AVR32917: picoPower Board getting started

Features

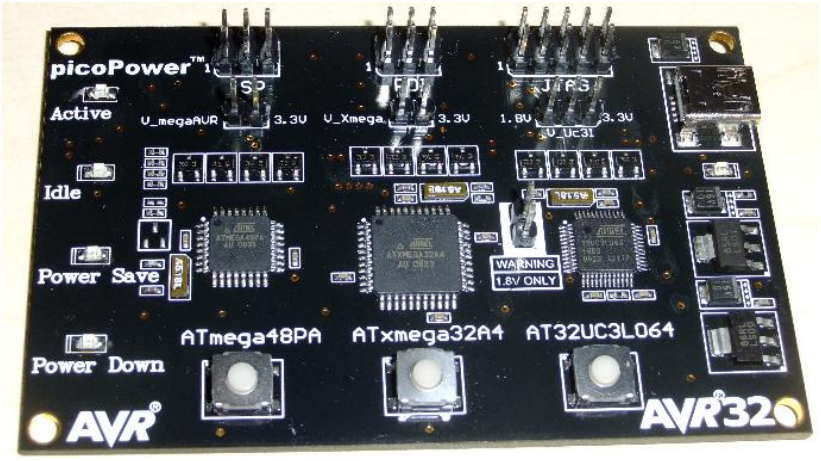
- **Introduction to the picoPower® Board**
- **Includes the evaluation demo application**

1 Introduction

Atmel®'s picoPower technology provides power saving modes while maintaining MCU performance. picoPower enabled microcontrollers incorporate a number of techniques for reducing the power consumption in both active and sleep modes and still react quickly from any sleep mode . The purpose of the picoPower Board is to get familiar with the general power-saving features of AVR® and AVR32 microcontrollers.

This document describes the picoPower function of ATmega48PA, ATxmega32A4 and AT32UC3L064.

Figure 1-1: The picoPower Board.



32-bit AVR® Microcontrollers

Application Note

Preliminary

Rev. 32136A-AVR-12/09

2 picoPower Board

2.1 Featured modes of operation

The picoPower Board features 4 modes for each device.

For ATmega48PA and ATxmega32A4, the modes are:

- Active mode
- Idle mode
- Power Save mode
- Power Down mode

For AT32UC3L064, the modes are:

- Active mode
- Idle mode
- Static mode with RTC
- Static mode without RTC

To switch the operation mode, you need only press the button below the device. A LED will light up once a key is pressed, and remain lit up until the key is released. The related device will enter the corresponding operation mode once the LED turns off.

For example, if you press the button below the device ATmega48PA once and the Idle LED blinks, the ATmega48PA will have entered Idle mode. Press the button again, and the Power Save LED will blink once as the device switches to this mode.

The details of the different operating modes for each device are presented in Table 2-1 to Table 2-3.

Table 2-1: Details of ATmega48PA operating modes.

Operating mode	Operating mode in Datasheet	CPU	All peripherals	32kHz crystal	Clock Frequency
Active	Active	ON	OFF	OFF	1MHz[1]
Idle	Idle	OFF	OFF	OFF	1MHz[1]
Power Save	Power Save	OFF	OFF	ON	N/C
Power Down	Power Down	OFF	OFF	OFF	N/C

Notes :
1. The 1MHz clock needs to be calibrated according to AVR053: **Calibration of internal RC oscillator** in order to get the exact consumption value. The consumption for ATmega48PA presented here is based on this calibration.

Table 2-2: Details of ATxmega32A4 operating modes.

Operating mode	Operating mode in Datasheet	CPU	All peripherals	32kHz crystal	Clock Frequency
Active	Active	ON	OFF	OFF	2MHz
Idle	Idle	OFF	OFF	OFF	2MHz
Power Save	Power Save	OFF	OFF	ON	N/C
Power Down	Power Down	OFF	OFF	OFF	N/C

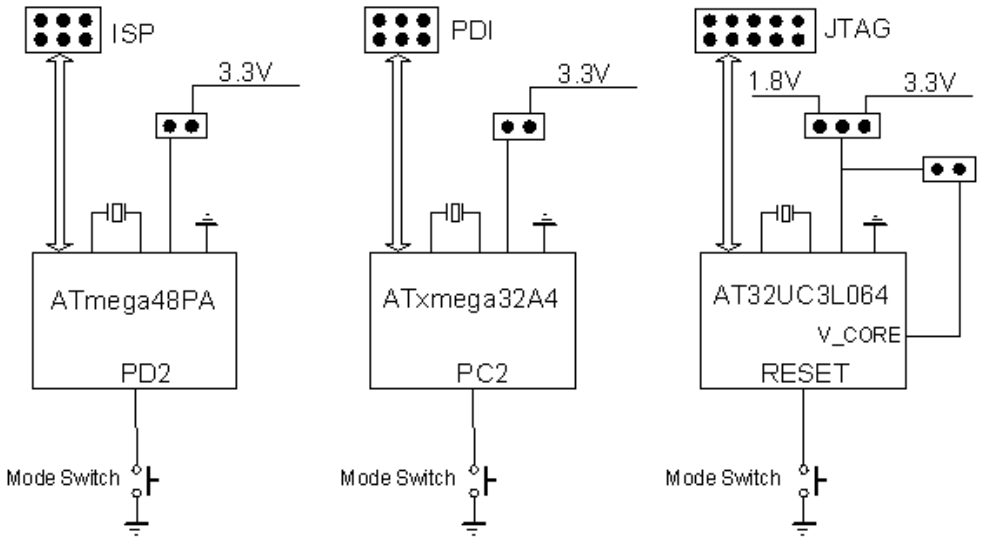
Table 2-3: Details of AT32UC3L064 operating modes.

