



# Quad Operational Amplifier – LM124A

Low power, Quad Operational Amplifier in bare die form

Rev 1.0  
16/06/18

## Description

The LM124A consists of x4 independent, frequency compensated operational amplifiers specifically designed to operate from a single power supply over a wide input voltage range. Input common-mode voltage range includes ground and output voltage can also swing to ground. Unity gain crossover frequency and input bias current are temperature-compensated to provide high stability. Split-supply operation is also possible with supply current drain independent of voltage supplied for low power consumption. The device operates over the military temperature range.

## Features:

- Temperature compensated bandwidth (unity gain)
- Temperature compensated  $I_{B(MAX)}$ : 100nA
- Wide power supply range, single supply: 3V-32V or dual supplies:  $\pm 1.5V$  to  $\pm 16V$
- Low  $V_{OS}$ : 1mV, and  $I_{OS}$  : 2nA
- Differential input voltage range equal to the power supply voltage
- Large output voltage: 0V to  $V_{CC} - 1.5V$  swing
- Input Common-Mode Voltage range includes GND

## Ordering Information

The following part suffixes apply:

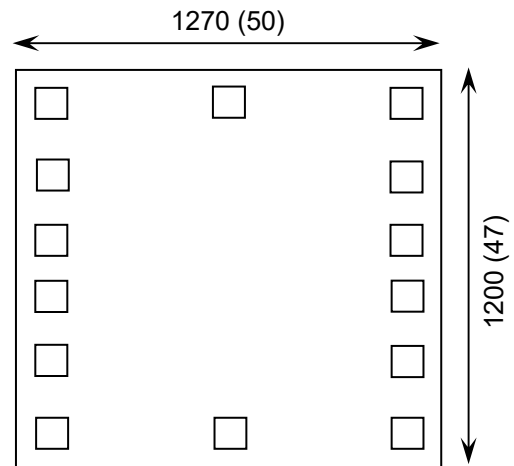
- No suffix - MIL-STD-883 /2010B Visual Inspection
- "H" - MIL-STD-883 /2010B Visual Inspection + MIL-PRF-38534 Class H LAT
- "K" - MIL-STD-883 /2010A Visual Inspection (Space) + MIL-PRF-38534 Class K LAT

LAT = Lot Acceptance Test.

For further information on LAT process flows see below.

[www.siliconsupplies.com/quality/bare-die-lot-qualification](http://www.siliconsupplies.com/quality/bare-die-lot-qualification)

## Die Dimensions in $\mu m$ (mils)



## Supply Formats:

- Default – Die in Waffle Pack (400 per tray capacity)
- Sawn Wafer on Tape – On request
- Unsawn Wafer – On request
- Die Thickness  $\leftrightarrow$  280 $\mu m$ (11 Mils) – On request
- Assembled into Ceramic Package – On request

## Mechanical Specification

Die Size (Unsawn)	1270 x 1200 50 x 47	$\mu m$ mils
Minimum Bond Pad Size	90 x 90 3.54 x 3.54	$\mu m$ mils
Die Thickness	280 ( $\pm 10$ ) 11.02 ( $\pm 0.39$ )	$\mu m$ mils
Top Metal Composition	Al	
Back Metal Composition	N/A – Bare Si	

