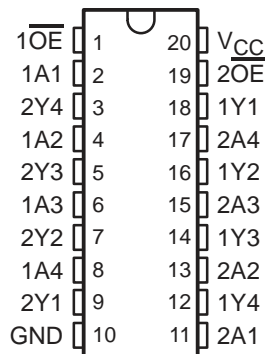


# SN74HC244-EP OCTAL BUFFER AND LINE DRIVER WITH 3-STATE OUTPUTS

SCLS463A – JULY 2002 – REVISED JANUARY 2004

- **Controlled Baseline**
  - One Assembly/Test Site, One Fabrication Site
- **Extended Temperature Performance of Up To  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product-Change Notification**
- **Qualification Pedigree†**
- **3-State Outputs Drive Bus Lines or Buffer Memory Address Registers**
- **High-Current Outputs Drive Up To 15 LSTTL Loads**

DW OR PW PACKAGE  
(TOP VIEW)



† Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life.

## description/ordering information

This octal buffer and line driver is designed specifically to improve both the performance and density of 3-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters. The SN74HC244 is organized as two 4-bit buffers/drivers with separate output-enable ( $\overline{\text{OE}}$ ) inputs. When  $\overline{\text{OE}}$  is low, the device passes noninverted data from the A inputs to the Y outputs. When  $\overline{\text{OE}}$  is high, the outputs are in the high-impedance state.

## ORDERING INFORMATION

TA	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 125°C	SOP – DW	Tape and reel	SN74HC244QDWREP	SHC244EP
	TSSOP – PW	Tape and reel	SN74HC244QPWREP	SHC244EP
–55°C to 125°C	SOP – DW	Tape and reel	SN74HC244MDWREP	HC244MEP

‡ Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

FUNCTION TABLE  
(each buffer/driver)

INPUTS		OUTPUT
$\overline{\text{OE}}$	A	Y
L	H	H
L	L	L
H	X	Z



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 Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
INSTRUMENTS**

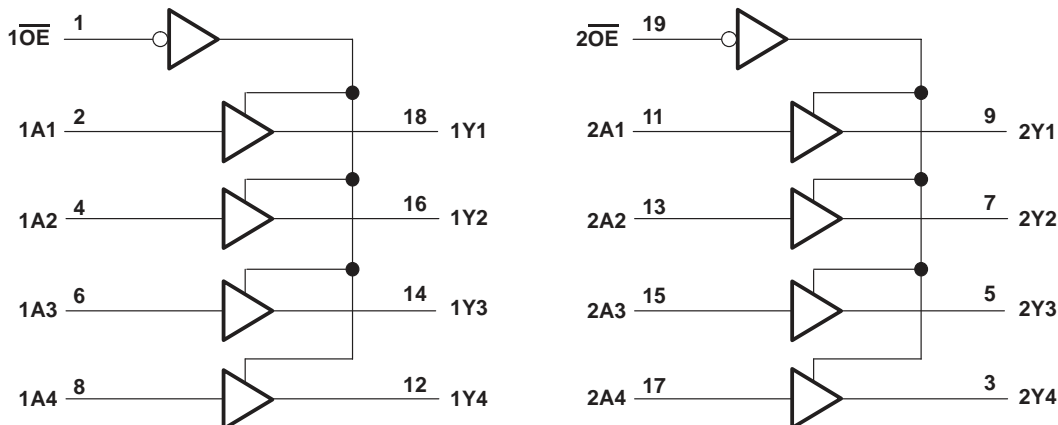
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# SN74HC244-EP OCTAL BUFFER AND LINE DRIVER WITH 3-STATE OUTPUTS

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## logic diagram (positive logic)



## absolute maximum ratings over operating free-air temperature range†

Supply voltage range, $V_{CC}$	-0.5 V to 7 V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) (see Note 1)	$\pm 20$ mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1)	$\pm 20$ mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )	$\pm 35$ mA
Continuous current through $V_{CC}$ or GND	$\pm 70$ mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): DW package	58°C/W
PW package	83°C/W
Storage temperature range, $T_{stg}$	-65°C to 150°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. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The package thermal impedance is calculated in accordance with JESD 51-7.

