RS-Lx432V Quick Start Guide

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RS-L6432V RF Compliance Notices

The following RF emissions statements apply exclusively to the RS-L6432V model radar sensor.

1.1 FCC and ISED Identification Label

The RS-L6432V device has been certified to be in compliance with FCC Part 15 and ISED ICES-003. Due to its size the required FCC ID including the grantee code is included in this manual below.

FCC ID: 2ASVZ-03

Due to its size the required IC ID including the company code is included in this manual below.

IC: 30644-03

1.2 FCC Compliance Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation. Please note that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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1.3 FCC RF Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, this equipment should be installed and operated with minimum distance 20 cm (7.9 in) between the antenna and your body during normal operation. Users must follow the specific operating instructions for satisfying RF exposure compliance.

1.4 ISED Non-Interference Disclaimer

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

This device complies with the Canadian ICES-003 Class A specifications. CAN ICES-003(A) / NMB-003 (A).

1.5 ISED RF Exposure Statement

This equipment complies with ISED RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm (7.9 inches) between the radiator and any part of your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

RS-L6432V RF Special Compliance Notices

The following RF emissions statements apply exclusively to the RS-L6432V model radar sensor.

2.1 FCC Compliance Statement

CFR 47 Part 15.255 Statement:

Limitations for use are as follows:

(a) General. Operation under the provisions of this section is not permitted for equipment used on satellites.

(b) Operation on aircraft. Operation on aircraft is permitted under the following conditions:

(1) When the aircraft is on the ground.

(2) While airborne, only in closed exclusive on-board communication networks within the aircraft, with the following exceptions:

(i) Equipment shall not be used in wireless avionics intra-communication (WAIC) applications where external structural sensors or external cameras are mounted on the outside of the aircraft structure.

(ii) Except as permitted in paragraph (b)(3) of this section, equipment shall not be used on aircraft where there is little attenuation of RF signals by the body/fuselage of the aircraft.

(iii) Field disturbance sensor/radar devices may only operate in the frequency band 59.3-71.0 GHz while installed in passengers' personal portable electronic equipment (e.g., smartphones, tablets) and shall comply with paragraph (b)(2)(i) of this section, and relevant requirements of paragraphs (c)(2) through (c)(4) of this section.

(3) Field disturbance sensors/radar devices deployed on unmanned aircraft may operate within the frequency band 60-64 GHz, provided that the transmitter not exceed 20 dBm peak EIRP. The sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds. Operation shall be limited to a maximum of 121.92 meters (400 feet) above ground level.

2.2 ISED Compliance Statement

According to RSS-210 Annex J, the devices certified under this annex are not permitted to be used on satellites.

Devices used on aircraft are permitted under the following conditions:

a. Except as allowed in J.2(b), devices are only to be used when the aircraft is on the ground.

b. Devices used in-flight are subject to the following restrictions:

i. they shall be used within closed, exclusive on-board, communication networks within the aircraft

ii. they shall not be used in wireless avionics intra-communication (WAIC) applications where external structural sensors or external cameras are mounted on the outside of the aircraft structure

iii. they shall not be used on aircraft equipped with a body/fuselage that provides little or no RF attenuation except when installed on unmanned air vehicles (UAVs) and complying with J.2(d)

iv. devices operating in the 59.3-71.0 GHz band shall not be used except if they meet all of the following conditions:

1. they are FDS
2. they are installed within personal portable electronic devices
3. they comply with the relevant requirements in J.3.2(a), J.3.2(b) and J.3.2(c)

c. Devices' user manuals shall include text indicating restrictions shown in J.2(a) and J.2(b).

d. FDS devices deployed on UAVs shall comply with all of the following conditions:

i. they operate in the 60-64 GHz band

ii. the UAVs limit their altitude operation to the regulations established by Transport Canada (e.g. altitudes below 122 metres above ground)

iii. they comply with J.3.2(d)

Introduction

This document outlines how to get started with the D3 Engineering DesignCore® RS-L6432V Radar Sensor.

3.1 Prerequisites

Operating the sensor will require the following hardware:

- RS-L6432V Sensor
- USB-C to USB-A cable

Exercising the sensor will require the following software packages be installed:

- Required
  - USB UART driver for XR21V1410. https://www.maxlinear.com/support/design-tools/softwaredrivers.
  - Ensure you select the correct driver for your operating system.
  - Terminal program such as Tera Term https://teratermproject.github.io/index-en.html
  - D3 Visualizer: See your downloads on the D3 Web Store.
- Optional
  - Uniflash: https://www.ti.com/tool/UNIFLASH (To load firmware to the sensor).

