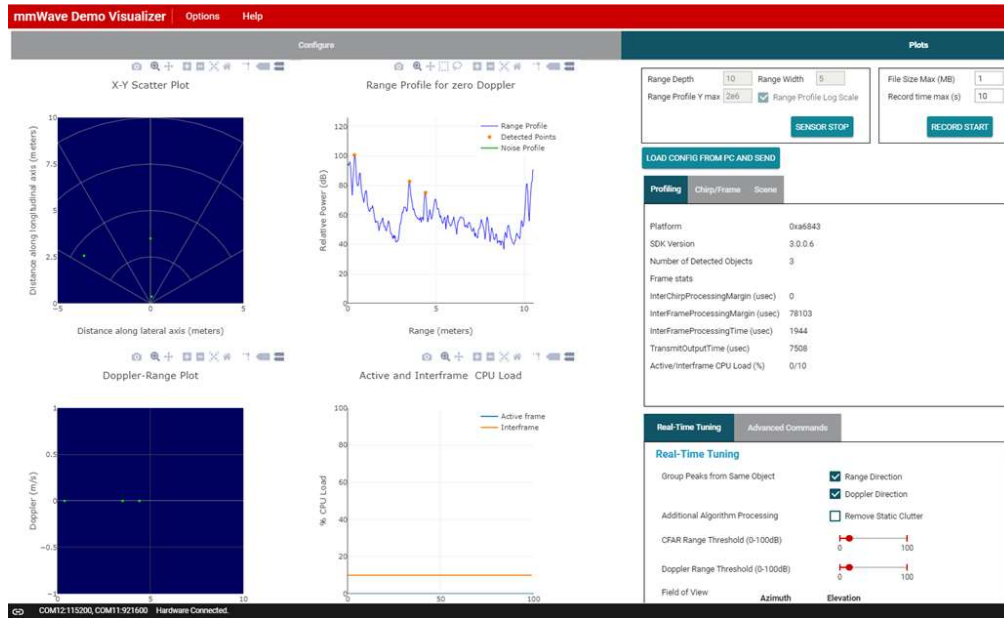


Overview of MMWAVE SDK Demo - 68xx HWA Version

This is the mmWave SDK out-of-box demo lab for the TI IWR68xx EVM. Run this TI IWR68xx EVM out-of-box demo to view processed TI mmWave sensor data in configurable plots using the web-based mmWave Demo Visualizer.

NOTE: This version of the SDK out-of-box demo is for IWR68xx EVM but only uses the on-chip Hardware FFT accelerator (HWA) and does not utilize the c674x DSP. In this User Guide many of labels show xWR64xx but the demo is compatible with the IWR68xx device.



Hardware and Software Requirements

Hardware

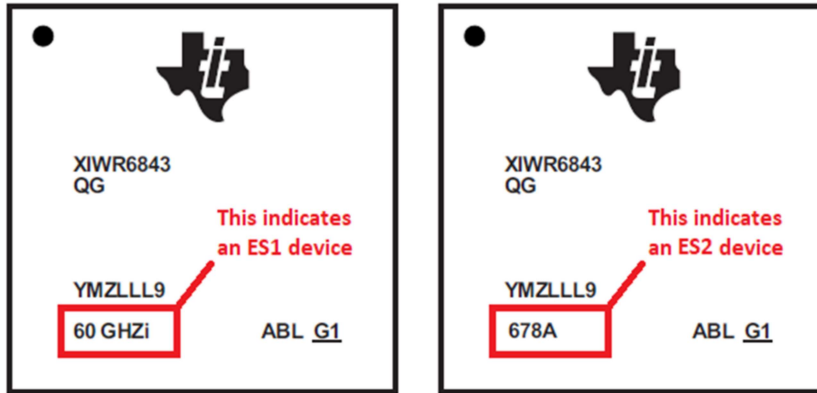
Item	Details
IWR6843ISK Antenna Module Board	IWR6843ISK ES2.0 Antenna Module (http://www.ti.com/tool/IWR6843ISK)
MMWAVEICBOOST Carrier Board	OPTIONAL: MMWAVEICBOOST Carrier Board (http://www.ti.com/tool/MMWAVEICBOOST) for CCS based development and debugging
	Note: The rest of this document will refer to the above board combination as EVM .
Computer	Windows 7 or 10 PC with Google Chrome Browser and TI Cloud Agent Extension installed.
Micro USB Cable	Provided with the Industrial Radar Carrier Board (http://www.ti.com/tool/MMWAVEICBOOST)
Power Supply	5V, 3A with 2.1-mm barrel jack (center positive). The power supply can be wall adapter style or a battery pack with a USB to barrel jack cable.



