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SEMICONDUCTOR



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PLED

LMV324IDR(MS)

Product specification

GENERAL DESCRIPTION

The LMV324IDR(MS) (quad) are general purpose, low offset, high frequency response and low power operational amplifiers. With an excellent bandwidth of 1MHz, a slew rate of 1V/μs, and a quiescent current of 28μA per amplifier at 5V, the LMV324IDR(MS) family can be designed into a wide range of applications.

The LMV324IDR(MS) op-amps are designed to provide optimal performance in low voltage and low power systems. The input common-mode voltage range includes ground, and the maximum input offset voltage are 3mV. These parts provide rail-to-rail output swing into heavy loads.

The LMV324IDR(MS) families of operational amplifiers are specified at the full temperature range of -40°C to +125°C under single or dual power supplies of 1.5V to 5.5V.

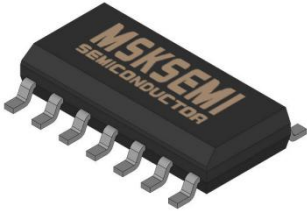
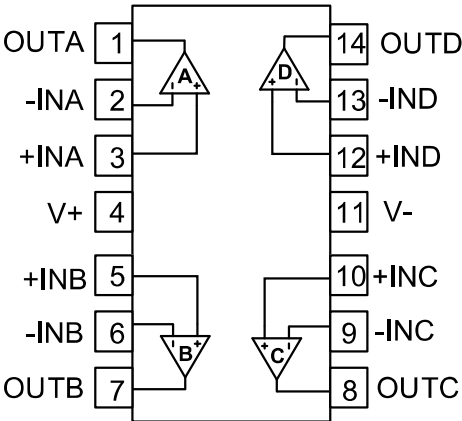

FEATURES

- Input Offset Voltage: 1mV (Typical)
- Low Supply Current: 28μA (Vs=5V)
- Supply Range: 1.8V to 5.5V
- Gain Bandwidth: 1MHz (Vs=5V)
- Slew rate: 1V/μs (Vs=5V)
- Rail-to-Rail Input and Output
- Low Cost
- Micro size Packages:
- LMV324IDR(MS): SOIC-14

APPLICATIONS

- Battery and Power Supply Control
- Audio Outputs
- Smoke/Gas/Environment Sensors
- Portable Equipment and Mobile Devices
- Sensor Interfaces
- Active Filters
- Medical Equipment

Pin Configuration and Functions

| PACKAGE OUTLINE | Pin Assignments | Marking |
|---|---|--|
|  |  |  <p>Note: ***=batch</p> |
| SOIC-14 | | |

Pin Description

| PIN | | I/O | DESCRIPTION |
|------|--------|-----|---------------------------------|
| NAME | Number | | |
| +INA | 3 | | Noninverting input, channel A |
| +INB | 5 | | Noninverting input, channel B |
| +INC | 10 | | Noninverting input, channel C |
| +IND | 12 | | Noninverting input, channel D |
| -INA | 2 | | Inverting input, channel A |
| -INB | 6 | | Inverting input, channel B |
| -INC | 9 | | Inverting input, channel C |
| -IND | 13 | | Inverting input, channel D |
| OUTA | 1 | 0 | Output, channel A |
| OUTB | 7 | 0 | Output, channel B |
| OUTC | 8 | | Output, channel C |
| OUTD | 14 | 0 | Output, channel D |
| V- | 4 | — | Negative (lowest) power supply |
| V+ | 11 | — | Positive (highest) power supply |

