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1 Block and pin connection diagrams

Figure 1. Block diagram

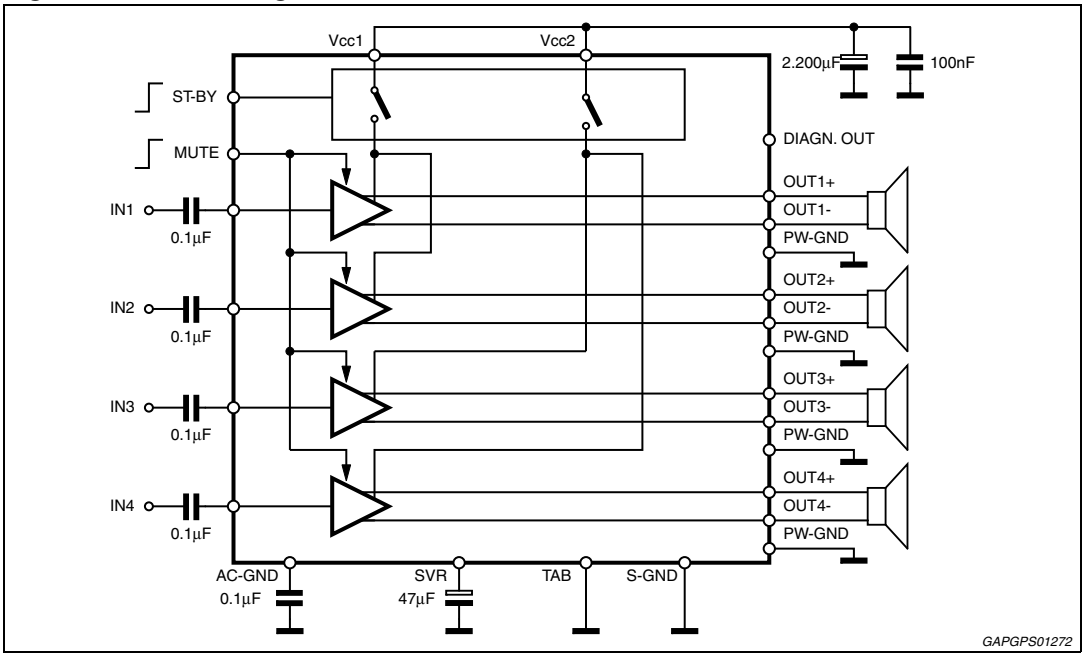
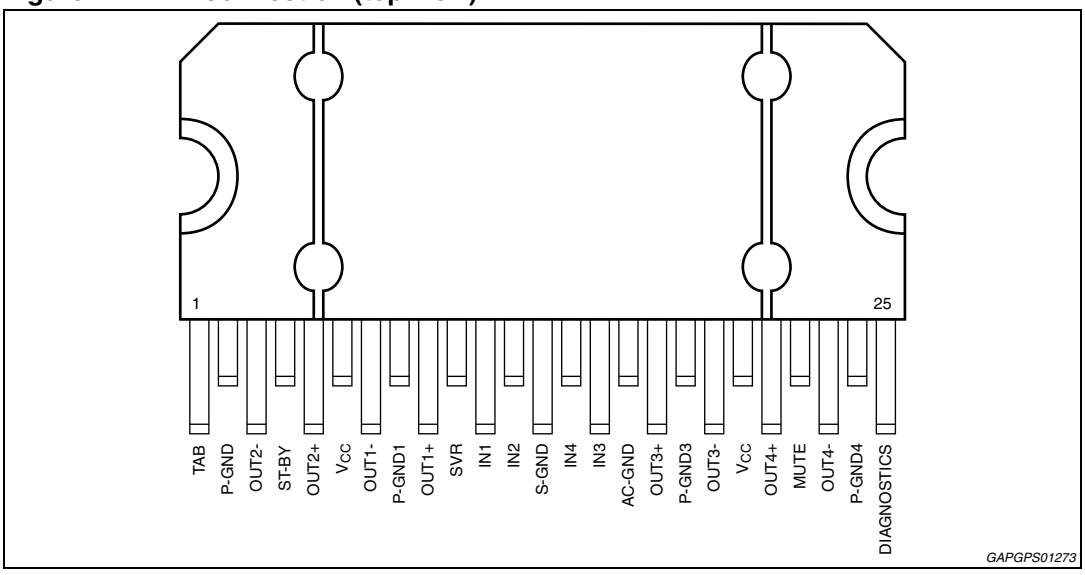


Figure 2. Pin connection (top view)



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	28	V
$V_{S\ (pk)}$	Peak supply voltage (t = 50 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 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

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

V_S = 14.4 V; f = 1 kHz; R_g = 600 Ω; R_L = 4 Ω;T_{amb} = 25 °C; Refer to the test and application diagram (*Figure 3*), unless otherwise specified.

