TI mmWave Training

mmWave Demo

NOTE: ES3.0 devices only

This version of the mmWave Demo lab will work only with xWR1443BOOST ES3.0 EVMs, which require **mmWave SDK version 2.1 or above**. Please look at the next slide for information on identifying the version of the device on your EVM.

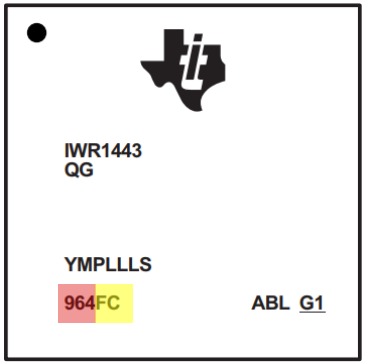
To download past versions of mmWave Industrial Toolbox which support ES2.0 EVMs, please follow the directions provided under **How to access previous Industrial Toolbox versions** at the bottom of the Industrial Toolbox landing page

How to identify ES Version

A. If the EVM has an “ES3.0” sticker, the device version is ES3.0

OR

B. The device marking can be checked as noted in the device errata

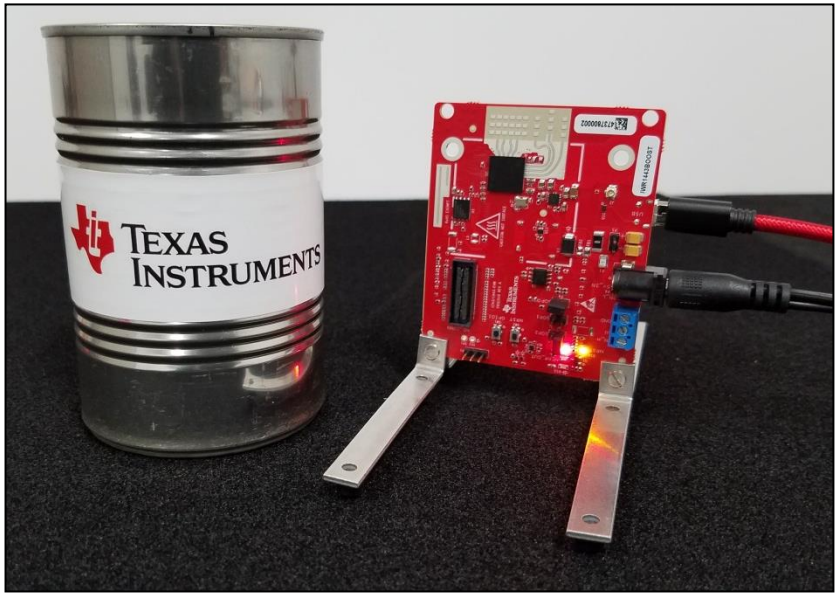


- If the part identifier reads “964FC" (highlighted in red and yellow), the device version is ES3.0
  - This version of the lab is compatible with your EVM.
- If the part identifier reads “964D", the device version is ES2.0
  - This version of the lab is NOT Compatible with your EVM. Please download a previous version.

Contents

Lab Overview

- Configurable visualization tool for processed radar data
- The following plots are available:
  - Scatter Plot
  - Range Profile
  - Noise Profile
  - Range Azimuth Heat Map
  - Range Doppler Heat Map
  - Statistics

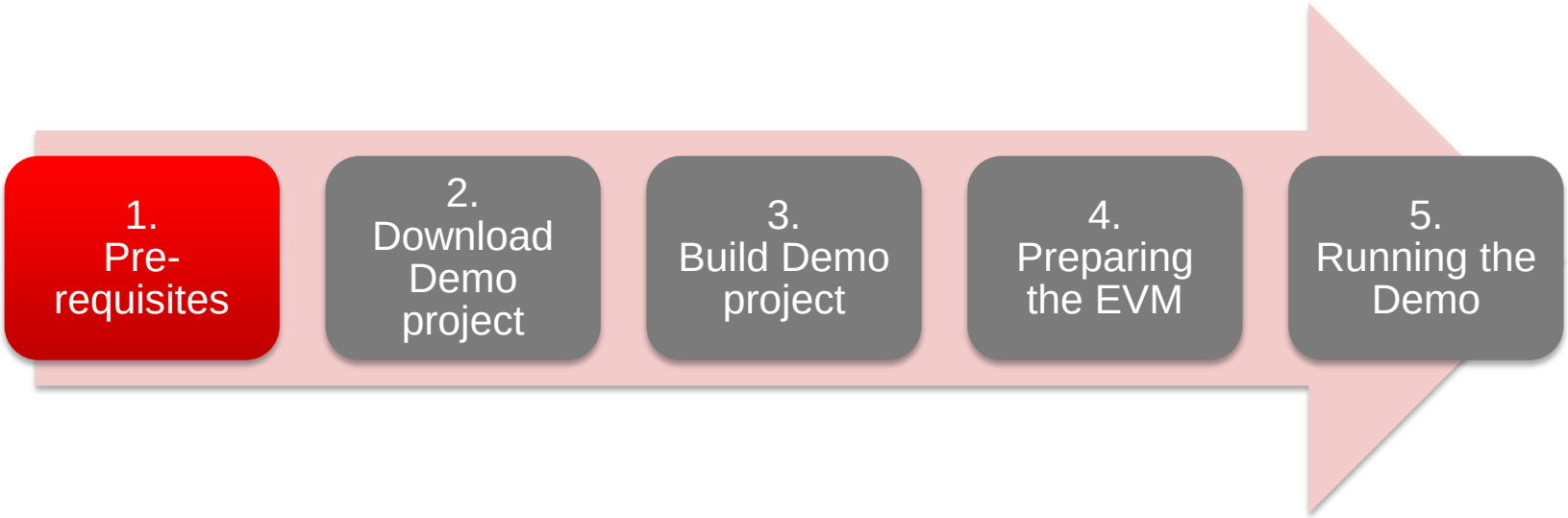


1. Requirements

- Software
  - **Pre-requisites**
    - Latest TI mmWave SDK and all related dependencies installed as mentioned in the mmWave SDK release notes.
  - Google Chrome with TI Cloud Agent Extension
    - For running the mmWave Demo Visualizer
    - Download from TI Cloud Agent or install when accessing the demo
  - mmWave SDK Demo
    - Download from TI Resource Explorer
  - UniFlash
    - For flashing firmware images onto
    - Download from TI.com/tool/uniflash
  - XDS110 Drivers
    - For EVM XDS device support
    - Included with CCS Installation, or standalone through TI XDS Emulation Software

