

FEATURES

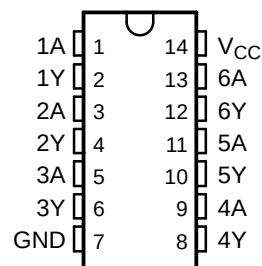
- Operates From 1.65 V to 3.6 V
- Max t_{pd} of 2.8 ns at 3.3 V
- ± 24 -mA Output Drive at 3.3 V
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)

DESCRIPTION/ORDERING INFORMATION

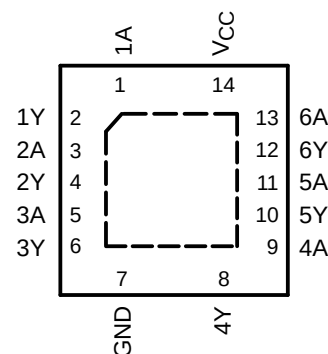
This hex inverter contains six independent inverters designed for 1.65-V to 3.6-V V_{CC} operation.

The SN74ALVC04 performs the Boolean function $Y = \bar{A}$.

**D, DGV, NS, OR PW PACKAGE
(TOP VIEW)**



**RGY PACKAGE
(TOP VIEW)**



ORDERING INFORMATION

T_A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	QFN - RGY	Tape and reel	SN74ALVC04RGYR	VA04
	SOIC - D	Tube	SN74ALVC04D	ALVC04
		Tape and reel	SN74ALVC04DR	
	SOP - NS	Tape and reel	SN74ALVC04NSR	ALVC04
	TSSOP - PW	Tube	SN74ALVC04PW	VA04
		Tape and reel	SN74ALVC04PWR	
	TVSOP - DGV	Tape and reel	SN74ALVC04DGVR	VA04

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

**FUNCTION TABLE
(each inverter)**

INPUT A	OUTPUT Y
H	L
L	H

LOGIC DIAGRAM, EACH INVERTER (POSITIVE LOGIC)



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.

SN74ALVC04 HEX INVERTER

SCES117J–JULY 1997–REVISED JULY 2004

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

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

		MIN	MAX	UNIT
V_{CC}	Supply voltage range	-0.5	4.6	V
V_I	Input voltage range ⁽²⁾	-0.5	4.6	V
V_O	Output voltage range ⁽²⁾⁽³⁾	-0.5	$V_{CC} + 0.5$	V
I_{IK}	Input clamp current	$V_I < 0$	-50	mA
I_{OK}	Output clamp current	$V_O < 0$	-50	mA
I_O	Continuous output current		±50	mA
	Continuous current through V_{CC} or GND		±100	mA
θ_{JA}	Package thermal impedance	D package ⁽⁴⁾	86	°C/W
		DGV package ⁽⁴⁾	127	
		NS package ⁽⁴⁾	76	
		PW package ⁽⁴⁾	113	
		RGY package ⁽⁵⁾	47	
T_{stg}	Storage temperature range	-65	150	°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.
- (2) The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) This value is limited to 4.6 V maximum.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.
- (5) The package thermal impedance is calculated in accordance with JESD 51-5.

RECOMMENDED OPERATING CONDITIONS⁽¹⁾

		MIN	MAX	UNIT
V_{CC}	Supply voltage	1.65	3.6	V
V_{IH}	High-level input voltage	$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	$0.65 \times V_{CC}$	V
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	1.7	
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	2	
V_{IL}	Low-level input voltage	$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	$0.35 \times V_{CC}$	V
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	0.7	
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	0.8	
V_I	Input voltage	0	3.6	V
V_O	Output voltage	0	V_{CC}	V
I_{OH}	High-level output current	$V_{CC} = 1.65 \text{ V}$	-4	mA
		$V_{CC} = 2.3 \text{ V}$	-12	
		$V_{CC} = 2.7 \text{ V}$	-12	
		$V_{CC} = 3 \text{ V}$	-24	
I_{OL}	Low-level output current	$V_{CC} = 1.65 \text{ V}$	4	mA
		$V_{CC} = 2.3 \text{ V}$	12	
		$V_{CC} = 2.7 \text{ V}$	12	
		$V_{CC} = 3 \text{ V}$	24	
$\Delta t/\Delta v$	Input transition rise or fall rate		5	ns/V
T_A	Operating free-air temperature	-40	85	°C

- (1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

ELECTRICAL CHARACTERISTICS

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

PARAMETER	TEST CONDITIONS	V_{CC}	MIN	TYP ⁽¹⁾	MAX	UNIT
V_{OH}	$I_{OH} = -100\ \mu A$	1.65 V to 3.6 V	$V_{CC} - 0.2$			V
	$I_{OH} = -4\ mA$	1.65 V	1.2			
	$I_{OH} = -6\ mA$	2.3 V	2			
	$I_{OH} = -12\ mA$	2.3 V	1.7			
		2.7 V	2.2			
		3 V	2.4			
	$I_{OH} = -24\ mA$	3 V	2			
V_{OL}	$I_{OL} = 100\ \mu A$	1.65 V to 3.6 V			0.2	V
	$I_{OL} = 4\ mA$	1.65 V			0.45	
	$I_{OL} = 6\ mA$	2.3 V			0.4	
	$I_{OL} = 12\ mA$	2.3 V			0.7	
		2.7 V			0.4	
	$I_{OL} = 24\ mA$	3 V			0.55	
I_I	$V_I = V_{CC}$ or GND	3.6 V			± 5	μA
I_{CC}	$V_I = V_{CC}$ or GND, $I_O = 0$	3.6 V			10	μA
ΔI_{CC}	One input at $V_{CC} - 0.6\ V$, Other inputs at V_{CC} or GND	3 V to 3.6 V			750	μA
C_i	$V_I = V_{CC}$ or GND	3.3 V			3.5	pF

(1) All typical values are at $V_{CC} = 3.3\ V$, $T_A = 25^\circ C$.

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 1.8\ V$	$V_{CC} = 2.5\ V$ $\pm 0.2\ V$		$V_{CC} = 2.7\ V$		$V_{CC} = 3.3\ V$ $\pm 0.3\ V$		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	Y	(1)	1	3	3.3		1	2.8	ns

(1) This information was not available at the time of publication.

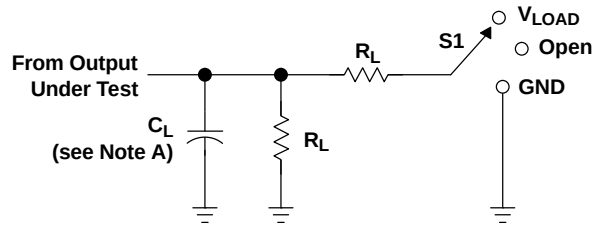
OPERATING CHARACTERISTICS

$T_A = 25^\circ C$

PARAMETER	TEST CONDITIONS	$V_{CC} = 1.8\ V$	$V_{CC} = 2.5\ V$	$V_{CC} = 3.3\ V$	UNIT
		TYP	TYP	TYP	
C_{pd} Power dissipation capacitance per inverter	$C_L = 0$, $f = 10\ MHz$	(1)	23	27.5	pF

(1) This information was not available at the time of publication.

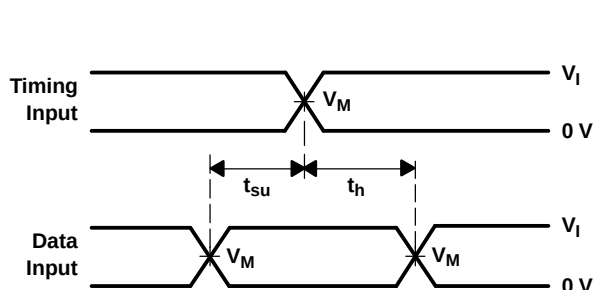
PARAMETER MEASUREMENT INFORMATION



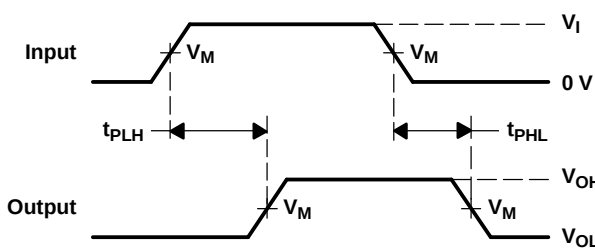
LOAD CIRCUIT

TEST	S1
t_{pd} t_{PLZ}/t_{PZH} t_{PHZ}/t_{PZH}	Open V_{LOAD} GND

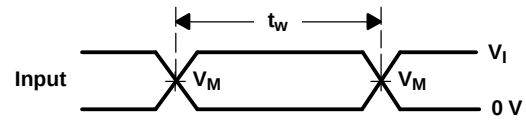
V_{CC}	INPUT		V_M	V_{LOAD}	C_L	R_L	V_{Δ}
	V_I	t_r/t_f					
$1.8\text{ V} \pm 0.15\text{ V}$	V_{CC}	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k Ω	0.15 V
$2.5\text{ V} \pm 0.2\text{ V}$	V_{CC}	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 Ω	0.15 V
2.7 V	2.7 V	$\leq 2.5\text{ ns}$	1.5 V	6 V	50 pF	500 Ω	0.3 V
$3.3\text{ V} \pm 0.3\text{ V}$	2.7 V	$\leq 2.5\text{ ns}$	1.5 V	6 V	50 pF	500 Ω	0.3 V



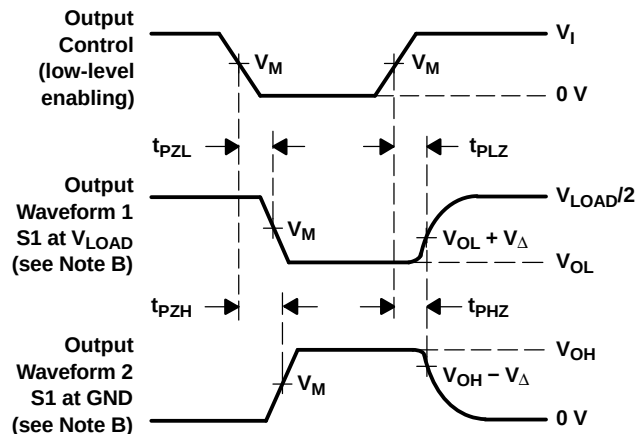
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

- NOTES:
- C_L includes probe and jig capacitance.
 - 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.
 - All input pulses are supplied by generators having the following characteristics: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$.
 - The outputs are measured one at a time, with one transition per measurement.
 - t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - t_{PZL} and t_{PZH} are the same as t_{en} .
 - t_{PLH} and t_{PHL} are the same as t_{pd} .
 - All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
SN74ALVC04D	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVC04
SN74ALVC04D.B	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVC04
SN74ALVC04DGVR	Active	Production	TVSOP (DGV) 14	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	VA04
SN74ALVC04DGVR.B	Active	Production	TVSOP (DGV) 14	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	VA04
SN74ALVC04DR	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVC04
SN74ALVC04DR.B	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVC04
SN74ALVC04DRE4	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVC04
SN74ALVC04DRG4	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVC04
SN74ALVC04PW	Active	Production	TSSOP (PW) 14	90 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	VA04
SN74ALVC04PW.B	Active	Production	TSSOP (PW) 14	90 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	VA04
SN74ALVC04PWR	Active	Production	TSSOP (PW) 14	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	VA04
SN74ALVC04PWR.B	Active	Production	TSSOP (PW) 14	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	VA04
SN74ALVC04PWRG4	Active	Production	TSSOP (PW) 14	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	VA04
SN74ALVC04RGYR	Active	Production	VQFN (RGY) 14	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	VA04
SN74ALVC04RGYR.B	Active	Production	VQFN (RGY) 14	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	VA04
SN74ALVC04RGYRG4	Active	Production	VQFN (RGY) 14	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	VA04

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts 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.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

