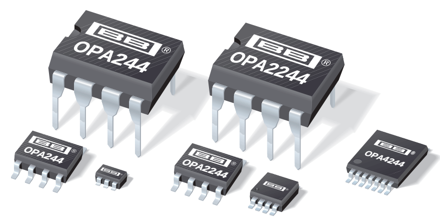
BURR - BROWN®



OPA244
OPA2244
OPA4244

*Micro*_Power_, Single-Supply OPERATIONAL AMPLIFIERS *Micro*_Amplifier_™ Series

FEATURES

- *Micro*SIZE PACKAGES
  OPA244 (Single): SOT-23-5
  OPA2244 (Dual): MSOP-8
  OPA4244 (Quad): TSSOP-14
- *Micro*POWER: I_Q = 50µA/channel
- SINGLE SUPPLY OPERATION
- WIDE BANDWIDTH: 430kHz
- WIDE SUPPLY RANGE:
  Single Supply: 2.2V to 36V
  Dual Supply: ±1.1V to ±18V

APPLICATIONS

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

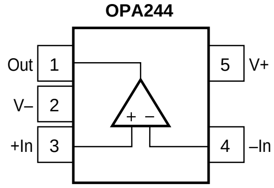
DESCRIPTION

The OPA244 (single), OPA2244 (dual), and OPA4244 (quad) op amps are designed for very low quiescent current (50µA/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 (±1.1V to ±18V). 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.

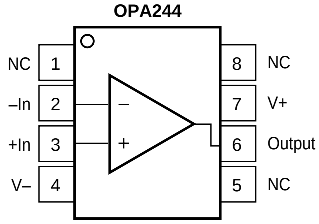
All versions are offered in miniature, surface-mount packages. OPA244 (single version) comes in the tiny 5-lead SOT-23-5 surface mount, SO-8 surface mount, and 8-pin DIP. OPA2244 (dual version) is available in the MSOP-8 surface mount, SO-8 surface-mount, and 8-pin DIP. The OPA4244 (quad) comes in the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

OPA244



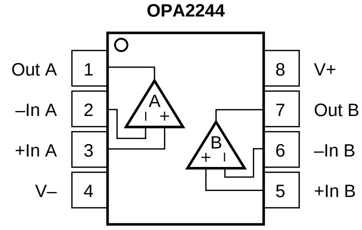
SOT-23-5

OPA244



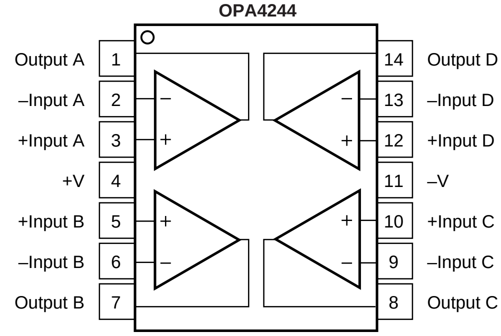
8-Pin DIP, SO-8

OPA2244



8-Pin DIP, SO-8, MSOP-8

OPA4244



TSSOP-14

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

 PDS-1437C Printed in U.S.A. December, 1999

SPECIFICATIONS: V_S = +2.6V to +36V

Boldface limits apply over the specified temperature range, **T_A = –40°C to +85°C**

At T_A = +25°C, R_L = 20kΩ connected to ground, unless otherwise noted.

		OPA244NA, PA, UA			
PARAMETER	**CONDITION**	**MIN**	**TYP[1]**	**MAX**	**UNITS**
OFFSET VOLTAGE					
Input Offset Voltage V_{OS}	V_S = ±7.5V, V_{CM} = 0		±0.7	±1.5	mV
T_A = –40°C to 85°C				**±2**	mV
vs Temperature dV_{OS}/dT	**T_A = –40°C to 85°C**		**±4**		μV/°C
vs Power Supply PSRR	V_S = +2.6V to +36V		5	50	μV/V
T_A = –40°C to 85°C	V_S = +2.6V to +36V			**50**	μV/V
INPUT BIAS CURRENT					
Input Bias Current I_B	V_{CM} = V_S/2		–10	–25	nA
Input Offset Current I_{OS}	V_{CM} = V_S/2		±1	±10	nA
NOISE					
Input Voltage Noise, f = 0.1kHz to 10kHz			0.4		μVp-p
Input Voltage Noise Density, f = 1kHz e_n			22		nV/√Hz
Current Noise Density, f = 1kHz i_n			40		fA/√Hz
INPUT VOLTAGE RANGE					
Common-Mode Voltage Range V_{CM}		0		(V+) – 0.9	V
Common-Mode Rejection CMRR	V_S = ±18V, V_{CM} = –18V to +17.1V	84	98		dB
T_A = –40°C to 85°C	V_S = ±18V, V_{CM} = –18V to +17.1V	**84**			dB
INPUT IMPEDANCE					
Differential			10^6 || 2		Ω || pF
Common-Mode			10^9 || 2		Ω || pF
OPEN-LOOP GAIN					
Open-Loop Voltage Gain A_{OL}	V_O = 0.5V to (V+) – 0.9	86	106		dB
T_A = –40°C to 85°C	V_O = 0.5V to (V+) – 0.9	**86**			dB
FREQUENCY RESPONSE					
Gain-Bandwidth Product GBW			430		kHz
Slew Rate SR	G = 1		–0.1/+0.16		V/μs
Settling Time 0.01%	10V Step		150		μs
Overload Recovery Time	V_{IN} • Gain = V_S		8		μs
OUTPUT					
Voltage Output, Positive V_O	A_{OL} ≥ 80dB, R_L = 20kΩ to V_S/2	(V+) – 0.9	(V+) – 0.75		V
T_A = –40°C to 85°C	A_{OL} ≥ 80dB, R_L = 20kΩ to V_S/2	**(V+) – 0.9**	(V+) – 0.75		V
Voltage Output, Negative	A_{OL} ≥ 80dB, R_L = 20kΩ to V_S/2	0.5	0.2		V
T_A = –40°C to 85°C	A_{OL} ≥ 80dB, R_L = 20kΩ to V_S/2	**0.5**	**0.2**		V
Voltage Output, Positive	A_{OL} ≥ 80dB, R_L = 20kΩ to Ground		(V+) – 0.75		V
T_A = –40°C to 85°C	A_{OL} ≥ 80dB, R_L = 20kΩ to Ground		(V+) – 0.75		V
Voltage Output, Negative	A_{OL} ≥ 80dB, R_L = 20kΩ to Ground		0.1		V
T_A = –40°C to 85°C	A_{OL} ≥ 80dB, R_L = 20kΩ to Ground		**0.1**		V
Short-Circuit Current I_{SC}			–25/+12		mA
Capacitive Load Drive C_{LOAD}			See Typical Curve		
POWER SUPPLY					
Specified Voltage Range V_S	**T_A = –40°C to 85°C**	**+2.6**		**+36**	V
Minimum Operating Voltage			+2.2		V
Quiescent Current I_Q	I_O = 0		50	60	μA
T_A = –40°C to 85°C	I_O = 0			**70**	μA
TEMPERATURE RANGE					
Specified Range		–40		85	°C
Operating Range		–55		125	°C
Storage Range		–65		150	°C
Thermal Resistance θ_{JA}					
SOT-23-5 Surface-Mount			200		°C/W
SO-8 Surface-Mount			150		°C/W
8-Pin DIP			100		°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°C to +85°C**

