

# UTC TEA1110A LINEAR INTEGRATED CIRCUIT

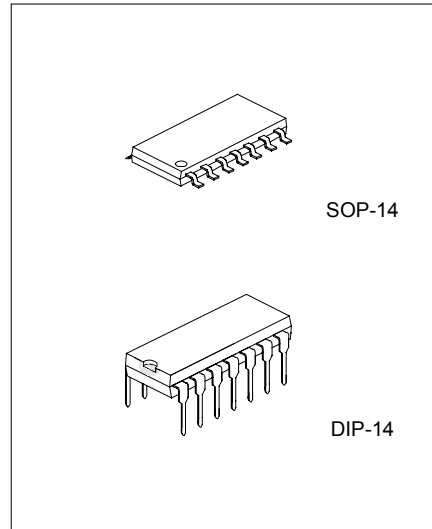
## LOW VOLTAGE VERSATILE TELEPHONE TRANSMISSION CIRCUIT WITH DIALLER INTERFACE

### 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

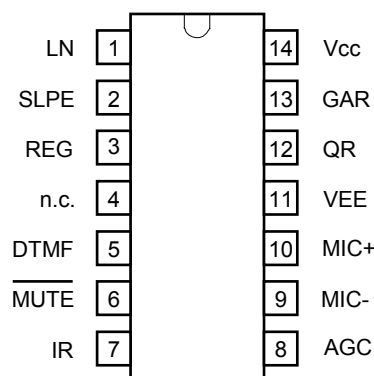
- \*Low DC line voltage; operates down to 1.6 V (excluding voltage drop over external polarity guard)
- \*Voltage regulator with adjustable DC voltage
- \*Provides a supply for external circuits
- \*Symmetrical high impedance inputs (64kΩ) for dynamic, magnetic or piezo-electric microphones
- \*Asymmetrical high impedance input (32kΩ) 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

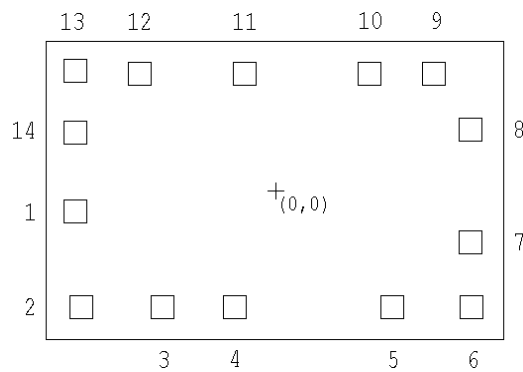


# UTC TEA1110A LINEAR INTEGRATED CIRCUIT

## 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:  $\mu\text{m}$

# UTC TEA1110A LINEAR INTEGRATED CIRCUIT

## ABSOLUTE MAXIMUM RATINGS

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

## ELECTRIC CHARACTERISTICS

(I<sub>line</sub>=15mA, V<sub>EE</sub>=0V, R<sub>SLPE</sub>=20Ω, AGC pin connected to V<sub>EE</sub>, Z<sub>line</sub>=600Ω, f=1kHz, Ta=25°C, unless otherwise specified)

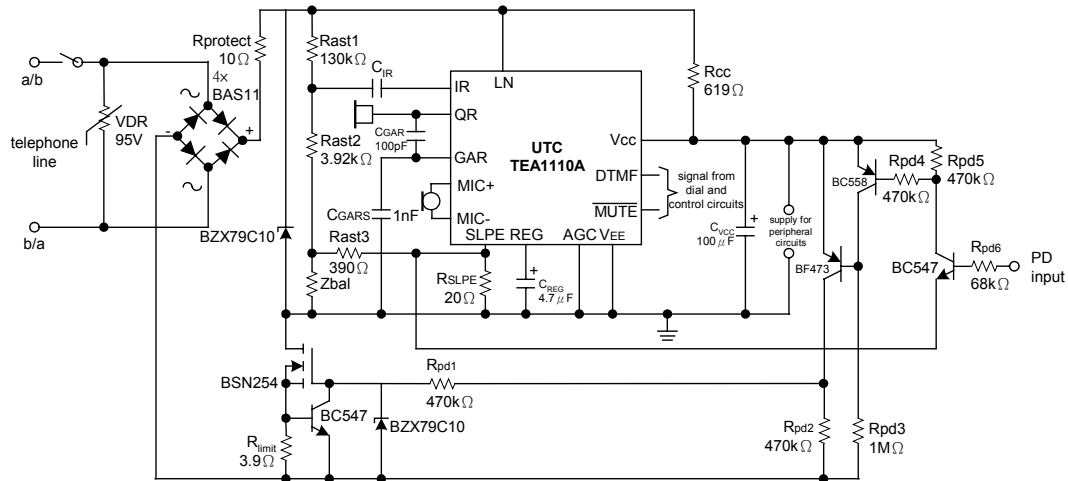
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Supplies (pins VLN, VCC, SLPE and REG)						
Stabilized voltage between LN and SLPE	V <sub>ref</sub>		3.1	3.35	3.6	V
DC line voltage	V <sub>LN</sub>	I <sub>line</sub> = 1 mA		1.6		V
		I <sub>line</sub> = 4 mA		2.3		V
		I <sub>line</sub> = 15 mA	3.35	3.65	3.95	V
		I <sub>line</sub> = 140 mA			6.9	V
DC line voltage with an external resistor RVA	V <sub>LN(exR)</sub>	R <sub>VA(SLPE-REG)</sub> = 27kΩ		4.4		V
DC line voltage variation with temperature referred to 25 °C	ΔV <sub>LN(T)</sub>	T <sub>a</sub> = -25 to +75 °C		±30		mV
internal current consumption	I <sub>cc</sub>	V <sub>cc</sub> = 2.9 V		1.1	1.4	mA
Supply voltage for peripherals	V <sub>cc</sub>	I <sub>p</sub> =0mA		2.9		V
Equivalent supply voltage resistance	R <sub>ccint</sub>	I <sub>p</sub> =0.5mA		550	620	Ω
Microphone amplifier (pins MIC+ and MIC-)						
Voltage gain from MIC+/MIC- to LN	G <sub>vtx</sub>	V <sub>MIC</sub> = 4 mV (RMS)	42.7	43.7	44.7	dB
Gain variation with frequency referred to 1 kHz	ΔG <sub>vtx(f)</sub>	f = 300 to 3400 Hz		±0.2		dB
Gain variation with temperature referred to 25°C	ΔG <sub>vtx(T)</sub>	T <sub>a</sub> = -25 to +75 °C		±0.3		dB
Common mode rejection ratio	CMRR			80		dB
Maximum sending signal(RMS value)	V <sub>LN(max)</sub> (rms)	I <sub>line</sub> = 15 mA; THD = 2%	1.4	1.7		V
		I <sub>line</sub> = 4 mA, THD = 10%		0.8		V
Noise output voltage at pin LN, pins MIC+/MIC- shorted through 200Ω	V <sub>notx</sub>			-78.5		dBmp
Receiving amplifier (pins IR, QR and GAR)						
Voltage gain from IR to QR	G <sub>vrx</sub>	V <sub>IR</sub> = 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		$\pm 0.2$		dB
Gain variation with temperature referred to 25°C	$\Delta G_{vrx}(T)$	Ta = -25 to +75 °C		$\pm 0.3$		dB
Gain voltage reduction range	$\Delta G_{vrxr}$	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
<b>Automatic gain control (pin AGC)</b>						
Gain control range for microphone and receiving amplifiers with respect to Iline=15mA	$\Delta G_{vtrx}$	Iline = 85 mA		5.9		dB
Highest line current for maximum gain	Istart			23		mA
Lowest line current for minimum gain	Istop			56		mA
<b>DTMF amplifier (pin DTMF)</b>						
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		$\pm 0.2$		dB
Gain variation with temperature referred to 25°C	$\Delta G_{vdtmf}(T)$	Ta = -25 to +75 °C		$\pm 0.4$		dB
Voltage gain from DTMF to QR (confidence tone)	Gvct	VDTMF = 20 mV (RMS), RL = 150 Ω		-15		dB
<b>Mute function (pin MUTE)</b>						
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	$\Delta G_{vtrxm}$	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  $\Omega$ . 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.

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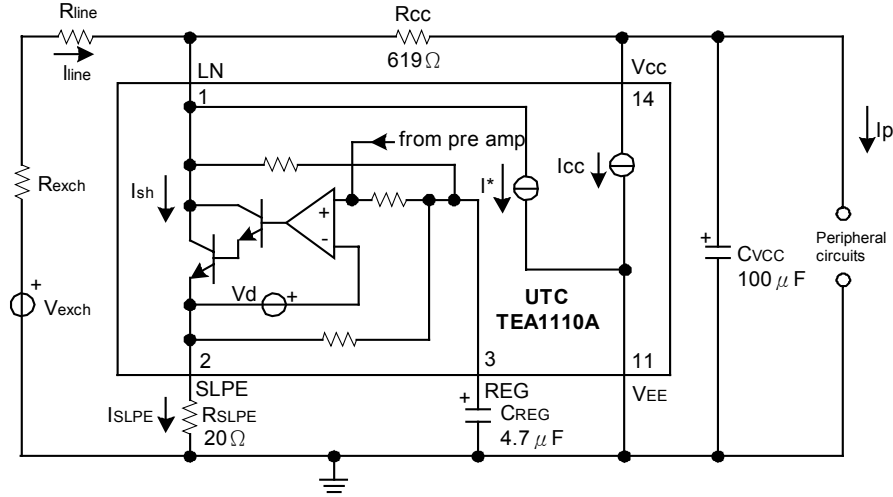
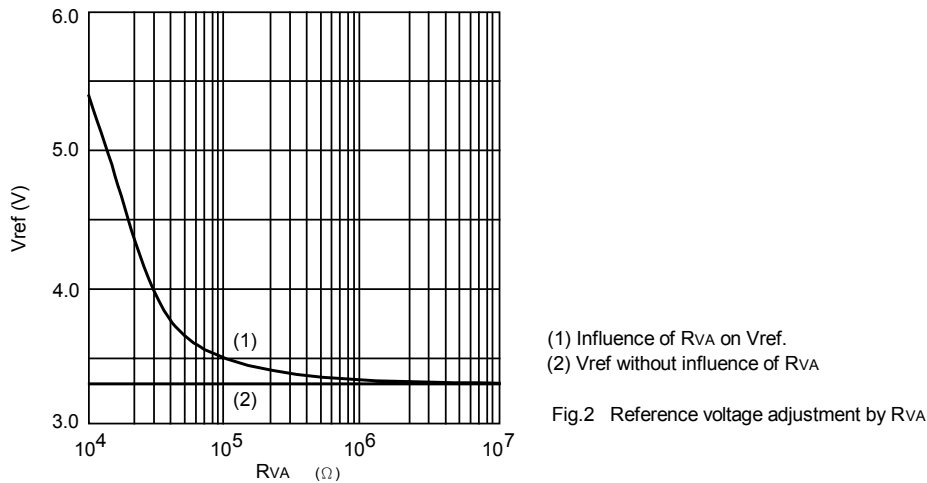


Fig. 1 Supply configuration.



(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:

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

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

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 (Rexch), 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.

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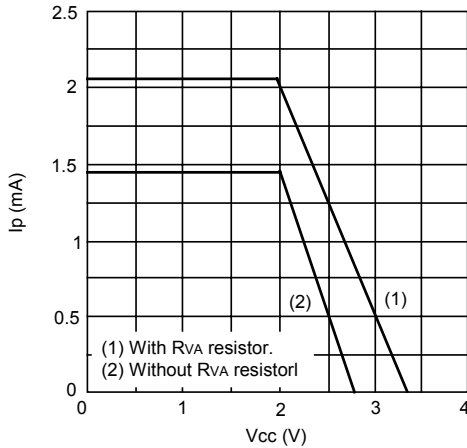


Fig.3 Typical current  $I_p$  available from  $V_{cc}$  for peripheral circuits at  $I_{line}=15mA$ .

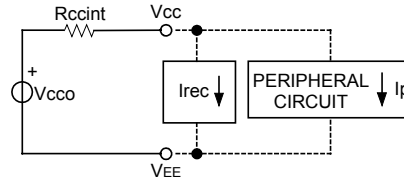
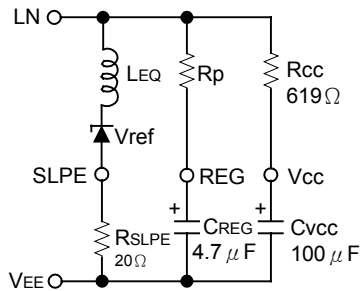


Fig.4  $V_{cc}$  supply voltage for peripherals

## 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 kΩ. 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.

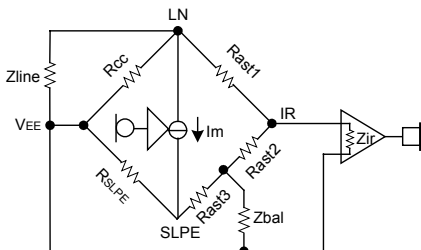


Fig.6 Equivalent circuit of UTC TEA1110A anti-sidetone bridge



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