

## DIGITAL AUDIO PROCESSOR WITH ANALOG INTERFACE

Check for Samples: [TAS3308](#)

### FEATURES

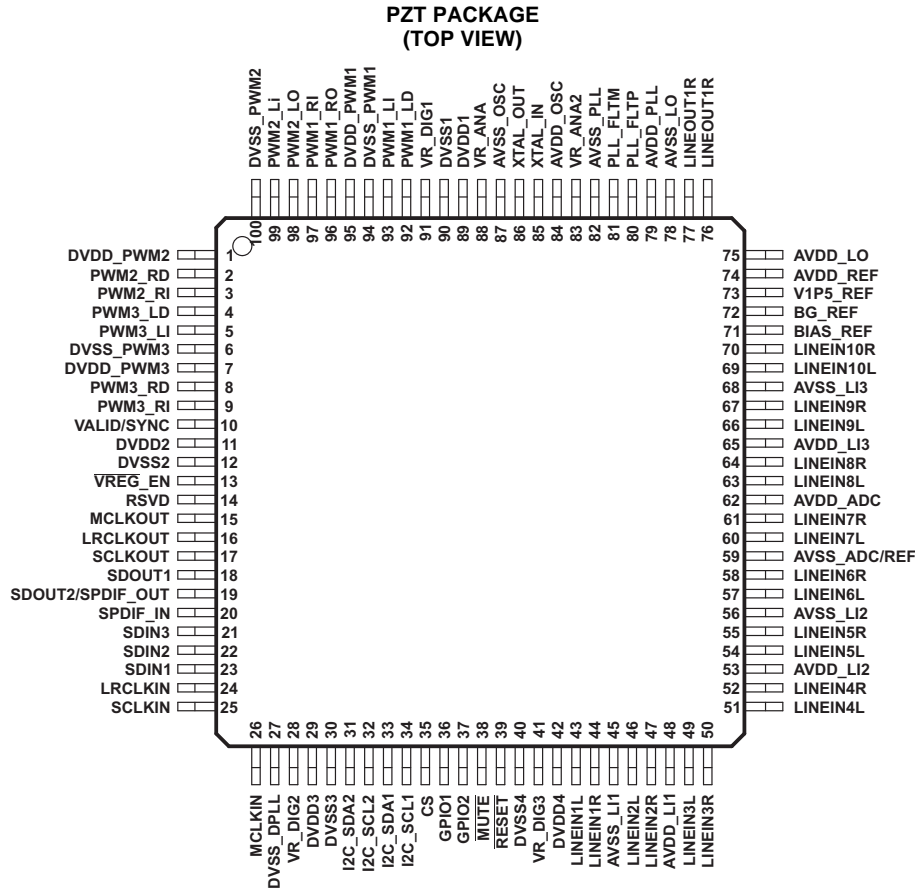
- **Digital Audio Processor**
  - Fully Programmable With the Graphical, Drag-and-Drop PurePath Studio™ Software Development Environment
  - 135-MHz Operation 48-Bit Data Path With 76-Bit Accumulator
  - Hardware Single-Cycle Multiplier (28 × 48)
  - Five Simultaneous Operations Per Clock Cycle
  - Usable 1k Data RAM Words (48 Bit), Usable 1k Coefficient RAM (28 Bit)
  - Usable 2.8k Program RAM
  - 360 ms at 48 kHz, 17k Words 24-Bit Delay Memory
  - Slave Mode  $F_s$  is 32.44.1 and 48 kHz With Auto Sample Rate Detection
  - Master Mode  $F_s$  is 48 kHz
- **Analog Audio Input/Output**
  - 10:1 Stereo Analog Input MUX
  - Stereo Analog Pass-Through Channel
  - Stereo, Single-Ended ADC (100 dB DNR Typical)
  - Six Differential PWM Outputs (105 dB DNR Typical)
  - PurePath™ Digital Technology Minimizes Pop/Click
  - Fourth Order Chaotic Noise Shaper With Non-Linear Correction
- **Digital Audio Input/Output**
  - Three Synchronous Serial Audio Inputs (Six Channels)
  - Two Synchronous Serial Audio Outputs (Four Channels)
  - Input and Output Data Formats: 16-, 20-, or 24-Bit Data Left, Right, and I<sup>2</sup>S
  - S/PDIF Transmitter
- **System Control Processor**
  - Embedded 8051 WARP Microprocessor
  - Programmable Using Standard 8051 C Compilers
  - Four Programmable GPIO pins
- **General Features**
  - Two I<sup>2</sup>C Ports for Slave or Master Download
  - Single 3.3-V Power Supply
  - Integrated Regulators

