THOMSON SEMICONDUCTORS

LM146
LM246
LM346

PROGRAMMABLE QUAD OPERATIONAL AMPLIFIERS

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 = 1.4 mA (I_{set} = 10 μA)
Gain-bandwith product = 1 MHz (I_{set} = 10 μA)
Slew rate = 0.4 V/μs (I_{set} = 10 μA)
Input bias current = 50 nA (I_{set} = 10 μA)
I_{set} = current into pin 8 and pin 9 (see schematic diagram)

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

- Programmable electrical characteristics.
- Battery powered operation.
- Low supply current (350 μA/amplifier).
- Gain-bandwidth product : 1 MHz.
- Large dc voltage gain : 120 dB.
- Low noise voltage : 28 nV/$\sqrt{Hz}$.
- Wide power supply range : ±1.5 V to ±22 V.
- Classe AB output stage. No cross-over distortion.
- Overload protection for inputs and outputs.

ORDERING INFORMATION

Hi-Rel versions available - See chapter 14

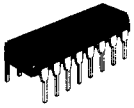
PART NUMBER	TEMPERATURE RANGE	PACKAGE			
		DP	DG	FP	GC
LM146	−55°C to +125°C		•		•
LM246	−25°C to + 85°C	•	•		
LM346	0°C to + 70°C	•	•	•	

Examples : LM146DG, LM246DP

PROGRAMMABLE QUAD OPERATIONAL AMPLIFIERS

CASES

CB-79



DP SUFFIX
PLASTIC PACKAGE
DG SUFFIX
CERDIP PACKAGE

CB-359

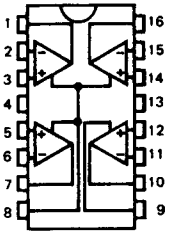
FP SUFFIX
PLASTIC MICROPACKAGE

CB-705

GC SUFFIX
TRICECOP (LCC)

PIN ASSIGNMENTS
(Top views)

CB-79 and CB-359



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

CB-705

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

Réf. 00220

THOMSON SEMICONDUCTORS
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THOMSON COMPONENTS

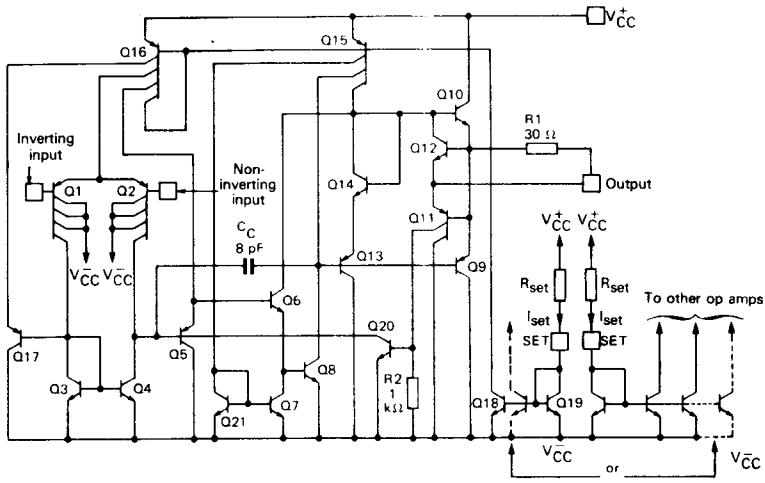
MAXIMUM RATINGS

Rating	Symbol	LM146	LM246	LM346	Unit
Supply voltage	V_{CC}	± 22	± 18	± 18	V
Input voltage (Note 1)	V_I	± 15	± 15	± 15	V
Differential input voltage	V_{ID}	± 30	± 30	± 30	V
Output short-circuit duration (Note 2)		Indefinite	Indefinite	Indefinite	
Power dissipation GC suffix DG suffix	P_{tot}	665 680	500	500 900	mW
Operating free-air temperature range	T_{oper}	− 55 to + 125	− 25 to + 85	0 to + 70	°C
Storage temperature range	T_{stg}	− 65 to + 150	− 65 to + 150	− 65 to + 150	°C

Note 1 : For supply voltages less than ± 15 V, the absolute maximum input voltage is equal to the supply voltage.

