



iCE40 UltraPlus RGB LED Controller with BLE

User Guide

FPGA-UG-02010 Version 1.1

March 2017

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1. Introduction

The RGB LED Controller demo generates configurable Pulse Width Modulation (PWM) outputs to control RGB LEDs by adjusting color, brightness, blink rate and ramp rate. Bluetooth Low Energy (BLE) is used to communicate between an Android phone and the demo board.

Figure 2.1 shows the MDP board details.

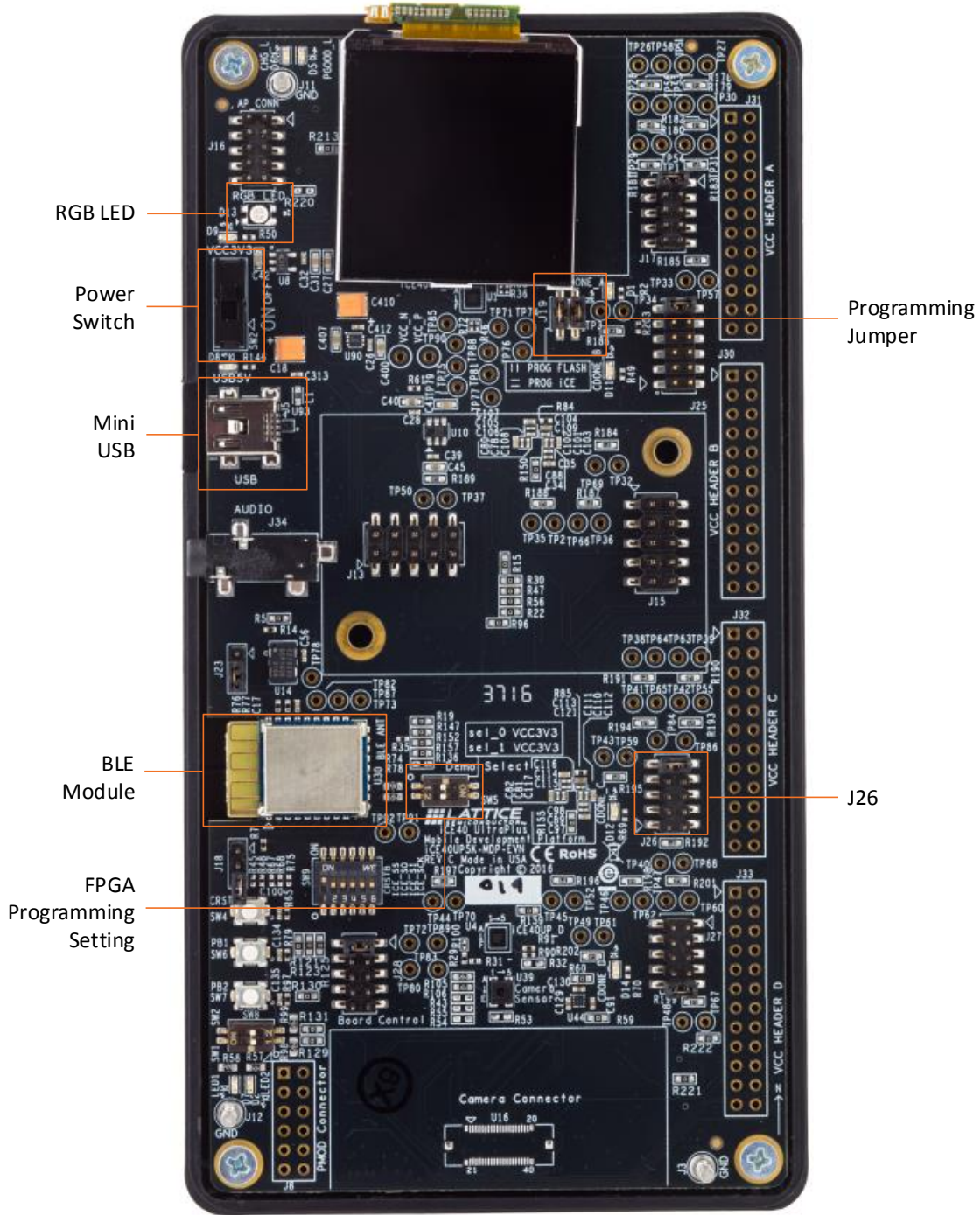


Figure 1.1. iCE40 UltraPlus MDP Board Details

2. Demo Setup

2.1. Block Diagram

Figure 2.1 shows the demo block diagram.

