

MSKSEMI 美森科

SEMICONDUCTOR



ESD



TVS



TSS



MOV



GDT



PLED

TLV333IDBVR-MS/TLV2333IDR-MS

Product specification

GENERAL DESCRIPTION

The TLVx333 series of CMOS operational amplifiers use a proprietary auto-calibration technique to simultaneously provide very low offset voltage ($\pm 4\mu\text{V}$, maximum) and near-zero drift over time and temperature. These miniature, high-precision, low quiescent current ($13.5\mu\text{A}$) amplifiers offer high impedance inputs that have a common-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 ($\pm 0.9\text{ V}$) and up to 5.5 V ($+2.75\text{ V}$) can be used. These devices are optimized for low voltage, single-supply operation.

The TLV333IDBVR-MS (single version) is available in the 5-pin SOT23, while the TLV2333IDR-MS (dual version) is available in the 8-pin SOIC and packages. All versions are specified for operation from -25°C to 125°C .

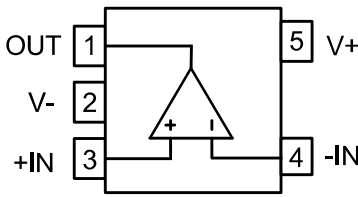

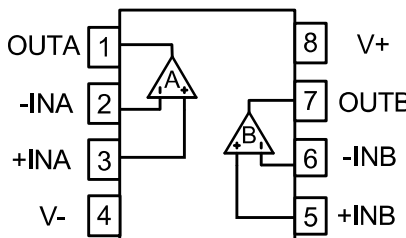

FEATURES

- Input Offset Voltage: $\pm 1\mu\text{V}$ (Typ)
- Zero Drift: $0.01\mu\text{V}/^\circ\text{C}$ (Typ)
- 0.01Hz-10Hz Noise: $1.5\mu\text{Vpp}$
- Quiescent Current: $13.5\mu\text{A}$
- 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:
TLV333IDBVR-MS: SOT-23-5
TLV2333IDR-MS: SOP-8

TYPICAL APPLICATIONS

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

PACKAGE/ORDER INFORMATION

Part Number	Op Temp ($^\circ\text{C}$)	Package	Pin Configuration	Marking	QTY
TLV333IDBVR-MS	$-25^\circ\text{C} \sim 125^\circ\text{C}$	SOT23-5			3000
TLV2333IDR-MS	$-25^\circ\text{C} \sim 125^\circ\text{C}$	SOP8			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

