

**OPA241**  
**OPA2241**  
**OPA4241**  
**OPA251**  
**OPA2251**  
**OPA4251**

## Single-Supply, *MicroPOWER* OPERATIONAL AMPLIFIERS

**OPA241 Family** optimized for +5V supply.

**OPA251 Family** optimized for  $\pm 15V$  supply.

### FEATURES

- **MicroPOWER:**  $I_Q = 25\mu A$
- **SINGLE-SUPPLY OPERATION**
- **RAIL-TO-RAIL OUTPUT (within 50mV)**
- **WIDE SUPPLY RANGE**  
 Single Supply: +2.7V to +36V  
 Dual Supply:  $\pm 1.35V$  to  $\pm 18V$
- **LOW OFFSET VOLTAGE:**  $\pm 250\mu V$  max
- **HIGH COMMON-MODE REJECTION:** 124dB
- **HIGH OPEN-LOOP GAIN:** 128dB
- **SINGLE, DUAL, AND QUAD**

### APPLICATIONS

- **BATTERY OPERATED INSTRUMENTS**
- **PORTABLE DEVICES**
- **MEDICAL INSTRUMENTS**
- **TEST EQUIPMENT**

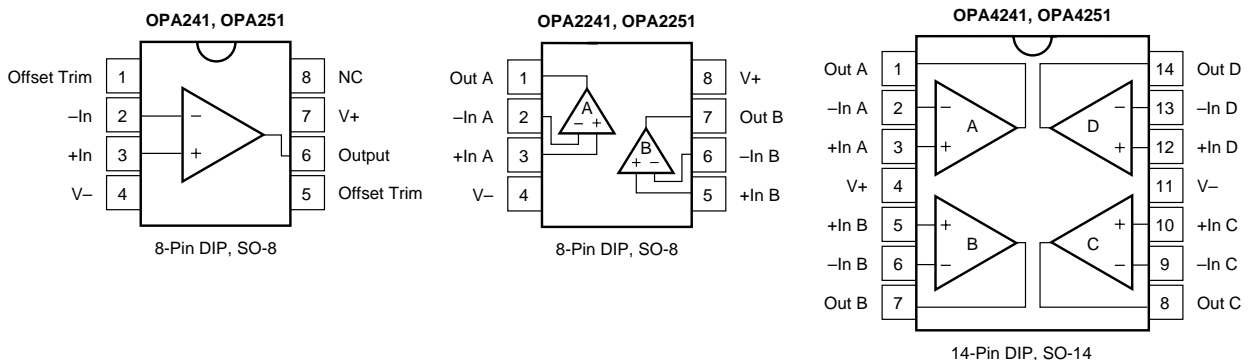
### DESCRIPTION

The OPA241 series and OPA251 series are specifically designed for battery powered, portable applications. In addition to very low power consumption ( $25\mu A$ ), these amplifiers feature low offset voltage, rail-to-rail output swing, high common-mode rejection, and high open-loop gain.

The OPA241 series is optimized for operation at low power supply voltage while the OPA251 series is optimized for high power supplies. Both can operate from either single (+2.7V to +36V) or dual supplies ( $\pm 1.35V$  to  $\pm 18V$ ). The input common-mode voltage range extends 200mV below the negative supply—ideal for single-supply applications.

They are unity-gain stable and can drive large capacitive loads. Special design considerations assure that these products are easy to use. High performance is maintained as the amplifiers swing to their specified limits. Because the initial offset voltage ( $\pm 250\mu V$  max) is so low, user adjustment is usually not required. However, external trim pins are provided for special applications (single versions only).

The OPA241 and OPA251 (single versions) are available in standard 8-pin DIP and SO-8 surface-mount packages. The OPA2241 and OPA2251 (dual versions) come in 8-pin DIP and SO-8 surface-mount packages. The OPA4241 and OPA4251 (quad versions) are available in 14-pin DIP and SO-14 surface-mount packages. All are fully specified from  $-40^\circ C$  to  $+85^\circ C$  and operate from  $-55^\circ C$  to  $+125^\circ C$ .



# SPECIFICATIONS: $V_S = 2.7V$ to $5V$

At  $T_A = +25^\circ C$ ,  $R_L = 100k\Omega$  connected to  $V_S/2$ , unless otherwise noted.