IWR6843 ES2.0 Only

This lab is only compatible with ES2.0 version of IWR6843. Check the device version on your IWR6843ISK using the on-chip device markings as shown below>

1. If line 4 reads 678A , you have an ES2 device. In this case, this lab is compatible with your EVM.
2. If line 4 reads 60 GHZi , you have an older ES1 device. In this case, the lab is NOT compatible with your EVM. ES2 IWR6843ISK boards are orderable from the EVM link above.



Software

Tool	Version	Download Link
TI mmWave SDK	3.5.x.x	Link to Latest mmWave SDK (http://software-dl.ti.com/ra-processors/esd/MMWAVE-SDK/latest/index_FDS.html) To access a previous version of the mmWave SDK scroll to the bottom of the table and click the link under "MMWAVE-SDK previous release". Repeat to continue stepping back to previous versions.
mmWave Demo Visualizer	3.5.0+	Available online at https://dev.ti.com/gallery/view/mmwave/mmWave_Demo_Visualizer/ (https://dev.ti.com/gallery/view/mmwave/mmWave_Demo_Visualizer/)
mmWave Industrial Toolbox	Latest	Download and install the toolbox. Go to Using TI Resource Explorer & the mmWave Industrial Toolbox (../..../docs/readme.html) for instructions.
Uniflash	Latest	Uniflash tool is used for flashing TI mmWave Radar devices. Download offline tool (http://www.ti.com/tool/UNIFLASH) or use the Cloud version (https://dev.ti.com/uniflash/#!/)

Quickstart

The quickstart guide covers setting up the EVM, flashing firmware, and running the demo.

1. Setup the EVM for Flashing Mode

- For MMWAVEICBOOST + Antenna Module setup: Follow the instructions for Hardware Setup for Flashing in MMWAVEICBOOST Mode

(../../common/docs/hardware_setup/hw_setup_mmwaveicboost_mode_flashing.html)

- For IWR6843ISK in Standalone/Modular Mode: Follow the instructions for Hardware Setup of IWR6843ISK/ODS for Flashing Mode
(../../common/docs/hardware_setup/hw_setup_isk_ods_modular_mode_flashing.html)

2. Flash the EVM using Uniflash

Flash the binary listed below using UniFlash. Follow the instructions for using UniFlash

(../../common/docs/software_setup/using_uniflash_with_mmwave.html)


BIN Name	Location
xwr64xx_mmw_demo.bin	<INDUSTRIAL_TOOLBOX_INSTALL_DIR>\mmwave_industrial_toolbox_<VER>\out_of_box_demo\68xx_mmwave_sdk_hwa\prebuilt_binaries\xwr64xx_mmw_demo.bin

3. Setup the EVM for Functional Mode

- For MMWAVEICBOOST + Antenna Module setup: Follow the instructions for Hardware Setup of MMWAVEICBOOST + Antenna Module for Functional Mode
(../../common/docs/hardware_setup/hw_setup_mmwaveicboost_mode_functional.html)
- For IWR6843ISK in Standalone/Modular Mode: Follow the instructions for Hardware Setup of IWR6843ISK/ODS for Functional Mode
(../../common/docs/hardware_setup/hw_setup_isk_ods_modular_mode_functional.html)

4. Run the Lab

1. GUI Setup

- Power up the EVM and connect it to the Windows PC with the provided USB cable (make sure that the SOP2 jumper is removed). Mount the setup vertically as shown in Physical Setup
- Using Google Chrome, navigate to the following URL: <https://dev.ti.com/mmWaveDemoVisualizer>
(<https://dev.ti.com/mmWaveDemoVisualizer>)
- If prompted, follow the on-screen instructions for installing TI Cloud Agent (this is need the first time on a new PC)
- In the GUI menu, select Options → Serial Port
- In the serial port window, enter the appropriate port in each of the drop down menus based on your port numbers from the Flash the EVM section
- Click on Configure to connect the GUI to the EVM. The GUI Status bar should show **Conected:** 

