MSKSEMI 美森科
SEMICONDUCTOR

ESD TVS TSS MOV GDT PLED

OPA330AIDBVR-MS/OPA2330AIDR-MS

Product specification

GENERAL DESCRIPTION

The OPAx330 series of CMOS operational amplifiers use a proprietary auto-calibration technique to simulta neously provide very low offset voltage (±4uV,maximum)and near-zero drift over time and temperature. These miniature,high-precision,low quiescent current (13.5uA)amplifiers offer high impedance inputs that have a com mon-mode range 100 mV beyond the rails,and rail-to-rail output that swings within 50 mV of the rails.Single or dual supplies as low as 1.8 V(±0.9 V)and up to 5.5 V(+2.75 V)can be used.These devices are optimized for low voltage, single-supply operation.

The OPA330AIDBVR-MS(single version)is available in the 5-pin SOT23, while the OPA2330AIDR-MS(dual ve rsion)is available in the 8-pin SOIC and packages.All versions are specified for operation from -25°℃ to 12 5℃.

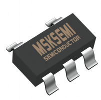
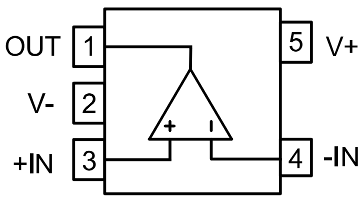
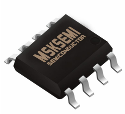
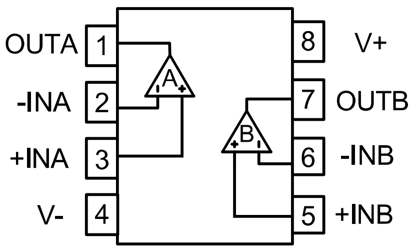
FEATURES

- Input Offset Voltage:±1μV(Typ)
- Zero Drift:0.01μV/℃(Typ)
- 0.01Hz-10Hz Noise:1.5μVpp
- Quiescent Current:13.5μA
- High Open-Loop Gain:150dB
- Single or Dual Supply Operation
- Supply Voltage:1.8V to 5.5V
- Rail-to-Rail Input/Output
- Micro Size Packages:
  OPA330AIDBVR-MS:SOT-23-5
  OPA2330AIDR-MS:SOP-8

TYPICALAPPLICATIONS

- Temperature Sensors
- Active Filtering
- Transducers
- Electronic Scales
- Temperature Measurements
- Medical Instrumentation
- Battery-Powered Instruments
- Handheld Test Equipment

PACKAGE/ORDER INFORMATION

Part Number	Op Temp(℃)	Package		Pin Configuration	Marking	QTY
OPA330AIDBVR-MS	-25°C~125℃	SOT23-5			OCFQ	3000
OPA2330AIDR-MS	-25°C~125℃	SOP8			MSKSEMI OPA2330A MS XXX	2500

Pin Description

PIN		I/O	DESCRIPTION
NAME	SOT-23-5		
+IN	3	I	Positive(noninverting)input
-IN	4	I	Negative (inverting)input
NC	-	-	No Connection
OUT	1	O	Output
V+	5	-	Positive (highest)power supply
V-	2	-	Negative (lowest)power supply

PIN		I/O	DESCRIPTION
NAME	SOP-8		
+INA	3	I	Noninverting input,channel A
+INB	5	I	Noninverting input,channel B
-INA	2	I	Inverting input,channel A
-INB	6	I	Inverting input,channel B
OUTA	1	O	Output,channel A
OUTB	7	O	Output,channel B
V-	4	-	Negative (lowest)power supply
V+	8	-	Positive(highest)power supply

