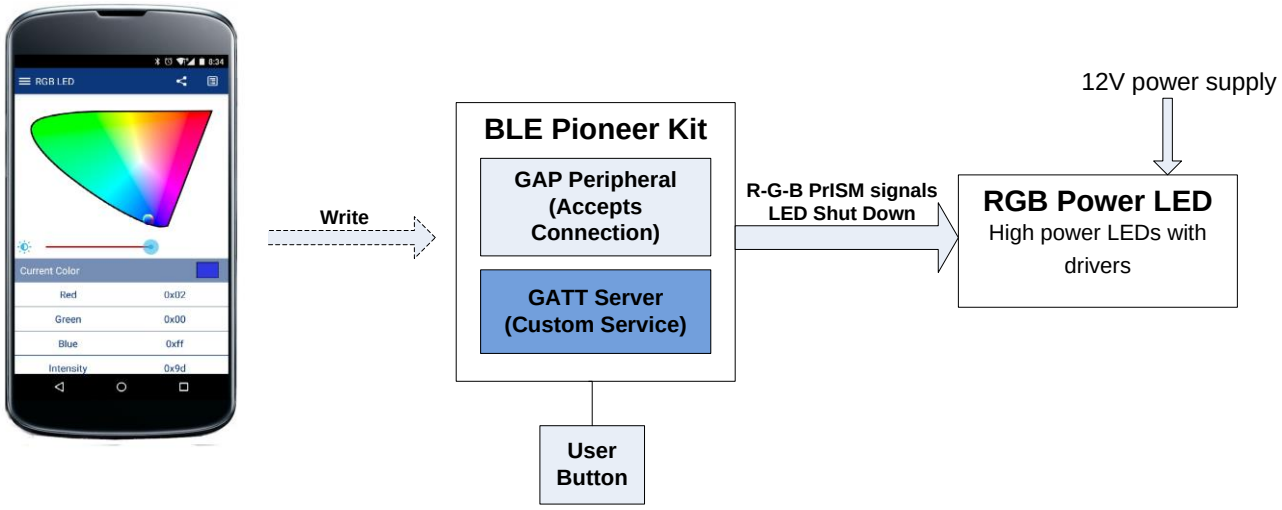
Objective

This example demonstrates color and brightness control of a RGB Power LED over BLE Custom Service.

Overview

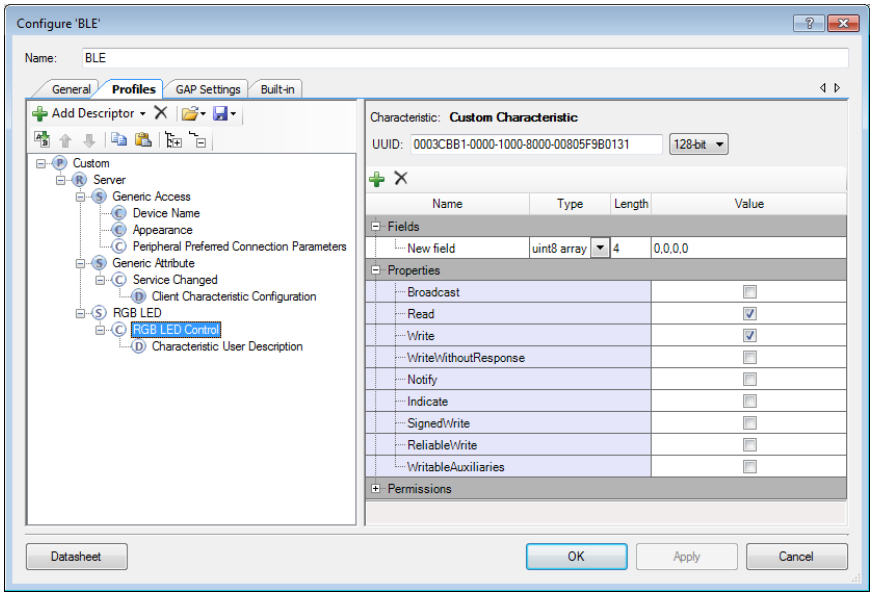
This example implements the RGB Power LED control over BLE using a custom service. It demonstrates the basic building block for light control inside home or any other space using BLE enabled devices. Using Cypress''s PrISM technology, the RGB LED color and brightness is controlled with flicker-free transitions. Refer application note AN47372 - PrISM™ Technology for LED Dimming for more details on the technology. Figure 1 shows the block diagram of the setup.