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

PARAMETER	CONDITION	OPA241UA, PA OPA2241UA, PA OPA4241UA, PA			OPA251UA, PA OPA2251UA, PA OPA4251UA, PA			UNITS
		MIN	TYP <sup>(1)</sup>	MAX	MIN	TYP <sup>(1)</sup>	MAX	
<b>OFFSET VOLTAGE</b> Input Offset Voltage $V_{OS}$ $T_A = -40^\circ C$ to $+85^\circ C$ vs Temperature $dV_{OS}/dT$ vs Power Supply PSRR $T_A = -40^\circ C$ to $+85^\circ C$ Channel Separation (dual, quad)	$T_A = -40^\circ C$ to $+85^\circ C$ $V_S = 2.7V$ to $36V$ $V_S = 2.7V$ to $36V$		$\pm 50$ <b><math>\pm 100</math></b> $\pm 0.4$ 3 0.3	$\pm 250$ <b><math>\pm 400</math></b> 30 <b>30</b>		$\pm 100$ <b><math>\pm 130</math></b> $\pm 0.6$ * *	* *	$\mu V$ $\mu V$ $\mu V/^\circ C$ $\mu V/V$ $\mu V/V$
<b>INPUT BIAS CURRENT</b> Input Bias Current <sup>(2)</sup> $I_B$ $T_A = -40^\circ C$ to $+85^\circ C$ Input Offset Current $I_{OS}$ $T_A = -40^\circ C$ to $+85^\circ C$			-4 $\pm 0.1$	-20 <b>-25</b> $\pm 2$ $\pm 2$		* *		nA nA nA nA
<b>NOISE</b> Input Voltage Noise, $f = 0.1Hz$ to $10Hz$ Input Voltage Noise Density, $f = 1kHz$ $e_n$ Current Noise Density, $f = 1kHz$ $i_n$			1 45 40			* * *		$\mu Vp-p$ $nV/\sqrt{Hz}$ $fA/\sqrt{Hz}$
<b>INPUT VOLTAGE RANGE</b> Common-Mode Voltage Range $V_{CM}$ Common-Mode Rejection Ratio CMRR $T_A = -40^\circ C$ to $+85^\circ C$	$V_{CM} = -0.2V$ to $(V+) - 0.8V$ $V_{CM} = 0V$ to $(V+) - 0.8V$	-0.2 80 <b>80</b>	106	$(V+) - 0.8$		* *		V dB dB
<b>INPUT IMPEDANCE</b> Differential Common-Mode			$10^7 \parallel 2$ $10^9 \parallel 4$			* *		$\Omega \parallel pF$ $\Omega \parallel pF$
<b>OPEN-LOOP GAIN</b> Open-Loop Voltage Gain $A_{OL}$ $T_A = -40^\circ C$ to $+85^\circ C$	$R_L = 100k\Omega$ , $V_O = (V-)+100mV$ to $(V+)-100mV$ $R_L = 100k\Omega$ , $V_O = (V-)+100mV$ to $(V+)-100mV$ $R_L = 10k\Omega$ , $V_O = (V-)+200mV$ to $(V+)-200mV$ $R_L = 10k\Omega$ , $V_O = (V-)+200mV$ to $(V+)-200mV$	100 <b>100</b> 100 <b>100</b>	120 120			* * *		dB dB dB dB
<b>FREQUENCY RESPONSE</b> Gain-Bandwidth Product GBW Slew Rate SR Overload Recovery Time	$V_S = 5V$ , $G = 1$ $V_{IN} \cdot G = V_S$		35 0.01 60			* * *		kHz V/ $\mu s$ $\mu s$
<b>OUTPUT</b> Voltage Output Swing from Rail <sup>(3)</sup> $V_O$ $T_A = -40^\circ C$ to $+85^\circ C$ $T_A = -40^\circ C$ to $+85^\circ C$ Short-Circuit Current $I_{SC}$ Single Versions Dual, Quad Versions Capacitive Load Drive $C_{LOAD}$	$R_L = 100k\Omega$ to $V_S/2$ , $A_{OL} \geq 70dB$ $R_L = 100k\Omega$ to $V_S/2$ , $A_{OL} \geq 100dB$ $R_L = 100k\Omega$ to $V_S/2$ , $A_{OL} \geq 100dB$ $R_L = 10k\Omega$ to $V_S/2$ , $A_{OL} \geq 100dB$ $R_L = 10k\Omega$ to $V_S/2$ , $A_{OL} \geq 100dB$		50 75 100	100 <b>100</b> 200 <b>200</b>		* * * *		mV mV mV mV mA mA
<b>POWER SUPPLY</b> Specified Voltage Range $V_S$ Operating Voltage Range Quiescent Current (per amplifier) $I_Q$ $T_A = -40^\circ C$ to $+85^\circ C$	$T_A = -40^\circ C$ to $+85^\circ C$ $I_O = 0$ $I_O = 0$	<b>+2.7</b>	+2.7 to +5 $\pm 25$	<b>+36</b> $\pm 30$ <b><math>\pm 36</math></b>	*	* *	*	V V $\mu A$ $\mu A$
<b>TEMPERATURE RANGE</b> Specified Range Operating Range Storage Range Thermal Resistance $\theta_{JA}$ 8-Pin DIP SO-8 Surface Mount 14-Pin DIP SO-14 Surface Mount		-40 -55 -55		+85 +125 +125	* * *		* * *	$^\circ C$ $^\circ C$ $^\circ C$ $^\circ C/W$ $^\circ C/W$ $^\circ C/W$ $^\circ C/W$

\* Specifications the same as OPA241UA, PA.

NOTES: (1)  $V_S = +5V$ . (2) The negative sign indicates input bias current flows out of the input terminals. (3) Output voltage swings are measured between the output and power supply rails.

The information provided herein is believed to be reliable; however, BURR-BROWN assumes no responsibility for inaccuracies or omissions. BURR-BROWN assumes no responsibility for the use of this information, and all use of such information shall be entirely at the user's own risk. Prices and specifications are subject to change without notice. No patent rights or licenses to any of the circuits described herein are implied or granted to any third party. BURR-BROWN does not authorize or warrant any BURR-BROWN product for use in life support devices and/or systems.

# SPECIFICATIONS: $V_S = \pm 15V$

At  $T_A = +25^\circ C$ ,  $R_L = 100k\Omega$  connected to ground, unless otherwise noted.

