

# Quadruple Operational Amplifiers

## DESCRIPTION

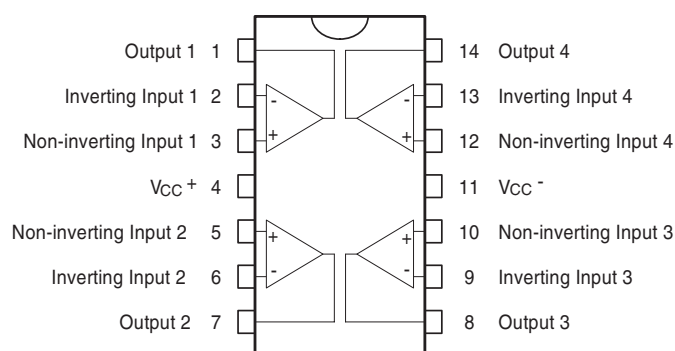
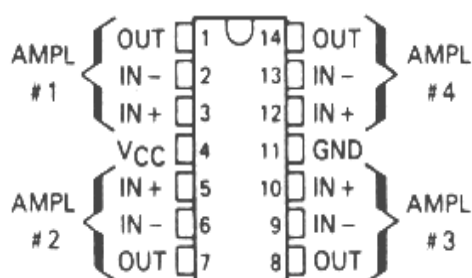
The LM324 consists of four independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain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

Application areas include transducer amplifiers, DC gain blocks and all the conventional op amp circuits.

## FEATURES

- Wide range of supply voltages
- Low supply current drain independent of supply voltage
- Low input biasing current
- Low input offset voltage and offset current
- Input common-mode voltage range includes ground
- Differential input voltage range equal to the power supply voltage
- DC voltage gain 100 V/ mV Typ
- Internally frequency compensation

## PACKAGE INFORMATION



**Quadruple Operational Amplifiers**
**ELECTRICAL CHARACTERISTICS**

 at specified free-air temperature,  $V_{CC} = 5V$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		LM324			UNIT
			MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{CC} = 5V$ to MAX, $V_{IC} = V_{ICR}$ min, $V_O = 1.4V$	25 °C		3	7	mV
		Full temperature range			9	
$\alpha V_{IO}$ Average temperature coefficient of input offset voltage		Full temperature range		7		$\mu V/^\circ C$
$I_{IO}$ Input offset current	$V_O = 1.4V$	25 °C		2	50	nA
		Full temperature range			150	
$\alpha I_{IO}$ Average temperature coefficient of input offset current		Full temperature range		10		$\mu A/^\circ C$
$I_{IB}$ Input bias current	$V_O = 1.4V$	25 °C		-20	-250	nA
		Full temperature range			-500	
$V_{ICR}$ Common-mode input voltage range	$V_{CC} = 5V$ to MAX	25 °C	0 to $V_{CC} - 1.5$			V
		Full temperature range	0 to $V_{CC} - 2$			
$V_{OH}$ High-level output voltage	$R_L = 2\text{ k}\Omega$	25 °C	$V_{CC} - 1.5$			V
	$V_{CC} = \text{MAX}$ , $R_L = 2\text{ k}\Omega$	Full temperature range	26			
	$V_{CC} = \text{MAX}$ , $R_L = 10\text{ k}\Omega$	Full temperature range	27	28		
$V_{OL}$ Low-level output voltage	$R_L = 10\text{ k}\Omega$	Full temperature range		5	20	mV
$A_{VD}$ Large-signal differential voltage amplification	$V_{CC} = 15V$ , $V_O = 1V$ to $11V$ , $R_L \geq 2\text{ k}\Omega$	25 °C	25	100		V/mV
		Full temperature range	15			
CMRR Common-mode rejection ratio	$V_{CC} = 5V$ to MAX, $V_{IC} = V_{ICR}$ min	25 °C	65	80		dB
$k_{SVR}$ Supply voltage rejection ratio ( $\Delta V_{CC}/\Delta V_{IO}$ )	$V_{CC} = 5V$ to MAX	25 °C	65	100		dB
$V_{O1}/V_{O2}$ Crosstalk attenuation	$f = 1\text{ kHz}$ to $20\text{ kHz}$	25 °C		120		dB
$I_O$ Output current	$V_{CC} = 15V$ , $V_{ID} = 1V$ , $V_O = 0$	25 °C	-20	-30		mA
		Full temperature range	-10			
	$V_{CC} = 15V$ , $V_{ID} = -1V$ , $V_O = 15V$	25 °C	10	20		
		Full temperature range	5			
$V_{ID} = -1V$ , $V_O = 200\text{ mV}$	25 °C	12	30		$\mu A$	
$I_{OS}$ Short-circuit output current	$V_{CC}$ at $5V$ , GND at $-5V$ , $V_O = 0$	25 °C		$\pm 40$	$\pm 60$	mA
$I_{CC}$ Supply current (four amplifiers)	$V_O = 2.5V$ , No load	Full temperature range		1.5	2.4	mA
	$V_{CC} = \text{MAX}$ , $V_O = 0.5V_{CC}$ , No load	Full temperature range		1.1	3	

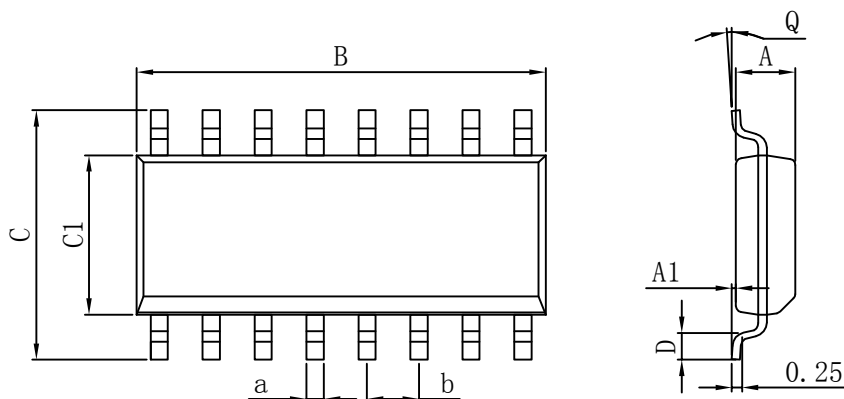
\* All characteristics are measured under open loop conditions with zero common-mode input voltage unless otherwise specified.

