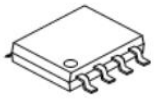
Low voltage audio power amplifier

Description

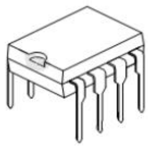
- The LM386 audio power amplifier is primarily used in low-voltage consumer products. To minimize external components, the voltage gain is internally set to 20. However, by adding an external resistor and capacitor between pins 1 and 8, the voltage gain can be adjusted to any value up to 200.
- The input is referenced to ground, while the output is automatically biased to half of the supply voltage. At a 6V supply voltage, its static power consumption is only 24mW, making the LM386 particularly suitable for battery-powered applications.
- The LM386 is available in DIP8 and SOP8 packages.

Package outline



SOP-8

LM386M-1



DIP-8

LM386N-1

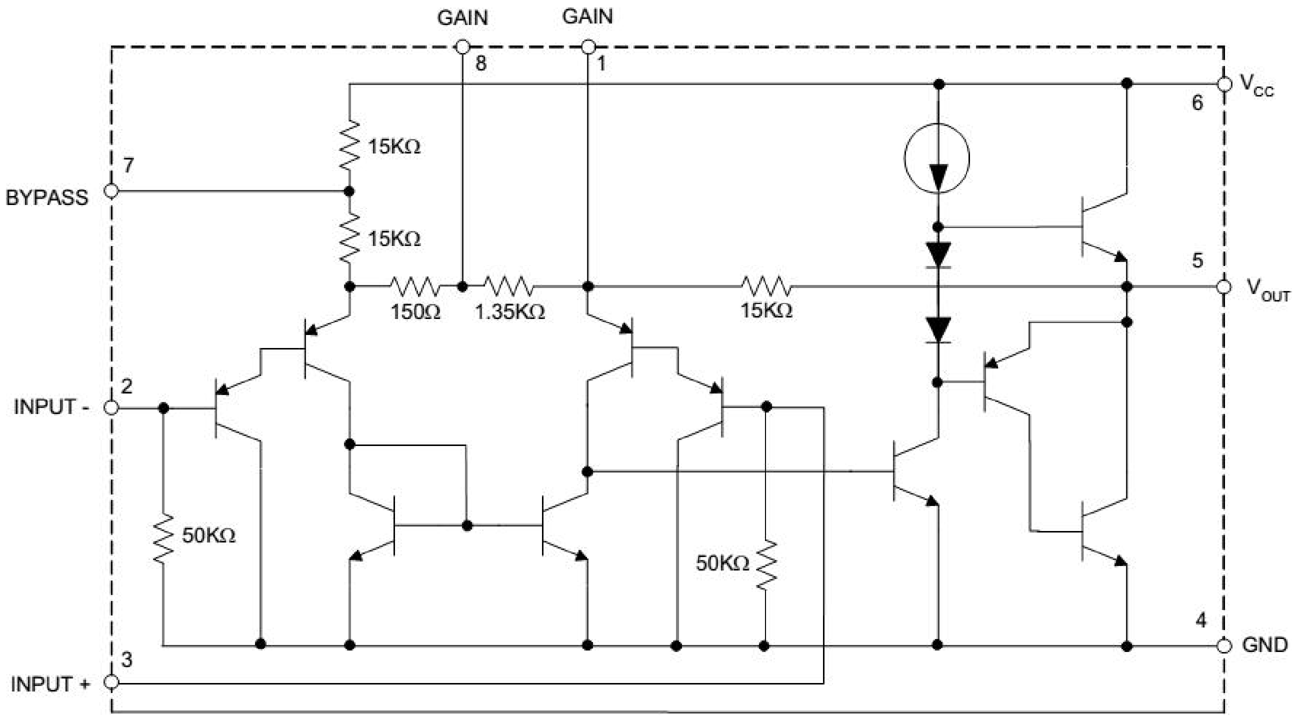
Features

- Low quiescent power consumption for battery operation
- Adjustable voltage gain from 20 to 200
- Wide supply voltage range, V_{CC} = 4 to 12V
- Minimal external components
- Low distortion

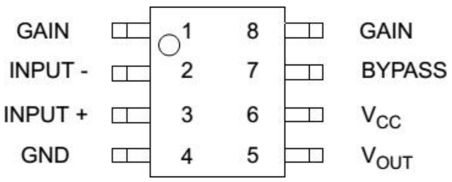
Applications

- AM/FM radio audio amplifier
- Line driver
- Portable recorder audio power amplifier
- Ultrasonic driver
- Hands-free telephone speaker system
- Small servo driver
- Television audio system
- Power converter

Electrical Schematic



Pin Distribution



Pin Function Symbol

Pin	Symbol	Pin	Symbol
1	gain	5	V_{OUT}
2	input-	6	V_{CC}
3	input+	7	bypass
4	GND	8	GAIN

