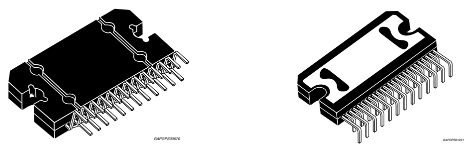
TDA7560

4 x 51 W quad bridge car radio amplifier

Datasheet — production data

Features

- Superior output power capability:
  - 4 x 51 W/4 Ω max.
  - 4 x 45 W/4 Ω EIAJ
  - 4 x 30 W/4 Ω @ 14.4 V, 1 kHz, 10 %
  - 4 x 80 W/2 Ω max.
  - 4 x 77 W/2 Ω EIAJ
  - 4 x 55 W/2 Ω @ 14.4 V, 1 kHz, 10 %
- Multipower BCD technology
- MOSFET output power stage
- Excellent 2 Ω driving capability
- Hi-Fi class distortion
- Low output noise
- Standby function
- Mute function
- Automute at min. supply voltage detection
- Low external component count:
  - Internally fixed gain (26 dB)
  - No external compensation
  - No bootstrap capacitors
- On board 0.35 A high side driver
- Protections:
  - Output short circuit to GND, to V_S, across the load
  - Very inductive loads
  - Overrating chip temperature with soft thermal limiter
  - Output DC offset detection
  - Load dump voltage
  - Fortuitous open GND
  - Reversed battery
  - ESD



Flexiwatt25 (vertical) **Flexiwatt25 (horizontal)**

Description

The TDA7560 is a breakthrough BCD (Bipolar / CMOS / DMOS) technology class AB audio power amplifier in Flexiwatt 25 package designed for high power car radio.

The fully complementary P-Channel/N-Channel output structure allows a rail to rail output voltage swing which, combined with high output current and minimized saturation losses sets new power references in the car-radio field, with unparalleled distortion performances.

Table 1. Device summary

Order code	Package	Packing
TDA7560	Flexiwatt25 (vertical)	Tube
TDA7560H	Flexiwatt25 (horizontal)	Tube

This is information on a product in full production.

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1 Block and pin connection diagram

Figure 1. Block diagram

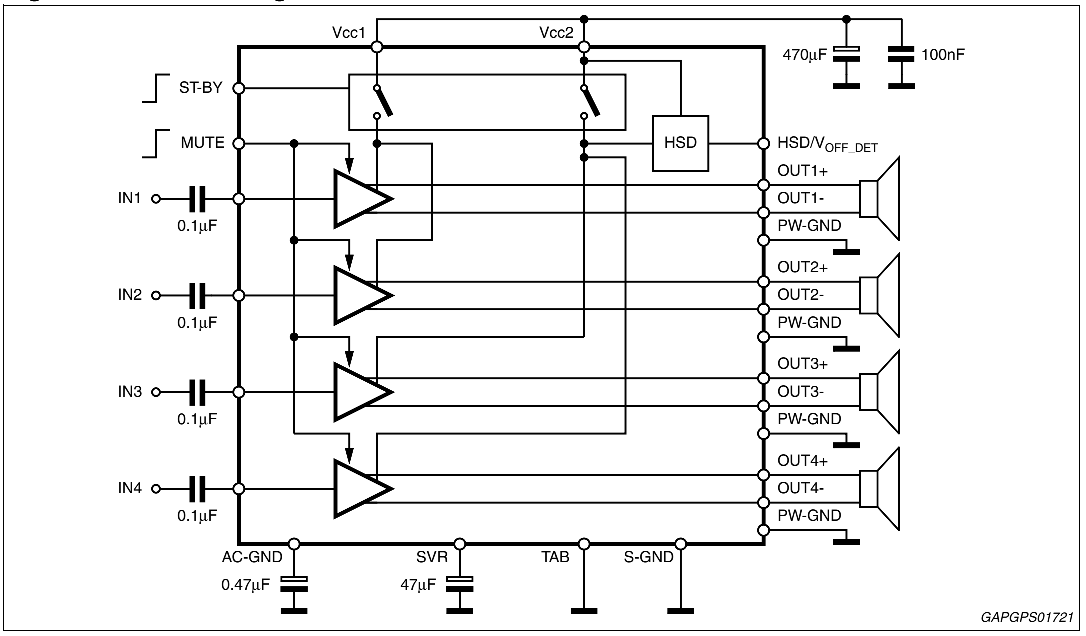
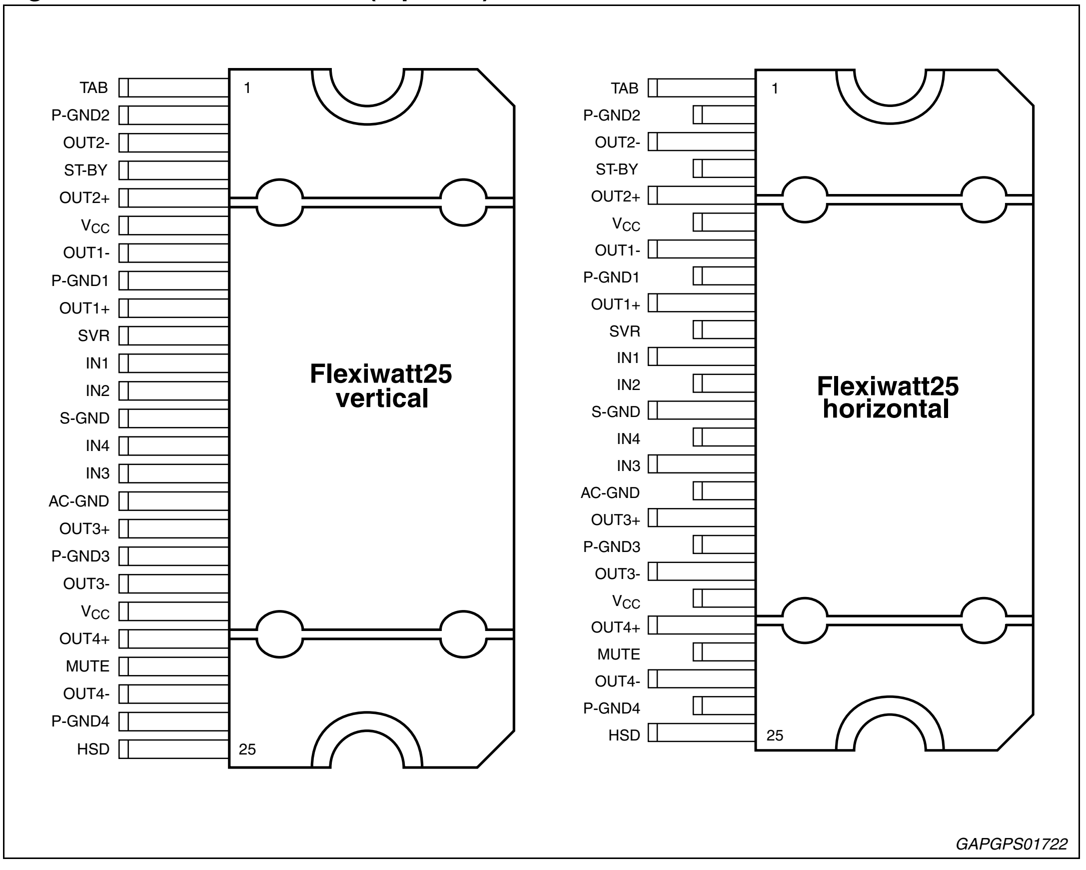


Figure 2. Pins connection (top view)



2 Electrical specifications

2.1 Absolute maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Operating supply voltage	18	V
$V_{CC\ (DC)}$	DC supply voltage	28	V
$V_{CC\ (pk)}$	Peak supply voltage (for t = 50 ms)	50	V
I_O	Output peak current Repetitive (duty cycle 10 % at f = 10 Hz) Non repetitive (t = 100 µs)	9 10	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

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

Table 4. Electrical characteristics

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{q1}	Quiescent current	$R_L = \infty$	80	200	320	mA
V_{OS}	Output offset voltage	Play Mode	-	-	±50	mV
dV_{OS}	During mute ON/OFF output offset voltage	-	-	-	±60	mV
G_v	Voltage gain	-	25	26	27	dB
dG_v	Channel gain unbalance	-	-	-	±1	dB
P_o	Output power	V_S = 13.2 V; THD = 10 % V_S = 13.2 V; THD = 1 % V_S = 14.4 V; THD = 10 % V_S = 14.4 V; THD = 1 %	23 16 28 20	25 19 30 23	-	W

Table 4. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
P_o	Output power	V_S = 13.2 V; THD = 10 %, 2 Ω V_S = 13.2 V; THD = 1 %, 2 Ω V_S = 14.4 V; THD = 10 %, 2 Ω V_S = 14.4 V; THD = 1 %, 2 Ω	42 32 50 40	45 34 55 43	-	W
$P_{o\ EIAJ}$	EIAJ output power(1)	V_S = 13.7 V; R_L = 4 Ω V_S = 13.7 V; R_L = 2 Ω	41 72	45 77	-	W
$P_{o\ max.}$	Max. output power(1)	V_S = 14.4 V; R_L = 4 Ω V_S = 14.4 V; R_L = 2 Ω V_S = 15.2 V; R_L = 4 Ω	43 75	50 80 51	-	W
THD	Distortion	P_o = 4 W P_o = 15 W; R_L = 2 Ω	-	0.006 0.015	0.02 0.03	%
e_{No}	Output noise	"A" Weighted Bw = 20 Hz to 20 kHz	-	35 50	50 70	μV
SVR	Supply voltage rejection	f = 100 Hz; V_r = 1 Vrms	50	70	-	dB
f_{ch}	High cut-off frequency	P_O = 0.5 W	100	300	-	kHz
R_i	Input impedance		80	100	120	KΩ
C_T	Cross talk	f = 1 kHz P_O = 4 W f = 10 kHz P_O = 4 W	60 50	70 60	-	dB
I_{SB}	Standby current consumption	$V_{ST\text{-}BY}$ = 1.5V	-	-	20	µA
		$V_{ST\text{-}BY}$ = 0 V	-	-	10	
I_{pin5}	Standby pin current	$V_{ST\text{-}BY}$ = 1.5 V to 3.5 V	-	-	±10	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	P_{Oref} = 4W	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
$V_{AM\ in}$	VS automute threshold	(Amp: Mute) Att ≥ 80 dB; P_{Oref} = 4 W (Amp: Play) Att < 0.1 dB; P_O = 0.5 W	6.5	7 7.5	 8	V
I_{pin22}	Muting pin current	V_{MUTE} = 1.5 V (Sourced current)	7	12	18	µA
		V_{MUTE} = 3.5 V	-5	-	18	µA
HSD section						
$V_{dropout}$	Dropout voltage	I_O = 0.35 A; V_S = 9 to 16 V	-	0.25	0.6	V
I_{prot}	Current limits	-	400	-	800	mA