Functional Block Diagram

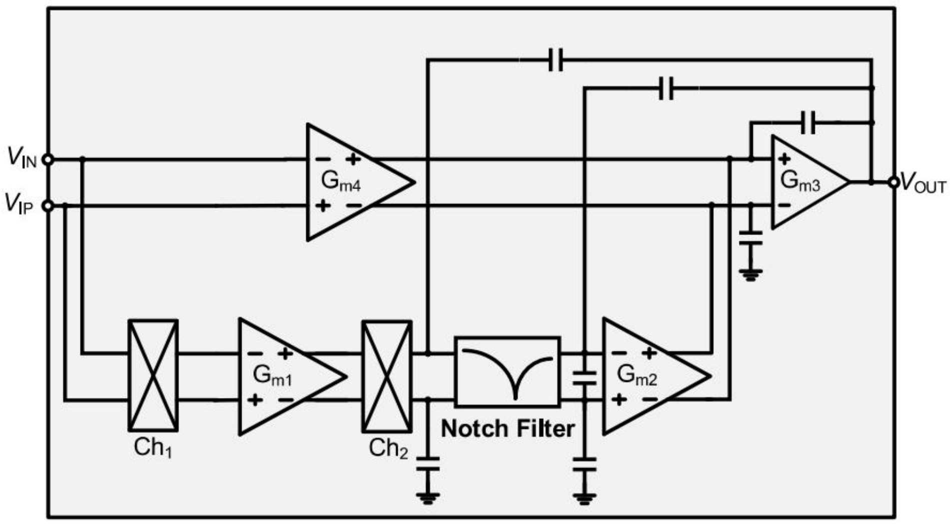


Figure 1. Typical Application

SPECIFICATIONS

Absolute Maximum Ratings[1]

	MIN	MAX	UNIT
Supply Voltage		7	V
Signal Input Terminals Voltage [2]	- 0.3	(V+) + 0.3	V
Signal Input Terminals Current [2]	-1	1	mA
Output Short-Circuit[3]	Continuous		mA
Junction Temperature, T_J		150	°C
Operating Temperature Range, T_A	-25	150	°C
Storage Temperature Range, Tstg	-35	150	°C

(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 0.3V beyond the supply rails should be current limited to 10mA or less.

(3) Short-circuit to ground, one amplifier per package.

ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM)	±4000	V
		Charged-device model (CDM)	±1000	V

Recommended Operating Conditions

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

		MIN	MAX	UNIT
Supply Voltage, V_S	Single-supply	1.8	5.5	V
	Dual-supply	±0.9	±2.75	V
Specified temperature		-25	125	°C

ELECTRICAL CHARACTERISTICS

At T_A = 25°C, V_S = ±2.5V, V_{IN}=0V, unless otherwise noted.

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNIT
OFFSET VOLTAGE						
V_{OS}	Input Offset Voltage			±1	±10	μV
dV_{OS}/dT	Input Offset Voltage Average Drift	T_A = -25°C to 125°C		0.01		μV/℃
INPUT CURRENT						
I_B	Input Bias Current			1	20	pA
		T_A = -25°C to 125°C			180	pA
I_{OS}	Input Offset Current			1	20	pA
NOISE						
V_N	Input Voltage Noise	f=0.1Hz to 10Hz		1.5	2	$μV_{PP}$
	Input Voltage Noise PSD	f=1kHz		79.4		nV/√Hz
INPUT VOLTAGE						
V_{CM}	Common-Mode Voltage Range		(VS-)-0.1		(VS+)+0.1	V
CMRR	Common-Mode Rejection Ratio	$ΔV_{IN}$=1V	130	135		dB
GAIN						
A_V	Open-Loop Voltage Gain	$ΔV_{OUT}$=1V	140	150		dB
FREQUENCY RESPONSE						
GBW	Gain-Bandwidth Product			550		kHz
SR	Slew Rate	G = +1 , V_{IN}=4V Step		0.1		V/us
OUTPUT						
$V_{OUT-SWING}$	Output Swing from Rail			0.32	0.5	mV
I_{SC}	Output Short-Circuit Current			21		mA
C_L (1)	Capacitive Load Drive	G = +1 , V_{IN}=4V Step			1	nF
POWER SUPPLY						
PSRR	Power-Supply Rejection Ratio	$ΔV_S$=1V		135		dB

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V_S	Operating Voltage Range	I_O=0A	1.8		5.5	V
I_Q	Quiescent Current/Amplifier	OPA330AIDBVR-MS		13.5		uA
		OPA2330AIDR-MS		25		uA

(1) Capacitive load drive means that above a given maximum value, the output waveform will oscillate under the step response.

