# DUAL AUDIO OPERATIONAL AMPLIFIER

## FEATURES

- **Operating Voltage . . . ±2 V to ±18 V**
- **Low Noise Voltage . . . 1.2 μVrms (Typ)**
- **Wide GBW . . . 15 MHz (Typ)**
- **Low THD . . . 0.05% (Typ)**
- **Slew Rate . . . 5.5 V/μsec (Typ)**
- **Suitable for Applications Such as Audio Preamplifier, Active Filter, Headphone Amplifier, Industrial Measurement Equipment**

## DESCRIPTION/ORDERING INFORMATION

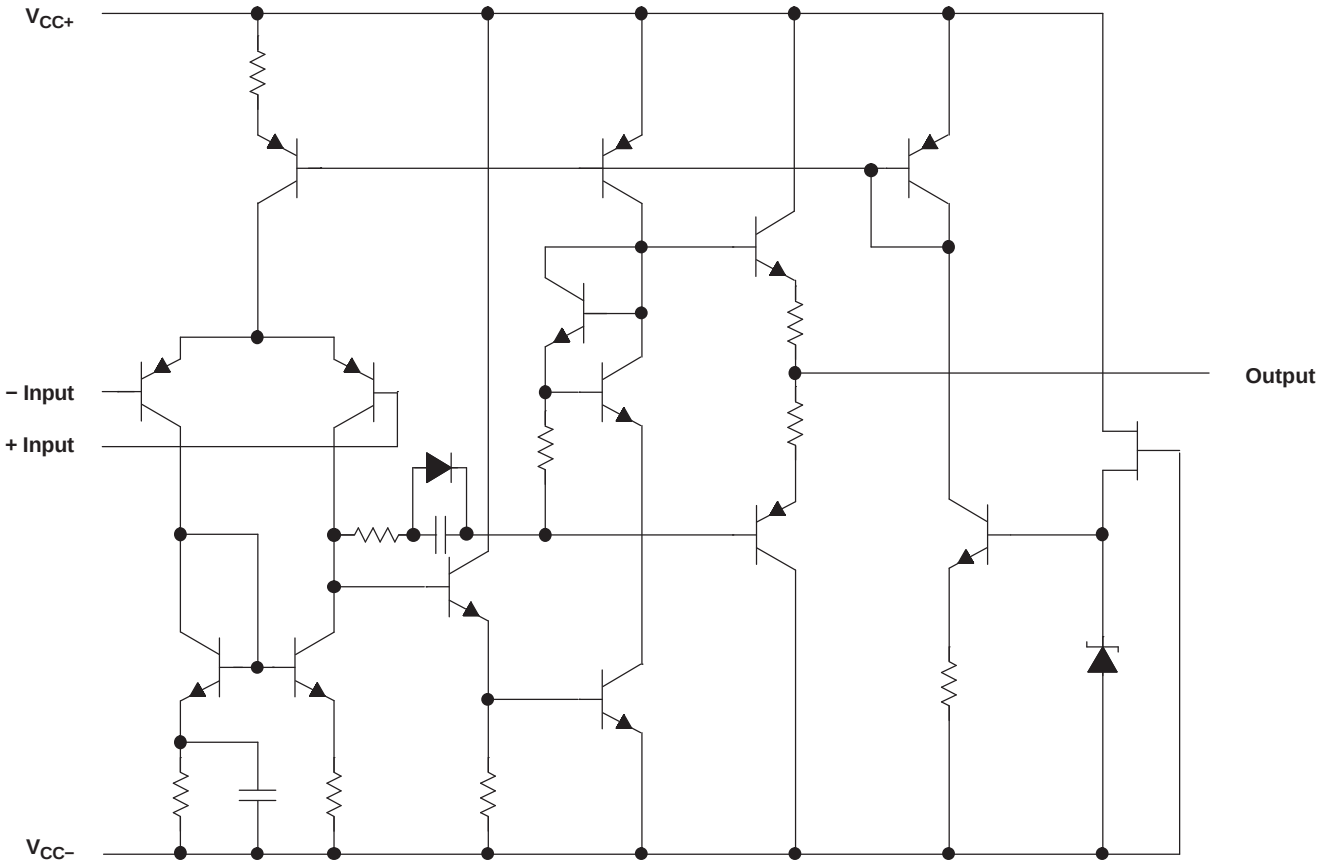
The RC4560 is a high-gain, wide-bandwidth, dual operational amplifier capable of driving 20 V peak-to-peak into 400-Ω loads. The RC4560 combines many of the features of the RC4558, but with wider bandwidth and higher slew rate, making this device ideal for active filters, data and telecommunications, and many instrumentation applications.

