



OPA344 OPA2344 OPA4344

OPA345 OPA2345 OPA4345

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LOW POWER, SINGLE-SUPPLY, RAIL-TO-RAIL OPERATIONAL AMPLIFIERS

MicroAmplifier™ Series

FEATURES

- RAIL-TO-RAIL INPUT
- RAIL-TO-RAIL OUTPUT (within 1mV)
- LOW QUIESCENT CURRENT: 150µA typ
- MicroSIZE PACKAGES

SOT23-5

MSOP-8

TSSOP-14

GAIN-BANDWIDTH

OPA344: 1MHz, $G \ge 1$ OPA345: 3MHz, $G \ge 5$

SLEW RATE

OPA344: 0.8V/μs OPA345: 2V/μs

● THD + NOISE: 0.006%

APPLICATIONS

- PCMCIA CARDS
- DATA ACQUISITION
- PROCESS CONTROL
- AUDIO PROCESSING
- COMMUNICATIONS
- ACTIVE FILTERS
- TEST EQUIPMENT

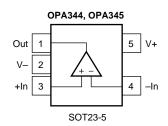
DESCRIPTION

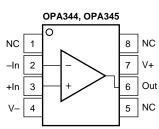
The OPA344 and OPA345 series rail-to-rail CMOS operational amplifiers are designed for precision, low-power, miniature applications. The OPA344 is unity gain stable, while the OPA345 is optimized for gains greater than or equal to five, and has a gain-bandwidth product of 3MHz.

The OPA344 and OPA345 are optimized to operate on a single supply from 2.5V and up to 5.5V with an input common-mode voltage range that extends 300mV beyond the supplies. Quiescent current is only 250µA (max).

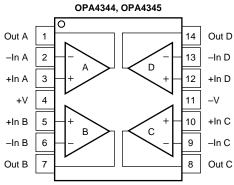
Rail-to-rail input and output make them ideal for driving sampling analog-to-digital converters. They are also well suited for general purpose and audio applicaitons and providing I/V conversion at the output of D/A converters. Single, dual and quad versions have identical specs for design flexibility.

A variety of packages are available. All are specified for operation from -40°C to 85°C. A SPICE macromodel is available for design analysis.



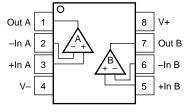


SO-8, 8-Pin DIP (OPA344 Only)



TSSOP-14, SO-14, 14-PIn DIP (OPA4344 Only)

OPA2344. OPA2345



SO-8, MSOP-8, 8-Pin DIP (OPA2344 Only)

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: $V_S = 2.7V$ to 5.5V

At T_A = +25°C, R_L = 10k Ω connected to $V_S/2$ and V_{OUT} = $V_S/2$, unless otherwise noted. **Boldface** limits apply over the temperature range, T_A = -40°C to +85°C.

-0.3 76 74	### TYP ### ±0.2 ### ±3 ### 30 ### 0.2 ### 130 ### 130 ### 10.2 ### 30 ### 0.5	#10 cal Curve ±10	mV mV μV/°C μV/V μV/V dB
76	±0.8 ±3 30 0.2 130 ±0.2 See Typic ±0.2	±1.2 200 250 ±10 cal Curve	mV μV/°C μV/V μV/V dB
76	See Typio ±0.2	cal Curve	pА
76	30		
76			μVrms nV/√Hz fA/√Hz
70 68 66 64	92 84 80	(V+) + 0.3	V dB dB dB dB dB
	10 ¹³ 3 10 ¹³ 6		$\Omega \mid\mid$ pF $\Omega \mid\mid$ pF
V 104 V 100 V 96 V 90	122 120		dB dB dB dB
z	1 0.8 5 8 2.5 0.006		MHz V/μs μs μs μs
	1 3 40	10 10 400	mV mV mV
S	±15 See Typical Cur		mV mA
2.7	2.5 to 5.5 150	5.5 250 300	V V μΑ μΑ
-40 -55 -65	200 150 100 150 100	85 125 150	°C °C °C °C/W °C/W °C/W °C/W °C/W
	2.7 -40 -55	2.7 2.7 2.5 to 5.5 150 -40 -55 -65 200 150 100 150 100	5 8 2.5 0.006 1 1 3 10 10 40 400 400 400 400 ±15 See Typical Curve 2.7 5.5 2.5 to 5.5 150 250 300 -40 85 125 -65 125 150 200 150 100 150

NOTE: (1) Output voltage swings are measured between the output and power-supply rails.



SPECIFICATIONS: $V_S = 2.7V$ to 5.5V

At T_A = +25°C, R_L = 10k Ω connected to $V_S/2$ and V_{OUT} = $V_S/2$, unless otherwise noted. **Boldface** limits apply over the temperature range, T_A = -40°C to +85°C.

PARAMETER		CONDITION	MIN	TYP	MAX	UNITS
OFFSET VOLTAGE Input Offset Voltage Over Temperature vs Temperature vs Power Supply Over Temperature Channel Separation, dc f = 1kHz	V _{OS} dV _{OS} /dT PSRR	$V_S = +5.5V$, $V_{CM} = V_S/2$ $V_S = 2.7V$ to 5.5V, $V_{CM} < (V+) -1.8V$ $V_S = 2.7V$ to 5.5V, $V_{CM} < (V+) -1.8V$		±0.2 ±0.8 ±3 30 0.2	±1 ±1.2 200 250	mV mV μV/°C μV/V μV/V dB
INPUT BIAS CURRENT Input Bias Current Over Temperature Input Offset Current	I _B			±0.2 See Typi ±0.2	±10 cal Curve ±10	pA pA pA
NOISE Input Voltage Noise Input Voltage Noise Density Current Noise Density	e _n i _n	f = 0.1 to 50kHz f = 10kHz f = 10kHz		8 30 0.5		μVrms nV/√Hz fA/√Hz
INPUT VOLTAGE RANGE Common-Mode Voltage Range Common-Mode Rejection Ratio Over Temperature Common-Mode Rejection Ratio Over Temperature Common-Mode Rejection Ratio Over Temperature	V _{CM} CMRR CMRR CMRR	$\begin{split} & \forall_{\rm S} = +5.5 \forall, -0.3 \forall < \forall_{\rm CM} < (\forall +) \text{-} 1.8 \\ & \forall_{\rm S} = +5.5 \forall, -0.3 \forall < \forall_{\rm CM} < (\forall +) \text{-} 1.8 \\ & \forall_{\rm S} = +5.5 \forall, -0.3 \forall < \forall_{\rm CM} < 5.8 \forall \\ & \forall_{\rm S} = +5.5 \forall, -0.3 \forall < \forall_{\rm CM} < 5.8 \forall \\ & \forall_{\rm S} = +2.7 \forall, -0.3 \forall < \forall_{\rm CM} < 3 \forall \\ & \forall_{\rm S} = +2.7 \forall, -0.3 \forall < \forall_{\rm CM} < 3 \forall \end{split}$	-0.3 76 74 70 68 66 64	92 84 80	(V+) + 0.3	V dB dB dB dB dB
INPUT IMPEDANCE Differential Common-Mode		O . Om		10 ¹³ 3 10 ¹³ 6		Ω pF Ω pF
OPEN-LOOP GAIN Open-Loop Voltage Gain Over Temperature Over Temperature	A _{OL}	$\begin{split} R_L &= 100k\Omega, \ 10\text{mV} < V_O < (V+) - 10\text{mV} \\ R_L &= 100k\Omega, \ 10\text{mV} < V_O < (V+) - 10\text{mV} \\ R_L &= 5k\Omega, \ 400\text{mV} < V_O < (V+) - 400\text{mV} \\ R_L &= 5k\Omega, \ 400\text{mV} < V_O < (V+) - 400\text{mV} \end{split}$	104 100 96 90	122 120		dB dB dB dB
FREQUENCY RESPONSE Gain-Bandwidth Product Slew Rate Settling Time, 0.1% 0.01% Overload Recovery Time Total Harmonic Distortion + Noise	GBW SR THD+N	$C_L = 100pF$ $G = 5, 2V \text{ Output Step}$ $G = 5, 2V \text{ Output Step}$ $G = 5, 2V \text{ Output Step}$ $V_{IN} \bullet G = V_S$ $V_S = 5.5V, V_O = 2.5Vp-p, G = 5, f = 1kHz$	30	3 2 1.5 1.6 2.5 0.006		MHz V/µs µs µs µs µs
OUTPUT Voltage Output Swing from Rail ⁽¹⁾ Over Temperature Over Temperature Short-Circuit Current	I _{sc}	$\begin{split} R_L &= 100 k \Omega, \ A_{OL} \geq 96 dB \\ R_L &= 100 k \Omega, \ A_{OL} \geq 104 dB \\ R_L &= 100 k \Omega, \ A_{OL} \geq 100 dB \\ R_L &= 5 k \Omega, \ A_{OL} \geq 96 dB \\ R_L &= 5 k \Omega, \ A_{OL} \geq 90 dB \end{split}$		1 3 40 ±15	10 10 400 400	mV mV mV mV mA
Capacitive Load Drive POWER SUPPLY Specified Voltage Range Operating Voltage Range Quiescent Current (per amplifier)	V _S	V _S = 5.5V, I _O = 0	2.7	2.5 to 5.5	5.5 250	V V μΑ
Over Temperature TEMPERATURE RANGE Specified Range Operating Range Storage Range Thermal Resistance SOT23-5 Surface Mount MSOP-8 Surface Mount SO-8 Surface Mount TSSOP-14 Surface Mount SO-14 Surface Mount	$ heta_{ extsf{JA}}$		-40 -55 -65	200 150 150 100 100	85 125 150	μΑ °C °C °C °C/W °C/W °C/W °C/W °C/W °C/

