



## Features

- Single 3-V Supply Voltage
- High Power-added Efficient Power Amplifier ( $P_{out}$  Typically 23 dBm)
- Ramp-controlled Output Power
- Current-saving Standby Mode
- Few External Components
- HP-VFQFP-N16 Package

Electrostatic sensitive device.  
Observe precautions for handling.

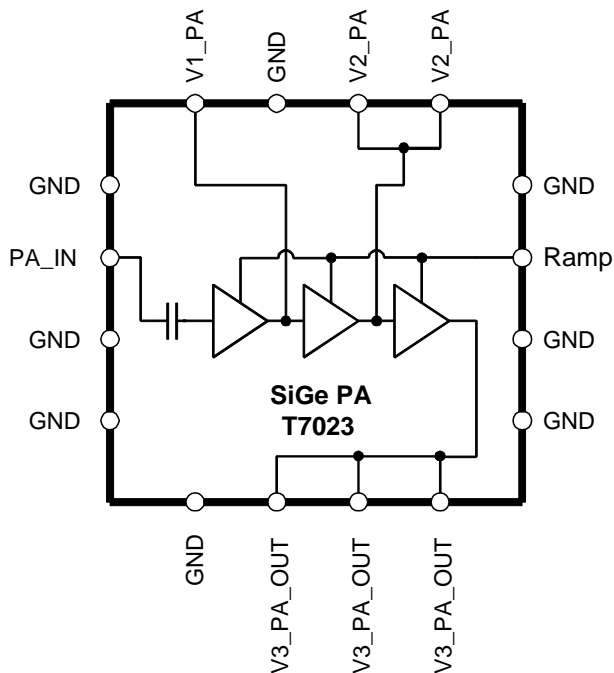


## Description

The T7023 is a monolithic SiGe power amplifier. It is especially designed for operation in TDMA systems like Bluetooth and WDCT.

Due to the ramp-control feature and a very low quiescent current, an external switch transistor for  $V_S$  is not required.

Figure 1. Block Diagram



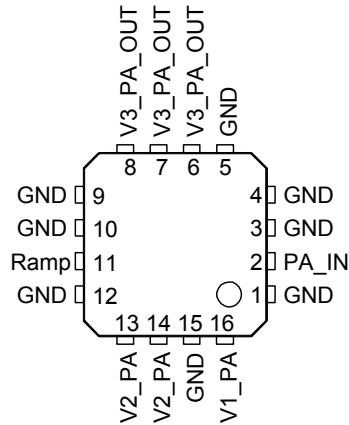
## Bluetooth™ 2.4-GHz Power Amplifier

### T7023



## Pin Configuration

Figure 2. Pinning HP-VFQFP-N16



## Pin Description

Pin	Symbol	Function
1	GND	Ground
2	PA_IN	Power amplifier input
3	GND	Ground
4	GND	Ground
5	GND	Ground
6	V3_PA_OUT	Inductor to power supply and matching network for power amplifier output
7	V3_PA_OUT	Inductor to power supply and matching network for power amplifier output
8	V3_PA_OUT	Inductor to power supply and matching network for power amplifier output
9	GND	Ground
10	GND	Ground
11	RAMP	Power ramping control input
12	GND	Ground
13	V2_PA	Inductor to power supply for power amplifier
14	V2_PA	Inductor to power supply for power amplifier
15	GND	Ground
16	V1_PA	Supply voltage for power amplifier
Slug	GND	Ground

## Absolute Maximum Ratings

All voltages are referred to ground (Pins GND and slug), no RF

Parameters	Symbol	Value	Unit
Supply voltage Pins V1_PA, V2_PA and V3_PA_OUT	$V_S$	6	V
Junction temperature	$T_J$	150	°C
Storage temperature	$T_{stg}$	-40 to +125	°C
RF input power PA	$P_{inPA}$	10 dBm	dBm

## Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient HP-VFQFP-N16, Slug soldered on pcb	$R_{thJA}$	40	K/W

## Operating Range

All voltages are referred to ground (Pins GND and slug). Power supply points are V1\_PA, V2\_PA, V3\_PA\_OUT. The following table represents the sum of all supply currents depending on the TX mode.