Table 4. Electrical characteristics

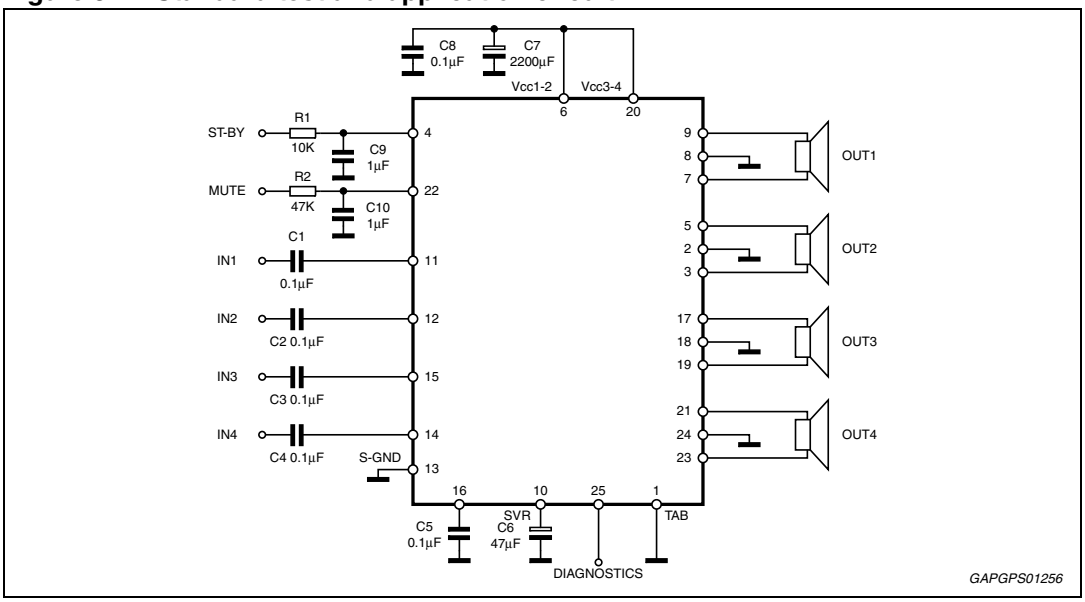
Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{q1}	Quiescent current	-	-	180	300	mA
V_{OS}	Output offset voltage	-	-	-	100	mV
G_v	Voltage gain	-	25	26	27	dB
P_o	Output power	THD = 10% THD = 1% THD = 10%; V_S = 13.2 V THD = 1%; V_S = 13.2 V	21 16.5 17 14	23 19 20 16	-	W
$P_{o\ max.}$	Max. output power (1)	V_S = 14.4 V	33	35	-	W
		V_S = 15.2 V	-	42	-	W
THD	Distortion	P_o = 4 W	-	0.04	0.3	%

Table 4. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
e_{No}	Output noise	"A" Weighted Bw = 20 Hz to 20 kHz	-	50 65	- 150	µV µV
SVR	Supply voltage rejection	f = 100 Hz	50	65	-	dB
f_{cl}	Low cut-off frequency	-	-	20	-	Hz
f_{ch}	High cut-off frequency	-	75		-	kHz
R_i	Input impedance	-	70	100	-	kΩ
C_T	Cross talk	f = 1 kHz	50	70	-	dB
I_{SB}	Standby current consumption	Vs_{tandby} =0 V	-	-	15	µA
$V_{SB\ out}$	Standby out threshold voltage	(Amp: on)	3.5	-	-	V
$V_{SB\ IN}$	Standby in threshold voltage	(Amp: off)	-	-	1.5	V
A_M	Mute attenuation	V_O = 1Vrms	80	90	-	dB
$V_{M\ out}$	Mute out threshold voltage	(Amp: play)	3.5	-	-	V
$V_{M\ in}$	Mute in threshold voltage	(Amp: mute)	-	-	1.5	V
$I_{m\ (L)}$	Muting pin current	V_{MUTE} = 1.5V (source current)	5	10	16	µA
I_{CDOFF}	Clipping detector "off" output average current	THD = 1% (1)	-	100	-	µA
I_{CDON}	Clipping detector "on" output average current	THD = 10% (1)	100	240	350	µA

1. Diagnostics output pulled-up to 5 V with 10 kΩ series resistor.

Figure 3. Standard test and application circuit



2.4 PCB and component layout

Referred to *Figure 3: Standard test and application circuit*.

