

Features

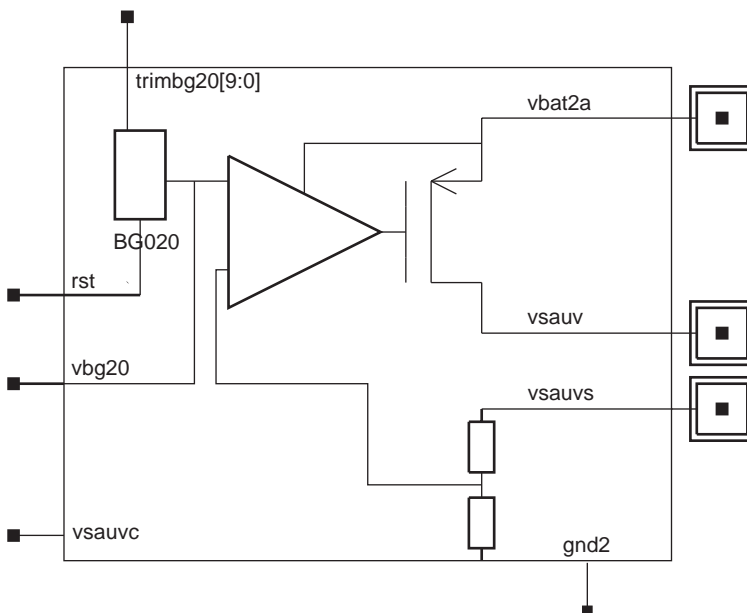
- Low Quiescent Current, Low Drop Out Voltage Regulator
- 2.5V Fixed Output Voltage
- 3V to 5.5V Supply Operation
- 5 mA Maximum Load Current
- Power-down Mode Consumption Less Than 1 μ A
- 0.35 μ m CMOS Technology
- Typical Application: Real Time Clock (RTC), Backup Battery Supply in Mobile Terminals
- Maximum Current Consumption 10 μ A

Description

RE031 is a Low Drop Out (LDO) voltage regulator macrocell with a fixed 2.5V output voltage, rated for loads up to 5 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 internal reference voltage (bandgap voltage) has been included. The target reference voltage is 1.2V, with a tolerance of 4%, delivered by an external trimming code. Current reference is generated inside the cell through a circuit supplied by V_{BAT} . The remote sense terminal, V_{SAUVS} , provides regulation at the load, by connecting it together with the output terminal, V_{SAUV} , near a critical point to improve the regulation performance (e.g., connecting them at the package pin by double bonding thus avoiding the bonding resistance influence). A capacitor of 2.2 μ F connected from V_{SAUV} 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)**

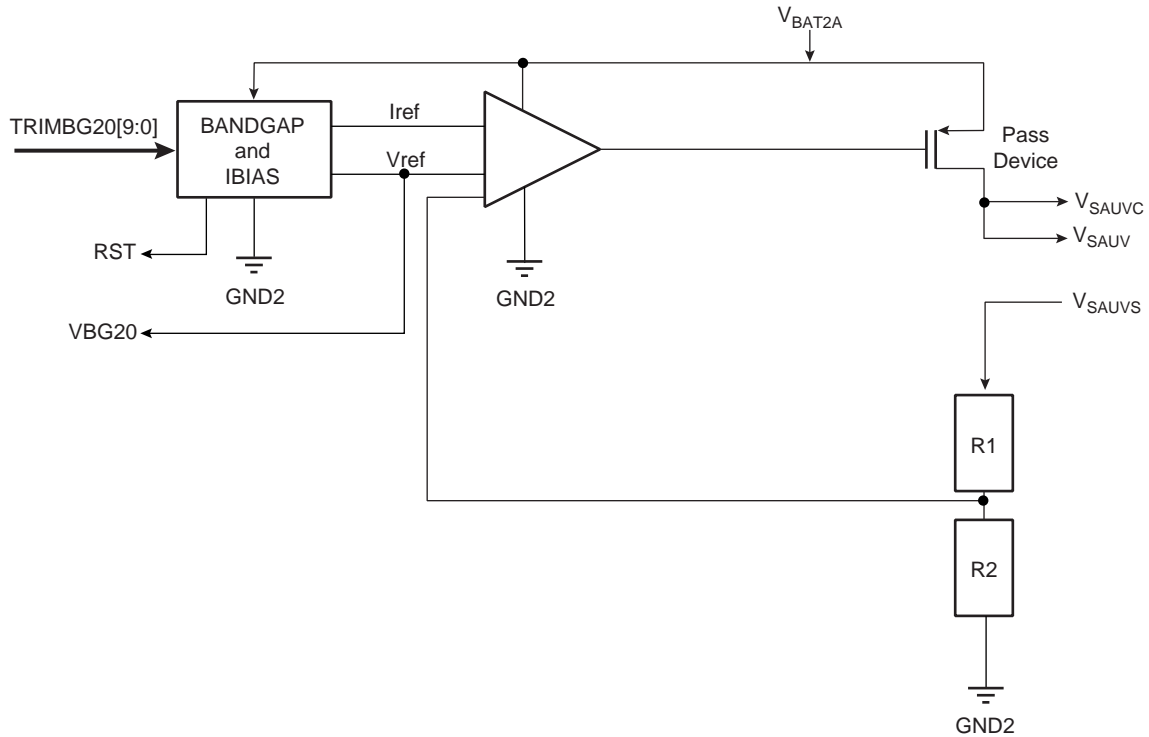
**RE031
Fixed 2.5V
5 mA
Low Quiescent
Current
LDO Voltage
Regulator**

