20W BRIDGE AMPLIFIER FOR CAR RADIO

DESCRIPTION

The TDA2005 is class B dual audio power amplifier, have designed for car radio application.

ZIP-11/Multiwatt11

FEATURES

- High output power:

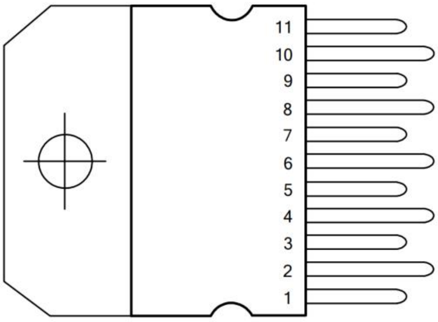
  P_{OUT}=10+10W@R_L=2Ω, THD=10%

  P_{OUT}=20W@R_L=4Ω, THD=1%

ORDERING INFORMATION

DEVICE	Package Type	MARKING	Packing	Packing Qty
TDA2005R	ZIP-11/Multiwatt11	TDA2005	TUBE	500pcs/box

PIN CONFIGURATION



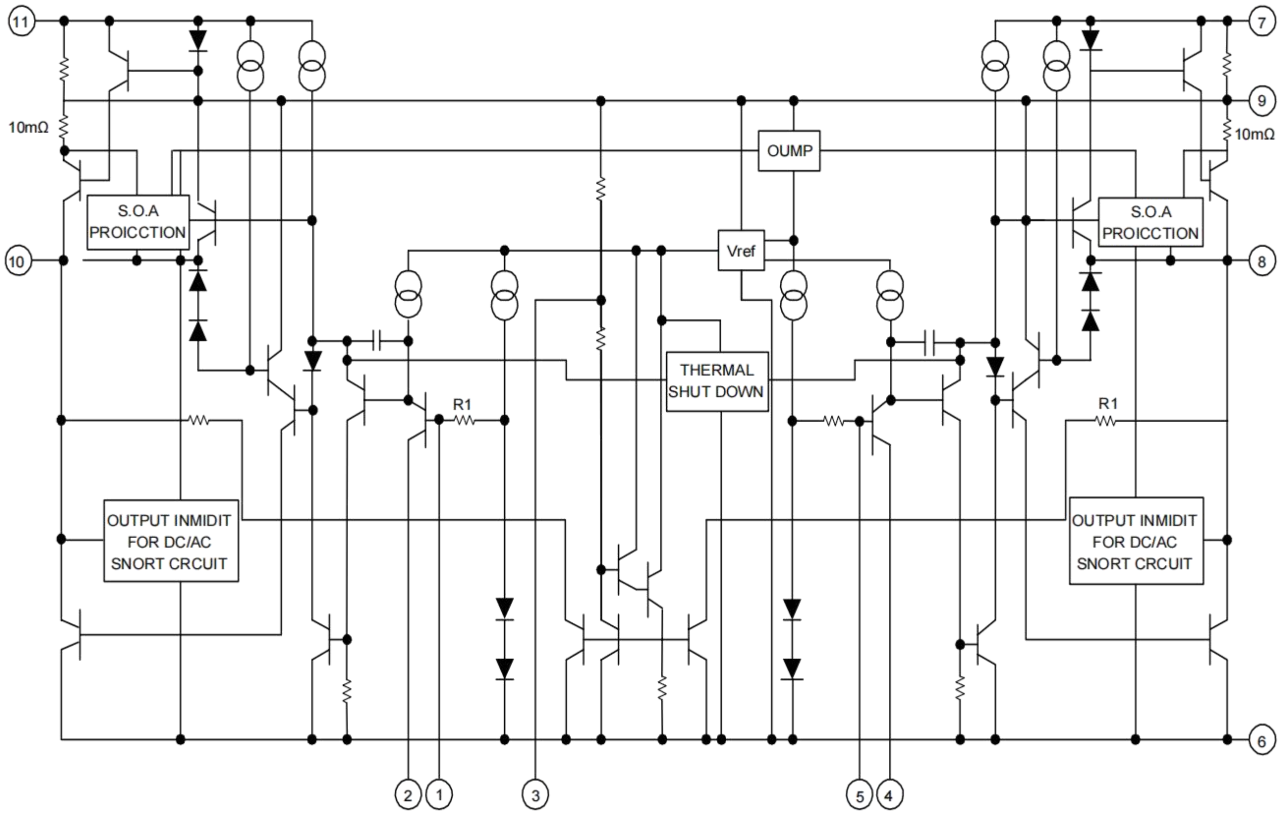
ZIP-11/Multiwatt11

*TAB CONNECTED TO PIN 6

PIN DESCRIPTION

PIN NO. ZIP-11/Multiwatt11	PIN NAME
1	INPUT+ (1)
2	INPUT- (1)
3	SVRR
4	INPUT- (2)
5	INPUT+ (2)
6	GND
7	BOOTSTRAP 2
8	OUTPUT 2
9	+VS
10	OUTPUT 1
11	BOOTSTRAP 1

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	RATINGS	UNIT
Operating Supply Voltage		Vss	18	V
DC Supply Voltage		Vss	28	V
Peak Supply Voltage (for 50ms)		Vss	40	V
Output Peak Current (Note)	non repetitive t=0.1ms	Io	4.5	A
	repetitive f ≥10Hz	Io	3.5	A
Power Dissipation at Tc=60℃		P_D	30	W
Junction Temperature		T_J	+150	℃
Storage Temperature		T_{STG}	-40 ~ 150	℃

Note: The max. output current is internally limited.

THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Thermal Resistance Junction-Case	θ_{JC}	3.0	℃/W

ELECTRICAL CHARACTERISTICS

(Refer to the application circuit, Ta=25℃, Gv=50dB, Rth(heatsink)=4℃/W, unless otherwise specified.)

