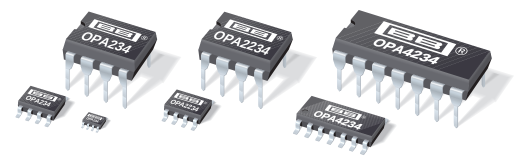
BURR - BROWN®



OPA234
OPA2234
OPA4234

For most current data sheet and other product information, visit www.burr-brown.com

Low Power, Precision SINGLE-SUPPLY OPERATIONAL AMPLIFIERS

FEATURES

- **WIDE SUPPLY RANGE:**
  Single Supply: V_S = +2.7V to +36V
  Dual Supply: V_S = ±1.35V to ±18V
- **GUARANTEED PERFORMANCE: +2.7V, +5V, and ±15V**
- **LOW QUIESCENT CURRENT: 250μA/amp**
- **LOW INPUT BIAS CURRENT: 25nA max**
- **LOW OFFSET VOLTAGE: 100μV max**
- **HIGH CMRR, PSRR, and A_{OL}**
- **SINGLE, DUAL, and QUAD VERSIONS**

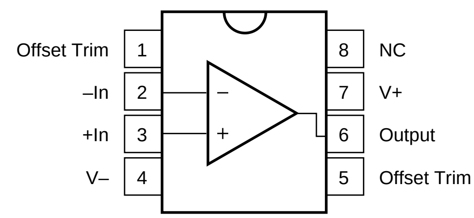
DESCRIPTION

The OPA234 series low cost op amps are ideal for single supply, low voltage, low power applications. The series provides lower quiescent current than older "1013"-type products and comes in current industry-standard packages and pinouts. The combination of low offset voltage, high common-mode rejection, high power supply rejection, and a wide supply range provides excellent accuracy and versatility. Single, dual, and quad versions have identical specifications for maximum design flexibility. These general purpose op amps are ideal for portable and battery powered applications.

OPA234 series op amps operate from either single or dual supplies. In single supply operation, the input common-mode range extends below ground and the output can swing to within 50mV of ground. Excellent phase margin makes the OPA234 series ideal for demanding applications, including high load capacitance. Dual and quad designs feature completely independent circuitry for lowest crosstalk and freedom from interaction.

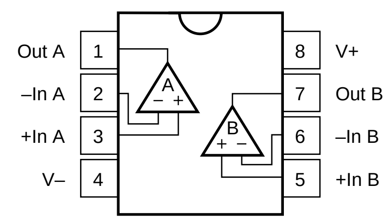
Single version packages are DIP-8, SO-8 surface-mount, and a space-saving MSOP-8 surface-mount. Dual packages are DIP-8 and SO-8 surface-mount. Quad packages are DIP-14 and SO-14 surface-mount. All are specified for –40°C to +85°C operation.

OPA234



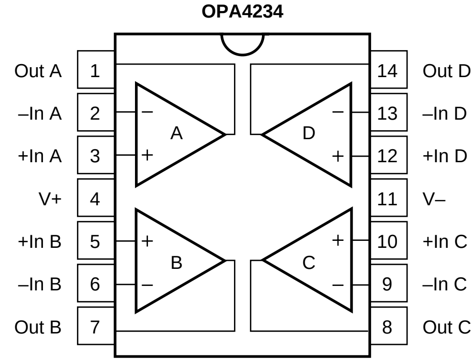
8-Pin DIP, SO-8, MSOP-8

OPA2234



8-Pin DIP, SO-8

OPA4234



14-Pin DIP
SO-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-1318B Printed in U.S.A., May, 2000

SPECIFICATIONS: V_S = +5V

At T_A = 25°C, V_S = +5V, R_L = 10kΩ connected to V_S/2 and V_{OUT} = V_S/2, unless otherwise noted.

