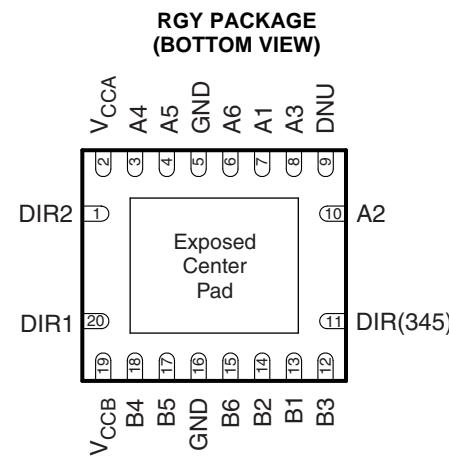
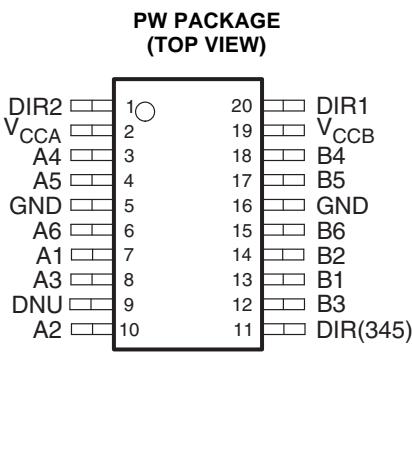


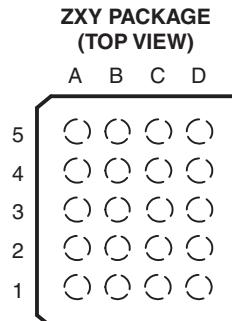
AUDIO CODEC AC'97 VOLTAGE-TRANSLATION TRANSCEIVER

FEATURES

- Voltage-Level Transceiver for Interfacing 1.8 V Audio Codec (AC'97) Controllers With 3.3 V AC'97 Codec Links
- Configurable I/O Switching Levels With Dual-Supply Pins Operating Over Full 1.2-V to 3.6-V Power-Supply Range
- For Low-Power Operation, A and B Ports Are Placed in High-Impedance State When Either Supply Voltage Is Switched Off
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
 - 7000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1500-V Charged-Device Model (C101)



The exposed center pad, if used, must be connected as a secondary ground or left electrically open.



TERMINAL ASSIGNMENTS (20-Ball ZXY Package)

| | A | B | C | D |
|----------|--------------------|------|----------|------------------|
| 5 | V _{CCA} | DIR2 | DIR1 | V _{CCB} |
| 4 | A5 | A4 | B4 | B5 |
| 3 | A6 | GND | GND | B6 |
| 2 | A3 | A1 | B2 | B1 |
| 1 | DNU ⁽¹⁾ | A2 | DIR(345) | B3 |

(1) DNU – Do not use; should be left unconnected

DESCRIPTION/ORDERING INFORMATION

The SN74AVC6T622 is a voltage-level transceiver for interfacing 1.8 V audio codec (AC'97) controllers, the audio/analog modem functionality found in personal computers, with 3.3V AC'97 codec links. With the digital switching levels of today's AC'97 codecs lowering to 1.8-V logic levels, the SN74AVC6T622 device can be used to bridge the gap between legacy 3.3-V AC'97 codecs and AC'97 controllers that are now operating at 1.8 V. The 6-bit wide SN74AVC6T622 device complies with the AC'97 electrical interface (both levels and timing) specification.



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.

Two supply-voltage pins allow the A-port and B-port input switching thresholds to be configured separately. The A port is designed to track V_{CCA} , while the B port is designed to track V_{CCB} . V_{CCA} and V_{CCB} can accept any supply voltage from 1.2 V to 3.6 V.

If either V_{CC} is switched off ($V_{CCA} = 0$ V and/or $V_{CCB} = 0$ V), all outputs are placed in the high-impedance state to conserve power.

The SN74AVC6T622 is available in two 0.5-mm-pitch ball grid array (BGA) packages. The 20-ball package has dimensions of 3 mm \times 2.5 mm, and the 24-ball package measures 3 mm \times 3 mm. Memory cards are widely used in mobile phones, PDAs, digital cameras, personal media players, camcorders, set-top boxes, etc. Low static power consumption and small package size make the SN74AVC6T622 an ideal choice for these applications.

ORDERING INFORMATION

| TA | PACKAGE ⁽¹⁾⁽²⁾ | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---------------|---------------------------|-------------------------------|------------------|
| -40°C to 85°C | QFN – RGY | SN74AVC6T622RGYR | WU622 |
| | TSSOP – PW | SN74AVC6T622PWR | WU622 |
| | UFBGA – ZXY (Pb-Free) | SN74AVC6T622ZX ^Y R | WU622 |

