

---

## AT12174: ATmega324PB Xplained Pro Demo

---

### APPLICATION NOTE

### Introduction

---

This application note describes a demo application on the Atmel® ATmega324PB Xplained Pro kit. The application is a temperature logger which utilizes different extension boards, which can be used with the ATmega324PB Xplained Pro Kit.

It displays the room temperature on an OLED display and uses a microSD card on the IO1 Xplained Pro Kit for data logging. Once the BUTTON 1 on OLED1 Xplained Pro is pressed, it starts to periodically store temperature values to the microSD card until the same button (BUTTON1) is pressed again.

The IO1 Xplained Pro has a temperature sensor and the provision for mounting a microSD card in which the temperature values can be stored. The OLED1 Xplained Pro Kit has an OLED display which is used as user interface.

The source code is available for downloading along with this application note.

### Features

---

- Sense the room temperature using an AT30TSE758 available on the IO1 Xplained Pro
- Use FAT file system on a microSD card to store room temperature in a text file
- OLED display and push buttons for user interface

## Table of Contents

---

Introduction.....	1
Features.....	1
1. Pre-requisites.....	3
2. Setup.....	4
2.1. Hardware Setup.....	4
2.1.1. ATmega324PB Xplained Pro.....	4
2.1.2. IO1 Xplained Pro.....	4
2.1.3. OLED1 Xplained Pro.....	5
2.1.4. Connecting the Hardware.....	5
2.2. Software Setup.....	7
3. Testing the Demo Application.....	9
3.1. Application Overview.....	9
3.1.1. Reading the Temperature.....	9
3.1.2. Displaying the Temperature.....	9
3.1.3. Storing the Temperature on microSD Card.....	9
3.2. Procedure and Result.....	10
4. References.....	11
5. Revision History.....	12

## 1. Pre-requisites

The solution discussed in this document requires:

- Atmel Studio 7.0 or later
- ATmega324PB Xplained Pro kit
- IO1 Xplained Pro
- OLED1 Xplained Pro
- Demo application project available for download along with the application note

## 2. Setup

### 2.1. Hardware Setup

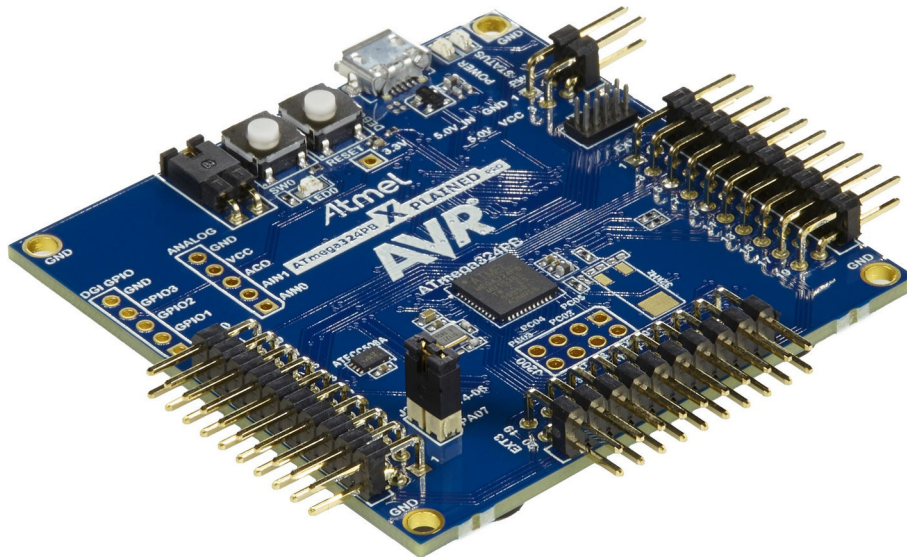
The example code provided in this application note uses ATmega324PB Xplained Pro kit and the extension boards IO1 Xplained Pro and OLED1 Xplained Pro.