Serial Port Configuration

mmWave:User/Application Port (CLI CFG_port)
Ports:
Baud Rates:

mmWave:Auxillary Data port (Demo output DATA_port)

REFRESHOKCANCEL

2. Running the Demo

- On the Configure Tab, select the appropriate mmWave SDK and the **xWR64XX device** from the Platform dropdown menu
- **NOTE:** Since we are using the HWA version of this lab, the **xWR64XX device** must be selected.
- Use the available sliders to create the desired configuration.
 - You can also use the presets available in the Desirable Configuration drop-down list.
 - Additional details about the configuration parameters can be found in the mmWave Demo Visualizer User Guide (<http://www.ti.com/lit/pdf/swru529>)

mmWave Demo Visualizer | Options Help

Configure

Setup Details

Platform	xWR64xx
SDK version (*)	3.4
Antenna Config (Azimuth Res - deg)	4Rx,2Tx(15 deg)

Desirable Configuration	Best Range Resolution
Frequency Band (GHz)	60-64

Scene Selection

Frame Rate (fps)	<div><div></div><div></div></div> <div>130</div> <div>10</div>
Range Resolution (m)	<div><div></div><div></div></div> <div>0.0390.047</div> <div>0.044</div>
Maximum Unambiguous Range (m)	<div><div></div><div></div></div> <div>3.9521.61</div> <div>9.02</div>
Maximum Radial Velocity (m/s)	<div><div></div><div></div></div> <div>0.619.59</div> <div>1</div>
Radial Velocity Resolution (m/s)	<div><div></div><div></div></div> <div>0.13</div> <div>0.13</div>

- Select the desired plots under Plot Selection (e.g. Scatter Plot, Range Azimuth Plot)

- When ready to send the configuration, click on Send Config To mmWave Device

Plot Selection

☒ Scatter Plot
 ☐ Range Azimuth Heat Map

☒ Range Profile
 ☐ Range Doppler Heat Map

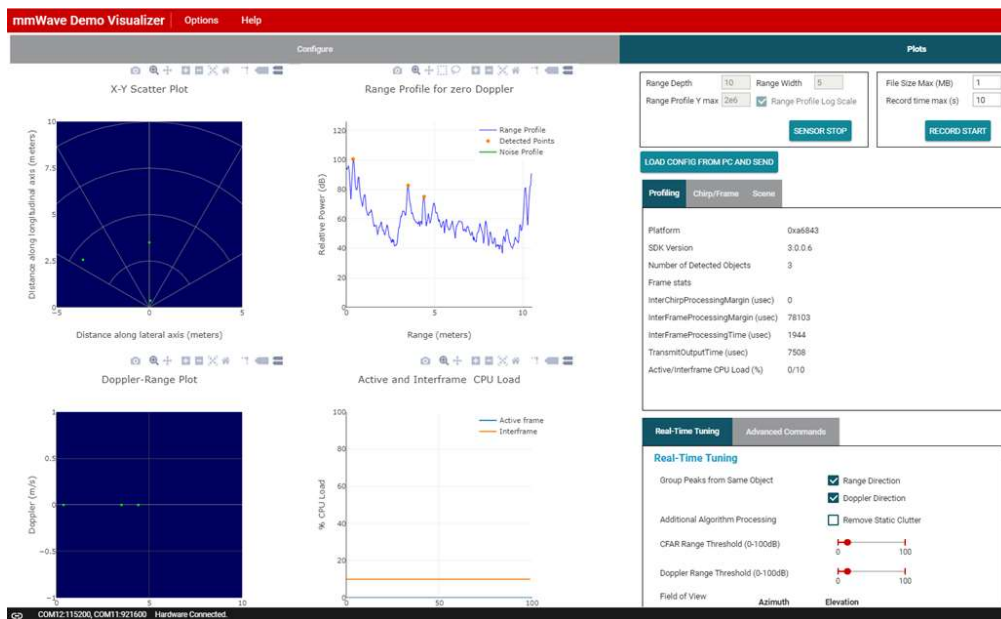
☐ Noise Profile
 ☒ Statistics

SEND CONFIG TO MMWAVE DEVICE

SAVE CONFIG TO PC

RESET SELECTION

- Click on the Plots tab to view the plots that were selected to be shown



- Move a highly reflective object in front of the EVM and see how the demo responds.
 - You can use the Real Time Tuning controls shown below to adjust CFAR thresholds, Modify Field of View and enable or disable Peak grouping in real time.

