D3 Engineering

Define | Design | Deploy

RS-x843AOPC Quick Start Guide

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1.0 Introduction

This document outlines how to get started with the **D3 Engineering DesignCore® RS-1843AOPC and RS-6843AOPC Radar Sensors**.

1.1 Prerequisites

Operating the sensor will require the following hardware:

- **RS-1843AOPC or RS-6843AOPC Sensor**
- One of these CAN to USB adapters:
  - Peak Systems PCAN-USB CAN FD Adapter
  - Grid Connect CANUSB COM FD Adapter
- A USB to 3.3V UART adapter capable of high data rates such as this Prolific PL2303-based DTECH unit: (https://www.amazon.com/dp/B07R8BQYW1)

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

- Tera Term, available from https://osdn.net/projects/ttssh2/releases/
- If using the Peak Systems PCAN-USB CAN FD Adapter, CAN drivers and PCAN-View software, available from https://www.peak-system.com/PCAN-USB.199.0.html?&L=1.

2.0 Interfaces

2.1 J6 Power Connector

This connector is a Molex 53261-0471. The pinout is as shown in Figure 1. The power supply should be 5 VDC +/- 5% at up to 1.5 A.

IMPORTANT: If using the USB to 3.3 V UART adapter, ensure power is supplied via J6 prior to connecting the USB adapter to the PC or damage could occur.

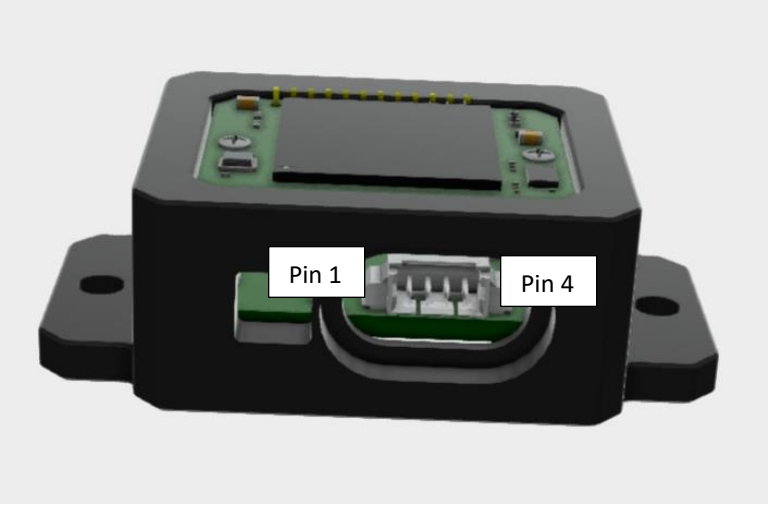

Figure 1. J3 Power and CAN Connection

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The pinout when viewing the sensor radar side up is Pin 1 to the left and Pin 4 to the right.

Table 1. J3 CAN and Power Connector Pinout (Left to Right, Radar Side Up)

Pin No.	Signal	PCAN-USB DB-9 Pin
1	VDD_5V0	N/C
2	CAN_H	7
3	CAN_L	2
4	DGND	3

2.2 SW1 Run/Program Switch

SW 1 is used to select run mode or flash programming mode. This is needed only to reprogram the secondary bootloader. If the secondary bootloader is already programmed, programming the application can be performed via the UART header with Tera Term using the XMODEM protocol or via CAN using the D3 CAN reprogramming utility. Typically, this switch can be left in the Run position.

Flash programming mode is selected by aligning the switch away from the white strip on the switch body.
Run mode is selected by aligning the switch in line with the white strip on the switch body.
The sensor must be reset (power cycled) to enact the switch selection.

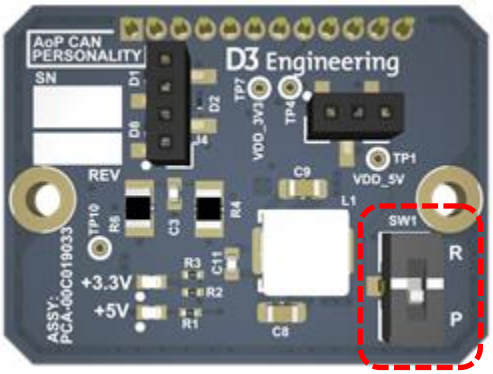

Figure 2. AOP Sensor in Flash Programming Mode

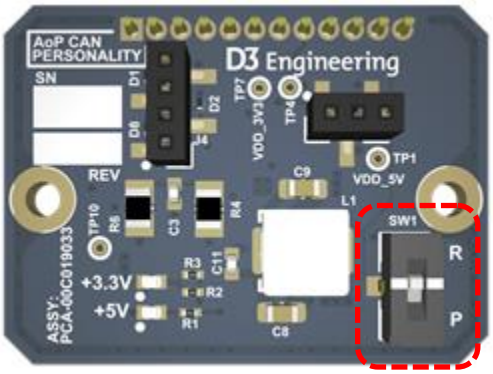

Figure 3. AOP Sensor in Run Mode

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2.3 J10 Sync Header

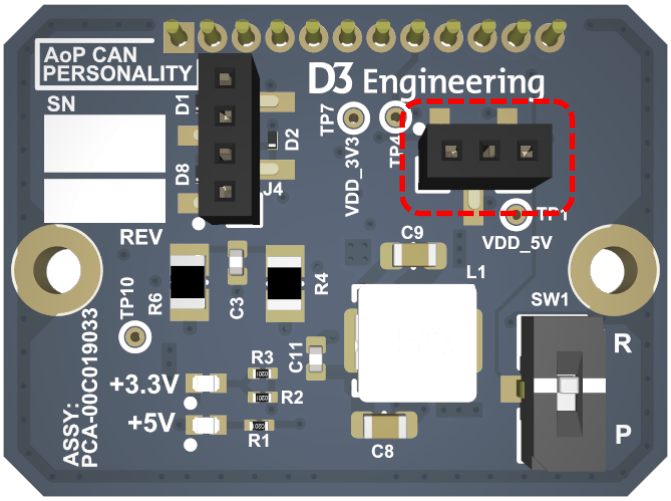

Figure 4. J10 Sync Header

The pin definitions from left to right in Figure 4 are given in Table 2. Note that the functions are selected by resistor population on the AOP radar board, not the USB board. See Figure 5.

IMPORTANT: If using the Sync Header, ensure power is supplied via J6 prior to applying voltage to the SYNC_IN signal on J10 or damage could occur.

Table 2. J10 Functions

J10 Pin	Default Function – RFIC Ball (Resistor Population)	Alternate Function – RFIC Ball (Resistor Population)
1	SPI_MOSI_1 – F2 (R40 in, R39 out)	SYNC_IN – U12 (R40 out, R39 in)
2	GND	GND
3	SPI_MISO_1 – D1 (R42 in, R41 out)	AR_SOP_1/SYNC_OUT – M3 (R42 out, R41 in)

These signals use 3.3 V logic and are directly connected to the RFIC. No protection is supplied in the circuit.
Note: SYNC_OUT is multiplexed with SOP1, and therefore should not be driven high or low during reset.