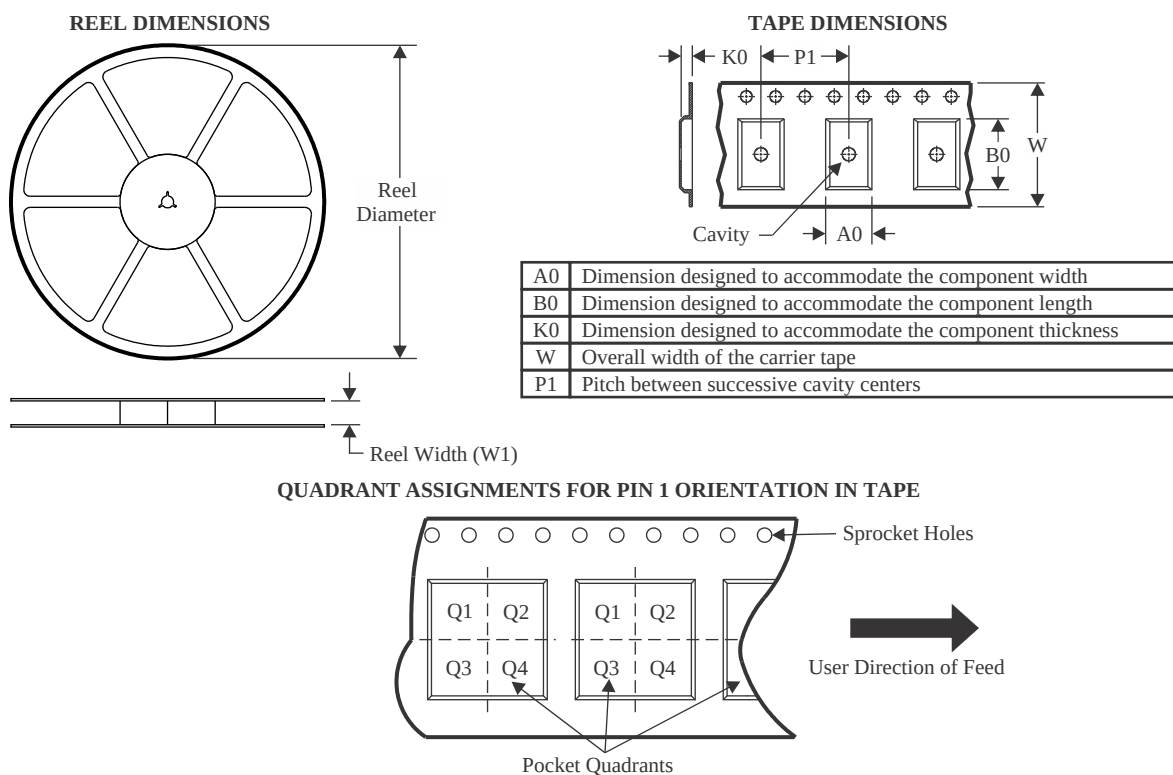
(6) Part marking: There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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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.

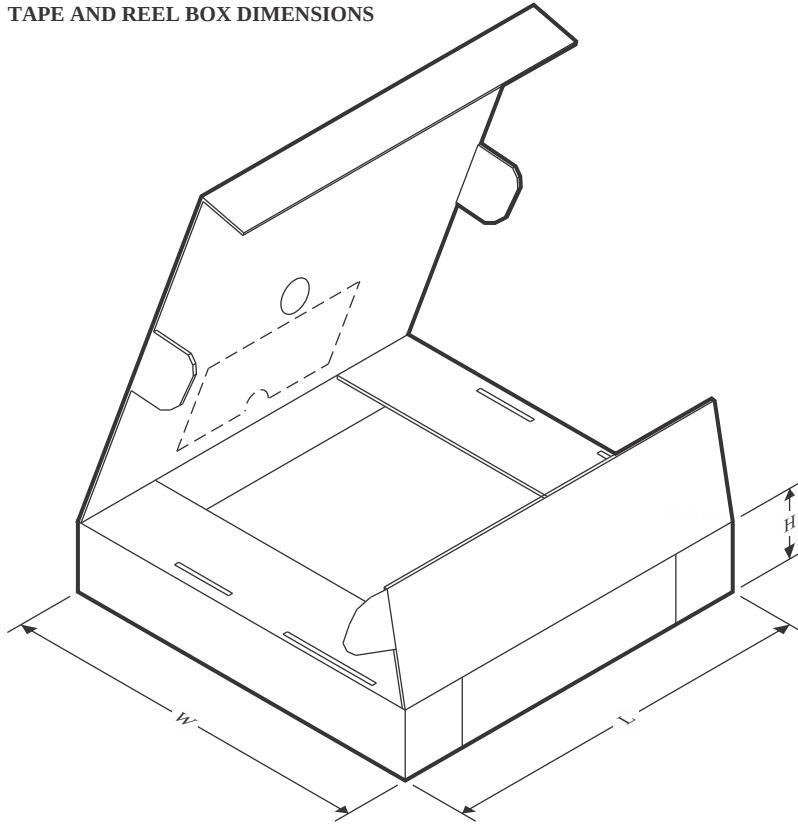
TAPE AND REEL INFORMATION



*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
SN74ALVC04DGVR	TVSOP	DGV	14	2000	330.0	12.4	6.8	4.0	1.6	8.0	12.0	Q1
SN74ALVC04DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74ALVC04PWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74ALVC04RGYR	VQFN	RGY	14	3000	330.0	12.4	3.75	3.75	1.15	8.0	12.0	Q1