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TYPICAL CHARACTERISTICS

At TA = 25°C, V_S = ±2.5V, V_{IN}=0V, unless otherwise noted.

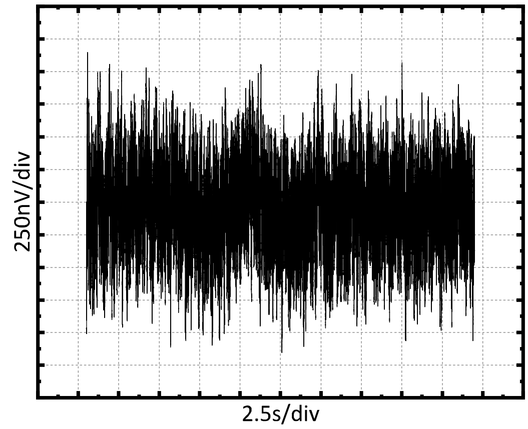

Figure 2. 0.1Hz-10Hz Noise

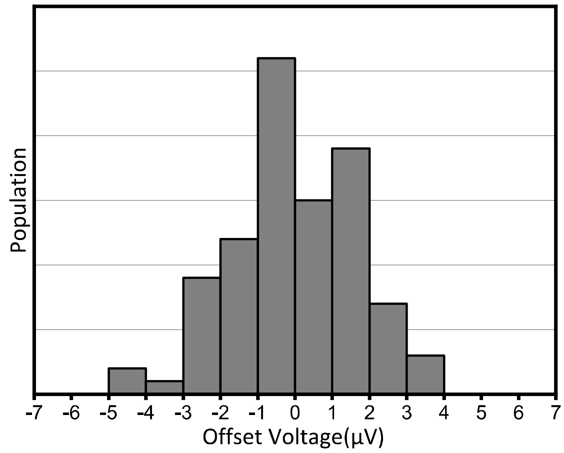

Figure 3. Offset Voltage Production Distribution

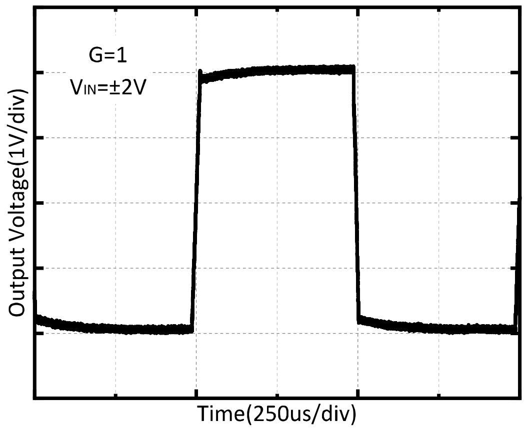

