

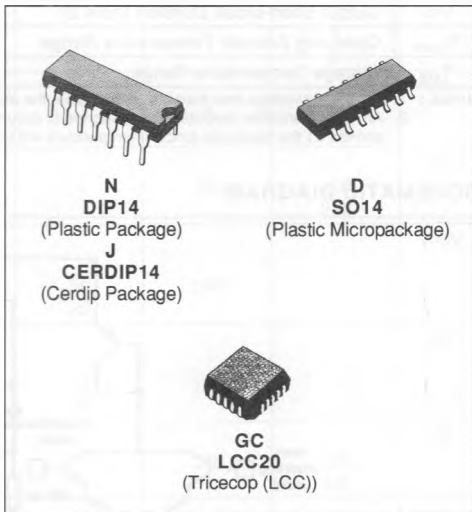
DIFFERENTIAL INPUT QUAD OP-AMPS

- LOW SUPPLY CURRENT : 0.53 mA/AMPLIFIER
- CLASS AB OUTPUT STAGE : NO CROSS-OVER DISTORTION
- PIN COMPATIBLE WITH LM124
- LOW INPUT OFFSET VOLTAGE : 1 mV
- LOW INPUT OFFSET CURRENT : 2 nA
- LOW INPUT BIAS CURRENT : 30 nA
- GAIN BANDWIDTH PRODUCT : 1.3 MHz
- HIGH DEGREE OF ISOLATION BETWEEN AMPLIFIERS : 120 dB
- OVERLOAD PROTECTION FOR INPUTS AND OUTPUTS

DESCRIPTION

The LM148 consists of four independent, high gain internally compensated, low power operational amplifiers which have been designed to provide functional characteristics identical to those of the familiar UA741 operational amplifier. In addition the total supply current for all four amplifiers is comparable to the supply current of a single UA741 type op amp. Other features include input offset current and input bias current which are much less than those of a standard UA741. Also, excellent isolation between amplifiers has been achieved by independently biasing each amplifier and using layout techniques which minimize thermal coupling.

The LM148 can be used anywhere multiple UA741 type amplifiers are being used and in applications where amplifier matching or high packing density is required.



ORDER CODES

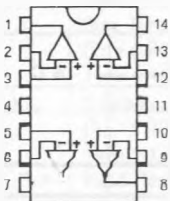
Part Number	Temperature Range	Package			
		N	J	GC	D
LM148	-55 °C to +125 °C	■	■	■	
LM248	-40 °C to +105 °C	■		■	■
LM348	0 °C to +70 °C	■			■

Note : Hi-Rel Versions Available

Examples : LM148J, LM348D.

PIN CONNECTIONS (top views)

DIP14/CERDIP14
SO14



E88LM148-00

LCC20



E88LM148-01

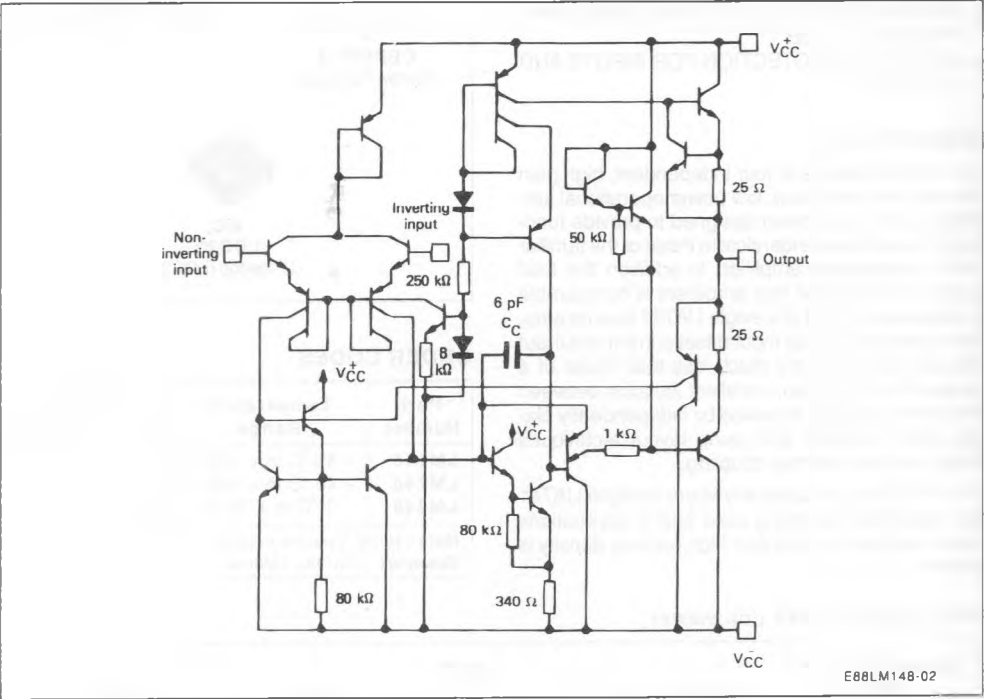
- | | |
|----------------------------|----------------------------|
| 1 - NC | 15 - NC |
| 2 - Output 1 | 16 - Vcc |
| 3 - Inverting input 1 | 17 - NC |
| 4 - Non-inverting input 1 | 18 - Non-inverting input 4 |
| 5 - NC | 19 - Inverting input 4 |
| 6 - Vcc | 20 - Output 4 |
| 7 - NC | |
| 8 - Non-inverting input 2 | |
| 9 - Inverting input 2 | |
| 10 - Output 2 | |
| 11 - NC | |
| 12 - Output 3 | |
| 13 - Inverting input 3 | |
| 14 - Non-inverting input 3 | |

