

User Manual

DA16200 Evaluation Kit

UM-WI-023

Abstract

This user manual describes how to set-up and use the DA16200 Evaluation Kit, version 6.0 & 7.0. If you are using EVK version 5.0 or lower, please refer to the previous version of this manual.

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1 Terms and Definitions

DPM	Dynamic Power Management
AP	Access Point
USB	Universal Serial Bus
UART	Universal Asynchronous Receiver-Transmitter
RTC	Real Time Clock
WPS	Wi-Fi Protected Setup
SSID	Service Set Identifier
SDK	Software Development Kit
ARP	Address Resolution Protocol

2 References

- [1] DA16200, Datasheet, Dialog Semiconductor
- [2] UM-WI-002, DA16200, SDK Programmer Guide, User Manual, Dialog Semiconductor
- [3] UM-B-114, DA14531, Devkit Pro Hardware, User Manual, Dialog Semiconductor
- [4] UM-WI-012, DA16200 SPI SFlash Downloader, User Manual Rev 1v5, Dialog Semiconductor

3 DA16200 Module EVK

Figure 1 shows the hardware configuration of the DA16200 Module Evaluation Kit (EVK).

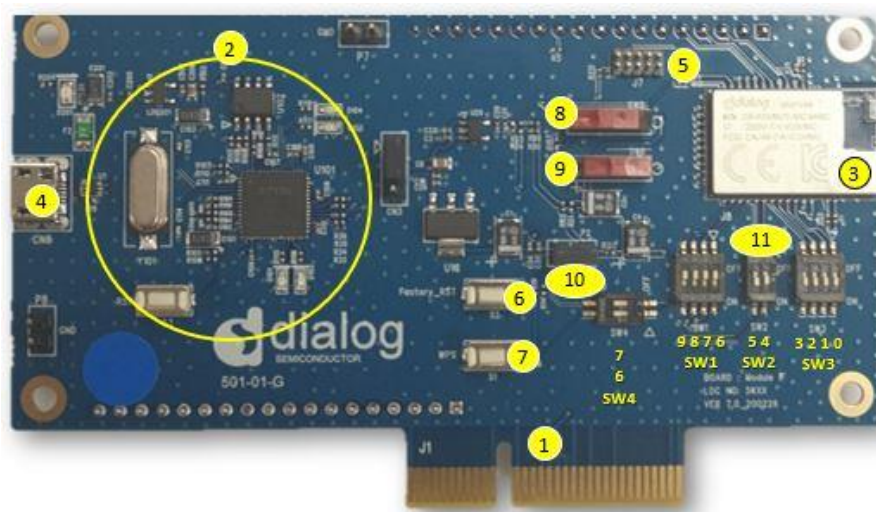


Figure 1: Hardware Configuration

DA16200 has the following components:

1. Main board: DA16200 module (DA16200MOD-AAC4WA32) is installed on the PCI type main board.
2. USB Interface part.
3. DA16200MOD-AAC4WA32 Wi-Fi Module.
4. USB Port: UART0 (for debug) and UART1 (for AT command).
5. JTAG PIN: to be able to connect I-jet (a JTAG debugger from IAR). See Figure 2.
 - a. Pin 7 on each end is keyed with a white plug, so Pin 7 should be removed on EVK.



Figure 2: JTAG Pin Connection

6. Factory Reset Button: press for more than 5 seconds to initialize `nvr` data.
7. WPS Button: press to start WPS mode.
8. RTC Wake up key: switch to wake up the board from Sleep Mode.
9. RTC Power key: switch to turn the board on/off.
10. Pin (P2): selected part in red color is for current measurement. For normal operation, this pin should be shorted. See .
 - a. Pull out the Short Pin cap and use the jumper wire to connect to measuring equipment.

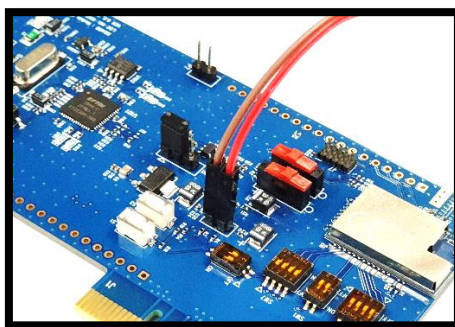


Figure 3: Test Point for Current Measurement

11. GPIO, SPI selective switch: SW2, SW3, SW4 (Default: on), SW1 (Default: off). See [Table 1](#).
- For more details on how to use the pins, see the schematic of the 6.0 EVK in the manual UM-WI-012 DA16200 SPI SFlash Downloader Rev 1v5 [\[4\]](#).

Table 1: GPIO, SPI Selective Switch

Selective Switch	On	Off
SW3 : GPIO 0, 1, 2, 3	Image download using SPI 1	Not defined
SW2 : GPIO 4, 5	UART 1(TXD, RXD) to FT232H	UART 1 to external MCU for Test
SW1 : GPIO 6, 7	Image download using SPI 2	WPS, Factory Reset
SW1 : GPIO 8, 9	Image download using SPI 2	Not defined
SW4 : GPIO 6, 7	WPS, Factory Reset	Not defined

4 Test Sequence

This section describes test sequence for how we show the DA16200 benefits of the following test items:

- Current measure (Section [7](#))
 - Section [7.1](#) > Section [5.1](#), [5.2](#) > Section [7.2](#) (Sleep1), Section [7.3](#) (Sleep 2)
 - Section [7.1](#) > Section [5.1](#), [5.2](#) > Section [6](#) > Section [7.4](#)
- Ping test (Section [7.5](#))
- Section [5.1](#), [5.2](#), [5.3](#) > (Section [6](#)) > Section [7.5](#)
- Throughput test (section [9](#))
- Section [5.1](#), [5.2](#), [5.3](#) > Section [9](#)
- SoftAP test (Section [5.4](#))
- Section [5.1](#), [5.2](#) > Section [5.4](#)
- Firmware update
- Section [5.1](#), [5.2](#) > Section [11](#)

5 Wi-Fi Mode Setup

This section describes how to setup the Station and Soft-AP mode that are supported by DA16200.

- Station: a mode that runs the 802.11 STA interface.
- Soft-AP: a mode that runs the Software Access Point. Know that the Soft-AP mode does not support full-fledged commercial level Access Point features. This mode is normally used for Provisioning.

5.1 DA16200 Connecting the Board

This section describes the installation procedure for the drivers, the configuration of the serial port, and all necessary steps to verify the connection with the PC as well as solutions to any problems that may occur.

On first connection to a host PC with Microsoft Windows as operating system, the system will detect several devices and will automatically install all necessary drivers. If not automatically installed, then get the driver from the following url: http://www.ftdichip.com/Drivers/CDM/CDM21224_Setup.zip.

There are two virtual COM ports created by the Windows driver. The first COM port (lower number, COM35 in this example) provides a UART interface for debugging or firmware download between the PC and the DA16200. The second (higher number, COM36 in this example) is used for ATCOMMAND. See [Figure 4](#).

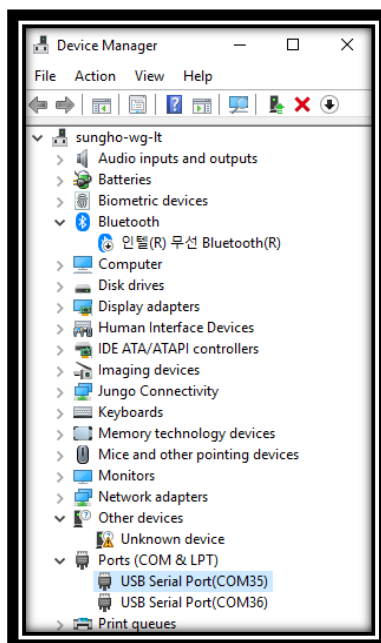


Figure 4: Check COM ports on Device Manager

5.2 Configure the Serial Port for UART

On a Windows Host the utility **Tera Term** is used to fully validate the connection to the DA16200 EVK. **Tera Term** is a free software terminal emulator (communication program) that supports multiple communication including serial port connections. Download **Tera Term** from <https://tssh2.osdn.jp>. Run the **teraterm-x.yy.exe** executable and follow the installation wizard.

To make sure that the communication between the DA16200 EVK and the host PC is properly established, the UART connection between the two nodes needs to be verified. For that purpose, do the following steps:

1. Connect the DA16200 EVK to the PC via USB cable to USB Port.
2. Verify that the host discovered two serial ports as shown in [Figure 4](#). The second is connected to UART (see section 5.1).

3. Open **Tera Term** from the Windows Start menu.
4. In the **Tera Term: New connection** dialog:
 - a. Select **Serial**.
 - b. Select the COM Port to use.
 - c. Click **OK**.
5. Select **Setup > Serial Port** and configure your UART port with the parameters as shown in [Figure 5](#).
6. Open the Lowest COM port number assigned to the DA16200 EVK (see [Figure 4](#)), to figure out which port number is used by Windows by running the Device Manager. Make sure that the UART is configured as shown in [Figure 5](#).

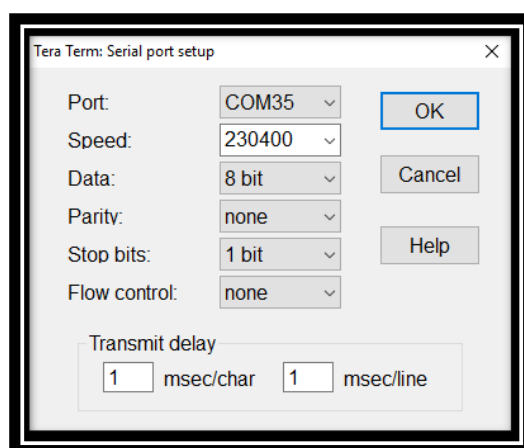


Figure 5: Serial Port Setup

5.3 Setup for Station Mode

Easy Setup is a Wi-Fi configuration wizard to easily configure the Wi-Fi functions of DA16200.

1. Run command `setup`.

NOTE

From here on, the setup query statements will continue. So please answer the questions as follows:

2. Stop all services for the setting. Are you sure? [Yes/No]: type **Yes**
See [Figure 6](#).

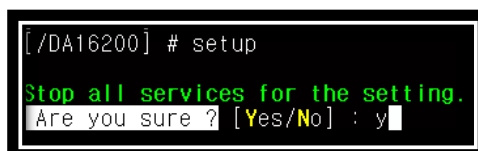


Figure 6: Easy Setup Start

3. COUNTRY CODE? [Quit] (Default KR) : type **US** for testing
See [Figure 7](#).

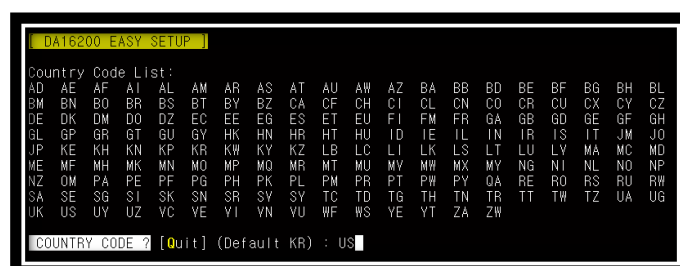


Figure 7: Country Selection

4. MODE? [1/2/3/4/5/6/Quit] (Default Station): type **1**
See Figure 8.

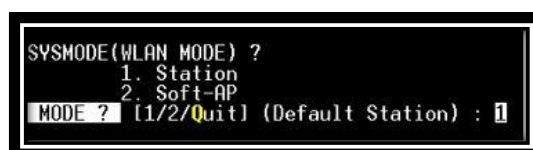


Figure 8: Station mode Selection

5. SELECT SSID? (1~30/Manual/Quit) : type **1**
See Figure 9.
- a. Select the SSID of the AP to which you want to connect. If there is no AP that you want to connect to, please press **Enter** to rescan.
For example: SSID **ACST_AC_TEST2** is selected for testing.

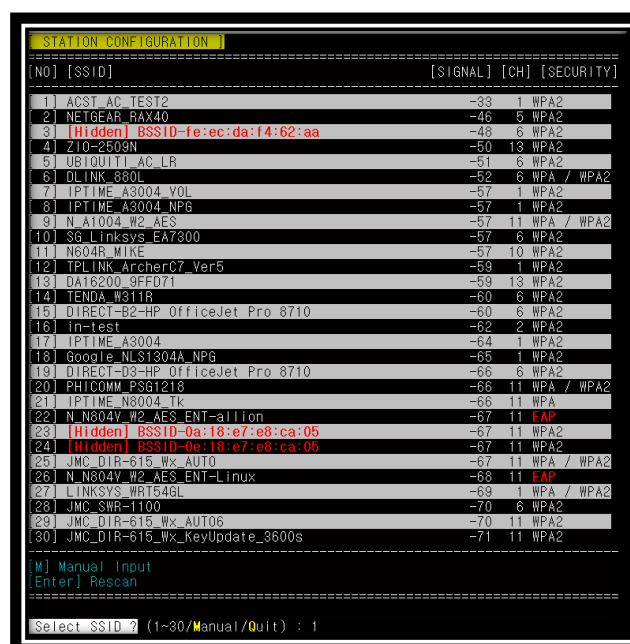


Figure 9: AP Selection

6. PSK-KEY (ASCII characters 8~63 or hexadecimal characters 64)? [Quit]
: ***** type the password that matches the encryption method of the selected AP.
7. WIFI CONFIGURATION CONFIRM? [Yes/No/Quit] : type **Y**. See Figure 10.
8. IP Connection Type? [Automatic IP/Static IP/Quit]: type **A**
IP is automatically assigned by DHCP.
9. IP CONFIGURATION CONFIRM? [Yes/No/Quit] : type **Y**

10. SNTP Client enable: type **N**

If time synchronization is not needed, then there is no need to run the SNTP Client.

11. Dynamic Power Management? [Yes/No/Quit]: type **N**

See section 6.1 for more information about DPM.

```
=====
SSID      : ACST_AC_TEST2
AUTH      : WPA/WAP2
ENCRYPTION: TKIP/AES(CCMP)
PSK KEY   : acstac12
KEY TYPE  : ASCII
Hidden AP : Not connect
=====
WIFI CONFIGURATION CONFIRM ? [Yes/No/Quit] : Y
IP Connection Type ? [Automatic IP/Static IP/Quit] : A
IP Connection Type: Automatic IP
IP CONFIGURATION CONFIRM ? [Yes/No/Quit] : Y
SNTP Client enable ? [Yes/No/Quit] : N
FCI Dynamic Power Management ? [Yes/No/Quit] : N
```

Figure 10: Check Wi-Fi Configuration

12. Once all settings are made as shown in Figure 10, the configuration is saved and the system will reboot as shown in Figure 11.

```
Configuration OK
Reboot....

P.TIM is relocated to RETMEM (20f835c0, 3)
dpm_init_retmemory::350 DPM INIT CONFIGURATION(1)
Wakeup source is 0x1

*****
* ----- DA16200 SDK Information -----
*
* - CPU Type       : Cortex-M4 (80MHz)
* - OS Type        : ThreadX 5.7
* - Serial Flash   : 16 Mbits (2 MBytes)
* - SDK Type       : Generic v1.1.0
* - F/W Version    : RTOS-GEN01-01-8254-000000
* - SLIB-GEN01-01-8209-000000
* - F/W Build Time : Sep  9 2019 19:55:35
* - Boot Index     : 0
*
*****

[1213] ADC CAL loop 1, time 135 us

System Mode : Station Only (0)
>>> FC9K supplicant Ver1.00-20170213-01
>>> MAC address (sta0) : ec:9f:0d:9f:f9:3a
>>> sta0 interface add OK
>>> Start STA mode...

>>> UART1 : Clock=80000000, BaudRate=115200
>>> UART1 : DMA Enabled...
>>> Selected BSS 88:36:6c:42:79:6c ssid='ACST_AC_TEST2' (-18)
>>> Network Interface (wlan0) : UP
>>> Associated with 88:36:6c:42:79:6c

Connection COMPLETE to 88:36:6c:42:79:6c

-- DHCP Client WLAN0: SEL
-- DHCP Client WLAN0: REQ
-- DHCP Client WLAN0: BOUND
   Assigned addr : 192.168.0.67
   netmask       : 255.255.255.0
   gateway       : 192.168.0.1
   DNS addr      : 168.126.63.1

   DHCP Server IP : 192.168.0.1
   Lease Time     : 02h 00m 00s
   Renewal Time   : 01h 00m 00s
```

Figure 11: Wi-Fi Configuration Completed

5.4 Setup for Soft-AP Mode

The setup for the Soft-AP mode is almost same as for the STA mode. You can also use Easy Setup to set up the Soft-AP mode. Do the following instructions:

1. At the prompt, run command `setup`.

Note 1 From here on, the setup query statements will continue. So please answer the questions as follows:

2. MODE? [1/2/3/4/5/6/Quit] (Default Station): type **2**

See [Figure 12](#).

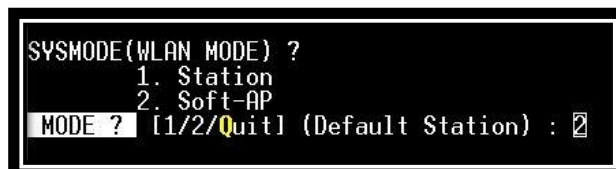


Figure 12: Soft-AP Mode Selection

3. SSID? (Default 16200_9FFFFFF): **TEST AP**. See [Figure 13](#).
 - o Choose the SSID you want to use.
4. AUTHENTICATION? [1/2/3/4/5/QUIT]: type **4**
 - o WPA2-PSK is recommended
5. ENCRYPTION? [1/2/3/Quit]: type **2**
6. PSK-KEY (ASCII characters 8~63 or hexadecimal characters 64)? [Quit]
 - : ***** Enter the password you want to use.

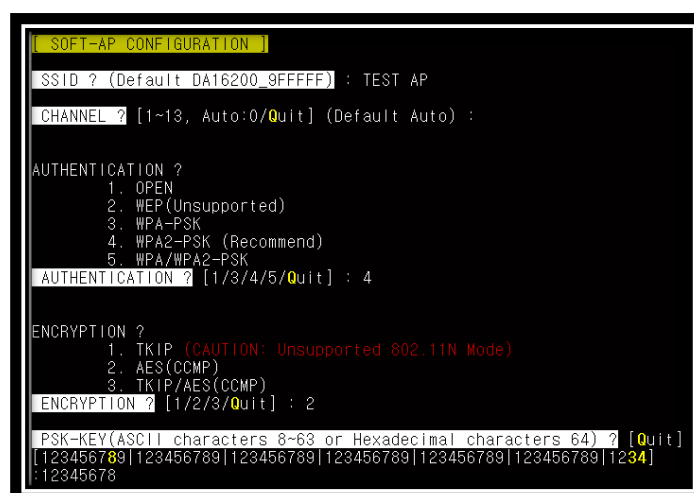


Figure 13: Setup AP

7. Do you want to set advanced Wi-Fi configuration? [No/Yes/Quit] (Default No): type **N**
See [Figure 14](#).
8. WIFI CONFIGURATION CONFIRM? [Yes/No/Quit]: type **Y**
9. IP ADDRESS? [Quit] (Default 10.0.0.1): press **[ENTER]**
10. SUBNET? [Quit] (Default 255.255.255.0): press **[ENTER]**
11. GATEWAY? [Quit] (Default 10.0.0.1): press **[ENTER]**
12. DNS? [Quit] (Default 8.8.8.8): press **[ENTER]**
13. IP CONFIGURATION CONFIRM? [Yes/No/Quit]: type **Y**
14. DHCP SERVER CONFIGURATION? [Yes/No/Quit]: type **Y**
15. DHCP SERVER LEASE IP Count (MAX 10)? [Quit] (Default 10): press **[ENTER]**

16. DHCP SERVER LEASE TIME (60 ~ 86400 SEC)? [Quit] (Default 1800): press **[ENTER]**

17. DHCP SERVER CONFIGURATION CONFIRM? [Yes/No/Quit]: type **Y**

```

Do you want to set advanced WiFi configuration? [No/Yes/Quit] (Default No) : N

=====
SSID      : TEST_AP
CHANNEL   : AUTO(ACS)
AUTH      : WPA2
ENCRYPTION: AES(CCMP)
PSK KEY   : 12345678
KEY TYPE  : ASCII
WIFI MODE : 11b/g/n
=====
WiFi CONFIGURATION CONFIRM? [Yes/No/Quit] : Y

IP ADDRESS? [Quit] (Default 10.0.0.1) :
SUBNET? [Quit] (Default 255.255.255.0) :
GATEWAY? [Quit] (Default 10.0.0.1) :
DNS? [Quit] (Default 8.8.8.8) :
=====
[WLAN1]
IP ADDRESS: 10.0.0.1
SUBNET    : 255.255.255.0
GATEWAY   : 10.0.0.1
DNS       : 8.8.8.8
=====
IP CONFIGURATION CONFIRM? [Yes/No/Quit] : Y

DHCP SERVER CONFIGURATION? [Yes/No/Quit] : Y

DHCP SERVER LEASE IP Count(MAX 10)? [Quit] (Default 10) :
DHCP SERVER LEASE TIME(60 ~ 86400 SEC)? [Quit] (Default 1800) :
=====
[DHCP SERVER]
Start IP  : 10.0.0.2
END IP    : 10.0.0.11
DNS       : 8.8.8.8
LEASE TIME: 1800
=====
DHCP SERVER CONFIGURATION CONFIRM? [Yes/No/Quit] : Y

```

Figure 14: AP Mode Selection

```

Configuration OK

Reboot...

P.TIM is relocated to RETMEM (20f835c0, 3)
dpm_init_retmemory::350 DPM INIT CONFIGURATION(1)

Wakeup source is 0x0

*****
*                               DA16200 SDK Information                               *
* -----*
*
* - CPU Type       : Cortex-M4 (80MHz)
* - OS Type        : ThreadX 5.7
* - Serial Flash   : 16 Mbits (2 MBytes)
* - SDK Type       : Generic v1.1.0
* - F/W Version    : RTOS-GEN01-01-8254-000000
*                  : SLIB-GEN01-01-8209-000000
* - F/W Build Time : Sep  9 2019 19:55:35
* - Boot Index     : 0
*
*****

[11806] ADC CAL loop 14, time 10729 us

System Mode : Soft-AP (1)
Starting DHCP Server(WLAN1)
>>> FC9K supplicant Ver1.00-20170213-01
>>> Add SoftAP Interface (softap1) ...
>>> MAC address (softap1) : ec:9f:0d:9f:f9:3b
>>> softap1 interface add OK
>>> AP Operating Channel: AUTO

>>> UART1 : Clock=80000000, BaudRate=115200
>>> UART1 : DMA Enabled ...
ACS: Ideal channel is 12
>>> Network Interface (wlan1) : UP
BSS Isolate Enabled

Soft-AP is Ready (ec:9f:0d:9f:f9:3b)

```

Figure 15: AP Setup Completed

Once all settings are made as given above, the configuration is saved, and the system will reboot.

A message is printed that Soft-AP mode started successfully. See [Figure 15](#).

6 DPM setup

6.1 What is DPM

DPM (Dynamic Power Management) is a synthesis of breakthrough ultra-low power technologies that enable extremely low power operation in the DA16200. DPM shuts down every micro element of the chip that is not in use, which allows a near zero level of power consumption when not actively transmitting or receiving data. Such low-power consumption can provide a battery life of one year or more, depending on the application. DPM also enables ultra-low power transmit and receive modes when the SoC needs to be awake to exchange information with other devices. Advanced algorithms enable to stay asleep until the exact required moment to wake up to transmit or receive.

6.2 Enable DPM Mode

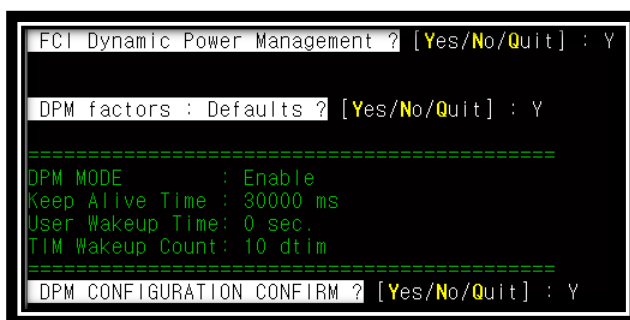
This section shows how to enable the DPM mode:

1. Do the steps in section 5.1 until step 11: **Dynamic Power Management? [Yes/No/Quit]**.
2. At prompt **Dynamic Power Management? [Yes/No/Quit]**: type **Y**. See Figure 16.
 - a. To use default DPM factor, **DPM factors: Defaults? [Yes/No/Quit]**, type **Y**
 - b. **DPM CONFIGURATION CONFIRM [Yes/No/Quit]**: type **Y**

NOTE

TIM wakeup count 10 dtim is the default value. This means: $10dtim \times 102.4 = 1,024 \text{ ms} = 1\text{sec}$ @ DTIM = 1 (in case that AP DTIM = 3, 10dtim is 921.6 ms)

Wake-up from sleep state takes place every 1 seconds to check for a receive packet



```

FCI Dynamic Power Management ? [Yes/No/Quit] : Y
DPM factors : Defaults ? [Yes/No/Quit] : Y
=====
DPM MODE      : Enable
Keep Alive Time : 30000 ms
User Wakeup Time: 0 sec.
TIM Wakeup Count: 10 dtim
=====
DPM CONFIGURATION CONFIRM ? [Yes/No/Quit] : Y
  
```

Figure 16: Setting DPM Factor with Default

- c. To use user-defined DPM factor, **DPM factors: Defaults? [Yes/No/Quit]**, type **N**. See Figure 17.
 - i. **DPM Keep Alive Time (0~600000 ms)? [Quit] (Default 30000 ms)**: press **[ENTER]** or type value within range
 - ii. **DPM User Wakeup Time (0~86400 Sec.)? [Quit] (Default 0 Sec.)**: press **[ENTER]** or type value within range
 - iii. **DPM TIM Wakeup Count (1~65535 dtim)? [Quit] (Default 10)**: press **[ENTER]** or type value within range
 - iv. **DPM CONFIGURATION CONFIRM [Yes/No/Quit]**: type **Y**

```

FCI Dynamic Power Management ? [Yes/No/Quit] : y

DPM factors : Defaults ? [Yes/No/Quit] : n

DPM Keep Alive Time(0~600000 ms) ? [Quit] (Default 30000 ms) :
DPM User Wakeup Time(0~86400 Sec.) ? [Quit] (Default 0 Sec.) :
DPM TIM Wakeup Count(1~65535 dtim) ? [Quit] (Default 10) :
=====
DPM MODE      : Enable
Keep Alive Time : 30000 ms
User Wakeup Time: 0 sec.
TIM Wakeup Count: 10 dtim
=====
DPM CONFIGURATION CONFIRM ? [Yes/No/Quit] : y

```

Figure 17: Setting DPM factor with User Defined

- After reboot, DA16200 will enter DPM sleep. The print message >>> Start DPM Power-Down!!! means that DA16200 has entered DPM Sleep. See Figure 18.

```

Connection COMPLETE to 88:36:6c:42:79:6c

-- DHCP Client WLAN0: SEL
-- DHCP Client WLAN0: REQ
-- DHCP Client WLAN0: BOUND
    Assigned addr   : 192.168.0.64
        netmask    : 255.255.255.0
        gateway    : 192.168.0.1
        DNS addr   : 168.126.63.1

    DHCP Server IP  : 192.168.0.1
    Lease Time      : 02h 00m 00s
    Renewal Time    : 01h 40m 00s

>>> Start DPM Power-Down !!!

```

Figure 18: DPM Mode Running after Reboot

NOTE

After the system starts running with DPM, user input via the UART will not work from that moment.

6.3 Hold DPM Mode

Once the system starts running with DPM, user input via the UART does not work anymore from that moment. This is because the UART interface is down during DPM Sleep, which is normal. To exit this state and start over with `setup`, do the following instructions:

- Copy the string `dpm hold` to the clipboard.
 - For example: open Notepad, type `dpm hold`, and then copy (Ctrl + C) the command string.
- Use RTC_PWR_KEY to power off (move to OFF position).
- Use RTC_PWR_KEY to power on (move to ON position).
- Before the message >>> Start DPM Power-Down !!! is printed on the console, quickly do the following:
 - With the `dpm hold` string copied, right-click in the terminal window to paste the string.
 - Immediately press the **ENTER** key.

- c. Once this procedure is done quickly and successfully, the message DPM Sleep Manager HOLD... is printed. See [Figure 19](#).
 - d. If the DPM mode does not stop successfully, you may need to retry several times.
5. Run `setup` again to configure DA16200 in a different mode.

```

*****
*                               DA16200 SDK Information                               *
*                               -----                               *
*
* - CPU Type       : Cortex-M4 (80MHz)
* - OS Type        : ThreadX 5.7
* - Serial Flash   : 16 Mbits (2 MBytes)
* - SDK Type       : Generic v1.1.0
* - F/W Version    : RTOS-GEN01-01-8254-000000
*                  : SLIB-GEN01-01-8209-000000
* - F/W Build Time : Sep  9 2019 19:45:04
* - Boot Index     : 0
*
*****

[1230] ADC CAL loop 1, time 138 us
System Mode : Station Only (0)
>>> FC9K supplicant Ver1.00-20170213-01
>>> Wi-Fi mode : b/g/n -> b/g (for DPM)
>>> MAC address (sta0) : ec:9f:0d:9f:f9:34
>>> sta0 interface add OK
>>> Start STA mode...

[/DA16200] #
[/DA16200] # >>> Selected BSS 88:36:6c:42:79:6c ssid='ACST_AC_TEST2' (-25
)
>>> Network Interface (wlan0) : UP
>>> Associated with 88:36:6c:42:79:6c

[/DA16200] #
Connection COMPLETE to 88:36:6c:42:79:6c

-- DHCP Client WLAN0: SEL
-- DHCP Client WLAN0: REQ
dpm hold

- DPM Sleep Manager HOLD ...
[/DA16200] #
[/DA16200] #
[/DA16200] # -- DHCP Client WLAN0: BOUND
Assigned addr : 192.168.0.69
netmask      : 255.255.255.0
gateway      : 192.168.0.1
DNS addr     : 168.126.63.1

DHCP Server IP : 192.168.0.1
Lease Time     : 02h 00m 00s
Renewal Time   : 01h 40m 00s

dpm hold

- DPM Sleep Manager HOLD ...
[/DA16200] #
[/DA16200] #
[/DA16200] # dpm hold

- DPM Sleep Manager HOLD ...
[/DA16200] #

```

Figure 19: DPM Mode Hold

6.4 Disable DPM Mode

Though we make DPM enabled during `setup`, we can disable DPM mode with command `dpm off` at the prompt. DA16200 will be reboot and connect to AP as shown in [Figure 20](#).

```

~/DA16200 #
~/DA16200 # dpm off

>>> Network Interface (wlan0) : DOWN
[wpa_supplicant_event_disassoc] CTRL-Event-DISCONNECTED bssid=88:36:6c:9a:f5:4e
ally_generated=1
[wpa_supp_ev_disassoc_fin] Disconnect event - remove keys
P.TIM is relocated to RETMEM (20f835c0, 3)
dpm_init_retmemory::350 DPM INIT CONFIGURATION(1)

Wakeup source is 0x0

*****
*          DA16200 SDK Information
* -----
*
* - CPU Type       : Cortex-M4 (80MHz)
* - OS Type        : ThreadX 5.7
* - Serial Flash   : 16 Mbits (2 MBytes)
* - SDK Type       : Generic v1.1.0
* - F/W Version    : RTOS-GEN01-01-8254-000000
*                  : SLIB-GEN01-01-8209-000000
* - F/W Build Time : Sep  9 2019 19:55:35
* - Boot Index     : 0
*
*****

[1208] ADC CAL loop 1, time 135 us

System Mode : Station Only (0)
>>> FC9K supplicant Ver1.00-20170213-01
>>> MAC address (sta0) : ec:9f:0d:9f:f9:34
>>> sta0 interface add OK
>>> Start STA mode...

>>> UART1 : Clock=80000000, BaudRate=115200
>>> UART1 : DMA Enabled ...
>>> Selected BSS 88:36:6c:9a:f5:4e ssid='Dialog_CS_Jinwoo' (-21)
>>> Network Interface (wlan0) : UP
>>> Associated with 88:36:6c:9a:f5:4e

Connection COMPLETE to 88:36:6c:9a:f5:4e

-- DHCP Client WLAN0: SEL
-- DHCP Client WLAN0: REQ
-- DHCP Client WLAN0: BOUND
    Assigned addr : 192.168.0.5
        netmask   : 255.255.255.0
        gateway   : 192.168.0.1
        DNS addr  : 164.124.101.2

    DHCP Server IP : 192.168.0.1
    Lease Time     : 02h 00m 00s
    Renewal Time   : 01h 00m 00s

```

Figure 20: DPM Mode Off

7 Current Measurement

For more detailed information on Sleep mode, please see section 'Low Power Operation Mode' in DA16200 Datasheet [1]. To measure the current waveform, connect EVK's current measurement point (P2) with the measurement instrument (KEYSIGHT 14585A).

7.1 Test Setup

Figure 21 shows a typical test setup environment.

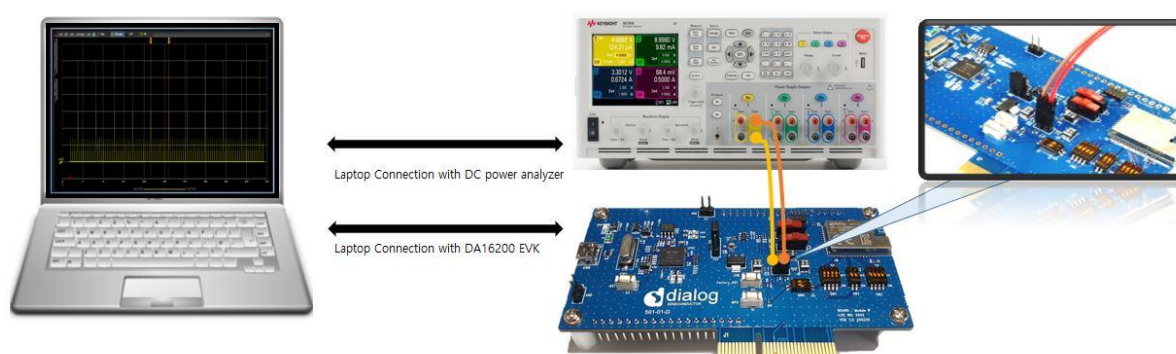


Figure 21: Current Test Environment

7.2 Sleep 1

To measure the Sleep 1 current, use RTC_PWR_KEY to power off (move to OFF position). See section 3, number 9. See Figure 22.

7.3 Sleep 2

To measure the Sleep 2 current, the following command is required:

1. Use RTC_PWR_KEY to power on (move to on position). See section 3, number 9.
2. Command `factory` to make DA16200 use default setting.
3. The board will reboot.
4. At prompt, run command `sleep 2 time(sec) [/DA16200/SYS.HAL] # sleep 2 time(sec)`
 - For instance, `[/DA16200/SYS.HAL] # sleep 2 10`
 - It will sleep for a set amount of time (10 seconds), and then reboot and wake up.

7.4 Sleep 3

1. Do the steps in section 6.2 until step 3.
 - When you run the DA16200 with DPM settings, DA16200 will run DPM Sleep, wake up for Beacon check and Keep Alive according to the configured DTIM

For example: the current waveform in Figure 22 shows settings DTIM 10 (about 1sec @ AP DTIM=1) and Keep Alive 30s.

Sleep 3 current means current between RX or between RX and TX.

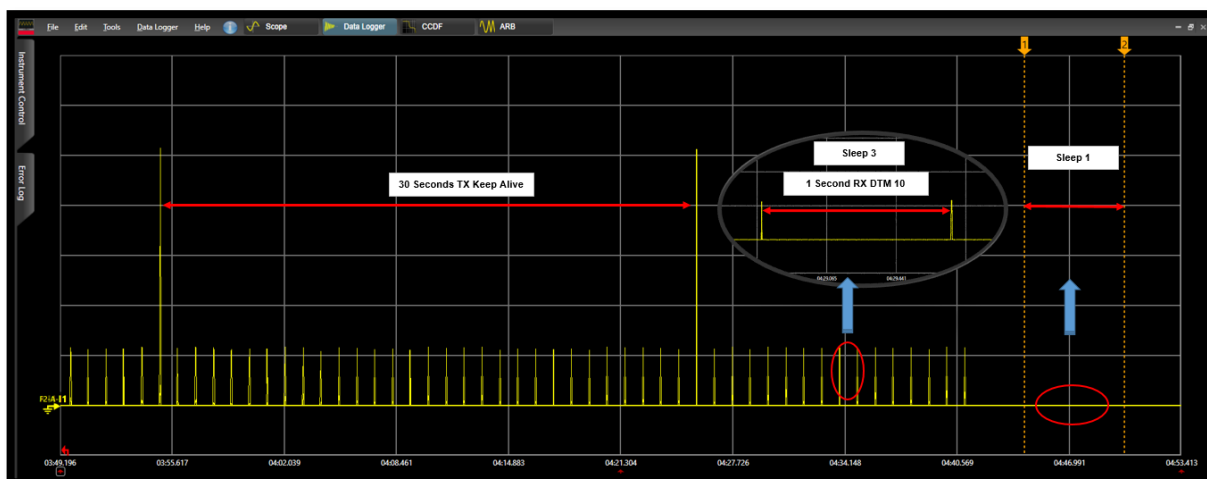


Figure 22: Current Measurement with DPM

7.5 Current Measurement with SmartSnippets Tool

7.5.1 Test Setup

Figure 23 shows a typical test setup environment with PRO-MB development kit and SmartSnippets Tool.

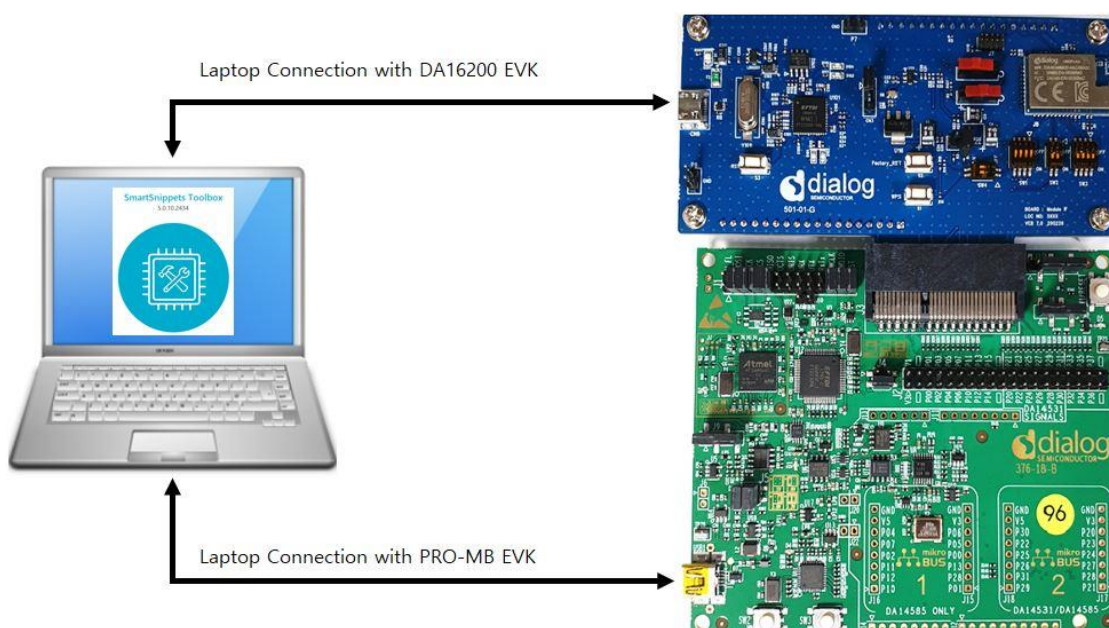


Figure 23: Hardware Setup with PRO-MB Development Kit

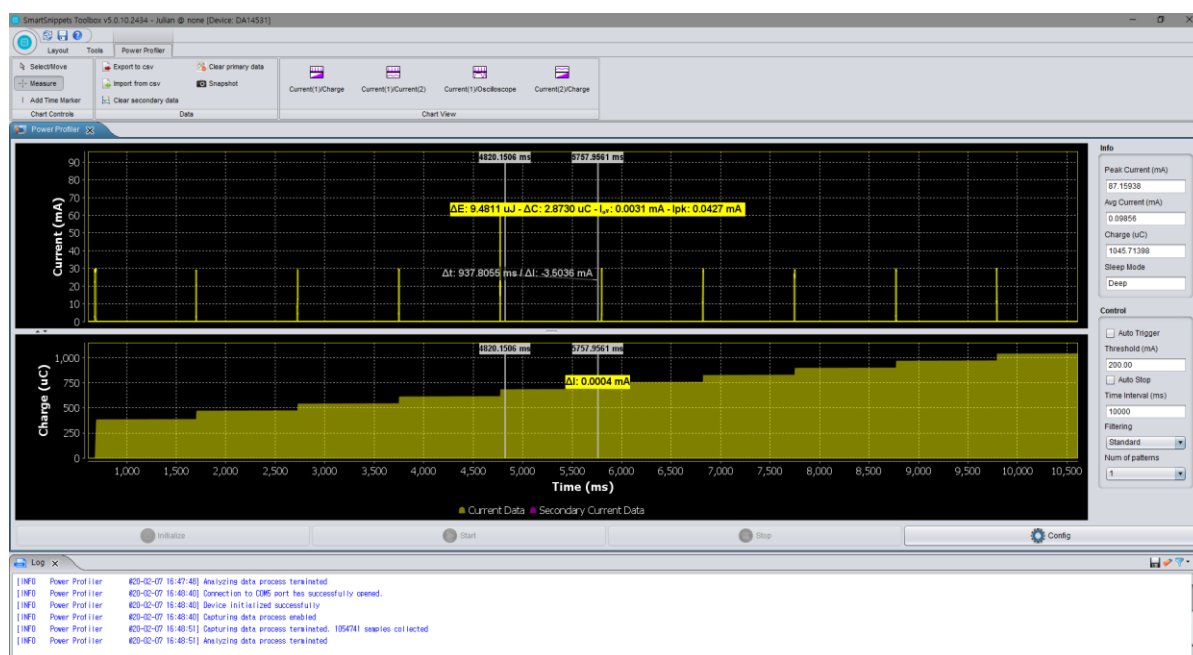


Figure 24: Current Measurement with SmartSnippets

For more details on how to use SmartSnippets, see UM-B-114 DA14531 Devkit Pro Hardware User manual 1v1 [3].

The user manual can be downloaded from the customer support portal. Direct link: [manual](#)

The SmartSnippets tool can be downloaded from the customer support portal. Direct link: [windows](#)
[linux](#)

8 Ping Test

DA16200 has command `ping` to verify communication test (Ping Test) during DPM mode.

8.1 Test Setup

For a communication test (Ping Test) there are two stations (DA16200 and Laptop) and an Access Point (AP) required. Both must be connected to the same sub-network AP. See [Figure 25](#). DA16200 must be connected to the AP via WIFI, and the laptop must be connected to the AP with an Ethernet cable. After configuration, DA16200 will be in DPM Sleep mode (sleep 3). Then DA16200 can wake up from sleep mode when unicast packets are sent, while remaining in sleep mode most of the time. In this test, a Ping application that runs on the laptop acts as a network peer that sends a unicast packet to DA16200. This is to check if DA16200 in DPM Sleep mode can successfully wake up and receive the unicast packets in real-time.



Figure 25: Ping Test Environment

1. Run the command window (CMD) as administrator.
2. Type command `ipconfig` to see what the IP address is of the laptop. See [Figure 26](#).
For example: the laptop's IP is 192.168.0.65, and the Default Gateway IP is 192.168.0.1

```

Connection-specific DNS Suffix  . : 
Link-local IPv6 Address . . . . . : fe80::9809:ccc1:b552:e47f%19
IPv4 Address. . . . . : 192.168.0.65
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.0.1
  
```

Figure 26: Ethernet IP Address Assign

3. Run the DA16200 terminal window and set DA16200 in Station mode (see section 5.3).
 - For example: the assigned IP of DA16200 is 192.168.0.66. See [Figure 27](#).

```

Connection COMPLETE to 88:36:6c:42:79:6c
-- DHCP Client WLAN0: SEL
-- DHCP Client WLAN0: REQ
-- DHCP Client WLAN0: BOUND
    Assigned addr   : 192.168.0.66
      netmask       : 255.255.255.0
      gateway       : 192.168.0.1
      DNS addr      : 168.126.63.1

    DHCP Server IP  : 192.168.0.1
    Lease Time      : 02h 00m 00s
    Renewal Time    : 01h 40m 00s
  
```

Figure 27: DA16200 IP Address Assign

8.2 Add ARP Record

This section describes how to add a DHCP assigned IP address to the ARP table and to change that IP address from a dynamic to a static IP address.

Since retransmission logic is not included in the higher protocol (TCP / UDP), an additional ARP record is required for ping tests between the laptop and the DA16200 operating in DPM sleep mode.

1. Use command `arp -s 192.168.0.66 ec-9f-f9-32` to add an ARP record manually.

NOTE

When you set the ARP cache to static with command `arp -s` on higher versions of Windows, you may get an error like Failed to add ARP entry, Access is denied.

