SGS TDA2190

LINEAR INTEGRATED CIRCUIT

COMPLETE TV SOUND CHANNEL WITH V.C.R. AND C.C.C.

The TDA 2190 is a monolithic integrated circuit in 16-lead dual in-line power dip. It performs the following functions:

- IF limiter-amplifier and low-pass filter.
- FM detector.
- DC volume control.
- AF preamplifier and AF power amplifier with thermal shut-down protection and choice of class B or C.C.C. operation mode
- VCR facility with common pin for input and output (playback and recording).
- VCR input and FM Detector DC switching for recording and playback.

The main features of TDA 2190 are:

- Suitable for all TV standards with FM modulation.
- Class B or constant current consumption (C.C.C.) operation mode.
- Video cassette recorder (VCR) facility according to DIN norms.
- DC or AC volume control.
- Physiological volume and tone controls (AC volume control mode).
- LC or ceramic filters can be used for input and detector networks.
- High output power (10W) easily achieved by very simple external stage.

Performance

- Very low spread of DC volume control.
- DC volume control thermally compensated.
- Very low current ripple in C.C.C. operation mode.
- 4W output power.
- No radiation problem

Safety

- Thermal protection of AF output stage.
- Short-circuit protection of VCR input-output pin.

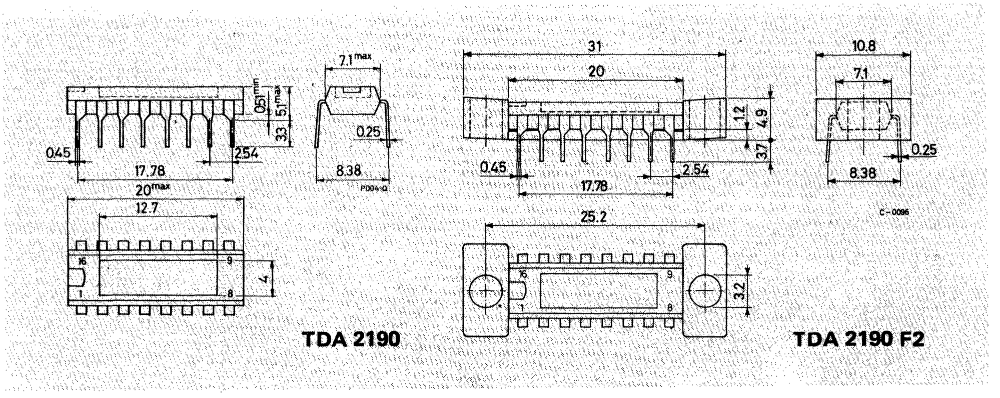
ABSOLUTE MAXIMUM RATINGS

V_s	Supply voltage (pins 14 and 15)	28	V
V_i	Input peak voltage (pin 10)	1	V
V_3	Voltage at pin 3	V_S	V
I_o	Output peak current (non repetitive)	2	A
I_o	Output peak current (repetitive)	1.5	A
P_{tot}	Power dissipation at T_{case} = 75°C	15	W
T_{stg}, T_j	Storage and junction temperature	-40 to 150	°C

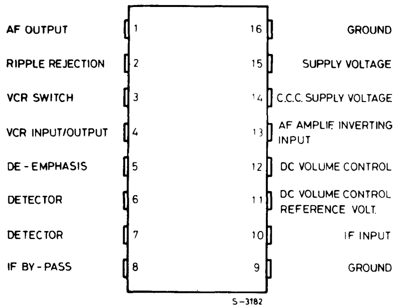
ORDERING NUMBERS: TDA 2190
TDA 2190 F2

MECHANICAL DATA

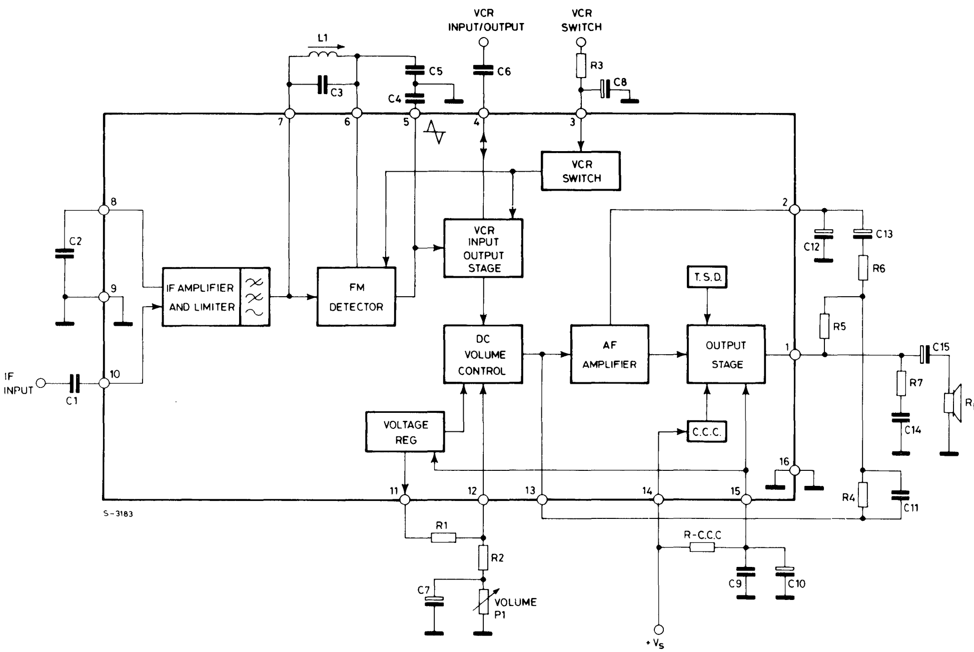
Dimensions in mm



CONNECTION DIAGRAM



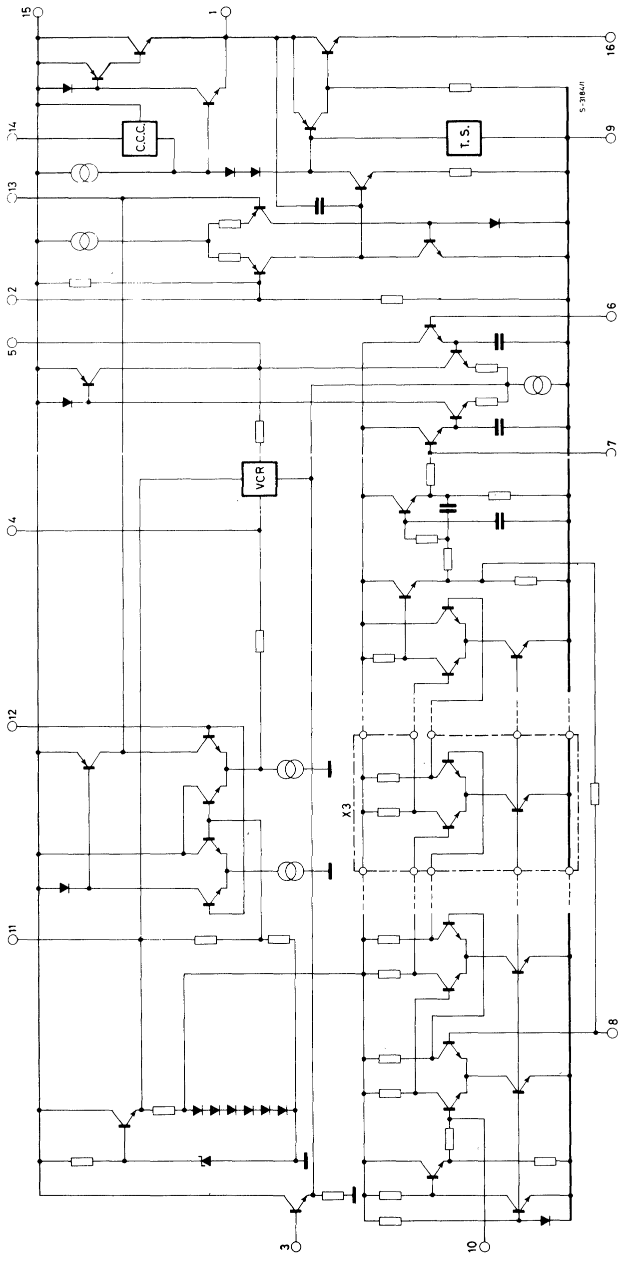
BLOCK DIAGRAM



THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max.	5	°C/W

SCHEMATIC DIAGRAM



ELECTRICAL CHARACTERISTICS (Refer to the test circuit, V_s = 24V, f_o = 5.5MHz, f_m = 1KHz, class B, T_{amb} = 25°C, unless otherwise specified)

Parameter		Test conditions		Min.	Typ.	Max.	Unit

DC CHARACTERISTICS

V_s	Supply voltage (pins 14 and 15)			11		28	V
V_o	Quiescent output voltage (pin 1)	V_s = 24V	P_1 = 0	11	12	13	V
		V_s = 12V	P_1 = 0	5.1	6	6.9	V
V_4	Pin 4 DC voltage	Playback and recording		5	6	7	V
V_{11}	DC volume control reference voltage	P_1 = 0 to 5 KΩ		4	4.7	5.5	V
V_{14-15}	C.C.C. reference voltage (between pins 14 and 15)			0.9	1.1	1.3	V
I_d	Quiescent drain current	V_s = 24V	P_1 = 0	25	45	65	mA
		V_s = 12V	P_1 = 0	20	35	50	mA

IF AMPLIFIER AND DETECTOR

$V_{i\ (threshold)}$	Input limiting voltage at pin 10	P_1 = 0	Δf = ± 25 KHz		40	100	μV
V_5	Recovered audio voltage	$V_i \geq$ 1 mV P_1 = 0	Δf = ± 25 KHz	240	400	480	mV
AMR	Amplitude modulation rejection	V_i = 1 mV m = 0.3	Δf = ± 50 KHz		62		dB
R_i	Input resistance (pin 10)	V_i = 1 mV			10		KΩ
C_i	Input capacitance (pin 10)	V_i = 1 mV			5		pF

DC VOLUME CONTROL

A	Volume attenuation (resistance control)	P_1 = 0Ω P_1 = 2.3 KΩ P_1 = 5 KΩ		80 22	90 30 0	 38 3	dB dB dB
V_C	Control voltage	A = 90 dB A = 30 dB A = 0 dB			0 1.5 3		V V V
$\frac{\Delta A}{\Delta T_{tab}}$	Volume attenuation thermal drift (resistance control)	T_{tab} = 25 to 85°C P_1 = 2.3 KΩ			-0.05		$\frac{dB}{°C}$

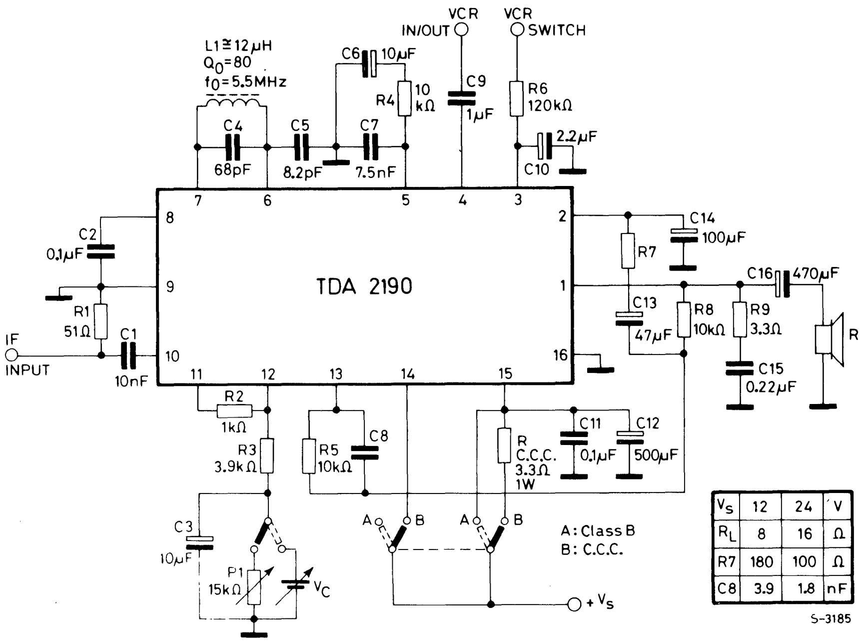
AUDIO FREQUENCY AMPLIFIER

P_o	Output power in class B mode	d = 10% V_s = 24V V_s = 12V d = 2% V_s = 24V V_s = 12V	 R_L = 16Ω R_L = 8Ω R_L = 16Ω R_L = 8Ω		 4.1 1.5 3 1.2		 W W W W

