Data Sheet

Audio power amplifiers

LM380 RS stock number 306-819
TBA820 M RS stock number 302-491
TDA2030 RS stock number 307-424
TDA2004 RS stock number 309-543

A range of audio power amplifiers with output powers. These versatile devices form the basic building blocks for constructing high quality amplifiers using a minimum of additional components.

LM380

An audio power amplifier with a fixed gain of 50 (34dB). The input stage allows inputs to be ground referenced or ac coupled as required and the output is automatically centred at one half of the supply voltage. The device is protected with both current limiting and thermal shutdown circuity and is housed in a 14 pin DIL package.

Maximum ratings

Supply voltage	22V
Peak current	1.3A
Package dissipation (internally limited)	10W
Input voltage	±0.5V
Max. junction temperature	150°C
Operating temperature range	0 to 70°C

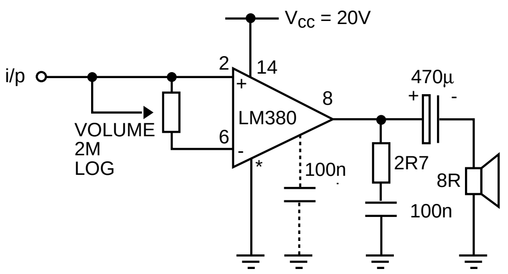
Typical electrical characteristics

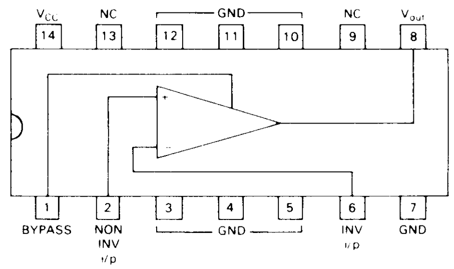
Fixed loop gain	50 (34dB)
Input sensitivity	150mV r.m.s.
Input resistance	150kΩ
Supply voltage range	8 to 22V max.
Bandwidth	100kHz
Quiescent current	7mA

Thermal data

Thermal resistance:	in free air above 25°C	100°C/W
	with 4 sq. in heatsink (PCB)	50°C/W

Figure 1





Note: Non-inv i/p is connected internally to GND via 150 kΩ resistor.

Applications

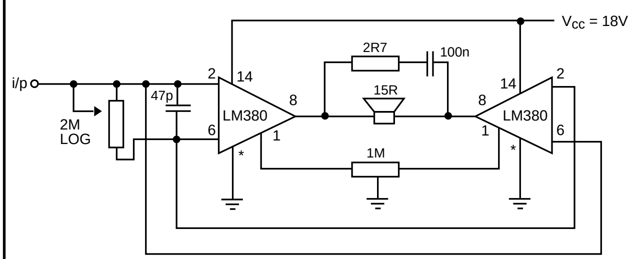
Single ended output amplifier

A simple amplifier can be constructed using only a few external components (P_{out} = 2W V_{CC} = 20V) as shown in Figure 1. The input may be from crystal or ceramic pick-ups, cartridge or microphone, or may be from the LM381.

Bridge amplifier

For an increase in output, two amplifiers may be connected in the configuration shown below. This provides twice the voltage swing across the load for a given supply. A 15Ω load is necessary due to current limitations and therefore the overall output power is increased by a factor of two over the single amplifier.

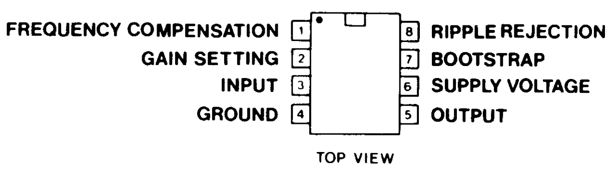
Figure 2



Note:
* Pins 3, 4, 5, and 10, 11, 12 (output ground) and Pin 7 (input ground) should all be connected to supply ground. Two square inches of PCB copper or metal strip connected to the central output ground pins of the IC will provide sufficient heatsinking to enable a 2 Watt output to be obtained at V_{CC} = 20V, Z_o = 8Ω.

TBA 820M

The **RS** TBA 820M is a monolithic integrated audio amplifier in an 8 pin dual-in-line plastic package. Featuring a wide supply voltage range of 3 to 16V, low quiescent current and good ripple rejection, this IC is ideally suited for use in battery powered equipment. Maximum output power is 2W into 8Ω at a supply voltage of 12V.



