iCE40 UltraPlus Sensor Data Buffer with BLE - Radiant Software

User Guide

FPGA-UG-02058 Version 1.0

June 2018

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Acronyms in This Document

A list of acronyms used in this document.

Acronym	Definition
APK	Application Package Kit
BLE	Bluetooth Low Energy
FPGA	Field-Programmable Gate Array
I²C	Inter-Integrated Circuit
MDP	Mobile Development Platform
PCM	Pulse Code Modulation
PDM	Pulse Density Modulation
SPI	Serial Peripheral Interface
SSP	System Solution Platform

1. Introduction

The iCE40 UltraPlus™ Sensor Data Buffer with BLE demo shows the application of the sensor data buffer feature with Bluetooth Low Energy (BLE) on the iCE40 UltraPlus Mobile Development Platform (MDP). Data from the three sensors below is read for ten seconds and sent to the application to playback the movement.

- Accelerometer
- Gyroscope
- Magnetic field

2. Functional Description

Figure 2.1 shows the demo block diagram.

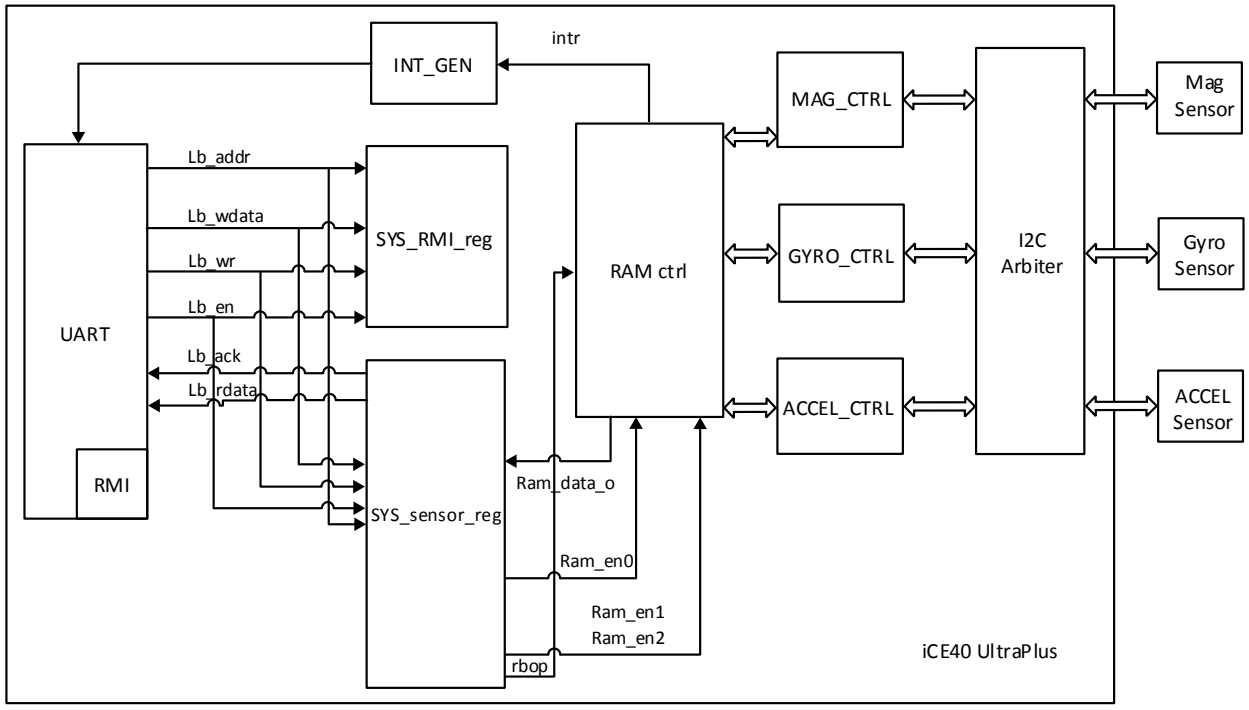

Figure 2.1. iCE40 UltraPlus Sensor Data Buffer with BLE Demo Block Diagram

3. Demo Setup

This section describes the demo setup.

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

Figure 3.1. Android Phone with Jelly Bean 4.3 or KitKat 4.4 and the iCE40 UltraPlus MDP

3.1. Hardware Requirements

- Android phone
- iCE40 UltraPlus MDP
- USB Mini Port

3.2. Software and Firmware Requirements

- Android Jelly Bean 4.3 or KitKat 4.4
- Radiant Programmer
  (Refer to the http://www.latticesemi.com/Products/DesignSoftwareAndIP/FPGAandLDS/Radiant)
- Programming file for the iCE40 UltraPlus MDP

3.3. Configuring the MDP Board

3.3.1. Setting Jumpers and Switches

Board reconfiguration is needed before running this demo. Figure 3.2 highlights (in orange boxes) all switches and jumpers need to be verified or reconfigured on Mobile Development Platform (MDP) board.

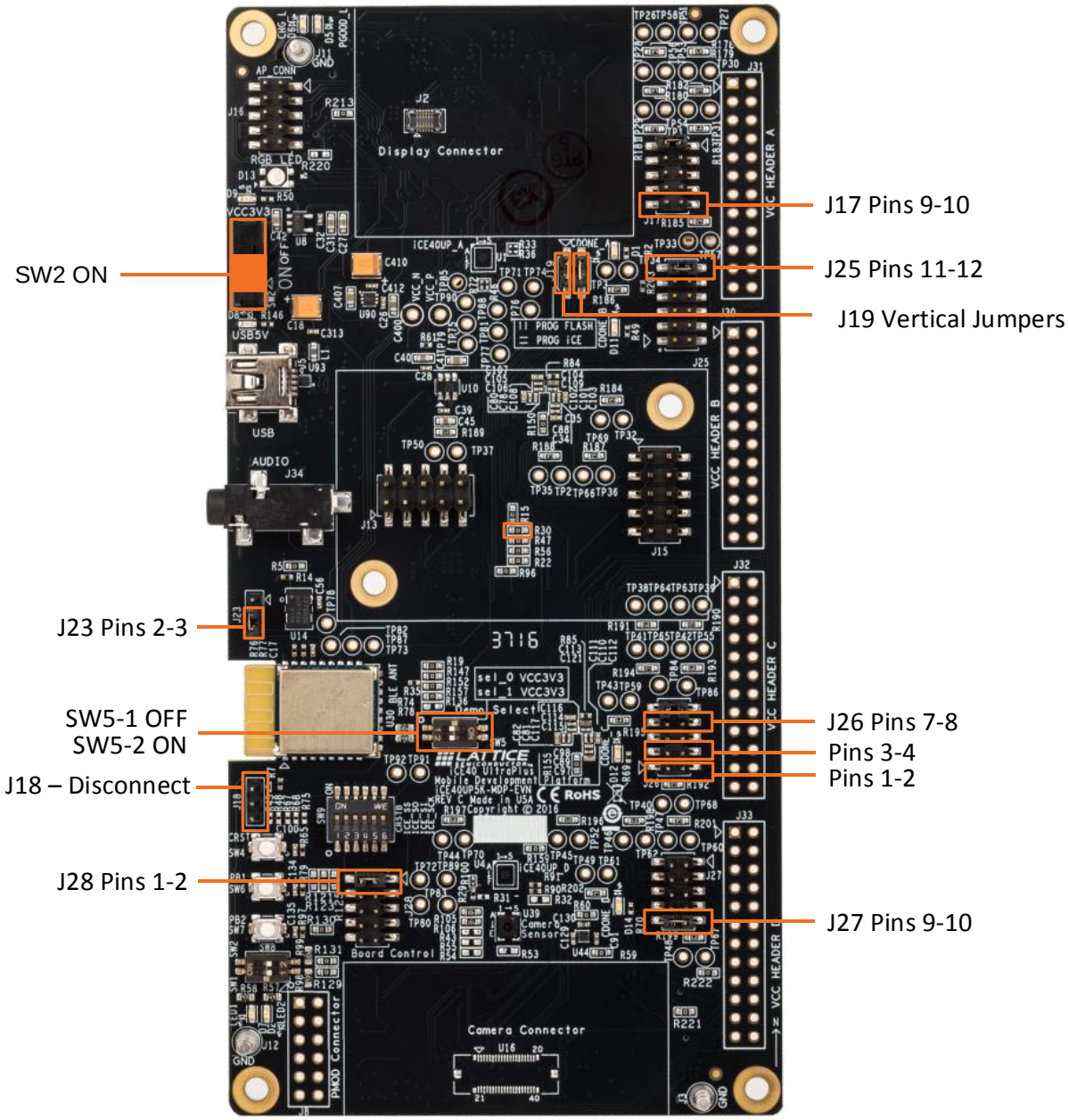

Figure 3.2. MDP Board Configuration

Table 3.1 lists the detailed information of these configurations on switches and jumpers.

Table 3.1. Detailed Information of the Board Configuration

Items	Configuration	Description
J17, J27	Shunt pin 9-10	Disable ICE40UP5K_A/D devices.
J25	Shunt pin 11-12	Disable ICE40UP5K_B device.
J26	Shunt pins 1-2, 3-4, 7-8	Enable ICE40UP5K_C device.
J28	Shunt pin 1-2	Enable Board control for programming SPI Flash.
J19	Shunt pins 1-3, 2-4 (vertical)	Enable programming SPI Flash
J23	Shunt pin 2-3	Use Xtal U14 as clock source.
J18	Disconnect	Default BLE program
SW2	Set to ON	Power switch, slide down for power-on.
SW5	Set SW5-1 to OFF, and SW5-2 to ON.	Select ICE40UP5K_C as target device.

4. Programming the Demo

4.1. Programming the Bitmaps to the MDP Board

To program the bitmaps to the MDP board:

1. Power ON the iCE40 UltraPlus MDP.
2. Start the Radiant Programmer tool.
3. In the Getting Started dialog box, select **Create a new project from a scan** as shown in Figure 4.1.
4. Set Cable to **HW-USBN-2B (FTDI)**.
5. Set Port to **FTUSB-0**.