(1) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

(2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

REFERENCE DESIGN

AC'97 Controller

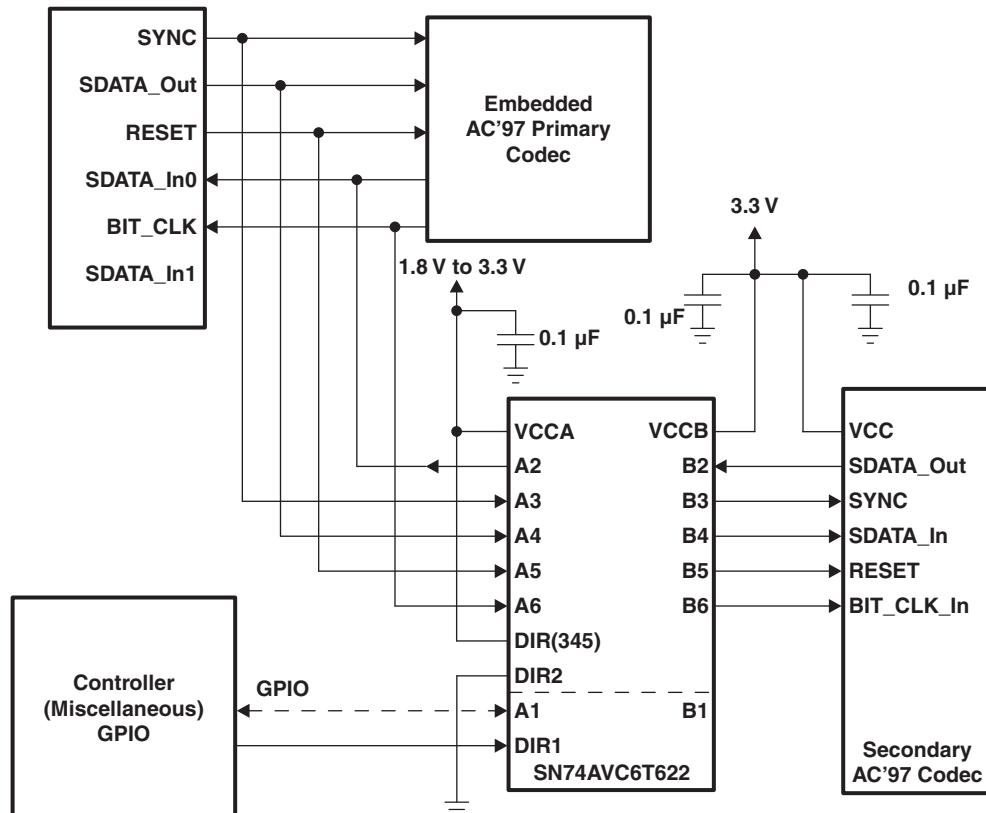


Figure 1. Interfacing 1.8 V AC'97 Controllers With 3.3 V AC'97 Controllers

TERMINAL FUNCTIONS

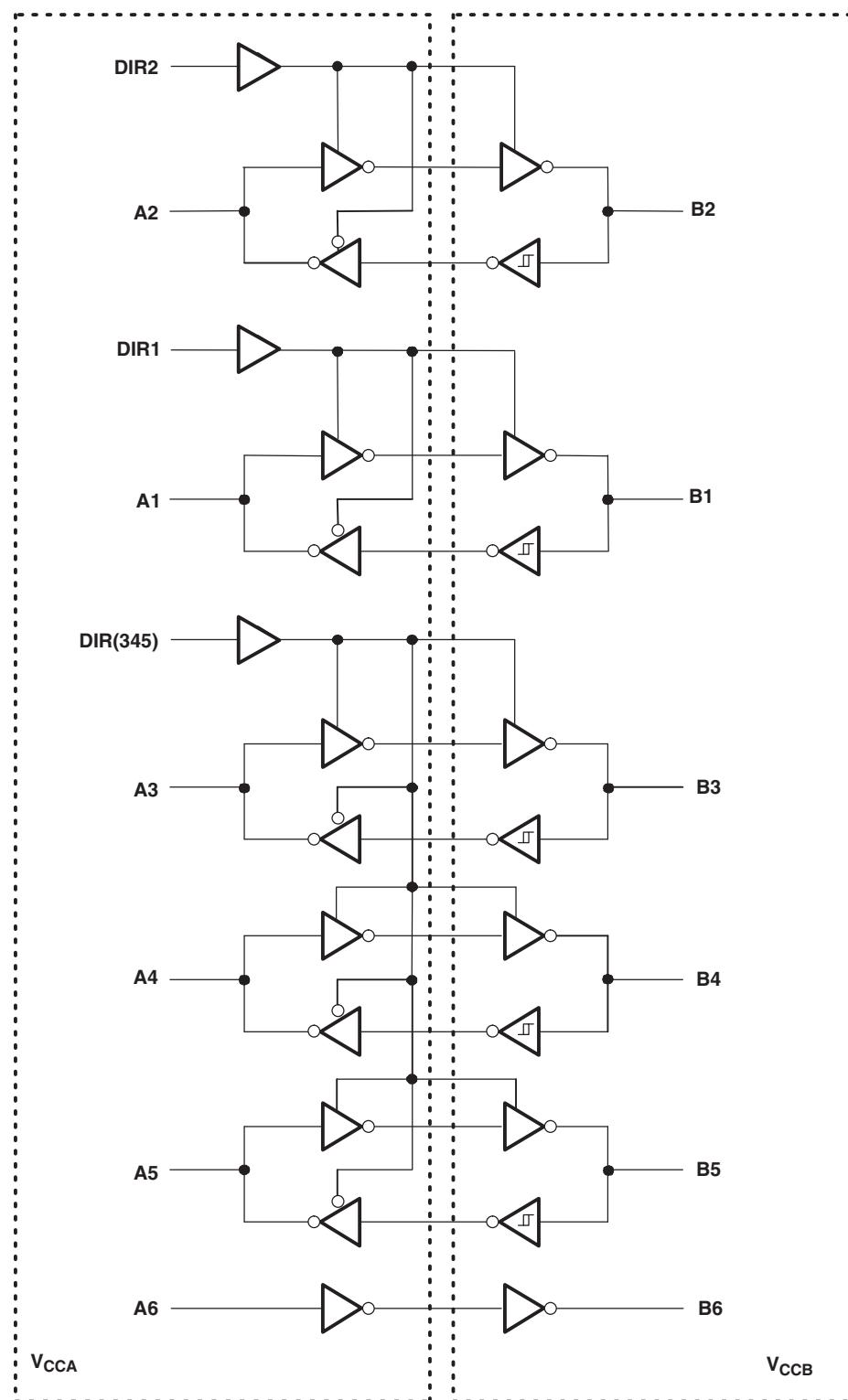
| ZXY BALL NO. | RGY, PW PIN NO. | NAME | TYPE | DESCRIPTION |
|--------------------|--------------------|------------------|------|--|
| A1 | 9 | DNU | | Do not use; leave unconnected |
| A2 | 8 | A3 | I | AC'97 controller SYNC signal |
| A3 | 6 | A6 | I | AC'97 controller BIT_CLK signal |
| A4 | 4 | A5 | I | AC'97 controller RESET signal |
| A5 | 2 | V _{CCA} | Pwr | A-port supply voltage. V _{CCA} powers all A-port I/Os and control pins. |
| B1 | 10 | A2 | O | AC'97 controller SDATA_In0 signal |
| B2 | 7 | A1 | I/O | GPIO to miscellaneous GPIO controller |
| B3, C3 | 5, 16 | GND | — | Ground |
| B4 | 3 | A4 | I | AC'97 controller SDATA_Out signal |
| B5 | 1 | DIR2 | — | Should be tied to GND |
| C1 | 11 | DIR(345) | — | Should be tied to V _{CCA} |
| C2 | 14 | B2 | I | Secondary AC'97 codec SDATA_Out signal |
| C4 | 18 | B4 | O | Secondary AC'97 codec SDATA_In signal |
| C5 | 20 | DIR1 | I | Direction control from miscellaneous GPIO controller |
| D1 | 12 | B3 | O | Secondary AC'97 codec SYNC signal |
| D2 | 13 | B1 | O | Optional GPIO signal if A1 is enabled |
| D3 | 15 | B6 | O | Secondary AC'97 codec BIT_CLK_In signal |
| D4 | 17 | B5 | O | Secondary AC'97 codec RESET signal |
| D5 | 19 | V _{CCB} | Pwr | B-port supply voltage. V _{CCB} powers all B-port I/Os and control pins. |

FUNCTION TABLES

| CONTROL INPUT DIR2 | OUTPUT CIRCUITS | | OPERATION |
|-----------------------|-----------------|---------|-----------|
| | A2 | B2 | |
| High | Hi-Z | Enabled | A2 to B2 |
| Low | Enabled | Hi-Z | B2 to A2 |

| CONTROL INPUT DIR1 | OUTPUT CIRCUITS | | FUNCTION |
|-----------------------|-----------------|---------|----------|
| | A1 | B1 | |
| High | Hi-Z | Enabled | A1 to B1 |
| Low | Enabled | Hi-Z | B1 to A1 |

| CONTROL INPUT DIR(345) | OUTPUT CIRCUITS | | FUNCTION |
|---------------------------|-----------------|------------|----------|
| | A3, A4, A5 | B3, B4, B5 | |
| High | Hi-Z | Enabled | A3 to B3 |
| | | | A4 to B4 |
| | | | A5 to B5 |
| Low | Enabled | Hi-Z | B3 to A3 |
| | | | B4 to A4 |
| | | | B5 to A5 |

LOGIC DIAGRAM (POSITIVE LOGIC)


ABSOLUTE MAXIMUM RATINGS⁽¹⁾

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

| | | MIN | MAX | UNIT |
|---|---|----------------------------|----------------------|------|
| V_{CCA} | Supply voltage range | –0.5 | 4.6 | V |
| V_I | Input voltage range ⁽²⁾ | I/O ports (A port) | –0.5 | 4.6 |
| | | I/O ports (B port) | –0.5 | 4.6 |
| | | Control inputs | –0.5 | 4.6 |
| V_O | Voltage range applied to any output in the high-impedance or power-off state ⁽²⁾ | A port | –0.5 | 4.6 |
| | | B port | –0.5 | 4.6 |
| V_O | Voltage range applied to any output in the high or low state ⁽²⁾⁽³⁾ | A port | –0.5 V_{CCA} + 0.5 | V |
| | | B port | –0.5 V_{CCB} + 0.5 | |
| 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_{CCA} , V_{CCB} , or GND | | | ±100 | mA |
| θ_{JA} | Package thermal impedance | PW package ⁽⁴⁾ | 83 | °C/W |
| | | RGY package ⁽⁵⁾ | 37 | |
| | | ZXY package ⁽⁴⁾ | 193 | |
| 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 voltage and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The output positive-voltage rating may be exceeded up to 4.6 V maximum if the output current rating is observed.
- (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⁾⁽²⁾⁽³⁾

| | | V_{CCI} | V_{CCO} | MIN | MAX | UNIT |
|---------------------|------------------------------------|---------------------------|------------------|-----------------------|-----------|------|
| V_{CCA} | Supply voltage | | | 1.2 | 3.6 | V |
| V_{CCB} | Supply voltage | | | 1.2 | 3.6 | V |
| V_{IH} | High-level input voltage | All inputs ⁽⁴⁾ | 1.2 V to 1.95 V | $V_{CCI} \times 0.65$ | V | |
| | | | 1.95 V to 2.7 V | | 1.7 | |
| | | | 2.7 V to 3.6 V | | 2 | |
| V_{IL} | Low-level input voltage | All inputs ⁽⁴⁾ | 1.2 V to 1.95 V | $V_{CCI} \times 0.35$ | V | |
| | | | 1.95 V to 2.7 V | | 0.7 | |
| | | | 2.7 V to 3.6 V | | 0.8 | |
| V_I | Input voltage | Control inputs | | 0 | 3.6 | V |
| $V_{I/O}$ | Input/output voltage | Active state | | 0 | V_{CCO} | V |
| | | 3-state | | 0 | 3.6 | |
| I_{OH} | High-level output current (A port) | | 1.2 V | mA | mA | |
| | | | 1.4 V to 1.6 V | | | |
| | | | 1.65 V to 1.95 V | | | |
| | | | 2.3 V to 2.7 V | | | |
| | | | 3 V to 3.6 V | | | |
| I_{OL} | Low-level output current (A port) | | 1.2 V | mA | mA | |
| | | | 1.4 V to 1.6 V | | | |
| | | | 1.65 V to 1.95 V | | | |
| | | | 2.3 V to 2.7 V | | | |
| | | | 3 V to 3.6 V | | | |
| I_{OH} | High-level output current (B port) | | 1.2 V | mA | mA | |
| | | | 1.4 V to 1.6 V | | | |
| | | | 1.65 V to 1.95 V | | | |
| | | | 2.3 V to 2.7 V | | | |
| | | | 3 V to 3.6 V | | | |
| I_{OL} | Low-level output current (B port) | | 1.2 V | mA | mA | |
| | | | 1.4 V to 1.6 V | | | |
| | | | 1.65 V to 1.95 V | | | |
| | | | 2.3 V to 2.7 V | | | |
| | | | 3 V to 3.6 V | | | |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | | | | 5 | ns/V |
| T_A | Operating free-air temperature | | | -40 | 85 | °C |

(1) V_{CCI} is the V_{CC} associated with the input port.