Rev. 2707B-PMGMT-03/03



Functional Diagram

Figure 2. Functional Diagram



Pin Description

Pin Name	I/O	Type	Function	Value
V_{BAT2A}	Power supply	External pad	Power supply	3V to 5.5V
V_{SAUV}	Analog output	External pad	Output voltage	2.4V to 2.6V
V_{SAUVS}	Analog input	External pad	Sense voltage	2.4V to 2.6V
V_{SAUVC}	Analog output	Internal pin	Output voltage	2.4V to 2.6V
GND2	Ground	Internal pin	Ground	0
TRIMBG20	Digital bus	Internal pin	Bandgap Reference Trimming	0 to V_{SAUV}
RST	Digital output	Internal pin	POR signal	0 to V_{SAUV}
VBG20	Analog output	Internal pin	Voltage reference	1.231V

RE031 2.5V 5 mA LDO Voltage Regulator

Absolute Maximum Ratings*

V_{IN}	-0.3V to 6.5V
Digital Signals.....	-0.3V to 5.5V
Output Current.....	Internally Limited
Junction Temperature	-20°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_A = -20°C to +85°C, supply voltage = 3V to 5.5V unless otherwise specified, output capacitance = 2.2 μ F.

Table 1. Electrical Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Unit	
V_{SAUVC}	Auxiliary Operating Supply Voltage		2.4	2.5	2.6	V	
V_{SAUV}	Output Voltage		2.4	2.5	2.6	V	
I_{SAUV}	Output Current				5	mA	
I_{QQ}	Quiescent Current				10	μ A	
ΔV_{DC}	Line Regulation	$I_{SAUV} = 5$ mA		12		mV	
ΔV_{TRAN}	Transient Line Regulation	$I_{SAUV} = 5$ mA rise time = fall time = 5 μ s		37		mV	
ΔV_{DC}	Load Regulation	10% - 90% of max I_{SAUV}		10		mV	
ΔV_{TRAN}	Transient Load Regulation	10% - 90% of max I_{SAUV} rise time = fall time = 5 μ s		5		mV	
PSRR	Power Supply Rejection Ratio at Full Load	$V_{BAT} = 3$ V	@ 100 Hz		-55		dB
			@ 1 kHz		-35		dB
			@ 20 kHz		-12		dB
			@ 100 kHz		-12		dB
		$V_{BAT} = 4.25$ V	@ 100 Hz		-50		dB
			@ 1 kHz		-35		dB
			@ 20 kHz		-13		dB
			@ 100 kHz		-13		dB
		$V_{BAT} = 5.5$ V	@ 100 Hz		-40		dB
			@ 1 kHz		-35		dB
			@ 20 kHz		-13		dB
			@ 100 kHz		-10		dB
V_N	Output Noise	Bandwidth = 10 Hz to 100 kHz; output current = 5 mA		1051		μ V _{RMS}	
I_{SD}	Shut Down Current				1	μ A	

Note: 1. Obtained by considering the parasitics of a TFBGA100 Package.

Control Modes

Trimming

The bandgap inside RE031 has trimming capability, i.e., it is possible to compensate the bandgap resistance variations due to process gradients through the TRIMBG20[9:0] signal. In order to reduce the sensitivity of the bandgap voltage to resistance variations, the trimming has been designed to compensate up to $\pm 40\%$ of resistance variations.

Table 2. Truth Table

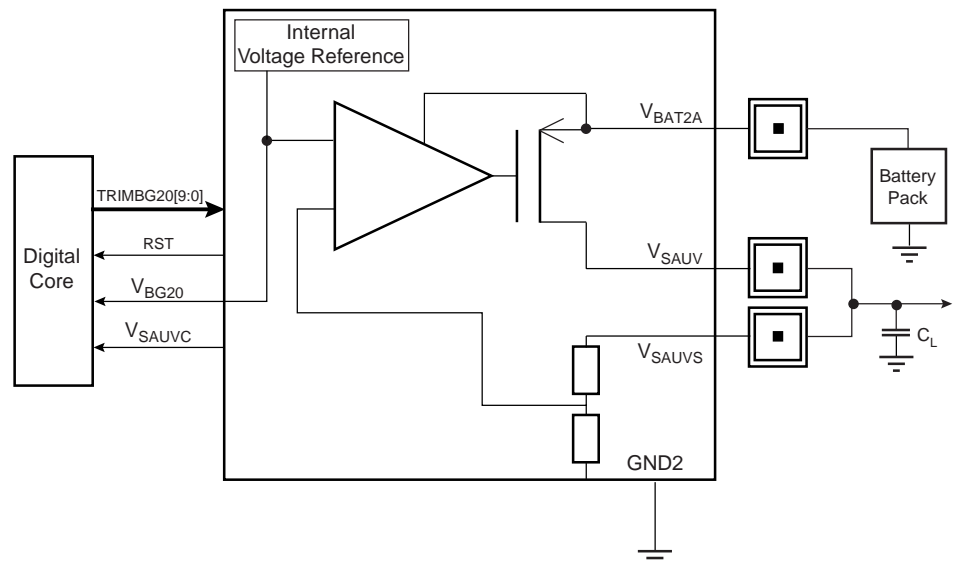
Resistance Variation	TRIMBG20[9:0]
+35% to +40%	1001000000
+20% to +35%	0101000000
+5% to +25%	0011000000
-5% to +5%	0000000000
-15% to -5%	0001100000
-22.5% to -15%	0001010000
-27.5% to -22.5%	0001001000
-32.5% to -27.5%	0001000100
-35% to -32.5%	0001000010
-37.5% to -35%	0001000001
-40% to -37.5%	0001000000

Application Example

A ceramic capacitor of $2.2 \mu\text{F}$ with ESR between $20 \text{ m}\Omega$ and $250 \text{ m}\Omega$ connected from V_{SAUV} to ground is needed for external compensation.

Description	Min	Typ	Max	Units
Capacitor (C_L)	1.8	2.2	2.6	μF

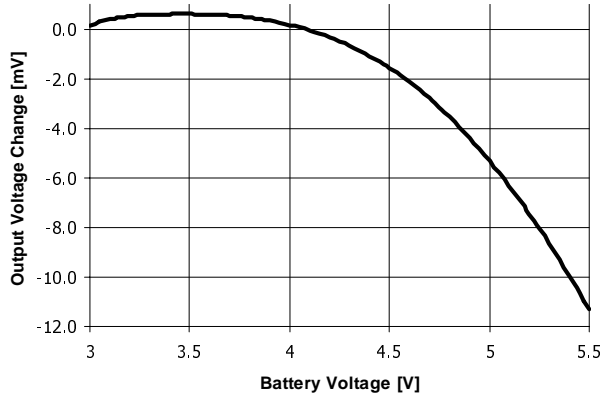
Figure 3. Application Example



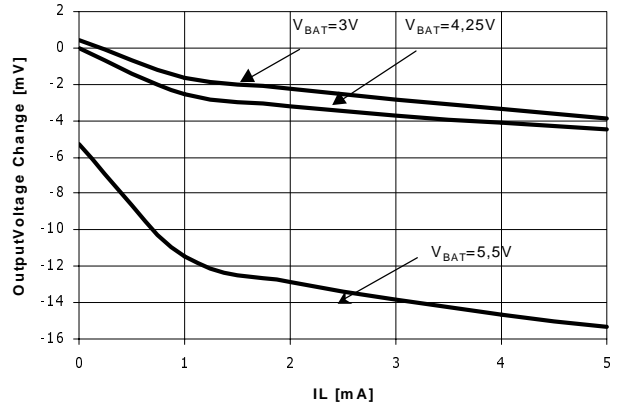
RE031 2.5V 5 mA LDO Voltage Regulator

Typical Performance Characteristics (Conditions specified on page 7.)

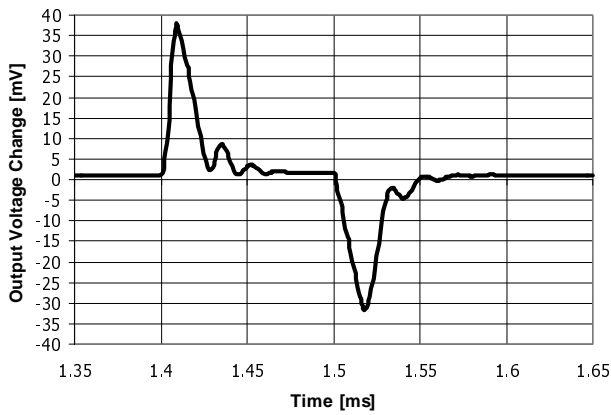
Static Line Regulation at Full Load



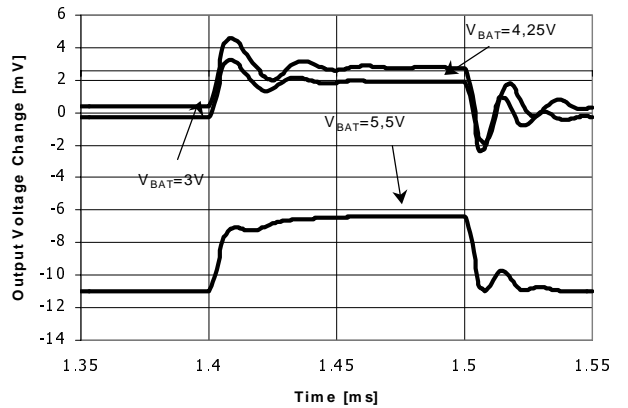
Static Load Regulation



Transient Line Regulation at Full Load

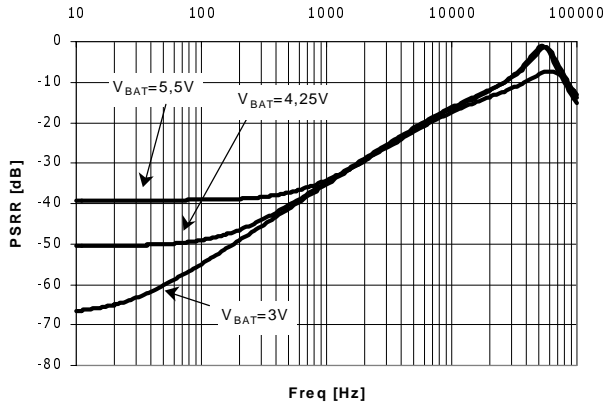


Transient Load Regulation

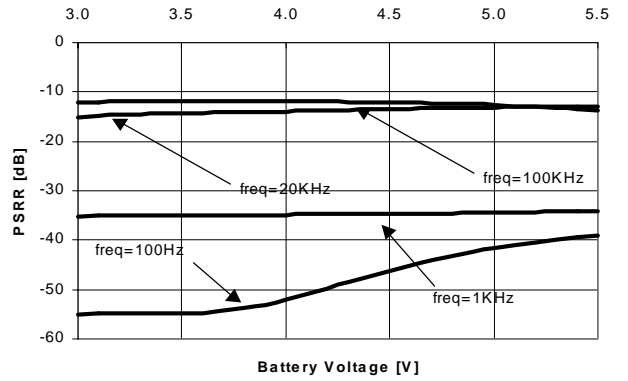


Typical Performance Characteristics (Conditions specified on page 7.)

