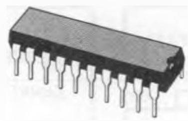
SGS-THOMSON
MICROELECTRONICS

TEA7053

SPEECH CIRCUIT

- 2/4 WIRES INTERFACE WITH
  - DOUBLE ANTISIDETONE NETWORK
  - RX GAIN AND AC IMPEDANCE EXTERNALLY PROGRAMMABLE
- DTMF INTERFACE
- PULSE DIAL INTERFACE
- 3.25 VOLTS SUPPLY FOR MICROPROCESSOR OR DIALER
- DC CHARACTERISTIC AND ON/OFF HOOK FOR FRANCE
- CONTROL AGAINST HIGH VOLTAGE TRANSIENTS



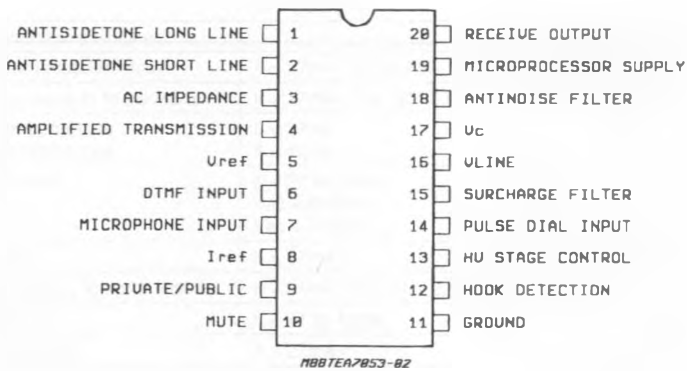
DIP20

ORDER CODE : TEA7053DP

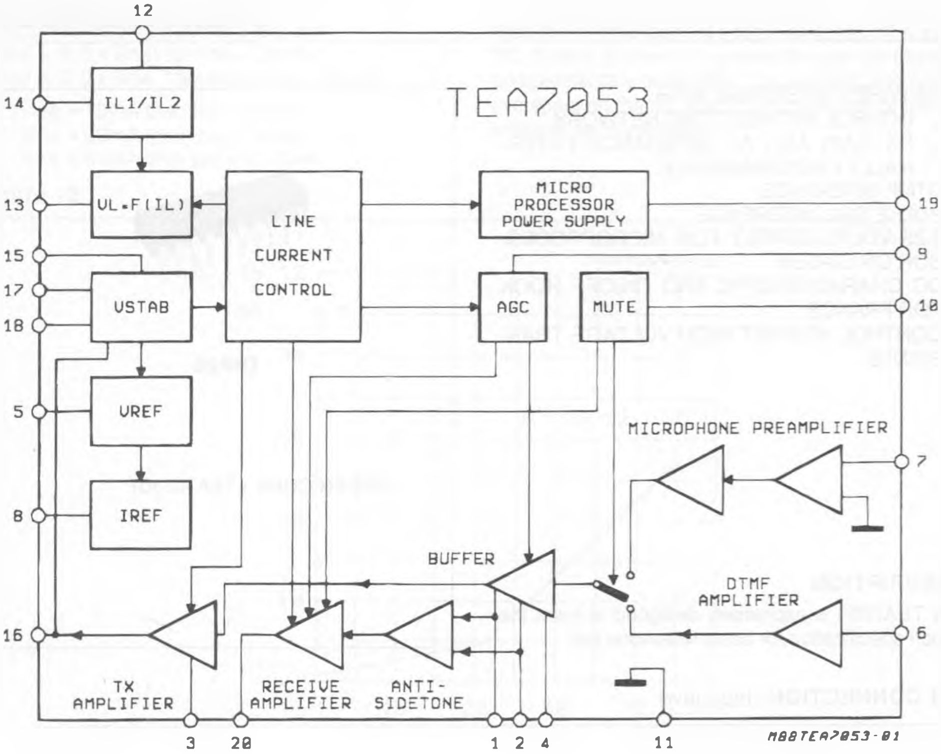
DESCRIPTION

The TEA7053 is expressely designed to meet the french specification for basic telephone set.