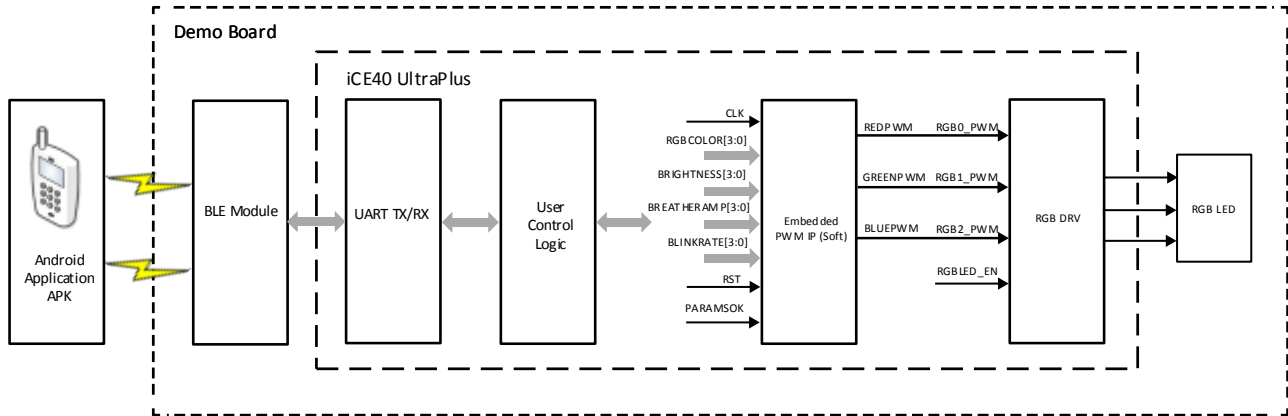


Figure 2.1. RGB LED Controller Demo Block Diagram

2.2. Requirements

The demo setup consists of an Android phone with Jelly Bean 4.3 or higher and the iCE40 UltraPlus™ Mobile Development Platform (MDP).

