
Getting Started with megaAVR® 0-series

Introduction

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This application note outlines how to get started with the megaAVR® 0-series devices.

Refer to the data sheet for further information on the differences between the megaAVR® 0-series devices.

Features

- Getting Started with megaAVR® 0-series Microcontrollers and Tools
- Getting Started with ATmega4809 Xplained Pro and Atmel Studio 7.0

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1. Relevant Devices

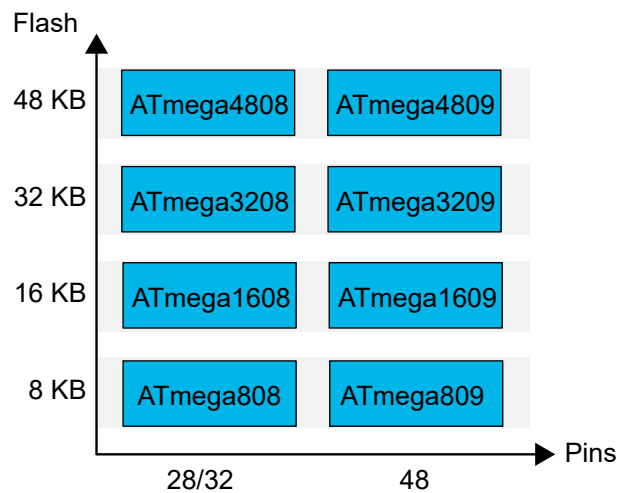
This chapter lists the relevant devices for this document.

1.1 megaAVR® 0-series

The figure below shows the megaAVR 0-series devices, laying out pin count variants and memory sizes:

- Vertical migration is possible without code modification, as these devices are fully pin and feature compatible.
- Horizontal migration to the left reduces the pin count and, therefore, the available features.

Figure 1-1. megaAVR® 0-series Overview



Devices with different Flash memory size typically also have different SRAM and EEPROM.

2. Get the Device Data Sheet

Web pages

- <https://www.microchip.com/wwwproducts/en/ATmega3208>
- <https://www.microchip.com/wwwproducts/en/ATmega3209>
- <https://www.microchip.com/wwwproducts/en/ATmega4808>
- <https://www.microchip.com/wwwproducts/en/ATmega4809>
- <https://www.microchip.com/wwwproducts/en/ATmega1608>
- <https://www.microchip.com/wwwproducts/en/ATmega1609>
- <https://www.microchip.com/wwwproducts/en/ATmega808>
- <https://www.microchip.com/wwwproducts/en/ATmega809>

Documents/files

- megaAVR 0-series Manual (.pdf)
- ATmega808/1608/3208/4808 – 28-pin Data sheet (.pdf)
- ATmega808/1608/3208/4808 – 32-pin Data sheet (.pdf)
- ATmega809/1609/3209/4809 – 48-pin Data sheet (.pdf)
- megaAVR 0-series Errata (.pdf)

The documentation for the megaAVR[®] 0-series is split into three document types:

- Manual (includes all device independent descriptions of the device)
- Data sheet¹ (includes all device dependent descriptions of the device, number of peripherals, pinout and electrical characteristics)
- Errata (includes all known erratas for the device)

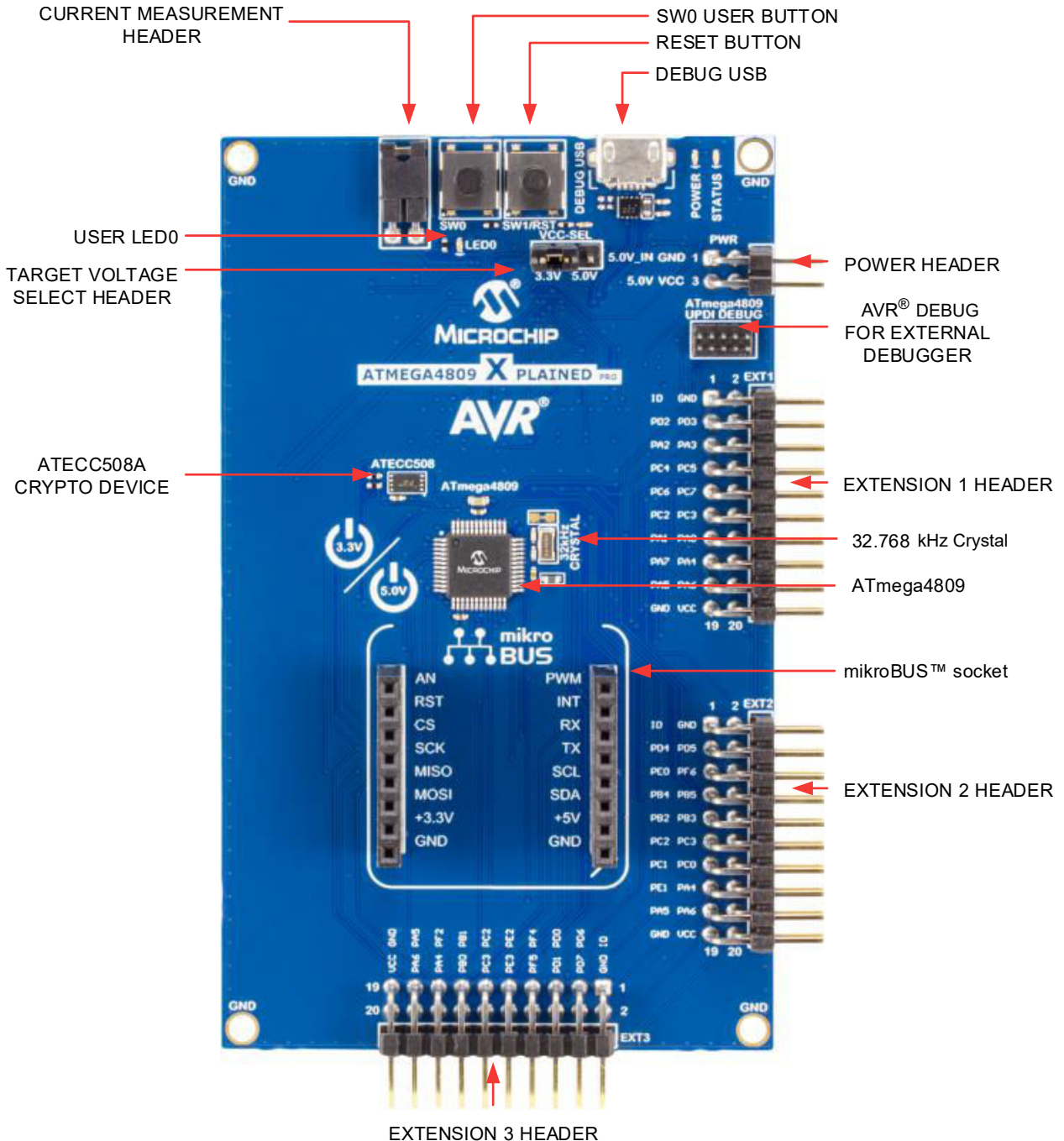
¹ For devices that are future products, the product brief is available instead of the data sheet.

