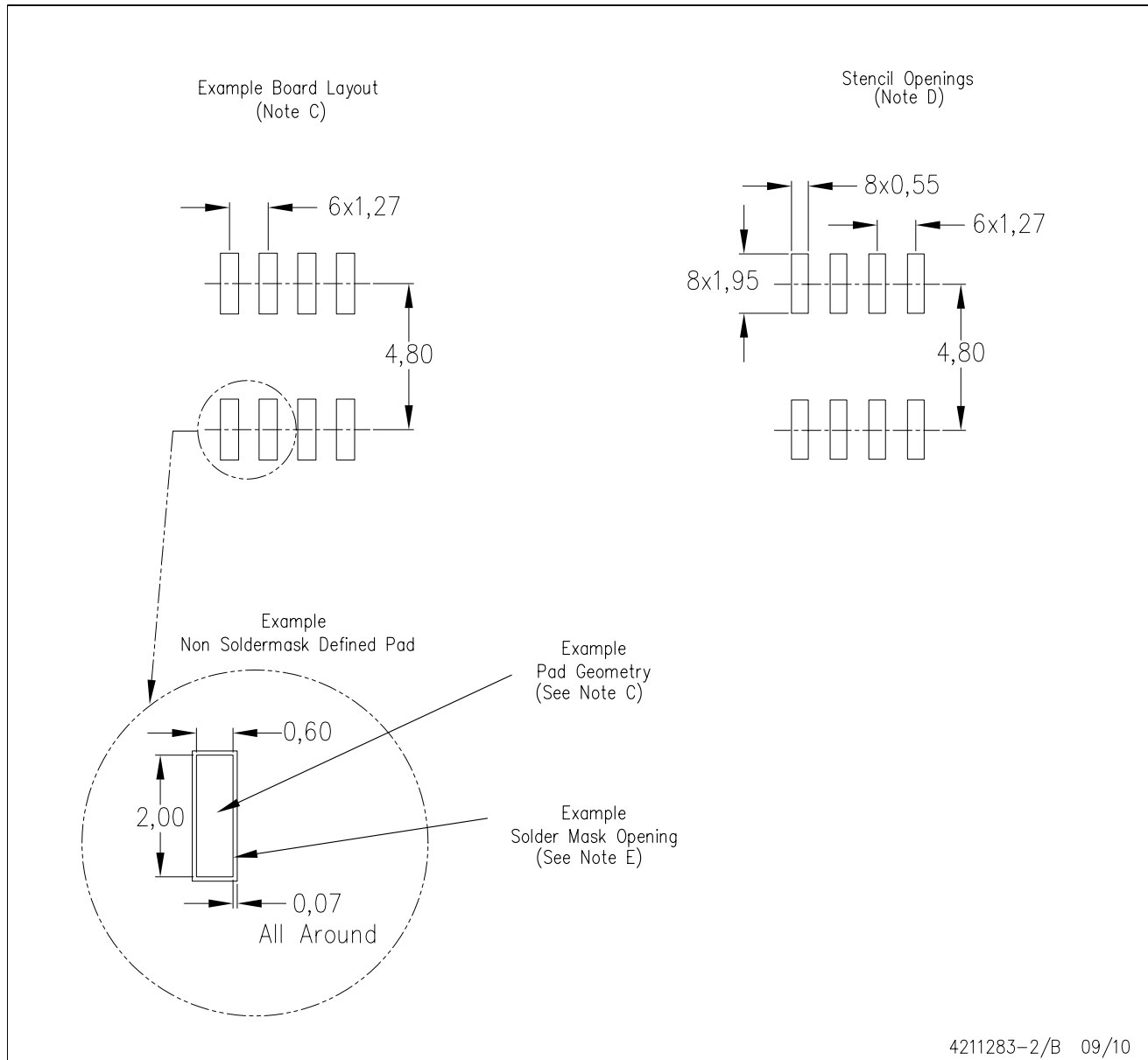


NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
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- $\triangle D$  Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
- E. Reference JEDEC MS-012 variation AA.

D (R-PDSO-G8)

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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RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>	Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
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