

## Description

The OPA340 series rail-to-rail CMOS operational amplifiers are optimized for low-voltage, single-supply operation. Rail-to-rail input and output and high-speed operation make them ideal for driving sampling analog-to-digital (A/D) converters. They are also well-suited for general purpose and audio applications as well as providing I/V conversion at the output of digital-to-analog (D/A) converters. Single, dual, and quad versions have identical specifications for design flexibility.

The OPA340 series operate on a single supply as low as 2.5 V with an input common-mode voltage range that extends 500 mV below ground and 500 mV above the positive supply. Output voltage swing is to within 1 mV of the supply rails with a 100-kΩ load. These devices offer excellent dynamic response (BW = 5.5 MHz, SR = 6 V/μs), yet quiescent current is only 750 nA. Dual and quad designs feature completely independent circuitry for lowest crosstalk and freedom from interaction.

All are specified from -40°C to 85°C and operate from -55°C to 125°C.

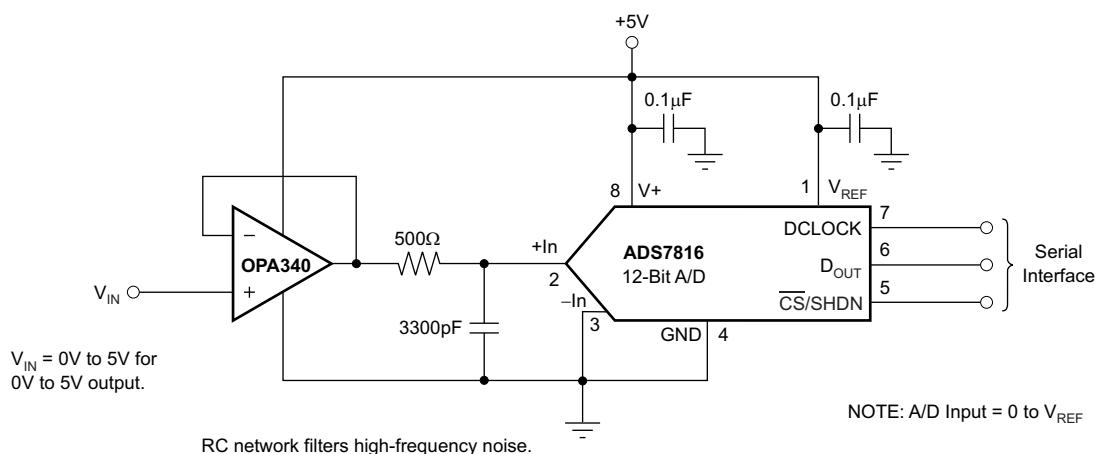
## Features

- Rail-to-Rail Input
- Rail-to-Rail Output (Within 1 mV)
- MicroSize Packages
- Wide Bandwidth: 5.5 MHz
- High Slew Rate: 6 V/μs
- Low THD + Noise: 0.0007% (f = 1 kHz)
- Low Quiescent Current: 750 nA/Channel
- Single, Dual, and Quad Versions

## Applications

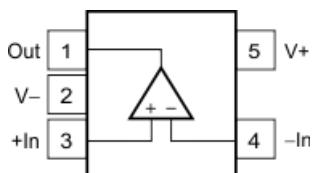
- Driving A/D Converters
- PCMCIA Cards
- Data Acquisition
- Process Control
- Audio Processing
- Communications
- Active Filters
- Test Equipment

### OPA340 in Noninverting Configuration Driving ADS7816

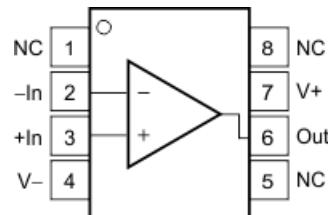


## Pin Configuration and Functions

**OPA340: 5-Pin SOT-23  
Top View**



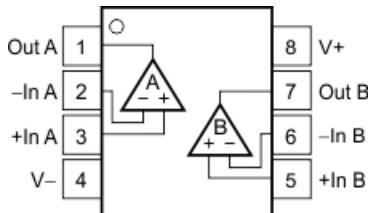
**OPA340: 8-Pin SOP-8  
Top View**



**Pin Functions: OPA340**

PIN			I/O	DESCRIPTION
NAME	SOT-23	SOP		
-IN	4	2	I	Negative (inverting) input
+IN	3	3	I	Positive (noninverting) input
NC	—	1, 5, 8	—	No internal connection (can be left floating)
OUT	1	6	O	Output
V-	2	4	—	Negative (lowest) power supply
V+	5	7	—	Positive (highest) power supply

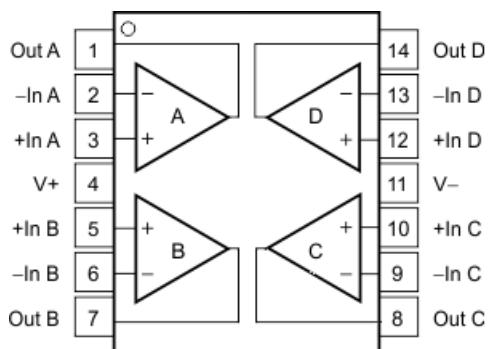
**OPA2340: 8-Pin SOP-8  
Top View**



**Pin Functions: OPA2340**

PIN			I/O	DESCRIPTION
NAME	SOP			
-IN A	2	I	Negative (inverting) input channel A	
+IN A	3	I	Positive (noninverting) input channel A	
-IN B	6	I	Negative (inverting) input channel B	
+IN B	5	I	Positive (noninverting) input channel B	
OUT A	1	O	Output channel A	
OUT B	7	O	Output channel B	
V-	4	—	Negative (lowest) power supply	
V+	8	—	Positive (highest) power supply	

**OPA4340: Package  
SOP-14  
Top View**



**Pin Functions: OPA4340**

NAME	PIN	I/O	DESCRIPTION
	SOP		
-IN A	2	I	Negative (inverting) input channel A
-IN B	6	I	Negative (inverting) input channel B
-IN C	9	I	Negative (inverting) input channel C
-IN D	13	I	Negative (inverting) input channel D
+IN A	3	I	Positive (noninverting) input channel A
+IN B	5	I	Positive (noninverting) input channel B
+IN C	10	I	Positive (noninverting) input channel C
+IN D	12	I	Positive (noninverting) input channel D
NC	—	—	No internal connection (can be left floating)
OUT A	1	O	Output, channel A
OUT B	7	O	Output, channel B
OUT C	8	O	Output, channel C
OUT D	14	O	Output, channel D
V-	11	—	Negative (lowest) power supply
V+	4	—	Positive (highest) power supply

## Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

		MIN	MAX	UNIT
Voltage	Supply voltage		5.5	V
	Signal input terminals <sup>(2)</sup>	-0.5	0.5	
Current	Signal input terminals <sup>(2)</sup>		10	mA
	Output short circuit <sup>(3)</sup>		Continuous	
Temperature	Operating, T <sub>A</sub>	-55	125	°C
	Junction, T <sub>J</sub>		150	
	Storage, T <sub>stg</sub>	-55	125	

- (1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5 V beyond the supply rails should be current limited to 10 mA or less.
- (3) Short-circuit to ground, one amplifier per package.

## ESD Ratings

		VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>	±600
		Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup>	±250

## Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	MAX	UNIT
Supply voltage		2.7	5.5	V
Specified temperature		-40	125	°C

## Thermal Information OPA340

THERMAL METRIC <sup>(1)</sup>	OPA340			UNIT	
	(SOT-23)	(SOP)	(SOP)		
		5 PINS	8 PINS		
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	207.9	142	83.8	°C/W
R <sub>θJC(top)</sub>	Junction-to-case (top) thermal resistance	71.2	90.2	70.7	°C/W
R <sub>θJB</sub>	Junction-to-board thermal resistance	36.0	82.5	59.5	°C/W
Ψ <sub>JT</sub>	Junction-to-top characterization parameter	2.0	39.4	11.6	°C/W
Ψ <sub>JB</sub>	Junction-to-board characterization parameter	35.2	82	37.7	°C/W
R <sub>θJC(bot)</sub>	Junction-to-case (bottom) thermal resistance	—	—	—	°C/W

**Thermal Information – OPA2340**

THERMAL METRIC <sup>(1)</sup>		OPA2340		UNIT	
		(SOP)			
		8 PINS			
R <sub>0JA</sub>	Junction-to-ambient thermal resistance	138.4		°C/W	
R <sub>0JC(top)</sub>	Junction-to-case (top) thermal resistance	89.5		°C/W	
R <sub>0JB</sub>	Junction-to-board thermal resistance	78.6		°C/W	
Ψ <sub>JT</sub>	Junction-to-top characterization parameter	29.9		°C/W	
Ψ <sub>JB</sub>	Junction-to-board characterization parameter	78.1		°C/W	
R <sub>0JC(bot)</sub>	Junction-to-case (bottom) thermal resistance	—		°C/W	

**Electrical Characteristics**At T<sub>A</sub> = 25°C, R<sub>L</sub> = 10 kΩ connected to V<sub>S</sub>/2, and V<sub>OUT</sub> = V<sub>S</sub>/2, unless otherwise noted.

PARAMETER		TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
V <sub>OS</sub>	Input offset voltage	V <sub>S</sub> = 5 V		±150	±500	µV
dV <sub>OS</sub> /dt	Input offset voltage vs temperature	T <sub>A</sub> = -40°C to 85°C, V <sub>S</sub> = 5 V		±2.5		µV/°C
PSRR	Input offset voltage vs power supply	V <sub>S</sub> = 2.7 V to 5.5 V, V <sub>CM</sub> = 0 V		30	120	µV/V
		V <sub>S</sub> = 2.7 V to 5.5 V, V <sub>CM</sub> = 0 V, T <sub>A</sub> = -40°C to 85°C, V <sub>S</sub> = 5 V			120	µV/°C
Channel separation, DC				0.2		µV/V
I <sub>S</sub>	Input bias current			±0.2	±10	pA
		Over temperature T <sub>A</sub> = -40°C to 85°C, V <sub>S</sub> = 5 V			±60	
I <sub>OS</sub>	Input offset current			±0.2	±10	pA
Input voltage noise		f = 0.1 kHz to 50 kHz		8		µV <sub>RMS</sub>
e <sub>n</sub>	Input voltage noise density	f = 1 kHz		25		nV/√Hz
i <sub>n</sub>	Current noise density	f = 1 kHz		3		fA/√Hz
V <sub>CM</sub>	Common-mode voltage range		-0.3		(V+) + 0.3	V
CMRR	Common-mode rejection ratio	-0.3 V < V <sub>CM</sub> < (V+) - 1.8 V	80	92		dB
		V <sub>S</sub> = 5 V, -0.3 V < V <sub>CM</sub> < 5.3 V	70	84		
		V <sub>S</sub> = 2.7 V, -0.3 V < V <sub>CM</sub> < 3 V	66	80		

(1) V<sub>S</sub> = 5 V.