(2) V_{CCO} is the V_{CC} associated with the output port.

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

(4) DIR2, DIR1, and DIR(345) are referenced to V_{CCA} .

ELECTRICAL CHARACTERISTICS⁽¹⁾⁽²⁾

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

| PARAMETER | | TEST CONDITIONS | | V _{CCA} | V _{CCB} | T _A = 25°C | | | UNIT | |
|-------------------------------------|--|--|---|------------------|------------------|------------------------|--------------------|-----|------|--|
| | | | | | | MIN | TYP ⁽³⁾ | MAX | | |
| V _{OH} | A port | I _{OH} = -100 µA | V _I = V _{IH} | 1.2 V to 3.6 V | 1.2 V to 3.6 V | V _{CCO} - 0.2 | | | V | |
| | | I _{OH} = -1 mA | | 1.2 V | 1.2 V | 1.1 | | | | |
| | | I _{OH} = -2 mA | | 1.4 V | 1.4 V | 1.05 | | | | |
| | | I _{OH} = -4 mA | | 1.65 V | 1.65 V | 1.2 | | | | |
| | | I _{OH} = -8 mA | | 2.3 V | 2.3 V | 1.75 | | | | |
| | | I _{OH} = -16 mA | | 3 V | 3 V | 2.3 | | | | |
| V _{OL} | A port | I _{OL} = 100 µA | V _I = V _{IL} | 1.2 V to 3.6 V | 1.2 V to 3.6 V | 0.2 | | | V | |
| | | I _{OL} = 1 mA | | 1.2 V | 1.2 V | 0.07 | | | | |
| | | I _{OL} = 2 mA | | 1.4 V | 1.4 V | 0.35 | | | | |
| | | I _{OL} = 4 mA | | 1.65 V | 1.65 V | 0.45 | | | | |
| | | I _{OL} = 8 mA | | 2.3 V | 2.3 V | 0.55 | | | | |
| | | I _{OL} = 16 mA | | 3 V | 3 V | 0.7 | | | | |
| V _{OH} | B port | I _{OH} = -100 µA | V _I = V _{IH} | 1.2 V to 3.6 V | 1.2 V to 3.6 V | V _{CCO} - 0.2 | | | V | |
| | | I _{OH} = -1 mA | | 1.2 V | 1.2 V | 1.1 | | | | |
| | | I _{OH} = -2 mA | | 1.4 V | 1.4 V | 1.05 | | | | |
| | | I _{OH} = -4 mA | | 1.65 V | 1.65 V | 1.2 | | | | |
| | | I _{OH} = -8 mA | | 2.3 V | 2.3 V | 1.75 | | | | |
| | | I _{OH} = -16 mA | | 3 V | 3 V | 2.3 | | | | |
| V _{OL} | B port | I _{OL} = 100 µA | V _I = V _{IL} | 1.2 V to 3.6 V | 1.2 V to 3.6 V | 0.2 | | | V | |
| | | I _{OL} = 1 mA | | 1.2 V | 1.2 V | 0.07 | | | | |
| | | I _{OL} = 2 mA | | 1.4 V | 1.4 V | 0.35 | | | | |
| | | I _{OL} = 4 mA | | 1.65 V | 1.65 V | 0.45 | | | | |
| | | I _{OL} = 8 mA | | 2.3 V | 2.3 V | 0.55 | | | | |
| | | I _{OL} = 16 mA | | 3 V | 3 V | 0.7 | | | | |
| I _I | Control inputs | V _I = V _{CCA} or GND | | 1.2 V to 3.6 V | 1.2 V to 3.6 V | ±1 | | | µA | |
| I _{off} | A or B port | V _I or V _O = 0 to 3.6 V | | 0 V | 0 V to 3.6 V | ±5 | | | µA | |
| | | | | 0 V to 3.6 V | 0 V | ±5 | | | | |
| I _{OZ} ⁽⁴⁾ | A or B port | V _O = V _{CCO} or GND, V _I = V _{CCI} or GND | See function table for input states when outputs are Hi Z | 3.6 V | 3.6 V | ±5 | | | µA | |
| I _{CCA} | | V _I = V _{CCI} or GND, I _O = 0 | | 1.2 V to 3.6 V | 1.2 V to 3.6 V | 10 | | | µA | |
| | | | | 3.6 V | 0 V | 10 | | | | |
| | | | | 0 V | 3.6 V | -1 | | | | |
| I _{CCB} | | V _I = V _{CCI} or GND, I _O = 0 | | 1.2 V to 3.6 V | 1.2 V to 3.6 V | 10 | | | µA | |
| | | | | 3.6 V | 0 V | -1 | | | | |
| | | | | 0 V | 3.6 V | 10 | | | | |
| I _{CCA} + I _{CCB} | V _I = V _{CCI} or GND, I _O = 0 | | | 1.2 V to 3.6 V | 1.2 V to 3.6 V | 15 | | | µA | |
| C _i | Control inputs | V _I = V _{CCA} or GND | | 1.8 V | 3 V | 1.5 | | | pF | |
| | Clock input | | | | | 2 | | | | |
| C _{io} | A port | V _O = V _{CCA} or GND | | 1.8 V | 3 V | 2.5 | | | pF | |
| | B port | V _O = V _{CCB} or GND | | | | 2.5 | | | | |

(1) V_{CCO} is the V_{CC} associated with the output port.(2) V_{CCI} is the V_{CC} associated with the input port.(3) All typical values are at T_A = 25°C.(4) For I/O ports, the parameter I_{OZ} includes the input leakage current.

OUTPUT SLEW RATES⁽¹⁾

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

| PARAMETER | FROM | TO | $V_{CCA} = 1.8 \text{ V} \pm 0.15 \text{ V}$, $V_{CCB} = 3 \text{ V} \pm 0.3 \text{ V}$ | | UNIT |
|-----------|------|-----|---|------------------|------|
| | | | MIN | MAX | |
| t_r | 10% | 90% | | 3 ⁽²⁾ | ns |
| t_f | 90% | 10% | | 3 ⁽²⁾ | ns |

(1) Values are characterized, but not production tested.

(2) Using $C_L = 15 \text{ pF}$ on the B side and $C_L = 7 \text{ pF}$ on the A side

TYPICAL SWITCHING CHARACTERISTICS

$T_A = 25^\circ\text{C}$, $V_{CCA} = 1.2 \text{ V}$ (see Figure 2)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.2 \text{ V}$ | $V_{CCB} = 1.5 \text{ V}$ | $V_{CCB} = 1.8 \text{ V}$ | $V_{CCB} = 2.5 \text{ V}$ | $V_{CCB} = 3 \text{ V}$ | $V_{CCB} = 3.3 \text{ V}$ | UNIT |
|-----------------|-----------------|----------------|---------------------------|---------------------------|---------------------------|---------------------------|-------------------------|---------------------------|------|
| | | | TYP | TYP | TYP | TYP | TYP | TYP | |
| t_{pd} | A | B | 3.8 | 3 | 2.6 | 2.5 | 2.5 | 2.6 | ns |
| | B | A | 4.6 | 4.2 | 4 | 3.9 | 3.9 | 3.8 | |
| | A6 | B6 | 3.8 | 3 | 2.6 | 2.5 | 2.5 | 2.6 | |
| | A2 | B2 | 3.8 | 3 | 2.6 | 2.5 | 2.5 | 2.6 | |
| | B2 | A2 | 4.6 | 4.2 | 4 | 3.9 | 3.9 | 3.8 | |
| $t_{en}^{(1)}$ | DIR | B | 4.8 | 4 | 3.7 | 3.4 | 3.4 | 3.4 | ns |
| | | A | 4.5 | 4.4 | 5 | 5.4 | 5.4 | 5.4 | |
| $t_{dis}^{(1)}$ | DIR | B | 6.3 | 5.2 | 5.6 | 4.8 | 4.8 | 6.1 | ns |
| | | A | 4.8 | 4.6 | 5.3 | 5.4 | 5.4 | 5.3 | |

(1) DIR refers to DIR2, DIR1, and DIR(345).

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, $V_{CCA} = 1.5 \text{ V} \pm 0.1 \text{ V}$ (see Figure 2)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.2 \text{ V}$ | $V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$ | $V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$ | $V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$ | $V_{CCB} = 3 \text{ V} \pm 0.3 \text{ V}$ | $V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$ | UNIT | | | | |
|-----------------|-----------------|----------------|---------------------------|---|--|---|---|---|------|-----|-----|-----|------|
| | | | TYP | MIN | MAX | MIN | MAX | MIN | MAX | | | | |
| t_{pd} | A | B | 3.4 | 1.1 | 5.6 | 1 | 4.8 | 1 | 3.9 | 0.9 | 3.9 | 0.9 | 3.8 |
| | B | A | 3.8 | 1.4 | 6 | 1.3 | 5.6 | 1.3 | 5.2 | 0.5 | 5.2 | 0.3 | 5.2 |
| | A6 | B6 | 3.4 | 1.1 | 5.6 | 1 | 4.8 | 1 | 3.9 | 0.9 | 3.9 | 0.9 | 3.8 |
| | A2 | B2 | 3.4 | 1.1 | 5.6 | 1 | 4.8 | 1 | 3.9 | 0.9 | 3.9 | 0.9 | 3.8 |
| | B2 | A2 | 3.8 | 1.4 | 6 | 1.3 | 5.6 | 1.3 | 5.2 | 0.5 | 5.2 | 0.3 | 5.2 |
| $t_{en}^{(1)}$ | DIR | B | 4 | 1.3 | 7.7 | 1.1 | 6.9 | 0.8 | 6.1 | 0.8 | 6 | 0.8 | 5.9 |
| | | A | 3.5 | 1.4 | 7 | 1.5 | 7.4 | 1.7 | 8.2 | 1.7 | 8.2 | 1.7 | 7.7 |
| $t_{dis}^{(1)}$ | DIR | B | 5.7 | 1.9 | 8.9 | 2.1 | 10.4 | 1.8 | 8.7 | 1.7 | 8.5 | 2.4 | 11.4 |
| | | A | 3.4 | 1.2 | 7 | 1.2 | 6.8 | 1.2 | 6.9 | 1.2 | 6.5 | 1.2 | 6.6 |

(1) DIR refers to DIR2, DIR1, and DIR(345).

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, $V_{CCA} = 1.8 \text{ V} \pm 0.15 \text{ V}$ (see [Figure 2](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.2 \text{ V}$ | $V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$ | $V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$ | $V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$ | $V_{CCB} = 3 \text{ V} \pm 0.3 \text{ V}$ | $V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$ | UNIT | | | | |
|-----------------|-----------------|----------------|---------------------------|---|--|---|---|---|------|-----|-----|-----|-----|
| | | | TYP | MIN | MAX | MIN | MAX | MIN | MAX | | | | |
| t_{pd} | A | B | 3.2 | 1 | 5.2 | 0.8 | 4.4 | 0.7 | 3.5 | 0.6 | 3.4 | 0.7 | 3.1 |
| | B | A | 3.4 | 1.1 | 5.2 | 1 | 4.8 | 0.9 | 4.3 | 0.3 | 4.3 | 0.2 | 4.3 |
| | A6 | B6 | 3.2 | 1 | 5.2 | 0.8 | 4.4 | 0.7 | 3.5 | 0.6 | 3.4 | 0.7 | 3.1 |
| | A2 | B2 | 3.2 | 1 | 5.2 | 0.8 | 4.4 | 0.7 | 3.5 | 0.6 | 3.4 | 0.7 | 3.1 |
| | B2 | A2 | 3.4 | 1.1 | 5.2 | 1 | 4.8 | 0.9 | 4.3 | 0.3 | 4.3 | 0.2 | 4.3 |
| $t_{en}^{(1)}$ | DIR | B | 3.5 | 1.2 | 6.8 | 0.9 | 6 | 0.7 | 5.1 | 0.7 | 5 | 0.7 | 4.8 |
| | | A | 2.9 | 1.1 | 4.7 | 1.1 | 5.2 | 1.4 | 5.1 | 1.4 | 5.1 | 1.4 | 5.3 |
| $t_{dis}^{(1)}$ | DIR | B | 5.3 | 1.6 | 8.4 | 2 | 9.5 | 1.6 | 8.2 | 1.4 | 8.1 | 2.2 | 8.2 |
| | | A | 3.6 | 1.3 | 7.7 | 1.2 | 7.9 | 1.3 | 7.5 | 1.3 | 7.5 | 1.3 | 7.6 |

(1) DIR refers to DIR2, DIR1, and DIR(345).

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, $V_{CCA} = 2.5 \text{ V} \pm 0.2 \text{ V}$ (see [Figure 2](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.2 \text{ V}$ | $V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$ | $V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$ | $V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$ | $V_{CCB} = 3 \text{ V} \pm 0.3 \text{ V}$ | $V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$ | UNIT | | | | |
|----------------|-----------------|----------------|---------------------------|---|--|---|---|---|------|-----|-----|-----|-----|
| | | | TYP | MIN | MAX | MIN | MAX | MIN | MAX | | | | |
| t_{pd} | A | B | 3 | 0.8 | 4.7 | 0.7 | 3.8 | 0.6 | 2.9 | 0.4 | 2.7 | 0.5 | 2.5 |
| | B | A | 3 | 0.9 | 4.4 | 0.7 | 3.9 | 0.6 | 3.3 | 0.3 | 3.2 | 0.3 | 3.2 |
| | A6 | B6 | 3 | 0.8 | 4.7 | 0.7 | 3.8 | 0.6 | 2.9 | 0.4 | 2.7 | 0.5 | 2.5 |
| | A2 | B2 | 3 | 0.8 | 4.7 | 0.7 | 3.8 | 0.6 | 2.9 | 0.4 | 2.7 | 0.5 | 2.5 |
| | B2 | A2 | 3 | 0.9 | 4.4 | 0.7 | 3.9 | 0.6 | 3.3 | 0.3 | 3.2 | 0.3 | 3.2 |
| $t_{en}^{(1)}$ | DIR | B | 3.1 | 1 | 5.7 | 0.8 | 4.8 | 0.5 | 3.9 | 0.5 | 3.7 | 0.5 | 3.6 |
| | | A | 2.2 | 0.7 | 3.5 | 0.6 | 4.3 | 1.2 | 4.4 | 0.7 | 4.6 | 0.4 | 4.7 |
| t_{dis} | DIR | B | 4.6 | 1.4 | 7.6 | 1.8 | 8.4 | 1.3 | 7.2 | 1.3 | 7.1 | 2 | 7.5 |
| | | A | 2.6 | 0.9 | 5.6 | 0.9 | 5.4 | 1 | 5.5 | 0.9 | 5.5 | 0.9 | 5.8 |

(1) DIR refers to DIR2, DIR1, and DIR(345).