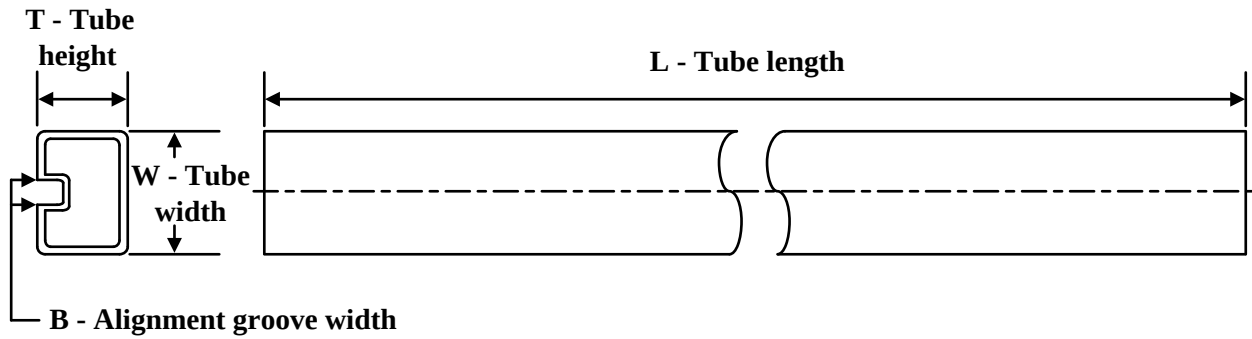
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ALVC04DGVR	TVSOP	DGV	14	2000	356.0	356.0	35.0
SN74ALVC04DR	SOIC	D	14	2500	356.0	356.0	35.0
SN74ALVC04PWR	TSSOP	PW	14	2000	356.0	356.0	35.0
SN74ALVC04RGYR	VQFN	RGY	14	3000	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)
SN74ALVC04D	D	SOIC	14	50	506.6	8	3940	4.32
SN74ALVC04D.B	D	SOIC	14	50	506.6	8	3940	4.32
SN74ALVC04PW	PW	TSSOP	14	90	530	10.2	3600	3.5
SN74ALVC04PW.B	PW	TSSOP	14	90	530	10.2	3600	3.5

GENERIC PACKAGE VIEW

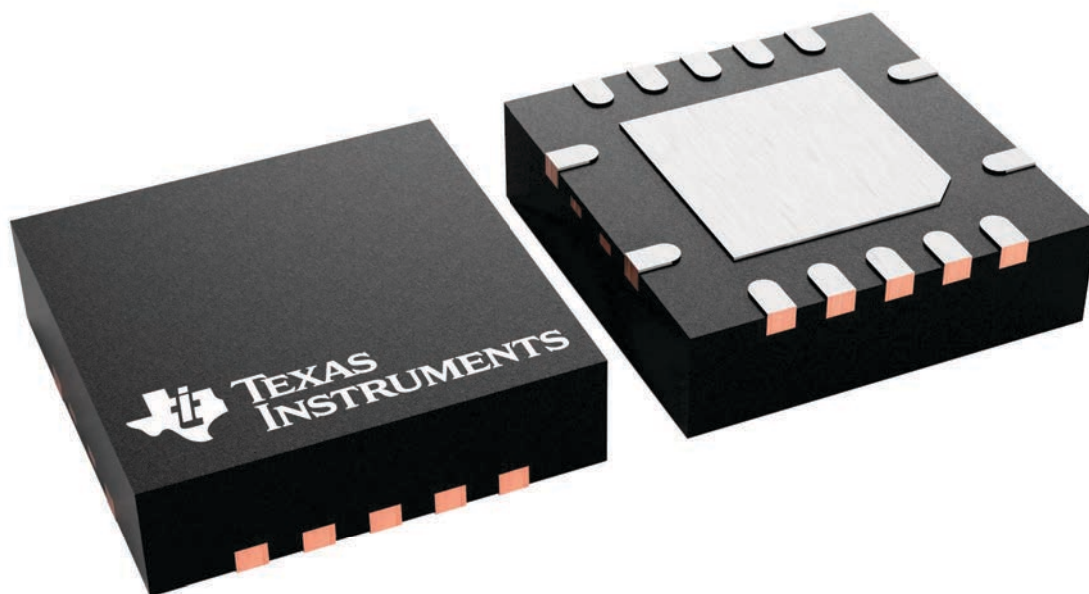
RGY 14

VQFN - 1 mm max height

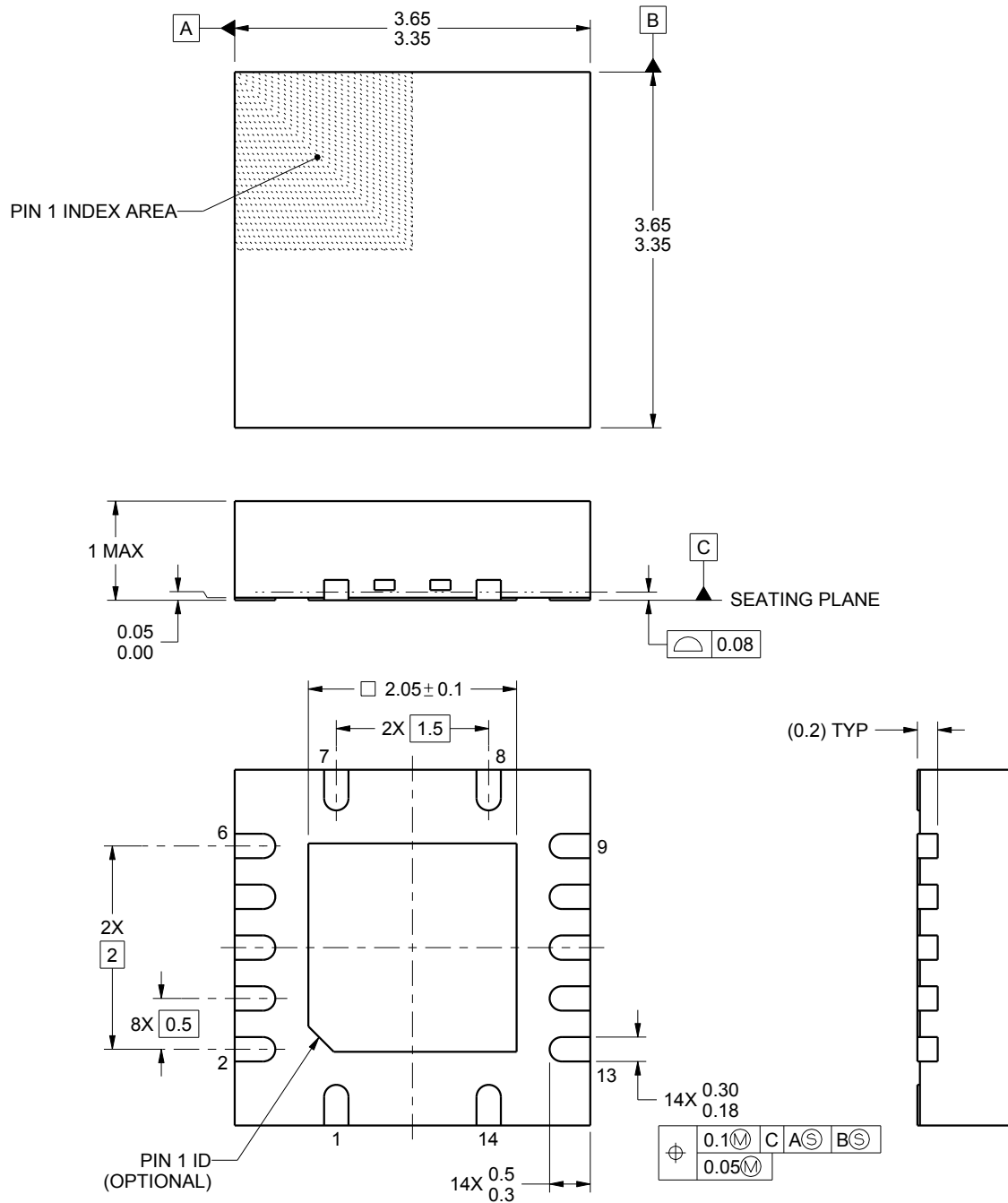
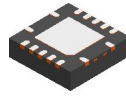
3.5 x 3.5, 0.5 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