**Electrical Characteristics (continued)**

At  $T_A = 25^\circ\text{C}$ ,  $R_L = 10 \text{ k}\Omega$  connected to  $V_S/2$ , and  $V_{\text{OUT}} = V_S/2$ , unless otherwise noted.

PARAMETER		TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
Differential				$10^{13} \parallel 3$		$\Omega \parallel \text{pF}$
Common-mode				$10^{13} \parallel 6$		$\Omega \parallel \text{pF}$
$A_{\text{OL}}$	Open-loop voltage gain	$R_L = 100 \text{ k}\Omega$ , $5 \text{ mV} < V_O < (V+) - 5 \text{ mV}$	106	124		dB
		$R_L = 10 \text{ k}\Omega$ , $5 \text{ mV} < V_O < (V+) - 50 \text{ mV}$	100	120		
		$R_L = 2 \text{ k}\Omega$ , $200 \text{ mV} < V_O < (V+) - 200 \text{ mV}$	94	114		
	Over temperature	$R_L = 100 \text{ k}\Omega$ , $5 \text{ mV} < V_O < (V+) - 5 \text{ mV}$ , $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ , $V_S = 5 \text{ V}$	106			
		$R_L = 10 \text{ k}\Omega$ , $5 \text{ mV} < V_O < (V+) - 50 \text{ mV}$ , $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ , $V_S = 5 \text{ V}$	100			
		$R_L = 2 \text{ k}\Omega$ , $200 \text{ mV} < V_O < (V+) - 200 \text{ mV}$ , $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ , $V_S = 5 \text{ V}$	94			
GBW	Gain-bandwidth product	$G = 1$		5.5		MHz
SR	Slew rate	$V_S = 5 \text{ V}$ , $G = 1$ , $C_L = 100 \text{ pF}$		6		$\text{V}/\mu\text{s}$
	Settling time, 0.1%	$V_S = 5 \text{ V}$ , 2-V step, $C_L = 100 \text{ pF}$		1		$\mu\text{s}$
	Settling time, 0.01%	$V_S = 5 \text{ V}$ , 2-V step, $C_L = 100 \text{ pF}$		1.6		$\mu\text{s}$
	Overload recovery time	$V_{\text{IN}} \times G = V_S$		0.2		$\mu\text{s}$
THD+N	Total harmonic distortion + noise	$V_S = 5 \text{ V}$ , $V_O = 3V_{\text{PP}}^{(2)}$ , $G = 1$ , $f = 1 \text{ kHz}$		0.0007%		
Voltage output swing from rail <sup>(2)</sup>		$R_L = 100 \text{ k}\Omega$ , $A_{\text{OL}} \geq 106 \text{ dB}$		1	5	mV
		$R_L = 10 \text{ k}\Omega$ , $A_{\text{OL}} \geq 106 \text{ dB}$		10		
		$R_L = 2 \text{ k}\Omega$ , $A_{\text{OL}} \geq 106 \text{ dB}$		40		
	Over temperature	$R_L = 100 \text{ k}\Omega$ , $A_{\text{OL}} \geq 106 \text{ dB}$ , $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ , $V_S = 5 \text{ V}$			5	
		$R_L = 10 \text{ k}\Omega$ , $A_{\text{OL}} \geq 106 \text{ dB}$ , $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ , $V_S = 5 \text{ V}$			50	
		$R_L = 2 \text{ k}\Omega$ , $A_{\text{OL}} \geq 106 \text{ dB}$ , $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ , $V_S = 5 \text{ V}$			200	
$I_{\text{SC}}$	Short-circuit current			$\pm 50$		mA
$C_{\text{LOAD}}$	Capacitive load drive		See Typical Characteristics			
$V_S$	Specified voltage range		2.7	5		V
$I_Q$	Operating voltage range	Lower end		2.5		V
		Higher end		5.5		
	Quiescent current (per amplifier)	$I_O = 0$ , $V_S = 5 \text{ V}$		750	950	$\mu\text{A}$
	Over temperature	$I_O = 0$ , $V_S = 5 \text{ V}$ , $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$			100	
	Specified range		-40		85	$^\circ\text{C}$
	Operating range		-55		125	$^\circ\text{C}$
	Storage range		-55		125	$^\circ\text{C}$

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

### Typical Characteristics

At  $T_A = 25^\circ\text{C}$ ,  $V_S = 5 \text{ V}$ , and  $R_L = 10 \text{ k}\Omega$  connected to  $V_S/2$ , unless otherwise noted.