PARAMETER		CONDITION	OPA234P, U, E OPA2234P, U			OPA234PA, UA, EA OPA2234PA, UA OPA4234PA, UA, U			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
OFFSET VOLTAGE									
Input Offset Voltage	V_{OS}	V_{CM} = 2.5V		±40	±100		*	±250	μV
OPA234E, EA				±100	±150		*	±350	μV
vs Temperature(1)	dV_{OS}/dT	Operating Temperature Range		±0.5	±3		*	*	μV/°C
vs Power Supply	PSRR	V_S = +2.7V to +30V, V_{CM} = 1.7V		3	10		*	20	μV/V
vs Time				0.2			*		μV/mo
Channel Separation (Dual, Quad)				0.3			*		μV/V
INPUT BIAS CURRENT									
Input Bias Current(2)	I_B	V_{CM} = 2.5V		–15	–30		*	–50	nA
Input Offset Current	I_{OS}	V_{CM} = 2.5V		±1	±5		*	*	nA
NOISE		f = 1kHz							
Input Voltage Noise Density	v_n			25			*		nV/√Hz
Current Noise Density	i_n			80			*		fA/√Hz
INPUT VOLTAGE RANGE									
Common-Mode Voltage Range			–0.1		(V+) –1	*		*	V
Common-Mode Rejection	CMRR	V_{CM} = –0.1V to 4V	91	106		86	*		dB
INPUT IMPEDANCE									
Differential				10^7 || 5			*		Ω || pF
Common-Mode		V_{CM} = 2.5V		10^{10} || 6			*		Ω || pF
OPEN-LOOP GAIN		V_O = 0.25V to 4V							
Open-Loop Voltage Gain	A_{OL}	R_L = 10kΩ	108	120		100	*		dB
		R_L = 2kΩ	86	96		86	*		dB
FREQUENCY RESPONSE									
Gain-Bandwidth Product	GBW	C_L = 100pF		0.35			*		MHz
Slew Rate	SR			0.2			*		V/μs
Settling Time: 0.1%		G = 1, 3V Step, C_L = 100pF		15			*		μs
0.01%		G = 1, 3V Step, C_L = 100pF		25			*		μs
Overload Recovery Time		(V_{IN}) (Gain) = V_S		16			*		μs
OUTPUT									
Voltage Output: Positive		R_L = 10kΩ to V_S/2	(V+) –1	(V+) –0.65		*	*		V
Negative		R_L = 10kΩ to V_S/2	0.25	0.05		*	*		V
Positive		R_L = 10kΩ to Ground	(V+) –1	(V+) –0.65		*	*		V
Negative		R_L = 10kΩ to Ground	0.1	0.05		*	*		V
Short-Circuit Current	I_{SC}			±11			*		mA
Capacitive Load Drive (Stable Operation)(3)		G = +1		1000			*		pF
POWER SUPPLY									
Specified Operating Voltage				+5			*		V
Operating Voltage Range			+2.7		+36	*		*	V
Quiescent Current (per amplifier)	I_Q	I_O = 0		250	300		*	*	μA
TEMPERATURE RANGE									
Specified Range			–40		+85	*		*	°C
Operating Range			–40		+125	*		*	°C
Storage			–55		+125	*		*	°C
Thermal Resistance	θ_{JA}								
8-Pin DIP				100			*		°C/W
SO-8 Surface-Mount				150			*		°C/W
MSOP-8 Surface-Mount				220			*		°C/W
14-Pin DIP				80			*		°C/W
SO-14 Surface-Mount				110			*		°C/W

* Specifications same as OPA234P,U,E.

NOTES: (1) Guaranteed by wafer-level test to 95% confidence level. (2) Positive conventional current flows into the input terminals. (3) See "Small-Signal Overshoot vs Load Capacitance" typical curve.

SPECIFICATIONS: V_S = +2.7V

At T_A = 25°C, V_S = +2.7V, R_L = 10kΩ connected to V_S/2 and V_{OUT} = V_S/2, unless otherwise noted.

PARAMETER		CONDITION	OPA234P, U, E OPA2234P, U			OPA234PA, UA, EA OPA2234PA, UA OPA4234PA, UA, U			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
OFFSET VOLTAGE									
Input Offset Voltage	V_{OS}	V_{CM} = 1.35V		±40	±100		✻	±250	μV
OPA234E, EA				±100	±150		✻	±350	μV
vs Temperature(1)	dV_{OS}/dT	Operating Temperature Range		±0.5	±3		✻	✻	μV/°C
vs Power Supply	PSRR	V_S = +2.7V to +30V, V_{CM} = 1.7V		3	10		✻	20	μV/V
vs Time				0.2			✻		μV/mo
Channel Separation (Dual, Quad)				0.3			✻		μV/V
INPUT BIAS CURRENT									
Input Bias Current(2)	I_B	V_{CM} = 1.35V		–15	–30		✻	–50	nA
Input Offset Current	I_{OS}	V_{CM} = 1.35V		±1	±5		✻	✻	n
NOISE		f = 1kHz							
Input Voltage Noise Density	v_n			25			✻		nV/√Hz
Current Noise Density	i_n			80			✻		fA/√Hz
INPUT VOLTAGE RANGE									
Common-Mode Voltage Range			–0.1		(V+) –1	✻		✻	V
Common-Mode Rejection	CMRR	V_{CM} = –0.1V to 1.7V	91	106		86	✻		dB
INPUT IMPEDANCE									
Differential				10^7 || 5			✻		Ω || pF
Common-Mode		V_{CM} = 1.35V		10^{10} || 6			✻		Ω || pF
OPEN-LOOP GAIN		V_O = 0.25V to 1.7V							
Open-Loop Voltage Gain	A_{OL}	R_L = 10kΩ	108	125		100	✻		dB
		R_L = 2kΩ	86	96		86	✻		dB
FREQUENCY RESPONSE									
Gain-Bandwidth Product	GBW	C_L = 100pF		0.35			✻		MHz
Slew Rate	SR			0.2			✻		V/μs
Settling Time: 0.1%		G = 1, 1V Step, C_L = 100pF		6			✻		μs
0.01%		G = 1, 1V Step, C_L = 100pF		16			✻		μs
Overload Recovery Time		(V_{IN}) (Gain) = V_S		8			✻		μs
OUTPUT									
Voltage Output: Positive		R_L = 10kΩ to V_S/2	(V+) –1	(V+) –0.6		✻	✻		V
Negative		R_L = 10kΩ to V_S/2	0.25	0.05		✻	✻		V
Positive		R_L = 10kΩ to Ground	(V+) –1	(V+) –0.65		✻	✻		V
Negative		R_L = 10kΩ to Ground	0.1	0.05		✻	✻		V
Short-Circuit Current	I_{SC}			±8			✻		mA
Capacitive Load Drive (Stable Operation)(3)		G = +1		1000			✻		pF
POWER SUPPLY									
Specified Operating Voltage				+2.7			✻		V
Operating Voltage Range			+2.7		+36	✻		✻	V
Quiescent Current (per amplifier)	I_Q	I_O = 0		250	300		✻	✻	μA
TEMPERATURE RANGE									
Specified Range			–40		+85	✻		✻	°C
Operating Range			–40		+125	✻		✻	°C
Storage			–55		+125	✻		✻	°C
Thermal Resistance	θ_{JA}								
8-Pin DIP				100			✻		°C/W
SO-8 Surface-Mount				150			✻		°C/W
MSOP-8 Surface-Mount				220			✻		°C/W
14-Pin DIP				80			✻		°C/W
SO-14 Surface-Mount				110			✻		°C/W

