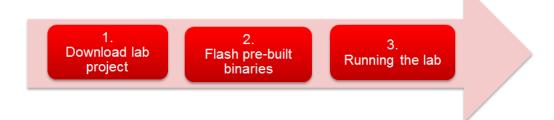# Getting Started Guide

mmWave Vital Signs Lab

Overview

- This lab demonstrates the use of mmWave technology to accurately measure the vital signs such as breathing rate and heart rate.
- The mmWave sensor IWR-1443 EVM is used for lab demonstration
- The Hardware accelerator and R4F core on the TI IWR1443 mmWave sensor is used to filter out the breathing and heart beat pattern from chest displacements and estimate the breathing rate and heart rate
- Breathing rate and heart rate as well as the corresponding waveforms are displayed on the PC-GUI for lab demonstration.

Required Hardware

- IWR-1443 EVM – **ES3.0** (For ES2.0 use the Vital Signs version 1.3 in the Industrial Toolbox 3.2.0 or earlier)
- Micro USB cable (included in the EVM package)
- 5V/2.5A Power Supply
    - Purchase from Digikey

Getting Started
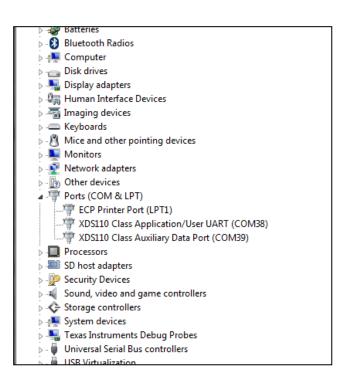
Step 1: Download the Lab Project

- The mmWave Lab projects are available as part of the TI CLOUD TOOLS under **Resource Explorer**

- Open the following page: https://dev.ti.com/ and select **Resource Explorer**

- In the Resource Explorer Window, select **Software ► mmWave Sensors ► Industrial Toolbox**

- Click the Download button ⬇ in the window that opens on the right side

- Download and install the Industrial Toolbox zip file

- The pre-built binaries are located in the folder:
    - **\labs\lab0002-vital-signs\ lab0002-vitalSigns_pjt\Prebuilt-binaries\xwr14xx_vitalSigns_lab_mss.bin**

Step 2: Flash Lab Binaries

- Power on the EVM using a 5V/2.5A power supply.
- Connect the EVM to your PC and check the COM ports in Windows Device Manager
- The EVM exports two virtual COM ports as shown below:
- XDS110 Class Application/User UART (COM$_{UART}$):
- Used for passing configuration data and firmware to the EVM
- XDS110 Class Auxiliary Data Port (COM$_{AUX}$)
- Used to send processed radar data output
- Note the COM$_{UART}$ and COM$_{AUX}$ port numbers, as they will be used later for flashing and running the Lab.
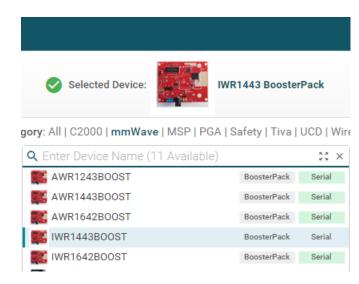

  COM$_{UART}$: COM38   **COM$_{AUX}$**: COM39
- The actual port numbers on your machine may be different

- Put the EVM in flashing mode by connecting jumpers on SOP0 and SOP2 as shown in the image.
- Open the **UniFlash** tool
- Download from TI.com/tool/uniflash
- In the **New Configuration** section, locate and select the appropriate device IWR1443
- Click **Start** to proceed

- In the **Program** tab, browse and locate demo MSS and RadarSS binary files as shown in figure below

Flash Image(s)

☐ Meta Image 1/RadarSS		🖴 Browse		
☑ Meta Image 2/MSS	xwr14xx_vitalSigns_lab_mss.bin Size: 125.32 KB	🖴 Browse	✕	Meta Image 2/MSS C:\ti\mmwave_training_<ver>\labs\lab0002-vital-signs\lab0002_vital_signs_pjt\prebuilt_binaries**xwr14xx_vitalSigns_lab_mss.bin**
☐ Meta Image 3		🖴 Browse		
☐ Meta Image 4		🖴 Browse		

- In the **Settings & Utilities** tab, fill the **COM Port** text box with the Application/User UART COM port number (**COM$_{UART}$**) noted earlier

