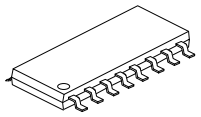
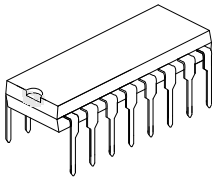
TEA1062N/TEA1062AN

LINEAR INTEGRATED CIRCUIT

LOW VOLTAGE TELEPHONE TRANSMISSION CIRCUIT WITH DIALLER INTERFACE



SOP-16



DIP-16

■ 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.
* Receivering amplifier for several types of earphones.
* Large amplification setting range on microphone and earpiece amplifiers.
* Line loss compensation facility, line current depedant (microphone and earpiece amplifiers).
* Gain control adaptable to exchange supply.
* Possibility to adjust the d.c. line voltage

■ ORDERING INFORMATION

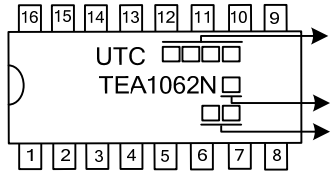
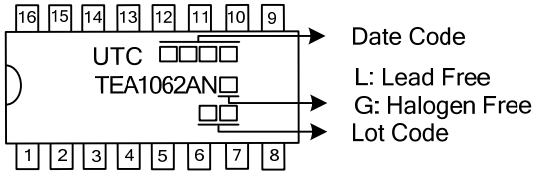
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Lead Free	Halogen Free		
TEA1062NL-D16-T	TEA1062NG-D16-T	DIP-16	Tube
-	TEA1062NG-S16-R	SOP-16	Tape Reel
TEA1062ANL-D16-T	TEA1062ANG-D16-T	DIP-16	Tube
-	TEA1062ANG-S16-R	SOP-16	Tape Reel

TEA1062NL-D16-T (1)Packing Type (2)Package Type (3)Green Package	(1) R: Tape Reel, T: Tube (2) D16: DIP-16, S16: SOP-16 (3) L: Lead Free, G: Halogen Free and Lead Free

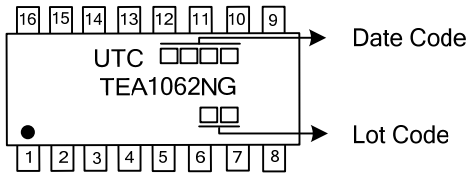
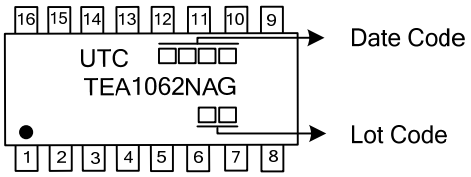
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■ MARKING

DIP-16

TEA1062N	TEA1062AN
	

SOP-16

TEA1062N	TEA1062NA
	

■ PIN CONFIGURATIONS

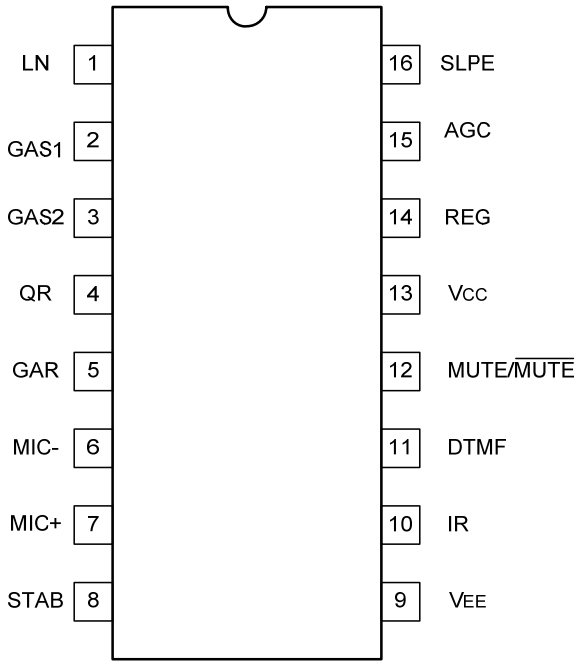


Fig. 1 Pin Configurations

■ 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_{EE}		Negative line terminal
10	IR	I	Receiving amplifier input
11	DTMF	I	Dual-tone multi-frequency input
12	MUTE/$\overline{\text{MUTE}}$	I	Mute input; TEA1062N high actived TEA1062AN low actived
13	Vcc		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