TYPICAL APPLICATION

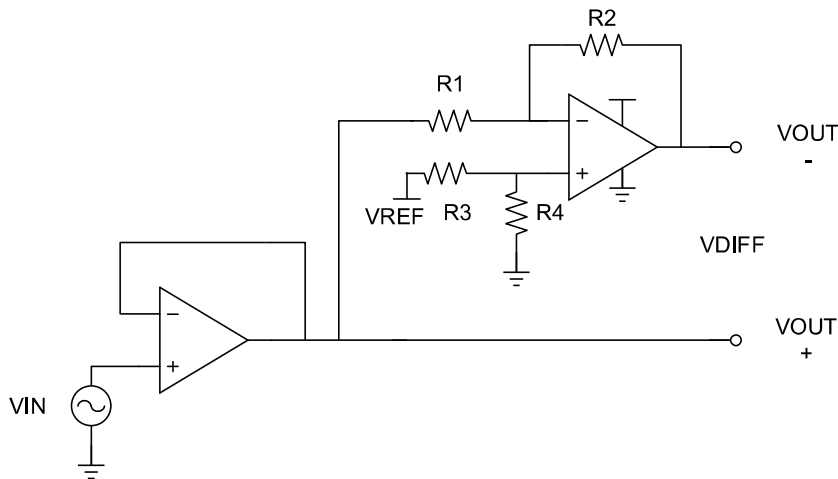


Figure 1. Typical Application

Detailed Description

Overview

The LMV324IDR(MS) devices are a low power, unity-gain stable, rail-to-rail operational amplifier that operate in a single-supply voltage range of 1.8V to 5.5V ($\pm 0.9V$ to $\pm 2.75V$). A high supply voltage of 6V (absolute maximum) can permanently damage the amplifier. Rail-to-rail input and output wobbles significantly increase the dynamic range, especially in low-supply applications. Good layout practices require that a 0.1 μ F capacitor be used where it is tightly threaded through the power supply pin.

Phase Reversal Protection

The LMV324IDR(MS) devices have internal phase-reversal protection. Many op amps exhibit phase reversal when the input is driven beyond the linear common-mode range. This condition is most often encountered in noninverting circuits when the input is driven beyond the specified common-mode voltage range, causing the output to reverse into the opposite rail. The input of the LMV324IDR(MS) prevents phase reversal with excessive commonmode voltage. Instead, the appropriate rail limits the output voltage

Typical Applications

1 Voltage Follower

As shown in Figure 12, 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 Detailed Descriptio

SPECIFICATIONS

Absolute Maximum Ratings⁽¹⁾

| | | MIN | MAX | UNIT |
|---------------|--|------------|------------|------|
| Voltage | Supply Voltage | | 6 | V |
| | Signal Input Terminals Voltage ⁽²⁾ | (V-) - 0.5 | (V+) + 0.5 | V |
| | Signal Input Terminals Voltage ⁽³⁾ | (V-) - 0.5 | (V+) + 0.5 | V |
| Current | Signal Input Terminals Current ⁽²⁾ | -10 | 10 | mA |
| | Signal output Terminals Current ⁽³⁾ | -200 | 200 | mA |
| | Output Short-Circuit ⁽⁴⁾ | Continuous | | |
| θ_{JA} | Operating Temperature Range | -55 | 125 | °C |
| | Storage Temperature Range | -65 | 150 | °C |
| | Junction Temperature | -40 | 150 | °C |

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

(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 10mA or less.

(3) Output terminals are diode-clamped to the power-supply rails. Output signals that can swing more than 0.5V beyond the supply rails should be current-limited to ± 200 mA or less.

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

ESD Ratings

| | | | VALUE | UNIT |
|-------------|-------------------------|----------------------------|------------|------|
| $V_{(ESD)}$ | Electrostatic discharge | Human-Body Model (HBM) | ± 2000 | V |
| | | Charged-Device Model (CDM) | ± 500 | V |
| | | Machine Model | 100 | V |

Recommended Operating Conditions

| | | MIN | MAX | UNIT |
|--|---------------|------------|------------|------|
| Supply voltage, $V_s = (V+) - (V-)$ | Single-supply | 1.5 | 5.5 | V |
| | Dual-supply | ± 0.75 | ± 2.75 | V |

ELECTRICAL CHARACTERISTICS (V_S = +5V)

 At T_A = 25°C, V_{CM}=V_{OUT}= V_S /2, unless otherwise noted.

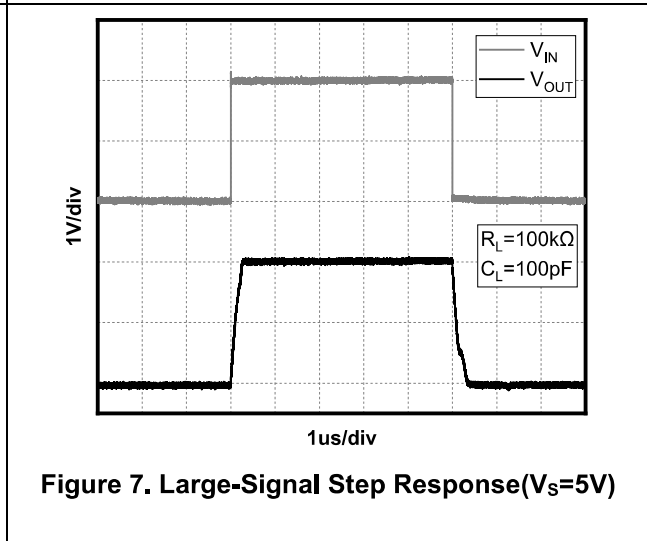
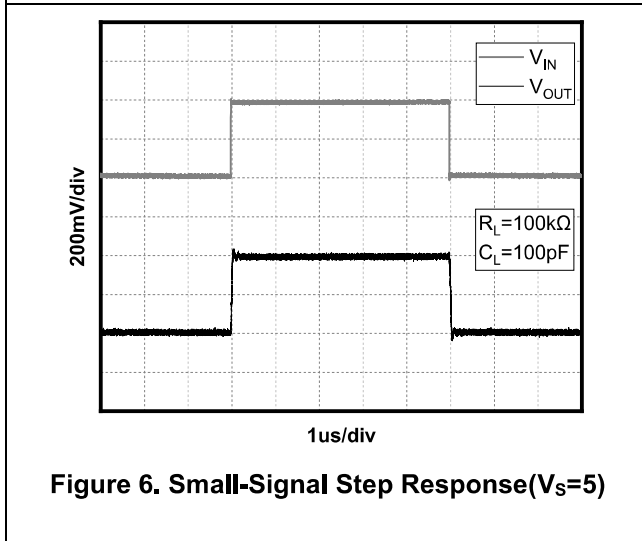
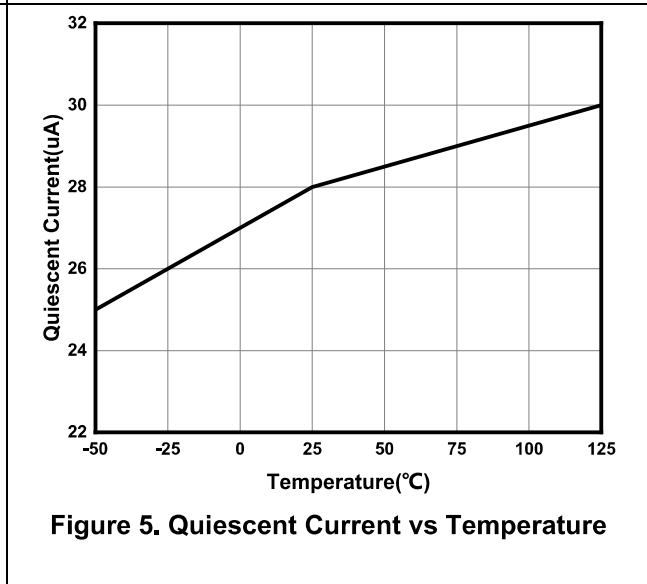
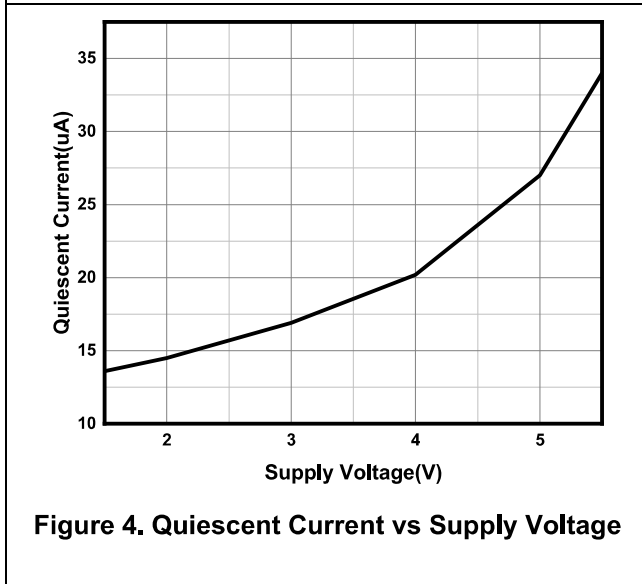
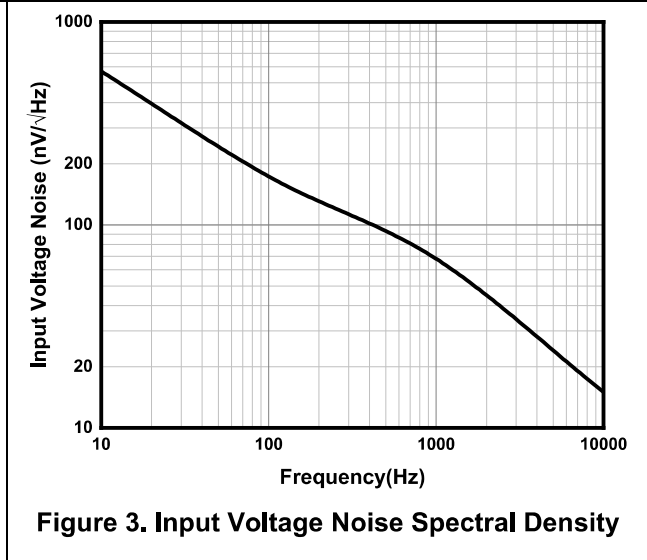
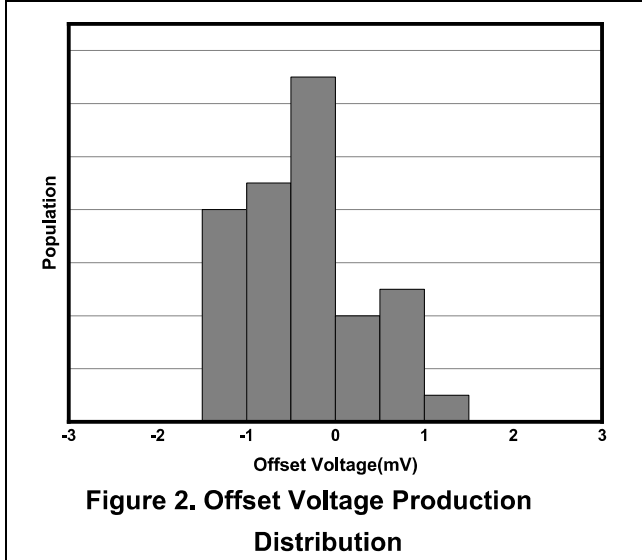
| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNIT |
|-------------------------------|------------------------------------|---|---------------------|------|-----------------------|
| OFFSET VOLTAGE | | | | | |
| V _{OS} | Input Offset Voltage | -3 | ±1 | 3 | mV |
| dV _{OS} /dT | Input Offset Voltage Average Drift | T _A = -55°C to 125°C | | 1.8 | µV/°C |
| INPUT CURRENT | | | | | |
| I _B | Input Bias Current | | 5 | | pA |
| I _{OS} | Input Offset Current | | 1 | | pA |
| NOISE | | | | | |
| V _N | Input Voltage Noise | f=0.1Hz to 10Hz | | 20 | µV _{PP} |
| e _n | Input Voltage Noise Density | f=1kHz | | 65 | nV/√Hz |
| INPUT VOLTAGE | | | | | |
| V _{CM} | Common-Mode Voltage Range | | V _S -0.1 | | V _S +0.1 V |
| CMRR | Common-Mode Rejection Ratio | V _{CM} =0.1V to 4V | 70 | 80 | dB |
| FREQUENCY RESPONSE | | | | | |
| GBW | Gain-Bandwidth Product | | | 1 | MHz |
| SR | Slew Rate | G = +1, V _{IN} =2V Step | | 1 | V/µs |
| t _s | Settling Time to 0.1% | G = +1, V _{IN} =2V Step | | 2.5 | µs |
| OUTPUT | | | | | |
| A _v | Open-Loop Voltage Gain | V _{OUT} =0.1V to 4.9V R _L =100kΩ | 80 | 100 | dB |
| V _{OUT-SWING} | Output Swing from Rail | R _L =100kΩ | | 5 | mV |
| I _{SC} | Output Short-Circuit Current | Source current | | 45 | mA |
| | | Sink current | | 70 | mA |
| C _L ⁽¹⁾ | Capacitive Load Drive | G = +1, V _{IN} =0.2V Step | | 1000 | pF |

| POWER SUPPLY | | | | | | |
|--------------|------------------------------|----------------------|-----|----|-----|---------|
| PSRR | Power-Supply Rejection Ratio | $V_S=1.5V$ to $5.5V$ | 80 | 90 | | dB |
| V_S | Operating Voltage Range | | 1.5 | | 5.5 | V |
| I_Q | Quiescent Current/Amplifier | $I_O=0A$ | | 28 | 40 | μA |

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

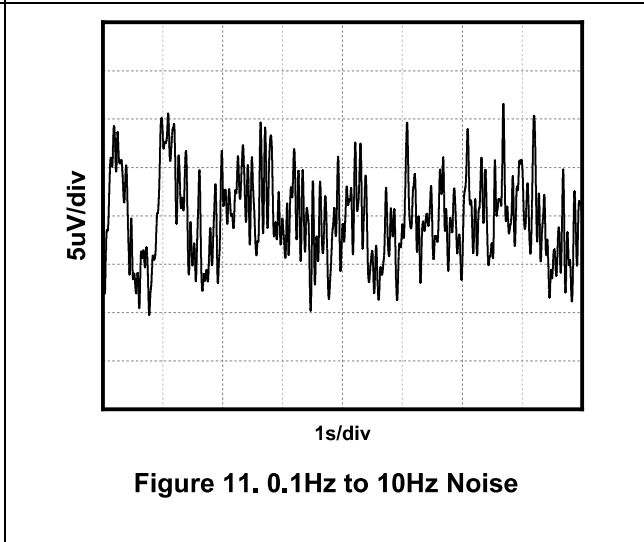
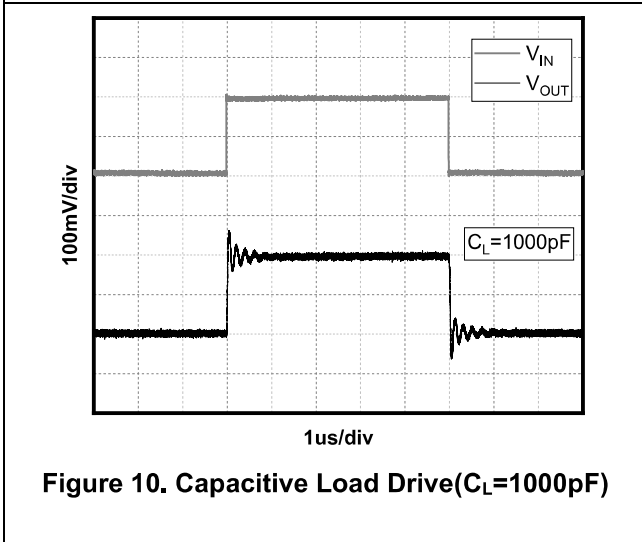
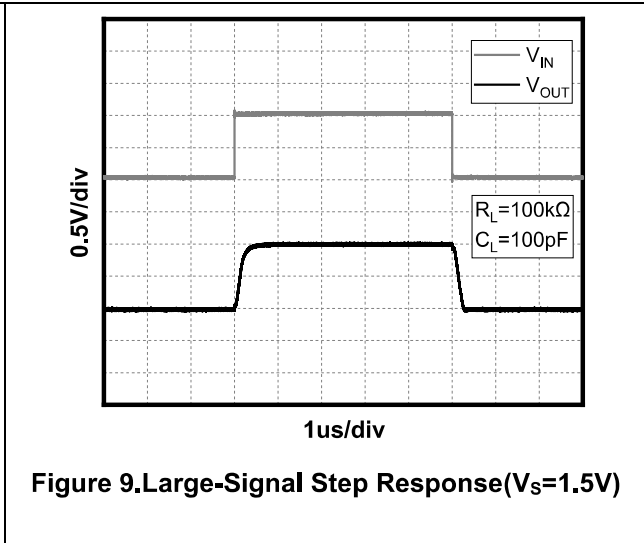
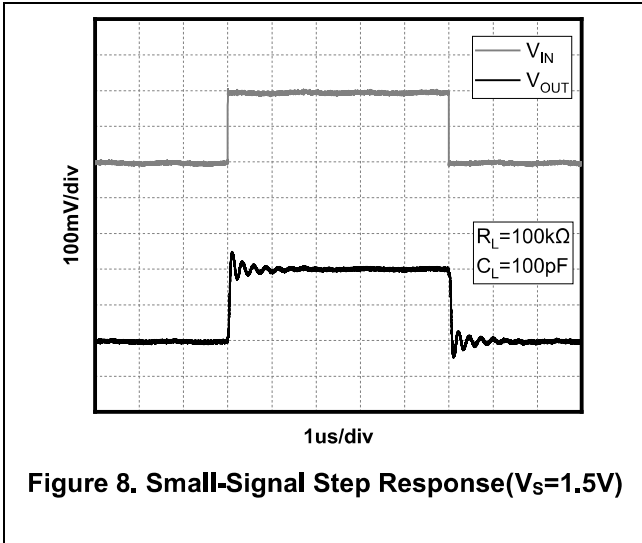
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$$V_{OUT} = V_{IN} \quad (1)$$

