

PRECISION SINGLE OPERATIONAL AMPLIFIERS

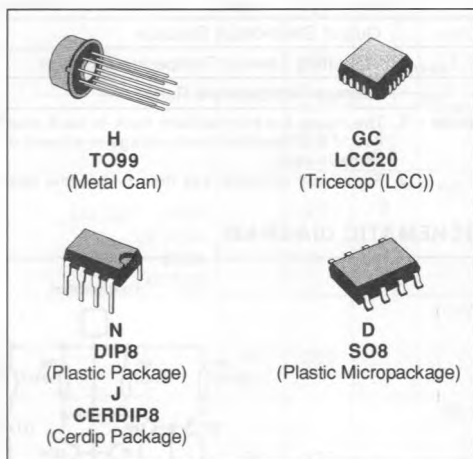
Outstanding characteristics of LM108A :

- INPUT OFFSET VOLTAGE : 0.5 mV MAXIMUM
- INPUT BIAS CURRENT : 3 nA MAXIMUM OVER FULL TEMPERATURE RANGE
- INPUT OFFSET CURRENT : 0.4 nA MAXIMUM OVER FULL TEMPERATURE RANGE
- POWER SUPPLY CURRENT : 600 μ A MAXIMUM
- GUARANTEED DRIFT CHARACTERISTICS
- SLEW RATE OF 10 V/ μ s AS INVERTING AMPLIFIER

DESCRIPTION

The LM108,A is a precision operational amplifier having specifications a factor ten better than FET amplifiers over a -55°C to $+125^{\circ}\text{C}$ temperature range. Selected units are available with offset voltages less than 1 mV and drifts less than 5 $\mu\text{V}/^{\circ}\text{C}$. This makes possible to eliminate offset adjustments, in most cases.

The device operates with supply voltages from ± 2 V to ± 20 V (LM308 : ± 2 V to ± 15 V) and has sufficient supply rejection to use unregulated supplies. Although the circuit is interchangeable with and uses the same compensation as the LM101A, an alternate compensation scheme can be used to make particularly insensitive to power supply noise and to make supply bypass capacitors unnecessary.

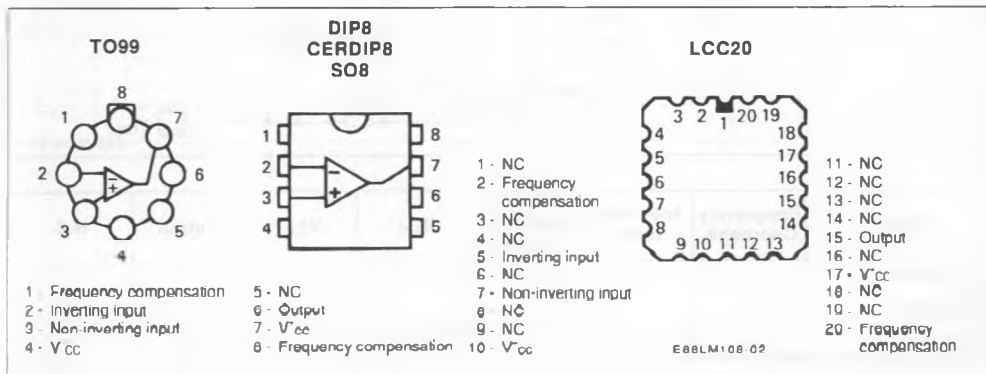


ORDER CODES

Part Number	Temperature Range	Package				
		H	J	N	GC	D
LM108,A	-55 to $+125^{\circ}\text{C}$	•	•		•	
LM208,A	-40 to $+105^{\circ}\text{C}$	•		•		•
LM308,A	0 to $+70^{\circ}\text{C}$	•		•		•

Note : Hi-Rel Versions Available
Examples : LM108H, LM108AH, LM308N

PIN CONNECTIONS (top views)

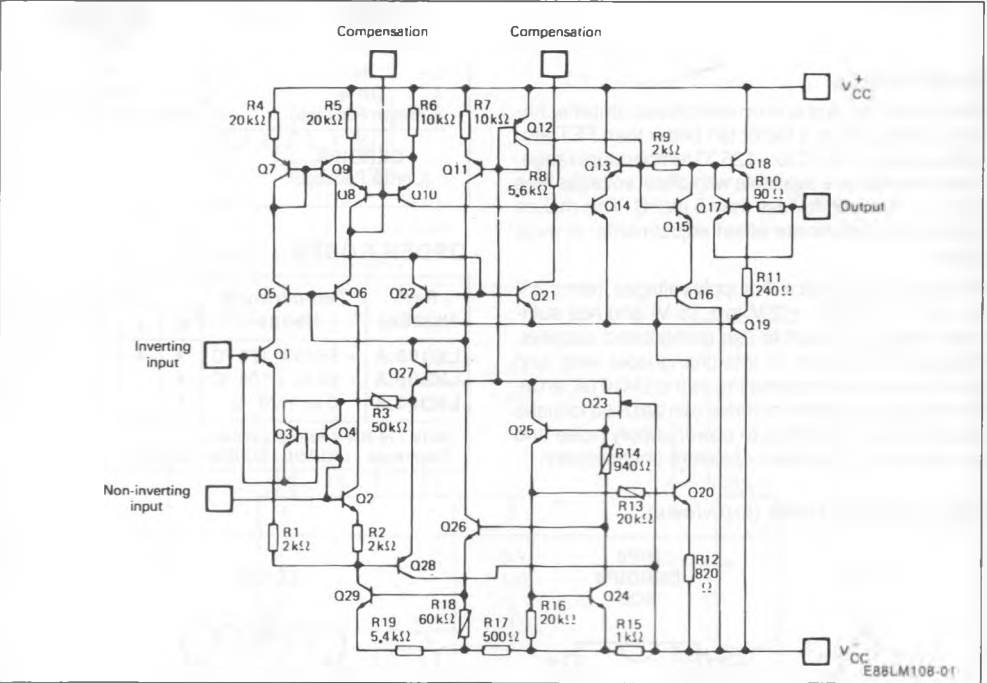


ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	LM108, A	LM208, A	LM308, A	Unit
V _{CC}	Supply Voltage	± 22	± 22	± 22	V
V _I	Input Voltage (note 2)	± 15	± 15	± 15	V
I _{IO}	Input Offset Current (note 1)	± 10	± 10	± 10	mA
P _{tot}	Power Dissipation LM108GC, LM108AGC	500 665	500	500	mW
	Output Short-circuit Duration	Indefinite	Indefinite	Indefinite	
T _{oper}	Operating Free-air Temperature Range	− 55 to + 125	− 40 to + 105	0 to + 70	°C
T _{stg}	Storage Temperature Range	− 65 to + 150	− 65 to + 150	− 65 to + 125	°C

- Notes : 1. The inputs are shunted with back-to-back diodes for overvoltage protection. Therefore, excessive current will flow if a differential input voltage in excess of 1 V is applied between the inputs unless some limiting resistance is used.
2. For supply voltages less than ± 15 V, the absolute maximum input voltage is equal to the supply voltage.

SCHEMATIC DIAGRAM



Case	Frequency Compens.	Inverting Input	Non- inverting Input	V _{CC}	V _{EE}	Output	N.C.
TO99/SO8 DIP CERDIP	1, 8	2	3	4	7	6	5
LCC20	2, 20	5	7	10	17	15	*

* LCC 20 : Other pins are not connected.

ELECTRICAL CHARACTERISTICS

LM308A : $0^{\circ}\text{C} \leq T_{\text{amb}} < +70^{\circ}\text{C}$ $C_1 = 33\text{ pF}$ $\pm 5 < V_{\text{CC}} < \pm 20\text{ V}$
 LM208A : $-40^{\circ}\text{C} \leq T_{\text{amb}} < +105^{\circ}\text{C}$ $C_1 = 33\text{ pF}$ $\pm 5 < V_{\text{CC}} < \pm 20\text{ V}$
 LM108A : $-55^{\circ}\text{C} \leq T_{\text{amb}} < +125^{\circ}\text{C}$ $C_1 = 33\text{ pF}$ $\pm 5 < V_{\text{CC}} < \pm 20\text{ V}$
 $\Rightarrow V_{\text{CC}} = \pm 15\text{ V}$

Symbol	Parameter	LM108A / LM208A LM308A			Unit
		Min.	Typ.	Max.	
V_{IO}	Input Offset Voltage $R_S = 10\text{ k}\Omega$ $T_{\text{amb}} = 25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$		0.3	0.5 0.75	mV
I_{IO}	Input Offset Current $T_{\text{amb}} = 25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$		0.05	0.2 0.4	nA
I_{IB}	Input Bias Current $T_{\text{amb}} = 25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$ LM108A - 208A LM308A LM108A 208A LM308A		0.6	2 4 3 7	nA
A_{VD}	Large Signal Voltage Gain ($V_O = \pm 10\text{ V}$, $R_L = 2\text{ k}\Omega$) $T_{\text{amb}} = 25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	80 60	300		V/mV
S_{VR}	Supply Voltage Rejection Ratio ($R_S \leq 10\text{ k}\Omega$) $T_{\text{amb}} = 25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	96 96	110		dB
I_{CC}	Supply Current, no Load $T_{\text{amb}} = 25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$		0.3	0.6 0.6	mA
V_i	Input Voltage Range $T_{\text{amb}} = 25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	-14 -14		+14 +14	V
CMR	Common-mode Rejection Ratio ($R_S \leq 10\text{ k}\Omega$) $T_{\text{amb}} = 25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	96 96	110		dB
I_{OS}	Output Short-circuit Current $T_{\text{amb}} = 25^{\circ}\text{C}$	3	10	20	mA
$\pm V_{\text{OPP}}$	Output Voltage Swing $T_{\text{amb}} = 25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$ $R_L = 10\text{ k}\Omega$ $R_L = 10\text{ k}\Omega$	13 13	14		V
S_{VO}	Slew-rate ($V_i = \pm 10\text{ V}$, $R_L = 2\text{ k}\Omega$, $C_L \leq 100\text{ pF}$, $T_{\text{amb}} = 25^{\circ}\text{C}$, unity Gain)		0.15		V/ μs

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	LM108A / LM208A LM308A			Unit
		Min.	Typ.	Max.	
t_r	Rise Time ($V_i = \pm 20$ mV, $R_L = 2$ k Ω , $C_L \leq 100$ pF, $T_{amb} = 25$ °C, unity gain) *		0.7		μ s
K_{OV}	Overshoot ($V_i = 20$ mV, $R_L = 2$ k Ω) $C_L \leq 100$ pF, $T_{amb} = 25$ °C, unity gain)		10		%
R_i	Input Resistance, $T_{amb} = 25$ °C *	30	70		M Ω
GBP	Gain Bandwidth Product ($V_i = 10$ mV, $R_L = 2$ k Ω , $C_L \leq 100$ pF) ($f = 100$ KHz, $T_{amb} = 25$ °C) *	0.3	0.8	1.2	MHz
THD	Total Harmonic Distortion ($f = 1$ KHz, $A_V = 20$ dB, $R_L = 2$ k Ω , $V_O = 2$ V _{PP} , $C_L \leq 100$ pF, $T_{amb} = 25$ °C) *		0.12		%
V_n	Equivalent Input Noise Voltage ($f = 1$ KHz, $R_g = 100$ Ω) *		20		nV/ $\sqrt{Hz}$
DV_{IO}	Input Offset Voltage Drift $T_{min} \leq T_{amb} \leq T_{max}$		1	5	μ V/°C
DI_{IO}	Input Offset Current Drift $T_{min} \leq T_{amb} \leq 25$ °C		0.5	2.5	pA/°C

ELECTRICAL CHARACTERISTICS

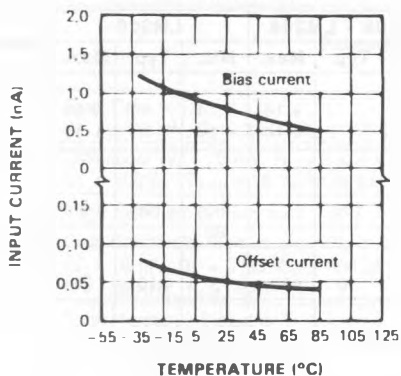
LM308 : $0 \leq T_{amb} \leq + 70$ °C $\pm 5 \leq V_{CC} \leq \pm 20$ VLM208 : $-40 \leq T_{amb} \leq + 105$ °C $\pm 5 \leq V_{CC} \leq \pm 20$ VLM108 : $-55 \leq T_{amb} \leq + 125$ °C $\pm 5 \leq V_{CC} \leq \pm 20$ V* $= \geq V_{CC} = \pm 15$ V

Symbol	Parameter	LM108 – LM208			LM308			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{IO}	Input Offset Voltage $R_S \leq 10$ k Ω $T_{amb} = 25$ °C $T_{min} \leq T_{amb} \leq T_{max}$		0.7	2 3		2	5 7	mV
I_{IO}	Input Offset Current $T_{amb} = 25$ °C $T_{min} \leq T_{amb} \leq T_{max}$		0.05	0.2 0.4		0.05	0.2 0.4	nA
I_{IB}	Input Bias Current $T_{amb} = 25$ °C $T_{min} \leq T_{amb} \leq T_{max}$		0.6	2 3		0.6	4 7	nA
A_{VD}	Large Signal Voltage Gain ($V_O = \pm 10$ V, $R_L = 2$ k Ω) $T_{amb} = 25$ °C $T_{min} \leq T_{amb} \leq T_{max}$ *	50 25	300		50 25	300		V/mV
S_{VR}	Supply Voltage Rejection Ratio ($R_S \leq 10$ k Ω) $T_{amb} = 25$ °C $T_{min} \leq T_{amb} \leq T_{max}$	80 80	96		80 80	96		dB
I_{CC}	Supply Current, no Load $T_{amb} = 25$ °C $T_{min} \leq T_{amb} \leq T_{max}$		0.3	0.6 0.6		0.3	0.6 0.6	mA

ELECTRICAL CHARACTERISTICS (continued)

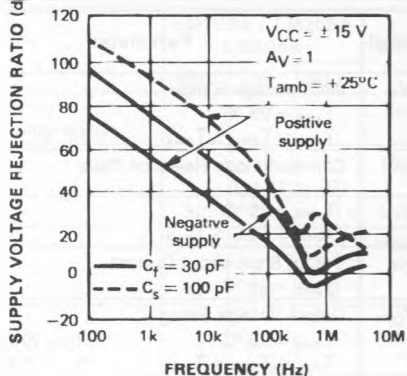
Symbol	Parameter	LM108 – LM208			LM308			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V_I	Input Voltage Range $T_{amb} = 25\text{ }^{\circ}\text{C}$ $T_{min} \leq T_{amb} \leq T_{max}$	- 14 - 14		+ 14 + 14	- 14 - 14		+ 14 + 14	V
CMR	Common-mode Rejection Ratio ($R_S \leq 10\text{ k}\Omega$) $T_{amb} = 25\text{ }^{\circ}\text{C}$ $T_{min} \leq T_{amb} \leq T_{max}$	80 80	100		80 80	100		dB
I_{OS}	Output Short-circuit Current $T_{amb} = 25\text{ }^{\circ}\text{C}$	3	10	20	3	10	20	mA
$\pm V_{OPP}$	Output Voltage Swing $T_{amb} = 25\text{ }^{\circ}\text{C}$ $T_{min} \leq T_{amb} \leq T_{max}$ $R_L = 10\text{ k}\Omega$ $R_L = 10\text{ k}\Omega$	13 13	14		13 13	14		V
S_{VO}	Slew-rate ($V_I = \pm 10\text{ V}$, $R_L = 2\text{ k}\Omega$, $C_L \leq 100\text{ pF}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$, unity gain)		0.15			0.15		V/ μ s
t_r	Rise Time ($V_I = \pm 20\text{ mV}$, $R_L = 2\text{ k}\Omega$, $C_L \leq 100\text{ pF}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$, unity gain)		0.7			0.7		μ s
K_{OV}	Overshoot ($V_I = 20\text{ mV}$, $R_L = 2\text{ k}\Omega$, $C_L \leq 100\text{ pF}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$, unity gain)		10			10		%
R_I	Input Resistance, $T_{amb} = 25\text{ }^{\circ}\text{C}$	30	70		10	40		M Ω
GBP	Gain Bandwidth Product ($V_I = 10\text{ mV}$, $R_L = 2\text{ k}\Omega$, $C_L \leq 100\text{ pF}$) ($f = 100\text{ kHz}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$)	0.3	0.8	1.2	0.3	0.8	1.2	MHz
THD	Total Harmonic Distortion ($f = 1\text{ kHz}$, $A_V = 20\text{ dB}$, $R_L = 2\text{ k}\Omega$, $V_O = 2\text{ V}_{PP}$, $C_L \leq 100\text{ pF}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$)		0.12			0.12		%
V_n	Equivalent Input Noise Voltage ($f = 1\text{ kHz}$, $R_G = 100\text{ }\Omega$)		20			20		nV/ $\sqrt{\text{Hz}}$
DV_{IO}	Input Offset Voltage Drift $T_{min} \leq T_{amb} \leq T_{max}$		3	15		6	30	$\mu\text{V}/^{\circ}\text{C}$
DI_{IO}	Input Offset Current Drift $T_{min} \leq T_{amb} \leq 25\text{ }^{\circ}\text{C}$		0.5	2.5		2	10	pA/ $^{\circ}\text{C}$

INPUT CURRENTS (Note 3)