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

PARAMETER	CONDITION	OPA241UA, PA OPA2241UA, PA OPA4241UA, PA			OPA251UA, PA OPA2251UA, PA OPA4251UA, PA			UNITS	
		MIN	TYP	MAX	MIN	TYP	MAX		
<b>OFFSET VOLTAGE</b> Input Offset Voltage $V_{OS}$ $T_A = -40^\circ C$ to $+85^\circ C$ vs Temperature $dV_{OS}/dT$ vs Power Supply PSRR $T_A = -40^\circ C$ to $+85^\circ C$ Channel Separation (dual, quad)	$T_A = -40^\circ C$ to $+85^\circ C$ $V_S = \pm 1.35V$ to $\pm 18V$ $V_S = \pm 1.35V$ to $\pm 18V$		±100 <b>±150</b> ±0.6 * *			±50 <b>±100</b> ±0.5 3 0.3	±250 <b>±300</b> 30 <b>30</b>	$\mu V$ $\mu V$ $\mu V/^\circ C$ $\mu V/V$ $\mu V/V$	
<b>INPUT BIAS CURRENT</b> Input Bias Current <sup>(1)</sup> $I_B$ $T_A = -40^\circ C$ to $+85^\circ C$ Input Offset Current $I_{OS}$ $T_A = -40^\circ C$ to $+85^\circ C$			*			-4	-20	nA	
<b>NOISE</b> Input Voltage Noise, $f = 0.1Hz$ to $10Hz$ Input Voltage Noise Density, $f = 1kHz$ $e_n$ Current Noise Density, $f = 1kHz$ $i_n$			*			1		$\mu Vp-p$	
<b>INPUT VOLTAGE RANGE</b> Common-Mode Voltage Range $V_{CM}$ Common-Mode Rejection Ratio CMRR $T_A = -40^\circ C$ to $+85^\circ C$	$V_{CM} = -15.2V$ to $14.2V$ $V_{CM} = -15V$ to $14.2V$		*			(V-) -0.2 100 <b>100</b>	124	(V+) -0.8	V dB dB
<b>INPUT IMPEDANCE</b> Differential Common-Mode			*				$10^7 \parallel 2$ $10^9 \parallel 4$	$\Omega \parallel pF$ $\Omega \parallel pF$	
<b>OPEN-LOOP GAIN</b> Open-Loop Voltage Gain $A_{OL}$ $T_A = -40^\circ C$ to $+85^\circ C$ $T_A = -40^\circ C$ to $+85^\circ C$	$R_L = 100k\Omega$ , $V_O = -14.75V$ to $+14.75V$ $R_L = 100k\Omega$ , $V_O = -14.75V$ to $+14.75V$ $R_L = 20k\Omega$ , $V_O = -14.7V$ to $+14.7V$ $R_L = 20k\Omega$ , $V_O = -14.7V$ to $+14.7V$		*			100 <b>100</b> 100 <b>100</b>	128  128	dB dB dB dB	
<b>FREQUENCY RESPONSE</b> Gain-Bandwidth Product GBW Slew Rate SR Overload Recovery Time	$G = 1$ $V_{IN} \cdot G = V_S$		*				35 0.01 60	kHz V/ $\mu s$ $\mu s$	
<b>OUTPUT</b> Voltage Output Swing from Rail <sup>(2)</sup> $V_O$ $T_A = -40^\circ C$ to $+85^\circ C$ $T_A = -40^\circ C$ to $+85^\circ C$ Short-Circuit Current $I_{SC}$ Single Versions Dual Versions Capacitive Load Drive $C_{LOAD}$	$R_L = 100k\Omega$ , $A_{OL} \geq 70dB$ $R_L = 100k\Omega$ , $A_{OL} \geq 100dB$ $R_L = 100k\Omega$ , $A_{OL} \geq 100dB$ $R_L = 20k\Omega$ , $A_{OL} \geq 100dB$ $R_L = 20k\Omega$ , $A_{OL} \geq 100dB$		*			50 75 100	250 <b>250</b> 300 <b>300</b>	mV mV mV mV mA mA	
<b>POWER SUPPLY</b> Specified Voltage Range $V_S$ Operating Voltage Range Quiescent Current (per amplifier) $I_Q$ $T_A = -40^\circ C$ to $+85^\circ C$	$T_A = -40^\circ C$ to $+85^\circ C$ $I_Q = 0$ $I_Q = 0$		*	*		±1.35	±15 ±27	±18 ±38 <b>±45</b>	V V $\mu A$ $\mu A$
<b>TEMPERATURE RANGE</b> Specified Range Operating Range Storage Range Thermal Resistance $\theta_{JA}$ 8-Pin DIP SO-8 Surface Mount 14-Pin DIP SO-14 Surface Mount			*	*		-40 -55 -55	+85 +125 +125	$^\circ C$ $^\circ C$ $^\circ C$ $^\circ C/W$ $^\circ C/W$ $^\circ C/W$ $^\circ C/W$	

\* Specifications the same as OPA251UA, PA.

NOTES: (1) The negative sign indicates input bias current flows out of the input terminals. (2) Output voltage swings are measured between the output and power supply rails.

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

Supply Voltage, V+ to V- .....	36V
Input Voltage <sup>(2)</sup> .....	(V-) -0.5V to (V+) +0.5V
Output Short Circuit to Ground <sup>(3)</sup> .....	Continuous
Operating Temperature .....	-55°C to +125°C
Storage Temperature .....	-55°C to +125°C
Junction Temperature .....	150°C
Lead Temperature (soldering, 10s) .....	300°C

NOTES: (1) Stresses above these ratings may cause permanent damage.  
 (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 5mA or less. (3) 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

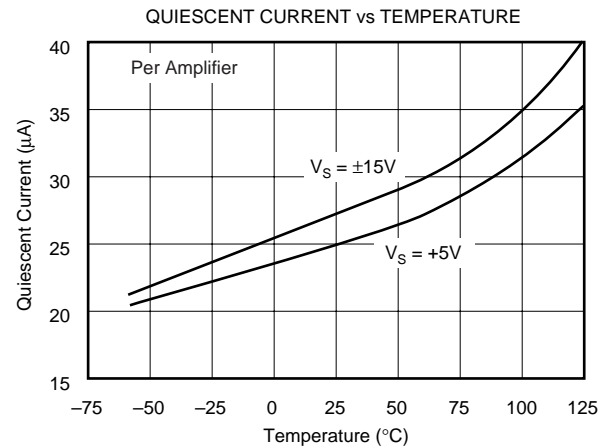
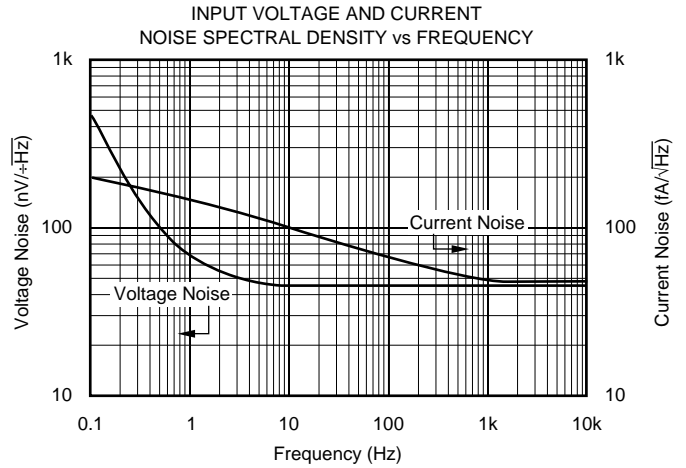
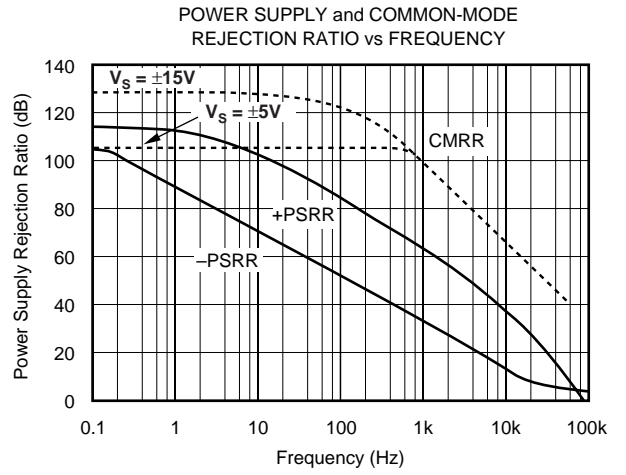
PRODUCT	SPECIFIED VOLTAGE	OPERATING VOLTAGE RANGE	PACKAGE	PACKAGE DRAWING NUMBER <sup>(1)</sup>	SPECIFICATION TEMPERATURE RANGE
<b>OPA241 SERIES</b>					
<b>Single</b>					
OPA241PA	2.7V to 5V	2.7V to 36V	8-Pin DIP	006	-40°C to +85°C
OPA241UA	2.7V to 5V	2.7V to 36V	SO-8 Surface Mount	182	-40°C to +85°C
<b>Dual</b>					
OPA2241PA	2.7V to 5V	2.7V to 36V	8-Pin DIP	006	-40°C to +85°C
OPA2241UA	2.7V to 5V	2.7V to 36V	SO-8 Surface Mount	182	-40°C to +85°C
<b>Quad</b>					
OPA4241PA	2.7V to 5V	2.7V to 36V	14-Pin DIP	010	-40°C to +85°C
OPA4241UA	2.7V to 5V	2.7V to 36V	SO-14 Surface Mount	235	-40°C to +85°C
<b>OPA251 SERIES</b>					
<b>Single</b>					
OPA251PA	±15V	2.7V to 36V	8-Pin DIP	006	-40°C to +85°C
OPA251UA	±15V	2.7V to 36V	SO-8 Surface Mount	182	-40°C to +85°C
<b>Dual</b>					
OPA2251PA	±15V	2.7V to 36V	8-Pin DIP	006	-40°C to +85°C
OPA2251UA	±15V	2.7V to 36V	SO-8 Surface Mount	182	-40°C to +85°C
<b>Quad</b>					
OPA4251PA	±15V	2.7V to 36V	14-Pin DIP	010	-40°C to +85°C
OPA4251UA	±15V	2.7V to 36V	SO-14 Surface Mount	235	-40°C to +85°C

NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book.

# TYPICAL PERFORMANCE CURVES

At  $T_A = +25^\circ\text{C}$ , and  $R_L = 100\text{k}\Omega$  connected to  $V_S/2$  (ground for  $V_S = \pm 15\text{V}$ ), unless otherwise noted.

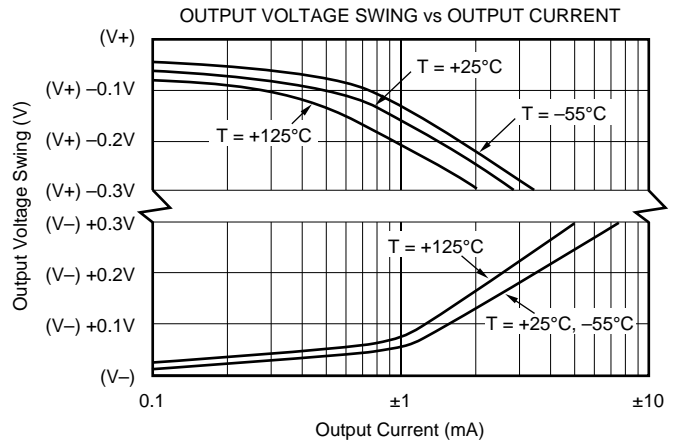
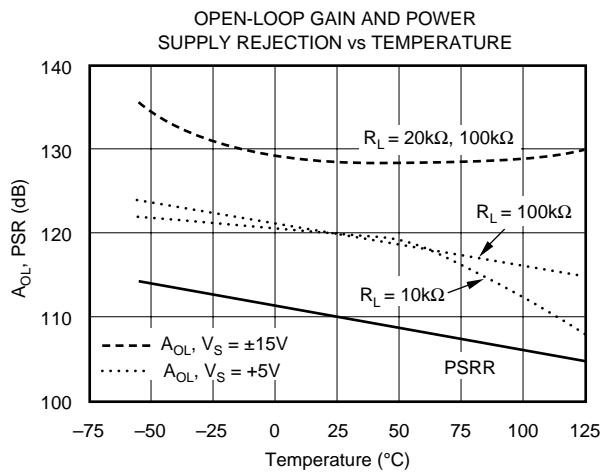
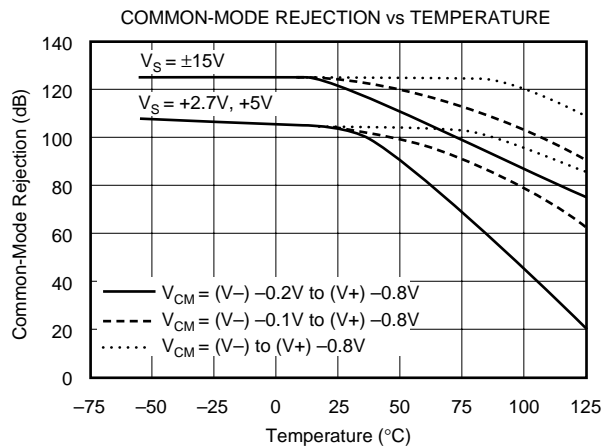
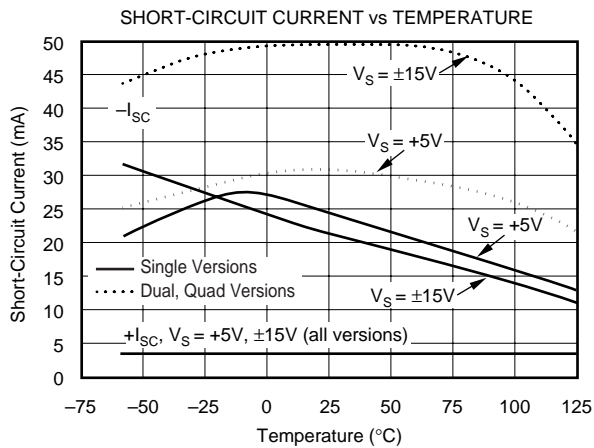
Curves apply to OPA241 and OPA251 unless specified.



