



IR TX Demo for iCE40 Ultra™ Wearable Development Platform User Guide

UG101 Version 1.0, September 2015

Demo Setup

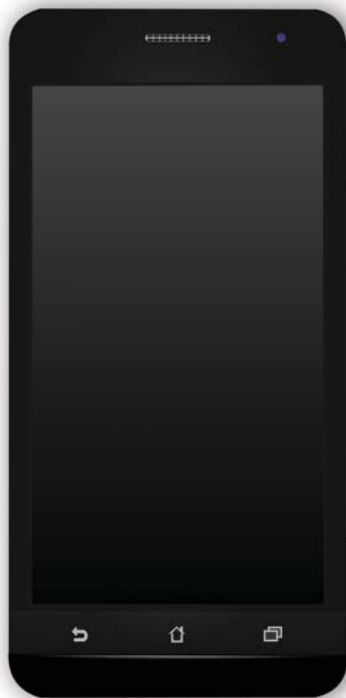
Hardware Requirements

- iCE40 Ultra™ Wearable Development Platform
- Android smart phone with Android 4.3 or 4.4
Note: Current design may not function correctly on Android 5.0.
- Windows PC or Linux machine for downloading the bit stream
- USB cable for programming the device

Software Requirements

- Lattice Diamond® Programmer software 3.3 or higher
- Android apk file *IRDemo_TX.apk*
- MachXO2™ device bitstream file *p2dsi.jed*
- iCE40 Ultra device bitstream file *wearable_IR_TX.bin*
- IR data files *ir_key1.txt*, *ir_key2.txt* and *ir_key3.txt*

Figure 1. Demo Setup



Smartphone with
Android 4.3 or higher



iCE40 Ultra Wearable
Development Platform

Jumper Settings for iCE40 Ultra Wearable Development Platform

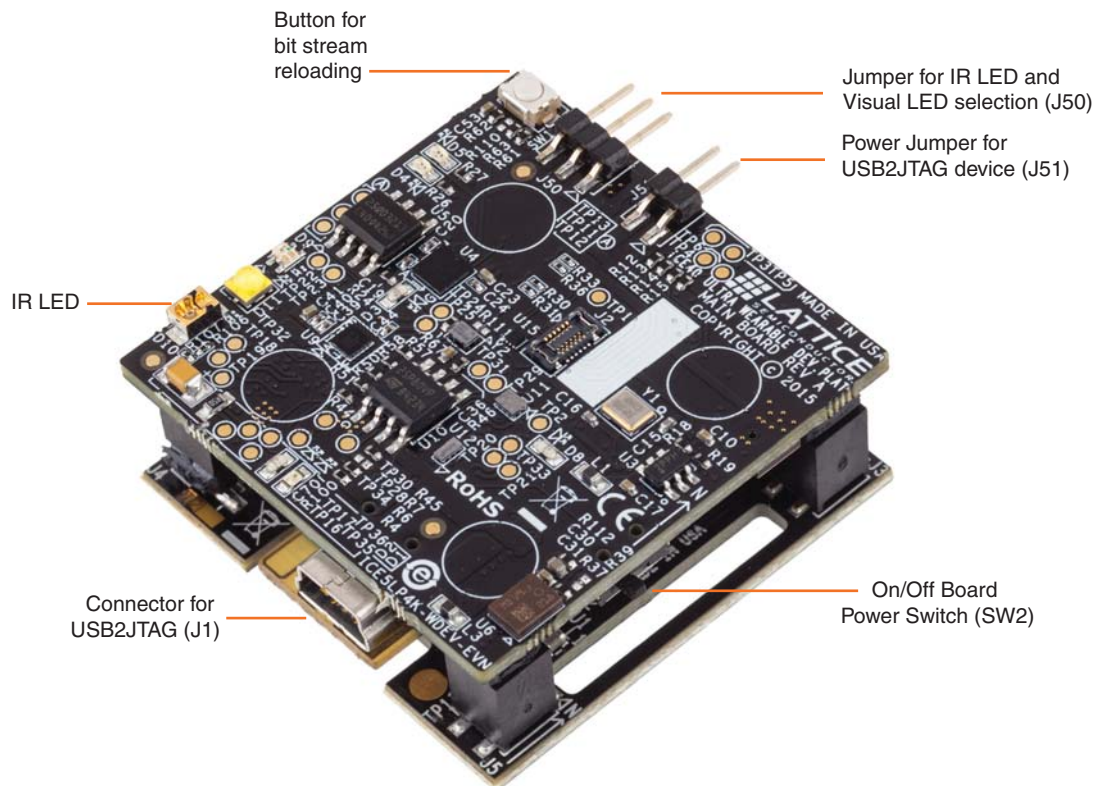
In this demo, there are two jumpers that need to be set.

