AN3634

Getting Started with the AVR® DB Family

Introduction

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This application note outlines how to get started with the AVR® DB Family of microcontrollers.

Refer to the data sheet for further information on the differences between the AVR® DB Family devices.

Features Presented in this Document

- Getting Started with AVR® DB Family Microcontrollers and Tools
- Getting Started with AVR128DB48 Curiosity Nano and Atmel Studio 7.0
- Getting Started with AVR128DB48 Curiosity Nano and MPLAB® X
- Code Examples in Atmel START and GitHub

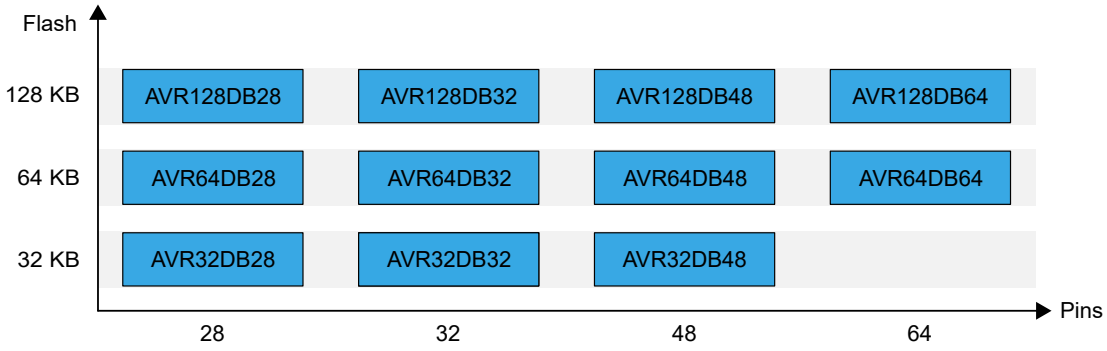
Table of Contents

1. Relevant Devices

This section lists the relevant devices for this document. The following figures show the different family 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
- Horizontal migration to the left reduces the pin count and, therefore, the available features
- Devices with different Flash memory sizes typically also have different SRAM and EEPROM

Figure 1-1. AVR® DB Family Overview



2. Get the Device Data Sheet

Product pages

- AVR32DB28: www.microchip.com/wwwproducts/en/AVR32DB28
- AVR32DB32: www.microchip.com/wwwproducts/en/AVR32DB32
- AVR32DB48: www.microchip.com/wwwproducts/en/AVR32DB48
- AVR64DB28: www.microchip.com/wwwproducts/en/AVR64DB28
- AVR64DB32: www.microchip.com/wwwproducts/en/AVR64DB32
- AVR64DB48: www.microchip.com/wwwproducts/en/AVR64DB48
- AVR64DB64: www.microchip.com/wwwproducts/en/AVR64DB64
- AVR128DB28: www.microchip.com/wwwproducts/en/AVR128DB28
- AVR128DB32: www.microchip.com/wwwproducts/en/AVR128DB32
- AVR128DB48: www.microchip.com/wwwproducts/en/AVR128DB48
- AVR128DB64: www.microchip.com/wwwproducts/en/AVR128DB64

Documents

- AVR DB Product Brief (.pdf)
- AVR128DB Data Sheet (.pdf)
- AVR128DB Silicon Errata and Data Sheet Clarifications (.pdf)

The documentation for the AVR® DB Family is split into two document types:

- Data sheet(1) (includes device description, number of peripherals, pinout and electrical characteristics)
- Errata (includes known errata for the device)

Note:

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

3. Relevant Documents

All relevant documents can be found under the documentation tab on the product page.

Below is a list of documents relevant to the AVR® DB Family Microcontrollers.

Table 3-1. Tech Briefs

Publication	GitHub Code Examples
TB3286 - Getting Started with Analog Signal Conditioning (OPAMP)	getting-started-with-opamp
TB3287 - Getting Started with Multi Voltage I/O (MVIO)	getting-started-with-mvio
TB3272 - Getting Started with High Frequency Crystal Oscillator (XOSCHF)	getting-started-with-xoschf

Table 3-2. Application Notes

Publication	GitHub Code Examples
AN3636 - Using the Internal OPAMP as Regulated Power Supply for MVIO	using-opamp-as-a-regulated-power-supply
AN3633 - Gain and Offset Calibration of the Analog Signal Conditioning (OPAMP) Peripheral	opamp-gain-and-offset-calibration
AN3632 - Constant-Current Driver Using the Analog Signal Conditioning (OPAMP) Peripheral	constant-current-driver-using-opamp
AN3631 - Low-BOM Microphone Interface Using the Analog Signal Conditioning (OPAMP) Peripheral	low-bom-mic-interface-using-opamp
AVR128DB CNANO OPAMP demo Firmware	cnano-opamp-demo-fw

Table 3-3. Opamp Model and MINDI Simulations

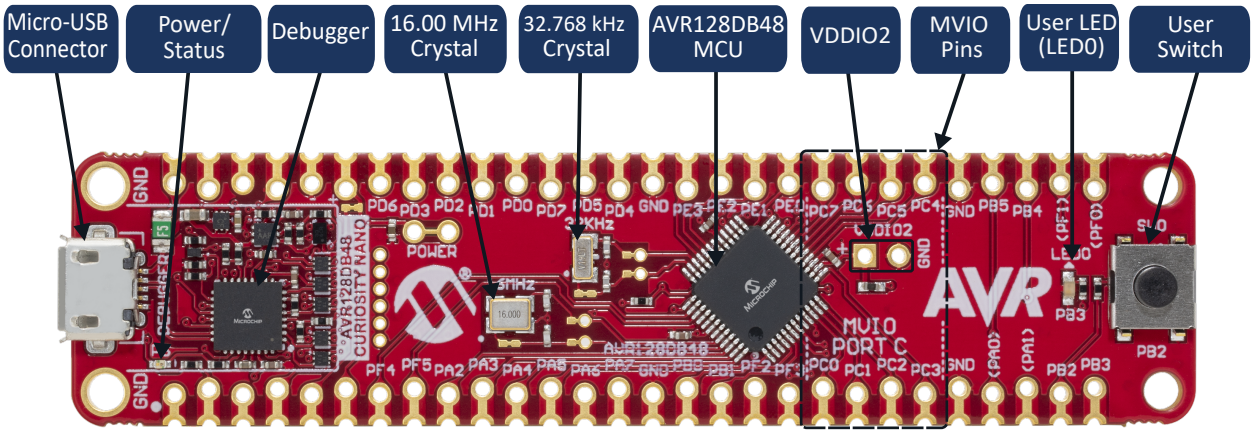
Opamp Models and MINDI® Schematics
avrdb-opamp-mindi-direct-connection
avrdb-opamp-mindi-voltage-follower
avrdb-opamp-mindi-non-inverting-pga
avrdb-opamp-mindi-inverting-pga
avrdb-opamp-mindi-integrator
avrdb-opamp-mindi-differential-amplifier
avrdb-opamp-mindi-dual-cascaded-non-inverting-pga
avrdb-opamp-mindi-dual-cascaded-inverting-pga
avrdb-opamp-mindi-triple-cascaded-non-inverting-pga
avrdb-opamp-mindi-triple-cascaded-inverting-pga
avrdb-opamp-mindi-instrumentation-amplifier

4. Get the Tools

Atmel Studio 7.0, which uses the GCC compiler, can be utilized as an IDE to get started with AVR® DB Family.

MPLAB® X, which uses the GCC or XC8 compiler, can be utilized as an IDE to get started with AVR® DB Family.

4.1 Get the AVR128DB48 Curiosity Nano Evaluation Kit



Web page: www.microchip.com/developmenttools/productdetails.aspx?partno=EV35L43A

Get the kit: www.microchipdirect.com/ProductSearch.aspx?Keywords=EV35L43A

Document/file:

- AVR128DB48 Curiosity Nano (.pdf)

Key Features

- AVR128DB48 Microcontroller
- One Yellow User LED
- One Mechanical User Switch
- Footprints for 32.768 kHz and 16.0 MHz Crystals
- On-Board Debugger:
  - Board identification in Atmel Studio/Microchip MPLAB® X
  - One green power and status LED
  - Programming and debugging
  - Virtual COM port (CDC)
  - Two logic analyzer channels (DGI GPIO)
- USB Powered
- Adjustable Target Voltage:
  - MIC5353 LDO regulator controlled by the on-board debugger
  - 1.8-5.1 V output voltage (limited by USB input voltage)
  - 500 mA maximum output current (limited by ambient temperature and output voltage)

The AVR128DB48 Curiosity Nano user guide covers how to power the kit and the detailed information on-board components, extension interface, and the hardware guide.

4.2 Get Code Examples from Atmel START

The code examples are available through Atmel START, which is a web-based tool that enables the configuration of the application code through a Graphical User Interface (GUI). The code can be downloaded for Atmel Studio

MPLAB X and IAR Embedded Workbench® via the direct example code link below or the **Browse Examples** button on the Atmel START front page.

The Atmel START webpage: Atmel START.

Code Examples

Finding code examples for devices in the AVR DB Family can be done by searching for the device name, e.g., AVR128DB48, 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 a `.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.

MPLAB® X

Download the code as an `.atzip` file for MPLAB X IDE from within Atmel START by clicking **Export project** followed by **Download pack**.

To open the Atmel START example in MPLAB X, select from the menu in MPLAB X, *File > Import > START MPLAB Project* and navigate to the `.atzip` file.

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.

4.3 Get Code Examples from GitHub

The code examples are available through GitHub, which is a web-based server that provides the application codes through a Graphical User Interface (GUI). The code examples can be opened in both Atmel Studio and MPLAB X. To open the Atmel Studio project in MPLAB X, select from the menu in MPLAB X, *File > Import > Atmel Studio Project* and navigate to `.cproj` file.

The GitHub webpage: GitHub.

Code Examples

Finding code examples for devices in the AVR DB Family can be done by searching for the device name, e.g., AVR128DB48, in the GitHub example browser.

Download the code as a `.zip` file from the example page on GitHub by clicking the **Clone** or **download** button.

4.4 Get Atmel Studio 7.0

Webpage: www.microchip.com/development-tools/atmel-studio-7

Document/file:

- Atmel Studio 7.0 Installer (.exe)

Atmel Studio 7.0 1.0.18 or later is the preferred IDE for developing and debugging firmware for the AVR® DB Family.

For device support, refer to 4.5 Get Device Support for Atmel Studio.

4.5 Get Device Support for Atmel Studio

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 the AVR® DB Family, update to the latest version by performing the following steps:

1. Click **Check for Updates**.
2. For AVR® DB Family, select the latest available version of *AVR-Dx_DFP*.
3. Click **Install**.

For offline installers, go to packs.download.atmel.com/. To install a package, double click on the installer file and follow the instructions. Any open Atmel Studio window 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.

4.6 Get MPLAB® X

Webpage: MPLAB® X IDE

Document/file:

- MPLAB X

MPLAB X can be utilized as an IDE for developing and debugging firmware for the AVR® DB Family.

For device support, refer to 4.7 Get Device Support for MPLAB X.

4.7 Get Device Support for MPLAB® X

MPLAB X: Support for new devices in MPLAB X can be added by using the *MPLAB Pack Manager*, which is found under *Tools → Packs*.

For the AVR® DB Family, update to the latest version by performing the following steps:

1. Click **Check for Updates**.
2. For the AVR® DB Family, select the latest available version of *AVR-Dx_DFP*.
3. Click **Install**.

For offline installers, go to packs.download.microchip.com/. To install a package, double click on the installer file and follow the instructions. Any open MPLAB X window will have to be closed for the installation to take effect.

4.8 Get MPLAB® Code Configurator

Webpage: MPLAB® Code Configurator

Document/file:

- MCC

MPLAB® Code Configurator can be utilized from within MPLAB® X IDE as a graphical programming interface that generates peripherals and libraries code for the AVR® DB Family.

4.9 Get IAR Embedded Workbench® for AVR®

Webpage: https://www.iar.com/iar-embedded-workbench/#!?architecture=AVR

Document/file: IAR Embedded Workbench installer for AVR®.

5. Atmel Studio Users Getting Started

5.1 Atmel Studio with AVR128DB48 Curiosity Nano

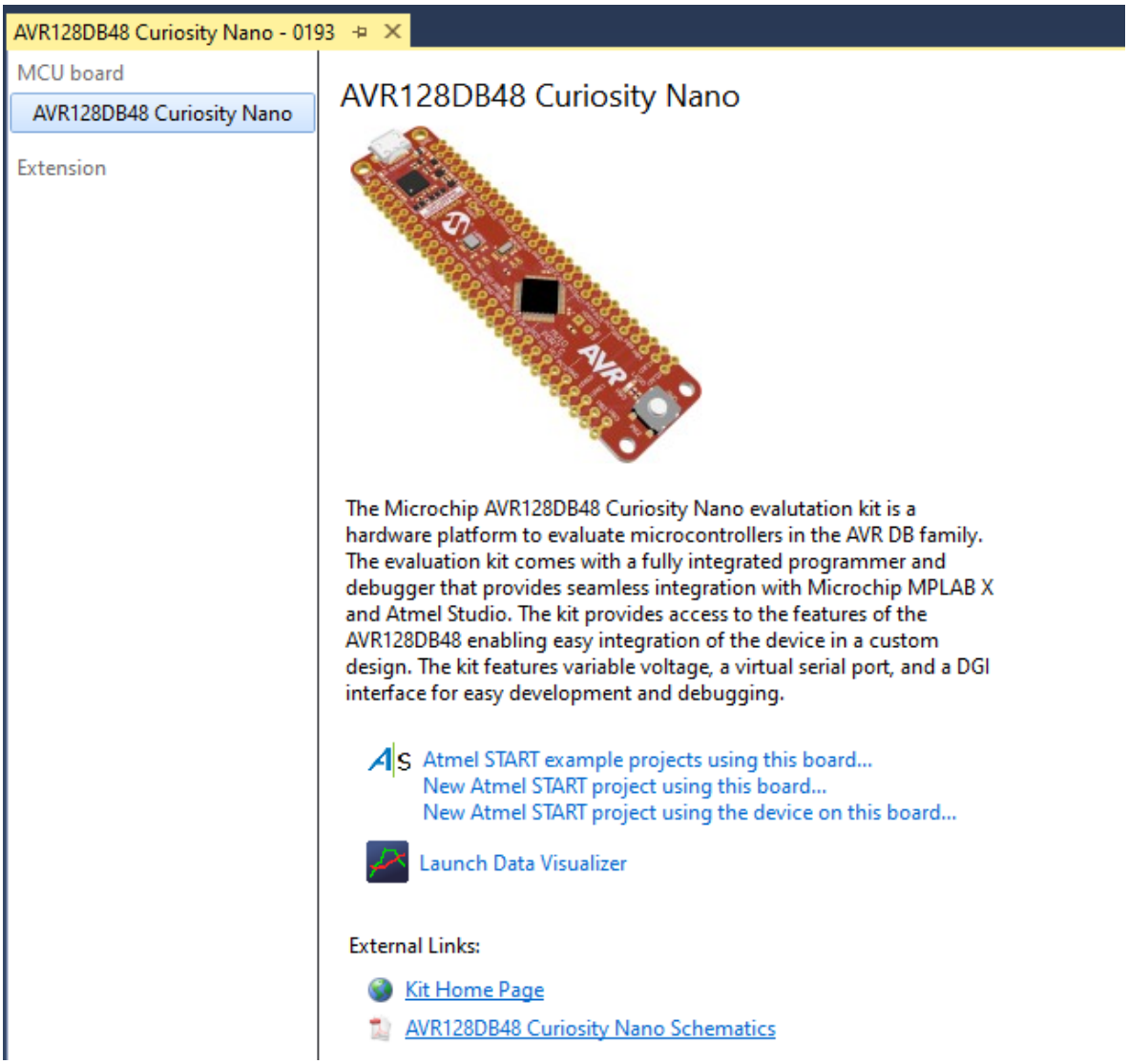
Prerequisites

- Atmel Studio 7.0.2397 or later installed
- The AVR128DB48 Curiosity Nano 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

