RS-Lx432S Quick Start Guide

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150 Lucius Gordon Drive
West Henrietta, NY 14586
p. 585.429.1550
f. 585.429.1551
www.d3embedded.com

150 Lucius Gordon Dr.
West Henrietta, NY 14586
phone: 585.429.1550
fax: 585.429.1551
www.d3embedded.com

Contents

1.0 RS-L6432S RF Compliance Notices 3
1.1 FCC and ISED Identification Label 3
1.2 FCC Compliance Statement 3
1.3 FCC RF Exposure Statement 3
1.4 ISED Non-Interference Disclaimer 3
1.5 ISED RF Exposure Statement 4
1.6 FCC and ISED Modular Approval Notice ..... **Error! Bookmark not defined.**
1.7 Class 2 Permissive Change Test Plan ..... **Error! Bookmark not defined.**
2.0 RS-L6432S RF Special Compliance Notices 4
2.1 FCC Compliance Statement 4
2.2 ISED Compliance Statement 4
3.0 Introduction 6
3.1 Prerequisites 6
4.0 Interfaces 6
4.1 J801 Multifunction Connector 6
4.2 LED 7
5.0 Collecting and Visualizing Data with the RS-Lx432S 8
5.1 Connections for Operation 8
5.2 Procedure 8
6.0 Running Demos Provided by Texas Instruments 9
7.0 (Optional) Programming the Sensor 10
7.1 Connections for Programming 10
7.2 Procedure 10

150 Lucius Gordon Dr.
West Henrietta, NY 14586
phone: 585.429.1550
fax: 585.429.1551
www.d3embedded.com

1.0 RS-L6432S/RS-L6432D RF Compliance Notices

The following RF emissions statements apply exclusively to the RS-L6432S/RS-L6432D model radar sensor.

1.1 FCC and ISED Identification Label

The RS-L6432S/RS-L6432D device has been certified to be in compliance with FCC Part 15 and ISED ICES-003. When this module is integrated within a final host, the end-product label must contain the following for FCC compliance:

Contains FCC ID: 2ASVZ-04

For compliance with ISED Canada labeling requirements, when this module is integrated within a final host, the end-product label must contain the following:

Contains IC: 30644-04

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.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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).

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempt de licence. L'exploitation est autorisée aux deux conditions suivantes :

150 Lucius Gordon Dr.
West Henrietta, NY 14586
phone: 585.429.1550
fax: 585.429.1551
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(1) L'appareil ne doit pas produire de brouillage;
(2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.
Cet appareil numérique de la Canadian ICES-003. Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

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.
Cet équipement est conforme aux limites d'exposition aux radiations ISED CNR-102 établies pour un environnement non contrôlé. Une distance de séparation d'au moins 20 cm doivent être maintenue entre l'antenne de cet appareil et toutes les personnes. Lanceurs ou ne peuvent pas coexister cette antenne ou capteurs avec d'autres.

2.0 RS-L6432S/RS-L6432D RF Special Compliance Notices

The following RF emissions statements apply exclusively to the RS-L6432S/ RS-L6432D 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.

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West Henrietta, NY 14586
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fax: 585.429.1551
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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)

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3.0 Introduction

This document outlines how to get started with the **D3 Engineering DesignCore® RS-Lx432S Radar Sensor**.

3.1 Prerequisites

Operating the sensor will require the following hardware:

- **RS-Lx432S Sensor**
- A suitable LV UART to USB bridge can be obtained from Amazon: https://www.amazon.com/gp/product/B09F6GZGX6

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

- D3 Visualizer: See your downloads on the D3 Web Store.

Optional for reprogramming:

- Uniflash: https://www.ti.com/tool/UNIFLASH (To load firmware to the sensor).

4.0 Interfaces

4.1 J801 Multifunction Connector

This connector is a Molex 53261-0971. The location and orientation pinout is as shown in Figure 1 and pin definitions are in Table 1.

