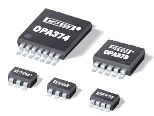
Burr-Brown Products
from Texas Instruments

# OPA373, OPA2373
# OPA374
# OPA2374, OPA4374




SBOS279D − SEPTEMBER 2003 − REVISED DECEMBER 2004

# 6.5MHz, 585μA, Rail-to-Rail I/O CMOS Operational Amplifier

## FEATURES

- **LOW OFFSET: 5mV (max)**
- **LOW $I_B$: 10pA (max)**
- **HIGH BANDWIDTH: 6.5MHz**
- **RAIL-TO-RAIL INPUT AND OUTPUT**
- **SINGLE SUPPLY: +2.3V to +5.5V**
- **SHUTDOWN: OPAx373**
- **SPECIFIED UP TO +125°C**
- ***Micro*SIZE PACKAGES: SOT23-5, SOT23-6, and SOT23-8**

## APPLICATIONS

- **PORTABLE EQUIPMENT**
- **BATTERY-POWERED DEVICES**
- **ACTIVE FILTERS**
- **DRIVING A/D CONVERTERS**

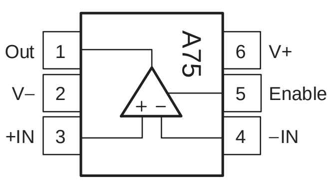
## DESCRIPTION

The OPA373 and OPA374 families of operational amplifiers are low power and low cost with excellent bandwidth (6.5MHz) and slew rate (5V/μs). The input range extends 200mV beyond the rails and the output range is within 25mV of the rails. Their speed/power ratio and small size make them ideal for portable and battery-powered applications.

The OPA373 family includes a shutdown mode. Under logic control, the amplifiers can be switched from normal operation to a standby current that is less than 1μA.

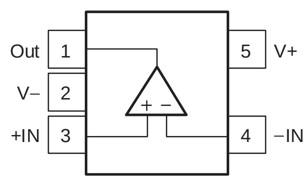
The OPA373 and OPA374 families of operational amplifiers are specified for single or dual power supplies of +2.7V to +5.5V, with operation from +2.3V to +5.5V. All models are specified for −40°C to +125°C.

**OPA373**



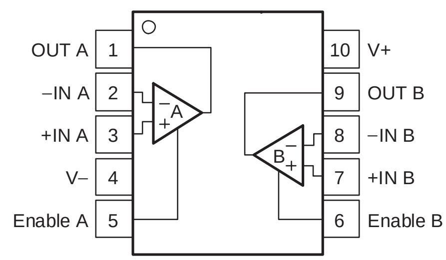

SOT23-6(1)

**OPA374**



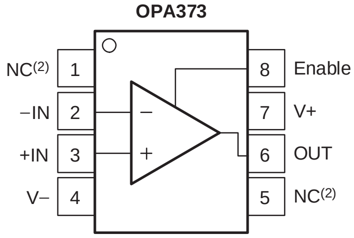

SOT23-5

**OPA2373**



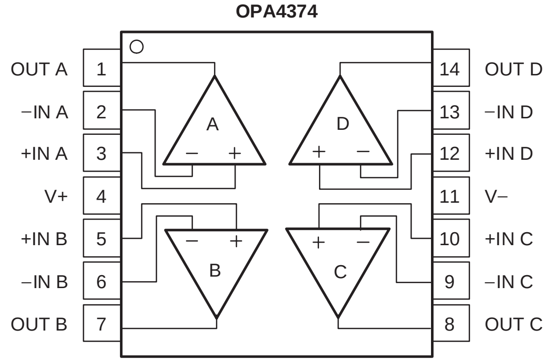

MSOP−10

**OPA373**



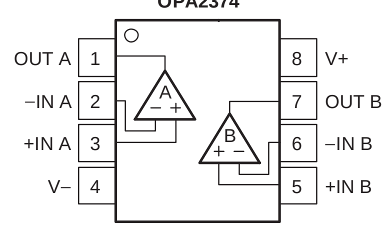

SO-8

**OPA4374**



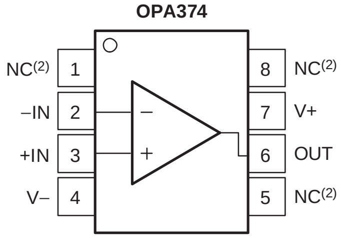

SO-14, TSSOP-14

**OPA2374**




SO-8, SOT23-8

**OPA374**




SO-8

(1) Pin 1 of the SOT23-6 is determined by orienting the package marking as shown.
(2) NC indicates no internal connection.

## PACKAGE/ORDERING INFORMATION(1)

| PRODUCT | PACKAGE-LEAD | PACKAGE DESIGNATOR | SPECIFIED TEMPERATURE RANGE | PACKAGE MARKING | ORDERING NUMBER | TRANSPORT MEDIA, QUANTITY |
|---|---|---|---|---|---|---|
| **Shutdown** | | | | | | |
| OPA373 | SOT23-6 | DBV | −40°C to +125°C | A75 | OPA373AIDBVT | Tape and Reel, 250 |
| ″ | ″ | ″ | ″ | ″ | OPA373AIDBVR | Tape and Reel, 3000 |
| OPA373 | SO-8 | D | −40°C to +125°C | OPA373A | OPA373AID | Rails, 100 |
| ″ | ″ | ″ | ″ | ″ | OPA373AIDR | Tape and Reel, 2500 |
| OPA2373 | MSOP-10 | DGS | −40°C to +125°C | AYO | OPA2373AIDGST | Tape and Reel, 250 |
| ″ | ″ | ″ | ″ | ″ | OPA2373AIDGSR | Tape and Reel, 2500 |
| **Non-Shutdown** | | | | | | |
| OPA374 | SOT23-5 | DBV | −40°C to +125°C | A76 | OPA374AIDBVT | Tape and Reel, 250 |
| ″ | ″ | ″ | ″ | ″ | OPA374AIDBVR | Tape and Reel, 3000 |
| OPA374 | SO-8 | D | −40°C to +125°C | OPA274A | OPA374AID | Rails, 100 |
| ″ | ″ | ″ | ″ | ″ | OPA374AIDR | Tape and Reel, 2500 |
| OPA2374 | SOT23-8 | DCN | −40°C to +125°C | ATP | OPA2374AIDCNT | Tape and Reel, 250 |
| ″ | ″ | ″ | ″ | ″ | OPA2374AIDCNR | Tape and Reel, 3000 |
| OPA2374 | SO-8 | D | −40°C to +125°C | OPA2374A | OPA2374AID | Rails, 100 |
| ″ | ″ | ″ | ″ | ″ | OPA2374AIDR | Tape and Reel, 2500 |
| OPA4374 | SO-14 | D | −40°C to +125°C | OPA4374A | OPA4374AID | Rails, 58 |
| ″ | ″ | ″ | ″ | ″ | OPA4374AIDR | Tape and Reel, 2500 |
| OPA4374 | TSSOP-14 | PW | −40°C to +125°C | OPA4374A | OPA4374AIPWT | Tape and Reel, 250 |
| ″ | ″ | ″ | ″ | ″ | OPA4374AIPWR | Tape and Reel, 2500 |

(1) For the most current package and ordering information, see the Package Option Addendum located at the end of this datasheet.

## ABSOLUTE MAXIMUM RATINGS(1)

| | |
|---|---|
| Supply Voltage | +7.0V |
| Signal Input Terminals, Voltage(2) | −0.5V to (V+) + 0.5V |
| Current(2) | ±10mA |
| Output Short-Circuit(3) | Continuous |
| Operating Temperature | −55°C to +150°C |
| Storage Temperature | −65°C to +150°C |
| Junction Temperature | +150°C |
| Lead Temperature (soldering, 10s) | +300°C |

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current-limited to 10mA or less.

(3) Short-circuit to ground, one amplifier per package.

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.

## ELECTRICAL CHARACTERISTICS: $V_S$ = +2.7V to +5.5V

**Boldface** limits apply over the specified temperature range, **$T_A$ = −40°C to +125°C.**

At $T_A$ = +25°C, $R_L$ = 10kΩ connected to $V_S$/2, and $V_{OUT}$ = $V_S$/2, unless otherwise noted.

