

# PROGRAMMABLE QUAD BIPOLAR OPERATIONAL AMPLIFIER

- PROGRAMMABLE ELECTRICAL CHARACTERISTICS
- LOW SUPPLY CURRENT (250µA/amplifier)
- GAIN-BANDWIDTH PRODUCT : 1MHz
- LARGE DC VOLTAGE GAIN : 120dB
- LOW NOISE VOLTAGE : 28nV/√Hz
- WIDE POWER SUPPLY RANGE / ±1.5V to ±22V
- 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-bandwidth 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 = 1mA ( $I_{set} = 10\mu A$ )

Gain bandwidth product = 1MHz ( $I_{set} = 10\mu A$ )

Slew rate = 0.5V/µs ( $I_{set} = 10\mu A$ )

Input bias current ≈ 30nA ( $I_{set} = 10\mu A$ )

$I_{set}$  = current into pin 8 and pin 9 (see schematic diagram)

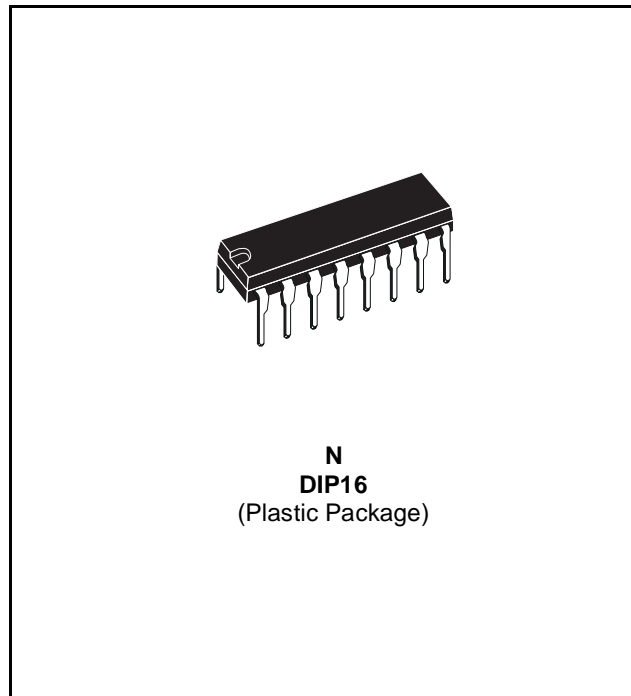
$$I_{set} = \frac{V_{CC+} - V_{CC-} - 0.6V}{R_{set}}$$

## ORDER CODE

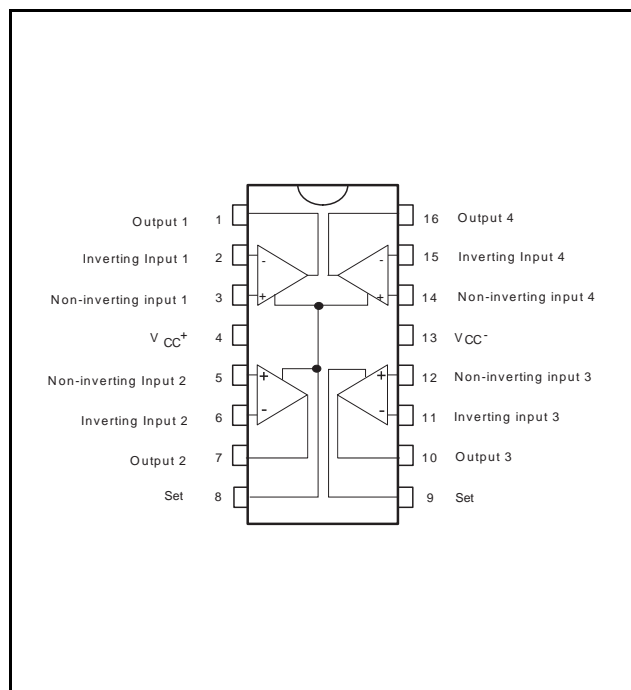
Part Number	Temperature Range	Package
		N
LM146	-55°C, +125°C	•
LM246	-40°C, +105°C	•
LM346	0°C, +70°C	•
<b>Example : LM246N</b>		

N = Dual in Line Package (DIP)