PIN CONNECTION (top view)



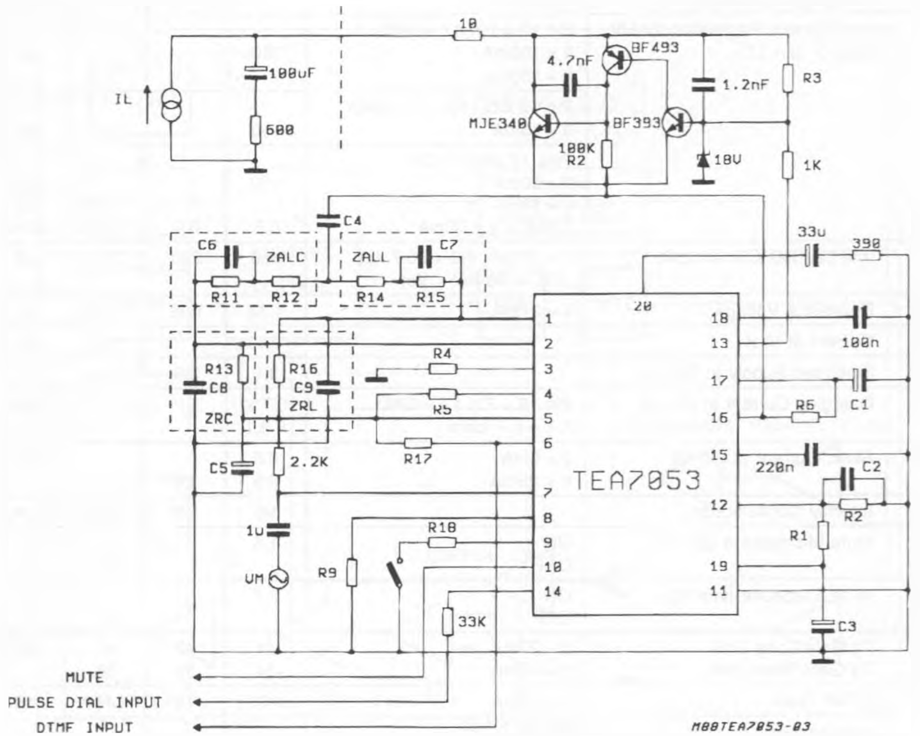
BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
Vc	Stabilized Voltage (pin 17)	Il = 27mA	2.35	2.6	2.85	V
Idem	Charging Current (pin 17)	Il = 27mA		2.6		mA
Ir	Line Current Regulation for HV Control (pin 17)	Pin 12 = Pin 17 = GND Il = 150mA Il = 100mA	 150 		 5	 µA
		Pin 12 ON ; Pin 17 = GND Il = 75mA	 150			 µA
   Ir/Il		Pins 12 and 17 ON Il = 60mA Il = 16mA 27mA < Il < 50mA	 150 0.8	 0.9	 100 1.0	 µA nA µA/mA
Iint	Internal Bias Current (pin 17)	Il = 27mA ; R9 = 26.7 KΩ ; (V16 = R6·Iint + Vc)	250	280	310	µA
Vref	Reference Voltage	Il = 27mA	1.32	1.38	1.47	V
Iref	Current at Vref		– 10		100	µA
Vmp	Stabilized Supply at Pin 19		3.1	3.3		V
Icmp	Charging Current at Pin 19	Pin 12 = Pin 17 = GND IL1 = Il – Idem	0.7 x x IL1			mA
Ispm	Static Current at Pin 19	Il = 6mA Il > 25mA	0.5 2.5	 2.8		mA
Iimp	Internal Consumption		90	120	160	µA
Vmh Vmb	Mute Microphone (pin 10)	ON OFF	1.6 		 0.8	V V
Vmh Vmb	Mute Earphone (pin 10)	ON OFF	2.7 		 2.1	V V
Gel Gec	Tx Gain Long Line Tx Gain Short Line	Il = 27mA Il = 42mA	41 34	42 36	43 38	dB
Gmf	DTMF Gain	Il = 27mA Pin 10 > 1.6V	41	42	43	dB
De	Tx Distortion	Il = 27 to 42mA Vl = 0dBm Vl = 3dBm			 3 10	 % %
Ze	Microphone Impedance		20			Kohm
Bep	Tx Noise (psophometric)	Il > 27mA ; 2K at Pins 5-7		– 713		dBmp
Re	Tx Attenuation in Mute Mode	Il = 27mA ; Pin 10 > 1.6V	60			dB
Grl Grc	Rx Gain Long Line Rx Gain Short Line	Il = 27mA Il = 42mA	29 22	30 24	31 26	dB
Dr	Rx Distortion	Il = 27 to 42mA Vec = 500mV Vec = 700mV			 3 10	 % %
Brp	Rx Noise	Il > 27mA		– 74		dBmp
Rc	Rx Attenuation in Mute Mode	Il = 27mA ; Pin 10 > 2.7V	60			dB
Gal	Antisidetone	Il = 27 to 42mA	– 22			dB
Zac	AC Impedance	Il > 27mA	500	650	800	Ω
Grs	Confidence Level V_{LINE} / V_{REC} (DTMF)	Pin 10 > 2.7V	35.5	38.5	41.5	dB