 "MAX"  $V_{CC}$  for testing purposes is 30 V. Operating temperature 0 - 70 °C.

Quadruple Operational Amplifiers

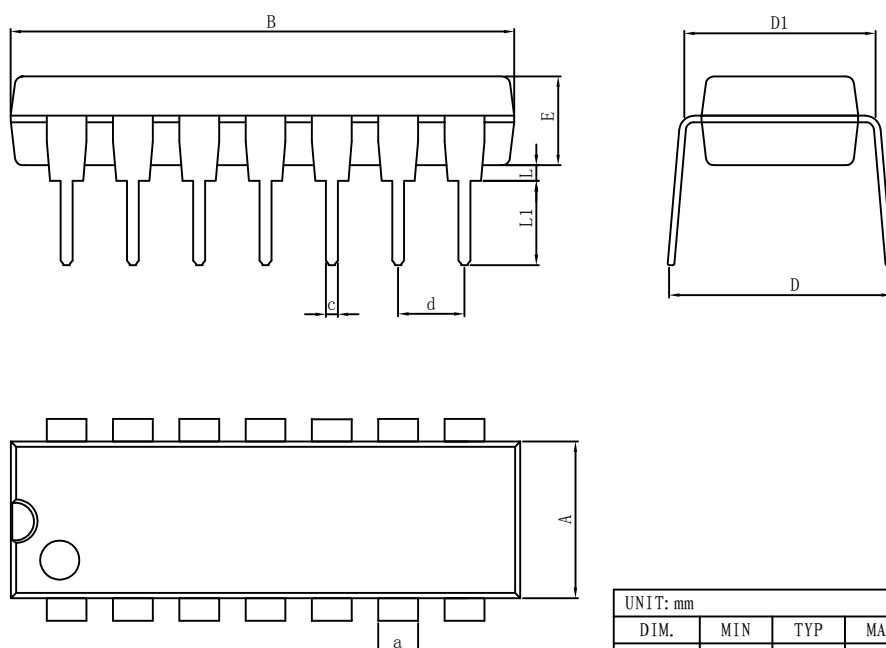
Package Dimension

SOP14



UNIT: mm							
DIM.	MIN	TYP	MAX	DIM.	MIN	TYP	MAX
A	4.520	4.570	4.620	a	0.400	0.420	0.440
A1	0.100	-	0.250	b	1.260	1.270	1.280
B	8.500	8.750	9.000	Q	0°	-	8°
C	5.800	6.100	6.250				
C1	3.800	3.900	4.000				
D	0.400	-	0.950				

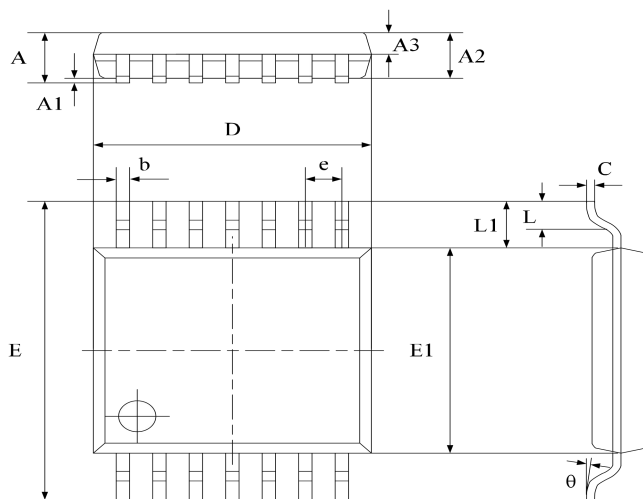
DIP14



UNIT: mm							
DIM.	MIN	TYP	MAX	DIM.	MIN	TYP	MAX
A	6.100	6.300	6.680	a	1.504	1.524	1.544
B	18.940	19.200	19.560	c	0.437	0.457	0.477
D	8.200	8.700	9.200	d	2.530	2.540	2.550
D1	7.42	7.62	7.82	L	0.500	-	0.800
E	3.100	3.300	3.550	L1	3.000	3.200	3.600

Quadruple Operational Amplifiers

TSSOP-14



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	-	1.200	-	0.0472
A1	0.050	0.150	0.002	0.006
A2	0.900	1.050	0.037	0.043
A3	0.390	0.490	0.016	0.020
b	0.200	0.290	0.008	0.012
C	0.130	0.180	0.005	0.007
D	4.860	5.060	0.198	0.207
E	6.200	6.600	0.253	0.269
E1	4.300	4.500	0.176	0.184
e	0.650 typ.		0.0256 typ.	
L1	1.000 ref.		0.0393 ref.	
L	0.450	0.750	0.018	0.031
θ	0°	8°	0°	8°

Ordering information

Order code	Package	Baseqty	Deliverymode	Marking
UMW LM324ADR	SOP-14	2500	Tape and reel	LM324A
UMW LM324PT	TSSOP-14	4000	Tape and reel	LM324
UMW LM324PWR	TSSOP-14	4000	Tape and reel	LM324
UMW LM324APT	TSSOP-14	4000	Tape and reel	LM324