Application Note

TIDA-010224
Additional Information for Low-Power Consumption Design

TEXAS INSTRUMENTS

Jingquan Zhu

ABSTRACT

TIDA-010224 is designed as a reference for low-power Wi-Fi® cameras capable of operating from battery supplies. In order to extend battery lifetime as much as possible, most sockets are chosen to have a shutdown current in the nA range (as shown in Figure 1-1) and the TPS63802 high-efficiency buck-boost is used. In order to better understand more easily evaluate TIDA-010224, this application note describes a few additional use cases, how to set up the compiler environment if code changes are needed, how to update the firmware of CC3235 and OA7000, and how to test these use cases.
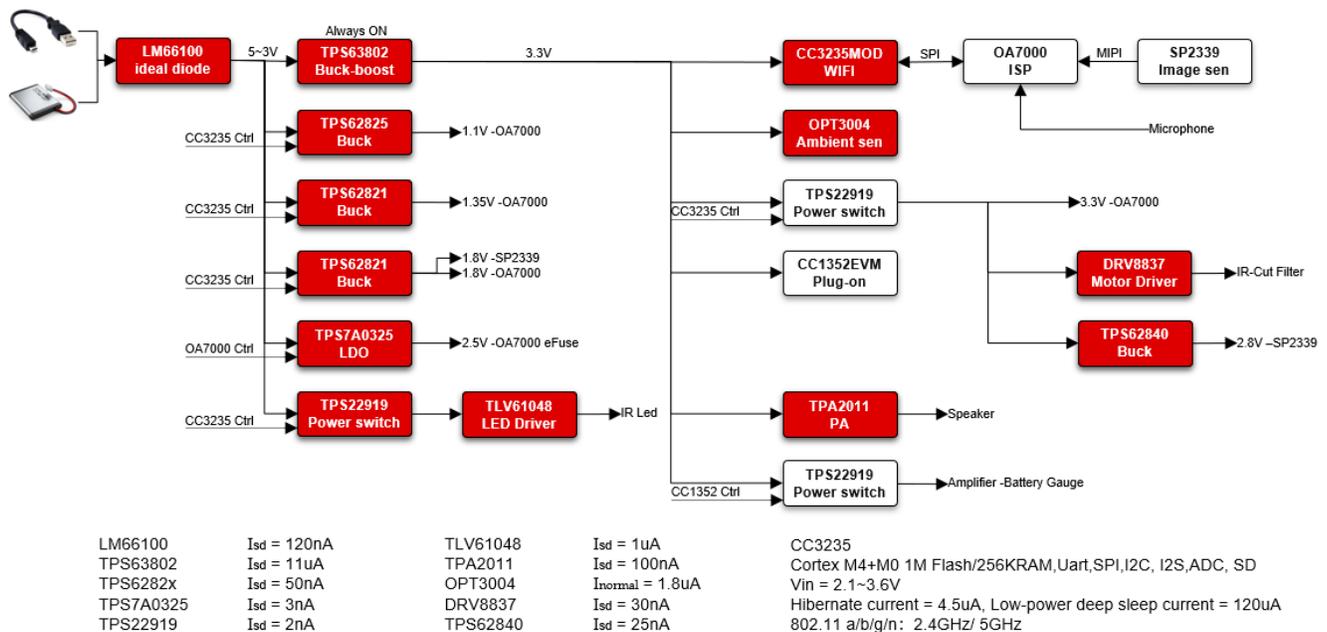
LM66100	I_{sd} = 120nA	TLV61048	I_{sd} = 1uA	CC3235
TPS63802	I_{sd} = 11uA	TPA2011	I_{sd} = 100nA	Cortex M4+M0 1M Flash/256KRAM,Uart,SPI,I2C, I2S,ADC, SD
TPS6282x	I_{sd} = 50nA	OPT3004	I_{normal} = 1.8uA	Vin = 2.1~3.6V
TPS7A0325	I_{sd} = 3nA	DRV8837	I_{sd} = 30nA	Hibernate current = 4.5uA, Low-power deep sleep current = 120uA
TPS22919	I_{sd} = 2nA	TPS62840	I_{sd} = 25nA	802.11 a/b/g/n：2.4GHz/ 5GHz

Figure 1-1. TIDA-010224 Hardware Design Structure

Table of Contents

List of Figures

List of Tables

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1 Introduction

Below are additional test cases demonstrating the design's low power consumption. In some cases build of material (BOM) and firmware changes are required.

Adding test cases:

- Testing current in hibernate mode
- Testing current in LPDS mode
- Testing average current under Intermittently connecting mode (sending 100 data to server)
- Testing average current under always connecting mode (sending 100 data to server)
- Test key step time when startup (via universal asynchronous receiver/transmitter (UART) printing or signal of connector)
- Evaluate performance of video and audio

Test case Features:

- The system can be put in wakeup from both Hibernate and LPDS mode via general-purpose input/output (GPIO) or real-time clock (RTC).
- The current in hibernate mode is around 20 µA/5 V.
- The current in LPDS mode is around 120 µA/5 V.
- Startup time from hibernate to full running is less than 500 ms.
- Configurable interval time in intermittently connecting mode or always connecting mode
- Configurable stream transferring of only video, video and audio, video and ring

2 Hardware BOM and Firmware Modification

In order to reduce leakage current as much as possible, there are some necessary changes to implement.

- Hardware bill of material (BOM) changes

Table 2-1. Table 1. BOM Changing of TIDA-010224

Change	Position	Note
Delete	CC1352 EVM board	In these test cases, no Sub-1 GHz connection.
Delete	R116, R137, R91, R152, R118, R35-R40, R127, R128	
Change Net	float U4.5 pin	
Change Net	Exchange resistor on R159 and R160 position	Make CC3235 can control

- Firmware changes

Table 2-2. Table 2. Firmware Changing of TIDA-010224

Add Function	Detail
Hibernate mode	- Enter Hibernate mode via UART input '1'. - Choose which audio from, no audio/from microphone/from ring music after RTSP connected. - Be wakeup by any of UART input. - If there is not a saved AP list in site, enter provisioning mode after it is in wakeup. - If there is a saved AP, connect with AP and prepare accepting RTSP connection after wakeup.

Table 2-2. Table 2. Firmware Changing of TIDA-010224 (continued)

Add Function	Detail
Intermittently Connected mode	• Enter Intermittently mode via UART input '2'. • Choose which audio from, no audio/from microphone/from ring music after RTSP connected. • Define remote TCP server IP address. • Define interval wakeup time from hibernate. • Output 100 data to remote TCP server after wakeup. • Wakeup by any UART input when it is in hibernate. • Enter accepting RTSP connection mode after wakeup by GPIO (UART input)
Always Connected with Long Sleep mode/with IOT mode	• Enter always connected mode via UART input '3' or '4'. • Define beacon time of connecting with AP. • Choose which audio from, no audio/from microphone/from ring music after RTSP connected. • Define remote TCP server IP address. • Define interval time of sending data to TCP server. • Send out 100 data to remote TCP server after wakeup from LPDS mode by RTC. • Wakeup by any UART input when it is in LPDS. • Enter accepting RTSP connection mode after wakeup by GPIO (UART input).
Measure Time of Key action mode	• Enter measure time mode via UART input '5'. • Define remote TCP server IP address. • Send 10 pages image data to TCP server after triggered by any UART input. • Print timestamp of key action, same time, output HW signal via CC3235 GPIO_06 pin.

3 Firmware Compiler Environment Setup (if change or evaluate code are needed)

3.1 Hardware and Software Prepared

Device

- TIDA-010224 demo board
- CC3235 Launch EVM
- PC
- 2x microUSB cable

Firmware compiled based on

- Code Composer Studio™ (CCS) Version: 11.1.0.00011
- Simplelink™ CC32xx SDK Version :5.30.00.08
- sysconfig tool Version: 1.11.0
- FreeRTOSv202107.00

3.2 Hardware Connection

1. Short J11.3 and J11.4 with a jumper in order to enable download function via UART.
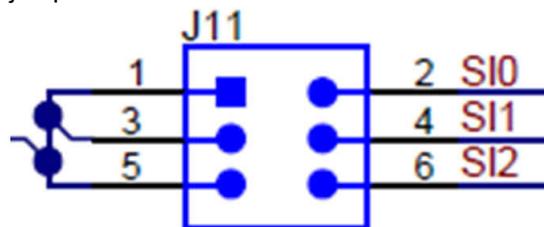
Figure 3-1. J11 Connector

2. Connect J13 to CC3235EVM board UART pin according to the *Connections Between CC32xx LaunchPad™ and Wireless Camera Module (J13 Connector)* figure in the *Design Guide: TIDA-010224 Low-Power Wireless Camera Reference Design for Extended Battery Life*.

