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Getting Started with PSoC 6 MCU on ModusToolbox

Author: Srinivas Nudurupati
Associated Part Family: All PSoC® 6 MCU devices
Software Version: ModusToolbox® 2.2 or above
See Related Application Notes and Code Examples

More code examples? We heard you.
To access an ever-growing list of PSoC code examples using ModusToolbox, please visit the Cypress GitHub site. You can also explore the PSoC video library here.

AN228571 introduces the PSoC 6 MCU, a dual-CPU programmable system-on-chip with Arm® Cortex®-M4 and Cortex-M0+ processors. This application note helps you explore the PSoC 6 MCU architecture and development tools and shows you how to create your first project using the Eclipse IDE for ModusToolbox. This application note also guides you to more resources available online to accelerate your learning about PSoC 6 MCU.

Contents
1 Introduction ......................................................... 1
2 Development Ecosystem ........................................ 4
  2.1 PSoC Resources ............................................. 4
  2.2 Firmware/Application Development ...................... 4
  2.3 Support for Other IDEs ..................................... 10
  2.4 FreeRTOS Support with ModusToolbox .................. 10
  2.5 Programming/Debugging .................................. 10
  2.6 PSoC 6 MCU Development Kits .......................... 11
3 Device Features ................................................ 12
4 My First PSoC 6 MCU Design Using
   Eclipse IDE for ModusToolbox .............................. 13
  4.1 Prerequisites .................................................. 13
  4.2 Using These Instructions .................................. 13
4.3 About the Design ............................................. 13
  4.4 Part 1: Create a New Application ......................... 14
  4.5 Part 2: View and Modify the Design ..................... 16
  4.6 Part 3: Write Firmware .................................... 19
  4.7 Part 4: Build the Application ............................ 25
  4.8 Part 5: Program the Device ............................... 25
  4.9 Part 6: Test Your Design .................................. 26
5 Summary ......................................................... 29
6 Related Application Notes and Code Examples ............ 29
  Appendix A. Glossary ........................................... 30
  Document History ............................................... 31
  Worldwide Sales and Design Support ........................ 32

1 Introduction

PSoC 6 MCU is Cypress’ ultra-low-power PSoC device with a dual-CPU architecture tailored for smart homes, IoT gateways, etc. The PSoC 6 MCU device is a programmable embedded system-on-chip that integrates the following features on a single chip:

- Single-CPU microcontroller: Arm Cortex-M4 (CM4); or dual-CPU microcontroller: Arm Cortex-M4 (CM4) and Cortex-M0+ (CM0+)
- Programmable analog and digital peripherals
- Up to 2 MB of flash and 1 MB of SRAM
- Fourth-generation CapSense® technology
- PSoC 6 MCU is suitable for a variety of power-sensitive applications such as:
  - Smart home sensors and controllers
  - Smart home appliances
  - Gaming controllers
  - Sports, smart phone, and virtual reality (VR) accessories
  - Industrial sensor nodes
Getting Started with PSoC 6 MCU on ModusToolbox

- Industrial logic controllers
- Advanced remote controllers
- Wearables

The ModusToolbox® Software Environment supports PSoC 6 MCU application development with a set of tools for configuring the device, setting up peripherals, and complementing your projects with world-class middleware, see the cypresssemiconductorco GitHub repos for BSPs for all the Cypress kits, libraries for popular functionality like CapSense and emWin, and a comprehensive array of example applications to get you started.

**Figure 1** illustrates an application-level block diagram for a real-world use case using PSoC 6 MCU.

**Figure 1. Application-Level Block Diagram Using PSoC 6 MCU**

PSoC 6 MCU is a highly capable and flexible solution. For example, the real-world use case in **Figure 1** takes advantage of these features:

- A buck converter for ultra-low-power operation
- An analog front end (AFE) within the device to condition and measure sensor outputs such as ambient light sensor
- Serial Communication Blocks (SCBs) to interface with multiple digital sensors such as motion sensors
- CapSense technology for reliable touch and proximity sensing
- Programmable Digital logic (Universal Digital Blocks or UDBs) and peripherals (Timer Counter PWM or TCPWM) to drive the display and LEDs respectively
- SDIO interface to a Cypress Wi-Fi/BT device to provide IoT cloud connectivity
- Product security features managed by CM0+ CPU and application features executed by CM4 CPU

There are four product lines in PSoC 6 which cater to different application needs. **Table 1** provides overview of different product lines:
Table 1. PSoC 6 MCU Product Lines

<table>
<thead>
<tr>
<th>Product Line</th>
<th>Security Firmware</th>
<th>Device Series</th>
<th>Details</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programmable</td>
<td>No</td>
<td>CY8C61x</td>
<td>Single core: 150-MHz Arm Cortex-M4</td>
<td>IoT gateways, smart home, home appliances, HMI, audio processing, and industrial concentrators</td>
</tr>
<tr>
<td>Performance</td>
<td>No</td>
<td>CY8C62x</td>
<td>Dual-core architecture: 150-MHz Arm Cortex-M4 and 100-MHz Cortex-M0+</td>
<td>Wearables, portable medical, industrial IoT, and smart home</td>
</tr>
<tr>
<td>Connectivity</td>
<td>No</td>
<td>CY8C63x</td>
<td>• Dual-core architecture: 150-MHz Arm Cortex-M4 and 100-MHz Cortex-M0+</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Bluetooth Low Energy (BLE) 5.0 radio with 2-Mbps data throughput</td>
<td></td>
</tr>
<tr>
<td>Security</td>
<td>Secure Boot</td>
<td>CYB064x</td>
<td>• 150-MHz Arm Cortex-M4 for the user application</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Hardware isolated, 100-MHz Arm Cortex-M0+ with privileged access to memory and peripherals for security functions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Bluetooth Low Energy (BLE) 5.0 radio with 2-Mbps data throughput</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Arm Platform Security Architecture Certifications- PSA L1, FIPS 140-2</td>
<td></td>
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<tr>
<td>AWS Standard Secure</td>
<td></td>
<td>CYS064x</td>
<td>• 150-MHz Arm Cortex-M4 for the user application</td>
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<td>• Hardware isolated, 100-MHz Arm Cortex-M0+ with privileged access to memory and peripherals for security functions</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Arm Platform Security Architecture Certifications- PSA L2*, FIPS 140-2*</td>
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</tbody>
</table>

* Available in future. Refer product page for the details.

Note that not all the features available in all the devices in a product line. See the device datasheets for more details.

This application note introduces you to the capabilities of the PSoC 6 MCU, gives an overview of the development ecosystem, and gets you started with a simple 'Hello World' application wherein you learn to use the PSoC 6 MCU. We will show you how to create the application from an empty starter application, but the completed design is available as a code example for ModusToolbox on GitHub.

For hardware design considerations, see AN218241 – PSoC 6 MCU Hardware Design Considerations.
2 Development Ecosystem

2.1 PSoC Resources

Cypress provides a wealth of data at www.cypress.com to help you to select the right PSoC device and quickly and effectively integrate it into your design. For a comprehensive list of PSoC 6 MCU resources, see How to Design with PSoC 6 MCU - KBA223067 in the Cypress community. The following is an abbreviated list of resources for PSoC 6 MCU.