Figure 4. Large-Signal Step Response

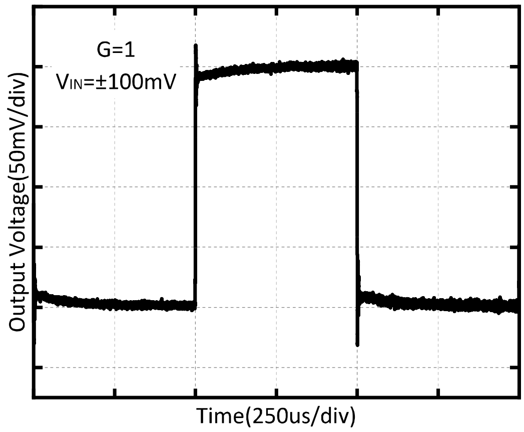

Figure 5. Small -Signal Step Response

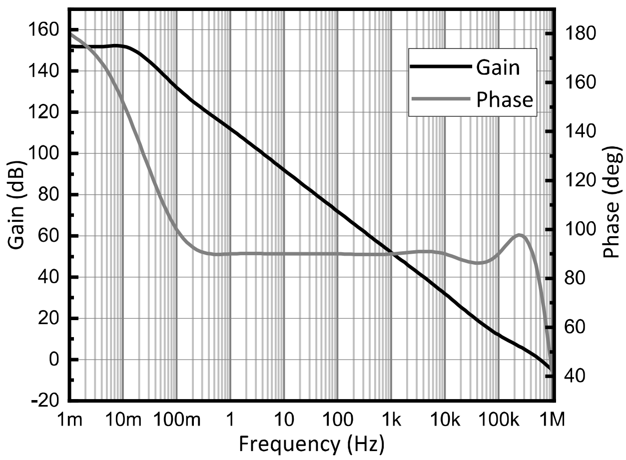

Figure 6. Open-Loop Gain and Phase vs Frequency

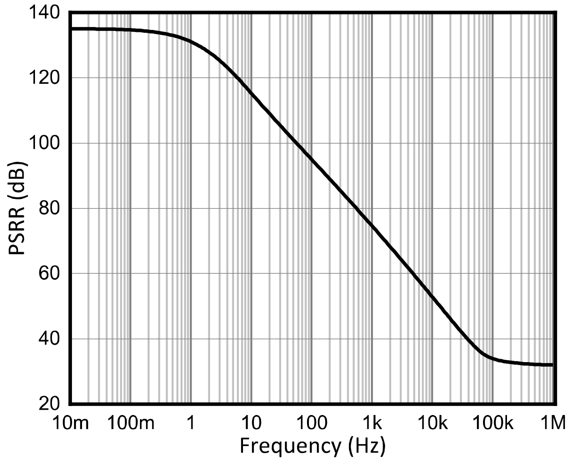

Figure 7. PSRR vs Frequency

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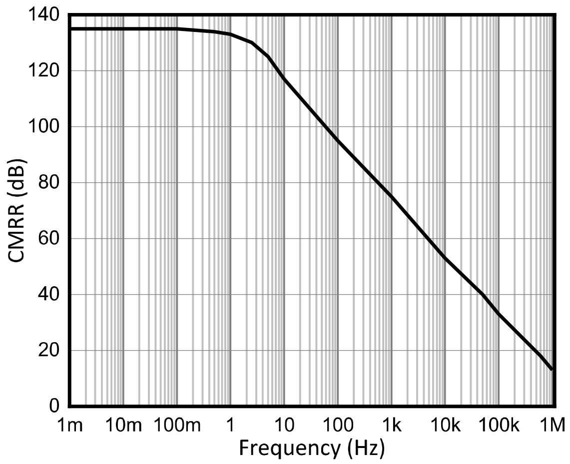

