



## 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
- 2-bit D/A for Volume Control
- Supply Voltages for All Functional Blocks of a Subscriber Set
- Operation Possible from 8-mA Line Currents



## Microcontroller-controlled Speech and Ringer Circuit

### U4037B-N

## Applications

- Telephone Sets

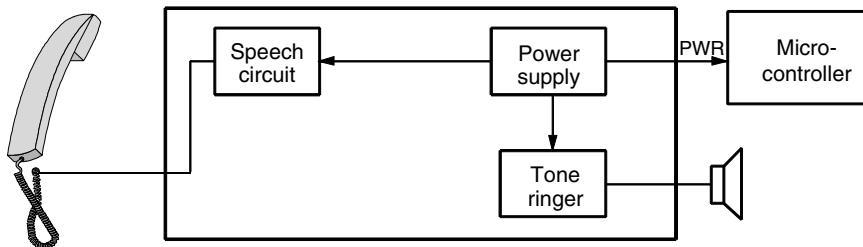
## Benefits

- Complete System Integration of Analog Signal Processing on One Chip
- Very Few External Components

## 1. Description

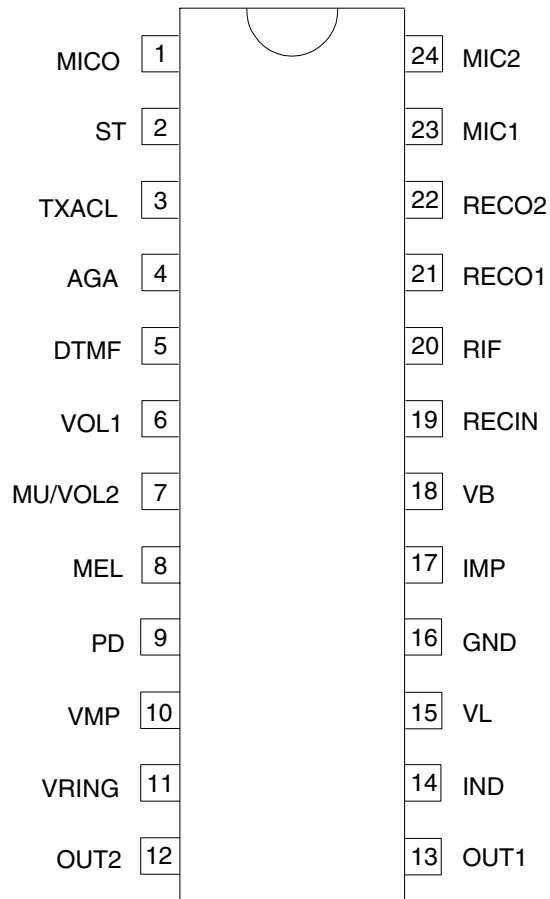
The microcontroller-controlled telephone circuit U4037B-N is a linear integrated circuit for use in telephone sets. It contains the speech circuit, tone-ringer interface, sidetone equivalent and ear-protection rectifiers. The circuit is line powered and contains all components necessary for amplification of signals and adaptation to the line.