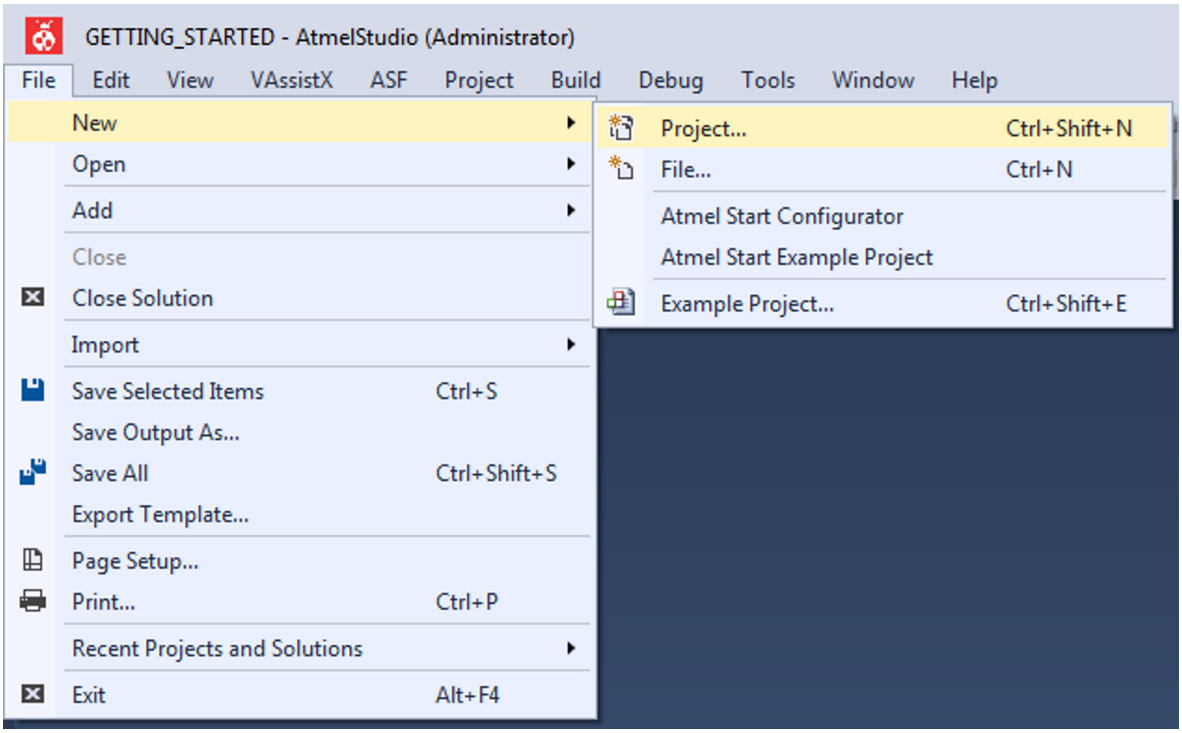
1. Launch Atmel Studio 7.0.
2. The page shown below will appear when AVR128DB48 Curiosity Nano is connected to Atmel Studio 7.0.

Figure 5-1. AVR128DB48 Curiosity Nano Page in Atmel Studio



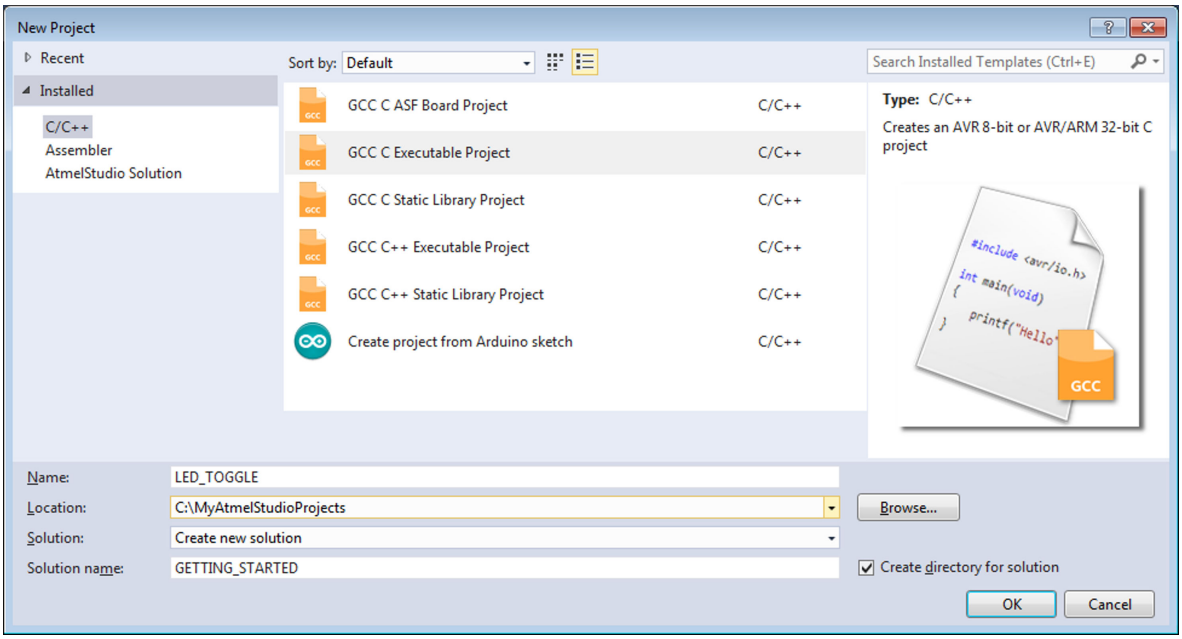
3. Start creating a new project by clicking **New** → **Project...** or by using **Ctrl+Shift+N** shortcut, as shown in Figure 5-2.

Figure 5-2. Create New Project in Atmel Studio



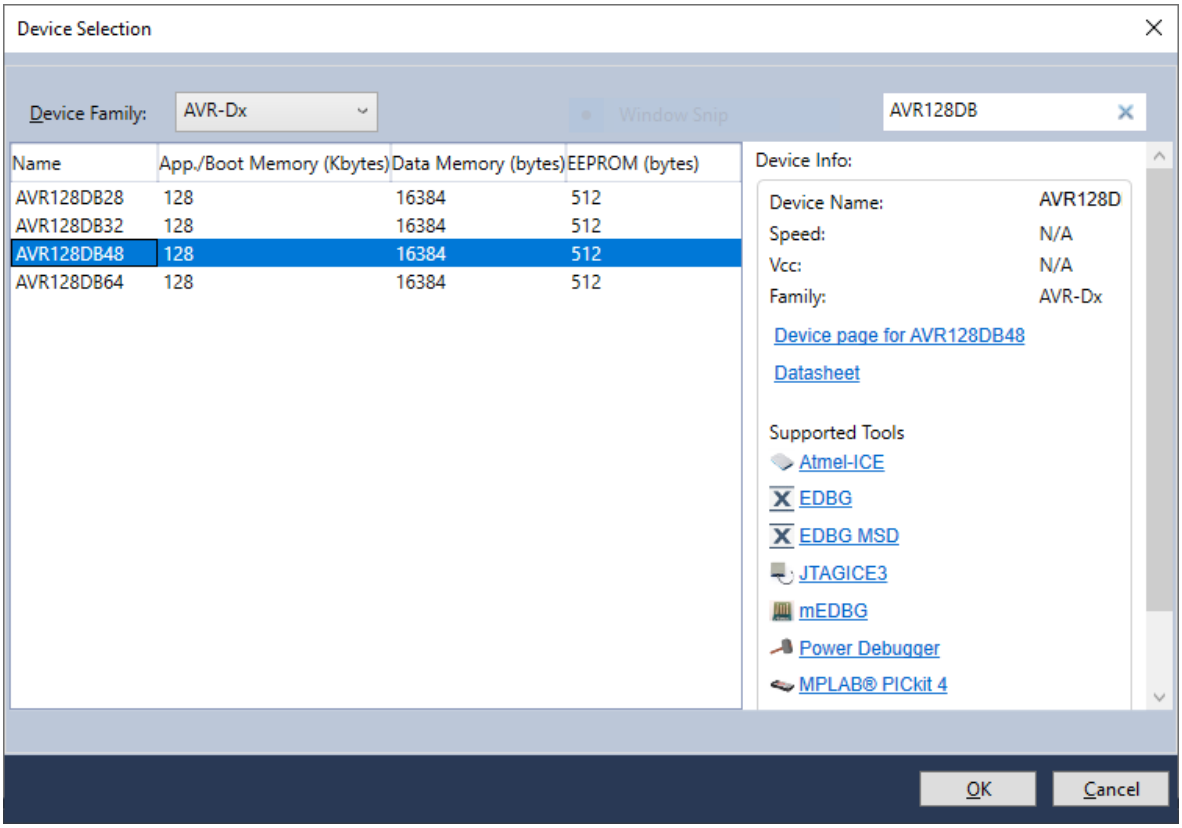
4. Select the **GCC C Executable Project** template, as shown in Figure 5-3, type in the name of the solution and project (e.g., *GETTING_STARTED* and *LED_TOGGLE*), and click **OK**.

