3.3V ECL Differential LVPECL/LVDS to LVTTL/LVCMOS Translator

Check for Samples: SN65EPT23

FEATURES

- **Dual 3.3 V Differential LVPECL/LVDS to LVTTL/LVCMOS Buffer Translator**
- **24 mA LVTTL Ouputs**
- **Operating Range**
  - **V_{CC} = 3.0 V to 3.6 V**
  - **GND = 0 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 LVTTL/LVCMOS translator device. The device includes circuitry to maintain inputs at Vcc/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

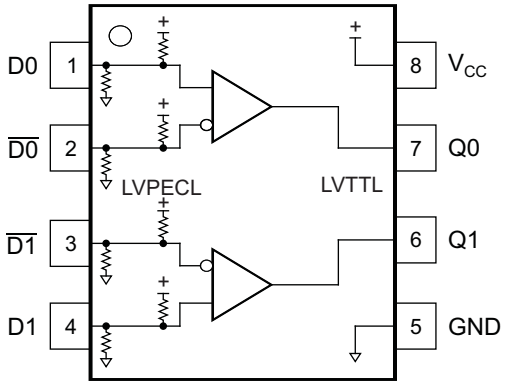

Table 1. Pin Description

PIN	FUNCTION
Q_0, Q_1	LVTTL/LVCMOS Outputs
D_0, $\overline{D}_0$, D_1, $\overline{D}_1$	Differential LVPECL/LVDS/CML Inputs
V_{CC}	Positive Supply
GND	Ground

ORDERING INFORMATION(1)

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

(1) Leaded device option not initially available; contact TI sales representative for further information.

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.

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

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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 Vi ≤ 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°C (mW)	THERMAL RESISTANCE, JUNCTION TO AMBIENT NO AIRFLOW	DERATING FACTOR T_A > 25°C (mW/°C)	POWER RATING T_A = 85°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
θ_{JB}	Junction-to Board Thermal Resistance	SOIC	79	°C/W
		MSOP	120	
θ_{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 kΩ
Internal pull up resistor	50 kΩ
Meets or exceeds JEDEC Spec EIA/JESD78 latchup test	

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LVTTL OUTPUT DC CHARACTERISTICS[1] (V_{CC} = 3.3 V; GND = 0 V, TA = -40C to 85C)[2]

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[3]	I_{OH} = –3.0 mA	2.4			2.4			2.4			V
V_{OL}	Output low voltage	I_{OL} = 24 mA			0.5			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 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) All values vary 1:1 with Vcc; Vcc can vary ±0.3V
(3) LVTTL output R_L = 500 Ω to GND

LVPECL INPUT DC CHARACTERISTICS[1] (V_{CC} = 3.3 V; GND = 0.0 V)[2]

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) [3]		1.2		3.3	1.2		3.3	1.2		3.3	V
I_{IH}	Input high current				150			150			150	µA
I_{IL}	Input low current	D	–150			–150			–150		0.5	µA
		$\overline{D}$										

(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) Input and output parameters vary 1:1 with V_{CC}. V_{CC} can vary ±0.3 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[1] (V_{CC} = 3.0 V to 3.6 V; GND = 0.0 V)[2] [3]

PARAMETER		–40°C			25°C			85°C			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
f_{MAX}	Max switching frequency[4] (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 [5]			400			400			400	ps
t_{JITTER}	Random clock jitter (RMS)[6]			10			10			10	ps
V_{PP}	Input voltage swing [7]	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 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) Input parameters vary 1:1 with V_{CC}. V_{CC} can vary ±0.3V .
(3) TTL output R_L = 500 Ω to GND and C_L = 20 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 V_{PP} at V_{CM} = 2.0 V and 1.2 V
(7) 200 mV input assured full logic swing at the output.

