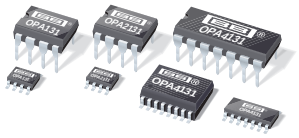


# OPA131
# OPA2131
# OPA4131

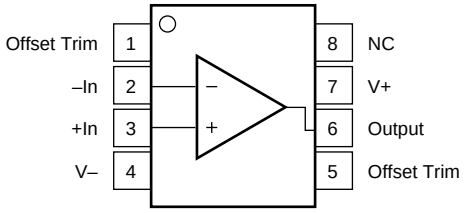
SBOS040A – NOVEMBER 1994 – REVISED DECEMBER 2002

# General-Purpose FET-INPUT OPERATIONAL AMPLIFIERS

## FEATURES

- **FET INPUT: $I_B$ = 50pA max**
- **LOW OFFSET VOLTAGE: 750μV max**
- **WIDE SUPPLY RANGE: ±4.5V to ±18V**
- **SLEW RATE: 10V/μs**
- **WIDE BANDWIDTH: 4MHz**
- **EXCELLENT CAPACITIVE LOAD DRIVE**
- **SINGLE, DUAL, QUAD VERSIONS**

OPA131




DIP-8, SO-8

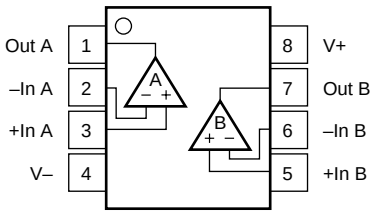
## DESCRIPTION

The OPA131 series of FET-input op amps provides high performance at low cost. Single, dual, and quad versions in industry-standard pinouts allow cost-effective design options.

The OPA131 series offers excellent general-purpose performance, including low offset voltage, drift, and good dynamic characteristics.

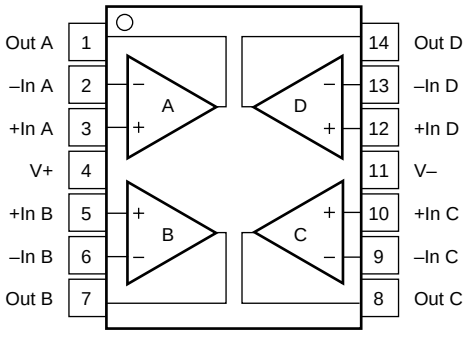
Single, dual, and quad versions are available in DIP and SO packages. Performance grades include commercial and industrial temperature ranges.

OPA2131



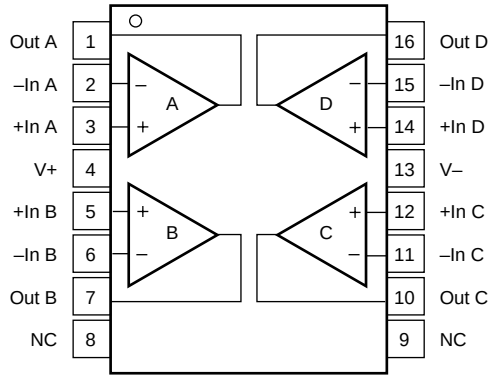

DIP-8, SO-8

OPA4131




DIP-14, SO-14

OPA4131




NC = No Connection

SOL-16

## ABSOLUTE MAXIMUM RATINGS[1]

| | |
|---|---|
| Supply Voltage, V+ to V– | 36V |
| Input Voltage | (V–) – 0.7V to (V+) + 0.7V |
| Output Short-Circuit[2] | Continuous |
| Operating Temperature | –55°C to +125°C |
| Storage Temperature | –55°C to +125°C |
| Junction Temperature | 150°C |
| Lead Temperature (soldering, 10s) | 300°C |

NOTES: (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. (2) Short-circuit to ground, one amplifier per package.

## ELECTROSTATIC DISCHARGE SENSITIVITY

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

## PACKAGE/ORDERING INFORMATION

| PRODUCT | PACKAGE-LEAD | PACKAGE DESIGNATOR[1] | SPECIFIED TEMPERATURE RANGE | PACKAGE MARKING | ORDERING NUMBER | TRANSPORT MEDIA, QUANTITY |
|---|---|---|---|---|---|---|
| **Single** | | | | | | |
| OPA131 | SO-8 | D | –40°C to +85°C | OPA131UJ | OPA131UJ | Rails, 100 |
| " | " | " | " | " | OPA131UJ/2K5 | Tape and Reel, 2500 |
| OPA131 | SO-8 | D | –40°C to +85°C | OPA131UA | OPA131UA | Rails, 100 |
| " | " | " | " | " | OPA131UA/2K5 | Tape and Reel, 2500 |
| OPA131 | SO-8 | D | –40°C to +85°C | OPA131U | OPA131U | Rails, 100 |
| " | " | " | " | " | OPA131U/2K5 | Tape and Reel, 2500 |
| **Dual** | | | | | | |
| OPA2131 | SO-8 | D | –40°C to +85°C | OPA2131UJ | OPA2131UJ | Rails, 100 |
| " | " | " | " | " | OPA2131UJ/2K5 | Tape and Reel, 2500 |
| OPA2131 | SO-8 | D | –40°C to +85°C | OPA2131UA | OPA2131UA | Rails, 100 |
| " | " | " | " | " | OPA2131UA/2K5 | Tape and Reel, 2500 |
| **Quad** | | | | | | |
| OPA4131 | DIP-14 | N | –40°C to +85°C | OPA4131PJ | OPA4131PJ | Rails, 25 |
| " | " | " | " | OPA4131PA | OPA4131PA | Rails, 25 |
| OPA4131 | SOL-16 | DW | –40°C to +85°C | OPA4131UA | OPA4131UA | Rails, 48 |
| " | " | " | " | " | OPA4131UA/1K | Tape and Reel, 1000 |
| OPA4131 | SOL-14 | D | –40°C to +85°C | OPA4131NJ | OPA4131NJ | Rails, 58 |
| " | " | " | " | OPA4131NA | OPA4131NA | Rails, 58 |

NOTE: (1) For the most current specifications and package information, refer to our web site at www.ti.com.

# ELECTRICAL CHARACTERISTICS

At $T_A$ = +25°C, $V_S$ = ±15V, and $R_L$ = 2kΩ, unless otherwise noted.

| PARAMETER | CONDITION | OPA131UA OPA2131UA OPA4131PA, UA, NA | | | OPA131UJ OPA2131UJ OPA4131PJ, NJ | | | UNITS |
|---|---|---|---|---|---|---|---|---|
| | | MIN | TYP | MAX | MIN | TYP | MAX | |
| **OFFSET VOLTAGE** | | | | | | | | |
| Input Offset Voltage | | | ±0.2 | ±1 | | * | ±1.5 | mV |
| OPA131U model only | | | ±0.2 | 0.75 | | | | mV |
| vs Temperature[1] | Operating Temperature Range | | ±2 | ±10 | | * | * | µV/°C |
| vs Power Supply | $V_S$ = ±4.5V to ±18V | | 50 | 200 | | * | * | µV/V |
| OPA131U model only | | | 50 | 100 | | | | µV/V |
| **INPUT BIAS CURRENT[2]** | | | | | | | | |
| Input Bias Current | $V_{CM}$ = 0V | | +5 | ±50 | | * | * | pA |
| vs Temperature | | | See Typical Characteristic | | | * | | |
| Input Offset Current | $V_{CM}$ = 0V | | ±1 | ±50 | | * | * | pA |
| **NOISE** | | | | | | | | |
| Input Voltage Noise | | | | | | | | |
| Noise Density, f = 10Hz | | | 21 | | | * | | nV/√Hz |
| f = 100Hz | | | 16 | | | * | | nV/√Hz |
| f = 1kHz | | | 15 | | | * | | nV/√Hz |
| f = 10kHz | | | 15 | | | * | | nV/√Hz |
| Current Noise Density, f = 1kHz | | | 3 | | | * | | fA/√Hz |
| **INPUT VOLTAGE RANGE** | | | | | | | | |
| Common-Mode Voltage Range | | (V–) + 3 | | (V+) – 1 | * | | * | V |
| Common-Mode Rejection | $V_{CM}$ = –12V to +14V | 70 | 80 | | * | * | | dB |
| OPA131U model only | | 80 | 86 | | | | | dB |
| **INPUT IMPEDANCE** | | | | | | | | |
| Differential | | | $10^{10}$ \|\| 1 | | | * | | Ω \|\| pF |
| Common-Mode | $V_{CM}$ = 0V | | $10^{12}$ \|\| 3 | | | * | | Ω \|\| pF |
| **OPEN-LOOP GAIN** | | | | | | | | |
| Open-Loop Voltage Gain | $V_O$ = –12V to +12V | 94 | 110 | | * | * | | dB |
| OPA131U model only | | 100 | 110 | | | | | dB |
| **FREQUENCY RESPONSE** | | | | | | | | |
| Gain-Bandwidth Product | | | 4 | | | * | | MHz |
| Slew Rate | | | 10 | | | * | | V/µs |
| Settling Time 0.1% | G = –1, 10V Step, $C_L$ = 100pF | | 1.5 | | | * | | µs |
| 0.01% | G = –1, 10V Step, $C_L$ = 100pF | | 2 | | | * | | µs |
| Total Harmonic Distortion + Noise | 1kHz, G = 1, $V_O$ = 3.5Vrms | | 0.0008 | | | * | | % |
| **OUTPUT** | | | | | | | | |
| Voltage Output, Positive | | (V+) – 3 | (V+) – 2.5 | | * | * | | V |
| Negative | | (V–) + 3 | (V–) + 2.5 | | * | * | | V |
| Short-Circuit Current | | | ±25 | | | * | | mA |
| **POWER SUPPLY** | | | | | | | | |
| Specified Operating Voltage | | | ±15 | | | * | | V |
| Operating Voltage Range | | ±4.5 | | ±18 | * | | * | V |
| Quiescent Current (per amplifier) | $I_O$ = 0 | | ±1.5 | ±1.75 | | * | ±2 | mA |
| **TEMPERATURE RANGE** | | | | | | | | |
| Operating Range | | –55 | | +125 | –55 | | +125 | °C |
| Storage | | –55 | | +125 | * | | * | °C |
| Thermal Resistance, $\theta_{JA}$ | | | | | | | | |
| DIP-8 | | | 100 | | | * | | °C/W |
| SO-8 | | | 150 | | | * | | °C/W |
| DIP-14 | | | 80 | | | * | | °C/W |
| SO-14, SOL-16 | | | 110 | | | * | | °C/W |