- Hardware
  - xWR14xx EVM
  - Micro USB cable (included in the EVM package)
  - 5V/2.5A Power Supply
    - Purchase from Digikey

Steps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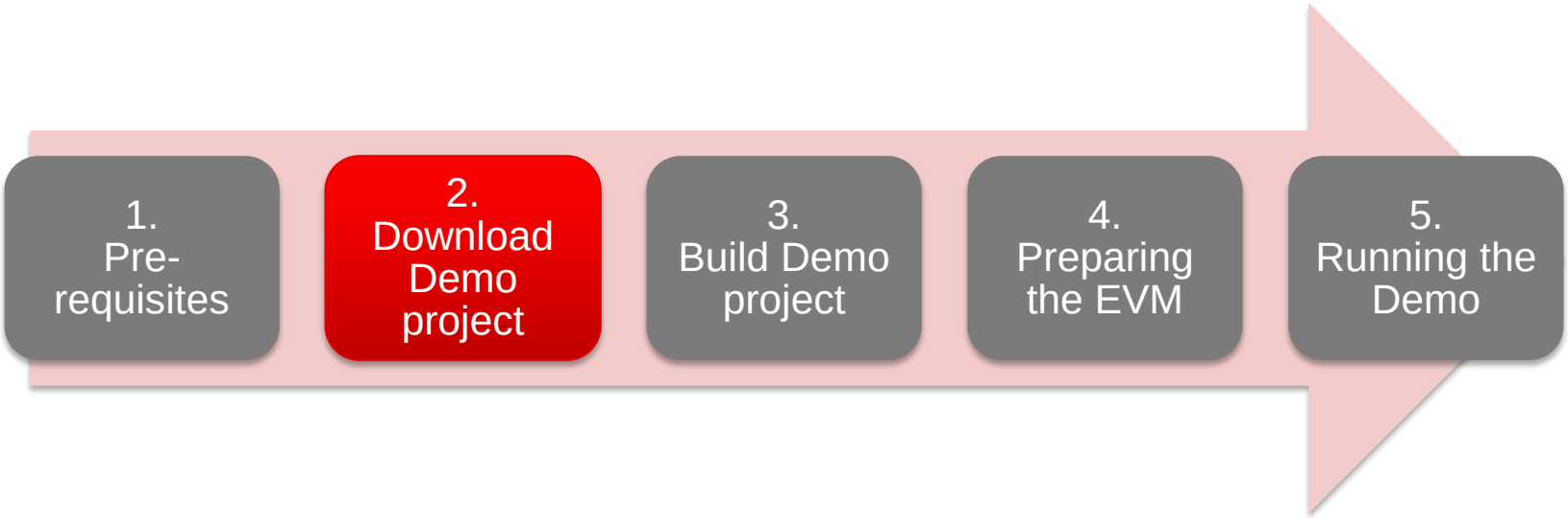
1. Pre-requisites

- Please install the TI mmWave SDK version mentioned in the table and all the required tools as mentioned in the mmWave SDK release notes.
  - The mmWave SDK release notes include the links for downloading the required tools.
- If you have already installed the mmWave SDK and all the required tools, you can move on to the next step i.e. downloading the lab on to your machine.

Tool	Version	Download Link
mmWave SDK	2.1.0.4	download link
CCS	8.1.0	download link
TI SYS/BIOS	6.53.02.00	Included in mmwave sdk installer
TI ARM Compiler	16.9.6.LTS	Included in mmwave sdk installer
TI CGT Compiler	8.1.3	Included in mmwave sdk installer
XDC	3.50.04.43	Included in mmwave sdk installer
C64x+ DSPLIB	3.4.0.0	Included in mmwave sdk installer
C674x DSPLIB	3.4.0.0	Included in mmwave sdk installer
C674x MATHLIB (little-endian, elf/coff format)	3.1.2.1	Included in mmwave sdk installer
mmwave device support packages	1.5.9 or later	Upgrade to the latest using CCS update process (see SDK user guide for more details)
TI Emulators package	7.0.188.0 or later	Upgrade to the latest using CCS update process (see SDK user guide for more details)
Uniflash	latest	Uniflash tool is used for flashing xWR1xxx devices Cloud version (Recommended): https://dev.ti.com/uniflash Offline version: http://www.ti.com/tool/uniflash
mmWave Demo Visualizer	latest	TI Gallery APP for configuring mmWave sensors and visualizing the point cloud objects generated by the mmWave SDK demo https://dev.ti.com/mmWaveDemoVisualizer

