50-µV V_{OS}, 0.25-µV/°C, 35-µA CMOS Operational Amplifiers Zero-Drift Series

Description

The OPA2330AIDR of CMOS operational amplifiers offer precision performance at a very competitive price. These devices are members simultaneously provide low offset voltage (50-µV maximum) and near-zero drift over time and temperature at only 35 µA (maximum) of quiescent current. The OPA330 family features rail-to-rail input and output in addition to near-flat 1/f noise, making this amplifier ideal for many applications and much easier to design into a system. These devices are optimized for low-voltage operation as low as 1.8 V (±0.9 V) and up to 5.5 V (±2.75 V).

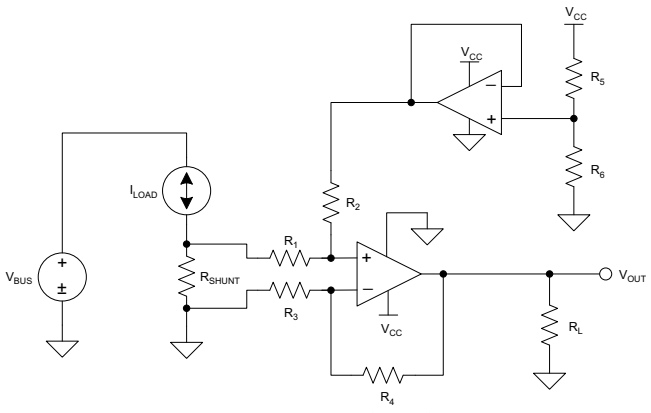
Applications

- Battery-Powered Instruments
- Temperature Measurements
- Transducer Applications
- Electronic Scales
- Medical Instrumentation
- Handheld Test Equipment
- Current Sense

Features

- Unmatched Price Performance
- Low Offset Voltage: 50 µV (Maximum)
- Zero Drift: 0.25 µV/°C (Maximum)
- Low Noise: 1.1 μV_{PP}, 0.1 Hz to 10 Hz
- Quiescent Current: 35 µA (Maximum)
- Supply Voltage: 1.8 V to 5.5 V
- Rail-to-Rail Input and Output
- Internal EMI Filtering

Bidirectional, Low-Side Current Sense



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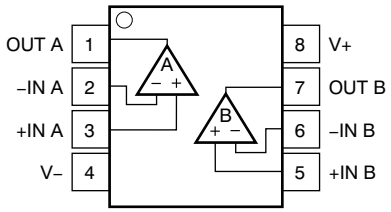
OPA2330:SOP-8 Top View



Pin Functions: OPA2330

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

Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

		MIN	MAX	UNIT
Voltage	Supply, V_S = (V+) – (V–)		7	V
	Signal input terminals(2) (TBD should terminal be pin?)	(V–) –0.3	(V+) + 0.3	V
Current	Signal input terminals(2)	–10	10	mA
	Output short-circuit(3)	Continuous		
Temperature	Operating range, T_A	–40	150	°C
	Junction, T_J		150	°C
	Storage, T_{stg}	–65	150	°C

ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±4000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101(2)	±1000	
		Machine model (MM)	±400	

Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
(V+) – (V–)	Supply voltage	±0.9 (1.8)	±2.5 (5)	±2.75 (5.5)	V
T_A	Specified temperature	–40	25	125	°C

Thermal Information: OPA2330

THERMAL METRIC(1)		OPA2330 (SOP) 8 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	124	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	73.7	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	64.4	°C/W
ψ_{JT}	Junction-to-top characterization parameter	18	°C/W
ψ_{JB}	Junction-to-board characterization parameter	63.9	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	—	°C/W

