4 x 45 W quad bridge car radio amplifier

AC7315

FEATURES

- High output power capability:
  - 4 x 45 W / 4 Ω max.
  - 4 x 26 W / 4 Ω @ 14.4 V, 1 kHz, 10 %
- Capable to operate in low voltage (6V) conditions("start stop")
- MOSFET output power stage
- Excellent GSM noise immunity
- Hi Fi class distortion
- Built in various detection circuits in pin25(output offset voltage, output short, over voltage)
- Low output offset voltage
- Standby function
- Mute function
- Auto mute at min. supply voltage detection
- Internally fixed gain (26 dB)

Protections:

- Output short circuit to Gnd, to Vs, across the load
- Very inductive loads
- Low power dissipation in any short circuit condition
- Load dump voltage
- Output DC offset detection
- ESD

Description

The AC7315 is an AB class audio power amplifier, packaged in FZIP25 and designed for car radio applications.

The amplifier use the complementary DMOS output stage in the BCD process, the DMOS output stage guarantee the perfect sound quality with high power output signal.

The amplifier contains four channels in BTL configuration and each with fixed gain of 26dB. Thanks for the outstanding THD spec, this device supply the hi-fi and clear sound quality. It is compliant to the OEM specification for low voltage operation ("Start Stop"). The max power is 4X45W in 4ohm load.

QUICK REFRENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_P	Operating supply voltage	-	6	-	18	V
I_q	Total quiescent current	RL=∞	-	135	-	mA
I_{stby}	Standby current	Vstby=0	-	-	1	uA
P_O	Output power	Vcc=14.4V,THD=10%	-	26	-	W
$P_{O\ max}$	Max output power	Vcc=14.4V,	-	40	-	W
		Vcc=15.2V	-	45	-	W
THD	Distortion	Po=4W	-	0.01	-	%
G_V	Voltage gain	-	25	26	27	dB
Ri	Input impedance	-	45	50	55	kΩ
C_T	Cross talk	f=1kHz;Po=4W	70	80	-	dB
A_M	Mute Attenuation	P_{oref}=7.75Vrms	80	90	-	dB

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1 Pin Configuration and Application circuit

1.1 Pin connection

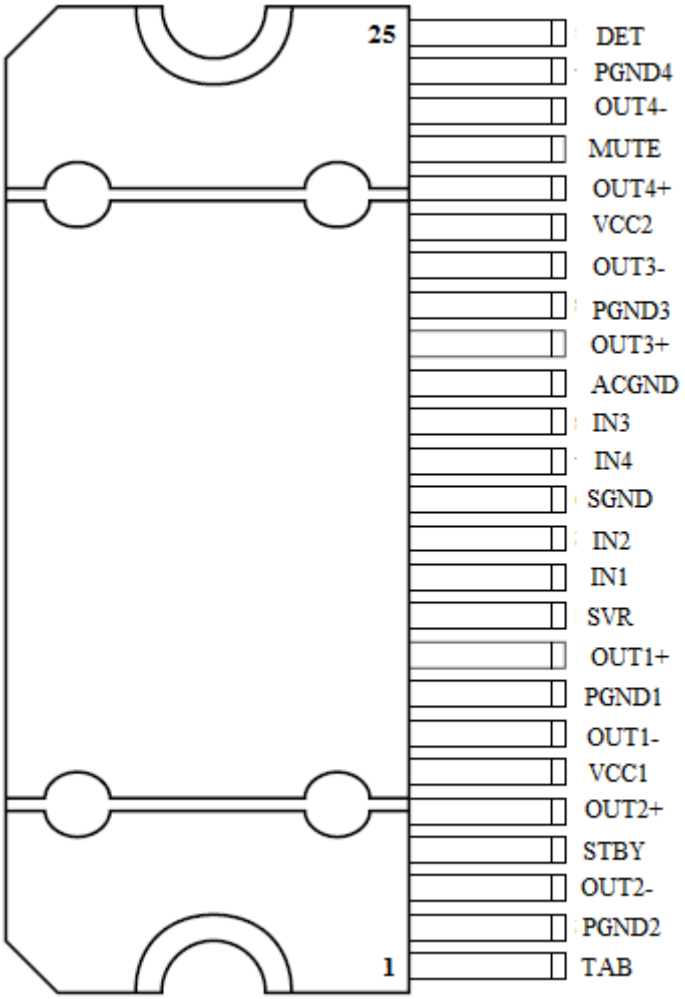


Figure 1. Pin connection (top view)