**ORDERING INFORMATION(1)**

| $T_A$ | PACKAGE(2) | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---|---|---|---|---|
| –40°C to 85°C | PDIP – P | Tube of 50 | RC4560IP | RC4560IP |
| | SOIC – D | Tube of 75 | RC4560ID | R4560I |
| | | Reel of 2500 | RC4560IDR | |
| | TSSOP – PW | Tube of 150 | RC4560IPW | R4560I |
| | | Reel of 2000 | RC4560IPWR | |

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

## EQUIVALENT CIRCUIT




## ABSOLUTE MAXIMUM RATINGS(1)

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

| | | | |
|---|---|---|---|
| $V_{CC\pm}$ | Supply voltage | | ±18 V |
| | Input voltage (any input) | | ±15 V |
| | Output current | | ±50 mA |
| $\theta_{JA}$ | Package thermal impedance(2)(3) | D package | 97°C/W |
| | | P package | 85°C/W |
| | | PW package | 149°C/W |
| $T_J$ | Operating virtual junction temperature | | 150°C |
| $T_{stg}$ | Storage temperature range | | −60°C to 125°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) Maximum power dissipation is a function of $T_J(max)$, $\theta_{JA}$, and $T_A$. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum $T_J$ of 150°C can impact reliability.

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

## RECOMMENDED OPERATING CONDITIONS

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

| | | MIN | MAX | UNIT |
|---|---|---|---|---|
| $V_{CC+}$ | Supply voltage | 2 | 16 | V |
| $V_{CC-}$ | | –2 | –16 | |
| $V_{ID}$ | Differential input voltage | | ±30 | V |
| $V_{ICR}$ | Input common mode range | –14 | 14 | V |
| $T_A$ | Operating free-air temperature range | –40 | 85 | °C |

## ELECTRICAL CHARACTERISTICS

$V_{CC±}$ = ±15 V, $T_A$ = 25°C (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{IO}$ | Input offset voltage | $R_S$ ≤ 10 kΩ | | 0.5 | 6 | mV |
| $I_{IO}$ | Input offset current | | | 5 | 200 | nA |
| $I_{IB}$ | Input bias current | | | 40 | 500 | nA |
| $A_{VD}$ | Large-signal differential voltage amplification | $R_L$ ≥ 2 kΩ, $V_O$ = ±10 V | 86 | 100 | | dB |
| $r_i$ | Input resistance | | 0.3 | 5 | | MΩ |
| $V_O$ | Output voltage swing | $R_L$ ≥ 2 kΩ | ±12 | ±14 | | V |
| | | $I_O$ = 25 mA | ±10 | ±12.5 | | |
| $V_{ICR}$ | Common-mode input voltage range | | ±12 | ±14 | | V |
| CMRR | Common-mode rejection ratio | $R_S$ ≤ 10 kΩ | 70 | 90 | | dB |
| $k_{SVR}$ | Supply-voltage rejection ratio (1) | $R_S$ ≤ 10 kΩ | 76.5 | 90 | | dB |
| $I_{CC}$ | Supply current (all amplifiers) | | | 4.3 | 5.7 | mA |

(1) Measured with $V_{CC±}$ differentially varied simultaneously from ±4 V to ±15 V