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, $V_{CCA} = 3.3\text{ V} \pm 0.3\text{ V}$ (see [Figure 2](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.2\text{ V}$ | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | $V_{CCB} = 3\text{ V} \pm 0.3\text{ V}$ | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | UNIT |
|-----------------|-----------------|----------------|--------------------------|---|--|---|---|---|------|
| | | | TYP | MIN MAX | MIN MAX | MIN MAX | MIN MAX | MIN MAX | |
| t_{pd} | A | B | 2.8 | 0.8 4.5 | 0.6 3.6 | 0.4 2.7 | 0.4 2.7 | 0.3 2.3 | ns |
| | B | A | 2.9 | 0.8 4.3 | 0.6 3.7 | 0.5 3 | 0.5 3 | 0.1 2.7 | |
| | A6 | B6 | 2.8 | 0.8 4.5 | 0.6 3.6 | 0.4 2.7 | 0.4 2.7 | 0.3 2.3 | |
| | A2 | B2 | 2.8 | 0.8 4.5 | 0.6 3.6 | 0.4 2.7 | 0.4 2.7 | 0.3 2.3 | |
| | B2 | A2 | 2.9 | 0.8 4.3 | 0.6 3.7 | 0.5 3 | 0.5 3 | 0.1 2.7 | |
| $t_{en}^{(1)}$ | DIR | B | 3 | 1 5.1 | 0.6 4.3 | 0.5 3.4 | 0.5 3.4 | 0.4 3 | ns |
| | | A | 2 | 0.6 3.1 | 0.6 5.4 | 0.7 5.4 | 0.7 5.4 | 0.5 5.4 | |
| $t_{dis}^{(1)}$ | DIR | B | 4.4 | 1.4 7.4 | 1.8 8.3 | 1.2 7 | 1.2 7 | 2 7.3 | ns |
| | | A | 3.7 | 1.5 8.1 | 1.5 7.9 | 1.5 7.9 | 1.5 7.9 | 1.5 8 | |

(1) DIR refers to DIR2, DIR1, and DIR(345).

TYPICAL FREQUENCY AND OUTPUT SKEW

$T_A = 25^\circ\text{C}$, $V_{CCA} = 1.2\text{ V}$ (see [Figure 2](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.2\text{ V}$ | $V_{CCB} = 1.5\text{ V}$ | $V_{CCB} = 1.8\text{ V}$ | $V_{CCB} = 2.5\text{ V}$ | $V_{CCB} = 3\text{ V}$ | $V_{CCB} = 3.3\text{ V}$ | UNIT | |
|-------------|--------------------|----------------|--------------------------|--------------------------|--------------------------|--------------------------|------------------------|--------------------------|------|----|
| | | | TYP | TYP | TYP | TYP | TYP | TYP | | |
| t_{max} | Clock | A6 | B6 | 95 | 95 | 95 | 95 | 95 | MHz | |
| | Data | A | B | 95 | 95 | 95 | 95 | 95 | | |
| | | B | A | 95 | 95 | 95 | 95 | 95 | | |
| $t_{sk(o)}$ | Channel-to-channel | A | B | 0.5 | 0.4 | 0.4 | 0.3 | 0.5 | 0.5 | ns |

MAXIMUM FREQUENCY AND OUTPUT SKEW

over recommended operating free-air temperature range, $V_{CCA} = 1.5\text{ V} \pm 0.1\text{ V}$ (see [Figure 2](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.2\text{ V}$ | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | $V_{CCB} = 3\text{ V} \pm 0.3\text{ V}$ | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | UNIT | |
|-------------|--------------------|----------------|--------------------------|---|--|---|---|---|------|----|
| | | | TYP | MIN MAX | MIN MAX | MIN MAX | MIN MAX | MIN MAX | | |
| f_{max} | Clock | A6 | B6 | 95 | 95 | 95 | 95 | 95 | MHz | |
| | Data | A | B | 95 | 95 | 95 | 95 | 95 | | |
| | | B | A | 95 | 95 | 95 | 95 | 95 | | |
| $t_{sk(o)}$ | Channel-to-channel | DIR | B | 0.3 | 0.3 | 0.3 | 0.3 | 0.5 | 0.4 | ns |

MAXIMUM FREQUENCY AND OUTPUT SKEW

over recommended operating free-air temperature range, $V_{CCA} = 1.8\text{ V} \pm 0.15\text{ V}$ (see [Figure 2](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.2\text{ V}$ | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | $V_{CCB} = 3\text{ V} \pm 0.3\text{ V}$ | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | UNIT | |
|-------------|--------------------|----------------|--------------------------|---|--|---|---|---|------|----|
| | | | TYP | MIN MAX | MIN MAX | MIN MAX | MIN MAX | MIN MAX | | |
| f_{max} | Clock | A6 | B6 | 95 | 95 | 95 | 95 | 95 | MHz | |
| | Data | A | B | 95 | 95 | 95 | 95 | 95 | | |
| | | B | A | 95 | 95 | 95 | 95 | 95 | | |
| $t_{sk(o)}$ | Channel-to-channel | DIR | B | 0.3 | 0.3 | 0.3 | 0.3 | 0.5 | 0.3 | ns |

MAXIMUM FREQUENCY AND OUTPUT SKEWover recommended operating free-air temperature range, $V_{CCA} = 2.5 \text{ V} \pm 0.2 \text{ V}$ (see [Figure 2](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.2 \text{ V}$ | $V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$ | $V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$ | $V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$ | $V_{CCB} = 3 \text{ V} \pm 0.3 \text{ V}$ | $V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$ | UNIT | |
|-------------|--------------------|----------------|---------------------------|---|--|---|---|---|------|----|
| | | | TYP | MIN | MAX | MIN | MAX | MIN | | |
| f_{max} | Clock | A6 | B6 | 95 | 95 | 95 | 95 | 95 | MHz | |
| | Data | A | B | 95 | 95 | 95 | 95 | 95 | | |
| $t_{sk(o)}$ | Channel-to-channel | DIR | B | 0.3 | 0.3 | 0.3 | 0.2 | 0.6 | 0.3 | ns |

MAXIMUM FREQUENCY AND OUTPUT SKEWover recommended operating free-air temperature range, $V_{CCA} = 3.3 \text{ V} \pm 0.3 \text{ V}$ (see [Figure 2](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.2 \text{ V}$ | $V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$ | $V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$ | $V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$ | $V_{CCB} = 3 \text{ V} \pm 0.3 \text{ V}$ | $V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$ | UNIT | |
|-------------|--------------------|----------------|---------------------------|---|--|---|---|---|------|----|
| | | | TYP | MIN | MAX | MIN | MAX | MIN | | |
| f_{max} | Clock | A6 | B6 | 95 | 95 | 95 | 95 | 95 | MHz | |
| | Data | A | B | 95 | 95 | 95 | 95 | 95 | | |
| $t_{sk(o)}$ | Channel-to-channel | DIR | B | 0.3 | 0.3 | 0.4 | 0.3 | 0.6 | 0.4 | ns |

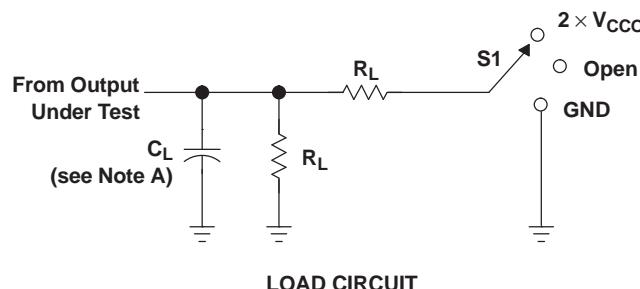
OPERATING CHARACTERISTICS

 $T_A = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | $V_{CCA} = V_{CCB} = 1.2\text{ V}$ | $V_{CCA} = V_{CCB} = 1.5\text{ V}$ | $V_{CCA} = V_{CCB} = 1.8\text{ V}$ | $V_{CCA} = V_{CCB} = 2.5\text{ V}$ | $V_{CCA} = V_{CCB} = 3\text{ V}$ | $V_{CCA} = V_{CCB} = 3.3\text{ V}$ | UNIT |
|-----------------|--------------------------------|---|------------------------------------|------------------------------------|------------------------------------|------------------------------------|----------------------------------|------------------------------------|------|
| | | | TYP | TYP | TYP | TYP | TYP | TYP | |
| $C_{pdA}^{(1)}$ | A-port input, B-port output | $C_L = 0$, $f = 10\text{ MHz}$, $t_r = t_f = 1\text{ ns}$ | 1.9 | 2 | 2.1 | 2.4 | 2.7 | 2.9 | pF |
| | B-port input, A-port output | | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | |
| $C_{pdB}^{(1)}$ | A-port input, B-port output | $C_L = 0$, $f = 10\text{ MHz}$, $t_r = t_f = 1\text{ ns}$ | 5.3 | 5.4 | 5.4 | 5.7 | 5.8 | 5.9 | pF |
| | B-port input, A-port output | | 0.3 | 0.3 | 0.4 | 0.5 | 0.6 | 0.6 | |

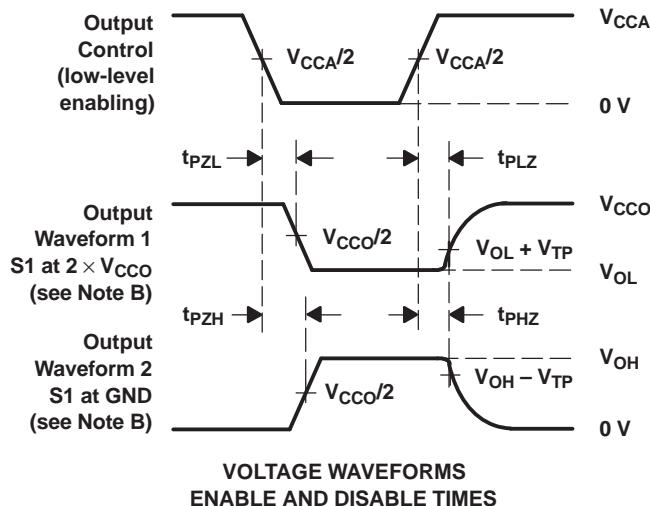
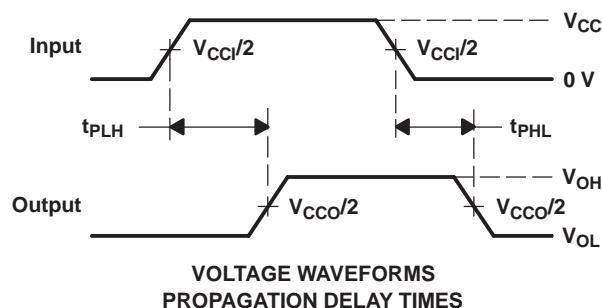
(1) Power dissipation capacitance per transceiver

PARAMETER MEASUREMENT INFORMATION



| TEST | S1 |
|-------------------|--------------------|
| t_{pd} | Open |
| t_{PLZ}/t_{PZL} | $2 \times V_{CCO}$ |
| t_{PHZ}/t_{PZH} | GND |

| V_{CCO} | C_L | R_L | V_{TP} |
|------------------------------------|-----------------|---------------------|------------------|
| $1.5 \text{ V} \pm 0.1 \text{ V}$ | 15 pF | $2 \text{ k}\Omega$ | 0.1 V |
| $1.8 \text{ V} \pm 0.15 \text{ V}$ | 15 pF | $2 \text{ k}\Omega$ | 0.15 V |
| $2.5 \text{ V} \pm 0.2 \text{ V}$ | 15 pF | $2 \text{ k}\Omega$ | 0.15 V |
| $3.3 \text{ V} \pm 0.3 \text{ V}$ | 15 pF | $2 \text{ k}\Omega$ | 0.3 V |



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: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $dv/dt \geq 1 \text{ V/ns}$.
- 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} .
- V_{CCI} is the V_{CC} associated with the input port.
- V_{CCO} is the V_{CC} associated with the output port.

Figure 2. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|-------------------|-----------------------|----------------------------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74AVC6T622PWR | ACTIVE | TSSOP | PW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74AVC6T622PWRG4 | ACTIVE | TSSOP | PW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74AVC6T622RGYR | ACTIVE | VQFN | RGY | 20 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| SN74AVC6T622RGYR4 | ACTIVE | VQFN | RGY | 20 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| SN74AVC6T622ZXYR | ACTIVE | BGA MI CROSTA R JUNI OR | ZXY | 20 | 2500 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM |

⁽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.

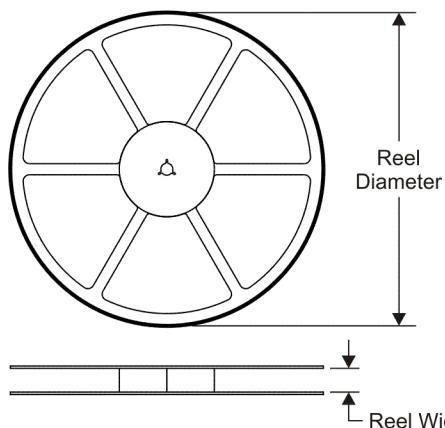
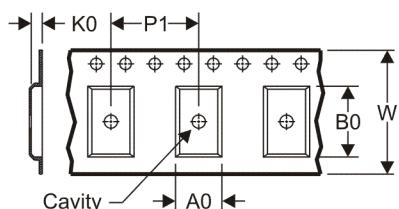
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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)

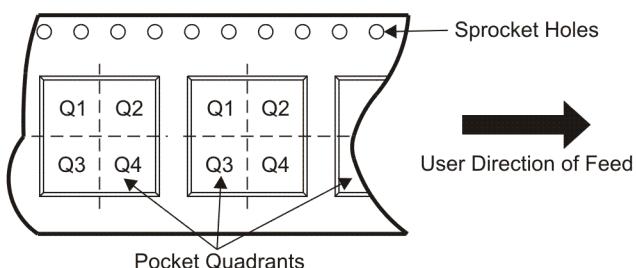
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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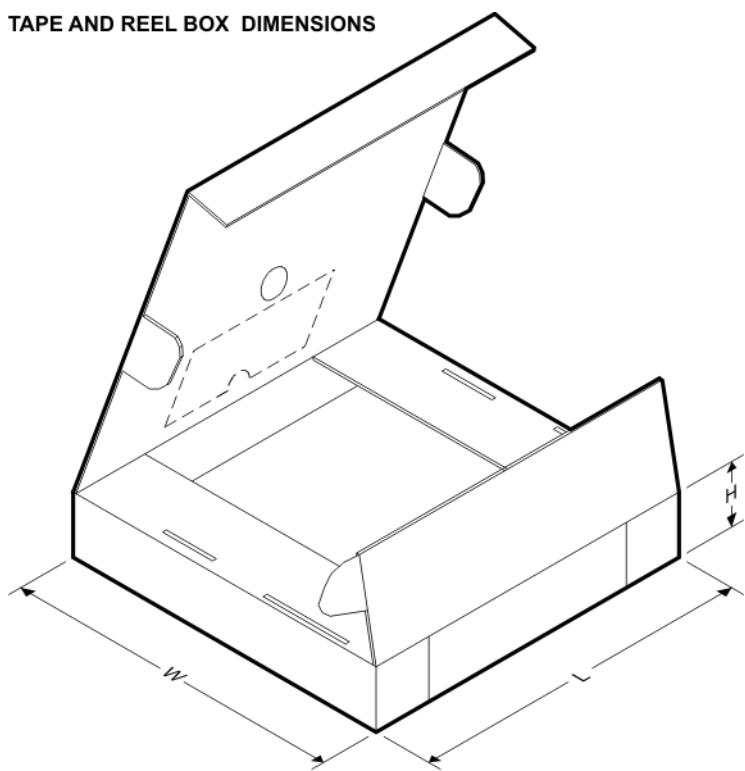
TAPE AND REEL INFORMATION
REEL DIMENSIONS

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 |

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 |
|------------------|----------------------------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74AVC6T622PWR | TSSOP | PW | 20 | 2000 | 330.0 | 16.4 | 6.95 | 7.1 | 1.6 | 8.0 | 16.0 | Q1 |
| SN74AVC6T622RGYR | VQFN | RGY | 20 | 3000 | 180.0 | 12.4 | 3.8 | 4.8 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74AVC6T622ZXYR | BGA MI CROSTA R JUNI OR | ZXY | 20 | 2500 | 330.0 | 12.4 | 2.8 | 3.3 | 1.0 | 4.0 | 12.0 | Q2 |

TAPE AND REEL BOX DIMENSIONS


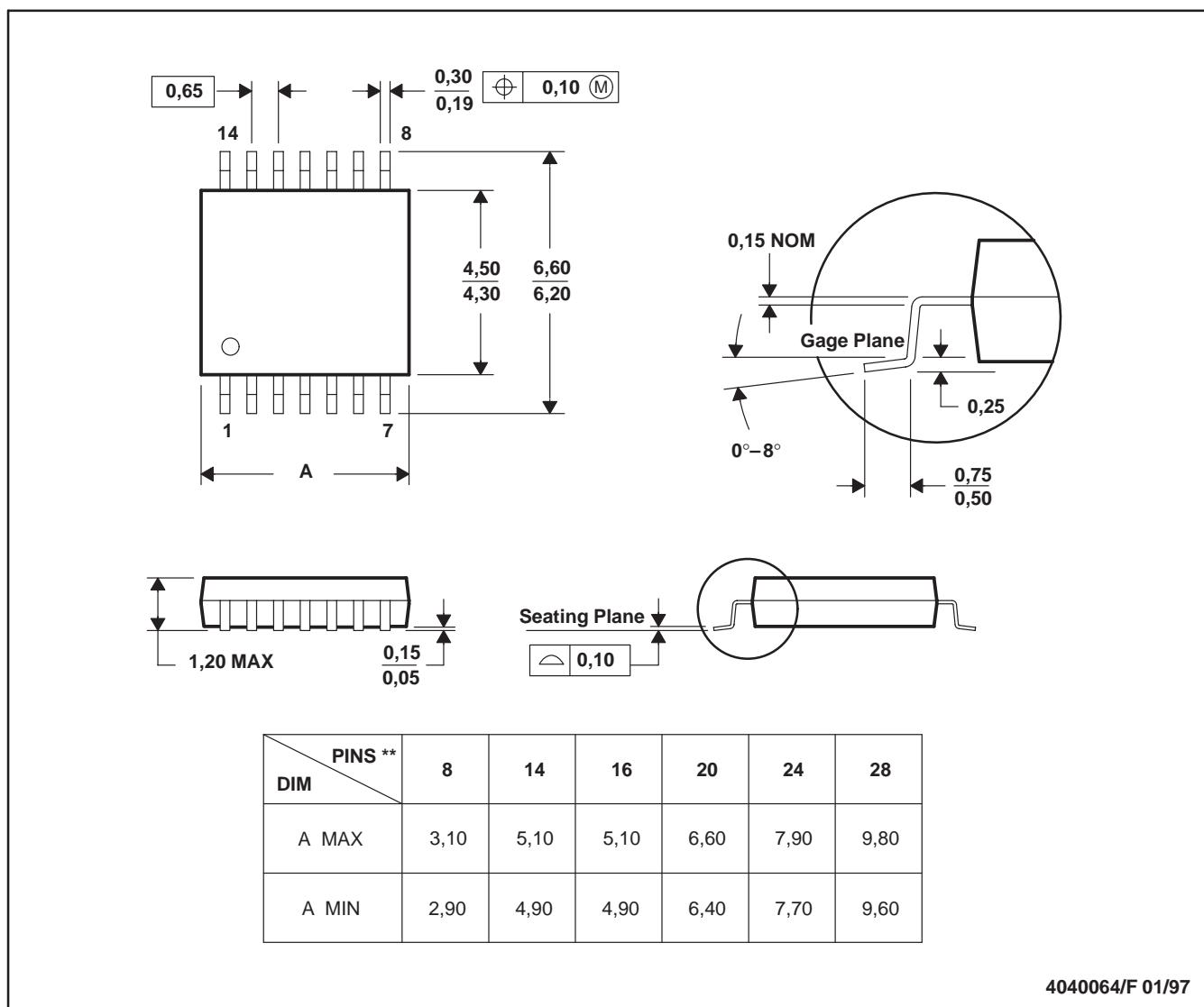
*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|------------------|----------------------|-----------------|------|------|-------------|------------|-------------|
| SN74AVC6T622PWR | TSSOP | PW | 20 | 2000 | 346.0 | 346.0 | 33.0 |
| SN74AVC6T622RGYR | VQFN | RGY | 20 | 3000 | 190.5 | 212.7 | 31.8 |
| SN74AVC6T622ZXYR | BGA MICROSTAR JUNIOR | ZXY | 20 | 2500 | 340.5 | 338.1 | 20.6 |

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN

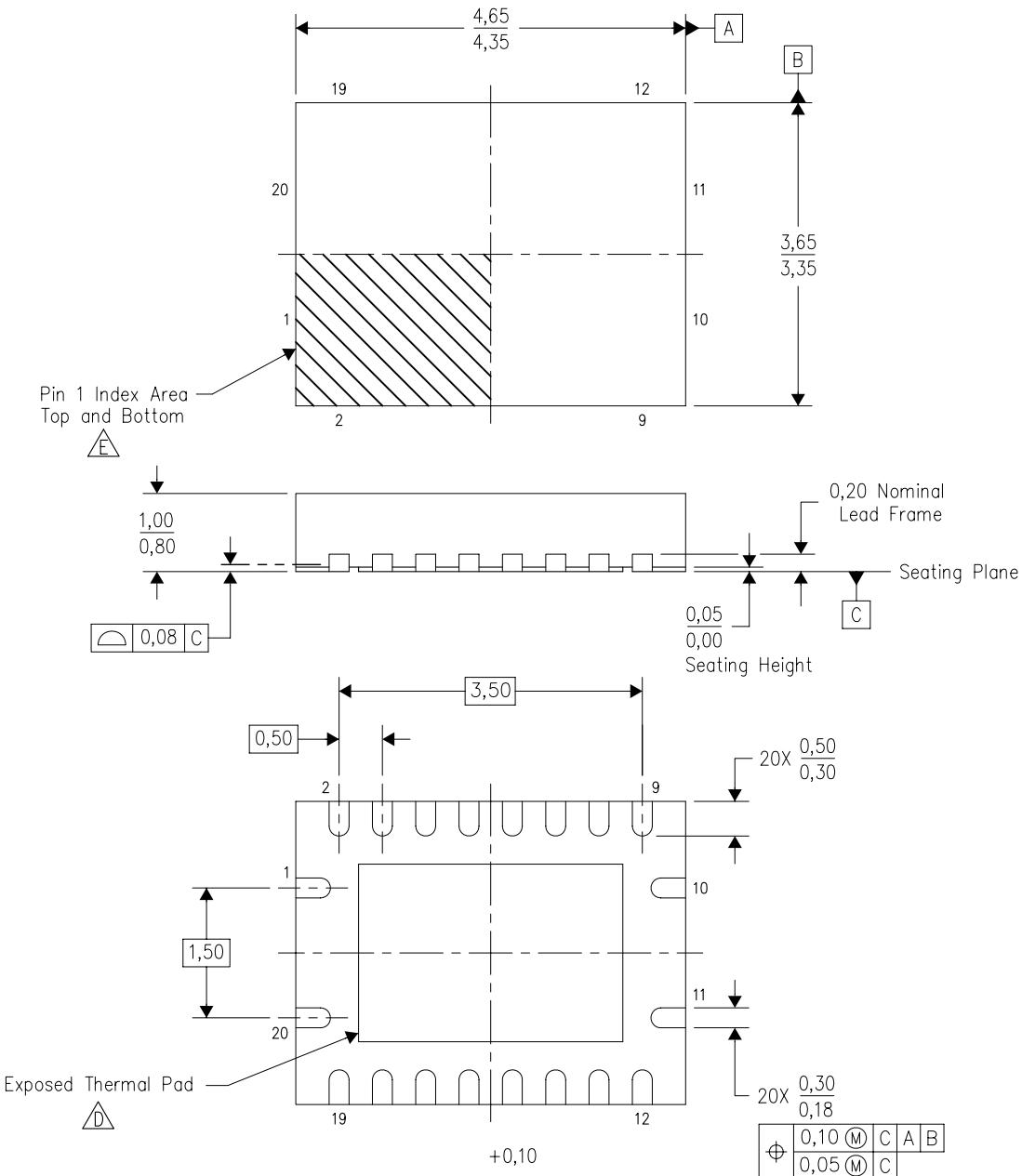


NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- Body dimensions do not include mold flash or protrusion not to exceed 0,15.
- Falls within JEDEC MO-153

RGY (R-PVQFN-N20)

PLASTIC QUAD FLATPACK NO-LEAD



Bottom View

4203539-4/H 06/2009

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. See the Product Data Sheet for details regarding the exposed thermal pad dimensions.

E. 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.

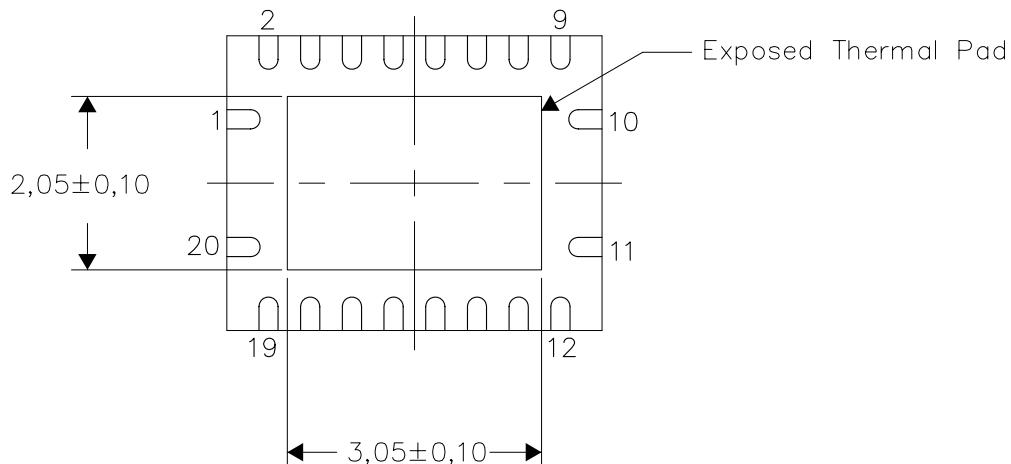
F. Package complies to JEDEC MO-241 variation BC.

