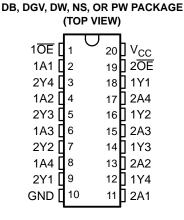
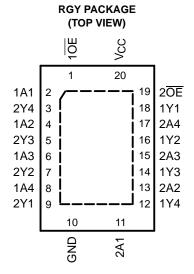
### SN74LV244AT OCTAL BUFFER/DRIVER WITH 3-STATE OUTPUTS

**FEATURES** 

- Inputs Are TTL-Voltage Compatible
- 4.5-V to 5.5-V V<sub>CC</sub> Operation
- Typical t<sub>nd</sub> = 5.4 ns at 5 V
- Typical V<sub>OLP</sub> (Output Ground Bounce)
   <0.8 V at V<sub>CC</sub> = 5 V, T<sub>Δ</sub> = 25°C
- Typical V<sub>OHV</sub> (Output V<sub>OH</sub> Undershoot)
   >2.3 V at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C
- Supports Mixed-Mode Voltage Operation on All Ports
- I<sub>off</sub> Supports Partial-Power-Down Mode Operation
- 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 octal buffer/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 SN74LV244AT is organized as two 4-bit buffers/line drivers with separate output-enable ( $\overline{OE}$ ) inputs. When  $\overline{OE}$  is low, the device passes data from the A inputs to the Y outputs. When  $\overline{OE}$  is high, the outputs are in the high-impedance state.

#### ORDERING INFORMATION

T <sub>A</sub>	PACK	AGE <sup>(1)</sup>	ORDERABLE PART NUMBER	TOP-SIDE MARKING
	QFN – RGY	Reel of 1000	SN74LV244ATRGYR	VV244
	SOIC - DW	Tube of 25	SN74LV244ATDW	LV244AT
	SOIC - DVV	Reel of 2000	SN74LV244ATDWR	LV244A1
	SOP - NS	Reel of 2000	SN74LV244ATNSR	74LV244AT
–40°C to 85°C	SSOP - DB	Reel of 2000	SN74LV244ATDBR	LV244AT
		Tube of 70	SN74LV244ATPW	
	TSSOP - PW	Reel of 2000	SN74LV244ATPWR	LV244AT
		Reel of 250	SN74LV244ATPWT	
	TVSOP – DGV	Reel of 2000	SN74LV244ATDGVR	LV244AT

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



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.



### **DESCRIPTION/ORDERING INFORMATION (CONTINUED)**

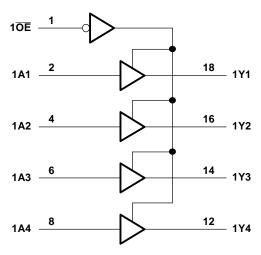
To ensure the high-impedance state during power up or power down,  $\overline{\text{OE}}$  shall be tied to  $V_{\text{CC}}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

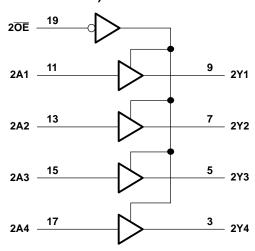
This device is fully specified for partial-power-down applications using  $I_{\text{off}}$ . The  $I_{\text{off}}$  circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