Operating mode	Operating mode in Datasheet	CPU	All peripherals	32kHz crystal	Clock Frequency
Active	Active	ON	OFF	ON	50MHz
Idle	Idle	OFF	OFF	ON	50MHz
Power Save	Static with RTC	OFF	OFF	ON	N/C
Power Down	Static without RTC	OFF	OFF	OFF	N/C

2.2 Hardware schematics

The schematics for the picoPower Board are shown in Figure 2-1 and are also printed on the bottom side of the picoPower Board.

Figure 2-1: Schematics of picoPower Board.



2.3 Operating voltage

For powering the devices, the picoPower Board features a USB mini connector. Two regulators generate 3.3V and 1.8V individually from the USB 5V supply.

3.3V is supplied to all three devices, and is the only voltage needed for the ATmega48PA and ATxmega32A4. The AT32UC3L064 can be powered by either 3.3V or 1.8V, depending on the mode of operation.

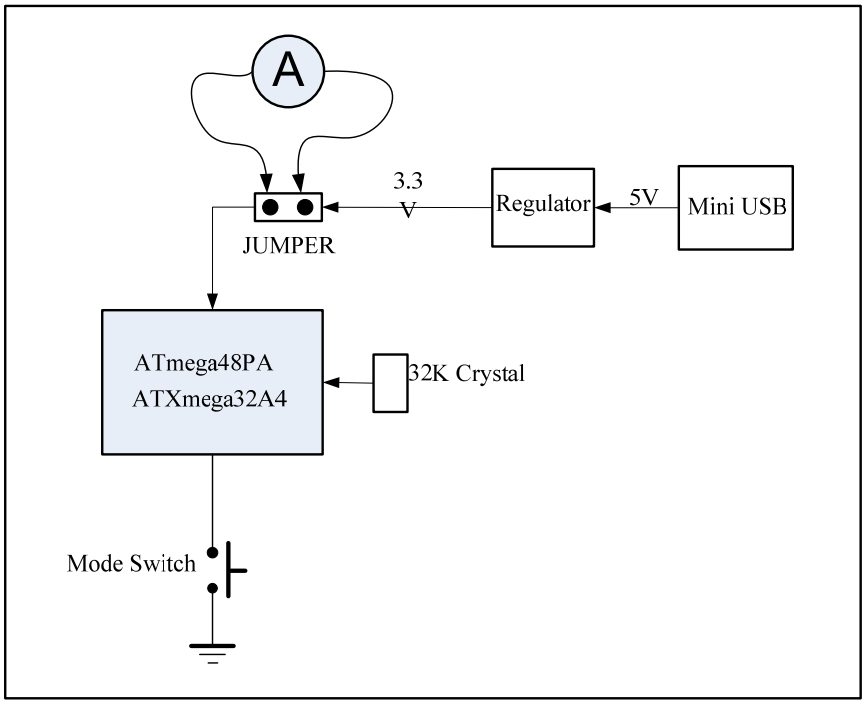
The two pin Jumper for UC3L064 connects the power supply to the VDDIO and VDDCORE pins on the device. VDDCORE should only be powered by 1.8V. Any voltage exceeding this limitation can cause physical damage to the device.

*WARNING: The 1.8V jumper must **only** be set if the 1.8V power supply is connected. The 1.8V jumper must be open while the 3.3V is connected or the device may be damaged.*

2.4 Current measurement

To measure the current consumption on ATmega48PA or ATxmega32A4, remove the cap from the related Jumper and connect an Ampere meter to the two pins, as shown in Figure 2-2.

Figure 2-2: Ampere meter connection for ATmega48PA and ATxmega32A4.

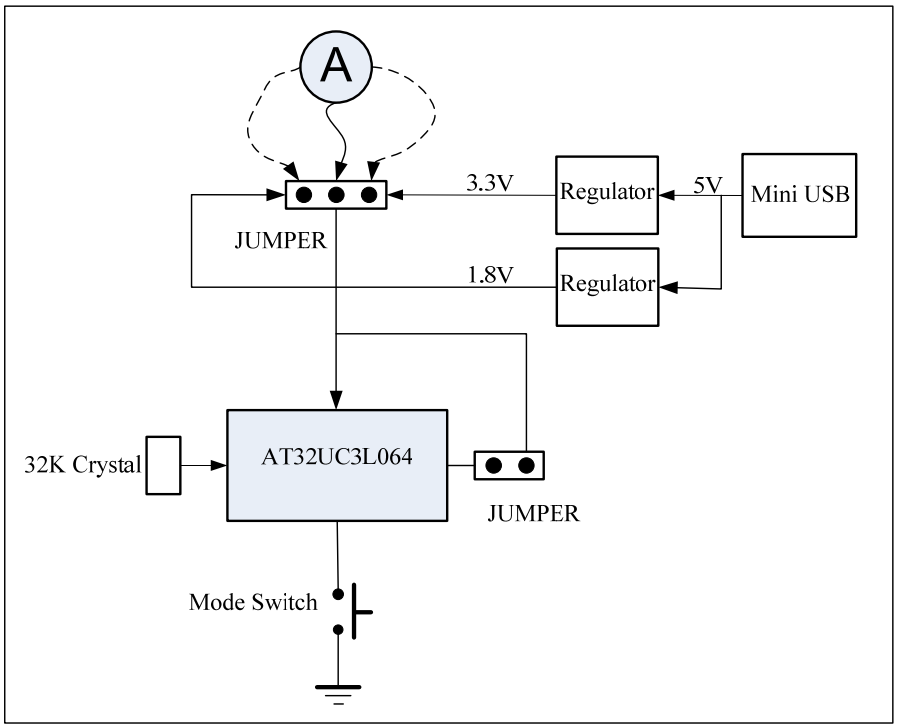


Press the key below the device to make sure which mode the device is in. The device enters the corresponding mode once the key is released and LED turns off.

To measure the current consumption on AT32UC3L064, connect the Ampere meter as shown in Figure 2-3. Since different power supply connections are needed for the normal sleep mode and shutdown mode, both regulated voltages are shown.

The purpose of the three pin jumper is to support all modes of operation on the same platform. For the shutdown mode, the power configuration should be ***3.3V Supply Mode with 1.8V Regulated I/O Line*** (refer to *3.5.3.3* of UC3L datasheet), but for all other modes, only use 1.8V as the power supply for the lowest power consumption (refer to 32.5 of UC3L datasheet for details regarding operation conditions).

Figure 2-3: Ampere meter connection for AT32UC3L064.



2.5 Power Consumption

The figures in the following subsections are extracts from the corresponding datasheets and can be used as reference for measurements. The figures show the typical current consumption in the different operating modes.

2.5.1 ATmega48PA

Figure 2-4: ATmega48PA in Active mode (device running at 1MHz).

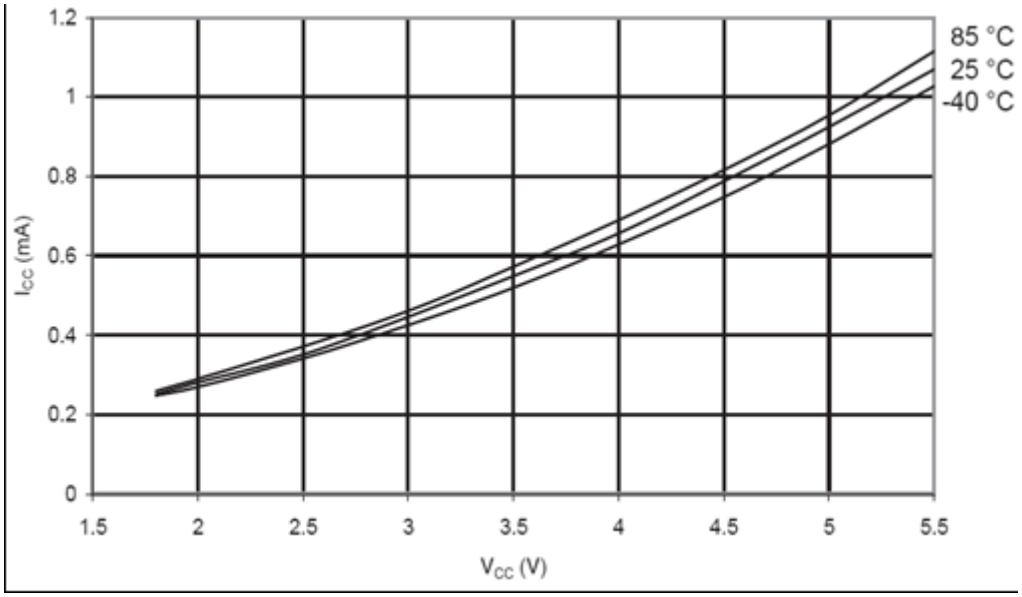


Figure 2-5: ATmega48PA in Idle mode (device running at 1MHz).

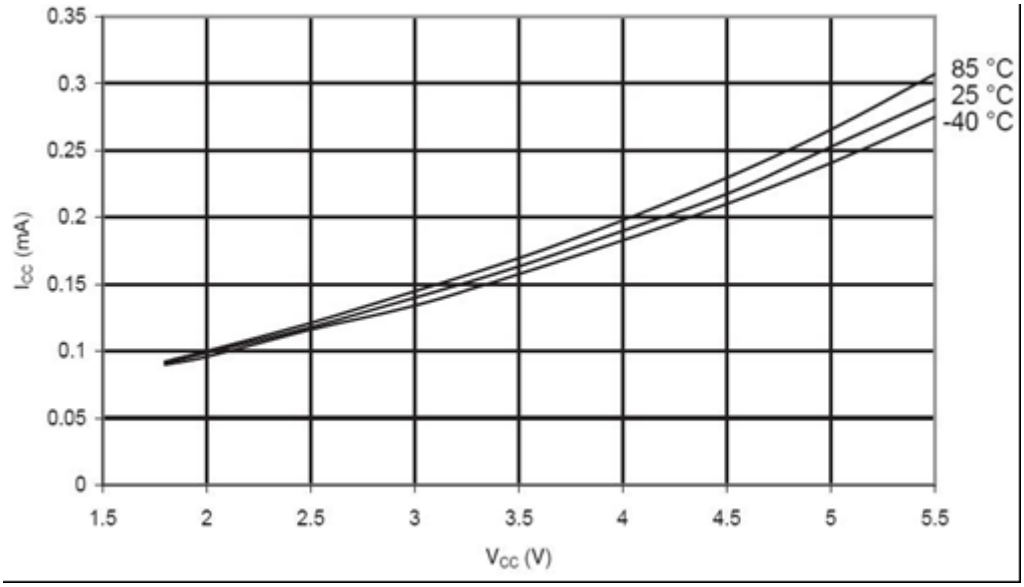


Figure 2-6: ATmega48PA in Power Down mode.

