

LM148, LM248, LM348 QUADRUPLE OPERATIONAL AMPLIFIERS

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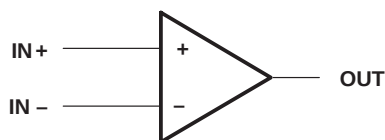
- μ A741 Operating Characteristics
- Low Supply Current Drain . . . 0.6 mA Typ (per amplifier)
- Low Input Offset Voltage
- Low Input Offset Current
- Class AB Output Stage
- Input/Output Overload Protection
- Designed to Be Interchangeable With National LM148, LM248, and LM348

description

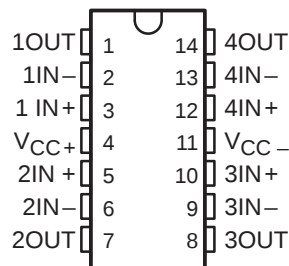
The LM148, LM248, and LM348 are quadruple, independent, high-gain, internally compensated operational amplifiers designed to have operating characteristics similar to the μ A741. These amplifiers exhibit low supply current drain, and input bias and offset currents that are much less than those of the μ A741.

The LM148 is characterized for operation over the full military temperature range of -55°C to 125°C , the LM248 is characterized for operation from -25°C to 85°C , and the LM348 is characterized for operation from 0°C to 70°C .

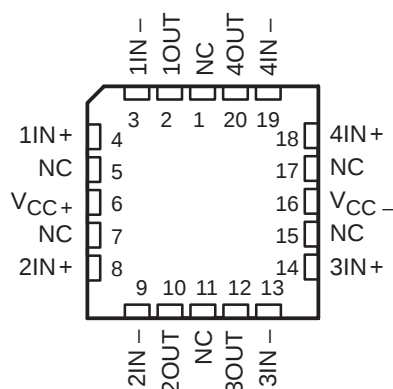
symbol (each amplifier)



LM148 . . . J PACKAGE
LM248, LM348 . . . D, N, OR PW PACKAGE
(TOP VIEW)



LM148 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

AVAILABLE OPTIONS

T_A	V_{IOmax} AT 25°C	PACKAGE				
		SMALL OUTLINE (D)	CHIP CARRIER (FK)	CERAMIC DIP (J)	PLASTIC DIP (N)	TSSOP (PW)
0°C to 70°C	6 mV	LM348D	—	—	LM348N	LM348PW
-25°C to 85°C	6 mV	LM248D	—	—	LM248N	—
-55°C to 125°C	5 mV	—	LM148FK	LM148J	—	—

The D package is available taped and reeled. Add the suffix R to the device type (e.g., LM348DR).



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

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LM148, LM248, LM348

QUADRUPLE OPERATIONAL AMPLIFIERS

SLOS058B – OCTOBER 1979 – REVISED AUGUST 1996

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

	LM148	LM248	LM348	UNIT
Supply voltage, V_{CC+} (see Note 1)	22	18	18	V
Supply voltage, V_{CC-} (see Note 1)	-22	-18	-18	V
Differential input voltage, V_{ID} (see Note 2)	44	36	36	V
Input voltage, V_I (either input, see Notes 1 and 3)	± 22	± 18	± 18	V
Duration of output short circuit (see Note 4)	unlimited	unlimited	unlimited	
Continuous total power dissipation	See Dissipation Rating Table			
Operating free-air temperature range, T_A	-55 to 125	-25 to 85	0 to 70	$^{\circ}\text{C}$
Storage temperature range	-65 to 150	-65 to 150	-65 to 150	$^{\circ}\text{C}$
Case temperature for 60 seconds	FK package	260		$^{\circ}\text{C}$
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds	J package	300		$^{\circ}\text{C}$
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	D, N, or PW package		260	$^{\circ}\text{C}$

- NOTES: 1. All voltage values, except differential voltages, are with respect to the midpoint between V_{CC+} and V_{CC-} .
2. Differential voltages are at $IN+$ with respect to $IN-$.
3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or the value specified in the table, whichever is less.
4. The output may be shorted to ground or either power supply. Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^{\circ}\text{C}$ POWER RATING	DERATING FACTOR	DERATE ABOVE T_A	$T_A = 70^{\circ}\text{C}$ POWER RATING	$T_A = 85^{\circ}\text{C}$ POWER RATING	$T_A = 125^{\circ}\text{C}$ POWER RATING
D	900 mW	7.6 mW/ $^{\circ}\text{C}$	32 $^{\circ}\text{C}$	611 mW	497 mW	N/A
FK	900 mW	11.0 mW/ $^{\circ}\text{C}$	68 $^{\circ}\text{C}$	878 mW	713 mW	273 mW
J	900 mW	11.0 mW/ $^{\circ}\text{C}$	68 $^{\circ}\text{C}$	878 mW	713 mW	273 mW
N	900 mW	9.2 mW/ $^{\circ}\text{C}$	52 $^{\circ}\text{C}$	734 mW	596 mW	N/A
PW	700 mW	5.6 mW/ $^{\circ}\text{C}$	N/A	448 mW	N/A	N/A

recommended operating conditions

	MIN	MAX	UNIT
Supply voltage, V_{CC+}	4	18	V
Supply voltage, V_{CC-}	-4	-18	V



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electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm 15$ V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		LM148			LM248			LM348			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	$V_O = 0$	25°C		1	5		1	6		1	6	mV
			Full range			6			7.5			7.5	
I_{IO}	Input offset current	$V_O = 0$	25°C		4	25		4	50		4	50	nA
			Full range			75			125			100	
I_{IB}	Input bias current	$V_O = 0$	25°C		30	100		30	200		30	200	nA
			Full range			325			500			400	
V_{ICR}	Common-mode input voltage range		Full range		± 12			± 12			± 12		V
V_{OM}	Maximum peak output voltage swing	$R_L = 10\text{ k}\Omega$	25°C		± 12	± 13		± 12	± 13		± 12	± 13	V
		$R_L \geq 10\text{ k}\Omega$	Full range		± 12			± 12			± 12		
		$R_L = 2\text{ k}\Omega$	25°C		± 10	± 12		± 10	± 12		± 10	± 12	
		$R_L \geq 2\text{ k}\Omega$	Full range		± 10			± 10			± 10		
A_{VD}	Large-signal differential voltage amplification	$V_O = \pm 10\text{ V}$, $R_L = \geq 2\text{ k}\Omega$	25°C		50	160		25	160		25	160	V/mV
			Full range		25			15			15		
r_i	Input resistance‡		25°C		0.8	2.5		0.8	2.5		0.8	2.5	M Ω
B_1	Unity-gain bandwidth	$A_{VD} = 1$	25°C		1			1			1		MHz
ϕ_m	Phase margin	$A_{VD} = 1$	25°C		60°			60°			60°		
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICRmin}$, $V_O = 0$	25°C		70	90		70	90		70	90	dB
			Full range		70			70			70		
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm} = \pm 9\text{ V}$ to $\pm 15\text{ V}$, $V_O = 0$	25°C		77	96		77	96		77	96	dB
			Full range		77			77			77		
I_{OS}	Short-circuit output current		25°C		± 25			± 25			± 25		mA
I_{CC}	Supply current (four amplifiers)	No load	25°C					2.4	4.5		2.4	4.5	mA
		$V_O = V_{OM}$			2.4	3.6							
V_{O1}/V_{O2}	Crosstalk attenuation	$f = 1\text{ Hz}$ to 20 kHz	25°C		120			120			120		dB

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. Full range for T_A is -55°C to 125°C for LM148, -25°C to 85°C for LM248, and 0°C to 70°C for LM348.

‡ This parameter is not production tested.

LM148, LM248, LM348

QUADRUPLE OPERATIONAL AMPLIFIERS

SLOS058B – OCTOBER 1979 – REVISED AUGUST 1996

operating characteristics, $V_{CC\pm} = \pm 15\text{ V}$, $T_A = 25^{\circ}\text{C}$

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
SR	Slew rate at unity gain	$R_L = 2\text{ k}\Omega$, $C_L = 100\text{ pF}$, See Figure 1		0.5		V/ μs

