THOMSON-EFCIS

Integrated Circuits

TDA2003

10 W CAR RADIO AUDIO AMPLIFIER

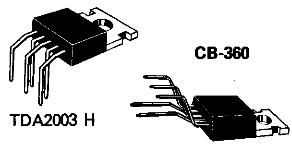
The TDA 2003 has improved performance with the same pin configuration as the TDA 2002. The additional features of TDA 2002; very low number of external components, ease of assembly, space and cost saving, are maintained. The device provides a high output current capability (up to 3.5 A) very low harmonic and cross-over distortion.
Completely safe operation is guaranteed due to protection against DC and AC short circuit between all pins and ground, thermal over-range, load dump voltage surge up to 40 V, polarity inversion and fortuitous open ground.

10 W CAR RADIO AUDIO AMPLIFIER

CASE

CB-367

CB-360

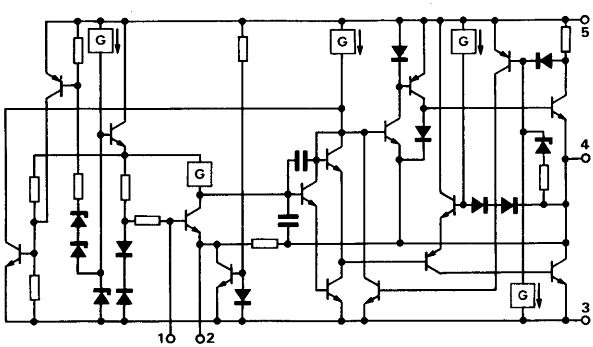


TDA2003 H

TDA2003V

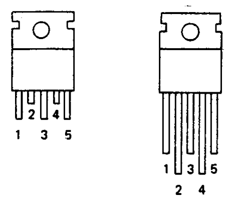
SP SUFFIX
PLASTIC PACKAGE

BLOCK DIAGRAM



PIN CONFIGURATIONS

CB 367	CB-360
Top view	Top view



1 Non inverting input
2 Inverting input
3 Ground
4 Output
5 Supply voltage

Tab is connected to pin 3

NT8024-A 1/13

THOMSON-EFCIS
Sales headquarters
45, av. de l'Europe - 78140 VELIZY - FRANCE
Tel. : (3) 946 97 19 / Telex : 204780 F

THOMSON-CSF COMPONENTS

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak supply voltage (50 ms)	V_{CC}	40	V
DC supply voltage	V_{CC}	28	V
Operating supply voltage	V_{CC}	18	V
Output peak current (repetitive)	I_O	3.5	A
Output peak current (no repetitive)	I_O	4.5	A
Power dissipation (T_{case} = 90 °C)	P_{tot}	20	W
Storage and junction temperature	$T_j - T_{stg}$	– 40 to + 150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Junction-case thermal resistance	$R_{th(j-c)}$	3 max.	°C/W

STATIC CHARACTERISTICS

T_{amb} = 25 °C; V_{CC} = 14.4 V; (see figure 1) (Unless otherwise stated)

Characteristic		Symbol	Min.	Typ.	Max.	Unit
Supply voltage		V_{CC}	8	–	18	V
Quiescent output voltage	Pin 4	V_O	6.1	6.9	7.7	V
Quiescent drain current	Pin 5	I_{CC}	–	44	50	mA

DYNAMIC CHARACTERISTICS

T_{amb} = 25 °C; V_{CC} = 14.4 V; A_V = 40 dB; (see figure 2) (Unless otherwise stated)

Characteristic	Symbol	Min.	Typ.	Max.	Unit
Output power (d = 10 %; f = 1kHz)	P_O				V
R_L = 4 Ω		5.5	6	–	
R_L = 2 Ω		9	10	–	
R_L = 3.2 Ω		–	7.5	–	
R_L = 1.6 Ω		–	12	–	
Input saturation voltage	V_I	300	–	–	mV

FIG. 1 – DC TEST CIRCUIT

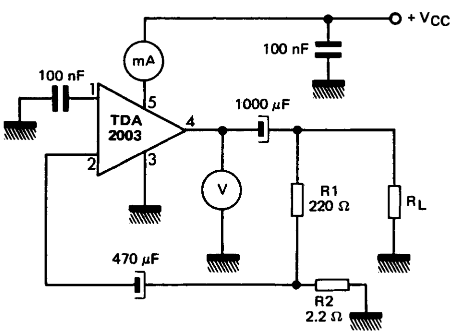
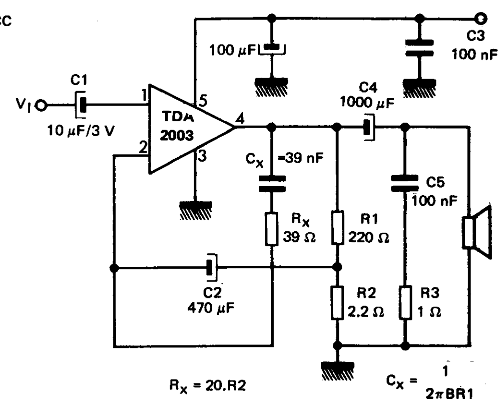