At T_A = +25°C, R_L = 20kΩ connected to ground, unless otherwise noted.

PARAMETER	CONDITION	OPA2244EA, PA, UA			UNITS
		MIN	TYP(1)	MAX	
OFFSET VOLTAGE					
Input Offset Voltage V_{OS}	V_S = ±7.5V, V_{CM} = 0		±0.7	±1.5	mV
T_A = –40°C to 85°C				**±2**	mV
vs Temperature dV_{OS}/dT	**T_A = –40°C to 85°C**		**±4**		µV/°C
vs Power Supply PSRR	V_S = +2.6V to +36V		5	50	µV/V
T_A = –40°C to 85°C	V_S = +2.6V to +36V			**50**	µV/V
Channel Separation			140		dB
INPUT BIAS CURRENT					
Input Bias Current I_B	V_{CM} = V_S/2		–10	–25	nA
Input Offset Current I_{OS}	V_{CM} = V_S/2		±1	±10	nA
NOISE					
Input Voltage Noise, f = 0.1kHz to 10kHz			0.4		µVp-p
Input Voltage Noise Density, f = 1kHz e_n			22		$nV/\sqrt{Hz}$
Current Noise Density, f = 1kHz i_n			40		$fA/\sqrt{Hz}$
INPUT VOLTAGE RANGE					
Common-Mode Voltage Range V_{CM}		0		(V+) – 0.9	V
Common-Mode Rejection CMRR	V_S = ±18V, V_{CM} = –18V to +17.1V	72	98		dB
T_A = –40°C to 85°C	V_S = ±18V, V_{CM} = –18V to +17.1V	**72**			dB
INPUT IMPEDANCE					
Differential			10^6 || 2		Ω || pF
Common-Mode			10^9 || 2		Ω || pF
OPEN-LOOP GAIN					
Open-Loop Voltage Gain A_{OL}	V_O = 0.5V to (V+) – 0.9	86	106		dB
T_A = –40°C to 85°C	V_O = 0.5V to (V+) – 0.9	**86**			dB
FREQUENCY RESPONSE					
Gain-Bandwidth Product GBW			430		kHz
Slew Rate SR	G = 1		–0.1/+0.16		V/µs
Settling Time 0.01%	10V Step		150		µs
Overload Recovery Time	V_{IN} • Gain = V_S		8		µs
OUTPUT					
Voltage Output, Positive V_O	A_{OL} ≥ 80dB, R_L = 20kΩ to V_S/2	(V+) – 0.9	(V+) – 0.75		V
T_A = –40°C to 85°C	A_{OL} ≥ 80dB, R_L = 20kΩ to V_S/2	**(V+) – 0.9**	(V+) – 0.75		V
Voltage Output, Negative	A_{OL} ≥ 80dB, R_L = 20kΩ to V_S/2	0.5	0.2		V
T_A = –40°C to 85°C	A_{OL} ≥ 80dB, R_L = 20kΩ to V_S/2	**0.5**	**0.2**		V
Voltage Output, Positive	A_{OL} ≥ 80dB, R_L = 20kΩ to Ground		(V+) – 0.75		V
T_A = –40°C to 85°C	A_{OL} ≥ 80dB, R_L = 20kΩ to Ground		(V+) – 0.75		V
Voltage Output, Negative	A_{OL} ≥ 80dB, R_L = 20kΩ to Ground		0.1		V
T_A = –40°C to 85°C	A_{OL} ≥ 80dB, R_L = 20kΩ to Ground		**0.1**		V
Short-Circuit Current I_{SC}			–25/+12		mA
Capacitive Load Drive C_{LOAD}			See Typical Curve		
POWER SUPPLY					
Specified Voltage Range V_S	**T_A = –40°C to 85°C**	**+2.6**		**+36**	V
Minimum Operating Voltage			+2.2		V
Quiescent Current (per amplifier) I_Q	I_O = 0		40	50	µA
T_A = –40°C to 85°C	I_O = 0			**63**	µA
TEMPERATURE RANGE					
Specified Range		–40		85	°C
Operating Range		–55		125	°C
Storage Range		–65		150	°C
Thermal Resistance θ_{JA}					
MSOP-8 Surface-Mount			200		°C/W
SO-8 Surface-Mount			150		°C/W
8-Pin DIP			100		°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°C to +85°C**

At T_A = +25°C, R_L = 20kΩ connected to ground, unless otherwise noted.

