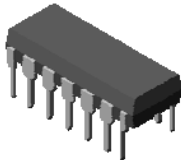

**SOP-14**

**DIP-14**

### Description

The SN324/P is quad operational amplifiers with true differential inputs. They have several distinct advantages over standard operational amplifier types in single supply applications.

The quad amplifier can operate at supply voltages as low as 3.0 V or as high as 32V, The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications.

The output voltage range also includes the negative power supply voltage.

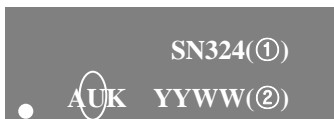
### Application

- ◆ Transducer amplifier
- ◆ DC gain blocks
- ◆ Conventional operational amplifiers

## ORDERING INFORMATION

Product	Marking	Package
SN324	SN324	SOP-14
SN324P	SN324P	DIP-14

### ▲ Marking Information



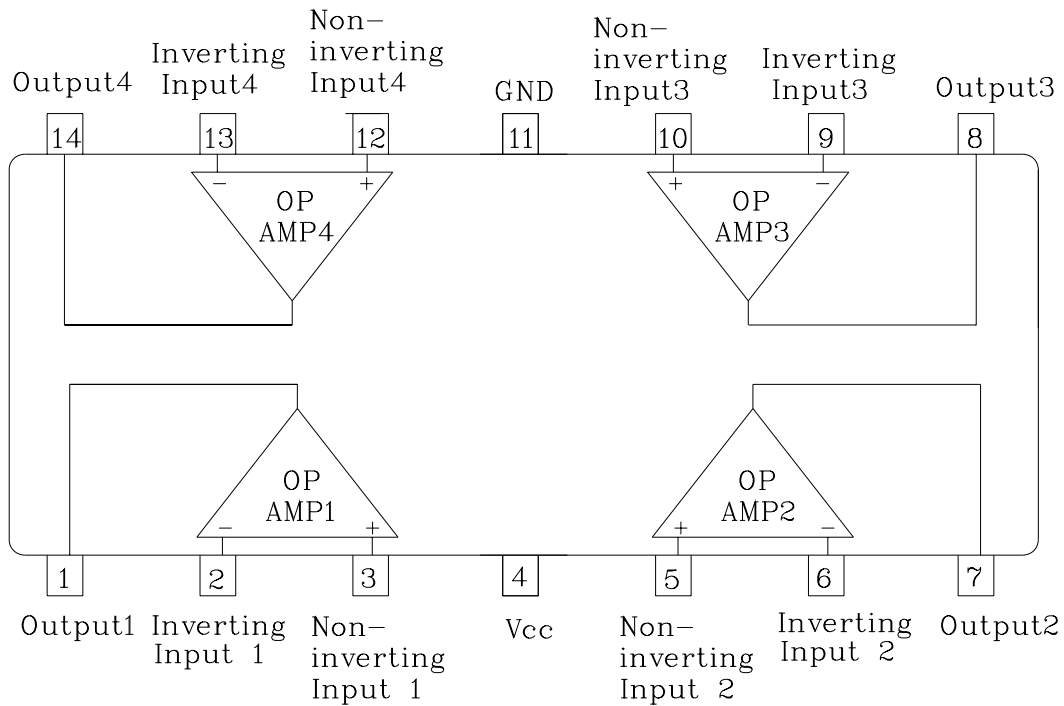
① Device Code

② Year & Week Code

### Features and Benefits

- ◆ Short Circuited Protected Outputs
- ◆ True Differential Input Stage
- ◆ Single Supply Operation: 3.0 V to 32 V
- ◆ Low Input Bias Currents: 100 nA Maximum
- ◆ Common Mode Range Extends to Negative Supply