#### 2.1.1. ATmega324PB Xplained Pro

This evaluation kit is a hardware platform to evaluate the ATmega324PB microcontroller. It includes an on-board Embedded Debugger, thus no external tools are necessary to program or debug the ATmega324PB.

The ATmega324PB Xplained Pro have extension headers EXT1, EXT3, and EXT4, which offers access to the I/O of the microcontroller in order to connect different Xplained Pro boards.

**Figure 2-1. ATmega324PB Xplained Pro Kit**

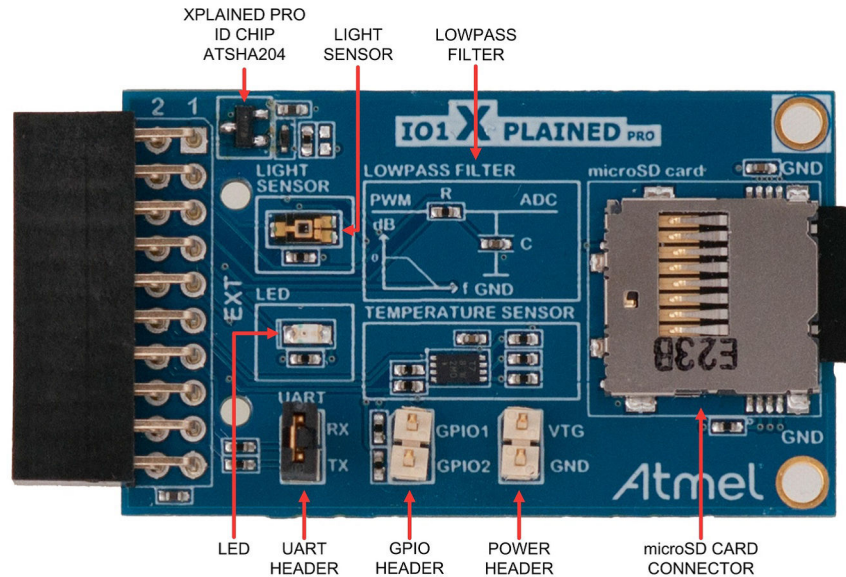


For more details on using this evaluation kit refer to the ATmega324PB Xplained Pro user guide available in [www.atmel.com](http://www.atmel.com), see Chapter [References](#).

#### 2.1.2. IO1 Xplained Pro

Atmel IO1 Xplained Pro extension board is a generic extension board for the Xplained Pro platform. It connects to any Xplained Pro standard extension header on any Xplained Pro Kit. IO1 Xplained Pro is designed to give a wide variety of functionality to Xplained Pro Kits including a microSD card, a temperature sensor, a light sensor, and more. See also Chapter [References](#).

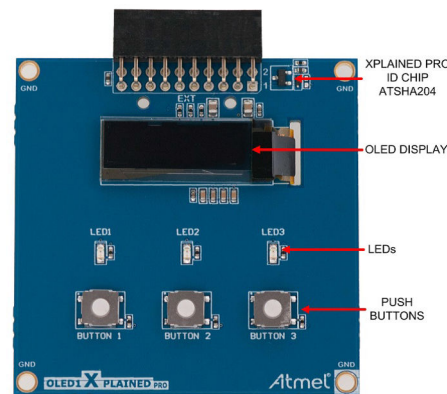
Figure 2-2. IO1 Xplained Pro Board



### 2.1.3. OLED1 Xplained Pro

OLED1 Xplained Pro is a basic extension board for the Xplained Pro platform with three LEDs, three push buttons, and one OLED display. The OLED display is controlled via a SPI interface up to 100MHz. OLED1 Xplained Pro connects to any Xplained Pro standard extension header on any Xplained Pro Kit. See also Chapter [References](#).

Figure 2-3. OLED1 Xplained Pro Board



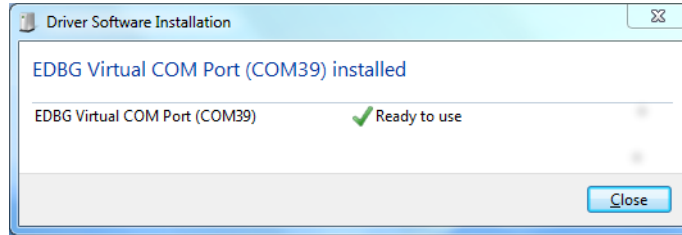
There are three push buttons available on OLED1 Xplained Pro. When a button is pushed the corresponding I/O pin is connected to ground. There are no external pull-up resistors on OLED1 Xplained Pro, so internal pull-up resistors have to be enabled in the target microcontroller.

### 2.1.4. Connecting the Hardware

This section guides the user on how to connect the ATmega324PB Xplained Pro with the Atmel Studio 7 and also how to connect the extension boards to the ATmega324PB Xplained Pro kit.

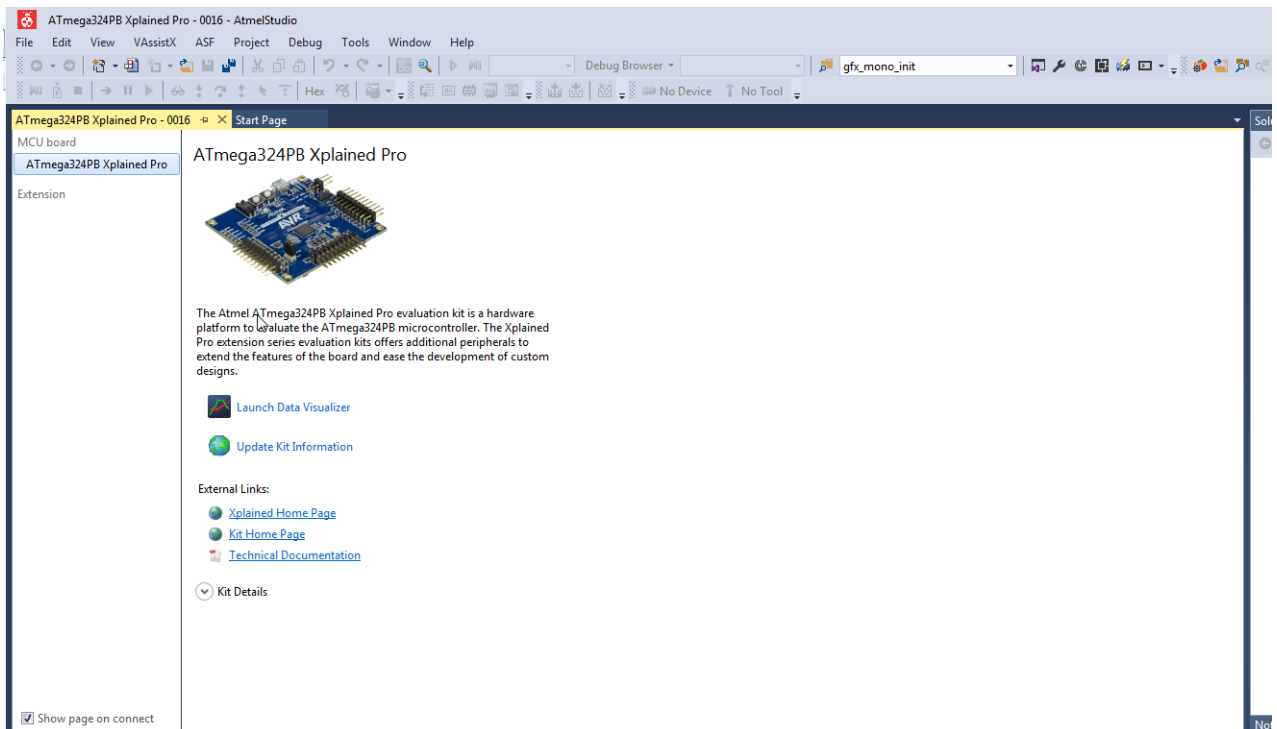
When the ATmega324PB Xplained Pro kit is connected to your computer for the first time, the operating system will perform a driver software installation. The Windows® Task bar will pop up a message, as displayed in the following screen-shot.