PARAMETER		CONDITION	OPA4244EA MIN	TYP(1)	MAX	UNITS
OFFSET VOLTAGE						
Input Offset Voltage	V_{OS}	V_S = ±7.5V, V_{CM} = 0		±0.7	±1.5	mV
T_A = –40°C to 85°C					**±2**	mV
vs Temperature	dV_{OS}/dT	**T_A = –40°C to 85°C**		**±4**		µV/°C
vs Power Supply	PSRR	V_S = +2.6V to +36V		5	50	µV/V
T_A = –40°C to 85°C		V_S = +2.6V to +36V			**50**	µV/V
Channel Separation				140		dB
INPUT BIAS CURRENT						
Input Bias Current	I_B	V_{CM} = V_S/2		–10	–25	nA
Input Offset Current	I_{OS}	V_{CM} = V_S/2		±1	±10	nA
NOISE						
Input Voltage Noise, f = 0.1kHz to 10kHz				0.4		µVp-p
Input Voltage Noise Density, f = 1kHz	e_n			22		nV/√Hz
Current Noise Density, f = 1kHz	i_n			40		fA/√Hz
INPUT VOLTAGE RANGE						
Common-Mode Voltage Range	V_{CM}		0		(V+) – 0.9	V
Common-Mode Rejection	CMRR	V_S = ±18V, V_{CM} = –18V to +17.1V	82	104		dB
T_A = –40°C to 85°C		V_S = ±18V, V_{CM} = –18V to +17.1V	**82**			dB
INPUT IMPEDANCE						
Differential				10^6 || 2		Ω || pF
Common-Mode				10^9 || 2		Ω || pF
OPEN-LOOP GAIN						
Open-Loop Voltage Gain	A_{OL}	V_O = 0.5V to (V+) – 0.9	86	106		dB
T_A = –40°C to 85°C		V_O = 0.5V to (V+) – 0.9	**86**			dB
FREQUENCY RESPONSE						
Gain-Bandwidth Product	GBW			430		kHz
Slew Rate	SR	G = 1		–0.1/+0.16		V/µs
Settling Time 0.01%		10V Step		150		µs
Overload Recovery Time		V_{IN} • Gain = V_S		8		µs
OUTPUT						
Voltage Output, Positive	V_O	A_{OL} ≥ 80dB, R_L = 20kΩ to V_S/2	(V+) – 0.9	(V+) – 0.75		V
T_A = –40°C to 85°C		A_{OL} ≥ 80dB, R_L = 20kΩ to V_S/2	**(V+) – 0.9**	(V+) – 0.75		V
Voltage Output, Negative		A_{OL} ≥ 80dB, R_L = 20kΩ to V_S/2	0.5	0.2		V
T_A = –40°C to 85°C		A_{OL} ≥ 80dB, R_L = 20kΩ to V_S/2	**0.5**	**0.2**		V
Voltage Output, Positive		A_{OL} ≥ 80dB, R_L = 20kΩ to Ground		(V+) – 0.75		V
T_A = –40°C to 85°C		A_{OL} ≥ 80dB, R_L = 20kΩ to Ground		(V+) – 0.75		V
Voltage Output, Negative		A_{OL} ≥ 80dB, R_L = 20kΩ to Ground		0.1		V
T_A = –40°C to 85°C		A_{OL} ≥ 80dB, R_L = 20kΩ to Ground		**0.1**		V
Short-Circuit Current	I_{SC}			–25/+12		mA
Capacitive Load Drive	C_{LOAD}			See Typical Curve		
POWER SUPPLY						
Specified Voltage Range	V_S	**T_A = –40°C to 85°C**	**+2.6**		**+36**	V
Minimum Operating Voltage				+2.2		V
Quiescent Current (per amplifier)	I_Q	I_O = 0		40	60	µA
T_A = –40°C to 85°C		I_O = 0			**70**	µA
TEMPERATURE RANGE						
Specified Range			–40		85	°C
Operating Range			–55		125	°C
Storage Range			–65		150	°C
Thermal Resistance	θ_{JA}					
TSSOP-14 Surface Mount				100		°C/W

NOTE: (1) V_S = +15V.

ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage, V+ to V–	36V
Input Voltage Range[2]	(V–) – 0.3V to (V+) + 0.3V
Input Current[2]	10mA
Output Short-Circuit[3]	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

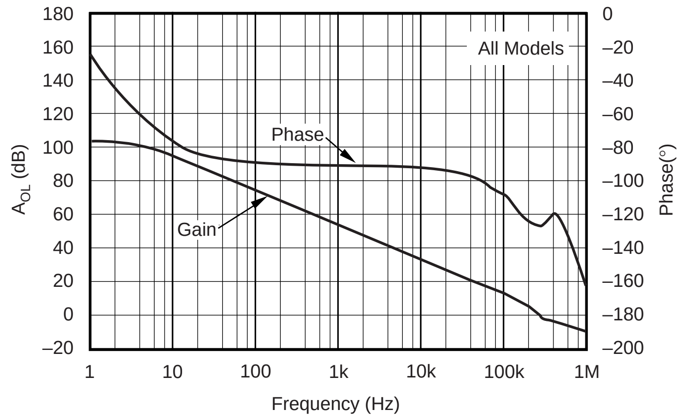
PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER[1]	TRANSPORT MEDIA
Single						
OPA244NA	SOT-23-5 Surface-Mount	331	–40°C to +85°C	A44	OPA244NA/250	Tape and Reel
"	"	"	"	"	OPA244NA/3K	Tape and Reel
OPA244PA	8-Pin DIP	006	–40°C to +85°C	OPA244PA	OPA244PA	Rails
OPA244UA	SO-8 Surface-Mount	182	–40°C to +85°C	OPA244UA	OPA244UA	Rails
"	"	"	"	"	OPA244UA/2K5	Tape and Reel
Dual						
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
Quad						
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.

