AVR364: MEGA-1284P Xplained Hardware User's Guide

Features

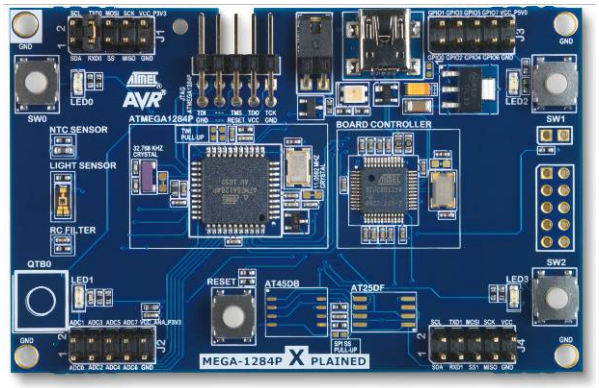
- Atmel® megaAVR® ATmega1284P microcontroller
  - Target controller
- Atmel AVR® AT32UC3B1256 32-bit microcontroller
  - Board controller
  - Communication gateway
- Analog input (to ADC)
  - Temperature sensor
  - Light sensor
  - RC filter
- Digital I/O
  - Three mechanical buttons
  - Four LEDs
  - Four expansion headers
- Footprints for external memory
  - Atmel AT45DB series DataFlash® serial flash
  - Atmel AT25DF series industrial standard serial data flash
- Touch
  - One Atmel QTouch® button

1 Introduction

The Atmel MEGA-1284P Xplained evaluation kit is a hardware platform for evaluating the ATmega1284P MCU.

The kit offers a large range of features that enable the megaAVR user to get started using megaAVR peripherals right away and to get an understanding of how to integrate a megaAVR MCU in their own design.

Figure 1-1. MEGA-1284P Xplained evaluation kit.



8-bit Atmel Microcontrollers

Application Note

Rev. 8377B-AVR-11/11

2 Related items

Atmel AVR Studio® 4 (free IDE from Atmel)
http://atmel.com/dyn/products/tools_card.asp?tool_id=2725&category_id=163&family_id=607&subfamily_id=760

Atmel AVR Dragon™ (on-chip programming and debugging tool)
http://atmel.com/dyn/products/tools_card.asp?tool_id=3891&category_id=163&family_id=607&subfamily_id=760

Atmel AVR JTAGICE mkII (on-chip programming and debugging tool)
http://atmel.com/dyn/products/tools_card.asp?tool_id=3353&category_id=163&family_id=607&subfamily_id=760

Atmel AVR ONE! (on-chip programming and debugging tool)
http://atmel.com/dyn/products/tools_card.asp?tool_id=4279&category_id=163&family_id=607&subfamily_id=760

3 General information

This document targets the Atmel ATmega1284P evaluation kit revision 3, and parts of the document may, therefore, be inconsistent with earlier revisions of the product. For earlier revisions, please refer to the schematics, which is the only documentation available for these revisions. The Atmel MEGA-1284P Xplained kit is intended to demonstrate the ATmega1284P, and the hardware that relates to the Atmel AT32UC3B1256 (board controller) is, therefore, not covered in detail in this document.

Figure 3-1. Overview of the MEGA-1284P Xplained kit.