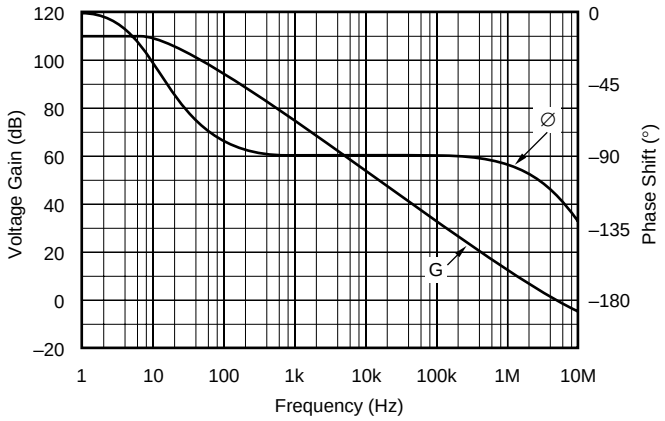
* Specifications same as OPA131UA.

NOTES: (1) Ensured by wafer test. (2) High-speed test at $T_J$ = 25°C.

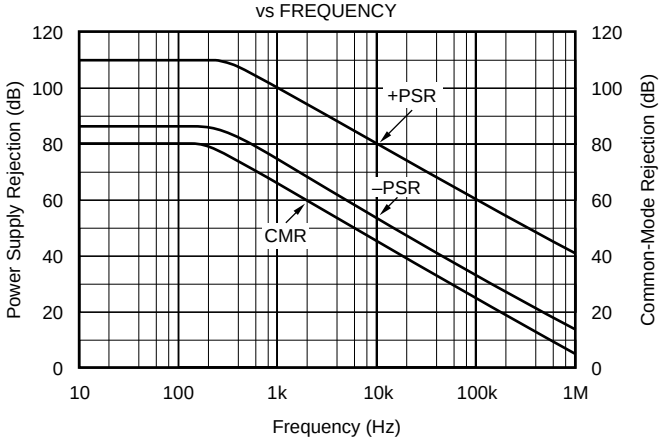
# TYPICAL CHARACTERISTICS

At $T_A$ = +25°C, $V_S$ = ±15V, and $R_L$ = 2kΩ, unless otherwise noted.