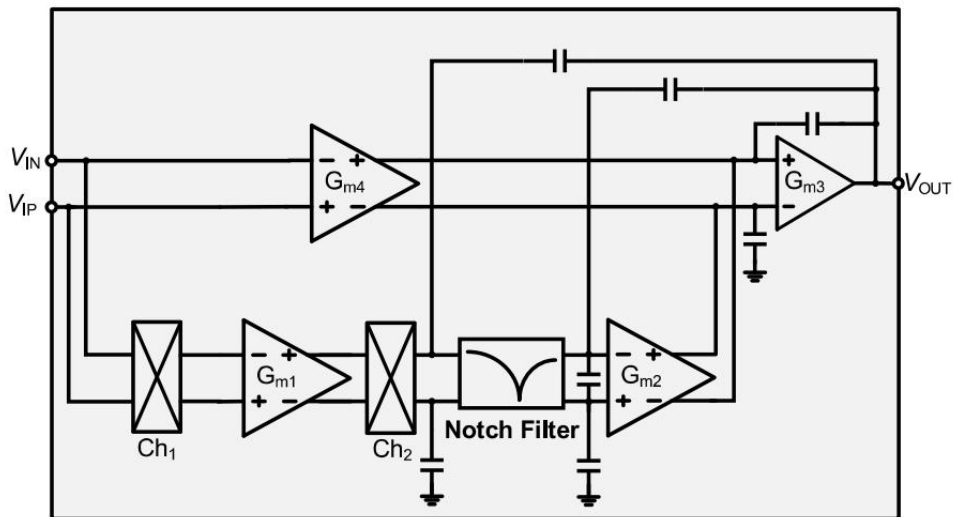


Figure 1. Typical Application

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, T _{stg}	-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 $T_A = 25^\circ\text{C}$, $V_S = \pm 2.5\text{V}$, $V_{IN} = 0\text{V}$, 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	$T_A = -25^\circ\text{C}$ to 125°C	0.01		$\mu\text{V}/^\circ\text{C}$
INPUT CURRENT					
I_B	Input Bias Current		1	20	pA
		$T_A = -25^\circ\text{C}$ to 125°C		180	pA
I_{OS}	Input Offset Current		1	20	pA
NOISE					
V_N	Input Voltage Noise	$f = 0.1\text{Hz}$ to 10Hz	1.5	2	μV_{PP}
	Input Voltage Noise PSD	$f = 1\text{kHz}$	79.4		$\text{nV}/\sqrt{\text{Hz}}$
INPUT VOLTAGE					
V_{CM}	Common-Mode Voltage Range		$(V_{S-}) - 0.1$	$(V_{S+}) + 0.1$	V
CMRR	Common-Mode Rejection Ratio	$\Delta V_{IN} = 1\text{V}$	130	135	dB
GAIN					
A_V	Open-Loop Voltage Gain	$\Delta V_{OUT} = 1\text{V}$	140	150	dB
FREQUENCY RESPONSE					
GBW	Gain-Bandwidth Product		550		kHz
SR	Slew Rate	$G = +1$, $V_{IN} = 4\text{V}$ Step	0.1		$\text{V}/\mu\text{s}$
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	$G = +1$, $V_{IN} = 4\text{V}$ Step		1	nF
POWER SUPPLY					
PSRR	Power-Supply Rejection Ratio	$\Delta V_S = 1\text{V}$	135		dB

V_s	Operating Voltage Range	$I_o=0A$	1.8		5.5	V
I_q	Quiescent Current/Amplifier	TLV333IDBVR-MS		13.5		μA
		TLV2333IDR-MS		25		μA

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

TYPICAL CHARACTERISTICS

At TA = 25°C, VS = ±2.5V, VIN=0V, unless otherwise noted.