Electrical Characteristics

at T_A = 25°C, R_L = 10 kΩ connected to midsupply, V_S = 1.8 V to 5.5 V, and V_{CM} = V_{OUT} = midsupply (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{OS}	Input offset voltage	V_S = 5 V			8	50	µV
dV_{OS}/dT	Input offset voltage versus temperature	At T_A = –40°C to +125°C			0.02	0.25	µV/°C
PSRR	Input offset voltage versus power supply	At T_A = –40°C to +125°C			1	10	µV/V
	Long-term stability(1)	V_S = 1.8 V to 5.5 V			See (1)		
	Channel separation, dc				0.1		µV/V
I_B	Input bias current	At 25°C			±200	±500	pA
							pA
		At T_A = –40°C to +125°C			±300		pA
I_{OS}	Input offset current	At 25°C			±400	±1000	pA
							pA
e_n	Input voltage noise density	f = 1 kHz			55		nV/√Hz
	Input voltage noise	f = 0.01 Hz to 1 Hz			0.3		$µV_{PP}$
		f = 0.1 Hz to 10 Hz			1.1		$µV_{PP}$
i_n	Input current noise	f = 10 Hz			100		fA/√Hz
V_{CM}	Common-mode voltage range			(V–) – 0.1		(V+) + 0.1	V
CMRR	Common-mode rejection ratio	At T_A = –40°C to +125°C, (V–) – 0.1 V < V_{CM} < (V+) + 0.1 V		100	115		dB
		At T_A = –40°C to +125°C, (V–) – 0.1 V < V_{CM} < (V+) + 0.1 V, V_S = 5.5 V					dB
							dB
	Differential				2		pF
	Common-mode				4		pF
A_{OL}	Open-loop voltage gain	At T_A = –40°C to +125°C, (V–) + 100 mV < V_O < (V+) – 100 mV, R_L = 10 kΩ		100	115		dB
GBW	Gain-bandwidth product	C_L = 100 pF			350		kHz
SR	Slew rate	G = +1			0.16		V/µs
	Voltage output swing from rail	At T_A = –40°C to +125°C			30	100	mV
I_{SC}	Short-circuit current				±5		mA
C_L	Capacitive load drive			See Typical Characteristics			
	Open-loop output impedance	f = 350 kHz, I_O = 0 mA			2		kΩ
V_S	Specified voltage range			1.8		5.5	V
I_Q	Quiescent current per amplifier	At T_A = –40°C to +125°C, I_O = 0 mA			21	35	µA
	Turnon time	V_S = 5 V			100		µs

(1) 300-hour life test at 150°C demonstrated randomly distributed variation of approximately 1 µV.

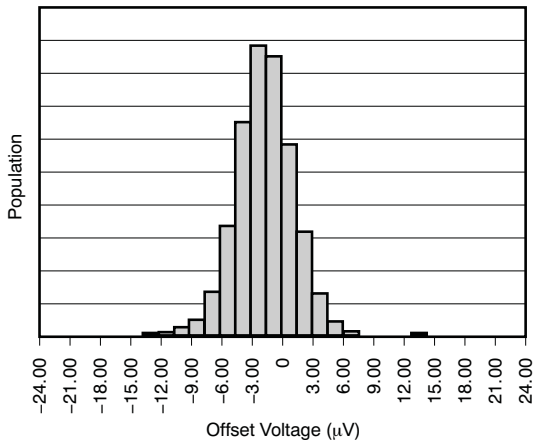


Figure 1. Offset Voltage Production Distribution

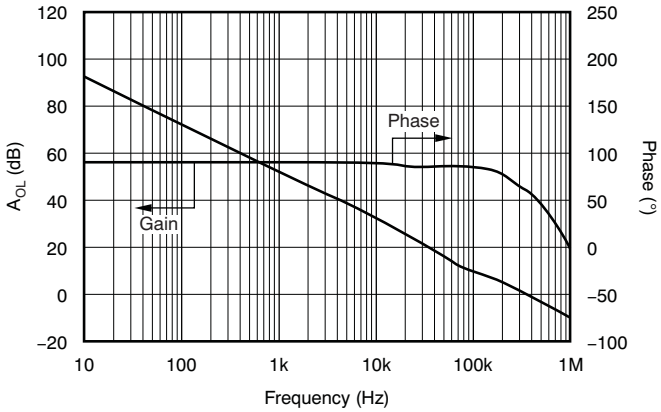


Figure 2. Open-Loop Gain vs Frequency

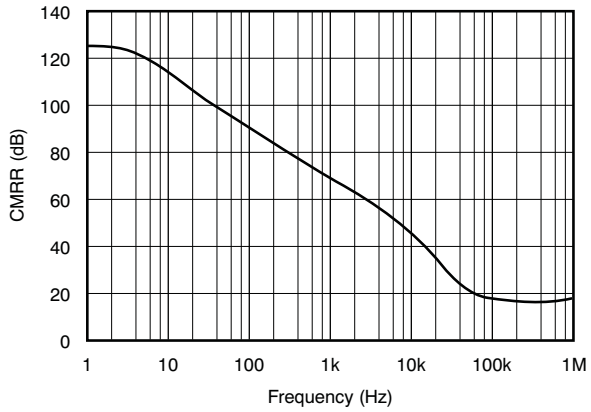


Figure 3. Common-Mode Rejection Ratio vs Frequency

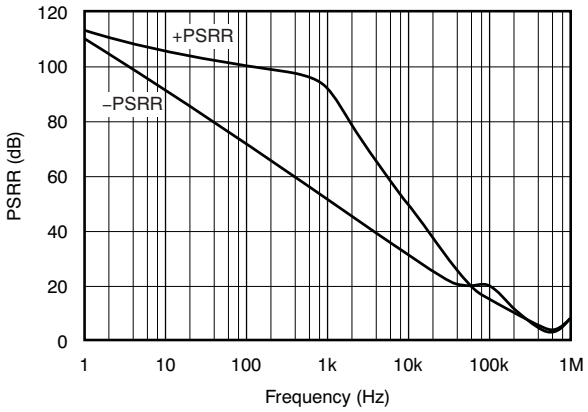


Figure 4. Power-Supply Rejection Ratio vs Frequency

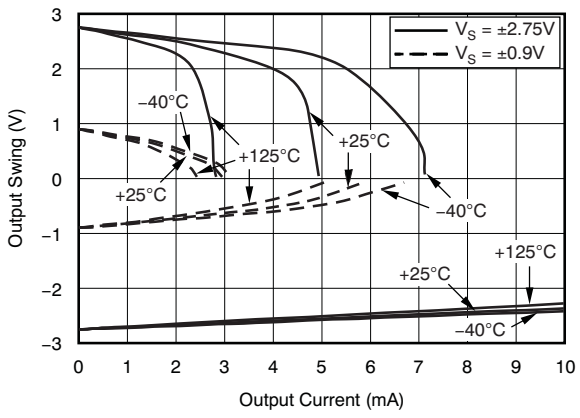


Figure 5. Output Voltage Swing vs Output Current

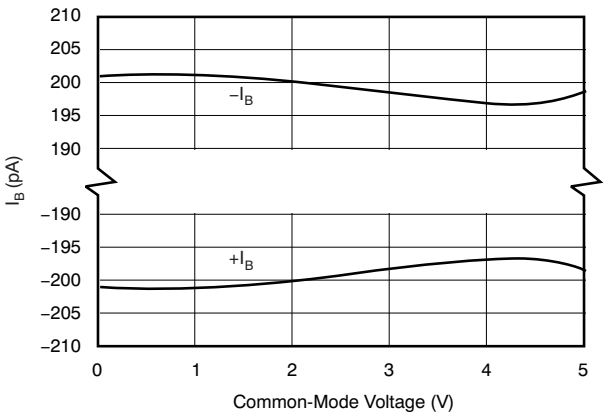


Figure 6. Input Bias Current vs Common-Mode Voltage

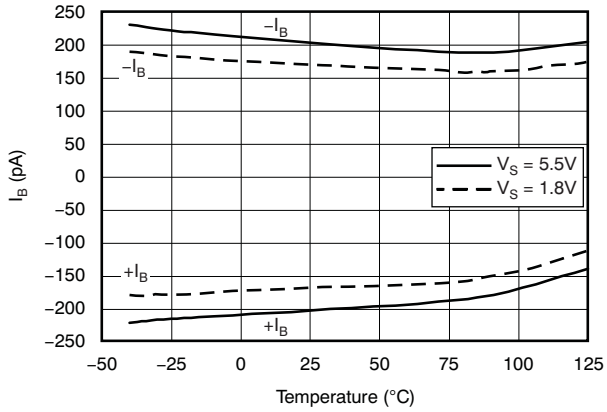


Figure 7. Input Bias Current vs Temperature

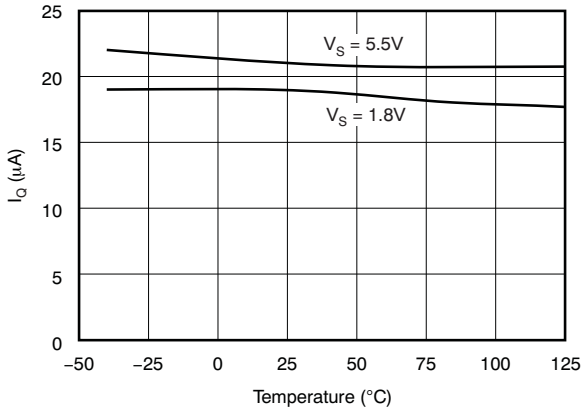


Figure 8. Quiescent Current vs Temperature

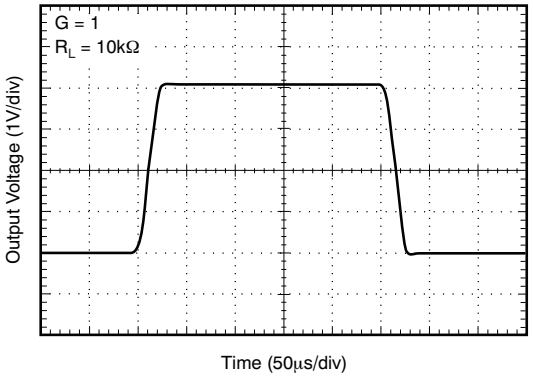


Figure 9. Large-Signal Step Response

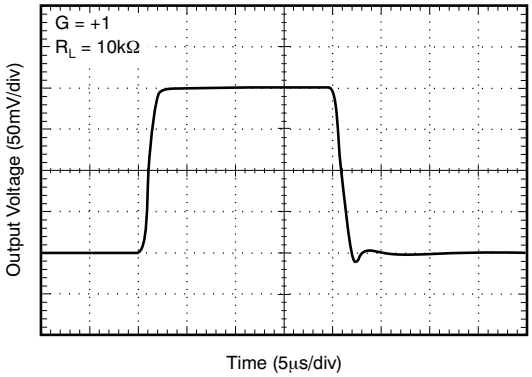


Figure 10. Small-Signal Step Response