✻ Specifications same as OPA234P,U,E.

NOTES: (1) Guaranteed by wafer-level test to 95% confidence level. (2) Positive conventional current flows into the input terminals. (3) See "Small-Signal Overshoot vs Load Capacitance" typical curve.

SPECIFICATIONS: V_S = ±15V

At T_A = 25°C, V_S = ±15V, R_L = 10kΩ connected to ground, unless otherwise noted.

PARAMETER		CONDITION	OPA234P, U, E OPA2234P, U MIN	TYP	MAX	OPA234PA, UA, EA OPA2234PA, UA OPA4234PA, UA, U MIN	TYP	MAX	UNITS
OFFSET VOLTAGE									
Input Offset Voltage	V_{OS}	V_{CM} = 0V		±70	±250		*	±500	µV
OPA4234U Model							±70	±250	µV
vs Temperature(1)	dV_{OS}/dT	Operating Temperature Range		±0.5	±5		*	*	µV/°C
vs Power Supply	PSRR	V_S = ±1.35V to ±18V, V_{CM} = 0V		3	10		*	20	µV/V
vs Time				0.2			*		µV/mo
Channel Separation (Dual, Quad)				0.3			*		µV/V
INPUT BIAS CURRENT									
Input Bias Current(2)	I_B	V_{CM} = 0V		–12	–25		*	–50	nA
Input Offset Current	I_{OS}	V_{CM} = 0V		±1	±5		*	*	nA
NOISE		f = 1kHz							
Input Voltage Noise Density	v_n			25			*		nV/√Hz
Current Noise Density	i_n			80			*		fA/√Hz
INPUT VOLTAGE RANGE									
Common-Mode Voltage Range			(V–)		(V+) –1	*		*	V
Common-Mode Rejection	CMRR	V_{CM} = –15V to 14V	91	106		86	*		dB
INPUT IMPEDANCE									
Differential				10^7 || 5			*		Ω || pF
Common-Mode		V_{CM} = 0V		10^{10} || 6			*		Ω || pF
OPEN-LOOP GAIN									
Open-Loop Voltage Gain	A_{OL}	V_O = –14.5V to 14V	110	120		100	*		dB
FREQUENCY RESPONSE									
Gain-Bandwidth Product	GBW	C_L = 100pF		0.35			*		MHz
Slew Rate	SR			0.2			*		V/µs
Settling Time: 0.1%		G = 1, 10V Step, C_L = 100pF		41			*		µs
0.01%		G = 1, 10V Step, C_L = 100pF		47			*		µs
Overload Recovery Time		(V_{IN}) (Gain) = V_S		22			*		µs
OUTPUT									
Voltage Output: Positive			(V+) –1	(V+) –0.7		*	*		V
Negative			(V–) +0.5	(V–) +0.15		*	*		V
Short-Circuit Current	I_{SC}			±22			*		mA
Capacitive Load Drive (Stable Operation)(3)		G = +1		1000			*		pF
POWER SUPPLY									
Specified Operating Voltage				±15			*		V
Operating Voltage Range			±1.35		±18	*		*	V
Quiescent Current (per amplifier)	I_Q	I_O = 0		±275	±350		*	*	µA
TEMPERATURE RANGE									
Specified Range			–40		+85	*		*	°C
Operating Range			–40		+125	*		*	°C
Storage			–55		+125	*		*	°C
Thermal Resistance	θ_{JA}								
8-Pin DIP				100			*		°C/W
SO-8 Surface-Mount				150			*		°C/W
MSOP-8 Surface-Mount				220			*		°C/W
14-Pin DIP				80			*		°C/W
SO-14 Surface-Mount				110			*		°C/W

* Specifications same as OPA234P,U,E.