# TYPICAL PERFORMANCE CURVES (CONT)

At  $T_A = +25^\circ\text{C}$ , and  $R_L = 100\text{k}\Omega$  connected to  $V_S/2$  (ground for  $V_S = \pm 15\text{V}$ ), unless otherwise noted.

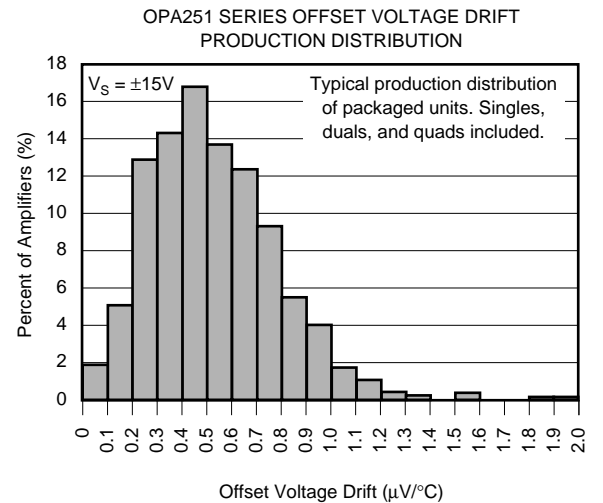
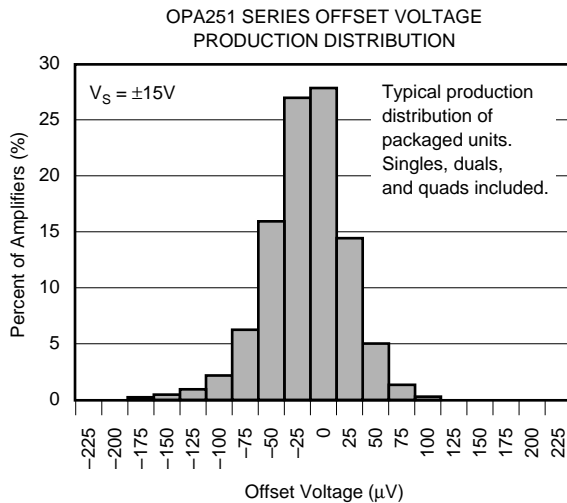
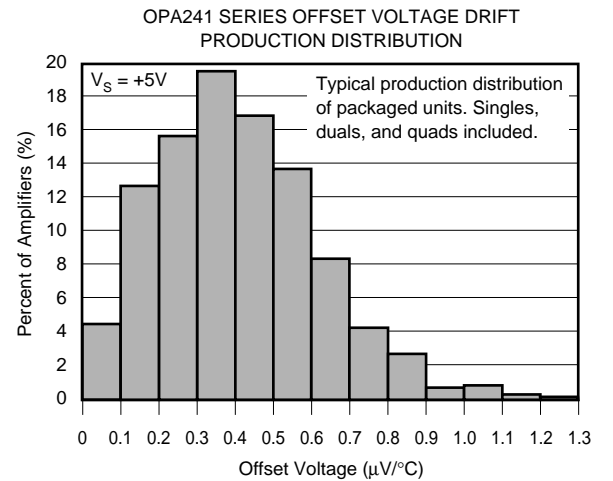
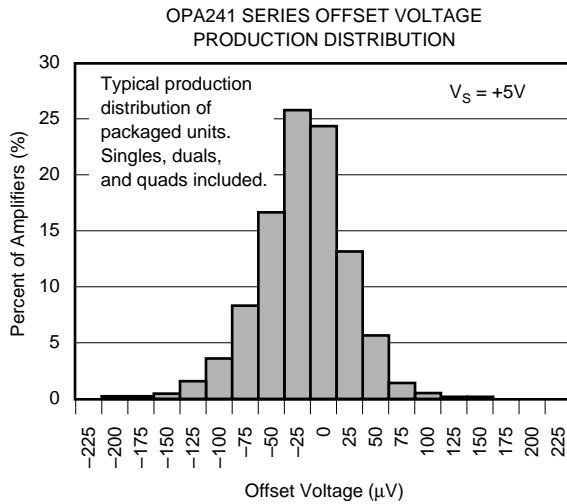
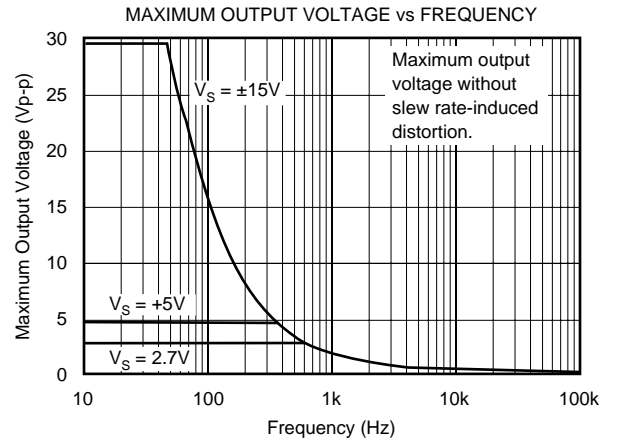
Curves apply to OPA241 and OPA251 unless specified.



# TYPICAL PERFORMANCE CURVES (CONT)

At  $T_A = +25^\circ\text{C}$ , and  $R_L = 100\text{k}\Omega$  connected to  $V_S/2$  (ground for  $V_S = \pm 15\text{V}$ ), unless otherwise noted.

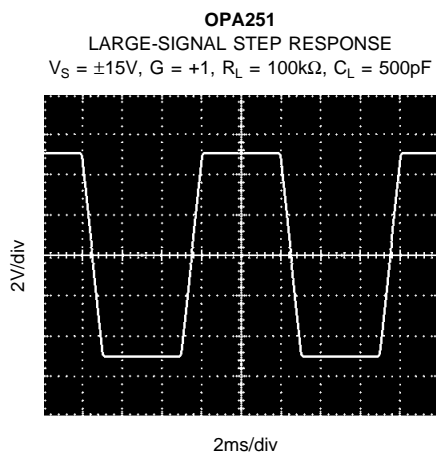
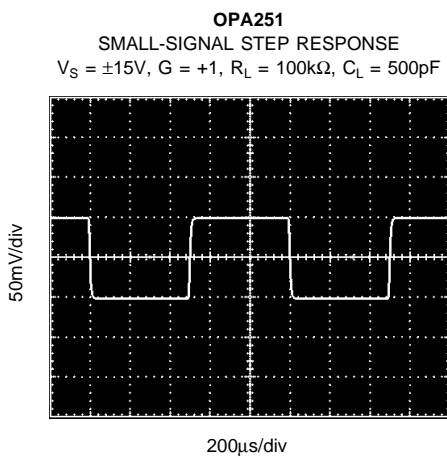
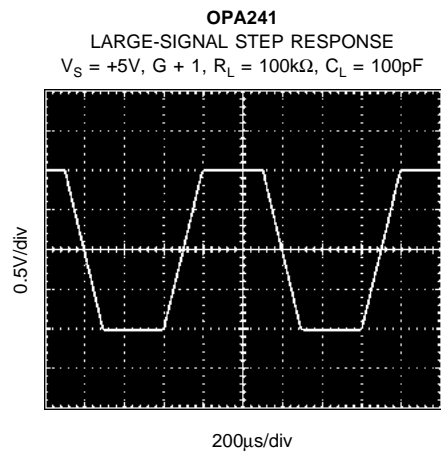
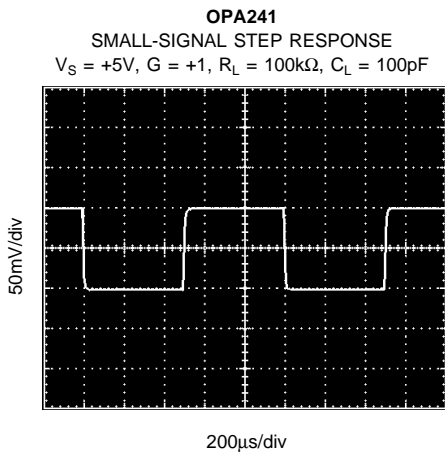
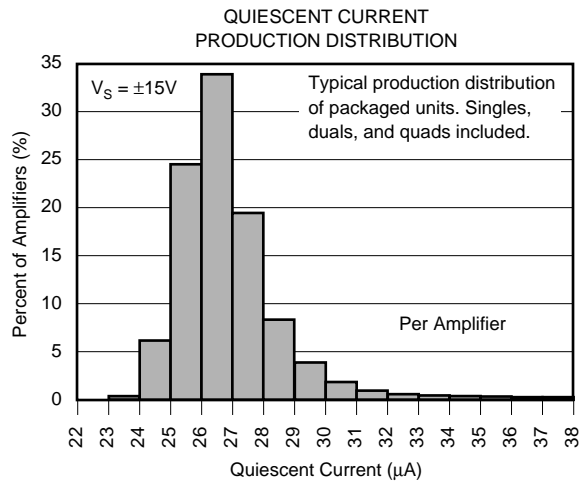
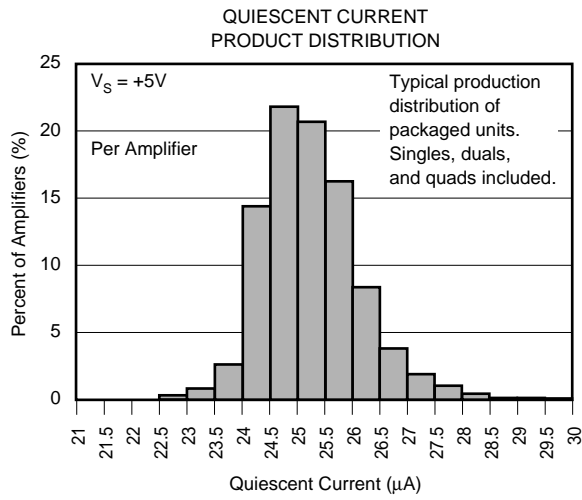
Curves apply to OPA241 and OPA251 unless specified.



# TYPICAL PERFORMANCE CURVES (CONT)

At  $T_A = +25^\circ\text{C}$ , and  $R_L = 100\text{k}\Omega$  connected to  $V_S/2$  (ground for  $V_S \pm 15\text{V}$ ), unless otherwise noted.

Curves apply to OPA241 and OPA251 unless specified.





# APPLICATIONS INFORMATION

The OPA241 and OPA251 series are unity-gain stable and suitable for a wide range of general purpose applications. Power supply pins should be bypassed with 0.01 $\mu$ F ceramic capacitors.

## OPERATING VOLTAGE

The OPA241 series is laser-trimmed for low offset voltage and drift at low supply voltage ( $V_S = +5V$ ). The OPA251 series is trimmed for  $\pm 15V$  operation. Both products operate over the full voltage range (+2.7V to +36V or  $\pm 1.35V$  to  $\pm 18V$ ) with some compromises in offset voltage and drift performance. However, all other parameters have similar performance. Key parameters are guaranteed over the specified temperature range,  $-40^\circ C$  to  $+85^\circ C$ . 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.

## OFFSET VOLTAGE TRIM

As mentioned previously, offset voltage of the OPA241 series is laser-trimmed at +5V. The OPA251 series is trimmed at  $\pm 15V$ . Because the initial offset is so low, user adjustment is usually not required. However, the OPA241 and OPA251 (single op amp versions) provide 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.

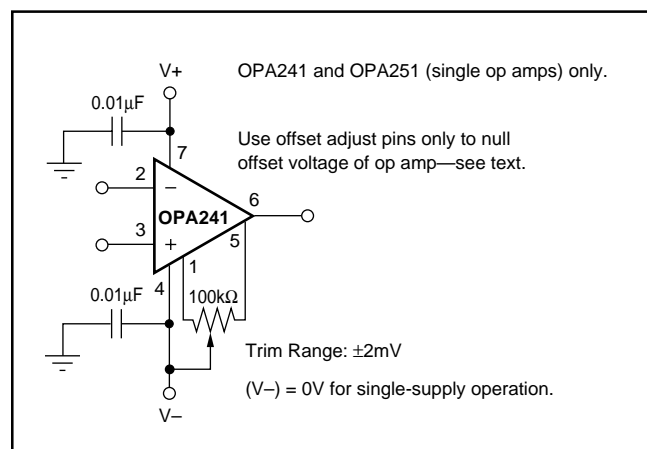


FIGURE 1. OPA241 and OPA251 Offset Voltage Trim Circuit.

