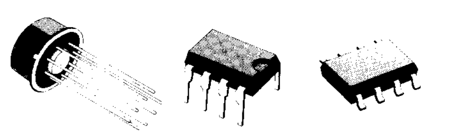
LM748

LINEAR INTEGRATED CIRCUITS

OPERATIONAL AMPLIFIERS

- SHORT CIRCUIT PROTECTION
- OFFSET VOLTAGE NULL CAPABILITY
- LARGE COMMON MODE AND DIFFERENTIAL VOLTAGE RANGE
- NO LATCH-UP
- SLEW-RATE = 5.5V/μs ($G_v = 10, C_c = 3.3pF$)

The LM748 series consists of general purpose operational amplifiers, intended for a wide range of analog applications where tailoring of frequency characteristics is desirable. High common mode voltage range and absence of "Latch-up" tendencies make the LM748 series ideal for use as a voltage follower. The high gain and wide range of operating voltage provide superior performance in integrators, summing amplifiers and general feedback applications. Unity gain frequency compensation is achieved by means of a single 30pF capacitors.



TO-99 **Minidip (Plastic and Ceramic)** **SO-8**

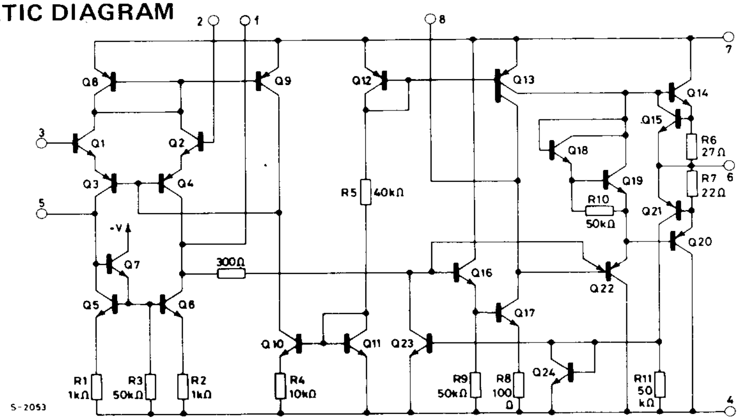
ABSOLUTE MAXIMUM RATINGS

		LM748/A	LM748I	LM748C
V_s	Supply voltage	± 22V	± 22V	± 22V
V_I (1)	Input voltage	± 15V	± 15V	± 15V
ΔV_I	Differential input voltage	± 30V	± 30V	± 30V
T_{op}	Operating temperature	-55 to 125°C	-25 to 85°C	0 to 70°C
	Output short circuit duration (2)	indefinite	indefinite	indefinite
T_j	Junction temperature	150°C	150°C	150°C
T_{stg}	Storage temperature	-65 to 150°C	-65 to 150°C	-65 to 150°C

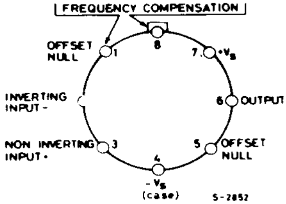
(1) For supply voltages less than ± 15V, input voltage is equal to the supply voltage

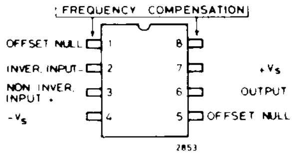
(2) The short circuit duration is limited by thermal dissipation

SCHEMATIC DIAGRAM



CONNECTION DIAGRAMS
(top views)





ORDERING NUMBERS

Type	TO-99	Ceramic Minidip	Plastic Minidip	SO-8
LM748	LM748 H	LM748J	—	—
LM748C	LM748 CH	LM748 CJ	LM748 CN	LM748 CD
LM748A	LM748 AH	—	—	—
LM748I	—	—	—	LM748ID

THERMAL DATA

		Plastic Minidip	Ceramic Minidip	TO-99	SO-8
$R_{th\ j\text{-}amb}$ Thermal resistance junction-ambient	max.	120°C/W	150°C/W	155°C/W	200°C/W

ELECTRICAL CHARACTERISTICS (see note)