NOTES: (1) Guaranteed by wafer-level test to 95% confidence level. (2) Positive conventional current flows into the input terminals. (3) See “Small-Signal Overshoot vs Load Capacitance” typical curve.

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.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V+ to V–	36V
Input Voltage	(V–) –0.7V to (V+) +0.7V
Output Short-Circuit[1]	Continuous
Operating Temperature	–40°C to +125°C
Storage Temperature	–55°C to +125°C
Junction Temperature	150°C
Lead Temperature (soldering, 10s)	300°C

NOTE: (1) Short-circuit to ground, one amplifier per package.

PACKAGE/ORDERING INFORMATION

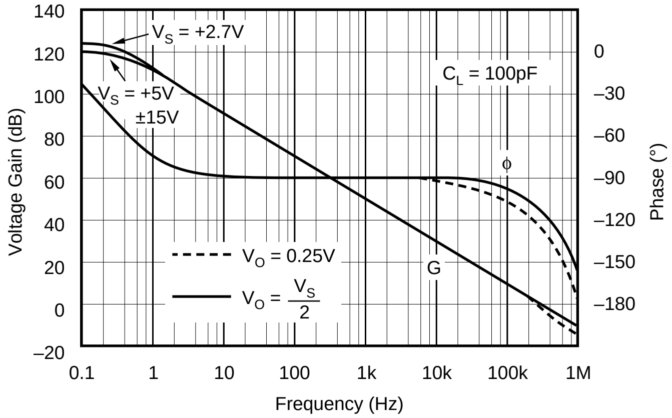
PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER[1]	TRANSPORT MEDIA
Single						
OPA234EA	MSOP-8 Surface-Mount	337	–40°C to +85°C	A34[2]	OPA234EA/250	Tape and Reel
"	"	"	"	"	OPA234EA/2K5	Tape and Reel
OPA234E	MSOP-8 Surface-Mount	337	–40°C to +85°C	A34[2]	OPA234E/250	Tape and Reel
"	"	"	"	"	OPA234E/2K5	Tape and Reel
OPA234PA	Plastic DIP-8	006	–40°C to +85°C	OPA234PA	OPA234PA	Rails
OPA234P	"	"	"	OPA234P	OPA234P	Rails
OPA234UA	SO-8 Surface-Mount	182	–40°C to +85°C	OPA234UA	OPA234UA	Rails
OPA234U	"	"	"	OPA234U	OPA234U	Rails
Dual						
OPA2234PA	Plastic DIP-8	006	–40°C to +85°C	OPA2234PA	OPA2234PA	Rails
OPA2234P	"	"	"	OPA2234P	OPA2234P	Rails
OPA2234UA	SO-8 Surface-Mount	182	–40°C to +85°C	OPA2234UA	OPA2234UA	Rails
OPA2234U	"	"	"	OPA2234U	OPA2234U	Rails
Quad						
OPA4234PA	Plastic DIP-8	006	–40°C to +85°C	OPA4234PA	OPA4234PA	Rails
OPA4234P	"	"	"	OPA4234P	OPA4234P	Rails
OPA4234UA	SO-8 Surface-Mount	182	–40°C to +85°C	OPA4234UA	OPA4234UA	Rails
OPA4234U	"	"	"	OPA4234U	OPA4234U	Rails

NOTE: (1) Models with a slash (/) are available only in Tape and Reel in the quantities indicated (e.g., /2K5 indicates 2500 devices per reel). Ordering 2500 pieces of "OPA234E//2K5" will get a single 2500-piece Tape and Reel. (2) The grade will be marked on the Reel.

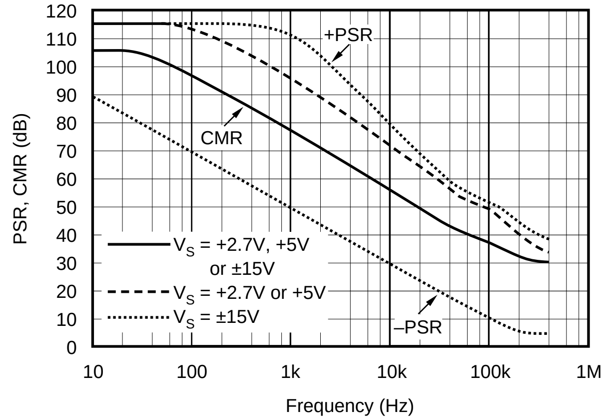
TYPICAL PERFORMANCE CURVES

At T_A = +25°C and R_L = 10kΩ unless otherwise noted.