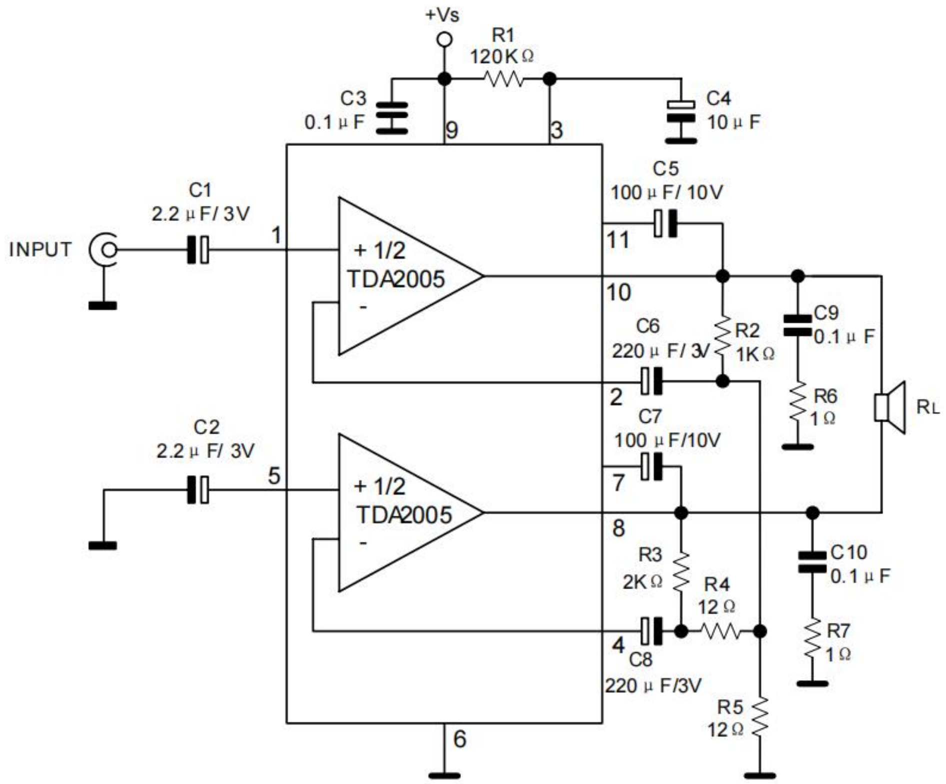
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
BRIDGE						
Supply Voltage	Vss		8		18	V
Output Offset Voltage (between pin 8 and pin 10)	Vos	Vss=14.4V Vss=13.2V			150 150	mV mV
Total Quiescent Drain Current	ID	Vss=14.4V, R_L=4Ω Vss=13.2V, R_L=3.2Ω		75 70	150 160	mA mA
Output Power	P_{OUT}	THD=10%, f=1Hz Vss=14.4V, R_L=4Ω R_L=3.2Ω Vss=13.2V, R_L=3.2Ω	18 20 17	20 22 19		W
Total Harmonic Distortion f=1KHz	THD	Vss=14.4V, R_L=4Ω P_{OUT}=50mW ~ 15W			1	%
		Vss=13.2V, R_L=3.2Ω P_{OUT}=50mW ~ 13W			1	%
Input Sensitivity f=1kHz	V_{IN}	P_{OUT}=2W, R_L=4Ω		9		mV
		P_{OUT}=2W, R_L=3.2Ω		8		mV
Input Resistance	R_{IN}	f=1kHz	70			kΩ
Low Frequency Roll Off (-3dB)	f_L	R_L=3.2Ω			40	Hz
High Frequency Roll Off (-3dB)	f_H	R_L=3.2Ω	20			kHz
Closed Loop Voltage Gain	G_V	f=1kHz		50		dB
Total Input Noise Voltage	eN	R_G=10kΩ(Note 1)		3	10	μV
Supply Voltage Rejection	SVR	R_G=10kΩ, C4=10μF F_{RIPPLE}=100Hz, V_{RIPPLE}=0.5V	45	55		dB
Efficiency	η	Vss=14.4V, f=1kHz P_{OUT}=20W, R_L=4Ω P_{OUT}=22W, R_L=3.2Ω		60 60		%
		Vss=13.2V, f=1kHz P_{OUT}=19W, R_L=3.2Ω		58		%
Thermal Shut-down Junction Temperature	T_J	Vss=14.4V, R_L=4Ω f=1kHz, P_D=13W		145		℃
Output Voltage With One Side of the Speaker Shorted to Ground	V_{OSH}	Vss=14.4V, R_L=4Ω Vss=13.2V, R_L=3.2Ω			2	V
STEREO						
Supply Voltage	Vss		8		18	V
Quiescent Output Voltage	V_{OUT}	Vss=14.4V Vss=13.2V	6.6 6	7.2 6.6	7.8 7.2	V V

Total Quiescent Drain Current	I_D	Vss=14.4V Vss=13.2V			65 62	120 120	mA mA
Output Power (each channel) f=1Hz, THD=10%	P_{OUT}	Vss=14.4V	R_L=4Ω	6	6.5		W
			R_L=3.2Ω	7	8		
			R_L=2Ω	9	10		
			R_L=1.6Ω	10	11		
		Vss=13.2V	R_L=3.2Ω	6	6.5		
			R_L=1.6Ω	9	10		
		Vss=16V, R_L=2Ω			12		
Total Harmonic Distortion (each channel) f=1KHz	THD	Vss=14.4V, R_L=4Ω P_{OUT}=50mW ~ 4W			0.2	1	%
		Vss=14.4V, RL=2Ω P_{OUT}=50mW ~ 6W			0.3	1	%
		Vss=13.2V, R_L=3.2Ω POUT=50mW ~ 3W			0.2	1	%
		Vss=13.2V, R_L=1.6Ω P_{OUT}=40mW ~ 6W			0.3	1	%
Cross Talk	C_T	Vss=14.4V, V_{OUT}=4VRMS R_L=4Ω, R_G=5KΩ	f=1KHz		60		dB
			f=10kHz		45		
Input Saturation Voltage	V_{IN}			300			mV
Input Sensitivity	VIN	f=1kHz, P_{OUT}=1W R_L=4Ω RL=3.2Ω			6 5.5		mV
Input Resistance	RIN	f=1kHz		70	200		kΩ
Low Frequency Roll Off (-3dB)	fL	R_L=2Ω				50	Hz
High Frequency Roll Off (-3dB)	fH	R_L=2Ω		15			kHz
Voltage Gain (open loop)	GV	f=1kHz			90		dB
Voltage Gain (close loop)	GV	f=1kHz		48	50	51	dB
Closed Loop Gain Matching	△GV				0.5		dB
Total Input Noise Voltage	En	R_G=10kΩ (Note 1)			1.5	5	μV
Supply Voltage Rejection	SVR	R_G=10kΩ, C3=10μF F_{RIPPLE}=100Hz, V_{RIPPLE}=0.5V		35	45		dB
Efficiency	η	Vss=14.4V, f=1kHz P_{OUT}=6.5W, R_L=4Ω P_{OUT}=10W, R_L=2Ω			70 60		% %
		Vss=13.2V, f=1kHz P_{OUT}=6.5W, R_L=3.2Ω P_{OUT}=100W, R_L=1.6Ω			70 60		% %

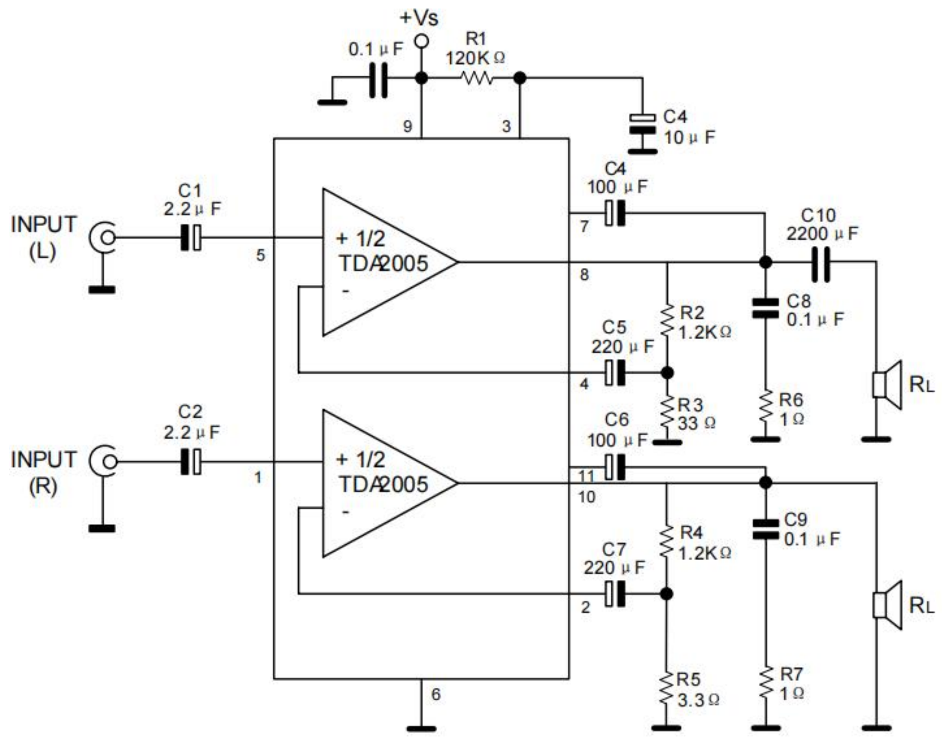
Note: 1. Bandwith Filter: 22Hz ~ 22kHz

TEST AND APPLICATION CIRCUIT

Bridge amplifier



Stereo amplifier



BRIDGE AMPLIFIER DESIGN

The following consideraions can be useful when designing a bridge amplifier.

