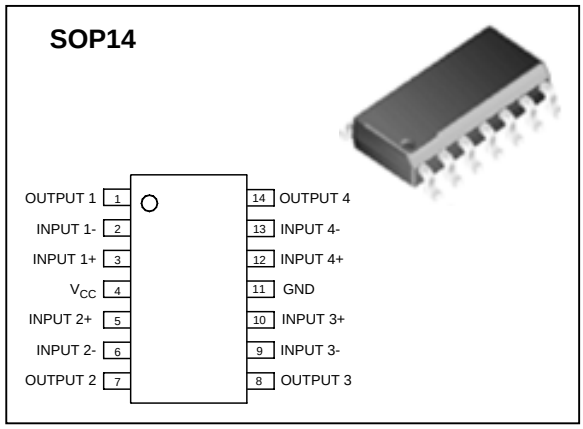
LM324 Low Power Quad Operational Amplifier

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 sup-ply 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: ± 1.5V to ± 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

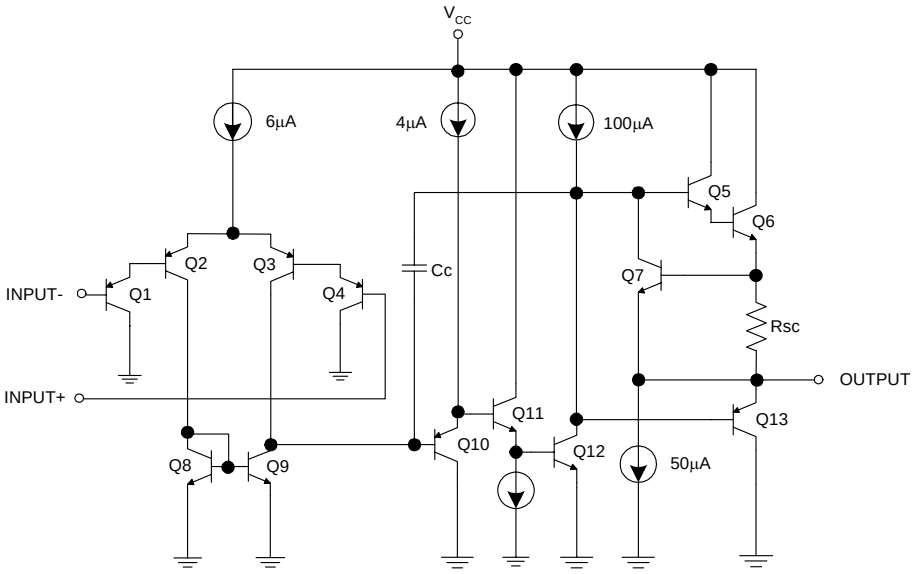


Figure 1. Functional Block Diagram of LM324

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} ≤ 15V and T_A = 25°C		Continuous	
Power Dissipation (T_A = 25°C)	P_D	400	mW
Junction Temperature	T_J	-25 to 125	°C
Storage Temperature Range	T_{STG}	-55 to 125	°C
Lead Temperature (Soldering, 10 Seconds)	T_{LEAD}	260	°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°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	°C

LM324 ELECTRICAL CHARACTERISTICS

V_{CC}=5V, GND=0, T_A=25°C unless otherwise specified.

Parameter		Symbol	Test Conditions		Min	Typ	Max	Unit
Input Offset Voltage		V_{IO}	V_O=1.4V, R_S=0Ω, 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=∞, 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≥2kΩ, 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		μA
Output Short Circuit to Ground		I_{SC}	V_{CC}=15V			40	60	mA
Output Voltage Swing		V_{OH}	V_{CC}=30V, R_L=2kΩ		26			V
			V_{CC}=30V, R_L=10kΩ		27	28		
		V_{OL}	V_{CC}=5V, R_L=10kΩ			5	20	mV
Thermal Resistance (Junction to Case)		θ_{JC}				98.84		°C/W
Slew Rate		SR	G = +1, 2V Output Step			0.5		V/μs

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°C). The upper end of the common-mode voltage range is V_{CC}-1.5V (at 25°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

