

OPA234
OPA2234
OPA4234

Low Power, Precision SINGLE-SUPPLY OPERATIONAL AMPLIFIERS

FEATURES

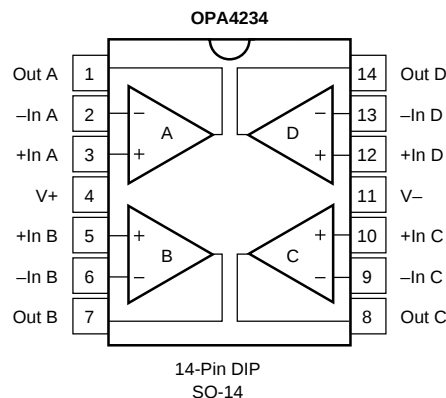
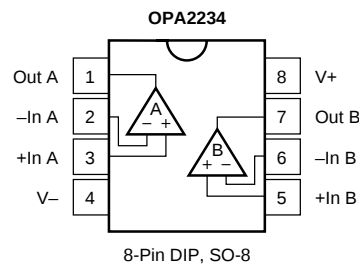
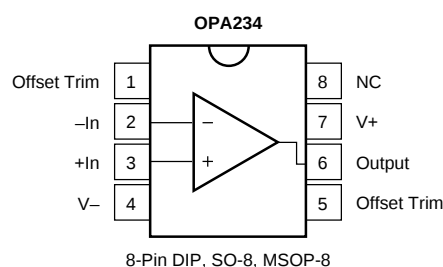
- **WIDE SUPPLY RANGE:**
Single Supply: $V_S = +2.7V$ to $+36V$
Dual Supply: $V_S = \pm 1.35V$ to $\pm 18V$
- **GUARANTEED PERFORMANCE:**
 $+2.7V$, $+5V$, and $\pm 15V$
- **LOW QUIESCENT CURRENT:** $250\mu A/\text{amp}$
- **LOW INPUT BIAS CURRENT:** $25nA$ max
- **LOW OFFSET VOLTAGE:** $100\mu V$ max
- **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 8-Pin DIP, SO-8 surface-mount, and a space-saving MSOP-8 surface-mount. Dual packages are 8-Pin DIP and SO-8 surface-mount. Quad packages are 14-Pin DIP and SO-14 surface-mount. All are specified for $-40^\circ C$ to $+85^\circ C$ operation.



SPECIFICATIONS: $V_S = +5V$

At $T_A = 25^\circ\text{C}$, $V_S = +5V$, $R_L = 10k\Omega$ 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		± 0.5	± 3		*	*	$\mu V/^\circ\text{C}$
vs Power Supply	PSRR		3	10		*	20	$\mu V/V$
vs Time			0.2			*		$\mu V/mo$
Channel Separation (Dual, Quad)			0.3			*		$\mu V/V$
INPUT BIAS CURRENT								
Input Bias Current ⁽²⁾ I_B	$V_{CM} = 2.5V$		-15	-25		*	-50	nA
Input Offset Current I_{OS}	$V_{CM} = 2.5V$		± 1	± 5		*	*	nA
NOISE								
Input Voltage Noise Density v_n	$f = 1\text{kHz}$		25			*		$nV/\sqrt{\text{Hz}}$
Current Noise Density i_n			80			*		$fA/\sqrt{\text{Hz}}$
INPUT VOLTAGE RANGE								
Common-Mode Voltage Range		-0.1		(V+) -1	*		*	V
Common-Mode Rejection CMRR	$V_{CM} = -0.1V$ to $4V$	96	106		86	*		dB
INPUT IMPEDANCE								
Differential			$10^7 \parallel 5$			*		$\Omega \parallel pF$
Common-Mode	$V_{CM} = 2.5V$		$10^{10} \parallel 6$			*		$\Omega \parallel pF$
OPEN-LOOP GAIN								
Open-Loop Voltage Gain A_{OL}	$V_O = 0.25V$ to $4V$ $R_L = 10k\Omega$ $R_L = 2k\Omega$	110 90	120 96		100 86	*		dB 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	$R_L = 10k\Omega$ to $V_S/2$	(V+) -1	(V+) -0.65		*	*		V
Negative	$R_L = 10k\Omega$ to $V_S/2$	0.25	0.05		*	*		V
Positive	$R_L = 10k\Omega$ to Ground	(V+) -1	(V+) -0.65		*	*		V
Negative	$R_L = 10k\Omega$ 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	*		*	$^\circ\text{C}$
Operating Range		-40		+125	*		*	$^\circ\text{C}$
Storage		-55		+125	*		*	$^\circ\text{C}$
Thermal Resistance θ_{JA}								
8-Pin DIP			100			*		$^\circ\text{C/W}$
SO-8 Surface-Mount			150			*		$^\circ\text{C/W}$
MSOP-8 Surface-Mount			220			*		$^\circ\text{C/W}$
14-Pin DIP			80			*		$^\circ\text{C/W}$
SO-14 Surface-Mount			110			*		$^\circ\text{C/W}$

