AN219434

PSoC 6 MCU Importing Generated Code into an IDE

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Associated Part Family: PSoC 6 MCU

Associated Code Examples: CE212736

Related Application Note: AN210781

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AN219434 shows how to import the code generated by PSoC Creator™, for the PSoC® 6 MCU architecture, into your preferred integrated development environment. With this knowledge, you can combine the benefits of automatically generated code with your preferred IDE. High-level options are explained, with detailed instructions for each option.

Contents

1 Introduction

A significant number of customers use the PSoC Creator tool as a hardware design platform but write application software in a different environment. There are several reasons why this might be. Your organization may have an established set of tools for developing products. You may wish to reuse legacy code built in another IDE. Or you may have a preferred development environment. This application note shows you how to use PSoC Creator generated code for the PSoC 6 MCU in such an IDE.

The PSoC 6 MCU is based on a dual-core ARM® Cortex®-M4 (CM4) and Cortex-M0+ (CM0+) Programmable System-on-Chip.

To enable firmware development for PSoC 6 MCU devices, Cypress provides two distinct development environments: one based on PSoC Creator, the other based on ModusToolbox software. Table 1 summarizes the key features for each workflow.

Table 1. Comparing PSoC Creator and ModusToolbox Software

Feature	PSoC Creator	ModusToolbox IDE
IDE Framework	Proprietary, not extensible	Eclipse-based, extensible
Driver Library	Peripheral Driver Library (PDL)	PSoC 6 Software (psoc6sw)
Code Generation	Components (including BLE and CapSense®)	Configurators: device, bluetooth, qspi, smartio, usbdev
Host OS	Windows	Windows, macOS, Linux
Middleware	BLE, dfu, em_eeprom, emWin, usb_dev, FreeRTOS	BLE, CapSense, csadc, csidac, dfu, em_eeprom, emWin, usb_dev, FreeRTOS
Post-processing tool	cymcuelftool (Windows, macOS, Linux)	cymcuelftool (Windows, macOS, Linux)

This app note discusses the PSoC Creator environment and workflow. AN225588, Using ModusToolbox Software with a Third-Party IDE, discusses that environment and workflow.

The Peripheral Driver Library (PDL) is a software development kit (SDK) for PSoC 6 MCU devices. Your firmware uses PDL API function calls to configure, initialize, enable, and use a peripheral driver. The PDL also includes support for middleware such as Bluetooth Low Energy (BLE), and real-time operating systems (RTOS). By design, the PDL is IDE-neutral.

However, PSoC Creator is fully integrated with the PDL. As a design environment, PSoC Creator helps you configure clocks, interrupts, pin assignments, and drivers using a friendly UI. To customize a driver, add a Component to the PSoC Creator design corresponding to the peripheral. Instead of writing configuration code, modify options in the Component. PSoC Creator then generates all the configuration code to set up the clocks, interrupts, pins, and custom drivers based on the design. When targeting a PSoC 6 MCU device, PSoC Creator generates code using the PDL. If you use the PDL without PSoC Creator, you must write all the configuration code for the design.

Generated code is a valuable resource because it handles a great deal of the complexity involved in setting up the firmware for a design. This application note explains how to use that generated code in any IDE. There is more than one way to do this. This note explores and explains your options. It also walks through an example to show you how it can be done. When you have finished this application note, you will know what your choices are, and how to integrate generated code into your preferred IDE.

Even if your circumstances prevent you from using generated code directly, all is not lost. This application note shows you how to use generated code to learn about the PDL.

To learn more about the PDL or PSoC Creator, see the Related Documents section for links to some of the available resources.

2 Integrating Generated Code

At a high level, there are two ways to integrate generated code into an IDE's project file. The two paths are:

- Export code from PSoC Creator and import that code into an IDE.
- Manually add generated source files to an IDE's project.

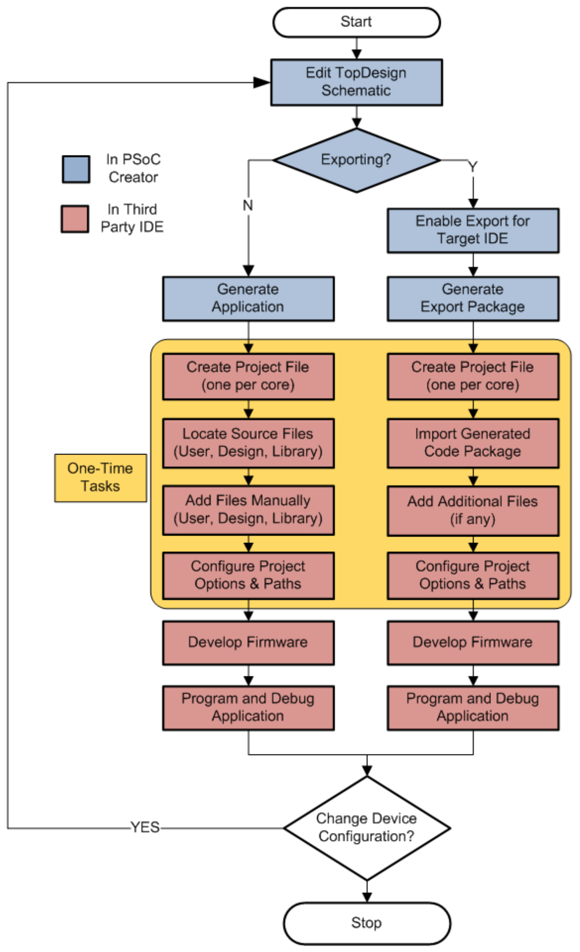
The flowchart in Figure 1 shows the tasks you perform for each path. This application note explains the one-time tasks noted in the flowchart. Based on your circumstances, one or the other path may be better for you.

The export path is available only for supported IDEs. See Exporting and Importing Generated Code for details about this path. Supported IDEs include:

- IAR Embedded Workbench
- Keil µVision
- Eclipse-based IDEs

Manually importing code works for any IDE, including supported IDEs. For supported IDEs, additional resources are available that make the manual approach easier, including a fully-configured project file, IDE-specific startup code, flash configuration files, and linker scripts. See Manually Importing Generated Code for details about this path.

Figure 1. Integrating Generated Code


Start
Edit TopDesign Schematic
Exporting?
In PSoC Creator
In Third Party IDE
N
Y
Enable Export for Target IDE
Generate Application
Generate Export Package
Create Project File (one per core)
Create Project File (one per core)
Locate Source Files (User, Design, Library)
Import Generated Code Package
One-Time Tasks
Add Files Manually (User, Design, Library)
Add Additional Files (if any)
Configure Project Options & Paths
Configure Project Options & Paths
Develop Firmware
Develop Firmware
Program and Debug Application
Program and Debug Application
YES
Change Device Configuration?
Stop

2.1 Advantages of Generated Code

If you use PSoC Creator to design and configure your system, you gain significant benefits of generated code. All the necessary configuration code is created for you. This code can be quite complex. For example, the generated code in *cyfitter_cfg.c* initializes all clocks, sets each clock's source and divider, and enables all the clocks in your design. It makes PDL API function calls to do so. This code is based on the clock tree configuration in the PSoC Creator design.

The BLE Component is another good example. The code to configure a BLE Component is typically hundreds of lines long, declares a dozen configuration structures, and defines the values for more than 100 fields. PSoC Creator generates all this code automatically, based on the BLE Component configuration in the design.

In addition to configuration code, PSoC Creator generates a simplified function API for each Component. The Component API is built on and uses the PDL API. This means that you can use the Component API instead of calling PDL functions directly. You can mix and match these APIs. They are consistent and compatible.

For example, to initialize, enable, and start a PWM using the PDL API, your code might look like this (ignoring errors):

```
Cy_TCPMW_PWM_Init (TCPWM1, counterNumber, &PWM_config);
Cy_TCPWM_Enable_Multiple (TCPWM1, whichCounters);
Cy_TCPWM_TriggerStart (TCPWM1, whichCounters);
```

By contrast, using the Component API, your code would look like this (for a TCPWM Component named `MyPWM`):

```
MyPWM_Start();
```

The code generator implements the proper sequence of function calls to enable the PWM. It also provides all the hardware-related parameters based on the design and configuration in PSoC Creator. If you examine the generated code for the `MyPWM_Start()` function, you find all three PDL API calls implemented for you, and called in the correct sequence.

The generated code is primarily in C source and header files, but may include assembler files and compiled binaries. If you add these generated files to an IDE project correctly, as described in this application note, iterative development is fully supported. When you modify the design in PSoC Creator and regenerate the application, the IDE recognizes that files have changed with no additional work required.

2.2 Limitations of Generated Code

PSoC Creator generates code compatible with the C99 standard. The compiler you use must support that standard. In addition, compilers can vary in subtle implementation details. There is always a chance that a particular compiler may handle some syntax in a non-standard way, but this is unusual.

The biggest limitation is that in most cases you cannot modify generated code. If you modify the code in a generated source file, the change is lost when you regenerate the code. Changes you make to generated code do not migrate upstream into the PSoC Creator design. If during the development cycle you discover that you need to modify the design, make the changes in PSoC Creator, and regenerate the application.

However, certain files generated by PSoC Creator are treated as user files. You can modify any user file without losing changes. See User Files.

2.3 Tool Compatibility

PSoC Creator and PSoC Programmer are proprietary tools built for Windows OS. When working with tools from other providers, you may encounter compatibility issues. For example, PSoC Creator adds proprietary information to the final hex file, and PSoC Programmer requires this information; other IDEs do not generate this information, so PSoC Programmer cannot use such a hex file.

ModusToolbox software and the newer Cypress Programmer do not have these issues.

