Quick Start Guide Sense2GoL Module

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1. Overview
2. Development Tools Installation
3. Flashing and Debugging
4. Configuration/Customization
5. GUI
6. UART data streaming

1 Overview

2 Development Tools Installation

3 Flashing and Debugging

4 Configuration/Customization

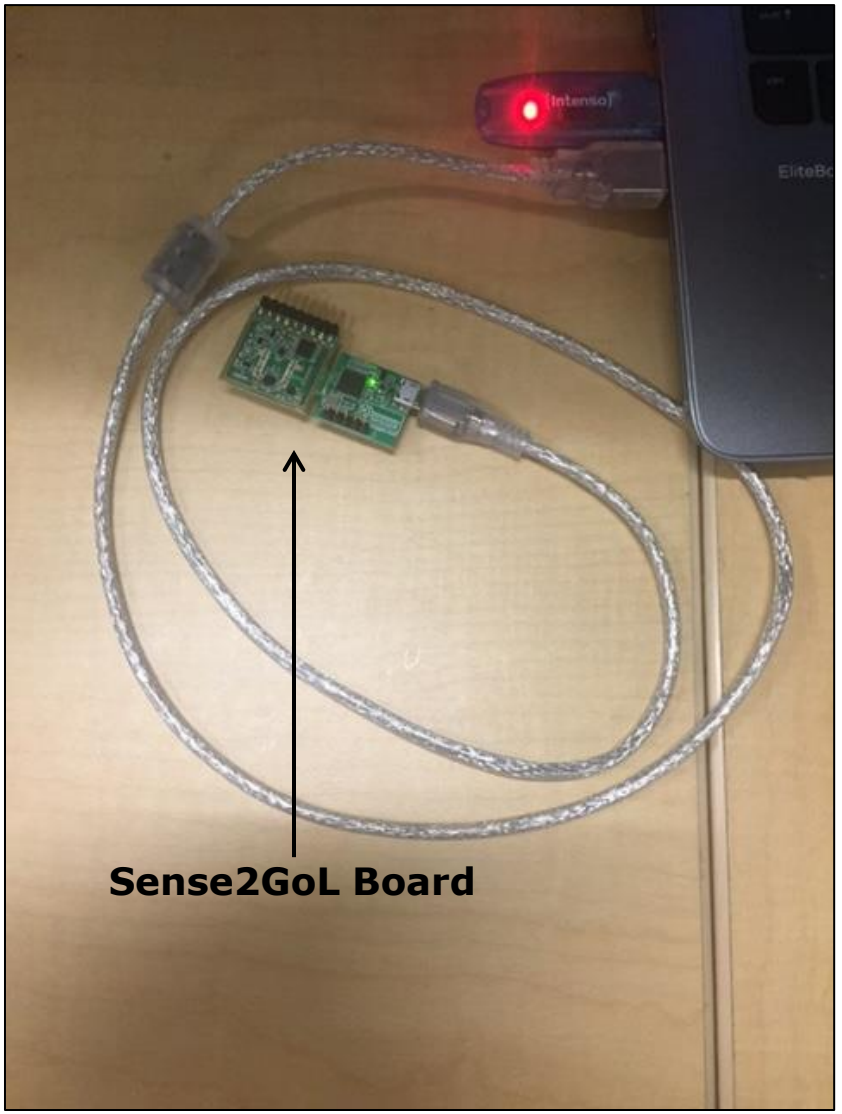
5 GUI

6 UART data streaming

Contents of Sense2GoL Development Kit

- Provided kit should contain
  - Sense2GoL 24GHz RADAR module
  - USB-to-micro-USB cable
  - USB stick containing firmware DAVE Project for Sense2GoL + GUI

- Connect hardware as seen in picture



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6 UART data streaming

Tools Installation

Flashing Tools

1. XMC Flasher
2. XMC Serial Port Drivers

Visualization Tool

1. Micrium uC/Probe GUI

Firmware Development Tools

1. DAVE
2. Segger J-Link

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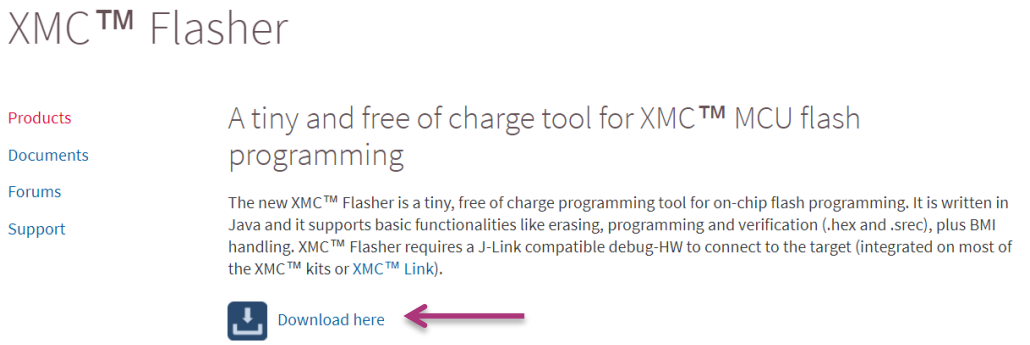
Flashing Tools
1. XMC Flasher

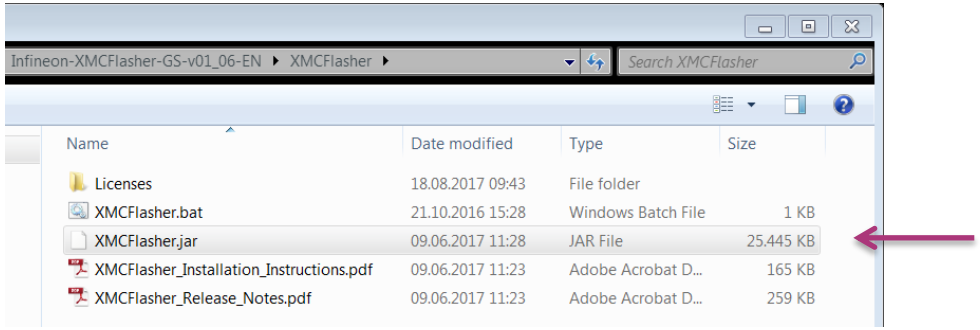
Installation Steps:

1. Download XMC Flasher **.zip file** from the following link

http://www.infineon.com/cms/en/product/microcontroller/32-bit-industrial-microcontroller-based-on-arm-registered-cortex-registered-m/xmc-development-tools-software-tools-and-partner/xmc-programming-tools-from-infineon/channel.html?channel=5546d462557e6e890155a0532c605bfe



2. Extract the downloaded .zip file and run the **XMCFlasher.jar file**



Flashing Tools
1. XMC Flasher

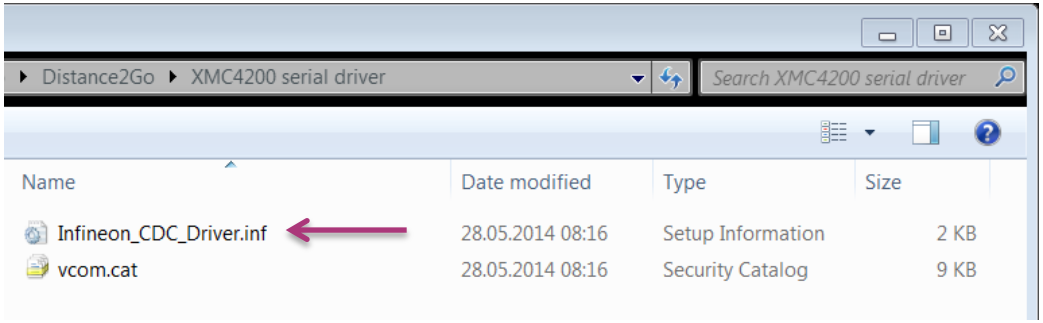
Note: Might need to install **Java** (32-bit or 64-bit) to run the XMCFlasher.jar file.

https://java.com/en/download/

Flashing Tools
2. XMC Serial Port Drivers

- If you are plugging in the XMC microcontroller for the first time into your PC/laptop, you will receive an error.

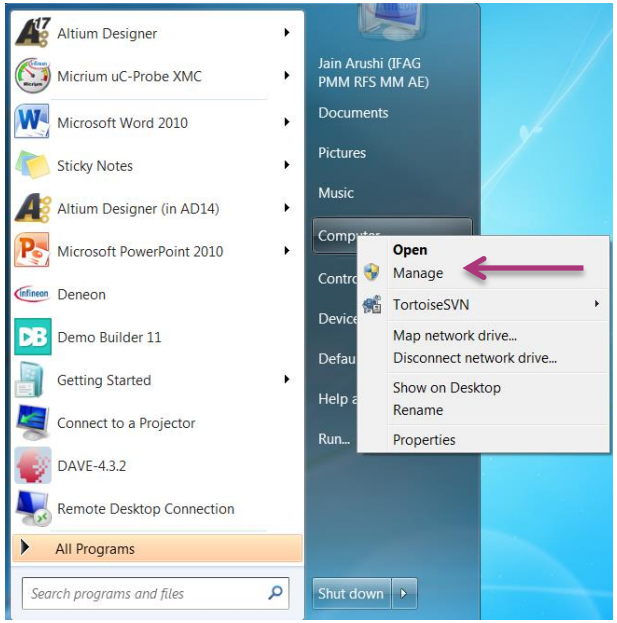
- XMC serial drivers are part of deliverables, comes under the folder 'Driver'.

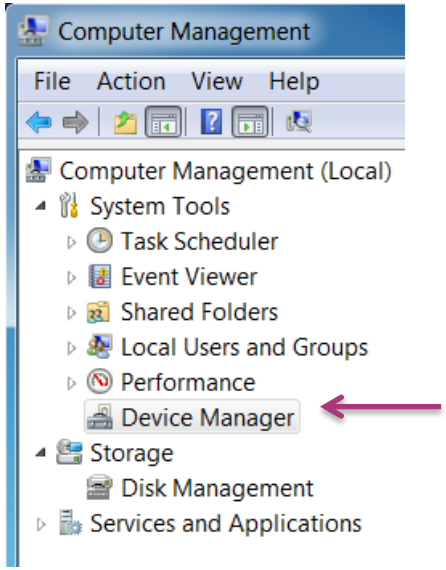


Flashing Tools
2. XMC serial port drivers

Installation Steps:

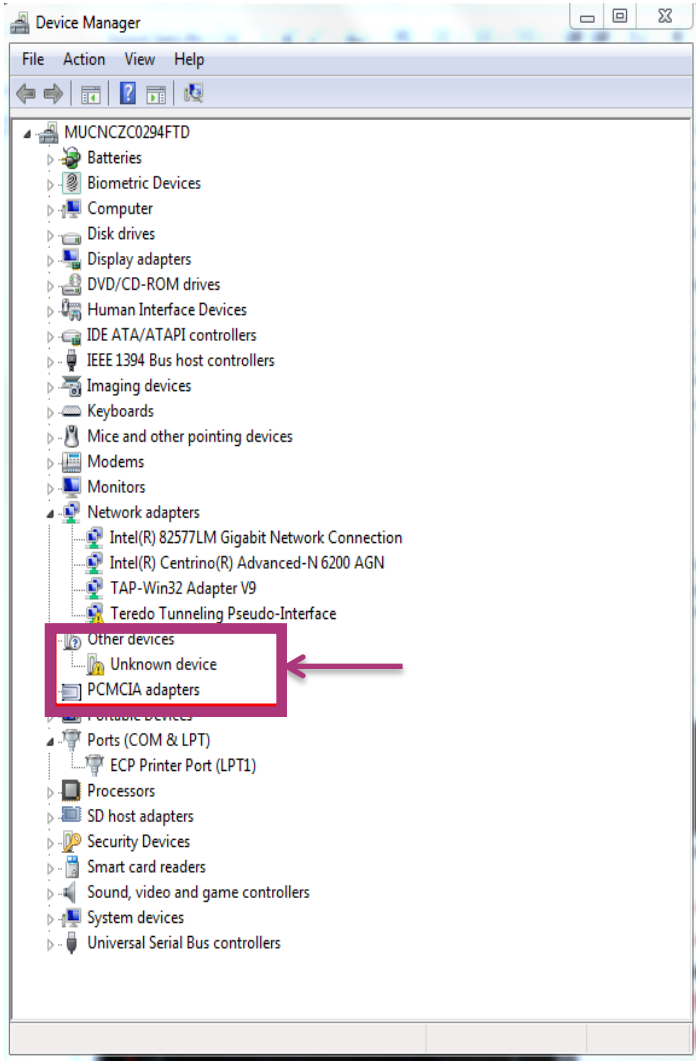
1. Right click on “My Computer”
2. Click “Manage” and a Computer Management window will be opened.
3. Click on “Device Manager”





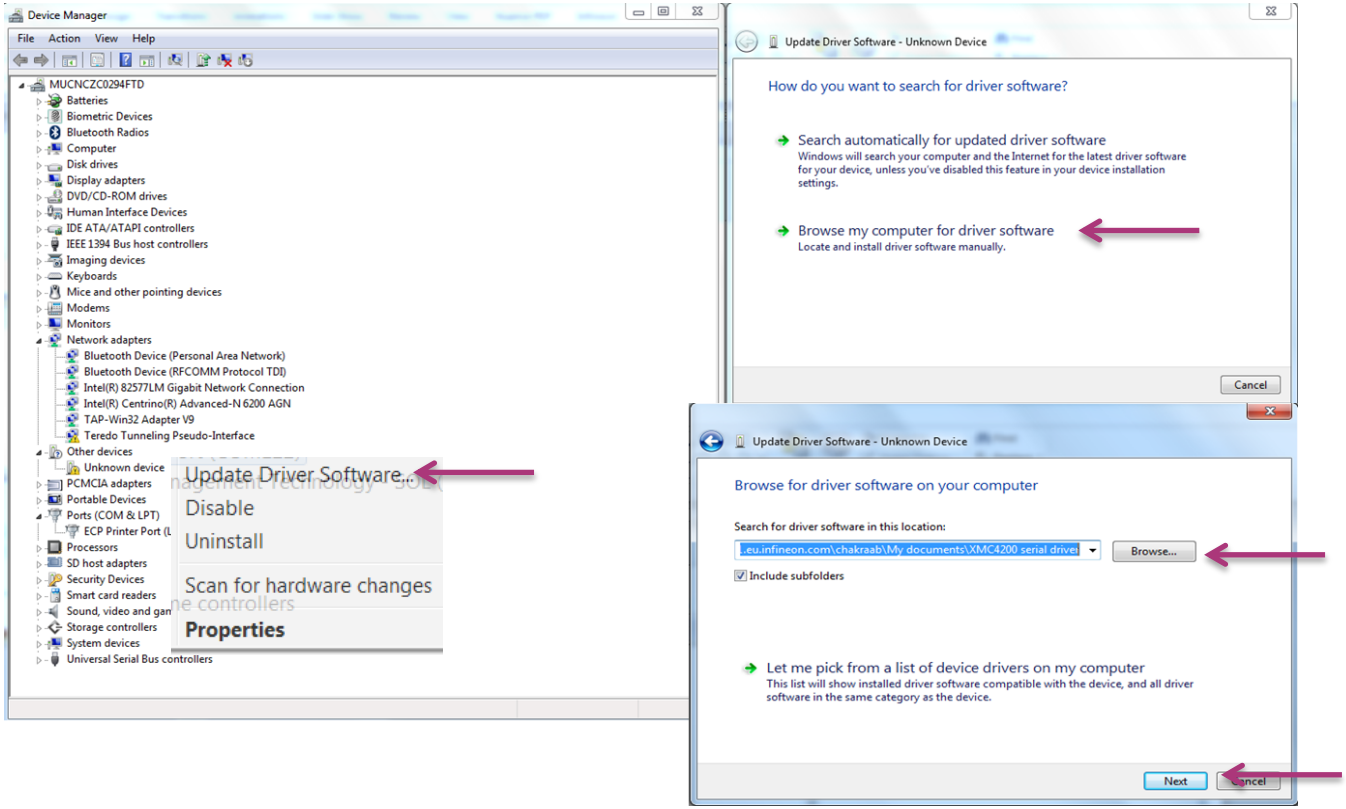
Flashing Tools
2. XMC Serial Port Drivers

4. Now connect the demo board to the computer via USB and the board will be detected under the “Other devices” category.
5. Right click on “Unknown Device”



Flashing Tools
2. XMC Serial Port Drivers

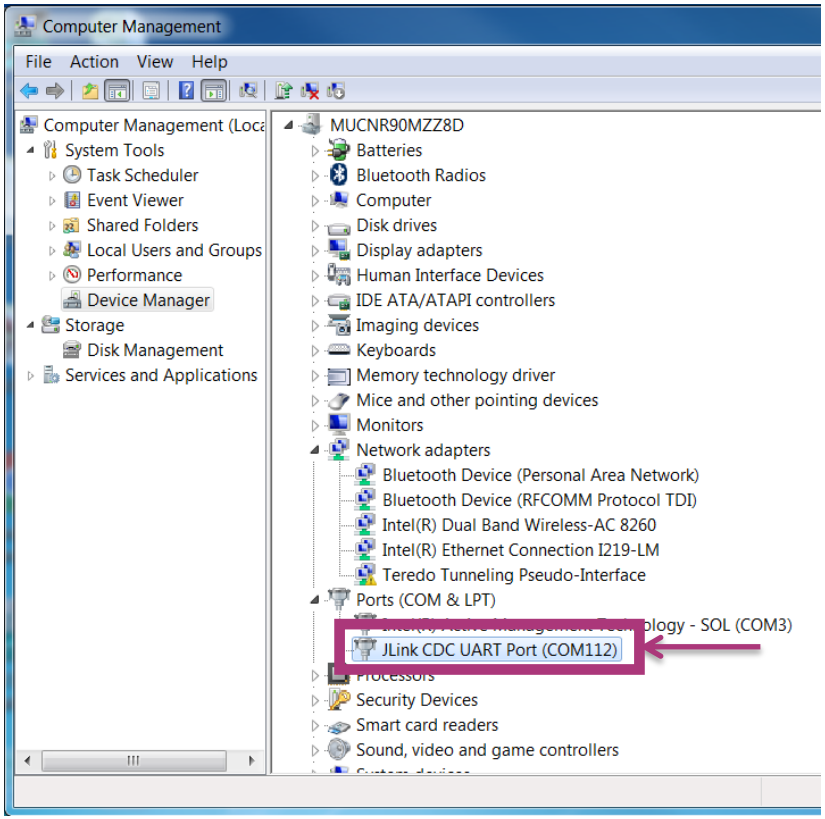
6. Click “Update Driver Software”
7. Select “Browse My Computer for Driver Software”.
8. Now browse to the directory where the drivers are stored (it’s part of deliverable in our case under ‘Driver’ folder) and click “Next”.