### APPLICATIONS

- Flat-Screen Televisions
- MP3 Player/Music Phone Docks
- Speaker Bars
- Mini/Micro-Component Systems
- Automotive Head Units
- Musical Instruments



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**DESCRIPTION**

The TAS3308 is a highly-integrated audio system-on-chip (SOC) consisting of a fully-programmable 48-bit digital audio processor, 10:1 stereo analog input MUX, stereo ADC, six PWM output channels, and other analog functionality. The TAS3308 is programmable with the graphical PurePath Studio™ and suite of DSP code development software. PurePath Studio™ is a highly intuitive, drag-and-drop development environment that minimizes software development effort while allowing the end user to utilize the power and flexibility of the TAS3308's digital audio processing core.

TAS3308 processing capability includes speaker equalization and cross over, volume/bass/treble control, signal mixing/MUXing/splitting, delay compensation, dynamic range compression, and many other basic audio functions. Audio functions such as matrix decoding, stereo widening, surround sound virtualization and psychoacoustic bass boost are also available with either third-party or TI royalty-free algorithms.

The TAS3308 contains a custom-designed, fully-programmable 135-MHz, 48-bit digital audio processor. A 76-bit accumulator ensures that the high precision necessary for quality digital audio is maintained during arithmetic operations.

A stereo 100-dB DNR ADC and six 105-dB DNR PWM output channels ensure that high quality audio is maintained through the whole signal chain. The PWM outputs utilize TI's PurePath Digital PWM technology and seamlessly interface with TI's extensive line of PWM input class D audio amplifiers.