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	LM148	LM248	LM348	Unit
V_{CC}	Supply Voltage	± 22	± 22	± 22	V
V_{ID}	Differential Input Voltage	± 44	± 44	± 44	V
V_I	Input Voltage (note 1)	± 22	± 22	± 22	V
P_{Tot}	Power Dissipation	500	500	500	mW
	Output Short-circuit Duration (note 2)	Indefinite	Indefinite	Indefinite	
T_{oper}	Operating Free-air Temperature Range	$- 55$ to $+ 125$	$- 40$ to $+ 105$	0 to $+ 70$	$^{\circ}C$
T_{stg}	Storage Temperature Range	$- 65$ to $+ 150$	$- 65$ to $+ 150$	$- 65$ to $+ 150$	$^{\circ}C$

Notes : 1. For supply voltage less than maximum value, the absolute maximum input voltage is equal to the supply vol-tage.
2. Any of the amplifier outputs can be shorted to ground indefinitely ; however, more than one should not be simultaneously shorted as the maximum junction temperature will be exceeded.

SCHEMATIC DIAGRAM



Case	Outputs	Inverting Inputs	Non-inverting Inputs	V_{CC}	V_{CC}	N.C.
DIP14 CERDIP14/SO14	1, 7, 8, 14	2, 6, 9, 13	3, 5, 10, 12	4	11	
LCC20	2, 10, 12, 20	3, 9, 13, 19	4, 8, 14, 18	6	16	*

* LCC20 : Other pins are not connected.