Flashing Tools
2. XMC Serial Port Drivers

9. After successful installation, the board is listed under “Ports” category in “Device Manager” tab of computer management window.

› Note down the COM port to which the board is connected. This will be helpful for working with the software later.



Tools Installation

Flashing Tools

1. XMC Flasher
2. XMC Serial Port Drivers

Visualization Tool

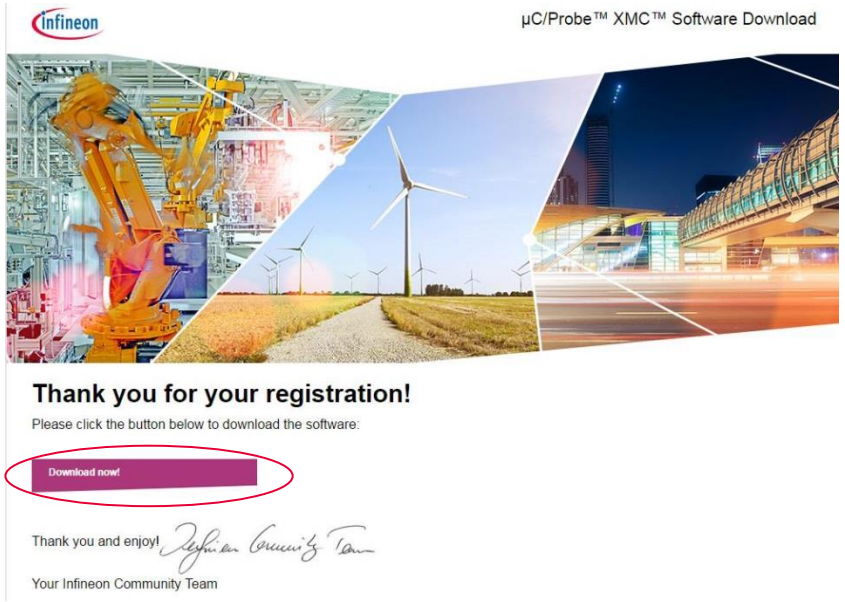
1. Micrium uC/Probe GUI

Firmware Development Tools

1. DAVE
2. Segger J-Link

Development Tools
Installing uC/Probe

- Installing Micrium uC/Probe: Install the latest version!
  - 1. If you have a previous version, uninstall it
  - 2. Download the latest version https://infineoncommunity.com/uC-Probe-XMC-software-download_ID712
    - Fill out the form and you will get a personal download link



Development Tools
Installing uC/Probe (cont´d)

- 3. Unzip the downloaded zip file somewhere on your hard drive
- 4. Depending on your PC, you may need to have administrator access to install software on your PC.
- 5. Run the executable
- 6. Agree to the license terms and then just keep clicking “Next” until installation is complete, then click “Finish”

Tools Installation

Flashing Tools

1. XMC Flasher
2. XMC 4200 serial port drivers

Visualization Tool

1. Micrium uC Probe GUI

Firmware Development Tools

1. DAVE
2. Segger J-Link

Firmware Development Tools
1. Installing DAVE

Installation Steps:

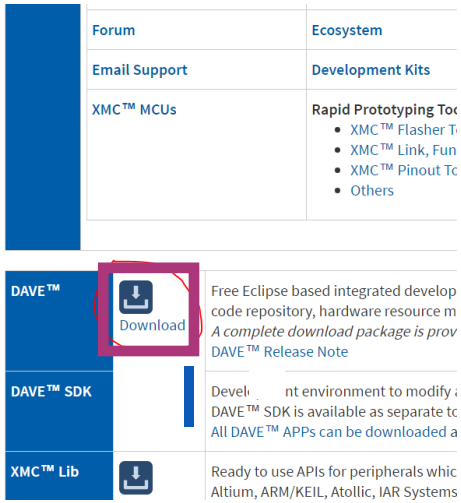
1. If you have a previous version of DAVE installed, check your hard drive location:

C:\Users\"your login name"\Infineon\D_LibraryStore_4.1

If this folder exists, rename or delete it.

2. Download the latest version of DAVE from

www.infineon.com/dave

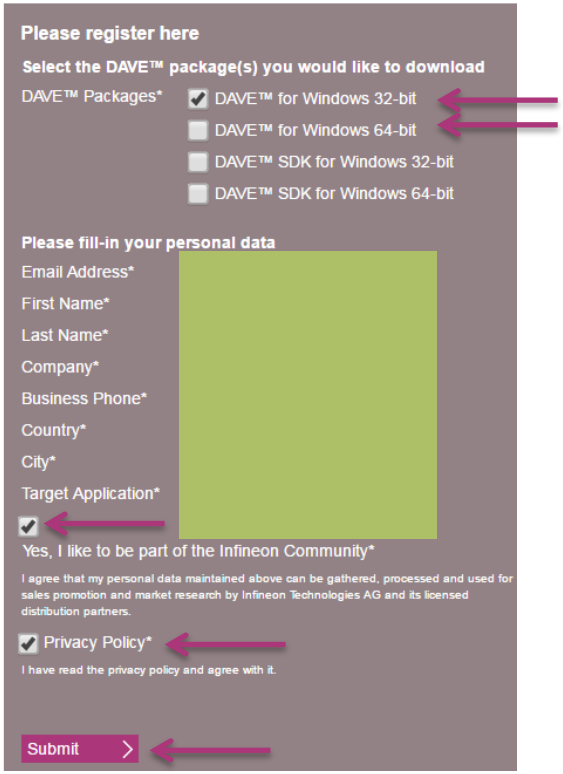


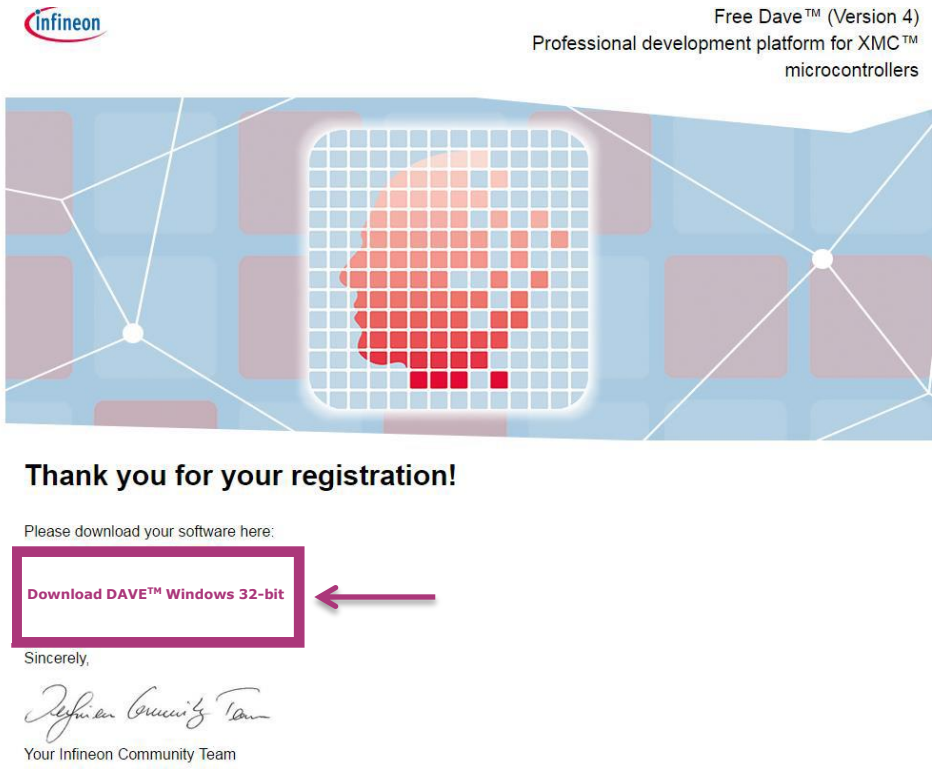
– Scroll down to the "DAVE™ Download" link.

Download can take up to 1 hour!

Firmware Development Tools
1. Installing DAVE (cont´d)

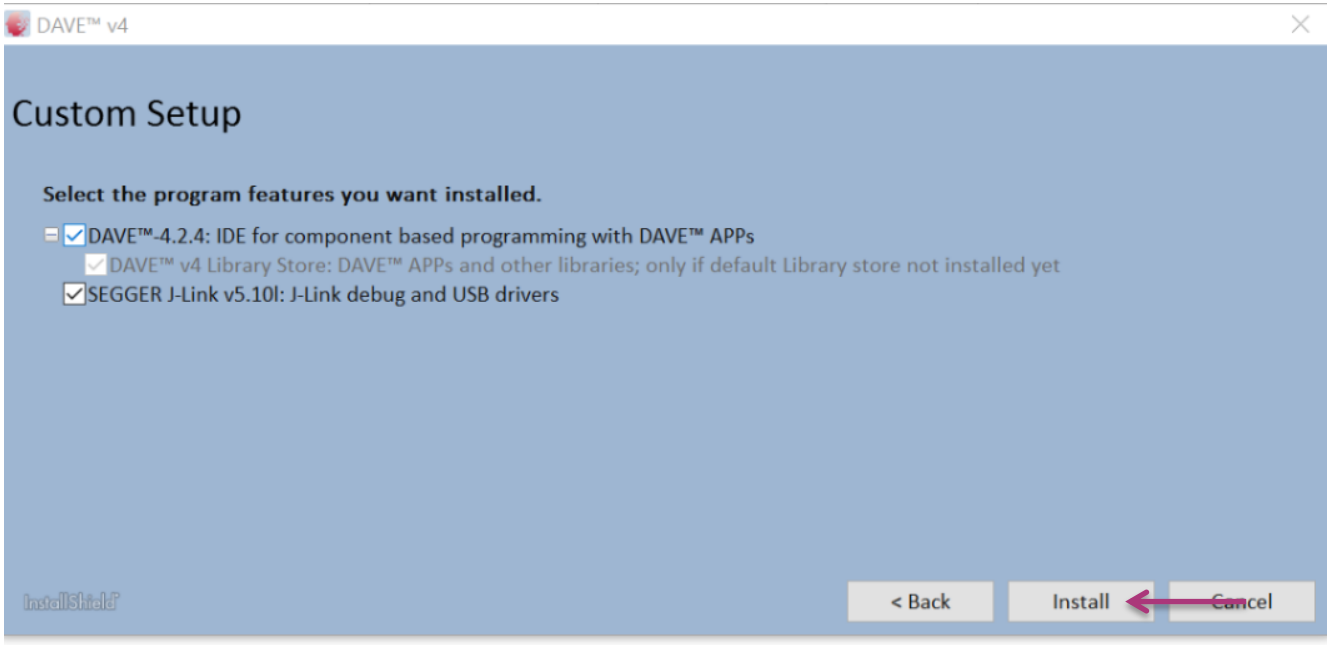
3. Select either the **32-bit** or **64-bit** version depending on your system (leave DAVE™ SDK unchecked as it is not needed)
4. Fill out the form and you will get a personal download link





Firmware Development Tools
1. Installing DAVE (cont´d)

5. Unzip the downloaded zip file on your hard drive
6. Depending on your PC, you may need to have administrator access to install the software.
7. Start the executable and make sure to install DAVE, the Library Store and SEGGER drivers (all boxes checked)

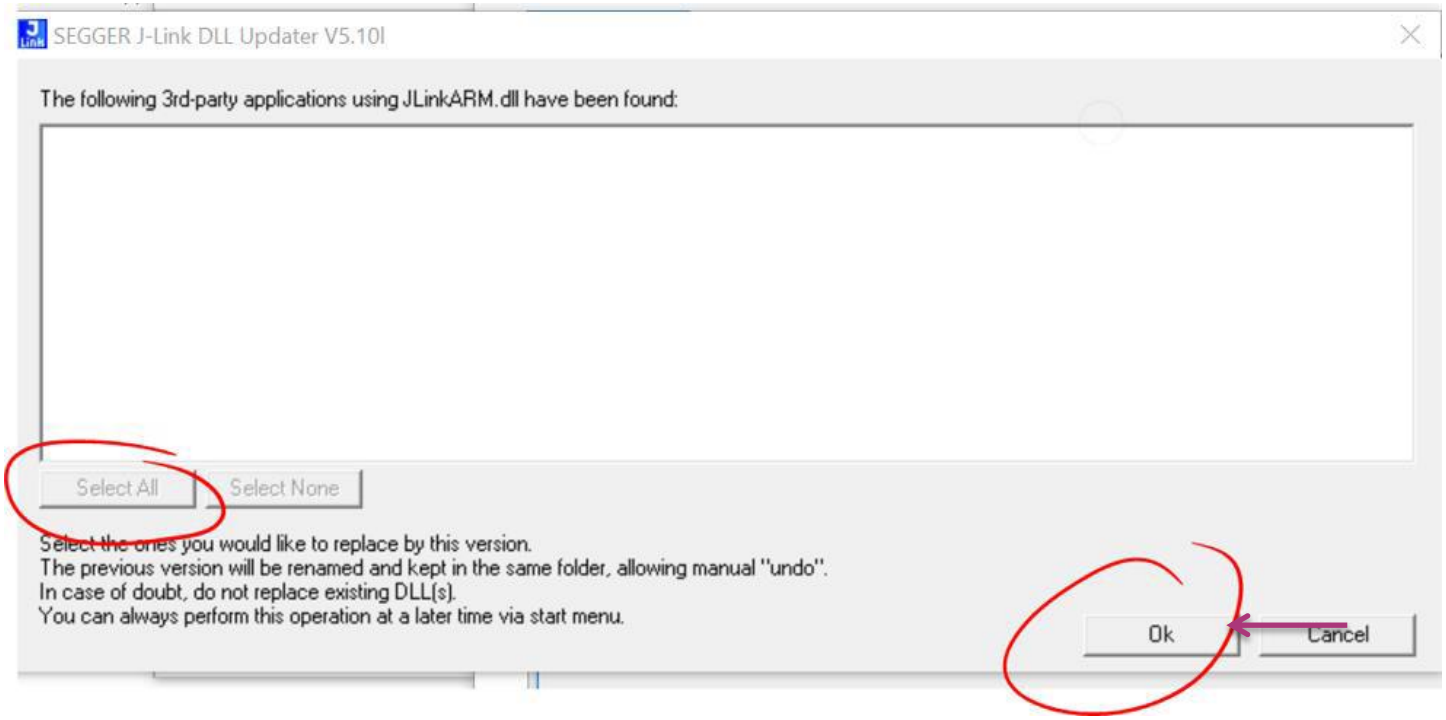


Firmware Development Tools
2. Installing J-Link

8. Accept license agreement and keep clicking “Next” then click “Finish”.
9. When the Segger JLINK installation starts, click “Next”.

Firmware Development Tools
2. Installing J-Link (cont´d)

10. Keep clicking “Next”.
11. If something like the screen below appears, click “Select All” (if it is not greyed out) and then “OK”.
12. Click “Finish”.



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Building, Flashing and Debugging Overview

Two ways to proceed from this step to flash the firmware:

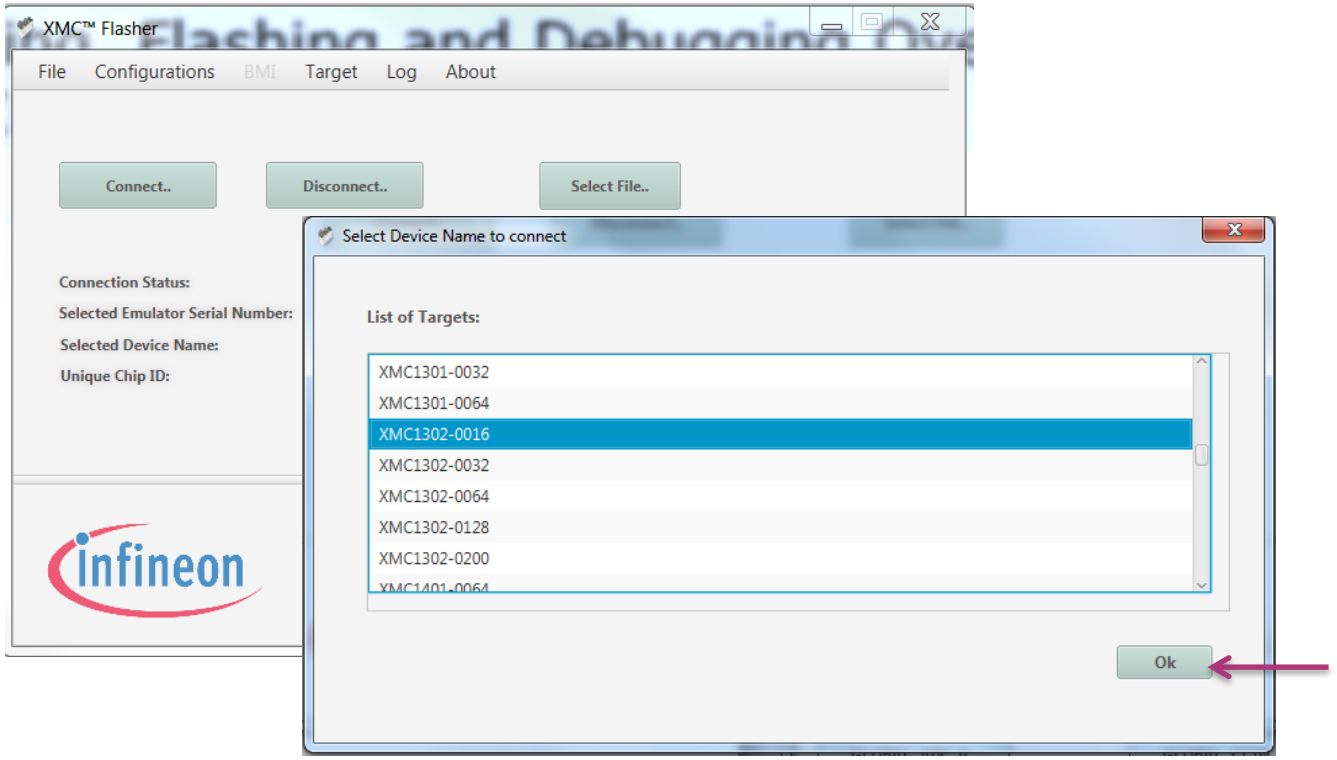
1. XMC Flasher
2. Dave Project

Building, Flashing and Debugging Overview Via XMC Flasher cont'd

1. Open the XMC flasher .jar file and click on the connect button to select the device name

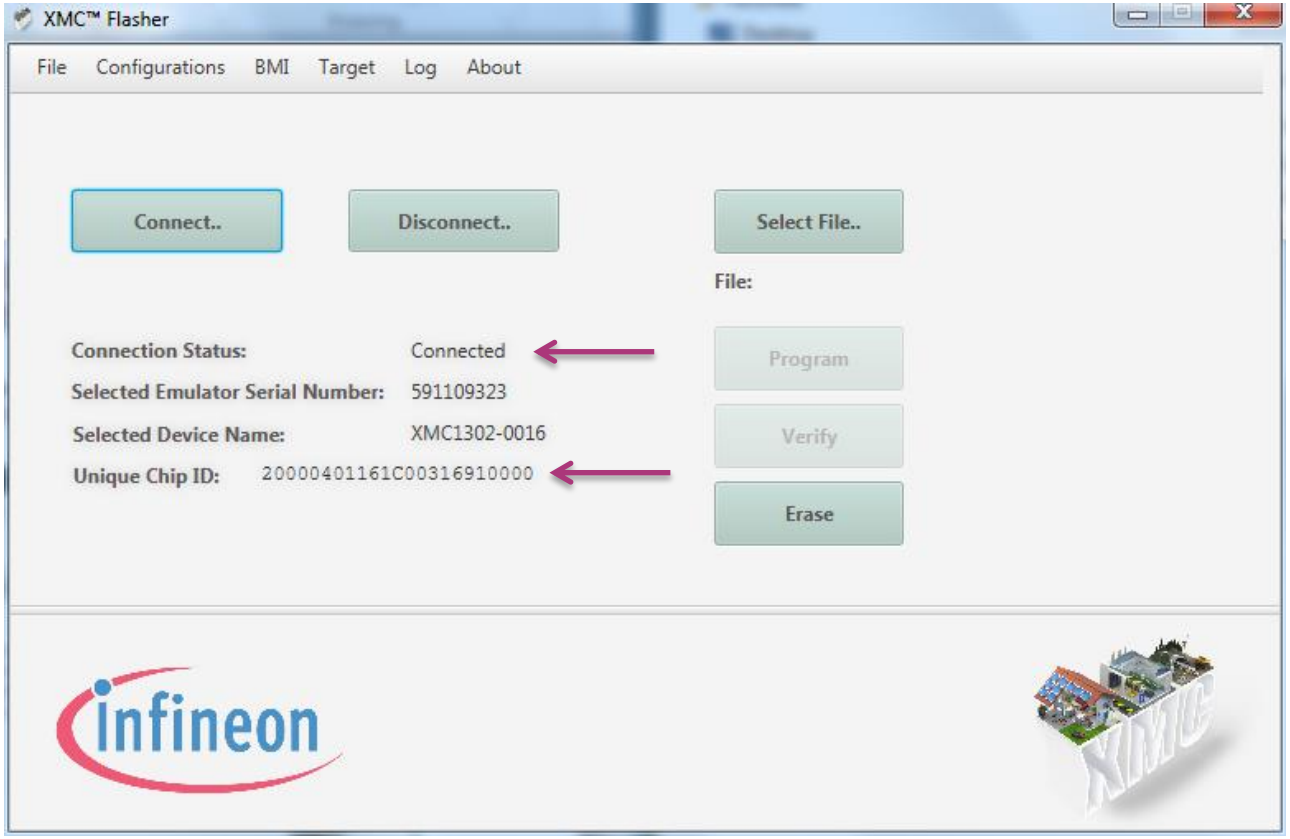
Building, Flashing and Debugging Overview Via XMC Flasher cont'd

2. Select the Device name form new window opened (XMC1302-16), then click 'OK'.



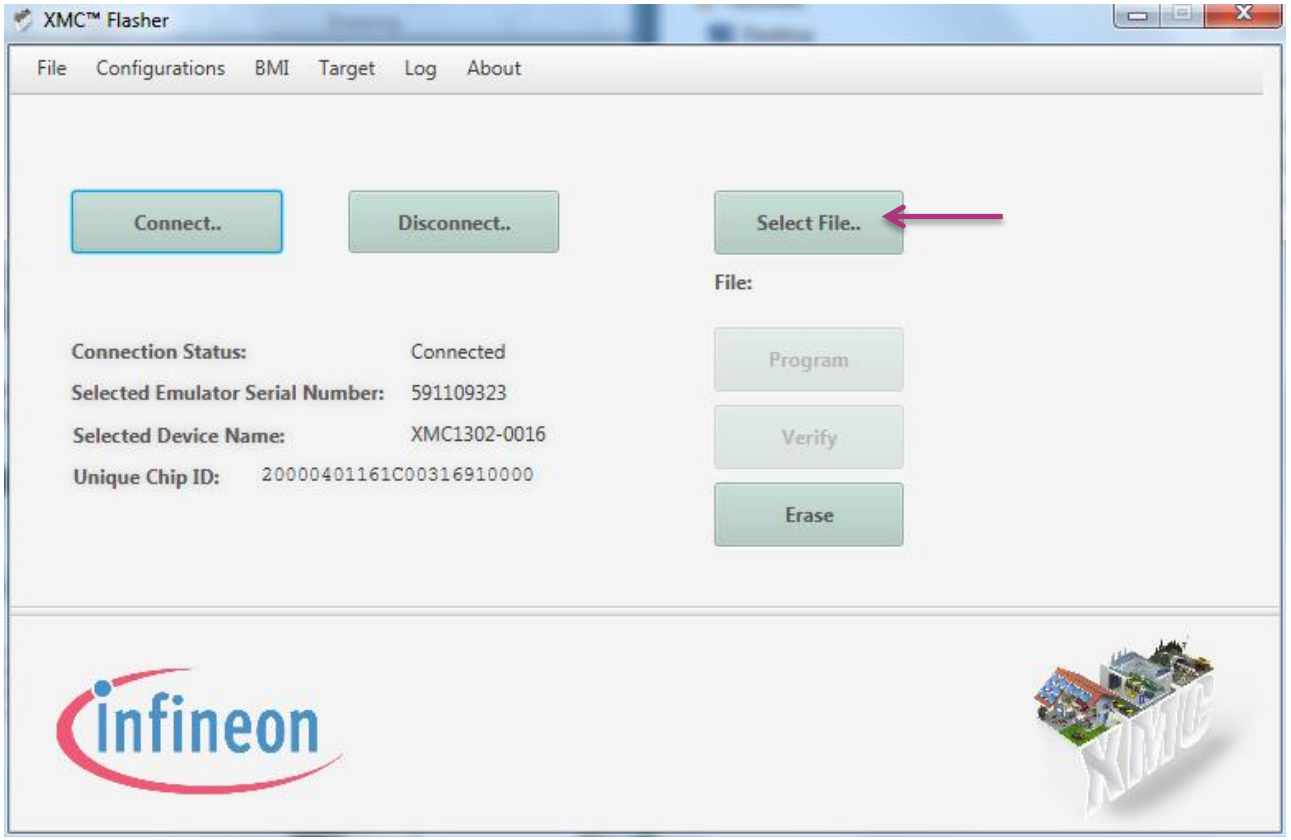
Building, Flashing and Debugging Overview Via XMC Flasher cont'd

3. If connection is successful, then 'Connection Status' would be connected. You can then see the 'Unique Chip ID' as well.



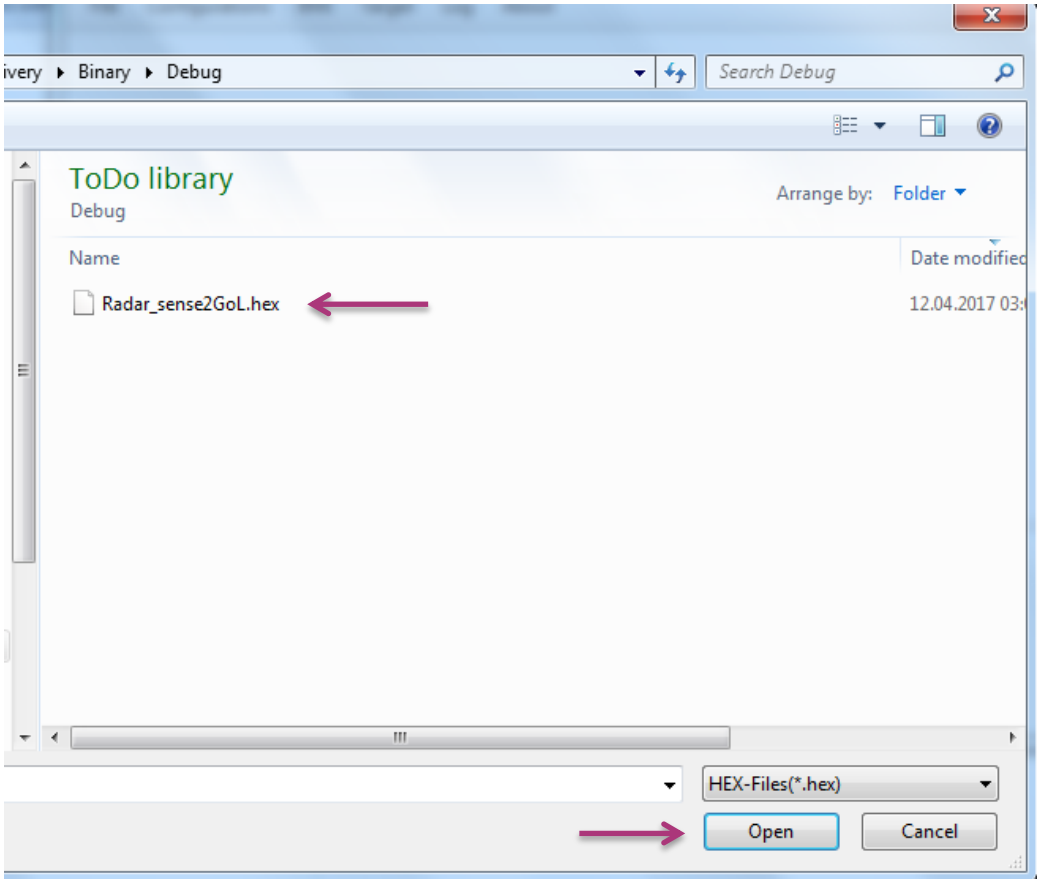
Building, Flashing and Debugging Overview Via XMC Flasher cont'd

4. After connection is done, select the **.hex file** (firmware is flashed through .hex file) by clicking on Select File button.



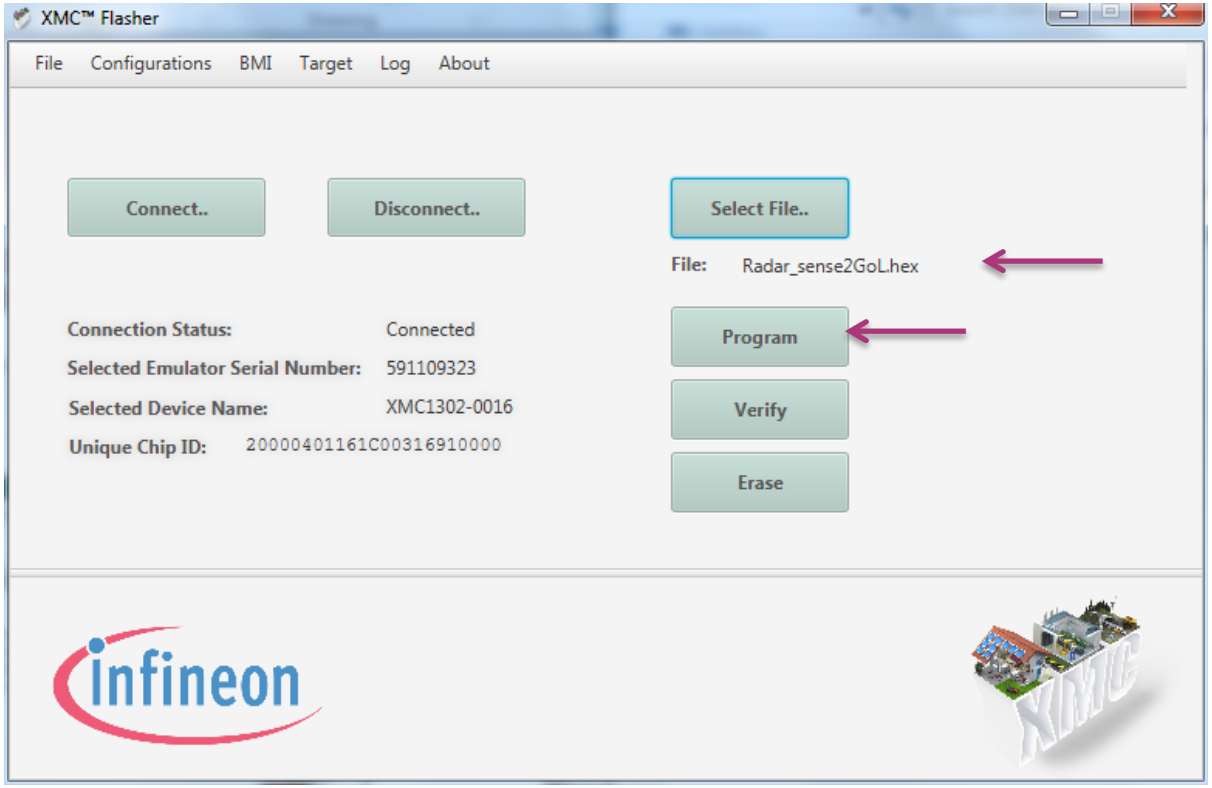
Building, Flashing and Debugging Overview Via XMC Flasher cont'd

5. Navigate to the binary folder containing Radar_sense2GoL.hex file and select it.
6. Click on 'Open' in the dialogue box.



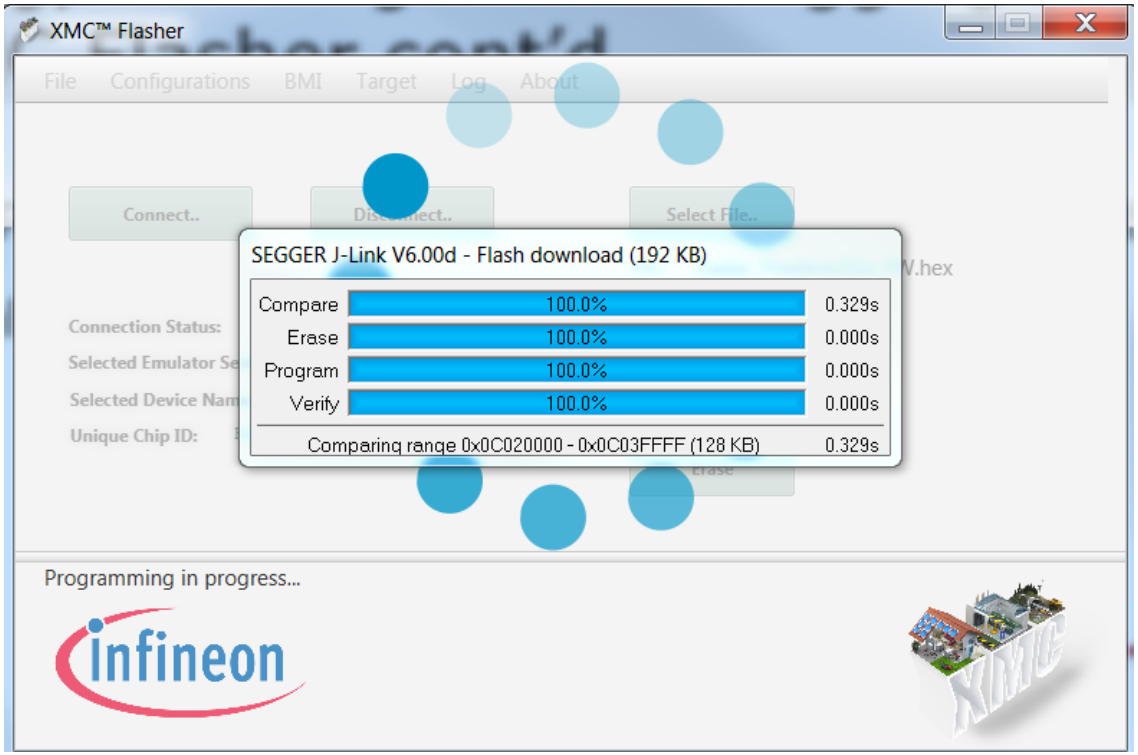
Building, Flashing and Debugging Overview Via XMC Flasher cont'd

7. Successful selection of hex file will list the name of .hex file under 'Select File' button.
8. Now click 'Program' button.