Parameter		Test conditions	LM748/748I Min.	LM748/748I Typ.	LM748/748I Max.	LM748A Min.	LM748A Typ.	LM748A Max.	LM748C Min.	LM748C Typ.	LM748C Max.	Unit
V_{os}	Input offset voltage	T_{amb} = 25°C, $R_g \leq 10\ k\Omega$		1	5					2	6	mV
		$R_g \leq 50\Omega$					0.5	2				mV
		T_{amb} = T_{min} to T_{max}, $R_g \leq 10\ k\Omega$		1	6						7.5	mV
		$R_g \leq 50\Omega$					0.5	3				mV
ΔV_{os}	Input offset voltage adjust. range	T_{amb} = 25°C		±15			±25			±15		mV
$\frac{\Delta V_{os}}{\Delta T}$	Average input offset voltage drift	$R_g \leq 50\Omega$					2.5	15				$\frac{\mu V}{°C}$
I_{os}	Input offset current	T_{amb} = 25°C		20	200		2	10		20	200	nA
		T_{amb} = T_{min} to T_{max}		50	500			25			300	nA
$\frac{\Delta I_{os}}{\Delta T}$	Average input offset current drift							0.15				$\frac{nA}{°C}$
I_b	Input bias current	T_{amb} = 25°C		80	500		20	75		80	500	nA
		T_{amb} = T_{min} to T_{max}			1.5			0.1			0.8	μA
R_i	Input resistance	T_{amb} = 25°C	0.3	2		2	10		0.3	2		MΩ
V_i	Input voltage range		±12	±13		±12	±13		±12	±13		V
G_v	Large signal voltage gain	T_{amb} = 25°C, $R_L \geq 2\ k\Omega$, V_s = ±15V, V_o = ±10V	94	104		94	108		86	104		dB
		T_{amb} = T_{min} to T_{max}, $R_L \geq 2\ k\Omega$, V_s = ±15V, V_o = ±10V	88			88			84			dB
V_o	Output voltage swing	V_s = ±15V, $R_L \geq 10\ k\Omega$	±12	±14		±12	±14		±12	±14		V
		$R_L \geq 2\ k\Omega$	±10	±13		±10	±13		±10	±13		V
I_{sc}	Output short circuit current			25			25			25		mA
CMR	Common mode rejection	$R_g \leq 10\ k\Omega$, V_{CM} = ±12V	70	90		80	95		70	90		dB
SVR	Supply voltage rejection	V_s = ±5 to ± 20V, $R_g \leq 10\ k\Omega$	76	90		80	97		76	90		dB
SR	Slew rate	T_{amb} = 25°C, $R_L \geq 2\ k\Omega$, G_v = 1		0.5			0.5			0.5		V/μs
		T_{amb} = 25°C, $R_L \geq 2\ k\Omega$, G_v = 10*		5.5			5.5			5.5		V/μs

* C_C = 3.5 pF

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	LM748/7481			LM748A			LM748C			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
	Transient respon. (unity gain)	T_{amb}= 25°C, V_i= 20 mV, C_c= 30 pF, R_L= 2 kΩ, $C_L \leq$ 100 pF										
	Rise time			0.2			0.2			0.2		μs
	Overshoot			5			5			5		%
I_s	Supply current	T_{amb}= 25°C		1.9	2.8		1.9	2.8		1.9	2.8	mA
P_S	Power consumption	T_{amb}= 25°C										
		V_s= ±20V					60	85				mW
		V_s= ±15V		60	85					60	85	mW
		V_s= ±15V										
		T_{amb}= T_{min}		60	100		60	100		60	100	mW
		T_{amb}= T_{max}		45	75		40	75				mW

Note. These specifications, unless otherwise specified, apply for V_s = ±15V and T_{amb} = -55 to 125°C for LM748 and LM748A. For LM748C and LM7481 these specifications apply for T_{amb} = 0 to 70°C (C_c = 30pF).

Fig. 1 - Voltage offset null circuit

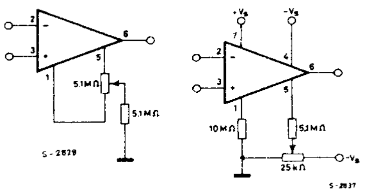
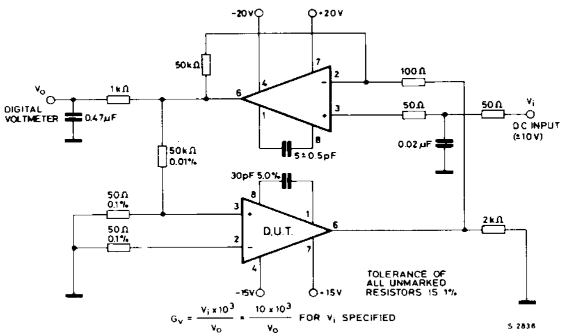