It is recommended to use command `netsh` to change the network settings

Do the following steps to change the ARP record to a static IP address:

2. Use command `arp -a` to view ARP table of the network interface. See [Figure 28](#).

- For example: `C:\WINDOWS\system32>arp -a`

```
Interface: 192.168.0.65 --- 0x13
Internet Address      Physical Address      Type
192.168.0.1           88-36-6c-42-79-6c    dynamic
192.168.0.66          ec-9f-0d-9f-f9-32    dynamic
192.168.0.255         ff-ff-ff-ff-ff-ff    static
224.0.0.2             01-00-5e-00-00-02    static
224.0.0.22            01-00-5e-00-00-16    static
224.0.0.251           01-00-5e-00-00-fb    static
224.0.0.252           01-00-5e-00-00-fc    static
239.255.255.250       01-00-5e-7f-ff-fa    static
255.255.255.255       ff-ff-ff-ff-ff-ff    static
```

Figure 28: Check ARP Record

3. Use command `netsh interface show interface` to find the interface name. See [Figure 29](#).

- For example: `C:\WINDOWS\system32>netsh interface show interface`

```
C:\WINDOWS\system32>netsh interface show interface

Admin State   State        Type          Interface Name
-----
Enabled       Connected    Dedicated     이더넷
Enabled       Disconnected Dedicated     Wi-Fi
```

Figure 29: Interface name for ARP Record

4. Use the interface name found for DA16200 to set the ARP cache to static with command `C:\WINDOWS\system32> netsh interface ipv4 add neighbors "<Interface Name>" "<IP>" "<MAC>"`. See [Figure 30](#).
 - For example: `C:\WINDOWS\system32> netsh interface ip add neighbors "이더넷" "192.168.0.66" "ec-9f-0d-9f-f9-32"`
5. Use command `arp -a` on the laptop to check if the ARP cache is configured correctly. See [Figure 30](#).
 - For example: `C:\WINDOWS\system32>arp -a`
 - DA16200's IP address 192.168.0.66 is added to ARP table as a static type


```
C:\WINDOWS\system32>netsh interface ip add neighbors "이더넷" "192.168.0.66" "ec-9f-0d-9f-f9-32"

C:\WINDOWS\system32>arp -a

Interface: 192.168.0.65 --- 0x13
Internet Address      Physical Address      Type
192.168.0.1           88-36-6c-42-79-6c    dynamic
192.168.0.66          ec-9f-0d-9f-f9-32    static
192.168.0.255         ff-ff-ff-ff-ff-ff    static
224.0.0.2             01-00-5e-00-00-02    static
224.0.0.22            01-00-5e-00-00-16    static
224.0.0.251           01-00-5e-00-00-fb    static
224.0.0.252           01-00-5e-00-00-fc    static
239.255.255.250       01-00-5e-7f-ff-fa    static
255.255.255.255       ff-ff-ff-ff-ff-ff    static
```

Figure 30: Success ARP Record for DA16200

6. Use command `arp -d` or `netsh interface ip delete arpccache` to initialize the ARP cache.

8.3 Perform Ping Test

Ping application is a simple generic application provided by Network Stack for network management purposes. Its main purpose is to check if a node is alive in the same sub network. Ping just sends out a request once and then waits for a reply. Ping prints the result only if a Reply packet arrives from the peer.

1. Make DPM enable. See section 6.2.

2. Run a ping on the Laptop. See Figure 31.

For example: `C:\WINDOWS\system32>ping 192.168.0.66 -t`

Next, DA16200 wakes up and receives the ping message, sends a reply and goes to DPM sleep again.

```

C:\WINDOWS\system32>ping 192.168.0.66 -t

Pinging 192.168.0.66 with 32 bytes of data:
Reply from 192.168.0.66: bytes=32 time=125ms TTL=128
Reply from 192.168.0.66: bytes=32 time=263ms TTL=128
Reply from 192.168.0.66: bytes=32 time=5ms TTL=128
Reply from 192.168.0.66: bytes=32 time=245ms TTL=128
Reply from 192.168.0.66: bytes=32 time=10ms TTL=128
Reply from 192.168.0.66: bytes=32 time=247ms TTL=128
Reply from 192.168.0.66: bytes=32 time=11ms TTL=128
Reply from 192.168.0.66: bytes=32 time=247ms TTL=128
Reply from 192.168.0.66: bytes=32 time=14ms TTL=128
Reply from 192.168.0.66: bytes=32 time=256ms TTL=128
Reply from 192.168.0.66: bytes=32 time=11ms TTL=128
Reply from 192.168.0.66: bytes=32 time=245ms TTL=128
Reply from 192.168.0.66: bytes=32 time=34ms TTL=128
Reply from 192.168.0.66: bytes=32 time=246ms TTL=128
Reply from 192.168.0.66: bytes=32 time=11ms TTL=128
Reply from 192.168.0.66: bytes=32 time=249ms TTL=128
Reply from 192.168.0.66: bytes=32 time=12ms TTL=128
Reply from 192.168.0.66: bytes=32 time=254ms TTL=128
Reply from 192.168.0.66: bytes=32 time=21ms TTL=128
Reply from 192.168.0.66: bytes=32 time=251ms TTL=128
Request timed out.

Ping statistics for 192.168.0.66:
    Packets: Sent = 22, Received = 21, Lost = 1 (4% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 5ms, Maximum = 263ms, Average = 1205ms
Control-C

```

```

Wakeup source is 0x82
>>> TIM STATUS: 0x00000001
>>> TIM : UC

>>> Start DPM Power-Down !!!
rwnx_send_set_ps_mode PS TIME (us) 139636

Wakeup source is 0x82
>>> TIM STATUS: 0x00000001
>>> TIM : UC

>>> Start DPM Power-Down !!!
rwnx_send_set_ps_mode PS TIME (us) 139642

Wakeup source is 0x82
>>> TIM STATUS: 0x00000001
>>> TIM : UC

```

Figure 31: Ping Test with DPM

NOTE

If you have multiple network interfaces enabled, then put the `arp` entry under the specific interface.
For example: `arp -s 192.168.20.52 aa-ff-00-88-66-80 -S 192.168.100.100`
192.168.100.100 is the interface from which the ping command should be sent. In this case, specifying network interface is required in the ping command.
For example: `ping 192.168.20.52 -S 192.168.100.100`

9 Throughput Test

DA16200 has command `iperf` to measure the packet transfer performance. This is known as the throughput test. To do the throughput test, prepare the DA16200 to operate in Station mode (see section 5.1) without using DPM (see section 6.4). This section shows the throughput test with the use of a TCP client / server protocol.

9.1 Test Setup

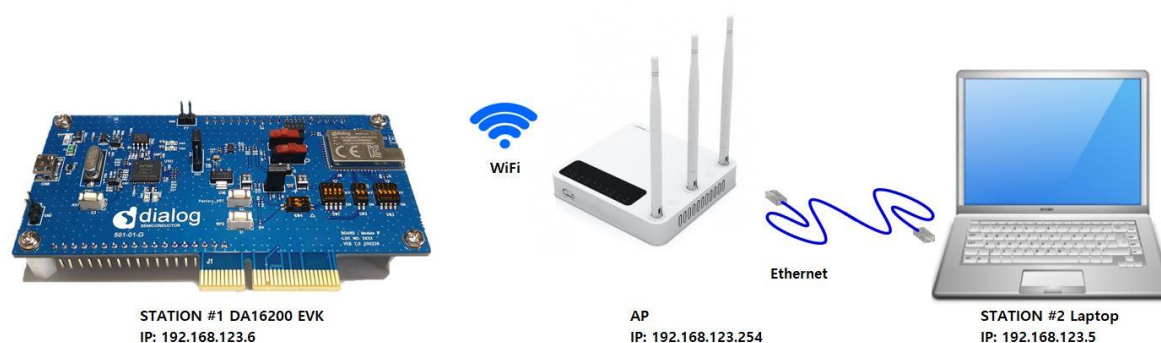


Figure 32: Iperf Test Environment

The Iperf tool should be ready on your laptop. **Iperf Version 2.0.9** is recommended.

Do the following steps to setup Iperf tool:

1. Download Iperf from <https://iperf.fr/iperf-download.php>.
2. Create a folder called **Iperf** in path **C:**
3. Unzip the downloaded file and move the contents to the Iperf folder.
4. Prepare the DA16200 to operate in Station mode. See sections 5.1 to 5.3.
5. Use command `iperf` or `iperf -h` to see the available options in Iperf. See Figure 33.
 - For example: `[/DA16200/NET] # iperf`

```
[/DA16200] # net
Command-List is changed, "NET"
[/DA16200/NET] # iperf
Usage: iperf -l [WLAN0|WLAN1] [-s|-c host][options]
iperf [-h] [-v]

Client/Server:
-l # Interface [WLAN0|WLAN1]
-u # use UDP rather than TCP
-p # server port to listen on/connect to
-w # TCP window size (4 ~ 64K)
-f, [kmKM] format to report: Kbits, Mbits, KBytes, MBytes
-d finish service
ex) iperf -d -c -u : udp client
iperf -d -c : tcp client
iperf -d -u : udp server
iperf -d : tcp server

Server specific:
-s # run in server mode
-T # Rx Time Out Min:1 sec, 'F' Forever

Client specific:
-c <host> run in client mode, connecting to <host>
-t # time in seconds to transmit for (default 10 secs)
-l # PacketSize option (UDP default 1470, IPv6 1448 TCP 1000)
-n # UDP Tx packet number
-S # WMM TOS option
[224|192]
[184|160|152|144|136]
[112|96|0]
[88|72|56|40|32]
-P, # Pair Index (0,1,2)
(default Max, Step 1~100 Mbps)
-o use Main Packet Pool

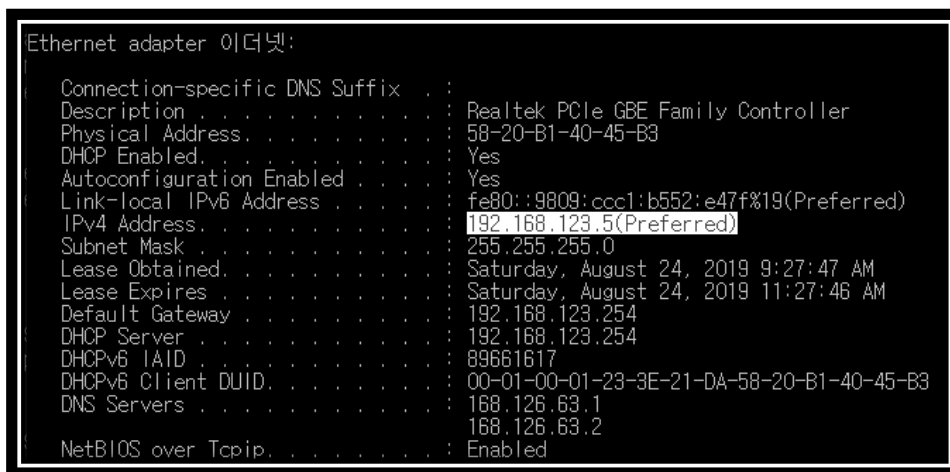
Miscellaneous:
-m # Print MIB info(debug only)
1 counter reset
2 counter retention
-h print this message
-v print version
[/DA16200/NET] #
```

Figure 33: Iperf Test Command

9.2 Iperf Test with Client Mode

To set-up the Iperf test with Client mode, do the following steps:

1. Connect the laptop you want to use as a server to the AP.
2. In the CMD window, use command `ipconfig/all` to find the IP address. See Figure 34.



```

Ethernet adapter 이더넷:

    Connection-specific DNS Suffix  . : 
    Description . . . . . : Realtek PCIe GBE Family Controller
    Physical Address. . . . . : 58-20-B1-40-45-B3
    DHCP Enabled. . . . . : Yes
    Autoconfiguration Enabled . . . . : Yes
    Link-local IPv6 Address . . . . . : fe80::9809:ccc1:b552:e47f%19(Preferred)
    IPv4 Address. . . . . : 192.168.123.5(Preferred)
    Subnet Mask . . . . . : 255.255.255.0
    Lease Obtained. . . . . : Saturday, August 24, 2019 9:27:47 AM
    Lease Expires . . . . . : Saturday, August 24, 2019 11:27:46 AM
    Default Gateway . . . . . : 192.168.123.254
    DHCP Server . . . . . : 192.168.123.254
    DHCPv6 IAID . . . . . : 89661617
    DHCPv6 Client DUID. . . . . : 00-01-00-01-23-3E-21-DA-58-20-B1-40-45-B3
    DNS Servers . . . . . : 168.126.63.1
    . . . . . : 168.126.63.2
    NetBIOS over Tcpip. . . . . : Enabled
  
```

Figure 34: Check IP address

NOTE

The IP address can be different depending on the home AP setting.

3. For stable Iperf testing, run the Windows Security APP to turn off the network firewall.
 - It is recommended to disable the laptop from all network firewalls before attempting a test. See Figure 35.

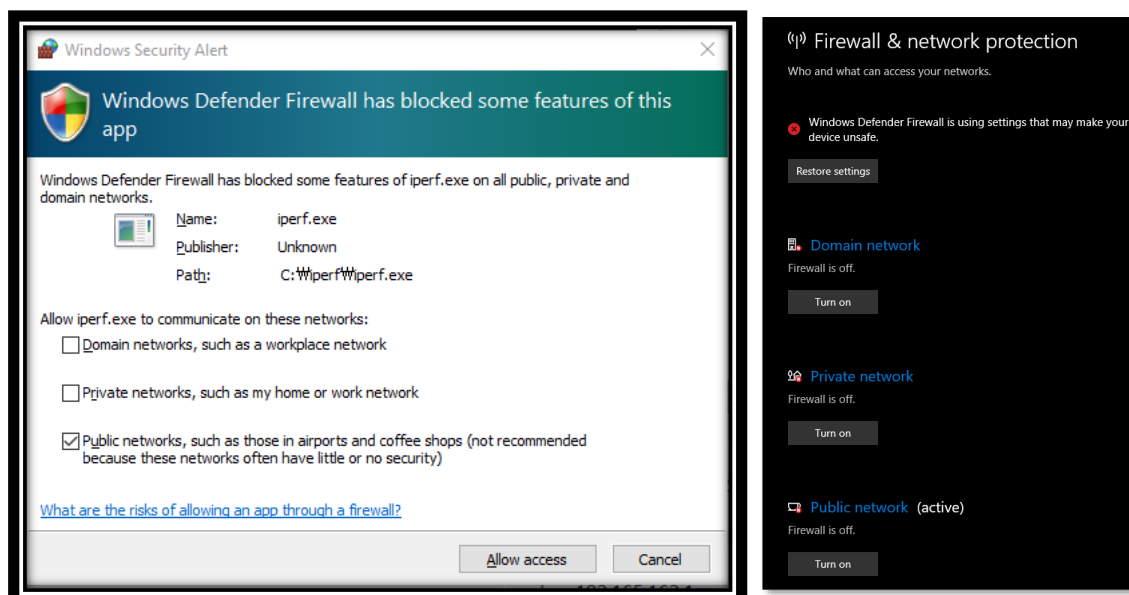


Figure 35: Disable Firewall for Iperf Test

4. In the CMD window, move to the directory where Iperf is installed, and type `iperf -s` to configure the TCP server.

```
C:\Wiperf>iperf -s
-----
Server listening on TCP port 5001
TCP window size: 208 KByte (default)
-----
```

Figure 36: Run Iperf Server on PC

NOTE

When you see the message as shown in [Figure 36](#), the Iperf test is ready to start.

5. In the DA16200 console window, run the Iperf test with Client mode. See [Figure 37](#).
 - For example: [/DA16200/NET] #iperf -I wlan0 -c 192.168.123.5 -t 5 -i 1
 - The format of the command type is:
 - iperf -I [INTERFACE] [-s/-c] [DESTINATION IP] (-u) -i [INTERVAL TIME] -t [TEST TIME]

```
[/DA16200/NET] # iperf -I wlan0 -c 192.168.123.5 -t 5 -i 1
[/DA16200/NET] #
[TCP] Transmit Test (Client) ==> 192.168.123.5:5001
```

TCP_TX	No	[Interval]	[Transfer]	[Bandwidth]	[Dst IP:Port]
TCP_TX	:0001	0.00~ 1.00	2.043 MBytes	17.146 Mbits/sec	192.168.123.5:5001
TCP_TX	:0002	1.00~ 2.00	2.110 MBytes	17.706 Mbits/sec	192.168.123.5:5001
TCP_TX	:0003	2.00~ 3.00	2.074 MBytes	17.403 Mbits/sec	192.168.123.5:5001
TCP_TX	:0004	3.00~ 4.00	2.110 MBytes	17.706 Mbits/sec	192.168.123.5:5001
TCP_TX	:0005	4.00~ 5.00	2.081 MBytes	17.461 Mbits/sec	192.168.123.5:5001
TCP_TX	:Total]	0.00~ 5.01	10.443 MBytes	17.487 Mbits/sec	192.168.123.5:5001

Figure 37: Run iperf Client on the DA16200

9.3 Iperf Test with Server Mode

A server mode test should be run with a configuration that is opposite to that of client mode. In this case, the DA16200 is prepared as a server. The laptop becomes a client and sends data to the DA16200.

1. In the DA16200 console window, please check the assigned IP address for DA16200 as shown in [Figure 38](#).

```
Connection COMPLETE to b8:55:10:e0:98:0a
-- DHCP Client WLAN0: SEL
-- DHCP Client WLAN0: REQ
-- DHCP Client WLAN0: BOUND
    Assigned addr   : 192.168.123.6
    netmask         : 255.255.255.0
    gateway         : 192.168.123.254
    DNS addr        : 168.126.63.1

    DHCP Server IP  : 192.168.123.254
    Lease Time      : 02h 00m 00s
    Renewal Time    : 01h 00m 00s
```

Figure 38: Check the IP address of DA16200

2. Run the Iperf test with Server mode on the DA16200 console window. See [Figure 39](#).
 - For example: [/DA16200/NET] # iperf -I wlan0 -s

```

[/DA16200/NET] # iperf -l wlan0 -s
iPerf Server(TCP): Ready
[/DA16200/NET] # █

[TCP] Receive Test (Server)
TCP_RX:[ No ] [Interval] [Transfer] [Bandwidth]
TCP_RX:[Total] 0.00- 5.12 9.750 MBytes 15.974 Mbits/sec 192.168.123.5:50625

```

Figure 39: Run Iperf Server on Terminal

3. In the CMD window, run the Iperf test with Client mode. See [Figure 40](#).
 - For example: C:\iperf>iperf -c 192.168.123.6 -t 5 -i 1

```

C:\iperf>iperf -c 192.168.123.6 -t 5 -i 1
-----
Client connecting to 192.168.123.6, TCP port 5001
TCP window size: 208 KByte (default)
-----
[ 3] local 192.168.123.5 port 50625 connected with 192.168.123.6 port 5001
[ ID] Interval      Transfer      Bandwidth
[ 3] 0.0- 1.0 sec   2.12 MBytes   17.8 Mbits/sec
[ 3] 1.0- 2.0 sec   1.88 MBytes   15.7 Mbits/sec
[ 3] 2.0- 3.0 sec   2.00 MBytes   16.8 Mbits/sec
[ 3] 3.0- 4.0 sec   1.88 MBytes   15.7 Mbits/sec
[ 3] 4.0- 5.0 sec   1.88 MBytes   15.7 Mbits/sec
[ 3] 0.0- 5.0 sec   9.75 MBytes   16.3 Mbits/sec

```

Figure 40: Run Iperf Client on the Laptop

10 DA16200 Commands

The DA16200 has various console commands to operate its functions. The UART0 interface connects the console with a serial terminal tool. Some commands in the following sections may be disabled according to the SDK's features configuration.

10.1 Console Commands

The DA16200 console commands are categorized as follow:

- **root**
 - [/DA16200] #
- **mem**
 - [/DA16200/MEM] #
- **sys**
 - [/DA16200/SYS] #
- **nvr**
 - [/DA16200/NVRAM] #
- **net**
 - [/DA16200/NET] #
- **user**
 - [/DA16200/USER] #

Use command `help` or `?` (Question mark) to list the available commands and options.

There is a function to display the console command history, and up to 5 commands can be saved. Use the following keys and characters to access the history function:

- `↑` or `↓` (arrow key) on your keyboard: show the command history one by one.
- `!` (Exclamation mark): view the list of the command history.
- `!` (Exclamation mark) + Number: select and execute one previous command in the list.

It is possible to move between categories. Use these options:

- `top`: move to the highest-rank, root.
- `up`: move to one step upper rank category.
- Category command (for example `sys`, `nvr`, `net`): move to the category. To run each commands of each category, go to the category first, or prefix the category name to the command as shown in the example:
 - `net`
 - `net.ifconfig`

10.1.1 Root Commands

Table 2: Root Commands

Command	Parameters	Description
help /?	(none)	Display help information for the corresponding category
up	(none)	Move up one rank category
top	(none)	Move to the Root category
.	(none)	Re-execute the previous command
!	(none) [index]	Display the history of executed commands Command index in the history For example: ! 1: echo test 2: echo 3: repeat 4: trace 5: help For example: !3 means re-execute command number 3 in the history
factory	(none)	Factory reset for all settings
ps	(none)	Display thread information
setup	(none)	DA16200 general function setting wizard (Easy Setup) Make step-by-step configuration settings for elements such as SYSMODE, WI-FI, and NETWORK
reboot	(none) [mode]	Reboot por: POR rebooting
reset	(none)	Reset to the Bootloader prompt
ver	(none)	Display SDK version & system information
time	[option]	Display or set the current time. - time set [YYYY-MM-DD] [hh:mm:ss]: set date and time - time zone [-hh:mm]: set time zone - time boot: display booting time - time uptime: display booting duration - time help: display help
getwlanmac	(none)	Display the MAC address for network interfaces
setwlanmac	[xx:xx:xx:xx:xx:xx xx-xx-xx-xx-xx-xx- xx xxxxxxxxxxxx]	Set up the MAC address for network interfaces. For example: setwlanmac aa:bb:cc:00:00:02 aa-bb-cc-00-00-02 aabbcc000002
dpm	[options]	Set DPM condition - on off: DPM feature enable or disable - status: DPM Status print - rtm: view DPM backup data - rtc: view DPM RTC timer - debug [level]: turn DPM debug on / off - level = 1(MSG_ERROR), 2(MSG_INFO), 3(MSG_DEBUG), 4(MSG_EXCESSIVE)

10.1.2 Network Commands

To move to the network command category, type the command `net`.

Table 3: Network Commands

Command	Parameter	Description
ifconfig	(none) [interface wlan0 wlan1] [options]	Display or set the basic network setting and status ● <code>ifconfig</code>: display basic network settings information ● <code>ifconfig -a</code>: display details of all network interfaces ● <code>ifconfig [wlan0 wlan1]</code>: display details of a network interface ● <code>ifconfig [wlan0 wlan1] [ipaddress] [subnet] [gateway]</code>: set static IP addresses to a network interface ● <code>ifconfig [wlan0 wlan1] dhcp</code>: enable/Disable DHCP to a network interface ● <code>ifconfig [wlan0 wlan1] [up down]</code>: go Up/Down a network interface ● <code>ifconfig [wlan0 wlan1] [start stop renew release]</code>: DHCP client command ● <code>ifconfig [wlan0 wlan1] [dns] [DNS ServerIP]</code>: set DNS server address (static IP) to a network interface ● <code>ifconfig help</code>: display help
ping	-I [interface wlan0 wlan1] [domain ip] -n [count] -l [size] -w [timeout] -i [interval]	Ping test to the target address with a certain option ● [interface wlan0 wlan1]: ○ Network interface. With no designated interface, an interface for a subnet band of the same destination IP address is designated ● [count]: the count of ping tests ● [size]: the size of data to be transmitted (max.: 10000) ● [timeout]: waiting time for a response to the transmitted message (min.: 10 ms) ● [interval]: waiting time for a message transmission (min.: 10 ms) ● [-6]: ping test with an IPv6 address For example: <code>ping 172.16.0.1 -l 1024 -n 10 -w 1000 -i 1000</code> <code>ping -6 fe80::1:2 -I wlan0</code>
arp	[interface] [options]	Display the ARP table of a network interface ● <code>a</code>: display the ARP table of every interface ● <code>d</code>: delete all of ARP table ● <code>Help</code>: Help display
arp send	[interface] [dst ipaddress]	Transmit the ARP request message of the target IP For example: <code>arp send wlan0 10.0.0.1</code>
garpsend	[interface] [option]	Transmit a GARP message with option: ● 0: normal garp ● 1: check IP conflict For example: <code>arp send wlan0</code>

Command	Parameter	Description
dhcpcd	[interface] [options]	DHCP server setting • boot [on off]: automatic start setting with a certain interface • range <Start IP ADDRESS> <END IP Address>: IP lease band setting (max. 10) • lease_time <Integer>: lease time setting (min. 60 sec.) • dns <IP Address>: lease IP DNS server address setting • response_delay <Integer>: time of response delay • status: display DHCP Server status • lease [0 1]: display IP lease table ◦ Display tables including un-allotted tables when flag = 1
iperf	-I [interface] [-s -c host] [options]	Setup Iperf client/server
cli	[options]	Refer to the CLI section
debug	[options]	Execute various types of debug commands • arp [on off]: arp debug message output on/off • dhcpcd [level]: DHCP Server debug level setting (level=0~2 default 0) • dhcpc [level]: DHCP Client debug level setting (level=0~5 default 1) • umac [on off] mask: debug umac 1 0x4
act	[on off]	Start or stop DPM Auto Configuration

10.2 CLI command

10.2.1 Overview

The DA16200 supplicant plays a key role in providing users with Wi-Fi functionality. Major functions include IEEE 802.11 management frame, various security functions (WPA & RSN by IEEE 802.11i) and CLI (Command Line Interface) to control DA16200 Wi-Fi performance.

The CLI in DA16200 can execute commands in the network command state.

For example, in the Station mode, the network information of DA16200 is obtained with CLI command: [/DA16200/NET] cli status. See [Figure 41](#).

```

[/DA16200] # net
    Command-List is changed, "NET"
[/DA16200/NET] # cli status
sta0
mac_address=ec:9f:0d:9f:ff:fe
bssid=88:36:6c:42:79:6c
ssid=ACST_AC_TEST2
id=0
mode=STATION
pairwise_cipher=CCMP
group_cipher=CCMP
key_mgmt=WPA2-PSK
channel=1
wpa_state=COMPLETED
handshake_state=3

[/DA16200/NET] #

```

Figure 41: CLI Check

10.2.2 CLI Format

There are four CLI formats (Type A~D):

- Read/Write Parameter (Type A)
 - Read: [/DA16200/NET] # cli [CLI]
 - Write: [/DA16200/NET] # cli [CLI] <VALUE>
- Write Only Parameter (Type B)
 - [/DA16200/NET] # cli [CLI] <VALUE> or cli [CLI] <OPTION> <VALUE>
- Read Only Parameter (Type C)
 - [/DA16200/NET] # cli [CLI] or cli [CLI] <OPTION>
- Execution Parameter (Type D)
 - [/DA16200/NET] # cli [CLI] or cli [CLI] < OPTION>

10.2.3 Common Commands

Table 4: CLI Commands in Common Mode

CLI	Parameter	Description
status	(none)	Get the main information on the interface being operated at DA16200 For example: [/DA16200/NET] # cli status
save_config	(none)	Save all parameters modified through CLI, etc. in NVRAM (Saved values become applicable after a reboot) (D) For example: [/DA16200/NET] # cli save_config * Information saved in NVRAM may be inquired with the following command: For example: [/DA16200/NVRAM] # printenv Total length (95) country_code (STR,03) KR SYSMODE (STR,02) 0 0: NETMODE (STR,02) 1 NO_Profile (STR,02) 1 NO_ssid (STR,16) "ACST AC TEST1"
select_network	<mode>	Execute a motion in a certain mode (STA access, AP operation, etc.) (D) ● <mode> STA: 0 AP: 1 For example: [/DA16200/NET] # cli select_network 0 ○ Implement STA access * For a certain mode through the select_network CLI, the following tasks need to be carried out first: ○ add_network (profile generation) ○ SSID generation through set_network ○ For AP operation, set up the frequency and country code values with command set_network ○ For Security, generate WPA or WEP key values with command set_network (option)
add_network	<mode>	Generate a specific mode (STA, AP) Profile (access information table) (D) <mode>: 0(STA) 1(AP) For example: [/DA16200/NET] # cli add_network 1 ○ Generate a profile for AP Mode

CLI	Parameter	Description
remove_network	<mode>	Delete a certain mode (STA, AP) profile (D) <mode>: 0(STA) 1(AP) For example: [/DA16200/NET] # cli remove_network 1 ○ Delete a profile for AP Mode
set_network	<mode> <variable> <value>	Set parameter values for a specific mode (STA, AP) (B) <mode>: 0(STA) 1(AP) <variable>: a specific parameter • ssid: [STA] Operation SSID for AP SSID / [AP] AP interface to be connected • psk: passphrase or PSK values • proto: for WPA use, set up the version (<WPA(=WPA1)> <RSN(=WPA2)> <WPA RSN>) • key_mgmt: key management mode (<NONE> <WPA_PSK> <WPA-EAP>) • pairwise: unicast data message encryption mode (<TKIP> <CCMP> <TKIP CCMP>) • group: broadcast data message encryption mode (<TKIP> <CCMP> <TKIP CCMP>) • wep_key#: WEP key (#:0~3) values • wep_tx_keyidx: WEP key index to be used • frequency: [AP] Operation Frequency (MHz) • mode: Operation Mode <0(STA)> <2(AP)> • Wi-Fi_mode: <0(BGN)> <1(GN)> <2(BG)> <3(N)> <4(G)> <5(B)> • beacon_int: [AP] Beacon transport interval • dtim_period: [AP] DTIM interval • ap_power: [AP] Output Power (dBm) • isolate: 'Isolate' Use (<0(off)> <1(on)>) • -disabled: automatic profiling prevented upon rebooting (<0(off)> <1(on)>) <value>: settings for a certain variable For example: [/DA16200/NET] # cli set_network 1 ssid 'DA16200_AP' ○ For DA16200 AP operation, SSID= DA16200_AP setting For example: [/DA16200/NET] # cli set_network 1 beacon_int 200 ○ For DA16200 AP operation, Beacon interval 20 ms setting For example: [/DA16200/NET] # cli set_network 0 key_mgmt WPA_PSK ○ For DA16200 STA operation, access in the WPA PSK security mode * A profile needs to be generated with command add_network so that a profile can be set with command set_network (with no profile, 'FAIL')
get_network	<mode> <variable>	Get specific parameter values for a specific mode (STA, AP) (C) <mode>: 0(STA) 1(AP) <variable>: a specific parameter For example: [/DA16200/NET] # cli set_network 0 ssid ○ Inquiry of an object subject to DA16200 STA access ("TEST_BED_AP") For example: [/DA16200/NET] # cli set_network 1 psk ○ For DA16200 AP operation, inquiry of the PSK password setting

CLI	Parameter	Description
country	<value>	Set a country related to channel operation (A) <value>: Country Code that meets ISO 3166-1 alpha-2 standards Default: KR For example: [/DA16200/NET] # cli country US ○ Set the Country Code to US For example: [/DA16200/NET] # cli country ○ KR
flush	(none)	For every interface (STA, AP), DA16200 deletes the Profile and closes DA16200 service operation (D)

10.2.4 STA Commands

Table 5: CLI Commands on STA mode

Command	Parameters	Description
scan	(none) or <freq>	Active scanning (Probe Request Broadcast) (D) For <freq> inputs, it is possible to scan APs of a certain frequency range (MHz) only (option) For example: [/DA16200/NET] # cli scan Scans all channels that correspond to the current country setting
disconnect	(none)	Disconnect the accessed AP (D) For example: [/DA16200/NET] # cli disconnect OK (With no AP being accessed, 'FAIL')
roam	(none) or <oper>	Roaming On/Off and Roaming status inquiry (A) <oper> run: On stop: Off Default: Roaming Off For example: [/DA16200/NET] # cli roam - Roaming=STOP, Threshold=-65 - Usage: cli roam [run/stop] For example: [/DA16200/NET] # cli roam stop - Roaming function-off
roam_threshold	<value>	Roaming triggering RSSI value (dBm) setting (B) <value>: Roaming threshold RSSI (dBm) Default: -65 (dBm) For example: [/DA16200/NET] # cli roam_threshold -85 Set the roaming threshold to -85 dBm

10.2.5 Soft-AP Commands

Table 6: CLI Commands on Soft-AP mode

Command	Parameter	Description
ap	<option>	AP interface beginning/closing/restarting (Applicable with no reboot after main info. modification of AP interface SSID, PSK, etc.) (D) <option>: start stop restart For example: [/DA16200/NET] # cli ap start - AP interface initiating (If it is being operated, 'FAIL') For example: [/DA16200/NET] # cli ap stop - AP interface closing (If not being operated, 'FAIL') For example: [/DA16200/NET] # cli set_network 1 ssid 'DA16200_AP2' For example: [/DA16200/NET] # cli ap restart - Modify SSID of the interface of AP being operated For example: [/DA16200/NET] # cli set_network 1 pairwise TKIP For example: [/DA16200/NET] # cli ap restart - Modify the AP interface encryption mode to TKIP

Command	Parameter	Description
ap_chan_switch	<Ch.>	Modify the AP interface operation channel (B) <Ch.>: AP operation channel (1~14) or frequency (MHz) For example: [/DA16200/NET] # cli ap_chan_switch 3 - Modify the AP interface channel to 3 (242 MHz) For example: [/DA16200/NET] # cli ap_chan_switch 11 2462 - Modify the AP interface channel to 11 (2462 MHz)
ap_status	(none)	Get main information about the interface at DA16200 (C) For example: <pre>[/DA16200/NET] # cli ap_status state=ENABLED phy=fc9k_phy0 freq=2472 num_sta_non_exp=0 num_sta_no_short_slot_time=0 num_sta_no_short_preamble=0 olbc=0 num_sta_ht_no_gf=0 num_sta_no_ht=0 num_sta_ht_20_mhz=0 num_sta_ht40_intolerant=0 olbc_ht=0 ht_op_mode=0x0 cac_time_seconds=0 cac_time_l</pre>
all_sta	(none)	Output the list information of STA being accessed to the AP interface (C) For example: <pre>[/DA16200/NET] # cli all_sta 50:77:05:DB:C4:3E flags=[AUTH] [ASSOC] [AUTHORIZED] [SHORT_PREAMBLE] [WMM] aid=1 capability=0x431 listen_interval=10 mode = 802.11n timeout_next=0 rx_packets=632 tx_packets=9 rx_bytes=67451 tx_bytes=4767 connected_time=77 sta_count=1</pre>
deauthenticate	<addr>	The deauthenticate message is transmitted to the access STA with a certain MAC address to cancel the access (D) <addr>: MAC address of the access STA For example: [/DA16200/NET] # cli deauthenticate aa:ff:01:00:00:00 Transmit the de-authentication message to STA whose MAC address is AA:FF:01:00:00:00
disassociate	<addr>	The disassociation message is transmitted to the access STA with a certain MAC address to cancel the access (D) <addr>: MAC address of the access STA For example: [/DA16200/NET] # cli disassociate aa:ff:01:00:00:00 Transmit the disassociation message to STA whose MAC address is AA:FF:01:00:00:00

Command	Parameter	Description
wmm_enabled	<value>	WMM function availability setting and inquiry (A) <value>: On: 1 Off: 0 Default: Off For example: [/DA16200/NET] # cli wmm_enabled 1 Use the WMM function
wmm_ps_enabled	<value>	WMM-PS function availability setting and inquiry (A) <value>: On: 1 Off: 0 Default: Off For example: [/DA16200/NET] # cli wmm_ps_enabled 1 Use the WMM-PS function
wmm_params	<target> <category> <AIFS> <CWmin> <CWmax> <Burst (AP) or TxOP Limit (STA)>	Set up details of DA16200 AP or STA's certain category WMM parameters (B) <target>: ap sta <category>: be(best-effort) bk(background) vi(video) vo(voice) For example: [/DA16200/NET] # cli wmm_params ap be 3 15 63 10 - For WMM AP's best-effort category, AIFS=3, CWmin=15, CWmax=63, and Burst=10 For example: [/DA16200/NET] # cli wmm_params sta vo 4 7 15 60 - For WMM STA's voice category, AIFS=4, CWmin=7, CWmax=15, TXOP_Limit=60
all_wmm	(none)	Inquiry of all parameters that can be set up by means of wmm_params CLI (C) (See example) For example: [/DA16200/NET] # cli all_wmm
acl_mac	<addr>	Add the MAC address to the Access Control Management List (B) <addr>: AP MAC Address For example: [/DA16200/NET] # cli acl_mac AA:FF:01:00:00:06 Add MAC address AA:FF:01:00:00:06 to ACL
Acl	<oper> <addr>	Set up, delete, or inquire the use of ACL (A) <oper>: allow deny clear delete (If none, inquire of it) <addr>: AP MAC Address (only when oper="delete") [/DA16200/NET] # cli acl [allow/deny/clear/delete mac_address] For example: [/DA16200/NET] # cli acl For example: [/DA16200/NET] # cli acl allow - Access allowed only for AP Lists in ACL For example: [/DA16200/NET] # cli acl deny - Access denied only for AP Lists in ACL For example: [/DA16200/NET] # cli acl clear - Entire ACL clear For example: [/DA16200/NET] # cli delete aa:ff:01:00:00:08 - Delete AA:FF:01:00:00:08 from ACL

Command	Parameter	Description
ap_max_inactivity	<value>	If there is no data frame exchange of accessed STA during the time setting, disconnect the STA (A) <value>: inactivity timeout (sec) Default: 300 (sec.) For example: [/DA16200/NET] # cli ap_max_inactivity 600 ○ Disconnect the access STA with no data frame exchange for 600 seconds For example: [/DA16200/NET] # cli ap_max_inactivity 0 ○ Uncheck data frame exchange of the accessed STA For example: [/DA16200/NET] # cli ap_max_inactivity ○ Read ap_max_inactivity value
ap_send_ka	<value>	A function to send 'keep-alive' NULL packets to the accessed STA at intervals of 30 seconds and check ACK receipts (A) <value>: On: 1 Off: 0 ● On: if the STA accessed to DA16200 AP interface goes out of coverage or is closed abnormally, disconnect will occur after the 'ap_max_inactivity timeout' passes ● Off: if there is no constant data frame exchange with the STA accessed to DA16200 AP interface for ap_max_inactivity timeout, then disconnect. Default: 0 (not used) For example: [/DA16200/NET] # cli ap_send_ka 1 ○ ap_send_ka=1
ap_rts	<value>	For AP mode operation, set up the RTS Threshold value to be used (A) <value>: The standard for a size of packets that use the RTS Control Frame (bytes) Default: 2437 (bytes) For example: [/DA16200/NET] # cli ap_rts 1000 ○ Use RTS for transmission of 1000 bytes or larger frames ○ ap_rts=1000 For example: [/DA16200/NET] # cli ap_rts ○ ap_rts=2437
greenfield	<value>	Enable/Disable use of Greenfield <value>: On: 1 Off: 0 If Greenfield is on, DA16200 uses 11n HT mode only. In that case, 11b, 11g info. and STA access are not allowed Default: 0 (not used) For example: [/DA16200/NET] # cli greenfield 1 ○ Use the Greenfield function ○ greenfield=1 For example: [/DA16200/NET] # cli greenfield ○ greenfield=0

10.2.6 Advanced Commands

Table 7: Advanced CLI Commands

Command	Parameters	Description
wps_pbc	(none)	Run WPS PBC (Push Button Configuration)
wps_pin	<pin>	Run WPS PIN method <pin> pin code (any: generate a random code) For example: [/DA16200/NET] # cli wps_pin 27833513 For example: [/DA16200/NET] # cli wps_pin any

11 Firmware Update

The security features of DA16200 support Secure Boot, to avoid booting with fake or untrusted images and to protect against being hacked. The DA16200 SoC includes a security hardware block called CryptoCell-312 (CC312). With proper security keys and certificates installed (in OTP and images), the DA16200 can boot in secure mode.

DA16200 requires three images. With a serial terminal tool, each image can be loaded individually into DA16200.

- <Bootloader image>: also known as Second Bootloader
 - DA16200_[image_type]-[vendor]-[major]-[minor]-[customer_ver]_[sflash_model].img
 - [Image_type]: Bootloader (BOOT), Main, or System library (SLIB)
 - [vendor]: Internal use by vendor
 - [major]: Major version
 - [minor]: Minor version or SDK patch version
 - [customer_ver]: User-configurable customer version
 - [sflash_model]: sflash model or type used
 - For example: DA16200_BOOT_GEN01-01-XXXX-000000_IS25WP016D.img
- <System Library image>: includes RF drivers, and libraries for DPM
 - For example: DA16200_SLIB_GEN01-01-XXXX-000000.img
- <Main image>: includes RTOS and applications
 - For example: DA16200_RTOS_GEN01-01-XXXX-000000.img

11.1 Flash MAP

DA16200 provides two images: #0 and #1. It is possible to use these regions for each image set and change the index of the booting image set. The default value of the Boot Index points to #0.

Table 8: 2 MB Serial Flash Memory Map

Address	Item	Size
0x0000_0000	2nd Bootloader	36 kB
0x0000_9000	Boot Index	4 kB
0x0000_A000	RTOS #0	924 kB
0x000F_1000	SLIB #0 (RamLib + TIM)	52 kB
0x000F_E000	RTOS #1	924 kB
0x001E_5000	SLIB #1 (RamLib + TIM)	52 kB

Table 9: 4 MB Serial Flash Memory Map

Address	Item	Size
0x0000_0000	2nd Bootloader	36 kB
0x0000_9000	Boot Index	4 kB
0x0000_A000	RTOS #0	1536 kB
0x0018_A000	SLIB #0 (RamLib + TIM)	64 kB
0x0020_0000	RTOS #1	1536 kB
0x0038_0000	SLIB #1 (RamLib + TIM)	64 kB

11.2 Bootloader Image

<Bootloader image> is also known as the second bootloader, which is the first thing loaded into memory for a factory-created DUT (for example with an empty flash).

Know that this image has SFDP information, which is important sflash type information, so always load this image before other images are loaded.

If you get a new SDK, then always load the <Bootloader image> first.

1. Power-on the DA16200 board.
2. At the [/DA16200] prompt, type `reset` to go to the Mask ROM prompt [MROM]. See Figure 42.

```
[/DA16200] # reset

*****
*   FCI   FC9K MaskROM BootLoader
*   Cortex-M4 (XTAL 40000 KHz, SYS 120000 KHz)
*   Console Baud Rate : 0 (00000000)
*   HW Version Num.   : fc905010
*   Build Option      : RomALL
*   RoSDK Date & Time : Mar 13 2019 13:05:45
*   Build Date & Time : Mar 13 2019 13:11:24
*                   http://www.fci.co.kr
*****

[MROM]
```

Figure 42: Mask ROM

3. At the [MROM] prompt, type `loady boot`. See Figure 43.

```
[MROM] loady boot
Load Addr: 000f6684
To cancel a session, press Ctrl+X
Load Y-Modem (Load Offset:f6684)
CC
xyzModem - CRC mode, 7(SOH)/29(STX)/0(CAN) PKTs, 9 retries, err:Timed o
ut
## Total Size      = 0x00007070 = 28784 Bytes
[MROM]
```

Figure 43: Bootloader Prompt on Command Window

4. Choose menu **File > Transfer > YMODEM > Send** to select the image file for the **Bootloader**. See Figure 44.
 - For example: DA16200_BOOT_GEN01-01-XXXX-000000_IS25WP016D.img

- The result is printed at the end of the transfer
Please ignore any messages like “err:..”

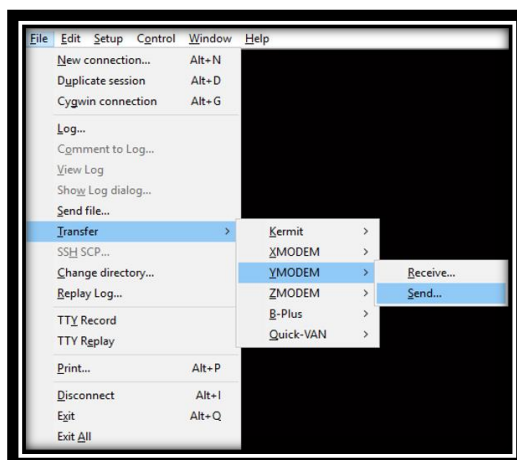


Figure 44: Load Image File

11.3 System Library Image

The <System Library image> includes system libraries, RF drivers and libraries to operate the DPM.

1. At the [MROM] prompt, type `loady f1000` to load a <System Library image> in boot index #0. See Figure 45.

NOTE

DA16200 has a different address based on Flash size and boot index.