## recommended operating conditions

		MIN	NOM	MAX	UNIT
$V_{CC}$	Supply voltage	2	5	6	V
$V_{IH}$	High-level input voltage	$V_{CC} = 2$ V	1.5		V
		$V_{CC} = 4.5$ V	3.15		
		$V_{CC} = 6$ V	4.2		
$V_{IL}$	Low-level input voltage	$V_{CC} = 2$ V	0	0.5	V
		$V_{CC} = 4.5$ V	0	1.35	
		$V_{CC} = 6$ V	0	1.8	
$V_I$	Input voltage	0		$V_{CC}$	V
$V_O$	Output voltage	0		$V_{CC}$	V
$t_t$	Input transition (rise and fall) time	$V_{CC} = 2$ V	0	1000	ns
		$V_{CC} = 4.5$ V	0	500	
		$V_{CC} = 6$ V	0	400	
$T_A$	Operating free-air temperature	Q-suffix device	-40	125	°C
		M-suffix device	-55	125	



**SN74HC244-EP**  
**OCTAL BUFFER AND LINE DRIVER**  
**WITH 3-STATE OUTPUTS**

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS		V <sub>CC</sub>	T <sub>A</sub> = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
V <sub>OH</sub>	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -20 μA	2 V	1.9	1.998		1.9	V	
			4.5 V	4.4	4.499		4.4		
			6 V	5.9	5.999		5.9		
		I <sub>OH</sub> = -6 mA	4.5 V	3.98	4.3		3.7		
		I <sub>OH</sub> = -7.8 mA	6 V	5.48	5.8		5.2		
V <sub>OL</sub>	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 20 μA	2 V		0.002	0.1		0.1	
			4.5 V		0.001	0.1		0.1	
			6 V		0.001	0.1		0.1	
		I <sub>OL</sub> = 6 mA	4.5 V		0.17	0.26		0.4	
		I <sub>OL</sub> = 7.8 mA	6 V		0.15	0.26		0.4	
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or 0		6 V		±0.1	±100		±1000	nA
I <sub>OZ</sub>	V <sub>O</sub> = V <sub>CC</sub> or 0,	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	6 V		±0.01	±0.5		±10	μA
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or 0,	I <sub>O</sub> = 0	6 V			8		160	μA
C <sub>i</sub>			2 V to 6 V		3	10		10	pF

switching characteristics over recommended operating free-air temperature range, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub>	T <sub>A</sub> = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
t <sub>pd</sub>	A	Y	2 V		40	115		170	ns
			4.5 V		13	23		34	
			6 V		11	20		29	
t <sub>en</sub>	$\overline{OE}$	Y	2 V		75	150		225	ns
			4.5 V		15	30		45	
			6 V		13	26		38	
t <sub>dis</sub>	$\overline{OE}$	Y	2 V		75	150		225	ns
			4.5 V		15	30		45	
			6 V		13	26		38	
t <sub>t</sub>		Y	2 V		28	60		90	ns
			4.5 V		8	12		18	
			6 V		6	10		15	

**SN74HC244-EP**  
**OCTAL BUFFER AND LINE DRIVER**  
**WITH 3-STATE OUTPUTS**

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switching characteristics over recommended operating free-air temperature range,  $C_L = 150 \text{ pF}$   
(unless otherwise noted) (see Figure 1)

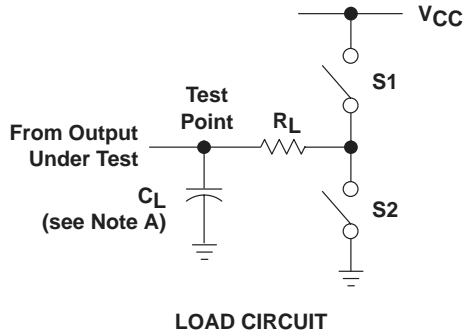
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub>	T <sub>A</sub> = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
t <sub>pd</sub>	A	Y	2 V	56	165		245	ns	
			4.5 V	18	33	49			
			6 V	15	28	42			
t <sub>en</sub>	$\overline{\text{OE}}$	Y	2 V	100	200		300	ns	
			4.5 V	20	40	60			
			6 V	17	34	51			
t <sub>t</sub>		Y	2 V	45	210		315	ns	
			4.5 V	17	42	63			
			6 V	13	36	53			