Real-Time Tuning

Advanced Commands

Real-Time Tuning

Group Peaks from Same Object ☒ Range Direction

Additional Algorithm Processing ☒ Doppler Direction

CFAR Range Threshold (0-100dB) ☐ Remove Static Clutter

Doppler Range Threshold (0-100dB)

Field of View

Angle of arrival (degrees)

Range (m)

Min Max

Min Max

Min Max

Min Max

RESET SEND

RESET SEND

- This concludes the Quick Start Section

Developer's Guide

Build the Firmware from Source Code

1. Software Requirements

Tool	Version	Download Link
TI mmWave SDK	3.5.x.x	Link to Latest mmWave SDK (http://software-dl.ti.com/ra-processors/esd/MMWAVE-SDK/latest/index_FDS.html) To access a previous version of the mmWave SDK scroll to the bottom of the table and click the link under "MMWAVE-SDK previous release". Repeat to continue stepping back to previous versions.
Code Composer Studio	8.3.1	Code Composer Studio v8.3.1 (http://processors.wiki.ti.com/index.php/Download_CCS)
mmWave Industrial Toolbox	Latest	Download and install the toolbox. Go to Using TI Resource Explorer & the mmWave Industrial Toolbox (http://processors.wiki.ti.com/index.php/Using_TI_Resource_Explorer) for instructions.


2. Import Lab Project

The mmWave SDK Out-of-box demo Lab CCS Project is available under on TI Resource Explorer under mmWave Sensors → mmWave Industrial Toolbox. You can import the project in your CCS workspace using TI Resource Explorer in CCS or using a browser. Both methods of importing projects are defined in the Expand boxes below.

- Start CCS and setup workspace as desired.
- Import the project below to CCS using either TI Resource Explorer in CCS or CCS Import Projects specs method:
 - `mmwave_sdk_68xx_hwa`

Expand for details on importing via TI Resource Explorer in CCS



- In the top toolbar, navigate to **View** → **Resource Explorer**
- In the **Resource Explorer** side panel (not the main panel with "Welcome to.."), navigate to **Software** → **mmWave Sensors** → **Industrial Toolbox - <ver>** → **Labs** → **mmWave SDK Demo - 68xx HWA Version**
- Under the expanded **mmWave SDK Demo - 68xx HWA Version** folder, there should be a CCS project named **mmwave_sdk_68xx_hwa**.
- Click on the project, which should open the project in the right main panel, and then click on the **Import to IDE** button .