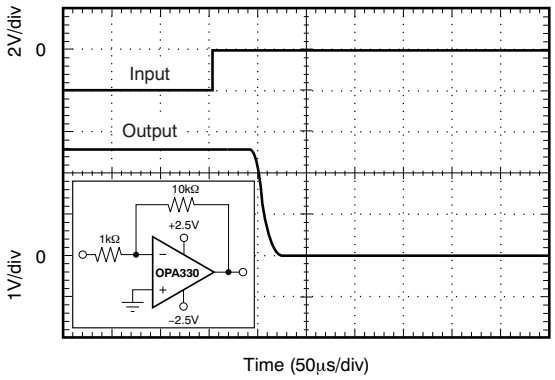


Figure 11. Positive Overvoltage Recovery

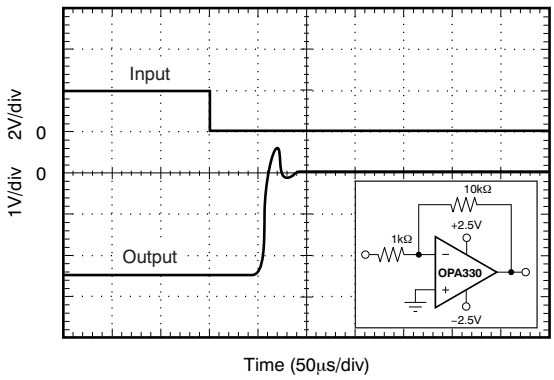


Figure 12. Negative Overvoltage Recovery

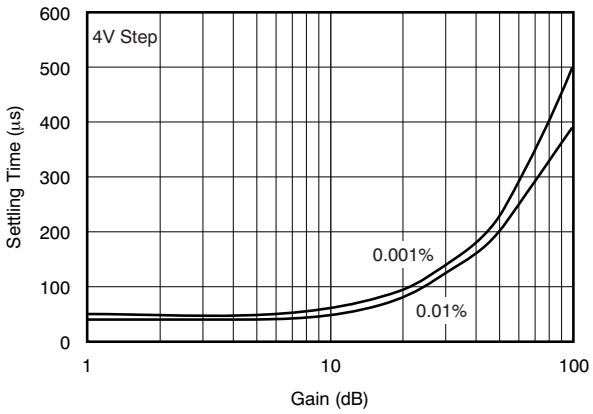


Figure 13. Settling Time vs Closed-Loop Gain

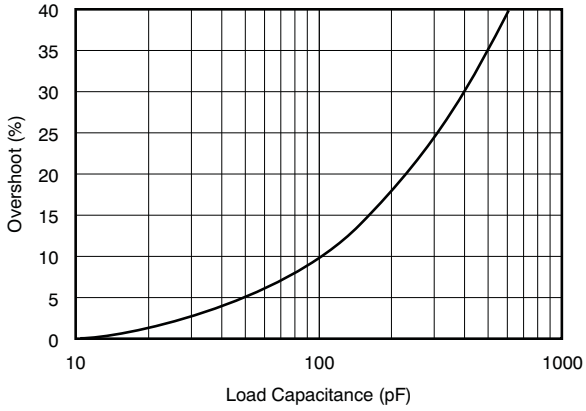


Figure 14. Small-Signal Overshoot vs Load Capacitance

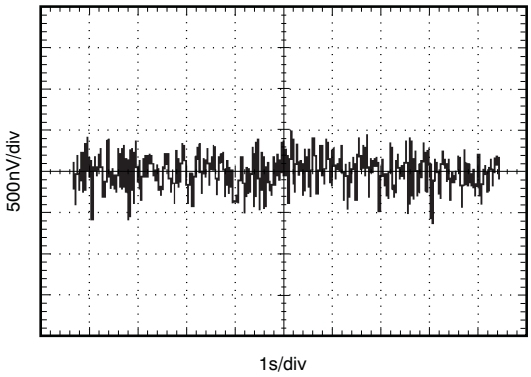


Figure 15. 0.1-Hz to 10-Hz Noise

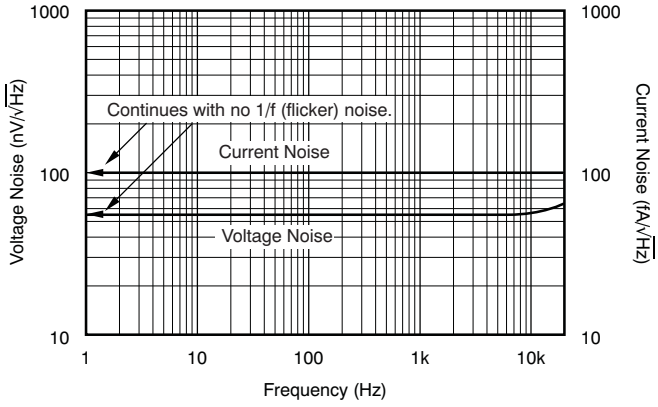