4231541/A



4219040/A 09/2015

NOTES:

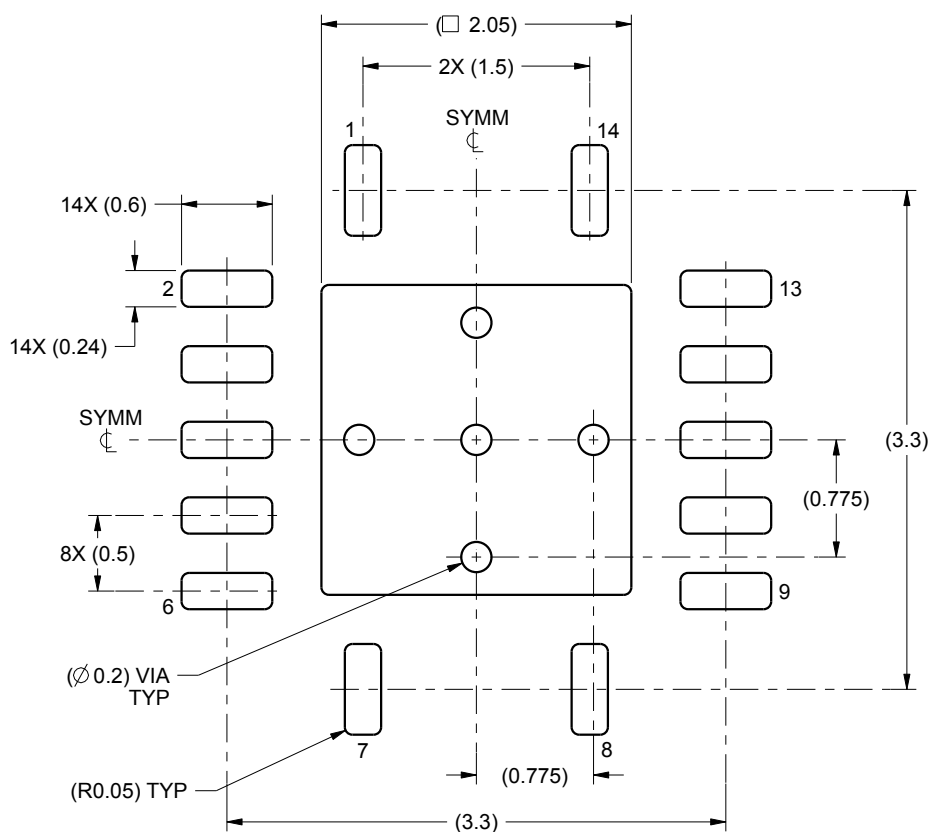
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

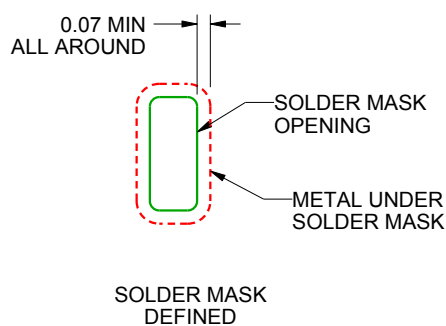
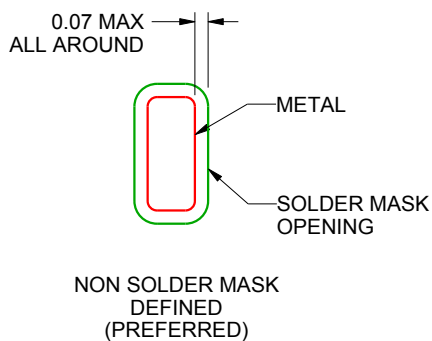
RGY0014A

VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
SCALE:20X



SOLDER MASK DETAILS

4219040/A 09/2015

NOTES: (continued)

