

Objective

This code example demonstrates encryption and decryption of data using the Advanced Encryption Standard (AES) algorithm in PSoC® 6 MCU.

Requirements

Tool: [ModusToolbox™ IDE 1.1](#)

Programming Language: C

Associated Parts: All [PSoC 6 MCU](#) parts

Related Hardware: [PSoC 6 BLE Pioneer Kit](#), [PSoC 6 WiFi-BT Pioneer Kit](#), [PSoC6 WiFi-Prototyping Kit](#)

Overview

This code example encrypts and decrypts user input data using the AES algorithm using a 128-bit key. The encrypted and decrypted data are displayed on a UART terminal emulator.

Hardware Setup

This example uses the kit's default configuration. Refer to the kit guide to ensure the kit is configured correctly.

Note: The PSoC 6 BLE Pioneer kit and the PSoC 6 WiFi-BT Pioneer kit ship with KitProg2. ModusToolbox only works with KitProg3. Before using this code example, make sure that the kit is upgraded to KitProg3. See [ModusToolbox Help > ModusToolbox IDE Documentation > User Guide; section PSoC 6 MCU KitProg Firmware Loader](#). If you do not upgrade, you will see an error like “unable to find CMSIS-DAP device” or “KitProg firmware is out of date”.

Software Setup

This example uses a terminal emulator to display the encryption and decryption results. If you don't have one, install one. The example uses Tera Term.

Operation

1. Connect the kit to your PC using the provided USB cable.
2. Import the code example into a new workspace. See [KBA225201](#)
3. Build the application. **Choose Project > Build All.**
4. Program the PSoC 6 MCU device. In the project explorer, select the **mainapp** project. In the Quick Panel, scroll to the Launches section and click the **Program (KitProg3)** configuration. Program configurations also build the code.
5. Open your terminal software and select the KitProg COM port. Set the other serial port parameters as follows:
 - a. Baud rate: 115200 bps
 - b. Data: 8 bit
 - c. Parity: None
 - d. Stop: 1 bit
 - e. Flow control: None

6. Press the reset button on the kit and enter the message to be encrypted. Note that in this example, the maximum message size is restricted to 100 characters. If you need to increase the message size change the macro MAX_MESSAGE_SIZE to the message size that you require.
7. Observe the results in the terminal window.

Figure 1 shows a sample output as displayed on Tera Term.

Figure 1. Sample Output Showing AES Encryption

```

*      CE220465 PSoC 6 Cryptography: AES Demonstration
*
*      This code example demonstrates encryption and decryption of data using
*      the Advanced Encryption Scheme (AES) algorithm in PSoC 6 MCU.
*
*      UART Terminal Settings: Baud Rate - 115200 bps, 8N1
*
*
Enter the message:
PSoC 6 MCU

Key used for Encryption:
0xAA 0xBB 0xCC 0xDD 0xEE 0xFF 0xFF 0xEE 0xDD 0xCC 0xBB 0xAA 0xAA 0xBB 0xCC 0xDD

Result of Encryption:
0x78 0x2D 0xA8 0xA0 0x92 0xB6 0x79 0xF3 0x4A 0x32 0xFF 0xB1 0x74 0x26 0x93 0x73

Result of Decryption:
PSoC 6 MCU

Enter the message:
  