**Ordering Information**

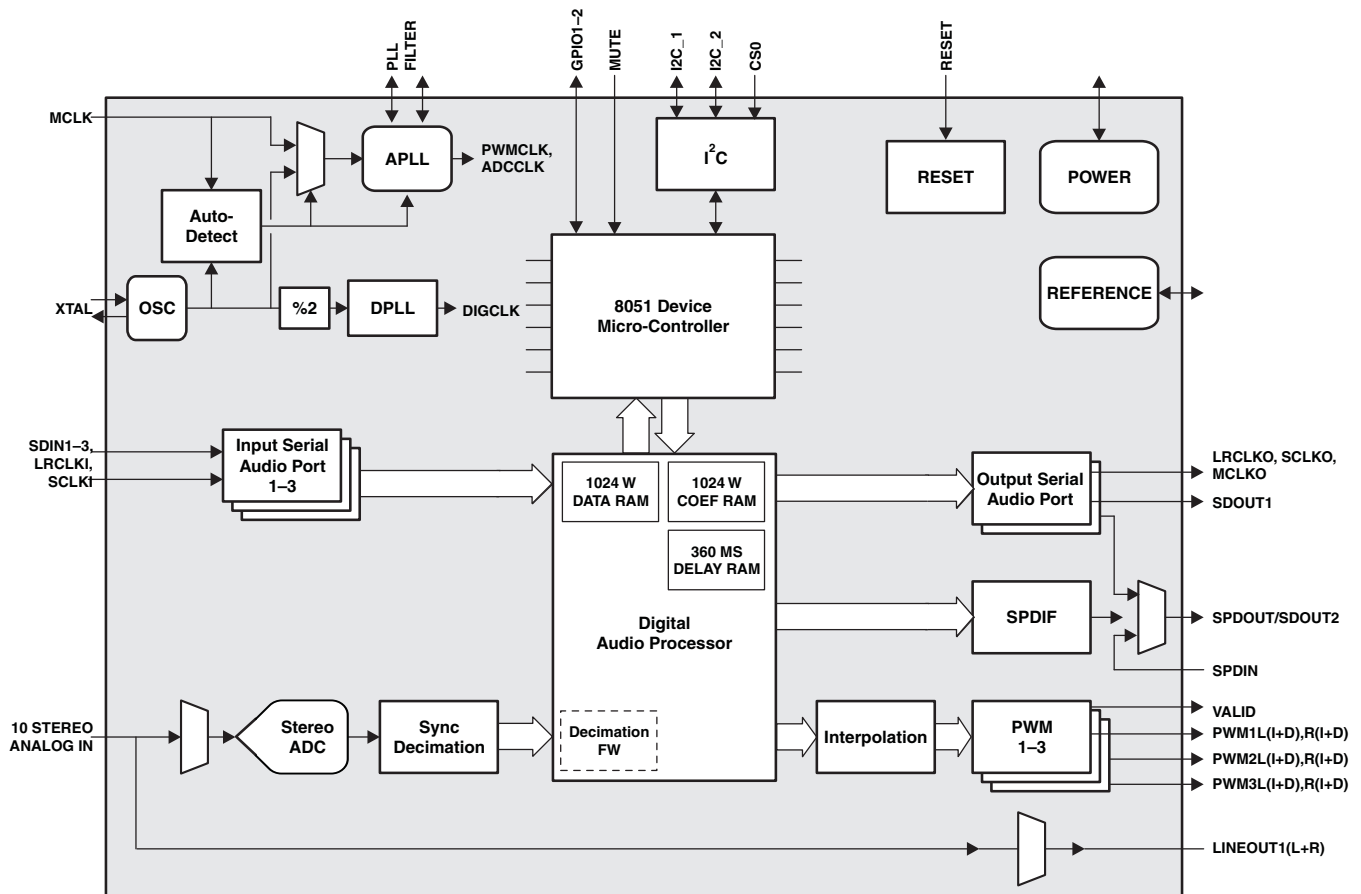
| T <sub>A</sub> | PACKAGE <sup>(1)</sup> | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|------------------------|-----------------------|------------------|
| 0°C to 70°C    | Tray                   | TAS3308PZT            | TAS3308PZT       |
|                | Tape and reel          | TAS3308PZTR           |                  |

(1) 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](http://www.ti.com).

The TAS3308 comprises nine functional blocks:

- Analog input/MUX/stereo ADC
- Three stereo PWM output for speaker/headphone/stereo
- Line driver outputs
- Clock, digital PLL, analog PLL, serial data interface, and auto-detect system
- Serial control interface/device control
- Audio DSP – digital audio processing
- 8051 device controller
- Power supply
- Internal references

### Block Diagram



APPLICATION INFORMATION

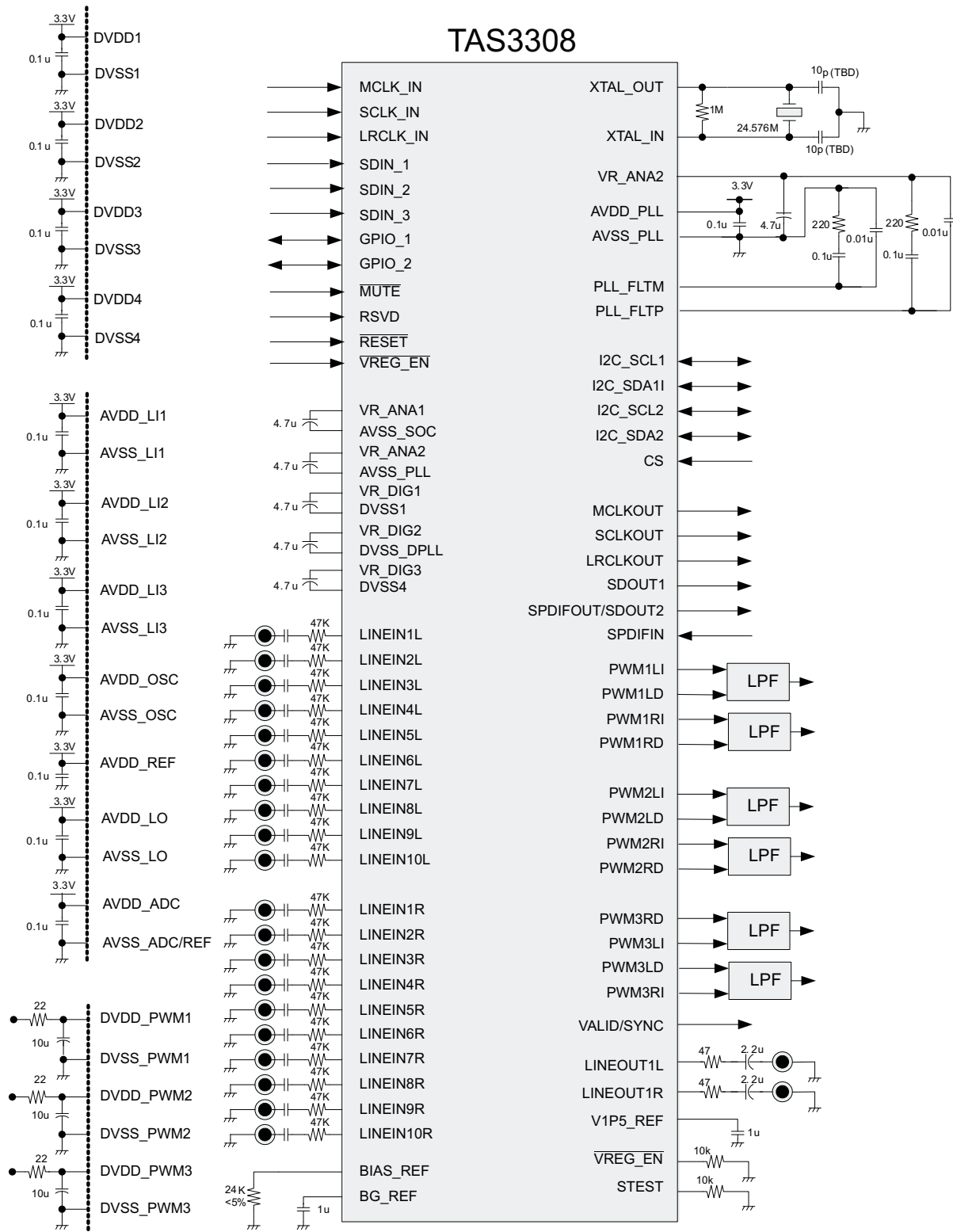


Figure 1. Peripheral Connections

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

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

|                  |                           |                                             | MIN  | MAX                                   | UNIT |
|------------------|---------------------------|---------------------------------------------|------|---------------------------------------|------|
| DVDD             | Supply voltage range      |                                             | -0.5 | 3.8                                   | V    |
| AVDD             |                           |                                             | -0.5 | 3.8                                   |      |
| DVDD_PWM         |                           |                                             | -0.5 | 3.8                                   |      |
| V <sub>I</sub>   | Input voltage range       | 3.3 V TTL                                   | -0.5 | V <sub>DD</sub> + 0.5                 | V    |
|                  |                           | 3.3 V LVCMOS                                | -0.5 | V <sub>DD</sub> + 0.5                 |      |
|                  |                           | 3.3 V analog                                | -0.5 | AV <sub>DD</sub> + 0.5                |      |
|                  |                           | 1.8 V LVCMOS                                | -0.5 | AV <sub>DD</sub> <sup>(2)</sup> + 0.5 |      |
| V <sub>O</sub>   | Output voltage range      | 3.3 V TTL                                   | -0.5 | V <sub>DD</sub> + 0.5                 | V    |
|                  |                           | 3.3 V LVCMOS                                | -0.5 | V <sub>DD</sub> + 0.5                 |      |
|                  |                           | 3.3 V analog                                | -0.5 | AV <sub>DD</sub> + 0.5                |      |
|                  |                           | 1.8 V LVCMOS                                | -0.5 | DV <sub>DD</sub> <sup>(3)</sup> + 0.5 |      |
|                  |                           |                                             | -0.5 | AV <sub>DD</sub> <sup>(4)</sup> + 0.5 |      |
| I <sub>IK</sub>  | Input clamp current       | V <sub>I</sub> < 0 or V <sub>I</sub> > DVDD |      | ±20                                   | mA   |
| I <sub>OK</sub>  | Output clamp current      | V <sub>O</sub> < 0 or V <sub>O</sub> > DVDD |      | ±20                                   | mA   |
| 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 operation conditions* is not implied. Exposure to absolute-maximum conditions for extended periods may affect device reliability.
- (2) AVDD is an internal 1.8-V supply derived from a regulator in the TAS3308 chip. Pin XTAL\_IN is the only TAS3308 input that is referenced to this 1.8-V logic supply. The absolute maximum rating listed is for reference; only a crystal should be connected to XTAL\_IN.
- (3) DVDD is an internal 1.8-V supply derived from regulators in the TAS3308 chip. DVDD is routed to DVDD\_BYPASS\_CAP to provide access to external filter capacitors, but should not be used to source power to external devices.
- (4) Pin XTAL\_OUT is the only TAS3308 output that is derived from the internal 1.8-V logic supply AVDD. The absolute maximum rating listed is for reference; only a crystal should be connected to XTAL\_OUT. AVDD is also routed to AVDD\_BYPASS\_CAP to provide access to external filter capacitors, but should not be used to source power to external devices.