Parameters	Symbol	Min.	Typ.	Max.	Unit
Supply voltage Pins V1_PA, V2_PA and V3_PA_OUT	$V_S$	2.7	3.0	4.6	V
Supply current	$I_S$		165		mA
Standby current	$I_{S\_standby}$		10		µA
Ambient temperature	$T_{amb}$	-25	+25	+70	°C

## Electrical Characteristics

Test conditions (unless otherwise specified):  $V_S = 3.0\text{ V}$ ,  $T_{\text{amb}} = 25^\circ\text{C}$

Parameters	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
<b>Power Amplifier <sup>(1)</sup></b>						
Supply voltage	Pins V1_PA, V2_PA and V3_PA_OUT	$V_S$	2.7	3.0	4.6	V
Supply current	TX	$I_{S\_TX}$		165		mA
	Standby	$I_{S\_standby}$			10	$\mu\text{A}$
Frequency range	TX	$f$	2.4		2.5	GHz
Gain-control range	TX	$\Delta\text{Gp}$	60	42		dB
Power gain maximum	TX Pin PA_IN to V3_PA_OUT	$G_p$	28	30	33	dB
Power gain minimum	TX Pin PA_IN to V3_PA_OUT	$G_p$	-40		-17	dB
Ramping voltage maximum	TX, power gain (maximum) Pin RAMP	$V_{\text{RAMP max}}$	1.7	1.75	1.83	V
Ramping voltage minimum	TX, power gain (minimum) Pin RAMP	$V_{\text{RAMP min}}$		0.1		V
Ramping current maximum	$V = 1.75\text{ V}$				0.5	mA
Power-added efficiency	TX	PAE	35	42		%
Saturated output power	TX, input power = 0 dBm referred to Pins V3_PA_OUT	$P_{\text{sat}}$	22	23	24	dBm
Input matching <sup>(2)</sup>	TX, Pin PA_IN	Load VSWR		<1.5:1		
Output matching <sup>(2)</sup>	TX, Pin V3_PA_OUT	Load VSWR		<1.5:1		
Harmonics at $P_{\text{sat}} = 23\text{ dBm}$	TX, Pin V3_PA_OUT	$2 f_o$			-30	dBc
Harmonics at $P_{\text{sat}} = 23\text{ dBm}$	TX, Pin V3_PA_OUT	$3 f_o$			-30	dBc

- Notes: 1. Power amplifier shall be unconditionally stable, maximum duty cycle 100%, true CW operation, maximum load mismatch and duration: VSWR 10:1 (all phases) 10 s,  $Z_G = 50\ \Omega$ .  
2. With external matching network, load impedance  $50\ \Omega$