Table 4. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
Offset detector (Pin 25)						
V_{M_ON}	Mute voltage for DC offset detection enabled	$V_{ST\text{-}BY}$ = 5 V	8	-	-	V
V_{M_OFF}			-	-	6	V
V_{OFF}	Detected differential output offset	$V_{ST\text{-}BY}$ = 5 V; V_{mute} = 8 V	±2	±3	±4	V
V_{25_T}	Pin 25 voltage for detection = True	$V_{ST\text{-}BY}$ = 5 V; V_{mute} = 8 V V_{OFF} > ±4 V	0	-	1.5	V
V_{25_F}	Pin 25 voltage for detection = False	$V_{ST\text{-}BY}$ = 5 V; V_{mute} = 8 V V_{OFF} > ±2 V	12	-	-	V

1. Saturated square wave output.

2.4 Standard test and application circuit, and PCB layout

Figure 3. Standard test and application circuit

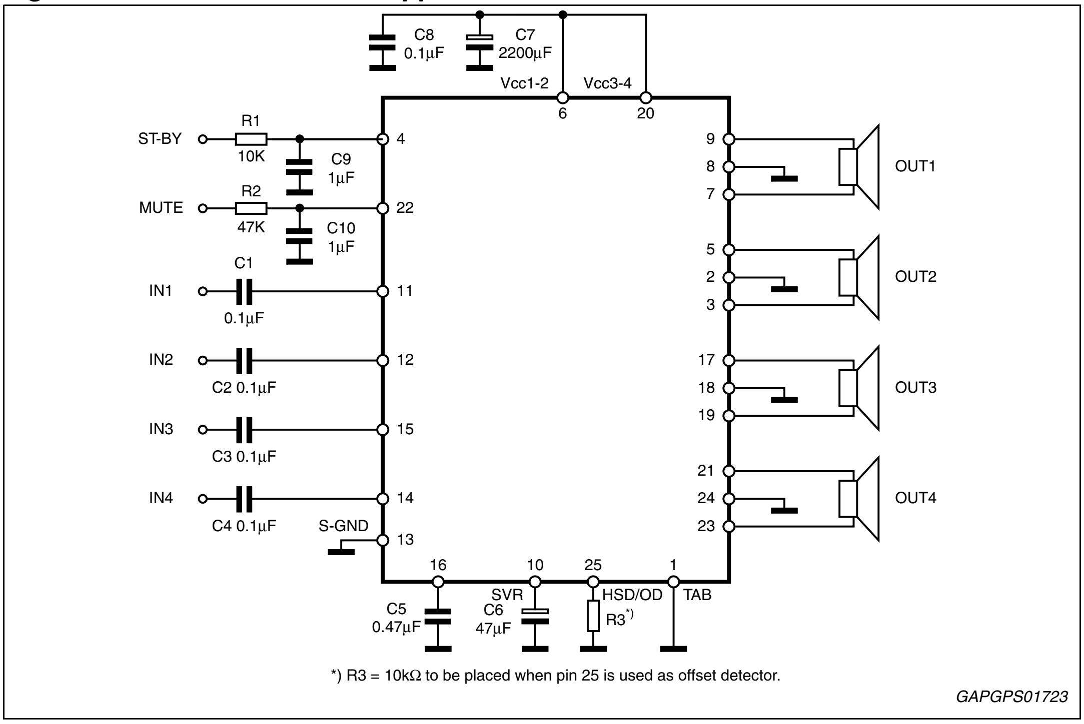
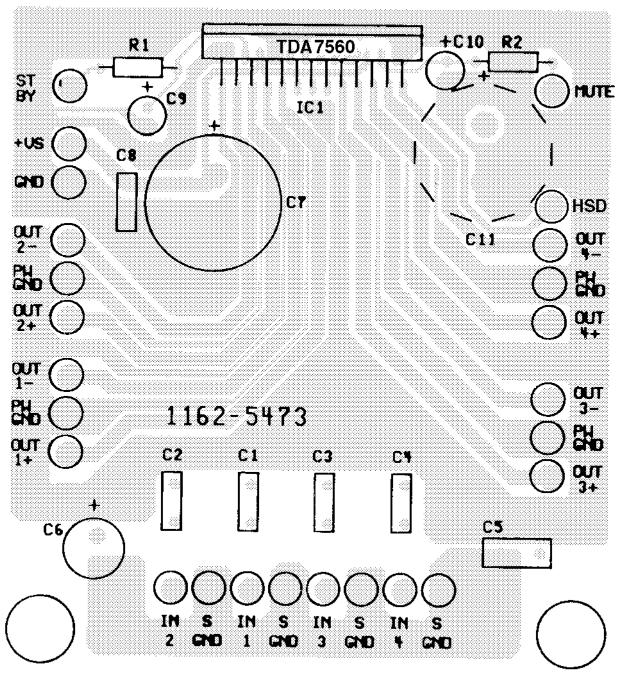
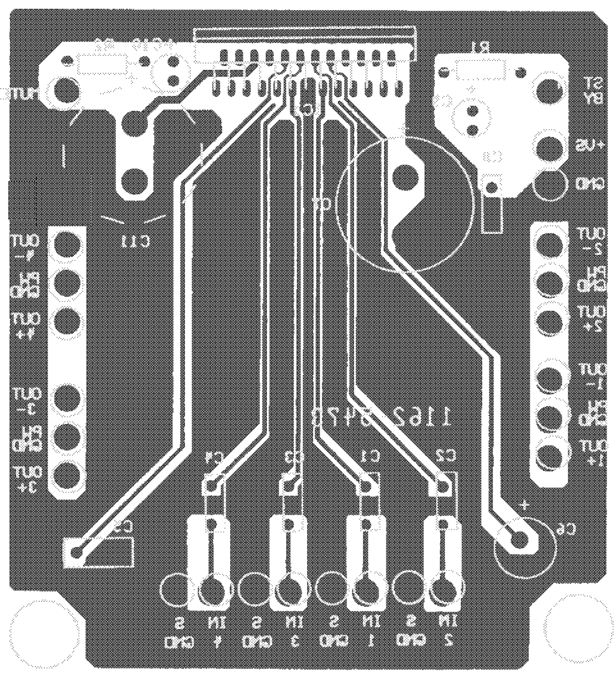


