
AT12615: Getting Started with ATmega168PB

Atmel AVR 8-bit Microcontrollers

Objective

- Get started with the ATmega168PB (Atmel® megaAVR® series device).
- Find the ATmega168PB device related links in the Atmel website (like documents, tools etc).
- Get started with Atmel Studio 6.2 (project creation and demo program (GPIO input / output configuration) development on a step by step basis). All these steps are also described in Atmel Studio help link.

Pre-requisites

- Atmel ATmega168PB Xplained Mini Kit
- Atmel Studio 6.2 or later

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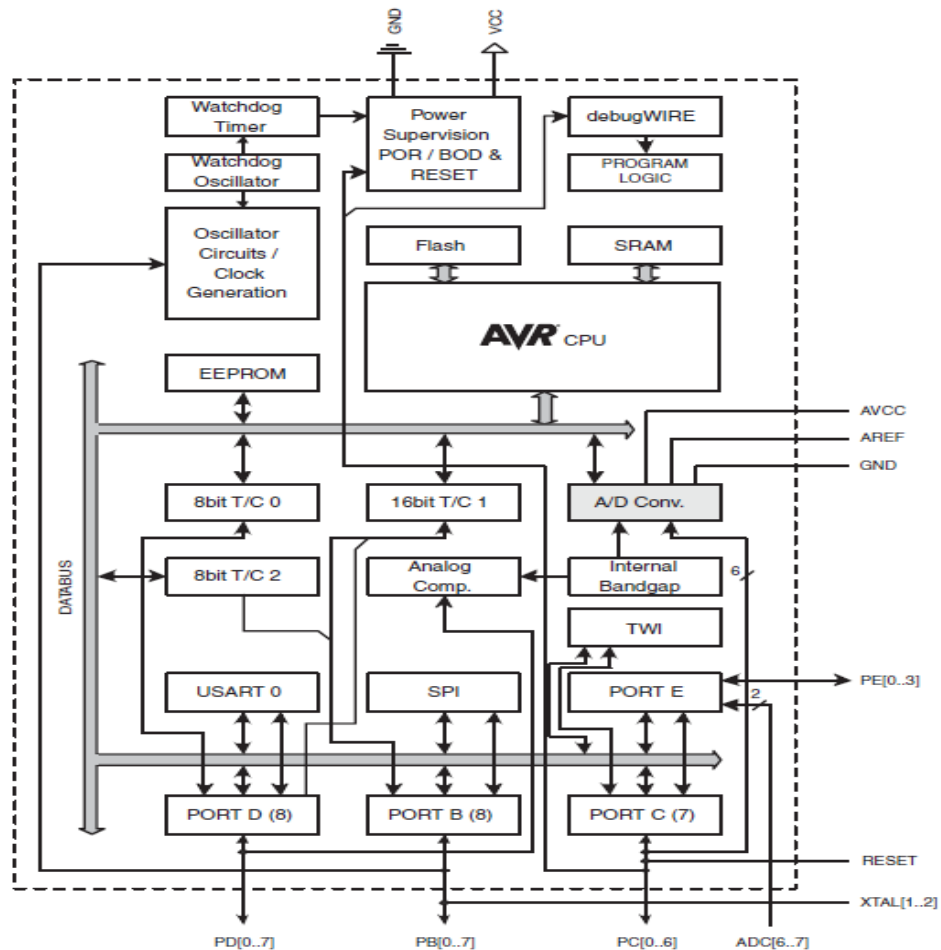
1 Getting Started with ATmega168PB

1.1 ATmega168PB Key Features

- AVR (Harvard) Architecture
- 20 MIPS @ 20 MHz
- High Code Density (Advanced RISC Instruction Set)
- On-Chip Hardware Multiplier
- Short Interrupt Latency 4 Clock Cycles
- Factory Calibrated Internal RC Oscillator
- Security with Fuses and Lock Bits
- Atmel QTouch[®] Library support
- Compatibility between devices (Portability)

Note: For detailed information (like flash size, number of pins, operating voltage range, number of peripheral channels, module description etc) refer to the ATmega168PB datasheet.