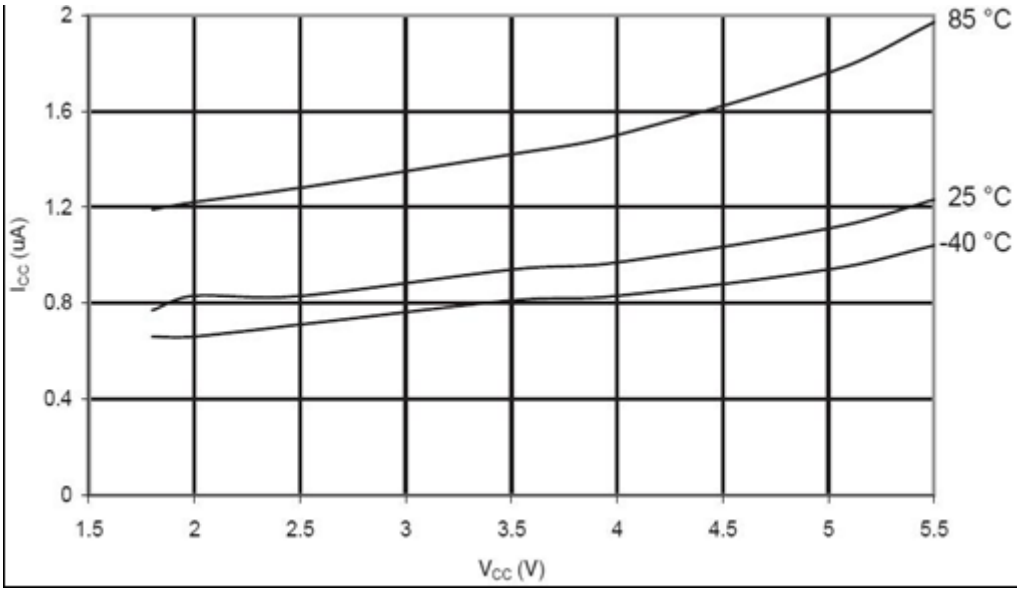
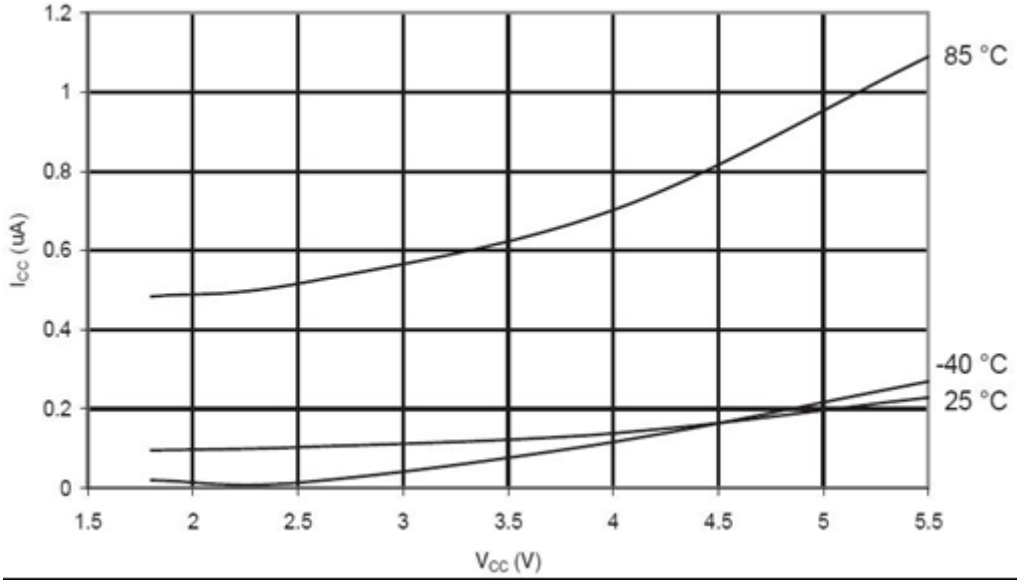


Figure 2-7: ATmega48PA in Power Save mode.



2.5.2 ATxmega32A4

Figure 2-8: ATxmega32A4 in Active mode (device running at 2MHz).

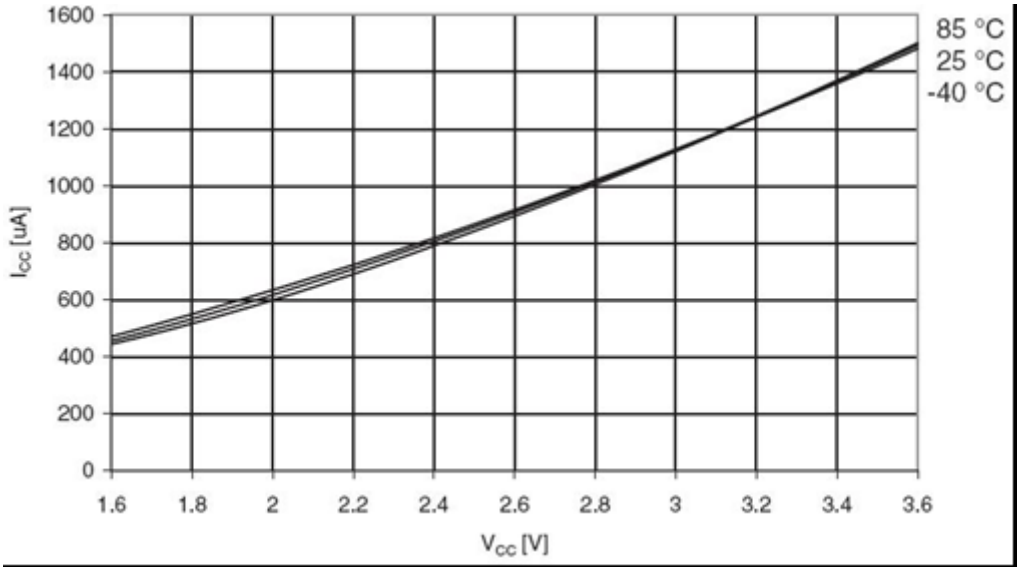


Figure 2-9: ATxmega32A4 in Idle mode(device running at 2MHz).

