SGS-THOMSON MICROELECTRONICS

LM146
LM246-LM346

PROGRAMMABLE QUAD OPERATIONAL AMPLIFIERS

- PROGRAMMABLE ELECTRICAL CHARACTERISTICS
- BATTERY POWERED OPERATION
- LOW SUPPLY CURRENT (250 µA/amplifier)
- GAIN-BANDWIDTH PRODUCT : 1 MHz
- LARGE DC VOLTAGE GAIN : 120 dB
- LOW NOISE VOLTAGE : 28 nV/√Hz
- WIDE POWER SUPPLY RANGE : ± 1.5 V TO ± 22 V
- CLASSE AB OUTPUT STAGE. NO CROSS-OVER DISTORTION
- OVERLOAD PROTECTION FOR INPUTS AND OUTPUTS

DESCRIPTION

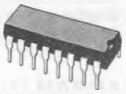
The LM346 consists of four independent, high gain, internally compensated, low power programmable amplifiers. Two external resistors (R_{set}) allow the user to program the gain-bandwith product, slew rate, supply current, input bias current, input offset current and input noise. For example the user can trade-off supply current for bandwidth or optimize noise figure for a given source resistance. In a similar way other amplifier characteristics can be tailored to the application.

Except for the two programming pins at the end of the package the LM346 pin out is the same as the LM324 and LM348.

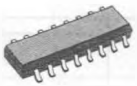
PROGRAMMING EQUATIONS :

Total supply current = 1 mA (I_{set} = 10 µA)
Gain-bandwith product = 1 MHz (I_{set} = 10 µA)
Slew rate = 0.5 V/µs (I_{set} = 10 µA)
Input bias current ≈ 30 nA (I_{set} = 10 µA)
I_{set} = current into pin 8 and pin 9 (see schematic diagram)

$$I_{set} = \frac{V_{CC}^{+} - V_{CC}^{-} - 0.6\ V}{R_{set}}$$



N – DIP16 – (Plastic Package)
J – CERDIP16 – (Cerdip Package)



D
SO16
(Plastic Micropackage)

GC
LCC20
(Tricecop (LCC))

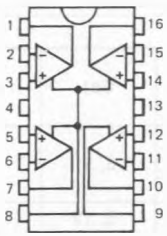
ORDER CODES

Part Number	Temperature Range	Package			
		N	J	D	GC
LM146	– 55 °C to + 125 °C		•		•
LM246	– 40 °C to + 105 °C	•	•	•	
LM346	0 °C to + 70 °C	•	•	•	

Note : Hi-rel Versions Available
Examples : LM146J, LM246N

PIN CONNECTIONS (top views)

DIP16 / CERDIP16
SO16



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 - Set
9 - Set
10 - Output 3
11 - Inverting input 3
12 - Non-inverting input 3
13 - V_{CC}^{+}
14 - Non-inverting input 4
15 - Inverting input 4
16 - Output 4