**Figure 2-4. ATmega324PB Xplained Pro Driver Installation**



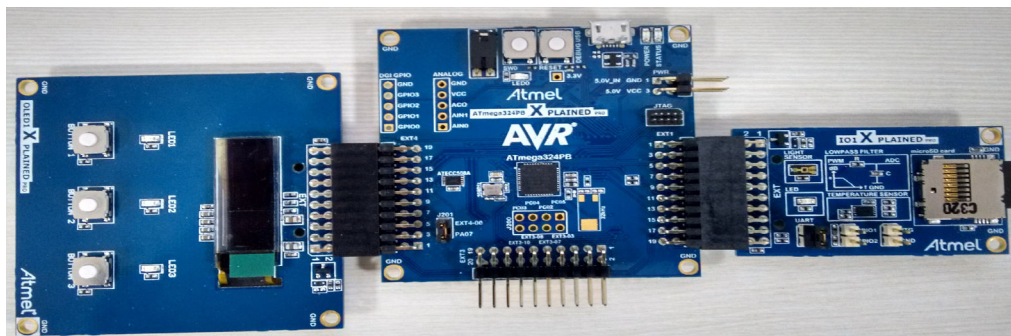
Once the ATmega324PB Xplained Pro kit is powered the green power LED will be lit and Atmel Studio will auto detect which Xplained Pro MCU- and extension board(s) are connected. As shown in the following figure Atmel Studio will present relevant information like datasheets and kit documentation.

**Figure 2-5. ATmega324PB Xplained Pro Detected in Atmel Studio**



This application is shown in the following figure. This figure shows the OLED1 Xplained Pro connected to the EXT4, and the IO1 Xplained Pro connected to the EXT1.

**Figure 2-6. Hardware Connection**



For pin details of the EXT headers, refer to the kit user guide.

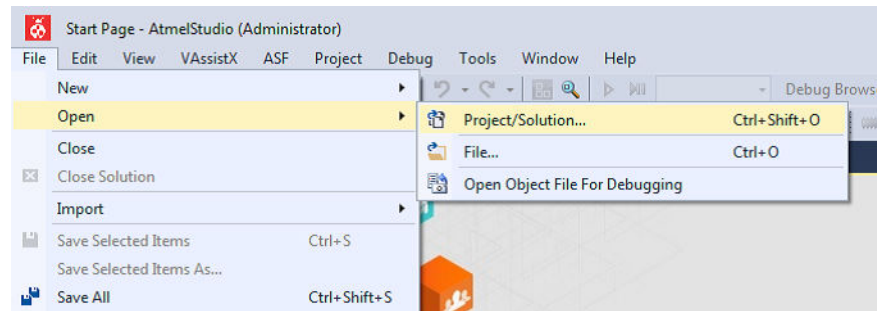
## 2.2. Software Setup

The demo application available for download along with the application note is developed in Atmel Studio 7.0.

To load the code in the Atmel Studio:

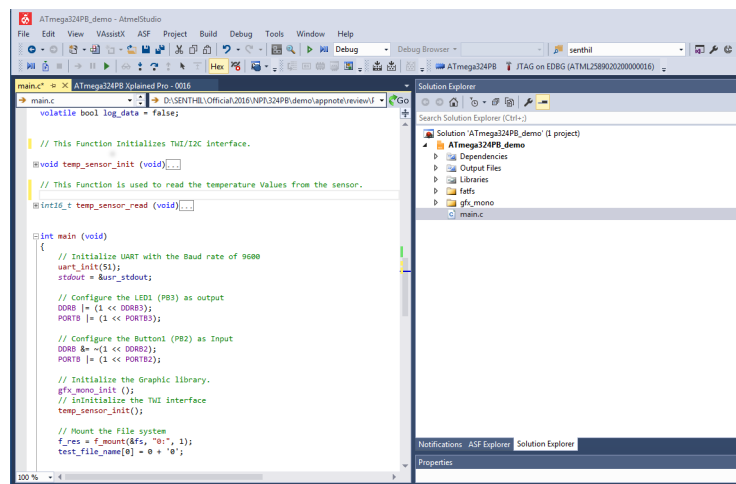
1. Extract the .zip file to get the project and associated source code.
2. Start Atmel Studio, go to **File > Open** and click on **Project/Solution**. The shortcut key is (**CTRL + Shift + O**).

**Figure 2-7. Opening Example Project in Atmel Studio**



3. The **OpenProject** Dialog box will appear.
4. Select the Example project solution file (.atsln) and click **Open**.
5. Alternative method is to double click the (.atsln) file from the extracted folder. This action will start Atmel Studio and then load the project.
6. The project will open as shown in the following figure.

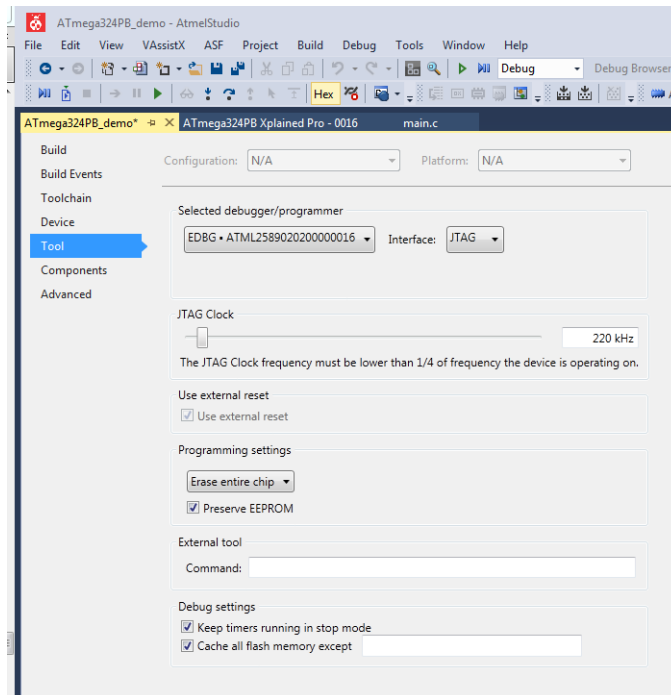
**Figure 2-8. Project Window**



7. To debug the project, go to **Project > Properties > Tool > Selected Debugger/Programmer** and select the **Tool** as EDBG and **Interface** as JTAG, shown as follows.



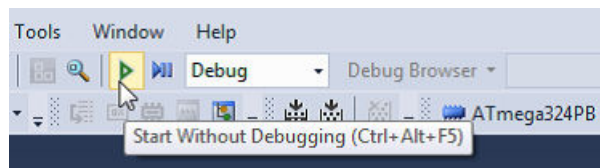
**Figure 2-9. Tool and Interface Settings**



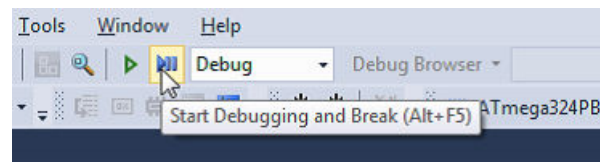
8. To program and execute the application, there are two options:
  - Start a debug session on the board, where the user will be able to program and debug
  - Program the generated .hex file into the controller and execute the application

We can choose one of these options in Atmel Studio as shown in the following screen capture.

**Figure 2-10. Start without Debugging**



**Figure 2-11. Start Debugging and Break**





## 3. Testing the Demo Application

This chapter explains how to test the demo application.

### 3.1. Application Overview

The application demonstrated in this application note measures the temperature and then displays the same on the OLED display. When BUTTON 1 on OLED1 Xplained Pro is pressed it starts to store the temperature values on the microSD card every 100 milliseconds and the data logging continues till BUTTON 1 is pressed again .

The demo project consists of the three components:

- Reading the temperature
- Displaying the temperature
- Storing the temperature on microSD card

#### 3.1.1. Reading the Temperature

In this demo application the temperature sensor (AT30TSE758) available on the IO1 Xplained Pro board is used to measure the room temperature. The temperature sensor values are read via the I<sup>2</sup>C interface. For more details, refer the device (AT30TSE752A/754A/758A) datasheet.

Inside main () function the user defined function `temp_sensor_init()` is called to initialize the I<sup>2</sup>C interface. Once the I<sup>2</sup>C communication is established the temperature sensor values are read from the AT30TSE758 using the `temp_sensor_read ()` function.

**Note:** It is also possible to read the temperature using the digital temperature sensor development library available at <http://www.atmel.com/tools/digitaltemperaturesensordevelopmentlibrary.aspx?tab=overview>

#### 3.1.2. Displaying the Temperature

The temperature values are displayed continuously on the OLED display.

OLED1 Xplained Pro features a 128 x 32 pixel white monochrome OLED display, the UG-2832HSWEG041 from WiseChip Semiconductor Inc. The display has a SSD1306 display controller by Solomon Systech built in and is controlled via a 4-wire SPI interface + reset. The OLED display does not have a SPI MISO signal. This means that data can only be written to the display, not read.

Inside main () function the library function `gfx_mono_init ()` (which is defined inside the Graphix library) is called to initialize the SSD1306 display controller. The library function `gfx_mono_draw_string ()` is used to show the temperature values on the display.

#### 3.1.3. Storing the Temperature on microSD Card

IO1 Xplained Pro features a microSD card connector that connects to cards via a SPI interface.

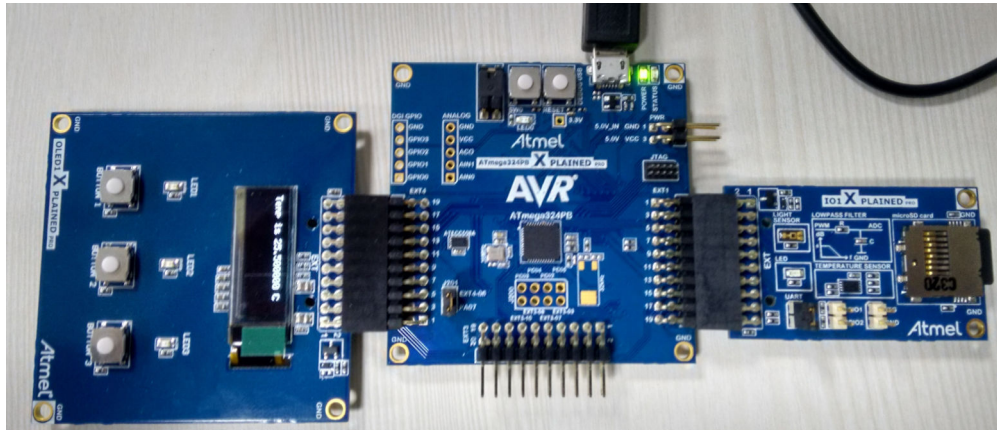
The demo application connects the target device (ATmega324PB) to the microSD card, mounts the FAT file system on the microSD card, opens a text file, and stores the temperature values into the text file.

In this application, once BUTTON 1 on OLED1 Xplained Pro is pressed the temperature values are stored on the microSD card every 100 milliseconds. The data logging continues till BUTTON 1 is pressed again.

