12 W CAR RADIO POWER AMPLIFIER

The TDA1020 is a monolithic integrated 12 W audio amplifier in a 9-lead single in-line (SIL) plastic package. The device is primarily developed as a car radio amplifier. At a supply voltage of V_P = 14,4 V, an output power of 7 W can be delivered into a 4 Ω load and 12 W into 2 Ω.

To avoid interferences and car ignition signals coming from the supply lines into the IC, frequency limiting is used beyond the audio spectrum in the preamplifier and the power amplifier.

The maximum supply voltage of 18 V makes the IC also suitable for mains-fed radio receivers, tape recorders or record players. However, if the supply voltage is increased above 18 V (< 45 V), the device will not be damaged (load dump protected). Also a short-circuiting of the output to ground (a.c.) will not destroy the device. Thermal protection is built-in. As a special feature, the circuit has a low stand-by current possibility.

The TDA1020 is pin-to-pin compatible with the TDA1010.

QUICK REFERENCE DATA

Supply voltage range	V_P		6 to 18 V
Repetitive peak output current	I_{ORM}	<	4 A
Output power at d_{tot} = 10% (with bootstrap)			
V_P = 14,4 V; R_L = 2 Ω	P_o	>	10 W
		typ.	12 W
V_P = 14,4 V; R_L = 4 Ω	P_o	typ.	7 W
V_P = 14,4 V; R_L = 8 Ω	P_o	typ.	3,5 W
Output power at d_{tot} = 10% (without bootstrap)			
V_P = 14,4 V; R_L = 4 Ω	P_o	>	4,5 W
Input impedance			
preamplifier (pin 8)	$\|Z_i\|$	typ.	40 kΩ
power amplifier (pin 6)	$\|Z_i\|$	typ.	40 kΩ
Total quiescent current at V_P = 14,4 V	I_{tot}	typ.	30 mA
Stand-by current	I_{sb}	<	1 mA
Storage temperature range	T_{stg}		−55 to + 150 °C
Crystal temperature	T_c	max.	150 °C

PACKAGE OUTLINE

9-lead SIL; plastic (SOT110B).

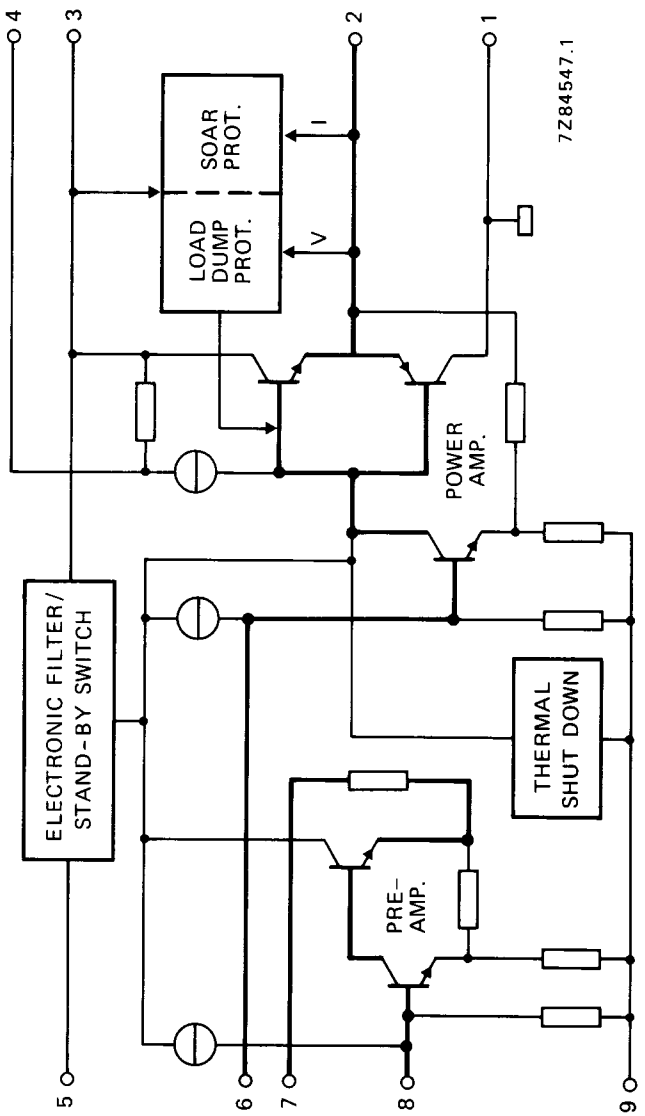


Fig. 1 Internal block diagram; the heavy lines indicate the signal paths.