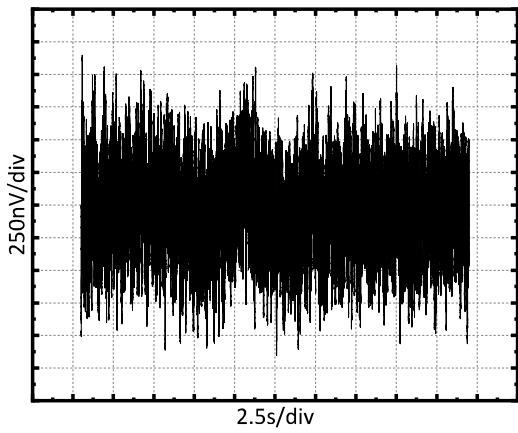


Figure 2. 0.1Hz-10Hz Noise

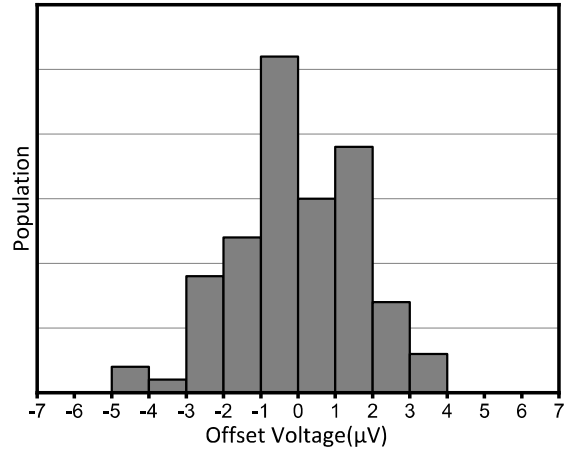


Figure 3. Offset Voltage Production Distribution

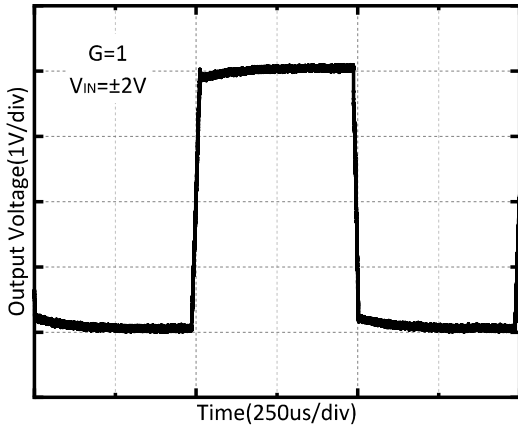


Figure 4. Large-Signal Step Response

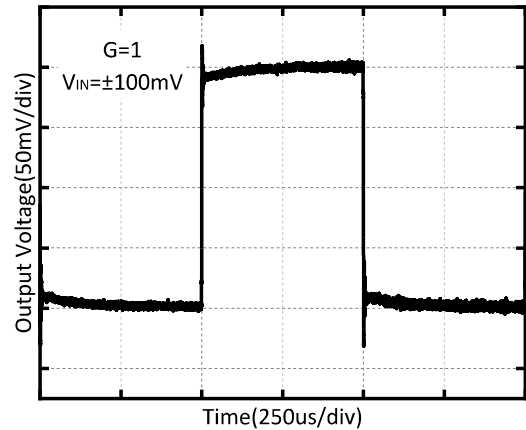


Figure 5. Small-Signal Step Response

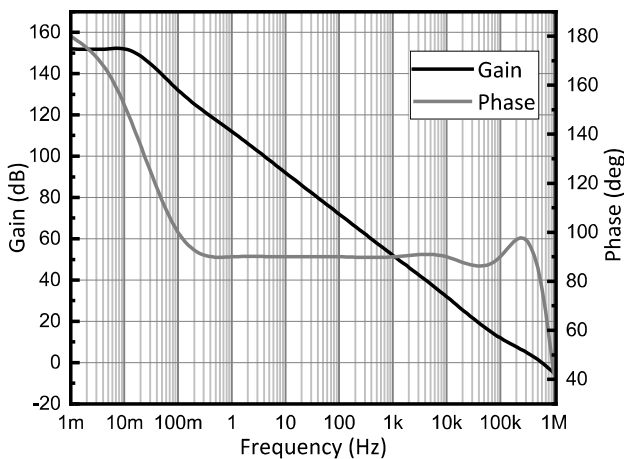


Figure 6. Open-Loop Gain and Phase vs Frequency

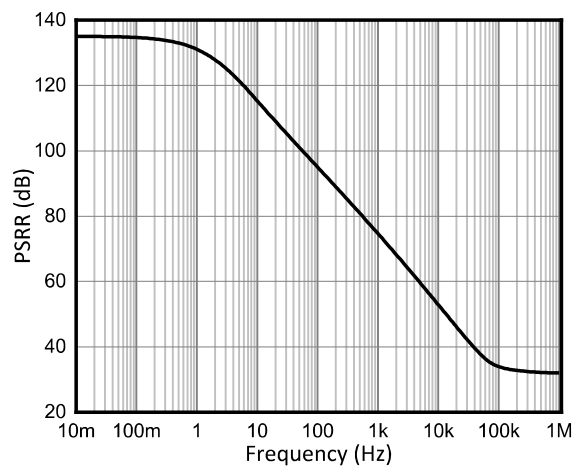


Figure 7. PSRR vs Frequency

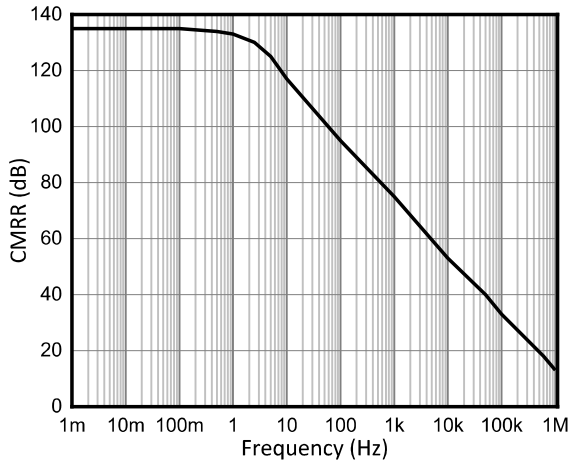


Figure 8. CMRR vs Frequency

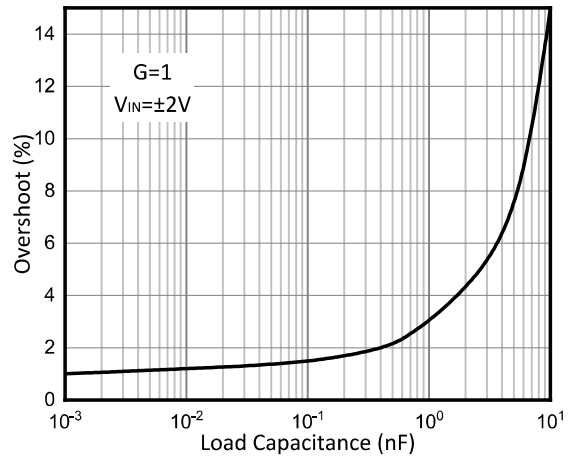


Figure 9. Large-Signal Overshoot vs Load Capacitance

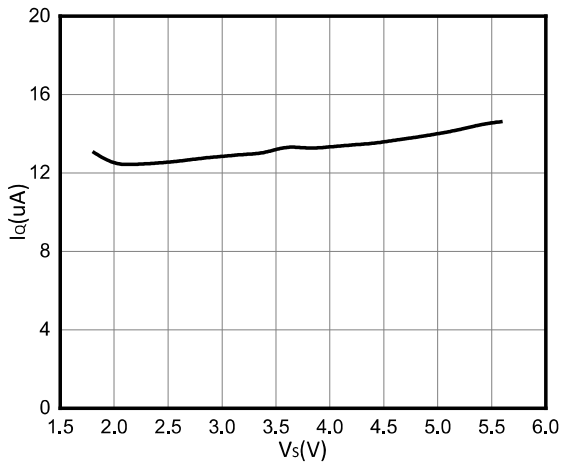


Figure 10. Quiescent Current vs Supply Voltage

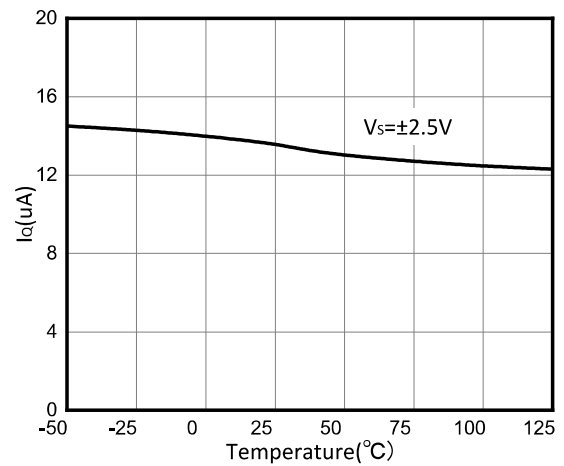


Figure 11. Quiescent Current vs Temperature

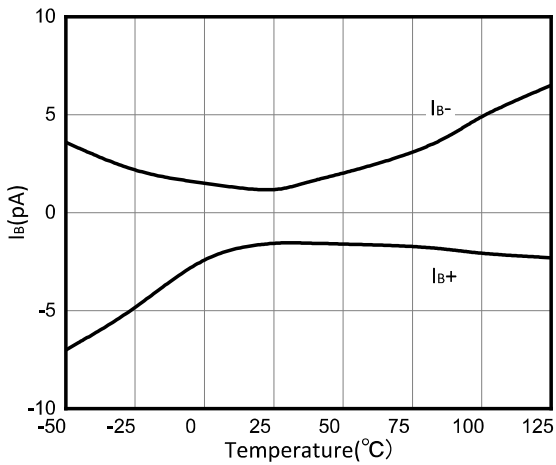


Figure 12. Input Bias Current vs Temperature

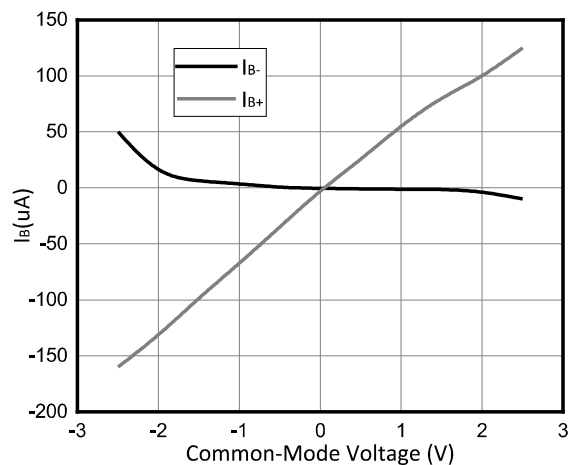


Figure 13. Input Bias Current vs Common-Mode Voltage

Detailed Description

Overview

The TLVx333 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

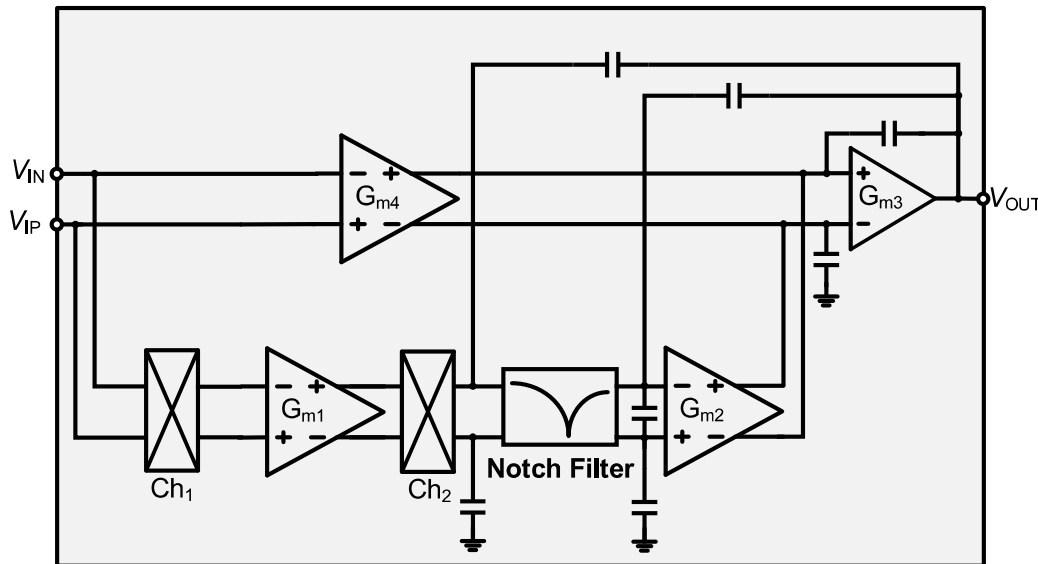


Figure 14. TLVx333 Functional Block Diagram

Feature Description

The TLVx333 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 $\mu\text{V}/\text{C}$ or higher, depending on materials used.

Input Voltage

The TLVx333 input common-mode voltage range extends 0.1 V beyond the supply rails. The TLVx333 is designed to cover the full range without the troublesome transition region found in some other rail-to-rail amplifiers.

Device Functional Modes

The TLVx333 device has a single functional mode. The device is powered on as long as the power supply voltage is between 1.8V (± 0.9 V) and 5.5V (± 2.75 V).

Application and Implementation

Application Information

The TLVx333 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- μ F 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

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

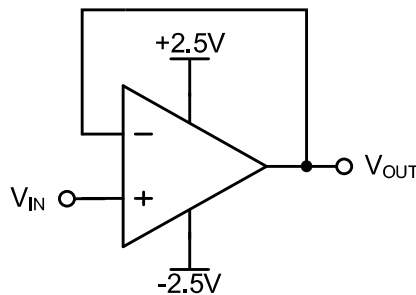


Figure 15. Voltage Follower

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 R_1 to R_2 . The output voltage V_{OUT} is inversely with the input voltage V_{IN} . The input impedance of the circuit is equal to R_1 , and the output voltage expression is

$$V_{OUT} = -\frac{R_2}{R_1} V_{IN} \quad (2)$$

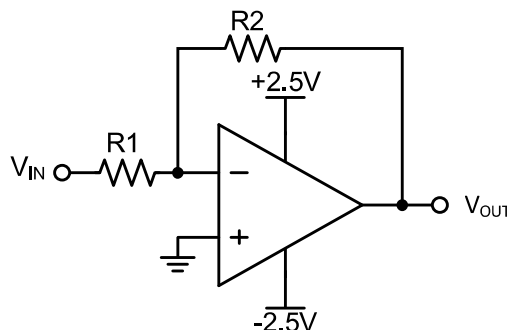


Figure 16. Inverting Proportional Amplifier

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

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

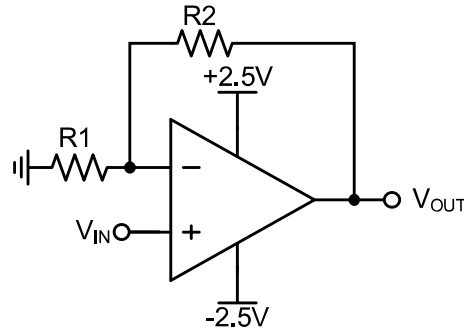
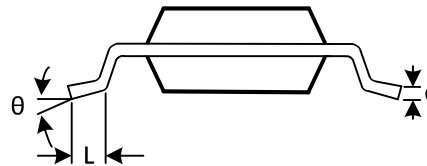
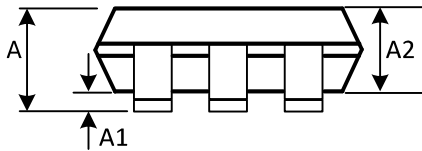
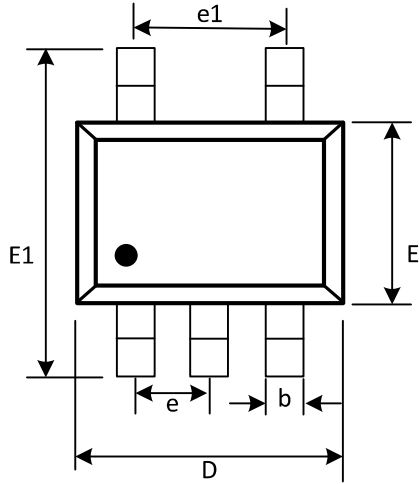


