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## Features

- Internally Frequency Compensated for Unity Gain
- Large DC Voltage Gain: 100dB
- Wide Power Supply Range:  
LM324/LM324A : 3V~32V (or  $\pm 1.5 \sim 16V$ )  
LM2902/LM2902A: 3V~26V (or  $\pm 1.5V \sim 13V$ )
- Input Common Mode Voltage Range Includes Ground
- Large Output Voltage Swing: 0V to VCC -1.5V
- Power Drain Suitable for Battery Operation

## Description

The LM324/LM324A, LM2902/LM2902A consist of four independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide voltage range. operation from split power supplies is also possible so long as the difference between the two supplies is 3 volts to 32



## Electrical Characteristics

( $V_{CC} = 5.0V$ ,  $V_{EE} = GND$ ,  $T_A = 25^\circ C$ , unless otherwise specified)

Parameter	Symbol	Conditions	LM324			LM2902			Unit		
			Min.	Typ.	Max.	Min.	Typ.	Max.			
Input Offset Voltage	$V_{IO}$	$V_{CM} = 0V$ to $V_{CC} - 1.5V$ $V_{O(P)} = 1.4V$ , $R_S = 0\Omega$ (Note1)	-	1.5	7.0	-	1.5	7.0	mV		
Input Offset Current	$I_{IO}$	$V_{CM} = 0V$	-	3.0	50	-	3.0	50	nA		
Input Bias Current	$I_{BIAS}$	$V_{CM} = 0V$	-	40	250	-	40	250	nA		
Input Common-Mode Voltage Range	$V_{I(R)}$	Note1	0	-	$V_{CC} - 1.5$	0	-	$V_{CC} - 1.5$	V		
Supply Current	$I_{CC}$	$R_L = \infty$ , $V_{CC} = 30V$ (LM2902, $V_{CC} = 26V$ )	-	1.0	3	-	1.0	3	mA		
		$R_L = \infty$ , $V_{CC} = 5V$	-	0.7	1.2	-	0.7	1.2	mA		
Large Signal Voltage Gain	$G_V$	$V_{CC} = 15V$ , $R_L = 2k\Omega$ $V_{O(P)} = 1V$ to $11V$	25	100	-	25	100	-	V/mV		
			$V_{O(H)}$	Note1	$R_L = 2k\Omega$	26	-	-	22	-	V
			$V_{O(L)}$	$R_L = 10k\Omega$	27	28	-	23	24	-	V
Output Voltage Swing		$V_{CC} = 5V$ , $R_L = 10k\Omega$	-	5	20	-	5	100	mV		
Common-Mode Rejection Ratio	CMRR	-	65	75	-	50	75	-	dB		
Power Supply Rejection Ratio	PSRR	-	65	100	-	50	100	-	dB		
Channel Separation	CS	$f = 1kHz$ to $20kHz$ (Note2)	-	120	-	-	120	-	dB		
Short Circuit to GND	ISC	$V_{CC} = 15V$	-	40	60	-	40	60	mA		
	ISOURCE	$V_{I(+)} = 1V$ , $V_{I(-)} = 0V$ $V_{CC} = 15V$ , $V_{O(P)} = 2V$	20	40	-	20	40	-	mA		
Output Current	ISINK	$V_{I(+)} = 0V$ , $V_{I(-)} = 1V$ $V_{CC} = 15V$ , $V_{O(P)} = 2V$	10	13	-	10	13	-	mA		
		$V_{I(+)} = 0V$ , $V_{I(-)} = 1V$ $V_{CC} = 15V$ , $V_{O(R)} = 200mV$	12	45	-	-	-	-	$\mu A$		
Differential Input Voltage	$V_{I(DIFF)}$	-	-	-	$V_{CC}$	-	-	$V_{CC}$	V		

### Note :

- $V_{CC} = 30V$  for LM324,  $V_{CC} = 26V$  for LM2902
- This parameter, although guaranteed, is not 100% tested in production.