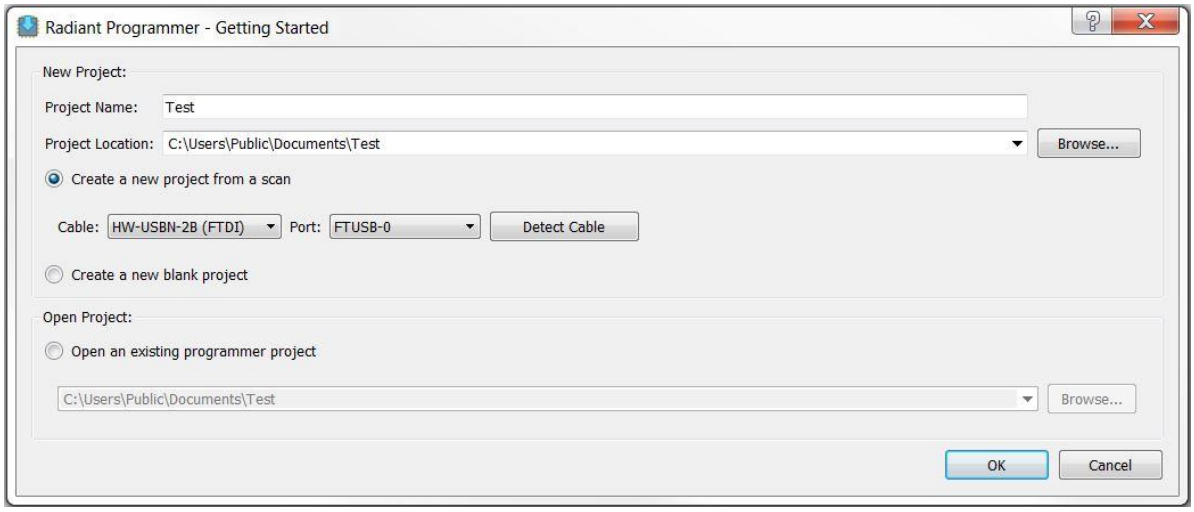

Figure 4.1. Getting Started Dialog Box

6. Click **OK**. This opens the Radiant Programmer main interface as shown in Figure 4.2.

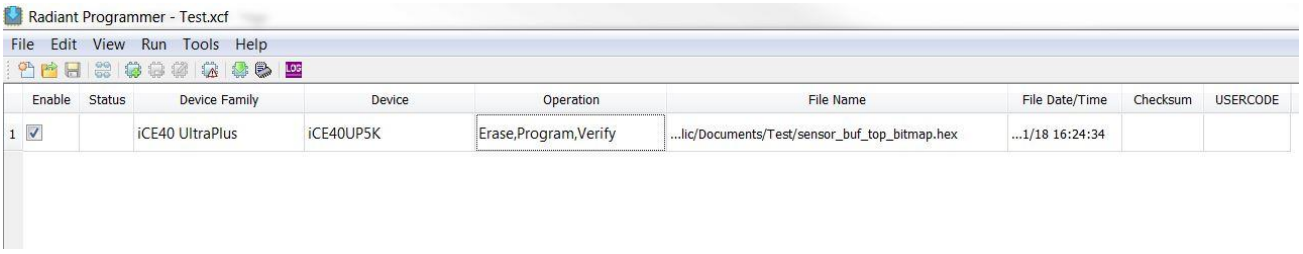

Figure 4.2. Radiant Programmer Main Interface

7. Select **iCE40 UltraPlus** under Device Family.
8. Select **iCE40UP5K** under Device.
9. Right-click on the device and select **Device Properties** in the context menu. The **Device Properties** dialog box is displayed as shown in Figure 4.3.

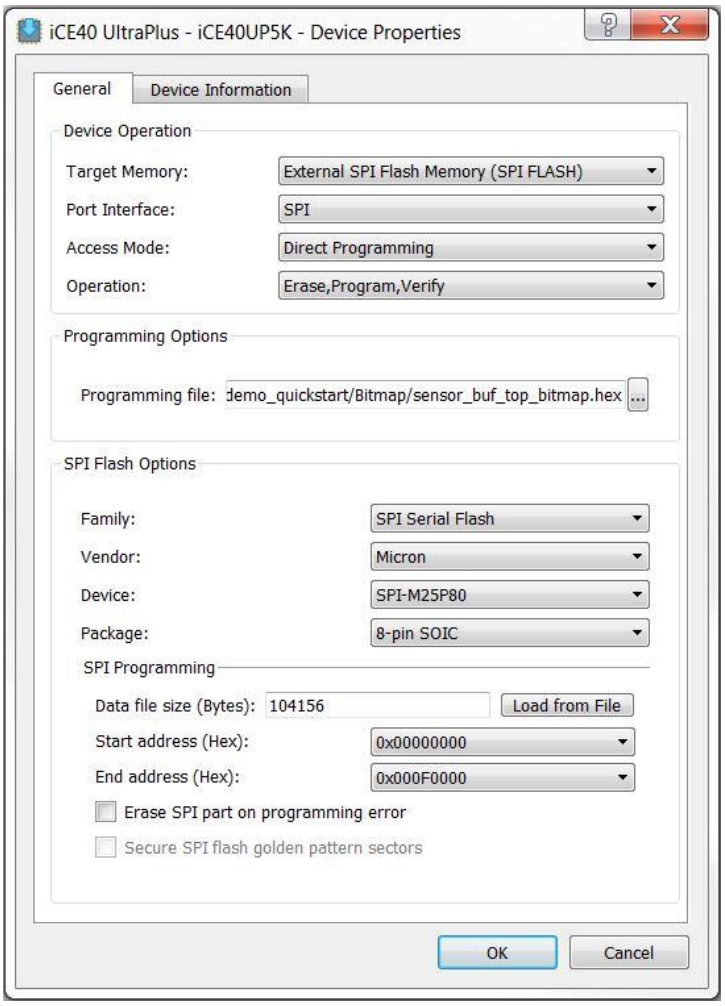

Figure 4.3. Device Properties Dialog Box

10. Select **External SPI Flash Programming** under **Target Memory**.
11. Select the program file `/Bitmap/sensor_buf_top_bitmap.hex`.
12. Select **Micron** under **Vendor**.
13. Select **SPI-M25P80** under **Device**.
14. Click **OK**.
15. Click the **Program Device** button to program the FPGA.

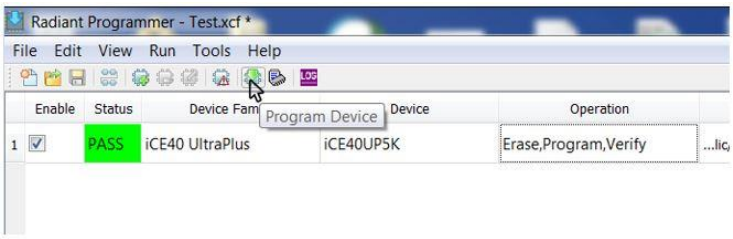

Figure 4.4. Program Button

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

If the programmer issues an error, recheck the connection.

4.2. Installing the Sensor Data Buffer BLE APK onto the Android Phone

To install the APK (Android application package) onto the Android Phone:

16. In the Android phone, select **Settings > Security > Unknown sources**.
17. Connect the phone to a PC and copy the `SensorBufferDemo.apk` to any directory on the phone.
18. On the phone, browse to the directory where the APK is copied and select it to install.
19. Deselect the **Unknown sources** option.

4.3. Connecting the iCE40 UltraPlus MDP to the Android Phone

To connect the iCE40 UltraPlus MDP to the Android phone:

20. Power ON the iCE40 UltraPlus MDP and the Android phone
21. Disable Bluetooth on the phone.
22. Go to the Apps menu and select **Sensor Buffer Demo**.
23. In the message prompt to activate Bluetooth on the phone, press **Allow** as shown in Figure 4.5.

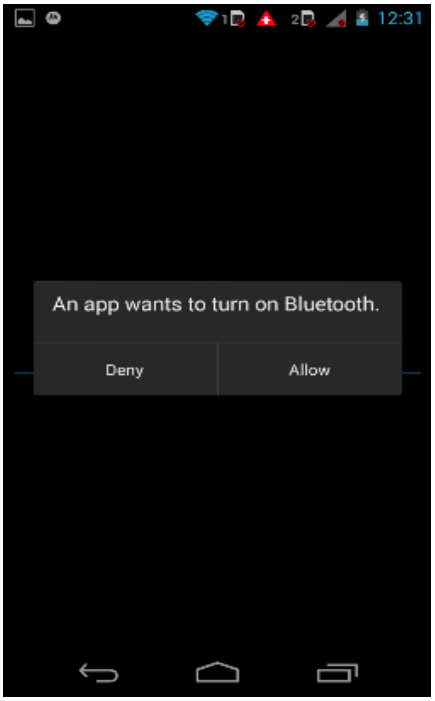

Figure 4.5. Activate Bluetooth Prompt

24. Select the **iCE40UP-MDP** device to connect the iCE40 UltraPlus device in the vicinity.
25. 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.