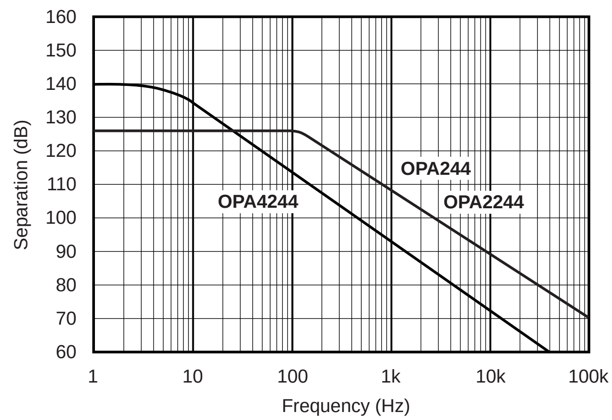
TYPICAL PERFORMANCE CURVES

At $T_A = 25°C$, $V_S = +15V$, and $R_L = 20kΩ$ connected to Ground, unless otherwise noted.

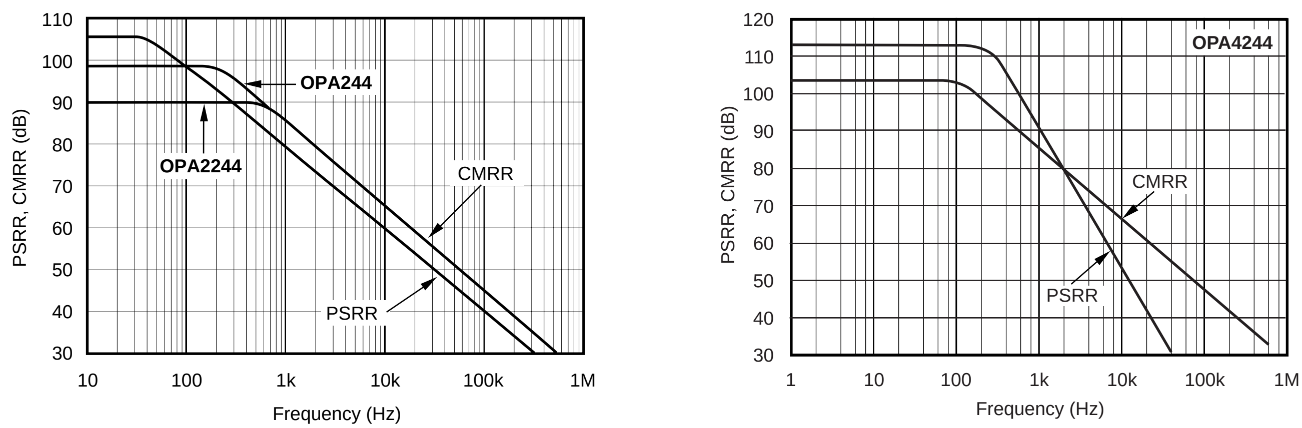
OPEN-LOOP GAIN AND PHASE vs FREQUENCY



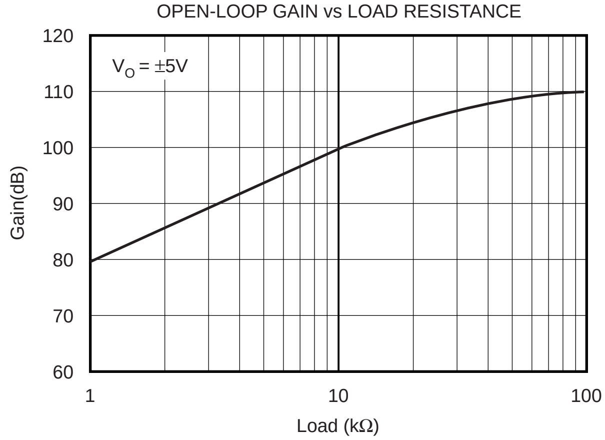
CHANNEL SEPARATION



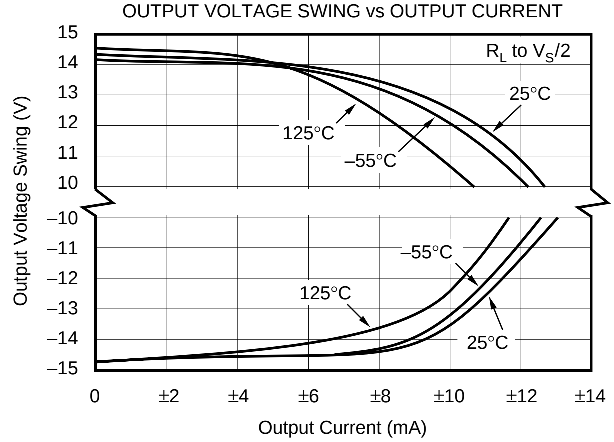
POWER SUPPLY AND COMMON-MODE REJECTION vs FREQUENCY