PARAMETER MEASUREMENT INFORMATION

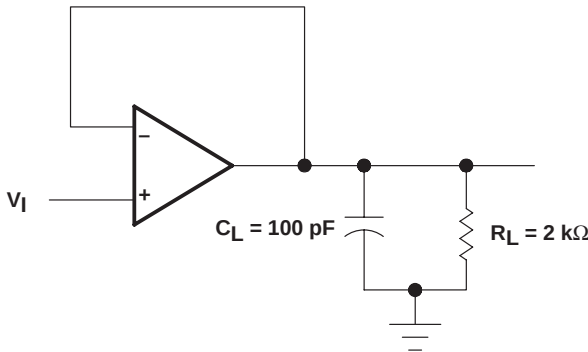


Figure 1. Unity-Gain Amplifier

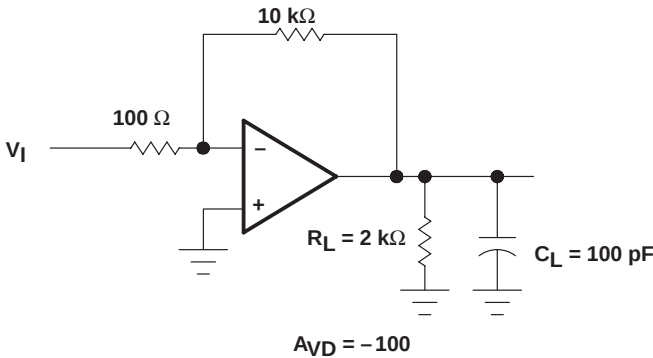


Figure 2. Inverting Amplifier

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LM348, QUAD GENERAL-PURPOSE OPERATIONAL AMPLIFIER

Device Status: Active

- > [Description](#)
- > [Features](#)
- > [Datasheets](#)
- > [Pricing/Samples/Availability](#)
- > [Application Notes](#)
- > [User Manuals](#)
- > [Development Tools](#)
- > [Applications](#)

Parameter Name	LM348
delta VCC (max) (V)	36
delta VCC (min) (V)	8
IDD / ICC per channel (max) (mA)	1.125
IDD / ICC per channel (typ) (mA)	0.6
GBW (typ) (MHz)	1
Slew Rate (typ) (V/us)	0.5
VIO (Full Range) (max) (mV)	7.5
VIO (25 deg C) (max) (mV)	6
IIB (typ) (pA)	30000
CMRR (typ) (dB)	90
Vn (typ) (nV/rtHz)	23
Number of Channels	4
Spec'd at VCC (V)	+/-15

Description

The LM148, LM248, and LM348 are quadruple, independent, high-gain, internally compensated operational amplifiers designed to have operating characteristics similar to the uA741. These amplifiers exhibit low supply current drain, and input bias and offset currents that are much less than those of the uA741.

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- Input/Output Overload Protection
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Datasheets

Full datasheet in Acrobat PDF: [slos058b.pdf](#) (78 KB)

Full datasheet in Zipped PostScript: [slos058b.psz](#) (79 KB)

Pricing/Samples/Availability

Orderable Device	Package	Pins	Temp (°C)	Status	Price/unit USD (100-999)	Pack Qty	Availability / Samples
LM348D	D	14		ACTIVE	0.64	50	Check stock or order
LM348DR	D	14		ACTIVE	0.57	2500	Check stock or order
LM348N	N	14		ACTIVE	0.64	25	Check stock or order
LM348NS	NS	14		ACTIVE			Check stock or order

Application Reports

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- [ANALOG APPLICATIONS JOURNAL, FEBRUARY 2000](#) (SLYT012A - Updated: 03/23/2000)
- [ANALOG APPLICATIONS JOURNAL, NOVEMBER 1999](#) (SLYT010A - Updated: 03/23/2000)
- [ANALYSIS OF THE Sallen-Key ARCHITECTURE](#) (SLOA024A - Updated: 08/04/1999)
- [ELECTROSTATIC DISCHARGE APPLICATION NOTE](#) (SSYA008 - Updated: 05/05/1999)
- [SIGNAL CONDITIONING PIEZOELECTRIC SENSORS](#) (SLOA033 - Updated: 10/03/1999)
- [SIGNAL CONDITIONING WHEATSTONE RESISTIVE BRIDGE SENSORS](#) (SLOA034 - Updated: 10/03/1999)
- [THERMAL CHARACTERISTICS OF LINEAR AND LOGIC PACKAGES USING JEDEC PCB DESIGNS](#) (SZZA017A - Updated: 09/15/1999)

User Manuals

- [UNIVERSAL OP AMP EVALUATION MODULE SELECTION GUIDE](#) (SLOU060, 10 KB - Updated: 02/15/2000)
- [UNIVERSAL OPERATIONAL AMPLIFIER EVM](#) (SLVU006A, 387 KB - Updated: 04/14/1999)
- [UNIVERSAL OPERATIONAL AMPLIFIER SINGLE, DUAL, QUAD \(MSOP/TSSOP\)](#) (SLOU055, 1196 KB - Updated: 11/11/1999)
- [UNIVERSAL OPERATIONAL AMPLIFIER SINGLE, DUAL, QUAD \(PDIP\)](#) (SLOU062, 1211 KB - Updated: 10/24/1999)
- [UNIVERSAL OPERATIONAL AMPLIFIER SINGLE, DUAL, QUAD \(SOIC\) EVALUATION MODULE](#)

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