Figure 1. RGB Power LED Control using CySmart Mobile App



In this project, PSoC 4 BLE acts as GAP Peripheral and GATT Server device. Any BLE Central device, such as BLE Dongle or BLE capable mobile device can connect to the BLE Pioneer Kit and send the four bytes of data over the RGB LED custom service. These four bytes are **Red:Green:Blue:Intensity**, each having a hex value ranging from 0x00 to 0xFF.

Figure 2. RGB LED Custom Characteristic



Requirements

Tool: PSoC Creator 3.1 SP1

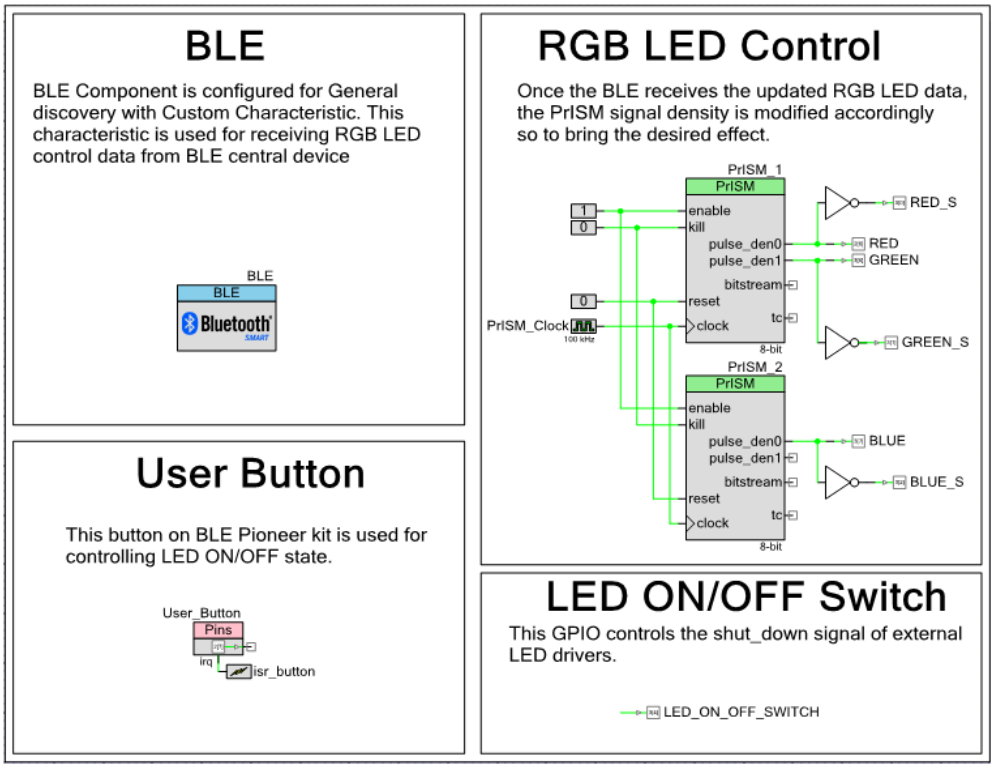
Programming Language: C (GCC 4.8.4 – included with PSoC Creator)

Associated Parts: All PSoC 4 BLE devices

Related Hardware: CY8CKIT-042-BLE, RGB Power LED shield/lamp (see attached schematic)

PSoC Creator Schematic

Figure 3. PSoC Creator Schematic (RGB Power LED Project)



The project uses following components:

1) **BLE Component**:

   BLE Component is configured for GAP Peripheral and GATT Server role. A custom service, named as RGB LED, is added in the component to allow the four byte data transfer to the BLE Pioneer Kit.

2) **PrISM Component**:

   The PrISM component deploys the Cypress's PrISM algorithm to control the intensity of a LED. For RGB color control, three signals are required that are generated from two PrISM components (one component supports two outputs).