5. Running the Demo

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

To run the demo:

26. Connect the Android phone application to the BLE device. Tap on the device that you want to connect with the application as shown in Figure 5.1.

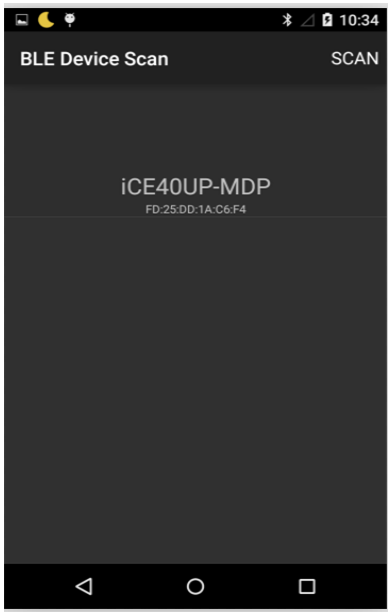

Figure 5.1. BLE Device Scan

27. Press the **Start Demo** button as shown in Figure 5.2.

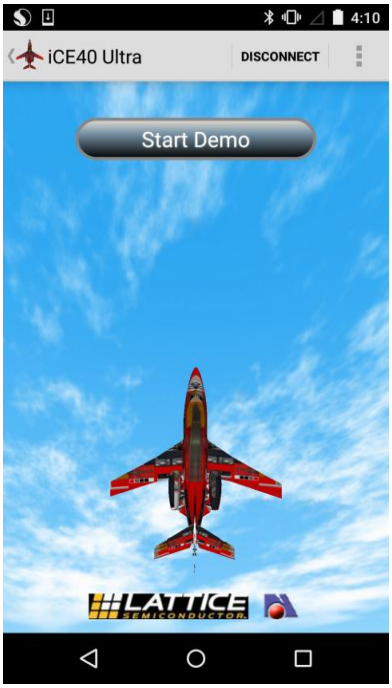

Figure 5.2. Start Demo Button

28. Press the **Airplane** button. The **FETCHING SENSOR DATA PLEASE WAIT** message is displayed as shown in Figure 5.3.

Figure 5.3. Airplane Button

29. Move the MDP board for ten seconds until the LED stops blinking. The sensor data produced by the movement of the MDP board is recorded.

    Note: The application waits for the interruption. Once interruption occurs, the application reads the sensor data from the buffer. Otherwise, the interface is reset and you need to press the **Airplane** button again.

30. If the data is collected successfully, the application uses these data to manipulate the 3D airplane image shown in Figure 5.4. The movement of the airplane mimics the recorded movement of the MDP board in the previous step. This playback also lasts for ten seconds.

Figure 5.4. Successful Operation

To test airplane movement again, press the Back button. The previous interface is displayed. Press on the **Airplane** button again as shown in Figure 5.5.

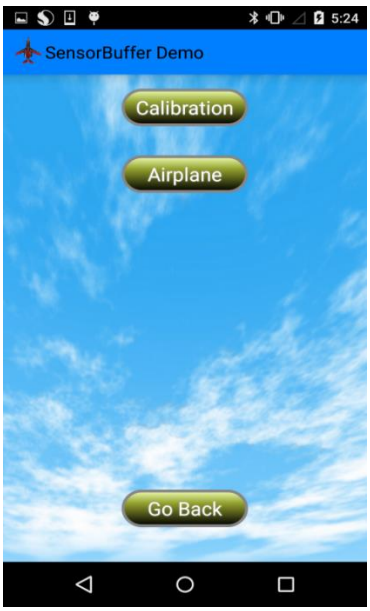

Figure 5.5. Interface is Reset

Technical Support Assistance

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

Revision History

Date	Version	Change Summary
June 2018	1.0	Initial release.

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