Interfaces

4.1 J403 USB Connector

J403 is a USB-C connector. The USB data and power signals are employed following the typical USB pinout. Power can be supplied via this connector. 0.5 A is the required current maximum. The WARN LED will illuminate if the sensor is starved of voltage.

4.2 LEDs

The three LEDs are WARN, 3V3, and 5V0.

- D403, “WARN” (Red) illuminates if the sensor is starved of voltage.
- D402, “3V3” (Yellow/Green) illuminates if 3.3 V power is active.
- D401, “5V0” (Yellow/Green) illuminates if 5.0 V power is present.

Verifying Data Output with the RS-L6432V

With this procedure you can observe data output from the sensor.

1. Power the sensor via the USB-C cable.
2. Verify that the 3V3 and 5V0 LEDs are lit on the sensor. If they are not, power cycle the board.
3. If you are using a custom data output format, use Tera Term to view the output from the sensor, and stop here.
4. If you are using standard data output format, get the D3 Visualizer, P/N 2000127 from your downloads on the D3 Web Store and unzip into a folder, and continue on below.
5. Start the visualizer and set the radar sensor serial ports as below, substituting your

"Ch A" serial port in both places (same port).

Figure 1. Setting the D3 Visualizer Serial Ports

6. Select Chirp file as "chirps\l6432\TrackingClassification_MidBw.cfg" by browsing into the chirps folder from the visualizer. Other versions will use a different Chirp file.
7. Click Start.
8. Observe the output and observe the dynamic returns displayed as shown in Figure 2.

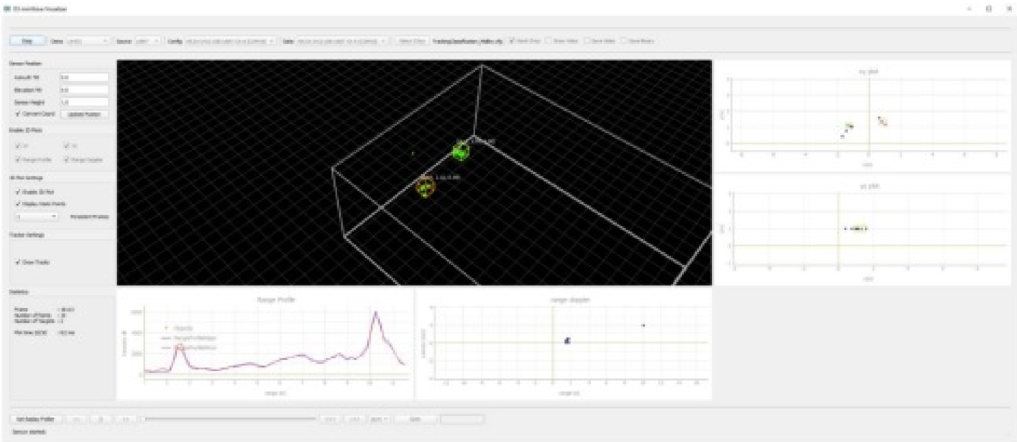

Figure 2. D3 Visualizer Data Display

Running Demos Provided by Texas Instruments

With the D3 RS-Lx432V sensor, you can also run demos provided by Texas Instruments. Texas Instruments demos can be found within TI's resource explorer (https://dev.ti.com/tirex). Navigate to mmWave radar sensors -> Embedded Software -> Radar Toolbox – X.Y.Z.W -> Getting Started with the xWRL6432.

Please note that the to keep the D3 RS-Lx432V sensor size small, the antenna geometry is different from that on the TI evaluation kit. To account for this, you must alter the configuration file to be used.

Replace any existing antGeometryCfg command with the revised version below:

% Correct D3 RS-L6432S and RS-L6432V antGeometryCfg 0 3 1 2 0 1 0 2 1 1 0 0 2.418 2.418

If this command is not already part of the configuration file, insert this line after the frameCfg command and before the guiMonitor command in the file.

TI has made the following demos available:

1. **Out Of Box Demo** – Identical to what's described in this guide.
2. **Human vs. Non-human Classification** – Point cloud returns, clustering and tracking,

with human classification.