| PARAMETER | | CONDITIONS | OPA373, OPA2373, OPA374, OPA2374, OPA4374 MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| **OFFSET VOLTAGE** | | | | | | |
| Input Offset Voltage | $V_{OS}$ | $V_S$ = 5V | | 1 | 5 | mV |
| **over Temperature** | | | | | **6.5** | **mV** |
| **Drift** | **$dV_{OS}/dT$** | | | **3** | | **μV/°C** |
| vs Power Supply | PSRR | $V_S$ = 2.7V to 5.5V, $V_{CM}$ < (V+) − 2V | | 25 | 100 | μV/V |
| **over Temperature** | | **$V_S$ = 2.7V to 5.5V, $V_{CM}$ < (V+) − 2V** | | | **150** | **μV/V** |
| Channel Separation, DC | | | | 0.4 | | μV/V |
| f = 1kHz | | | | 128 | | dB |
| **INPUT VOLTAGE RANGE** | | | | | | |
| Common-Mode Voltage Range | $V_{CM}$ | | (V−) − 0.2 | | (V+) + 0.2 | V |
| Common-Mode Rejection Ratio | CMRR | (V−) − 0.2V < $V_{CM}$ < (V+) − 2V | 80 | 90 | | dB |
| **over Temperature** | | **(V−) − 0.2V < $V_{CM}$ < (V+) − 2V** | **70** | | | **dB** |
| | | $V_S$ = 5.5V, (V−) − 0.2V < $V_{CM}$ < (V+) + 0.2V | 66 | | | dB |
| **over Temperature** | | **$V_S$ = 5.5V, (V−) − 0.2V < $V_{CM}$ < (V+) + 0.2V** | 60 | | | **dB** |
| **INPUT BIAS CURRENT** | | | | | | |
| Input Bias Current | $I_B$ | | | ±0.5 | ±10 | pA |
| Input Offset Current | $I_{OS}$ | | | ±0.5 | ±10 | pA |
| **INPUT IMPEDANCE** | | | | | | |
| Differential | | | | $10^{13}$ ‖ 3 | | Ω ‖ pF |
| Common-Mode | | | | $10^{13}$ ‖ 6 | | Ω ‖ pF |
| **NOISE** | | $V_{CM}$ < (V+) − 2V | | | | |
| Input Voltage Noise, f = 0.1Hz to 10Hz | | | | 10 | | $\mu V_{PP}$ |
| Input Voltage Noise Density, f = 10kHz | $e_n$ | | | 15 | | $nV/\sqrt{Hz}$ |
| Input Current Noise Density, f = 10kHz | $i_n$ | | | 4 | | $fA/\sqrt{Hz}$ |
| **OPEN-LOOP GAIN** | | | | | | |
| Open-Loop Voltage Gain | $A_{OL}$ | $V_S$ = 5V, $R_L$ = 100kΩ, 0.025V < $V_O$ < 4.975V | 94 | 110 | | dB |
| **over Temperature** | | **$V_S$ = 5V, $R_L$ = 100kΩ, 0.025V < $V_O$ < 4.975V** | **80** | | | **dB** |
| | | $V_S$ = 5V, $R_L$ = 5kΩ, 0.125V < $V_O$ < 4.875V | 94 | 106 | | dB |
| **over Temperature** | | **$V_S$ = 5V, $R_L$ = 5kΩ, 0.125V < $V_O$ < 4.875V** | **80** | | | **dB** |
| **OUTPUT** | | | | | | |
| Voltage Output Swing from Rail | | $R_L$ = 100kΩ | | 18 | 25 | mV |
| **over Temperature** | | **$R_L$ = 100kΩ** | | | **25** | **mV** |
| | | $R_L$ = 5kΩ | | 100 | 125 | mV |
| **over Temperature** | | **$R_L$ = 5kΩ** | | | **125** | **mV** |
| Short-Circuit Current | $I_{SC}$ | | | See Typical Characteristics | | |
| Capacitive Load Drive | $C_{LOAD}$ | | | See Typical Characteristics | | |
| Open-Loop Output Impedance | | f = 1MHz, $I_O$ = 0 | | 220 | | Ω |
| **FREQUENCY RESPONSE** | | $C_L$ = 100pF | | | | |
| Gain-Bandwidth Product | GBW | | | 6.5 | | MHz |
| Slew Rate | SR | G = +1 | | 5 | | V/μs |
| Settling Time, 0.1% | $t_S$ | $V_S$ = 5V, 2V Step, G = +1 | | 1 | | μs |
| 0.01% | | $V_S$ = 5V, 2V Step, G = +1 | | 1.5 | | μs |
| Overload Recovery Time | | $V_{IN}$ • Gain > $V_S$ | | 0.3 | | μs |
| Total Harmonic Distortion + Noise | THD+N | $V_S$ = 5V, $V_O$ = $3V_{PP}$, G = +1, f = 1kHz | | 0.0013 | | % |
| **ENABLE/SHUTDOWN** | | | | | | |
| $t_{OFF}$ | | | | 3 | | μs |
| $t_{ON}$ | | | | 12 | | μs |
| $V_L$ (shutdown) | | | V− | | (V−) + 0.8 | V |
| $V_H$ (amplifier is active) | | | (V−) + 2 | | V+ | V |
| Input Bias Current of Enable Pin | | | | 0.2 | | μA |
| $I_{QSD}$ (per amplifier) | | | | < 0.5 | 1 | μA |

## ELECTRICAL CHARACTERISTICS: $V_S$ = +2.7V to +5.5V (continued)

**Boldface** limits apply over the specified temperature range, **$T_A$ = −40°C to +125°C.**

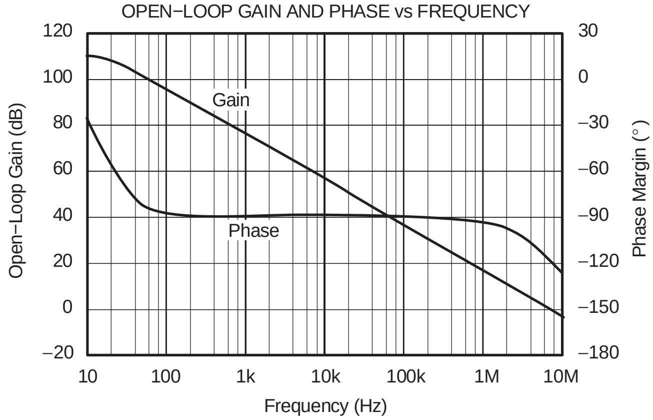
At $T_A$ = +25°C, $R_L$ = 10kΩ connected to $V_S$/2, and $V_{OUT}$ = $V_S$/2, unless otherwise noted.

| PARAMETER | | CONDITIONS | OPA373, OPA2373, OPA374, OPA2374, OPA4374 | | | |
|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | UNIT |
| **POWER SUPPLY** | | | | | | |
| Specified Voltage Range | $V_S$ | | 2.7 | | 5.5 | V |
| Operating Voltage Range | | | | 2.3 to 5.5 | | V |
| Quiescent Current (per amplifier) | $I_Q$ | $I_O$ = 0 | | 585 | 750 | μA |
| **over Temperature** | | | | | **800** | **μA** |
| **TEMPERATURE RANGE** | | | | | | |
| Specified Range | | | −40 | | +125 | °C |
| Operating Range | | | −55 | | +150 | °C |
| Storage Range | | | −65 | | +150 | °C |
| Thermal Resistance | $\theta_{JA}$ | | | | | °C/W |
| SOT23-5, SOT23-6, SOT23-8 | | | | +200 | | °C/W |
| MSOP-10, SO-8 | | | | +150 | | °C/W |
| SO-14, TSSOP-14 | | | | +100 | | °C/W |

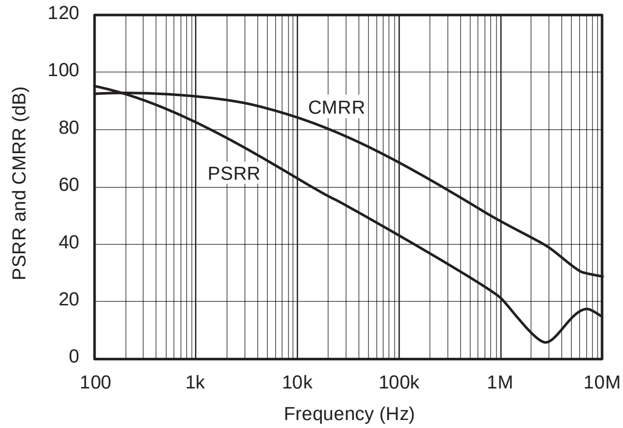
## TYPICAL CHARACTERISTICS

At $T_A = +25°C$, $R_L = 10k\Omega$ connected to $V_S/2$, and $V_{OUT} = V_S/2$, unless otherwise noted.