Absolute maximum ratings

Supply voltage	V_s	16V
Output peak current	I_o	1.5A
Power dissipation at T_{amb} = 50°C	P_{tot}	1W
Storage and junction temperature	T_{stg}, T_j	-40 to 150°C

Thermal data

Thermal resistance junction-ambient $R_{thj\text{-}amb}$ 100°C/W max.

Electrical characteristics V_s = 9V, T_{amb} = 25°C unless otherwise specified

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Supply voltage	V_s			3		16	V
Quiescent output voltage (Pin 5)	V_o			4	4.5 (Vs/2)	5	V
Quiescent drain current	I_d				4	12	mA
Bias current (Pin 3)	I_b				0.1		μA
Output power	P_o	d = 10% R_f = 120Ω	f = 1kHz				
		V_s = 12V	R_L = 8Ω		2		W
		V_s = 9V	R_L = 4Ω		1.6		W
		V_s = 9V	R_L = 8Ω	0.9	1.2		W
		V_s = 6V	R_L = 4Ω		0.75		W
		V_s = 3.5V	R_L = 4Ω		0.25		W
		V_s = 3V	R_L = 4Ω		0.20		W
Input sensitivity	$V_{I(rms)}$	P_o = 1.2W R_L = 8Ω F = 1kHz	R_f = 33Ω		16		mV
			R_f = 120Ω		60		mV
		P_o = 50mW R_L = 8Ω f = 1kHz	R_f = 33Ω		3.5		mV
			R_f = 120Ω		12		mV
Input resistance (Pin 3)	R_I	f = 1kHz			5		MΩ
Frequency response (-3dB)	B	R_L = 8Ω	C_B = 680 pF	25 to 7,000			Hz
		R_f = 120Ω	C_B = 220 pF	25 to 20,000			Hz
Distortion	d	P_o = 500mW R_L = 8Ω f = 1kHz	R_f = 33Ω		0.8		%
			R_f = 120Ω		0.4		%
Voltage gain (open loop)	G_v	F = 1kHz	R_L = 8Ω		75		dB
Voltage gain (closed loop)	G_v	R_L = 8Ω f = 1kHz	R_f = 33Ω		45		dB
			R_f = 120Ω		34		dB
Input noise voltage (*)	e_N				3		μV
Input noise current (*)	I_N				0.4		nA
Signal to noise ratio (*)	$\frac{S+N}{N}$	P_o = 1.2W R_L = 8Ω G_v = 34dB	R1 = 10KΩ		80		dB
			R1 - 50kΩ		70		dB
Supply voltage rejection	SVR	R_L = 8Ω $f_{(ripple)}$ = 100Hz C6 = 47μF R_f = 120Ω			42		dB

(*)B = 22Hz to 22kHz.

Figure 3 Output power vs. supply voltage

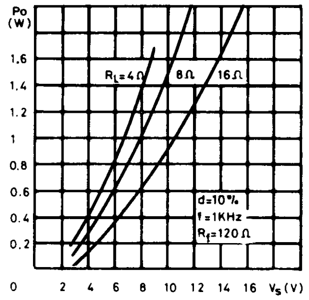


Figure 7 Suggested value of C_B vs. R_f

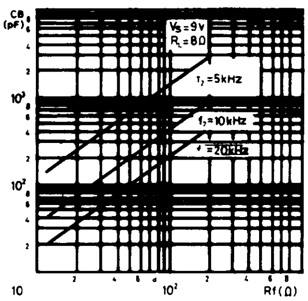


Figure 4 Frequency response

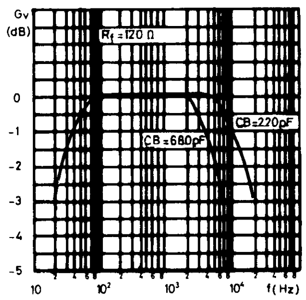


Figure 8 Voltage gain (closed loop) vs. R_F

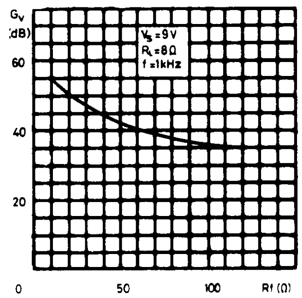
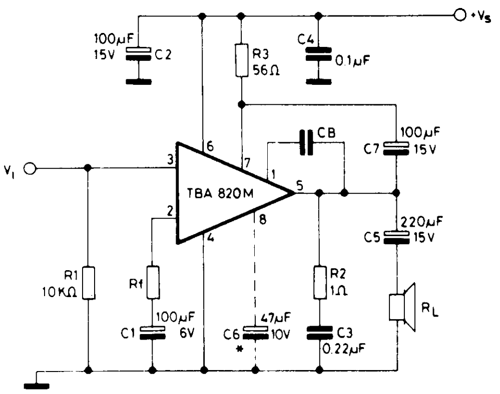
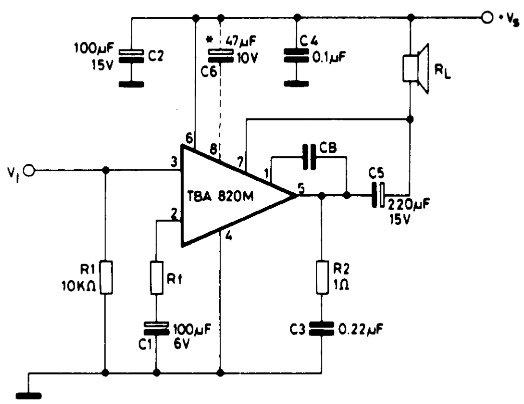


Figure 5 Circuit diagram with load connected to ground



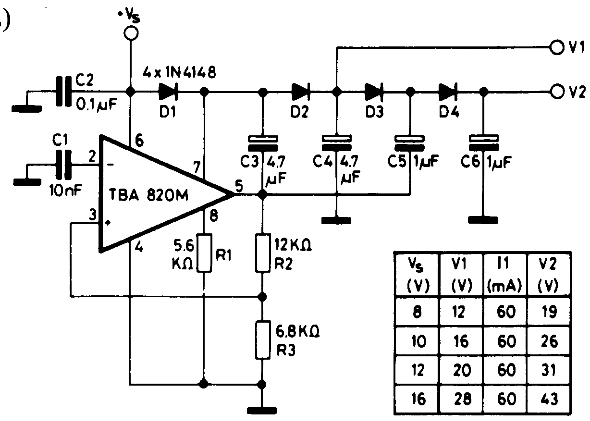
* Capacitor C6 must be used when high ripple rejection is required

Figure 9 Circuit diagram with load connected to the supply voltage



* Capacitor C6 must be used when high ripple rejection is required

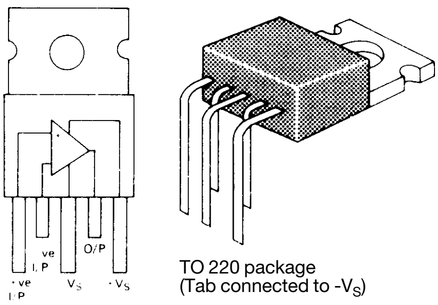
Figure 6 1.5W DC/DC converter (f = 40kHz)



Vs (V)	V1 (V)	I1 (mA)	V2 (V)
8	12	60	19
10	16	60	26
12	20	60	31
16	28	60	43

TDA 2030

The RS TDA 2030 is a high quality monolithic audio amplifier IC capable of producing an output power of up to 21W maximum into a 4Ω load. The device has a very low harmonic and crossover distortion. The THD is approx. 0.1% with output powers from 0.1 to 8W (8Ω load). The TDA 2030 features built in short circuit protection, thermal shut down and safe operating area protection.



TO 220 package
(Tab connected to $-V_S$)

Maximum ratings

Supply voltage V_S	±18V
Input voltage V_{in}	V_S
Differential i/p voltage V_{diff}	±15V
Output peak current (internally limited)	3.5A
Power dissipation at T_{case} = 60°C P_D	20W
Storage and junction temperature T_j	-40 to +150°C

Thermal data

Thermal resistance junction to case ______ 3°C/W max.