3 Exporting and Importing Generated Code

The export/import path is available for supported IDEs only. For supported IDEs, PSoC Creator provides an export package. Table 2 lists the export packages and which IDEs each package supports.

Table 2. Available Export Packages

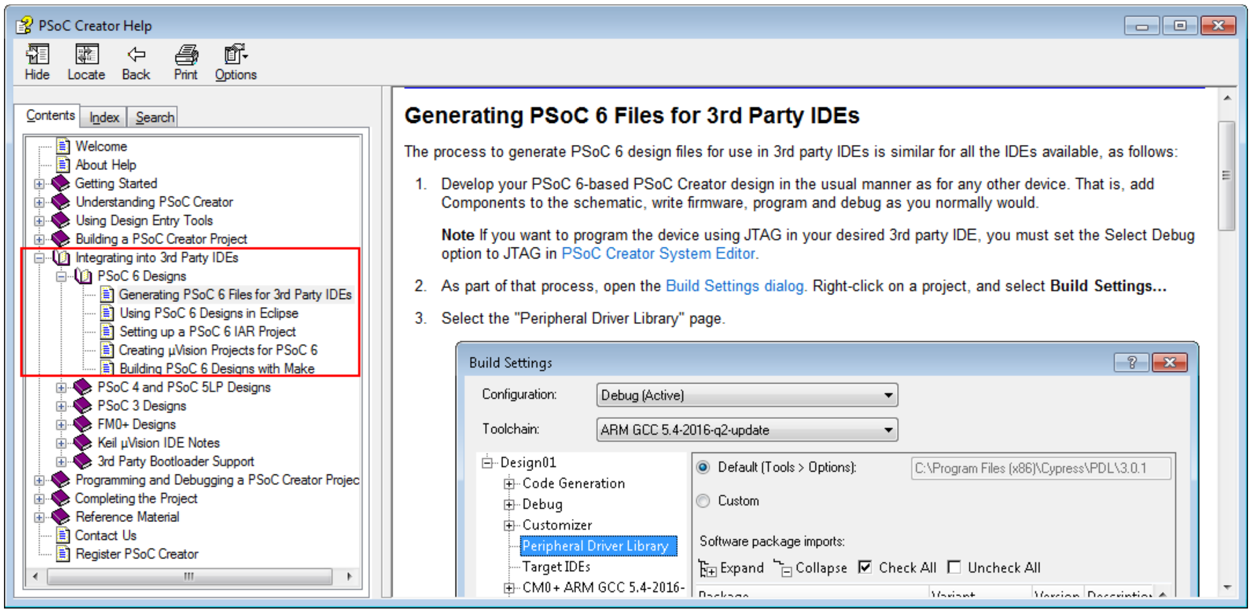
Package	Supported IDE	Principal File	Path
CMSIS Pack	Keil µVision v5 or later IAR Embedded Workbench v8.1 or later Eclipse-based IDEs that can import a CMSIS Pack	.pack file	*Export/Pack*
Inter-Project Connection File (IPCF)	IAR Embedded Workbench	.ipcf file (one per core)	*Export*
Makefile	GNU command-line tools	makefile	*<project>.cydsn*

The export/import process is the same for all supported IDEs. After developing your design, take these steps:

- In PSoC Creator:
  - Enable the creation of the export package
  - Build your code (this generates the export package)
- In the 3rd party IDE:
  - Create an empty project (one per core for multi-core devices)
  - Import the package into the empty project
  - If necessary, add additional files not included in the export package
  - Configure project options

The details of the export/import process vary *significantly* among supported IDEs. This section gives you an understanding of how the process works. The exact steps and precise details are described in the *PSoC Creator Help*, and in the *PSoC Creator User* Guide. This application note does *not* duplicate this information. You must use the documentation to successfully export and import a package into an IDE.

Figure 2. PSoC Creator Help Topics for Integrating into 3rd-Party IDEs



- Welcome
- About Help
- Getting Started
- Understanding PSoC Creator
- Using Design Entry Tools
- Building a PSoC Creator Project
- Integrating into 3rd Party IDEs
  - PSoC 6 Designs
    - Generating PSoC 6 Files for 3rd Party IDEs
    - Using PSoC 6 Designs in Eclipse
    - Setting up a PSoC 6 IAR Project
    - Creating µVision Projects for PSoC 6
    - Building PSoC 6 Designs with Make
  - PSoC 4 and PSoC 5LP Designs
  - PSoC 3 Designs
  - FM0+ Designs
  - Keil µVision IDE Notes
  - 3rd Party Bootloader Support
- Programming and Debugging a PSoC Creator Projec
- Completing the Project
- Reference Material
- Contact Us
- Register PSoC Creator

Generating PSoC 6 Files for 3rd Party IDEs

The process to generate PSoC 6 design files for use in 3rd party IDEs is similar for all the IDEs available, as follows:

1. Develop your PSoC 6-based PSoC Creator design in the usual manner as for any other device. That is, add Components to the schematic, write firmware, program and debug as you normally would.

   Note If you want to program the device using JTAG in your desired 3rd party IDE, you must set the Select Debug option to JTAG in PSoC Creator System Editor.
2. As part of that process, open the Build Settings dialog. Right-click on a project, and select **Build Settings...**
3. Select the "Peripheral Driver Library" page.

Build Settings

Configuration: Debug (Active)

Toolchain: ARM GCC 5.4-2016-q2-update

- Design01
  - Code Generation
  - Debug
  - Customizer
  - Peripheral Driver Library
  - Target IDEs
  - CM0+ ARM GCC 5.4-2016-

(●) Default (Tools > Options): C:\Program Files (x86)\Cypress\PDL\3.0.1

( ) Custom

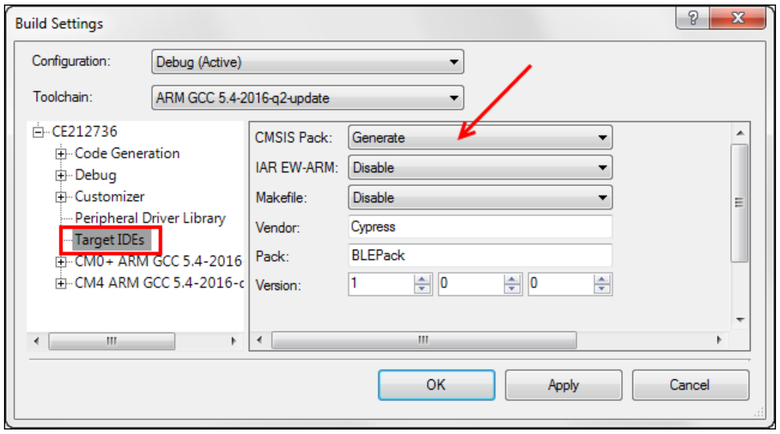
Software package imports:

Expand Collapse ☑ Check All ☐ Uncheck All

3.1 Enabling Export for a Target IDE

In PSoC Creator, use the **Project** > **Build Settings** menu command to open the project settings. Then, open the **Target IDEs** panel. Choose **Generate** for the export package you want to create. Figure 3 shows the CMSIS Pack option enabled. A CMSIS Pack is an IDE-agnostic delivery package for software components.

Figure 3. Enabling the CMSIS Pack Export Package



Configuration: Debug (Active)

Toolchain: ARM GCC 5.4-2016-q2-update

- CE212736
  - Code Generation
  - Debug
  - Customizer
  - Peripheral Driver Library
  - Target IDEs
  - CM0+ ARM GCC 5.4-2016
  - CM4 ARM GCC 5.4-2016-c

CMSIS Pack:	Generate
IAR EW-ARM:	Disable
Makefile:	Disable
Vendor:	Cypress
Pack:	BLEPack
Version:	1 0 0

As an example of how the export process varies, the **Vendor**, **Pack**, and **Version** information shown in the figure are required only for the CMSIS Pack. **IAR EW-ARM** has different options.

See PSoC Creator documentation for details.

3.2 Generating the Export Package

After enabling the creation of a package, build your code. Use the PSoC Creator **Build** > **Build <project>** command. Note that the **Build** > **Generate Application** command does *not* generate the export package.

The contents of the *Export* folder vary per package. The package is a collection of files. PSoC Creator puts each package at the location listed in Table 2. When importing the package, navigate to that location to find the required files.

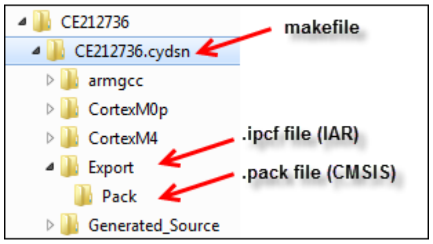
3.3 Importing the Package

The import step is highly variable, based on the IDE and package. This section introduces you to the general tasks that you must perform to import a package. Refer to the PSoC Creator documentation for the precise steps and details. There is a help topic for each supported IDE, as shown in Figure 2 on page 5.

In general, you perform these tasks:

- Create an empty project file (one per core for multi-core devices).
- Import generated code into each project file. Figure 4 shows where each package is located.
  - For a CMSIS Pack, install the Pack on your computer, and then import the Pack.
  - For IAR tools, establish a project connection using the *.ipcf* file.
  - For GNU tools, use the generated makefile.

Figure 4. Where to Find Export Packages



- In some cases, add additional files to each project file:
  - For CMSIS Pack, you can create the core-specific *main.c* and linker files from templates.
  - For IAR tools, these files are included in the project automatically.
- Set project options, which may include compiler, linker, and debugger settings.

Different packages require that you set different project options. For example, the IPCF connection for IAR tools requires that you modify output folder names for the CM4 project, so they do not conflict with the CM0+ project. For the CMSIS Pack, you also specify include paths for header files, provide a path to the linker command file, and so on. PSoC Creator documentation provides all the details. Ensure that you are familiar with that documentation before exporting and importing generated code. See Configuring an IDE Project File for more information about project options.