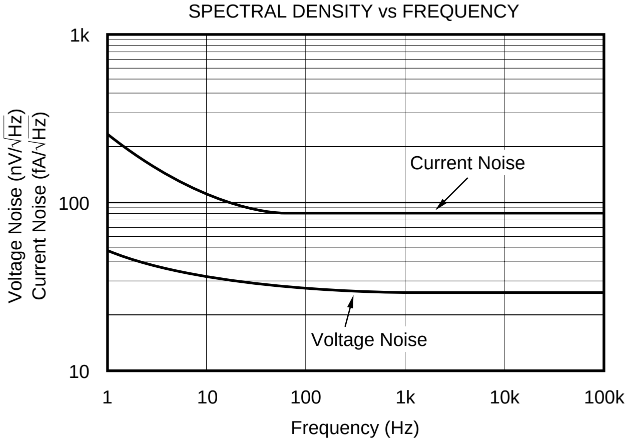
OPEN-LOOP GAIN/PHASE vs FREQUENCY



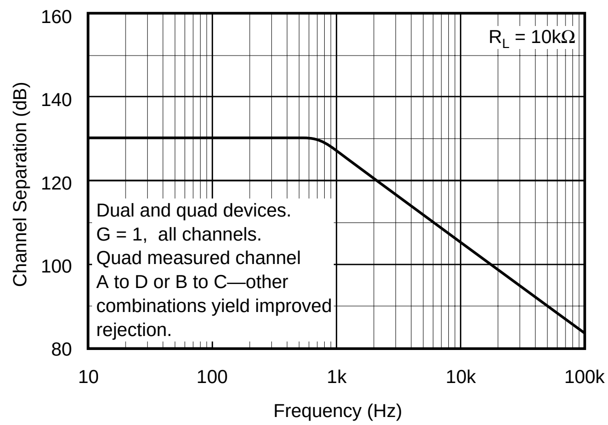
POWER SUPPLY AND COMMON-MODE REJECTION vs FREQUENCY