PINNING

1. Negative supply (substrate)
2. Output power stage
3. Positive supply (V_P)
4. Bootstrap
5. Ripple rejection filter
6. Input power stage
7. Output preamplifier
8. Input preamplifier
9. Negative supply

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage; operating (pin 3)	V_P	max.	18	V
Supply voltage; non-operating	V_P	max.	28	V
Supply voltage; load dump	V_P	max.	45	V
Non-repetitive peak output current	I_{OSM}	max.	6	A
Total power dissipation	see derating curves Fig. 2			
Storage temperature range	T_{stg}	−55 to + 150		°C
Crystal temperature	T_c	max.	150	°C
Short-circuit duration of load behind output electrolytic capacitor at 1 kHz sine-wave overdrive (10 dB); V_P = 14,4 V	t_{sc}	max.	100	hours

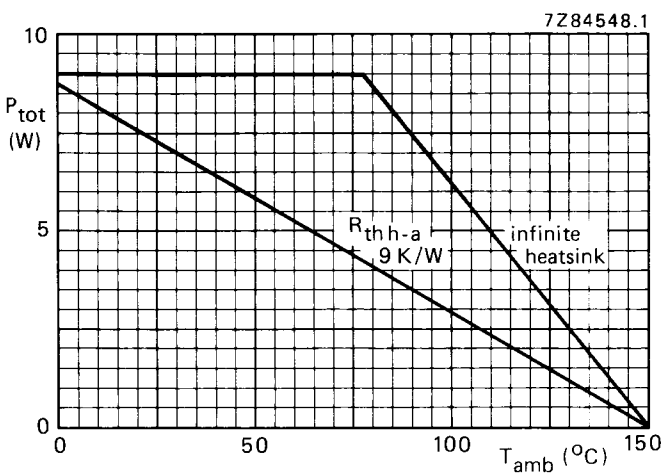


Fig. 2 Power derating curves.

HEATSINK DESIGN EXAMPLE

The derating of 8 K/W of the encapsulation requires the following external heatsink (for sine-wave drive):

10 W in 2 Ω at V_P = 14,4 V
maximum sine-wave dissipation: 5,2 W
T_{amb} = 60 °C maximum

$$R_{th\ j\text{-}a} = R_{th\ j\text{-}tab} + R_{th\ tab\text{-}h} + R_{th\ h\text{-}a} = \frac{150 - 60}{5,2} = 17,3\ K/W$$

Since $R_{th\ j\text{-}tab} + R_{th\ tab\text{-}h} = 8$ K/W, $R_{th\ h\text{-}a} = 17,3 - 8 \approx 9$ K/W.

D.C. CHARACTERISTICS

Supply voltage range (pin 3)	V_P		6 to 18 V
Repetitive peak output current	I_{ORM}	<	4 A
Total quiescent current			
at V_P = 14,4 V	I_{tot}	typ.	30 mA
at V_P = 18 V	I_{tot}	typ.	40 mA