PARAMETER		SINGLE ENDED	BRIDGE
V_{OUT} max	Peak Output Voltage (before clipping)	$\frac{1}{2}(Vs-2V_{CE}\,sat)$	$Vs-2V_{CE}\,sat$
I_{OUT} max	Peak Output Current (before clipping)	$\frac{1}{2}\frac{Vs-2V_{CE}\,sat}{R_L}$	$\frac{Vs-2V_{CE}\,sat}{R_L}$
P_{OUT} max	RMS Output Power (before clipping)	$\frac{1}{4}\frac{(Vs-2V_{CE}\,sat)^2}{2R_L}$	$\frac{(Vs-2V_{CE}\,sat)^2}{2R_L}$

Where: V_{CE} sat=output transistors saturation voltage
Vs=allowable supply voltage
R_L=load impedance

Voltage and current swings are twice for a bridge amplifier in comparison with single ended amplifier. In order words, with the same RL the bridge configuration can deliver an output power that is four times the output power of a single ended amplifier, while, with the same max output current the bridge configuration can deliver an output power that is twice the output power of a single ended amplifier. Core must be taken when selecting Vs and RL in order to avoid an output peak current above the absolute maximum rating.

From the expression for Io max, assuming Vs=14.4V and VCE sat=2V, the minimum load that can be driven by TDA2005 in bridge configuration is:

$$R_L\,min=\frac{Vs-2V_{CE}\,sat}{I_{OUT}\,max}=\frac{14.4-4}{3.5}=2.97\,\Omega$$

The voltage gain of the bridge configuration is given by (see Figure 3):

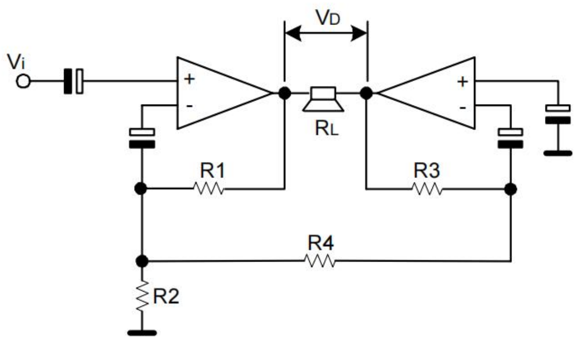
$$Gv=\frac{V_0}{V_1}=1+\frac{R_1}{\left(\frac{R_2\times R_4}{R_2+R_4}\right)}+\frac{R_3}{R_4}$$

For sufficiently high gains (40 ~ 50dB) it is possible to put R2=R4 and R3=2R1, simplifing the formula in:

$$Gv=4\frac{R_1}{R_2}$$

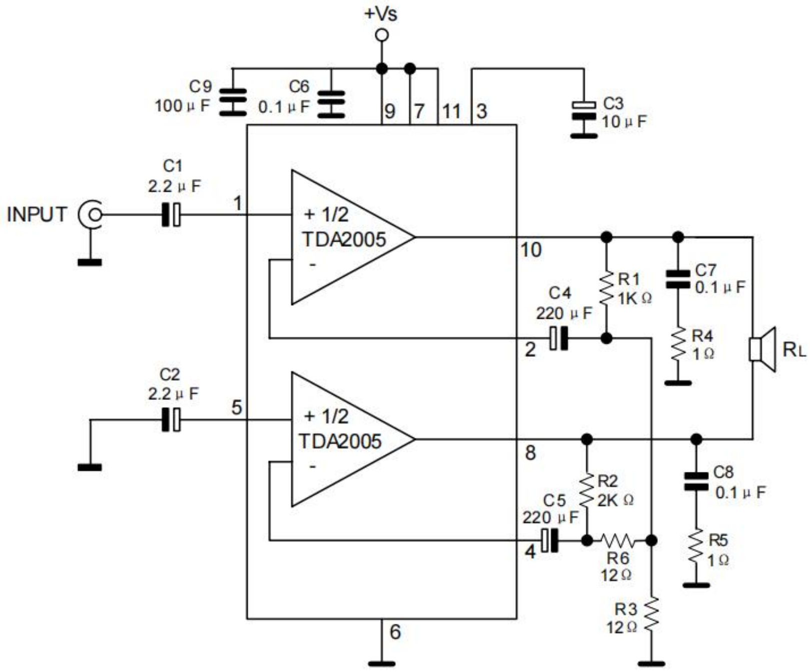
Gv (dB)	R1(Ω)	R2=R4(Ω)	R3(Ω)
40	1000	39	2000
50	1000	12	2000