Figure 4. PCB and component layout of the *Figure 3*.

Components and top copper layer



Bottom copper layer



2.5 Electrical characteristics curves

Figure 5. Quiescent current vs. supply voltage

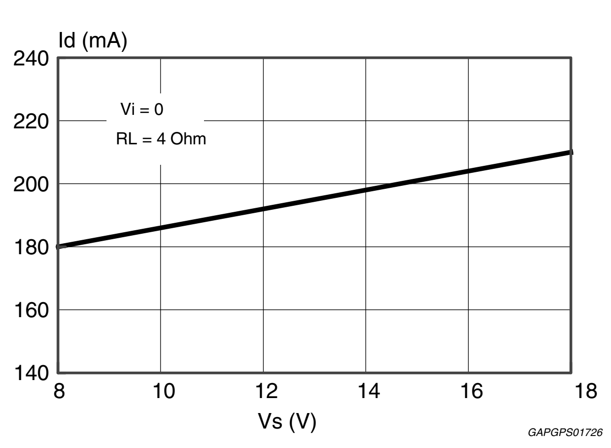


Figure 6. Output power vs. supply voltage (R_L = 4Ω)

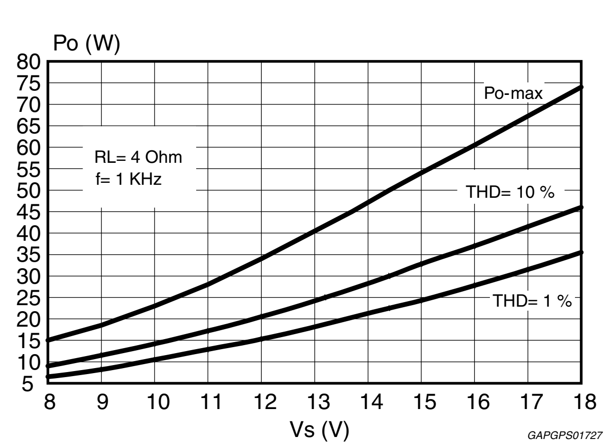


Figure 7. Output power vs. supply voltage (R_L = 2Ω)

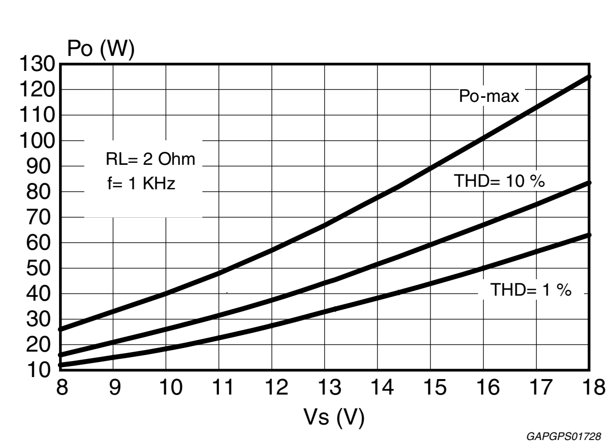


Figure 8. Distortion vs. output power (R_L = 4Ω)

