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TDA2040

25-watt hi-fi audio power amplifier

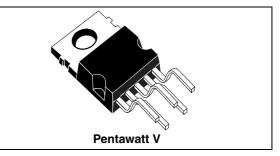
Datasheet – production data

Features

- Wide-range supply voltage, up to 40 V
- Single or split power supply
- Short-circuit protection to ground
- Thermal shutdown
- $P_0 = 25 \text{ W}$ @ THD = 0.5%, $V_S = \pm 17 \text{ V}$, $R_L = 4 \Omega$
- $\blacksquare P_{O} = 30 \text{ W } @ \text{ THD } = 10\%, \text{ V}_{S} = \pm 17 \text{ V}, \text{ R}_{L} = 4 \Omega$

Description

The TDA2040 is a monolithic integrated circuit in the Pentawatt[®] package, intended for use as an audio class-AB amplifier. Typically, it provides 25 W output power into 4 Ω with THD = 0.5% at V_S = 34 V. The TDA2040 provides high output current and has very low harmonic and crossover distortion. Furthermore, the device incorporates a patented short-circuit protection system

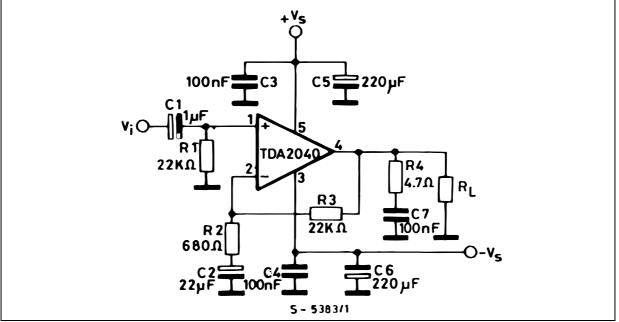


comprising an arrangement for automatically limiting the dissipated power so as to keep the operating point of the output transistors within their safe operating range. A thermal shutdown system is also included.

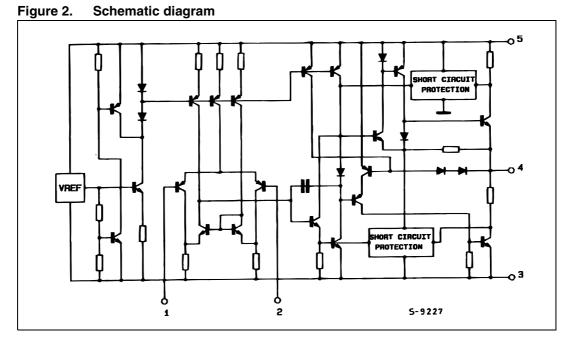
Table 1. Device summary

Order code	Package	
TDA2040V	Pentawatt V (vertical)	

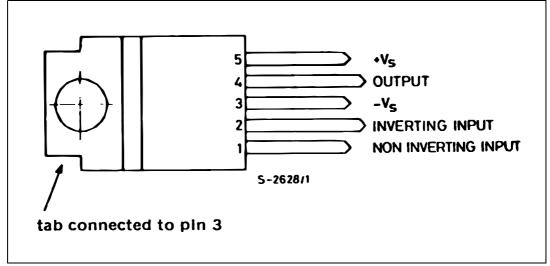




1 Pin connections







2 Electrical specifications

2.1 Absolute maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
Vs	Supply voltage	±20	V
Vi	Input voltage Vs		
Vi	Differential input voltage ±15		V
lo	Output peak current (internally limited)	rrent (internally limited) 4	
P _{tot}	Power dissipation at Tcase = 75 °C 25		W
T _{stg} , T _j	Storage and junction temperature	-40 to 150	°C
V _{ESD_HBM}	ESD maximum withstanding voltage range, test condition CDF-AEC-Q100-002- "Human body model"	±1500	V

2.2 Thermal data

Table 3.Thermal data

S	ymbol	Parameter		Тур	Max	Unit
R _{th}	n_j-case	Thermal resistance junction to case		-	3	°C/W



2.3 Electrical characteristics

The specifications given here were obtained with the conditions V_S = ±16 V, T_{amb} = 25 °C unless otherwise specified.

