

Features

- Low-noise Low Drop Out Voltage Regulator
- 2.6V Fixed Output Voltage
- 3V to 5.5V Supply Operation
- 160 mA Maximum Load Current
- Less Than 46 μA (max) Quiescent Current
- Power-down Mode Consumption Less Than 1 μA
- More Than 60 dB (Typical) PSRR at 1 kHz
- 68 μV_{RMS} Output Noise
- 0.35 μm CMOS Technology
- Typical Application: Baseband Section Supply in Mobile Terminals

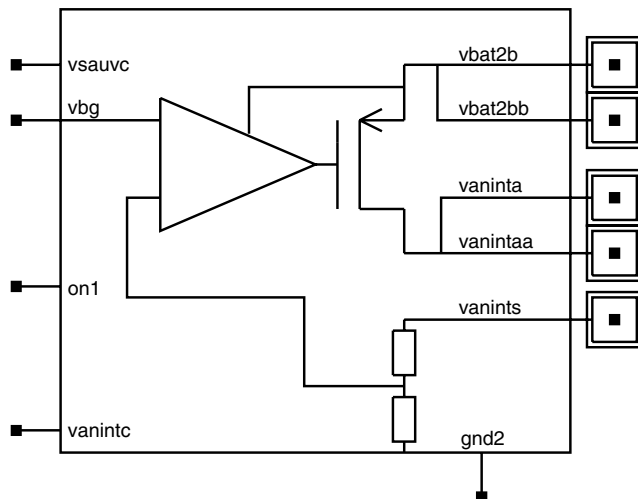
Description

RE023 is a Low Drop Out (LDO) voltage regulator macrocell with a fixed 2.6V output voltage, rated for loads up to 160 mA. It is designed to be integrated with other analog cells, digital logic, microcontrollers, DSP cores and memory blocks into system-on-chip products.

The circuit consists of a PMOS pass device, an error amplifier and a feedback resistive network, sized to achieve the required closed loop gain. These blocks make up the regulating loop. An over-current and short circuit protection circuit has been included to limit the output current delivered by the regulator, thus avoiding destruction in case of a short circuit.

An external reference voltage (bandgap voltage) is necessary for correct functionality. The target reference voltage is 1.231V, delivered, for example, by BG019. Double pads on the supply voltage $V_{\text{BAT2B}}/V_{\text{BAT2BB}}$ and output voltage $V_{\text{ANINTA}}/V_{\text{ANINTAA}}$ are used to reduce the total output resistance. Current reference is generated inside the cell through a circuit supplied by a $2.5\text{V} \pm 0.1\text{V}$ regulated input voltage on V_{SAUVC} . Remote sense terminal V_{ANINTS} provides regulation at the load by connecting it to the output terminal near a critical point to improve performance of the regulator (e.g., connecting them at the package pin by double-bonding, thus avoiding the bonding resistance influence). A ceramic capacitor of 2.2 μF connected from $V_{\text{ANINTA}}/V_{\text{ANINTAA}}$ to ground is needed as external compensation.

Figure 1. Symbol⁽¹⁾



Note: 1. Pin names are written as they appear on the user screen when the symbol is opened in the design tool environment.



Embedded ASIC Macrocell: Power Management for Mobile Terminals (PM)