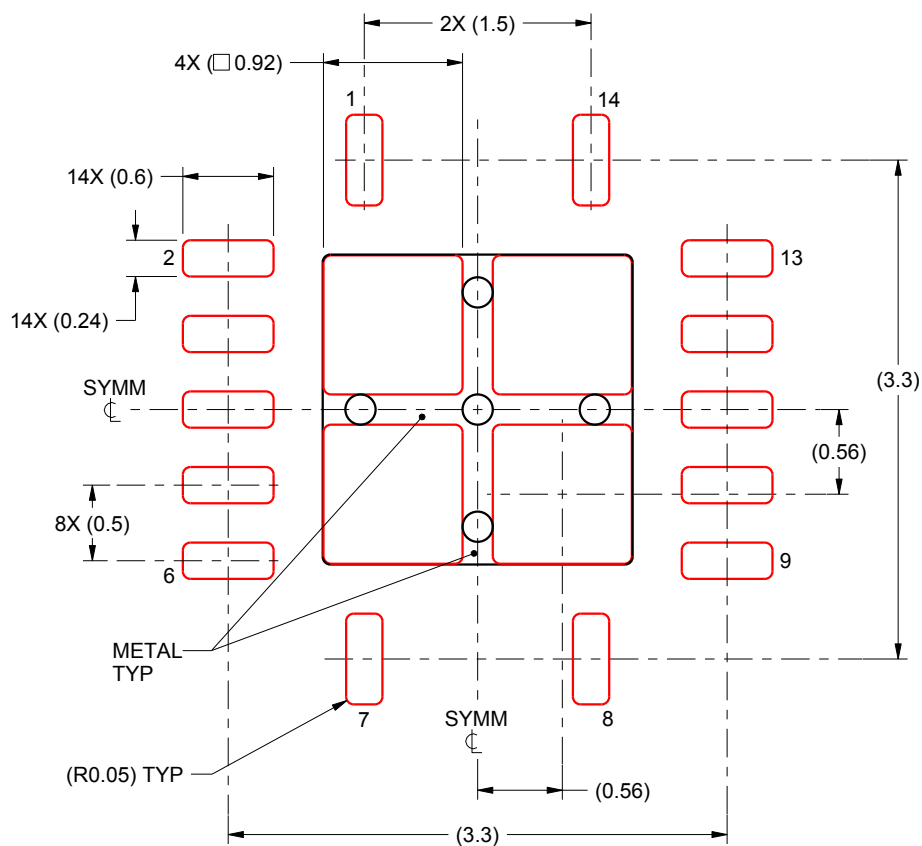
- This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slue271).

EXAMPLE STENCIL DESIGN

RGY0014A

VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



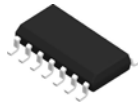
SOLDER PASTE EXAMPLE
 BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
 80% PRINTED SOLDER COVERAGE BY AREA
 SCALE:20X

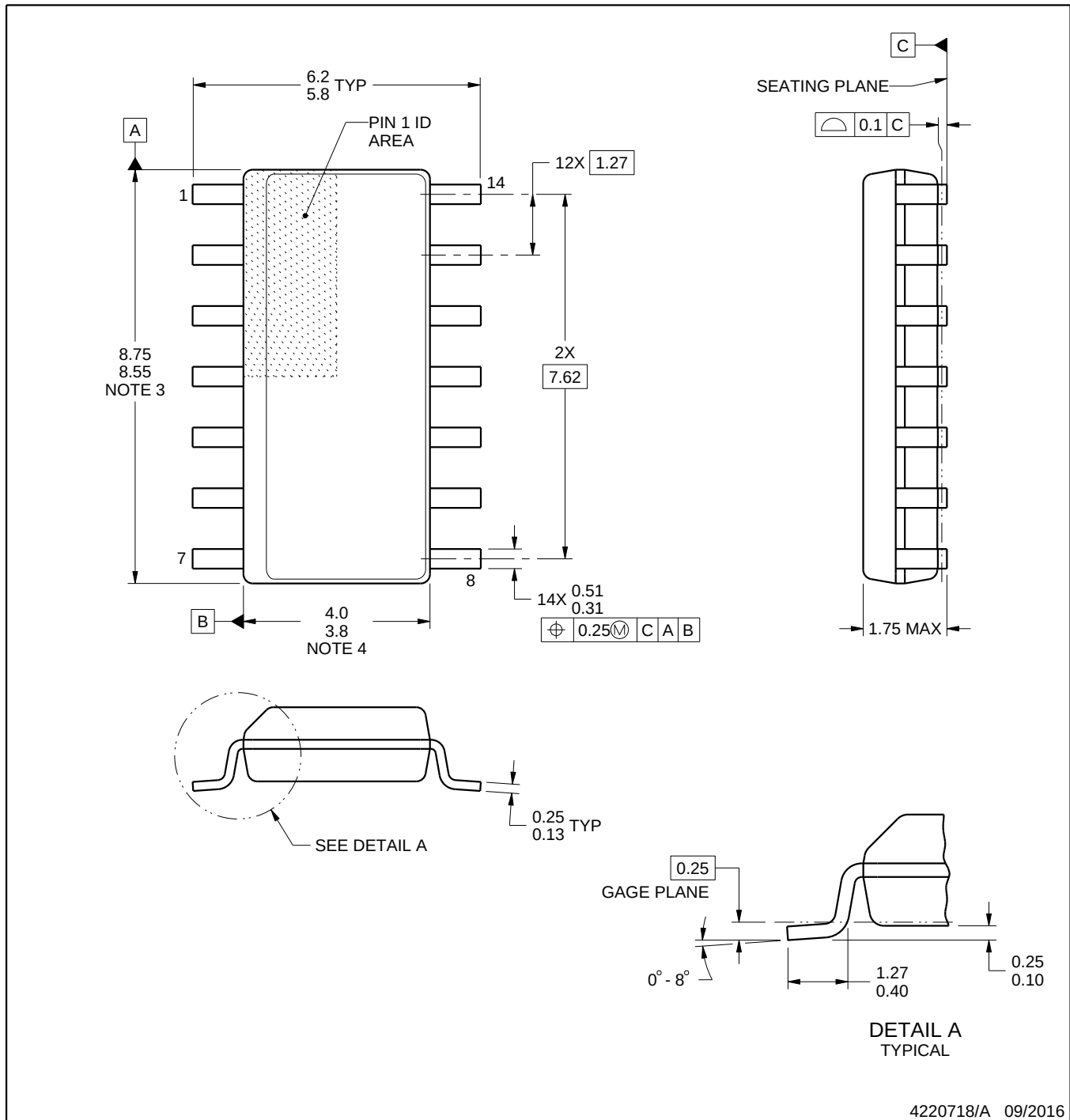
4219040/A 09/2015

NOTES: (continued)

5. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

D0014A**PACKAGE OUTLINE****SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