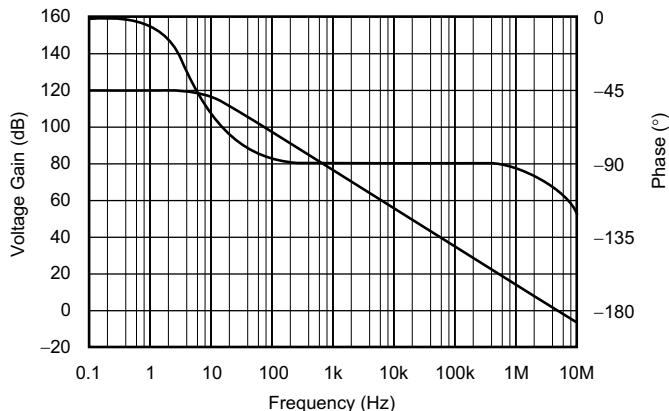


Figure 1. Open-Loop Gain/Phase vs Frequency

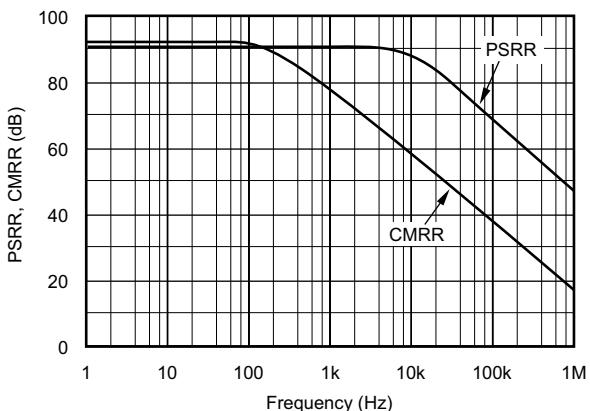


Figure 2. Power-Supply and Common-Mode Rejection vs Frequency

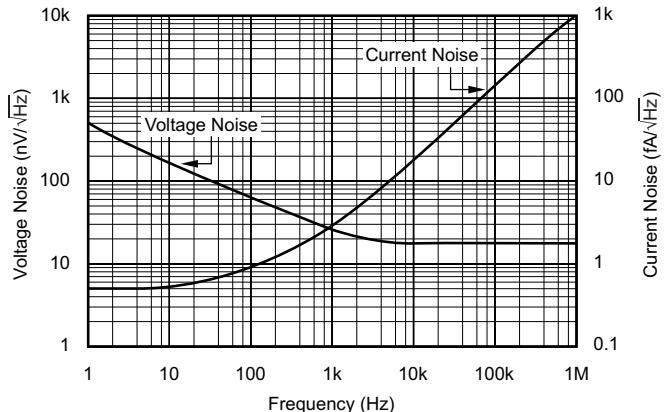


Figure 3. Input Voltage and Current Noise Spectral Density vs Frequency

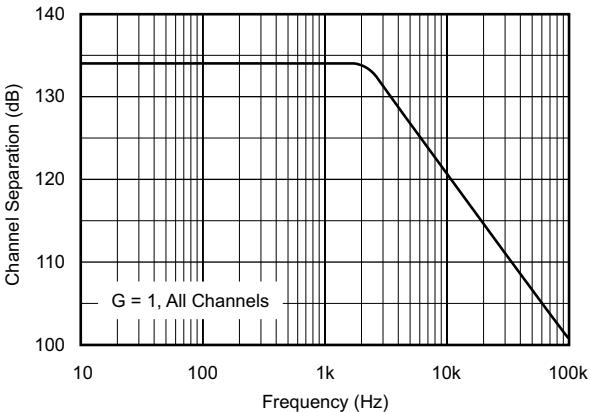


Figure 4. Channel Separation vs Frequency

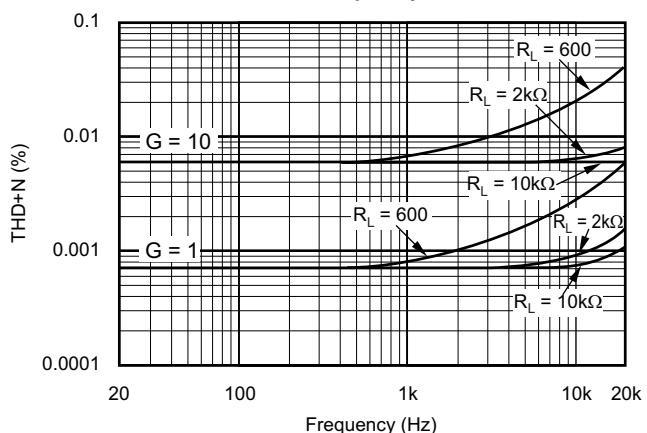


Figure 5. Total Harmonic Distortion + Noise vs Frequency

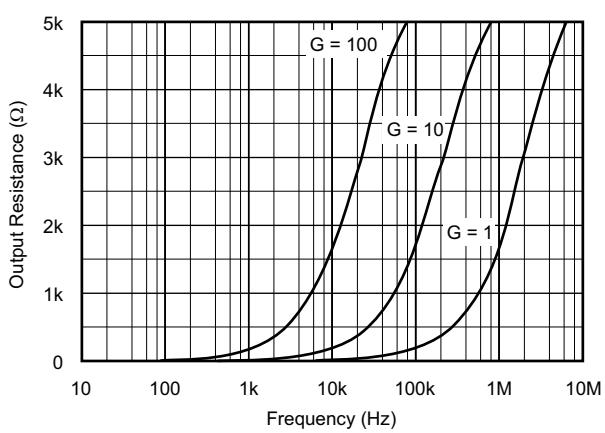


Figure 6. Closed-Loop Output Impedance vs Frequency

## Typical Characteristics

At  $T_A = 25^\circ\text{C}$ ,  $V_S = 5\text{ V}$ , and  $R_L = 10\text{ k}\Omega$  connected to  $V_S/2$ , unless otherwise noted.

