Quad Operational Amplifier – LM324A

Low power, Quad Operational Amplifier in bare die form

Rev 1.0
16/06/18

Description

The LM324A 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 part operates over the commercial temperature range.

Features:

- Temperature compensated bandwidth (unity gain)
- Temperature compensated $I_{B(MAX)}$: 200nA
- Wide power supply range, single supply: 3V-32V or dual supplies: ±1.5V to ±16V
- Low V_{OS}: 2mV, and I_{OS} : 5nA
- 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

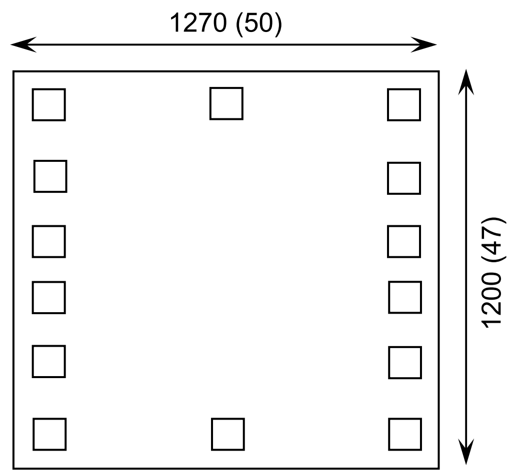
The following part suffixes apply:

- No suffix - MIL-STD-883 /2010B Visual Inspection

For High Reliability versions of this product please see

LM124 and LM124A

Die Dimensions in µm (mils)



Supply Formats:

- Default – Die in Waffle Pack (400 per tray capacity)
- Sawn Wafer on Tape – On request
- Unsawn Wafer – On request
- Die Thickness <> 280µm(11 Mils) – On request
- Assembled into Ceramic Package – On request

Mechanical Specification

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

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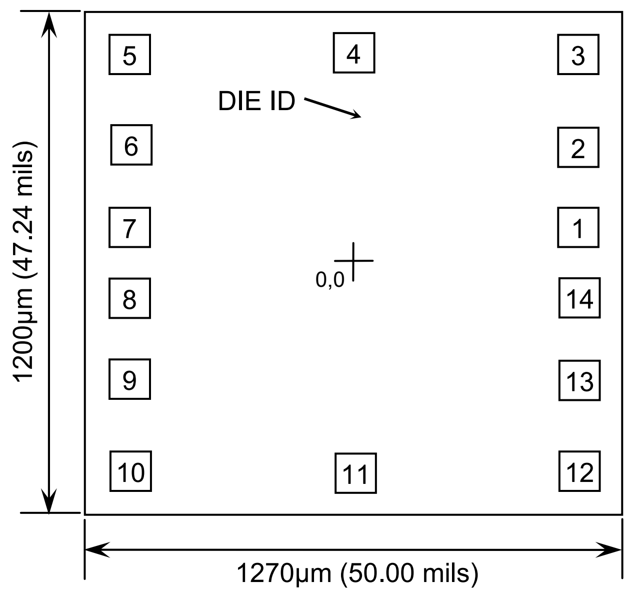
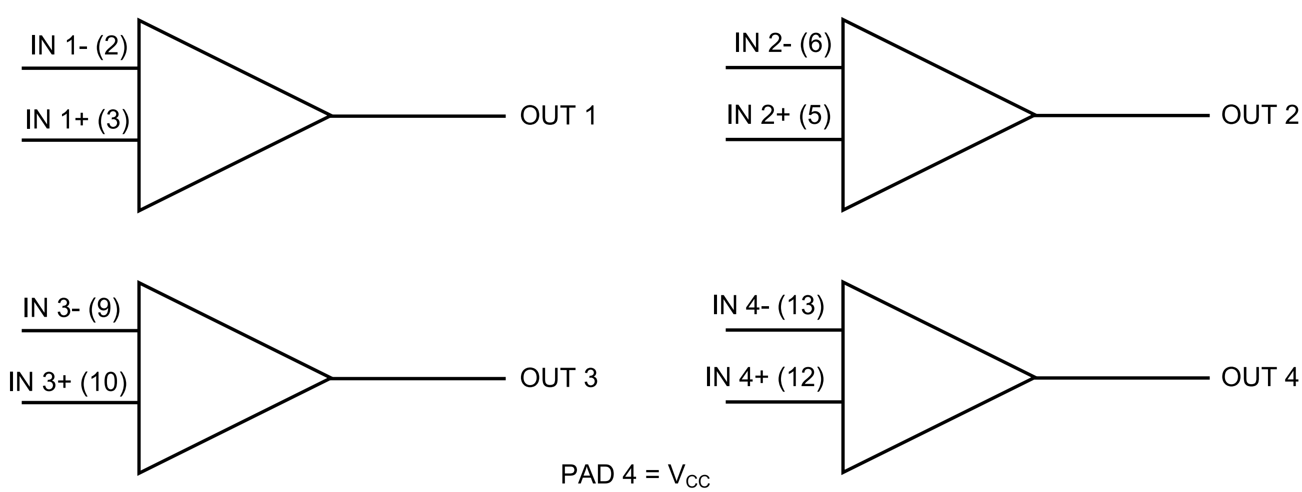
Pad Layout and Functions