Figure 1-1. Block Diagram



## 2. Pin Configuration

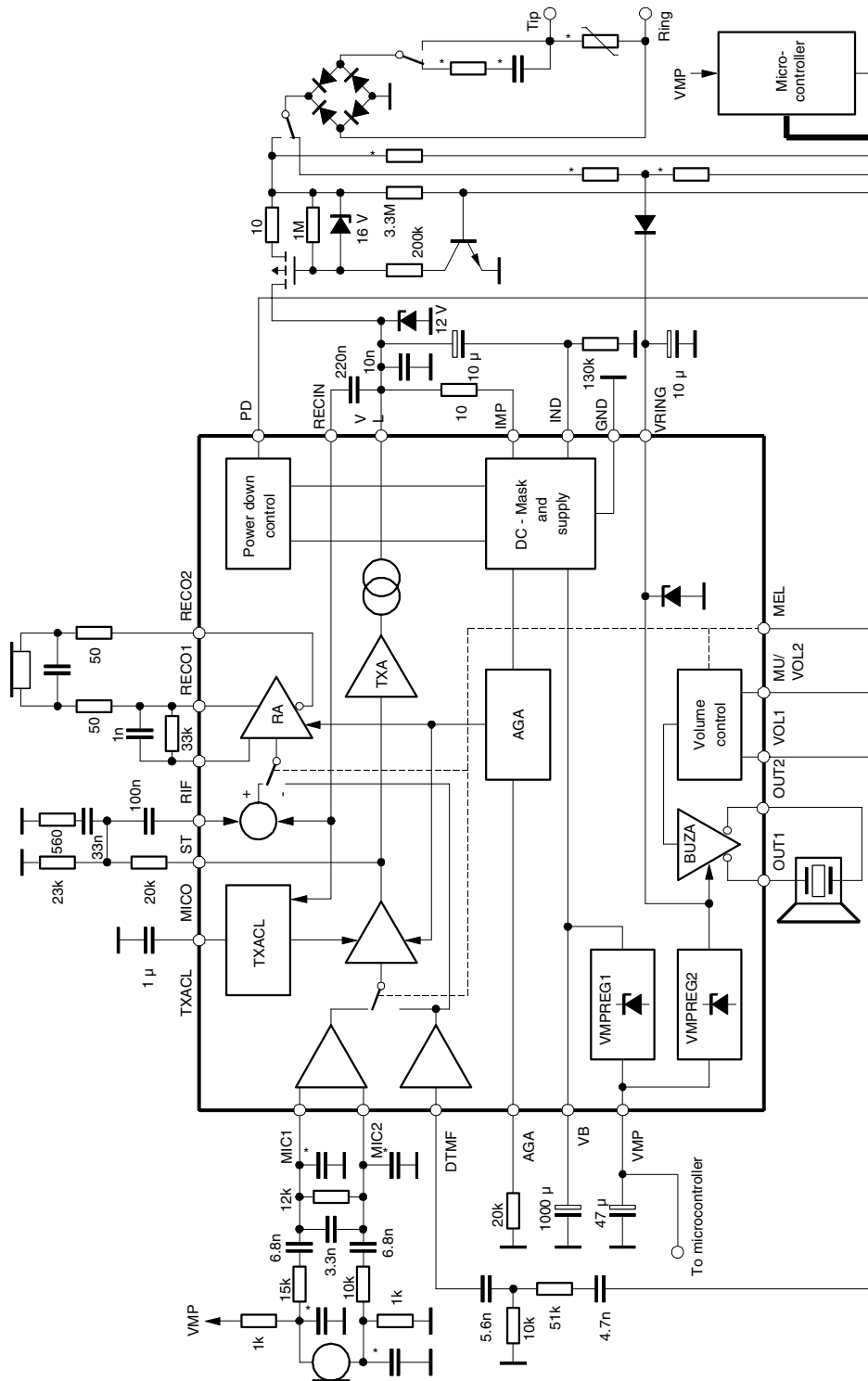
Figure 2-1. Pinning SO24



**Table 2-1.** Pin Description

Pin	Symbol	Function
1	MICO	Output of microphone preamplifier
2	ST	Sidetone reduction input, input resistance is approximately 25 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
6	VOL1	2-bit volume adjustment for tone ringer
7	MU/VOL2	1) 2-bit volume adjustment for tone ringer 2) Mute of microphone amplifier: - Speech condition, input MU/VOL2 low - DTMF condition input MU/VOL2 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
8	MEL	Input for melody
9	PD	Active high input for reducing the current consumption of the circuit, V <sub>L</sub> simultaneously is shorted by an internal switch
10	VMP	3.4V regulated supply voltage for peripheral circuits (especially microprocessors), minimum output current: 2 mA (ringing), 4 mA (speech mode)
11	VRING	Input for ringer supply voltage
12	OUT2	Differential 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 7V
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 amplifier
23	MIC1	Inverting input of microphone amplifier
24	MIC2	Non-inverting input of microphone amplifier

**Figure 2-2.** Detailed Block Diagram with External Components



\* Value depends on the application

### 3. Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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

### 4. Thermal Resistance

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

### 5. Electrical Characteristics

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

Parameters	Test Conditions	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	$T_{amb} = -10 \text{ to } +60^\circ\text{C}$	$\Delta G_T$			$\pm 0.5$	dB
CMRR of microphone amplifier		CMRR	60	80		dB
Input resistance of MIC amplifier		$R_i$		50		kW
Distortion at line	$I_L > 14 \text{ mA}$ $V_L = 700 \text{ mV}_{rms}$	$d_t$			2	%
Maximum output voltage	$I_L > 19 \text{ mA}$ , $d < 5\%$ $V_{MIC} = 10 \text{ mV}$ $CTXA = 1 \mu\text{F}$	$V_{Lmax}$	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	$CTXA = 1 \mu\text{F}$ 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

## 5. Electrical Characteristics (Continued)

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

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

### 5. Electrical Characteristics (Continued)

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

Parameters	Test Conditions	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	$V_{\text{pd}}$	2		0.3	V
	PD = inactive	$V_{\text{pd}}$				
Voltage drop at $V_{\text{L}}$	PD = active $I_{\text{L}} = 14 \text{ mA}$	$V_{\text{L}}$		1.5		V
	$I_{\text{L}} = 100 \text{ mA}$	$V_{\text{L}}$		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		$\mu\text{A}$

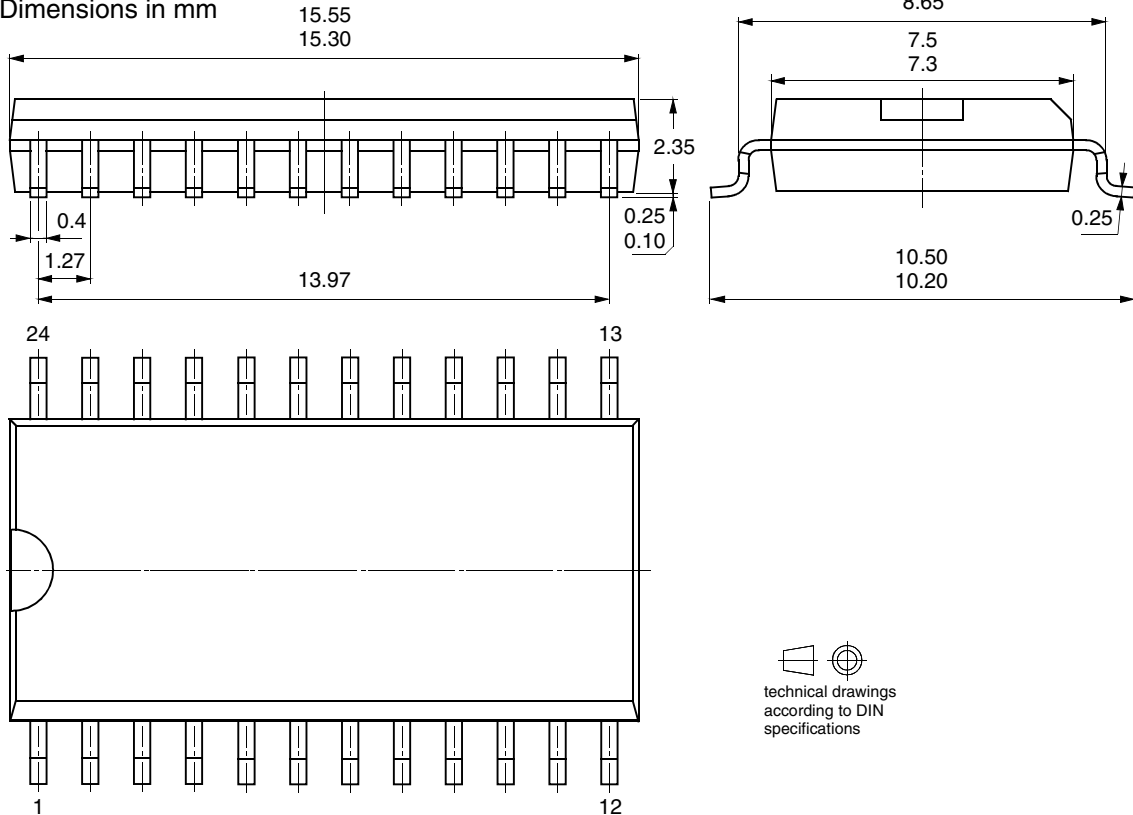
## 6. Ordering Information

Extended Type Number	Package	Remarks
U4037B-NFLY	SO24	Pb-free
U4037B-NFLG3Y	SO24	Taped and reeled, Pb-free

