

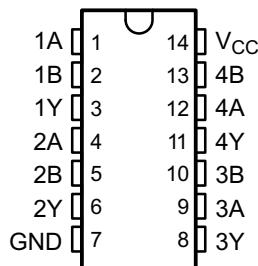
## QUADRUPLE 2-INPUT EXCLUSIVE-OR GATES

Check for Samples: [SN54AHC86](#), [SN74AHC86](#)

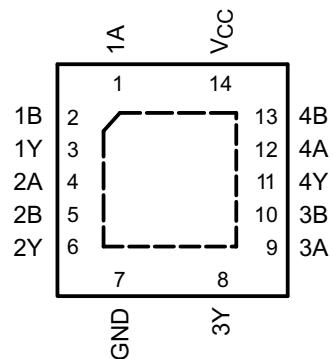
### FEATURES

- Operating Range 2-V to 5.5-V  $V_{CC}$
- 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)

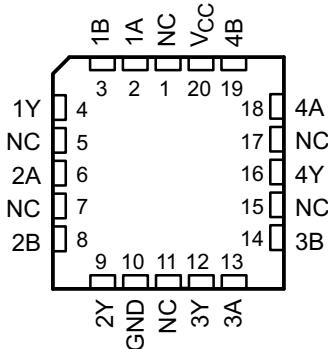
SN54AHC86 . . . J OR W PACKAGE  
SN74AHC86 . . . D, DB, DGV, N, NS,  
OR PW PACKAGE  
(TOP VIEW)



SN74AHC86 . . . RGY PACKAGE  
(TOP VIEW)



SN54AHC86 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

### DESCRIPTION

The 'AHC86 devices are quadruple 2-input exclusive-OR gates. These devices perform the Boolean function  $Y = A \oplus B$  or  $Y = \bar{A}B + A\bar{B}$  in positive logic.

A common application is as a true/complement element. If one of the inputs is low, the other input is reproduced in true form at the output. If one of the inputs is high, the signal on the other input is reproduced inverted at the output.

### FUNCTION TABLE (EACH GATE)

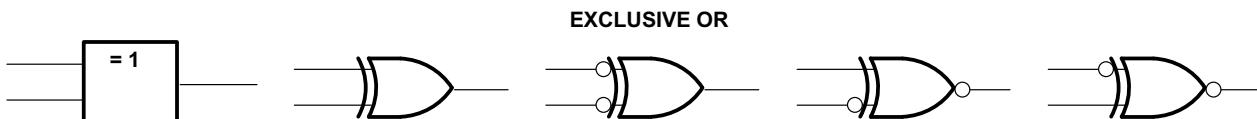
INPUTS		OUTPUT
A	B	Y
L	L	L
L	H	H
H	L	H
H	H	L



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.

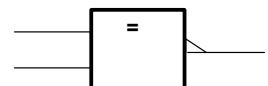
## EXCLUSIVE-OR LOGIC

An exclusive-OR gate has many applications, some of which can be represented better by alternative logic symbols.



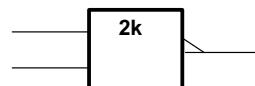
These are five equivalent exclusive-OR symbols valid for an SN74AHC86 gate in positive logic; negation may be shown at any two ports.

LOGIC-IDENTITY ELEMENT



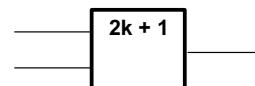
The output is active (low) if all inputs stand at the same logic level (i.e.,  $A = B$ ).

EVEN-PARITY ELEMENT



The output is active (low) if an even number of inputs (i.e., 0 or 2) are active.

ODD-PARITY ELEMENT



The output is active (high) if an odd number of inputs (i.e., only 1 of the 2) are active.

## ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

	VALUE	UNIT
Supply voltage range, $V_{CC}$	-0.5 to 7	V
Input voltage range, $V_I$ <sup>(2)</sup>	-0.5 to 7	V
Output voltage range, $V_O$ <sup>(2)</sup>	-0.5 to $V_{CC} + 0.5$	V
Input clamp current, $I_{IK}$ ( $V_I < 0$ )	-20	mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ )	$\pm 20$	mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )	$\pm 25$	mA
Continuous current through $V_{CC}$ or GND	$\pm 50$	mA
Package thermal impedance, $\theta_{JA}$	D package <sup>(3)</sup>	86
	DB package <sup>(3)</sup>	96
	DGV package <sup>(3)</sup>	127
	N package <sup>(3)</sup>	80
	NS package <sup>(3)</sup>	76
	PW package <sup>(3)</sup>	113
	RGY package <sup>(4)</sup>	47
Storage temperature range, $T_{stg}$	-65 to 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 and output voltage ratings may be exceeded if the input and output current ratings are observed.

(3) The package thermal impedance is calculated in accordance with JESD 51-7.

(4) The package thermal impedance is calculated in accordance with JESD 51-5

**RECOMMENDED OPERATING CONDITIONS<sup>(1)</sup>**

		SN54AHC86		SN74AHC86		UNIT
		MIN	MAX	MIN	MAX	
$V_{CC}$	Supply voltage	2	5.5	2	5.5	V
$V_{IH}$	High-level input voltage	$V_{CC} = 2\text{ V}$	1.5	1.5		V
		$V_{CC} = 3\text{ V}$	2.1	2.1		
		$V_{CC} = 5.5\text{ V}$	3.85	3.85		
$V_{IL}$	Low-level Input voltage	$V_{CC} = 2\text{ V}$	0.5	0.5		V
		$V_{CC} = 3\text{ V}$	0.9	0.9		
		$V_{CC} = 5.5\text{ V}$	1.65	1.65		
$V_I$	Input voltage	0	5.5	0	5.5	V
$V_O$	Output voltage	0	$V_{CC}$	0	$V_{CC}$	V
$I_{OH}$	High-level output current	$V_{CC} = 2\text{ V}$	-50	-50		mA
		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$	-4	-4		
		$V_{CC} = 5\text{ V} \pm 0.5\text{ V}$	-8	-8		
$I_{OL}$	Low-level output current	$V_{CC} = 2\text{ V}$	50	50		mA
		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$	4	4		
		$V_{CC} = 5\text{ V} \pm 0.5\text{ V}$	8	8		
$\Delta t/\Delta v$	Input Transition rise or fall rate	$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$	100	100		ns/V
		$V_{CC} = 5\text{ V} \pm 0.5\text{ V}$	20	20		
$T_A$	Operating free-air temperature	-55	125	-40	125	°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 operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	T <sub>A</sub> = 25°C	T <sub>A</sub> = -55°C TO 125°C		T <sub>A</sub> = -40°C TO 85°C		T <sub>A</sub> = -40°C TO 125°C		UNIT	
				SN54AHC86		SN74AHC86		SN74AHC86			
				MIN	TYP	MAX	MIN	MAX	MIN		
V <sub>OH</sub>	I <sub>OH</sub> = -50 µA	2 V	1.9	2		1.9		1.9		V	
		3 V	2.9	3		2.9		2.9			
		4.5 V	4.4	4.5		4.4		4.4			
	I <sub>OH</sub> = -4 mA	3 V	2.58			2.48		2.48			
	I <sub>OH</sub> = -8 mA	4.5 V	3.94			3.8		3.8			
V <sub>OL</sub>	I <sub>OL</sub> = 50 µA	2 V		0.1		0.1		0.1		V	
		3 V		0.1		0.1		0.1			
		4.5 V		0.1		0.1		0.1			
	I <sub>OH</sub> = 4 mA	3 V		0.36		0.5		0.44			
	I <sub>OH</sub> = 8 mA	4.5 V		0.36		0.5		0.44			
I <sub>I</sub>	V <sub>I</sub> = 5.5 V or GND	0 V to 5.5 V		±0.1		±1 <sup>(1)</sup>		±1		±1 µA	
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	5.5 V		2		20		20		20 µA	
C <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5 V		4	10			10		pF	

(1) On products compliant to MIL-PRF-38535, this parameter is not production tested at V<sub>CC</sub> = 0 V.

## SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, V<sub>CC</sub> = 3.3 V ± 0.3 V (unless otherwise noted) (see [Figure 1](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	T <sub>A</sub> = 25°C	T <sub>A</sub> = -55°C TO 125°C		T <sub>A</sub> = -40°C TO 85°C		T <sub>A</sub> = -40°C TO 125°C		UNIT	
					SN54AHC86		SN74AHC86		SN74AHC86			
					TYP	MAX	MIN	MAX	MIN	MAX		
t <sub>PLH</sub>	A or B	Y	C <sub>L</sub> = 15 pF	7 <sup>(1)</sup>	11 <sup>(1)</sup>	1 <sup>(1)</sup>	13 <sup>(1)</sup>	1	13	1	13	ns
				7 <sup>(1)</sup>	11 <sup>(1)</sup>	1 <sup>(1)</sup>	13 <sup>(1)</sup>	1	13	1	13	
t <sub>PLH</sub>	A or B	Y	C <sub>L</sub> = 50 pF	9.5	14.5	1	16.5	1	16.5	1	16.5	ns
				9.5	14.5	1	16.5	1	16.5	1	16.5	

(1) On products compliant to MIL-PRF-38535, this parameter is not production tested.

## SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, V<sub>CC</sub> = 5 V ± 0.5 V (unless otherwise noted) (see [Figure 1](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	T <sub>A</sub> = 25°C	T <sub>A</sub> = -55°C TO 125°C		T <sub>A</sub> = -40°C TO 85°C		T <sub>A</sub> = -40°C TO 125°C		UNIT	
					SN54AHC86		SN74AHC86		SN74AHC86			
					TYP	MAX	MIN	MAX	MIN	MAX		
t <sub>PLH</sub>	A or B	Y	C <sub>L</sub> = 15 pF	4.8 <sup>(1)</sup>	6.8 <sup>(1)</sup>	1 <sup>(1)</sup>	8 <sup>(1)</sup>	1	8	1	8	ns
				4.8 <sup>(1)</sup>	6.8 <sup>(1)</sup>	1 <sup>(1)</sup>	8 <sup>(1)</sup>	1	8	1	8	
t <sub>PLH</sub>	A or B	Y	C <sub>L</sub> = 50 pF	6.3	8.8	1	10	1	10	1	10	ns
				6.3	8.8	1	10	1	10	1	10	

(1) On products compliant to MIL-PRF-38535, this parameter is not production tested.

## NOISE CHARACTERISTICS

$V_{CC} = 5 \text{ V}$ ,  $C_L = 50 \text{ pF}$ ,  $T_A = 25^\circ\text{C}$ <sup>(1)</sup>

PARAMETER	SN74AHC86			UNIT
	MIN	TYP	MAX	
$V_{OL(P)}$ Quiet output, maximum dynamic $V_{OL}$		0.3	0.8	V
$V_{OL(V)}$ Quiet output, minimum dynamic $V_{OL}$		-0.3	-0.8	V
$V_{OH(V)}$ Quiet output, minimum dynamic $V_{OH}$	4.4			V
$V_{IH(D)}$ High-level dynamic input voltage	3.5			V
$V_{IL(D)}$ Low-level dynamic input voltage		1.5		V

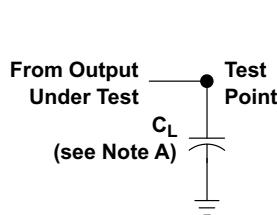
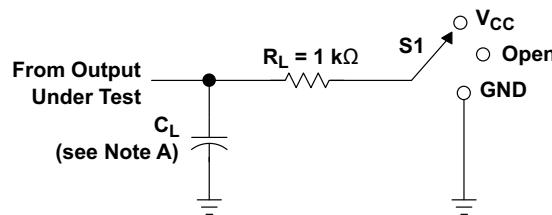
(1) Characteristics are for surface-mount packages only.

## OPERATING CHARACTERISTICS

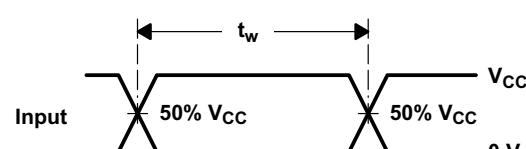
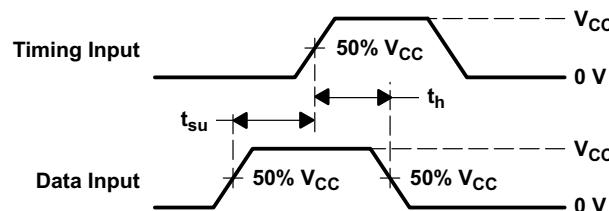
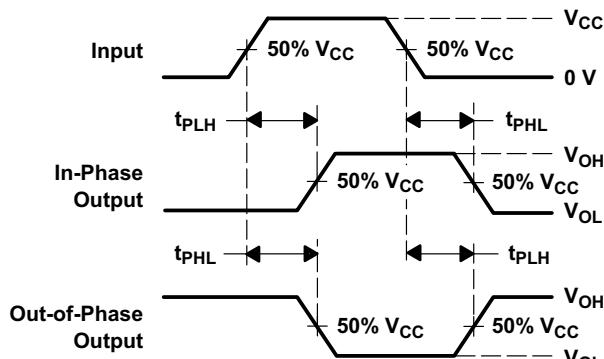
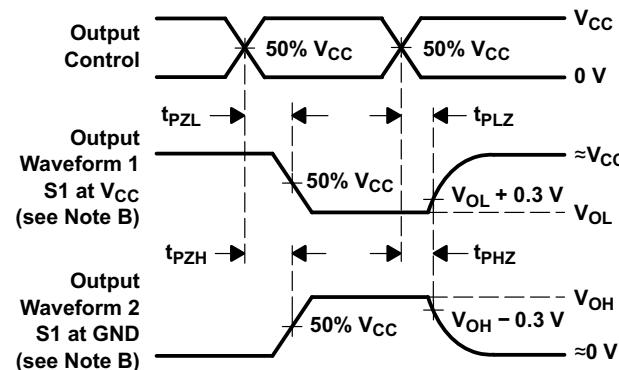
$V_{CC} = 5 \text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	TYP	UNIT
$C_{pd}$ Power dissipation capacitance	No load, $f = 1 \text{ MHz}$	18	pF

## PARAMETER MEASUREMENT INFORMATION

LOAD CIRCUIT FOR  
TOTUM-POLE OUTPUTSLOAD CIRCUIT FOR  
3-STATE AND OPEN-DRAIN OUTPUTS

TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	$V_{CC}$
$t_{PHZ}/t_{PZH}$	GND
Open Drain	$V_{CC}$

VOLTAGE WAVEFORMS  
PULSE DURATIONVOLTAGE WAVEFORMS  
SETUP AND HOLD TIMESVOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTSVOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES  
LOW- AND HIGH-LEVEL ENABLING

- $C_L$  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:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 3 \text{ ns}$ ,  $t_f \leq 3 \text{ ns}$ .
- The outputs are measured one at a time with one input transition per measurement.
- All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

## REVISION HISTORY

<b>Changes from Revision I (July 2003) to Revision J</b>	<b>Page</b>
• Changed document format from Quicksilver to DocZone. ....	1
• Extended operating temperature range to 125°C ....	3

**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
5962-9681601Q2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962-9681601Q2A SNJ54AHC86FK	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
5962-9681601QCA	ACTIVE	CDIP	J	14	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-9681601QC A SNJ54AHC86J	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
5962-9681601QDA	ACTIVE	CFP	W	14	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-9681601QD A SNJ54AHC86W	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74AHC86D	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	AHC86	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74AHC86DBLE	OBsolete	SSOP	DB	14		TBD	Call TI	Call TI	-40 to 125		
SN74AHC86DBR	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	HA86	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74AHC86DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	AHC86	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74AHC86DGVR	ACTIVE	TVSOP	DGV	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	HA86	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74AHC86DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	AHC86	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74AHC86N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 125	SN74AHC86N	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74AHC86NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 125	SN74AHC86N	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74AHC86NSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	AHC86	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74AHC86PW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	HA86	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74AHC86PWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	HA86	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74AHC86PWLE	OBsolete	TSSOP	PW	14		TBD	Call TI	Call TI	-40 to 125		
SN74AHC86PWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	HA86	<span style="background-color: red; color: white; padding: 2px;">Samples</span>

