

**Voice switched speakerphone IC****TEA1095****FEATURES**

- External power supply with power-down function
- Transmit channel with:
  - externally adjustable gain
  - transmit mute function
- Receive channel with:
  - externally adjustable gain
  - logarithmic volume control via a linear potentiometer
  - receive mute function
- Duplex controller consisting of:
  - signal envelope and noise envelope monitors for both channels with:
    - externally adjustable sensitivity
    - externally adjustable signal envelope time constant
    - externally adjustable noise envelope time constant
  - decision logic with:
    - externally adjustable switch-over timing
    - externally adjustable idle mode timing
    - externally adjustable dial tone detector in receive channel
  - voice switch control with:
    - adjustable switching range
    - constant sum of gain during switching
    - constant sum of gain at different volume settings.

**APPLICATIONS**

- Mains, battery or line-powered telephone sets
- Cordless telephones
- Answering machines
- Fax machines.

**GENERAL DESCRIPTION**

The TEA1095 is a bipolar circuit intended for use in mains, battery or line-powered telephone sets, cordless telephones, answering machines and fax machines. In conjunction with a member of the TEA106X, TEA111X families of transmission or TEA1096 transmission/listening-in circuits, the device offers a hands-free function. It incorporates a transmit amplifier, a receiver channel amplifier and a duplex controller with signal and noise monitors on both channels.

**ORDERING INFORMATION**

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TEA1095	DIP24	plastic dual in-line package; 24 leads (600 mil)	SOT101-1
TEA1095T	SO24	plastic small outline package; 24 leads; body width 7.5 mm	SOT137-1

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**QUICK REFERENCE DATA**

$V_{BB} = 5\text{ V}$ ;  $V_{GND} = 0\text{ V}$ ;  $f = 1\text{ kHz}$ ;  $T_{amb} = 25\text{ °C}$ ;  $MUTETX = \text{LOW}$ ;  $MUTERX = \text{LOW}$ ;  $PD = \text{LOW}$ ;  $R_{VOL} = 0\ \Omega$ ; measured in test circuit of Fig.11 unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{BB}$	supply voltage		2.9	–	12.0	V
$I_{BB}$	current consumption from pin $V_{BB}$		–	2.7	3.8	mA
$G_{vtx}$	voltage gain from TXIN to TXOUT in transmit mode	$V_{TXIN} = 1\text{ mV(RMS)}$ ; $R_{GATX} = 30.1\text{ k}\Omega$	–	15.5	–	dB
$\Delta G_{vtxr}$	gain adjustment with $R_{GATX}$		–15.5	–	+24.5	dB
$G_{vrx}$	voltage gain in receive mode from RXIN to RXOUT	$V_{RXIN} = 20\text{ mV(RMS)}$ ; $R_{GARX} = 16.5\text{ k}\Omega$	–	6.5	–	dB
$\Delta G_{vrxr}$	gain adjustment with $R_{GARX}$		–20.5	–	+19.5	dB
SWRA	switching range		–	40	–	dB
$\Delta\text{SWRA}$	switching range adjustment with $R_{SWR}$ referenced to $R_{SWR} = 365\text{ k}\Omega$		–40	–	+12	dB
$T_{amb}$	operating ambient temperature		–25	–	+75	°C

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BLOCK DIAGRAM

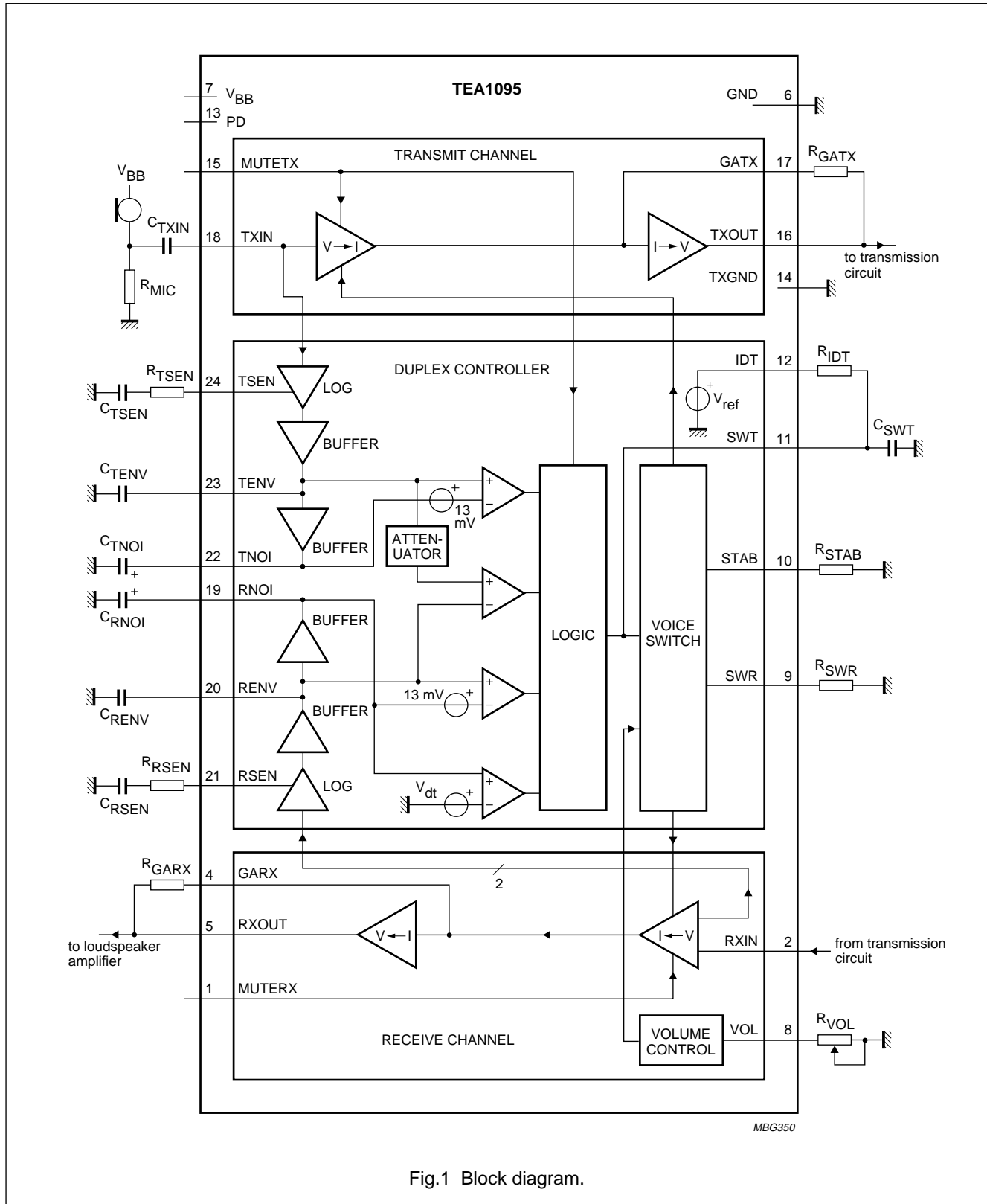


Fig.1 Block diagram.

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**PINNING**

SYMBOL	PIN	DESCRIPTION
MUTERX	1	receiver channel mute input
RXIN	2	receiver amplifier input
n.c.	3	not connected
GARX	4	receiver gain adjustment
RXOUT	5	receiver amplifier output
GND	6	ground reference
V <sub>BB</sub>	7	supply voltage input
VOL	8	receiver volume adjustment
SWR	9	switching range adjustment
STAB	10	reference current adjustment
SWT	11	switch-over timing adjustment
IDT	12	idle mode timing adjustment
PD	13	power-down input
TXGND	14	ground reference for the transmit channel
MUTETX	15	transmit channel mute input
TXOUT	16	transmit amplifier output
GATX	17	transmit gain adjustment
TXIN	18	transmit amplifier input
RNOI	19	receive noise envelope timing adjustment
RENV	20	receive signal envelope timing adjustment
RSEN	21	receive signal envelope sensitivity adjustment
TNOI	22	transmit noise envelope timing adjustment
TENV	23	transmit signal envelope timing adjustment
TSEN	24	transmit signal envelope sensitivity adjustment

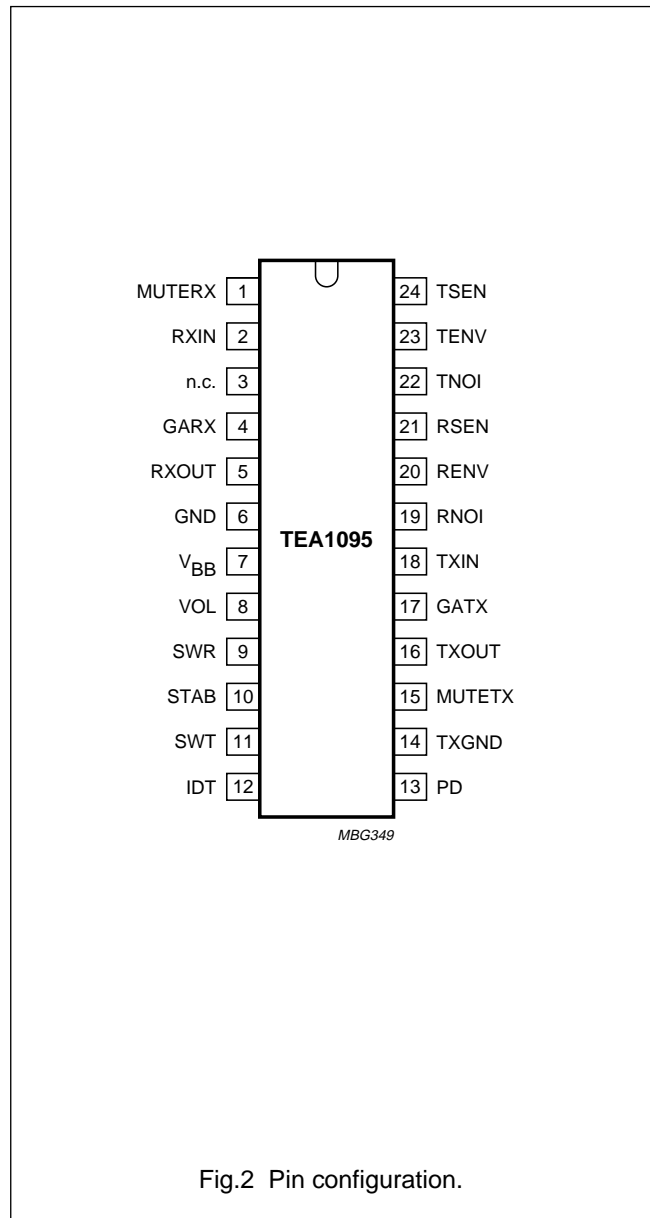


Fig.2 Pin configuration.

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**FUNCTIONAL DESCRIPTION**

The values given in the functional description are typical values except when otherwise specified.

A principle diagram of the TEA1096 is shown on the left side of Fig.3. The TEA1096 is a transmission and listening-in circuit. It incorporates a receiving amplifier for the earpiece, a transmit amplifier for the microphone, a loudspeaker amplifier and a hybrid. For more details on the TEA1096 circuit (please refer to *Data Handbook IC03*). The right side of Fig.3 shows a principle diagram of the TEA1095, a hands-free add-on circuit with a transmit amplifier, a receiver amplifier and a duplex controller.

As can be seen from Fig.3, a loop is formed via the sidetone network in the transmission circuit and the acoustic coupling between loudspeaker and microphone of the hands-free circuit. When this loop gain is greater than 1, howling is introduced. In a full duplex application, this would be the case. The loop-gain has to be much

lower than 1 and therefore has to be decreased to avoid howling. This is achieved by the duplex controller. The duplex controller of the TEA1095 detects which channel has the 'largest' signal and then controls the gains of the transmit amplifier and the receiver amplifier such that the sum of the gains remains constant. As a result, the circuit can be in three stable modes:

1. Transmit mode (Tx mode): the gain of the transmit amplifier is at its maximum and the gain of the receiver amplifier is at its minimum.
2. Receive mode (Rx mode): the gain of the receiver amplifier is at its maximum and the gain of the transmit amplifier is at its minimum.
3. Idle mode: the gain of the amplifiers is halfway between their maximum and minimum value.

The difference between the maximum gain and minimum gain is called the switching range.

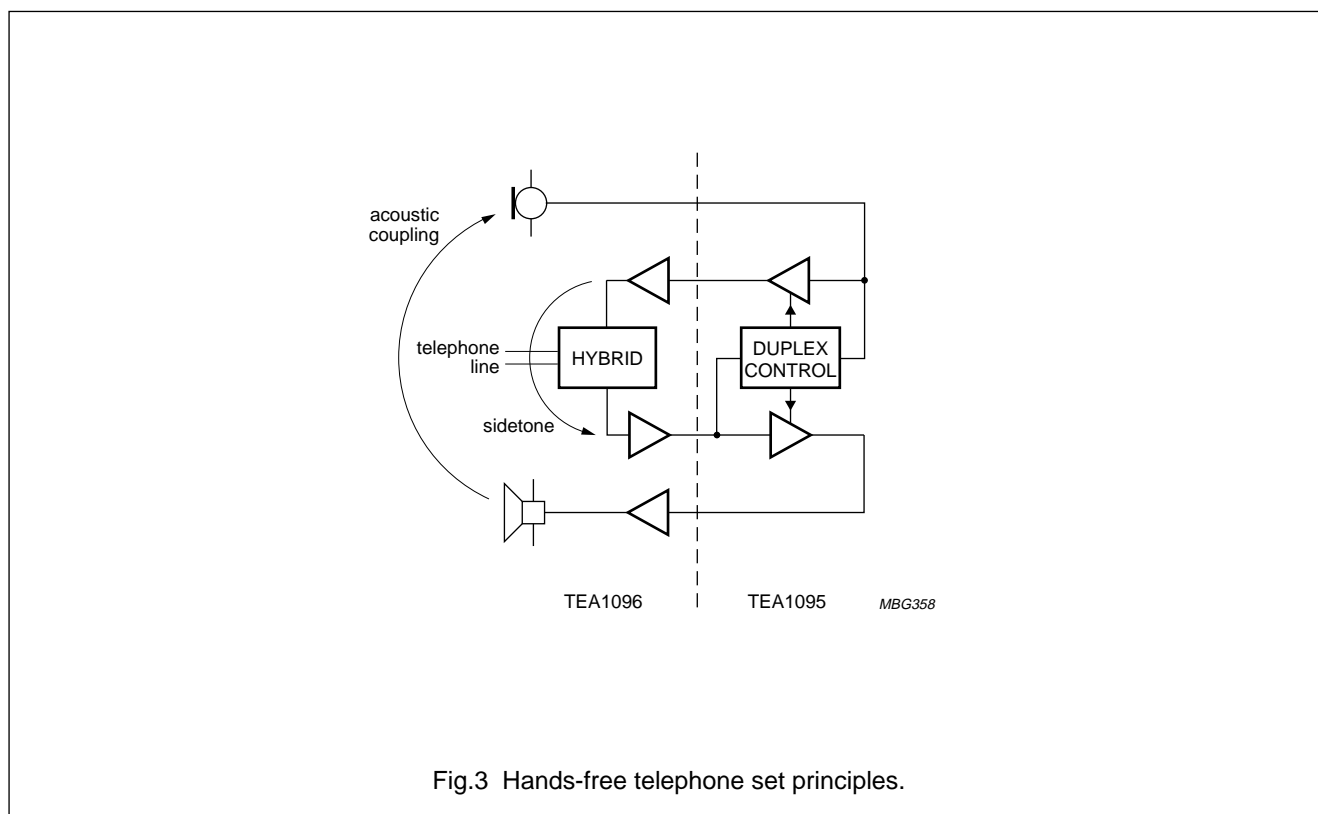


Fig.3 Hands-free telephone set principles.

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**Supply: pins  $V_{BB}$ , GND and PD**

The TEA1095 must be supplied with an external stabilized voltage source between pins  $V_{BB}$  and GND. In idle mode, without any signal, the internal supply current is 2.7 mA at  $V_{BB} = 5$  V.

To reduce current consumption during pulse dialling or register recall (flash), the TEA1095 is provided with a power-down (PD) input. When the voltage on PD is HIGH, the current consumption from  $V_{BB}$  is 140  $\mu$ A.

**Transmit channel: pins TXIN, GATX, TXOUT, TXGND and MUTETX**

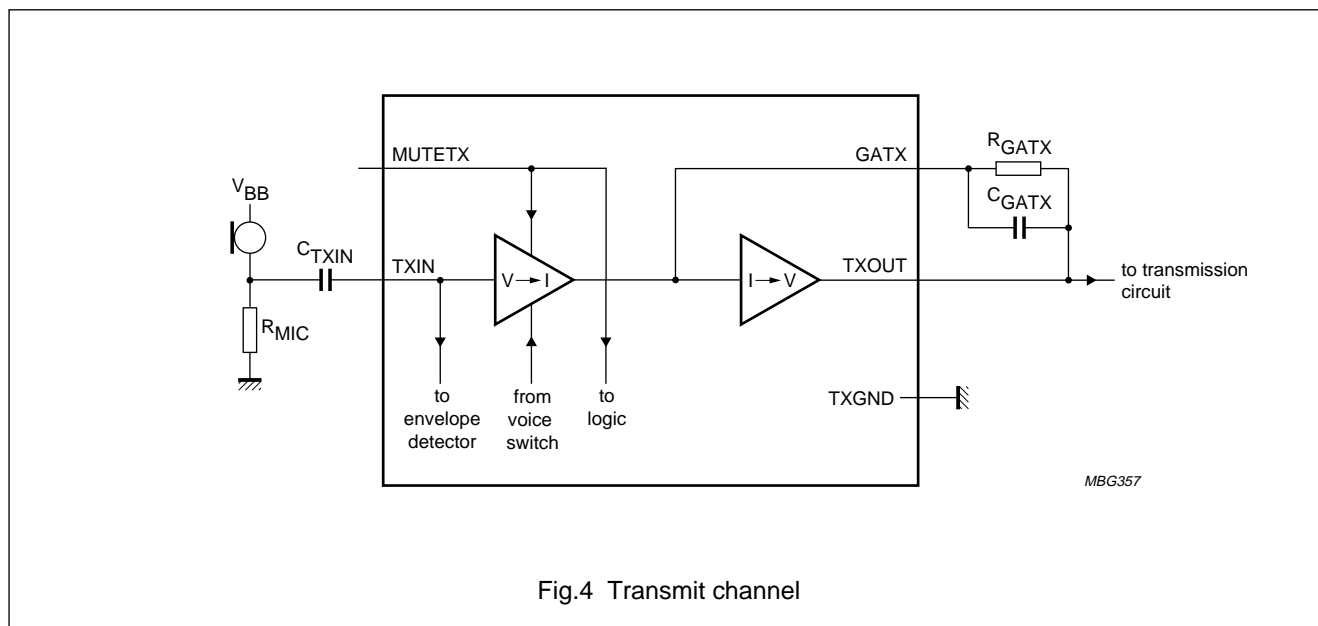
The TEA1095 has an asymmetrical transmit input (TXIN) with an input resistance of 20 k $\Omega$ . The gain of the input stage varies according to the mode of the TEA1095. In the transmit mode, the gain is at its maximum; in the receive

mode, it is at its minimum and in the idle mode, it is halfway between maximum and minimum. Switch-over from one mode to the other is smooth and click-free. The output capability at pin TXOUT is 20  $\mu$ A (RMS).

In the transmit mode, the overall gain of the transmit amplifier (from pin TXIN to TXOUT) can be adjusted from 0 dB to 40 dB to suit application specific requirements. The gain is proportional to the value of  $R_{GATX}$  and equals 15.5 dB with  $R_{GATX} = 30.1$  k $\Omega$ .

A capacitor must be connected in parallel with  $R_{GATX}$  to ensure stability of the transmit amplifier. Together with  $R_{GATX}$ , it also provides a first-order low-pass filter.

By applying a HIGH level on pin MUTETX, the transmit amplifier is muted and the TEA1095 is automatically forced into the receive mode.



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## Receive channel

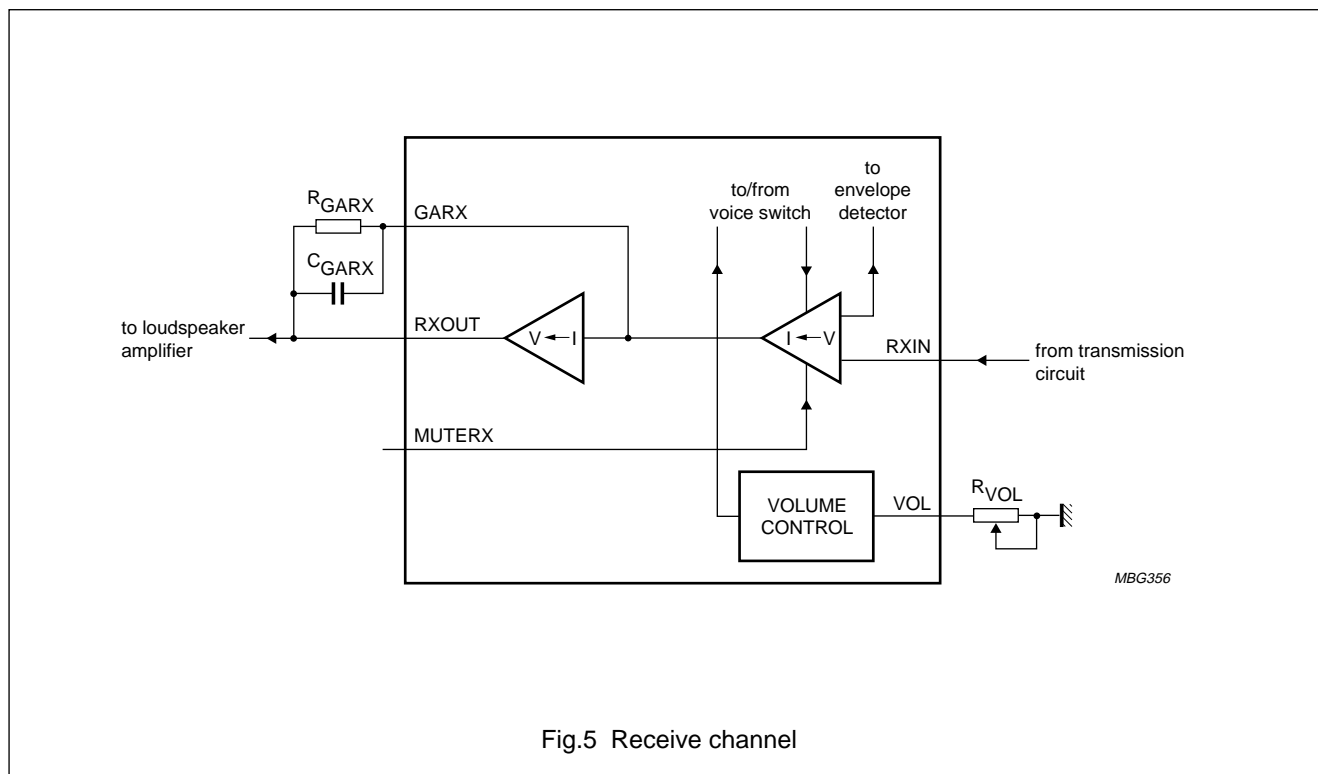


Fig.5 Receive channel

## RECEIVER AMPLIFIER: PINS RXIN, GARX, RXOUT AND MUTERX

The TEA1095 has an asymmetrical input (RXIN) for the receiver amplifier with an input resistance of 20 k $\Omega$ . The gain of the input stage varies according to the mode of the TEA1095. In the receive mode, the gain is at its maximum; in the transmit mode, it is at its minimum and in the idle mode, it is halfway between maximum and minimum. Switch-over from one mode to the other is smooth and click-free.

In the receive mode, the overall gain of the receive amplifier can be adjusted from  $-14$  dB to  $+26$  dB to suit application specific requirements. The gain from RXIN to RXOUT is proportional to the value of  $R_{GARX}$  and equals 6.5 dB with  $R_{GARX} = 16.5$  k $\Omega$ . A capacitor connected in parallel with  $R_{GARX}$  can be used to provide a first-order low-pass filter.

By applying a HIGH level on pin MUTERX, the receiver amplifier is muted and the TEA1095 is automatically forced into the transmit mode.

## VOLUME CONTROL: PIN VOL

The receiver amplifier gain can be adjusted with the potentiometer  $R_{VOL}$ . A linear potentiometer can be used to obtain logarithmic control of the gain of the receiver amplifier. Each 950  $\Omega$  increase of  $R_{VOL}$  results in a gain loss of 3 dB. The maximum gain reduction with the volume control is internally limited to the switching range.

## Duplex controller

SIGNAL AND NOISE ENVELOPE DETECTORS: PINS TSEN, TENV, TNOI, RSEN, RENV AND RNOI

The signal envelopes are used to monitor the signal level strength in both channels. The noise envelopes are used to monitor background noise in both channels. The signal and noise envelopes provide inputs for the decision logic. The signal and noise envelopes detectors are shown in Fig.6.

For the transmit channel, the input signal at TXIN is 40 dB amplified to TSEN. For the receive channel, the input signal at RXIN is 0 dB amplified to RSEN. The signals from TSEN and RSEN are logarithmically compressed and buffered to TENV and RENV respectively. The sensitivity of the envelope detectors is set with  $R_{TSEN}$  and  $R_{RSEN}$ .

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The capacitors connected in series with the two resistors block any DC component and form a first order high-pass filter. In the basic application (see Fig.12), it is assumed that  $V_{TXIN} = 1 \text{ mV (RMS)}$  and  $V_{RXIN} = 100 \text{ mV (RMS)}$  nominal and both  $R_{TSEN}$  and  $R_{RSEN}$  have a value of  $10 \text{ k}\Omega$ . With the value of  $C_{TSEN}$  and  $C_{RSEN}$  at  $100 \text{ nF}$ , the cut-off frequency is at  $160 \text{ Hz}$ .

The buffer amplifiers leading the compressed signals to TENV and RENV have a maximum source current of  $120 \mu\text{A}$  and a maximum sink current of  $1 \mu\text{A}$ . Together with the capacitors  $C_{TENV}$  and  $C_{RENV}$ , the timing of the signal envelope monitors can be set. In the basic application, the value of both capacitors is  $470 \text{ nF}$ . Because of the logarithmic compression, each  $6 \text{ dB}$  signal increase means  $18 \text{ mV}$  increase of the voltage on the envelopes TENV or RENV at room temperature. Thus, timings can be expressed in  $\text{dB/ms}$ . At room temperature, the  $120 \mu\text{A}$  sourced current corresponds to a maximum rise-slope of the signal envelope of  $85 \text{ dB/ms}$ . This is enough to track normal speech signals. The  $1 \mu\text{A}$  current sunk by TENV or

RENV corresponds to a maximum fall-slope of  $0.7 \text{ dB/ms}$ . This is enough for a smooth envelope and also eliminates the effect of echoes on switching behaviour.

To determine the noise level, the signal on TENV and RENV are buffered to TNOI and RNOI. These buffers have a maximum source current of  $1 \mu\text{A}$  and a maximum sink current of  $120 \mu\text{A}$ . Together with the capacitors  $C_{TNOI}$  and  $C_{RNOI}$ , the timing can be set. In the basic application of Fig.12, the value of both capacitors is  $4.7 \mu\text{F}$ . At room temperature, the  $1 \mu\text{A}$  sourced current corresponds to a maximum rise-slope of the noise envelope of approximately  $0.07 \text{ dB/ms}$ . This is small enough to track background noise and not to be influenced by speech bursts. The  $120 \mu\text{A}$  current that is sunk corresponds to a maximum fall-slope of approximately  $8.5 \text{ dB/ms}$ . However, during the decrease of the signal envelope, the noise envelope tracks the signal envelope so it will never fall faster than approximately  $0.7 \text{ dB/ms}$ . The behaviour of the signal envelope and noise envelope monitors is illustrated in Fig.7.

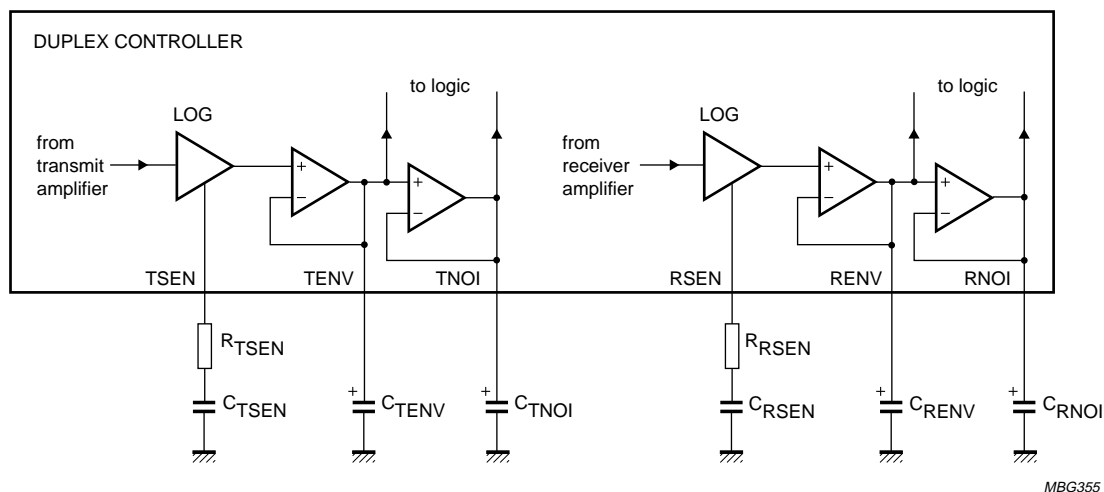


Fig.6 Signal and noise envelope detectors.



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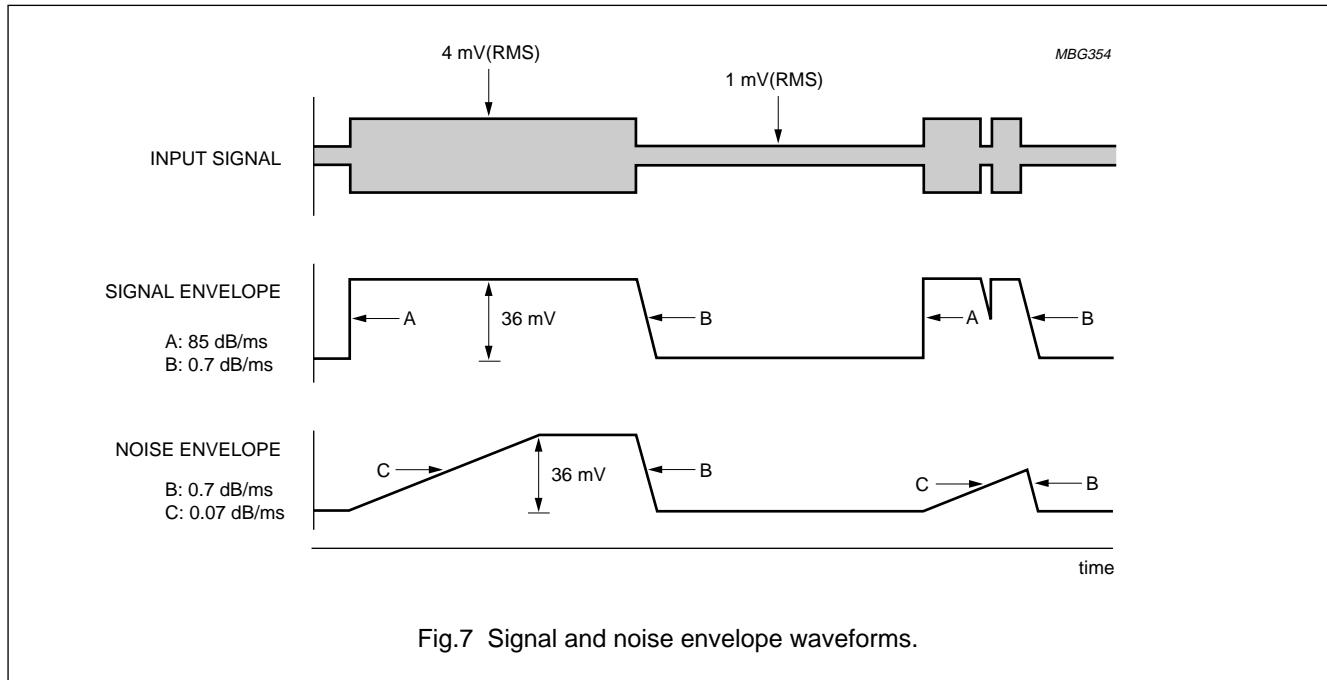
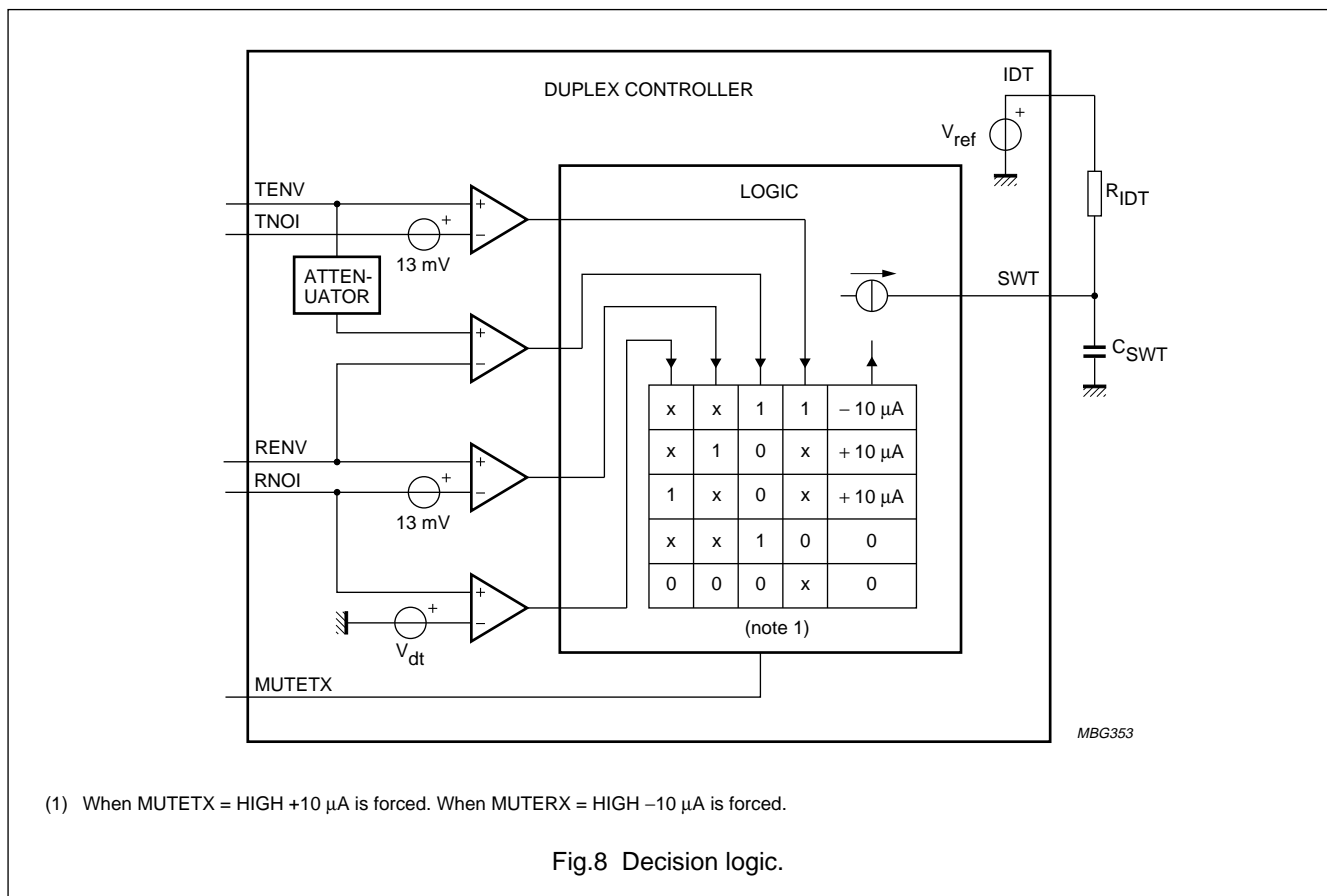


Fig.7 Signal and noise envelope waveforms.

DECISION LOGIC: PINS IDT AND SWT



(1) When MUTETX = HIGH +10  $\mu$ A is forced. When MUTERX = HIGH -10  $\mu$ A is forced.

Fig.8 Decision logic.

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The TEA1095 selects its mode of operation (transmit, receive or idle mode) by comparing the signal and the noise envelopes of both channels. This is executed by the decision logic. The resulting voltage on pin SWT is the input for the voice-switch.

To facilitate the distinction between signal and noise, the signal is considered as speech when its envelope is more than 4.3 dB above the noise envelope. At room temperature, this is equal to a voltage difference  $V_{ENV-NOI} = 13$  mV. This so called speech/noise threshold is implemented in both channels.

The signal on TXIN contains both speech and the signal coming from the loudspeaker (acoustic coupling). When receiving, the contribution from the loudspeaker overrules the speech. As a result, the signal envelope on TENV is formed mainly by the loudspeaker signal. To correct this, an attenuator is connected between TENV and the TENV/RENV comparator. Its attenuation equals that applied to the transmit amplifier.

When a dial tone is present on the line, without monitoring, the tone would be recognized as noise because it is a signal with a constant amplitude. This would cause the TEA1095 to go into the idle mode and the user of the set would hear the dial tone fade away. To prevent this, a dial tone detector is incorporated which, in standard application, does not consider the input signals at RXIN as noise when they have a level greater than 42 mV (RMS). This level is proportional to  $R_{RSEN}$ .

As can be seen from Fig.8, the output of the decision logic is a current source. The logic table gives the relationship between the inputs and the value of the current source. It can charge or discharge the capacitor  $C_{SWT}$  with a current of 10  $\mu$ A (switch-over). If the current is zero, the voltage on SWT becomes equal to the voltage on IDT via the high ohmic resistor  $R_{IDT}$  (idling). The resulting voltage difference between SWT and IDT determines the mode of the TEA1095 and can vary between  $-400$  mV and  $+400$  mV.

**Table 1** Modes of TEA1095.

$V_{SWT} - V_{IDT}$ (mV)	MODE
$<-180$	transmit mode
0	idle mode
$>180$	receive mode

The switch-over timing can be set with  $C_{SWT}$ , the idle mode timing with  $C_{SWT}$  and  $R_{IDT}$ . In the basic application given in Fig.12,  $C_{SWT}$  is chosen at 220 nF and  $R_{IDT}$  at 2.2 M $\Omega$ .

This enables a switch-over time from transmit to receive mode or vice-versa of approximately 13 ms (580 mV swing on SWT). The switch-over time from idle mode to transmit mode or receive mode is approximately 4 ms (180 mV swing on SWT).

The switch-over time from receive mode or transmit mode to idle mode is equal to  $4 \times R_{IDT} C_{SWT}$  and is approximately 2 s (idle mode time).

The inputs MUTETX and MUTERX overrule the decision logic. When MUTETX goes HIGH, the capacitor  $C_{SWT}$  is charged with 10  $\mu$ A resulting in the receive mode. When the voltage on pin MUTERX goes HIGH, the capacitor  $C_{SWT}$  is discharged with 10  $\mu$ A resulting in the transmit mode.

#### VOICE-SWITCH: PINS STAB AND SWR

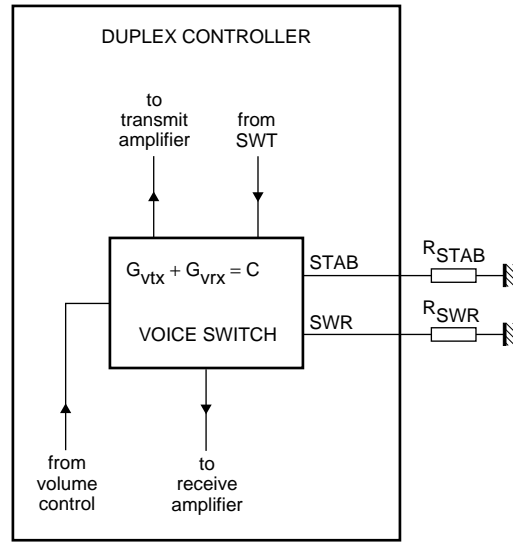
A diagram of the voice-switch is illustrated in Fig.9. With the voltage on SWT, the TEA1095 voice-switch regulates the gains of the transmit and the receive channel such that the sum of both is kept constant.

In the transmit mode, the gain of the transmit amplifier is at its maximum and the gain of the receive amplifier is at its minimum. In the receive mode, the opposite applies. In the idle mode, both transmit and receive amplifier gains are halfway. The difference between maximum and minimum is the so called switching range. This range is determined by the ratio of  $R_{SWR}$  and  $R_{STAB}$  and is adjustable between 0 and 52 dB.  $R_{STAB}$  should be equal to 3.65 k $\Omega$  and sets an internally used reference current. In the basic application diagram given in Fig.12,  $R_{SWR}$  is equal to 365 k $\Omega$  which results in a switching range of 40 dB. The switch-over behaviour is illustrated in Fig.10.

In the receive mode, the gain of the receive amplifier can be reduced using the volume control. Since the voice-switch keeps the sum of the gains constant, the gain of the transmit amplifier is increased at the same time (see dashed curves in Fig.10). In the transmit mode however, the volume control has no influence on the gain of the transmit amplifier or the gain of the receive amplifier. Consequently, the switching range is reduced when the volume is reduced. At maximum reduction of volume, the switching range becomes 0 dB.

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Where C = constant.

Fig.9 Voice switch.

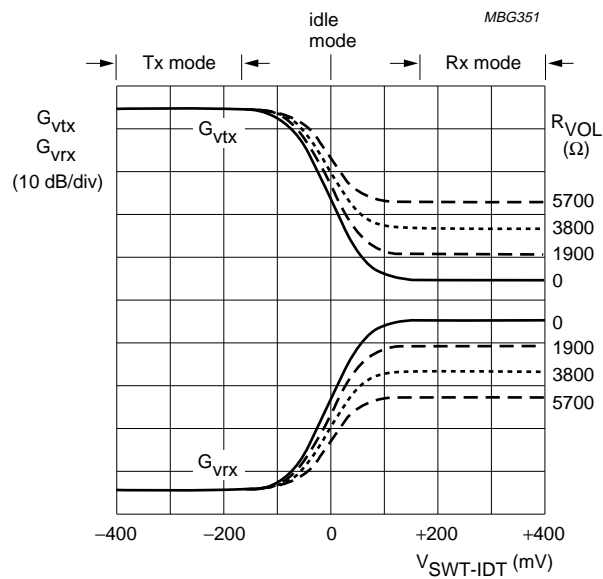


Fig.10 Switch-over behaviour.

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**LIMITING VALUES**

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{n(max)}$	maximum voltage on all pins; except pins $V_{BB}$ , and RXIN		$V_{GND} - 0.4$	$V_{BB} + 0.4$	V
$V_{RIN(max)}$	maximum voltage on pin RXIN		$V_{GND} - 1.2$	$V_{BB} + 0.4$	V
$V_{BB(max)}$	maximum voltage on pin $V_{BB}$		$V_{GND} - 0.4$	12.0	V
$T_{stg}$	IC storage temperature		-40	+125	°C
$T_{amb}$	operating ambient temperature		-25	+75	°C

**THERMAL CHARACTERISTICS**

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient in free air		
	TEA1095	50	K/W
	TEA1095T	75	K/W

**CHARACTERISTICS**

$V_{BB} = 5\text{ V}$ ;  $V_{GND} = 0\text{ V}$ ;  $f = 1\text{ kHz}$ ;  $T_{amb} = 25\text{ °C}$ ; MUTETX = LOW; MUTERX = LOW; PD = LOW;  $R_{VOL} = 0\ \Omega$ ; measured in test circuit of Fig.11; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Supply (<math>V_{BB}</math>, PD and GND)</b>						
$V_{BB}$	supply voltage		2.9	–	12.0	V
$I_{BB}$	current consumption from pin $V_{BB}$		–	2.7	3.8	mA
<b>POWER-DOWN INPUT PD</b>						
$V_{IL}$	LOW level input voltage		$V_{GND} - 0.4$	–	0.3	V
$V_{IH}$	HIGH level input voltage		1.5	–	$V_{BB} + 0.4$	V
$I_{PD}$	power-down input current	PD = HIGH	–	2.5	5	$\mu\text{A}$
$I_{BB(PD)}$	current consumption from pin $V_{BB}$ in power-down mode	PD = HIGH	–	140	190	$\mu\text{A}$
<b>Transmit channel (TXIN, GATX, TXOUT, MUTETX and TXGND)</b>						
<b>TRANSMIT AMPLIFIER</b>						
$ Z_{i} $	input impedance between pins TXIN and TXGND		17	20	23	k $\Omega$
$G_{vtx}$	voltage gain from pin TXIN to TXOUT in transmit mode	$V_{TXIN} = 1\text{ mV (RMS)}$	–	15.5	–	dB
$\Delta G_{vtxr}$	voltage gain adjustment with $R_{GATX}$		-15.5	–	+24.5	dB
$\Delta G_{vtxT}$	voltage gain variation with temperature referenced to 25 °C	$V_{TXIN} = 1\text{ mV (RMS)}$ ; $T_{amb} = -25\text{ to }+75\text{ °C}$	–	$\pm 0.3$	–	dB
$\Delta G_{vtxf}$	voltage gain variation with frequency referenced to 1 kHz	$V_{TXIN} = 1\text{ mV (RMS)}$ ; $f = 300\text{ to }3400\text{ Hz}$	–	$\pm 0.3$	–	dB

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{notx}$	noise output voltage at pin TXOUT	pin TXIN connected to TXGND through 200 $\Omega$ in series with 10 $\mu$ F; psophometrically weighted (P53 curve)	–	–100	–	dBmp
<b>TRANSMIT MUTE INPUT MUTETX</b>						
$V_{IL}$	LOW level input voltage		$V_{GND} - 0.4$	–	0.3	V
$V_{IH}$	HIGH level input voltage		1.5	–	$V_{BB} + 0.4$	V
$I_{MUTETX}$	input current	MUTETX = HIGH	–	2.5	5	$\mu$ A
$\Delta G_{vtxm}$	voltage gain reduction with MUTETX active	MUTETX = HIGH	–	80	–	dB
<b>Receive channel (RXIN, GARX, RXOUT and MUTERX)</b>						
<b>RECEIVE AMPLIFIER</b>						
$ Z_i $	input impedance between pins RXIN and GND		17	20	23	k $\Omega$
$G_{vrx}$	voltage gain in receive mode; between RXIN and RXOUT	$V_{RXIN} = 20$ mV (RMS)	–	6.5	–	dB
$\Delta G_{vrxr}$	voltage gain adjustment with $R_{GARX}$		–20.5	–	+19.5	dB
$\Delta G_{vrxT}$	voltage gain variation with temperature referenced to 25 $^{\circ}$ C	$V_{RXIN} = 20$ mV (RMS); $T_{amb} = -25$ to $+75$ $^{\circ}$ C	–	$\pm 0.3$	–	dB
$\Delta G_{vrxf}$	voltage gain variation with frequency referenced to 1 kHz	$V_{RXIN} = 20$ mV (RMS); $f_i = 300$ to 3400 Hz	–	$\pm 0.3$	–	dB
$V_{norx(rms)}$	noise output voltage at pin RXOUT (RMS value)	input RXIN short-circuited through 200 $\Omega$ in series with 10 $\mu$ F; psophometrically weighted (P53 curve)	–	20	–	$\mu$ V
$\Delta G_{vrxv}$	voltage gain variation referenced to $\Delta R_{VOL} = 950$ $\Omega$	when total attenuation does not exceed the switching range	–	3	–	dB
<b>RECEIVE MUTE INPUT MUTERX</b>						
$V_{IL}$	LOW level input voltage		$V_{GND} - 0.4$	–	0.3	V
$V_{IH}$	HIGH level input voltage		1.5	–	$V_{BB} + 0.4$	V
$I_{MUTERX}$	input current	MUTERX = HIGH	–	2.5	5	$\mu$ A
$\Delta G_{vrxm}$	gain reduction with MUTERX active	MUTERX = HIGH	–	80	–	dB

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Envelope and noise detectors (TSEN, TENV, RSEN and RENV)</b>						
PREAMPLIFIERS						
$G_{V(TSEN)}$	voltage gain from TXIN to TSEN		–	40	–	dB
$G_{V(RSEN)}$	voltage gain between RXIN to RSEN		–	0	–	dB
LOGARITHMIC COMPRESSOR AND SENSITIVITY ADJUSTMENT						
$\Phi_{det(TSEN)}$	sensitivity detection on pin TSEN; voltage change on pin TENV when doubling the current from TSEN	$I_{TSEN} = 0.8$ to $160 \mu\text{A}$	–	18	–	mV
$\Phi_{det(RSEN)}$	sensitivity detection on pin RSEN; voltage change on pin RENV when doubling the current from RSEN	$I_{RSEN} = 0.8$ to $160 \mu\text{A}$	–	18	–	mV
SIGNAL ENVELOPE DETECTORS						
$I_{source(ENV)}$	maximum current sourced from pin TENV or RENV		–	120	–	$\mu\text{A}$
$I_{sink(ENV)}$	maximum current sunk by pin TENV or RENV		0.75	1	1.25	$\mu\text{A}$
$\Delta V_{ENV}$	voltage difference between pins RENV and TENV	when $10 \mu\text{A}$ is sourced from both RSEN and TSEN; envelope detectors tracking; note 1	–	$\pm 3$	–	mV
NOISE ENVELOPE DETECTORS						
$I_{source(NOI)}$	maximum current sourced from pins TNOI or RNOI		0.75	1	1.25	$\mu\text{A}$
$I_{sink(NOI)}$	maximum current sunk by pins TNOI or RNOI		–	120	–	$\mu\text{A}$
$\Delta V_{NOI}$	voltage difference between pins RNOI and TNOI	when $2 \mu\text{A}$ is sourced from both RSEN and TSEN; noise detectors tracking; note 1	–	$\pm 3$	–	mV
DIAL TONE DETECTOR						
$V_{RINDT(rms)}$	threshold level at pin RXIN (RMS value)		–	42	–	mV

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Decision logic (IDT and SWT)</b>						
SIGNAL RECOGNITION						
$\Delta V_{Srx(th)}$	threshold voltage between pins RENV and RNOI to switch-over from receive to idle mode	$V_{RXIN} < V_{RINDT}$ ; note 2	–	13	–	mV
$\Delta V_{Stx(th)}$	threshold voltage between pins TENV and TNOI to switch-over from transmit to idle mode	note 2	–	13	–	mV
SWITCH-OVER						
$I_{sourceSWT}$	current sourced from pin SWT when switching to receive mode		7.5	10	12.5	$\mu A$
$I_{sinkSWT}$	current sunk by pin SWT when switching to transmit mode		7.5	10	12.5	$\mu A$
$I_{idleSWT}$	current sourced from pin SWT in idle mode		–	0	–	$\mu A$
<b>Voice switch (STAB and SWR)</b>						
SWRA	switching range		–	40	–	dB
$\Delta SWRA$	switching range adjustment	with $R_{SWR}$ referenced to 365 k $\Omega$	–40	–	+12	dB
$ \Delta G_v $	voltage gain variation from transmit mode to idle mode on both channels		–	20	–	dB
$G_{tr}$	gain tracking ( $G_{vtx} + G_{vrx}$ ) during switching, referenced to idle mode		–	$\pm 0.5$	–	dB

**Notes**

1. Corresponds to  $\pm 1$  dB tracking.
2. Corresponds to 4.3 dB noise/speech recognition level.

Voice switched speakerphone IC

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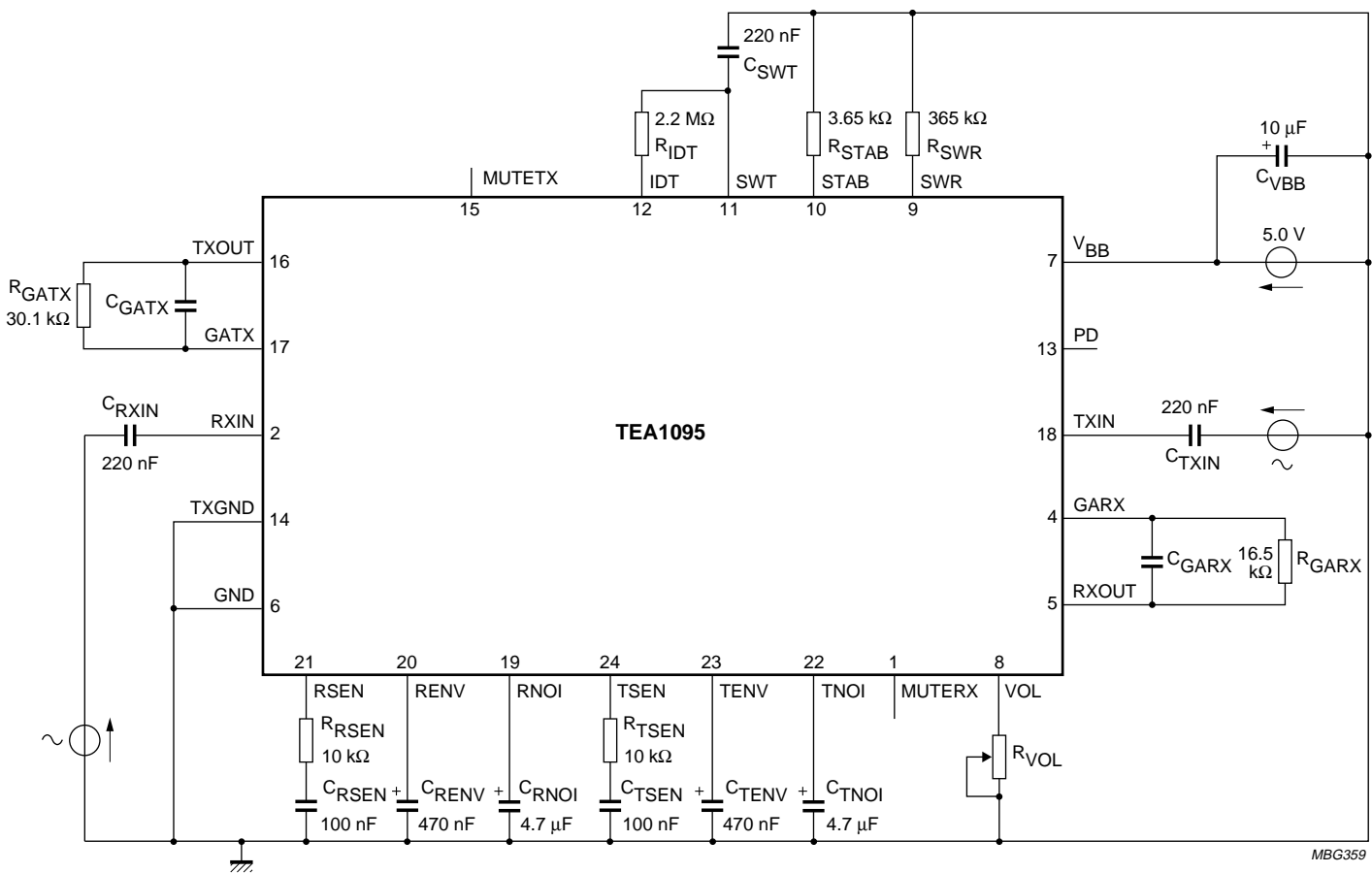


Fig.11 Test circuit.



Voice switched speakerphone IC

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APPLICATION INFORMATION

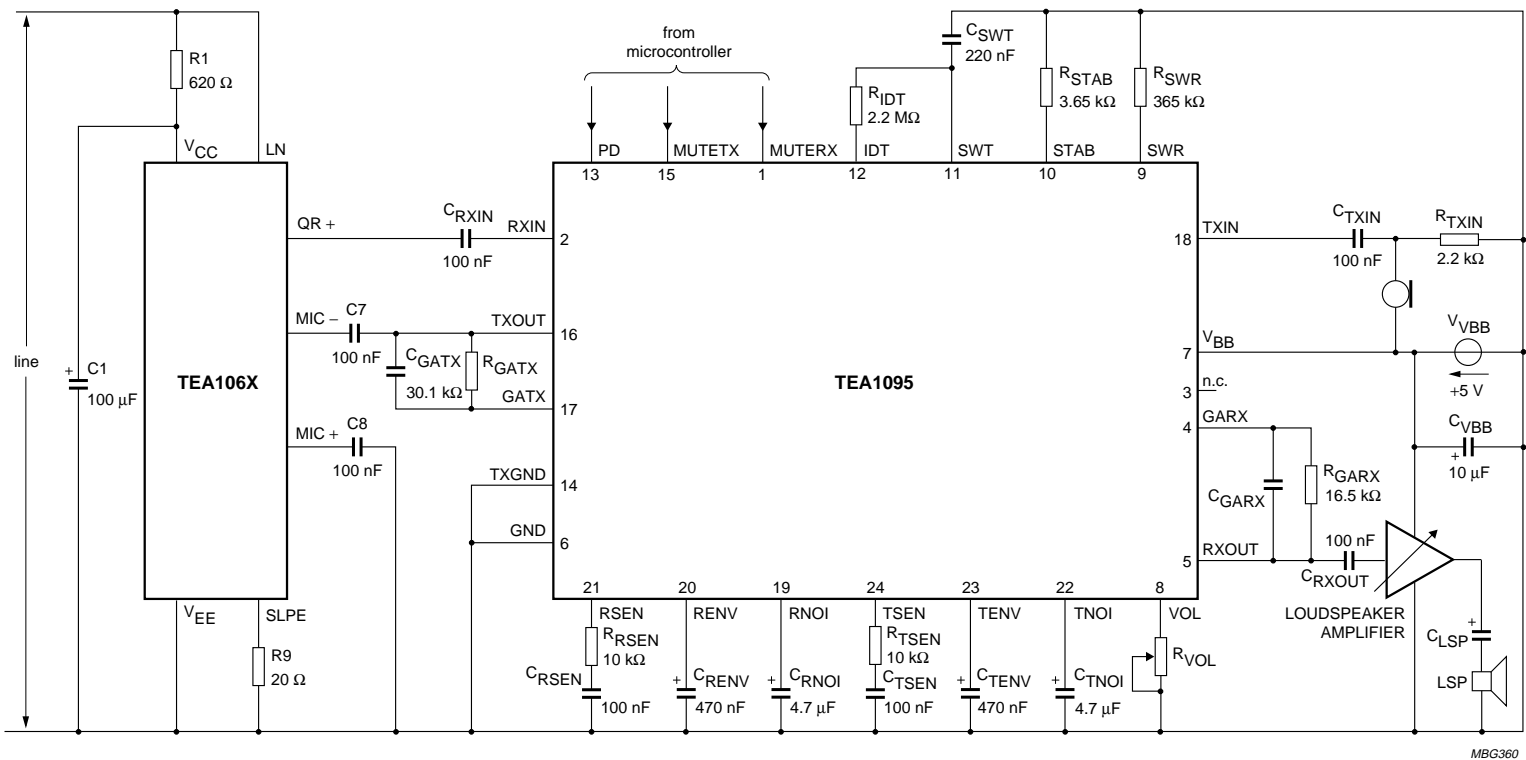
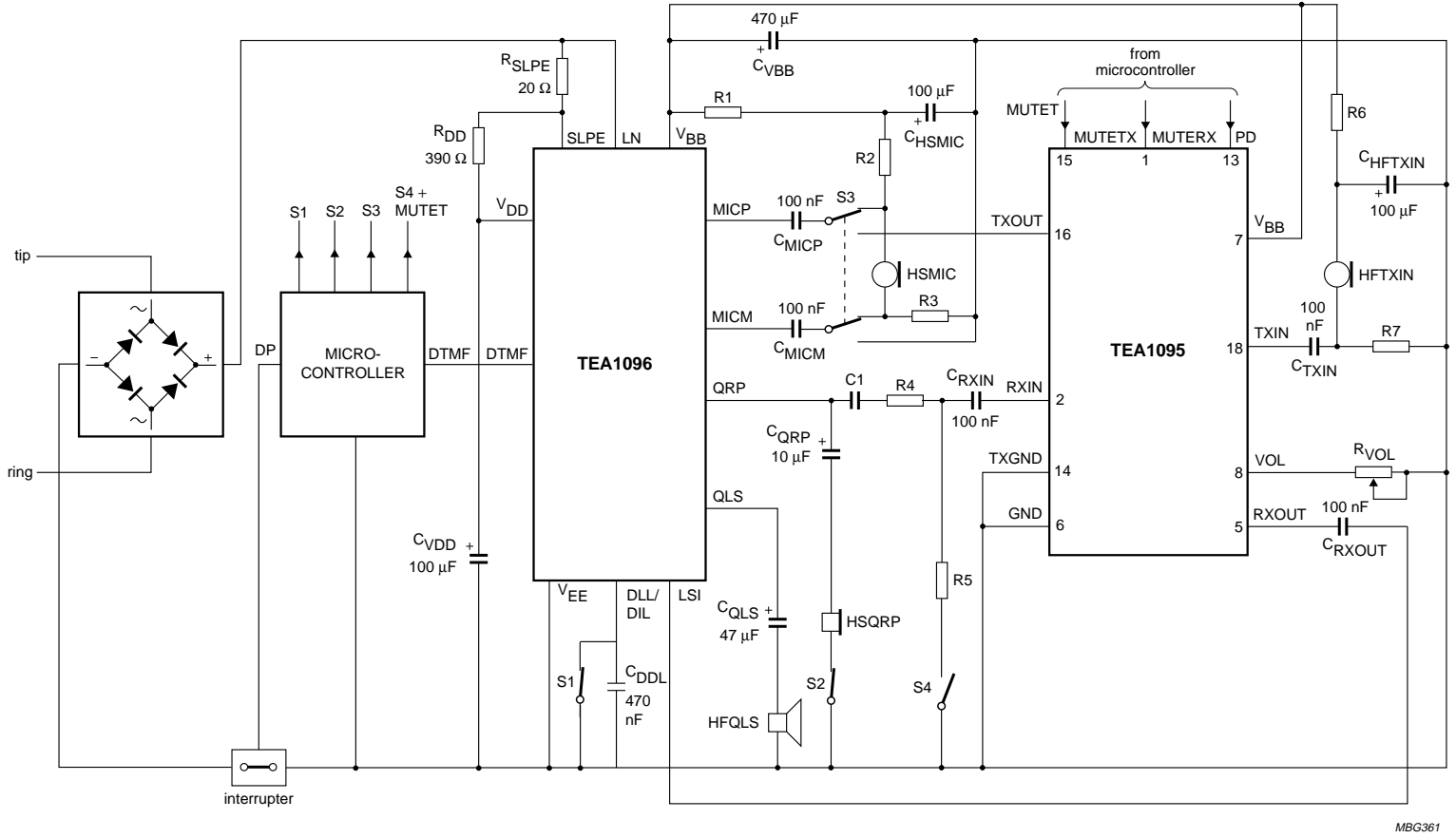


Fig.12 Basic application diagram.

Voice switched speakerphone IC

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MODE	SWITCH				MUTET
	S1	S2	S3	S4	
Hands-free	OPEN	OPEN	TXOUT	OPEN	LOW
Handset	CLOSED	CLOSED	HSMIC	OPEN	DON'T CARE
Handset plus listening-in	OPEN	CLOSED	HSMIC	CLOSED	HIGH

Fig.13 Application example.