LINEAR INTEGRATED CIRCUITS

LS148
LS148A
LS148C

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 = 3.5 pF)

The LS 148 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 LS 148 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 30 pF capacitor. The LS 148 series is available with hermetic gold chip (8000 series). This is particularly suitable for professional and telecom applications, wherever very high MTBF are required.

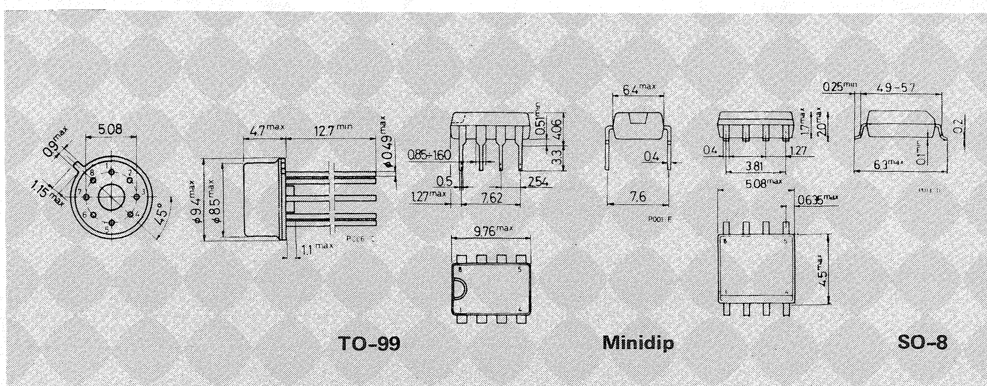
ABSOLUTE MAXIMUM RATINGS

		TO-99	Minidip	μpackage
V_s	Supply voltage		± 22V	
V_i (1)	Input voltage		± 15V	
ΔV_i	Differential input voltage		± 30V	
T_{op}	Operating temperature for **LS 148/LS 148A**		-55 to 125 °C	
	for **LS 148C**		0 to 70 °C	
	Output short circuit duration (2)		indefinite	
P_{tot}	Power dissipation at T_{amb} = 70°C	520 mW	665 mW	400 mW
T_{stg}	Storage temperature	-65 to 150 °C	-55 to 150 °C	-55 to 150 °C

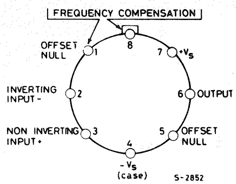
1) For supply voltage less than ± 15V, input voltage is equal to the supply voltage
2) The short circuit duration is limited by thermal dissipation.

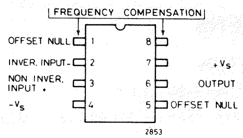
MECHANICAL DATA

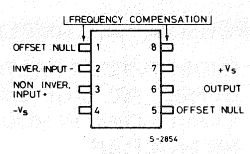
Dimensions in mm



CONNECTION DIAGRAMS AND ORDERING NUMBERS
(top views)

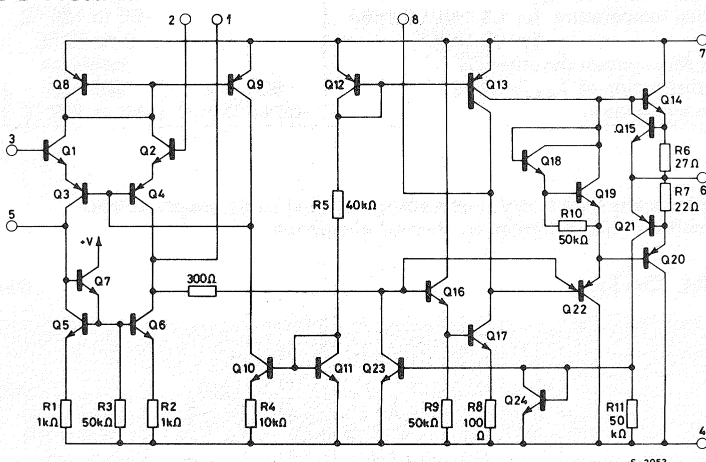






Type	TO-99	Minidip	SO-8
LS 148	LS 148 TB	—	—
LS 148A	LS 148 ATB	—	—
LS 148C	LS 148 CTB	LS 148 CB	LS 148 CM
LS 8148	—	—	LS 8148M
LS 8148A	—	—	LS 8148 AM
LS 8148C	—	—	LS 8148 CM

SCHEMATIC DIAGRAM



THERMAL DATA			TO-99	Minidip	SO-8
$R_{th\ j-amb}$	Thermal resistance junction-ambient	max	155 °C/W	120 °C/W	200* °C/W

* Measured with the device mounted on a ceramic substrate (25 x 16 x 0.6 mm)

ELECTRICAL CHARACTERISTICS (see note)

Symbol	Parameter	Test conditions	LS 148 Min.	LS 148 Typ.	LS 148 Max.	LS 148A Min.	LS 148A Typ.	LS 148A Max.	LS 148C Min.	LS 148C Typ.	LS 148C Max.	Unit
V_{os}	Input offset voltage	T_{amb}= 25°C $R_g \leq$ 10 kΩ		1	5					2	6	mV
		$R_g \leq$ 50Ω					0.5	2				mV
		T_{amb}= T_{min} to T_{max} $R_g \leq$ 10 kΩ		1	6						7.5	mV
		$R_g \leq$ 50Ω					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	$R_g \leq$ 50Ω					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 kΩ V_s= ±15V V_o= ±10V	94	104		94	108		86	104		dB
		T_{amb}= T_{min} to T_{max} $R_L \geq$ 2 kΩ V_s= ±15V V_o= ±10V	88			88			84			dB
V_o	Output voltage swing	V_s= ±15V $R_L \geq$ 10 kΩ	±12	±14		±12	±14		±12	±14		V
		$R_L \geq$ 2 kΩ	±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 kΩ V_{CM}= ±12V	70	90		80	95		70	90		dB
SVR	Supply voltage rejection	V_s= ±5 to ± 20V $R_g \leq$ 10 kΩ	76	90		80	97		76	90		dB
SR	Slew rate	T_{amb}= 25°C, $R_L \geq$ 2 kΩ, G_v= 1		0.5			0.5			0.5		V/µs
		T_{amb}= 25°C, $R_L \geq$ 2 kΩ, G_v= 10*		5.5			5.5			5.5		V/µs

* C_C = 3.5 pF

ELECTRICAL CHARACTERISTICS (continued)

	Parameter	Test conditions	LS 148			LS 148A			LS 148C			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 LS 148 and LS 148A. For LS 148C these specifications apply for T_{amb}= 0 to 70°C (C_c= 30 pF).

Fig. 1 - Voltage offset null circuit

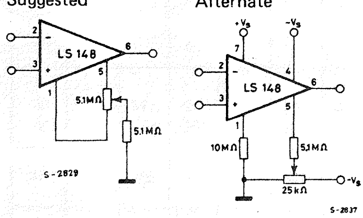
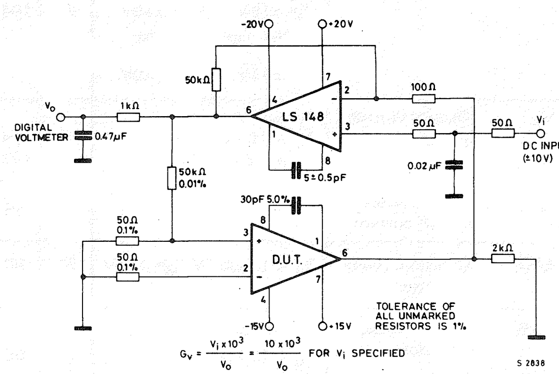