OPEN-LOOP GAIN vs LOAD RESISTANCE



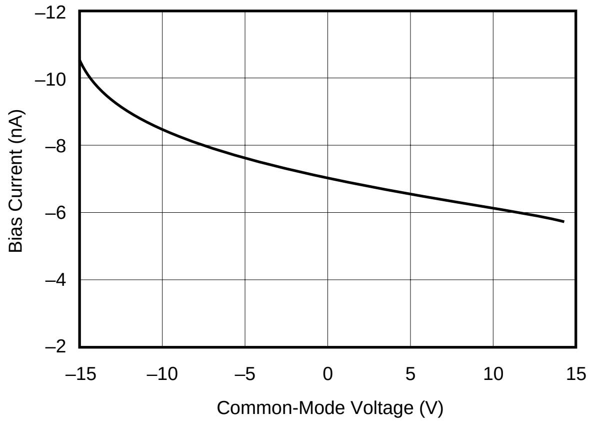
OUTPUT VOLTAGE SWING vs OUTPUT CURRENT



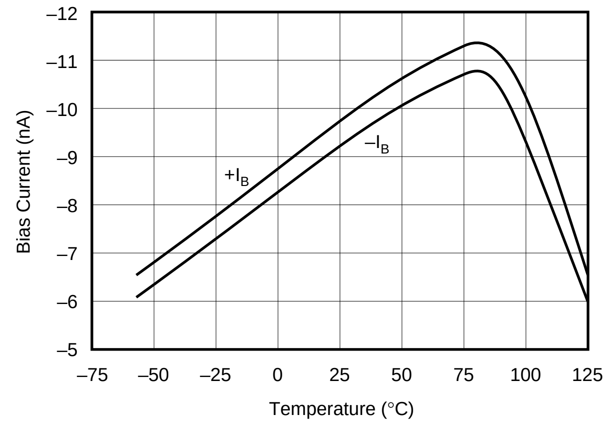
TYPICAL PERFORMANCE CURVES (Cont.)

At T_A = 25°C, V_S = +15V, and R_L = 20kΩ connected to Ground, unless otherwise noted.

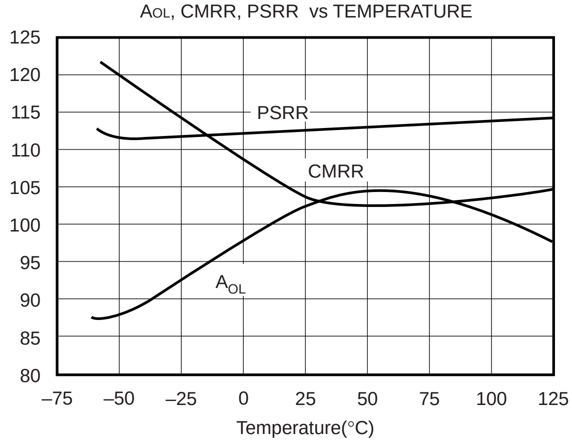
INPUT BIAS CURRENT
vs INPUT COMMON-MODE VOLTAGE



