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## Getting Started with the AVR<sup>®</sup> DD Family

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### Introduction

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This application note outlines how to get started with the AVR<sup>®</sup> DD Family of microcontrollers.

Refer to the data sheet for further information on the differences between the AVR<sup>®</sup> DD Family devices.

### Features Presented in this Document

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- Getting Started with AVR<sup>®</sup> DD Family Microcontrollers and Tools
- Getting Started with AVR64DD32 Curiosity Nano and Microchip Studio 7.0
- Getting Started with AVR64DD32 Curiosity Nano and MPLAB<sup>®</sup> X
- Code Examples in GitHub

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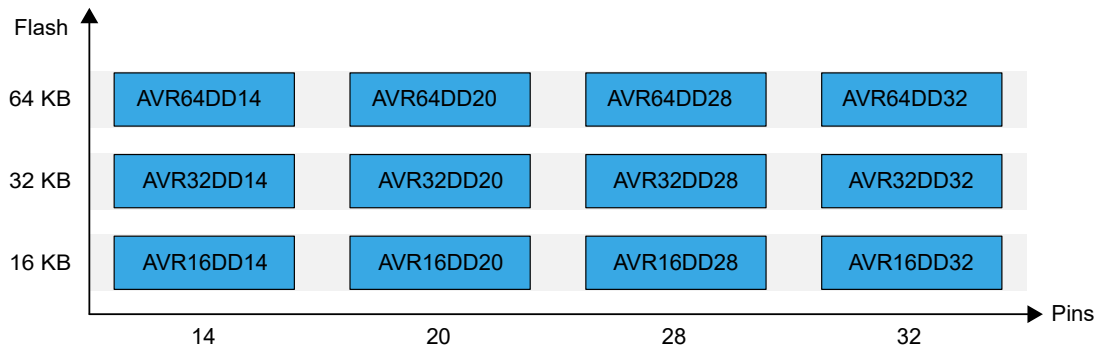
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## 1. Relevant Devices

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<sup>®</sup> DD Family Overview**



## 2. Get the Device Data Sheet

### Product pages

- AVR16DD14: [www.microchip.com/en-us/product/avr16dd14](http://www.microchip.com/en-us/product/avr16dd14)
- AVR16DD20: [www.microchip.com/en-us/product/avr16dd20](http://www.microchip.com/en-us/product/avr16dd20)
- AVR16DD28: [www.microchip.com/en-us/product/avr16dd28](http://www.microchip.com/en-us/product/avr16dd28)
- AVR16DD32: [www.microchip.com/en-us/product/avr16dd32](http://www.microchip.com/en-us/product/avr16dd32)
- AVR32DD14: [www.microchip.com/en-us/product/avr32dd14](http://www.microchip.com/en-us/product/avr32dd14)
- AVR32DD20: [www.microchip.com/en-us/product/avr32dd20](http://www.microchip.com/en-us/product/avr32dd20)
- AVR32DD28: [www.microchip.com/en-us/product/avr32dd28](http://www.microchip.com/en-us/product/avr32dd28)
- AVR32DD32: [www.microchip.com/en-us/product/avr32dd32](http://www.microchip.com/en-us/product/avr32dd32)
- AVR64DD14: [www.microchip.com/en-us/product/avr64dd14](http://www.microchip.com/en-us/product/avr64dd14)
- AVR64DD20: [www.microchip.com/en-us/product/avr64dd20](http://www.microchip.com/en-us/product/avr64dd20)
- AVR64DD28: [www.microchip.com/en-us/product/avr64dd28](http://www.microchip.com/en-us/product/avr64dd28)
- AVR64DD32: [www.microchip.com/en-us/product/avr64dd32](http://www.microchip.com/en-us/product/avr64dd32)

### Documents

- [AVR DD Product Brief \(.pdf\)](#)
- [AVR64DD28/32 Data Sheet \(.pdf\)](#)
- [AVR64DD28/32 Silicon Errata and Data Sheet Clarifications \(.pdf\)](#)
- [AVR64DD14/20 Data Sheet \(.pdf\)](#)
- [AVR64DD14/20 Silicon Errata and Data Sheet Clarifications \(.pdf\)](#)
- [AVR16/32DD28/32 Data Sheet \(.pdf\)](#)
- [AVR16/32DD28/32 Silicon Errata and Data Sheet Clarifications \(.pdf\)](#)
- [AVR16/32DD14/20 Data Sheet \(.pdf\)](#)
- [AVR16/32DD14/20 Silicon Errata and Data Sheet Clarifications \(.pdf\)](#)

The documentation for the AVR<sup>®</sup> DD Family is split into two document types:

- Data sheet<sup>(1)</sup> (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® DD Family Microcontrollers.

**Table 3-1. Tech Briefs**

Publication	GitHub Code Examples
<a href="#">TB3287 - Getting Started with Multi Voltage I/O (MVIO)</a>	<a href="#">getting-started-with-mvio</a>
<a href="#">TB3272 - Getting Started with High Frequency Crystal Oscillator (XOSCHF)</a>	<a href="#">getting-started-with-xoschf</a>

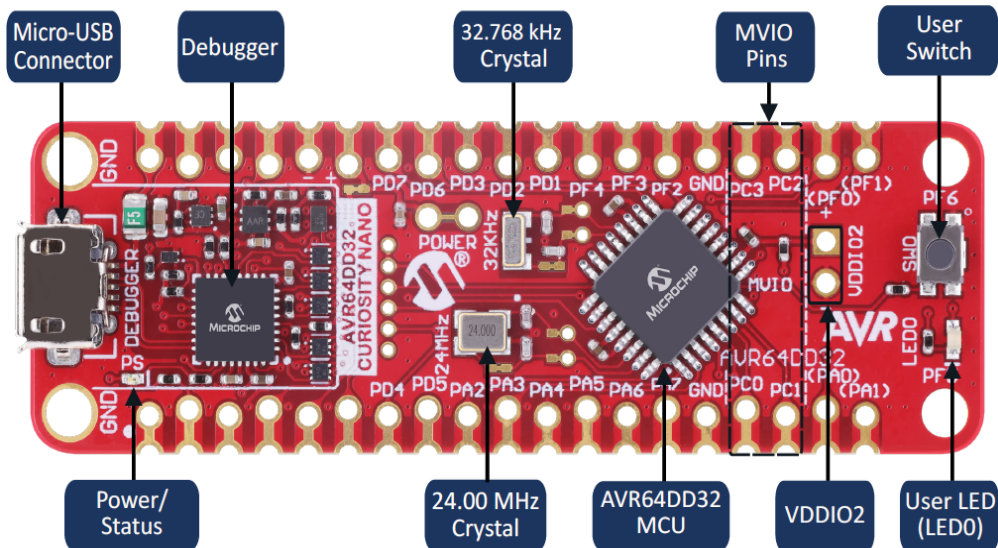
**Table 3-2. Code Examples**

GitHub Code Example
<a href="#">Getting Started Applications</a>
<a href="#">Curiosity Nano Out-of-the-Box Application</a>
<a href="#">Quadrature Decoder</a>
<a href="#">Button Matrix Driver</a>
<a href="#">Pin Multiplexing Applications</a>
<a href="#">Using USART in RS485 Mode</a>
<a href="#">Neopixel Application</a>

## 4. Get the Tools

Microchip Studio 7.0, which uses the GCC compiler, can be utilized as an IDE to get started with AVR® DD Family. MPLAB® X, which uses the GCC or XC8 compiler, can be utilized as an IDE to get started with AVR® DD Family.

### 4.1 Get the AVR64DD32 Curiosity Nano Evaluation Kit



**Web page:** [www.microchip.com/en-us/development-tool/EV72Y42A](http://www.microchip.com/en-us/development-tool/EV72Y42A)

**Get the kit:** [www.microchipdirect.com/dev-tools/EV72Y42A?allDevTools=true](http://www.microchipdirect.com/dev-tools/EV72Y42A?allDevTools=true)

**Document/file:**

- AVR64DD32 Curiosity Nano (.pdf)

**Key Features**

- AVR64DD32 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 Microchip Studio/ 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 AVR64DD32 Curiosity Nano user guide covers how to power the kit and the detailed information on-board components, extension interface, and the hardware guide.

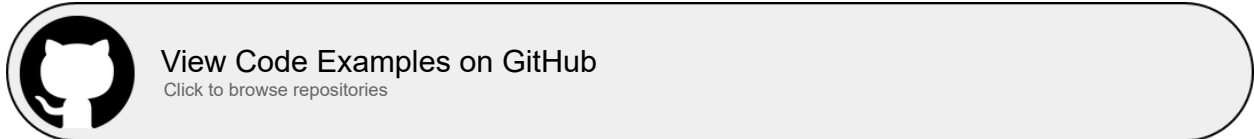
### 4.2 Get Code Examples from GitHub

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

The GitHub webpage: [GitHub](#).

#### Code Examples

Finding code examples for devices in the AVR DD Family can be done by searching for the device name, e.g., AVR64DD32, 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.

### 4.3 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® DD Family.

For device support, refer to [4.4. Get Device Support for MPLAB X](#).

### 4.4 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® DD Family, update to the latest version by performing the following steps:

1. Click **Check for Updates**.
2. For the AVR® DD Family, select the latest available version of *AVR-Dx\_DFP*.
3. Click **Install**.

For offline installers, go to [packs.download.microchip.com/](https://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.

### 4.5 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® DD Family.

### 4.6 Get Microchip Studio 7.0

Webpage: [Microchip Studio](#)

**Document/file:**

- Microchip Studio for AVR and SAM Devices 7.0 Installer (.exe)

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

For device support, refer to [4.7. Get Device Support for Microchip Studio](#).

## 4.7 Get Device Support for Microchip Studio

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

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

1. Click **Check for Updates**.
2. For AVR® DD Family, select the latest available version of *AVR-Dx\_DFP*.
3. Click **Install**.

For offline installers, go to [packs.download.atmel.com/](https://packs.download.atmel.com/). To install a package, double click on the installer file and follow the instructions. Any open Microchip 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 pack. The service pack is available at *My Pages* on <https://iar.com> (*MyPages* is available for users with registered IAR™ licenses, using the same email address that was used to register the license).

## 4.8 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. MPLAB® X Users Getting Started

### 5.1 MPLAB® X with AVR64DD32 Curiosity Nano

#### Prerequisites

- MPLAB X installed

#### Workflow

1. Launch MPLAB X.
2. The page shown in [Figure 5-1](#) will appear when AVR64DD32 Curiosity Nano is connected to MPLAB X.

**Figure 5-1. AVR64DD32 Curiosity Nano Page in MPLAB® X**

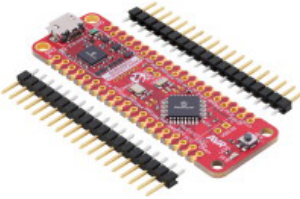
MCU Boards

- ✓ AVR64DD32 Curiosity Nano
- 
- 
- 
- 
- 
- 
- 
- 
- 

Extension

- None
- 
- 
- 
-

### AVR64DD32 Curiosity Nano



The Microchip AVR64DD32 Curiosity Nano evaluation kit is a hardware platform to evaluate microcontrollers in the AVR DD family. The evaluation kit comes with a fully integrated programmer and debugger that provides seamless integration with Microchip MPLAB X and Microchip Studio. The kit provides access to the features of the AVR64DD32 enabling easy integration of the device in a custom design. The kit features variable voltage, a virtual serial port, and a DGI interface for easy development and debugging.

External Links

- [AVR64DD32 Code Examples on GitHub](#)
- [AVR64DD32 Curiosity Nano Out-of-the-Box Code](#)
- [AVR64DD32 Curiosity Nano Hardware User Guide](#)
- [Kit Home Page](#)
- [AVR64DD32 Curiosity Nano Schematics](#)
- [AVR64DD32 Datasheet](#)

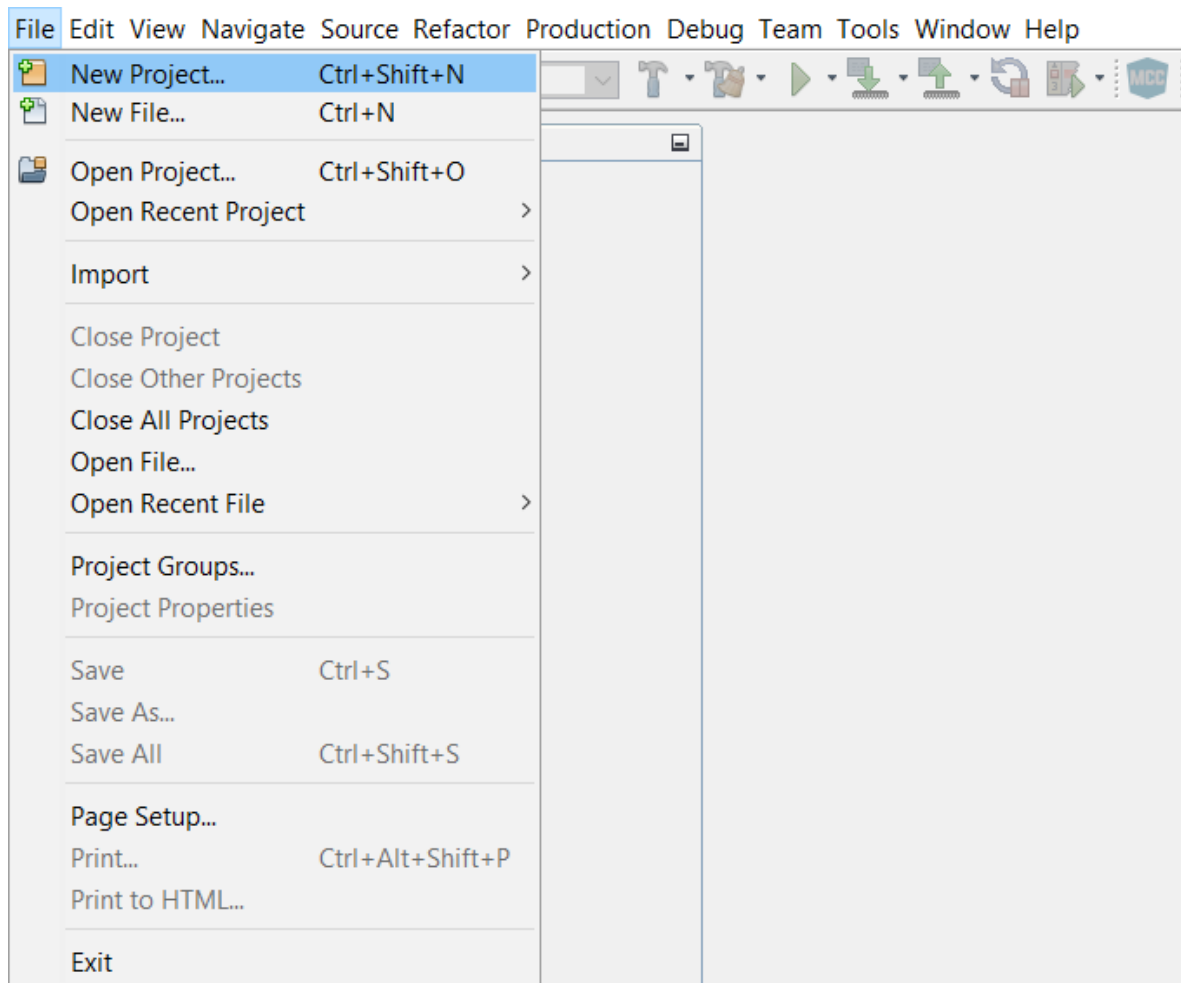
Kit Information

Design Files

- [Open Altium project in Browser](#)
- [Download Altium project](#)
- [AVR64DD32 Curiosity Nano Schematics](#)
- [Manufacturing documentation](#)

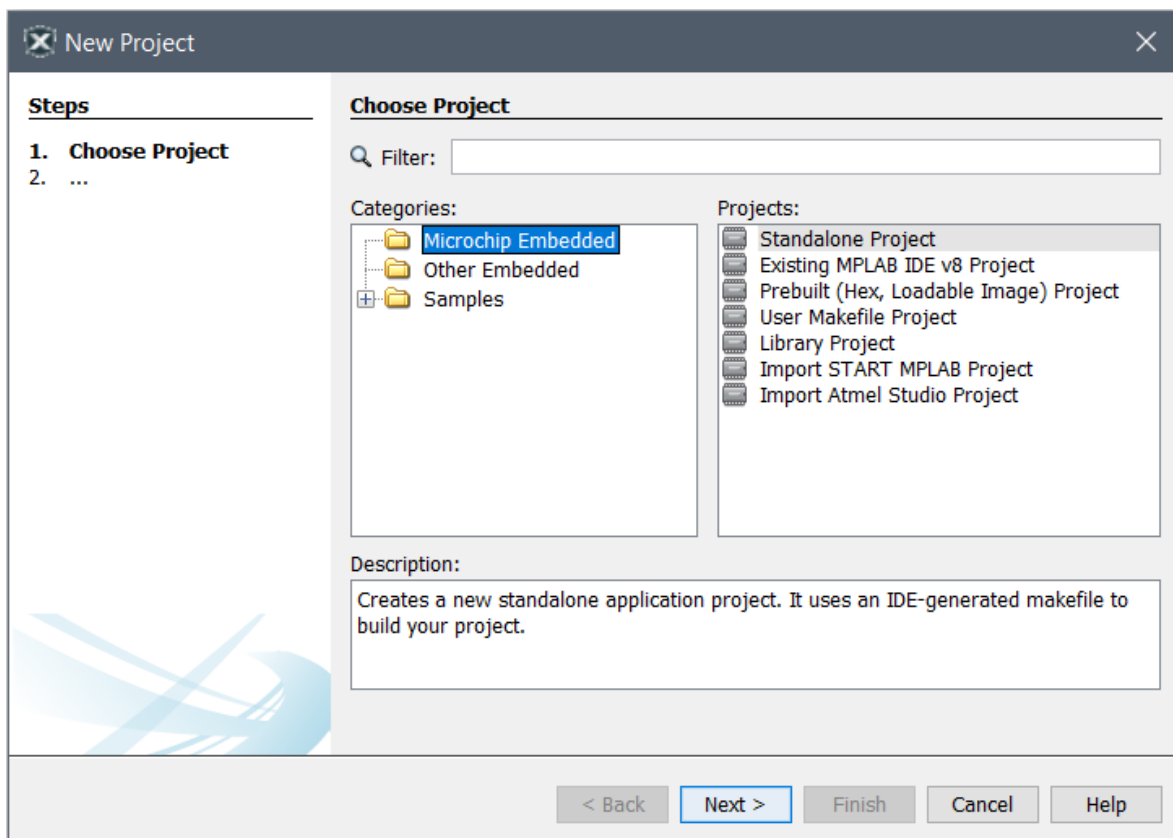
3. Start creating a new project by clicking **File** → **New Project...** or by using the **Ctrl+Shift+N** shortcut, as shown in [Figure 5-2](#).

Figure 5-2. Create New Project in MPLAB® X



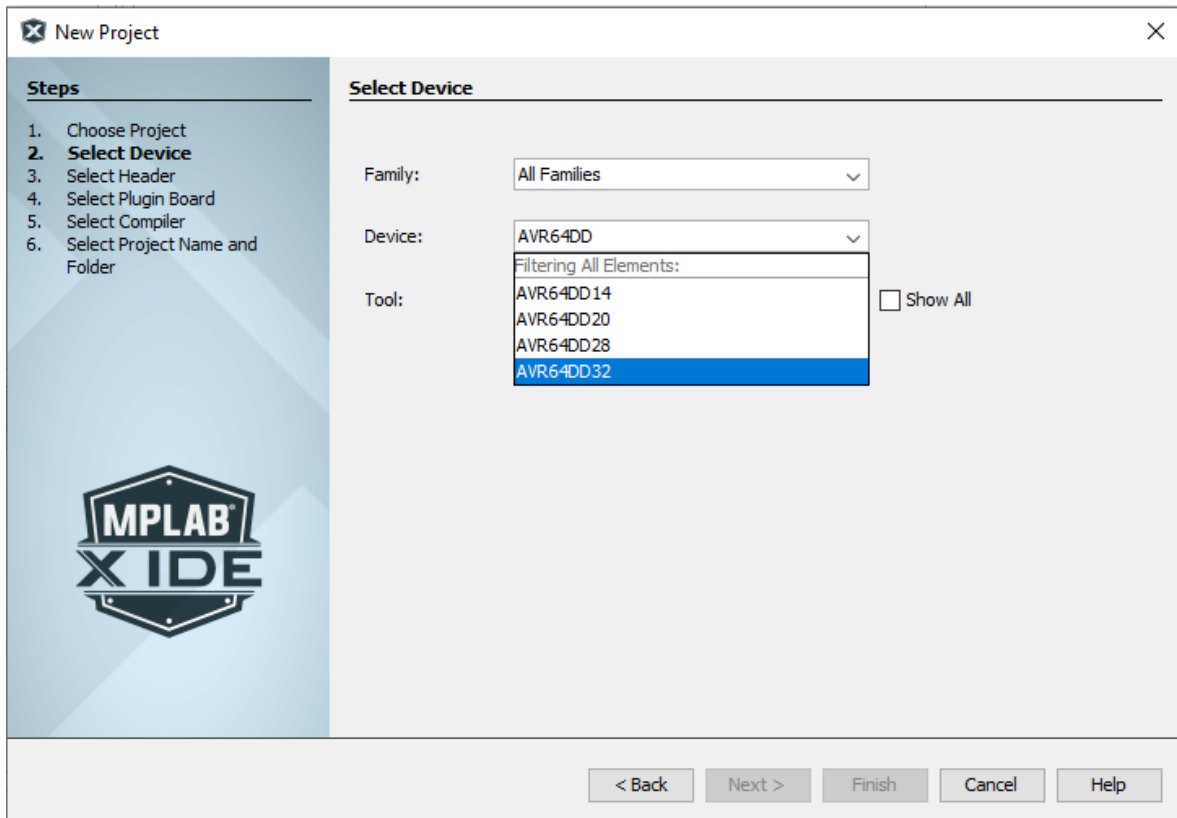
4. Select the **Categories** → **Microchip Embedded** and **Projects** → **Standalone Project** template from [Figure 5-6](#), and click **Next**.

Figure 5-3. New Project Window



5. Select AVR64DD32 (see [Figure 5-4](#)) and click **Next**.

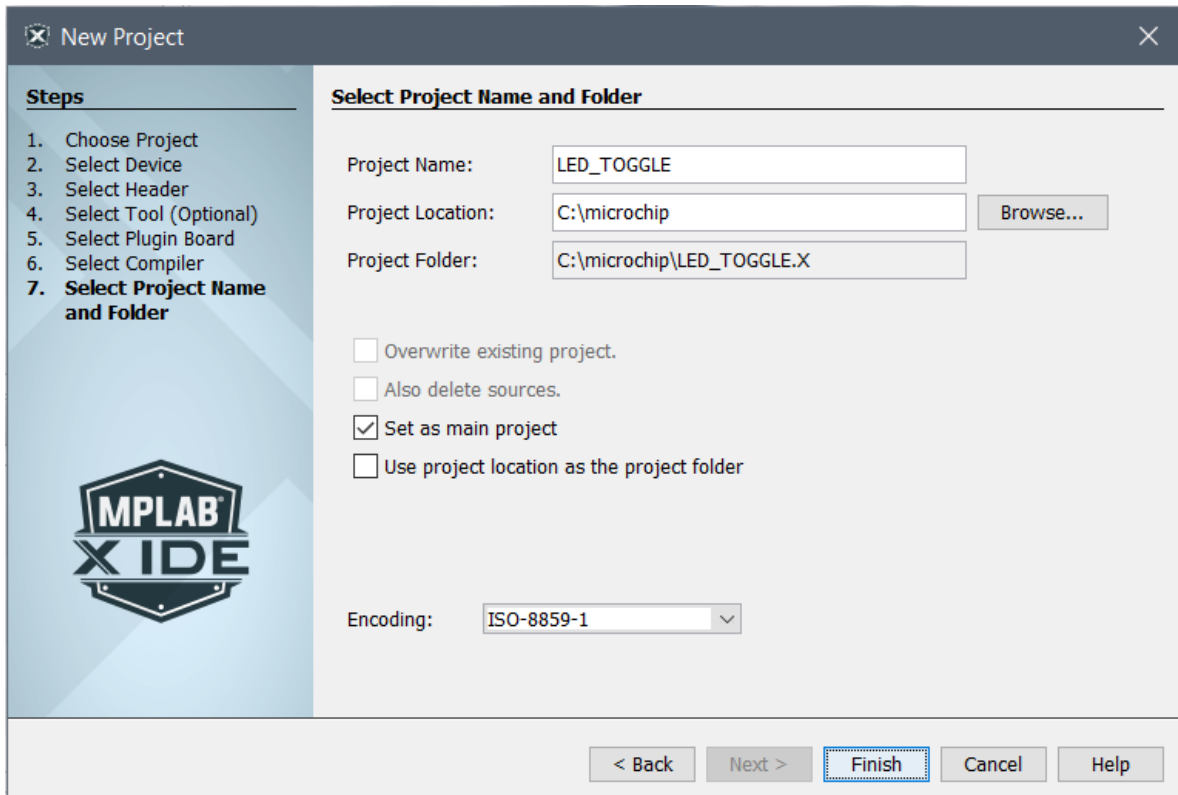
Figure 5-4. Device Selection Window



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

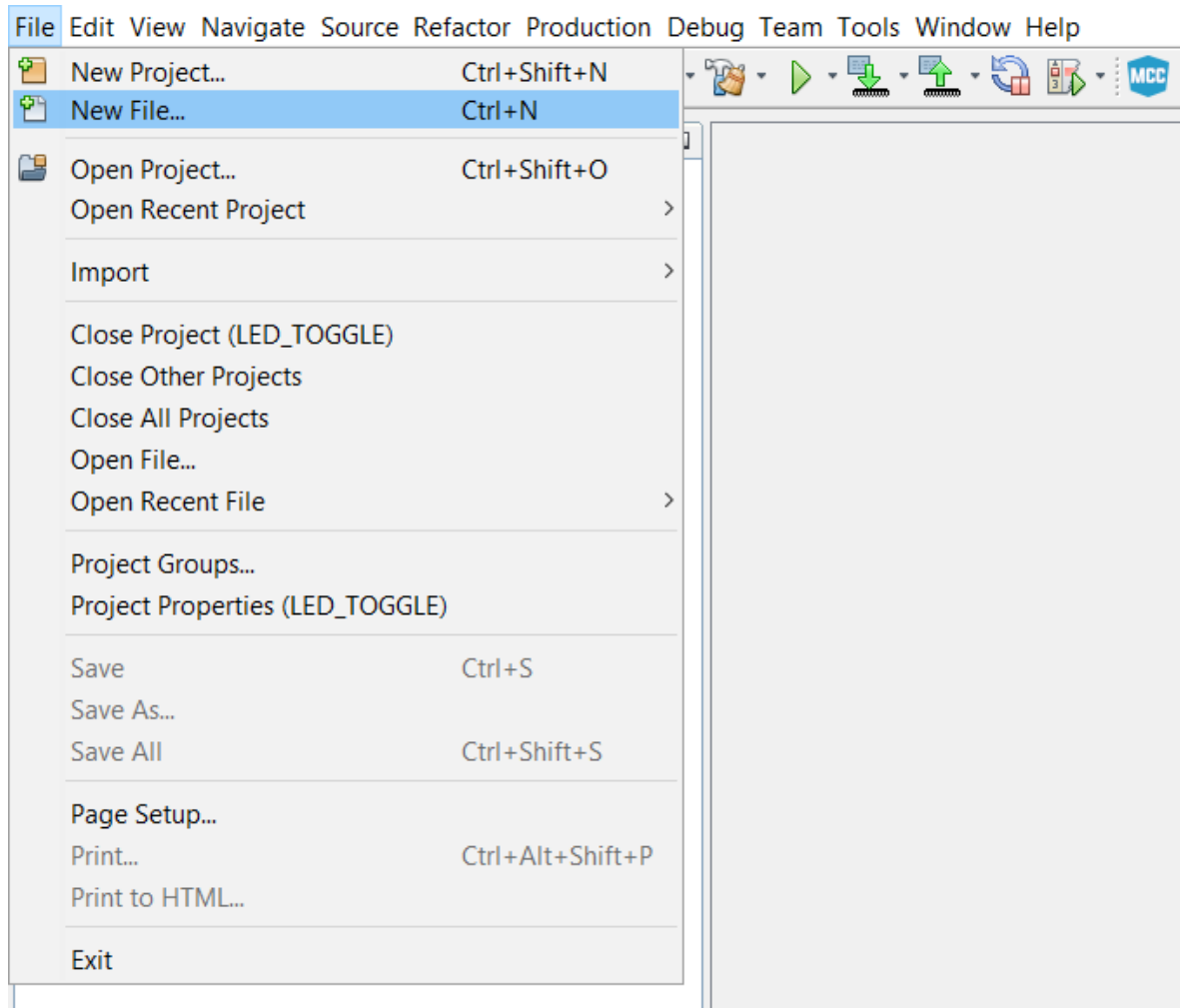
6. Type in the name of the project (e.g., *LED\_TOGGLE*) and the project location (e.g., *C:\microchip*), and click **Finish**.

Figure 5-5. Project Name and Location Selection Window



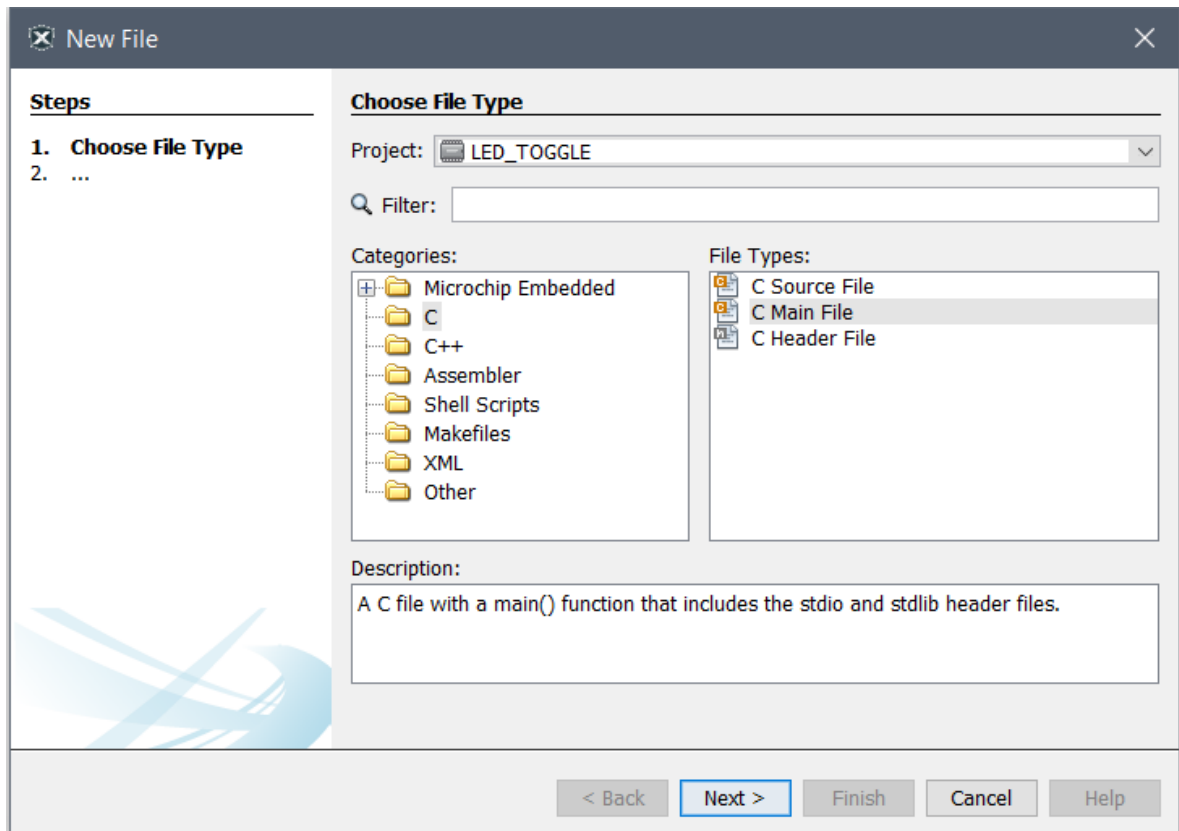
7. Create a new `main.c` file by clicking **File** → **New File...** or by using **Ctrl+N** shortcut, as shown in [Figure 5-6](#).

Figure 5-6. Create a New File in MPLAB® X



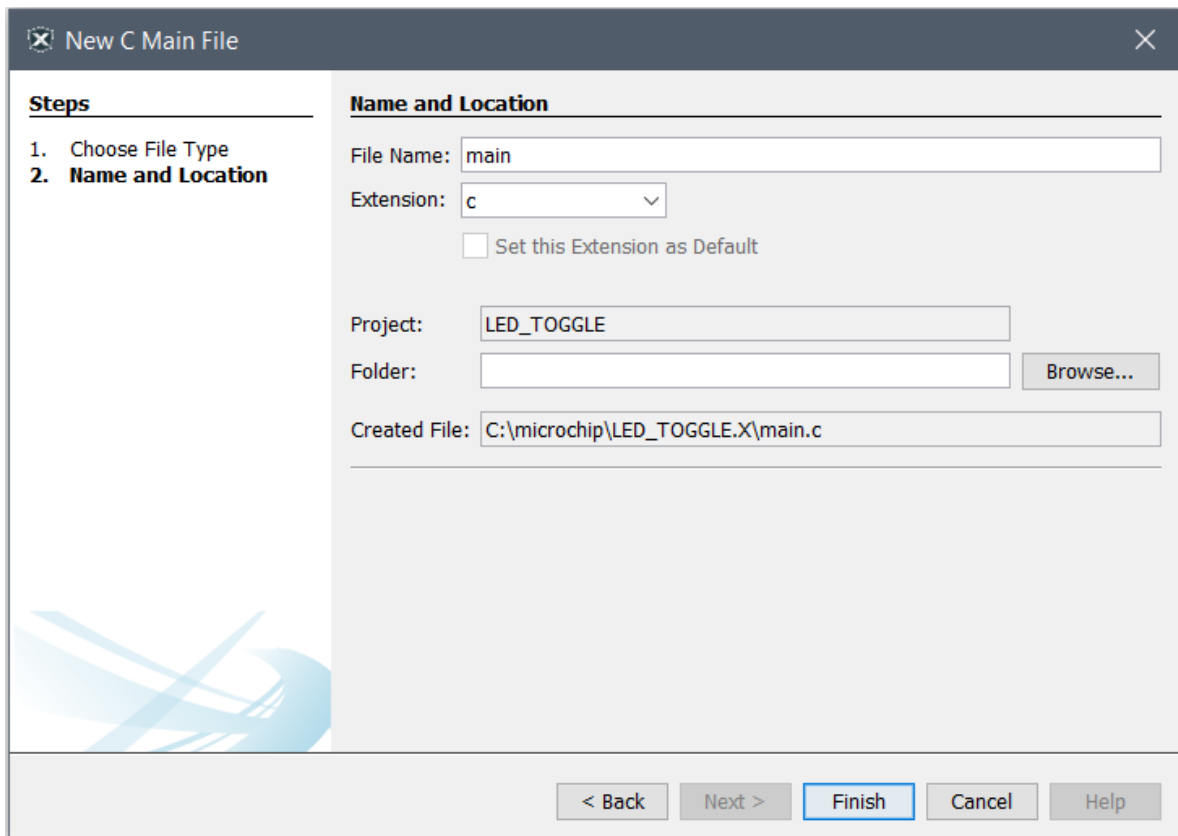
8. Select the **Categories** → **C** and **File Types** → **C Main File** template from [Figure 5-7](#), and click **Next**.

Figure 5-7. New File Window



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

**Figure 5-8. File Name Window**



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

```
int main (void)
{
    /* Configure SW0 as input */
    PORTF.DIRCLR = PIN6_bm;

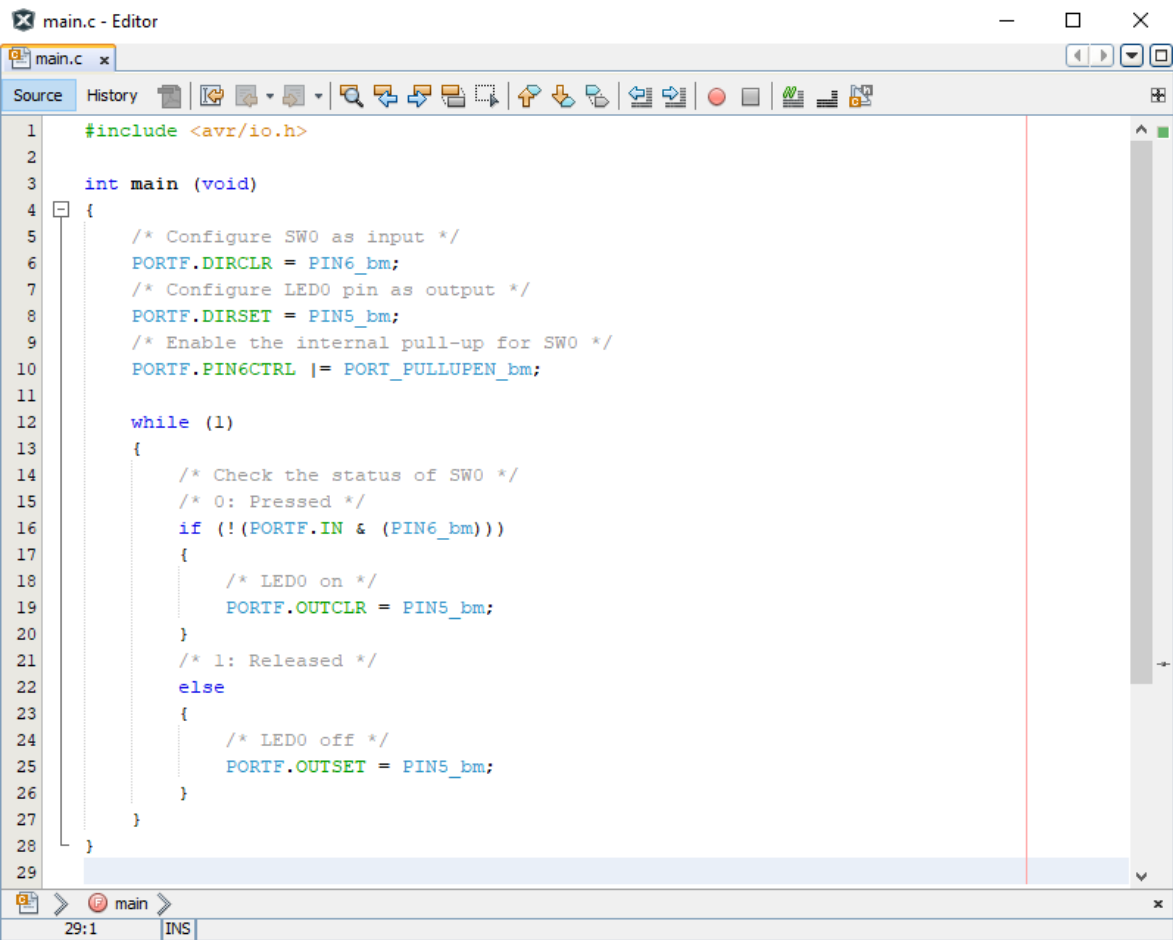
    /* Configure LED0 pin as output */
    PORTF.DIRSET = PIN5_bm;

    /* Enable the internal pull-up for SW0 */
    PORTF.PIN6CTRL |= PORT_PULLUPEN_bm;

    while (1)
    {
        /* Check the status of SW0 */
        /* 0: Pressed */
        if (!(PORTF.IN & (PIN6_bm)))
        {
            /* LED0 on */
            PORTF.OUTCLR = PIN5_bm;
        }
        /* 1: Released */
        else
        {
            /* LED0 off */
            PORTF.OUTSET = PIN5_bm;
        }
    }
}
```

Add `#include<avr/io.h>` in `main.c`. In the code editor, the code will appear as shown in [Figure 5-9](#).

Figure 5-9. Code Editor Window



```
1  #include <avr/io.h>
2
3  int main (void)
4  {
5      /* Configure SW0 as input */
6      PORTF.DIRCLR = PIN6_bm;
7      /* Configure LED0 pin as output */
8      PORTF.DIRSET = PIN5_bm;
9      /* Enable the internal pull-up for SW0 */
10     PORTF.PIN6CTRL |= PORT_PULLUPEN_bm;
11
12     while (1)
13     {
14         /* Check the status of SW0 */
15         /* 0: Pressed */
16         if (!(PORTF.IN & (PIN6_bm)))
17         {
18             /* LED0 on */
19             PORTF.OUTCLR = PIN5_bm;
20         }
21         /* 1: Released */
22         else
23         {
24             /* LED0 off */
25             PORTF.OUTSET = PIN5_bm;
26         }
27     }
28 }
29
```

11. Build the code by clicking on **Production** → **Clean and Build Main Project** or by using the **Shift + F11** shortcut.
12. Verify that LED0 is lit when SW0 is pushed on the AVR64DD32 Curiosity Nano.

## 6. What's Next

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

### Software:

- [Microchip Studio](#)
- Microchip Studio help: **Help** → **View Help** (shortcut **CTRL+F1**)
- [Microchip Gallery](#)
- [MPLAB X](#)
- IAR Embedded Workbench for AVR: Go to [www.iar.com](http://www.iar.com), search for "AVR".

### Firmware:

- [GitHub examples](#)

### Hardware:

- [AN2519: AVR Microcontroller Hardware Design Considerations](#)
- [AVR IBIS files](#)
- [AVR BDSL files](#)
- Atmel-ICE:
  - [User Guide](#)
  - [Buy](#)
- Power Debugger:
  - [User Guide](#)
  - [Buy](#)
- MPLAB Snap:
  - [Buy](#)
- MPLAB PICKit® 4:
  - [Buy](#)

### Other:

- AVR Freaks®: [www.avrfreaks.net/](http://www.avrfreaks.net/)
- Application notes:  
[www.microchip.com/paramChartSearch/chart.aspx?branchID=30047](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:  
[www.microchip.com/paramChartSearch/chart.aspx?branchID=30047](http://www.microchip.com/paramChartSearch/chart.aspx?branchID=30047)
- More online technical documentation concerning various products: [onlinedocs.microchip.com/](http://onlinedocs.microchip.com/)
- Microchip Technical Support: [microchipsupport.force.com/s/](http://microchipsupport.force.com/s/)

**7. Revision History**

Doc. Rev.	Date	Comments
A	02/2023	Initial document release

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## Microchip Information

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### The Microchip Website

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Microchip provides online support via our website at [www.microchip.com/](http://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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To register, go to [www.microchip.com/pcn](http://www.microchip.com/pcn) and follow the registration instructions.

### Customer Support

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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](http://www.microchip.com/support)

### Microchip Devices Code Protection Feature

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

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- 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. Microchip is committed to continuously improving the code protection features of our products.

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