operating characteristics, T<sub>A</sub> = 25°C

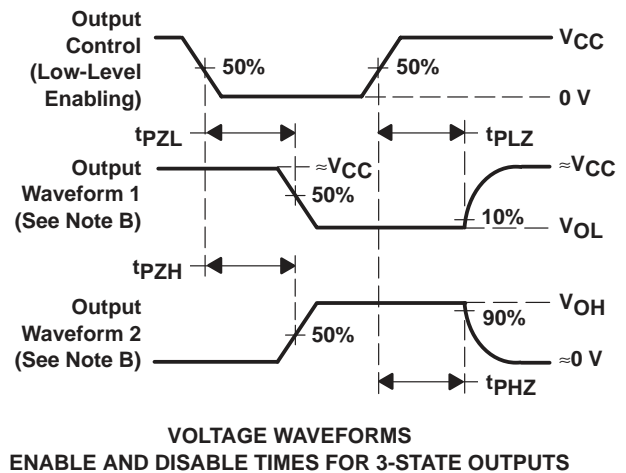
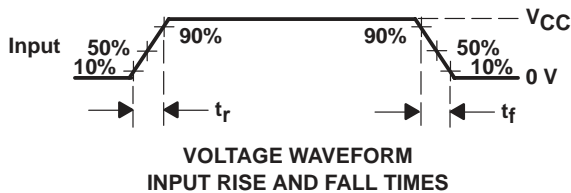
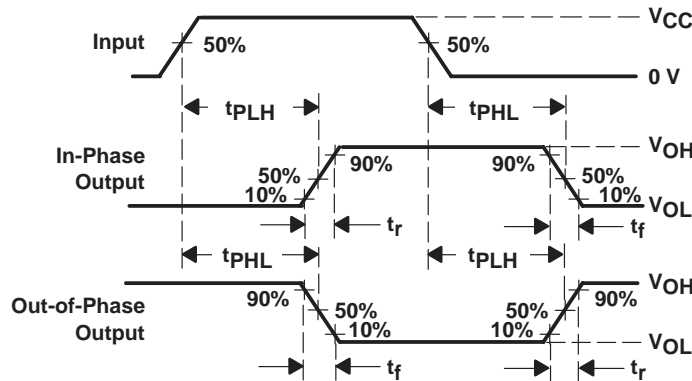
PARAMETER		TEST CONDITIONS	TYP	UNIT
C <sub>pd</sub>	Power dissipation capacitance per buffer/driver	No load	35	pF



**PARAMETER MEASUREMENT INFORMATION**



PARAMETER	$R_L$	$C_L$	S1	S2	
$t_{en}$	$t_{PZH}$	1 k $\Omega$	50 pF or 150 pF	Open	Closed
	$t_{PZL}$			Closed	Open
$t_{dis}$	$t_{PHZ}$	1 k $\Omega$	50 pF	Open	Closed
	$t_{PLZ}$			Closed	Open
$t_{pd}$ or $t_t$	--	50 pF or 150 pF	Open	Open	



- NOTES:
- A.  $C_L$  includes probe and test-fixture capacitance.
  - B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
  - C. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  1 MHz,  $Z_O = 50 \Omega$ ,  $t_r = 6$  ns,  $t_f = 6$  ns.
  - D. The outputs are measured one at a time with one input transition per measurement.
  - E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - G.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

**Figure 1. Load Circuit and Voltage Waveforms**

## 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
SN74HC244MDWREP	ACTIVE	SOIC	DW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC244MEP	<a href="#">Samples</a>
SN74HC244QDWREP	ACTIVE	SOIC	DW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	SHC244EP	<a href="#">Samples</a>
SN74HC244QPWREP	ACTIVE	TSSOP	PW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	SHC244EP	<a href="#">Samples</a>
SN74HC244QPWREPG4	ACTIVE	TSSOP	PW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	SHC244EP	<a href="#">Samples</a>
V62/03607-01XE	ACTIVE	SOIC	DW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC244MEP	<a href="#">Samples</a>
V62/03607-02XE	ACTIVE	SOIC	DW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	SHC244EP	<a href="#">Samples</a>
V62/03607-02YE	ACTIVE	TSSOP	PW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	SHC244EP	<a href="#">Samples</a>

(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.

<sup>(6)</sup> 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.

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**OTHER QUALIFIED VERSIONS OF SN74HC244-EP :**

- Catalog: [SN74HC244](#)
  
- Automotive: [SN74HC244-Q1](#)
  
- Military: [SN54HC244](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
  
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
  
- Military - QML certified for Military and Defense Applications

**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
SN74HC244MDWREP	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1
SN74HC244QDWREP	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1
SN74HC244QPWREP	TSSOP	PW	20	2000	330.0	16.4	6.95	7.1	1.6	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)
SN74HC244MDWREP	SOIC	DW	20	2000	367.0	367.0	45.0
SN74HC244QDWREP	SOIC	DW	20	2000	367.0	367.0	45.0
SN74HC244QPWREP	TSSOP	PW	20	2000	356.0	356.0	35.0