Steps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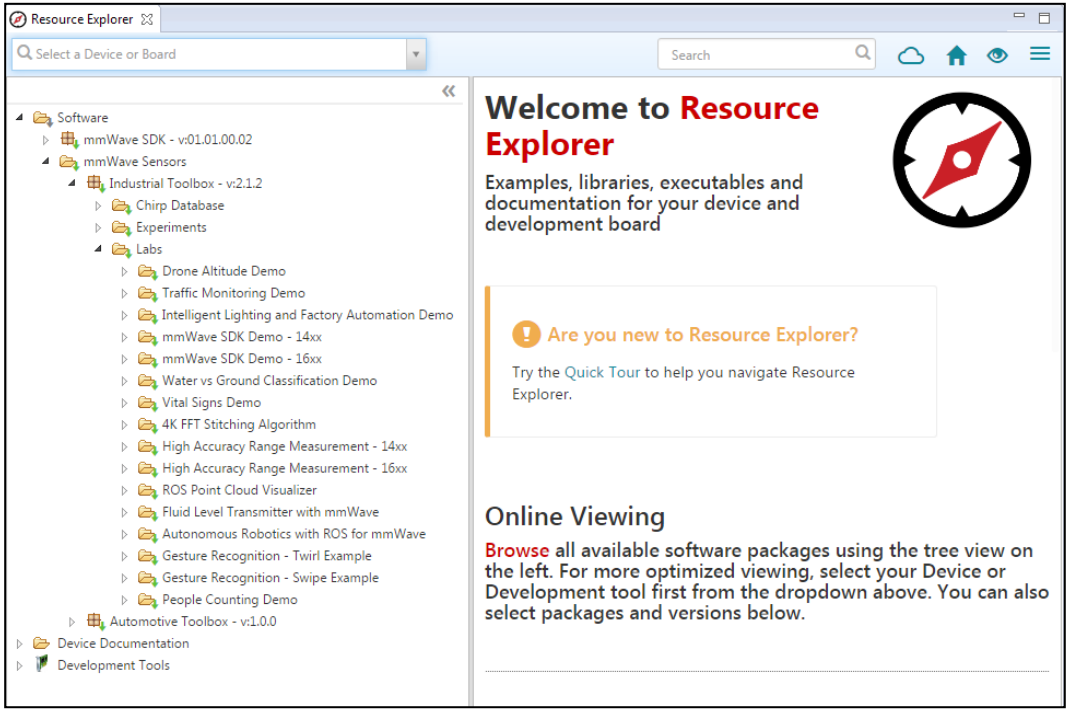
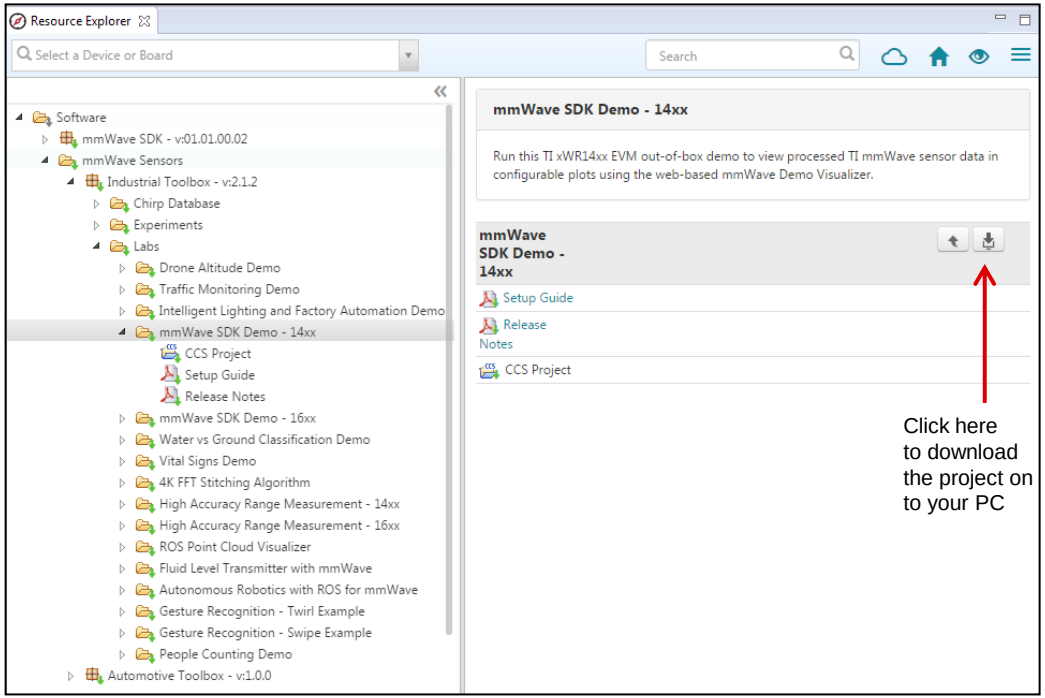
2. Download the Lab project

- The mmWave projects are available under **mmWave Sensors ► Industrial Toolbox** in CCS Resource Explorer.
- To download the mmWave demo, start CCS v8.1.0 and select **View ► Resource Explorer** to open the Resource Explorer.
- In the Resource Explorer Window, select **Software ► mmWave Sensors ► Industrial toolbox ► Labs**.



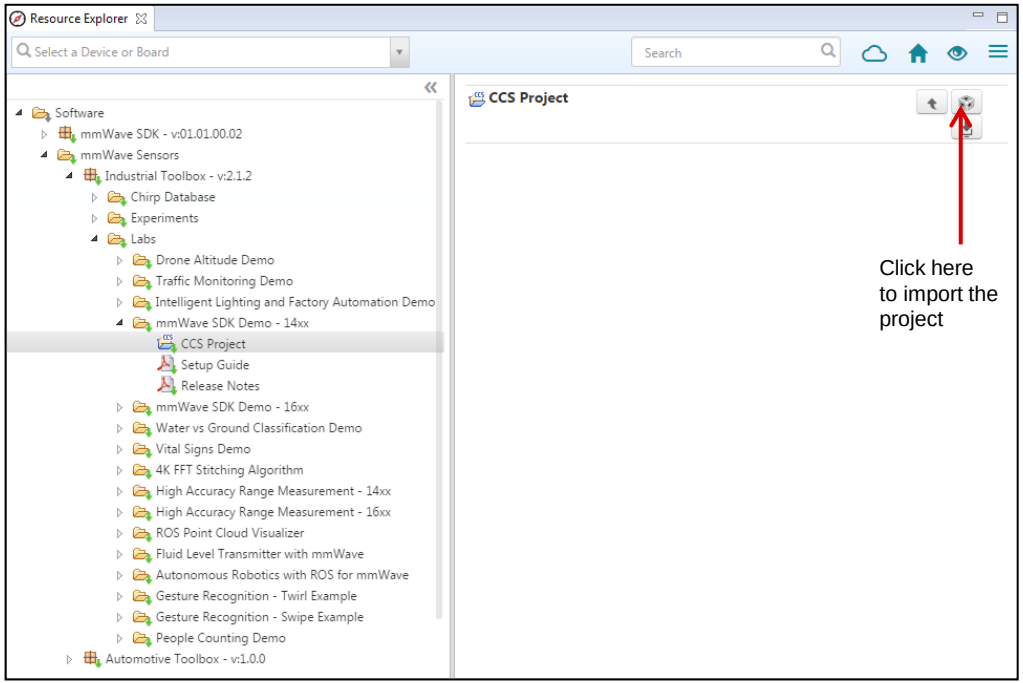
2. Download - continued

- Select the **14xx mmWave SDK** demo in the left view.
- The right view shows the contents of the Lab which contains the CCS Project and the PC GUI.
- Click on the **Download and Install** button  in the top right corner as shown.
- Select the **Make Available Offline** option from the drop down to start downloading the Lab.

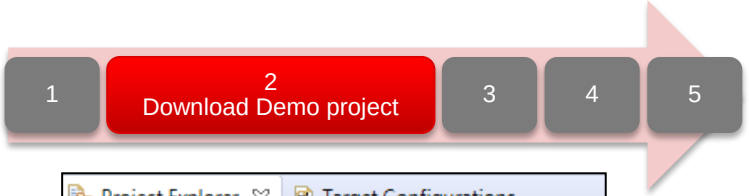


2. Download - continued

- The project will be downloaded in C:\ti\mmwave_industrial_toolbox_<ver>
- Select the CCS Project file in the left view
- Click on the **Import to IDE**  button which should be visible in the right side view after a successful download.
- This copies the project in the user's workspace and imports it into the CCS project explorer.
  - It is important to note that the copy created in the workspace is the one that gets imported in CCS. The original project downloaded in mmwave_industrial_toolbox is not modified.