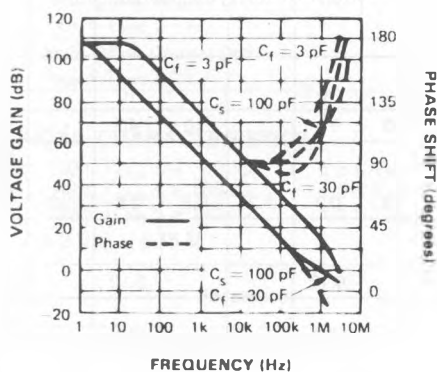
E88LM108-03

POWER SUPPLY REJECTION RATIO



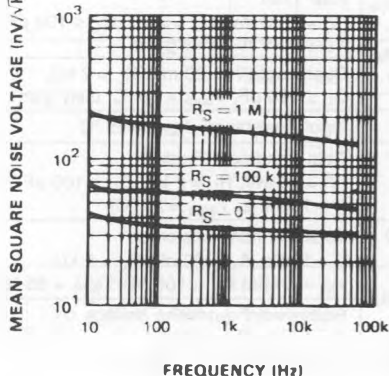
E88LM108-05

OPEN LOOP FREQUENCY RESPONSE



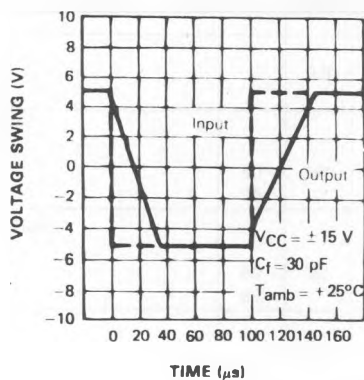
E88LM108-06

INPUT NOISE VOLTAGE



E88LM108-07

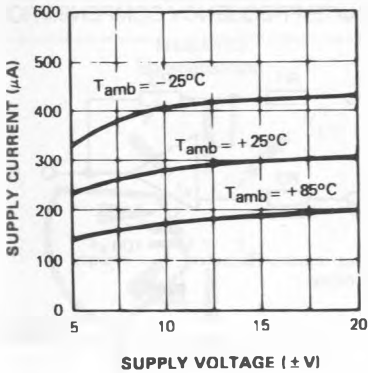
VOLTAGE FOLLOWER PULSE RESPONSE



E88LM108-08

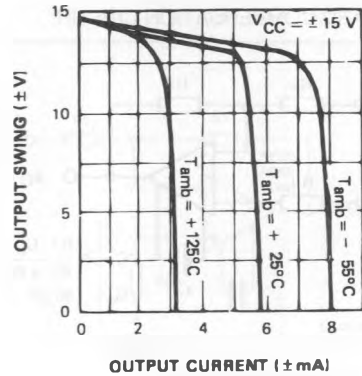
Note : 3 LM108A : $-55^\circ\text{C} \leq T_{amb} \leq +125^\circ\text{C}$, $\pm 5\text{ V} \leq V_{CC} \leq \pm 20\text{ V}$.
 LM208A : $-40^\circ\text{C} \leq T_{amb} \leq +105^\circ\text{C}$, $\pm 5\text{ V} \leq V_{CC} \leq \pm 20\text{ V}$.

SUPPLY CURRENT



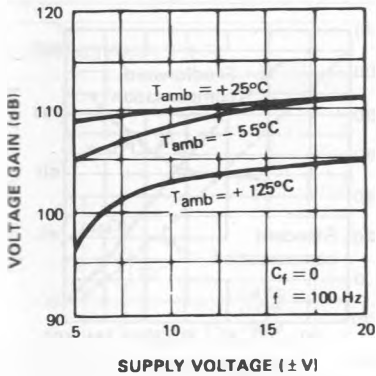
E88LM108-11

OUTPUT SWING



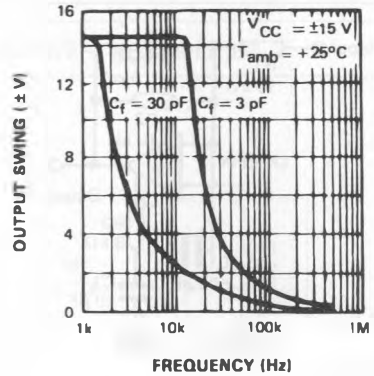
E88LM108-12

VOLTAGE GAIN



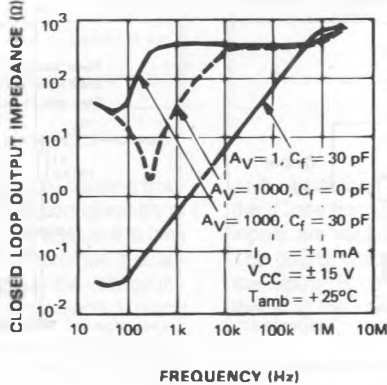
E88LM108-18

LARGE SIGNAL FREQUENCY RESPONSE



E88LM108-20

CLOSED LOOP OUTPUT IMPEDANCE

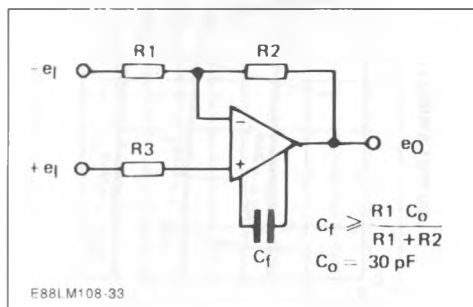


FREQUENCY (Hz)

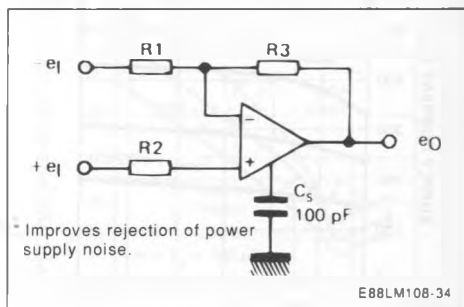
E88LM108-21

BASIC DIAGRAMS

STANDARD COMPENSATION CIRCUIT

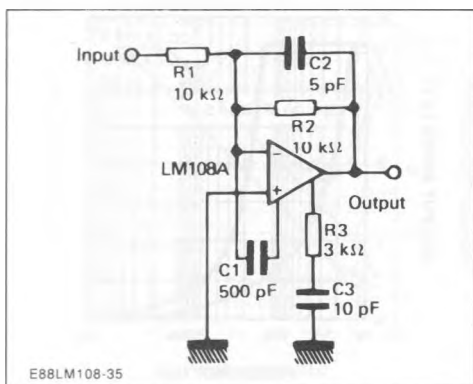


ALTERNATE FREQUENCY COMPENSATION

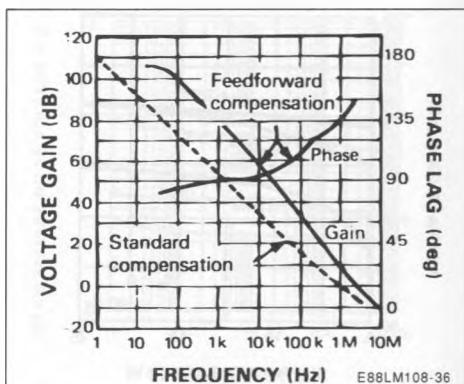


TYPICAL APPLICATIONS

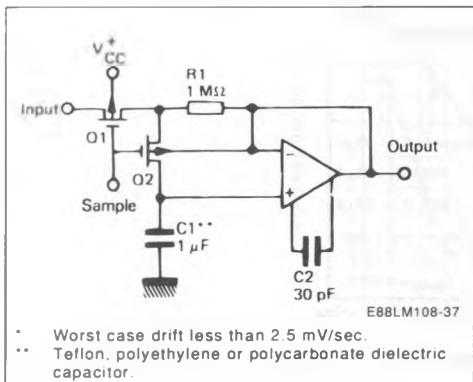
STANDARD FEEDFORWARD



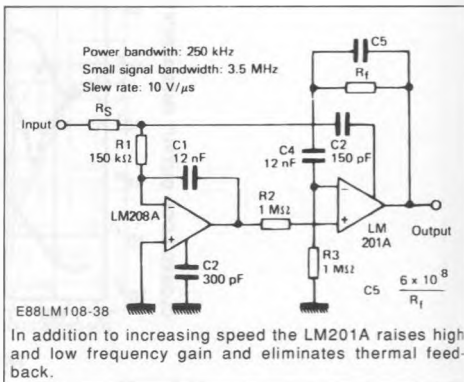
OPEN LOOP VOLTAGE GAIN



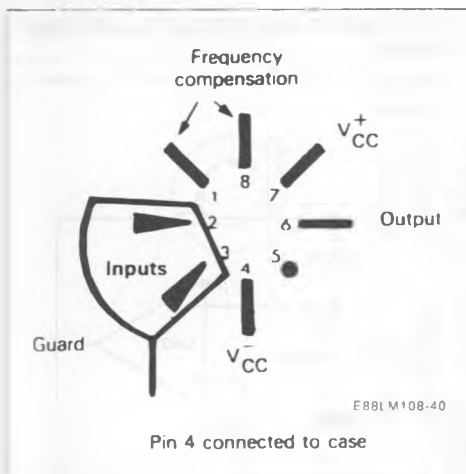
FEEDFORWARD COMPENSATION FOR DECOUPLING LOAD CAPACITANCE



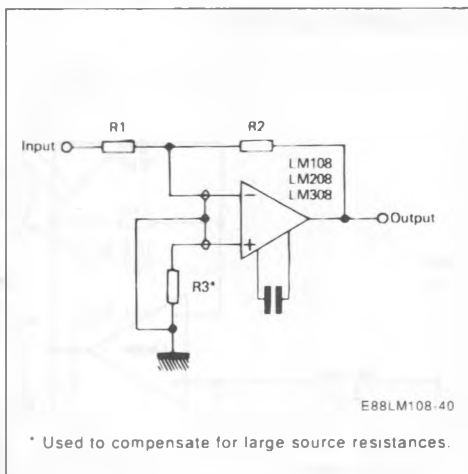
SAMPLE AND HOLD



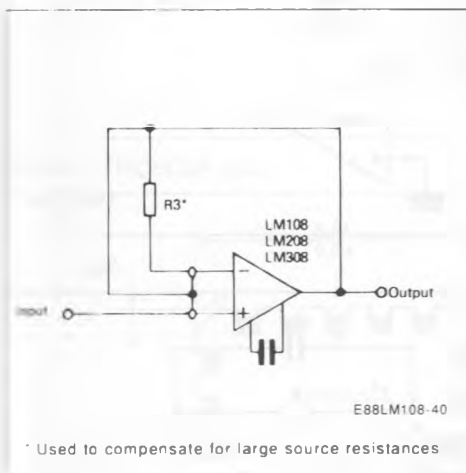
B-11 METAL CAN (top view)



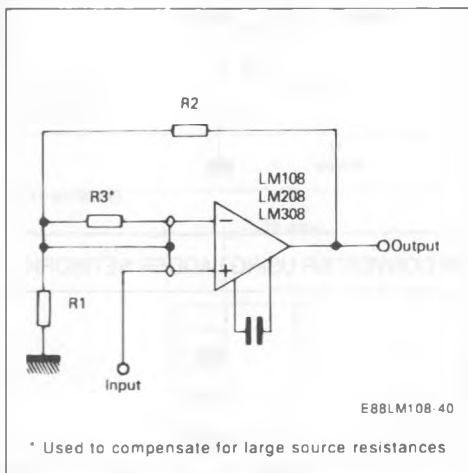
INVERTING AMPLIFIER



FOLLOWING AMPLIFIER



NON-INVERTING AMPLIFIER



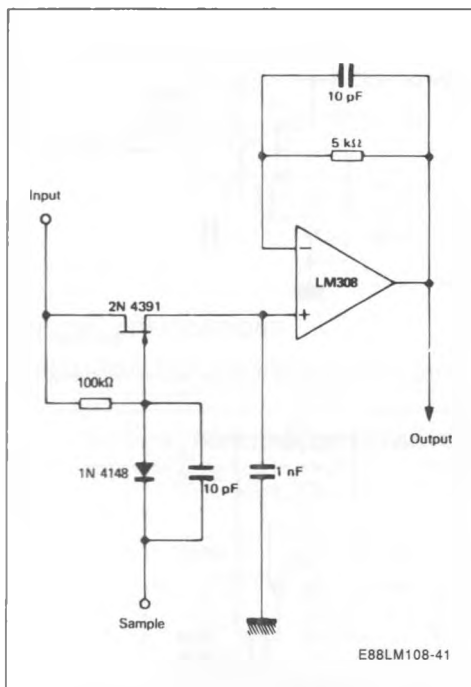
INPUT GUARDING

Leakage currents are on the verge of causing trouble at $+125^{\circ}\text{C}$. The standard pin configuration of most IC op amps has the input pins adjacent to pins which are the supply potentials. Therefore, it is advisable to employ guarding to reduce the voltage difference between the inputs and adjacent metal

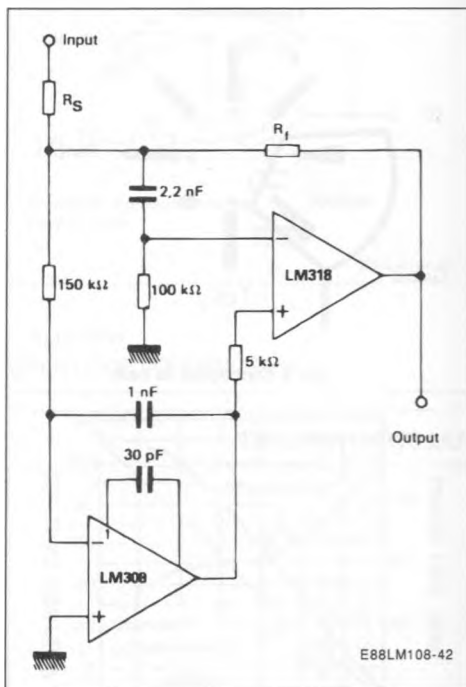
runs. A ten-lead pin circle is used, and the leads of the IC are formed so that the holes adjacent to the inputs are vacant when it is inserted in the board. The guard, which is a conductive ring surrounding the inputs, is connected to a low impedance point that is at the same potential as the inputs.

TYPICAL APPLICATION DIAGRAMS

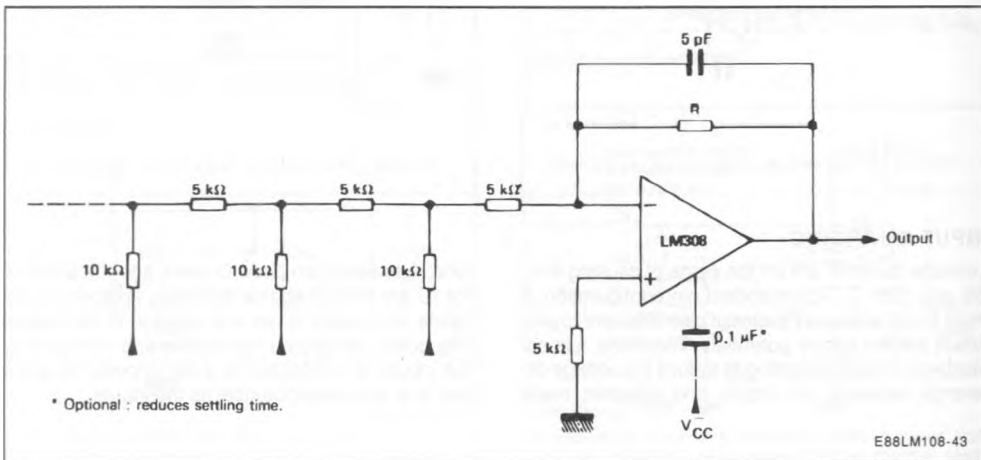
FAST SAMPLE AND HOLD



FAST SUMMING AMPLIFIER WITH LOW INPUT CURRENT

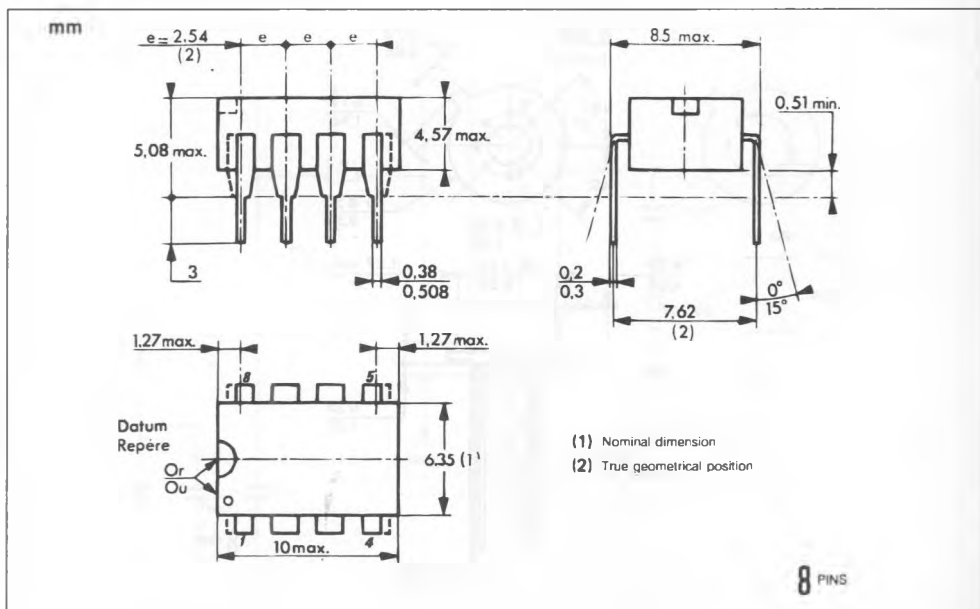


D/A CONVERTER USING LADDER NETWORK



MECHANICAL DATA (continued)

8 PINS – PLASTIC DIP OR CERDIP



8 PINS – PLASTIC MICROPACKAGE SO