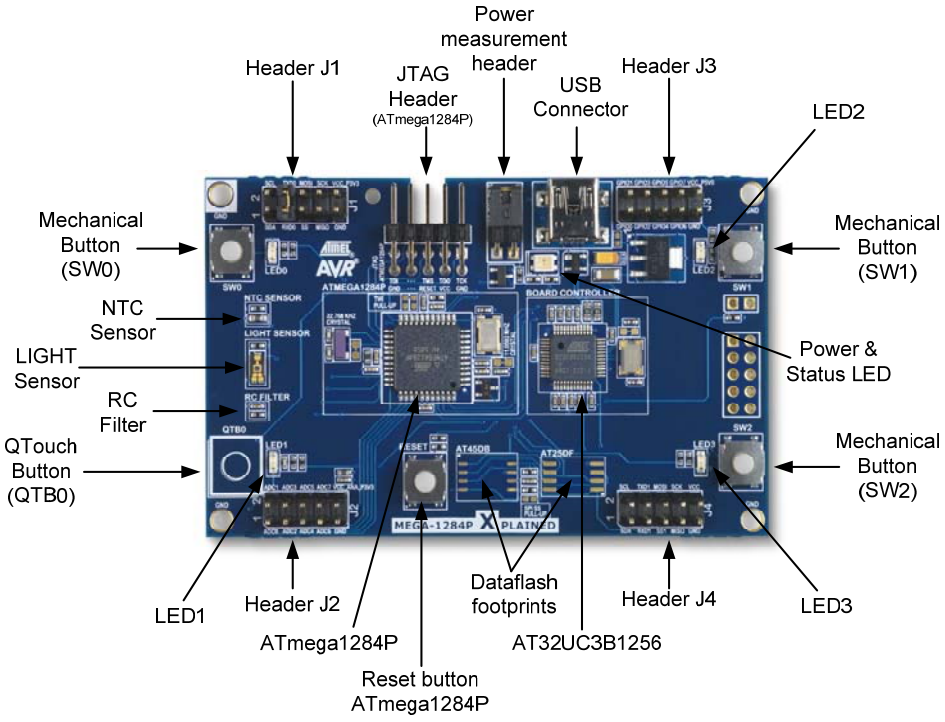
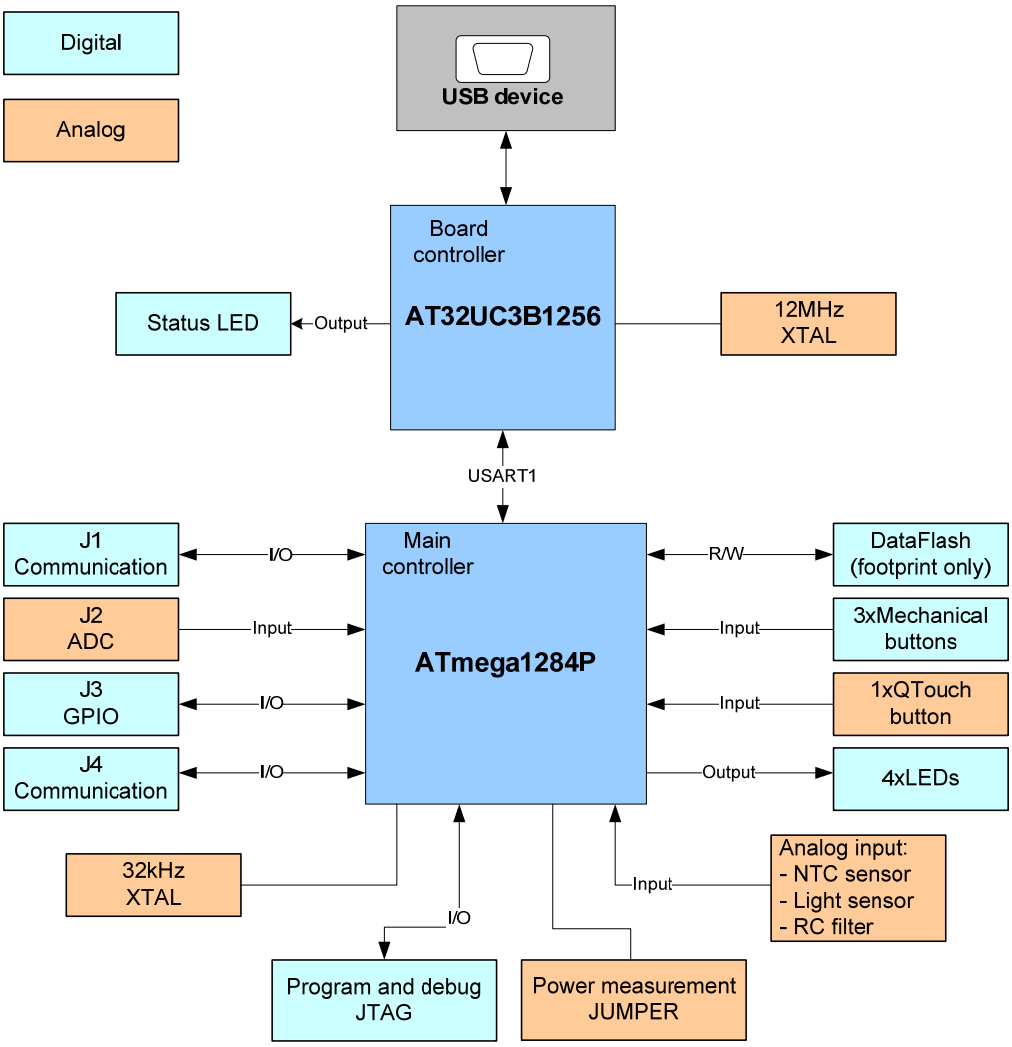


