



**OPA244**  
**OPA2244**  
**OPA4244**

## MicroPower, Single-Supply OPERATIONAL AMPLIFIERS

### MicroAmplifier™ Series

## FEATURES

- **MicroSIZE PACKAGES**  
 OPA244 (Single): SOT-23-5  
 OPA2244 (Dual): MSOP-8  
 OPA4244 (Quad): TSSOP-14
- **MicroPOWER:**  $I_Q = 50\mu\text{A}/\text{channel}$
- **SINGLE SUPPLY OPERATION**
- **WIDE BANDWIDTH:** 430kHz
- **WIDE SUPPLY RANGE:**  
 Single Supply: 2.2V to 36V  
 Dual Supply:  $\pm 1.1\text{V}$  to  $\pm 18\text{V}$

## APPLICATIONS

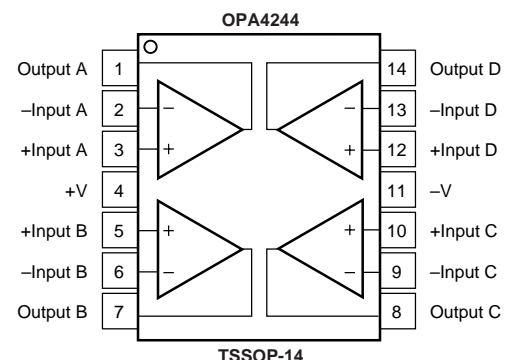
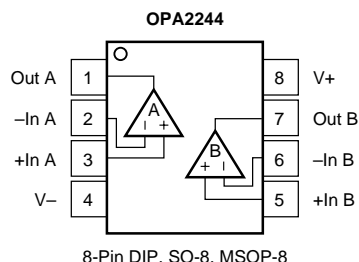
- **BATTERY POWERED SYSTEMS**
- **PORTABLE EQUIPMENT**
- **PCMCIA CARDS**
- **BATTERY PACKS AND POWER SUPPLIES**
- **CONSUMER PRODUCTS**

## DESCRIPTION

The OPA244 (single), OPA2244 (dual), and OPA4244 (quad) op amps are designed for very low quiescent current ( $50\mu\text{A}/\text{channel}$ ), yet achieve excellent bandwidth. Ideal for battery powered and portable instrumentation, all versions are offered in micro packages for space-limited applications. The dual and quad versions feature completely independent circuitry for lowest crosstalk and freedom from interaction, even when overdriven or overloaded.

The OPA244 series is easy to use and free from phase inversion and overload problems found in some other op amps. These amplifiers are stable in unity gain and excellent performance is maintained as they swing to their specified limits. They can be operated from single (+2.2V to +36V) or dual supplies ( $\pm 1.1\text{V}$  to  $\pm 18\text{V}$ ). The input common-mode voltage range includes ground—ideal for many single supply applications. All versions have similar performance. However, there are some differences, such as common-mode rejection. All versions are interchangeable in most applications.

All versions are offered in miniature, surface-mount packages. OPA244 (single version) comes in the tiny 5-lead SOT-23-5 surface mount, SO-8 surface mount, and 8-pin DIP. OPA2244 (dual version) is available in the MSOP-8 surface mount, SO-8 surface-mount, and 8-pin DIP. The OPA4244 (quad) comes in the TSSOP-14 surface mount. They are fully specified from  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$  and operate from  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$ . A SPICE Macromodel is available for design analysis.



International Airport Industrial Park • Mailing Address: PO Box 11400, Tucson, AZ 85734 • Street Address: 6730 S. Tucson Blvd., Tucson, AZ 85706 • Tel: (520) 746-1111  
 Twx: 910-952-1111 • Internet: <http://www.burr-brown.com/> • Cable: BBRCORP • Telex: 066-6491 • FAX: (520) 889-1510 • Immediate Product Info: (800) 548-6132

# SPECIFICATIONS: $V_S = +2.6V$ to $+36V$

**Boldface** limits apply over the specified temperature range,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$

At  $T_A = +25^{\circ}C$ ,  $R_L = 20k\Omega$  connected to ground, unless otherwise noted.