3. Get the Tools

Atmel Studio 7.0, which uses GCC compiler, is the preferred IDE to get started with megaAVR® 0-series.

3.1 Get the ATmega4809 Xplained Pro Evaluation Kit

Figure 3-1. ATmega4809 Xplained Pro Kit



Web page: <http://www.microchip.com/developmenttools/productdetails.aspx?partno=atmega4809-xpro>

Get the kit: <http://www.microchipdirect.com/ProductSearch.aspx?Keywords=atmega4809-xpro>

Document/file:

- ATmega4809 Xplained Pro (.pdf)

Key Features

- ATmega4809 Microcontroller
- Selectable Target Voltage
 - 3.3V
 - 5.0V (USB/external power)
- One Mechanical Reset/User Programmable Button
- One Mechanical User Programmable Button
- One Yellow User Programmable LED
- ATECC508 CryptoAuthentication™ device
- 32.768 kHz Crystal
- Three Xplained Pro Extension Headers
- One mikroBUS™ Socket
- 10-pin, 50-mil AVR® Debug Connector with UPDI
- Embedded Debugger
 - Auto-ID for board identification in Atmel Studio
 - One yellow status LED
 - One green board power LED
 - Symbolic debug of complex data types including scope information
 - Programming and debugging, including power measurements
 - Data Gateway Interface: SPI, I²C, four GPIOs
 - Virtual COM port (CDC)
- USB Powered

The ATmega4809 Xplained Pro user guide covers how to power the kit and the detailed information on board components, extension interface, and the hardware guide.

3.2 Get the STK600 Starter Kit

Figure 3-2. STK600 Starter Kit



Table 3-1. STK600 Device Support for megaAVR® 0-Series

Device	Routing Card	Socket Card
ATmega3209	STK600-RC048M-107	STK600-QFN48
ATmega3209	STK600-RC048M-107	STK600-TQFP48
ATmega4809	STK600-RC048M-107	STK600-QFN48
ATmega4809	STK600-RC048M-107	STK600-TQFP48
ATmega1609	STK600-RC048M-107	STK600-QFN48
ATmega1609	STK600-RC048M-107	STK600-TQFP48

For device support for other devices, refer to: http://www.microchip.com/STK600_Starter_Kit-Users_Guide

Web page: <http://www.microchip.com/ATSTK600>

Get the kit: <https://www.microchipdirect.com/product/ATSTK600>

Document/file:

- STK600 User Guide (.pdf)

Key features

- AVR® Studio 4/AVR32 Studio/AVR Studio 5/Atmel Studio Compatible
- USB Interface to PC for Programming and Control
- Powered from USB Bus or from an External 10-15V DC Power Supply
- Adjustable Target V_{CC} (0-5.5V)

- Two Adjustable Reference Voltages with High Accuracy (0-5.0V, 10 mV res.)
- Clock Oscillator, Adjustable On-The-Fly from Atmel Studio (0-50 MHz, 0.1% res.)
- Serial In-System Programming (ISP) of tinyAVR and megaAVR® Devices
- PDI Programming of AVR XMEGA® Devices
- JTAG Programming of megaAVR, AVR XMEGA, and AVR UC3 Devices
- aWire Programming of AVR UC3 Devices
- ISP and JTAG Programming of AVR Devices in External Target Systems
- Flexible Routing and Socket Card System for Easy Mounting of all Supported Devices
- Eight Push Buttons for General Use
- Eight LEDs for General Use
- All AVR I/O Ports are Easily Accessible through Pin Header Connectors
- Expansion Connectors for Plug-In Modules and Prototyping Area
- On-Board 4 Mb DataFlash for Nonvolatile Data
- USB mini-AB (On-The-Go) Connector for AVR Devices with USB
- PHY and DSUB-9 Connector for RS-232 Interface
- PHY and DSUB-9 Connector for CAN Bus
- PHY and Header for LIN Bus
- Device Board with an ATmega2560 AVR Microcontroller Included

The [STK600 User Guide](#) describes how to power the kit and includes detailed information about board components, extension interface, and the hardware description.

3.3 Get Source Code from Atmel | START

The example code is available through Atmel | START, which is a web-based tool that enables configuration of application code through a Graphical User Interface (GUI). The code can be downloaded for both Atmel Studio and IAR Embedded Workbench® via the direct example code-link below or the *Browse examples* button on the Atmel | START front page.

Atmel | START web page: <http://microchip.com/start>

Example Code

Finding example code for devices in the megaAVR 0-series can be done by searching for the device name, e.g. ATmega4809, in the Atmel | START example browser.

Click *User guide* in Atmel | START for details and information about example projects. The *User guide* button can be found in the example browser, and by clicking the project name in the dashboard view within the Atmel | START project configurator.

Atmel Studio

Download the code as an `.atzip` file for Atmel Studio from the example browser in Atmel | START, by clicking *Download selected example*. To download the file from within Atmel | START, click *Export project* followed by *Download pack*.

Double click the downloaded `.atzip` file and the project will be imported to Atmel Studio 7.0.

IAR Embedded Workbench

For information on how to import the project in IAR Embedded Workbench, open the [Atmel | START User Guide](#), select *Using Atmel Start Output in External Tools*, and *IAR Embedded Workbench*. A link to the

Atmel | START User Guide can be found by clicking *Help* from the Atmel | START front page or *Help And Support* within the project configurator, both located in the upper right corner of the page.

3.4 Get Atmel Studio 7.0

Web page: <http://www.microchip.com/development-tools/atmel-studio-7>

Document/file:

- Atmel Studio 7.0 (build 1645) Installer (.exe)

Atmel Studio 7.0 or later is the preferred IDE for developing and debugging firmware for the megaAVR[®] 0-series.

For device support, refer to [3.6 Get Device Support](#).

3.5 Get IAR Embedded Workbench for AVR

Web page: <https://www.iar.com/iar-embedded-workbench/#!?architecture=AVR>

Document/file: IAR Embedded Workbench installer for AVR.

3.6 Get Device Support

Atmel Studio: Support for new devices in Atmel Studio can be added by using the *Device Pack Manager*, which is found under *Tools → Device Pack Manager*.

For megaAVR[®] 0-series, update to the latest version by performing the following steps:

1. Click *Check for Updates*.
2. For megaAVR[®] 0-series, select the latest available version of *ATmega_DFP*.
3. Click *Install*.

For offline installers, go to <http://packs.download.atmel.com/>. To install a package, double click on the installer file and follow the instructions. Any open Atmel Studio windows will have to be closed for the installation to take effect.