Figure 3-2. Functional overview of the Atmel MEGA-1284P Xplained kit.



3.1 Preprogrammed firmware

The MEGA-1284P Xplained kit comes with both the Atmel ATmega1284P and the Atmel AT32UC3B1256 preprogrammed.

The preprogrammed firmware in the ATmega1284P is set up with example code that allows the user to choose different sleep modes, and provides an example of how to use the light sensor to dim the four onboard LEDs. It also includes a boot loader (AVROSP) which allows the user to reprogram the ATmega1284P without using an external programmer. Please refer to the Atmel application note, AVR370: MEGA-1284P Xplained Getting Started Guide, for more details regarding the preprogrammed firmware.

The preprogrammed AT32UC3B1256 firmware offers features such as a boot loader for self-programming of the board controller itself, and a USART-to-USB gateway, which can be used to communicate with the target controller, the ATmega1284P.

3.2 Power supply

The kit is powered via the USB connector, which presents two options for powering it: Either connect the kit to a PC through a USB cable or to a 5V USB power supply (AC/DC adapter).

The 5V is regulated to 3.3V with an LDO regulator, which provides power to the entire board. The Atmel ATmega1284P is powered by 3.3V, but if 1.8V operation is desired, some modifications to the board are needed. This includes replacing the regulator with one that delivers a 1.8V output and rerouting the power to the device (see schematic for an explanation). As some of the other ICs on the Atmel MEGA-1284P Xplained require 3.3V to operate correctly, these devices have to be removed.

3.3 Measuring the ATmega1284P power consumption

As part of an ATmega1284Pevaluation, it can be of interest to measure its power consumption. The two-pin power measurement header is the only connection between the VCC_P3V3 common power plane and the VCC_MCU_P3V3 power plane. By replacing the jumper with an ammeter, it is possible to determine the ATmega1284P current consumption. To locate the power measurement header, please refer to Figure 3-1.

Do not power the board without having the jumper or an ammeter mounted. If this is done the board might be powered through an I/O pin. The result might be erratic behavior and the device might get damaged.

3.4 Communication through the USART-to-USB gateway

The ATmega1284P USART is connected to a USART on the Atmel AT32UC3B1256. The ATmega1284P USART is communicating at 57600 baud using one start bit, eight data bits, one stop bit, and no parity.

When the AT32UC3B1256 device is enumerated (connected to a PC). the data transmitted from the ATmega1284P is passed to a (virtual) COM port. This means that it is possible to use a terminal program on a PC to receive the transmitted data. Similarly data transmitted from the PC COM port is passed to the ATmega1284P USART through the gateway.

4 Connectors

The Atmel MEGA-1284P Xplained kit has five 10-pin, 100mil headers. Two headers have a fixed communication interface (J1 and J4). One header has analog functionality (J2), and the last header (J3) has general purpose digital I/O.

The 90° angled header is the Atmel ATmega1284P JTAG programming and debugging header.

For the location of the respective headers, refer to Figure 3-1.

4.1 Programming headers

The ATmega1284P can be programmed and debugged by connecting an external programming/debugging tool to the JTAG pin header. The pin header has a standard JTAG programmer pin-out (refer to online help in the Atmel AVR Studio), enabling tools like the Atmel AVR JTAGICE mkII or the Atmel AVR ONE! to be connected directly to the header.

The grey, female, 10-pin header on the AVR JTAGICE mkII must be used when connecting to the kit. A scoring in the board is made to fit the orientation tab on the header.

A standoff adapter (nr. 1) is needed when using the AVR ONE!

