

## μC-Controlled Speech and Ringer Circuit

### Description

The μC-controlled telephone circuit U4037B is a linear integrated circuit for use in telephone sets. It contains the speech circuit, tone-ringer interface, sidetone equivalent

and ear-protection rectifiers. The circuit is line powered and contains all components necessary for amplification of signals and adaptation to the line.

### Features

- DC characteristic adjustable
- Receive gain adjustable
- Symmetrical input of microphone amplifier
- Anti-clipping in transmit direction
- Automatic line-loss compensation
- Symmetrical output of earpiece amplifier
- Built-in ear protection
- DTMF and MUTE input
- Adjustable sidetone suppression independent of sending and receiving amplification
- Power down
- Tone-ringer interface
- Zero-crossing detection

- 2-bit D/A for volume control
- Supply voltages for all functional blocks of a subscriber set
- Operation possible from 8-mA line currents

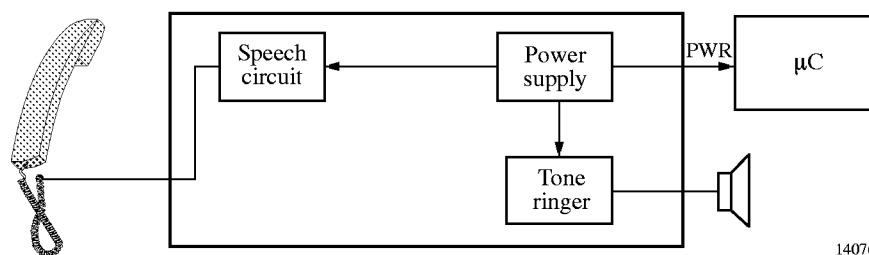
### Benefits

- Complete system integration of analog signal processing on one chip
- Very few external components

### Applications

Telephone sets

### Block Diagram



### Ordering Information

Type	Package	Remarks
U4037B-NFL	SO24	
U4037B-NFLG3	SO24	Taped and reeled

## Pin Description

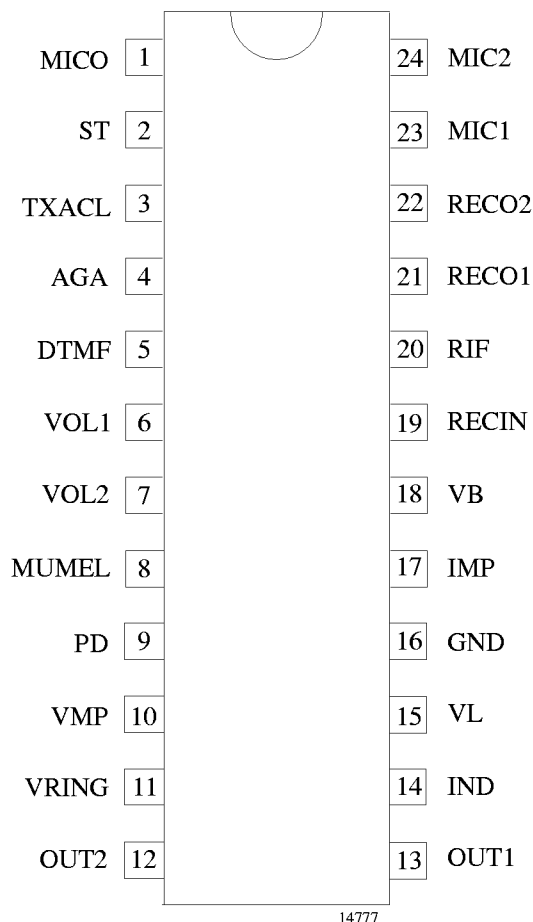


Figure 1. Pinning

Pin	Symbol	Function
1	MICO	Output of microphone preamplifier
2	ST	Sidetone reduction input input resistance is approx. 300 $\Omega$ , maximum load impedance: 10 k $\Omega$ .
3	TXACL	Time constant of anti-clipping in transmit path
4	AGA	Automatic gain adjustment with line current, a resistor connected from this pin to GND sets the starting point maximum gain change: 6 dB.
5	DTMF	Input for DTMF signals