Several files in a project are core- or IDE-specific, such as linker files, startup code, the makefile, and others. The correct files for each core and IDE are in the package. When you import the package, the correct files are included.

Note: Many core-specific files are user-editable files, initially generated by PSoC Creator. You can modify these files and changes will not be lost when you rebuild the PSoC Creator project. See User Files for more information.

3.4 Supporting Iterative Development

After importing the generated code, you will likely encounter the need to change your design. Make the required change in the PSoC Creator project, and rebuild the project. Do not modify files in the *Generated_Source* folder. Any change will be lost when you regenerate code.

When you rebuild the code in PSoC Creator, an updated package appears in the *Export* folder. The code generation process may have modified files, added new files, or removed files.

For the CMSIS Pack export, reinstall the Pack. Locate the pack file in the *Export* folder, and double-click to install. The unzip dialog includes an alert that the Pack is already installed. Replace it. The IDE automatically recognizes the changes, including added or removed files. Rebuild your code in the IDE to update the executable.

The IAR inter-project connection file points to the PSoC Creator *Generated_Source* folder. The IDE automatically recognizes the changes, including added or removed files. There is no need to reconnect to the *.ipcf* file. Simply rebuild your code in the IDE to update the executable.

For a makefile, ensure that your build process uses the files in the *Export* folder. If it does, then a simple clean and build updates the executable using the new code.

3.5 Export/Import Review

PSoC Creator documentation describes all the details. The import process begins with a new, empty project in the IDE.

For a CMSIS Pack, project setup for the IDE involves multiple steps. The Pack may be imported into a variety of IDEs, and each IDE is unique in how it handles build options, so you are required to set several options. This is a one-time task. Any change in the code (from a design change in PSoC Creator) is handled transparently. Just reinstall the Pack.

Inter-project connection is a protocol proprietary to the IAR tools. Because it is designed for one IDE, the project connection sets most options automatically. This is a very friendly process.

4 Manually Importing Generated Code

Manual import works for any IDE, including supported IDEs that have an export/import process. For a non-supported IDE, manual import is the only option.

To begin, you must have generated code. In PSoC Creator, the **Build** > **Generate Application** command is sufficient. You do not need to compile the code. To manually import generated code, you:

- Create a project in the IDE (one for each core for a multi-core device).
- Locate and identify the generated files you need.
- Add those files to the project.

This section gives you the background required to understand what files PSoC Creator generates, where to find them, and which you need to add to your project. Manually Importing Generated Code – an Example walks you through the process in detail.

4.1 Creating a Project File

This discussion assumes that you are familiar with your preferred IDE, that you know how to create and configure a project file, and that you have a project configured to work with each core on a multi-core PSoC 6 MCU device. See Configuring an IDE Project File for information on the kinds of options that must be configured.

You can start with a new, empty project file. However, Cypress provides a pre-configured template project for each supported IDE and PSoC 6 MCU core. There are CM4 and CM0+ projects for the µVision IDE, the IAR IDE, and the other supported IDEs. PDL template projects are fully described in the *PDL v3.0 User Guide* section titled *Using PDL Template Projects*. Template projects are located here: *<PDL Install Folder>/devices/psoc6/<series>/projects.*

Most build options in the template project are set correctly. Changes required when importing the generated code are discussed in this application note. In addition, the include paths in the template are project-relative. If you move the template project file to a different location, you must modify these paths. See Where to Get PDL Library Files.

4.2 Locating and Identifying Source Files

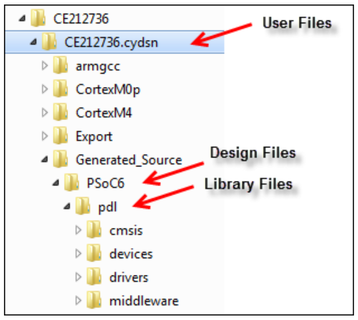
PSoC Creator generates three kinds of source files:

- User files – files you may modify
- Design files – files specific to the PSoC Creator design and Components
- Library files – files from the PDL

The following sections describe each kind of source file in detail.

PSoC Creator puts these files in various folders inside the *<project>.cydsn* folder. This application note refers to this location simply as the *cydsn* folder. Figure 5 shows the folder tree and locations for generated source files.

Figure 5. Where to Find Generated Files



4.2.1 User Files

A user file is one that you may change based on the requirements of your design. PSoC Creator generates the file (which may be functionally empty), and never changes it. These are the key concepts to understand about user files:

- The files are created automatically when you create a PSoC Creator project and generate the application for the first time.
- PSoC Creator does not change or replace these files once they are created. Therefore, you can modify these files as required for your design.
- All files are local copies, so changes have no impact on other projects or the installed PDL library.
- For a multi-core device, add core-specific files to the correct project in your IDE; add shared files to the project for each core.
- You do not need every file; some are specific to a particular tool chain.

Table 3 lists common user files. User files are at the top level of the *cydsn* folder (except for the startup code, as noted in the table). Some file names vary based on the device. The table uses the *psoc63* series as the example. Some files are core-specific. Startup code and linker files are also IDE-specific. Use the appropriate files for your project. Disregard the others. If you use an unsupported IDE, provide equivalent files compatible with the IDE.

Depending upon your design, there may be additional user files. Any source file at the top level of the *cydsn* folder is a user file and should be added to one or both projects, depending on whether the file is core-specific.

Table 3. PSoC Creator Generated User Files

File	Action	Source	Usage	Notes
main_cm0p.c *main_cm4.c*	Add to project[1], or provide your own.	Generated	Required	PSoC Creator puts the user files at the top level of the *cydsn* folder
cy_ipc_config.c/h	Add source file to the project for each core. Provide path to header[2].	Copied from PDL	Required	Configuration files for inter-processor communication peripheral (not IAR .ipcf)
cyapicallbacks.h	Provide the path to the header.	Generated	Required	An empty file for the user to implement macro callbacks (see PSoC Creator Help topic *Writing Code*)
system_psoc63.h	Provide the path to the header.	Copied from PDL	Required	Per-series; contains user-definable clock configuration macros
system_psoc63_cm4.c *system_psoc63_cm0plus.c*	Add to the project[1].	Copied from PDL	Required	Per-series and core; system configuration code
startup_psoc63_cm4.s *startup_psoc63_cm0plus.s*	Add to the project[1]. For an unsupported IDE, provide a startup file.	Copied from PDL	Use the file for your IDE	Per-series, core, and IDE; startup code is located in *.cydsn/<IDE>/startup*
startup_psoc63_cm4.s *startup_psoc63_cm0plus.s*				
startup_psoc63_cm4.S *startup_psoc63_cm0plus.S*				
cy8c6xx7_cm4_dual.icf *cy8c6xx7_cm0plus.icf*	Set project options to use the core-specific linker file. For an unsupported IDE, provide a linker file.	Copied from PDL	Use the file for your IDE	Per-series, core, and IDE; linker command file
cy8c6xx7_cm4_dual.scat *cy8c6xx7_cm0plus.scat*				
cy8c6xx7_cm4_dual.ld *cy8c6xx7_cm0plus.ld*				

[1] Add core-specific files to the project for the corresponding core.

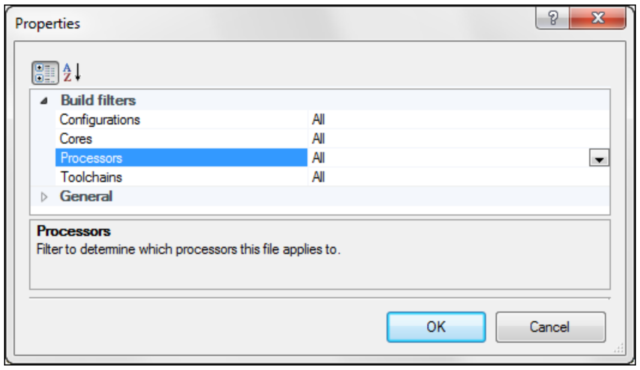
[2] All header files listed in this table are in the same folder, so a single path provides access to all.

Note: Although the default *cyapicallbacks.h* file is empty, there is no easy way to remove it from the project. It is included by another automatically generated header file. If you delete the `#include` statement that includes this header, that statement reappears the next time you generate code.

Note: A PDL template project has user files and paths from the installed PDL location, rather than the generated files (copies) in the *cydsn* folder. When manually importing code, replace the files with the local copies in the *cydsn* folder. See Where to Get PDL User Files.

While some files are core-specific, some are used by each core in a multi-core device. The file *cy_ipc_config.c* is a good example. Each core uses the same file to set up inter-processor communication. When manually importing a shared file into an IDE, the file must be added to the project for each core. If in doubt, right-click a file in the PSoC Creator Workspace Explorer pane and examine its properties to see which core, processor, or toolchain uses the file.

Figure 6. Properties for the *cy_ipc_config.c* File



Properties

Build filters

Configurations	All
Cores	All
Processors	All
Toolchains	All

General

Processors
Filter to determine which processors this file applies to.

4.2.2 Design Files

PSoC Creator automatically generates several files that are specific to your design. In some cases, these files are specific to a supported IDE as well. All design files are in this folder: *cydsn/Generated_Source/PSoC6*.

Design files are described in PSoC Creator Help in the *Building a PSoC Creator Project > Generated Files (PSoC 6)* topic. The design files also include a source and header file for each Component in the design. If a Component is based on a Universal Digital Block (UDB), all the files required to configure and use the Component are among the design files.

These are the key concepts to understand about design files:

- PSoC Creator may change these files any time you generate the application.
- Do not modify these files; any change will be lost when you generate the application.
- Component-specific files are named <Component Name>.h and <Component Name>.c.
- Some files are optional and/or IDE-specific (see Table 4).
- Most design files are shared files. For a multi-core device, add shared files to the project for each core. Any core-specific file identifies the core in the file name.

Table 4 lists design files, and the action required to use a file in your project.

Table 4. PSoC Creator Generated Design Files

File	Action	Usage	Notes
project.h	Provide path to header[1].	Required	Includes all headers listed in this table
<Component Name>.c/h	Add source file to project. Provide path to header.	Required	Header file included by *project.h*
cyfitter.h	Provide path to header.	Required	`#define` for design-specific addresses and values
cyfitter_cfg.c/h	Add source file to the project.. Provide path to header.	Required	Code to configure the device before reaching `main()`
cyfitter_gpio.h	Provide path to header.	Required	`#define` for design-specific addresses and values for pin configuration
cyfitter_sysint.h	Provide path to header.	Required	`#define` for design-specific interrupts
cyfitter_sysint_cfg.c/h	Add source file to project. Provide path to header.	Required	Code to configure system interrupts
cymetadata.c	Add to project.	Required	Defines all extra memory spaces that need to be included.

File	Action	Usage	Notes
cydevice_trm.h	Provide path to header.	Required	Defines all addresses in the configuration space of the device
cydisabledsheets.h	Provide path to header.	Required	`#define` for disabled schematic pages; empty if there are none
cydevicegnu_trm.inc	Include in your assembler code if required.	Optional	Per IDE; defines all addresses in the configuration space of the device for the assembler
cydeviceiar_trm.inc			
cydevicerv_trm.inc			
cycodeshareexport.ld	Set project options to use the script if required.	Optional	Per-IDE; linker script to export or import symbols to/from a different application; typically empty
cycodeshareimport.ld			
cycodeshareimport.scat			

[1] All header files listed in this table are in the same folder, so a single path provides access to all.

The default *main_cm0p.c* and *main_cm4.c* files include *project.h*. The *project.h* file in turn includes all other required headers among the design files. If you provide your own *main.c* files, ensure that you include *project.h*.

Note: Although *cydisabledsheets.h* is typically empty, there is no easy way to remove it from the project. It is included by *project.h*. If you delete the `#include` statement, that statement reappears the next time you generate code.

4.2.3 Library Files

Library files are copies of files from the PDL installation. PSoC Creator automatically copies the required files into subfolders of the *cydsn/Generated_Source/PSoC6/pdl* folder. See the *PDL v3.0 User Guide* to learn about the PDL.

These are the key concepts to understand about library files:

- Only required files are copied, not the entire PDL.
- Some files may be assembler source files, or precompiled binaries.
- PSoC Creator never modifies library files.
- Do not modify these files; any change will be lost when you generate the application.
- Most library files are shared files. For a multi-core device, add shared files to the project for each core. Any core-specific file identifies the core in the file name.

What library files appear in the *pdl* folder tree depends upon your design. Table 5 lists the key locations in the tree, what is in each folder, and how to use those files in a project.

Table 5.PSoC Creator Generated Library Files

Path/Folder	Action	Notes
pdl/cmsis/include	Provide a path to this folder.	CMSIS header files
pdl/devices/psoc6/ip	Provide a path to this folder.	Header files for IP blocks on the device
pdl/devices/psoc6/<series>/include	Provide a path to this folder.	Device-specific header files
pdl/drivers/peripheral	Add source files to project. Provide a path to this folder.	Source and header files for peripheral drivers used in the design; do not add paths to subfolders.
pdl/middleware	Add source files to project. Provide a path to this folder.	Source and header files for the BLE stack; do not add paths to subfolders.

Note: The system library (syslib) peripheral driver has an assembler file as part of its implementation. It must be added to the project along with the C source file. Manually Importing Generated Code – an Example shows you how.

Note: The *pdl/drivers/peripheral* and *pdl/middleware* folders each have subfolders. Do not add paths to each subfolder. The PDL source code provides the path in the `#include` statement. For example, to include the *gpio.h* file, the include statement in the PDL source code is: `#include "gpio/cy_gpio.h"`. So, you only need a path to the *peripheral* folder.

Note: A PDL template project has paths that point to the installed PDL location, rather than the generated files (copies) in the *cydsn* folder. When manually importing files, reset these paths to point to the *cydsn* folder. See Where to Get PDL Library Files.

4.3 Adding Files to a Project

As you identify the files you need, add them to the IDE's project file. Each IDE has its own way of adding a file to a project. For example, the IDE may support drag and drop, or adding a batch of files through the IDE's user interface.

There are three key principles to keep in mind as you add the files:

First, add each file directly from its location in the PSoC Creator *cydsn* folder. This is critical to support iterative development. If you change the design in PSoC Creator, some generated files will change. By pointing the IDE project at the files in the *cydsn* folder, you ensure that any changes to the files appear in your project.

Second, some files are core-specific. Add core-specific files to the corresponding project. For a multi-core device, add shared files to both projects. The file name for a core-specific file identifies the core.

Third, you must add include paths so that the preprocessor can locate required header files. The good news is that most headers are grouped into single folders. Some developers prefer to add the header files to a project for easy access to the file. Even if you do, most IDEs still require that you add include paths for the preprocessor.

4.3.1 Where to Get PDL User Files

Some PSoC Creator generated user files start as copies of default PDL files. Do not use the original PDL files. Use the generated copies in the *cydsn* folder.

User files may be changed by the user. If you change the original PDL file, that change affects any other project using that file. Best practice dictates that you use the copies in the *cydsn* folder. See User Files.

If you start with a PDL template project, you should:

- Remove the user files from the project (they are the originals from the PDL installation).
- Add the same files back to the project from the *cydsn* folder.
- Delete the project-relative path to the */include* folder. It typically looks something like this in an IDE: *../../../include.*
- Add a path to the *cydsn* folder where PSoC Creator puts the user files.

If you start with an empty project, add the files from the *cydsn* folder, and set a path to this folder.

4.3.2 Where to Get PDL Library Files

Library files are copies of the PDL files and should never be changed by the user. Add these files from the *cydsn/Generated_Source/PSoC6/pdl* folder. PSoC Creator copies only the library files you need.

A PDL template project has preset paths to PDL header files that point to original files in the PDL installation, not the generated code. If you start with a PDL template project, you should:

- Delete any project-relative path to the PDL installation.
- Replace with paths to the same locations in the *cydsn/Generated_Source/PSoC6/pdl* folder.

The preset paths may include */cmsis/include*, */ip*, and */drivers/peripheral*.

4.4 Supporting Iterative Development

After you import the generated code and set project options so that the project builds in the IDE, you will encounter the need to change your design. Importing files into an IDE involves some effort, but this is a one-time task.

The key requirement to support iterative development is simple: import the files from the *cydsn* folder. After making design changes in the PSoC Creator project, build the code. Depending on the changes, the code generation process may modify, add, or remove files.

Modified Files

PSoC Creator modifies only design files. If you add the generated code from the *cydsn* folder to your project file, the next build will use the latest version of the files. Rebuild your code in the IDE to update the executable. No additional work is required.

Added or Removed Files

Add any new file (either design file or library file) to your project. Similarly, if a file is no longer necessary, you can remove it from your project file. Then rebuild your code in the IDE to update the executable.

4.5 Manual Import Review

While this section provides significant details about PSoC Creator generated code, the process of manually importing generated code into an IDE project file is quite simple:

1. Identify the generated files you need (user, design, and library).
2. Add them to the project file (from their location in the *cydsn* folder).
3. Set include paths to find the header files.

5 Manually Importing Generated Code – an Example

This section walks you through the process of importing generated code from a relatively complex code example. Because every project and IDE is different, this example is not a series of precise steps and directions.

To gain maximum value from this walk-through, you should download, install, and build (using PSoC Creator) the CE21736 code example. Create a new empty project in an IDE. Then explore the contents of the PSoC Creator *cydsn* folder as you import the code.

A single example cannot cover all eventualities. Among the variables are the choice of project file (template or empty), which IDE to use (many possibilities), the nature of the firmware itself, and the particulars of your build environment.

The information in Manually Importing Generated Code should enable you to make informed decisions for your circumstances. Given the broad number of choices, each of which would result in a different example, this walk-through is based on the following options:

- An empty project file – this approach supports any IDE.
- Keil µVision tools – although this is a supported IDE, this choice provides a contrast to allow users to determine which path is better for their circumstances, CMSIS Pack or manual import.
- CE212736 as the example project – because it provides a rich domain for exploring the choices you face when importing code.

CE212736 – PSoC 6 MCU with Bluetooth Low Energy Connectivity uses the BLE stack, assembler source code, and precompiled binary files, as well as several peripheral drivers. This walk-through does not run the code example on hardware or explain its functionality.

This walk-through imports code into a CM4 project. For a multi-core device, you build both CM0+ and CM4 projects.

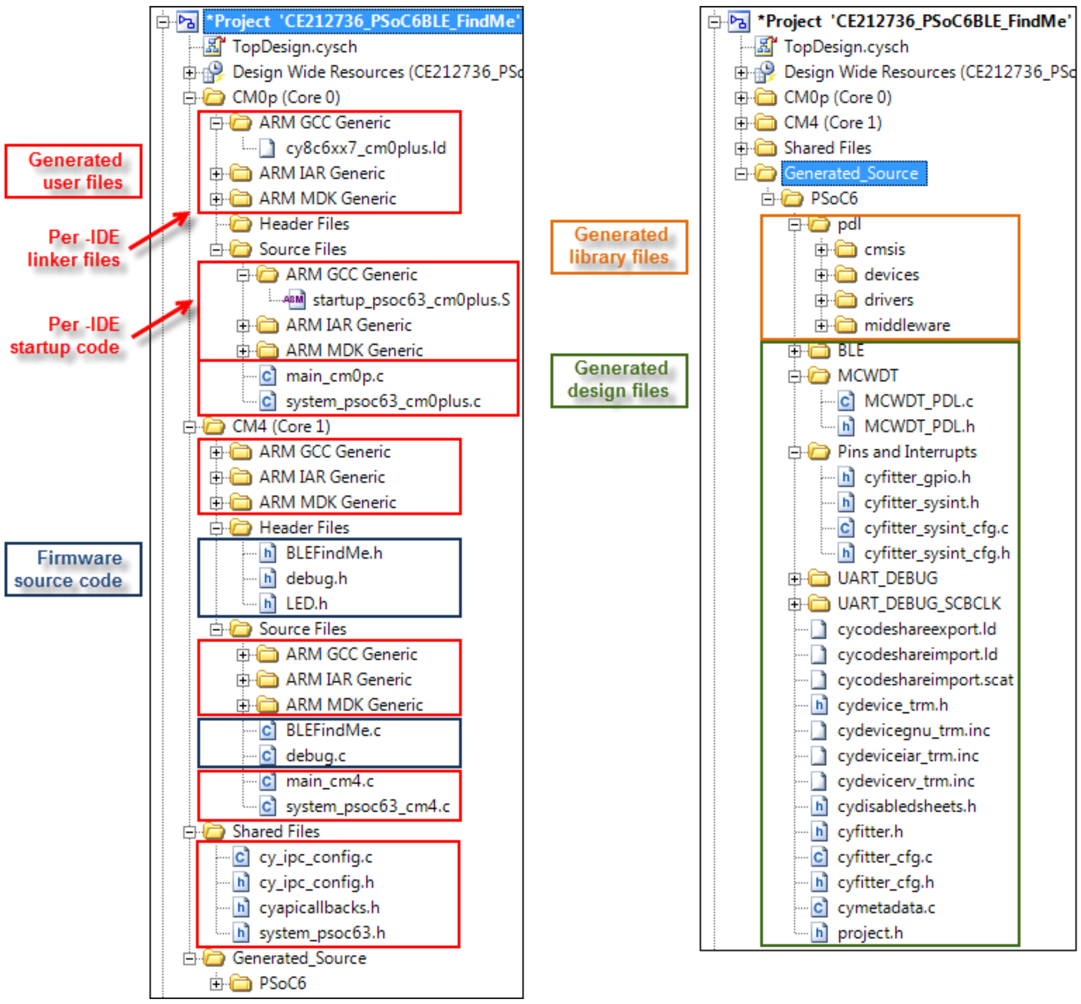
After you complete the design and build the PSoC Creator project, the process is identical for each core:

1. Set up the IDE project file.
2. Add files to the project.
3. Set include paths.
4. Build the project in the IDE.

5.1 Complete the Design and Build the Project

You must be able to successfully generate the application in PSoC Creator before you import to an IDE. Figure 7 shows the PSoC Creator workspace explorer after building the CE212736 project.

Figure 7. PSoC Creator Workspace Explorer



```
*Project 'CE212736_PSoC6BLE_FindMe'
    TopDesign.cysch
    Design Wide Resources (CE212736_PSo
    CM0p (Core 0)
        ARM GCC Generic
            cy8c6xx7_cm0plus.ld
        ARM IAR Generic
        ARM MDK Generic
        Header Files
        Source Files
            ARM GCC Generic
                startup_psoc63_cm0plus.S
            ARM IAR Generic
            ARM MDK Generic
            main_cm0p.c
            system_psoc63_cm0plus.c
    CM4 (Core 1)
        ARM GCC Generic
        ARM IAR Generic
        ARM MDK Generic
        Header Files
            BLEFindMe.h
            debug.h
            LED.h
        Source Files
            ARM GCC Generic
            ARM IAR Generic
            ARM MDK Generic
            BLEFindMe.c
            debug.c
            main_cm4.c
            system_psoc63_cm4.c
    Shared Files
        cy_ipc_config.c
        cy_ipc_config.h
        cyapicallbacks.h
        system_psoc63.h
    Generated_Source
        PSoC6
```

```
*Project 'CE212736_PSoC6BLE_FindMe'
    TopDesign.cysch
    Design Wide Resources (CE212736_PSo
    CM0p (Core 0)
    CM4 (Core 1)
    Shared Files
    Generated_Source
        PSoC6
            pdl
                cmsis
                devices
                drivers
                middleware
            BLE
            MCWDT
                MCWDT_PDL.c
                MCWDT_PDL.h
            Pins and Interrupts
                cyfitter_gpio.h
                cyfitter_sysint.h
                cyfitter_sysint_cfg.c
                cyfitter_sysint_cfg.h
            UART_DEBUG
            UART_DEBUG_SCBCLK
            cycodeshareexport.ld
            cycodeshareimport.ld
            cycodeshareimport.scat
            cydevice_trm.h
            cydevicegnu_trm.inc
            cydeviceiar_trm.inc
            cydevicerv_trm.inc
            cydisabledsheets.h
            cyfitter.h
            cyfitter_cfg.c
            cyfitter_cfg.h
            cymetadata.c
            project.h
```

The *Generated_Source* item in the Workspace Explorer pane contains all the files that are in the project's *cydsn/Generated_Source* folder. This design uses a BLE Component, a multi-counter watchdog timer (MCWDT), and a UART to print debug messages to a terminal window. It also has pins to control LEDs, and sets up system interrupts.

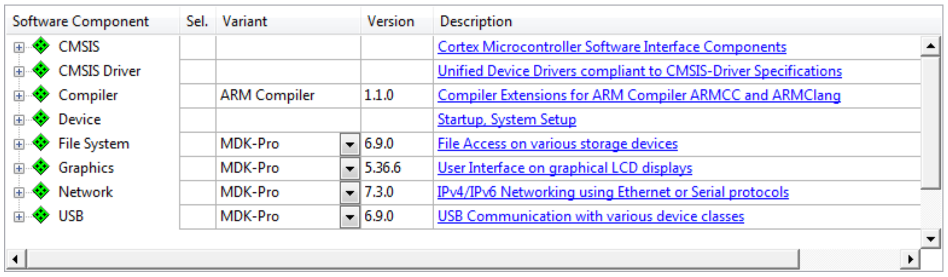
Because this is a complete code example, the project also contains the firmware source code to implement the example. If you prefer to develop code in another IDE, typically you would create these files in the IDE, not in PSoC Creator.

5.2 Set Up the IDE Project File

Create a new project. Typically, the IDE requires that you specify the target device. There are likely to be additional steps in an IDE's project creation process.

For example, in Keil µVision tools, choose **Project** > **New µVision Project**. Specify the target device. After specifying the device, pick software packs. Figure 8 shows an example. For this walk-through, no pack is required.

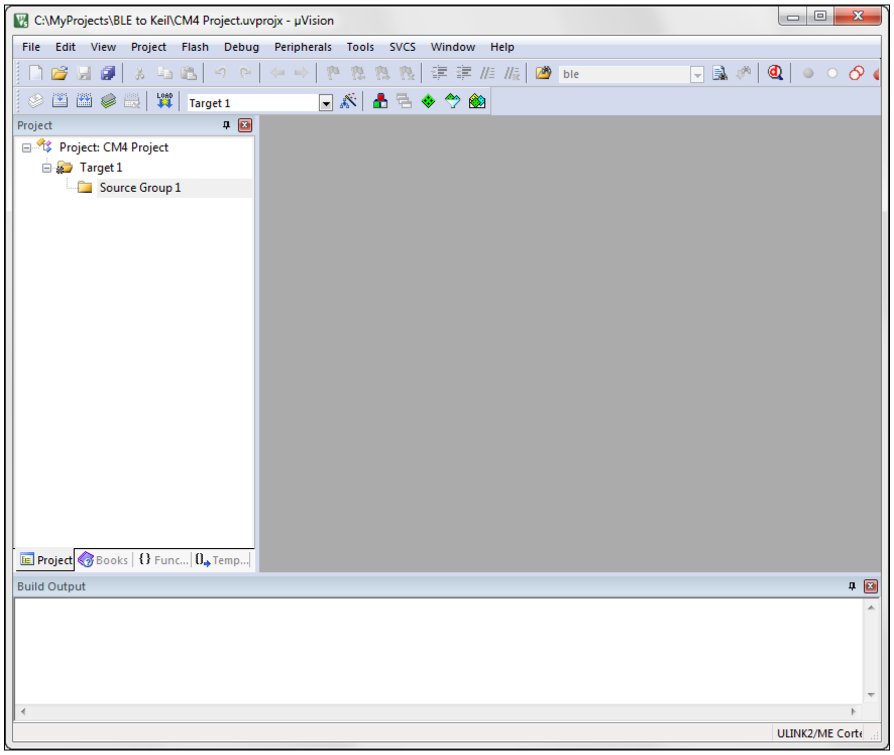
Figure 8. µVision Software Pack Selection



Software Component	Sel.	Variant	Version	Description
CMSIS				Cortex Microcontroller Software Interface Components
CMSIS Driver				Unified Device Drivers compliant to CMSIS-Driver Specifications
Compiler		ARM Compiler	1.1.0	Compiler Extensions for ARM Compiler ARMCC and ARMClang
Device				Startup, System Setup
File System		MDK-Pro	6.9.0	File Access on various storage devices
Graphics		MDK-Pro	5.36.6	User Interface on graphical LCD displays
Network		MDK-Pro	7.3.0	IPv4/IPv6 Networking using Ethernet or Serial protocols
USB		MDK-Pro	6.9.0	USB Communication with various device classes

When done, an empty project appears, as shown in Figure 9. For this example, we named the project as "CM4 Project". When importing code for a multi-core device, you need a project for each core.

Figure 9. An Empty Project in the µVision IDE

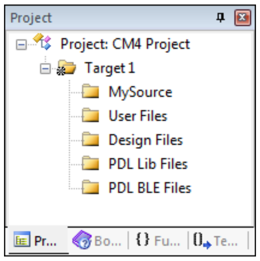


5.3 Add Files to the Project

Identify the files you need and add them to your project. Each IDE has its own workflow for adding files.

An IDE typically has a file explorer pane of some kind. You can add or remove groups within the project to organize your files as you see fit. The guidance in this section is merely that: guidance. You may prefer another organizational scheme. Figure 10 shows the group structure used in this walk-through. It matches the kinds of files PSoC Creator generates, with one exception. Because the BLE stack is a large collection of files, this example puts them in a dedicated group.

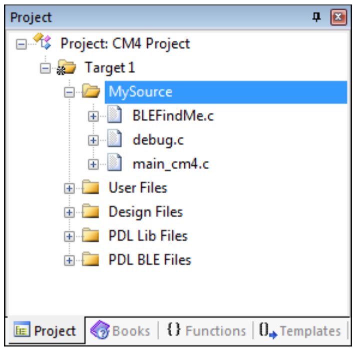
Figure 10. Arbitrary Group Structure in the µVision IDE



5.3.1 Add Firmware Files

Because this walk-through imports a fully-functional code example, we import the firmware files into the MySource group, as shown in Figure 11. The firmware files are all in the *cydsn* folder for the PSoC Creator project. In your own work, you would create your own firmware files, and organize them in the project file as you see fit.

Figure 11. Firmware Files Added to the Project



Note: When repeating this process for the CM0+ project, add files specific to that core.

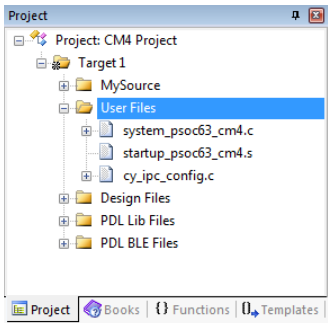
5.3.2 Add User Files

User files are generated by PSoC Creator, but you can change these files. User files are located at the top level of the *cydsn* folder. The startup code is in an IDE-specific folder. See User Files. In this case the user files are:

- A system configuration file (core-specific)
- A startup file (IDE- and core-specific)
- A configuration file for the inter-processor communication peripheral

Figure 12 shows the user files in the project explorer.

Figure 12. User Files Added to the Project



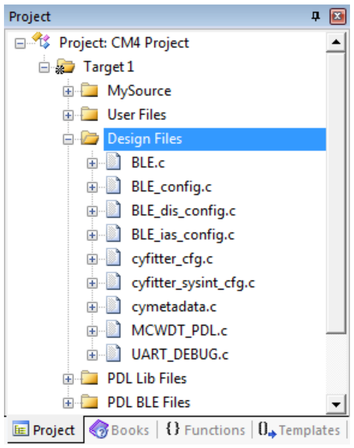
Note: The startup file is IDE-specific assembler source code. The generated code includes the startup code for all supported IDEs. Use the file you need. If you are working with an unsupported IDE, provide your own startup code.

5.3.3 Add Design Files

Design files are the source and header files generated by PSoC Creator specific to your system design and its Components. See 4.2.2 Design Files. Design files are located in the *cydsn/Generated_Source/PSoC6* folder.

Figure 13 shows the design files for this project added to the µVision project. These include the *cyfitter* and *cymetadata* files, as well as the Component-specific source files for the BLE, MCWDT, and UART Components.

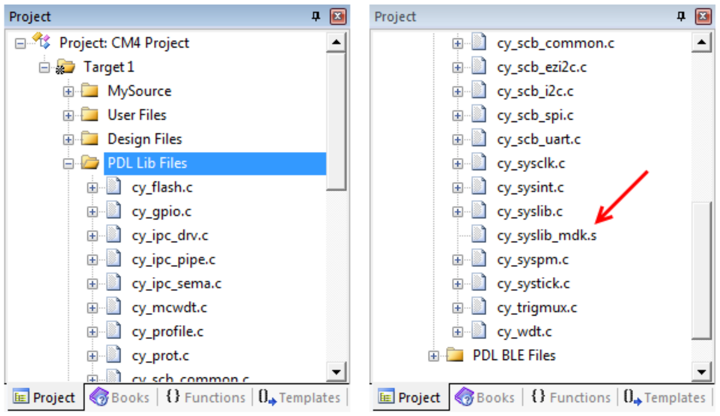
Figure 13. Design Files Added to the Project



5.3.4 Add PDL Library Files

Library files are copied from the PDL installation. See Library Files. Based on your design, PSoC Creator copies required files into the *cydsn/Generated_Source/PSoC6/pdl/drivers/peripheral* folder. Figure 14 shows the peripheral driver files for this project added to the IDE.

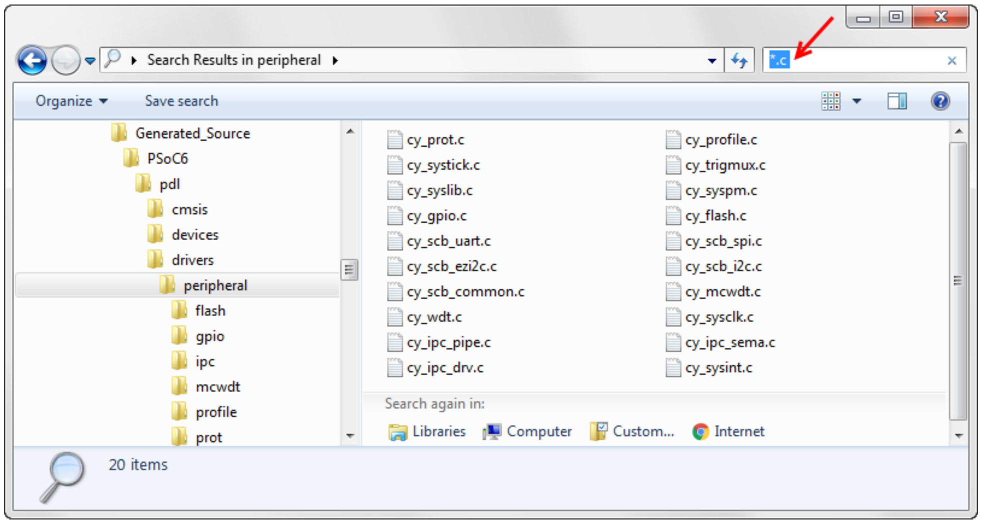
Figure 14. Library Files Added to the Project



Note: The implementation for the system library (syslib) includes an IDE-specific assembler file, called out in Figure 14. If this file is not added to the project, the build fails.

Tip: Each driver has its own subfolder within the *peripheral* folder. Adding source files can be tedious as you navigate up and down the folder structure. If an IDE supports adding files by drag and drop, you can use Windows Explorer to make the task easier. Go to the *peripheral* folder, and search for *.c. All the .c files appear as shown in Figure 15. You can then drag these into the IDE. (Unfortunately, this tip does not work for the µVision IDE.) Don't forget to add the assembly source file as well.

Figure 15. Searching for .c Files



Search Results in peripheral

*.c

Organize ▾ Save search

Generated_Source
PSoC6
pdl
cmsis
devices
drivers
peripheral
flash
gpio
ipc
mcwdt
profile
prot

cy_prot.c	cy_profile.c
cy_systick.c	cy_trigmux.c
cy_syslib.c	cy_syspm.c
cy_gpio.c	cy_flash.c
cy_scb_uart.c	cy_scb_spi.c
cy_scb_ezi2c.c	cy_scb_i2c.c
cy_scb_common.c	cy_mcwdt.c
cy_wdt.c	cy_sysclk.c
cy_ipc_pipe.c	cy_ipc_sema.c
cy_ipc_drv.c	cy_sysint.c

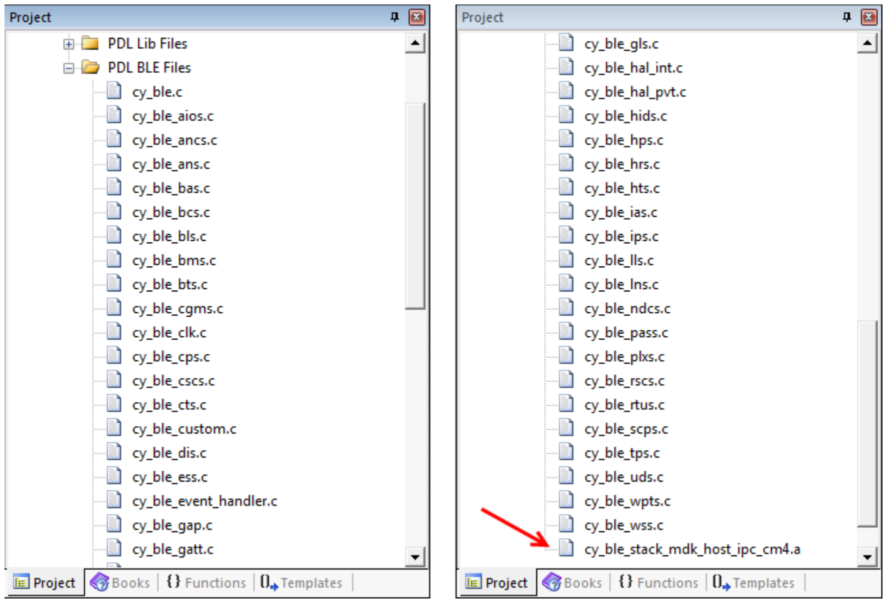
Search again in:
Libraries Computer Custom... Internet

20 items

5.3.5 Add BLE Library Files

The final collection of files used in this design is the BLE stack. The generated code is located at *cydsn/Generated_Source/PSoC6/pdl/middleware/ble* folder. Some parts of the BLE stack are provided as core-specific binary libraries, not source code. All required source files and binary libraries must be added to the project.

Figure 16. BLE Stack Files Added to the Project



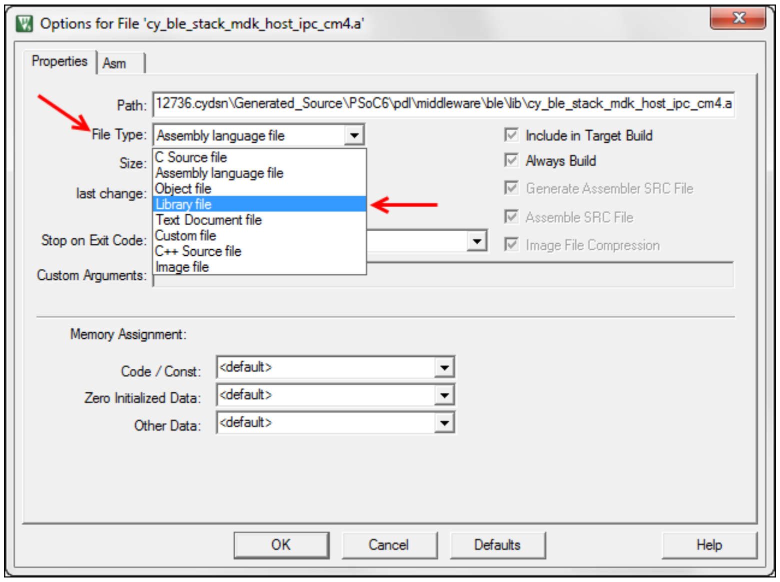
Project
PDL Lib Files
PDL BLE Files
cy_ble.c
cy_ble_aios.c
cy_ble_ancs.c
cy_ble_ans.c
cy_ble_bas.c
cy_ble_bcs.c
cy_ble_bls.c
cy_ble_bms.c
cy_ble_bts.c
cy_ble_cgms.c
cy_ble_clk.c
cy_ble_cps.c
cy_ble_cscs.c
cy_ble_cts.c
cy_ble_custom.c
cy_ble_dis.c
cy_ble_ess.c
cy_ble_event_handler.c
cy_ble_gap.c
cy_ble_gatt.c

Project
cy_ble_gls.c
cy_ble_hal_int.c
cy_ble_hal_pvt.c
cy_ble_hids.c
cy_ble_hps.c
cy_ble_hrs.c
cy_ble_hts.c
cy_ble_ias.c
cy_ble_ips.c
cy_ble_lls.c
cy_ble_lns.c
cy_ble_ndcs.c
cy_ble_pass.c
cy_ble_plxs.c
cy_ble_rscs.c
cy_ble_rtus.c
cy_ble_scps.c
cy_ble_tps.c
cy_ble_uds.c
cy_ble_wpts.c
cy_ble_wss.c
cy_ble_stack_mdk_host_ipc_cm4.a

Note: When repeating this process for the CM0+ project, add libraries specific to that core.

Note: An IDE may treat the library file as an assembler source file rather than a library, which causes build errors. The IDE may have a property to control this. For example, Figure 17 shows the file properties dialog for the µVision IDE.

Figure 17. Setting the File Type in the µVision IDE


Options for File 'cy_ble_stack_mdk_host_ipc_cm4.a'

Path: 12736.cydsn\Generated_Source\PSoC6\pdl\middleware\ble\lib\cy_ble_stack_mdk_host_ipc_cm4.a

File Type: Assembly language file

C Source file
Assembly language file
Object file
Library file
Text Document file
Custom file
C++ Source file
Image file

☑ Include in Target Build
☑ Always Build
☑ Generate Assembler SRC File
☑ Assemble SRC File
☑ Image File Compression

Memory Assignment:

Code / Const: <default>
Zero Initialized Data: <default>
Other Data: <default>

5.4 Set Include Paths

The IDE's build system must locate all necessary header files. Some developers prefer to add header files directly to the project explorer for ease of access. However, this typically does not set include paths for the IDE.

Each IDE has its own way of setting include paths. This example assumes that you know how to add include paths in your preferred IDE. The goal of this section is to show you *what* paths you need to add, not how to add them.

In the µVision IDE, you add paths in the target options C/C++ panel in the **Include Paths** item.

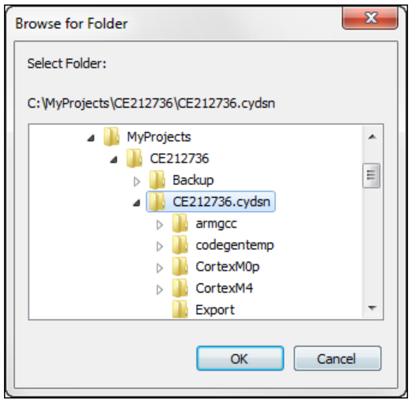
5.4.1 Set a Path to User Files

All header files for the PSoC Creator generated user files are in the *cydsn* folder. The path of course depends upon where you put the PSoC Creator project. In this example, the path for the CE212736 project could look like this:

C:/MyProjects/CE212736/CE212736.cydsn

Figure 18 shows setting that path in the µVision IDE.

Figure 18. Setting the Path to the *cydsn* Folder


Browse for Folder

Select Folder:

C:\MyProjects\CE212736\CE212736.cydsn

Note: In this example, the firmware header files are also in this folder, so there is no need for a separate path for them.

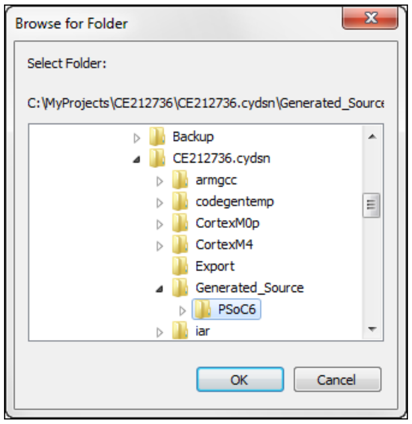
5.4.2 Set a Path to Design Files

All header files for the PSoC Creator generated design files are in the *cydsn/Generated_Source/PSoC6* folder. In this example, the path for the CE212736 project could look like this:

C:/MyProjects/CE212736/CE212736.cydsn/Generated_Source/PSoC6

Figure 19 shows setting that path in the µVision IDE.

Figure 19. Setting the Path to the Design Files


Browse for Folder

Select Folder:

C:\MyProjects\CE212736\CE212736.cydsn\Generated_Source

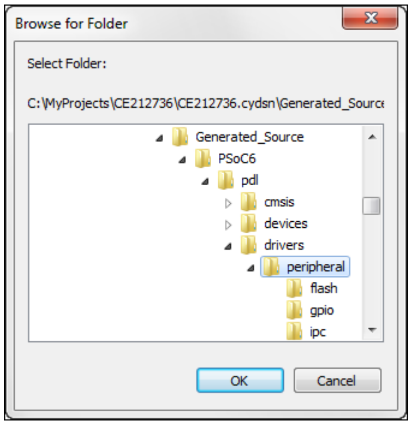
5.4.3 Set a Path to *peripheral* Folder (Driver Files)

Although each peripheral driver has its own subfolder, the source code provides the path to include any header file within the peripheral folder. As a result, a single path works for all locations in this folder tree. In this example, the path for the CE212736 project could look like this:

C:/MyProjects/CE212736/CE212736.cydsn/Generated_Source/PSoC6/pdl/drivers/peripheral

Figure 20 shows setting that path in the µVision IDE.

Figure 20. Setting the Path to the PDL Driver Library


Browse for Folder

Select Folder:

C:\MyProjects\CE212736\CE212736.cydsn\Generated_Source

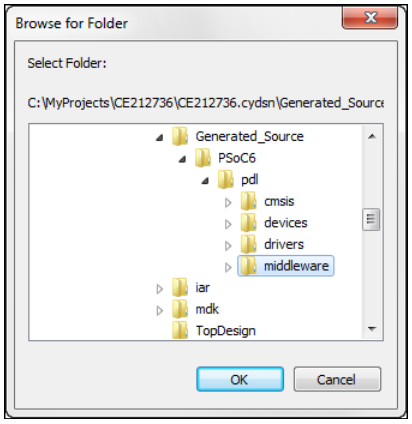
5.4.4 Set a Path to the *middleware* Folder (BLE Stack)

Although the BLE stack is in a subfolder, the source code provides the path to include any header file within the *middleware* folder. As a result, a single path works for all locations in this folder tree. In this example, the path for the CE212736 project could look like this:

C:/MyProjects/CE212736/CE212736.cydsn/Generated_Source/PSoC6/pdl/middleware

Figure 21 shows setting that path in the µVision IDE.

Figure 21. Setting the Path to the BLE Stack



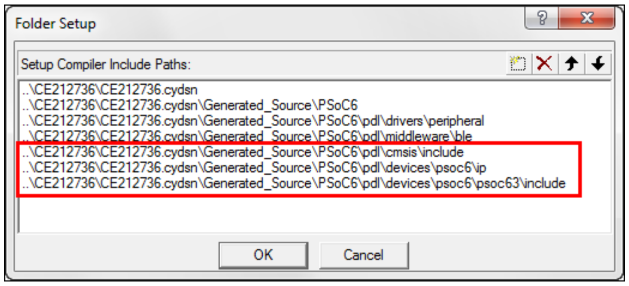
5.4.5 Set Other Required Paths

There are other header files that must be included for a successful build. PSoC Creator provides copies of these header files in the *cydsn/Generated_Source/PSoC6/pdl* folder:

- CMSIS header files: *cydsn/Generated_Source/PSoC6/pdl/cmsis/include*
- The ip header files: *cydsn/Generated_Source/PSoC6/pdl/devices/psoc6/ip*
- Series-specific header files: *cydsn/Generated_Source/PSoC6/pdl/devices/psoc6/<series>/include*

Figure 22 shows these three paths set in the µVision IDE, pointing to the generated code.

Figure 22. Paths to Other Required Header Files



```
..\CE212736\CE212736.cydsn
..\CE212736\CE212736.cydsn\Generated_Source\PSoC6
..\CE212736\CE212736.cydsn\Generated_Source\PSoC6\pdl\drivers\peripheral
..\CE212736\CE212736.cydsn\Generated_Source\PSoC6\pdl\middleware\ble
..\CE212736\CE212736.cydsn\Generated_Source\PSoC6\pdl\cmsis\include
..\CE212736\CE212736.cydsn\Generated_Source\PSoC6\pdl\devices\psoc6\ip
..\CE212736\CE212736.cydsn\Generated_Source\PSoC6\pdl\devices\psoc6\psoc63\include
```

Note: If you start with a PDL template project, these three paths may already be set for you. However, they point to the original files in the PDL installation, not the generated code. You should modify these paths to point to the corresponding locations in the *cydsn* folder. See Where to Get PDL Library Files.

5.5 Build the Project in the IDE

Before compiling the code, you must configure all options required for your application to build successfully. This application note is about how to import generated code into an IDE, not about how to configure a project in any given IDE. However, Configuring an IDE Project File provides additional background.

With all the required files added and all paths set correctly, build your project. It should build successfully. You may encounter warnings or errors. Each IDE has a unique interface, as well as unique options, default settings, and warning and error messages. Because of the variability in IDEs, this application note cannot provide detailed guidance on handling errors. Your familiarity with your IDE will go a long way towards resolving any issues you encounter.

Related to importing code, however, there are typically three kinds of errors you may encounter.

If a “file not found” error occurs for a header file, locate the actual file in your file system. Ensure that there is an include path for that file.

If a function or symbol is undefined, make sure all user, design, and library files have been added to the project, and that any header file that declares the symbol is found. For example, failing to include binary libraries causes this kind of error.

Even when all files and paths are correct, you may get a cascade of compiler or linker errors. There may be a setting in your project not configured correctly. For example, if the compiler in the IDE does not default to supporting the C99 standard, ensure that support is enabled.

5.6 Example Review

This section provided an example of importing code manually into an IDE. While a single example cannot cover all situations, the tasks are straightforward:

1. Create and configure a project file in the IDE, one per core for a multi-core device. Or, start with a PDL template project.
2. Add the required PSoC Creator generated files to the project file (for a multi-core device, do this for each core).
3. Set include paths for those files.

PDL template projects provide flash configuration, linker, and startup files. If you prefer an unsupported IDE, use those as a reference. The IDE-specific files are located here: *<PDL Install Folder>/devices/psoc6/<series>/common*.

Finally, this application note teaches you the basic principles of importing code, such as what files exist, where to find them, and how to use them. You will need to apply this knowledge to your circumstances.

6 Summary

Writing software for a dual-core embedded system, like the PSoC 6 MCU, can be a daunting task. PSoC Creator simplifies that process. You create and configure a design using a friendly UI. PSoC Creator generates all the code required to implement that design, literally at the click of a button. You focus on real value, creating firmware on top of that generated code.

You can develop that firmware entirely in PSoC Creator, but many developers and organizations have a preferred development system.

This application note showed you how to use PSoC Creator generated code in a third-party IDE: either a supported IDE via export and import, or any IDE via manually importing the required files. You learned about the different kinds of generated files, where to find the files, and how to add them to the IDE's project.

The knowledge contained in this application note enables you to combine the best of both worlds: high-quality generated code to shorten development time, and your preferred IDE.

7 Related Documents

Application Notes	
AN210781 – Getting Started with PSoC 6 MCU with Bluetooth Low Energy (BLE) Connectivity	Describes PSoC 6 MCU with BLE Connectivity devices and how to build your first PSoC Creator project
AN215656 – PSoC 6 MCU: Dual-Core CPU System Design	Describes the dual-core CPU architecture in PSoC 6 MCU, and shows how to build a simple dual-core design
AN225588 – PSoC 6 MCU Importing Generated Code into an IDE	Describes the analogous process for ModusToolbox software and configurators, rather than the PDL and PSoC Creator
PSoC 6 MCU	
PSoC 6 MCU home page	Provides access to all PSoC 6 MCU resources
PSoC 6 MCU community	Discusses PSoC 6 MCU questions
Peripheral Driver Library (documents installed with the PDL)	
Peripheral Driver Library v3.0 User Guide	Overview of the library and how to use it
Peripheral Driver Library API Reference	Detailed technical reference for the API
PSoC Creator	
PSoC Creator Product Page	Access to downloads, training, components, and more
PSoC Creator Quick Start Guide	Get up and running quickly
PSoC Creator User Guide	Comprehensive manual
Development Kit Documentation	
CY8CKIT-062-BLE PSoC 6 BLE Pioneer Kit	

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Appendix A. Configuring an IDE Project File

For the code to build successfully, you must configure the IDE project file with settings for various options. Because each IDE has a unique UI and default settings, how to configure an empty project for any particular IDE is beyond the scope of this application note. However, a general concept of what you need to configure is invaluable. Armed with that knowledge, you can locate and set the appropriate options in the IDE.

Table 6 lists several options required to configure an IDE project file. For any given IDE, there may be additional options. The default setting for any option may already be set correctly.

Table 6. IDE Options

Type	Option	Notes
Device	Target	If the IDE supports a particular device, select the device. This typically sets other device-dependent options automatically. If the device is not listed in the IDE, choose a generic Cortex M4 or M0+ device, and ensure that all device-dependent options are set correctly.
Compiler	C99 Support	Enable support for the C99 standard.
	Floating Point	Enable floating point support for the CM4 core.
	Optimizations	Set the compiler optimization level appropriate for your build.
	Debugging	Generate debug information for a debug build.
	Include Paths	Set include paths. This application note discusses all paths related to generated code.
	Debug Symbol	Conditionally-compiled PDL code requires a debug symbol be defined. For a debug build, define DEBUG. For a non-debug build, define NDEBUG.
	Device Symbol	Conditionally-compiled device-specific PDL code requires the correct symbol be defined. This symbol controls which device-specific header file is used for the build. See *cy_device_headers.h*.
Linker	Command File	Specify the path to the linker script. The PDL provides linker files for supported IDEs. If the IDE has device-specific support, this may be set automatically.
	Other Settings	Set other linker options for your build. For example, generate a linker map file, output debug information, generate a log file, and so forth.
Debugger	Debug Connection	Specify a supported debug connection (probe), such as J-Link or CMSIS-DAP.
	Connection Settings	Based on your debug connection, specify various connection settings such as reset options, connection speed, cache options, download options, and so forth.
	Memory Configuration	Specify memory regions for the device. If the IDE has device-specific support, this may be set automatically.
	Register Description	The PDL provides a system view description (SVD) file for register-level debug information. If the IDE has device-specific support, this may be set automatically.
	Flashloader	Specify the flashloader to use for downloading the executable to the device. If the IDE has device-specific support, this may be set automatically.

Appendix B. Using Generated Code for Learning

Even if you cannot import PSoC Creator generated code because of your circumstances, that code is still a valuable resource to assist firmware development.

In this case, the principal value of the PSoC Creator generated code is as a learning resource for how to use the PDL. There are several areas in which this is a significant help, including but not limited to:

- Clock configuration – see *system_<series>_cm0plus.c*, *system_<series>_cm4.c*, and *cyfitter_cfg.c*
- Interrupt configuration – see *cyfitter_sysint_cfg.c*
- Pin configuration – see *cyfitter_gpio.h* and *cyfitter_cfg.c*
- Inter-processor communication configuration – see *cy_ipc_config.c*
- Peripheral configuration – see the Component-specific .c and .h files
- PDL function API – see the Component-specific .c and .h files

In each case, you can extract code snippets, particular functions, algorithms, or even complete files from within the generated code and use them in your own code. For example, you may choose to copy the configuration structures for a peripheral, or refer to these structures as you write your own code.

PSoC Creator generates a Component-specific API on top of the PDL API. The Component API typically has a function defined that maps 1:1 to the PDL API. The Component API provides required hardware parameters based on the design. It also typically includes `start()` and `stop()` functions that make PDL API calls (in the correct sequence) required to initialize, enable, or terminate a particular peripheral. You can explore the Component API to see how it uses the PDL API.

In addition, because most of the PDL is provided as source code, you can explore the PDL source files to see what registers are used to control features and behavior.

There are dependencies among the various generated code files. The code generation process defines symbols and uses its own naming conventions. It creates a complete API for each Component. You decide how much to use directly, and how much to adapt to fit your firmware development processes.

Document History

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*A	5833896	JETT	07/26/2017	First public release.
*B	6003554	JETT	01/09/2018	Updated to new AN template Updated for PSoC Creator UI change for IDE-specific files Updated to allow for single-core devices
*C	6540539	JETT	04/16/2019	Added discussion of ModusToolbox software and analogous process Added discussion of tool compatibility with PSoC Creator and PSoC Programmer Update to latest AN template

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