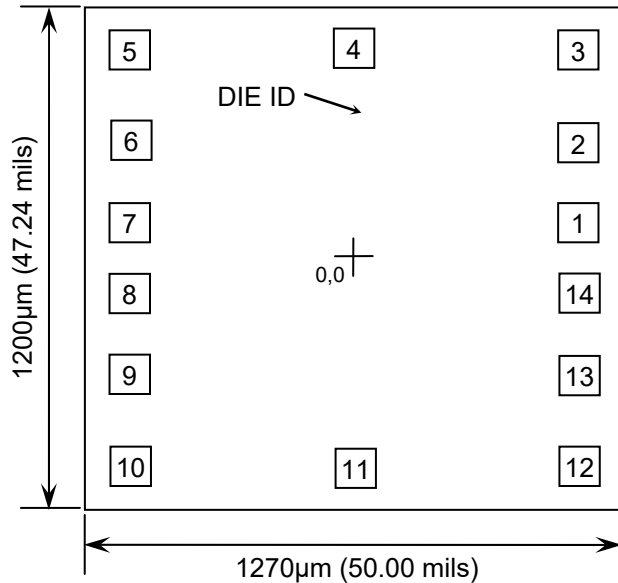




# Quad Operational Amplifier – LM124A

Rev 1.0  
16/06/18

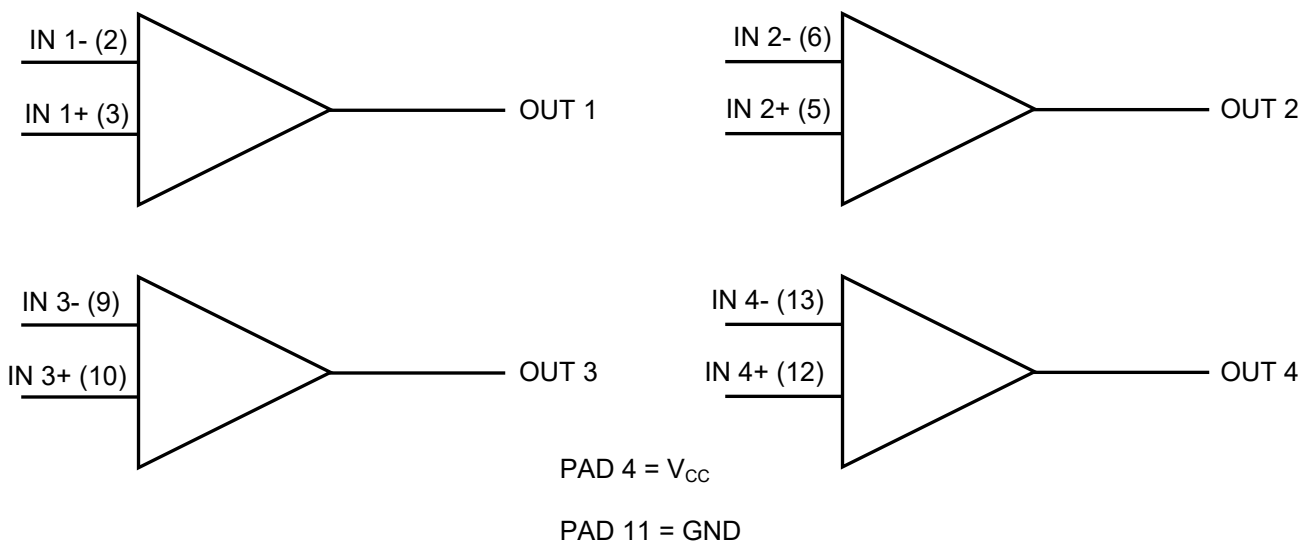
## Pad Layout and Functions



PAD	FUNCTION	COORDINATES (µm)	
		X	Y
1	OUTPUT 1	532	84
2	INPUT 1-	532	280
3	INPUT 1+	532	496
4	V <sub>CC</sub>	0	497
5	INPUT 2+	-532	496
6	INPUT 2-	-532	280
7	OUTPUT 2	-532	84
8	OUTPUT 3	-532	-84
9	INPUT 3-	-532	-280
10	INPUT 3+	-532	-496
11	GND	0	-497
12	INPUT 4+	532	-496
13	INPUT 4-	532	-280
14	OUTPUT 4	532	-84

CHIP BACK POTENTIAL IS FLOAT

## Logic Diagram





# Quad Operational Amplifier – LM124A

Rev 1.0  
16/06/18

## Absolute Maximum Ratings<sup>1</sup>

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage – Single Supply	$V_{CC}$	40	V
Supply Voltage – Split Supply		±20	V
Input Differential Voltage Range	$V_{IDR}$	40	V
Input Common Mode Voltage Range	$V_{ICR}$	-0.3 to 40	V
Output Short Circuit to Ground	-	Continuous	-
Junction Temperature	$T_J$	150	°C
Input Current (per pin) <sup>2</sup>	$I_{IN}$	50	mA

1. Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.
2.  $V_{IN} < -0.3V$ . This input current exists when voltage is driven negative at any of the input leads

## Recommended Operating Conditions

PARAMETER	SYMBOL	MIN	MAX	UNITS
DC Supply Voltage	$V_{CC}$	±2.5 or 5	±16 or 32	V
Operating Temperature	$T_A$	-55	+125	°C