Electrical Characteristics T_{amb} = 25°C, V_S = ± 14V unless otherwise specified

Parameter	Test conditions	Min.	Typ.	Max.	Unit
Supply voltage V_S		±6 (+12)		±18 (+ 36)	V
Input offset voltage V_{in} (offset)	V_S = ±18V		±2	±20	mV
Quiescent drain current I_d	V_S = ±18V		40	60	mA
Input bias current I_b	V_S = ±18V		0.2	2	μA
Input offset current I_{in} (offset)	V_S = ±18V		±20	±200	nA
Output power P_O	d = 13% V_S = 30V f = 1kHz Z_O = 4Ω G_V = 30dB		17	21	W
Input resistance R_{in}	+ve I/P	0.5	5		MΩ
Voltage gain G_V	Open Loop		90		dB
Input noise voltage e_n	BW (-3dB) = 22Hz to 22kHz		3	10	μV
Supply voltage rejection ratio	R_L = 4Ω Z_o = 4Ω G_V = 30dB f_{ripple} = 100Hz	40	50		dB

Figures in brackets refer to operating limits

Figure 10 **Typical distortion vs. output power**

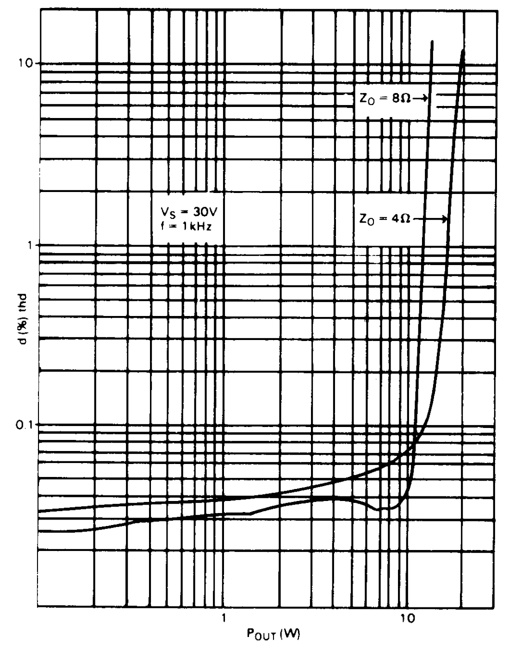
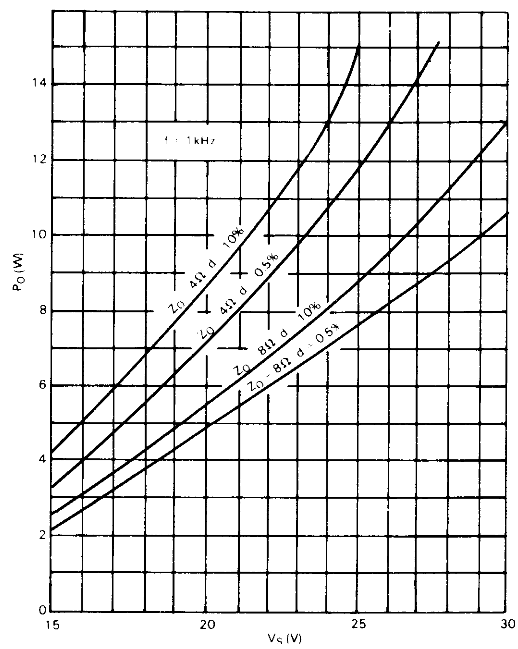


Figure 11 **Typical output power vs. supply voltage**



Applications

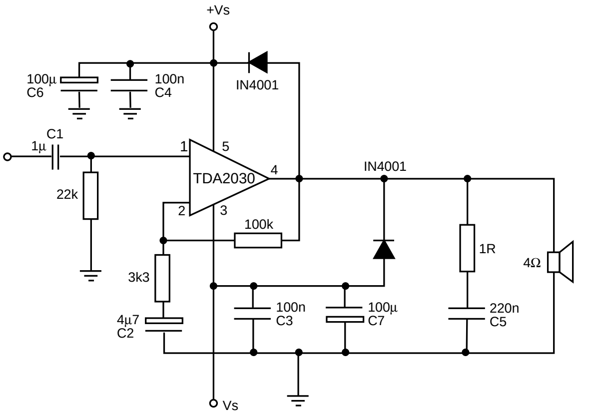
Power amplifier—dual supply rail

The circuit shown in Figure 12 will deliver up to 13W into a load impedance of 4Ω or 10W into a load impedance of 8Ω with distortion approx. 0.1%. A suitable pre-amplifier is the LM381. A printed circuit board is available **RS** stock no. 434-576. Suitable heatsink **RS** stock no. 401-497 (per stereo pair). A suitable power supply is shown in Figure 14.