- **Overview:** PSoC Portfolio, PSoC Roadmap
- **PSoC 6 MCU Webpage**
- **Product Selectors:** PSoC 6 MCU
- **Datasheets** describe and provide electrical specifications for each device family.
- **Application Notes and Code Examples** cover a broad range of topics, from basic to advanced level. You can also browse our collection of code examples. See Code Examples.
- **Technical Reference Manuals (TRMs)** provide detailed descriptions of the architecture and registers in each device family.
- **PSoC 6 MCU Programming Specification** provides the information necessary to program the nonvolatile memory of PSoC 6 MCU devices.
- **CapSense Design Guides:** Learn how to design capacitive touch-sensing applications with PSoC devices.
- **Development Tools:** Cypress provides many low-cost kits and shield boards for evaluation, design, and development of different applications using PSoC 6 MCUs.
- **Training Videos:** Cypress provides video training on our products and tools, including a dedicated series on PSoC 6 MCU.
- **Technical Support:** PSoC6 Community Forum, Knowledge Base Articles

2.2 Firmware/Application Development

Cypress provides two development platforms that you can use for application development with PSoC 6 MCU:

- **ModusToolbox:** ModusToolbox software includes configuration tools, low-level drivers, middleware libraries, and operating system support, as well as other packages that enable you to create MCU and wireless applications. It also includes an Eclipse IDE, which provides an integrated flow with all the ModusToolbox tools. ModusToolbox supports stand-alone device and middleware configurators that are fully integrated into the Eclipse IDE. Use the configurators to set the configuration of different blocks in the device and generate code that can be used in firmware development. ModusToolbox supports all PSoC 6 MCU devices. It is recommended that you use ModusToolbox for all application development for PSoC 6 MCUs. See the ModusToolbox User Guide for more information.

  Cypress provides libraries and enablement software at the Cypress GitHub site.

  Cypress software resources available at GitHub support one or more of the target ecosystems:

  - MCU and Bluetooth SoC ecosystem – a full-featured platform for PSoC 6 MCU, Bluetooth, and Bluetooth Low Energy application development
  - Mbed OS ecosystem – provides an embedded operating system, transport security and cloud services to create connected embedded solutions
  - Amazon FreeRTOS ecosystem – extends the FreeRTOS kernel with software libraries that make it easy to securely connect small, low-power devices to AWS cloud services

  ModusToolbox tools and resources can also be used in the command line. Please refer to the Using Command Line section in the ModusToolbox User Guide for detailed documentation.

- **PSoC Creator:** A Cypress-proprietary IDE that runs on Windows only. It supports a subset of PSoC 6 MCU devices as well as other PSoC device families such as PSoC 3, PSoC 4, and PSoC 5LP. See AN221774 Getting Started with PSoC 6 on PSoC Creator for more information.

2.2.1 Choosing an IDE

ModusToolbox, the latest-generation toolset, includes the Eclipse IDE and therefore is supported across Windows, Linux, and macOS platforms. Eclipse IDE for ModusToolbox is integrated with quick launchers for tools and design configurators in the Quick Panel. ModusToolbox also supports 3rd-party IDEs, including Visual Studio Code, Arm MDK (µVision), and IAR Embedded Workbench. The tool supports all PSoC 6 MCU devices. The associated hardware and middleware configurators also work on all three host operating systems.

Certain features of PSoC 6 MCU such as UDBs and USB host are not currently supported in ModusToolbox. Cypress will release new versions of ModusToolbox in the future to support these features and improve the user experience.
Use ModusToolbox to take advantage of the power and extensibility of an Eclipse-based IDE. ModusToolbox is supported on Windows, Linux, and macOS. It is recommended to use ModusToolbox if you want to build an IoT application using Cypress IoT devices, or if you are using a PSoC 6 MCU device not supported on PSoC Creator.

PSoC Creator is the long-standing Cypress-proprietary tool that runs on Windows only. This mature IDE includes a graphical editor that supports schematic based design entry with the help of Components. PSoC Creator supports all PSoC 3, PSoC 4, and PSoC 5LP devices, and a subset of PSoC 6 MCU devices.

Choose PSoC Creator if you are inclined towards using a graphical editor for design entry and code generation, and if the PSoC MCU that you are planning to use is supported by the IDE or if you are intending to use the UDBs on the PSoC MCU.

2.2.2 ModusToolbox Software

ModusToolbox is a set of tools and software that enables an immersive development experience for creating converged MCU and wireless systems and enables you to integrate Cypress devices into your existing development methodology. To achieve this goal, ModusToolbox leverages popular third-party ecosystems such as FreeRTOS and Arm Mbed, and adds Cypress-specific features for Wi-Fi, Bluetooth, CapSense, and security.

Eclipse IDE for ModusToolbox is a multi-platform development environment that supports application configuration and development.

Figure 2 shows a high-level view of the tools/resources included in the ModusToolbox software. For a more in-depth overview of the ModusToolbox software, see ModusToolbox User Guide.

![Figure 2. ModusToolbox Software](image)

ModusToolbox installer includes the design configurators and tools, and the build system infrastructure. The build system infrastructure includes the new project creation wizard that can be run independent of the Eclipse IDE, the make infrastructure, and other tools.
ModusToolbox provides four reference flows for firmware development using PSoC 6 MCU and other Cypress Wi-Fi/BT devices.

1. FreeRTOS Development Flow – FreeRTOS is an open source operating system for microcontrollers that makes small, low-power edge devices easy to program, deploy, secure, connect, and manage. FreeRTOS extends the FreeRTOS kernel, a popular open source operating system for microcontrollers, with software libraries that make it easy to securely connect small, low-power devices to AWS cloud services like AWS IoT Core or to more powerful edge devices running AWS IoT Greengrass.

To get started with firmware development on PSoC 6 MCU using Amazon FreeRTOS, visit Getting Started with FreeRTOS.

2. Arm Mbed OS Development Flow – Arm Mbed OS is a free, open-source embedded operating system designed specifically for the “things” in the Internet of Things. It includes all the features you need to develop a connected product based on an Arm Cortex-M microcontroller, including security, connectivity, an RTOS, and drivers for sensors and I/O devices.

To get started with firmware development on PSoC 6 using Mbed OS, refer to Getting Started with PSoC 6 MCU and CYW43xxx in Mbed OS.

3. MCU and Bluetooth SoC ecosystem – This is the native development flow supported by the Eclipse IDE for ModusToolbox for PSoC 6 MCU. You can use it on the bare metal or with an RTOS of your choosing.

4. AnyCloud Development Flow – AnyCloud is a collection of libraries that is based on industry-standard lwIP TCP/IP stack and Mbed TLS network security. It enables rapid development of Wi-Fi and Bluetooth applications on PSoC 6 MCU devices. AnyCloud enables development with custom or alternative third-party cloud management approaches with a fully open, customizable, and extensible source code distribution. AnyCloud includes Wi-Fi Connection Manager, Wi-Fi Middleware Core, Wi-Fi Host Driver, FreeRTOS kernel, RTOS Abstraction library, MQTT, OTA, LPA, Secure Sockets, and Bluetooth Stack.