Bridge Configuratio

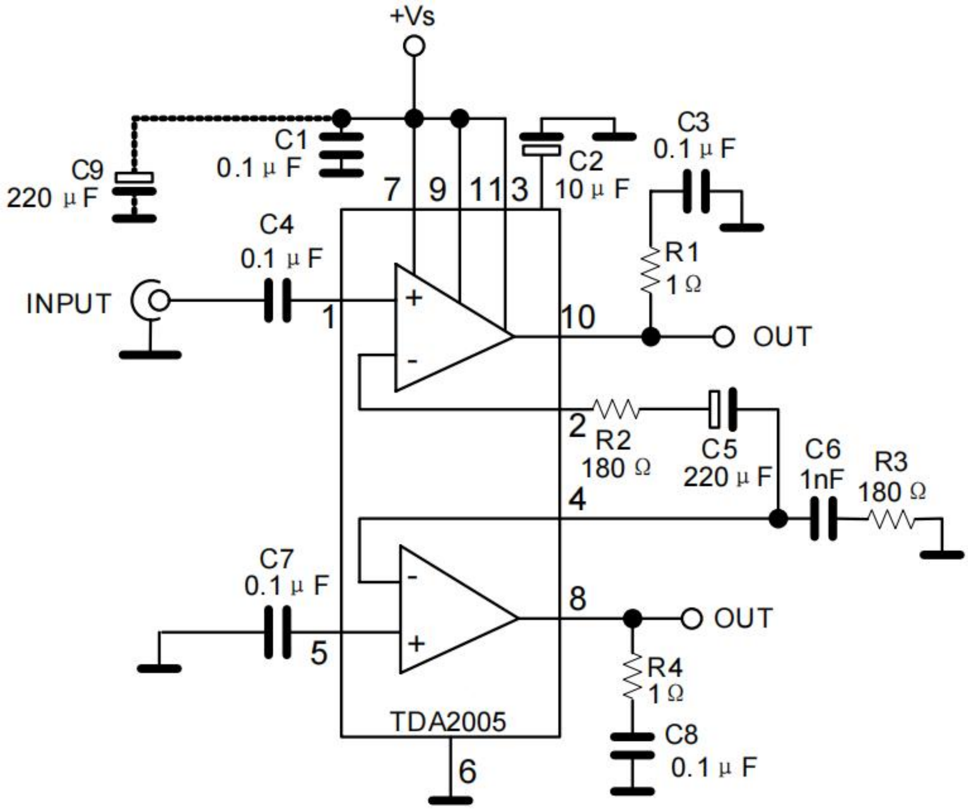


APPLICATION INFORMATION

Bridge Amplifier without Boostrap

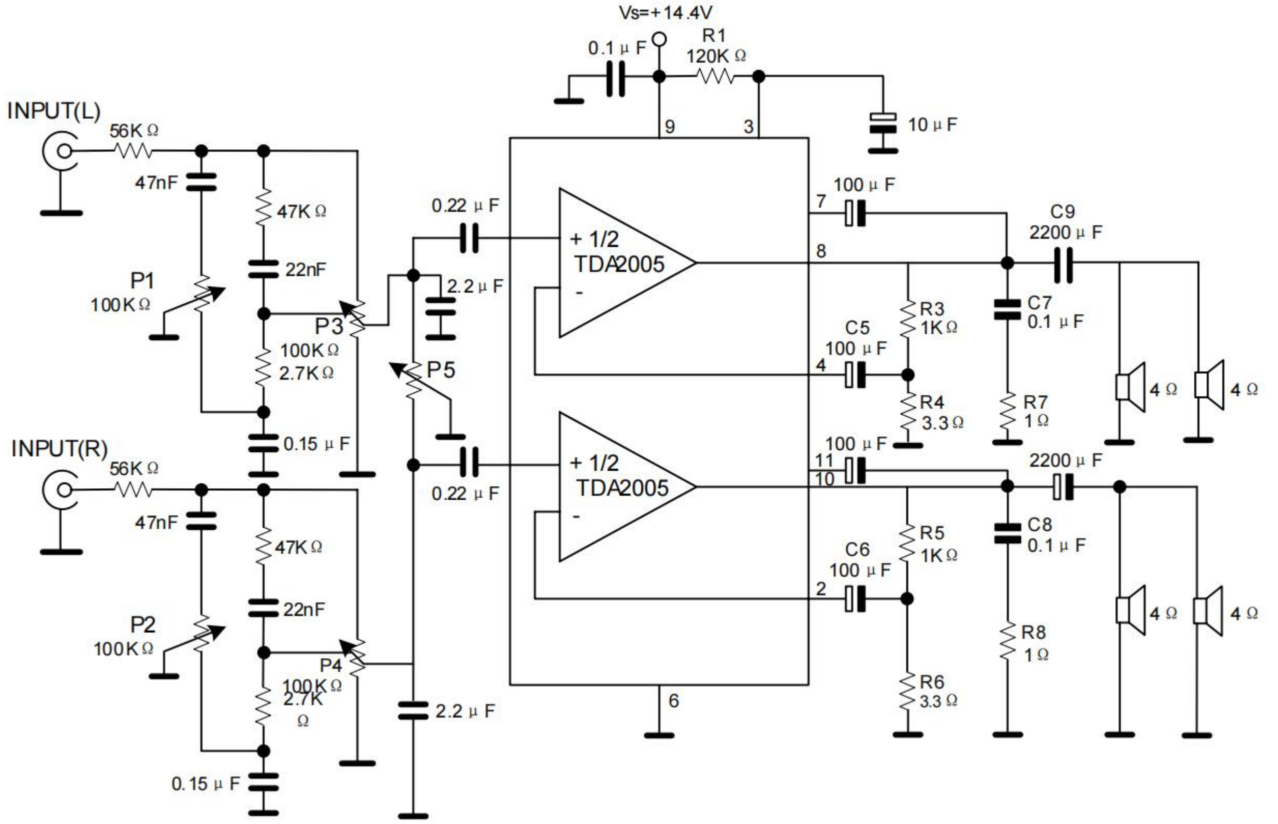


Low Cost Bridge Amplifier (Gv=42dB)

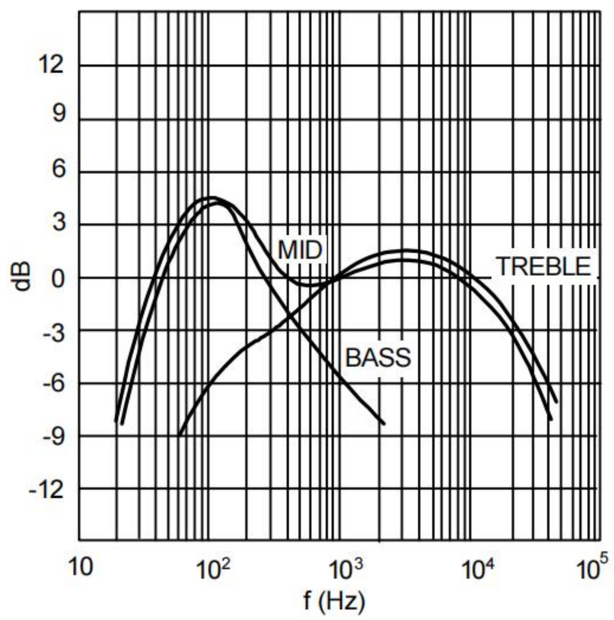


APPLICATION INFORMATION(Cont.)

10+10W Stereo Amplifier with Tone Balance and Loudness Control

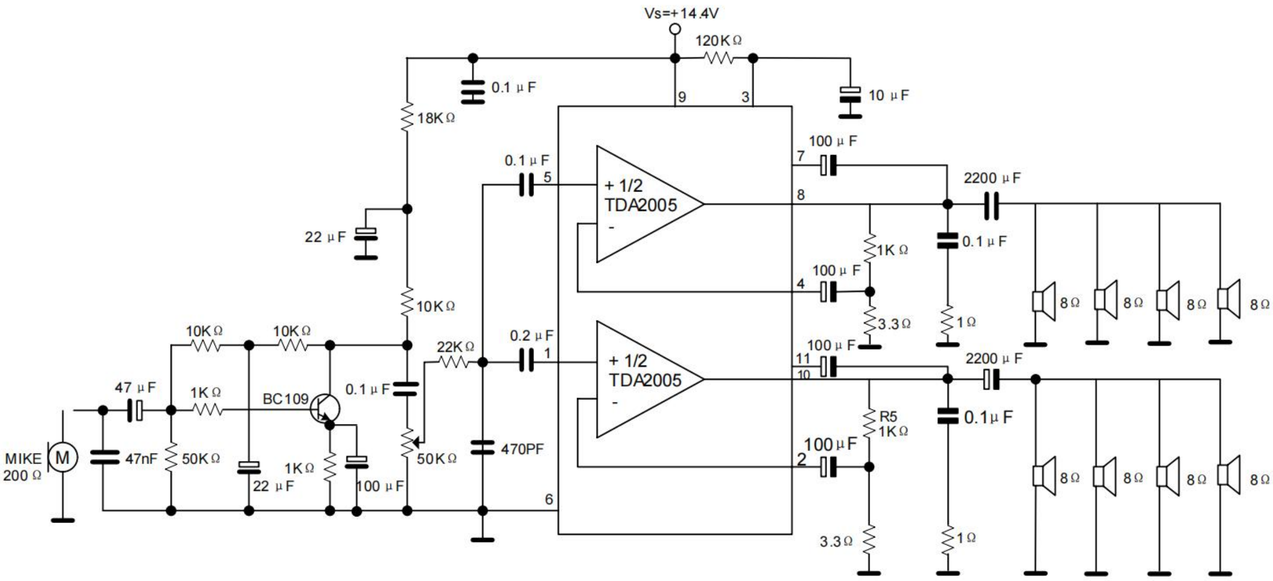


Tone Control Response (circuit of Fihure 8)