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
AUDIO FREQUENCY AMPLIFIER (continued)						
P_o	Output power in C.C.C. mode	d = 10% V_s = 24V R_L = 16Ω V_s = 12V R_L = 8Ω		3.5 1.2		W W
B	Frequency response of audio amplifier (-3 dB)	P_o = 1W R_L = 16Ω		50 ÷ 10000		Hz
SVR	Supply voltage rejection ratio	P_1 = 0 V_i = 1 mV Δf = 0 R_L = 16Ω f_{ripple} = 100 Hz		50		dB
V.C.R.						
V_3	Input switching voltage for recording				2	V
V_3	Input switching voltage for playback		8.5			V
R_3	Input resistance	V_3 = 1 to 10V	50	100		KΩ
V_{4i}	Input voltage (playback)	V_3 ⩾ 8.5V P_{out} = 1W P_1 = 5 KΩ	45	90	180	mV
V_{4out}	Output voltage (recording)	V_3 ⩽ 2V V_i = 1 mV P_1 = 0 Δf = ± 25 KHz	240	400	480	mV
R_{4i}	Input resistance (playback)	V_3 ⩾ 8.5V	10	13		KΩ
R_{4out}	Output resistance (recording)	V_3 ⩽ 2V		140		Ω
d	Total harmonic distortion of pin 4 output signal	P_1 = 0 V_i = 1 mV Δf = ± 25 KHz V_3 ⩽ 2V		0.5		%
SVR	Supply voltage rejection at output pin 4	P_1 = 0 V_3 ⩽ 2V V_i ⩾ 1 mV Δf = 0 f_{ripple} = 100 Hz		50		dB
$\frac{S+N}{N}$	Signal and noise to noise ratio (pin 4)	V_3 ⩽ 2V V_i ⩾ 1 mV Δf = ± 50 KHz	50	67		dB
OVERALL CIRCUIT						
$\frac{S+N}{N}$	Signal and noise to noise ratio	V_i ⩾ 1 mV V_o = 4V Δf = ± 50 KHz	50	67		dB
d	Distortion	P_o = 50 mW Δf = ± 25 KHz V_s = 24V R_L = 16Ω V_s = 12V R_L = 8Ω		0.5 0.5		% %

TEST CIRCUIT



V_S	12	24	V
R_L	8	16	Ω
R7	180	100	Ω
C8	3.9	1.8	nF

Fig. 1 - Relative audio output and signal to noise ratio vs. input signal

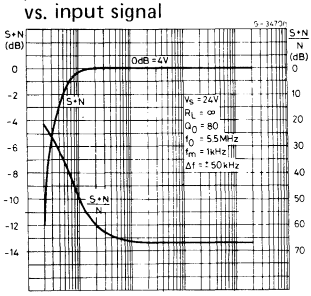


Fig. 2 - AM rejection vs. input signal

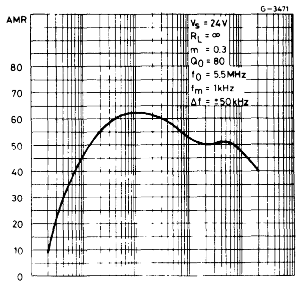


Fig. 3 - ΔAM rejection vs. tuning frequency change

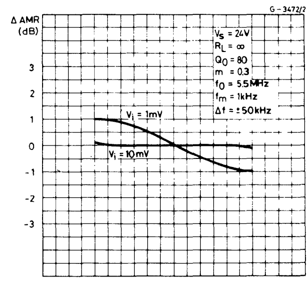


Fig. 4 - Detected audio voltage (pin 5) vs. unloaded Q-factor of the detector coil

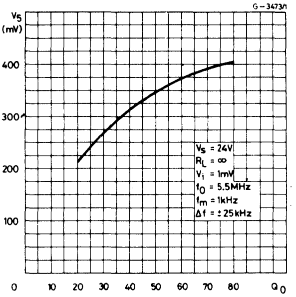


Fig. 5 - Distortion of the detected signal (pin 5) vs. unloaded Q-factor of the detector coil

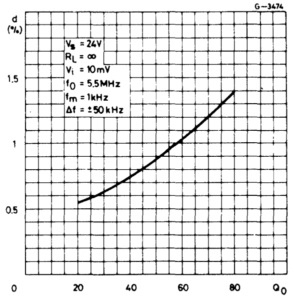


Fig. 6 - Output voltage attenuation vs. DC volume control resistance (P1) and vs. DC volume control voltage (V_C)

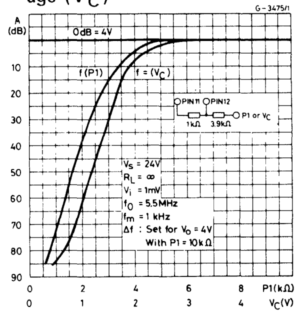


Fig. 7 - Distortion vs. frequency deviation

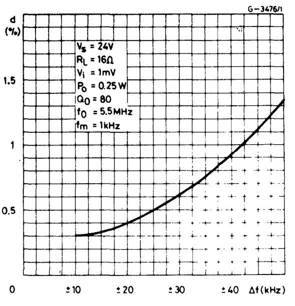


Fig. 8 - Distortion vs. tuning frequency change

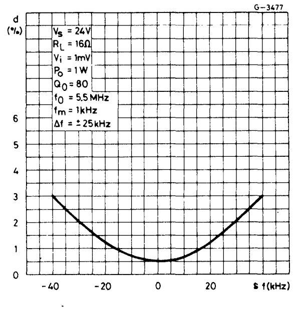


Fig. 9 - Switch-off attenuation of the VCR at pin 4 vs. switch-off voltage at pin 3