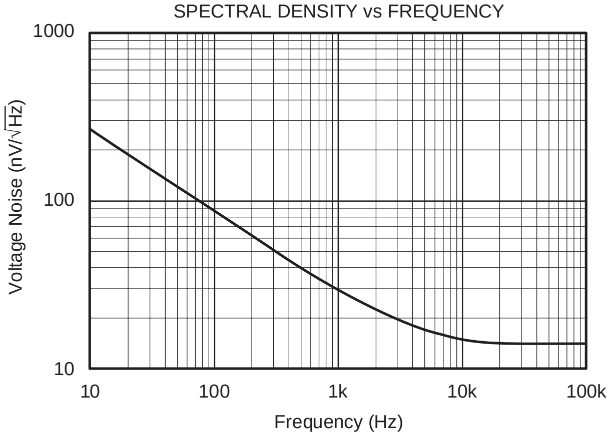
OPEN−LOOP GAIN AND PHASE vs FREQUENCY



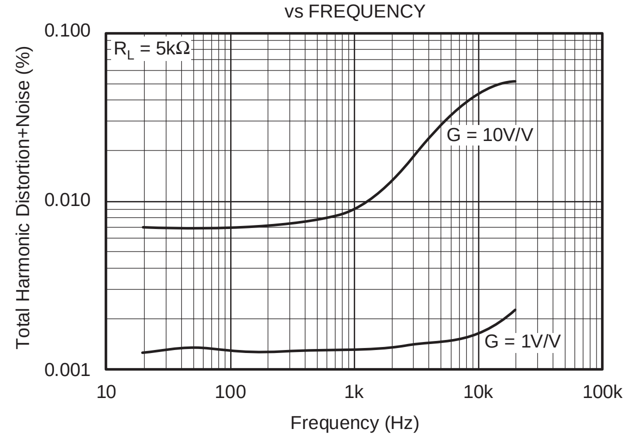

POWER−SUPPLY AND COMMON−MODE REJECTION RATIO vs FREQUENCY



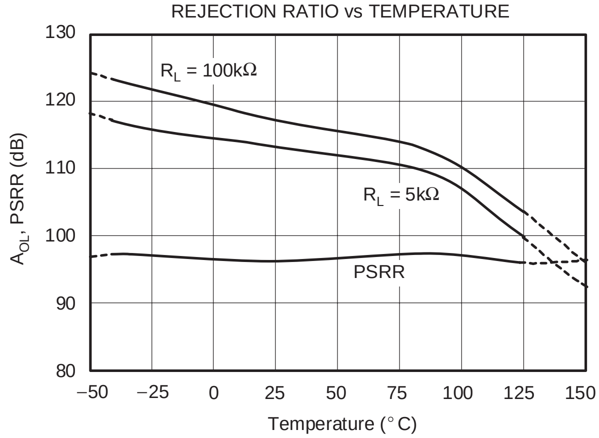

INPUT VOLTAGE NOISE SPECTRAL DENSITY vs FREQUENCY



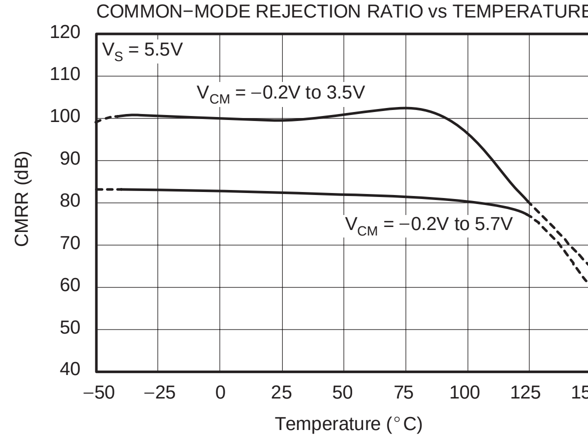

TOTAL HARMONIC DISTORTION+NOISE vs FREQUENCY




OPEN−LOOP GAIN AND POWER−SUPPLY REJECTION RATIO vs TEMPERATURE



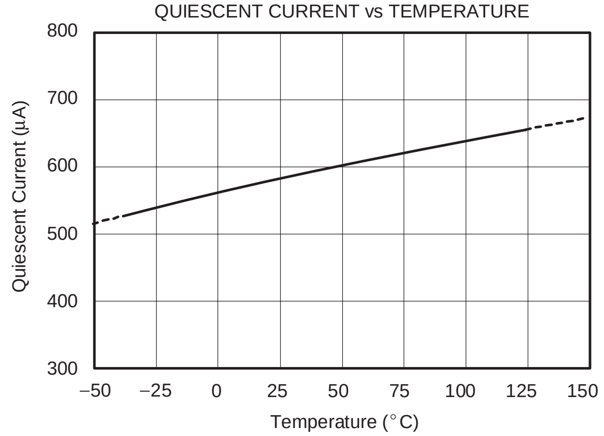

COMMON−MODE REJECTION RATIO vs TEMPERATURE



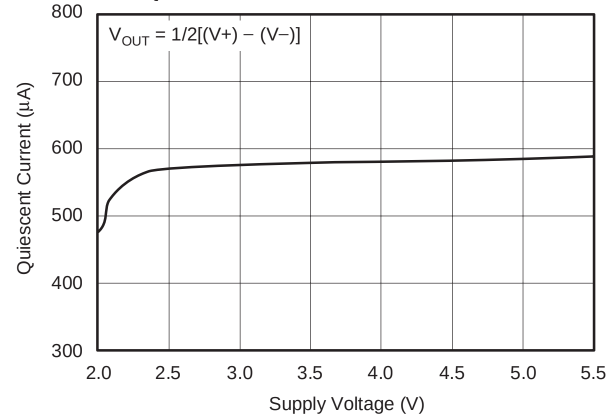
## TYPICAL CHARACTERISTICS (continued)

At $T_A$ = +25°C, $R_L$ = 10kΩ connected to $V_S$/2, and $V_{OUT}$ = $V_S$/2, unless otherwise noted.

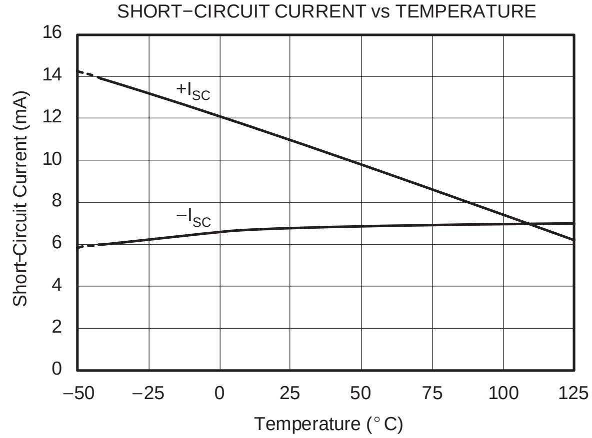
QUIESCENT CURRENT vs TEMPERATURE



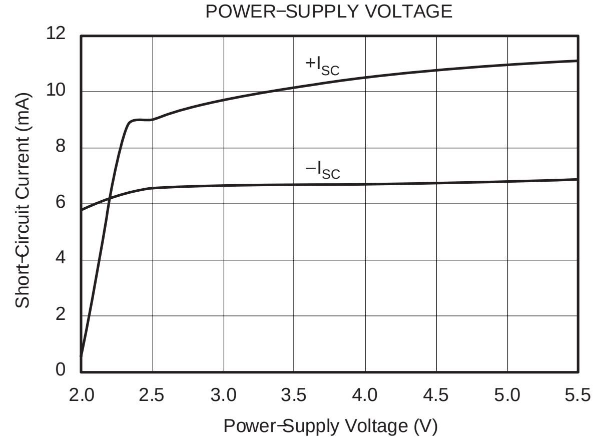

QUIESCENT CURRENT vs SUPPLY VOLTAGE



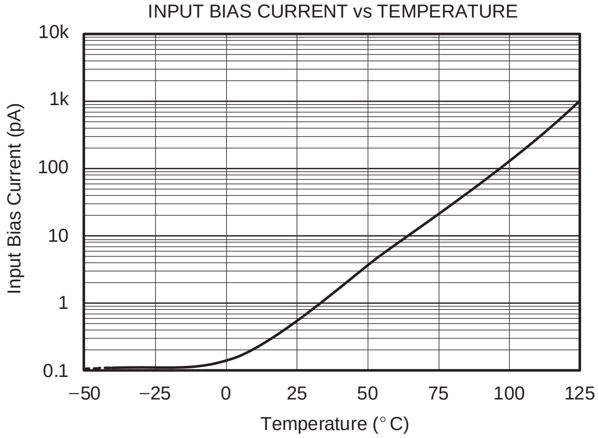

SHORT−CIRCUIT CURRENT vs TEMPERATURE



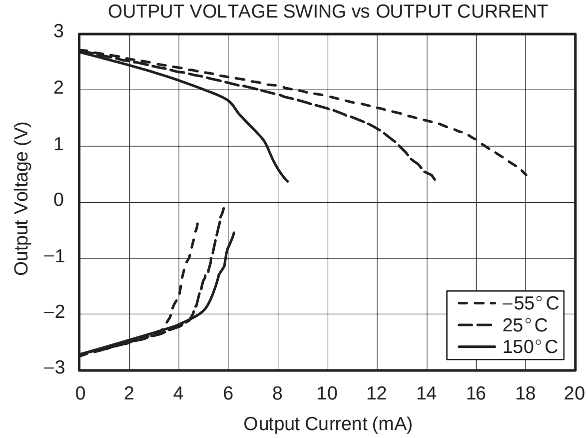

CONTINUOUS SHORT−CIRCUIT CURRENT vs POWER−SUPPLY VOLTAGE




INPUT BIAS CURRENT vs TEMPERATURE



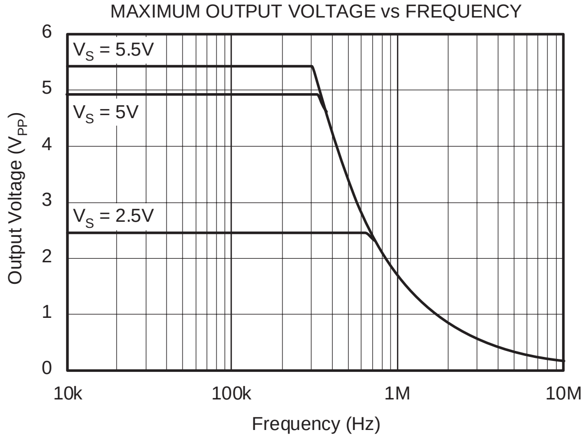

OUTPUT VOLTAGE SWING vs OUTPUT CURRENT



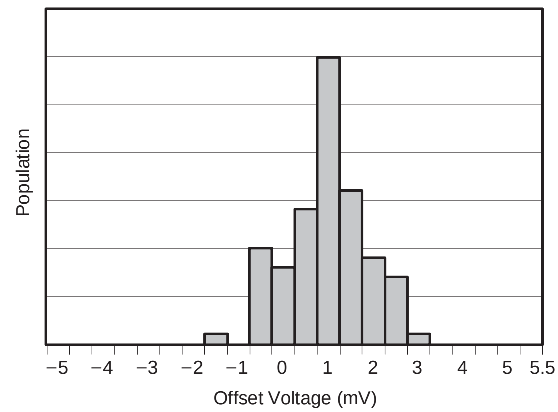
## TYPICAL CHARACTERISTICS (continued)

At $T_A$ = +25°C, $R_L$ = 10kΩ connected to $V_S$/2, and $V_{OUT}$ = $V_S$/2, unless otherwise noted.

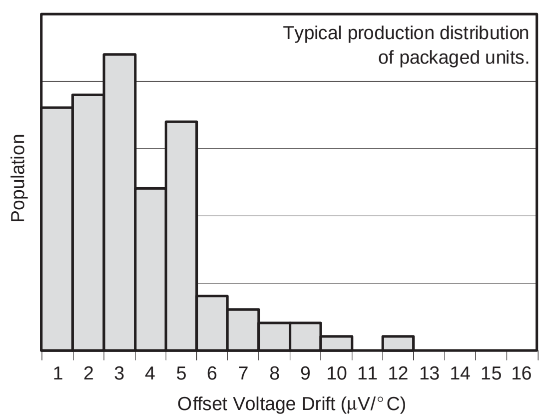
MAXIMUM OUTPUT VOLTAGE vs FREQUENCY



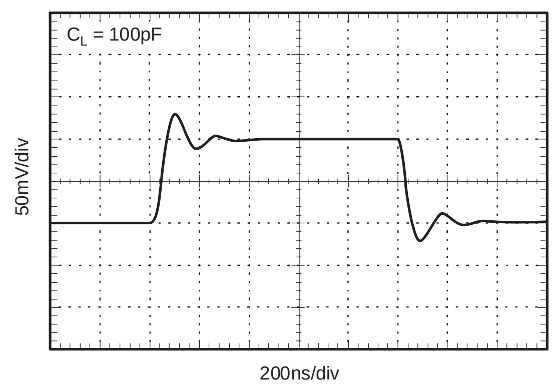

OFFSET VOLTAGE PRODUCTION DISTRIBUTION



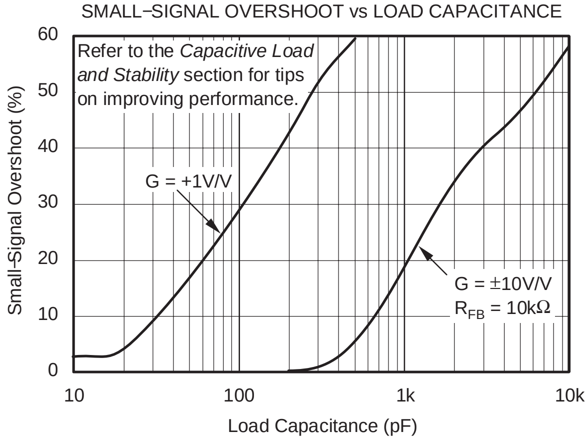

OFFSET VOLTAGE DRIFT MAGNITUDE PRODUCTION DISTRIBUTION



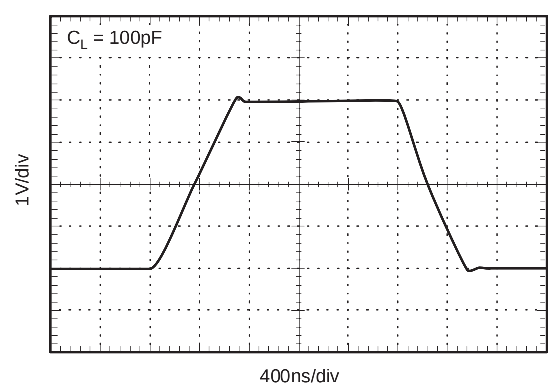

SMALL−SIGNAL STEP RESPONSE




SMALL−SIGNAL OVERSHOOT vs LOAD CAPACITANCE

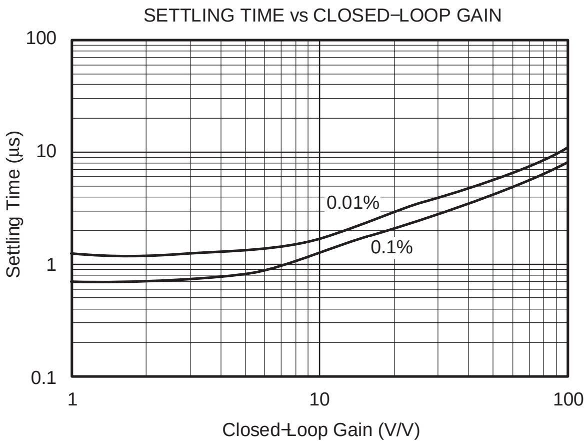


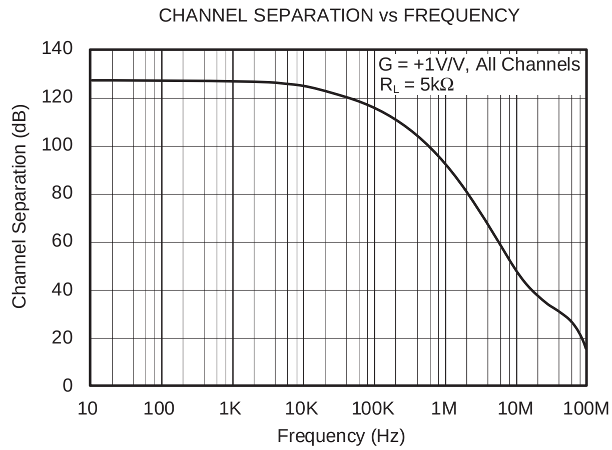

LARGE−SIGNAL STEP RESPONSE



## TYPICAL CHARACTERISTICS (continued)

At $T_A$ = +25°C, $R_L$ = 10kΩ connected to $V_S$/2, and $V_{OUT}$ = $V_S$/2, unless otherwise noted.



# APPLICATIONS

The OPA373 and OPA374 series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. Rail-to-rail input and output make them ideal for driving sampling Analog-to-Digital Converters (ADCs). Excellent AC performance makes them well suited for audio applications. The class AB output stage is capable of driving 100kΩ loads connected to any point between V+ and ground.

The input common-mode voltage range includes both rails, allowing the OPA373 and OPA374 series op amps to be used in virtually any single-supply application up to a supply voltage of +5.5V.

Rail-to-rail input and output swing significantly increases dynamic range, especially in low-supply applications.

Power-supply pins should be bypassed with 0.01μF ceramic capacitors.

## OPERATING VOLTAGE

The OPA373 and OPA374 op amps are specified and tested over a power-supply range of +2.7V to +5.5V (±1.35V to ±2.75V). However, the supply voltage may range from +2.3V to +5.5V (±1.15V to ±2.75V). Supply voltages higher than 7.0V (absolute maximum) can permanently damage the amplifier. Parameters that vary over supply voltage or temperature are shown in the Typical Characteristics section of this data sheet.

## COMMON-MODE VOLTAGE RANGE

The input common-mode voltage range of the OPA373 and OPA374 series extends 200mV beyond the supply rails. This is achieved with a complementary input stage—an N-channel input differential pair in parallel with a P-channel differential pair. The N-channel pair is active for input voltages close to the positive rail, typically (V+) − 1.65V to 200mV above the positive supply, while the P-channel pair is on for inputs from 200mV below the negative supply to approximately (V+) − 1.65V. There is a 500mV transition region, typically (V+) − 1.9V to (V+) − 1.4V, in which both pairs are on. This 500mV transition region, shown in Figure 1, can vary ±300mV with process variation. Thus, the transition region (both stages on) can range from (V+) − 2.2V to (V+) − 1.7V on the low end, up to (V+) − 1.6V to (V+) − 1.1V on the high end. Within the 500mV transition region PSRR, CMRR, offset voltage, offset drift, and THD may be degraded compared to operation outside this region.

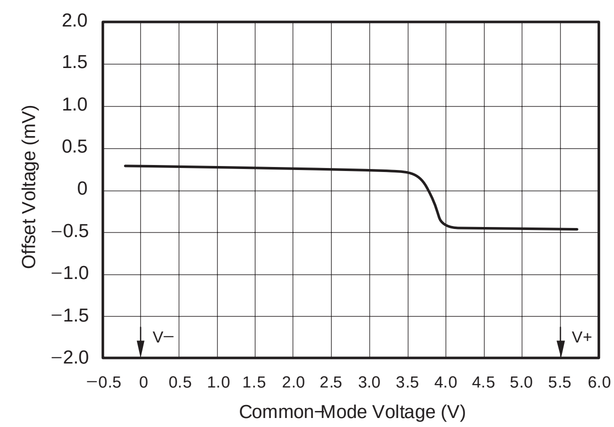



**Figure 1. Behavior of Typical Transition Region at Room Temperature**

## RAIL-TO-RAIL INPUT

The input common-mode range extends from (V−) − 0.2V to (V+) + 0.2V. For normal operation, inputs should be limited to this range. The absolute maximum input voltage is 500mV beyond the supplies. Inputs greater than the input common-mode range but less than the maximum input voltage, while not valid, will not cause any damage to the op amp. Unlike some other op amps, if input current is limited, the inputs may go beyond the supplies without phase inversion, as shown in Figure 2.

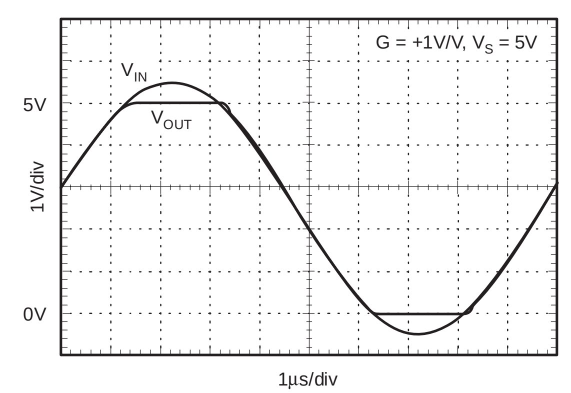



**Figure 2. OPA373: No Phase Inversion with Inputs Greater Than the Power-Supply Voltage**

Normally, input bias current is approximately 500fA; however, input voltages exceeding the power supplies by more than 500mV can cause excessive current to flow in or out of the input pins. Momentary voltages greater than 500mV beyond the power supply can be tolerated if the current on the input pins is limited to 10mA. This is easily accomplished with an input resistor; see Figure 3. (Many input signals are inherently current-limited to less than 10mA, therefore, a limiting resistor is not required.)

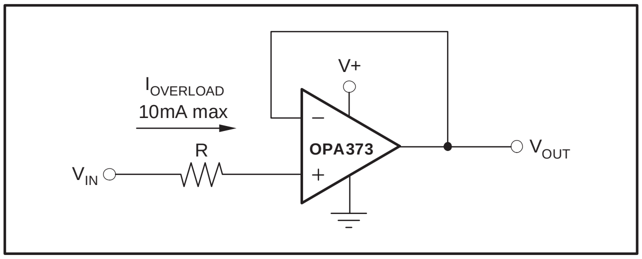



**Figure 3. Input Current Protection for Voltages Exceeding the Supply Voltage**

## RAIL-TO-RAIL OUTPUT

A class AB output stage with common-source transistors is used to achieve rail-to-rail output. For light resistive loads ( > 100kΩ), the output voltage can typically swing to within 18mV from the supply rails. With moderate resistive loads (5kΩ to 50kΩ), the output can typically swing to within 100mV from the supply rails and maintain high open-loop gain. See the Typical Characteristics curve, *Output Voltage Swing vs Output Current*, for more information.

## CAPACITIVE LOAD AND STABILITY

OPA373 series op amps can drive a wide range of capacitive loads. However, under certain conditions, all op amps may become unstable. Op amp configuration, gain, and load value are just a few of the factors to consider when determining stability. An op amp in unity-gain configuration is the most susceptible to the effects of capacitive load. The capacitive load reacts with the op amp output resistance, along with any additional load resistance, to create a pole in the small-signal response that degrades the phase margin. The OPA373 series op amps perform well in unity-gain configuration, with a pure capacitive load up to approximately 250pF. Increased gains allow the amplifier to drive more capacitance. See the Typical Characteristics curve, *Small-Signal Overshoot vs Capacitive Load*, for further details.

One method of improving capacitive load drive in the unity-gain configuration is to insert a small (10Ω to 20Ω) resistor, $R_S$, in series with the output, as shown in Figure 4. This significantly reduces ringing while maintaining DC performance for purely capacitive loads. When there is a resistive load in parallel with the capacitive load, $R_S$ must be placed within the feedback loop as shown to allow the feedback loop to compensate for the voltage divider created by $R_S$ and $R_L$.

In unity-gain inverter configuration, phase margin can be reduced by the reaction between the capacitance at the op amp input and the gain setting resistors, thus degrading capacitive load drive. Best performance is achieved by using small valued resistors. However, when large valued resistors cannot be avoided, a small (4pF to 6pF) capacitor, $C_{FB}$, can be inserted in the feedback, as shown in Figure 5. This significantly reduces overshoot by compensating the effect of capacitance, $C_{IN}$, which includes the amplifier input capacitance and PC board parasitic capacitance.

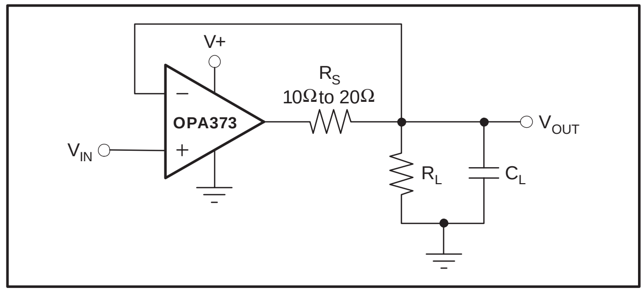



**Figure 4. Series Resistor in Unity-Gain Configuration Improves Capacitive Load Drive**

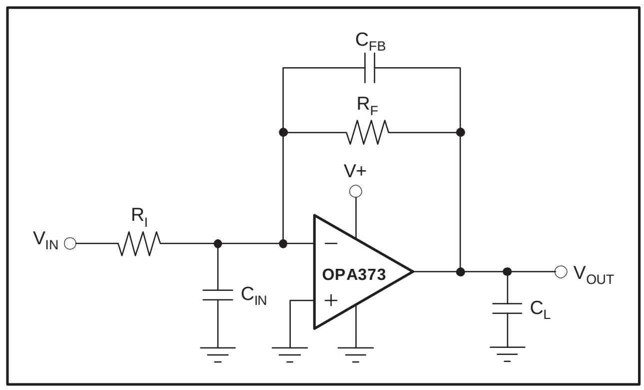



**Figure 5. Improving Capacitive Load Drive**

For example, when driving a 100pF load in unity-gain inverter configuration, adding a 6pF capacitor in parallel with the 10kΩ feedback resistor decreases overshoot from 57% to 12%, as shown in Figure 6.

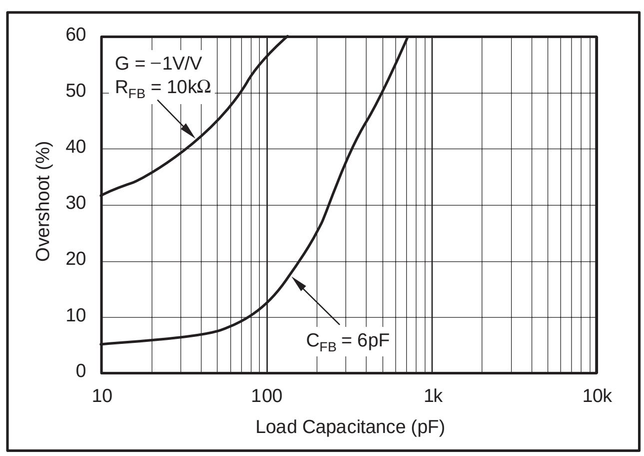



**Figure 6. Improving Capacitive Load Drive**

## DRIVING ADCs

The OPA373 and OPA374 series op amps are optimized for driving medium-speed sampling ADCs. The OPA373 and OPA374 op amps buffer the ADC input capacitance and resulting charge injection, while providing signal gain.

The OPA373 is shown driving the ADS7816 in a basic noninverting configuration, as shown in Figure 7. The ADS7816 is a 12-bit, *Micro*Power sampling converter in the MSOP-8 package. When used with the low-power, miniature packages of the OPA373, the combination is ideal for space-limited, low-power applications. In this configuration, an RC network at the ADC input can be used to provide anti-aliasing filtering.

Figure 8 shows the OPA373 driving the ADS7816 in a speech band-pass filtered data acquisition system. This small, low-cost solution provides the necessary amplification and signal conditioning to interface directly with an electret microphone. This circuit will operate with $V_S$ = 2.7V to 5V.

The OPA373 is shown in the inverting configuration described in Figure 9. In this configuration, filtering may be accomplished with the capacitor across the feedback resistor.

## ENABLE/SHUTDOWN

OPA373 and OPA374 series op amps typically require 585µA quiescent current. The enable/shutdown feature of the OPA373 allows the op amp to be shut off in order to reduce this current to less than 1µA.