Figure 1 : Test Circuit.



R1 = 820KΩ	R12 = 0Ω	C1 = 100μF	C6 = 27pF
R2 = 820KΩ	R13 = 2.7KΩ	C2 = 4.7μF	C7 = 27pF
R3 = 1.5MΩ	R14 = 0Ω	C3 = 10μF	C8 = 2.2nF
R4 = 75Ω	R15 = 140KΩ	C4 = 1μF	C9 = 2.2nF
R5 = 5.1KΩ	R16 = 2.7KΩ	C5 = 100μF	C11 = 220μF
R8 = 13KΩ	R17 = 1.2 KΩ		
R9 = 26.7KΩ	R18 = 680KΩ for private complex		
R11 = 140KΩ			

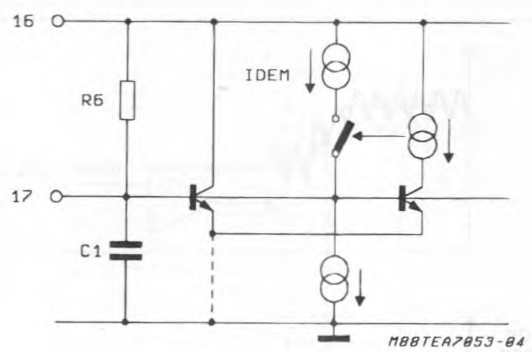
SGS-THOMSON MICROELECTRONICS

CIRCUIT DESCRIPTION

1. DC-Characteristics

1.1. VC (pin 17). The stabilized voltage Vc is connected to Vline (pin 16) through an internal shunt regulator which presents to the line a high AC impedance at frequencies higher than 200Hz. At this purpose the value of C1 (at pin 17) must be not lower than 47 microFarad.

Figure 2.



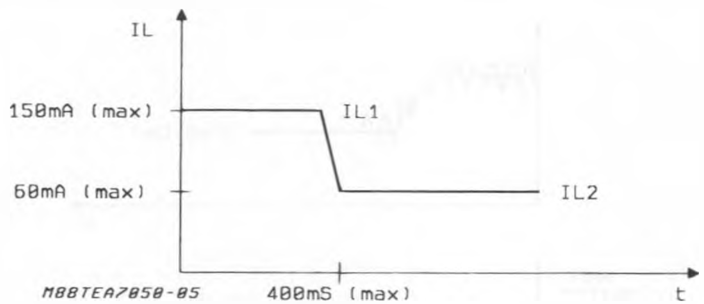
At "Off-hook", with only DC voltage applied to the line terminals, C1 fixes the timing of the line current profile at :

- - 150mA max for a time shorter than 400msec (T-charge)
- - 60mA max in steady state (conversation)

T-charge of 240msec (typ) is obtained with C1=220µF

$$\text{T-charge} = \frac{\text{Vc x C1}}{\text{Idem}} \text{ typically.}$$

Figure 3.



1.2. HOOK DETECTION (in ring mode) (pin 12). The DC-characteristic requested to allow off-hook detection by the exchange during ring call may be accomplished :

a) through an analog control (R-C) or

b) by a microprocessor.

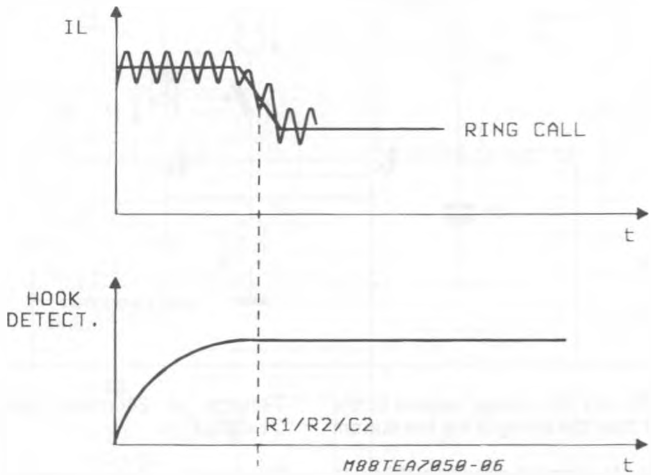
a) Application with standard dialer (analog control)

The components R1, R2 and C2 define the timing of the DC characteristic and also limit at 75mA-peak the line current during decadic dialing.

Optimum values are : - R1 x C2 = 1.8sec ; R2 x C2 = 0.8sec.

To reduce the minimum time between a "on-hook / off-hook" sequence, R2 may be replaced by a switch to ground.

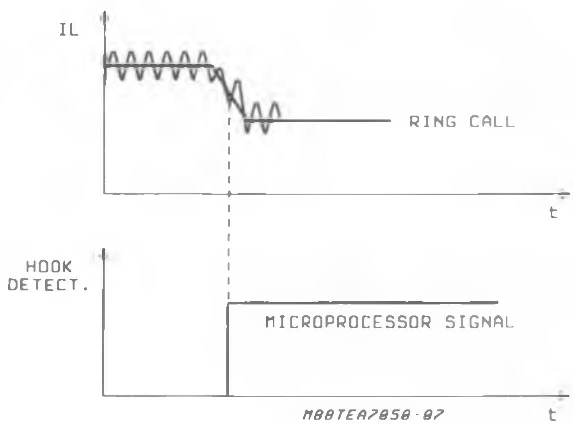
Figure 4.



b) Application with a microprocessor

Pin 12 may be controlled directly by the micro-controller, through a resistor R1b which replaces R1, R2 and C2.

Figure 5.



1.3. V_{LINE} (pin 16). The line voltage (pin 16) is determined by the value of the external resistor R6 and by the internal current, Iint, flowing between Vc (pin 17) and Ground (see also parag. 1.1.) :

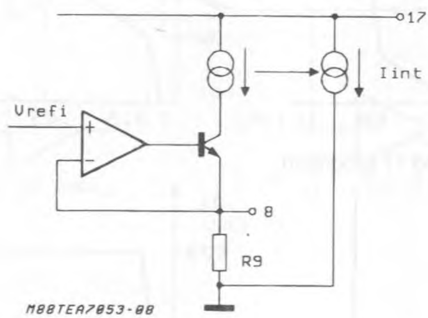
$$V_{LINE} = Vc + R6 * Iint.$$

Vc is fixed by design at about 2.6 volts.

Iint is reversely related to R9 (Iint = 7.5V/R9 at I_{LINE} = 27mA).

V_{LINE} must be externally adjusted (with R6) to guarantee both DC and AC characteristic in accordance to the french standards. At this purpose it is suggested that Vline equals 5.6 volts at Iline = 16mA. This typical value is obtained with R6 = 13Kohm.

Figure 6.



1.4. HIGH VOLTAGE CONTROL STAGE (pin 13). The behaviour of "HV control" is determined by several conditions, both internal (Iline sensor) and external (pins 12 and 17) with the purpose to accomplish the different DC characteristics and transitory conditions imposed by the French specification :

a) steady DC-characteristic and lightnings (pins 12 and 17 0N)

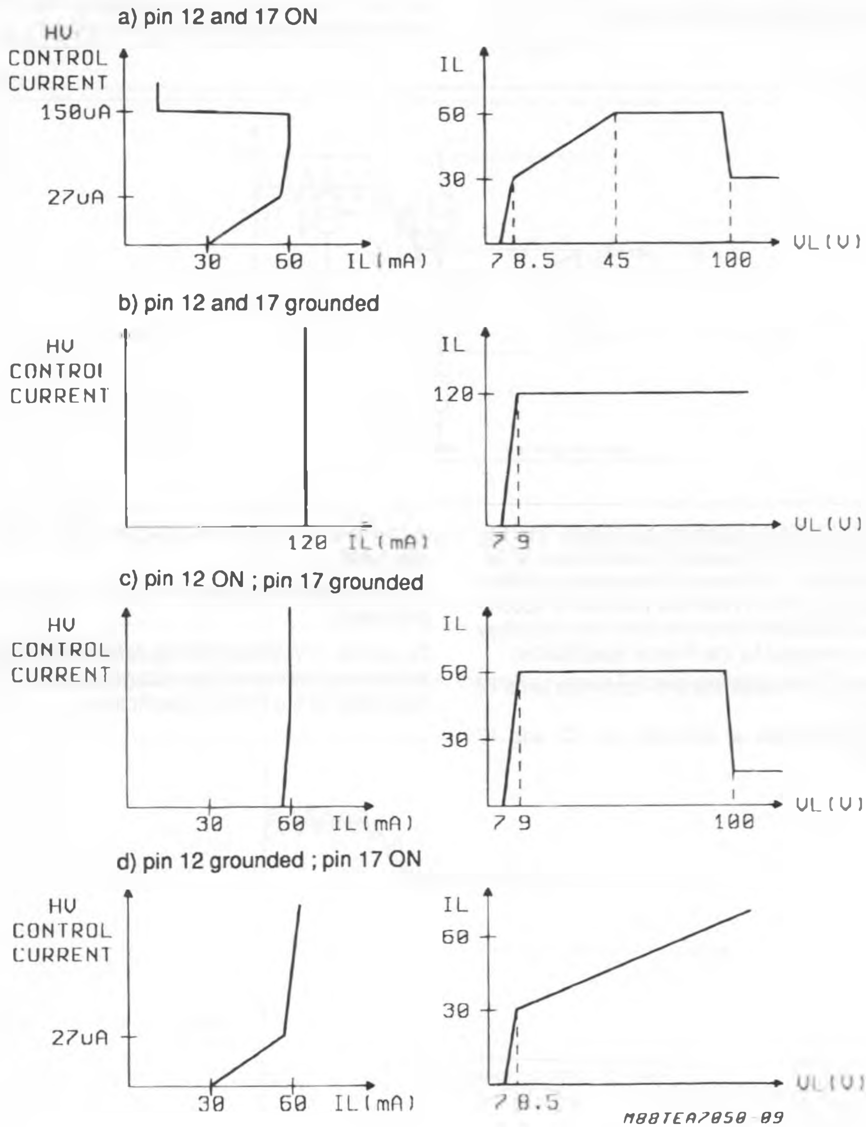
b) DC-characteristic at off-hook (pin 12 and 17 grounded)

c) DC-characteristic during decadic dialing (pin 17 grounded)

d) DC-characteristic after off-hook in ringing (pin 12 grounded)

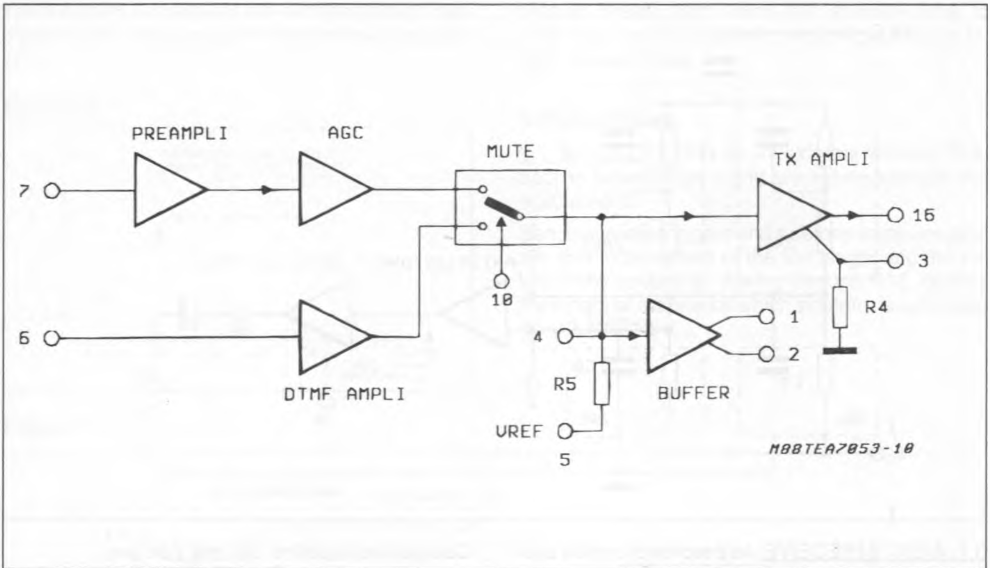
To do that, HV control pin regulates the current injected into the external high voltage transistor stage, requested by the French specification.

Figure 7.


a) pin 12 and 17 ON
HV
CONTROL
CURRENT
150uA
27uA
30
60
IL(mA)
IL
60
30
VL(V)
7
8.5
45
100
b) pin 12 and 17 grounded
HV
CONTROL
CURRENT
120
IL(mA)
IL
120
VL(V)
7
9
c) pin 12 ON ; pin 17 grounded
HV
CONTROL
CURRENT
30
60
IL(mA)
IL
60
30
VL(V)
7
9
100
d) pin 12 grounded ; pin 17 ON
HV
CONTROL
CURRENT
27uA
30
60
IL(mA)
IL
60
30
VL(V)
7
8.5
M88TEA7050-09

2. Transmission Chain

Figure 8 .



2.1. A.G.C. IN TRANSMISSION. The transmission gain between Microphone Input (pin 7) and Vline (pin 16) is internally decreased of 6dB when the line current varies from 27mA to 42mA with a constant AC load of 600ohms.

2.2. SENDING IMPEDANCE. The impedance of the Output Stage Amplifier, Zout, is determined by the impedance Z4 at pin 3.

Zout = 10.65 x Z4.

The total AC impedance shown to the line is the parallel

Zpar = Zout//Zint//Zext

where :

- Zint = 10kohm // 8.5nF (internal)
- Zext = R6 // C4 (at pin 16)

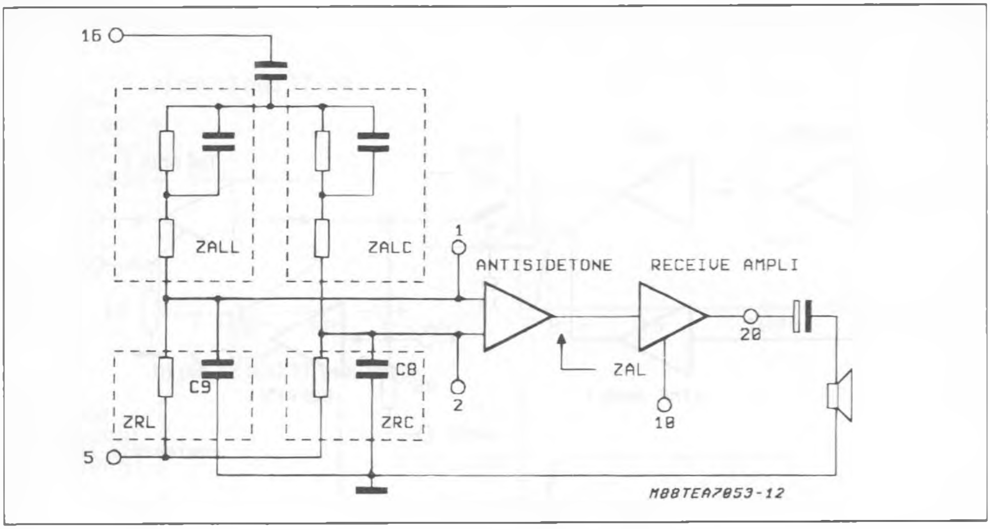
2.3. SENDING MUTE. In normal speech operation (Vmute at pin 10 0.8V), the signal at Microphone Input (pin 7) is amplified to Vline (pin 16) with the gains Gec (short line), Gel (long line) or intermediate, depending on Iline.

In sending mute condition (Vmute 1.6V) these gains are reduced of at least 60dB. In the same condition DTMF input (pin 6) is activated, with gain Gmf to the line independent from Iline.

2.4. ANTISIDETONE BUFFER. The signal coming from the sending preamplifier is internally presented at pin 4 and than buffered to pins 1 and 2 for sidetone cancellation (see paragraph 3.2.).

3. Receive Chain

Figure 9.



3.1. A.G.C. IN RECEIVE. As described for the transmission chain, also the receiving gains Gr, from pins 1 and 2 to pin 20, have a reduction of 6dB when Iline moves from 27mA to 42mA.

3.2. SIDETONE COMPENSATION. The circuit is provided with a double anti-sidetone network to optimize sidetone both at long and short lines.

Before entering pins 1 and 2, the received signal is attenuated by two attenuating networks :

Zall / Zrl to pin 1 for long lines sidetone compensation,
Zalc / Zrc to pin 2 for short lines sidetone compensation.
Zrl and Zrc define the total receive gains :

a) $\frac{V\ 20}{V\ 16} = Grl \times \frac{Zrl}{Zrl + Zall}$ for long lines

b) $\frac{V\ 20}{V\ 16} = Grc \times \frac{Zrc}{Zrc + Zalc}$ for short lines

Zall and Zalc define the sidetone compensation of the circuit.
The equivalent balancing impedance is given by the formula :

$$Zal = K * Zalc + (1-K) * Zall$$

where :

- K = 0 at Iline = 27mA or lower (long line)
- K varies from 0 to 1 with Iline between 27mA and 42mA,
- K = 1 at Iline = 42mA or higher (short line).

Calculations to define Zall and Zalc are :

a) $Zall = 70 \times R5 \times \frac{Zline(long) // Zext // Zint // Zout}{Zout}$

b) $Zalc = 70 \times R5 \times \frac{Zline(short) // Zext // Zint // Zout}{Zout}$

where :

- Zext = R6 // C4 // (Zelectret) (at pin 16)
- Zint = 10Kohms // 8.5nF (internal impedance)
- Zout = 10.65 * Z4 (at pin 3 ; see paragr. 2.2.)
- Zline (short) and (long) are the impedances of the line at 0Km and 3.5 Km.
- R5 = 5.1 Kohm ± 1 %

3.3. AC IMPEDANCE. The total AC impedance of the circuit to the line is :

Zpar = Zout//Zint//Zext//Zalc//Zall (see par. 2.2. and 3.2.)
= Zout//Zint//Zext (Zalc, Zall >> Zpar)

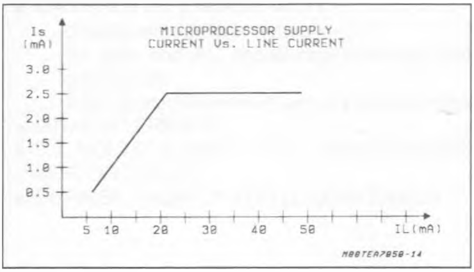
3.4. RECEIVE MUTE (AND CONFIDENCE LEVEL). When the receive channel is muted (Vmute at pin 10 2.7V) the receive gain is reduced of 60dB minimum.

In this condition an internal connection is activated from line DTMF output (pin 16) to Receive Output (pin 20) with a gain Gmf = 38.5dB to provide acoustic feedback of the DTMF transmission.

4. Microprocessor Interface

4.1. MICROPROCESSOR SUPPLY (PIN 19). At "off-hook" the first priority of the circuit is to make some current available at the Microprocessor Supply (pin 19) to charge quickly the external capacitor C3.

Figure 10.



This charging current is : Icpm = 0.7 * (Iline - Idem), where Idem = 2.6mA is the current charging C1.

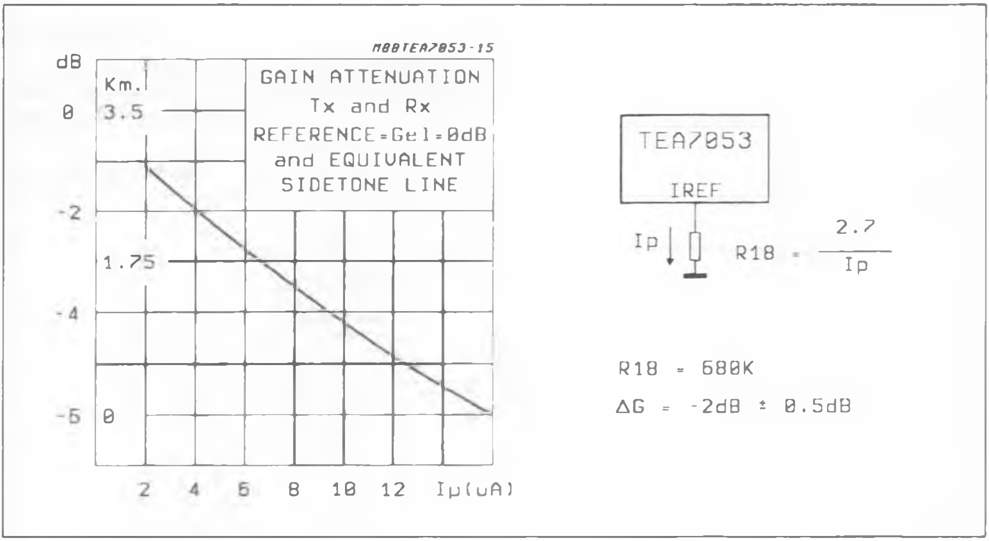
Vmp = 3.25V in normal operation and current increases linearly from 0.5mA min, at Iline = 6mA, to 2.5mA min, at Iline = 27mA, remaining stable for higher values of Iline.

5. Public/Private

5.1. A.G.C. OFF (PIN 9). An external resistor, R18, applied between pin 9 and ground disconnects the AGC control.

Sending, receiving gain and sidetone compensation are now independent of the line lenght and the value of the current Ip, flowing through R18, defines the lenght of the line for which sidetone is optimized (Ip = 2.7V/R18).

Figure 11.



5.2. SECRET FUNCTION (PIN 10). The Mute pin allows "Secret Function" (only microphone muted), when the circuit is used for private market.

As the control of sending and receiving must have different threshold levels, it can be operated with a three levels logic :

a) Vm = 0V speech mode ;
b) Vm = 1.8V microphone muted ;
c) Vm = 3.0V all speech muted.