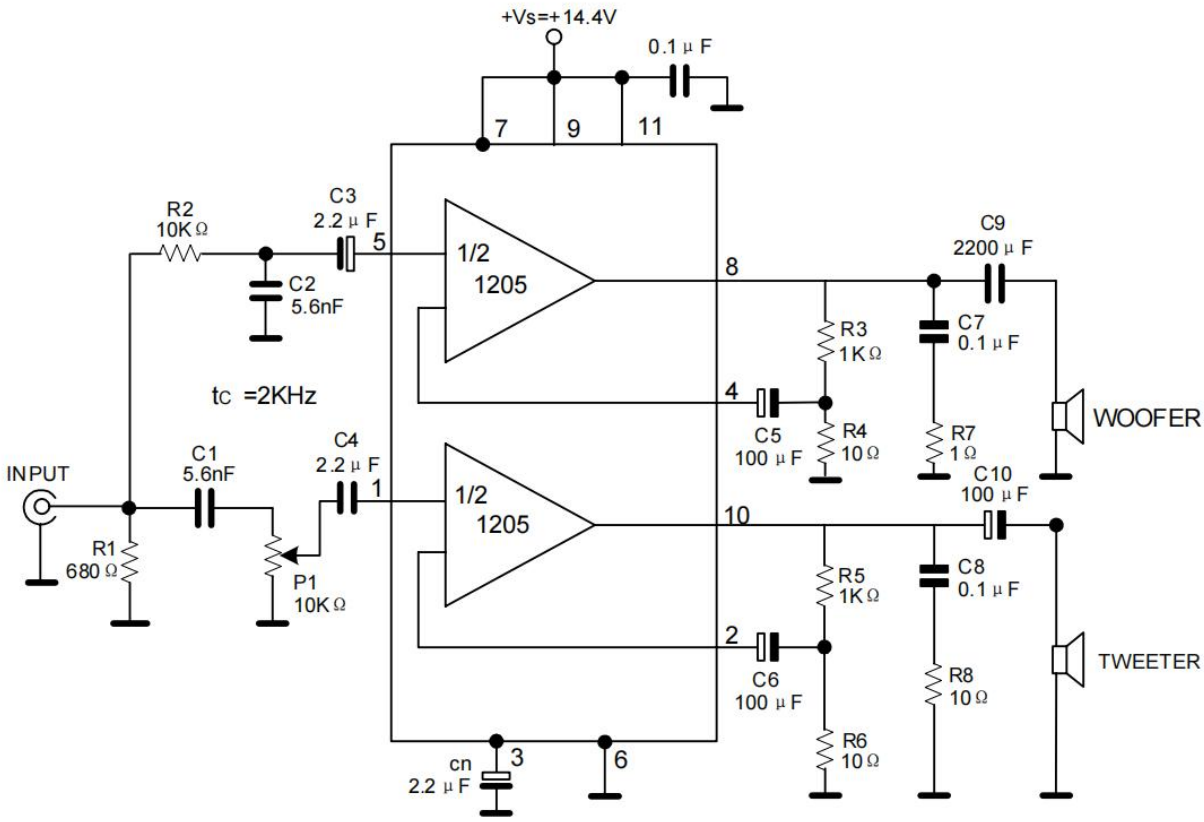


APPLICATION INFORMATION(Cont.)

20W Bus Amplifier



Simple 20W Two Way Amplifier (Fc=2kHz)



APPLICATION INFORMATION(Cont.)

Bridge Amplifier Circuit suited for Low-gain Applications (Gv=34dB)

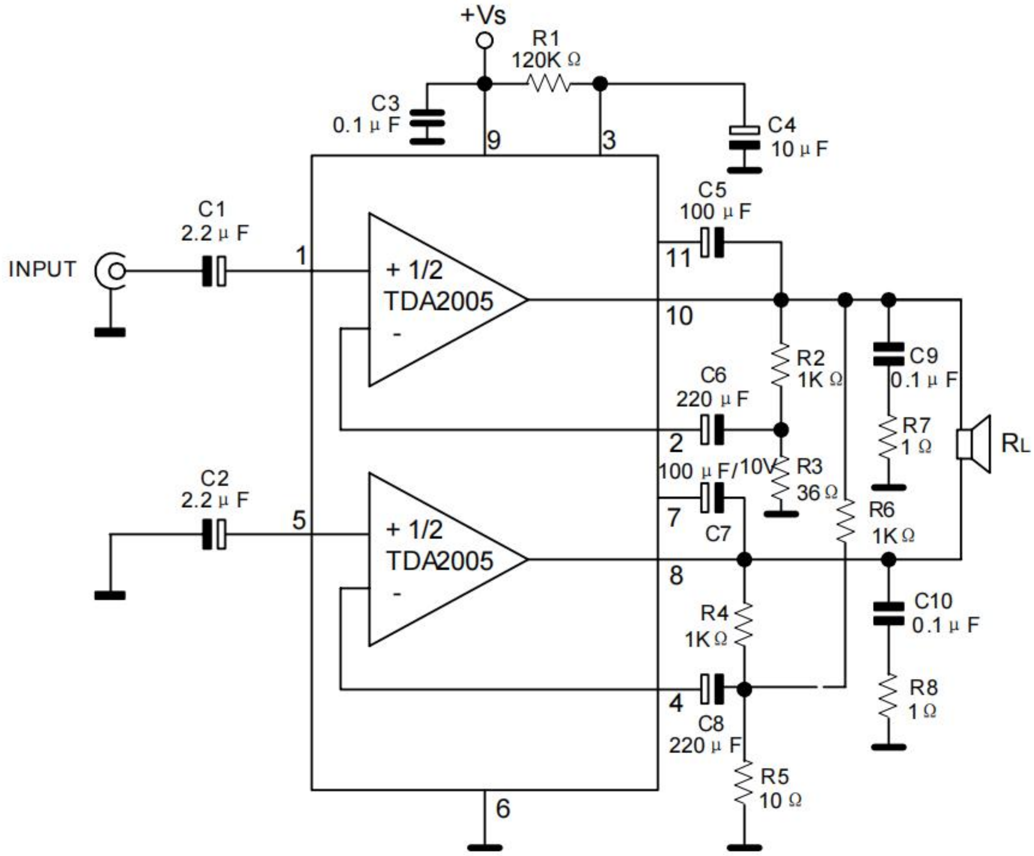
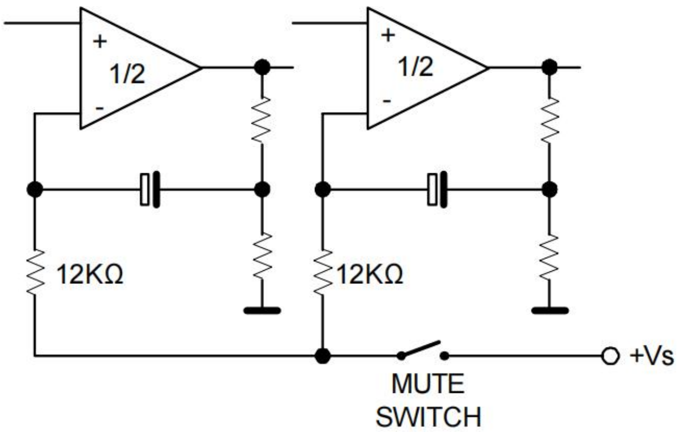


Figure 1. Example of Muting Circuit



BUILT-IN PROTECTION SYSTEMS

LOAD DUMP VOLTAGE SURGE

The TDA2005 has a circuit which enables it to withstand a voltage pulse train, on pin9, of the type shown in Figure 3.

If the supply voltage peaks to more than 40V, then an LC filter must be inserted between the supply and pin9, in order to assure that the pulses at pin 9 will be held withing the limits shown.

A suggested LC network is shown in Figure 2, With this network, a train of pulses with amplitude up to 120V and width of 2ms can be applied at point A, This type of protection is ON when the supply voltage (pulse or DC) exceeds 18V. For this reason the maximum operating supply voltage is 18V.

Figure 2

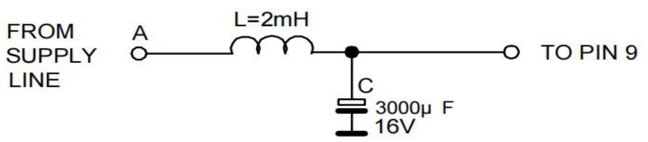
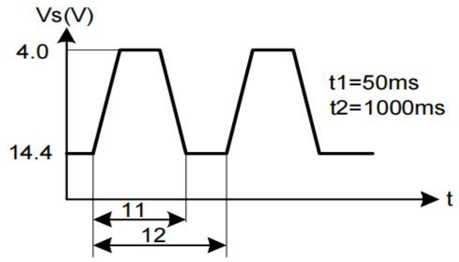


Figure 3



SHORT CIRCUIT (AC AND DC CONDITIONS)

The TDA2005 can withstand a permanent short circuit on the output for a supply voltage up to 16V.

POLARITY INVERSION

High current (up to 10A) can be handled by the device with no damage for a longer period than the blow-out time of a quick 2A fuse (normally connected in series with the supply). This feature is added to avoid destruction, if during fitting to the car, a mistake on the connection of the supply is made.

OPEN GROUND

When the ratio is in the ON condition and the ground is accidentally opened, a standard audio amplifier will be damaged. On the TDA2005 protection diodes are included to avoid any damage.

INDUCTIVE LOAD

A protection diode is provided to allow use of the TDA2005 with inductive loads.

DC VOLTAGE

The maxim operating DC voltage for the TDA2005 is 18V.

However the device can withstand a DC voltage up to 28V with no damage. This could occur during winter if two batteries are series connected to crank the engine.

THERMAL SHUT-DOWN

The presence of a thermal limiting circuit offers the following advantages:

(1). An overload on the output (even if it is permanent), or an excessive ambient temperature can be easily withstood.

(2). The heatsink can have a smaller factor of safety compared with that of a conventional circuit. There is no device damage in the case of excessive junction temperature; all that happens is that Po (and therefore Ptot) and Id are reduced.

The maximum allowable power dissipation depends upon the size of the external heatsink (i.e. its thermal resistance); Figure 4 shows the dissipation power as a function of ambient temperature for different thermal resistance.

LOUDSPEAKER PROTECTION

The circuit offers loudspeaker protection during short circuit for one wire to ground.

TYPICAL CHARACTERISTICS

Figure 4. Maximum Allowable Power Dissipation versus Ambient Temperature

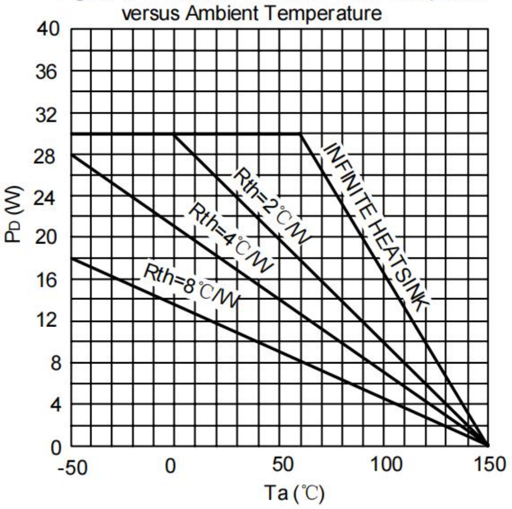


Figure 5. Output Power and Drain Current Versus Case Temperature

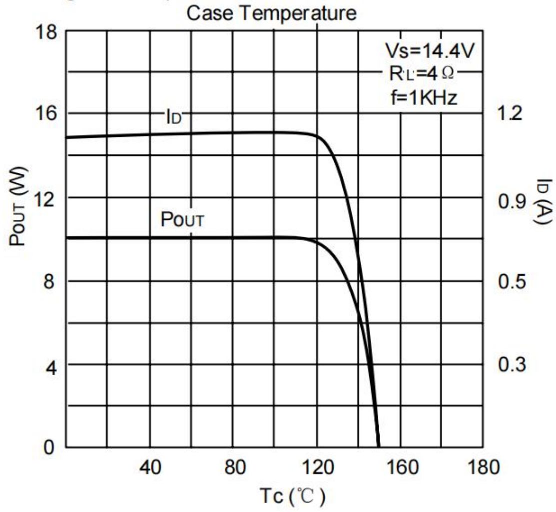


Figure 6. Output Power and Drain Current Versus Case Temperature

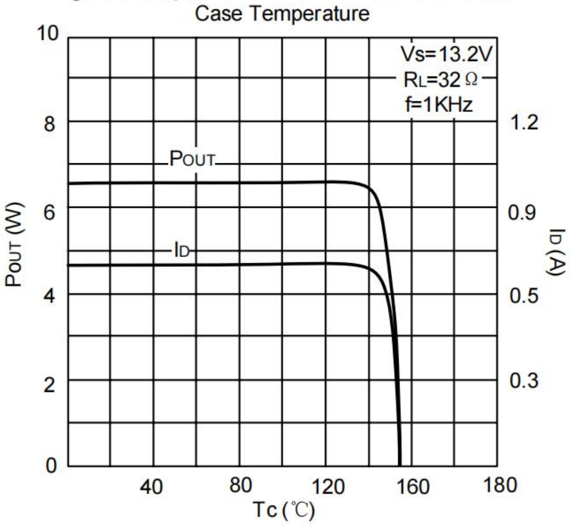


Figure 7. Output Offset Voltage versus Supply Voltage

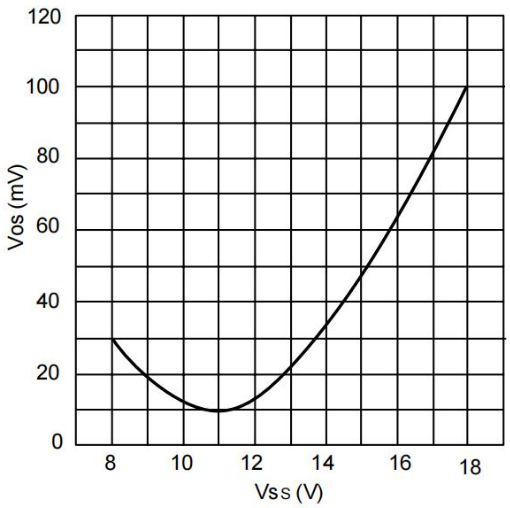


Figure 8. Distortion versus Output Power (bridge amplifier)

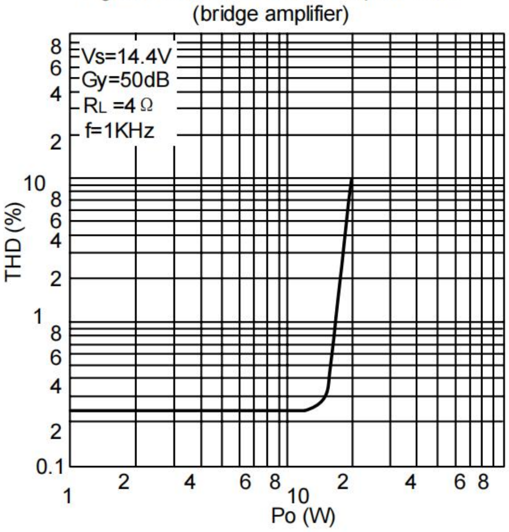
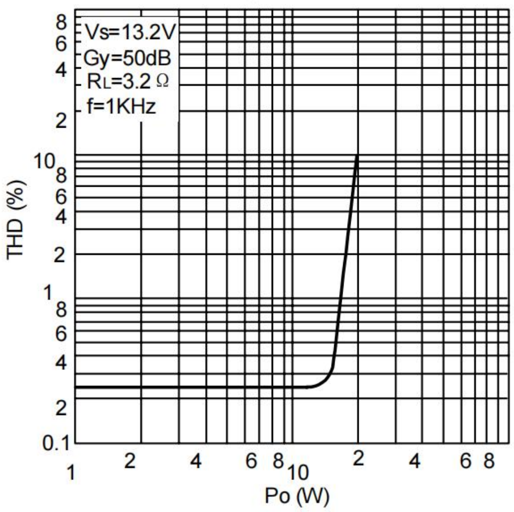


Figure 9. Distortion versus Output Power (bridge amplifier)



TYPICAL CHARACTORISTICS (cont.)