NOTE: (1) Output voltage swings are measured between the output and power-supply rails.



ABSOLUTE MAXIMUM RATINGS(1)

Supply Voltage, V+ to V	7.5V
Signal Input Terminals, Voltage(2)	(V-) -0.5V to (V+) +0.5V
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 Tolerance (Human Body Model)	4000V

NOTES: (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. Functional operation of the device at these conditions, or beyond the specified operating conditions, 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.

ELECTROSTATIC DISCHARGE SENSITIVITY

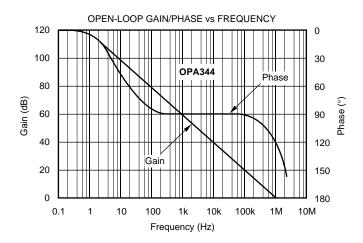
This integrated circuit can be damaged by ESD. Burr-Brown recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

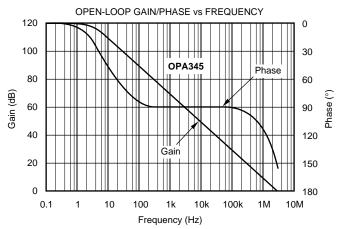
PACKAGE/ORDERING INFORMATION

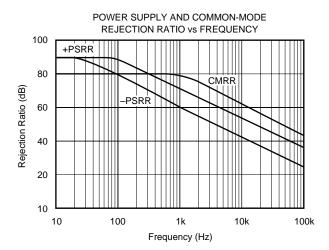
PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER ⁽¹⁾	TRANSPORT MEDIA
OPA344NA	SOT23-5	331	-40°C to +85°C	B44 "	OPA344NA/250 OPA344NA/3K	Tape and Reel Tape and Reel
OPA344UA	SO-8	182	-40°C to +85°C	OPA344UA "	OPA344UA OPA344UA/2K5	Rails Tape and Reel
OPA344PA	8-Pin Dip	006	-40° C to +85°C	OPA344PA	OPA344PA	Rails
OPA2344EA	MSOP-8	337	-40°C to +85°C	C44	OPA2344EA/250 OPA2344EA/2K5	Tape and Reel Tape and Reel
OPA2344UA	SO-8	182 "	-40°C to +85°C	OPA2344UA "	OPA2344UA OPA2344UA/2K5	Rails Tape and Reel
OPA2344PA	8-Pin DIP	006	-40°C to +85°C	OPA2344PA	OPA2344PA	Rails
OPA4344EA	TSSOP-14	357 "	-40°C to +85°C	OPA4344EA "	OPA4344EA/250 OPA4344EA/2K5	Rails Tape and Reel
OPA4344UA	SO-14	235	-40°C to +85°C	OPA4344UA "	OPA4344UA OPA4344UA/2K5	Rails Tape and Reel
OPA4344PA	14-Pin DIP	010	-40°C to +85°C	OPA4344PA	OPA4344PA	Rails
OPA345NA	SOT23-5	331 "	-40°C to +85°C	A45	OPA345NA/250 OPA345NA/3K	Tape and Reel Tape and Reel
OPA345UA "	SO-8 "	182	-40°C to +85°C	OPA345UA "	OPA345UA OPA345UA/2K5	Rails Tape and Reel
OPA2345EA	MSOP-8	337	-40°C to +85°C	B45	OPA2345EA/250 OPA2345EA/2K5	Tape and Reel Tape and Reel
OPA2345UA	SO-8	182 "	-40°C to +85°C	OPA2345UA "	OPA2345UA OPA2345UA/2K5	Rails Tape and Reel
OPA4345EA	TSSOP-14	357 "	-40°C to +85°C	OPA4345EA	OPA4345EA/250 OPA4345EA/2K5	Tape and Reel Tape and Reel
OPA4345UA	SO-14 "	235	-40°C to +85°C	OPA4345UA "	OPA4345UA OPA4345UA/2K5	Rails Tape and Reel