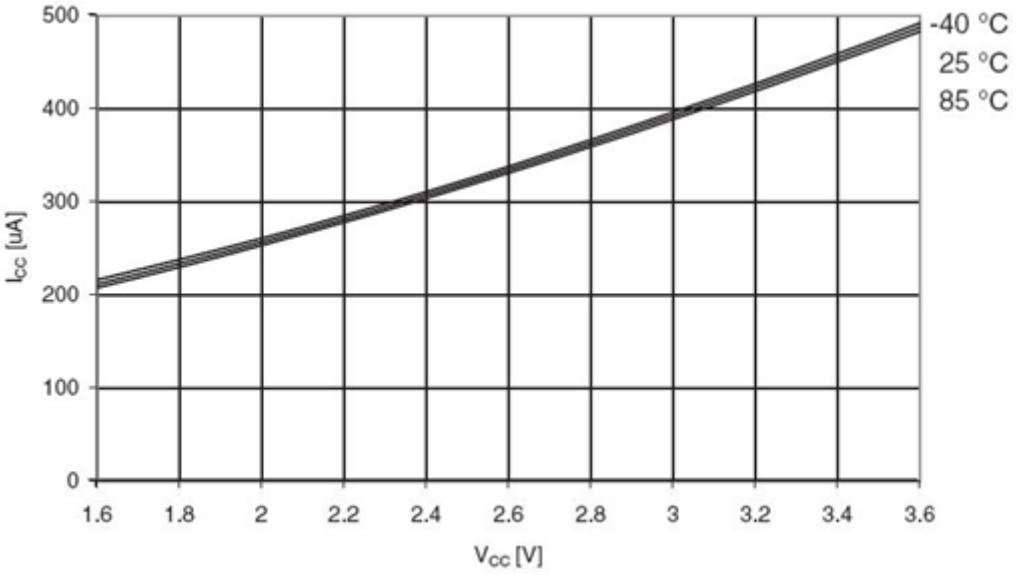


Figure 2-10: ATxmega32A4 in Power Save mode.

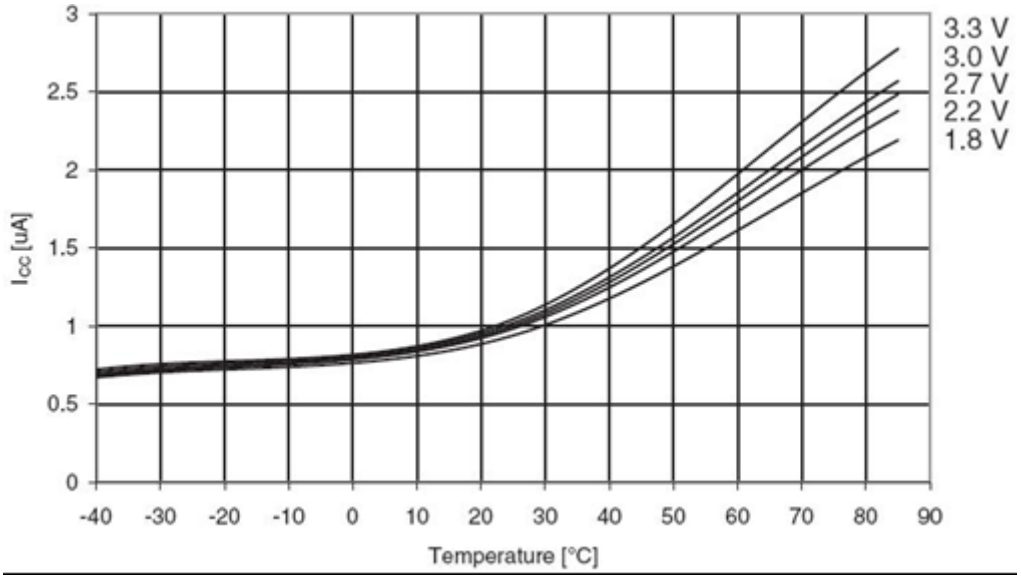
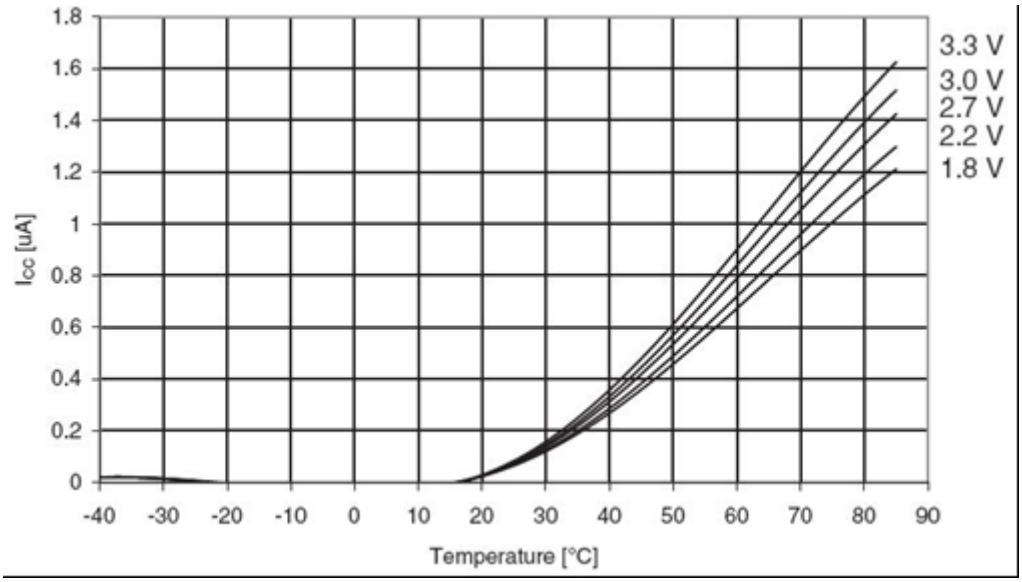


Figure 2-11: ATxmega32A4 in Power Down mode.



2.5.3 AT32UC3L064

Figure 2-12: Current consumption for AT32UC3L064 in different modes.

Mode	Conditions	Measured on	Consumption Typ	Unit
Active	CPU running a recursive Fibonacci algorithm from flash with 1 wait state	Amp0	300	µA/MHz
Idle		Amp0	150	µA/MHz
Frozen		Amp0	90	µA/MHz
Standby		Amp0	70	µA/MHz
Stop		Amp0	30	µA
DeepStop		Amp0	20	µA
Static	AST and OSC32K running	Amp0	7	µA
	AST and OSC32K stopped	Amp0	5	µA
Shutdown	AST and OSC32K running	Amp0	1.5	µA
	AST and OSC32K stopped	Amp0	0.1	µA

3 Firmware

3.1 General

The main purpose of the firmware is to enter different sleep modes based on the current status. The status is updated when the key is pressed.