PARAMETER	CONDITION	OPA244NA, PA, UA			UNITS
		MIN	TYP <sup>(1)</sup>	MAX	
<b>OFFSET VOLTAGE</b> Input Offset Voltage $T_A = -40^{\circ}C$ to $85^{\circ}C$ vs Temperature vs Power Supply $T_A = -40^{\circ}C$ to $85^{\circ}C$	$V_{OS}$ $V_S = \pm 7.5V, V_{CM} = 0$ $dV_{OS}/dT$ $PSRR$ $T_A = -40^{\circ}C$ to $85^{\circ}C$ $V_S = +2.6V$ to $+36V$ $V_S = +2.6V$ to $+36V$		$\pm 0.7$ $\pm 4$ 5	$\pm 1.5$ $\pm 2$ 50 <b>50</b>	mV mV $\mu V/^{\circ}C$ $\mu V/V$ $\mu V/V$
<b>INPUT BIAS CURRENT</b> Input Bias Current Input Offset Current	$I_B$ $I_{OS}$ $V_{CM} = V_S/2$ $V_{CM} = V_S/2$		-10 $\pm 1$	-25 $\pm 10$	nA nA
<b>NOISE</b> Input Voltage Noise, $f = 0.1kHz$ to $10kHz$ Input Voltage Noise Density, $f = 1kHz$ Current Noise Density, $f = 1kHz$	$e_n$ $i_n$		0.4 22 40		$\mu Vp-p$ $nV/\sqrt{Hz}$ $fA/\sqrt{Hz}$
<b>INPUT VOLTAGE RANGE</b> Common-Mode Voltage Range Common-Mode Rejection $T_A = -40^{\circ}C$ to $85^{\circ}C$	$V_{CM}$ CMRR $V_S = \pm 18V, V_{CM} = -18V$ to $+17.1V$ $V_S = \pm 18V, V_{CM} = -18V$ to $+17.1V$	0 84 <b>84</b>	98	$(V+) - 0.9$	V dB dB
<b>INPUT IMPEDANCE</b> Differential Common-Mode			$10^6 \parallel 2$ $10^9 \parallel 2$		$\Omega \parallel pF$ $\Omega \parallel pF$
<b>OPEN-LOOP GAIN</b> Open-Loop Voltage Gain $T_A = -40^{\circ}C$ to $85^{\circ}C$	$A_{OL}$ $V_O = 0.5V$ to $(V+) - 0.9$ $V_O = 0.5V$ to $(V+) - 0.9$	86 <b>86</b>	106		dB dB
<b>FREQUENCY RESPONSE</b> Gain-Bandwidth Product Slew Rate Settling Time 0.01% Overload Recovery Time	GBW SR $G = 1$ 10V Step $V_{IN} \cdot \text{Gain} = V_S$		430 -0.1/+0.16 150 8		kHz V/ $\mu s$ $\mu s$ $\mu s$
<b>OUTPUT</b> Voltage Output, Positive $T_A = -40^{\circ}C$ to $85^{\circ}C$ Voltage Output, Negative $T_A = -40^{\circ}C$ to $85^{\circ}C$ Voltage Output, Positive $T_A = -40^{\circ}C$ to $85^{\circ}C$ Voltage Output, Negative $T_A = -40^{\circ}C$ to $85^{\circ}C$ Short-Circuit Current Capacitive Load Drive	$V_O$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $I_{SC}$ $C_{LOAD}$	$(V+) - 0.9$ <b><math>(V+) - 0.9</math></b> 0.5 <b>0.5</b> 0.1 <b>0.1</b> -25/+12	$(V+) - 0.75$ $(V+) - 0.75$ 0.2 <b>0.2</b> $(V+) - 0.75$ $(V+) - 0.75$ 0.1 <b>0.1</b> -25/+12		V V V V V V V V mA
<b>POWER SUPPLY</b> Specified Voltage Range Minimum Operating Voltage Quiescent Current $T_A = -40^{\circ}C$ to $85^{\circ}C$	$V_S$ $I_Q$ $T_A = -40^{\circ}C$ to $85^{\circ}C$ $I_O = 0$ $I_O = 0$	<b>+2.6</b>	+2.2 50	<b>+36</b> 60 <b>70</b>	V V $\mu A$ $\mu A$
<b>TEMPERATURE RANGE</b> Specified Range Operating Range Storage Range Thermal Resistance SOT-23-5 Surface-Mount SO-8 Surface-Mount 8-Pin DIP	$\theta_{JA}$	-40 -55 -65		85 125 150	$^{\circ}C$ $^{\circ}C$ $^{\circ}C$ $^{\circ}C/W$ $^{\circ}C/W$ $^{\circ}C/W$

NOTE: (1)  $V_S = +15V$ .