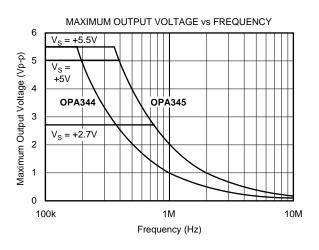
NOTE: (1) Models with a slash (/) are available only in Tape and Reel in the quantities indicated (e.g., /2K5 indicates 2500 devices per reel). Ordering 2500 pieces of "OPA344UA/2K5" will get a single 2500-piece Tape and Reel.

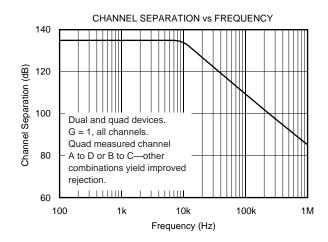
TYPICAL PERFORMANCE CURVES

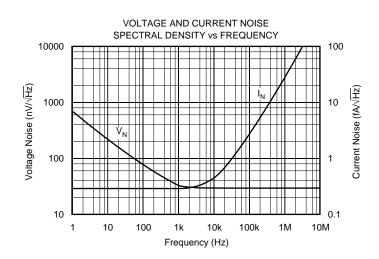




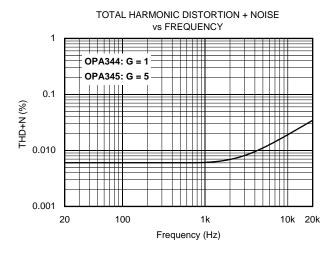


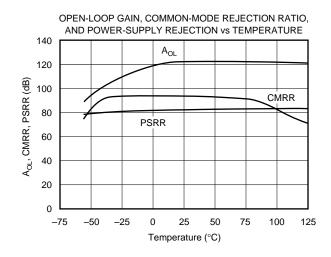


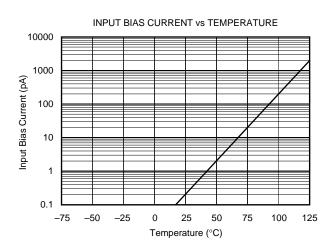


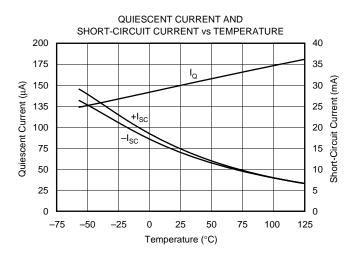


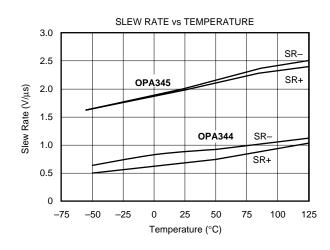
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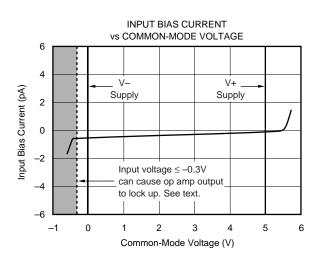