Fig. 2 - Gain test circuit



Typical performance curves for LM748

Fig. 3 – Input bias current vs. ambient temperature

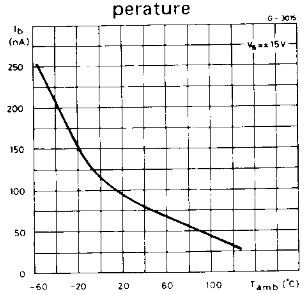


Fig. 4 – Input resistance vs. ambient temperature

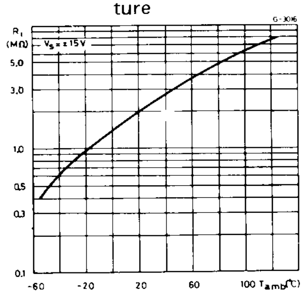


Fig. 5 – Output short-circuit current vs. ambient temperature

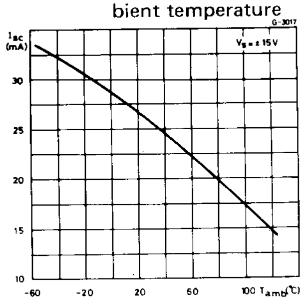


Fig. 6 – Input offset current vs. ambient temperature

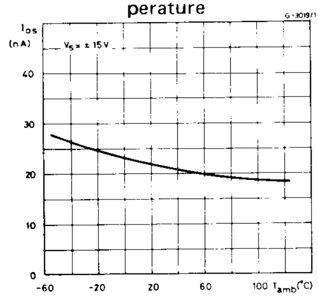


Fig. 7 – Power consumption vs. ambient temperature

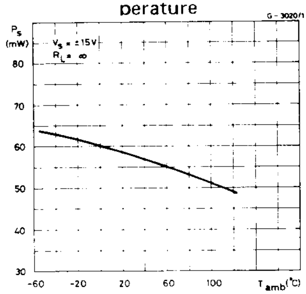
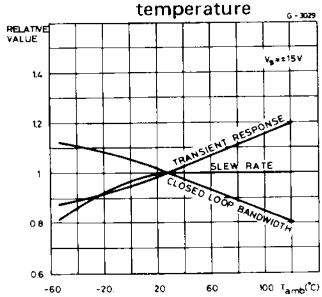


Fig. 8 – Frequency characteristics vs. ambient temperature



Typical performance curves for LM748C

Fig. 9 – Input bias current vs. ambient temperature

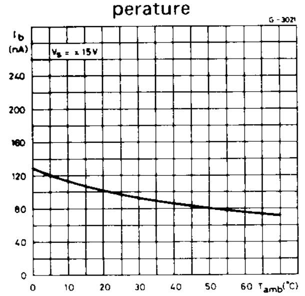


Fig. 10 – Input resistance vs. ambient temperature

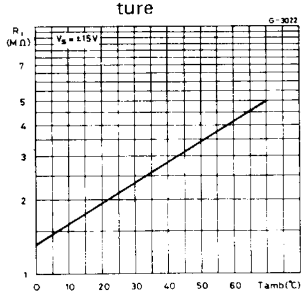


Fig. 11 – Output short-circuit current vs. ambient temperature

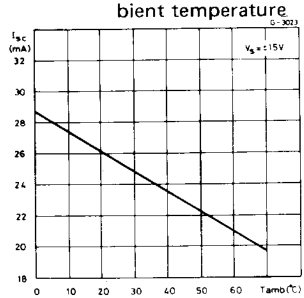


Fig. 12 - Input offset current vs. ambient temperature

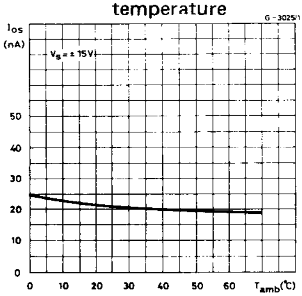


Fig. 13 - Power consumption vs. ambient temperature

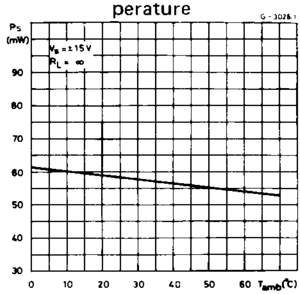
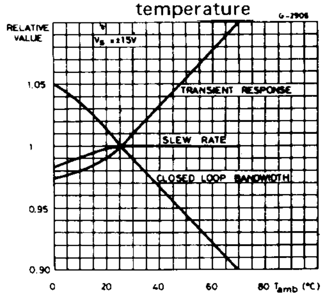


