DATA FILE

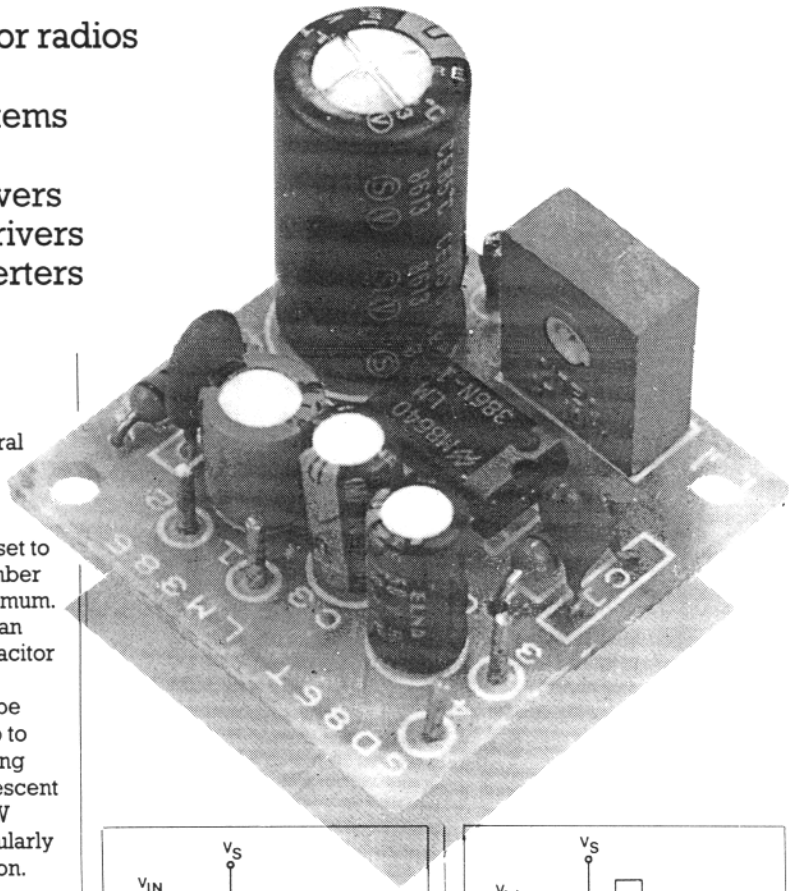
LM386 LOW VOLTAGE POWER AMP

Features

- ★ PCB available
- ★ Suited to battery operation
- ★ Low quiescent current drain (6mA)
- ★ Broad supply voltage range (4V to 12V)
- ★ Minimum number of external parts
- ★ Adjustable voltage gain from 20 to 200
- ★ Ground referenced input
- ★ Low level of distortion
- ★ Self-centring quiescent output voltage
- ★ Eight pin DIL package

Applications

- ★ AF amplifier for radios
- ★ Intercoms
- ★ TV sound systems
- ★ Line drivers
- ★ Ultrasonic drivers
- ★ Small servo drivers
- ★ Voltage converters



General Description

The LM386 is a general purpose power amplifier designed for use in low voltage applications. The voltage gain is internally set to 20 (26dB) to keep the number of external parts to a minimum. However, the addition of an external resistor and capacitor between pins 1 and 8 will allow the voltage gain to be increased to any value up to 200 (46dB). When operating from a 6V supply the quiescent power drain is only 36mW making the LM386 particularly useful for battery operation.

Application Hints

To make the LM386 more versatile, two pins (1 and 8) are provided for gain control. If pin 1 and pin 8 are left open, as in Figure 1, the internal 1.35kΩ resistor sets the voltage gain to 20 (26dB). By connecting a capacitor from pin 1 to pin 8, as in Figure 2, bypassing the internal resistor, the voltage gain can be increased to 200 (46dB). The voltage gain may be set to any value between 20 and 200 by connecting a resistor in series with the capacitor, see Figure 3. Gain control may also be achieved by capacitively coupling a FET or resistor from pin 1 to ground. It is possible to connect external components in parallel with the internal feedback resistors to tailor the gain and frequency response for different applications; for example the bass response may be effectively increased by connecting a capacitor and resistor in series between pin 1 and pin 5, see Figure 4. A resistor value of 15kΩ will produce an effective bass boost of approximately 6dB. The lowest resistor value for stable operation is 10kΩ if pin 8 is open because the amplifier is only compensated for closed loop gains greater than 9; values as low as 2kΩ can be used if pin 1 and pin 8 have been bypassed.