IAR: Support for new devices in IAR Embedded Workbench can be added by installing the latest service package. The service package is available at *My Pages* on <https://iar.com>.

4. Atmel Studio Users Getting Started

4.1 Atmel Studio with ATmega4809 Xplained Pro

Prerequisites

- Atmel Studio 7.0 1645 or above installed
- The ATmega4809 Xplained Pro board connected to Atmel Studio 7.0 via the on-board USB connector, which is connected to the embedded debugger. The kit will be powered by the USB, and the embedded debugger will enable debugging and programming via the USB.

Workflow

1. Launch Atmel Studio 7.0.
2. The page shown in the figure below will appear when ATmega4809 Xplained Pro is connected to Atmel Studio 7.0.

Figure 4-1. ATmega4809 Xplained Pro Page in Atmel Studio

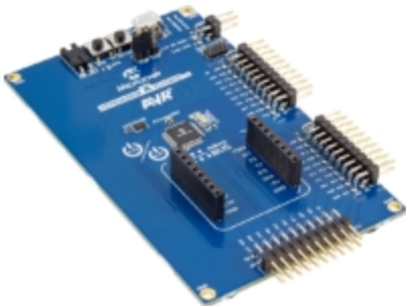
ATmega4809 Xplained Pro - 0338

MCU board

ATmega4809 Xplained Pro

Extension

ATmega4809 Xplained Pro



The Microchip ATmega4809 Xplained Pro evaluation kit is a hardware platform to evaluate the ATmega4809 microcontroller. The Xplained Pro extension series evaluation kits offers additional peripherals to extend the features of the board and ease the development of custom designs.

AS [Atmel START example projects using this board...](#)
[New Atmel START project using this board...](#)
[New Atmel START project using the device on this board...](#)

External Links:

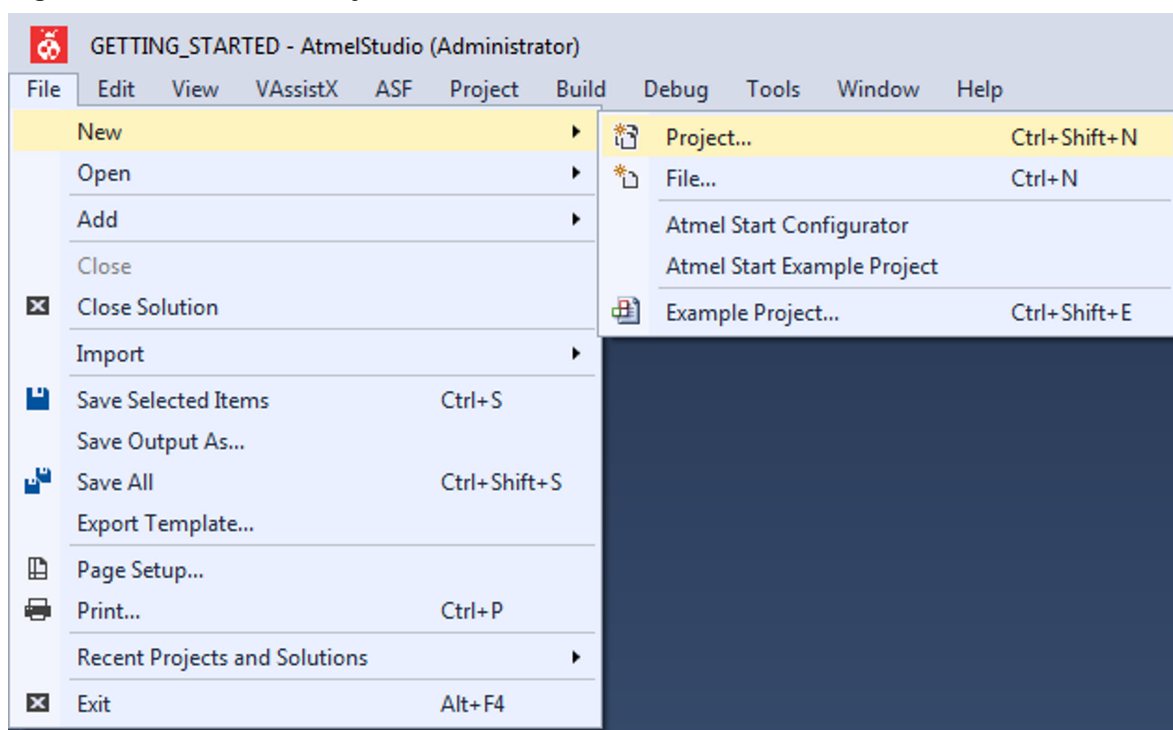
[Kit Home Page \(see downloads for documentation\)](#)
[ATmega4809 Xplained Pro Schematics](#)
[Xplained Home Page \(find other kits and extensions\)](#)

☒ Show page on connect
[Update board database](#)

Kit Details

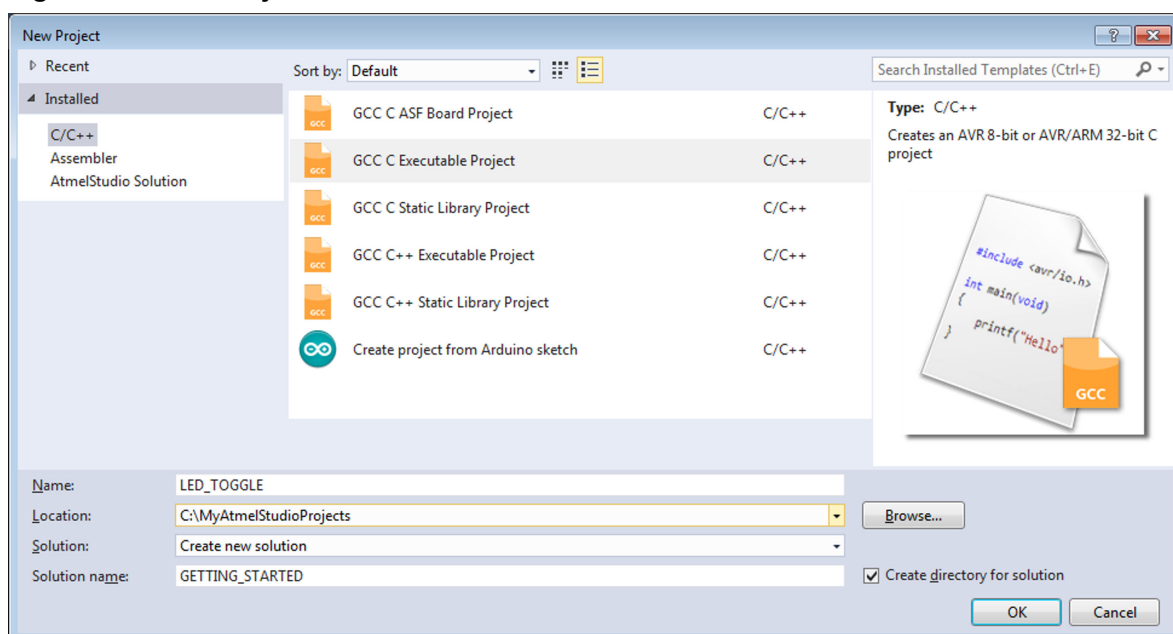
3. Start creating a new project by clicking *New → Project...* or by using the shortcut *Ctrl+Shift+N*, as shown in the following figure.

Figure 4-2. Create New Project in Atmel Studio

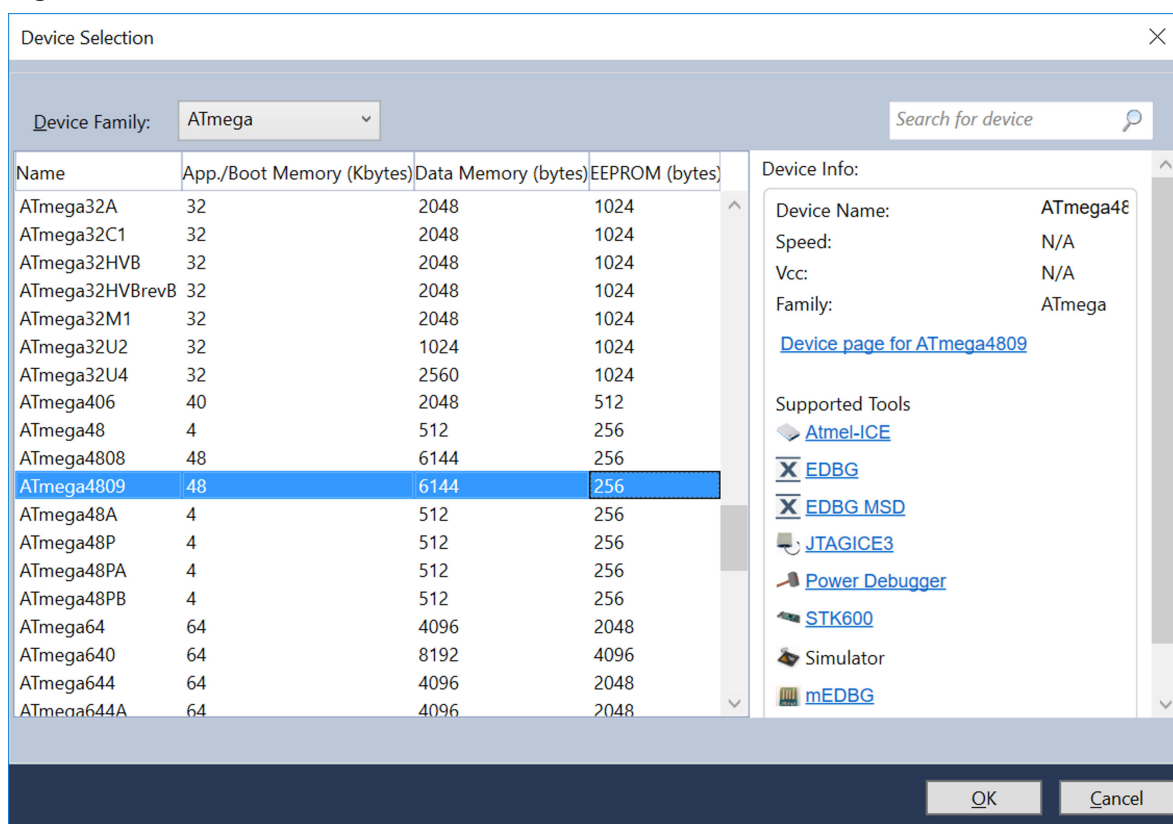


4. Select the *GCC C Executable Project* template from the new project wizard shown in the figure below, type in the name of the solution and project (e.g. *GETTING_STARTED* and *LED_TOGGLE*), and click **OK**.

Figure 4-3. New Project Wizard



5. Select ATmega4809 from the device selection wizard as shown in the figure below, and click **OK**.

Figure 4-4. Device Selection Wizard

A new project with a `main.c` file associated with it will be generated in Atmel Studio.

- Replace the 'main' loop in the `main.c` file with the following code snippet:

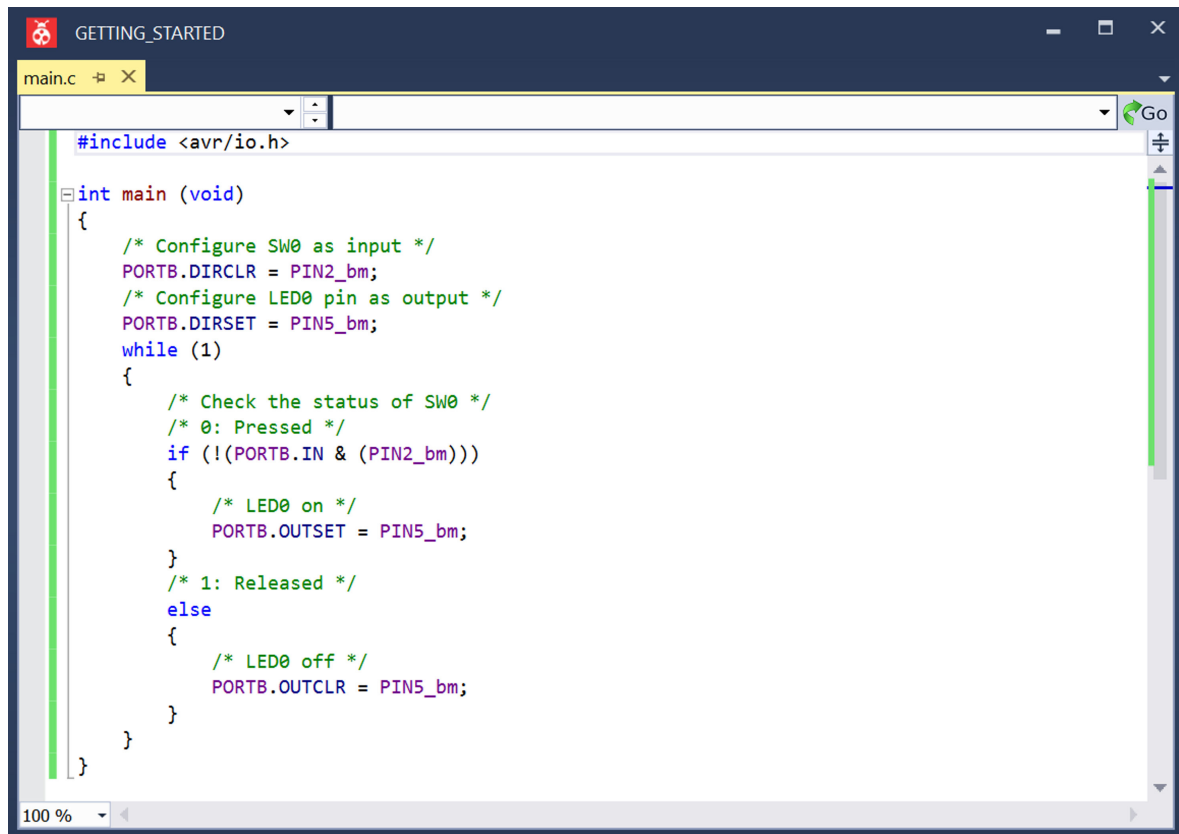
```
int main (void)
{
    /* Configure SW0 as input */
    PORTB.DIRCLR = PIN2_bm;

    /* Configure LED0 pin as output */
    PORTB.DIRSET = PIN5_bm;

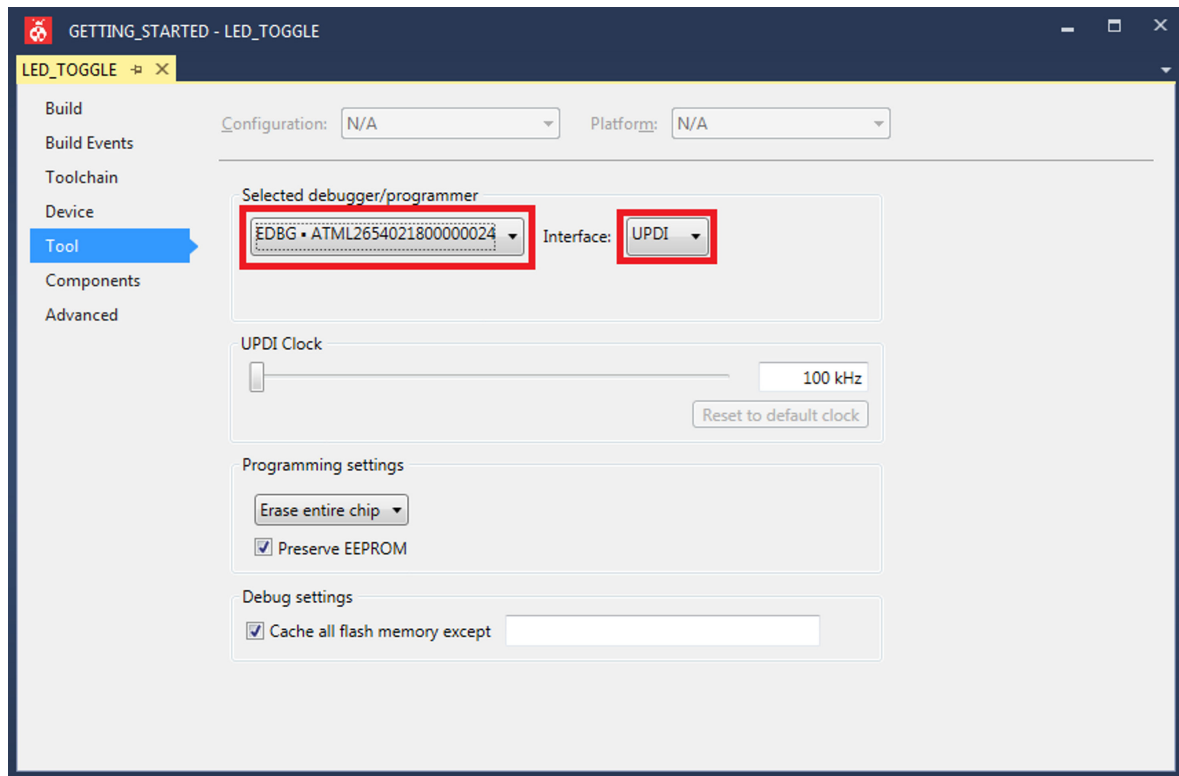
    while (1)
    {
        /* Check the status of SW0 */
        /* 0: Pressed */
        if (!(PORTB.IN & (PIN2_bm)))
        {
            /* LED0 on */
            PORTB.OUTSET = PIN5_bm;
        }
        /* 1: Released */
        else
        {
            /* LED0 off */
            PORTB.OUTCLR = PIN5_bm;
        }
    }
}
```

In the code editor, the code should appear as shown in the figure below.

Figure 4-5. Code Editor Window



7. Open project properties by clicking *Project* → *Properties* or by using the shortcut *ALT+F7*.
8. In the *Tool* view (see the figure below) set *Selected debugger/programmer* to EDBG and *Interface* to UPDI.

Figure 4-6. Debugger and Interface for ATmega4809

9. Build the project by clicking **Build** → **Build Solution** or by using the shortcut **F7**.
10. Program ATmega4809 with the project code and start debugging by clicking **Debug** → **Start debugging and break** or by using the shortcut **ALT+F5**. The application is programmed onto the device and program execution should break in main.
11. Run the code by clicking **Debug** → **Continue** or by using the shortcut **F5**.
12. Verify that LED0 is lit when SW0 is pushed on the ATmega4809 Xplained Pro.

4.2 Atmel Studio with STK600

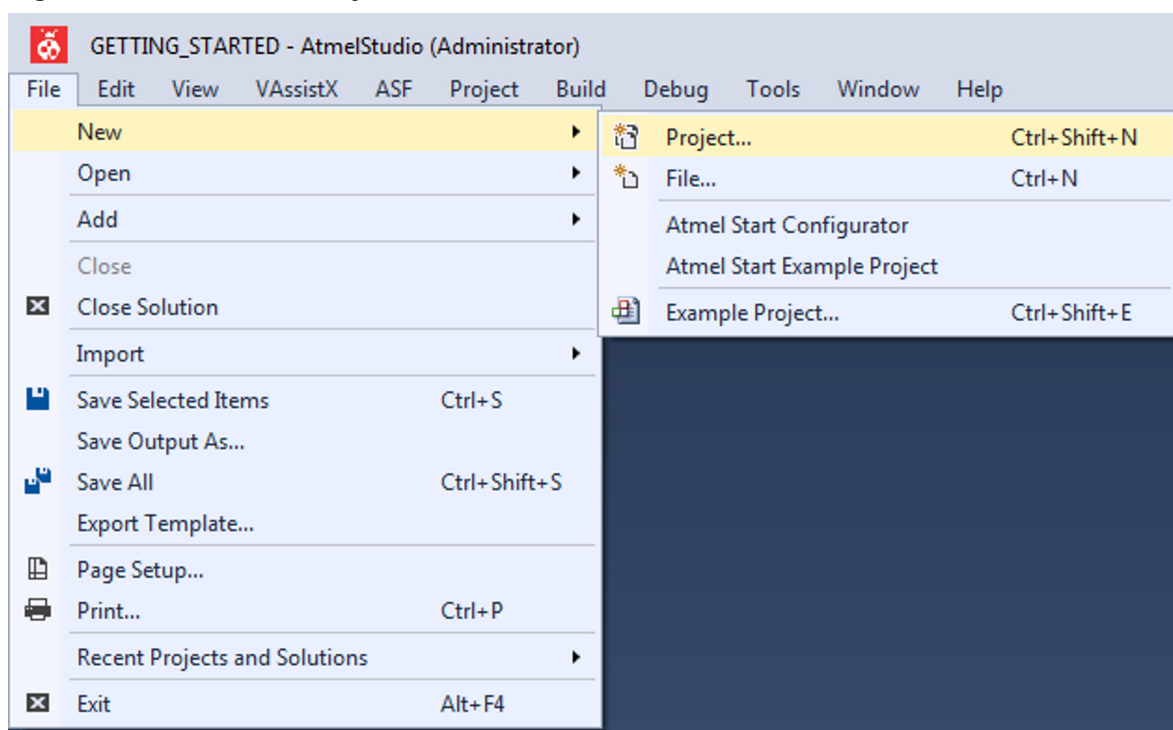
Prerequisites

- Atmel Studio 7.0 1645 or above installed
- The STK600 board connected to Atmel Studio 7.0 via the on-board USB connector.

Workflow

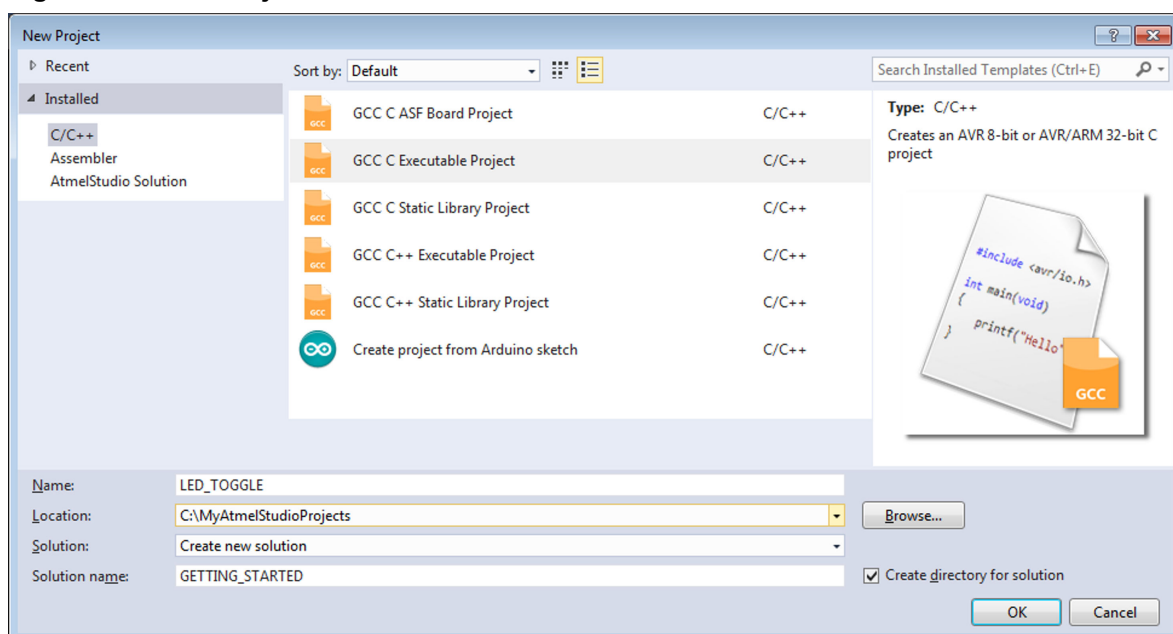
1. Launch Atmel Studio 7.0.
2. Start creating a new project by clicking **New** → **Project...** or by using the shortcut **Ctrl+Shift+N**, as shown in the figure below.

Figure 4-7. Create New Project in Atmel Studio

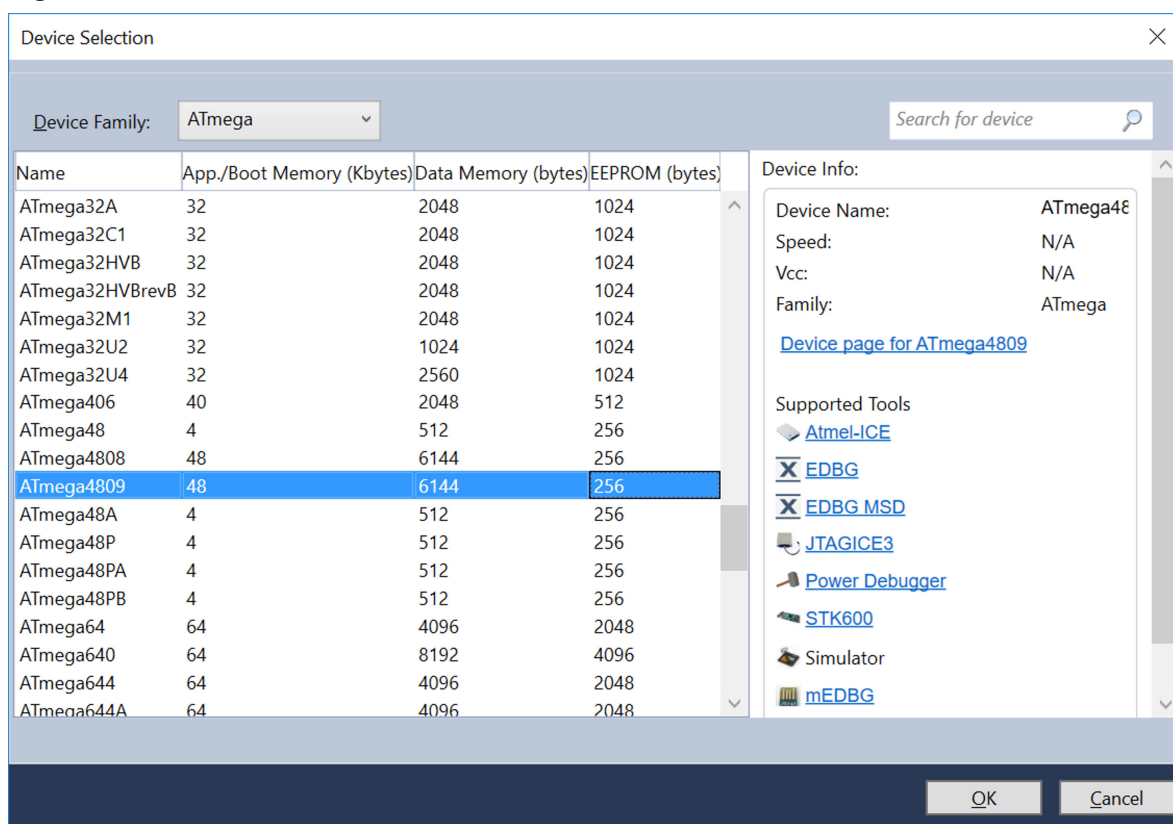


3. Select the *GCC C Executable Project* template from the new project wizard shown in the following figure, type in the name of the solution and project (e.g. *GETTING_STARTED* and *LED_TOGGLE*), and click **OK**.

Figure 4-8. New Project Wizard



4. Select ATmega4809 from the device selection wizard as shown in the figure below, and click **OK**.

Figure 4-9. Device Selection Wizard

A new project with a `main.c` file associated with it will be generated in Atmel Studio.

- Replace the 'main' function in the `main.c` file with the following code snippet:

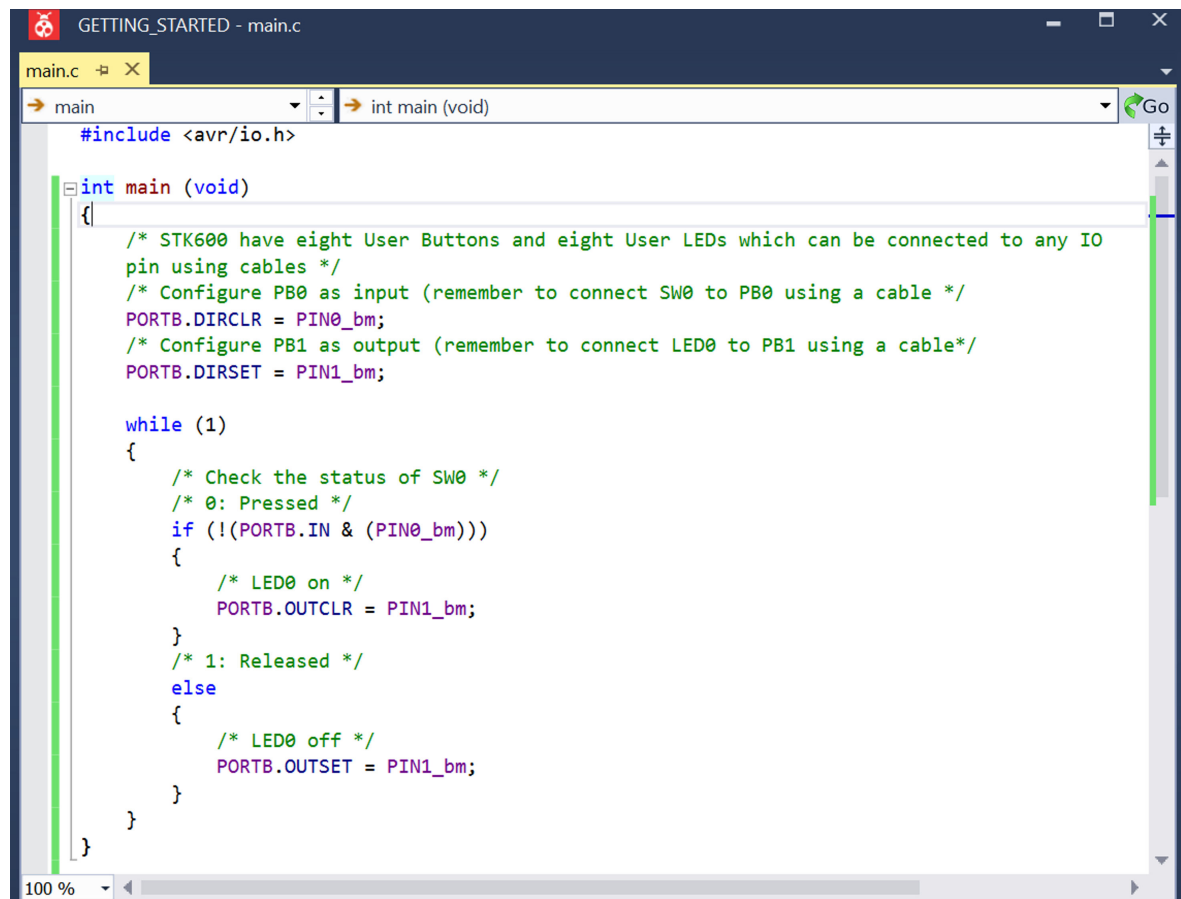
```
int main (void)
{
    /* STK600 have eight User Buttons and eight User LEDs which can be connected to any IO
    pin using cables */
    /* Configure PB0 as input (remember to connect SW0 to PB0 using a cable */
    PORTB.DIRCLR = PIN0_bm;

    /* Configure PB1 as output (remember to connect LED0 to PB1 using a cable*/
    PORTB.DIRSET = PIN1_bm;

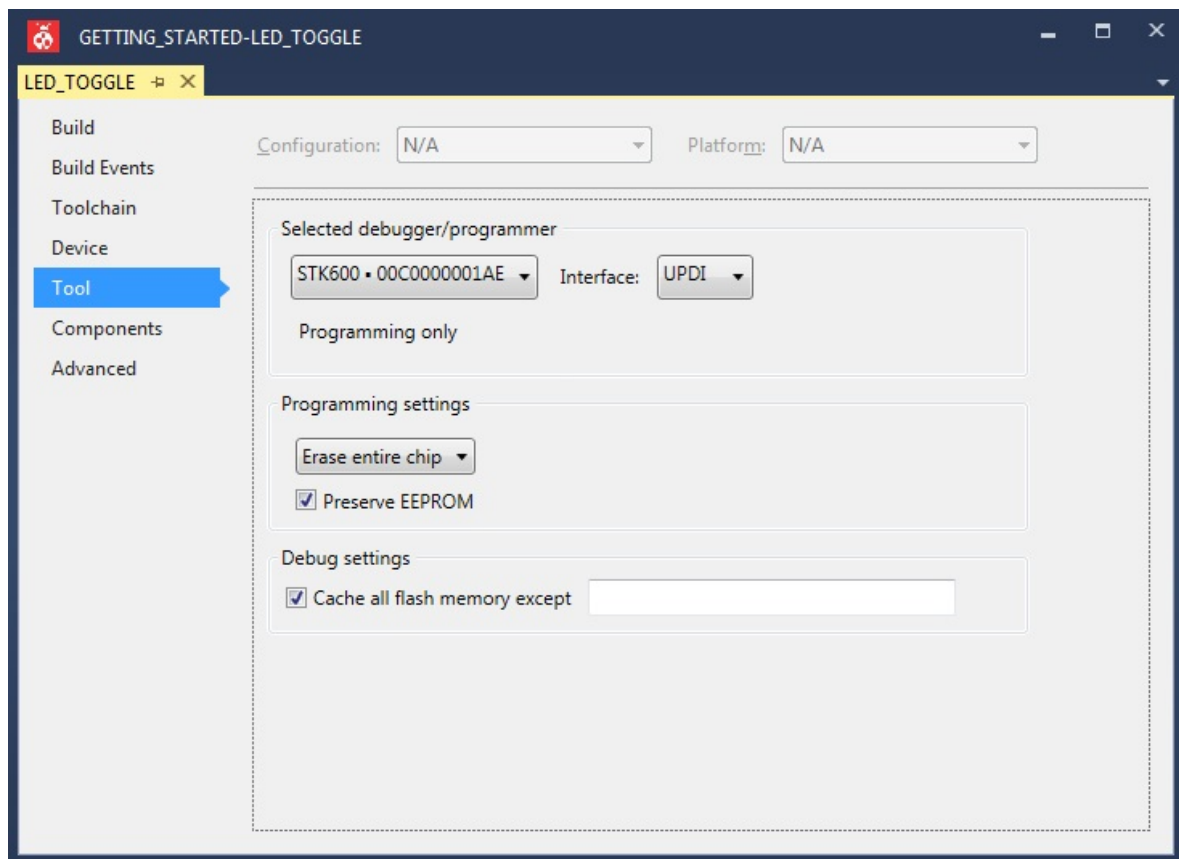
    while (1)
    {
        /* Check the status of SW0 */
        /* 0: Pressed */
        if (!(PORTB.IN & (PIN0_bm)))
        {
            /* LED0 on */
            PORTB.OUTCLR = PIN1_bm;
        }
        /* 1: Released */
        else
        {
            /* LED0 off */
            PORTB.OUTSET = PIN1_bm;
        }
    }
}
```

In the code editor, the code may appear as shown in the figure below.

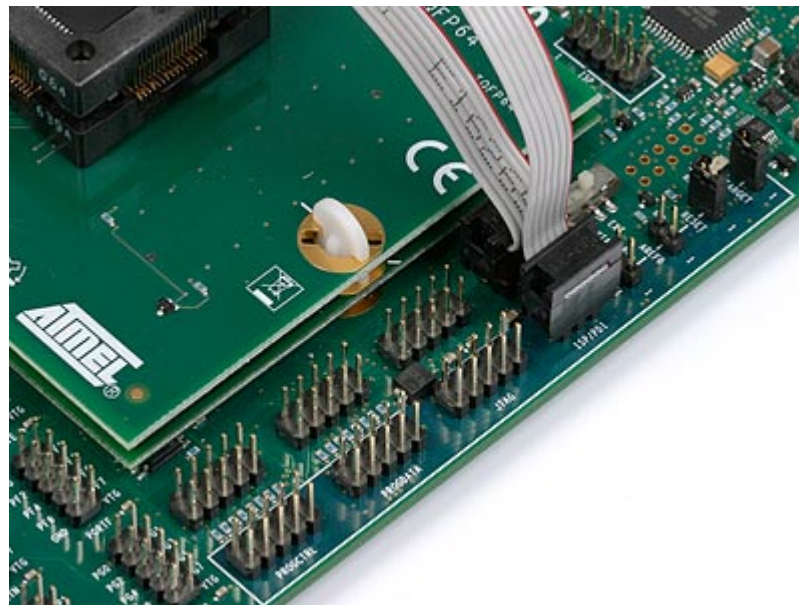
Figure 4-10. Code Editor Window



6. Open project properties by clicking *Project* → *Properties* or by using the shortcut *ALT+F7*.
7. In *Tool* view (figure below), set *Selected debugger/programmer* to STK600 and *Interface* to UPDI.

Figure 4-11. Debugger and Interface for ATmega4809

8. Build the project by clicking **Build** → **Build Solution** or using the shortcut **F7**.
9. Connect the embedded debugger on STK600 to ATmega4809 by connecting a cable between the ISP/PDI headers, as shown in the figure below.

Figure 4-12. UPDI Connection on STK600

10. Connect PB2 to SW0, and PB5 to LED0 by using cables.

11. Load the code onto the STK600 and start debugging by clicking *Debug → Start debugging and break* or by using the shortcut *ALT+F5*. The application is programmed onto the device and the program execution should break in main.
12. Run the code by clicking *Debug → Continue* or by using the shortcut *F5*.
13. Verify that LED0 is lit when SW0 is pushed on STK600.

5. What's Next

For further information on related AVR products and IDE, refer to the links below:

Software:

- Atmel Studio: <http://www.microchip.com/avr-support/atmel-studio-7>
- Atmel Studio help: *Help* → *View Help* (shortcut *CTRL+F1*)
- Atmel Gallery: <https://gallery.microchip.com/>

Firmware:

- Atmel START documentation: <http://start.atmel.com/static/help/index.html>
- Atmel START examples: <http://microchip.com/start/#examples>

Hardware:

- AVR042: AVR Hardware Design Considerations: http://www.microchip.com/AVR042:AVR_Hardware_Design_Considerations
- AVR IBIS files: <http://www.microchip.com/doclisting/TechDoc.aspx?type=IBIS>
- AVR BSDL files: <http://www.microchip.com/doclisting/TechDoc.aspx?type=BSDL>

Recommended programming/debugging tools:

- Atmel-ICE:
 - Documentation: http://www.microchip.com/Atmel-ICE_Debugger_User_Guide
 - Buy: <https://www.microchip.com/Development-Tools/atatmel-ice>
- Power debugger:
 - Documentation: http://www.microchip.com/42696D_Power_Debugger_User_Guide
 - Buy: <https://www.microchip.com/Development-Tools/atpowerdebugger>

Other:

- AVR Freaks®: <http://www.avrfreaks.net/>
- Application notes: <http://www.microchip.com/paramChartSearch/chart.aspx?branchID=30047>, find the preferred device and go to the product page. All relevant application notes can be found under the documentation tab.
- AVR product selector: <http://www.microchip.com/paramChartSearch/chart.aspx?branchID=30047>
- More technical documentation concerning various products: <https://www.microchip.com/webdoc>
- Microchip Technical Support: <http://www.microchip.com/support/hottopics.aspx>

6. Revision History

Doc. Rev.	Date	Comments
B	10/2018	- Added ATmega808/809/1608/1609 to figure 1-1, chapter 2 and table 3-1. - Fixed grammar and punctuation.
A	02/2018	Initial document release

The Microchip Web Site

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- **General Technical Support** – Frequently Asked Questions (FAQ), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

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Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or Field Application Engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the web site at: <http://www.microchip.com/support>

Microchip Devices Code Protection Feature

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.

- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as “unbreakable.”

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ISO/TS 16949

Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC[®] MCUs and dsPIC[®] DSCs, KEELOQ[®] code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

Worldwide Sales and Service

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