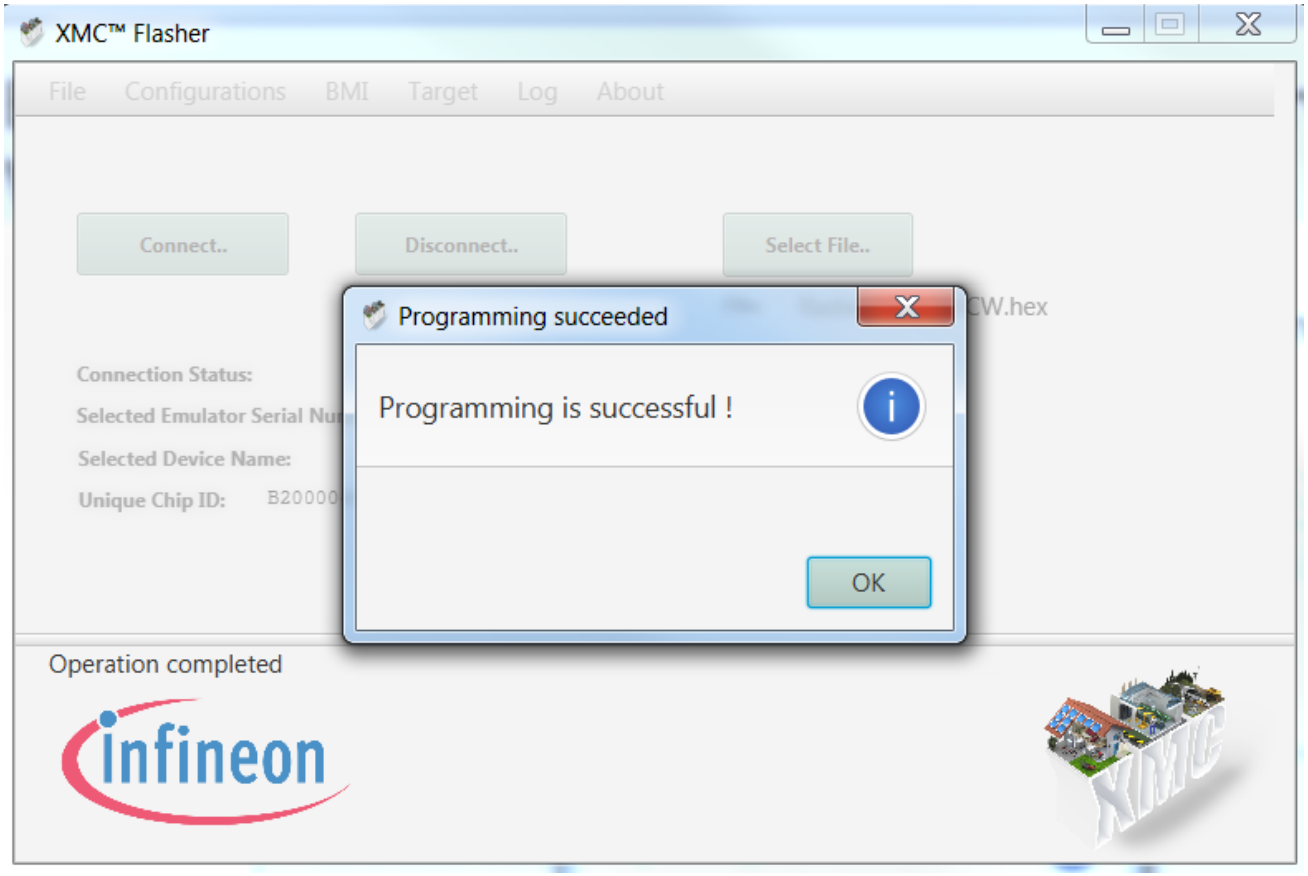
Building, Flashing and Debugging Overview Via XMC Flasher cont'd

9. SEGGER progress window will open. It will also verify if the .hex file is flashed or not.



Building, Flashing and Debugging Overview Via XMC Flasher cont'd

Congrats! You have successfully flashed the firmware using XMC Flasher.



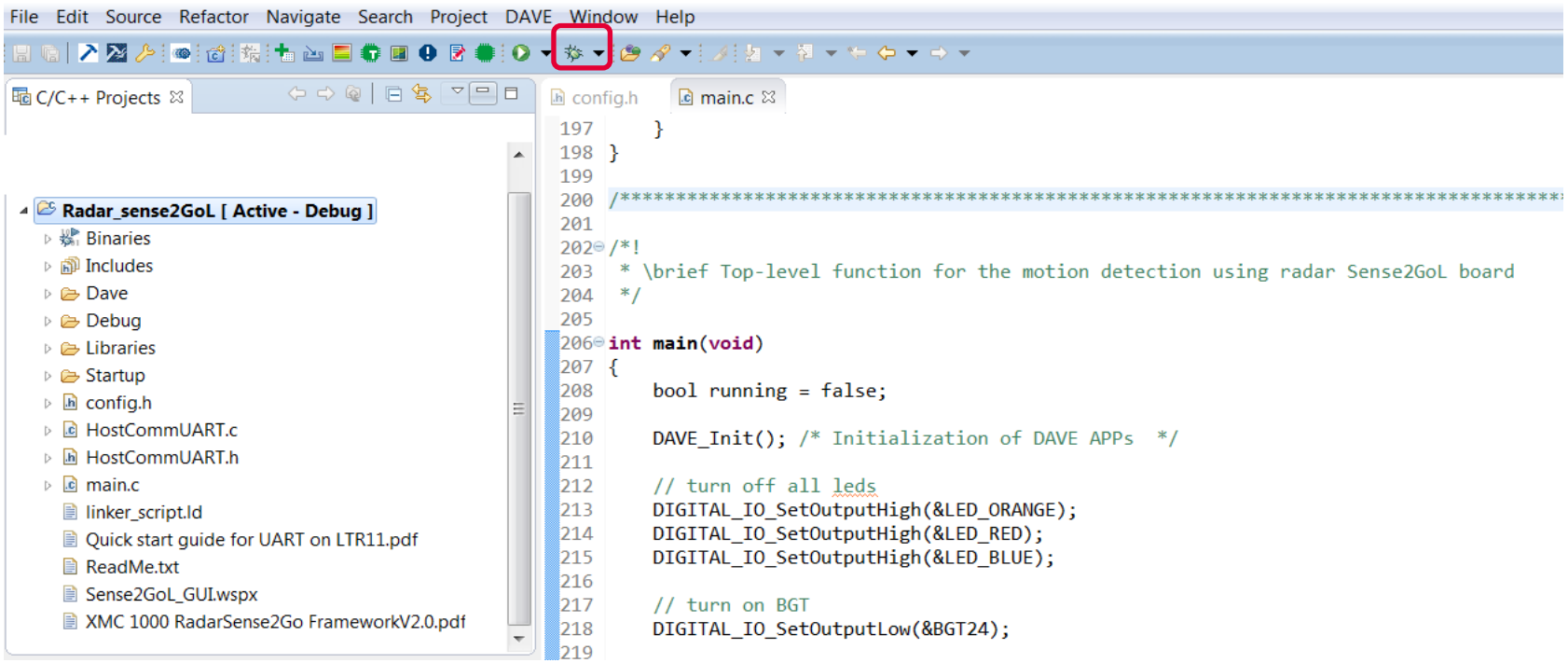
Building, Flashing and Debugging Overview

Two ways to proceed from this step to flash the firmware;

1. XMC Flasher
2. Dave Project

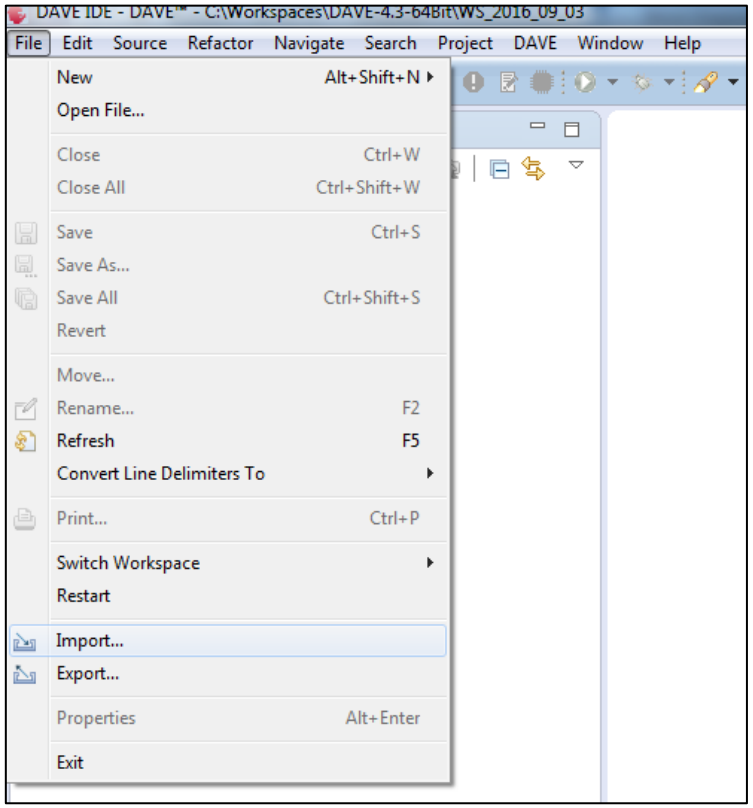
Building, Flashing and Debugging DAVE project

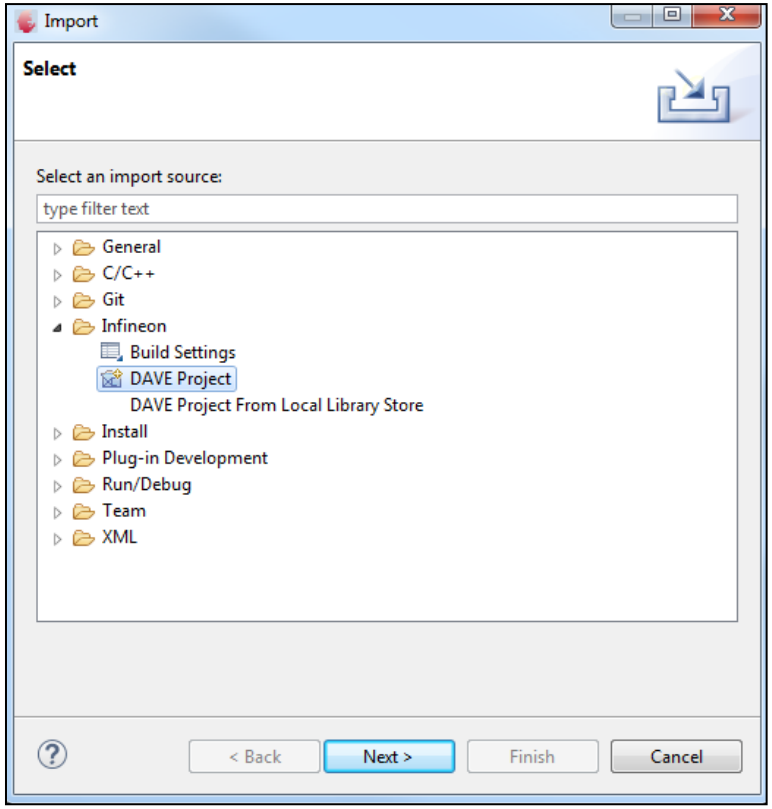
- 1. Import/Open FW project in DAVE
- 2. Connect Sense2GoL kit via USB
- 3. Create Debug Configurations
  - To start flashing and debugging within the DAVE project



Building, Flashing and Debugging
DAVE: Importing Project

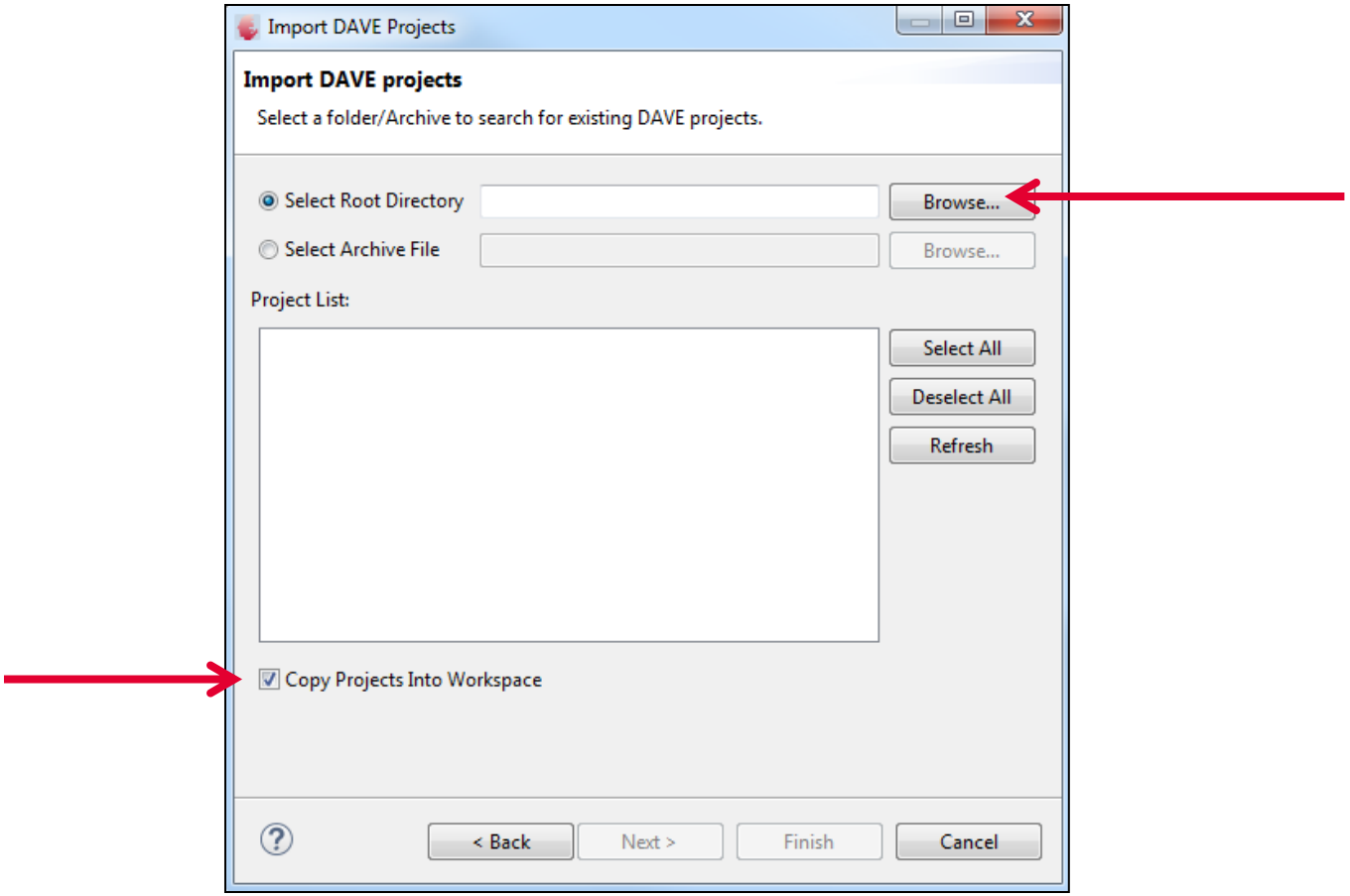
- To import the Sense2GoL firmware project into DAVE:
  - Navigate to File > Import
    - Infineon > DAVE Project





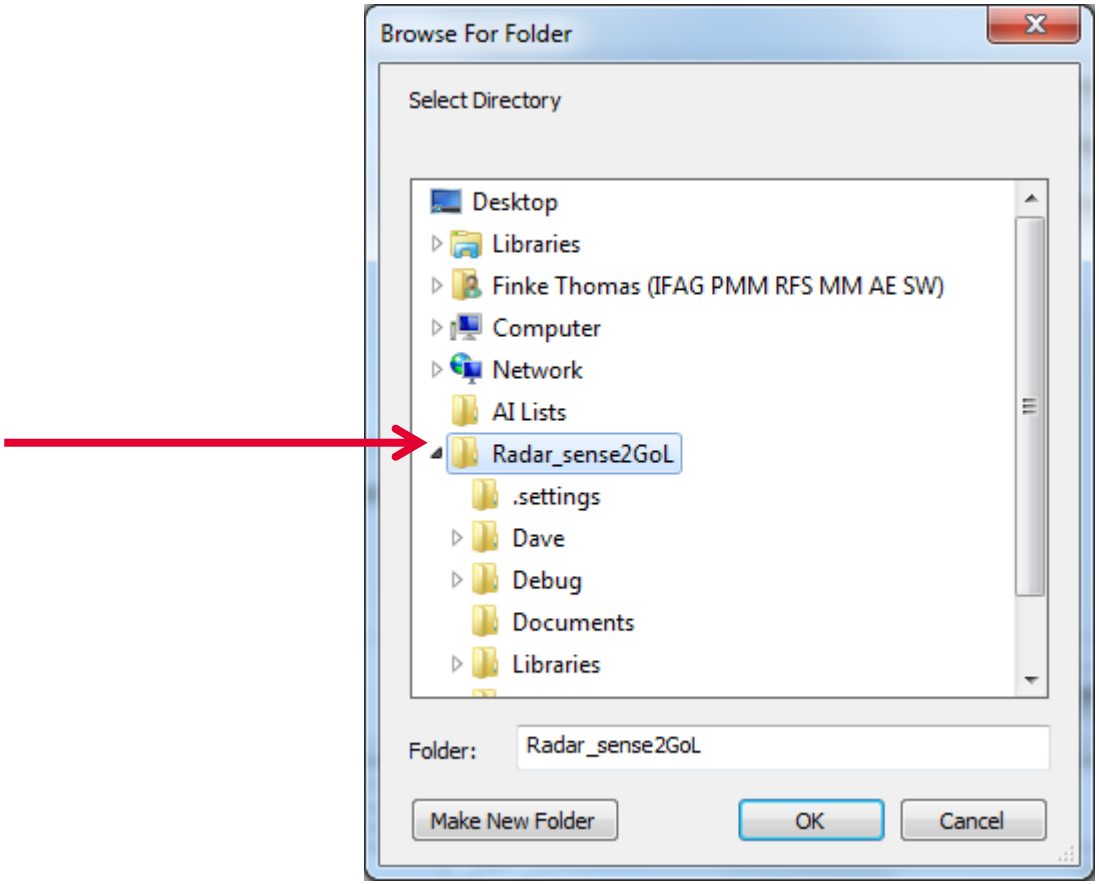
Building, Flashing and Debugging
DAVE: Importing Project

- Check “Copy Projects Into Workspace”
- Select “Browse” beside “Select Root Directory”