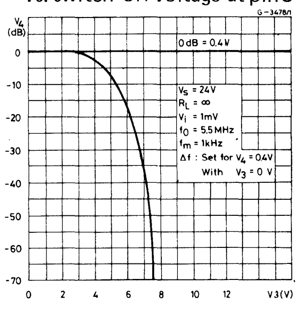


Fig. 10 - Overall frequency response

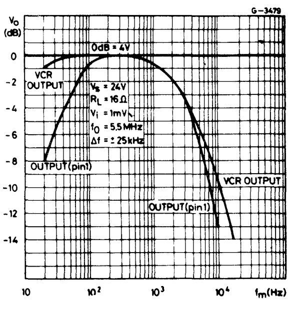


Fig. 11 - Audio amplifier frequency response

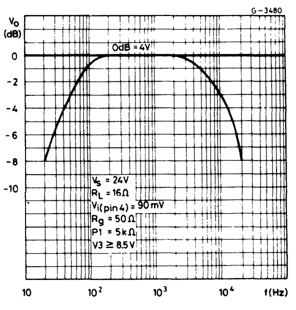


Fig. 12 - Distortion vs. output power (V_s= 24V and R_L= 16Ω)

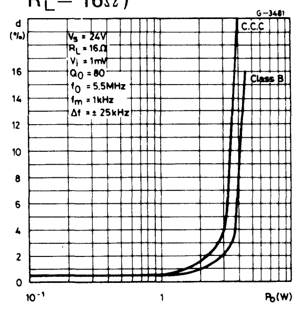


Fig. 13 - Distortion vs. output power (V_s= 12V and R_L= 8Ω)

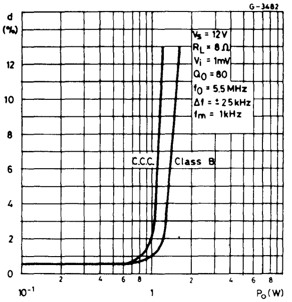


Fig. 14 - Output power vs. supply voltage (class B mode)

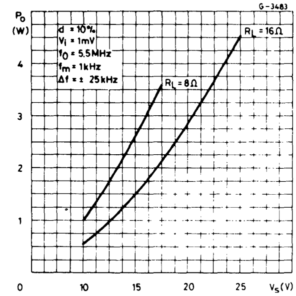


Fig. 15 - Maximum power dissipation vs. supply voltage (sine wave operation; class B mode)

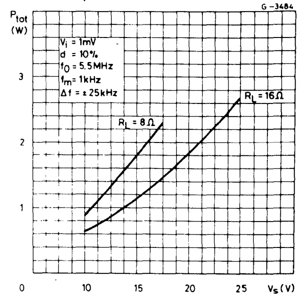


Fig. 16 - Power dissipation and efficiency vs. output power (class B mode)

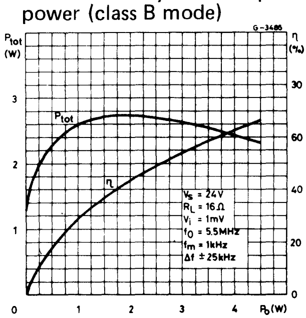


Fig. 17 - Output power vs. supply voltage (C.C.C. mode)

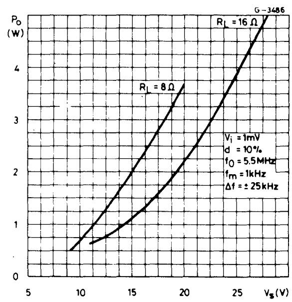


Fig. 18 - Power dissipation and efficiency vs. output power (C.C.C. mode)

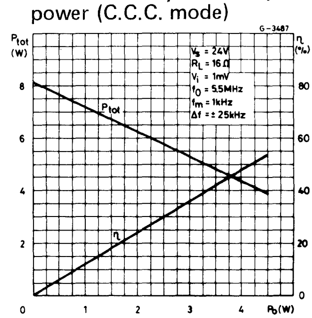


Fig. 19 - Current ripple vs. R-CCC value (C.C.C. mode only)

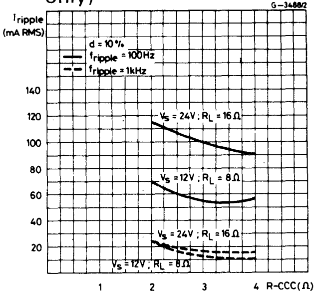


Fig. 20 - Current ripple vs. signal frequency (C.C.C. mode only)

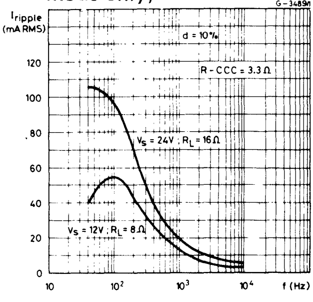
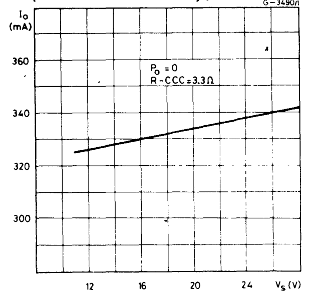


Fig. 21 - Quiescent drain current vs. supply voltage (C.C.C. mode only).



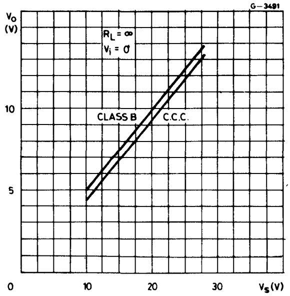


Fig. 22 - Quiescent output voltage (pin 1) vs. supply voltage

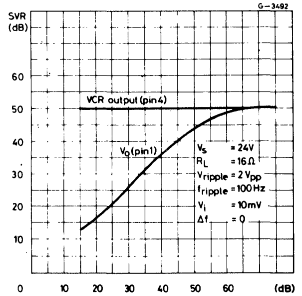


Fig. 23 - Supply voltage ripple rejection vs. volume control attenuation

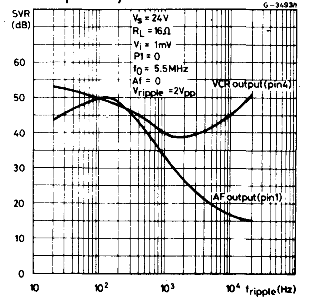


Fig. 24 - Supply voltage ripple rejection at the AF and VCR outputs vs. ripple frequency

APPLICATION INFORMATION (Refer to the block diagram)

IF amplifier and limiter

The IF sound signal is amplified and limited by a chain of 6 differential stages. To avoid the possibility of radiation problems an active low pass filter has been integrated to eliminate the high frequency harmonics from the signal sent to the detector.