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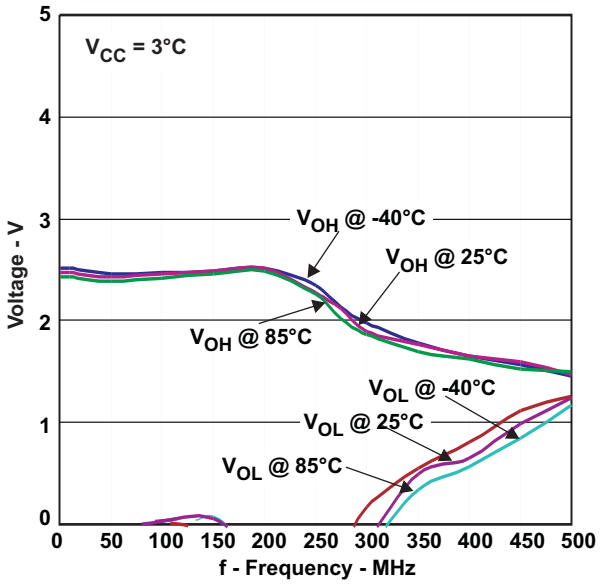

Figure 1. Maximum Switching Frequency V_{CC} = 3.0 V

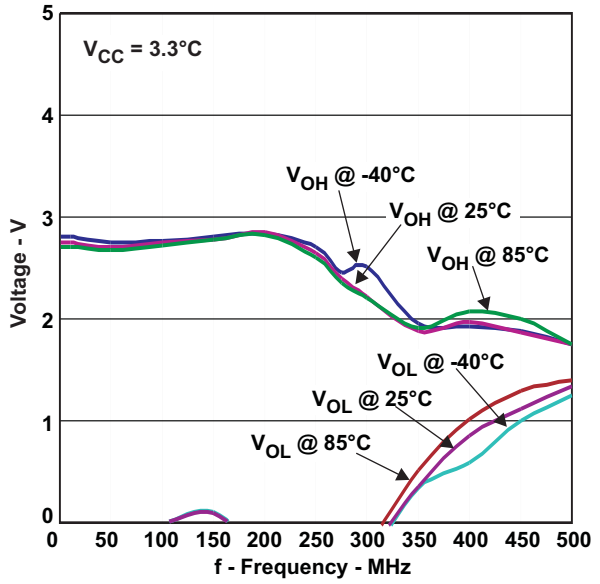

Figure 2. Maximum Switching Frequency V_{CC} = 3.3 V

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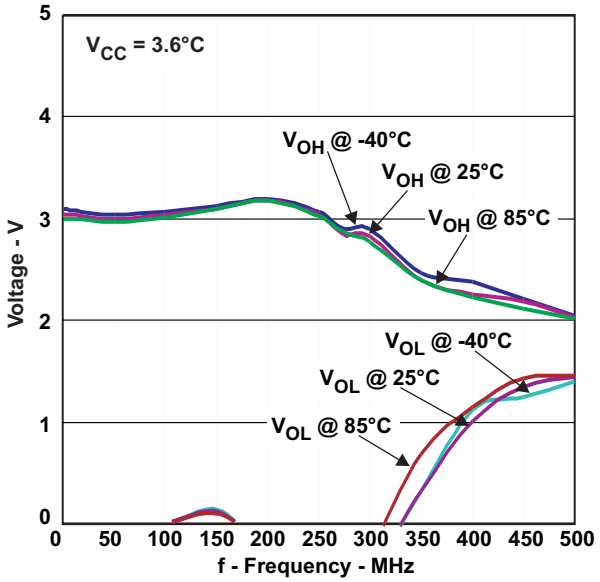