Note 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.
CB-79/CB-359	3, 5, 12, 14	2, 6, 11, 15	13	4	1, 7, 10, 16	8, 9	–
CB-705	3, 8, 14, 19	4, 7, 15, 18	17	5	2, 9, 13, 20	10, 12	*

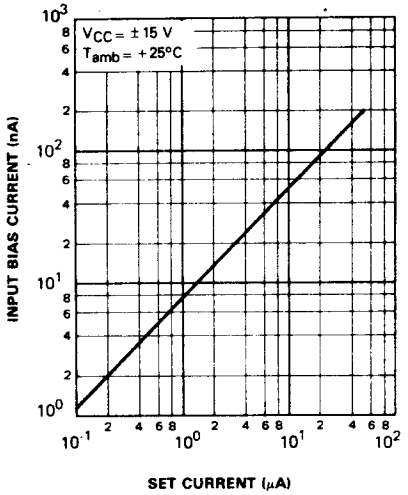
* **CB-705** : Other pins are not connected.

ELECTRICAL CHARACTERISTICS

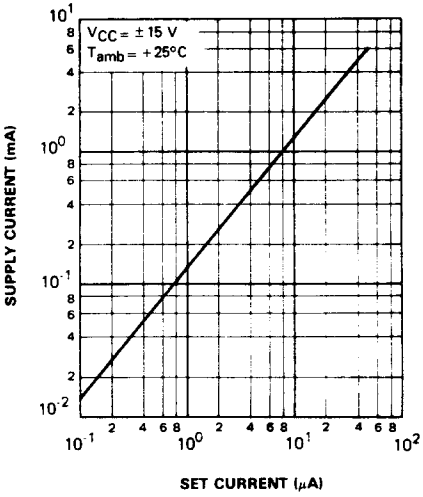
LM146 : $-55°C \leq T_{amb} \leq +125°C$, $V_{CC} = \pm 15$ V, $I_{set} = 10\mu A$
LM246 : $0°C \leq T_{amb} \leq +70°C$, $V_{CC} = \pm 15$ V, $I_{set} = 10\mu A$
LM346 : $-25°C \leq T_{amb} \leq +85°C$, $V_{CC} = \pm 15$ V, $I_{set} = 10\mu A$
(Unless otherwise specified)

Characteristic	Symbol	LM146			LM246, LM346			Unit
		Min	Typ	Max	Min	Typ	Max	
Input offset voltage ($R_S \leq 50\ \Omega$) $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$	V_{IO}	– –	0.5 0.5	5 6	– –	0.5 0.5	6 7.5	mV
Input offset current $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$	I_{IO}	– –	2 2	20 25	– –	2 2	100 100	nA
Input bias current $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$	I_{IB}	– –	50 50	100 100	– –	50 50	250 250	nA
Large signal voltage gain ($\Delta V_O = \pm 10$ V, $R_L = 10$ kΩ) $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$	A_{VD}	100 50	1000 1000	– –	50 25	1000 1000	– –	V/mV
Supply voltage rejection ratio $R_S \leq 10$ kΩ, $T_{amb} = +25°C$ $R_S \leq 50\ \Omega$, $T_{min} \leq T_{amb} \leq T_{max}$	SVR	80 76	100 100	– –	74 74	100 100	– –	dB
Supply current $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$	I_{CC}	– –	1.4 1.5	2 2	– –	1.4 1.5	2.5 2.5	mA
Input voltage range $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$	V_I	± 13.5 ± 13.5	± 14 ± 14	– –	± 13.5 ± 13.5	± 14 ± 14	– –	V
Common-mode rejection ratio $R_S \leq 10$ kΩ, $T_{amb} = +25°C$ $R_S \leq 50\ \Omega$, $T_{min} \leq T_{amb} \leq T_{max}$	CMR	80 70	100 100	– –	70 70	100 100	– –	dB
Output short-circuit current ($T_{amb} = +25°C$)	I_{OS}	5	20	30	5	20	30	mA
Output voltage swing ($R_L \geq 10$ kΩ) $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$	V_{OPP}	± 12 ± 12	± 14 ± 14	– –	± 12 ± 12	± 14 ± 14	– –	V
Gain-bandwidth product ($T_{amb} = +25°C$)	GBp	0.8	1.2	–	0.5	1.2	–	MHz
Slew rate ($T_{amb} = +25°C$)	S_{VO}	–	0.4	–	–	0.4	–	V/μs
Equivalent input noise voltage ($f = 1$ kHz, $T_{amb} = +25°C$)	V_n	–	28	–	–	28	–	nV/√Hz
Input resistance ($T_{amb} = +25°C$)	R_I	–	1	–	–	1	–	MΩ
Input capacitance ($T_{amb} = +25°C$)	C_I	–	2	–	–	2	–	pF
Channel separation ($\Delta V_O = 0$V to $+12$ V, $R_L \geq 10$ kΩ, $T_{amb} = +25°C$)	V_{O1}/V_{O2}	–	120	–	–	120	–	dB
Phase margin ($C_L = 100$ pF, $T_{amb} = +25°C$)	φM	–	60	–	–	60	–	Degree