**Electrical Characteristics** (Continued)

(VCC = 5.0V, VEE = GND, unless otherwise specified)

The following specification apply over the range of  $0^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$  for the LM324 ; and the  $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$  for the LM2902

Parameter	Symbol	Conditions	LM324			LM2902			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Input Offset Voltage	$V_{IO}$	$V_{ICM} = 0\text{V to } V_{CC} - 1.5\text{V}$ $V_{O(P)} = 1.4\text{V}, R_S = 0\Omega$ (Note1)	-	-	9.0	-	-	10.0	mV
Input Offset Voltage Drift	$\Delta V_{IO}/\Delta T$	$R_S = 0\Omega$ (Note2)	-	7.0	-	-	7.0	-	$\mu\text{V}/^{\circ}\text{C}$
Input Offset Current	$I_{IO}$	$V_{CM} = 0\text{V}$	-	-	150	-	-	200	nAV

**Note:**

1. VCC=30V for LM324 , VCC = 26V for LM2902
2. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics** (Continued)(V<sub>CC</sub> = 5.0V, V<sub>EE</sub> = GND, T<sub>A</sub> = 25°C, unless otherwise specified)

Parameter	Symbol	Conditions	LM324A			LM2902A			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Input Offset Voltage	V								

**Note:**

1. V<sub>CC</sub>=30V for LM324A ; V<sub>CC</sub>=26V for LM2902A
2. This parameter, although guaranteed, is not 100% tested in production.

## Electrical Characteristics (Continued)

( $V_{CC} = 5.0V$ ,  $V_{EE} = GND$ , unless otherwise specified)

The following specification apply over the range of  $0^{\circ}C \leq T_A \leq +70^{\circ}C$  for the LM324A ; and the  $-40^{\circ}C \leq T_A \leq +85^{\circ}C$