## OPERATING CHARACTERISTICS

$V_{CC±}$ = ±15 V, $T_A$ = 25°C (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | TYP | UNIT |
|---|---|---|---|---|
| SR | Slew rate at unity gain | | 5.5 | V/µs |
| GBW | Gain bandwidth product | | 15 | MHz |
| THD | Total harmonic distortion | $V_O$ = 5 V, $R_L$ = 2 kΩ, f = 1 kHz, $A_{VD}$ = 20 dB | 0.05 | % |
| $V_n$ | Equivalent input noise voltage | RIAA, $R_S$ ≤ 2 kΩ, 30-kHz LPF | 1.2 | µVrms |

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RC4560ID | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | R4560I | Samples |
| RC4560IDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | R4560I | Samples |
| RC4560IDRE4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | R4560I | Samples |
| RC4560IP | ACTIVE | PDIP | P | 8 | 50 | Green (RoHS & no Sb/Br) | NIPDAU | N / A for Pkg Type | -40 to 85 | RC4560IP | Samples |
| RC4560IPW | ACTIVE | TSSOP | PW | 8 | 150 | Green (RoHS & no Sb/Br) | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | R4560I | Samples |
| RC4560IPWR | ACTIVE | TSSOP | PW | 8 | 2000 | Green (RoHS & no Sb/Br) | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | R4560I | 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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

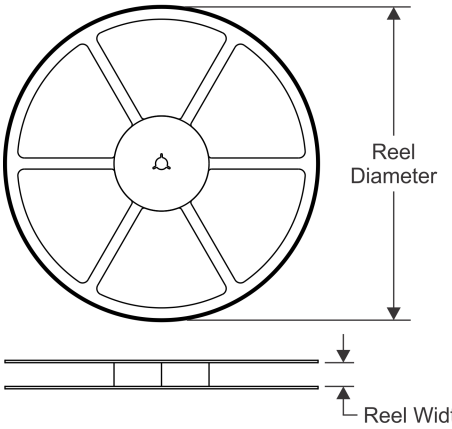
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

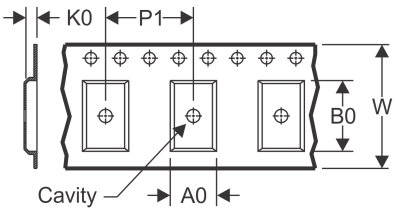
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

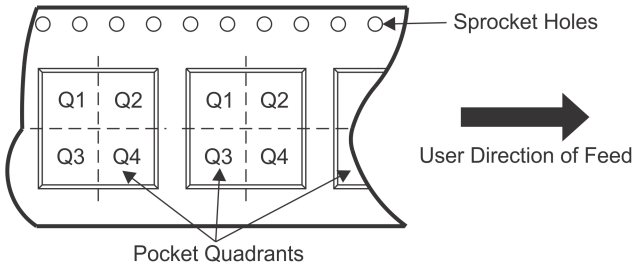



**TAPE DIMENSIONS**




| | |
|---|---|
| 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 |

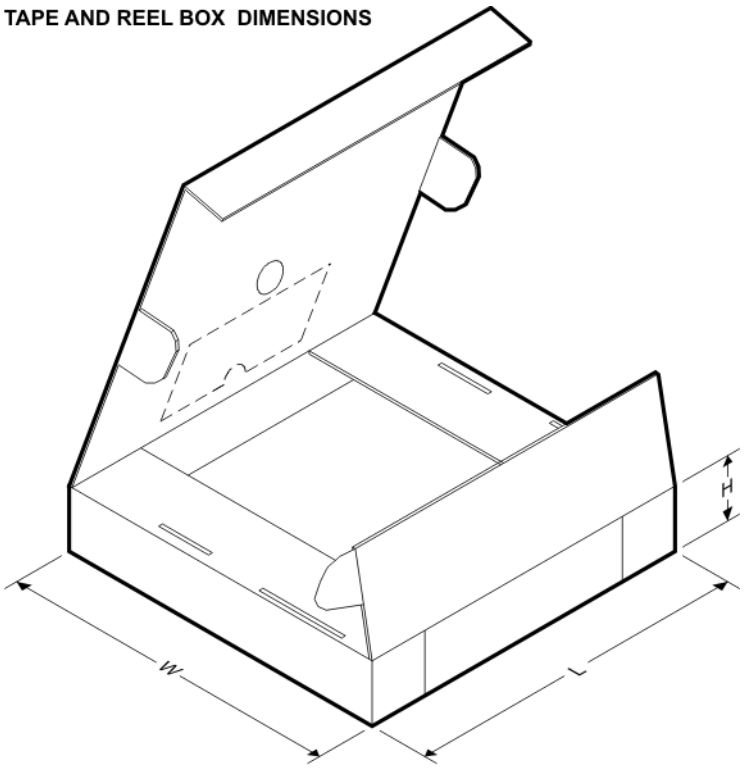
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*All dimensions are nominal

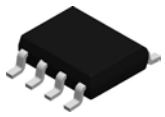
| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RC4560IDR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| RC4560IPWR | TSSOP | PW | 8 | 2000 | 330.0 | 12.4 | 7.0 | 3.6 | 1.6 | 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) |
|---|---|---|---|---|---|---|---|
| RC4560IDR | SOIC | D | 8 | 2500 | 340.5 | 338.1 | 20.6 |
| RC4560IPWR | TSSOP | PW | 8 | 2000 | 367.0 | 367.0 | 35.0 |

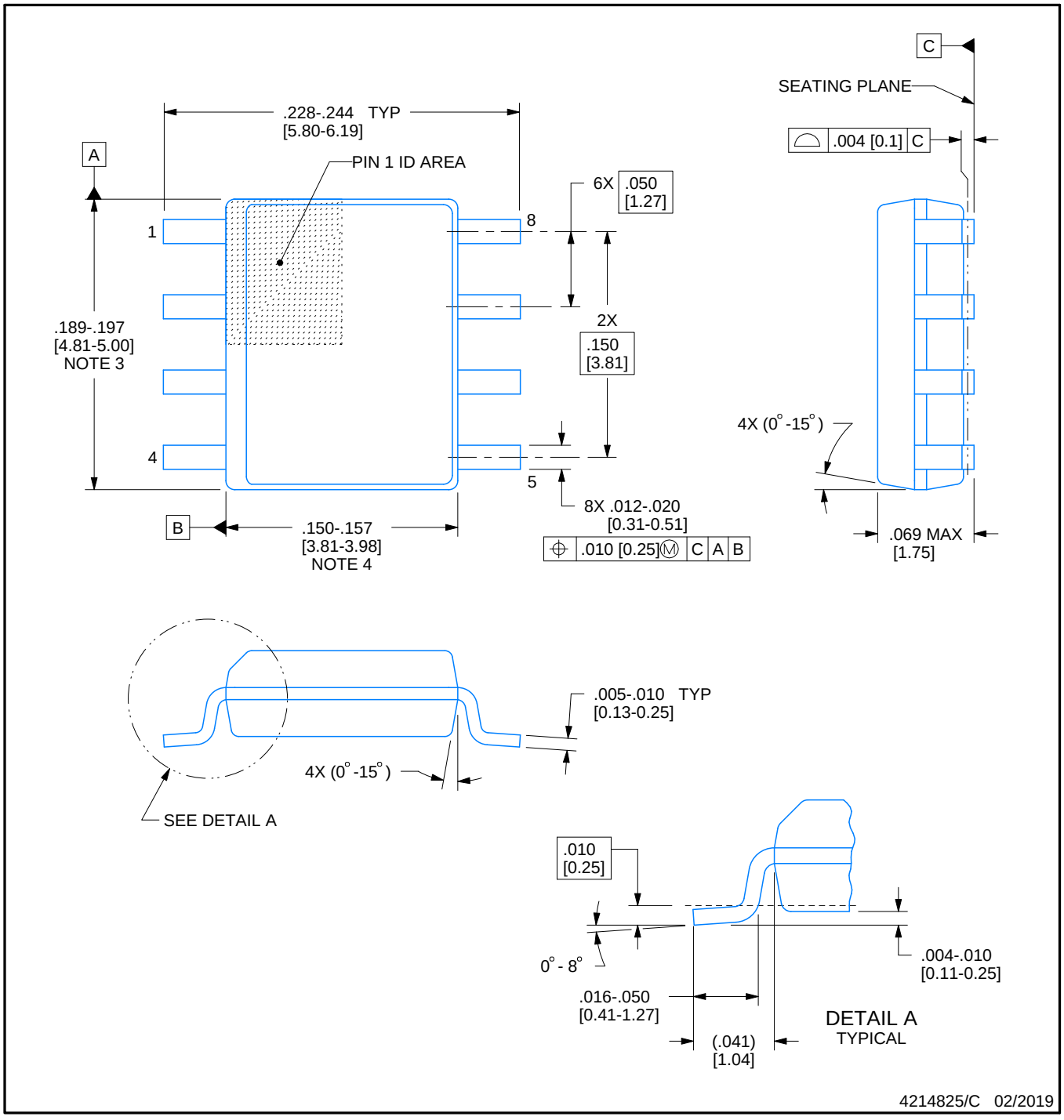


# PACKAGE OUTLINE

## D0008A

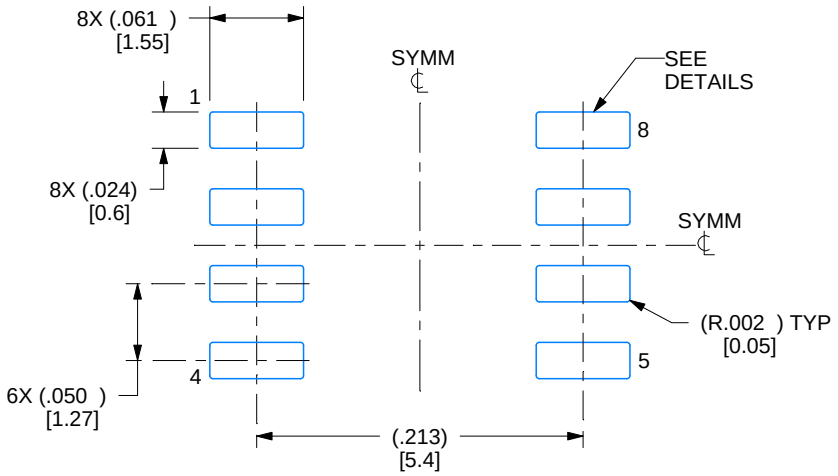
## SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

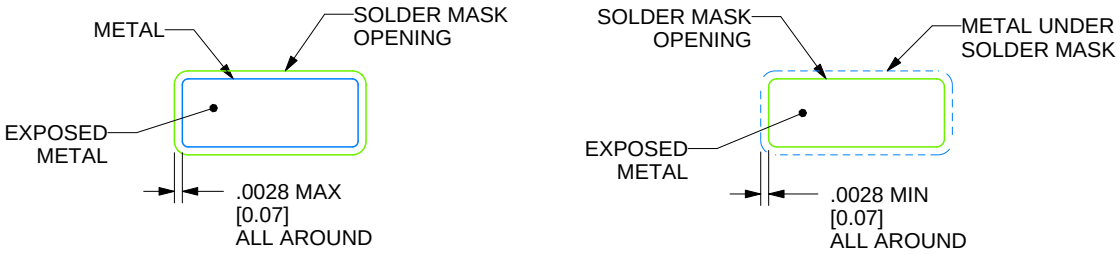



NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. 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 .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.




LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X




SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

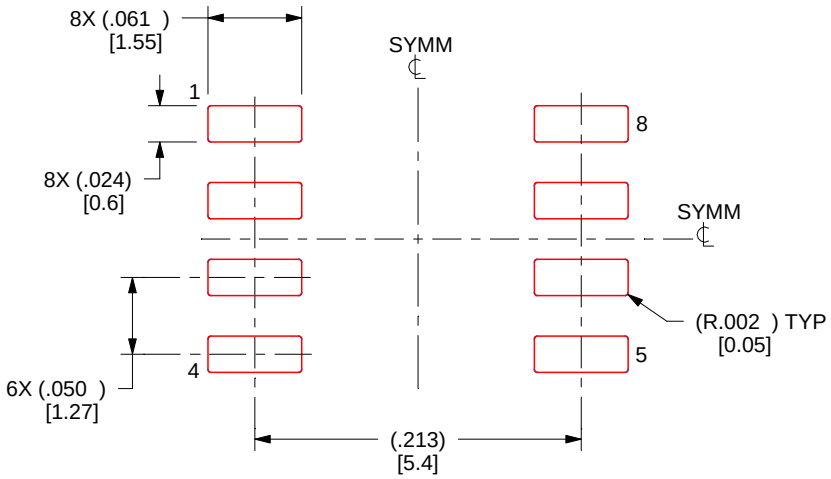
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