Pin 10 is the non inverting input of the amplifier-limiter and it is used as input of the IF sound signal coming from the input network which can employ either LC or ceramic filters.
The typical input impedance of pin 10 is 10 KΩ, 5 pF at $f_o = 5.5$ MHz.

Pin 8 is the inverting input, of the amplifier-limiter. The DC negative feedback of the amplifier is applied internally to this pin which must therefore be decoupled by means of a by pass capacitor toward ground.

FM detector

Signal detection is obtained by means of a peak differential detector which enables radiation problems to be minimized.

Pin 7 is the first input of the peak differential detector and it is the output of the low pass filter. The typical output impedance is 2.7 KΩ.

Pin 6 is the second input of the peak differential detector. This pin must be supplied with the same DC voltage as the other input (pin 7) and this is done by coil L1.
External components L1 C3 and C5 transform the frequency variations into amplitude variations useful to drive the detector. Network L1 C3 C5 has two resonance frequencies:

$$f_1 \text{ series resonance for } X_{C5} = \frac{X_{L1} \cdot X_{C3}}{X_{C3} + X_{L1}}$$

$$f_2 \text{ parallel resonance for } X_{L1} = X_{C3}$$

APPLICATION INFORMATION (continued)

Coil L1 must be tuned at frequency f_o = IF sound, equidistant from frequencies f_1 and f_2 to which the peaks of the "S" response of the detector correspond. The separation between the peaks is defined by

the ratio $\frac{f_2^2}{f_1^2} = 1 + \frac{C5}{C3}$.

Network L1 C3 C5 can obviously be substituted by a ceramic filter.

Pin 5 is the output of the FM detector. Its output impedance of 20 KΩ, in combination with capacitor C4 connected between pin 5 and ground, defines the time constant of the deemphasis. The detector "S" curve is visible at pin 5. Improved AMR performance can be obtained by connecting a 10 KΩ 10 μF RC series network between pin 5 and ground.

VCR

This function, required by receivers capable of recording complete TV signals, is made in accordance with DIN Norms. A single pin (pin 4) acts both as output of the signal to be recorded and as input of the signal to be played back. The function of this pin is changed by means of a control, applied to pin 3, consisting of two different levels of DC voltage. The operating conditions of pins 3 and 4 are:

Mode	VCR Switch pin 3	Function of pin 4	Impedance of pin 4	Signal at pin 4
Recording	$V_3 \leq 2V$	Output	R4 = 140Ω	V_4 = 400 mV
Playback	$V_3 \geq 8.5V$	Input	R4 = 13 KΩ	V_4 = 90 mV

In the recording state the output signal at pin 4 is independent of the volume control, while during playback the signal applied at pin 4 is regulated by the volume control before being sent to the audio amplifier.

Pin 3, input of the VCR switch, has an impedance greater than 50KΩ for any value of input voltage. Control pulses at pin 3 with very sharp edges cause temporary unbalancing of the circuit and produce audible signals. This effect is eliminated by means of R3 C8 which slows down the control edges. In the playback state the IF sound signal coming from the detector is automatically blocked by the VCR switch.

Pin 4, input-output of the audio signal, has a DC typical voltage of 6V. C6 must therefore be used to decouple it from the VCR.
The output signal of pin 4 can be used to perform the AC volume control (fig. 31). The potentiometer must be connected between pin 4 and ground and the slider must be connected to pin 13 after DC decoupling.

DC volume control

The audio signal coming from the FM detector or from the VCR is adjusted in amplitude by means of a DC controlled active attenuator. The attenuation can be changed either by means of a potentiometer or by means of a DC voltage.

Pin 11 supplies the reference voltage for the volume control.
This voltage is between 4V and 5.5V and has a thermal coeff. of +0.25%/°C. The maximum current which can be supplied by pin 11 is 10 mA.

APPLICATION INFORMATION (continued)

Pin 12 is the input of the DC volume control. To minimize the attenuation spreads, the volume control network R1, R2, P1 is supplied by the reference voltage of pin 11. The attenuation of the signal is inversely proportional to the voltage applied at pin 12; therefore maximum attenuation is for $V_{12} = 0$ or for P1 = 0 . Capacitor C7, connected in parallel to the volume potentiometer, eliminates any signals or spikes picked up by the connection wires of the potentiometer. The volume control characteristic depends on the configuration and on the values of the components of the network connected to pins 11 and 12. The suggested values are: R1= 1 KΩ R2= 3.9 KΩ and P1= 5 KΩ with linear variation; with this network a linear variation of the output power is obtained. Different slopes of the volume control and relative networks are shown in figs. 25 and 26.

Fig. 25

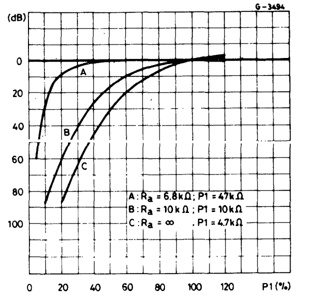
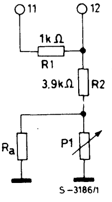


Fig. 26



The volume can also be controlled by means of a DC voltage applied between resistor R2 and ground instead of potentiometer P1. Using this configuration, volume variation can be obtained by means of remote control as shown in fig. 36.

AF amplifier

The AF amplifier consists of an operational amplifier with thermally protected (thermal shut down) output stage. By using a simple external variant the power stage can be made to operate in class B or in costant current consumption.

Pin 1 is the output of the power amplifier. The network which defines the gain and the band of the audio amplifier is connected between pins 1, 2 and 13.
The input voltage of the amplifier is I · R4, where I is the signal output current of the DC volume control block. The closed loop gain of the amplifier is given by G_v= R5/R6;
Therefore the output voltage is given by

$$V_o = I \cdot R4 \cdot \frac{R5}{R6}$$

Changing the values of these resistors, different output voltage (i.e. different closed loop gain) can be obtained.
When impedances, rather than pure resistors, are used, the closed loop gain is changed with frequency. In particular at high frequencies the gain is reduced by capacitor C11 and at low frequencies it is reduced by capacitor C13.
The Boucherot cell R7 C14 guarantees the stability of the circuit in all the operating conditions.

