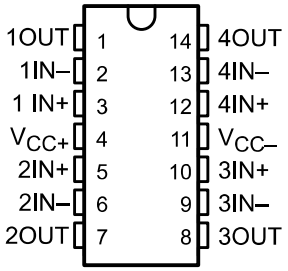
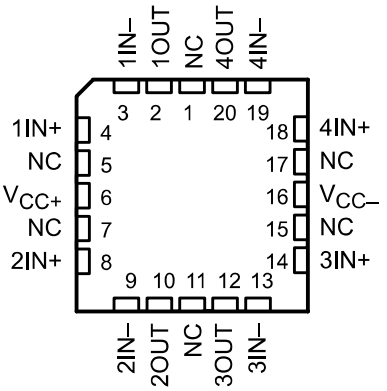
- μA741 Operating Characteristics
- Low Supply-Current Drain . . . 0.6 mA Typ (per amplifier)
- Low Input Offset Voltage
- Low Input Offset Current
- Class AB Output Stage
- Input/Output Overload Protection
- Designed to Be Interchangeable With Industry Standard LM148, LM248, and LM348

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



LM148 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description/ordering information

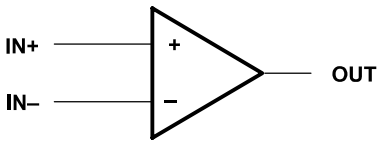
The LM148, LM248, and LM348 are quadruple, independent, high-gain, internally compensated operational amplifiers designed to have operating characteristics similar to the μA741. These amplifiers exhibit low supply-current drain and input bias and offset currents that are much less than those of the μA741.

ORDERING INFORMATION

T_A	V_{IO}max AT 25°C	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	6 mV	PDIP (N)	Tube of 25	LM348N	LM348N
		SOIC (D)	Tube of 50	LM348D	LM348
			Reel of 2500	LM348DR	
		SOP (NS)	Reel of 2000	LM348NSR	LM348
–25°C to 85°C	6 mV	PDIP (N)	Tube of 25	LM248N	LM248N
		SOIC (D)	Tube of 50	LM248D	LM248
			Reel of 2500	LM248DR	
–55°C to 125°C	5 mV	CDIP (J)	Tube of 25	LM148J	LM148J
		LCCC (FK)	Tube of 50	LM148FK	LM148FK

† Package drawings, standard packing quantities, thermal data, symboliztion, and PCB design guidelines are available at www.ti.com/sc/package.

symbol (each amplifier)



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

Supply voltage, V_{CC+} (see Note 1): LM148 . . . . . 22 V
LM248, LM348 . . . . . 18 V
Supply voltage, V_{CC-} (see Note 1): LM148 . . . . . –22 V
LM248, LM348 . . . . . –18 V
Differential input voltage, V_{ID} (see Note 2): LM148 . . . . . 44 V
LM248, LM348 . . . . . 36 V
Input voltage, V_I (either input, see Notes 1 and 3): LM148 . . . . . –22 V
LM248, LM348 . . . . . –18 V
Duration of output short circuit (see Note 4) . . . . . Unlimited
Operating virtual junction temperature, T_J . . . . . 150°C
Package thermal impedance, θ_{JA} (see Notes 5 and 6): D package . . . . . 86°C/W
N package . . . . . 80°C/W
NS package . . . . . 76°C/W
Package thermal impedance, θ_{JC} (see Notes 7 and 8): FK package . . . . . 5.61°C/W
J package . . . . . 15.05°C/W
Case temperature for 60 seconds: FK package . . . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: J package . . . . . 300°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: D, N, or NS package . . . . . 260°C
Storage temperature range, T_{stg} . . . . . –65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES:
1. All voltage values, unless otherwise noted, 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.
5. Maximum power dissipation is a function of $T_J(max)$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperautre is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
6. The package thermal impedance is calculated in accordance with JESD 51-7.
7. Maximum power dissipation is a function of $T_J(max)$, θ_{JC}, and T_C. The maximum allowable power dissipation at any allowable ambient temperautre is $P_D = (T_J(max) – T_C)/\theta_{JC}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
8. The package thermal impedance is calculated in accordance with MIL-STD-883.

recommended operating conditions

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

electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±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 kΩ		25°C	±12	±13		±12	±13		±12	±13		V
		$R_L \geq$ 10 kΩ		Full range	±12			±12			±12			
		R_L = 2 kΩ		25°C	±10	±12		±10	±12		±10	±12		
		$R_L \geq$ 2 kΩ		Full range	±10			±10			±10			
A_{VD}	Large-signal differential voltage amplification	V_O = ±10 V, R_L = ≥ 2 kΩ		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		MΩ
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	$V_{IC} = V_{ICR}$min, V_O = 0		25°C	70	90		70	90		70	90		dB
				Full range	70			70			70			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±9 V to ±15 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	V_O = 0	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 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.

operating characteristics, $V_{CC\pm}$ = ±15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
SR	Slew rate at unity gain	R_L = 2 kΩ, C_L = 100 pF, See Figure 1		0.5		V/μs

PARAMETER MEASUREMENT INFORMATION

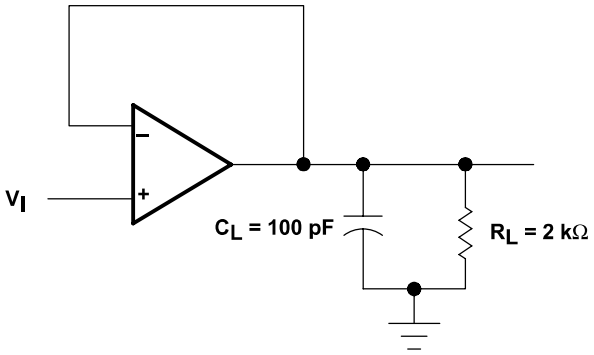


Figure 1. Unity-Gain Amplifier

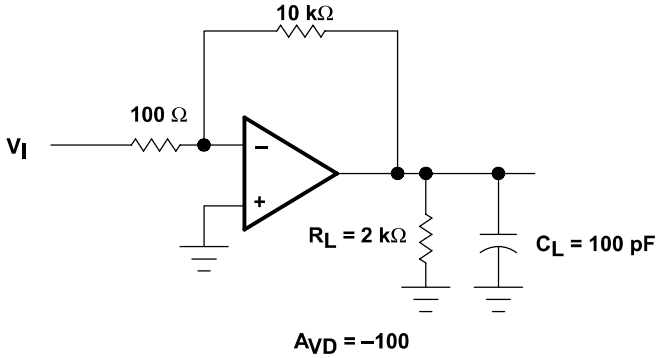


Figure 2. Inverting Amplifier