



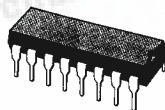
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**TEA7531**

## MONITOR AMPLIFIER

- PROGRAMMABLE GAIN IN STEPS OF 6dB OR LINEARLY
- ON/OFF POSITION
- LOW VOLTAGE
- POWER : 100mW AT 5V



**DIP-16**  
(Plastic 0.25)



**SO-16J**

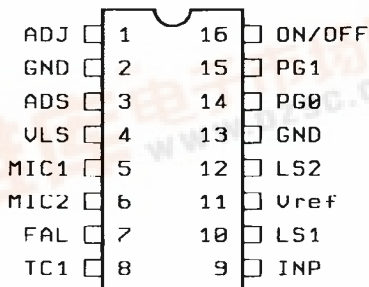
### DESCRIPTION

This 16 pins IC is designed for monitor (loudspeaker) telephone set and provides :

- a) Signal amplification for monitoring (loudspeaker)
- b) Antiacoustic feedback (antilarсен)
- c) Antidistortion by automatic gain adaptation

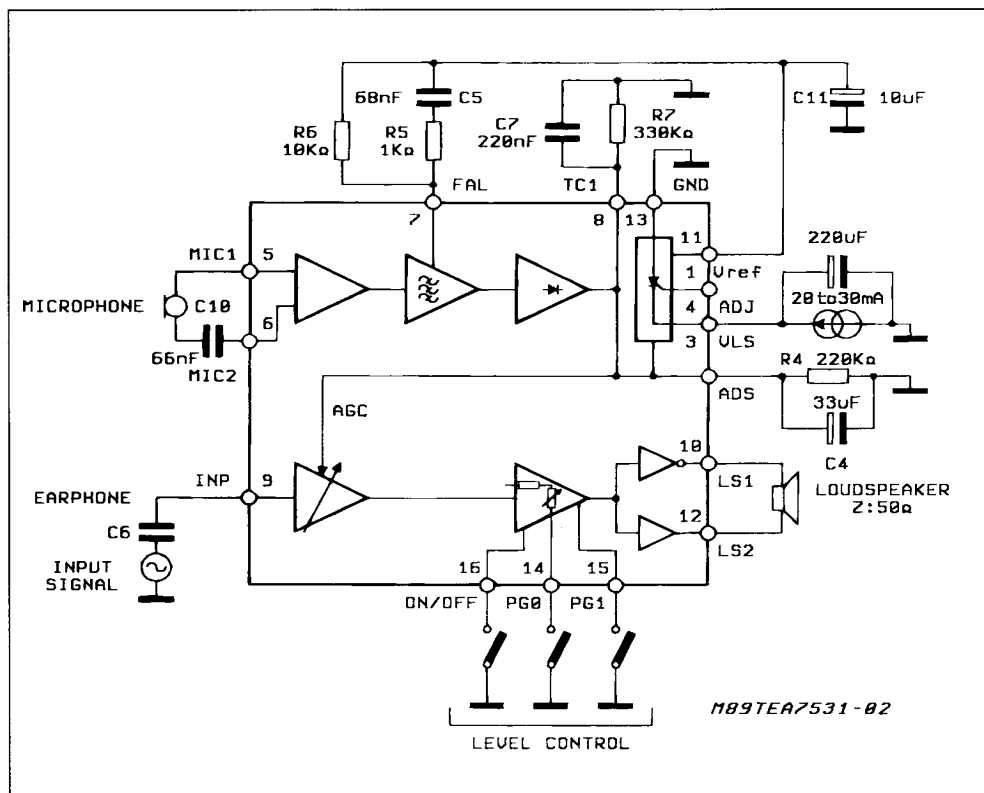
**ORDER CODES :** TEA7531DP (DIP16)  
TEA7531FP (SO-16J)

### PIN CONNECTION (top view)



M89TEA7531-01

### BLOCK DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
T <sub>op</sub>	Temperature Range	− 5 to + 45	°C
V <sub>LS</sub>	Supply Voltage	6	V
I <sub>LS</sub>	Supply Current for T > 300ms for T ≤ 300ms	90 150	mA
V <sub>L</sub>	Voltage Level (pins, PG0, PG1, ON/OFF)	− 0.6 > to V <sub>LS</sub> + 0.6	V

## PIN DESCRIPTION

N°	Symbol	Description
1	ADJ	Adjust Internal Reference $V_{LS}$
2	GND	Ground
3	ADS	Antidistortion
4	$V_{LS}$	Supply
5	MIC1	Microphone Input
6	MIC2	Microphone input
7	FAL	Antilarsen Filter
8	TC1	Antilarsen Time Constant
9	INP	Input Signal
10	LS1	Output Loudspeaker 2
11	$V_{REF}$	Internal Resistance
12	LS2	Output Loudspeaker 2
13	GND	Ground
14	PG0	Inputs Program Level to Loudspeaker
15	PG1	
16	ON/OFF	

## FUNCTIONAL DESCRIPTION

TEA7531 performs the following functions :

The circuit amplifies the incoming signal and feeds it to the loudspeaker. PG0 and PG1 inputs are used to set the loudspeaker gain in a range of 32dB to 14dB in 6dB steps.

The TEA7531 inputs (PG0, PG1, ON/OFF) permit the loudspeaker to be cut-off thus ensuring privacy of communication.

- The antilarsen (antiacoustic feedback) system is incorporated.

- The maximum power available on a 50 ohms impedance loudspeaker is 25mW at 3 volts and 100mW at 5 volts.

Limit values for external components :

R3 min = 5 kohms (R3 adjust VLS).

R7 max = 390 kohms.

