

---

## Features

- Very High Transmitting Frequency Accuracy Compared to SAW Solutions (Enables Receivers at Lower Bandwidth than with SAW Resonators)
- Lower Cost than the Usual Discrete Solutions Using SAW and Transistors
- Supply Voltage 2.0 V to 5.5 V in the Temperature Range -20°C to 70°C  
Supply Voltage 2.2 V to 5.5 V in the Temperature Range -40°C to 85°C
- XTO Output for Clocking the Microcontroller, Thereby Together with the ATAR090 or ATAR890 Results in the Optimum System Cost-effectiveness
- One-chip Solution with Minimum External Circuitry
- Very Small SSO16 Package, Pitch 0.635, 150 mil
- "Single-ended Open-collector" Output (Same Antennas as in Discrete Solutions Can Be Used, Simpler Adaptation of Magnetic Loop Antennas)
- Very Large FSK Frequency Deviation Achievable by  $\pm 100$  ppm Pulling of the Reference Crystal
- Enables Receivers at Lower Bandwidth than with SAW Resonators
- ESD Protection According to MIL-STD.883 (4 KV HBM) Except Pins XTO1/ 2, ANT and LF

Electrostatic sensitive device.  
Observe precautions for handling.



## Description

The U2741B is a PLL transmitter IC which has been especially developed for the demands of RF low-cost data transmission systems at data rates up to 20 kBaud.

The transmitting frequency range is 300 MHz to 450 MHz. The device can be used in both FSK and ASK systems.