Power amplifier—dual supply rail

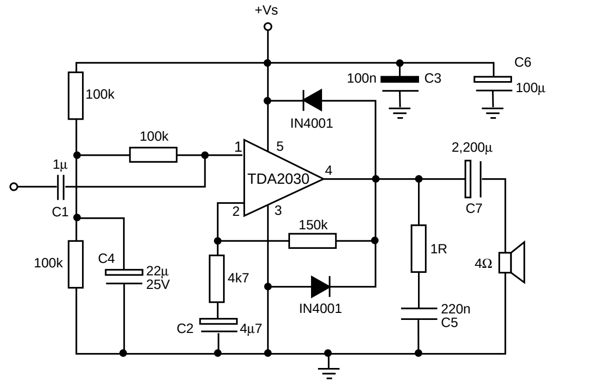
The circuit shown in Figure 13 gives a similar performance to the dual supply rail version. A suitable regulator for a power supply is the **RS** 317K **RS** stock no. 306-976 or High Power Regulator **RS** stock no. 308-152. The printed circuit board **RS** stock no. 434-576 will accommodate single or dual rail amplifier circuits.

Figure 12 **Dual supply rail amplifier**



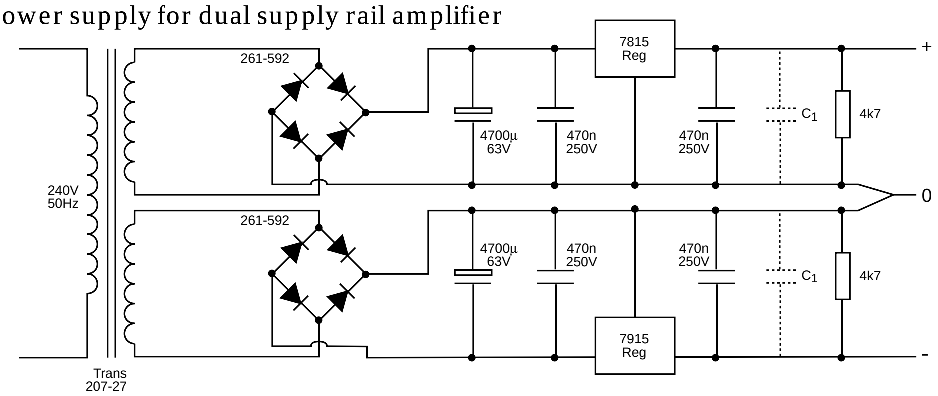
Decoupling capacitors C3, C4, C6 and C7 should be mounted as close as possible to the integrated circuit to minimise the effect of lead lengths. The maximum input, before clipping, with V_S = ±15V and output load 10Ω is 283mV rms.

Figure 13 **Single supply rail amplifier**



All resistors 0.5W.
C7 is an off-board component.
Decoupling capacitors C3 and C6 should be mounted as close as possible to the integrated circuit to minimise the effect of lead lengths.

Figure 14 **Power supply for dual supply rail amplifier**

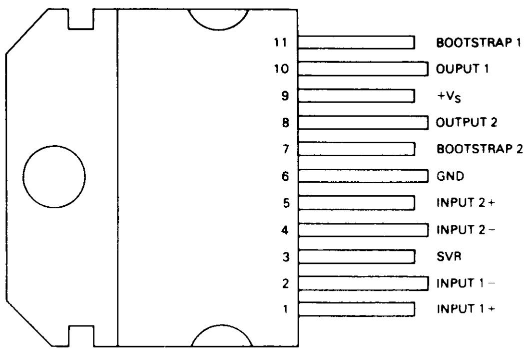


A power supply printed circuit board is available. **RS** stock no. 434-289 (two boards required for dual supply). The 4700µF 63V capacitor **RS** stock no. 105-329 may be mounted using clip **RS** stock no. 543-383. C_1 and C_1 (100nF disc ceramic capacitors, **RS** stock no. 124-178) may be added to improve stability. Suitable heatsink for both regulators **RS** stock no. 401-497. PSU leads should be kept short to prevent instability.

TDA 2004

The RS TDA 2004 is a Class B, dual, audio power amplifier in an 11 lead tab mounting plastic package. Each amplifier is capable of delivering up to 9W into a 4Ω load (17V supply, THD 10%). The two amplifiers may be operated as a stereo pair or connected in a bridge connection to increase power output to four times the power available in a single ended mode. Built-in short circuit protection, thermal shut down and safe operating area limiting are included to increase device reliability. A ready made printed circuit board is available under RS stock no. 434-598 which can accommodate either the stereo amplifier circuit or bridge amplifier as shown in Figures 18 and 19 respectively.