Table 1. J801 Functions

J801 pin	LV UART Mode Function
1	Ground
2	/EXT_RST (into sensor) Pull low to place the sensor in reset.
3	EXT_SOP0 (into sensor) When pulled low during boot the sensor with boot into flash mode. For normal boot this pin should be left floating.
4	UART_RX (into sensor) This should be connected to the LV UART to USB bridge's TX data output
5	Not Connected
6	Not Connected
7	UART_TX (out of sensor) This should be connected to the LV UART to USB bridge's RX data input
8	EXT_SYNC (into sensor)
9	5 VDC IN (into sensor)

150 Lucius Gordon Dr.
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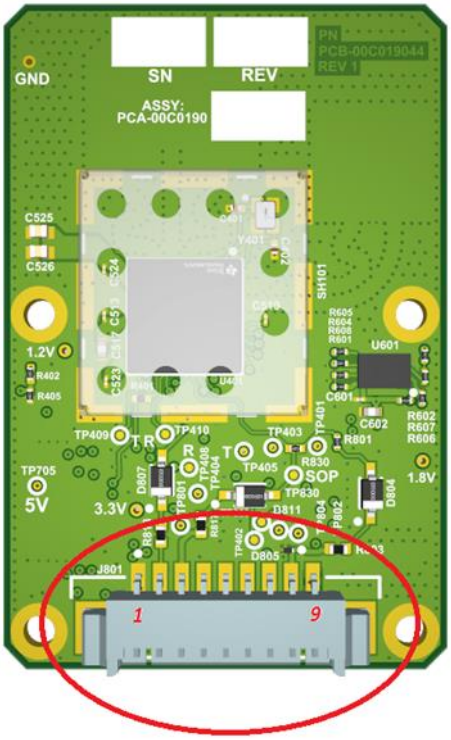

Figure 1

WARNING: The signal lines use 3.3 V logic and are directly connected to the RFIC. No protection is supplied in the circuit.

4.2 LED

There is a single dual-color LED to indicate voltage status:

- YELLOW indicates undervoltage/brownout condition
- GREEN indicates 5V (power good)

150 Lucius Gordon Dr.
West Henrietta, NY 14586
phone: 585.429.1550
fax: 585.429.1551
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5.0 Collecting and Visualizing Data with the RS-Lx432S

5.1 Connections for Operation

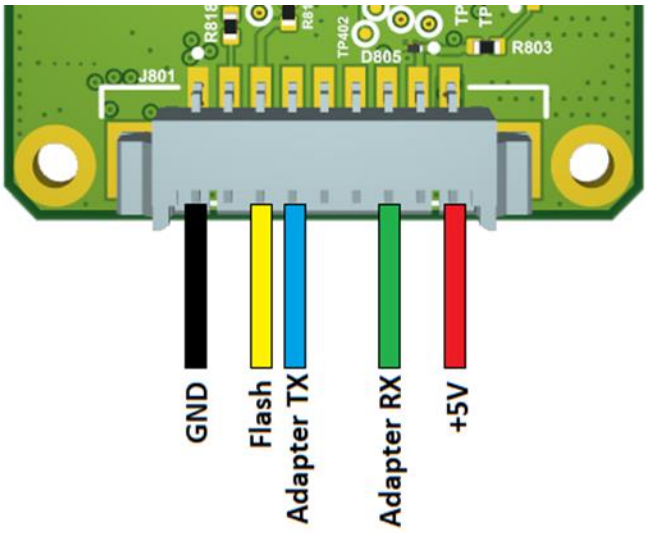

Figure 2: Connections for Operation

5.2 Procedure

With this procedure you can collect and visualize data from the sensor.

1. Ensure Pin 3 of the connector is floating.
2. Apply Power to Pin 9.
3. Verify that the LED is green, indicating power good.
4. Get the D3 Visualizer, P/N 2000127 from your downloads on the D3 Web Store and unzip into a folder.
5. Start the visualizer and set both radar sensor serial ports to the port of your serial interface.
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 11.

150 Lucius Gordon Dr.
West Henrietta, NY 14586
phone: 585.429.1550
fax: 585.429.1551
www.d3embedded.com

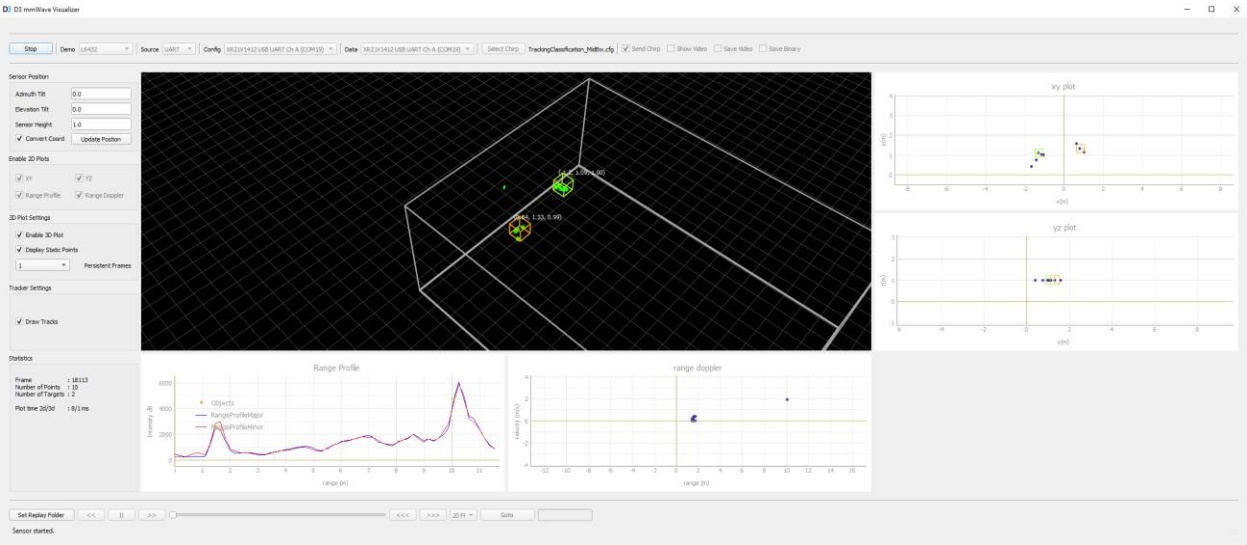

Figure 11. D3 Visualizer Data Display

6.0 Running Demos Provided by Texas Instruments

With the D3 RS-Lx432S 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 to keep the D3 RS-Lx432S 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 Occupancy Monitoring** – Detects people inside a room.

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8. **Onlooker Detection** – Detects someone approaching an office worker from behind.

All of these demos use the binary that is supplied with your RS-Lx432S, 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.

7.0 (Optional) Programming the Sensor

Your sensor will ship with software already programmed, so this procedure is only provided in case you want to reprogram it.

7.1 Connections for Programming

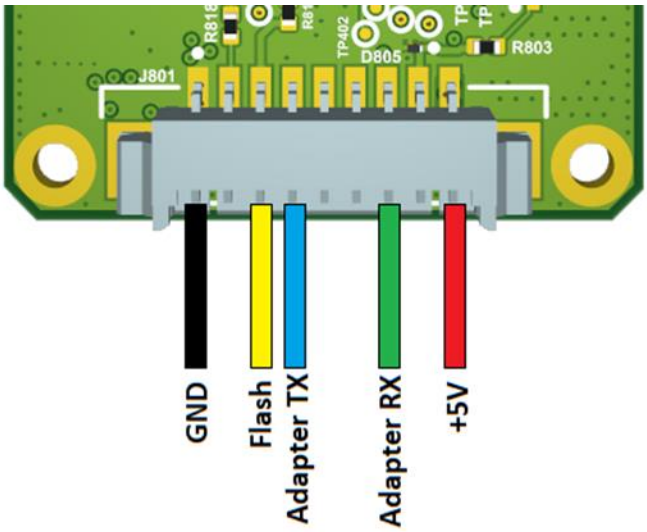

Figure 3: Connections for Programming

7.2 Procedure

1. Ensure any USB cable is disconnected from the radar module (this prevents possible back-feeding).
2. Ground Pin 3 (EXT_SOP0)
3. Apply +5V to the sensor over its supply line (Pin9). (Booting with Pin 3 held low causes the L6432 to boot in firmware flash mode.)
4. Ensure that the LED is Green indicating good power
5. Release Pin 3
6. Connect the SENSOR to the PC
7. Launch Uniflash.
8. Depending on which sensor you have, select from the list of available devices then click Start. (Note: these devices are found in the mmWave category). For example, for the RS-L6432S, select IWRL6432.

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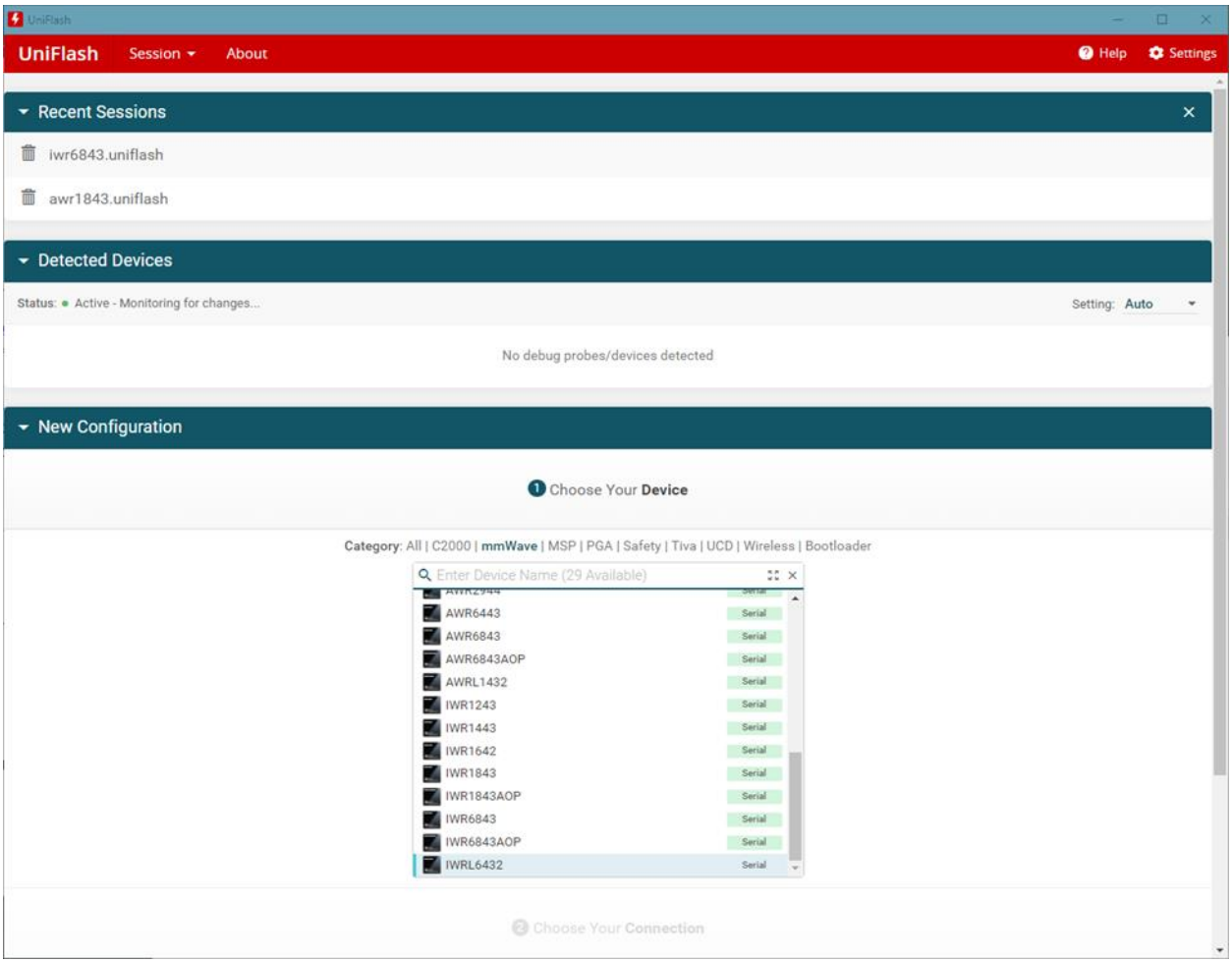

Figure 4: Uniflash configured to program the sensor

9. Set the COM port to which your sensor is attached.

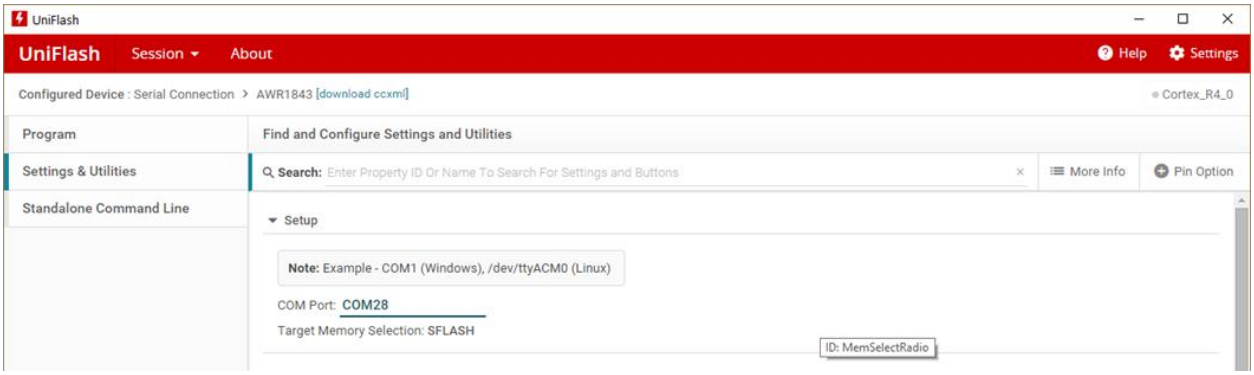

Figure 5: Uniflash COM Port selection (bottom)

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West Henrietta, NY 14586
phone: 585.429.1550
fax: 585.429.1551
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To program the RS-Lx432S, use the binary file <*filename*>.appimage from the "My Account" download. Note, you will need to select all file extensions when browsing for the files.

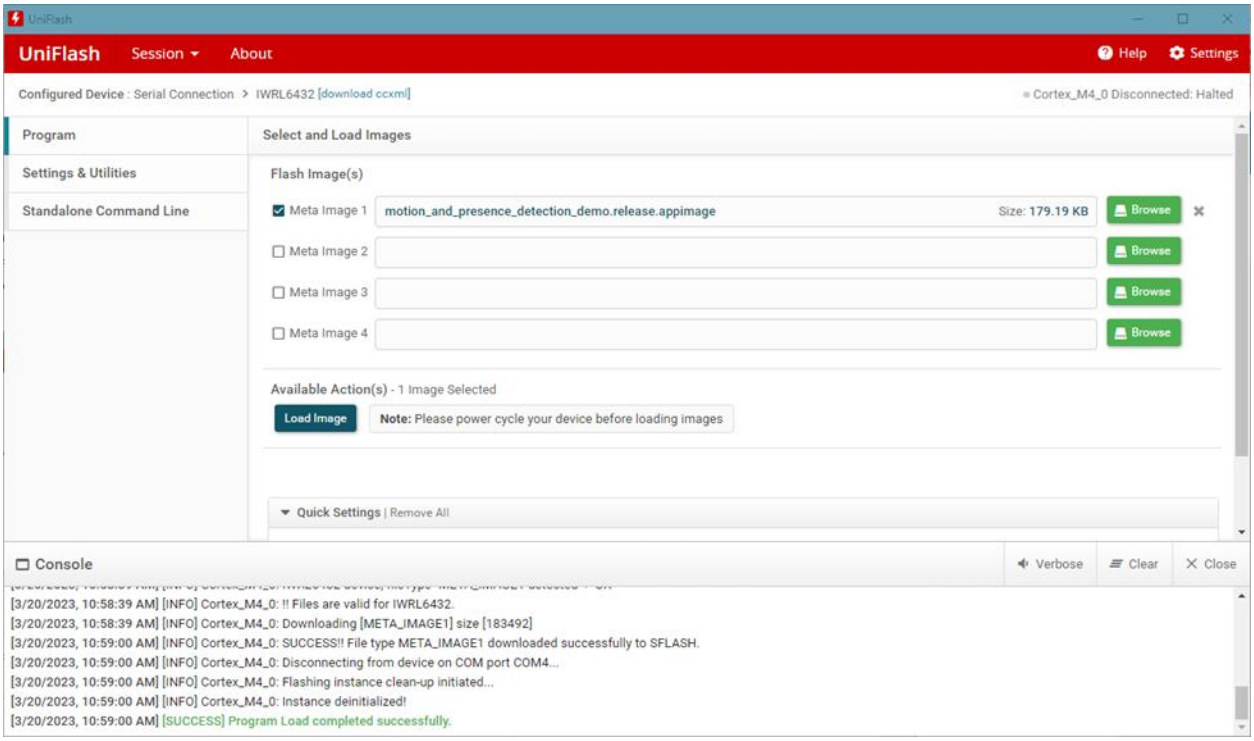

Figure 6: Uniflash configured to program a sensor

10. Once Uniflash has been properly configured, press the **Load Images** button. Wait until the Console displays the message: **[Success] Program Load completed successfully**
11. When the sensor is rebooted (either by power cycling, or by toggling the reset line) the sensor will boot with the new software.