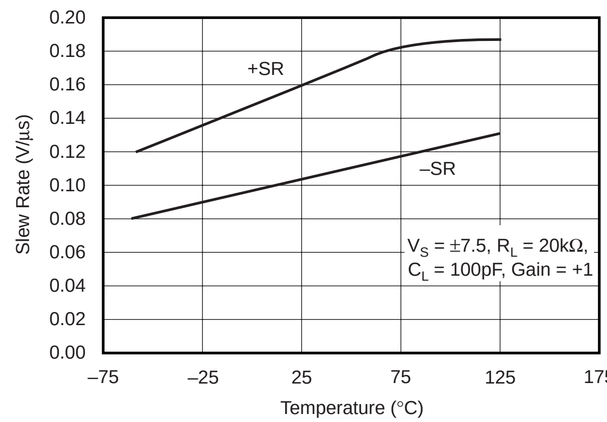
INPUT BIAS CURRENT vs TEMPERATURE



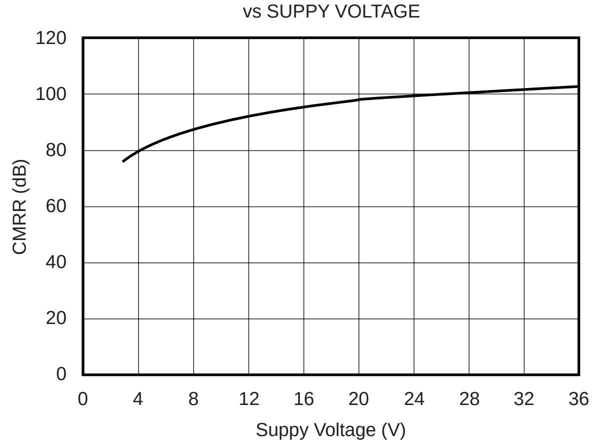
AOL, CMRR, PSRR vs TEMPERATURE



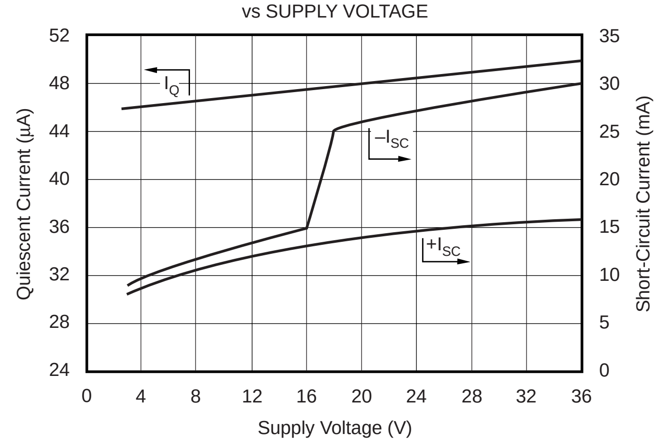
SLEW RATE vs TEMPERATURE



COMMON-MODE REJECTION
vs SUPPY VOLTAGE



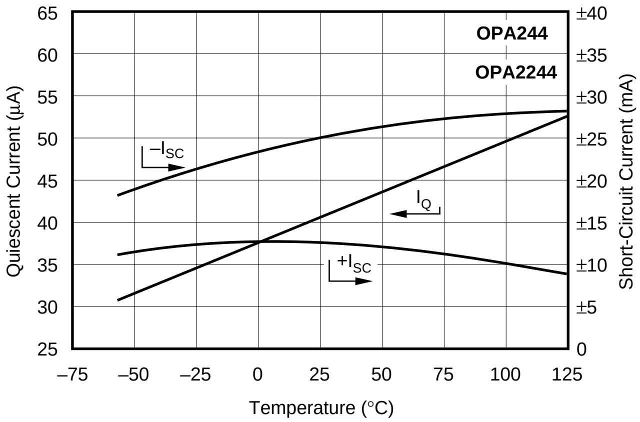
QUIESCENT CURRENT AND SHORT-CIRCUIT
vs SUPPLY VOLTAGE

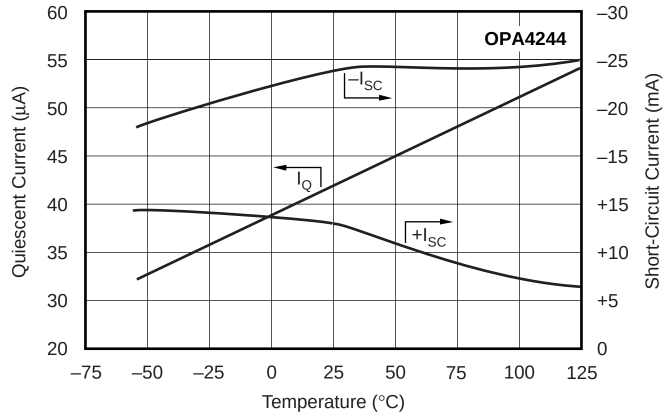


TYPICAL PERFORMANCE CURVES (Cont.)

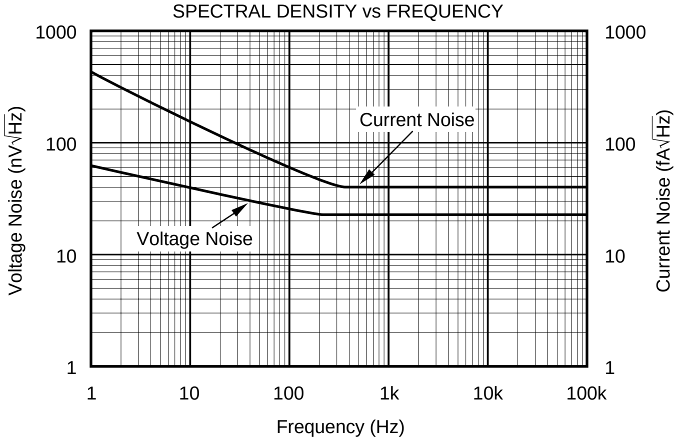
At $T_A = 25°C$, $V_S = +15V$, and $R_L = 20k\Omega$ connected to Ground, unless otherwise noted.