For ATmega48PA and ATxmega32A4, the key press triggers a pin interrupt. The status is updated in the ISR, and the sleep mode is then set accordingly in the main loop.

For AT32UC3L064, the key press resets the chip. The status variable is stored in RAM and the reset does not clear it, so each reset will cause a change of sleep mode.

3.2 Flowcharts

Figure 3-1: Flowchart for ATmega48PA and ATxmega32A4.

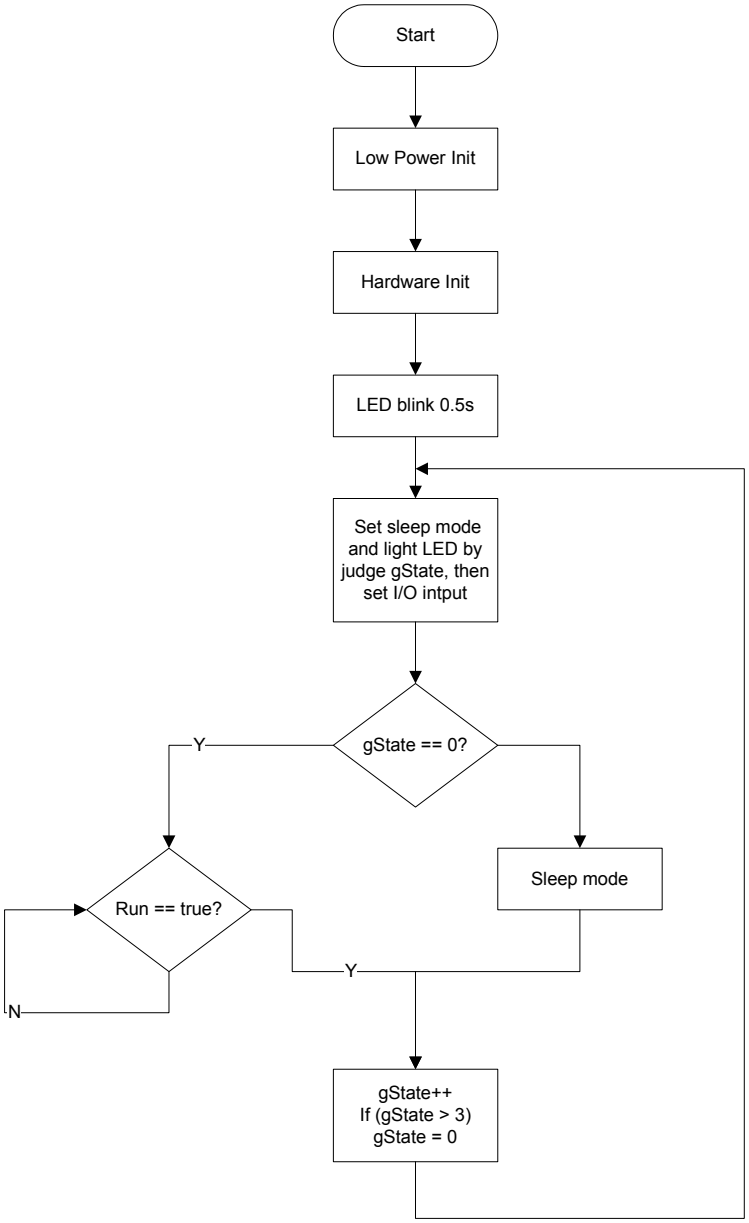
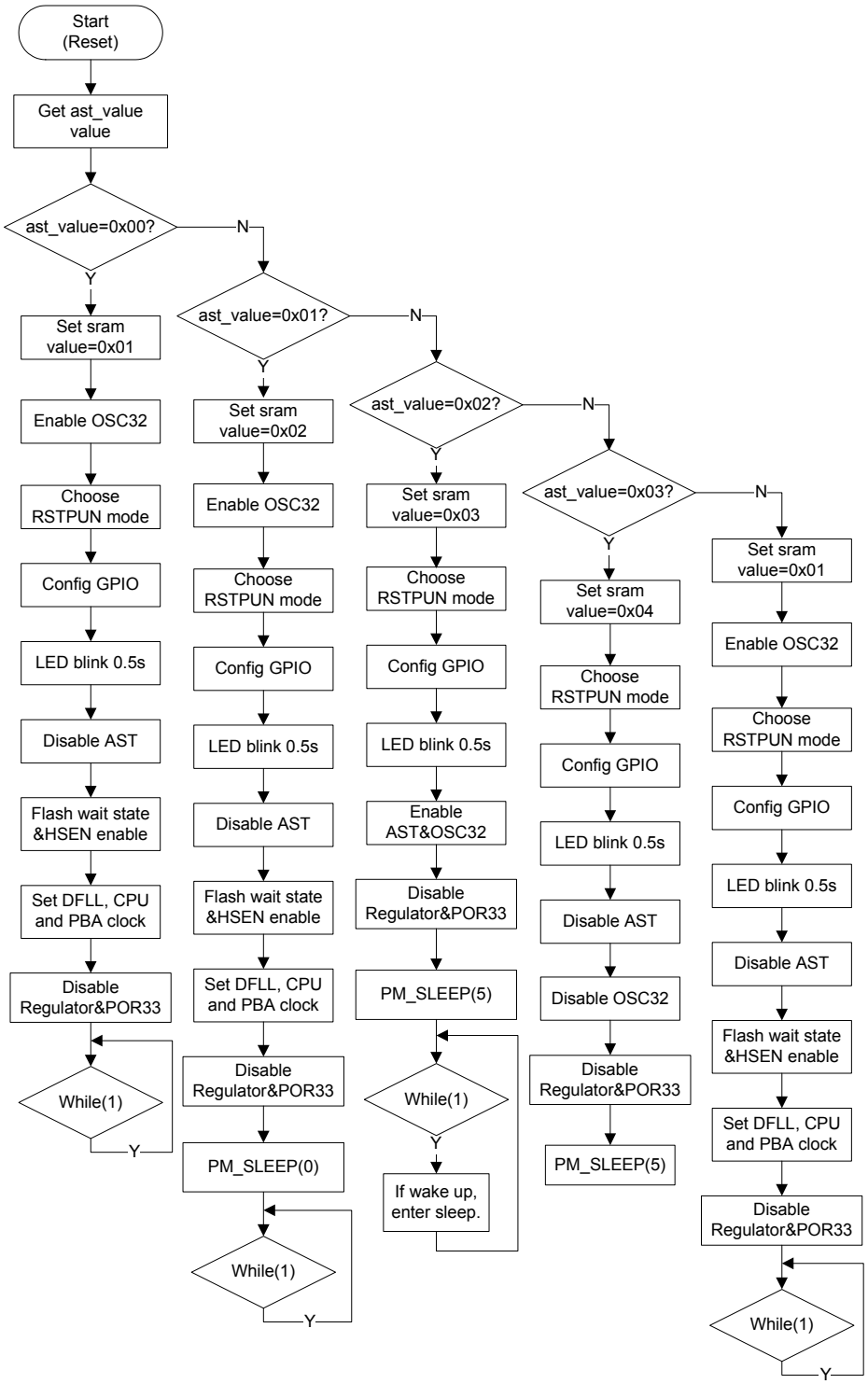


