LINEAR INTEGRATED CIRCUIT

SGS TDA2040

22W Hi-Fi AUDIO POWER AMPLIFIER

The TDA 2040 is a monolithic integrated circuit in Pentawatt® package, intended for use as an audio class AB amplifier. Typically it provides 22W output power (d = 0.5%) at V_s = 32V/4Ω. The TDA 2040 provides high output current and has very low harmonic and cross-over distortion. Further the device incorporates a patented short circuit protection system comprising an arrangement for automatically limiting the dissipated power so as to keep the working point of the output transistors within their safe operating area. A thermal shut-down system is also included.

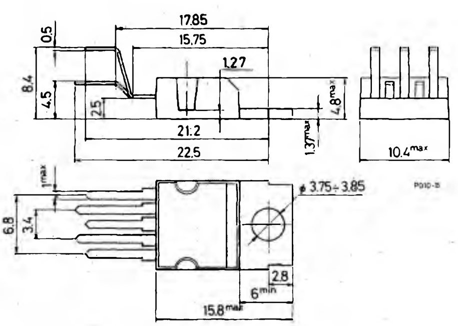
ABSOLUTE MAXIMUM RATINGS

V_s	Supply voltage	± 20	V
V_i	Input voltage	V_s	
V_i	Differential input voltage	± 15	V
I_o.	Output peak current (internally limited)	4	A
P_{tot}	Power dissipation at T_{case} = 75°C	25	W
T_{stg}, T_j	Storage and junction temperature	-40 to 150	°C

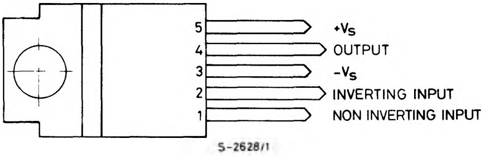
ORDERING NUMBER: TDA 2040V

MECHANICAL DATA

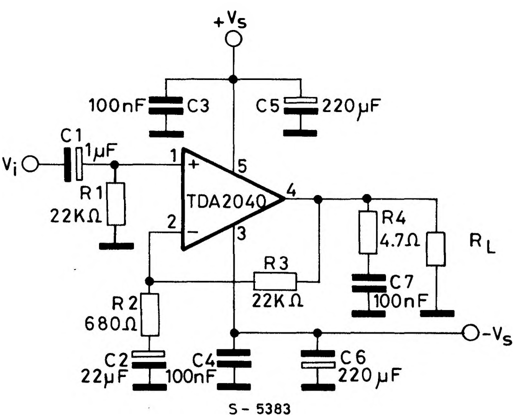
Dimensions in mm



CONNECTION DIAGRAM
(top view)



TEST CIRCUIT



THERMAL DATA

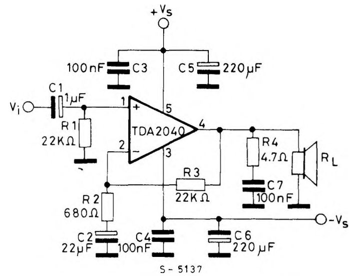
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	3	°C/W

ELECTRICAL CHARACTERISTICS (Refer to the test circuit, $V_s = \pm 16V$, $T_{amb} = 25°C$ unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
V_s	Supply voltage		± 2.5			V
I_d	Quiescent drain current	$V_s = \pm 4.5V$			30	mA
				45	100	mA
I_b	Input bias current			0.3	1	μA
V_{os}	Input offset voltage			± 2	± 20	mV
I_{os}	Input offset current				±200	nA
P_o	Output power	d = 0.5% $T_{case} = 60°C$ f = 1 KHz $R_L = 4\Omega$ $R_L = 8\Omega$	20	22 12		W
		f = 15 KHz $R_L = 4\Omega$	15	18		W
BW	Power bandwidth	$P_o = 1W$ $R_L = 4\Omega$		100		KHz
G_v	Open loop voltage gain	f = 1 KHz		80		dB
G_v	Closed loop voltage gain	f = 1 KHz	29.5	30	30.5	dB
d	Total harmonic distortion	$P_o = 0.1$ to 10W $R_L = 4\Omega$ f = 40 to 15000Hz f = 1 KHz		0.08 0.03		%
e_N	Input noise voltage	B = curve A		2		μV
		B = 22 Hz to 22 KHz		3		μV
i_N	Input noise current	B = curve A		50		pA
		B = 22 Hz to 22 KHz		80		pA
R_i	Input resistance (pin 1)		0.5	5		MΩ
SVR	Supply voltage rejection	$R_L = 4\Omega$ $G_v = 30$ dB $R_g = 22$ KΩ f = 100 Hz $V_{ripple} = 0.5$ V_{rms}	40	48		dB
η	Efficiency	f = 1 KHz $P_o = 12W$ $R_L = 8\Omega$ $P_o = 22W$ $R_L = 4\Omega$		66 63		%
T_j	Thermal shut-down junction temperature			145		°C

APPLICATION INFORMATION

Fig. 1 - Amplifier with split power supply (*)



$V_s = \pm$ 16V
R_L = 4Ω
$P_o \geqslant$ 15W (d = 0.5%)

Fig. 2 - P.C. board and components layout of the circuit of fig. 1.

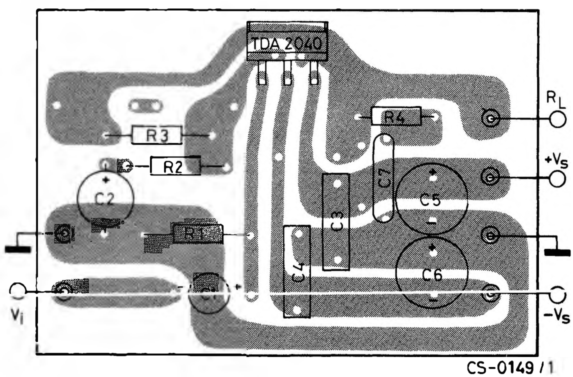


Fig. 3 - Amplifier with single supply (*)

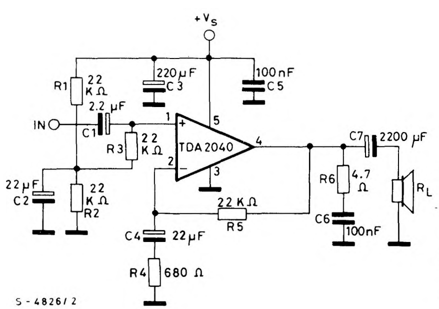
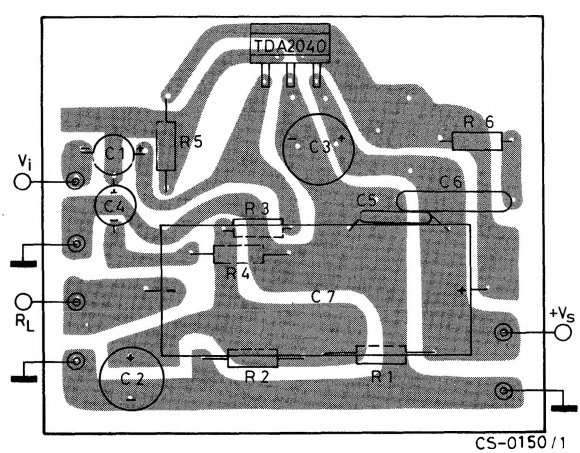


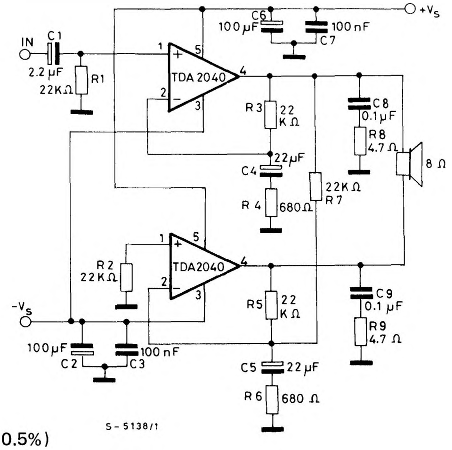
Fig. 4 - P.C. board and components layout of the circuit of fig. 3.