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LCC20

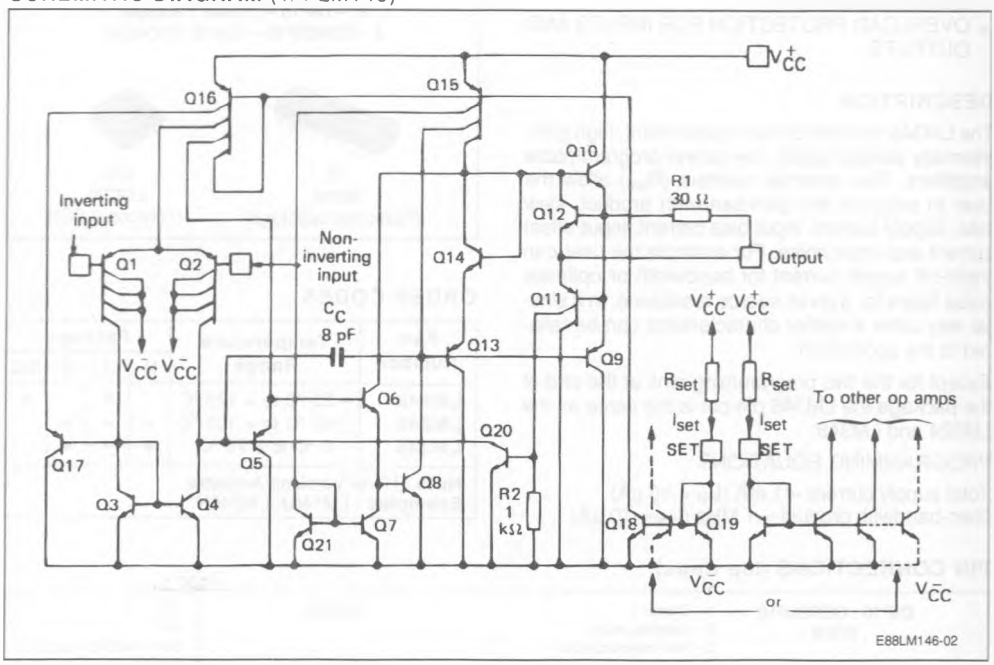
1 - NC
2 - Output 1
3 - Inverting input 1
4 - Non-inverting input 1
5 - V_{CC}^{-}
6 - NC
7 - Non-inverting input 2
8 - Inverting input 2
9 - Output 2
10 - Set 1, 2, 4
11 - NC
12 - Set 3
13 - Output 3
14 - Inverting input 3
15 - Non-inverting input 3
16 - NC
17 - V_{CC}^{+}
18 - Non-inverting input 4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

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	LM146	LM246	LM346	Unit
V_{CC}	Supply Voltage	± 22	± 22	± 22	V
V_I	Input Voltage (note 1)	± 15	± 15	± 15	V
V_{ID}	Differential Input Voltage	± 30	± 30	± 30	V
	Output Short-circuit Duration (note 2)	Indefinite	Indefinite	Indefinite	
P_{tot}	Power Dissipation N/D Suffix GC Suffix J Suffix	 665 900	 500 900	 500 900	mW
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 voltages less than ± 15 V, the absolute maximum input voltage is equal to the supply voltage.
2. Any of the amplifier outputs can be shorted to ground indefinitly ; however more than one should not be simultaneously shorted as the maximum junction temperature will be exceeded.

SCHEMATIC DIAGRAM (1/4 LM146)



Case	Inverting Inputs	Non-inverting Inputs	V_{CC}^-	V_{CC}^+	Outputs	Set	N.C.
DIP16 CERDIP16 SO16	3, 5, 12, 14	2, 6, 11, 15	13	4	1, 7, 10, 16	8, 9	
LCC 20	3, 8, 14, 19	4, 7, 15, 18	17	5	2, 9, 13, 20	10, 12	*

* LCC20 : Other pins are not connected.

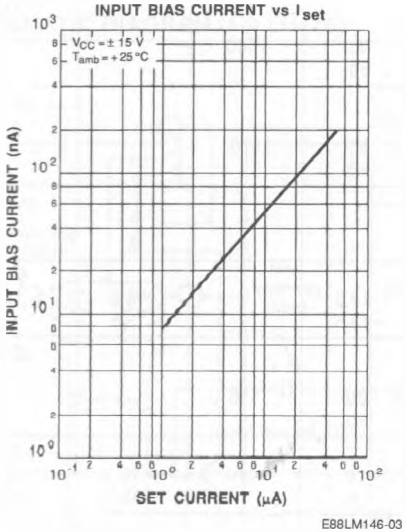
ELECTRICAL CHARACTERISTICS

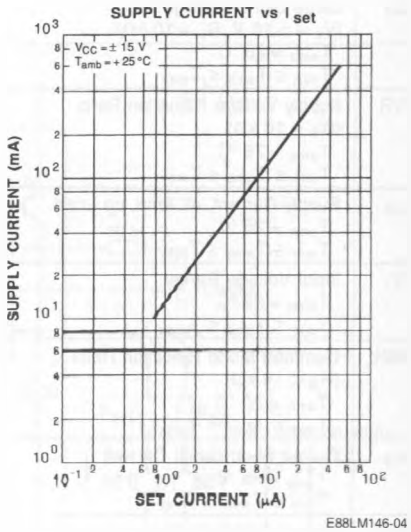
LM346 : $0\ °C \le T_{amb} \le +\ 70\ °C$, $V_{CC} = \pm 15\ V$, $I_{set} = 10\ \mu A$
LM246 : $-40\ °C \le T_{amb} \le +105\ °C$, $V_{CC} = \pm 15\ V$, $I_{set} = 10\ \mu A$
LM146 : $-55\ °C \le T_{amb} \le +125\ °C$, $V_{CC} = \pm 15\ V$, $I_{set} = 10\ \mu A$

Symbol	Parameter	LM146-LM246-LM346			Unit
		Min.	Typ.	Max.	
V_{IO}	Input Offset Voltage ($R_S \le 10\ k\Omega$) $T_{amb} = 25\ °C$ $T_{min} \le T_{amb} \le T_{max}$		0.5	3 5	mV
I_{IO}	Input Offset Current $T_{amb} = 25\ °C$ $T_{min} \le T_{amb} \le T_{max}$		2	20 25	nA
I_{IB}	Input Bias Current $T_{amb} = 25\ °C$ $T_{min} \le T_{amb} \le T_{max}$		30	100 100	nA
A_{vd}	Large Signal Voltage Gain ($V_o = \pm 10\ V$, $R_L = 10\ k\Omega$) $T_{amb} = 25\ °C$ $T_{min} \le T_{amb} \le T_{max}$	100 50	1000		V/mV
SVR	Supply Voltage Rejection Ratio ($R_S \le 10\ k\Omega$) $T_{amb} = 25\ °C$ $T_{min} \le T_{amb} \le T_{max}$	80 80	110		dB
I_{CC}	Supply Current, all Amp, no Load $T_{amb} = 25\ °C$ $T_{min} \le T_{amb} \le T_{max}$		1	2 2	mA
V_I	Input Voltage Range $T_{amb} = 25\ °C$ $T_{min} \le T_{amb} \le T_{max}$	−13.5 −13.5		+13.5 +13.5	V
CMR	Common Mode Rejection Ratio ($R_S \le 10\ k\Omega$) $T_{amb} = 25\ °C$ $T_{min} \le T_{amb} \le T_{max}$	80 70	110		dB
I_{OS}	Output Short-circuit Current $T_{amb} = 25\ °C$ $T_{min} \le T_{amb} \le T_{max}$	10 4	20	30 35	mA
$\pm V_{opp}$	Output Voltage Swing $T_{amb} = 25\ °C$ $R_L = 10\ k\Omega$ $T_{min} \le T_{amb} \le T_{max}$ $R_L = 10\ k\Omega$	12 12	14		V
S_{vo}	Slew-rate ($V_I = \pm 10\ V$, $R_L = 10\ k\Omega$, $C_L \le 100\ pF$, $T_{amb} = 25\ °C$, Unity Gain)	0.3	0.5		V/µs
R_I	Input Resistance, $T_{amb} = 25\ °C$		1		MΩ
C_I	Input Capacitance, $T_{amb} = 25\ °C$		2		pF

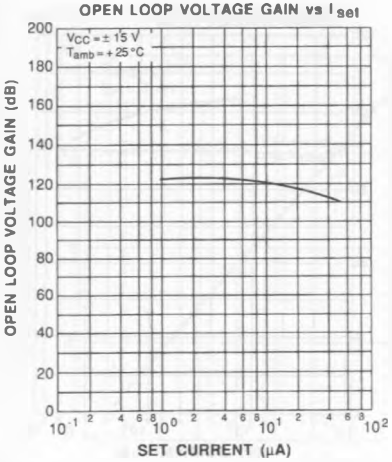
ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	LM146-LM246-LM346			Unit
		Min.	Typ.	Max.	
V_{o1}/V_{o2}	Channel Separation ($R_L \geq 10$ KΩ) ($V_o = 12$ V_{pp})		120		dB
GPB	Gain Bandwidth Product ($V_i = 10$ mV, $R_L = 10$ KΩ, $C_L \leq 100$ pF f = 100 KHz, $T_{amb} = 25$ °C)	0.8	1	1.6	MHz
THD	Total Harmonic Distortion (f = 1 KHz, $A_v = 20$ dB, $R_L = 10$ KΩ $C_L \leq 100$ pF, $T_{amb} = 25$ °C, $V_o = 2$ V_{pp})		0.015		%
V_n	Equivalent Input Noise Voltage (f = 1 KHz, $R_g = 100$ Ω)		28		nV/√Hz





OPEN LOOP VOLTAGE GAIN vs I_{set}



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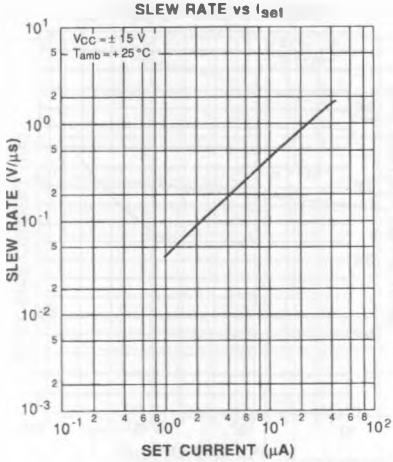
SLEW RATE vs I_{set}



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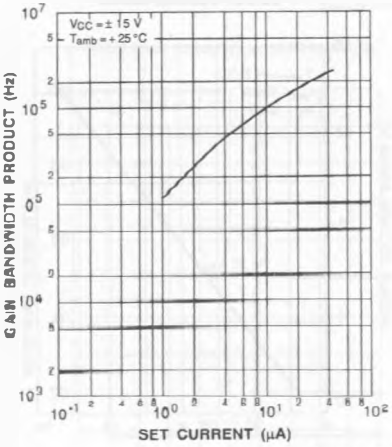
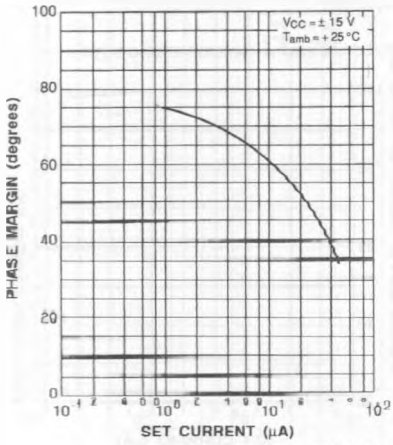
GAIN BANDWIDTH PRODUCT vs I_{set}