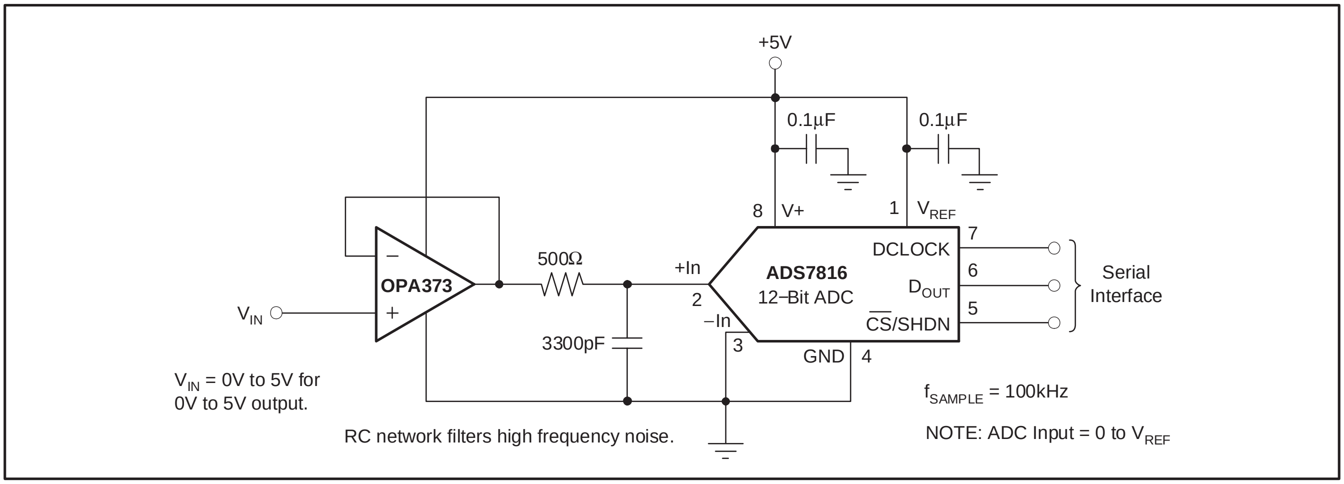



**Figure 7. The OPA373 in Noninverting Configuration Driving the ADS7816**

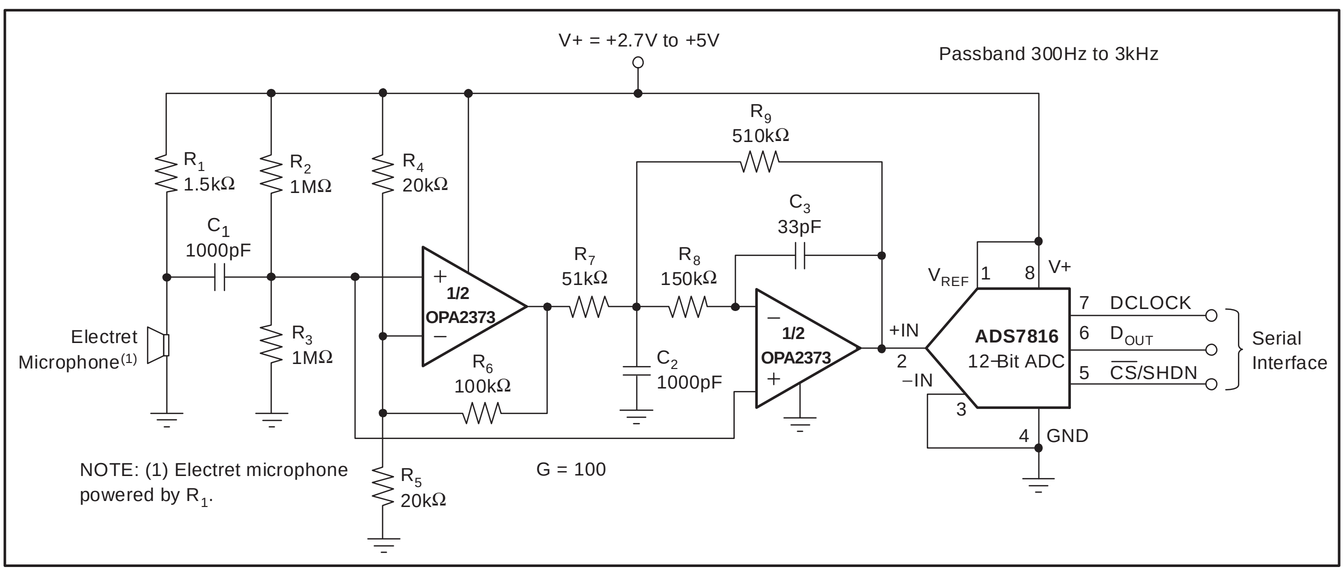



**Figure 8. The OPA2373 as a Speech Bypass Filtered Data Acquisition System**

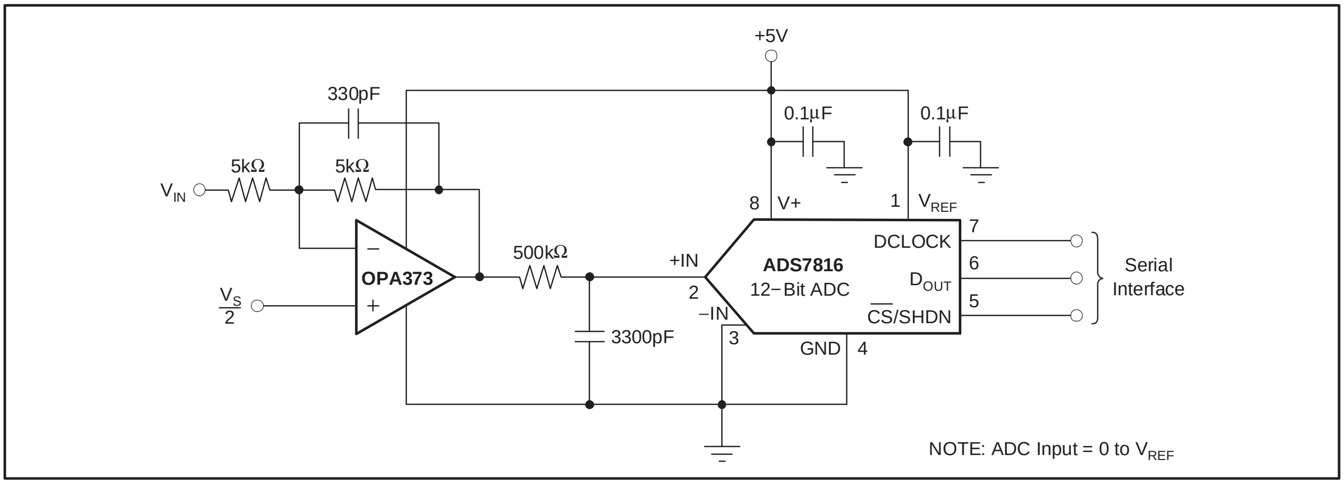



**Figure 9. The OPA373 in Inverting Configuration Driving the ADS7816**

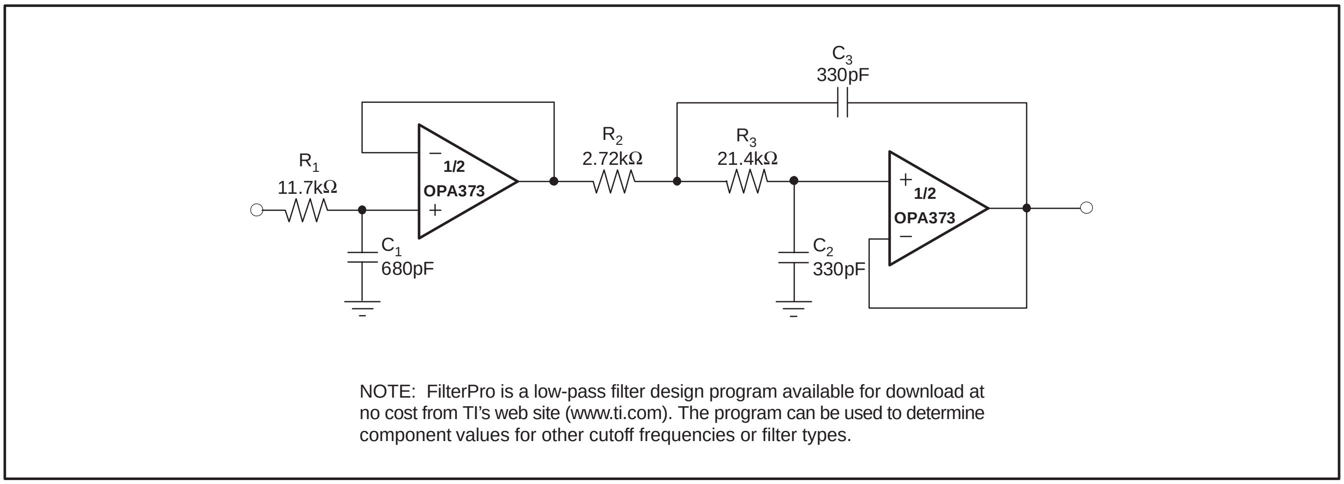



**Figure 10. Three-Pole Sallen-Key Butterworth Low-Pass Filter**

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| OPA2373AIDGSR | ACTIVE | MSOP | DGS | 10 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA2373AIDGSRG4 | ACTIVE | MSOP | DGS | 10 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA2373AIDGST | ACTIVE | MSOP | DGS | 10 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA2373AIDGSTG4 | ACTIVE | MSOP | DGS | 10 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA2374AID | ACTIVE | SOIC | D | 8 | 100 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA2374AIDCNR | ACTIVE | SOT-23 | DCN | 8 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA2374AIDCNRG4 | ACTIVE | SOT-23 | DCN | 8 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA2374AIDCNT | ACTIVE | SOT-23 | DCN | 8 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA2374AIDCNTG4 | ACTIVE | SOT-23 | DCN | 8 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA2374AIDG4 | ACTIVE | SOIC | D | 8 | 100 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA2374AIDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA2374AIDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA373AID | ACTIVE | SOIC | D | 8 | 100 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA373AIDBVR | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA373AIDBVRG4 | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA373AIDBVT | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA373AIDBVTG4 | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA373AIDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA373AIDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA374AID | ACTIVE | SOIC | D | 8 | 100 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA374AIDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| OPA374AIDBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| OPA374AIDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| OPA374AIDBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| OPA374AIDG4 | ACTIVE | SOIC | D | 8 | 100 | Green (RoHS & no Sb/Br) | 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) |
|---|---|---|---|---|---|---|---|---|
| OPA374AIDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA374AIDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA4374AID | ACTIVE | SOIC | D | 14 | 58 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA4374AIDG4 | ACTIVE | SOIC | D | 14 | 58 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA4374AIDR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA4374AIDRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA4374AIPWR | ACTIVE | TSSOP | PW | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA4374AIPWRG4 | ACTIVE | TSSOP | PW | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA4374AIPWT | ACTIVE | TSSOP | PW | 14 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| OPA4374AIPWTG4 | ACTIVE | TSSOP | PW | 14 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |

(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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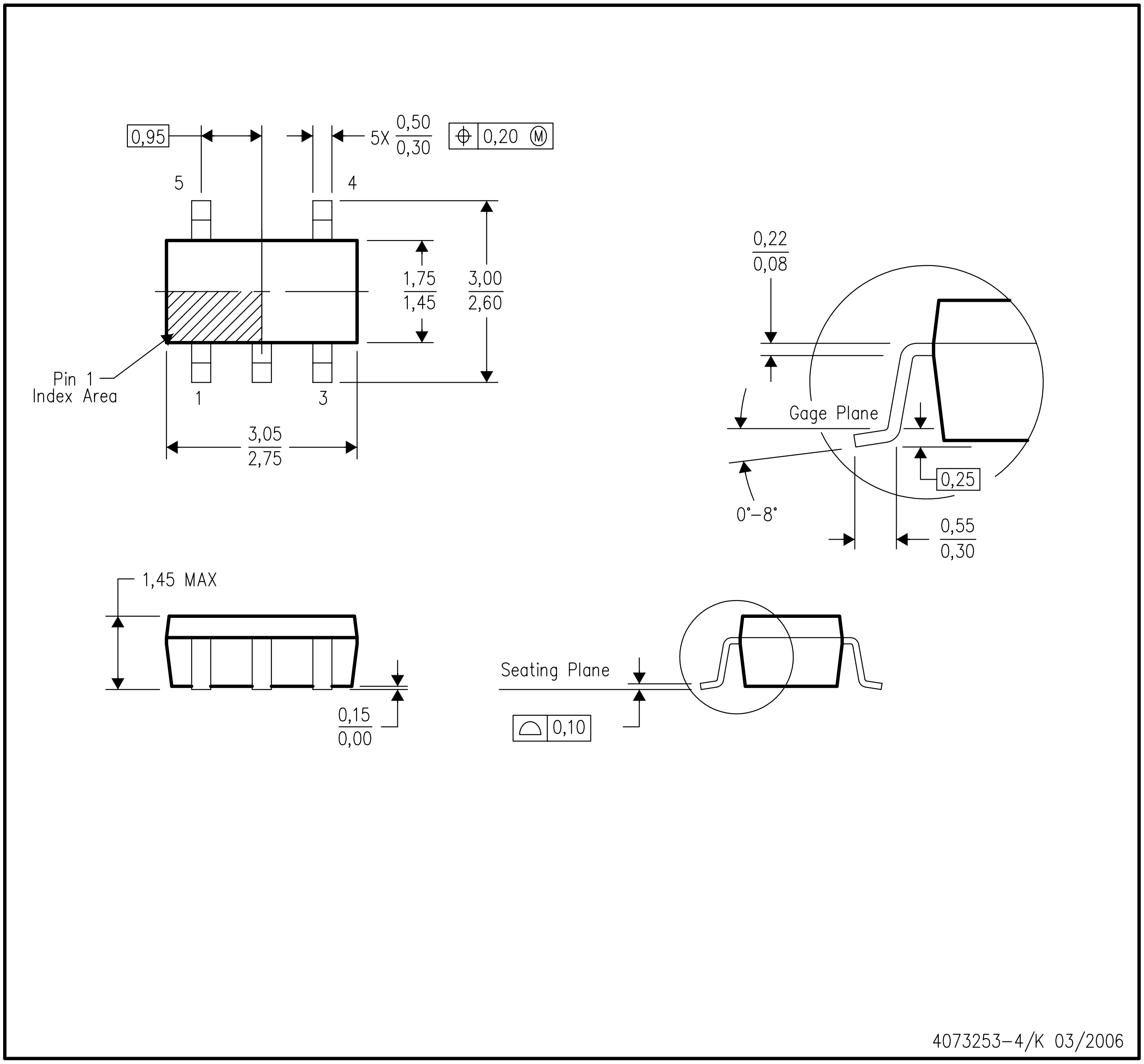
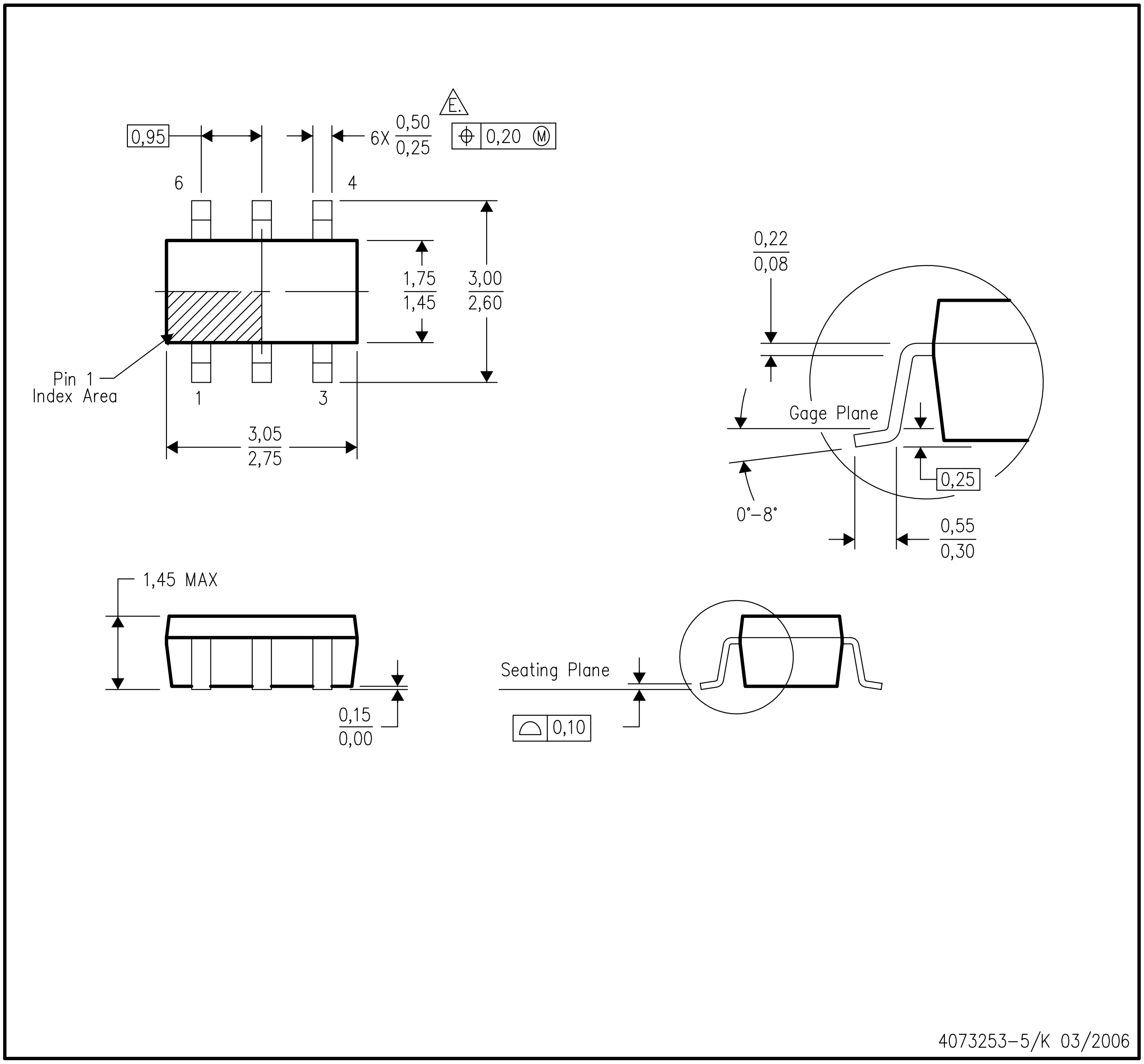
DBV (R-PDSO-G5) PLASTIC SMALL-OUTLINE PACKAGE