Fig. 2 - Gain test circuit



Typical performance curves for LS 148

Fig. 3 - Input bias current vs. ambient temperature

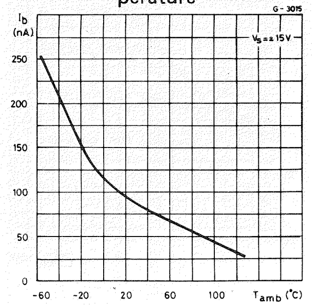


Fig. 4 - Input resistance vs. ambient temperature

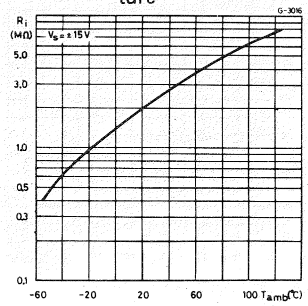


Fig. 5 - Output short-circuit current vs. ambient temperature

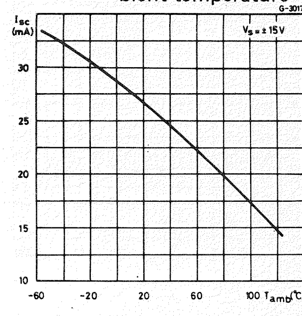


Fig. 6 - Input offset current vs. ambient temperature

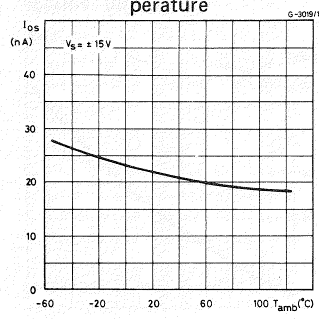


Fig. 7 - Power consumption vs. ambient temperature

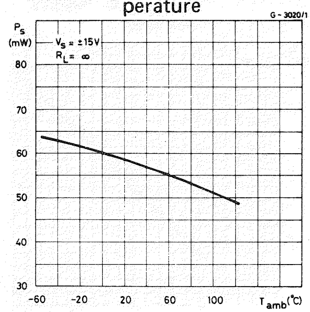
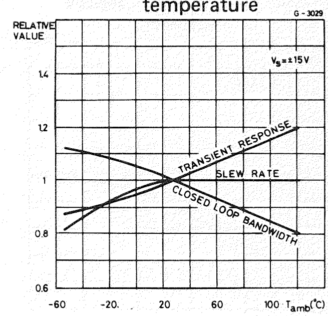


Fig. 8 - Frequency characteristics vs. ambient temperature



Typical performance curves for LS 148C

Fig. 9 - Input bias current vs. ambient temperature

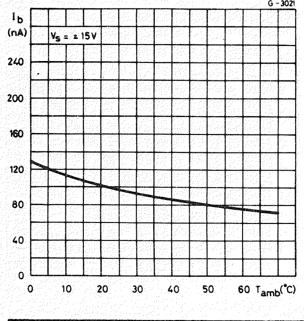


Fig. 10 - Input resistance vs. ambient temperature

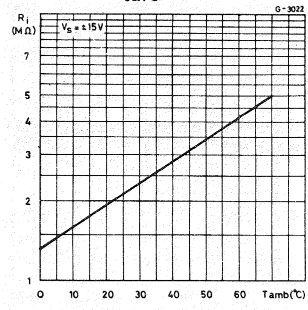


Fig. 11 - Output short-circuit current vs. ambient temperature

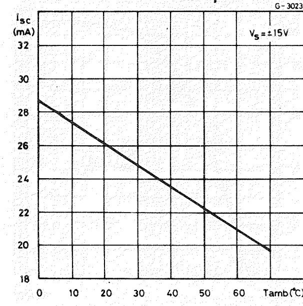


Fig. 12 - Input offset current vs. ambient temperature

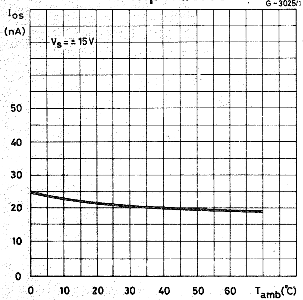


Fig. 13 - Power consumption vs. ambient temperature

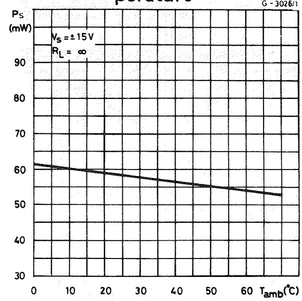
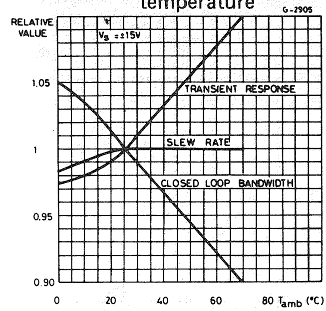


Fig. 14 - Frequency characteristics vs. ambient temperature



Typical performance curves for LS 148 and LS 148C

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

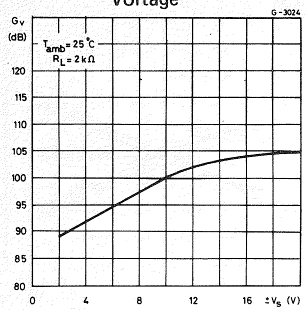


Fig. 16 - Output voltage swing vs. supply voltage

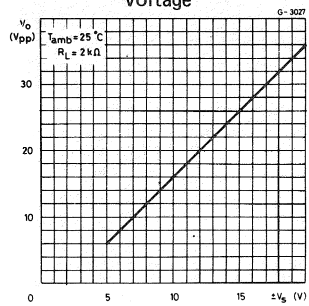


Fig. 17 - Power consumption vs. supply voltage

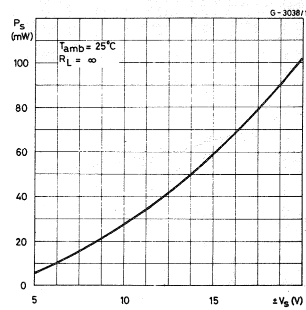


Fig. 18 - Output voltage swing vs. load resistance

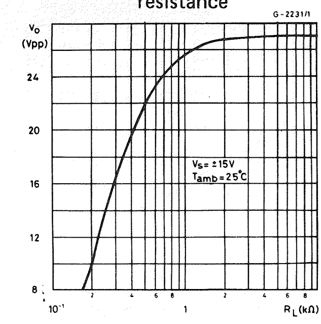


Fig. 19 - Input offset current vs. supply voltage

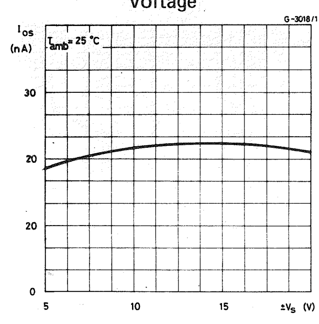


Fig. 20 - Input common mode voltage range vs. supply voltage

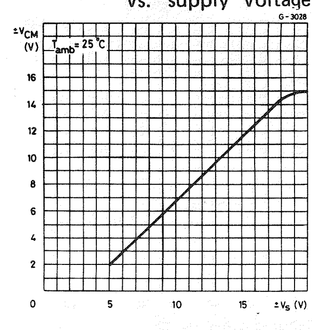


Fig. 21 - Input noise voltage vs. frequency

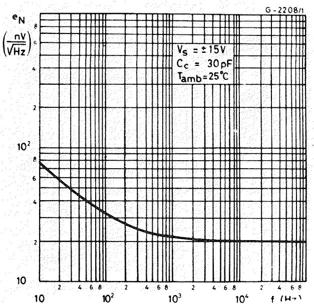


Fig. 22 - Input noise current vs. frequency

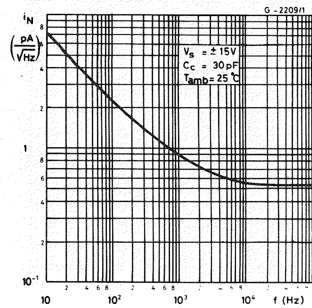


Fig. 23 - Broadband noise for various bandwidths

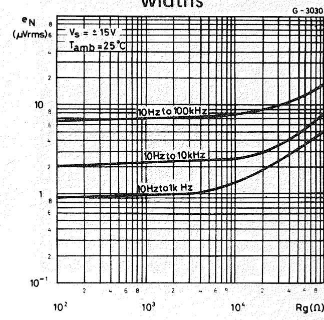


Fig. 24 - Open loop frequency and phase response vs. frequency

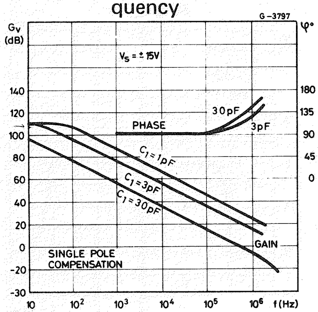


Fig. 25 - Output voltage swing vs. frequency

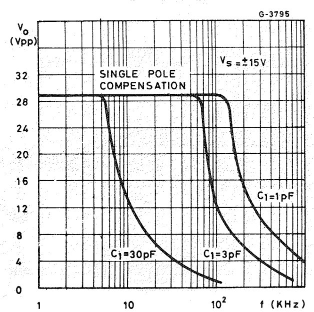


Fig. 26 - Slew-rate