## RECOMMENDED OPERATING CONDITIONS

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

| PARAMETER       |                                   | MEASUREMENTS                    | MIN                   | NOM                   | MAX | UNIT |
|-----------------|-----------------------------------|---------------------------------|-----------------------|-----------------------|-----|------|
| DVDD            | Digital supply voltage            |                                 | 3                     | 3.3                   | 3.6 | V    |
| AVDD            | Analog supply voltage             | 3.3 V analog                    | 3                     | 3.3                   | 3.6 | V    |
| DVDD_PWM        | PWM supply voltage                | 3.3 V PWM                       | 3                     | 3.3                   | 3.6 | V    |
| V <sub>IH</sub> | High-level input voltage          | 3.3 V TTL                       | 2                     |                       |     | V    |
|                 |                                   | 3.3 V LVCMOS (I <sup>2</sup> C) | 0.7 × V <sub>DD</sub> |                       |     |      |
|                 |                                   | 1.8 V LVCMOS (XTAL_IN)          | 1.26                  |                       |     |      |
| V <sub>IL</sub> | Low-level input voltage           | 3.3 V TTL                       |                       |                       | 0.8 | V    |
|                 |                                   | 3.3 V LVCMOS (I <sup>2</sup> C) | 0                     | 0.3 × V <sub>DD</sub> |     |      |
|                 |                                   | 1.8 V LVCMOS (XTAL_IN)          |                       | 0.54                  |     |      |
| T <sub>A</sub>  | Operating ambient air temperature | Specifying parametrics          | 0                     | 25                    | 70  | °C   |
|                 |                                   | Specifying functions            | -20                   | 25                    | 70  |      |
| T <sub>J</sub>  | Junction temperature              |                                 | 0                     |                       | 96  | °C   |