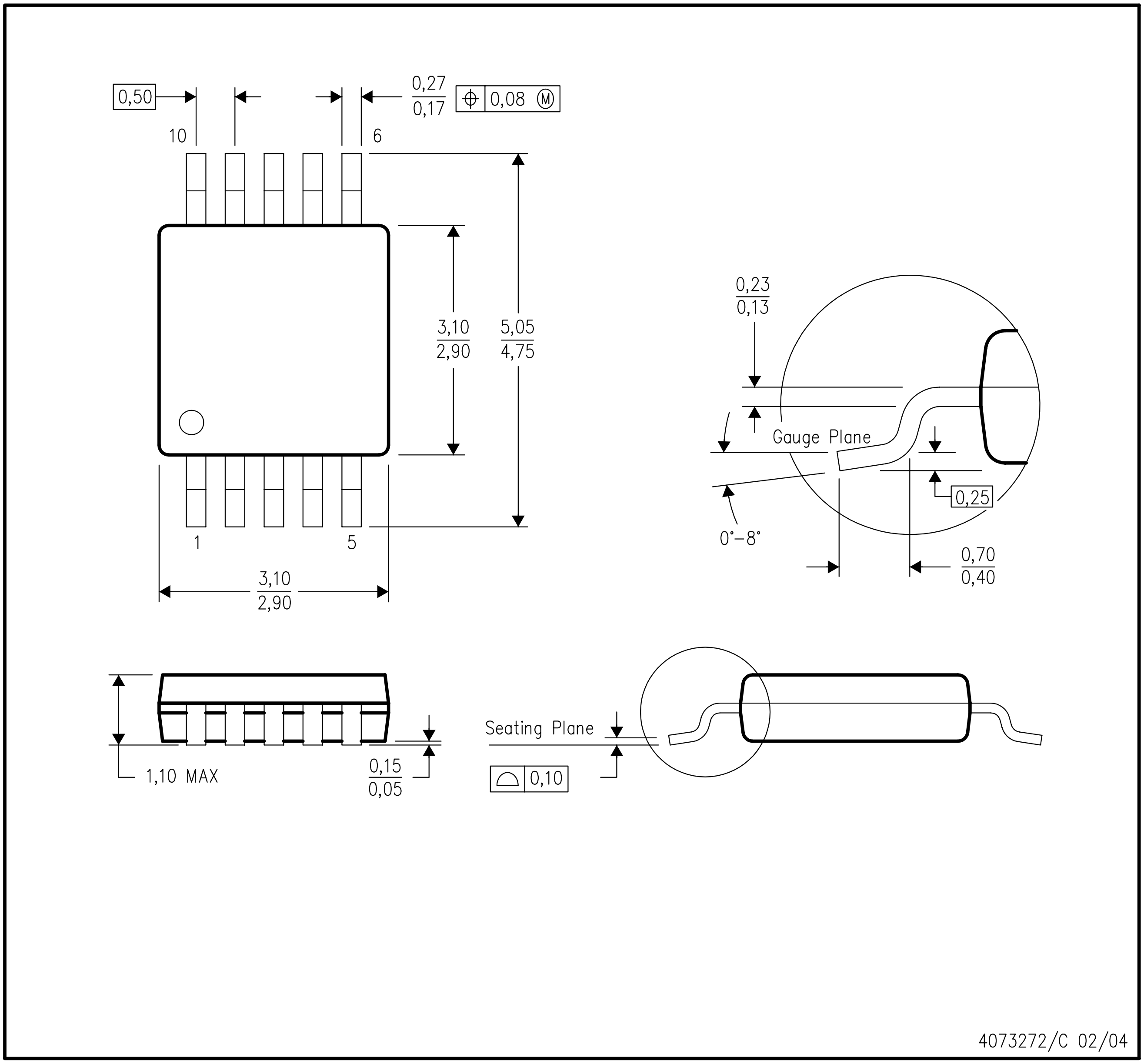

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO-178 Variation AA.

DBV (R-PDSO-G6) PLASTIC SMALL-OUTLINE PACKAGE



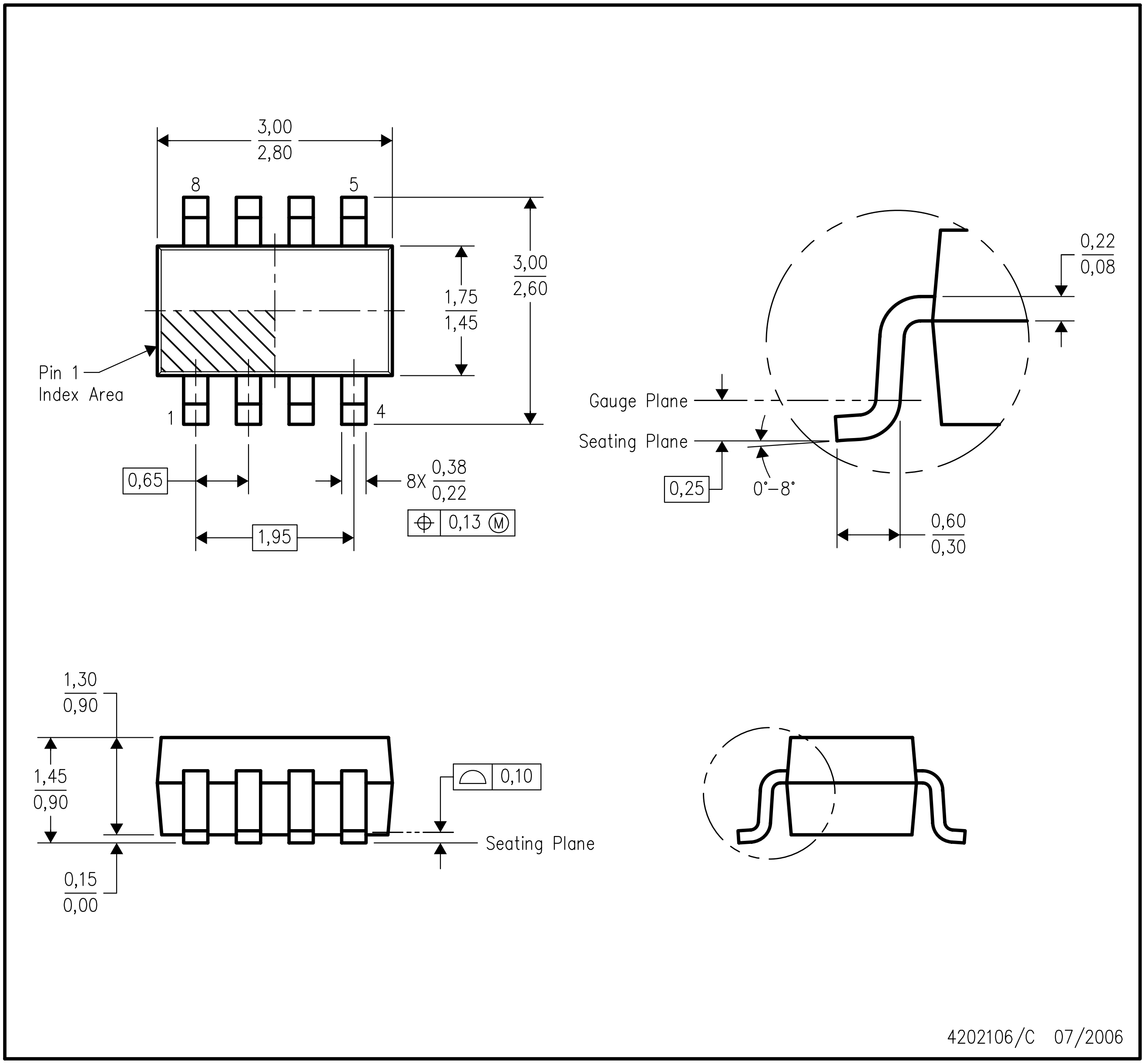

NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
- D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
- E. Falls within JEDEC MO-178 Variation AB, except minimum lead width.