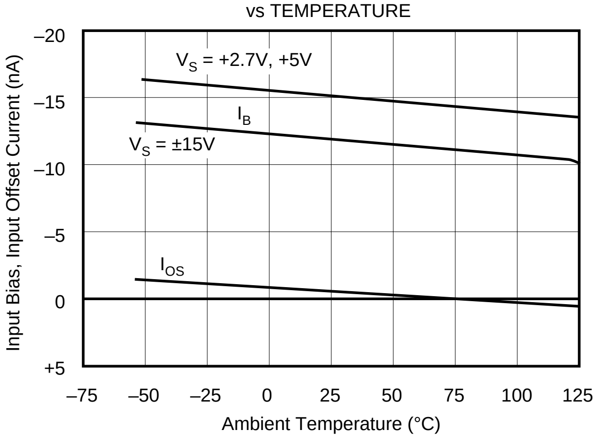
INPUT NOISE AND CURRENT NOISE SPECTRAL DENSITY vs FREQUENCY



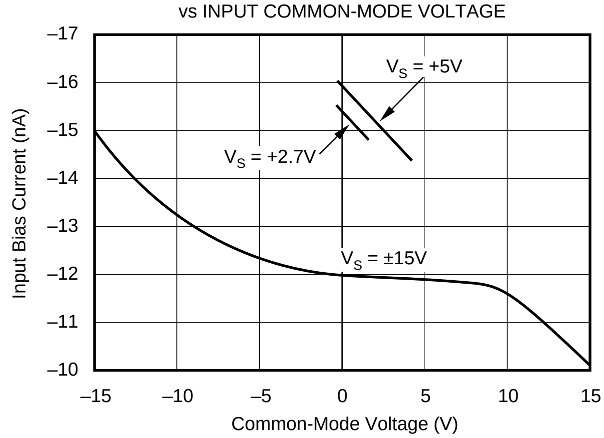
CHANNEL SEPARATION vs FREQUENCY



INPUT BIAS AND INPUT OFFSET CURRENT vs TEMPERATURE

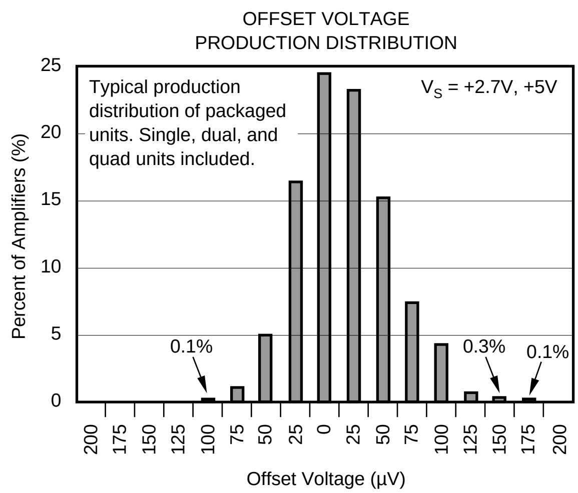


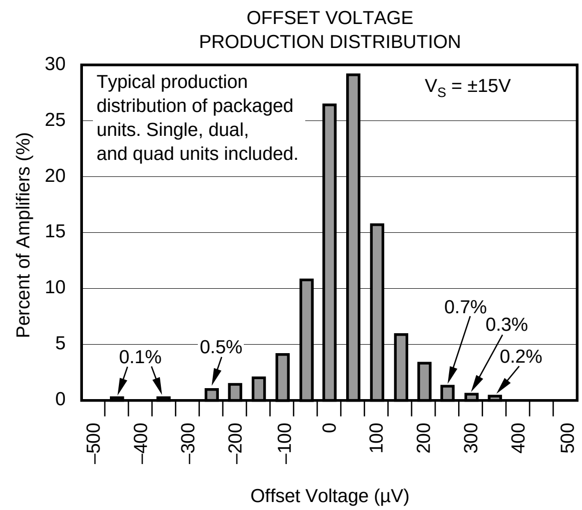
INPUT BIAS CURRENT vs INPUT COMMON-MODE VOLTAGE

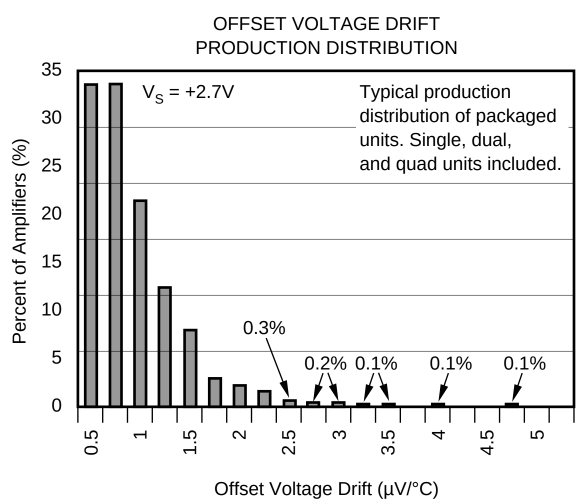


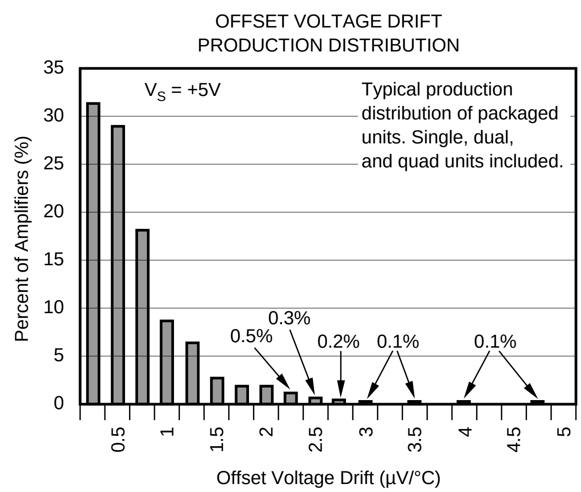
TYPICAL PERFORMANCE CURVES (Cont.)

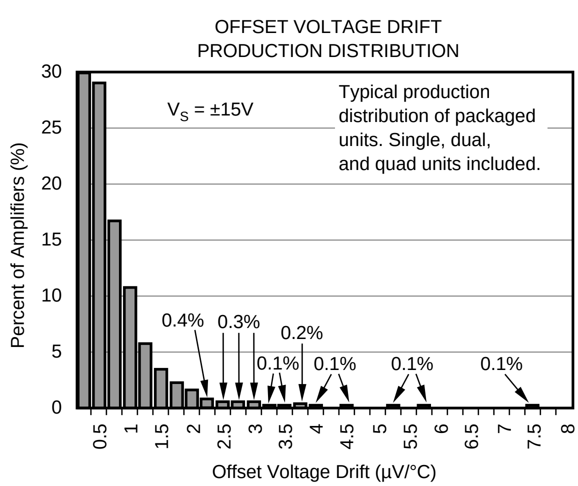
At $T_A = +25°C$ and $R_L = 10k\Omega$ unless otherwise noted.