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# SPECIFICATIONS: $V_S = +2.6V$ to $+36V$

**Boldface** limits apply over the specified temperature range,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$

At  $T_A = +25^{\circ}C$ ,  $R_L = 20k\Omega$  connected to ground, unless otherwise noted.

PARAMETER	CONDITION	OPA2244EA, PA, UA			UNITS
		MIN	TYP <sup>(1)</sup>	MAX	
<b>OFFSET VOLTAGE</b> Input Offset Voltage $T_A = -40^{\circ}C$ to $85^{\circ}C$ vs Temperature vs Power Supply $T_A = -40^{\circ}C$ to $85^{\circ}C$ Channel Separation	$V_{OS}$ $V_S = \pm 7.5V, V_{CM} = 0$ $dV_{OS}/dT$ $PSRR$ $T_A = -40^{\circ}C$ to $85^{\circ}C$ $V_S = +2.6V$ to $+36V$ $V_S = +2.6V$ to $+36V$		$\pm 0.7$ $\pm 4$ 5 140	$\pm 1.5$ $\pm 2$ 50 <b>50</b>	mV mV $\mu V/^{\circ}C$ $\mu V/V$ $\mu V/V$ dB
<b>INPUT BIAS CURRENT</b> Input Bias Current Input Offset Current	$I_B$ $I_{OS}$ $V_{CM} = V_S/2$ $V_{CM} = V_S/2$		-10 $\pm 1$	-25 $\pm 10$	nA nA
<b>NOISE</b> Input Voltage Noise, $f = 0.1kHz$ to $10kHz$ Input Voltage Noise Density, $f = 1kHz$ Current Noise Density, $f = 1kHz$	$e_n$ $i_n$		0.4 22 40		$\mu Vp-p$ $nV/\sqrt{Hz}$ $fA/\sqrt{Hz}$
<b>INPUT VOLTAGE RANGE</b> Common-Mode Voltage Range Common-Mode Rejection $T_A = -40^{\circ}C$ to $85^{\circ}C$	$V_{CM}$ CMRR $V_S = \pm 18V, V_{CM} = -18V$ to $+17.1V$ $V_S = \pm 18V, V_{CM} = -18V$ to $+17.1V$	0 72 <b>72</b>	98	$(V+) - 0.9$	V dB dB
<b>INPUT IMPEDANCE</b> Differential Common-Mode			$10^6 \parallel 2$ $10^9 \parallel 2$		$\Omega \parallel pF$ $\Omega \parallel pF$
<b>OPEN-LOOP GAIN</b> Open-Loop Voltage Gain $T_A = -40^{\circ}C$ to $85^{\circ}C$	$A_{OL}$ $V_O = 0.5V$ to $(V+) - 0.9$ $V_O = 0.5V$ to $(V+) - 0.9$	86 <b>86</b>	106		dB dB
<b>FREQUENCY RESPONSE</b> Gain-Bandwidth Product Slew Rate Settling Time 0.01% Overload Recovery Time	GBW SR G = 1 10V Step $V_{IN} \cdot Gain = V_S$		430 $-0.1/+0.16$ 150 8		kHz V/ $\mu s$ $\mu s$ $\mu s$
<b>OUTPUT</b> Voltage Output, Positive $T_A = -40^{\circ}C$ to $85^{\circ}C$ Voltage Output, Negative $T_A = -40^{\circ}C$ to $85^{\circ}C$ Voltage Output, Positive $T_A = -40^{\circ}C$ to $85^{\circ}C$ Voltage Output, Negative $T_A = -40^{\circ}C$ to $85^{\circ}C$ Short-Circuit Current Capacitive Load Drive	$V_O$ $I_{SC}$ $C_{LOAD}$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground See Typical Curve	$(V+) - 0.9$ <b><math>(V+) - 0.9</math></b> 0.5 <b>0.5</b> 0.1 <b>0.1</b> $-25/+12$	$(V+) - 0.75$ $(V+) - 0.75$ 0.2 <b>0.2</b> $(V+) - 0.75$ $(V+) - 0.75$ 0.1 <b>0.1</b> $-25/+12$	V V V V V V V V mA	
<b>POWER SUPPLY</b> Specified Voltage Range Minimum Operating Voltage Quiescent Current (per amplifier) $T_A = -40^{\circ}C$ to $85^{\circ}C$	$V_S$ $I_Q$ $T_A = -40^{\circ}C$ to $85^{\circ}C$ $I_O = 0$ $I_O = 0$	<b>+2.6</b>	+2.2 40	<b>+36</b> 50 <b>63</b>	V V $\mu A$ $\mu A$
<b>TEMPERATURE RANGE</b> Specified Range Operating Range Storage Range Thermal Resistance MSOP-8 Surface-Mount SO-8 Surface-Mount 8-Pin DIP	$\theta_{JA}$	-40 -55 -65		85 125 150	$^{\circ}C$ $^{\circ}C$ $^{\circ}C$ $^{\circ}C/W$ $^{\circ}C/W$ $^{\circ}C/W$