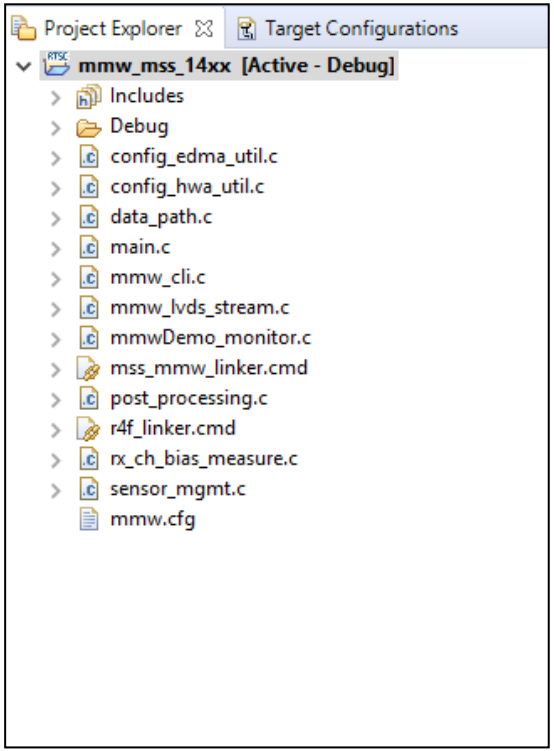
2. Download - continued



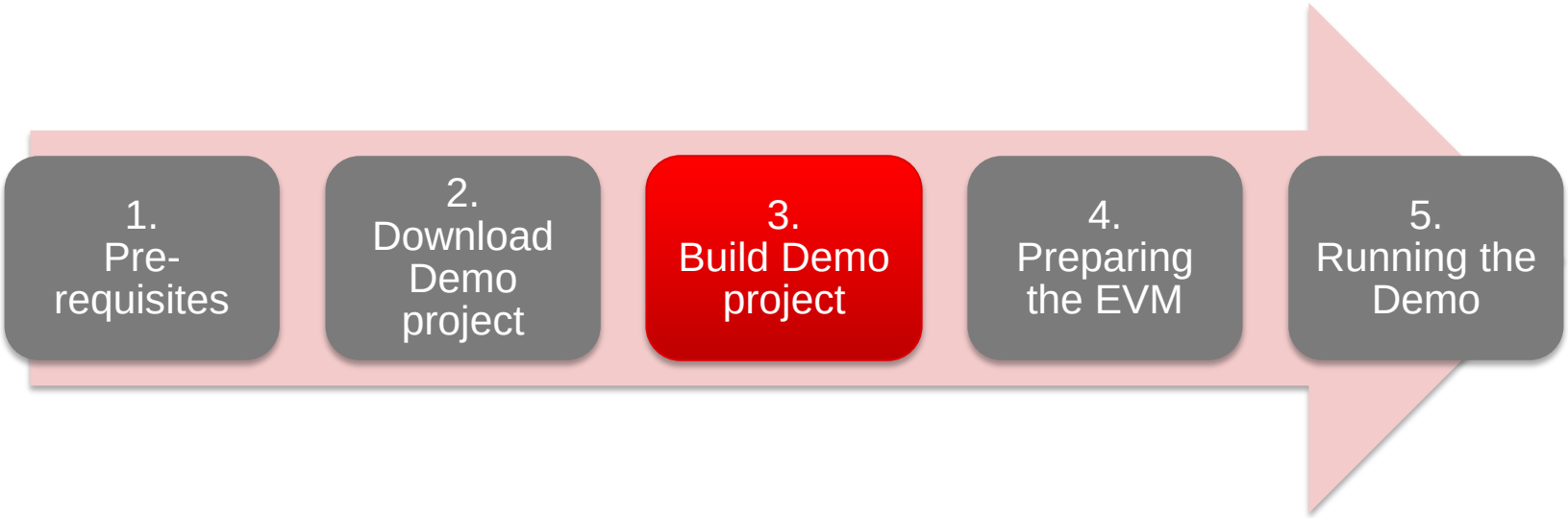
- After successfully completing the **Import to IDE** operation, the project should be visible in CCS Project Explorer as shown here.

- At this point, we have successfully downloaded the mmWave demo and imported it in CCS.

- We are ready to move on to the next step i.e. Building the project.



Steps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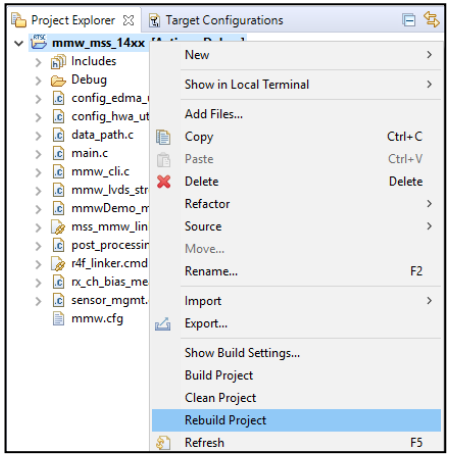
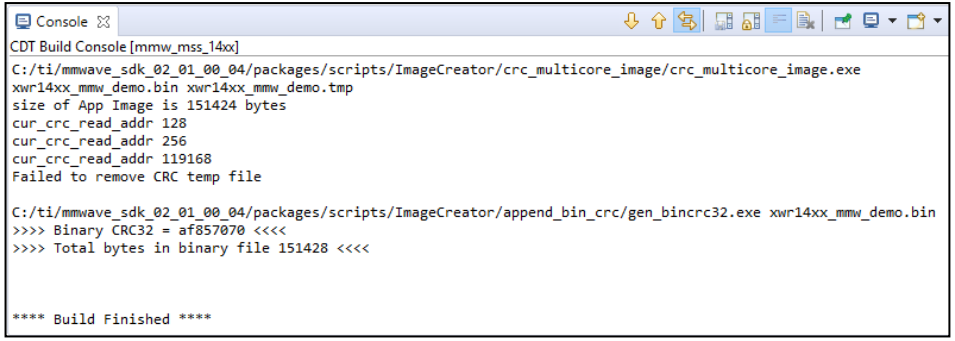
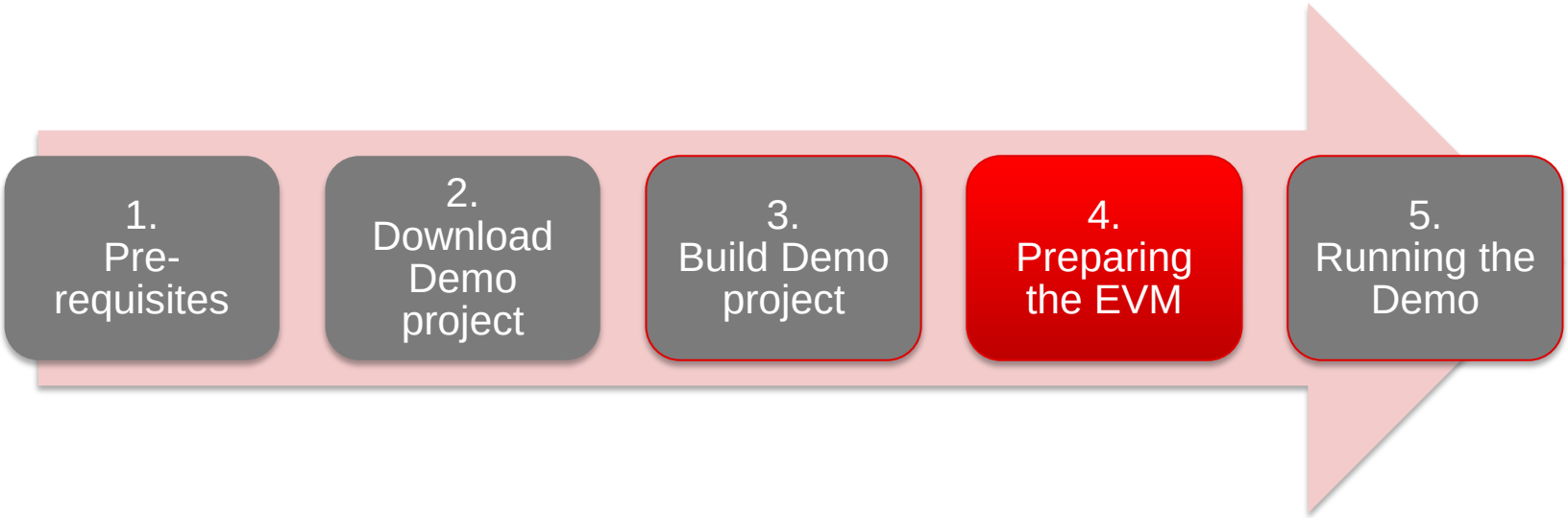
3. Build the Lab