1.2 ATmega168PB Block Diagram



Note: For detailed information (like module description) refer to the ATmega168PB datasheet.


1.3 ATmega168PB Device Related Website Links

The ATmega168PB product overview webpage (as shown below) is available at the following link <http://www.atmel.com/devices/ATMEGA168PB.aspx>

Home > Products > Microcontrollers > AVR 8- and 32-bit MCUs > megaAVR MCUs

ATmega168PB

Overview Parameters Tools Documents Applications





Get Started

We'll tell you all you need to know to start evaluating and working with this product.

- » [Start Now](#)
- » [Contact Sales](#)
- » [Request Samples](#)
- » [Sign-up for News](#)

Datasheet

PDF Software Description

-  **ATmega48PB/88PB/168PB Preliminary Summary**
(file size: 893KB, 23 pages, revision B, updated: 11/2014)
-  **ATmega48PB/88PB/168PB Complete**
(file size: 7.7MB, 359 pages, revision B, updated: 11/2014)

[More Documents...](#)

Related Items

- » [Third Party Support](#)
- » [Consultants](#)
- » [University Program](#)
- » [AVR Knowledge Base](#)
- » [Technical Support](#)
- » [What's Changed](#)
- » [Mature Devices](#)

The high-performance Atmel® picoPower® 8-bit AVR® RISC-based microcontroller combines 16KB ISP flash memory with read-while-write capabilities, 512B EEPROM, 1KB SRAM, 27 general purpose I/O lines, 32 general-purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, USART with wake-up on start of transmission, a byte-oriented 2-wire serial interface, SPI serial port, 8-channel 10-bit A/D converter, programmable watchdog timer with internal oscillator, a 9 byte unique serial number and five software selectable power-saving modes. The device operates between 1.8-5.5 volts.

By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

[Check distributor inventory](#)

Key Parameters

Parameter	Value
Flash (Kbytes):	16 Kbytes
Pin Count:	32
Max. Operating Freq. (MHz):	20 MHz
CPU:	8-bit AVR
# of Touch Channels:	16
Hardware QTouch Acquisition:	No
Max I/O Pins:	27

In 'Parameters' tab, we can find the configuration parameter details (like flash size, number of peripheral channels etc) for this device.

<http://www.atmel.com/devices/ATMEGA168PB.aspx?tab=parameters>

In 'Documents' tab, we can find all the related documents (like datasheet, application notes) for this device

<http://www.atmel.com/devices/ATMEGA168PB.aspx?tab=documents>

In the above link under 'datasheet' section there are two documents

- **Complete** version (includes all peripheral descriptions and electrical characteristics)
- **Summary** version (includes Ordering Information, pin out, and Packaging Information)

The device related application notes (like hardware design considerations) and its associated firmware (if any) is also available in the above specified link.

In 'Applications' tab, we can find the recommended application areas for (not limited to) for this device

<http://www.atmel.com/devices/ATMEGA168PB.aspx?tab=applications>

In 'Tools' tab, we can find all the related tools (like IDE, programmer, debugger, evaluation kits, BSDL files) for this device

<http://www.atmel.com/devices/ATMEGA168PB.aspx?tab=tools>

If we click 'ATmega168PB Xplained Mini' from the above link then we can view the ATmega168PB Xplained Mini kit's overview webpage (as shown below)

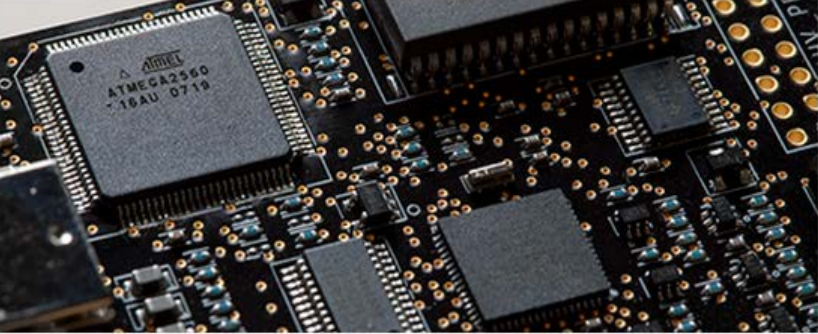
<http://www.atmel.com/tools/MEGA168PB-XMINI.aspx?tab=overview>

1.4 ATmega168PB Xplained Mini Kit

Home > Products > Microcontrollers > AVR 8- and 32-bit MCUs > megaAVR MCUs

ATmega168PB Xplained Mini

Overview | Devices | Documents | Applications | Related Tools



Get Started

We'll tell you all you need to know to start evaluating and working with this product.

- » **Start Now** ▾
- » **Contact Sales** ▾
- » **Request Samples** ▾
- » **Sign-up for News** ▾

The Atmel ATmega168PB Xplained Mini evaluation kit is a hardware platform for evaluating the Atmel ATmega168PB microcontroller. The evaluation kit comes with a fully-integrated debugger that provides seamless integration with Atmel Studio 6.2 or later. The kit provides access to the features of the ATmega168PB enabling easy integration of the device in a custom design.

Key Features

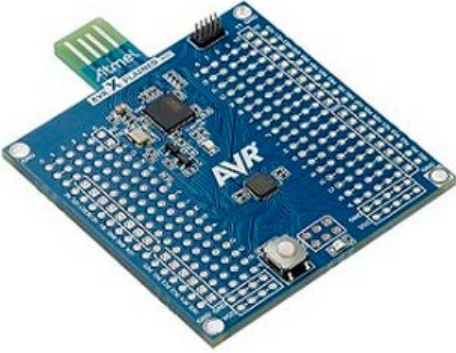
- On-board debugger with full source-level debugging support in Atmel Studio
- Auto-ID for board identification in Atmel Studio 6.2
- Access to all signals on target MCU
- One green status LED
- One mechanical user pushbutton
- Virtual COM port (CDC)
- 16MHz target clk
- USB-powered
- Arduino shield-compatible foot prints
- Target SPI bus header foot print
- Xplained Pro extension headers can easily be strapped in
- Supported with application examples published on Atmel Spaces

Ordering code: ATMEGA168PB-XMINI

Buy Tool

Related Items

- » Third Party Support
- » Consultants
- » University Program
- » AVR Knowledge Base
- » Technical Support
- » What's Changed
- » Mature Devices



If we click on 'Buy Tool' from the above link then we can purchase the same kit from our Atmel Store

<http://store.atmel.com/PartDetail.aspx?q=p:10500404>

In 'documents' tab from the above link we can find the kit related documents like (schematic, user guide).

<http://www.atmel.com/tools/MEGA168PB-XMINI.aspx?tab=documents>

Note: For detailed information like header and connections refer to the ATmega168PB Xplained Mini User Guide which is available at the above specified link.

1.5 Atmel Studio

1.5.1 Atmel Studio Webpage

The Atmel Studio installer (free IDP) is available at the following (as shown below) link

<http://www.atmel.com/tools/ATMELSTUDIO.aspx>

1.5.2 Atmel Studio Microsite

To learn more about Atmel Studio refer to the following micro site link

http://www.atmel.com/microsite/atmel_studio6/

Version 6.2
Released for Production

ATMEL STUDIO 6

One Collaborative Studio
With Integrated App Store and Shared Workspace

[DOWNLOAD NOW](#)

Atmel Studio 6 - The Studio to Design All Embedded Systems

What's New in Atmel Studio 6.2

Atmel introduces the latest [Xplained Mini development kit](#), an easy-to-use development board with extensive examples.

Develop and Debug Atmel applications in a single, integrated environment with Atmel-ICE

Studio 6.2 support for the new Atmel-ICE probe provides advanced programming and debugs connectivity for Atmel ARM- and AVR-based MCUs, including the ability to capture data trace information

Accelerate Your Time to Market with Percepio Trace™

Gain insight into the run-time of embedded software with trace visualization. Percepio Trace for Atmel Studio features

- Control-flow trace (tasks and interrupts)
- Custom data plots
- Application debug output
- Statistical code profiling
- Support for viewing MCU event counters
- Real-time operating system (RTOS) awareness

[Atmel Gallery Overview: Introduction of the Gallery](#)

[Atmel Studio 6 Read the White Paper](#)

[ASF Design \(1 of 5\): Starting with a board, XMEGA-A3BU Xplained](#)

[Atmel Studio ring](#)

In 'Videos' tab we can find the getting started videos (like editor, creating a new C (gcc) project, debugging AVR applications, debugging ARM® applications etc)

http://www.atmel.com/microsite/atmel_studio6/videos.aspx

1.6 Connecting the ATmega168PB Xplained Mini kit

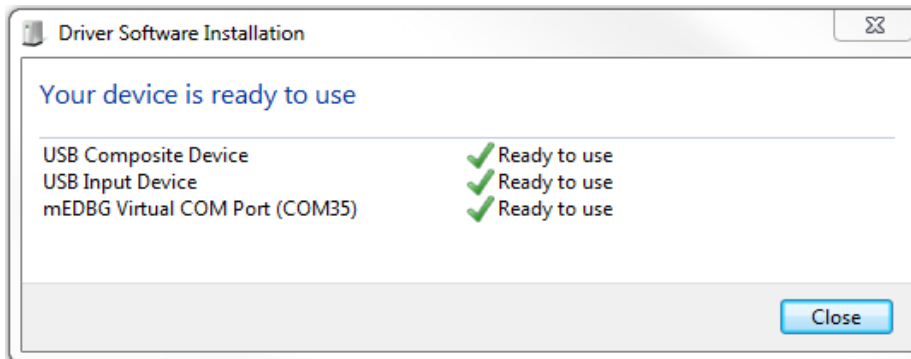
This section helps user to connect the ATmega168PB Xplained Mini with Atmel Studio 6.2

1. Download and install Atmel Studio version 6.2 or later.
2. Launch Atmel Studio.
3. Connect the ATmega168PB Xplained Mini to the USB port and it will be visible in Atmel Studio

1.6.1 Auto board identification of ATmega168PB Xplained Mini Kit

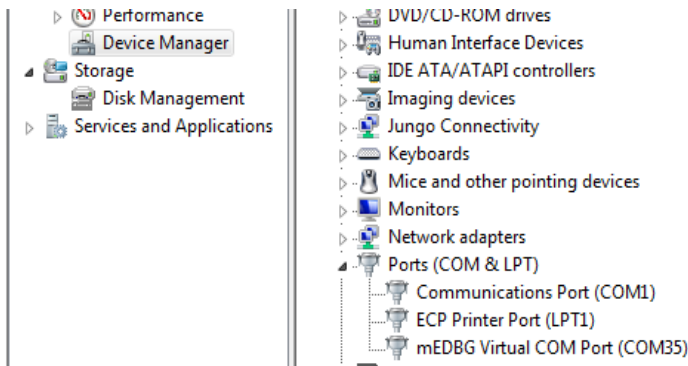
1. Once the ATmega168PB Xplained Mini kit is connected to the PC, the Windows® Task bar will pop-up a message as shown in figure.

Figure: ATmega168PB Xplained Mini Driver Installation



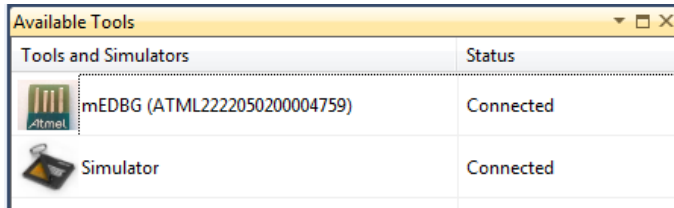
2. If the driver installation is proper, EDBG will be listed in the Device Manager as shown in figure.

Figure: Successful mEDBG Driver Installation



3. Open Atmel Studio 6.2, Go to 'View' -> 'Available Atmel Tools'. The EDBG should get listed in the tools as "EDBG" and the tool status should display as "Connected". This indicates that the tool is communicating properly with Atmel Studio.

Figure: mEDBG under Available Atmel Tools



1.6.2 Connect the ATmega168PB Xplained Mini UART to the mEDBG COM Port

1. Connect the mEDBG USB to the PC.
2. Use the Device Manager to find the COM port number.
3. Default COM port settings are 9600 baud N 8 1. The COM port settings can be changed using the Device Manager.

1.7 Programming and Debugging

This section helps to program and debug the ATmega168PB Xplained Mini kit using mEDBG.

1.7.1 Programming the ATmega168PB Xplained Mini using mEDBG

1. Connect the mEDBG USB to the PC.
2. Go to Atmel Studio: Click Tools, select Device Programming, and select the connected mEDBG as Tool with Device = ATmega168PB and Interface = ISP, click Apply.
3. Select "Memories" and locate the source hex or elf file and then click Program.
4. If the source contains fuse settings go to "Production file" and upload the elf file and program the fuses.

Note: If ISP programming fails it could be because debugWIRE is enabled. See debugging section on how to disable debugWIRE mode.

1.7.2 Debugging the ATmega168PB Xplained Mini using mEDBG

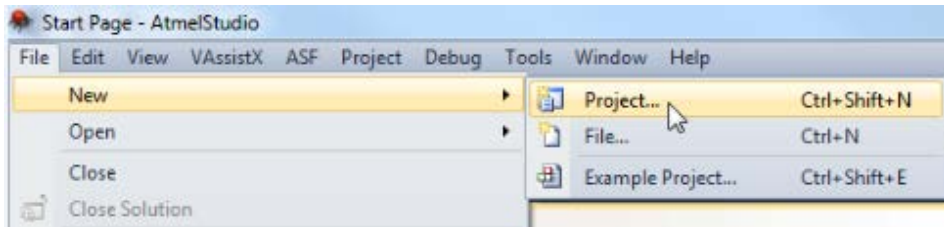
1. Start Atmel Studio.
2. Connect the mEDBG USB to the PC.
3. Open your project.
4. In the Project menu select the project properties page, select the Tools tab and select mEDBG as debugger and debugWIRE as interface.
5. In the Debug menu click Start Debugging and Break.
6. Atmel Studio will display an error message if the DWEN fuse in the ATmega168PB is not enabled, click YES to make Studio set the fuse using the ISP interface.
7. A debug session is started with a break in main, debugging can start.
8. When exiting debug mode select "Disable debugWIRE and Close" in the Debug menu, this will disable the DWEN fuse.

Note: If not exiting debug mode by selecting "Disable debugWIRE and Close" in the Debug menu, the DWEN fuse will be enabled and the target will still be in debug mode, i.e. it will not be possible to program the target using the SPI (ISP) interface.

2 Creating an Example Application in Atmel Studio

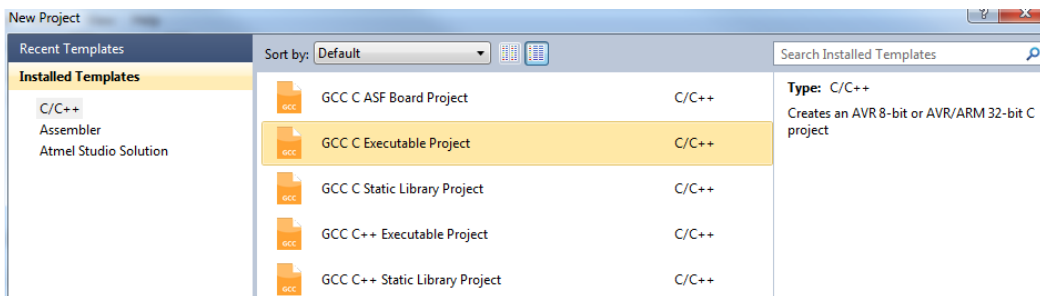
1. After connecting the board, to create a new project in Atmel Studio go to 'File' -> 'New' and click on 'Project...' (as shown in figure 2-1)

Figure 2-1. Creating New Project in Atmel Studio



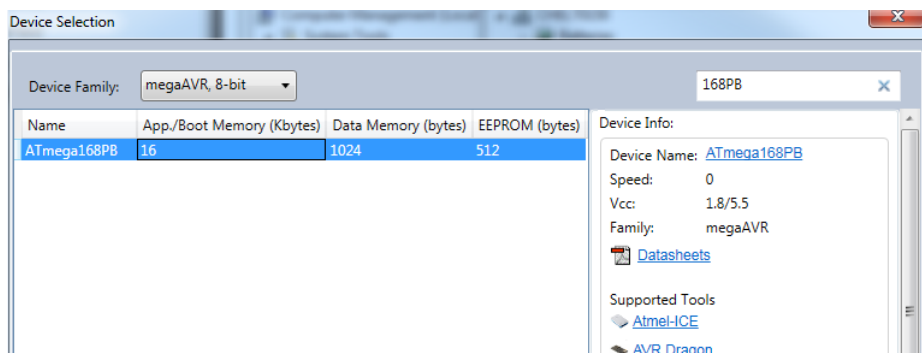
2. The New Project wizard will display as shown in figure 2-2 and select "GCC C executable Project" template and name the project and click "OK" to get the device selection wizard.

Figure 2-2. New Project Wizard



3. The Device Selection wizard will display as shown in figure 2-3 and select the ATmega168PB device from megaAVR device family then click OK.

Figure 2-3. Device Selection Wizard



4. The new project and .c file will be created as shown in figure 2.4.

Add the following code snippet (LED control using push button) in .c file.

```

int main(void)
{
    //configure LED pin as output
    DDRB |= 1<<DDR5;

    while(1)
    {
        /* check the button status (press - 0 , release - 1 ) */
        if(!(PINB & (1<<PIN7)))
        {
            /* switch off (0) the LED until key is pressed */
            PORTB &= ~(1<<PORT5);
        }

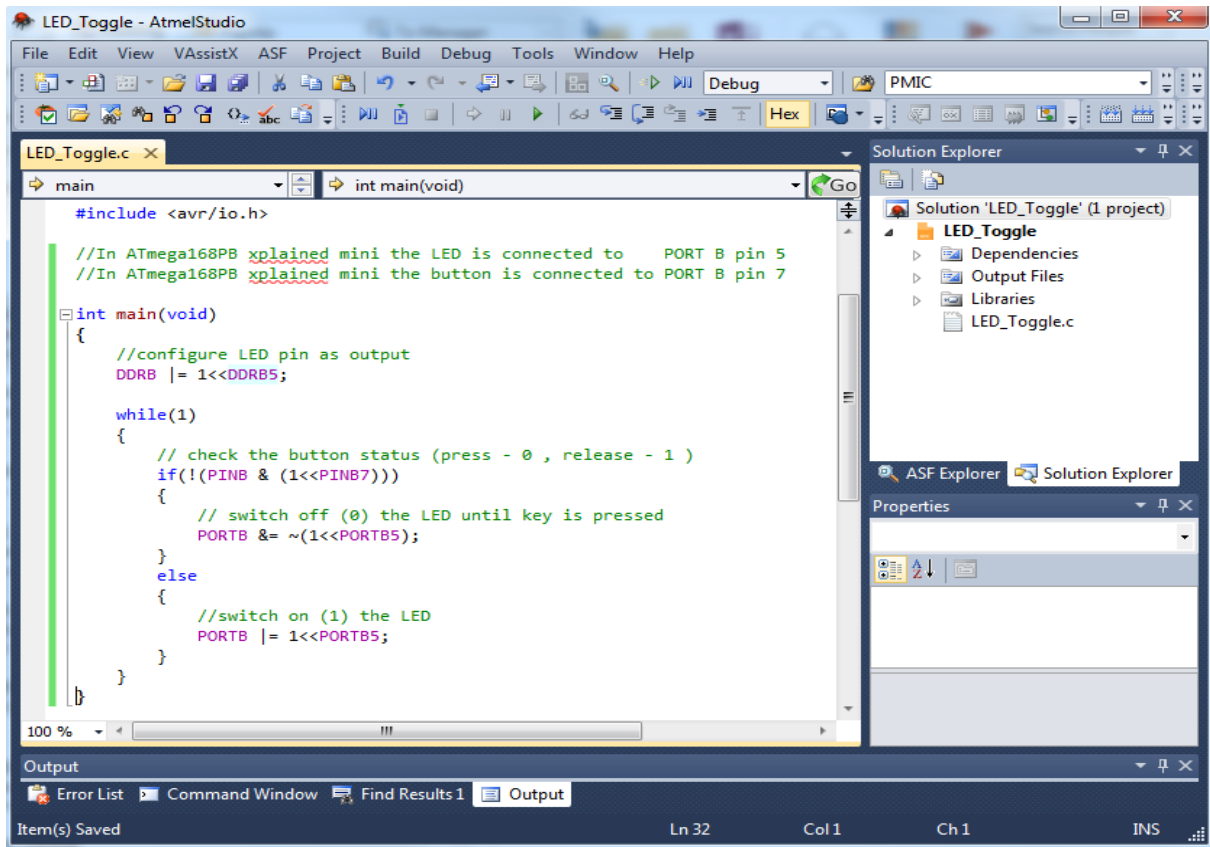
        else
        {
            /* switch on (1) the LED*/
            PORTB |= 1<<PORT5;
        }
    }
}

```

5. Code Explanation:

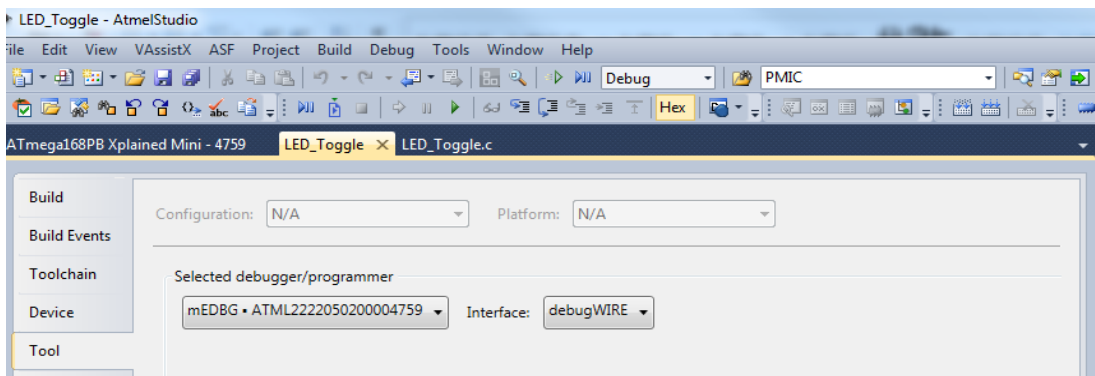
- Each PORT has three registers DDRx, PORTx, and PINx.
- The DDRx register is used to configure the port pin direction. 1 - Output ; 0 - Input.
- If one pin is configured as output pin and if the respective bit in PORTx is written logic one then the respective port pin is driven high. If the same bit is written logic zero then the pin will be driven low.
- The PINx register is used to return the logic level available on port pin.
- In the above example code we use PB7 Button as input and PB5 LED0 as output.
- We are controlling the LED0 based on the push button status.
- As long the button is in pressed state (0) then the LED0 will not glow (0).
- If we release the button (1) then the LED0 will glow (1 - default).

Figure 2-4. Project Window



6. In order to debug this project, configure the Tool and Interface in the Project properties. To open the project properties, go to 'Project' menu -> 'Properties'. In the project properties, go to "Tool" tab -> Under the Selected Debugger/Programmer, select the tool as "mEDBG" and interface as "debugWIRE" as shown in figure 2-5 Tool and Interface Settings.

Figure 2-5. Tool and Interface Settings



7. To program and execute the application, we have two options.

- a. We can start a debug session on the board, where we will be able to program and debug.
- b. We can program the generated hex file into the controller and execute the application.

In this case we will program the code with no debugging, so we select the green arrow for "Start without Debugging".

Both these options can be done on ATmega168PB Xplained Mini as shown in figure 2-6 and figure 2-7.

Note: If not exiting debug mode by selecting "Disable debugWIRE and Close" in the Debug menu, the DWEN fuse will be enabled and the target will still be in debug mode, i.e. it will not be possible to program the target using the SPI.

Figure 2-6. Start without Debugging

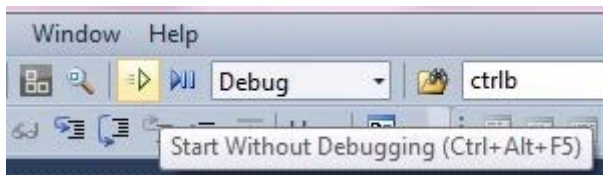
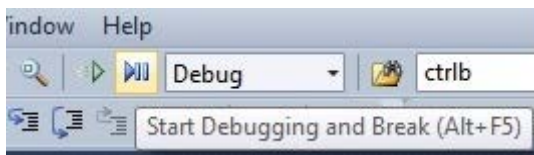


Figure 2-7. Start Debugging and Break



3 What's Next?

- Atmel Studio videos
http://www.atmel.com/microsite/atmel_studio6/videos.aspx
- Atmel Studio online help
<http://www.atmel.com/webdoc/atmelstudio/>
- Atmel Studio offline help (After installing Atmel Studio)

 In Atmel Studio
 Help -> View Help (Ctrl+F1) -> Atmel Studio
- ASF (Atmel Software framework) Getting Started and ASF Reference manual
<http://www.atmel.com/tools/AVRSOFTWAREFRAMEWORK.aspx?tab=documents>
- ASF online documentation
<http://asf.atmel.com/docs/latest/>
- Technical documentation for various products
<http://www.atmel.com/webdoc/>
- Atmel Gallery
<https://gallery.atmel.com/>
- Production Selection Guide
 Atmel MCU Selector on <http://www.atmel.com/>
- Ordering Samples
https://secure.atmel.com/forms/secure/verifylogin.aspx?target_url=samplestore
- Buying evaluation board & kits
<http://store.atmel.com/>
- Technical Documentation
<http://www.atmel.com/design-support/documentation/default.aspx>
- Knowledge Base and Technical Support/Design Support
<http://www.atmel.com/design-support/>
- Collaborative workspace
<http://spaces.atmel.com>
- AVR Freaks community
<http://www.avrfreaks.net/>

4 Revision History

Doc. Rev.	Date	Comments
42422A	03/2015	Initial document release



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