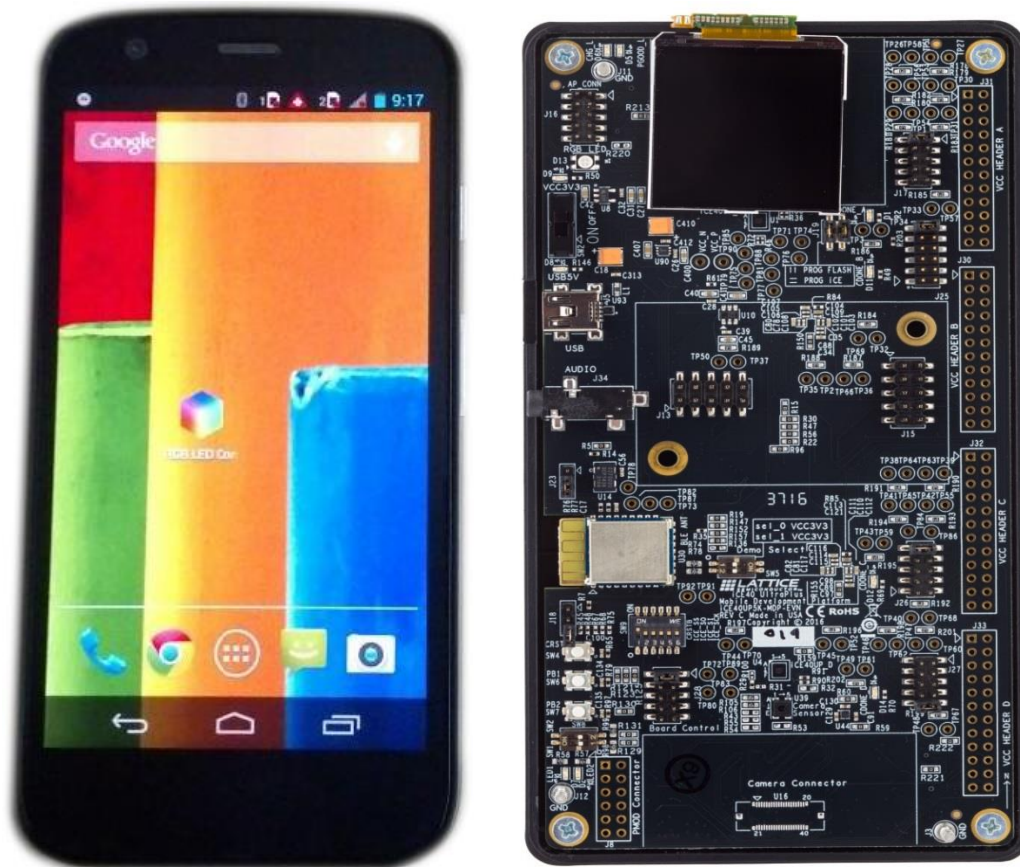


Figure 2.2. Android Phone with Jelly Bean 4.3 or KitKat 4.4 and UltraPlus Mobile Development Platform

2.3. Jumper Settings

This section describes the default jumper configuration for the board.

1. Connect J23 2/3 to enable the oscillator.
2. Switch SW5 to OFF/ON to select iCE40UP_C.
3. Connect jumper J19 for flash program.
4. Connect J26 1/2 and 3/4.

3. Programming the Bitmaps to the MDP Board

To program the bitmaps to the MDP board:

1. Connect the iCE40 UltraPlus MDP to the PC using a USB mini port (J5).
2. Power ON the iCE40 UltraPlus MDP.
3. Start the Diamond Programmer tool.
4. In the Getting Started dialog box, select **Create a new project from a JTAG scan** as shown in [Figure 3.1](#).
5. Set **Cable to HW-USBN-2B (FTDI)**.
6. Set **Port to FTUSB-0**.