The System Library address map register depends on the flash memory size. Currently DA16200 EVK uses 2 MB SFLASH MAP even though there is SFLASH 4 MB memory on the module. Therefore, the address must be 0xf1000 for boot index 0 or 0x1E5000 for boot index 1. In this case, at the [MROM] prompt, type `loady f1000` or `loady 1e5000`

So, if customer uses 4 MB SFLASH MAP for the application, the address must be 0x18a000 for boot index 0 or 0x380000 for boot index 1. In this case, at the [MROM] prompt, type `loady 18a000` for boot index #0 or `loady 380000` for boot index #1

For more details, please refer to DA16200 SDK Programmer Guide [2].

```
[MROM] loady f1000
Load Addr: 000f6684
To cancel a session, press Ctrl+X
Load Y-Modem (Load Offset:f6684)
CC
xyzModem - CRC mode, 3(SOH)/29(STX)/0(CAN) PKTs, 5 retries, err:Timed o
ut
## Total Size      = 0x000072a0 = 29344 Bytes
```

Figure 45: System Library Prompt on Command Window

2. Choose menu **File > Transfer > YMODEM > Send** to select the <System Library image> file. See Figure 46.
 - For example: DA16200_SLIB_GEN01-XX-YYYY-ZZZZZZ.img

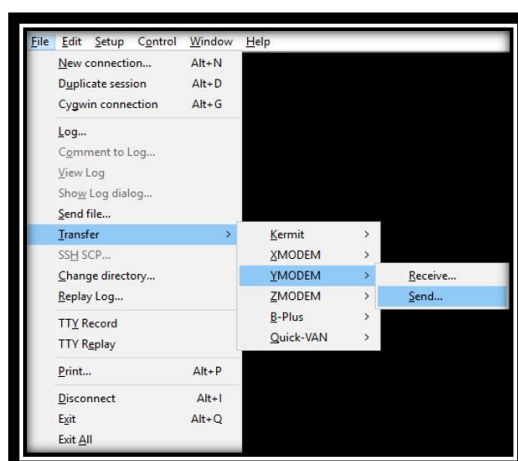


Figure 46: Load Image File

11.4 Main RTOS Image

This <Main image> contains RTOS, Wi-Fi libraries, and system/user applications.

1. At the [MROM] prompt, type `loady a000`. See Figure 47.

NOTE

DA16200 has a different address based on flash size and boot index.

The System Library address map register depends on the flash memory size. Currently DA16200 EVK uses 2 MB SFLASH MAP even though there is SFLASH 4 MB memory on the module. Therefore, the address must be 0xa000 for boot index 0 or 0xfe000 for boot index 1. In this case, at the [MROM] prompt, type `loady a000` or `loady fe000`.

So, if the customer uses a 4 MB SFLASH MAP for the application, the address must be 0xa000 for boot index 0 or 0x200000 for boot index 1. In this case, at the [MROM] prompt, type `loady a000` for boot index #0 or `loady 200000` for boot index #1.

For more details, please refer to DA16200 SDK Programmer Guide [2].

```
[MROM] loady a000
Load Addr: 000f6684
To cancel a session, press Ctrl+X
Load Y-Modem (Load Offset:f6684)
CC
xyzModem - CRC mode, 1(SOH)/828(STX)/0(CAN) PKTs, 7 retries, err:Timed out
## Total Size      = 0x000cee80 = 847488 Bytes
[MROM] _
```

Figure 47: Main Image Prompt on Command Window

2. Choose menu **File > Transfer > YMODEM > Send** to select the <Main image> file. See Figure 48.
 - For example: DA16200_RTOS_GEN01-XX-YYYY-ZZZZZZ.img

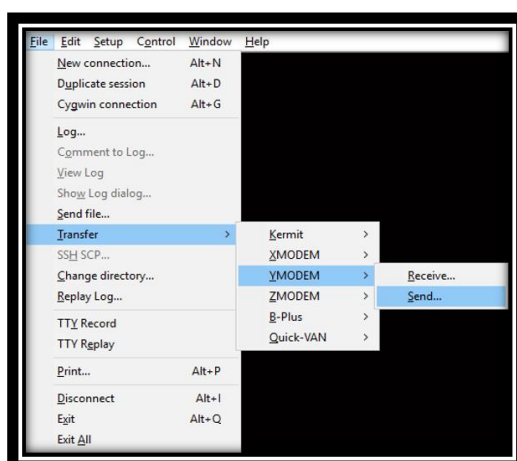


Figure 48: Load Image file

3. If the three images are loaded, then at the [MROM] prompt, type `boot` to boot your images.
4. Run `factory reset` as shown in Figure 49.

```
[/DA16200] # factory
FACTORY RESET [N/y/?] y

Start Factory-Reset ...

Rebooting....

RaLIB is relocated to RETMEM (20f815c0, 567, 18758114, 18758114)
P.TIM is relocated to RETMEM (20f835c0, 2)
dpm_init_retmemory::326 DPM INIT CONFIGURATION(1)

Wakeup source is 0x0

*****
*                               DA16200 SDK Information                               *
* -----
*
* - CPU Type       : Cortex-M4 (80MHz)
* - OS Type        : ThreadX 5.7
* - Serial Flash   : 16 Mbits (2 MBytes)
* - SDK Type       : Manufacture v1.0.0
* - F/W Version    : RTOS-GEN01-01-7149-000000
* - F/W Build Time : Aug  8 2019 10:26:18
* - Boot Index     : 0
*
*****

System Mode : Station Only (0)
>>> FC9K supplicant Ver1.00-20170213-01
>>> MAC address (sta0) : ec:9f:0d:9f:ff:fe
>>> sta0 interface add OK
>>> Start STA mode...

>>> UART1 : Clock=800000000, BaudRate=115200
>>> UART1 : DMA Enabled ...

[/DA16200] #
```

Figure 49: Factory Mode Prompt on Command Window

NOTE

Now everything is done.

11.5 Download Image with Script (Macro)

You can download all images automatically with the use of a script.

1. In the **Control** menu, select **Macro**.
2. In the **MACRO: Open macro** dialog window, Choose a **.ttl** file. See [Figure 50](#).

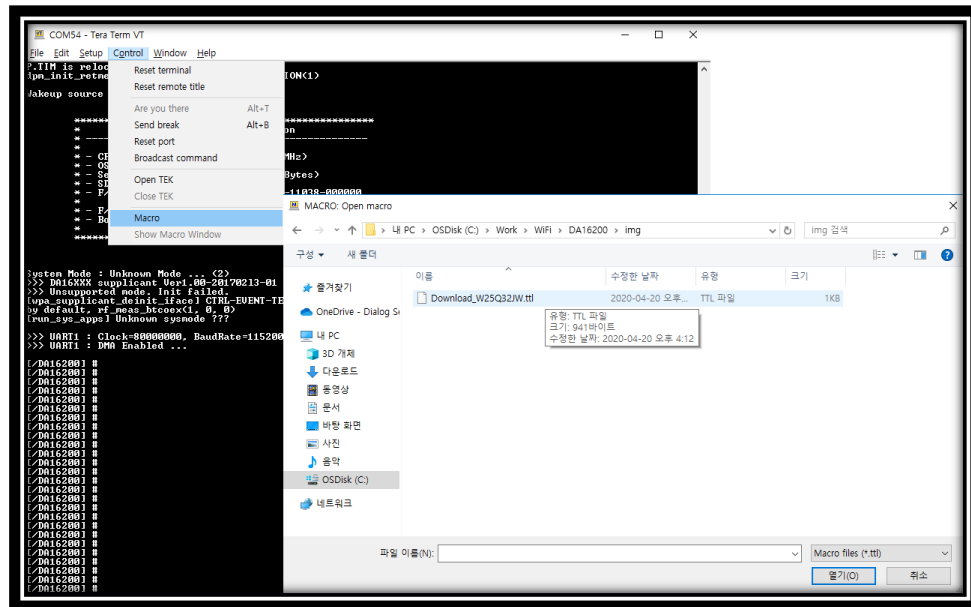


Figure 50. Load Macro

3. The download starts with the bootloader image. See [Figure 51](#).

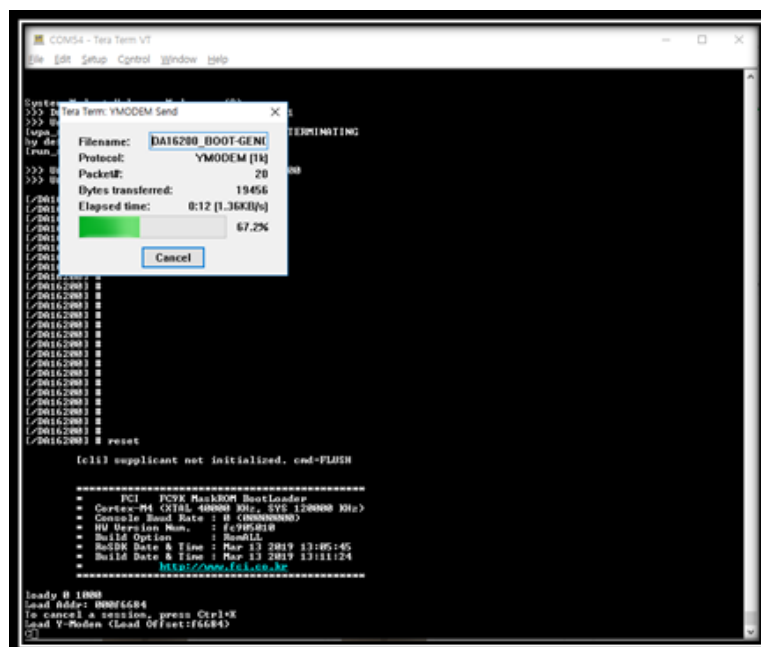


Figure 51. Download Bootloader

4. Download RTOS image. See [Figure 52](#).

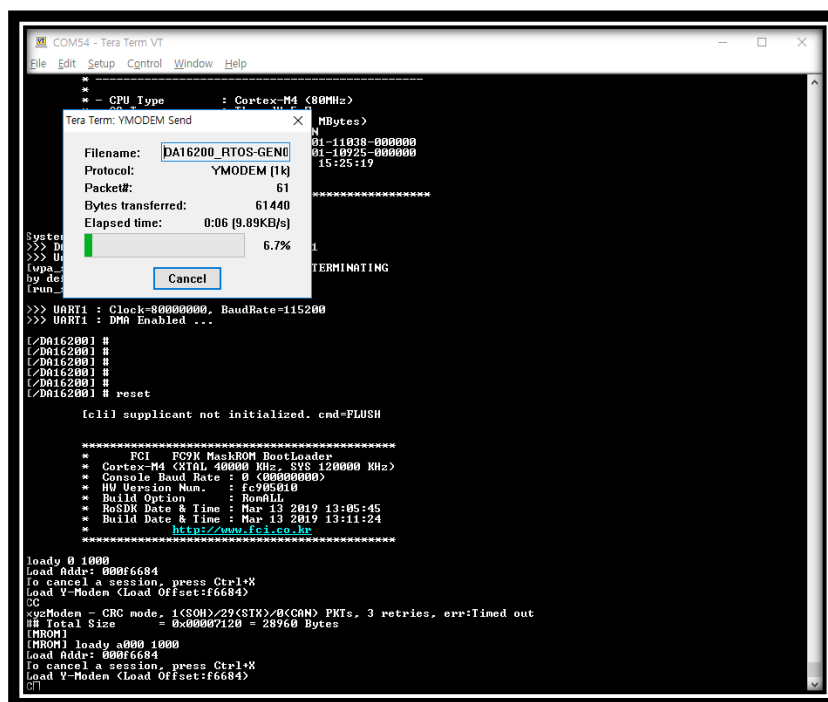


Figure 52. Download RTOS Image

5. Download the SLIB Image. See Figure 53.

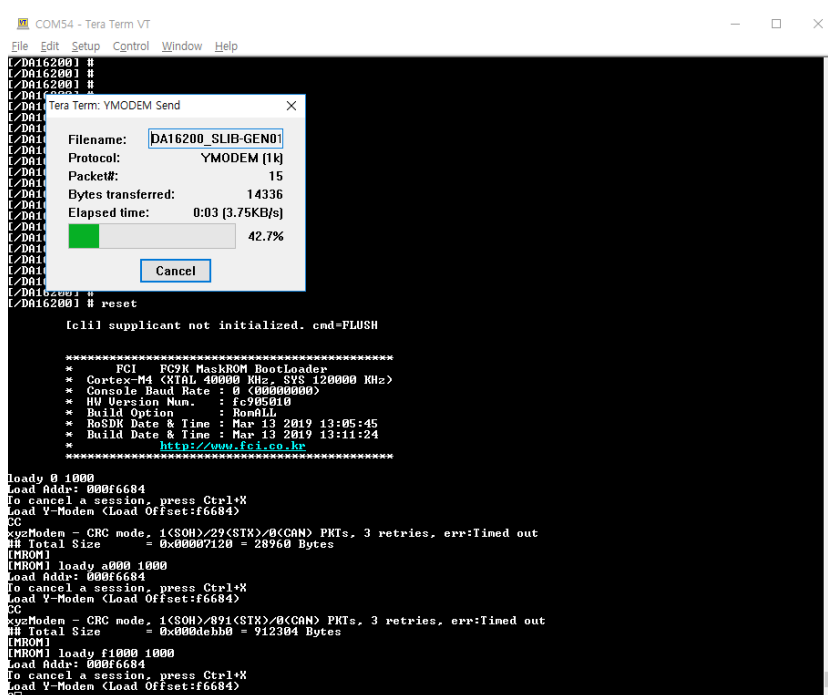


Figure 53. Download Slib Image

6. DA16200 will boot automatically after all images are downloaded.

NOTE

TTL command references

send : Sends data.

Format : send <data1> <data2>....

sendln : Sends data with new-line.

Format : sendln <data1> <data2>....

waitln : Waits a line that contains string.

Format : waitln <string1> [<string2> ...]

mpause : Pauses.

Format : mpause <time>, milliseconds

getdir : Gets the current working directory for MACRO.

Format : getdir <strvar>

strconcat : Appends a string.

Format : strconcat <strvar> <string>

ymodemsend : Sends a file from the host with the YMODEM protocol.

Format : ymodemsend <filename>

11.6 SFD checking

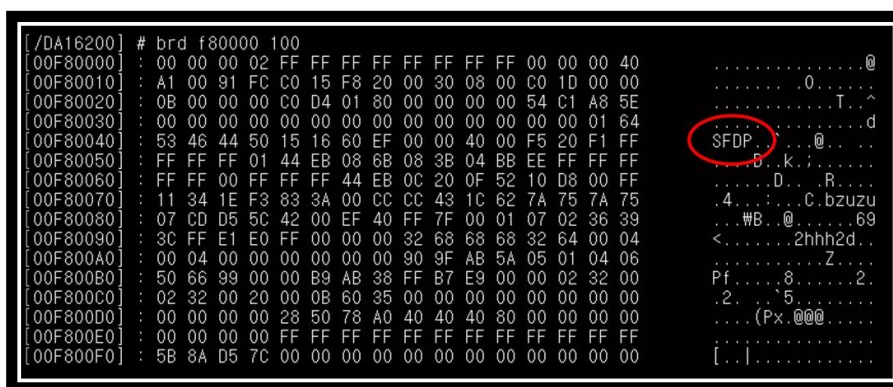
SFDP information of SFLASH is added to the boot loader image. When the boot loader image loads into the DA16200, SFDP information is copied to the Retention Memory.

However, under certain conditions, the ROM of the DA16200 has the task to clear the contents of Retention Memory. If the SFDP information in the Retention Memory is deleted due to certain conditions, the bootloader image should be loaded again. In this case, we recommend that the **boot loader image** and the **other two image files** (RTOS and SLIB) are loaded again.

If the images load normal, then use command [/DA16200] # brd f80000 100 to check if the SFDP information is copied to the Retention Memory. See Figure 54.