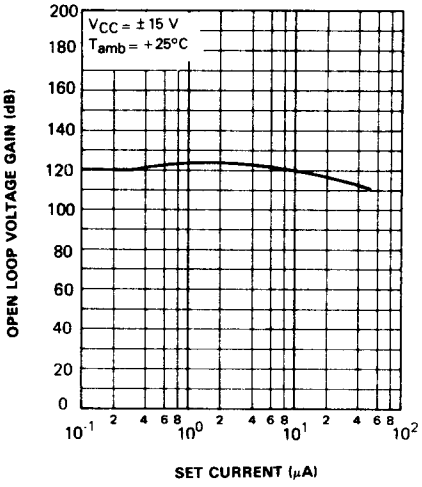
INPUT BIAS CURRENT vs I_{set}



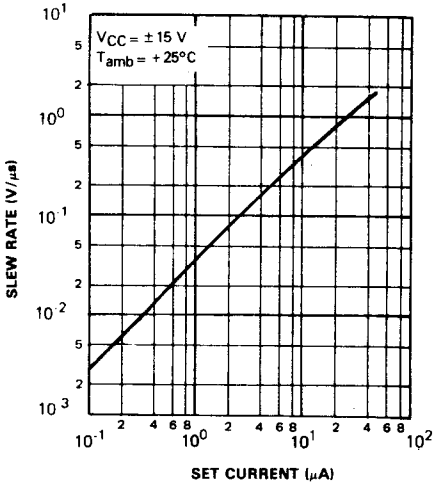
SUPPLY CURRENT vs I_{set}



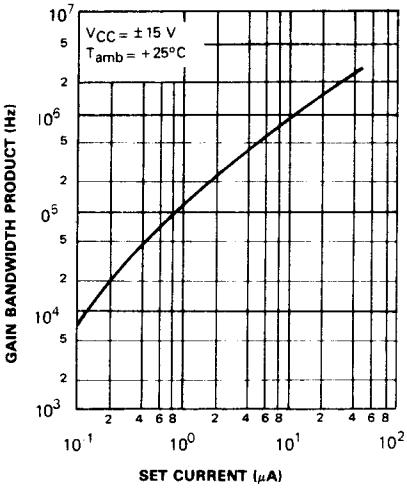
OPEN LOOP VOLTAGE GAIN vs I_{set}



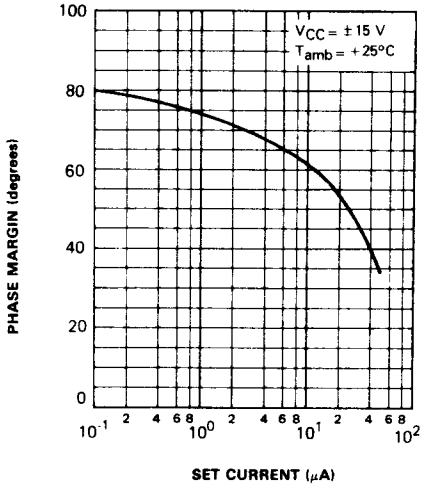
SLEW RATE vs I_{set}



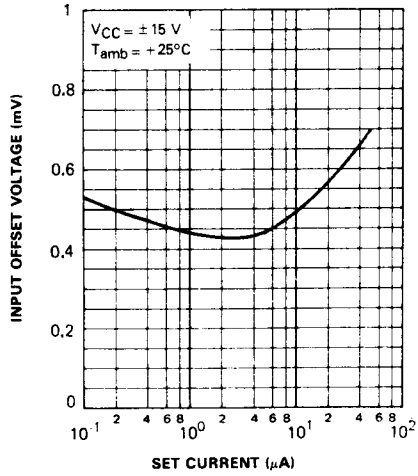
GAIN BANDWIDTH PRODUCT vs I_{set}



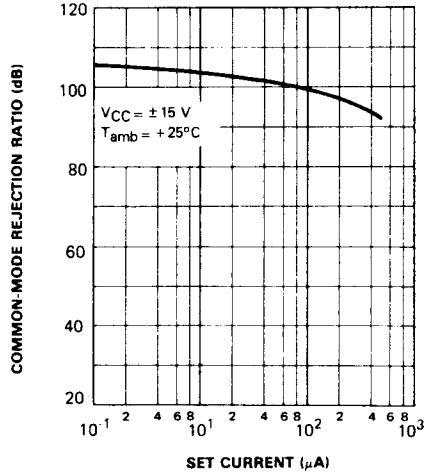
PHASE MARGIN vs I_{set}



