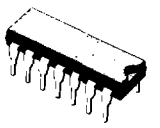
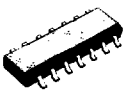
DIFFERENTIAL INPUT QUAD OP-AMPs

- LOW SUPPLY CURRENT : 0.53 mA/AMPLIFIER
- CLASS AB OUTPUT STAGE : NO CROSSOVER 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



N
DIP14
(Plastic Package)



D
SO14
(Plastic Micropackage)

J
CERDIP14
(Cerdip Package)

GC
LCC20
(Tricecop (LCC))

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.

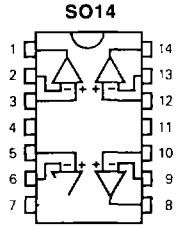
ORDER CODES

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, LM349D.

PIN CONNECTIONS (top views)

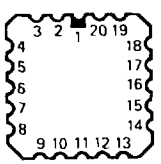
DIP14/CERDIP14
SO14



E88LM148-00

1 - Output 1
2 - Inverting input 1
3 - Non-inverting input 1
4 - V_{cc}
5 - Non-inverting input 2
6 - Inverting input 2
7 - Output 2
8 - Output 3
9 - Inverting input 3
10 - Non-inverting input 3
11 - V_{cc}
12 - Non-inverting input 4
13 - *Inverting input 4*
14 - Output 4

LCC20



E88LM148-01

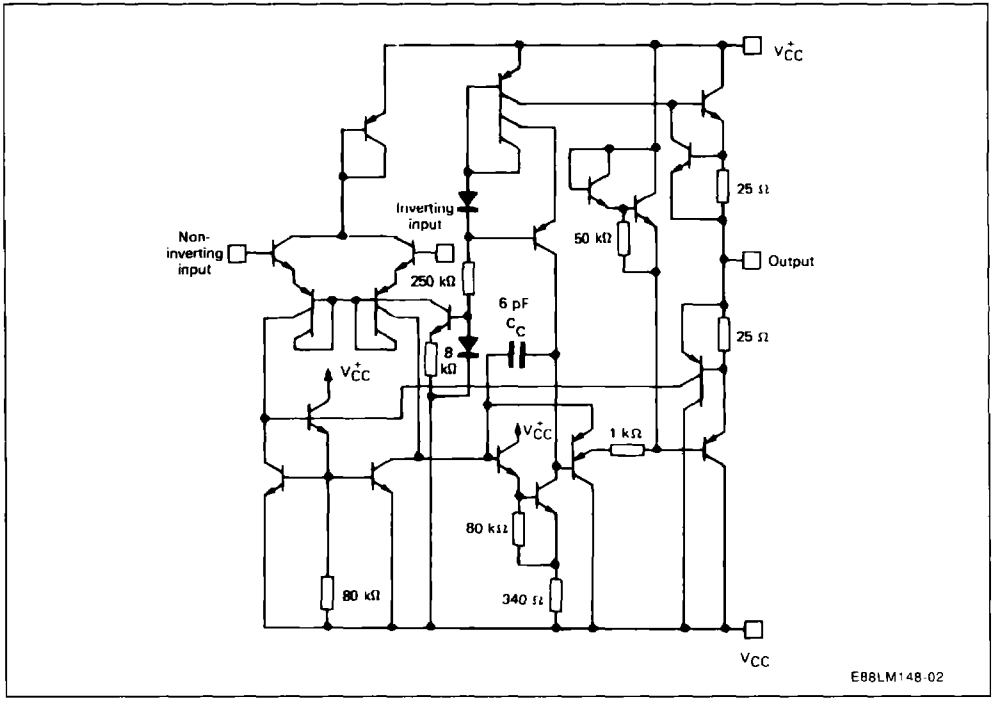
1 - NC
2 - Output 1
3 - Inverting input 1
4 - Non-inverting input 1
5 - NC
6 - V_{cc}
7 - NC
8 - Non-inverting input 2
9 - Inverting input 2
10 - Output 2
11 - NC
12 - Output 3
13 - *Inverting input 3*
14 - Non-inverting input 3
15 - NC
16 - V_{cc}
17 - NC
18 - Non-inverting input 4
19 - Inverting input 4
20 - Output 4

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	°C
T_{stg}	Storage Temperature Range	− 65 to + 150	− 65 to + 150	− 65 to + 150	°C

Notes : 1. For supply voltage less than maximum value, the absolute maximum input voltage is equal to the supply voltage.
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.

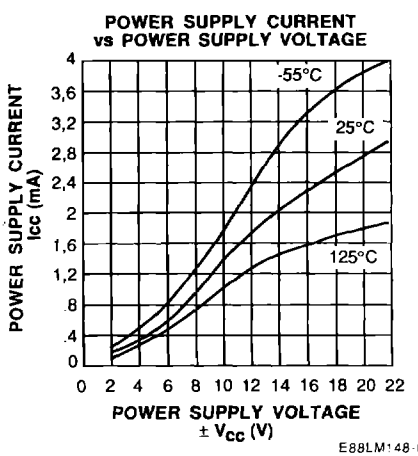
ELECTRICAL CHARACTERISTICS

LM148 : $-55\,°C \le T_{amb} \le +125\,°C$, $V_{CC} = \pm 15\,V$
LM248 : $-40\,°C \le T_{amb} \le +105\,°C$, $V_{CC} = \pm 15\,V$
LM348 : $0\,°C \le T_{amb} \le +70\,°C$, $V_{CC} = \pm 15\,V$
(unless otherwise specified)

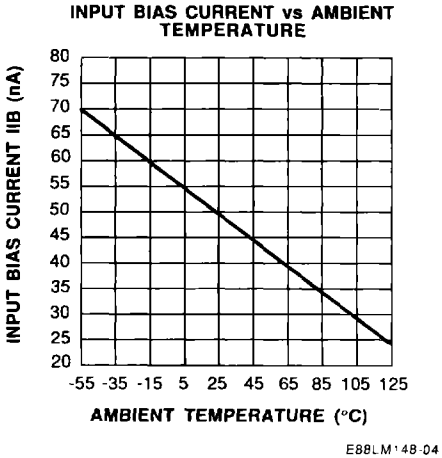
Symbol	Parameter	LM148/248/348			Unit
		Min.	Typ.	Max.	
V_{IO}	*Input Offset Voltage* $R_S \le 10\,k\Omega$ $T_{amb} = +25\,°C$ $T_{min} \le T_{amb} \le T_{max}$		1	5 6	mV
I_{IO}	Input Offset Current $T_{amb} = +25\,°C$ $T_{min} \le T_{amb} \le T_{max}$		2	20 40	nA
I_{IB}	Input Bias Current $T_{amb} = +25\,°C$ $T_{min} \le T_{amb} \le T_{max}$		30	100 200	nA
A_{VD}	Large Signal Voltage Gain ($V_O = \pm 10\,V$, $R_L \ge 2\,k\Omega$) $T_{amb} = +25\,°C$ $T_{min} \le T_{amb} \le T_{max}$	 50 25	 160		V/mV
SVR	Supply Voltage Rejection Ratio ($R_S \le 10\,k\Omega$) $T_{amb} = +25\,°C$ $T_{min} \le T_{amb} \le T_{max}$	 77 77	 100		dB
I_{CC}	Supply Current, all Amp, no Load $T_{amb} = +25\,°C$ $T_{min} \le T_{amb} \le T_{max}$		2.1	3.6 4.8	mA
V_I	Input Voltage Range $T_{amb} = +25\,°C$ $T_{min} \le T_{amb} \le T_{max}$	 −12 −12		 +12 +12	V
CMR	Common-mode Rejection Ratio ($R_S \le 10\,k\Omega$) $T_{amb} = +25\,°C$ $T_{min} \le T_{amb} \le T_{max}$	 70 70	 110		dB
I_{OS}	Output Short-circuit Current $T_{amb} = +25\,°C$	 10	 25	 35	mA
$\pm V_{OPP}$	Output Voltage Swing $T_{amb} = +25\,°C$ $R_L = 10\,k\Omega$ $R_L = 2\,k\Omega$ $T_{min} \le T_{amb} \le T_{max}$ $R_L = 10\,k\Omega$ $R_L = 2\,k\Omega$	 12 10 12 10	 13 12		V
S_{VO}	Slew Rate ($V_i = \pm 10\,V$, $R_L = 2\,k\Omega$, $C_L \le 100\,pF$, $T_{amb} = +25\,°C$, unity gain)	 0.25	 0.5		V/µs
t_r	Rise Time ($V_i = \pm 20\,mV$, $R_L = 2\,k\Omega$, $C_L \le 100\,pF$, $T_{amb} = +25\,°C$, unity gain)		 0.3		µs
K_{ov}	Overshoot ($V_i = \pm 20\,mV$, $R_L = 2\,k\Omega$, $C_L \le 100\,pF$, $T_{amb} = +25\,°C$, unity gain)		 5		%
R_I	Input Resistance, $T_{amb} = +25\,°C$	0.8	2.5		MΩ
GPB	Gain-bandwidth Product ($V_i = \pm 10\,mV$, $R_L = 2\,k\Omega$, $C_L \le 100\,pF$, $f = 100\,KHz$, $T_{amb} = +25\,°C$)	 0.7	 1.3	 1.6	MHz

ELECTRICAL CHARACTERISTICS (continued)

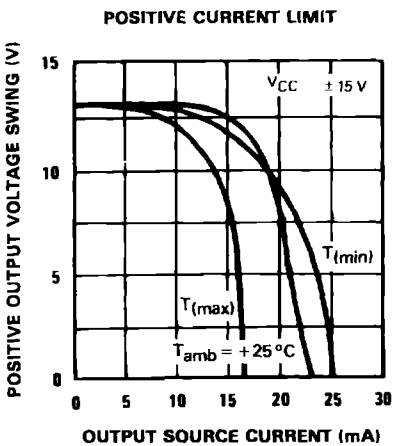
Symbol	Parameter	LM148/248/348			Unit
		Min.	Typ.	Max.	
THD	Total Harmonic Distortion (f = 1 KHz, A_V = 20 dB, R_L = 2 kΩ, V_O = 2 V_{PP}, C_L ≤ 100 pF, T_{amb} = + 25 °C)		0.08		%
V_n	Equivalent Input Noise Voltage (f = 1 kHz, R_G = 100 Ω)		40		nV/√Hz
V_{O1}/V_{O2}	Channel Separation		120		dB



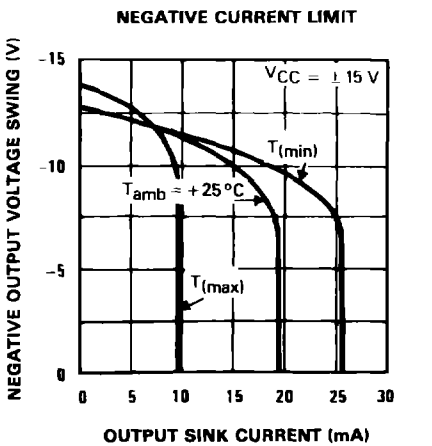
E88LM148-03



E88LM148-04

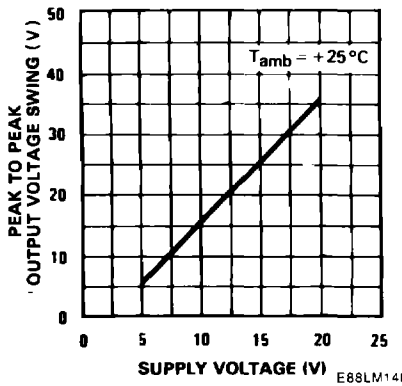


E88LM148-05