DGS (S-PDSO-G10) PLASTIC SMALL-OUTLINE PACKAGE



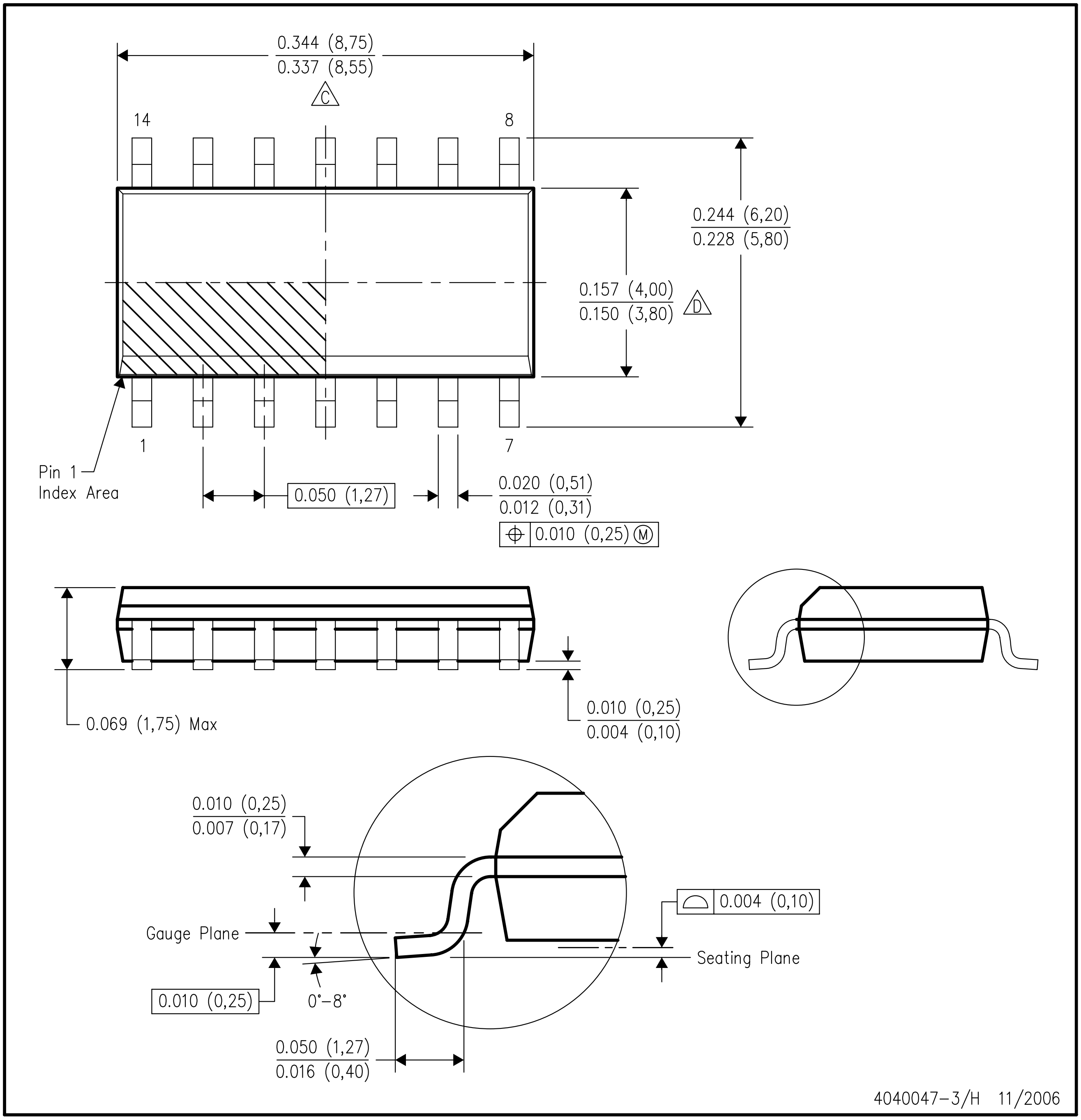

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO-187 variation BA.

# DCN (R-PDSO-G8) PLASTIC SMALL-OUTLINE PACKAGE (DIE DOWN)



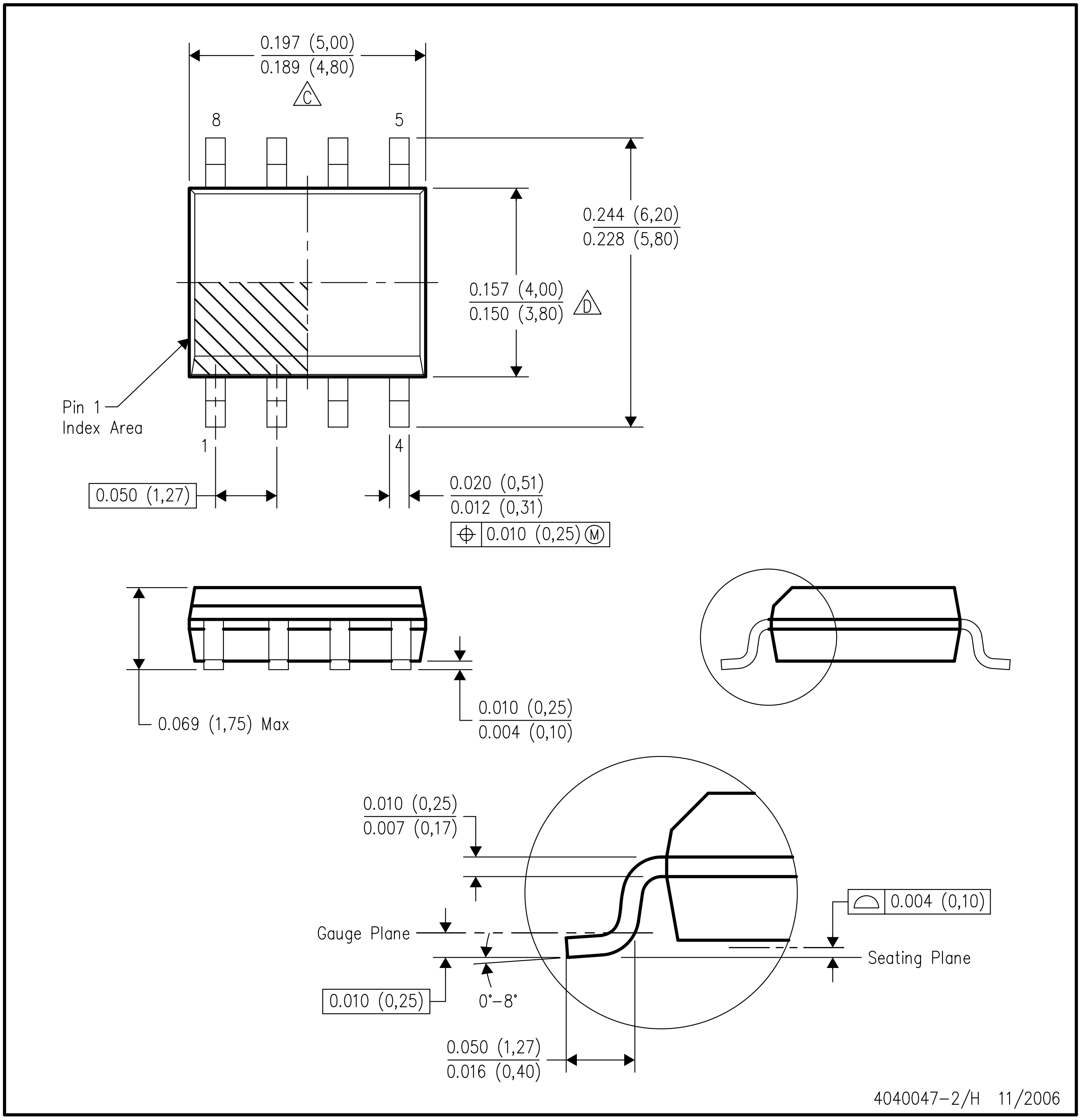

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Package outline exclusive of mold flash, metal burr & dambar protrusion/intrusion.
D. Package outline inclusive of solder plating.
E. A visual index feature must be located within the Pin 1 index area.
F. Falls within JEDEC MO-178 Variation BA.

## D (R–PDSO–G14) PLASTIC SMALL–OUTLINE PACKAGE




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 .006 (0,15) per end.
D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
E. Reference JEDEC MS-012 variation AB.

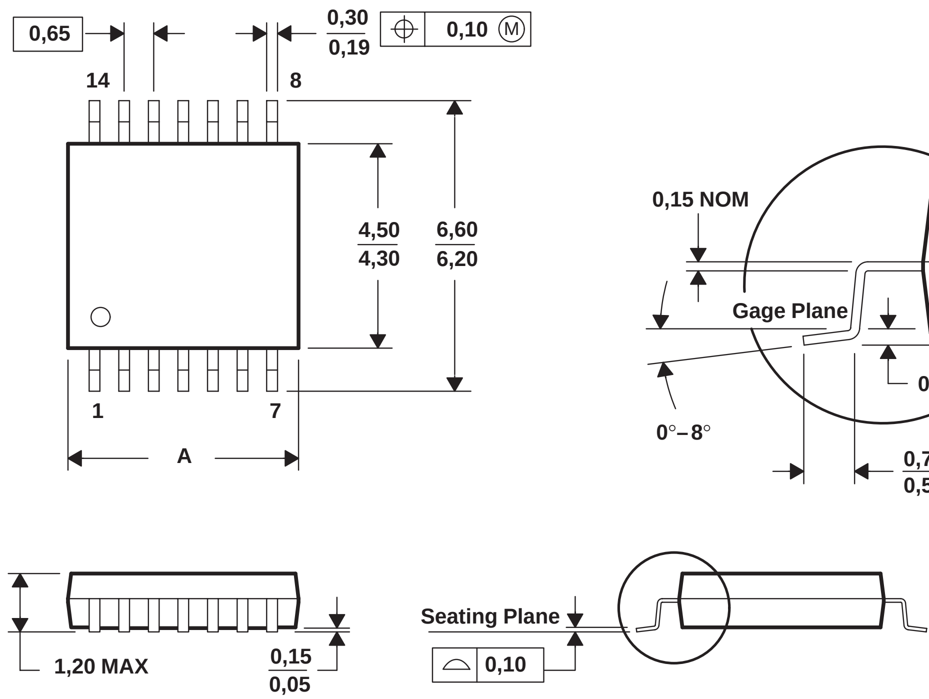
D (R-PDSO-G8) PLASTIC SMALL-OUTLINE PACKAGE




NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
E. Reference JEDEC MS-012 variation AA.

**PW (R-PDSO-G**)** **PLASTIC SMALL-OUTLINE PACKAGE**

**14 PINS SHOWN**




| PINS ** / DIM | 8 | 14 | 16 | 20 | 24 | 28 |
|---|---|---|---|---|---|---|
| A MAX | 3,10 | 5,10 | 5,10 | 6,60 | 7,90 | 9,80 |
| A MIN | 2,90 | 4,90 | 4,90 | 6,40 | 7,70 | 9,60 |

4040064/F 01/97

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.
D. Falls within JEDEC MO-153

## IMPORTANT NOTICE



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| Data Converters | dataconverter.ti.com | Automotive | www.ti.com/automotive |
| DSP | dsp.ti.com | Broadband | www.ti.com/broadband |
| Interface | interface.ti.com | Digital Control | www.ti.com/digitalcontrol |
| Logic | logic.ti.com | Military | www.ti.com/military |
| Power Mgmt | power.ti.com | Optical Networking | www.ti.com/opticalnetwork |
| Microcontrollers | microcontroller.ti.com | Security | www.ti.com/security |
| Low Power Wireless | www.ti.com/lpw | Telephony | www.ti.com/telephony |
| | | Video & Imaging | www.ti.com/video |
| | | Wireless | www.ti.com/wireless |


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