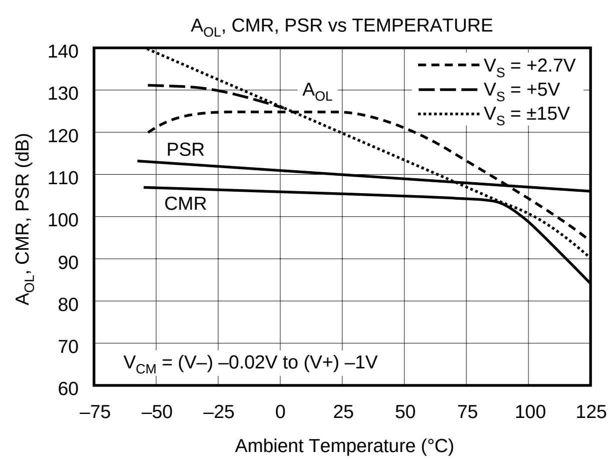








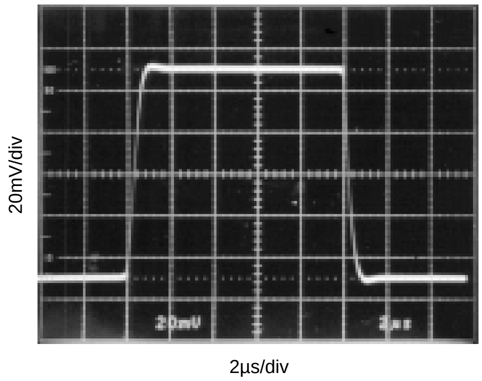




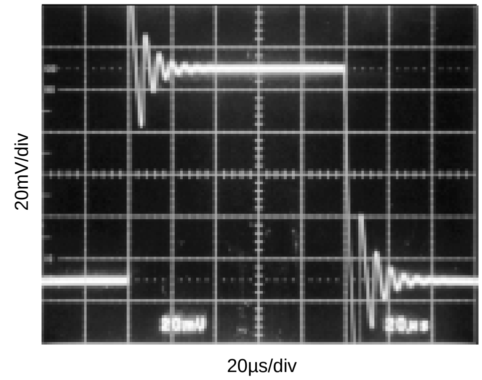
TYPICAL PERFORMANCE CURVES (Cont.)

At T_A = +25°C and R_L = 10kΩ unless otherwise noted.

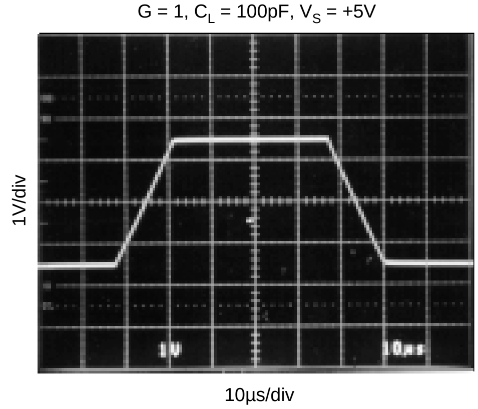
SMALL-SIGNAL STEP RESPONSE
G = 1, C_L = 100pF, V_S = +5V



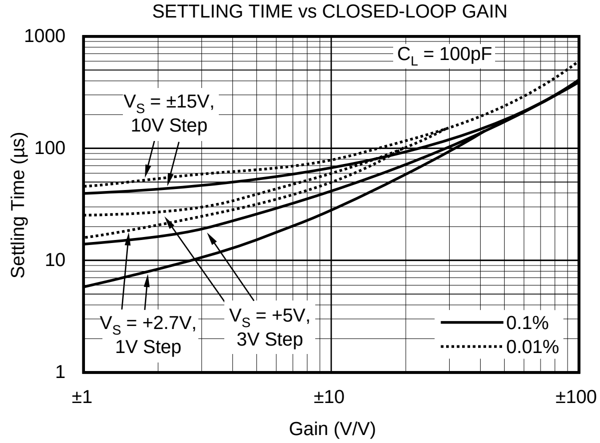
SMALL-SIGNAL STEP RESPONSE
G = 1, C_L = 10,000pF, V_S = +5V



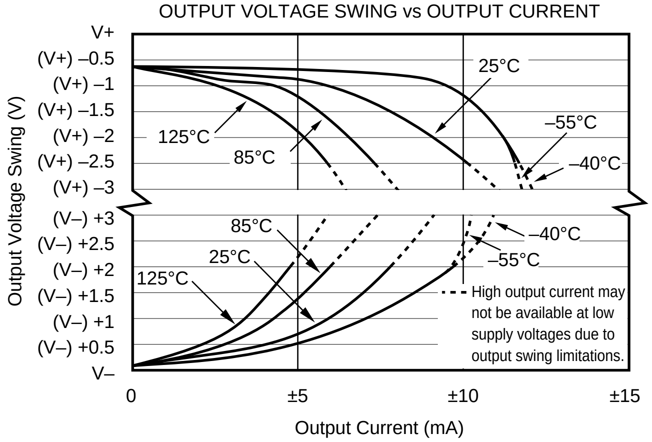
LARGE-SIGNAL STEP RESPONSE
G = 1, C_L = 100pF, V_S = +5V