* Specifications same as OPA234P.

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.

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SPECIFICATIONS: $V_S = +2.7V$

At $T_A = 25^\circ C$, $V_S = +2.7V$, $R_L = 10k\Omega$ 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		*	*	$\mu V/^\circ C$
vs Power Supply PSRR	$V_S = +2.7V$ to $+30V$, $V_{CM} = 1.7V$		3	10		*	20	$\mu V/V$
vs Time			0.2			*		$\mu V/mo$
Channel Separation (Dual, Quad)			0.3			*		$\mu V/V$
INPUT BIAS CURRENT								
Input Bias Current ⁽²⁾ I_B	$V_{CM} = 1.35V$		-15	-25		*	-50	nA
Input Offset Current I_{OS}	$V_{CM} = 1.35V$		± 1	± 5		*	*	n
NOISE								
Input Voltage Noise Density v_n	$f = 1kHz$		25			*		$nV/\sqrt{Hz}$
Current Noise Density i_n			80			*		$fA/\sqrt{Hz}$
INPUT VOLTAGE RANGE								
Common-Mode Voltage Range		-0.1		(V+) -1	*		*	V
Common-Mode Rejection CMRR	$V_{CM} = -0.1V$ to $1.7V$	96	106		86	*		dB
INPUT IMPEDANCE								
Differential			$10^7 \parallel 5$			*		$\Omega \parallel pF$
Common-Mode	$V_{CM} = 1.35V$		$10^{10} \parallel 6$			*		$\Omega \parallel pF$
OPEN-LOOP GAIN								
Open-Loop Voltage Gain A_{OL}	$V_O = 0.25V$ to $1.7V$ $R_L = 10k\Omega$ $R_L = 2k\Omega$	110 90	125 96		100 86	*		dB 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	$R_L = 10k\Omega$ to $V_S/2$	(V+) -1	(V+) -0.6		*	*		V
Negative	$R_L = 10k\Omega$ to $V_S/2$	0.25	0.05		*	*		V
Positive	$R_L = 10k\Omega$ to Ground	(V+) -1	(V+) -0.65		*	*		V
Negative	$R_L = 10k\Omega$ 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	*		*	$^\circ C$
Operating Range		-40		+125	*		*	$^\circ C$
Storage		-55		+125	*		*	$^\circ C$
Thermal Resistance θ_{JA}								
8-Pin DIP			100			*		$^\circ C/W$
SO-8 Surface-Mount			150			*		$^\circ C/W$
MSOP-8 Surface-Mount			220			*		$^\circ C/W$
14-Pin DIP			80			*		$^\circ C/W$
SO-14 Surface-Mount			110			*		$^\circ C/W$

* Specifications same as OPA234P.

