AN2503

Getting Started with tinyAVR® 1-series

Features

- Getting Started with tinyAVR® 1-series Microcontrollers and Tools
- Getting Started with ATtiny817 Xplained Mini and Atmel Studio 7.0

Introduction

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This application note outlines how to get started with the tinyAVR® 1-series devices.

Refer to the data sheet for further information on the differences between the tinyAVR® 1-series devices.

Table of Contents

1. Relevant Devices

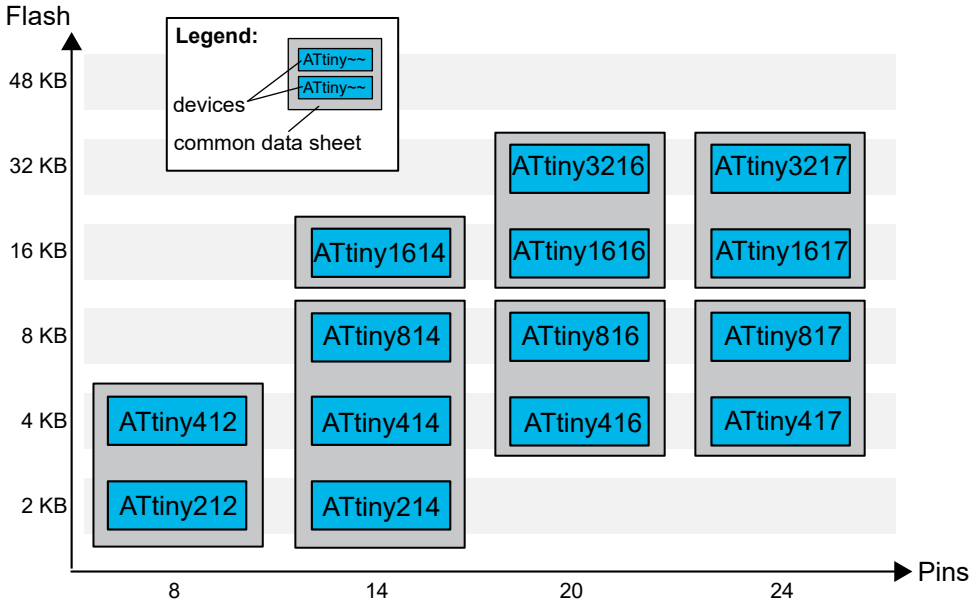
This chapter lists the relevant devices for this document.

1.1 tinyAVR® 1-series

The figure below shows the tinyAVR® 1-series devices, laying out pin count variants and memory sizes:

- Vertical migration upwards is possible without code modification, as these devices are pin compatible and provide the same or more features. Downward migration may require code modification due to fewer available instances of some peripherals.
- Horizontal migration to the left reduces the pin count and therefore, the available features.

Figure 1-1. tinyAVR® 1-series Overview



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

2. Get the Device Datasheet

Web pages

- http://www.microchip.com/wwwproducts/en/ATtiny212
- http://www.microchip.com/wwwproducts/en/ATtiny214
- http://www.microchip.com/wwwproducts/en/ATtiny412
- http://www.microchip.com/wwwproducts/en/ATtiny414
- http://www.microchip.com/wwwproducts/en/ATtiny416
- http://www.microchip.com/wwwproducts/en/ATtiny417
- http://www.microchip.com/wwwproducts/en/ATtiny814
- http://www.microchip.com/wwwproducts/en/ATtiny816
- http://www.microchip.com/wwwproducts/en/ATtiny817
- http://www.microchip.com/wwwproducts/en/ATtiny1614
- http://www.microchip.com/wwwproducts/en/ATtiny1616
- http://www.microchip.com/wwwproducts/en/ATtiny1617
- http://www.microchip.com/wwwproducts/en/ATtiny3216
- http://www.microchip.com/wwwproducts/en/ATtiny3217

Documents/files

- ATtiny212/412 Data Sheet (summary, complete)(.pdf)
- ATtiny214/414/814 Data Sheet (summary, complete)(.pdf)
- ATtiny416/816 Data Sheet (summary, complete)(.pdf)
- ATtiny417/817 Data Sheet (summary, complete)(.pdf)
- ATtiny416/417/816/817 Automotive Data Sheet (complete)(.pdf)
- ATtiny1614 Data Sheet (complete)(.pdf)
- ATtiny1616/3216 Data Sheet (complete)(.pdf)
- ATtiny1617/3217 Data Sheet (complete)(.pdf)
- ATtiny1616/1617 Automotive Data Sheet (complete)(.pdf)

There are two versions of the data sheet:

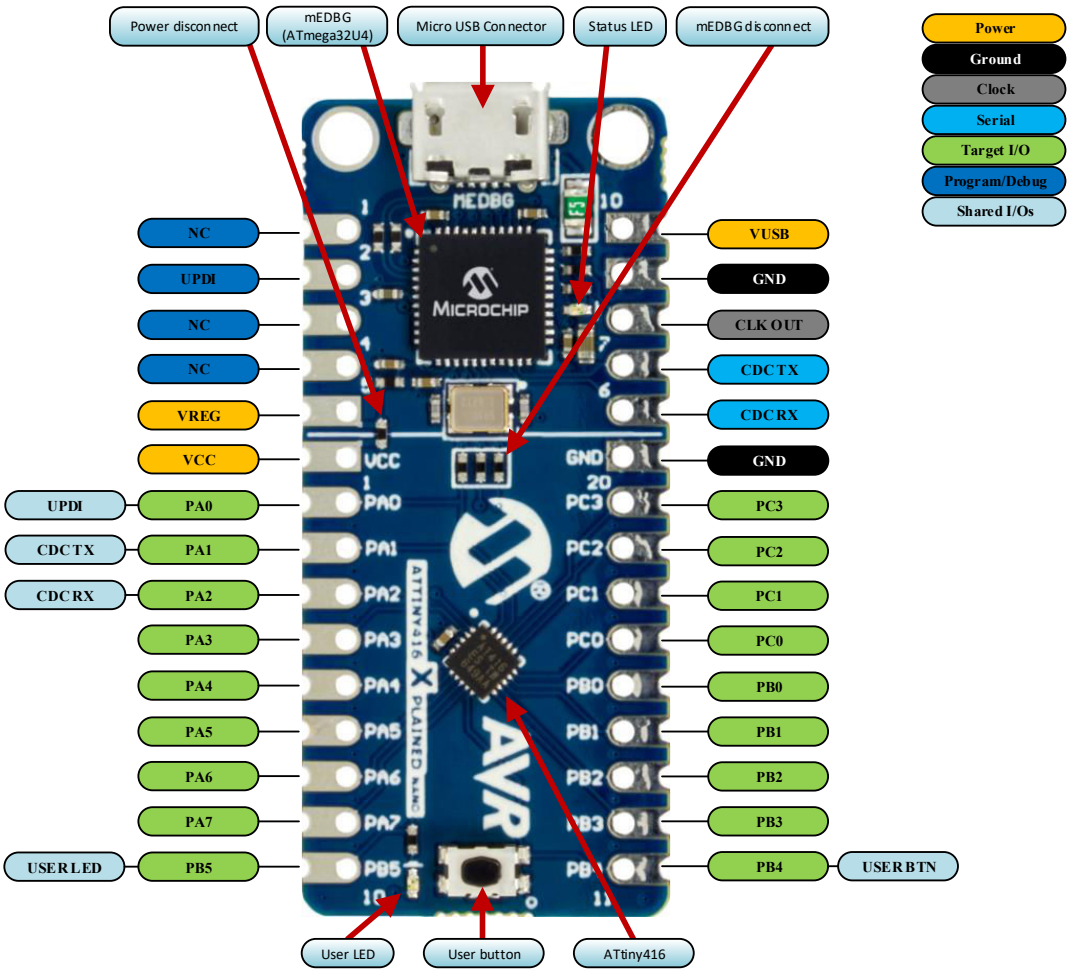
- Complete version (includes all peripheral descriptions and electrical characteristics)
- Summary version

3. Get the Tools

Atmel Studio 7.0, which uses GCC compiler, is the preferred IDE to get started with tinyAVR® 1-series.