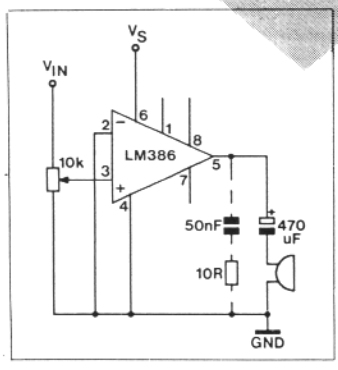


Figure 1. Amplifier with gain of 20 (26dB).

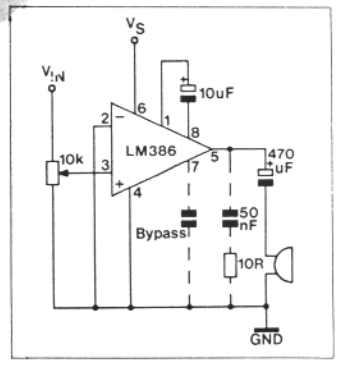


Figure 2. Amplifier with gain of 200 (46dB).

Power Supply Requirements

The LM386 will operate over a wide range of voltages between 4V and 12V making it ideal for battery operation, the optimum voltage for minimum distortion being around 6V. If the LM386 is used with a mains derived DC power supply it is important that the supply rail is adequately decoupled to

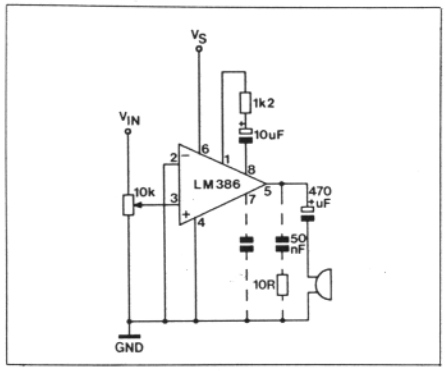
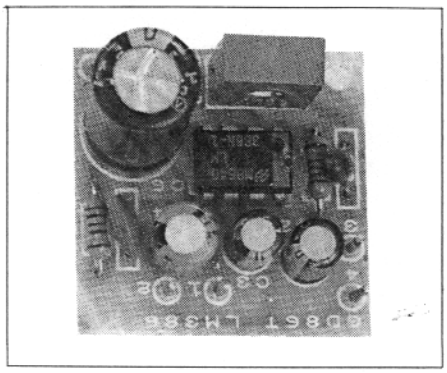


Figure 3. Amplifier with gain of 50 (34dB).



An assembled pcb.

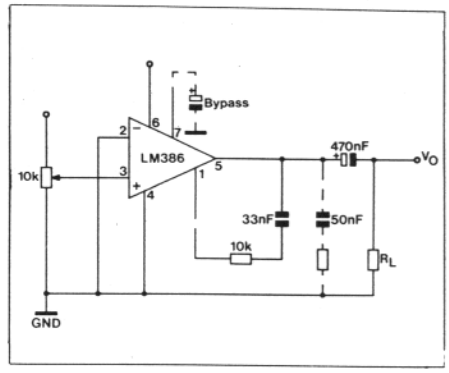


Figure 4. Amplifier with bass boost.