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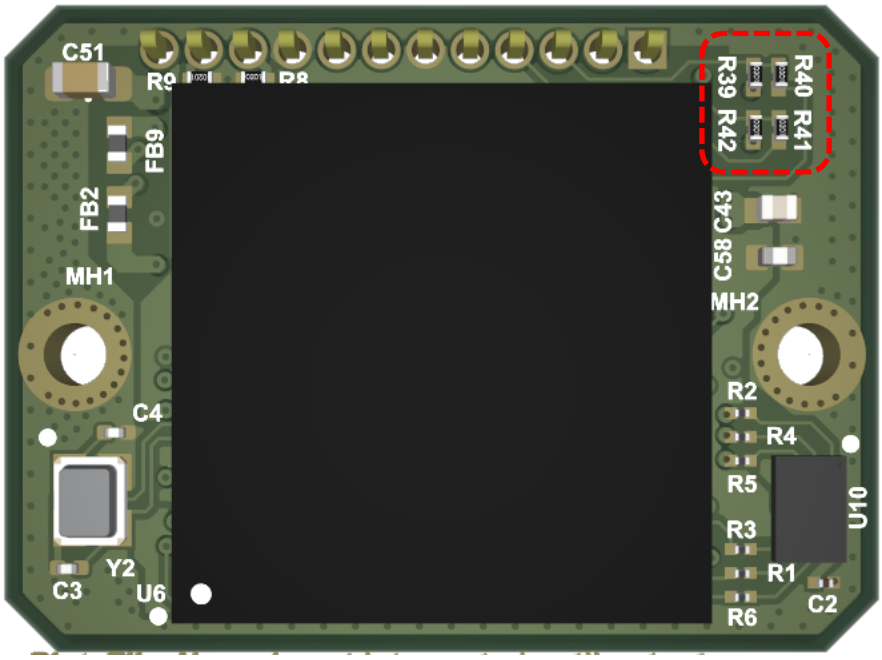

Figure 5. J10 Pin Function Selection Resistor Locations

2.4 J4 UART Header

The UART header provides a bidirectional interface with the command line (UART_RS232_TX/UART_RS232_RX) and a one-way output from the sensor for data (UART_AR_AUX). The order of the UART_RS232_TX and RX pins depends on the board revision. Please note that these signals are 3.3V logic level, not RS-232 levels.

IMPORTANT: If using the USB to 3.3 V UART adapter, ensure power is supplied via J6 prior to connecting the USB adapter to the PC or damage could occur.

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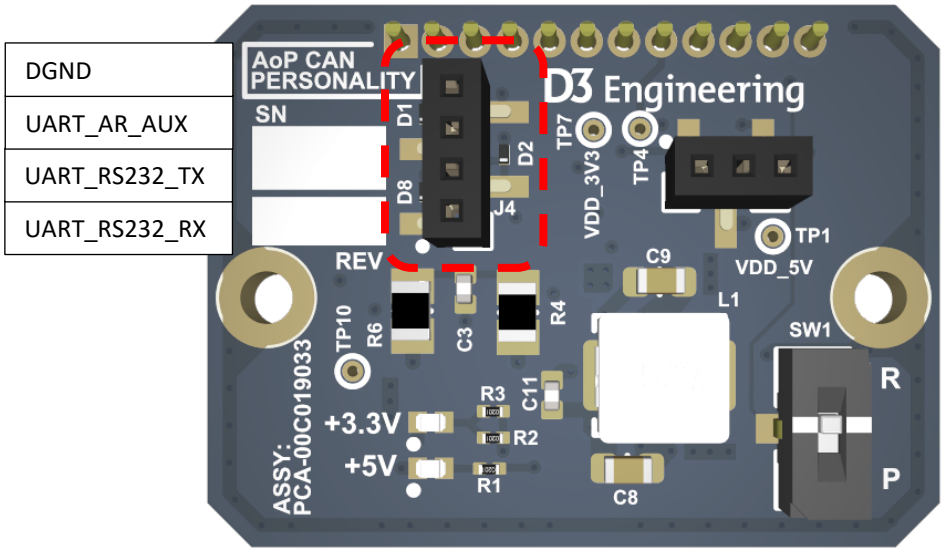

Figure 6. J3 UART Header – Rev 1.2 and Earlier

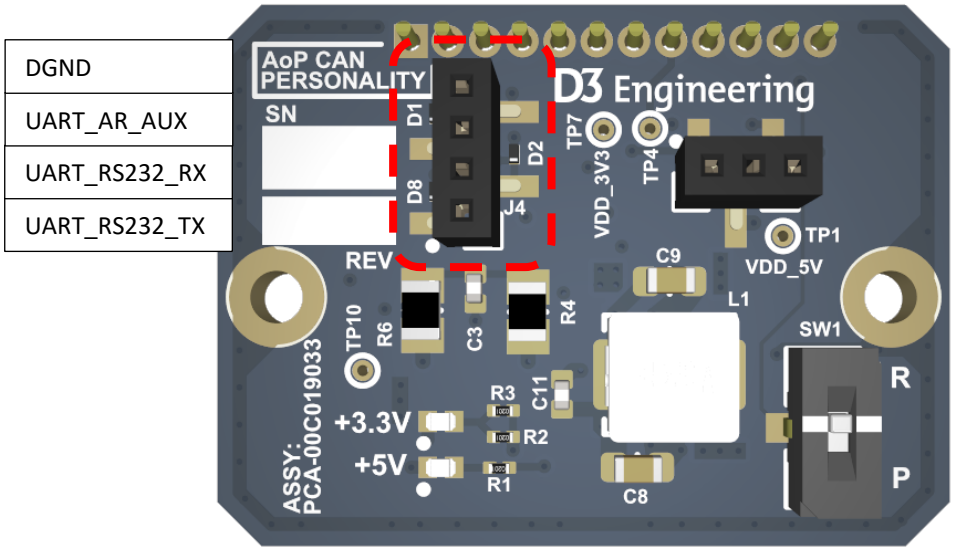

Figure 7. J3 Programming Header – Rev 2 and Later

J4 can be used to both program the radar chip, and to see radar detection data over UART.

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Table 3 J3 Pin Definitions

Pin	Signal	Function with USB Personality board
1	UART_RS232_TX	Receive Data In from USB to serial adapter. Note: this is a 3.3 V logic signal, not RS-232 levels.
2	UART_RS232_RX	Transmit Data Out from USB to serial adapter. Note: this is a 3.3 V logic signal, not RS-232 levels.
3	UART_AR_AUX	Radar Point Cloud Data Output. Note: this is a 3.3 V logic signal, not RS-232 levels.
4	GND	Board Ground

2.5 LEDs

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

- WARN illuminates if the sensor is starved of voltage.
- 3V3 illuminates if 3.3 V power is active.
- 5V0 illuminates if 5.0 V power is present.

2.6 Internal Header

The internal header connects the CAN Personality board with the AOP sensor board. This header is a 0.050" center 12-pin header.

Table 4. Internal Header Pinout

Pin	Signal	Function with USB Personality board
1	SPI_CS_1	Not Connected
2	SPI_CLK_1	Not Connected
3	SYNC_IN/SPI_MOSI_1	Sync input for frame triggering
4	AR_SOP1/SYNC_OUT/SPI_MISO1	Sync output for frame triggering
5	AR_SOP2	Run/Program Selection
6	AR_3V3	3.3 V power
7	VDD_5V0	5 V power
8	AR_RESET_N	sensor reset
9	GND	Ground
10	UART_RS232_RX	3.3 V Level (Not RS-232) UART TX Data Out of sensor
11	UART_RS232_TX	3.3 V Level (Not RS-232) UART RX Data Into sensor
12	UART_AR_AUX	3.3 V Level (Not RS-232) UART radar data out

3.0 Communications Verification

Once the CAN application is running on the RS-x843AOPC, object data is sent over CAN. This operation is tested by (a) running the PCAN-View Application with the PCAN-USB FD or (b) using Tera Term with the simpler CANUSB COM FD. The RS-x843AOPC must be connected to power and CAN via the 4-pin Molex connector and cable assembly as shown previously in Figure 1.

The pinout of the PCAN-USB FD and CANUSB COM FD DB-9 connectors are identical as shown in the figure below. Do not connect other pins on the connector.

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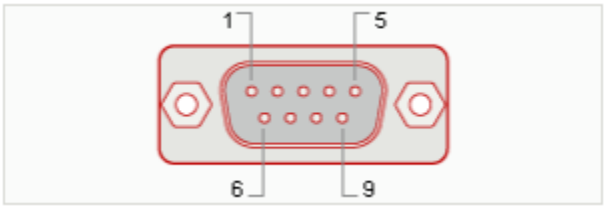

PIN	Function
2	CAN-L
3	CAN-Ground
7	CAN-H

Figure 8. PCAN-USB FD or CANUSB COM FD Connector Pinout

Connect the PCAN-USB FD or CANUSB COM FD pins to the RS-x843AOPC.