PAD	FUNCTION	COORDINATES (µm)	
		X	Y
1	OUTPUT 1	532	84
2	INPUT 1-	532	280
3	INPUT 1+	532	496
4	V_{CC}	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



PAD 4 = V_{CC}

PAD 11 = GND

Absolute Maximum Ratings[1]

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)[2]	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	0	+70	°C

DC Electrical Characteristics (T_A = 0°C to +70°C unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS		LIMITS			UNITS
				MIN	TYP	MAX	
Input Offset Voltage	V_{IO}	V_O =1.4V, R_S = 0Ω, V_{CC} = 5V to 30V V_{ICM}=0V to V_{CC}-1.5V	25°C	-	2	3	mV
			70°C	-	-	5	
Input Offset Voltage Drift	$\Delta V_{IO} / \Delta T$	R_S = 0Ω		-	7	30	μV/°C
Input Offset Current	I_{IO}	$I_{I(+)}$ or $I_{I(-)}$, V_{CM} = 0V	25°C	-	5	30	nA
			70°C	-	-	75	
Input Offset Current Drift	$\Delta I_{IO} / \Delta T$	R_S = 0Ω		-	10	300	pA/°C
Input Bias Current	I_{IB}	$I_{I(+)}$ or $I_{I(-)}$, V_{CM} = 0V	25°C	-	45	100	nA
			70°C	-	-	200	
Supply Current	I_{CC}	R_L=∞,V_{CC} = 5V, V_O = 0V		-	0.7	1.2	mA
		R_L=∞,V_{CC}=30V, V_O = 0V		-	1.5	3	
Common Mode Input Voltage range[3]	V_{ICR}	V_{CC} = 30V	25°C	0	-	V_{CC} -1.5	V
			70°C	0	-	V_{CC} -2	
Differential Input Voltage range[3]	V_{IDR}	All V_{IN} ≥ 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.

DC Electrical Characteristics continued (T_A = 0°C to +70°C unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS		LIMITS MIN	TYP	MAX	UNITS
Large-Signal Open-Loop Voltage Gain	A_{VOL}	V_{CC} = 15V, V_O = 1V to 11V R_L ≥ 2KΩ	25°C	25	100	-	V/mV
			70°C	15	-	-	
Output High-Level Voltage swing	V_{OH}	V_{CC} = 30V, R_L=2KΩ		26	-	-	V
		V_{CC} = 30V, R_L=10KΩ		27	28	-	
Output Low-Level Voltage swing	V_{OL}	V_{CC} = 5V, R_L=10KΩ		-	5	20	mV
Common-Mode Rejection Ratio	CMRR	V_{CC} = 30V, R_S=10KΩ,	25°C	65	85	-	dB
Power Supply Rejection Ratio	PSSR	V_{CC} = 5V to 30V	25°C	65	100	-	dB
Channel Separation	V_{O1}/V_{O2}	f =1KHz to 20KHz T_A = 25°C		-	-120	-	dB
Output Short-Circuit current to GND	I_{SC}	V_{CC} = 15V, V_O = 0V T_A = 25°C		-	40	60	mA
Output Source Current	I_{SOURCE}	V_{IN}+ = 1V, V_{IN}- =0V, V_{CC} =15V, V_O = 2V	25°C	20	40	-	mA
			70°C	10	20	-	
Output Sink Current	I_{SINK}	V_{IN}+ = 0V, V_{IN}- =1V, V_{CC} =15V, V_O = 2V	25°C	10	20	-	mA
			70°C	5	8	-	
		V_{IN}+ = 0V, V_{IN}- =1V, V_{CC} =15V, V_O = 0.2V, T_A = 25°C		12	50	-	µA

Typical Characteristics

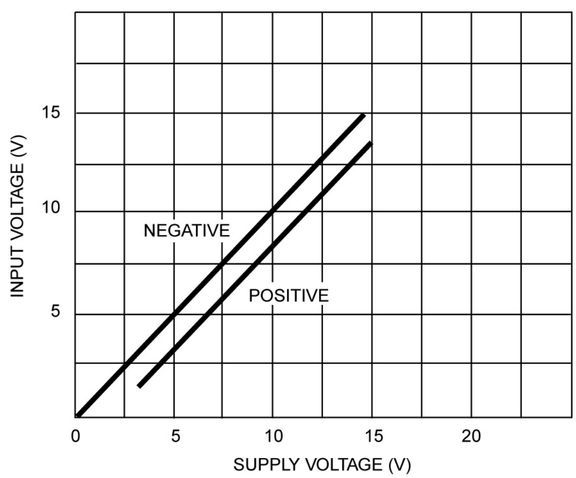


FIGURE 1. Input Voltage Range versus Supply Voltage

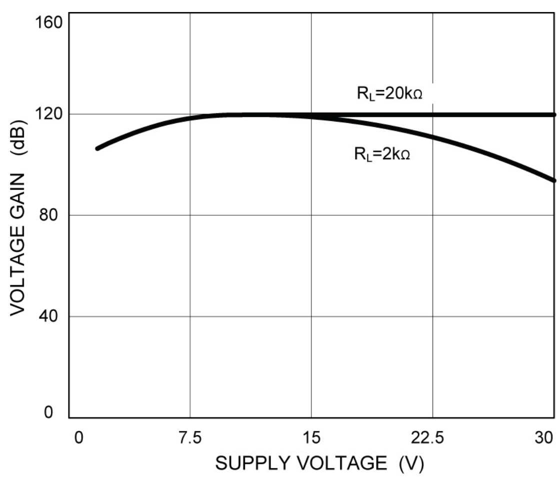


FIGURE 2. Voltage Gain

Typical Characteristics continued

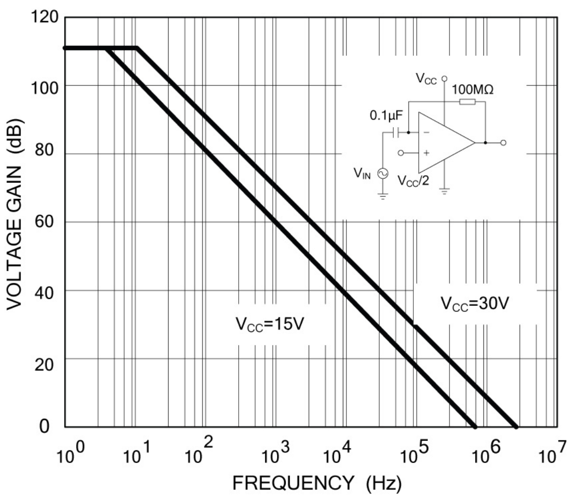


FIGURE 3. Open-Loop Response

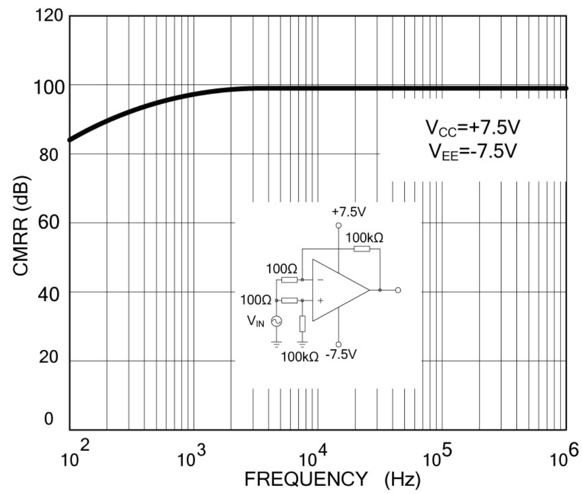


FIGURE 4. Common-Mode Rejection Ratio