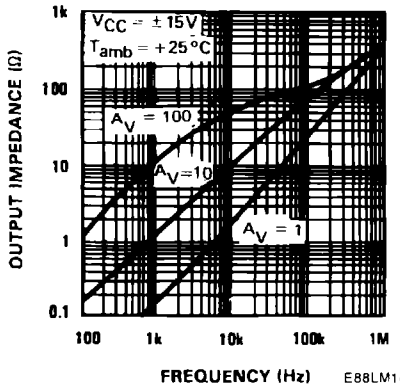
E88LM148-06

OUTPUT VOLTAGE SWING



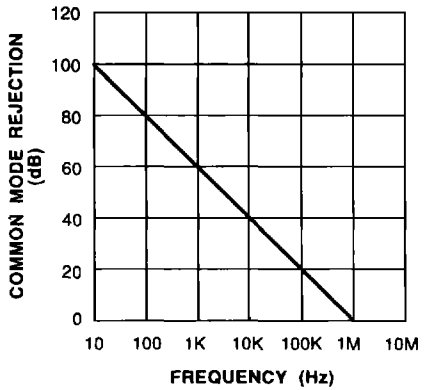
E88LM148-07

OUTPUT IMPEDANCE



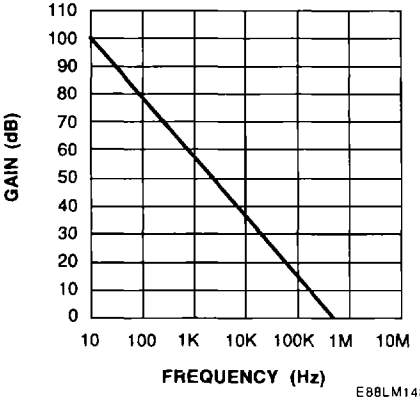
E88LM148-08

COMMON MODE REJECTION RATIO vs FREQUENCY



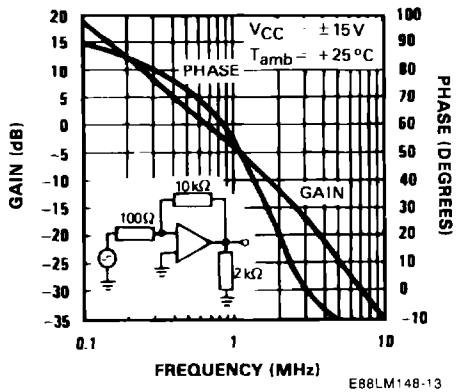
E88LM148-09

OPEN LOOP FREQUENCY RESPONSE



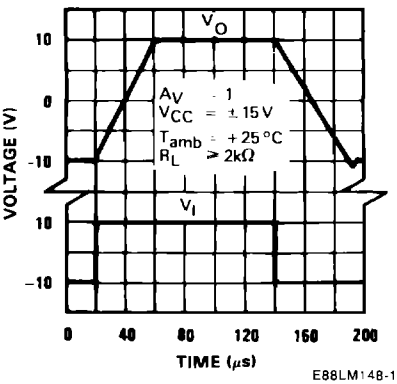
E88LM148-10

BODE PLOT (LM148)



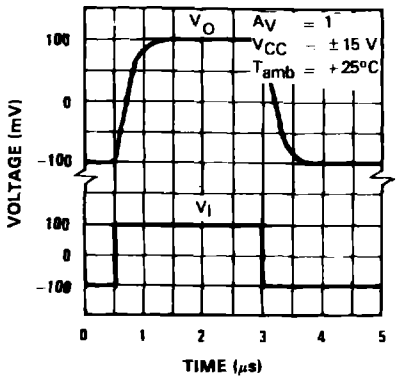
E88LM148-13

LARGE SIGNAL PULSE RESPONSE (LM148)



