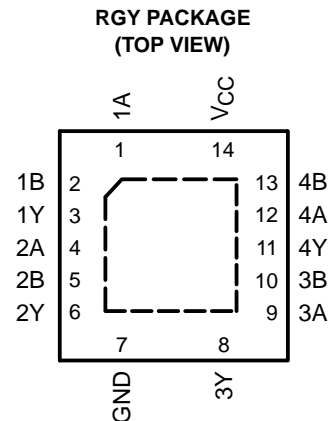


## FEATURES

- Optimized for 1.8-V Operation and Is 3.6-V I/O Tolerant to Support Mixed-Mode Signal Operation
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- Sub-1-V Operable
- Max  $t_{pd}$  of 2.2 ns at 1.8 V
- Low Power Consumption, 10- $\mu$ A Max  $I_{CC}$
- $\pm 8$ -mA Output Drive at 1.8 V
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- 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 quadruple 2-input positive-OR gate is operational at 0.8-V to 2.7-V  $V_{CC}$ , but is designed specifically for 1.65-V to 1.95-V  $V_{CC}$  operation.

The SN74AUC32 device performs the Boolean function  $Y = A + B$  or  $Y = \overline{\overline{A} \cdot \overline{B}}$  in positive logic.

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

## ORDERING INFORMATION

| $T_A$         | PACKAGE <sup>(1)</sup> |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---------------|------------------------|---------------|-----------------------|------------------|
| -40°C to 85°C | QFN – RGY              | Tape and reel | SN74AUC32RGYR         | MS32             |

(1) 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 GATE)

| INPUTS |   | OUTPUT |
|--------|---|--------|
| A      | B | Y      |
| H      | X | H      |
| X      | H | H      |
| L      | L | L      |

## LOGIC DIAGRAM, EACH GATE (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.

# SN74AUC32 QUADRUPLE 2-INPUT POSITIVE-OR GATE

SCES513A–NOVEMBER 2003–REVISED MARCH 2005

## 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      | 3.6            | V    |
| $V_I$         | Input voltage range <sup>(2)</sup>  | -0.5      | 3.6            | V    |
| $V_O$         | Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup> | -0.5      | 3.6            | V    |
| $V_O$         | Output voltage range <sup>(2)</sup>   | -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   |           | ±20            | mA   |
|               | Continuous current through $V_{CC}$ or GND  |           | ±100           | mA   |
| $\theta_{JA}$ | Package thermal impedance <sup>(3)</sup>  |           | 47             | °C/W |
| $T_{stg}$     | 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) The package thermal impedance is calculated in accordance with JESD 51-5.

## Recommended Operating Conditions<sup>(1)</sup>

|                     |                                    | MIN                                       | MAX                  | UNIT |
|---------------------|------------------------------------|---|----------------------|------|
| $V_{CC}$            | Supply voltage                     | 0.8                                       | 2.7                  | V    |
| $V_{IH}$            | High-level input voltage           | $V_{CC} = 0.8$ V                          | $V_{CC}$             | V    |
|                     |                                    | $V_{CC} = 1.1$ V to 1.95 V                | $0.65 \times V_{CC}$ |      |
|                     |                                    | $V_{CC} = 2.3$ V to 2.7 V                 | 1.7                  |      |
| $V_{IL}$            | Low-level input voltage            | $V_{CC} = 0.8$ V                          | 0                    | V    |
|                     |                                    | $V_{CC} = 1.1$ V to 1.95 V                | $0.35 \times V_{CC}$ |      |
|                     |                                    | $V_{CC} = 2.3$ V to 2.7 V                 | 0.7                  |      |
| $V_I$               | Input voltage                      | 0   | 3.6                  | V    |
| $V_O$               | Output voltage                     | 0   | $V_{CC}$             | V    |
| $I_{OH}$            | High-level output current          | $V_{CC} = 0.8$ V                          | -0.7                 | mA   |
|                     |                                    | $V_{CC} = 1.1$ V                          | -3                   |      |
|                     |                                    | $V_{CC} = 1.4$ V                          | -5                   |      |
|                     |                                    | $V_{CC} = 1.65$ V                         | -8                   |      |
|                     |                                    | $V_{CC} = 2.3$ V                          | -9                   |      |
| $I_{OL}$            | Low-level output current           | $V_{CC} = 0.8$ V                          | 0.7                  | mA   |
|                     |                                    | $V_{CC} = 1.1$ V                          | 3                    |      |
|                     |                                    | $V_{CC} = 1.4$ V                          | 5                    |      |
|                     |                                    | $V_{CC} = 1.65$ V                         | 8                    |      |
|                     |                                    | $V_{CC} = 2.3$ V                          | 9                    |      |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | $V_{CC} = 0.8$ V to 1.65 V <sup>(2)</sup> | 20                   | ns/V |
|                     |                                    | $V_{CC} = 1.65$ V to 2.3 V <sup>(3)</sup> | 20                   |      |
|                     |                                    | $V_{CC} = 2.3$ V to 2.7 V <sup>(3)</sup>  | 20                   |      |
| $T_A$               | 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.
- (2) The data was taken at  $C_L = 15$  pF,  $R_L = 2$  k $\Omega$  (see Figure 1).
- (3) The data was taken at  $C_L = 30$  pF,  $R_L = 500$   $\Omega$  (see Figure 1).