3. **In-cabin Life Presence Detection Demo –** Detects automotive cabin occupancy, for example to detect children left behind.
4. **In-cabin Intruder Detection Demo** – Detects people outside a vehicle who are reaching inside.
5. **Truck Bed Monitoring Demo** – Detects someone reaching into the bed of a pickup truck.
6. **Radar Doorbell** – Detects someone approaching the door.
7. **Indoor OccupancyMonitoring** – Detects people inside a room.
8. **Onlooker Detection** – Detects someone approaching an office worker from behind.

All of these demos use the binary that is supplied with your RS-L6432V, but use different chirp configurations and visualizers.
To support deployable functionality, D3 can provide support to improve and tune the available algorithms, and also can design and implement algorithms from scratch.
Please contact us for more information.

Application Programming and Communications

Your sensor comes programmed with the appropriate software. Use this procedure only if necessary. This procedure programs the device and tests the Serial/UART connection. There are separate instructions below for two cases, (a) your unit has the secondary bootloader programmed or (b) your unit does not have the secondary bootloader programmed on it.

7.1 Application Programming with Secondary Bootloader

You can use these steps to program the application image. Use these instructions if you already have the secondary bootloader programmed (you see a countdown at bootup).
The Secondary Bootloader (SBL) allows simplified application programming and field reprogramming without manipulating I/Os to control the boot mode of the radar chip. To program the application, use Tera Term to communicate with the bootloader already programmed onto the sensor.

1. Connect to the sensor’s COM port with Tera Term.
2. When the sensor powers up, you will see the output in Figure 3.

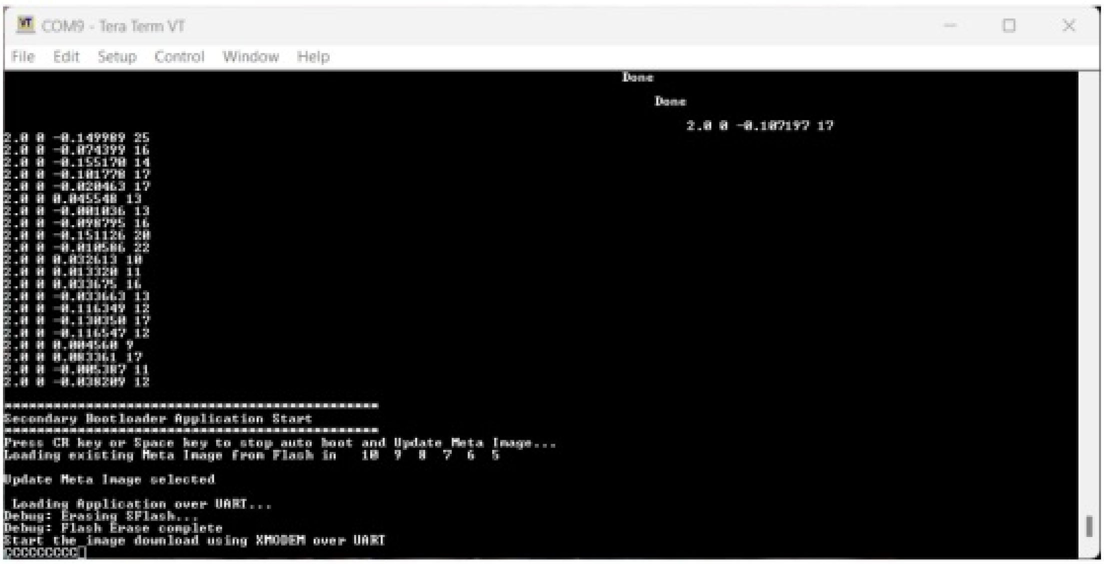

Figure 3. Secondary Bootloader Startup

1. When you see the countdown, “10 9 8 …”, hit “p” or “P” to instruct the SBL to accept an application image download.
2. When you see “CCCCC”, in the Tera Term menu, select Transfer->XMODEM->Send.
3. Select the application image file specified in the assembly BOM in the dialog.
4. Ensure that you select the “1K” option checkbox as shown in Figure 4.