## D0008A

## SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



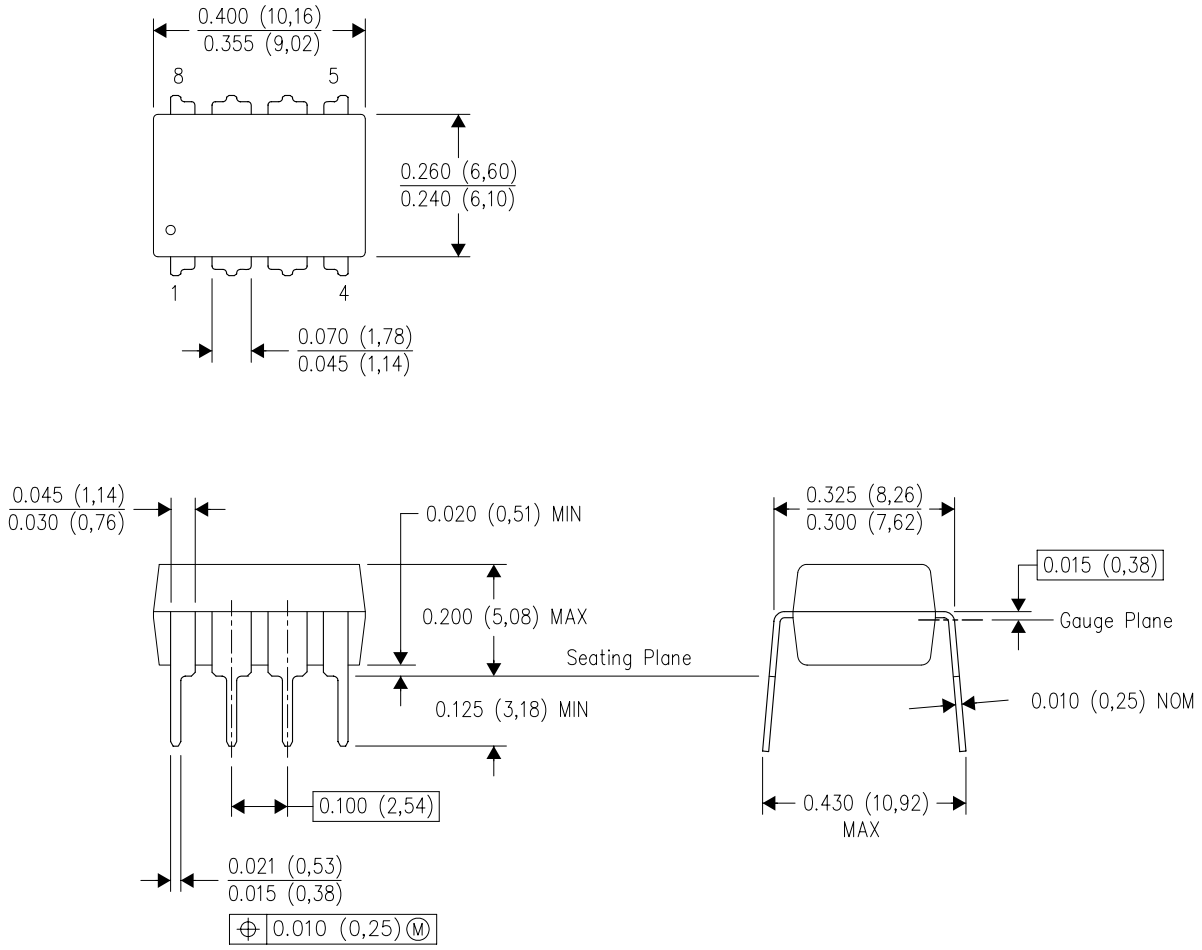

SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

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.

