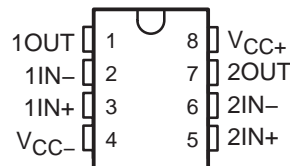


NE5532, NE5532A, SA5532, SA5532A DUAL LOW-NOISE OPERATIONAL AMPLIFIERS

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- Equivalent Input Noise Voltage
5 nV/ $\sqrt{\text{Hz}}$ Typ at 1 kHz
- Unity-Gain Bandwidth . . . 10 MHz Typ
- Common-Mode Rejection
Ratio . . . 100 dB Typ
- High dc Voltage Gain . . . 100 V/mV Typ
- Peak-to-Peak Output Voltage Swing 32 V
Typ With $V_{CC\pm} = \pm 18\text{ V}$ and $R_L = 600\ \Omega$
- High Slew Rate . . . 9 V/ μs Typ
- Wide Supply-Voltage Range . . . $\pm 3\text{ V}$ to
 $\pm 20\text{ V}$

NE5532, NE5532A . . . D, P, OR PS PACKAGE
SA5532, SA5532A . . . D OR P PACKAGE
(TOP VIEW)



description/ordering information

The NE5532, NE5532A, SA5532, and SA5532A are high-performance operational amplifiers combining excellent dc and ac characteristics. They feature very low noise, high output-drive capability, high unity-gain and maximum-output-swing bandwidths, low distortion, high slew rate, input-protection diodes, and output short-circuit protection. These operational amplifiers are compensated internally for unity-gain operation. These devices have specified maximum limits for equivalent input noise voltage.

ORDERING INFORMATION

| T_A | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING | |
|---------------|--------------|----------------------------|----------------------------|---------------------|---------|
| 0°C to 70°C | PDIP – P | Tube of 50 | NE5532P | NE5532P | |
| | | | NE5532AP | NE5532AP | |
| | SOIC – D | Tube of 75 Reel of 2500 | NE5532D | N5532 | |
| | | | NE5532DR | | |
| | | | Tube of 75 Reel of 2500 | NE5532AD | N5532A |
| | | | | NE5532ADR | |
| SOP – PS | Reel of 2000 | NE5532PSR | N5532 | | |
| | | NE5532APSR | N5532A | | |
| –40°C to 85°C | PDIP – P | Tube of 50 | SA5532P | SA5532P | |
| | | | SA5532AP | SA5532AP | |
| | SOIC – D | Tube of 75 Reel of 2500 | SA5532D | SA5532 | |
| | | | SA5532DR | | |
| | | | Tube of 75 Reel of 2500 | SA5532AD | SA5532A |
| | | | | SA5532ADR | |

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



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 **TEXAS
INSTRUMENTS**

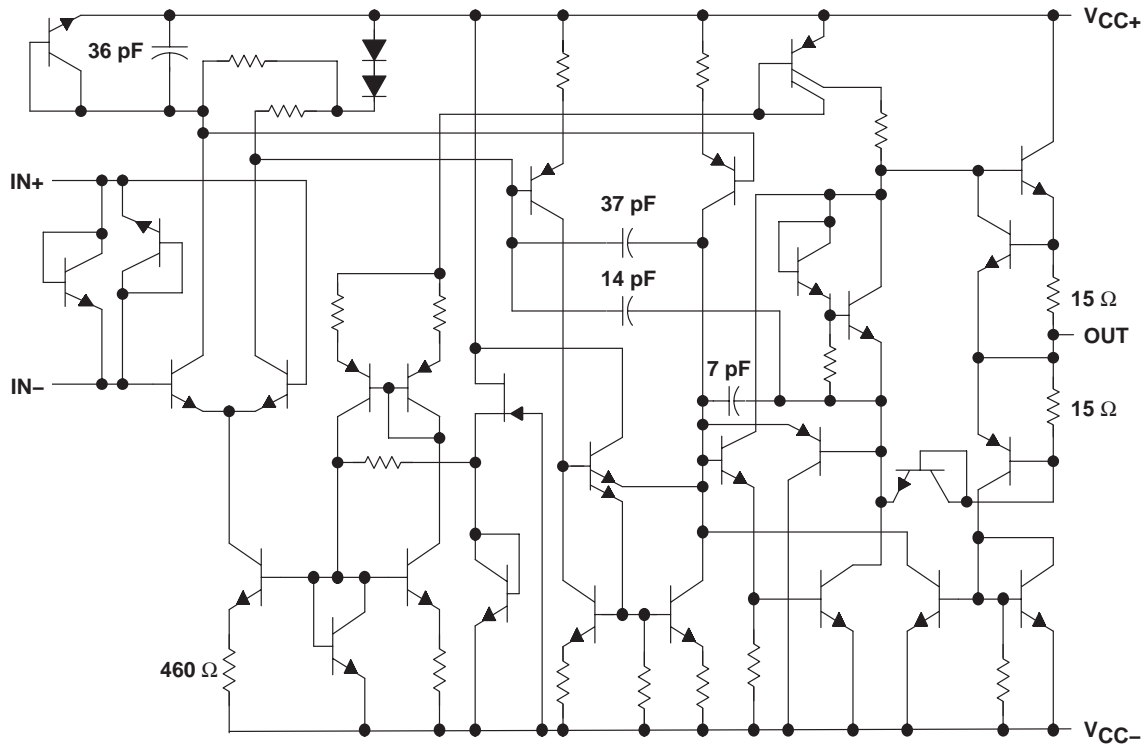
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NE5532, NE5532A, SA5532, SA5532A DUAL LOW-NOISE OPERATIONAL AMPLIFIERS

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schematic (each amplifier)



Component values shown are nominal.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

| | |
|-------------------------------------------------------------------------------|----------------|
| Supply voltage (see Note 1): V_{CC+} | 22 V |
| V_{CC-} | -22 V |
| Input voltage, either input (see Notes 1 and 2) | $V_{CC\pm}$ |
| Input current (see Note 3) | ± 10 mA |
| Duration of output short circuit (see Note 4) | Unlimited |
| Package thermal impedance, θ_{JA} (see Notes 5 and 6): D package | 97°C/W |
| P package | 85°C/W |
| PS package | 95°C/W |
| Operating virtual junction temperature, T_J | 150°C |
| Storage temperature range, T_{stg} | -65°C to 150°C |

† 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.

- NOTES:
1. All voltage values, except differential voltages, are with respect to the midpoint between V_{CC+} and V_{CC-} .
 2. The magnitude of the input voltage must never exceed the magnitude of the supply voltage.
 3. Excessive input current will flow if a differential input voltage in excess of approximately 0.6 V is applied between the inputs, unless some limiting resistance is used.
 4. The output may be shorted to ground or either power supply. Temperature and/or supply voltages must be limited to ensure the maximum dissipation rating is not exceeded.
 5. Maximum power dissipation is a function of $T_J(\max)$, θ_{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 affect reliability.
 6. The package thermal impedance is calculated in accordance with JESD 51-7.

NE5532, NE5532A, SA5532, SA5532A DUAL LOW-NOISE OPERATIONAL AMPLIFIERS

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recommended operating conditions

| | | MIN | MAX | UNIT | |
|------------------|--------------------------------------|-----------------|-----|------|----|
| V _{CC+} | Supply voltage | 5 | 15 | V | |
| V _{CC-} | Supply voltage | -5 | -15 | V | |
| T _A | Operating free-air temperature range | NE5532, NE5532A | 0 | 70 | °C |
| | | SA5532, SA5532A | -40 | 85 | |