1.2 Application circuit

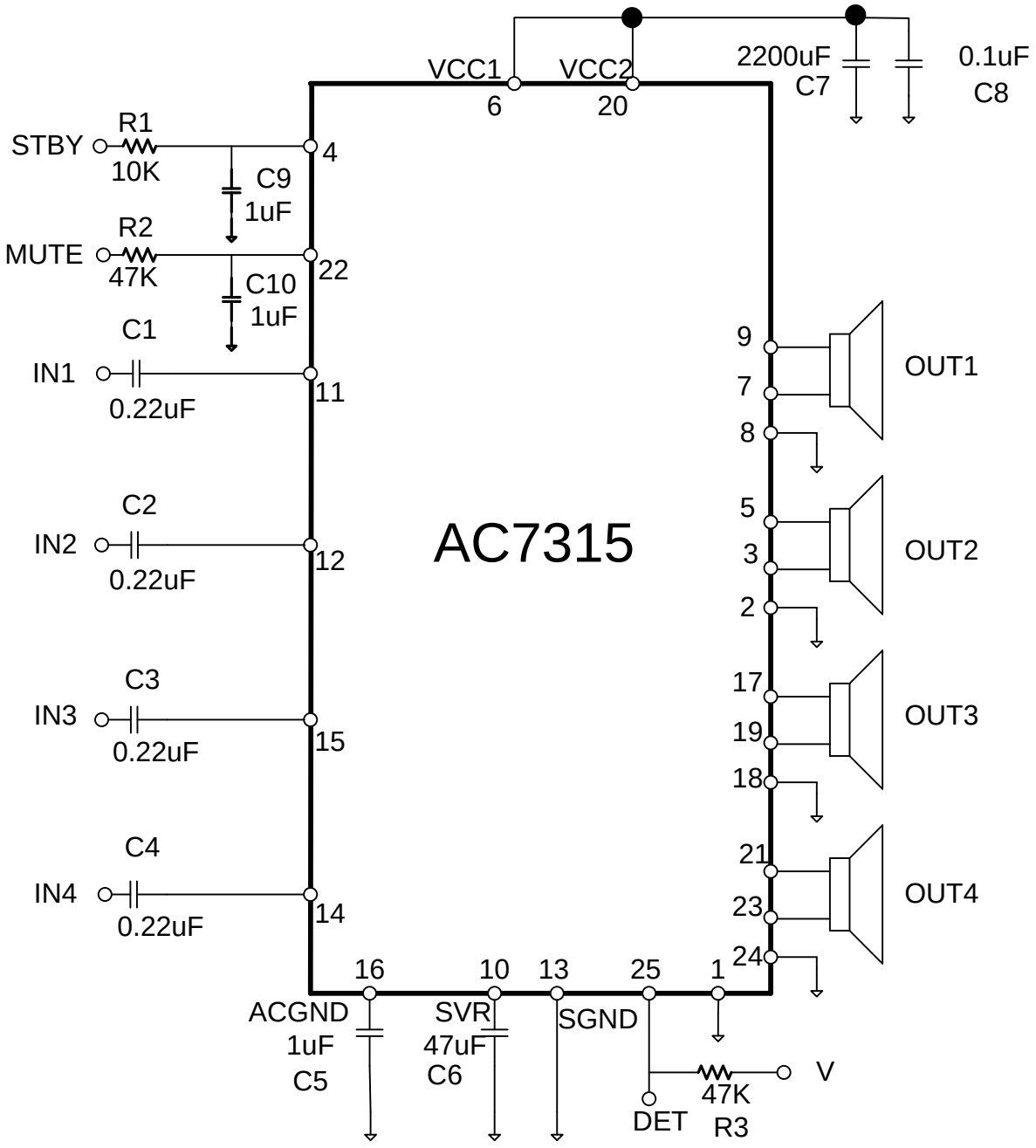


Figure 2: Application circuit of AC7315

1.3 Pin Function Descriptions

Pin	Pin name	Description	Type
1	TAB	Device slug connection	-
2	PGND2	Channels 2 power ground	Ground
3	OUT2-	Channels 2 negative output	Output
4	STBY	Standby	Input
5	OUT2+	Channels 2 positive output	Output
6	VCC1	Supply voltage	Supply
7	OUT1-	Channels 1 negative output	Output
8	PGND1	Channels 1 power ground	Output
9	OUT1+	Channels 1 positive output	Output
10	SVR	Supply voltage rejection pin	Supply
11	IN1	Channel 1 input	Input
12	IN2	Channel 2 input	Input
13	SGND	Signal ground	Ground
14	IN4	Channel 4 input	Input
15	IN3	Channel 3 input	Input
16	ACGND	AC ground	Ground
17	OUT3+	Channels 3 positive output	Output
18	PGND3	Channels 3 power ground	Ground
19	OUT3-	Channels 3 negative output	Output
20	VCC2	Supply voltage	Supply
21	OUT4+	Channels 4 positive output	Output
22	MUTE	Mute pin	Input
23	OUT4-	Channels 4 negative output	Output
24	PGND4	Channels 4 power ground	Ground
25	DET	Offset detection	Output(open drain)

2 Electrical specifications

2.1 Absolute maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_S	Operating supply voltage	18	V
$V_{S\ (DC)}$	DC supply voltage	30	V
$V_{S\ (pk)}$	Peak supply voltage (t = 200 ms)	50	V
I_O	Output peak current: Repetitive (duty cycle 10 % at f = 10 Hz) Non repetitive (t = 100 µs)	 4.5 5.5	A
P_{tot}	Power dissipation, (T_{case} = 70 °C)	80	W
T_j	Junction temperature	150	°C
T_{stg}	Storage temperature	– 55 to 150	°C
$V_{stby\ max}$	STBY pin max voltage	-0.3 to Vs	V
$V_{mute\ max}$	Mute pin max voltage	-0.3 to 6	V

2.2 Thermal data

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{th\ j\text{-}case}$	Thermal resistance junction-to-case max.	1	°C/W

2.3 Electrical characteristics

Refer to the test and application diagram, V_S = 14.4 V; f = 1 kHz; R_g = 600 Ω; R_L = 4 Ω; T_{amb} = 25 °C; unless otherwise specified.

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
General characteristic						
Vs	Supply voltage range	–	6	-	18	V
I_q	Quiescent current	$R_L = \infty$	-	135	-	mA
Istby	Stangby current consumption	-	-	-	1	uA
V_{OS}	Output offset voltage	Play mode	-	-	±100	mV
dV_{OS}	During mute ON/OFF output offset voltage	ITU R-ARM weighted	-10	-	+10	mV
	During STBY ON/OFF output offset voltage					
R_i	Input Impedance	-	45	50	55	kΩ
Audio performances						
G_v	Voltage gain	-	25	26	27	dB
P_o	Output power	THD = 10 %; V_S = 14.4 V	-	26	-	W
$P_{o\ max}$	Max.output power	V_S = 14.4 V	-	40	-	W
		V_S = 15.2 V	-	45	-	
THD	Distortion	P_o = 4 W	-	0.01	-	%
e_{No}	Output noise	"A" Weighted	-	100	-	μV
		Bw = 20 Hz to 20 kHz	-	130	-	μV
SVR	Supply voltage rejection	f = 100 Hz; V_r = 1 Vrms	50	65	-	dB
f_{ch}	High cut-off frequency	P_o = 0.5 W	-	140	-	kHz
C_T	Cross talk	f = 1 kHz; P_o = 4 W	70	80	-	dB
		f = 10 kHz; P_o = 4 W	-	60	-	dB
A_M	Mute attenuation	P_{Oref} = 7.75Vrms	80	90	-	dB
Control pin characteristics						
V_{SB_H}	Power On threshold voltage	(Amp: ON)	2.2	-	-	V
V_{SB_L}	Power off threshold voltage	(Amp: OFF)	-	-	0.5	V
V_{M_H}	Mute OFF threshold voltage	(Amp: play)	2.2	-	-	V
V_{M_L}	Mute ON threshold voltage	(Amp: mute)	-	-	0.5	V
$V_{AM\ in}$	V_S automute threshold	(Amp: mute); Att. ≥ 80 dB; P_{Oref} = 4 W	-	5	5.5	V
		(Amp: play); Att. < 0.1 dB; P_O = 0.5 W	-	-	6	
Voffset	DC offset threshold voltage	-	-	2	-	V
V_{DET_SAT}	DET pin saturation voltage	Io=500uA,(pin25=low)	-	0.1	-	V