Once the RS-x843AOPC is connected to the adapter, monitor the data output from the RS-x843AOPC following one of the following methods below.

3.1 Communication Verification Using PCAN-USB FD

Setup PCAN View like so:

Figure 9. PCAN-View Application

Observe messages are received by PCAN-View. Message types are enumerated in Table 5. Cycle time and Data will vary.

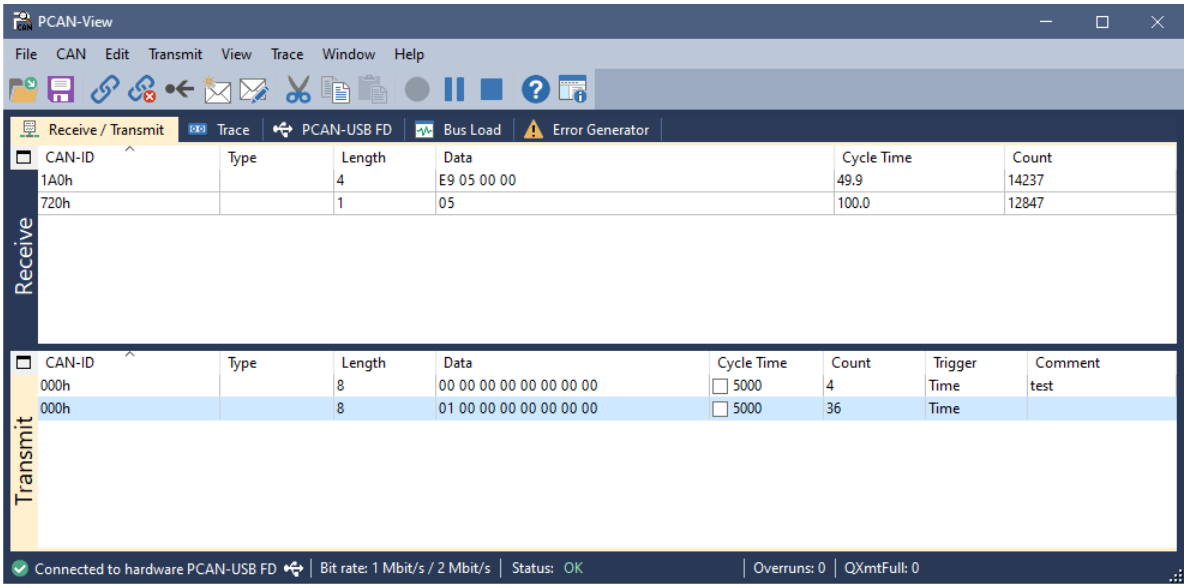

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Figure 10. PCAN-View Application Data

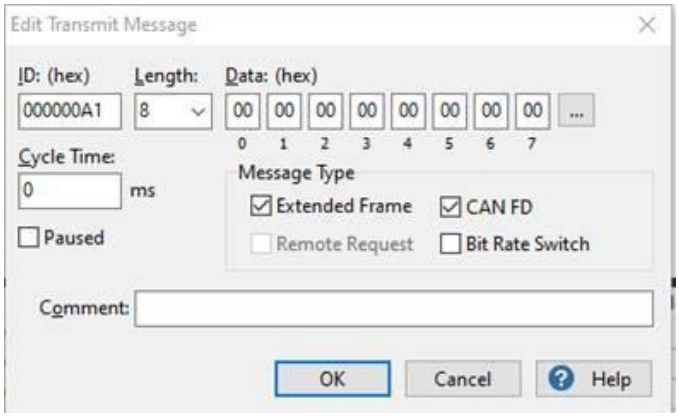

Figure 11. PCAN-View Application Configuration

Table 5. CAN Message Types

Hex ID	Message Type
B1	CAN_MESSAGE_MMWDEMO_PADDING
C1	CAN_MESSAGE_MMWDEMO_HEADER
D1	CAN_MESSAGE_MMWDEMO_DETECTED_POINTS
D2	CAN_MESSAGE_MMWDEMO_RANGE_PROFILE
D3	CAN_MESSAGE_MMWDEMO_NOISE_PROFILE
D4	CAN_MESSAGE_MMWDEMO_AZIMUTH_STATIC_HEAT_MAP
D5	CAN_MESSAGE_MMWDEMO_RANGE_DOPPLER_HEAT_MAP
D6	CAN_MESSAGE_MMWDEMO_STATS
D7	CAN_MESSAGE_MMWDEMO_SIDE_INFO
D8	CAN_MESSAGE_MMWDEMO_TEMPERATURE

The contents of the messages is described in the mmWave SDK User Guide at https://www.ti.com/tool/MMWAVE-SDK.

3.2 Communication Verification Using CANUSB COM FD

Using the CANUSB COM FD requires one configuration adjustment to prevent Windows from thinking the adapter is a mouse (which creates erratic behavior). Do these steps before you connect the CAN adapter to the UUT, but after you connect the adapter to the PC.

Go into Device Manager and find the adapter (COM10 in this case).

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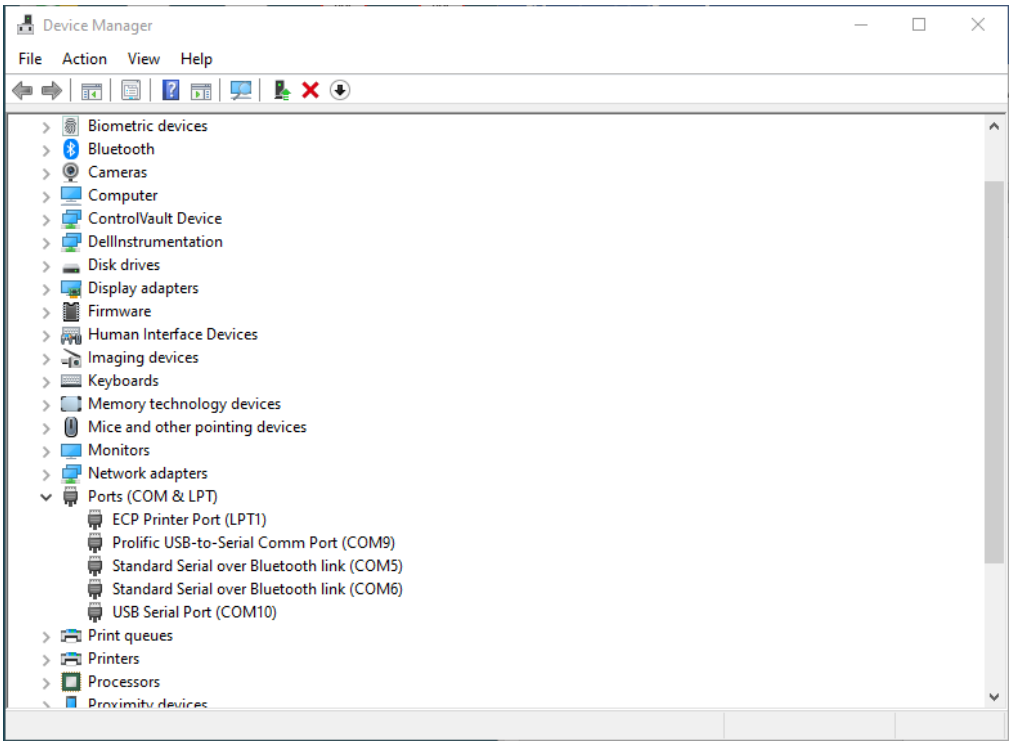

Figure 12. CANUSB COM FD Device

Right Mouse over the device for the adapter and select Properties.