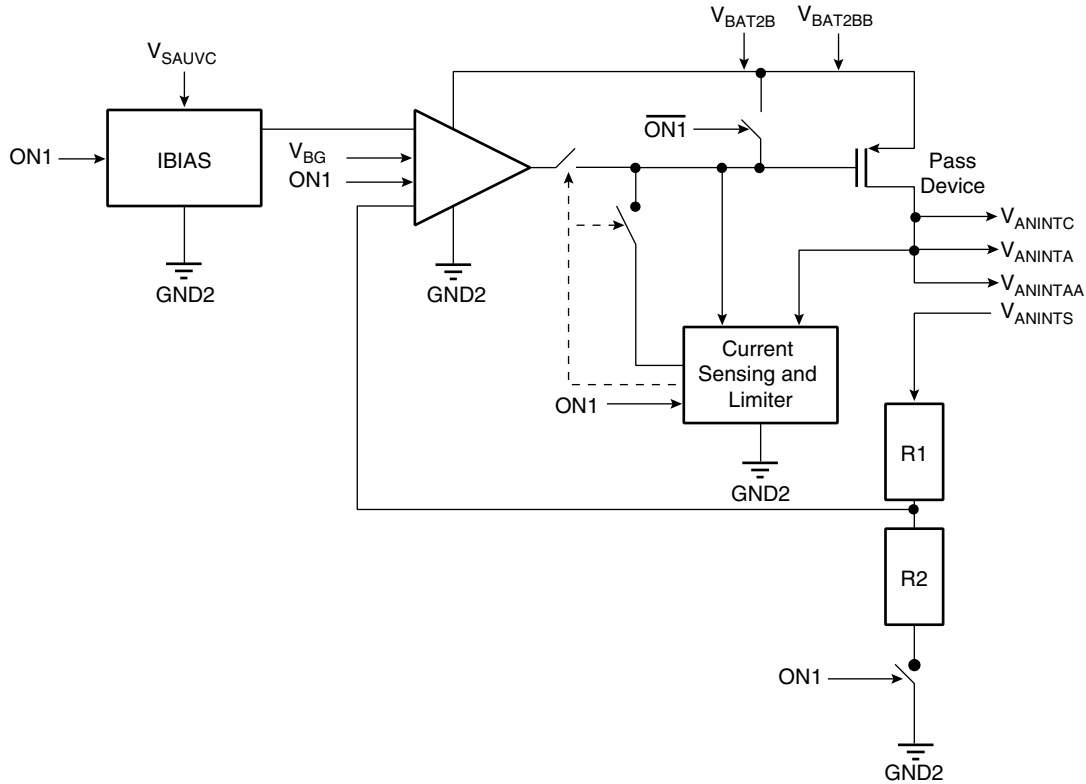
RE023 Fixed 2.6V 160 mA LDO Voltage Regulator

Rev. 2702A-01/02



Functional Diagram

Figure 2. Functional Diagram



Pin Description

Pin Name	I/O	Type	Function	Value
V_{BAT2B}	Power supply	External pad	Power supply	3V to 5.5V
V_{BAT2BB}	Power supply	External pad	Power supply	3V to 5.5V
V_{ANINTA}	Analog output	External pad	Output voltage	2.5V to 2.7V
$V_{ANINTAA}$	Analog output	External pad	Output voltage	2.5V to 2.7V
V_{ANINTS}	Analog output	External pad	Sense voltage	2.5V to 2.7V
V_{ANINTC}	Analog output	Internal pin	Output voltage	2.5V to 2.7V
GND2	Ground	Internal pin	Ground	0
V_{SAUVC}	Power supply	Internal pin	Power supply	$2.5V \pm 0.1V$
V_{BG}	Analog input	Internal pin	Voltage reference	1.231V
ON1	Digital input	Internal pin	Enable command	0 or V_{BAT2B}/V_{BAT2BB}

Absolute Maximum Ratings*

V_{IN}	-0.3V to 6.5V
Digital Signals.....	-0.3V to 5.5V
Output Current.....	Internally Limited
Junction Temperature	-40°C to 150°C

*NOTICE: 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 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.

Electrical Specifications⁽¹⁾

T_J = -20°C to 125°C, V_{BAT2B}/V_{BAT2BB} = 3V to 5.5V unless otherwise specified, output capacitance = 2.2 μ F.

Table 1. Electrical Specifications

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{BAT2B}/V_{BAT2BB}	Operating Supply Voltage		3		5.5	V
V_{SAUVC}	Auxiliary Operating Supply Voltage		2.4	2.5	2.6	V
T_J	Junction Temperature Range		-20		125	°C
$V_{ANINTA}/V_{ANINTAA}$	Output Voltage		2.5	2.6	2.7	V
$I_{ANINTA}/I_{ANINTAA}$	Output Current				160	mA
I_{QQ}	Quiescent Current				46	μ A
ΔV_{DC}	Line Regulation	V_{BAT2B}/V_{BAT2BB} : 3.4V to 3V; $I_{ANINTA}/I_{ANINTAA}$ = 160 mA		0.2	0.235	mV
ΔV_{TRAN}	Transient Line Regulation	V_{BAT2B}/V_{BAT2BB} : 3.4V to 3V; $I_{ANINTA}/I_{ANINTAA}$ = 160 mA rise time = fall time = 5 μ s		3.6	6.9	mV
ΔV_{DC}	Load Regulation	10% - 90% of max $I_{ANINTA}/I_{ANINTAA}$		0.6	6.95	mV
ΔV_{TRAN}	Transient Load Regulation	10% - 90% of max $I_{ANINTA}/I_{ANINTAA}$; rise time = fall time = 5 μ s		4.8	9.3	mV

Table 1. Electrical Specifications (Continued)

Symbol	Parameter	Condition	Min	Typ	Max	Unit
PSRR	Power Supply Rejection Ratio at Full Load	$V_{BAT} = 3V$	@ 100 Hz	-70	-57	dB
			@ 1 kHz	-68	-55	dB
			@ 20 kHz	-46	-35	dB
			@ 100 kHz	-36	-26	dB
		$V_{BAT} = 4.25V$	@ 100 Hz	-64	-56	dB
			@ 1 kHz	-64	-56	dB
			@ 20 kHz	-50	-50	dB
			@ 100 kHz	-41	-41	dB
		$V_{BAT} = 5.5V$	@ 100 Hz	-59	-51	dB
			@ 1 kHz	-59	-51	dB
			@ 20 kHz	-50	-47	dB
			@ 100 kHz	-42	-40	dB
V_N	Output Noise ⁽²⁾	Bandwidth: 10 Hz to 100 kHz; output current = 160 mA		68	81	μV_{RMS}
T_R	Rise Time	100% of $I_{ANINTA}/I_{ANINTAA}$; 10% - 90% $V_{ANINTA}/V_{ANINTAA}$			70	μs
I_{SD}	Shut Down Current				1	μA
I_{CC}	Short-circuit current				400	mA

Notes: 1. Obtained by considering the parasitics of a TFBGA100 Package.
2. Obtained by using BG019 as reference voltage generator.

Control Modes

All digital signals are referred to the supply voltage $V_{BAT2B/BAT2BB}$.

Table 2. Truth Table

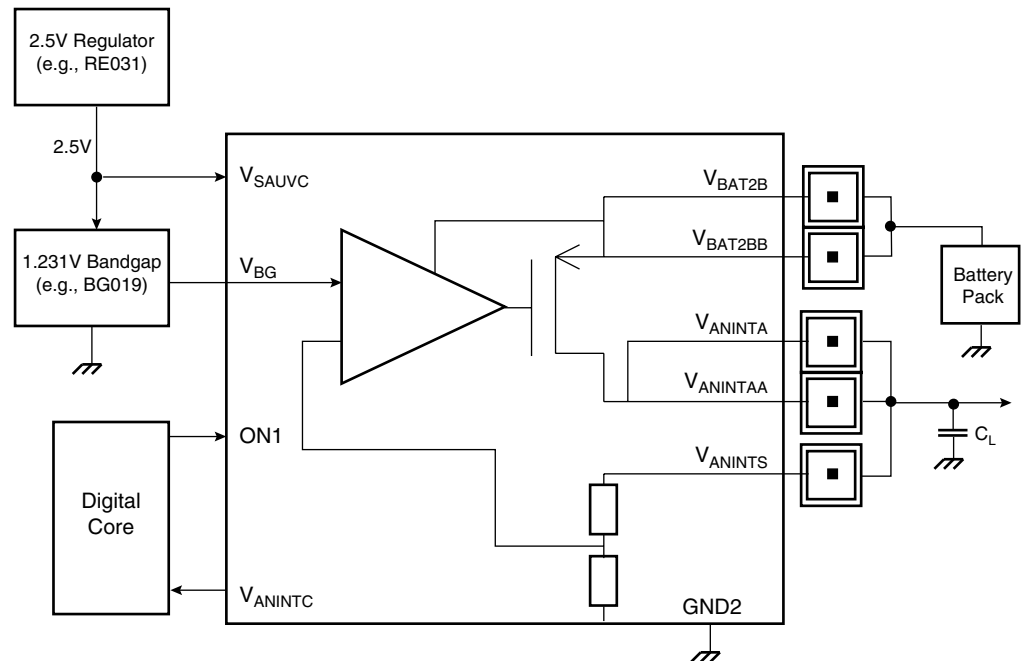
ON1	$V_{ANINTA}/V_{ANINTAA}$
0	Power down (High-Z)
1	Power on, $V_{ANINTA}/V_{ANINTAA} = 2.6V$

Application Example

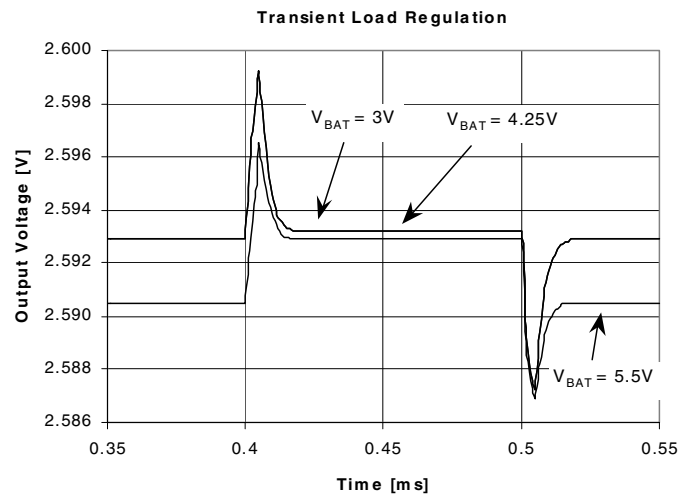
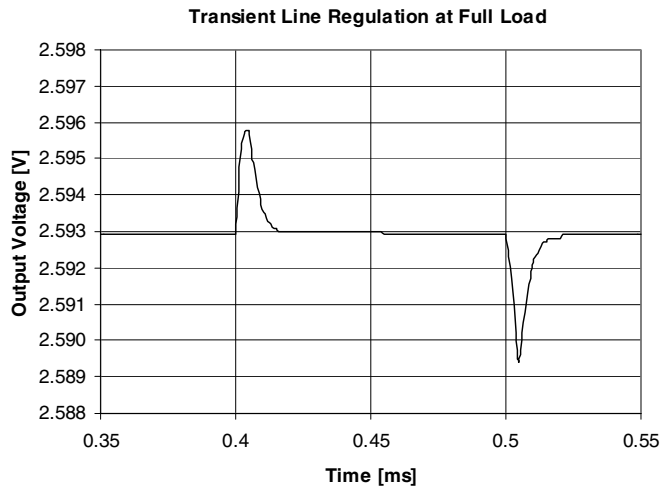
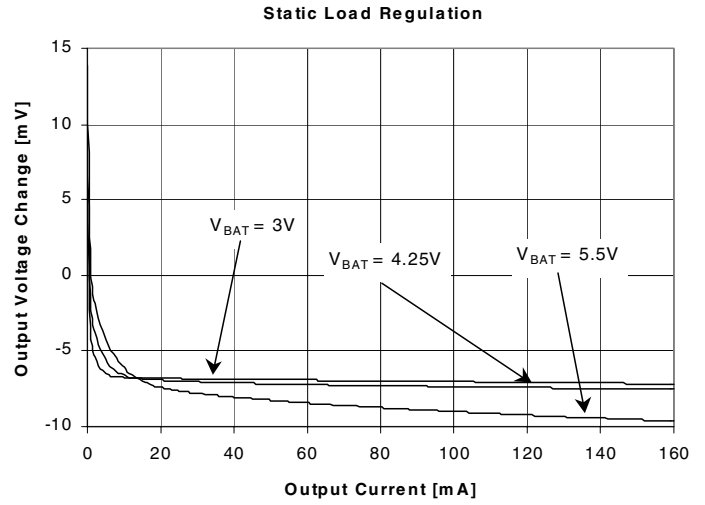
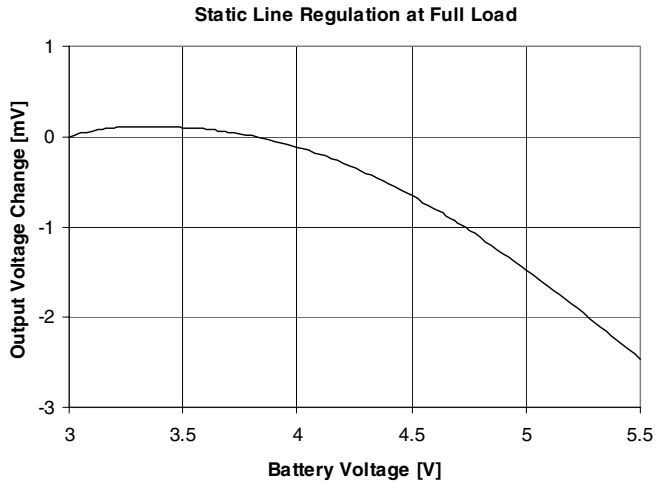
A ceramic capacitor of 2.2 μF with ESR between 20 m Ω and 250 m Ω connected from $V_{ANINTA}/V_{ANINTAA}$ to ground is needed as external compensation.