ELECTRICAL CHARACTERISTICS

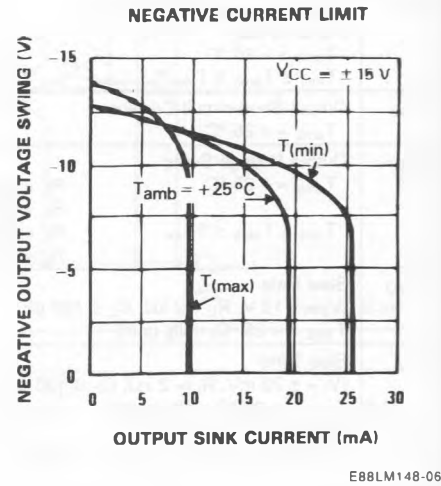
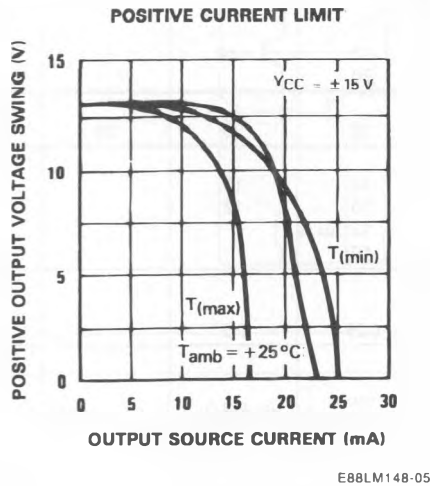
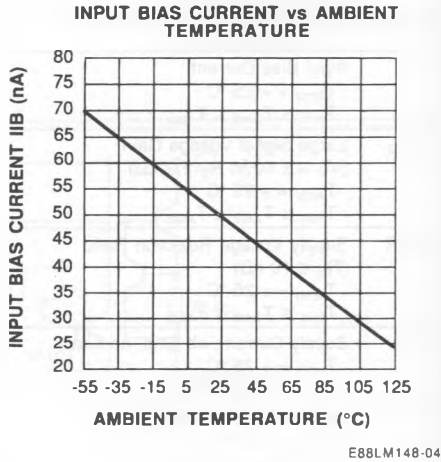
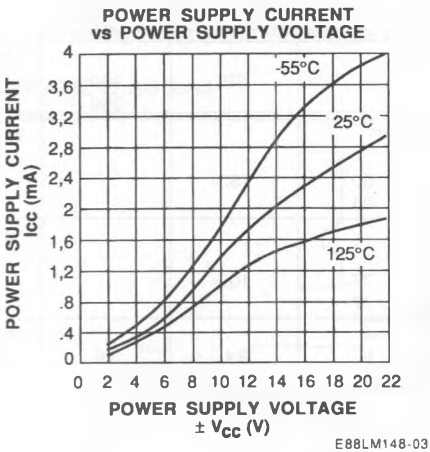
LM148 : $-55^{\circ}\text{C} \leq T_{\text{amb}} \leq +125^{\circ}\text{C}$, $V_{\text{CC}} = \pm 15\text{ V}$ LM248 : $-40^{\circ}\text{C} \leq T_{\text{amb}} \leq +105^{\circ}\text{C}$, $V_{\text{CC}} = \pm 15\text{ V}$ LM348 : $0^{\circ}\text{C} \leq T_{\text{amb}} \leq +70^{\circ}\text{C}$, $V_{\text{CC}} = \pm 15\text{ V}$

(unless otherwise specified)

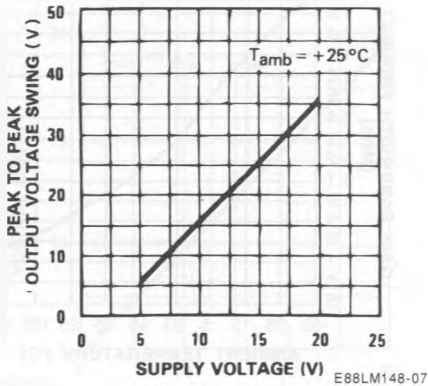
Symbol	Parameter	LM148/248/348			Unit
		Min.	Typ.	Max.	
V_{IO}	Input Offset Voltage $R_{\text{S}} \leq 10\text{ k}\Omega$ $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$		1	5 6	mV
I_{IO}	Input Offset Current $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$		2	20 40	nA
I_{IB}	Input Bias Current $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$		30	100 200	nA
A_{VD}	Large Signal Voltage Gain ($V_{\text{O}} = \pm 10\text{ V}$, $R_{\text{L}} \geq 2\text{ k}\Omega$) $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	50 25	160		V/mV
SVR	Supply Voltage Rejection Ratio ($R_{\text{S}} \leq 10\text{ k}\Omega$) $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	77 77	100		dB
I_{CC}	Supply Current, all Amp, no Load $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$		2.1	3.6 4.8	mA
V_{I}	Input Voltage Range $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	-12 -12		+12 +12	V
CMR	Common-mode Rejection Ratio ($R_{\text{S}} \leq 10\text{ k}\Omega$) $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	70 70	110		dB
I_{OS}	Output Short-circuit Current $T_{\text{amb}} = +25^{\circ}\text{C}$	10	25	35	mA
$\pm V_{\text{OPP}}$	Output Voltage Swing $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$ $R_{\text{L}} = 10\text{ k}\Omega$ $R_{\text{L}} = 2\text{ k}\Omega$ $R_{\text{L}} = 10\text{ k}\Omega$ $R_{\text{L}} = 2\text{ k}\Omega$	12 10 12 10	13 12		V
S_{VO}	Slew Rate ($V_{\text{I}} = \pm 10\text{ V}$, $R_{\text{L}} = 2\text{ k}\Omega$, $C_{\text{L}} \leq 100\text{ pF}$, $T_{\text{amb}} = +25^{\circ}\text{C}$, unity gain)	0.25	0.5		V/ μs
t_{r}	Rise Time ($V_{\text{I}} = \pm 20\text{ mV}$, $R_{\text{L}} = 2\text{ k}\Omega$, $C_{\text{L}} \leq 100\text{ pF}$, $T_{\text{amb}} = +25^{\circ}\text{C}$, unity gain)		0.3		μs
K_{OV}	Overshoot ($V_{\text{I}} = \pm 20\text{ mV}$, $R_{\text{L}} = 2\text{ k}\Omega$, $C_{\text{L}} \leq 100\text{ pF}$, $T_{\text{amb}} = +25^{\circ}\text{C}$, unity gain)		5		%
R_{I}	Input Resistance, $T_{\text{amb}} = +25^{\circ}\text{C}$	0.8	2.5		M Ω
GPB	Gain-bandwidth Product ($V_{\text{I}} = \pm 10\text{ mV}$, $R_{\text{L}} = 2\text{ k}\Omega$, $C_{\text{L}} \leq 100\text{ pF}$, $f = 100\text{ KHz}$, $T_{\text{amb}} = +25^{\circ}\text{C}$)	0.7	1.3	1.6	MHz

ELECTRICAL CHARACTERISTICS (continued)

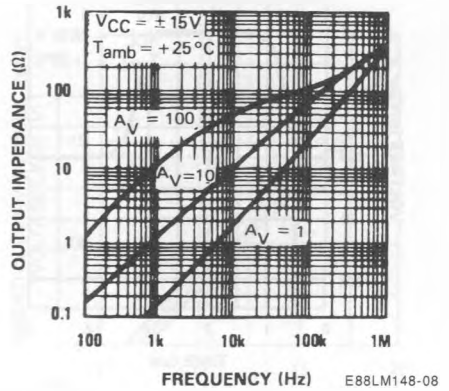
Symbol	Parameter	LM148/248/348			Unit
		Min.	Typ.	Max.	
THD	Total Harmonic Distortion ($f = 1\text{ KHz}$, $A_v = 20\text{ dB}$, $R_L = 2\text{ k}\Omega$, $V_O = 2\text{ V}_{PP}$, $C_L \leq 100\text{ pF}$, $T_{amb} = +25\text{ }^\circ\text{C}$)		0.08		%
V_n	Equivalent Input Noise Voltage ($f = 1\text{ kHz}$, $R_G = 100\text{ }\Omega$)		40		$\text{nV}/\sqrt{\text{Hz}}$
V_{O1}/V_{O2}	Channel Separation		120		dB



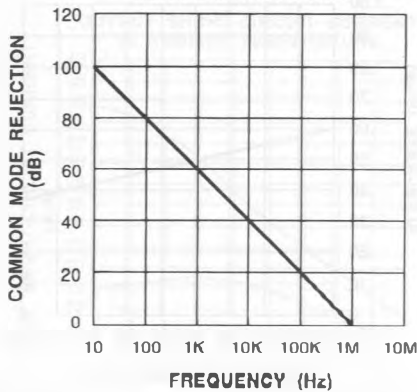
OUTPUT VOLTAGE SWING



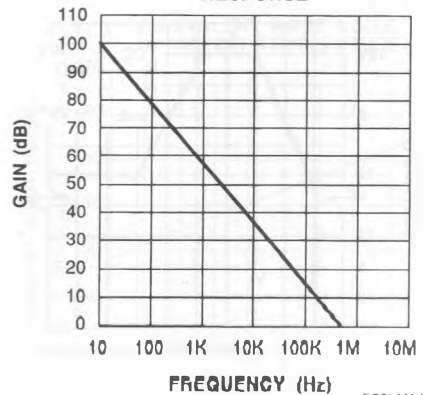
OUTPUT IMPEDANCE



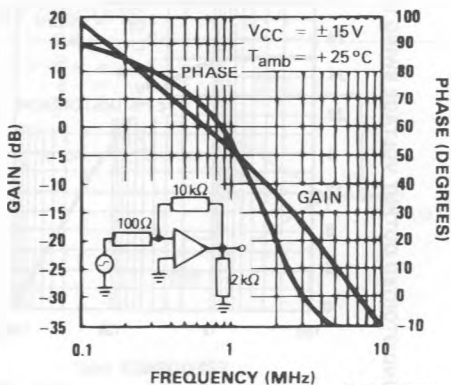
COMMON MODE REJECTION RATIO vs FREQUENCY



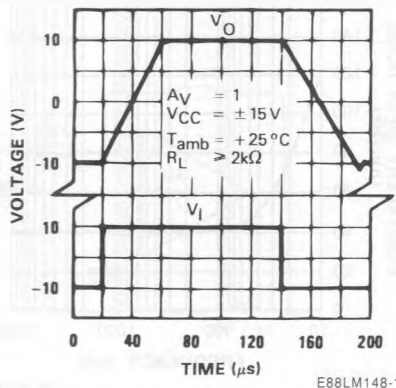
OPEN LOOP FREQUENCY RESPONSE



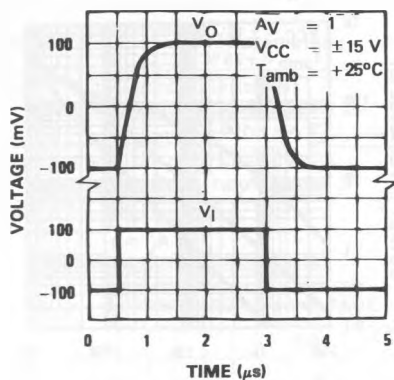
BODE PLOT (LM148)



LARGE SIGNAL PULSE RESPONSE (LM148)

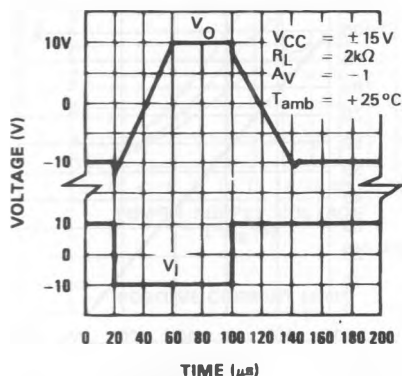


SMALL SIGNAL PULSE RESPONSE (LM148)



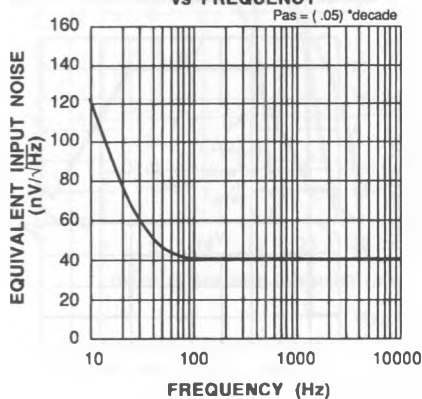
E88LM148-15

INVERTING LARGE SIGNAL PULSE RESPONSE (LM148)



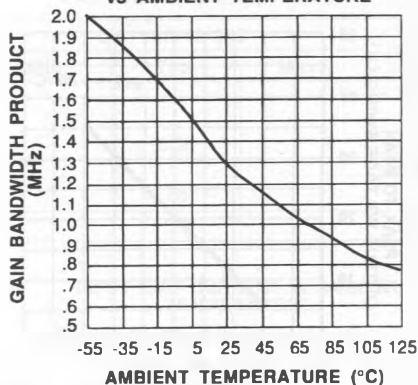
E88LM148-19

EQUIVALENT INPUT NOISE vs FREQUENCY



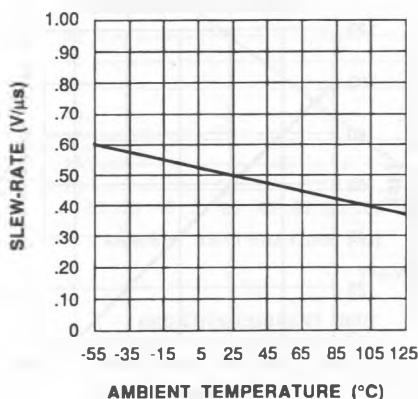
E88LM148-21

GAIN BANDWIDTH PRODUCT vs AMBIENT TEMPERATURE



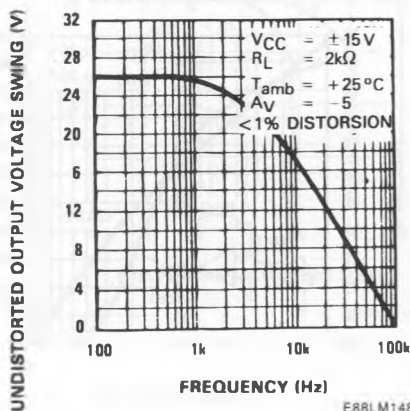
E88LM148-17

SLEW-RATE vs TEMPERATURE

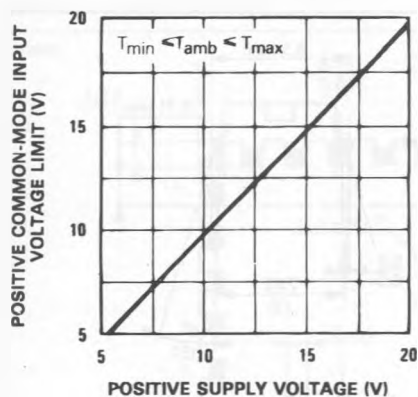


E88LM148-20

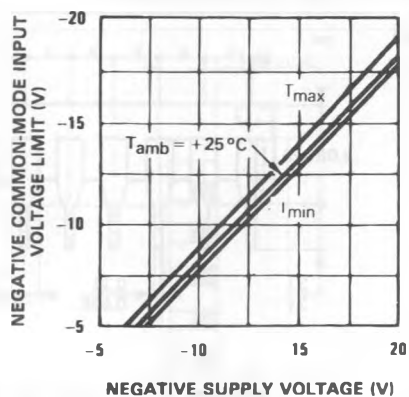
UNDISTORTED OUTPUT VOLTAGE SWING



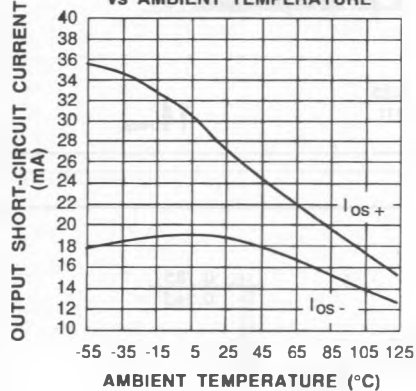
E88LM148-22

POSITIVE COMMON-MODE
INPUT VOLTAGE LIMIT

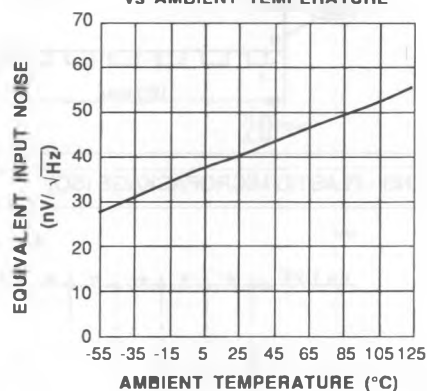
E88LM148-23

NEGATIVE COMMON-MODE
INPUT VOLTAGE LIMIT

E88LM148-24

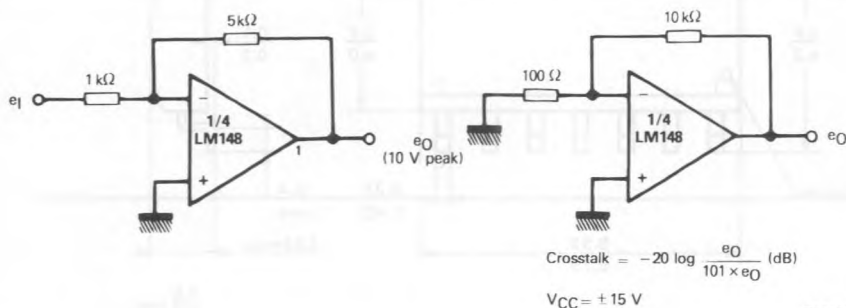
OUTPUT SHORT-CIRCUIT CURRENT
vs AMBIENT TEMPERATURE

E88LM148-26

EQUIVALENT INPUT NOISE
vs AMBIENT TEMPERATURE

E88LM148-27

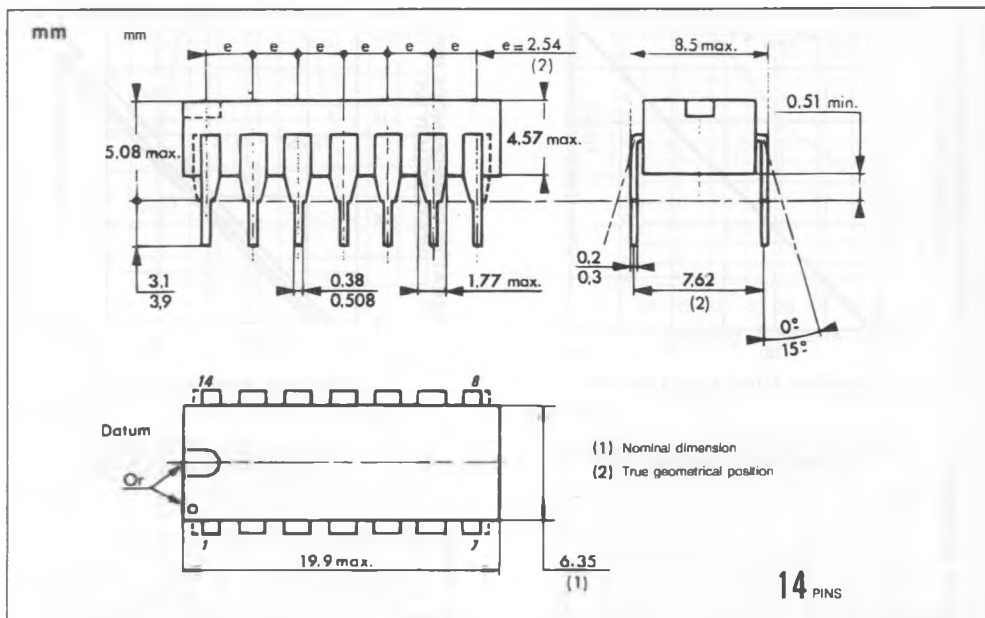
TEST CIRCUITS



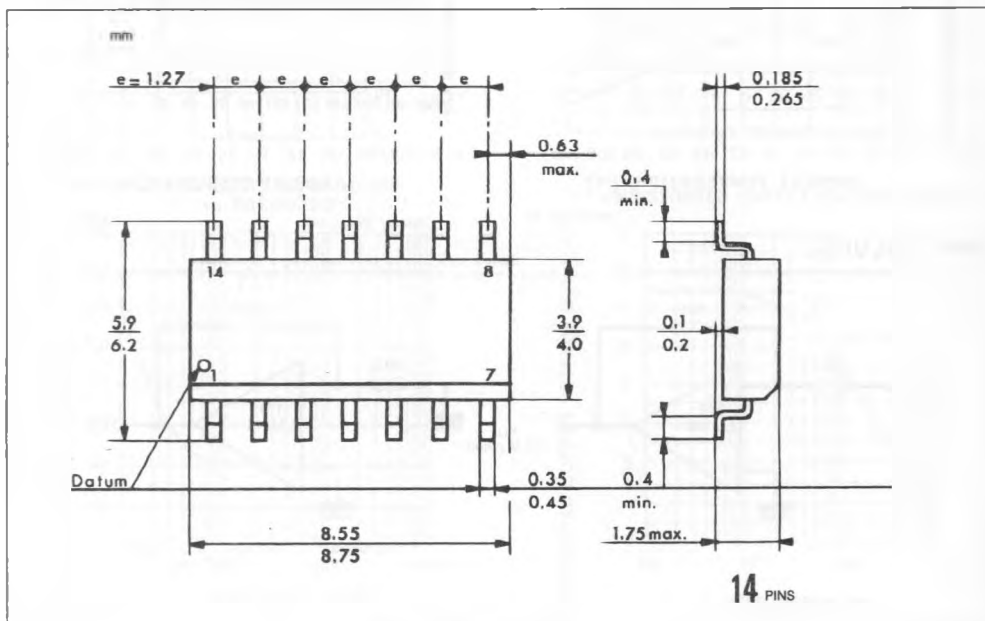
E88LM148-25

PACKAGE MECHANICAL DATA

14 PINS – PLASTIC DIP OR CERP



14 PINS - PLASTIC MICROPACKAGE (SO)



PACKAGE MECHANICAL DATA (continued)

20 PINS - TRICECOP (LCC)