Symbol	Parameter	Test conditions	Min	Тур	Max	Unit
Vs	Supply voltage	-	±4.5	-	±20	V
1		V _S = ±4.5 V		-	30	mA
I _d	Quiescent drain current	$V_{S} = \pm 20 V$	-	45	100	mA
I _b	Input bias current	$V_{S} = \pm 20 V$	-	0.3	1	μA
V _{OS}	Input offset voltage	$V_{S} = \pm 20 V$	-	±2	±20	mV
I _{OS}	Input offset current	-	-		±200	nA
P _o Output power	d = 0.5%, f = 1 kHz, $T_{amb} = 60 \text{ °C}$ $R_L = 4 \Omega$ $R_L = 4 \Omega$, $V_S = \pm 17$ $R_I = 8 \Omega$	20	22 25 12	-	W	
	$H_{L} = 0.5\%, f = 15 \text{ kHz}; T_{amb} = 60 \text{ °C}$ $H_{L} = 4 \Omega$ $H_{L} = 4 \Omega, V_{S} = \pm 17$ $d = 10\%, f = 1 \text{ kHz}$ $H_{L} = 4 \Omega, V_{S} = \pm 17$	15	18 20 30	-		
BW	Power bandwidth	$P_o = 1 \text{ W}, \text{ R}_L = 4 \Omega$	-	100	-	Hz
G _{vOL}	Voltage gain (open loop)	f = 1 kHz	-	80	-	dB
Gv	Voltage gain (closed loop)	f = 1 kHz	29.5	30	30.5	dB
d	Total harmonic distortion	$P_o = 0.1$ to 10 W, $R_L = 4 \Omega$, f = 40 to 15000 Hz	-	0.08	-	%
		$P_o = 0.1$ to 10 W, $R_L = 4 \Omega$, f = 1 kHz	-	0.03	-	%
e _N	Input noise voltage	B = Curve A B = 22 Hz to 22 kHz	-	2 3	- 10	μV
۱ _N	Input noise current	B = Curve A B = 22 Hz to 22 kHz	-	50 80	- 200	pА
R _i	Input resistance (pin 1)	-	0.5	5	-	MΩ
SVRR	Supply voltage rejection ratio	G_V = 30 dB, R_L = 4 Ω,R_g = 22 k Ω,f = 100 Hz V_{ripple} = 0.5 V RMS		50	-	dB
h	Efficiency	f = 1 kHz $P_o = 12$ W, $R_L = 8 \Omega$ $P_o = 22$ W, $R_L = 4 \Omega$	-	66 63	-	%
Тj	Thermal shutdown junction temperature	-	-	-	145	°C

Table 4.Electrical characteristics



2.4 Characterizations

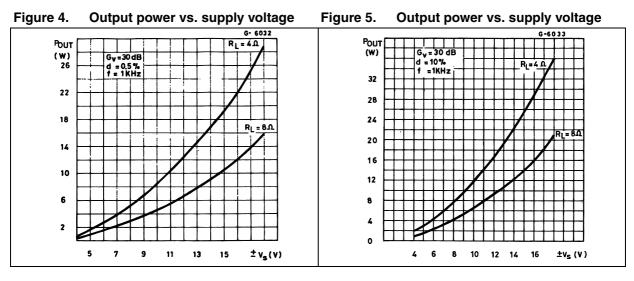
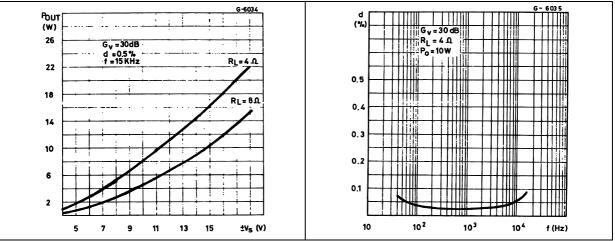