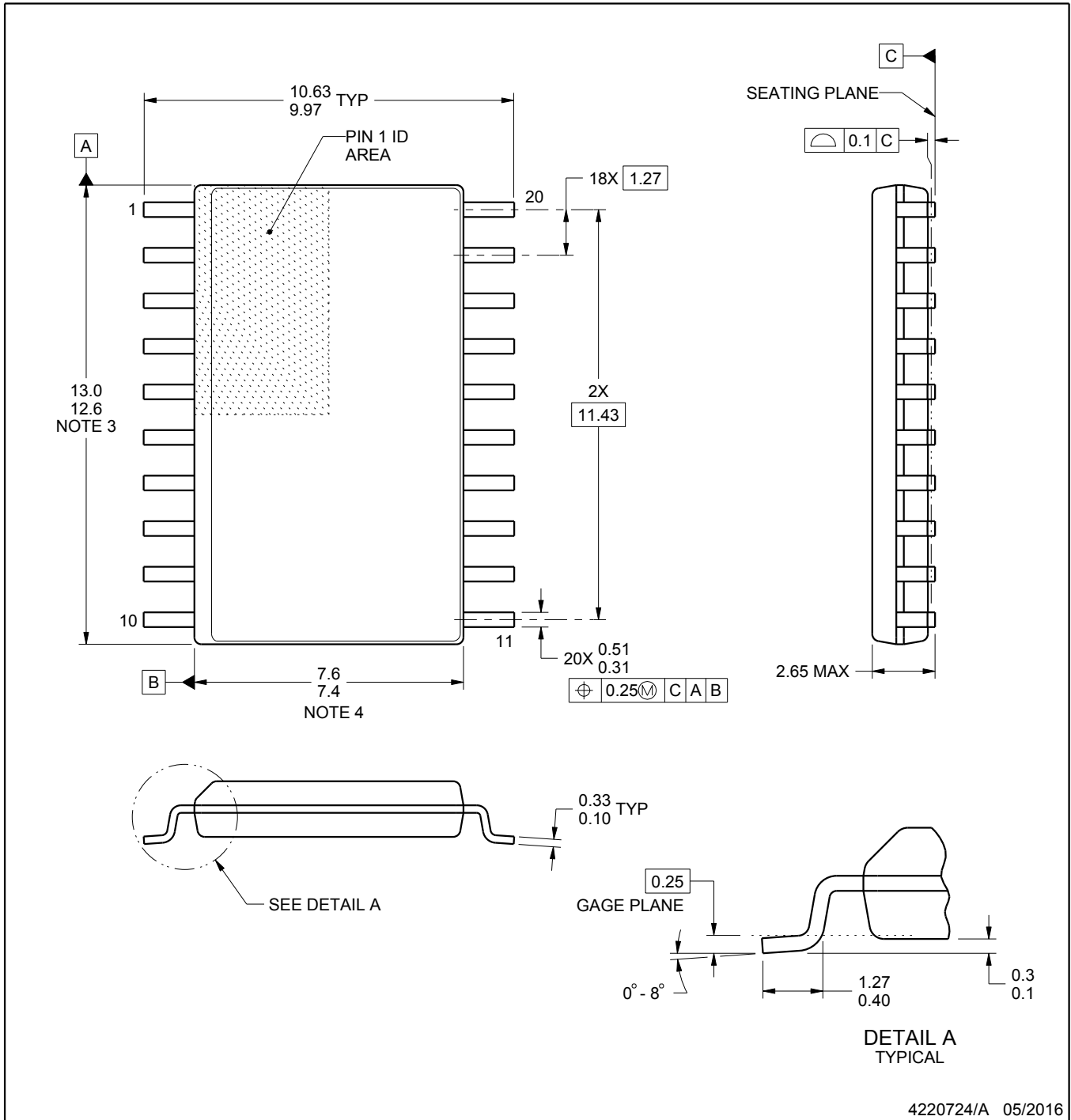
# DW0020A



# PACKAGE OUTLINE

## SOIC - 2.65 mm max height

SOIC



4220724/A 05/2016

**NOTES:**

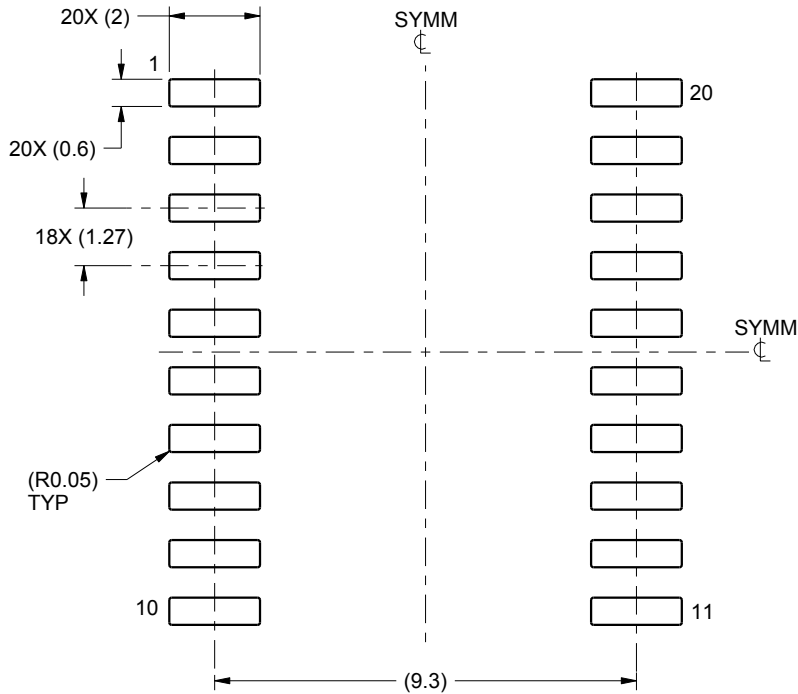
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm per side.