Figure 3-2: Flowchart for AT32UC3L064.



4 Operation step

4.1 Installation

To compile the code supplied with this application note it is necessary to install the development tools AVR Studio, AVR32 Studio and the GNU Toolchain.

4.2 Programming the devices

Open the project corresponding to each device, build the project and generate the ELF files. Then download it into the chip using the related programming headers.

Each device has a separate programming header. The ATmega48PA uses ISP, the ATxmega32A4 uses PDI and the AT32UC3L064 uses JTAG.

The connection with JTAGICE mkII is shown for the different devices in in Figure 4-1 to Figure 4-3.

Figure 4-1: JTAGICE mkII connection for ATmega48PA.

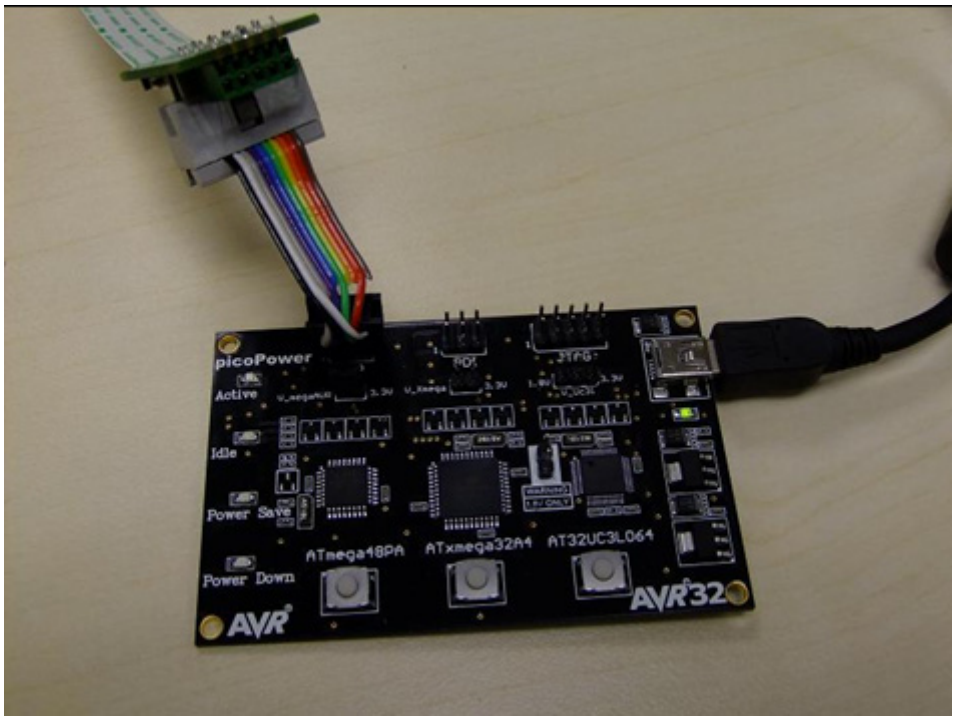


Figure 4-2: JTAGICE mkII connection for ATxmega32A4.