3.1 Get the ATtiny416 Xplained Nano Evaluation Kit

Figure 3-1. ATtiny416 Xplained Nano Kit



Web page: www.microchip.com/Development-Tools/attiny416-xnano

Get the kit: https://www.microchipdirect.com/product/attiny416-xnano

Document/file:

- ATtiny416 Xplained Nano User Guide (.pdf)

Key Features

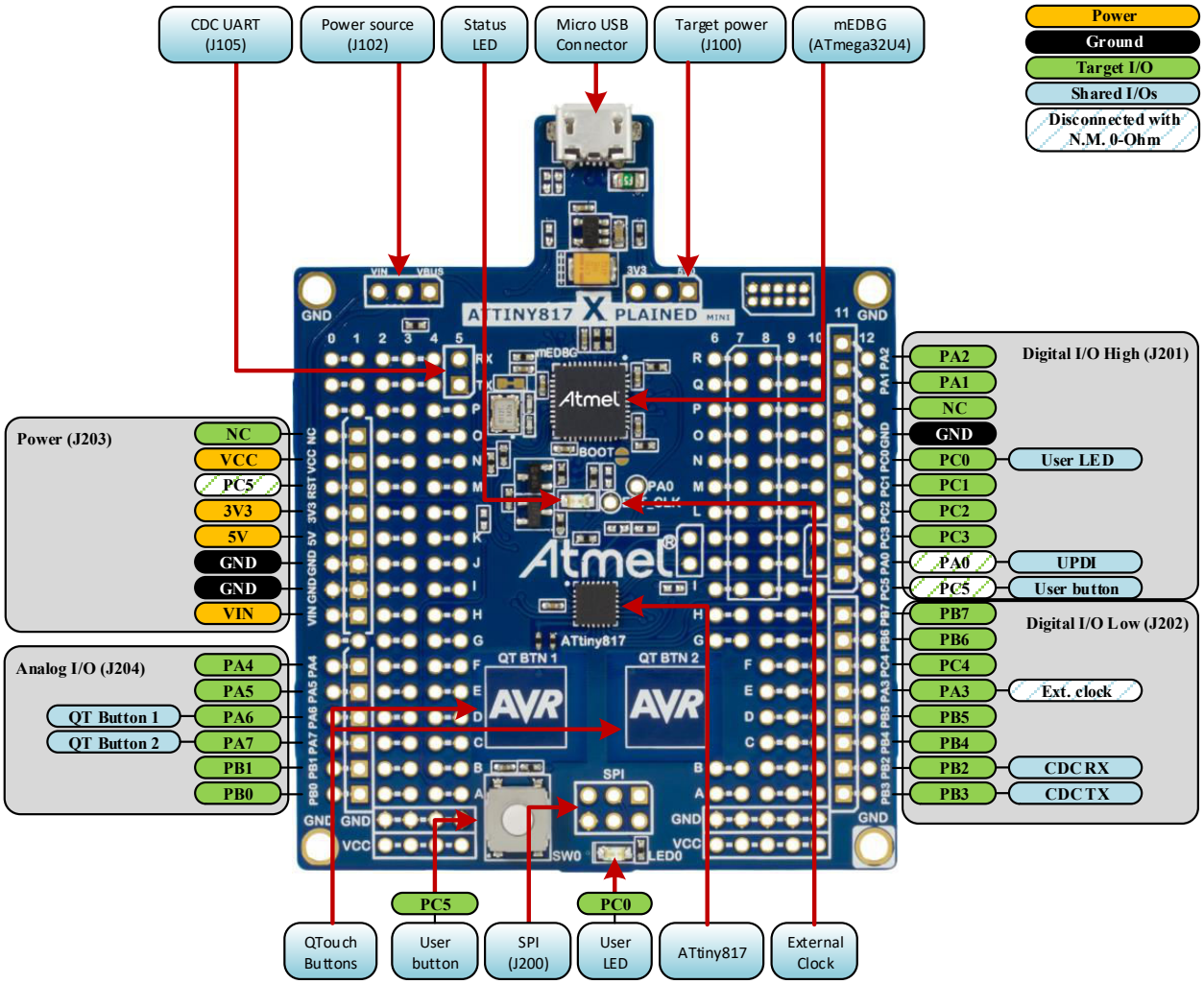
- ATtiny416 microcontroller
- One yellow user LED
- One mechanical button
- mEDBG
  - Auto-ID for board identification in Atmel Studio

  - One green board status LED
  - Programming
  - Virtual COM port (CDC)
- USB powered

The ATtiny416 Xplained Nano User Guide covers how to power the kit and includes detailed information about board components, extension interface, and the hardware user guide.

3.2 Get the ATtiny817 Xplained Mini Evaluation Kit

Figure 3-2. ATtiny817 Xplained Mini Kit



Web page: www.microchip.com/Development-Tools/attiny817-xmini

Get the kit: https://www.microchipdirect.com/product/attiny817-xmini

Document/file:

- ATtiny817 Xplained Mini User Guide (.pdf)

Key Features

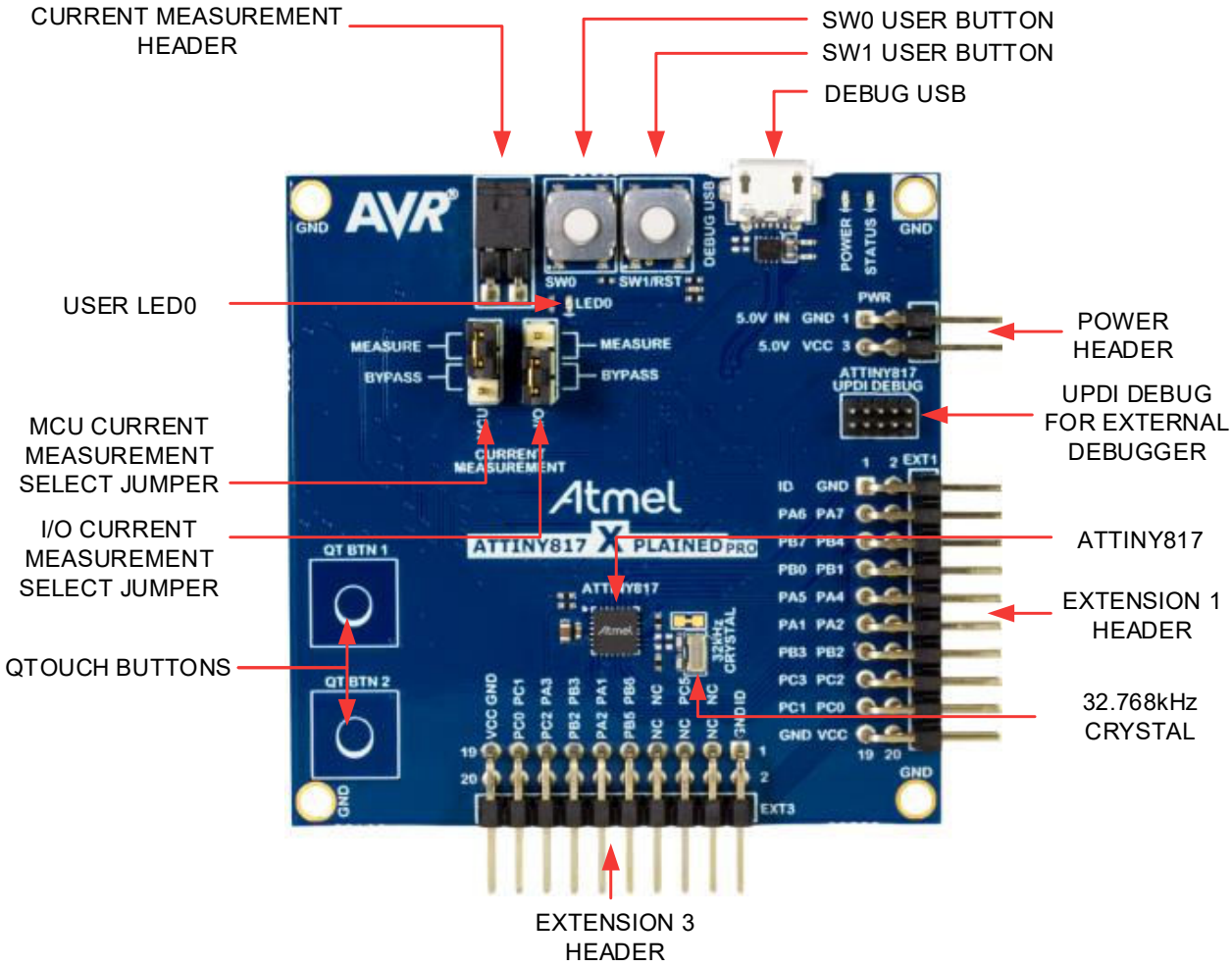
- ATtiny817 microcontroller

- One yellow user LED
- One mechanical button
- Two QTouch® buttons
- mEDBG
  - Auto-ID for board identification in Atmel Studio
  - One green board status LED
  - Programming and debugging
  - Virtual COM port (CDC)
- USB powered
- ATtiny817 power sources:
  - 5.0V from USB
  - 3.3V regulator
  - External voltage
- Arduino shield compatible footprints

The ATtiny817 Xplained Mini User Guide covers how to power the kit and includes detailed information about board components, extension interface, and the hardware user guide.

3.3 Get the ATtiny817 Xplained Pro Evaluation Kit

Figure 3-3. ATtiny817 Xplained Pro Kit



Web page: www.microchip.com/Development-Tools/attiny817-xpro

Get the kit: https://www.microchipdirect.com/product/attiny817-xpro

Document/file:

- ATtiny817 Xplained Pro User Guide (.pdf)

Key Features

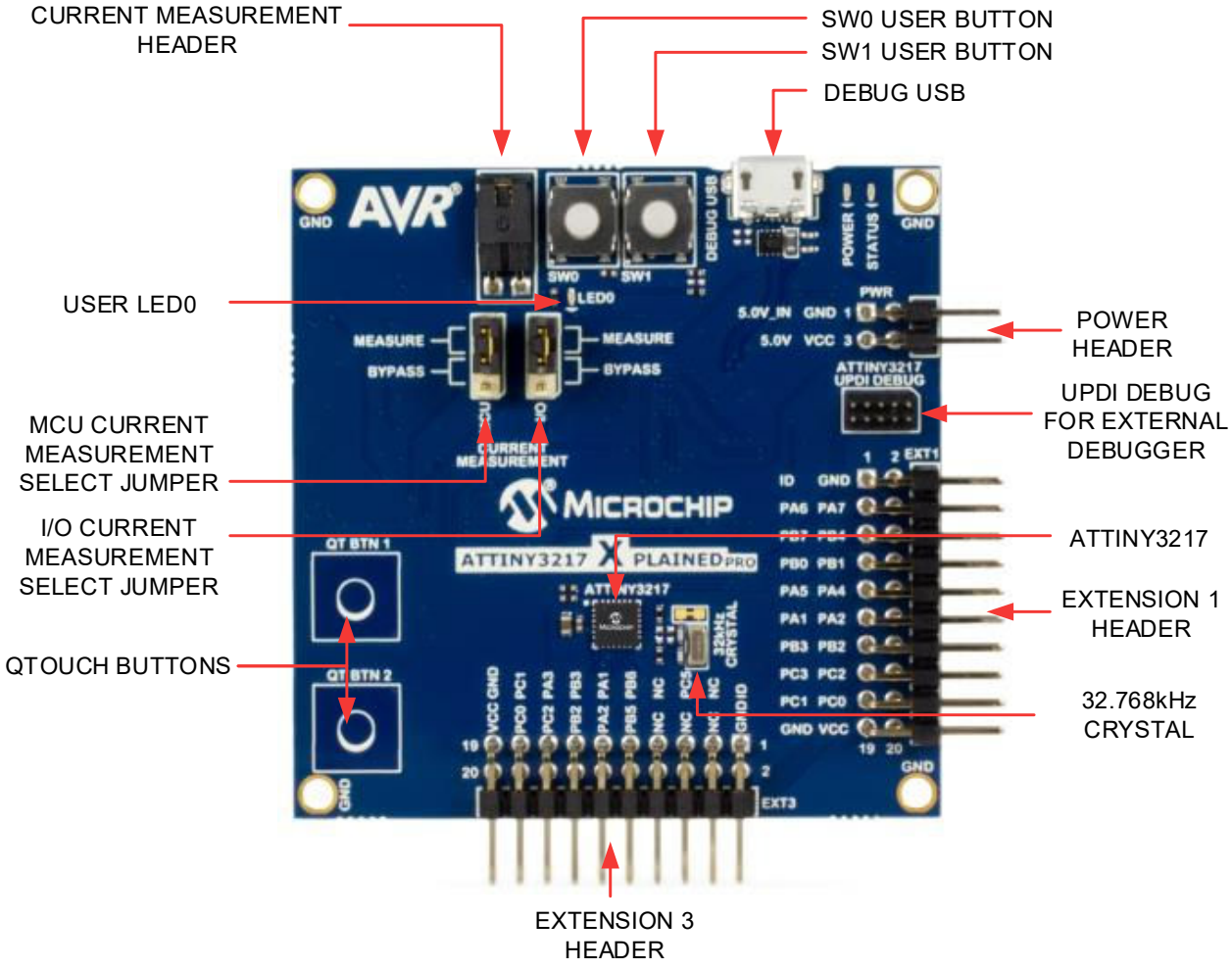
- ATtiny817 microcontroller
- Two mechanical user buttons
- Two QTouch® buttons
- One yellow user LED
- 32.768 kHz crystal
- Two Xplained Pro extension headers
- Embedded Debugger:
  - Auto-ID for board identification in Atmel Studio
  - One yellow status LED

  - One green board power LED
  - Symbolic debug of complex data types including scope information
  - Programming and debugging, including power measurements
  - Data Gateway Interface: SPI, I^2C, two GPIOs
  - Virtual COM port (CDC)
- Embedded current measurement circuitry, with Microchip Data Visualizer support for data visualization
- USB powered
- Supported with application examples in Atmel | START

The ATtiny817 Xplained Pro User Guide covers how to power the kit and includes detailed information about board components, extension interface, and the hardware user guide.

3.4 Get the ATtiny3217 Xplained Pro Evaluation Kit

Figure 3-4. ATtiny3217 Xplained Pro Kit



Web page: www.microchip.com/Development-Tools/attiny3217-xpro

Get the kit: https://www.microchipdirect.com/product/attiny3217-xpro

Document/file:

- ATtiny3217 Xplained Pro User Guide (.pdf)

Key Features

- ATtiny3217 microcontroller
- Two mechanical user buttons
- Two QTouch® buttons
- One yellow user LED
- 32.768 kHz crystal
- Two Xplained Pro extension headers
- 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, I^2C, two GPIOs
  - Virtual COM port (CDC)
- Embedded current measurement circuitry (XAM)
  - Measures power consumption of the ATtiny3217 and/or peripherals
  - Measures current between 100 nA and 400 mA
  - Current measurement data are shown in Microchip Data Visualizer
- USB powered
- Supported with application examples in Atmel | START

The ATtiny3217 Xplained Pro User Guide covers how to power the kit and includes detailed information about board components, extension interface, and the hardware user guide.

3.5 Get the STK600 Starter Kit

Figure 3-5. STK600 Starter Kit

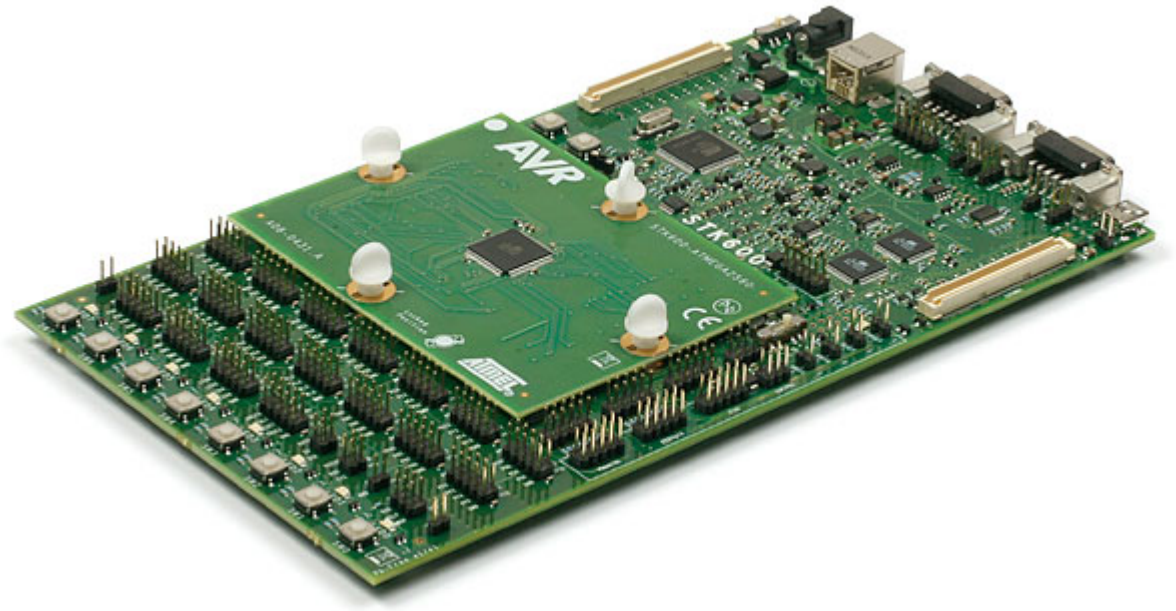


Table 3-1. STK600 Device Support for tinyAVR 1-series

Device	Routing Card	Socket Card
ATtiny214	STK600-RC020T-104	STK600-SOIC
ATtiny414	STK600-RC020T-104	STK600-SOIC
ATtiny416	STK600-RC020T-104	STK600-SOIC
ATtiny417	STK600-RC024T-103	STK600-QFN24
ATtiny814	STK600-RC020T-104	STK600-SOIC
ATtiny816	STK600-RC020T-104	STK600-SOIC
ATtiny817	STK600-RC024T-103	STK600-QFN24
ATtiny1614	STK600-RC020T-104	STK600-SOIC
ATtiny1616	STK600-RC020T-104	STK600-SOIC
ATtiny1617	STK600-RC024T-103	STK600-QFN24
ATtiny3216	STK600-RC020T-104	STK600-SOIC
ATtiny3217	STK600-RC024T-103	STK600-QFN24

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 Non-volatile 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.

