National Semiconductor

LM148/LM248/LM348
Quad 741 Op Amps

General Description

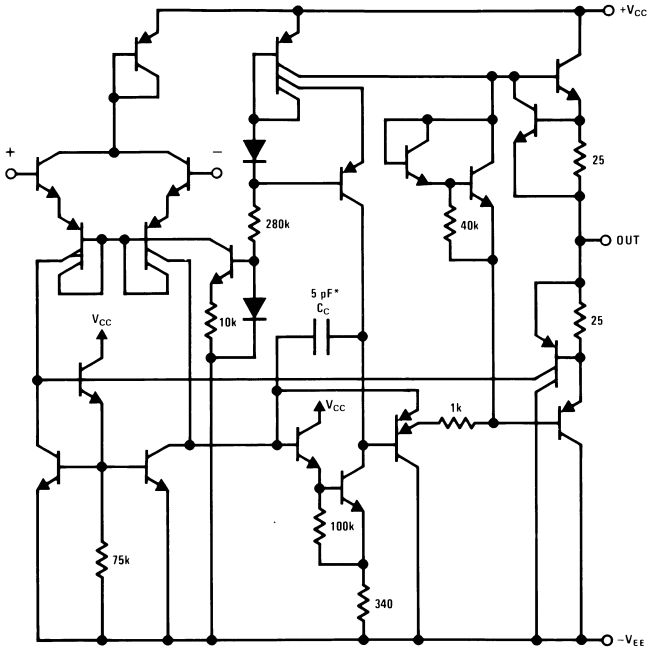
The LM148 series is a true quad 741. It consists of four independent, high gain, internally compensated, low power operational amplifiers which have been designed to provide functional characteristics identical to those of the familiar 741 operational amplifier. In addition the total supply current for all four amplifiers is comparable to the supply current of a single 741 type op amp. Other features include input offset currents and input bias current which are much less than those of a standard 741. Also, excellent isolation between amplifiers has been achieved by independently biasing each amplifier and using layout techniques which minimize thermal coupling.

The LM148 can be used anywhere multiple 741 or 1558 type amplifiers are being used and in applications where amplifier matching or high packing density is required. For lower power refer to LF444.

Features

- 741 op amp operating characteristics
- Class AB output stage—no crossover distortion
- Pin compatible with the LM124
- Overload protection for inputs and outputs
- Low supply current drain: 0.6 mA/Amplifier
- Low input offset voltage: 1 mV
- Low input offset current: 4 nA
- Low input bias current 30 nA
- High degree of isolation between amplifiers: 120 dB
- Gain bandwidth product
- LM148 (unity gain): 1.0 MHz

Schematic Diagram



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* 1 pF in the LM149

Absolute Maximum Ratings (Note 4)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

	LM148	LM248	LM348
Supply Voltage	±22V	±18V	±18V
Differential Input Voltage	±44V	±36V	±36V
Output Short Circuit Duration (Note 1)	Continuous	Continuous	Continuous
Power Dissipation (P_d at 25˚C) and Thermal Resistance (θ_{jA}), (Note 2)			
Molded DIP (N) P_d	—	—	750 mW
θ_{jA}	—	—	100˚C/W
Cavity DIP (J) P_d	1100 mW	800 mW	700 mW
θ_{JA}	110˚C/W	110˚C/W	110˚C/W
Maximum Junction Temperature (T_{jMAX})	150˚C	110˚C	100˚C
Operating Temperature Range	$-55˚C \le T_A \le +125˚C$	$-25˚C \le T_A \le +85˚C$	$0˚C \le T_A \le +70˚C$
Storage Temperature Range	−65˚C to +150˚C	−65˚C to +150˚C	−65˚C to +150˚C
Lead Temperature (Soldering, 10 sec.) Ceramic	300˚C	300˚C	300˚C
Lead Temperature (Soldering, 10 sec.) Plastic			260˚C
Soldering Information			
Dual-In-Line Package			
Soldering (10 seconds)	260˚C	260˚C	260˚C
Small Outline Package			
Vapor Phase (60 seconds)	215˚C	215˚C	215˚C
Infrared (15 seconds)	220˚C	220˚C	220˚C
See AN-450 “Surface Mounting Methods and Their Effect on Product Reliability” for other methods of soldering surface mount devices.			
ESD tolerance (Note 5)	500V	500V	500V

Electrical Characteristics

(Note 3)