Heatsink tab connected to GND (Pin 6)



Absolute maximum ratings

Supply voltage V_S ______ 18V
Peak supply voltage (for 50ms) ______ 40V
Output peak current (non repetitive t = 0.1 ms) ______ 4.5A
Output peak current (repetitive f≥10Hz) ______ 3.5A
Power dissipation at T_{CASE} = 90°C ______ 30W
Storage and junction temperature ______ -40 to +150°C

Thermal data

Thermal resistance junction to case (θjc) ______ 3°C/W max.
Thermal shutdown case temperature ______ 135°C typ.

Electrical characteristics (Refer to the test circuit, T_{amb} = 25°C, G_V = 50dB, $R_{th\ (heatsink)}$ = 4°C/W, unless otherwise specified)

	Parameter	Test conditions		Min.	Typ.	Max.	Unit
V_S	Supply voltage			8		18	V
V_O	Quiescent output voltage	V_S = 14.4V		6.6	7.2	7.8	V
		V_S = 13.2V		6.0	6.6	7.2	V
I_d	Total quiescent drain current	V_S = 14.4V			65	120	mA
		V_S = 13.2V			62	120	mA
I_{SB}	Stand-by current	Pin 3 grounded			5		mA
P_o	Output power (each channel)	f = 1kHz	d = 10%				
		V_S = 14.4V					
			R_L = 4Ω	6	6.5		W
			R_L = 3.2Ω	7	8		W
			R_L = 2Ω	9	10(*)		W
			R_L = 1.6Ω	10	11		W
		V_S = 13.2V					
			R_L = 3.2Ω	6	6.5		W
			R_L = 1.6Ω	9	10		W
		V_S = 16V					
			R_L = 2Ω		12		W
d	Distortion (each channel)	f = 1kHz					
		V_S = 14.4V	R_L=4Ω				
		P_O = 50mW to 4W			0.2	1	%
		V_S = 14.4V	R_L = 2Ω				
		P_O = 50mW to 6W			0.3	1	%
		V_S = 13.2V	R_L = 3.2Ω				
		P_O = 50mW to 3W			0.2	1	%
		V_S=13.2V	R_L = 1.6Ω				
		P_O = 50mW to 6W			0.3	1	%
CT	Cross talk	V_S = 14.4V					
		V_O = 4V_{rms}	R_L = 4Ω				
		f = 1kHz		50	60		dB
		f = 10kHz	R_g = 5KΩ	40	45		dB
V_i	Input sensitivity	f = 1kHz					
		P_O = 1W					
		R_L = 4Ω			6		mV
		R_L = 3.2Ω			5.5		mV
V_i	Input saturation voltage			300			mV
R_i	Input resistance (non inverting input	f = 1kHz		70	200		kΩ
R_i	Input resistance (inverting input)	f = 1kHz			10		kΩ
f_L	Low frequency roll off (-3dB)	R_L = 4Ω				35	Hz
		R_L = 2Ω				50	Hz
		R_L = 3.2Ω				40	Hz
		R_L = 1.6Ω				55	Hz

Electrical characteristics (Refer to the test circuit, T_{amb} = 25°C, G_v = 50dB, $R_{th\ (heatsink)}$ = 4°C/W, unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
f_H	High frequency roll off (-3dB)	R_L = 4Ω R_L = 2Ω R_L = 3.2Ω R_L = 1.6Ω	15 15 15 15			kHz kHz kHz kHz
G_v	Voltage gain (open loop)	f = 1kHz		90		dB
G_v	Voltage gain (closed loop)	f = 1kHz	48	50	51	dB
	Closed loop gain matching			0.5		dB
e_N	Total input noise voltage	R_g = 10kΩ(°)		1.5	5	μV
SVR	Supply voltage rejection	f_{ripple} = 100Hz R_g = 10kΩ C_3 = 10μF V_{ripple} = 0.5V_{rms}	35	45		dB
n	Efficiency	V_S = 14.4V f = 1kHz R_L = 4Ω P_O = 6.5W R_L = 2Ω P_O = 10W V_S = 13.2V f = 1kHz R_L = 3.2Ω P_O = 6.5W R_L = 1.6Ω P_O = 10W		70 60 70 60		% % % %
T_{sd}	Thermal shut down case temperature	V_S = 14.4V R_L = 4Ω f = 1kHz P_{tot} = 5.5W	125	135		°C

(*) 9.3W without bootstrap.
(°) Bandwidth filter: 22Hz to 22kHz.