Figure 3. Maximum Switching Frequency V_{CC} = 3.6 V

Typical Output Loading Used for Device Evaluation

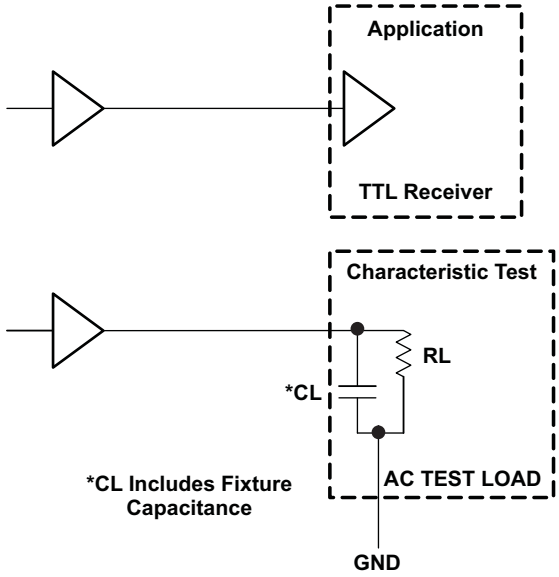

Figure 4. TTL Output Loading Used for Device Evaluation

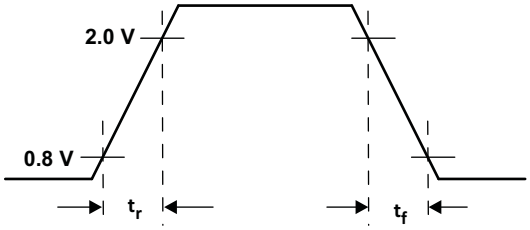

Figure 5. Output Rise and Fall Times

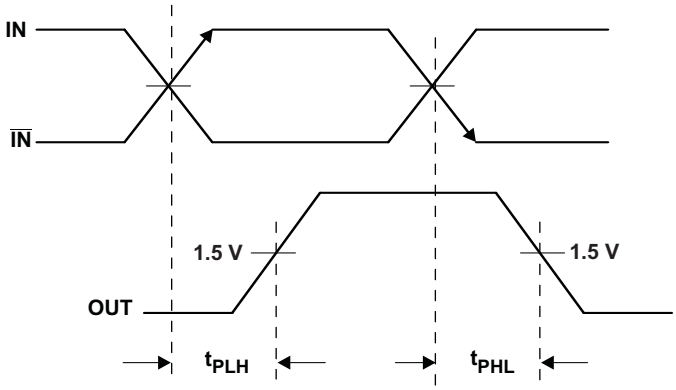

Figure 6. Output Propagation Delay

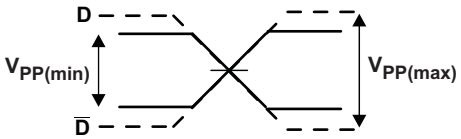

Figure 7. Input Voltage Swing

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REVISION HISTORY

Changes from Original (November 2009) to Revision A	Page
• Deleted last row from the Pin Description Table (EP)	1

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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
SN65EPT23D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 85	EPT23	Samples
SN65EPT23DGK	ACTIVE	VSSOP	DGK	8	80	Green (RoHS & no Sb/Br)	NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	SSTI	Samples
SN65EPT23DGKR	ACTIVE	VSSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	SSTI	Samples
SN65EPT23DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 85	EPT23	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/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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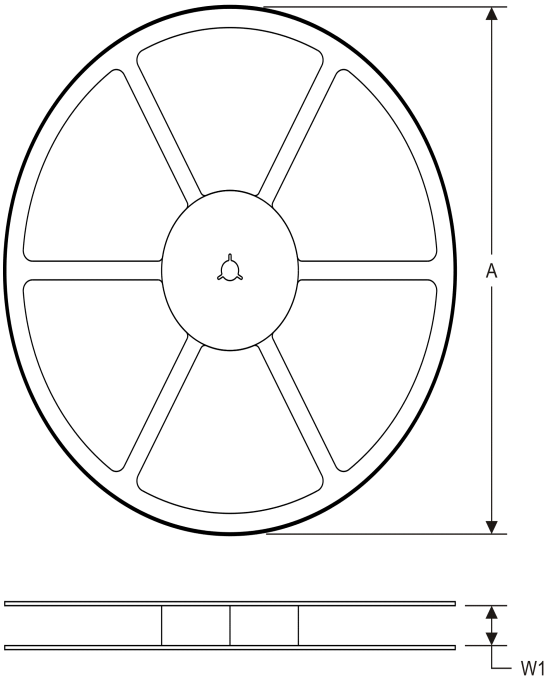
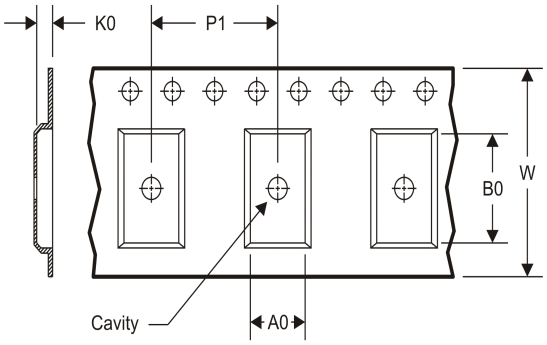
TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



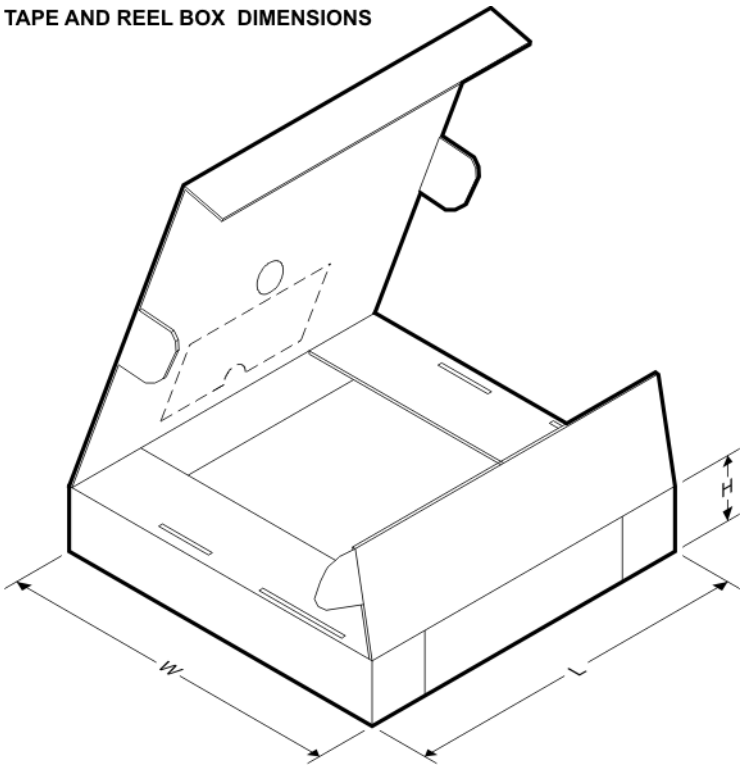
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

TAPE AND REEL INFORMATION

*All dimensions are nominal

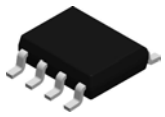
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN65EPT23DGKR	VSSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
SN65EPT23DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65EPT23DGKR	VSSOP	DGK	8	2500	367.0	367.0	35.0
SN65EPT23DR	SOIC	D	8	2500	367.0	367.0	35.0

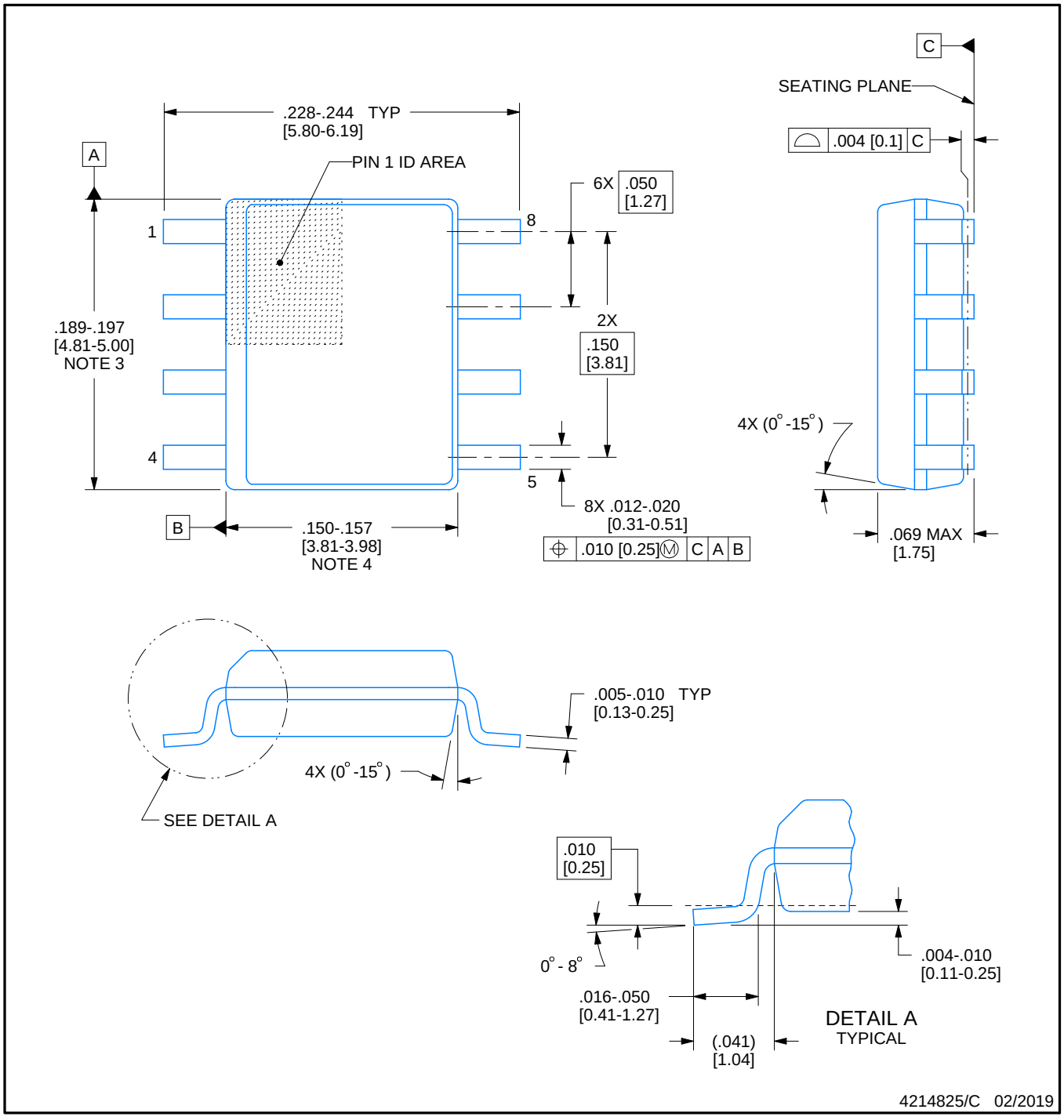


PACKAGE OUTLINE

D0008A

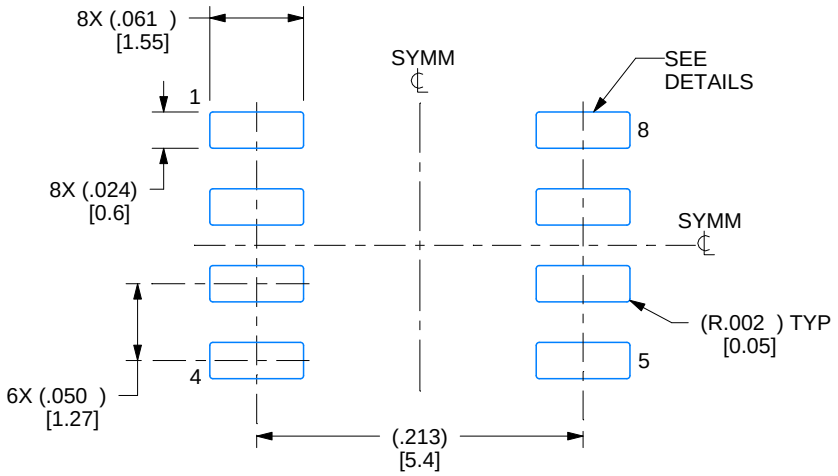
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

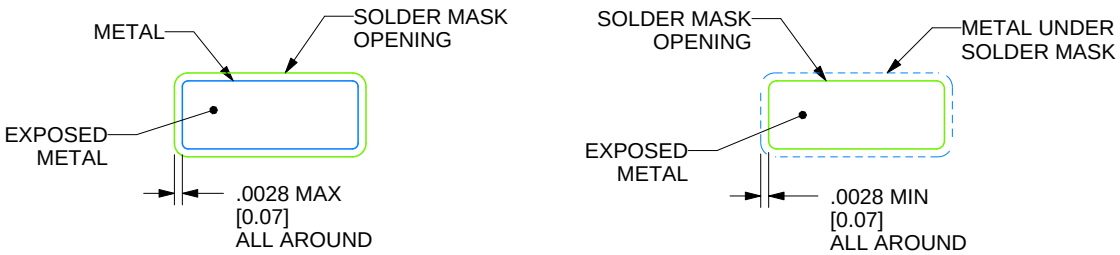


NOTES:

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)

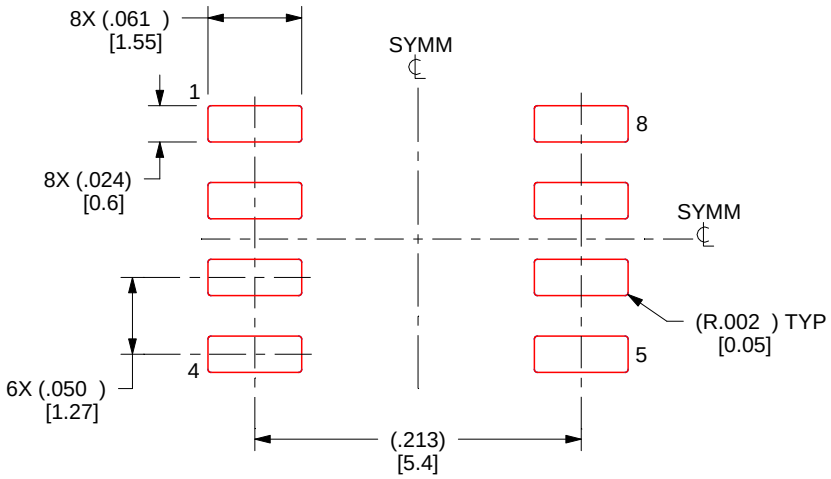
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



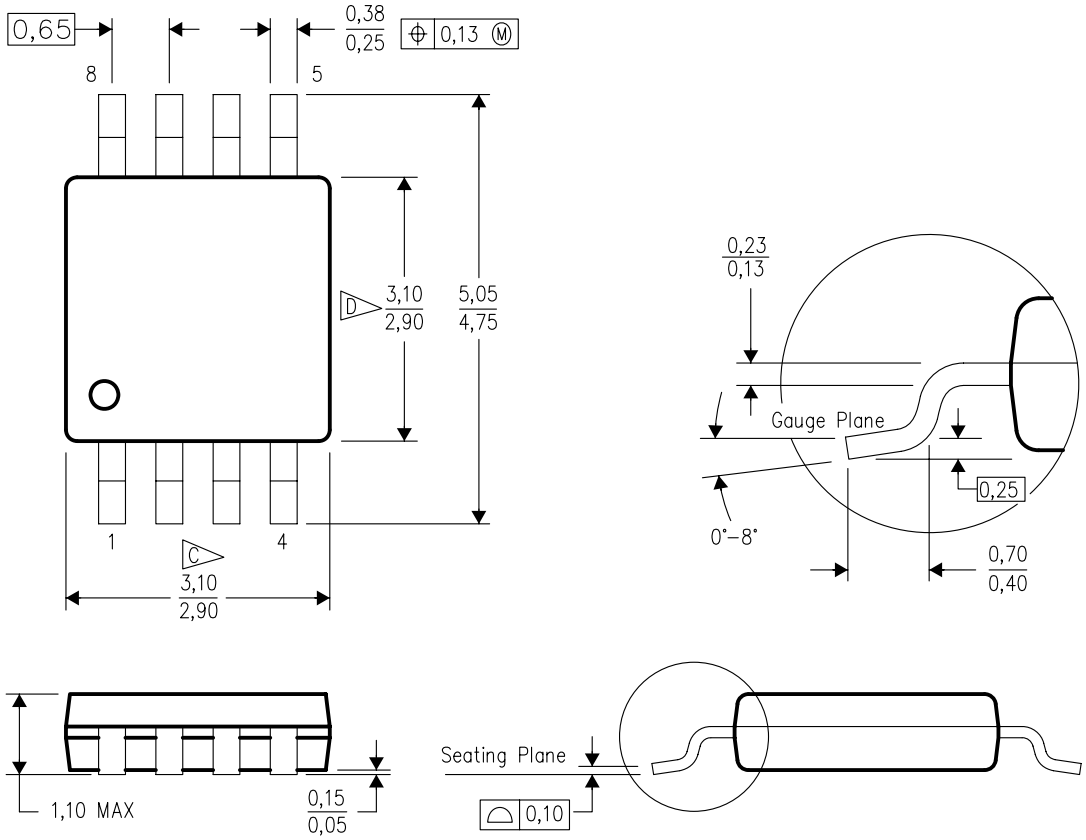
SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

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.

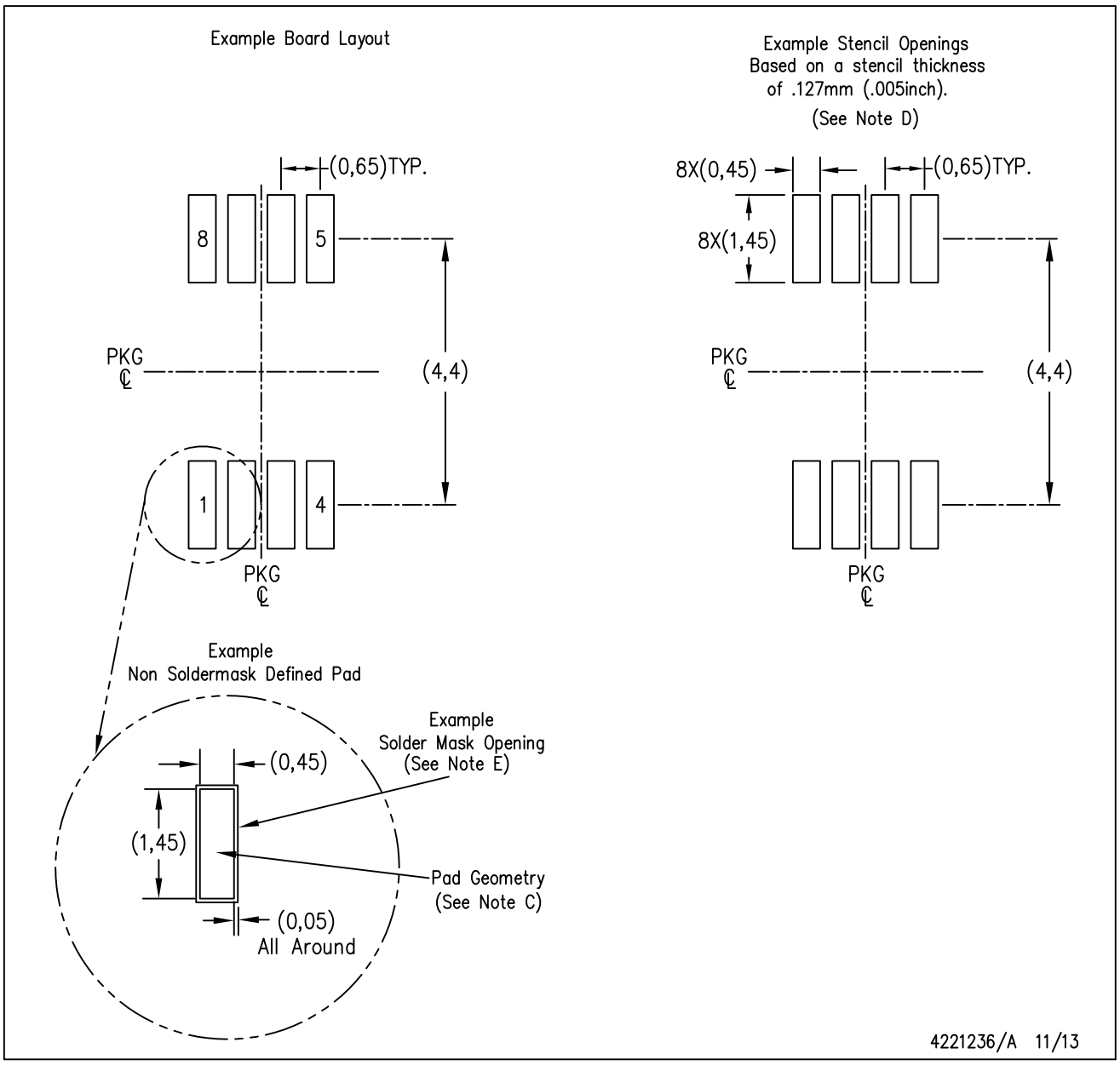
DGK (S–PDSO–G8) PLASTIC SMALL–OUTLINE PACKAGE



4073329/E 05/06

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.

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. 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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