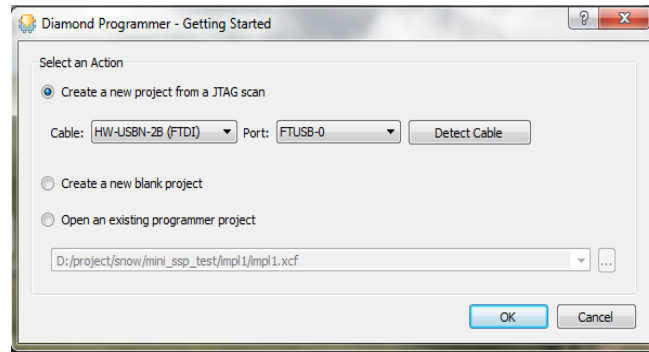


Figure 3.1. Getting Started Dialog Box

7. Click **OK**. This opens the Diamond Programmer main interface as shown in [Figure 3.2](#).

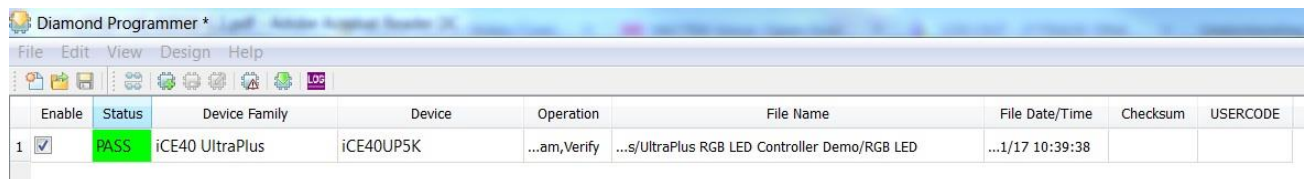


Figure 3.2. Diamond Programmer Main Interface

8. Select **iCE40 UltraPlus** under **Device Family**.
9. Select **iCE40UP5K** under **Device**.
10. Double-click under **Operation** to open the Device Properties dialog box as shown in [Figure 3.3](#).
11. Select **SPI Flash Programming** under **Access mode**.
12. Select the program file `/bitmap/ble_rgb_led_top_bitmap.hex`.
13. Select **Micron** under **Vendor**.
14. Select **SPI-M25P80** under **Device**.
15. Click **OK**.