3. Connect J5 to CC3235EVM board's J7(XDS10 OUT) connector with a JTAG cable.
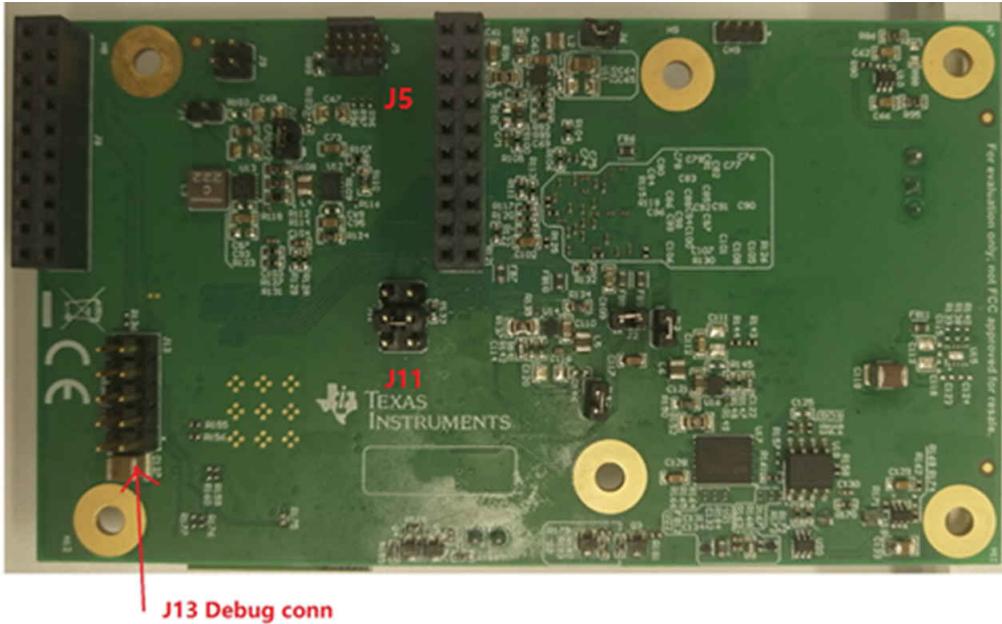
Figure 3-2. PCB Connector

4. Connect the PC to the camera board and the CC3235EVM board with the 2x USB cable. Power on these two boards.

3.3 CCS Environment Configuration

1. Unzip FreeRTOS™ package (download from freertos.org) in a folder, and add variable in dialog from CCS->Window->Preferences->Code Compose Studio->Build->Variables.
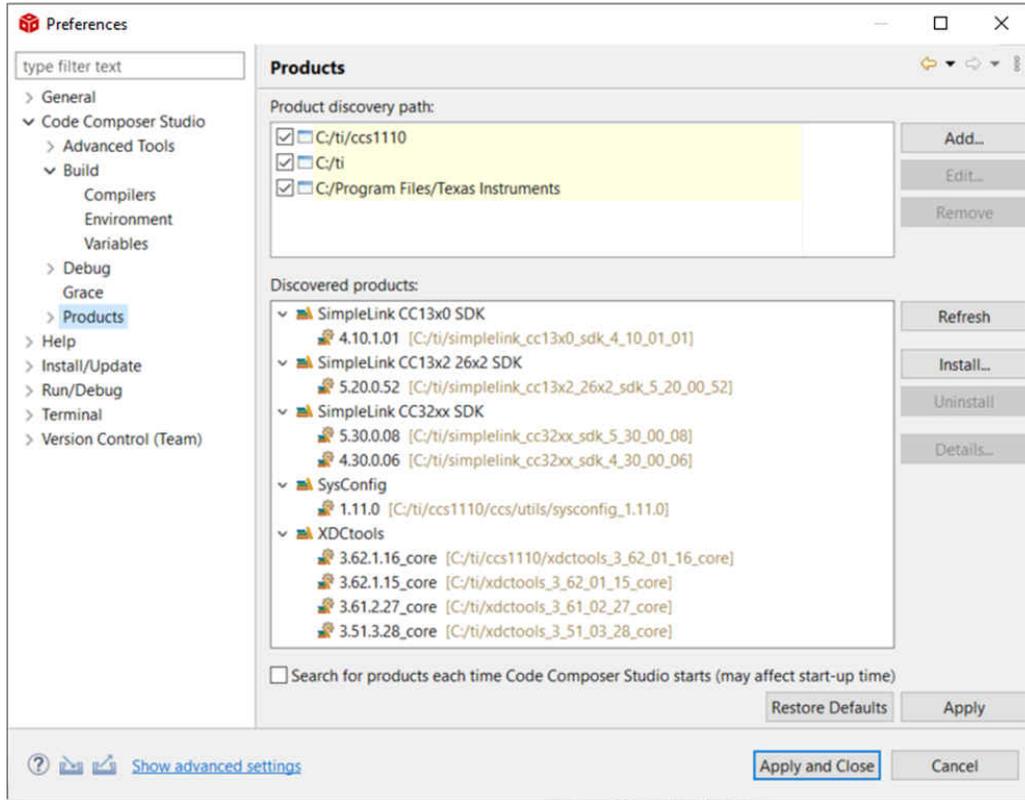
Variable name: FREERTOS_INSTALL_DIR

Value: C:\ti\FreeRTOSv202107.00 (unzip folder address)
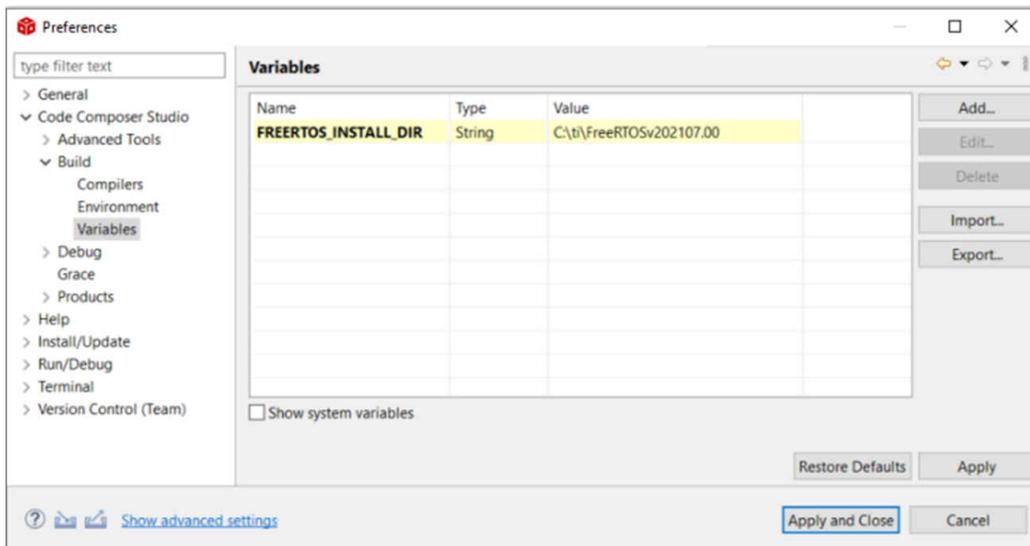
Figure 3-3. FreeRTOS Variable Dialog in CCS

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2. Install Simplelink CC32xx SDK and the sysconfig tool (download from TI.com). Refresh product in dialog from CCS->Window->Preferences-> Code Compose Studio->Products.


Figure 3-4. Installed Products Dialog in CCS

3. Open Workspace in CCS.

    If there is no available workspace when CCS is started, a dialog will pop up to ask to select a directory as workspace. Browse to the unzipped CC3235 Firmware folder and click 'Launch'.

    If a workspace in CCS is already opened, browse to the unzipped CC3235 Firmware folder in dialog from CCS->File->Switch Workspace->Other, and click 'Launch'.
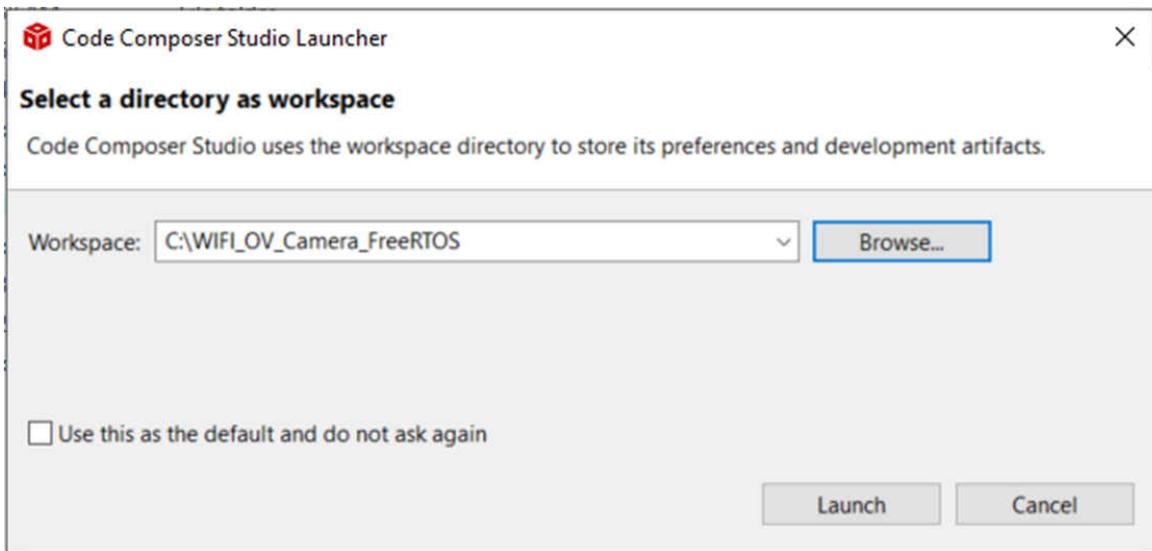
Figure 3-5. Launch Project in CCS

4 Upgrade Firmware of CC3235 and OA7000

4.1 Prepared Components

Device

- TIDA-010224 demo board
- USB to UART (3.3 V TTL) or CC32xx Launch EVM
- PC
- 5 V microUSB Power and 2x microUSB cable

Software

- Uniflash from TI
- Serial assist tool
- mftfw_tools from Omnivisioin

4.2 Upgrade CC3235 Firmware

1. Make SOP(J11) jumper to short J11.3 and J11.4 as shown in shown in Figure 3-1.
2. Serial port connection:
   a. Plug USB2Uart in PC.
   b. Connect USB2Uart (TTL) pin to TIDA-010224 board J13.
      i. If using the universal USB to 3.3V TTL tool, connect J13.3(TX), J13.5(RX) and J13.9(GND).
      ii. If using the CC32xx EVM, connect the pin according to the *Connections Between CC32xx LaunchPad™ and Wireless Camera Module (J13 Connector)* figure in the *Design Guide: TIDA-010224 Low-Power Wireless Camera Reference Design for Extended Battery Life*.
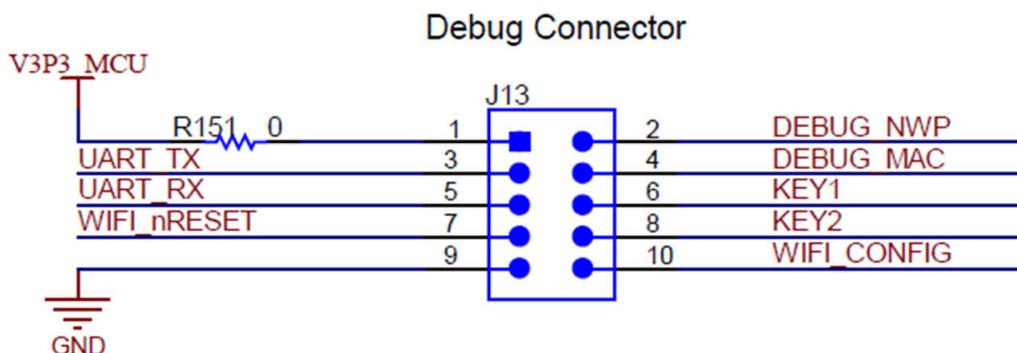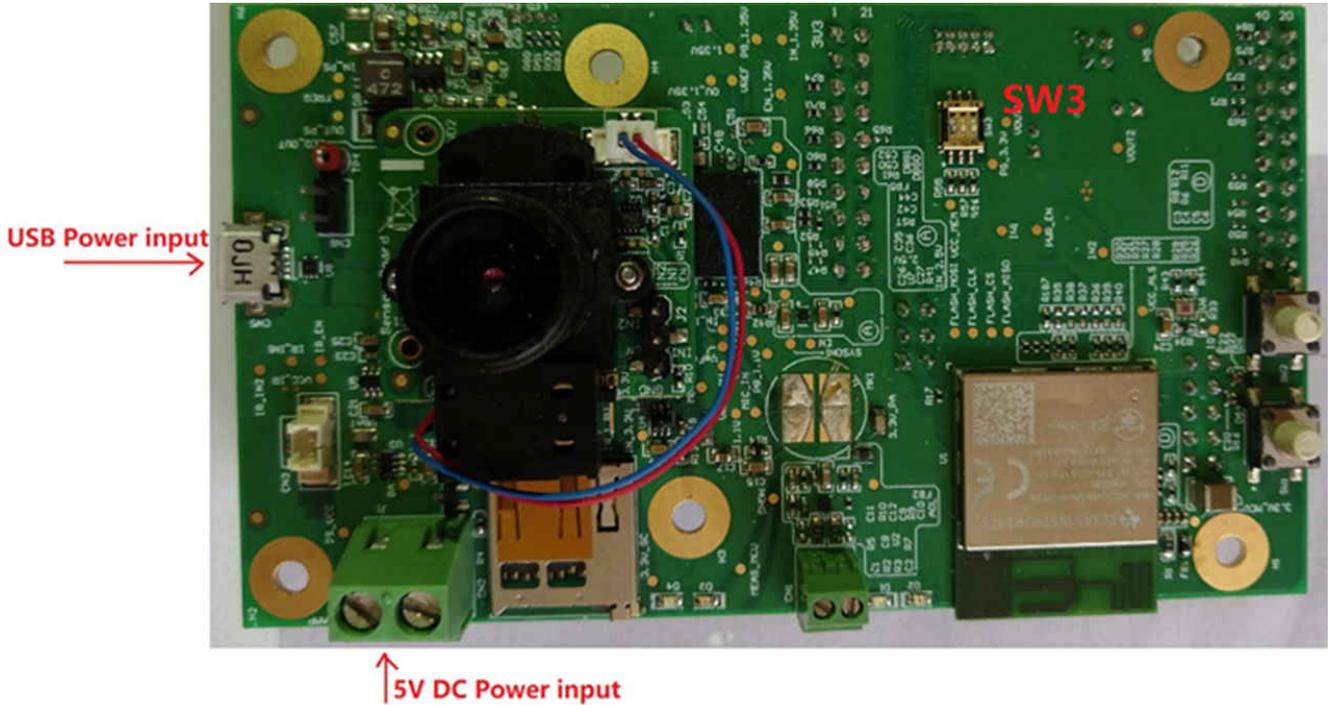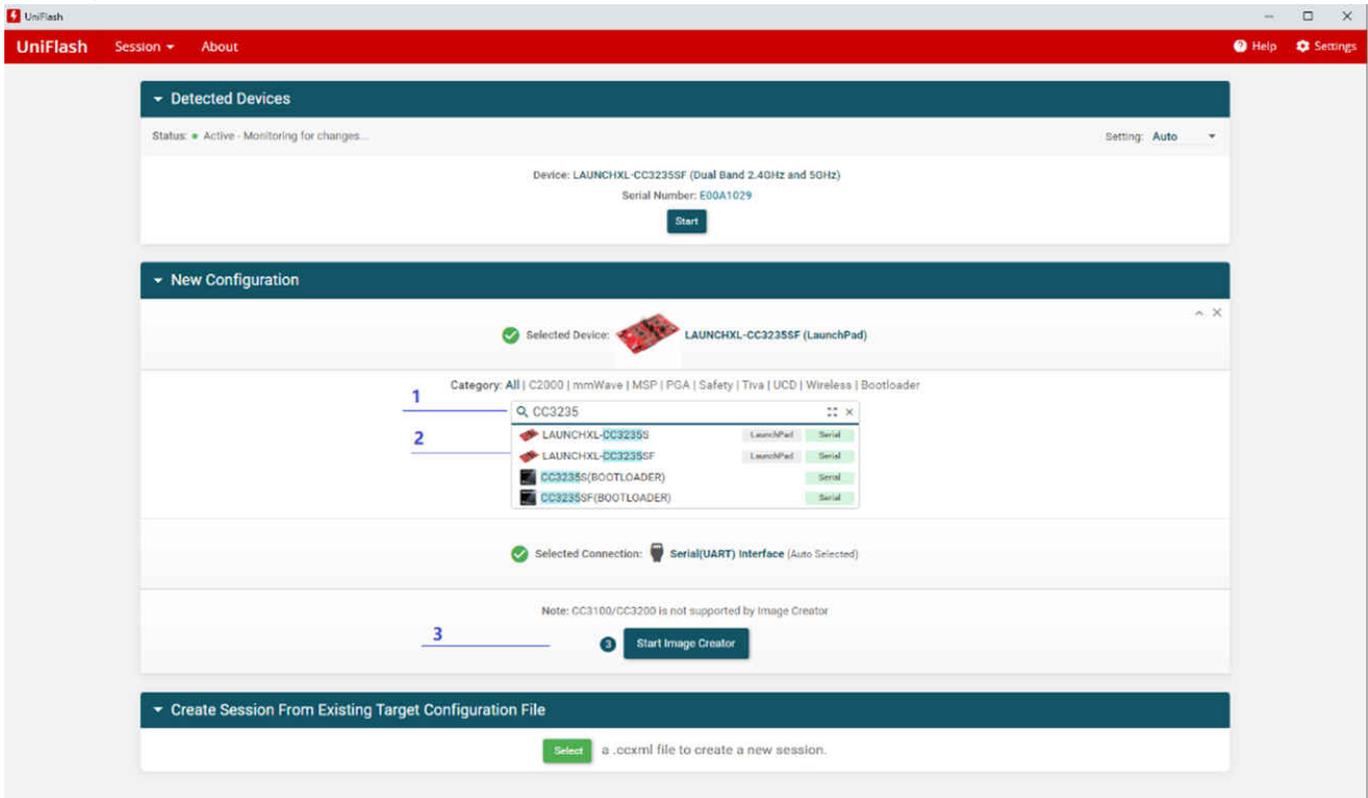

Figure 4-1. J13 Connector

3. Power up:
   a. Connect USB power input of board to PC or USB adapter with microUSB cable.

Figure 4-2. PCB USB/5 V Power Input Connector and SW3 Connector

4. Open Uniflash, select as below.

Figure 4-3. Uniflash Startup Page

   a. Input CC3235.