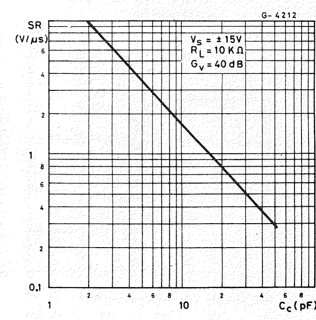


Fig. 27 - Compensation capacitance vs. closed loop voltage gain

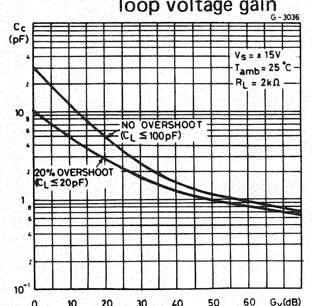


Fig. 28 - Input resistance and input capacitance vs. frequency

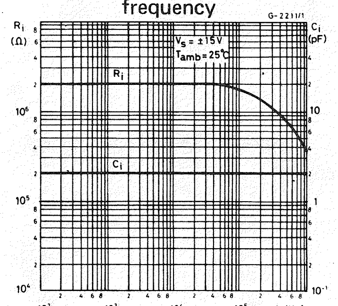


Fig. 29 - Output resistance vs. frequency

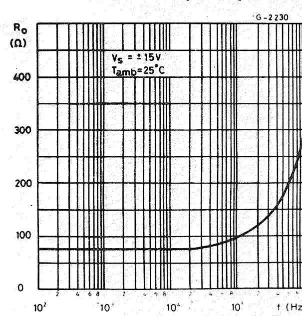


Fig. 30 - Frequency characteristics vs. supply voltage

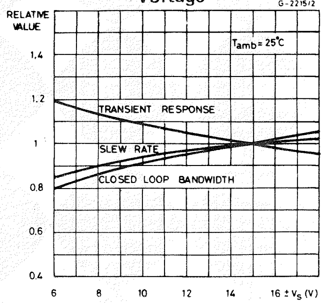


Fig. 31 - Voltage follower transient response (unity gain)

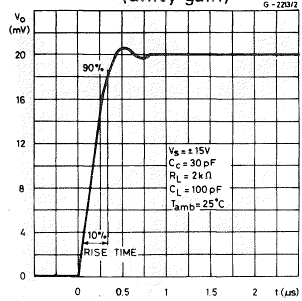


Fig. 32 - Transient response test circuit

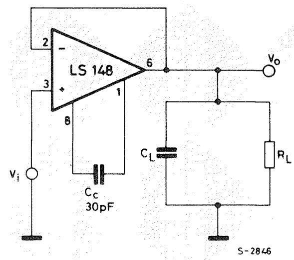


Fig. 33 - Voltage follower large-signal pulse response

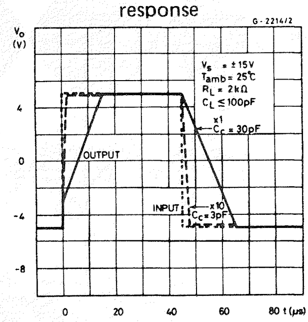


Fig. 34 - Feed forward compensation

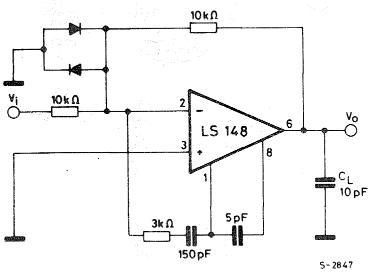
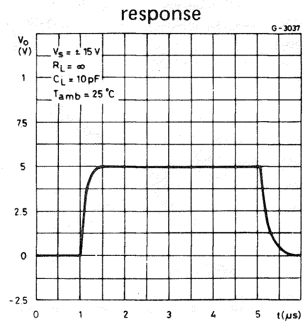
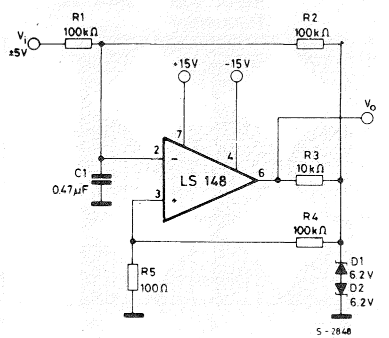


Fig. 35 - Large signal feed forward transient response



TYPICAL APPLICATIONS

Fig. 36 - Pulse width modulator



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

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

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