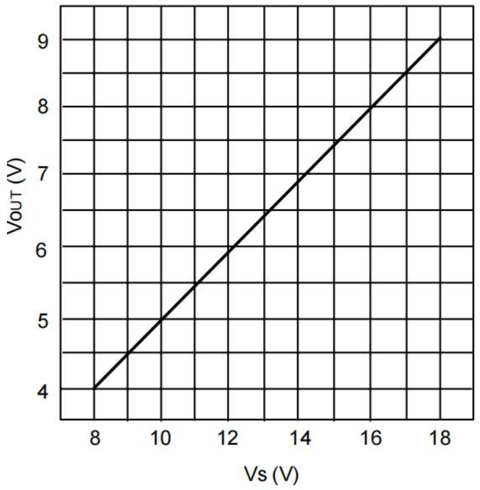


Figure 10. Quiescent Output Voltage versus Supply Voltage (Stereo amplifier)

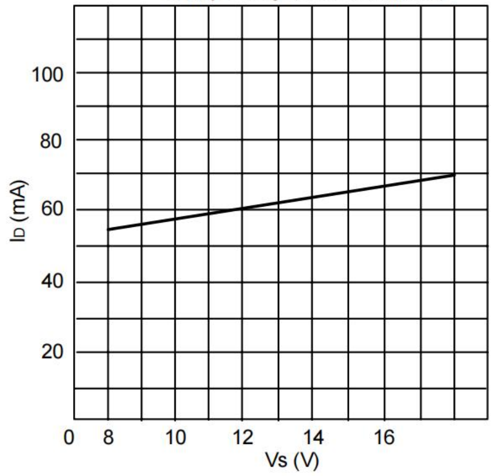


Figure 11. Quiescent Drain Current versus Supply Voltage(Stereo amplifier)

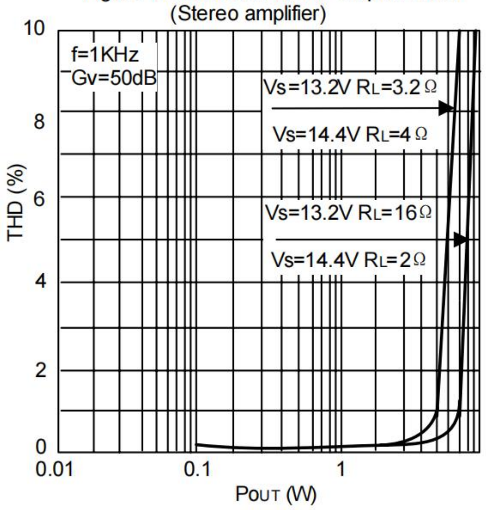


Figure 12. Distortion versus Output Power (Stereo amplifier)

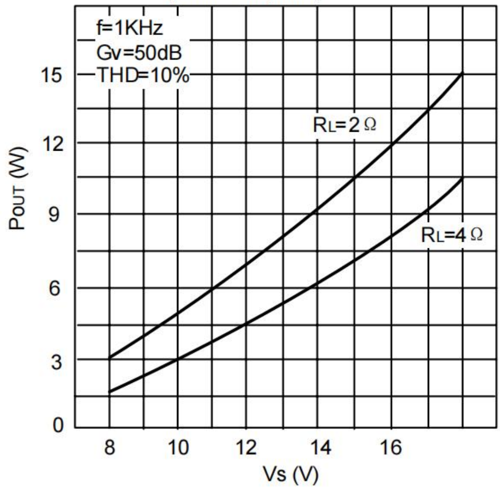


Figure 13. Output Power versus Supply Voltage (Stereo amplifier)

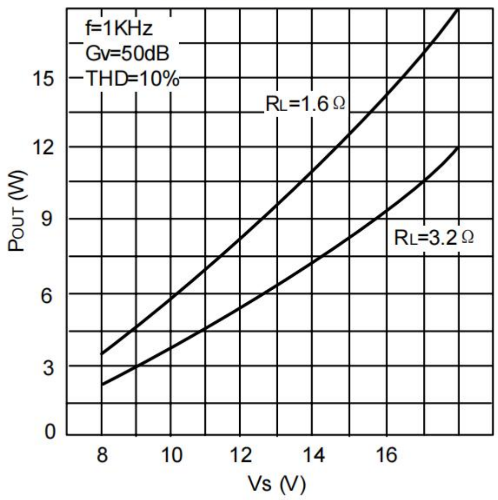


Figure 14. Output Power versus Supply Voltage (Stereo amplifier)

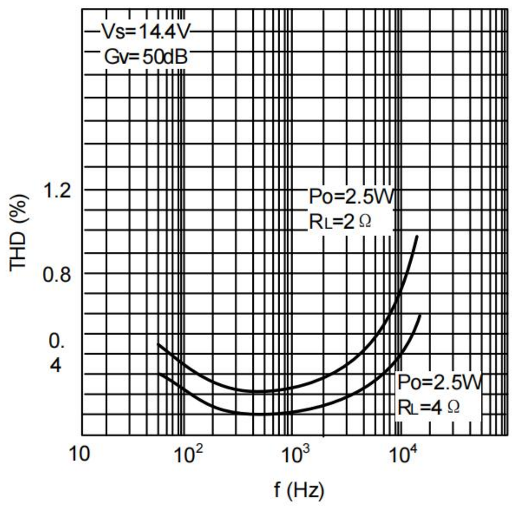


Figure 15. Distortion versus Frequency (Stereo amplifier)

TYPICAL CHARACTORISTICS (cont.)

Figure 16. Distortion versus Frequency
(Stereo amplifier)

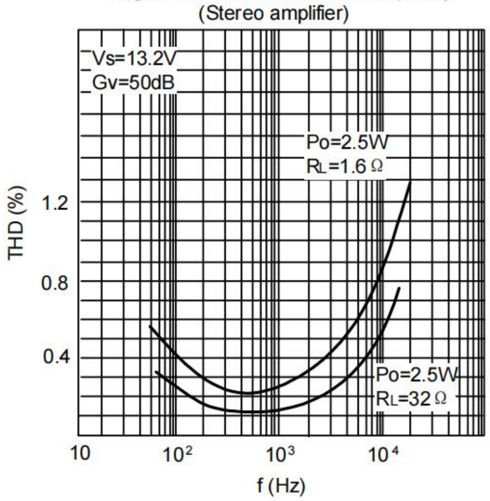


Figure17. Supply Voltage Rejection versusC 3
(Stereo amplifier)

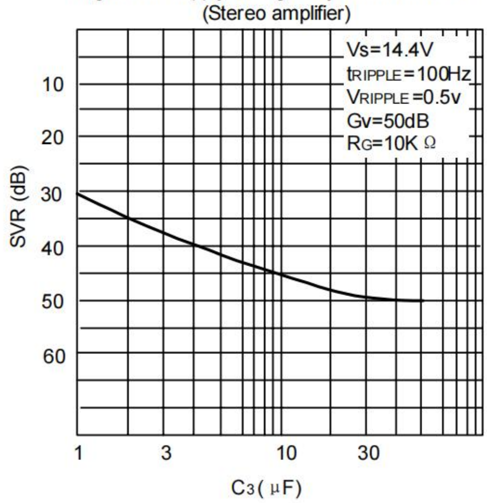


Figure 18. Supply Voltage Rejection versus
Frequency(Stereo amplifier)

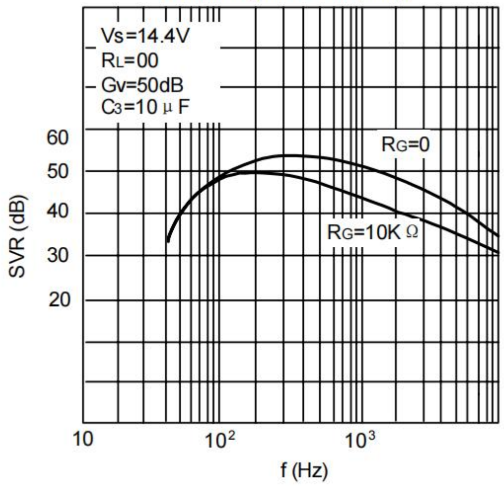


Figure 19. Supply Voltage Rejection versus C 2 and
C3 (Stereo amplifier)

