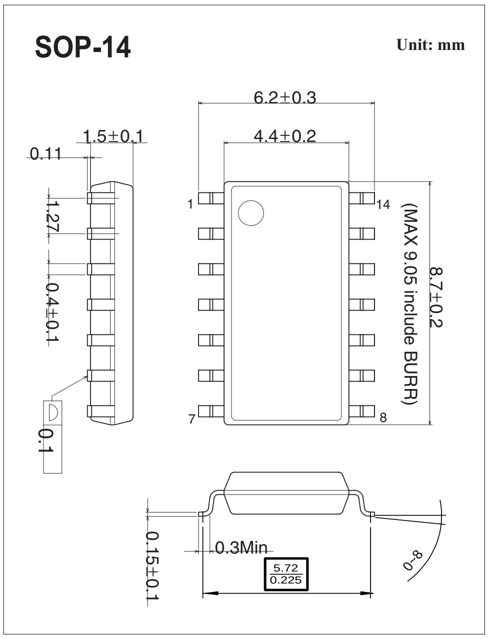
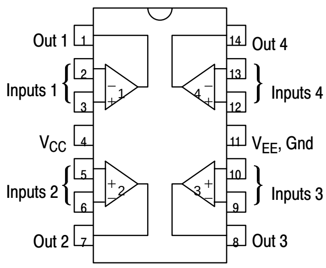
Quadruple Operational Amplifiers
LM324

Features

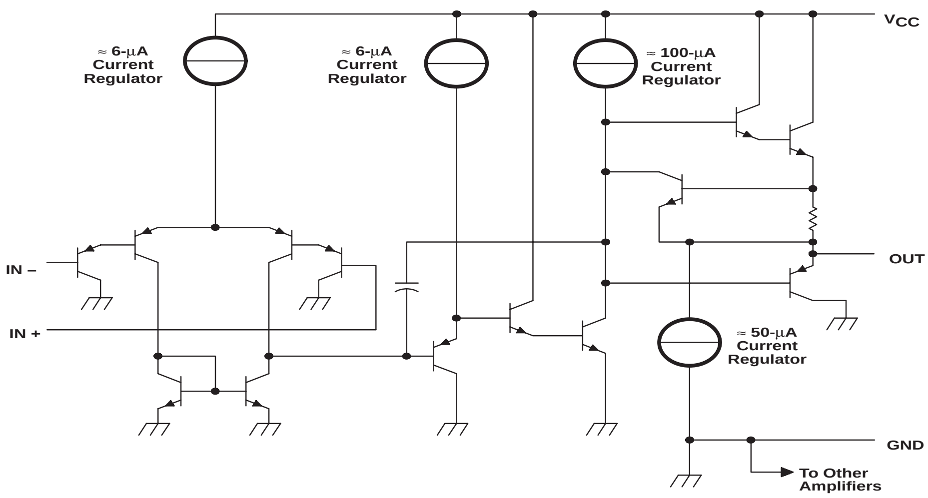
- 2-kV ESD Protection (K-Suffix Devices)
- Wide Supply Range:
  - Single Supply . . . 3 V to 32 V
  - or Dual Supplies . . ±1.5 V to ±16 V
- Low Supply-Current Drain Independent of Supply Voltage . . . 0.8 mA Typ
- Common-Mode Input Voltage Range Includes Ground, Allowing Direct Sensing Near Ground
- Low Input Bias and Offset Parameters:
  - Input Offset Voltage . . . 3 mV Typ
    A Versions . . . 2 mV Typ
  - Input Offset Current . . . 2 nA Typ
  - Input Bias Current . . . 20 nA Typ
    A Versions . . . 15 nA Typ
- Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage . . . 32 V
- Open-Loop Differential Voltage Amplification . . . 100 V/mV Typ
- Internal Frequency Compensatio





SOP-14

■ schematic (each amplifier)



http://www.luguang.cn mail:lge@luguang.cn

■ Absolute maximum ratings over operating free-air temperature range

Parameter	Rating	Unit
Supply voltage, V_{CC} *1	32	V
Differential input voltage, V_{ID} *2	±32	V
Input voltage, V_I (either input)	-0.3 to 32	V
Duration of output short circuit (one amplifier) to ground at (or below) T_A = 25℃,V_{CC} ⩽ 15 V *3	Unlimited	
Package thermal impedance, θ_{JA}*4	76	℃/W
Operating virtual junction temperature, T_J	150	℃
Storage temperature range, Tstg	-65 to 150	℃
Charged-Device Model	±2	kV

*1 All voltage values (except differential voltages and V_{CC} specified for the measurement of I_{OS}) are with respect to the network GND.

*2 Differential voltages are at IN+, with respect to IN-.

*3 Short circuits from outputs to V_{CC} can cause excessive heating and eventual destruction.

*4 Maximum power dissipation is a function of $T_{J(max)}$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(max)}-T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150℃ can affect reliability.

■ Operating conditions, V_{CC}=±15 V, T_A=25℃

Parameter	Symbol	Testconditons	Typ	Unit
Slew rate at unity gain	S_R	R_L = 1 MΩ, C_L = 30 pF, V_I =±10 V (see Figure 1)	0.5	V/μs
Unity-gain bandwidth	B_1	R_L = 1 MΩ, CL = 20 pF (see Figure 1)	1.2	MHz
Equivalent input noise voltage	V_n	R_S = 100Ω, V_I = 0 V, f = 1 kHz (see Figure 2)	35	nV/√Hz

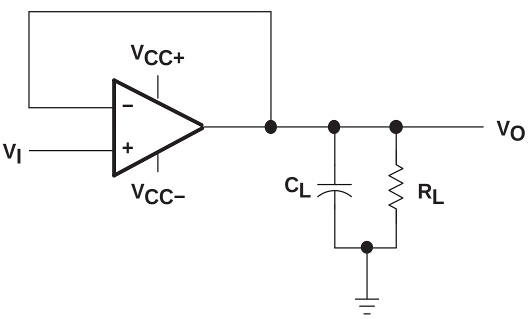


Figure 1. Unity-Gain Amplifier

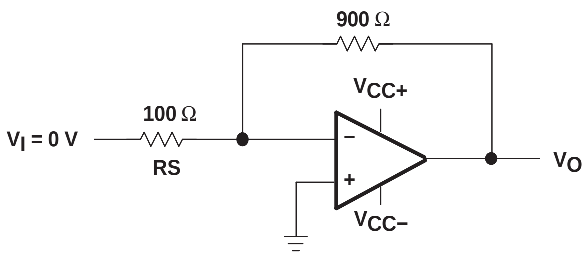


Figure 2. Noise-Test Circuit

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LM324

■ Electrical characteristics at specified free-air temperature, V_{CC} = 5 V (unless otherwise noted)

Parameter	Symbol	T_A *2	Testconditons *1	Min	Typ *3	Max	Unit
Input offset voltage	V_{IO}	25℃	V_{CC} = 5 V to MAX,		3	7	mV
		Full range	V_{IC} = V_{ICRmin}, V_O = 1.4 V			9	
Input offset current	I_{IO}	25℃	V_O = 1.4 V		2	50	nA
		Full range				150	
Input bias current	I_{IB}	25℃	V_O = 1.4 V		-20	-250	nA
		Full range				-500	
Common-mode input voltage range	V_{ICR}	25℃	V_{CC} = 5 V to MAX	0 to V_{CC}-1.5			V
		Full range		0 to V_{CC}-2			V
High-level output voltage	V_{OH}	25℃	R_L = 2 KΩ	V_{CC}-1.5			V
		25℃	R_L = 10 KΩ				
		Full range	V_{CC} = MAX, R_L = 2 kΩ	26			
		Full range	V_{CC} = MAX, $R_L \geqslant$ 10 kΩ	27	28		
Low-level output voltage	V_{OL}	Full range	$R_L \leqslant$ 10 kΩ		5	20	mV
Large-signal differential voltage amplification	A_{VD}	25℃	V_{CC} = 15 V, V_O = 1 V to 11 V, $R_L \geqslant$ 2 kΩ	25	100		V/mV
		Full range		15			
Common-mode rejection ratio	CMRR	25℃	V_{IC} = V_{ICRmin}	65	80		dB
Supply-voltage rejection ratio (△V_{CC}/△V_{IO})	k_{SVR}	25℃		65	100		dB
Crosstalk attenuation	V_{O1}/V_{O2}	25℃	f = 1 kHz to 20 kHz		120		dB
Output current	I_O	25℃	Source V_{CC} = 15 V, V_{ID} = 1 V, V_O = 0	-20	-30	-60	mA
		Full range		-10			
		25℃	Sink V_{CC} = 15 V, V_{ID} = -1 V, V_O = 15 V	10	20		
		Full range		5			
		25℃	V_{ID} = -1 V, V_O = 200 mV	12	30		μA
Short-circuit output current	I_{OS}	25℃	V_{CC} at 5 V, GND at -5 V, V_O = 0,		±40	60	mA
Supply current (four amplifiers)	I_{CC}	Full range	V_O = 2.5 V, No load		0.7	1.2	mA
		Full range	V_{CC} = MAX, V_O = 0.5 V_{CC}, No load		1.4	3	

*1 All characteristics are measured under open-loop conditions, with zero common-mode input voltage, unless otherwise specified.

*2 for 2 0℃ to 70℃

*3 All typical values are at T_A = 25℃.

■ Marking

Marking	LM324

■ Ordering Information

Deviece	Packaging	Shipping
LM324	SOP14	2500/Tape&Reel

■ Typlacl Characteristics

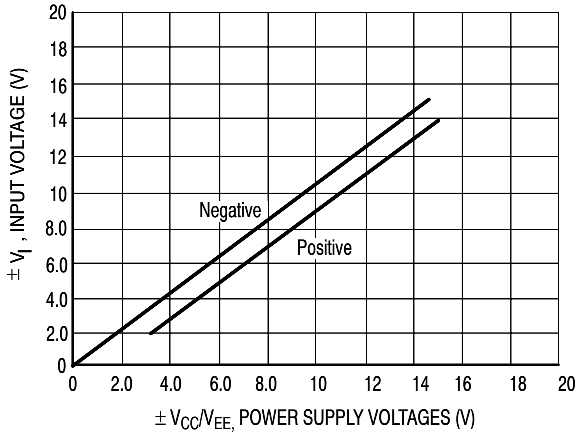

Figure 4. Input Voltage Range

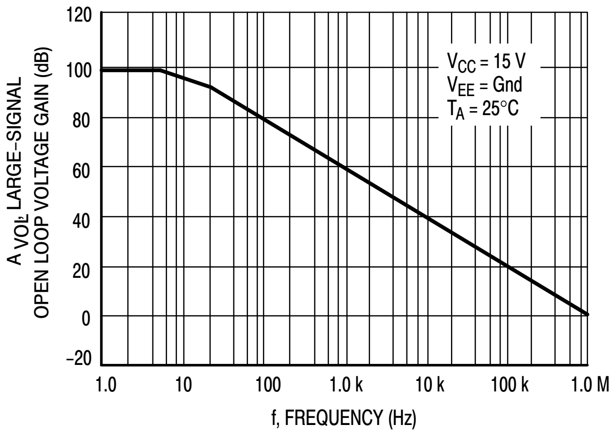

Figure 5. Open Loop Frequency

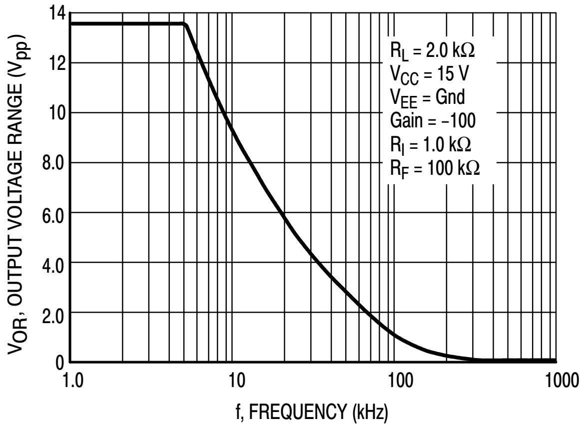

Figure 6. Large–Signal Frequency Response

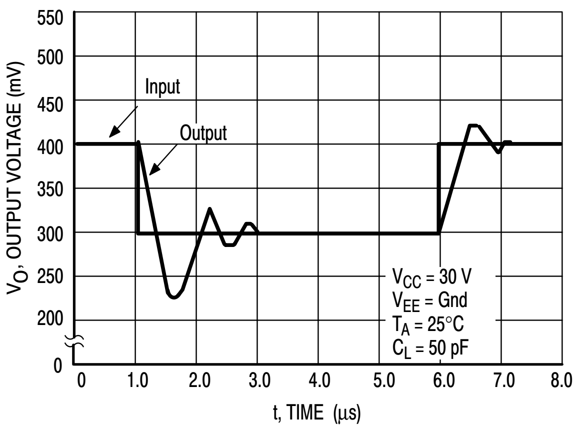

Figure 7. Small–Signal Voltage Follower Pulse Response (Noninverting)

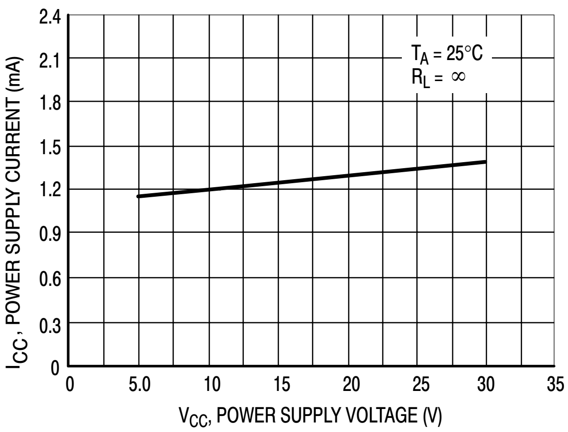

Figure 8. Power Supply Current versus Power Supply Voltage

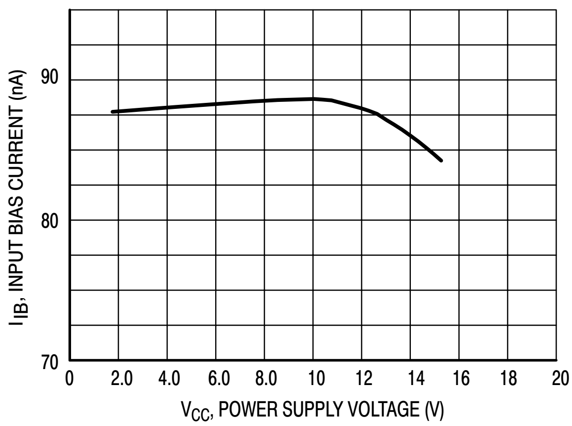

Figure 9. Input Bias Current versus Power Supply Voltage