3.6 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(s) 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 tinyAVR 1-series can be done by searching for the device name, e.g. ATtiny817, in the Atmel | START example browser.

Press *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 *About* from the Atmel | START front page or *Help And Support* within the project configurator, both located in the upper right corner of the page.

3.7 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 tinyAVR® 1-series.

For device support, refer to 4. Get Device Support.

3.8 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.

4. 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 tinyAVR® 1-series, update to the latest version by performing the following steps:

1. Click *Check for Updates*.
2. For tinyAVR® 1-series, select the latest available version of *ATtiny_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 from *My Pages* on https://iar.com.

5. Atmel Studio Users Getting Started

5.1 Atmel Studio with ATtiny817 Xplained Mini

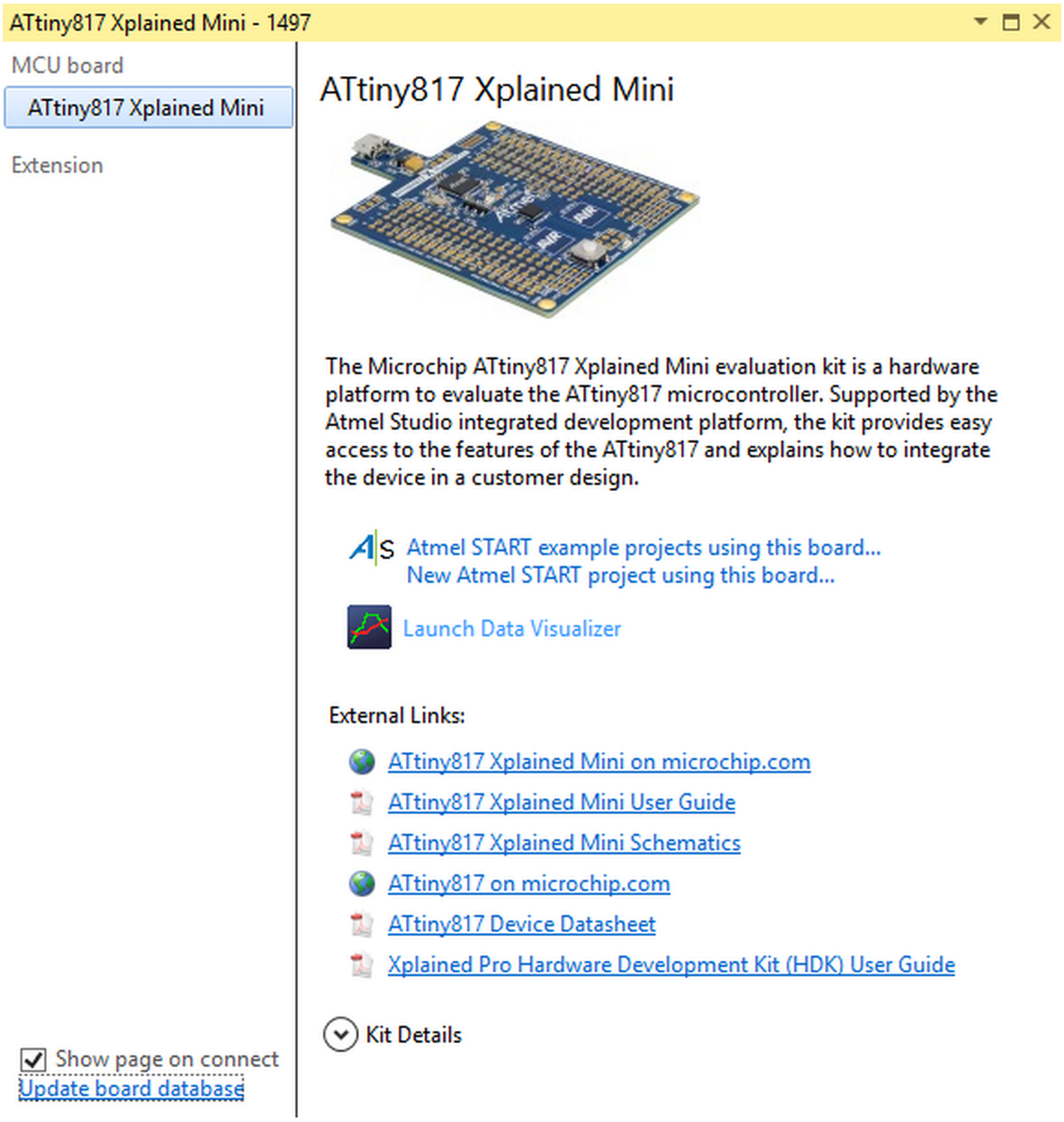
Prerequisites

- Atmel Studio 7.0 1645 or above installed
- The ATtiny817 Xplained Mini 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

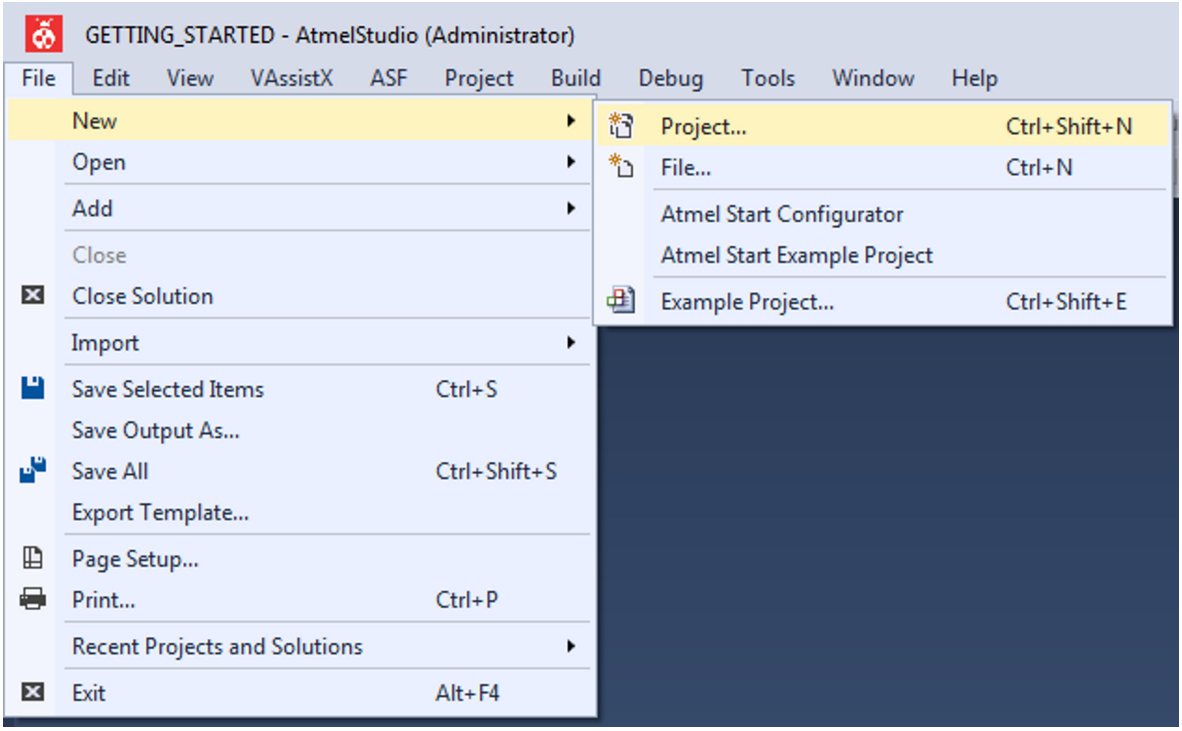
1. Launch Atmel Studio 7.0.
2. The page shown in the figure below will appear when ATtiny817 Xplained Mini is connected to Atmel Studio 7.0.

Figure 5-1. ATtiny817 Xplained Mini Page in Atmel Studio



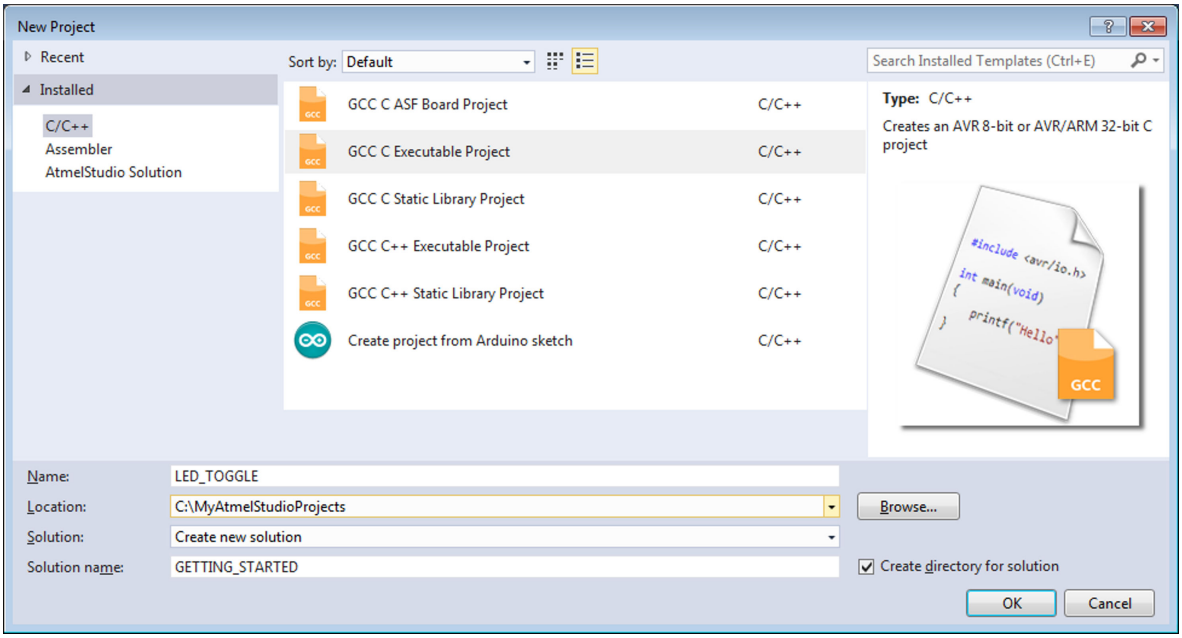
3. Start creating a new project by clicking *New* → *Project...* or by using the shortcut *Ctrl+Shift+N*, as shown in the figure below.

Figure 5-2. Create New Project in Atmel Studio



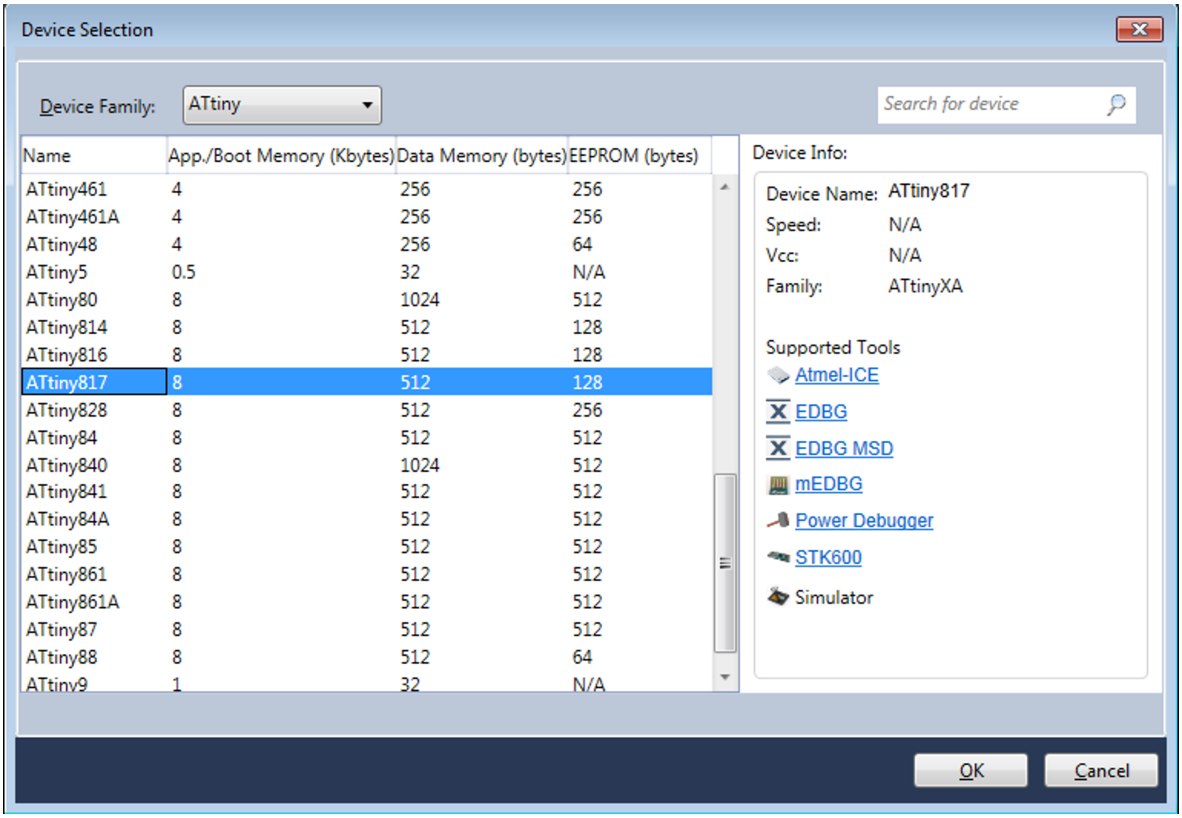
4. Select the *GCC C Executable Project* template from the new project wizard shown in the figure below, type in the name of the solution and project (e.g. *GETTING_STARTED* and *LED_TOGGLE*), and click *OK*.

Figure 5-3. New Project Wizard



5. Select ATtiny817 from the device selection wizard as shown in the figure below, and click *OK*.

Figure 5-4. Device Selection Wizard



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

6. Replace the `main` loop in the *main.c* file with the following code snippet:

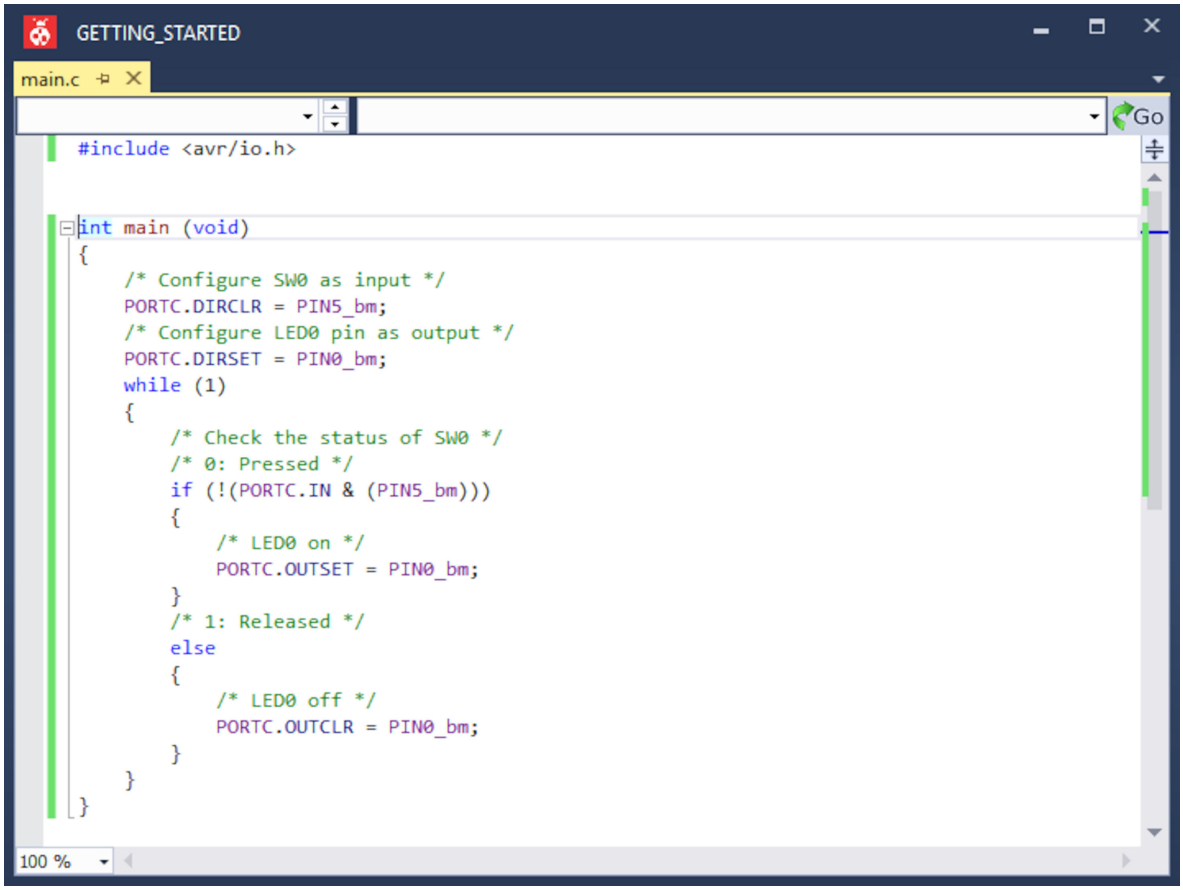
```
int main (void)
{
  /* Configure SW0 as input */
  PORTC.DIRCLR = PIN5_bm;

  /* Configure LED0 pin as output */
  PORTC.DIRSET = PIN0_bm;

  while (1)
  {
    /* Check the status of SW0 */
    /* 0: Pressed */
    if (!(PORTC.IN & (PIN5_bm)))
    {
      /* LED0  on */
      PORTC.OUTSET = PIN0_bm;
    }
    /* 1: Released */
    else
    {
      /* LED0 off */
      PORTC.OUTCLR = PIN0_bm;
    }
  }
}
```

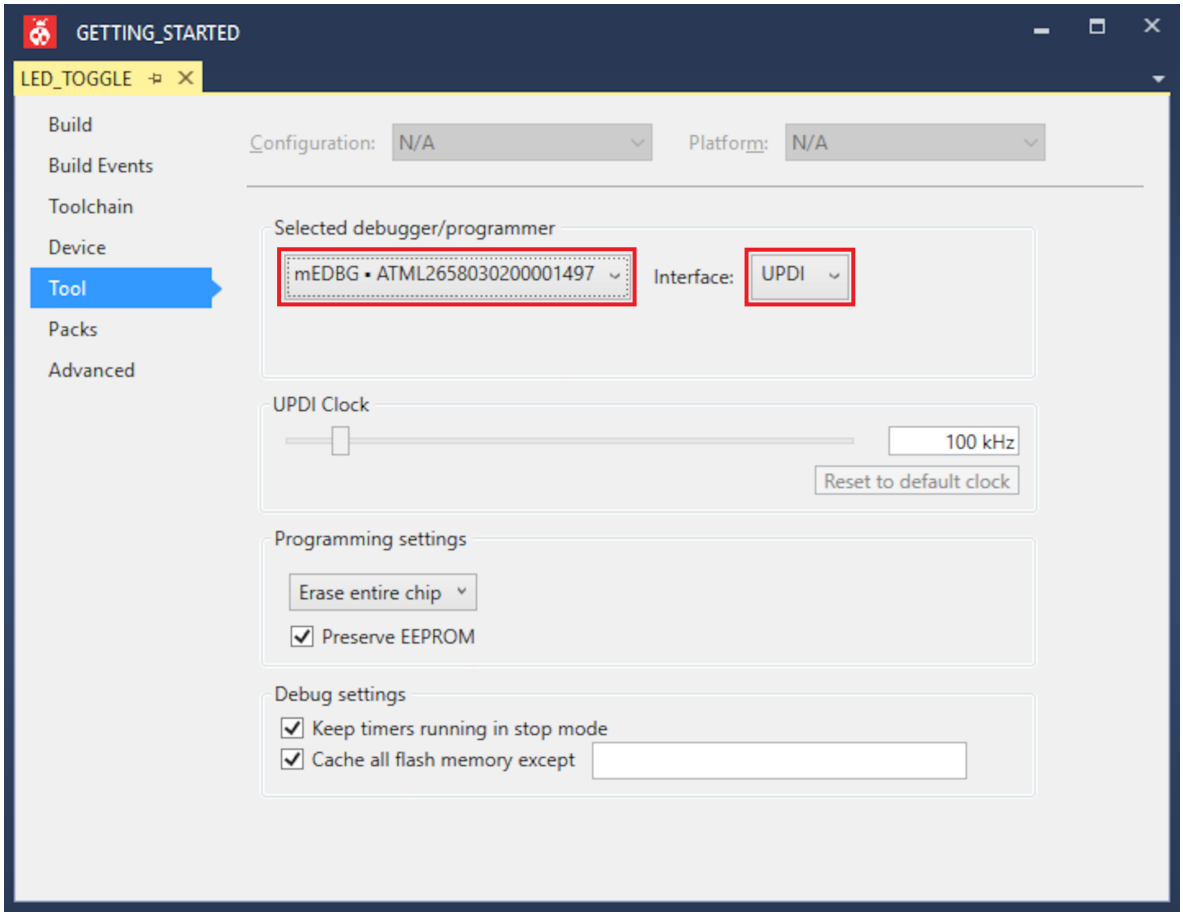
In the code editor, the code should appear as shown in the figure below.

Figure 5-5. 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 mEDBG and *Interface* to UPDI.

Figure 5-6. Debugger and Interface for ATtiny817



9. Build the project by clicking *Build → Build Solution* or by using the shortcut *F7*.
10. Program ATtiny817 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 ATtiny817 Xplained Mini.

5.2 Atmel Studio with STK600

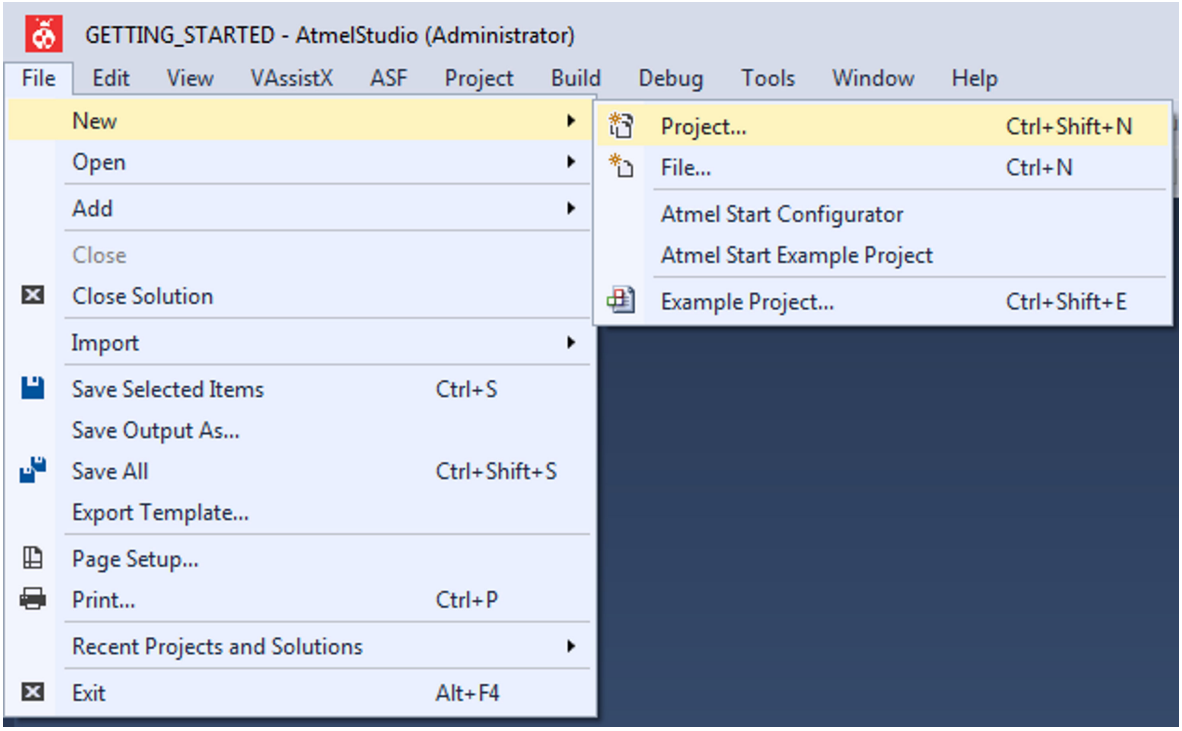
Prerequisites

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

Workflow

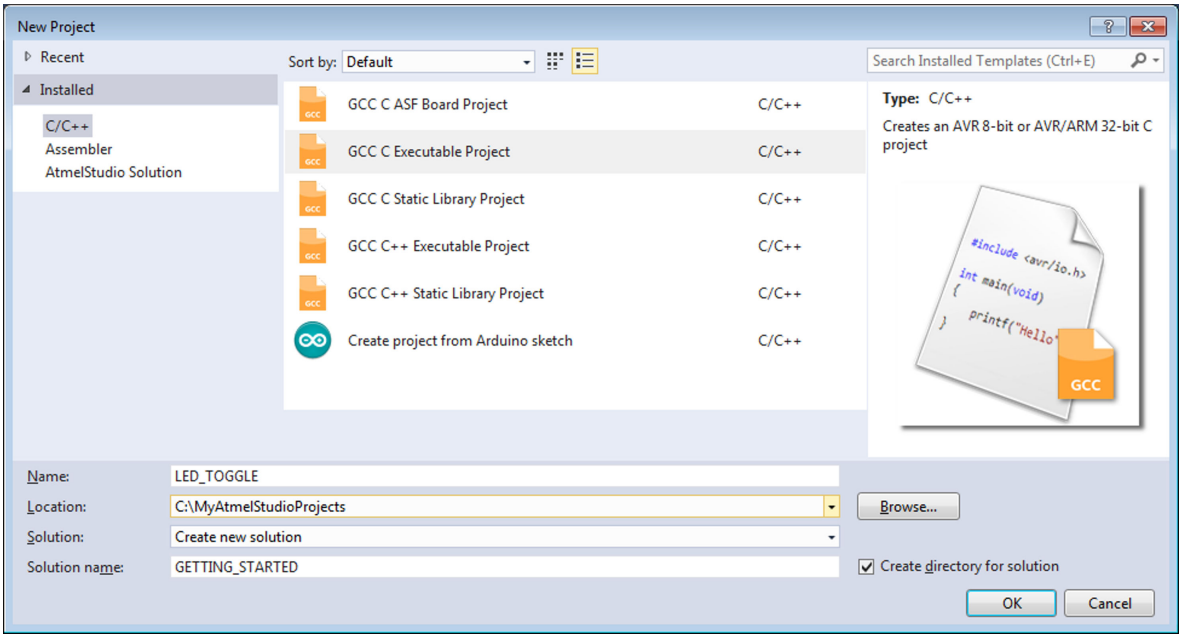
1. Launch Atmel Studio 7.0.
2. Start creating a new project by clicking *New → Project...* or by using the shortcut *Ctrl+Shift+N*, as shown in the figure below.

Figure 5-7. Create New Project in Atmel Studio



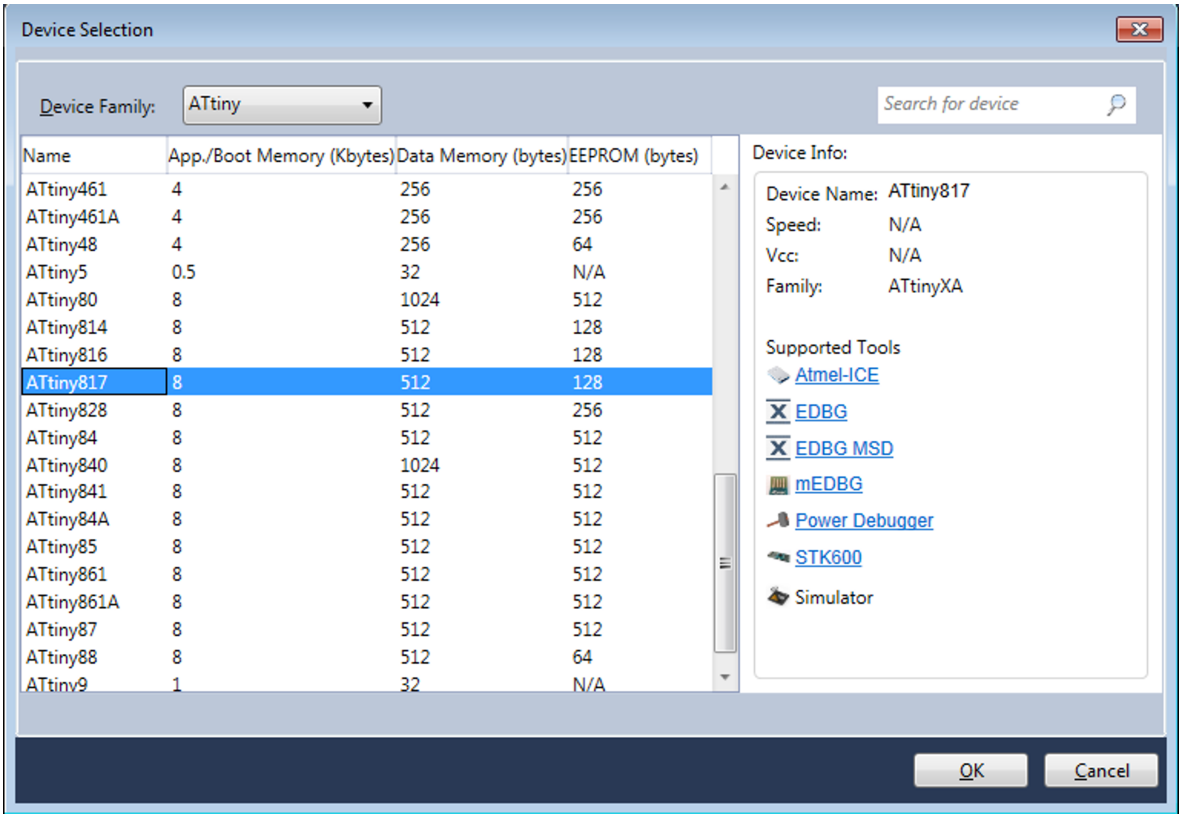
3. Select the *GCC C Executable Project* template from the new project wizard shown in the figure below, type in the name of the solution and project (e.g. *GETTING_STARTED* and *LED_TOGGLE*), and click *OK*.

Figure 5-8. New Project Wizard



4. Select ATtiny817 from the device selection wizard as shown in the figure below, and click *OK*.

Figure 5-9. Device Selection Wizard



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

5. Replace the *main* function in the *main.c* file with the following code snippet:

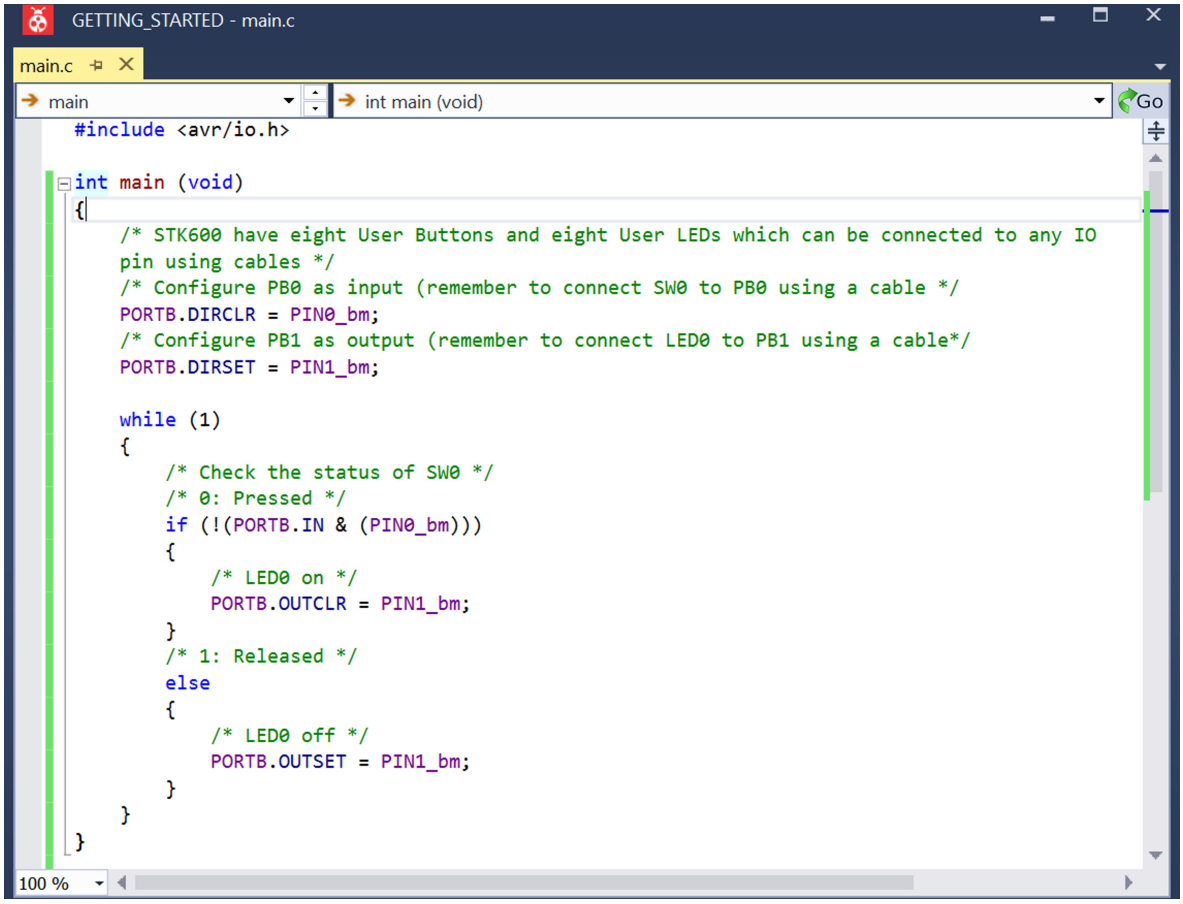
```
int main (void)
{
  /* STK600 have eight User Buttons and eight User LEDs which can be connected to any IO
pin using cables */
  /* Configure PB0 as input (remember to connect SW0 to PB0 using a cable */
  PORTB.DIRCLR = PIN0_bm;

  /* 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;
    }
  }
}
```

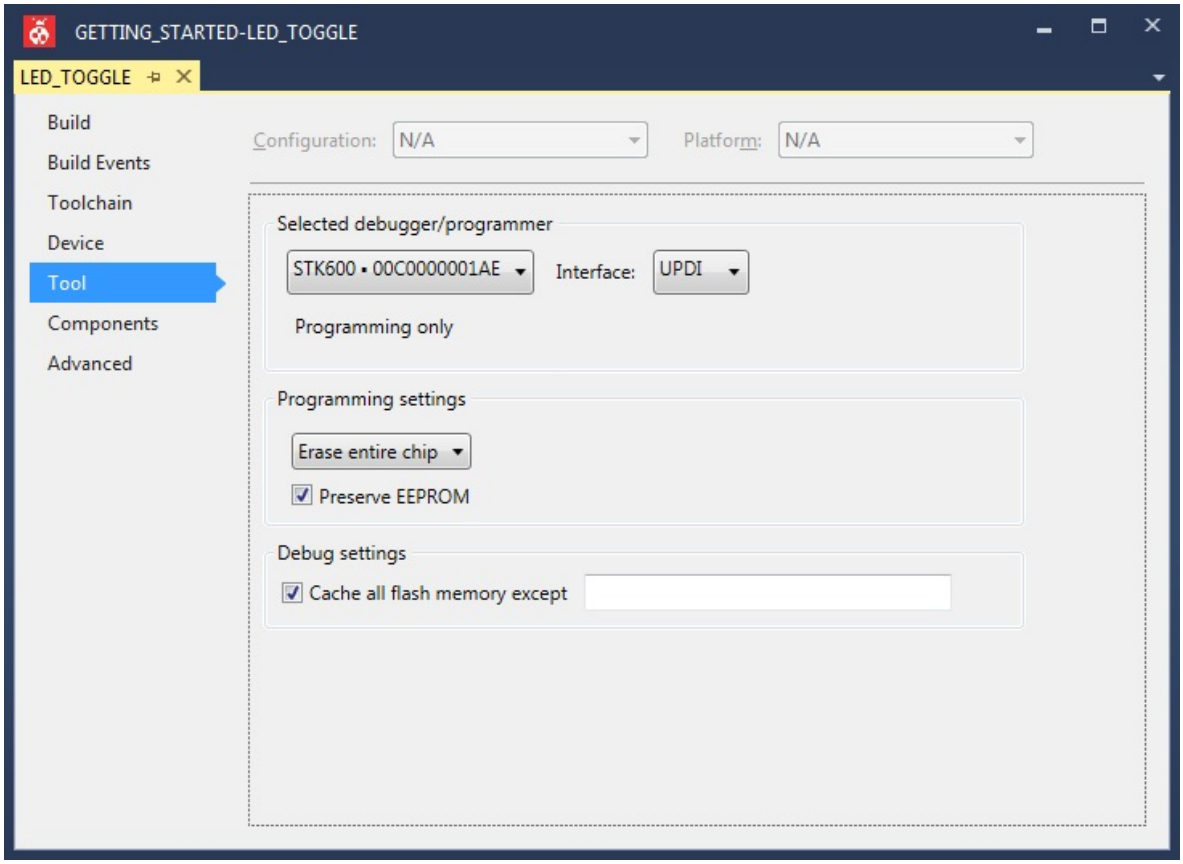
In the code editor, the code should appear as shown in the figure below.

Figure 5-10. Code Editor Window



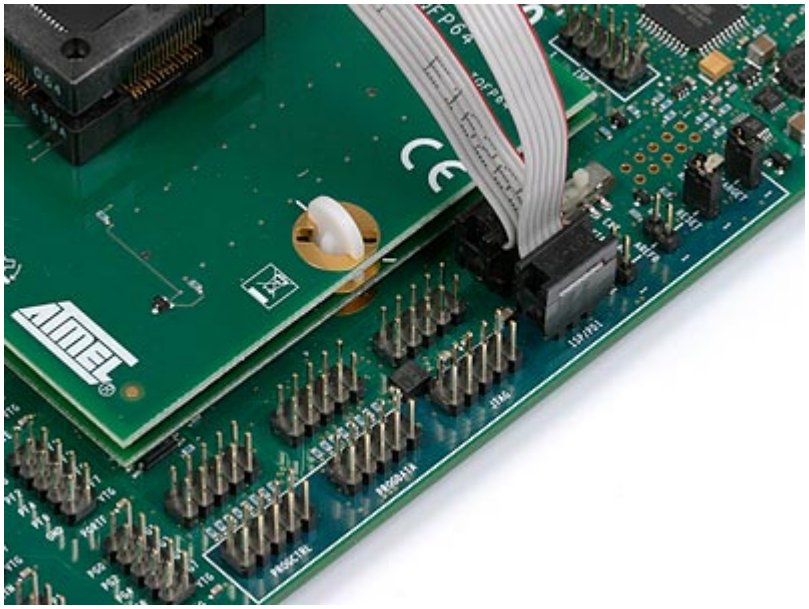
6. Open project properties by clicking *Project* → *Properties* or by using the shortcut *ALT+F7*.
7. In the *Tool* view (see the figure below) set *Selected debugger/programmer* to STK600 and *Interface* to UPDI.

Figure 5-11. Debugger and Interface for ATtiny817



8. Build the project by clicking *Build → Build Solution* or using the shortcut *F7*.
9. Connect the embedded debugger on STK600 to ATtiny817 by connecting a cable between the ISP/PDI headers, as shown in the figure below.

Figure 5-12. UPDI Connection on STK600



10. Connect PC5 to SW0, and PC0 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.

6. 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 BDSL 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

7. Revision History

Doc. Rev.	Date	Comments
B	06/2018	• Added device support for *ATtiny3216* and *ATtiny3217*. • Added kit support for *ATtiny416 Xplained Nano* and *ATtiny3217 Xplained Pro* • Fixed bug in *ATtiny817 Xplained Mini* example.
A	08/2017	• Microchip DS00002503 Rev. A. replaces Atmel AVR42781 Rev. A. • Renamed from *AVR42781: Getting Started With ATtiny417/814/816/817* to *Getting Started with tinyAVR 1-series*, and restructured the document in order to cover more devices. • Added device support for *ATtiny1614*, *ATtiny1616*, and *ATtiny1617*.
42781A	09/2016	Initial document release.

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