## ◆ Internal Block Diagram



## ◆ Pin Description

No	Symbol	I/O	Description
1	Output1	O	OP-Amp1's Output
2	IN1(-)	I	OP-Amp1's Inverting Input
3	IN1(+)	I	OP-Amp1's Non- Inverting Input
4	V <sub>CC</sub>	PWR	V <sub>CC</sub> for Dual Operational Amplifier
5	IN2(+)	I	OP-Amp2's Non- Inverting Input
6	IN2(-)	I	OP-Amp2's Inverting Input
7	Output2	O	OP-Amp2's Output
8	Output3	O	OP-Amp3's Output
9	IN3(-)	I	OP-Amp3's Inverting Input
10	IN3(+)	I	OP-Amp3's Non- Inverting Input
11	GND	GND	Ground
12	IN4(+)	I	OP-Amp4's Non- Inverting Input
13	IN4(-)	I	OP-Amp4's Inverting Input
14	Output4	O	OP-Amp4's Output

### Absolute maximum ratings

Characteristic	Symbol	Ratings	Unit	
Supply voltage	$V_{CC}$	36 or $\pm 18$	V	
Differential input voltage	$V_{IND}$	36	V	
Input voltage	$V_{IN}$	-0.3 ~ +36	V	
Power Dissipation	$P_D$	SOP-14	800	mW
		DIP-14	1300	mW
Operating temperature	$T_{opr}$	-40 ~ +85	$^{\circ}C$	
Storage temperature	$T_{stg}$	-55 ~ 150	$^{\circ}C$	

### Electrical Characteristics

(Unless otherwise specified.  $V_{CC} = 5V$ ,  $V_{EE} = GND$  and  $0^{\circ}C \leq T_a \leq +70^{\circ}C$ )

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit	
Input offset voltage	$V_{IOS}$	$V_{CC} = 5\sim 30V$ $R_g = 0\Omega$	-	2	7	mV	
Input offset current	$I_{IOS}$	-	-	5	30	nA	
Input bias current	$I_{IB}$	-	-	45	150	nA	
Input common mode voltage range	$V_{ICR}$	$V_{CC} = 30V$ , $T_a = 25^{\circ}C$	0	-	$V_{CC} - 1.5$	V	
Supply current	$I_{CC}$	$R_L = \infty$ , All Channel	-	0.7	1.2	mA	
Large signal voltage gain	$G_V$	$V_{CC} = 15V$ $R_L \geq 2 K\Omega$	86	100	-	dB	
Output voltage swing	$V_{OH}$	$V_{CC} = 30V$ , $R_L = 2 K\Omega$	26	-	-	V	
		$R_L = 10 K\Omega$	27	28	-		
	$V_{OL}$	$V_{CC} = 5V$ , $R_L \leq 10 K\Omega$	-	5	20	mV	
Common mode rejection ratio	CMRR	$V_{CC} = 5V \sim 15V$ , $V_{IC} = V_{IVRMIN}$ $T_a = 25^{\circ}C$	65	85	-	dB	
Power supply rejection ratio	PSRR	$V_{CC} = 5V \sim 15V$ , $T_a = 25^{\circ}C$	65	100	-	dB	
Output source current	$I_{O+}$	$V_{CC} = 15V$ $V_{IN+} = 1V$ , $V_{IN-} = 0V$	$T_a = 25^{\circ}C$	20	40	-	mA
				10	-	-	
Output sink current	$I_{O-}$	$V_{CC} = 15V$ $V_{IN+} = 0V$ , $V_{IN-} = 1V$	$T_a = 25^{\circ}C$	10	20	-	mA
				5	-	-	
		$V_{OUT} = 200mV$ , $T_a = 25^{\circ}C$ $V_{IN+} = 0V$ , $V_{IN-} = 1V$ , $V_{CC} = 15V$	12	45	-	$\mu A$	

### Electrical Characteristic Curves

Fig. 1  $I_{CC}-V_{CC}$

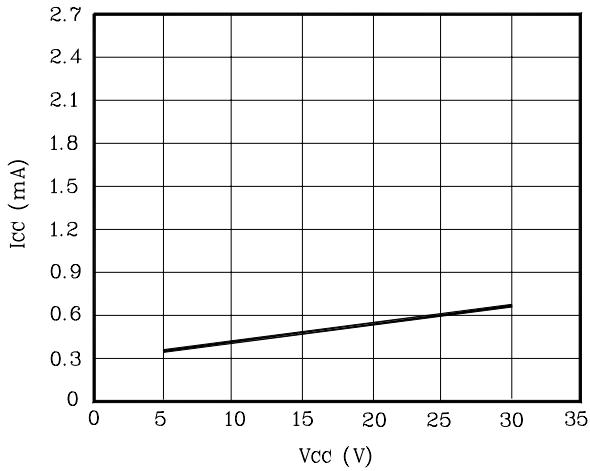


Fig. 2  $I_{IB}-V_{CC}$

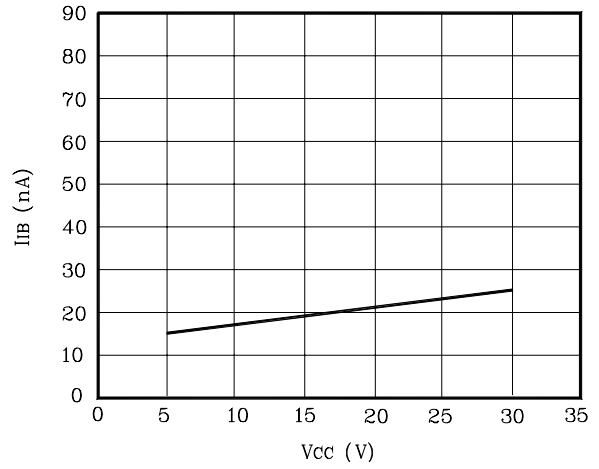


Fig. 3  $V_{IOS}-T_a$

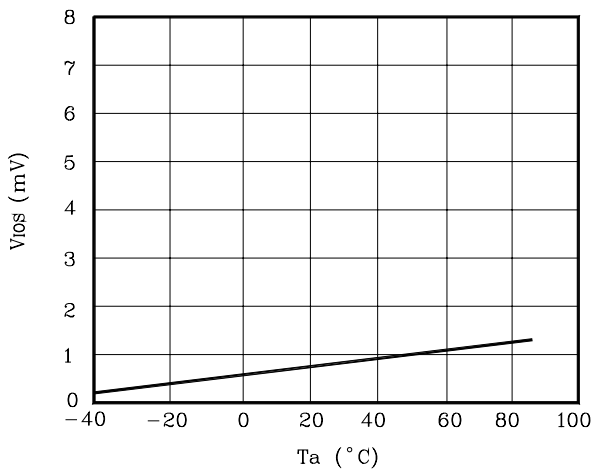


