

# Low Voltage Audio Power AMP

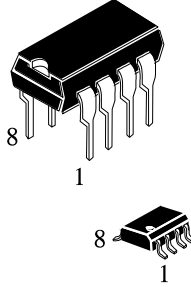
**IL386**

The IL386 is a power amplifier designed for use in low voltage consumer applications. The gain is internally set to 20 to keep external part count low, but the addition of an external resistor and capacitor between pins 1 and 8 will increase the gain to any value up to 200.

The inputs are ground referenced while the output is automatically biased to one half the supply voltage. The quiescent power drain is only 24 mW when operating from a 6 volt supply, making the IL386 ideal for battery operation.

## FEATURES

- Battery Operation
- Minimum External Parts
- Wide Supply Voltage Range: 4 V - 12 V
- Low Quiescent Current Drain: 4 mA
- Voltage Gains from 20 to 200
- Ground Referenced Input
- Self-Centering Output Quiescent Voltage
- Low Distortion
- Eight Pin Dual-In-Line Package



N SUFFIX  
PLASTIC

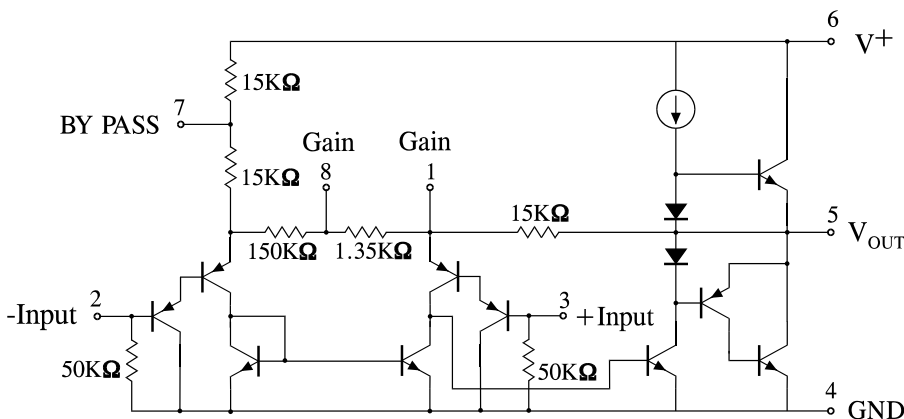
D SUFFIX  
SOIC

**ORDERING INFORMATION**  
IL386N Plastic  
IL386D SOIC  
T<sub>A</sub> = 0° to 70° C for all package

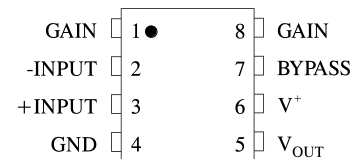
## ORDERING INFORMATION

Device	Operating Temperature Range	Package	Packing
IL386N	T <sub>A</sub> = 0° to 70° C	DIP-8	Tube
IL386D		SO-8	Tube
IL386DT		SO-8	Tape & Reel

## SCHEMATIC DIAGRAM



## PIN ASSIGNMENT



## MAXIMUM RATINGS\*

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	15	V
V <sub>IN</sub>	Input Voltage	±0.4	V
P <sub>D</sub>	Power Dissipation	1.25	W
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C
T <sub>J</sub>	Junction Temperature	+150	°C
T <sub>L</sub>	Lead Temperature	+300	°C

\* Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V <sub>CC</sub>	Supply Voltage	4.0	12	V
T <sub>A</sub>	Operating Temperature, All Package Types	0	+70	°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V<sub>IN</sub> and V<sub>OUT</sub> should be constrained to the range GND ≤ (V<sub>IN</sub> or V<sub>OUT</sub>) ≤ V<sub>CC</sub>.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V<sub>CC</sub>). Unused outputs must be left open.