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
SN74AHC86PWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	HA86	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74AHC86RGYR	ACTIVE	VQFN	RGY	14	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	HA86	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74AHC86RGYRG4	ACTIVE	VQFN	RGY	14	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	HA86	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SNJ54AHC86FK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962-9681601Q2A SNJ54AHC86FK	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SNJ54AHC86J	ACTIVE	CDIP	J	14	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-9681601QC A SNJ54AHC86J	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SNJ54AHC86W	ACTIVE	CFP	W	14	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-9681601QD A SNJ54AHC86W	<span style="background-color: red; color: white; padding: 2px;">Samples</span>

(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) 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)

(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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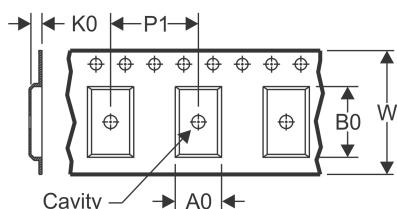
**OTHER QUALIFIED VERSIONS OF SN54AHC86, SN74AHC86 :**

- Catalog: [SN74AHC86](#)
- Military: [SN54AHC86](#)

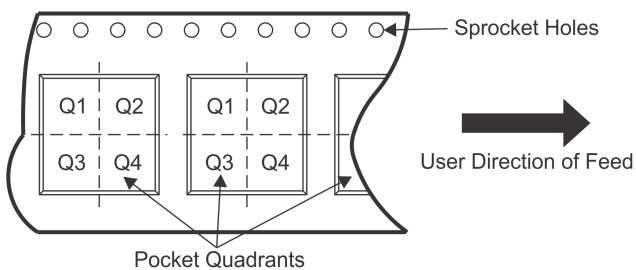
NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

**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
SN74AHC86DBR	SSOP	DB	14	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
SN74AHC86DGVR	TVSOP	DGV	14	2000	330.0	12.4	6.8	4.0	1.6	8.0	12.0	Q1
SN74AHC86DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74AHC86NSR	SO	NS	14	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
SN74AHC86PWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74AHC86RGYR	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)
SN74AHC86DBR	SSOP	DB	14	2000	367.0	367.0	38.0
SN74AHC86DGVR	TVSOP	DGV	14	2000	367.0	367.0	35.0
SN74AHC86DR	SOIC	D	14	2500	367.0	367.0	38.0
SN74AHC86NSR	SO	NS	14	2000	367.0	367.0	38.0
SN74AHC86PWR	TSSOP	PW	14	2000	367.0	367.0	35.0
SN74AHC86RGYR	VQFN	RGY	14	3000	367.0	367.0	35.0

J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)

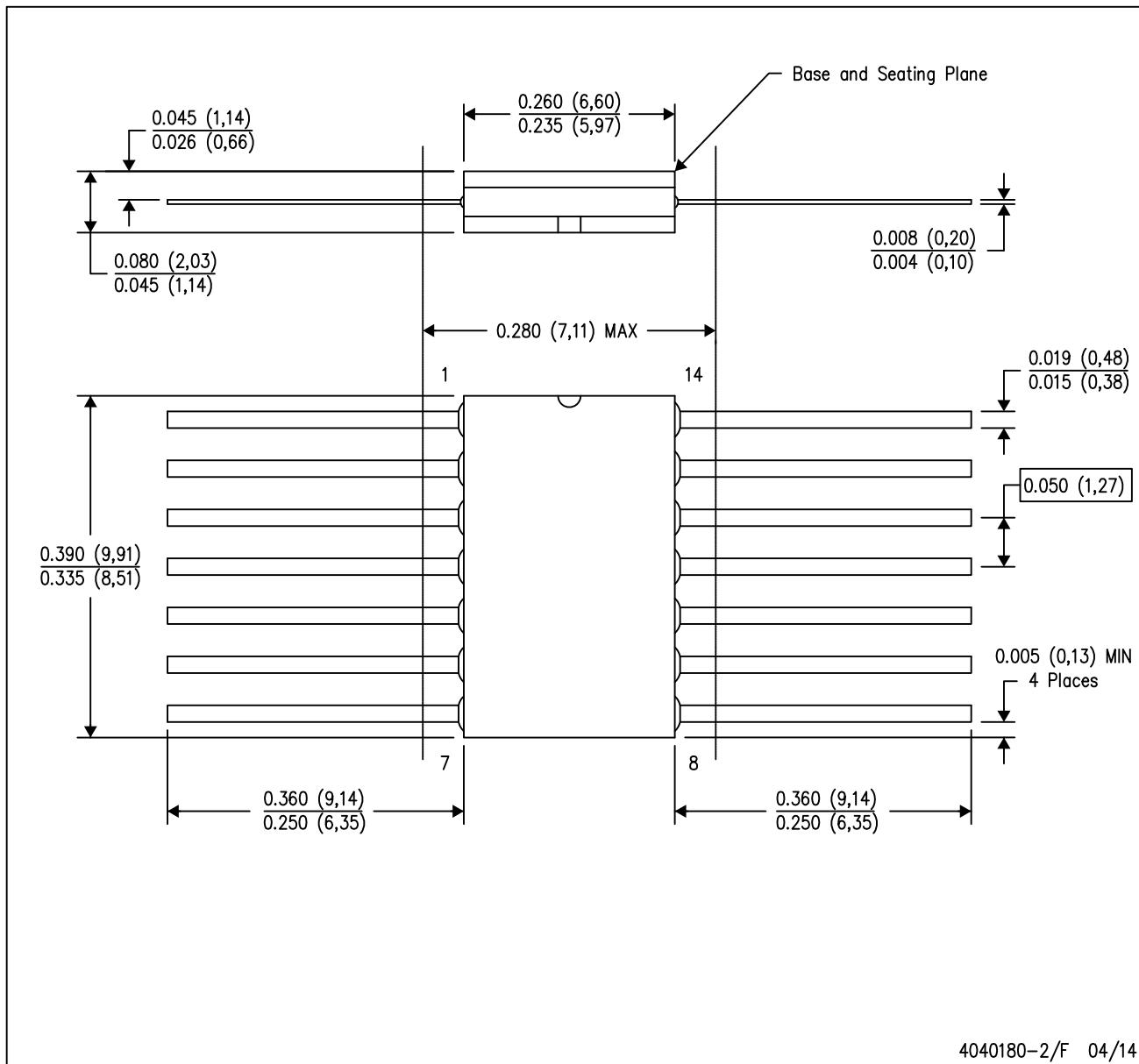


4040083/F 03/03

NOTES: A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.  
C. This package is hermetically sealed with a ceramic lid using glass frit.  
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.  
E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

W (R-GDFP-F14)