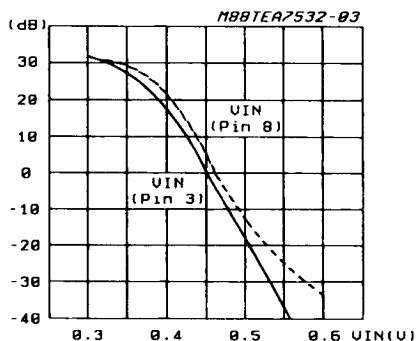
R6 min = R7/35.

R max between pin 5 and 6 = 10 kohms + C min = 10nf.

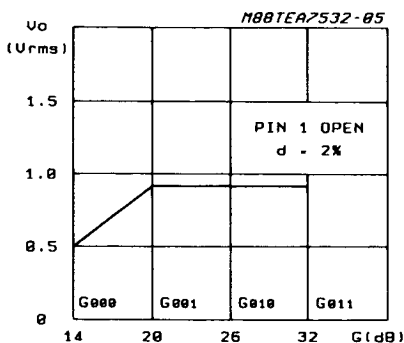
ELECTRICAL CHARACTERISTICS : (T<sub>amb</sub> = 25°C, I<sub>LS</sub> = 30mA unless otherwise specified)

Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
V <sub>LS1</sub>	V <sub>LS</sub> Supply	I <sub>LS</sub> = 2mA (fig. 6)	2.8	3.0	3.2	V
		I <sub>LS</sub> = 30mA (fig. 6)		3.15	3.4	
V <sub>LSM</sub>	V <sub>LS</sub> Maximum	I <sub>pin 1</sub> = 40μA (fig. 6, SO = closed)			5.5	V
V <sub>ADJ</sub>	Voltage Pin 1	I <sub>LS</sub> = 2mA to 30mA (fig. 6)	1.1	1.25	1.4	V
G	Loudspeaker Amplifier Gain = $\frac{V_{(10)} - V_{(12)}}{V_{(9)}}$	f = 800Hz (fig. 7) V <sub>(10)</sub> - V <sub>(12)</sub> = 0.8V <sub>rms</sub>				
		ON/OFF    PG0    PG1				
G000		GND    GND    GND	12	14	16	dB
G001		GND    GND    V <sub>LS</sub>	18	20	22	dB
G010		GND    V <sub>LS</sub> GND	24	26	28	dB
G011		GND    V <sub>LS</sub> V <sub>LS</sub>	30	32	34	dB
G100		V <sub>LS</sub> X    X		- 30	- 20	dB
THD	Distortion	f = 300Hz to 2kHz V <sub>(10)</sub> - V <sub>(12)</sub> = 0.8V <sub>rms</sub> G = G011 ; (fig. 7)			2	%
Z <sub>MICIN</sub>	Microphone Input	Symetrical at (pins 5-6) fig. 8 Asymetrical at (pin 6) fig. 8	28.5	4.5 36.0	43.5	kΩ kΩ
Z <sub>INPIN</sub>	Earphone Input	(fig. 8)	2.2	2.8	3.4	kΩ
V <sub>OFFS</sub>	Output Offset [V <sub>(10)</sub> - V <sub>(12)</sub> ]	G011 ; (fig. 7)	- 50		50	mV
I <sub>ON/OFF</sub> I <sub>PG0</sub> I <sub>PG1</sub>	Input Current ON State	V <sub>PGi</sub> = 0V ; (fig. 7)	- 10 - 10 - 10	- 5 - 5 - 5		μA
I <sub>ON/OFF</sub> I <sub>PG0</sub> I <sub>PG1</sub>	Input Current OFF State	V <sub>PGi</sub> = V <sub>LS</sub> ; (fig. 7)			1 1 1	μA
V <sub>IL ON/OFF</sub> V <sub>IL PG0</sub> V <sub>IL PG1</sub>	Input Voltage ON State				0.45 0.45 0.45	V V V
V <sub>IH ON/OFF</sub> V <sub>IH PG0</sub> V <sub>IH PG1</sub>	Input Voltage OFF State		1.5 1.5 1.5			V V V
G <sub>MIC</sub>	Microphone Gain = V <sub>(7)</sub> /[V <sub>(5)</sub> - V <sub>(6)</sub> ]	V <sub>MIC</sub> = 10m Vrms f = 2kHz ; (fig. 9)	21.5	23.0	24.5	dB
V <sub>8</sub>	Voltage Pin 8		0.48	0.67	0.90	V
G <sub>ATT</sub>	Loudspeaker Attenuated Gain = [V <sub>(10)</sub> - V <sub>(12)</sub> ]/V <sub>(9)</sub>	G011 ; V <sub>(8)</sub> = 0.6V ; (fig. 9)		- 30	- 20	dB
		G011 ; V <sub>(8)</sub> = 0.4V ; (fig. 9)	20	30		dB

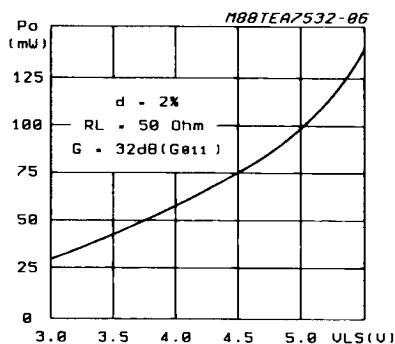
**Figure 1 :** Loudspeaker Gain versus Voltage on Pin(3) - (8) with Pin 2 Open.



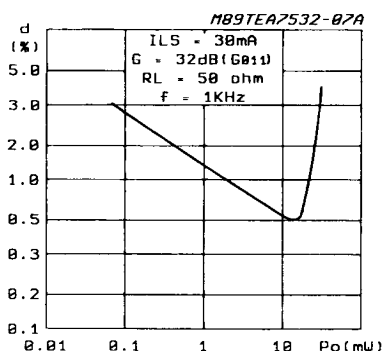
**Figure 2 :** AC Output Voltage versus Amplifier Gain.