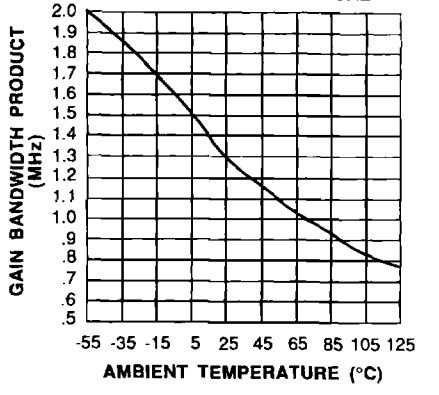
E88LM148-14

SMALL SIGNAL PULSE RESPONSE (LM148)



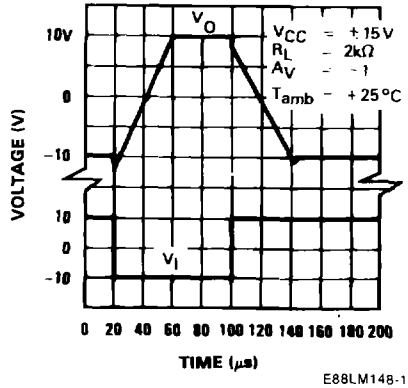
E88LM148-15

GAIN BANDWIDTH PRODUCT vs AMBIENT TEMPERATURE



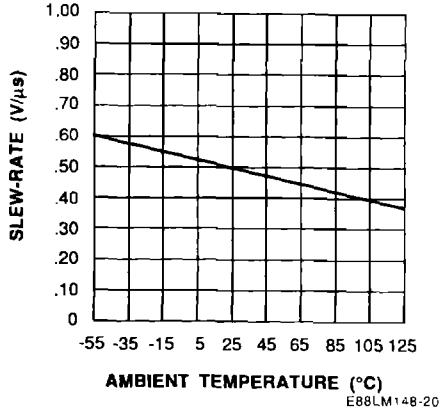
E88LM148-17

INVERTING LARGE SIGNAL PULSE RESPONSE (LM148)