3) **Digital Input Pin Component**:

   One GPIO is configured as Digital Input for receiving the User Button press signal. Also, this GPIO is set in interrupt mode to allow interrupt being raised on button press. An **ISR** component is used for registering the interrupt.

4) **Digital Output Pin Component**:

   Few GPIOs are configured as Digital Output pins for following purpose:

   a. Driving RGB LED signals for onboard LED on BLE Pioneer Kit

   b. Driving RGB LED signals of external RGB Power LED Board.

   c. Controlling LED On/Off signal

Hardware Setup

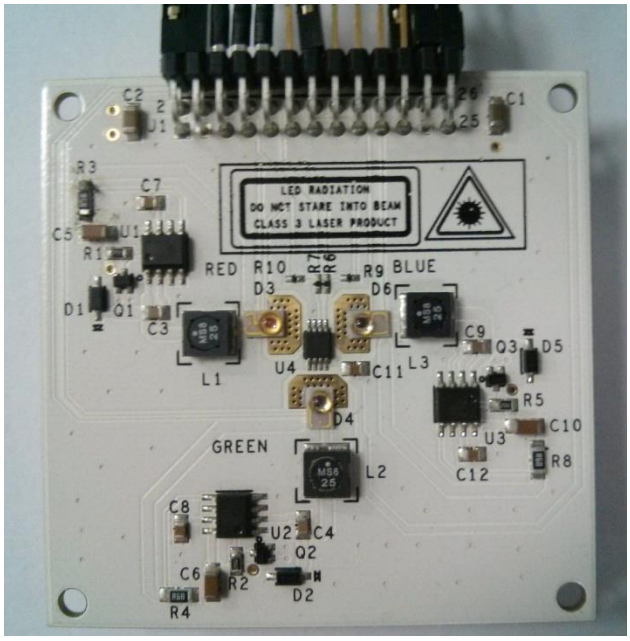
To test this project, a RGB LED shield or lamp along with BLE Pioneer Kit is required. The RGB LED Shield control should be PWM type or similar. Protocol based LED's (such as DMX) is not supported by this project.

As the BLE Pioneer Kit cannot provide high voltage/current as required by the RGB LED shield, external power source will be required. The voltage and current range of RGB LED shields vary depending on the wattage of the shield and the proper power source should be used accordingly.

Note: The RGB Power LEDs are high power products and can be damaging to look directly at. Ensure proper safety steps are taken before using them.

There are many RGB Power LEDs available in market that can be used along with the project. Also, a RGB shield can be created and interfaced with BLE Pioneer Kit for demonstration. The demonstration of this project is done using one such custom RGB Power LED board, as shown in Figure 4. See the attached file for the schematic of the shield used.

Figure 4. Custom RGB Power LED Board

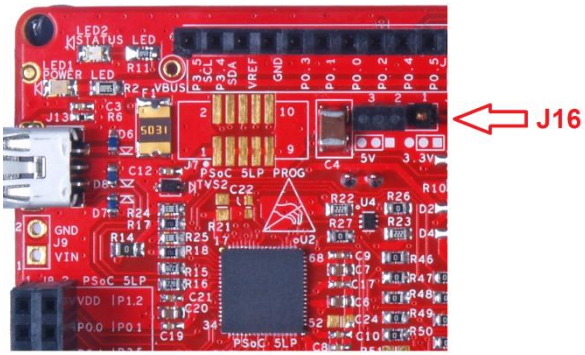


Testing

Setup the test by following these steps:

1) Open the PSoC Creator example project *PSoC_4_BLE_RGB_Power_LED_Control*.
2) On BLE Pioneer Kit, place the jumper **J16** in 2-3 position to enable 5V operation. This is done as the external RGB LED shield used operates signals in 5V level.