5. Reference JEDEC registration MS-013.

# EXAMPLE BOARD LAYOUT

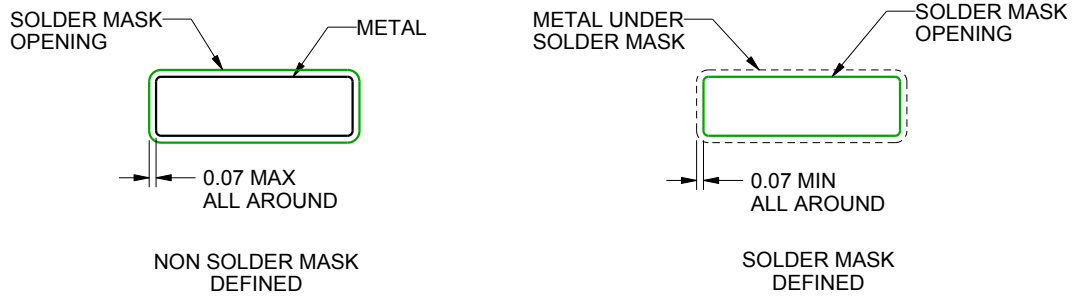
DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

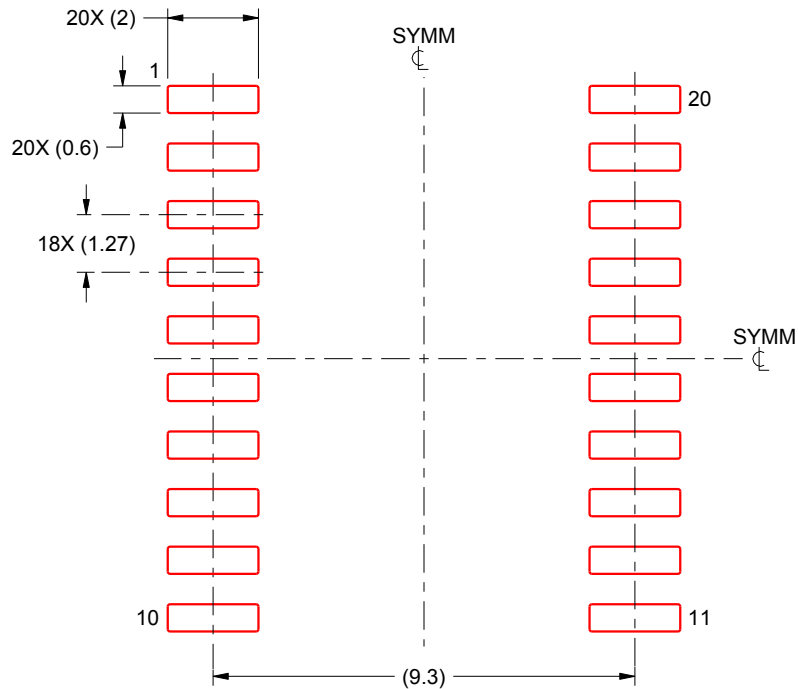
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC

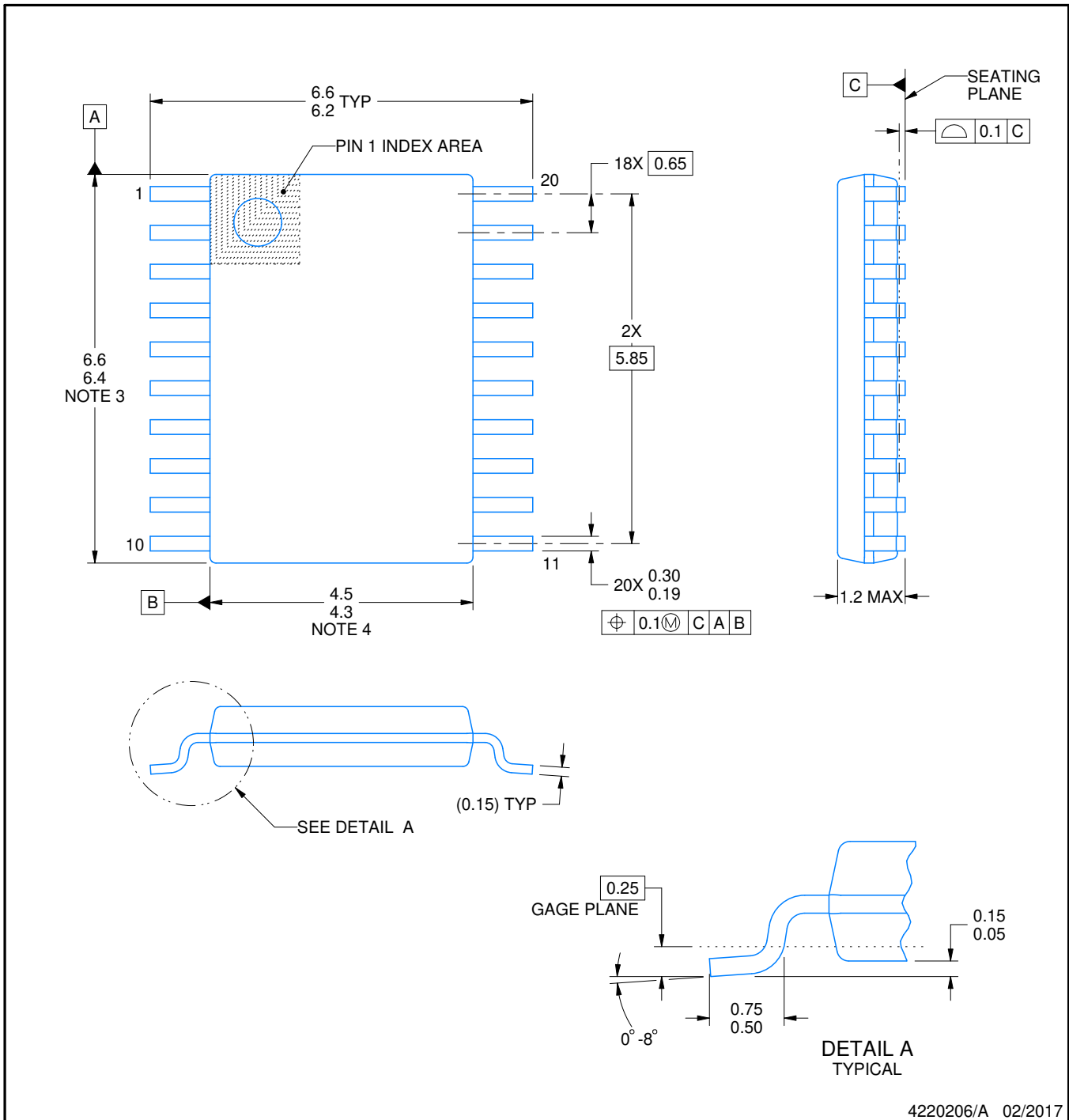


SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:6X

4220724/A 05/2016

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.