2.4 Characteristic Chart

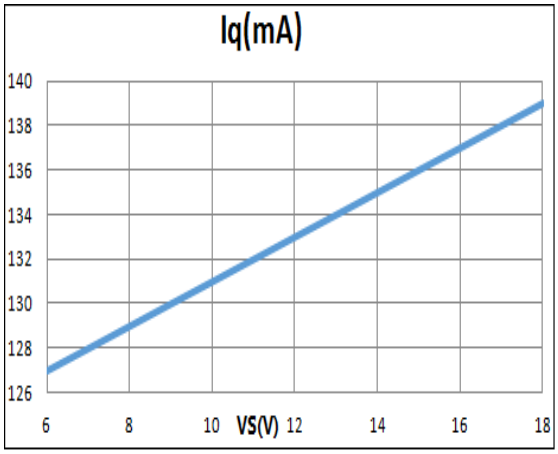


Figure1: Quiescent Current vs. Supply voltage

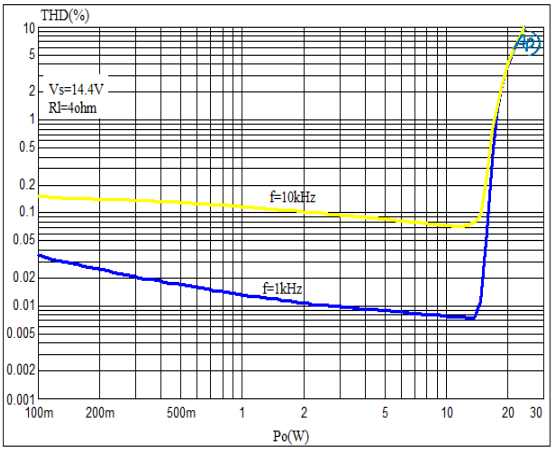


Figure2: Distortion vs. Output Power (4ohm) Vs=14.4V

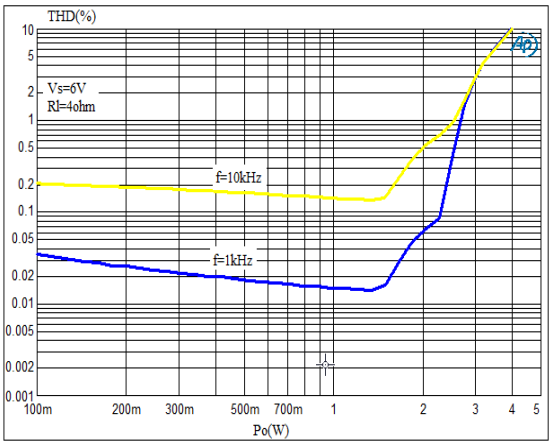


Figure3: Distortion vs. Output Power (4ohm) Vs=6V

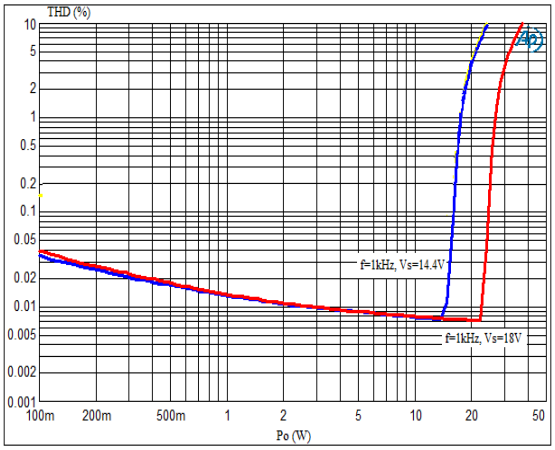


Figure4: Distortion vs. Output Power (4ohm) Vs=18V

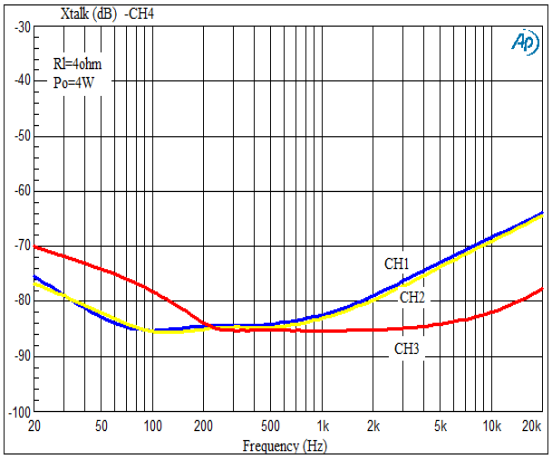


Figure5: Crosstalk vs. frequency Vs=14.4V

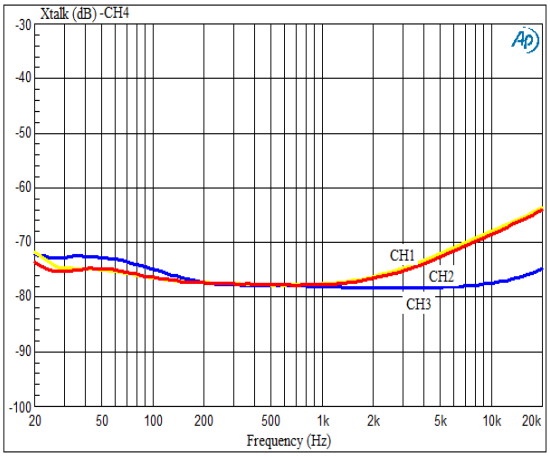


Figure6: Crosstalk vs. frequency Vs=6V

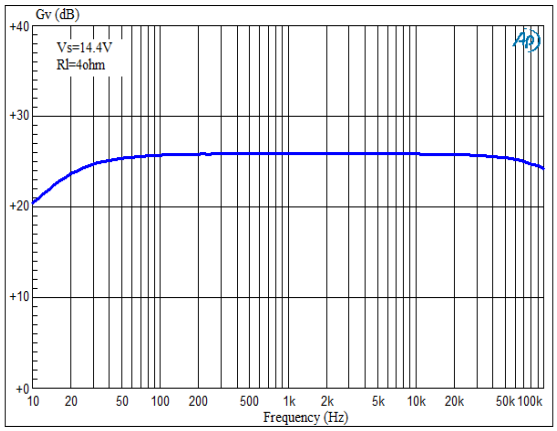


Figure7: Voltage Gain vs. frequency

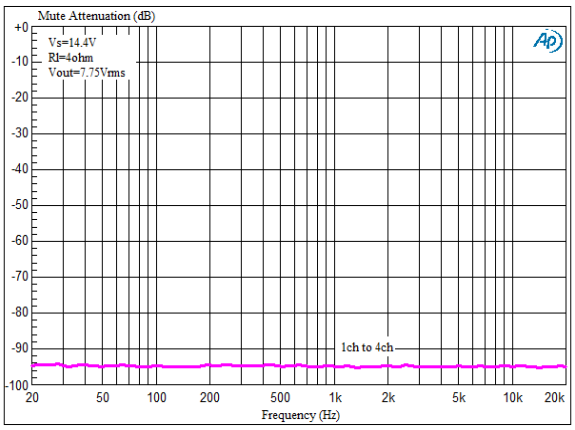
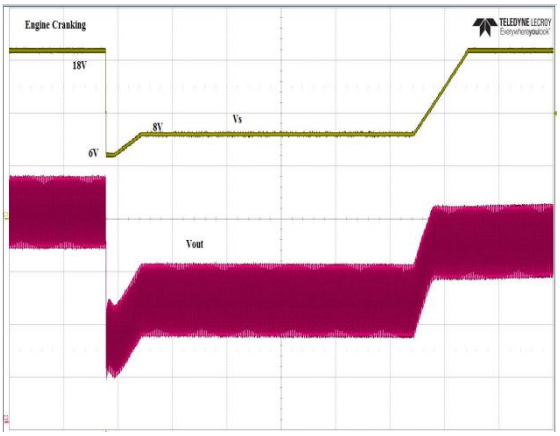


Figure8: Mute attenuation vs. frequency



Firgure9: Engine cranking profile

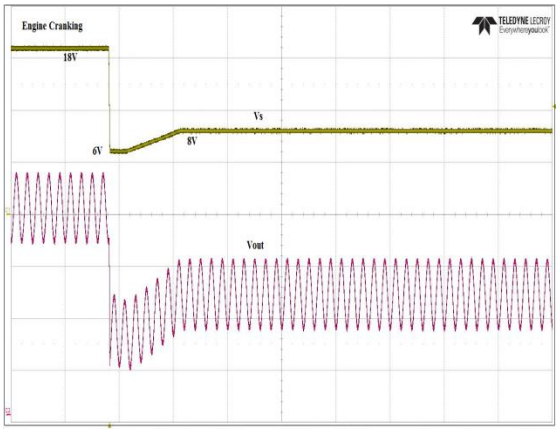
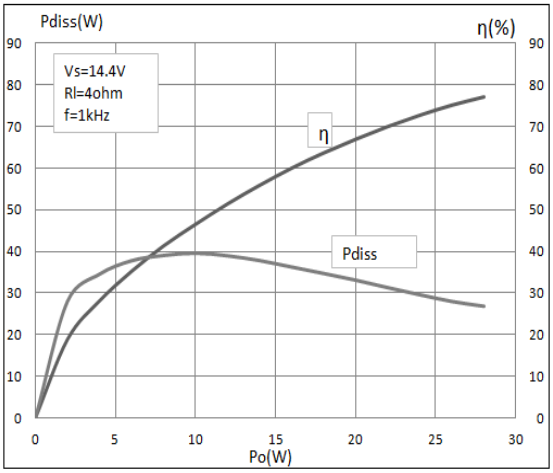


