

7MHz, Rail-to-Rail I/O CMOS Operational Amplifier

FEATURES

- **HIGH GAIN BANDWIDTH:7MHz**
- **RAIL-TO-RAIL INPUT AND OUTPUT**
±0.7mV Typical Vos
- **INPUT VOLTAGE RANGE: -0.1V to +5.6V**
with Vs = 5.5V
- **SUPPLY RANGE: +2.5V to +5.5V**

- **SPECIFIED UP TO +125°C**
- **Micro SIZE PACKAGES: SOIC14,TSSOP14**

DESCRIPTION

The RES4374 families of products offer low voltage operation and rail-to-rail input and output, as well as excellent speed/power consumption ratio, providing an excellent bandwidth (7MHz) and slew rate of 3.7V/us. The op-amps are unity gain stable and feature an ultra-low input bias current.

APPLICATIONS

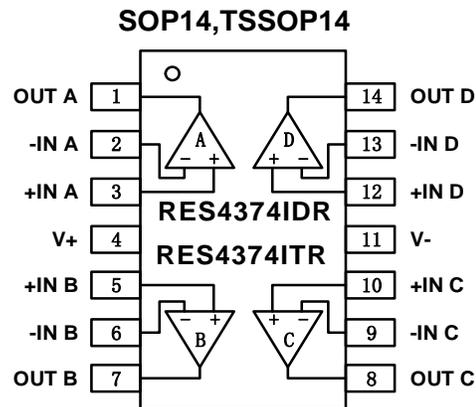
- **SENSORS**
- **PHOTODIODE AMPLIFICATION**
- **ACTIVE FILTERS**
- **TEST EQUIPMENT**
- **DRIVING A/D CONVERTERS**

Device Information ⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE(NOM)
RES4374IDR	SOIC14	8.65mm×3.90mm
RES4374ITR	TSSOP14	5.00mm×4.40mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Pin Configuration and Functions (Top View)



Pin Description

NAME	PIN	I/O	DESCRIPTION
	SOP14,TSSOP14		
-INA	2	I	Inverting input, channel A
+INA	3	I	Noninverting input, channel A
-INB	6	I	Inverting input, channel B
+INB	5	I	Noninverting input, channel B
-INC	9	I	Inverting input, channel C
+INC	10	I	Noninverting input, channel C
-IND	13	I	Inverting input, channel D
+IND	12	I	Noninverting input, channel D
OUTA	1	O	Output, channel A
OUTB	7	O	Output, channel B
OUTC	8	O	Output, channel C
OUTD	14	O	Output, channel D
V-	11	-	Negative (lowest) power supply
V+	4	-	Positive (highest) power supply

SPECIFICATIONS

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 pin ⁽²⁾	(V-)-0.5	(V+) +0.5	
	Signal output pin ⁽³⁾	(V-)-0.5	(V+) +0.5	
Current	Signal input pin ⁽²⁾	-10	10	mA
	Signal output pin ⁽³⁾	-70	70	mA
	Output short-circuit ⁽⁴⁾	Continuous		
Temperature	Operating range, T_A	-40	125	°C
	Junction, T_J		150	
	Storage, T_{stg}	-65	150	

(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 ± 70 mA or less.

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

ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM)	± 5000	V
		Machine Model (MM)	± 400	

Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
Supply voltage, $V_S=(V+) - (V-)$	Single-supply	2.5		5.5	V
	Dual-supply	± 1.25		± 2.75	

Thermal Information:RES4374IDR,RES4374ITR

THERMAL METRIC ⁽¹⁾		RES4374IDR,RES4374ITR		UNIT
		14PINS		
		SOIC14	TSSOP14	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	83.8	120.8	°C/W
$R_{\theta JC(top)}$	Junction-to-case(top) thermal resistance	70.7	34.3	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	59.5	62.8	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	11.6	1	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	37.7	56.5	°C/W
$R_{\theta JC(bot)}$	Junction-to-case(bottom) thermal resistance	N/A	N/A	°C/W

PACKAGE/ORDERING INFORMATION

Orderable Device	Package Type	Pin	Channel	Op Temp(°C)	Device Marking ⁽¹⁾	Package Qty
RES4374IDR	SOIC14	14	4	-40°C~125°C	RES4374IDR	Tape and Reel,4000
RES4374ITR	TSSOP14	14	4	-40°C~125°C	RES4374ITR	Tape and Reel,4000

NOTE:

(1) There may be additional marking, which relates to the lot trace code information(data code and vendor code), the logo or the environmental category on the device.

