

LM324 Quadruple Operational Amplifiers

1. General Description

1.1 Description

The LM324 series include four high-voltage (30V) op amps. These devices provide outstanding value for cost-sensitive applications, with features including low offset, common-mode input range to ground, and high differential input voltage capability.

The LM324 series are unity-gain stable and achieve a low offset voltage maximum of 1mV. Integrated EMI and RF filters enable the LM324 devices to be used in the most rugged, environmentally challenging applications.

1.2 Features

- Wide range of single supply voltage 3V to 30V
- Low input offset voltage: 1mV
- EMI rejection: integrated RF and EMI filter
- Low input bias current: 20nA(typical)
- Common-mode input voltage range includes V_{-}
- Input voltage differential can be driven up to supply voltage

1.3 Device Information

PART NUMBER	PACKAGE
LM324	SOP

2. Connection Diagrams and Pin Description

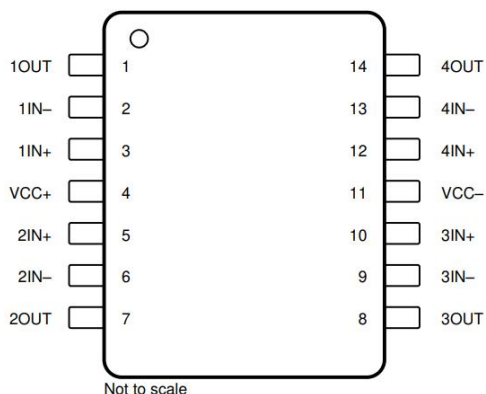


Figure 2.1: Top View

PIN No.	NAME	I/O	FUNCTION
1	1OUT	O	Output
2	1IN-	I	Negative Input
3	1IN+	I	Positive Input
4	VCC+		Positive (highest) supply
5	2IN+	I	Positive Input
6	2IN-	I	Negative Input
7	2OUT	O	Output
8	3OUT	O	Output
9	3IN-	I	Negative Input
10	3IN+	I	Positive Input
11	VCC-		Negative (lowest) supply or ground (for single-supply operation)
12	4IN+	I	Positive Input
13	4IN-	I	Negative Input
14	4OUT	O	Output