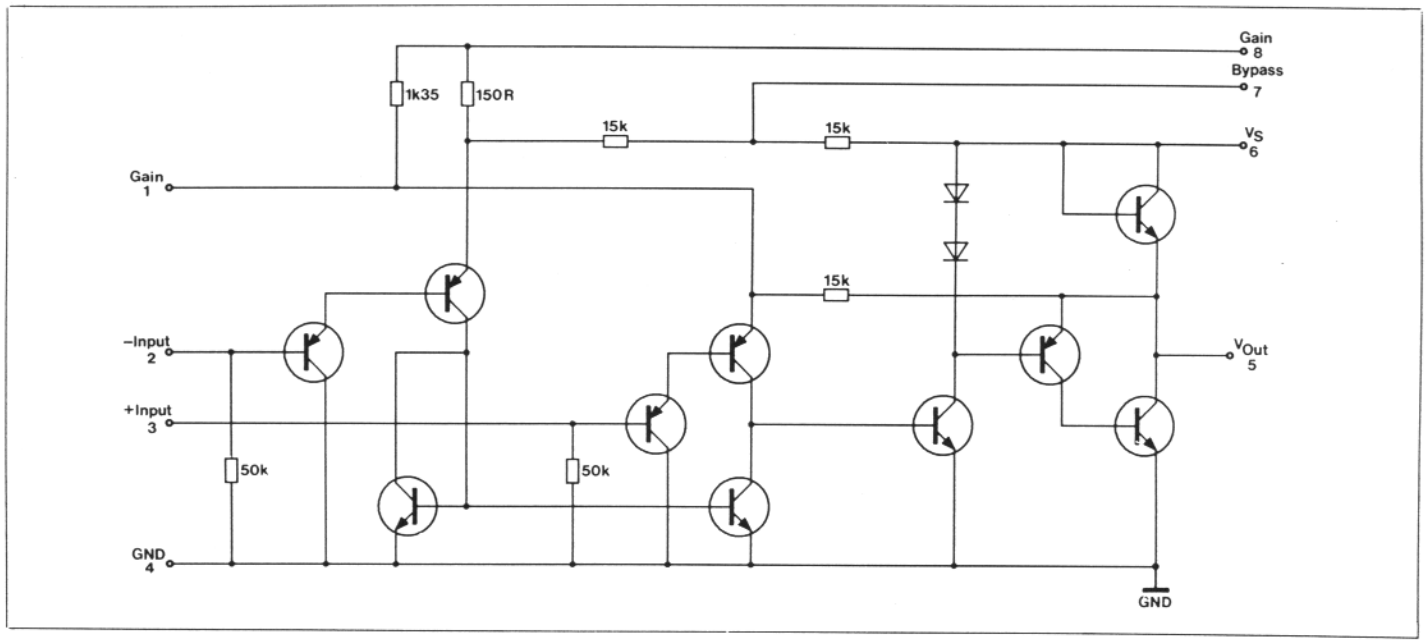


Figure 5. IC schematic diagram.

prevent the introduction of mains derived noise into the amplifier. Decoupling close to the IC is also necessary, to prevent any high frequency instability.

Input Biasing

Referring to the IC schematic, Figure 5, it may be seen that both inputs are biased to ground with a 50kΩ resistor. The base current of the input transistors is around 250nA, so the inputs are at approximately 12.5mV when left open. If the DC source resistance driving the LM386 is higher than 250kΩ there will be very little additional DC offset. Where the DC source resistance is less than 10kΩ, the unused input can be shorted to ground to keep the offset low. For DC source resistances between these values any excess offset may be eliminated by connecting a resistor equal in value to the DC source resistance, between the unused input and ground. When using the LM386 with higher gains it is necessary to bypass the unused input to prevent degradation of gain or any possible instability; this may be achieved by connecting a 0.1μF capacitor or a short (depending on the DC source resistance on the driven input) from the unused input to ground.

Printed Circuit Board

A high quality fibreglass PCB, with printed legend is available as an aid to construction of the basic LM386 amplifier circuit. Referring to Figure 6, the power supply is connected between P1 (+V) and P2 (0V), the optimum voltage being around 6V (see Table 1). Input signals are applied between P3 and P4 and the output is taken from P5 and P6 (the amplifier will operate satisfactorily into an 8Ω load). The overall voltage gain of the amplifier is set by RV1, the

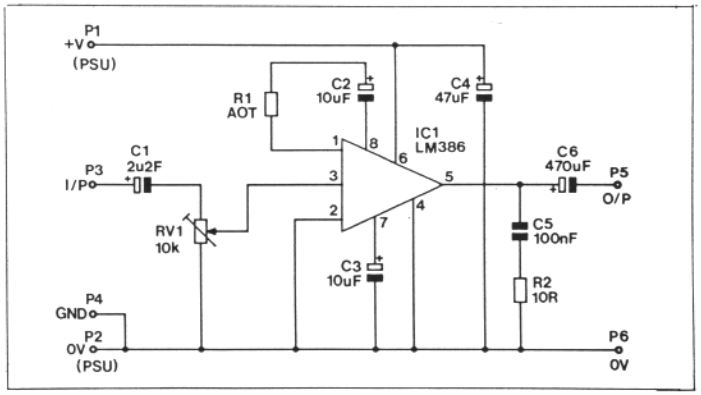


Figure 6. Module circuit diagram.