▼ Setup

Note: Example - COM1 (Windows), /dev/ttyACM0 (Linux)

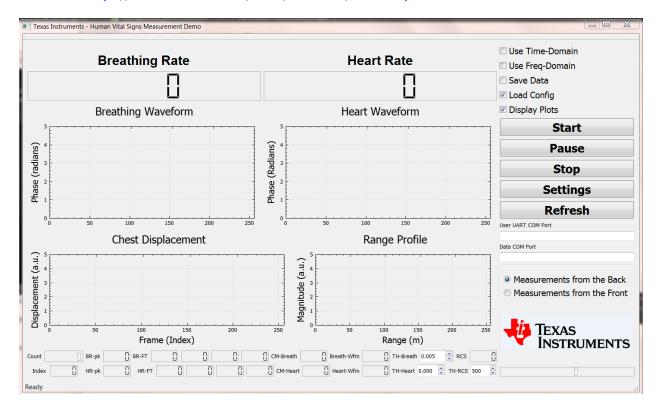COM Port: **COM38**

Target Memory Selection: **SFLASH**

- Return to the **Program** tab, power cycle the device and click on **Load Images**
- When the flash procedure completes, UniFlash's console should indicate: [SUCCESS] Program Load completed

successfully

- Power off the board and remove the jumper from only header **SOP2** (this puts the board back in functional mode)

Step 3: Run the Lab

- Install XDS Emulation Package on the PC host if needed from the following

    http://processors.wiki.ti.com/index.php/XDS_Emulation_Software_Package

- If CCS is installed on the PC host, the XDS Emulation package has already been installed during the CCS installation process.

- Execute the Demo GUI located in:

    - *\labs\lab0002-vital-signs\lab0002_vital_signs_gui\VitalSignsRadar_Demo.exe*

- Screen below will appear if GUI starts. If the GUI does not start please install the Visual Studio runtime vc_redist.x64.exe.
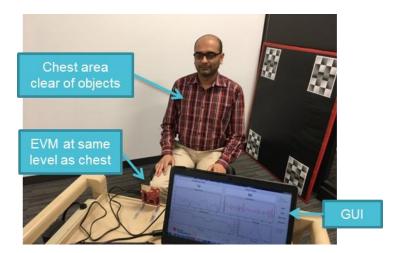
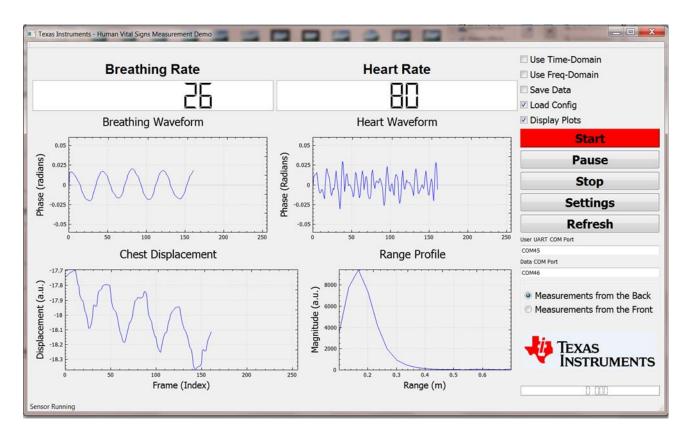   https://www.microsoft.com/en-us/download/details.aspx?id=48145

- In the GUI, select "Measurements from the Front" if it is desired to place the mmWave sensor in the front.

- Check that EVM is powered on and the USB cable connected to the PC host running the GUI. In the GUI, select "Start".

mmWave Sensor Placement

- In order to test with Sensor in Front, the EVM can be placed on metal brackets.
- The subject should sit stationary in a chair about 0.5-1.0 m in front of the sensor.
- The subject should stay still for 10-15 seconds for accurate readings.

- A snapshot of the PC-GUI showing the measured vital signs is shown below

- A good test to verify if the sensor is positioned correctly and if accurate measurements are being made is to ask the subject to hold their breath. The breathing-rate should go to zero and turn red, the breathing waveform plot should be more or less constant and the heart rate waveforms should still be **visible**. If the breathing rate does not go to zero OR the heart rate waveform is not visible then either the subject is not properly aligned with the radar or there is interference coming from other moving objects within the Radar field-of-view.