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

| PARAMETER | TEST CONDITIONS† | | NE5532, NE5532A SA5532, SA5532A | | | UNIT | |
|------------------|-----------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------------|------|-----|------|------|
| | | | MIN | TYP | MAX | | |
| V _{IO} | Input offset voltage | V _O = 0 | T _A = 25°C | | 0.5 | 4 | mV |
| | | | T _A = Full range‡ | | 5 | | |
| I _{IO} | Input offset current | T _A = 25°C | | 10 | 150 | nA | |
| | | T _A = Full range‡ | | 200 | | | |
| I _{IB} | Input bias current | T _A = 25°C | | 200 | 800 | nA | |
| | | T _A = Full range‡ | | 1000 | | | |
| V _{ICR} | Common-mode input-voltage range | | | ±12 | ±13 | V | |
| V _{OPP} | Maximum peak-to-peak output-voltage swing | R _L ≥ 600 Ω | V _{CC±} = ±15 V | | 24 | 26 | V |
| | | | V _{CC±} = ±18 V | | 30 | 32 | |
| A _{VD} | Large-signal differential-voltage amplification | R _L ≥ 600 Ω, V _O = ±10 V | T _A = 25°C | | 15 | 50 | V/mV |
| | | | T _A = Full range‡ | | 10 | | |
| | | R _L ≥ 2 kΩ, V _O = ±10 V | T _A = 25°C | | 25 | 100 | |
| | | | T _A = Full range‡ | | 15 | | |
| A _{vd} | Small-signal differential-voltage amplification | f = 10 kHz | | 2.2 | | V/mV | |
| B _{OM} | Maximum-output-swing bandwidth | R _L = 600 Ω | V _O = ±10 V | | 140 | | kHz |
| | | | V _{CC±} = ±18 V, V _O = ±14 V | | 100 | | |
| B ₁ | Unity-gain bandwidth | R _L = 600 Ω, | C _L = 100 pF | | 10 | | MHz |
| r _i | Input resistance | | | 30 | 300 | kΩ | |
| z _o | Output impedance | A _{VD} = 30 dB, R _L = 600 Ω, f = 10 kHz | | 0.3 | | Ω | |
| CMRR | Common-mode rejection ratio | V _{IC} = V _{ICR} min | | 70 | 100 | dB | |
| k _{SVR} | Supply-voltage rejection ratio (ΔV _{CC±} /ΔV _{IO}) | V _{CC±} = ±9 V to ±15 V, V _O = 0 | | 80 | 100 | dB | |
| I _{OS} | Output short-circuit current | | | 10 | 38 | 60 | mA |
| I _{CC} | Total supply current | V _O = 0, No load | | 8 | 16 | mA | |
| | Crosstalk attenuation (V _{O1} /V _{O2}) | V _{O1} = 10 V peak, f = 1 kHz | | 110 | | dB | |

† All characteristics are measured under open-loop conditions, with zero common-mode input voltage, unless otherwise specified.

‡ Full temperature ranges are: -40°C to 85°C for the SA5532 and SA5532A, and 0°C to 70°C for the NE5532 and NE5532A.



NE5532, NE5532A, SA5532, SA5532A

DUAL LOW-NOISE OPERATIONAL AMPLIFIERS

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operating characteristics, $V_{CC\pm} = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | NE5532, SA5532 | | | NE5532A, SA5532A | | | UNIT |
|-----------|--------------------------------|---------------------------------------------------------------------------------------------|----------------|-----|-----|------------------|-----|------------------------|------------------------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| SR | Slew rate at unity gain | | 9 | | | 9 | | | V/ μ s |
| | Overshoot factor | $V_I = 100\text{ mV}$, $R_L = 600\ \Omega$, $A_{VD} = 1$, $C_L = 100\text{ pF}$ | 10 | | | 10 | | | % |
| V_n | Equivalent input noise voltage | f = 30 Hz | 8 | | | 8 | 10 | nV/ $\sqrt{\text{Hz}}$ | |
| | | f = 1 kHz | 5 | | | 5 | 6 | | |
| I_n | Equivalent input noise current | f = 30 Hz | 2.7 | | | 2.7 | | | pA/ $\sqrt{\text{Hz}}$ |
| | | f = 1 kHz | 0.7 | | | 0.7 | | | |



PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|--------------------------------------------|
| NE5532AD | ACTIVE | SOIC | D | 8 | 75 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR |
| NE5532ADE4 | ACTIVE | SOIC | D | 8 | 75 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR |
| NE5532ADR | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR |
| NE5532ADRE4 | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR |
| NE5532AIP | OBSOLETE | PDIP | P | 8 | | TBD | Call TI | Call TI |
| NE5532AP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| NE5532APSR | ACTIVE | SO | PS | 8 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| NE5532APSRE4 | ACTIVE | SO | PS | 8 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| NE5532D | ACTIVE | SOIC | D | 8 | 75 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR |
| NE5532DE4 | ACTIVE | SOIC | D | 8 | 75 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR |
| NE5532DG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1YEAR |
| NE5532DR | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR |
| NE5532DRE4 | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR |
| NE5532DRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1YEAR |
| NE5532IP | OBSOLETE | PDIP | P | 8 | | TBD | Call TI | Call TI |
| NE5532P | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| NE5532PSR | ACTIVE | SO | PS | 8 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| NE5532PSRE4 | ACTIVE | SO | PS | 8 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SA5532AD | ACTIVE | SOIC | D | 8 | 75 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SA5532ADE4 | ACTIVE | SOIC | D | 8 | 75 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SA5532ADR | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SA5532ADRE4 | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SA5532AP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| SA5532D | ACTIVE | SOIC | D | 8 | 75 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SA5532DE4 | ACTIVE | SOIC | D | 8 | 75 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SA5532DR | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free | CU NIPDAU | Level-2-260C-1 YEAR/ |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|--------------------------------------------|
| | | | | | | (RoHS) | | Level-1-235C-UNLIM |
| SA5532DRE4 | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SA5532P | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |

⁽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) 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.