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)

Symbol	Parameter	Test Conditions	Guaranteed Limits			Unit
			Min	Typ	Max	
V <sup>+</sup>	Operating Supply Voltage		4		12	V
I <sup>+</sup>	Quiescent Current	V <sup>+</sup> = 6 V, V <sub>IN</sub> = 0			8	mA
P <sub>O</sub>	Output Power	V <sup>+</sup> = 6V, R <sub>L</sub> = 8Ω, THD=10% V <sup>+</sup> = 9V, R <sub>L</sub> = 8Ω, THD=10%	250 500	325 1000		mW
A <sub>V</sub>	Voltage Gain	V <sup>+</sup> = 6V, f=1kHz 10μF from Pin 1 and 8	24 44	26 46	28 48	dB
BW	Bandwidth	V <sup>+</sup> = 6V, Pins 1 and 8 Open	250			KHz
THD	Total Harmonic Distortion	V <sup>+</sup> = 6V, R <sub>L</sub> = 8Ω, P <sub>OUT</sub> =125mW, f=1kHz, Pins 1 and 8 Open			1.0	%
PSRR	Power Supply Rejection Ratio	V <sup>+</sup> = 6V, f=1kHz, C <sub>BYPASS</sub> =10μF, Pins 1 and 8 Open		45		dB
R <sub>IN</sub>	Input Resistance		30		130	KΩ
I <sub>B</sub>	Input Bias Current	V <sup>+</sup> = 6V, Pins 2 and 3 Open		250	400	nA

**ELECTRICAL CHARACTERISTICS** ( $T_A = 0 \sim 70^\circ\text{C}$ )

Symbol	Parameter	Test Conditions	Guaranteed Limits			Unit
			Min	Typ	Max	
$V^+$	Operating Supply Voltage		4		12	V
$I^+$	Quiescent Current	$V^+ = 6\text{ V}, V_{IN} = 0$			8	mA
$P_O$	Output Power	$V^+ = 6\text{ V}, R_L = 8\Omega, \text{THD} = 10\%$ $V^+ = 9\text{ V}, R_L = 8\Omega, \text{THD} = 10\%$	220 480	325 1000		mW
$A_V$	Voltage Gain	$V^+ = 6\text{ V}, f = 1\text{ kHz}$ 10 $\mu\text{F}$ from Pin 1 and 8	22 42	26 46	30 50	dB
BW	Bandwidth	$V^+ = 6\text{ V}$ , Pins 1 and 8 Open	250			KHz
THD	Total Harmonic Distortion	$V^+ = 6\text{ V}, R_L = 8\Omega, P_{OUT} = 125\text{ mW}$ , $f = 1\text{ kHz}$ , Pins 1 and 8 Open			1.5	%
PSRR	Power Supply Rejection Ratio	$V^+ = 6\text{ V}, f = 1\text{ kHz}, C_{BYPASS} = 10\mu\text{F}$ , Pins 1 and 8 Open		45		dB
$R_{IN}$	Input Resistance		20		150	K $\Omega$
$I_B$	Input Bias Current	$V^+ = 6\text{ V}$ , Pins 2 and 3 Open		250	600	nA

**APPLICATION INFORMATION****GAIN CONTROL**

To make the IL386 a more versatile amplifier, two pins (1 and 8) are provided for gain control. With pins 1 and 8 open the 1.35 K $\Omega$  resistor sets the gain at 20 (26 dB). If a capacitor is put from pin 1 to 8, bypassing the 1.35 K $\Omega$  resistor, the gain will go up to 200 (46 dB). If a resistor is placed in series with the capacitor, the gain can be set to any value from 20 to 200. Gain control can also be done by capacitively coupling a resistor (or FET) from pin 1 to ground.

Additional external components can be placed in parallel with the internal feedback resistors to tailor the gain and frequency response for individual applications. For example, we can compensate poor speaker bass response by frequency shaping the feedback path. This is done with a series RC from pin 1 to 5 (paralleling the internal 15 K $\Omega$  resistor). For 6 dB effective bass boosts:  $R \approx 15\text{ K}\Omega$ , the lowest value for good stable operation is  $R = 10\text{ K}\Omega$  if pin 8 is open. If pins 1 and 8 are bypassed then R as low as 2 K $\Omega$  can be used. This restriction is because the amplifier is only compensated for closed-loop gains greater than 9.