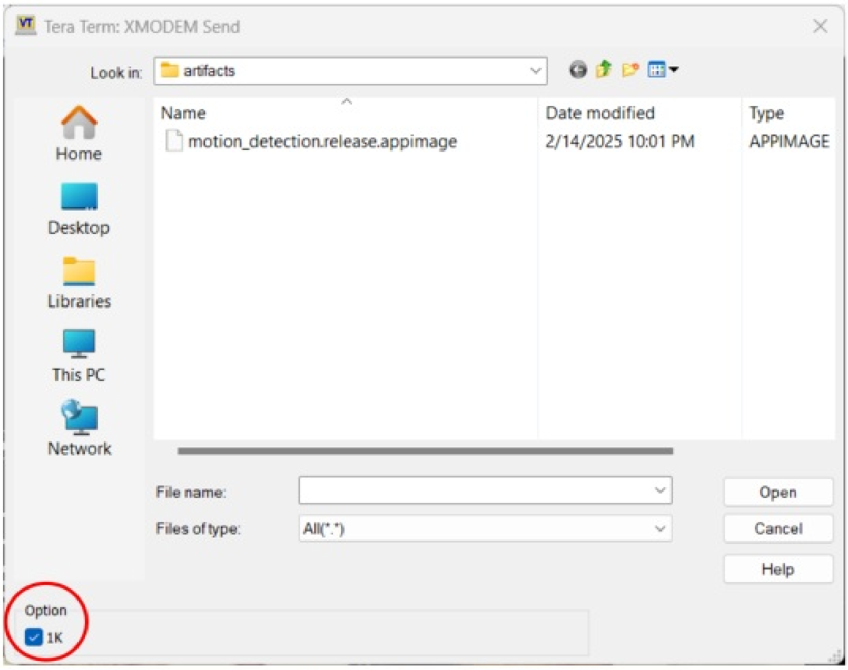

Figure 4. XModem File Transfer Selection Dialog

5. Observe the transfer progress dialog as shown in Figure 5.

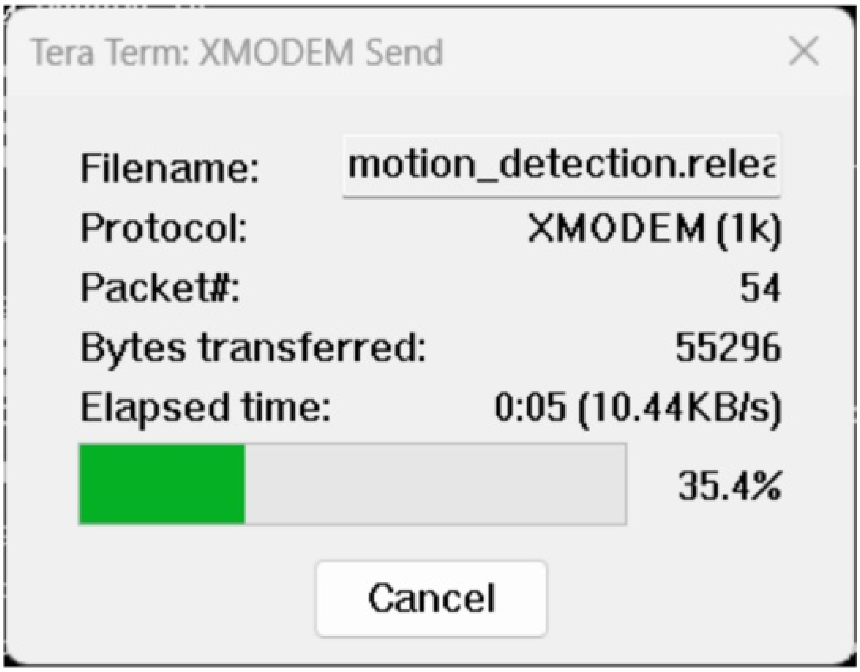

Figure 5. XModem Transfer Progress Dialog

6. When the XModem Transfer is complete, the application begins immediately.
7. The sensor is ready for data verification.

7.2 Application Programming without Secondary Bootloader

You can use these steps to program the secondary bootloader and/or the application image itself. If your unit already has the secondary bootloader (you see a countdown at bootup), follow application programming instructions in section 7.1 above.

Perform the steps in EITHER Section 7.2.1 or Section 7.2.2, not both

7.2.1 Entering Programming Mode – Software Method

Use this method if the unit is Rev 4 or lower and is sealed in an enclosure. If the unit is Rev A or later, you will need to follow the instructions in section 7.2.2. After completing all of the steps in this section, proceed to Section

7.2.3: Programming Completion.

