

UTC TEA1110A LINEAR INTEGRATED CIRCUIT

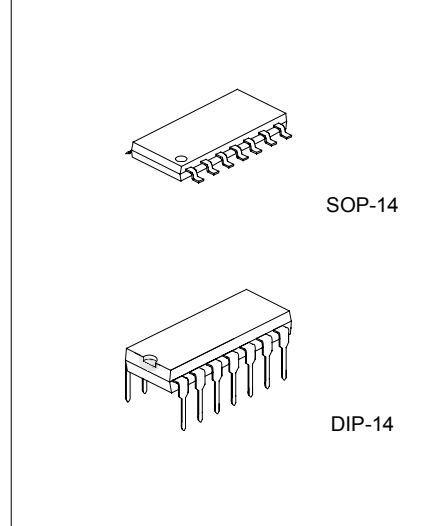
LOW VOLTAGE VERSATILE TELEPHONE TRANSMISSION CIRCUIT WITH DIALLER INTERFACE

DESCRIPTION

The UTC TEA1110A is a bipolar integrated circuit that performs all speech and line interface functions required in fully electronic telephone sets. It performs electronic switching between speech and dialling. The IC operates at a line voltage down to 1.6 V DC (with reduced performance) to facilitate the use of telephone sets connected in parallel.

FEATURES

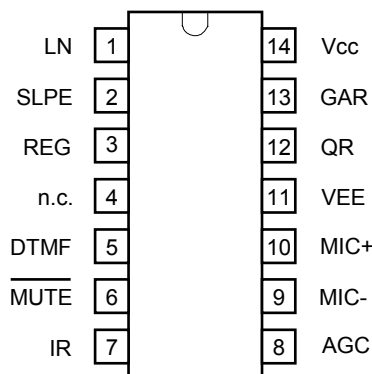
- *Low DC line voltage; operates down to 1.6 V (excluding voltage drop over external polarity guard)
- *Voltage regulator with adjustable DC voltage
- *Provides a supply for external circuits
- *Symmetrical high impedance inputs (64k Ω) for dynamic, magnetic or piezo-electric microphones
- *Asymmetrical high impedance input (32k Ω) for electric microphones
- *DTMF input with confidence tone
- *MUTE input for pulse or DTMF dialling
- *Receiving amplifier for dynamic, magnetic or piezo-electric earpieces
- *AGC line loss compensation for microphone and earpiece amplifiers.



APPLICATIONS

- *Line powered telephone sets, cordless telephones, fax machines, answering machines.

PIN CONFIGURATION

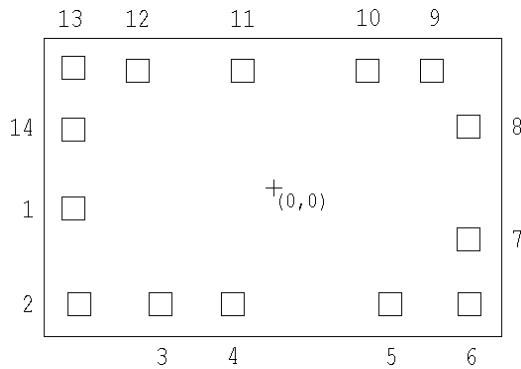


UTC TEA1110A LINEAR INTEGRATED CIRCUIT

PIN DESCRIPTION

SYMBOL	PIN No.	PAD No.	DESCRIPTION
LN	1	1	Positive line terminal
SLPE	2	2	Slope (DC resistance) adjustment
REG	3	3	Line voltage regulator decoupling
n.c.	4	4	Not connected
DTMF	5	5	Dual-tone multi-frequency input
MUTE	6	6	Mute input to select speech or dialing mode (active LOW)
IR	7	7	Receiving amplifier input
AGC	8	8	Automatic gain control/line loss compensation
MIC-	9	9	Inverting microphone amplifier input
MIC+	10	10	Non-inverting microphone amplifier input
VEE	11	11	Negative line terminal
QR	12	12	Earpiece amplifier output
GAR	13	13	Earpiece amplifier gain adjustment
Vcc	14	14	Supply voltage for internal circuit

BONDING PAD LOCATIONS



SYMBOL	PAD No.	COORDINATES	
		x	y
LN	1	-791	-82
SLPE	2	-767.5	-460
RGE	3	-445	-460
n.c.	4	-157.5	-460
DTMF	5	467	-460
MUTE	6	780.5	-459
IR	7	774.5	-205.5
AGC	8	774.5	241
MIC-	9	629.5	461
MIC+	10	375	461
VEE	11	-121.5	461
QR	12	-536.5	461
GAR	13	-791	471
Vcc	14	-791	227.5

UNIT: μm

UTC TEA1110A LINEAR INTEGRATED CIRCUIT

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNIT
Positive continuous line voltage	V _{LN}	V _{EE} -0.4 ~ 12	V
Repetitive line voltage during switch-on or line interruption		V _{EE} -0.4 ~ 13.2	V
Maximum voltage on all pins	V _{n (max)}	V _{EE} -0.4 ~ V _{CC} +0.4	V
Maximum line current (R _{SLPE} =20Ω)	I _{line}	140	mA
Total power dissipation (Ta=75°C)	P _{tot}	588	mW
DIP-14 SOP-14		384	
Storage temperature	T _{stg}	-40~+125	°C
Ambient temperature	T _a	-25~+75	°C
Maximum Junction temperature	T _j	125	°C

ELECTRIC CHARACTERISTICS

(I_{line}=15mA, V_{EE}=0V, R_{SLPE}=20Ω, AGC pin connected to V_{EE}, Z_{line}=600Ω, f=1kHz, Ta=25°C, unless otherwise specified)

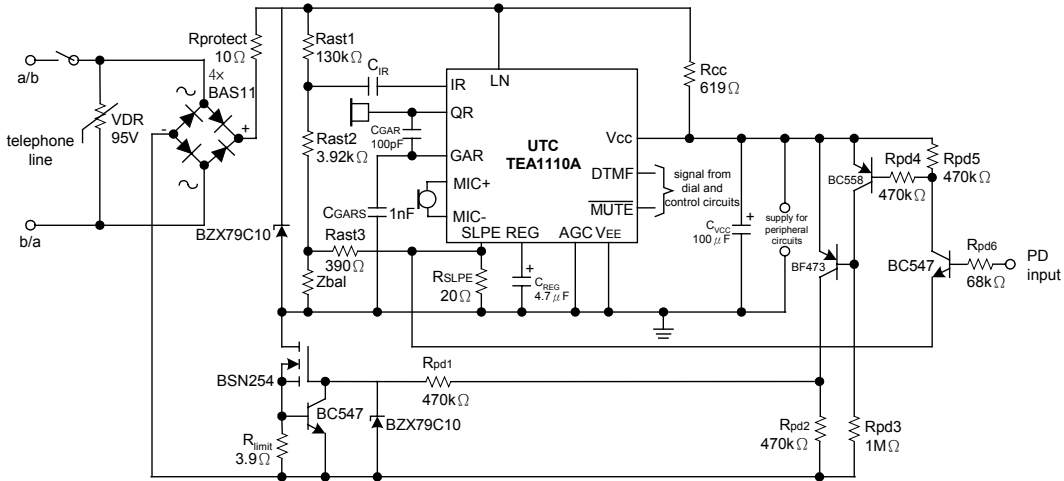
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Supplies (pins VLN, VCC, SLPE and REG)						
Stabilized voltage between LN and SLPE	V _{ref}		3.1	3.35	3.6	V
DC line voltage	V _{LN}	I _{line} = 1 mA		1.6		V
		I _{line} = 4 mA		2.3		V
		I _{line} = 15 mA	3.35	3.65	3.95	V
		I _{line} = 140 mA			6.9	V
DC line voltage with an external resistor RVA	V _{LN(exR)}	R _{VA(SLPE-REG)} = 27kΩ		4.4		V
DC line voltage variation with temperature referred to 25 °C	ΔV _{LN(T)}	T _a = -25 to +75 °C		±30		mV
internal current consumption	I _{cc}	V _{cc} = 2.9 V		1.1	1.4	mA
Supply voltage for peripherals	V _{cc}	I _p =0mA		2.9		V
Equivalent supply voltage resistance	R _{ccint}	I _p =0.5mA		550	620	Ω
Microphone amplifier (pins MIC+ and MIC-)						
Voltage gain from MIC+/MIC- to LN	G _{vtx}	V _{MIC} = 4 mV (RMS)	42.7	43.7	44.7	dB
Gain variation with frequency referred to 1 kHz	ΔG _{vtx(f)}	f = 300 to 3400 Hz		±0.2		dB
Gain variation with temperature referred to 25°C	ΔG _{vtx(T)}	T _a = -25 to +75 °C		±0.3		dB
Common mode rejection ratio	CMRR			80		dB
Maximum sending signal(RMS value)	V _{LN(max)} (rms)	I _{line} = 15 mA; THD = 2%	1.4	1.7		V
		I _{line} = 4 mA, THD = 10%		0.8		V
Noise output voltage at pin LN, pins MIC+/MIC- shorted through 200Ω	V _{notx}			-78.5		dBmp
Receiving amplifier (pins IR, QR and GAR)						
Voltage gain from IR to QR	G _{vrx}	V _{IR} = 4 mV (RMS)	32	33	34	dB

UTC TEA1110A LINEAR INTEGRATED CIRCUIT

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Gain variation with frequency referred to kHz	$\Delta G_{vrx}(f)$	f = 300 to 3400 Hz		± 0.2		dB
Gain variation with temperature referred to 25°C	$\Delta G_{vrx}(T)$	Ta = -25 to +75 °C		± 0.3		dB
Gain voltage reduction range	ΔG_{vrxr}	external resistor connected between GAR and QR			14	dB
Maximum receiving signal (RMS value)	$V_{o(rms)}$	IP = 0 mA sine wave drive, RL = 150Ω, THD = 2%		0.25		V
		IP = 0 mA sine wave drive, RL = 450 Ω, THD = 2%		0.35		
Noise output voltage at pin R (RMS value)	$V_{norx(rms)}$	Gvrx = 33 dB, IR open-circuit, RL = 150 Ω		-87		dBVp
Automatic gain control (pin AGC)						
Gain control range for microphone and receiving amplifiers with respect to Iline=15mA	ΔG_{vtrx}	Iline = 85 mA		5.9		dB
Highest line current for maximum gain	Istart			23		mA
Lowest line current for minimum gain	Istop			56		mA
DTMF amplifier (pin DTMF)						
Voltage gain from DTMF to LN	Gvdtmf	VDTMF = 20 mV (RMS), MUTE = LOW	24.1	25.3	26.5	dB
Gain variation with frequency referred to 1kHz	$\Delta G_{vdtmf}(f)$	f = 300 to 3400 Hz		± 0.2		dB
Gain variation with temperature referred to 25°C	$\Delta G_{vdtmf}(T)$	Ta = -25 to +75 °C		± 0.4		dB
Voltage gain from DTMF to QR (confidence tone)	Gvct	VDTMF = 20 mV (RMS), RL = 150 Ω		-15		dB
Mute function (pin MUTE)						
LOW level input voltage	VIL		VEE - 0.4		VEE +0.3	V
HIGH level input voltage	VIH		VEE +1.5		VCC +0.4	V
Input current	IMUTE			1.5		μ A
Gain reduction for microphone and receiving amplifiers	ΔG_{vtrxm}	MUTE = LOW		80		dB

UTC TEA1110A LINEAR INTEGRATED CIRCUIT

APPLICATION INFORMATION CIRCUIT (Typical application of the UTC TEA1110A in sets with Pulse Dialling or Flash facilities)



FUNCTIONAL DESCRIPTION

Supply (pins LN, SLPE, VCC and REG)

The supply for the UTC TEA1110A and its peripherals is obtained from the telephone line (see Fig.1). The IC generates a stabilized reference voltage (V_{ref}) between pins LN and SLPE. V_{ref} is temperature compensated and can be adjusted by means of an external resistor (R_{VA}). V_{ref} equals 3.35 V and can be increased by connecting R_{VA} between pins REG and SLPE (see Fig.2), or decreased by connecting R_{VA} between pins REG and LN. The voltage at pin REG is used by the internal regulator to generate V_{ref} and is decoupled by C_{REG} , which is connected to VEE. This capacitor, converted into an equivalent inductance (see Section "Set impedance"), realizes the set impedance conversion from its DC value (R_{SLPE}) to its AC value (R_{CC} in the audio-frequency range). The voltage at pin SLPE is proportional to the line current.

The voltage at pin LN is:

$$V_{LN} = V_{ref} + R_{SLPE} \times I_{SLPE}$$

$$I_{SLPE} = I_{line} - I_{CC} - I_{P} - I^{*}$$

Where:

I_{line} = line current

I_{CC} = current consumption of the IC

I_{P} = supply current for peripheral circuits

I^{*} = current consumed between LN and VEE.

The preferred value for R_{SLPE} is 20 Ω . Changing R_{SLPE} will affect more than the DC characteristics; it also influences the microphone and DTMF gains, the gain control characteristics, the sidetone level and the maximum output swing on the line.

UTC TEA1110A LINEAR INTEGRATED CIRCUIT

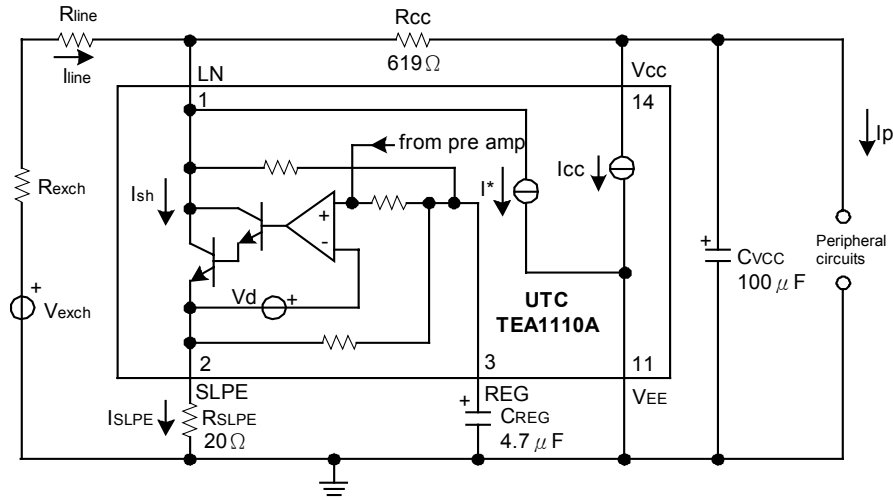
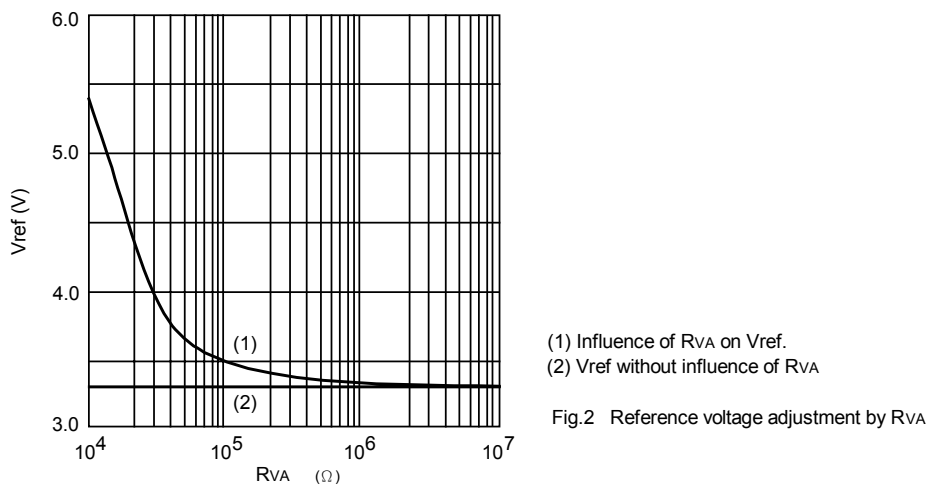


Fig. 1 Supply configuration.



(1) Influence of RVA on Vref.
(2) Vref without influence of RVA

Fig.2 Reference voltage adjustment by RVA

The internal circuitry of the UTC TEA1110A is supplied from pin Vcc. This voltage supply is derived from the line voltage by means of a resistor (Rcc) and must be decoupled by a capacitor CVCC. It may also be used to supply peripheral circuits such as dialling or control circuits. The Vcc voltage depends on the current consumed by the IC and the peripheral circuits as shown by the formula:

$$V_{cc} = V_{cc0} - R_{ccint} \times (I_p - I_{rec})$$

$$V_{cc0} = V_{LN} - R_{cc} \times I_{cc} \quad (\text{see also Figs 3 and 4}).$$

Rccint is the internal equivalent resistance of the voltage supply, and Irec is the current consumed by the output stage of the earpiece amplifier.

The DC line current flowing into the set is determined by the exchange supply voltage (Vexch), the feeding bridge resistance (Rrexch), the DC resistance of the telephone line (Rline) and the reference voltage (Vref). With line currents below 7.5 mA, the internal reference voltage (generating Vref) is automatically adjusted to a lower value. This means that more sets can operate in parallel with DC line voltages (excluding the polarity guard) down to an absolute minimum voltage of 1.6 V. At currents below 7.5 mA, the circuit has limited sending and receiving levels. This is called the low voltage area.

UTC TEA1110A LINEAR INTEGRATED CIRCUIT

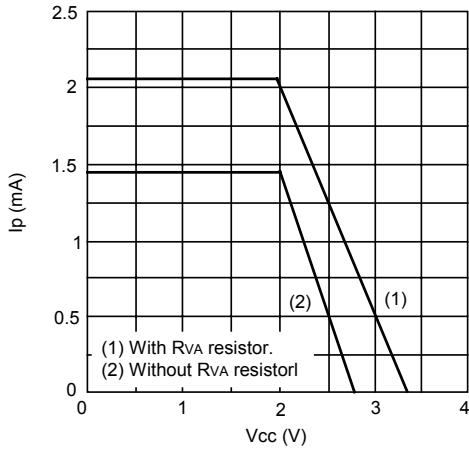


Fig.3 Typical current I_p available from V_{cc} for peripheral circuits at $I_{line}=15mA$.

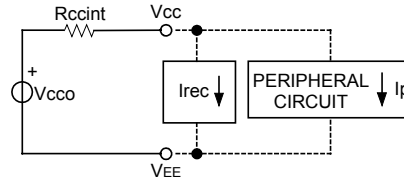
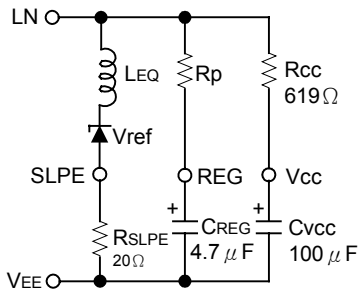


Fig.4 V_{cc} supply voltage for peripherals

Set impedance

In the audio frequency range, the dynamic impedance is mainly determined by the R_{cc} resistor. The equivalent impedance of the circuit is illustrated in Fig.5.



$$LEQ = C_{REG} \times R_{SLPE} \times R_p$$

R_p = internal resistance
 $R_p = 15.5k\Omega$

Fig.5 Equivalent impedance between LN and VEE

Microphone amplifier (pins MIC+ and MIC-)

The UTC TEA1110A has symmetrical microphone inputs. The input impedance between pins MIC+ and MIC- is $64k\Omega$ ($2 \times 32k\Omega$). Automatic gain control is provided on this amplifier for line loss compensation.

Receiving amplifier (pins IR, GAR and QR)

The receiving amplifier has one input (IR) and one output (QR). The input impedance between pin IR and pin VEE is $20k\Omega$. The voltage gain from pin IR to pin QR can be decreased by connecting an external resistor R_{GAR} between pins GAR and QR; the adjustment range is 14 dB. Two external capacitors C_{GAR} (connected between GAR and QR) and C_{GARS} (connected between GAR and VEE) ensure stability. The C_{GAR} capacitor provides a first-order low-pass filter. The cut-off frequency corresponds to the time constant $C_{GAR} \times (R_{GARint} // R_{GAR})$. R_{GARint} is the internal resistor (connected between pins GAR and QR) which sets the gain with a typical value of 125 kW. The condition $C_{GARS} = 10 \times C_{GAR}$ must be fulfilled to ensure stability.

The output voltage of the receiving amplifier is specified for continuous wave drive. The maximum output swing depends on the DC line voltage, the R_{cc} resistor, the ICC current consumption of the circuit, the I_p current consumption of the peripheral circuits and the load impedance.

UTC TEA1110A LINEAR INTEGRATED CIRCUIT

Automatic gain control is provided on this amplifier for line loss compensation.

Automatic gain control (pin AGC)

The UTC TEA1110A performs automatic line loss compensation. The automatic gain control varies the gain of the microphone amplifier and the gain of the receiving amplifier in accordance with the DC line current. The control range is 5.9 dB (which corresponds approximately to a line length of 5 km for a 0.5 mm diameter twisted-pair copper cable with a DC resistance of 176 Ω /km and an average attenuation of 1.2 dB/km). The IC can be used with different configurations of feeding bridge (supply voltage and bridge resistance) by connecting an external resistor R_{AGC} between pins AGC and V_{EE} .

This resistor enables the I_{start} and I_{stop} line currents to be increased (the ratio between I_{start} and I_{stop} is not affected by the resistor). The AGC function is disabled when pin AGC is left open-circuit.

Mute function (pin MUTE)

The mute function performs the switching between the speech mode and the dialling mode. When \overline{MUTE} is LOW, the DTMF input is enabled and the microphone and receiving amplifiers inputs are disabled. When \overline{MUTE} is HIGH, the microphone and receiving amplifiers inputs are enabled while the DTMF input is disabled. A pull-up resistor is included at the input.

DTMF amplifier (pin DTMF)

When the DTMF amplifier is enabled, dialling tones may be sent on line. These tones can be heard in the earpiece at a low level (confidence tone). The UTC TEA1110A has an asymmetrical DTMF input. The input impedance between DTMF and V_{EE} is 20 k Ω . The automatic gain control has no effect on the DTMF amplifier.

SIDETONE SUPPRESSION

The UTC TEA1110A anti-sidetone network comprising R_{CC}/Z_{line} , R_{ast1} , R_{ast2} , R_{ast3} , R_{SLPE} and Z_{bal} (see Fig.6) suppresses the transmitted signal in the earpiece. Maximum compensation is obtained when the following conditions are fulfilled:

$$R_{SLPE} \times R_{ast1} = R_{cc} \times (R_{ast2} + R_{ast3})$$

$$K = \frac{(R_{ast2} \times (R_{ast3} + R_{SLPE}))}{(R_{ast1} \times R_{SLPE})}$$

$$Z_{bal} = k \times Z_{line}$$

The scale factor k is chosen to meet the compatibility with a standard capacitor from the E6 or E12 range for Z_{bal} .

In practice, Z_{line} varies considerably with the line type and the line length. Therefore, the value of Z_{bal} should be for an average line length which gives satisfactory sidetone suppression with short and long lines. The suppression also depends on the accuracy of the match between Z_{bal} and the impedance of the average line.

The anti-sidetone network for the UTC TEA1110A (as shown in Application information circuit) attenuates the receiving signal from the line by 32 dB before it enters the receiving amplifier. The attenuation is almost constant over the whole audio frequency range.

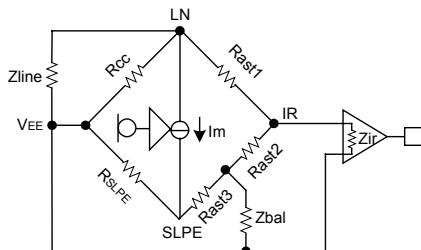


Fig.6 Equivalent circuit of UTC TEA1110A anti-sidetone bridge

UTC TEA1110A LINEAR INTEGRATED CIRCUIT

UTC assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all UTC products described or contained herein. UTC products are not designed for use in life support appliances, devices or systems where malfunction of these products can be reasonably expected to result in personal injury. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner. The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice.