Talaria TWO™ (INP2045)

Ultra-Low Power Multi-Protocol Wireless Platform SoC

IEEE 802.11 b/g/n, BLE 5.0

User Guide for Talaria TWO MPD Demo Tool - Overview

Release: 10-30-2023

Revision History

Version	Date	Comments
0.6.1	07-21-2020	First release.
1.0	09-23-2020	Updated for SDK 2.1.1 release & MPD Tool version v1.1.
2.0	05-13-2021	Updated for SDK 2.2 release & MPD Tool version v2.2.
2.1	07-05-2021	Added note for PROG RAM functionality.
3.0	08-12-2021	Updated for SDK 2.3 release.
3.1	08-27-2021	Updated for SDK 2.3.1 release.
4.0	09-21-2021	Low Power Scan added as part of SDK 2.4 release – still need to be added.
4.1	10-13-2021	Updated with the following: - One-Click Installation of libusbk driver Help option for the Tool
4.2	11-16-2021	Updated Appendix with steps to assign a new EVK serial number to device.
4.3	01-25-2022	Updated Demo Tool GUI.
4.4	02-01-2022	Updated MQTT broker.
4.5	02-16-2022	Updated prerequisites with the requirement of Microsoft Visual C++ Redistributable Software Package.
5.0	05-16-2022	Updated with Otti logs for MPD and iPerf3 modes as applicable.
5.1	06-09-2022	Updated with Wireshark captures for MPD and iPref3 as applicable.
5.2	06-29-2022	Split the MPD demo tool documentation into multiple parts.
5.3	07-07-2022	Updated for SDK 2.5 release.
5.4	08-05-2022	Updated driver installation for Windows OS.
5.5	08-23-2022	Updated list of Regulatory Domains.
6.0	09-06-2022	Updated to reflect the appropriate Max_Listen_Time for Standard Scan.
6.1	10-17-2022	Updated for SDK 2.6 release.
6.2	10-27-2022	Updated to reflect the "View Menu option" of the console.
6.3	11-18-2022	Updated with Prerequisites to run the application in Linux.
7.0	08-21-2023	Updated to include steps to add a new serial number to the Talaria TWO EVK manually.
7.1	10-30-2023	Updated with the latest version of the MPD GUI Tool.

Contents

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Tables

Terms & Definitions

AP	Access Point
ARP	Address Resolution Protocol
COM	Composite Device Driver
ELF	Extensible Linking Format
EVK	Evaluation Kit
FTDI	Future Technology Devices International
GARP	Gratuitous Address Resolution Protocol
GUI	Graphical User Interface
HTTP	Hyper Text Transfer Protocol
HTTPS	Hyper Text Transfer Protocol Secure
iPerf	Internet Performance Working Group
MPD	Multipurpose Demo
MQTT	Message Queuing Telemetry Transport
SSID	Service Set Identifier
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
URL	Uniform Resource Locator
USB	Universal Serial Bus

Introduction

This document provides an overview of the Talaria TWO MPD Demo Tool, which is a GUI tool that enables quick evaluation of power consumption and throughput performances of Talaria TWO modules. This tool is bundled with two applications:

- Multipurpose Demo (MPD) primarily intended to verify power consumption under various protocol scenarios (such as TCP, UDP, HTTP etc.)
- iPerf3 application to showcase throughput performance
- Standard scan and Low power scan, which enables to configure different scan feature

Note: A detailed description of the different MPD, iPerf3 and Scan modes are described in Part 2 and Part 3 of the MPD Demo Tool User Guide respectively.

This GUI is intended for use with the INP3010 and INP3011 Talaria TWO evaluation boards to enable easy programming and accelerated evaluations.

Prerequisites

Each release of the Demo Tool is equipped with binaries for Windows and Linux operating systems, and signed firmware images (ELFs) for MPD and iPerf3 applications. Though this document specifically describes the use of the GUI on a Windows platform, the procedure is similar for Linux OS as well. The content of the release is shown in Figure 1

Application `INP_T2_Demo_Windows.exe` is for Windows platform while `INP_T2_Demo_Linux` is for the Linux OS.
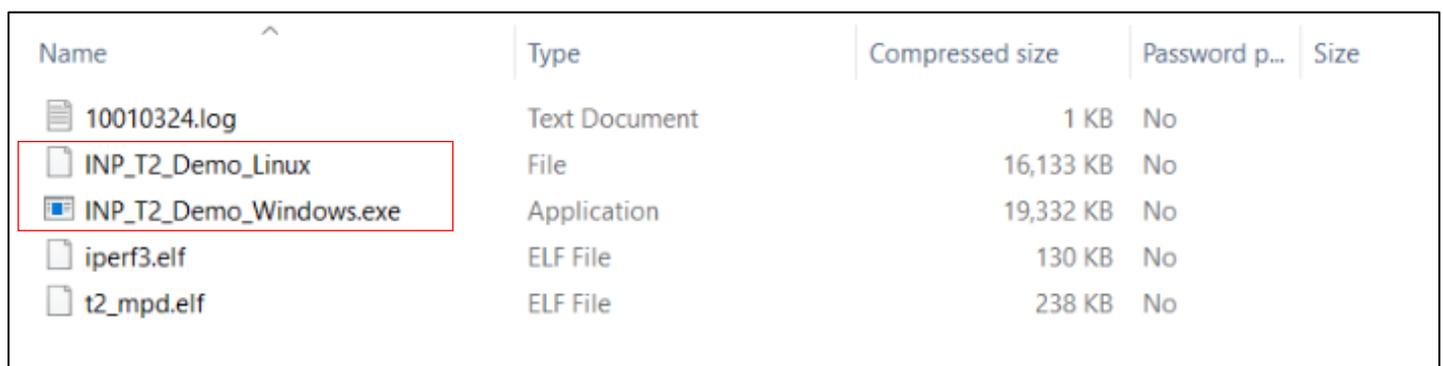
Name	Type	Compressed size	Password p...	Size
10010324.log	Text Document	1 KB	No	
INP_T2_Demo_Linux	File	16,133 KB	No	
INP_T2_Demo_Windows.exe	Application	19,332 KB	No	
iperf3.elf	ELF File	130 KB	No	
t2_mpd.elf	ELF File	238 KB	No	

Figure 1: Folder Contents

Using MPD Tool in Linux

There are two ways in which the `INP_T2_Demo_Linux` can be used in Linux:

1. Run the `INP_T2_Demo_Linux` tool from terminal with sudo command. For example:

```
sudo /home/sdk_x.y/pc_tools/MPD/bin/INP_T2_Demo_Linux
```

Note: x and y in sdk_x.y refers to the SDK package release version.

2. Double click on `INP_T2_Demo_Linux`.

Add udev rules and double click on the feature to extend folder access permission. Execute the following steps:

Step 1: Create `Libusb_T2.rules` file in */etc/udev/rules.d* directory.

Step 2: Add the following rules to `Libusb_T2.rules` file.

Libusb_T2.rules:

```
SUBSYSTEMS=="usb", ATTRS{idVendor}=="0403", ATTRS{idProduct}=="6011",

GROUP="users", MODE="0666"
```

In case of `Permission Denied` error, execute the following step (Step 3) to extend folder access permission.

Step 3: Run the following command in the terminal to extend permissions to the selected folder and its files.

```
sudo chmod -R a+rwx /Path/to/sdk folder
```

The Demo tool verifies the signature of the ELFs prior to downloading it onto the evaluation board. In case the ELFs are tampered with, an error message as shown in Figure 2 is printed on the console.
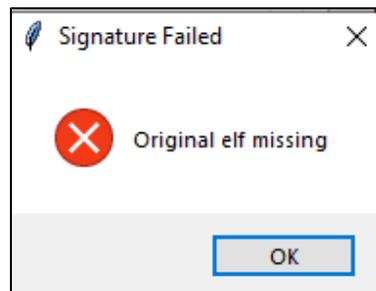
Figure 2: Signature failed window

The Talaria TWO evaluation board uses FT4323h, which is a 4-port USB to UART converter with MPSEE support. By default, these ports enumerate as COM ports in Windows OS which does not take advantage of the MPSEE capabilities of the FTDI device. The usage of these ports in the evaluation board is given in Table 1.

Port	Usage
A	Connected to JTAG pins, this enables JTAG debugging using OpenOCD
B	Connected to EN_CHIP pin, which enables resetting the module
C	Connected to UART pins, this is used for programming the module
D	Connected to GPIO17 pin which is the default debug log console port

Table 1: Usage of ports in the evaluation board

To utilize these capabilities, on Windows OS, `libusbK` driver needs to be installed to communicate and control the Talaria TWO module via the FTDI device on the evaluation board. The tools/applications provided by InnoPhase IoT will use this driver.

Talaria TWO Demo Tool comes with an option of `One-Click Installation` of libusbk driver. In case the driver is not installed, the tool will ask for user confirmation to install this driver. If the user selects `yes`, various `User Account Control` authentication screens will appear to complete the driver installation (as shown in Figure 5).

Note:

1. In case of any other unwanted libusbk drivers that are already installed, the tool will automatically uninstall the unwanted drivers. This action needs `User Account Control` authentication screens shown in Figure 6, in addition to Figure 5. Each unwanted drives will require a separate `User Account Control` authentication for uninstallation.

2. Talaria TWO Evaluation Board may get detected under any already installed device driver (using `libusbk` driver). In this case, the tool will follow the procedure of `One-Click Installation` of libusbk driver (as shown in Figure 5), and might get completed a with pop-up message "`Driver Installation Failed`". This will result in any one of the following two conditions:

   a. Device found: EVK serial number field in the download tool GUI is populated with appropriated EVK serial number. In this case, ignore the error message "`Driver Installation Failed`" and continue using the tool. To avoid this from happening repeatedly, update the driver for Talaria TWO Evaluation Board to "`InnoPhase T2 Evaluation Board`" driver, from device manager (as shown in Figure 3). Then, ensure the Talaria TWO Evaluation Board is detected under "`libusbK USB Devices`" in device manager (as shown in Figure 4).
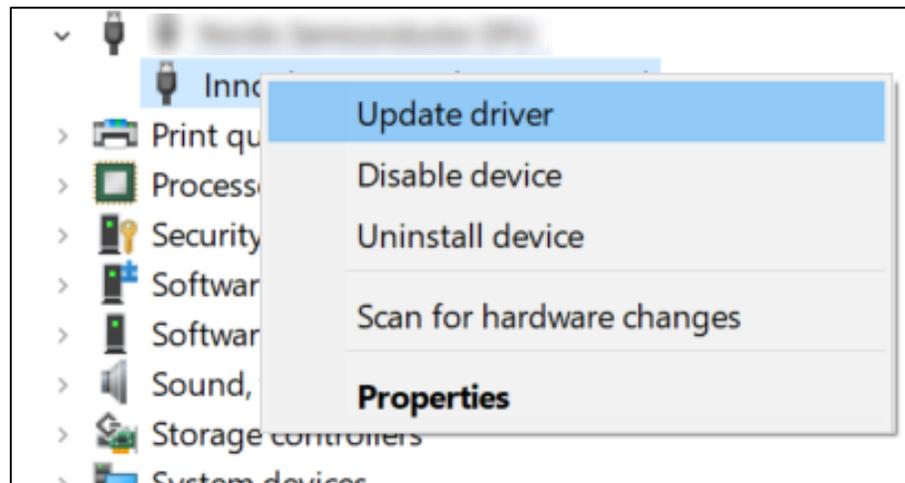
Figure 3: Update device driver for Talaria TWO Evaluation Board

b. No device found: Manually install the driver using instructions from section: Installation Instructions for libusbK Driver and ensure that the Talaria TWO Evaluation Board is detected under `libusbK USB Devices` driver (as shown in Figure 4).
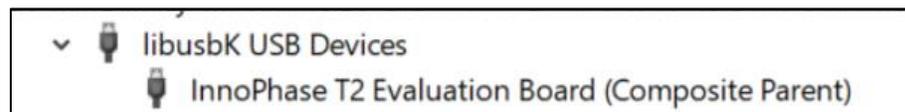
Figure 4: Talaria TWO Evaluation board under "libusbk USB Devices" driver

3. Even after successful installation of the driver, there might be possibility of the device not being identified for the first time. In this case, close the tool and re-open it. The user is notified of the same through a pop-up message: `No Device Connected. Please close and reopen the Tool.`
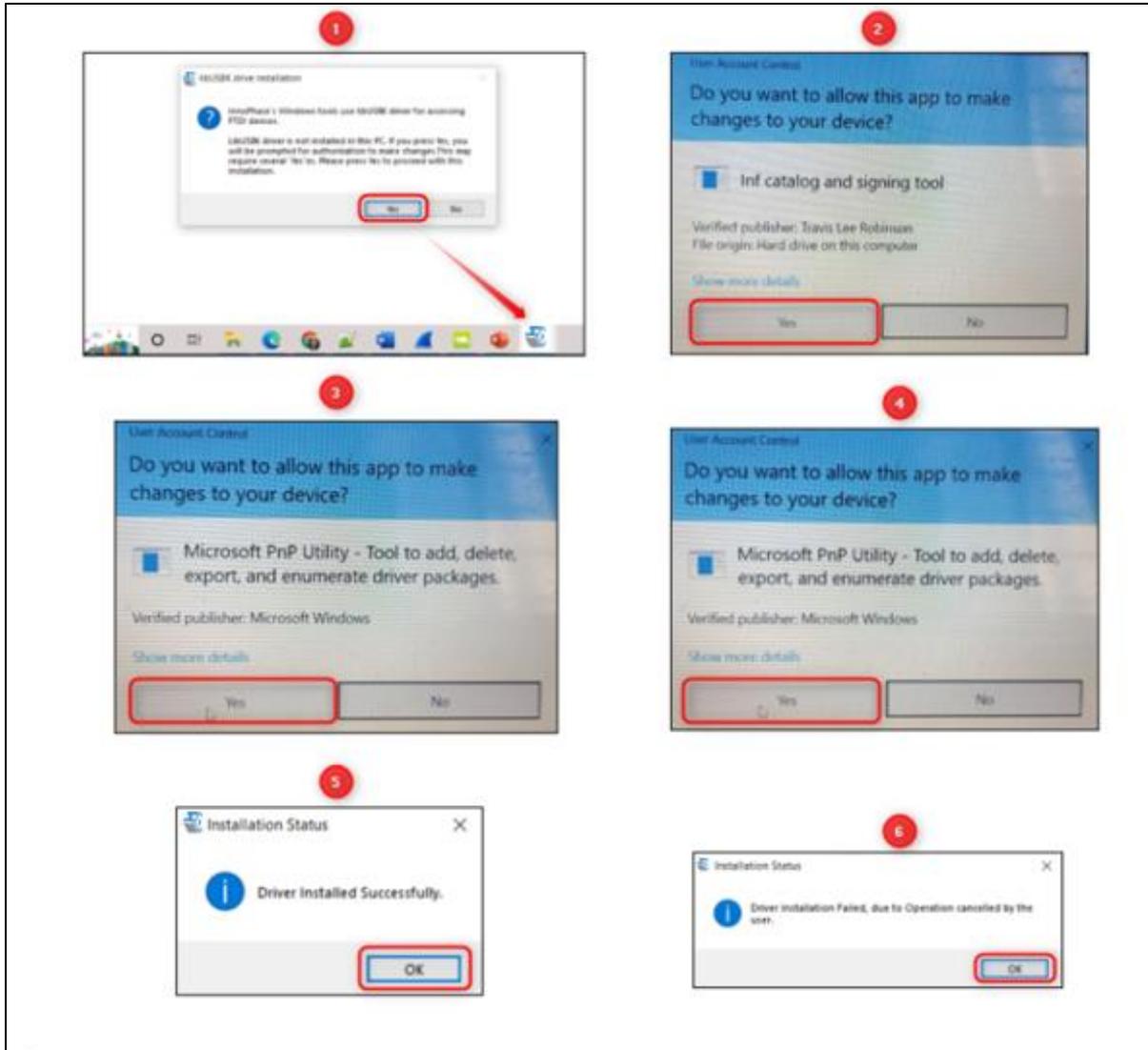
Figure 5: User Account Control authentication to complete driver installation

From Figure 5:

Image 1: Pop-up message for user confirmation, where the user chooses `Yes`.

Image 2: On clicking `Yes`, windows authentication prompt appears on Task bar.

Image 3: Click on `Yes` in the next window.

Image 4: Click `Yes` for the subsequent User Account Control authentication to complete driver installation.

Image 5: Pop-up message indicating successful driver installation.

Image 6: Pop-up message, in case of user chooses `No`.
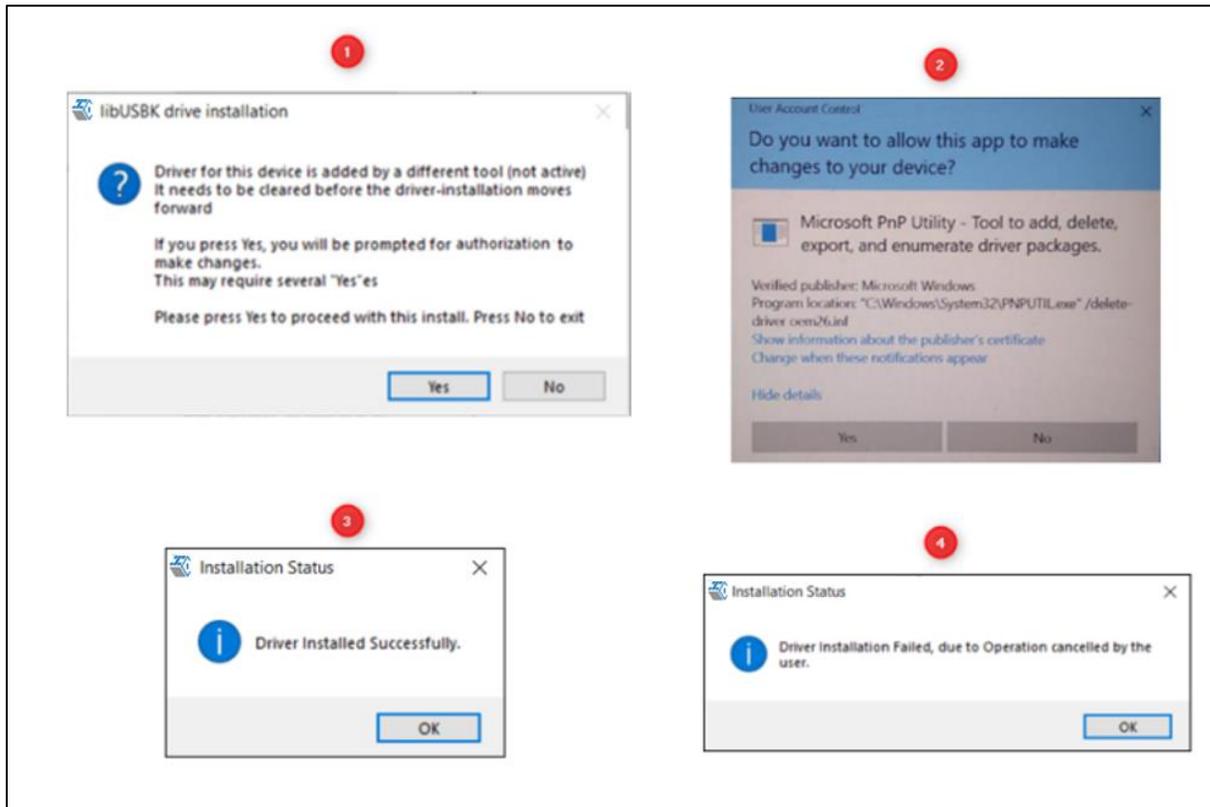
Figure 6: User Account Control authentication to delete unwanted libusbk drivers

From Figure 6:

Image 1: Pop-up message for user confirmation, where the user chooses `Yes`.

Image 2: Click `Yes` for the subsequent User Account Control authentication to delete unwanted drivers.

Image 3: Pop-up message indicating successful driver installation.

Image 4: Pop-up message, in case of user chooses `No`.

In case the driver installation using Talaria TWO Demo Tool is not successful, the user can manually install the driver using instructions in section: Installation Instructions for libusbK Driver. Instructions to change driver is available in section: Update Driver from libusK Driver to COM Port.

Microsoft Visual C++ Redistributable Software Package

Microsoft Visual C++ Redistributable software package is a prerequisite for Windows platform to run the application `INP_T2_Demo_Windows.exe` successfully. Incase this software package is not installed on the Windows platform, application will not launch, leading to a fatal error message as shown in Figure 7.

In such a scenario, install the Microsoft Visual C++ Redistributable software package using the link https://www.microsoft.com/en-in/download/details.aspx?id=48145 and relaunch the application.
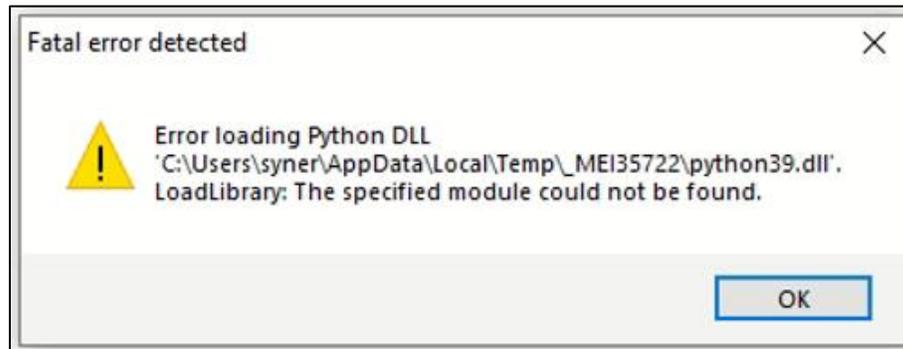
Figure 7: Error message for missing Microsoft Visual C++ Redistributable Software Package

Installation Instructions for libusbK Driver

Download the free software Zadig, available here: - **https://zadig.akeo.ie/.** Connect your Windows PC or Laptop to the evaluation board using the provided USB cable. Now, open Zadig and click on `Options`. Select `List All Devices` and deselect `Ignore Hubs or Composite Parents` as shown in Figure 8.
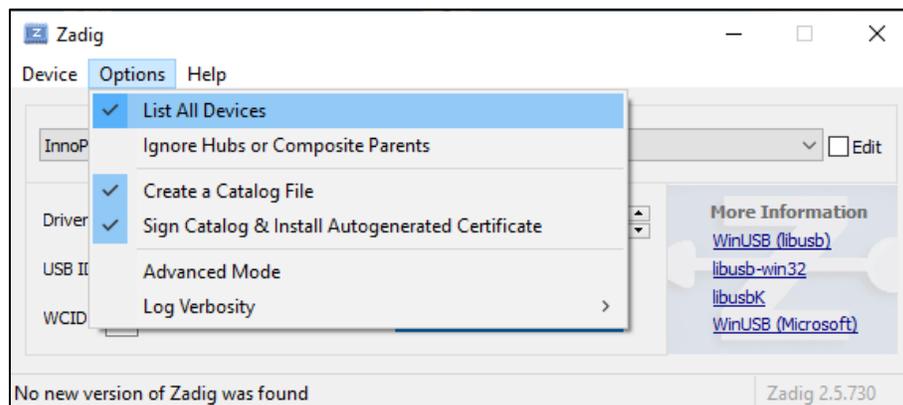
Figure 8: Listing devices in Zadig

To establish communication with Talaria TWO module via the FTDI device on the InnoPhase Evaluation Board, the Talaria TWO USB driver must be `libusbK`. In case the current driver is not `libusbK`, use the drop-down menu to select `libusbK` and click on `Replace Driver` which will update the drivers to `libusbK`.
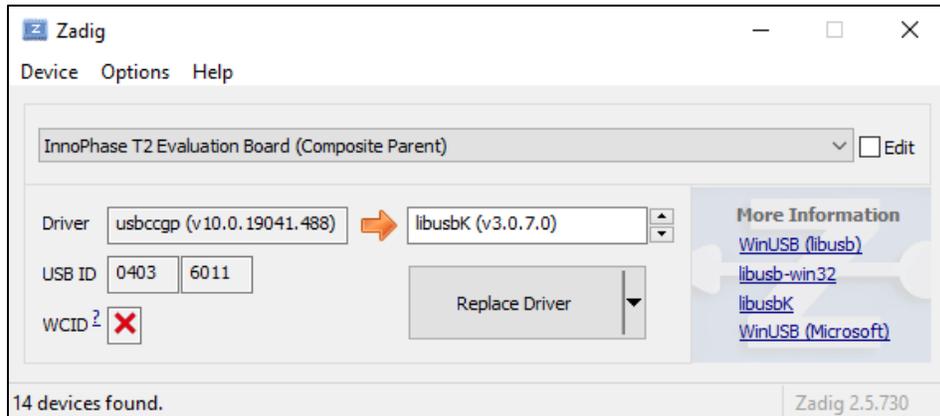
Figure 9: Updating Talaria TWO USB driver to libusbK

Block Diagram
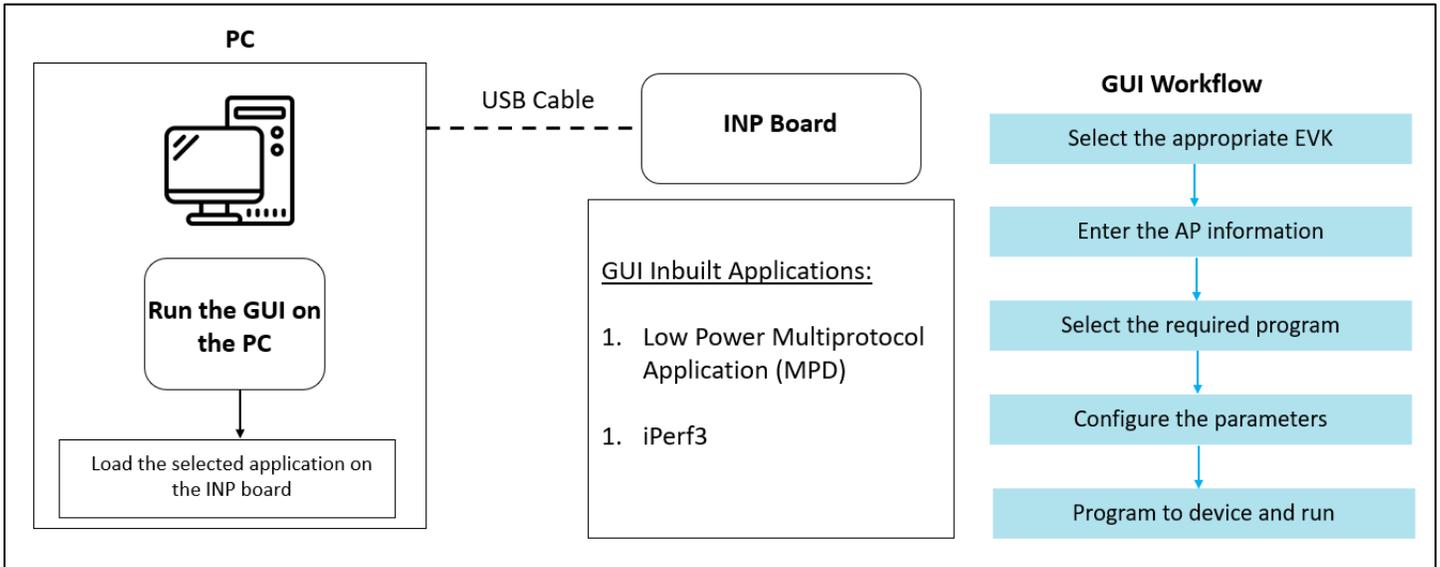
Figure 10: Block Diagram

GUI

On launching the application, the GUI window as shown in Figure 11 will come into view.

Note: In case of windows display setting `Scale and layout` is more than 125%, GUI window might go out of screen.
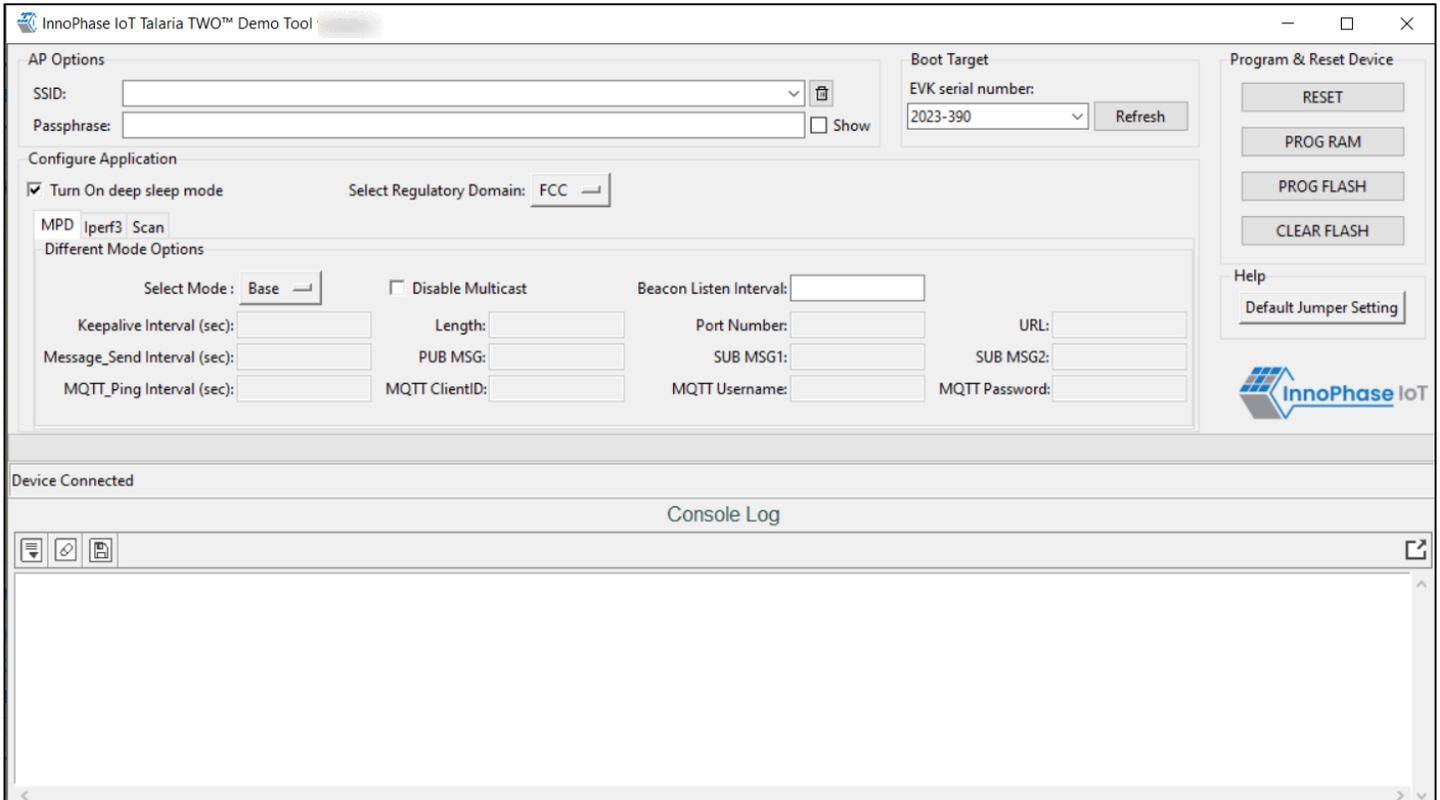
Figure 11: Demo Tool GUI

1. **Boot Target**: Connected EVKs appear in the EVK serial number drop-down and the appropriate EVK can be selected.

   Note:
   If any connected EVK devices do not have a serial number, the Download tool will automatically handle this by generating a new serial number and update the same onto the corresponding device. During this process, the tool will indicate this in the status bar, as shown in Figure 12.

   Format of the new serial number:
   ```
   <year_stamp>-<integer>
   ```
   where,
   - <year_stamp>: Current year. For example: 2023
   - <integer>: Formed from the sum of last 3 octets (in decimal) of the MAC address found in the device.
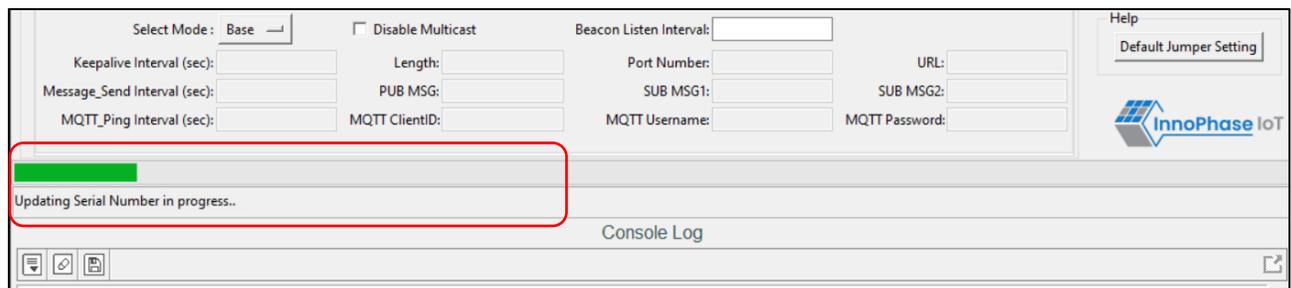
   Figure 12: Boot target – Serial number update

   Since a new serial number is generated from the MAC address of the device, devices with the same MAC address will get updated with the same serial number. This is an expected behavior.

   User can manually update the new serial number to the device following the instructions mentioned in section: New Serial Number to Device – Manual Method.

2. **AP Options**: The SSID and Passphrase entered in the respective fields will connect the EVK board to the Access Point. Once connected, as per requirement MPD/iPerf3/Scan applications can be loaded by selecting the appropriate tab.

3. **Configure the Application**: Configure the Setup Parameters:
   a. **Turn On deep sleep mode**: When the processor is idle or is waiting for an event or data to occur or be received, turning ON the `Turn On deep sleep mode` feature by checking the box adjacent to the field will put Talaria TWO in a power saving mode.

   b. **Select Regulatory Domain**: Depending on their region of operation, the user can select any one of the following appropriate regulatory domains to establish a connection between the EVK board and the Access Point:
      i. FCC
      ii. ETSI

        iii.   TELEC

        iv.   KCC

4. **Program and Reset the Device**:

    a. **Reset**:

       Reload the application in Flash memory

    b. **CLEAR Flash**:

       Erase the application in Flash memory

    c. **PROG RAM**:

       Program the application to RAM memory

    d. **PROG Flash**:

       Program the application to Flash memory

Note:

`PROG RAM` will clear the application from Flash. The user is alerted of the same during `PROG RAM` through a pop-up message as shown in Figure 13. User can select the `Do not show again` checkbox to stop this pop-up message from appearing next time.
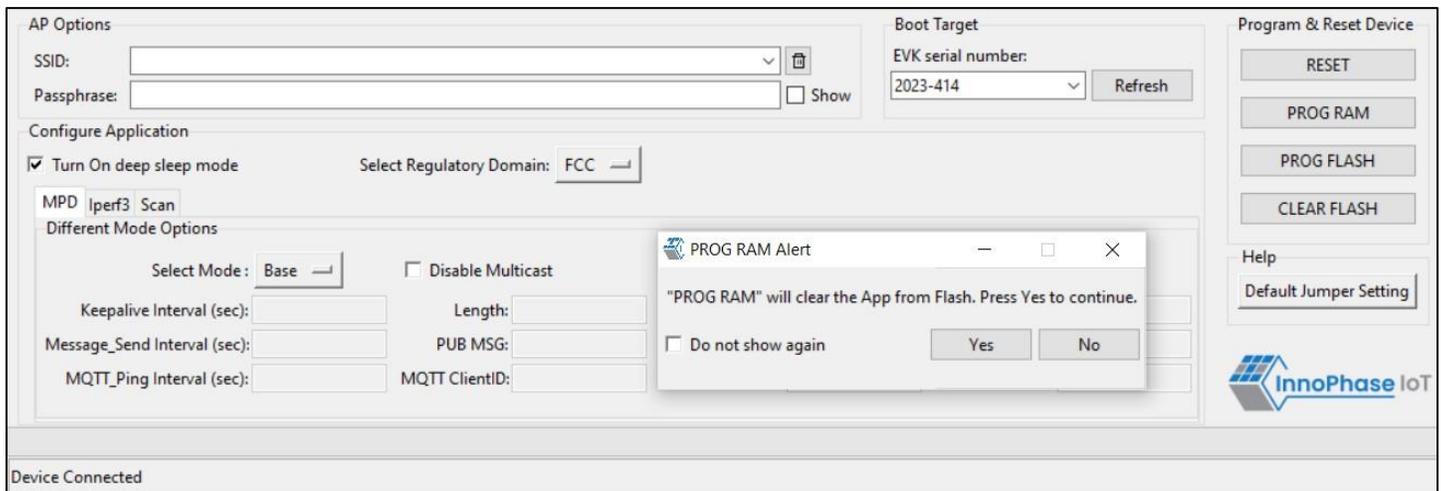
Figure 13: PROG RAM alert message

The console window is as shown in Figure 14.
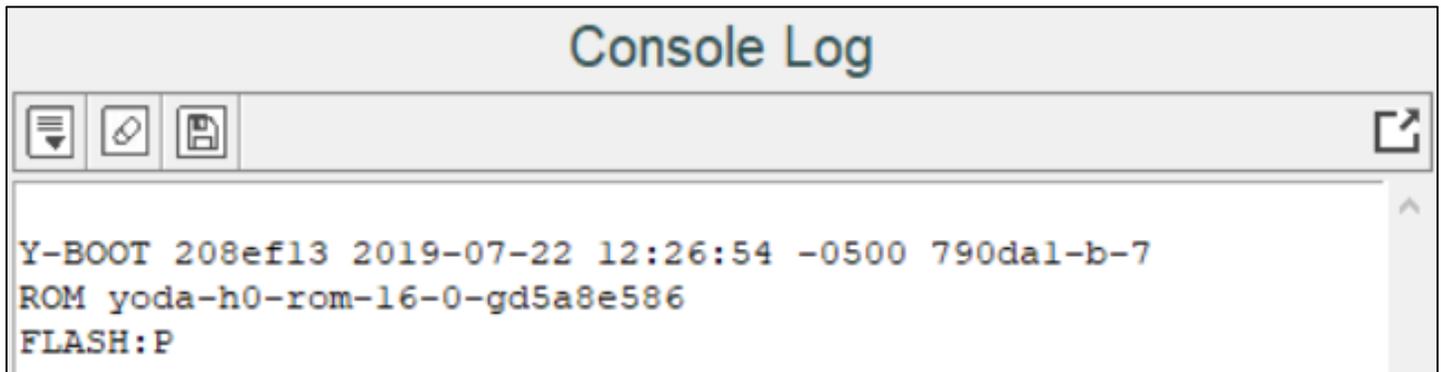
Figure 14: Console window

The console window has the following icons (with Hover Text):

1. **Auto Scroll** ⬇: Enables scrolling of console content till the end (default mode).

2. **Pause Scroll** ⬇: Turns OFF `Auto Scroll` mode.

3. **Clear Console** ⬧: Clears console window content.

4. **Save Logs** 💾: Opens a file dialog with `Console_Output.log` as the default file name to save the logs.

    Note: Only upcoming data after starting the `Save Logs` is saved in the file.

5. **Stop Save Logs** : Stops saving console logs to the file. This icon appears after `Save Logs` is started successfully.

6. **Pop Out** ↗: Pops out the console window separate from the GUI window.

7. **Pop In** ↗: Embeds the console and GUI window together.

Keeping this tool idle for a while (around 2 to 3 hours), may lead to loss of communication to the EVK device. This is indicated in the console as "`Error communicating with FTDI device`", as show in Figure 15. Workaround for this is as follows:

1. Close the tool
2. Unplug & re-plug the EVK
3. Re-open the tool again
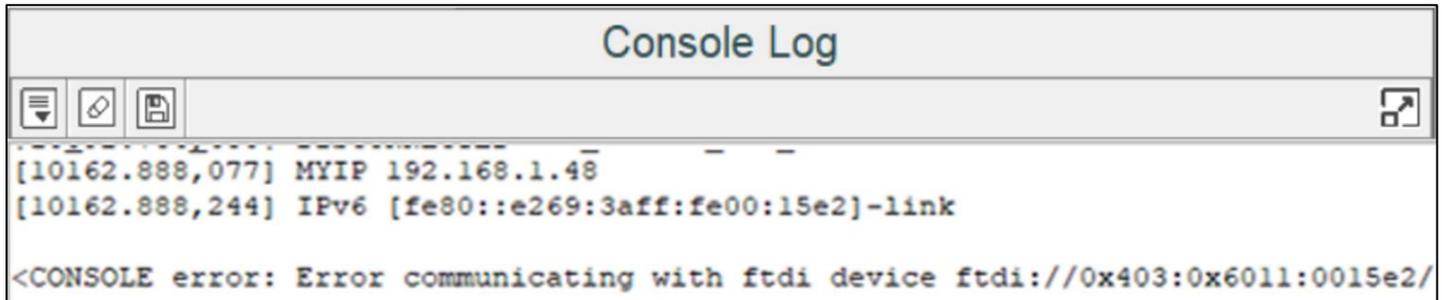
Figure 15: Error communicating with FTDI device

MPD

1. Enter the APs `SSID` and `passphrase` where, DTIM in the AP is set to 1.
2. To automatically load the signed firmware image for MPD application, select the MPD tab.
3. For all the modes, the `Keep Alive Wake time` is fixed as 2 in the application. This time is the time window in milliseconds during which Talaria TWO will wait in receive mode before going to sleep.
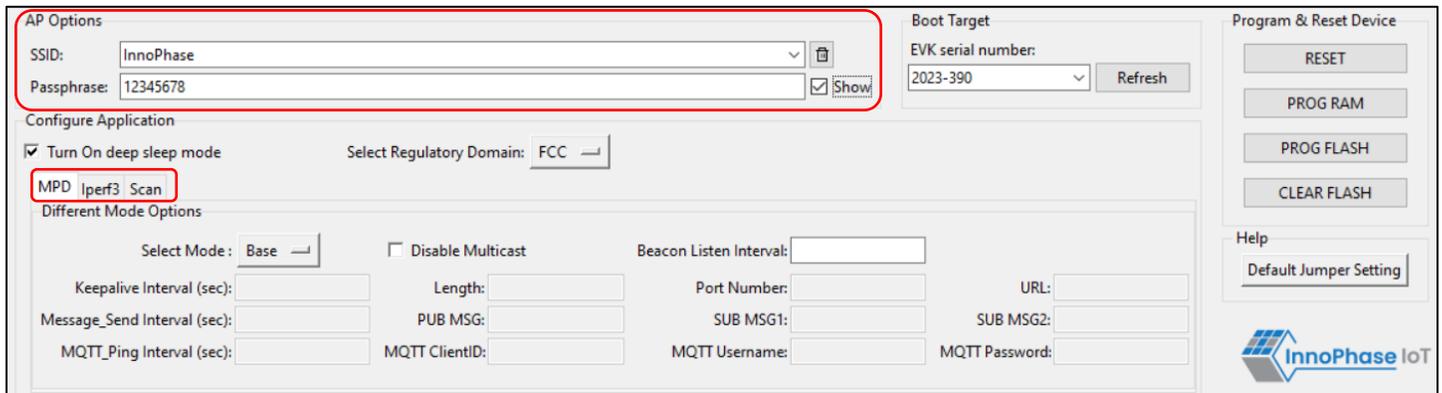
Figure 16: MPD tab

Note: Check the `Show` checkbox to see the passphrase value.

For more information on the different modes in which the MPD application can be used, refer document: `UG_MPD_Demo_Tool_Part_2_MPD_Modes.pdf` (*sdk_x.y\pc_tools\MPD\doc*).

Note: x and y in sdk_x.y refer to the SDK release version.

iPerf3

The iperf.exe application can be downloaded from the following link: https://iperf.fr/iperf-download.php

1. Enter the `SSID` and `passphrase`.
2. To automatically load the signed firmware image for iPerf3 application, select the iPerf3 tab.
3. It is recommended to click on `PROG Flash` to start Talaria TWO as a Server.

Figure 17: Selecting iPerf3

Note:

1. In case the `PROG RAM` option does not load the application, click on `PROG Flash`.
2. Work around for the above limitation is to click `Reset` before clicking on `PROG RAM` again.
3. Work around for error with `CLEAR Flash` option: Click `Reset` before clicking on `CLEAR Flash` again.

For more information on the different modes in which the iPerf3 application can be used, refer document: `UG_MPD_Demo_Tool_Part_3_iPerf3_and_Scan.pdf` (*sdk_x.y\pc_tools\MPD\doc*).

Scan

The `Scan` tab allows the user to actively scan for nearby Access Points.

Figure 18: Scan tab

Choose the Scheme: User can choose Standard Wi-Fi Scan or Low-Power Wi-Fi Smart Scan for scanning.

1. **Standard Wi-Fi Scan**: In this scan mode, Talaria TWO scans each channel with the configured scan time (default being 40ms).
2. **Low Power Wi-Fi Smart Scan**: In this scan mode, Talaria TWO reduces the overall current consumption by enabling dynamic dwelling and napping features.

Default values of parameters for `Standard Wi-Fi` and `Low-Power Wi-Fi` scan are shown in Table 2. Depending on the user's choice of the scanning scheme, respective default values will be set to corresponding parameters.

Default Value			
Parameters	**Standard Wi-Fi scan**	**Low-Power Wi-Fi Scan**	**Remark**
No_of_Probes	2	1	Configurable
Ide_Slots	3	3	Configurable
Select the Required Probe Rate	11b_1Mbps	11b_6Mbps	Configurable
NAP Enable	No	Yes	Hard coded

Table 2: Default values for Standard Wi-Fi and Low-Power Wi-Fi Scan

The following scan parameters can be configured from the tool:

1. `SSID` (optional): Providing the SSID helps enable scan for a specific AP.
2. `BSSID` (optional): Providing the BSSID helps enable scan for a specific AP.
3. `No_of_probes`: Maximum number of probes to send in an active scan.
4. Idle slots: Maximum number of idle slots to decide whether the user should keep listening or not.
5. `Min_Listen_Time(ms)`: Minimum amount of time (in milliseconds) to listen for probe responses on the channel after transmitting the probe request.
6. `Max_Listen_Time(ms)`: Maximum amount of time (in milliseconds, including listen and probe requests) to stay on the channel.
7. `Wait_Time(ms)`: Idle time between each channel (giving other parties access to the media).
8. `Scan Interval (ms)`: Time duration in milliseconds in which Talaria TWO scans the vicinity for networks.
9. `Probe_rate`: The rate as defined by `rate_t` used to transmit the probe request. If this field is set to `0xffff`, no probes will be sent and the scan will only be passive.

For more information on the Standard Wi-Fi and Low Power Wi-Fi scan, refer document:
`UG_MPD_Demo_Tool_Part_3_iPerf3_and_Scan.pdf` (*sdk_x.y\pc_tools\MPD\doc*).

Help

Help provides information about default Jumper/Switch settings. Clicking on `Default Jumper Setting` as shown in Figure 19 will pop-up new window with default Jumper/Switch settings information as shown in Figure 20.
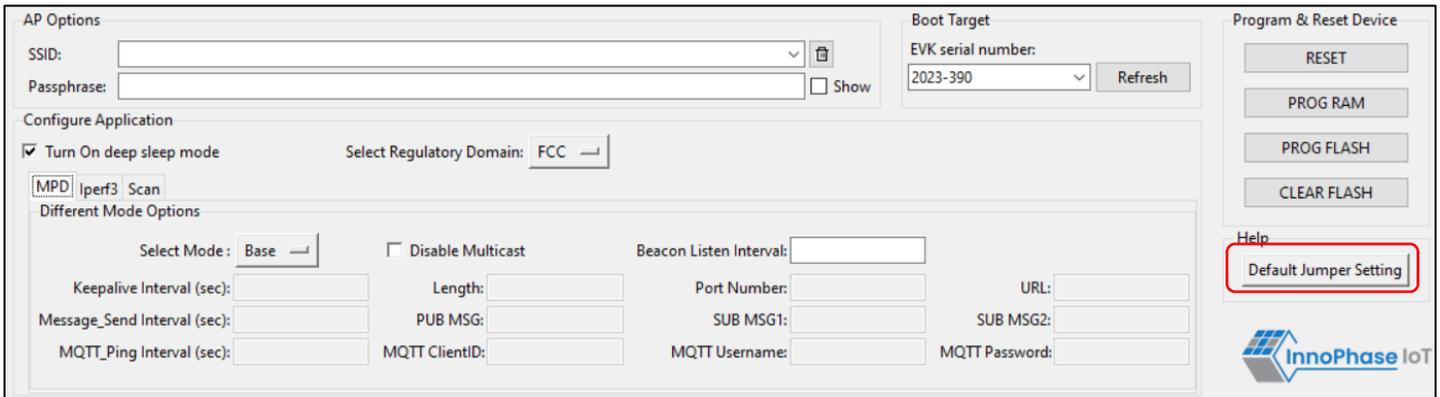
Figure 19: Help Frame
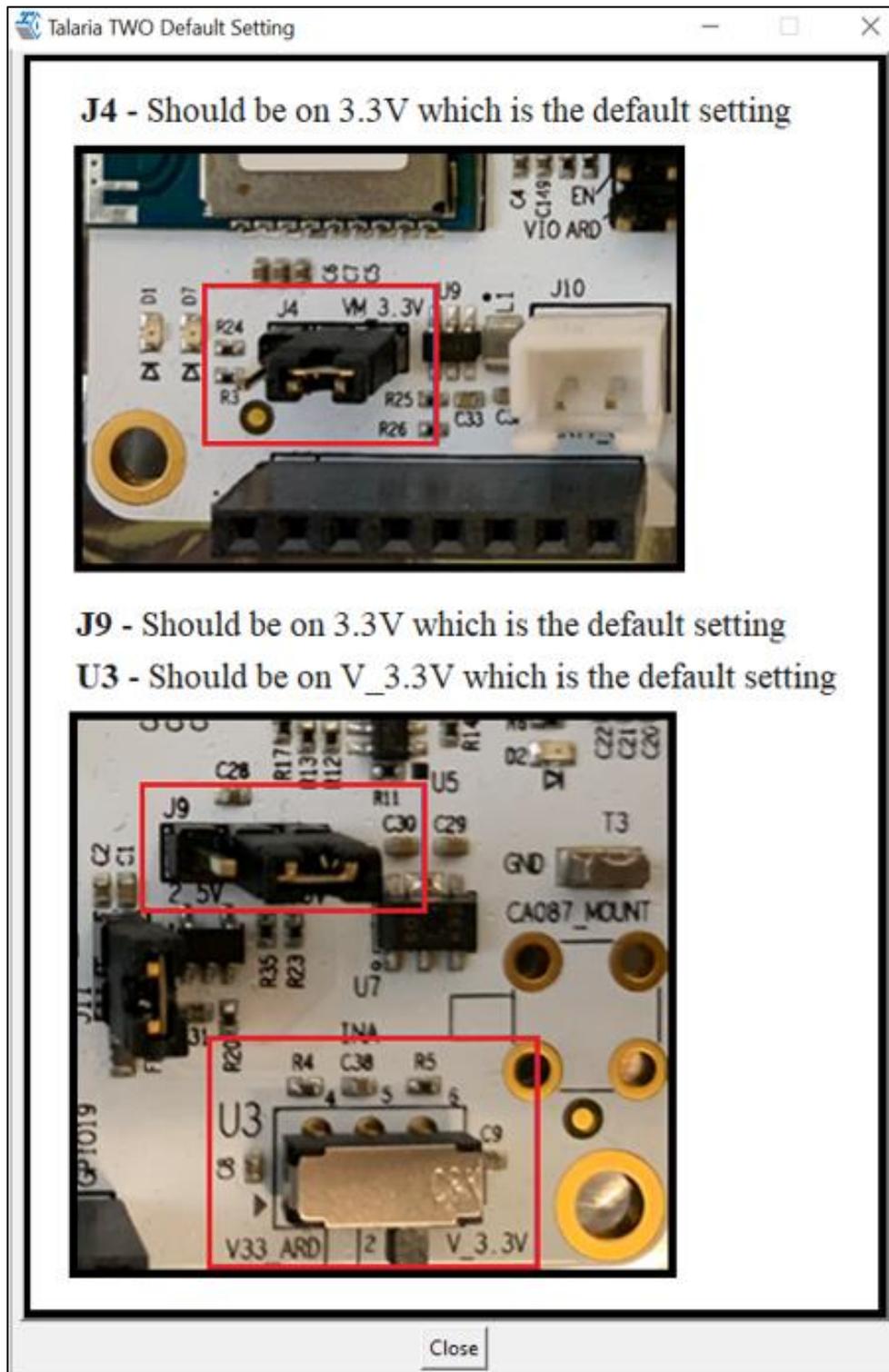
Figure 20: Default Jumper/Switch setting Window

Note: Default Jumper/Switch setting window will appear every time when tool is launched, as shown in Figure 21. To turn this feature OFF permanently, check the `Do not show again` option and close the window.
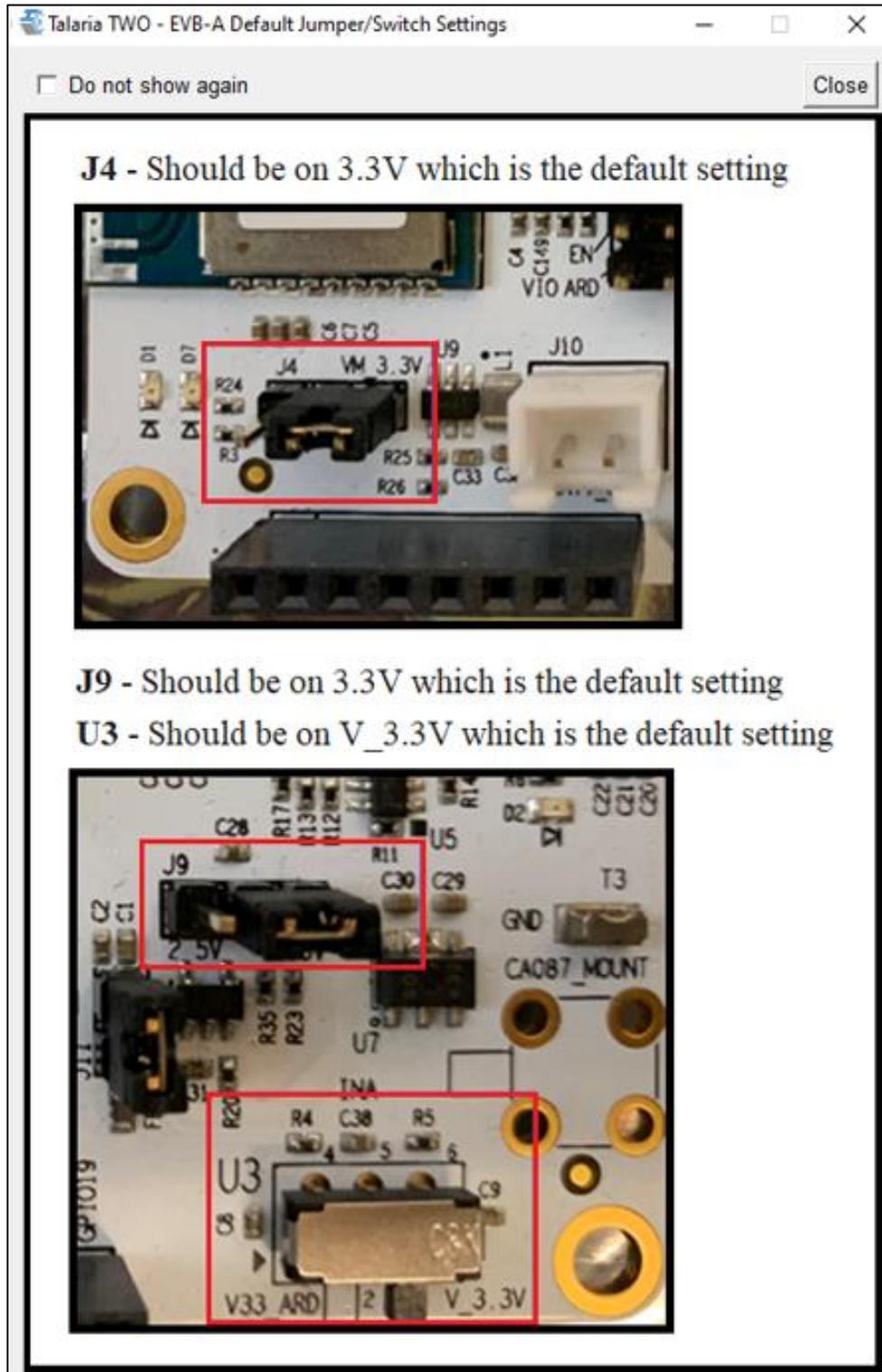
Figure 21: Default Jumper/Switch setting Window during Tool Launch

Appendix

Update Driver from libusK Driver to COM Port

To update and retrieve COM ports, follow the following steps:

1. Go to `Device Manager`. Expand the `libusbK USB Devices` and right click on the `InnoPhase T2 Evaluation Board (Composite Parent)`. Click on `Update Driver` as shown in Figure 22.
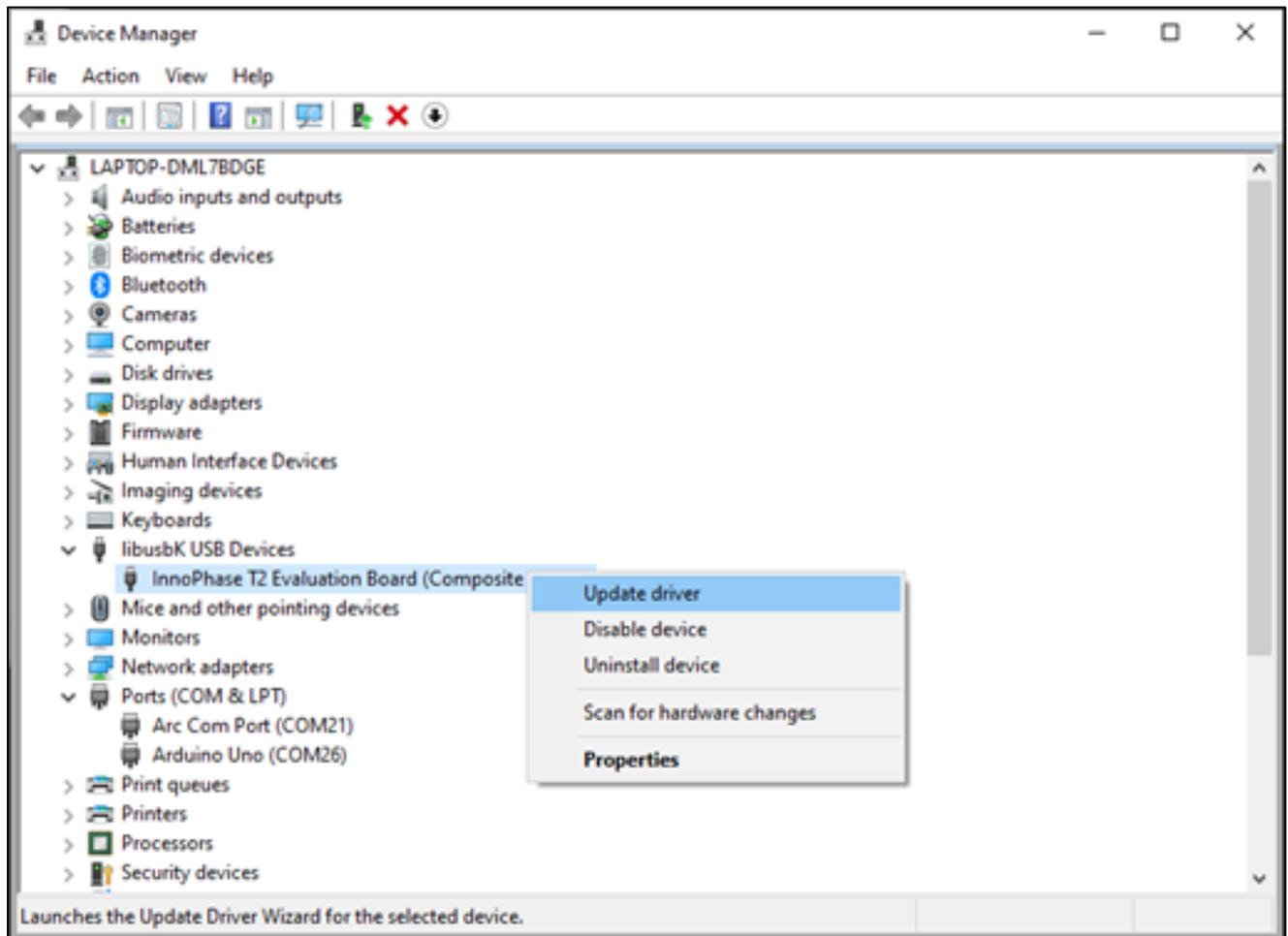
Figure 22: Device Manager

2. On the new window, click on `Let me pick from a list of available drivers on my computer` option and click on `Next`.
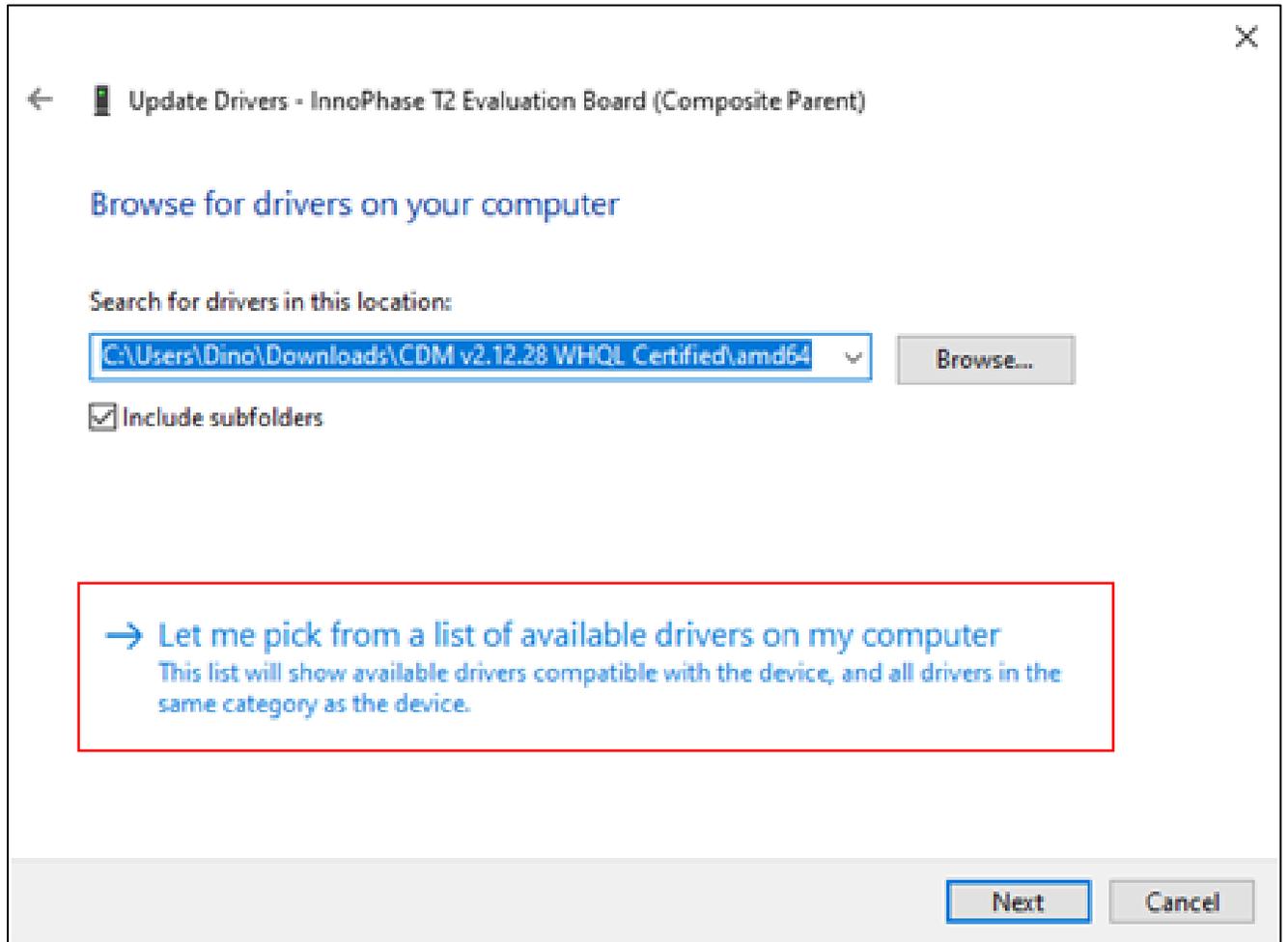
Figure 23: Update Devices

3. Select `USB Composite Device` and install the same for reinstalling COM posts.
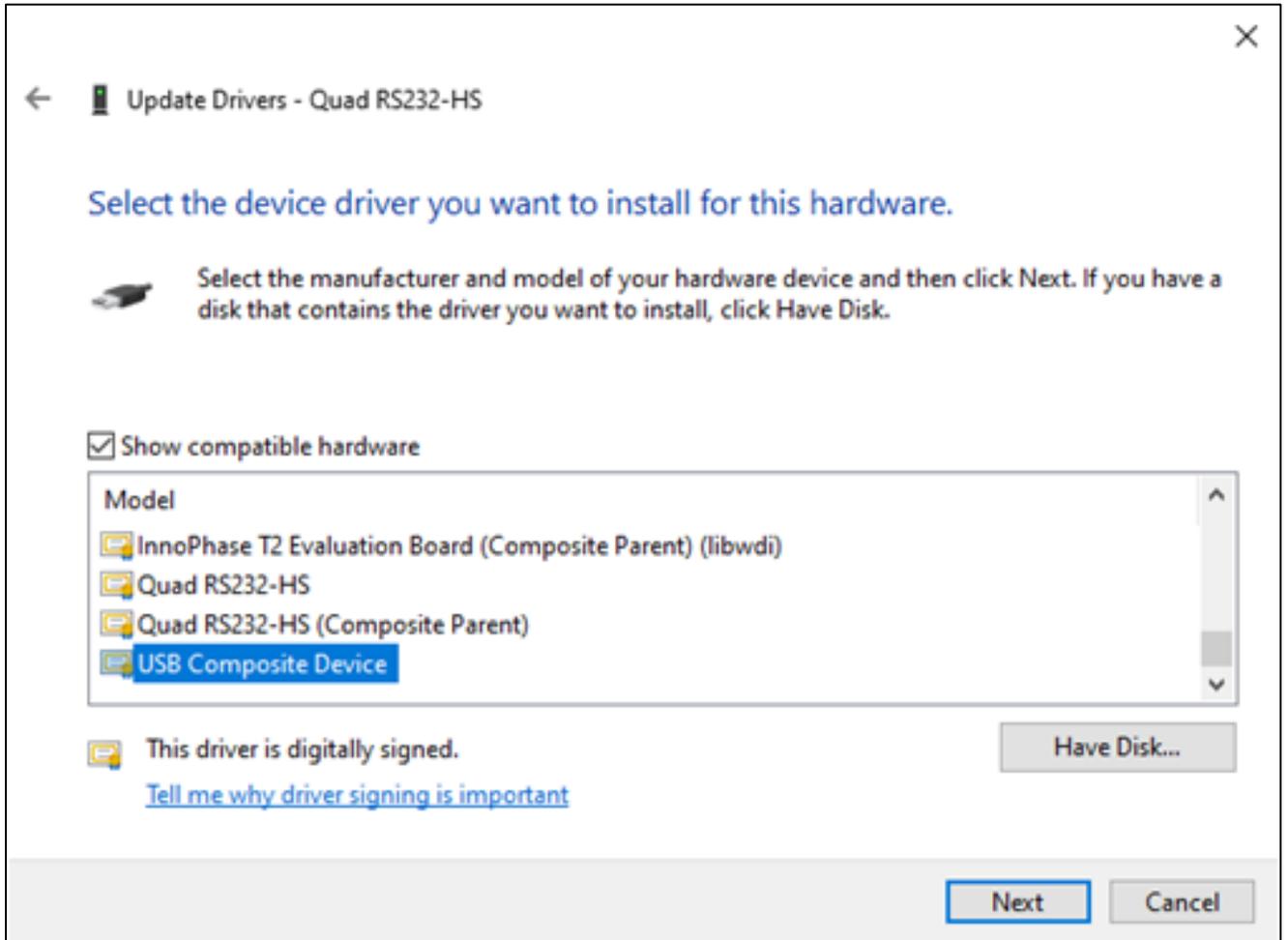
Figure 24: Select the device driver

New Serial Number to Device – Manual Method

There might be certain instances where the user may need to manually change/add a new EVK serial number to the Talaria TWO (T2) device.

The manually update Talaria TWO device's serial number, follow the subsequent steps:

1. Ensure the device connected is detected under `COM Port`.
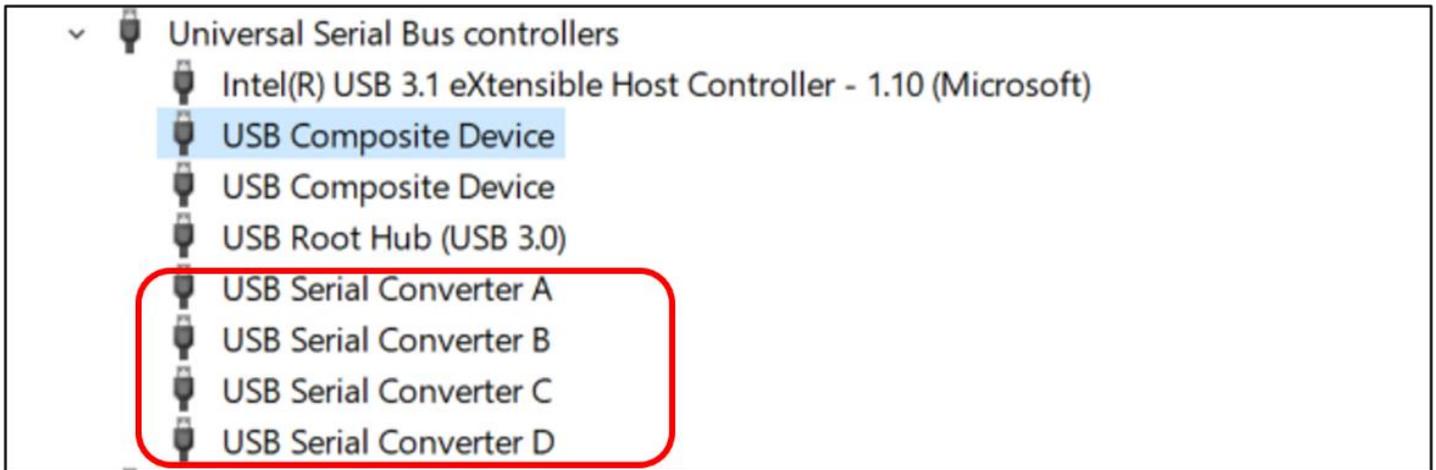
Figure 25: Device Manager – Composite Device

2. In case the device is not detected under `COM Port`, follow the instruction available in section: Update Driver from libusK Driver to COM Port to change the driver to `USB Composite Device`.

3. Once the device is recognized under `COM Port`, install `FT_Prog` software with the help of Utilities - FTDI (ftdichip.com) to change the FTDI device property as required.

4. Open the FT_Prog software and click on `Scan & Parse` button to detect the COM devices. FT_Prog software shows the identified devices in tree with device properties.
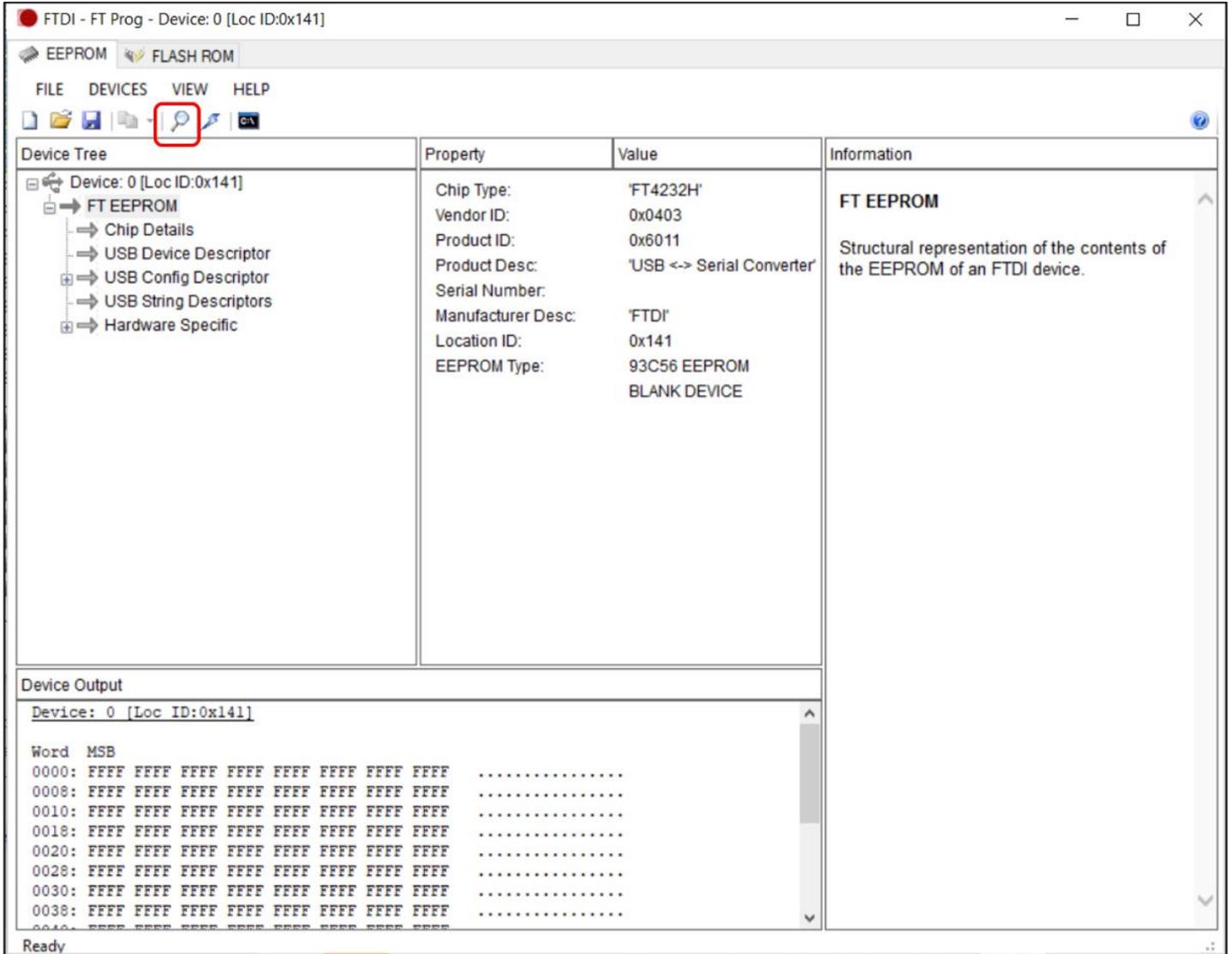
Figure 26: FT_Prog - Device detected

5. To update the serial number, click on `USB String Descriptor`. Add the new serial number in the `Serial Number` field and change the product description as `InnoPhase T2 Evaluation Board`.
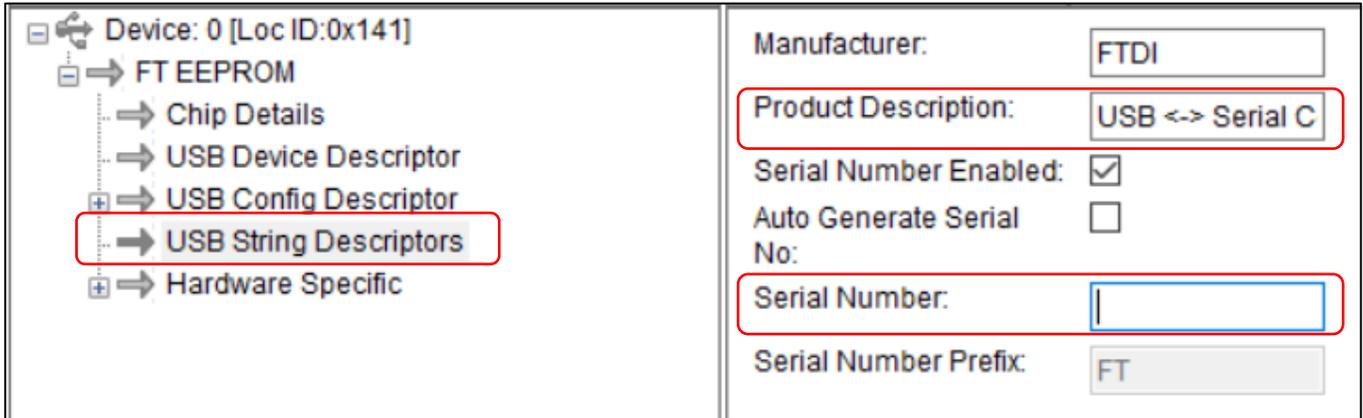
Figure 27: FT_Prog - Update Serial Number

6. To upload the changes to the device, right click on `FT EEPROM` and click on `Program Device`.
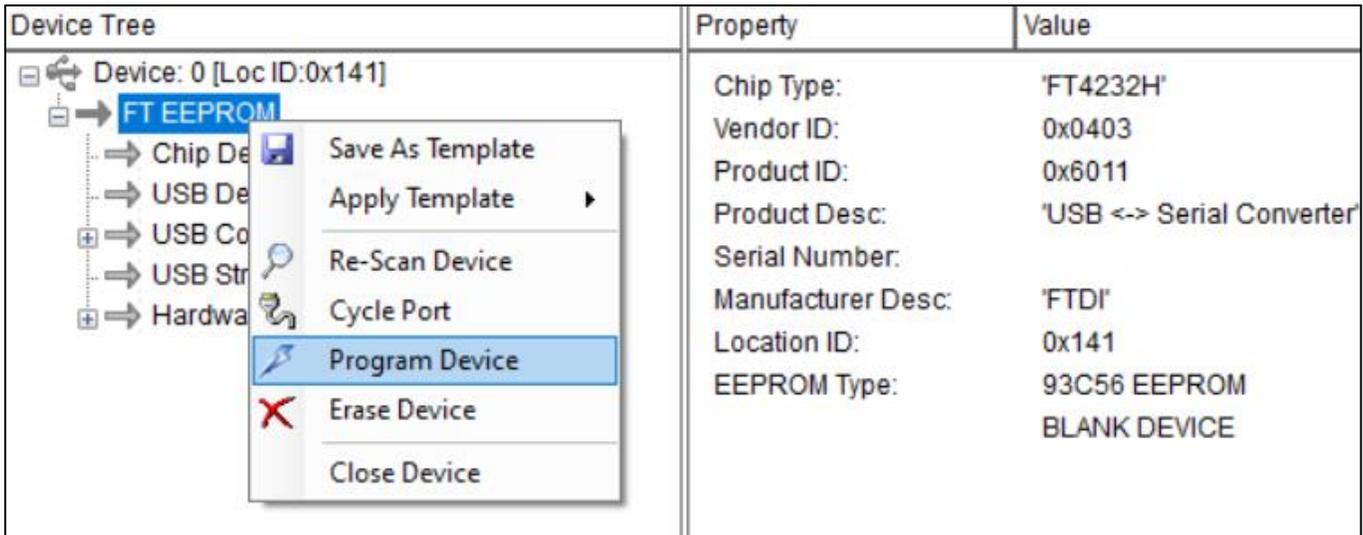
Figure 28: FT_Prog - Program Device

7. The device will now be updated with the new serial number as shown in Figure 29.

Device Tree	Property	Value

Device: 0 [Loc ID:0x151]
  FT EEPROM
    Chip Details
    USB Device Descriptor
    USB Config Descriptor
    USB String Descriptors
    Hardware Specific
	Chip Type:
	Vendor ID:
	Product ID:
	Product Desc:
	Serial Number:
	Manufacturer Desc:
	Location ID:
	EEPROM Type:
		'FT4232H'
		0x0403
		0x6011
		'InnoPhase T2 Evaluation Board'
		2023-105
		'FTDI'
		0x151
		93C56 EEPROM

Figure 29: FT_Prog - Updated Serial Number

8. In case the new serial number is not updated in Device Manager, unplug and re-plug the device to refresh the connection.

References

1. UG_Download_Tool.pdf
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1. Sales Support: Contact an InnoPhase sales representative via email – sales@innophaseiot.com
2. Technical Support:
    a. Visit: https://innophaseiot.com/contact/
    b. Also Visit: https://innophaseiot.com/talaria-two-modules/
    c. Contact: support@innophaseiot.com

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