Figure 16. Current and Voltage Noise Spectral Density vs Frequency

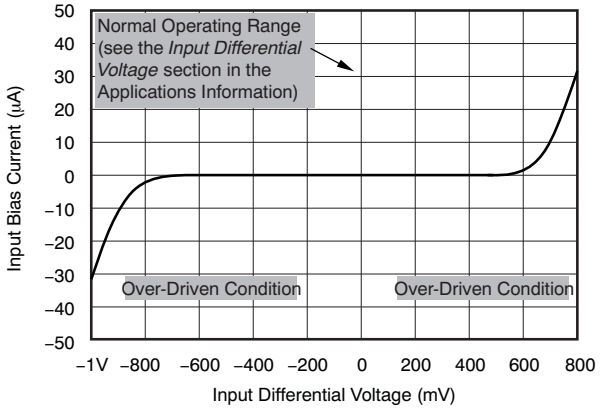
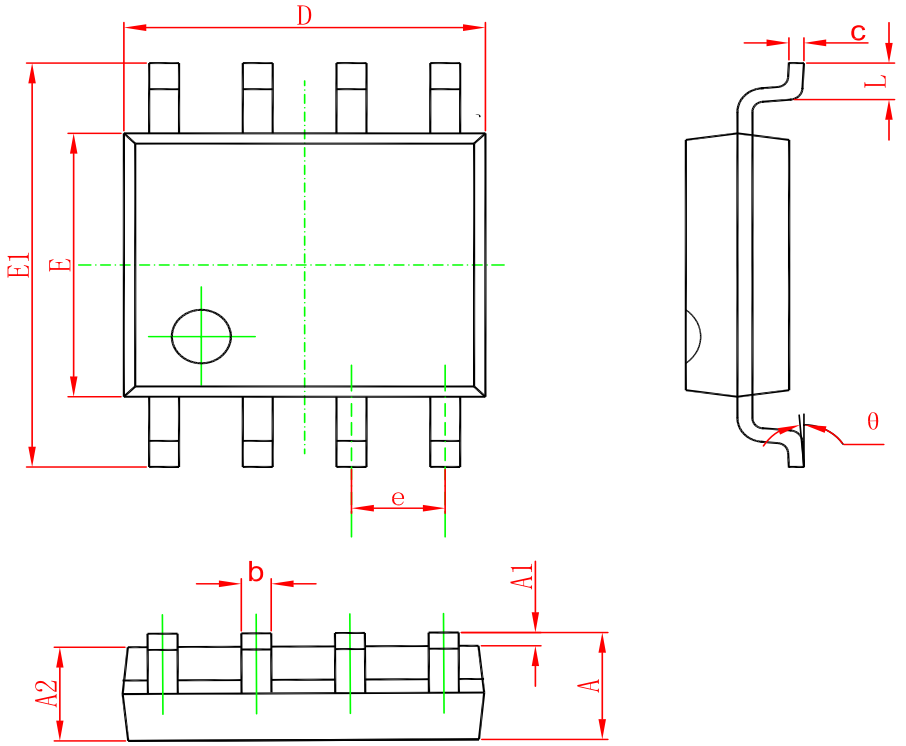


Figure 17. Input Bias Current vs Input Differential Voltage

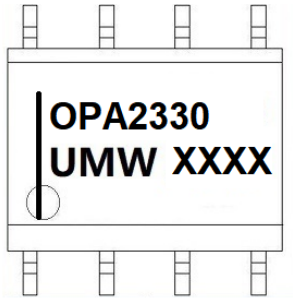
Package Dimension

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°

Marking



Ordering information

Order code	Package	Baseqty	Deliverymode
UMW OPA2330AIDR	SOP-8	2500	Tape and reel