FIG. 2 – AC TEST CIRCUIT



ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min.	Typ.	Max.	Unit
Input sensitivity	S				mV
f = 1 kHz; P_O = 0.5 W; R_L = 4 Ω		–	14	–	
P_O = 6 W; R_L = 4 Ω		–	55	–	
P_O = 0.5 W; R_L = 2 Ω		–	10	–	
P_O = 10 W; R_L = 2 Ω		–	50	–	
Bandwidth (– 3 dB)	B				Hz
P_O = 1 W; R_L = 4 Ω			40 to 15.000		
Harmonic distortion	d				%
0.05 W ⩽ P_O ⩽ 4.5 W; R_L = 4 Ω; f = 1 kHz		–	0.15	–	
0.05 W ⩽ P_O ⩽ 7.5 W; R_L = 2 Ω; f = 1 kHz		–	0.15	–	
Input resistance (f = 1 kHz) Pin 1	R_I	70	150	–	kΩ
Voltage gain (R_L = 4 Ω; f = 1 kHz)	A_V				dB
Open loop		–	80	–	
Closed loop		39.5	40	40.5	
Input noise voltage	V_n				µV
B (– 3 dB) = 10 to 25.000 Hz; B (– 20 dB) = 4 to 27.000 Hz		–	1	5	
Input noise current	i_n				pA
B (– 3 dB) = 10 to 25.000 Hz; B (– 20 dB) = 4 to 27.000 Hz		–	60	200	
Efficiency	η				%
f = 1 kHz; P_O = 6 W; R_L = 4 Ω		–	69	–	
P_O = 10 W; R_L = 2 Ω		–	65	–	
Supply voltage rejection	SVR				dB
f = 100 Hz; V_{ripple} = 0.5 V; R_G = 10 kΩ; R_L = 4 Ω		30	36	–	

TYPICAL CHARACTERISTICS

FIG. 3 — QUIESCENT OUTPUT VOLTAGE VERSUS SUPPLY VOLTAGE

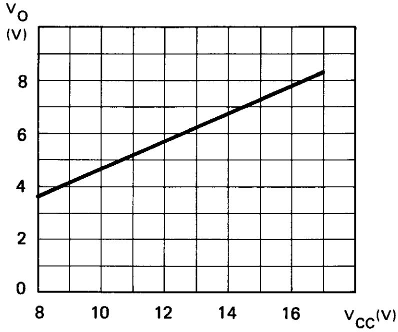


FIG. 4 — QUIESCENT DRAIN CURRENT VERSUS SUPPLY VOLTAGE

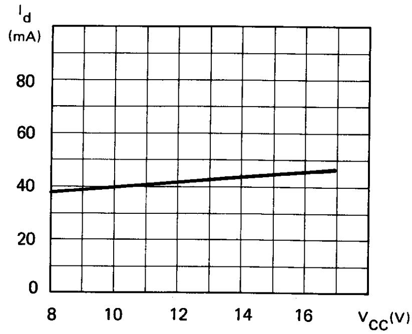


FIG. 5 — OUTPUT POWER VERSUS SUPPLY VOLTAGE

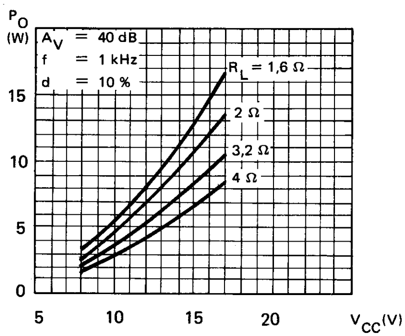
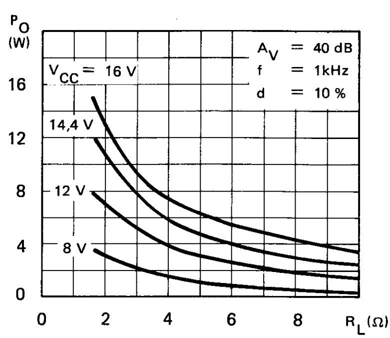


FIG. 6 — OUTPUT POWER VERSUS R_L



TYPICAL CHARACTERISTICS (continued)