Figure10: Engine cranking profile



Firgure11: Total power dissipation vs. efficiency (R_L=4ohm)

3 General information

3.1 Input stage

The AC7315's inputs are ground- compatible. If the standard value for the input capacitors (0.22uF) is adopted, the low frequency cut-off will amount to 16Hz. For optimum pop performances, the capacitor connect to ACGND should be four times bigger than input capacitors.

3.2 Standby and muting

Standby and mute pins are 3.3V and 5V compatible.

RC cells at both mute and standby pins have always to be used in order to smooth the transition for preventing any audible noise. A time constant slower than 2.5V/ms is suggested for the standby pin and 0.5V/ms for the mute pin.

If the standby function is not used, it should steadily be connected to Vs through a 470kΩ resistor.

3.3 SVR

The capacitor on SVR sets the start up and shut down times. It helps to have pop free transitions. Its minimum recommended value is 10uF. This capacitor also helps the supply voltage ripple rejection.

To make device allow a continuous operation when the battery falls down (start stop), SVR is set as the VCC/4 to make sure the device can fully operating, only the maximum output power is reduced according to the available voltage supply.

If the battery voltage drops below the minimum operating voltage of 6V the amplifier is fast muted, the capacitor on SVR is discharged and the amplifier restarts when the battery voltage returns to the correct voltage.

3.4 Protection Functions

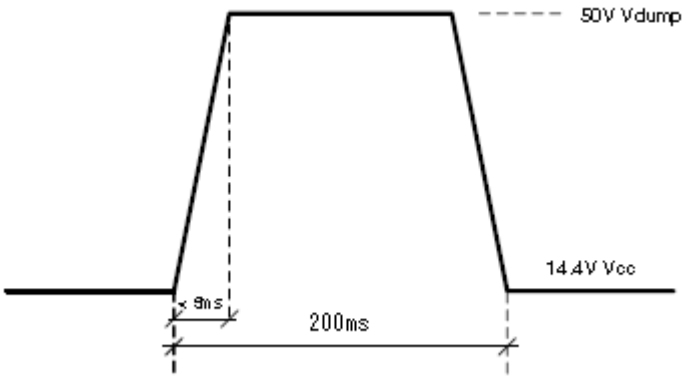
3.4.1 Short to VCC, short to GND, Output to output short

When the device detect output pins are short to VCC, short to GND or output to output short, device will be protected automatically. When these wrong connection is canceled device will return automatically.

3.4.2 Over voltage and load dump protection

When VCC pin voltage is higher than 19V, the amplifier is switched to a high impedance state. It stops playing till the supply voltage returns in the operation rang.

The amplifier is protected against load dump surges having amplitude as high as 50V and a rising time lower than 5ms.



3.4.3 Thermal protection

If the junction temperature of the IC reached Tj=150°C, a smooth mute is applied to reduce the output power and limit power dissipation. If this is not enough and the junction temperature still continue to increase, the amplifier will switched off when reached the maximum temperature of 170°C.

3.5 DET pin

DET pin has been reused as 3 functions warning message. When there is a DC offset voltage between OUT (+) and OUT (-), the detection result will be shown in DET pin. In case of shorting output to Vdd/Gnd or over voltage, the result will be detected.

3.5.1 DC offset detection

The function of dc offset detector is to detect the offset voltage between OUT+ and OUT- . When an anomalous input DC offset applied the output will be input value multiplied by the amplifier gain which will produce a dangerous large offset at the output. In fact this DC output offset may lead to speakers damage for overheating. To correctly detect a DC offset, the power amplifier has to be un-muted with no input signal.

When the differential output voltage is out of a window comparator with threshold ±1.5V (typ), the DET pin will be pulled down.

3.5.2 Output to VCC/GND short detection and over Voltage

When output short to VCC/GND or over voltage is turned on the MOS transistor and can be detected. Threshold of over voltage protection: VCC=20V (typ).

In the case of output short to VCC/GND will be turn on the MOS transistor and can be detected. When sink current is 500uA the saturation voltage will be 0.1V.

4 Package Information

FZIP25 (Vertical)