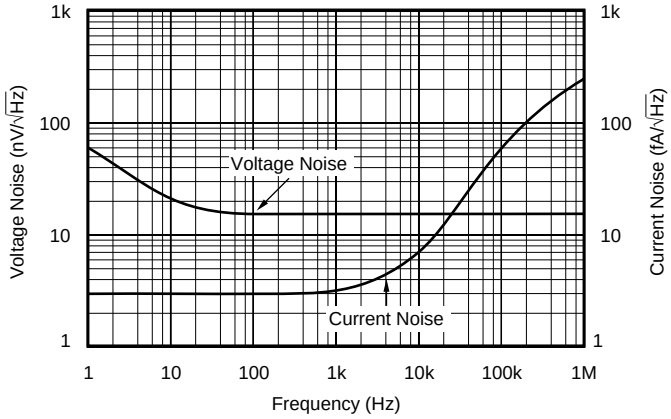
OPEN-LOOP GAIN/PHASE vs FREQUENCY



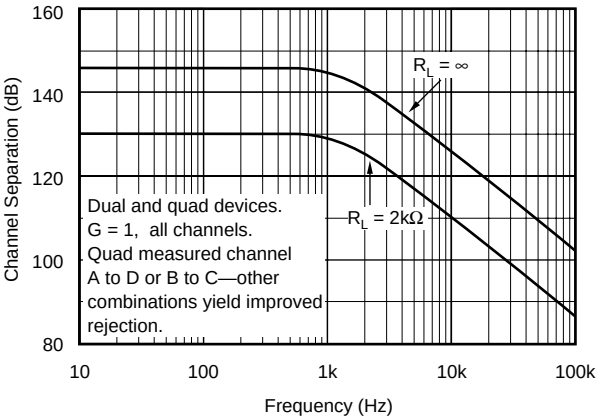

POWER SUPPLY AND COMMON-MODE REJECTION vs FREQUENCY



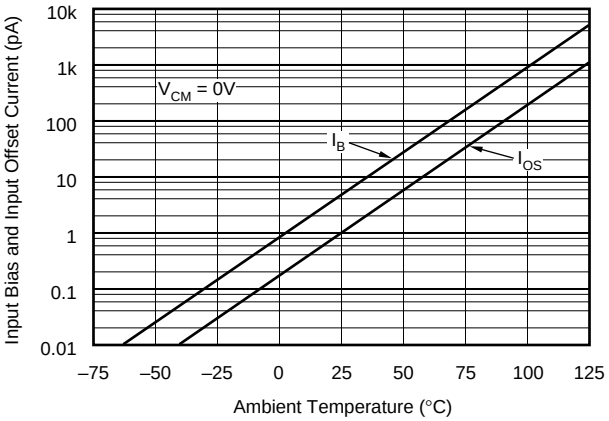

INPUT VOLTAGE AND CURRENT NOISE SPECTRAL DENSITY vs FREQUENCY



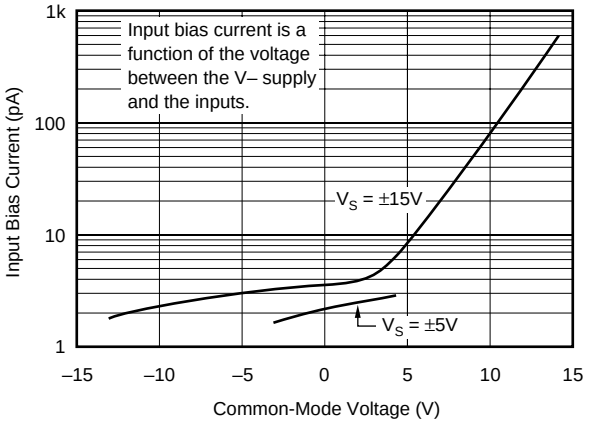

CHANNEL SEPARATION vs FREQUENCY




INPUT BIAS AND INPUT OFFSET CURRENT vs TEMPERATURE



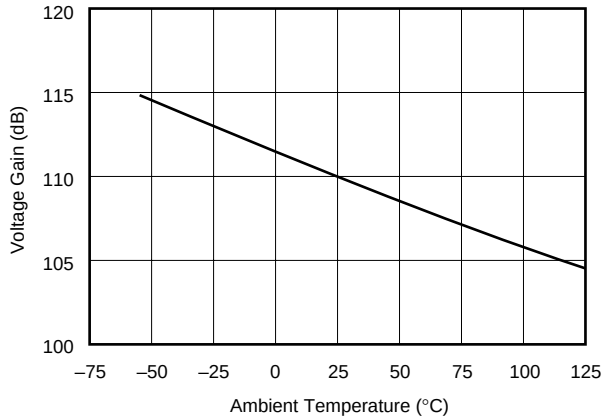

INPUT BIAS CURRENT vs INPUT COMMON-MODE VOLTAGE



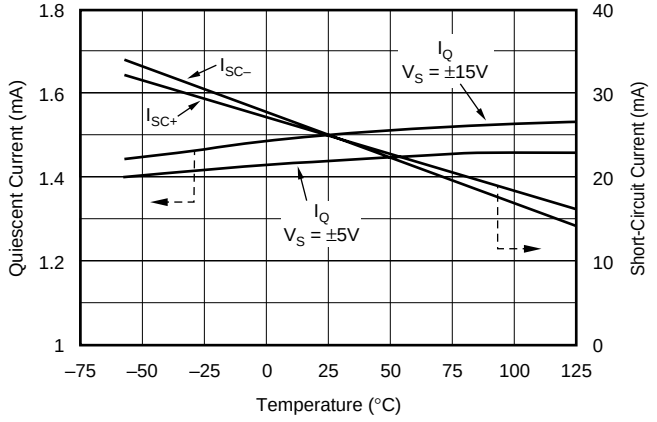
# TYPICAL CHARACTERISTICS (Cont.)

At $T_A$ = +25°C, $V_S$ = ±15V, and $R_L$ = 2kΩ, unless otherwise noted.

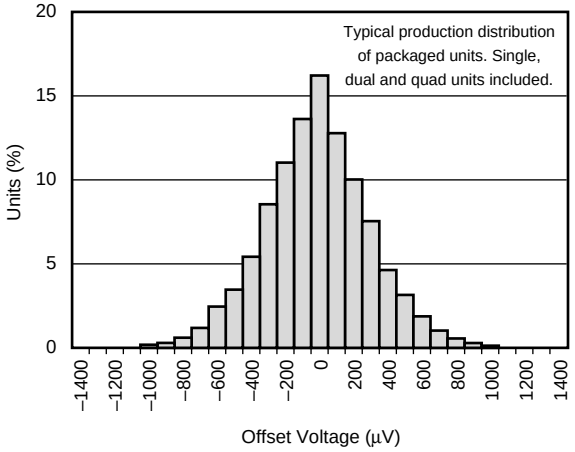
OPEN-LOOP GAIN vs TEMPERATURE



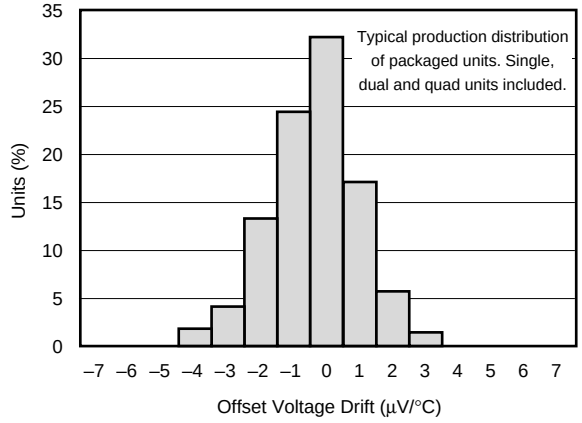

QUIESCENT CURRENT AND SHORT-CIRCUIT CURRENT vs TEMPERATURE



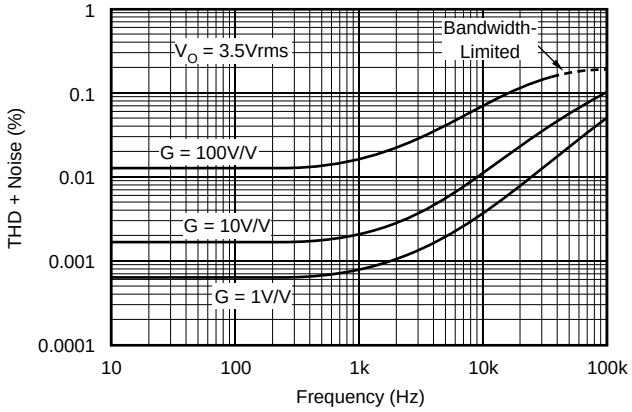

OFFSET VOLTAGE PRODUCTION DISTRIBUTION



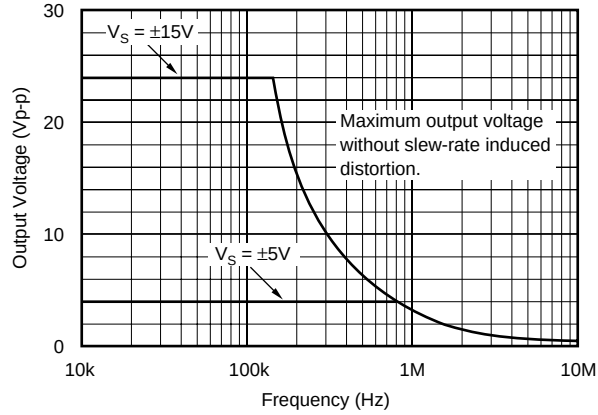

OFFSET VOLTAGE DRIFT PRODUCTION DISTRIBUTION




TOTAL HARMONIC DISTORTION + NOISE vs FREQUENCY



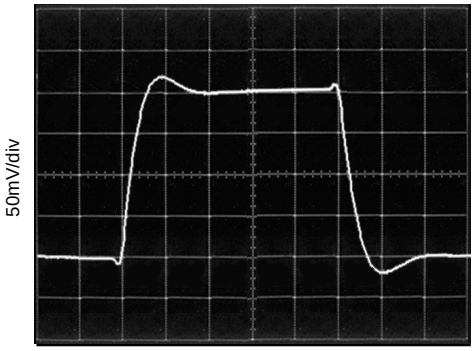

MAXIMUM OUTPUT VOLTAGE vs FREQUENCY



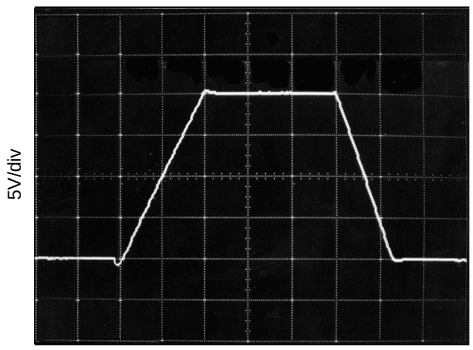
# TYPICAL CHARACTERISTICS (Cont.)

At $T_{CASE}$ = +25°C, $V_S$ = ±15V, and $R_L$ = 2kΩ, unless otherwise noted.

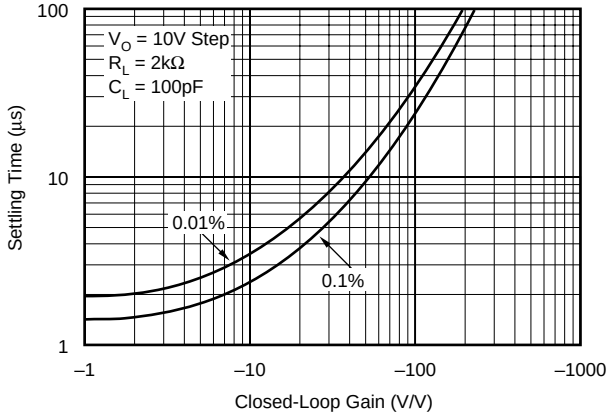
SMALL-SIGNAL STEP RESPONSE
G =1, $C_L$ = 300pF



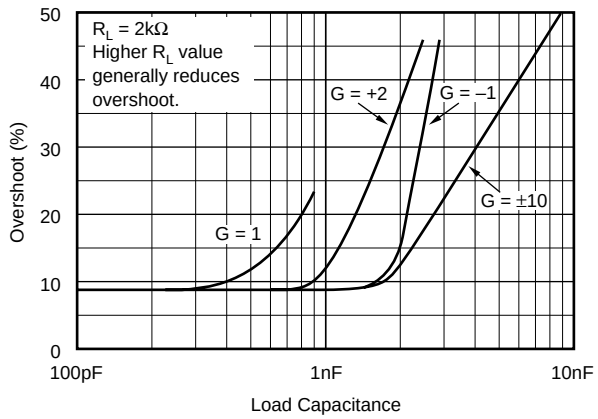

LARGE-SIGNAL STEP RESPONSE
G = 1, $C_L$ = 300pF



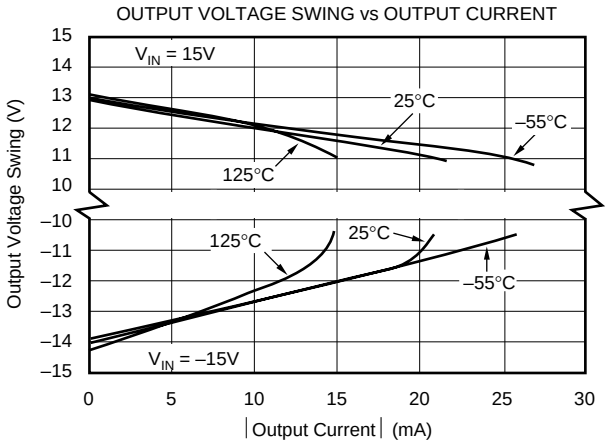

SETTLING TIME vs CLOSED-LOOP GAIN




SMALL-SIGNAL OVERSHOOT
vs LOAD CAPACITANCE




OUTPUT VOLTAGE SWING vs OUTPUT CURRENT



# APPLICATIONS INFORMATION

The OPA131 series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. Power-supply pins should be bypassed with 10nF ceramic capacitors or larger.

The OPA131 series op amps are free from unexpected output phase-reversal common with FET op amps. Many FET-input op amps exhibit phase-reversal of the output when the input common-mode voltage range is exceeded. This can occur in voltage-follower circuits, causing serious problems in control-loop applications. All circuitry is completely independent in dual and quad versions, assuring normal behavior when one amplifier in a package is overdriven or short-circuited.

## OFFSET VOLTAGE TRIM

The OPA131 (single op amp version) provides offset voltage trim connections on pins 1 and 5. Offset voltage can be adjusted by connecting a potentiometer as shown in Figure 1. This adjustment should be used only to null the offset of the op amp, not system offset or offset produced by the signal source.

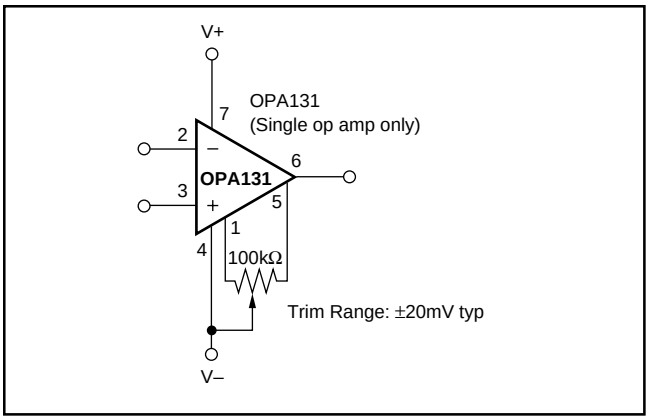



FIGURE 1. OPA131 Offset Voltage Trim Circuit.

## INPUT BIAS CURRENT

The input bias current is approximately 5pA at room temperature and increases with temperature as shown in the typical characteristic “Input Bias Current vs Temperature.”

Input bias current also varies with common-mode voltage and power supply voltage. This variation is dependent on the voltage between the negative power supply and the common-mode input voltage. The effect is shown in the typical curve “Input Bias Current vs Common-Mode Voltage.”

## 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| OPA131P | OBSOLETE | PDIP | P | 8 | | TBD | Call TI | Call TI | | | |
| OPA131PA | OBSOLETE | PDIP | P | 8 | | TBD | Call TI | Call TI | | | |
| OPA131PJ | OBSOLETE | PDIP | P | 8 | | TBD | Call TI | Call TI | | | |
| OPA131U | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -55 to 125 | OPA 131U | Samples |
| OPA131UA | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -55 to 125 | OPA 131U A | Samples |
| OPA131UA/2K5 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -55 to 125 | OPA 131U A | Samples |
| OPA131UAE4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -55 to 125 | OPA 131U A | Samples |
| OPA131UG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -55 to 125 | OPA 131U | Samples |
| OPA131UJ | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -55 to 125 | OPA 131UJ | Samples |
| OPA131UJ/2K5 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -55 to 125 | OPA 131UJ | Samples |
| OPA131UJE4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -55 to 125 | OPA 131UJ | Samples |
| OPA2131PA | OBSOLETE | PDIP | P | 8 | | TBD | Call TI | Call TI | | | |
| OPA2131PJ | OBSOLETE | PDIP | P | 8 | | TBD | Call TI | Call TI | | | |
| OPA2131UA | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -55 to 125 | OPA 2131UA | Samples |
| OPA2131UA/2K5 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -55 to 125 | OPA 2131UA | Samples |
| OPA2131UA/2K5E4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -55 to 125 | OPA 2131UA | Samples |
| OPA2131UA/2K5G4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -55 to 125 | OPA 2131UA | Samples |
| OPA2131UAE4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -55 to 125 | OPA 2131UA | Samples |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| OPA2131UAG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -55 to 125 | OPA 2131UA | Samples |
| OPA2131UJ | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | | OPA 2131UJ | Samples |
| OPA2131UJ/2K5 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | | OPA 2131UJ | Samples |
| OPA2131UJ/2K5G4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | | OPA 2131UJ | Samples |
| OPA2131UJG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | | OPA 2131UJ | Samples |
| OPA4131NA | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -40 to 85 | OPA4131NA | Samples |
| OPA4131NAG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -40 to 85 | OPA4131NA | Samples |
| OPA4131NJ | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -40 to 85 | OPA4131NJ | Samples |
| OPA4131NJG4 | ACTIVE | SOIC | D | 14 | | TBD | Call TI | Call TI | -40 to 85 | | Samples |
| OPA4131PA | ACTIVE | PDIP | N | 14 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | N / A for Pkg Type | -40 to 85 | OPA4131PA | Samples |
| OPA4131PAG4 | ACTIVE | PDIP | N | 14 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | N / A for Pkg Type | -40 to 85 | OPA4131PA | Samples |
| OPA4131PJ | ACTIVE | PDIP | N | 14 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | N / A for Pkg Type | -40 to 85 | OPA4131PJ | Samples |
| OPA4131PJG4 | ACTIVE | PDIP | N | 14 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | N / A for Pkg Type | -40 to 85 | OPA4131PJ | Samples |
| OPA4131UA | ACTIVE | SOIC | DW | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -40 to 85 | OPA4131UA | Samples |
| OPA4131UA/1K | ACTIVE | SOIC | DW | 16 | 1000 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -40 to 85 | OPA4131UA | Samples |
| OPA4131UAG4 | ACTIVE | SOIC | DW | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU-DCC | Level-3-260C-168 HR | -40 to 85 | OPA4131UA | 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)** 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.

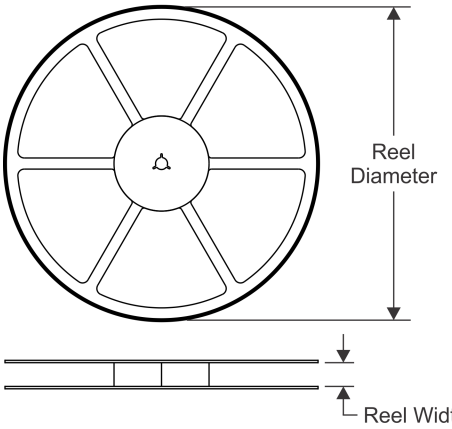
**(4)** There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

**(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.

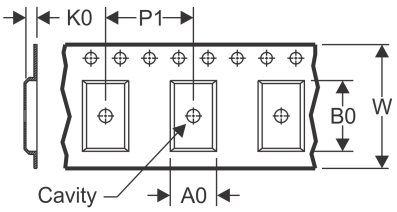
**(6)** Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

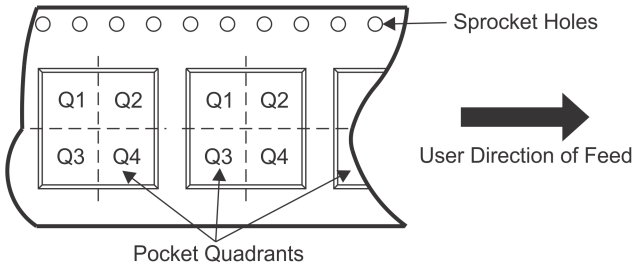



**TAPE DIMENSIONS**




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

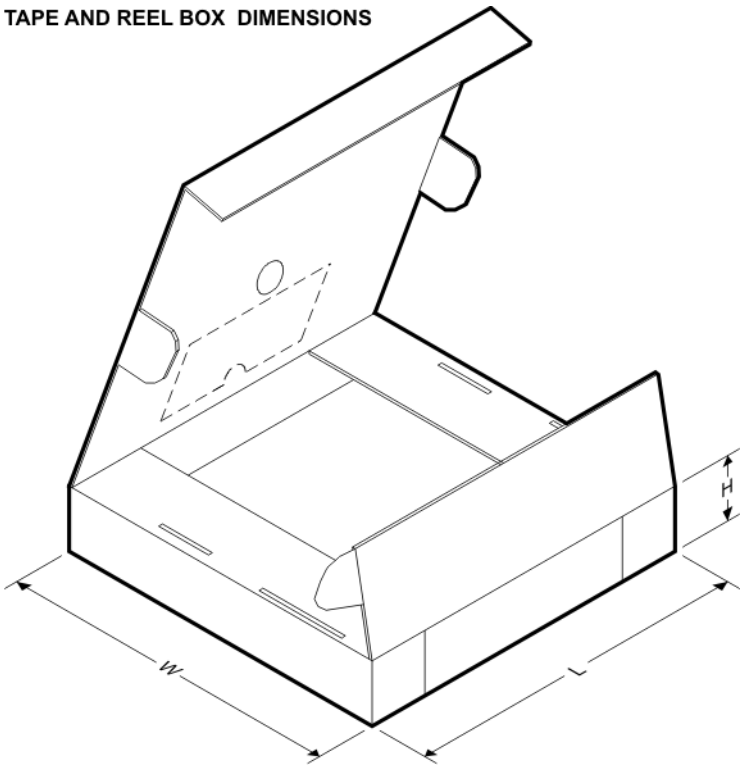
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OPA131UA/2K5 | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| OPA131UJ/2K5 | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| OPA2131UA/2K5 | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| OPA2131UJ/2K5 | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| OPA4131UA/1K | SOIC | DW | 16 | 1000 | 330.0 | 16.4 | 10.75 | 10.7 | 2.7 | 12.0 | 16.0 | Q1 |

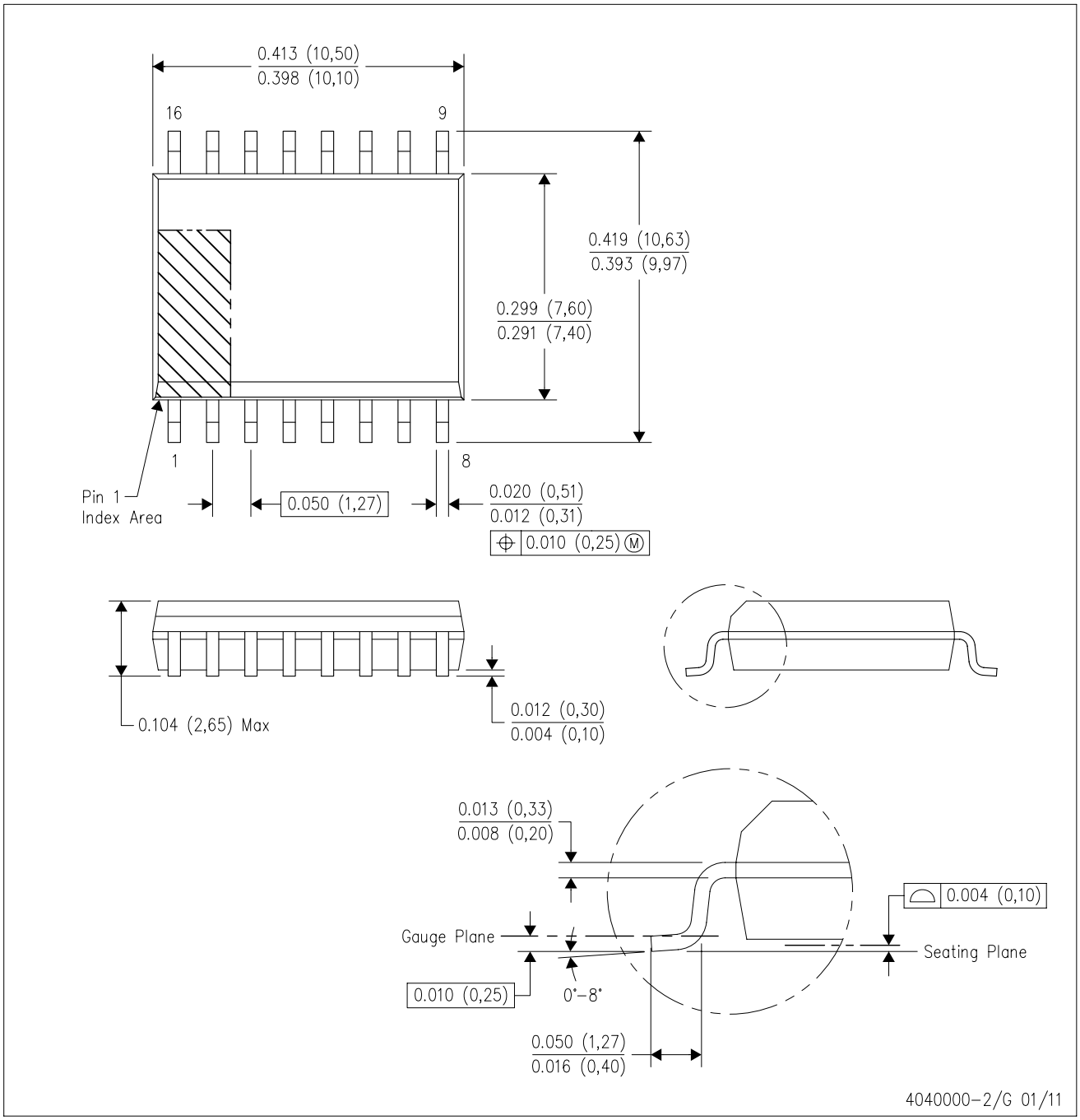
TAPE AND REEL BOX DIMENSIONS




*All dimensions are nominal

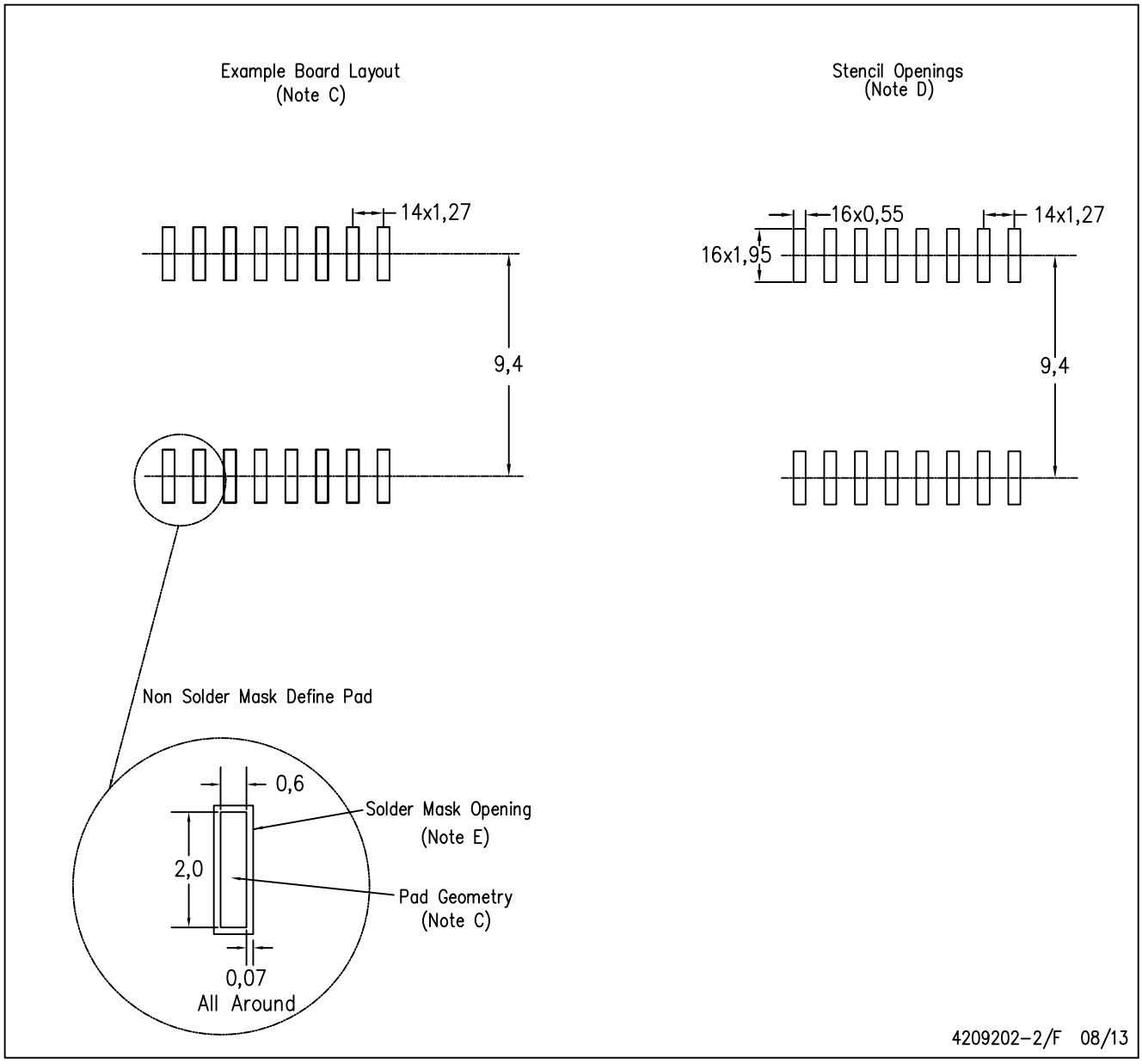
| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| OPA131UA/2K5 | SOIC | D | 8 | 2500 | 367.0 | 367.0 | 35.0 |
| OPA131UJ/2K5 | SOIC | D | 8 | 2500 | 367.0 | 367.0 | 35.0 |
| OPA2131UA/2K5 | SOIC | D | 8 | 2500 | 367.0 | 367.0 | 35.0 |
| OPA2131UJ/2K5 | SOIC | D | 8 | 2500 | 367.0 | 367.0 | 35.0 |
| OPA4131UA/1K | SOIC | DW | 16 | 1000 | 367.0 | 367.0 | 38.0 |

DW (R–PDSO–G16) PLASTIC SMALL OUTLINE



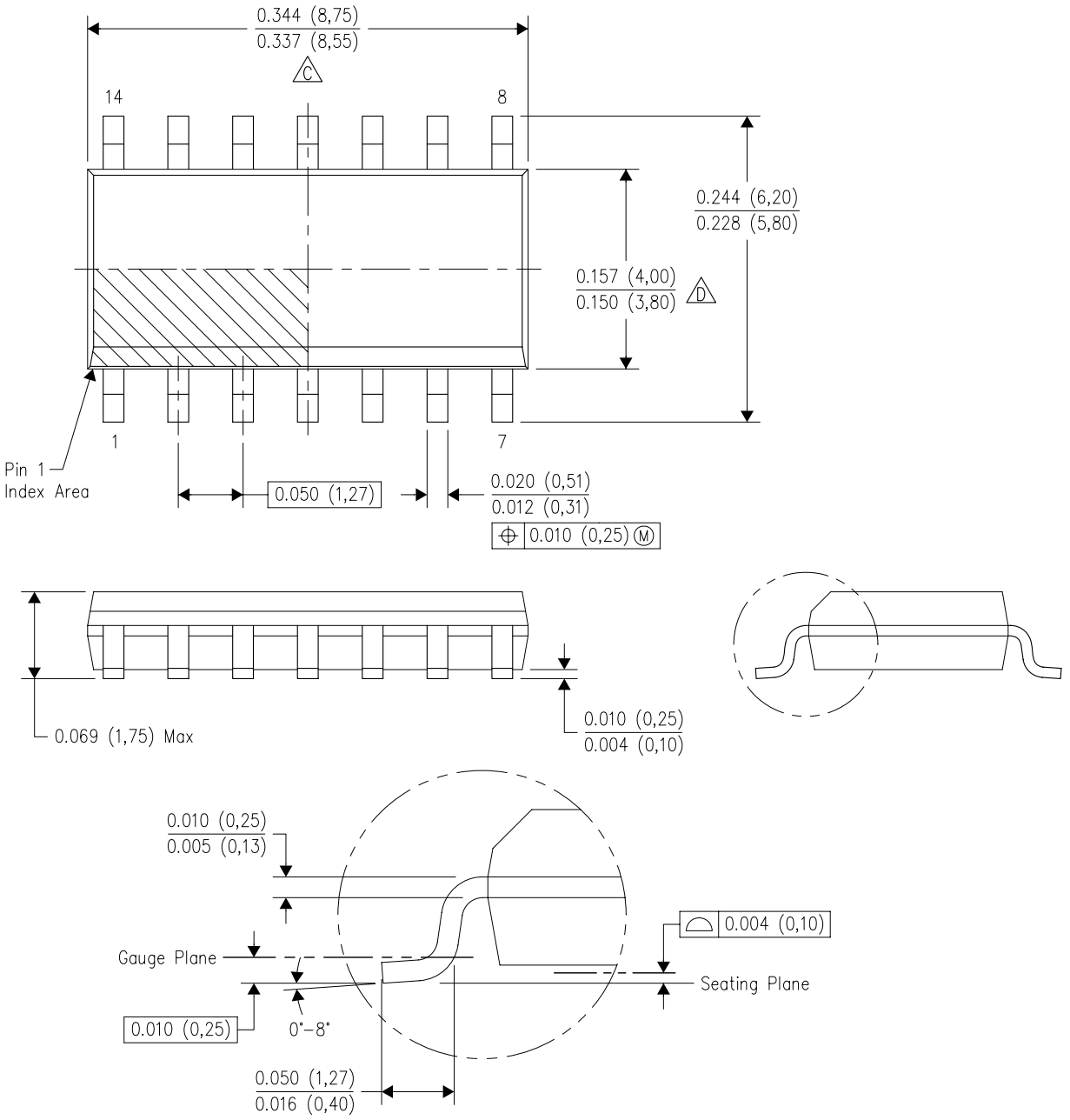

NOTES:
A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS–013 variation AA.

DW (R–PDSO–G16) PLASTIC SMALL OUTLINE




NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Refer to IPC7351 for alternate board design.
D. 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
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