---

## UHF ASK/FSK Transmitter

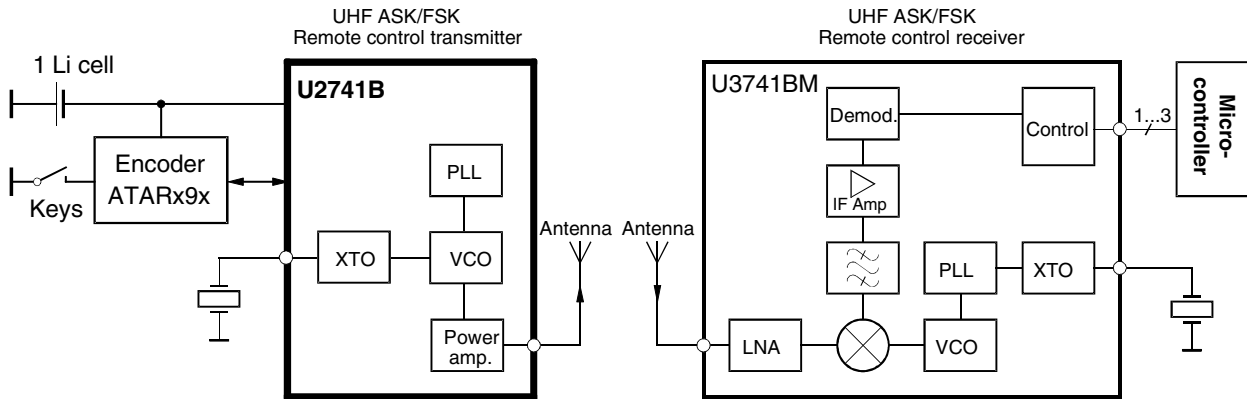
---

### U2741B

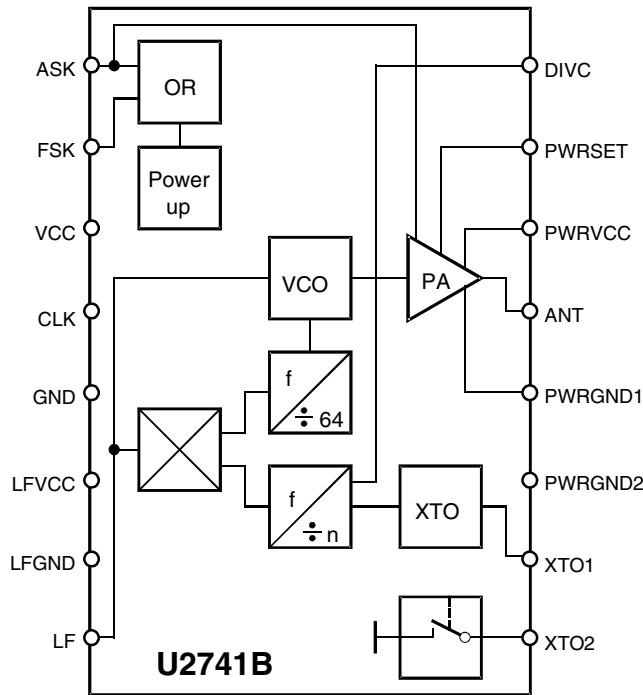
Rev. 4733A-RKE-11/03



**Figure 1. System Block Diagram**

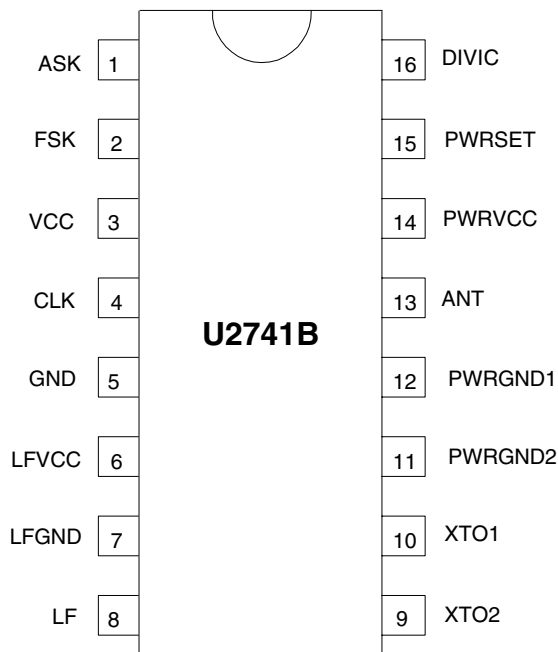


**Figure 2. Block Diagram**



## Pin Configuration

Figure 3. Pinning SSO16



## Pin Description

Pin	Symbol	Function
1	ASK	Modulation input ASK
2	FSK	Modulation input FSK
3	VCC	Supply voltage
4	CLK	Clock output
5	GND	Ground
6	Lfvcc	Supply voltage VCO
7	LFGND	VCO ground
8	LF	Circuit PLL loop
9	XTO2	FM modulation output
10	XTO1	Connection for crystal
11	PWRGND2	Power GND2
12	PWRGND1	Power GND1
13	ANT	RF output
14	PWRVCC	Supply voltage power amplifier
15	PWRSET	Applied to VCC
16	DIVIC	Pitch factor setting for crystal L: high crystal frequency H: low crystal frequency

## General Description

The fully integrated VCO and the “single-ended open-collector” output allow particularly simple, low-cost RF miniature transmitters to be assembled. The single-ended output enables a considerably simplified adaptation of both a magnetic loop antenna of any form or a  $\lambda/4$  antenna. This is because the load impedance must not be balanced as would be the case with a differential output.

The XTO's frequency can be selected at either 13.56 MHz (USA 9.844 MHz) or 6.78 MHz (USA 4.9219 MHz). Thus, it is possible to use not only exceptionally small SMD crystals at 13.56 MHz but also very low-cost 6.78 MHz crystals in a wired metal package (e.g., in the HC49S housing). The frequency is selected by connecting pin 16 (DIVC) to either GND or  $V_S$ .

At high frequencies, crystals have a very fast start-up time ( $< 1.5$  ms at 13.56 MHz,  $< 3$  ms at 6.78 MHz), whereby a wait time of 5 to 10 ms is required until the transmitter IC is locked. This means that the processor does not need to poll a lock detect output.

## Functional Description

The IC can be switched on at both the FSK and the ASK input. The IC's ChipSelect is performed by the logical OR operation of ASK and FSK input. In the case of  $V_{FSK}$ ,  $V_{ASK} \leq 0.3$  V, the power-down supply current is  $I_{S_{off}} < 0.35$   $\mu$ A. The ASK input activates the power amplifier and the PLL. The FSK input only activates the PLL and, if capacitor  $C_3$  is installed, pulls the crystal to the lower frequency, whereby the transmitter is FSK modulated. After switching on at FSK, the VCO locks onto the 32 or 64 times higher frequency of the crystal oscillator.

## FSK Transmission

The U2741B is switched on by  $V_{FSK} = V_S$ . 5 ms later,  $V_S$  is applied to  $V_{ASK}$ . The output can then be modulated by means of pin FSK. This is done by connecting capacitor  $C_3$  in parallel to the load capacitor  $C_4$ .

## ASK Transmission

The U2741B is activated by  $V_{FSK} = V_S$ .  $V_{ASK}$  remains 0 V for 5 ms, then the output power can be modulated by means of pin ASK. In this case,  $V_{FSK}$  remains  $= V_S$  during the message, the capacitor  $C_3$  is not mounted.

## Take-over of the Clock Pulse in the Microcontroller

The clock of the crystal oscillator can be used for clocking the microcontroller. The ATAR090 and ATAR890 have the special feature of starting with an integrated RC oscillator to switch on the U2741B with  $V_{FSK} = V_S$ . 5 ms later, the 3.39-MHz clock frequency is present, so that the message can be sent with crystal accuracy.

## Application Circuit

The following component values are recommendations for a typical application.  $C_5$ ,  $C_6$ , and  $C_7$  are block capacitors. The values of these capacitors depend on the board layout.  $C_5 = 1$  nF,  $C_6 = 1$  nF, and  $C_7 = 22$  nF are typically used here. For  $C_5$ , the impedance between  $f = 100$  MHz and  $f = 1$  GHz should be as low as possible.

$C_3$  is not needed in ASK transmitter applications. In the case of FSK,  $C_3$  is selected in such a way that the desired transmission frequency deviation is achieved (typical  $\pm 30$  kHz). The capacitance here depends upon the crystal's load capacity ( $C_4$ ) recommended by the manufacturer of the crystal.  $C_2 = 3.9$  nF,  $C_1 = 15$  nF, and  $R_4 = 220$   $\Omega$ .

$C_{Loop1}$  and  $C_{Loop2}$  are selected so that the antenna oscillates in resonance and the adaptation to the appropriate impedance transformation is possible.

$L_{Feed}$  is an inductor for the antenna's DC current supply. A typical value is  $L_{Feed} = 220$  nH.  $L_{Feed}$  can be either printed on the PC board or be a discrete component.

## Output Power Measurement

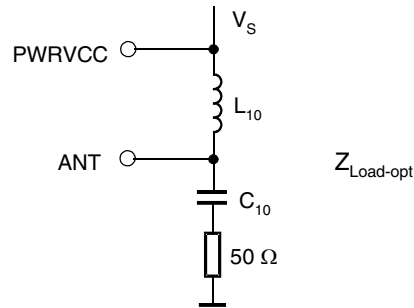
The output network [as shown in Figure 4] can be used for output power evaluation, the exact values of  $L_{10}$  and  $C_{10}$  depend on the layout.

$L_{10}$  and  $C_{10}$  form the transformation network to adopt the output impedance of the IC to  $50 \Omega$ . Table 1 shows the values for an output power of 2 mW and an  $R_{PWRSET} = 1.2 \text{ k}\Omega$ .