Pin	Symbol	Function
6	VOL1	2-bit volume adjustment for tone ringer
7	VOL2	
8	MUMEL	1. Input for melody 2. Mute of microphone amplifier: – Speech condition, input MUMEL low – DTMF condition input MUMEL high DTMF signal at Pin 5 is fed to the line. A part of the DTMF- signal is passed to the receiving amplifier as a confidence signal during dialing.
9	PD	Active high input for reducing the current consumption of the circuit, simultaneously $V_L$ is shorted by an internal switch
10	VMP	Regulated supply voltage 3.3 V for peripheral circuits (esp. micropro- cessors), minimum output current: 2 mA (ringing) 4 mA (speech mode)
11	VRING	Input for ringing signal protected by internal Zener diode
12	OUT2	Output for tone ringer
13	OUT1	
14	IND	The internal equivalent inductance of the circuit is proportional to the value of the capacitor at this pin, a resistor connected to ground may be used to reduce the DC line voltage
15	VL	Line voltage
16	GND	Reference point for DC- and AC- output signals
17	IMP	Impedance adjustment
18	VB	Unregulated supply voltage for peripheral circuits (voice switch), limited to typically 7 V
19	RECIN	Receiver input
20	RIF	Pin for adjustment of frequency response and gain of receiver
21	RECO1	Output of receiving amplifier
22	RECO2	Inverting output of receiving ampl.
23	MIC1	Inverting input of microphone ampl.
24	MIC2	Non-inverting input of microphone amplifier

### Detailed Block Diagram with External Components

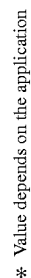


Figure 2. Application circuit

## Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
Line current	$I_L$	140	mA
DC line voltage	$V_L$	12	V
Maximum input current	$I_{RING}$	15	mA
Junction temperature	$T_j$	125	°C
Ambient temperature	$T_{amb}$	-25 to +75	°C
Storage temperature	$T_{stg}$	-55 to +150	°C
Total power dissipation, $T_{amb} = 60^\circ\text{C}$	$P_{tot}$	520	W

## Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient SO24	$R_{thJA}$	75	K/W

## Electrical Characteristics

$f = 1\text{ kHz}$ ,  $0\text{ dBm} = 775\text{ mV}_{rms}$ ,  $I_{MP} = 2\text{ mA}$ ,  $T_{amb} = 25^\circ\text{C}$ ,  $Z_{ear} = 68\text{ nF} + 100\text{ }\Omega$ ,  $Z_M = 68\text{ nF}$ , unless otherwise specified

Parameters	Test Conditions / Pin	Symbol	Min	Typ	Max	Unit
<b>DC characteristics</b>						
DC voltage drop over circuit	$I_L = 2\text{ mA}$ $I_L = 14\text{ mA}$ $I_L = 60\text{ mA}$ $I_L = 100\text{ mA}$	$V_L$	4.6 8.8	2.4 5.0 7.5 9.4	5.4 10.0	V
<b>Transmission amplifier, <math>I_L = 14\text{ mA}</math>, <math>V_{MIC} = 2\text{ mV}</math>, unless otherwise specified</b>						
Transmitting amplification		$G_T$	47	48	49	dB
Frequency response	$I_L \geq 14\text{ mA}$ , $f = 300\text{ to }3400\text{ Hz}$	$\Delta G_T$			$\pm 0.5$	dB
Gain change with current	$I_L = 14\text{ to }100\text{ mA}$	$\Delta G_T$			$\pm 0.5$	dB
Gain deviation	$T_{amb} = -10\text{ to }+60\text{ }^\circ\text{C}$	$\Delta G_T$			$\pm 0.5$	dB
CMRR of microphone amplifier		CMRR	60	80		dB
Input resistance of MIC amplifier		$R_i$		50		k $\Omega$
Distortion at line	$I_L > 14\text{ mA}$ $V_L = 700\text{ mV}_{rms}$	$d_t$			2	%
Maximum output voltage	$I_L > 19\text{ mA}$ , $d < 5\%$ $V_{mic} = 10\text{ mV}$ $CTXA = 1\text{ }\mu\text{F}$	$V_{Lmax}$	1.8	3	4.2	dBm
Noise at line psophometrically weighted	$I_L > 14\text{ mA}$ $G_T = 48\text{ dB}$	no		-80	-72	dBmp
Anti-clipping attack time release time	$CTXA = 1\text{ }\mu\text{F}$ each 3 dB overdrive			0.5 9		ms
Line-loss compensation	$I_L = 100\text{ mA}$ , $RAGA = 20\text{ k}\Omega$	$\Delta G_{TI}$	-6.4	-5.8	-5.2	dB
Mute suppression	$I_L \geq 14\text{ mA}$	$G_{TM}$	60	80		dB