- With the mmw project selected in Project Explorer, right click on the project and select **Rebuild Project**.
  - Selecting **Rebuild** instead of **Build** ensures that the project is always re-compiled. This is especially important in case the previous build failed with errors.
- On successful completion of the build, you should see the output in CCS console as shown here and the following two files should be produced in the project debug directory
  - xwr14xx_mmw_demo_mss.xer4f
  - xwr14xx_mmw_demo.bin
- If the build fails with errors, please ensure that all the pre-requisites are installed as mentioned in the mmWave SDK release notes.
  - Please note that pre-built binary files, both .xer4f and .bin, are provided with the demo under mmwave SDK.
  - Look under <mmwave_sdk_install_dir>\packages\ti\demo\xwr14xx\mmw





Steps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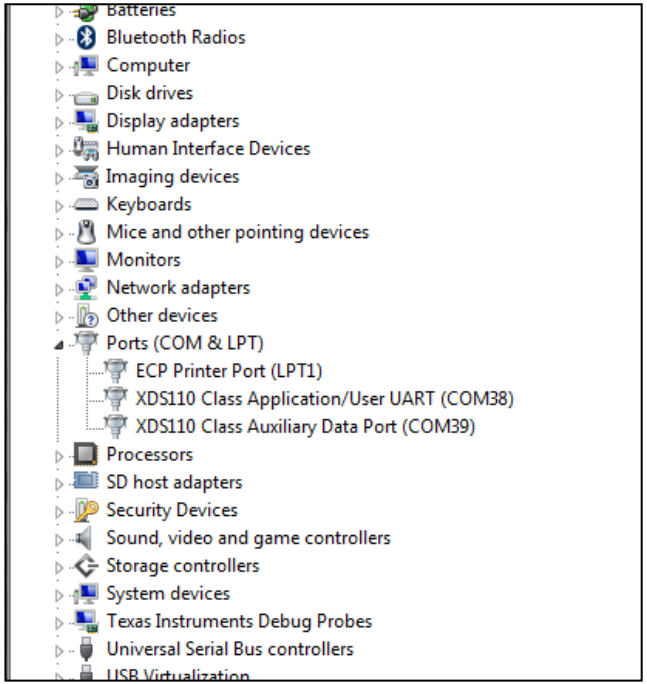
4.1 Preparing the EVM

- There are two ways to execute the compiled code on the EVM:
  - Deployment mode: Flashing the binary (.bin image) on to the EVM serial flash
    - In this mode, the EVM boots autonomously from flash and starts running the bin image.
  - Debug mode: Downloading and running the executable (.xer4f image) from CCS.
    - You will need to flash a small CCS debug firmware on the EVM (one time) to allow connecting with CCS. This debug firmware image is provided with the mmWave SDK.
  - As a recap, the build process in Step 3 produces both the .bin and .xer4f images.

- This presentation explains the second method i.e. Debug mode (CCS).
  - To prepare the EVM for debug mode, we start with flashing the CCS debug firmware image.
  - Please note that the same flashing process can be used to flash the Lab binary to run it in deployment mode.

4.2 Connecting to the EVM

- 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.

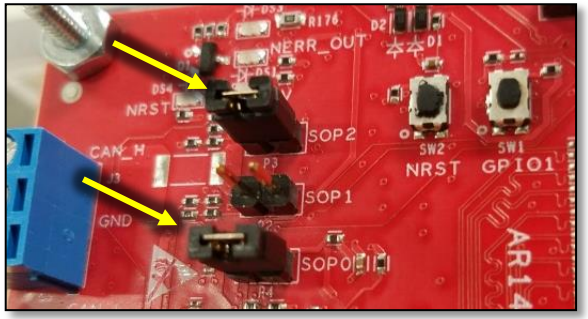


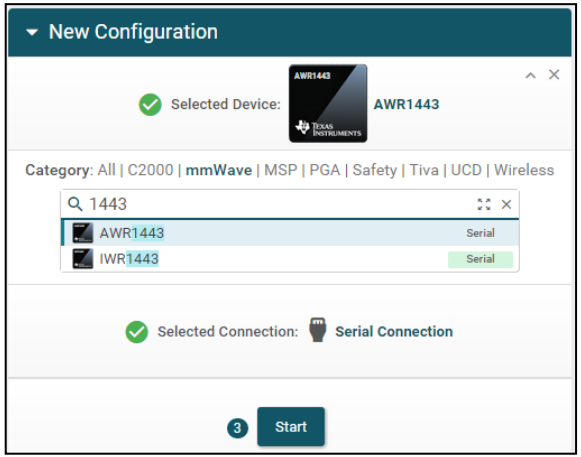
COM_{UART}: COM38 **COM_{AUX}**: COM39

- The actual port numbers on your machine may be different

4.3 Flashing CCS debug firmware

1. Put the EVM in flashing mode by connecting jumpers on SOP0 and SOP2 as shown in the image.
2. Open the **UniFlash** tool
3. In the **New Configuration** section, locate and select the appropriate device (xWR14xx)
4. Click **Start** to proceed