Parameter	Conditions	LM148			LM248			LM348			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	$T_A = 25˚C$, $R_S \le 10\ k\Omega$		1.0	5.0		1.0	6.0		1.0	6.0	mV
Input Offset Current	$T_A = 25˚C$		4	25		4	50		4	50	nA
Input Bias Current	$T_A = 25˚C$		30	100		30	200		30	200	nA
Input Resistance	$T_A = 25˚C$	0.8	2.5		0.8	2.5		0.8	2.5		MΩ
Supply Current All Amplifiers	$T_A = 25˚C$, $V_S = \pm15V$		2.4	3.6		2.4	4.5		2.4	4.5	mA
Large Signal Voltage Gain	$T_A = 25˚C$, $V_S = \pm15V$ $V_{OUT} = \pm10V$, $R_L \ge 2\ k\Omega$	50	160		25	160		25	160		V/mV
Amplifier to Amplifier Coupling	$T_A = 25˚C$, f = 1 Hz to 20 kHz (Input Referred) See Crosstalk Test Circuit		−120			−120			−120		dB
Small Signal Bandwidth	$T_A = 25˚C$, LM148 Series		1.0			1.0			1.0		MHz
Phase Margin	$T_A = 25˚C$, LM148 Series ($A_V = 1$)		60			60			60		degrees
Slew Rate	$T_A = 25˚C$, LM148 Series ($A_V = 1$)		0.5			0.5			0.5		V/μs
Output Short Circuit Current	$T_A = 25˚C$		25			25			25		mA
Input Offset Voltage	$R_S \le 10\ k\Omega$			6.0			7.5			7.5	mV
Input Offset Current				75			125			100	nA

Electrical Characteristics (Continued)

(Note 3)

Parameter	Conditions	LM148			LM248			LM348			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Bias Current				325			500			400	nA
Large Signal Voltage Gain	V_S = ±15V, V_{OUT} = ±10V, R_L > 2 kΩ	25			15			15			V/mV
Output Voltage Swing	V_S = ±15V, R_L = 10 kΩ	±12	±13		±12	±13		±12	±13		V
	R_L = 2 kΩ	±10	±12		±10	±12		±10	±12		V
Input Voltage Range	V_S = ±15V	±12			±12			±12			V
Common-Mode Rejection Ratio	R_S ≤ 10 kΩ	70	90		70	90		70	90		dB
Supply Voltage Rejection	R_S ≤ 10 kΩ, ±5V ≤ V_S ≤ ±15V	77	96		77	96		77	96		dB

Note 1: Any of the amplifier outputs can be shorted to ground indefinitely; however, more than one should not be simultaneously shorted as the maximum junction temperature will be exceeded.

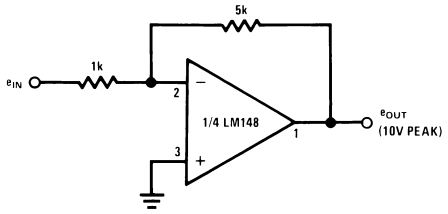
Note 2: The maximum power dissipation for these devices must be derated at elevated temperatures and is dicated by T_{JMAX}, θ_{JA}, and the ambient temperature, T_A. The maximum available power dissipation at any temperature is $P_d = (T_{JMAX} - T_A)/\theta_{JA}$ or the 25˚C P_{DMAX}, whichever is less.

Note 3: These specifications apply for V_S = ±15V and over the absolute maximum operating temperature range ($T_L \le T_A \le T_H$) unless otherwise noted.

Note 4: Refer to RETS 148X for LM148 military specifications.

Note 5: Human body model, 1.5 kΩ in series with 100 pF.

Cross Talk Test Circuit V_S = ±15V



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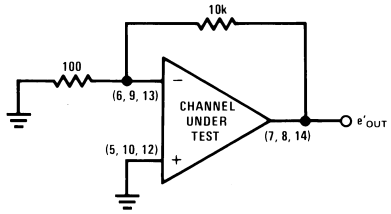

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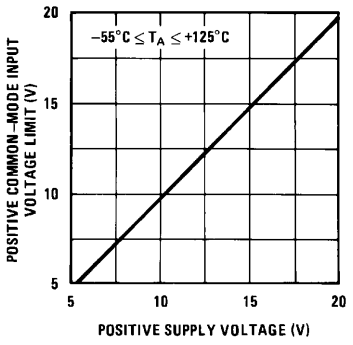

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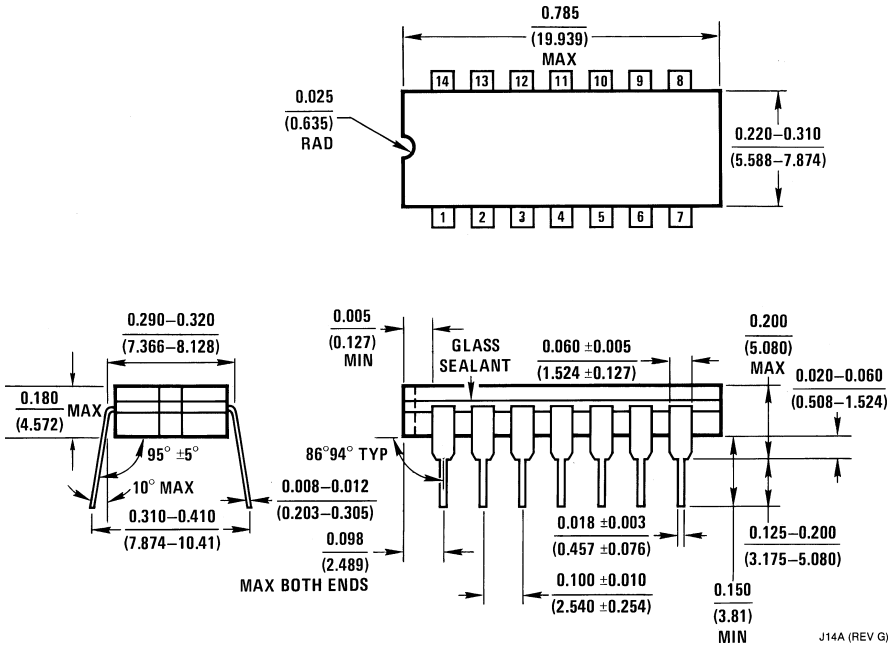
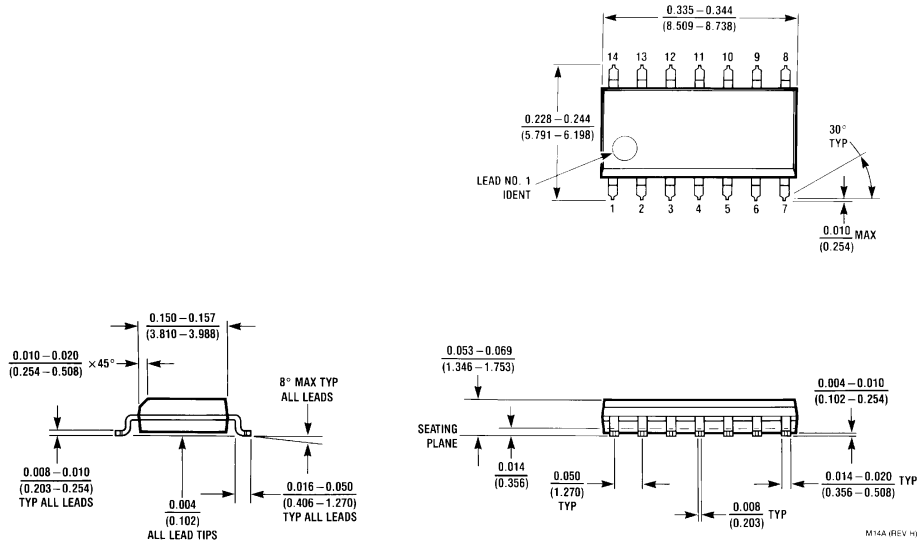
Physical Dimensions inches (millimeters)

unless otherwise noted

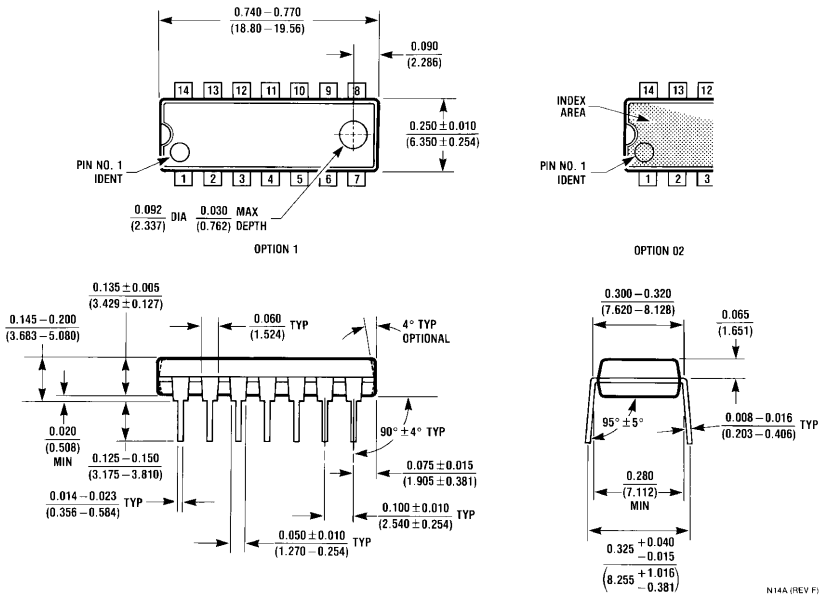


Ceramic Dual-In-Line Package (J)
Order Number LM148J, LM148J/883, LM248J
NS Package Number J14A



S.O. Package (M)
Order Number LM348M or LM348MX
NS Package Number M14A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



Molded Dual-In-Line Package (N)
Order Number LM348N
NS Package Number N14A

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