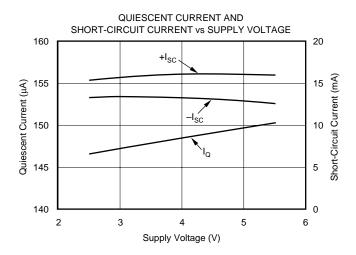


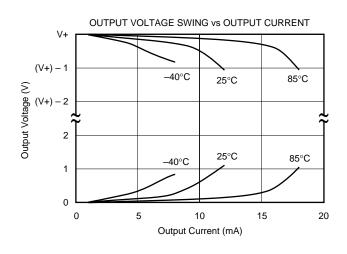


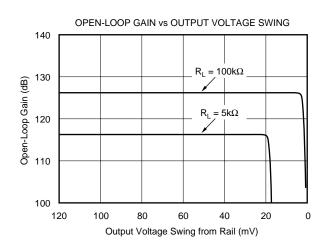


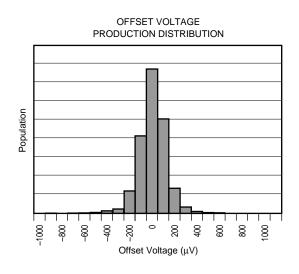


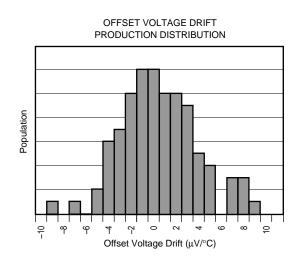
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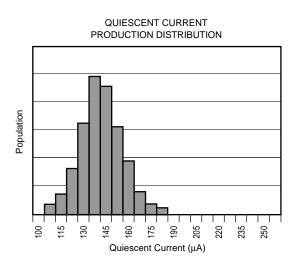




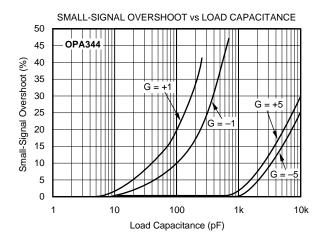


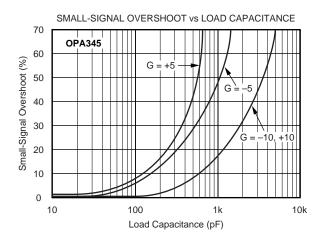


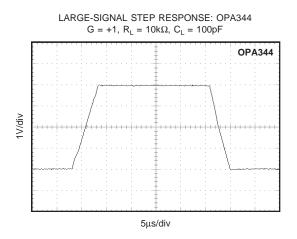


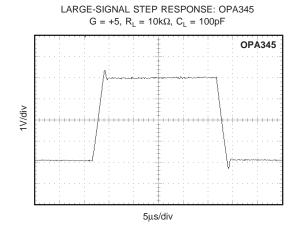


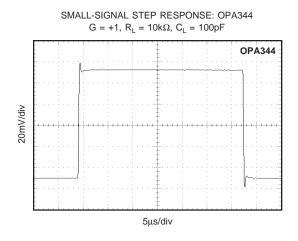
TYPICAL PERFORMANCE CURVES (Cont.)

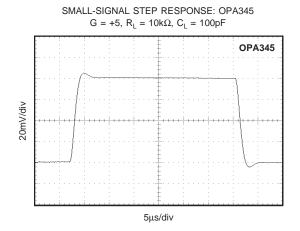












APPLICATIONS INFORMATION

OPA344 series op amps are unity gain stable and can operate on a single supply, making them highly versatile and easy to use. OPA345 series op amps are optimized for applications requiring higher speeds with gains of 5 or greater.

Rail-to-rail input and output swing significantly increases dynamic range, especially in low supply applications. Figure 1 shows the input and output waveforms for the OPA344 in unity-gain configuration. Operation is from $V_S = +5V$ with a $10k\Omega$ load connected to $V_S/2$. The input is a 5Vp-p sinusoid. Output voltage is approximately 4.997Vp-p.

Power supply pins should be by passed with 0.01pF ceramic capacitors.

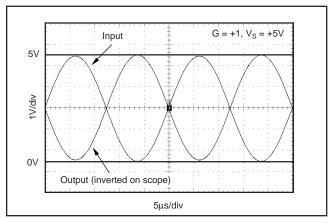


FIGURE 1. Rail-to-Rail Input and Output.

OPERATING VOLTAGE

OPA344 and OPA345 series op amps are fully specified and guaranteed from +2.7V to +5.5V. In addition, many specifications apply from -40°C to +85°C. Parameters that vary significantly with operating voltages or temperature are shown in the Typical Performance Curves.

RAIL-TO-RAIL INPUT

The input common-mode voltage range of the OPA344 and OPA345 series extends 300mV beyond the supply rails. This is achieved with a complementary input stage—an Nchannel input differential pair in parallel with a P-channel differential pair (see Figure 2). The N-channel pair is active for input voltages close to the positive rail, typically (V+) – 1.3V to 300mV above the positive supply, while the Pchannel pair is on for inputs from 300mV below the negative supply to approximately (V+) -1.3V. There is a small transition region, typically (V+) - 1.5V to (V+) - 1.1V, in which both pairs are on. This 400mV transition region can vary 300mV with process variation. Thus, the transition region (both stages on) can range from (V+) - 1.8V to (V+)-1.4V on the low end, up to (V+) - 1.2V to (V+) - 0.8V on the high end. Within the 400mV transition region PSRR, CMRR, offset voltage, offset drift, and THD may be degraded compared to operation outside this region. For more information on designing with rail-to-rail input op amps, see Figure 3 "Design Optimization with Rail-to-Rail Input Op Amps."