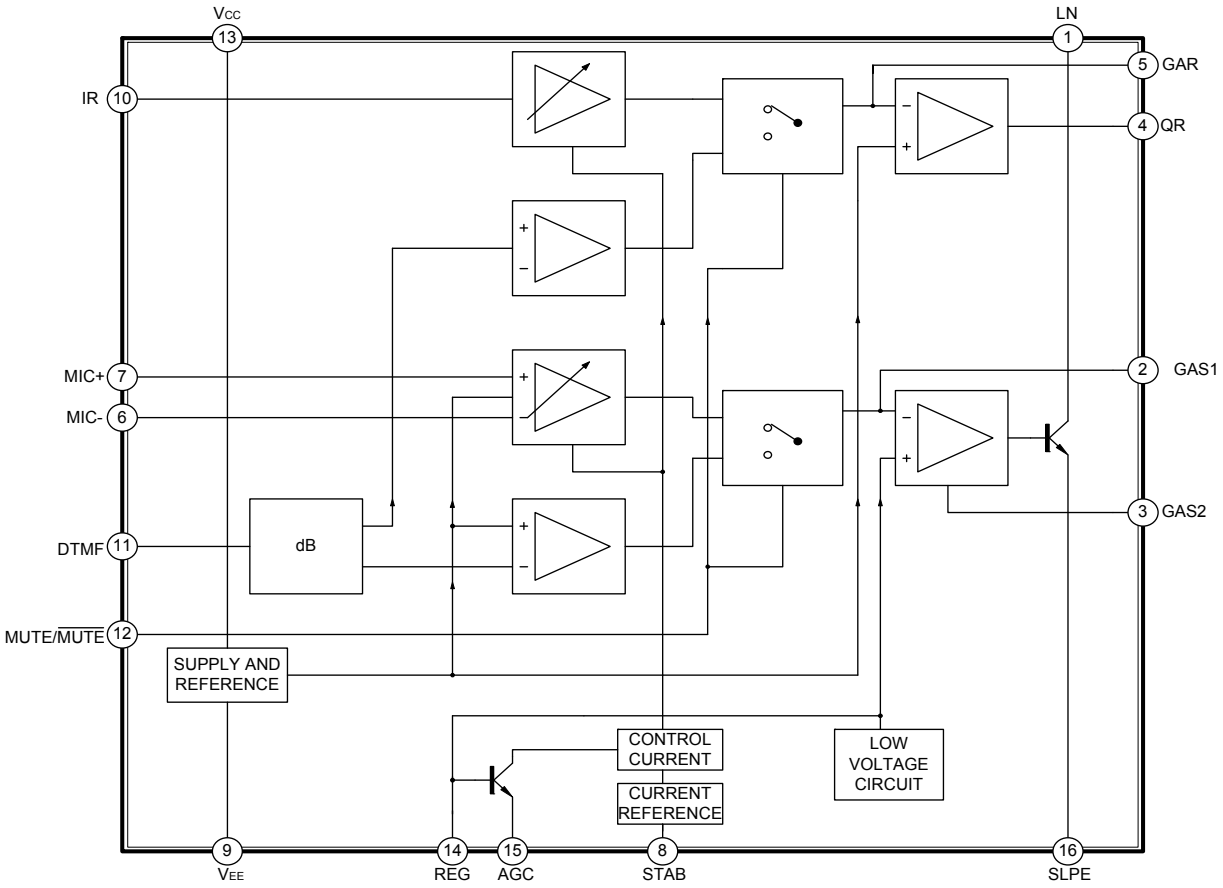


Fig. 2 Block Diagram

■ 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=13Ω, R9=20Ω(see Fig.15))	$V_{LN(RPL)}$	28	V
Line Current (Note1) (R9=20Ω)	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=20Ω)	P_D	640	mW
Junction Temperature	T_J	+125	°C
Operating Ambient Temperature Range	T_{OPR}	-25 ~ +75	°C
Storage Temperature Range	T_{STG}	-40 ~ +125	°C

Note: 1. Mostly dependent on the maximum required Ta and the voltage between LN and SLPE (see Figs 6).
2. Calculated for the maximum ambient temperature specified Ta=75°C and a maximum junction temperature of 125°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	θ_{JA}	75	°C/W

■ ELECTRICAL CHARACTERISTICS (I_{LINE}=11~140mA; V_{EE}=0V; f=800Hz; Ta=25°C; unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
SUPPLY; LN AND VCC(PINS 1 AND 13)								
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 to REG) =68kΩ			3.5		V
			I_{LINE} =15mA, R_{VA}(REG to SLPE) =39kΩ			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	Ip=1.2mA; MUTE=HIGH	2.2	2.7		V
				Ip=0mA; MUTE=HIGH		3.4		V
	TEA1062AN		I_{LINE}=15mA	Ip=1.2mA; $\overline{\text{MUTE}}$=LOW	2.2	2.7		V
				Ip=0mA; $\overline{\text{MUTE}}$=LOW		3.4		V
MICROPHONE INPUTS MIC+ AND MIC- (PINS 6 AND 7)								
Input impedance (differential) Between MIC- and MIC+		| Zi |			64		kΩ
Input impedance (sigle-ended) MIC- or MIC+ to V_{EE}						32		kΩ
Common Mode Rejection Ratio		CMRR				82		dB
Voltage Gain MIC+ or MIC- to LN		Gv	I_{LINE}=15mA, R7=68kΩ		50.5	52.0	53.5	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_{LINE} =50mA			±0.2		dB

■ ELECTRICAL CHARACTERISTICS(Cont.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
DUAL-TONE MULTI-FREQUENCY INPUT DTMF (PIN 11)						
Input Impedance	$\|Zi\|$			20.7		kΩ
Voltage Gain From DTMF to LN	Gv	I_{LINE} =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_{LINE} =50mA		±0.2		dB
GAIN ADJUSTMENT GAS1 AND GAS2 (PINS 2 AND 3)						
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_{LN}(rms)	I_{LINE} =15mA, THD=10%	1.7	2.3		V
		I_{LINE} =4mA, THD=10%		0.8		V
Noise Output Voltage	V_{NO}(rms)	I_{LINE} =15mA; R7=68kΩ; 200Ω between MIC- and MIC+; psophometrically weighted		-69		dBmp
RECEIVING AMPLIFIER INPUT IR (PIN 10)						
Input Impedance	$\|Zi\|$			21		kΩ
RECEIVING AMPLIFIER OUTPUT QR (PIN 4)						
Output Impedance	$\|Z_O\|$	I_{LINE} =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_{LINE} =50mA		±0.2		dB
Output Voltage THD=2%	V_O(rms)	sinwave drive, Ip=0mA, R4=100kΩ; I_{LINE} =15mA, RL=150Ω	0.22	0.33		V
		RL=450Ω	0.3	0.48		V
THD=10%		R4=100kΩ I_{LINE} =4mA, RL=150Ω		15		mV
Noise Output Voltage	V_{NO}(rms)	I_{LINE}=15mA, R4=100kΩ, IR open – circuit psophometrically weighted RL=300Ω		50		μV
GAIN ADJUSTMENT GAR (PIN 5)						
Gain Variation Of Receiving Amplifier Achievable By Varying R4 Between GAR And QR	ΔGv		-11		0	dB
MUTE INPUT (PIN 12)						
Input Voltage(HIGH)	V_{IH}		1.5		V_{CC}	V
Input Voltage(LOW)	V_{IL}				0.3	V
Input Current	I_{MUTE}			8	15	μA
REDUCTION OF GAIN						
MIC+ Or MIC- To LN TEA1062N	ΔGv	MUTE=HIGH		70		dB
TEA1062AN		$\overline{MUTE}$=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
AUTOMATIC GAIN CONTROL INPUT AGC (PIN 15)						
Controlling The Gain From IR To QR And The Gain From MIC+/MIC- to LN; R6 Between AGC And V_{EE} Gain Control Range	ΔGv	R6=110kΩ, I_{LINE} =70mA		-5.8		dB
Highest Line Current For Maximum Gain	I_{LINE}			23		mA
Lowest Line Current For Minimum Gain				61		mA

■ FUNCTIONAL DESCRIPTION

Supply: V_{CC}, 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 Vcc 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 Vcc and V_{EE} while the internal voltage regulator is decoupled by a capacitor between REG and V_{EE}. The DC current drawn by the device will vary in accordance with varying values of the exchange voltage (Vexch), the feeding bridge resistance (Rexch) and the DC resistance of the telephone line (R_{LINE}). The UTC TEA1062N/TEA1062AN has an internal current stabilizer operating at a level determined by a 3.6kΩ resistor connected between STAB and V_{EE} (see Fig.8). When the line current(I_{LINE}) is more than 0.5mA greater than the sum of the IC supply current (Icc) and the current drawn by the peripheral circuitry connected to V_{CC}(Ip) the excess current is shunted to V_{EE} via LN. The regulated voltage on the line terminal(V_{LN}) can be calculated as:

$V_{LN}=Vref+I_{SLPE}*R9$ or;

$V_{LN}=Vref+[(I_{LINE}-I_{CC}-0.5*10^{-3}A)-I_P]*R9$

where: Vref is an internally generated temperature compensated reference voltage of 3.7V and R9 is an external resistor connected between SLPE and V_{EE}. In normal use the value of R9 would be 20Ω. Changing the value of R9 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 $I_{SLPE} \geqq I_{CC}+0.5mA+I_P$, the static behavior of the circuit is that of a 3.7V regulator diode with an internal resistance equal to that of R9. In the audio frequency range the dynamic impedance is largely determined by R1. 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_{VA}). 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_P) available from V_{CC} for peripheral circuits depends on the external components used. Fig.9 shows this current for V_{CC} > 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 R1, as shown in Fig.16, or, by increasing the DC line voltage by means of an external resistor(R_{VA}) 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 R7=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 R7 which is connected between GAS1 and GAS2. Stability is ensured by the external capacitors, C6 connected between GAS1 and SLPE and C8 connected between GAS1 and V_{EE}. The value of C6 is 100pF but this may be increased to obtain a first-order low-pass filter. The value of C8 is 10 times the value of C6. The cut-off frequency corresponds to the time constant R7*C6.

MUTE INPUT (MUTE/$\overline{\text{MUTE}}$)

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 (parallal opration of more sets) the circuit is always in speech condition independant of the DC level applied to the MUTE/$\overline{\text{MUTE}}$ 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 R7=68kΩ) and varies with R7 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 R4=100kΩ). 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 R4 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, C4 and C7, ensure stability. C4 is normally 100pF and C7 is 10 times the value of C4. The value of C4 may be increased to obtain a first-order low-pass filter. The cut-off frequency will depend on the time constant R4*C4. 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(R6) 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 176Ω/km and average attenuation of 1.2dB/km. Resistor R6 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 R6. 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, $R1//Z_{LINE}$, R2, R3, R8, R9 and Z_{BAL}, (see Fig.4) suppresses the transmitted signal in the earpiece. Compensation is maximum when the following conditions are fulfilled:

$$(a)R9\times R2= R1\times\left(R3+\frac{R8\times Z_{BAL}}{R8+Z_{BAL}}\right)$$

$$(b)[Z_{BAL}/(Z_{BAL}+R8)]=[ZI_{LINE}/(Z_{LINE}+R1)]$$

If fixed values are chosen for R1, R2, R3 and R9 then condition(a) will always be fulfilled when $|R8//Z_{BAL}| \ll R3$. To obtain optimum side-tone suppression condition(b) has to be fulfilled which results in:

$Z_{BAL}=(R8/R1)\ Z_{LINE}=k*Z_{LINE}$ where k is a scale factor;

K=(R8/R1).

The scale factor (k), dependent on the value of R8, is chosen to meet following criteria:

(a) Compatibility with a standard capacitor from the E6 or E12 range for Z_{BAL},

(b) $|Z_{BAL}//R8| \ll R3$ fulfilling condition (a) and thus ensuring correct anti-sidetone bridge operation,

(c) $|Z_{BAL}+R8| \gg R9$ 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 ZI_{LINE} = 210Ω+(1265Ω//140nF) representing a 5km line of 0.5 mm diameter, copper, twisted pair cable matched to 600Ω(176Ω/km;38nF/km). When k=0.64 then R8=390Ω, Z_{BAL}=130Ω+(820Ω//220nF).

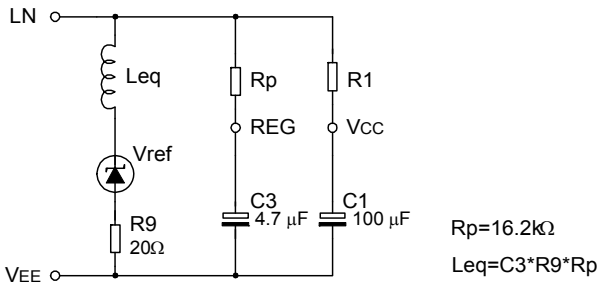


Fig.3 Equivalent impedance circuit

The anti-sidetone network for the UTCTEA1062N/TEA1062AN family shown in Fig.4 attenuates the signl 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 convertional 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.

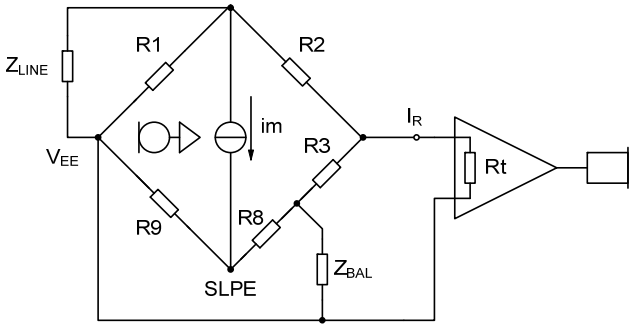


Fig. 4 Equivalent circuit of UTC TEA1062N/TEA1062AN anti-sidetone bridge

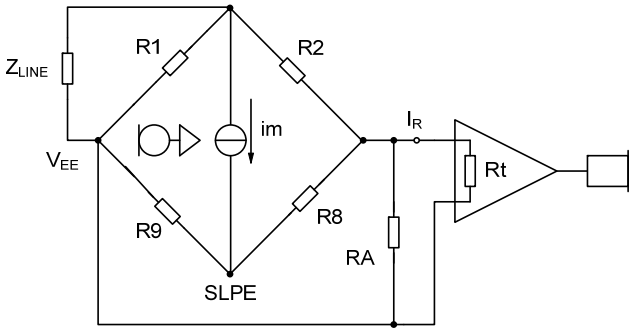


Fig. 5 Equivalent circuit of an anti-sidetone network in a wheatstone bridge configuration

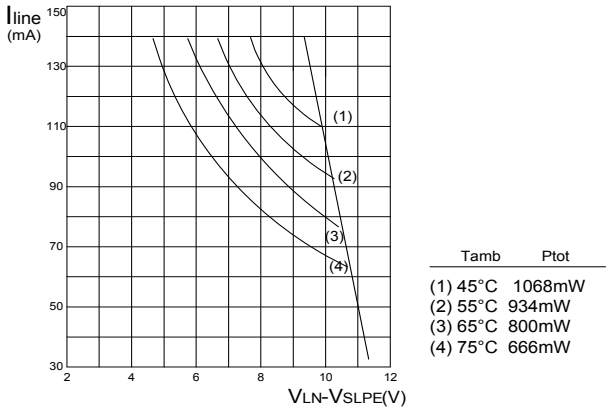


Fig.6 UTC TEA1062N/TEA1062AN safe operating area

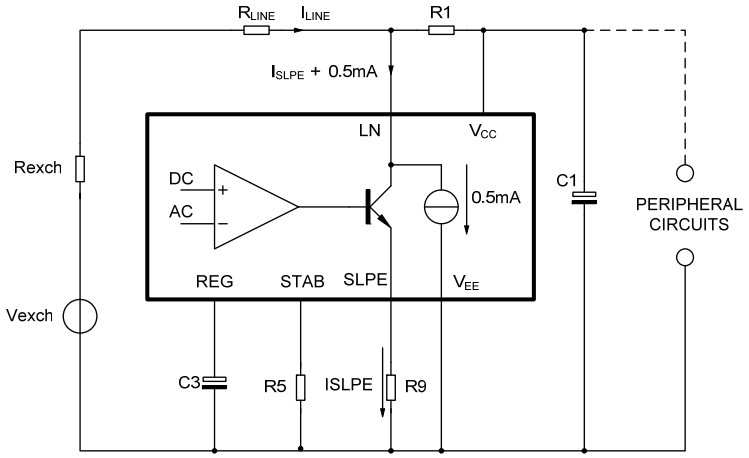
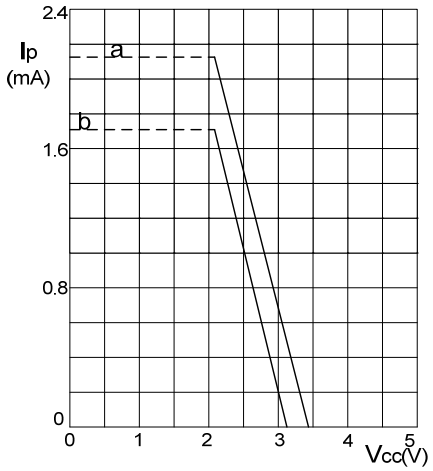


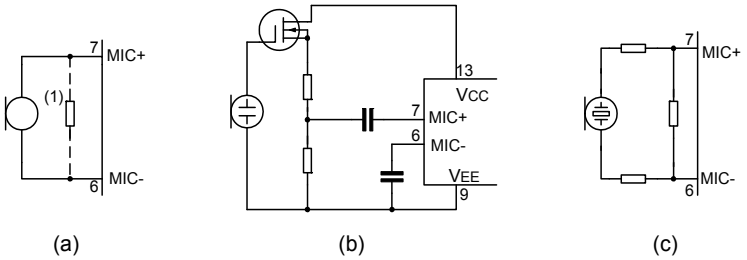
Fig.8 Supply arrangement



(a) Ip=2.1mA
(b) Ip=1.7mA
I_{LINE}=15mA at V_{LN}=4V
R1=620Ω and R9=20Ω

Fig.9 Typical current Ip available from Vcc peripheral circuitry with Vcc≧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; Vo(rms)=150mV,RL=150Ω.The supply possibilities can be increased simply by setting the voltage drop over the circuit VLN to a high value by means of resistor RVA connected between REG and SLPE.



(a) (b) (c)

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.

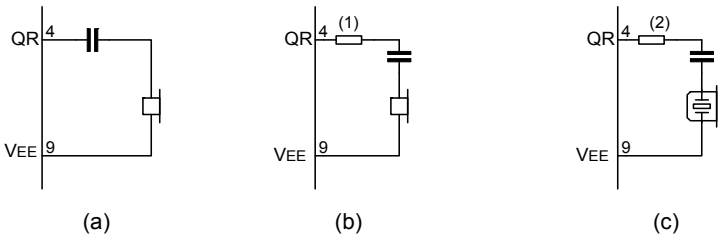


Fig.11 Alternative receiver arrangement

(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)

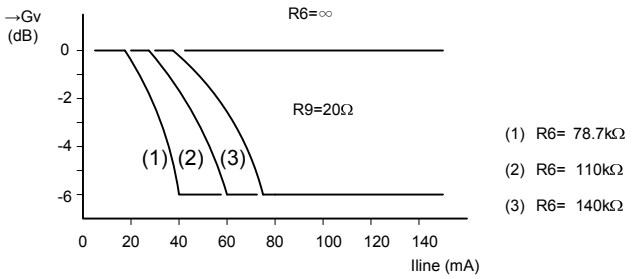


Fig. 12 Variation of gain with line current, with R6 as a parameter.

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

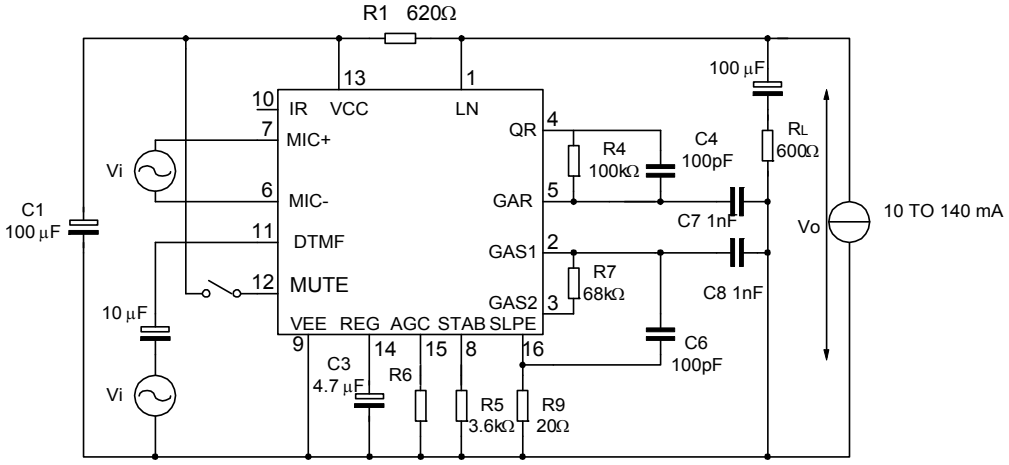


Fig.13 Test circuit defining voltage gain of MIC+, MIC- and DTMF inputs.

Voltage gain is defined as: $G_V=20*\log(|V_O/V_I|)$. For measuring the gain from MIC+ and MIC- the MUTE input should be HIGH(UTC TEA1062N is LOW) or open-circuit, for measuring the DTMF input MUTE should be LOW(UTC TEA1062N is HIGH) .Inputs not under test should be open-circuit.

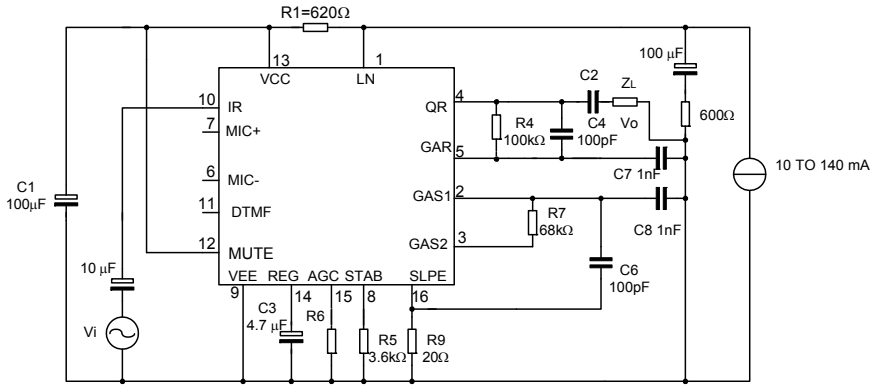


Fig.14 Test circuit for defining voltage gain of the receiving amplifier.
Voltage gain is defined as: $G_V=20*\log(|V_O/V_I|)$.

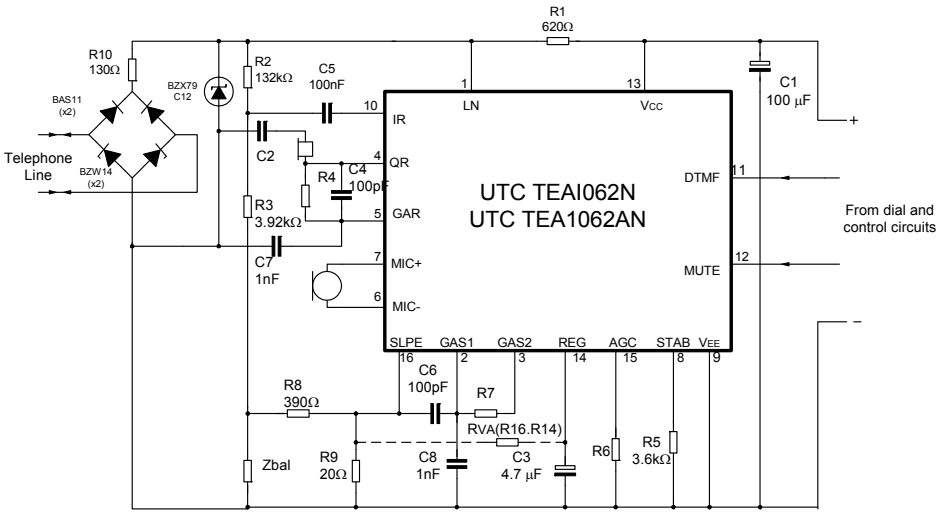


Fig.15 Typical application of the UTC TEA1062AN, shown here with a piezoelectric earpiece and DTMF dialling. The bridge to the left, the Zener diode and R10 limit the current into the circuit and the voltage across the circuit during line transients. Pulse dialling or register recall required a different protection arrangement.
The DC line voltage can be set to a higher value by resistor R_{VA}(REG to SLPE).

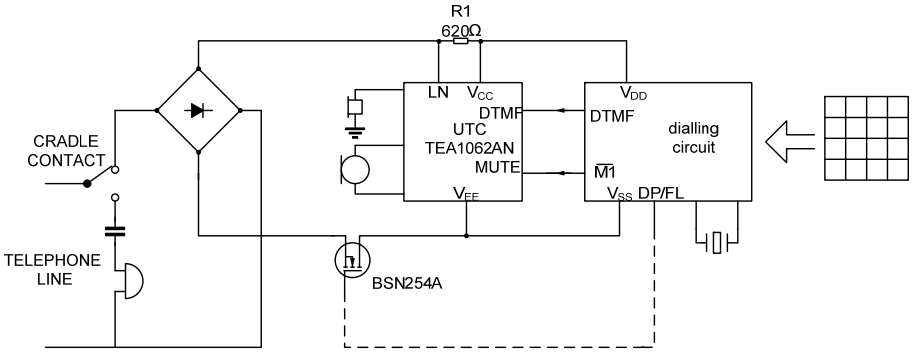


Fig.16 Typical applications of the UTC TEA1062N/TEA1062AN (simplified)
The dashed lines show an optional flash (register recall by timed loop break).

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