Limit parameters （T_{amb}=25℃）

Parameter	Symbol	Value	Unit
maximum input voltage	V_{IN}	±0.4	V
voltage	V_{CC}	15	V
maximum allowable power consumption	P_D	660	mW
soldering temperature (10 seconds)	T_S	260	℃
junction temperature	T_J	150	℃
operating temperature	T_{amb}	0~70	℃
storage temperature	T_{STG}	-40~125	℃

Electrical properties: (V_{CC}=6V , R_L=8Ω , f=1kHz , T_{amb}=25℃)

Parameter	Conditions	Symbol	Value			Unit
			Min.	Type	Max.	
voltage		V_{CC}	4		12	V
quiescent supply current	V_{CC}=6V,V_{IN}=0	I_{CC}	-	4	8	mA
output power	V_{CC}=6V, R_L=8,THD=10%	P_O	250	325	-	mW
	V_{CC}=9V, R_L=8,THD=10%		500	700	-	
voltage gain	V_{CC}=6V,f=1kHz	A_V	-	26	-	dB
	Connect a 10μF capacitor between pins 1 and 8		-	46	-	
bandwidth	V_{CC}= 6V, pins 1 and 8 are open circuit	BW	-	300	-	kHz
total harmonic distortion	V_{CC}= 6V,R_L = 8Ω,P_O= 125mW,f = 1kHz, pins 1 and 8 are open circuit	THD	-	0.2	-	%
power supply ripple rejection ratio	V_{CC}=6V,f=1kHz,C_{BYPASS}=10μF, Pins 1 and 8 are open circuit, with the output as a reference	PSRR		50		dB
input resistance		R_{IN}	-	50	-	kΩ
input bias current	V_{CC}=6V,Pins 2 and 3 are open circuit.	IB	-	250	-	nA

Application diagram:

Fig.1 Amplifier Gain = 20 (Minimum Components)