Figure 15 **Output power vs. R_L**

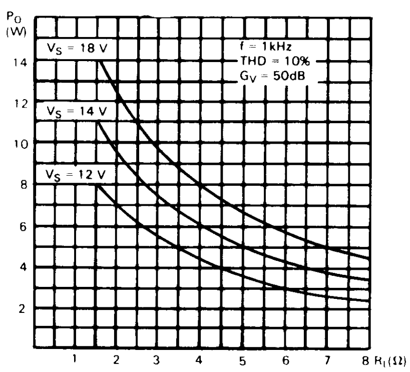


Figure 16 **Distortion vs. output power**

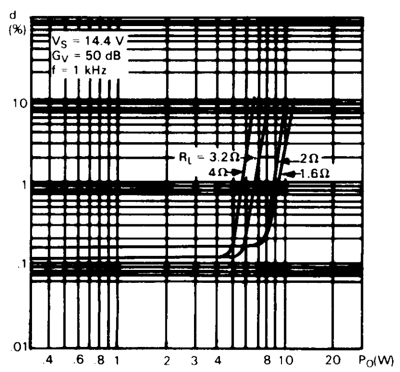
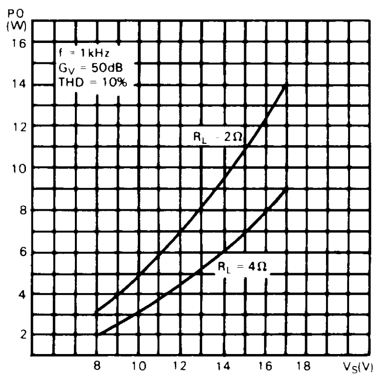


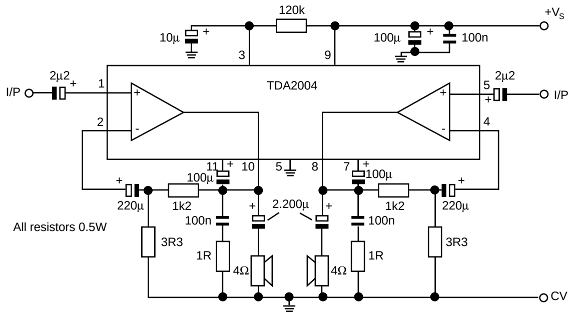
Figure 17 **Output power vs. V_S**



Applications

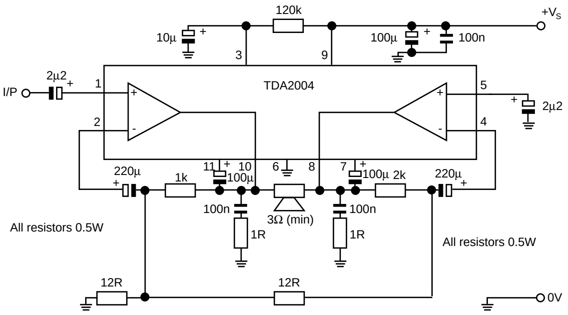
(Ready made PCB RS stock no. 434-598, is suitable for both stereo and bridge amplifiers.)

Figure 18 **Stereo amplifier**



The above circuit is a stereo amplifier capable of delivering 4W/channel into 4Ω loads at a THD of 0.2% for a V_S of 15V and an output signal of 12mV rms. The LM381 can be employed as a preamplifier. Suitable heatsink for the RS TDA2004 is available under RS stock no. 401-497 (4° C/W). Decouple the power supply as close to the IC as possible. The maximum input, before clipping, with V_S = 15V and output load 10Ω is 15.5mV rms.

Figure 19 **Bridge amplifier**



The TDA 2004 can be connected as a bridge amplifier as shown above. This arrangement can produce four times the power output of a single ended design. In order to operate within maximum output current limits the minimum load impedance is limited to 3Ω. The maximum output power into a 3Ω load at 15V supply is approximately 20W. A suitable heatsink is available under RS stock no. 401-497 (4° C/W). Decouple the power supply as close to the IC as possible.

Note: In either case, the amplifier is likely to be unstable with the input(s) left open. If this is a possibility in your application a 47kΩ resistor should be connected between the input(s) and the input ground track.

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