- Connect the USB2JTAG Power Jumper (J51) for FTDI device.
- Connect jumper J50 pin1 and pin2 to enable IR LED.

For more information about the board, see EB100, [iCE40 Ultra Wearable Development Platform User Guide](#).

Wearable Board Details

Figure 2. Wearable Board Details

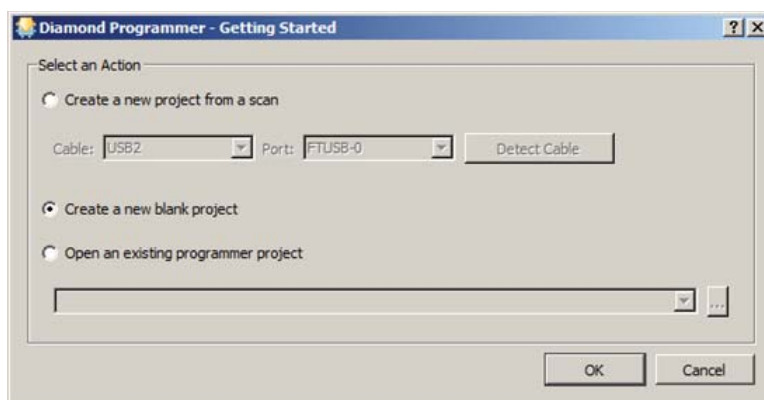


Flashing Bitmaps to Wearable Board

To flash bitmaps to wearable board:

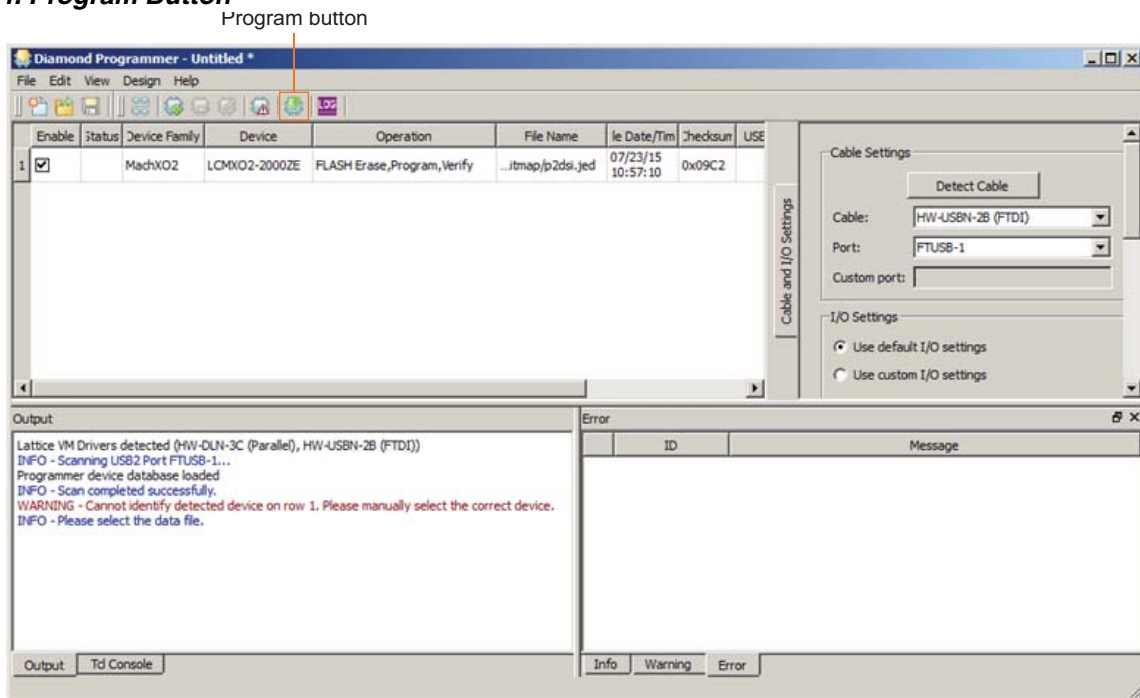
1. Connect jumper J51 to power on USB2JTAG device.
2. Connect the wearable board to the PC through the USB mini socket (see EB100, [iCE40 Ultra Wearable Development Platform User Guide](#)).
3. Power on the board using the Power Switch (see EB100, [iCE40 Ultra Wearable Development Platform User Guide](#)).
4. Start Diamond Programmer.
5. In the Getting Started dialog box, select **Create a new blank project** and click **OK**. This opens the main interface of Diamond Programmer.