1. Connect the D3 PCA-00C019043 board to the computer.
2. Open Device Manager from the Start menu.
3. In Device Manager, look for the heading “Ports (COM & LPT)” and expand it.

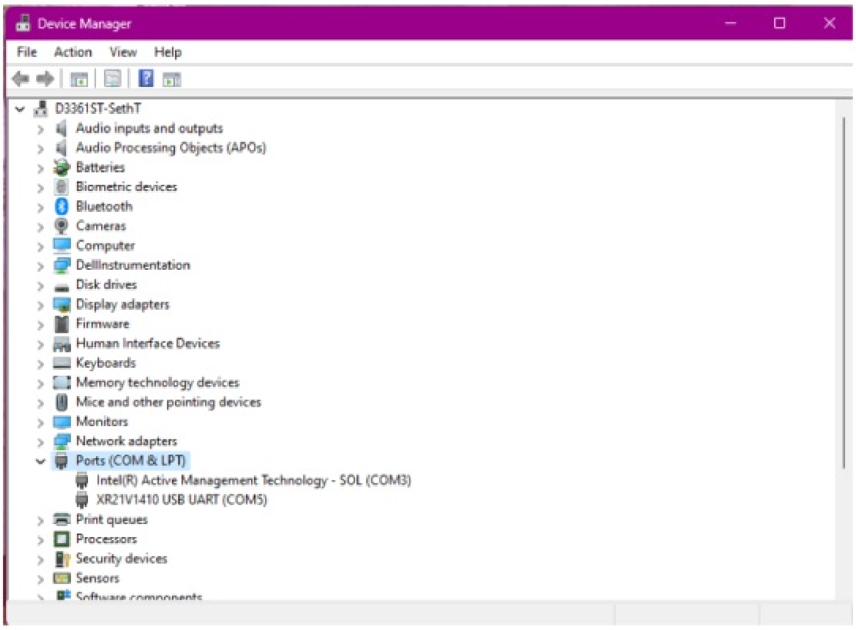

Figure 6. Show Device in Windows Device Manager

4. Under this heading, there should be a device labeled XR21V1410 USB UART – take note of the COM# of this device.
5. Open the MaxLinear Sample USB UART GUI (Serial Test App).

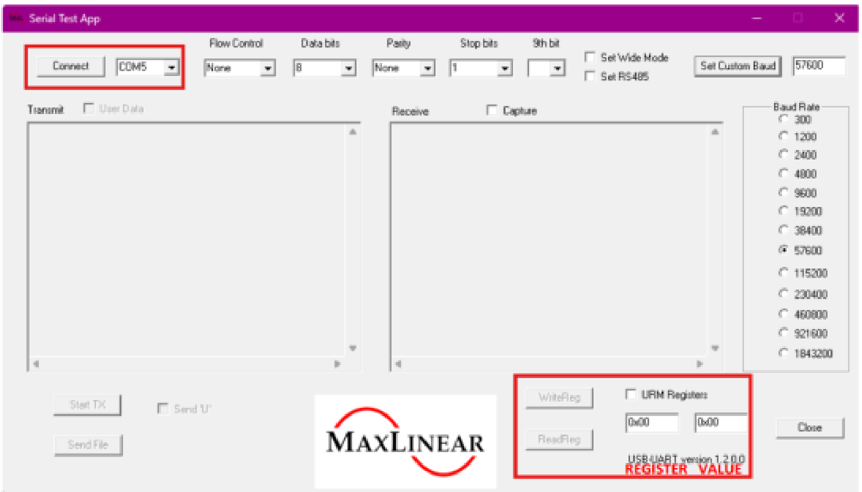

Figure 7. MaxLinear Tool for Register Controls

6. In the dropdown in the top left of the Serial Test App, next to the “Connect” button, select the COM# of the XR21V1410 device from Step 4.
7. Click the “Connect” button in the Serial Test App
8. In the bottom right of the Serial Test App, there are two buttons “WriteReg” and “ReadReg”, and two input boxes to their right. The input box closest to the buttons will be referred to as the “Register” and the further input box as the “Value”. For each of the combinations that follow, enter the data into the input boxes, then click the “WriteReg” button.

   a. For Rev 3 and earlier

   i. Register: 0x1B, Value: 0x5 (sets GPIO 0 and 2 as outputs)

   ii. Register: 0x1E, Value: 0x5 (sets GPIO 0 and 2 low)

iii. Register: 0x1D, Value: 0x1 (sets GPIO 0 high)

b. For Rev A and later

i. Register: 0x1B, Value: 0x28 (sets GPIO 3 and 5 as outputs)

ii. Register: 0x1E, Value: 0x28 (sets GPIO 3 and 5 low)

iii. Register: 0x1D, Value: 0x08 (sets GPIO 3 high)

9. Click the "Disconnect" button in the top left of the Serial Test App
10. Proceed to Section 7.2.3: Programming Completion.