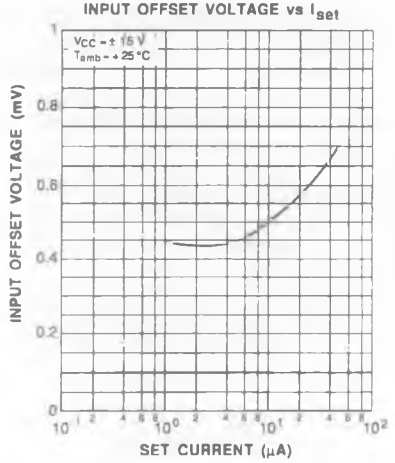
E88LM146-07

PHASE MARGIN vs I_{set}



E88LM146-08

INPUT OFFSET VOLTAGE vs I_{set}



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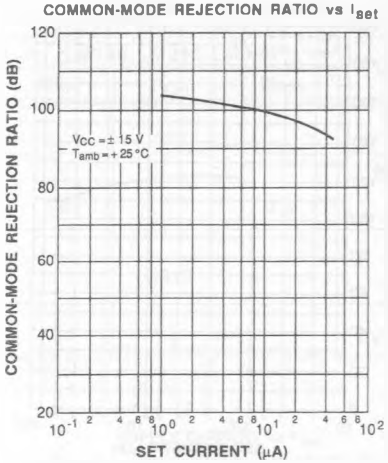
COMMON-MODE REJECTION RATIO vs I_{set}



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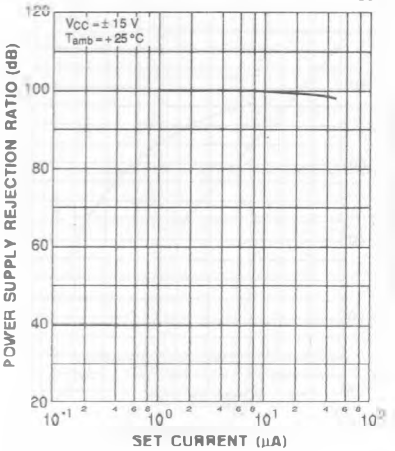
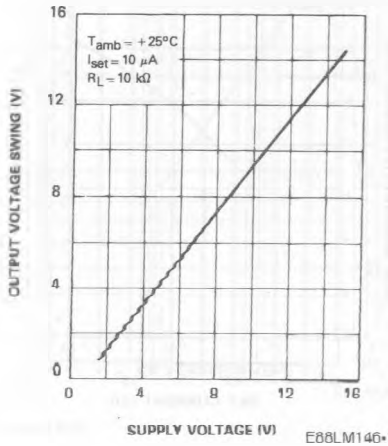
POWER SUPPLY REJECTION RATIO vs I_{set}



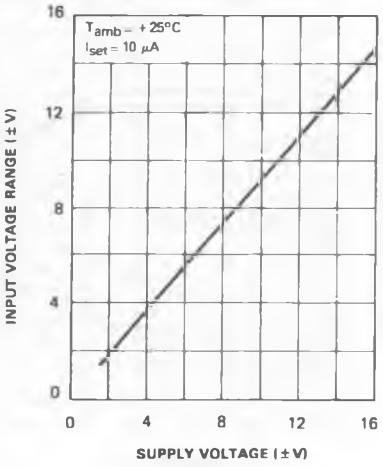
E88LM146-11

OUTPUT VOLTAGE SWING



E88LM146-12

INPUT VOLTAGE RANGE



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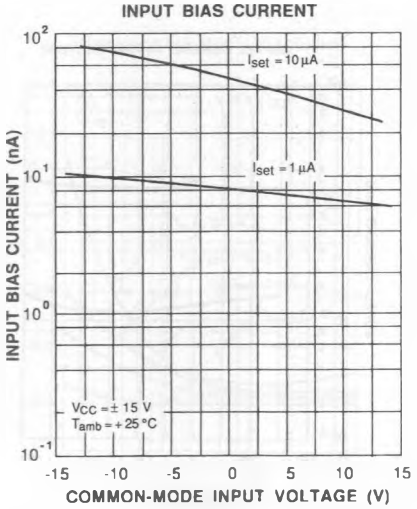
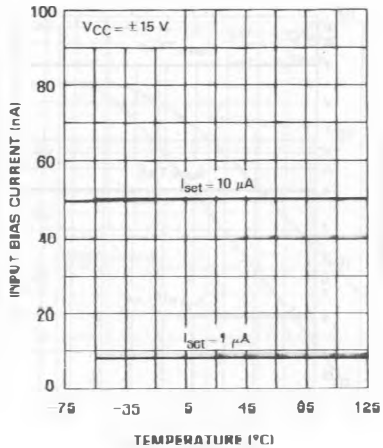
INPUT BIAS CURRENT