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: $V_S = \pm 15V$

At $T_A = 25^\circ C$, $V_S = \pm 15V$, $R_L = 10k\Omega$ connected to ground, 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 OPA4234U Model vs Temperature ⁽¹⁾ vs Power Supply vs Time Channel Separation (Dual, Quad)	V_{OS} dV_{OS}/dT PSRR $V_{CM} = 0V$ Operating Temperature Range $V_S = \pm 1.35V$ to $\pm 18V$, $V_{CM} = 0V$		± 70 ± 0.5 3 0.2 0.3	± 250 ± 5 10		$*$ ± 70 $*$ $*$ $*$	± 500 ± 250 $*$ 20	μV μV $\mu V/^\circ C$ $\mu V/V$ $\mu V/mo$ $\mu V/V$
INPUT BIAS CURRENT Input Bias Current ⁽²⁾ Input Offset Current	I_B I_{OS} $V_{CM} = 0V$ $V_{CM} = 0V$		-12 ± 1	-25 ± 5		$*$ $*$	-50 $*$	nA nA
NOISE Input Voltage Noise Density Current Noise Density	$f = 1kHz$ v_n i_n		25 80			$*$ $*$		$nV/\sqrt{Hz}$ $fA/\sqrt{Hz}$
INPUT VOLTAGE RANGE Common-Mode Voltage Range Common-Mode Rejection	$CMRR$ $V_{CM} = -15V$ to $14V$	(V-) 96	106	(V+) -1	$*$ 86	$*$	$*$	V dB
INPUT IMPEDANCE Differential Common-Mode	$V_{CM} = 0V$		$10^7 \parallel 5$ $10^{10} \parallel 6$			$*$ $*$		$\Omega \parallel pF$ $\Omega \parallel pF$
OPEN-LOOP GAIN Open-Loop Voltage Gain	A_{OL} $V_O = -14.5V$ to $14V$	110	120		100	$*$		dB
FREQUENCY RESPONSE Gain-Bandwidth Product Slew Rate Settling Time: 0.1% 0.01% Overload Recovery Time	GBW SR $C_L = 100pF$ $G = 1$, 10V Step, $C_L = 100pF$ $G = 1$, 10V Step, $C_L = 100pF$ (V_{IN}) (Gain) = V_S		0.35 0.2 41 47 22			$*$ $*$ $*$ $*$ $*$		MHz V/ μs μs μs μs
OUTPUT Voltage Output: Positive Negative Short-Circuit Current Capacitive Load Drive (Stable Operation) ⁽³⁾	I_{SC} $G = +1$	(V+) -1 (V-) +0.5	(V+) -0.7 (V-) +0.15 ± 22 1000		$*$ $*$	$*$ $*$ $*$ $*$		V V mA pF
POWER SUPPLY Specified Operating Voltage Operating Voltage Range Quiescent Current (per amplifier)	I_Q $I_O = 0$	± 1.35	± 15 ± 275	± 18 ± 350	$*$	$*$ $*$	$*$ $*$	V V μA
TEMPERATURE RANGE Specified Range Operating Range Storage Thermal Resistance 8-Pin DIP SO-8 Surface-Mount MSOP-8 Surface-Mount 14-Pin DIP SO-14 Surface-Mount	θ_{JA}	-40 -40 -55		+85 +125 +125	$*$ $*$ $*$		$*$ $*$ $*$	$^\circ C$ $^\circ C$ $^\circ C$ $^\circ C/W$ $^\circ C/W$ $^\circ C/W$ $^\circ C/W$ $^\circ C/W$

* Specifications same as OPA234P.

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.