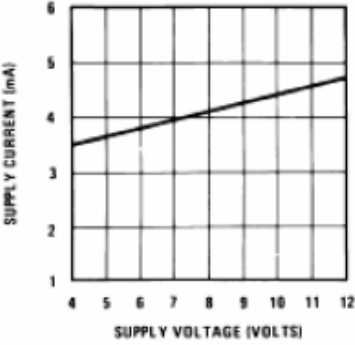
**INPUT BIASING**

The schematic shows that both inputs are biased to ground with a 50 K $\Omega$  resistor. The base current of the input transistors is about 250 nA, so the inputs are at about 12.5 mV when left open. If the dc source resistance driving the IL386 is higher than 250 K $\Omega$  it will contribute very little additional offset (about 2.5 mV at the input, 50 mV at the output). If the dc source resistance is less than 10 K $\Omega$ , then shorting the unused input to ground will keep the offset low (about 2.5 mV at the input, 50 mV at the output). For dc source resistances between these values we can eliminate excess offset by putting a resistor from the unused input to ground, equal in value to the dc source resistance. Of course all offset problems are eliminated if the input is capacitively coupled.

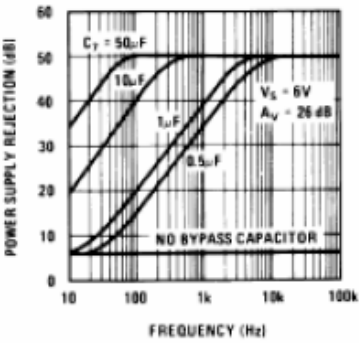
When using the IL386 with higher gains (by bypassing the 1.35 K $\Omega$  resistor between pins 1 and 8) it is necessary to bypass the unused input, preventing degradation of gain and possible instabilities. This is done with a 0.1  $\mu\text{F}$  capacitor or a short to ground depending on the dc source resistance on the driven input.

TYPICAL PERFORMANCE CHARACTERISTICS

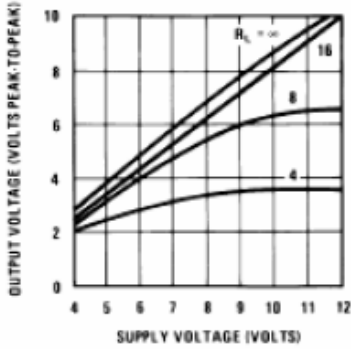
Quiescent Supply Current vs Supply Voltage



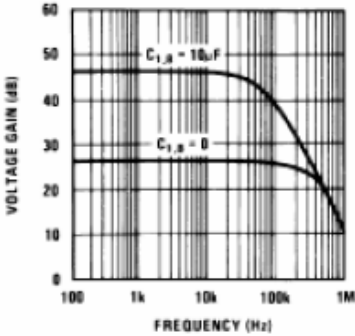
Power Supply Rejection Ratio (Referred to the Output) vs Frequency



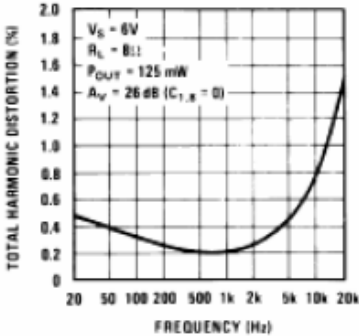
Peak-to-Peak Output Voltage Swing vs Supply Voltage