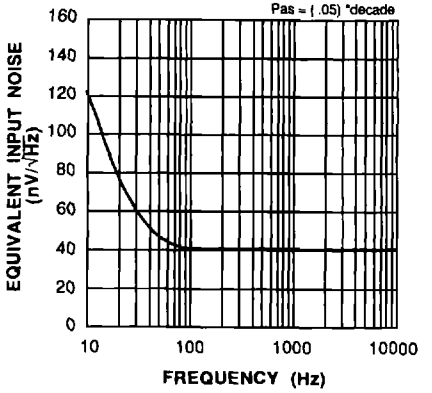
E88LM148-19

SLEW-RATE vs TEMPERATURE



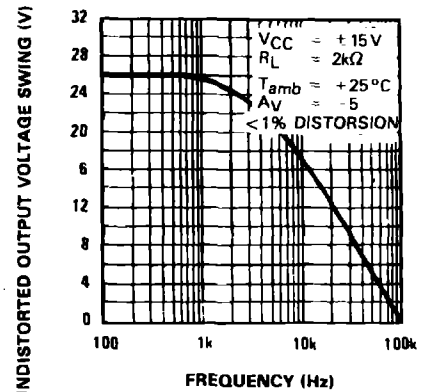
E88LM148-20

EQUIVALENT INPUT NOISE vs FREQUENCY



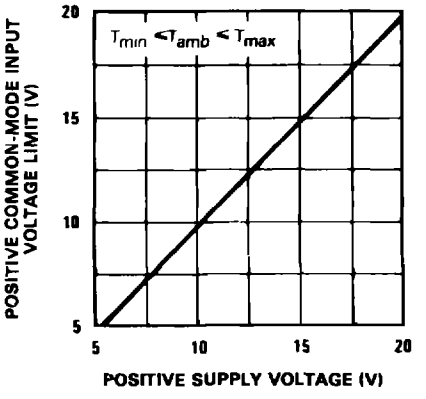
E88LM148-21

UNDISTORTED OUTPUT VOLTAGE SWING



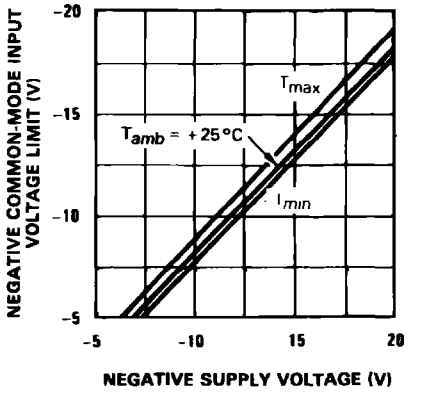
E88LM148-22

POSITIVE COMMON-MODE INPUT VOLTAGE LIMIT



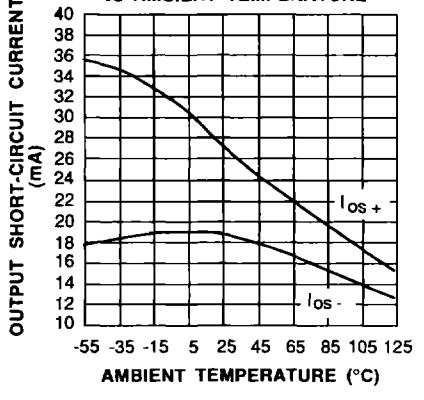
E88LM148-23

NEGATIVE COMMON-MODE INPUT VOLTAGE LIMIT