## ELECTRICAL CHARACTERISTICS

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

| PARAMETER                      | MEASUREMENT                   | TEST CONDITIONS                 | MIN                                                                     | MAX                    | UNITS |
|--------------------------------|-------------------------------|---------------------------------|-------------------------------------------------------------------------|------------------------|-------|
| V <sub>OH</sub>                | High-level output voltage     | 3.3 V TTL                       | I <sub>OH</sub> = -4 mA                                                 | 2.4                    | V     |
|                                |                               | 3.3 V LVCMOS (I <sup>2</sup> C) | I <sub>OH</sub> = -0.10 mA                                              | V <sub>DD5</sub> - 0.2 |       |
|                                |                               | 1.8 V LVCMOS (XTAL_OUT)         | I <sub>OH</sub> = -0.6 mA                                               | 1.197                  |       |
| V <sub>OL</sub>                | Low-level output voltage      | 3.3 V TTL                       | I <sub>OL</sub> = 4 mA                                                  | 0.5                    | V     |
|                                |                               | 3.3 V LVCMOS (I <sup>2</sup> C) | I <sub>OL</sub> = 0.10 mA                                               | 0.2                    |       |
|                                |                               | 1.8 V LVCMOS (XTAL_OUT)         | I <sub>OL</sub> = 1.8 mA                                                | 0.585                  |       |
| I <sub>OZ</sub>                | High-impedance output current | 3.3 V TTL                       |                                                                         | ±20                    | μA    |
|                                |                               | 3.3 V LVCMOS (I <sup>2</sup> C) | Driver only, driver disable                                             | ±20                    |       |
| I <sub>IL</sub> <sup>(1)</sup> | Low-level input current       | 3.3 V TTL                       | V <sub>I</sub> = V <sub>IL</sub>                                        | ±1                     | μA    |
|                                |                               | 3.3 V LVCMOS (I <sup>2</sup> C) | V <sub>I</sub> = V <sub>IL</sub> , Receiver only                        | ±1                     |       |
|                                |                               | 1.8 V LVCMOS (XTAL_IN)          | V <sub>I</sub> = V <sub>IL</sub>                                        | ±1                     |       |
| I <sub>IH</sub> <sup>(2)</sup> | High-level input current      | 1.8 V LVCMOS (XTAL_IN)          | V <sub>I</sub> = V <sub>IH</sub>                                        | ±1                     | μA    |
|                                |                               | 3.3 V LVCMOS (I <sup>2</sup> C) | V <sub>I</sub> = V <sub>IH</sub> , Receiver only                        | ±1                     |       |
|                                |                               | 3.3 V TTL                       | V <sub>I</sub> = V <sub>IH</sub>                                        | ±1                     |       |
| I <sub>DVDD</sub>              | Digital supply current        |                                 | DSP clock = 135 MHz<br>LRCLKIN/LRCLKOUT = 48 KHz,<br>XTALI = 24.576 MHz | 160                    | mA    |
| I <sub>AVDD</sub>              | Analog supply current         |                                 | DSP clock = 135 MHz<br>LRCLKIN/LRCLKOUT = 48 KHz,<br>XTALI = 24.576 MHz | 40                     | mA    |
| I <sub>DVDD</sub>              | Digital supply current        |                                 | $\overline{\text{RESET}} = \text{LOW}$                                  | 100                    | mA    |
| I <sub>AVDD</sub>              | Analog supply current         |                                 | $\overline{\text{RESET}} = \text{LOW}$                                  | 10                     | mA    |

- (1) Value given is for those input pins that connect to an internal pullup resistor as well as an input buffer. For inputs that have a pulldown resistor or no resistor, I<sub>IL</sub> is ±1 μA.
- (2) Value given is for those input pins that connect to an internal pulldown resistor as well as an input buffer. For inputs that have a pullup resistor or no resistor, I<sub>IH</sub> is ±1 μA.

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Top-Side Markings<br>(4) | Samples |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|------------------|----------------------|--------------|--------------------------|---------|
| TAS3308PZT       | NRND          | TQFP         | PZT                | 100  | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-3-260C-168 HR  | 0 to 70      | TAS3308PZT               |         |
| TAS3308PZTR      | NRND          | TQFP         | PZT                | 100  | 1000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-3-260C-168 HR  | 0 to 70      | TAS3308PZT               |         |

(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) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.

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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 |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TAS3308PZTR | TQFP         | PZT             | 100  | 1000 | 330.0              | 24.4               | 17.0    | 17.0    | 1.5     | 20.0    | 24.0   | Q2            |