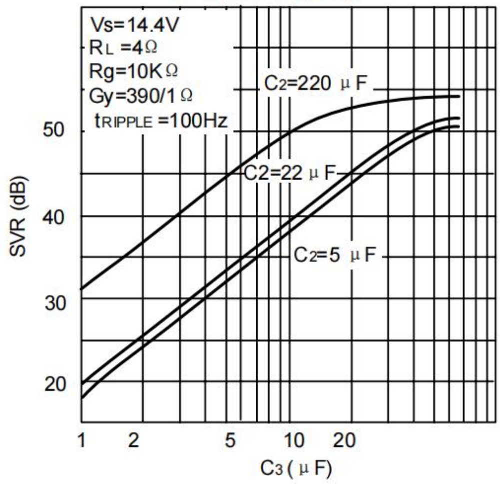


Figure 20. Supply Voltage Rejection versus C 2 and C3
(Stereo amplifier)

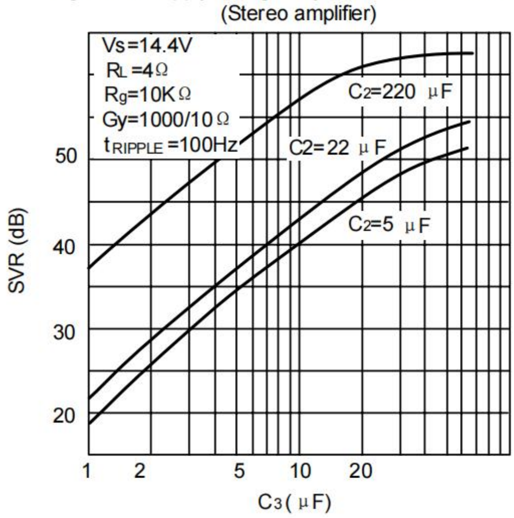
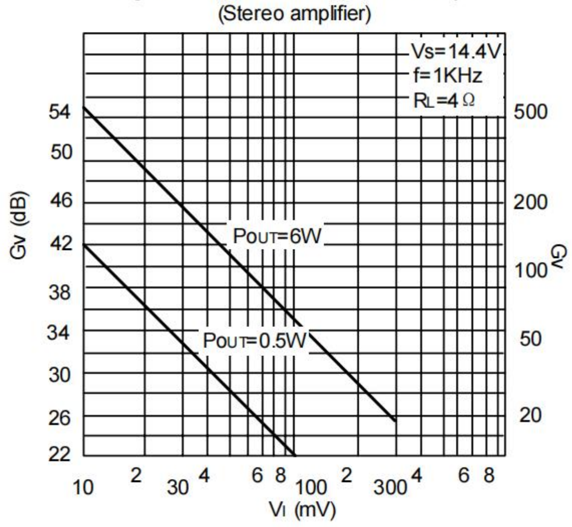


Figure 21. Gain versus Input Sensitivity
(Stereo amplifier)



TYPICAL CHARACTORISTICS (cont.)

Figure 22. Gain versus Input Sensitivity (Stereo amplifier)

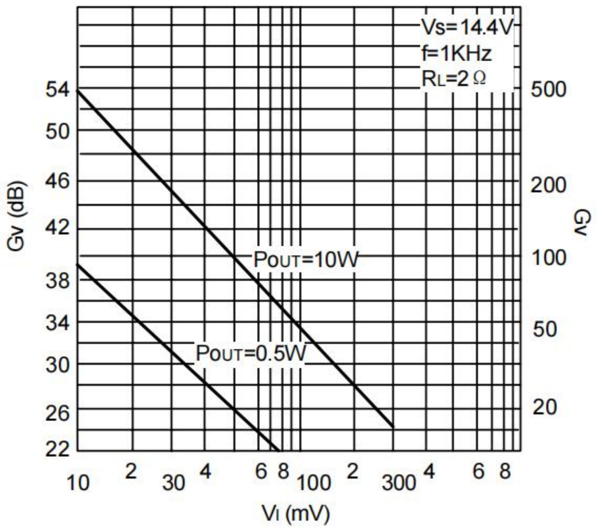


Figure 23. Total Power Dissipation and Efficiency versus Output Power (Bridge amplifier)

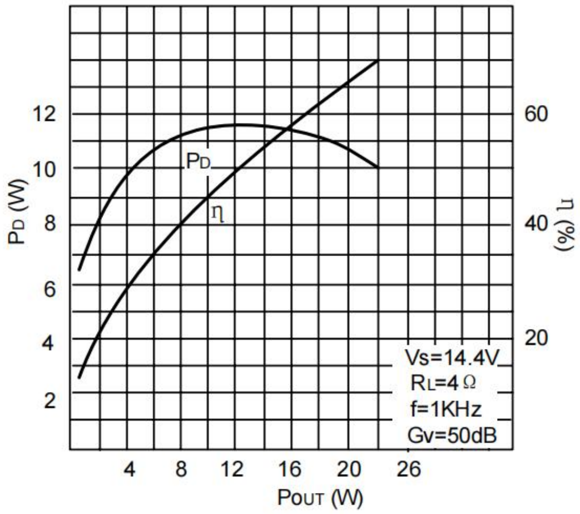
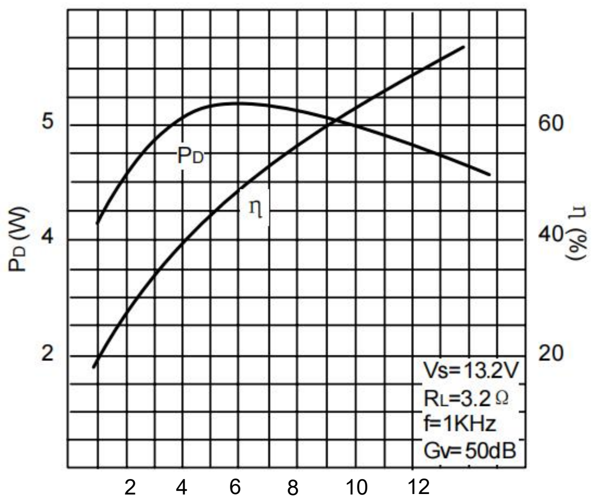
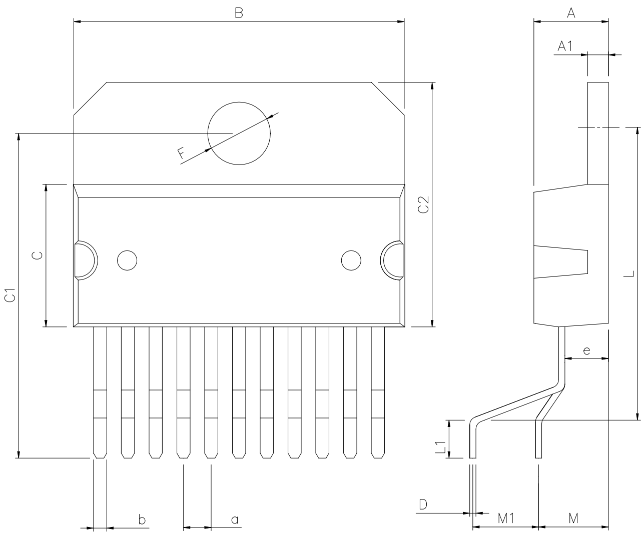


Figure 24. Total Power Dissipation and Efficiency versus Output Power (Stereo amplifier)



Physical Dimensions

ZIP-11



Dimensions In Millimeters(ZIP-11)														
Symbol:	A	A1	B	C	C1	C2	D	F	L	L1	M	M1	a	b	e
Min:	4.4	1.2	19.6	10.3	21.9	17.2	0.49	3.65	17.4	3.2	4.25	4.73	1.45	0.88	2.65 TYP
Max:	5.0	1.6	20.6	10.9	22.5	17.7	0.55	3.85	18.1	4.5	4.85	5.43	1.95	0.95	

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