Pin 2, the non inverting input of the audio amplifier, is connected to an integrated voltage divider which fixes its DC voltage at $V_s/2$.

APPLICATION INFORMATION (continued)

Since the voltage of pin 2 is the reference of the input differential stage of the audio amplifier, both the voltage of pin 13 and the voltage of pin 1 are equal to $V_s/2$. Capacitor C12, connected between pin 2 and ground, has the dual function of eliminating the audio signals from pin 2 and providing the supply voltage ripple rejection.

Pin 13 is the inverting input of the audio preamplifier; the outoput of the DC volume control is also connected to this pin.

Supply

The device can operate either in class B or in C.C.C. mode. In class B the supply current is highly variable and depends on the power supplied to the load. The supply must therefore be well filtered to prevent modulation effects on the supply itself which may influence other circuits in the TV. In C.C.C. mode supply current is constant and the supply system can therefore be simplified; for example the sound channel can be supplied directly by the line transformer without problems of modulation of the picture size.

Pin 15 is the main supply of the device; when it is connected directly to the power supply and pin 14 is left open, the circuit operates in class B.

Pin 14 is the supply point for C.C.C. The reference system, connected between pin 14 and pin 15, determines a constant voltage of 1.1V between the two pins. To make the device operate in C.C.C. mode, pin 14 must be connected to the supply and a resistor R-CCC must be connected between pin 14 and pin 15; the value of this resistor defines the quiescent current I_{CCC}= 1.1V/R-CCC.

Pin 9 is the main ground of the circuit.

Pin 16 is the ground of the power output stage only.

APPLICATION INFORMATION (continued)

Fig. 27 - Typical application circuit (class B mode)

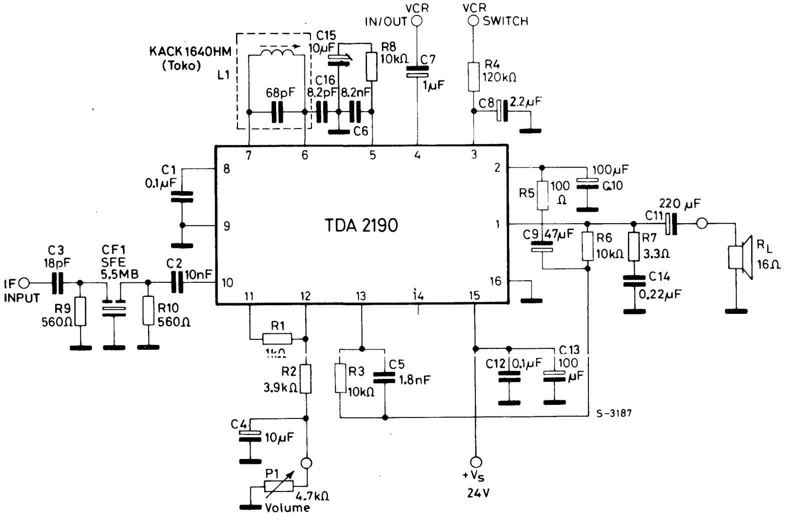
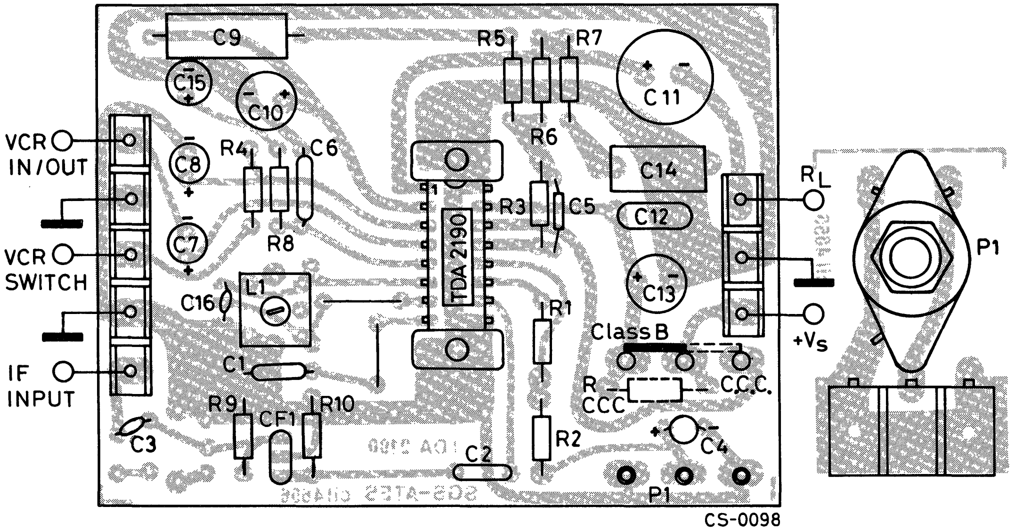


Fig. 28 - P.C. board and component layout of the circuit shown in fig. 27 (1:1 scale)



APPLICATION INFORMATION (continued)

Fig. 29 - Application using a ceramic discriminator and an LC network at the IF input (C.C.C. mode)