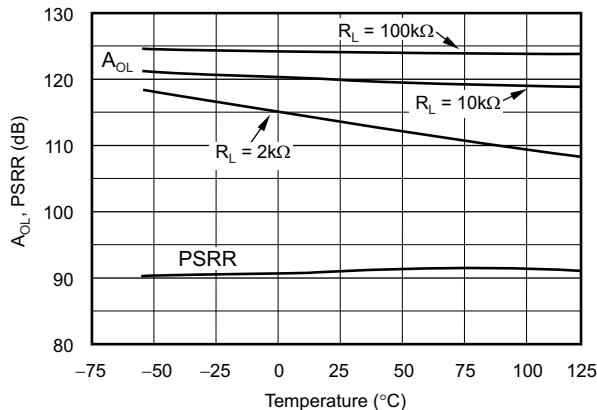


Figure 7. Open-Loop Gain and Power-Supply Rejection vs Temperature

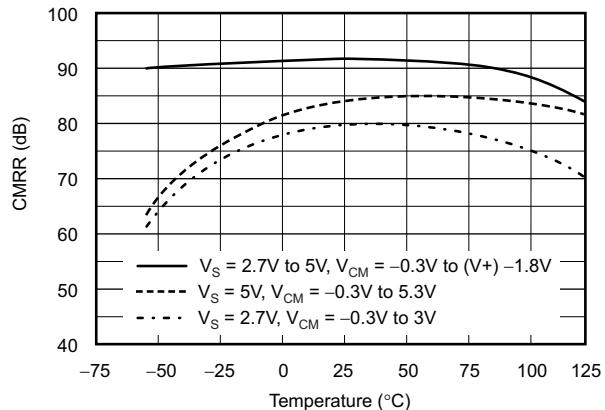


Figure 8. Common-Mode Rejection vs Temperature

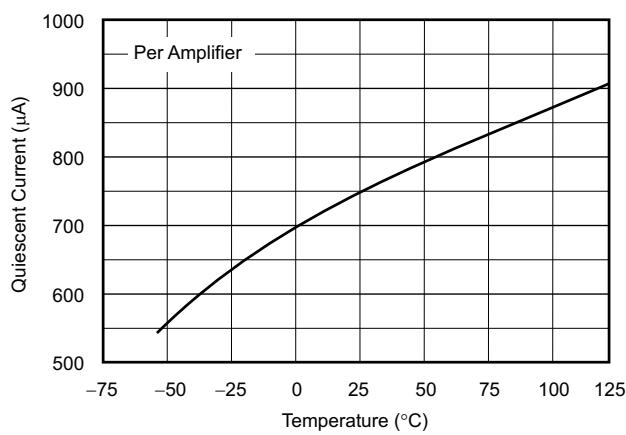


Figure 9. Quiescent Current vs Temperature

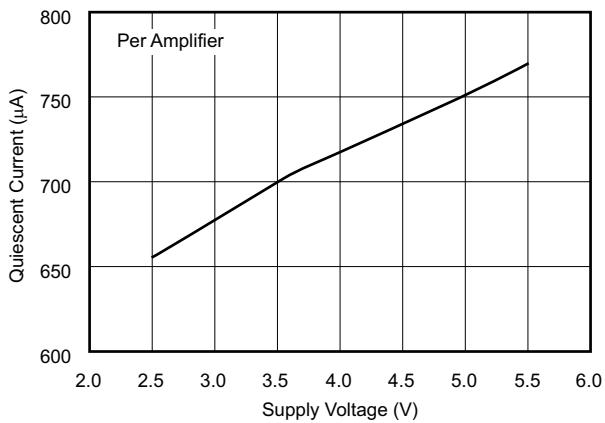


Figure 10. Quiescent Current vs Supply Voltage

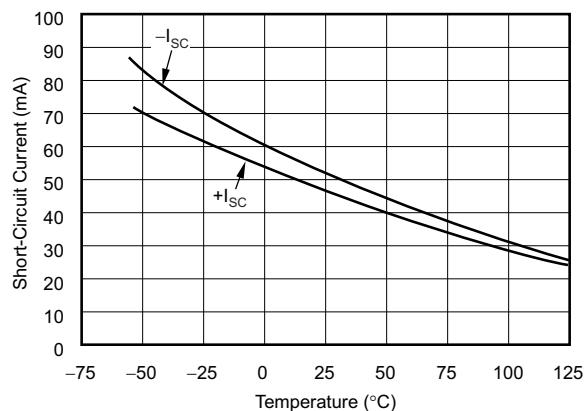


Figure 11. Short-Circuit Current vs Temperature

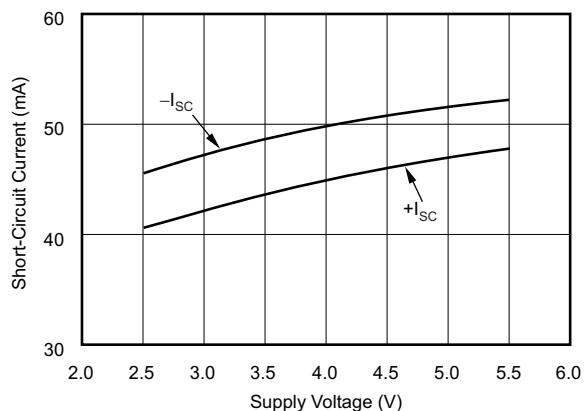


Figure 12. Short-Circuit Current vs Supply Voltage

## Typical Characteristics

At  $T_A = 25^\circ\text{C}$ ,  $V_S = 5 \text{ V}$ , and  $R_L = 10 \text{ k}\Omega$  connected to  $V_S/2$ , unless otherwise noted.

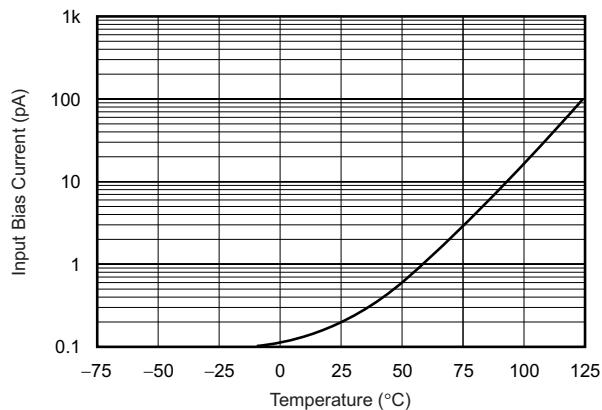


Figure 13. Input Bias Current vs Temperature

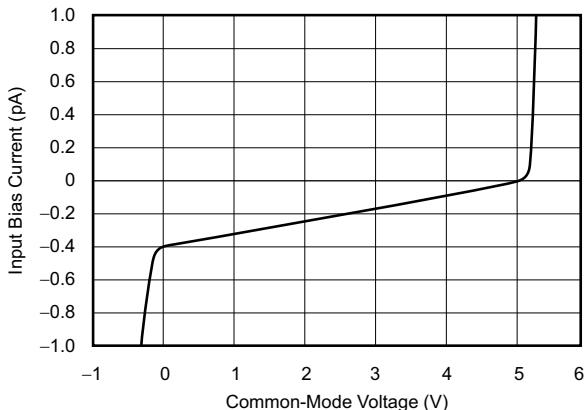


Figure 14. Input Bias Current vs Input Common-Mode Voltage

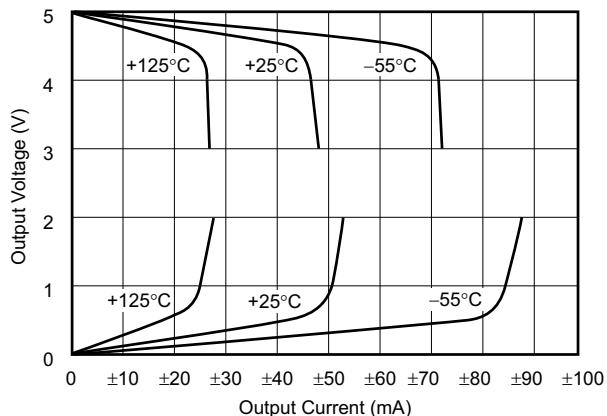


Figure 15. Output Voltage Swing vs Output Current

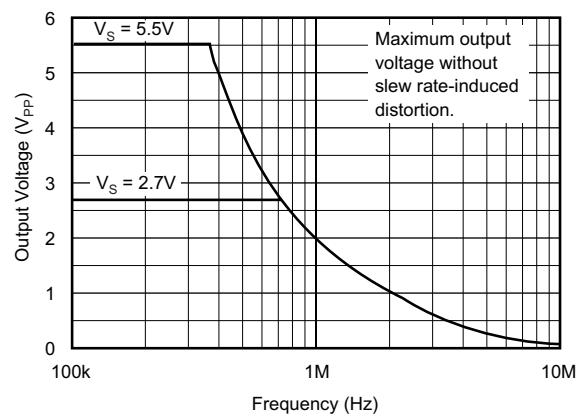


Figure 16. Maximum Output Voltage vs Frequency

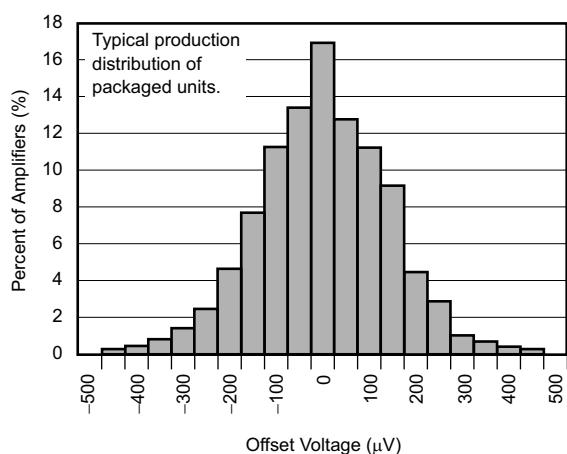


Figure 17. Offset Voltage Production Distribution

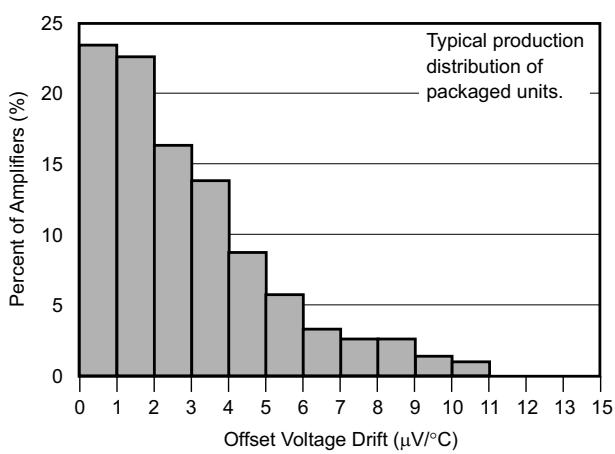
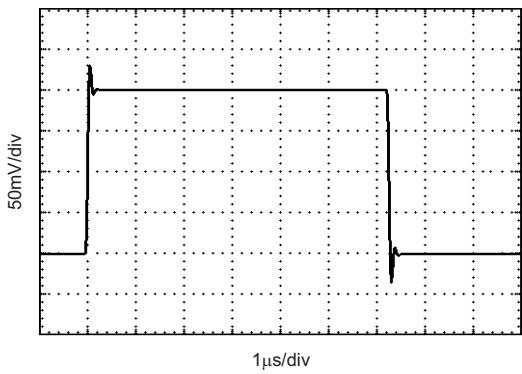


Figure 18. Offset Voltage Drift Magnitude Production Distribution