Description	Min	Typ	Max	Units
Capacitor, C_L	1.8	2.2	2.6	μF

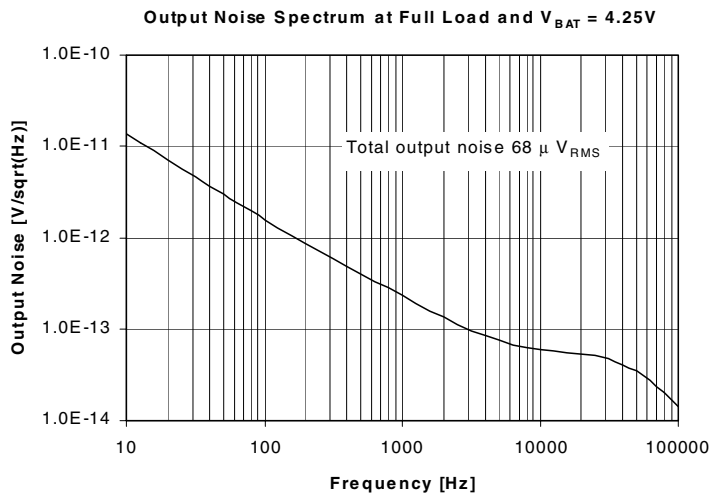
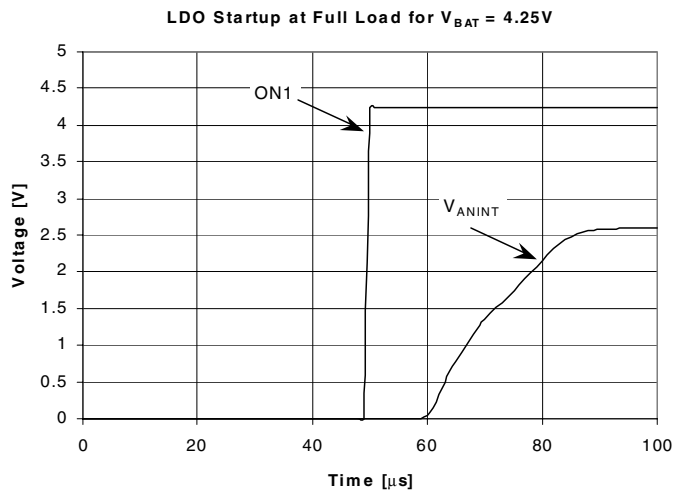
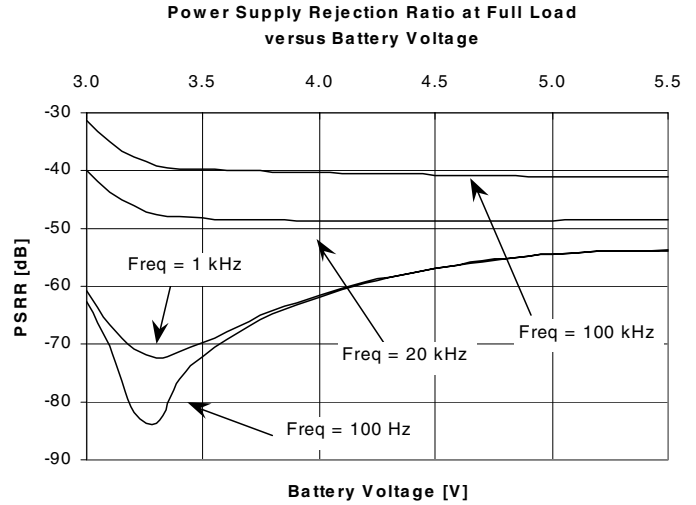
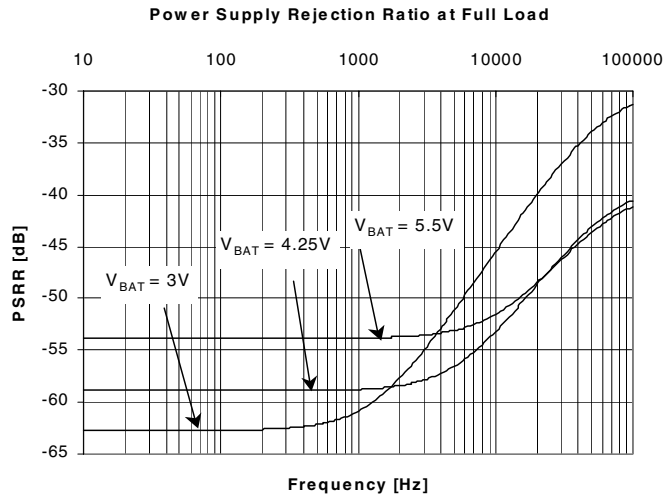
Figure 3. Application Example