Expand for details on importing via CCS Import Projects specs

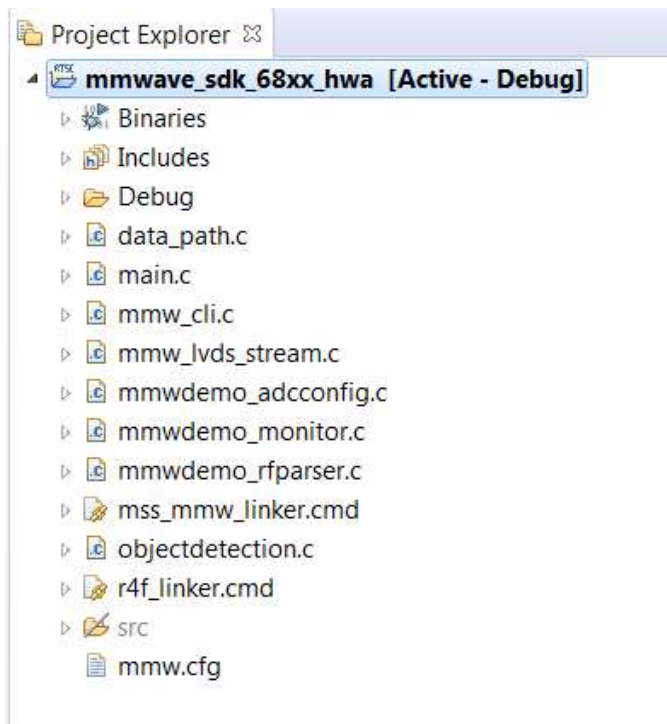


- In the top toolbar, navigate to **Project** → **Import CCS Projects...**
- With the **Select search-directory** option enabled, click **Browse...**, navigate to the **68xx_mmwave_sdk_hwa** folder at `C:\ti\<mmwave_industrial_toolbox_install_dir>\labs\out_of_box_demo\68xx_mmwave_sdk_hwa`, and then click **OK**.
- Under **Discovered projects**, select **mmwave_sdk_68xx_hwa** then click **Finish**.



Successful Import to IDE

After using either method, the **mmwave_sdk_68xx_mss** project should be visible in **CCS Project Explorer**





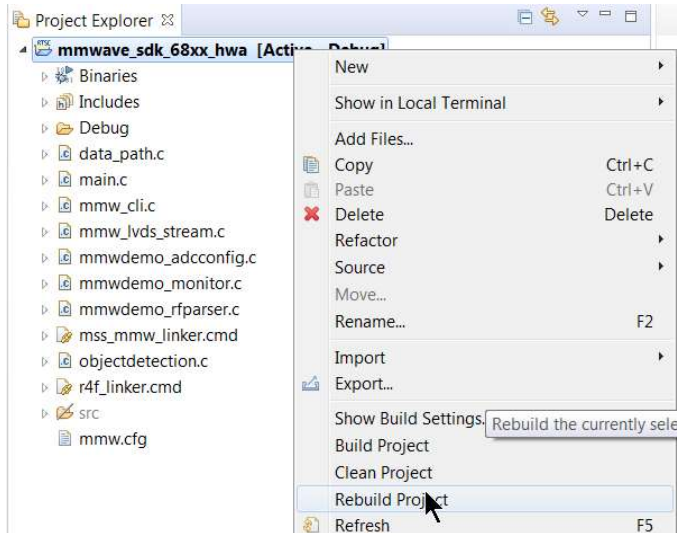
Project Workspace

When importing projects to a workspace, a copy is created in the workspace. It is important to note that the copy in user's workspace is the one that gets built and all modifications will only be implemented for the workspace copy. The original project downloaded in mmWave Industrial Toolbox is not modified.

3. Build the Lab

With the `mmwave_sdk_68xx_hwa` 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.



Successful Project Build

In the **Project Explorer** panel, navigate to and expand `mmwave_sdk_68xx_hwa` → **Debug** directory. On successful build, the following files should appear in the **Debug** folder:

- `xwr64xx_mmw_demo.bin` (this is the flashable binary used for deployment mode)
- `xwr64xx_mmw_mss.xer4f` (this is the Cortex R4F binary used for CCS debug mode)



Build Fails with Errors

If the build fails with errors, please ensure that all the prerequisites are installed as mentioned in the mmWave SDK release notes.



Note

As mentioned in the Quickstart section, pre-built binary files, both `.xer4f` and `.bin`, are provided in mmWave SDK under `C:\ti\mmwave_sdk_03_04_xx_xx\packages\ti\demo\xwr64xx\mmw.`

4. Execute the Lab

There are two ways to execute the compiled code on the EVM:

- **Deployment mode:** In this mode, the EVM boots autonomously from flash and starts running the bin image
 - Using Uniflash, flash the **xwr64xx_mmw_demo.bin** found at
`<PROJECT_WORKSPACE_DIR>\mmwave_sdk_68xx_hwa\Debug\xwr64xx_mmw_demo.bin`
 - The procedure to flash the EVM is the same as detailed in the Flash the EVM section.
- **Debug mode:** This mode is used for downloading and running the executable (.xer4f) from CCS. This mode enables JTAG connection with CCS while lab is running; useful during development and debugging

Expand for help with Debug mode:



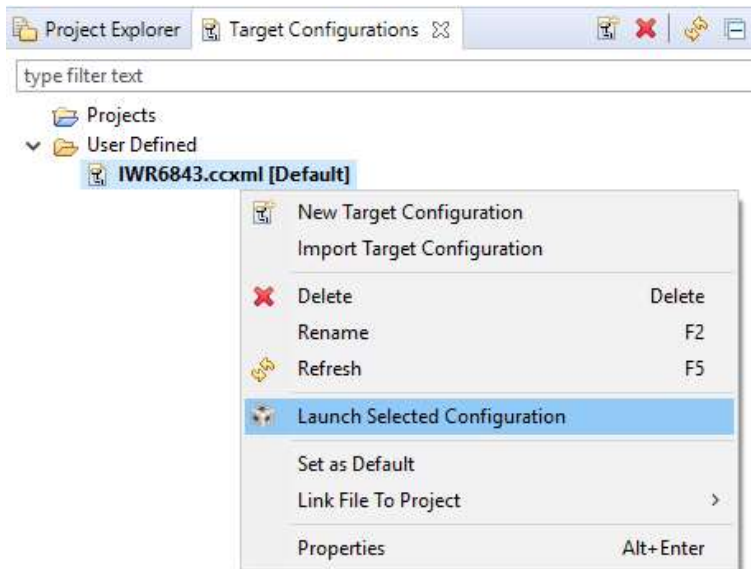
The CCS debug firmware (provided with the mmWave SDK) needs to be flashed once on the EVM.

- CCS Debug method is enabled by flashing the CCS Debug Firmware (provided with the mmWave SDK) using the methods covered in the Quickstart Flash the Device section.
- Use the following image instead

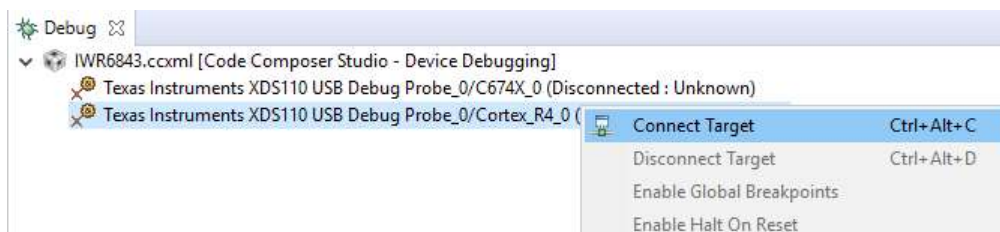
Image	Location	Comment
Meta Image 1	C:\ti\mmwave_sdk_<ver>\packages\ti\utils\ccsdebug\xwr68xx_ccsdebug.bin	Provided with the mmWave SDK

After the CCS debug firmware has been flashed, connect the EVM to CCS

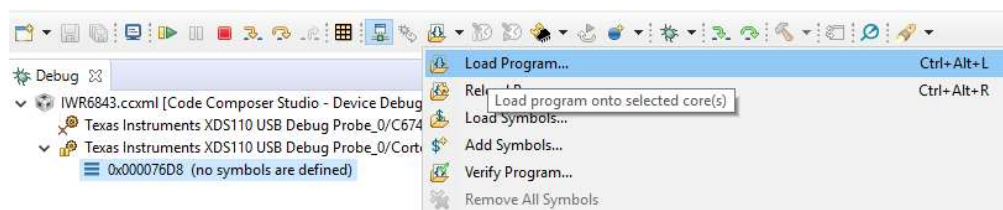
- Create a target configuration (skip to "Open the target..." if config already created previously in another lab for xwr68xx)
 - Go to **File** → **New** → **New Target Configuration File**
 - Specify an appropriate file name (ex: IWR68xx.ccxml) and check "**Use shared location**". Click **Finish**.
- In the configuration editor window:
 - Select **Texas Instruments XDS110 USB Debug Probe** for Connection
 - Select **IWR6843** in the **Board or Device** text box.
 - Press the **Save** button to save the target configuration.
 - [Optional]: Press the **Test Connection** button to check the connection with the board.
- Open the target configuration window by going to **View** → **Target Configurations**.
 - Under **User Defined** configurations the target configuration previously created should appear.
 - Right click on the target configuration and select **Launch Select Configuration**. The target configuration will launch in the **Debug Window**.