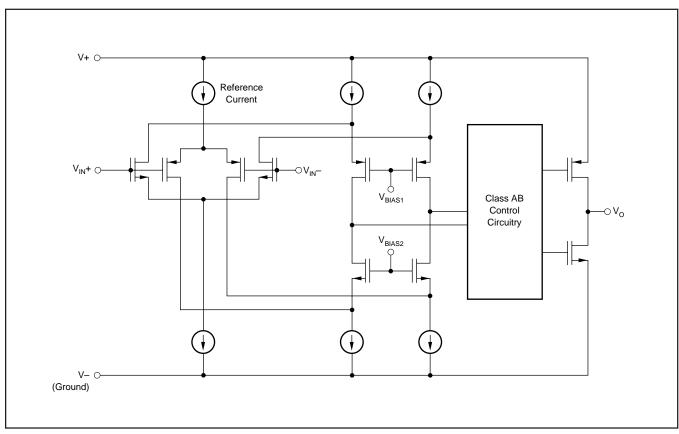


FIGURE 2. Simplified Schematic.

DESIGN OPTIMIZATION WITH RAIL-TO-RAIL INPUT OP AMPS

Rail-to-rail op amps can be used in virtually any op amp configuration. To achieve optimum performance, however, applications using these special double-input-stage op amps may benefit from consideration of their special behavior.

In many applications, operation remains within the common-mode range of only one differential input pair. However some applications exercise the amplifier through the transition region of both differential input stages. Although the two input stages are laser trimmed for excellent matching, a small discontinuity may occur in this transition. Careful selection of the circuit configuration, signal levels and biasing can often avoid this transition region.

With a unity-gain buffer, for example, signals will traverse this transition at approximately 1.3V below V+ supply and may exhibit a small discontinuity at this point.

The common-mode voltage of the non-inverting amplifier is equal to the input voltage. If the input signal always remains less than the transition voltage, no discontinuity will be created. The closed-loop gain of this configuration can still produce a rail-to-rail output.

Inverting amplifiers have a constant common-mode voltage equal to V_B . If this bias voltage is constant, no discontinuity will be created. The bias voltage can generally be chosen to avoid the transition region.

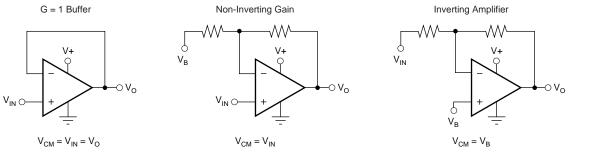


FIGURE 3. Design Optimization with Rail-to-Rail Input Op Amps.

COMMON-MODE REJECTION

The CMRR for the OPA344 and OPA345 is specified in several ways so the best match for a given application may be used. First, the CMRR of the device in the common-mode range below the transition region ($V_{\rm CM} < (V+) - 1.8V$) is given. This specification is the best indicator of the capability of the device when the application requires use of one of the differential input pairs. Second, the CMRR at $V_{\rm S} = 5.5V$ over the entire common-mode range is specified. Third, the CMRR at $V_{\rm S} = 2.7V$ over the entire common-mode range is provided. These last two values include the variations seen through the transition region.

INPUT VOLTAGE BEYOND THE RAILS

If the input voltage can go more than 0.3V below the negative power supply rail (single-supply ground), special precautions are required. If the input voltage goes sufficiently negative, the op amp output may lock up in an inoperative state. A Schottky diode clamp circuit will prevent this—see Figure 4. The series resistor prevents excessive current (greater than 10mA) in the Schottky diode and in the internal ESD protection diode, if the input voltage can exceed the positive supply voltage. If the signal source is limited to less than 10mA, the input resistor is not required.

RAIL-TO-RAIL OUTPUT

A class AB output stage with common-source transistors is used to achieve rail-to-rail output. This output stage is capable of driving 600Ω loads connected to any potential

between V+ and ground. For light resistive loads (> $50k\Omega$), the output voltage can typically swing to within 1mV from supply rail. With moderate resistive loads ($2k\Omega$ to $50k\Omega$), the output can swing to within a few tens of milli-volts from the supply rails while maintaining high open-loop gain. See the typical performance curve "Output Voltage Swing vs Output Current."