## Typical Operating Characteristics

Figure 3. Output Power and PAE versus Supply Voltage

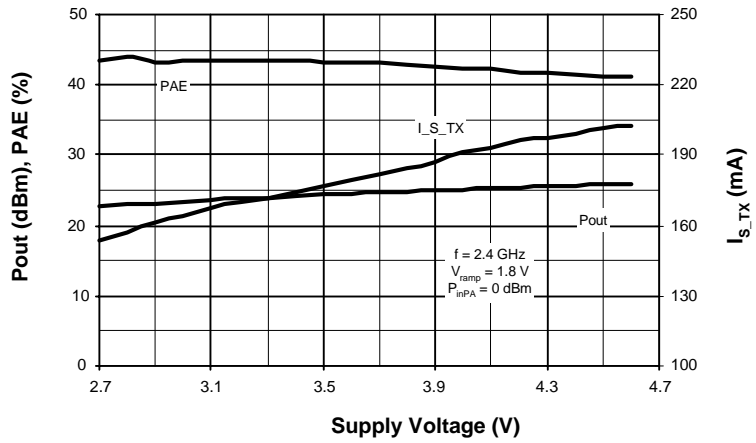


Figure 4. Output Power and PAE versus Frequency

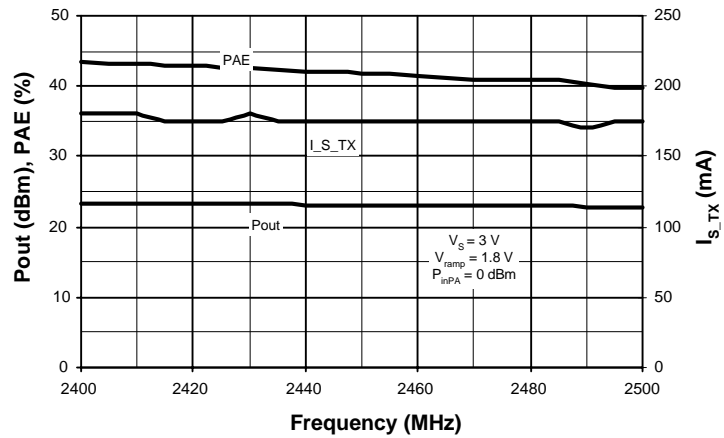
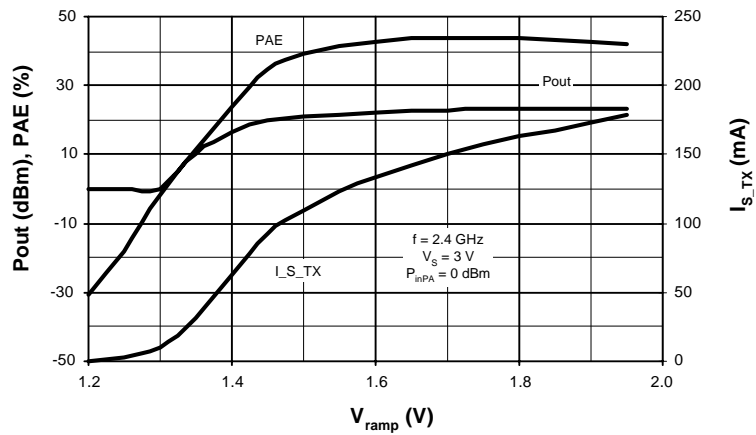
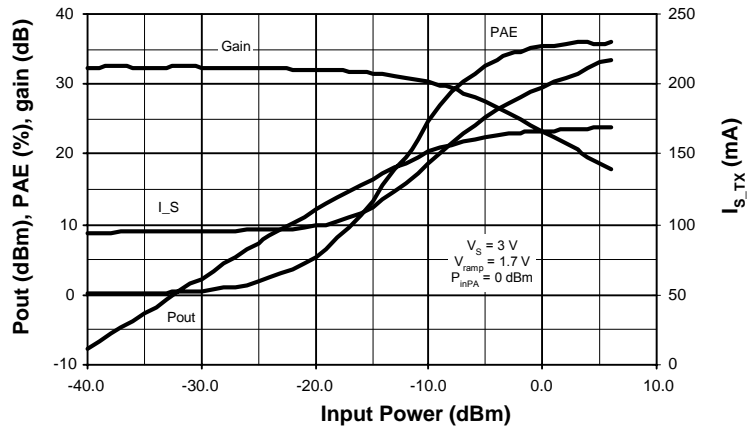