Pin 1 on the JTAG header is at the top right corner. This is rotated 180° compared to the other headers (J1, J2, J3, and J4).

Table 4-1. MEGA-1284P Xplained programming and debugging interface – JTAG.

Pin	JTAG [1]
1	TCK
2	GND
3	TDO
4	VCC
5	TMS
6	nSRST
7	-
8	-
9	TDI
10	GND

Note: 1. Standard pin-out for the AVR JTAGICE mkII and other Atmel programming tools

The Atmel AT32UC3B1256 can be programmed through its boot loader. The boot loader is evoked by shorting the two holes marked *BOOTLOADER BOARD CONTROLLER* on the bottom side of the board before applying power to the board. The two holes have 100mil spacing, enabling the user to solder in a two-pin header and use a jumper to easily enter the boot loader. Programming is performed through the boot loader programmer target in the Atmel AVR Studio.

Alternatively, the AT32UC3B1256 can also be programmed by connecting a programming tool, such as the AVR JTAGICE mkII, to the 10 holes marked *JTAG BOARD CONTROLLER* on the bottom side of the board. The holes have 100mil spacing, letting the user solder in a 10-pin header to program the board controller.

Please note that programming the Atmel AT32UC3B1256 using a programming tool will erase the boot loader.

Please refer to the Atmel application note, AVR370: MEGA-1284P Xplained Getting Started Guide, for more details regarding how to program the onboard microcontrollers.

4.2 I/O expansion headers

There are four available I/O expansion headers in the kit. Because of the low pin count on the device, the I/O expansion header pins are shared with onboard functionality. If “clean” expansion ports are needed, cut-straps are available to remove onboard functionality. Table 4-2 through Table 4-5 show what is shared on the respective header pins.

Table 4-2. Atmel MEGA-1284P Xplained I/O expansion header – J1.

Pin	J1	ATmega1284P pin	Shared with onboard functionality
1	TWI SDA	PC1	Header J4, board controller
2	TWI SCL	PC0	Header J4, board controller
3	USART RXD0	PD0	Header J4
4	USART TXD0	PD1	Header J4
5	SPI SS (1)	PB4	Board controller
6	SPI MOSI (1)	PB5	Header J4, DataFlash, board controller
7	SPI MISO (1)	PB6	Header J4, DataFlash, board controller
8	SPI SCK (1)	PB7	Header J4, DataFlash, board controller
9	GND	-	-
10	VCC_P3V3	-	-

Note: 1. These signals can be disconnected from the board controller by cutting the cut-straps marked *SPI* on the bottom side of the board.

Table 4-3. MEGA-1284P Xplained I/O expansion header – J2.

Pin	J2	ATmega1284P pin	Shared with onboard functionality
1	ADC0 (1)	PA0	Possible to connect to AREF
2	ADC1	PA1	-
3	ADC2	PA2	-
4	ADC3	PA3	-
5	ADC4	PA4	-
6	ADC5 (2)	PA5	Filter output
7	ADC6 (2)	PA6	Light sensor
8	ADC7 (2)	PA7	NTC sensor
9	GND	-	-
10	VCC_ANA_P3V3	-	-

Notes: 1. AREF with 100nF capacitor to GND can be connected to ADC0 by shorting two pads marked *EXTERNAL AREF* on the bottom side of the board.

2. These signals can be disconnected from the sensor/filter output by cutting the cut-straps marked *SENSORS & FILTER* on the bottom side of the board.

Table 4-4. Atmel MEGA-1284P Xplained I/O expansion header – J3.

Pin	J3	ATmega1284P pin	Shared with onboard functionality
1	GPIO0	PB0	SW0, LED0
2	GPIO1	PB1	SW1, LED2
3	GPIO2	PB2	SW2, LED3
4	GPIO3	PB3	LED1
5	GPIO4	PD4	J4 (SPI SS1), DataFlash (SPI SS1)
6	GPIO5 (1)	PD5	Filter input
7	GPIO6	PC4	JTAG(TDO)
8	GPIO7	PC5	JTAG(TDI)
9	GND	-	-
10	VCC_P5V0 (2)	-	-

Notes: 1. This signal can be disconnected from the filter input by cutting the cut-strap marked *FILTER INPUT* in the *SENSORS & FILTER* section on the bottom side of the board.