Figure 8. CMRR vs Frequency

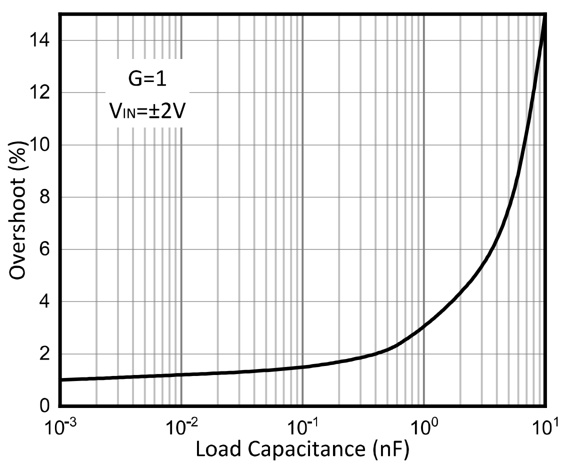

Figure 9. Large-Signal Overshoot vs Load Capacitance

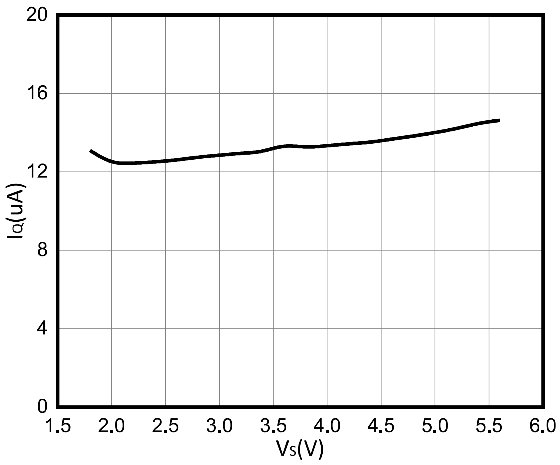

Figure 10. Quiescent Current vs Supply Voltage

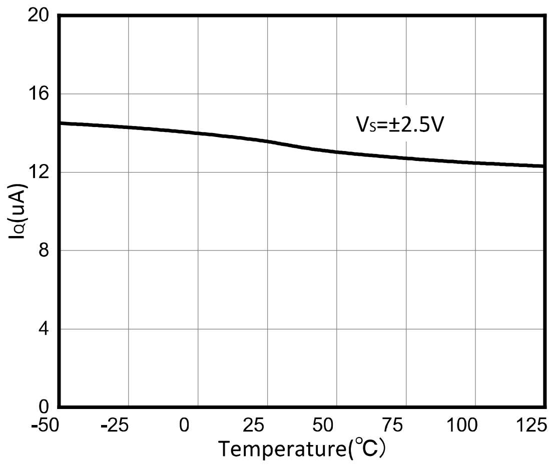

Figure 11. Quiescent Current vs Temperature

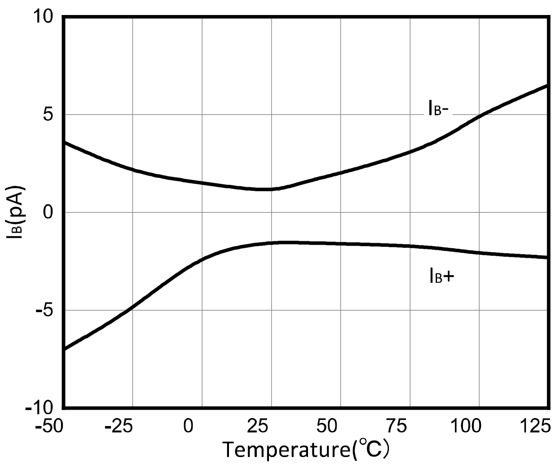

Figure 12. Input Bias Current vs Temperature

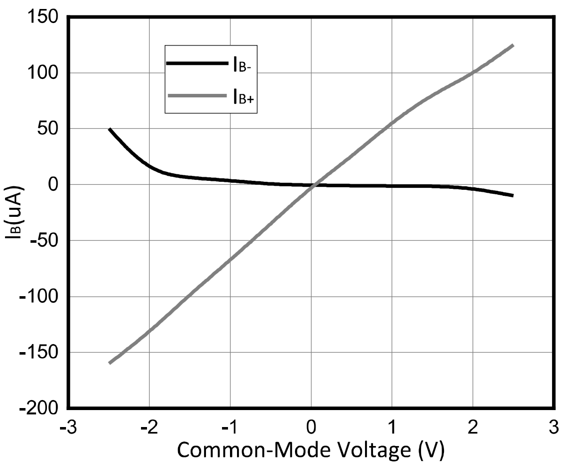

Figure 13. Input Bias Current vs Common-Mode Voltage

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Detailed Description

Overview

The OPAx330 is a family of Zero-Drift, low-power, rail-to-rail input and output operational amplifiers. These devices operate from 1.8 V to 5.5 V, are unity-gain stable, and are suitable for a wide range of general-purpose applications. The Zero-Drift architecture provides ultra low offset voltage and near-zero offset voltage drift.

