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## AT12489: Getting Started with Atmel ATtiny102 and ATtiny104

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### APPLICATION NOTE

#### Description

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This application note is for getting started with the Atmel® ATtiny102/104 AVR® based microcontroller.

The Atmel ATtiny102/104 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, ATtiny102/104 achieves throughputs close to 1 MIPS per MHz. This empowers the system designer to optimize the device for power consumption versus processing speed.

#### Features

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- Getting started with the ATtiny102/104 microcontroller and tools.
- Getting started with Atmel ATtiny104 Xplained Nano Kit and Atmel Studio 7.

This application note contains a list of all tools required to start using ATtiny102/104 and provides references for additional information.

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# 1. Getting Started with Atmel ATtiny102 and ATtiny104

## 1.1. Key Features

- AVR (Harvard) Architecture
- Single Level Pipelining
- In-system Reprogrammable Flash Memory
- 12 MIPS throughput at 12MHz
- Most Single Clock Cycle Execution
- High Code Density (Advanced RISC Instruction Set)
- Programmable Supply Voltage Level Monitor with Interrupt and Reset
- Low Power MCU with various Sleep Modes
- Accurate Internal Calibrated Oscillator
- Fast and Normal Start-up Time Options
- Security with Fuses and Lock Bits
- Compatibility between devices (portability)

**Note:** For more information about ATtiny102 and ATtiny104, refer to the device datasheet.

## 1.2. Device Related Website Links

The ATtiny102/104 product webpages are available at the following links:

ATtiny102: <http://www.atmel.com/devices/ATTINY102.aspx>

ATtiny104: <http://www.atmel.com/devices/ATTINY104.aspx>

Figure 1-1. Device Webpage

**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**

**Buy Now**

The high-performance Atmel® tinyAVR® picoPower® 8-bit RISC-based microcontroller (MCU) combines 1KB in-system programmable Flash memory, 32 bytes SRAM, 12 general-purpose I/O lines, 16 general-purpose working registers, one 16-bit timer/counters with two PWM channels, internal and external interrupts, an 8-channel 10-bit A/D converter, on-chip analog comparator, one full duplex USART, programmable watchdog timer with internal oscillator, internal calibrated oscillator, 10-bytes unique ID (serial number), three calibrated internal voltage references (1.1V, 2.2V and 4.3V), and four software selectable power saving modes. A version with faster startup time is available under a dedicated part number. 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.

The ATtiny104 device is a small, very versatile, low-cost, easy-to-use microcontroller suited to almost any application. It can be used for system monitoring, battery measurement, battery charging, voltage measurement, current measurement, interface to buttons, switches, drive of small motors, drive of one or more LEDs, and more. The integrated USART provides means for wired or wireless interface, making it possible to make a powerful, yet small and low-cost solution for any Internet of Things (IoT) end-node.

**Key Parameters**

Parameter	Value
Flash (kBytes):	1 kBytes
Pin Count:	14
Max. Operating Freq. (MHz):	12 MHz
CPU:	8-bit AVR
# of Touch Channels:	0
Hardware QTouch Acquisition:	No
Max I/O Pins:	12
Ext Interrupts:	12
USB Speed:	No
USB Interface:	No

+ More

**Related Items**

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

The ATtiny102 product webpage is available at the following link : <http://www.atmel.com/devices/ATTINY102.aspx>

The product webpage has five tabs to provide specific information related to the device.

- The **Overview** tab provides the basic information related to the device such as Key Parameters, Datasheet, link to buy the device, etc.

ATtiny102: <http://www.atmel.com/devices/ATTINY102.aspx?tab=overview>

ATtiny104: <http://www.atmel.com/devices/ATTINY104.aspx?tab=overview>

- The **Parameters** tab provides the details of various configuration parameters for the device.  
ATtiny102: <http://www.atmel.com/devices/ATTINY102.aspx?tab=parameters>  
ATtiny104: <http://www.atmel.com/devices/ATTINY104.aspx?tab=parameters>
- The **Tools** tab - all the related tools such as IDE, Programmer, Debugger, Evaluation Kits, and BSDL files are listed. This tab features the link to ATtiny104 Xplained Nano kit's webpage.  
ATtiny102: <http://www.atmel.com/devices/ATTINY102.aspx?tab=tools>  
ATtiny104: <http://www.atmel.com/devices/ATTINY104.aspx?tab=tools>
- The **Documents** tab provides all the related documents such as datasheet and application notes.  
ATtiny102: <http://www.atmel.com/devices/ATTINY102.aspx?tab=documents>  
ATtiny104: <http://www.atmel.com/devices/ATTINY104.aspx?tab=documents>
  - The **Datasheet** section contains two types of datasheets:  
Preliminary/Complete version includes all peripheral descriptions and electrical characteristics.  
  
Preliminary Summary/Summary version includes ordering information, pin out, and packaging information.
  - The **Application Notes** section has the device related Application Notes such as Peripheral Usage, Getting Started, Hardware design considerations, etc., and its associated firmware (if available).
- The **Applications** tab provides the recommended application areas (not limited to) for this device.  
ATtiny102: <http://www.atmel.com/devices/ATTINY102.aspx?tab=applications>  
ATtiny104: <http://www.atmel.com/devices/ATTINY104.aspx?tab=applications>

### 1.3. ATtiny104 Xplained Nano Kit

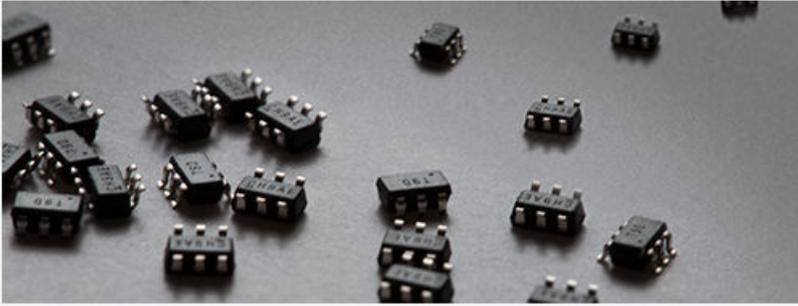
The details about ATtiny104 Xplained Nano Kit is available in the following link.

<http://www.atmel.com/tools/ATTINY104-XNANO.aspx>

Device **Ordering Information** is available in the bottom section of the page.

Figure 1-2. ATtiny104 Xplained Nano Webpage

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](#)

**Related Items**

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

**Buy Now**

The Atmel® ATTINY104-XNANO Xplained Nano evaluation kit is a hardware platform for evaluating ATTiny102/ATTiny104 microcontrollers.

Supported by the Atmel Studio free integrated development platform, the kit provides easy access to all device I/O, one button, and one LED.

The Xplained Nano evaluation kit includes an on-board programmer, and no external tools are necessary to program the ATtiny104 host MCU that drives the board. The onboard programmer can be completely disconnected from the host MCU or it can be used to program any other MCU with the Tiny Programming Interface (TPI).

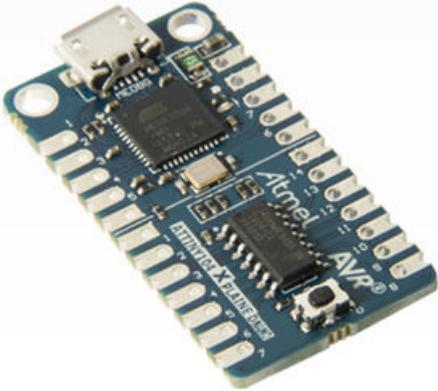
**Key Features**

- **Atmel ATTiny104 host 14-pin 1kB Flash MCU**
- **Embedded programmer for programming the host MCU**
- **One mechanical button**
- **One LED**
- **Access to all I/O lines**

**Ordering Information**

Ordering Code	Atmel Store Availability <sup>1</sup>	Unit Price <sup>2</sup>	Buy Online
ATTINY104-XNANO	0	Varies	<a href="#">Check Distributor</a>

<sup>1</sup>Backlog orders can be placed for items currently not available.  
<sup>2</sup>Suggested retail price per unit for budgetary use only.



Documents tab displays the kit related documents such as schematics and user guides.

<http://www.atmel.com/tools/ATTINY104-XNANO.aspx?tab=documents>

**Note:** For detailed information about the kit such as headers and connections, refer to ATtiny104 Xplained Nano User Guide.

## 1.4. Atmel Studio

### 1.4.1. Atmel Studio Webpage

The Atmel Studio (free IDE) installer is available at:

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

### 1.4.2. Atmel Studio Microsite

To learn more about Atmel Studio, refer to the following microsite:

<http://www.atmel.com/microsite/atmel-studio/>

**Figure 1-3. Atmel Studio Microsite Webpage**



In the **Videos** tab the getting started videos such as creating a new C (GCC) project, debugging AVR applications, debugging ARM® applications, etc. are available.

<http://www.atmel.com/Microsite/atmel-studio/videos.aspx>

## 1.5. Connecting the ATtiny104 Xplained Nano Kit

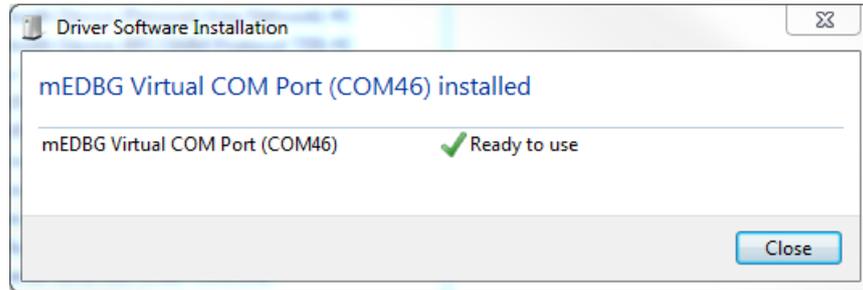
This section helps the user to connect the ATtiny104 Xplained Nano with the Atmel Studio 7.

1. Download and install [Atmel Studio 7](#) or later versions.
2. Launch the Atmel Studio application.
3. Connect the ATtiny104 Xplained Nano to the USB port and it will be visible in the Atmel Studio.

### 1.5.1. Auto Board Identification of Xplained Nano Kit

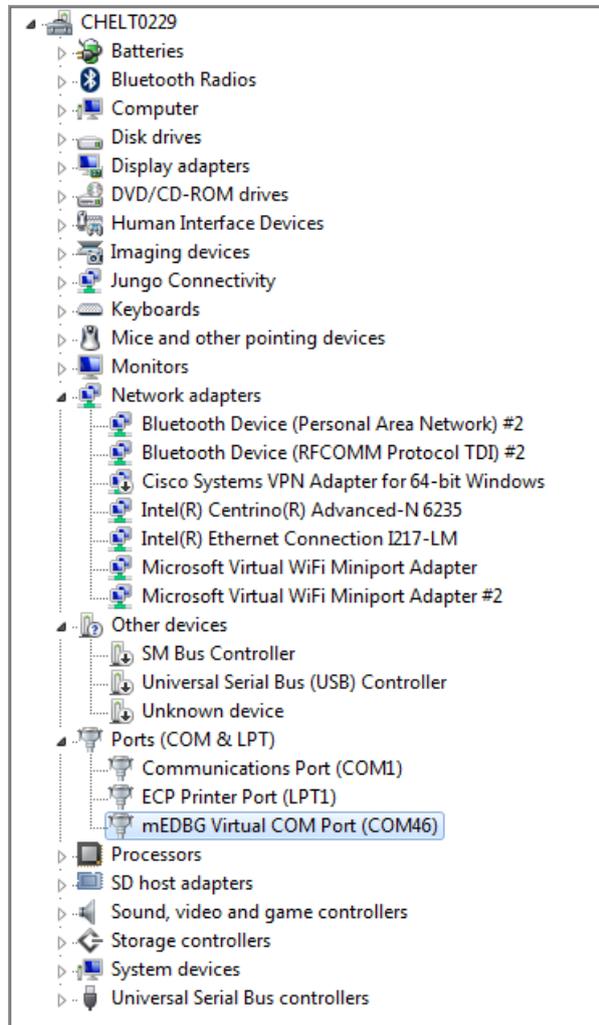
- When the ATtiny104 Xplained Nano kit is connected to the PC, the Windows® Task bar will pop-up a message, as displayed in the following screenshot.