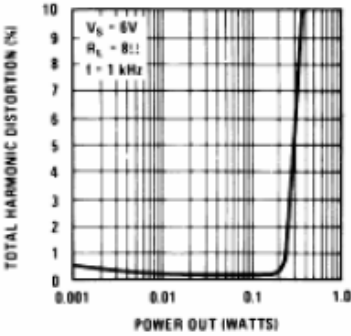
Voltage Gain vs Frequency



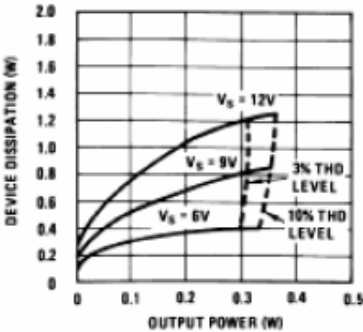
Distortion vs Frequency



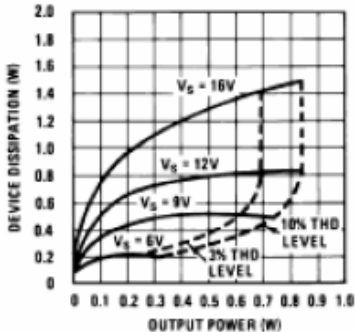
Distortion vs Output Power



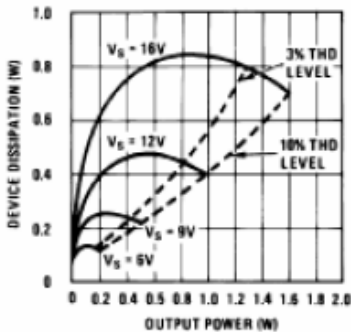
Device Dissipation vs Output Power—4Ω Load



Device Dissipation vs Output Power—8Ω Load

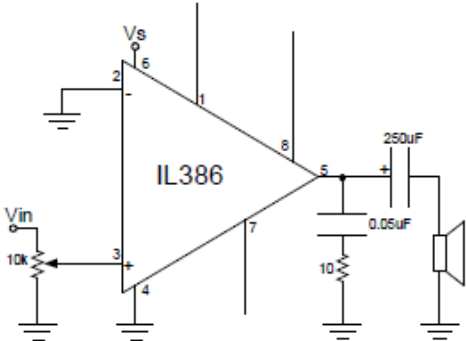


Device Dissipation vs Output Power—16Ω Load

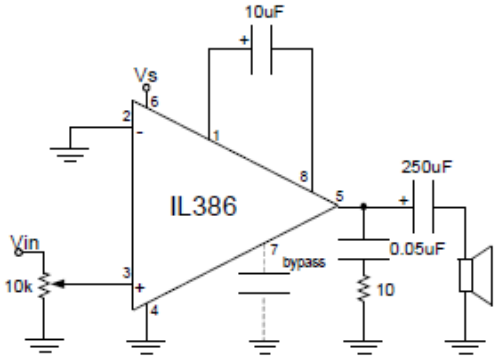


TYPICAL APPLICATION

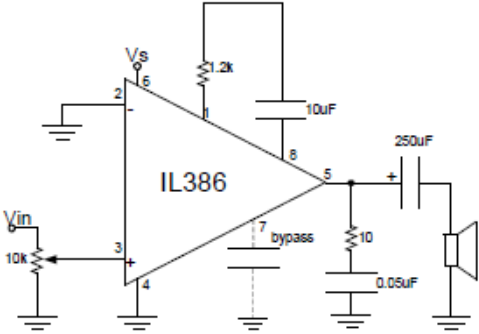
Amplifier with Gain=20  
Minimum Parts



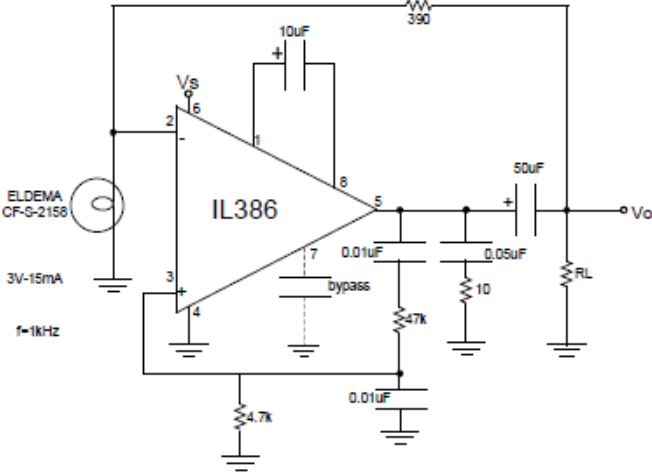
Amplifier with Gain=200



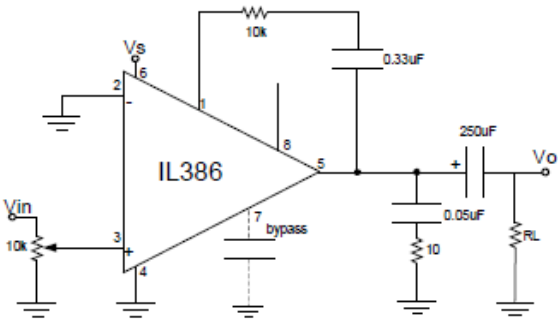
Amplifier with Gain=50



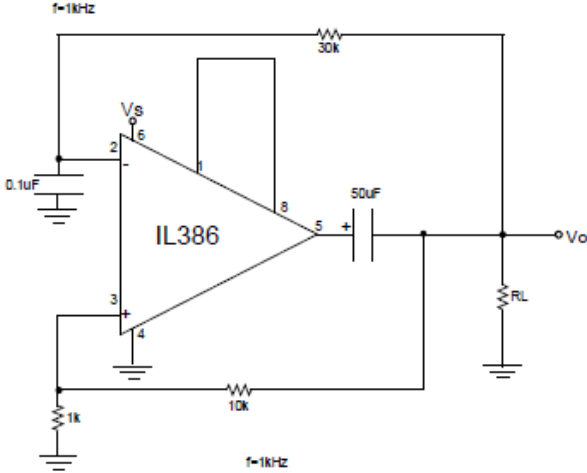
Low Distortion Power Weinbridge Oscillator



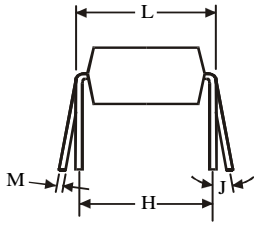
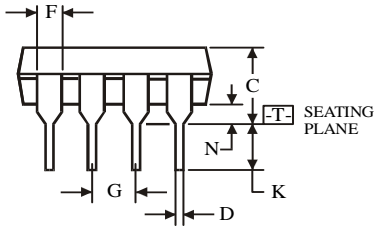
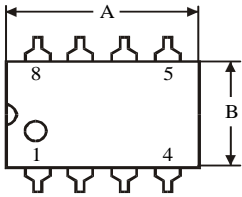
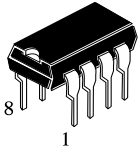
Amplifier with Bass Boost



Square Wave Oscillator



**N SUFFIX PLASTIC DIP  
(MS - 001BA)**



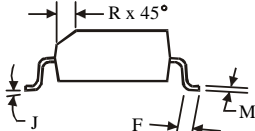
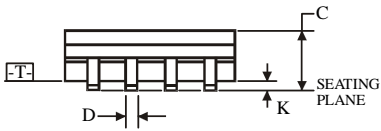
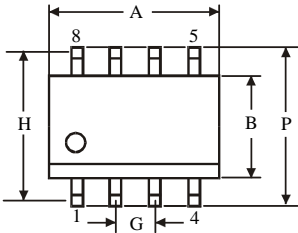
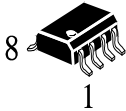
$\oplus 0.25 (0.010) \text{ (M) T}$

Symbol	Dimension, mm	
	MIN	MAX
A	8.51	10.16
B	6.1	7.11
C		5.33
D	0.36	0.56
F	1.14	1.78
G	2.54	
H	7.62	
J	0°	10°
K	2.92	3.81
L	7.62	8.26
M	0.2	0.36
N	0.38	

**NOTES:**

- Dimensions "A", "B" do not include mold flash or protrusions.  
Maximum mold flash or protrusions 0.25 mm (0.010) per side.

**D SUFFIX SOIC  
(MS - 012AA)**



$\oplus 0.25 (0.010) \text{ (M) T C (M)}$

Symbol	Dimension, mm	
	MIN	MAX
A	4.8	5
B	3.8	4
C	1.35	1.75
D	0.33	0.51
F	0.4	1.27
G	1.27	
H	5.72	
J	0°	8°
K	0.1	0.25
M	0.19	0.25
P	5.8	6.2
R	0.25	0.5

**NOTES:**

- Dimensions A and B do not include mold flash or protrusion.
- Maximum mold flash or protrusion 0.15 mm (0.006) per side for A; for B - 0.25 mm (0.010) per side.

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