Figure 5. Output Power and PAE versus Ramp Voltage



**Figure 6.** Output Power and PAE versus Input Power



**Figure 7.** P<sub>out</sub> versus V<sub>ramp</sub> and Temperature

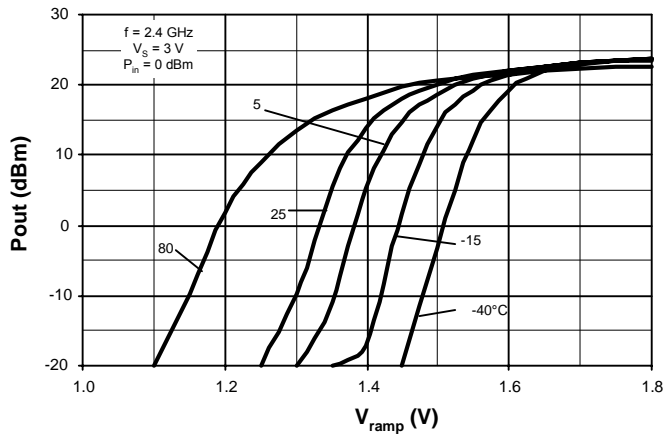


Figure 8. Output Power versus  $I_{Ramp}$  Current

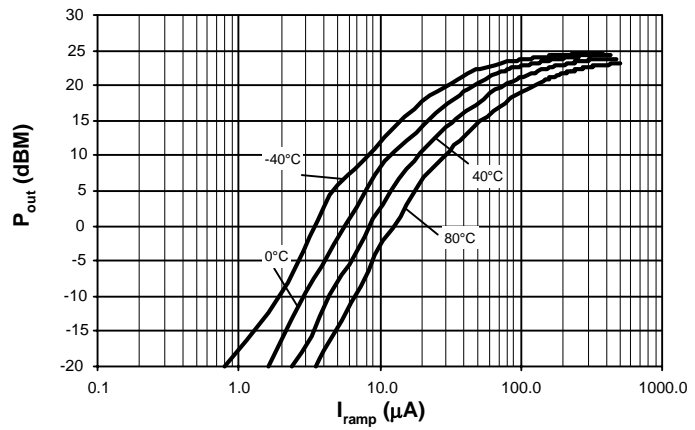
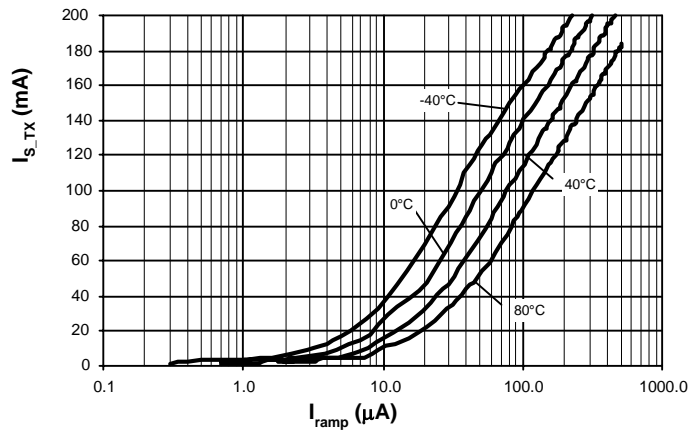
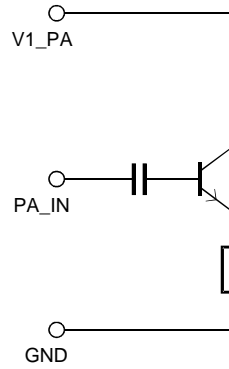


Figure 9.  $I_{S\_TX}$  versus  $V_{Ramp}$  Current

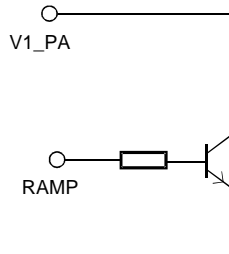


# Input/Output Circuits

**Figure 10.** Input Circuit PA\_IN/V1\_PA



**Figure 11.** Input Circuit RAMP/V1\_PA



**Figure 12.** Input Circuit V2\_PA

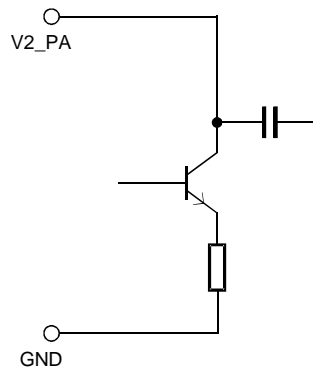




Figure 13. Input/Output Circuit V3\_PA\_OUT

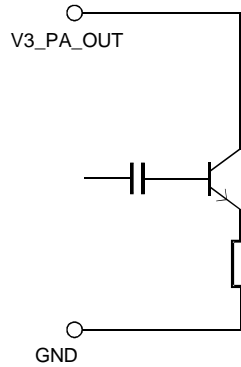
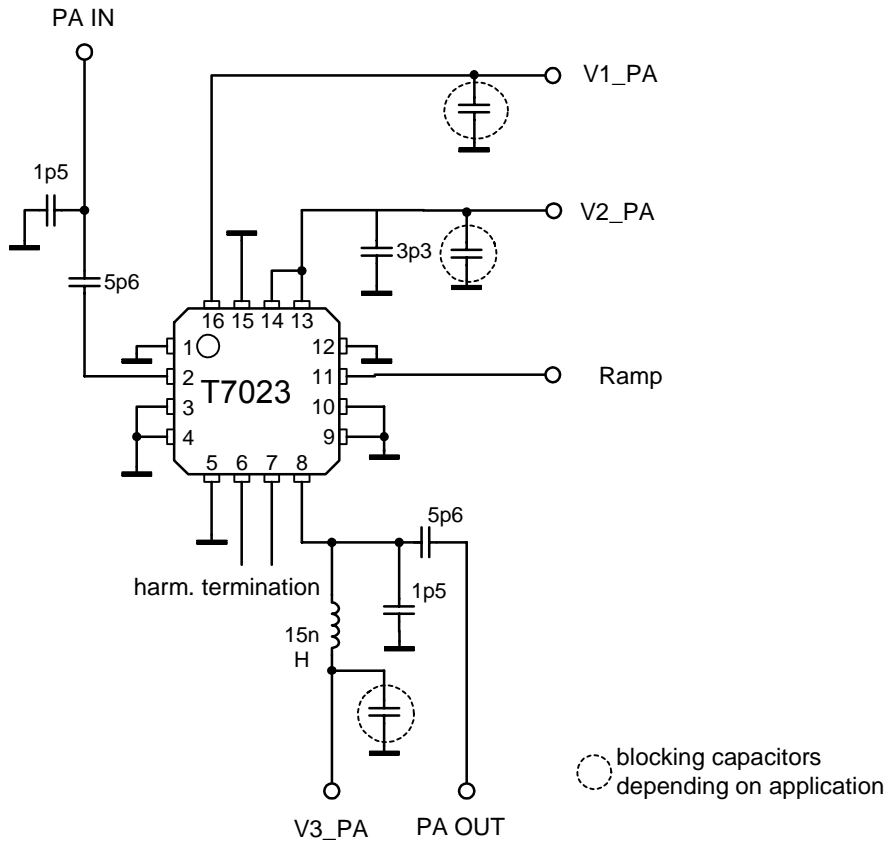