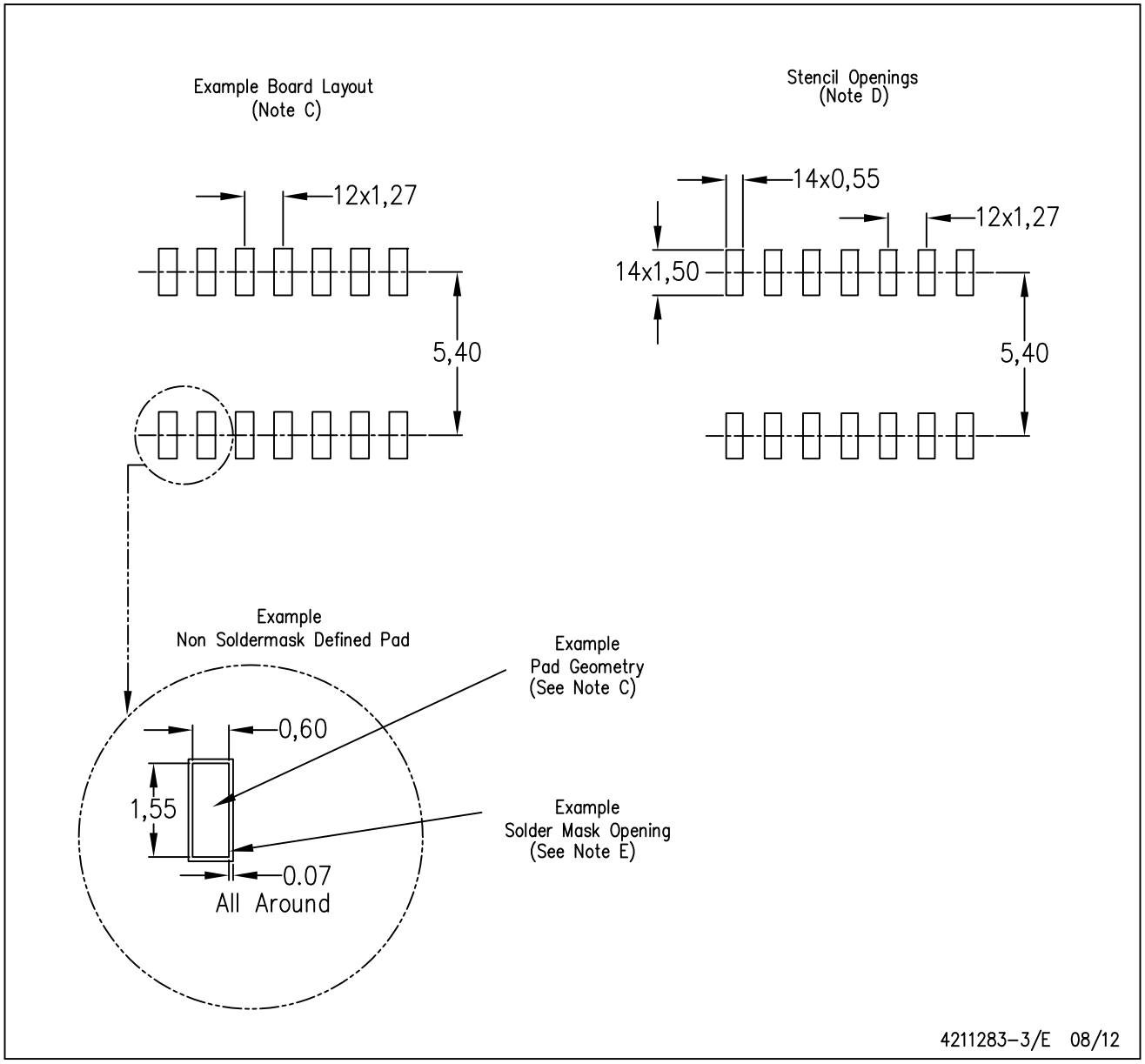
D (R–PDSO–G14) PLASTIC SMALL OUTLINE




4040047–5/M 06/11

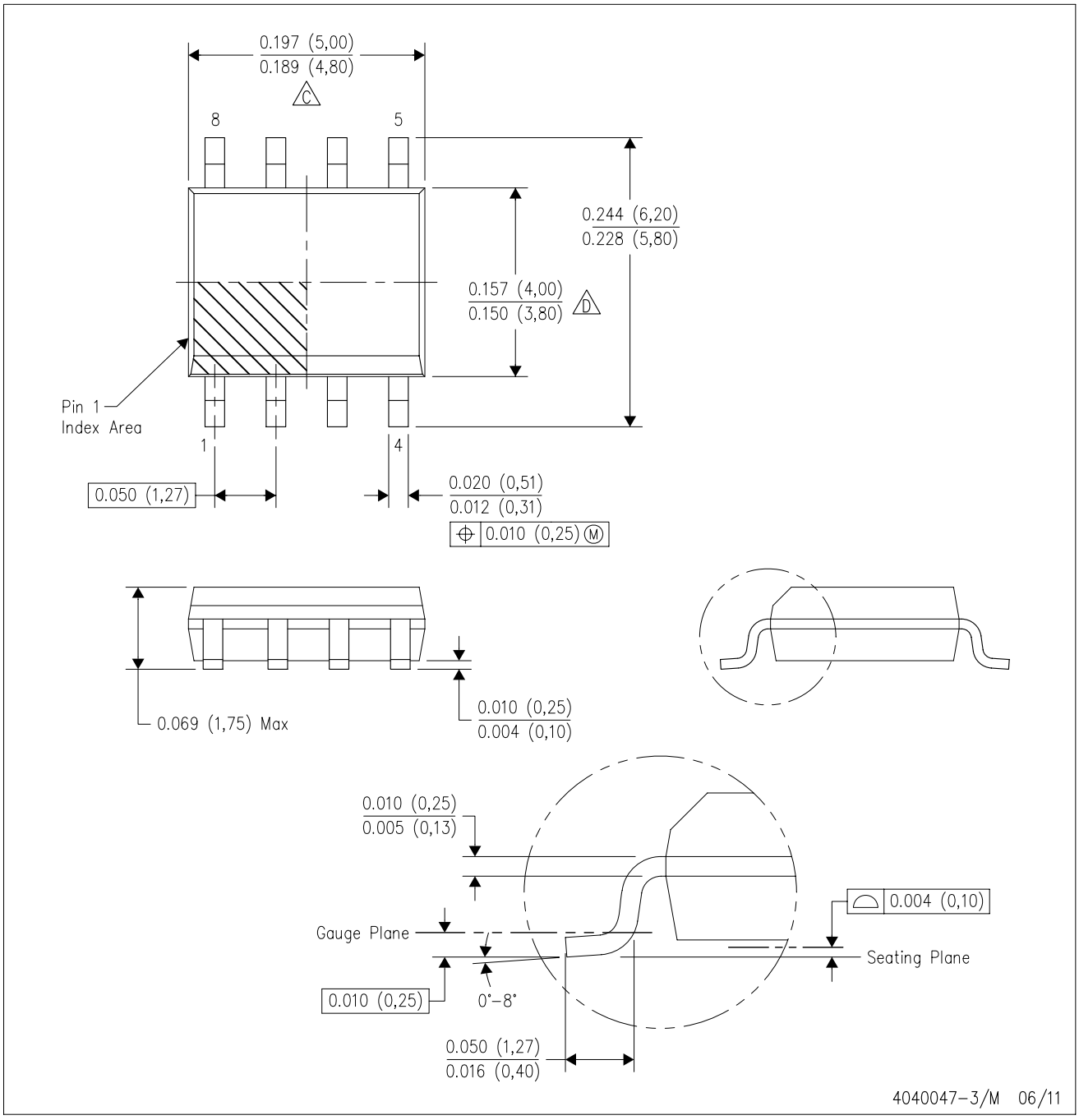
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AB.

D (R–PDSO–G14) PLASTIC SMALL OUTLINE



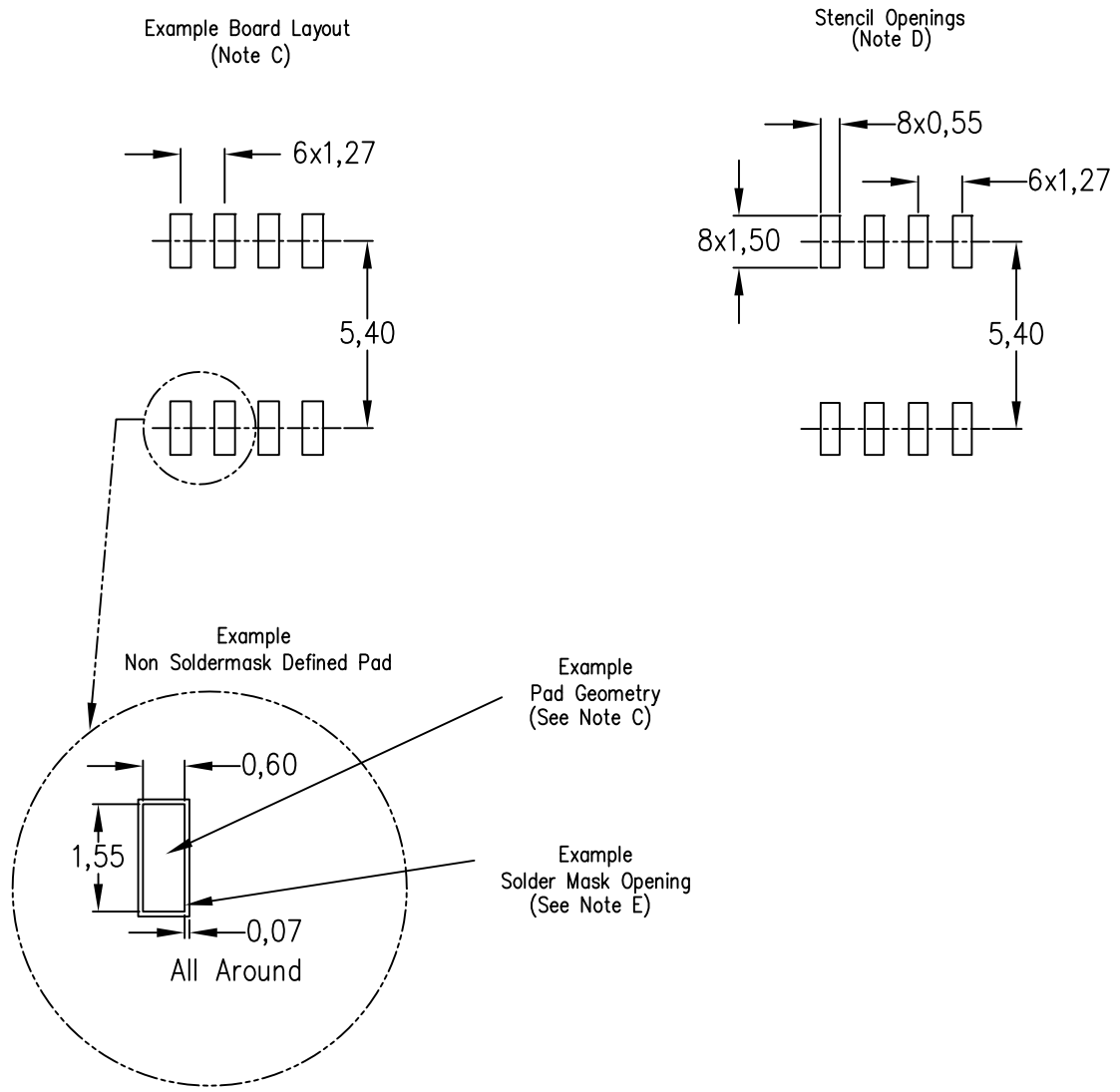

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC–7525 for other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