CERAMIC DUAL FLATPACK



4040180-2/F 04/14

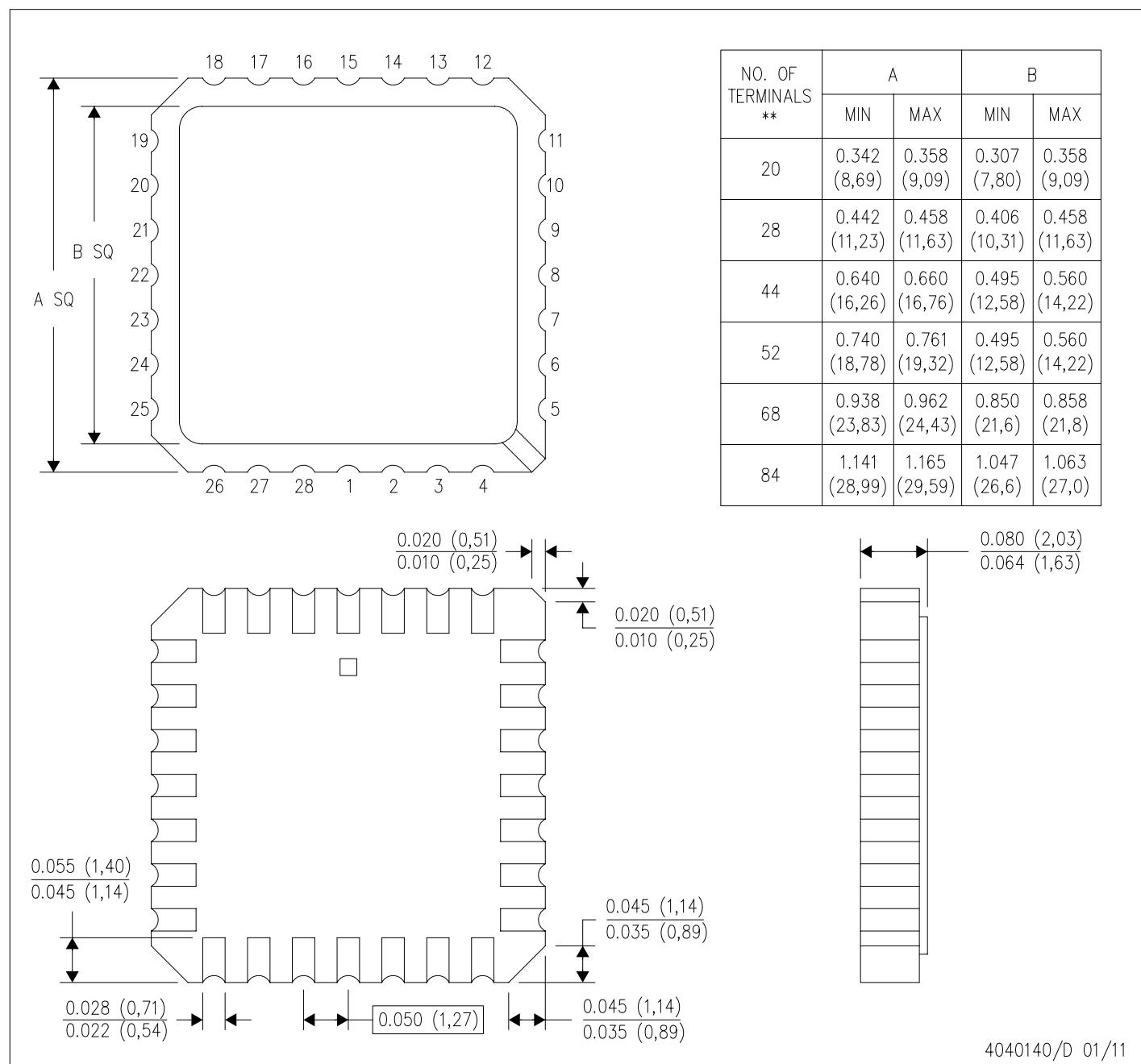
NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. This package can be hermetically sealed with a ceramic lid using glass frit.
- D. Index point is provided on cap for terminal identification only.
- E. Falls within MIL-STD 1835 GDFP1-F14

FK (S-CQCC-N\*\*)

28 TERMINAL SHOWN

LEADLESS CERAMIC CHIP CARRIER



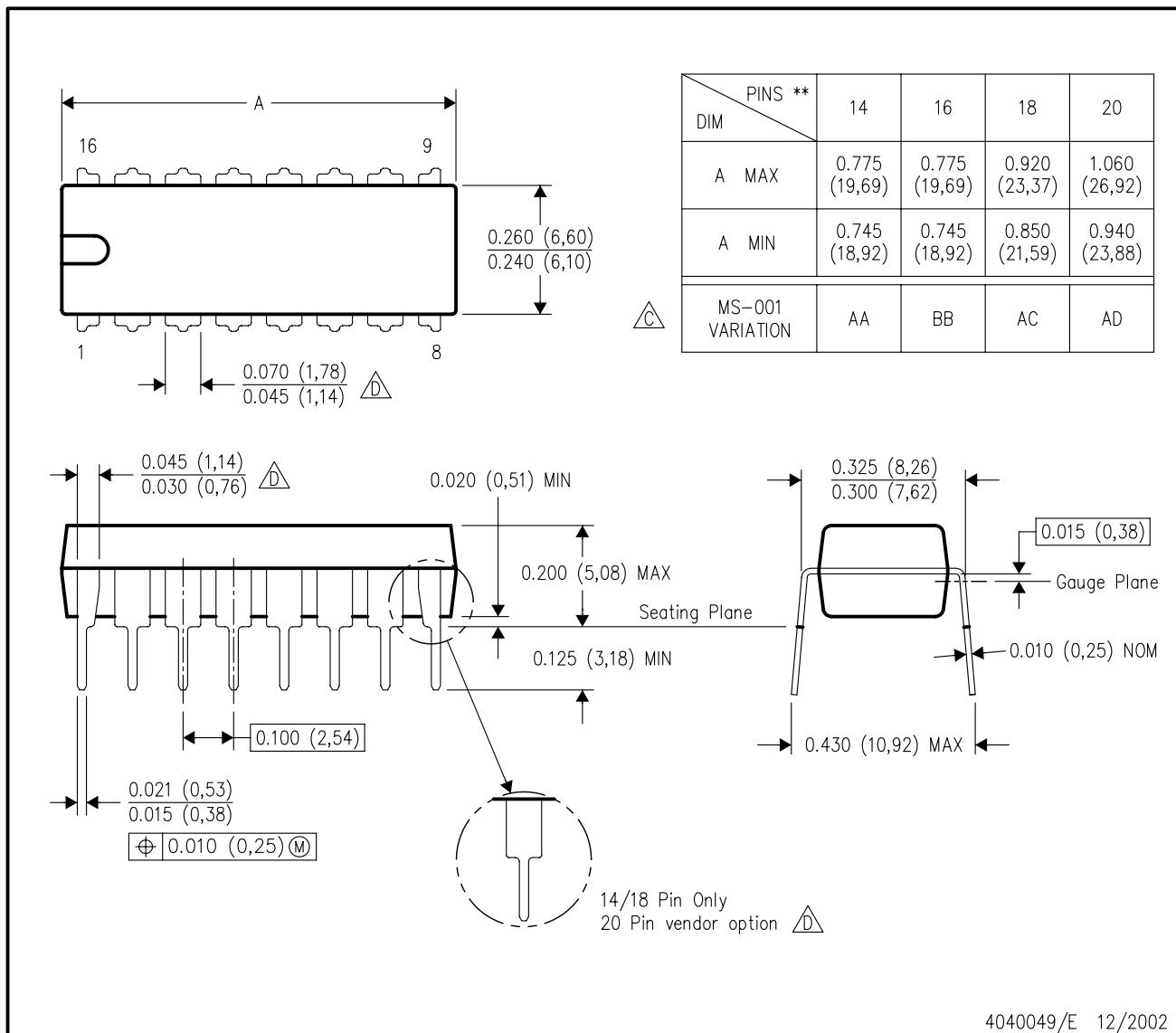
NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. This package can be hermetically sealed with a metal lid.  
 D. Falls within JEDEC MS-004

4040140/D 01/11

## N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



NOTES: A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.