## DC Electrical Characteristics ( $T_A = -55^{\circ}C$ to $+125^{\circ}C$ unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	LIMITS			UNITS	
			MIN	TYP	MAX		
Input Offset Voltage	$V_{IO}$	$V_O = 1.4V$ , $R_S = 0\Omega$ , $V_{CC} = 5V$ to $30V$ $V_{ICM} = 0V$ to $V_{CC} - 1.5V$	25°C	-	1	2	mV
			125°C	-	-	4	
Input Offset Voltage Drift	$\Delta V_{IO} / \Delta T$	$R_S = 0\Omega$	-	7	20	$\mu V / ^{\circ}C$	
Input Offset Current	$I_{IO}$	$I_{I(+)}$ or $I_{I(-)}$ , $V_{CM} = 0V$	25°C	-	2	10	nA
			125°C	-	-	30	
Input Offset Current Drift	$\Delta I_{IO} / \Delta T$	$R_S = 0\Omega$	-	10	200	$pA / ^{\circ}C$	
Input Bias Current	$I_{IB}$	$I_{I(+)}$ or $I_{I(-)}$ , $V_{CM} = 0V$	25°C	-	20	50	nA
			125°C	-	40	100	
Supply Current	$I_{CC}$	$R_L = \infty, V_{CC} = 5V, V_O = 0V$	-	0.7	1.2	mA	
		$R_L = \infty, V_{CC} = 30V, V_O = 0V$	-	1.5	3		
Common Mode Input Voltage range <sup>3</sup>	$V_{ICR}$	$V_{CC} = 30V$	25°C	0	-	$V_{CC} - 1.5$	V
			125°C	0	-	$V_{CC} - 2$	
Differential Input Voltage range <sup>3</sup>	$V_{IDR}$	All $V_{IN} \geq GND$ or $V_{CC-}$ (if used)	-	-	$V_{CC}$	V	

3. The input signal voltage and the input common mode voltage should not be allowed to go negative by more than 0.3V. The positive limit of the common mode voltage range is  $V_{CC} - 1.5V$ , but either or both inputs can go to +32V without damage.





# Quad Operational Amplifier – LM124A

Rev 1.0

16/06/18

## DC Electrical Characteristics continued ( $T_A = -55^\circ\text{C}$ to $+125^\circ\text{C}$ unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	LIMITS			UNITS	
			MIN	TYP	MAX		
Large-Signal Open-Loop Voltage Gain	$A_{VOL}$	$V_{CC} = 15V$ , $V_O = 1V$ to $11V$ $R_L \geq 2K\Omega$	$25^\circ\text{C}$	50	100	-	V/mV
			$125^\circ\text{C}$	25	-	-	
Output High-Level Voltage swing	$V_{OH}$	$V_{CC} = 30V$ , $R_L = 2K\Omega$	26	-	-	V	
		$V_{CC} = 30V$ , $R_L = 10K\Omega$	27	28	-		
Output Low-Level Voltage swing	$V_{OL}$	$V_{CC} = 5V$ , $R_L = 10K\Omega$	-	5	20	mV	
Common-Mode Rejection Ratio	CMRR	$V_{CC} = 30V$ , $R_S = 10K\Omega$ ,	$25^\circ\text{C}$	70	85	-	dB
Power Supply Rejection Ratio	PSSR	$V_{CC} = 5V$ to $30V$	$25^\circ\text{C}$	65	100	-	dB
Channel Separation	$V_{O1}/V_{O2}$	$f = 1KHz$ to $20KHz$ $T_A = 25^\circ\text{C}$	-	-120	-	dB	
Output Short-Circuit current to GND	$I_{SC}$	$V_{CC} = 15V$ , $V_O = 0V$ $T_A = 25^\circ\text{C}$	-	40	60	mA	
Output Source Current	$I_{SOURCE}$	$V_{IN+} = 1V$ , $V_{IN-} = 0V$ , $V_{CC} = 15V$ , $V_O = 2V$	$25^\circ\text{C}$	20	40	-	mA
			$125^\circ\text{C}$	10	20	-	
Output Sink Current	$I_{SINK}$	$V_{IN+} = 0V$ , $V_{IN-} = 1V$ , $V_{CC} = 15V$ , $V_O = 2V$	$25^\circ\text{C}$	10	20	-	mA
			$125^\circ\text{C}$	10	15	-	
		$V_{IN+} = 0V$ , $V_{IN-} = 1V$ , $V_{CC} = 15V$ , $V_O = 0.2V$ , $T_A = 25^\circ\text{C}$	12	50	-	$\mu\text{A}$	