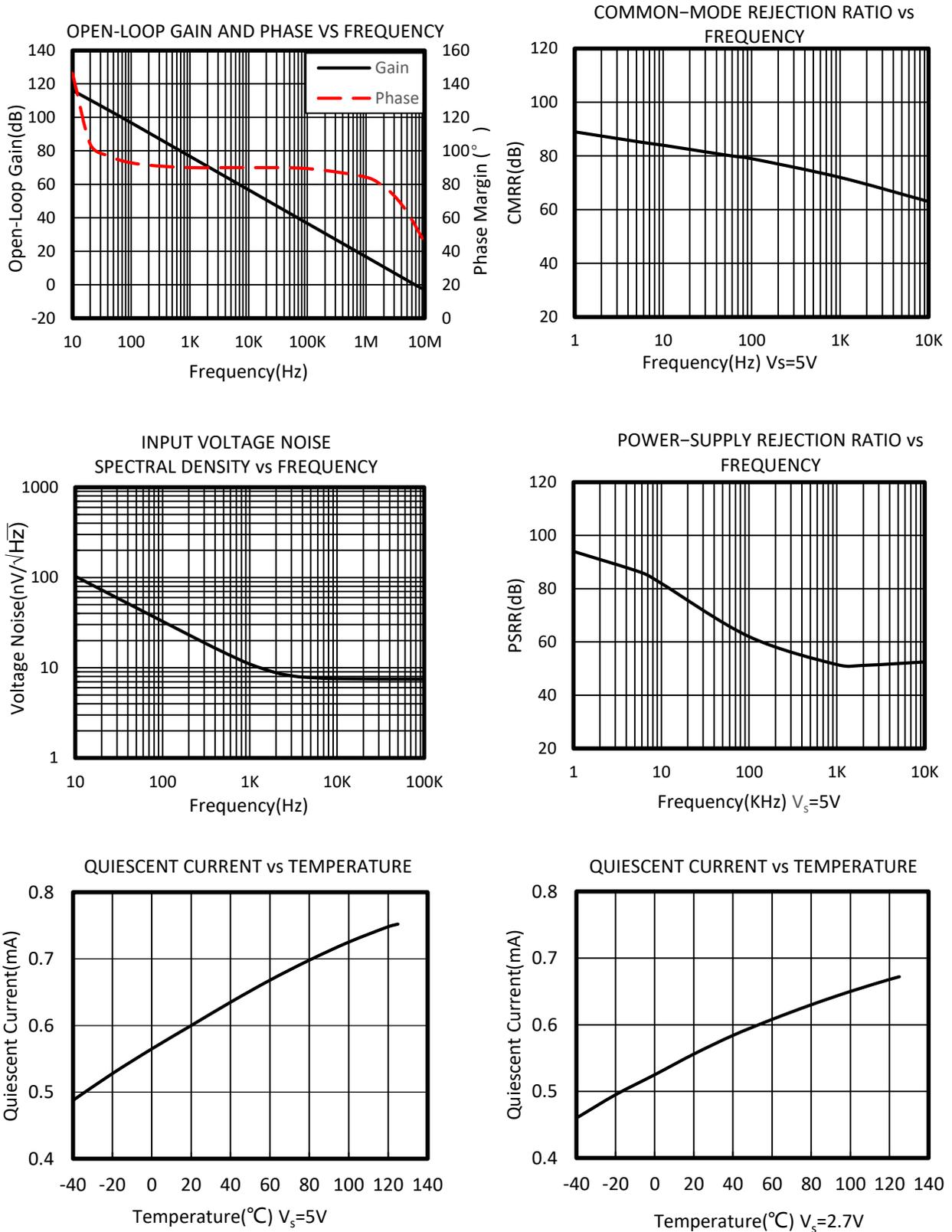
ELECTRICAL CHARACTERISTICS
RES4374IDR,RES4374ITR

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

PARAMETER		CONDITIONS	T_J					
				MIN	TYP	MAX	UNIT	
POWER SUPPLY								
V_S	Operating Voltage Range		25°C	2.5		5.5	V	
I_Q	Quiescent Current/Amplifier		25°C		600	800	μA	
PSRR	Power-Supply Rejection Ratio	$V_S=2.5\text{V to }5.5\text{V}$, $V_{cm}=(V_-)+0.5\text{V}$	25°C	78	93		dB	
			$-40^\circ\text{C to }125^\circ\text{C}$	72				
INPUT								
V_{os}	Input Offset Voltage		25°C	-3	± 0.7	3	mV	
$V_{os\ TC}$	Input Offset Voltage Average Drift	$-40^\circ\text{C to }125^\circ\text{C}$			2		$\mu\text{V}/^\circ\text{C}$	
I_B	Input Bias Current		25°C		± 1	± 10	pA	
I_{os}	Input Offset Current		25°C		± 1	± 10	pA	
V_{cm}	Common-Mode Voltage Range	$V_S= 5.5\text{V}$	25°C	-0.1		5.6	V	
CMRR	Common-Mode Rejection Ratio	$V_S= 5.5\text{V}$, $V_{cm} = -0.1\text{V to }4\text{V}$	25°C	74	92		dB	
			$-40^\circ\text{C to }125^\circ\text{C}$	68				
			25°C	62	83			
			$-40^\circ\text{C to }125^\circ\text{C}$	60				
OUTPUT								
AOL	Open-Loop Voltage Gain	$R_L=2\text{K}\Omega$, $V_o= 0.15\text{V to }4.85\text{V}$	25°C	96	102		dB	
			$-40^\circ\text{C to }125^\circ\text{C}$	83				
			$R_L=10\text{K}\Omega$, $V_o= 0.05\text{V to }4.95\text{V}$	25°C	98	106		
			$-40^\circ\text{C to }125^\circ\text{C}$	85				
	Output Swing From Rail	$R_L=2\text{K}\Omega$	25°C		40		mV	
		$R_L=10\text{K}\Omega$			7			
I_{out}	Output Short-Circuit Current		25°C		50		mA	
FREQUENCY RESPONSE								
SR	Slew Rate		25°C		3.7		V/us	
GBP	Gain-Bandwidth Product		25°C		7		MHz	
PM	Phase Margin		25°C		64		$^\circ$	
t_s	Setting Time,0.1%				0.5		μs	
	Overload Recovery Time	$V_{IN}\cdot\text{Gain} \geq V_S$			0.5		μs	
NOISE								
e_n	Input Voltage Noise Density	$f = 1\text{KHz}$	25°C		11		nV/ $\sqrt{\text{Hz}}$	
		$f = 10\text{KHz}$	25°C		7.5		nV/ $\sqrt{\text{Hz}}$	
ENABLE/SHUTDOWN(RS621S,RS622S)								
$I_{Q(OFF)}$	Supply Current in Shutdown		25°C		<1		μA	
t_{OFF}			25°C		3		μs	
t_{ON}			25°C		20		μs	
V_L	Shut Down		25°C	V_-		$(V_-)+0.8$	V	
V_H	Amplifier Is Active		25°C	$(V_-)+2$		V_+	V	

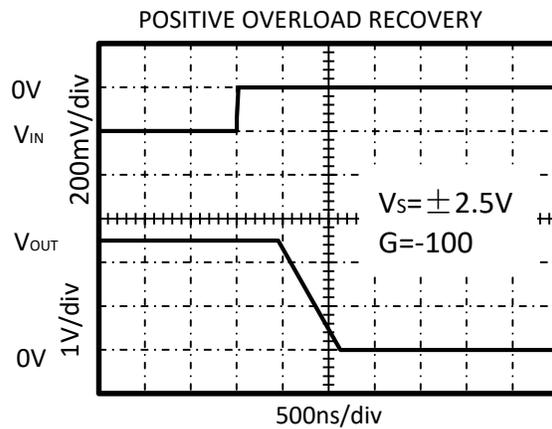
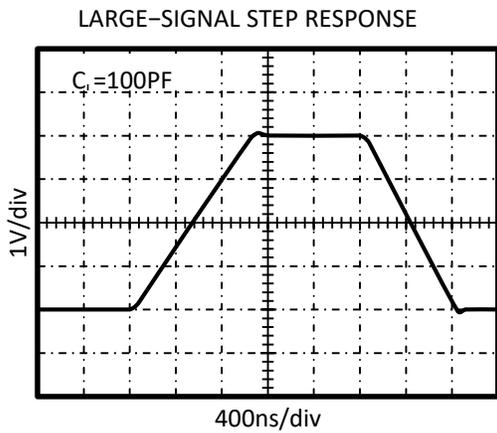
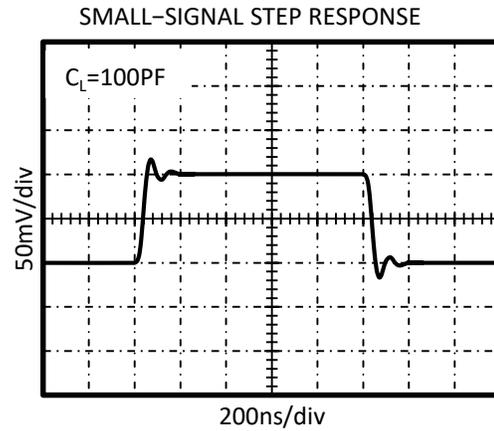
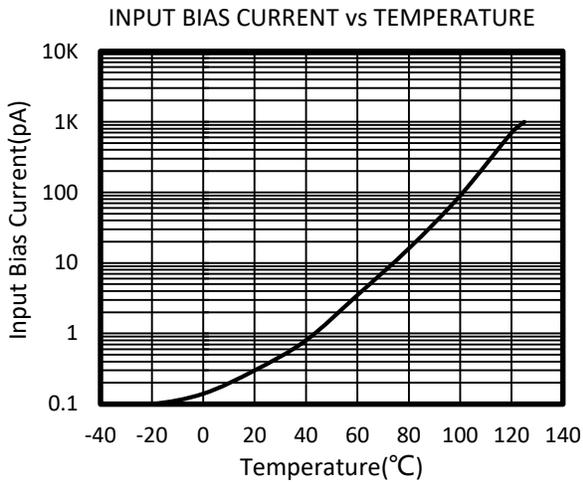
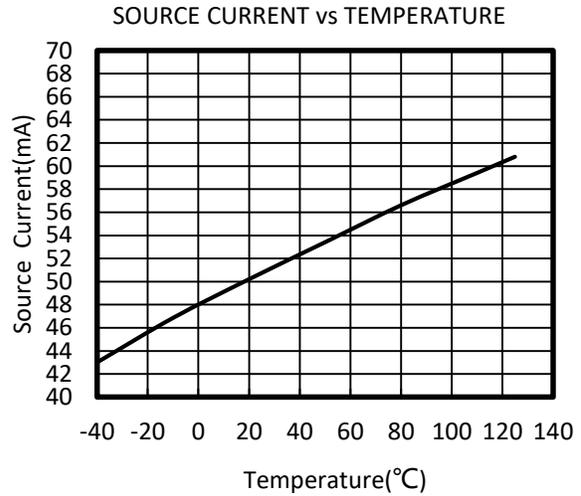
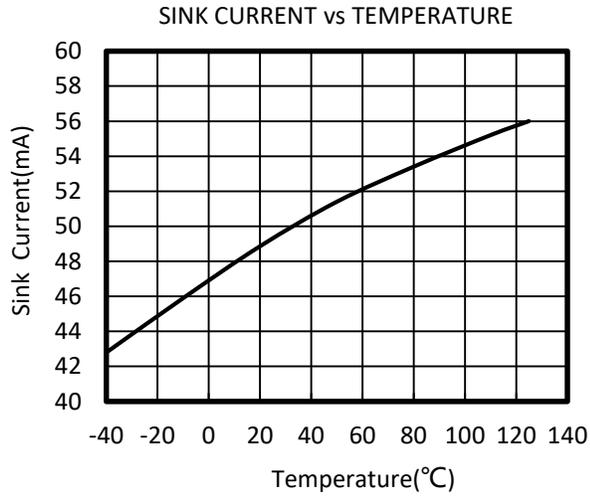
TYPICAL CHARACTERISTICS