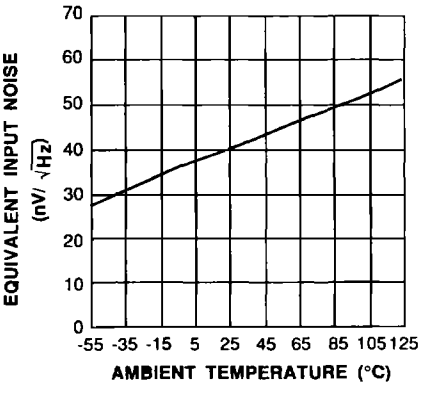
E88LM148-24

OUTPUT SHORT-CIRCUIT CURRENT vs AMBIENT TEMPERATURE



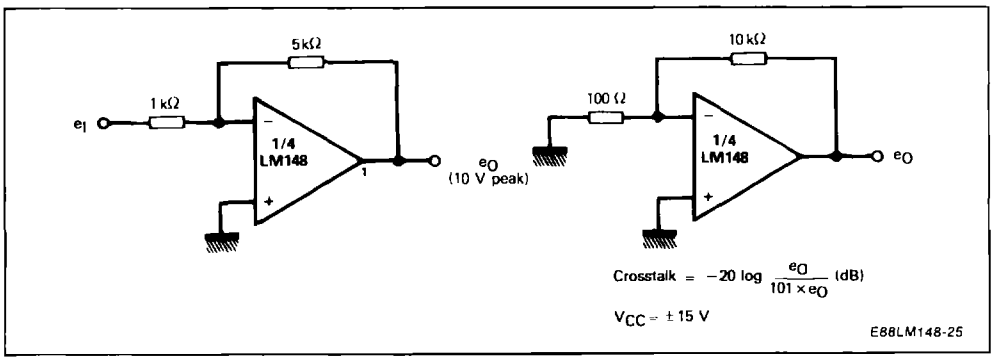
E88LM148-26

EQUIVALENT INPUT NOISE vs AMBIENT TEMPERATURE



E88LM148-27

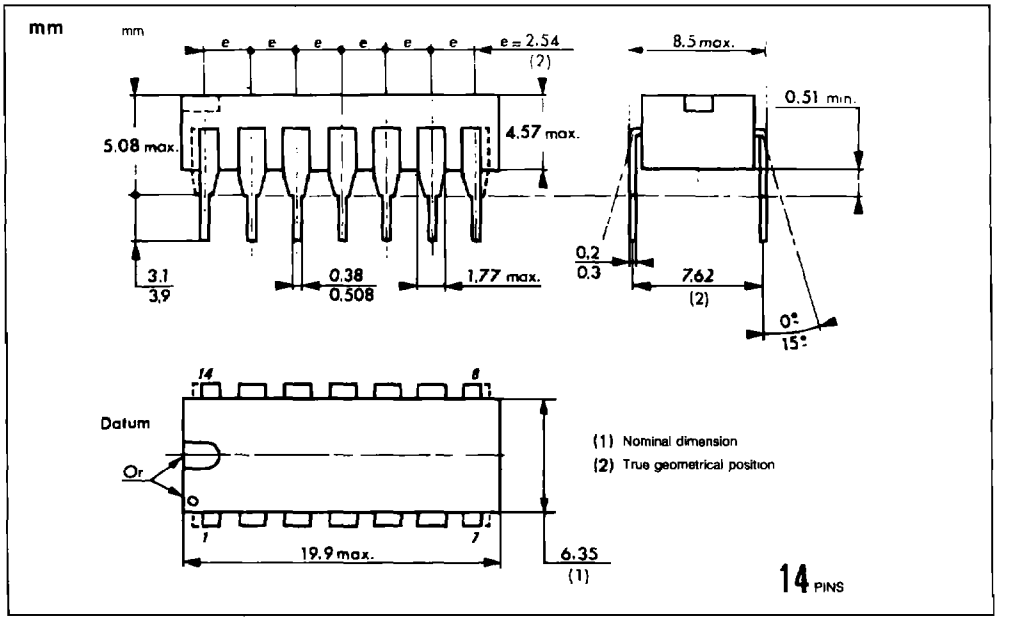
TEST CIRCUITS



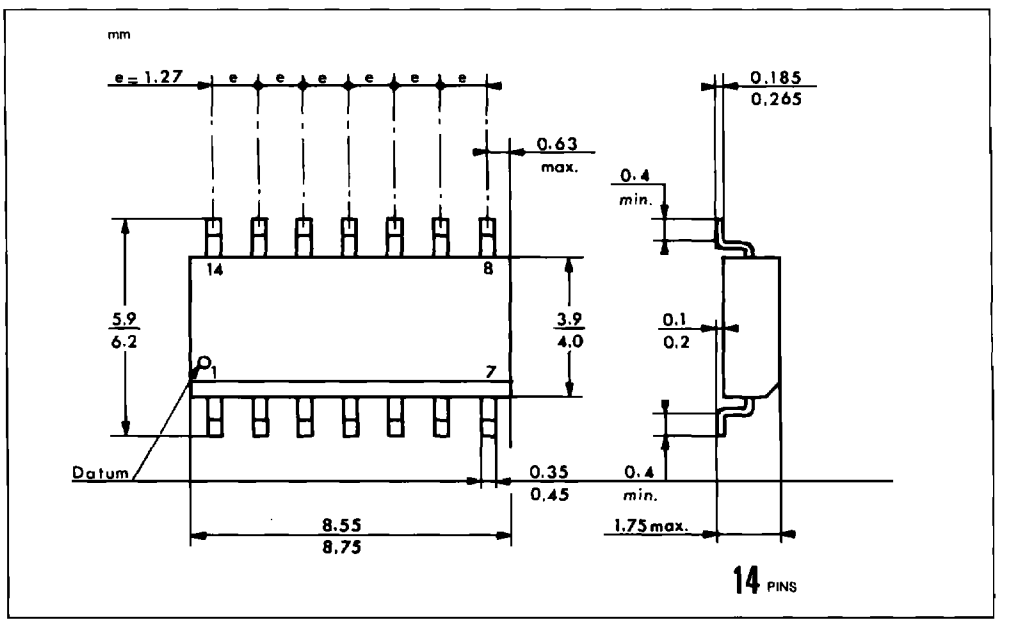
E88LM148-25

PACKAGE MECHANICAL DATA

14 PINS – PLASTIC DIP OR CERDIP



14 PINS - PLASTIC MICROPACKAGE (SO)



PACKAGE MECHANICAL DATA (continued)

20 PINS - TRICECOP (LCC)