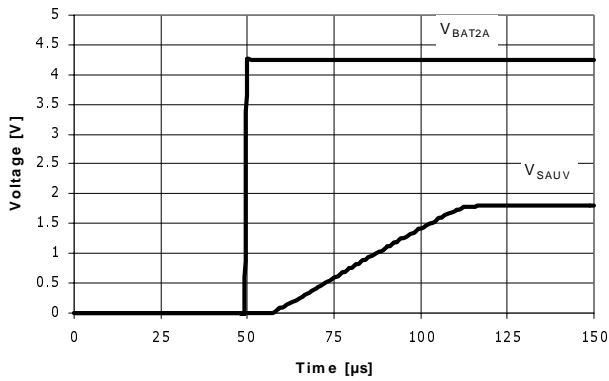
Power Supply Rejection Ratio at Full Load



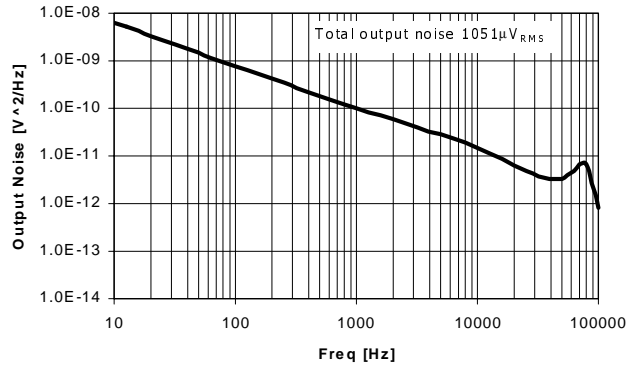
Power Supply Rejection Ratio at Full Load Versus Battery Voltage in Low Power Mode



LDO Startup at Full Load for Vbat = 4.25V in Low Power Mode



Output Noise Spectrum at Full Load and Vbat=4.25V

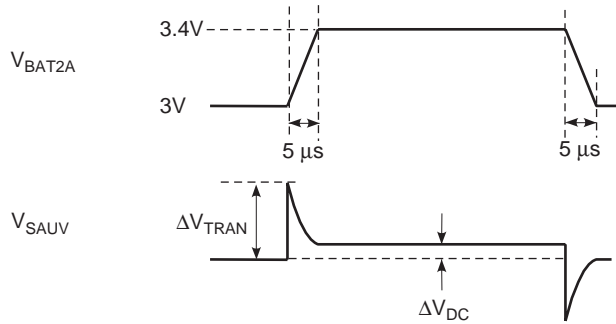


Terminology

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.

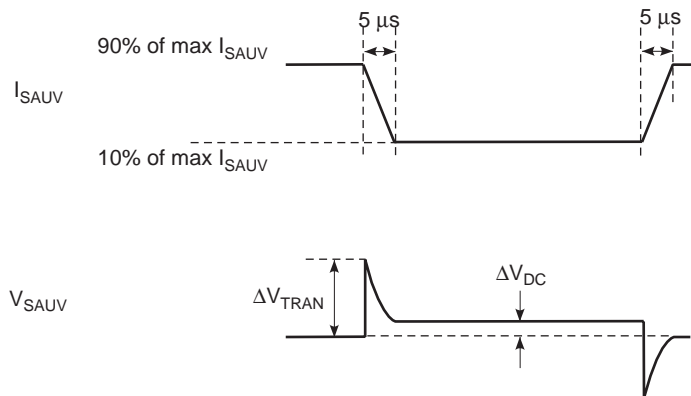
Figure 4. Line Regulation



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
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 Tsimhatsui
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
TEL 1(408) 441-0311
FAX 1(408) 436-4314

Microcontrollers

2325 Orchard Parkway
San Jose, CA 95131
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
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
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

e-mail

literature@atmel.com

Web Site

<http://www.atmel.com>

© Atmel Corporation 2003.

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

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



Printed on recycled paper.