3. Schematic Diagram

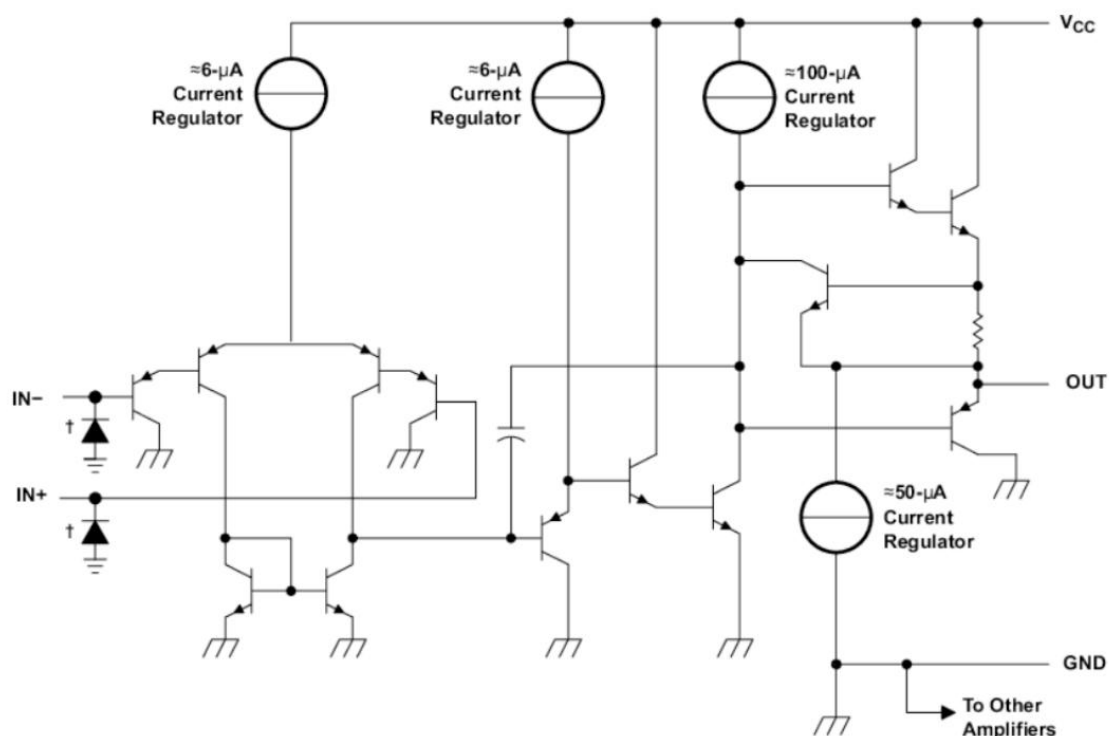


Figure 3.1: LM324 Functional Block Diagram

4. Specifications

4.1 Absolute Maximum Ratings

(Ta=25°C, unless otherwise specified)

Symbol	Parameter	MIN	MAX	Unit
V _{CC}	Single Supply Voltage ⁽¹⁾		32	V
V _{ID}	Differential Input Voltage ⁽²⁾	-32	32	V
V _I	Input Voltage(either input)	-0.3	V _{CC}	V
I _O	Duration of Output Short Circuit to Ground ⁽³⁾	Unlimited		
T _J	Junction Temperature		125	°C
T _{OP}	Operating Temperature	-40	85	°C

Absolute maximum ratings are those values beyond which the device could be permanently damaged, These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under normal operating conditions.

(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.

4.2 Recommended Operating Conditions

($T_a=25^{\circ}\text{C}$, unless otherwise specified)

Symbol	Parameter	MIN	TYP	MAX	Unit
V_{CC}	Supply Voltage	3		30	V
V_{CM}	Common-Mode Voltage	0		$V_{CC}-2$	V

4.3 Electrical Characteristics

($T_a=25^{\circ}\text{C}$, $V_{CC}=5\text{V}$, unless otherwise specified)

Symbol	Parameter	Test Condition	MIN	TYP	MAX	Unit
I_{CC}	Supply Current(four amplifiers)	$V_O=2.5\text{V}$, no load	--	0.7	1.2	mA
		$V_{CC}=\text{MAX}$, $V_O=0.5V_{CC}$, no load	--	1.5	3	mA
I_B	Input Bias Current	$V_O=1.4\text{V}$	--	-20	--	nA
V_{IO}	Input Offset Voltage	$V_{CC}=5\text{V}$ to MAX $V_O=1.4\text{V}$, $V_{IC}=V_{ICR}(\text{min})$	--	1	7	mV
I_{IO}	Input Offset Current	$V_O=1.4\text{V}$	--	2	--	nA
V_{ICR}	Common-Mode Voltage Range	$T_a=25^{\circ}\text{C}$	0	-	$V_{CC}-1.5$	V
A_{VD}	Large Signal Differential Voltage Amplification	$V_{CC}=15\text{V}$, $V_O=1\text{V}$ to 11V , $R_L \geq 2\text{k}\Omega$	--	25	100	V/mV
V_{OH}	High-Level Output Voltage	$R_L=2\text{k}\Omega$	$V_{CC}-1.5$	--	--	V
V_{OL}	Low-Level Output Voltage	$R_L \leq 10\text{k}\Omega$	--	--	20	mV
CMRR	Common-Mode Rejection Ratio	$V_{IC}=V_{ICR}(\text{min})$	--	80	--	dB
K_{SVR}	Supply-Voltage Rejection Ratio($\Delta V_{CC} / \Delta V_{IO}$)		--	100	--	dB
V_{O1} / V_{O2}	Crosstalk Attenuation	$f=1\text{ kHz}$ to 20 kHz	--	120	--	dB

(1) All characteristics are measured under open-loop conditions, with zero common-mode input voltage, unless otherwise specified. MAX V_{CC} for testing purposes is 30 V for the others.

5. Applications information

A typical application for an operational amplifier in an inverting amplifier. This amplifier takes a positive voltage on the input, and makes it a negative voltage of the same magnitude. In the same manner, it also makes negative voltages positive.

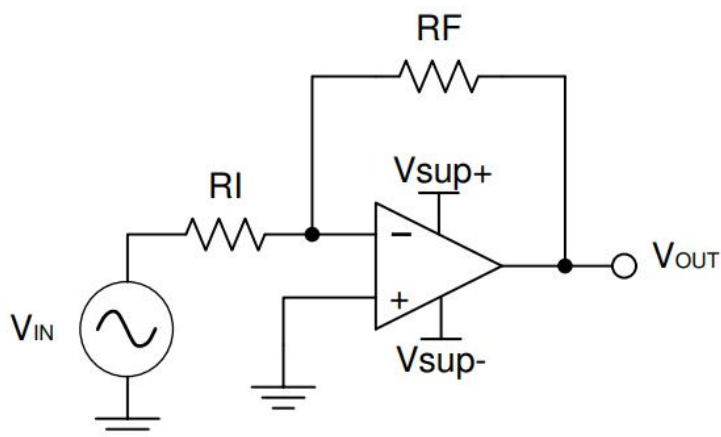


Figure 5.1 Application Schematic

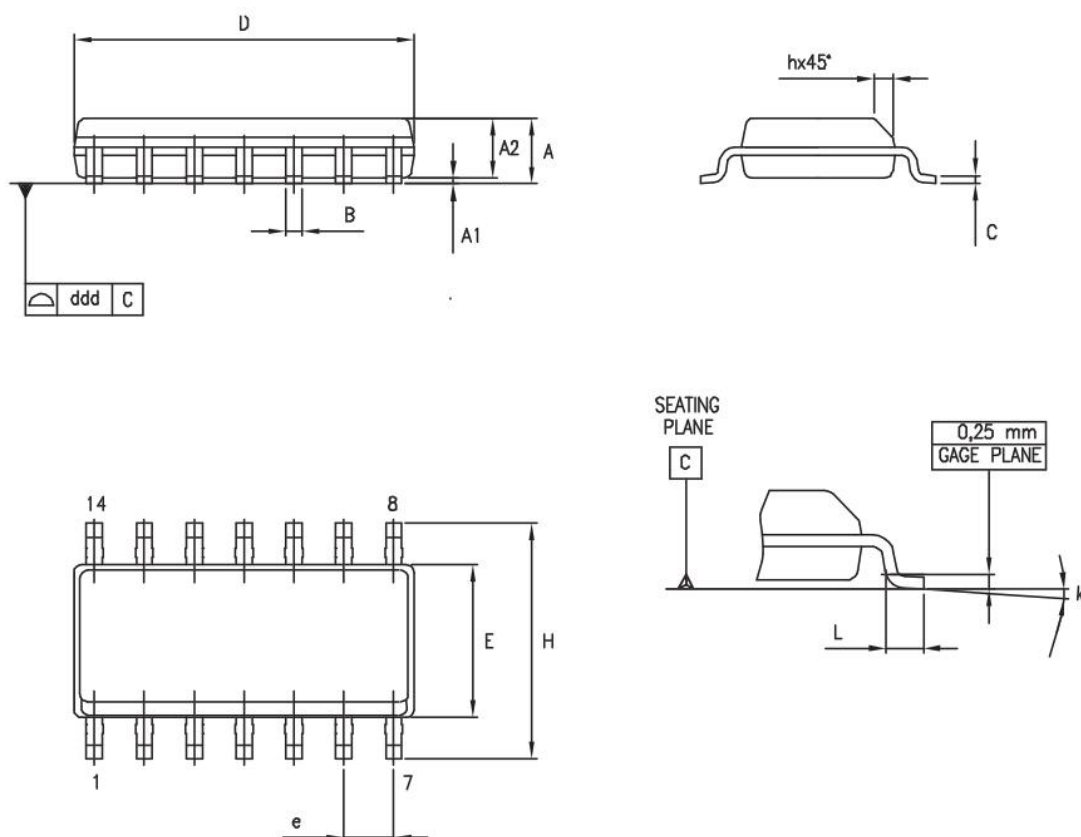


6. Ordering Information

Orderable Device	Package Type	Pins	Packing	Package Qty
LM324NS14ARDQ	SOP	14	Tape & Reel	4000

7. Package Information

7.1 SOP14



Dimensions						
Ref.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.35		1.75	0.05		0.068
A1	0.10		0.25	0.004		0.009
A2	1.10		1.65	0.04		0.06
B	0.33		0.51	0.01		0.02
C	0.19		0.25	0.007		0.009
D	8.55		8.75	0.33		0.34
E	3.80		4.0	0.15		0.15
e		1.27			0.05	
H	5.80		6.20	0.22		0.24
h	0.25		0.50	0.009		0.02
L	0.40		1.27	0.015		0.05
k	8° (max.)					
ddd			0.10			0.004