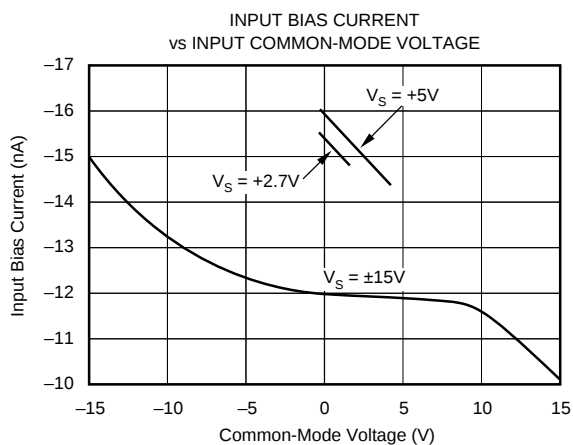
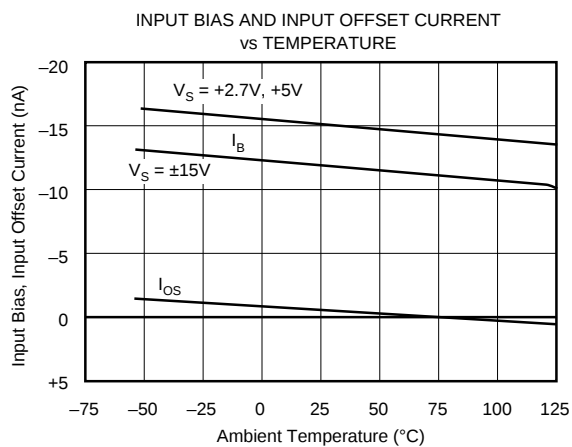
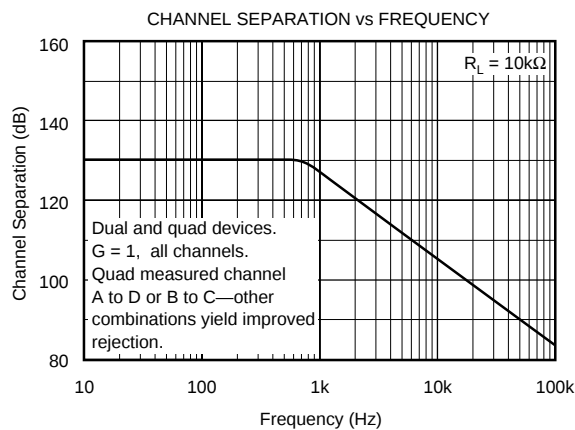
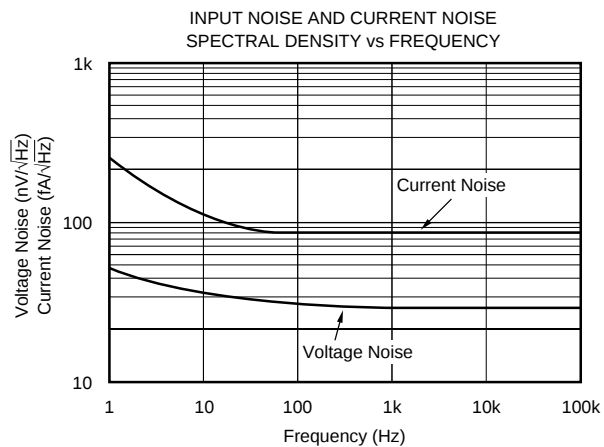
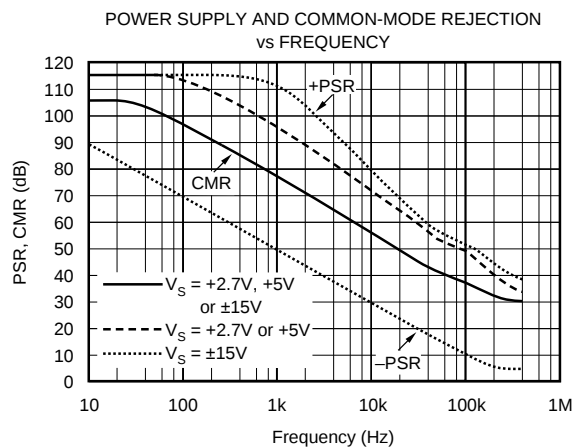
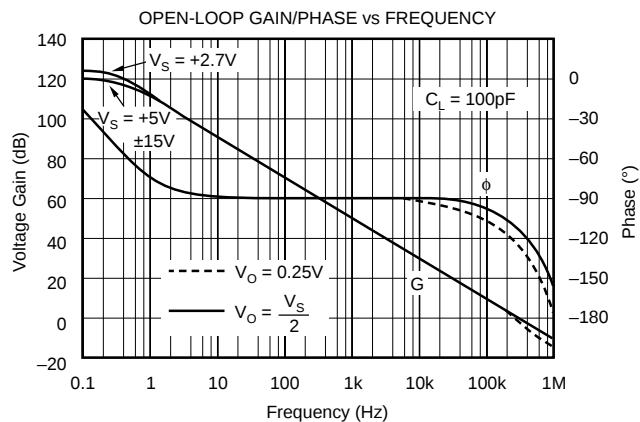
PACKAGE/ORDERING INFORMATION

PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER ⁽¹⁾	TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER ⁽²⁾
Single					
OPA234EA	MSOP-8 Surface-Mount	337	–40°C to +85°C	A34 ⁽³⁾	OPA234EA-250
OPA234E	MSOP-8 Surface-Mount	337	–40°C to +85°C	A34 ⁽³⁾	OPA234EA-2500
OPA234PA	8-Pin Plastic DIP	006	–40°C to +85°C	OPA234PA	OPA234E-2500
OPA234P	8-Pin Plastic DIP	006	–40°C to +85°C	OPA234P	OPA234PA
OPA234UA	SO-8 Surface-Mount	182	–40°C to +85°C	OPA234UA	OPA234P
OPA234U	SO-8 Surface-Mount	182	–40°C to +85°C	OPA234U	OPA234UA
Dual					
OPA2234PA	8-Pin Plastic DIP	006	–40°C to +85°C	OPA2234PA	OPA234U
OPA2234P	8-Pin Plastic DIP	006	–40°C to +85°C	OPA2234P	OPA2234PA
OPA2234UA	SO-8 Surface-Mount	182	–40°C to +85°C	OPA2234UA	OPA2234P
OPA2234U	SO-8 Surface-Mount	182	–40°C to +85°C	OPA2234U	OPA2234UA
Quad					
OPA4234PA	14-Pin Plastic DIP	010	–40°C to +85°C	OPA4234PA	OPA2234U
OPA4234UA	SO-14 Surface-Mount	235	–40°C to +85°C	OPA4234UA	OPA4232PA
OPA4234U	SO-14 Surface-Mount	235	–40°C to +85°C	OPA4234U	OPA4234UA

NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book. (2) Models with -250 and -2500 are available only in Tape & Reel in the quantity indicated (e. g., -250 indicates 250 devices per reel). Ordering 2500 pieces of "OPA234EA-2500" will get a single 2500 piece Tape & Reel. For detailed Tape & Reel mechanical information, refer to Appendix B of Burr-Brown IC Data Book. (3) The grade will be marked on the Reel.

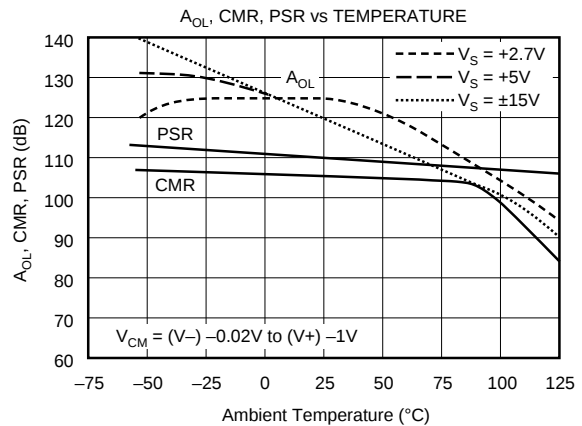
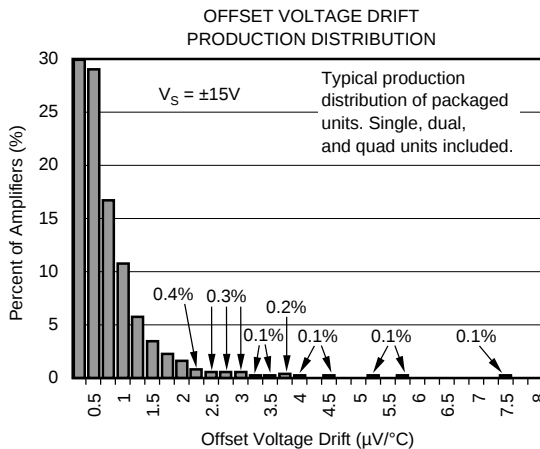
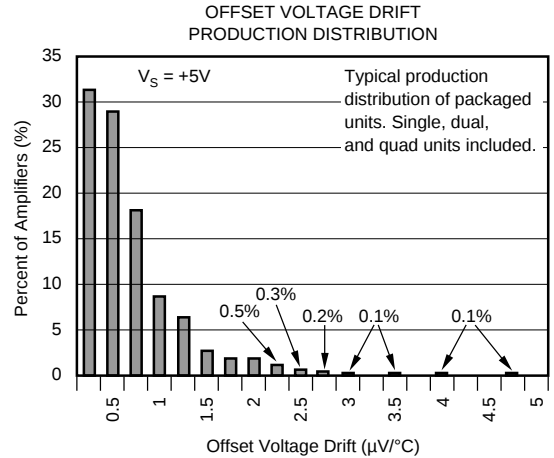
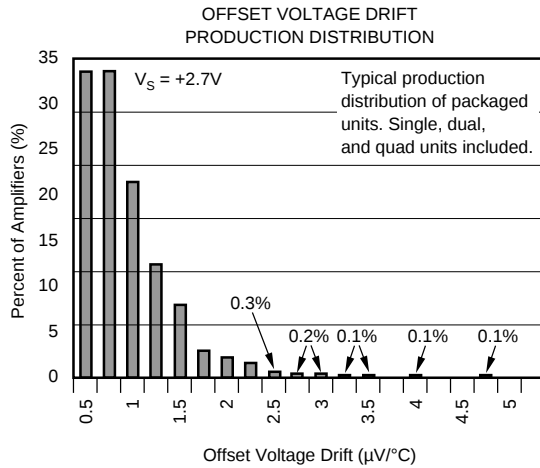
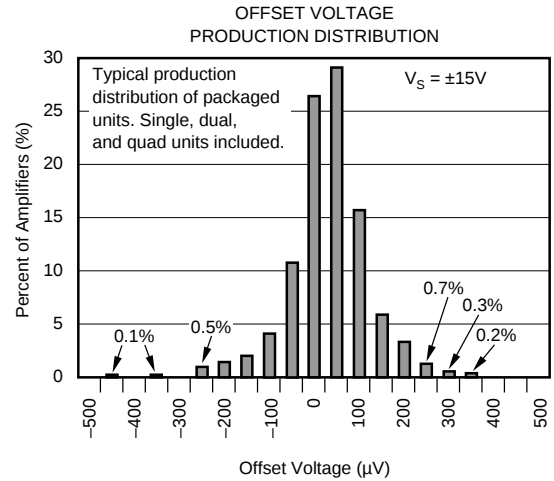
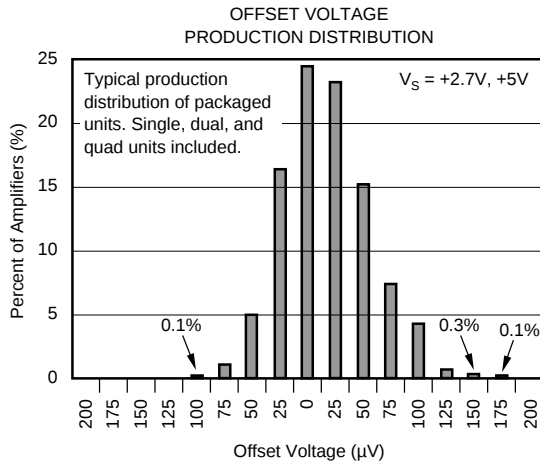
TYPICAL PERFORMANCE CURVES

At $T_A = +25^\circ\text{C}$ and $R_L = 10\text{k}\Omega$ unless otherwise noted.