4.3 Flashing CCS debug firmware

5. In the **Program** tab, browse and locate the binary as shown below:

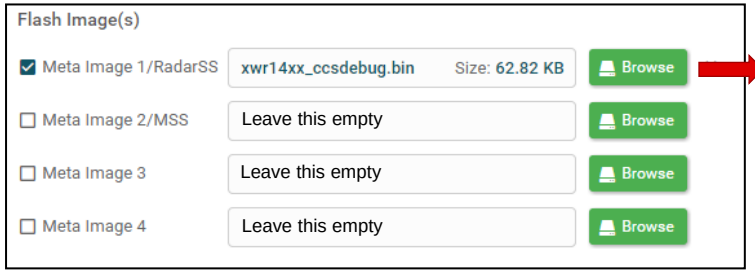
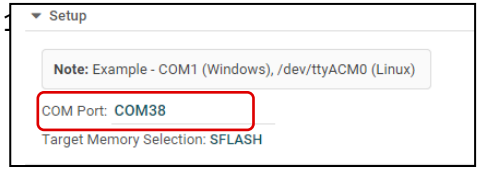


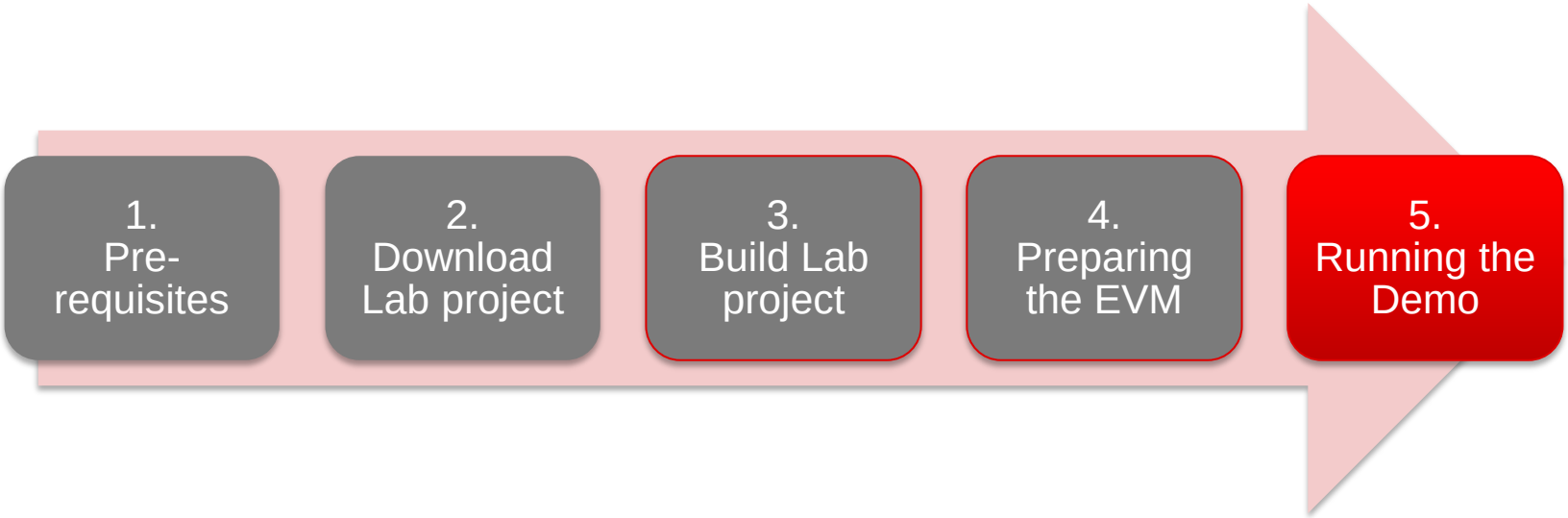
Image	Location
Meta Image 1/RadarSS	C:\ti\mmwave_sdk_02_01_00_04\packages\ti\utils\ccsdebug\xwr14xx_ccsdebug.bin

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



7. Return to the **Program** tab, power cycle the device and click on **Load Images**
8. When the flash procedure completes, UniFlash's console should indicate: [SUCCESS] Program Load completed successfully
9. Power off the board and remove the jumper from only header **SOP2** (this puts the board back in functional mode)