### Electrical Characteristics

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

| PARAMETER        |               | TEST CONDITIONS   | V <sub>CC</sub> | MIN                   | TYP <sup>(1)</sup> | MAX | UNIT |
|------------------|---------------|---|-----------------|-----------------------|--------------------|-----|------|
| V <sub>OH</sub>  |               | I <sub>OH</sub> = -100 μA                                   | 0.8 V to 2.7 V  | V <sub>CC</sub> - 0.1 |                    |     | V    |
|                  |               | I <sub>OH</sub> = -0.7 mA                                   | 0.8 V           | 0.55                  |                    |     |      |
|                  |               | I <sub>OH</sub> = -3 mA                                     | 1.1 V           | 0.8                   |                    |     |      |
|                  |               | I <sub>OH</sub> = -5 mA                                     | 1.4 V           | 1                     |                    |     |      |
|                  |               | I <sub>OH</sub> = -8 mA                                     | 1.65 V          | 1.2                   |                    |     |      |
|                  |               | I <sub>OH</sub> = -9 mA                                     | 2.3 V           | 1.8                   |                    |     |      |
| V <sub>OL</sub>  |               | I <sub>OL</sub> = 100 μA                                    | 0.8 V to 2.7 V  | 0.2                   |                    |     | V    |
|                  |               | I <sub>OL</sub> = 0.7 mA                                    | 0.8 V           | 0.25                  |                    |     |      |
|                  |               | I <sub>OL</sub> = 3 mA                                      | 1.1 V           | 0.3                   |                    |     |      |
|                  |               | I <sub>OL</sub> = 5 mA                                      | 1.4 V           | 0.4                   |                    |     |      |
|                  |               | I <sub>OL</sub> = 8 mA                                      | 1.65 V          | 0.45                  |                    |     |      |
|                  |               | I <sub>OL</sub> = 9 mA                                      | 2.3 V           | 0.6                   |                    |     |      |
| I <sub>I</sub>   | A or B inputs | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 0 to 2.7 V      | ±5                    |                    |     | μA   |
| I <sub>off</sub> |               | V <sub>I</sub> or V <sub>O</sub> = 2.7 V                    | 0               | ±10                   |                    |     | μA   |
| I <sub>CC</sub>  |               | V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0 | 0.8 V to 2.7 V  | 10                    |                    |     | μA   |
| C <sub>i</sub>   |               | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 2.5 V           | 2                     |                    |     | pF   |

(1) All typical values are at T<sub>A</sub> = 25°C.

### Switching Characteristics

over recommended operating free-air temperature range, C<sub>L</sub> = 15 pF (unless otherwise noted) (see Figure 1)

| PARAMETER       | FROM (INPUT) | TO (OUTPUT) | V <sub>CC</sub> = 0.8 V | V <sub>CC</sub> = 1.2 V ± 0.1 V |     | V <sub>CC</sub> = 1.5 V ± 0.1 V |     | V <sub>CC</sub> = 1.8 V ± 0.15 V |     |     | V <sub>CC</sub> = 2.5 V ± 0.2 V |     | UNIT |
|-----------------|--------------|-------------|-------------------------|---------------------------------|-----|---------------------------------|-----|----------------------------------|-----|-----|---------------------------------|-----|------|
|                 |              |             | TYP                     | MIN                             | MAX | MIN                             | MAX | MIN                              | TYP | MAX | MIN                             | MAX |      |
| t <sub>pd</sub> | A or B       | Y           | 5.3                     | 0.9                             | 3.5 | 0.7                             | 2.7 | 0.6                              | 1   | 2.2 | 0.5                             | 1.3 | ns   |

### Switching Characteristics

over recommended operating free-air temperature range, C<sub>L</sub> = 30 pF (unless otherwise noted) (see Figure 1)

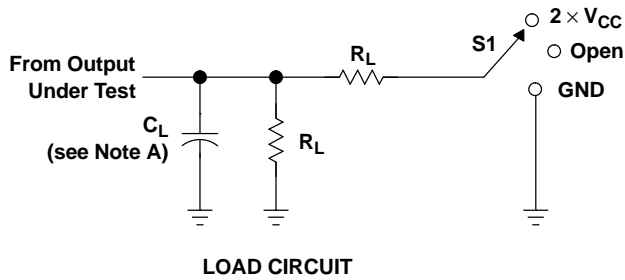
| PARAMETER       | FROM (INPUT) | TO (OUTPUT) | V <sub>CC</sub> = 1.8 V ± 0.15 V |     |     | V <sub>CC</sub> = 2.5 V ± 0.2 V |     | UNIT |
|-----------------|--------------|-------------|----------------------------------|-----|-----|---------------------------------|-----|------|
|                 |              |             | MIN                              | TYP | MAX | MIN                             | MAX |      |
| t <sub>pd</sub> | A or B       | Y           | 0.9                              | 1.6 | 2.5 | 0.6                             | 2.1 | ns   |

### operating characteristics

T<sub>A</sub> = 25°C

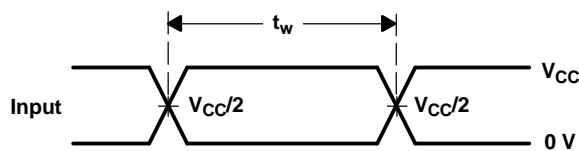
| PARAMETER       | TEST CONDITIONS                             | V <sub>CC</sub> = 0.8 V | V <sub>CC</sub> = 1.2 V | V <sub>CC</sub> = 1.5 V | V <sub>CC</sub> = 1.8 V | V <sub>CC</sub> = 2.5 V | UNIT |
|-----------------|---|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|------|
|                 |   | TYP                     | TYP                     | TYP                     | TYP                     | TYP                     |      |
| C <sub>pd</sub> | Power dissipation capacitance<br>f = 10 MHz | 14                      | 14                      | 14                      | 14                      | 17                      | pF   |

PARAMETER MEASUREMENT INFORMATION

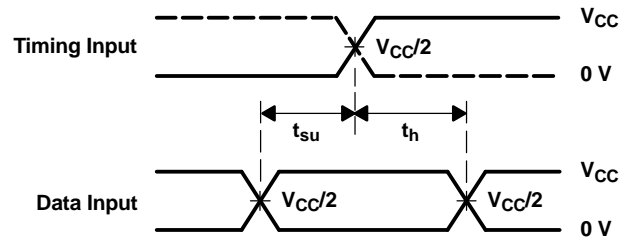


| TEST              | S1                |
|-------------------|-------------------|
| $t_{PLH}/t_{PHL}$ | Open              |
| $t_{PLZ}/t_{PZL}$ | $2 \times V_{CC}$ |
| $t_{PHZ}/t_{PZH}$ | GND               |

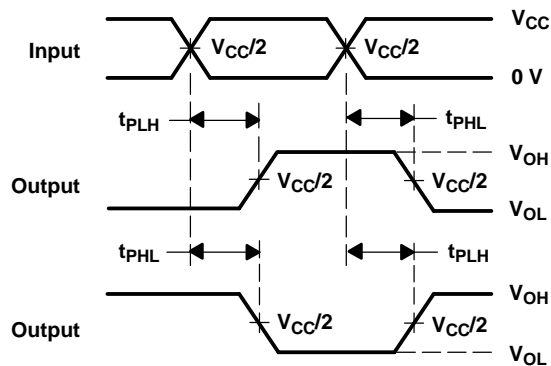
| $V_{CC}$           | $C_L$ | $R_L$        | $V_{\Delta}$ |
|--------------------|-------|--------------|--------------|
| 0.8 V              | 15 pF | 2 k $\Omega$ | 0.1 V        |
| 1.2 V $\pm$ 0.1 V  | 15 pF | 2 k $\Omega$ | 0.1 V        |
| 1.5 V $\pm$ 0.1 V  | 15 pF | 2 k $\Omega$ | 0.1 V        |
| 1.8 V $\pm$ 0.15 V | 15 pF | 2 k $\Omega$ | 0.15 V       |
| 2.5 V $\pm$ 0.2 V  | 15 pF | 2 k $\Omega$ | 0.15 V       |
| 1.8 V $\pm$ 0.15 V | 30 pF | 1 k $\Omega$ | 0.15 V       |
| 2.5 V $\pm$ 0.2 V  | 30 pF | 500 $\Omega$ | 0.15 V       |