NOTE: (1)  $V_S = +15V$ .

# SPECIFICATIONS: $V_S = +2.6V$ to $+36V$

**Boldface** limits apply over the specified temperature range,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$

At  $T_A = +25^\circ\text{C}$ ,  $R_L = 20\text{k}\Omega$  connected to ground, unless otherwise noted.

PARAMETER	CONDITION	OPA4244EA			UNITS
		MIN	TYP <sup>(1)</sup>	MAX	
<b>OFFSET VOLTAGE</b> Input Offset Voltage $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ vs Temperature vs Power Supply $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Channel Separation	$V_{OS}$ $V_S = \pm 7.5V, V_{CM} = 0$ $dV_{OS}/dT$ $PSRR$ $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ $V_S = +2.6V$ to $+36V$ $V_S = +2.6V$ to $+36V$		$\pm 0.7$ $\pm 4$ 5 140	$\pm 1.5$ $\pm 2$ 50 <b>50</b>	mV mV $\mu\text{V}/^\circ\text{C}$ $\mu\text{V}/V$ $\mu\text{V}/V$ dB
<b>INPUT BIAS CURRENT</b> Input Bias Current Input Offset Current	$I_B$ $I_{OS}$ $V_{CM} = V_S/2$ $V_{CM} = V_S/2$		-10 $\pm 1$	-25 $\pm 10$	nA nA
<b>NOISE</b> Input Voltage Noise, $f = 0.1\text{kHz}$ to $10\text{kHz}$ Input Voltage Noise Density, $f = 1\text{kHz}$ Current Noise Density, $f = 1\text{kHz}$	$e_n$ $i_n$		0.4 22 40		$\mu\text{Vp-p}$ $\text{nV}/\sqrt{\text{Hz}}$ $\text{fA}/\sqrt{\text{Hz}}$
<b>INPUT VOLTAGE RANGE</b> Common-Mode Voltage Range Common-Mode Rejection $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$	$V_{CM}$ CMRR $V_S = \pm 18V, V_{CM} = -18V$ to $+17.1V$ $V_S = \pm 18V, V_{CM} = -18V$ to $+17.1V$	0 82 <b>82</b>		$(V+) - 0.9$ 104	V dB dB
<b>INPUT IMPEDANCE</b> Differential Common-Mode			$10^6 \parallel 2$ $10^9 \parallel 2$		$\Omega \parallel \text{pF}$ $\Omega \parallel \text{pF}$
<b>OPEN-LOOP GAIN</b> Open-Loop Voltage Gain $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$	$A_{OL}$ $V_O = 0.5V$ to $(V+) - 0.9$ $V_O = 0.5V$ to $(V+) - 0.9$	86 <b>86</b>	106		dB dB
<b>FREQUENCY RESPONSE</b> Gain-Bandwidth Product Slew Rate Settling Time 0.01% Overload Recovery Time	GBW SR $G = 1$ 10V Step $V_{IN} \cdot \text{Gain} = V_S$		430 $-0.1/+0.16$ 150 8		kHz $\text{V}/\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
<b>OUTPUT</b> Voltage Output, Positive $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Voltage Output, Negative $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Voltage Output, Positive $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Voltage Output, Negative $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Short-Circuit Current Capacitive Load Drive	$V_O$ $I_{SC}$ $C_{LOAD}$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to $V_S/2$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to $V_S/2$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to $V_S/2$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground See Typical Curve	$(V+) - 0.9$ <b><math>(V+) - 0.9</math></b> 0.5 <b>0.5</b> 0.1 <b>0.1</b> $-25/+12$	$(V+) - 0.75$ $(V+) - 0.75$ 0.2 <b>0.2</b> $(V+) - 0.75$ $(V+) - 0.75$ 0.1 <b>0.1</b>		V V V V V V V V mA
<b>POWER SUPPLY</b> Specified Voltage Range Minimum Operating Voltage Quiescent Current (per amplifier) $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$	$V_S$ $I_Q$ $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ $I_O = 0$ $I_O = 0$	<b>+2.6</b>	+2.2 40	<b>+36</b> 60 <b>70</b>	V V $\mu\text{A}$ $\mu\text{A}$
<b>TEMPERATURE RANGE</b> Specified Range Operating Range Storage Range Thermal Resistance TSSOP-14 Surface Mount	$\theta_{JA}$	-40 -55 -65		85 125 150	$^\circ\text{C}$ $^\circ\text{C}$ $^\circ\text{C}$ $^\circ\text{C}/W$

NOTE: (1)  $V_S = +15V$ .

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

Supply Voltage, V+ to V- .....	36V
Input Voltage Range <sup>(2)</sup> .....	(V-) – 0.3V to (V+) + 0.3V
Input Current <sup>(2)</sup> .....	10mA
Output Short-Circuit <sup>(3)</sup> .....	Continuous
Operating Temperature .....	–55°C to +125°C
Storage Temperature .....	–65°C to +150°C
Junction Temperature .....	150°C
Lead Temperature (soldering, 10s) .....	300°C
ESD Capability .....	2000V

NOTES: (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. (2) Inputs are diode-clamped to the supply rails and should be current-limited to 10mA or less if input voltages can exceed rails by more than 0.3V. (3) Short-circuit to ground, one amplifier per package.



## ELECTROSTATIC DISCHARGE SENSITIVITY

This integrated circuit can be damaged by ESD. Burr-Brown 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	PACKAGE DRAWING NUMBER	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER <sup>(1)</sup>	TRANSPORT MEDIA
<b>Single</b>						
OPA244NA	SOT-23-5 Surface-Mount	331	–40°C to +85°C	A44	OPA244NA/250	Tape and Reel
"	"	"	"	"	OPA244NA/3K	Tape and Reel
OPA244PA	8-Pin DIP	006	–40°C to +85°C	OPA244PA	OPA244PA	Rails
OPA244UA	SO-8 Surface-Mount	182	–40°C to +85°C	OPA244UA	OPA244UA	Rails
"	"	"	"	"	OPA244UA/2K5	Tape and Reel
<b>Dual</b>						
OPA2244EA	MSOP-8 Surface-Mount	337	–40°C to +85°C	A44	OPA2244EA/250	Tape and Reel
"	"	"	"	"	OPA2244EA/2K5	Tape and Reel
OPA2244PA	8-Pin DIP	006	–40°C to +85°C	OPA2244PA	OPA2244PA	Rails
OPA2244UA	SO-8 Surface-Mount	182	–40°C to +85°C	OPA2244UA	OPA2244UA	Rails
"	"	"	"	"	OPA2244UA/2K5	Tape and Reel
<b>Quad</b>						
OPA4244EA	TSSOP-14 Surface-Mount	357	–40°C to +85°C	OPA4244EA	OPA4244EA/250	Tape and Reel
"	"	"	"	"	OPA4244EA/2K5	Tape and Reel

NOTE: (1) Products followed by a slash (/) are only available in Tape and Reel in the quantities indicated (e.g., /250 indicates 250 devices per reel). Ordering 3000 pieces of "OPA244NA/3K" will get a single 3000 piece Tape and Reel.

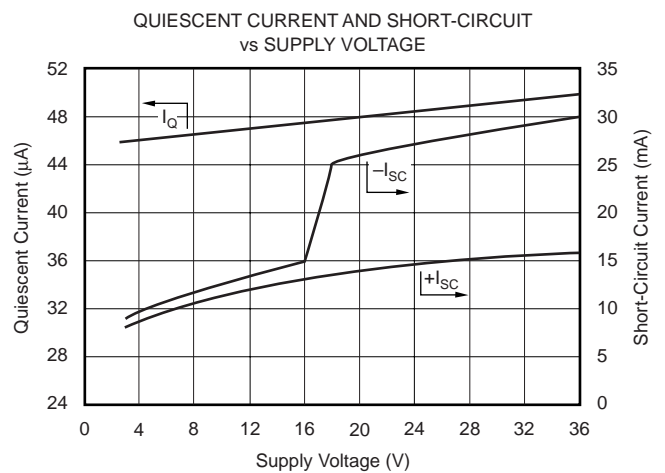
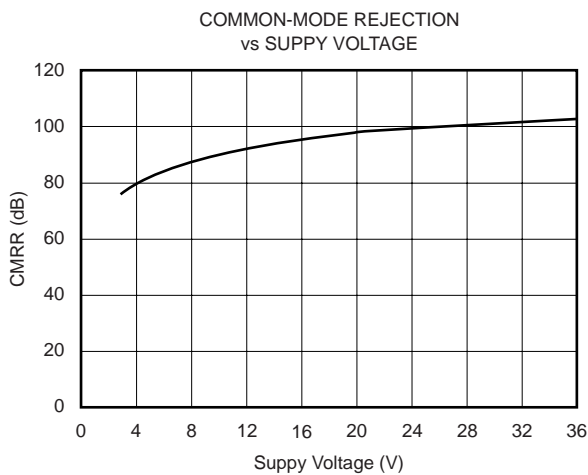
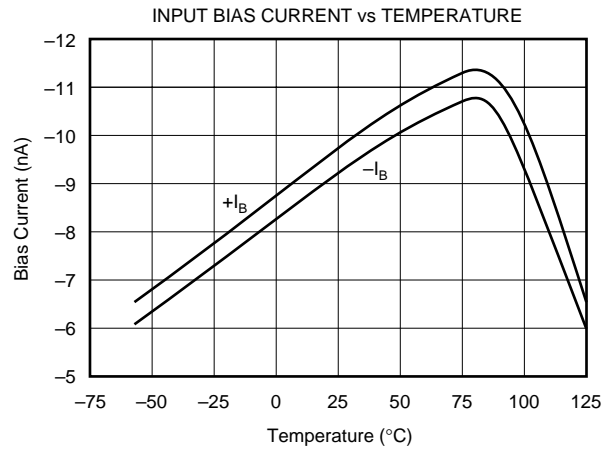
# TYPICAL PERFORMANCE CURVES

At  $T_A = 25^\circ\text{C}$ ,  $V_S = +15\text{V}$ , and  $R_L = 20\text{k}\Omega$  connected to Ground, unless otherwise noted.



# TYPICAL PERFORMANCE CURVES (Cont.)

At  $T_A = 25^\circ\text{C}$ ,  $V_S = +15\text{V}$ , and  $R_L = 20\text{k}\Omega$  connected to Ground, unless otherwise noted.



# TYPICAL PERFORMANCE CURVES (Cont.)

At  $T_A = 25^\circ\text{C}$ ,  $V_S = +15\text{V}$ , and  $R_L = 20\text{k}\Omega$  connected to Ground, unless otherwise noted.

QUIESCENT AND SHORT-CIRCUIT CURRENT vs TEMPERATURE



INPUT VOLTAGE AND CURRENT NOISE SPECTRAL DENSITY vs FREQUENCY



MAXIMUM OUTPUT VOLTAGE vs FREQUENCY



SMALL SIGNAL OVERSHOOT vs LOAD CAPACITANCE





# TYPICAL PERFORMANCE CURVES (Cont.)

At  $T_A = 25^\circ\text{C}$ ,  $V_S = +15\text{V}$ , and  $R_L = 20\text{k}\Omega$  connected to Ground, unless otherwise noted.

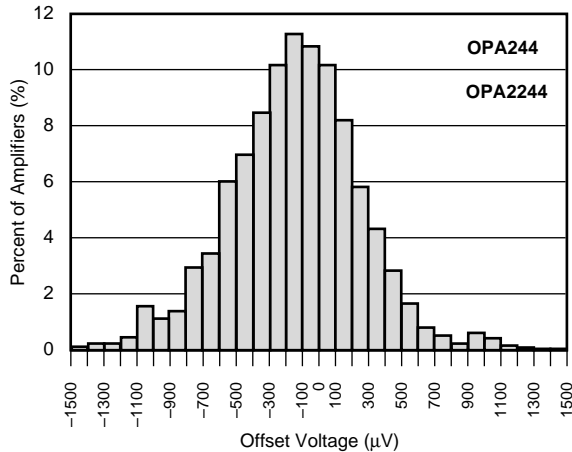
LARGE-SIGNAL STEP RESPONSE,  $G = 1$ ,  $C_L = 100\text{pF}$



SMALL-SIGNAL STEP RESPONSE,  $G = 1$ ,  $C_L = 100\text{pF}$



OFFSET VOLTAGE PRODUCTION DISTRIBUTION



# TYPICAL PERFORMANCE CURVES (Cont.)

At  $T_A = 25^\circ\text{C}$ ,  $V_S = +15\text{V}$ , and  $R_L = 20\text{k}\Omega$  connected to Ground, unless otherwise noted.

OFFSET VOLTAGE PRODUCTION DISTRIBUTION



# APPLICATIONS INFORMATION

The OPA244 is unity-gain stable and suitable for a wide range of general purpose applications. Power supply pins should be bypassed with 0.01µF ceramic capacitors.

## OPERATING VOLTAGE

The OPA244 can operate from single supply (+2.2V to +36V) or dual supplies (±1.1 to ±18V) with excellent performance. Unlike most op amps which are specified at only one supply voltage, the OPA244 is specified for real world applications; a single set of specifications applies throughout the +2.6V to +36V (±1.3 to ±18V) supply range.

This allows a designer to have the same assured performance at any supply voltage within this range. In addition, many key parameters are guaranteed over the specified temperature range, -40°C to +85°C. Most behavior remains unchanged throughout the full operating voltage range. Parameters which vary significantly with operating voltage or temperature are shown in typical performance curves.

Useful information on solder pad design for printed circuit boards can be found in Burr-Brown's Application Bulletin AB-132B, "Solder Pad Recommendations for Surface-Mount Devices," easily found at Burr-Brown's web site (<http://www.burr-brown.com>).



FIGURE 1. Low and High-Side Battery Current Sensing.

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
OPA2244EA/250	ACTIVE	VSSOP	DGK	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
OPA2244EA/250G4	ACTIVE	VSSOP	DGK	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
OPA2244EA/2K5	ACTIVE	VSSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
OPA2244EA/2K5G4	ACTIVE	VSSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
OPA2244PA	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	
OPA2244PAG4	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	
OPA2244UA	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	
OPA2244UA/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	
OPA2244UA/2K5G4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	
OPA2244UAG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	
OPA244NA/250	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
OPA244NA/250G4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
OPA244NA/3K	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
OPA244NA/3KG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
OPA244PA	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	
OPA244PAG4	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	
OPA244UA	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
OPA244UA/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	
OPA244UA/2K5E4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	
OPA244UAE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	
OPA4244EA/250	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	
OPA4244EA/250E4	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	
OPA4244EA/2K5	ACTIVE	TSSOP	PW	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	
OPA4244EA/2K5E4	ACTIVE	TSSOP	PW	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

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**TAPE AND REEL INFORMATION**
**REEL DIMENSIONS**

**TAPE DIMENSIONS**


A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

**TAPE AND REEL INFORMATION**

\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
OPA2244EA/250	VSSOP	DGK	8	250	180.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA2244EA/2K5	VSSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA2244UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA244UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA4244EA/250	TSSOP	PW	14	250	180.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
OPA4244EA/2K5	TSSOP	PW	14	2500	330.0	12.4	6.9	5.6	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)
OPA2244EA/250	VSSOP	DGK	8	250	210.0	185.0	35.0
OPA2244EA/2K5	VSSOP	DGK	8	2500	367.0	367.0	35.0
OPA2244UA/2K5	SOIC	D	8	2500	367.0	367.0	35.0
OPA244UA/2K5	SOIC	D	8	2500	367.0	367.0	35.0
OPA4244EA/250	TSSOP	PW	14	250	210.0	185.0	35.0
OPA4244EA/2K5	TSSOP	PW	14	2500	367.0	367.0	35.0



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.

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-G5)

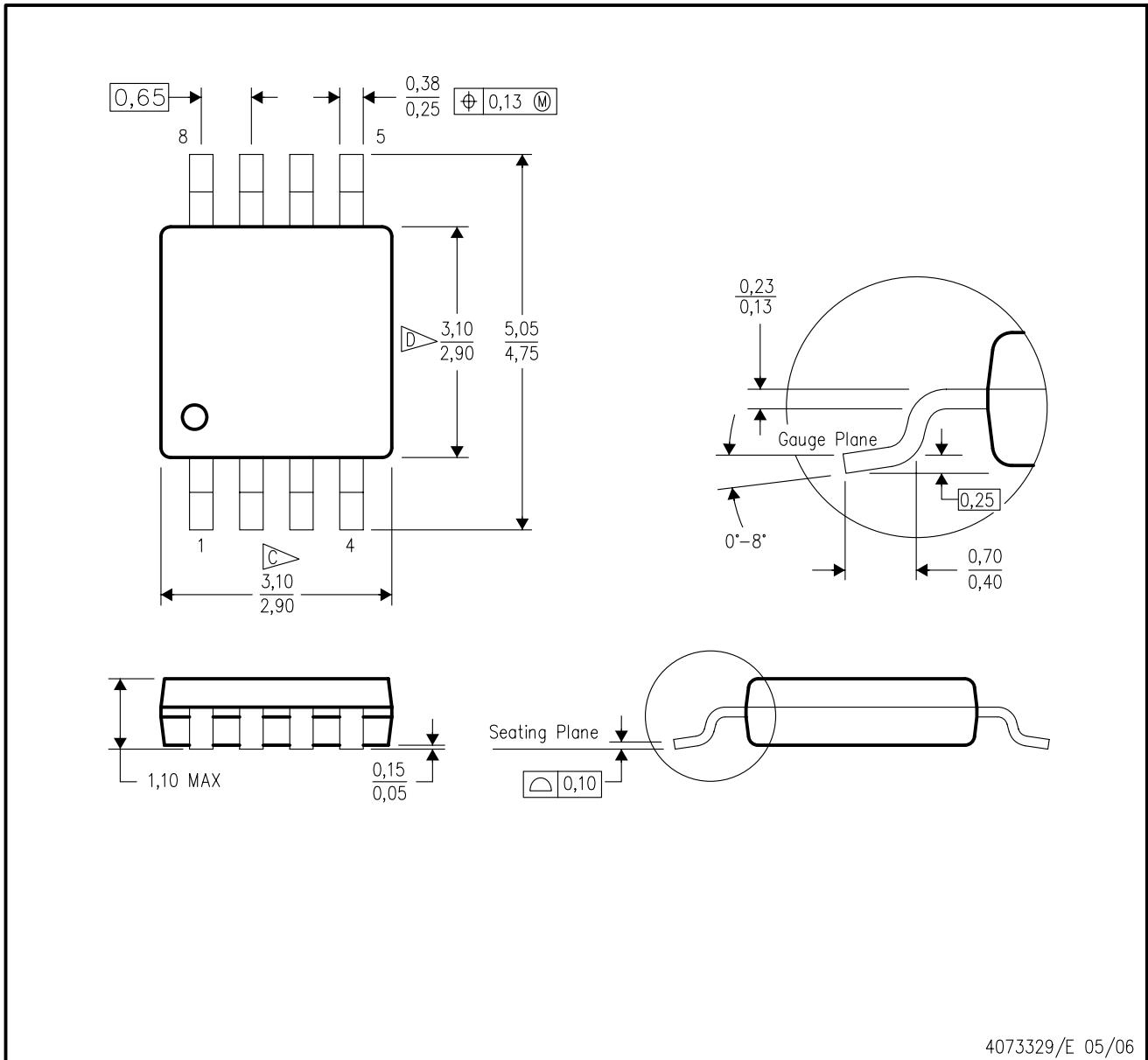
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
  - D. Publication IPC-7351 is recommended for alternate designs.
  - E. 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

DGK (S-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 length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per end.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
  - E. Falls within JEDEC MO-187 variation AA, except interlead flash.

# MECHANICAL DATA

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - 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 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - 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.
  - 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



4211283-2/E 08/12

- 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.



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