2. Pin 10 of header J3 is connected to the USB voltage (VCC_P5V0).

Table 4-5. MEGA-1284P Xplained I/O expansion header – J4.

Pin	J4	ATmega1284P pin	Shared with onboard functionality
1	TWI SDA	PC1	Header J1, board controller
2	TWI SCL	PC0	Header J1, board controller
3	USART RXD1	PD2	Board controller
4	USART TXD1	PD3	Board controller
5	SPI SS1	PD4	Header J3 (GPIO4), DataFlash
6	SPI MOSI (1)	PB5	Header J1, DataFlash, board controller
7	SPI MISO (1)	PB6	Header J1, DataFlash, board controller
8	SPI SCK (1)	PB7	Header J1, DataFlash, board controller
9	GND	-	-
10	VCC_P3V3	-	-

Note: 1. These signals can be disconnected from the board controller by cutting the cut-straps marked *SPI* on the bottom side of the board.

5 Memories

The Atmel MEGA-1284P Xplained kit does not have any external memories mounted on the board. Footprints are available for adding either an industrial standard flash device or an Atmel proprietary serial DataFlash device.

The footprints share the same SPI lines, including the chip select, and it is, therefore, not possible to mount devices on both footprints at the same time.

Table 5-1. Compatible devices for the footprints.

Atmel AT45DB	Atmel AT25DF
AT45DB64D2-CNU	AT25DF641A-SH
AT45DB321D-MWU	AT25DF321A-SH
AT45DB161D-SS	AT25DF161-SH
AT45DB081D-SS	AT25DF081-SSH
AT45DB041D-SS	AT25DF021-SSH
AT45DB021D-SS	
AT45DB011D-SS	

6 Miscellaneous I/O

6.1 Mechanical buttons

The board is equipped with three mechanical buttons. The buttons (SW0:2) are shared with LED0, LED2, and LED3. Onboard protection circuitry is added to avoid a short when driving the port high at the same time as pushing the button, which will short it to the ground. To be able to use both button and LED, time multiplexing has to be used.

To be able to detect a button press, the firmware has to periodically set the I/O pin to input with pull-up and check if it is low. When doing this fast enough, the human eye will not see any change in the LED.

6.2 LEDs

The Atmel MEGA-1284P Xplained has four standard yellow LEDs mounted onboard, which are connected to the Atmel ATmega1284P. The four LEDs are active low.

LED0, LED2, and LED3 are shared with the three mechanical buttons (SW0:2). When turning an LED on, set the I/O pin to output low. When turning an LED off, set the I/O pin as input with pull-up. The protection circuitry added to the button will make the LED shine brighter when the button is pressed and the LED is turned on. When the LED is off, any button press will light up the LED.

The Atmel MEGA-1284P Xplained also has one dual LED mounted near the USB connector. This is the power and status LED, which is connected to the board controller. This LED will be green when power is applied, and will toggle between green and orange when communication over USB is ongoing.

6.3 Analog I/O

An RC filter, a light sensor, and an NTC are connected to ADC5, ADC6, and ADC7, respectively. These analog sources can be used as input to the ADC. All of the analog signals can be disconnected by cutting the cut-straps on the bottom side of the board.

The RC filter (first-order low-pass) has an approximate 3dB cut-off frequency of 159Hz. The input to the RC filter is GPIO5 (PD5) on the ATmega1284P, which can be configured to output a PWM signal to the RC filter. This can be used to generate a DC voltage on the output of the RC filter, which can be measured on the ADC5 pin. As this is a first-order filter, the ripple on the DC voltage is inversely proportional to the input frequency. A higher input frequency will result in lower ripple on the output.

6.4 Touch

The MEGA-1284P XPLAINED kit has one Atmel QTouch button, QTB0.

Table 6-1. MEGA-1284P Xplained touch connections.

Touch sensor onboard reference	QTouch method pin name	ATmega1284P pin
QTB0	SNSK0	PD7
QTB0	SNS0	PD6

6.5 Board controller

The Atmel AT32UC3B1256 board controller and the Atmel ATmega1284P are connected through TWI, SPI, and USART interfaces. All interfaces can be used to communicate between the devices, but only the USART is implemented by default on the board controller.