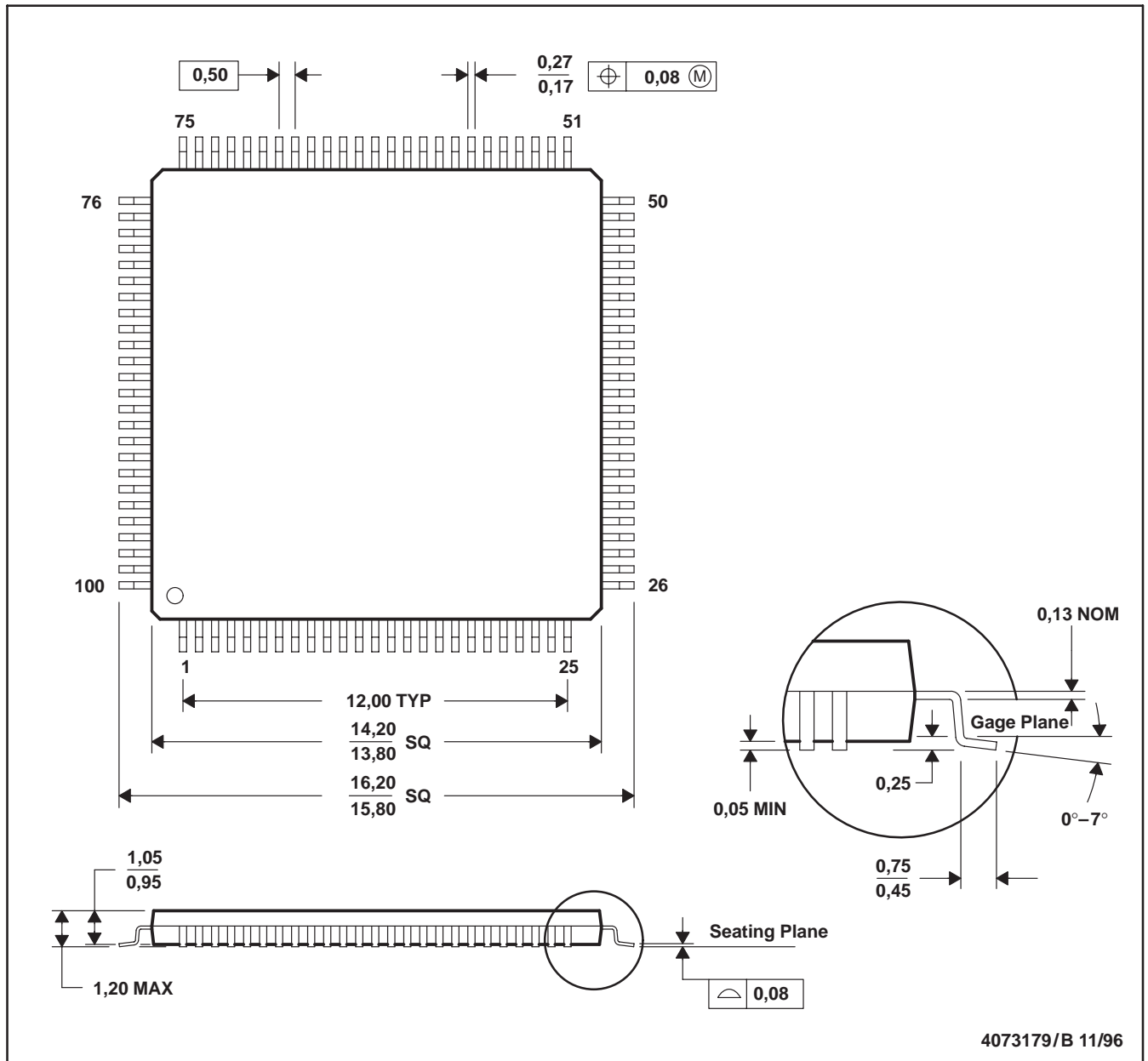
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device      | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TAS3308PZTR | TQFP         | PZT             | 100  | 1000 | 367.0       | 367.0      | 45.0        |

PZT (S-PQFP-G100)

PLASTIC QUAD FLATPACK



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Falls within JEDEC MS-026

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### Applications

|                               |                                                                                          |
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| Consumer Electronics          | <a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>                   |
| Energy and Lighting           | <a href="http://www.ti.com/energy">www.ti.com/energy</a>                                 |
| Industrial                    | <a href="http://www.ti.com/industrial">www.ti.com/industrial</a>                         |
| Medical                       | <a href="http://www.ti.com/medical">www.ti.com/medical</a>                               |
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