Figure 3. Getting Started Dialog Box



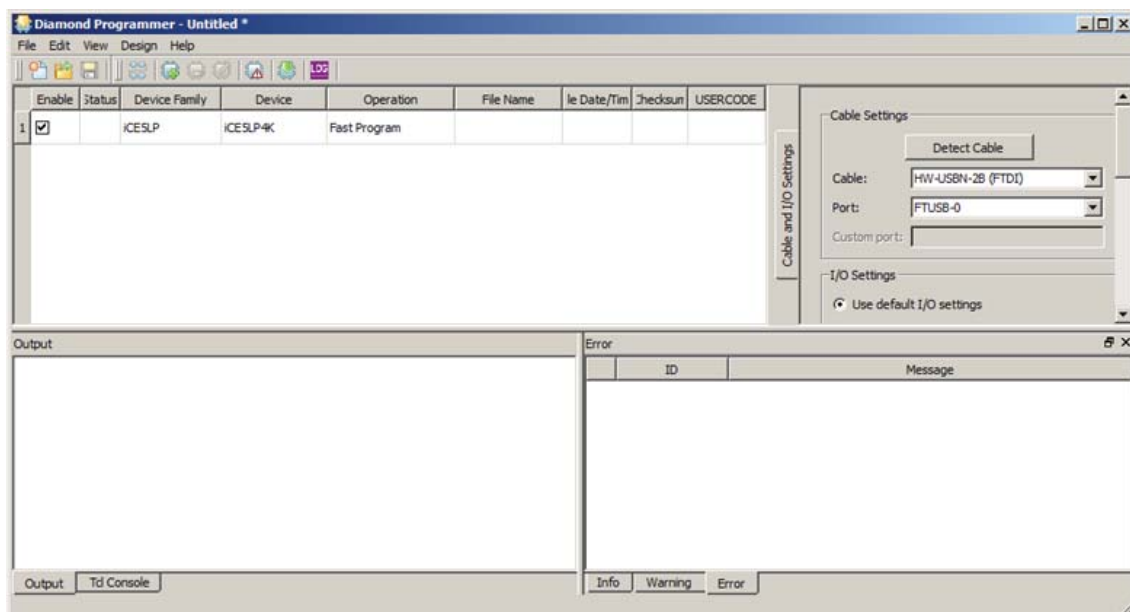
6. Select **MachXO2** under Device Family.
7. Select **LCMXO2-2000ZE** under Device.
8. Set Cable to **HW-USBN-2B (FTDI)**.
9. Set Port to **FTUSB-1**.
10. Select the **/IRLEDTX/bitmap/p2dsi.jed** file under File Name.
11. Click the **Program** button to flash MachXO2 and check Status.

Figure 4. Program Button



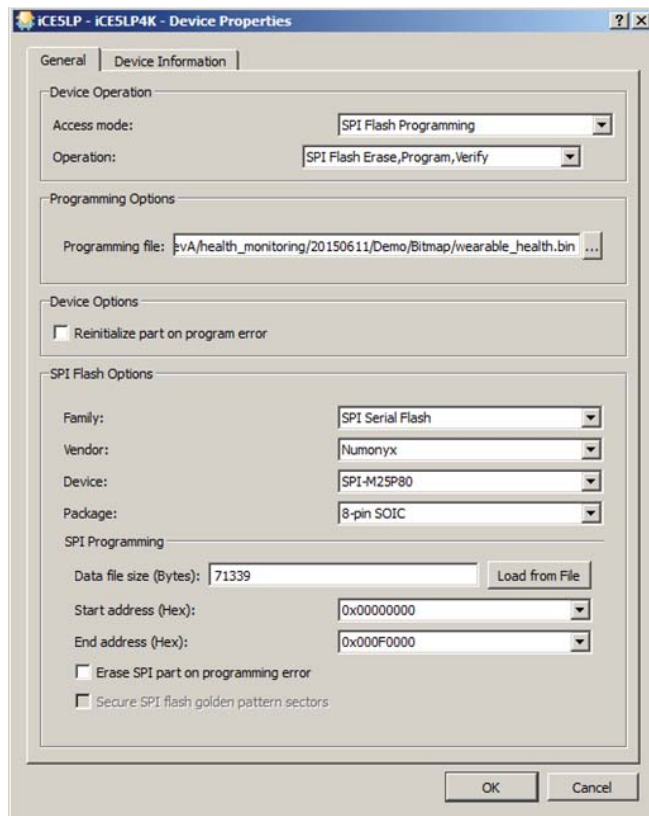
12. After programing MachXO2, select **iCE5LP4K** under Device Family.
13. Select **iCE5LP4K** under Device.
14. Set Cable to **HW-USB-2B (FTDI)**.
15. Set Port to **FTUSB-0**.

Figure 5. Programming the iCE40 Ultra Device



16. Double-click on a blank area in Operation to open the Device Properties dialog box.

Figure 6. Device Properties



17. Configure the settings as shown in Figure 6.
18. Select the program file `/IRLEDTX/bitmap/wearable_ir_tx.bin`. Then click **OK**.
19. Click the **Program** button to flash the iCE40 device and check Status.

Installing IRDemo_TX.apk to Android Phone

To install IRDemo_TX.apk to Android:

1. In the Android phone, go to **Settings > Security > Unknown sources** to allow the installation of the APK directly to the Android phone.
2. Connect the Android phone with the PC and make sure the driver is ok.
3. There are two methods to install the application.
 - Open a Windows command line tool and change the directory to `/IRLEDTX/apk/`. Install the application by using the command below.

```
adb install IRDemo_TX.apk
```

- Go to the `/IRLEDTX/apk/` directory. Copy the IRDemo_TX.apk into the phone, and then install it on the phone.

4. Deselect the **Unknown sources** option.

Preparing the IR Data File

The IRDemo_TX application needs to read IR operation information from a data file stored in the SD card. One data file realizes one IR operation.

The application supports three different operations at the same time. The names of the three files are indicated below. These files need to be stored in the root directory of the SD card.