Fig. 14 - Frequency characteristics vs. ambient temperature



Typical performance curves for LM748 and LM748C

Fig. 15 - Open loop voltage gain vs. supply voltage

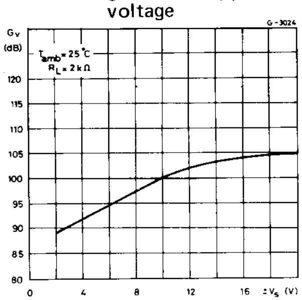


Fig. 16 - Output voltage swing vs. supply voltage

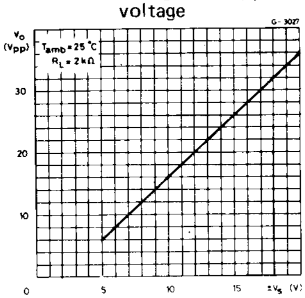


Fig. 17 - Power consumption vs. supply voltage

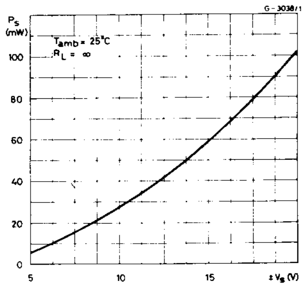


Fig. 18 - Output voltage swing vs. load resistance

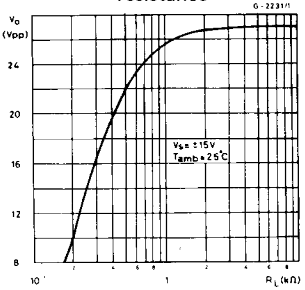


Fig. 19 - Input offset current vs. supply voltage

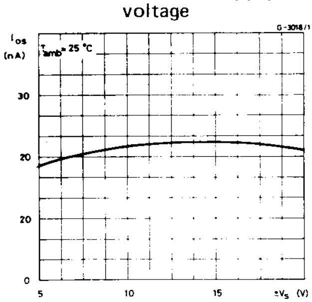


Fig. 20 - Input common mode voltage range vs. supply voltage

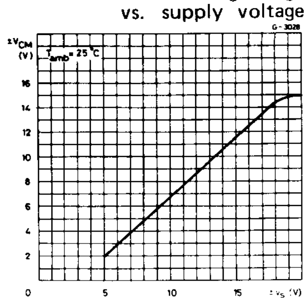


Fig. 21 - Input noise voltage vs. frequency

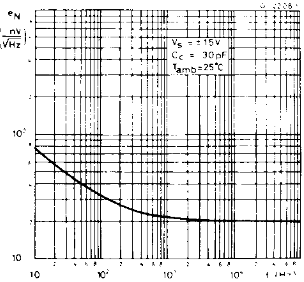


Fig. 22 - Input noise current vs. frequency

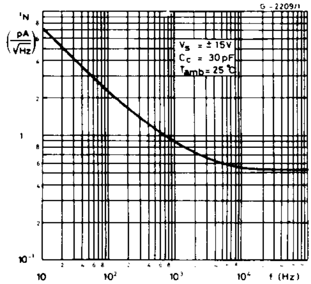


Fig. 23 - Broadband noise for various bandwidths

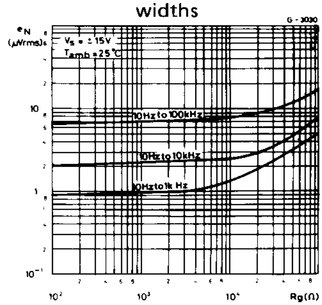


Fig. 24 - Open loop frequency and phase response vs. frequency

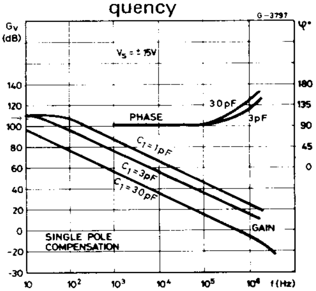


Fig. 25 - Output voltage swing vs. frequency

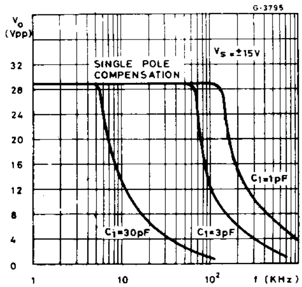


Fig. 26 - Slew-rate

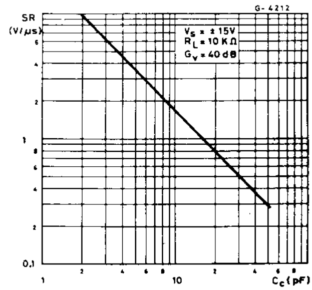


Fig. 27 - Compensation capacitance vs. closed loop voltage gain