4220718/A 09/2016

NOTES:

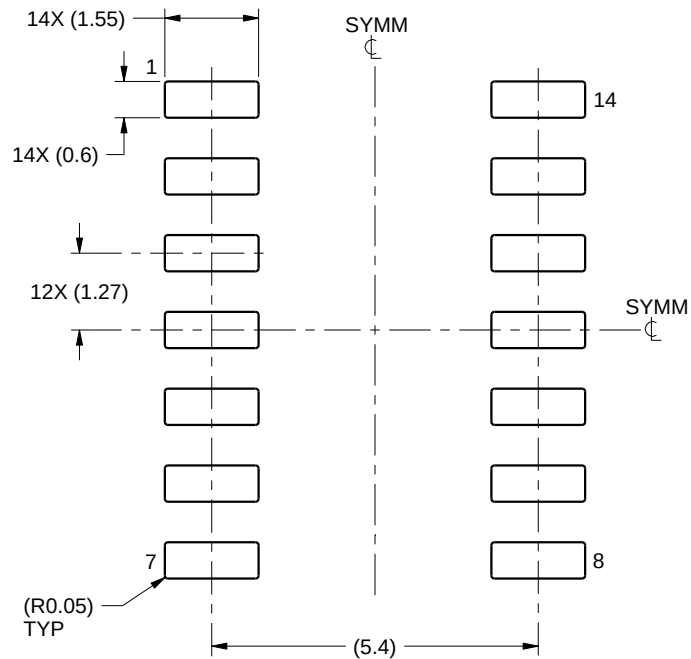
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate 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-012, variation AB.

EXAMPLE BOARD LAYOUT

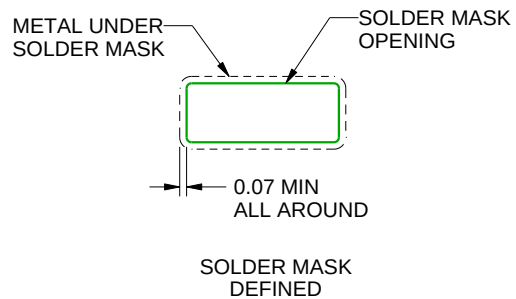
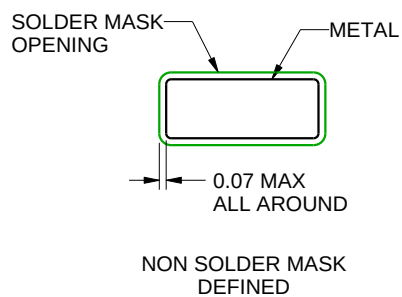
D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

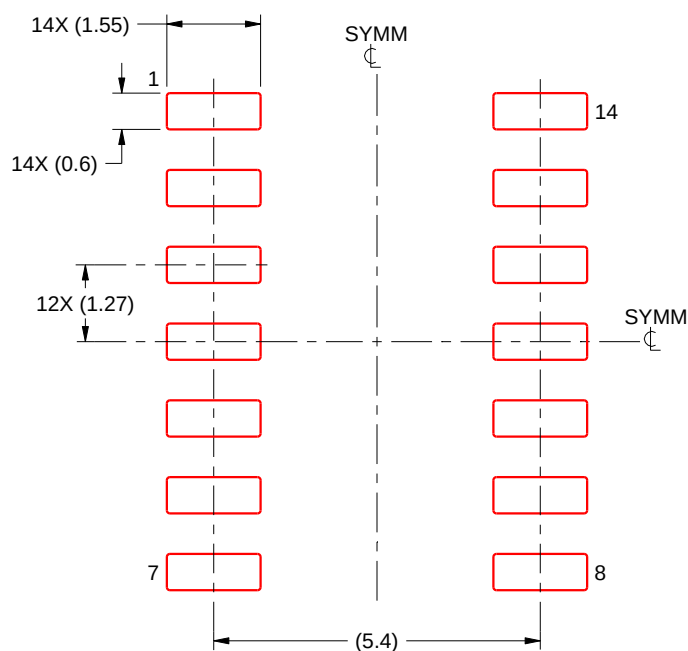
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:8X