QUIESCENT AND SHORT-CIRCUIT CURRENT vs TEMPERATURE

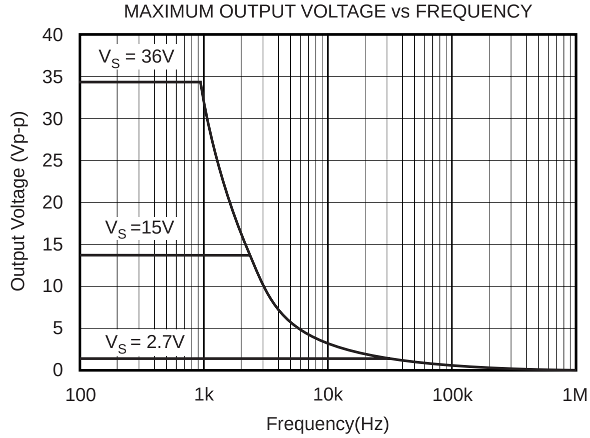




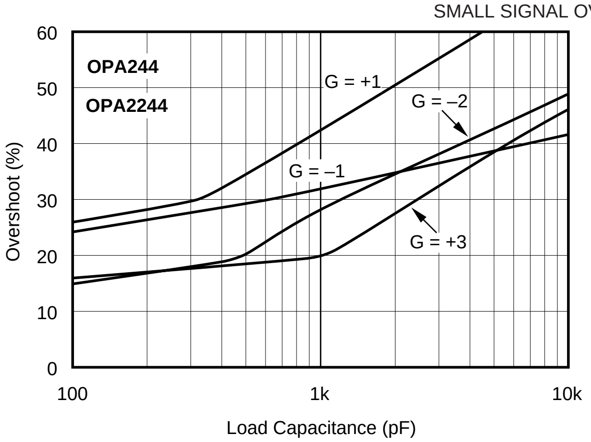
INPUT VOLTAGE AND CURRENT NOISE SPECTRAL DENSITY vs FREQUENCY

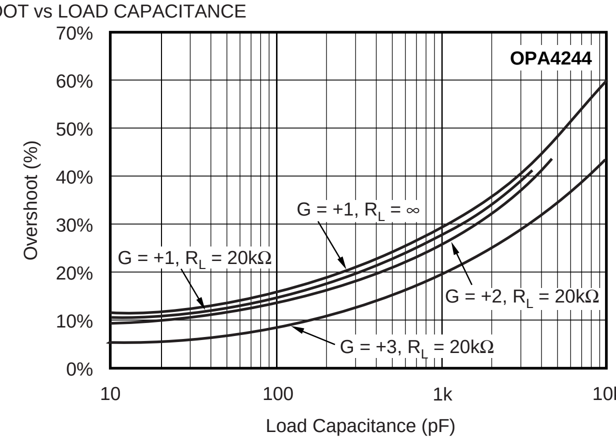


MAXIMUM OUTPUT VOLTAGE vs FREQUENCY



SMALL SIGNAL OVERSHOOT vs LOAD CAPACITANCE

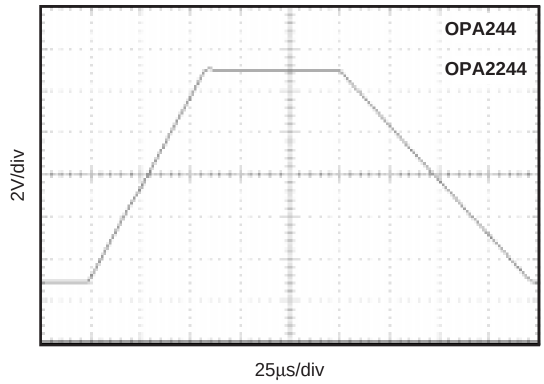


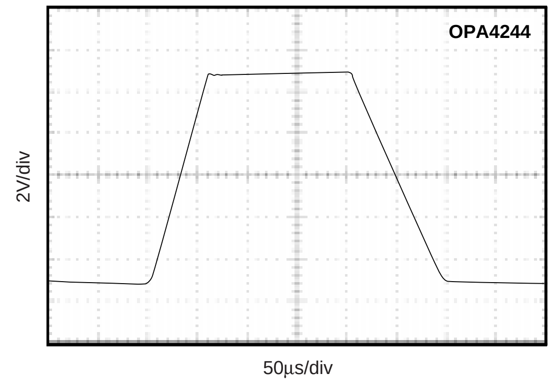


TYPICAL PERFORMANCE CURVES (Cont.)

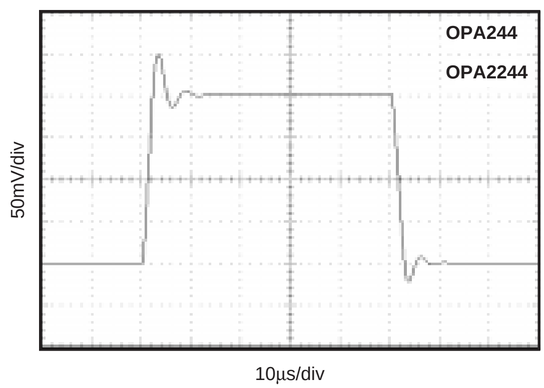
At T_A = 25°C, V_S = +15V, and R_L = 20kΩ connected to Ground, unless otherwise noted.

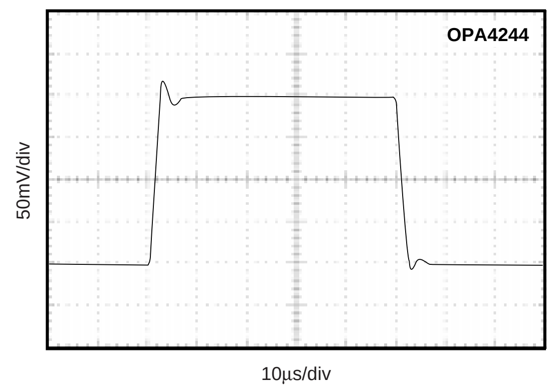
LARGE-SIGNAL STEP RESPONSE, G = 1, C_L = 100pF



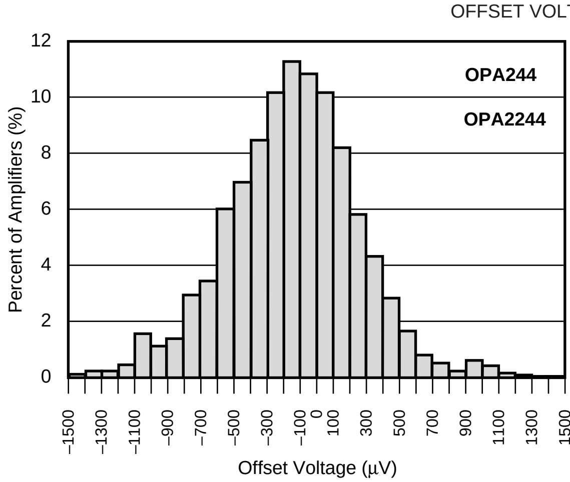


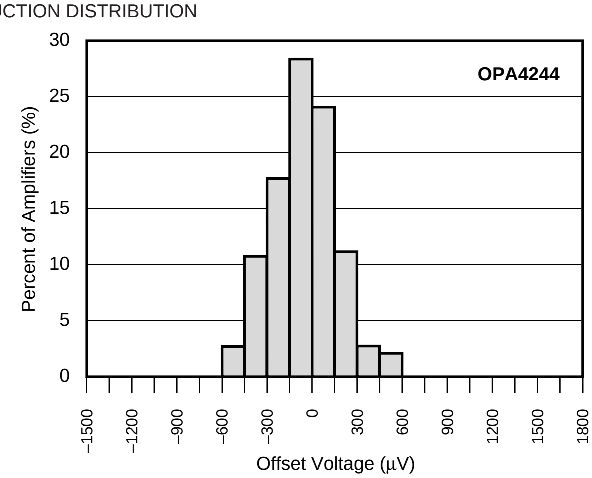
SMALL-SIGNAL STEP RESPONSE, G = 1, C_L = 100pF