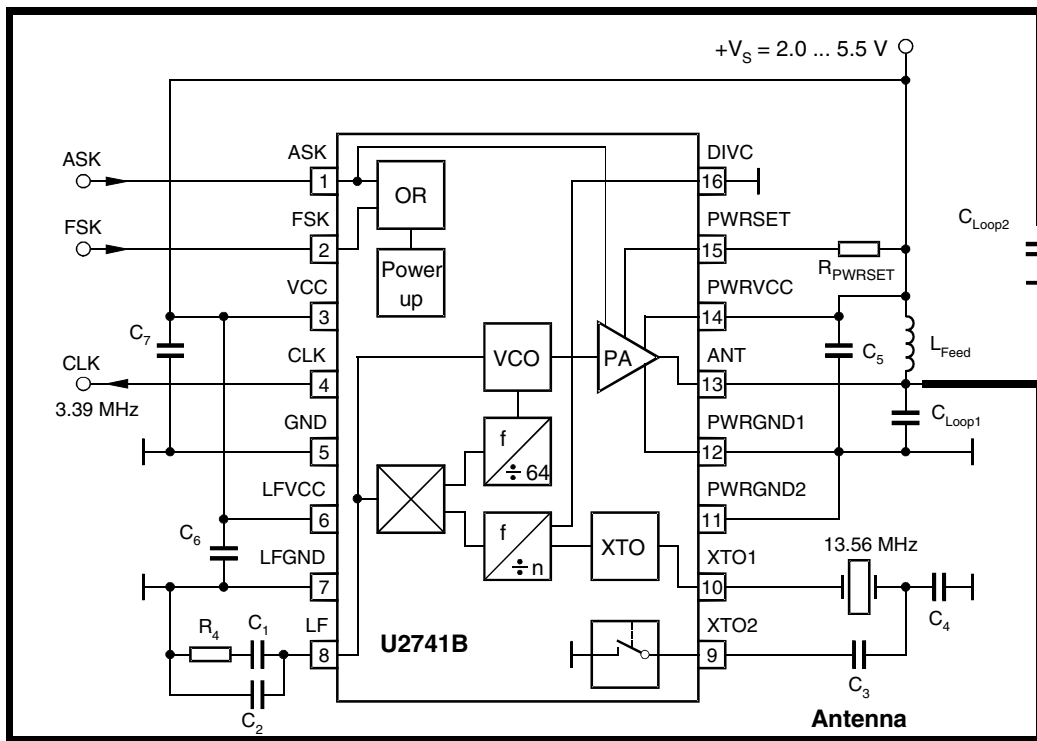
**Table 1.** Transformation Network

f/MHz	C10/pF	L10/nH	Z <sub>Load_opt</sub> /Ω
315	2.7	56	260 + j330
433.92	1.8	33	185 + j268

**Figure 4.** Measurement Output Network



**Figure 5.** Application Circuit



## 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	Min.	Max.	Unit
Supply voltage	$V_S$		6	V
Power dissipation	$P_{tot}$		250	mW
Junction temperature	$T_j$		150	°C
Storage temperature	$T_{stg}$	-55	125	°C
Ambient temperature	$T_{amb}$	-40	105	°C

## Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient	$R_{thJA}$	180	K/W

## Electrical Characteristics

All parameters are referred to GND (pin 5). The possible operating ranges refer to different circuit conditions:

$V_S = 2.0\text{ V to }5.5\text{ V}$  at  $T_{amb} = -20^\circ\text{C to }+70^\circ\text{C}$ ,  $V_S = 2.2\text{ V to }5.5\text{ V}$  at  $T_{amb} = -40^\circ\text{C to }+85^\circ\text{C}$  (typically  $25^\circ\text{C}$ ,  $3\text{ V}$ )

Parameters	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
Supply current (power down)	$V_{ASK}, V_{FSK} \leq 0.3\text{ V}, V_S < 3.6\text{ V}$	$I_{Soff}$			0.35	$\mu\text{A}$
Supply current (power up, output OFF)	$V_{ASK} = \text{GND}, V_{FSK} = V_S, V_S = 3\text{ V}$	$I_{Son}$		4.7	6.2	mA
Supply current (power up, output ON)	$V_{ASK} = V_S, V_S = 3\text{ V}, R_{PWRSET} = 1.2\text{ k}\Omega$	$I_{Stransmit}$		10	12.5	mA
Output power	$V_S = 3\text{ V}, T_{amb} = 25^\circ\text{C}, f = 433.92\text{ MHz}$ $R_{PWRSET} = 1.2\text{ k}\Omega$ $R_{PWRSET} = 1.8\text{ k}\Omega$	$P_{Ref}$	1.5	3	5	dBm
		$P_{Ref}$	-0.5	1	3	dBm
Output power variation for the full temperature range	$T_{amb} = -40^\circ\text{C to }+85^\circ\text{C}, f = 433.92\text{ MHz},$ $V_S = 3.0\text{ V}$ $V_S = 2.4\text{ V}$	$\Delta P_{Ref}$			-1.5	dB
		$\Delta P_{Ref}$			-4.0	dB
Output power variation for $f = 315\text{ MHz}$ compared to $f = 433.92\text{ MHz}$	$T_{amb} = -20^\circ\text{C to }+85^\circ\text{C}, f = 433.92\text{ MHz},$ $V_S = 2.0\text{ V}$ $P_{out} = P_{Ref} + \Delta P_{Ref}$	$\Delta P_{Ref}$		1.5		dB
Maximum peak output antenna voltage	at $P_{out} = 2.0\text{ mW}$ , the load impedance must be selected to meet the $V_{out}$ maximum requirement the supply current is not dependent on the load impedance tolerance	$V_{outmax}$		$V_S - 0.7\text{ V}$		$V_{(peak)}$
Spurious emission	at $T_{amb} = 25^\circ\text{C}$ $f_o \pm (n \times f_{PC})$ where $f_{PC} = 6.78\text{ MHz}$ Load capacitance at CLK $\leq 3\text{ pF}$ $f = 230\text{ MHz to }470\text{ MHz}$ $f < 230\text{ MHz}, f > 470\text{ MHz}$	Em			-40	dBc
		Em			-58	dBc