Figure 7. Distortion vs. frequency





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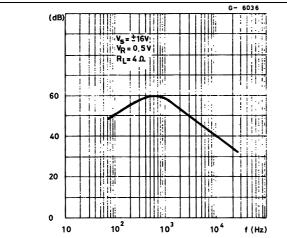


Figure 9. SVRR vs. voltage gain

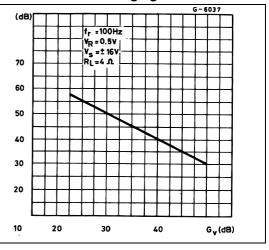


Figure 10. Quiescent drain current vs. supply Figure 11. Open loop gain vs. frequency voltage

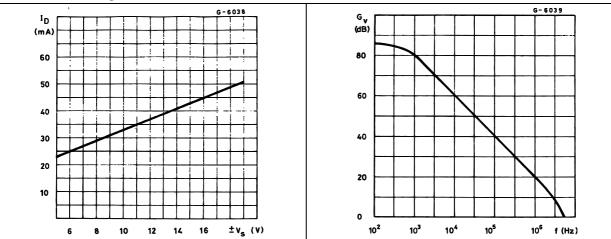
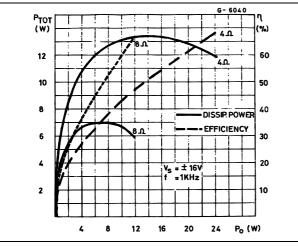


Figure 12. Power dissipation vs. output power





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3 Applications

3.1 Circuits and PCB layout

Figure 13. Amplifier with split power supply

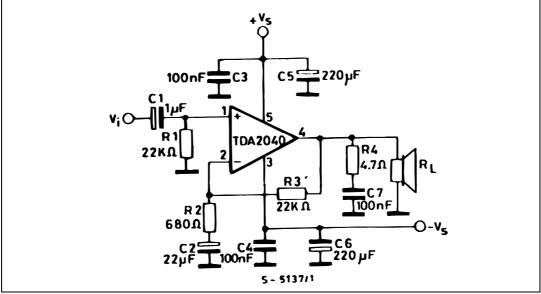
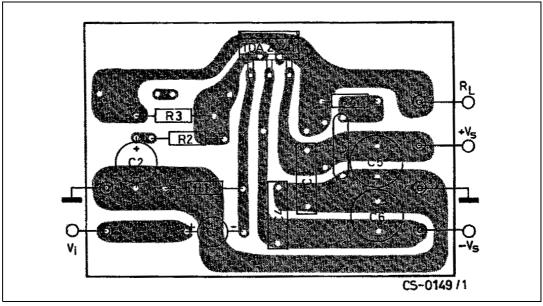


Figure 14. PCB and components layout for the circuit of the amplifier with split power supply



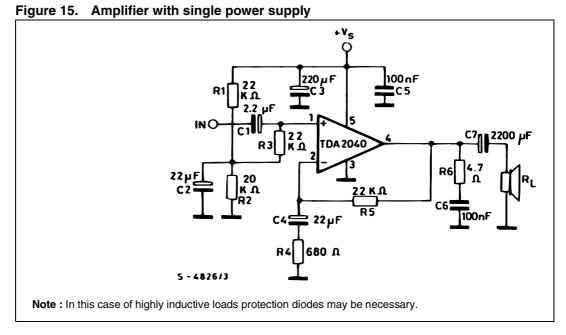
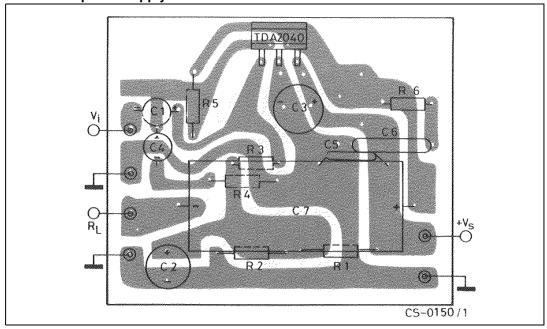