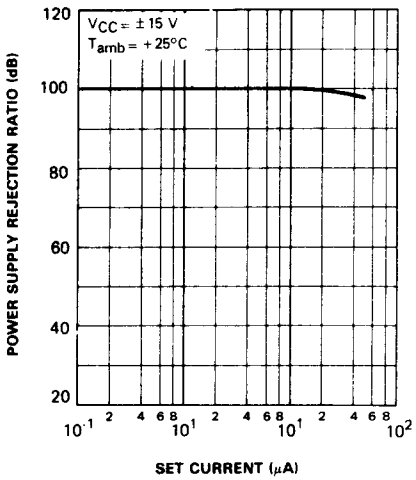
INPUT OFFSET VOLTAGE vs I_{set}



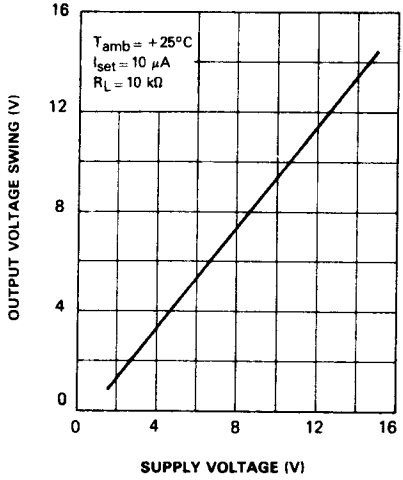
COMMON-MODE REJECTION RATIO vs I_{set}



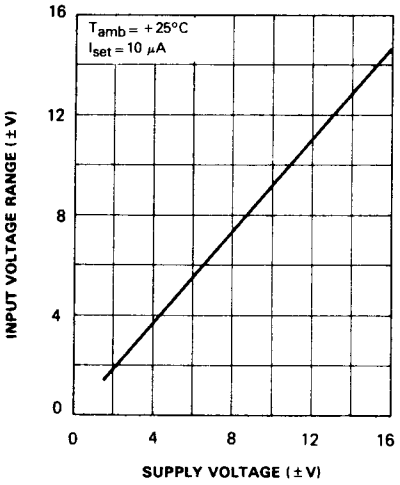
POWER SUPPLY REJECTION RATIO vs I_{set}



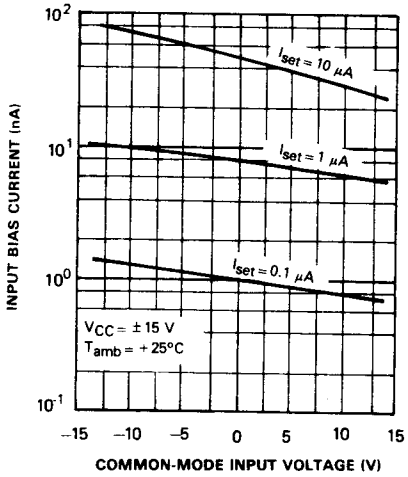
OUTPUT VOLTAGE SWING



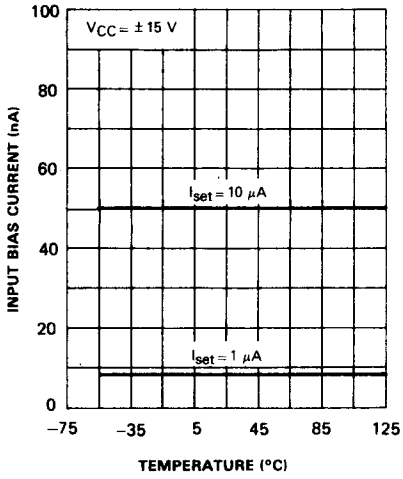
INPUT VOLTAGE RANGE



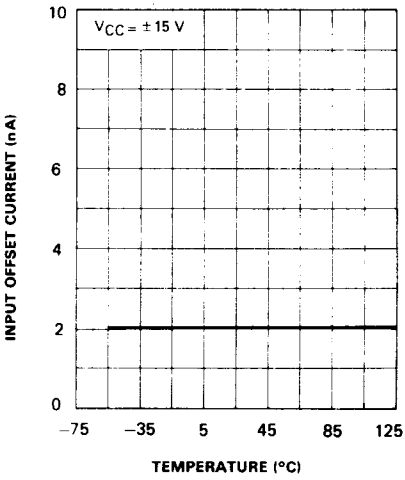
INPUT BIAS CURRENT