Figure 14. Application Board Schematic



## Ordering Information

Extended Type Number	Package	Remarks
T7023-PES	HP-VFQFP-N16	Tube
T7023-PEQ	HP-VFQFP-N16	Taped and reeled

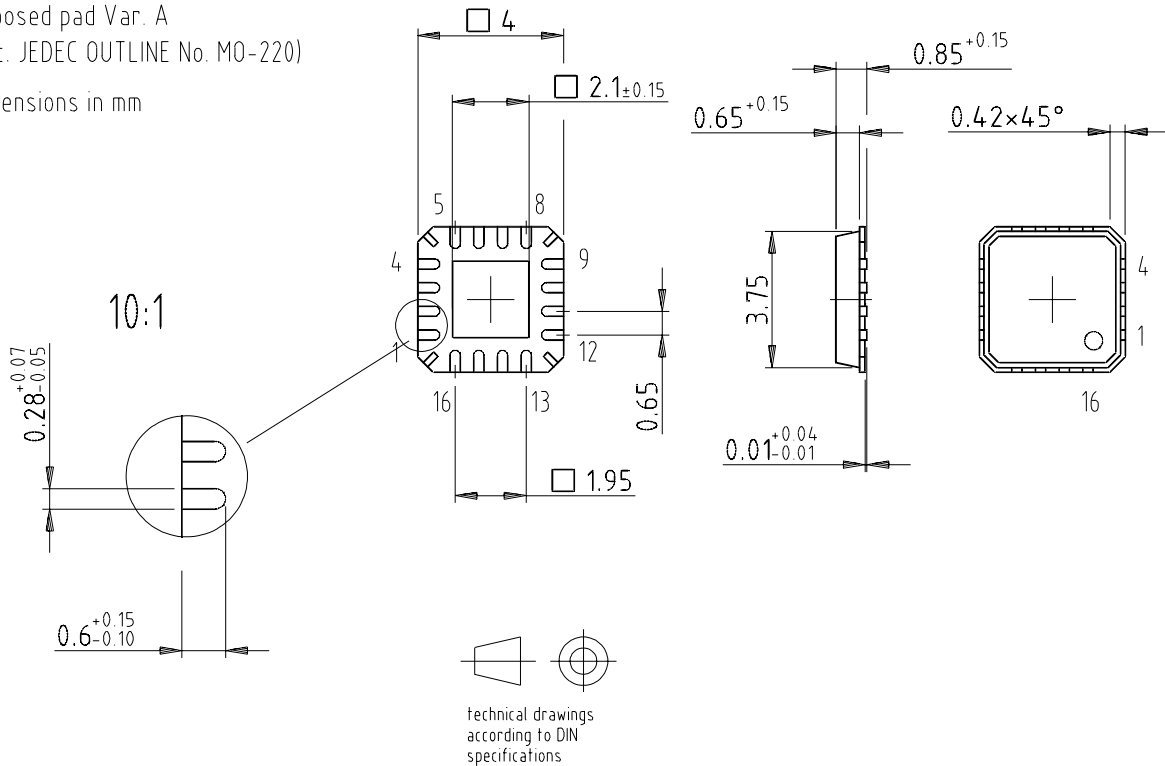
## Package Information

Package: HP-VFQFP-N16

Exposed pad Var. A

(acc. JEDEC OUTLINE No. MO-220)

Dimensions in mm





## 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](mailto: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® is the registered trademark of Atmel.

The Bluetooth name and the Bluetooth trademarks are owned by Bluetooth SIG, Inc, and are used by Atmel Corporation under license.

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



Printed on recycled paper.