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



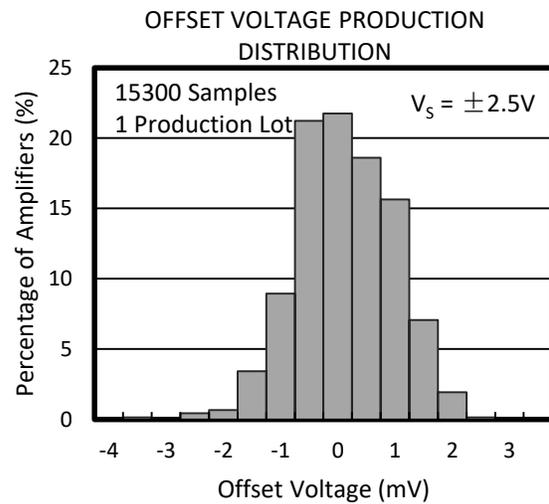
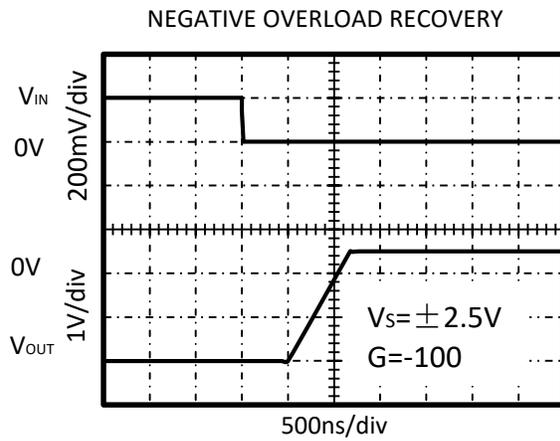
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Detailed Description

Overview

The RES4374IDR, RES4374ITR are high precision, rail-to-rail operational amplifiers that can be run from a single-supply voltage 2.5V to 5.5V ($\pm 1.25V$ to $\pm 2.75V$). Supply voltages higher than 7V (absolute maximum) can permanently damage the amplifier. Rail-to-rail input and output swing significantly increases dynamic range, especially in low-supply applications. Good layout practice mandates use of a 0.1 μ F capacitor placed closely across the supply pins.

Phase Reversal Protection

The RES4374 family has 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 RES4374 prevents phase reversal with excessive common-mode voltage. Instead, the appropriate rail limits the output voltage. This performance is shown in figure 1.

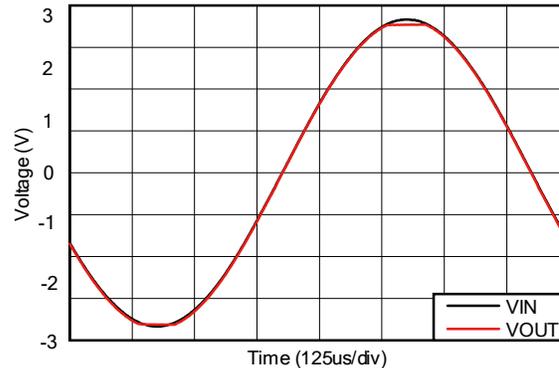


Figure 1. Output Waveform Devoid of Phase Reversal During an Input Overdrive Condition