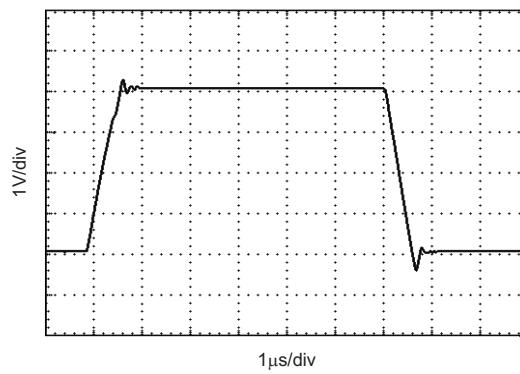
### Typical Characteristics

At  $T_A = 25^\circ\text{C}$ ,  $V_S = 5 \text{ V}$ , and  $R_L = 10 \text{ k}\Omega$  connected to  $V_S/2$ , unless otherwise noted.



$C_L = 100 \text{ pF}$

Figure 19. Small-Signal Step Response



$C_L = 100 \text{ pF}$

Figure 20. Large-Signal Step Response

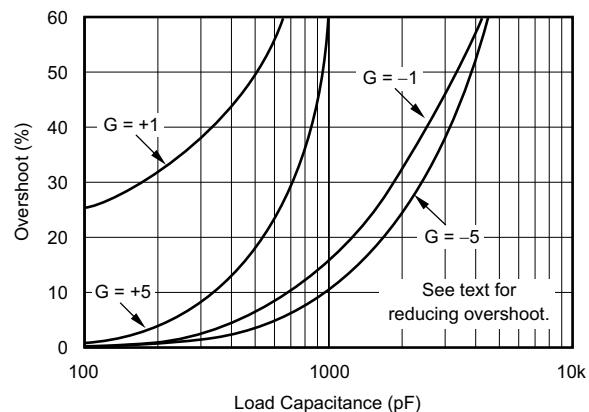


Figure 21. Small-Signal Overshoot vs Load Capacitance

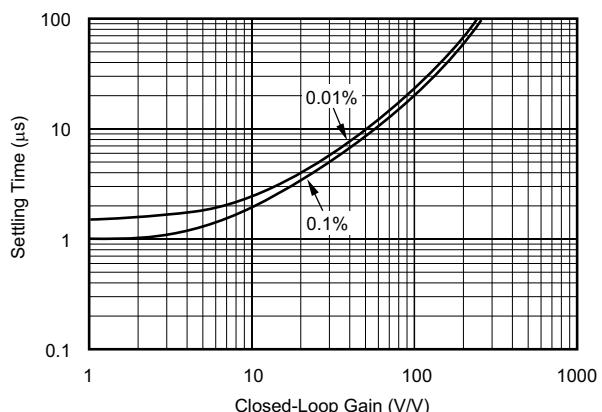
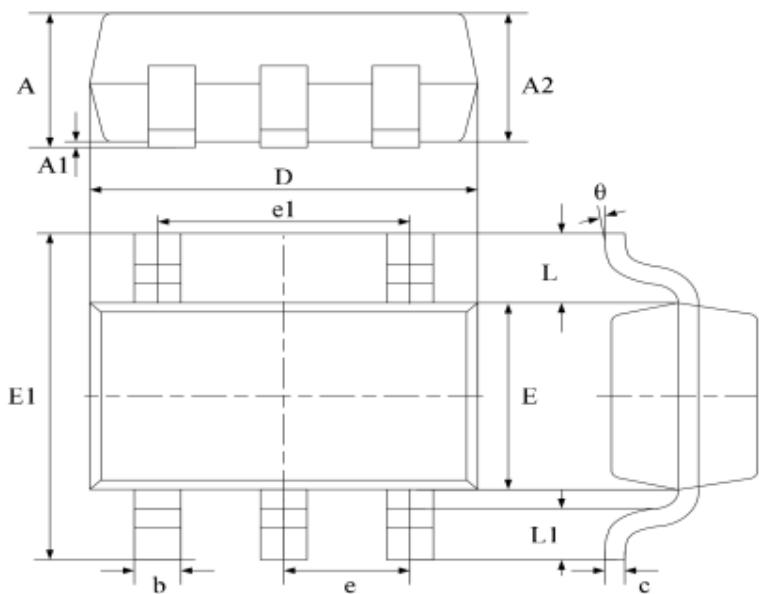
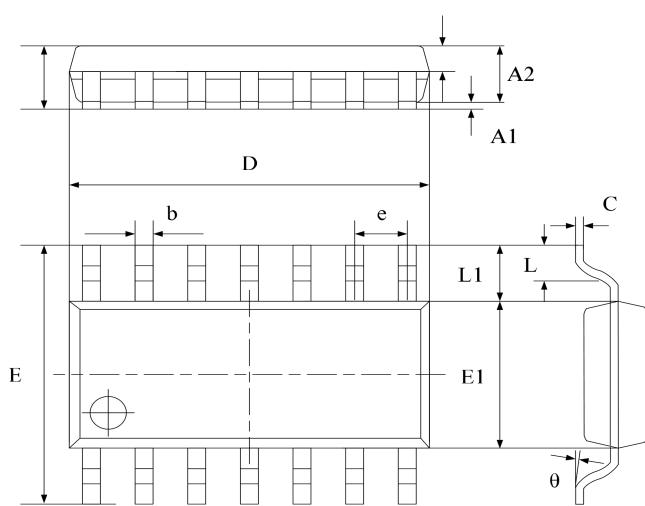