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.

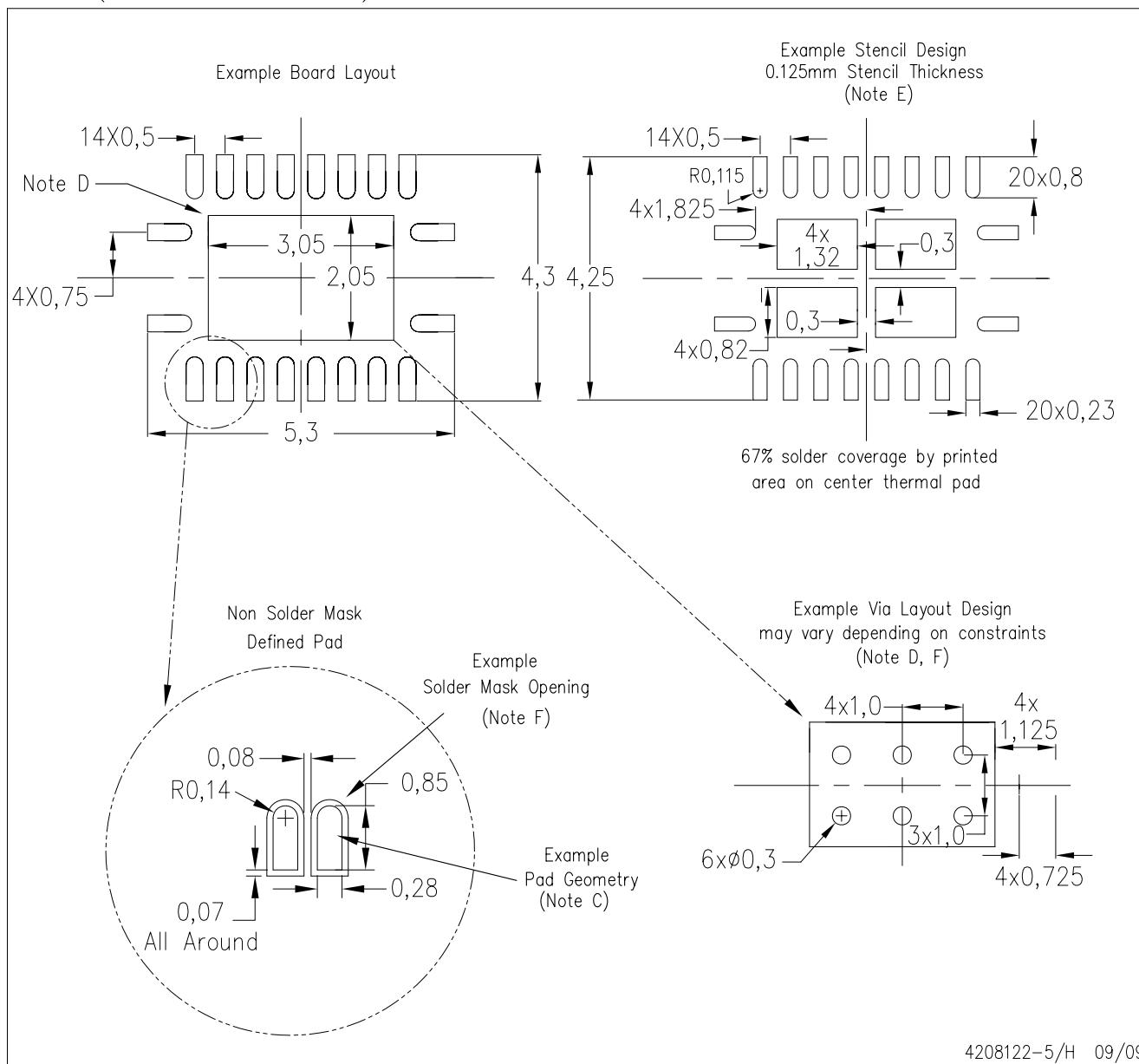


Bottom View

NOTE: All linear dimensions are in millimeters

Exposed Thermal Pad Dimensions

RGY (R-PVQFN-N20)

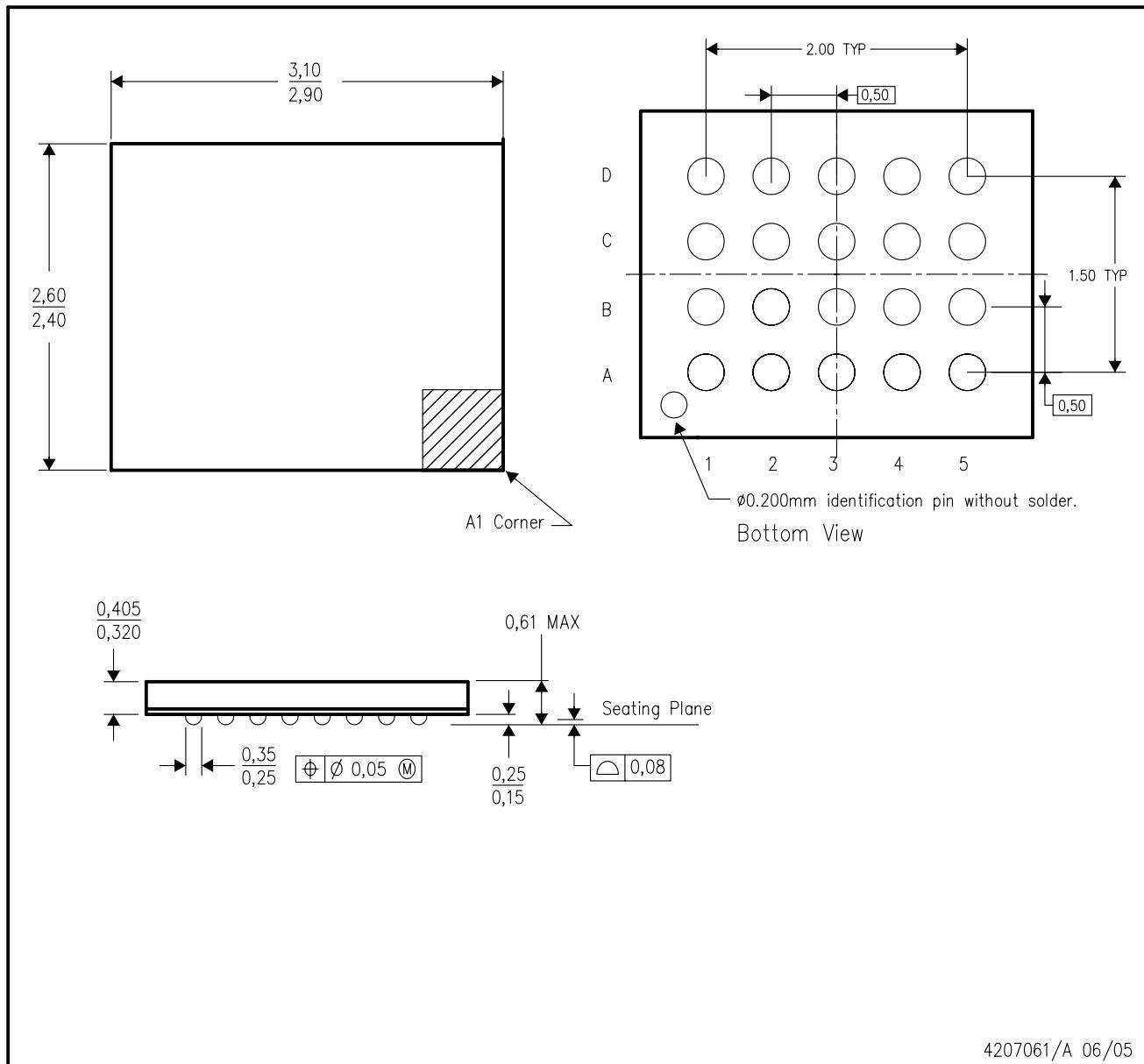


NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate 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 <<http://www.ti.com>>.
- 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.

ZXY (S-PBGA-N20)

PLASTIC BALL GRID ARRAY



NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- This package is a lead-free solder ball design.

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