To get started with AnyCloud on PSoC 6 MCU, refer to the AnyCloud code examples on the cypressesemiconductorco GitHub repo.

All the above development flows depend on Cypress-provided low level resources. These include:

- **Board Support Packages (BSP)** – A BSP is the layer of firmware containing board-specific drivers and other functions. The board support package is a set of libraries that provide APIs to initialize the board and provide access to board level peripherals. It includes low-level resources such as Peripheral Driver Library (PDL) for PSoC 6 MCU and has macros for board peripherals. It uses the HAL to configure the board. Custom BSPs can be created to enable support for end-application boards. Refer to the Board support Packages section in ModusToolbox User Guide for more information.

- **Hardware Abstraction Layer (HAL)** – The Cypress Hardware Abstraction Layer (HAL) provides a high-level interface to configure and use hardware blocks on Cypress MCUs. It is a generic interface that can be used across multiple product families. The focus on ease-of-use and portability means the HAL does not expose all the low-level peripheral functionality. The HAL wraps the lower level drivers (like PSoC 6 PDL) and provides a high-level interface to the MCU. The interface is abstracted to work on any MCU. This helps you write application firmware independent of the target MCU. The HAL can be combined with platform-specific libraries (such as PSoC 6 PDL) within a single application. You can leverage the HAL’s simpler and more generic interface for most of an application, even if one portion requires finer-grained control.

- **PSoC 6 Peripheral Driver Library (PDL)** – The Cypress PDL integrates device header files, startup code, and peripheral drivers into a single package. The PDL supports the PSoC 6 MCU device family. The drivers abstract the hardware functions into a set of easy-to-use APIs. These are fully documented in the PDL API Reference. The PDL reduces the need to understand register usage and bit structures, thus easing software development for the extensive set of peripherals in the PSoC 6 MCU series. You configure the driver for your application, and then use API calls to initialize and use the peripheral.

- Extensive middleware libraries that provide specific capabilities to an application. The available middleware spans across connectivity (Bluetooth, AWS IoT, BLE, Secure Sockets) to PSoC 6-specific functionality (CapSense, USB, device firmware upgrade (DFU), emWin). All the middleware is delivered as libraries and via Cypress GitHub repositories.
2.2.3 **PSoC 6 Software Resources**

The PSoC 6 software includes driver and middleware configurators to get you started developing firmware with PSoC 6 MCU. It contains Configurators, drivers, libraries, middleware, as well as various utilities, makefiles, and scripts. It also includes relevant drivers, middleware, and examples for use with Cypress IoT devices and connectivity solutions. You may use any or all tools in any environment you prefer.

2.2.3.1 **Configurators**

ModusToolbox software provides graphical applications called Configurators that make it easier to configure a hardware block. For example, instead of having to search through all the documentation to configure a serial communication block as a UART with a desired configuration, open the appropriate Configurator and set the baud rate, parity, and stop bits. Upon saving the hardware configuration, the tool generates the "C" code to initialize the hardware with the desired configuration.

Configurators are independent of each other, but they can be used together to provide flexible configuration options. They can be used stand alone, in conjunction with other tools, or within a complete IDE. Configurators are used for:

- Setting options and generating code to configure drivers
- Setting up connections such as pins and clocks for a peripheral
- Setting options and generating code to configure middleware

For PSoC 6 MCU applications, the available Configurators include:

- **Device Configurator**: Set up the system (platform) functions, as well as the basic peripherals (e.g., UART, Timer, PWM).
- **CapSense Configurator and Tuner**: Configure CapSense and generate the required code.
- **USB Configurator**: Configure USB settings and generate the required code.
- **QSPI Configurator**: Configure external memory and generate the required code.
- **Smart I/O Configurator**: Configure the Smart I/O.
- **BLE Configurator**: Configure the Bluetooth Low Energy (BLE) settings.

Each of the above configurators create their own files (e.g.: `design.cycapsense` for CapSense). The configurator files (`design.modus` or `design.cycapsense`) are usually provided with the BSP. When an application is created based on a BSP, the files are copied into the application. You can also create custom device configurator files for an application and override the ones provided by the BSP. See ModusToolbox Help for more details.

2.2.3.2 **Library Management for PSoC 6 MCU**

With the release of ModusToolbox v2.2, there are now two flows for developing applications: MTB Flow and LIB Flow. The difference between the two flows is the way BSPs and libraries are structured.

**MTB Flow**: This is the new flow for all new applications using MTB 2.2; it is recommended to use this flow for developing applications. Using this flow, applications can optionally share Board Support Packages (BSPs) and libraries. If needed, different applications can use different versions of the same BSP/library. The file types associated with libraries using this flow have a .mtb extension.

Going further, Section 4 of this document describes creating a new application using the MTB Flow.

**LIB Flow**: Here, the Board Support Packages (BSPs) and libraries are structured such that each project has its own version of BSP and Libraries which cannot be shared with other applications. The file types associated with libraries using this flow have a .lib extension.

For more information on MTB and LIB Flow, see the Library Manager User Guide located at `<install_dir>/ModusToolbox/tools_<version>/library-manager/docs/library-manager.pdf`.

2.2.3.3 **Software Development for PSoC 6 MCU**

Cypress provides significant source code and tools to enable software development for PSoC 6 MCUs. You use tools to specify how you want to configure the hardware, generate code for that purpose which you use in your firmware, and include various middleware libraries for additional functionality, like BLE connectivity or FreeRTOS. This source code makes it easier to develop the firmware for supported devices. It helps you quickly customize and build firmware without the need to understand the register set.
In the ModusToolbox environment, you use Configurators to configure either the device, or a middleware library, like the BLE stack or CapSense functionality.

The PSoC 6 Peripheral Driver Library code is delivered as the mtb-pdl-cat1 library. Middleware is delivered as separate libraries for each feature/function.

Whether you use Eclipse IDE, a third-party IDE, or the command line, firmware developers who wish to work at the register level should refer to the driver source code from the PDL. The PDL includes all the device-specific header files and startup code you need for your project. It also serves as a reference for each driver. Because the PDL is provided as source code, you can see how it accesses the hardware at the register level.

Some devices do not support particular peripherals. The PDL is a superset of all the drivers for any supported device. This superset design means:

- All API elements needed to initialize, configure, and use a peripheral are available.
- The PDL is useful across various PSoC 6 MCU devices, regardless of available peripherals.
- The PDL includes error checking to ensure that the targeted peripheral is present on the selected device.

This enables the code to maintain compatibility across members of the PSoC 6 MCU device family as long as the peripherals are available. A device header file specifies the peripherals that are available for a device. If you write code that attempts to use an unsupported peripheral, you will get an error at compile time. Before writing code to use a peripheral, consult the datasheet for the particular device to confirm support for that peripheral.