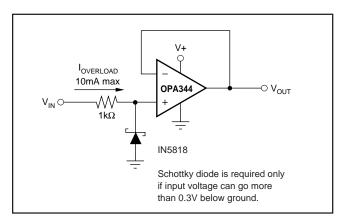


FIGURE 4. Input Current Protection for Voltages Exceeding the Supply Voltage.

CAPACITIVE LOAD AND STABILITY

The OPA344 in a unity-gain configuration and the OPA345 in gains greater than 5 can directly drive up to 250pF pure capacitive load. Increasing the gain enhances the amplifier's ability to drive greater capacitive loads. See the typical

performance curve "Small-Signal Overshoot vs Capacitive Load." In unity-gain configurations, capacitive load drive can be improved by inserting a small (10Ω to 20Ω) resistor, R_S , in series with the output, as shown in Figure 5. This significantly reduces ringing while maintaining dc performance for purely capacitive loads. However, if there is a resistive load in parallel with the capacitive load, a voltage divider is created, introducing a dc error at the output and slightly reducing the output swing. The error introduced is proportional to the ratio R_S/R_L , and is generally negligible.

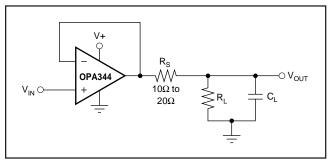


FIGURE 5. Series Resistor in Unity-Gain Configuration Improves Capacitive Load Drive.

DRIVING A/D CONVERTERS

The OPA344 and OPA345 series op amps are optimized for driving medium-speed sampling A/D converters. The OPA344 and OPA345 op amps buffer the A/D's input capacitance and resulting charge injection while providing signal gain.

Figures 6 shows the OPA344 in a basic noninverting configuration driving the ADS7822. The ADS7822 is a 12-bit, micro-power sampling converter in the MSOP-8 package. When used with the low-power, miniature packages of the OPA344, the combination is ideal for space-limited, low-power applications. In this configuration, an RC network at the A/D's input can be used to filter charge injection.

Figure 7 shows the OPA2344 driving an ADS7822 in a speech bandpass 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 with less than $500\mu A$ quiescent current.

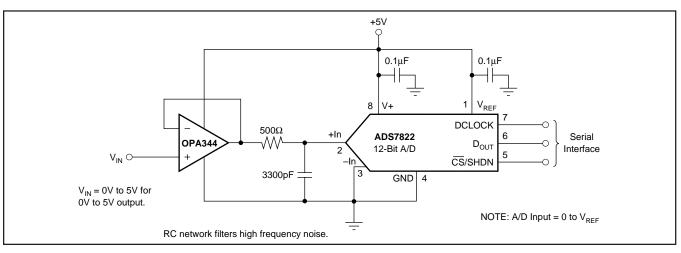


FIGURE 6. OPA344 in Noninverting Configuration Driving ADS7822.

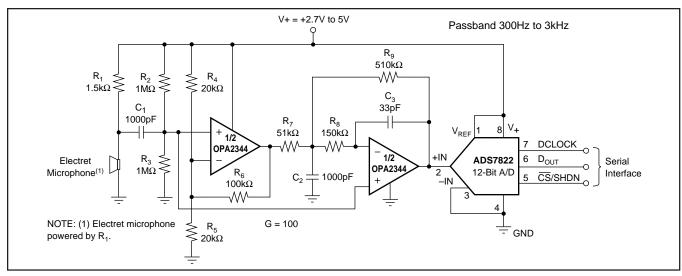


FIGURE 7. Speech Bandpass Filtered Data Acquisition System.



PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Packag Qty	e Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
OPA2344EA/250	ACTIVE	MSOP	DGK	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2344EA/250G4	ACTIVE	MSOP	DGK	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2344EA/2K5	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2344EA/2K5G4	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2344PA	ACTIVE	PDIP	Р	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
OPA2344PAG4	ACTIVE	PDIP	Р	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
OPA2344UA	ACTIVE	SOIC	D	8	100	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2344UA/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2344UA/2K5G4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2344UAG4	ACTIVE	SOIC	D	8	100	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2345EA/250	ACTIVE	MSOP	DGK	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2345EA/250G4	ACTIVE	MSOP	DGK	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2345EA/2K5G4	ACTIVE	MSOP	DGK	8		TBD	Call TI	Call TI
OPA2345UA	ACTIVE	SOIC	D	8	100	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2345UA/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2345UA/2K5G4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2345UAG4	ACTIVE	SOIC	D	8	100	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA344NA/250	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA344NA/250G4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA344NA/3K	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA344NA/3KG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA344PA	ACTIVE	PDIP	Р	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
OPA344PAG4	ACTIVE	PDIP	Р	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
OPA344UA	ACTIVE	SOIC	D	8	100	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA344UA/2K5	ACTIVE	SOIC	D	8	2500	·	CU NIPDAU	Level-2-260C-1 YEAR