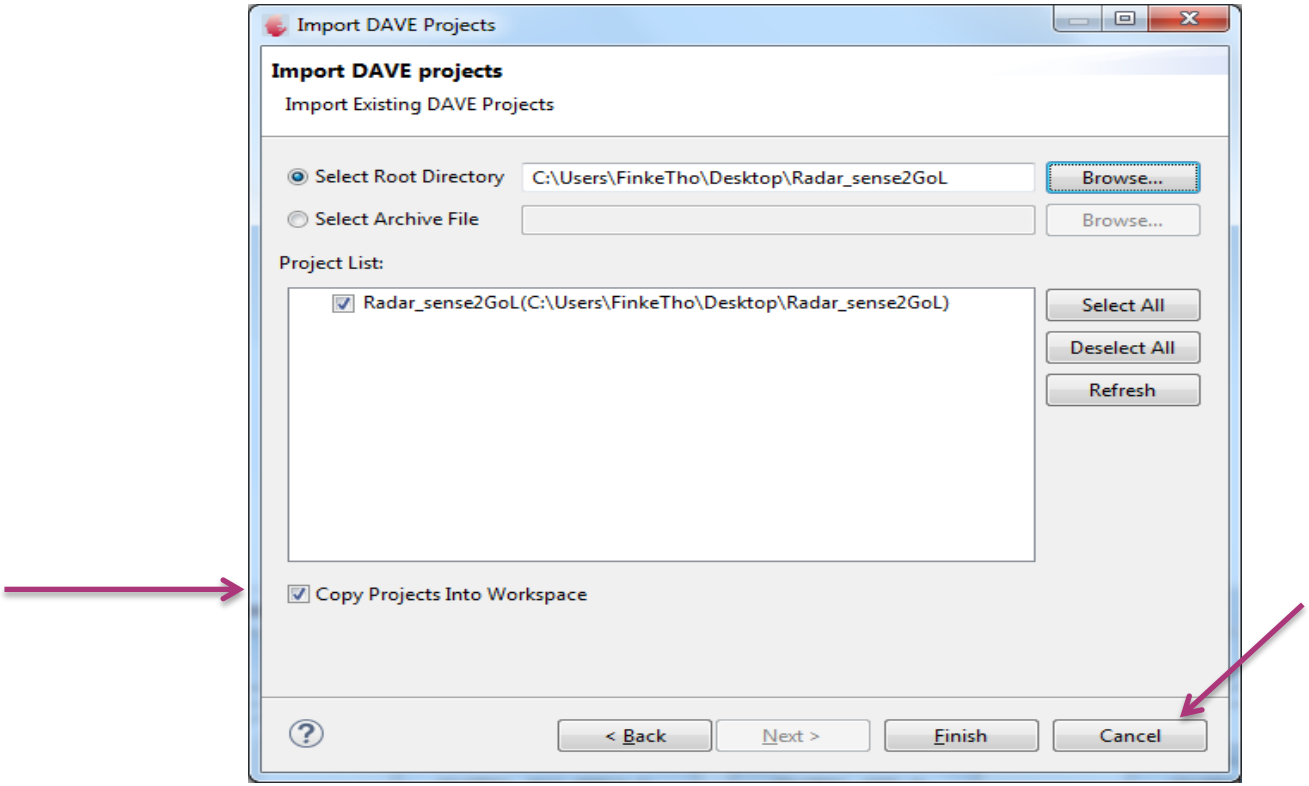
Building, Flashing and Debugging DAVE: Specifying Root Directory

› Select 'Radar_sense2GoL' folder from location where you have extracted the .zip file of DAVE project. For example, here we have in the Desktop/Radar_sense2GoL



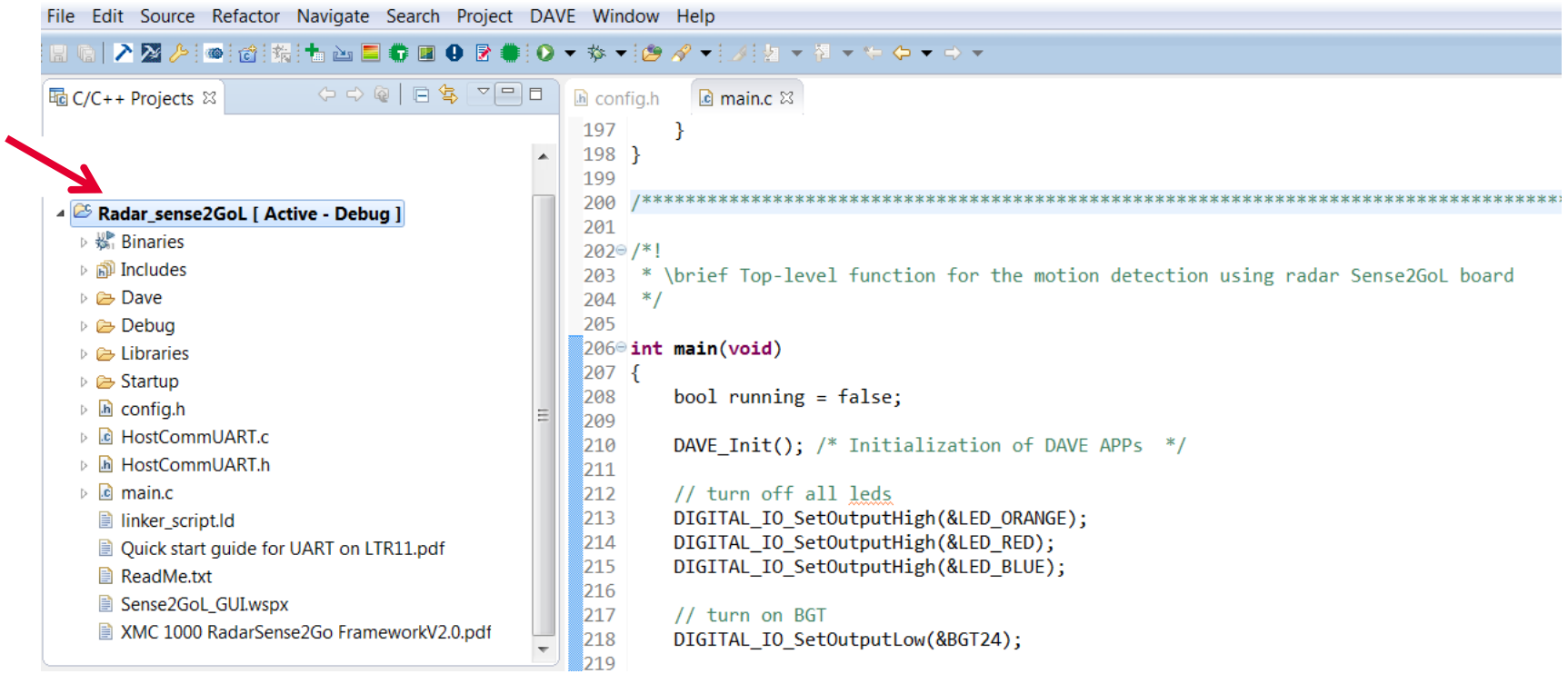
Building, Flashing and Debugging
DAVE: Import project

- The Project File should appear under Project List. Press 'Finish'.
- Check 'Copy Projects Into Workspace'



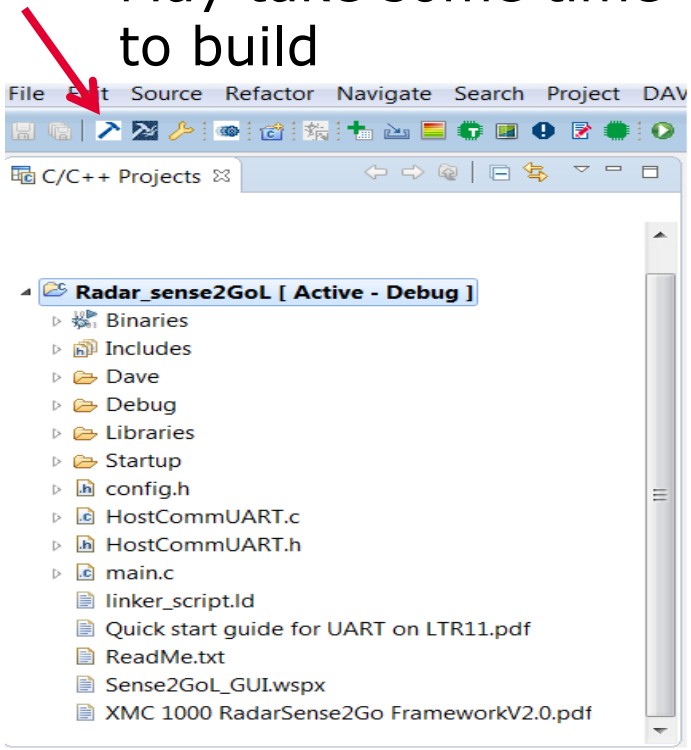
Building, Flashing and Debugging
DAVE: Finalized Import

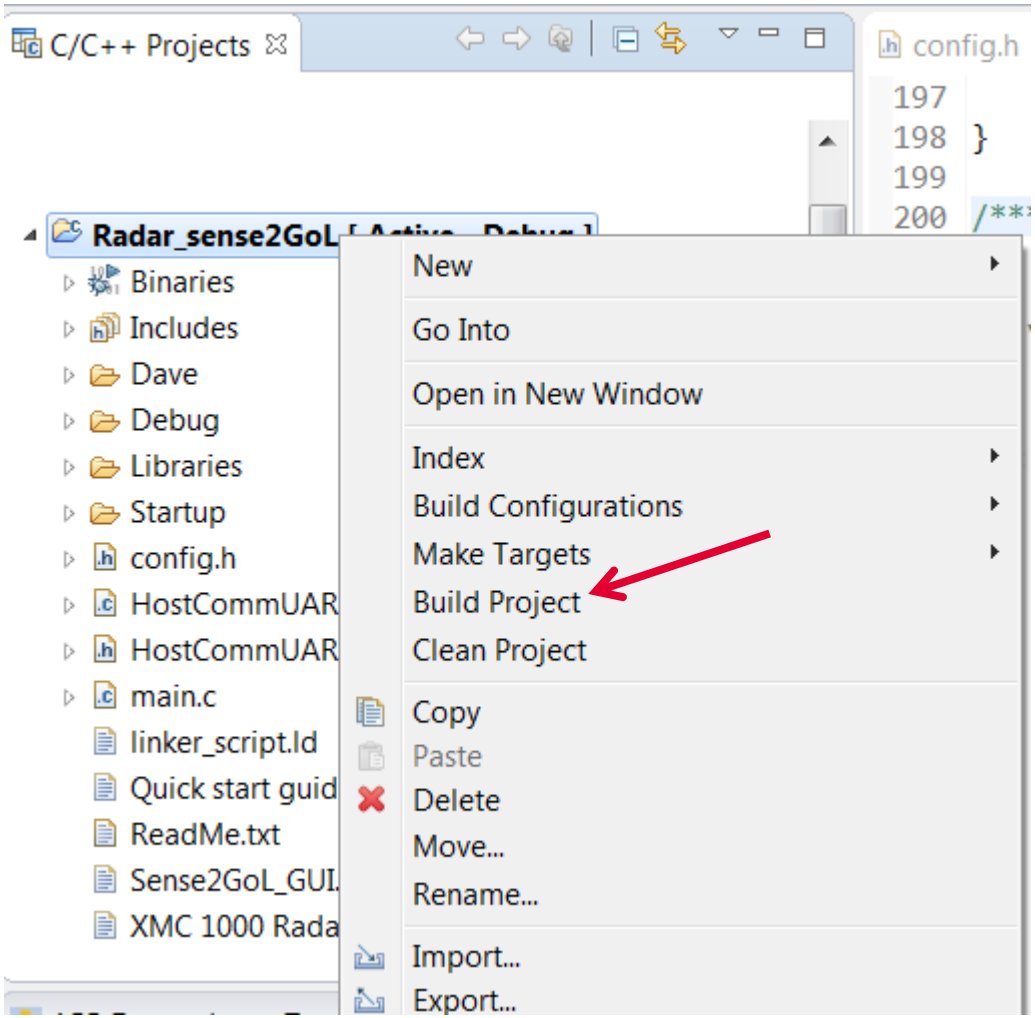
› The following should appear. Expand the project dropdown



Building, Flashing and Debugging
DAVE: Building Project

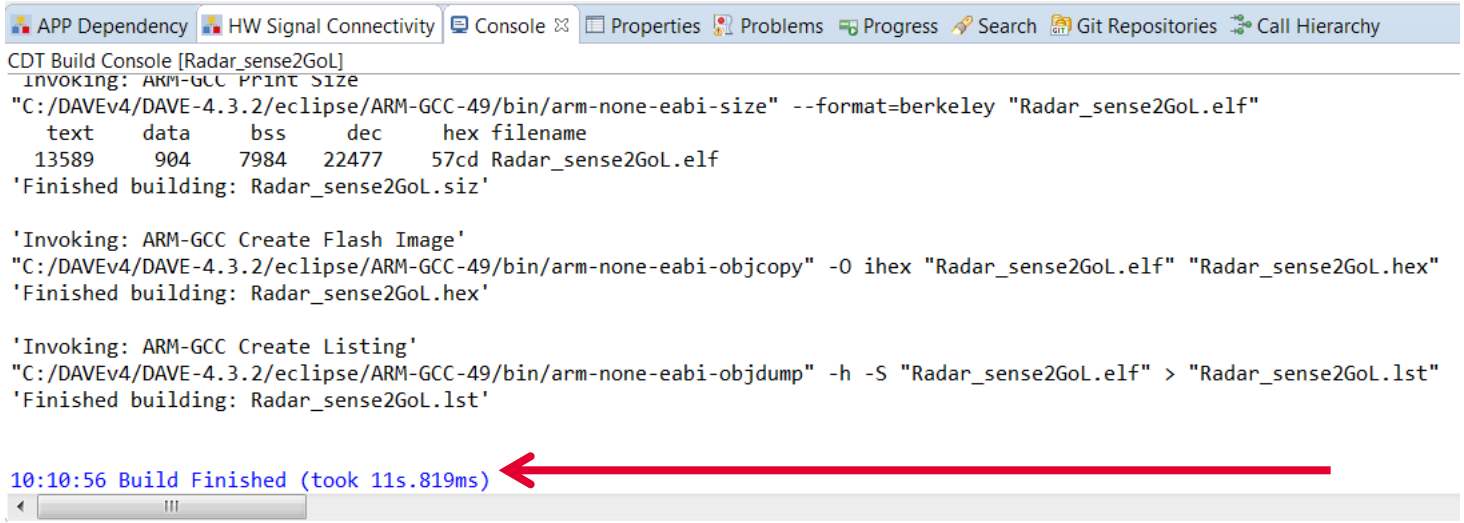
- Build Active Project via toolbar button OR right-click Active Project → Build Project
  - May take some time to build





Building, Flashing and Debugging
DAVE: Build Finish

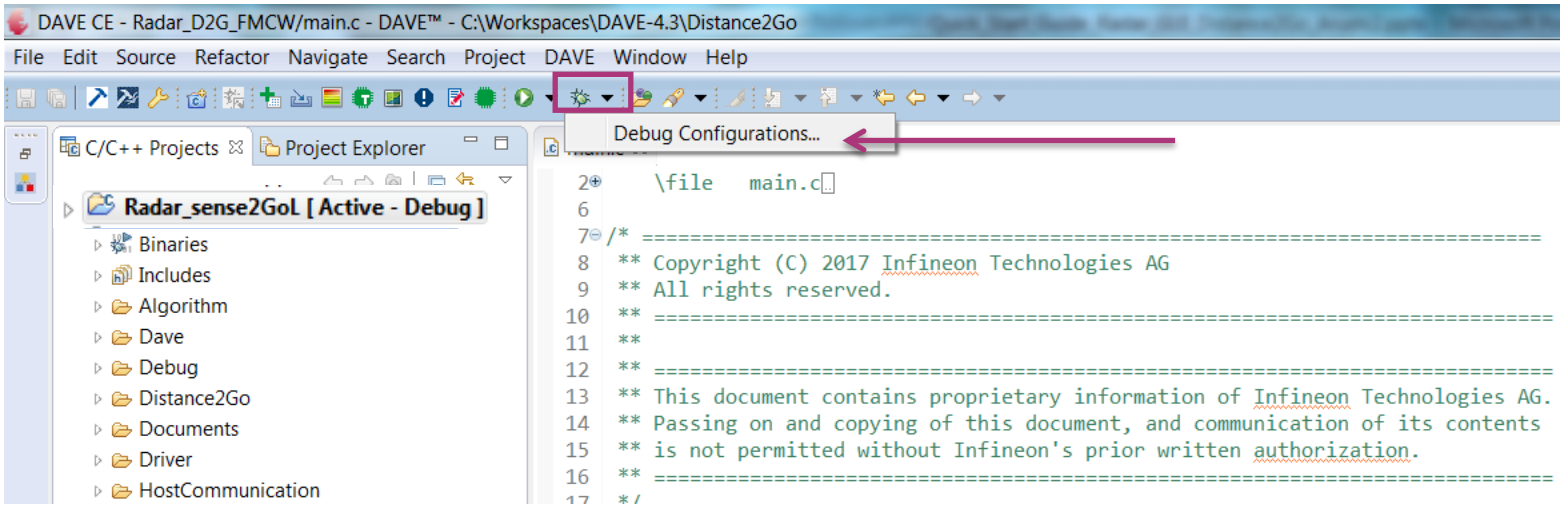
- Confirm successfully built by looking in the console…



Building, Flashing and Debugging
DAVE: Create debug configuration

In order to flash and debug the firmware in DAVE, need to follow these step.