# FUNCTION TABLE (EACH 4-BIT BUFFER/DRIVER)

INP	UTS	OUTPUT
ŌĒ	Α	Υ
L	Н	Н
L	L	L
Н	X	Z

#### **LOGIC DIAGRAM (POSITIVE LOGIC)**







### SN74LV244AT OCTAL BUFFER/DRIVER WITH 3-STATE OUTPUTS

### Absolute Maximum Ratings<sup>(1)</sup>

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

			MIN	MAX	UNIT	
$V_{CC}$	Supply voltage range		-0.5	7	V	
$V_{I}$	Input voltage range(2)		-0.5	7	V	
Vo	Voltage range applied to any output in the	high-impedance or power-off state <sup>(2)</sup>	-0.5	7	V	
Vo	Output voltage range applied in the high of	or low state <sup>(2)(3)</sup>	-0.5	V <sub>CC</sub> + 0.5	V	
I <sub>IK</sub>	Input clamp current	V <sub>1</sub> < 0		-20	mA	
I <sub>OK</sub>	Output clamp current	V <sub>O</sub> < 0		-50	mA	
Io	Continuous output current	$V_O = 0$ to $V_{CC}$		±35	mA	
	Continuous current through V <sub>CC</sub> or GND					
		DB package <sup>(4)</sup>		70		
		DGV package <sup>(4)</sup>		92		
0	Deal and the good in a day of	DW package <sup>(4)</sup>		58	0000	
$\theta_{JA}$	Package thermal impedance	NS package <sup>(4)</sup>		60	°C/W	
		PW package (4)		83		
		RGY package <sup>(5)</sup>		37		
T <sub>stg</sub>	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 and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) This value is limited to 5.5 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<sup>(1)</sup>

			MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage		4.5	5.5	V
$V_{IH}$	High-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2		V
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V		0.8	V
VI	Input voltage		0	5.5	V
.,	Outrot valta as	High or low state	0	$V_{CC}$	V
Vo	Output voltage	3-state	0	5.5	V
I <sub>OH</sub>	High-level output current	V <sub>CC</sub> = 4.5 V to 5.5 V		-16	mA
I <sub>OL</sub>	Low-level output current	V <sub>CC</sub> = 4.5 V to 5.5 V		16	mA
Δt/Δν	Input transition rise or fall rate	V <sub>CC</sub> = 4.5 V to 5.5 V		20	ns/V
T <sub>A</sub>	Operating free-air temperature		-40	85	°C

<sup>(1)</sup> All unused inputs of the device must be held at V<sub>CC</sub> 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 <sub>CC</sub>	T,	λ = 25°C	;	T <sub>A</sub> = -		UNIT	
			MIN	TYP	MAX	MIN	MAX		
V	$I_{OH} = -50 \mu A$	4.5 V	4.4	4.5		4.4		V	
V <sub>OH</sub>	$I_{OH} = -16 \text{ mA}$	4.5 V	3.8			3.8		V	
V	$I_{OL} = 50 \mu A$	4.5 V		0	0.1		0.1	V	
V <sub>OL</sub>	$I_{OL} = 16 \text{ mA}$	4.5 V			0.55		0.55	V	
I <sub>I</sub>	$V_I = 5.5 \text{ V or GND}$	0 to 5.5 V			±0.1		±1	μΑ	
I <sub>OZ</sub>	$V_O = V_{CC}$ or GND	5.5 V			±0.25		±2.5	μΑ	
I <sub>cc</sub>	$V_I = V_{CC}$ or GND, $I_O = 0$	5.5 V			2		20	μΑ	
$\Delta I_{CC}^{(1)}$	One input at 3.4 V, Other inputs at V <sub>CC</sub> or GND	5.5 V			1.35		1.5	mA	
I <sub>off</sub>	$V_I$ or $V_O = 0$ to 5.5 V	0			0.5		5	μΑ	
C <sub>i</sub>	$V_I = V_{CC}$ or GND			4.5				pF	

<sup>(1)</sup> This is the increase in supply current for each input at one of the specified TTL voltage levels, rather than 0 V or V<sub>CC</sub>.