A.C. CHARACTERISTICS

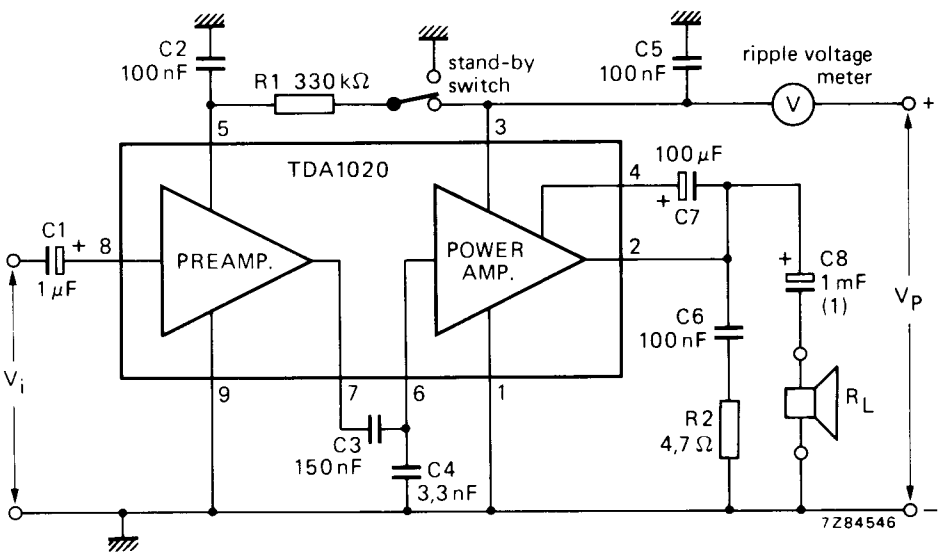
T_{amb} = 25 °C; V_P = 14,4 V; R_L = 4 Ω; f = 1 kHz; unless otherwise specified; see also Fig. 3

Output power at d_{tot} = 10%; with bootstrap (note 1)			
V_P = 14,4 V; R_L = 2 Ω	P_o	>	10 W
		typ.	12 W
V_P = 14,4 V; R_L = 4 Ω	P_o	>	6 W
		typ.	7 W
V_P = 14,4 V; R_L = 8 Ω	P_o	typ.	3,5 W
Output power at d_{tot} = 1%; with bootstrap (note 1)			
V_P = 14,4 V; R_L = 2 Ω	P_o	typ.	9,5 W
V_P = 14,4 V; R_L = 4 Ω	P_o	typ.	6 W
V_P = 14,4 V; R_L = 8 Ω	P_o	typ.	3 W
Output voltage (r.m.s. value)			
R_L = 1 kΩ; d_{tot} = 0,5%	$V_{o(rms)}$	typ.	5 V
Output power at d_{tot} = 10%; without bootstrap	P_o	>	4,5 W
Voltage gain			
preamplifier (note 2)	G_{v1}	typ.	17,7 dB
			16,7 to 18,7 dB
power amplifier	G_{v2}	typ.	29,5 dB
			28,5 to 30,5 dB
total amplifier	$G_{v\,tot}$	typ.	47 dB
			46,2 to 48,2 dB
Input impedance			
preamplifier	$\|Z_i\|$	typ.	40 kΩ
			28 to 52 kΩ
power amplifier	$\|Z_i\|$	typ.	40 kΩ
			28 to 52 kΩ
Output impedance			
preamplifier	$\|Z_o\|$	typ.	2,0 kΩ
			1,4 to 2,6 kΩ
power amplifier	$\|Z_o\|$	typ.	50 mΩ
Output voltage (r.m.s. value) at d_{tot} = 1%			
preamplifier (note 2)	$V_{o(rms)}$	>	1 V
		typ.	1,5 V
Frequency response	B		50 Hz to 25 kHz
Noise output voltage (r.m.s. value; note 3)			
R_S = 0 Ω	$V_{n(rms)}$	typ.	0,3 mV
		<	0,5 mV
R_S = 8,2 kΩ	$V_{n(rms)}$	typ.	0,5 mV
		<	1,0 mV

Ripple rejection (note 4)			
at f = 100 Hz; C2 = 1 μF	RR	typ.	44 dB
at f = 1 kHz to 10 kHz	RR	>	48 dB
		typ.	54 dB
Bootstrap current at onset of clipping (pin 4)			
R_L = 4 Ω and 2 Ω	I_4	typ.	40 mA
Stand-by current (note 5)	I_{sb}	<	1 mA
Crystal temperature for −3 dB gain	T_c	>	150 °C

Notes

1. Measured with an ideal coupling capacitor to the speaker load.
2. Measured with a load resistor of 40 kΩ.
3. Measured according to IEC curve-A.
4. Maximum ripple amplitude is 2 V; input is short-circuited.
5. Total current when disconnecting pin 5 or short-circuited to ground (pin 9).
6. The tab must be electrically floating or connected to the substrate (pin 9).



(1) With R_L = 2 Ω, preferred value of C8 = 2200 μF.

Fig. 3 Test circuit.