## Typical Characteristics

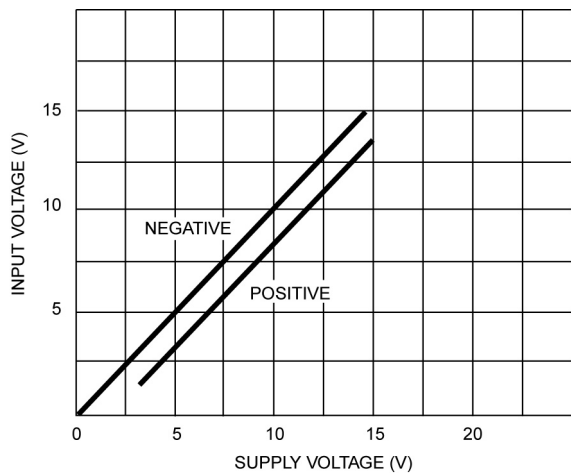


FIGURE 1. Input Voltage Range versus Supply Voltage

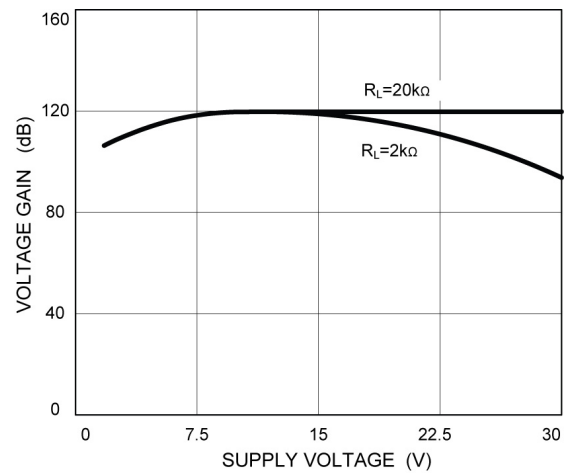


FIGURE 2. Voltage Gain





# Quad Operational Amplifier – LM124A

Rev 1.0  
16/06/18

## Typical Characteristics continued

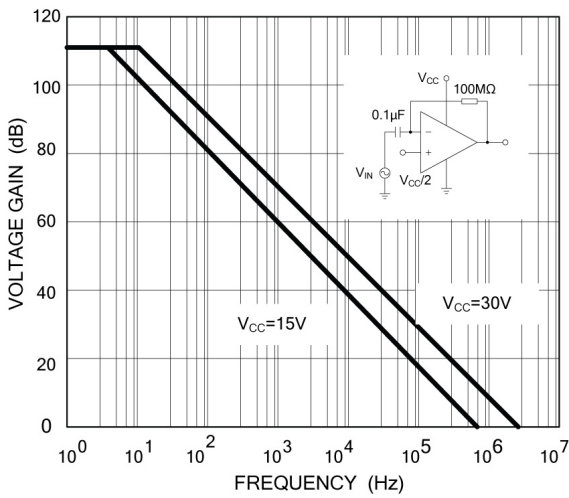


FIGURE 3. Open-Loop Response

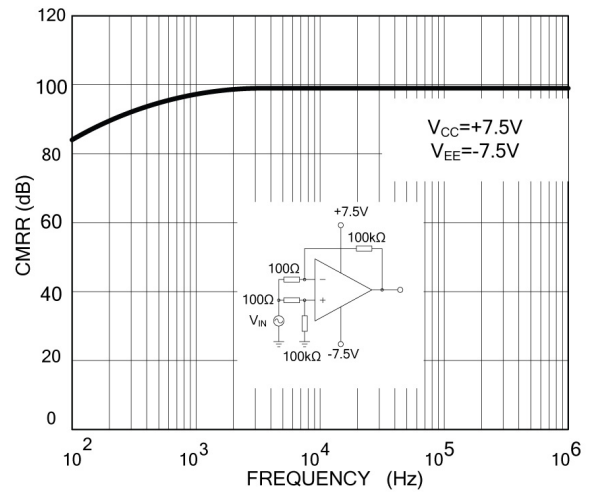


FIGURE 4. Common-Mode Rejection Ratio

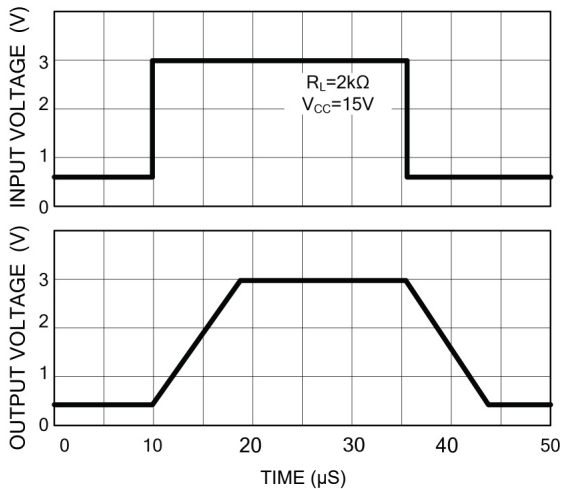


FIGURE 5. Voltage Follower Pulse Response (Large Signal)

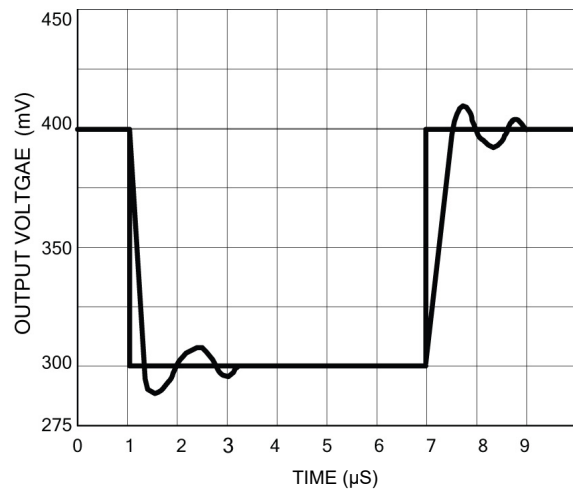


FIGURE 6. Voltage Follower Pulse Response (Small Signal)



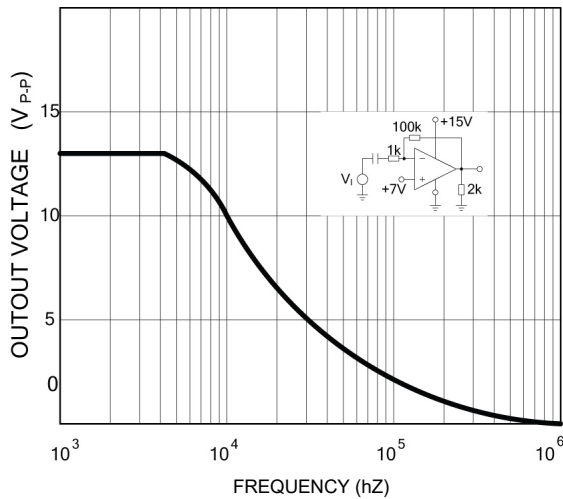


# Quad Operational Amplifier – LM124A

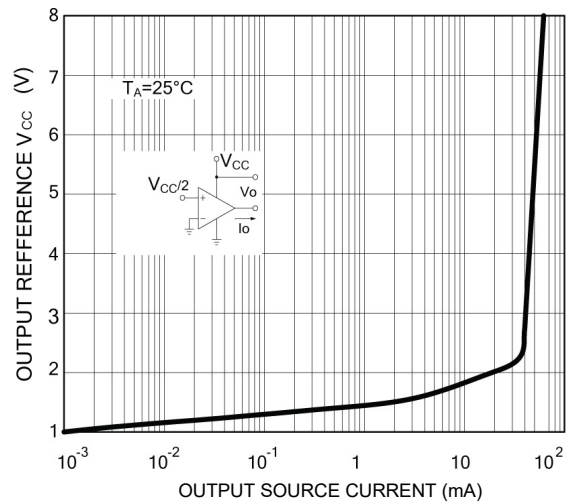
Rev 1.0

16/06/18

## Typical Characteristics continued



**FIGURE 7.** Frequency Response (Large Signal)



**FIGURE 8.** Output Current Sourcing

**DISCLAIMER:** The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Silicon Supplies Ltd hereby disclaims any and all warranties and liabilities of any kind.

**LIFE SUPPORT POLICY:** Silicon Supplies Ltd components may be used in life support devices or systems only with the express written approval of Silicon Supplies Ltd, if a failure of such components can reasonably be expected to cause the failure of that life support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