Functional Block Diagram

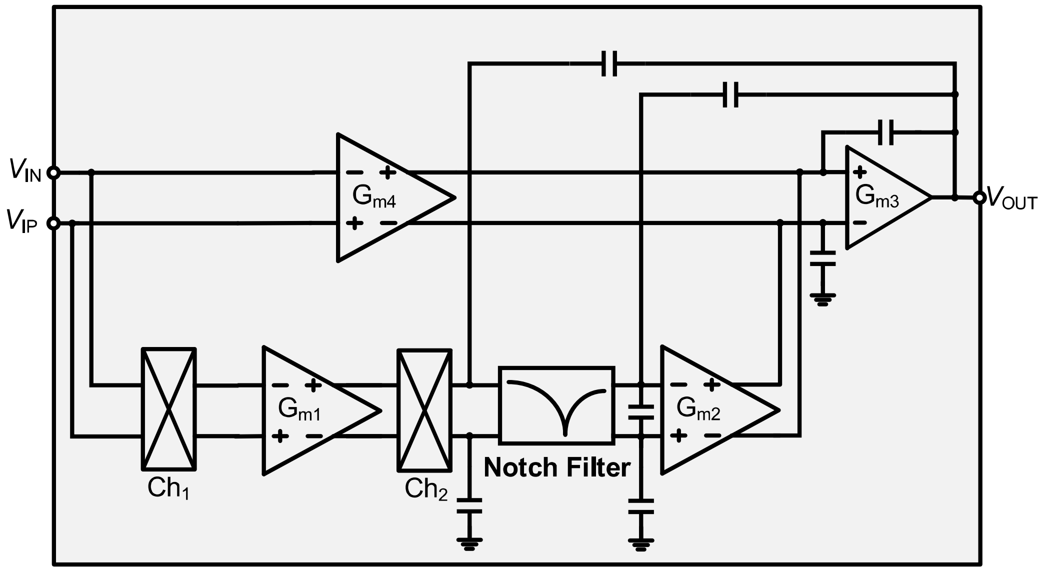


Figure 14. OPAx333 Functional Block Diagram

Feature Description

The OPAx330 are unity-gain stable and free from unexpected output phase reversal. These devices use a proprietary auto-calibration technique to provide low offset voltage and very low drift over time and temperature. For lowest offset voltage and precision performance, optimize circuit layout and mechanical conditions. Avoid temperature gradients that create thermoelectric (Seebeck) effects in the thermocouple junctions formed from connecting dissimilar conductors. Cancel these thermally-generated potentials by assuring they are equal on both input terminals. Other layout and design considerations include:

- Use low thermoelectric-coefficient conditions (avoid dissimilar metals).
- Thermally isolate components from power supplies or other heat sources.
- Shield operational amplifier and input circuitry from air currents, such as cooling fans.

Following these guidelines reduces the likelihood of junctions being at different temperatures, which can cause thermoelectric voltages of 0.1 μV/°C or higher, depending on materials used.

Input Voltage

The OPAx330 input common-mode voltage range extends 0.1 V beyond the supply rails. The OPAx330 is designed to cover the full range without the troublesome transition region found in some other rail-to-rail amplifiers.

Device Functional Modes

The OPAx330 device has a single functional mode. The device is powered on as long as the power supply voltage is between 1.8 V (±0.9 V) and 5.5 V (±2.75 V).

Application and Implementation

Application Information

The OPAx330 family is a unity-gain stable, precision operational amplifier with very low offset voltage drift; these devices are also free from output phase reversal. Applications with noisy or high-impedance power supplies require decoupling capacitors close to the device power-supply pins. In most cases, 0.1-μF capacitors are adequate.