As Figure 3 shows, with the Eclipse IDE for ModusToolbox, you can:

1. Choose a board support package (BSP).
2. Create a new application based on a list of starter applications, filtered by kit.
3. Add middleware.
4. Develop your application firmware using the Cypress HAL or PDL for PSoC 6 MCU.
2.2.4 ModusToolbox Help

Visit the ModusToolbox home page to download and install the latest version of ModusToolbox. Launch Eclipse IDE for ModusToolbox and navigate to the following items:

Choose Help > ModusToolbox General Documentation:

- **User Guide**: This guide primarily covers the ModusToolbox aspects of building, programming and debugging applications. It also covers various aspects of the tools installed along with the IDE.
- **ModusToolbox Documentation Index**: Provides brief descriptions and links to various types of documentation included as part the ModusToolbox software.
- **ModusToolbox Installation Guide**: Provides instructions for installing the ModusToolbox software.
- **Release Notes**

For documentation on Eclipse IDE for ModusToolbox, choose Help > Eclipse IDE for ModusToolbox Documentation:

- **Quick Start Guide**: Provides you the basics for using Eclipse IDE for ModusToolbox
- **User Guide**: Provides descriptions about creating applications as well as building, programming, and debugging them using Eclipse IDE
- **Eclipse IDE for ModusToolbox Help**: Provides description on how to create new applications, update application code, change middleware settings, and program/debug applications
- **Eclipse IDE Survival Guide**
2.3 Support for Other IDEs
You can develop firmware for PSoC 6 MCUs using your favorite IDE such as IAR Embedded Workbench or Visual Studio Code.

ModusToolbox configurators are standalone tools that can be used to set up and configure PSoC 6 MCU resources and other middleware components without using the Eclipse IDE. The device configurator and middleware configurators use the design.x files within the application workspace. You can then point to the generated source code and continue developing firmware in your IDE.

If there is a change in the device configuration, edit the design.x files using the configurators and regenerate the code for the target IDE. Cypress recommends that you generate resource configurations using the configuration tools provided with ModusToolbox software.

See AN225588 – Using ModusToolbox Software with a Third-Party IDE for details.

2.4 FreeRTOS Support with ModusToolbox
Adding native FreeRTOS support to a ModusToolbox application project is like adding any library/middleware. You can import the FreeRTOS middleware into your application by using the Library Manager. Select the application project and click the Library Manager link in the Quick Panel. Select freertos from the Libraries > PSoC 6 Middleware dialog, as Figure 4 shows.

The .mtb file pointing to the FreeRTOS middleware is added to the application project. The middleware content is also downloaded and placed inside the corresponding folder called freertos. To continue working with FreeRTOS follow the steps in the Quick Start section of FreeRTOS documentation.

Figure 4. Import FreeRTOS middleware in ModusToolbox Application

2.5 Programming/Debugging
All PSoC 6 Kits have a KitProg3 onboard programmer/debugger. It supports Cortex Microcontroller Software Interface Standard - Debug Access Port (CMSIS-DAP). See the KitProg3 User Guide for details.

The Eclipse IDE requires KitProg3 and uses the OpenOCD protocol for debugging PSoC 6 MCU applications. It also supports GDB debugging using industry standard probes like the Segger J-Link.

Note: The PSoC 6 Wi-Fi-BT Pioneer Kit (CY8CKIT-062-WIFI-BT) and PSoC 6 BLE Pioneer Kit (CY8CKIT-062-BLE) have the KitProg2 onboard programmer/debugger. To work with Eclipse IDE, upgrade the kit to KitProg3.

ModusToolbox includes the fw-loader command-line tool to update CY8CIT-062-WiFi-BT and CY8CIT-062-BLE kits and switch the KitProg firmware from KitProg2 to KitProg3. Refer to the PSoC 6 Programming/Debugging - KitProg Firmware Loader section in the Eclipse IDE for ModusToolbox User Guide for more details.

For more information on debugging firmware on PSoC devices with ModusToolbox, refer to Program and Debug section in the Eclipse IDE for ModusToolbox user guide.
2.6 PSoC 6 MCU Development Kits

Table 2. Development Kits

<table>
<thead>
<tr>
<th>Product Line</th>
<th>Development Kits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td></td>
</tr>
<tr>
<td>• PSoC 6 WiFi-BT Pioneer Kit (CY8CKIT-062-WiFi-BT)</td>
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<tr>
<td>• PSoC 6 Wi-Fi BT Prototyping Kit (CY8CPROTO-062-4343W)</td>
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<td>• PSoC 62S2 Wi-Fi BT Pioneer Kit (CY8CKIT-062S2-43012)</td>
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<tr>
<td>• PSoC 62S3 Wi-Fi BT Prototyping Kit (CY8CPROTO-062S3-4343W)</td>
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<tr>
<td>• PSoC 62S1 Wi-Fi BT Pioneer Kit (CYW9P62S1-43438EVB-01)</td>
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<td>• PSoC 62S1 Wi-Fi BT Pioneer Kit (CYW9P62S1-43012EVB-01)</td>
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<tr>
<td>• PSoC 62S4 Pioneer Kit (CY8CKIT-062S4)</td>
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<td>Connectivity</td>
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<td>• PSoC 6 BLE Prototyping Kit (CY8CPROTO-063-BLE)</td>
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<td>Security</td>
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<tr>
<td>• PSoC 64 Standard Secure - AWS Wi-Fi BT Pioneer Kit (CY8CKIT-064S0S2-4343W)</td>
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</table>

For the complete list of kits for the PSoC 6 MCU along with the shield modules, see the Microcontroller (MCUs) Kits page.
3 Device Features

PSoc 6 MCU product lines have extensive feature sets as shown in Figure 5. The following is a list of its major features. For more information, see the device datasheet, the Technical Reference Manual (TRM), and the section on Related Application Notes and Code Examples.

- **MCU Subsystem**
  - 150-MHz Arm Cortex-M4 and 100-MHz Arm Cortex-M0+
  - Up to 2 MB of flash with additional 32 KB for EEPROM emulation and 32-KB supervisory flash
  - Up to 1 MB of SRAM with selectable Deep Sleep retention granularity at 32-KB retention boundaries
  - Inter-processor communication supported in hardware
  - DMA controllers
- **Security Features**
  - Cryptography accelerators and true random number generator function
  - One-time programmable eFUSE for secure key storage
  - Secure boot with hardware hash-based authentication
- **I/O Subsystem**
  - Up to 104 GPIOs with programmable drive modes, drive strength, slew rates
  - Two ports with Smart I/O that can implement Boolean operations
- **Programmable Digital Blocks, Communication Interfaces**
  - Up to 12 UDBs for custom digital peripherals
  - Up to 32 TCPWM blocks configurable as 16-bit/32-bit timer, counter, PWM, or quadrature decoder
  - Up to 13 SCBs configurable as I2C Master or Slave, SPI Master or Slave, or UART
  - Controller Area Network interface with Flexible Data Rate
  - Up to two Secure Digital Host Controllers with support for SD, SDIO, and eMMC interfaces
  - Audio subsystem with up to two I2S interface and two PDM channels
  - SMIF interface with support for execute-in-place from external quad SPI flash memory and on-the-fly encryption and decryption
  - USB Full-Speed Device Interface
- **Programmable Analog Blocks**
  - Up to two opamps that can operate in system deep sleep mode
  - Up to two 12-bit SAR ADCs with maximum of 2-Msp sample rate and capability to function in system deep sleep mode in some of the PSoC 6 MCUs
  - One 12-bit, 500 ksp voltage-mode DAC
  - Up to two low-power comparators which can be used to wake up the device from all the low-power modes
  - 1.2-V bandgap reference with 1% tolerance for use with SAR ADCs and the DAC.
- **CapSense with SmartSense™ Auto-tuning**
  - Supports both CapSense Sigma-Delta (CSD) and CapSense Transmit/Receive (CSX) controllers
  - Provides best-in-class SNR, liquid tolerance, and proximity sensing
- **Operating Voltage Range, Power Domains, and Low-power Modes**
  - Device operating voltage: 1.71 V to 3.6 V with user-selectable core logic operation at either 1.1 V or 0.9 V
  - Multiple on-chip regulators: low-drop out (LDO for Active, Deep Sleep modes), buck converter
  - Six power modes for fine-grained power management
  - An “Always ON” backup power domain with built-in RTC, power management integrated circuit (PMIC) control, and limited SRAM backup
4 My First PSoC 6 MCU Design Using Eclipse IDE for ModusToolbox