```

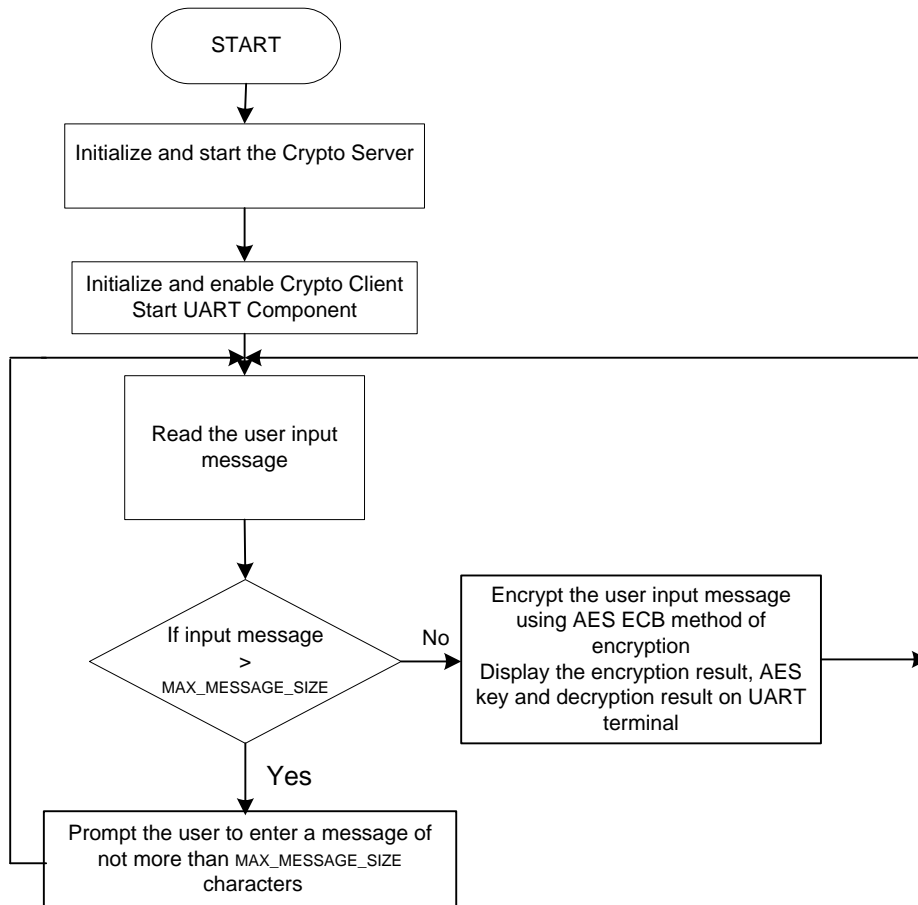
Design and Implementation

AES is a symmetric block cipher data encryption algorithm which means that it uses the same key for encryption and decryption of data. The AES operation works on 128-bit block size and uses keys of 128 bits, 192 bits, or 256 bits of length.

Cryptographic operation implemented in this example is based on a Client-Server model. The firmware initializes and starts the Crypto server. Access to the server is through the Inter-Processor Communication (IPC) driver. The firmware initializes and starts the client. The firmware then provides the configuration data required for AES encryption technique and requests the crypto server to run the cryptographic operation.

In this example, the user input message is read from the UART terminal and encrypted using the AES algorithm with a key length of 128 bits. The 128-bit encrypted data is displayed on the UART terminal. Then, you can view the decrypted message on the UART terminal and verify that the decryption operation produces the same original encrypted message. Figure 2 shows the firmware flowchart.