Typical Performance Characteristics (Conditions specified on page 8)



Typical Performance Characteristics (Conditions specified on page 8)

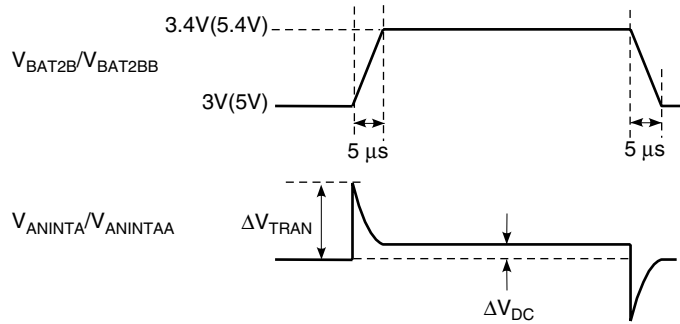


Terminology

Line Regulation

Measures the maximum transient and DC variations of the output voltage of the LDO when the supply changes between two specified values with fixed load current; minimum rise time and fall time is 5 μ s.

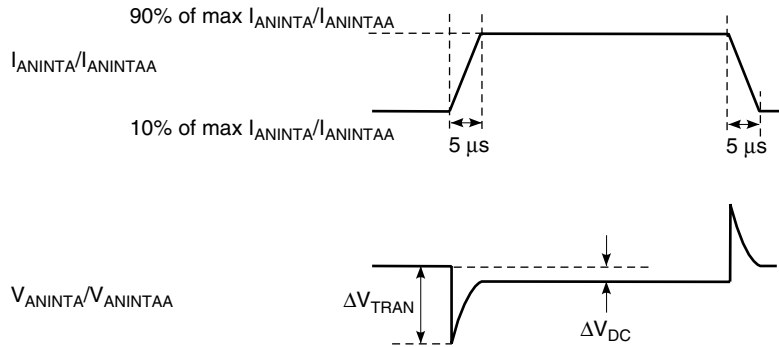
Figure 4. Line Regulation



Load Regulation

Measures the maximum transient and DC variations of the output voltage of the LDO when the load current changes between two specified values with fixed power supply; minimum rise time and fall time is 5 μ s.

Figure 5. Load Regulation





Atmel Headquarters

Corporate Headquarters

2325 Orchard Parkway
San Jose, CA 95131
TEL 1(408) 441-0311
FAX 1(408) 487-2600

Europe

Atmel SarL
Route des Arsenaux 41
Casa Postale 80
CH-1705 Fribourg
Switzerland
TEL (41) 26-426-5555
FAX (41) 26-426-5500

Asia

Atmel Asia, Ltd.
Room 1219
Chinachem Golden Plaza
77 Mody Road Tsimhatsui
East Kowloon
Hong Kong
TEL (852) 2721-9778
FAX (852) 2722-1369

Japan

Atmel Japan K.K.
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

Atmel Corporate
2325 Orchard Parkway
San Jose, CA 95131
TEL 1(408) 436-4270
FAX 1(408) 436-4314

Microcontrollers

Atmel Corporate
2325 Orchard Parkway
San Jose, CA 95131
TEL 1(408) 436-4270
FAX 1(408) 436-4314

Atmel Nantes

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

Atmel Rousset
Zone Industrielle
13106 Rousset Cedex, France
TEL (33) 4-42-53-60-00
FAX (33) 4-42-53-60-01

Atmel Colorado Springs
1150 East Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906
TEL 1(719) 576-3300
FAX 1(719) 540-1759

Atmel Smart Card ICs
Scottish Enterprise Technology Park
Maxwell Building
East Kilbride G75 0QR, Scotland
TEL (44) 1355-803-000
FAX (44) 1355-242-743

RF/Automotive

Atmel Heilbronn
Theresienstrasse 2
Postfach 3535
74025 Heilbronn, Germany
TEL (49) 71-31-67-0
FAX (49) 71-31-67-2340

Atmel Colorado Springs
1150 East Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906
TEL 1(719) 576-3300
FAX 1(719) 540-1759

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

Atmel Grenoble
Avenue de Rochepleine
BP 123
38521 Saint-Egreve Cedex, France
TEL (33) 4-76-58-30-00
FAX (33) 4-76-58-34-80

e-mail

literature@atmel.com

Web Site

<http://www.atmel.com>

© Atmel Corporation 2002.

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

Atmel is the registered trademark of Atmel.

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



Printed on recycled paper.