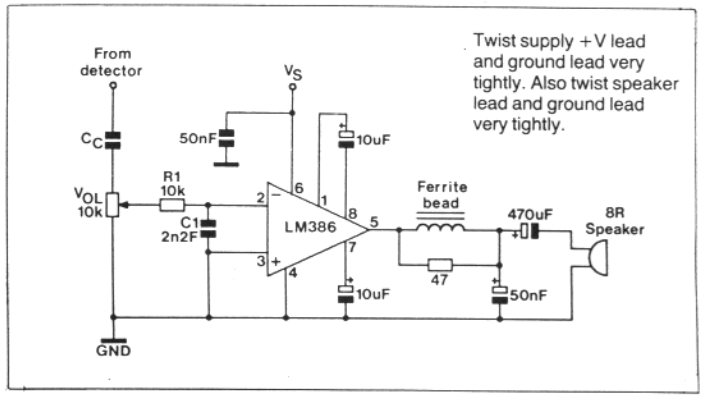


Figure 7. Power amplifier for AM radio.

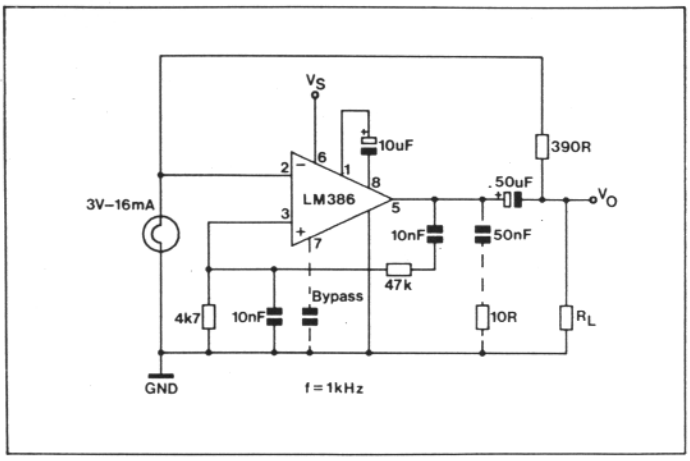


Figure 8. Low distortion power Wien bridge oscillator.

maximum gain being determined by the value of R1. Figures 7 to 9 show various applications and Figure 10 gives details of various functions of the LM386. Pin out information is given in Figure 11. The layout of the PCB is shown in Figure 12.

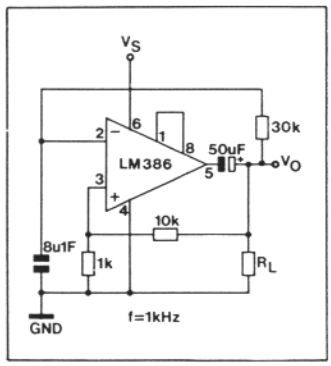


Figure 9. Square wave oscillator.

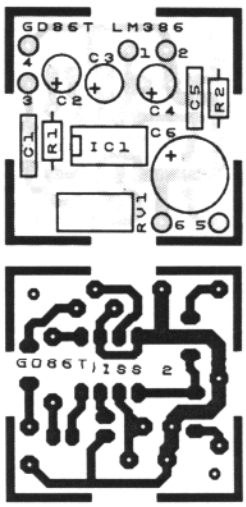


Figure 12. PCB overlay and track.

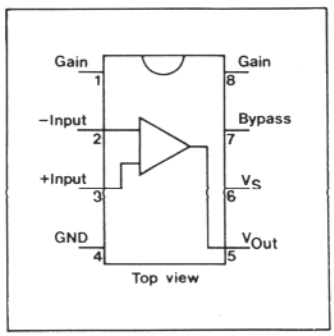


Figure 11. LM386 pinout.

Parameter	Conditions	Min.	Typ.	Max.
Supply voltage (Vs)			4V DC	12V DC
Quiescent current (Iq)	Vs = 6V, Vin = 0V		4mA	8mA
Input resistance (R in)			50kΩ	
Output power (Pout)	Vs = 6V, R1 = 8Ω, THD = 10%	20mW	325mW	
Voltage gain (Av)	Vs = 6V, f = 1kHz 10μF capacitor from pin 1 to pin 8 of IC		26dB	46dB
Bandwidth (BW)	Vs = 6V, pin 1 and pin 8 of IC open		300kHz	
Total Harmonic Distortion (THD)	Vs = 6V, R1 = 8Ω, Pout = 125mW, f = 1kHz pin 1 and pin 8 of IC open		0·2%	
Input Bias Current (I bias)	Vs = 6V, pin 2 and pin 3 open		250nA	

Table 1. Electrical characteristics of LM386.