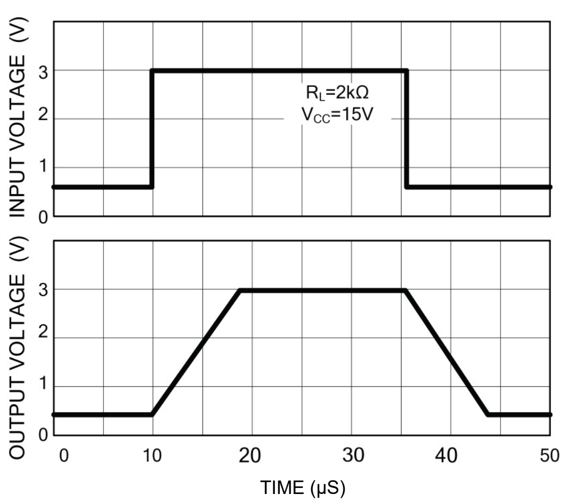


FIGURE 5. Voltage Follower Pulse Response
(Large Signal)

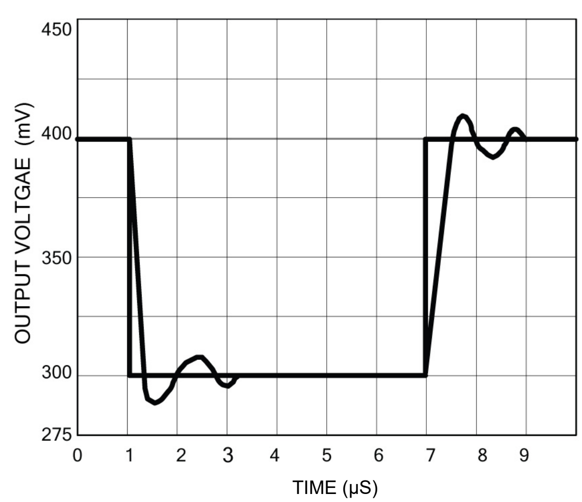


FIGURE 6. Voltage Follower Pulse Response
(Small Signal)

Typical Characteristics continued

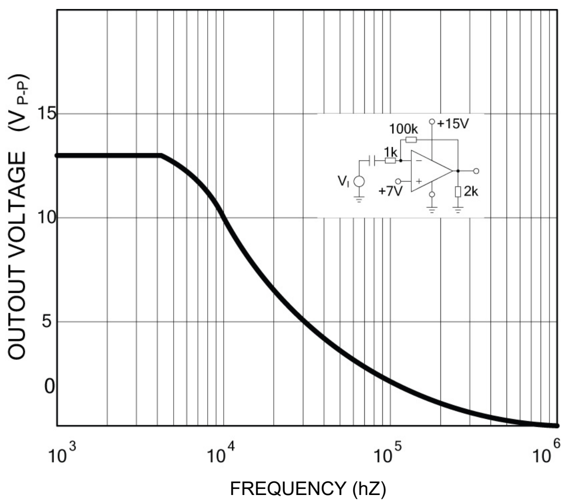


FIGURE 7. Frequency Response
(Large Signal)

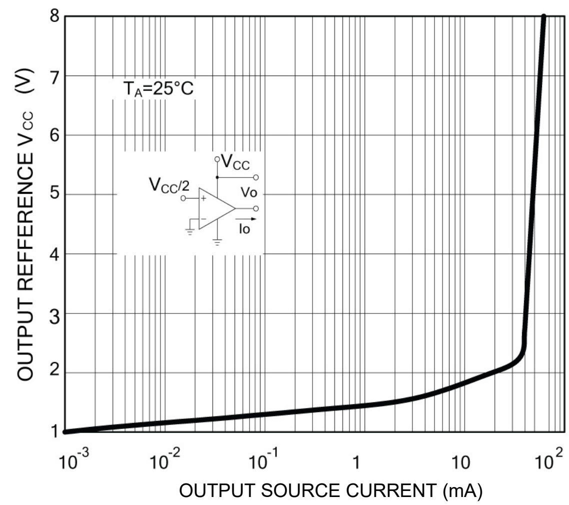


FIGURE 8. Output Current Sourcing