Figure 4. Components and top copper layer

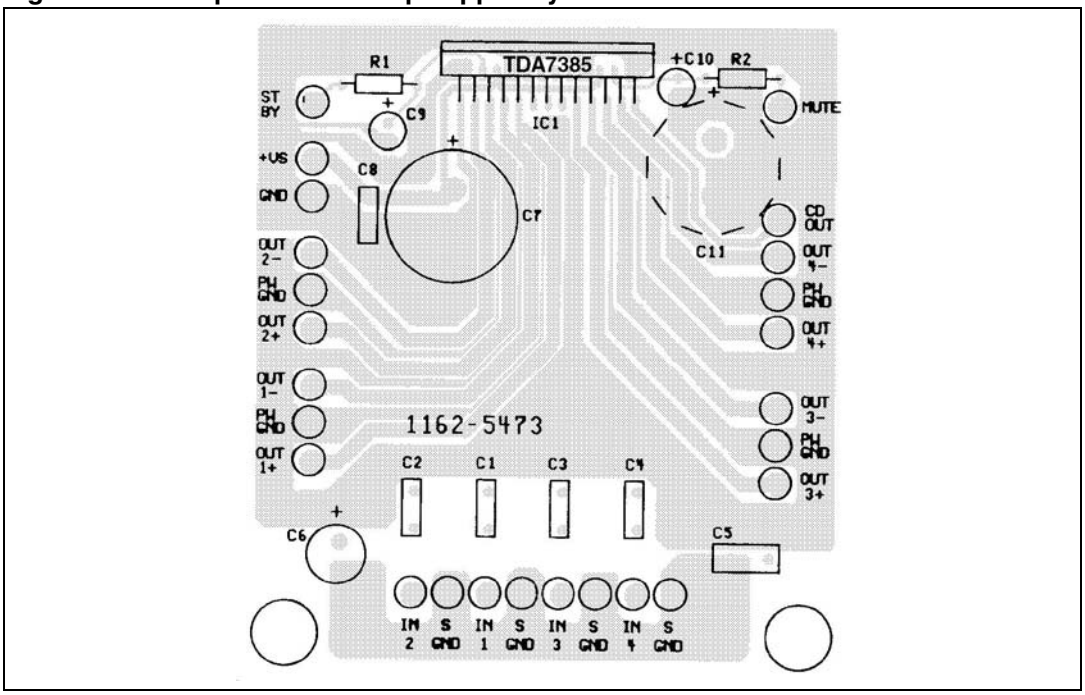
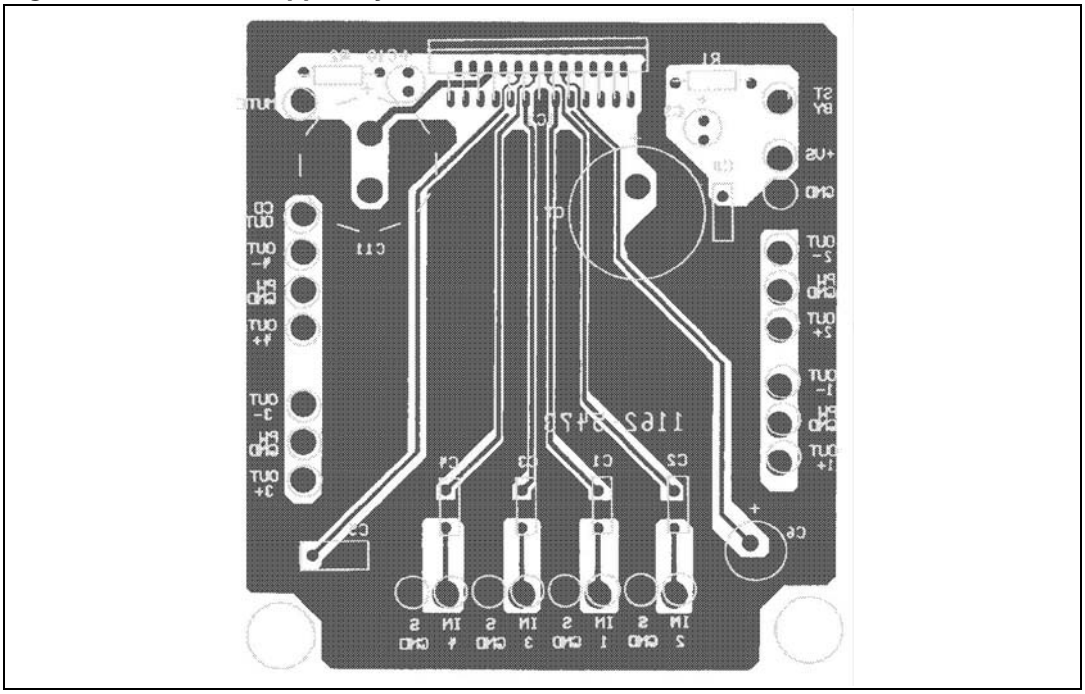


Figure 5. Bottom copper layer



2.5 Electrical characteristic curves

Figure 6. Quiescent current vs. supply voltage

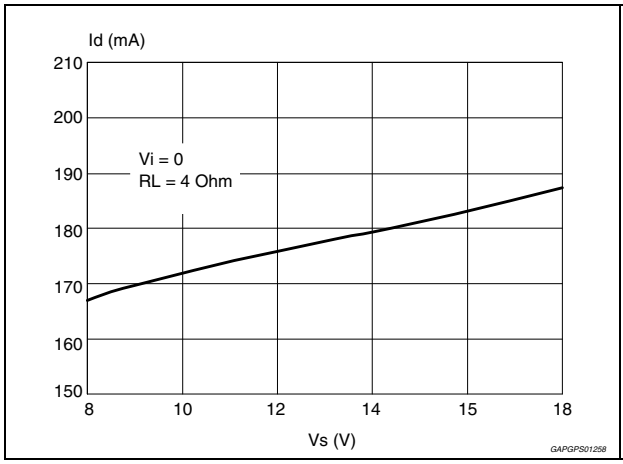


Figure 7. Quiescent output voltage vs. supply voltage

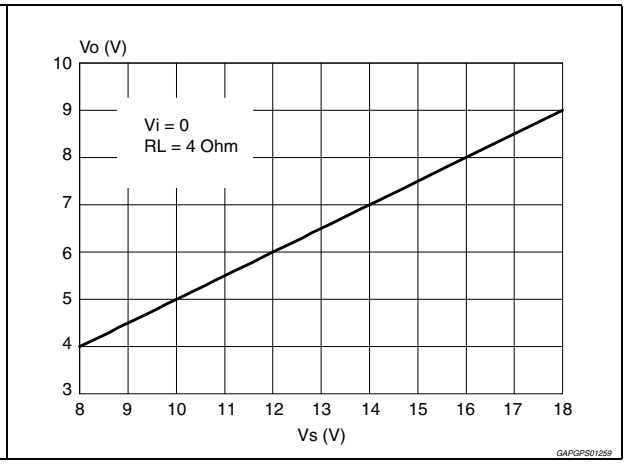


Figure 8. Output power vs. supply voltage (4Ω)