Steps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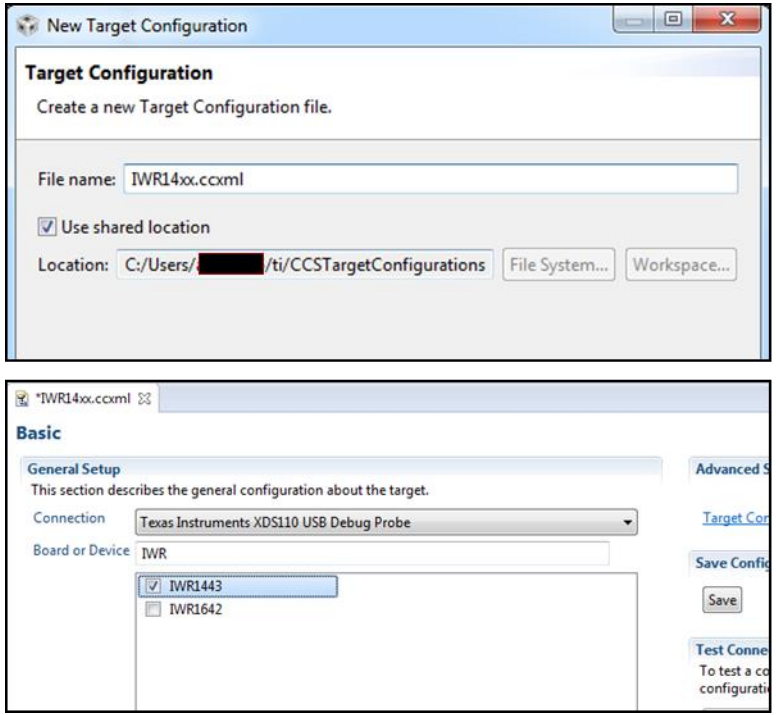
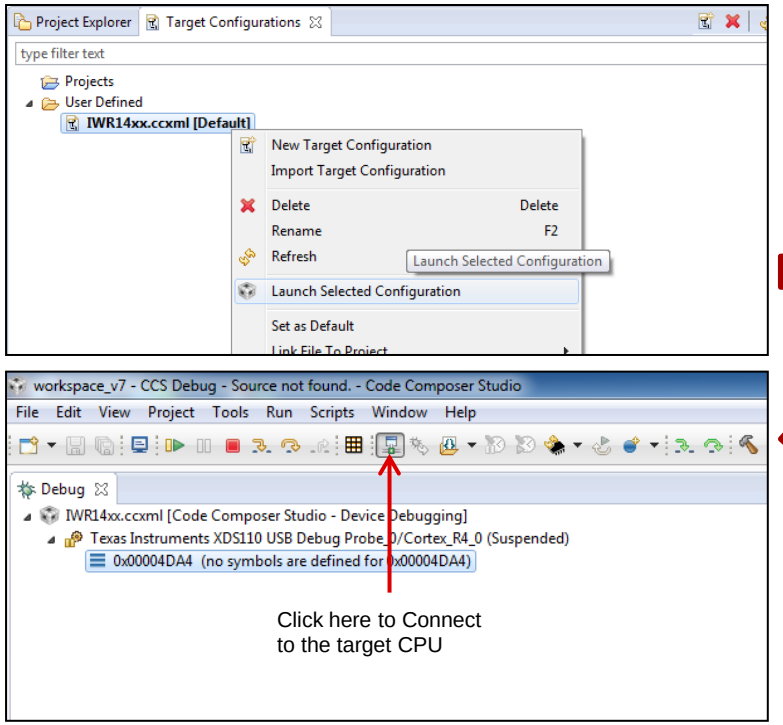
5.1 Connecting EVM to CCS

- It is assumed that you were able to download and build the Lab in CCS (completed steps 1, 2 and 3)
- To connect the Radar EVM to CCS, we need to create a target configuration
  - Go to File ► New ► New Target Configuration File
  - Name the target configuration accordingly and check the “Use shared location” checkbox. Press Finish
  - In the configuration editor window:
    - Select “Texas Instruments XDS110 USB Debug Probe” for **Connection**
    - Select **IWR1443** or **AWR1443** in the **Board or Device** list
    - Press the **Save** button to save the target configuration.
    - You can press the **Test Connection** button to check the connection with the board.



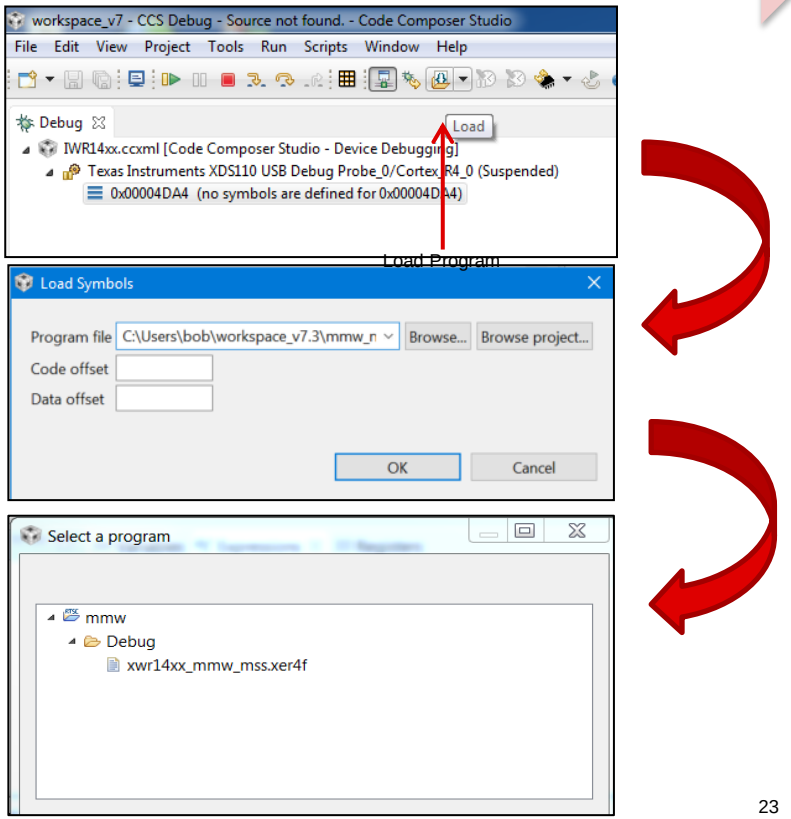
5.1 Connecting - continued

- Go to **View ► Target Configurations** to open the target configuration window.
- You should see your target configuration under **User Defined** configurations.
- Right click on the target configuration and select **Launch Select Configuration**.
- This will launch the target configuration in the debug window.
- Select the Texas Instruments XDS110 USB Debug probe and press the **Connect Target** button 



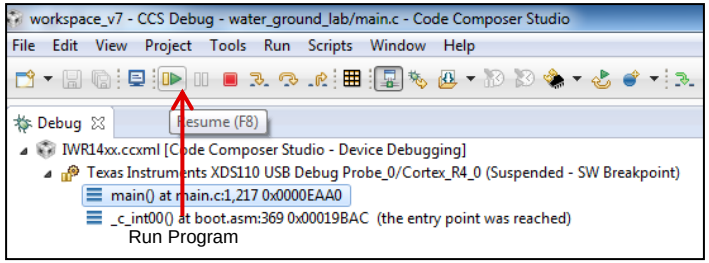
5.2 Loading the binary

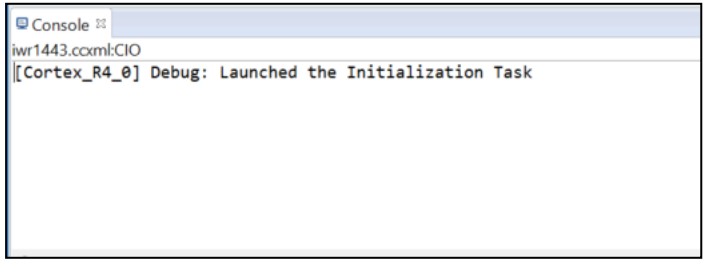
- With the target connected, click on the **Load** button in the toolbar.
- In the **Load Program** dialog, press the **Browse Project** button .
- Select the lab executable (.xer4f) as shown and press OK.
- Press OK again in the **Load Program** dialog.



5.3 Running the binary

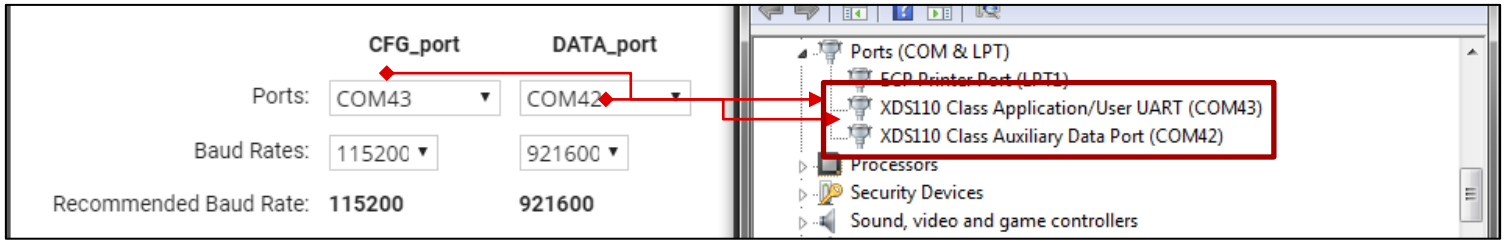
- With the executable loaded, press the Run/Resume button 
- The program should start executing and generate console output as shown.





5.4 Running the Lab GUI

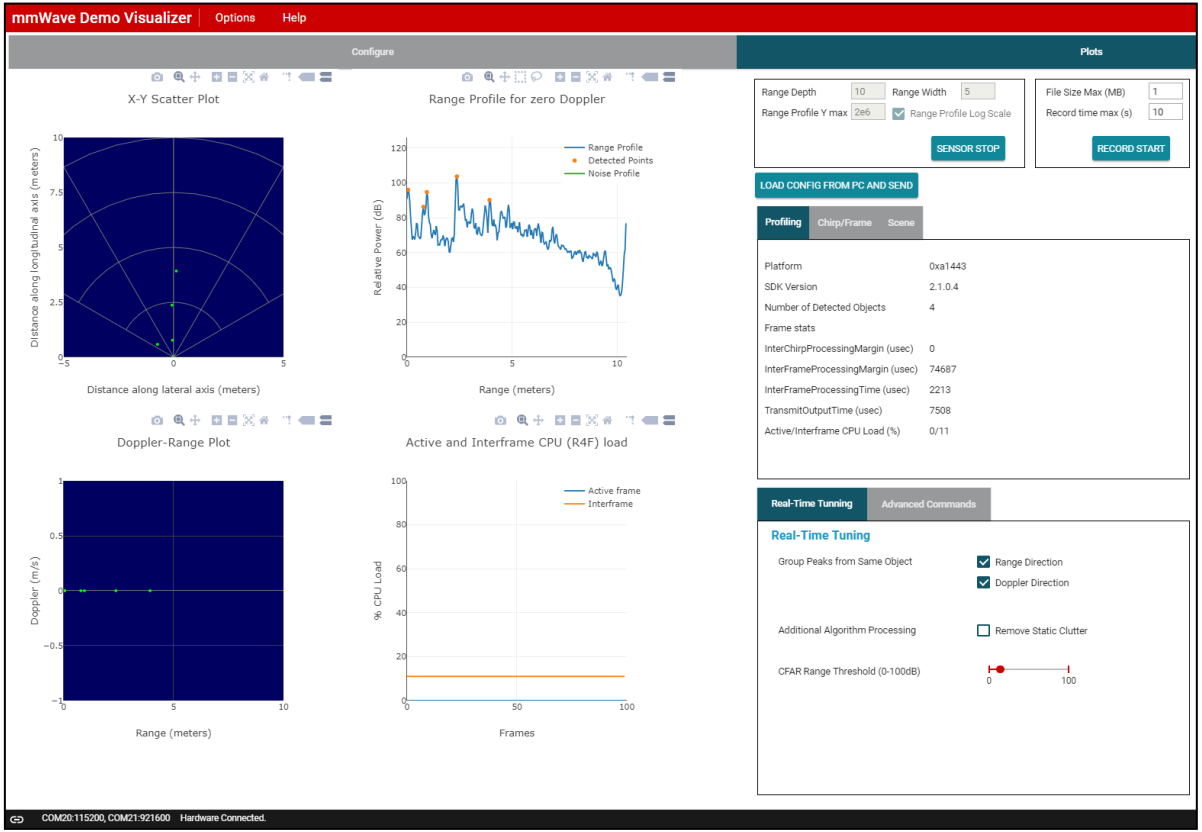
1. Using Google Chrome, navigate to the following URL: https://dev.ti.com/mmWaveDemoVisualizer
   – Alternatively, go to https://dev.ti.com/gallery and search for “mmWave Demo Visualizer”
2. If prompted, follow the on-screen instructions for installing TI Cloud Agent
3. Once the demo is loaded, go to **Options → Serial Port**
4. In the serial port window, enter the appropriate port in each of the drop down menus based on your port numbers from Step 2



5.4 Running GUI - continued

5. Click on **Configure** and the demo will automatically connect to the EVM
   - Not connected:  Connected: 
   - If the connection fails, try clicking on the connection icon in the bottom left corner
6. Select the appropriate mmWave device from the **Platform** dropdown menu
7. Use the available options to create the desired configuration
   - Additional details about the configuration parameters can be found in the **mmWave Demo Visualizer User Guide**
8. When ready to send the configuration, click on **Send Config To mmWave Device**
9. Click on the **Plots** tab to view the plots that were selected to be shown
10. Move a highly reflective object in front of the EVM and see how the demo responds

5.4 Running GUI - continued



Learn more about TI mmWave Sensors

- Learn more about xWR1x devices, please visit the product pages
  - IWR1443: http://www.ti.com/product/IWR1443
  - IWR1642: http://www.ti.com/product/IWR1642
  - AWR1443: http://www.ti.com/product/AWR1443
  - AWR1642: http://www.ti.com/product/AWR1642
- Get started evaluating the platform with xWR1x EVMs, purchase EVM at
  - IWR1443 EVM: http://www.ti.com/tool/IWR1443BOOST
  - IWR1642 EVM: http://www.ti.com/tool/IWR1642BOOST
  - AWR1443 EVM: http://www.ti.com/tool/AWR1443BOOST
  - AWR1642 EVM: http://www.ti.com/tool/AWR1642BOOST
- Download mmWave SDK @ http://www.ti.com/tool/MMWAVE-SDK
- Ask question on TI's E2E forum mmWave Sensors forum @ https://e2e.ti.com/support/sensor/mmwave_sensors/