FIG. 7 — GAIN VERSUS INPUT SENSITIVITY

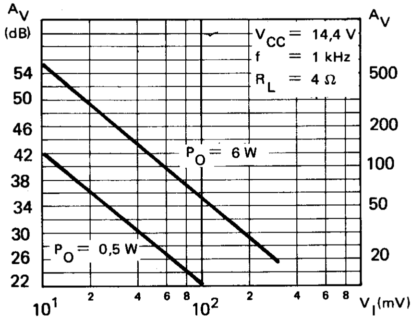


FIG. 8 — GAIN VERSUS INPUT SENSITIVITY

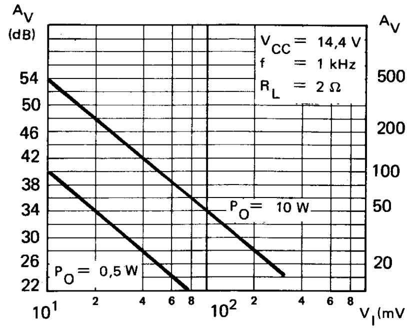


FIG. 9 — DISTORTION VERSUS OUTPUT POWER

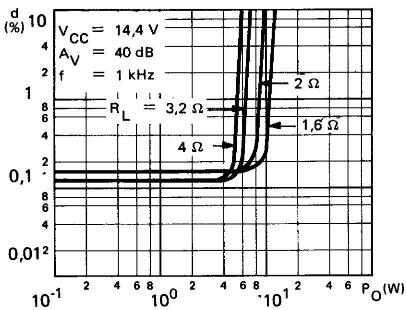


FIG. 10 — DISTORTION VERSUS FREQUENCY

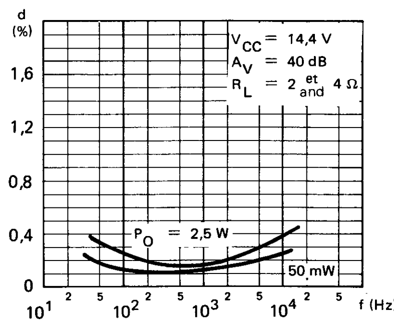


FIG. 11 — SUPPLY VOLTAGE REJECTION VERSUS VOLTAGE GAIN

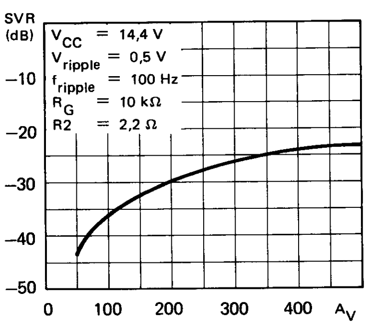
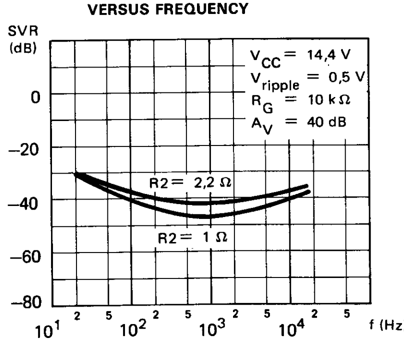


FIG. 12 — SUPPLY VOLTAGE REJECTION VERSUS FREQUENCY



TYPICAL CHARACTERISTICS (continued)

FIG. 13 — POWER DISSIPATION AND EFFICIENCY VERSUS OUTPUT POWER (R_L = 4 Ω)

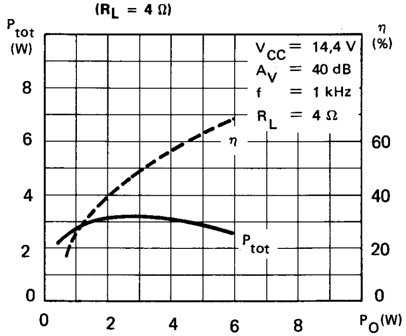


FIG. 14 — POWER DISSIPATION AND EFFICIENCY VERSUS OUTPUT POWER (R_L = 2 Ω)

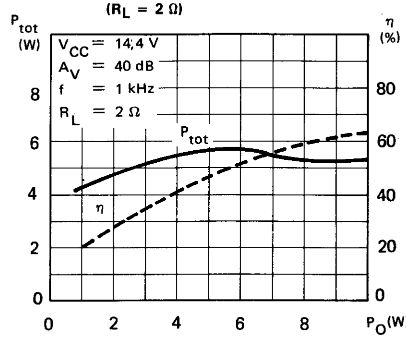


FIG. 15 — MAXIMUM POWER DISSIPATION VERSUS SUPPLY VOLTAGE (SINE WAVE OPERATION)