4220206/A 02/2017

NOTES:

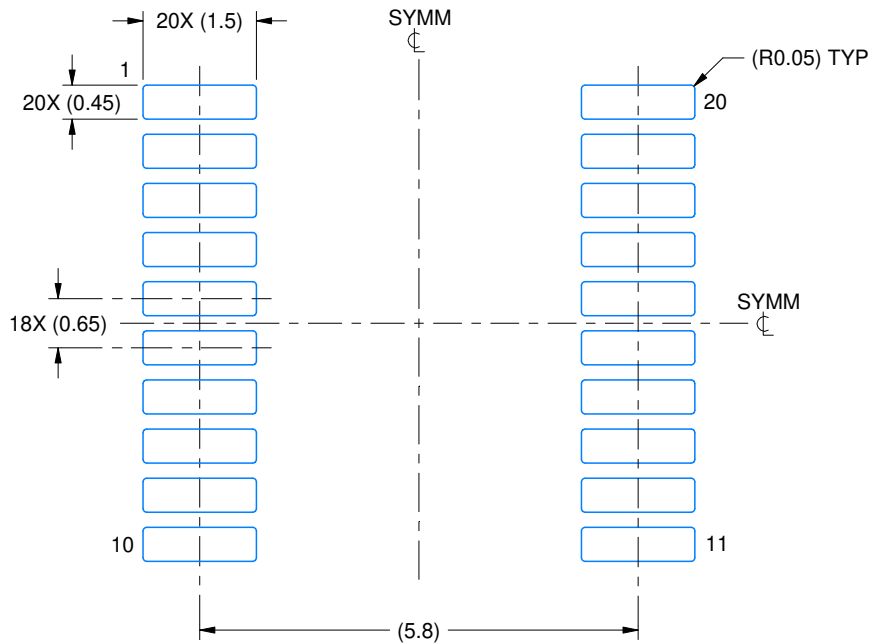
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or 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-153.

# EXAMPLE BOARD LAYOUT

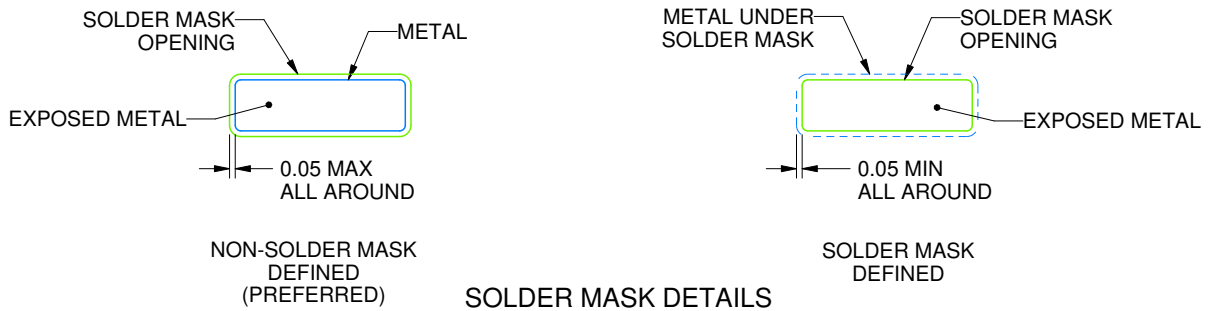
PW0020A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4220206/A 02/2017

NOTES: (continued)

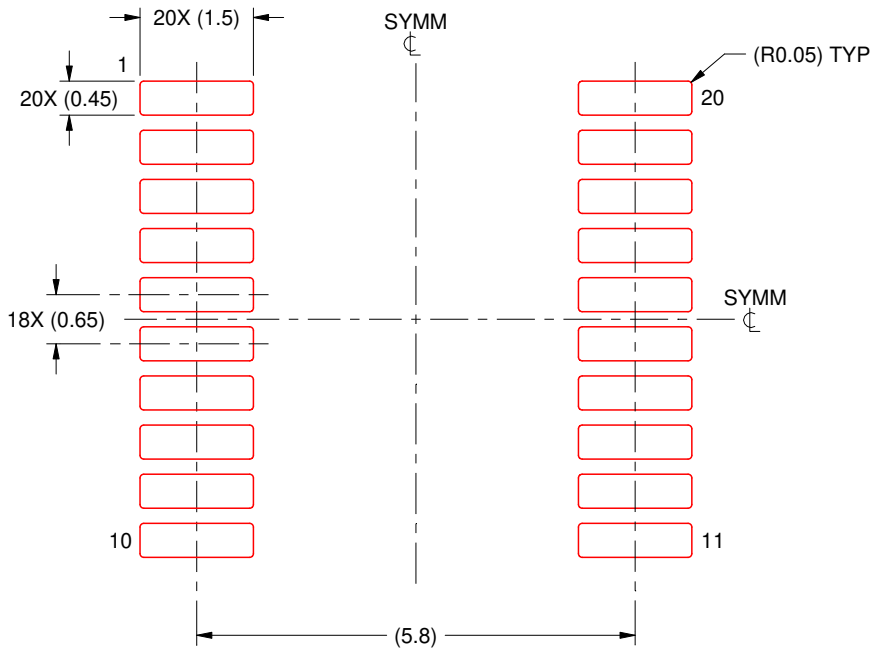
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0020A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