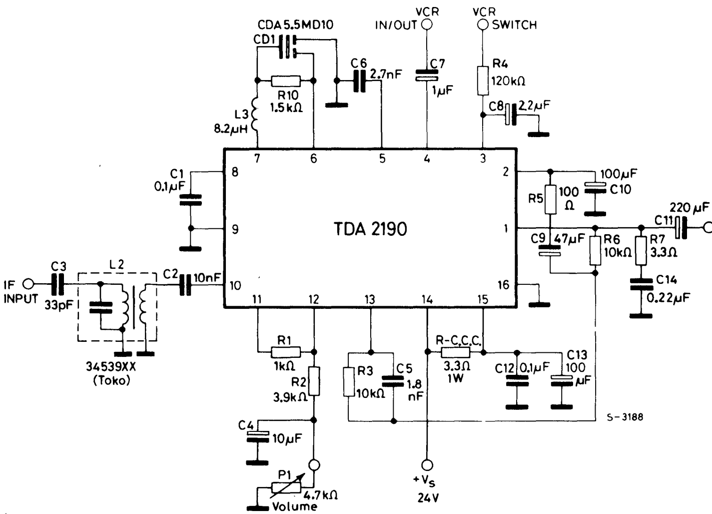
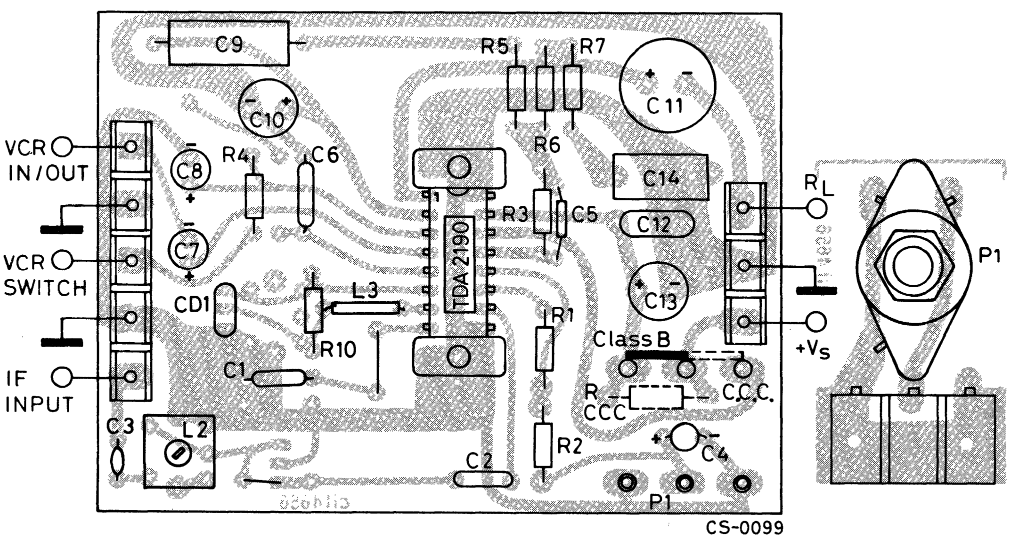


Fig. 30 - P.C. board and component layout of the circuit shown in fig. 29. (1:1 scale)



APPLICATION INFORMATION (continued)

Fig. 31 - Application circuit with AC volume control

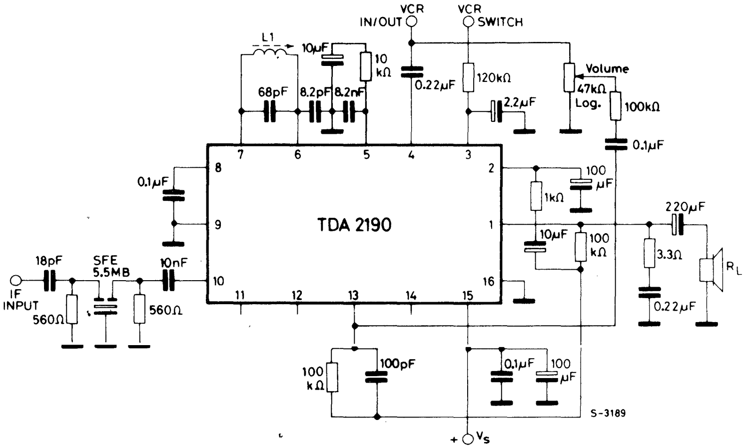
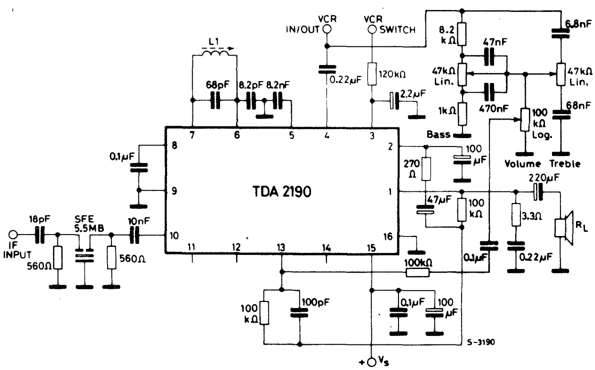
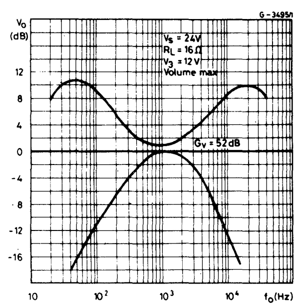


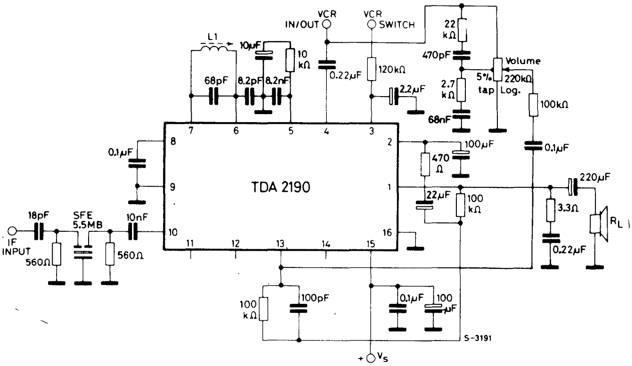
Fig. 32 - Application circuit with tone controls





APPLICATION INFORMATION (continued)

Fig. 33 - Application circuit with physiological volume control



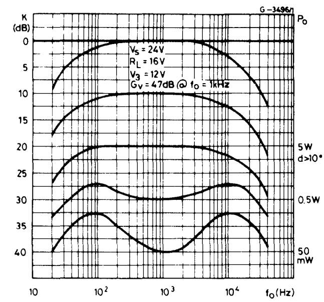
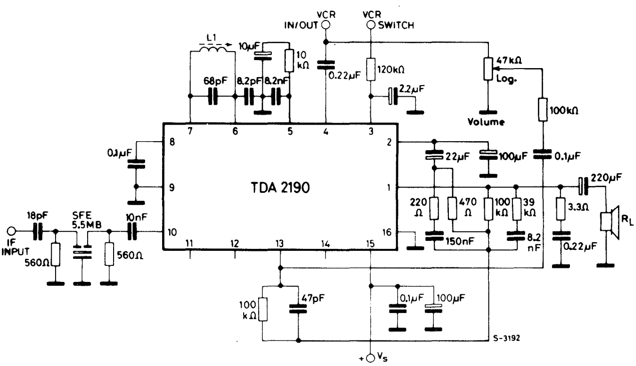
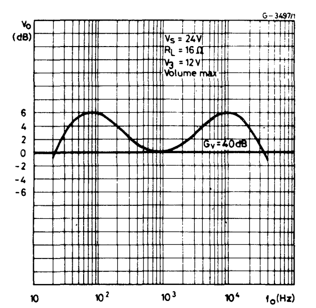