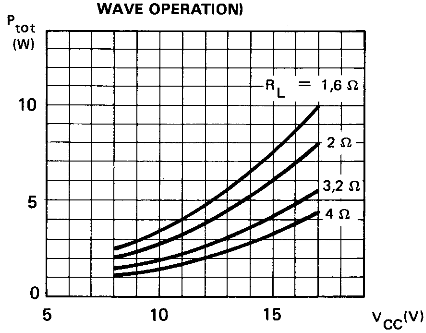


FIG. 16 — MAXIMUM ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

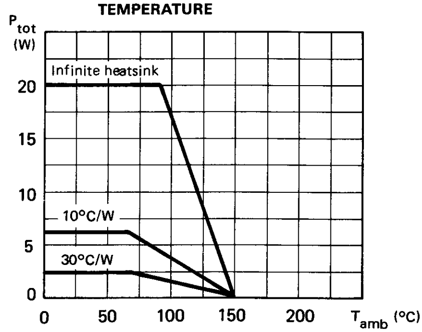


FIG. 17 — TYPICAL VALUES OF CAPACITOR (C_X) FOR DIFFERENT VALUES OF FREQUENCY RESPONSE (B)

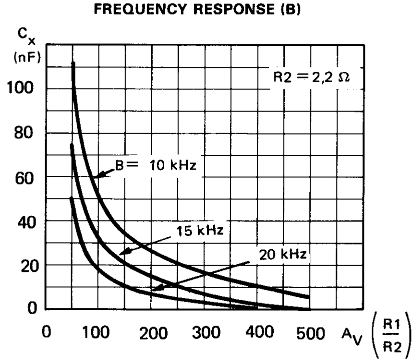
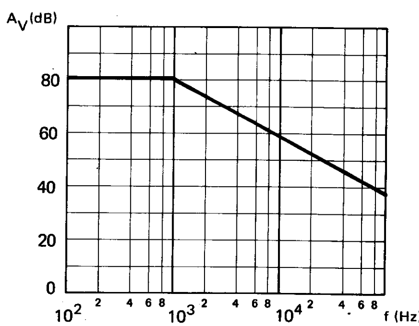


FIG. 18 — OPEN LOOP VOLTAGE GAIN VERSUS FREQUENCY



PRATICAL CONSIDERATIONS

Component	Recommended value	Purpose	Larger than recommended value	Smaller than recommended value
C1	10 μF	Input DC decoupling		Noise at switch-on, switch-off
C2	470 μF	Ripple rejection		Degradation of SVR
C3	0,1 μF	Supply bypassing		Danger of oscillation
C4	1000 μF	Output coupling to load		Higher low frequency cutoff
C5	0,1 μF	Frequency stability		Danger of oscillation at high frequencies with inductive loads
C_x	$\cong \frac{1}{2\pi \ BR1}$	Upper frequency cutoff	Lower bandwidth	Larger bandwidth
R1	$(A_V - 1) \cdot R2$	Setting of gain		Increase of drain current
R2	2,2 Ω	Setting of gain and SVR	Degradation of SVR	
R3	1 Ω	Frequency stability	Danger of oscillation at high frequencies with inductive loads	
R_x	≅ 20 R2	Upper frequency cutoff	Poor high frequency attenuation	Danger of oscillation

PRINTED CIRCUIT BOARD

The layout shown in figure 20 is recommended. If different layours are used, the ground points of input 1 and input 2 must be well decoupled from the ground of the output through which a rather high current flows.

ASSEMBLY SUGGESTION

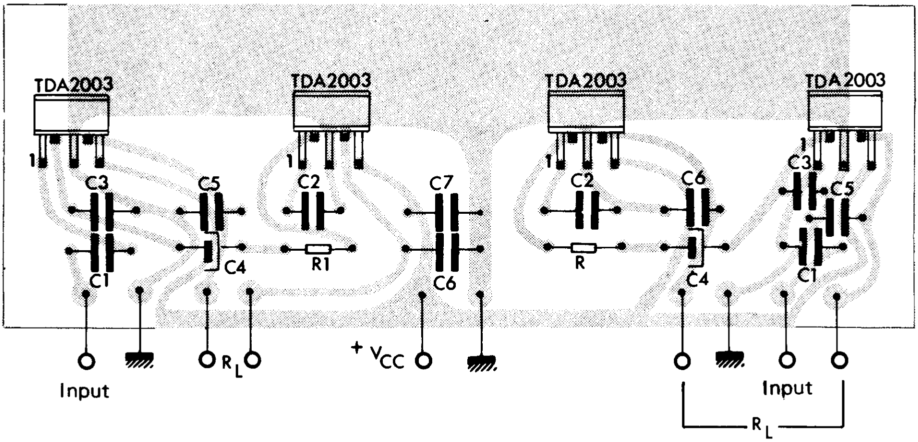
The device does not require insulation between the package and the heatsink. Pin lenght should be as short as possible. The soldering temperature must not exceed 260 °C for 12 seconds.