TYPICAL PERFORMANCE CURVES (CONT)

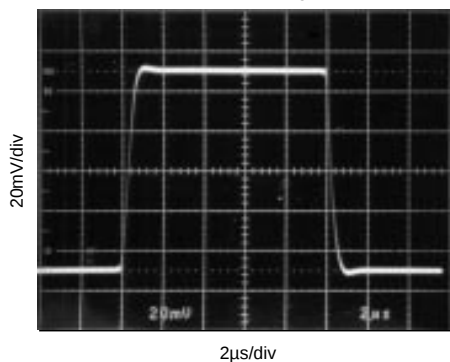
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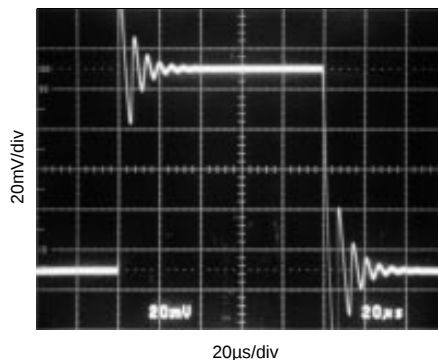
TYPICAL PERFORMANCE CURVES (CONT)

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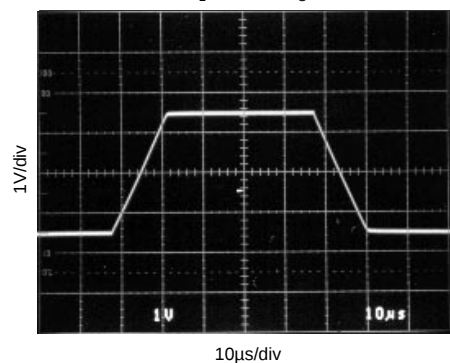
SMALL-SIGNAL STEP RESPONSE
 $G = 1$, $C_L = 100\text{pF}$, $V_S = +5\text{V}$



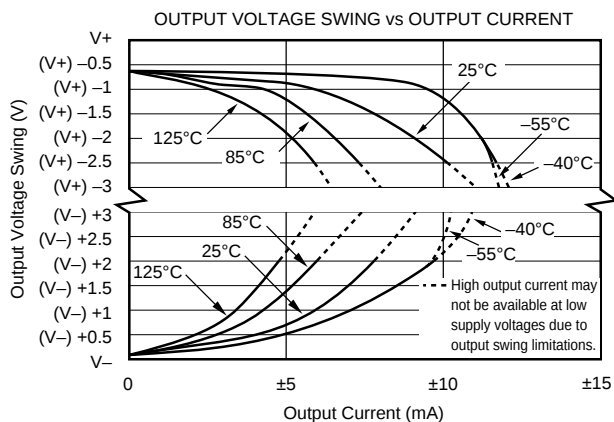
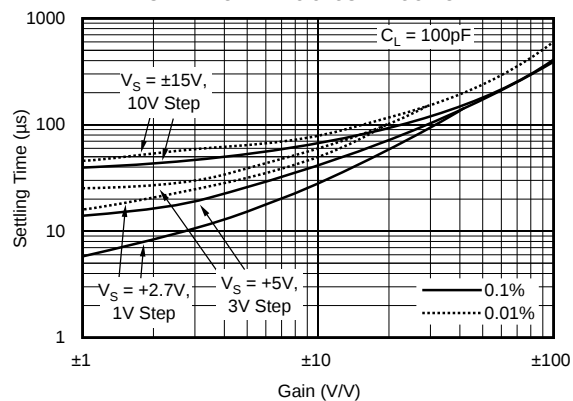
SMALL-SIGNAL STEP RESPONSE
 $G = 1$, $C_L = 10,000\text{pF}$, $V_S = +5\text{V}$



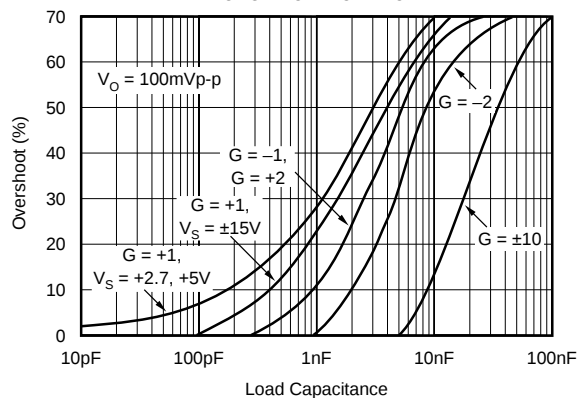
LARGE-SIGNAL STEP RESPONSE
 $G = 1$, $C_L = 100\text{pF}$, $V_S = +5\text{V}$



SETTLING TIME vs CLOSED-LOOP GAIN

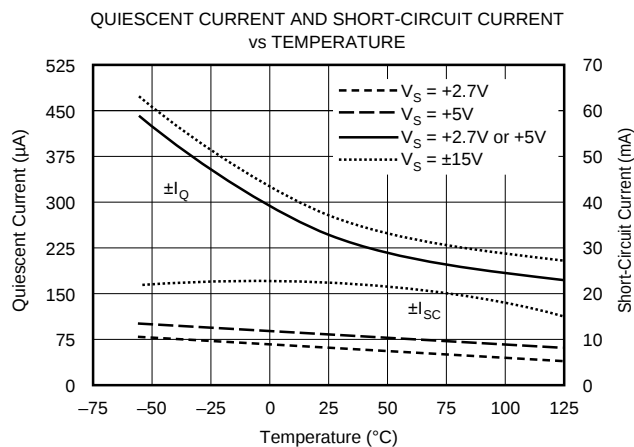
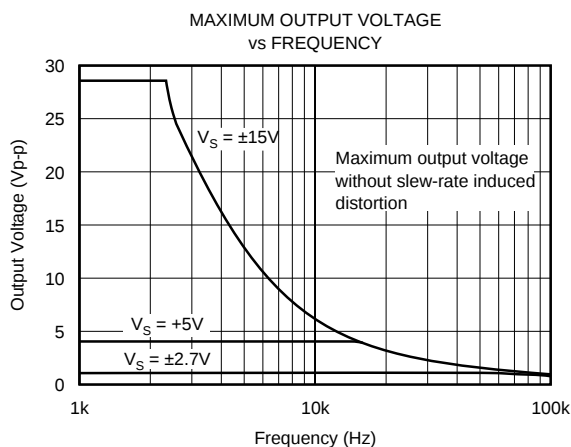


SMALL-SIGNAL OVERSHOOT
vs LOAD CAPACITANCE



TYPICAL PERFORMANCE CURVES (CONT)

At $T_A = +25^\circ\text{C}$ and $R_L = 10\text{k}\Omega$ 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 ($\pm 1.35\text{V}$ to $\pm 18\text{V}$) supplies with excellent performance. Specifications are production tested with +2.7V, +5V, and $\pm 15\text{V}$ 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.

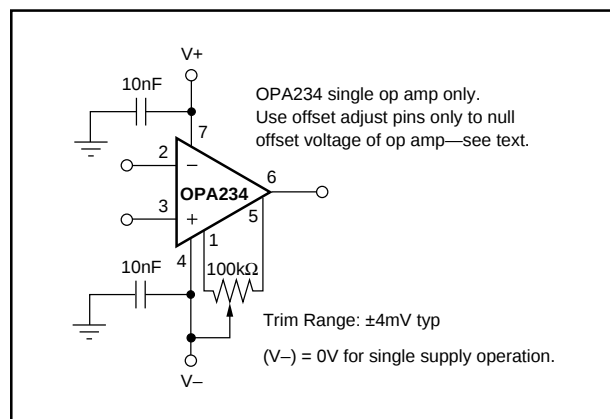


FIGURE 1. OPA234 Offset Voltage Trim Circuit.