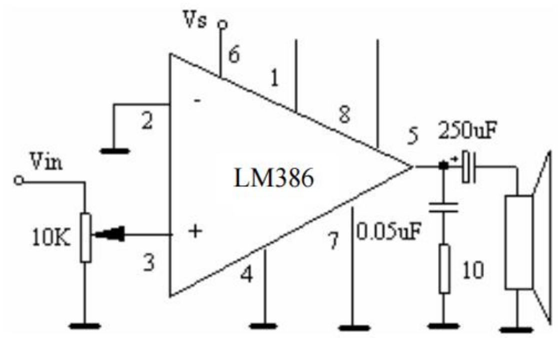


Fig.2 Amplifier Gain = 200

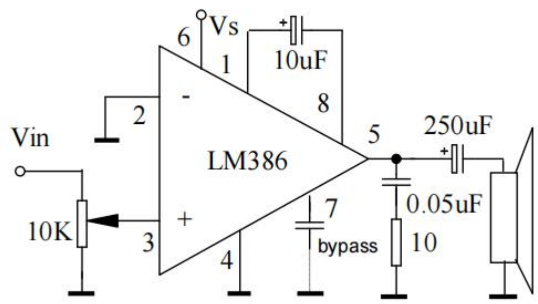


Fig.3 Amplifier Gain = 50

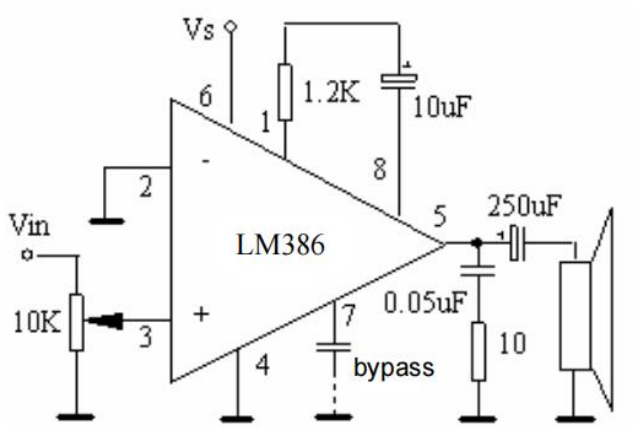


Fig.4 Square Wave Oscillator

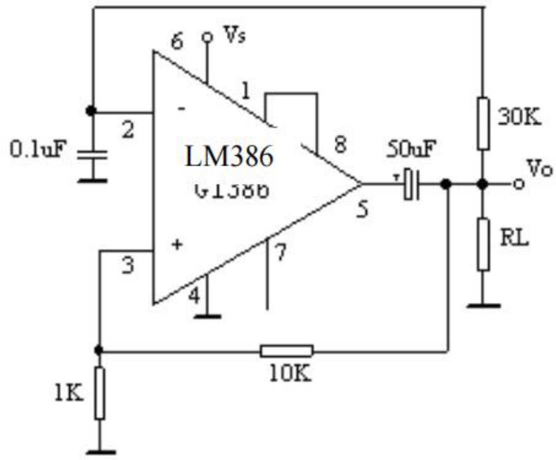


Fig.5 Low Frequency Boost Amplifier

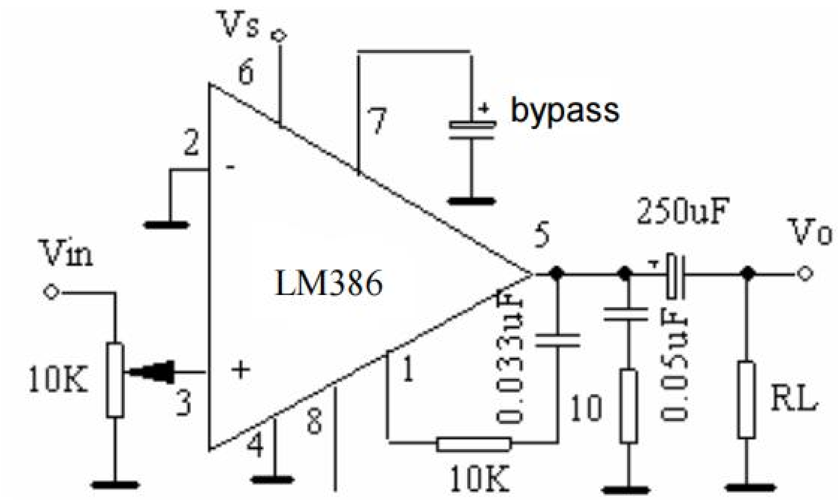
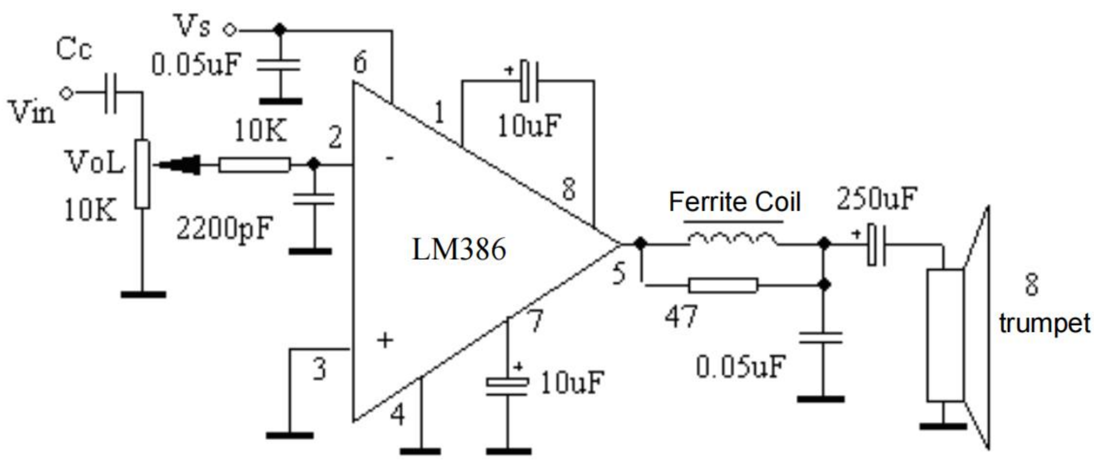


Fig.6 AM Radio Audio Amplifier



Application points:

Gain control

To enhance flexibility in using the LM386, two gain control pins (pins 1 and 8) are provided. When pins 1 and 8 are open circuit, a 1.35kΩ resistor sets the gain to 20 (26dB). Connecting a capacitor across the 1.35kΩ resistor increases the gain to 200 (46dB). By serially adding a resistor and capacitor, the gain can be adjusted continuously between 20 and 200. Gain control can also be achieved by AC-coupling a resistor (FET) between pin 1 and ground.

In some special applications, external RC components can be connected in parallel with the internal negative feedback resistor to adjust the gain and frequency response. For example, I can compensate for the low sensitivity of the speaker in the low frequency band by improving the negative feedback frequency response network. This can be achieved by connecting an RC series network between pins 1 and 5 (in parallel with the internal 15k resistor). For an effective low-frequency boost of 6dB: R15k When pin 8 is open, the minimum value of R that can ensure stable operation is R=10k. If there is a bypass capacitor between pins 1 and 8, the minimum value of R is reduced to R=2k. The reason for this limitation is that the internal compensation of the amplifier is only to a closed-loop gain greater than 9.

Input bias

From the internal equivalent circuit, we can see that there is a 50k resistor connected to the ground at each of the two input terminals, and the base current of the input transistor is about 250nA, so there is about 12.5mV voltage at the input terminal when it is open circuit. When the internal resistance of the DC signal source driving the LM386 is greater than 250k, it will produce a very small additional offset (about 2.5mV at the input terminal and about 50mV at the output terminal). When the internal resistance of the DC signal source is between the above two, we can eliminate the additional offset by connecting a resistor as large as the internal resistance of the signal source between the unused input terminal and the ground. Of course, when the input terminal is AC coupled, the additional offset voltage problem mentioned above does not exist.

When the LM386 is used in a higher voltage gain (1.35k resistor bypass between pins 1 and 8), the unused input must be bypassed to prevent gain reduction and possible unstable operation. This can be achieved by connecting a 0.1F capacitor to ground or shorting it directly to ground, depending on the internal resistance of the DC signal source.