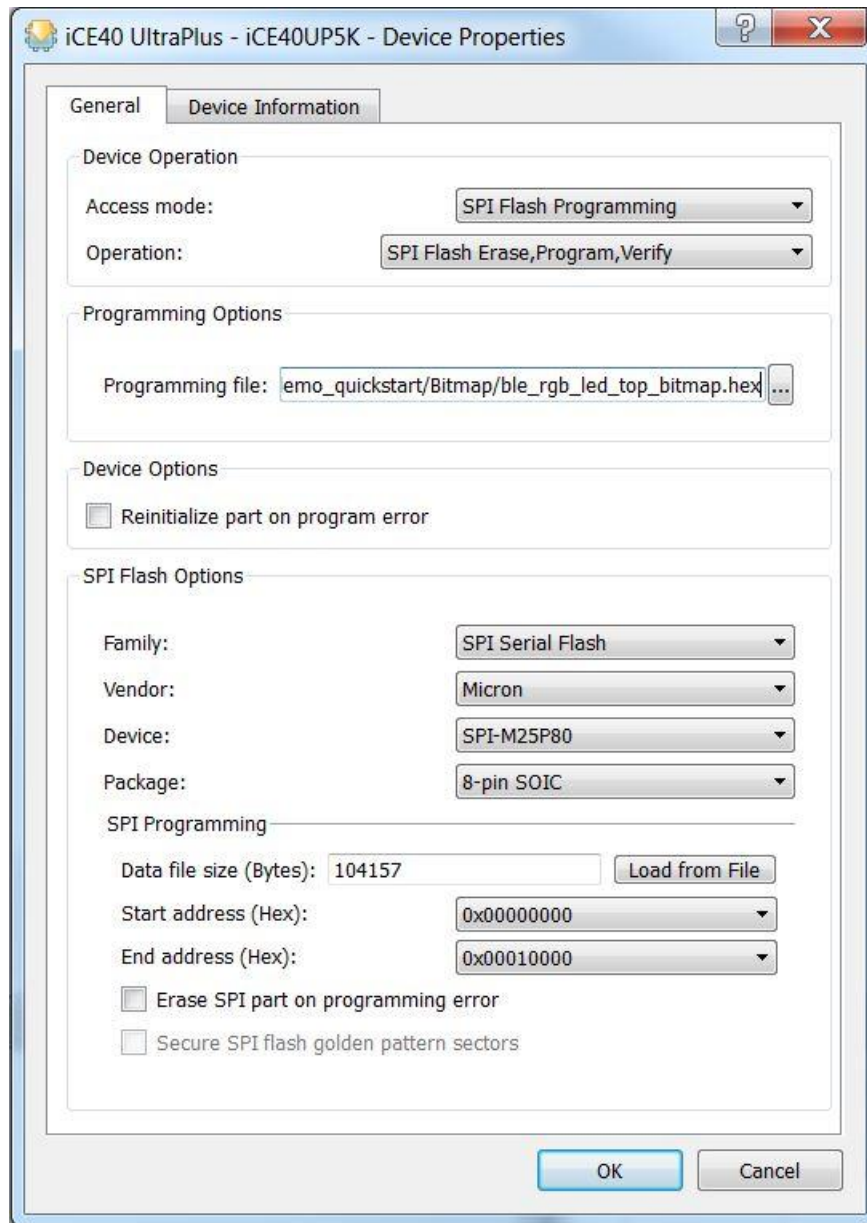


Figure 3.3. Device Properties Dialog Box

16. Click the **Program** button to program the FPGA.

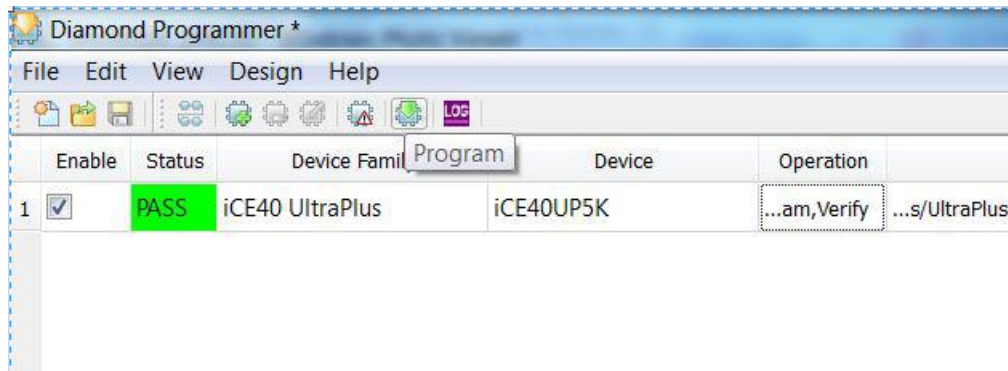


Figure 3.4. Program Button

17. When the programming sequence is completed, the CDONE LED glows on the iCE40 UltraPlus MDP.

If the programmer issues an error, recheck the connection.

4. Installing the RGB LED Controller BLE APK in the Android Phone

To install the APK (Android application package) in the Android phone:

1. In the Android phone, select **Settings > Security > Unknown sources**.
2. Connect the phone to a PC and copy the `RGB LED Controller BLE.apk` to any directory on the phone.
3. On the phone, browse to the directory where the APK was copied and select it to install.
4. Deselect the **Unknown sources** option.

5. Connecting the iCE40 UltraPlus MDP to the Android Phone

To connect the iCE40 UltraPlus MDP to the Android Phone:

1. Power ON the iCE40 UltraPlus MDP and the Android phone
2. Disable Bluetooth.
3. Go to the Apps menu and select **RGB LED Controller BLE Demo**.
4. In the message prompt to activate Bluetooth on the phone, press **Allow** as shown in [Figure 5.1](#).

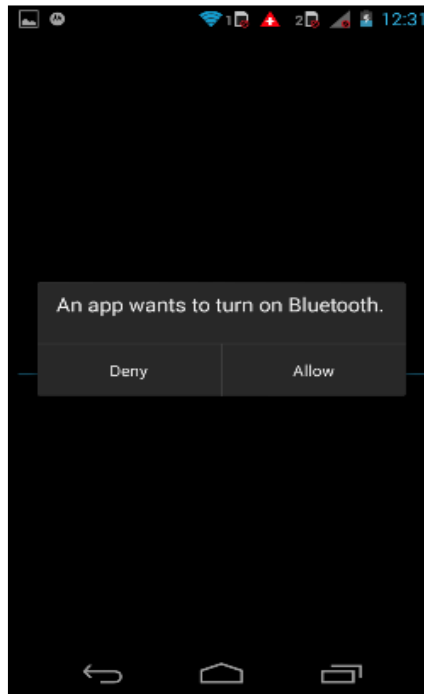


Figure 5.1. Activate Bluetooth Prompt

5. Select the **iCE40UP-MDP** device to connect the iCE40 UltraPlus device in the vicinity.
6. If the top right text box displays **CONNECT**, it means that the device has been disconnected. Press **CONNECT** or press the back button to reconnect the device.

6. Running the Demo

Follow the steps in previous sections to so that the iCE40 UltraPlus MDP and Android phone are ready with the necessary bitmap and application.

