Order this data sheet by LMT324/D

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

LMT324, B, LMT2902

Advance Information

Quad Low Power Operational Amplifiers

The LMT324, B is a family of quad operational amplifiers with true differential inputs. These devices have several distinct advantages over standard operational amplifiers. The quad amplifier can operate at supply voltages as low as 3.0 V or as high as 32 V, with quiescent currents about one-fifth of those associated with the MC1741 (on a per amplifier basis). The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications. The output voltage range also includes the negative power supply voltage.

- Short Circuit Protected Outputs
- True Differential Input Stage
- Single Supply Operation: 3.0 to 32 V
- Low Input Bias Currents
- Four Amplifiers per Package
- Internally Compensated
- Common Mode Range Extends to Negative Supply
- Single and Split Supply Operation
- Industry Standard Pinouts

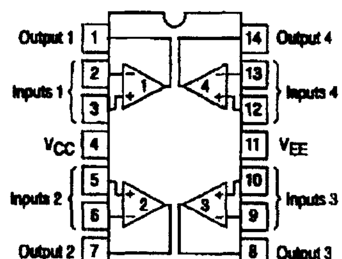
QUAD DIFFERENTIAL INPUT OPERATIONAL AMPLIFIERS

SILICON MONOLITHIC INTEGRATED CIRCUIT

N SUFFIX
PLASTIC PACKAGE
CASE 646

D SUFFIX
PLASTIC PACKAGE
CASE 751A
(SO-14)

PIN CONNECTIONS



(Quad, Top View)

MAXIMUM RATINGS (T_A = 25°C, unless otherwise noted.)

Rating	Symbol	LMT324, LMT324B	LMT2902	Unit
Power Supply Voltages Single Supply Split Supply	 V_{CC} V_{CC}, V_{EE}	 32 ±16	 26 ±13	Vdc
Input Differential Voltage Range	V_{IDR}	±32	±26	Vdc
Input Common Mode Voltage Range	V_{ICR}	–0.3 to 32	–0.3 to 26	Vdc
Output Short Circuit Duration	t_S	Continuous		sec
Junction Temperature	T_J	150		°C
Storage Temperature Range	T_{stg}	–55 to +125		°C
Ambient Operating Temperature Range	T_A	0 to +70	–40 to +105	°C

CAUTION: These devices do not have internal ESD protection circuitry and are rated as CLASS 1 devices per the ESD test method in MIL-STD-883D. They should be handled using standard ESD prevention methods to avoid damage to the device.

ORDERING INFORMATION

Device	Temperature Range	Package
LMT324N LMT324D	0° to +70°C	Plastic DIP SO-14
LMT324BN LMT324BD	0° to +70°C	Plastic DIP SO-14
LMT2902N LMT2902D	–40° to +105°C	Plastic DIP SO-14

This document contains information on a new product. Specifications and information herein are subject to change without notice.

ELECTRICAL CHARACTERISTICS (V_{CC} = +5.0V, V_{EE} = Ground, T_A = 25°C, unless otherwise noted.)