Figure 5-3. New Project Wizard



5. Select AVR128DB48 as shown in Figure 5-4, and click **OK**.

Figure 5-4. Device Selection Wizard



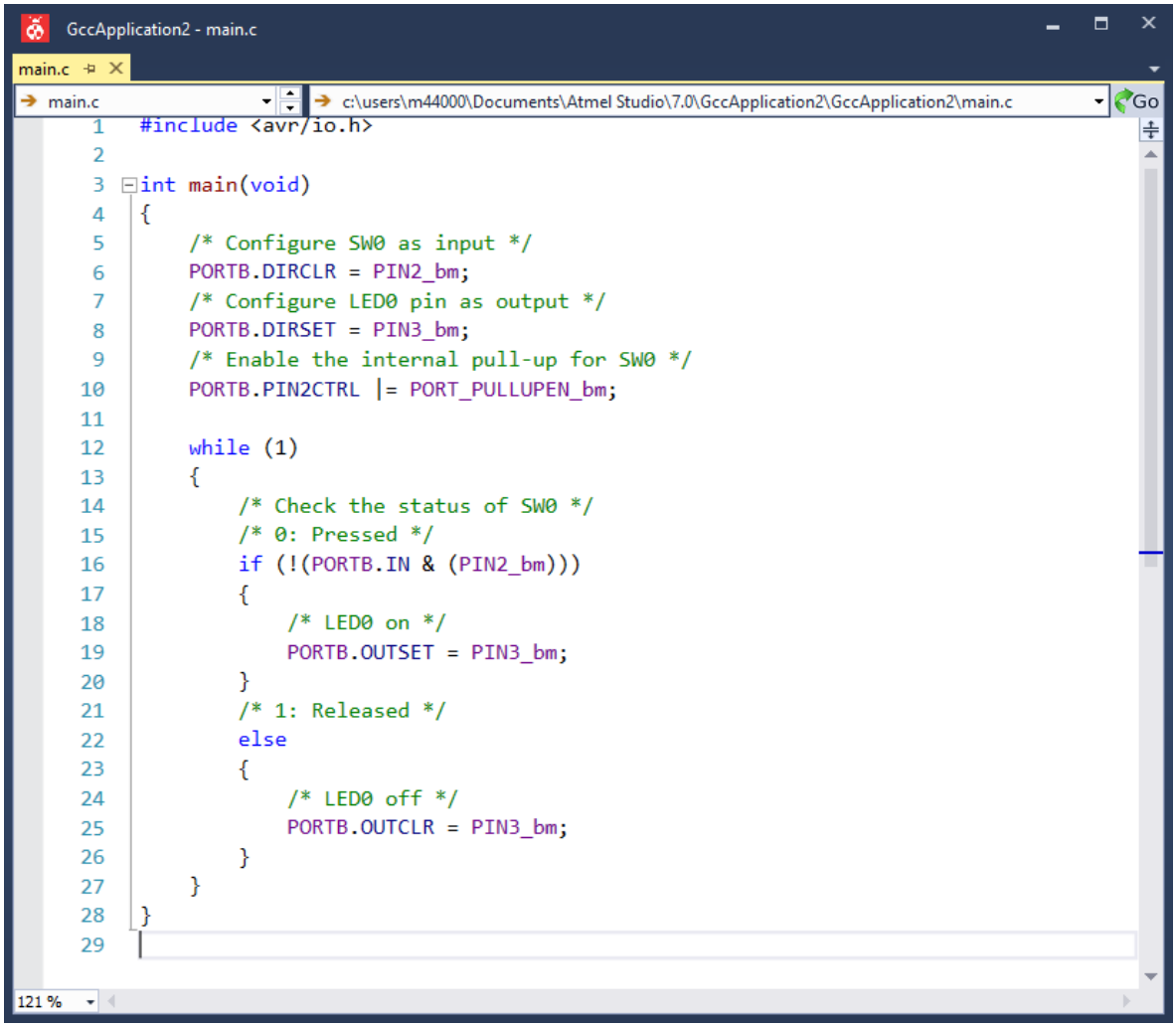
A new project with a `main.c` file associated will be generated in Atmel Studio.

6. Replace 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 = PIN3_bm;

  /* Enable the internal pull-up for SW0 */
  PORTB.PIN2CTRL |= PORT_PULLUPEN_bm;

  while (1)
  {
    /* Check the status of SW0 */
    /* 0: Pressed */
    if (!(PORTB.IN & (PIN2_bm)))
    {
      /* LED0  on */
      PORTB.OUTSET = PIN3_bm;
    }
    /* 1: Released */
    else
    {
      /* LED0 off */
      PORTB.OUTCLR = PIN3_bm;
    }
  }
}
```

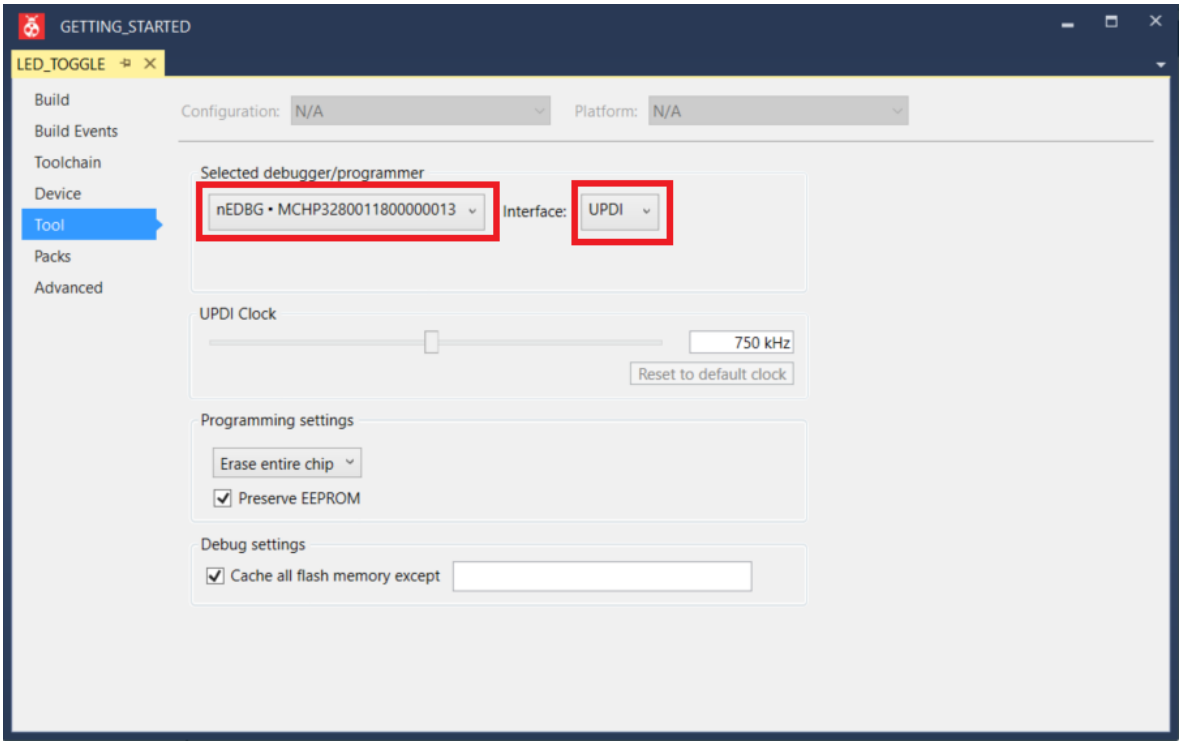
In the code editor, the code will appear, as shown in Figure 5-5.

Figure 5-5. Code Editor Window



7. Open project properties by clicking **Project** → **Properties** or by using the **ALT+F7** shortcut.
8. In the **Tool** view (see Figure 5-6), set *Selected debugger/programmer* to nEDBG and *Interface* to UPDI.

Figure 5-6. Debugger and Interface for AVR128DB48



9. Build the project by clicking **Build** → **Build Solution** or by using the **F7** shortcut.
10. Program AVR128DB48 with the project code and start debugging by clicking **Debug** → **Start debugging and break** or by using the **ALT+F5** shortcut. The application is programmed onto the device, and program execution will break in `main()` function.
11. Run the code by clicking **Debug** → **Continue** or by using the **F5** shortcut .
12. Verify that LED0 is lit when SW0 is pushed on the AVR128DB48 Curiosity Nano.

6. MPLAB® X Users Getting Started

6.1 MPLAB® X with AVR128DB48 Curiosity Nano

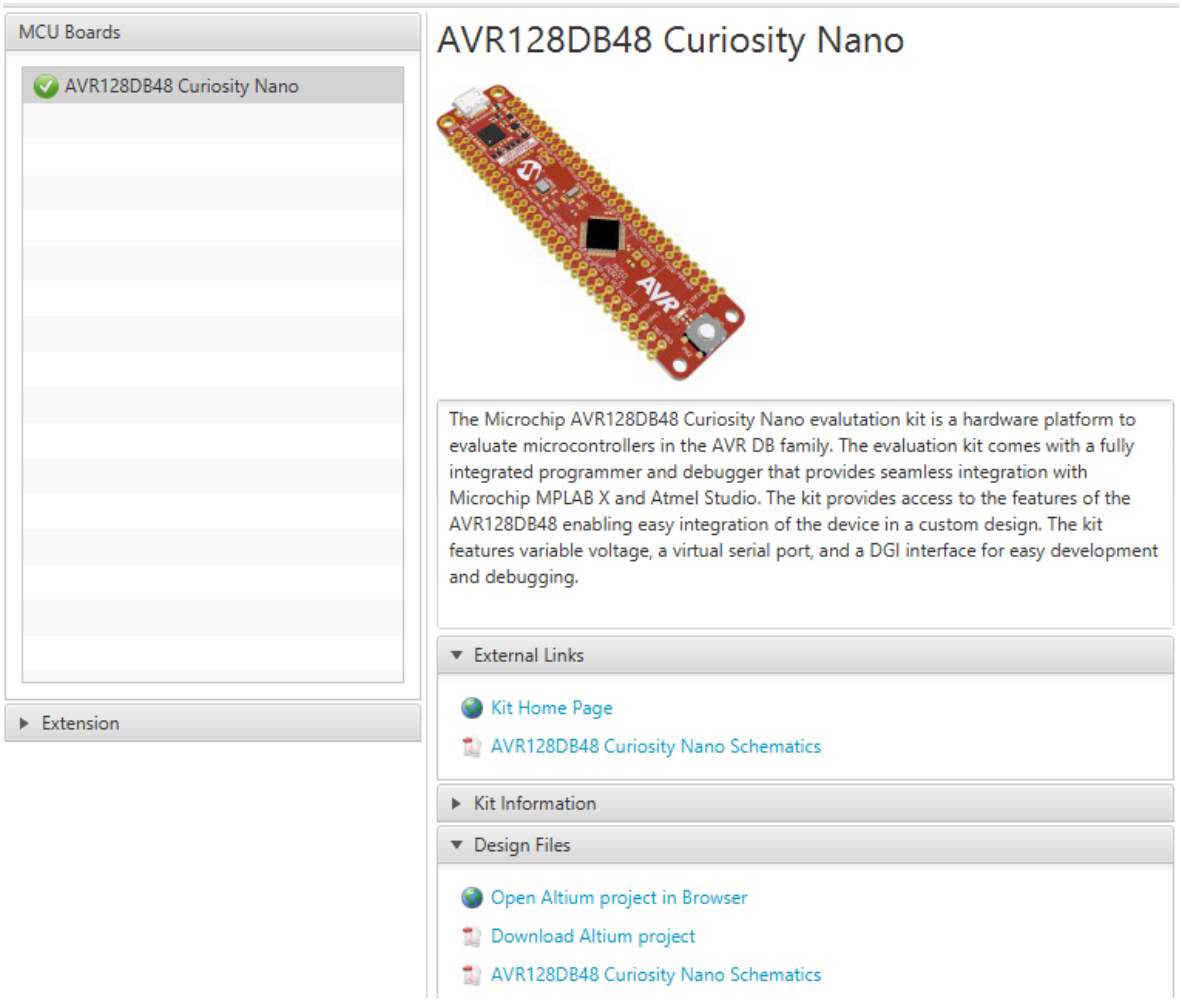
Prerequisites

- MPLAB X installed
- The AVR128DB48 Curiosity Nano Board connected to MPLAB X 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

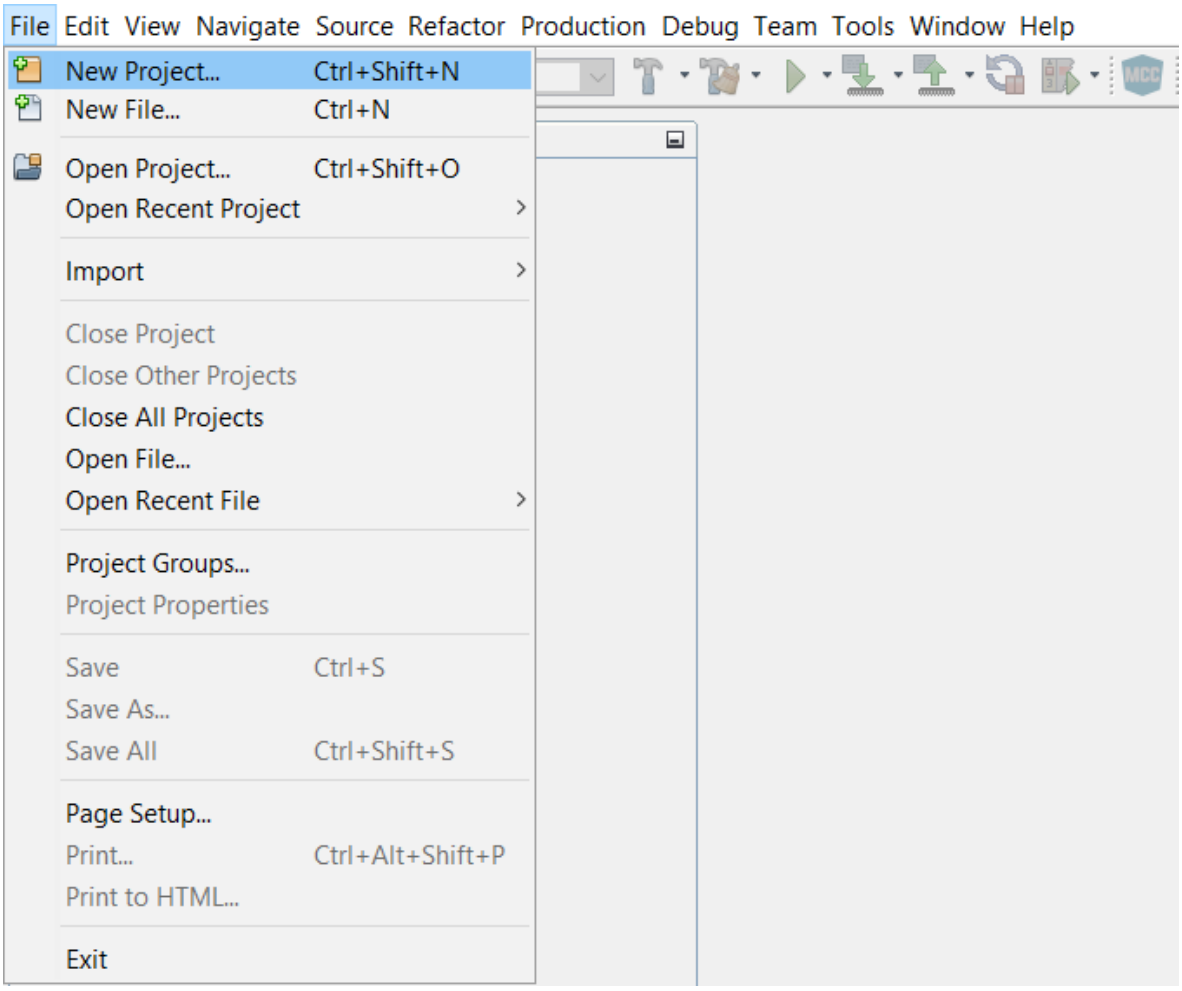
1. Launch MPLAB X.
2. The page shown in Figure 6-1 will appear when AVR128DB48 Curiosity Nano is connected to MPLAB X.

Figure 6-1. AVR128DB48 Curiosity Nano Page in MPLAB® X



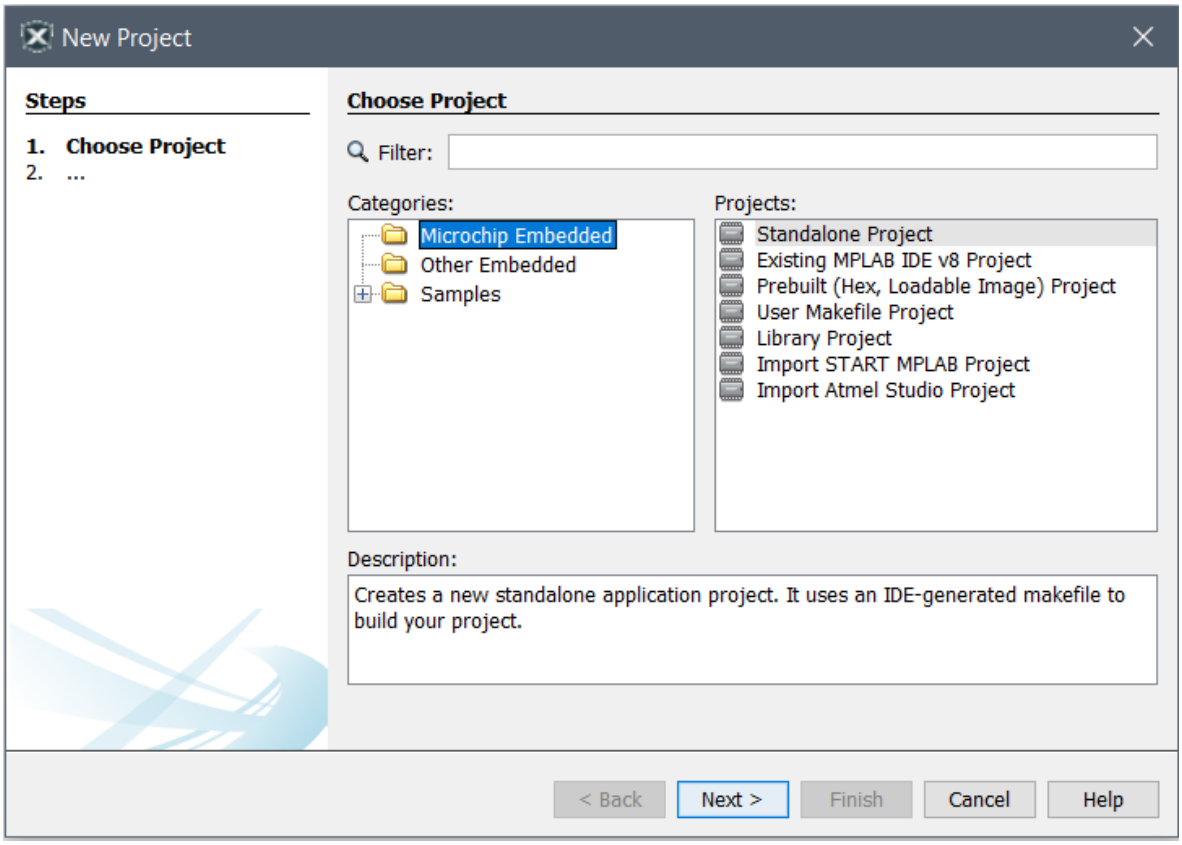
3. Start creating a new project by clicking **File** → **New Project...** or by using **Ctrl+Shift+N** shortcut, as shown in Figure 6-2.

Figure 6-2. Create New Project in MPLAB® X



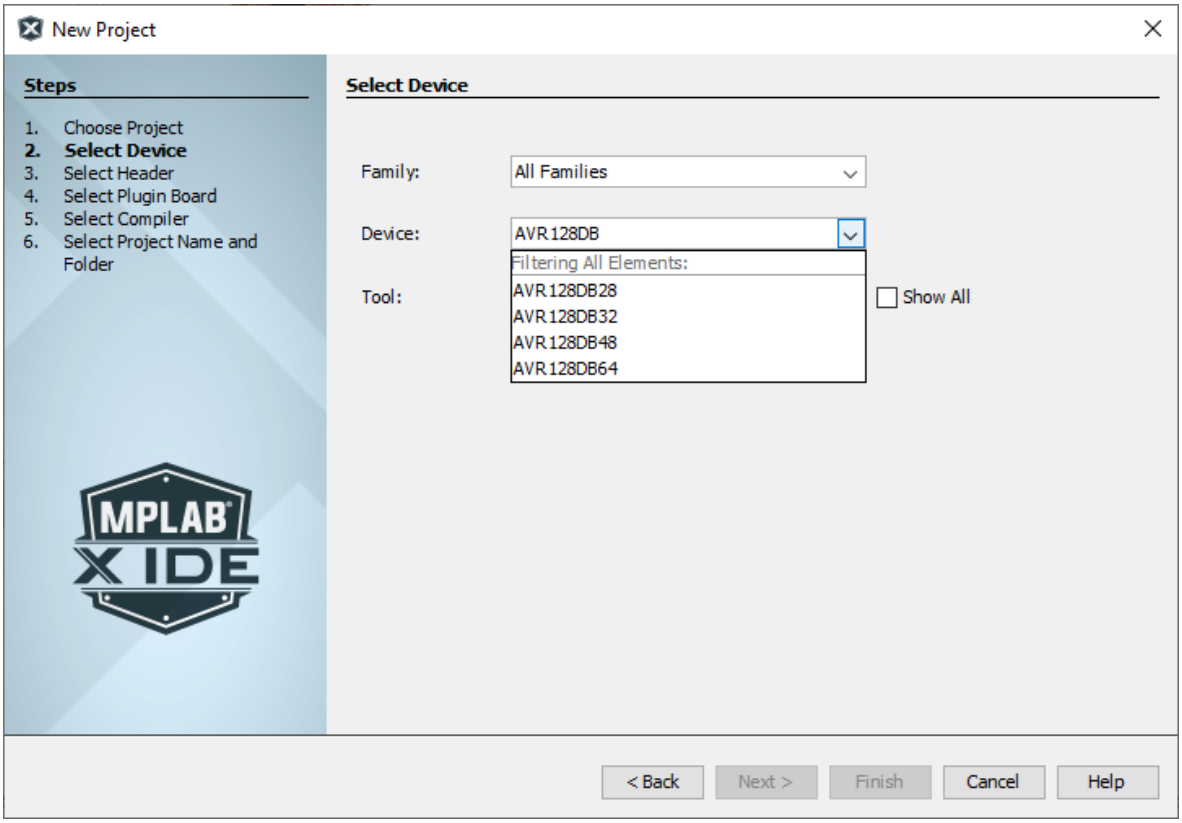
4. Select the **Categories** → **Microchip Embedded** and **Projects** → **Standalone Project** template from Figure 6-6, and click **Next**.

Figure 6-3. New Project Window



5. Select AVR128DB48 (see Figure 6-4) and click **Next**.

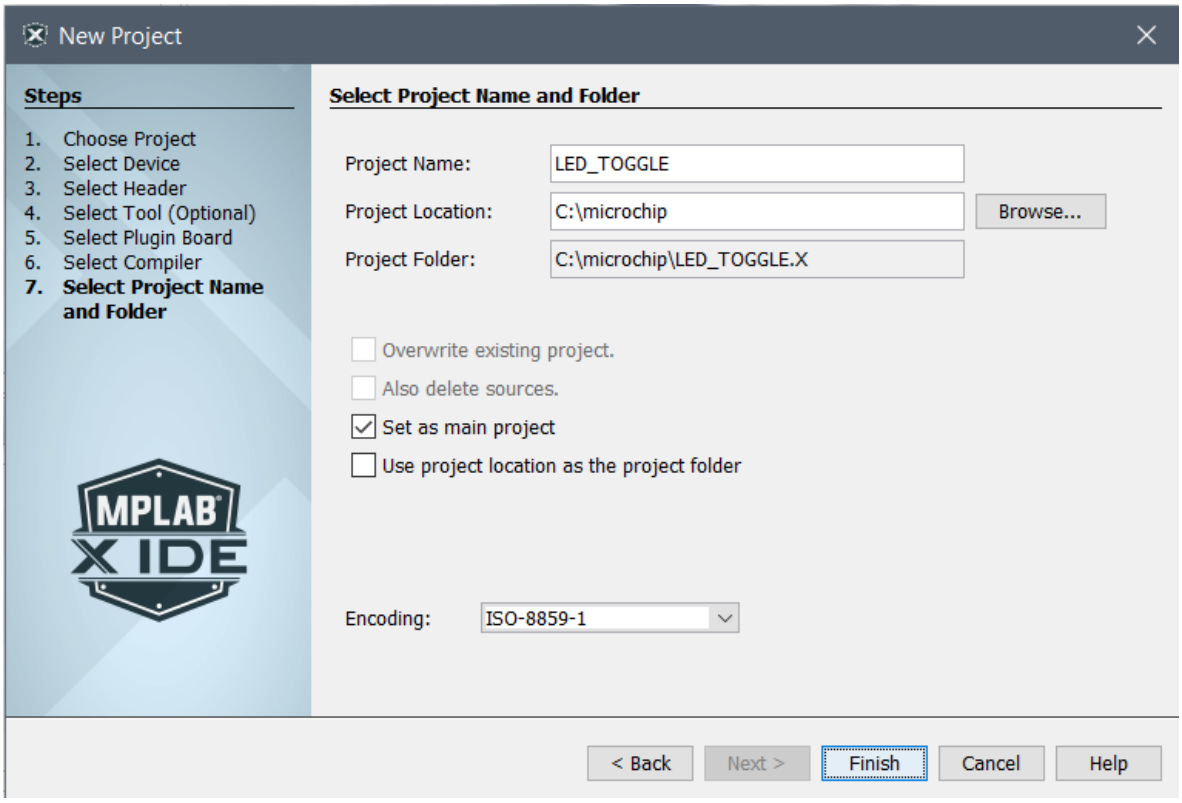
Figure 6-4. Device Selection Window



Then select the board and the desired compiler, if there are any.

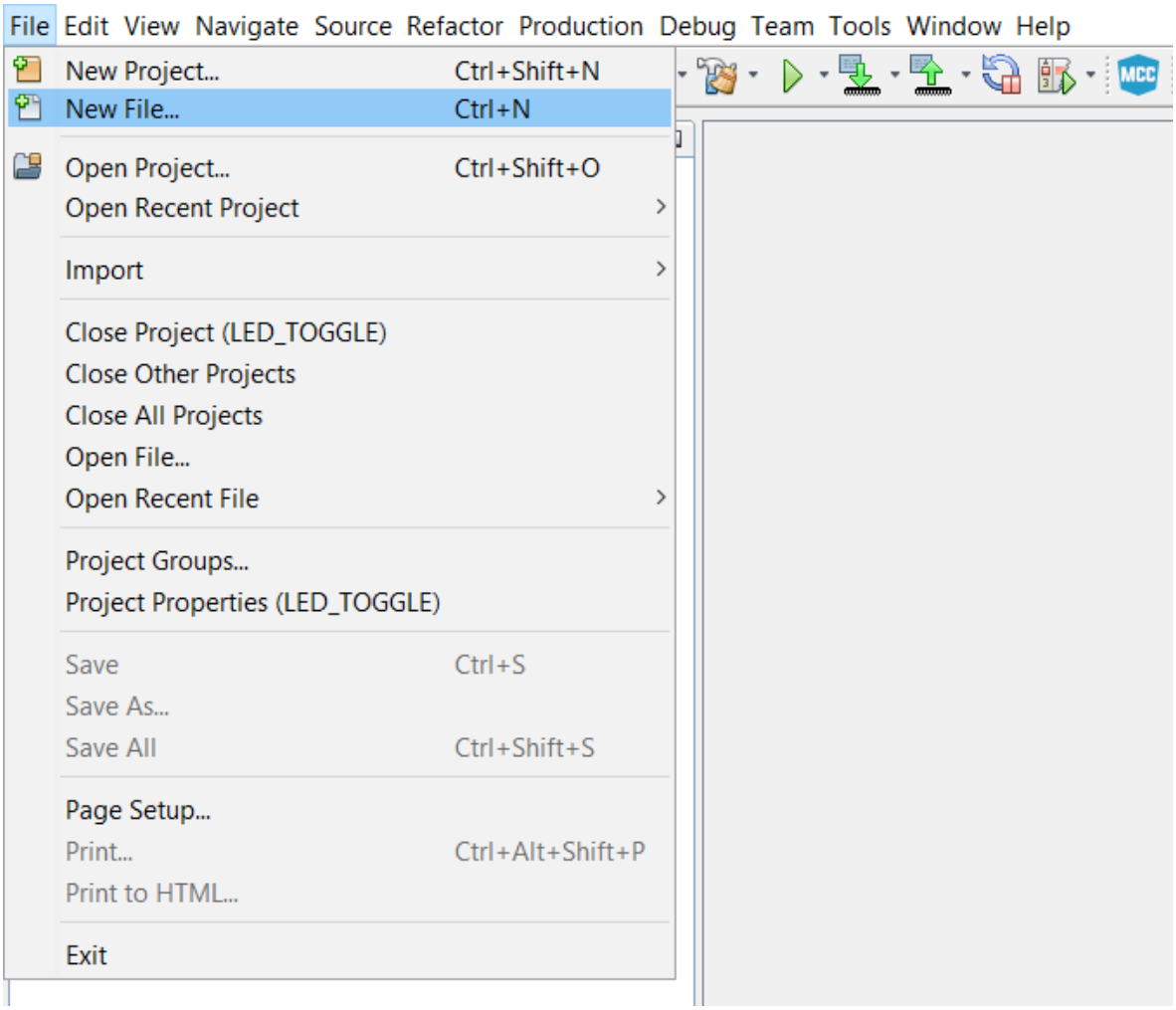
6. Type in the name of the project (e.g., *LED_TOGGLE*) and the project location (e.g., *C:\microchip*), and click **Finish**.

Figure 6-5. Project Name and Location Selection Window



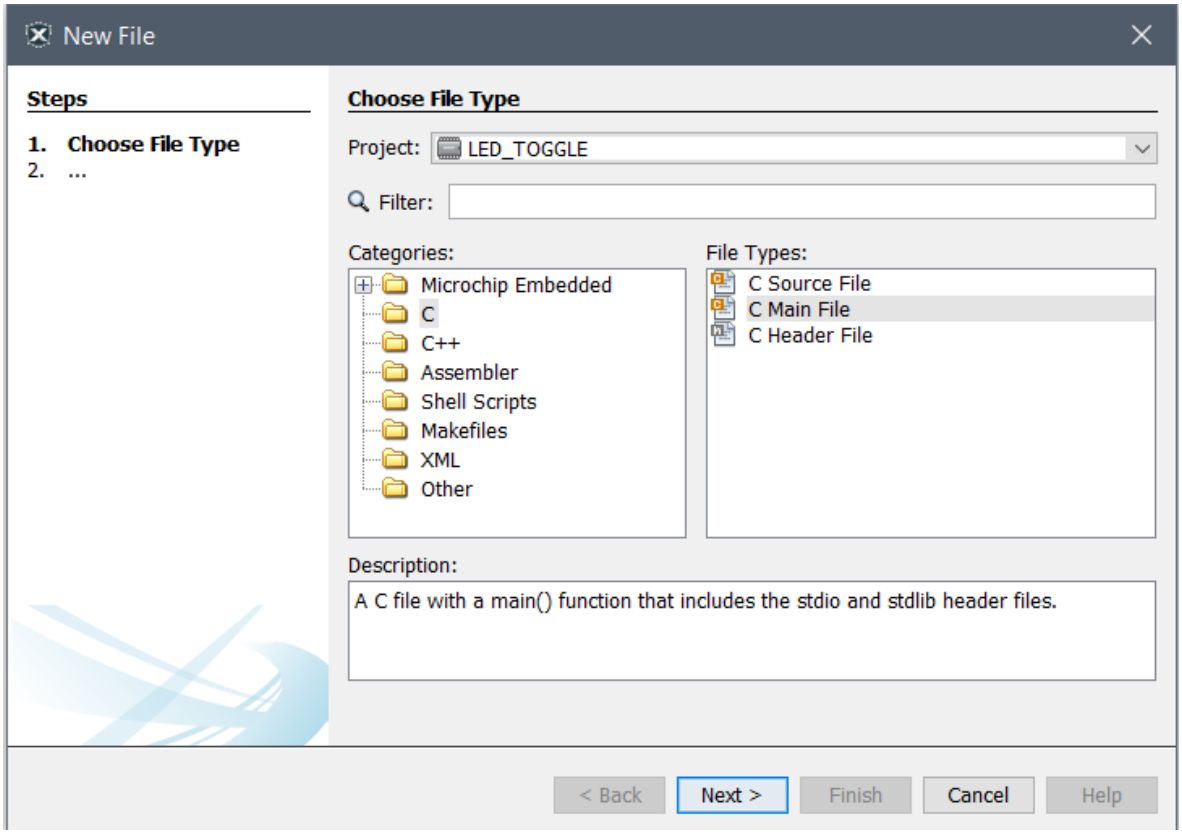
7. Create a new `main.c` file by clicking **File** → **New File...** or by using **Ctrl+N** shortcut, as shown in Figure 6-6.

Figure 6-6. Create a New File in MPLAB® X



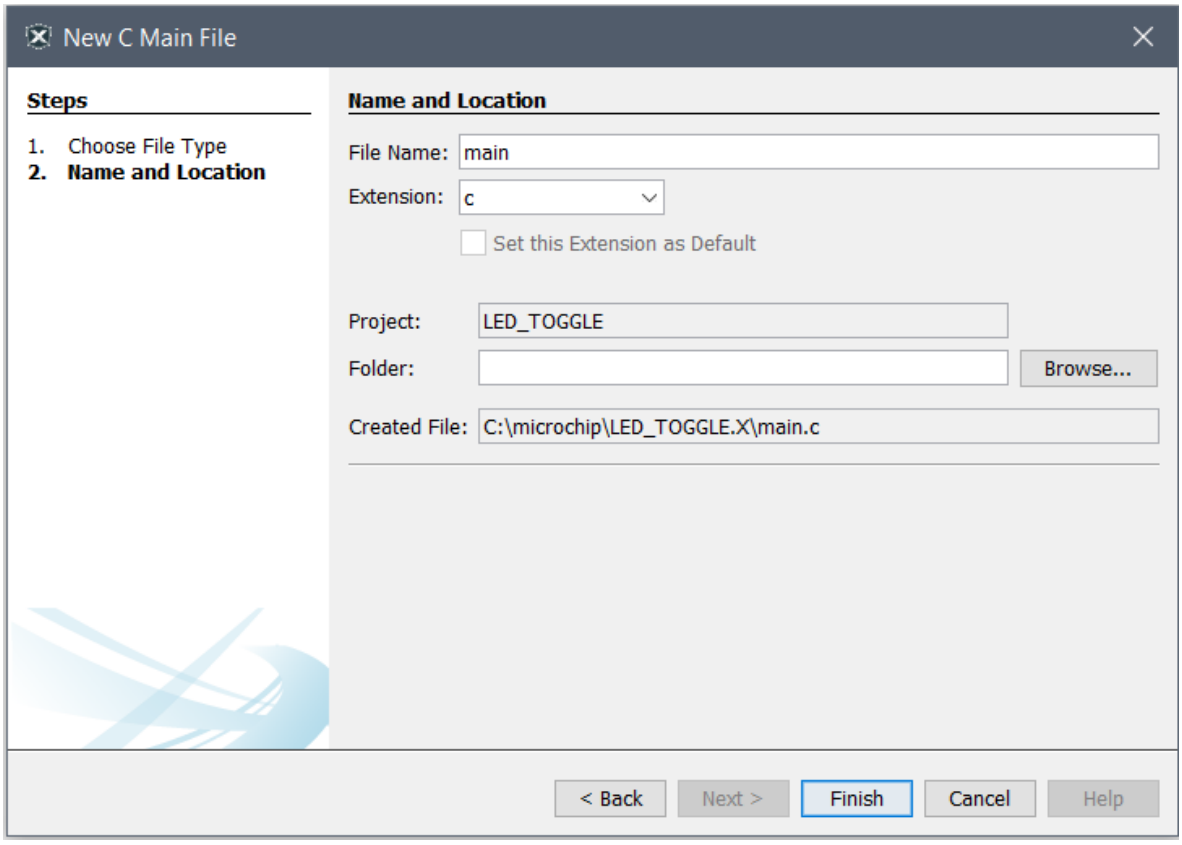
8. Select the **Categories** → **C** and **File Types** → **C Main File** template from Figure 6-7, and click **Next**.

Figure 6-7. New File Window



9. Type in the name of the file (e.g., *main*) and click **Finish**.

Figure 6-8. File Name Window

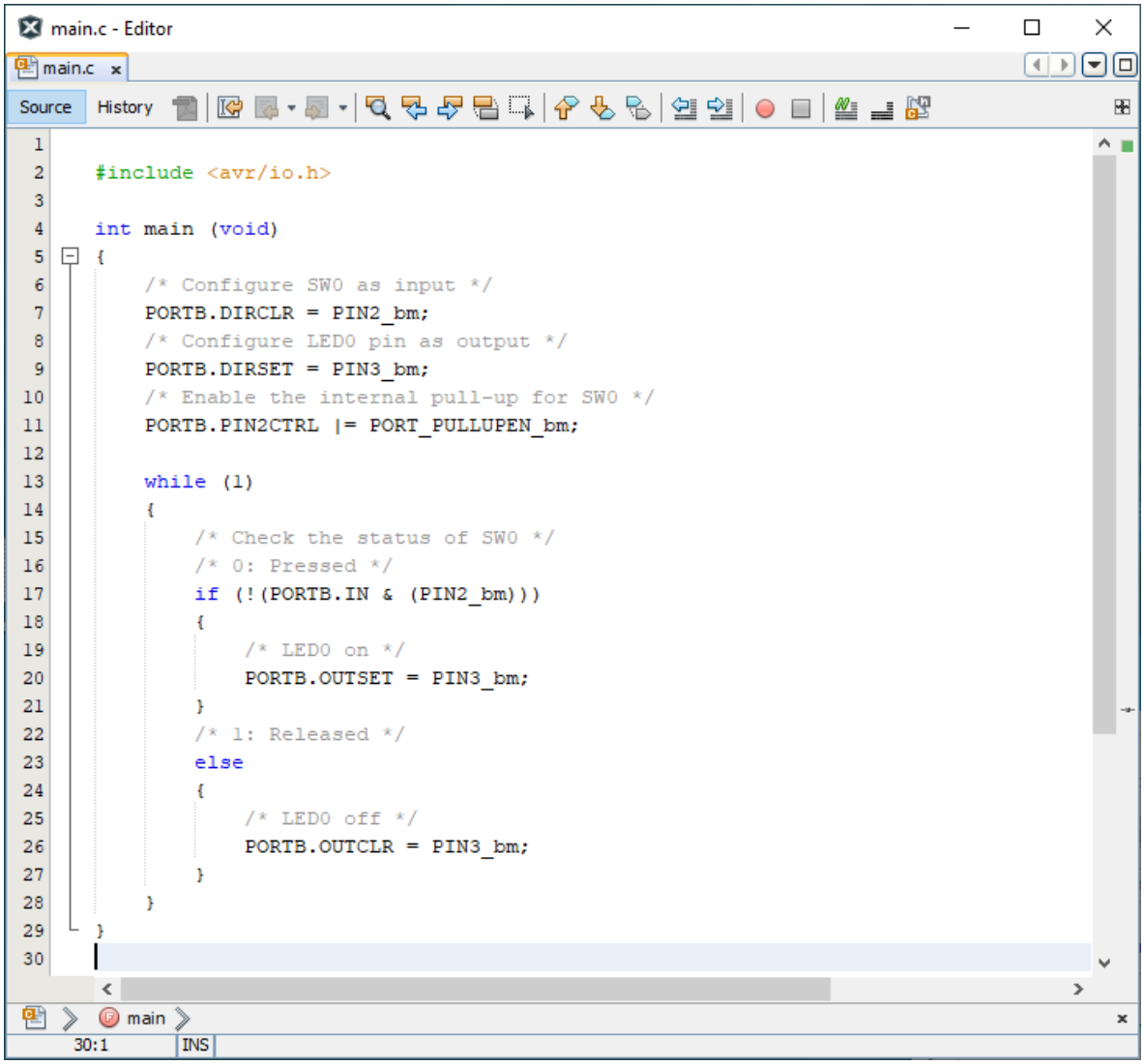


10. Replace the `main.c` file with the following code snippet:

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

  /* Configure LED0 pin as output */
  PORTB.DIRSET = PIN3_bm;

  /* Enable the internal pull-up for SW0 */
  PORTB.PIN2CTRL |= PORT_PULLUPEN_bm;

  while (1)
  {
    /* Check the status of SW0 */
    /* 0: Pressed */
    if (!(PORTB.IN & (PIN2_bm)))
    {
      /* LED0  on */
      PORTB.OUTSET = PIN3_bm;
    }
    /* 1: Released */
    else
    {
      /* LED0 off */
      PORTB.OUTCLR = PIN3_bm;
    }
  }
}
```