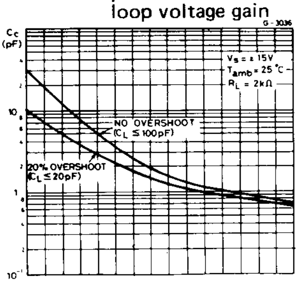


Fig. 28 - Input resistance and input capacitance vs. frequency

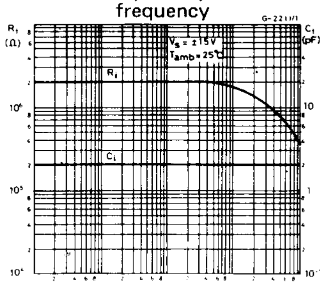


Fig. 29 - Output resistance vs. frequency

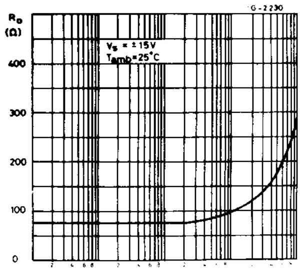


Fig. 30 - Frequency characteristics vs. supply voltage

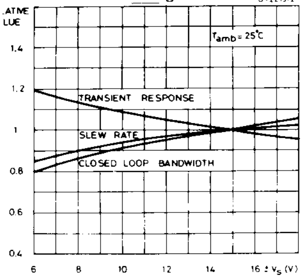


Fig. 31 - Voltage follower transient response (unity gain)

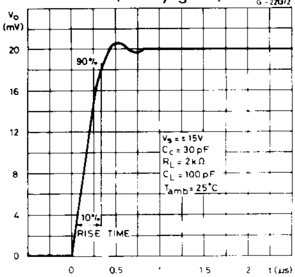


Fig. 32 - Transient response test circuit

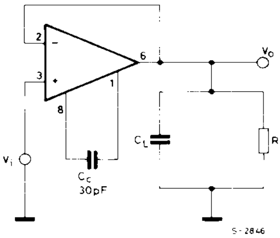


Fig. 33 - Voltage follower large-signal pulse response

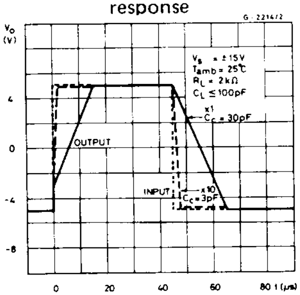


Fig. 34 - Feed forward compensation

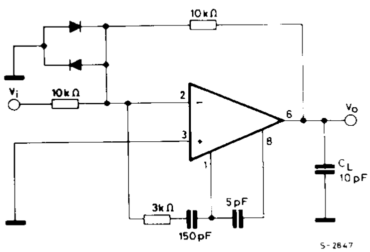
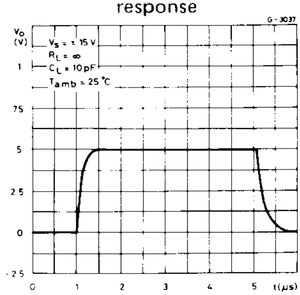
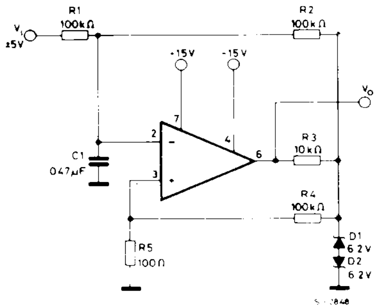


Fig. 35 - Large signal feed forward transient response



TYPICAL APPLICATIONS

Fig. 36 - Pulse width modulator



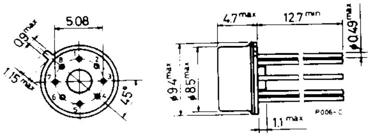
$$f_c = \frac{1}{2\pi R2\,C1}$$

$$f_n = \frac{1}{2\pi R1\,C1} = \frac{1}{2\pi R2\,C2}$$

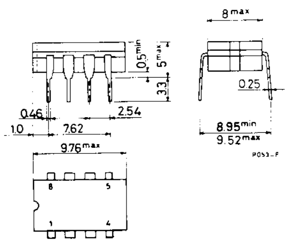
$f_c < f_n < f_{unity\ gain}$

MECHANICAL DATA (Dimensions in mm)

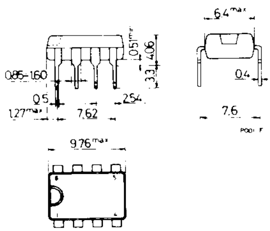
TO-99



Ceramic Minidip



Plastic Minidip



SO-8