Fig. 4  $I_{O+}-T_a$

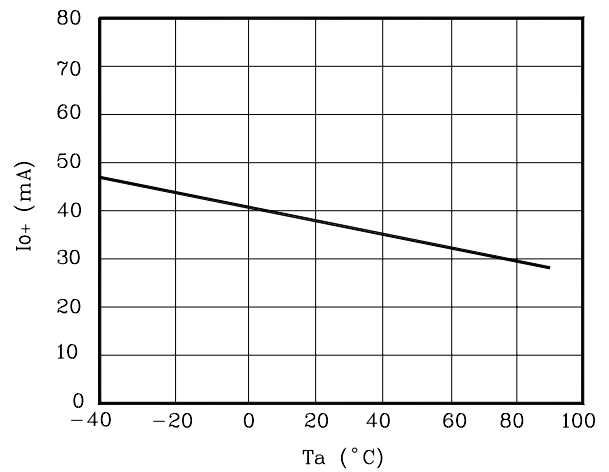


Fig. 5 CMRR-f

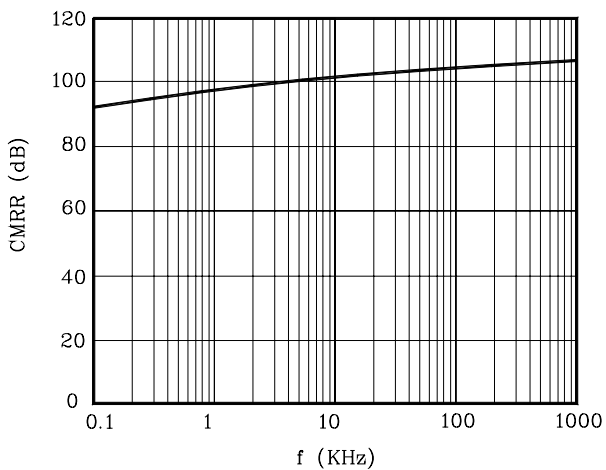
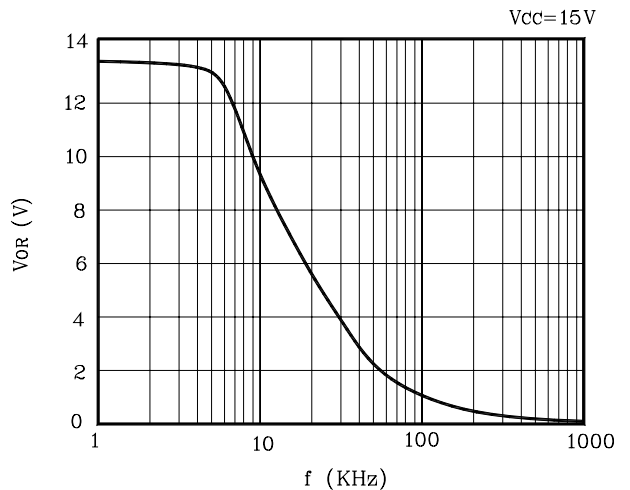
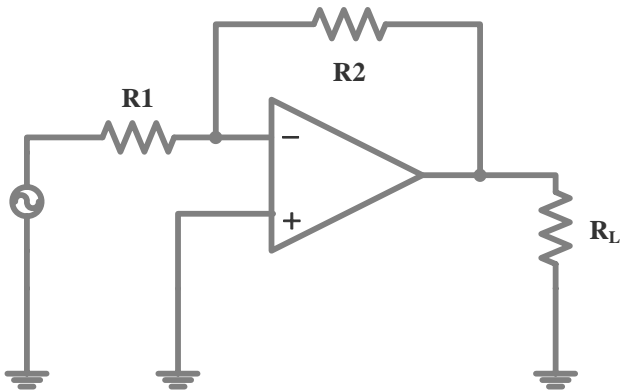