To run the demo:

1. Connect the Android phone app to the BLE device.
2. Launch the application.
3. Click on the various colors to change the color of the RGB LED.
4. Move the sliders to control brightness, blinking and breathing. For details, refer to the [RGB LED Controller with BLE Interface Demo Application Features](#) section.

7. RGB LED Controller with BLE Interface Demo Application Features

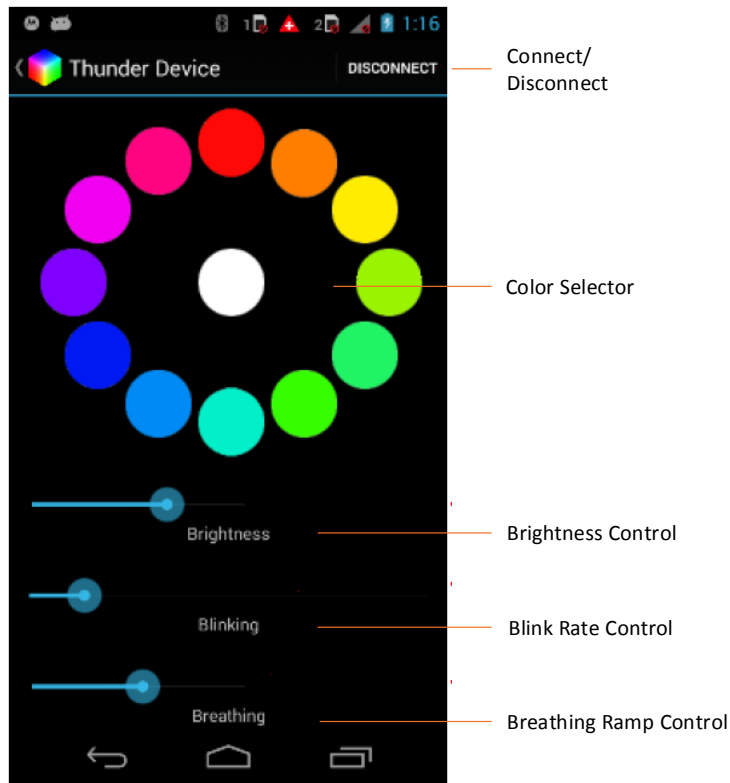


Figure 7.1. Application Interface

The top half of the screen is the color selector. You can select between 13 different colors from the pallet.

The **Brightness** slider controls the brightness of LEDs. Moving the slider from left to right increases the brightness level.

The **Blinking** slider controls the blinking of LEDs. Moving the slider to the leftmost position results in no blinking. Moving the slider from left to right increases the blink OFF period from 0.256 second to 3.84 second in 15 steps of 0.256 each. The blink ON time is constant at one second.

The **Breathing** slider controls the breathing ramp of LEDs. Moving the slider from left to right increases the breathing speed.

8. Resource Utilization

Table 8.1. Resource Utilization

Resource Type	Device and Demo	
	ICE40 UltraPlus (5K UWG30)	Current Demo
LogicCells	5280	379
PLBs	660	91
BRAMs	30	0
PLLs	1	0
I2Cs	2	0
SPIs	2	0
SBIODs	3	0
DSPs	8	0
RGBADRVs	1	1
LEDDAIPs	1	1
LFOSCs	1	0
HFOSCs	1	0
SPRAMs	4	0

Technical Support Assistance

For assistance, submit a technical support case at www.latticesemi.com/techsupport.

Revision History

Date	Version	Change Summary
March 2017	1.1	Removed copyright page.
		Added minor editorial changes to the Introduction section.
		Created Demo Setup section and placed Block Diagram , Requirements , and Jumper Settings as subsections. <ul style="list-style-type: none"> • Updated Figure 1.1. iCE40 UltraPlus MDP. • Added minor editorial changes. • Revised configuration in the Jumper Settings section.
		Updated steps 8 and 9 in the Programming the Bitmaps to the MDP Board section. Added Figure 3.4. Program Button .
		Updated the procedure in the Installing the RGB LED Controller BLE APK in the Android Phone section.
December 2016	1.0	Initial release.



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