D (R–PDSO–G8) PLASTIC SMALL OUTLINE



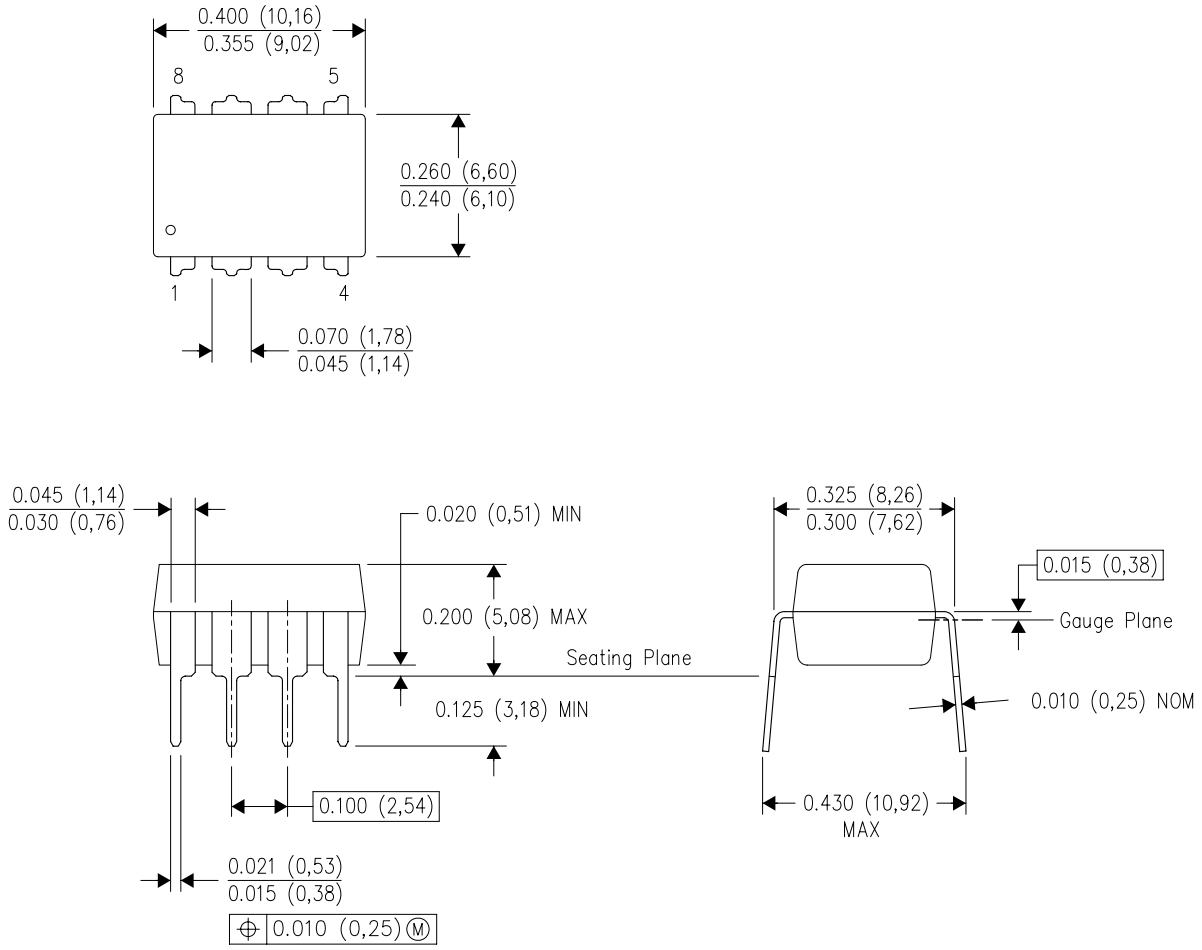

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AA.

D (R–PDSO–G8) PLASTIC SMALL OUTLINE




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. 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 other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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

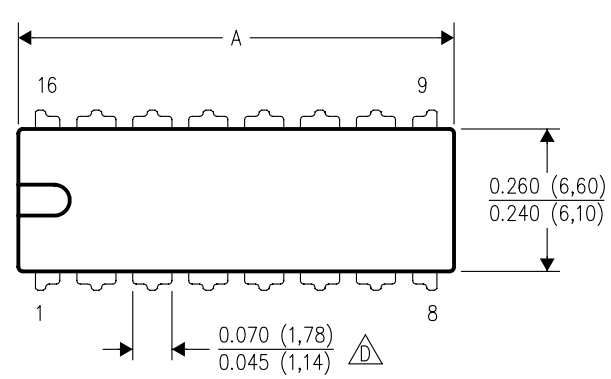



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001 variation BA.

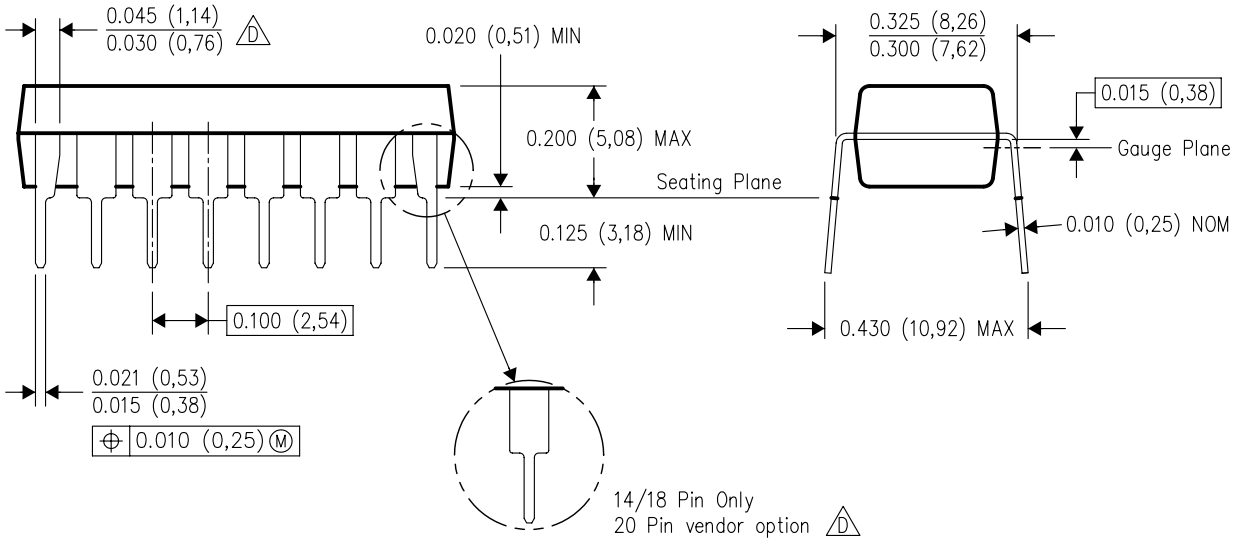
## N (R–PDIP–T**)

## PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN




| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---|---|---|---|---|
| A MAX | 0.775 (19,69) | 0.775 (19,69) | 0.920 (23,37) | 1.060 (26,92) |
| A MIN | 0.745 (18,92) | 0.745 (18,92) | 0.850 (21,59) | 0.940 (23,88) |
| MS–001 VARIATION (C) | AA | BB | AC | AD |




4040049/E 12/2002

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

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