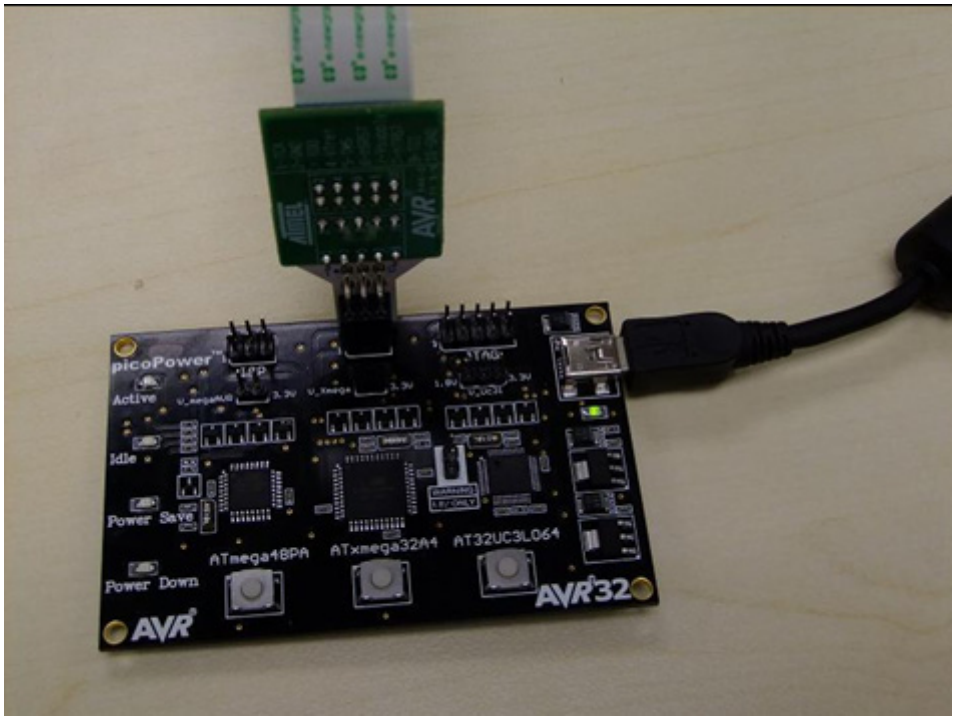
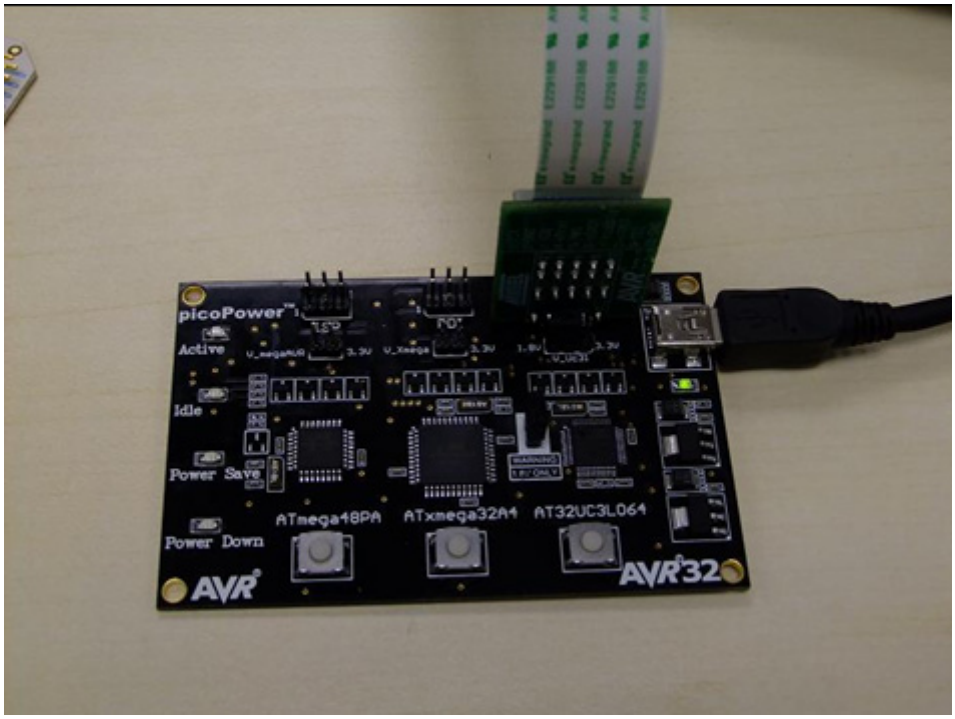


Figure 4-3: JTAGICE mkII connection for AT32UC3L064.

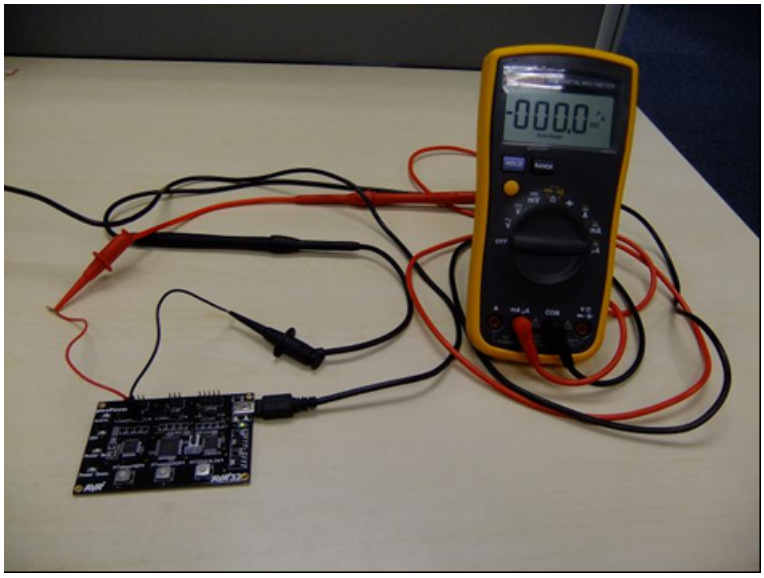


4.3 Measure the current

You can measure the current by following the steps below. ATmega48PA is used here as an example:

- Take off the jumper cap for the ATmega48PA.
- Connect an Ampere meter to the two pins of the jumper.
- Power on the board, and the ATmega48PA will enter Active mode as default.
- Then, you can record the current value shown on the Ampere meter.
- Press the key to switch the operating mode to Idle mode, the LED for Idle mode will blink once.
- Record the value in the Ampere meter and so on. You will get all the currents for the 4 working modes.
- Compare the values with the corresponding table in 2.5.

Figure 4-4: Measurement setup for ATmega48PA.



Headquarters

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

International

Atmel Asia
Unit 1-5 & 16, 19/F
BEA Tower, Millennium City 5
418 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
Tel: (852) 2245-6100
Fax: (852) 2722-1369

Atmel Europe
Le Krebs
8, Rue Jean-Pierre Timbaud
BP 309
78054 Saint-Quentin-en-
Yvelines Cedex
France
Tel: (33) 1-30-60-70-00
Fax: (33) 1-30-60-71-11

Atmel 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

Product Contact

Web Site
www.atmel.com

Technical Support
avr@atmel.com

Sales Contact
www.atmel.com/contacts

Literature Request
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.

© 2009 Atmel Corporation. All rights reserved. Atmel®, Atmel logo and combinations thereof, AVR®, AVR® logo, picoPower® and others, are the registered trademarks or trademarks of Atmel Corporation or its subsidiaries. Other terms and product names may be trademarks of others.