### **Switching Characteristics**

over recommended operating free-air temperature range,  $V_{CC}$  = 5 V  $\pm$  0.5 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM	то	LOAD	T,	ղ = 25°0	3	MIN	MAX	UNIT
PARAMETER	(INPUT)	(OUTPUT)	CAPACITANCE	MIN	TYP	MAX	IVIIIN	WAX	ONII
t <sub>PLH</sub>	A or B	B or A	$C_1 = 15 \text{ pF}$	2.6	5/4	7.4	1	8.5	ns
t <sub>PHL</sub>	AUID	B Or A	C <sub>L</sub> = 15 pr	2.4	5.4	7.4	1	8.5	115
t <sub>PZH</sub>	<del>OE</del>	A or B	C <sub>L</sub> = 15 pF	2.2	7.7	10.4	1	12	nc
t <sub>PZL</sub>	OE	AUID	C <sub>L</sub> = 15 pr	2.7	7.7	10.4	1	12	ns
t <sub>PHZ</sub>	OE.	A or B	C <sub>L</sub> = 15 pF	2.2	3.9	7.7	1	8	ns
t <sub>PLZ</sub>	ŌĒ		C <sub>L</sub> = 15 pr	2.5	3.9	7.7	1	8	113
t <sub>PLH</sub>	A or B	B or A	C <sub>L</sub> = 50 pF	4	5.9	8.9	1	9.5	ns
t <sub>PHL</sub>	AOIB			4.7	5.9	8.9	1	9.5	113
t <sub>PZH</sub>	<del>OE</del>	A or B	C = 50 pF	3.9	8.2	11.4	1	13	ns
t <sub>PZL</sub>	OE	AUIB	$C_L = 50 \text{ pF}$	4.9	8.2	11.4	1	13	115
t <sub>PHZ</sub>	<del>OE</del>	A or B	C <sub>L</sub> = 50 pF	3.3	8.8	11.4	1	13	ne
t <sub>PLZ</sub>	OE .	AUIB	OL = 50 pF	3.2	8.8	11.4	1	13	ns
t <sub>sk(o)</sub>			C <sub>L</sub> = 50 pF			1		1	ns

### Noise Characteristics<sup>(1)</sup>

 $V_{CC} = 5 \text{ V}, C_L = 50 \text{ pF}$ 

	PARAMETER	Т	T <sub>A</sub> = 25°C			
	PARAMETER	MIN	TYP	MAX	UNIT	
V <sub>OL(P)</sub>	Quiet output, maximum dynamic V <sub>OL</sub>		0.8	1	V	
$V_{OL(V)}$	Quiet output, minimum dynamic V <sub>OL</sub>		-0.8	-1	V	
V <sub>OH(V)</sub>	Quiet output, minimum dynamic V <sub>OH</sub>		4		V	
$V_{IH(D)}$	High-level dynamic input voltage	2			V	
$V_{IL(D)}$	Low-level dynamic input voltage			0.8	V	

<sup>(1)</sup> Characteristics are for surface-mount packages only.





SCES572C-JUNE 2004-REVISED AUGUST 2005

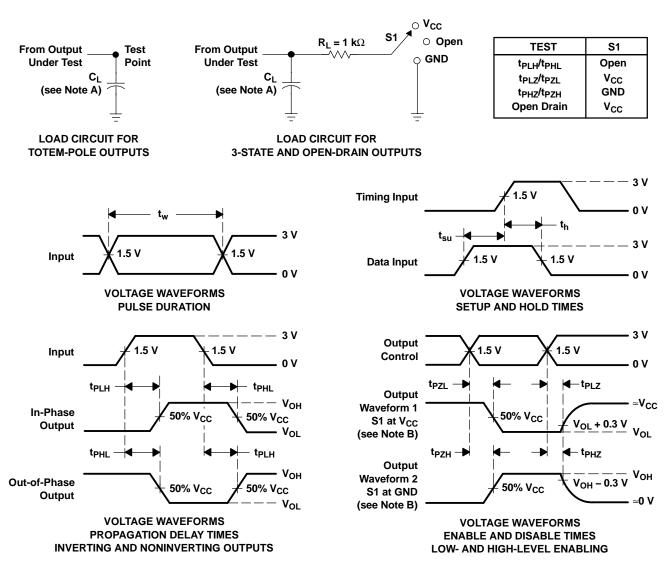
### **Operating Characteristics**

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

	PARAMETER		TEST CO	ONDITIONS	TYP	UNIT
$C_{pd}$	Power dissipation capacitance	Outputs enabled	$C_L = 50 \text{ pF},$	f = 10 MHz	8	pF