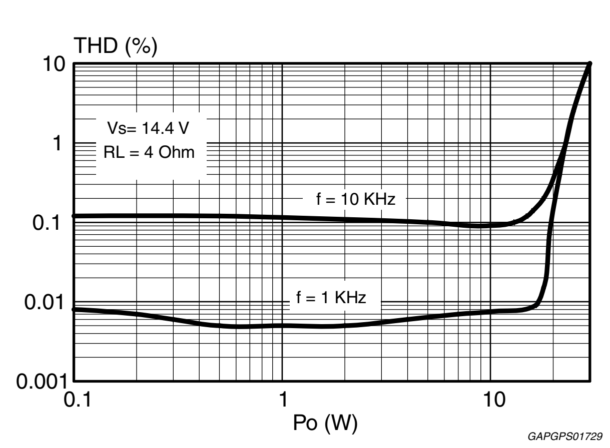


Figure 9. Distortion vs. output power (R_L = 2Ω)

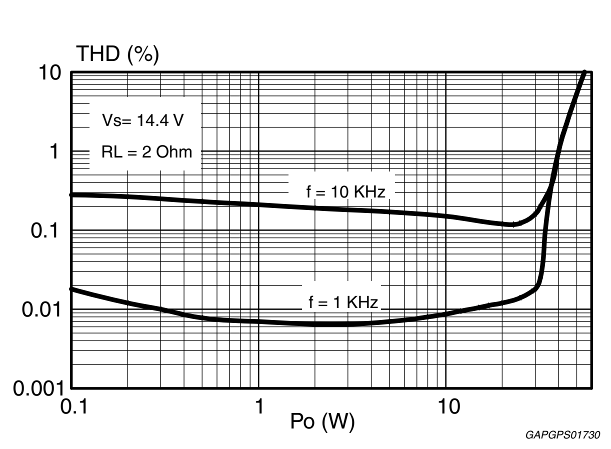


Figure 10. Distortion vs. frequency (R_L = 4Ω)

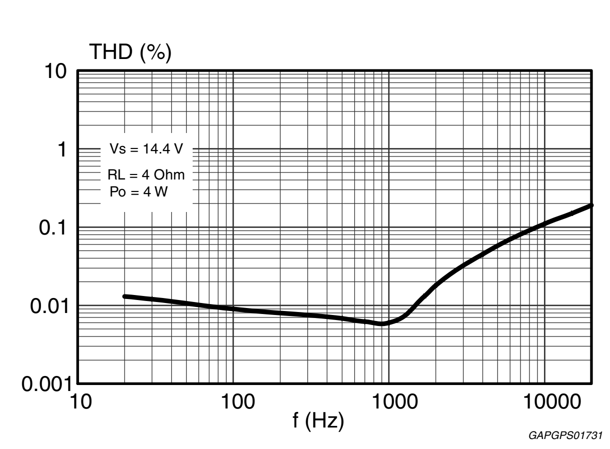


Figure 11. Distortion vs. frequency (R_L = 2Ω)

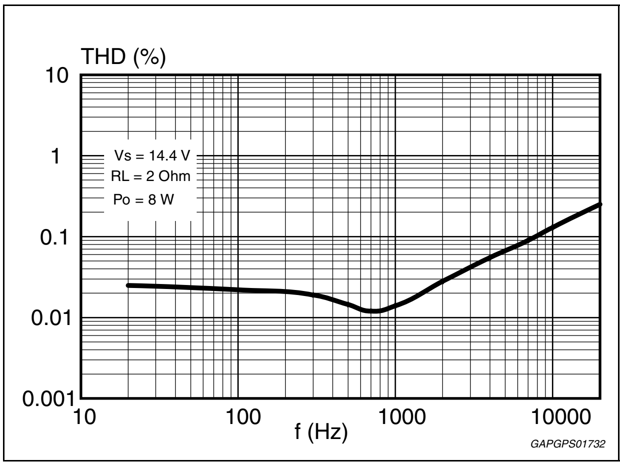


Figure 12. Crosstalk vs. frequency

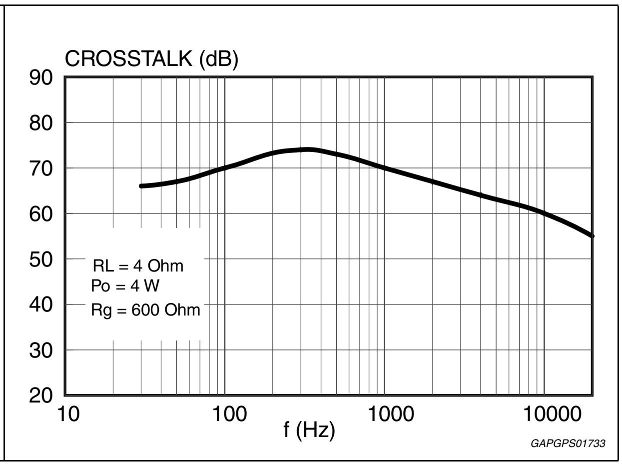


Figure 13. Supply voltage rejection vs. frequency

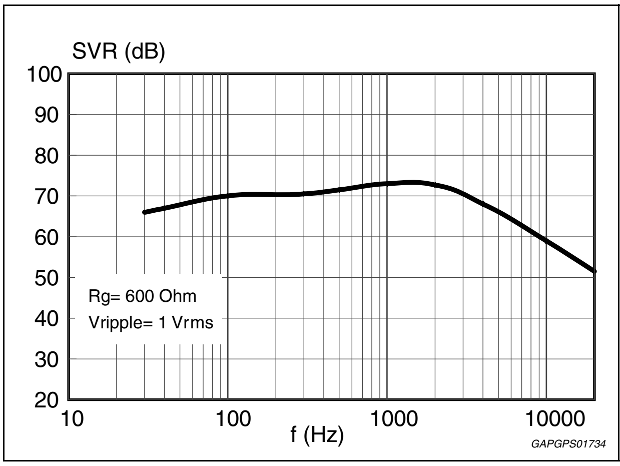


Figure 14. Output attenuation vs. supply voltage

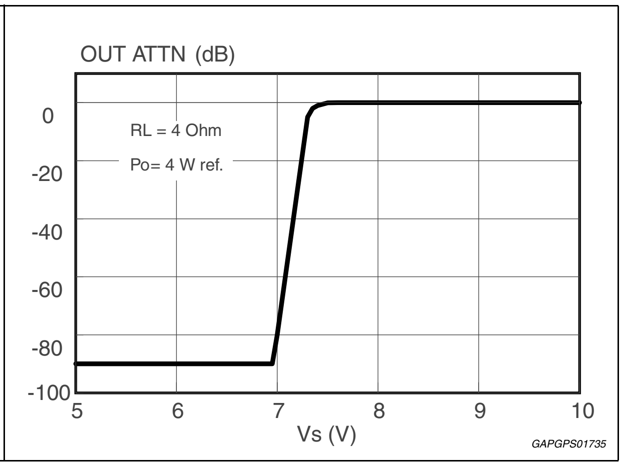


Figure 15. Output noise vs. source resistance

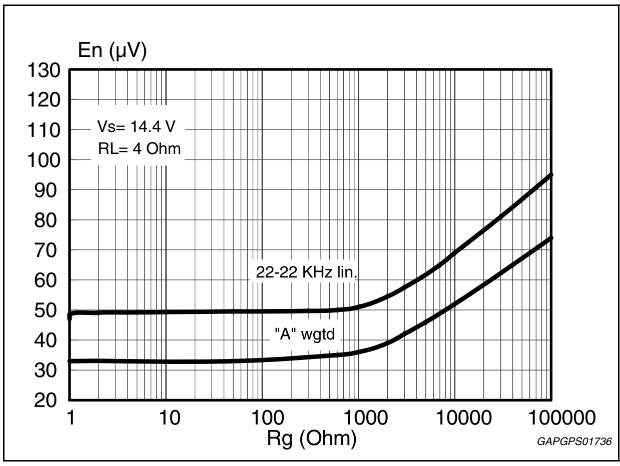


Figure 16. Power dissipation and efficiency vs. output power (sine-wave operation)

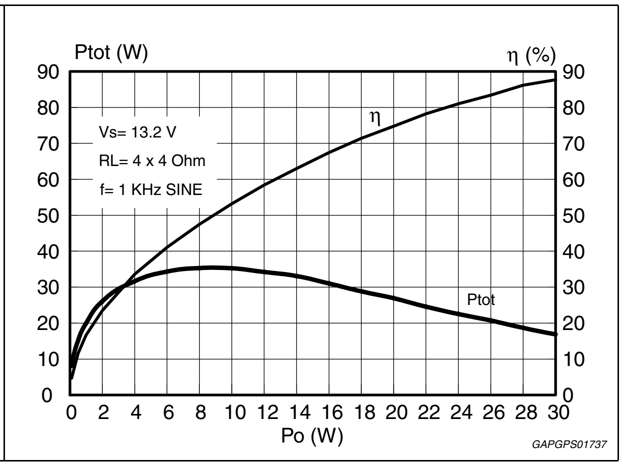


Figure 17. Power dissipation vs. output power (music/speech simulation); $R_L = 4 \times 4\Omega$

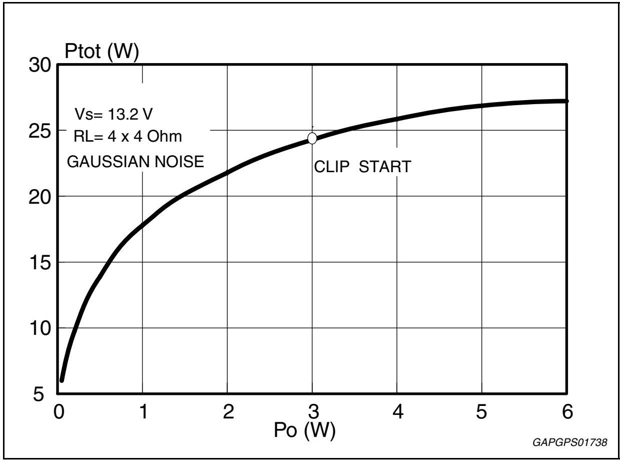


Figure 18. Power dissipation vs. output power (music/speech simulation); $R_L = 4 \times 2\Omega$