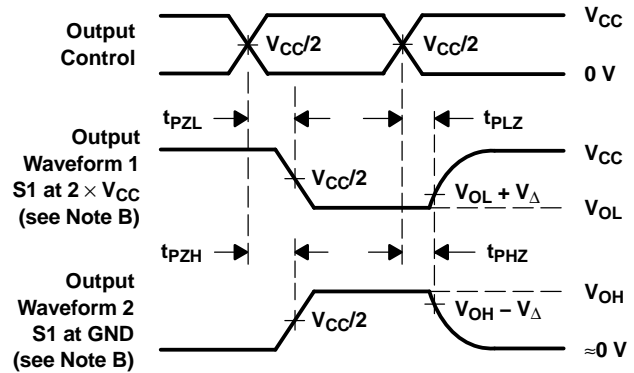
VOLTAGE WAVEFORMS  
 PULSE DURATION



VOLTAGE WAVEFORMS  
 SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
 PROPAGATION DELAY TIMES  
 INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS  
 ENABLE AND DISABLE TIMES  
 LOW- AND HIGH-LEVEL ENABLING

- NOTES: A.  $C_L$  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  $\leq$  10 MHz,  $Z_O = 50 \Omega$ , slew rate  $\geq$  1 V/ns.  
 D. The outputs are measured one at a time, with one 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  $t_{pd}$ .  
 H. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74AUC32RGYR    | ACTIVE                | VQFN         | RGY             | 14   | 3000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-2-260C-1 YEAR          |
| SN74AUC32RGYRG4  | ACTIVE                | VQFN         | RGY             | 14   | 3000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-2-260C-1 YEAR          |

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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**TAPE AND REEL INFORMATION**
**REEL DIMENSIONS**

**TAPE DIMENSIONS**


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

**TAPE AND REEL INFORMATION**

\*All dimensions are nominal

| Device        | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74AUC32RGYR | 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) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74AUC32RGYR | VQFN         | RGY             | 14   | 3000 | 367.0       | 367.0      | 35.0        |

RGY (S-PVQFN-N14)

PLASTIC QUAD FLATPACK NO-LEAD



- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - QFN (Quad Flatpack No-Lead) package configuration.
  - The package thermal pad must be soldered to the board for thermal and mechanical performance.
  - 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.
  - Package complies to JEDEC MO-241 variation BA.



RGY (S-PVQFN-N14)

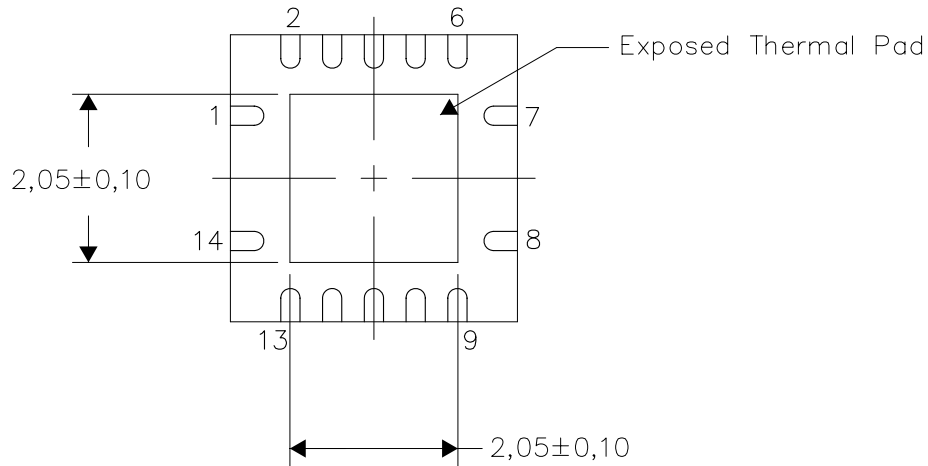
PLASTIC QUAD FLATPACK NO-LEAD

**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

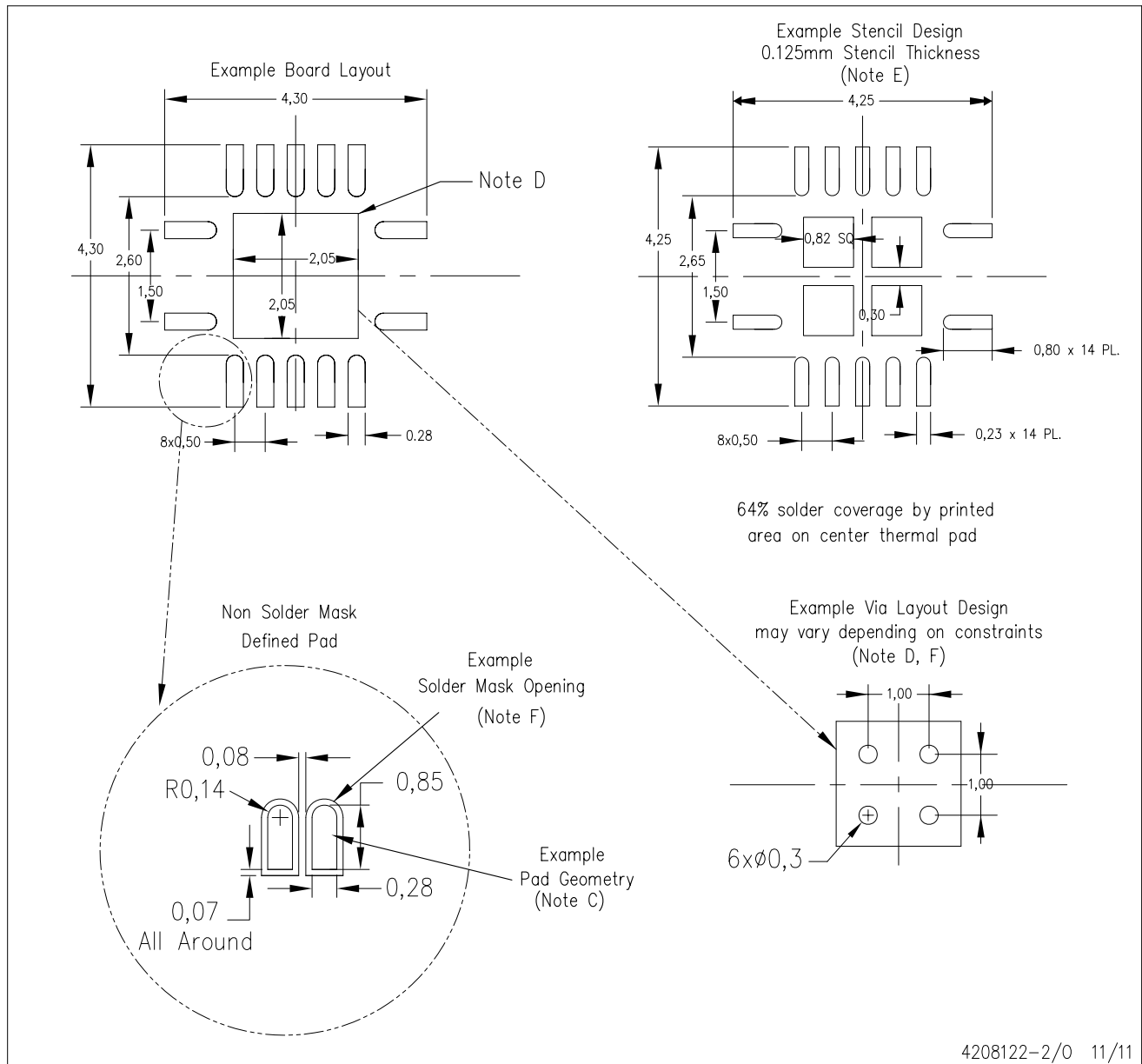
Exposed Thermal Pad Dimensions

4206353-2/0 11/11

NOTE: All linear dimensions are in millimeters

RGY (S-PVQFN-N14)

PLASTIC QUAD FLATPACK NO-LEAD



- 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.

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|                        |  |
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| Data Converters        | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>                       |
| DLP® Products          | <a href="http://www.dlp.com">www.dlp.com</a>   |
| DSP                    | <a href="http://dsp.ti.com">dsp.ti.com</a>   |
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| Logic                  | <a href="http://logic.ti.com">logic.ti.com</a>                                       |
| Power Mgmt             | <a href="http://power.ti.com">power.ti.com</a>                                       |
| 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 Mobile 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> |

### Applications

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|-------------------------------|--|
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| Computers and Peripherals     | <a href="http://www.ti.com/computers">www.ti.com/computers</a>                           |
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