# Typical Performance Characteristics

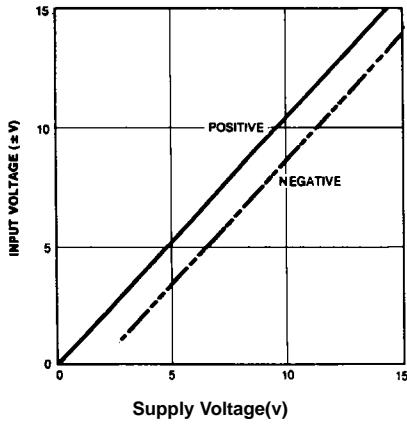


Figure 1. Input Voltage Range vs Supply Voltage

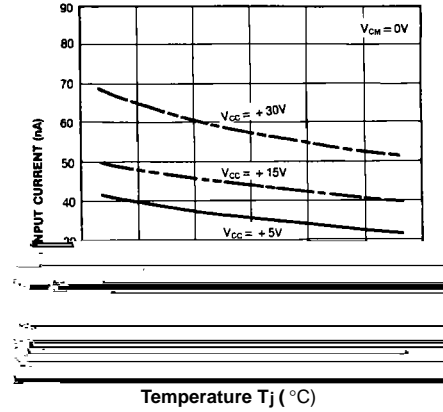


Figure 2. Input Current vs Temperature

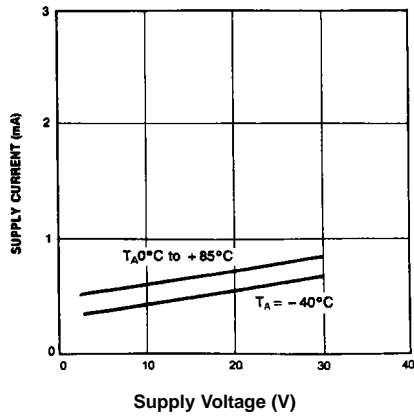


Figure 3. Supply Current vs Supply Voltage

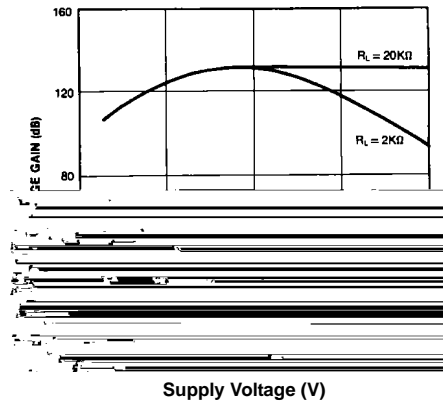


Figure 4. Voltage Gain vs Supply Voltage

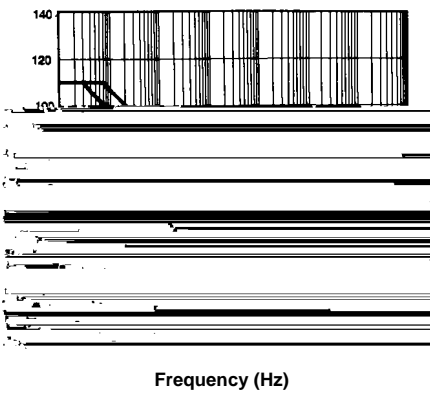


Figure 5. Open Loop Frequency Response

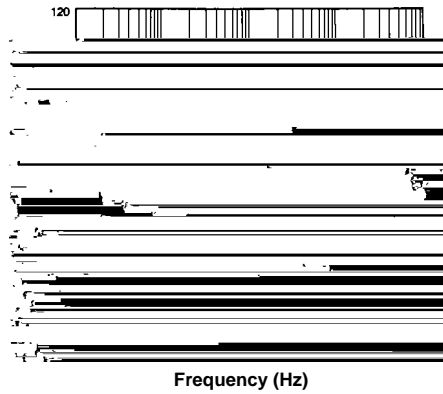


Figure 6. Common mode Rejection Ratio



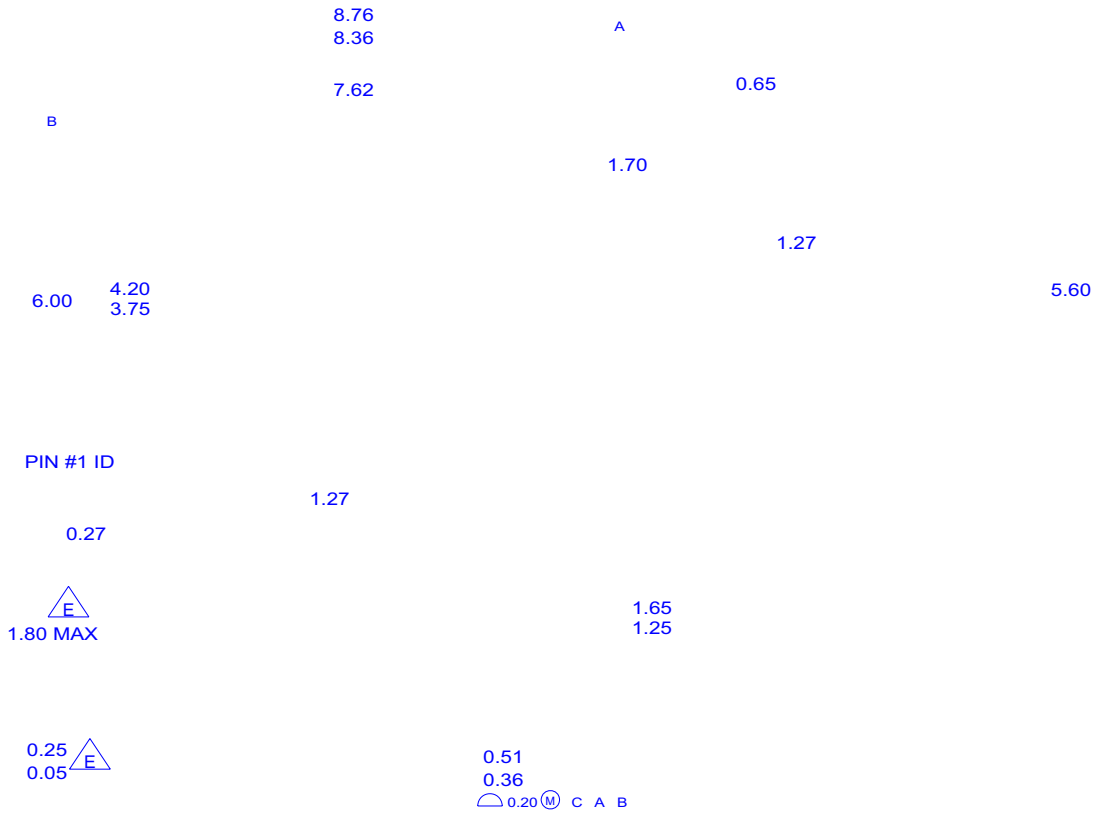




# Mechanical Dimensions (Continued)

## Package

Dimensions in millimeters



## Ordering Information

Product Number	Package	Operating Temperature
LM324N	14-DIP	0 ~ +70°C
LM324AN		
LM324M	14-SOP	
LM324AM		
LM2902N	14-DIP	-40 ~ +85°C
LM2902M	14-SOP	
LM2902AM		

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