## CAPACITIVE LOAD AND STABILITY

The OPA241 series and OPA251 series can drive a wide range of capacitive loads. However, all op amps under certain conditions may be unstable. Op amp configuration, gain, and load value are just a few of the factors to consider when determining stability.

Figures 2 and 3 show the regions where the OPA241 series and OPA251 series have the potential for instability. As shown, the unity gain configuration with low supplies is the most susceptible to the effects of capacitive load. With  $V_S = +5V$ ,  $G = +1$ , and  $I_{OUT} = 0$ , operation remains stable with load capacitance up to approximately 200pF. Increasing supply voltage, output current, and/or gain significantly improves capacitive load drive. For example, increasing the supplies to  $\pm 15V$  and gain to 10 allows approximately 2700pF to be driven.

One method of improving capacitive load drive in the unity gain configuration is to insert a resistor inside the feedback loop as shown in Figure 4. This reduces ringing with large capacitive loads while maintaining dc accuracy. For example, with  $V_S = \pm 1.35V$  and  $R_S = 5k\Omega$ , the OPA241 series and OPA251 series perform well with capacitive loads in excess of 1000pF. Without the series resistor, capacitive load drive is typically 200pF for these conditions. However, this method will result in a slight reduction of output voltage swing.



FIGURE 2. Stability—Capacitive Load versus Output Current for Low Supply Voltage.

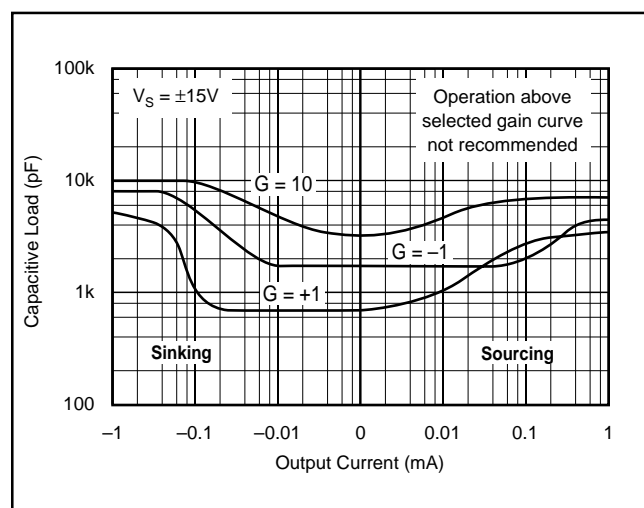


FIGURE 3. Stability—Capacitive Load versus Output Current for  $\pm 15V$  Supplies.

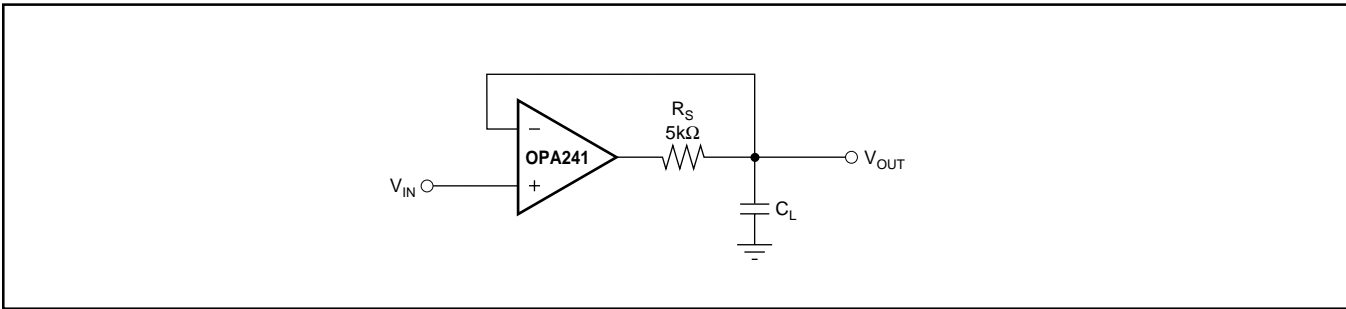


FIGURE 4. Series Resistor in Unity Gain Configuration Improves Capacitive Load Drive.