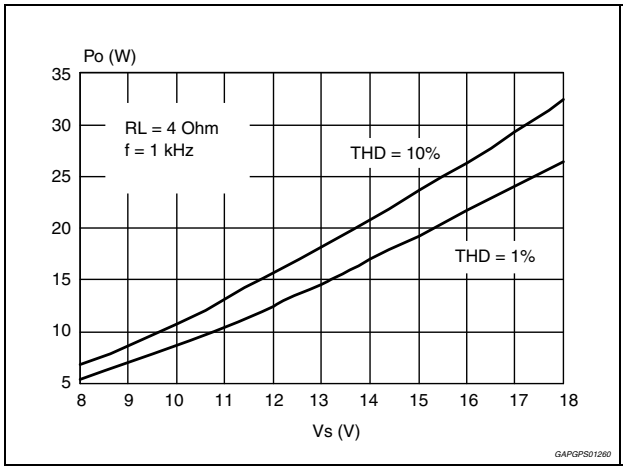


Figure 9. Distortion vs. output power

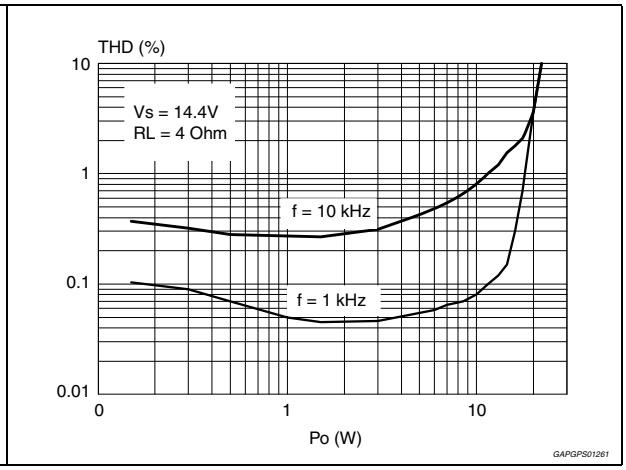


Figure 10. Distortion vs. frequency

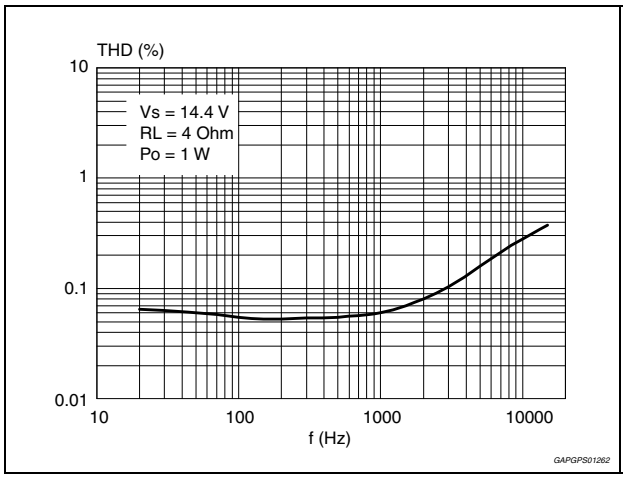


Figure 11. Supply voltage rejection vs. frequency by varying C6

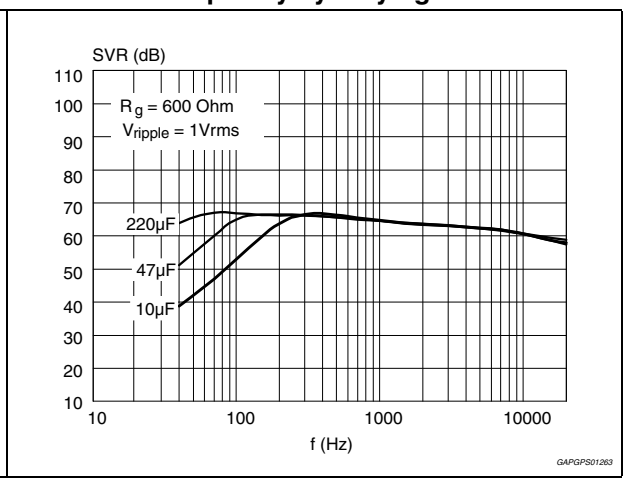


Figure 12. Output noise vs. source resistance

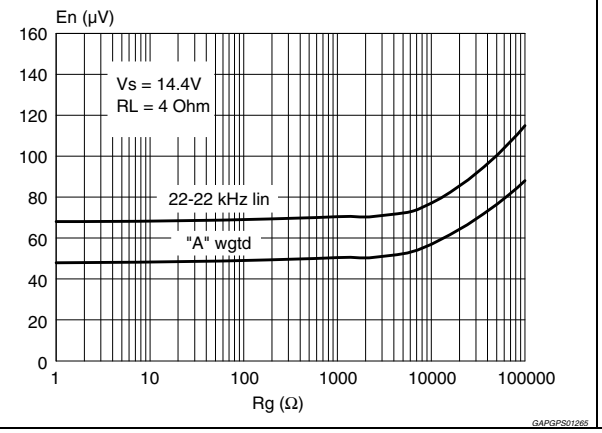
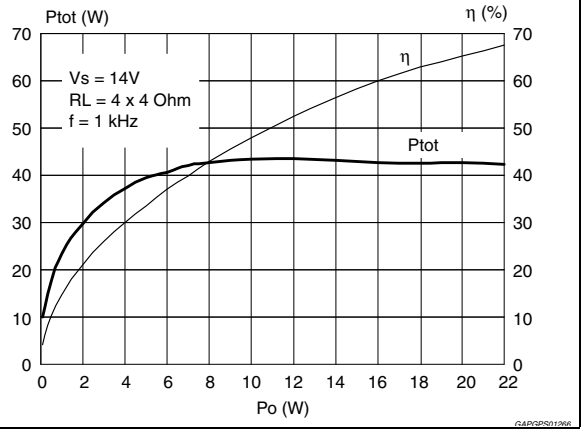


Figure 13. Power dissipation and efficiency vs. output power



3 Application hints

Referred to the circuit of *Figure 3*.

3.1 Biasing and SVR

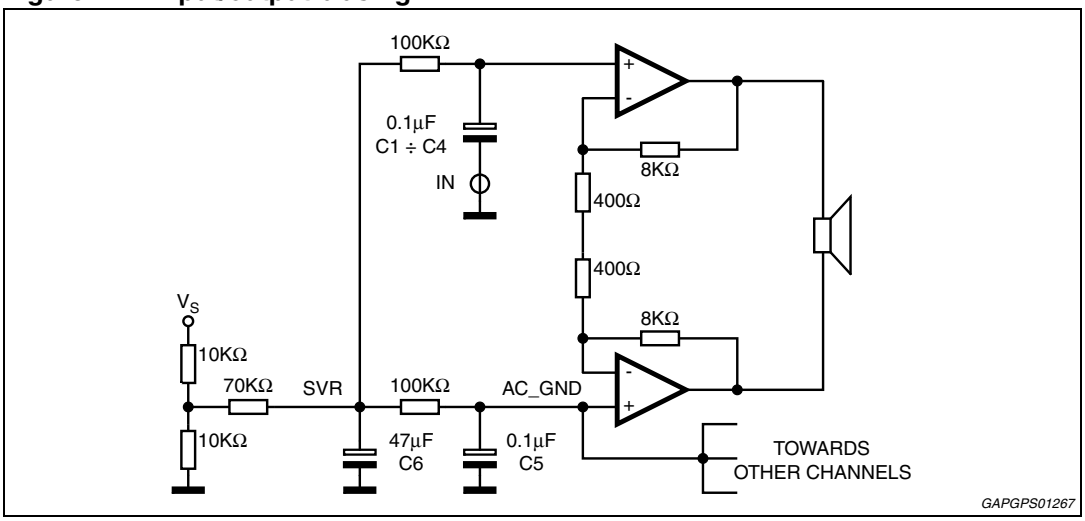
As shown by *Figure 14*, all the TDA7385's main sections, such as Inputs, Outputs AND AC-GND (pin 16) are internally biased at half supply voltage level (Vs/2), which is derived from the Supply Voltage Rejection (SVR) block. In this way no current flows through the internal feedback network. The AC-GND is common to all the 4 amplifiers and represents the connection point of all the inverting inputs.

Both individual inputs and AC-GND are connected to Vs/2 (SVR) by means of 100 kΩ resistors.

To ensure proper operation and high supply voltage rejection, it is of fundamental importance to provide a good impedance matching between Inputs and AC-GROUND terminations. This implies that **C_1, C_2, C_3, C_4, C_5 capacitors have to carry the same nominal value and their tolerance should never exceed ± 10 %.**

Besides its contribution to the ripple rejection, the SVR capacitor governs the turn ON/OFF time sequence and, consequently, plays an essential role in the pop optimization during ON/OFF transients. To conveniently serve both needs, **its minimum recommended value is 10µF**.

Figure 14. Input/output biasing



3.2 Input stage

The TDA7385's inputs are ground-compatible and can stand very high input signals (± 8 Vpk) without any performances degradation.

If the standard value for the input capacitors (0.1 µF) is adopted, the low frequency cut-off will amount to 16 Hz.

3.3 Standby and muting

Standby and muting facilities are both CMOS-compatible. If unused, a straight connection to Vs of their respective pins would be admissible. Conventional low-power transistors can be employed to drive muting and stand-by pins in absence of true CMOS ports or microprocessors. R-C cells have always to be used in order to smooth down the transitions for preventing any audible transient noises.

Since a DC current of about 10 µA normally flows out of pin 22, the maximum allowable muting-series resistance (R_2) is 70 kΩ, which is sufficiently high to permit a muting capacitor reasonably small (about 1µF).

If R_2 is higher than recommended, the involved risk will be that the voltage at pin 22 may rise to above the 1.5 V threshold voltage and the device will consequently fail to turn OFF when the mute line is brought down.

About the stand-by, the time constant to be assigned in order to obtain a virtually pop-free transition has to be slower than 2.5V/ms.

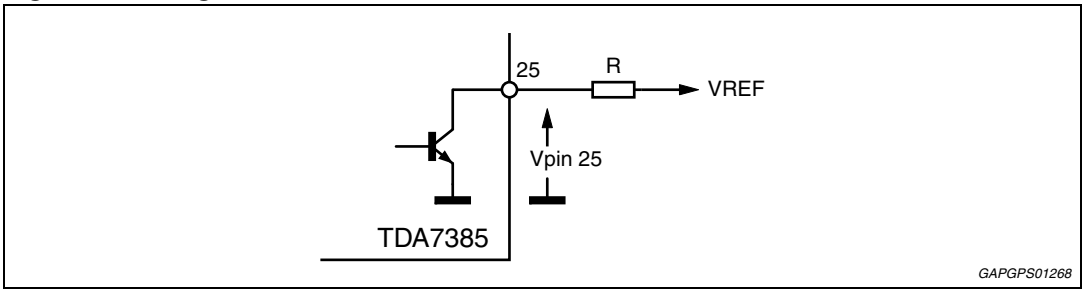
3.4 Diagnostics facility

The TDA7385 is equipped with a diagnostics circuitry able to detect the following events:

- Clipping in the output stage
- overheating (thermal shut-down proximity)
- Output misconnections (OUT-GND and OUT-V_S shorts)

Diagnostics information is available across an open collector output located at pin 25 (*Figure 15*) through a current sinking whenever at least one of the above events is recognized.

Figure 15. Diagnostics circuit



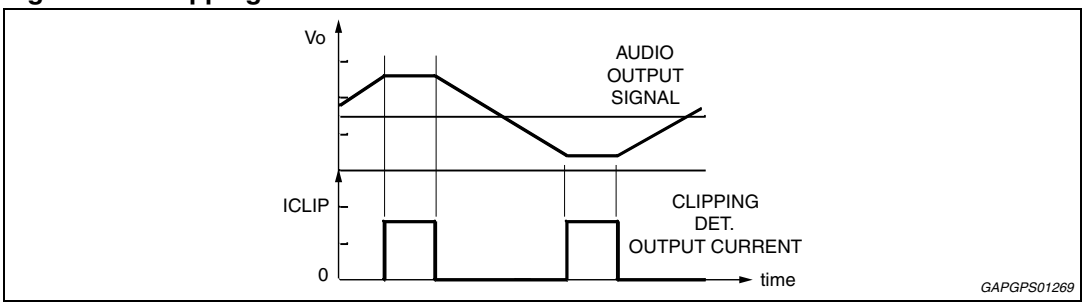
Among them, the **Clipping Detector** acts in a way to output a signal as soon as one or more power transistors start being saturated.

As a result, the clipping-related signal at pin 25 takes the form of pulses, which are perfectly synchronized with each single clipping event in the music program and reflect the same duration time (*Figure 16*). Applications making use of this facility usually operate a filtering/integration of the pulses train through passive R-C networks and realize a volume (or tone bass) stepping down in association with microprocessor-driven audioprocessors. The maximum load that pin 25 can sustain is 1 kΩ.

Due to its operating principles, the clipping detector has to be viewed mainly as a power-dependent feature rather than frequency-dependent. This means that clipping state will be immediately signaled out whenever a fixed power level is reached, regardless of the audio

frequency. In other words, this feature offers the means to counteract the extremely sound-damaging effects of clipping, caused by a sudden increase of odd order harmonics and appearance of serious inter-modulation phenomena.

Figure 16. Clipping detection waveforms



Another possible kind of distortion control could be the setting of a maximum allowable THD limit (e.g. 0.5%) over the entire audio frequency range. Besides offering no practical advantages, this procedure cannot be much accurate, as the non-clipping distortion is likely to vary over frequency.

In case of **Overheating**, pin 25 will signal out the junction temperature proximity to the thermal shut-down threshold. This will typically start about 2°C before the thermal shut-down threshold is reached.