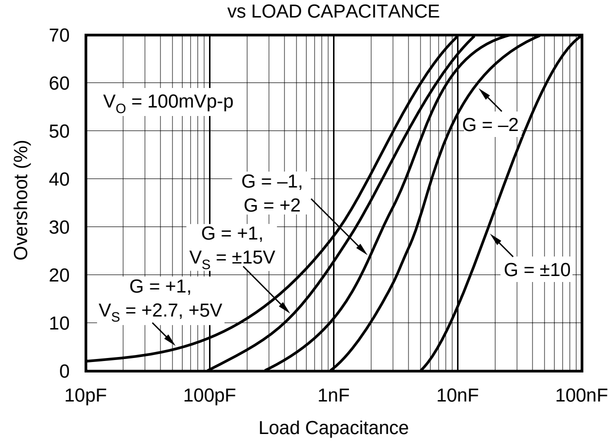
SETTLING TIME vs CLOSED-LOOP GAIN



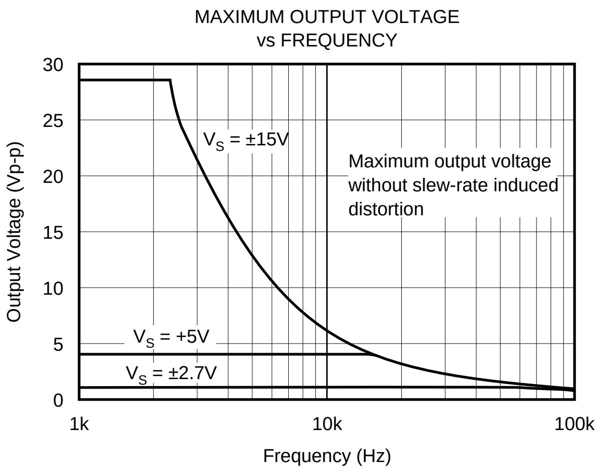
OUTPUT VOLTAGE SWING vs OUTPUT CURRENT

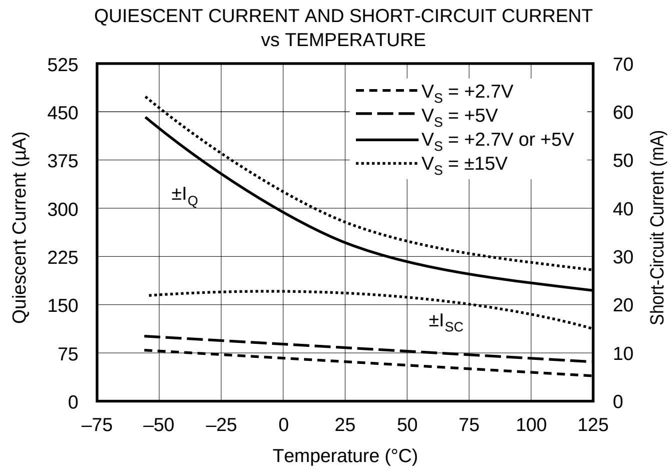


SMALL-SIGNAL OVERSHOOT
vs LOAD CAPACITANCE



At $T_A = +25°C$ and $R_L = 10kΩ$ unless otherwise noted.





APPLICATIONS INFORMATION

OPA234 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.

OPERATING VOLTAGE

OPA234 series op amps operate from single (+2.7V to +36V) or dual (±1.35V to ±18V) supplies with excellent performance. Specifications are production tested with +2.7V, +5V, and ±15V supplies. Most behavior remains unchanged throughout the full operating voltage range. Parameters which vary significantly with operating voltage are shown in typical performance curves.

OFFSET VOLTAGE TRIM

Offset voltage of OPA234 series amplifiers is laser trimmed and usually requires no user adjustment. The OPA234 (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 to adjust system offset or offset produced by the signal source. Nulling offset could degrade the offset drift behavior of the op amp. While it is not possible to predict the exact change in drift, the effect is usually small.

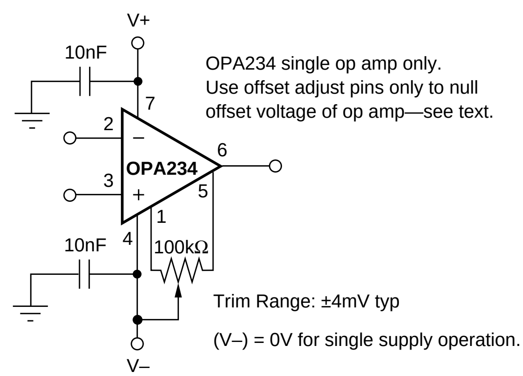


FIGURE 1. OPA234 Offset Voltage Trim Circuit.