Characteristics	Symbol	LMT324 Min	LMT324 Typ	LMT324 Max	LMT324B Min	LMT324B Typ	LMT324B Max	Unit
Input Offset Voltage, V_{CC} = 5.0 V to 30 V, V_{ICR} = 0 V to V_{CC} −1.7 V, V_O = 1.4 V, R_S = 0 Ω T_A = +25°C T_A = T_{high} to T_{low} (Note 1)	V_{IO}	 — —	 2.0 —	 7.0 9.0	 — —	 2.0 —	 4.5 7.0	mV
Average Temp. Coefficient of Input Offset Voltage T_A = T_{high} to T_{low}	$\Delta V_{IO}/\Delta T$	—	7.0	—	—	7.0	30	µV/°C
Input Offset Current T_A = T_{high} to T_{low} (Note 1)	I_{IO}	— —	5.0 —	50 150	— —	5.0 —	30 75	nA
Average Temp. Coefficient of Input Offset Current T_A = T_{high} to T_{low}	$\Delta I_{IO}/\Delta T$	—	10	—	—	10	300	pA/°C
Input Bias Current T_A = T_{high} to T_{low}	I_{IB}	— —	−90 —	−250 −500	— —	−45 —	−100 −200	nA
Input Common Mode Voltage Range (Note 2) V_{CC} = 30 V, T_A = +25°C V_{CC} = 30 V, T_A = T_{high} to T_{low}	V_{ICR}	 0 0	 — —	 28.3 28	 0 0	 — —	 28.3 28	V
Differential Input Voltage Range	V_{IDR}	—	—	V_{CC}	—	—	V_{CC}	V
Large Signal Open-Loop Voltage Gain R_L = 2.0 kΩ, V_{CC} = 15 V, for Large V_O Swing T_A = T_{high} to T_{low}	A_{VOL}	 25 15	 100 —	 — —	 25 15	 100 —	 — —	V/mV
Channel Separation 1.0 kHz ≤ f ≤ 20 kHz, Input Referenced	CS	—	−120	—	—	−120	—	dB
Common Mode Rejection Ratio R_S ≤ 10 kΩ	CMRR	65	70	—	65	70	—	dB
Power Supply Rejection Ratio	PSRR	65	100	—	65	100	—	dB
Output Voltage Range	V_{OR}	0	—	3.3	0	—	3.3	V
Output Voltage (High Limit) V_{CC} = 5.0 V, R_L = 2.0 kΩ, T_A = +25°C V_{CC} = 30 V, R_L = 2.0 kΩ, T_A = T_{high} to T_{low} V_{CC} = 30 V, R_L = 10 kΩ, T_A = T_{high} to T_{low}	V_{OH}	 3.3 26 27	 3.5 — 28	 — — —	 3.3 26 27	 3.5 — 28	 — — —	V
Output Voltage (Low Limit) V_{CC} = 5.0 V, R_L = 10 kΩ, T_A = T_{high} to T_{low}	V_{OL}	—	5.0	20	—	5.0	20	mV
Output Source Current (V_{ID} = +1.0 V, V_{CC} = 15 V) T_A = T_{high} to T_{low}	I_{O+}	20 10	40 20	— —	20 10	40 20	— —	mA
Output Sink Current (V_{ID} = −1.0 V, V_{CC} = 15 V) T_A = +25°C T_A = T_{high} to T_{low} (Note 1) V_{ID} = −1.0 V, V_O = 200 mV, T_A = +25°C	I_{O-}	 10 5.0 12	 20 8.0 50	 — — —	 10 5.0 12	 20 8.0 50	 — — —	 mA mA µA
Output Short Circuit to Ground (Note 3)	I_{SC}	—	40	60	—	40	60	mA
Power Supply Current (T_A = T_{high} to T_{low}) V_{CC} = 30 V, V_O = 0 V, R_L = ∞ V_{CC} = 5.0 V, V_O = 0 V, R_L = ∞	I_{CC}	 — —	 — —	 3.0 1.2	 — —	 1.4 0.7	 3.0 1.2	mA

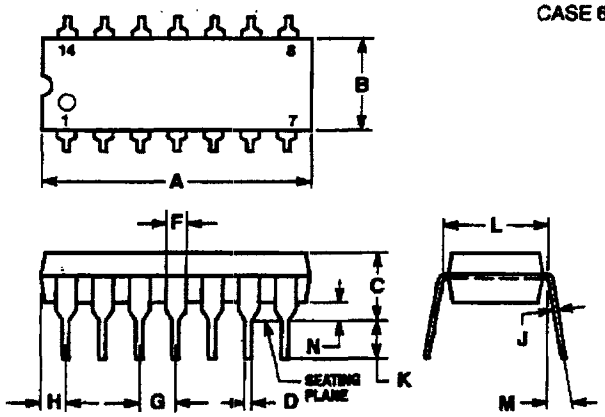
NOTES: 1. T_{low} = 0°C, T_{high} = +70°C for LMT324, B.
T_{low} = −40°C, T_{high} = +105°C for LMT2902.
2. The input common mode voltage (V_{ICR}) or either input signal voltage should not be allowed to go negative by more than 0.3 V.
3. Short circuits from the output to V_{CC} can cause excessive heating and eventual destruction. Destructive dissipation can result from simultaneous shorts on all amplifiers.

ELECTRICAL CHARACTERISTICS (V_{CC} = +5.0V, V_{EE} = Ground, T_A = 25°C, unless otherwise noted.)