This section does the following:
- Demonstrate how to build a simple PSoC 6 MCU-based design and program it on to the development kit.
- Make it easy to learn PSoC 6 MCU design techniques and how to use the Eclipse IDE for ModusToolbox.

4.1 Prerequisites
Before you get started, make sure that you have the appropriate development kit for your PSoC 6 MCU product line, and have installed the required software. You also need internet access to the Cypress GitHub repositories during project creation.

4.1.1 Hardware
- The design is developed for PSoC 6 Wi-Fi BT Prototyping Kit (CY8CPROTO-062-4343W). However, you can build the projects for other development kits. See the Using These Instructions section.

4.1.2 Software
- ModusToolbox 2.2 or Above
After installing the software, refer to the ModusToolbox User Guide to get an overview of the software.

4.2 Using These Instructions
These instructions are grouped into several sections. Each section is devoted to a phase of the application development workflow. The major sections are:
- Part 1: Create a New Application
- Part 2: View and Modify the Design
- Part 3: Write Firmware
- Part 4: Build the Application
- Part 5: Program the Device
- Part 6: Test Your Design

This design is developed for the PSoC 6 Wi-Fi BT Prototyping Kit (CY8CPROTO-062-4343W). You can use other supported kits to test this example by selecting the appropriate kit while creating the application. The code described in the sections that follow has been tested on the following additional kits.
- PSoC 6 Wi-Fi-BT Pioneer Kit (CY8CKIT-062-WiFi-BT)
- PSoC 6 BLE Pioneer Kit (CY8CKIT-062-BLE)
- PSoC 6 BLE Prototyping Kit (CY8CPROTO-063-BLE)
- PSoC 62S2 Wi-Fi BT Pioneer Kit (CY8CKIT-062S2-43012)
- PSoC 62S1 Wi-Fi BT Pioneer Kit (CYW9P62S1-43438EVB-01)
- PSoC 62S1 Wi-Fi BT Pioneer Kit (CYW9P62S1-43012EVB-01)
- PSoC 62S3 Wi-Fi BT Prototyping Kit (CY8CPROTO-062S3-4343W)
- PSoC 62S4 Pioneer Kit (CY8CKIT-062S4)

4.3 About the Design
This design uses the CM4 CPU of the PSoC 6 MCU to execute two tasks: UART communication and LED control.
At device reset, the Cypress-supplied pre-built CM0+ application image enables the CM4 CPU and configures the CM0+ CPU to go to sleep. The CM4 CPU uses the UART to print a “Hello World” message to the serial port stream, and starts blinking the user LED on the kit. When the user presses the enter key on the serial console, the blinking is paused or resumed.
4.4 Part 1: Create a New Application

This section takes you on a step-by-step guided tour of the new application process. It uses the ‘Empty PSoC6 App’ starter application and guides you through the design development stages, and programming.

If you are familiar with developing projects with ModusToolbox, you can use the ‘Hello World’ starter application directly. It is a complete design, with all the firmware written for the supported kits. You can walk through the instructions and observe how the steps are implemented in the code example.

If you start from scratch and follow all the instructions in this application note, you use the code example as a reference while following the instructions.

Launch Eclipse IDE for ModusToolbox to get started. Please note that Eclipse IDE for ModusToolbox needs access to the internet to successfully clone the starter application onto your machine.

1. Select a new workspace.

   At launch, Eclipse IDE for ModusToolbox presents a dialog to choose a directory for use as the workspace directory. The workspace directory is used to store workspace preferences and development artifacts. You can choose an existing empty directory by clicking the Browse button, as Figure 6 shows. Alternatively, you can type in a directory name to be used as the workspace directory along with the complete path, and Eclipse IDE will create the directory for you.

   ![Figure 6. Select a Directory as the Workspace](image)

2. Create a new ModusToolbox Application.

   A. Click New Application in the Start group of the Quick Panel.

   B. Alternatively, you can choose File > New > ModusToolbox Application, as Figure 7 shows.

   The Eclipse IDE for ModusToolbox Application window appears.

   ![Figure 7. Create a New ModusToolbox Application](image)
3. Select a target PSoC 6 development kit.

ModusToolbox speeds up the development process by providing BSPs that set various workspace/project options for the specified development kit in the new application dialog.

A. In the **Choose Board Support Package (BSP)** dialog, choose the **Kit Name** that you have. The steps that follow use **CY8CPROTO-062-4343W**. See Figure 8 for help with this step.

B. Click **Next**.

---

**Figure 8. Choose Target Hardware**

![Figure 8 - Choose Board Support Package](image-url)

- **A**
  - In the **Choose Board Support Package (BSP)** dialog, choose the **Kit Name** that you have. The steps that follow use **CY8CPROTO-062-4343W**. See Figure 8 for help with this step.

- **B**
  - Click **Next**.
C. In the **Starter Application** dialog, select **Empty PSoC6 App** starter application, as Figure 9 shows.

D. In the **Name** field, type in a name for the application, such as **Hello_World**. You can choose to leave the default name if you prefer.

E. Click **Create** to create the application, as Figure 10 shows, wait for the Project Creator to automatically close once the project is successfully created.

![Figure 9. Choose Starter Application](image)

**Figure 9. Choose Starter Application**

You have successfully created a new ModusToolbox application for a PSoC 6 MCU.

The BSP uses CY8C624ABZI-D54 as the default device that is mounted on the **PSoC 6 Wi-Fi-BT Prototyping Kit (CY8CPROTO-062-4343W)** along with the CYW4343WKUBG Wi-Fi/BT radio.

If you are using custom hardware based on PSoC 6 MCU, or a different PSoC 6 MCU part number, please refer to the **Creating your Own BSP** section in the **ModusToolbox User Guide**. The guide is also available under **ide_2.2>docs** folder of the ModusToolbox installation directory.