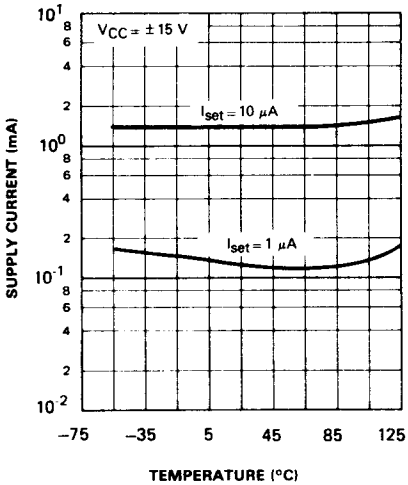
INPUT BIAS CURRENT vs TEMPERATURE



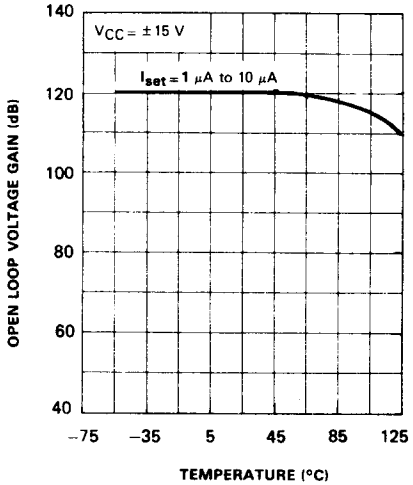
INPUT OFFSET CURRENT vs TEMPERATURE



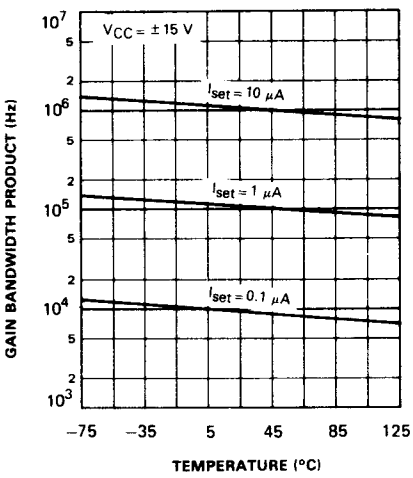
SUPPLY CURRENT vs TEMPERATURE



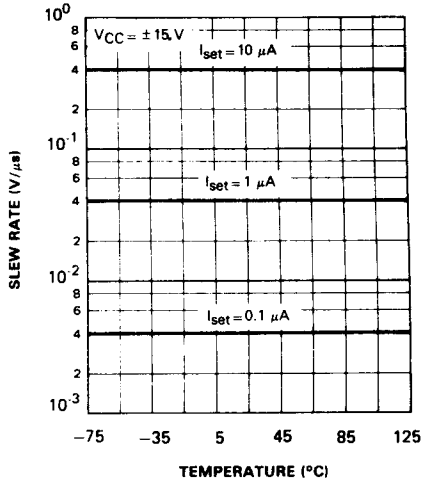
OPEN LOOP VOLTAGE GAIN vs TEMPERATURE



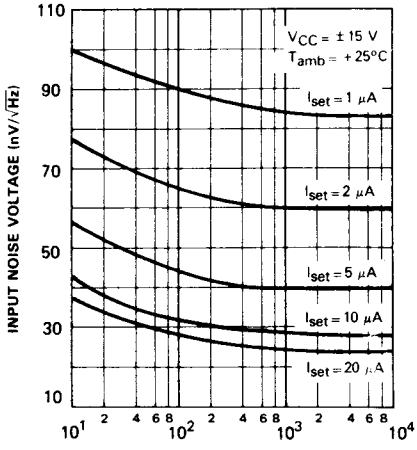
GAIN BANDWIDTH PRODUCT vs TEMPERATURE



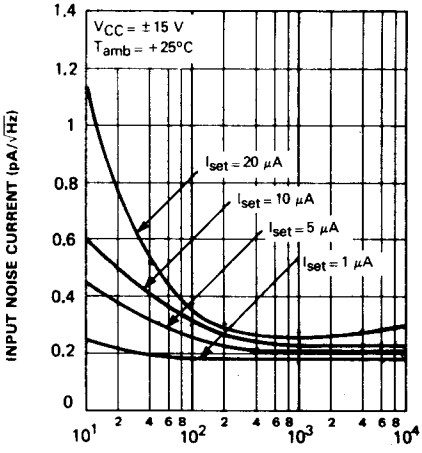
SLEW RATE vs TEMPERATURE



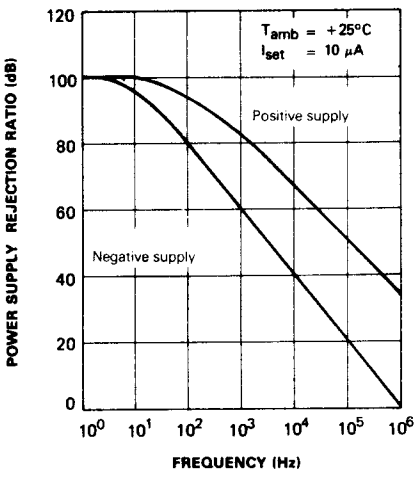
INPUT NOISE VOLTAGE vs FREQUENCY



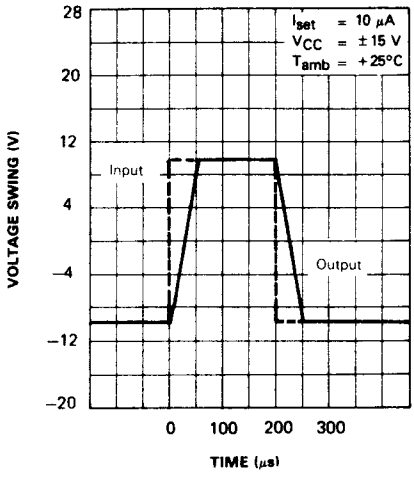
INPUT NOISE CURRENT vs FREQUENCY



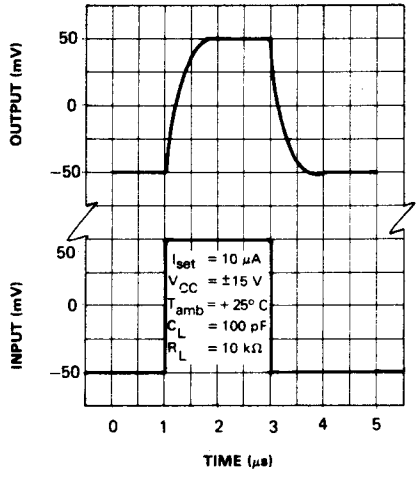
POWER SUPPLY REJECTION RATIO



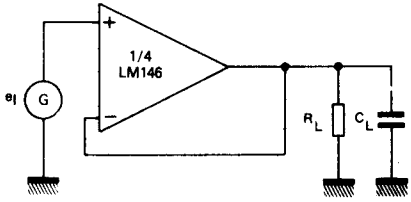
VOLTAGE FOLLOWER PULSE RESPONSE

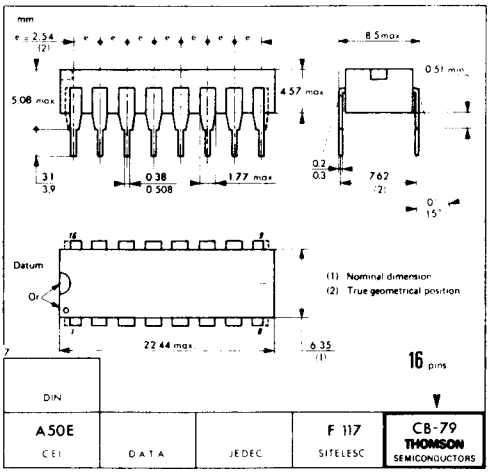


VOLTAGE FOLLOWER TRANSIENT RESPONSE

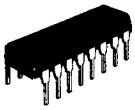


TRANSIENT RESPONSE TEST CIRCUIT

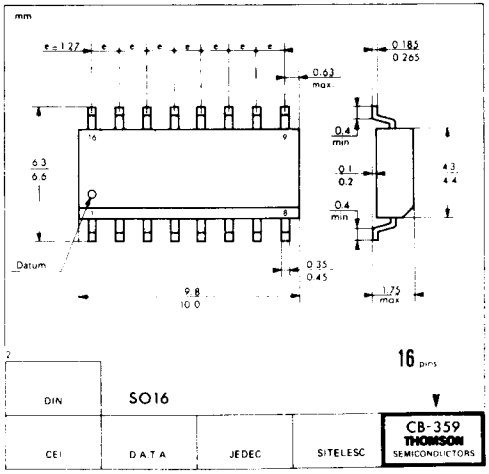




CB-79



DP SUFFIX
PLASTIC PACKAGE
DG SUFFIX
CERDIP PACKAGE

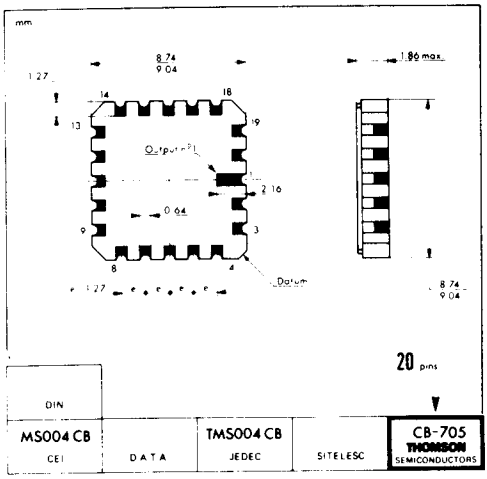


CB-359

FP SUFFIX
PLASTIC MICROPACKAGE

CB-705

GC SUFFIX
TRICECOP (LCC)



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Please inquire with our sales offices about the availability of the different packages.