Figure 1-4. ATtiny104 Xplained Nano Driver Installation



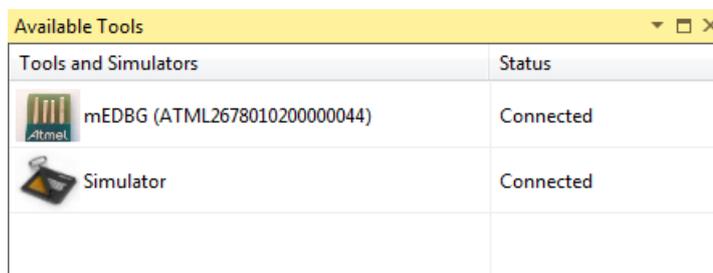
- If the driver installation is successful, mEDBG will be listed in the Device Manager, as displayed in the following screenshot.

Figure 1-5. Successful mEDBG Driver Installation



- Launch Atmel Studio.
- Go to **View > Available Atmel Tools**. The mEDBG should get listed in the tools as mEDBG and the tool status should display as **Connected**. This indicates that the tool is communicating as expected with the Atmel Studio.

Figure 1-6. mEDBG under Available Atmel Tools



The screenshot shows a window titled "Available Tools" with a yellow header bar. Below the header is a table with two columns: "Tools and Simulators" and "Status". The table contains two rows of data.

Tools and Simulators	Status
 mEDBG (ATML2678010200000044)	Connected
 Simulator	Connected

### 1.5.2. Connect the ATtiny104 Xplained Nano UART to the mEDBG COM Port

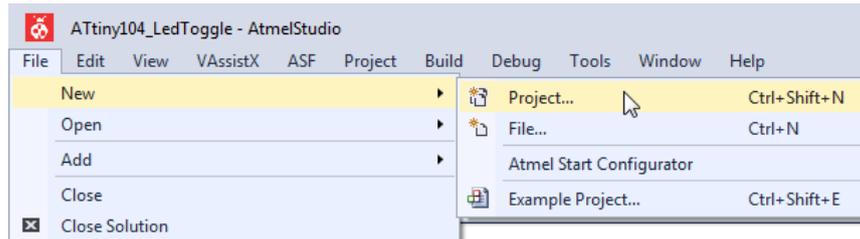
1. Connect the mEDBG USB to the PC.
2. Use the Device Manager to find the COM port number.
3. Default COM port settings are 9600 baud N 8 1. The COM port settings can be changed by using the Device Manager.

## 2. Creating an Example Application in Atmel Studio

To create a new project in Atmel Studio after connecting the ATtiny104 Xplained Nano:

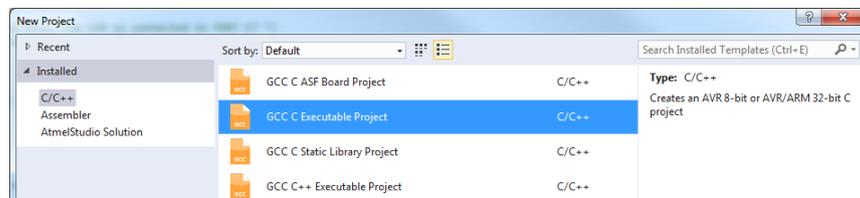
1. Go to **File > New > Project (Ctrl+Shift+N)**.

**Figure 2-1. Creating New Project in Atmel Studio**



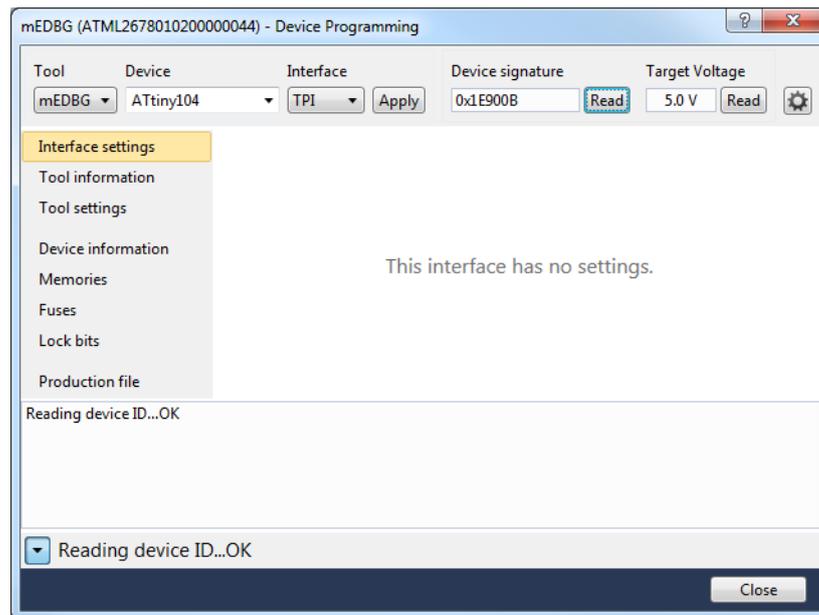
2. In the **New Project wizard** displayed, select the **GCC C executable Project** template, name the project, and click **OK** to get the device selection wizard.

**Figure 2-2. New Project Wizard**



3. The Device Selection wizard appears as follows. Select the **ATtiny104** device from the drop-down list and click **OK**.

**Figure 2-3. Device Selection Wizard**



4. The new project and the `main.c` file will be created.
5. Add the following code snippet (LED control using push button) in the `main.c` file.

```
int main(void)
{
    /* enable the pull-up function */
    PUEB |= 1<<PORTB1;
```

```

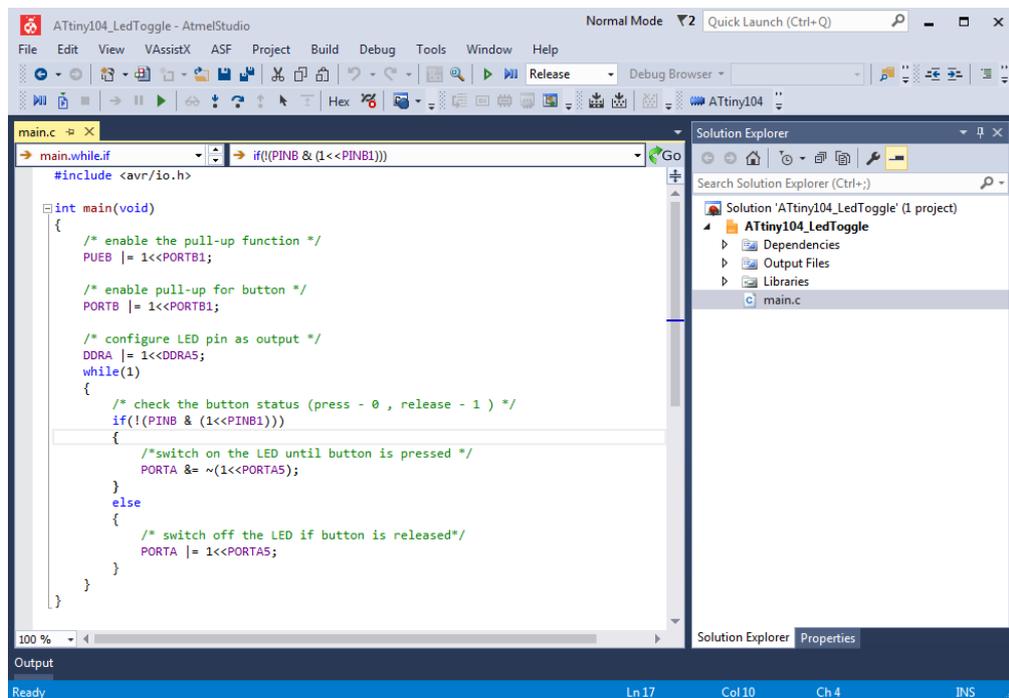
/* enable pull-up for button */
PORTB |= 1<<PORTB1;

/* configure LED pin as output */
DDRA |= 1<<DDRA5;
while(1)
{
    /* check the button status (press - 0 , release - 1 ) */
    if(!(PINB & (1<<PINB1)))
    {
        /*switch on the LED until button is pressed */
        PORTA &= ~(1<<PORTA5);
    }
    else
    {
        /* switch off the LED if button is released*/
        PORTA |= 1<<PORTA5;
    }
}
}

```

6. The project and the main.c file with the code snippet appears as shown.

**Figure 2-4. Project Window**

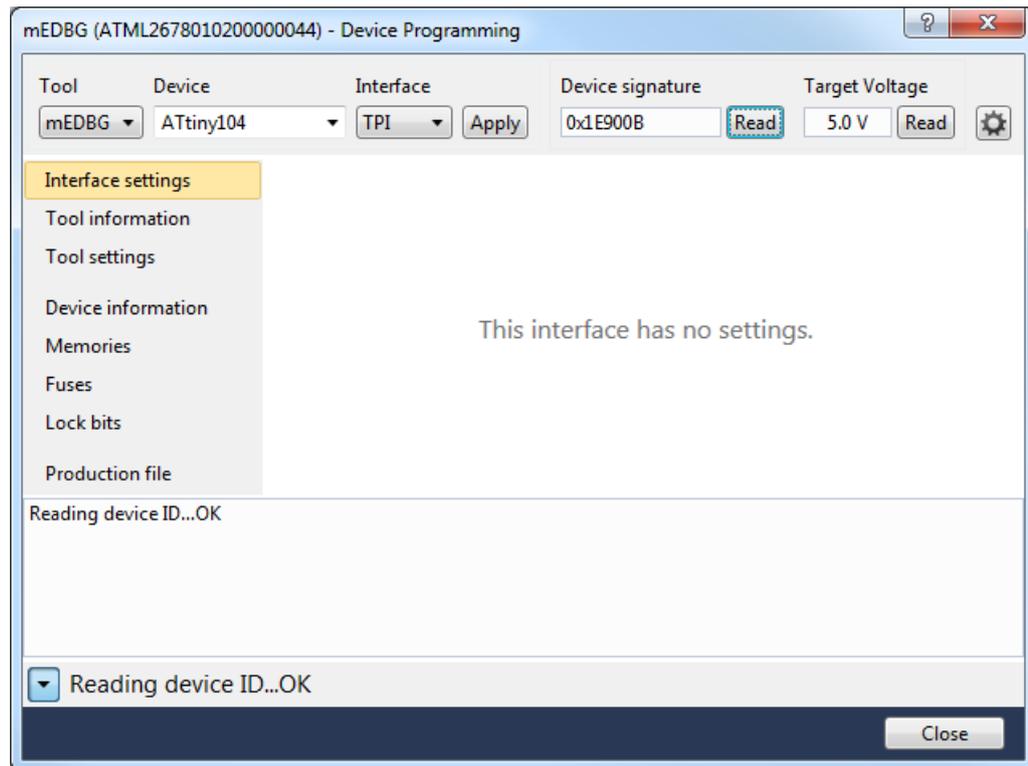


7. Code explanation:

- The application uses the mechanical button and yellow LED of ATtiny104 Xplained Nano kit. They are connected to Port Pin PB1 and PA5, respectively.
- Each PORT has three registers; DDRx, PORTx, and PINx.
- The DDRx register is used to configure the port pin direction.
  - 1 - Output
  - 0 - Input
- The kit does not have pull-up resistors onboard and hence internal pull-up has to be enabled for the button.
- Configure the PUEx register to enable internal pull-up of the corresponding port pin.

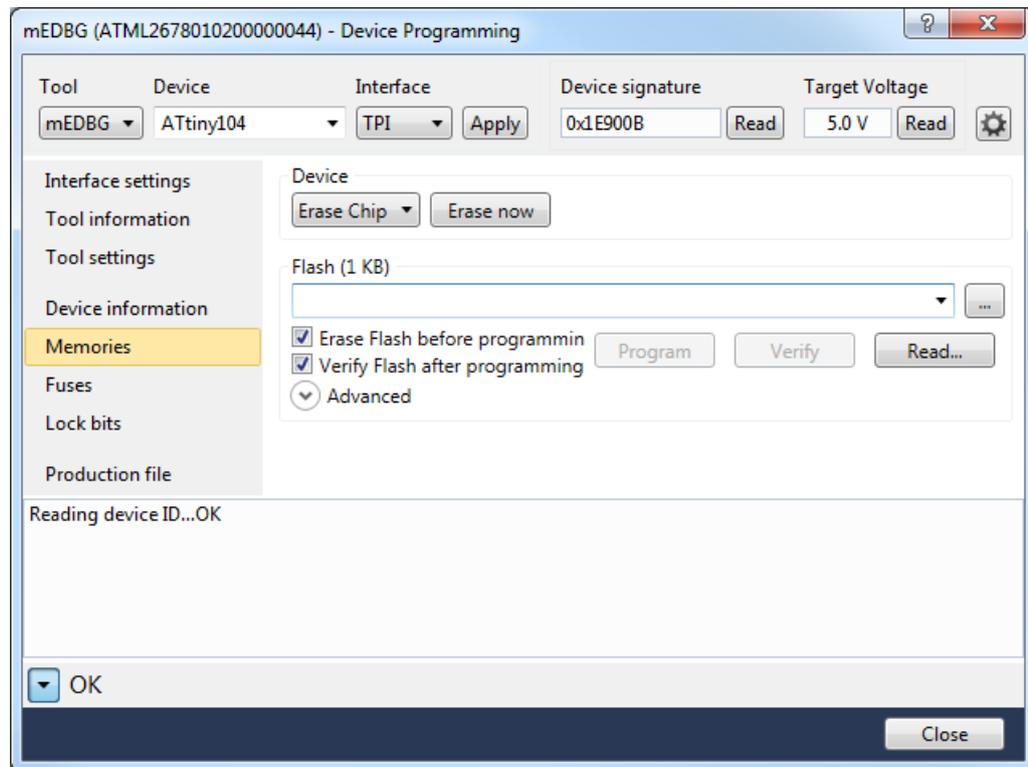
- When a pin is configured as input and the respective bit in PORTx is written logic one, the respective pin is internally pulled up.
  - The PINx register is used to return the logic level available on the port pin.
  - The button connected to pin PB1 is configured as input with pull-up enabled. LED connected to Pin PA5 is configured as output.
  - The LED is controlled based on the button status. When the button is not pressed the LED will not glow. When pressing the button the LED will glow.
8. Go to **Build > Build Solution (F7)** to compile the project.
  9. When the code is compiled successfully, go to **Tools > Device Programming (Ctrl+Shift+P)**.
  10. Select the **Tool** (as **mEDBG**), **Device** (as **ATtiny104**), and **Interface** (as **TPI**). Click **Apply**.

**Figure 2-5. Tool and Interface Settings**



11. **Read** the **Device Signature** and **Target Voltage** to ensure proper connection.
12. In the **Device Programming** window, go to **Memories** Tab. Click **Erase now** to erase the device.
13. To program the device with the hex file, browse the **\*.hex/elf** file location and click **Program**.

Figure 2-6. Tool and Interface Settings



14. The working of the application can be tested manually. The LED shall turn ON when the button is pressed and turns OFF when the button is released.

### 3. What's Next?

- Atmel Studio videos  
<http://www.atmel.com/Microsite/atmel-studio/videos.aspx>
- Atmel Studio online help  
<http://www.atmel.com/webdoc/atmelstudio/>
- Atmel Studio offline help (after installing Atmel Studio)  
Open 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 and buying evaluation board and kits:  
<http://www.atmel.com/>. Go to **Buy > Atmel store**
- 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
42678A	02/2016	Initial document release



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