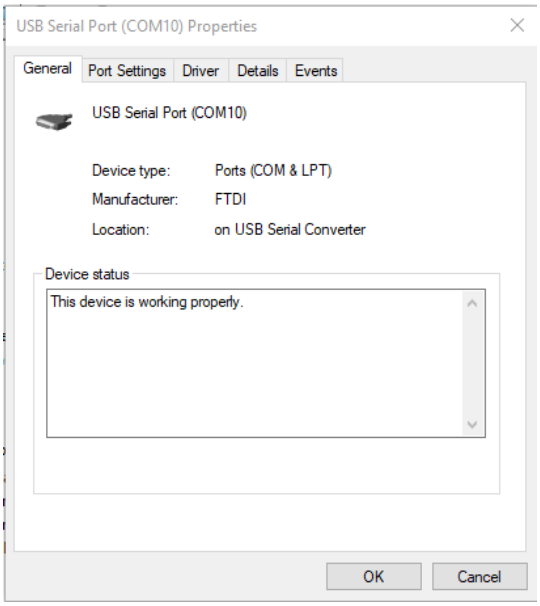

Figure 13. CANUSB COM FD Device Properties

Click Port Settings.

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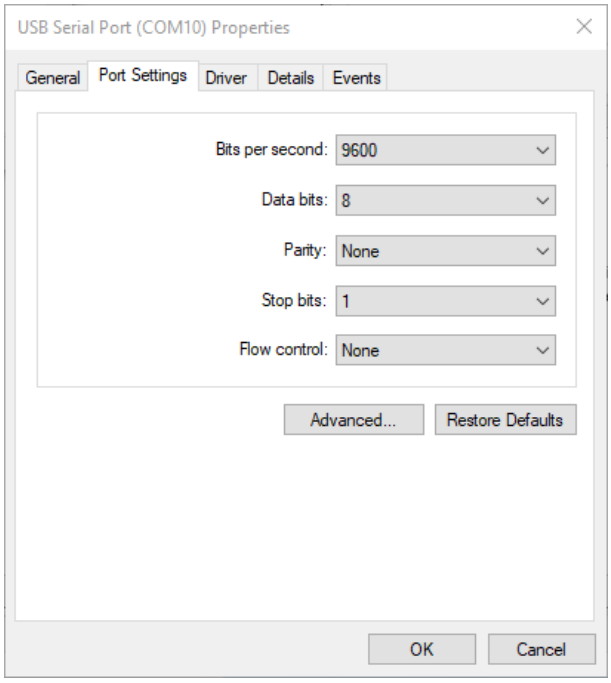

Figure 14. CANUSB COM FD Device Properties

Click Advanced.

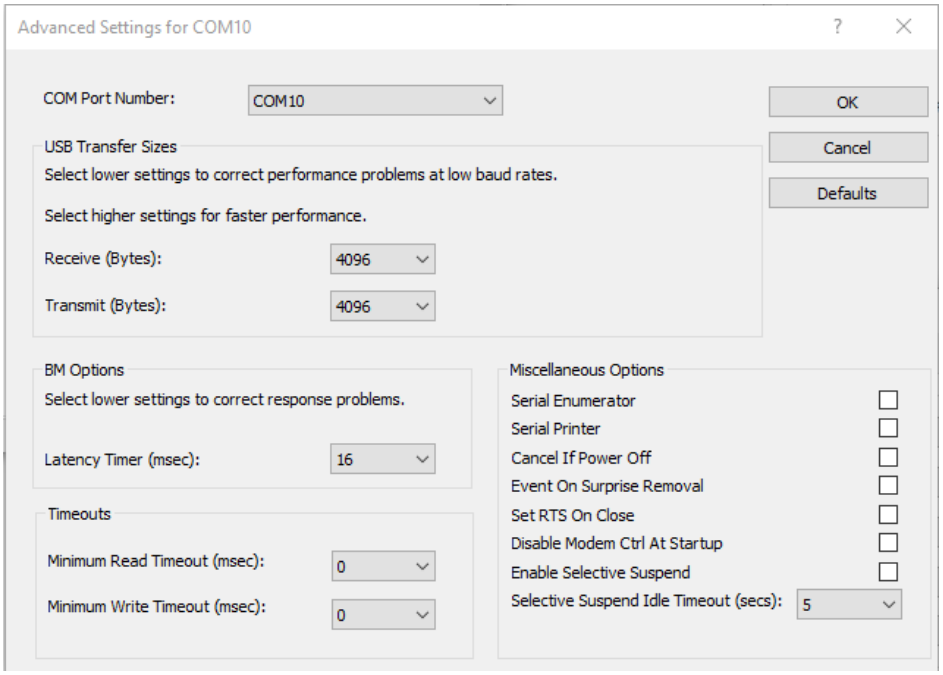

Figure 15. CANUSB COM FD Device Properties

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Make sure “Serial Enumerator” is unchecked as shown above.

Click Ok on each of the windows and apply the settings.

To verify CAN communications, connect the UUT to the CAN adapter as described above. The setup will look something like Figure 16. Note the 120 Ohm terminating resistor that must be added. Use Tera Term to connect to the CANUSB COM FD as shown in Figure 17.

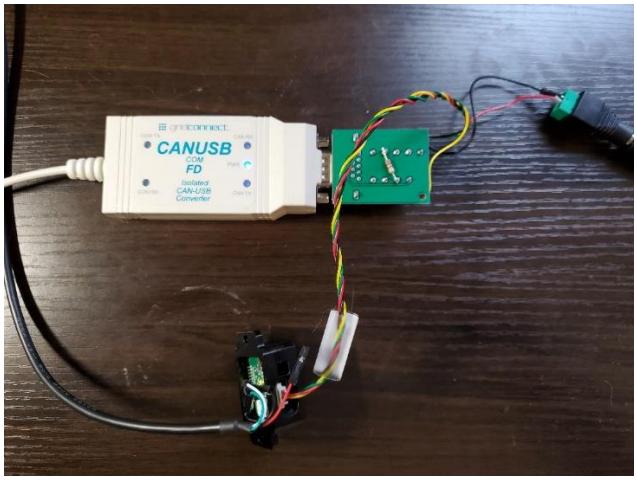

Figure 16. CANUSB COM FD Adapter Connection

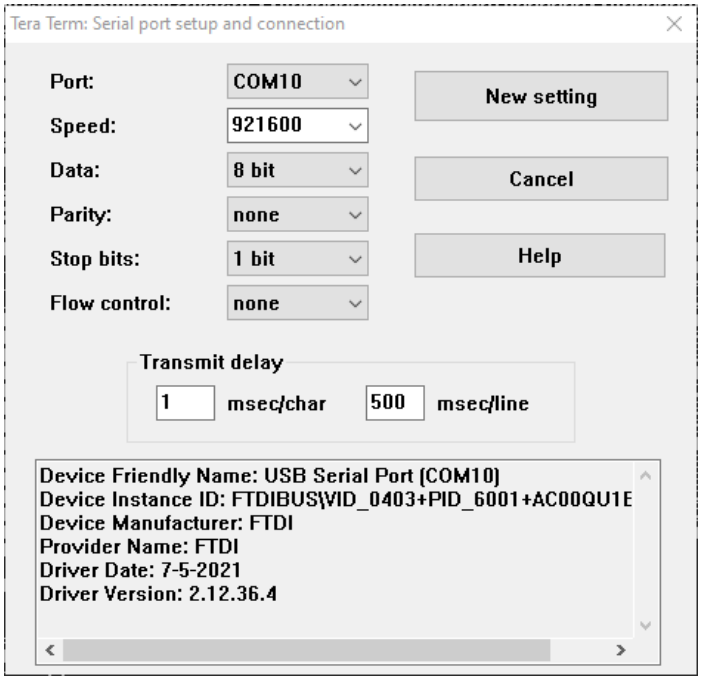

Figure 17. Tera Term Setup for CANUSB COM FD Adapter

Press the configuration button on the adapter momentarily to enter config mode.

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A “>” prompt appears in the Tera Term window.

Enter “config”, “can”, “baud 500000”, and “FDbaud 2000000”.

Use “show” to verify the configuration as shown in Figure 18.

Type “exit” to get back to the “config>” menu.

Type “save” to safe the configuration.

IMPORTANT: You must save the configuration from the “config>” prompt after exiting the CAN configuration submenu. This will be retained so it only needs to be done once.