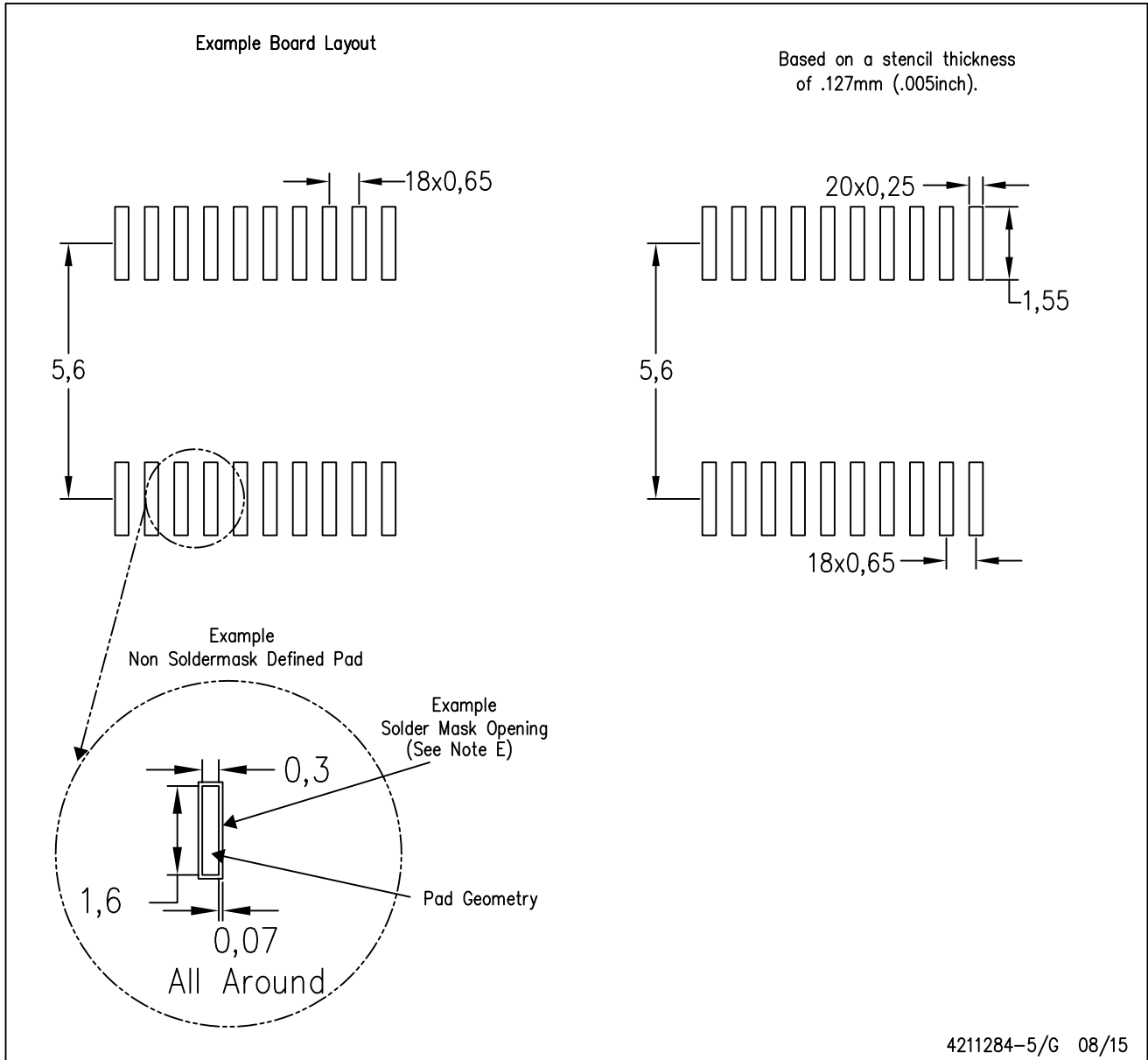
4220206/A 02/2017

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.

PW (R-PDSO-G20)

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 design.
  - 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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