Typical Applications

1 Voltage Follower

As shown in Figure 15, the voltage gain is 1. With this circuit, the output voltage V_{OUT} is configured to be equal to the input voltage V_{IN}. Due to the high input impedance and low output impedance, the circuit can also stabilize the output voltage, the output voltage expression is

$$V_{OUT}=V_{IN} \quad (1)$$

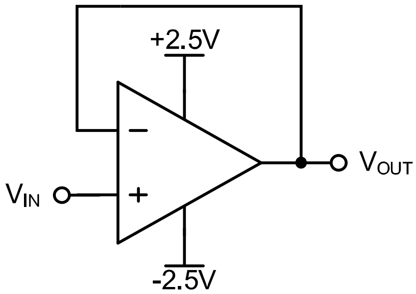


Figure 15. Voltage Follower

2 Inverting Proportional Amplifier

As shown in Figure 16, for a reverse-phase proportional amplifier, the input voltage V_{IN} is amplified by a voltage gain that depends on the ratio of R1 to R2. The output voltage V_{OUT} is inversely with the input voltage V_{IN}. The input impedance of the circuit is equal to R1, and the output voltage expression is

$$V_{OUT}=-\frac{R2}{R1}V_{IN} \quad (2)$$

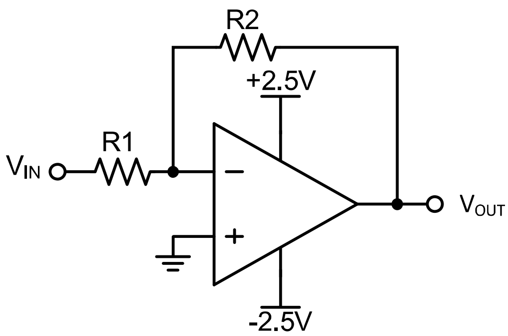


Figure 16. Inverting Proportional Amplifier

3 Noninverting Proportional Amplifier

As shown in Figure 17, for a noninverting amplifier, the input voltage V_{IN} is amplified by a voltage gain that depends on the ratio of R1 to R2. The output voltage V_{OUT} is in phase with the input voltage V_{IN}. In fact, this circuit has a high input impedance because its input side is the same as the input side of the operational amplifier. The output voltage expression is

$$V_{OUT}=(1+\frac{R2}{R1})V_{IN} \tag{3}$$

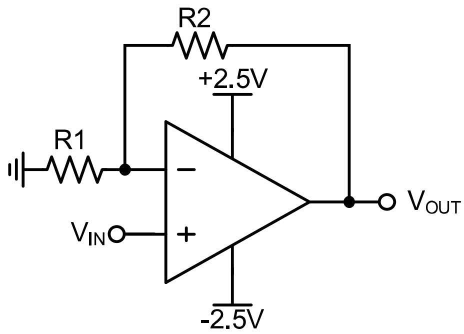
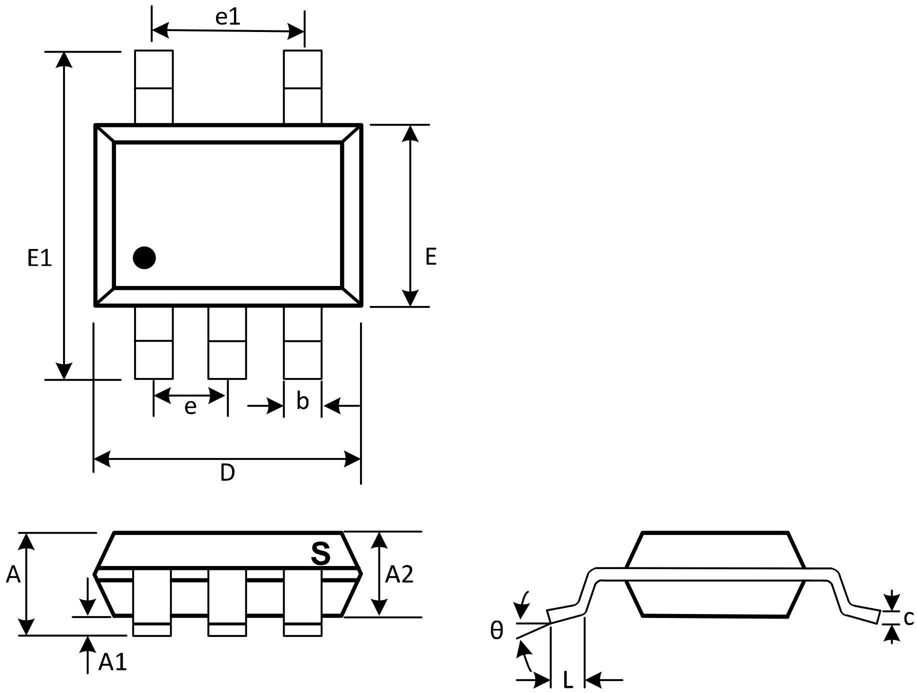


Figure 17. Noninverting Proportional Amplifier

PACKAGE DESCRIPTION

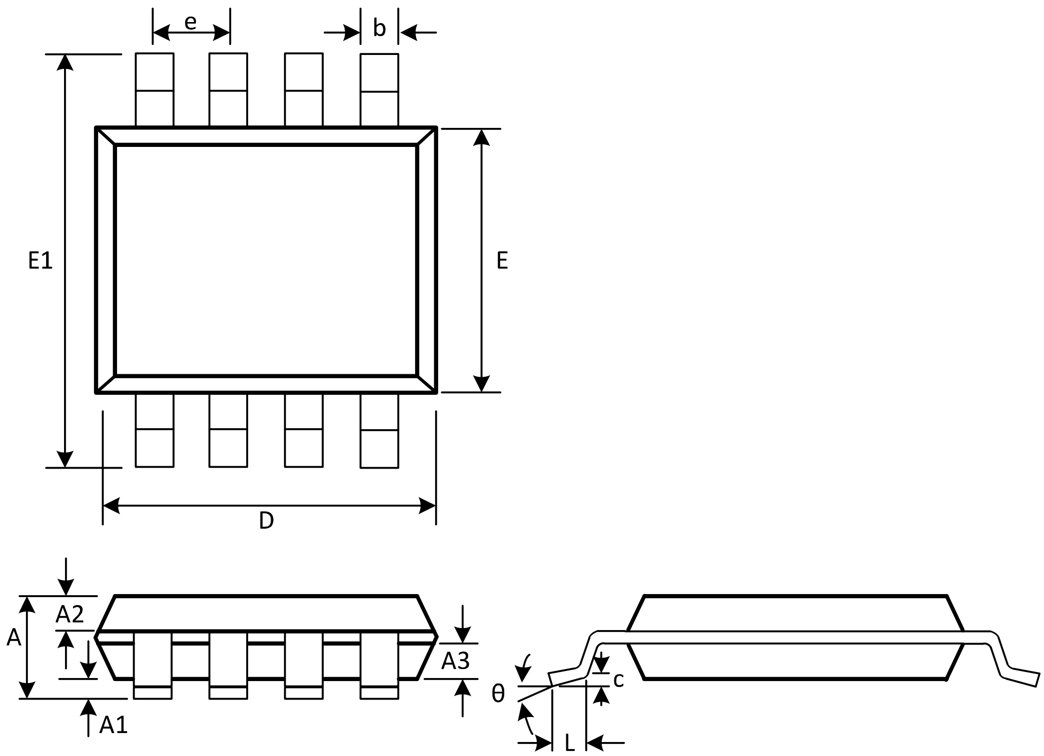
OT23-5



(Unit: mm)

Symbol	Min	Max
A	1.05	1.25
A1	0	0.1
A2	1.05	1.15
b	0.3	0.5
c	0.1	0.2
D	2.82	3.02
e	0.95(BSC)	
e1	1.9(BSC)	
E	1.5	1.7
E1	2.65	2.95
L	0.3	0.6
θ	0°	8°

SOP-8



(Unit: mm)

Symbol	Min	Max
A	1.300	1.600
A1	0.050	0.200
A2	0.550	0.650
A3	0.550	0.650
b	0.356	0.456
c	0.203	0.233
D	4.800	5.000
e	1.270(BSC)	
E	3.800	4.000
E1	5.800	6.200
L	0.400	0.800
θ	0°	8°

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