   b.   Select LAUNCHXL-CC3235SF.
   c.   Click 'Start Image Creator' button.
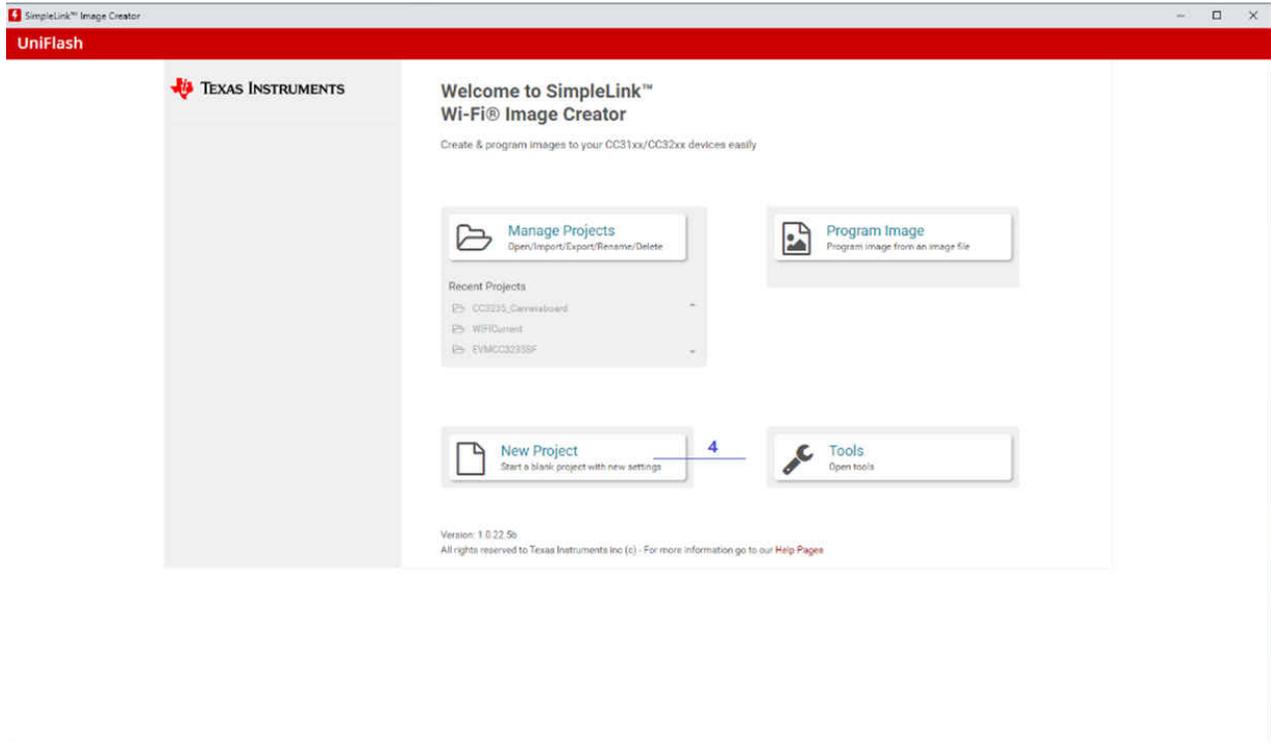

Figure 4-4. Uniflash Image Creator Setting Page 1
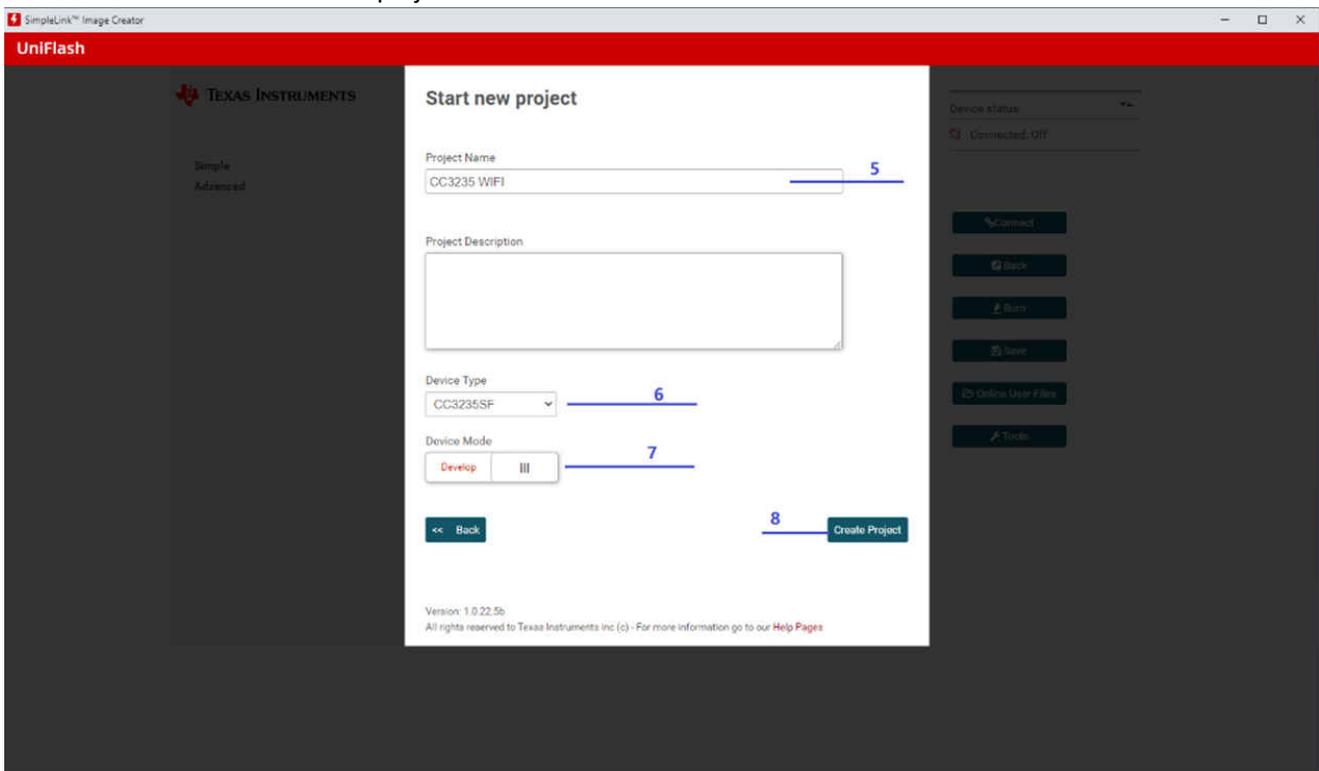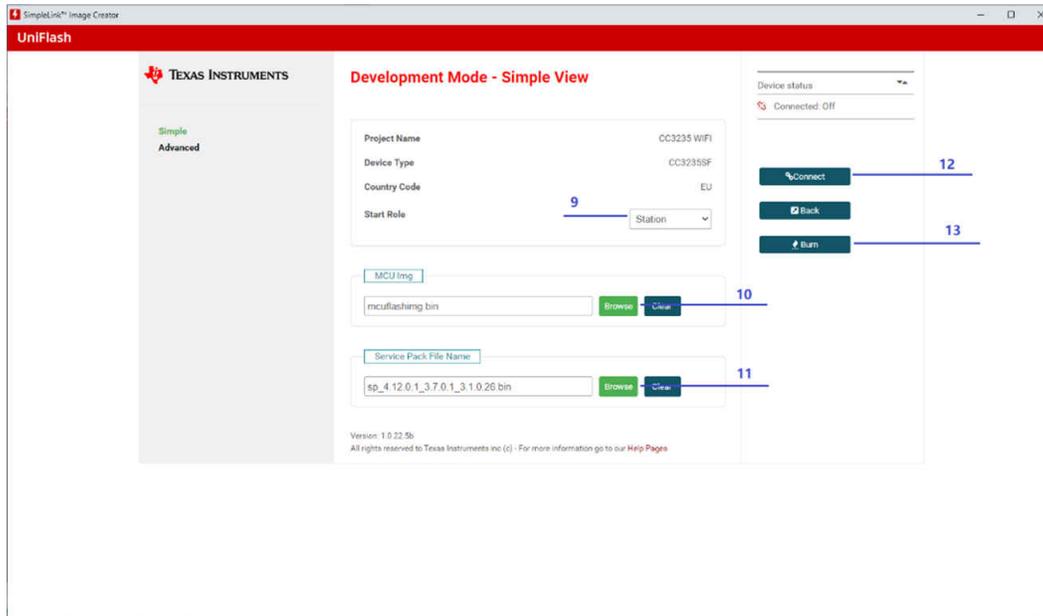
   d.   Click and Create a new project.

Figure 4-5. Uniflash Image Creator Setting Page 2

   e.   Input project name.
   f.   Select CC3235SF.

g. Select Develop mode.

Figure 4-6. Uniflash Image Creator Setting Page 3

h. Click to create.
i. Select 'Station'.
j. Browse and select 'WIFI_Current.bin'.
k. Browse and select 'sp_4.12.0.1_3.7.0.1_3.1.0.26.bin' to install CC32xx SDK. It is located in "\ti\simplelink_cc32xx_sdk_5_30_00_08\tools\cc32xx_tools\servicepack-cc3x35".
l. Click to connect PC to board.
m. Click 'Burn' to create the image and burn.
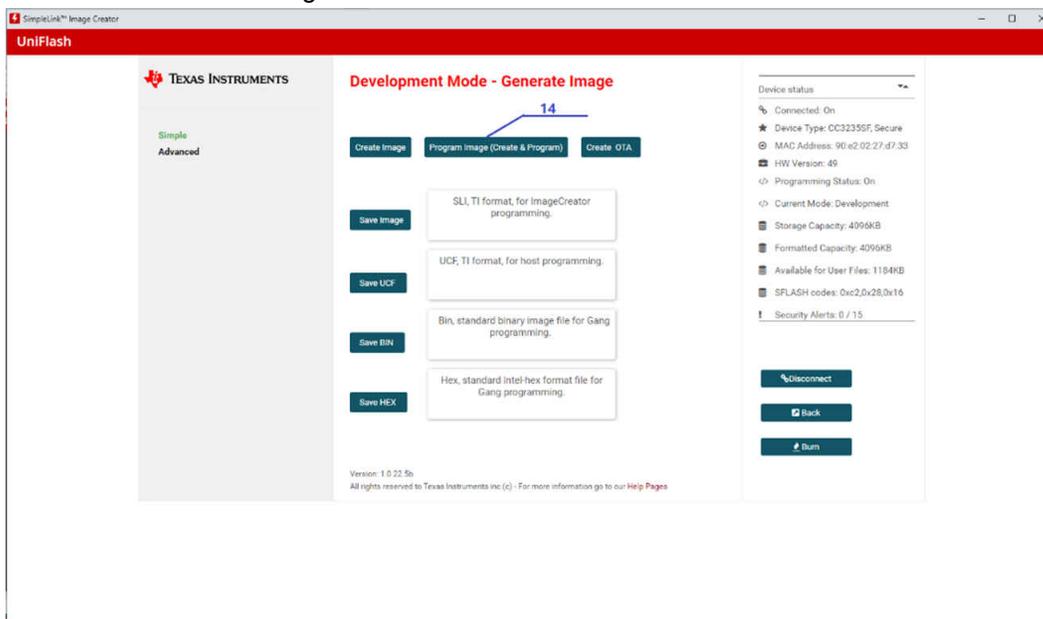
Figure 4-7. Uniflash Image Creator Setting Page 4

n. Click 'Program image' button.
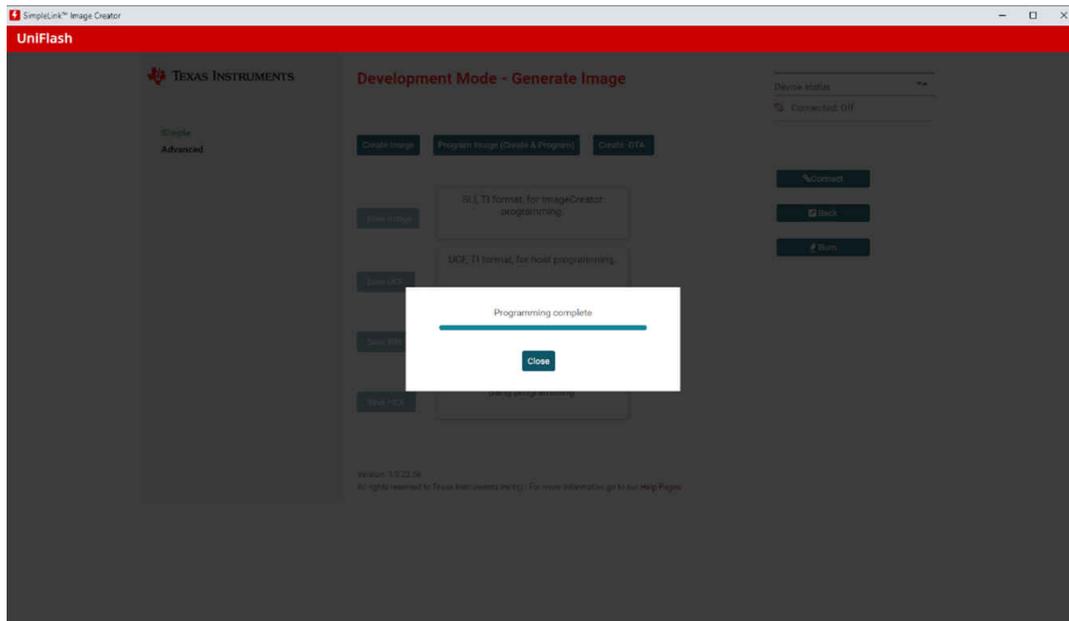
Figure 4-8. Uniflash Image Creator Setting Page 5

4.3 Upgrade OA7000 Firmware

1. Make SW3 jumper to '100'.

Figure 4-9. SW3 Boot-Mode Selection

2. Connect the microUSB cable to the PC and camera board.
3. Connect the USB2Uart tool to the PC and camera board serial port as described in Section 4.2.
4. Open the serial assist tool in the PC, and open the COMx port with '115200, 8 bit, None parity, 1 Stop bit, None handshaking'.
5. Power up camera board via 'USB power input'.
6. Input '1' for hibernate.
7. Input '1' for only video.
8. Input any to wakeup camera board from hibernate and power on OA7000.

Note

Because OA7000 power is controlled by CC3235, first, you need power on OA7000.

---

9. Open MFT.exe in mftfw_tools, select as shown in Figure 4-10.
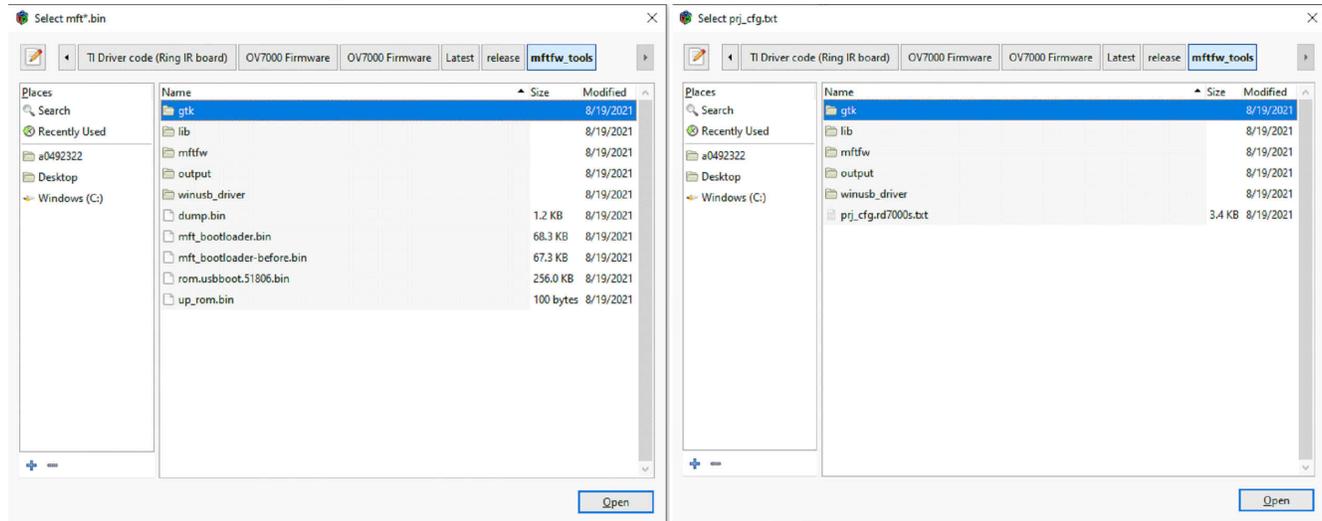
Figure 4-10. MFT Tool Setting Page 1

10. Double click 'mftfw'->oa7000s->mftfw.bin in 'Select mft*.bin' dialog. Then a new dialog window pops up named 'Select prj_cfg.txt'.

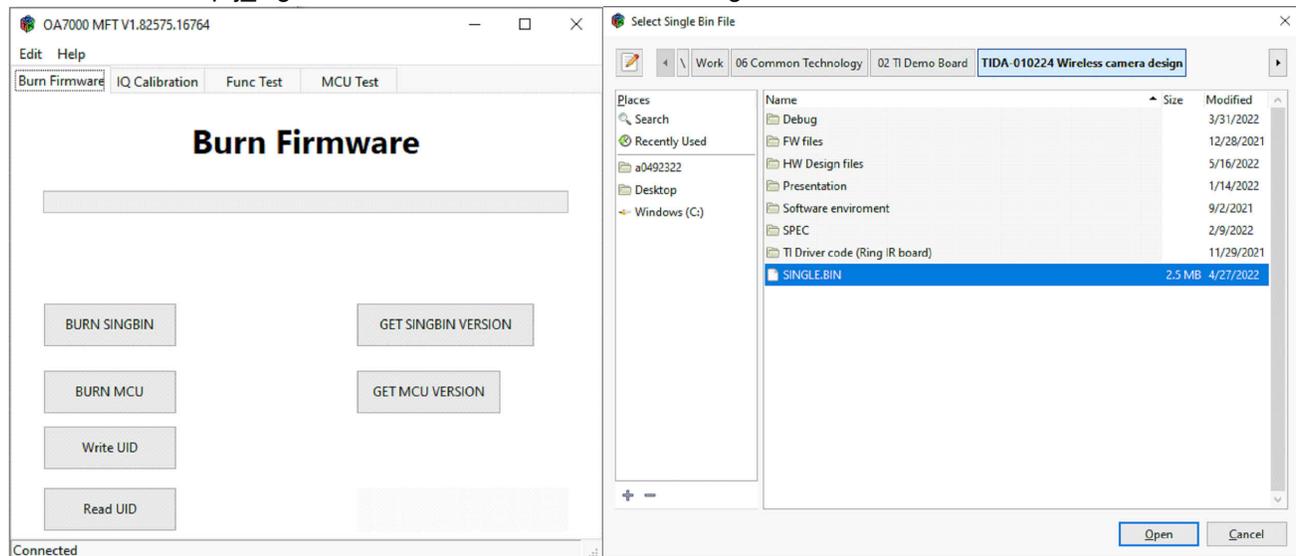11. Double click 'prj_cfg.rd7000s.txt'. It returns the main dialog named 'OA7000 MFTxxxxx'.

Figure 4-11. MFT Tool Setting Page 2

12. In this dialog, it shows 'Connected'. Click the 'BURN SINGBIN' button.

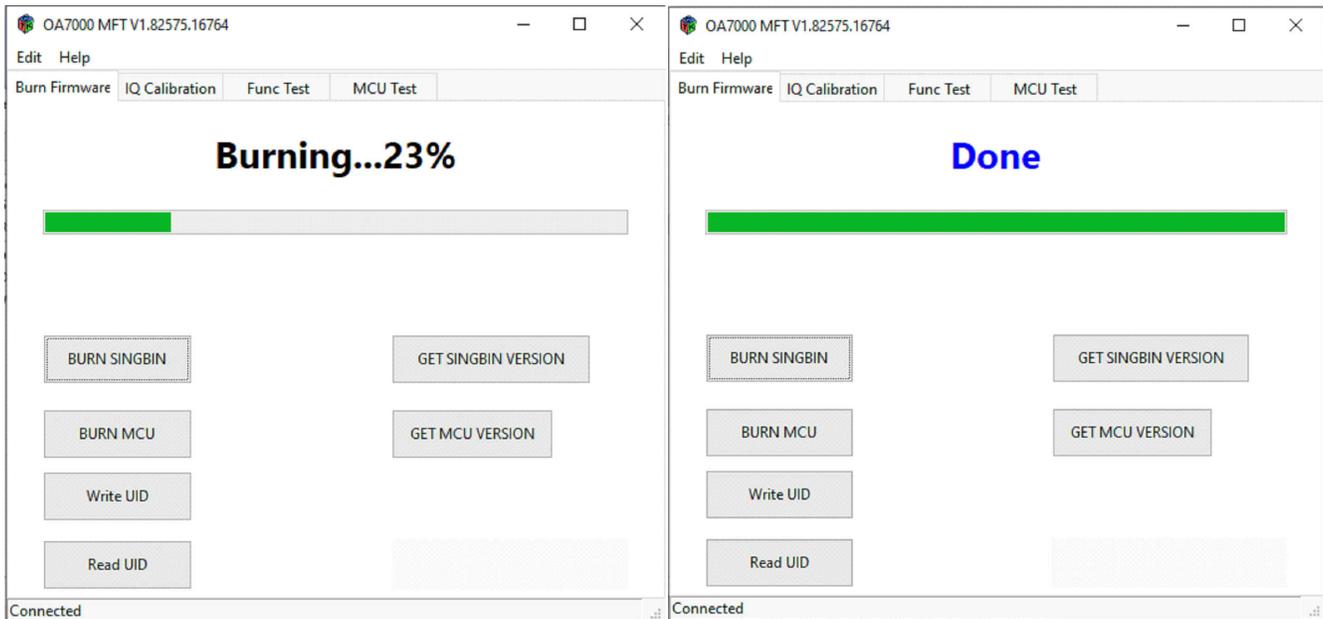13. Find 'SINGLE.BIN' and double click it. bin file burns to OA7000.

Figure 4-12. MFT Tool Setting Page 3

5 How to Test Current and Startup Time

5.1 Prepared Components

Device

- TIDA-010224 demo board
- USB to UART (3.3 V TTL) or CC32xx Launch EVM
- WIFI AP
- PC
- Cell Phone
- 5 V microUSB Power and cable
- Current meter or DC analyzer (optional)

Software

- Serial assist tool
- Net assist tool
- Network Stream video player (EasyPlayer for RTSP or something like this)
- SimpleLink Wi-Fi® Starter Pro APK (download from google store or Apple APP store)

5.2 Setup Test Environment

1. Power connection:
   a. If testing current, Power on from 5 V DC terminal. If only testing functions, USB power input connector is also OK.
2. Serial port connection:
   a. Plug USB2Uart in PC.
   b. Connect USB2Uart(TTL) pin to TIDA-010224 board J13 as shown in Figure 3-1.
      i. If selecting universal USB to 3.3 V TTL tool, connect J13.3(TX), J13.5(RX) and J13.9(GND).
      ii. If selecting CC32xx EVM, connect the pin as shown in the *Connections Between CC32xx LaunchPad™ and Wireless Camera Module (J13 Connector)* figure in the *Design Guide: TIDA-010224 Low-Power Wireless Camera Reference Design for Extended Battery Life*.

3. Setup serial assist tool:
   a. Open the related USB2Uart port before the following settings:
      i. Baud rate: 115200
      ii. Data bits: 8
      iii. Parity: none
      iv. Stop bit: 1
      v. Handshaking: none
      vi. Sending: + CR(Enter key)
4. Setup net assist tool:
   a. PC connect with AP. Open the TCP server before the following settings:
      i. IP address: PC host IP
      ii. Host port: 5001
      iii. Receive: HEX

Note

Close VPN if opened.

5.3 Start Testing

Power on the TIDA-010224 board. The serial tool receives a message as shown in Figure 5-1.

```
*********************************Start V2.1********************************

Startup Tick = 0 s: 0 ms.
the first start
*** Choose demo working mode : ***
    1) for Hibernate.
    2) for Intermittently Connected.
    3) for Always Connected with Long Sleep
    4) for Always Connected with IOT mode
    5) for measure Time of Key action
Please enter your use case selection:
1
```

Figure 5-1. Board UART Output Start Page

1. Provisioning mode.

   If there is no Wi-Fi AP connected, selecting '1' makes the board enter into Hibernate (provisioning) mode for configuring AP SSID and Password into the demo board. Details are:

   a. Input '1' makes the board enter hibernate.
   b. Select the video and which audio to use. It is preparing to play the video after wake-up from hibernate by the UART input. After the input is finished, the board enters into hibernate.

```
Select Audio source when transfer video stream
1)   Only video
2)   Audio from inside ring data
3)   Audio from Micphone
Please select audio type:
Entering Hibernate
Entering HIB
```

Figure 5-2. Select Video Stream Type via UART

c. Input '1' again, wake up board for provisioning, as shown in Figure 5-3.


```
================================
Provisioning Start Ver. 01.01.00.00
================================

CHIP 823132185
MAC  31.3.7.0.1
PHY  3.1.0.26
NWP  4.12.0.1
ROM  8738
HOST 3.0.1.71
MAC address: 90:e2:2:27:d7:33

Starting Provisioning! mode=2 (0-AP, 1-SC, 2-AP+SC, 3-AP+SC+WAC)
```

Figure 5-3. Provisioning Status Output via UART

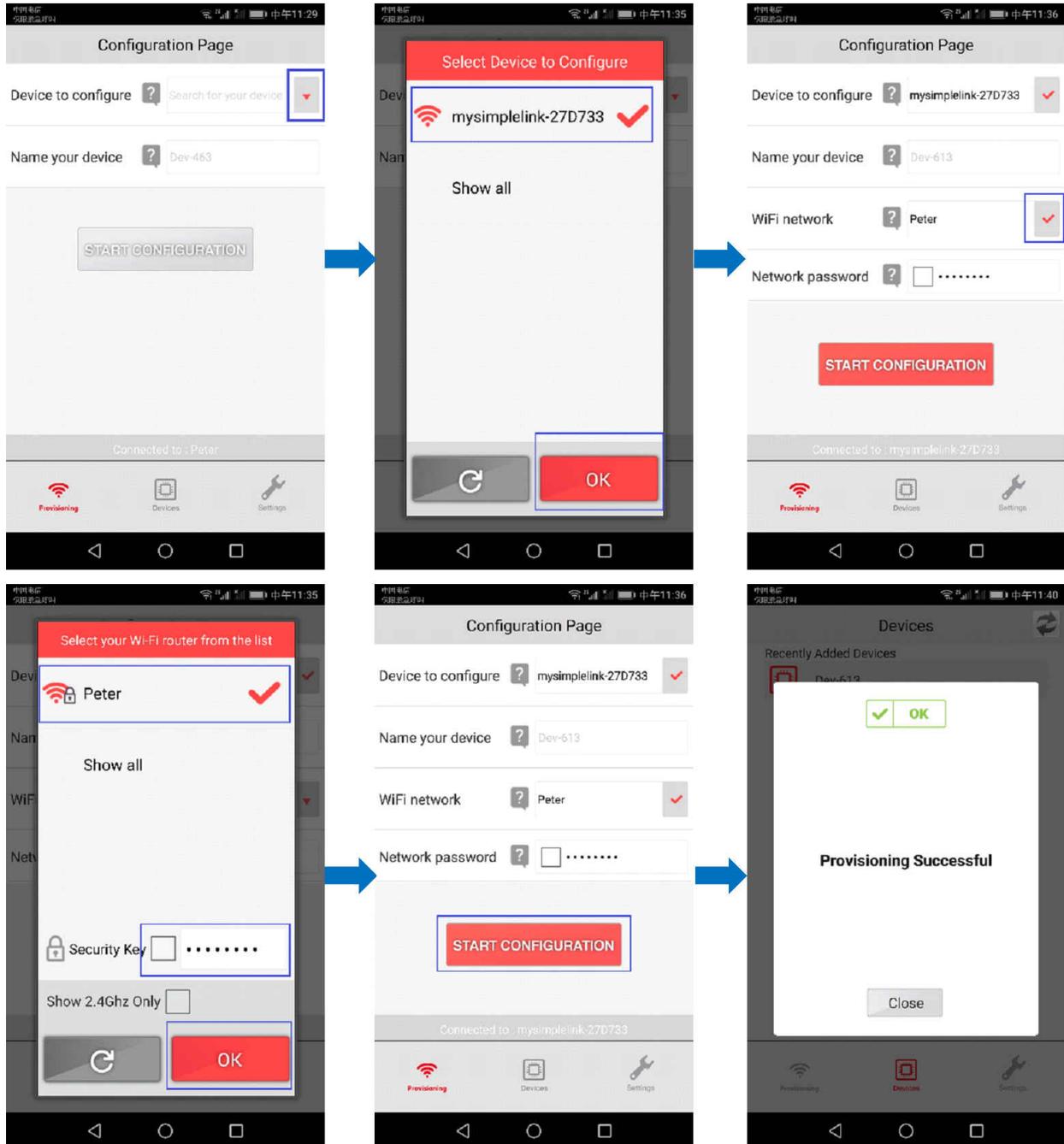d. Open "SimpleLink Wi-Fi Starter Pro" APP in cell phone.

Figure 5-4. "SimpleLink Wi-Fi Starter Pro" Configuration Processing

e. Click the 'blue marked' button.
f. Select 'mysimplexxx'.
g. Select your Wi-Fi AP.
h. Input password.
i. Click the 'start configuration' button and select 'close' to finish provisioning. UART print as shown in Figure 5-5.

```
Starting Provisioning! mode=2 (0-AP, 1-SC, 2-AP+SC, 3-AP+SC+WAC)

[Provisioning] Profile Added: SSID:
[Provisioning] Profile confirmation: WLAN Connected!
[Provisioning] Profile confirmation: IP Acquired!
[Provisioning] Profile Confirmation Success!
[Provisioning] Stopped:    Current Role: STA
WLAN Status: CONNECTED
Connected to SSID: Peter
ProvisioningComplete IP Acquired: IP=192.168.0.103 , Gateway=192.168.0.1
```

**Figure 5-5. Provisioning IP Address Acquired**

j. After provisioning, power off/on to restart demo board again. All of test functions could be continued.

2. Hibernate mode.

This mode is for testing board current in hibernate, entering provisioning if there is no recognized Wi-Fi AP and watch video stream via APP. Details are:

After power on, input '1' makes the board enter into hibernate mode. You can measure the current via 5 V power input connector. Typically, the current is about 20 µA.

When entering hibernate mode, any UART input wakes up the board and exits hibernate. Actually, UART input is similar with GPIO trigger input. This mode is quite similar with some applications that only need buttons or alarm inputs such as PIR input to wake up the system.

After waking up the board, it is ready to accept RTSP request. In this mode, you can run network stream APP to watch. As shown in Figure 5-6, click '+' to add a new address, input rtsp address and port. For example, rtsp://192.168.0.103:554, choose UDP. Click 'OK'(确定) to open video stream.
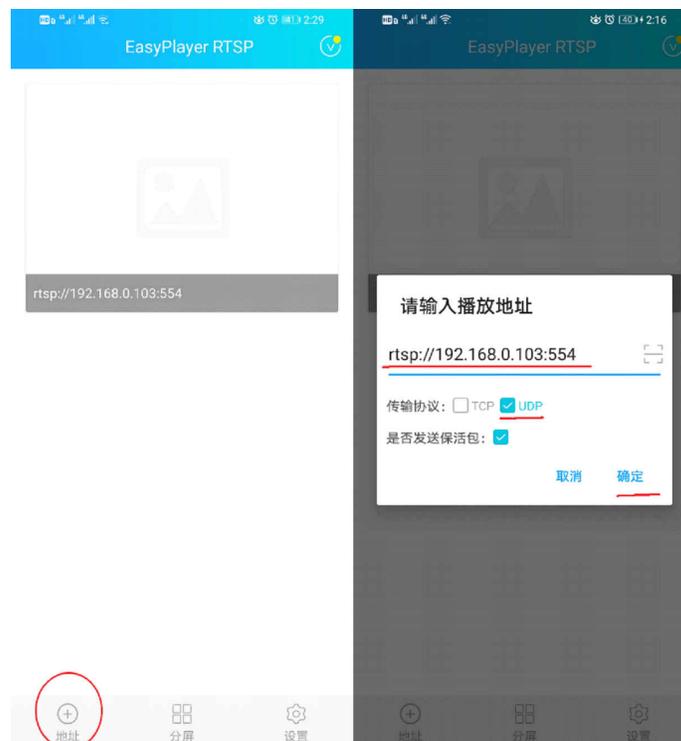
Figure 5-6. RTSP Configuration

> **Note**
> If measure current is in hibernate mode, make sure to disconnect with the JTAG cable and unplug the J1 jumper.

3. Intermittently Connected mode.

   This mode is for the testing the board average current, which is intermittently sending status data to server and enters into hibernate. It is also woken up by any input via UART and entering into ready to accept RTSP request when it is in hibernate mode. Same as above, UART input is similar with the GPIO trigger input. This mode it is quite similar with some applications that report status and heartbeat signal to remote servers with long interval time. Details are:

   a. After power on, input '2' makes the board enter into intermittently connected mode.
   b. Select video and which audio to use. It is preparing to play the video after wake-up from hibernate by the UART input.
   c. Input remote TCP server IP address such as 192.168.10.105.
   d. Input interval time in second such as 10.
   e. Board is woken up intermittently by RTC and sends 100 data to remote TCP sever again and again.
   f. Any UART input wakes up the board from hibernate to prepare accepting RTSP request mode.
   g. UART tool Print:

```
***********************************Start V2.1***********************************

Startup Tick = 0 s: 0 ms.
the first start
*** Choose demo working mode : ***
    1) for Hibernate.
    2) for Intermittently Connected.
    3) for Always Connected with Long Sleep
    4) for Always Connected with IOT mode
    5) for measure Time of Key action
Please enter your use case selection:
2

Select Audio source when transfer video stream
1)  only video
2)  Audio from inside ring data
3)  Audio from Micphone
Please select audio type:
Please input Destination IP address: xxx.xxx.xxx.xxx
192.168.0.105
Destination IP address is :  c0a80069
 Please enter your interval time in seconds :
Interval Time is :  131082
 Entering IntermittentlyConnected
Intermittently Connecting...
wait for IP acquired......
if don't exit this loop, please restart and enter into option 1 for provisioning
    [Event] STA connected to AP
    BSSID:d0:c7:c0:4f:45:86
    SSID:Peter
IPV4_ACQUIRED IP Acquired
    IP=192.168.0.103 , Gateway=192.168.0.1
Sent 100 Data to Server


***********************************Start V2.1***********************************

Startup Tick = 0 s: 0 ms.
Woken by RTC
Intermittently Connecting...
wait for IP acquired......
if don't exit this loop, please restart and enter into option 1 for provisioning
    [Event] STA disconnected from AP      (Reason Code = 1)
    [Event] STA disconnected from AP      (Reason Code = 202)
    [Event] STA connected to AP
    BSSID:d0:c7:c0:4f:45:86
    SSID:Peter
IPV4_ACQUIRED IP Acquired
    IP=192.168.0.103 , Gateway=192.168.0.1
    [Event] STA disconnected from AP      (Reason Code = 6)
    [Event] STA connected to AP
    BSSID:d0:c7:c0:4f:45:86
    SSID:Peter
IPV4_ACQUIRED IP Acquired
    IP=192.168.0.103 , Gateway=192.168.0.1
Sent 100 Data to Server


***********************************Start V2.1***********************************

Startup Tick = 0 s: 0 ms.
Woken by RTC
Intermittently Connecting...
wait for IP acquired.....
```

Figure 5-7. UART Printing in Intermittently Mode

h. Net assist tool Print:


```
[2022-05-23 15:19:15.377]# RECV HEX FROM 192.168.0.103 :64569>
00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F 20 21 22 23 24 25 26 27 28
29 2A 2B 2C 2D 2E 2F 30 31 32 33 34 35 36 37 38 39 3A 3B 3C 3D 3E 3F 40 41 42 43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F 50 51
52 53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F 60 61 62 63

[2022-05-23 15:19:15.387]# Client 192.168.0.103:64569 offline.

[2022-05-23 15:19:45.751]# Client 192.168.0.103:57413 gets online.

[2022-05-23 15:19:45.754]# RECV HEX FROM 192.168.0.103 :57413>
00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F 20 21 22 23 24 25 26 27 28
29 2A 2B 2C 2D 2E 2F 30 31 32 33 34 35 36 37 38 39 3A 3B 3C 3D 3E 3F 40 41 42 43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F 50 51
52 53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F 60 61 62 63

[2022-05-23 15:19:45.759]# Client 192.168.0.103:57413 offline.

[2022-05-23 15:19:56.999]# Client 192.168.0.103:60986 gets online.

[2022-05-23 15:19:57.005]# RECV HEX FROM 192.168.0.103 :60986>
00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F 20 21 22 23 24 25 26 27 28
29 2A 2B 2C 2D 2E 2F 30 31 32 33 34 35 36 37 38 39 3A 3B 3C 3D 3E 3F 40 41 42 43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F 50 51
52 53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F 60 61 62 63

[2022-05-23 15:19:57.010]# Client 192.168.0.103:60986 offline.

[2022-05-23 15:20:06.905]# Client 192.168.0.103:50118 gets online.

[2022-05-23 15:20:06.910]# RECV HEX FROM 192.168.0.103 :50118>
00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F 20 21 22 23 24 25 26 27 28
29 2A 2B 2C 2D 2E 2F 30 31 32 33 34 35 36 37 38 39 3A 3B 3C 3D 3E 3F 40 41 42 43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F 50 51
52 53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F 60 61 62 63

[2022-05-23 15:20:06.915]# Client 192.168.0.103:50118 offline.

[2022-05-23 15:20:16.851]# Client 192.168.0.103:58191 gets online.

[2022-05-23 15:20:16.856]# RECV HEX FROM 192.168.0.103 :58191>
00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F 20 21 22 23 24 25 26 27 28
29 2A 2B 2C 2D 2E 2F 30 31 32 33 34 35 36 37 38 39 3A 3B 3C 3D 3E 3F 40 41 42 43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F 50 51
52 53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F 60 61 62 63

[2022-05-23 15:20:16.867]# Client 192.168.0.103:58191 offline.
```

Figure 5-8. Net Assist Receiver Printing in Intermittently Mode

In Net printing, a new connection is created every time. The connection is lost between sending data.

Note

TCP server must be opened before finished configuration. If don't receive TCP data in server, please try to close VPN or add net assist software in white list of firewall software.

---

4. Always Connected with Long Sleep/with IOT mode.

This mode is for testing board average current that is intermittently sending status data to the server and entering into LPDS. In this mode, the network connection between the test board and the Wi-Fi AP is not lost. It is also woken up by any input via UART when it is in LPDS. This mode it is quite similar with some application that only report status and heartbeat signals to remote servers, and are able to respond to server requests quickly because the connection socket is not lost in the remote server.

Note

IOT and Long Sleep mode need AP supporting.

---

    a. Details are:

        i. After power on, input '3' or '4' will make board enter into Always Connected with Long Sleep or with IOT mode.

        ii. Input beacon interval time to keep alive in AP connecting list.

        iii. Select video and which audio from, it is preparing for play video after wake-up from hibernate by UART input.

        iv. Input remote server IP address, such as 192.168.10.105.

        v. Input interval time of sending data in second, such as 10.

        vi. Board will be woken up intermittently by RTC and send 100 data to remote TCP sever again and again.

        vii. Any UART input will wakeup board from hibernate to prepare accepting RTSP request mode.

    b. UART tool print:

```
*********************************Start V2.1*************************************

Startup Tick = 0 s: 0 ms.
the first start
*** Choose demo working mode : ***
    1) for Hibernate.
    2) for Intermittently Connected.
    3) for Always Connected with Long Sleep
    4) for Always Connected with IOT mode
    5) for measure Time of Key action
Please enter your use case selection:
3
    [Event] STA connected to AP
    BSSID:d0:c7:c0:4f:45:86
    SSID:Peter
    [Event] STA connected to AP
    BSSID:d0:c7:c0:4f:45:86
    SSID:Peter
IPV4_ACQUIRED IP Acquired
    IP=192.168.0.101 , Gateway=192.168.0.1
*** LSI ***
Please enter your LSI duration in milliseconds (min- 100 msec, max- 20000 msec):  100
IPV4_ACQUIRED IP Acquired
    IP=192.168.0.101 , Gateway=192.168.0.1
IPV4_ACQUIRED IP Acquired
    IP=192.168.0.101 , Gateway=192.168.0.1
IPV4_ACQUIRED IP Acquired
    IP=192.168.0.101 , Gateway=192.168.0.1

Select Audio source when transfer video stream
1)   Only video
2)   Audio from inside ring data
3)   Audio from Micphone
Please select audio type:
Please input Destination IP address: xxx,xxx,xxx,xxx
192.168.0.105
Destination IP address is :  c0a80069
 Please enter your interval time in seconds :
Interval Time is :   262154
 Starting AlwaysConnected_LSI mode
    [Event] STA connected to AP
    BSSID:d0:c7:c0:4f:45:86
    SSID:Peter
IPV4_ACQUIRED IP Acquired
    IP=192.168.0.101 , Gateway=192.168.0.1
Send Packet...
Send Packet...
Send Packet...
Send Packet...
Send Packet...
```

Figure 5-9. UART Printing in Always Connecting Mode

c. Net assist tool print:

Figure 5-10. Net Assist Receiver Printing in Always Connecting Mode

In Net printing, A new connection is created firstly, and it isn't lost between sending data.

> **Note**
> TCP server must be open before finished configuration. If you do not receive TCP data in your server, try to close VPN or add net assist software in white list of firewall software.

5. Measure Time of Key action.

This mode is for testing the board startup time that is from exiting hibernate to sending out the 10 frames of image. It is able to be woken up by any input via UART for testing. You can get the printing timestamp log via UART or test the wave via J13.2 pin with oscilloscope. Details are:

a. After power on, input '5' makes the board enter into Measure Time of Key action mode.
b. Input remote server IP address such as 192.168.10.105. Then test board enters into Hibernate.

c. Any input via UART wakes up board and send data out to remote TCP server after getting the image frame.

```
*********************************Start V2.1*********************************
Startup Tick = 0 s: 0 ms.

[MeasureTimeTask] -- woken by GPIO and finished CC3235 initialize. Tick = 0 s: 12 ms.

[MeasureTimeTask] -- Power up OV.  Tick = 0 s: 20 ms.

[MeasureTimeTask] -- start OV configuration. Tick = 0 s: 151 ms.
     [Event] STA connected to AP
     BSSID:d0:c7:c0:4f:45:86
     SSID:Peter
IPV4_ACQUIRED IP Acquired
     IP=192.168.0.101 , Gateway=192.168.0.1

[MeasureTimeTask] -- Get No.0 image size. datasize = 256 Tick = 433 ms.

[MeasureTimeTask] -- Get No.0 image data. Tick = 0 s: 447 ms.

[MeasureTimeTask] -- Get No.1 image size. datasize = 40 Tick = 519 ms.

[MeasureTimeTask] -- Get No.1 image data. Tick = 0 s: 533 ms.

[MeasureTimeTask] -- Get No.2 image size. datasize = 40 Tick = 557 ms.

[MeasureTimeTask] -- Get No.2 image data. Tick = 0 s: 571 ms.

[MeasureTimeTask] -- Get No.3 image size. datasize = 304 Tick = 640 ms.

[MeasureTimeTask] -- Get No.3 image data. Tick = 0 s: 654 ms.

[MeasureTimeTask] -- Get No.4 image size. datasize = 104 Tick = 695 ms.

[MeasureTimeTask] -- Get No.4 image data. Tick = 0 s: 709 ms.

[MeasureTimeTask] -- Get No.5 image size. datasize = 1240 Tick = 768 ms.

[MeasureTimeTask] -- Get No.5 image data. Tick = 0 s: 782 ms.

[MeasureTimeTask] -- Get No.6 image size. datasize = 3272 Tick = 850 ms.

[MeasureTimeTask] -- Get No.6 image data. Tick = 0 s: 865 ms.

[MeasureTimeTask] -- Get No.7 image size. datasize = 4096 Tick = 892 ms.

[MeasureTimeTask] -- Get No.7 image data. Tick = 0 s: 908 ms.

[MeasureTimeTask] -- Get No.8 image size. datasize = 2240 Tick = 931 ms.

[MeasureTimeTask] -- Get No.8 image data. Tick = 0 s: 946 ms.

[MeasureTimeTask] -- Get No.9 image size. datasize = 3456 Tick = 977 ms.

[MeasureTimeTask] -- Get No.9 image data. Tick = 0 s: 992 ms.

[MeasureTimeTask] -- Send out Page infor and Image data and Entering HIB. Tick = 1 s: 8 ms.
```

Figure 5-11. UART Printing in Measure Startup Mode

Figure 5-12. Net Assist Receiver Printing in Measure Startup Mode

Note
The startup time is affected by WIFI connection time, especially in the first time running.

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