As various kind of diagnostics information is available at pin 25 (clipping, shorts and overheating), it may be necessary to operate some distinctions on order to treat each event separately. This could be achieved by taking into account the intrinsically different timing of the diagnostics output under each circumstance.

In fact, clipping will produce pulses normally much shorter than those present under faulty conditions. An example of circuit able to distinguish between the two occurrences is shown by *Figure 18*.

3.5 Stability and layout considerations

If properly layouted and hooked to standard car-radio speakers, the TDA7385 will be intrinsically stable with no need of external compensations such as output R-C cells. Due to the high number of channels involved, this translates into a very remarkable components saving if compared to similar devices on the market.

To simplify pc-board layout designs, each amplifier stage has its own power ground externally accessible (pins 2,8,18,24) and one supply voltage pin for each couple of them. Even more important, this makes it possible to achieve the highest possible degree of separation among the channels, with remarkable benefits in terms of cross-talk and distortion features.

About the layout grounding, it is particularly important to connect the AC-GND capacitor (C_5) to the signal GND, as close as possible to the audio inputs ground: this will guarantee high rejection of any common mode spurious signals.

The SVR capacitor (C_6) has also to be connected to the signal GND.

Supply filtering elements (C_7, C_8) have naturally to be connected to the power-ground and located as close as possible to the Vs pins.

Pin 1, which is mechanically attached to the device's tab, needs to be tied to the cleanest power ground point in the pc-board, which is generally near the supply filtering capacitors.

Figure 17. Diagnostics waveforms

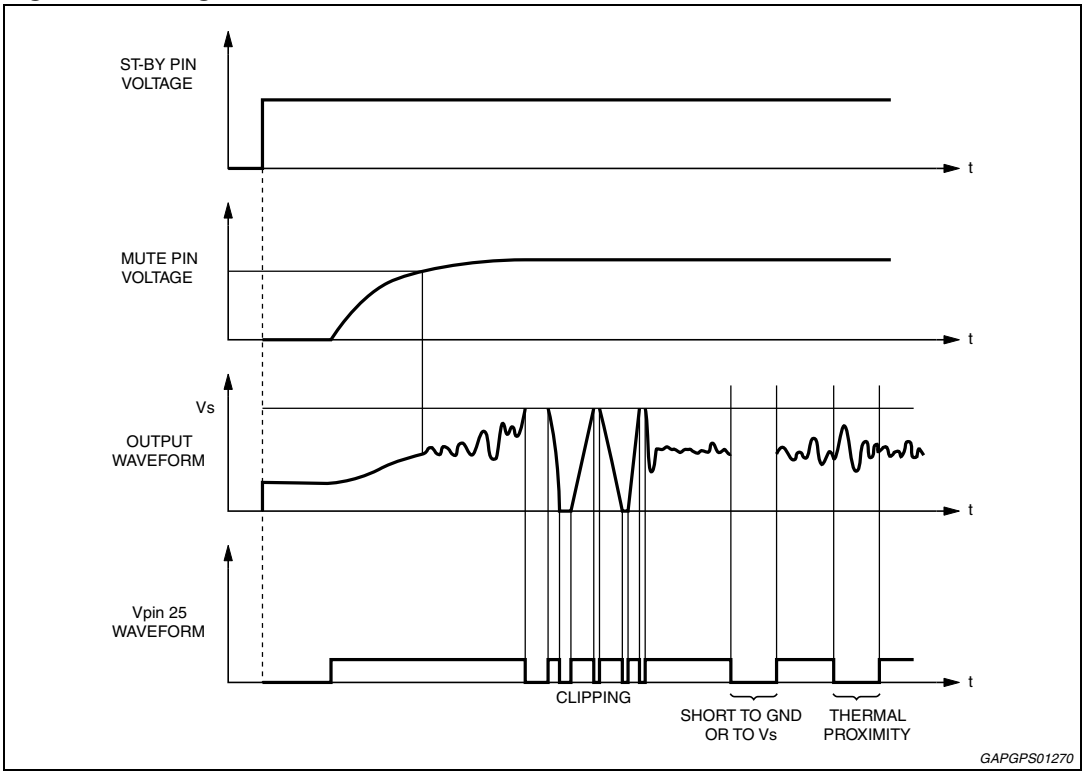
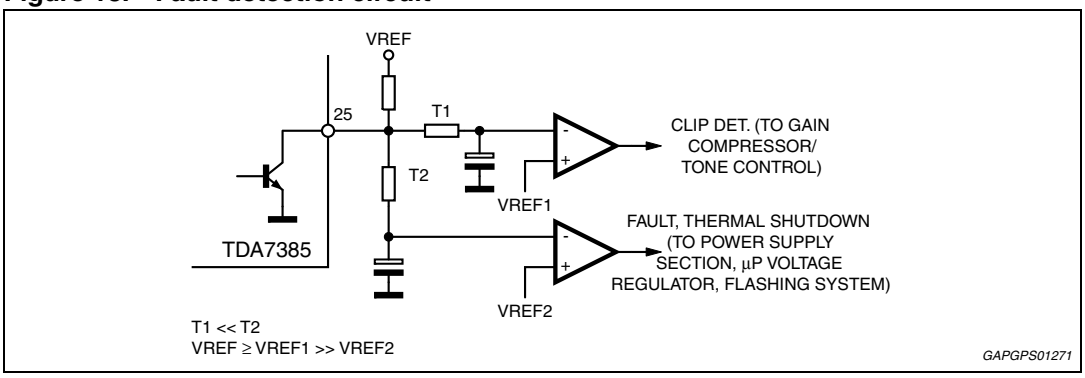


Figure 18. Fault detection circuit



4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*.