EMI Rejection Ratio (EMIRR)

The electromagnetic interference (EMI) rejection ratio, or EMIRR, describes the EMI immunity of operational amplifiers. An adverse effect that is common to many operational amplifiers is a change in the offset voltage as a result of RF signal rectification. An operational amplifier that is more efficient at rejecting this change in offset as a result of EMI has a higher EMIRR and is quantified by a decibel value. Measuring EMIRR can be performed in many ways, but this document provides the EMIRR IN+, which specifically describes the EMIRR performance when the RF signal is applied to the noninverting input pin of the operational amplifier. In general, only the noninverting input is tested for EMIRR for the following three reasons:

- Operational amplifier input pins are known to be the most sensitive to EMI, and typically rectify RF signals better than the supply or output pins.
- The noninverting and inverting operational amplifier inputs have symmetrical physical layouts and exhibit nearly matching EMIRR performance.
- EMIRR is easier to measure on noninverting pins than on other pins because the noninverting input pin can be isolated on a printed-circuit-board (PCB). This isolation allows the RF signal to be applied directly to the noninverting input pin with no complex interactions from other components or connecting PCB traces.

Detailed Description (continued)

The EMIRR IN+ of the RES4374 is plotted versus frequency in Figure 2. If available, any dual and quad operational amplifier device versions have approximately identical EMIRR IN+ performance. The RES4374 unity-gain bandwidth is 7MHz. EMIRR performance below this frequency denotes interfering signals that fall within the operational amplifier bandwidth.

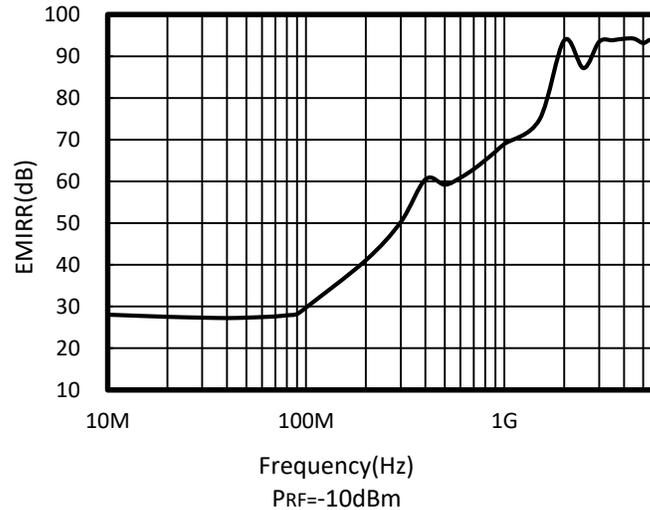


Figure 2. RES4374 EMIRR vs Frequency

EMIRR IN+ Test Configuration

Figure 3 shows the circuit configuration for testing the EMIRR IN+. An RF source is connected to the operational amplifier noninverting input pin using a transmission line. The operational amplifier is configured in a unity-gain buffer topology with the output connected to a low-pass filter (LPF) and a digital multimeter (DMM). A large impedance mismatch at the operational amplifier input causes a voltage reflection; however, this effect is characterized and accounted for when determining the EMIRR IN+. The resulting dc offset voltage is sampled and measured by the multimeter. The LPF isolates the multimeter from residual RF signals that can interfere with multimeter accuracy.