### 3.2. Procedure and Result

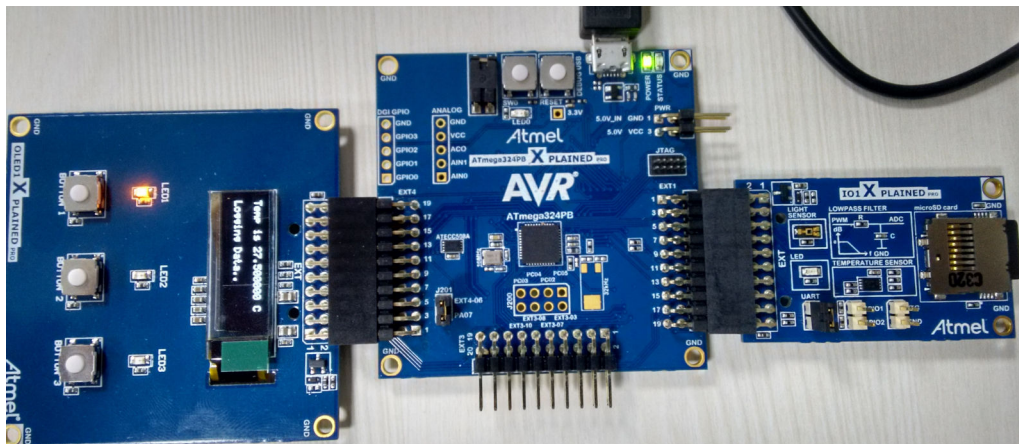
When the application is programmed into the device (ATmega324PB) on the ATmega324PB Xplained Pro kit as shown in the following figure, the temperature will be displayed on the OLED display found on OLED1 Xplained Pro.

Figure 3-1. Temperature Displayed on the OLED Display



When BUTTON 1 on OLED1 Xplained Pro is pressed once, the data logging starts (i.e. the temperature value is stored on the microSD card every 100ms). The LED1 is turned ON and also a message "Logging Data..." is displayed on the OLED display. This is shown in the following figure.

Figure 3-2. Storing the Temperature on microSD Card



This data logging continues till BUTTON 1 is pressed again. When the BUTTON 1 is pressed again, the data logging on the microSD card is stopped and the LED1 is turned OFF.

## 4. References

1. ATmega324PB Xplained Pro - User Guide <http://www.atmel.com/tools/ATMEGA324PB-XPRO.aspx?tab=documents>
2. IO1 Xplained Pro - User Guide <http://www.atmel.com/tools/ATIO1-XPRO.aspx?tab=documents>
3. OLED1 Xplained Pro - User Guide <http://www.atmel.com/tools/ATOLED1-XPRO.aspx?tab=documents>

## 5. Revision History

Doc. Rev.	Date	Comments
42682A	03/2016	Initial document release



**Atmel Corporation** 1600 Technology Drive, San Jose, CA 95110 USA T: (+1)(408) 441.0311 F: (+1)(408) 436.4200 | [www.atmel.com](http://www.atmel.com)

© 2016 Atmel Corporation. / Rev.: Atmel-42682A-ATmega324PB-Xplained-Pro-Demo\_AT12074\_Application Note-03/2016

Atmel®, Atmel logo and combinations thereof, Enabling Unlimited Possibilities®, AVR®, and others are registered trademarks or trademarks of Atmel Corporation in U.S. and other countries. Windows® is a registered trademark of Microsoft Corporation in U.S. and or other countries. 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 products 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.

**SAFETY-CRITICAL, MILITARY, AND AUTOMOTIVE APPLICATIONS DISCLAIMER:** Atmel products are not designed for and will not be used in connection with any applications where the failure of such products would reasonably be expected to result in significant personal injury or death ("Safety-Critical Applications") without an Atmel officer's specific written consent. Safety-Critical Applications include, without limitation, life support devices and systems, equipment or systems for the operation of nuclear facilities and weapons systems. Atmel products are not designed nor intended for use in military or aerospace applications or environments unless specifically designated by Atmel as military-grade. Atmel products are not designed nor intended for use in automotive applications unless specifically designated by Atmel as automotive-grade.