APPLICATION SUGGESTION

The recommended component values are those shown in the application circuits of fig. 19. Different values can be used. The following table is intended to aid the car-radio designer.

APPLICATION INFORMATION (continued)

FIG. 25 – P.C. BOARD AND COMPONENT LAYOUT FOR THE LOW-COST BRIDGE AMPLIFIER OF FIG. 23 STEREO VERSION (1/1 SCALE)



BUILT-IN PROTECTION SYSTEMS

LOAD DUMP VOLTAGE SURGE

The TDA2003 has a circuit which enables is to withstand a voltage pulse train, on pin 5, of the type shown in fig. 26.

If the supply voltage peaks to more than 40 V, then an LC filter must be inserted between the supply and pin 5, in order to assure that the pulses at pin 5 will be held within the limits shown in fig. 26.

A suggested LC network is shown in fig. 27. With this network, a train of pulses with amplitude up to 120 V and width 2 ms can be applied at point A.

Figure 26

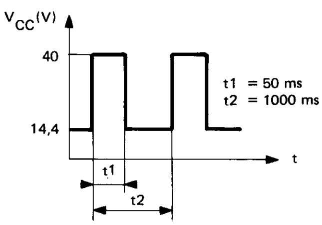
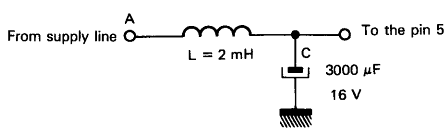


Figure 27



SHORT-CIRCUIT (AC AND DC CONDITIONS)

The TDA2003 can withstand a permanent short-circuit on the output for a supply voltage up to 16 V.

BUILT-IN PROTECTION SYSTEMS (continued)

POLARITY INVERSION

High current (up to 5 A) can be handled by the device with no damage for a longer period than the blow-out time of a quick 1 A fuse (normally connected in series with the supply). This feature is added to avoid destruction if, during fitting to the car, a mistake on the connection of the supply is made.

OPEN GROUND

When the radio is in the ON condition and the ground is accidentally opened, a standard audio amplifier will be damaged. On the TDA2003 protection diodes are included to avoid any damage.

INDUCTIVE LOAD

A protection diode is provided between pin 4 and 5 (see the internal schematic diagram) to allow use of the TDA2003 with inductive loads. In particular, the TDA2003 can drive a coupling transformer for audio modulation.

DC VOLTAGE

The maximum operating DC voltage on the TDA2003 is 18 V. However the device can withstand a DC voltage up to 28 V with to damage. This could occur during winter if two batteries are series connected to crank the engine.

THERMAL SHUT-DOWN

The presence of a thermal limiting circuit offers the following advantages:

1 — An overload on the output (even if it is permanent), or an excessive ambient temperature can be easily withstood.
2 — The heatsink can have a smaller factor of safety compared with that of a conventional circuit. There is no device damage in the case of excessive junction temperature: all that happens is that P_O (and therefore P_{tot}) and I_d are reduced (figs. 28 and 29).

FIG. 28 — OUTPUT POWER AND DRAIN CURRENT VERSUS CASE TEMPERATURE

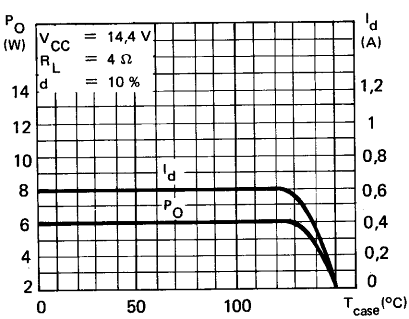
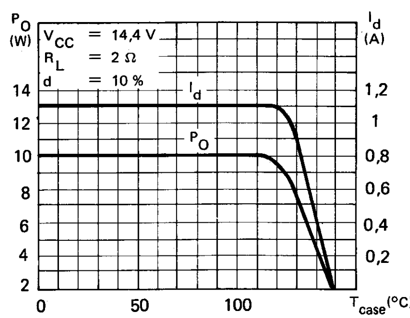


FIG. 29 — OUTPUT POWER AND DRAIN CURRENT VERSUS CASE TEMPERATURE



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