Fig. 34 - Application circuit with fixed bass and treble boost





APPLICATION INFORMATION (continued)

Fig. 35 - Application circuit for 10W of output power when V_s= 22V and R_L= 4Ω

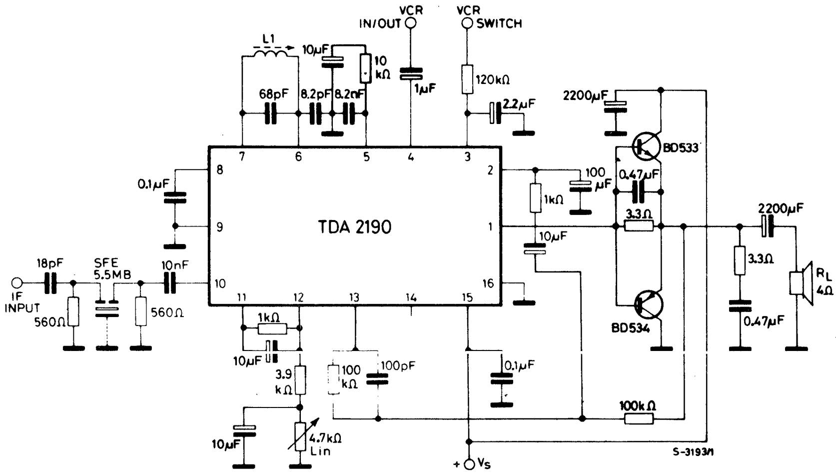
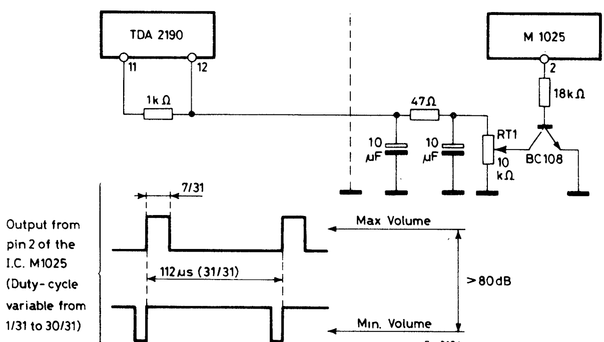


Fig. 36 - Remote volume control. The output of the sound channel increases when the duty-cycle at pin 2 of the I.C. M1025 decreases



NOTE:
RT1 must be set for the normalization of the output power (P_o= 100 mW).
Procedure:
– IF input at pin 10 of the TDA 2190
V_s= 24V; R_L= 16Ω; V_i= 1 mV; f_o= 5.5 MHz; Δf = ± 25 KHz; f_m = 1 KHz.

Whith the normalizated output of the I.C. M1025 (duty cycle of 10/31), set RT1 for 1.26 V_{RMS} across the load R_L = 16Ω.

MOUNTING INSTRUCTIONS

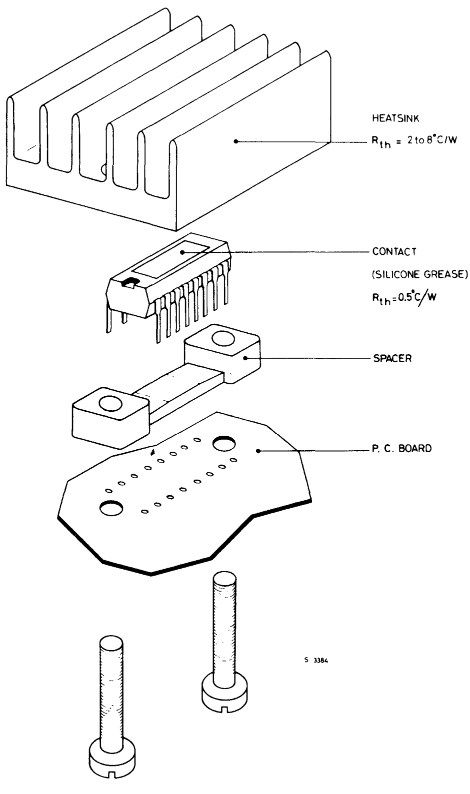
The power dissipated in the circuit must be removed by adding an external heatsink as shown in figs. 37 and 38.

The system for attaching the heatsink is very simple: it uses a plastic spacer which is supplied with the device on request (TDA 2190 F2).

Thermal contact between the copper slug (of the package) and the heatsink is guaranteed by the pressure which the screws exert via the spacer and the printed circuit board; this is due to the particular shape of the spacer.

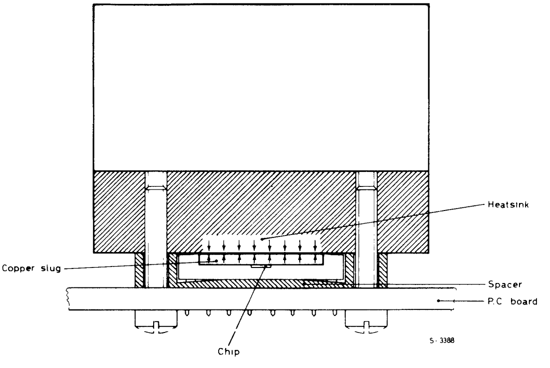
Note : The most negative supply voltage is connected to the copper slug, hence to the heatsink (because it is in contact with the slug).

Fig. 37 - Mounting system



MOUNTING INSTRUCTIONS (continued)

Fig. 38 - Cross-section of mounting system



The maximum allowable power dissipation depends upon the size of the external heatsink (i.e. its thermal resistance): fig. 39 shows this dissipable power as a function of ambient temperature for an heatsink having 5°C/W.

Fig. 39 - Maximum allowable power dissipation vs. ambient temperature