Figure 16. PCB and components layout for the circuit of the amplifier with single power supply





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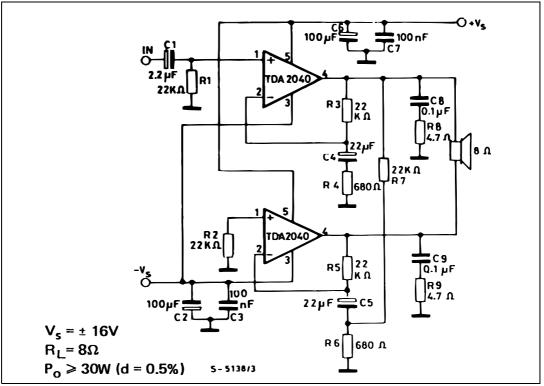
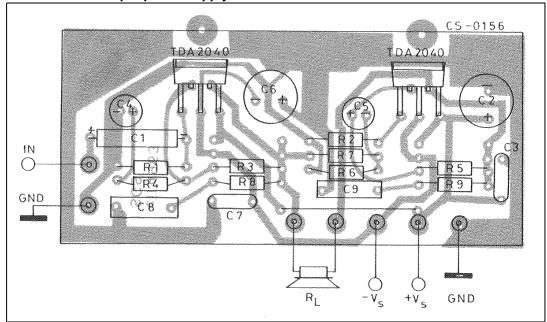


Figure 17. 30-watt bridge amplifier with split power supply

Figure 18. PCB and components layout for the circuit of the 30-watt bridge amplifier with split power supply



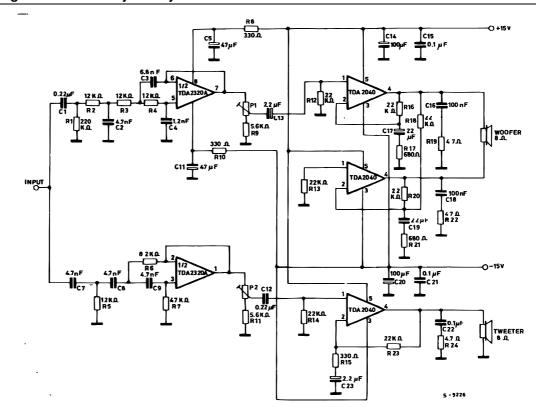
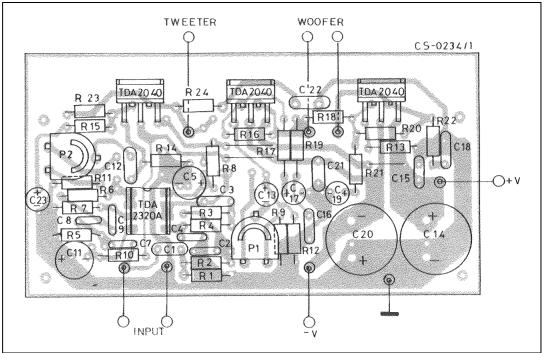


Figure 19. Two-way hi-fi system with active crossover

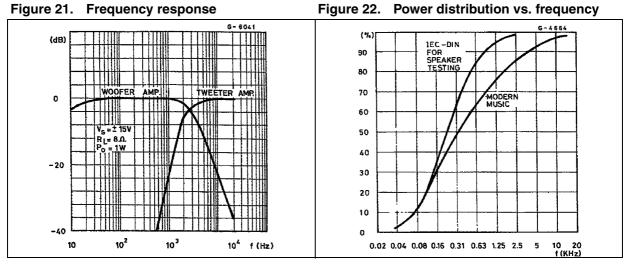
Figure 20. PCB and components layout for the circuit of the two-way hi-fi system with active crossover





3.2 Multiway speaker systems and active boxes

Multiway loudspeaker systems provide the best possible acoustic performance since each loudspeaker is specially designed and optimized to handle a limited range of frequencies. Commonly, these loudspeaker systems divide the audio spectrum into two, three or four bands.