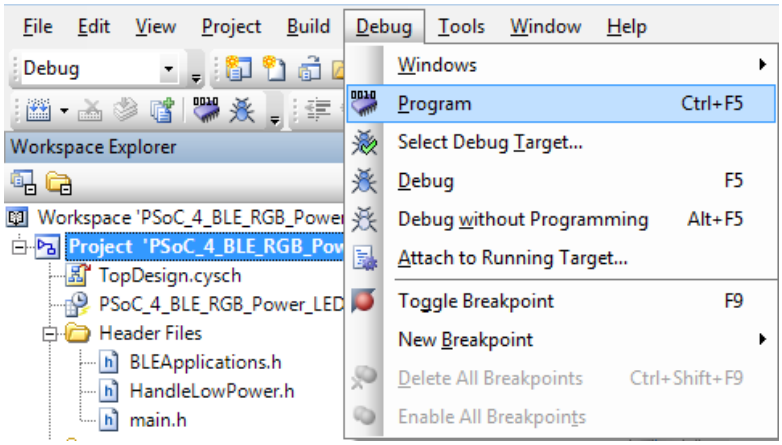
Figure 5. J16 jumper for 5V operation



3) Connect the BLE Pioneer Kit with PSoC 4 BLE module to the PC using connector **J13**. Allow USB enumeration to complete.

4) Click on **Debug -> Program** to program the BLE Pioneer Kit with *PSoC_4_BLE_RGB_Power_LED_Control* project.

Figure 6. Program project



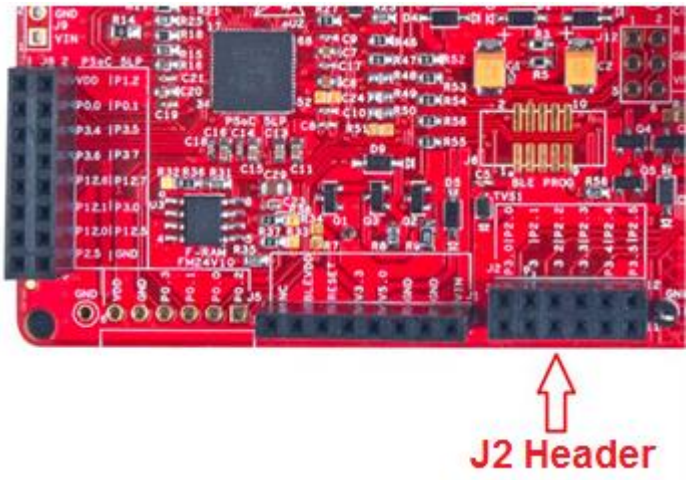
5) Disconnect the USB from BLE Pioneer Kit.

6) Connect the following pins from header **J2** on BLE Pioneer Kit to the external RGB Power LED shield.

Table 1. External Connections

Signal	PSoC 4 BLE GPIO
RED color	P3_0
GREEN color	P3_1
BLUE color	P3_2
LED On/Off	P3_4
User Switch	P2_7

Figure 7. J2 Header on BLE Pioneer Kit



7) Reconnect the BLE Pioneer Kit to PC using USB cable to power the kit. The blinking Red LED on the BLE Pioneer Kit indicates advertisement.

8) Plug the 12V power adapter output to the RGB Power LED Shield.

9) Press user button **SW2** on BLE Pioneer Kit once to enable the LED ON signal. Each press on the button will toggle the ON/OFF state of external RGB Power LED.

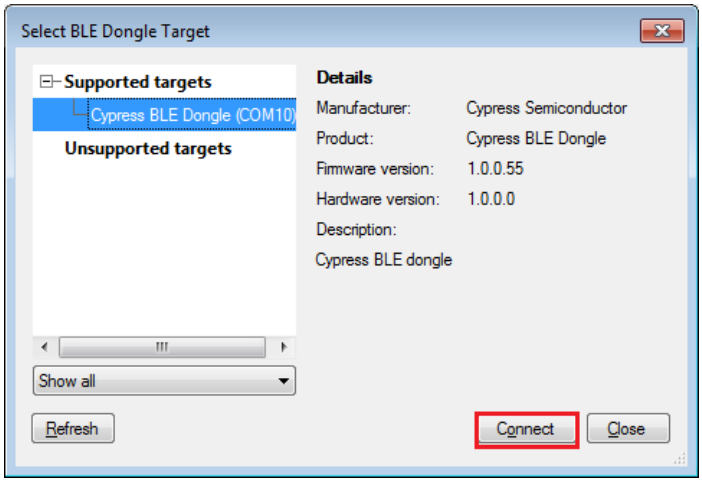
For testing with CySmart PC Tool:

10) Connect BLE Dongle to the PC. Allow enumeration to complete.

Figure 8. Connect BLE Dongle to PC

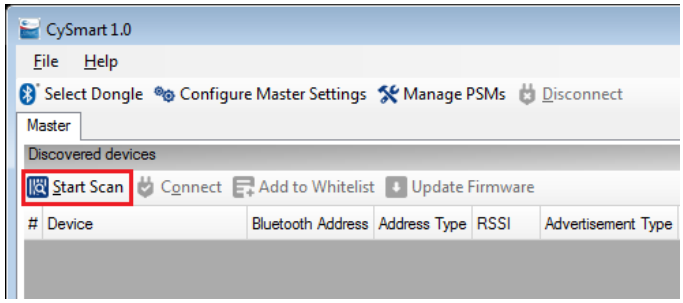
11) Open CySmart PC Tool on the PC. Select the BLE Dongle and click connect.

Figure 9. Select BLE Dongle



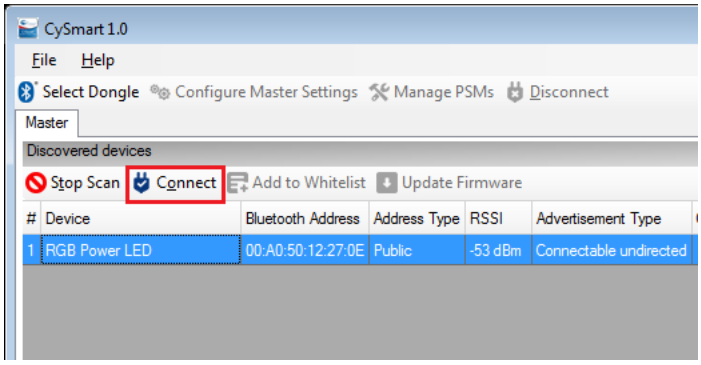
12) Click on **Start Scan**. Device with name ***RGB Power LED*** should be listed in the tool.

Figure 10. Start Scan



13) Select this device and click **Connect**.

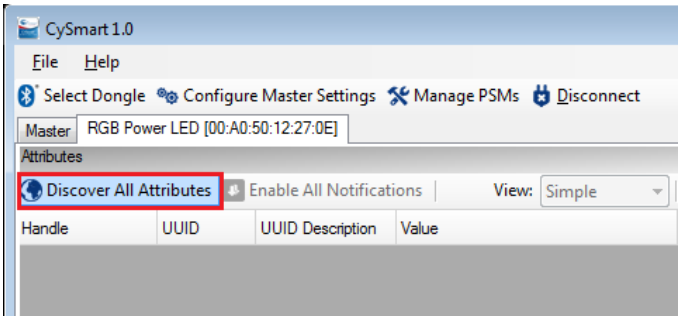
Figure 11. Connect to RGB Power LED



14) After the device is disconnected, there will be a pop-up for Connection parameter update. This will update the connection interval and supervision timeout. Click on **Yes**.

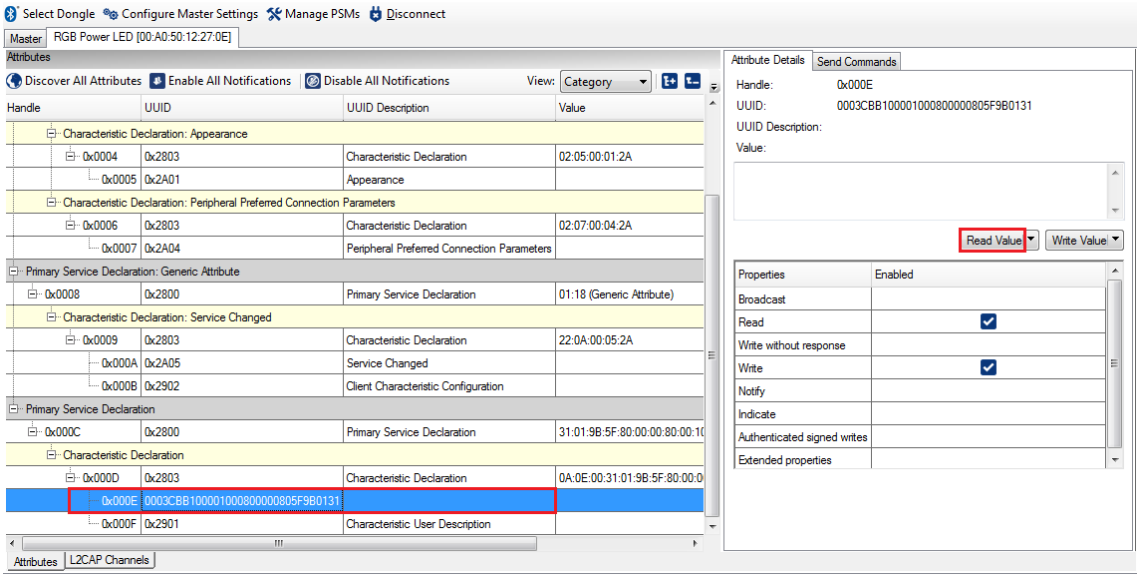
15) Click on **Discover All Attributes**. This will list the supported services and characteristics by the device.

Figure 12. Discover All Attributes



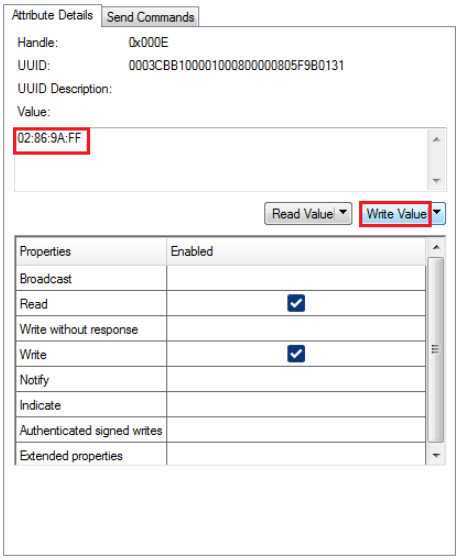
16) Locate the RGB LED Characteristic. For this project, it will be with handle value as 0x000E. Click on it and then click on **Read Value** at the right. This will read and display the current 4 byte value of the RGB LED characteristic.

Figure 13. Read RGB LED Characteristic



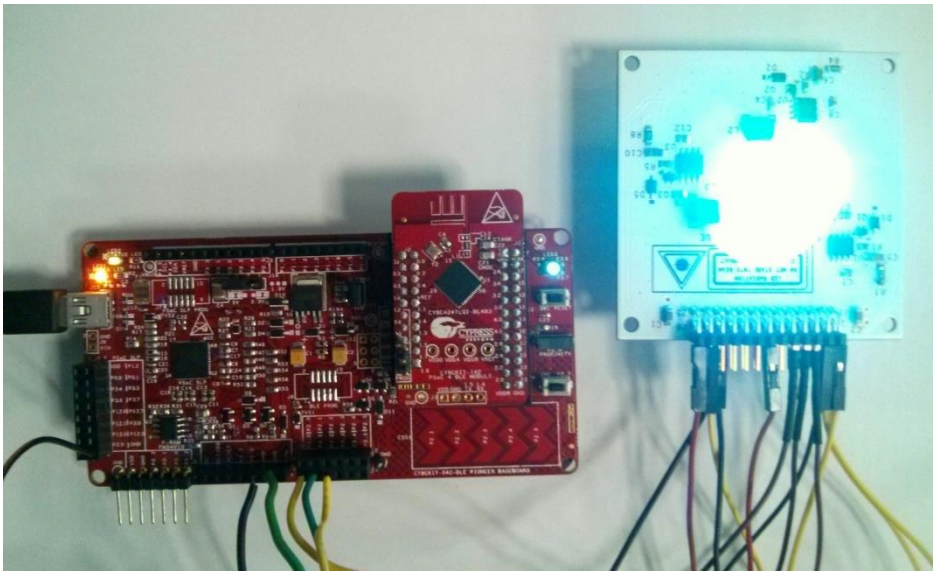
17) Modify the four bytes to desired value [RED:GREEN:BLUE:INTENSITY] and then click on **Write Value**. The corresponding color will be displayed on the RGB LED shield.