* In the case of highly inductive loads protection diodes may be necessary.

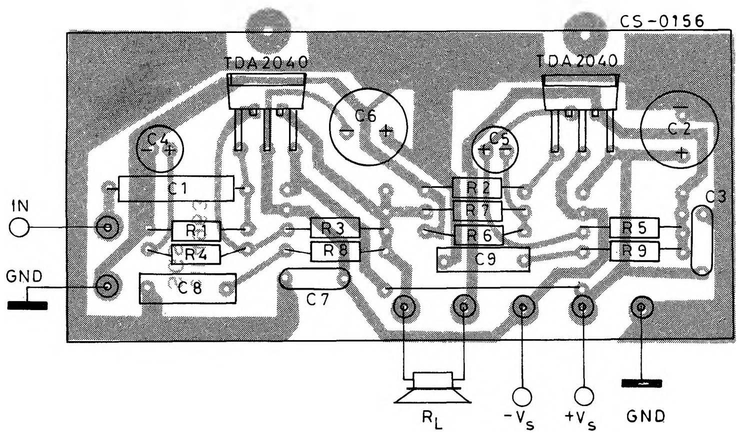
APPLICATION INFORMATION (continued)

Fig. 5 – 30W Bridge amplifier with split power supply



$V_s = \pm$ 16V
R_L = 8Ω
$P_o \geqslant$ 30W (d = 0.5%)

Fig. 6 – P.C. board and components layout for the circuit of fig. 5.



APPLICATION INFORMATION (continued)

Multiway speaker systems and active boxes

Multiway loudspeaker systems provide the best possible acoustic performance since each lodspeaker 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 HiFi audio range the bands covered by each loudspeaker must overlap slightly. 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 to determine the cutoff frequencies of the crossover filters (see fig. 7). As an example, a 100 W three-way system with crossover frequencies of 400 Hz and 3KHz would require 50W for the woofer, 35W for the midrange unit and 15W 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

Fig. 7 - Power distribution vs. frequency

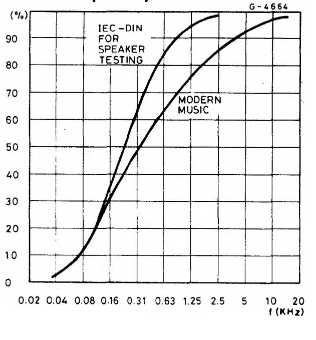
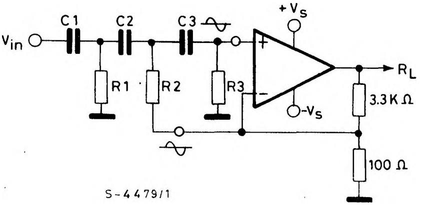


Fig. 8 - Active power filter



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 SGS is shown in fig. 8.
The proposed circuit can realize combined power amplifiers and 12 dB/octave or 18 dB/octave high-pass or low-pass filters.
In practice, at the input pins of the amplifier two equal and in-phase voltages are available, as required for the active filter operation.
The impedance at the pin (–) is of the order of 100Ω, while that of the pin (+) is very high, which is also what was wanted.

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

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

In the block diagram of fig. 9 is represented an active loudspeaker system completely realized using power integrated circuits, rather than the traditional discrete transistors or hybrids, very high quality is obtained by driving the audio spectrum into three bands using active crossovers (TDA 2320A) and a separate amplifier and loudspeaker for each band.
A modern subwoofer/midrange/tweeter solution is used.

Fig. 9 - High power active loudspeaker system using TDA 2030A and TDA 2040