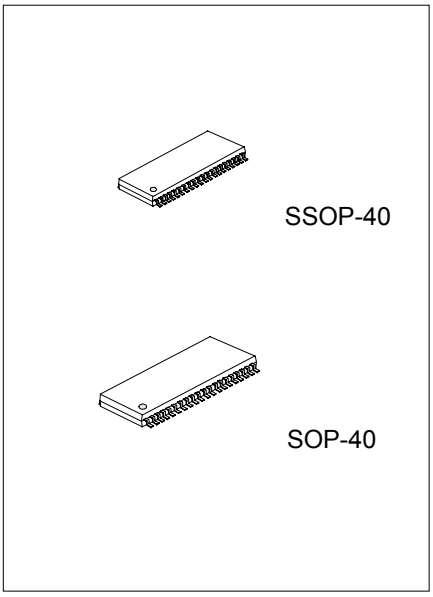
UTC TEA1098A LINEAR INTEGRATED CIRCUIT

SPEECH AND HANDSFREE



*Pb-free plating product number: TEA1098AL

DESCRIPTION

The UTC TEA1098A is designed to includes a line interface, handset (HS) microphone and earpiece amplifiers, handsfree (HF),microphone and loudspeaker amplifiers and a duplex controller with signal and noise monitors on both channels for telephony applications. It also equipped with Digital volume control for both earphone and loudspeaker amplifiers.

FEATURES

Line interface

*Operating voltage down to 1.6 V .
*Built-in adjustable DC voltage regulator
*Transmitting amplifier Usable with dynamic, magnetic , piezo-electric or electricmicrophones
*Receiving amplifier for dynamic, magnetic or piezo-electric earpieces with AGC for line loss compensation.
*$\overline{\text{DTMF}}$ input for confidence tone
*$\overline{\text{MUTE}}$ input for pulse or DTMF dialling

Supplies

*Provides 3.35V regulated supply for microcontrollers or dialers
* Optimized power supply that depends on line current
*Filtered 2.0V for electric microphone
*$\overline{\text{Pd}}$ pin that can have chip power-down.

Handsfree

*Asymmetrical high input impedance for electreic microphone
*Loudspeaker amplifier with single-ended rail-to-rail output and externally adjustable gain
* Loudspeaker amplifier with Dynamic limiter and 8 steps digital volume control
*Duplex controller with Signal and noise envelope monitors for both channels and have sensitivities and switch-over and idle mode timing adjustable.
* Voice switch control have adjustable switching range and constant sum of gain during switching

APPLICATIONS

*Line powered telephone sets.

PIN CONFIGURATION

PIN DESCRIPTION

SYMBOL	PIN No.	PAD No.	DESCRIPTION
$\overline{PD}$	1	40	Power-down input (active LOW)
$\overline{MUTE}$	2	41	Logic input (active LOW)
$\overline{BPC}$	3	42	Logic input (active LOW)
EVCI	4	43	Logic input for digital volume control (earpiece and loudspeaker LSB)
LVCI	5	44	Logic input for digital volume control (loudspeaker MSB)
HFRX	6	1	Receive input for loudspeaker amplifier
TNOI	7	2	Transmit noise envelope timing adjustment
TENV	8	3	Transmit signal envelope timing adjustment
TSEN	9	4	Transmit signal envelope sensitivity adjustment
RNOI	10	5	Receive noise envelope timing adjustment
RSEN	11	6	Receive signal envelope sensitivity adjustment
RENV	12	7	Receive signal envelope timing adjustment
DLC	13	8	Dynamic limiter capacitor for the loudspeaker amplifier
V_{BB}	14	9	Stabilized supply for internal circuitry
GALS	15	10	Loudspeaker amplifier gain adjustment
LSAO	16	11	Loudspeaker amplifier output
n.c.		12	Not connected
GND	17	13	Ground reference
SLPE	18	14 and 15	Line current sense
LN	19	16	Positive line terminal
REG	20	17	Line voltage regulator decoupling
IR	21	18	Receive amplifier input
AGC	22	19	Automatic gain control or line loss compensation
V_{DD}	23	20	3.35V regulated voltage supply for microcontrollers
MICS	24	21	Microphone supply
STAB	25	22	Reference current adjustment
SWR	26	23	Switching range adjustment
n.c.		24	Not connected
SWT	27	25	Switch-over timing adjustment
IDT	28	26	Idle mode timing adjustment
TXOUT	29	27	Handsfree microphone amplifier output
GATX	30	28	Handsfree microphone amplifier gain adjustment
TXIN	31	29	Handsfree microphone amplifier input
GNDTX	32	30 and 31	Ground reference for microphone amplifiers
MIC-	33	32	Negative handset microphone amplifier input
MIC+	34	33	Positive handset microphone amplifier input
DTMF	35	34	Dual tone multi-frequency input
EARO	36	35	Earpiece amplifier output
GARX	37	36	Earpiece amplifier gain adjustment
RECO	38	37	Receive amplifier output
HFTX	39	38	Transmit input for line amplifier
HFC	40	39	Logic input

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNIT
Positive continuous line voltage	V_{LN}	-0.4 ~ +12	V
Repetitive line voltage during switch-on or line interruption		-0.4 ~ +13.2	V
Maximum voltage on pins REG, SLPE, IR and AGC	$V_{n\ (max)}$	-0.4 ~ V_{LN}+0.4	V
Maximum voltage on all other pins except V_{DD}		-0.4 ~ V_{BB}+0.4	V
Maximum line current	I_{line}	130	mA
Total power dissipation (Ta=75℃)	Ptot	400	mW
Storage temperature	Tstg	-40 ~ +125	℃
Ambient temperature	Ta	-25 ~ +75	℃
Junction temperature	Tj	125	℃

ELECTRIC CHARACTERISTICS

(I_{line}=15mA, R_{SLPE}=20Ω, Z_{line}=600Ω, f=1kHz, Ta=25℃, pin AGC connected to pin LN, $\overline{PD}$=HIGH, HFC=LOW, $\overline{MUTE}$=HIGH, $\overline{BPC}$=HIGH, all DC levels are referenced to GND, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supplies						
LINE INTERFACE AND INTERNAL SUPPLY (pins LN,SLPE,REG and V_{BB})						
Stabilized voltage between pins SLPE and GND	V_{SLPE}	I_{line}=15mA	3.4	3.7	4	V
		I_{line}=70mA	5.7	6.1	6.5	V
Stabilized voltage with an external resistor R_{VA} between REG and SLPE	V_{REF}	R_{VA} = 40 kΩ		4.5		V
Stabilized voltage variation with temperature referenced to 25 ℃	$\triangle V_{REF(T)}$	Ta=-25 to +75℃		±60		mV
Line voltage	V_{LN}	I_{line}=1mA		1.55		V
		I_{line}=4mA		2.35		V
		I_{line}=15mA	3.7	4.0	4.3	V
		I_{line}=130mA		8.7	9.3	V
Regulated supply voltage for internal circuitry	V_{BB}	I_{line}=15mA, I_{BB}=0	2.75	3.0	3.25	V
		I_{line}=70mA, I_{BB}=0	4.9	5.3	5.7	V
Line current for voltage increase	I_{line}	Start current		18		mA
		Stop current		45		mA
Regulated voltage variation with temperature referenced to 25℃	$\triangle V_{BB(T)}$	Ta=-25 ~ +75℃		±30		mV
Current available on pin V_{BB}	I_{BB}	In speech mode		11		mA
		In handsfree mode		9		
SUPPLY FOR PERIPHERALS (pin V_{DD})						
Regulated supply voltage on V_{DD}	V_{DD}	V_{BB}>3.35V+0.25V(typ.)	3.1	3.35	3.6	V
		Otherwise		V_{BB}-0.25		V
Regulated voltage variation with temperature referenced to 25℃	$\triangle V_{DD(T)}$	Ta=-25 to +75℃, V_{BB}>3.35V+0.25V(typ.)		±30		mV
Current consumption on V_{DD}	I_{DD}	In trickle mode, I_{line}=0mA, V_{DD}=1.5V, V_{BB} discharging		15	150	nA
Current sunk from external source	$I_{DD(ext)}$	In ringer mode, I_{line} = 0, V_{DD} = 3.35 V			75	mA
Current available for peripherals	$I_{DD(o)}$	V_{DD}=3.3V		-3		mA

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
SUPPLY FOR MICROPHONE (pin MICS)						
Supply voltage for a microphone	V_{MICS}			2.0		V
POWER-DOWN INPUT (PIN $\overline{PD}$)						
LOW-level input voltage	V_{IL}		-0.4		+0.3	V
HIGH-level input voltage	V_{IH}		1.4		V_{BB}+0.3	V
Input current at low voltage	$I_{i(PD)(l)}$			-3	-6	μA
Current consumption on V_{BB} during power-down phase	$I_{BB(PD)}$	PD=LOW		460		μA
TX Amplifiers						
TX HANDSET MICROPHONE AMPLIFIER (pins MIC+, MIC- and LN)						
Voltage gain from pins MIC+/MIC- to LN	$G_{V(MIC-LN)}$	V_{MIC} = 5 mV (RMS)	43.3	44.3	45.3	dB
Gain variation with frequency referenced to 1 kHz	$\triangle G_{V(f)}$	f = 300 ~ 3400 Hz		±0.25		dB
Gain variation with temperature referenced to 25°C	$\triangle G_{V(T)}$	Ta = -25 ~ +75°C		±0.25		dB
Common mode rejection ratio	CMRR			80		dB
Total harmonic distortion at LN	THD	V_{LN} = 1.4 V (RMS)			2	%
		I_{line} = 4 mA, V_{LN} = 0.12 V (RMS)			10	%
Noise output voltage at pin LN, pins MIC+/MIC- shorted through 200Ω	$V_{no(LN)}$			-77		dBmp
Gain reduction when muted	$\triangle G_{V(mute)}$	$\overline{MUTE}$=0, see Table 2	60	80		dB
Gain reduction in microphone mute mode	$\triangle G_{V(MIC)(mute)}$	V_{MIC} = 10 mV (RMS), $\overline{MUTE}$ = 1, BPC = 0, see Table 2	60			dB
DTMF AMPLIFIER (pins DTMF, LN and RECO)						
Voltage gain from pins DTMF to LN	$G_{V(DTMF-LN)}$	V_{DTMF} = 50 mV (RMS)	24.35	25.35	26.35	dB
Gain variation with frequency referenced to 1 kHz	$\triangle G_{V(f)}$	f = 300 ~ 3400 Hz		±0.25		dB
Gain variation with temperature referenced to 25°C	$\triangle G_{V(T)}$	Ta = –25 ~ +75°C		±0.25		dB
Gain reduction if not active	$\triangle G_{V(mute)}$	$\overline{MUTE}$=1, see Table 2	60	80		dB
Voltage gain from pin DTMF to RECO in handsfree mode	$G_{V(DTMF-RECO)}$	V_{DTMF} = 50 mV (RMS), $\overline{MUTE}$ = 0, HFC = 1		-17		dB
Voltage gain from pin DTMF to RECO in handset mode	$G_{V(DTMF-RECO)}$	V_{DTMF} = 50 mV (RMS), $\overline{MUTE}$ = 0, HFC = 0, EVCI=0		-28.2		dB
Digital volume control adjustment range in handset mode	$\triangle G_{V(DTMF-RECO)}$	V_{DTMF} = 50 mV (RMS), $\overline{MUTE}$ = 0, HFC = 0		-12.75		dB
Digital volume control adjustment step in handset mode	$\triangle G_{V(DTMF-RECO)}$	$\overline{MUTE}$ = 0, HFC = 0, per step		4.25		dB
TX AMPLIFIER USING HFTX (pins HFTX AND LN						
Voltage gain from pin HFTX to LN	$G_{V(HFTX-LN)}$	V_{HFTX} = 15 mV (RMS)	33.5	34.7	35.9	dB
Gain variation with frequency referenced to 1 kHz	$\triangle G_{V(f)}$	f = 300 ~ 3400 Hz		±0.25		dB
Gain variation with temperature referenced to 25°C	$\triangle G_{V(T)}$	Ta = -25 ~ +75°C		±0.35		dB
Total harmonic distortion at LN	THD	V_{LN} = 1.4 V (RMS)			2	%
Maximum input voltage at HFTX (RMS value)	$V_{HFTX(rms)}$	I_{line} = 70 mA, THD = 2%		85		mV

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Noise output voltage at pin LN; pin HFTX shorted to GND through 200Ω in series with 10μF	$V_{no(LN)}$			-77		dBmp
Gain reduction when muted	$\triangle G_{v(mute)}$	$\overline{MUTE}$ = 0, see Table 2	60	80		dB
Gain reduction in microphone mute mode	$\triangle G_{v(MIC)(mute)}$	$\overline{MUTE}$ = 1, $\overline{BPC}$=0, see Table 2	60			dB
RX Amplifiers						
RX AMPLIFIERS USING IR(pins IR and RECO)						
Roltage gain from pin IR to RECO (handset mode)	$G_{v(IR-RECO)(HF)}$	V_{IR}=4mV(RMS), HFC=1	28.4	29.4	30.4	dB
Voltage gain from pin IR to RECO (handsfree mode)	$G_{v(IR-RECO)(HS)}$	V_{IR}=4mV(RMS), HFC=0, EVCI=0	16.2	17.2	18.2	dB
Digital volume control adjustment range in handset mode	$\triangle G_{v(IR-RECO)}$	V_{IR}=4mV(RMS), HFC= 0, EVCI = V_{DD}	13	14.5	16	dB
Digital volume control adjustment step in handset mode	$\triangle G_{v(IR-RECO)}$	HFC = 0, per step		+4.85		dB
Gain variation with frequency referenced to 1 kHz	$\triangle G_{v(f)}$	f = 300 ~ 3400 Hz		±0.25		dB
Gain variation with temperature referenced to 25℃	$\triangle G_{v(T)}$	Ta = -25 ~ +75℃		±0.3		dB
Maximum input voltage on IR (referenced to LN) (RMS value)	$V_{IR(rms)(max)}$	I_{line}= 70 mA, THD = 2%		50		mV
Maximum output voltage on RECO (RMS value)	$V_{RECO(rms)(max)}$	THD=2%, $G_{v(RECO-EARO)}$=12dB	0.75	0.9		V
Noise output voltage at pin RECO, pin IR is an open-circuit (RMS value)	$V_{no(RECO)(rms)}$			-84		dBVp
Gain reduction if not activated	$\triangle G_{v(mute)}$	$\overline{MUTE}$ = 0, see Table 2	60	80		dB
RX EARPIECE AMPLIFIER (pins GARX and EARO)						
Gain voltage range between pins RECO and EARO	$\triangle G_{v(RECO-EARO)}$		0		20	dB
Maximum output voltage on EARO (RMS value)	$V_{EARO(rms)(max)}$	sine wave drive, R_L=150Ω, THD < 2%	0.75	0.9		V
Noise output voltage at pin EARO, pin IR is an open-circuit (RMS value)	$V_{no(EARO)(rms)}$	$G_{v(EARO)}$=12dB, EVCI=0		-84		dBVp
Automatic Gain Control (pin AGC)						
Gain control range for transmit and receive amplifiers affected by the AGC, with respect to I_{line} = 15mA	$\triangle G_{v(trx)}$	I_{line} = 70mA, $G_{v(MIC-LN)}$, $G_{v(IR-RECO)}$, R_{AGC}=0	5.45	6.45	7.45	dB
		I_{line}= 70mA for $G_{v(HFTX-LN)}$, R_{AGC}=0	5.8	6.8	7.8	dB
Highest line current for maximum gain	I_{start}			23		mA
Lowest line current for maximum gain	I_{stop}			57		mA
I_{start} adjustment range with R_{AGC}	$\triangle I_{start}$				40	mA
Logic Inputs(pins HFC $\overline{MUTE}$ and $\overline{BPC}$)						
LOW-level input voltage	V_{IL}		-0.4		+0.3	V
HIGH-level input voltage	V_{IH}		1.4		V_{BB}+0.3	V
Input current at low voltage for pin HFC for pin $\overline{MUTE}$ for pin $\overline{BPC}$	$I_{i(l)}$	V_{BB} = 3.0 V		 0 -5 -2.5		μA

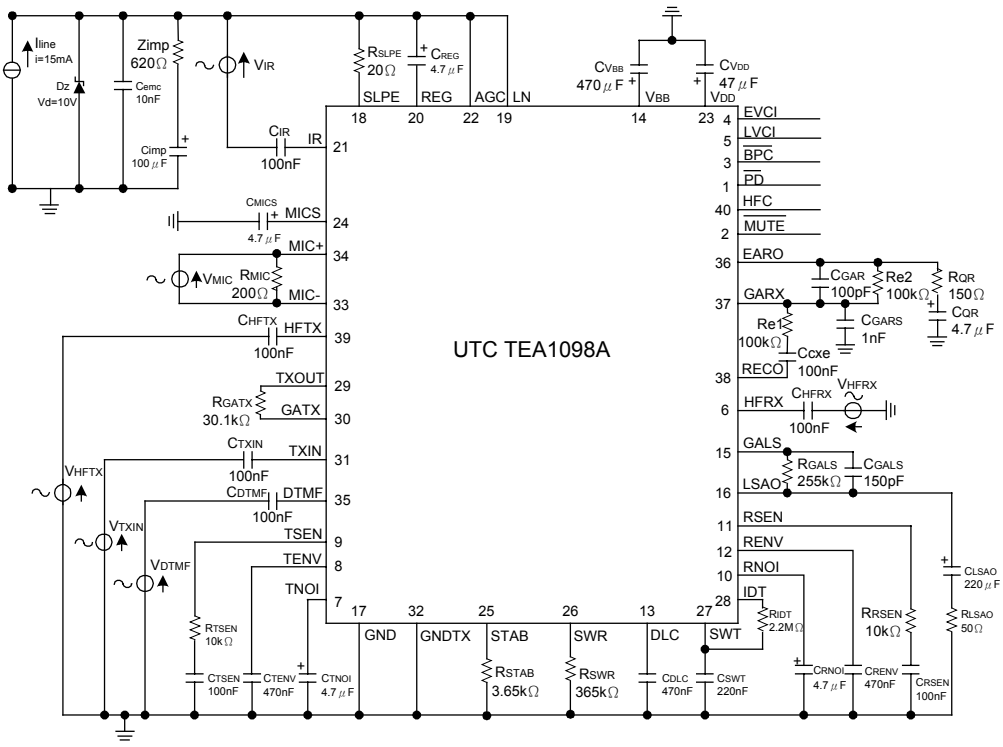
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input current at high voltage for pin HFC for pin $\overline{\text{MUTE}}$ for pin $\overline{\text{BPC}}$	$I_{i(h)}$	V_{BB} = 3.0 V		2.5 0 0		μA
Handsfree mode (HFC = HIGH)						
HF MICROPHONE AMPLIFIER (pins TXIN, TXOUT and GATX)						
Voltage gain from pin TXIN to TXOUT	$G_{V(TXIN-TXOUT)}$	V_{TXIN} = 3 mV (RMS), R_{GATX} = 30.1kΩ	12.7	15.2	17.7	dB
Voltage gain adjustment with R_{GATX}	△Gv		-15		+16	dB
Gain variation with frequency referenced to 1 kHz	△Gv(f)	f = 300 ~ 3400 Hz		±0.1		dB
Gain variation with temperature referenced to 25 ℃	△Gv(T)	Ta = -25 ~ +75 ℃		±0.15		dB
Noise output voltage at pin TXOUT, pin TXIN is shorted through 200Ω in series with 10μF to GNDTX	$V_{no(TXOUT)(rms)}$	$G_{V(TXIN)}$=15dB, RMS value		-101		dBVp
Gain reduction when muted	△Gv(mute)	$\overline{\text{MUTE}}$ = 0, see Table 2	60	80		dB
Gain reduction in secret mode	△Gv(SEC)	V_{TXIN} = 10 mV (RMS), $\overline{\text{MUTE}}$ = 1, BPC = 0, see Table 2	60			dB
HF LOUDSPEAKER AMPLIFIER (pins HFRX, LSAO, GALS and DLC)						
Voltage gain from pin HFRX to LSAO	$G_{V(HFRX-LSAO)}$	V_{HFRX} = 30 mV (RMS), R_{GALS} = 255 kΩ, LVCI=V_{DD}, EVCI=V_{DD}	24.5	27	29.5	dB
Digital volume control adjustment range	△$G_{V(HFRX-LSAO)}$	V_{HFRX} = 30 mV (RMS), R_{GALS} = 255 kΩ	25.5	27	28.5	dB
Digital volume adjustment step	△$G_{V(step)}$	Per step		3.85		dB
Voltage gain adjustment with RGALS	△Gv		-28		+7	dB
Gain variation with frequency referenced to 1 kHz	△Gv(f)	f = 300 ~ 3400 Hz		±0.3		dB
Gain variation with temperature referenced to 25℃	△Gv(T)	Ta = -25 ~ +75℃		±0.3		dB
Maximum input voltage at pin HFRX (RMS value)	$V_{HFRX(rms)}$ (max)	I_{line} = 70 mA, R_{GALS} = 33 kΩ, for THD = 2% in the input stage		580		mV
Noise output voltage at pin LSAO, pin HFRX is open-circuit (RMS value)	$V_{no(LSAO)(rms)}$	LVCI=V_{DD}, EVCI=V_{DD}		-79		dBVp
Gain reduction if not activated	△Gv(mute)	See Table 2	60			dB
Output voltage capability (RMS value) at pin LSAO with sine wave signal and loaded with 50Ω + 220μF, G_{VLSAO} = 28 dB	$V_{LSAO(rms)}$	I_{BB} = 0 mA, I_{DD} = 1 mA I_{line} = 18 mA I_{line} = 30 mA Iline > 50 mA		0.9 1.3 1.6		V
Maximum output current at pin LSAO (peak value)	$I_{LSAO(max)}$		150	300		mA
DYNAMIC LIMITER (pins LSAO AND DLC)						
Attack time	t_{att}	V_{HFRX} jumps up from 20 mV to 20 mV + 10 dB			5	ms
		V_{BB} jumps below $V_{BB(th)}$		1		ms

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Total harmonic distortion	THD	V_{HFRX} = 20 mV +10 dB; t > t_{att}		1	2	%
V_{BB} limiter threshold	$V_{BB(th)}$			2.7		V
MUTE RECEIVE (pin DLC)						
Threshold voltage required on pin DLC to obtain mute receive condition	$V_{DLC(th)}$				0.2	V
Threshold current sourced by pin DLC in mute receive condition	$I_{DLC(th)}$	V_{DLC} = 0.2 V		100		μA
Voltage gain reduction in mute receive condition	$\triangle G_{vrx(mute)}$	V_{DLC} = 0.2 V	60	80		dB
TX and RX ENVELOPE and NOISE DETECTORS (pins TSEN, TENV, TNOI, RSEN, RENV and RNOI)						
Logarithmic compressor and sensitivity adjustment						
Sensitivity detection on pin TSEN, voltage change on pin TENV when doubling the current from TSEN	$\triangle V_{det(TSEN)}$	I_{TSEN} = 0.8 ~ 160 μA		18		mV
Sensitivity detection on pin RSEN, voltage change on pin RENV when doubling the current from RSEN	$\triangle V_{det(RSEN)}$	I_{RSEN} = 0.8 ~ 160 μA		18		mV
Signal envelope detectors						
Maximum current sourced from pin TENV or RENV	$I_{source(ENV)}$			120		μA
Maximum current sunk by pin TENV or RENV	$I_{sink(ENV)}$		-1.25	-1	-0.75	μA
Voltage difference between pins RENV and TENV	$\triangle V_{ENV}$	10 μA is sourced from both RSEN and TSEN, signal detectors tracking, note 1		$\pm$3		mV
Noise envelope detectors						
Maximum current sourced from pin TNOI or RNOI	$I_{source(NOI)}$		0.75	1	1.25	μA
Maximum current sunk by pin TNOI or RNOI	$I_{sink(NOI)}$			-120		μA
Voltage difference between pins RNOI and TNOI	$\triangle V_{NOI}$	5 μA is sourced from both RSEN and TSEN, noise detectors tracking, note 1		$\pm$3		mV
DIAL TONE DETECTOR						
Threshold level at pin HFRX (RMS value)	$V_{HFRX(th)(rms)}$	R_{RSEN} = 10 kΩ, C_{RSEN}=100nF		25		mV
TX LEVEL LIMITER						
Threshold level at pin TXIN (RMS value)	$V_{TXIN(th)(rms)}$	R_{TSEN} = 10 kΩ		0.75		mV
DECISION LOGIC (pins IDT AND SWT)						
Signal recognition						
Threshold voltage between RENV/ RNOI or between TENV/TNOI to switch-over from Idle mode to RX/ TX mode	$\triangle V_{Srx(th)}$	V_{HFRX} < $V_{HFRX(th)}$, V_{TXIN} < $V_{TXIN(th)}$, note 2		13		mV
Switch-over						
Current sourced from pin SWT when switching to receive mode	$I_{source(SWT)}$		7.5	10	12.5	μA
Current sunk by pin SWT when switching to transmit mode	$I_{sink(SWT)}$		-12.5	-10	-7.5	μA

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Current sourced from pin SWT in Idle mode	$I_{idle(SWT)}$			0		μA
VOICE SWITCH (pins STAB AND SWR)						
Switching range	SWR			40		dB
Switching range adjustment	△SWR	R_{SWR} =365 kΩ	-40		+12	dB
Voltage gain variation from transmit or receive mode to Idle mode	$\lvert\triangle Gv\rvert$	SWRA=40 dB		±20		dB
Gain tracking (Gvtx + Gvrx) during switching, referenced to Idle mode	Gtr			±0.5		dB

Notes
1. Corresponds to ±1dB tracking.
2. Corresponds to 4.3dB noise/speech recognition level.

TEST CIRCUIT



TYPICAL APPLICATION CIRCUIT

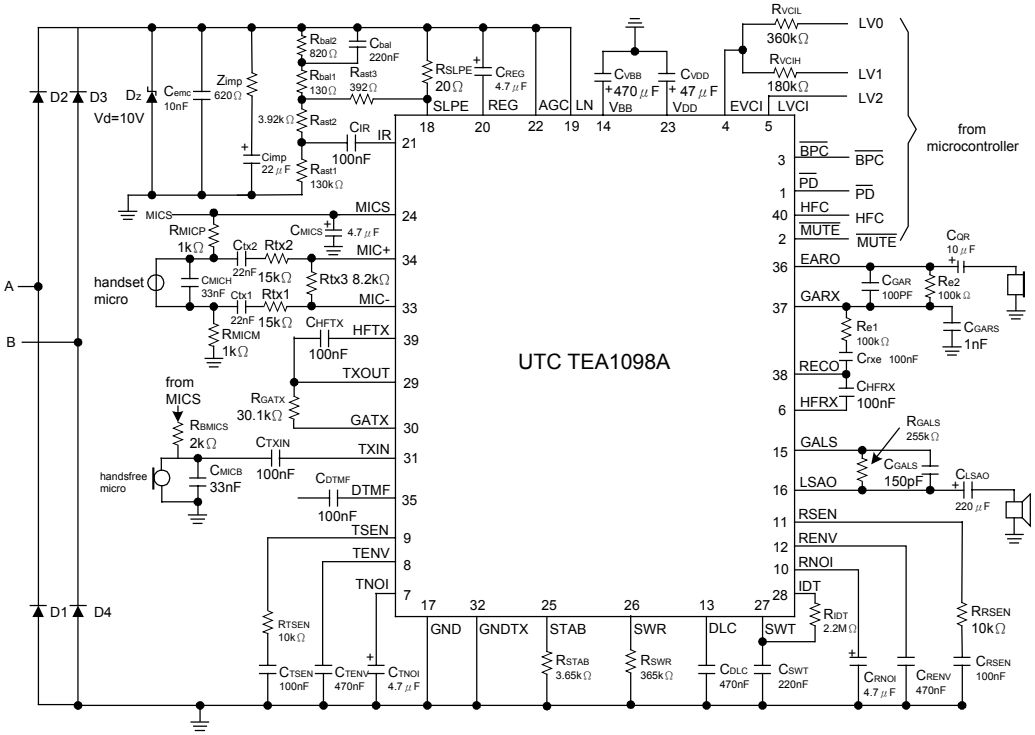
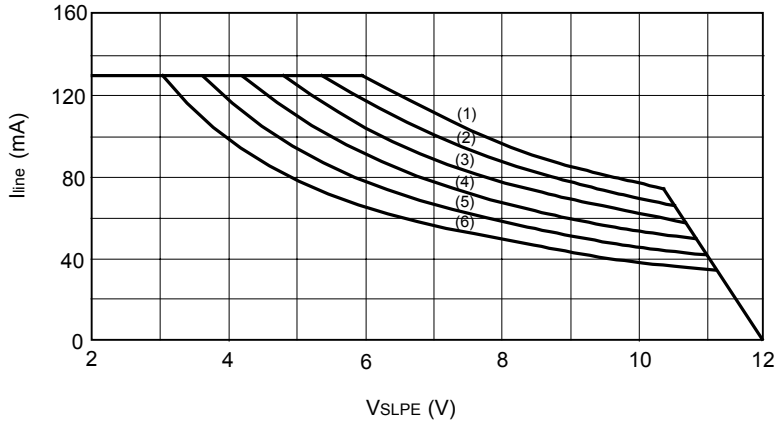


Fig. 7 Voice switch

Logic Inputs

Table 2 Selection of transmit and receive channels for 5 different application modes

LOGIC INPUTS			FEATURES	APPLICATION EXAMPLES
HFC	$\overline{\text{MUTE}}$	$\overline{\text{BPC}}$		
0	0	0	DTMF to RECO, RECO to EARO, MICS is active	handset beep mode
0	0	1	DTMF to LN, DTMF to RECO, RECO to EARO, MICS is active	handset dialling mode
0	1	0	IR to RECO, RECO to EARO, MICS is active	handset secret mode
0	1	1	MIC to LN, IR to RECO, RECO to EARO, MICS is active	handset conversation mod
1	0	0	DTMF to RECO, HFRX to LSAO, MICS is active	handsfree beep mode
1	0	1	DTMF to LN, DTMF to RECO, HFRX to LSAO, MICS is active	handsfree dialling mod
1	1	0	IR to RECO, HFRX to LSAO, MICS is active	handsfree secret mode
1	1	1	TXIN to TXOUT, HFTX to LN, IR to RECO, HFRX to LSAO, MICS is active	handsfree conversation mode



CURVE	Ta(℃)	Ptot(mW)
(1)	25	790
(2)	35	710
(3)	45	630
(4)	55	550
(5)	65	470
(6)	75	390

Safe operating area