## Electrical Characteristics (Continued)

All parameters are referred to GND (pin 5). The possible operating ranges refer to different circuit conditions:

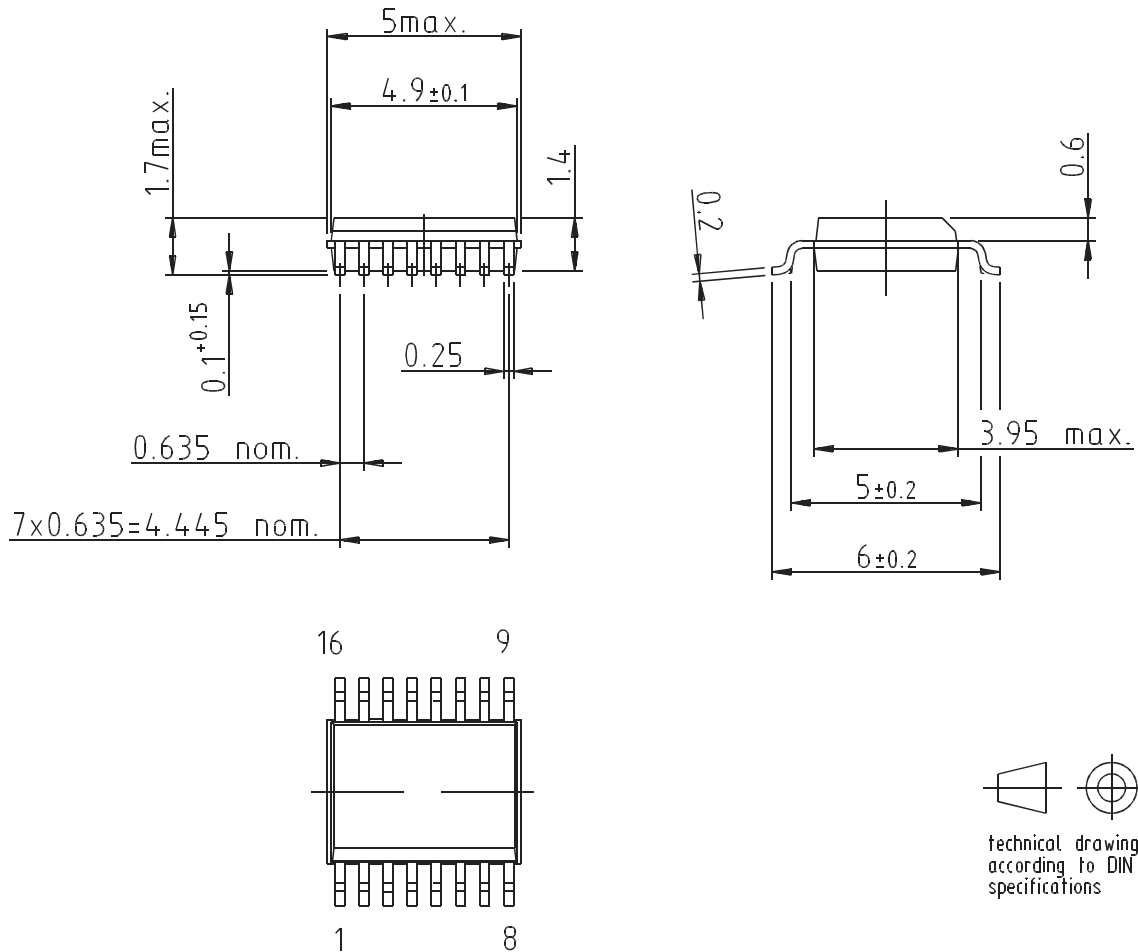
$V_S = 2.0\text{ V to }5.5\text{ V}$  at  $T_{amb} = -20^\circ\text{C to }+70^\circ\text{C}$ ,  $V_S = 2.2\text{ V to }5.5\text{ V}$  at  $T_{amb} = -40^\circ\text{C to }+85^\circ\text{C}$  (typically  $25^\circ\text{C}$ ,  $3\text{ V}$ )