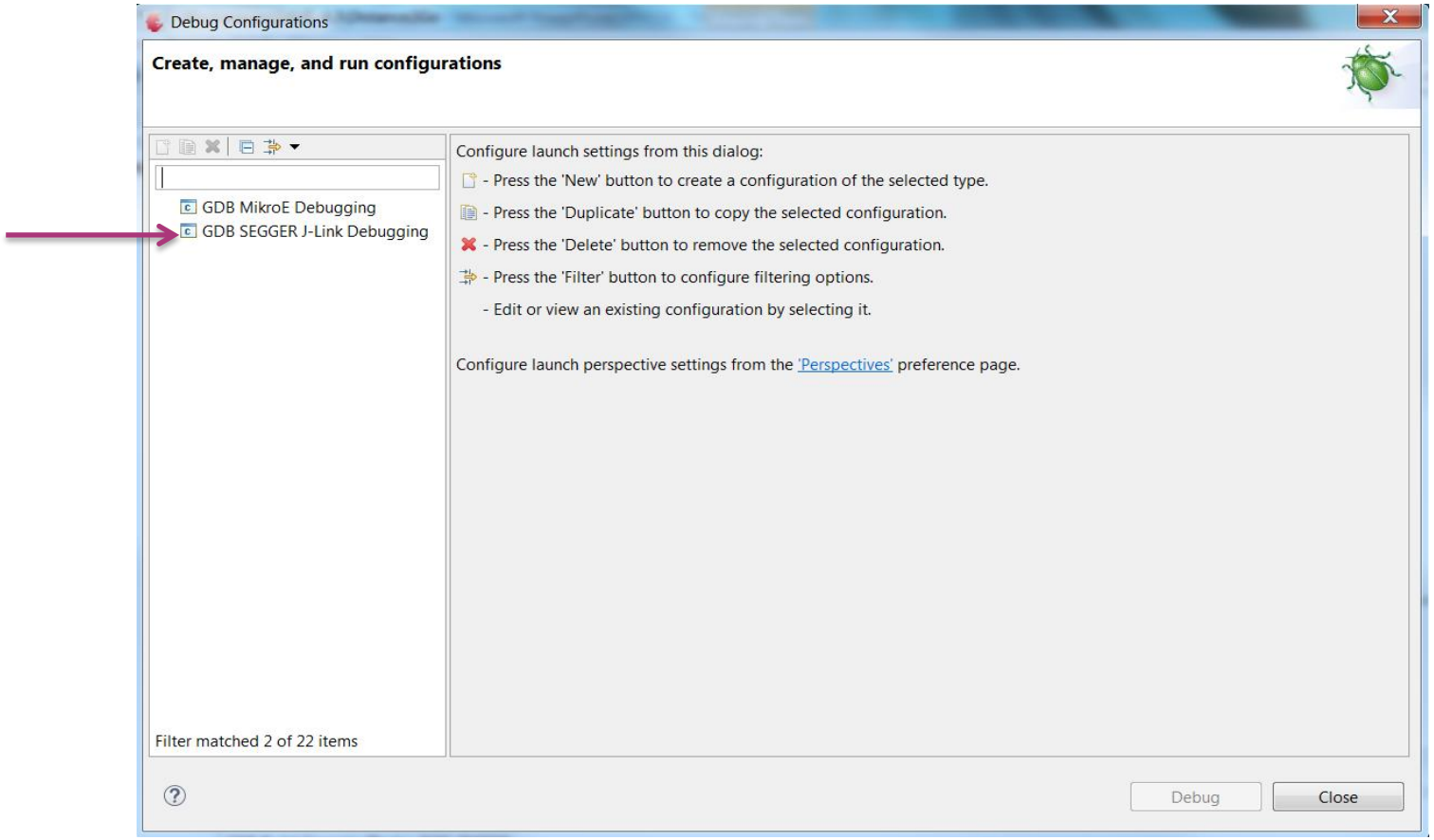
1. Select the debug configurations by clicking on the drop down menu of Debug button as shown in Figure below, i.e. 'Debug' → 'Debug Configurations'



Building, Flashing and Debugging
DAVE: Create debug configuration cont'd

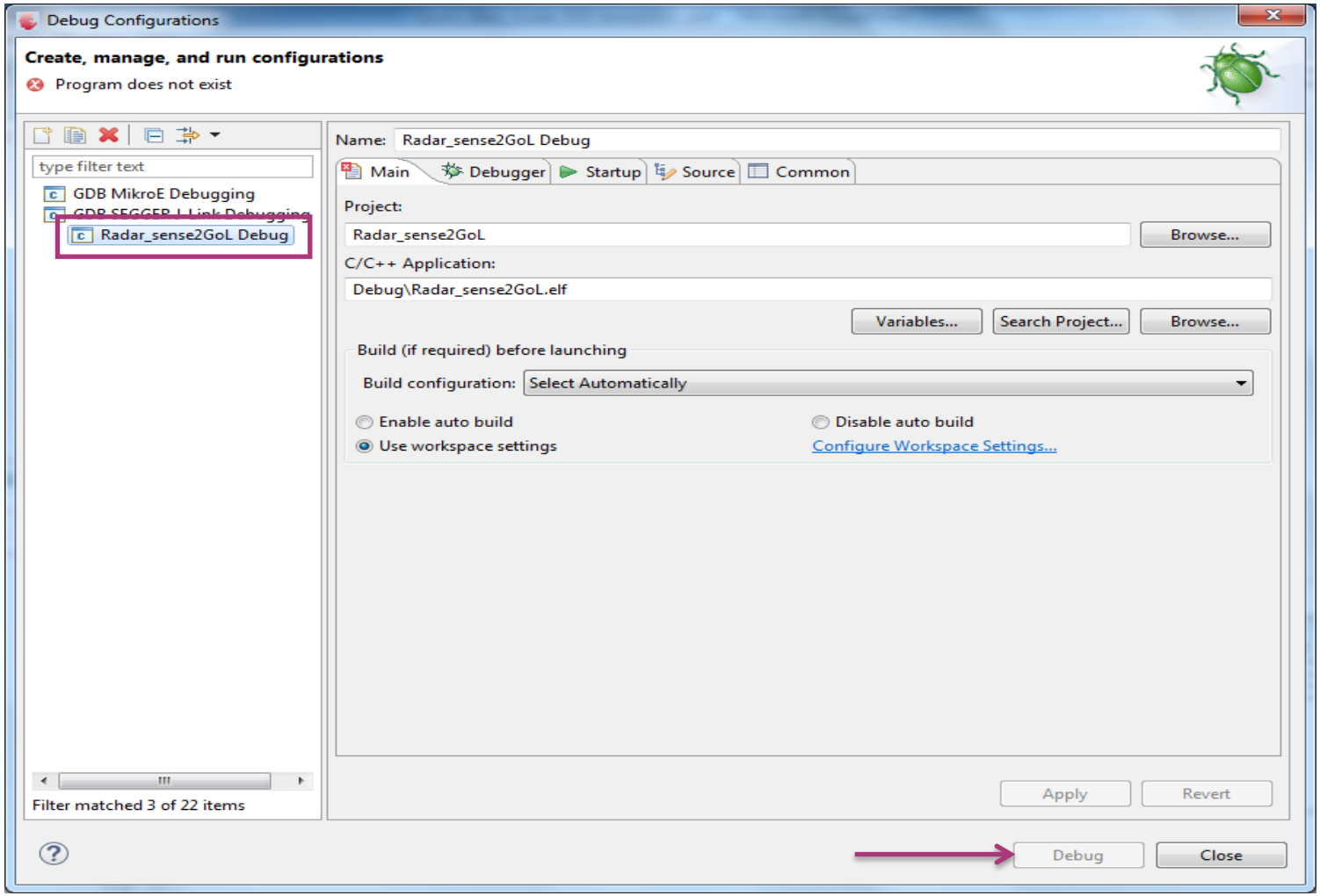
Following debug configurations are opened.

2. Double click on the 'GDB SEGGER J-Link Debugging' to create debug configurations.



Building, Flashing and Debugging
DAVE: Create debug configuration cont'd

Click on the 'Debug' button to flash and debug the DAVE project.



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Configuration/Customization Overview

- The Sense2GoL project can be customized by setting parameters in the config.h file
- On each change of the config.h file the project has to be re-build and flashed again

Configuration/Customization
Config.h File

- Following can be configured;
  - Sampling freq in Hz (Fs/2 will be the maximum doppler frequency captured)
  - Detection threshold to filter out weak targets
  - FFT_SIZE (Caution: need to update the FFT size on Micrium GUI else it will crash)
  - Enable / Disable UART from code (also done by GUI)
    - For further UART configurations, please refer to the ”Quick start guide for UART on LTR11.pdf ”
  - Minimum/Maximum velocity to be detected

config.h | main.c

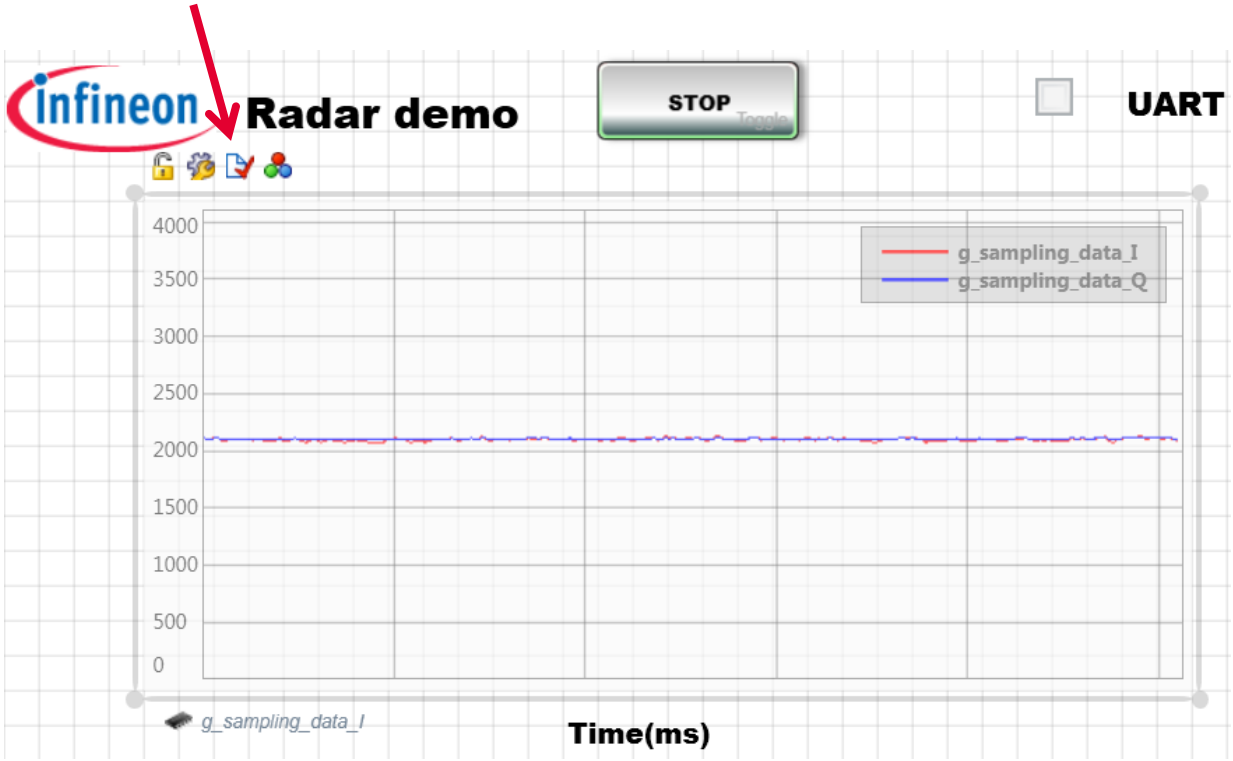
```
36
37 /*
38 ================================================================================
39    2. DEFINITIONS
40 ================================================================================
41 */
42
43 #define SAMPLING_FREQ_HZ (3000)       /**< sampling frequency in Hz.
44                                        PLEASE CHANGE ACCORDING TO YOUR
45                                        REQUIREMENTS!!! */
46 #define DETECTION_THRESHOLD (200)     /**< threshold of fft magnitude. all
47                                        magnitudes below this value will be
48                                        ignored.
49                                        PLEASE CHANGE ACCORDING TO YOUR
50                                        REQUIREMENTS!!! */
51 #define FFT_SIZE (256)                /**< number of fft points */
52 #define UART_RAW_DATA (0)             /**control for execution of UART feature to
53                                        transmit raw IQ from ADC. BE CAREFUL: WHEN
54                                        SENDING RAW DATA VIA UART INTERFACE GUI
55                                        WILL BE VERY SLOW AND NOT USABLE.TURN OFF
56                                        WHEN USING GUI */
57 #define MOTION_MIN_VELOCITY (0.5)     /**< min velocity to detect motion */
58 #define MOTION_MAX_VELOCITY (20)      /**< max velocity to detect motion */
59
60 /*
61 ================================================================================
62    3. TYPES
63 ================================================================================
64 */
```

Configuration/Customization
Changing FFT_SIZE

- After changing the FFT_SIZE in config.h file, one need to change the X-axis maximum samples in Micrium GUI, otherwise GUI will crash.
- For that, next sections will explain how to change the X-axis maximum sample count for;
  - Time Graph
  - Frequency Graph

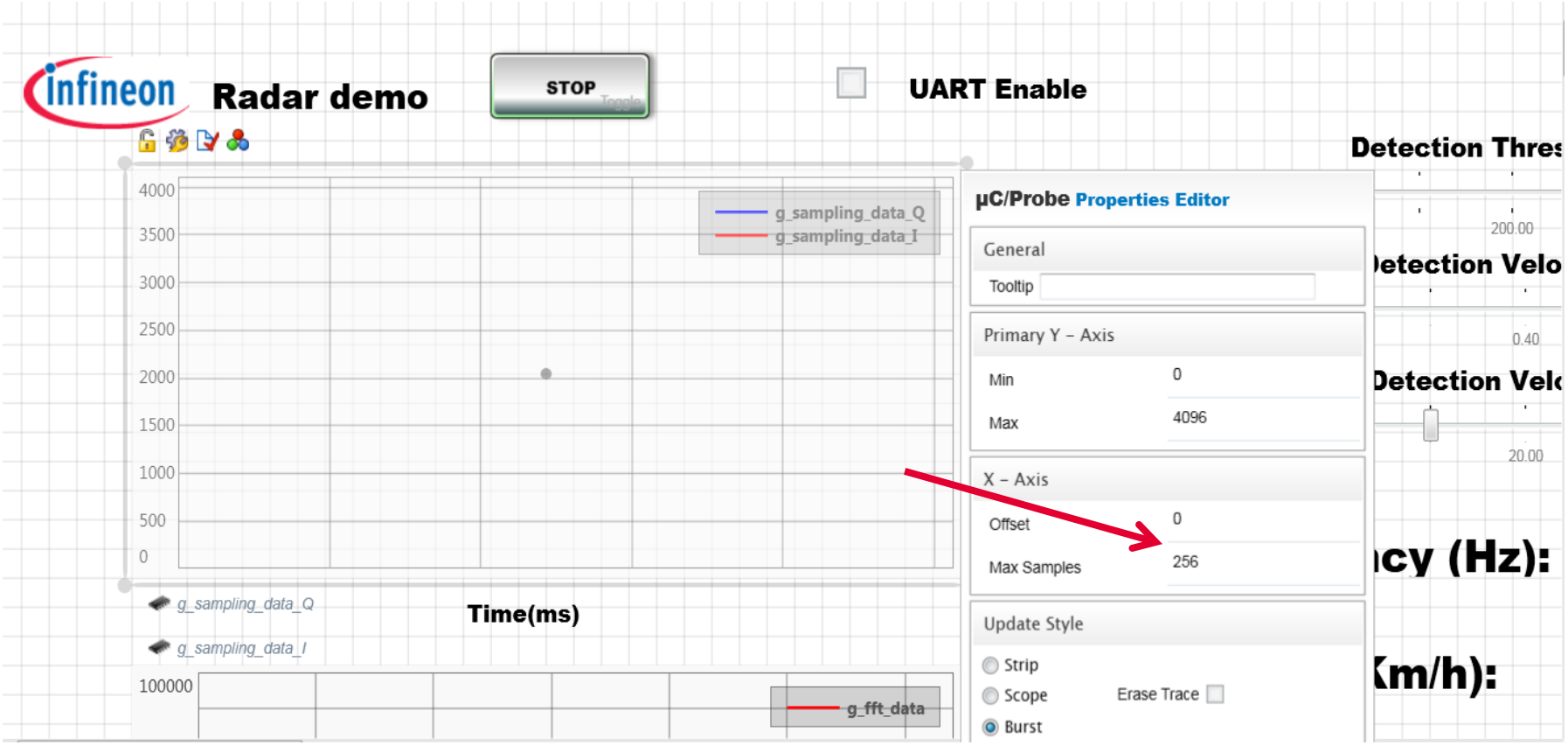
Configuration/Customization
Change Max. samples count in Time Graph

- When user click on the Time graph, four control icons appear at the top-left of the graph.
- Here, click on the Properties Editor of Time graph as shown below.