Characteristics	Symbol	LMT2902			Unit
		Min	Typ	Max	
Input Offset Voltage, V_{CC} = 5.0 V to 30 V, V_{ICR} = 0 V to V_{CC} −1.7 V, V_O = 1.4 V, R_S = 0 Ω	V_{IO}				mV
T_A = +25°C		—	2.0	7.0	
T_A = T_{high} to T_{low} (Note 1)		—	—	10	
Average Temp. Coefficient of Input Offset Voltage T_A = T_{high} to T_{low}	$\Delta V_{IO}/\Delta T$	—	7.0	—	µV/°C
Input Offset Current	I_{IO}	—	5.0	50	nA
T_A = T_{high} to T_{low} (Note 1)		—	—	200	
Average Temp. Coefficient of Input Offset Current T_A = T_{high} to T_{low}	$\Delta I_{IO}/\Delta T$	—	10	—	pA/°C
Input Bias Current	I_{IB}	—	−90	−250	nA
T_A = T_{high} to T_{low}		—	—	−500	
Input Common Mode Voltage Range (Note 2)	V_{ICR}				V
V_{CC} = 30 V, T_A = +25°C		0	—	24.3	
V_{CC} = 30 V, T_A = T_{high} to T_{low}		0	—	24	
Differential Input Voltage Range	V_{IDR}	—	—	V_{CC}	V
Large Signal Open-Loop Voltage Gain	A_{VOL}				V/mV
R_L = 2.0 kΩ, V_{CC} = 15 V, for Large V_O Swing		25	100	—	
T_A = T_{high} to T_{low}		15	—	—	
Channel Separation 1.0 kHz ≤ f ≤ 20 kHz, Input Referenced	CS	—	−120	—	dB
Common-Mode Rejection Ratio R_S ≤ 10 kΩ	CMRR	50	70	—	dB
Power Supply Rejection Ratio	PSRR	50	100	—	dB
Output Voltage Range	V_{OR}	0	—	3.3	V
Output Voltage (High Limit)	V_{OH}				V
V_{CC} = 5.0 V, R_L = 2.0 kΩ, T_A = +25°C		3.3	3.5	—	
V_{CC} = 30 V, R_L = 2.0 kΩ, T_A = T_{high} to T_{low}		22	—	—	
V_{CC} = 30 V, R_L = 10 kΩ, T_A = T_{high} to T_{low}		23	24	—	
Output Voltage (Low Limit) V_{CC} = 5.0 V, R_L = 10 kΩ, T_A = T_{high} to T_{low}	V_{OL}	—	5.0	100	mV
Output Source Current (V_{ID} = +1.0 V, V_{CC} = 15 V)	I_{O+}	20	40	—	mA
T_A = T_{high} to T_{low}		10	20	—	
Output Sink Current (V_{ID} = −1.0 V, V_{CC} = 15 V)	I_{O-}				
T_A = +25°C		10	20	—	mA
T_A = T_{high} to T_{low} (Note 1)		5.0	8.0	—	mA
V_{ID} = −1.0 V, V_O = 200 mV, T_A = +25°C		—	—	—	µA
Output Short Circuit to Ground (Note 3)	I_{SC}	—	40	60	mA
Power Supply Current (T_A = T_{high} to T_{low})	I_{CC}				mA
V_{CC} = 30 V, V_O = 0 V, R_L = ∞		—	—	3.0	
V_{CC} = 5.0 V, V_O = 0 V, R_L = ∞		—	—	1.2	

OUTLINE DIMENSIONS

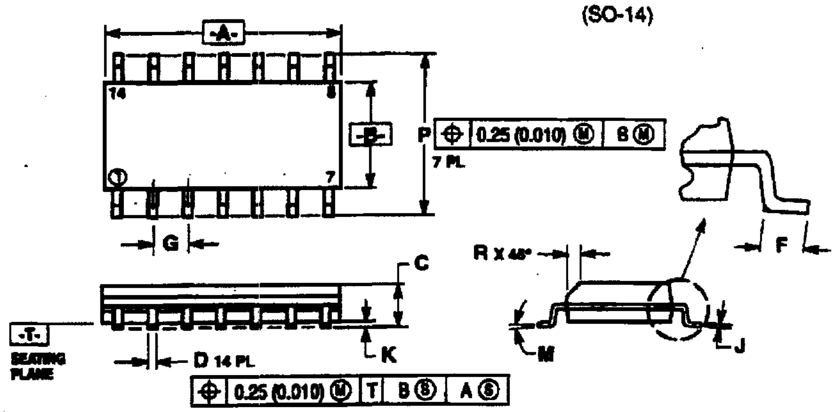
N SUFFIX
PLASTIC PACKAGE
CASE 646-06



NOTES:
1. LEADS WITHIN 0.13 (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
4. ROUNDED CORNERS OPTIONAL.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	0.715	0.770	18.16	19.56
B	0.240	0.260	6.10	6.60
C	0.145	0.185	3.69	4.69
D	0.015	0.021	0.38	0.53
F	0.040	0.070	1.02	1.78
G	0.100 BSC		2.54 BSC	
H	0.052	0.095	1.32	2.41
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.300 BSC		7.62 BSC	
M	0°	10°	0°	10°
N	0.015	0.039	0.39	1.01

D SUFFIX
PLASTIC PACKAGE
CASE 751A-03
(SO-14)



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	8.55	8.75	0.337	0.344
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.228	0.244
R	0.25	0.50	0.010	0.019

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