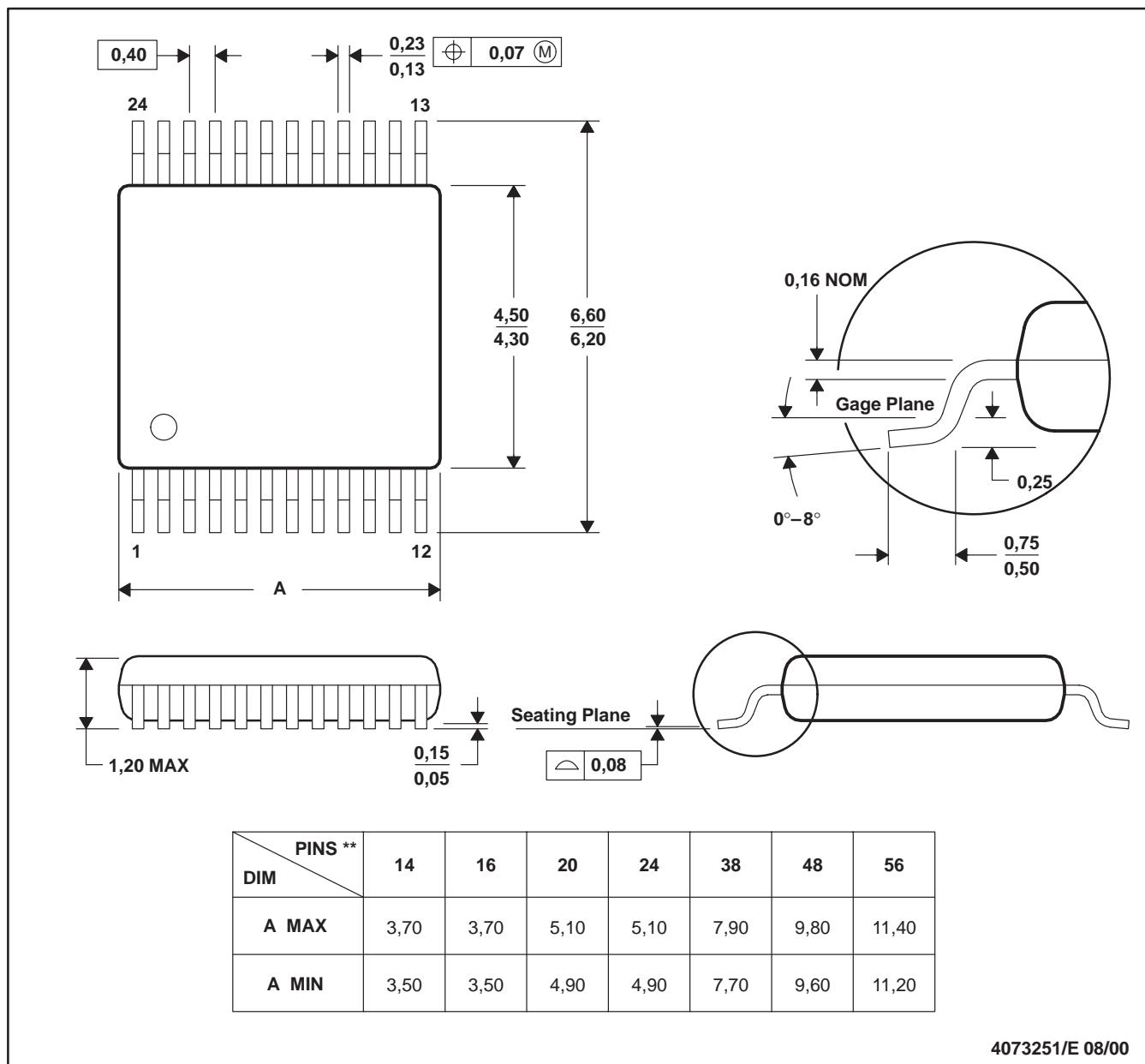
△ Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).

△ The 20 pin end lead shoulder width is a vendor option, either half or full width.

## DGV (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE

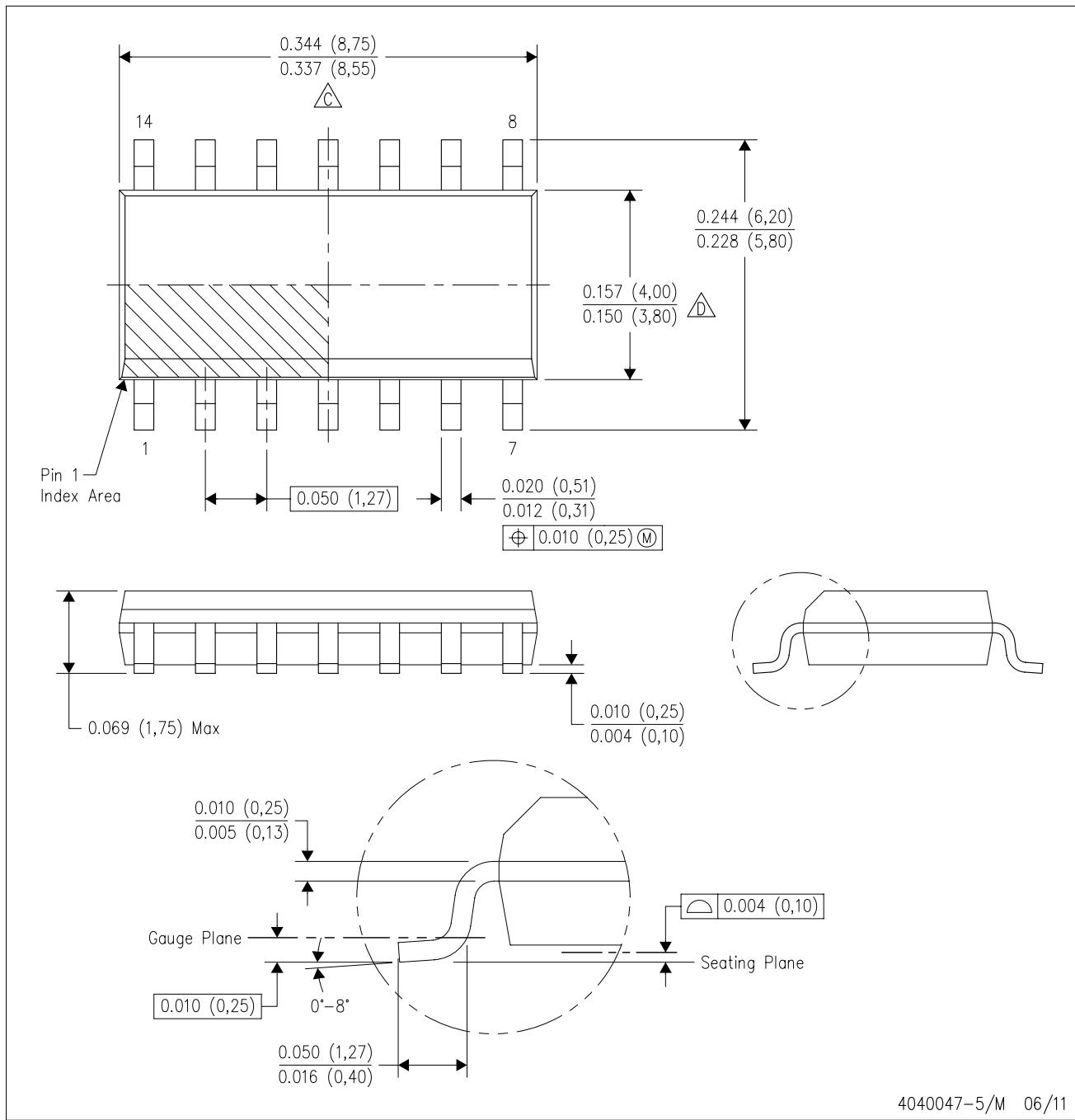
24 PINS SHOWN



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

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



NOTES: A. All linear dimensions are in inches (millimeters).

B. This drawing is subject to change without notice.

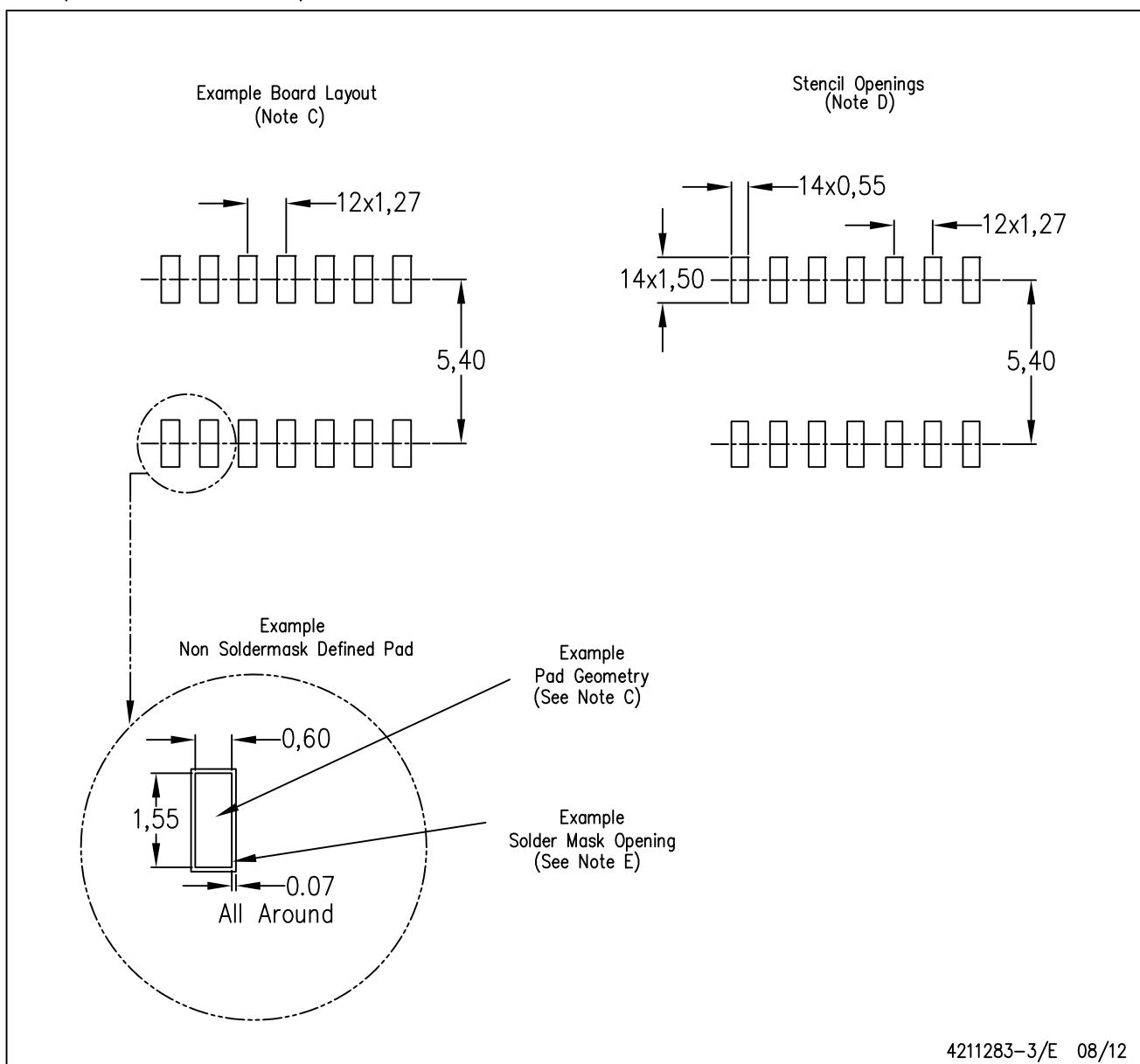
(C) Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0.15) each side.

(D) Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0.43) each side.

E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



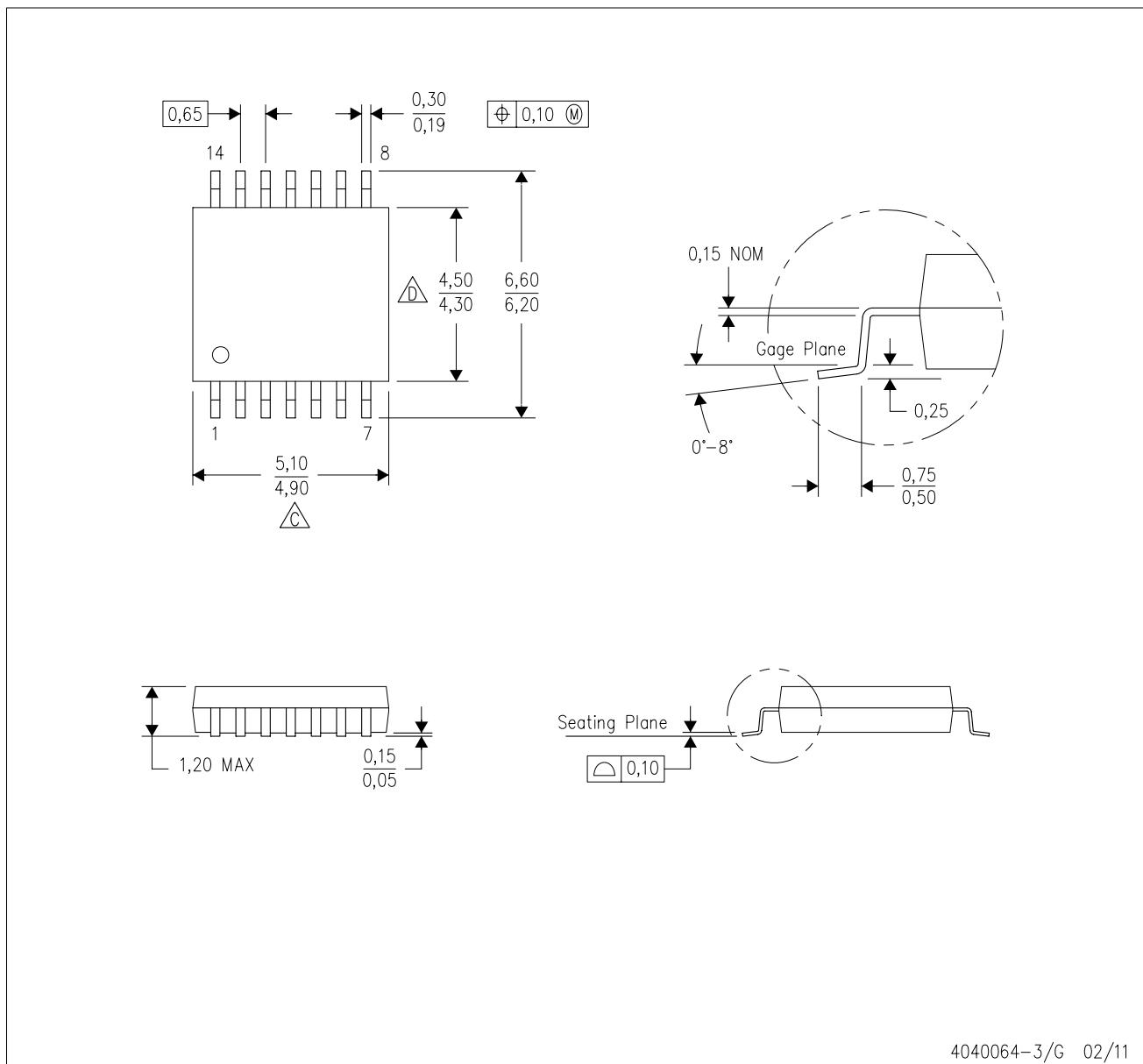
4211283-3/E 08/12

NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- Publication IPC-7351 is recommended for alternate designs.
- 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.
- Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



NOTES: A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.

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 each side.