Parameters	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
Oscillator frequency XTO	M-version: at $T_{amb} = 25^\circ\text{C}$ N-version: full temperature range (monitoring) Crystal frequency = 13.56 MHz	$f_{XTO}$	13.56 - 30 ppm	13.56	13.56 + 30 ppm	MHz
	Crystal frequency = 6.78 MHz	$f_{XTO}$	6.78 - 30 ppm	6.78	6.78 + 30 ppm	MHz
	Load capacity of the crystal must be selected accordingly					
Loop bandwidth	For best LO noise Loop filter components: $C_2 = 3.9\text{ nF}$ , $C_1 = 15\text{ nF}$ , $R_4 = 220\ \Omega$	$B_{Loop}$		100		kHz
Phase noise PLL	Referring to the phase comparator $f_{PC} = 6.78\text{ MHz}$	$PN_{PLL}$		-111	-105	dBc/Hz
Phase noise VCO	at 1 MHz at 36 MHz	$PN_{VCO}$ $PN_{VCO}$		-91 -123	-87 -119	dBc/Hz
Frequency range of the VCO		$f_{VCO}$	300		450	MHz
Clock output (CMOS microcontroller compatible)		$Clk_{out}$		$f_{out}/128$		MHz
Load capacitance at CLK		$C_{CLK}$			10	pF
Series resonance R of the crystal	$f_{XTO} = 13.56\text{ MHz}$	$R_s$			80	$\Omega$
	$f_{XTO} = 9.84\text{ MHz}$	$R_s$			100	
	$f_{XTO} = 6.78\text{ MHz}$	$R_s$			150	
	$f_{XTO} = 4.90\text{ MHz}$	$R_s$			225	
FSK modulation frequency rate	Duty cycle of the modulation signal = 50%	$f_{modFSK}$	0		20	kHz
ASK modulation frequency rate	Duty cycle of the modulation signal = 50%	$f_{modASK}$	0		20	kHz
CLK output						
- Output current Low	$V_{CLK} = 0.2 \times V_S$	$I_{ol}$	150			$\mu\text{A}$
- Output current Low	$V_{CLK} = 0.3 \times V_S$	$I_{ol}$	200			$\mu\text{A}$
- Output current High	$V_{CLK} = 0.8 \times V_S$	$I_{oh}$	-150			$\mu\text{A}$
- Output current High	$V_{CLK} = 0.7 \times V_S$	$I_{oh}$	-200		100	$\mu\text{A}$
ASK input						
- Low level input voltage		$V_{ASKl}$			0.3	V
- High level input voltage		$V_{ASKh}$	1.7			V
- Input current High		$I_{ASKh}$			140	$\mu\text{A}$
FSK input						
- Low level input voltage		$V_{FSKl}$			0.3	V
- High level input voltage		$V_{FSKh}$	1.7			V
- Input current High		$I_{FSKh}$			140	$\mu\text{A}$

## Ordering Information

Extended Type Number	Package	Remarks
U2741B-NFB	SSO16	Tube, optimized power-supply rejection, value of $C_4$ differs from M-version, enhanced XTO stability
U2741B-NFBG3	SSO16	Taped and reeled, see above

## Package Information



Drawing refers to following types: SS016  
 Package acc. JEDEC MO 137 AB





## 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 Arsenalux 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:** Atmel Corporation makes no warranty for the use of its products, other than those expressly contained in the Company's standard warranty which is detailed in Atmel's Terms and Conditions located on the Company's web site. The Company assumes no responsibility for any errors which may appear in this document, reserves the right to change devices or specifications detailed herein at any time without notice, and does not make any commitment to update the information contained herein. No licenses to patents or other intellectual property of Atmel are granted by the Company in connection with the sale of Atmel products, expressly or by implication. Atmel's products are not authorized for use as critical components in life support devices or systems.

© Atmel Corporation 2003. All rights reserved.

Atmel® and combinations thereof are the registered trademarks of Atmel Corporation or its subsidiaries.

Other terms and product names may be the trademarks of others.



Printed on recycled paper.