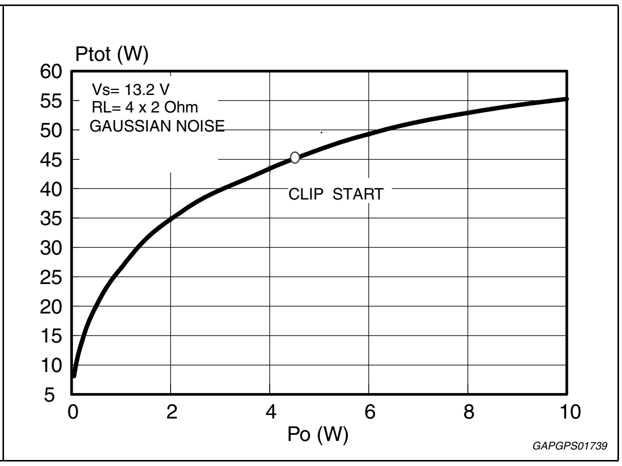
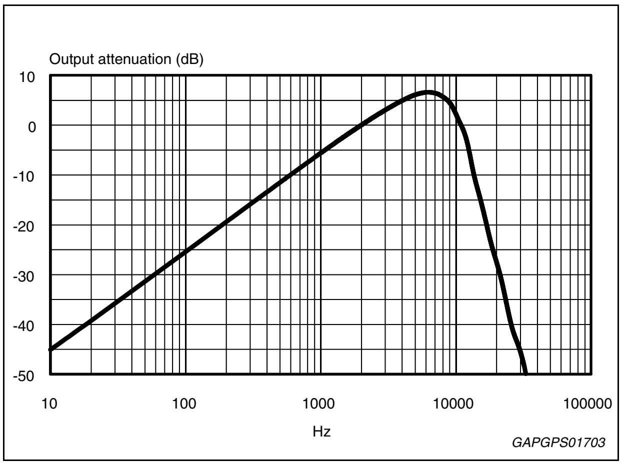


Figure 19. ITU R-ARM frequency response, weighting filter for transient pop



3 Application hints

(ref. to the circuit of *Figure 3*)

3.1 SVR

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 10 µF**.

3.2 Input stage

The TDA7560'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 (0.1µF) 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. In absence of true CMOS ports or microprocessors, a direct connection to Vs of these two pins is admissible but a 470 kOhm equivalent resistance should be present between the power supply and the muting and ST-BY pins.
R-C cells have always to be used in order to smooth down the transitions for preventing any audible transient noises.
About the standby, the time constant to be assigned in order to obtain a virtually pop-free transition has to be slower than 2.5 V/ms.

3.4 DC offset detector

The TDA7560 integrates a DC offset detector to avoid that an anomalous DC offset on the inputs of the amplifier may be multiplied by the gain and result in a dangerous large offset on the outputs which may lead to speakers damage for overheating. The feature is enabled by the MUTE pin (according to *Table 4*) and works with the amplifier unmuted and with no signal on the inputs.
The DC offset detection is signaled out on the HSD pin. To ensure the correct functionality of the Offset Detector it is necessary to connect a pulldown 10 kΩ resistor between HSD and ground.

3.5 Heatsink definition

Under normal usage (4 Ohm speakers) the heatsink's thermal requirements have to be deduced from *Figure 17*, which reports the simulated power dissipation when real music/speech programmes are played out. Noise with gaussian-distributed amplitude was employed for this simulation. Based on that, frequent clipping occurrence (worst-case) will cause P_{diss} = 26 W. Assuming T_{amb} = 70 °C and T_{CHIP} = 150 °C as boundary conditions, the heatsink's thermal resistance should be approximately 2 °C/W. This would avoid any thermal shutdown occurrence even after long-term and full-volume operation

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.

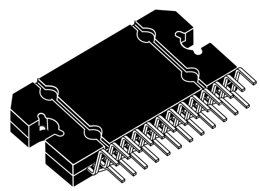
ECOPACK® is an ST trademark.

Figure 20. Flexiwatt25 (vertical) 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)

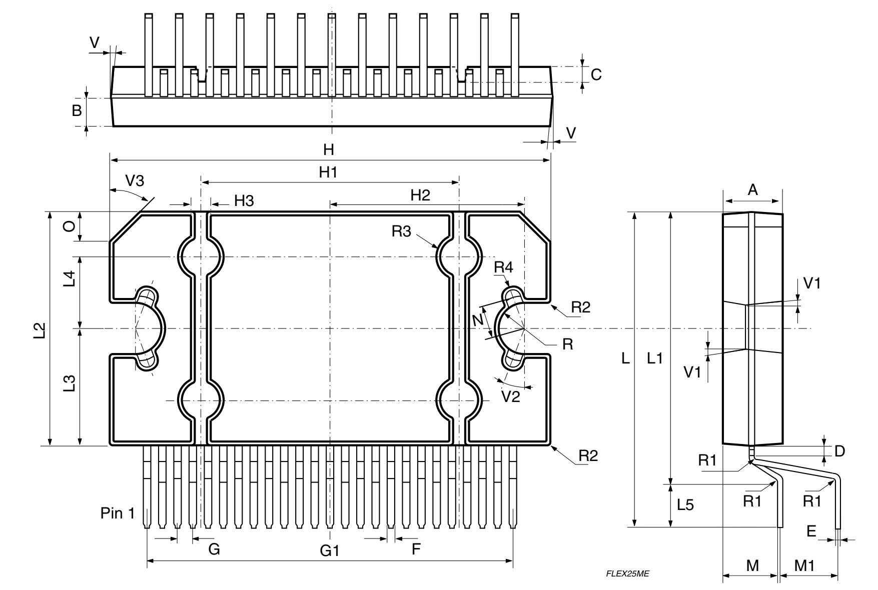


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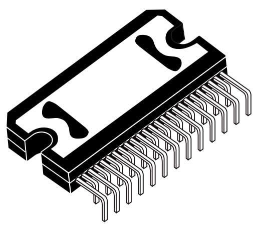
Figure 21. Flexiwatt25 (horizontal) mechanical data and package dimensions

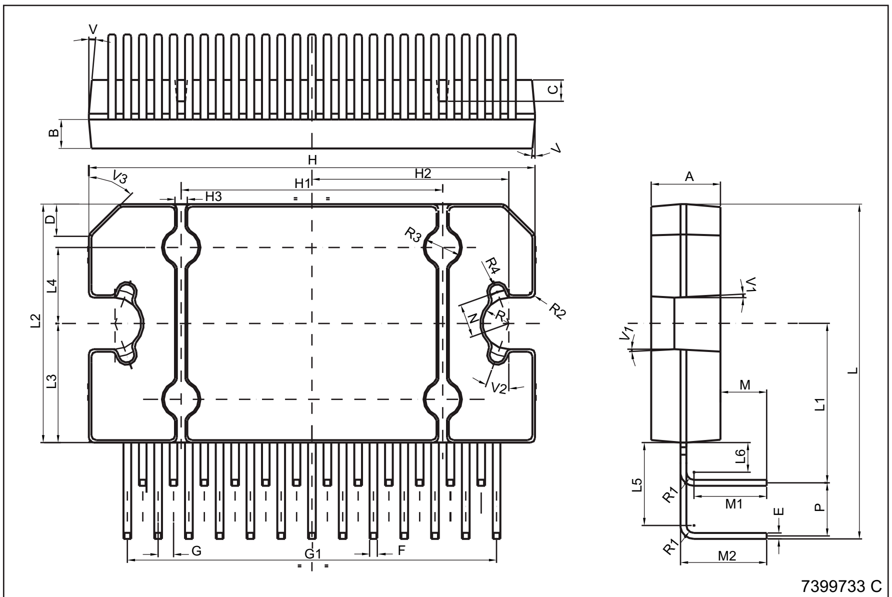
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.45	4.50	4.65	0.175	0.177	0.183
B	1.80	1.90	2.00	0.070	0.074	0.079
C		1.40			0.055	
D		2.00			0.079	
E	0.37	0.39	0.42	0.014	0.015	0.016
F (1)			0.57			0.022
G	0.75	1.00	1.25	0.029	0.040	0.049
G1	23.70	24.00	24.30	0.933	0.945	0.957
H (2)	28.90	29.23	29.30	1.139	1.150	1.153
H1		17.00			0.669	
H2		12.80			0.503	
H3		0.80			0.031	
L (2)	21.64	22.04	22.44	0.852	0.868	0.883
L1	10.15	10.5	10.85	0.40	0.413	0.427
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	5.15	5.45	5.85	0.203	0.214	0.23
L6	1.80	1.95	2.10	0.070	0.077	0.083
M	2.75	3.00	3.50	0.108	0.118	0.138
M1		4.73			0.186	
M2		5.61			0.220	
N		2.20			0.086	
P	3.20	3.50	3.80	0.126	0.138	0.15
R		1.70			0.067	
R1		0.50			0.02	
R2		0.30			0.12	
R3		1.25			0.049	
R4		0.50			0.02	
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 (Horizontal)



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5 Revision history

Table 5. Document revision history

Date	Revision	Changes
20-Dec-2001	1	Initial release.
10-Feb-2005	2	Improved value from 75 to 20mA of the “standby current consumption” parameter in the *Table 4: Electrical characteristics on page 6*.
18-Sep-2008	3	Document reformatted. Added new order code in Flexiwatt25 horizontal package. Updated *Figure 3: Standard test and application circuit*. Updated *Table 4: Electrical characteristics*. Updated *Section 3.4: DC offset detector* and *Section 3.3: Standby and muting*. Added *Figure 19: ITU R-ARM frequency response, weighting filter for transient pop*.
07-Nov-2008	4	Modified max. values of the V_{OS} and THD parameter in *Table 4: Electrical characteristics*.
11-Sep-2012	5	Updated *Features on page 1*; Updated *Section 2.3: Electrical characteristics*.
16-Sep-2013	6	Updated Disclaimer.

Please Read Carefully: