



## TEA1062N/TEA1062AN

## LINEAR INTEGRATED CIRCUIT

### LOW VOLTAGE TELEPHONE TRANSMISSION CIRCUIT WITH DIALLER INTERFACE

#### DESCRIPTION

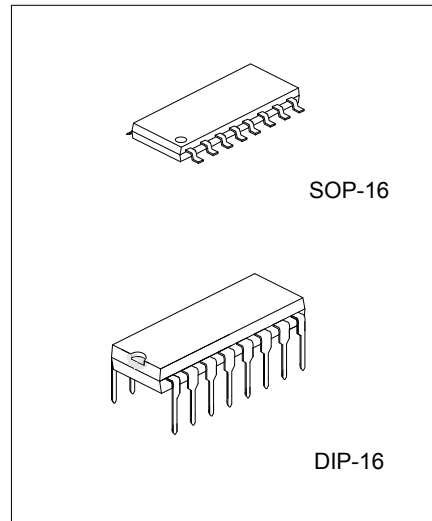
The UTC **TEA1062N/TEA1062AN** is a bipolar integrated circuit performing all speech and line interface function, required in the fully electronic telephone sets. It performs electronic switching between dialing speech. The circuit is able to operate down to D.C. line voltage of 1.6V (with reduced performance) to facilitate the use of more telephone sets in parallel.

#### FEATURES

- \* Low d.c. line voltage; operates down to 1.6V (excluding polarity guard).
- \* Voltage regulator with adjustment static resistance.
- \* Provides supply with limited current for external circuitry.
- \* Symmetrical high-impedance inputs (64kΩ) for dynamic, magnetic or piezoelectric microphones.
- \* Asymmetrical high-impedance inputs (32kΩ) for electrets microphones.
- \* DTMF signal input with confidence tone.
- \* Mute input for pulse or DTMF dialing.
- \* Receiving amplifier for several types of earphones.
- \* Large amplification setting range on microphone and earpiece amplifiers.
- \* Line loss compensation facility, line current dependant (microphone and earpiece amplifiers).
- \* Gain control adaptable to exchange supply.
- \* Possibility to adjust the d.c. line voltage

#### ORDERING INFORMATION

Order Number			Package	Packing
Normal	Lead Free	Halogen Free		
TEA1062N-D16-T	TEA1062NL-D16-T	TEA1062NG-D16-T	DIP-16	Tube
TEA1062N-S16-R	TEA1062NL-S16-R	TEA1062NG-S16-R	SOP-16	Tape Reel
TEA1062AN-D16-T	TEA1062ANL-D16-T	TEA1062ANG-D16-T	DIP-16	Tube
TEA1062AN-S16-R	TEA1062ANL-S16-R	TEA1062ANG-S16-R	SOP-16	Tape Reel



Lead-free:  
TEN1062NL/TEN1062ANL  
Halogen-free:  
TEN1062NG/TEN1062ANG

<p>TEA1062NL-D16-T</p>	<p>(1) Packing Type (2) Package Type (3) Lead Plating</p>	<p>(1) R: Tape Reel, T: Tube (2) D16: DIP-16, S16: SOP-16 (3) G: Halogen Free, L: Lead Free, Blank: Pb/Sn</p>
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### ■ PIN CONFIGURATIONS

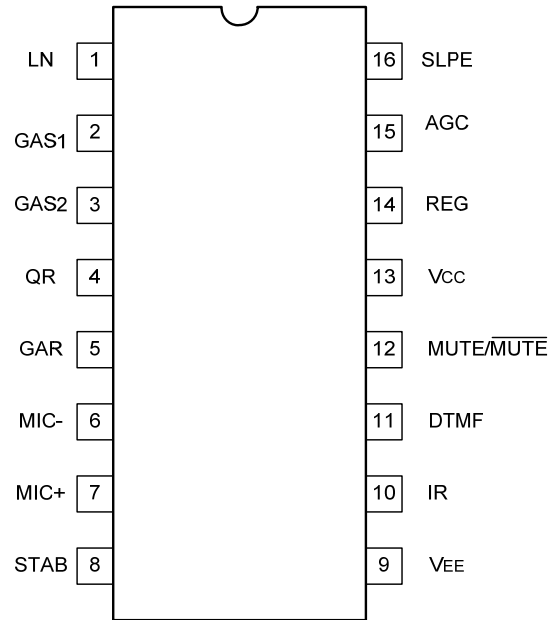


Fig. 1 Pin Configurations

### ■ PIN DESCRIPTIONS

PIN NO	PIN NAME	I/O	DESCRIPTION
1	LN	I	Positive line terminal
2	GAS1	I	Gain adjustment; transmitting amplifier
3	GAS2	I	Gain adjustment; transmitting amplifier
4	QR	O	Non-inverting output, receiving amplifier
5	GAR	I	Gain adjustment; receiving amplifier
6	MIC-	I	Inverting microphone input
7	MIC+	I	On-inverting microphone input
8	STAB	I	Current stabilizer
9	V <sub>EE</sub>		Negative line terminal
10	IR	I	Receiving amplifier input
11	DTMF	I	Dual-tone multi-frequency input
12	MUTE/MUTE	I	Mute input; TEA1062N high activated TEA1062AN low activated
13	V <sub>CC</sub>		Positive supply decoupling
14	REG	I	Voltage regulator decoupling
15	AGC	I	Automatic gain control input
16	SLPE	I	Slope (DC resistance) adjustment

■ BLOCK DIAGRAM

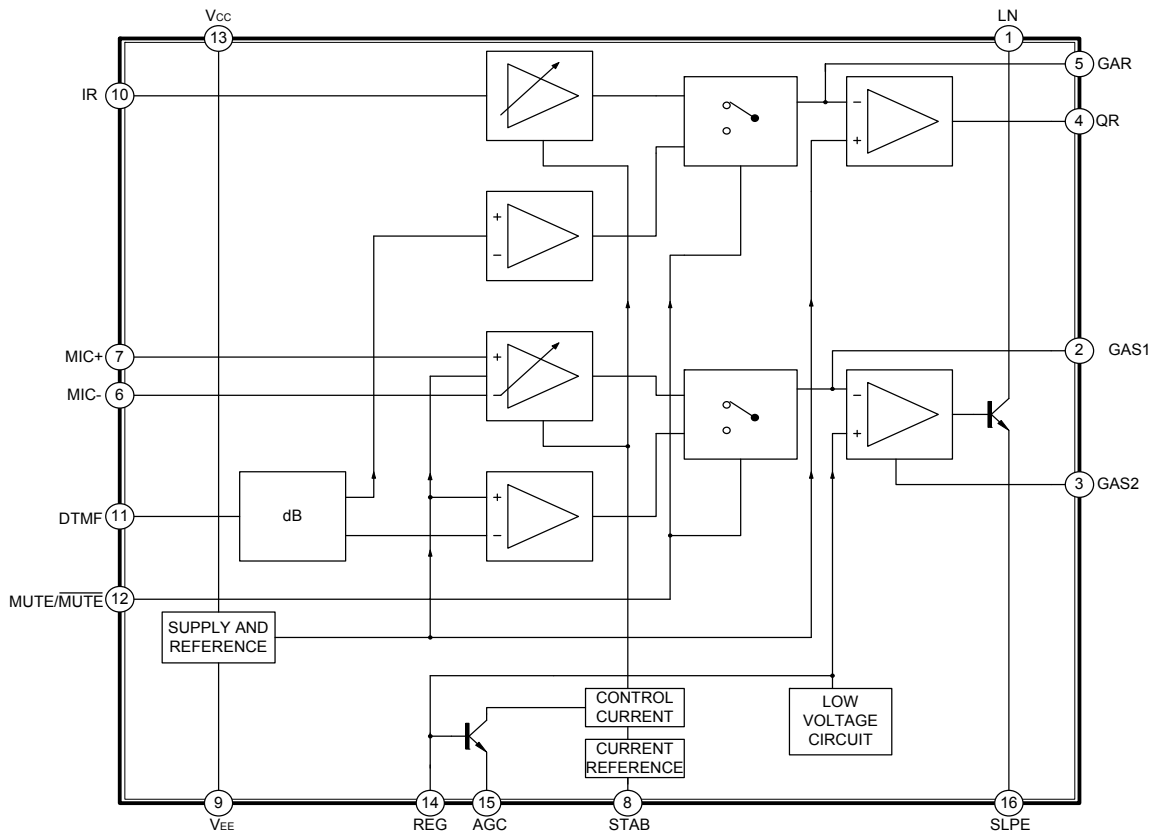


Fig. 2 Block Diagram

### ■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNIT
Positive Continuous Line Voltage	$V_{LN}$	12	V
Repetitive Line Voltage During Switch-On Or Line Interruption	$V_{LN(RL)}$	13.2	V
Repetitive Peak Line Voltage for a 1 ms Pulse/5s(R10=13 $\Omega$ , R9=20 $\Omega$ (see Fig.15))	$V_{LN(RPL)}$	28	V
Line Current (Note1) (R9=20 $\Omega$ )	$I_{LINE}$	140	mA
Voltage on All Other Pins	$V_{I(+)}$	$V_{CC}+0.7$	V
	$V_{I(-)}$	-0.7	V
Total Power Dissipation (Note2) (R9=20 $\Omega$ )	$P_D$	640	mW
Junction Temperature	$T_J$	+125	$^{\circ}C$
Operating Ambient Temperature Range	$T_{OPR}$	-25 ~ +75	$^{\circ}C$
Storage Temperature Range	$T_{STG}$	-40 ~ +125	$^{\circ}C$

Note: 1. Mostly dependent on the maximum required  $T_a$  and the voltage between LN and SLPE (see Figs 6 ).

2. Calculated for the maximum ambient temperature specified  $T_a=75^{\circ}C$  and a maximum junction temperature of  $125^{\circ}C$ .

3. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

### ■ THERMAL DATA

PARAMETER	SYMBOL	RATING	UNIT
Thermal Resistance From Junction to Ambient in Free Air	$\theta_{JA}$	75	$^{\circ}C/W$

■ ELECTRICAL CHARACTERISTICS ( $I_{LINE}=11\sim 140mA$ ;  $V_{EE}=0V$ ;  $f=800Hz$ ;  $T_a=25^{\circ}C$ ; unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
<b>SUPPLY; LN AND VCC(PINS 1 AND 13)</b>							
Voltage Drop Over Circuit, Between LN and $V_{EE}$	$V_{LN}$	MIC inputs open	$I_{LINE}=1mA$		1.6		V
			$I_{LINE}=4mA$		1.9		V
			$I_{LINE}=15mA$	3.55	4.0	4.25	V
			$I_{LINE}=100mA$	4.9	5.7	6.5	V
			$I_{LINE}=140mA$			7.5	V
Variation with Temperature	$\Delta V_{LN}/\Delta T$	$I_{LINE}=15mA$		-0.3		mV/K	
Voltage Drop Over Circuit, Between LN and $V_{EE}$ with External Resistor $R_{VA}$		$I_{LINE}=15mA$ , $R_{VA}(LN \text{ to } REG)=68k\Omega$		3.5		V	
		$I_{LINE}=15mA$ , $R_{VA}(REG \text{ to } SLPE)=39k\Omega$		4.5		V	
Supply Current	$I_{CC}$	$V_{CC}=2.8V$		0.9	1.35	mA	
Supply Voltage Available for Peripheral Circuitry	TEA1062N	$V_{CC}$	$I_{LINE}=15mA$	$I_p=1.2mA$ ; MUTE=HIGH	2.2	2.7	V
				$I_p=0mA$ ; MUTE=HIGH		3.4	V
	TEA1062AN	$V_{CC}$	$I_{LINE}=15mA$	$I_p=1.2mA$ ; MUTE=LOW	2.2	2.7	V
				$I_p=0mA$ ; MUTE=LOW		3.4	V
<b>MICROPHONE INPUTS MIC+ AND MIC- (PINS 6 AND 7)</b>							
Input impedance (differential) Between MIC- and MIC+	$ Z_i $			64		k $\Omega$	
Input impedance (sigle-ended) MIC- or MIC+ to $V_{EE}$				32		k $\Omega$	
Common Mode Rejection Ratio	CMRR			82		dB	
Voltage Gain MIC+ or MIC- to LN	$G_v$	$I_{LINE}=15mA$ , $R_7=68k\Omega$	50.5	52.0	53.5	dB	
Gain Variation with Frequency at $f=300Hz$ and $f=3400Hz$	$\Delta G_{vf}$	w.r.t.800Hz		$\pm 0.2$		dB	
Gain Variation with Temperature at $-25^{\circ}C$ and $+75^{\circ}C$	$\Delta G_{vT}$	w.r.t. $25^{\circ}C$ , without R6; $I_{LINE}=50mA$		$\pm 0.2$		dB	

## ■ ELECTRICAL CHARACTERISTICS(Cont.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
<b>DUAL-TONE MULTI-FREQUENCY INPUT DTMF (PIN 11)</b>							
Input Impedance	Zi			20.7		kΩ	
Voltage Gain From DTMF to LN	Gv	I <sub>LINE</sub> =15mA, R7=68kΩ	24	25.5	27	dB	
Gain Variation With Frequency at f=300Hz and f=3400Hz	ΔGvf	w.r.t.800Hz		±0.2		dB	
Gain Variation With Temperature at -25°C and +75°C	ΔGvT	w.r.t.25°C, I <sub>LINE</sub> =50mA		±0.2		dB	
<b>GAIN ADJUSTMENT GAS1 AND GAS2 (PINS 2 AND 3)</b>							
Gain Variation Of The Ransmitting Amplifier By Varying R7 Between GAS1 And GAS2	ΔGv		-8		0	dB	
Sending Amplifier Output LN (pin 1) Output Voltage	V <sub>LN(rms)</sub>	I <sub>LINE</sub> =15mA, THD=10%	1.7	2.3		V	
		I <sub>LINE</sub> =4mA, THD=10%		0.8		V	
Noise Output Voltage	V <sub>NO(rms)</sub>	I <sub>LINE</sub> =15mA; R7=68kΩ; 200Ω between MIC- and MIC+; psophometrically weighted		-69		dBmp	
<b>RECEIVING AMPLIFIER INPUT IR (PIN 10)</b>							
Input Impedance	Zi			21		kΩ	
<b>RECEIVING AMPLIFIER OUTPUT QR (PIN 4)</b>							
Output Impedance	Zo	I <sub>LINE</sub> =15mA; RL(from pin 9 to pin 4 )=300Ω		4		Ω	
Voltage Gain From IR To QR	Gv		29.5	31	32.5	dB	
Gain Variation With Frequency at f=300Hz and f=3400Hz	ΔGvf	w.r.t.800Hz		±0.2		dB	
Gain Variation With Temperature at -25°C and +75°C	ΔGvT	w.r.t.25°C without R6 I <sub>LINE</sub> =50mA		±0.2		dB	
Output Voltage	THD=2%	V <sub>O(rms)</sub>	sinwave drive, Ip=0mA, R4=100kΩ; I <sub>LINE</sub> =15mA	RL=150Ω	0.22	0.33	V
				RL=450Ω	0.3	0.48	V
		THD=10%		R4=100kΩ I <sub>LINE</sub> =4mA	RL=150Ω		15
Noise Output Voltage	V <sub>NO(rms)</sub>	I <sub>LINE</sub> =15mA, R4=100kΩ, IR open – circuit psophometrically weighted RL=300Ω		50		μV	
<b>GAIN ADJUSTMENT GAR (PIN 5)</b>							
Gain Variation Of Receiving Amplifier Achievable By Varying R4 Between GAR And QR	ΔGv		-11		0	dB	
<b>MUTE INPUT (PIN 12)</b>							
Input Voltage(HIGH)	V <sub>IH</sub>		1.5		V <sub>CC</sub>	V	
Input Voltage(LOW)	V <sub>IL</sub>				0.3	V	
Input Current	I <sub>MUTE</sub>			8	15	μA	
<b>REDUCTION OF GAIN</b>							
MIC+ Or MIC- To LN	TEA1062N	ΔGv	MUTE=HIGH		70	dB	
	TEA1062AN		MUTE=LOW				
Voltage Gain From DTMF To QR	Gv	R4=100kΩ, RL=300Ω		-19		dB	

■ ELECTRICAL CHARACTERISTICS(Cont.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>AUTOMATIC GAIN CONTROL INPUT AGC ( PIN 15)</b>						
Controlling The Gain From IR To QR And The Gain From MIC+/MIC- to LN; R6 Between AGC And V <sub>EE</sub> Gain Control Range	$\Delta G_V$	R6=110k $\Omega$ , I <sub>LINE</sub> =70mA		-5.8		dB
Highest Line Current For Maximum Gain	I <sub>LINE</sub>			23		mA
Lowest Line Current For Minimum Gain				61		mA

## ■ FUNCTIONAL DESCRIPTION

### Supply: V<sub>CC</sub>, LN, SLPE, REG and STAB

Power for the UTC TEA1062N/TEA1062AN and its peripheral circuits is usually obtained from the telephone line. The IC supply voltage is derived from the line via a dropping resistor and regulated by the UTC TEA1062N/TEA1062AN. The supply voltage V<sub>CC</sub> may also be used to supply external circuits e.g. dialling and control circuits. Decoupling of the supply voltage is performed by a capacitor between V<sub>CC</sub> and V<sub>EE</sub> while the internal voltage regulator is decoupled by a capacitor between REG and V<sub>EE</sub>. The DC current drawn by the device will vary in accordance with varying values of the exchange voltage (V<sub>exch</sub>), the feeding bridge resistance (R<sub>exch</sub>) and the DC resistance of the telephone line (R<sub>LINE</sub>). The UTC TEA1062N/TEA1062AN has an internal current stabilizer operating at a level determined by a 3.6kΩ resistor connected between STAB and V<sub>EE</sub> (see Fig.8). When the line current(I<sub>LINE</sub>) is more than 0.5mA greater than the sum of the IC supply current (I<sub>CC</sub>) and the current drawn by the peripheral circuitry connected to V<sub>CC</sub>(I<sub>P</sub>) the excess current is shunted to V<sub>EE</sub> via LN. The regulated voltage on the line terminal(V<sub>LN</sub>) can be calculated as:

$$V_{LN}=V_{ref}+I_{SLPE}*R_9 \text{ or;}$$

$$V_{LN}=V_{ref}+[(I_{LINE} - I_{CC} - 0.5*10^{-3}A) - I_P]*R_9$$

where: V<sub>ref</sub> is an internally generated temperature compensated reference voltage of 3.7V and R<sub>9</sub> is an external resistor connected between SLPE and V<sub>EE</sub>. In normal use the value of R<sub>9</sub> would be 20Ω. Changing the value of R<sub>9</sub> will also affect microphone gain, DTMF gain, gain control characteristics, side tone level, maximum output swing on LN and the DC characteristics (especially at the lower voltages). Under normal conditions, when I<sub>SLPE</sub> ≅ I<sub>CC</sub>+0.5mA + I<sub>P</sub>, the static behavior of the circuit is that of a 3.7V regulator diode with an internal resistance equal to that of R<sub>9</sub>. In the audio frequency range the dynamic impedance is largely determined by R<sub>1</sub>. Fig.3 shows the equivalent impedance of the circuit.

At line currents below 9mA the internal reference voltage is automatically adjusted to a lower value(typically 1.6V at 1mA) This means that more sets can be operated in parallel with DC line voltages (excluding the polarity guard) down to an absolute minimum voltage of 1.6V. With line currents below 9mA the circuit has limited sending and receiving levels. The internal reference voltage can be adjusted by means of an external resistor(R<sub>VA</sub>). This resistor when connected between LN and REG will decrease the internal reference voltage and when connected between REG and SLPE will increase the internal reference voltage. Current(I<sub>P</sub>) available from V<sub>CC</sub> for peripheral circuits depends on the external components used. Fig.9 shows this current for V<sub>CC</sub> > 2.2V. If MUTE of TEA1062N is LOW (TEA1062AN is HIGH) when the receiving amplifier is driven the available current is further reduced. Current availability can be increased by connecting the supply IC(1081) in parallel with R<sub>1</sub>, as shown in Fig.16, or, by increasing the DC line voltage by means of an external resistor(R<sub>VA</sub>) connected between REG and SLPE.

### MICROPHONE INPUTS(MIC+ AND MIC-) AND GAIN PINS (GAS1 AND GAS2)

The UTC TEA1062N/TEA1062AN has symmetrical inputs. Its input impedance is 64kΩ (2\*32kΩ) and its voltage gain is typically 52 dB (when R<sub>7</sub>=68kΩ. see Fig.13). Dynamic, magnetic, piezoelectric or electret (with built-in FET source followers) can be used. Microphone arrangements are illustrated in Fig.10. The gain of the microphone amplifier can be adjusted between 44dB and 52dB to suit the sensitivity of the transducer in use. The gain is proportional to the value of R<sub>7</sub> which is connected between GAS1 and GAS2. Stability is ensured by the external capacitors, C<sub>6</sub> connected between GAS1 and SLPE and C<sub>8</sub> connected between GAS1 and V<sub>EE</sub>. The value of C<sub>6</sub> is 100pF but this may be increased to obtain a first-order low-pass filter. The value of C<sub>8</sub> is 10 times the value of C<sub>6</sub>. The cut-off frequency corresponds to the time constant R<sub>7</sub>\*C<sub>6</sub>.

### MUTE INPUT (MUTE/MUTE)

A LOW (UTC TEA1062N is HIGH) level at UTC TEA1062AN  $\overline{\text{MUTE}}$  enables DTMF input and inhibited the microphone inputs and the receiving amplifier inputs; a HIGH (UTC TEA1062N is LOW) level or an open circuit does the reverse. Switching the mute input will cause negligible clicks at the telephone outputs and on the line. In case the line current drops below 6mA (parallel operation of more sets) the circuit is always in speech condition independent of the DC level applied to the MUTE/MUTE input.

### DUAL-TONE MULTI-FREQUENCY INPUT (DTMF)

When the DTMF input is enabled dialling tones may be sent onto the line. The voltage gain from DTMF to LN is typically 25.5dB(when R<sub>7</sub>=68kΩ) and varies with R<sub>7</sub> in the same way as the microphone gain. The signalling tones can be heard in the earpiece at a low level (confidence tone).

## ■ FUNCTIONAL DESCRIPTION(Cont.)

### RECEIVING AMPLIFIER (IR,QR AND GAR)

The receiving amplifier has one input (IR) and a non-inverting output (QR). Earpiece arrangements are illustrated in Fig.11. The IR to QR gain is typically 31dB (when  $R_4=100k\Omega$ ). It can be adjusted between 20 and 31dB to match the sensitivity of the transducer in use. The gain is set with the value of  $R_4$  which is connected between GAR and QR. The overall receive gain, between LN and QR, is calculated by subtracting the anti-sidetone network attenuation (32dB) from the amplifier gain. Two external capacitors,  $C_4$  and  $C_7$ , ensure stability.  $C_4$  is normally 100pF and  $C_7$  is 10 times the value of  $C_4$ . The value of  $C_4$  may be increased to obtain a first-order low-pass filter. The cut-off frequency will depend on the time constant  $R_4 \cdot C_4$ . The output voltage of the receiving amplifier is specified for continuous-wave drive. The maximum output voltage will be higher under speech conditions where the peak to RMS ratio is higher.

### AUTOMATIC GAIN CONTROL INPUT (AGC)

Automatic line loss compensation is achieved by connecting a resistor( $R_6$ ) between AGC and  $V_{EE}$ . The automatic gain control varies the gain of the microphone amplifier and the receiving amplifier in accordance with the DC line current. The control range is 5.8dB which corresponds to a line length of 5km for a 0.5mm diameter twisted pair copper cable with a DC resistance of  $176\Omega/km$  and average attenuation of 1.2dB/km. Resistor  $R_6$  should be chosen in accordance with the exchange supply voltage and its feeding bridge resistance(see Fig.12 and Table 1). The ratio of start and stop currents of the AGC curve is independent of the value of  $R_6$ . If no automatic line loss compensation is required the AGC may be left open-circuit. The amplifier, in this condition, will give their maximum specified gain.

### SIDE-TONE SUPPRESSION

The anti-sidetone network,  $R_1//Z_{LINE}$ ,  $R_2$ ,  $R_3$ ,  $R_8$ ,  $R_9$  and  $Z_{BAL}$ , (see Fig.4) suppresses the transmitted signal in the earpiece. Compensation is maximum when the following conditions are fulfilled:

$$(a) R_9 \times R_2 = R_1 \times \left( R_3 + \frac{R_8 \times Z_{BAL}}{R_8 + Z_{BAL}} \right)$$

$$(b) \left[ \frac{Z_{BAL}}{Z_{BAL} + R_8} \right] = \left[ \frac{Z_{LINE}}{Z_{LINE} + R_1} \right]$$

If fixed values are chosen for  $R_1$ ,  $R_2$ ,  $R_3$  and  $R_9$  then condition(a) will always be fulfilled when  $|R_8/Z_{BAL}| \ll R_3$ . To obtain optimum side-tone suppression condition(b) has to be fulfilled which results in:

$$Z_{BAL} = (R_8/R_1) Z_{LINE} = k \cdot Z_{LINE} \text{ where } k \text{ is a scale factor;}$$

$$K = (R_8/R_1).$$

The scale factor ( $k$ ), dependent on the value of  $R_8$ , is chosen to meet following criteria:

- (a) Compatibility with a standard capacitor from the E6 or E12 range for  $Z_{BAL}$ ,
- (b)  $|Z_{BAL}/R_8| \ll R_3$  fulfilling condition (a) and thus ensuring correct anti-sidetone bridge operation,
- (c)  $|Z_{BAL} + R_8| \gg R_9$  to avoid influencing the trans-mitter gain.

In practice  $Z_{LINE}$  varies considerably with the type and length. The value chosen for  $Z_{BAL}$  should therefore be for an average line length thus giving optimum setting for short or long lines.

### EXAMPLE:

The balance impedance  $Z_{BAL}$  at which the optimum suppression is present can be calculated by: Suppose  $Z_{LINE} = 210\Omega + (1265\Omega//140nF)$  representing a 5km line of 0.5 mm diameter, copper, twisted pair cable matched to  $600\Omega$  ( $176\Omega/km; 38nF/km$ ). When  $k=0.64$  then  $R_8=390\Omega$ ,  $Z_{BAL}=130\Omega + (820\Omega//220nF)$ .



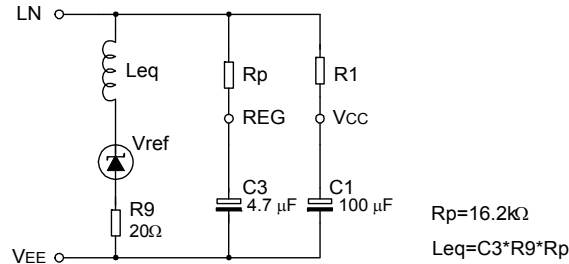


Fig.3 Equivalent impedance circuit

The anti-sidetone network for the UTC/TEA1062N/TEA1062AN family shown in Fig.4 attenuates the signal received from the line by 32 dB before it enters the receiving amplifier. The attenuation is almost constant over the whole audio frequency range. Fig.5 shows a conventional Wheatstone bridge anti-sidetone circuit that can be used as an alternative. Both bridge types can be used with either resistive or complex set impedances.

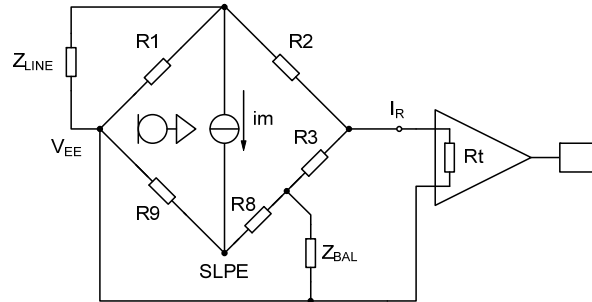


Fig. 4 Equivalent circuit of UTC TEA1062N/TEA1062AN anti-sidetone bridge

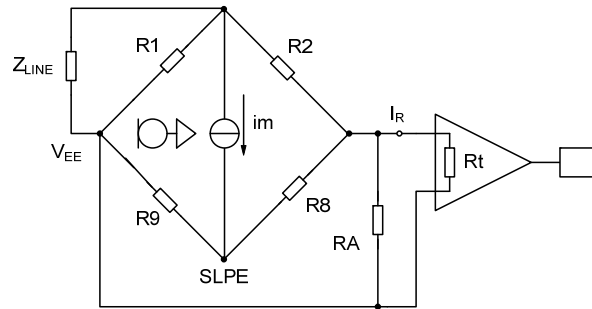


Fig. 5 Equivalent circuit of an anti-sidetone network in a wheatstone bridge configuration

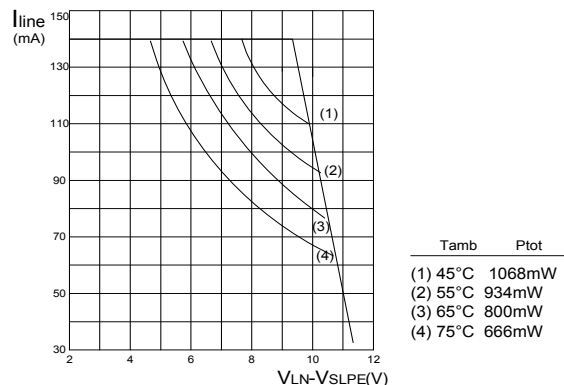


Fig.6 UTC TEA1062N/TEA1062AN safe operating area

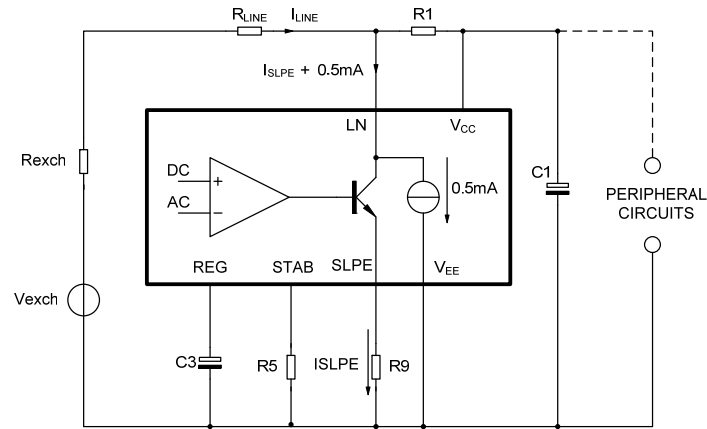


Fig.8 Supply arrangement

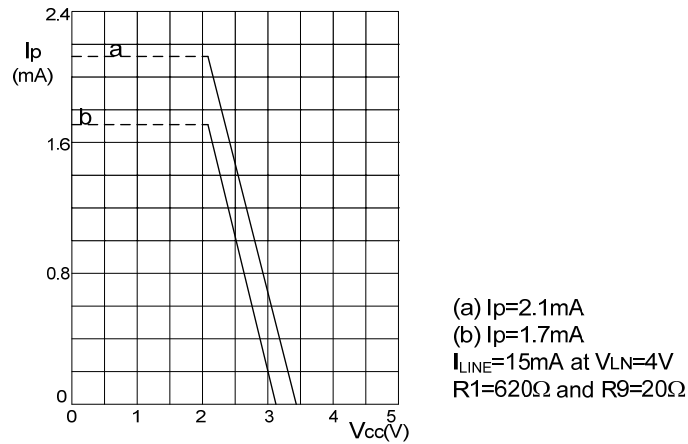


Fig.9 Typical current  $I_p$  available from  $V_{CC}$  peripheral circuitry with  $V_{CC} \geq 2.2V$ .

curve (a) is valid when the receiving amplifier is not driven or when MUTE =LOW (UTC TEA1062N is HIGH) .curve(b) is valid when MUTE=HIGH(UTC TEA1062N is LOW) and the receiving amplifier is driven;  $V_o(rms)=150mV, R_L=150\Omega$ . The supply possibilities can be increased simply by setting the voltage drop over the circuit  $V_{LN}$  to a high value by means of resistor  $R_{VA}$  connected between REG and SLPE.

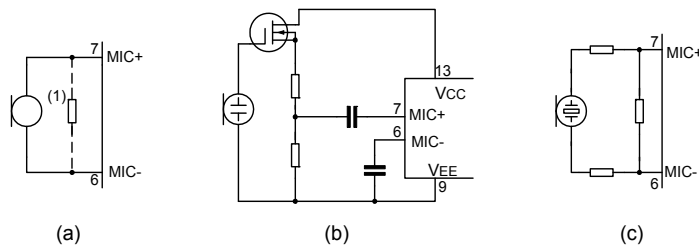


Fig. 10 Alternative microphone arrangement

- (a) Magnetic or dynamic microphone. The resistor marked(1) may be connected to decrease the terminating impedance.
- (b) Electret microphone.
- (c) Piezoelectric microphone.

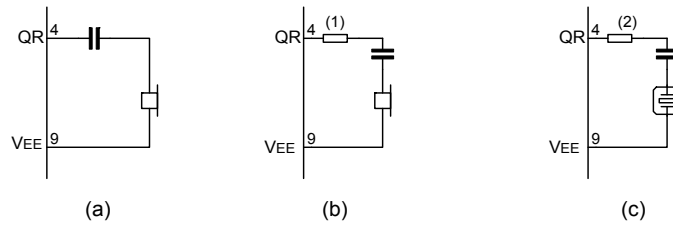


Fig.11 Alternative receiver arrangement

- (a) Dynamic earpiece.
- (b) Magnetic earpiece. The resistor marked(1) may be connected to prevent distortion(inductive load)
- (c) Piezoelectric earpiece. The earpiece marked(2) is required to increase the phase margin (capacitive load)

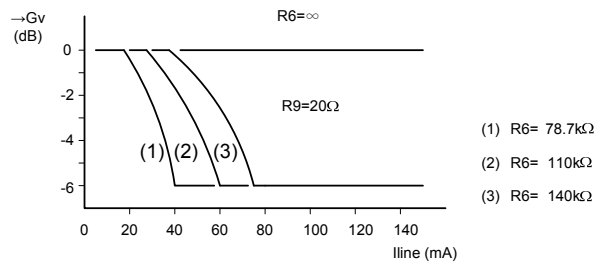


Fig. 12 Variation of gain with line current, with R6 as a parameter.

		Rexch(Ω)			
		400	600	800	1000
Vexch(V)		R6(kΩ)			
		36	100	78.7	x
48	140	110	93.1	82	
60	x	x	120	102	

Table 1 Values of resistor R6 for optimum line loss compensation for various usual values of exchange supply voltage (Vexch) and exchange feeding bridge resistance(Rexch);R9=20Ω.

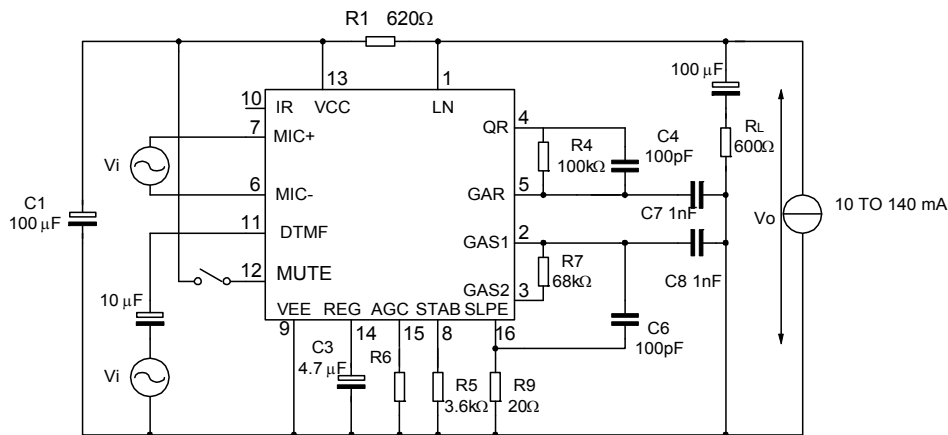


Fig.13 Test circuit defining voltage gain of MIC+, MIC- and DTMF inputs.



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