OFFSET VOLTAGE PRODUCTION DISTRIBUTION

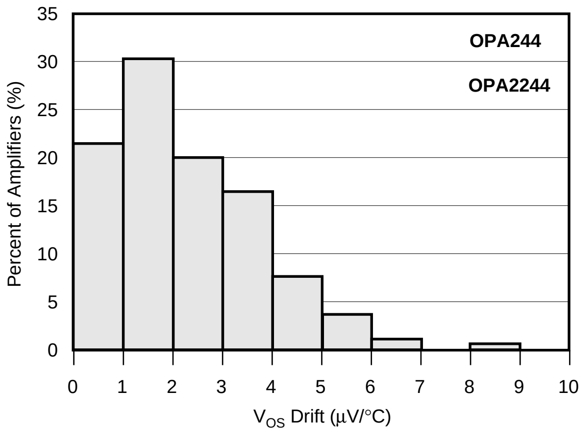


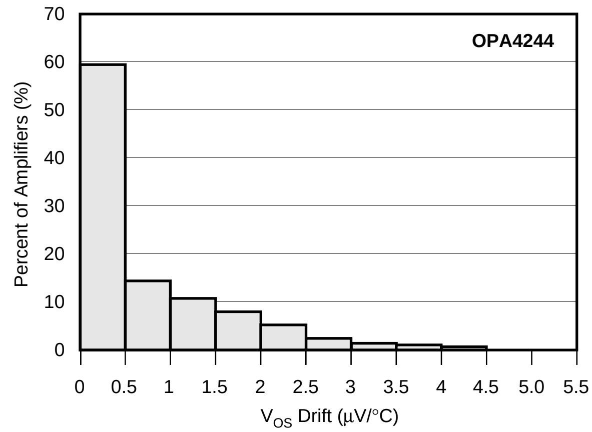


TYPICAL PERFORMANCE CURVES (Cont.)

At $T_A = 25°C$, $V_S = +15V$, and $R_L = 20k\Omega$ 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).

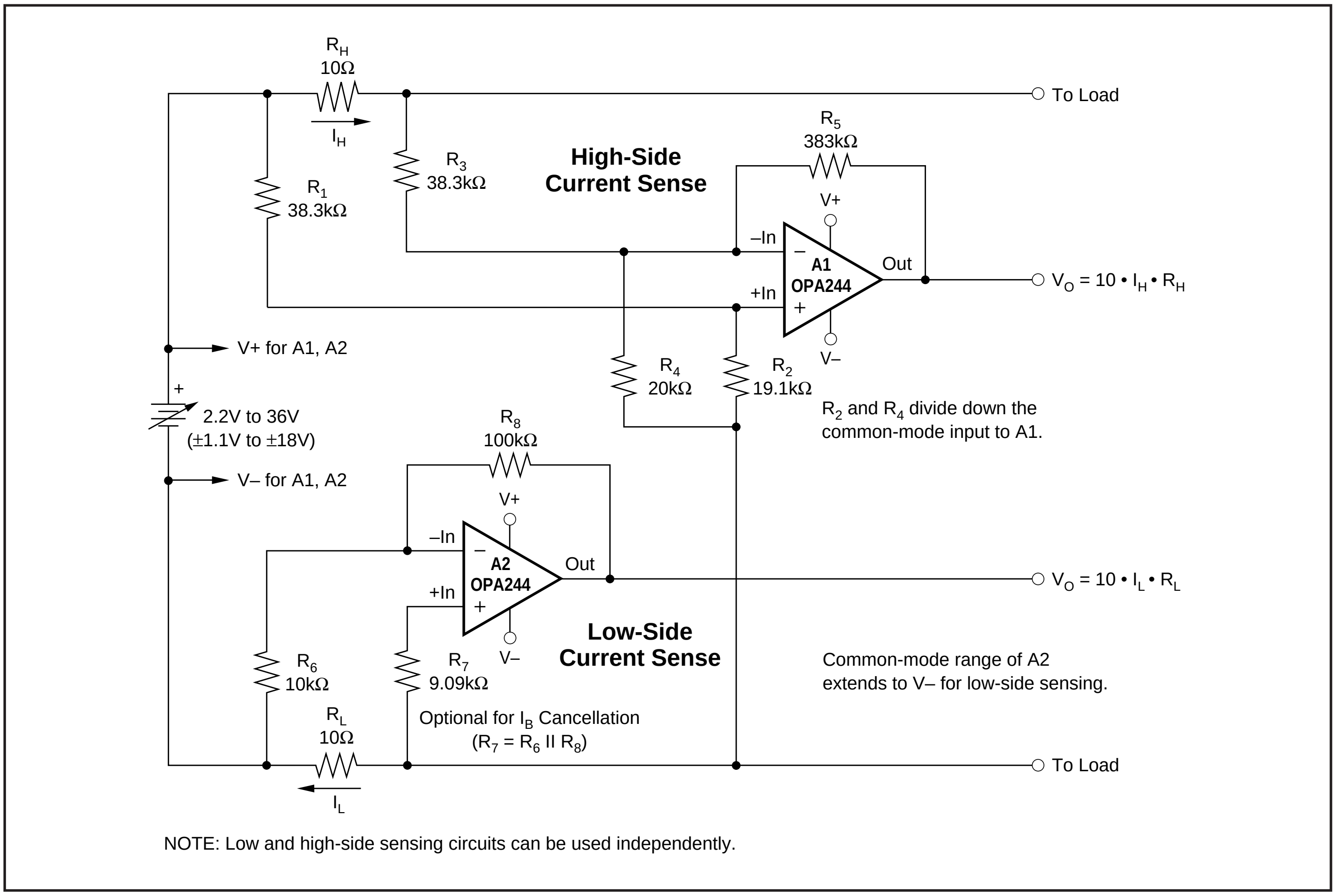


FIGURE 1. Low and High-Side Battery Current Sensing.