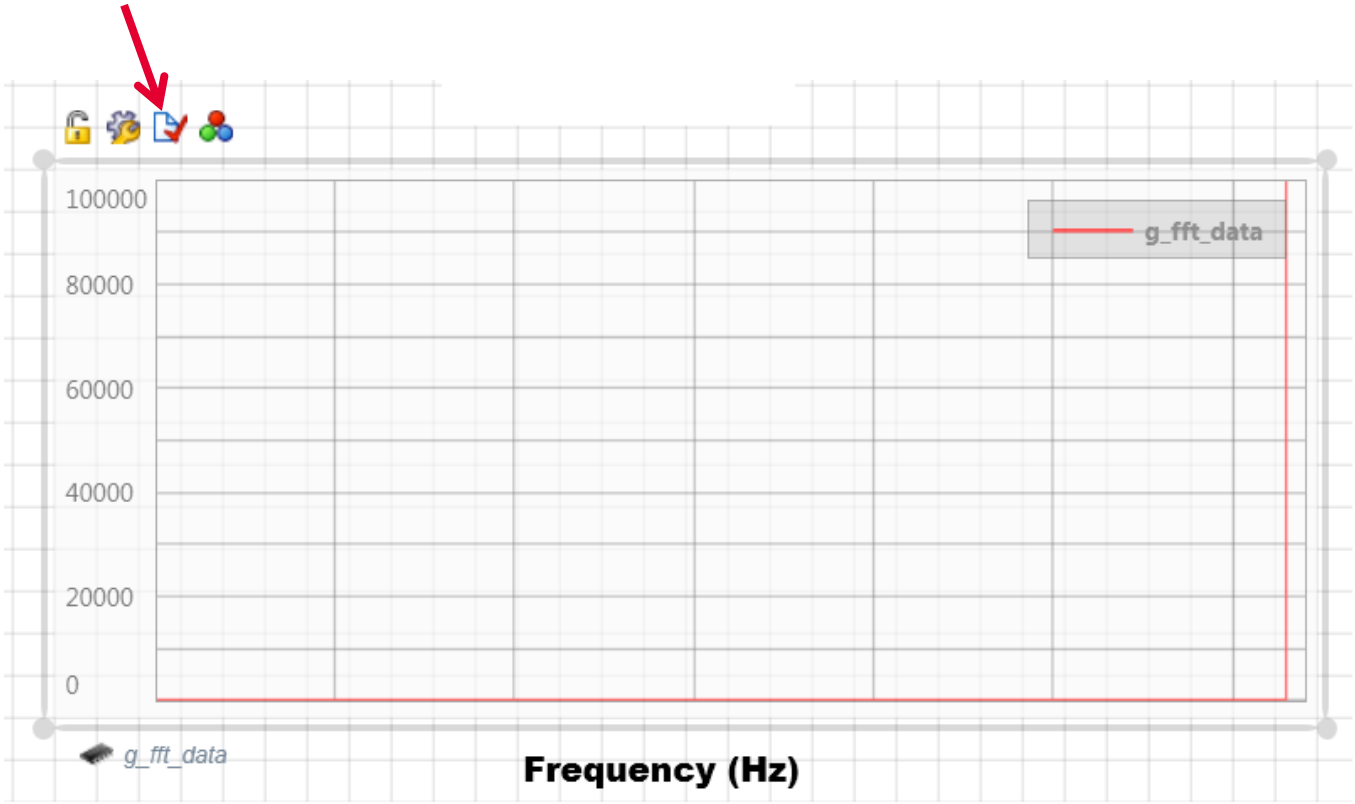
Configuration/Customization
Change Max. samples count in Time Graph

- Select Maximum samples on X-Axis equal to the FFT_SIZE value e.g. 256



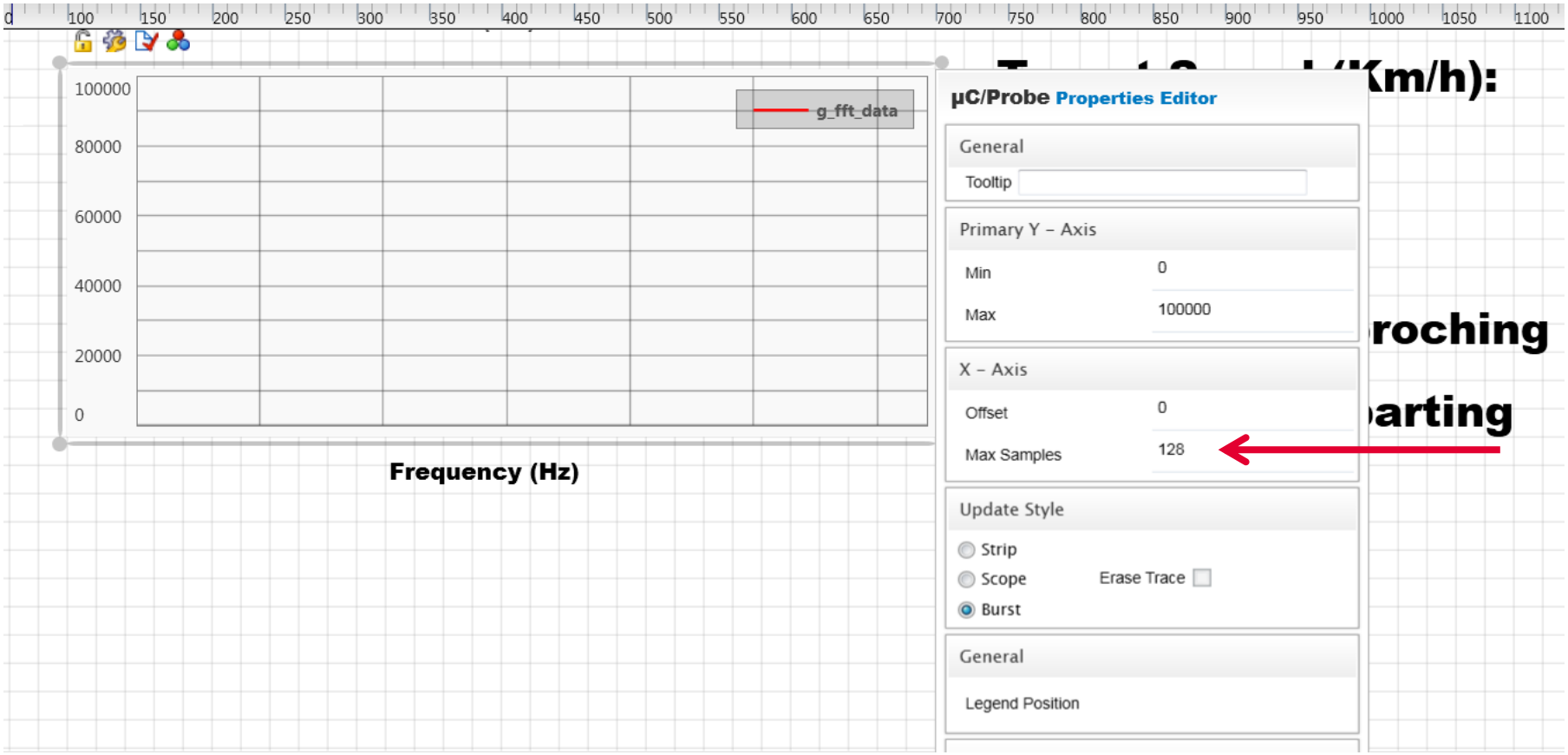
Configuration/Customization
Change Max. samples count in Freq. Graph

- When user click on the Frequency graph, four control icons appear at the top-left of the graph.
- Here, click on the Properties Editor of Frequency graph as shown below.



Configuration/Customization
Change Max. samples count in Freq Graph

- Select Max samples on X-axis equal to the FFT_SIZE/2 value
  - e.g. if FFT_SIZE = 256, then the value in Max. samples on X-Axis property should be set to FFT_SIZE/2 = 256/2 = 128



1 Overview

2 Development Tools Installation

3 Flashing and Debugging

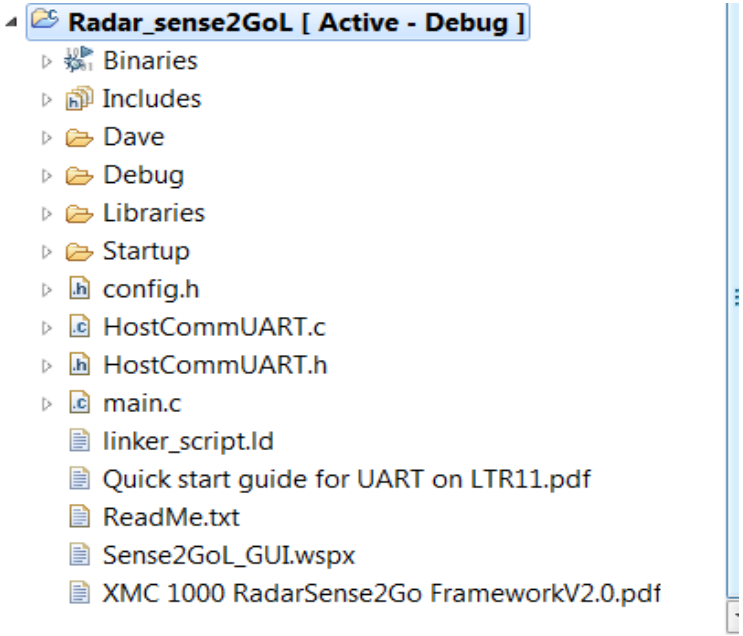
4 Configuration/Customization

5 GUI

6 UART data streaming

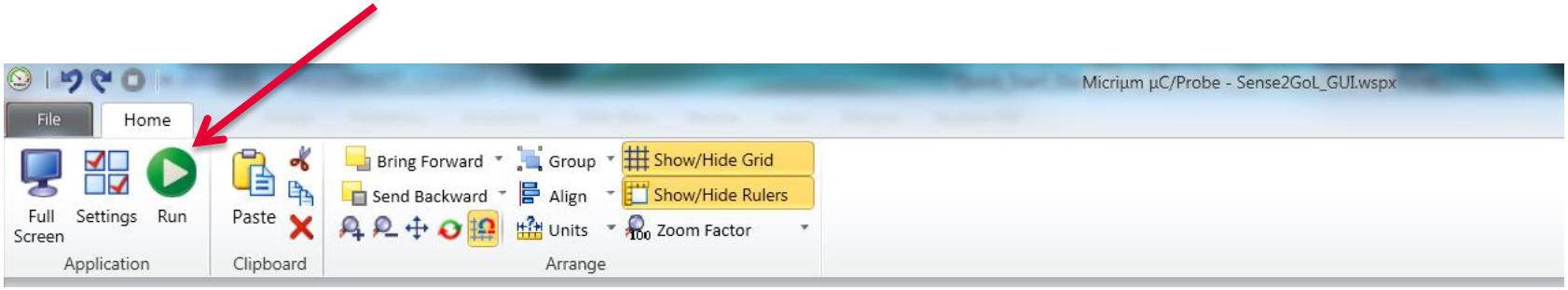
GUI
Overview

- 1. Open GUI by opening uC/Probe project inside FW
  - Sense2GoL_GUI.wspx
  - Can be done
    - In DAVE™ by double clicking file
    - In file explorer by double clicking file



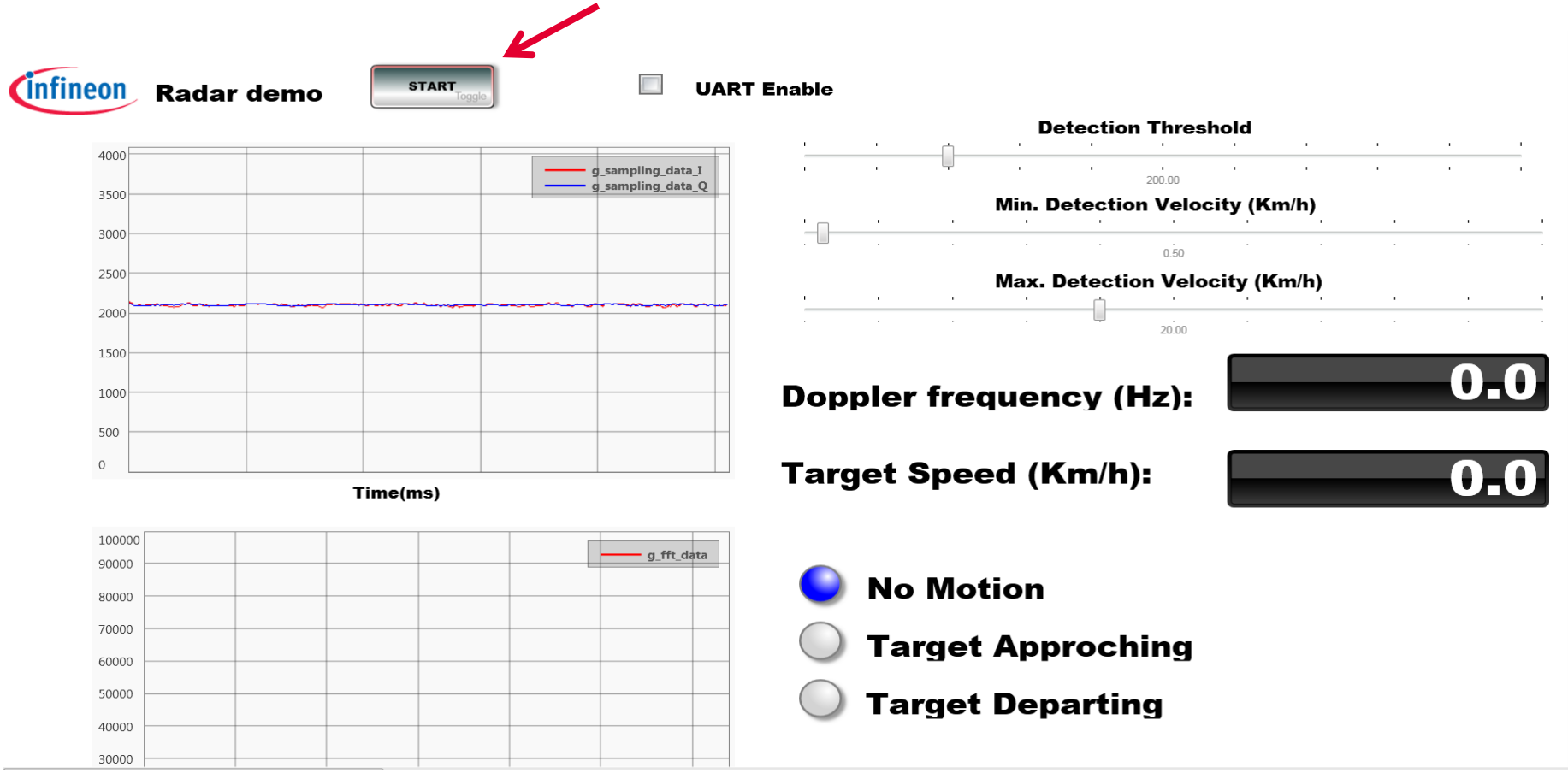
GUI
Overview (cont´d)

- 2. Connect Sense2GoL kit via USB
  - Please ensure USB port on debugger board is connected
- 3. Start GUI by clicking **Run** button



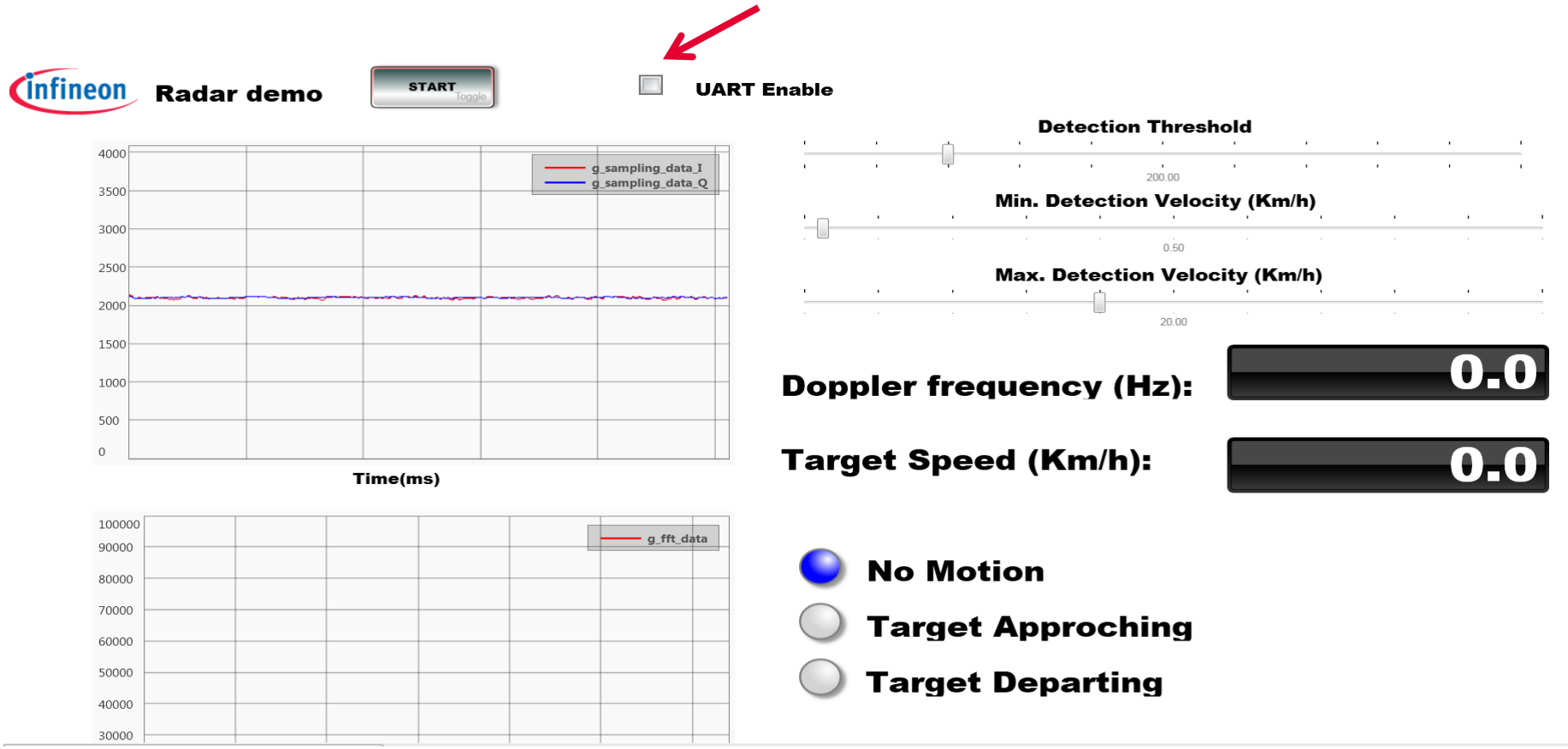
GUI
Starting GUI

- The following GUI should appear… size appropriately to fit screen
  - **PRESS START TO BEGIN DATA COLLECTION**