Example code to read the Retention Memory and check if SFDP is alive:

- [/DA16200] # brd f80000 100



```

[/DA16200] # brd f80000 100
00F80000 : 00 00 00 02 FF FF FF FF FF FF 00 00 00 40 .....@
00F80010 : A1 00 91 FC C0 15 F8 20 00 30 08 00 C0 1D 00 00 .....0.
00F80020 : 0B 00 00 00 C0 D4 01 80 00 00 00 00 54 C1 A8 5E .....T.^
00F80030 : 00 00 00 00 00 00 00 00 00 00 00 00 00 01 64 .....d
00F80040 : 53 46 44 50 15 16 60 EF 00 00 40 00 F5 20 F1 FF SFDP.....@
00F80050 : FF FF FF 01 44 EB 08 6B 08 3B 04 BB EE FF FF FF .....B.k.;
00F80060 : FF FF 00 FF FF FF 44 EB 0C 20 0F 52 10 D8 00 FF .....D..R...
00F80070 : 11 34 1E F3 83 3A 00 CC CC 43 1C 62 7A 75 7A 75 .....4...C.bzuzu
00F80080 : 07 CD D5 5C 42 00 EF 40 FF 7F 00 01 07 02 36 39 .....#B..@.....69
00F80090 : 3C FF E1 E0 FF 00 00 00 32 68 68 68 32 64 00 04 <.....2hhh2d..
00F800A0 : 00 04 00 00 00 00 00 00 90 9F AB 5A 05 01 04 06 .....Z...
00F800B0 : 50 66 99 00 00 B9 AB 38 FF B7 E9 00 00 02 32 00 Pf.....8.....2.
00F800C0 : 02 32 00 20 00 0B 60 35 00 00 00 00 00 00 00 .....2...`5.....
00F800D0 : 00 00 00 00 28 50 78 A0 40 40 40 80 00 00 00 .....(Px.@@@
00F800E0 : 00 00 00 00 FF FF FF FF FF FF FF FF FF FF .....
00F800F0 : 5B 8A D5 7C 00 00 00 00 00 00 00 00 00 00 00 [...].....

```

Figure 54: SFDP

11.7 Serial Flash Recovery

When the serial flash is replaced, the flash memory map is changed, or if you think that the flash memory is corrupted, then follow the steps below to re-initialize or recover sflash and check the process:

1. Boot DA16200.
2. At the [/DA16200] # prompt, run command reset

- At [MROM] prompt, run command `sflash info` to read serial flash information.

For example, SFLASH: ef601615

This is the flash product ID of W25Q32JW. See also the IDs below.

W25Q32JWSNIQ: ef601615

IS25WP016D: 9d701514

IS25LQ032B: 9d401615s

- Run command `ymodem sfdp`
- In the `build\SBOOT\SFDP` folder, find Flash SFDP file which is corresponding to Flash ID as `W25Q32JW.bin`.
- Run command [MROM] `sflash erase 0 200000` to erase the entire flash for recovery.
 - Know that this command can take a long time to complete. Please wait until the [MROM] prompt appears again.
- Re-load all images in the specified order for serial flash recovery.
 - [MROM] `loady boot`
 - [MROM] `loady f1000`
 - [MROM] `loady a000`
- Run command `boot` to boot DA16200. The image version is printed.
- Initialize NVRAM for Serial Flash Recovery with following commands:

```
[/DA16200] #
[/DA16200] # nvram
[/DA16200/NVRAM] # nvedit erase sflash
[/DA16200/NVRAM] # nvedit clear
[/DA16200/NVRAM] # nvcfg update sflash
update , sflash completed
[/DA16200/NVRAM] # nvedit load sflash
nvedit , load completed
[/DA16200/NVRAM] #
```



```
[/DA16200] # nvram
Command-List is changed, "NVRAM"
[/DA16200/NVRAM] # nvedit erase sflash
[/DA16200/NVRAM] # nvedit clear
[/DA16200/NVRAM] # nvcfg update sflash
update , sflash completed
[/DA16200/NVRAM] # nvedit load sflash
nvedit , load completed
```

Figure 55: Initialize NVRAM

11.8 Serial Flash Recovery from Boot

If there are any memory conflicts during updating the image or errors while building the SDK, there may be a case that it cannot run DA16200. In this case, you cannot do anything in the command window. DA16200 must be forced to enter boot mode. Follow the procedure below.

- Use RTC_PWR_KEY to power off (move to OFF position).
 - Connect the two pins. Pin 17(F_CLK) and pin 18(GND) in the header Pin (J3) of the external connector of EVK. See [Figure 56](#)

- F_CLK is connected to Pin 21 of the module connector

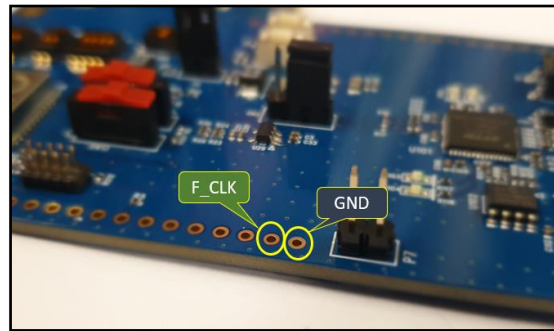


Figure 56: Recovery Point in the EVK

2. Use RTC_PWR_KEY to power on (move to ON position).
 - Boot DA16200. Turn the power on when the two pins are connected
 - Disconnect the two pins. Pin 17 (F_CLK) and pin 18 (GND)
3. See the DA16200 go into the **BOOT** mode. See Figure 57.
4. At the [BOOT] # prompt, run command `reset`.
5. Do the steps in section 11.7 from step 3.

```

[[[Oops Dump : c0f0]]
[[[Hard Fault]]
--RTC Time : 00000000.0003693

Register-Dump
R0 :00093990, R1 :00000000, R2 :020c7668, R3 :000ccdc8
R4 :000cb5ad, R5 :000f7c84, R6 :000f84b4, R7 :00000000
R8 :00000000, R9 :00000000, R10 :000cb5ad, R11 :000f84b4
R12 :0000063c, SP :000cce48, LR :00002ccf, PC :0018ba2e
PSR :61000000, EXC :fffffffd,

Fault Status
SHCSR :00000000, CFSR :00080000, HFSR :40000000
DFSR :00000000, MMFAR :e000ed34, BFAR :e000ed38
AFSR :00000000,

FC9K SysInfo
SICS[0] = 04300000
SICS[1] = 00000000
SICS[2] = 00000000
SICS[3] = 00000000
SICS[4] = 00000000
SICS[5] = 01234de2

Stack
Stack-Dump (48)
[0x000cce48] : 000cce6c 0008d650 00000000 000f84f6 000f84f9 00000000 00092a98 00080778
[0x000cce68] : 00080748 000f84d8 00000176 000f84da 000f84e9 000f84f3 00000000 00000000
[0x000cce88] : 00000000 000f84f6 000f84f9 00000000 000f8544 000f84ff 000f851b 00000000
[0x000cee08] : 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[0x000cee08] : 00000000 00000000 0001080b 00040000 00000018 00000000 00080778 000f7c78
[0x000cee08] : 00000000 00000000 00000050 00183b69 000ccf58 000f7c78 000cb5a4 00000000

Thread: umac_fc9k
stack_ptr : 000ccef8
stack_base : 000cc790
stack_end : 000ccf8b
stack_high : 000cccf8
max_usage : 00000094
suspend : 00000000

Thread Stack (32)
[0x000ccef8] : 000ccf58 000f7c78 000cb5a4 00000000 00000000 00000000 00000000 00000010
[0x000ccf18] : 00000010 00000000 00000000 00091e40 00000006 0000265d 00003fa2 00093928
[0x000ccf38] : 00139414 00000000 00091e70 00000000 00000000 000cc790 00000000 00138b98
[0x000ccf38] : 000f7c78 00000000 00091e40 00080774 00080778 00003805 00000000 00000000
Image Code, CRC Failed (9fc87af6 - 09aa010e, 23200)!!
Boot Err: wrong image [40000000](01)

*****
* FCI FC9K MaskROM BootLoader
* Cortex-M4 (XTAL 40000 Khz, SYS 120000 Khz)
* Console Baud Rate : 0 (00000000)
* HW Version Num. : fc905010
* Build Option : RomALL
* ReSDK Date & Time : Mar 13 2019 13:05:45
* Build Date & Time : Mar 13 2019 13:11:24
* http://www.fci.co.kr
*****

[BOOT] #

```

Figure 57: Run with BOOT mode

11.9 Boot Index Change

To change the boot index, you must change the boot index number and then reboot. After the reboot is complete, verify that the version printed at boot and the **boot_idx** values have changed.

The following console commands can change the boot index:

```

• boot_idx 0 // to boot with boot index 0
• boot_idx 1 // to boot with boot index 1
[/DA16200] # boot_idx 1      // or boot_idx_0
[/DA16200] # reboot

>>> Network Interface (wlan0) : DOWN
[wp_supplicant_event_disassoc] CTRL-EVENT-DISCONNECTED bssid=aa:ab:ac:ad:ae:af
reason=3 locally_generated=1
[wp_supp_ev_disassoc_fin] Disconnect event - remove keys
RaLIB is relocated to RETMEM (20f815c0, 564, 12904718, 12904718)
P.TIM is relocated to RETMEM (20f835c0, 3)
dpm_init_retmemory::316 DPM INIT CONFIGURATION(1)

Wakeup source is 0x0
*****
*                               DA16200 SDK Information
* -----
*
* - CPU Type           : Cortex-M4 (80 MHz)
* - OS Type            : ThreadX 5.7
* - Serial Flash       : 16 Mbits (2 MBytes)
* - SDK Type           : Generic v1.0.0
* - F/W Version        : RTOS-GEN01-01-7140-000000
*                     : SLIB-GEN01-01-7089-000000
* - F/W Build Time     : Jul  5 2019 17:35:59
* - Boot Index       : 1
*
*****

```

11.10 MAC Address checking

By default, a MAC address is programmed in the OTP. However, if for some reason no MAC address is and cleared.

For example: [/DA16200] # setwlanmac aa:ff:00:00:00:00

At prompt [/DA16200] # type command getwlanmac to check where the MAC address was written. One of the following lines is displayed: MAC TYPE: OTP MAC or NVRAM MAC. See example:

```

[/DA16200] # getwlanmac

MAC TYPE: OTP MAC

WLAN0 - EC:9F:0D:9F:F9:34
WLAN1 - EC:9F:0D:9F:F9:35

```

NOTE

Each EVK should have a unique address, and the last number of address must be even.

12 Country Codes

Table 10: Country Codes

Code	Country	Code	Country	Code	Country	Code	Country
AD	Andorra	EC	Ecuador	LC	Saint Lucia	RE	Reunion
AE	United Arab Emirates	EE	Estonia	LI	Liechtenstein	RO	Romania
AF	Afghanistan	EG	Egypt	LK	Sri Lanka	RS	Serbia
AI	Anguilla	ES	Spain	LS	Lesotho	RU	Russia
AL	Albania	ET	Ethiopia	LT	Lithuania	RW	Rwanda
AM	Armenia	EU	Europe	LU	Luxembourg	SA	Saudi
AR	Argentina	FI	Finland	LV	Latvia	SE	Sweden
AS	Samoa	FM	Micronesia	MA	Morocco	SG	Singapore
AT	Austria	FR	France	MC	Monaco	SI	Slovenia
AU	Australia	GA	Gabon	MD	Moldova	SK	Slovakia
AW	Aruba	GB	United Kingdom	ME	Montenegro	SN	Senegal
AZ	Azerbaijan	GD	Grenada	MF	Saint Martin	SR	Suriname
BA	Bosnia	GE	Georgia	MH	Marshall Islands	SV	El Salvador
BB	Barbados	GF	French Guiana	MK	Macedonia	SY	Syria
BD	Bangladesh	GH	Ghana	MN	Mongolia	TC	Turks Caicos
BE	Belgium	GL	Greenland	MO	Macao	TD	Chad
BF	Burkina Faso	GP	Guadeloupe	MP	Northern Mariana Islands	TG	Togo
BG	Bulgaria	GR	Greece	MQ	Martinique	TH	Thailand
BH	Bahrain	GT	Guatemala	MR	Mauritania	TN	Tunisia
BL	Barthelemy	GU	Guam	MT	Malta	TR	Turkey
BM	Bermuda	GY	Guyana	MU	Mauritius	TT	Trinidad and Tobago
BN	Brunei	HK	Hong Kong	MV	Maldives	TW	Taiwan
BO	Bolivia	HN	Honduras	MW	Malawi	TZ	Tanzania
BR	Brazil	HR	Croatia	MX	Mexico	UA	Ukraine
BS	Bahamas	HT	Haiti	MY	Malaysia	UG	Uganda
BT	Bhutan	HU	Hungary	NG	Nigeria	UK	United Kingdom
BY	Belarus	ID	Indonesia	NI	Nicaragua	US	USA
BZ	Belize	IE	Ireland	NL	Netherlands	UY	Uruguay
CA	Canada	IL	Israel	NO	Norway	UZ	Uzbekistan
CF	Central Africa	IN	India	NP	Nepal	VA	Vatican City

Code	Country	Code	Country	Code	Country	Code	Country
CH	Switzerland	IR	Iran	NZ	New Zealand	VC	St. Vincent and Grenadines
CI	Ivory Coast	IS	Iceland	OM	Oman	VE	Venezuela
CL	Chile	IT	Italy	PA	Panama	VI	Virgin Islands, US
CN	China	JM	Jamaica	PE	Peru	VN	Vietnam
CO	Colombia	JO	Jordan	PF	Polynesia	VU	Vanuatu
CR	Costa Rica	JP	Japan	PG	Papua New Guinea	WF	Wallis and Futuna Islands
CU	Cuba	KE	Kenya	PH	Philippines	WS	Samoa
CX	Christmas Island	KH	Cambodia	PK	Pakistan	YE	Yemen
CY	Cyprus	KN	St. Kitts and Nevis	PL	Poland	YT	Mayotte
CZ	Czech	KP	N.Korea	PM	St. Pierre and Miquelon	ZA	S.Africa
DE	Germany	KR	S.Korea	PR	Puerto Rico	ZW	Zimbabwe
DK	Denmark	KW	Kuwait	PT	Portugal	ALL	ALL
DM	Dominica	KY	Cayman Islands	PW	Palau		
DO	Dominican Rep	KZ	Kazakhstan	PY	Paraguay		
DZ	Algeria	LB	Lebanon	QA	Qatar		

Revision History

Revision	Date	Description
1.7	04-May-2020	Updated figures based on EVK 7.0 revision
1.6	14-Nov-2019	Small textual changes in updates done in version 1.5
1.5	04-Nov-2019	Add boot index configuration in Section 11.1, 11.3, 11.4 and 11.8
1.4	15-Oct-2019	Layout update; Removed Draft status
1.3	14-Oct-2019	Error correction at page 9, 10, 48 and 50 Added explanation to use 2MB SFLASH MAP and 4MB SFLASH MAP at page 45 Added reference at page 6
1.2	20-Sep-2019	Error correction Add detailed description for test Section 4 added to show test sequence Section 10, Section 11 moved to the end
1.1	23-Aug-2019	Error correction
1.0	17-Jul-2019	Initial Version

Status Definitions

Status	Definition
DRAFT	The content of this document is under review and subject to formal approval, which may result in modifications or additions.
APPROVED or unmarked	The content of this document has been approved for publication.

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