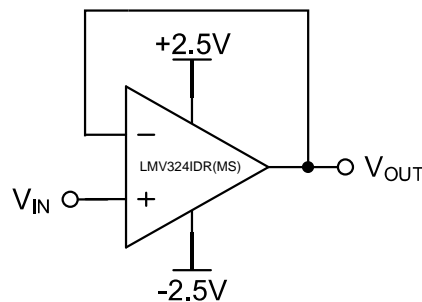


Figure 12. Voltage Follower

2 Inverting Proportional Amplifier

As shown in Figure 13, 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

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

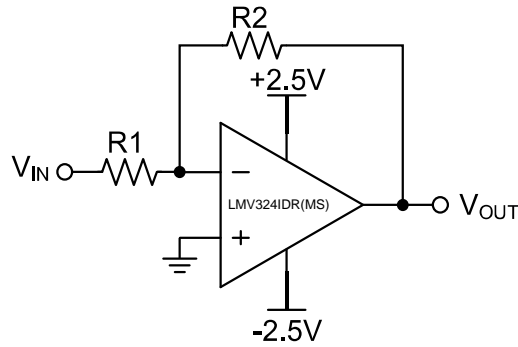


Figure 13. Inverting Proportional Amplifier

3 Noninverting Proportional Amplifier

As shown in Figure 14, 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

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

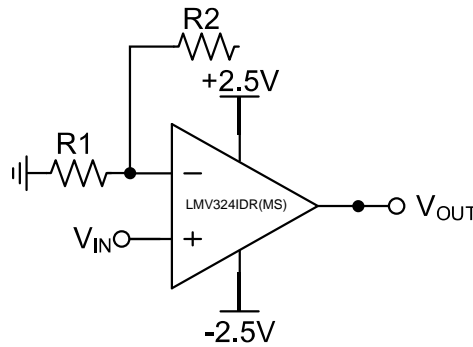


Figure 14. Noninverting Proportional Amplifier

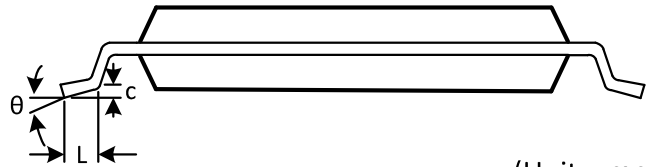
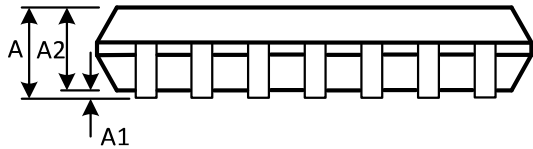
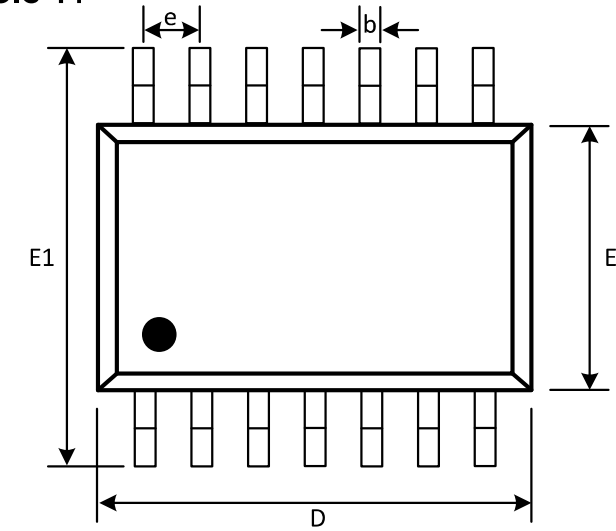
Layout Guidelines

Attention to good layout practices is always recommended. Keep traces short. When possible, use a PCB ground plane with surface-mount components placed as close to the device pins as possible. Place a 0.1uF capacitor closely across the supply pins.

These guidelines should be applied throughout the analog circuit to improve performance and provide benefits such as reducing the EMI susceptibility.

PACKAGE DESCRIPTION

SOIC-14



(Unit: mm)

| Symbol | Min | Max |
|--------|------------|-------|
| A | 1.350 | 1.750 |
| A1 | 0.100 | 0.250 |
| A2 | 1.350 | 1.550 |
| b | 0.310 | 0.510 |
| c | 0.100 | 0.250 |
| D | 8.450 | 8.850 |
| e | 1.270(BSC) | |
| E | 5.800 | 6.200 |
| E1 | 3.800 | 4.000 |
| L | 0.400 | 1.270 |
| θ | 0° | 8° |

REEL SPECIFICATION

| P/N | PKG | QTY |
|---------------|---------|------|
| LMV324IDR(MS) | SOIC-14 | 2500 |

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