24-Dec-2007

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	e Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
OPA344UA/2K5G4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA344UAG4	ACTIVE	SOIC	D	8	100	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA345NA/250	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA345NA/250G4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA345NA/3KG4	ACTIVE	SOT-23	DBV	5		TBD	Call TI	Call TI
OPA345UA	ACTIVE	SOIC	D	8	100	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA345UAG4	ACTIVE	SOIC	D	8	100	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA4344EA/250	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
OPA4344EA/250G4	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
OPA4344EA/2K5	ACTIVE	TSSOP	PW	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
OPA4344EA/2K5G4	ACTIVE	TSSOP	PW	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
OPA4344PA	ACTIVE	PDIP	N	14	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
OPA4344PAG4	ACTIVE	PDIP	N	14	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
OPA4344UA	ACTIVE	SOIC	D	14	58	Green (RoHS & no Sb/Br)	Call TI	Level-2-260C-1 YEAR
OPA4344UA/2K5	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	Call TI	Level-2-260C-1 YEAR
OPA4344UA/2K5G4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	Call TI	Level-2-260C-1 YEAR
OPA4344UAG4	ACTIVE	SOIC	D	14	58	Green (RoHS & no Sb/Br)	Call TI	Level-2-260C-1 YEAR
OPA4345EA/250	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA4345EA/250G4	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA4345UA	ACTIVE	SOIC	D	14	58	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA4345UA/2K5G4	ACTIVE	SOIC	D	14		TBD	Call TI	Call TI
OPA4345UAG4	ACTIVE	SOIC	D	14	58	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.



PACKAGE OPTION ADDENDUM

24-Dec-2007

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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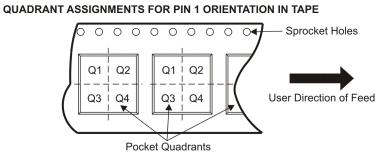
TAPE AND REEL INFORMATION



TAPE DIMENSIONS + K0 - P1 - B0 W Cavity - A0 -

Α0	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

— Reel Width (WT)



*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
OPA2344EA/250	MSOP	DGK	8	250	180.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA2344EA/2K5	MSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA2344UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA2345EA/250	MSOP	DGK	8	250	180.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA2345UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA344NA/250	SOT-23	DBV	5	250	180.0	8.4	3.2	3.1	1.39	4.0	8.0	Q3
OPA344NA/3K	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.1	1.39	4.0	8.0	Q3
OPA344UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA345NA/250	SOT-23	DBV	5	250	180.0	8.4	3.2	3.1	1.39	4.0	8.0	Q3
OPA4344EA/250	TSSOP	PW	14	250	180.0	12.4	7.0	5.6	1.6	8.0	12.0	Q1
OPA4344EA/2K5	TSSOP	PW	14	2500	330.0	12.4	7.0	5.6	1.6	8.0	12.0	Q1
OPA4344UA/2K5	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
OPA4345EA/250	TSSOP	PW	14	250	180.0	12.4	7.0	5.6	1.6	8.0	12.0	Q1





*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
OPA2344EA/250	MSOP	DGK	8	250	184.0	184.0	50.0
OPA2344EA/2K5	MSOP	DGK	8	2500	346.0	346.0	29.0
OPA2344UA/2K5	SOIC	D	8	2500	346.0	346.0	29.0
OPA2345EA/250	MSOP	DGK	8	250	184.0	184.0	50.0
OPA2345UA/2K5	SOIC	D	8	2500	346.0	346.0	29.0
OPA344NA/250	SOT-23	DBV	5	250	190.5	212.7	31.8
OPA344NA/3K	SOT-23	DBV	5	3000	190.5	212.7	31.8
OPA344UA/2K5	SOIC	D	8	2500	346.0	346.0	29.0
OPA345NA/250	SOT-23	DBV	5	250	190.5	212.7	31.8
OPA4344EA/250	TSSOP	PW	14	250	184.0	184.0	50.0
OPA4344EA/2K5	TSSOP	PW	14	2500	346.0	346.0	29.0
OPA4344UA/2K5	SOIC	D	14	2500	346.0	346.0	33.0
OPA4345EA/250	TSSOP	PW	14	250	190.5	212.7	31.8

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