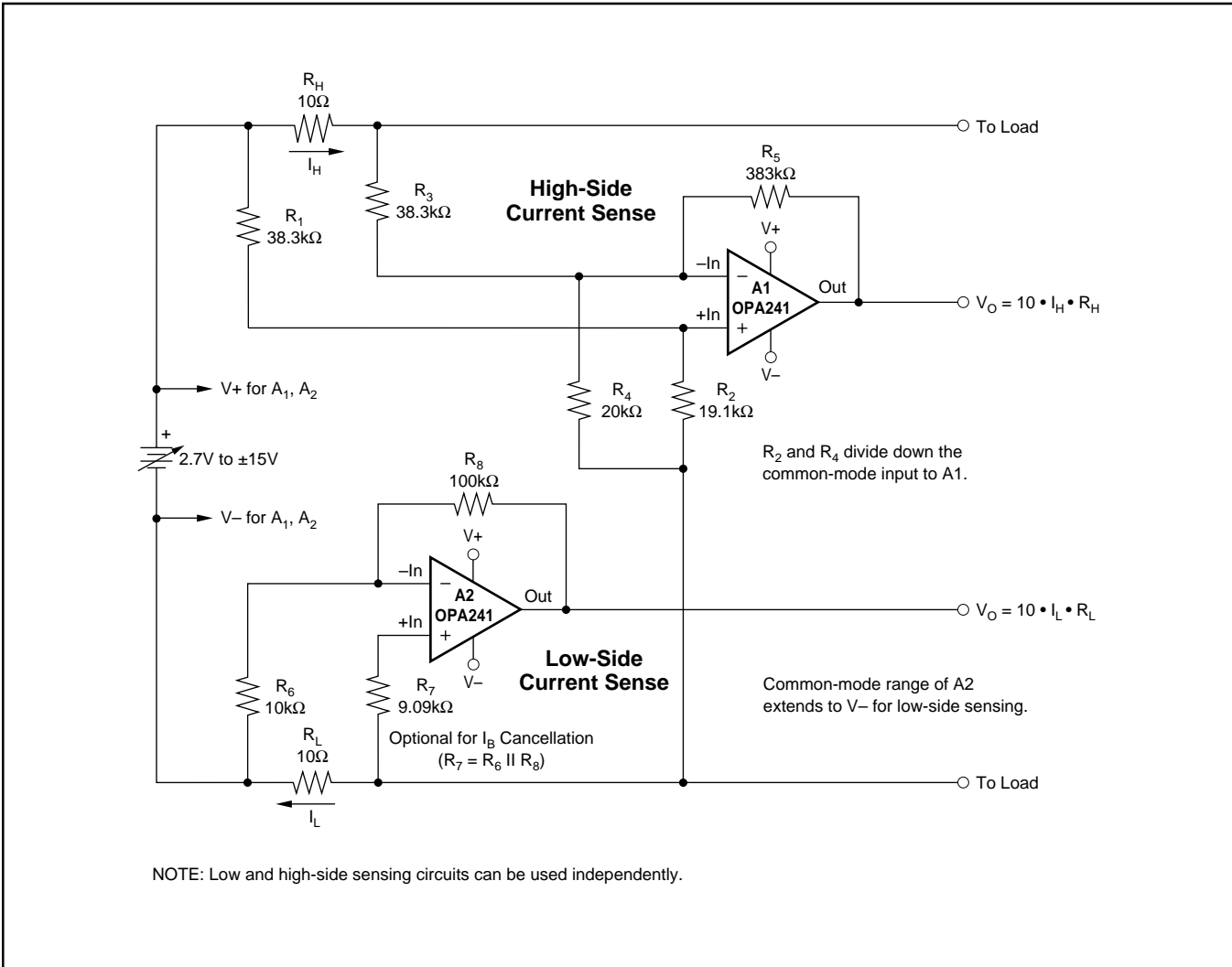




FIGURE 5. Low and High-Side Battery Current Sensing.

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
OPA2241PA	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA2241PA	<a href="#">Samples</a>
OPA2241PAG4	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA2241PA	<a href="#">Samples</a>
OPA2241UA	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2241UA	<a href="#">Samples</a>
OPA2241UA/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2241UA	<a href="#">Samples</a>
OPA2241UA/2K5G4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2241UA	<a href="#">Samples</a>
OPA2241UAG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2241UA	<a href="#">Samples</a>
OPA2251PA	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA2251PA	<a href="#">Samples</a>
OPA2251PAG4	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA2251PA	<a href="#">Samples</a>
OPA2251UA	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2251UA	<a href="#">Samples</a>
OPA2251UA/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2251UA	<a href="#">Samples</a>
OPA2251UA/2K5G4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2251UA	<a href="#">Samples</a>
OPA2251UAG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2251UA	<a href="#">Samples</a>
OPA241PA	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA241PA	<a href="#">Samples</a>
OPA241PAG4	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA241PA	<a href="#">Samples</a>
OPA241UA	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 85	OPA 241UA	<a href="#">Samples</a>
OPA241UA/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 85	OPA 241UA	<a href="#">Samples</a>
OPA241UA/2K5E4	PREVIEW	SOIC	D	8		TBD	Call TI	Call TI	-40 to 85		

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
OPA241UA/2K5G4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 85	OPA 241UA	<a href="#">Samples</a>
OPA241UAE4	PREVIEW	SOIC	D	8		TBD	Call TI	Call TI	-40 to 85		
OPA241UAG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 85	OPA 241UA	<a href="#">Samples</a>
OPA251PA	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA251PA	<a href="#">Samples</a>
OPA251PAG4	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA251PA	<a href="#">Samples</a>
OPA251UA	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 251UA	<a href="#">Samples</a>
OPA251UA/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 251UA	<a href="#">Samples</a>
OPA251UA/2K5G4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 251UA	<a href="#">Samples</a>
OPA251UAG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 251UA	<a href="#">Samples</a>
OPA4241PA	ACTIVE	PDIP	N	14	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA4241PA	<a href="#">Samples</a>
OPA4241PAG4	ACTIVE	PDIP	N	14	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA4241PA	<a href="#">Samples</a>
OPA4241UA	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU-DCC	Level-3-260C-168 HR		OPA4241UA	<a href="#">Samples</a>
OPA4241UA/2K5	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU-DCC	Level-3-260C-168 HR		OPA4241UA	<a href="#">Samples</a>
OPA4241UAG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU-DCC	Level-3-260C-168 HR		OPA4241UA	<a href="#">Samples</a>
OPA4251PA	ACTIVE	PDIP	N	14	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA4251PA	<a href="#">Samples</a>
OPA4251PAG4	ACTIVE	PDIP	N	14	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA4251PA	<a href="#">Samples</a>
OPA4251UA	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU-DCC	Level-3-260C-168 HR		OPA4251UA	<a href="#">Samples</a>
OPA4251UA/2K5	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU-DCC	Level-3-260C-168 HR		OPA4251UA	<a href="#">Samples</a>

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
OPA4251UA/2K5G4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU-DCC	Level-3-260C-168 HR		OPA4251UA	
OPA4251UAG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU-DCC	Level-3-260C-168 HR		OPA4251UA	

(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.

**OBSELETE:** 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.

**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.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.



**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
OPA2241UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA2251UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA241UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA251UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA4241UA/2K5	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
OPA4251UA/2K5	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
OPA2241UA/2K5	SOIC	D	8	2500	367.0	367.0	35.0
OPA2251UA/2K5	SOIC	D	8	2500	367.0	367.0	35.0
OPA241UA/2K5	SOIC	D	8	2500	367.0	367.0	35.0
OPA251UA/2K5	SOIC	D	8	2500	367.0	367.0	35.0
OPA4241UA/2K5	SOIC	D	14	2500	367.0	367.0	38.0
OPA4251UA/2K5	SOIC	D	14	2500	367.0	367.0	38.0



P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MS-001 variation BA.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  -  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  -  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4211283-3/E 08/12

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AA.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



4211283-2/E 08/12

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)