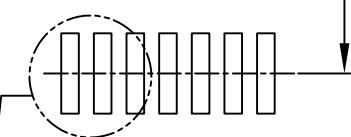
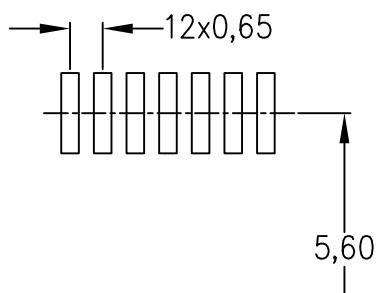
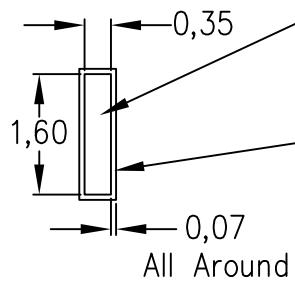
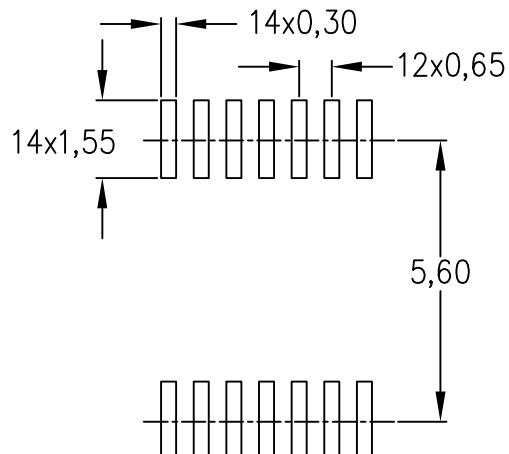
 D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.

E. Falls within JEDEC MO-153

4040064-3/G 02/11

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE

Example Board Layout  
(Note C)Example  
Non Soldermask Defined PadExample  
Pad Geometry  
(See Note C)Example  
Solder Mask Opening  
(See Note E)Stencil Openings  
(Note D)

4211284-2/F 12/12

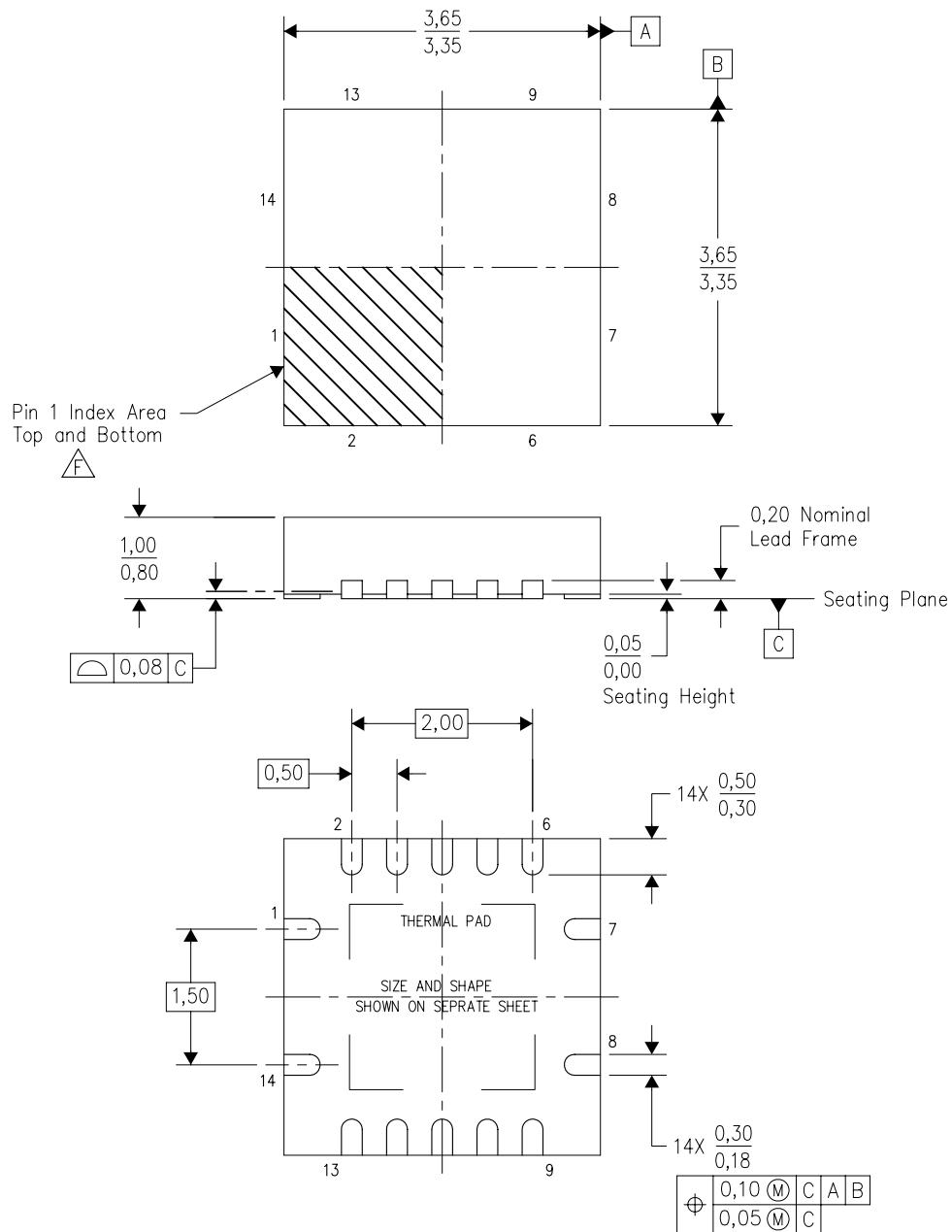
NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- Publication IPC-7351 is recommended for alternate designs.
- 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.
- Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

## MECHANICAL DATA

RGY (S-PVQFN-N14)

PLASTIC QUAD FLATPACK NO-LEAD



Bottom View

4203539-2/l 06/2011

NOTES:

- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
- B. This drawing is subject to change without notice.
- C. QFN (Quad Flatpack No-Lead) package configuration.
- D. The package thermal pad must be soldered to the board for thermal and mechanical performance.
- E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
- F. Pin 1 identifiers are located on both top and bottom of the package and within the zone indicated. The Pin 1 identifiers are either a molded, marked, or metal feature.
- G. Package complies to JEDEC MO-241 variation BA.

# THERMAL PAD MECHANICAL DATA

RGY (S-PVQFN-N14)

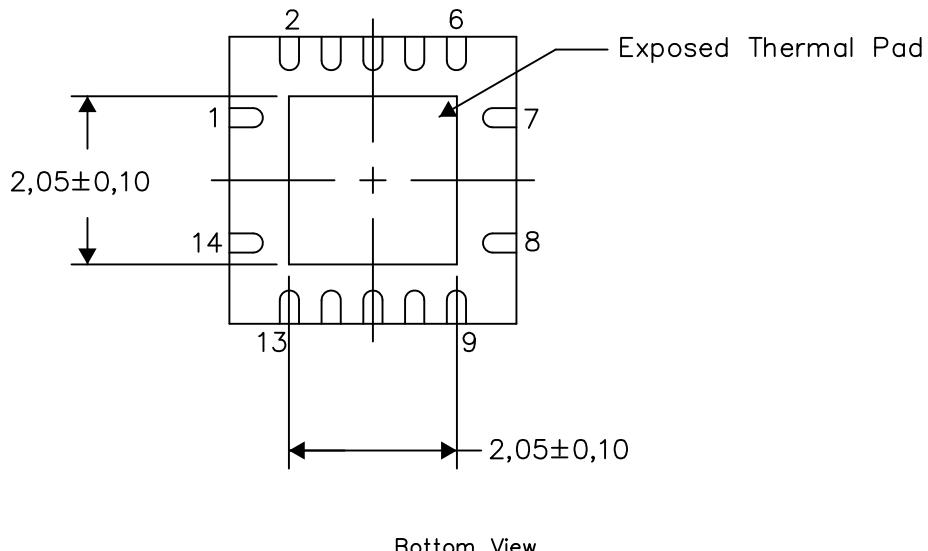
PLASTIC QUAD FLATPACK NO-LEAD

## THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at [www.ti.com](http://www.ti.com).

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

Exposed Thermal Pad Dimensions

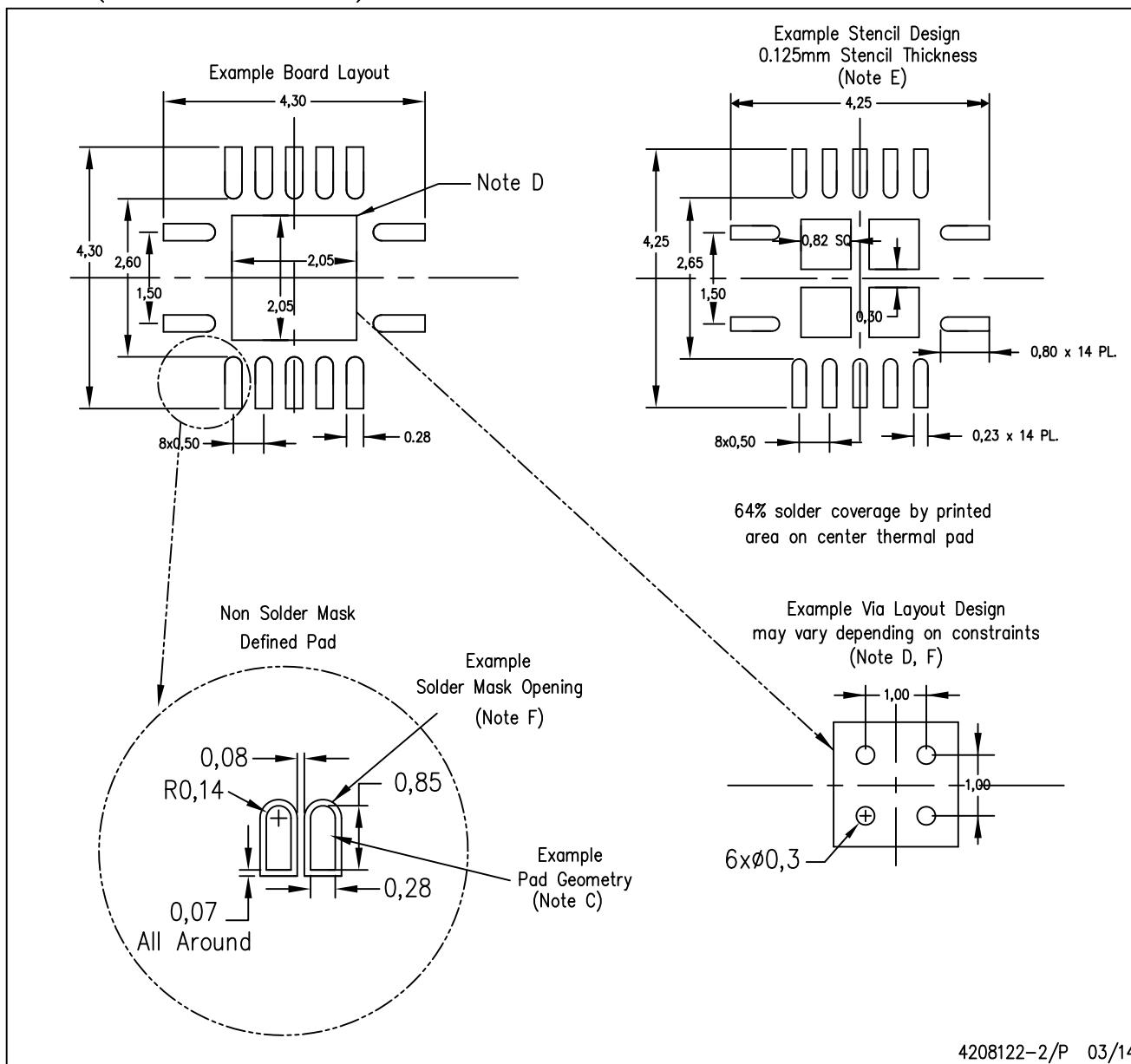
4206353-2/P 03/14

NOTE: All linear dimensions are in millimeters

## LAND PATTERN DATA

RGY (S-PVQFN-N14)

PLASTIC QUAD FLATPACK NO-LEAD



4208122-2/P 03/14

NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- Publication IPC-7351 is recommended for alternate designs.
- This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat-Pack QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at [www.ti.com](http://www.ti.com) <<http://www.ti.com>>.
- 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 stencil design considerations.
- Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.

## MECHANICAL DATA

**NS (R-PDSO-G\*\*)**

## PLASTIC SMALL-OUTLINE PACKAGE

**14-PINS SHOWN**



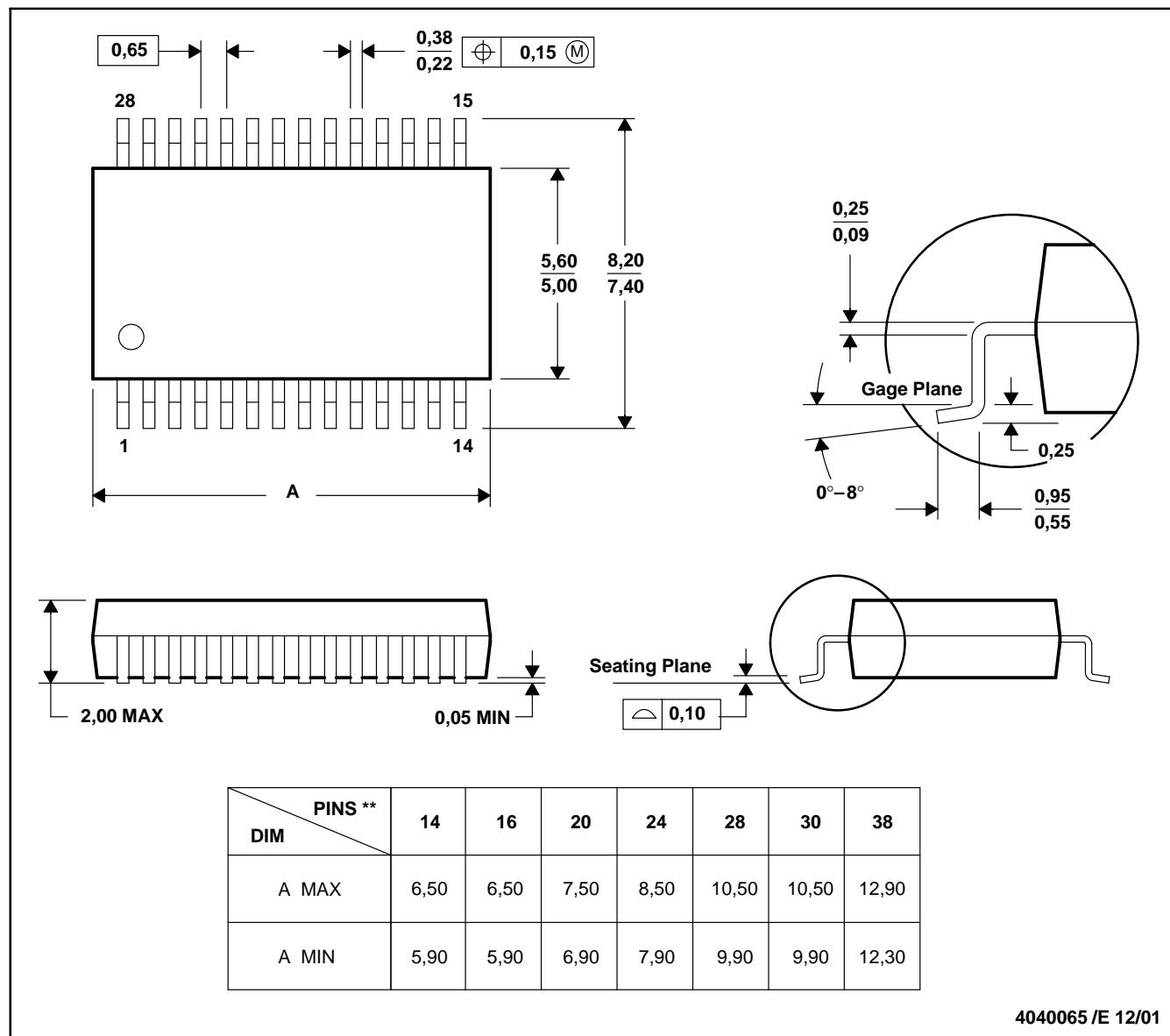
NOTES:

- 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.

## DB (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE

28 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.  
 D. Falls within JEDEC MO-150

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DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
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Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
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Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>
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