Figure 2. Firmware Flow



Resources and Settings

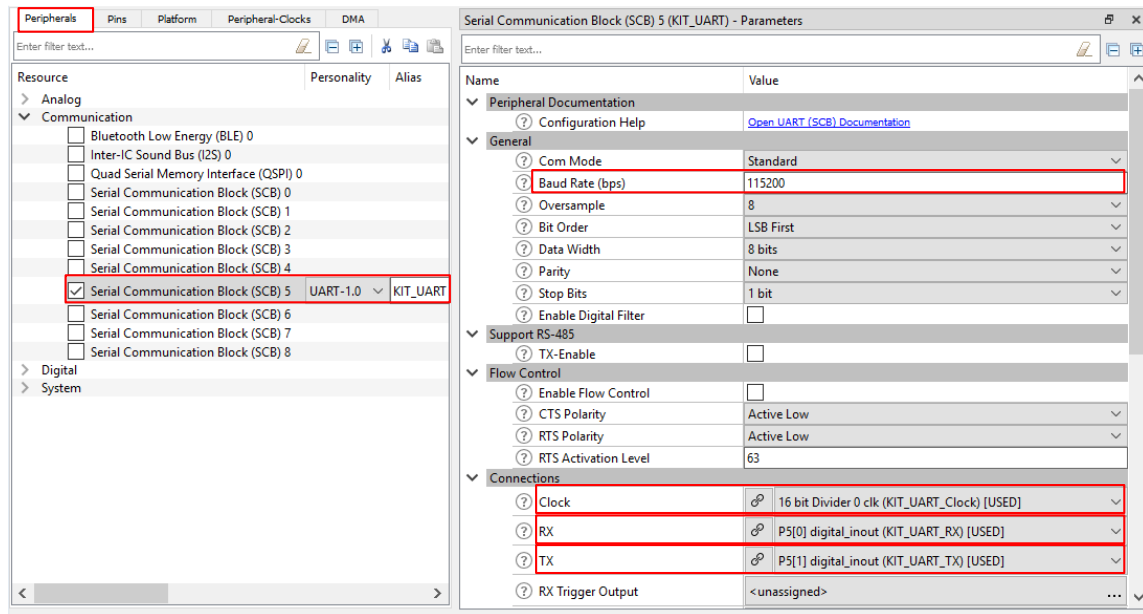
Table 1 lists the ModusToolbox resources used in this example, and how they are used in the design. For pin usage and configuration, open the Pins tab of the *design.modus* file.

Table 1. ModusToolbox Resources

Resource	Alias	Purpose
Serial Communication Block (SCB) – UART mode	KIT_UART	Send to and receive data from the UART Terminal.

Figure 3 highlights the non-default settings for the SCB (UART mode).

Figure 3. SCB (UART mode) Configuration



Reusing This Example

This example is designed for the supported kits. To port the design to a different PSoC 6 MCU device, right click an application project and choose **Change Device**. If changing to a different kit, you may need to reassign pins.

Table 2. Device and Pin Mapping Table across PSoC 6 MCU Kits

Kit Name	Device Used	KIT_UART_RX	KIT_UART_TX
CY8CKIT-062-BLE	CY8C6347BZI-BLD53	P5[0]	P5[1]
CY8CKIT-062-WiFi-BT	CY8C6247BZI-D54	P5[0]	P5[1]
CY8CPROTO-062-4343W	CY8C624ABZI-D44	P5[0]	P5[1]

In some cases, a resource used by a code example (for example, an IP block) is not supported on another device. In that case, the example will not work. If you build the code targeted at such a device, you will get errors. See the device datasheet for information on what a particular device supports.

Related Documents

For a comprehensive list of PSoC 6 MCU resources, see [KBA223067](#) in the Cypress community.

Application Notes	
AN210781 – Getting Started with PSoC 6 MCU with Bluetooth Low Energy (BLE) Connectivity	Describes PSoC 6 MCU with BLE Connectivity devices.
AN215656 – PSoC 6 MCU: Dual-CPU System Design	Describes the dual-CPU architecture in PSoC 6 MCU, and shows how to build a simple dual-CPU design
Code Examples	

Visit the Cypress GitHub site for a comprehensive collection of code examples using ModusToolbox IDE	
Device Documentation	
PSoC 6 MCU: PSoC 63 with BLE Datasheet	PSoC 6 MCU: PSoC 63 with BLE Architecture Technical Reference Manual
Development Kits	
CY8CKIT-062-BLE PSoC 6 BLE Pioneer Kit	
CY8CKIT-062-WiFi-BT PSoC 6 WiFi-BT Pioneer Kit	
CY8CPROTO-062-4343W PSoC 6 Wi-Fi BT Prototyping Kit	
Tool Documentation	
ModusToolbox IDE	The Cypress IDE for IoT designers

Cypress Resources

Cypress provides a wealth of data at www.cypress.com to help you to select the right device, and quickly and effectively integrate the device into your design.

For the PSoC 6 MCU devices, see [KBA223067](#) in the Cypress community for a comprehensive list of PSoC 6 MCU resources.

Document History

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Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	6374033	VKVK	11/02/2018	New code example
*A	6482062	VKVK	02/11/2019	Updated the project for ModusToolbox 1.1

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