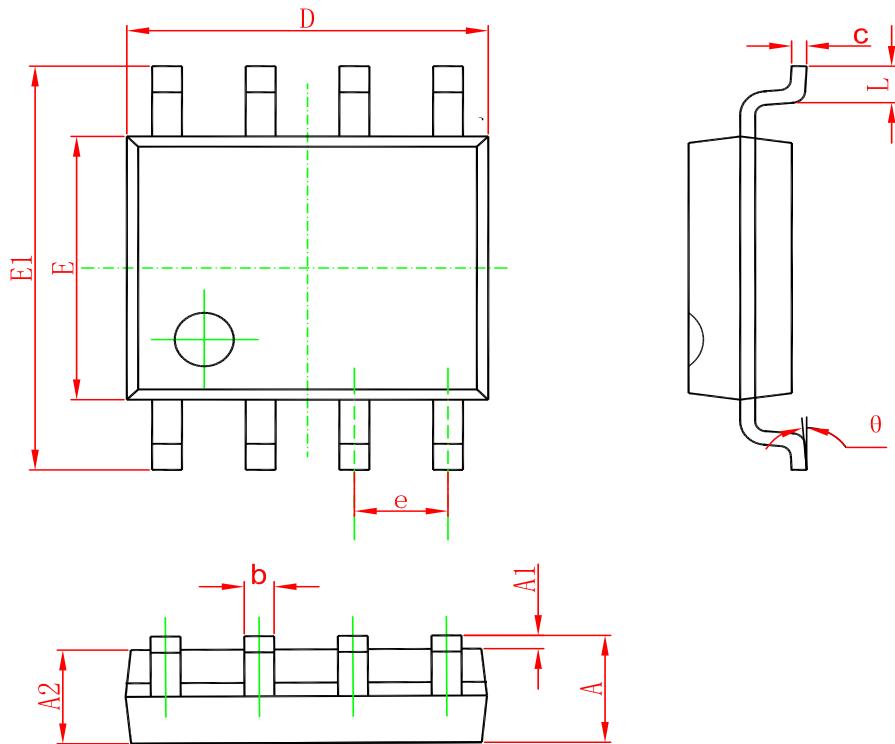
Figure 22. Settling Time vs Closed-Loop Gain

**Package Dimension****SOT23-5**

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.040	1.350	0.042	0.055
A1	0.040	0.150	0.002	0.006
A2	1.000	1.200	0.041	0.049
b	0.380	0.480	0.015	0.020
c	0.110	0.210	0.004	0.009
D	2.720	3.120	0.111	0.127
E	1.400	1.800	0.057	0.073
E1	2.600	3.000	0.106	0.122
e	0.950 typ.		0.037 typ.	
e1	1.900 typ.		0.078 typ.	
L	0.700 ref.		0.028 ref.	
L1	0.300	0.600	0.012	0.024
θ	0°		8°	

**SOP-14**

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.450	1.850	0.059	0.076
A1	0.100	0.300	0.004	0.012
A2	1.350	1.550	0.055	0.063
A3	0.550	0.750	0.022	0.031
b	0.406typ.		0.017typ.	
C	0.203typ.		0.008typ.	
D	8.630	8.830	0.352	0.360
E	5.840	6.240	0.238	0.255
E1	3.850	4.050	0.157	0.165
e	1.270 typ.		0.050 typ.	
L1	1.040 ref.		0.041 ref.	
L	0.350	0.750	0.014	0.031
θ	2°	8°	2°	8°

**SOP-8**

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

## Ordering information

Order code	Package	Baseqty	Deliverymode	Marking
UMW OPA4340UA	SOP-14	2500	Tape and reel	OPA4340UA
UMW OPA2340UA	SOP-8	2500	Tape and reel	OPA2340UA
UMW OPA340UA	SOP-8	2500	Tape and reel	OPA340UA
UMW OPA340NA	SOT23-5	3000	Tape and reel	A40 U