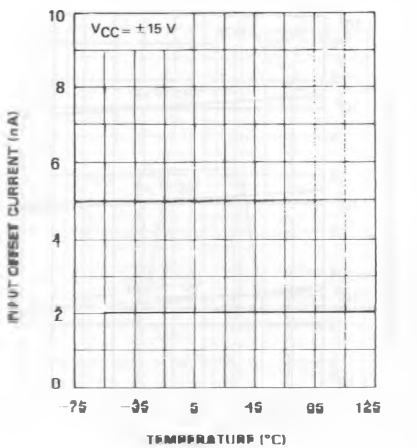
E88LM146-14

INPUT BIAS CURRENT vs TEMPERATURE



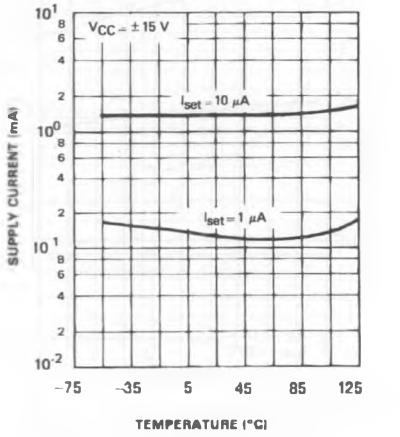
E88LM146-15

INPUT OFFSET CURRENT vs TEMPERATURE



E88LM146-16

SUPPLY CURRENT vs TEMPERATURE



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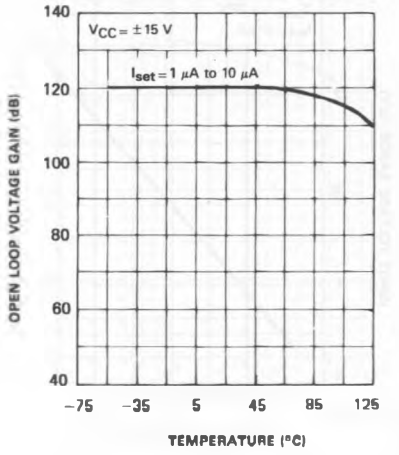
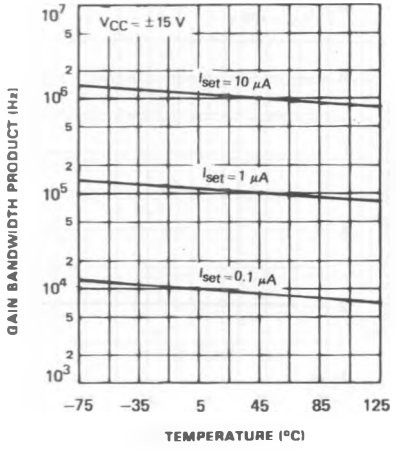
OPEN LOOP VOLTAGE GAIN vs TEMPERATURE



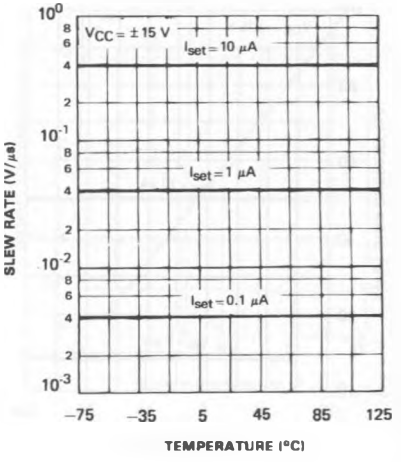
E88LM146-18

GAIN BANDWIDTH PRODUCT vs TEMPERATURE



E88LM146-19

SLEW RATE vs TEMPERATURE



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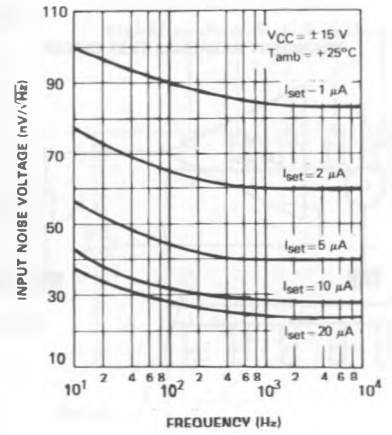
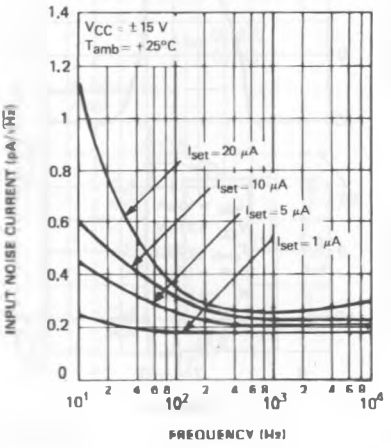
INPUT NOISE VOLTAGE vs FREQUENCY



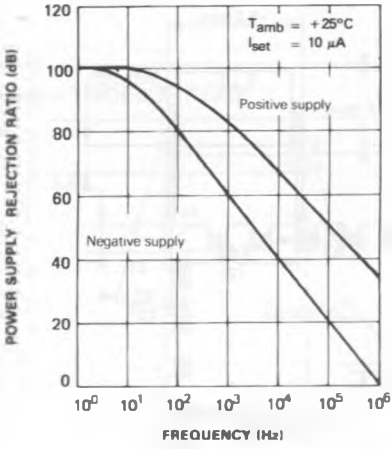
E88LM146-21

INPUT NOISE CURRENT vs FREQUENCY



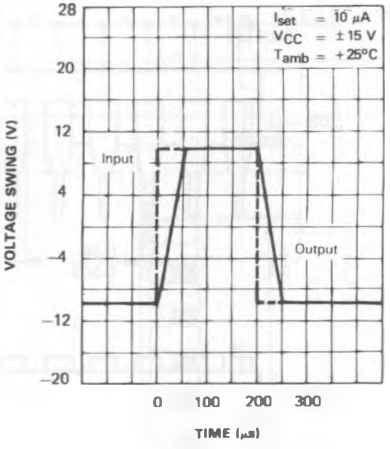
E88LM146-22

POWER SUPPLY REJECTION RATIO



E88LM146-23

VOLTAGE FOLLOWER PULSE RESPONSE



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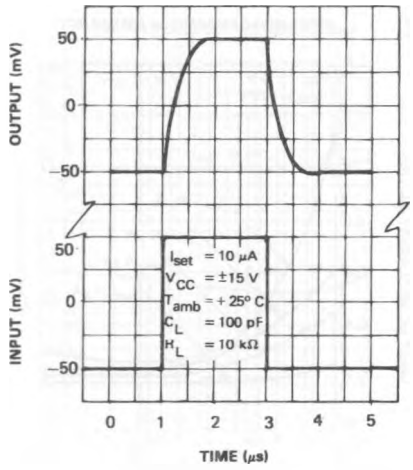

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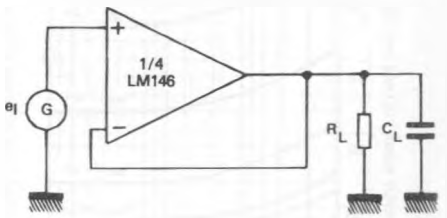
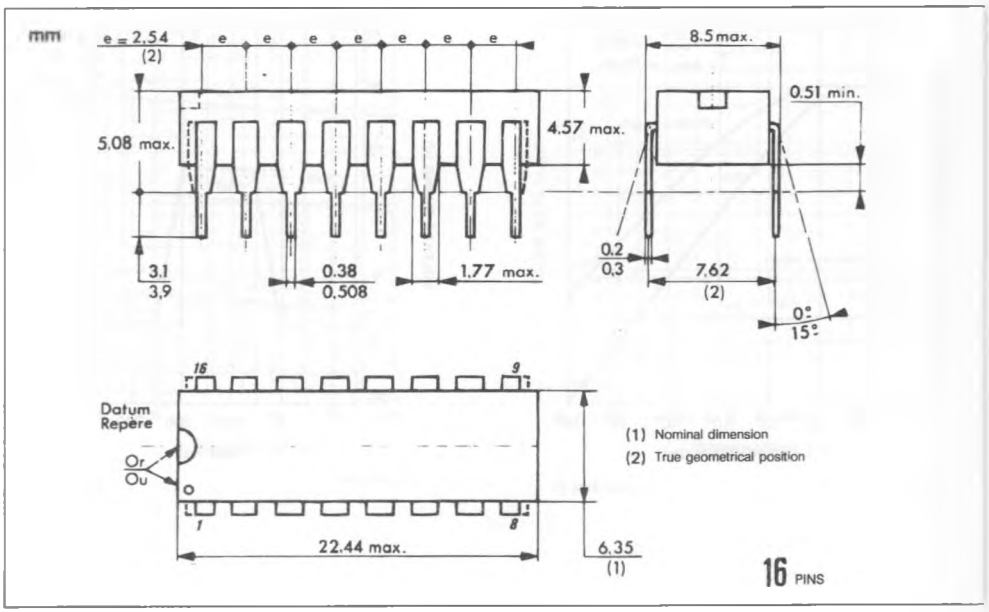
TRANSIENT RESPONSE TEST CIRCUIT



E88LM146-26

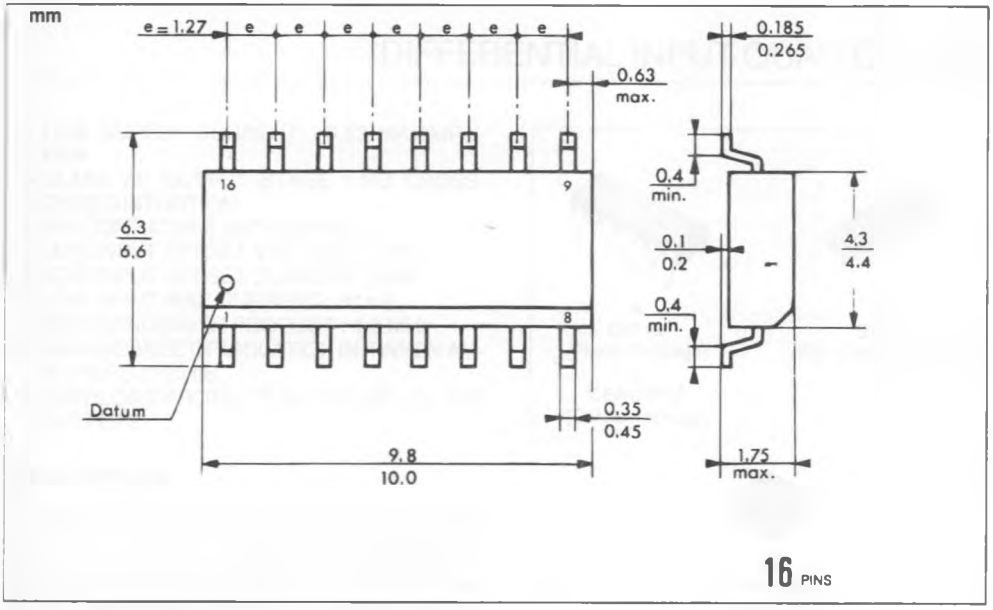
PACKAGE MECHANICAL DATA

16 PINS – PLASTIC DIP OR CERDIP



PACKAGE MECHANICAL DATA (continued)

16 PINS – PLASTIC MICROPACKAGE (SO)



20 PINS – TRICECOP (LCC)