4.5 **Part 2: View and Modify the Design**

*Figure 11 shows the ModusToolbox project explorer interface displaying the structure of the application project.*

In the Eclipse IDE for ModusToolbox, a PSoC 6 MCU application consists of a project to develop code for the CM4 CPU. A project folder consists of various subfolders – each denoting a specific aspect of the project.

a. An application project contains a Makefile which is typically at the root folder. It has instructions on how to recreate the project. This file also contains the set of directives that the make tool uses to compile and link the application project. There can be more than one project in an application, and each dependent project usually resides within its own folder within the application folder and contains its own Makefile.

b. The **build** folder contains all the artifacts resulting from the make build of the project. The output files are organized by target BSPs.
c. The *deps* folder contains *.mtb* files, which provide the location from which ModusToolbox pulls the BSP/library that is directly referenced by the application. These files typically contain the GitHub location of the entire library. The *.mtb* files also contain a git Commit Hash or Tag that tells which version of the library is to be fetched and a path as to where the library should be stored.

For example, the `TARGET_CY8CPROTO-062-4343W.mtb` file points to `https://github.com/cypresssemiconductorco/TARGET_CY8CKIT-062S2-43012/#latestv1.X#$$ASSET_REPO$$/TARGET_CY8CKIT-062S2-43012/latest-v1.X`. The `latest-v1.X` tag in the link denotes the specific release of the BSP. The variable `$$ASSET_REPO$$` points to the root of the shared location. If the library has to be local to the application instead of shared, use `$$LOCAL$$` instead of `$$ASSET_REPO$$`.


d. The *libs* folder also contains *.mtb* files, these point to libraries that are included indirectly as a dependency of a BSP or another library. For each indirect dependency, the Library Manager places an *.mtb* file in this folder. These files have been populated based on the targets available in *deps* folder.

For example, using BSP lib file `TARGET_CY8CPROTO-062-4343W.mtb` populates *libs* folder with the following *.mtb* files: `capsense.mtb`, `core-lib.mtb`, `core-make.mtb`, `mtb-hal-cat1.mtb`, `mtb-pdl-cat1.mtb`, `psoc6cm0p.mtb`, `recipe-make-cat1a.mtb`.

The *libs* folder contains *mtb.mk* file, which stores the relative paths of the all the libraries required by the application. The build system uses this file to find all the libraries required by the application.

e. By default, when creating a new application or adding a BSP/library to an existing application and specifying it as shared, all BSPs/libraries are placed in an *mtb_shared* directory adjacent to the application directory(ies).

The *mtb_shared* folder is shared between different applications that use the same versions of BSP/library.
The files provided by the BSP are listed under the `TARGET_x` folder. All the configuration files generated by the device and peripheral configurators are included in the `GeneratedSource` folder of the BSP and are prefixed with `cycfg_`. These files contain the design configuration as defined by the BSP. You can view and modify the design configuration by clicking the Device Configurator link in the Quick Panel. However, note that if you upgrade the BSP library to a newer version, the manual edits done to the `design.x` files are lost. You can also create custom device configurator files for an application and override the ones provided by the BSP. See **Modifying the BSP Configuration for a Single Application** section in the ModusToolbox User Guide for more details.

The BSP folder also contains the linker scripts and the startup code for the PSoC 6 MCU device used on the board.

Because the `mtb_shared` folder is shared between different applications that use the same versions of BSP/library, any changes made to the BSP for one application will be reflected in the other application. If multiple applications use the same BSP, you should create a custom BSP for each application. For more information on creating custom BSP for an application, see the “Modifying the BSP Configuration for a Single Application” section in the ModusToolbox User Guide.

Of interest are the configuration files that are in the `COMPONENT_BSP_x` folder. Click on the Device Configurator link in the Quick Panel. Figure 12 shows the resulting window called the Device Configurator window. You can also double-click open the other `design.x` files to open them in their respective configurators or click the corresponding links in the Quick Panel.

![Figure 12. design.modus Overview](image)

The Device Configurator window provides a **Resources Categories** pane. Here you can choose between different resources available in the device such as peripherals, pins, and clocks from the **List of Resources**.

You can choose how a resource behaves by choosing a **Personality** for the resource. For example, a Serial Communication Block (SCB) resource can have a EZI2C, I2C, SPI, or UART personalities. The **Alias** is your name for the resource, which is used in firmware development. One or more aliases can be specified by using a comma to separate them (with no spaces).

The **Parameters** pane is where you enter the configuration parameters for each enabled resource and the selected personality. The **Code Preview** pane shows the configuration code generated per the configuration parameters selected. This code is populated in the `cycfg_` files in the GeneratedSource folder. Any errors, warnings, and information messages arising out of the configuration are displayed in the **Notices** pane.
The application project contains relevant files that help you create an application for the CM4 CPU (main.c), while the CM0+ application is supplied as a C file (psoc6_02_cm0p_sleep.c for CY8C624ABZI-D44 device) by Cypress. See the psoc6cm0p library. This C file is compiled and linked with the CM4 image as part of the normal build process.

At this point in the development process, we are ready to add the required middleware to the design. The only middleware required for the Hello World application is the retarget-io library.

Figure 13. Add the retarget-io Middleware

1. Add retarget-io middleware.
   In this step, you will add the retarget-io middleware to redirect standard input and output streams to the UART configured by the BSP. The initialization of the middleware will be done in main.c code.
   
   A. In the Quick Panel, click on the Library Manager link.
   B. In the subsequent dialog, select the Libraries tab.
   C. Under Board Utils, select and enable retarget-io.
   D. Click Update.
   
   The files necessary to use the retarget-io middleware are added in the mtb_shared > retarget_io folder, and the .mtb file is also added to the deps folder, as Figure 13 shows.

2. Configuration of UART, timer peripherals, pins and system clocks
   The configuration of the debug UART peripheral, timer peripheral, pins and system clocks can be done directly in the code using the function APIs provided by BSP and HAL. See Part 3: Write Firmware.

4.6 Part 3: Write Firmware
   At this point in the development process, you have created an application, with the assistance of an application template and modified it to add the retarget-io middleware. In this part, you write the firmware that implements the design functionality.

   If you are working from scratch using the Empty PSoC 6 starter application, you can copy the respective source code to the main.c of the application project from the code snippet provided in this section. If you are using the Hello World code example, all the required files are already in the application.

   Firmware Flow
   We now examine the code in the main.c file of the application. Figure 14 shows the firmware flowchart.
The CM0+ CPU comes out of reset and enables the CM4 CPU. The CM0+ CPU is then configured to go to sleep by the Cypress-provided CM0+ application. Resource initialization for this example is performed by the CM4 CPU. It configures the system clocks, pins, clock to peripheral connections, and other platform resources.

When the CM4 CPU is enabled, the clocks and system resources are initialized by the BSP initialization function. The retarget-io middleware is configured to use the debug UART, and the user LED is initialized. The debug UART prints a “Hello World!” message on the terminal emulator – the on-board KitProg3 acts the USB-UART bridge to create the virtual COM port. A timer object is configured to generate an interrupt every 1000 milliseconds. At each Timer interrupt, the CM4 CPU toggles the LED state on the kit.

The firmware is designed to accept ‘Enter’ key as an input and on every press of the ‘Enter’ key the firmware starts or stops the blinking of the LED.

Note that the application code uses BSP/HAL/middleware functions to execute the intended functionality.

cybsp_init() - This BSP function sets up the HAL hardware manager and initializes all the system resources of the device including but not limited to the system clocks and power regulators.

cy_retarget_io_init() - This function from retarget-io middleware uses the aliases set up for debug UART pins to configure the debug UART with a standard baud rate of 115200 and also redirects the input/output stream to the debug UART.

cyhal_gpio_init() - This function from the gpio HAL initializes the physical pin to drive the LED. The LED used is derived from the BSP definition.

timer_init() - This function wraps a set of timer HAL function calls to instantiate and configure a timer. It also sets up a callback for the timer interrupt.

Copy the following code snippet to main.c of your application project.

```c
#include "cy_pdl.h"
#include "cyhal.h"
#include "cybsp.h"
#include "cy_retarget_io.h"

/*******************************************************************************
* Macros
*******************************************************************************/
#define LED_BLINK_TIMER_CLOCK_HZ (10000)
#define LED_BLINK_TIMER_PERIOD (9999)

/*******************************************************************************
* Function Prototypes
*******************************************************************************/
void timer_init(void);
static void isr_timer(void *callback_arg, cyhal_timer_event_t event);

/*******************************************************************************
* Global Variables
*******************************************************************************/
bool timer_interrupt_flag = false;
bool led_blink_active_flag = true;
extern cyhal_uart_t cy_retarget_io_uart_ob;
uint8_t uart_read_value;

cyhal_timer_t led_blink_timer;

/*******************************************************************************
* Function Name: main
*******************************************************************************/
```
# Getting Started with PSoC 6 MCU on ModusToolbox

```c
int main(void)
{
    cy_rslt_t result;
    /* Initialize the device and board peripherals */
    result = cybsp_init();
    /* Board init failed. Stop program execution */
    if (result != CY_RSLT_SUCCESS)
    {
        CY_ASSERT(0);
    }
    /* Enable global interrupts */
    __enable_irq();
    /* Initialize retarget-io to use the debug UART port */
    result = cy_retarget_io_init(CYBSP_DEBUG_UART_TX, CYBSP_DEBUG_UART_RX, 
                             CY_RETARGET_IO_BAUDRATE);
    /* retarget-io init failed. Stop program execution */
    if (result != CY_RSLT_SUCCESS)
    {
        CY_ASSERT(0);
    }
    /* Initialize the User LED */
    result = cyhal_gpio_init((cyhal_gpio_t) CYBSP_USER_LED, 
                          CYHAL_GPIO_DIR_OUTPUT, CYHAL_GPIO_DRIVE_STRONG, 
                          CYBSP_LED_STATE_OFF);
    /* gpio init failed. Stop program execution */
    if (result != CY_RSLT_SUCCESS)
    {
        CY_ASSERT(0);
    }
    /* ANSI ESC sequence for clear screen */
    printf("\x1b[2J\x1b[;H");
    printf("*************** "
           "PSoC 6 MCU: Hello World! Example "
           "*************** \r\n\n");
    printf("Hello World!!\r\n\n");
    printf("For more PSoC 6 MCU projects, 
           visit our code examples repositories:
           \r\n\n");
    printf("1. ModusToolbox Examples:\r\n https://github.com/
           "cyverssemiconductorco/Code-Examples-for-ModusToolbox"
           "-Software\r\n\n");
    printf("2. MBed OS Examples:\r\n https://os.mbed.com/teams/Cypress/\r\n\n");
    /* Initialize timer to toggle the LED */
    timer_init();
    printf("Press 'Enter' key to pause or 
           resume blinking the user LED \r\n\n");
    for(;;)
    {
        /* Check if 'Enter' key was pressed */
        if(cyhal_uart_getc(&cy_retarget_io_uart_obj, &uart_read_value, 1) \n           == CY_RSLT_SUCCESS)
        {
            if (uart_read_value == '\r')
            {
```
/* Pause LED blinking by stopping the timer */
if (led_blink_active_flag)
{
    cyhal_timer_stop(&led_blink_timer);
    printf("LED blinking paused \r\n");
}
else /* Resume LED blinking by starting the timer */
{
    cyhal_timer_start(&led_blink_timer);
    printf("LED blinking resumed\r\n");
}
/* Move cursor to previous line */
printf("\x1b[1F");

led_blink_active_flag ^= 1;
}
/* Set the event on which timer interrupt occurs and enable it */
cyhal_timer_enable_event(&led_blink_timer, CYHAL_TIMER_IRQ_TERMINAL_COUNT,
                         7, true);

/* Start the timer with the configured settings */
cyhal_timer_start(&led_blink_timer);
}

/*******************************************************************************
* Function Name: isr_timer
*******************************************************************************
static void isr_timer(void *callback_arg, cyhal_timer_event_t event)
{
    (void) callback_arg;
    (void) event;

    timer_interrupt_flag = true;
}
Figure 14. Firmware Flowchart

This completes the summary of how the firmware works in the code example. Feel free to explore the source files for a deeper understanding.
4.7 Part 4: Build the Application
This section shows how to build the application.

1. Build the Application.
   A. Select the application project in the Project Explorer window and click on the Build \texttt{<name>} Application shortcut under the \texttt{<name>} group in the Quick Panel. It selects the Debug build configuration and compiles/links all projects that constitute the application.
   B. The Console view lists the results of the build operation, as Figure 15 shows.

![Figure 15. Build the Application](image)

If you encounter errors, revisit prior steps to ensure that you accomplished all the required tasks.

Note: You can also use the command line interface (CLI) to build the application. Please refer to Using the Command Line section in the ModusToolbox User Guide. This document is located in the \/ide\_\texttt{<version>}/docs/ folder in the ModusToolbox installation.

4.8 Part 5: Program the Device
This section shows how to program the PSoC 6 MCU device.

ModusToolbox uses the OpenOCD protocol to program and debug applications on PSoC 6 MCU devices. For ModusToolbox to identify the device on the kit, the kit must be running KitProg3. Some Cypress kits are shipped with KitProg2 firmware instead of KitProg3. See Programming/Debugging for details. ModusToolbox includes the \texttt{fw-loader} command-line tool to switch the KitProg firmware from KitProg2 to KitProg3. Refer to the PSoC 6 MCU KitProg Firmware Loader section in the Eclipse IDE for ModusToolbox User Guide for more details.

If you are using a development kit with a built-in programmer (the CY8CPROTO-062-4343W, for example), connect the board to your computer using the USB cable.

If you are developing on your own hardware, you may need a hardware programmer/debugger; for example, a Cypress CY8CKIT-005 MiniProg4.

1. Program the Application.
   A. Connect to the board and perform the following step.
B. Select the application project and click on the `<application name>` Program (KitProg3_MiniProg4) shortcut under the Launches group in the Quick Panel, as Figure 16 shows. The IDE will select and run the appropriate run configuration. Note that this step will also perform a build if any files have been modified since the last build.

Figure 16. Programming an Application to a Device

The Console view lists the results of the programming operation, as Figure 17 shows.

Figure 17. Console – Programming Results

4.9 Part 6: Test Your Design

This section describes how to test your design.

Follow the steps below to observe the output of your design. This note uses Tera Term as the UART terminal emulator to view the results. You can use any terminal of your choice to view the output.

1. Select the serial port.

   Launch Tera Term and select the USB-UART COM port as Figure 18 shows. Note that your COM port number may be different.
2. **Set the baud rate.**

Set the baud rate to 115200 under **Setup > Serial port** as Figure 19 shows.

3. **Reset the device.**

Press the reset switch (SW1) on the kit. A message appears on the terminal as Figure 20 shows. The user LED on the kit will start blinking.

4. **Pause/resume LED blinking functionality.**
Press the **Enter** Key to pause/resume blinking the LED. When the LED blinking is paused, a corresponding message will be displayed on the terminal as Figure 21 shows.

**Figure 21. UART Message from CM4 CPU**

![UART Message from CM4 CPU](image-url)

For more PSoC 6 MCU projects, visit our code examples repositories:

1. ModusToolbox Examples:
   - [GitHub](https://github.com/cypress semiconductor co/Code-Examples-for-ModusToolbox-Software)

2. Nucleo OS Examples:
   - [Nucleo](https://www.nucleo.com/general/cypress/)

Press ‘Enter’ key to pause or resume blinking the user LED

**LED blinking paused**
5 Summary

This application note explored the PSoC 6 MCU device architecture and the associated development tools. PSoC 6 MCU is a truly programmable embedded system-on-chip with configurable analog and digital peripheral functions, memory, and a dual-CPU system on a single chip. The integrated features and low-power modes make PSoC 6 MCU an ideal choice for smart home, IoT gateways, and other related applications.

6 Related Application Notes and Code Examples

For a complete and updated list of PSoC 6 MCU code examples, please visit our Cypress GitHub. For more PSoC 6 MCU-related documents, please visit our PSoC 6 MCU product web page.

Table 3 lists the system-level and general application notes that are recommended for the next steps in learning about PSoC 6 MCU and ModusToolbox.

<table>
<thead>
<tr>
<th>Document</th>
<th>Document Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN221774</td>
<td>Getting Started with PSoC 6 MCU on PSoC Creator</td>
</tr>
<tr>
<td>AN210781</td>
<td>Getting Started with PSoC 6 MCU with Bluetooth Low Energy (BLE) Connectivity on PSoC Creator</td>
</tr>
<tr>
<td>AN218241</td>
<td>PSoC 6 MCU Hardware Design Considerations</td>
</tr>
<tr>
<td>AN225588</td>
<td>Using ModusToolbox Software with a Third-Party IDE</td>
</tr>
<tr>
<td>AN219528</td>
<td>PSoC 6 MCU Low-Power Modes and Power Reduction Techniques</td>
</tr>
</tbody>
</table>

Table 4 lists the application notes (AN) for specific peripherals and applications.

<table>
<thead>
<tr>
<th>Document</th>
<th>Document Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN215656</td>
<td>PSoC 6 MCU Dual-CPU System Design</td>
</tr>
<tr>
<td>AN217666</td>
<td>PSoC 6 MCU Interrupts</td>
</tr>
<tr>
<td>AN92239</td>
<td>Proximity Sensing with CapSense</td>
</tr>
<tr>
<td>AN85951</td>
<td>PSoC 4 and PSoC 6 MCU CapSense Design Guide</td>
</tr>
<tr>
<td>AN213924</td>
<td>PSoC 6 MCU Device Firmware Update Software Development Kit Guide</td>
</tr>
</tbody>
</table>
Appendix A. Glossary

This section lists the most commonly used terms that you might encounter while working with Cypress’s PSoC family of devices.

**Board Support Package (BSP):** A BSP is the layer of firmware containing board-specific drivers and other functions. The board support package is a set of libraries that provide firmware APIs to initialize the board and provide access to board level peripherals.

**Cypress Programmer:** Cypress Programmer is a flexible, cross-platform application for programming Cypress devices. It can Program, Erase, Verify, and Read the flash of the target device.

**Hardware Abstraction Layer (HAL):** The HAL wraps the lower level drivers (like MTB-PDL-CAT1) and provides a high-level interface to the MCU. The interface is abstracted to work on any MCU.

**KitProg:** The KitProg is an onboard programmer/debugger with USB-I2C and USB-UART bridge functionality. The KitProg is integrated onto most PSoC development kits.

**MiniProg3 / MiniProg4:** Programming hardware for development that is used to program PSoC devices on your custom board or PSoC development kits that do not support a built-in programmer.

**Personality:** A personality expresses the configurability of a resource for a functionality. For example, the SCB resource can be configured to be an UART, SPI or I2C personalities.

**PSoC:** A programmable, embedded design platform that includes a CPU, such as the 32-bit Arm Cortex-M0, with both analog and digital programmable blocks. It accelerates embedded system design with reliable, easy-to-use solutions, such as touch sensing, and enables low-power designs.

**Middleware:** Middleware is a set of firmware modules that provide specific capabilities to an application. Some middleware may provide network protocols (e.g. MQTT), and some may provide high level software interfaces to device features (e.g. USB, audio).

**ModusToolbox:** An Eclipse based embedded design platform for IoT designers that provides a single, coherent, and familiar design experience combining the industry’s most deployed Wi-Fi and Bluetooth technologies, and the lowest power, most flexible MCUs with best-in-class sensing.

**Peripheral Driver Library:** The Peripheral Driver Library (PDL) simplifies software development for the PSoC 6 MCU architecture. The PDL reduces the need to understand register usage and bit structures, thus easing software development for the extensive set of peripherals available.

**WICED:** Cypress’s WICED (Wireless Internet Connectivity for Embedded Devices) is a full-featured platform with proven Software Development Kits (SDKs) and turnkey hardware solutions from partners to readily enable Wi-Fi and Bluetooth connectivity in system design.
Document History

Document Title: AN228571 – Getting Started with PSoC 6 MCU on ModusToolbox
Document Number: 002-28571

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<tr>
<th>Revision</th>
<th>ECN</th>
<th>Date</th>
<th>Description of Change</th>
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<tr>
<td>**</td>
<td>6697981</td>
<td>10/11/2019</td>
<td>New application note</td>
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<td>*A</td>
<td>6922602</td>
<td>07/14/2020</td>
<td>Updated Screenshots with latest release of ModusToolbox</td>
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<td>Added new supported PSoC 6 MCU devices</td>
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<td>Added AnyCloud description under ModusToolbox software</td>
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<td>*B</td>
<td>6940156</td>
<td>07/31/2020</td>
<td>Added new supported PSoC 6 MCU device – PSoC 62S4</td>
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<td>Added information on PSoC 6 product lines and development kits available for each product line</td>
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<td>*C</td>
<td>6965171</td>
<td>09/16/2020</td>
<td>Updated Figure 1.</td>
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<td>Updated Screenshots with MTB v2.2.</td>
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<td>Added mtb_shared folder description, updated application creation process with MTB flow</td>
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</tbody>
</table>
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