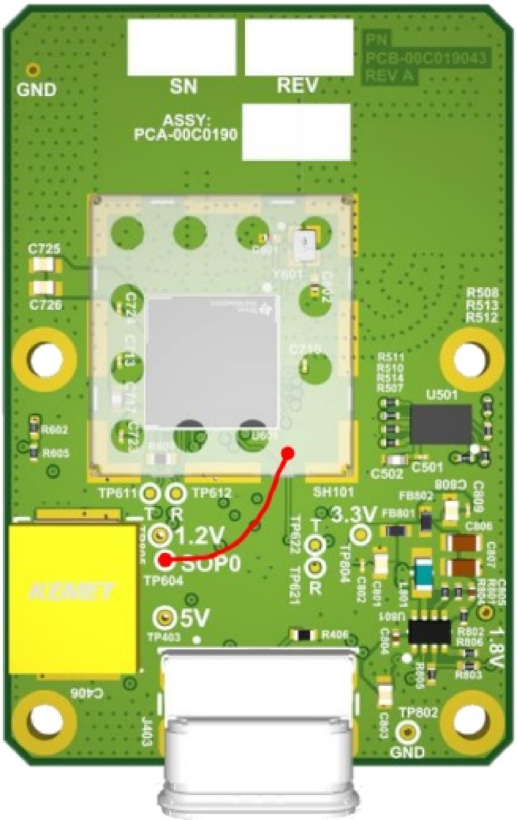

Figure 8. TP604 to Ground Temporary Short

7.2.3. Programming Completion

1. **Launch Uniflash.**
2. Select IWRL6432 or AWRL1432 from the list of available devices then click Start. These devices are in the mmWave category.

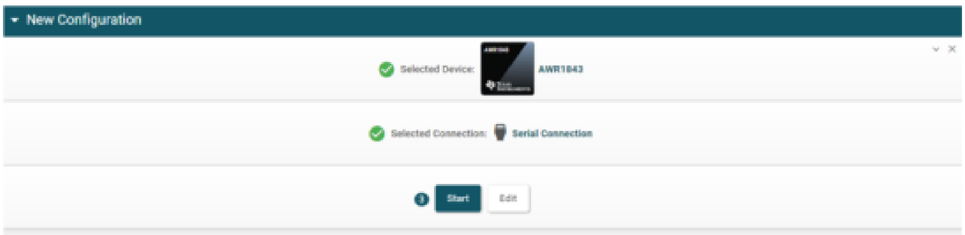

Figure 9. Uniflash configured to program the DUT

3. Set the COM port to match the device manager. The Uniflash COM Port selection should match the XR21V1412 UART Ch A port listed in the Windows Device Manager.

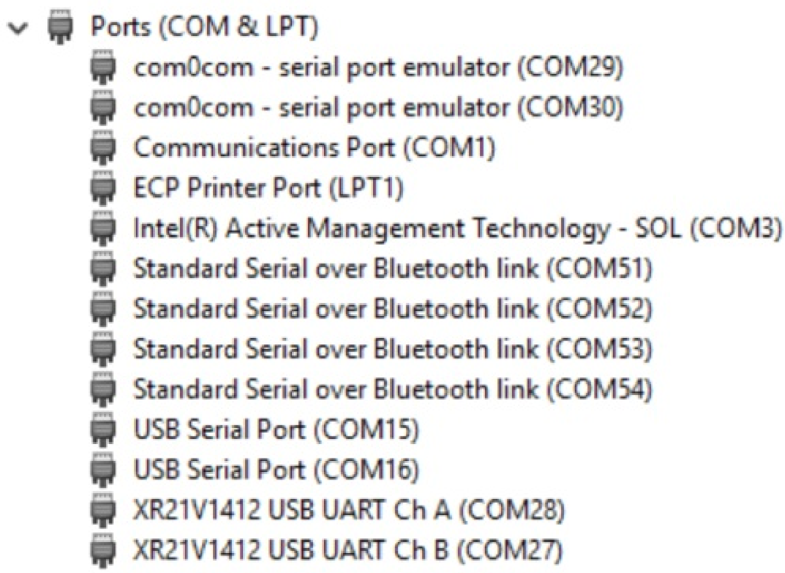

Figure 10. Windows Device Manager COM Ports

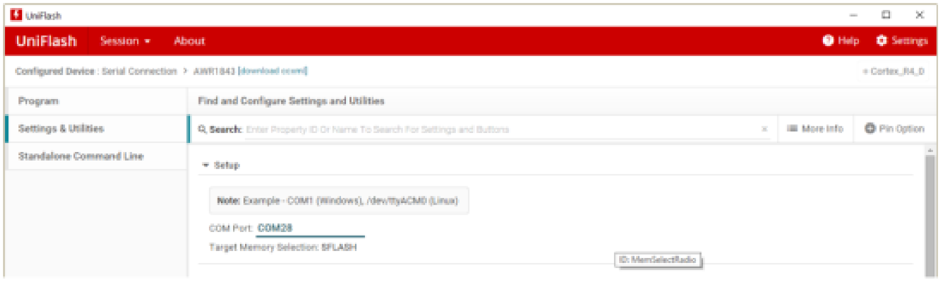

Figure 11. Uniflash COM Port Selection

4. Obtain the binary to program onto the DUT from your account on the D3 website.

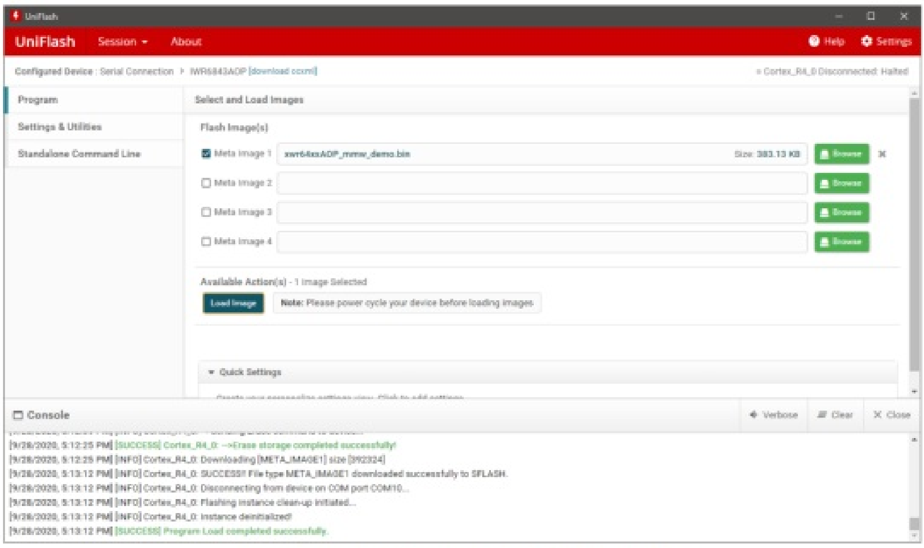

Figure 12. Uniflash Configured to Program a DUT

4. Once Uniflash has been properly configured, press the Load Image button. Wait until the Console displays the message: [Success] Program Load completed successfully.
5. Your sensor is now programmed with the secondary bootloader, the application image, or both if you selected two images.
6. If you programmed the secondary bootloader only, you can proceed to program an application as in section 7.1.
7. If you programmed an application, you can proceed to verify the data output as in

section 5.0.

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Documents / Resources

	D3Engineering RS-Lx432V DesignCore mmWave Radar Sensor [pdf] User Guide 2ASVZ-03, 2ASVZ03, 03, RS-Lx432V DesignCore mmWave Radar Sensor, RS-Lx432V, DesignCore mmWave Radar Sensor, mmWave Radar Sensor, Radar Sensor

References

- dev.ti.com/tirex
- Tera Term Open Source Project
- Software Drivers - MaxLinear
- UNIFLASH Software programming tool | TI.com
- User Manual

D3Engineering

-03, 2ASVZ-03, 2ASVZ03, D3Engineering, DesignCore mmWave Radar Sensor, mmWave Radar Sensor, Radar Sensor, RS-Lx432V, RS-Lx432V DesignCore mmWave Radar Sensor

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