## 7. Package Information

### Package SO24

Dimensions in mm



technical drawings according to DIN specifications





## Atmel Corporation

2325 Orchard Parkway  
San Jose, CA 95131, USA  
Tel: 1(408) 441-0311  
Fax: 1(408) 487-2600

## Regional Headquarters

### Europe

Atmel Sarl  
Route des Arsenaux 41  
Case Postale 80  
CH-1705 Fribourg  
Switzerland  
Tel: (41) 26-426-5555  
Fax: (41) 26-426-5500

### Asia

Room 1219  
Chinachem Golden Plaza  
77 Mody Road Tsimshatsui  
East Kowloon  
Hong Kong  
Tel: (852) 2721-9778  
Fax: (852) 2722-1369

### Japan

9F, Tonetsu Shinkawa Bldg.  
1-24-8 Shinkawa  
Chuo-ku, Tokyo 104-0033  
Japan  
Tel: (81) 3-3523-3551  
Fax: (81) 3-3523-7581

## Atmel Operations

### Memory

2325 Orchard Parkway  
San Jose, CA 95131, USA  
Tel: 1(408) 441-0311  
Fax: 1(408) 436-4314

### Microcontrollers

2325 Orchard Parkway  
San Jose, CA 95131, USA  
Tel: 1(408) 441-0311  
Fax: 1(408) 436-4314

La Chantrerie  
BP 70602  
44306 Nantes Cedex 3, France  
Tel: (33) 2-40-18-18-18  
Fax: (33) 2-40-18-19-60

### ASIC/ASSP/Smart Cards

Zone Industrielle  
13106 Rousset Cedex, France  
Tel: (33) 4-42-53-60-00  
Fax: (33) 4-42-53-60-01

1150 East Cheyenne Mtn. Blvd.  
Colorado Springs, CO 80906, USA  
Tel: 1(719) 576-3300  
Fax: 1(719) 540-1759

Scottish Enterprise Technology Park  
Maxwell Building  
East Kilbride G75 0QR, Scotland  
Tel: (44) 1355-803-000  
Fax: (44) 1355-242-743

### RF/Automotive

Theresienstrasse 2  
Postfach 3535  
74025 Heilbronn, Germany  
Tel: (49) 71-31-67-0  
Fax: (49) 71-31-67-2340

1150 East Cheyenne Mtn. Blvd.  
Colorado Springs, CO 80906, USA  
Tel: 1(719) 576-3300  
Fax: 1(719) 540-1759

### Biometrics/Imaging/Hi-Rel MPU/ High Speed Converters/RF Datacom

Avenue de Rochepleine  
BP 123  
38521 Saint-Egreve Cedex, France  
Tel: (33) 4-76-58-30-00  
Fax: (33) 4-76-58-34-80

---

### Literature Requests

[www.atmel.com/literature](http://www.atmel.com/literature)

**Disclaimer:** The information in this document is provided in connection with Atmel products. No license, express or implied, by estoppel or otherwise, to any intellectual property right is granted by this document or in connection with the sale of Atmel products. **EXCEPT AS SET FORTH IN ATMEL'S TERMS AND CONDITIONS OF SALE LOCATED ON ATMEL'S WEB SITE, ATMEL ASSUMES NO LIABILITY WHATSOEVER AND DISCLAIMS ANY EXPRESS, IMPLIED OR STATUTORY WARRANTY RELATING TO ITS PRODUCTS INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT. IN NO EVENT SHALL ATMEL BE LIABLE FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, PUNITIVE, SPECIAL OR INCIDENTAL DAMAGES (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF PROFITS, BUSINESS INTERRUPTION, OR LOSS OF INFORMATION) ARISING OUT OF THE USE OR INABILITY TO USE THIS DOCUMENT, EVEN IF ATMEL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.** Atmel makes no representations or warranties with respect to the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and product descriptions at any time without notice. Atmel does not make any commitment to update the information contained herein. Unless specifically provided otherwise, Atmel products are not suitable for, and shall not be used in, automotive applications. Atmel's products are not intended, authorized, or warranted for use as components in applications intended to support or sustain life.

© Atmel Corporation 2005. All rights reserved. Atmel®, logo and combinations thereof, Everywhere You Are® and others, are registered trademarks or trademarks of Atmel Corporation or its subsidiaries. Other terms and product names may be trademarks of others.



Printed on recycled paper.