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## **Getting Started with the MCC AVR® and PIC16/18 IEC60730 Class B Diagnostic Libraries**

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### **Introduction**

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The MPLAB® Code Configurator AVR® and PIC16/18 IEC60730 Class B Diagnostic Libraries are suites of diagnostic tests in compliance with the IEC 60730 Class B functional safety standard. These libraries are distributed as MPLAB X MCC modules, which allow quick and easy configuration using graphical interfaces. MCC generates code for MPLAB X and the MPLAB XC8 compiler projects, based on the selections and configuration.

This document contains instructions on how to install the libraries, add diagnostic tests, and run the examples.

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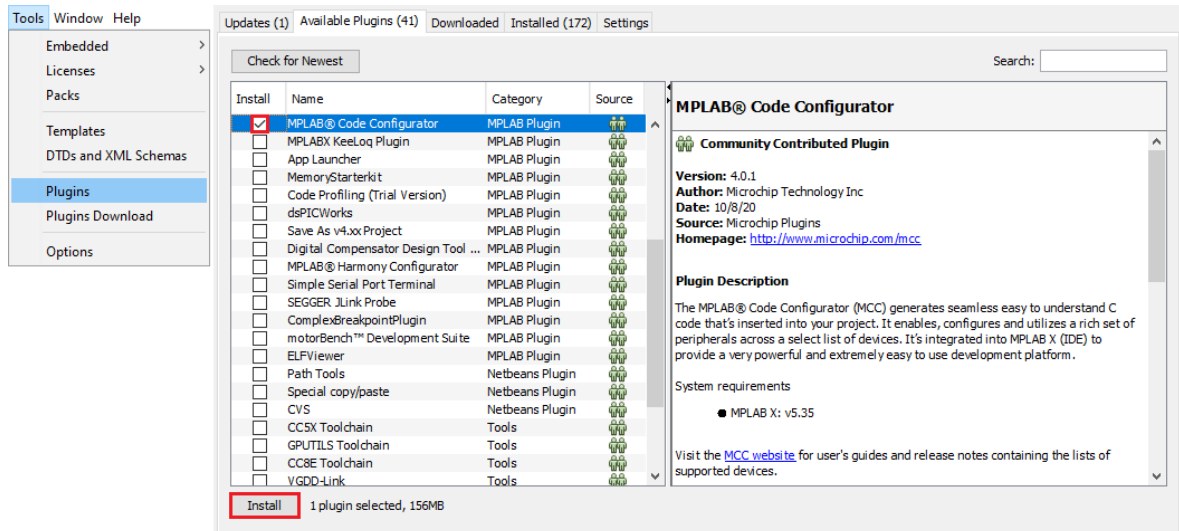
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## 1. Installing the Library

To use the libraries, install the [MPLAB Code Configurator](#) plug-in tool in the [MPLAB X IDE](#). This section describes how to install MCC and the IEC60730 Class B Diagnostic Libraries.

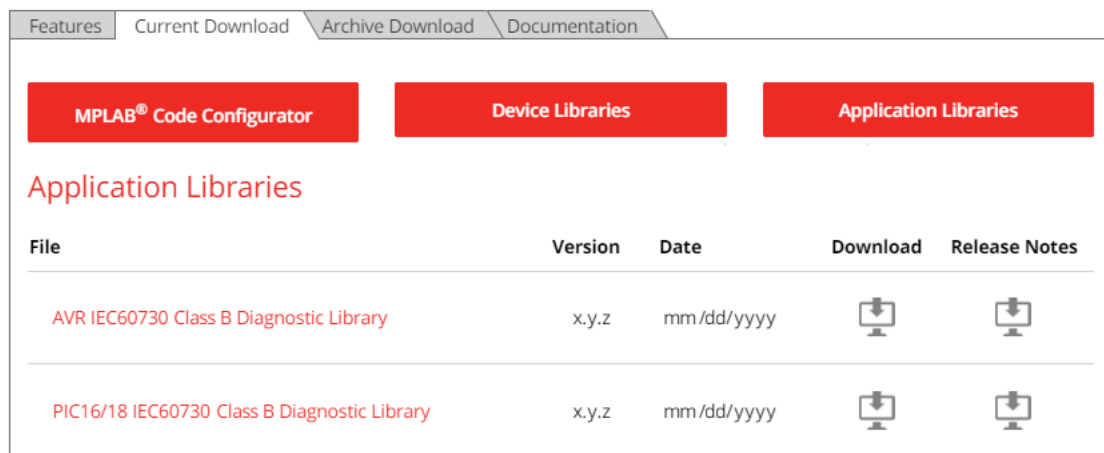
1. To install the MPLAB Code Configurator Plugin (see [Figure 1-1](#)):
  - 1.1. In the MPLAB X IDE, select **Plugins** from the Tools menu.
  - 1.2. Select the **Available Plugins** tab.
  - 1.3. Look for the MPLAB Code Configurator, and click **Install**.

**Figure 1-1. Installing MCC**



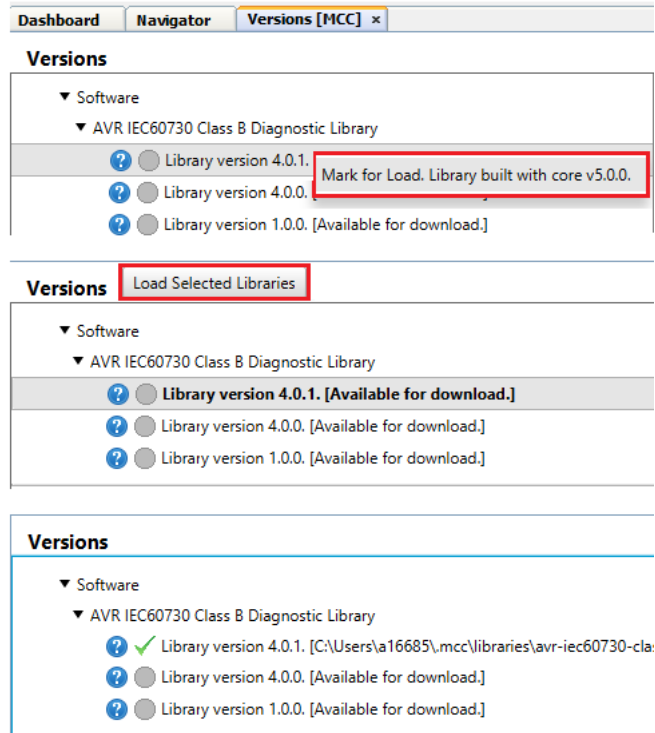
2. To install the IEC60730 Class B Diagnostic Libraries:
  - 2.1. Download the AVR and PIC16/18 IEC60730 Class B Diagnostic Libraries and release notes from the [MCC website](#) under *Current Download* → *Application Libraries* → *AVR IEC60730 Class B Diagnostic Library* and *PIC16/18 IEC60730 Class B Diagnostic Library* (see [Figure 1-2](#)).
  - 2.2. In the MPLAB X IDE, select **Options** from the Tools menu.
  - 2.3. In the **Plugins** → **MPLAB® Code Configurator 4.x** tab, click **Install Library**.
  - 2.4. Provide the path to the downloaded `avr-iec60730-class-b-diagnostic-library-x.y.z.mc3lib` or `pic16-pic18-iec60730-class-b-diagnostic-library-x.y.z.mc3lib` file.

**Figure 1-2. Downloading from the MCC Website**



3. To load the IEC60730 Class B Diagnostic Libraries from the MCC Versions Window (see [Figure 1-3](#)):
  - 3.1. Open MPLAB Code Configurator v4 from the *Tools* → *Embedded* menu.
  - 3.2. Expand the **Versions** tab under *Software* → *AVR IEC60730 Class B Diagnostic Library* or *Software* → *PIC16/18 IEC60730 Class B Diagnostic Library* (the green mark indicates the loaded version).
  - 3.3. Right click on the desired version of the library (see the [Note](#) below) and select **Mark for Load**.
  - 3.4. Click the **Load Selected Libraries** button to load the library.


**Figure 1-3. Loading from the MCC Versions Window**



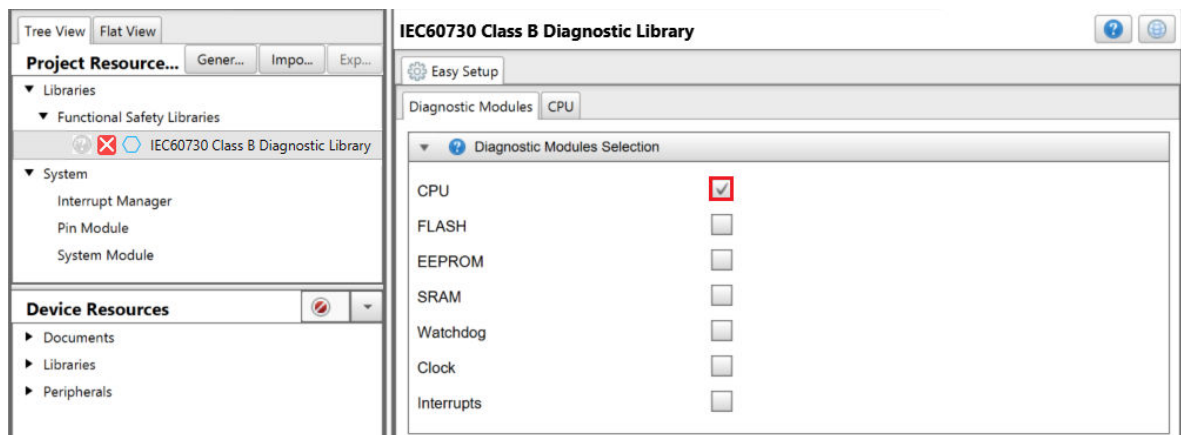
**Note:** The help icon beside the library version leads to the release notes.

## 2. Adding Diagnostic Tests

This section describes how to add diagnostic tests using MCC and the IEC60730 Class B Diagnostic Libraries in MPLAB X projects.

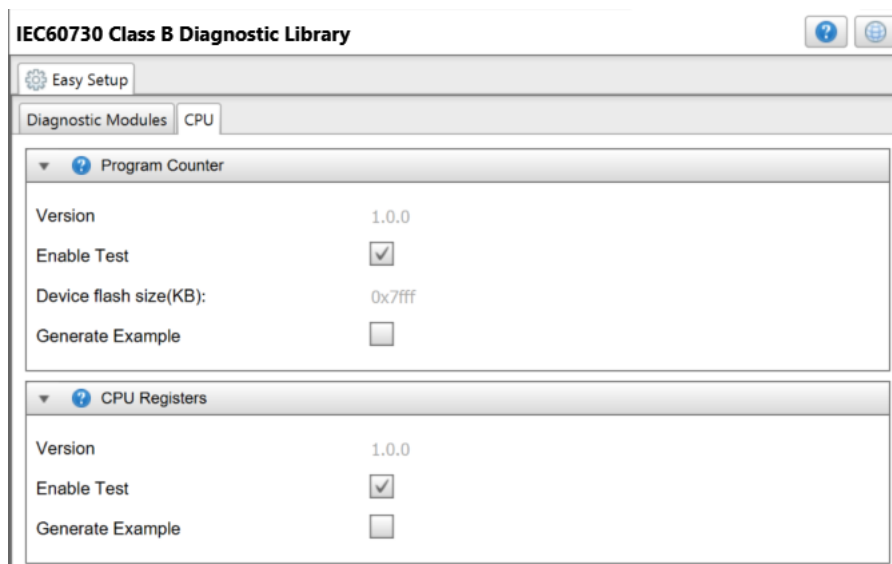
1. Create a new project in the MPLAB X IDE for any supported device specified in the library release notes (e.g., ATtiny3217). To view the release notes, refer to step 2.1 in [1. Installing the Library](#) or the [Note](#) above.
2. Open MCC by clicking **Tools** → **Embedded** → **MPLAB® Code Configurator v4**, or click the  icon.
3. In the Device Resources panel under the **Libraries** → **Functional Safety Libraries** drop-down, select **IEC60730 Class B Diagnostic Library**.
4. Enable the desired modules to be added from the **Diagnostic Modules** tab selection (e.g., **CPU**). This step will open the specific module tab, which contains the available diagnostic tests (see [Figure 2-1](#)).

**Figure 2-1. Enabling the CPU Tests**



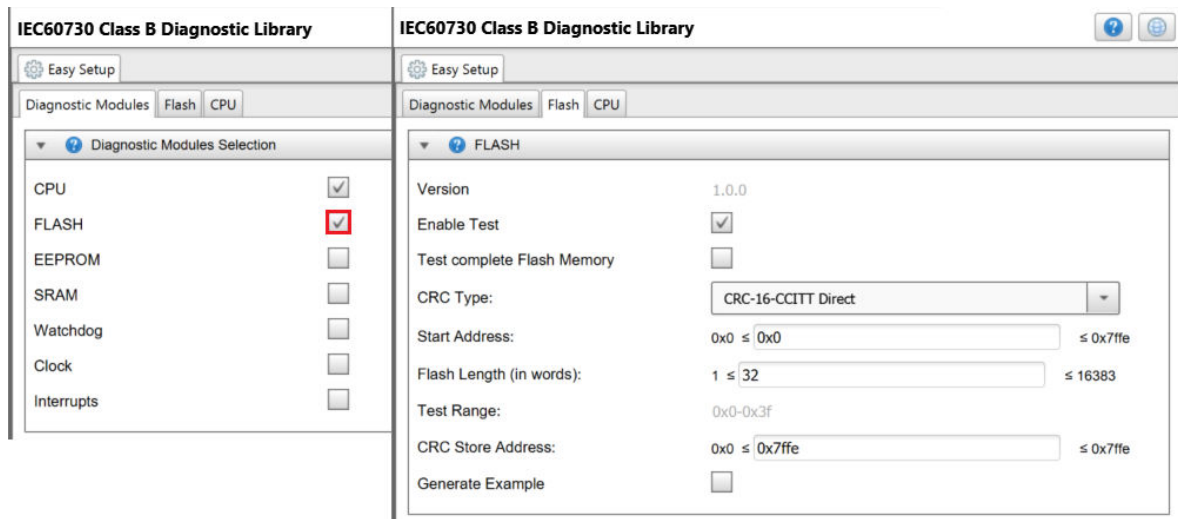
5. Switch to the **CPU** tab, and the available diagnostic tests are enabled by default (see [Figure 2-2](#)).

**Figure 2-2. Available CPU Tests**



6. Some diagnostic tests have configurable parameters for modifying the tests as needed. In [Figure 2-3](#), the Flash test has the option to test the entire Flash memory or just 32 words as set by the Flash Length parameter.

**Figure 2-3. Configuring the Flash Test**



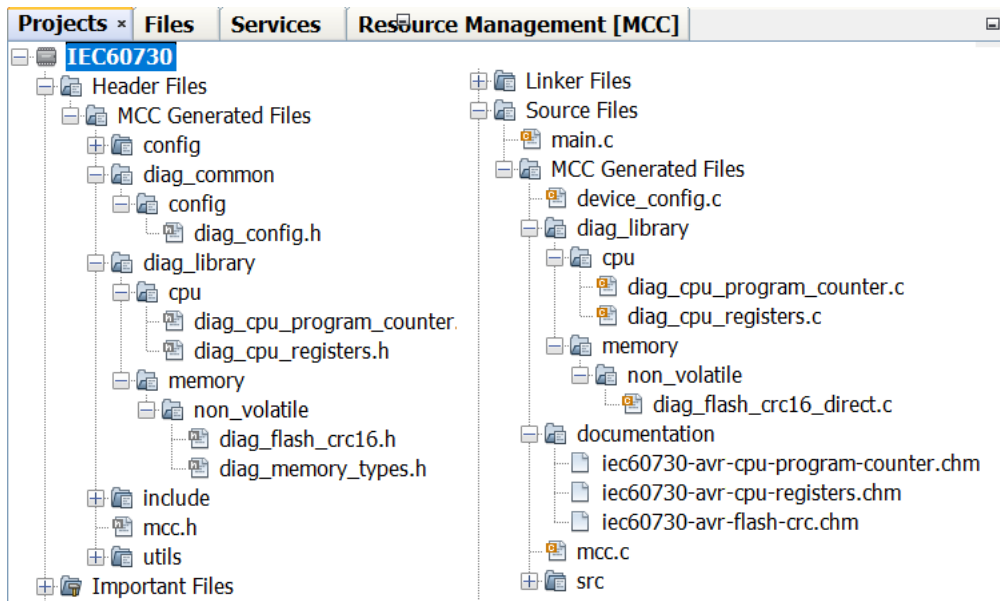
- Once all preferred tests are enabled and configured, click the **Generate** button to add these test codes, along with supporting API documentation, into the IDE project (see [Figure 2-4](#) and [Figure 2-5](#)).

**Figure 2-4. Generation of Test Files**

```

INFO: *****
INFO: Generation Results
INFO: *****
INFO: main.c Success. New file.
INFO: mcc_generated_files\config\clock_config.h Success. New file.
INFO: mcc_generated_files\device_config.c Success. New file.
INFO: ..generated_files\diag_common\config\diag_config.h Success. New file.
INFO: ..les\diag_library\cpu\diag_cpu_program_counter.c Success. New file.
INFO: ..les\diag_library\cpu\diag_cpu_program_counter.h Success. New file.
INFO: ..ted_files\diag_library\cpu\diag_cpu_registers.c Success. New file.
INFO: ..ted_files\diag_library\cpu\diag_cpu_registers.h Success. New file.
INFO: .._library\memory\non_volatile\diag_flash_crc16.h Success. New file.
INFO: ..y\memory\non_volatile\diag_flash_crc16_direct.c Success. New file.
INFO: ..library\memory\non_volatile\diag_memory_types.h Success. New file.
INFO: ..umentation\iec60730-avr-cpu-program-counter.chm Success. New file.
INFO: ..es\documentation\iec60730-avr-cpu-registers.chm Success. New file.
INFO: .._files\documentation\iec60730-avr-flash-crc.chm Success. New file.
INFO: mcc_generated_files\include\ccp.h Success. New file.
INFO: mcc_generated_files\include\cpuint.h Success. New file.
INFO: mcc_generated_files\include\nvmctrl.h Success. New file.
INFO: mcc_generated_files\include\pin_manager.h Success. New file.
INFO: mcc_generated_files\include\port.h Success. New file.
INFO: mcc_generated_files\include\protected_io.h Success. New file.
INFO: mcc_generated_files\include\rstctrl.h Success. New file.
INFO: mcc_generated_files\mcc.c Success. New file.
INFO: mcc_generated_files\mcc.h Success. New file.
INFO: mcc_generated_files\src\cpuint.c Success. New file.
INFO: mcc_generated_files\src\nvmctrl.c Success. New file.
INFO: mcc_generated_files\src\pin_manager.c Success. New file.
INFO: mcc_generated_files\src\protected_io.S Success. New file.
INFO: mcc_generated_files\utils\assembler.h Success. New file.
INFO: mcc_generated_files\utils\assembler\gas.h Success. New file.
INFO: mcc_generated_files\utils\assembler\iar.h Success. New file.
INFO: mcc_generated_files\utils\atomic.h Success. New file.
INFO: mcc_generated_files\utils\compiler.h Success. New file.
INFO: mcc_generated_files\utils\interrupt_avr8.h Success. New file.
INFO: mcc_generated_files\utils\utils.h Success. New file.
INFO: mcc_generated_files\utils\utils_assert.h Success. New file.
INFO: *****
INFO: Generation complete (total time: 21558 milliseconds)
INFO: *****
    
```

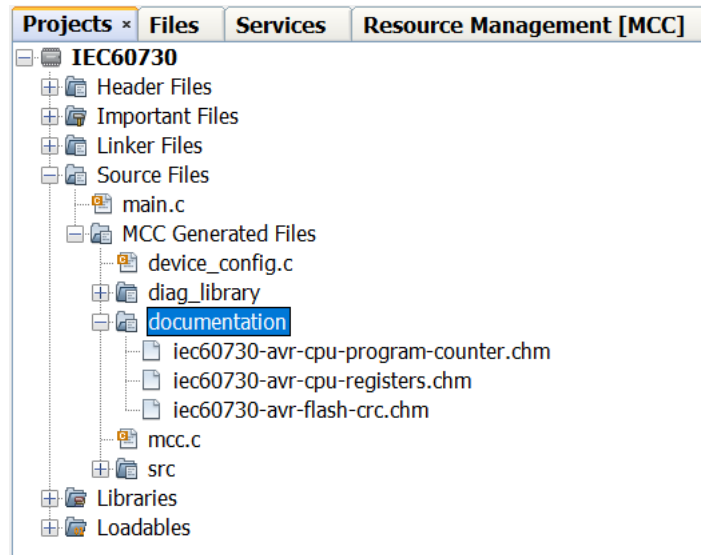
Figure 2-5. Project Files



### 3. Library API Documentation

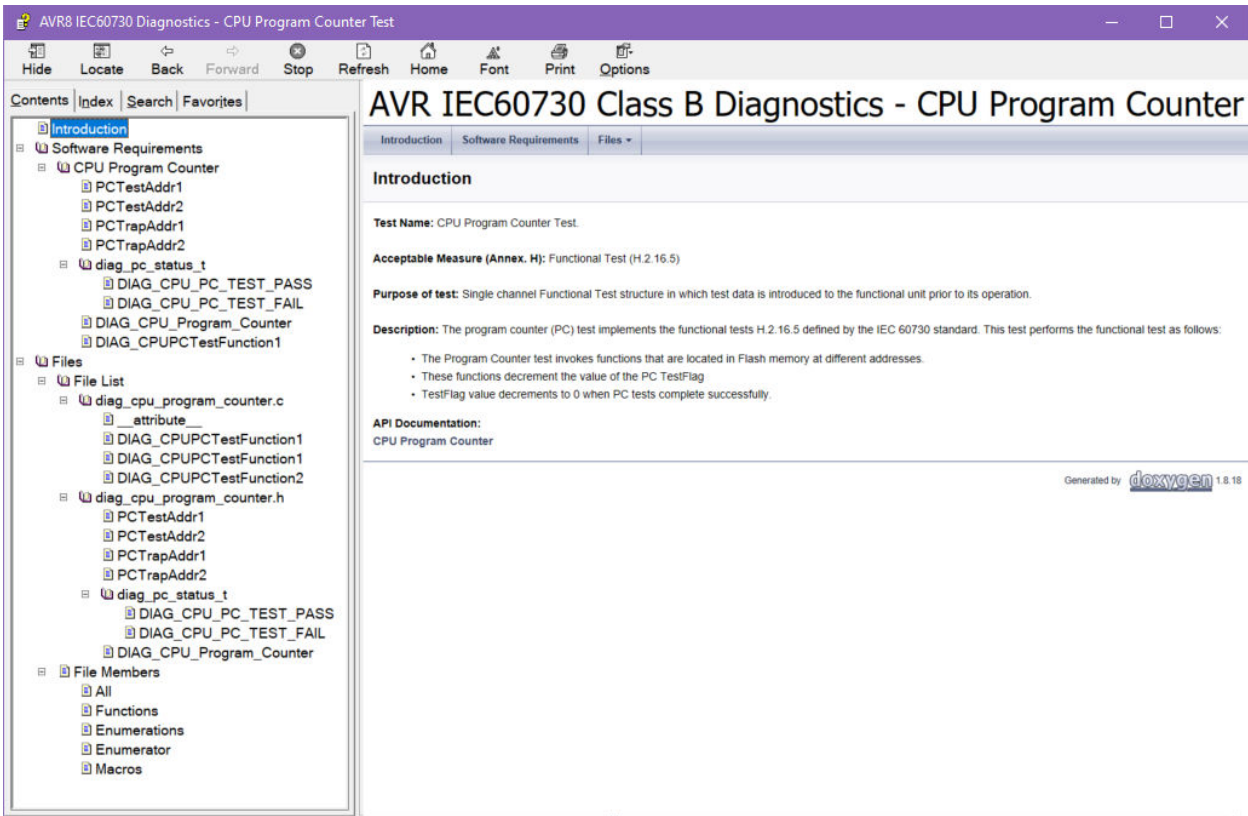
Each diagnostic test comes with the API documentation. Upon generating code from MCC for a diagnostic test, the associated API documentation is generated and can be accessed from `mcc_generated_files/documentation/iec60730-test-name.chm` (see [Figure 3-1](#)).

Figure 3-1. Navigating to the Test API Documentation



To view the API documentation, right click on the `.chm` file and select **Open in System**. These documents contain detailed descriptions for each test, and test code contents (see [Figure 3-2](#)), which help users understand the usage of the generated APIs.

Figure 3-2. CPU Program Counter Test API Documentation

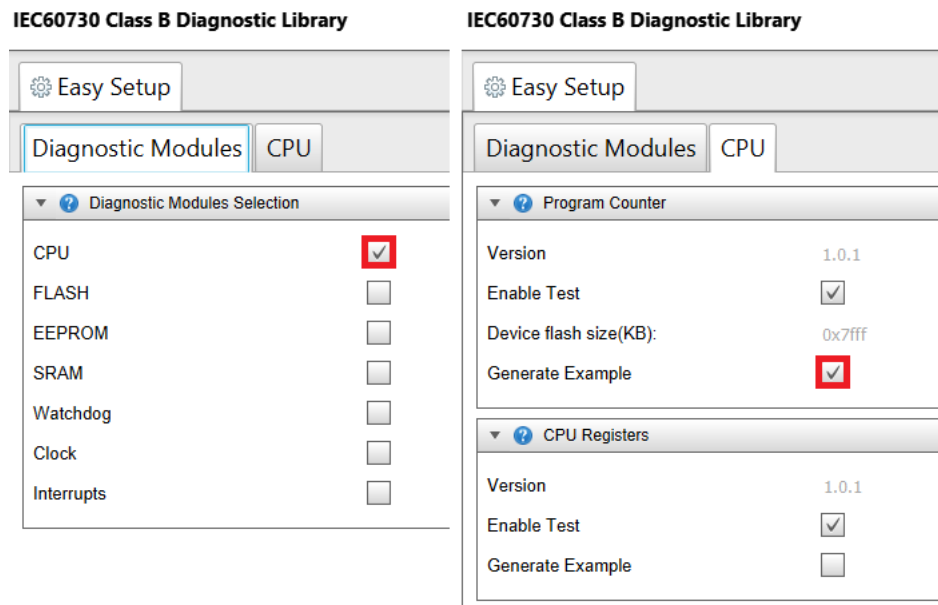


## 4. Running the Examples

Examples are available for each diagnostic test. Users can generate these examples if the options are enabled in the user interface.

1. In the MCC window, navigate to the IEC60730 Class B Diagnostic Library module and enable a diagnostic test (e.g., CPU Program Counter).
2. Switch to the **CPU** tab, and enable the Generate Example box of the Program Counter test (see [Figure 4-1](#)).

**Figure 4-1. Enabling the Program Counter Test Example**



3. For displaying the test example output, select a **USART** under Peripherals in the Device Resources panel.
4. Enable **Printf support** for AVR devices, or **Redirect STDIO to USART** for PIC® devices. Configure the other options to match the preferred serial terminal settings (see [Figure 4-2](#)).

Figure 4-2. Configuring the USART in ATtiny3217

5. Click the **Generate** button.
6. Include the header `mcc_generated_files/diag_common/examples/diag_common_example.h` in `main.c`. This header contains all the generated example functions.
7. Call the example function `DIAG_CPU_ProgramCounter_Example()` in `main()` (see [Figure 4-3](#)).

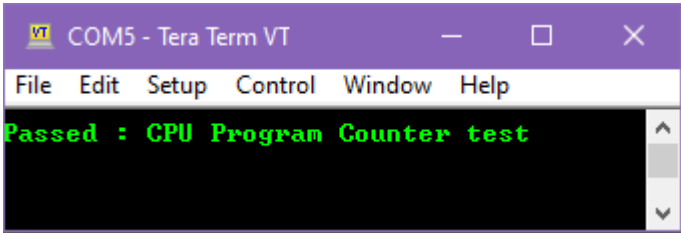
Figure 4-3. Adding the Test Example to `main.c`

```
#include "mcc_generated_files/mcc.h"
#include "mcc_generated_files/diag_common/examples/diag_common_example.h"

/*
 * Main application
 */
int main(void)
{
    /* Initializes MCU, drivers and middleware */
    SYSTEM_Initialize();
    DIAG_CPU_ProgramCounter_Example();
    /* Replace with your application code */
    while (1) {
    }
}
```

8. Connect a board with the selected device to the PC (e.g., an ATtiny3217 Curiosity Nano).
9. Build and program the board.
10. Open and configure a serial terminal to view the example output (see [Figure 4-4](#)).

Figure 4-4. Program Counter Test Output in the Serial Terminal



**5. Revision History**

Doc. Rev.	Date	Comments
A	01/2021	Initial document release.

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