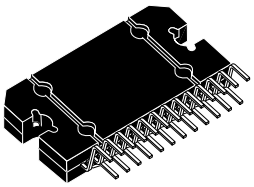
ECOPACK® is an ST trademark.

Figure 19. Flexiwatt25 mechanical data and package dimensions

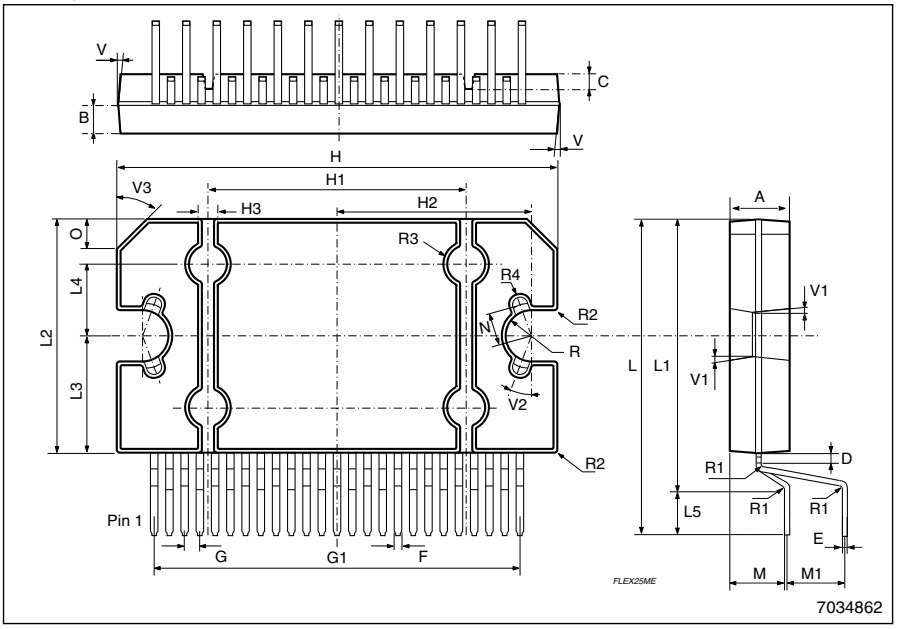
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.45	4.50	4.65	0.175	0.177	0.183
B	1.80	1.90	2.00	0.070	0.074	0.079
C		1.40			0.055	
D	0.75	0.90	1.05	0.029	0.035	0.041
E	0.37	0.39	0.42	0.014	0.015	0.016
F (1)			0.57			0.022
G	0.80	1.00	1.20	0.031	0.040	0.047
G1	23.75	24.00	24.25	0.935	0.945	0.955
H (2)	28.90	29.23	29.30	1.139	1.150	1.153
H1		17.00			0.669	
H2		12.80			0.503	
H3		0.80			0.031	
L (2)	22.07	22.47	22.87	0.869	0.884	0.904
L1	18.57	18.97	19.37	0.731	0.747	0.762
L2 (2)	15.50	15.70	15.90	0.610	0.618	0.626
L3	7.70	7.85	7.95	0.303	0.309	0.313
L4		5			0.197	
L5		3.5			0.138	
M	3.70	4.00	4.30	0.145	0.157	0.169
M1	3.60	4.00	4.40	0.142	0.157	0.173
N		2.20			0.086	
O		2			0.079	
R		1.70			0.067	
R1		0.5			0.02	
R2		0.3			0.12	
R3		1.25			0.049	
R4		0.50			0.019	
V	5° (Typ.)					
V1	3° (Typ.)					
V2	20° (Typ.)					
V3	45° (Typ.)					

(1): dam-bar protusion not included
(2): molding protusion included

OUTLINE AND MECHANICAL DATA



Flexiwatt25 (vertical)



GAPGPS00669

5 Revision history

Table 5. Document revision history

Date	Revision	Changes
10-Mar-2001	1	Initial release.
13-Nov-2008	2	Document reformatted. Added *Features on page 1*. Updated *Table 4: Electrical characteristics on page 6*. Updated *Section 4: Package information on page 15*.
09-Jan-2012	3	Modified *Features on page 1*; Updated *Table 4: Electrical characteristics*.
14-Jun-2012	4	Updated *Features on page 1*; Updated *Table 4: Electrical characteristics*.
26-Jul-2012	5	Updated *Figure 17: Diagnostics waveforms on page 14*.
16-Sep-2013	6	Updated Disclaimer.

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