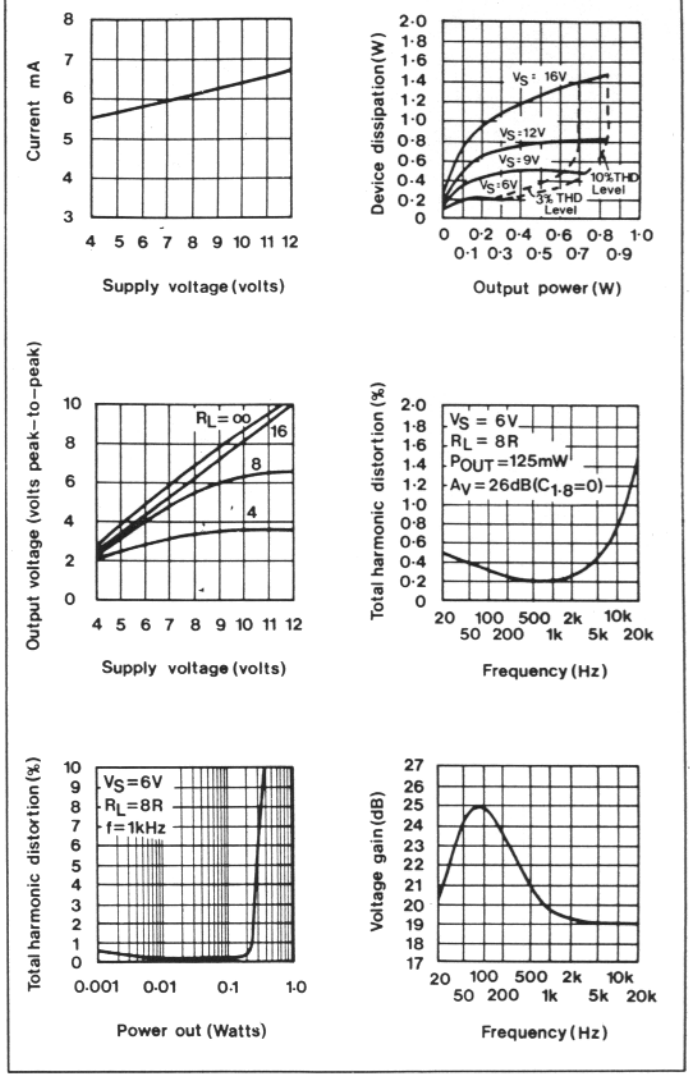


Figure 10 (a). Supply voltage vs quiescent current. (b). Device dissipation vs output (8Ω load). (c). Peak-to-peak output voltage swing vs supply voltage. (d). Distortion vs frequency. (e). Distortion vs output power. (f). Frequency response with bass boost.

LM386 BOARD PARTS LIST

RESISTORS: All 0·6W 1% Metal Film (Unless specified)			
R2	10Ω	1	(M10R)
RV1	10k Vert Enclosed Preset	1	(UH16S)
CAPACITORS			
C1	2μ2F 35V Tantalum	1	(WW62S)
C2,3	10μF 50V PC Electrolytic	2	(FF04E)
C4	47μF 16V Minelect	1	(YY37S)
C5	100nF Minidisc	1	(YR75S)
C6	470μF 16V PC Electrolytic	1	(FF15R)
SEMICONDUCTORS			
IC1	LM386	1	(UJ37S)
MISCELLANEOUS			
	Pin 2145	6	(FL24B)★
	PCB	1	(GD86T)
	Instruction Leaflet		(XU38R)
	Constructors' Guide	1	(XH79L)
OPTIONAL (Not in Kit)			
R1	Select on test	1	

The Maplin 'Get-You-Working' Service is available for this project.

The above items (excluding Optional) are available as a kit.

Order As LM76H (LM386 Kit).

Please Note: Items in the Parts List marked with a ★ are supplied in 'package' quantities (e.g., packet, strip, reel, etc.).

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