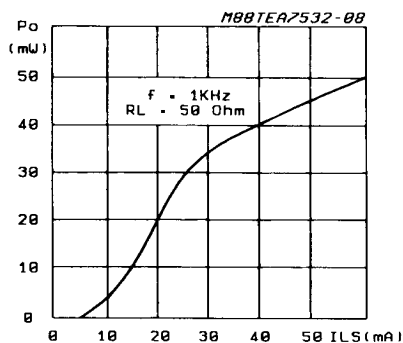
**Figure 3 :** Power Available on Loudspeaker versus  $V_{LS}$  Typical Curve.



**Figure 4 :** Distortion versus Output Power.



**Figure 5 :** Output Power versus Supply Current.



TEA7531

TEST CIRCUIT

Figure 6 : Shuntvoltage Regulator/Reference Voltage at Pin 1.

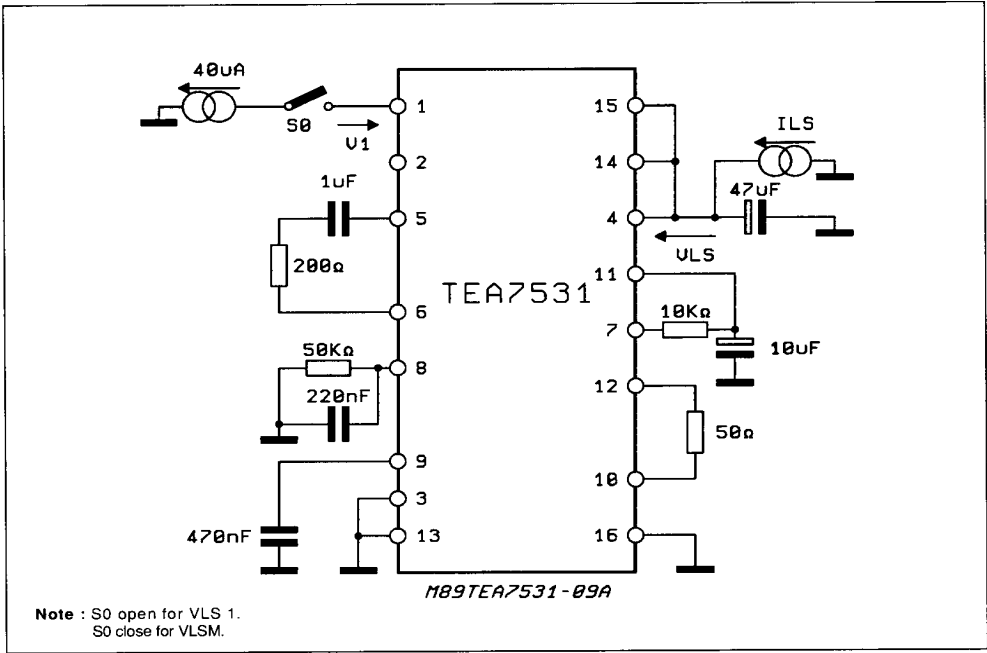
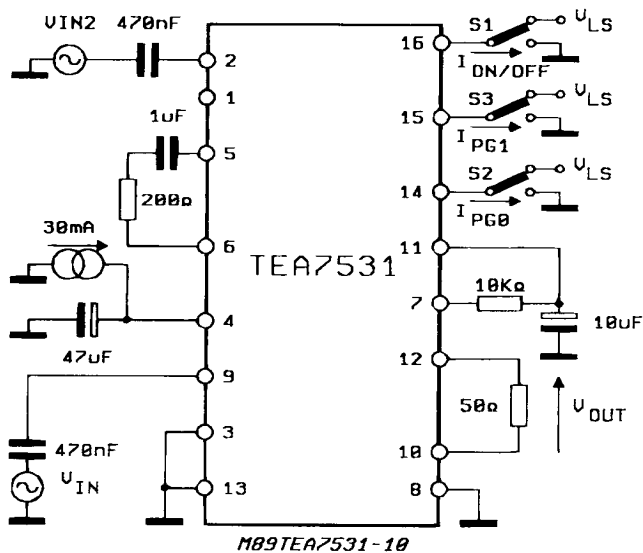


Figure 7 : Loudspeaker Amplifier : Gain/Distortion/Output Offset.



	S1	S2	S3
G1XX	1	X	X
G000	0	0	0
G010	0	1	0
G001	0	0	1
G011	0	1	1

$$G = \frac{V(10) - V(12)}{V(9)} = \frac{V_{out}}{V(9)}$$

- $V_{OFFS}$  with  $V_{in} = 0$

S1 :  $V_{LS} = 1$   
GND = 0

TEA7531

Figure 8 : Impedance ZMIC, ZINP and Zin2.