P (R–PDIP–T8) PLASTIC DUAL–IN–LINE PACKAGE



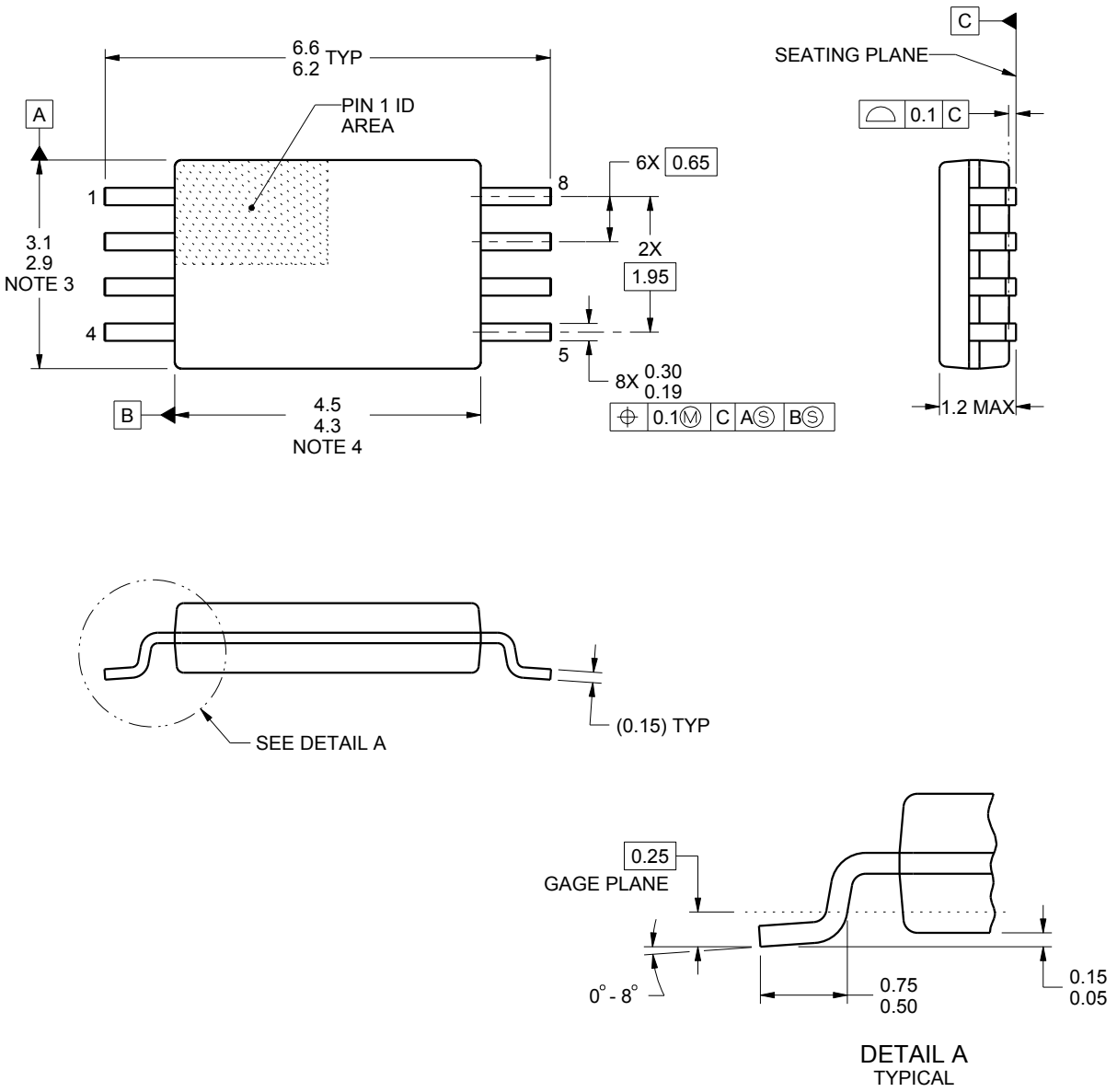

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001 variation BA.

# PACKAGE OUTLINE

## PW0008A

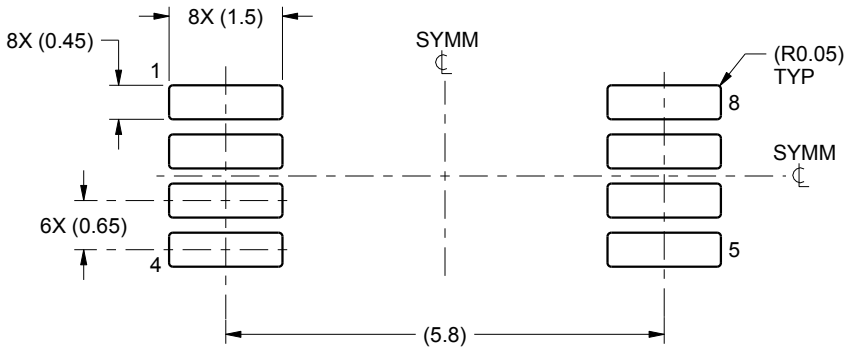
## TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE

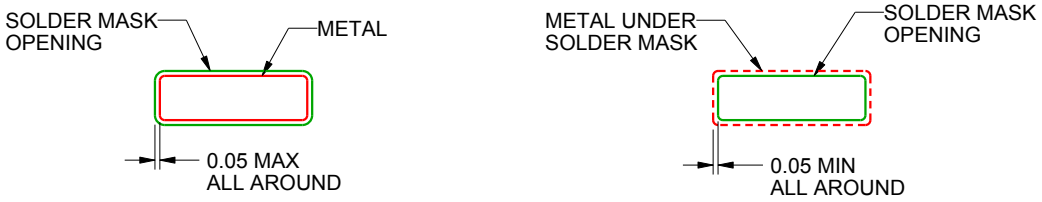



NOTES:

1. All linear dimensions are in millimeters. Any 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 0.25 mm per side.
5. Reference JEDEC registration MO-153, variation AA.




LAND PATTERN EXAMPLE
SCALE:10X

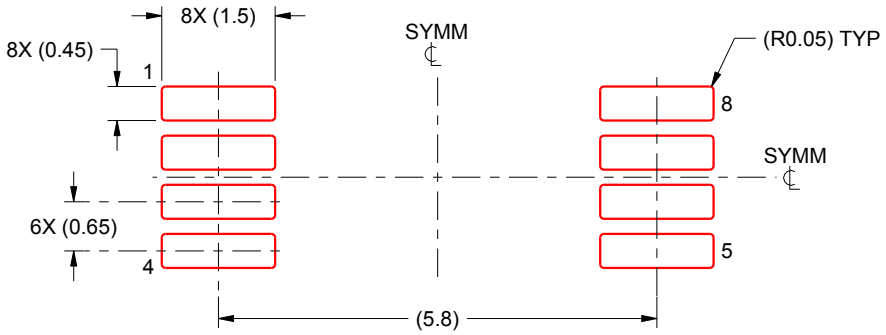



SOLDER MASK DETAILS
NOT TO SCALE

4221848/A 02/2015

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.




SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:10X

4221848/A 02/2015

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.

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