Table 6-2. ATmega1284P and board controller communication interface.

Interface	ATmega1284P pin	Atmel AT32UC3B1256 pin
UART RX (1)	PD2	PA24
UART TX (1)	PD3	PA23
TWI SCL	PC0	PA09
TWI SDA	PC1	PA10
SPI SS (2)	PB4	PA16
SPI MOSI (2)	PB5	PA14
SPI MISO (2)	PB6	PA25
SPI SCK (2)	PB7	PA17

Notes:
1. This represents the RX and TX on the ATmega1284P. The RX is connected to TX on the other device, and vice versa.
2. These signals can be disconnected from the board controller by cutting the cut-straps marked *SPI* on the bottom side of the board.

7 Included code example

For documentation, help, and examples on the drivers used, please refer to the Atmel application note, AVR370: MEGA-1284P Xplained Getting Started Guide.

8 Revision history

The kit revision can be identified by a barcode sticker on the bottom side of the kit.

For example, A09-1164/4 indicates that the product number for this kit is A09-1164 and the revision is 4.

8.1 Revision 4

Revision 4 of the MEGA-1284P Xplained kit is the first revision released.

9 EVALUATION BOARD/KIT IMPORTANT NOTICE

This evaluation board/kit is intended for use for **FURTHER ENGINEERING, DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY.** It is not a finished product, and may not (yet) comply with some or any technical or legal requirements that are applicable to finished products, including, without limitation, directives regarding electromagnetic compatibility, recycling (WEEE), FCC, CE, or UL (except as may be otherwise noted on the board/kit). Atmel supplied this board/kit "AS IS," without any warranties, with all faults, at the buyer's and further users' sole risk. The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies Atmel from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge and any other technical or legal concerns.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER USER NOR ATMEL SHALL BE LIABLE TO EACH OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

No license is granted under any patent right or other intellectual property right of Atmel covering or relating to any machine, process, or combination in which such Atmel products or services might be or are used.

Mailing Address: Atmel Corporation, 2325 Orchard Parkway, San Jose, CA 95131

Copyright © 2011, Atmel Corporation

10 Table of contents

Features *1*

1 Introduction *1*

2 Related items *2*

3 General information *3*

3.1 Preprogrammed firmware 4

3.2 Power supply 5

3.3 Measuring the ATmega1284P power consumption 5

3.4 Communication through the USART-to-USB gateway 5

4 Connectors *6*

4.1 Programming headers 6

4.2 I/O expansion headers 7

5 Memories *9*

6 Miscellaneous I/O *10*

6.1 Mechanical buttons 10

6.2 LEDs 10

6.3 Analog I/O 10

6.4 Touch 10

6.5 Board controller 11

7 Included code example *12*

8 Revision history *12*

8.1 Revision 3 12

9 EVALUATION BOARD/KIT IMPORTANT NOTICE *13*

10 Table of contents *14*



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

Atmel Asia Limited
Unit 01-5 & 16, 19F
BEA Tower, Milennium City 5
418 Kwun Tong Road
Kwun Tong, Kowloon
HONG KONG
Tel: (+852) 2245-6100
Fax: (+852) 2722-1369

Atmel Munich GmbH
Business Campus
Parkring 4
D-85748 Garching b. Munich
GERMANY
Tel: (+49) 89-31970-0
Fax: (+49) 89-3194621

Atmel Japan
9F, Tonetsu Shinkawa Bldg.
1-24-8 Shinkawa
Chou-ku, Tokyo 104-0033
JAPAN
Tel: (+81) 3523-3551
Fax: (+81) 3523-7581

© 2011 Atmel Corporation. All rights reserved.

Atmel®, Atmel logo and combinations thereof, AVR®, AVR® logo, AVR Studio®, megaAVR®, QTouch®, DataFlash®, and others are registered trademarks of Atmel Corporation or its subsidiaries. Other terms and product names may be trademarks of others.

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 THE ATMEL TERMS AND CONDITIONS OF SALES LOCATED ON THE ATMEL WEBSITE, 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 AND 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 products are not intended, authorized, or warranted for use as components in applications intended to support or sustain life.