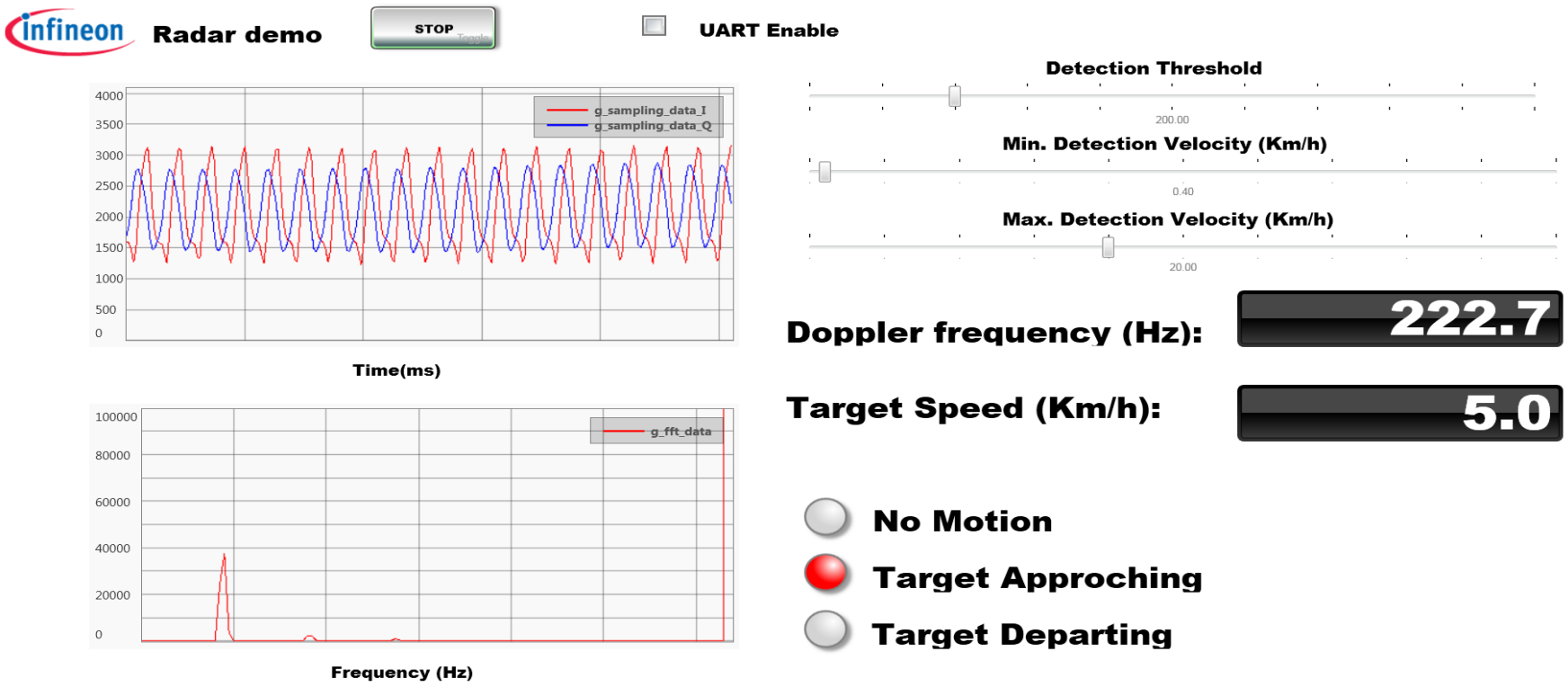
GUI
Capture Raw IQ ADC Samples via UART

› In order to capture the raw ADC samples via UART, click on the UART Enable check-box

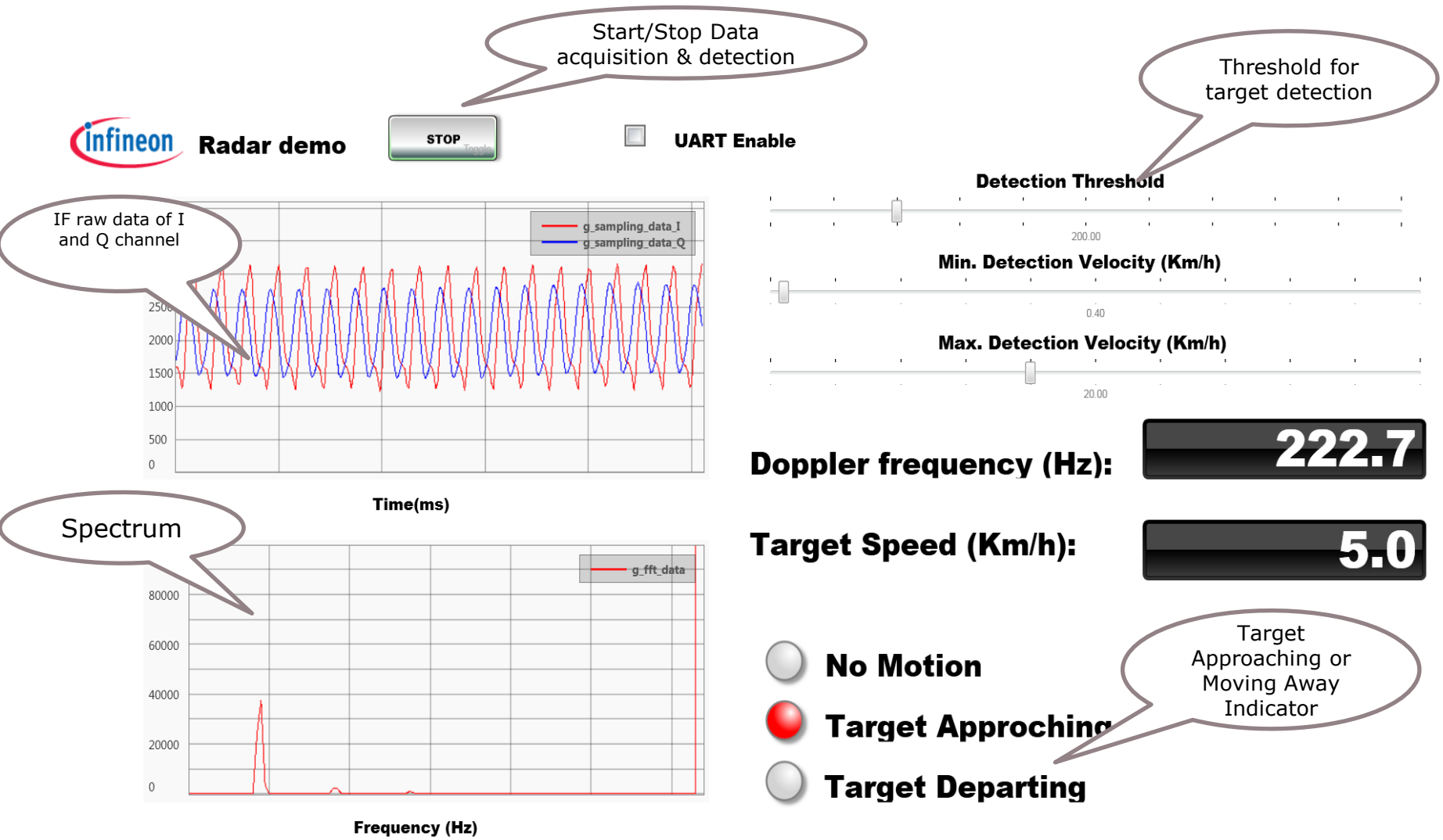


GUI Observations

- The radar should now detect movement and display data on GUI
  - Time & Frequency plots
  - Threshold can also be set, default 200
  - Minimum velocity (default 0.40km/h) and Maximum velocity (default 20km/h)
  - Max Doppler Frequency & Target Speed
  - Direction of Movement



GUI Reference



1 Overview

2 Development Tools Installation

3 Flashing and Debugging

4 Configuration/Customization

5 GUI

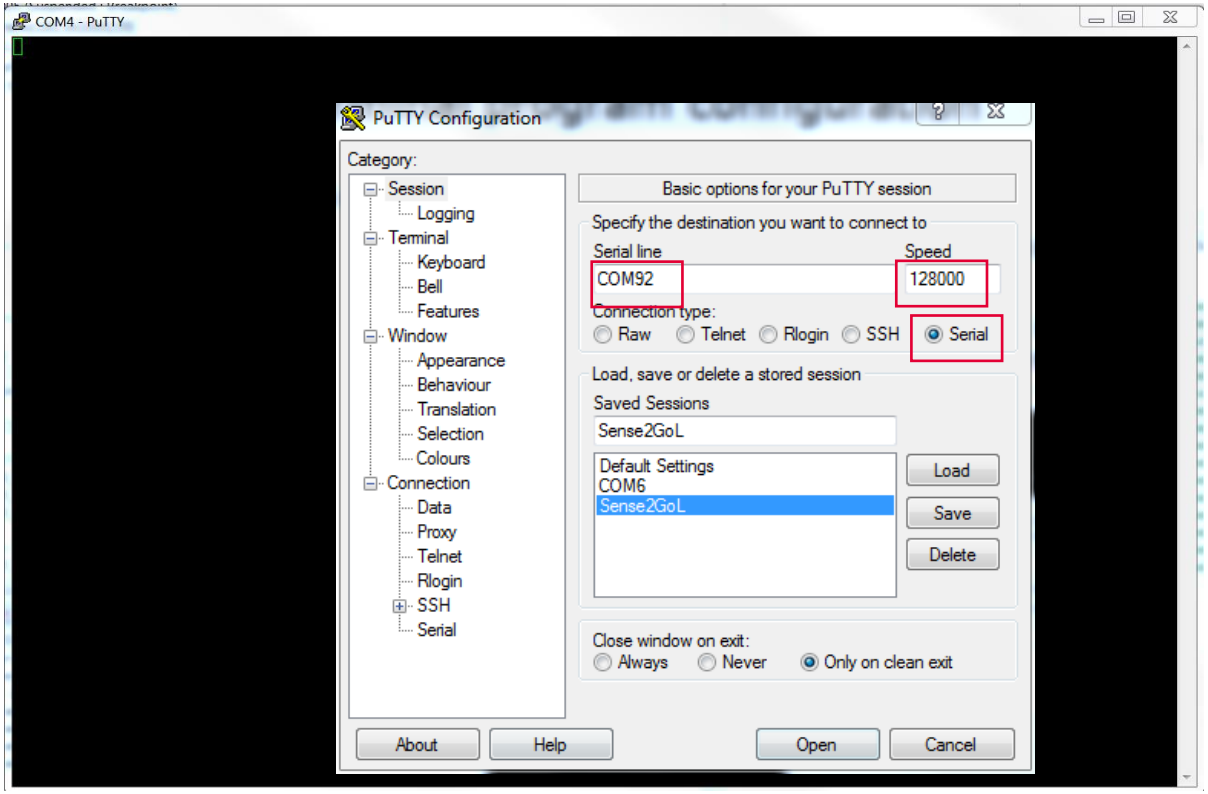
6 UART data streaming

UART data streaming
Overview

- Sampled ADC data is streamed by default via UART connection
- Via the transferred data it is possible to
  - View and export ADC data via Terminal program
  - Transfer data to MATLAB for processing

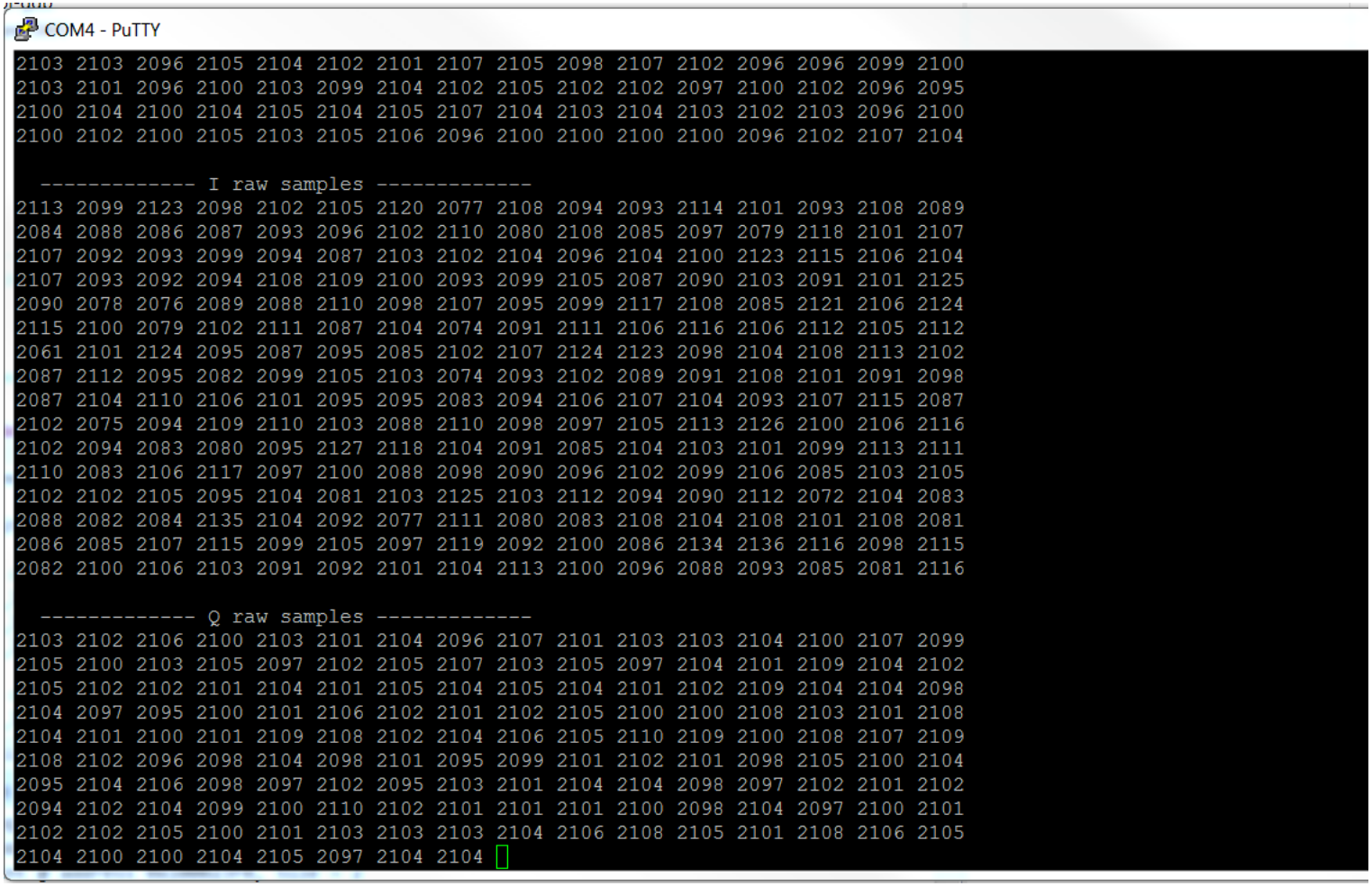
UART data streaming
Terminal program configuration

- Configure PuTTY
  - UART Configurations: Full-duplex, Direct mode, 128000 baud rate, 8 data-bits, 1 stop-bit, no parity
  - COM port number depends upon the HOST PC, look into the device manager for the COM port number your Sense2GoL connected, in this example it is COM92



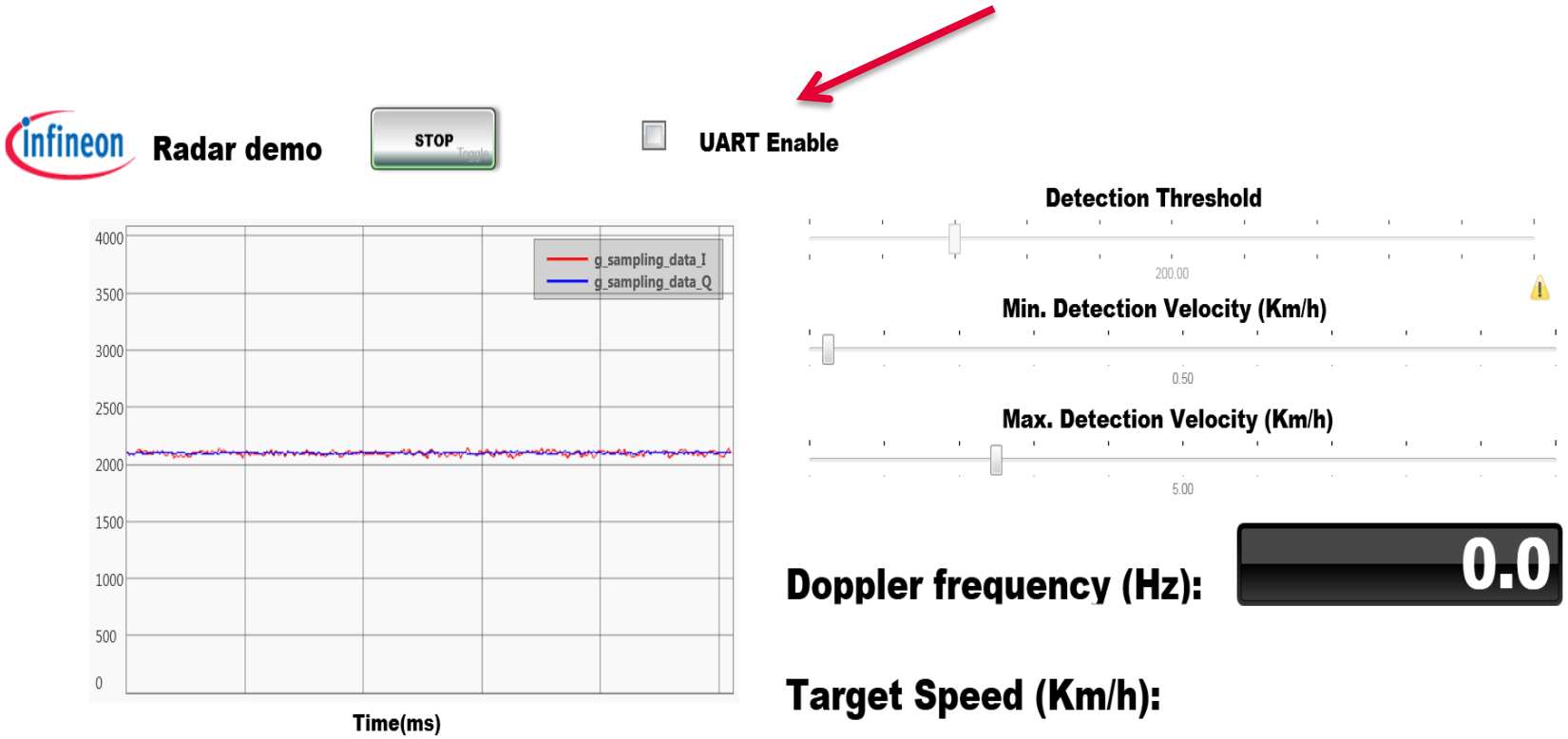
UART data streaming
Terminal program output

› Output a the PuTTY shell for the I and Q raw samples look like:



UART data streaming
Micrium GUI UART Setting

› Please ensure that UART streaming is enabled. By default it is but can be changed in Micrium GUI by disabling checkbox.



UART data streaming
Features of UART Library

- This UART Sense2GoL library supports the following data to be dumped at the HOST:
  1. Send raw ADC data to Host
     - I and Q (first 128 samples of I , followed by next 128 samples of Q)
     - Only I (128 samples)
     - Only Q (128 samples)
  2. Doppler measurements and FFT spectrum to Host
  3. Signed 16-bit, unsigned 16-bit and 32-bit are supported
  4. Any processing on the result needs to be done in **radarsense2gol_result()**

UART data streaming
Methods supported by UART Library

1. **dumpRawIQ_int16**
2. **dumpRawIQ_uint16**
3. **dumpRawIQ_uint32**
4. **dump_val_int16**
5. **dump_arr_int16**
6. **dump_val_uint16**
7. **dump_arr_uint16**
8. **dump_val_uint32**
9. **dump_arr_uint32**
10. **dump_val_float**

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