- ir_key1.txt
- ir_key2.txt
- ir_key3.txt

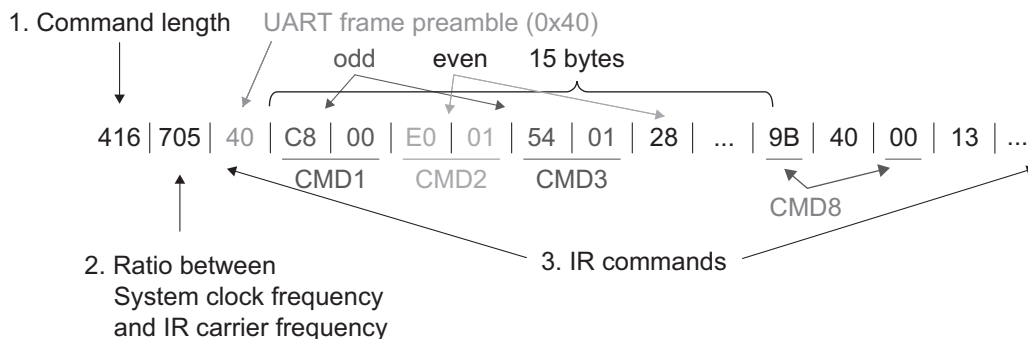
If you want to create specific command files, download the IR command from the internet and convert them into the data file according to the rules below.

The data file contains three parts. In the directory “/IRLEDTX/ misc/”, there are three data file examples. They can be used to control TCL TV L46F3500A-3D.

- ir_key1.txt is power on
- ir_key2.txt increases volume
- ir_key3.txt decrease volume.

The structure is shown in Figure 7.

Figure 7. Data File Structure



- (1) is the first decimal number representing the length of IR commands in one operation.
- (2) the second decimal number representing the ratio between system clock frequency and IR carrier frequency. The default frequency of system clock in this demo is 27 MHz. The ratio can be calculated using the formula below. The value must be integer.

$$\text{Ratio} = \lceil 27\text{MHz} / F_{\text{ir carrier}} \rceil$$

For example, if the carrier is 38 KHz, the ratio is 710.

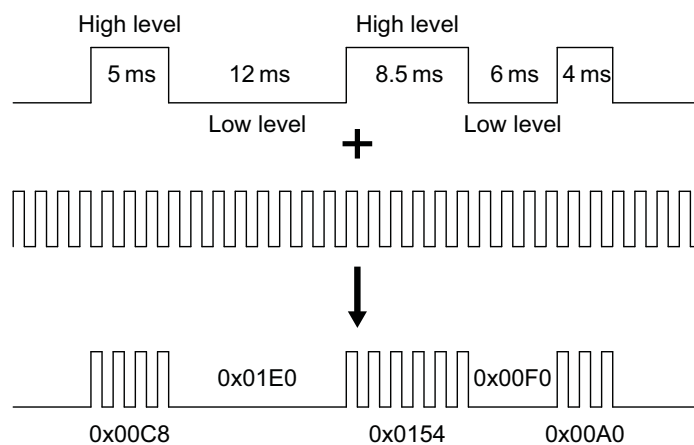
- (3) represents the IR commands in hexadecimal format.

As shown in Figure 7, the IR signal is modulated onto the carrier. To describe the duration of high level and low level, each command uses two bytes to indicate the number of carrier pulse in the duration. The high byte follows the low byte.

The commands with odd number describe the high level and the commands with even number describe the low level. The command also contains the UART frame preamble 0x40 in every 16 bytes.

For example, if the IR carrier frequency is 40 KHz and the IR command values are 0xC800, 0xE001, 0x5401, 0xF000, 0xA000 and so forth. The waveform is shown in Figure 8.

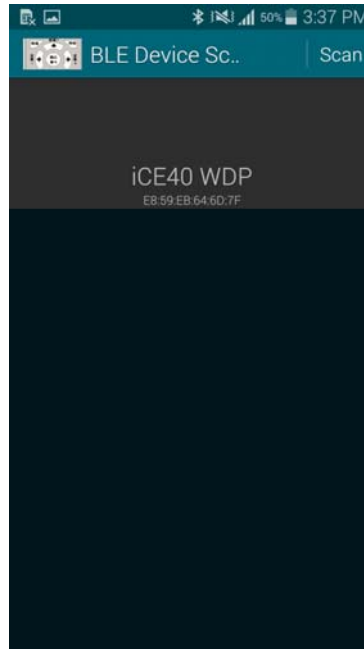
Figure 8. Waveform



Connecting the iCE40 Ultra Wearable Board to the Android Phone

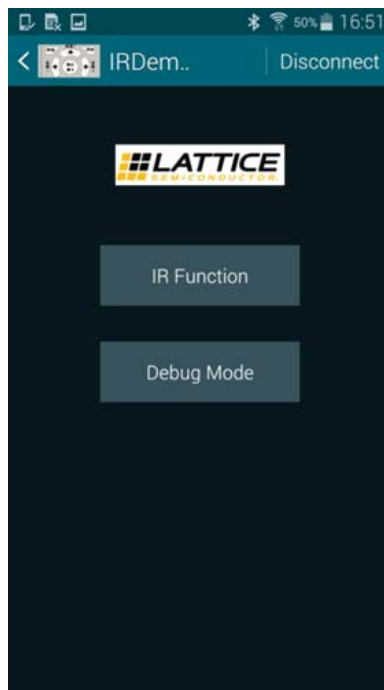
1. Power on the board using the Power Switch (see EB100, [iCE40 Ultra Wearable Development Platform User Guide](#)).
2. Enable Bluetooth on the Android phone.
3. Go to the Apps menu and click the **IRDemo_TX** icon to open the application.
4. Click the **Scan** button on the top right of the screen. An iCE40 Ultra BLE device is detected.

Figure 9. BLE Device Scan



5. Click **iCE40 WDP** to connect the iCE40 Ultra Wearable Development Platform and open the demo interface.

Figure 10. IR Tx Demo Device Connected



6. In Figure 10, if the top right text box displays Connect, it means that the device has been disconnected. Click **Connect** or click the **Back arrow** on the top left corner to reconnect the device.

Demo Procedure

Follow all the steps mentioned above so that the wearable board and the phone are ready with necessary bitmap and application respectively. The demo application also should be connected to the board via BLE.

To run the demo:

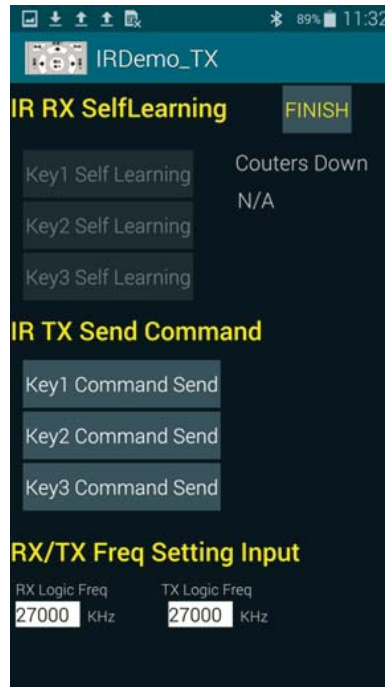
1. Click the **IR Function** button to enter the main interface. See Figure 11.

The main interface has three areas:

- IR RX SelfLearning (N/A for this demo)
- IR TX Send Command
- RX/TX Freq Setting Input.

In IR TX Send Command area, Key1 Command Send, Key2 Command Send and Key3 Command Send represent IR command file ir_key1.txt, ir_key2.txt and ir_key3.txt respectively.

Figure 11. IR Tx Interface



2. At the bottom of the interface, set the TX Logic Freq to **27000 KHz** before sending the command.
3. Aim the IR LED at the target device.
4. Click one of the three keys to control the device.

Technical Support Assistance

Submit a technical support case through www.latticesemi.com/techsupport.

Revision History

Date	Version	Change Summary
September 2015	1.0	Initial release.