Fig. 6  $V_{OR}-f$

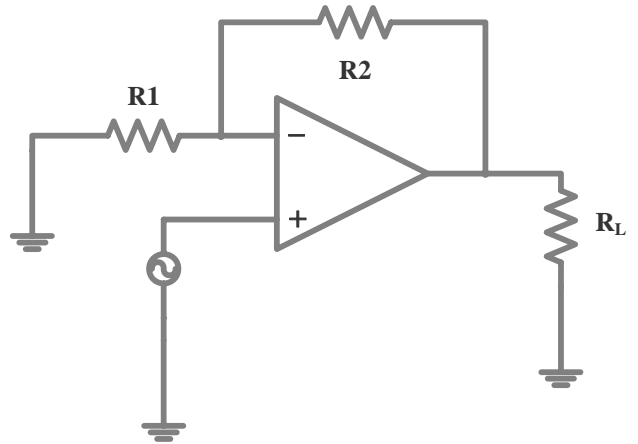


**Typical Applications**

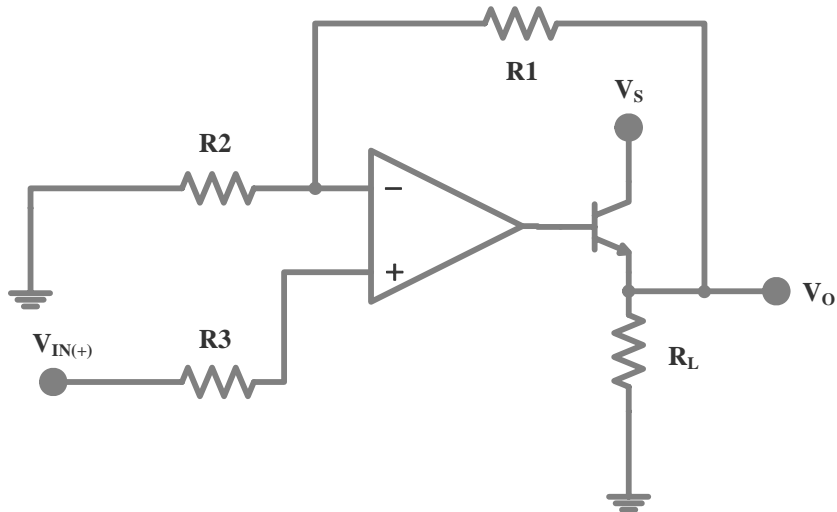
**Inverting Amplifier**



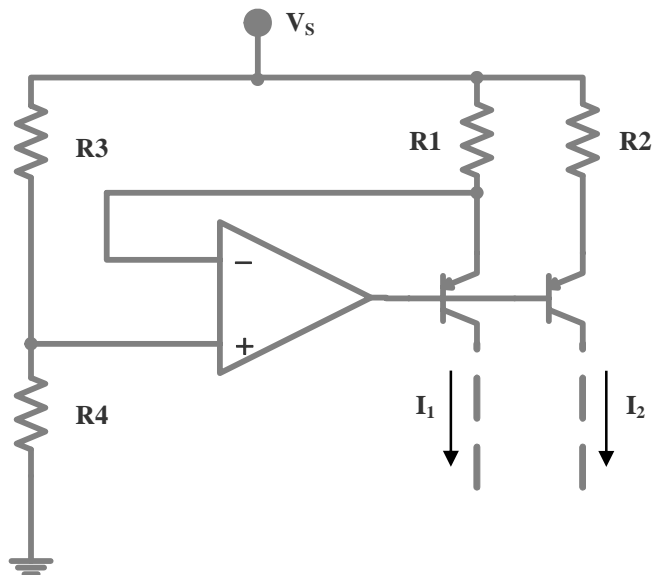
**Non-inverting Amplifier**



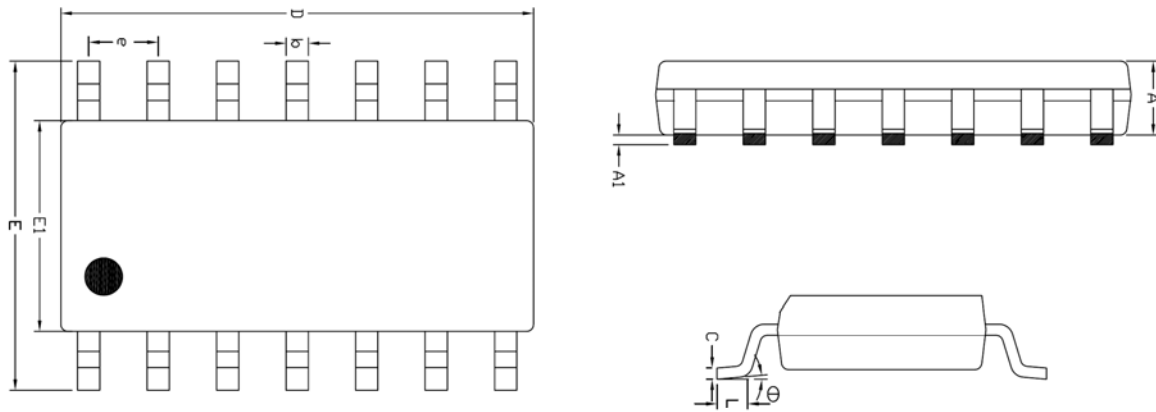
**Power Amplifier**



**Fixed Current Sources**

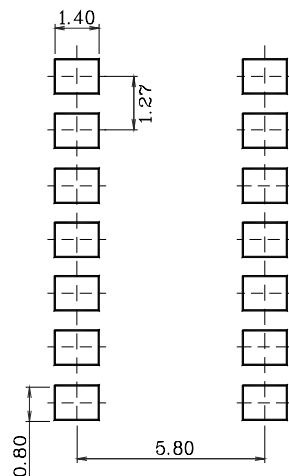


## Outline Dimension (Unit : mm)

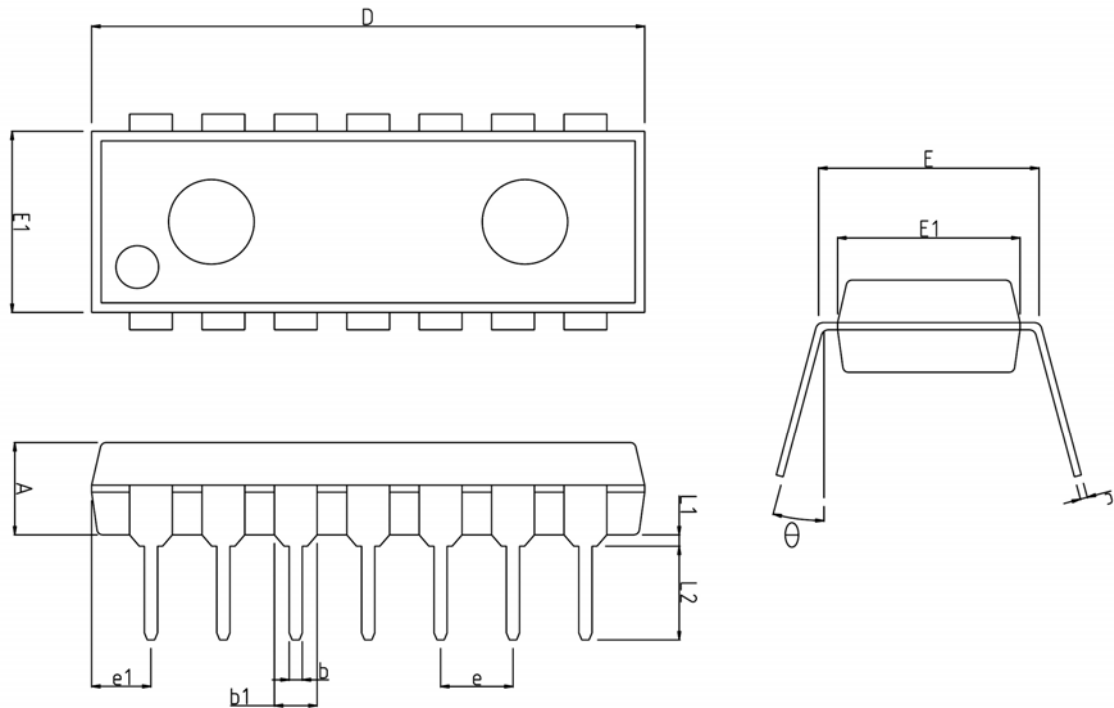


SYMBOL	MILLIMETER(mm)			NOTE
	MINIMUM	NOMINAL	MAXIMUM	
A	1.245	—	1.445	
A1	0.125	0.175	0.275	
b	0.320	0.420	0.520	
c	0.170	0.220	0.270	
D	8.536	8.636	8.736	
E	5.870	6.020	6.170	
E1	3.761	3.861	3.961	
e	1.270 BSC			
L	0.462	0.562	0.662	
θ	0 °	—	8 °	

## ※ Recommend PCB solder land (Unit : mm)



**Outline Dimension (Unit : mm)**



SYMBOL	MILLIMETERS			NOTE
	MINIMUM	NOMINAL	MAXIMUM	
A	3.05	3.25	3.45	
b	0.36	0.46	0.56	
b1	1.40	1.50	1.60	
c	0.20	0.25	0.35	
D	19.20	19.40	19.60	
E	7.37	7.62	7.87	
E1	6.20	6.40	6.60	
e	2.54 TYP			
e1	2.08 TYP			
L1	0.20	—	—	
L2	3.00	3.30	3.60	
theta	0°	—	15°	

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