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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P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE

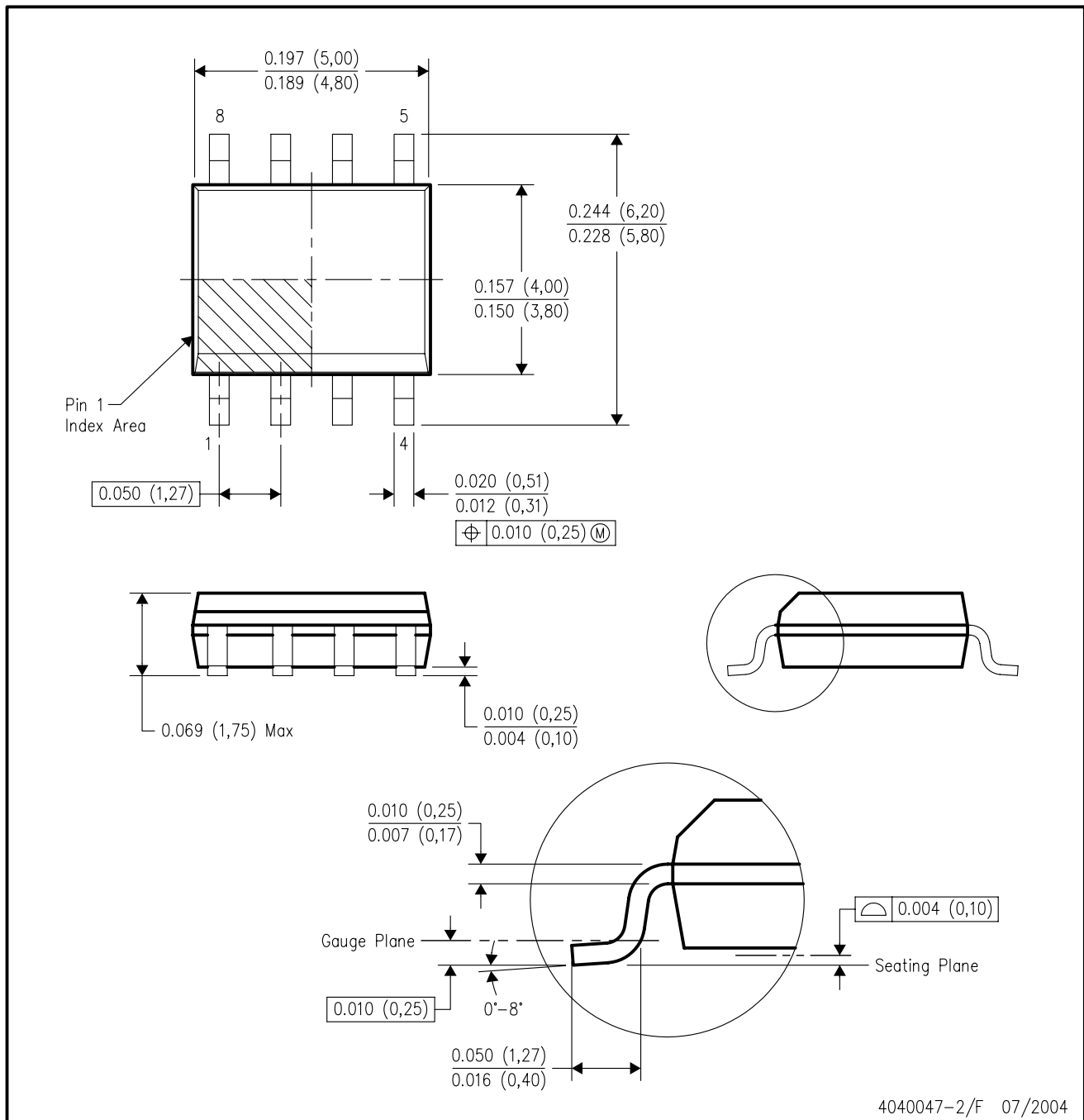


- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Falls within JEDEC MS-001

For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - D. Falls within JEDEC MS-012 variation AA.

MECHANICAL DATA

PS (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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