Figure 14. Write new RGB LED value



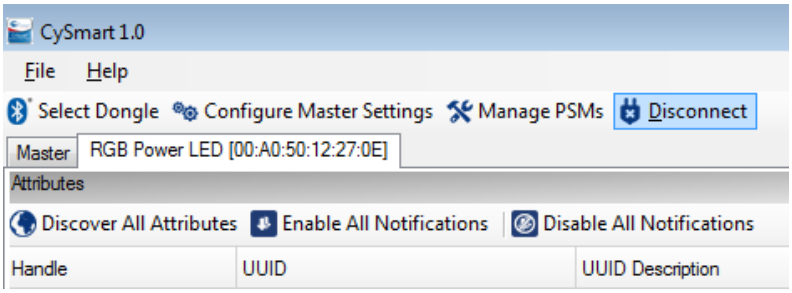
18) Write any other non-zero value to see appropriate color changes on the RGB LED Shield.

Figure 15. RGB Power LED control



19) To disconnect from the tool, click on the **Disconnect** button. The Kit will be disconnected and it will restart advertisement.

Figure 16. Disconnect the from existing BLE connection



For testing with CySmart iOS/Android App

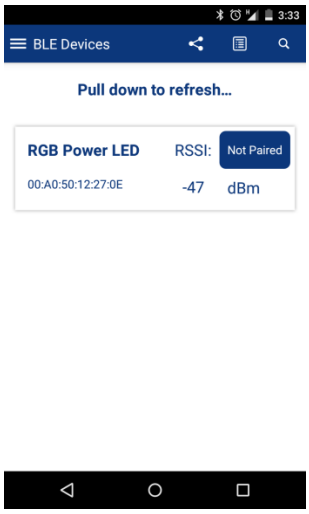
20) Follow steps 1-7 above.

21) Download the CySmart mobile App for iOS or Android device from App Store or Play Store, respectively.

22) Open the App on mobile device. If Bluetooth is not enabled, the App will ask to enable it.

23) After the Bluetooth is enabled, the App will search for all available BLE devices and list it on the App. Tap on **RBG Power LED** device to connect to it.

Figure 17. Select RGB Power LED device

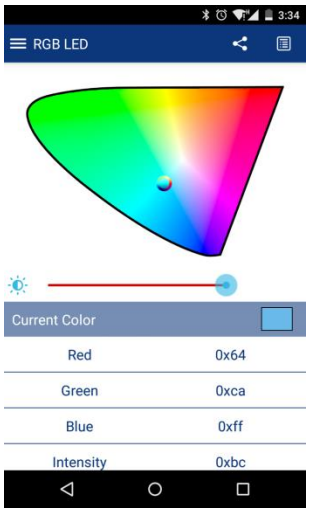


24) Scroll right through the icons to come to **RGB LED Service** icon. Tap on it to open the RGB LED GUI page.

Figure 18. Select RGB LED Service icon

25) Using the **Color gamut** to change the Red, Green and Blue color value and **Linear slider** to change the intensity, set the desired color on the RGB LED shield.

Figure 19. Change RGB LED color



26) To disconnect, click on back button to reach the Device page or close the App.

Related Documents

Table 2 lists all relevant application notes, code examples, knowledge base articles, device datasheets, and Component / user module datasheets.

Table 2. Related Documents

Document	Title	Comment
AN91267	Getting Started with PSoC 4 BLE	Provides an introduction to PSoC 4 BLE device that integrates a Bluetooth Low Energy radio system along with programmable analog and digital resources.
AN91445	Antenna Design Guide	Provides guidelines on how to design an antenna for BLE applications.
AN91162	Creating a BLE Custom Profile	Provides methodology to create your own custom BLE service/characteristic