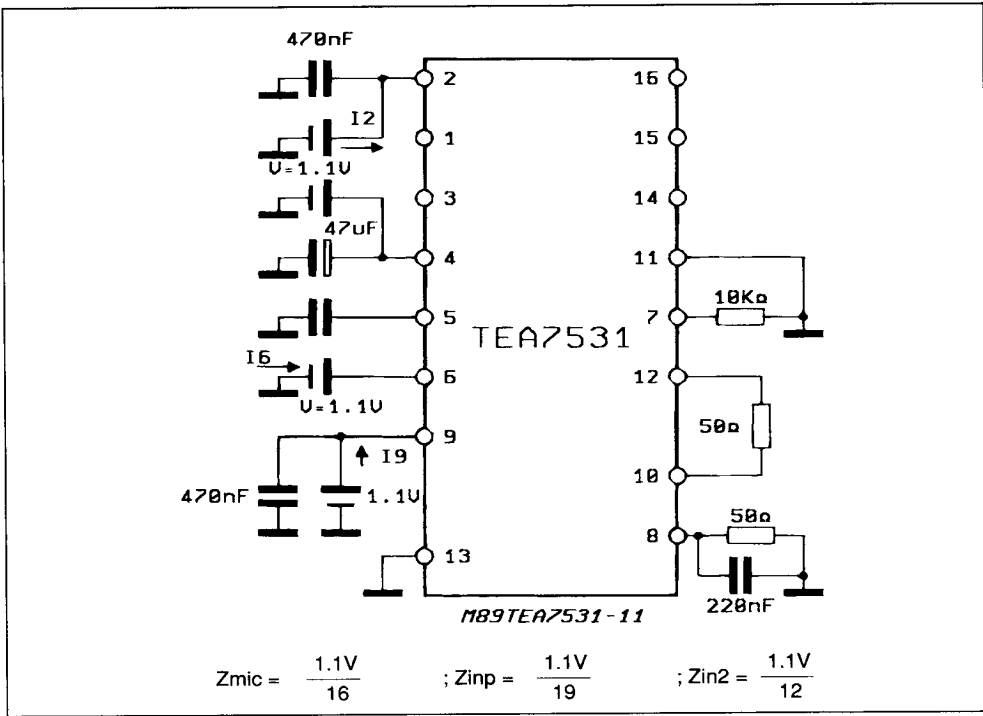
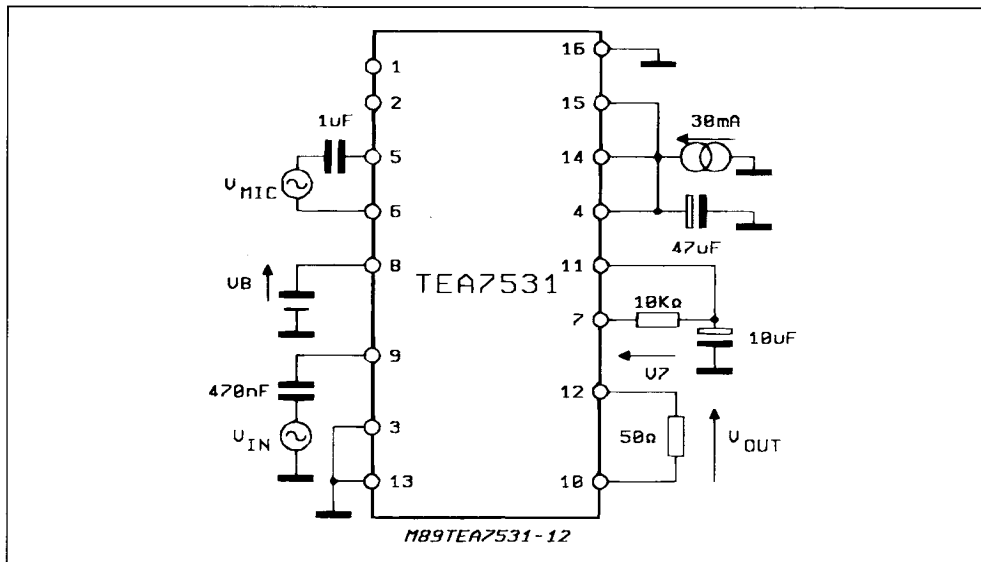




Figure 9 : Antiacoustic Feedback System at G011.



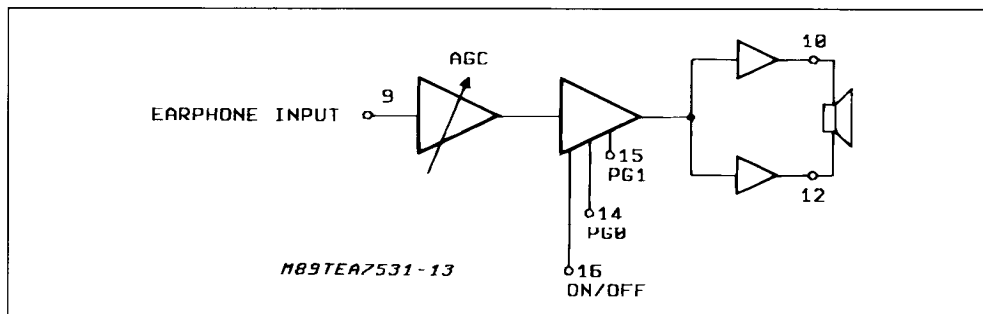
## CIRCUIT DESCRIPTION

TEA7531 is a 16 pin DIL integrated circuit providing the following facilities :

### 1.1. LOUDSPEAKER AMPLIFIER.

- Loudspeaker amplifier.
- Antiacoustic feed-back system (antilarsen system).

Figure 10.



The amplifier is divided into 3 main sections.

- Automatic Gain Control (AGC)
- Preamplifier
- Push-pull amplifier (bridge structure)

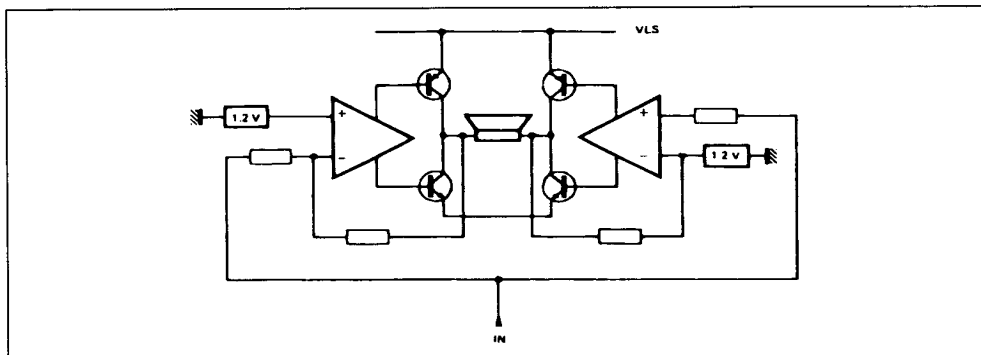
a) The AGC section is used for the antilarsen and antidistortion system.