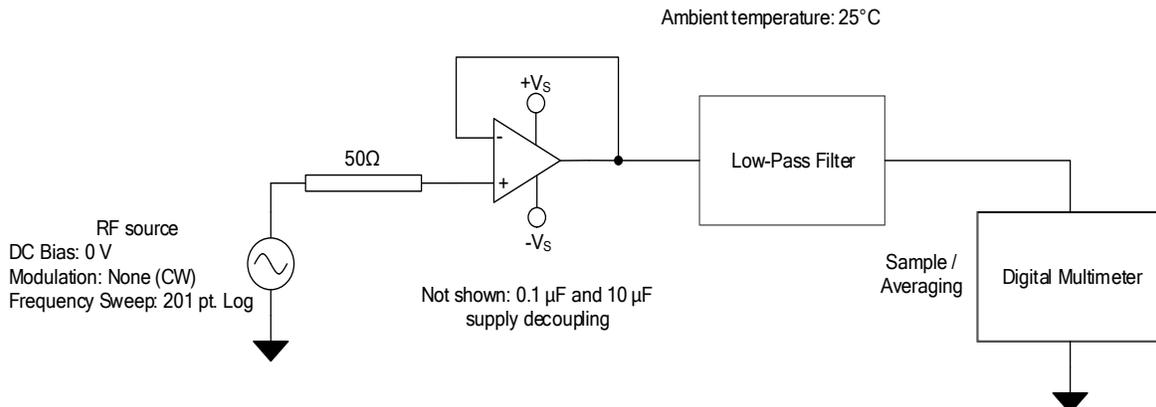


Figure 3. EMIRR IN+ Test Configuration Schematic

LAYOUT

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 0.1 μ F 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.

Layout Example

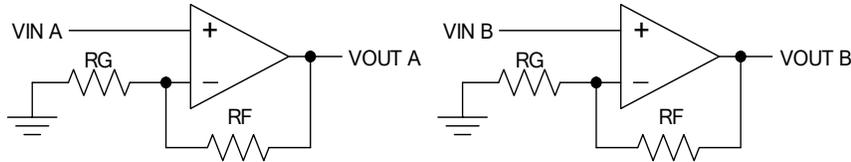


Figure 6. Schematic Representation

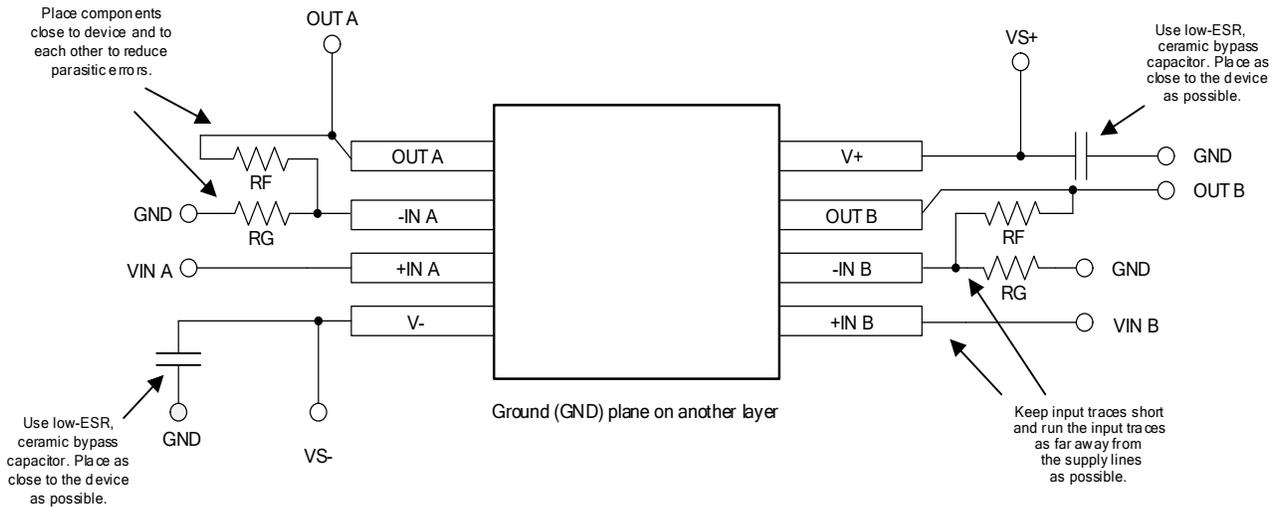
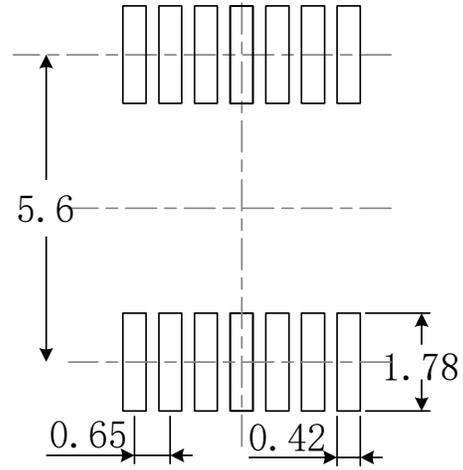
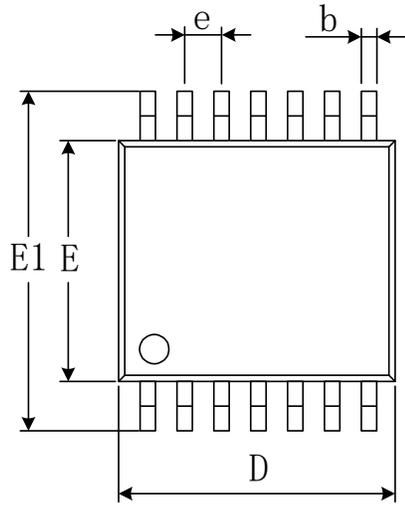
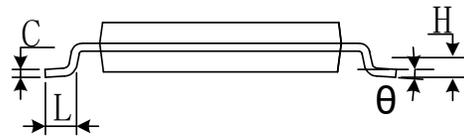
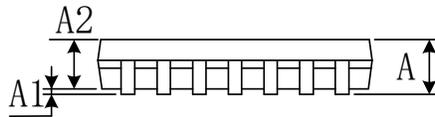


Figure 7. Layout Example

TSSOP14

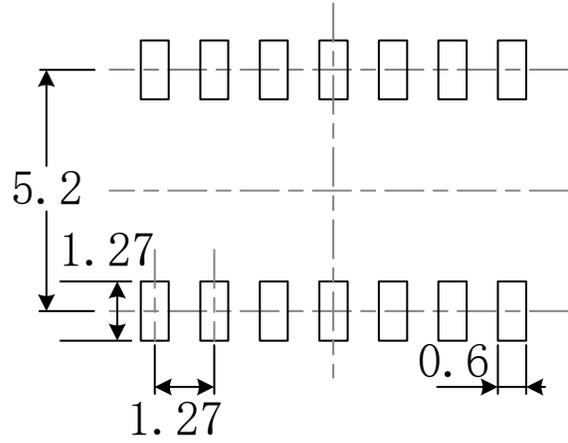
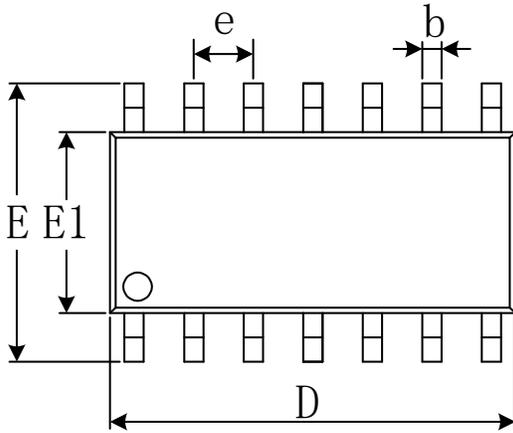


RECOMMENDED LAND PATTERN (Unit: mm)

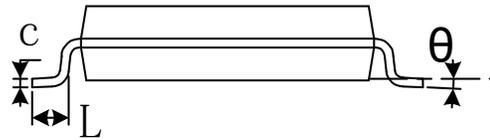
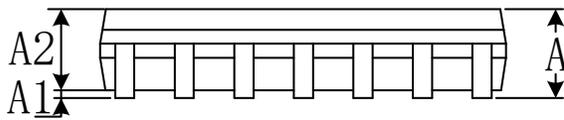


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650(BSC)		0.026(BSC)	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

SOIC14



RECOMMENDED LAND PATTERN (Unit: mm)



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	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°