Add `#inlude<avr/io.h>` in main.c. In the code editor, the code will appear as shown in Figure 6-9.

Figure 6-9. Code Editor Window



11. Build the code by clicking on **Production → Clean and Build Main Project** or by using the **Shift + F11** shortcut.
12. Program AVR128DB48 with the project code and start debugging by clicking **Debug → Debugging Main Project**.
13. Verify that LED0 is lit when SW0 is pushed on the AVR128DB48 Curiosity Nano.

7. What's Next

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

Software:

- Atmel Studio
- Atmel Studio help: **Help** → **View Help** (shortcut **CTRL+F1**)
- Microchip Gallery
- MPLAB X
- IAR Embedded Workbench for AVR :www.iar.com/iar-embedded-workbench/#!?architecture=AVR

Firmware:

- Atmel START documentation
- Atmel START examples
- GitHub examples

Hardware:

- AVR042: AVR Hardware Design Considerations
- AVR IBIS files
- AVR BDSL files

Recommended Programming/Debugging Tools:

- Atmel-ICE:
  - User Guide
  - Buy
- Power Debugger:
  - User Guide
  - Buy
- MPALB Snap:
  - Buy
- MPLAB PICkit® 4:
  - Buy

Other:

- AVR Freaks®: www.avrfreaks.net/
- Application notes: 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: www.microchip.com/paramChartSearch/chart.aspx?branchID=30047
- More technical documentation concerning various products: https://www.microchip.com/webdoc
- Microchip Technical Support: www.microchip.com/support/hottopics.aspx

8. Revision History

Doc. Rev.	Date	Comments
B	09/2020	Added Tech Brief and App Note numbers and fixed typo in link to "Using the Internal OPAMP as Regulated Power Supply for MVIO"
A	09/2020	Initial document release

The Microchip Website

Microchip provides online support via our website at www.microchip.com/. This website is used to make files and information easily available to customers. Some of the content available includes:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip design partner program member listing
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Microchip's product change notification service helps keep customers current on Microchip products. Subscribers will receive email notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, go to www.microchip.com/pcn and follow the registration instructions.

Customer Support

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Embedded Solutions Engineer (ESE)
- Technical Support

Customers should contact their distributor, representative or ESE for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in this document.

Technical support is available through the website at: 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 specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods being used in attempts to breach the code protection features of the Microchip devices. We believe that these methods require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Attempts to breach these code protection features, most likely, cannot be accomplished without violating Microchip's intellectual property rights.
- Microchip is willing to work with any customer who is concerned about the integrity of its code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "unbreakable." Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

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