## Electrical Characteristics (continued)

Parameters	Test Conditions / Pin	Symbol	Min.	Typ.	Max.	Unit
<b>Receiving amplifier, <math>I_L = 14</math> mA, unless otherwise specified, <math>V_{GEN} = 300</math> mV</b>						
Receiving amplification		$G_R$			12	dB
Adjustment range		$G_R$	-8		12	dB
Amplification of DTMF signal from DTMF IN to RECO 1, 2	$I_L \geq 14$ mA, $V_{DTMF} = 8$ mV	$G_{RM}$	14		20	dB
Frequency response	$I_L > 14$ mA, $f = 300$ to $3400$ Hz	$\Delta G_{RF}$			$\pm 0.5$	dB
Gain change with current	$I_L = 14$ to $100$ mA	$\Delta G_R$			$\pm 0.5$	dB
Gain deviation	$T_{amb} = -10$ to $+60^\circ\text{C}$	$\Delta G_R$			$\pm 0.5$	dB
Ear protection differential	$I_L \geq 14$ mA $V_{GEN} = 11 V_{rms}$	EP			2.2	$V_{rms}$
MUTE suppression	$I_L \geq 14$ mA	$\Delta G_R$	60			dB
Output voltage d $\leq 2\%$ differential	$I_L = 14$ mA $Z_{ear} = 68$ nF + $100 \Omega$		0.775			$V_{rms}$
Output voltage d $\leq 5\%$ differential	$I_L = 14$ mA $Z_{ear} = 68$ nF + $100 \Omega$ RDC = infinite		1.2			$V_{rms}$
Receiving noise psophometrically weighted	$Z_{ear} = 68$ nF + $100 \Omega$ $I_L \geq 14$ mA	ni			-64	dBmp
Output resistance	each output against GND	$R_o$			40	$\Omega$
Line-loss compensation	$R_{AGA} = 20$ k $\Omega$ , $I_L = 100$ mA	$\Delta G_{RI}$	-7.0	-6.0	-5.0	dB
Gain at low operating current	$I_L = 8$ mA, $I_{MP} = 1$ mA $I_M = 300 \mu\text{A}$ $V_{GEN} = 100$ mV RDC = $68$ k $\Omega$	$G_R$	10.5	12	13.5	dB
<b>DTMF-amplifier test conditions: <math>I_{MP} = 2</math> mA</b>						
DTMF amplification	$I_L = 15$ mA, $V_{DTMF} = 8$ mV Mute active	$G_D$	40.7	41.7	42.7	dB
Gain deviation	$I_L = 15$ mA $T_{amb} = -10$ to $+60^\circ\text{C}$	$G_D$			$\pm 0.5$	dB
Input resistance	$R_{GT} = 15$ k $\Omega$	$R_i$	15	20	25	k $\Omega$
Distortion of DTMF signal	$I_L \geq 15$ mA, $V_L = 0$ dBm	$d_D$			2	%
Gain deviation with current	$I_L = 15$ to $100$ mA	$\Delta G_D$			$\pm 0.5$	dB
<b>Supply voltages, <math>V_{mic} = 10</math> mV, <math>T_{amb} = -10</math> to <math>+60^\circ\text{C}</math></b>						
$V_{MP}$	$I_L = 8$ mA, RDC = $130$ k $\Omega$ $I_{MP} = 1$ mA	$V_{MP}$	3.1	3.4	3.6	V
<b>Ringin part, <math>I_{VMP} = 1</math> mA</b>						
Maximum output voltage	$V_{RING} = 20$ V	$V_{out}$		25		$V_{pp}$
Input impedance in speech mode	$f = 300$ Hz to $3400$ Hz $I_L > 15$ mA, $V_{TIP/RING} = 1.5 V_{rms}$	$R_i$	50			k $\Omega$

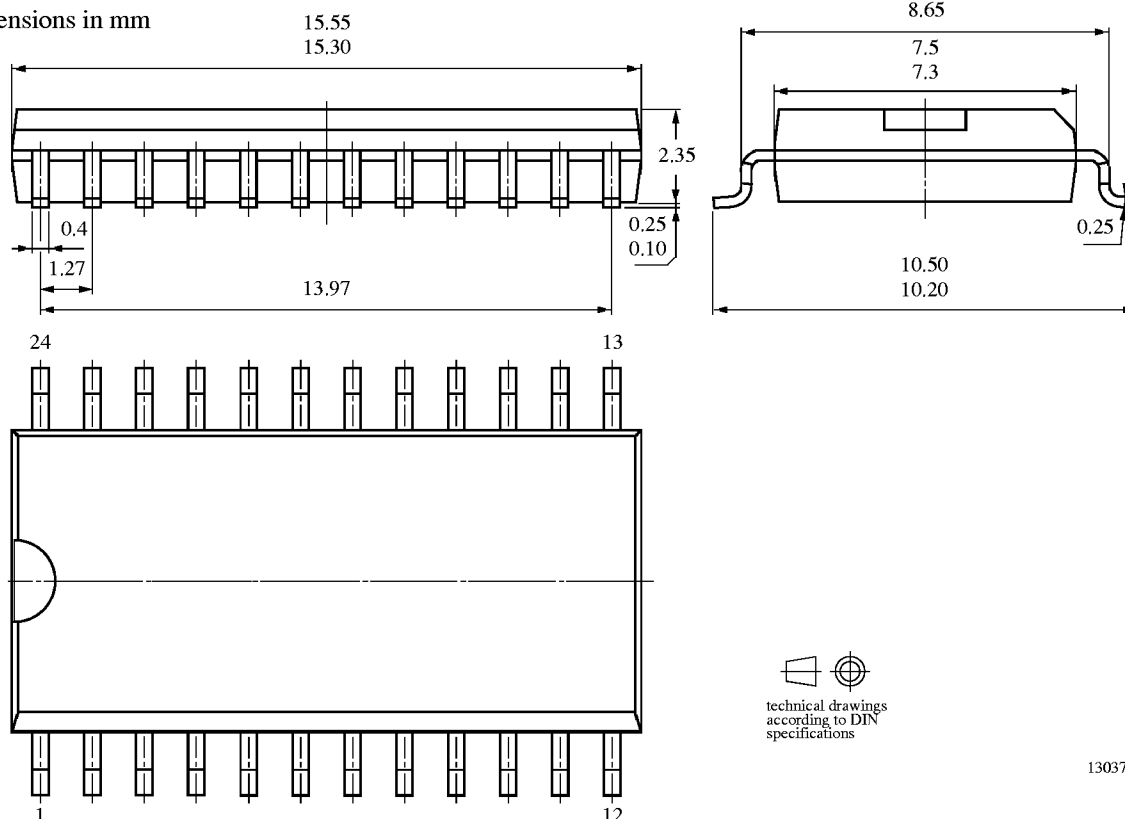
## Electrical Characteristics (continued)

Parameters	Test Conditions / Pin	Symbol	Min.	Typ.	Max.	Unit
Ringing part: Ringer output voltage	$f = 25 \text{ Hz}$ , $C_{\text{BUZ}} = 50 \text{ nF}$					
	$V_{\text{TIP/RING}} = 63 \text{ V}_{\text{rms}}$	$V_{\text{out}}$	28			$V_{\text{pp}}$
	$V_{\text{TIP/RING}} = 45 \text{ V}_{\text{rms}}$	$V_{\text{out}}$		18		$V_{\text{pp}}$
	$V_{\text{TIP/RING}} = 25 \text{ V}_{\text{rms}}$	$V_{\text{out}}$	7			$V_{\text{pp}}$
Volume adjustment steps		11		0		dB
		10		-6		
		01		-12		
		00		-24		
Zener diode voltage	$I_{\text{RING}} = 25 \text{ mA}$	$V_{\text{RINGmax}}$		28.5		V
<b>PD Input</b>						
PD input current	PD active, $I_{\text{L}} > 14 \text{ mA}$ $V_{\text{PD}} = V_{\text{MP}}$	$I_{\text{pd}}$		9		$\mu\text{A}$
Input voltage	PD = active PD = inactive	$V_{\text{pd}}$ $V_{\text{pd}}$	2		0.3	V
Voltage drop at $V_{\text{L}}$	PD = active, $I_{\text{L}} = 14 \text{ mA}$ $I_{\text{L}} = 100 \text{ mA}$ ,	$V_{\text{L}}$		1.5		V
		$V_{\text{L}}$		1.9		
Internal current consumption at $V_{\text{B}}$	$V_{\text{B}} = 3.5 \text{ V}$ , PD = active, $I_{\text{L}} = 0 \text{ mA}$	$I_{\text{B}}$		300		$\mu\text{A}$

## Package Information

### Package SO24

Dimensions in mm



technical drawings  
according to DIN  
specifications

13037

## Ozone Depleting Substances Policy Statement

It is the policy of **TEMIC Semiconductor GmbH** to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

**TEMIC Semiconductor GmbH** has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

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