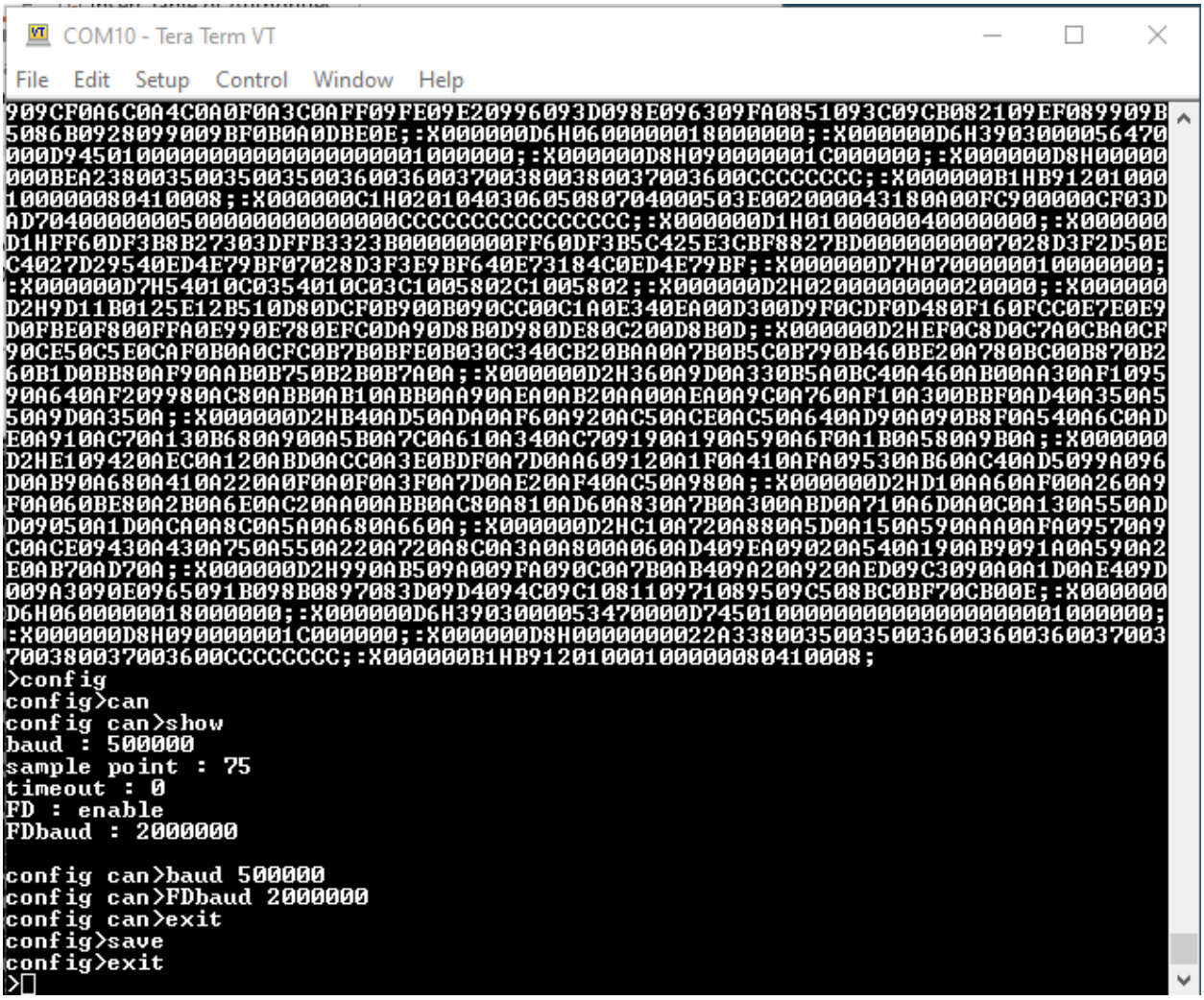

Figure 18. CANUSB COM FD Configuration

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Once the configuration is saved, type “exit” to exit to the main “>” menu, and “exit” again to return to normal operation.

Observe the data output streaming, which looks like the top of Figure 18.

The message types are given in Table 5**Error! Reference source not found.**.

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4.0 Appendix – Secondary Bootloader Programming

This procedure programs the secondary bootloader onto the device and verifies the Serial/UART connection.

IMPORTANT: If using the USB to 3.3 V UART adapter, ensure power is supplied via J6 prior to connecting the USB adapter to the PC or damage could occur.

1. Connect the Prolific USB to 3.3 V UART adapter as shown in Figure 19.

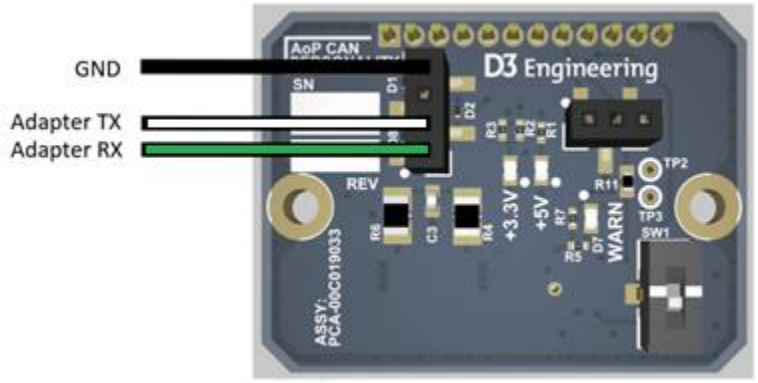

Figure 19. AOP Sensor USB to UART Connection – Rev 1.2 and Earlier

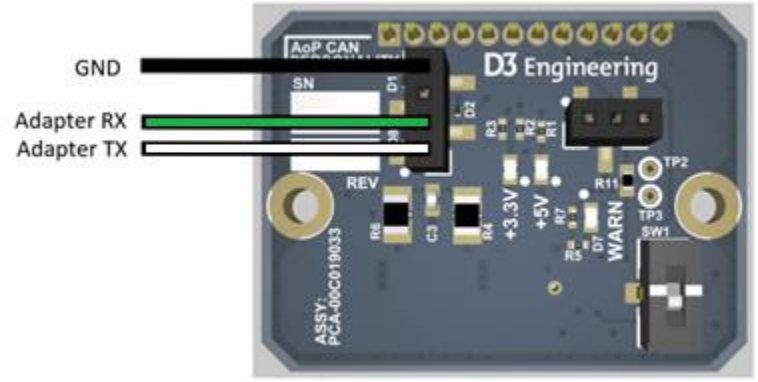

Figure 20. AOP Sensor USB to UART Connection – Rev 2 and Later

2. Place the RS-x843AOPC into flash mode by setting SW1. Use the switch to connect pins 1 and 2 to place the RS-x843AOPC into flash mode as shown below.

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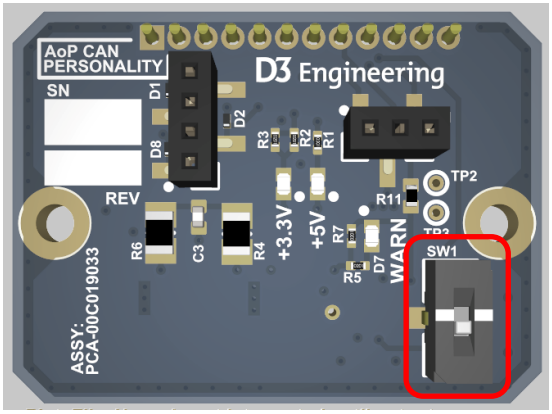

Figure 21. AOP Sensor in Flash Mode

3. Supply power to complete the transition to flash mode.
4. Connect the RS-x843AOPC to the PC via the USB to 3.3 V UART adapter.
5. Launch Uniflash.
6. Click mmWave.
7. Select AWR1843AOP, IWR6843AOP or AWR6843AOP from the list of available devices then click Start.

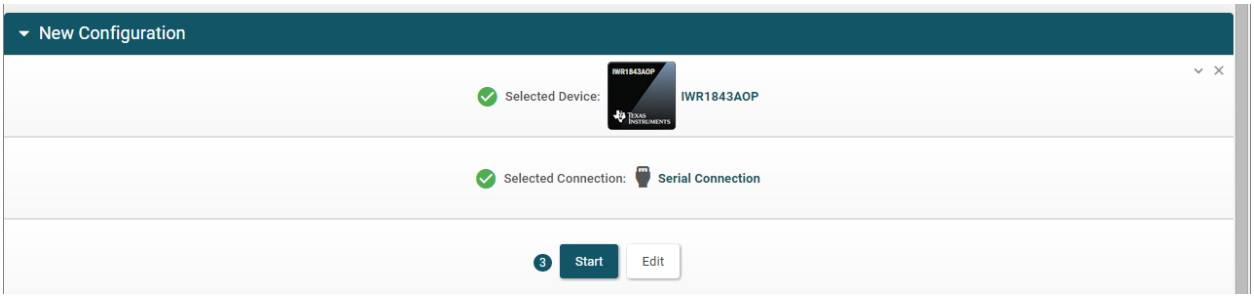

Figure 22. Uniflash Session Starting

8. Identify the COM port using Windows Device Manager. Use the COM port number for the Prolific USB-to-Serial adapter as identified in the Windows Device Manager (Figure 23). Enter this COM port number in the Uniflash COM Port selection (Figure 24).

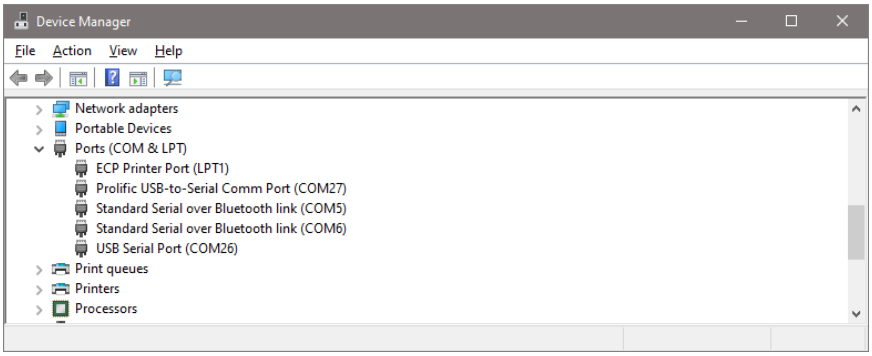

Figure 23. Windows Device Manager

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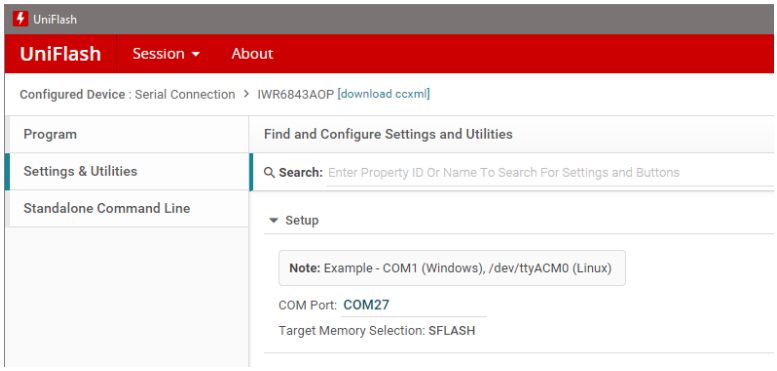

Figure 24. Uniflash COM Port Selection

9. Program the RS-x843AOPC, with the correct Secondary Bootloader Image.
   a. The RS-1843AOPC (1001596) gets 2000100, SW, CAN SBL, AWR1843AOP.
   b. The RS-6843AOPC (1001594) gets 2000101, SW, CAN SBL, IWR6843AOP.
   c. The RS-6843AOPCA (1001609) gets 2000101, SW, CAN SBL, IWR6843AOP.

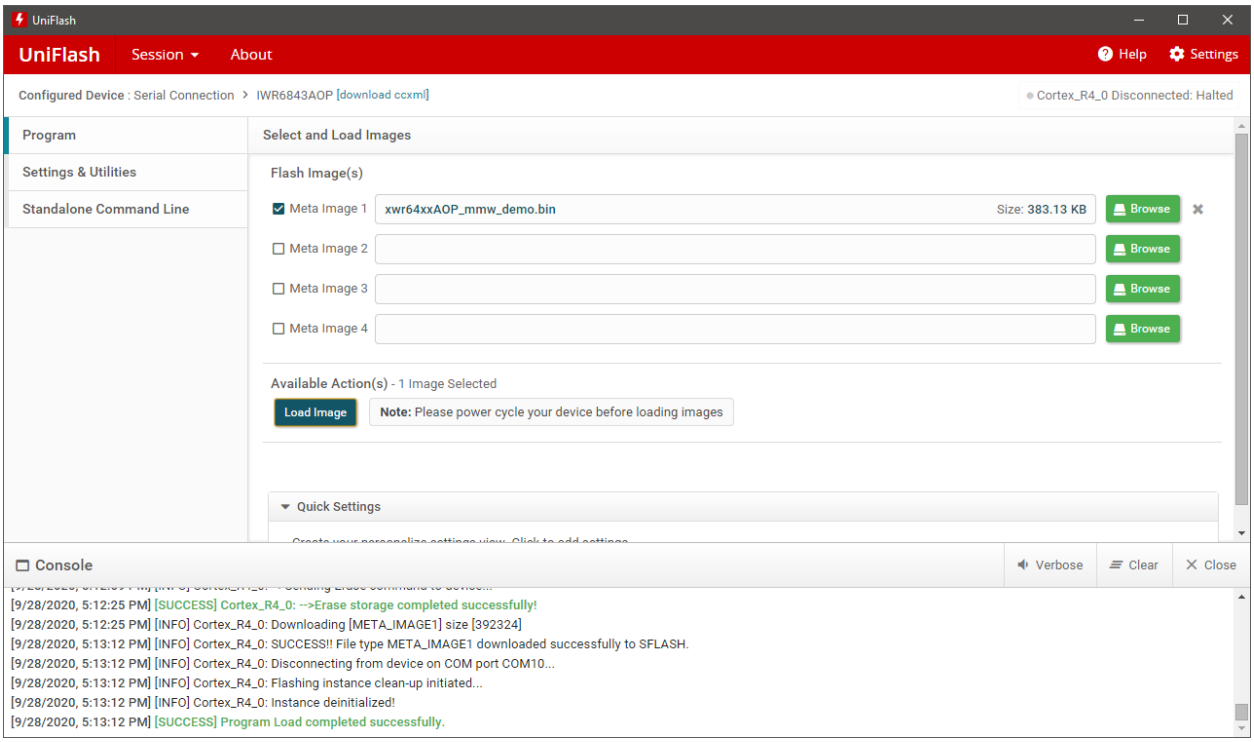

Figure 25. Uniflash Configured to Program a RS-x843AOPC

10. Once Uniflash has been properly configured, press the Load Image button. Wait until the Console displays the message: [Success] Program Load completed successfully.
11. Place the RS-x843AOPC into run mode by setting SW1. Use the switch to connect pins 2 and 3 to place the RS-x843AOPC into run mode as shown below.
12. Connect Tera Term to observe the console output from the UART.

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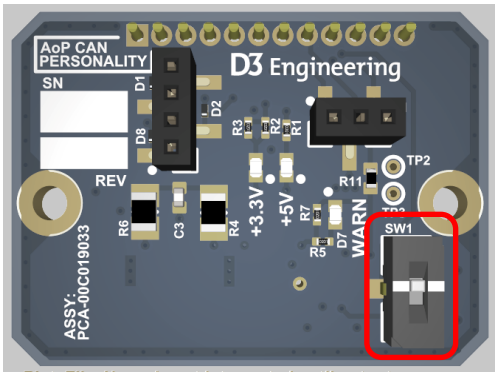

Figure 26. AOP Sensor in Run Mode

13. Cycle power to complete the transition to run mode. The RS-x843AOPC is now running the Secondary Bootloader so the CAN application can be programmed.
14. Verify the console displays the Secondary Bootloader banner as shown in the figure below.
15. Press 's' to stop the countdown in preparation for the next step.

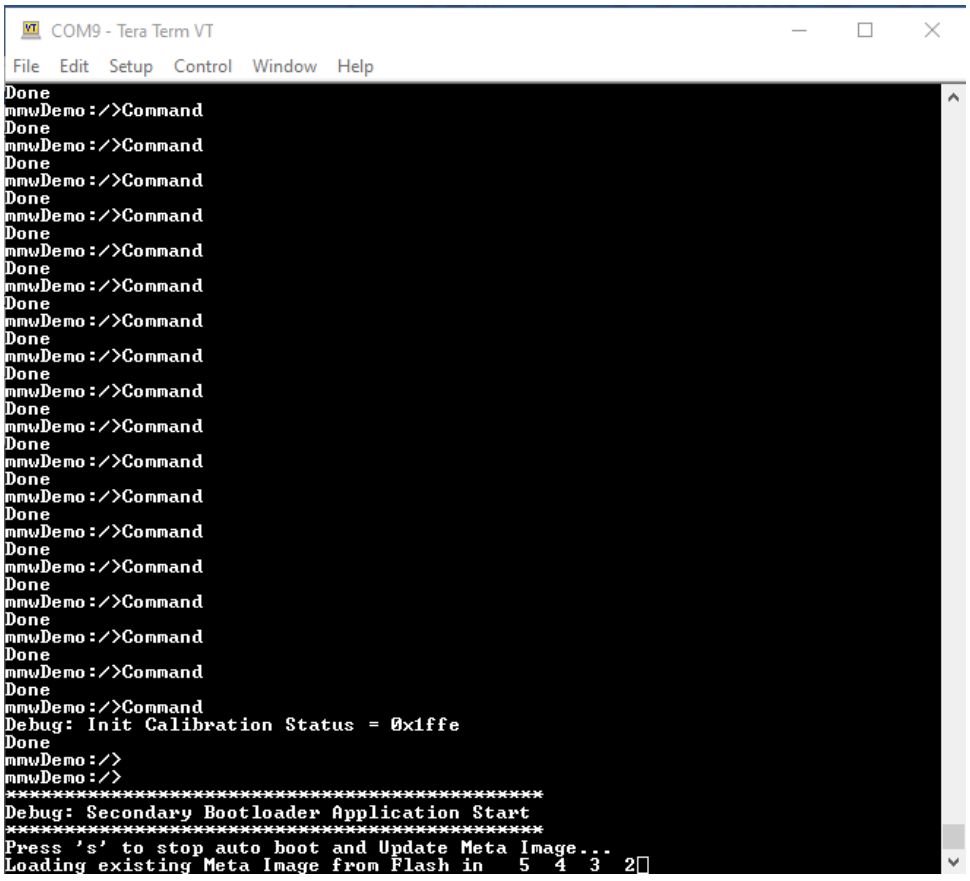

Figure 27. Console Running Secondary Bootloader

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5.0 Main Application Programming

You can program the main application via UART or CAN. Only one of the two methods (5.1 or 5.2) needs to be exercised.

5.1 Main Application Programming with XMODEM via UART

This procedure uses Tera Term to download firmware to the device using XMODEM. The Peak PCAN adapter is NOT needed for this method. To use this method, follow these steps:

1. Obtain the correct firmware image for the sensor you have.
    a. The RS-1843AOPC (1001596) gets 2000103_SW_CAN_App_IWR1843AOP "xwr18xx_mmw_demo_aop.bin".
    b. The RS-6843AOPC (1001594) gets 2000104_SW_CAN_App_IWR6843AOP "xwr68xx_mmw_demo_can_hcc.bin".
    c. The RS-6843AOPCA (1001609) gets 2000104_SW_CAN_App_IWR6843AOP "xwr68xx_mmw_demo_can_hcc.bin".
2. Use Tera Term to verify the secondary bootloader is starting and awaiting programming over UART by observing the countdown seen in Figure 28 below.

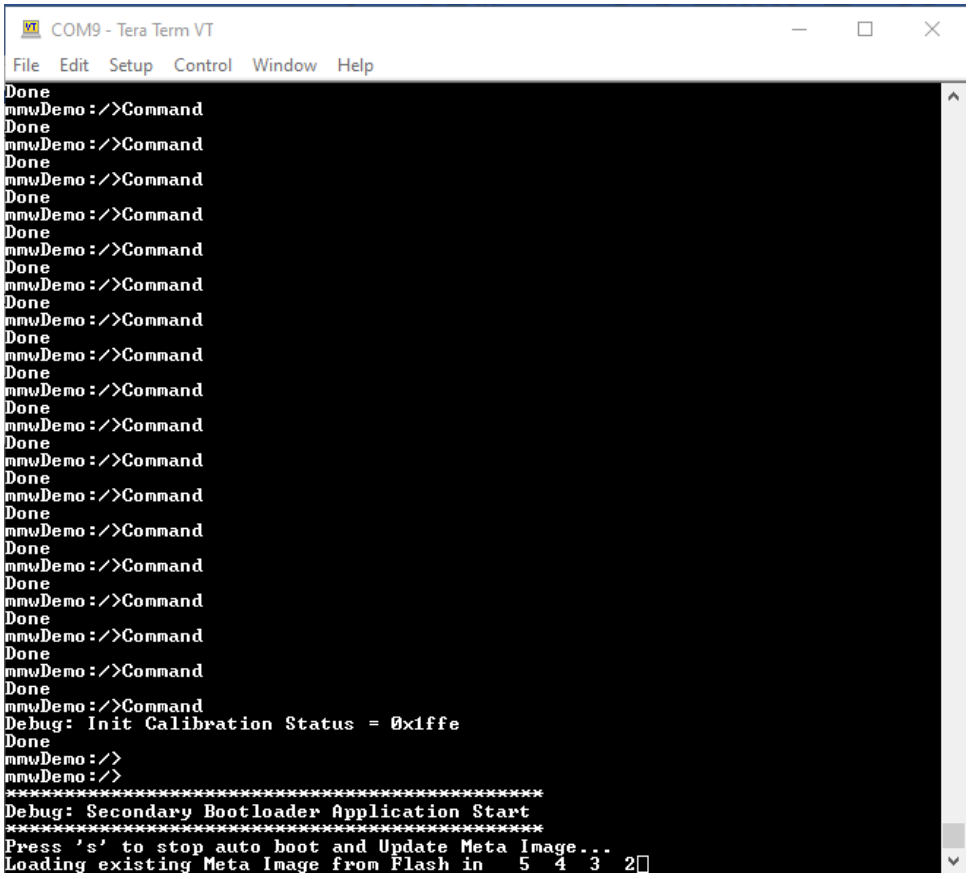

Figure 28. Secondary Bootloader Awaiting Application Programming

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3. Press ‘s’ to stop auto boot if you didn’t already do so.
4. Initiate the XMODEM file transfer as shown in Figure 29 below.

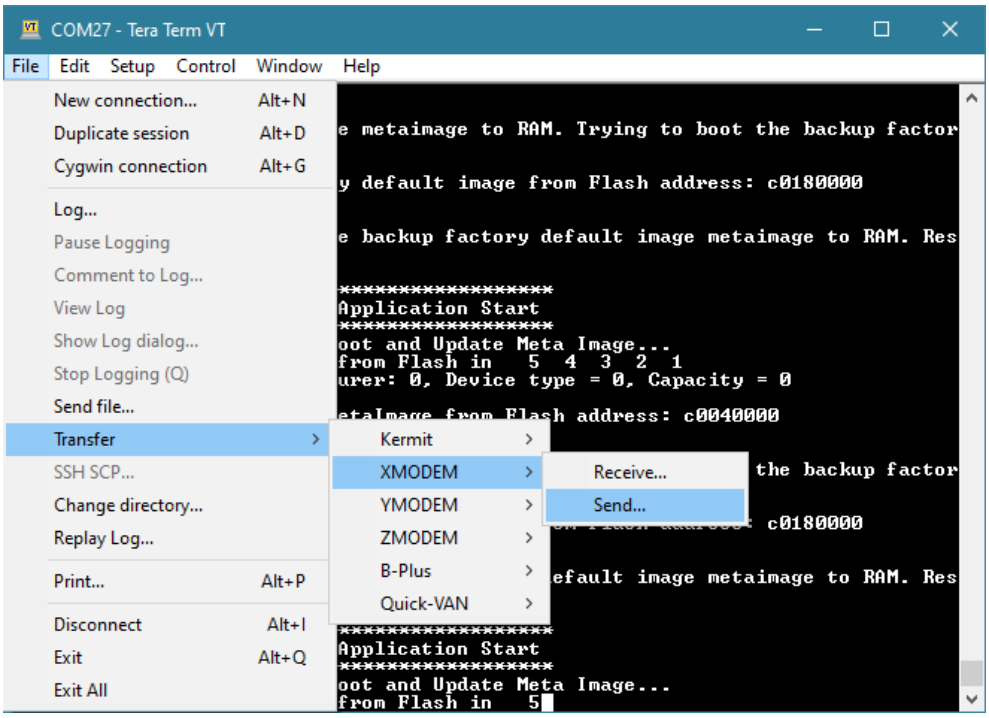

Figure 29. Initiating XMODEM Download with Tera Term

5. Select the correct binary as indicated earlier in this document.
6. If the transfer does not begin instantly, try again. If you don’t catch the bootloader at the right moment, it restarts and the second attempt will succeed. You will know programming is underway when you see the dialog show in Figure 30 below.

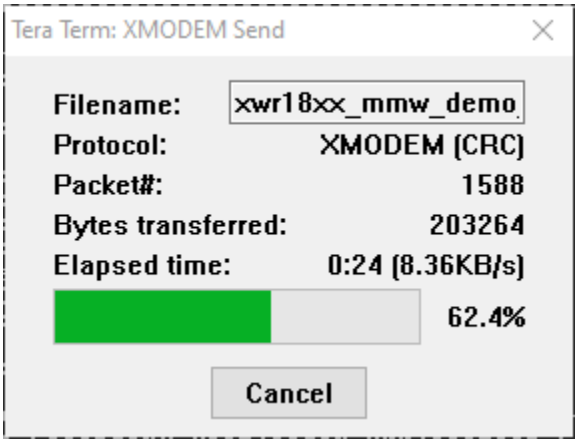

Figure 30. XMODEM Transfer Underway

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7. When programming completes, the device will automatically boot to the new firmware.
8. Verify that the device has booted properly by observing the Tera Term output shown in Figure 31 below. There must be no error indicated in the output. Look for the “Debug: Init …” message followed by Done ONLY.

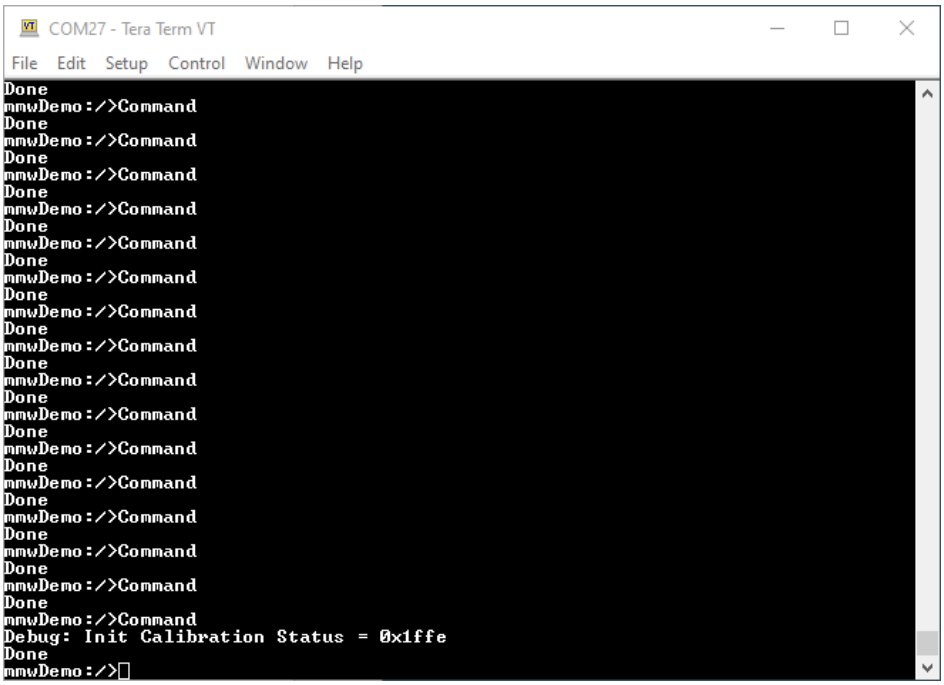

Figure 31. Device Booted to New Firmware

9. Verify that the unit boots the same way when you cycle power. Note, you will have to wait for the timer to count down before it starts.

5.2 Main Application Programming via CAN

This procedure uses PCAN (Peak) USB-CANFD adaptor to download firmware to the device. You do not need to complete this step if you already programmed using XMODEM.

To use this application with Peak PCAN adaptor follow these steps:

1. Copy PCANBasic.dll to 'C:\windows\SysWOW64' directory (Download from PCAN-Basic API).
2. Create a directory on drive C as: “C/users/<user>/CAN testing. Copy "CAN_Metaimage_Flasher.exe” and the .bin file from the list below into this directory.

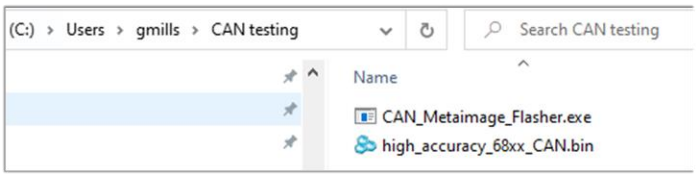

Figure 32. Files in CAN Testing Folder

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a. The RS-1843AOPC (1001596) gets 2000103_SW_CAN_App_IWR1843AOP "xwr18xx_mmw_demo_aop.bin".
b. The RS-6843AOPC (1001594) gets 2000104_SW_CAN_App_IWR6843AOP "xwr68xx_mmw_demo_can_hcc.bin".
c. The RS-6843AOPCA (1001609) gets 2000104_SW_CAN_App_IWR6843AOP "xwr68xx_mmw_demo_can_hcc.bin".

3. Open a command line prompt in the same directory containing the above. The easiest way to do this is with the keyboard command "shift-mouse right click" – "Open PowerShell window here".

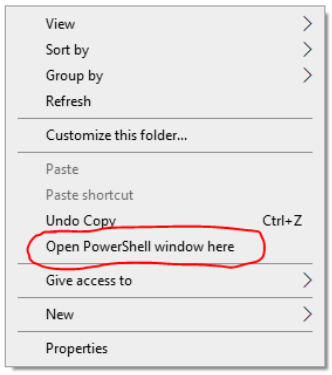

Figure 33. Opening PowerShell

4. Run the PC based CAN Command Line Instruction (CLI) based application. Press "y" when prompted, and the let the program run until completion.

.\CAN_Metaimage_Flasher.exe .\xwr18xx_mmw_demo_aop.bin
Or
.\CAN_Metaimage_Flasher.exe .\xwr68xx_mmw_demo_can_hcc.bin

```
PS C:\Users\gmills\CAN testing>
PS C:\Users\gmills\CAN testing>
PS C:\Users\gmills\CAN testing> .\CAN_Metaimage_Flasher.exe .\high_accuracy_68xx_CAN.bin
Number of cmd line arg = 2
argument 0       = C:\Users\gmills\CAN testing\CAN_Metaimage_Flasher.exe
argument 1       = .\high_accuracy_68xx_CAN.bin
Meta Image Size = 499460
CAN FD initialized
total chunk = 7804
last_chunk_size = 4
Stop autoboot(y/n)? y
Waiting for flash to erase....
Sending file
File Sent
PS C:\Users\gmills\CAN testing>
```

Figure 34. Running CAN_Metaimage_Flasher.exe in PowerShell

5. If there is no error is the application Meta-Image, the application will start executing automatically. Refer to Figure 31.