

SOP14 Plastic-Encapsulate Operational Amplifiers

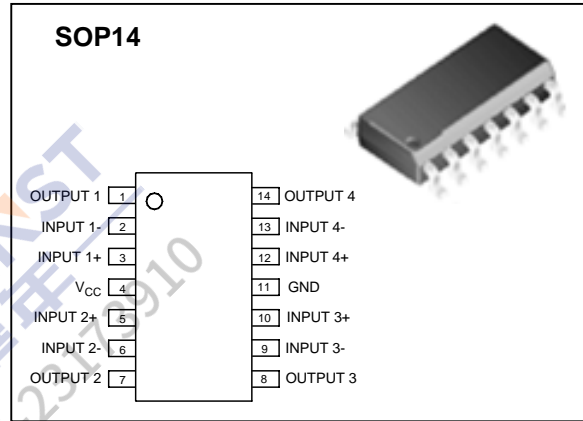
**LM324** Low Power Quad Operational Amplifier

**DESCRIPTION**

The LM324 consists of four independent, high gain and internally frequency compensated operational amplifiers, it is specifically designed to operate from a single power supply. Operation from split power supply is also possible and the low power supply current drain is independent of the magnitude of the power supply voltages.

**Features**

- Internally Frequency Compensated for Unity Gain
- Large Voltage Gain: 100dB (Typical)
- Low Input Bias Current: 45nA (Typical)
- Low Input Offset Voltage: 2mV (Typical)
- Low Supply Current: 0.5mA (Typical)
- Wide Power Supply Voltage Range:  
Single Supply: 3V to 30V  
Dual Supplies:  $\pm 1.5V$  to  $\pm 15V$
- Input Common Mode Voltage Range Includes Ground
- Large Output Voltage Swing: 0V to  $V_{CC}-1.5V$
- Power Drain Suitable for Battery Operation



**Applications**

- Battery Charger
- Cordless Telephone
- Switching Power Supply

**Functional Block Diagram**

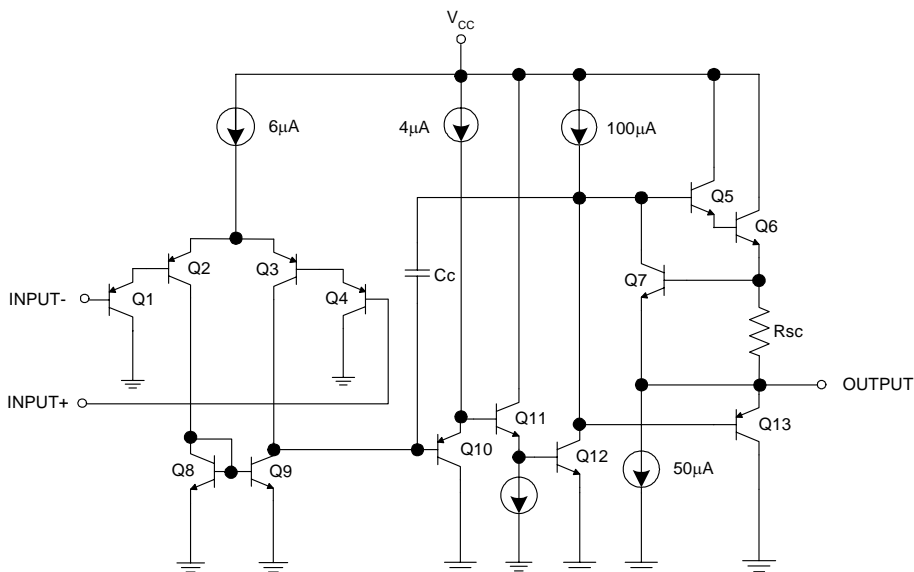


Figure 1. Functional Block Diagram of LM324

## LM324 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value	Unit
Power Supply Voltage	$V_{CC}$	32	V
Differential Input Voltage	$V_{ID}$	32	V
Input Voltage	$V_{IC}$	-0.3 to 32	V
Input Current ( $V_{IN} < -0.3V$ ) (Note 2)	$I_{IN}$	50	mA
Output Short Circuit to Ground (One Amplifier) (Note 3) $V_{CC} \leq 15V$ and $T_A = 25^\circ C$		Continuous	
Power Dissipation ( $T_A = 25^\circ C$ )	$P_D$	400	mW
Junction Temperature	$T_J$	-25 to 125	$^\circ C$
Storage Temperature Range	$T_{STG}$	-55 to 125	$^\circ C$
Lead Temperature (Soldering, 10 Seconds)	$T_{LEAD}$	260	$^\circ C$

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device under these conditions is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Note 2: This input current will only exist when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistors becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also lateral NPN parasitic transistor action on the IC chip. This transistor action can cause the output voltages of the op amps to go to the  $V_{CC}$  voltage level (or to ground for a large overdrive) for the time duration that an input is driven negative. This is not destructive and normal output states will re-establish when the input voltage, which was negative, again returns to a value greater than -0.3V (at  $25^\circ C$ )

Note 3: Short circuits from the output to  $V_{CC}$  can cause excessive heating and eventual destruction. When considering short circuits to ground, the maximum output current is approximately 40mA independent of the magnitude of  $V_{CC}$ . At values of supply voltage in excess of +15V, continuous short circuits can exceed the power dissipation ratings and cause eventual destruction. Destructive dissipation can result from simultaneous shorts on all amplifiers.

### Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Supply Voltage	$V_{CC}$	3	30	V
Ambient Operating Temperature Range	$T_A$	0	70	$^\circ C$

## LM324 ELECTRICAL CHARACTERISTICS

$V_{CC}=5V$ ,  $GND=0$ ,  $T_A=25^{\circ}C$  unless otherwise specified.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Offset Voltage	$V_{IO}$	$V_O=1.4V$ , $R_S=0\Omega$ , $V_{CC}=5V$ to $30V$		2	5	mV
Input Bias Current (Note 4)	$I_{BIAS}$	$I_{IN+}$ or $I_{IN-}$ , $V_{CM}=0V$		45	250	nA
Input Offset Current	$I_{IO}$	$I_{IN+}-I_{IN-}$ , $V_{CM}=0V$		5	50	nA
Input Common Mode Voltage Range (Note 5)	$V_{IR}$	$V_{CC}=30V$	0		$V_{CC}-1.5$	V
Supply Current	$I_{CC}$	$R_L=\infty$ , Over full temperature range on all OP Amps	$V_{CC}=30V$	1.5	3	mA
			$V_{CC}=5V$	0.6	2	
Large Signal Voltage Gain	$G_V$	$V_{CC}=15V$ , $R_L \geq 2k\Omega$ , $V_O=1V$ to $11V$	88	100		dB
Common Mode Rejection Ratio	CMRR	$V_{CM}=0V$ to $(V_{CC}-1.5)V$	65	85		dB
Power Supply Rejection Ration	PSRR	$V_{CC}=5V$ to $30V$	65	100		dB
Channel Separation (Note 6)	CS	$f=1kHz$ to $20kHz$		-120		dB
Output Current	Source	$I_{SOURCE}$	$V_{IN+}=1V$ , $V_{IN-}=0V$ , $V_{CC}=15V$ , $V_O=2V$	20	35	mA
	Sink	$I_{SINK}$	$V_{IN+}=0V$ , $V_{IN-}=1V$ , $V_{CC}=15V$ , $V_O=2V$	10	13	mA
			$V_{IN+}=0V$ , $V_{IN-}=1V$ , $V_{CC}=15V$ , $V_O=0.2V$	12	50	$\mu A$
Output Short Circuit to Ground	$I_{SC}$	$V_{CC}=15V$		40	60	mA
Output Voltage Swing	$V_{OH}$	$V_{CC}=30V$ , $R_L=2k\Omega$	26			V
		$V_{CC}=30V$ , $R_L=10k\Omega$	27	28		
	$V_{OL}$	$V_{CC}=5V$ , $R_L=10k\Omega$		5	20	mV
Thermal Resistance (Junction to Case)	$\theta_{JC}$			98.84		$^{\circ}C/W$
Slew Rate	SR	$G = +1$ , $2V$ Output Step		0.5		$V/\mu s$

Note 4: The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.

Note 5: The input common-mode voltage of either input signal voltage should not be allowed to go negatively by more than  $0.3V$  (at  $25^{\circ}C$ ). The upper end of the common-mode voltage range is  $V_{CC}-1.5V$  (at  $25^{\circ}C$ ), but either or both inputs can go to  $+32V$  without damages, independent of the magnitude of the  $V_{CC}$ .

Note 6: Due to proximity of external components, insure that coupling is not originating via stray capacitors between these external parts. This typically can be detected as this type of capacitance increases at higher frequencies.

# Typical Application

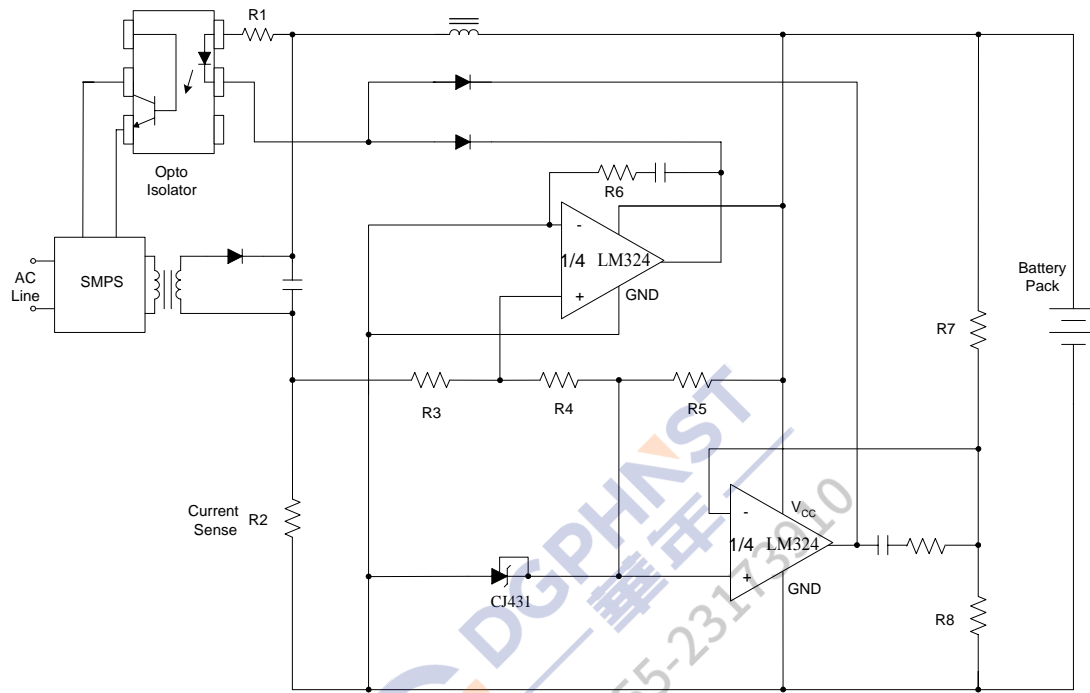


Figure 2. Battery Charger

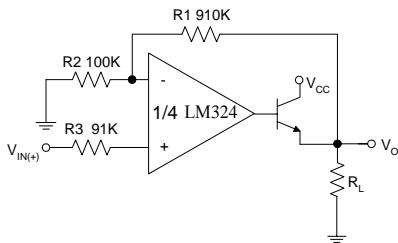


Figure 3. Power Amplifier

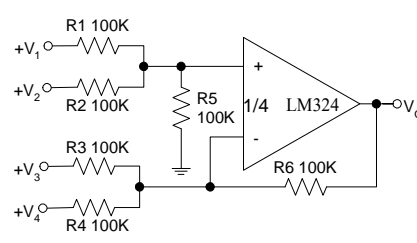


Figure 4. DC Summing Amplifier

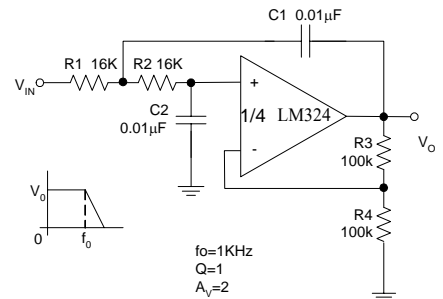


Figure 5. DC Coupled Low-Pass Active Filter

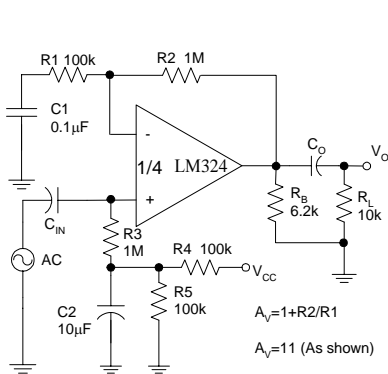


Figure 6. AC Coupled Non-Inverting Amplifier

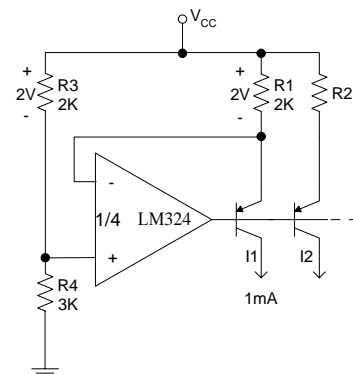


Figure 7. Fixed Current Sources

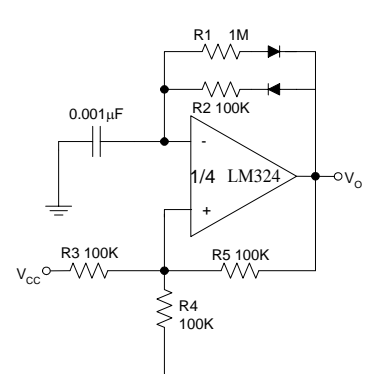
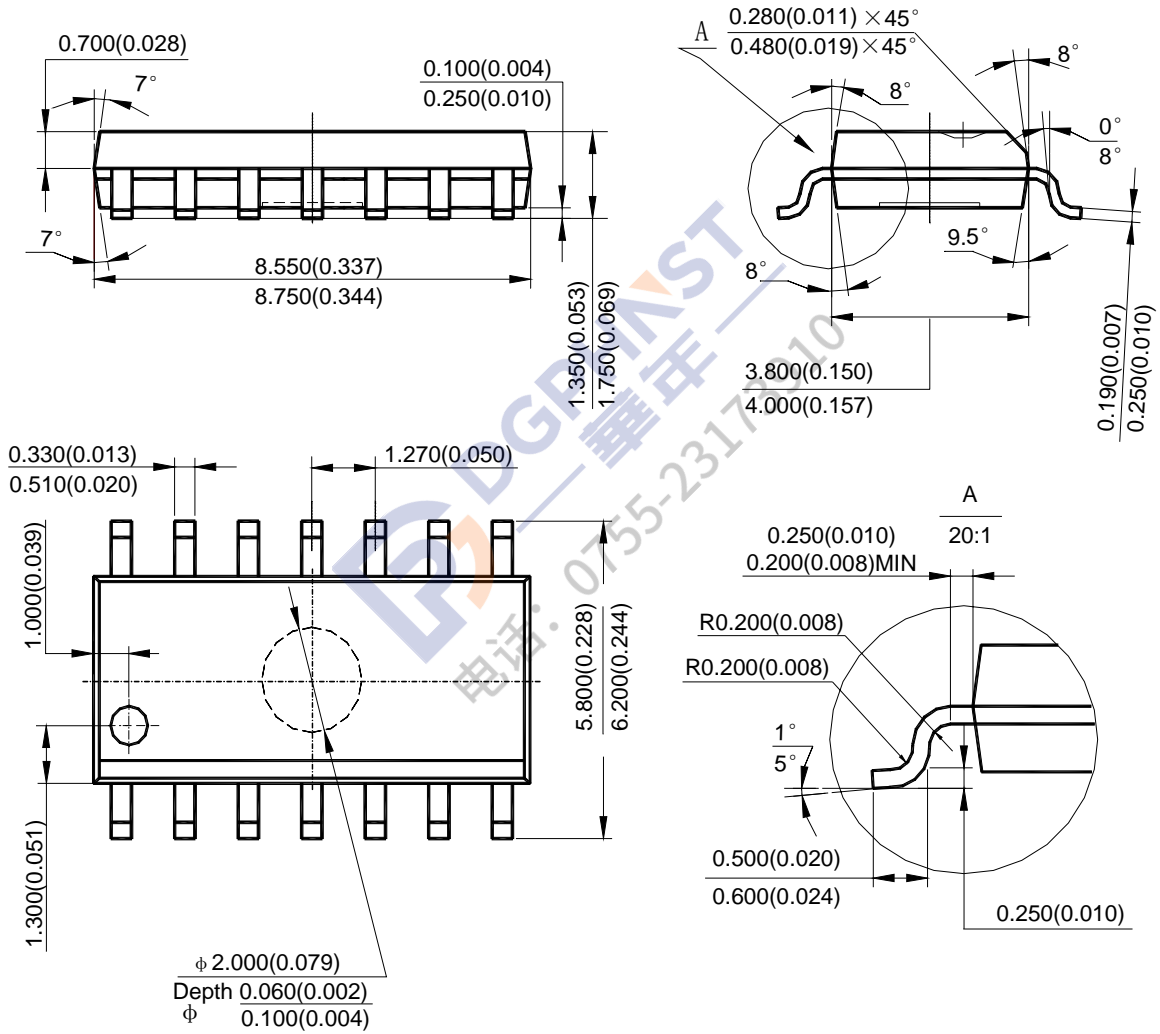


Figure 8. Pulse Generator

# SOP14 Package Outline Dimensions

Unit: mm(inch)



Note: Eject hole, oriented hole and mold mark is optional.

# DISCLAIMER

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