To maintain a flat frequency response over the hi-fi audio range the bands covered by each loudspeaker must overlap slightly. Any imbalance between the loudspeakers produces unacceptable results, therefore, it is important to ensure that each unit generates the correct amount of acoustic energy for its segment of the audio spectrum. In this respect it is also important to know the energy distribution of the music spectrum (see *Figure 22*) in order to determine the cutoff frequencies of the crossover filters. As an example, a 100-W three-way system with crossover frequencies of 400 Hz and 3 kHz would require 50 W for the woofer, 35 W for the midrange unit and 15 W for the tweeter.

Both active and passive filters can be used for crossovers but today active filters cost significantly less than a good passive filter using air-cored inductors and non-electrolytic capacitors. In addition, active filters do not suffer from the typical defects of passive filters:

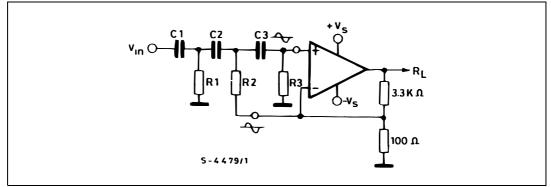
- power loss
- increased impedance seen by the loudspeaker (lower damping)
- difficulty of precise design due to variable loudspeaker impedance

Obviously, active crossovers can only be used if a power amplifier is provided for each drive unit. This makes it particularly interesting and economically sound to use monolithic power amplifiers.

In some applications, complex filters are not really necessary and simple RC low-pass and high-pass networks (6 dB/octave) can be recommended. The results obtained are excellent because this is the best type of audio filter and the only one free from phase and transient distortion. The rather poor out-of-band attenuation of single RC filters means that the loudspeaker must operate linearly well beyond the crossover frequency to avoid distortion.







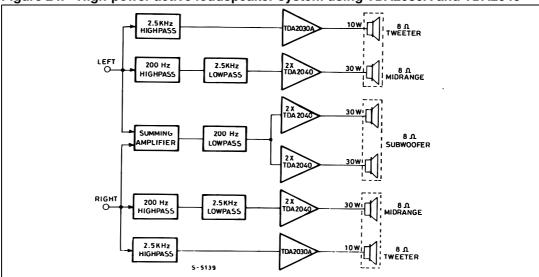
A more effective solution, named "Active Power Filter" by STMicroelectronics, is shown in *Figure 23*. The proposed circuit can be realized by combined power amplifiers and 12-dB/octave or 18-dB/octave high-pass or low-pass filters.

The component values calculated for fc = 900Hz using a Bessel 3rd order Sallen and Key structure are:

C1 = C2 = C3 = 22 nF R1 = 8.2 k Ω R2 = 5.6 k Ω R3 = 33 k Ω

In the block diagram of *Figure 24* is represented an active loudspeaker system completely realized using power integrated circuit, rather than the traditional discrete transistors on hybrids, very high quality is obtained by driving the audio spectrum into three bands using active crossovers (TDA2320A) and a separate amplifier and loudspeakers for each band. A modern subwoofer/midrange/tweeter solution is used.

Figure 24. High-power active loudspeaker system using TDA2030A and TDA2040





3.3 Practical considerations

3.3.1 Printed circuit board

The layout shown in *Figure 14* should be adopted by the designers. If different layouts are used, the ground points of input 1 and input 2 must be well decoupled from the ground return of the output in which a high current flows.

3.3.2 Assembly suggestion

No electrical isolation is needed between the package and the heatsink with single supply voltage configuration.

3.3.3 Application suggestions

The recommended values of the components are those shown in the application circuit of *Figure 13*. However, if different values are chosen then the following table can be helpful.

Component	Recommended value	Purpose	Larger than recommended value	Smaller than recommended value	
R1	22 kΩ	Non-inverting input biasing	Increase in input impedance	Decrease in input impedance	
R2	680 Ω	Closed-loop gain setting	Decrease in gain ⁽¹⁾	Increase in gain	
R3	22 kΩ	Closed-loop gain setting	Increase in gain	Decrease in gain ⁽¹⁾	
R4	4.7 Ω	Frequency stability	Danger of oscillation at high frequencies with inductive loads	-	
C1	1 µF	Input DC decoupling	-	Increase in low-frequency cut-off	
C2	22 µF	Inverting DC decoupling	-	Increase in low-frequency cut-off	
C3, C4	0.1 µF	Supply voltage bypass	-	Danger of oscillation	
C5, C6	220µF	Supply voltage bypass	-	Danger of oscillation	
C7	0.1µF	Frequency stability	-	Danger of oscillation	

 Table 5.
 Variations from recommended values

1. The value of closed loop gain must be higher than 24 dB



4 Package mechanical data

MIN. TYP. MAX. MIN. DIM. TYP. MAX. **OUTLINE AND** A 4.80 0.188 MECHANICAL DATA 1.37 0.054 2.40 0.094 D 2 80 0.11 D1 1.20 1.35 0.047 0.053 0.35 0.55 0.014 0.022 E Weight: 2.00gr E1 0.76 1.19 0.030 0.047 0.041 F 0.80 1.05 0.031 1.40 0.039 0.055 F1 1.00 3.20 3.40 0.134 0.142 G 3.60 0.126 G1 0.267 0.275 6.60 6.80 7.00 0.260 H2 10.40 0.41 H3 10.40 0.409 17.55 17.85 18.15 0.691 0.703 L 0.715 L1 15.95 0.612 0.620 0.628 15.55 15.75 L2 21.2 21.4 21.6 0.831 0.843 0.850 L3 22.3 22.5 22.7 0.878 0.886 0.894 L4 1.29 0.051 L5 2.60 3.00 0.102 0.118 L6 15.10 15.80 0.594 0.622 L7 6.60 0.236 0.260 6.00 L9 2.10 2.70 0.083 0.106 0.189 0.178 0.187 L10 4.30 4.80 0.170 Μ 4.23 4.75 0.167 4.5 4.25 0.148 0.157 0.187 M1 3.75 4.0 Pentawatt V V4 40° (Typ.) V5 90° (Typ.) DIA 3.65 3.85 0.143 0.151 L L1 M1 A М D . c [[D1 ¥5 L2 H2 L5 L3 E E1 Δíν G G1 НЗ 6 Dia L9 н2 L4 L10 L7 **RESIN BETWEEN** LEADS PENTVME 0015981 F

Figure 25. Pentawatt V outline drawing

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5 Revision history

Table 6.	Document revision history
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Date	Revision	Changes	
Apr-2003	3	Changes not recorded	
28-Oct-20104Added features list on page 1 Updated minimum supply voltage to ±4.5 V in Table 4 on page Corrected the title of Figure 15 on page 8 Updated presentation		Updated minimum supply voltage to ± 4.5 V in <i>Table 4 on page 4</i> Corrected the title of <i>Figure 15 on page 8</i>	
16-Jun-2011 5		Removed minimum value from Pentawatt (vertical) package dimension H3 (<i>Figure 25</i>); minor textual changes.	
17-Jul-20126Updated output power thro Description, Table 4).		Updated output power throughout datasheet (title, <i>Features</i> , <i>Description</i> , <i>Table 4</i>).	



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