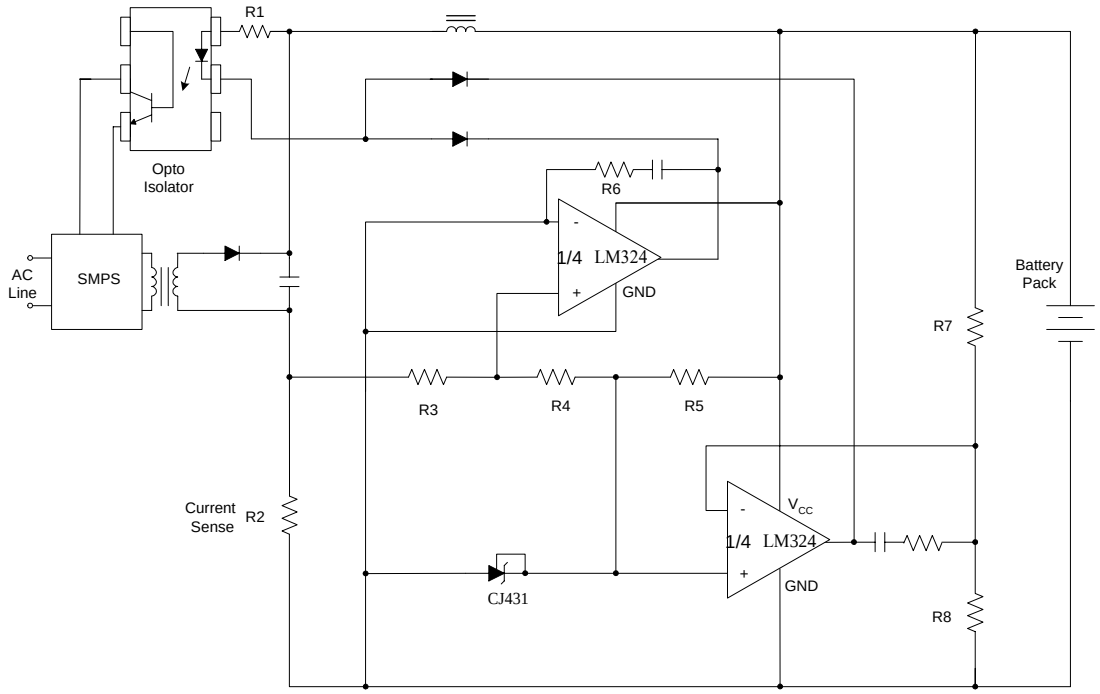


Figure 2. Battery Charger

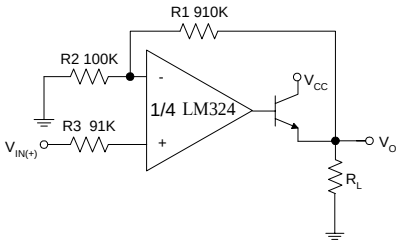


Figure 3. Power Amplifier

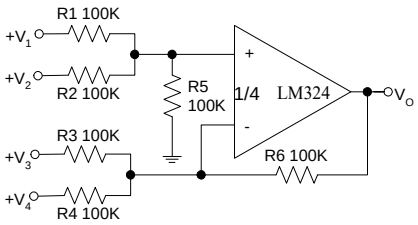


Figure 4. DC Summing Amplifier

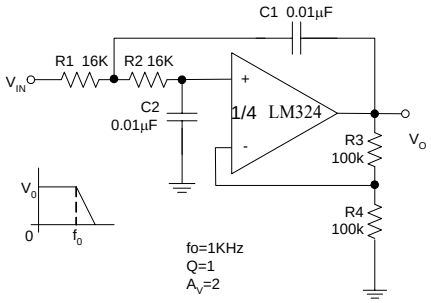


Figure 5. DC Coupled Low-Pass Active Filter

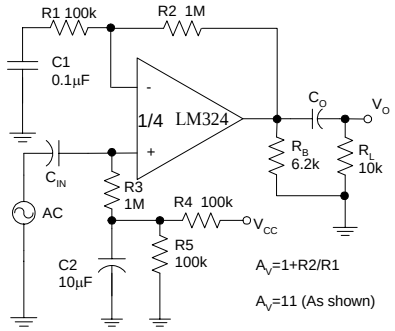


Figure 6. AC Coupled Non-Inverting Amplifier

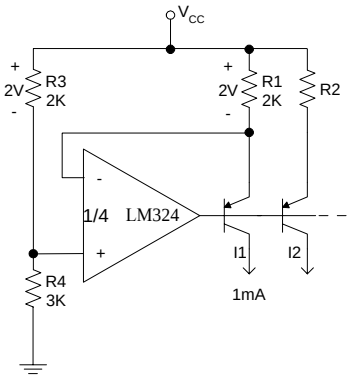


Figure 7. Fixed Current Sources

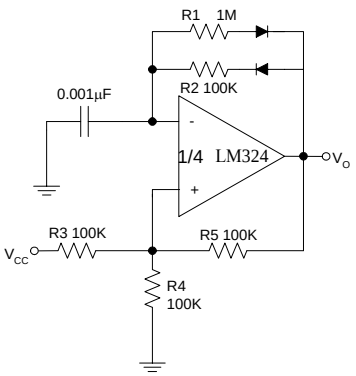
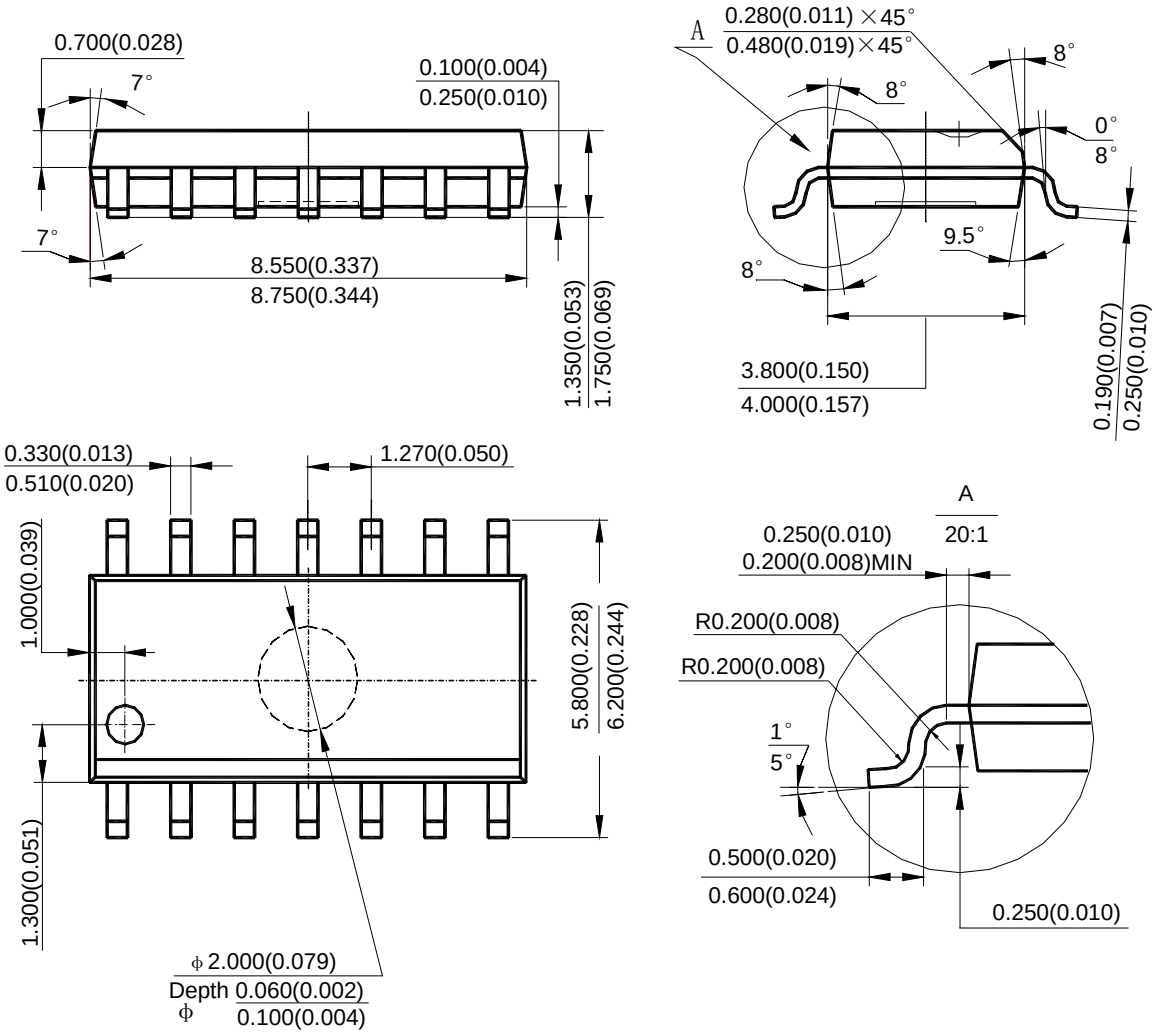


Figure 8. Pulse Generator

SOP14 Package Outline Dimensions

Unit: mm(inch)



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

DISCLAIMER

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