#### PARAMETER MEASUREMENT INFORMATION



NOTES: A. C<sub>L</sub> includes probe and jig 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. All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  1 MHz,  $Z_O = 50 \Omega$ ,  $t_f \leq$  3 ns.  $t_f \leq$  3 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<sub>PZL</sub> and t<sub>PZH</sub> are the same as t<sub>en</sub>.
- G.  $t_{PHL}$  and  $t_{PLH}$  are the same as  $t_{pd}$ .
- H. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuits and Voltage Waveforms





24-Aug-2014

#### **PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead/Ball Finish	MSL Peak Temp	Op Temp (°C)	Device Marking (4/5)	Samples
SN74LV244ATDWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV244AT	Samples
SN74LV244ATNSR	ACTIVE	SO	NS	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	74LV244AT	Samples
SN74LV244ATPW	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV244AT	Samples
SN74LV244ATPWR	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LV244AT	Samples
SN74LV244ATRGYR	ACTIVE	VQFN	RGY	20	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	VV244	Samples
SN74LV244ATRGYRG4	ACTIVE	VQFN	RGY	20	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	VV244	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) 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.



### PACKAGE OPTION ADDENDUM

24-Aug-2014

(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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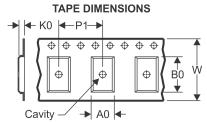
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### PACKAGE MATERIALS INFORMATION

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### TAPE AND REEL INFORMATION





	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	
P1	Pitch between successive cavity centers

#### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



#### \*All dimensions are nominal

All differsions are northinal													
Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant	
SN74LV244ATDWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1	
SN74LV244ATNSR	SO	NS	20	2000	330.0	24.4	9.0	13.0	2.4	12.0	24.0	Q1	
SN74LV244ATPWR	TSSOP	PW	20	2000	330.0	16.4	6.95	7.1	1.6	8.0	16.0	Q1	
SN74LV244ATRGYR	VQFN	RGY	20	3000	330.0	12.4	3.8	4.8	1.6	8.0	12.0	Q1	

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\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LV244ATDWR	SOIC	DW	20	2000	367.0	367.0	45.0
SN74LV244ATNSR	SO	NS	20	2000	367.0	367.0	45.0
SN74LV244ATPWR	TSSOP	PW	20	2000	367.0	367.0	38.0
SN74LV244ATRGYR	VQFN	RGY	20	3000	367.0	367.0	35.0



SOIC



- 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.



SOIC



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.



SOIC



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

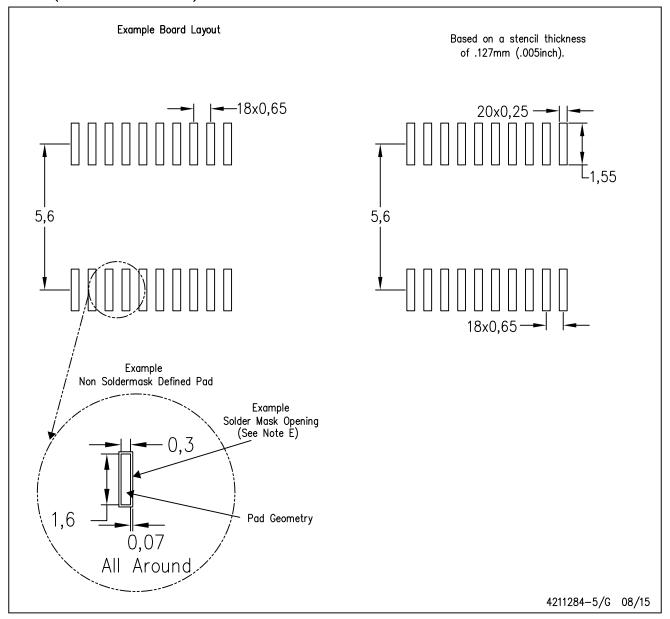


- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M—1994.
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
- E. Falls within JEDEC MO-153



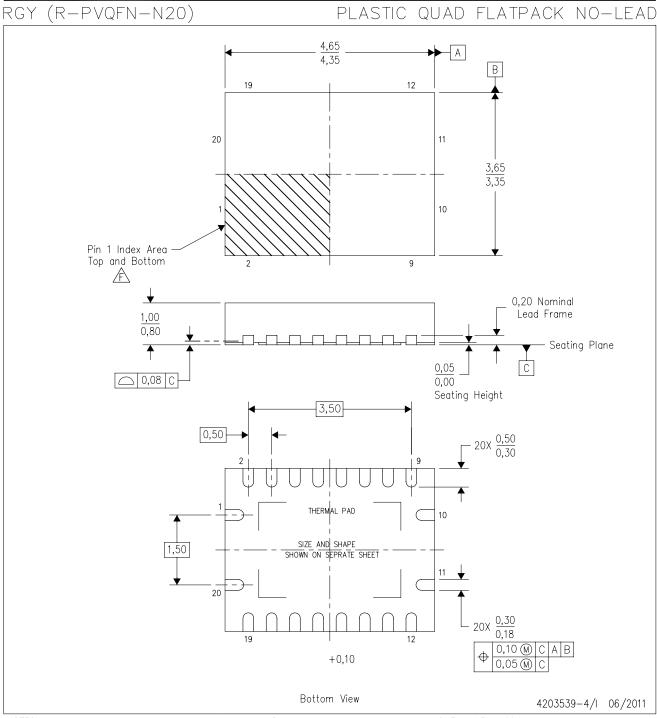
# PW (R-PDSO-G20)

### PLASTIC SMALL OUTLINE



- 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.





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.
- 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.



### RGY (R-PVQFN-N20)

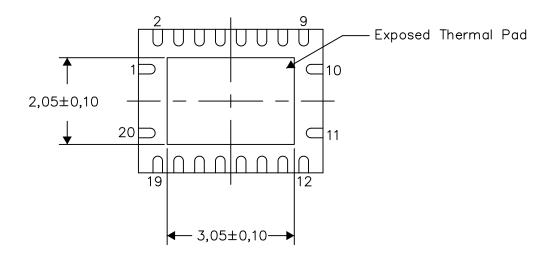
#### PLASTIC QUAD FLATPACK NO-LEAD

#### 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.

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



Bottom View

Exposed Thermal Pad Dimensions

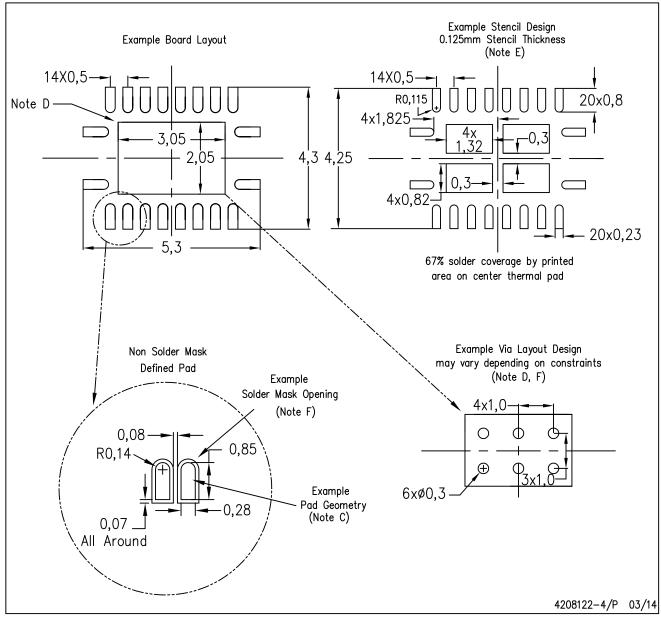
4206353-4/P 03/14

NOTE: All linear dimensions are in millimeters



## RGY (R-PVQFN-N20)

### PLASTIC QUAD FLATPACK NO-LEAD



- 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. 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 <a href="https://www.ti.com">http://www.ti.com</a>.
- E. 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.
- F. Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.



### **MECHANICAL DATA**

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

## 14-PINS SHOWN

#### PLASTIC SMALL-OUTLINE PACKAGE



- 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.



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