Figure 17. Noninverting Proportional Amplifier

PACKAGE DESCRIPTION

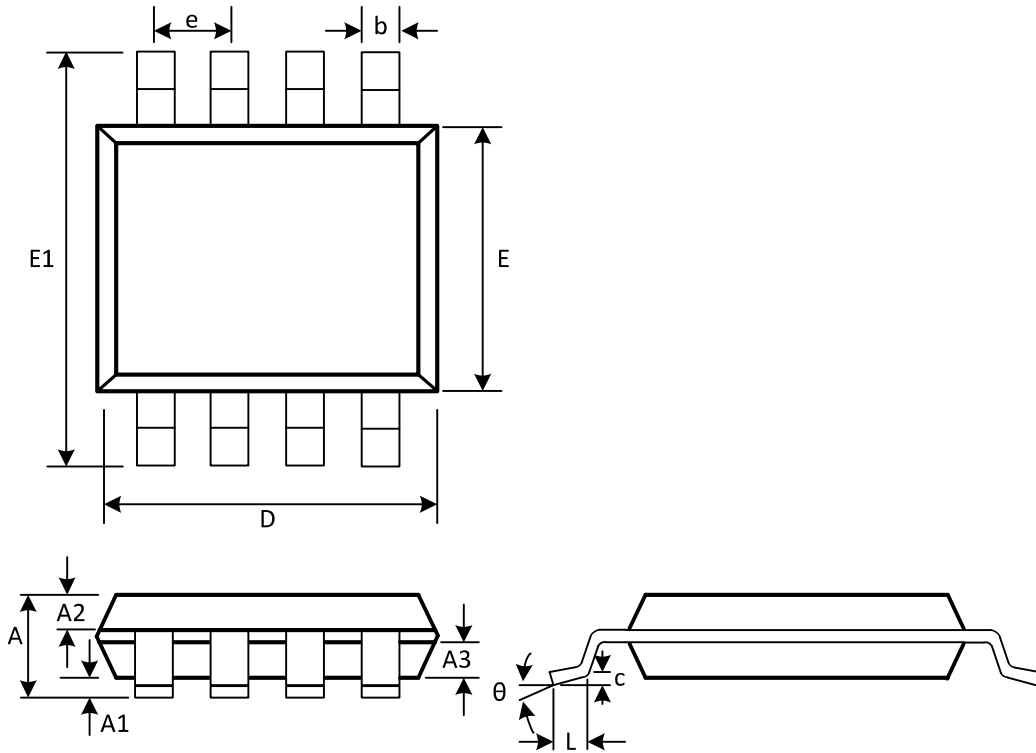
SOT23-5



(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°

Attention

- Any and all MSKSEMI Semiconductor products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your MSKSEMI Semiconductor representative nearest you before using any MSKSEMI Semiconductor products described or contained herein in such applications.
- MSKSEMI Semiconductor assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all MSKSEMI Semiconductor products described or contained herein.
- Specifications of any and all MSKSEMI Semiconductor products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.
- MSKSEMI Semiconductor strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all MSKSEMI Semiconductor products (including technical data, services) described or contained herein are controlled under any of applicable local export control laws and regulations, such products must not be exported without obtaining the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written permission of MSKSEMI Semiconductor.
- Information (including circuit diagrams and circuit parameters) herein is for example only ; it is not guaranteed for volume production. MSKSEMI Semiconductor believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the MSKSEMI Semiconductor product that you intend to use.

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for [Operational Amplifiers - Op Amps](#) category:

Click to view products by [MSKSEMI](#) manufacturer:

Other Similar products are found below :

[430227FB](#) [LT1678IS8](#) [NCV33202DMR2G](#) [NJM324E](#) [M38510/13101BPA](#) [NTE925](#) [AZV358MTR-G1](#) [AP4310AUMTR-AG1](#)
[AZV358MMTR-G1](#) [SCY33178DR2G](#) [NCV20034DR2G](#) [NTE778S](#) [NTE871](#) [NTE937](#) [NJU7057RB1-TE2](#) [SCY6358ADR2G](#)
[NJM2904CRB1-TE1](#) [UPC4570G2-E1-A](#) [UPC4741G2-E1-A](#) [UPC4574GR-9LG-E1-A](#) [NJM8532RB1-TE1](#) [EL2250CS](#) [EL5100IS](#) [EL5104IS](#)
[EL5127CY](#) [EL5127CYZ](#) [EL5133IW](#) [EL5152IS](#) [EL5156IS](#) [EL5162IS](#) [EL5202IY](#) [EL5203IY](#) [EL5204IY](#) [EL5210CS](#) [EL5210CYZ](#)
[EL5211IYE](#) [EL5220CY](#) [EL5223CLZ](#) [EL5223CR](#) [EL5224ILZ](#) [EL5227CLZ](#) [EL5227CRZ](#) [EL5244CS](#) [EL5246CS](#) [EL5246CSZ](#) [EL5250IY](#)
[EL5251IS](#) [EL5257IS](#) [EL5260IY](#) [EL5261IS](#)