- When used in a telephone set to avoid larsen effect the AGC automatically decreases loudspeaker amplifier gain.
- When the required output level exceeds the capabilities of the available current, the AGC decreases the loudspeaker amplifier gain to avoid distortion.

b) The preamplifier permits step control of amplifier gain in steps of 6dB, using pins PG0 and PG1, which may be controlled using switches or by a microprocessor. The amplifier may be muted using the ON/OFF control signal (pin 16).

c) The output amplifier uses a double push-pull configuration (H bridge) to get maximum dynamic range under limited supply conditions.

Figure 11.



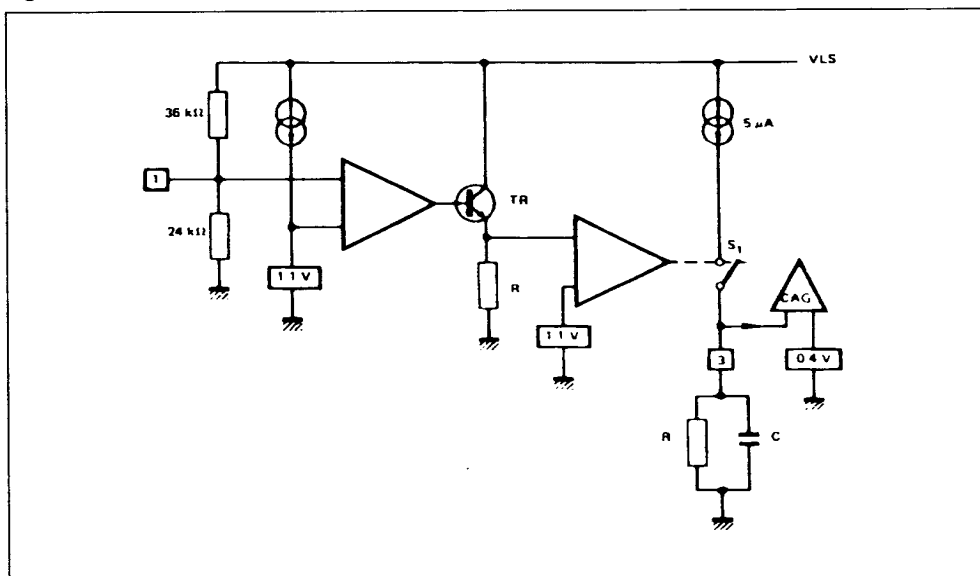
#### Amplifier dc supply.

In transmission mode, the supply voltage is controlled by the internal shunt DC regulator. For this reason, the TEA7531 should be supplied from a current source.

(see : supply considerations).

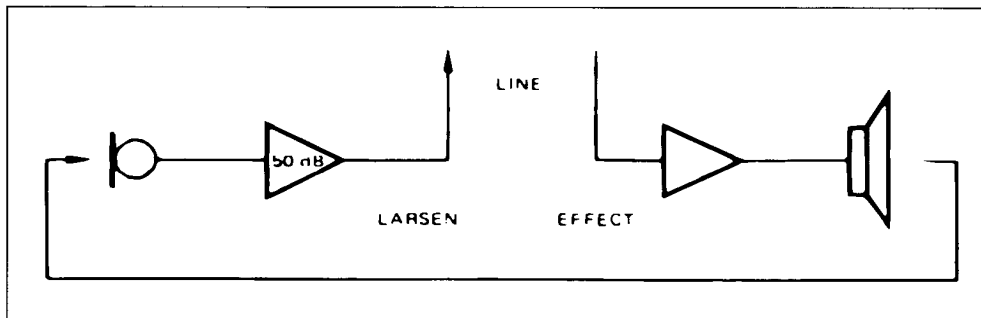
An antidistortion system is embodied which provides AGC control to avoid loudspeaker distortion under current-limited conditions.

Figure 12.



**Circuit action.**

When the supply voltage is insufficient, the voltage at pin 1, falls below the reference voltage 1.1V, resulting in transistor (TR) being switched off, resulting in zero current flow in resistor R. This state enables the gain control system. Under these conditions, the shunt DC supply will switch at a rate determined by the time constant of the RC network on pin 3.

**Figure 13.****Principle of operation.**

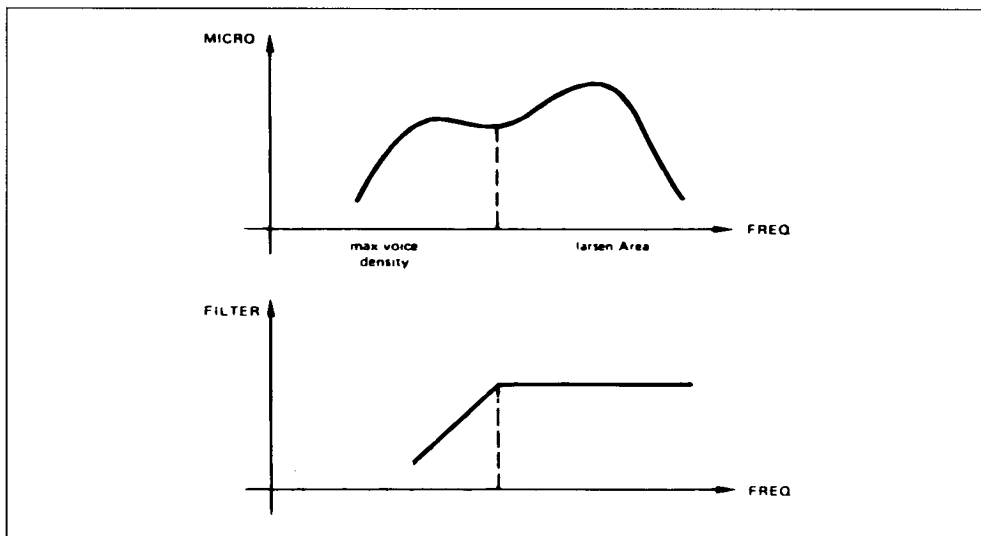
When examining the spectral density of the voice area and the larsen area, it can be seen that the do-

This switching action accommodates normal speech characteristics under low supply conditions.

**1.2. ANTIACOUSTIC FEED-BACK SYSTEM (antilarsen system)**

The purpose of this system is to control AGC action in order to avoid acoustic feed-back between the loudspeaker and the microphone, when used in a telephone set.

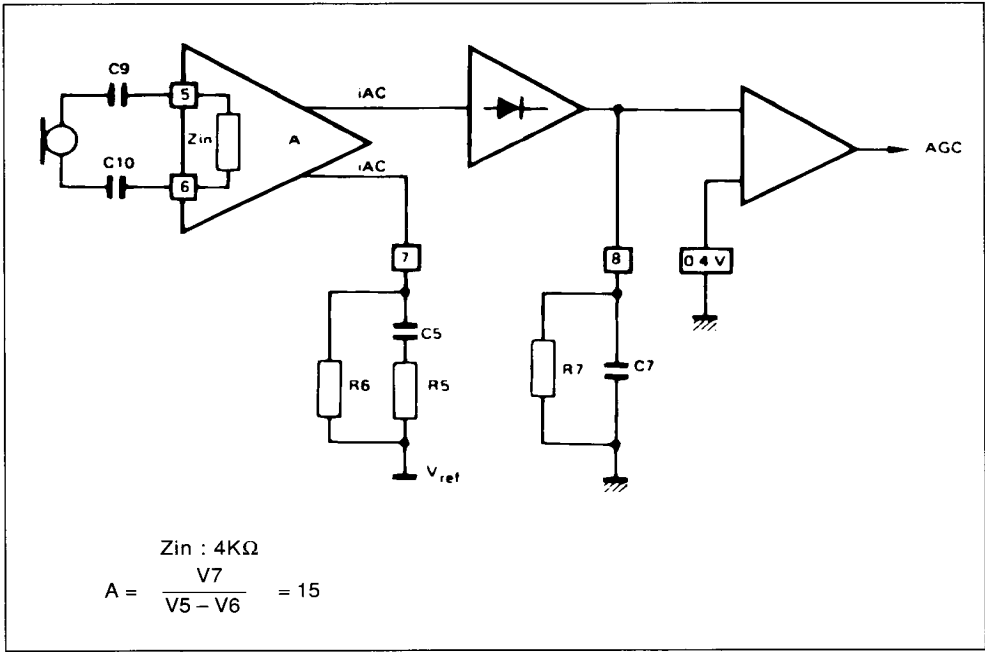
inant features of each exist in different frequency bands.

**Figure 14.**

To extract the larsen component, the microphone signal is first filtered by a second order filter (formed

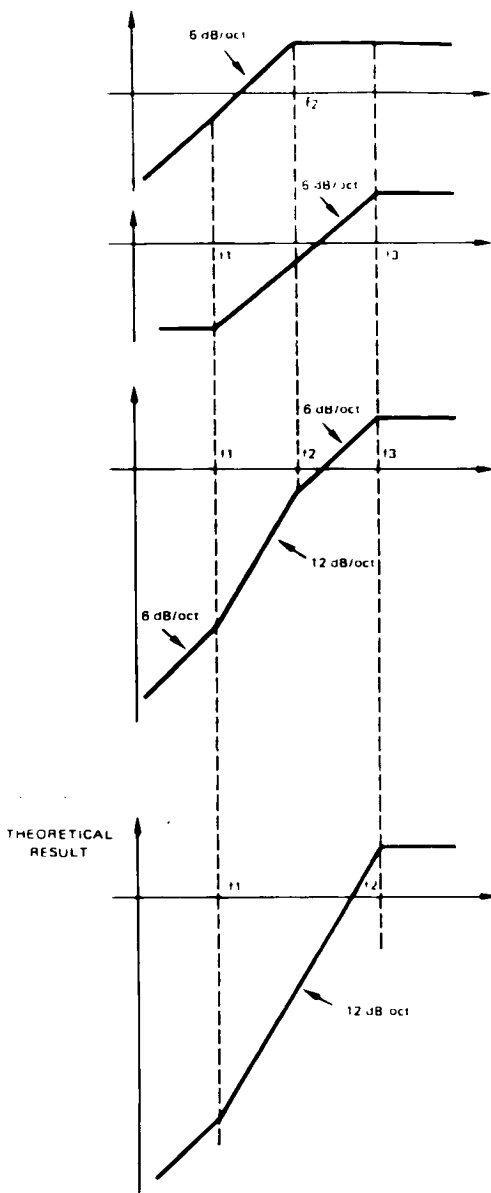
by two first order filters), then amplified and rectified in order to produce the AGC control signal.

Figure 15.



The first filter is generated by the capacitors on pins 5 and 6 ; the second filter by the R-C network on pin 7.

Figure 16 : Antilarsen System Filter Response.



Filter on pins 5 &amp; 6

$$f_2 = \frac{C_9 + C_{10}}{2\pi Z_{in} C_9 C_{10}}$$

Filter on pin 7

$$f_1 = \frac{1}{2\pi (R_5 + R_6) C_5}$$

$$f_3 = \frac{1}{2\pi R_5 C_5}$$

Antilarsen system  
Filter responseIf  $f_2 = f_3$  the Antilarsen system filter is equivalent to a second order filter.

$$\frac{C_9 + C_{10}}{2\pi Z_{in} C_9 C_{10}} = \frac{1}{2\pi R_5 C_5}$$

## TEA7531

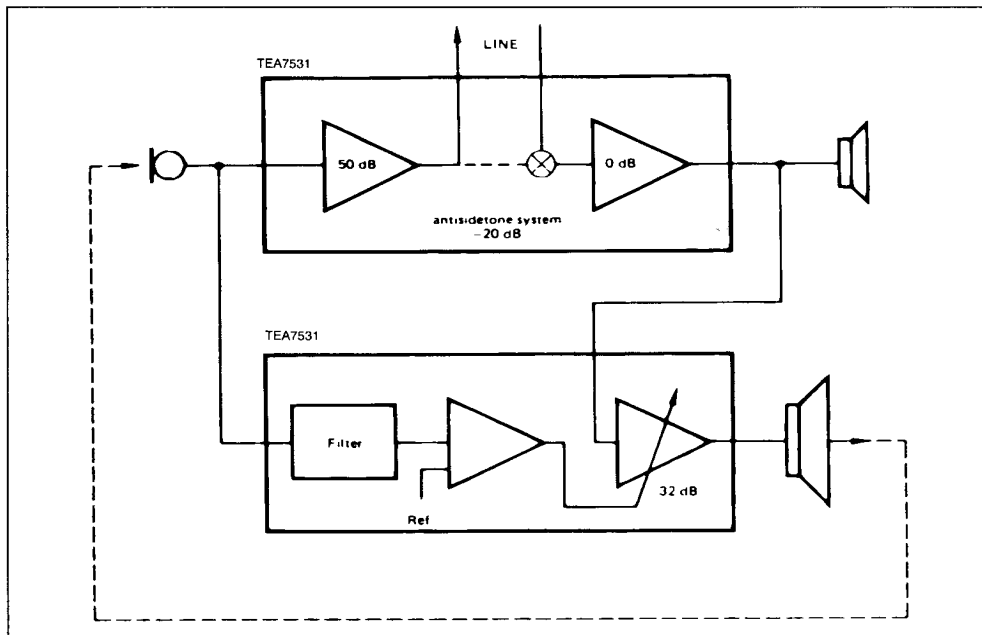
A complete telephone set has two antilarson systems :

- one in the transmission circuit (for example : TEA7051) antisdetone network ;

- one in the loudspeaker amplifier (for example : TEA7531).

Together these form a high efficiency antilarson system.

**Figure 17.**



### PIN FUNCTIONS

#### PIN 1 : ADJUST VLS

This pin is used to adjust the IC supply voltage.

#### PINS 2-13 Ground :

These pins have to be connected together.

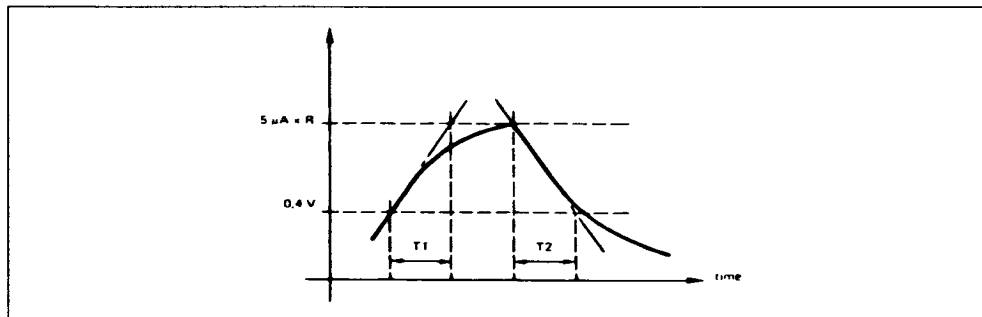
#### PIN 3 : AUTOMATIC GAIN CONTROL FILTER

The antidistortion system response is adjusted by the R-C network on this pin.

The AGC will be switched ON when the level on pin 3 is greater than the reference voltage (0.4V), the RC-network charges (current source ON) or discharges (current source OFF) according to the supply voltage.

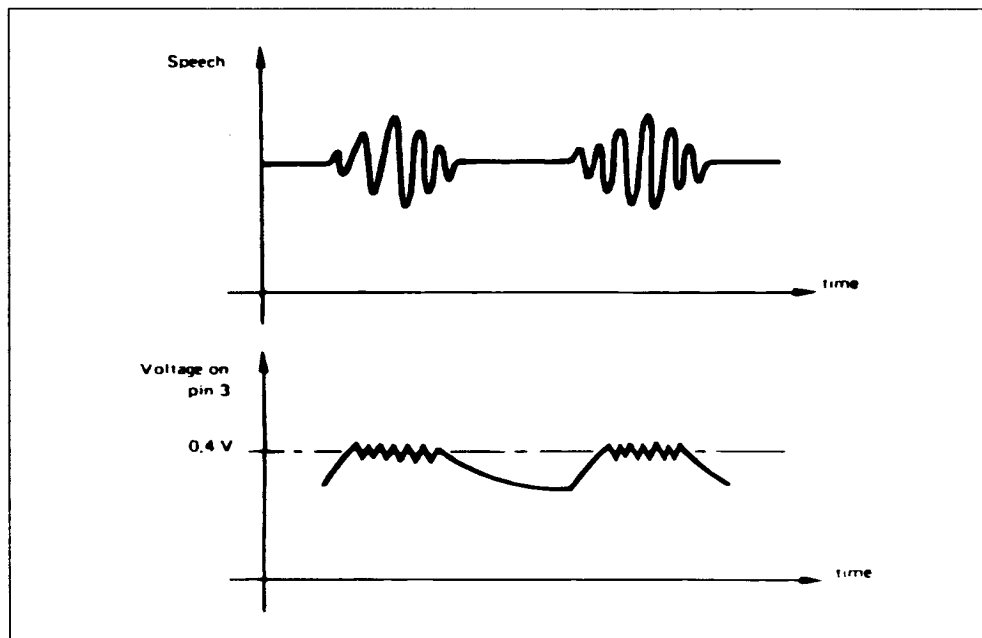
## THEORETICAL VOLTAGE ON PIN 3

Figure 18.



- The value of  $R$  affects the system time constant and the charge/discharge duty cycle.
- $R$  should be greater or equal than  $150\text{k}\Omega$  for correct AGC operation.
- The value of  $C$  only affects the system time constant.

Figure 19.



## PIN 4 : CIRCUIT SUPPLY VOLTAGE

With pin 1 open circuit, VLS is internally stabilized at 2.8V.

When the TEA7531 is under AGC control, the voltage on this pin varies slightly (due to AGC action).

### PIN 5/6 : MICROPHONE INPUTS

These are used for antilarсен control.

### PIN 7 : ANTILARSEN FILTER 1

The second filter of the antilarсен system (1 st filter : pins 5-6) is formed by the RC network R5C5. In order to obtain a second order filter for the antilarсен system, the cut-off frequency defined at this pin, should be the same as that chosen for the first filter.

For correct TEA7531 operation R6 and R5 should be fixed at 10k $\Omega$  and 1k $\Omega$  respectively.

### PIN 8 : ANTILARSEN FILTER 2

The gain and the response of the antilarсен system can be adjusted respectively by the resistor and the capacitor on this pin, according to the acoustic characteristics of the telephone set.

The value of the resistor should not exceed 390k $\Omega$ . When the voltage on this pin exceeds the threshold voltage of 0.4V, the AGC system is enabled.

### PIN 9 : EARPHONE INPUT

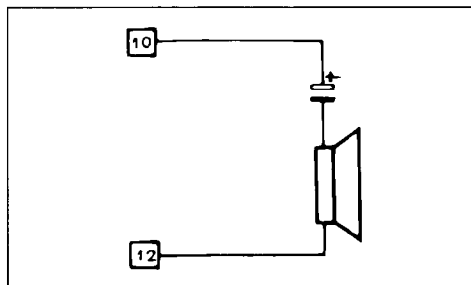
Input for loudspeaker signal.

### PIN 10-12 : LOUDSPEAKER OUTPUTS

Maximum output voltage :  $V_{pp} = 2 V_{LS} - 2.5V$  (with a gain of 32dB).

Maximum output current : depending of the supply current.

Figure 20.



Two loudspeaker connection methods are possible, using the amplifier in either "H" mode or "B" mode.

**Note :** It is advisable to connect a 47nF capacitor in parallel with the loudspeaker (between pins 10 and 12).

#### - "H" Mode

This is for low voltage working, but at a higher supply current. The highest output power is available in this mode, due to the 5.5V maximum supply voltage restriction, imposed by the TEA7531.

Loudspeaker impedance recommended value : 50 $\Omega$ .

Maximum gain available between earphone input and loudspeaker output : 32dB.

#### - "B" Mode

This allows higher voltage operation, but at a lower supply current.

Loudspeaker impedance recommended value : 25 $\Omega$ .

Maximum gain available between earphone input and loudspeaker output :  $32 - 6 = 26dB$ .

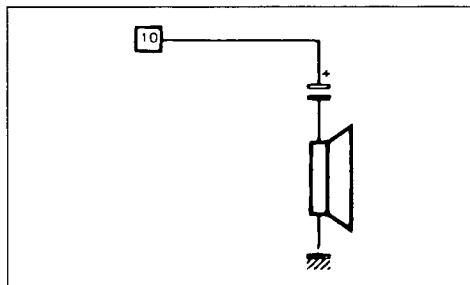
### PIN 11 : Vref : INTERNAL REFERENCE

Output which provides an internally regulated reference voltage.

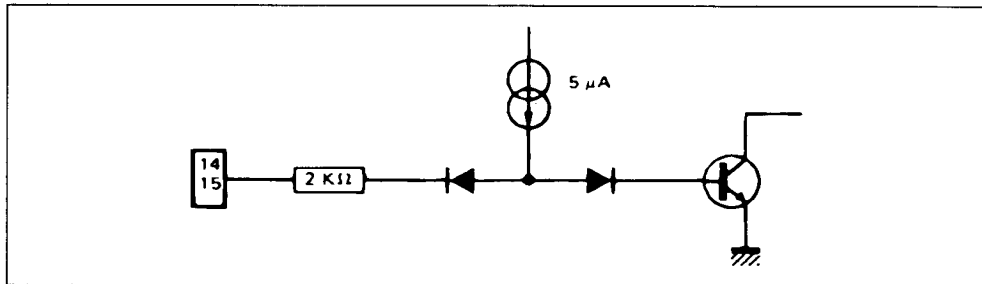
$V_{ref} = 1.1V$  typical

MAXIMUM AVAILABLE CURRENT : 5 $\mu A$ .

Figure 21.





**PIN 14-15 : GAIN ADJUSTMENT INPUTS****Figure 22.****PIN 16 : LOUDSPEAKER MUTING.**

PG0	PG1	
1	1	Gmax
1	0	Gmax - 6dB
0	1	Gmax - 12dB
0	0	Gmax - 18dB

These pins are used to adjust the loudspeaker.

Pin open circuit : high level = loudspeaker muted.

Pin low level : loudspeaker enabled.

See connection of Pins 14 and 15.