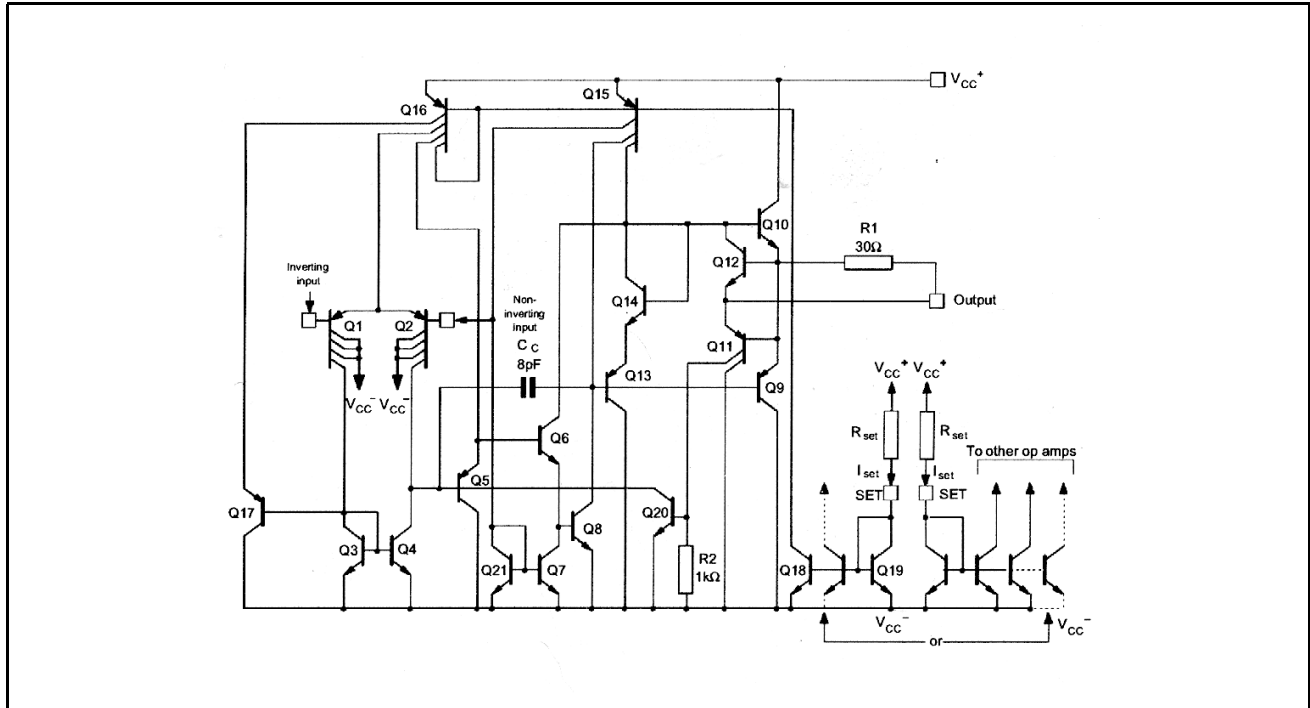
April 2003



## PIN CONNECTIONS (top view)



**SCHEMATIC DIAGRAM (1/4 LM146)**



**ABSOLUTE MAXIMUM RATINGS**

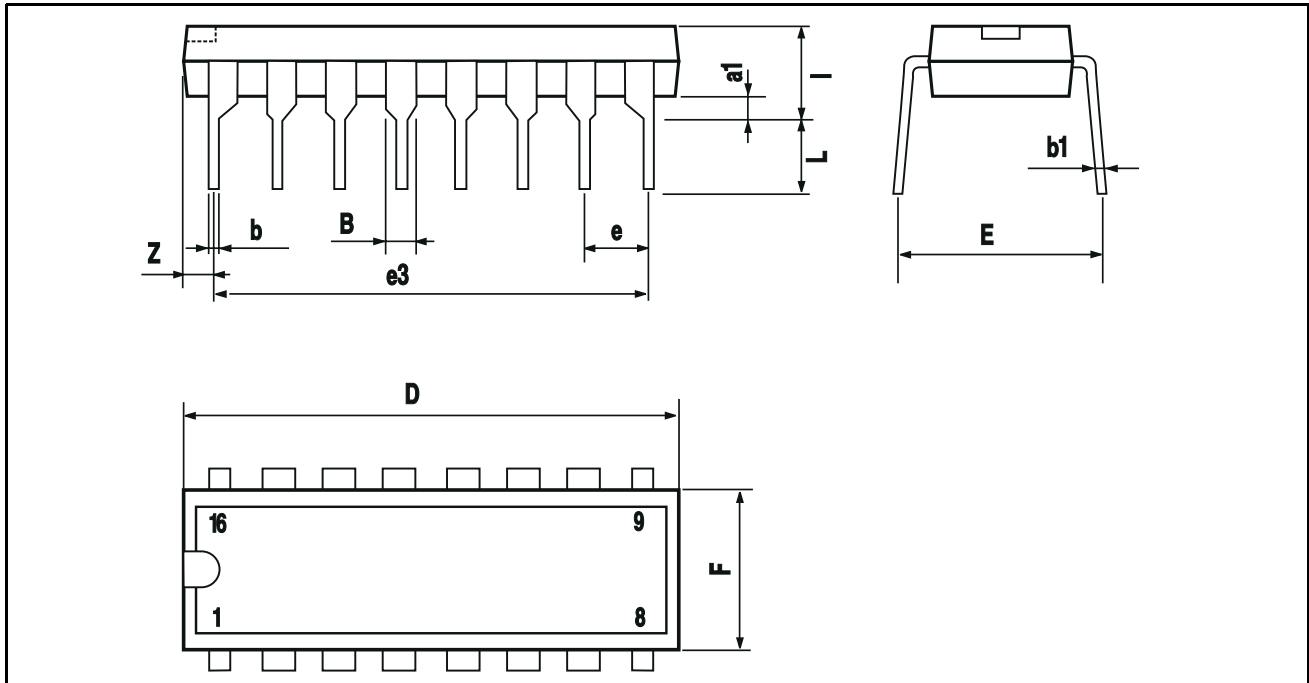
Symbol	Parameter	Value	Unit
$V_{CC}$	Supply voltage	$\pm 22$	V
$V_i$	I Input Voltage <sup>1)</sup>	$\pm 15$	V
$V_{id}$	Differential Input Voltage	$\pm 30$	V
	Output Short-circuit Duration <sup>2)</sup>	Infinite	
$P_{tot}$	Power Dissipation	500	mW
$T_{oper}$	Operating Free-air Temperature Range	LM146 LM246 LM346	$^{\circ}C$
$T_{stg}$	Storage Temperature Range	-65 to +150	$^{\circ}C$

1. For supply voltage less than  $\pm 15V$ , 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 will be exceeded.

**ELECTRICAL CHARACTERISTICS** $V_{CC^+} = \pm 15V$ ,  $I_{set} = 10\mu A$ ,  $T_{amb} = +25^\circ C$  (unless otherwise specified)

Symbol	Parameter	LM146			LM246 - LM346			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
$V_{io}$	Input Offset Voltage ( $R_s \leq 10k\Omega$ ) $T_{amb} = 25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$		0.5	3 5		0.5	5 6	mV
$I_{io}$	Input Offset Current $T_{amb} = 25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$		2	20 25		2	100 100	nA
$I_{ib}$	Input Bias Current $T_{amb} = 25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$		30	100 100		30	250 250	nA
$A_{vd}$	Large Signal Voltage Gain ( $V_o = \pm 10V$ , $R_L = 10k\Omega$ ) $T_{amb} = 25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$	100 50	1000		50 25	1000		V/mV
SVR	Supply Voltage Rejection Ratio ( $R_s \leq 10k\Omega$ ) $T_{amb} = 25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$	80 80	110		80 80	110		dB
$I_{cc}$	Supply Current, all Amp, no load $T_{amb} = 25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$		1	2 2		1	2 2	mA
$V_{icm}$	Input Common Mode Voltage Range $T_{amb} = 25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$	$\pm 13.5$ $\pm 13.5$			$\pm 13.5$ $\pm 13.5$			
CMR	Common Mode Rejection Ratio ( $R_s \leq 10k\Omega$ ) $T_{amb} = 25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$	80 70	110		80 70	110		dB
$I_{os}$	Output Short-circuit Current $T_{amb} = 25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$	10 4	20	30 35	10 4	20	30 35	mA
$\pm V_{opp}$	Output Voltage Swing ( $R_L \leq 10k\Omega$ ) $T_{amb} = 25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$	12 12	14		12 12	14		V
SR	Slew Rate ( $V_I = \pm 10V$ , $R_L = 10k\Omega$ , $C_L = 100pF$ , unity Gain)	0.3	0.5		0.3	0.5		V/ $\mu s$
$R_I$	Input Resistance		1			1		M $\Omega$
$C_I$	Input Capacitance		2			2		pF
$V_{o1}/V_{o2}$	Channel Separation ( $R_L = 10k\Omega$ , $V_o = 12V_{pp}$ )		120			120		dB
GBP	Gain Bandwidth Product ( $V_I = 10 mV$ , $R_L = 10k\Omega$ , $C_L = 100pF$ , $f = 100kHz$ )	0.8	1		0.5	1		MHz
THD	Total Harmonic Distortion ( $f = 1kHz$ , $A_v = 20dB$ , $R_L = 10k\Omega$ , $C_L = 100pF$ , $V_o = 2V_{pp}$ )		0.015			0.015		%
$e_n$	Equivalent Input Noise Voltage ( $f = 1kHz$ , $R_s = 100\Omega$ )		28			28		$\frac{nV}{\sqrt{Hz}}$

**PACKAGE MECHANICAL DATA**  
16 PINS - PLASTIC PACKAGE



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050

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