- Select the **Texas Instruments XDS110 USB Debug probe/Cortex_R4_0** and then right click and select **Connect Target**



- Load the binary
 - With the **Cortex_R4_0** target connected, click on the **Cortex_R4_0** target and then click **Load** button in the toolbar.



- In the **Load Program** dialog, press the **Browse Project** button .
- Select **xwr64xx_mmw_mss.xer4f** found at
`<PROJECT_WORKSPACE_DIR>\mmwave_sdk_68xx_hwa\Debug\xwr64xx_mmw_mss.xer4f` and press **Ok**.
- Press **Ok** again in the **Load Program** dialog.
- Run the binary
 - Select **Texas Instruments XDS110 USB Debug probe/Cortex_R4_0**, press the **Run/Resume** button 
 - The program should start executing and generate console output as shown.

```

Console
IWR6843.ccxml:CIO
[Cortex_R4_0] *****
Debug: Launching the MMW HWA Demo
*****
Debug: Launched the Initialization Task
Debug: UART Instance @0801e940 has been opened successfully
Debug: UART Instance @0801e94c has been opened successfully
Debug: mmWave Control Initialization was successful
Debug: mmWave Control Synchronization was successful
Debug: CLI is operational

```



Successful Run Binary

If binary is running correctly, the Console will include the “CLI is operational” message which indicates that the program is ready and waiting for the sensor configuration.

5. Output from mmWave Demo Visualizer and Output using DCA1000EVM

The mmWave Demo Visualizer is used to visualize processed output data from the mmWave radar device. This processed output data can be saved in binary form to a .DAT file. Additionally, raw ADC data can be saved for offline processing using the DCA1000 EVM (<https://www.ti.com/tool/DCA1000EVM>). To learn more about the structure of this output data please refer to the following resources:



Output Data versus Raw ADC Data

Output data refers to point cloud data (x,y,z,v). Raw ADC data refers to digitally sampled sensor data.

- Output Data Structure Information:
 - <MMWAVE_SDK_INTSALL_DIR>\packages\ti\demo\xwr68xx\mmw\docs\doxygen\html\index.html
- How to use the DCA1000EVM (<https://www.ti.com/tool/DCA1000EVM>) for raw data capture:
 - <MMWAVE_SDK_INTSALL_DIR>\docs\mmwave_sdk_user_guide.pdf
Section 3.3.2 mmWave Demo with LVDS-Based Instrumentation
- Parsing Script Information for mmWave Demo Visualizer
 - <MMWAVE_SDK_INTSALL_DIR>\docs\mmwave_sdk_user_guide.pdf
Section 3.3.1 mmWave Demo - Advanced GUI Options
- Parsing Script Location for mmWave Demo Visualizer and DCA1000EVM
(<https://www.ti.com/tool/DCA1000EVM>) for raw data capture:
 - <MMWAVE_SDK_INTSALL_DIR>\packages\ti\demo\parser_scripts

After running the lab using either method, the demo firmware should be executing on the EVM and waiting for sensor configuration. After this point, please follow the instructions provided in the Quickstart section to bring-up the mmWave Demo Visualizer for sending the configuration and visualizing the results.

Need More Help?

- Additional resources in the documentation of the mmWave SDK (note hyperlinks will only work if the mmWave SDK has been installed on PC):
- mmWave SDK User's Guide located at <mmwave_sdk_install_dir>/docs/mmwave_sdk_user_guide.pdf (http://software-dl.ti.com/ra-processors/esd/MMWAVE-SDK/latest/exports/mmwave_sdk_user_guide.pdf)
 - mmWave SDK Release Notes located at
<mmwave_sdk_install_dir>/docs/mmwave_sdk_release_notes.pdf (http://software-dl.ti.com/ra-processors/esd/MMWAVE-SDK/latest/exports/mmwave_sdk_release_notes.pdf)
- Search for your issue or post a new question on the mmWave E2E forum (https://e2e.ti.com/support/sensor/mmwave_sensors/f/1023)