4220718/A 09/2016

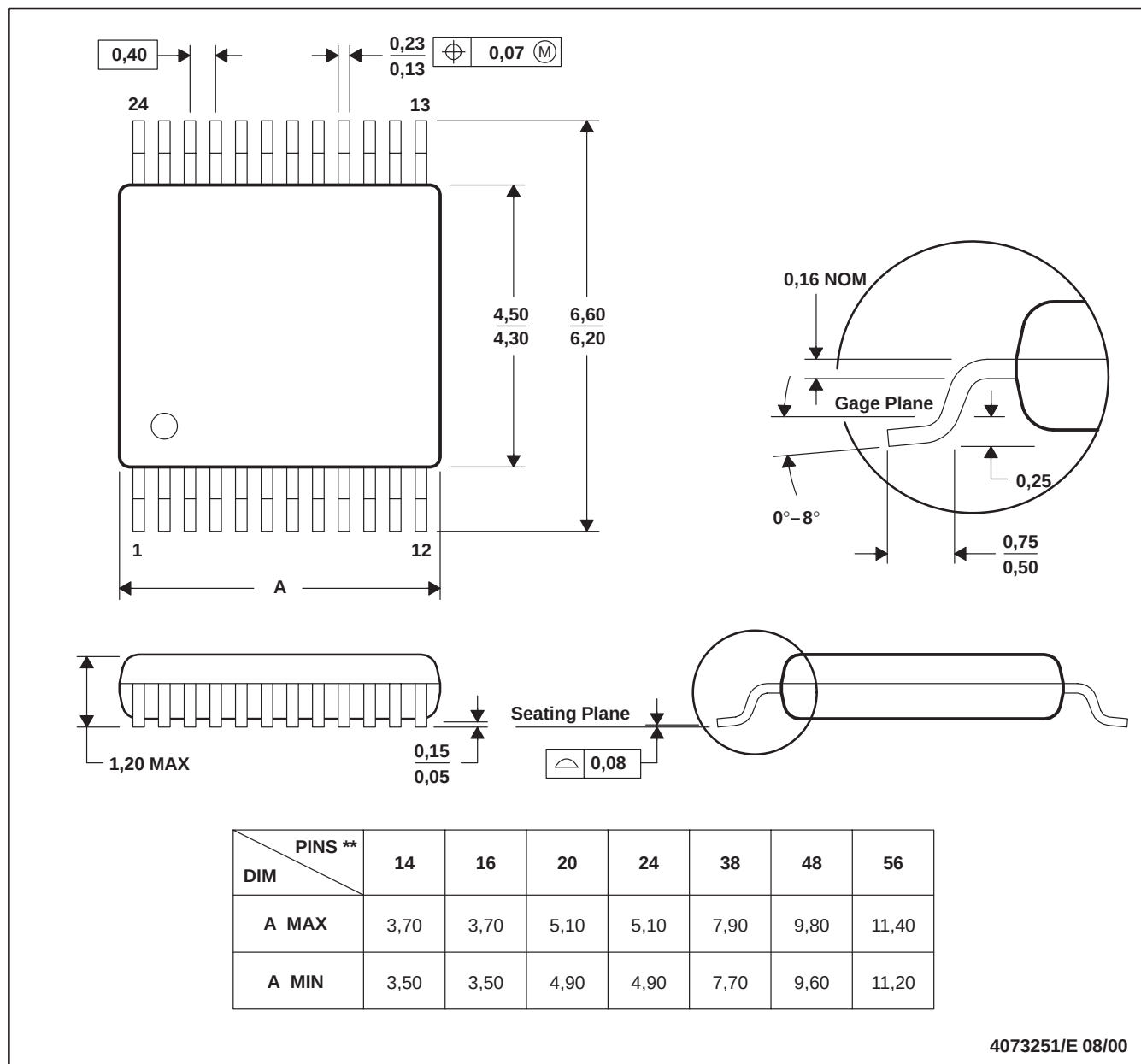
NOTES: (continued)

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.

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN

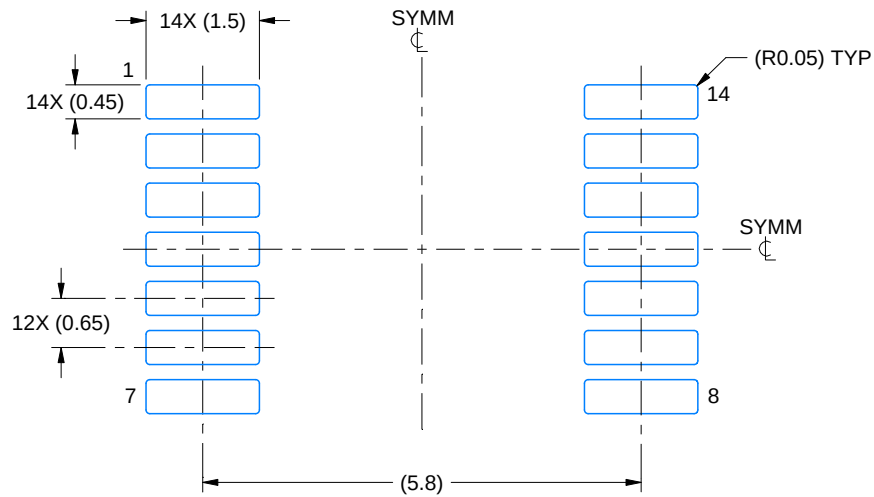


- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

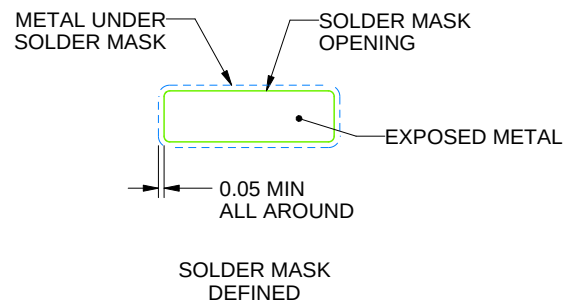
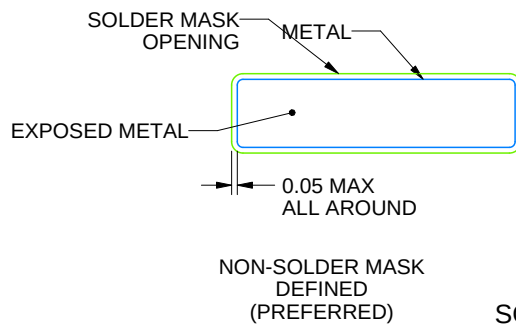
PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

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NOTES: (continued)

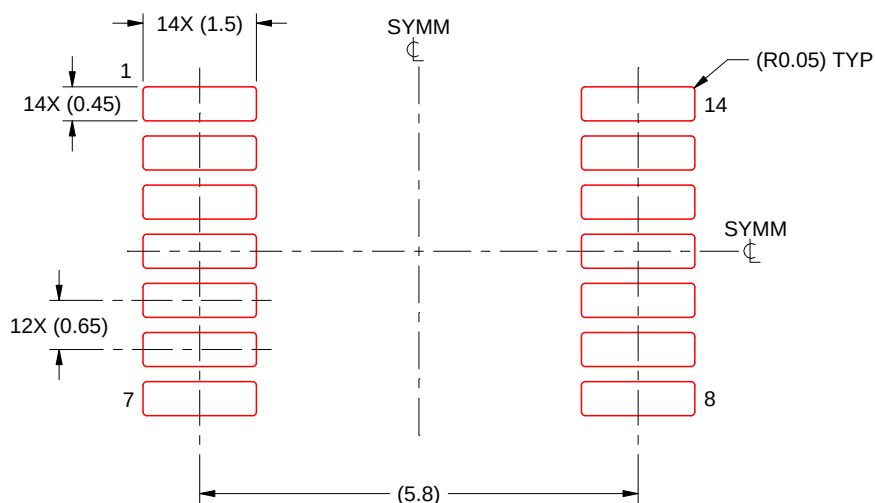
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

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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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