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 see 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
DA16200 Module EVK

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

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.
6. Factory Reset Button: press for more than 5 seconds to initialize nvram 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 Figure 3.
    a. Pull out the Short Pin cap and use the jumper wire to connect to measuring equipment.
11. GPIO, SPI selective switch: SW2, SW3, SW4 (Default: on), SW1 (Default: off). See Table 1.

a. 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>
<thead>
<tr>
<th>Selective Switch</th>
<th>On</th>
<th>Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW3 : GPIO 0, 1, 2, 3</td>
<td>Image download using SPI 1</td>
<td>Not defined</td>
</tr>
<tr>
<td>SW2 : GPIO 4, 5</td>
<td>UART 1 (TXD, RXD) to FT232H</td>
<td>UART 1 to external MCU for Test</td>
</tr>
<tr>
<td>SW1 : GPIO 6, 7</td>
<td>Image download using SPI 2</td>
<td>WPS, Factory Reset</td>
</tr>
<tr>
<td>SW1 : GPIO 8, 9</td>
<td>Image download using SPI 2</td>
<td>Not defined</td>
</tr>
<tr>
<td>SW4 : GPIO 6, 7</td>
<td>WPS, Factory Reset</td>
<td>Not defined</td>
</tr>
</tbody>
</table>

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)
- Section 5.1, 5.2, 5.3 > (Section 6) > Section 7
- 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
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 DA161200. The second (higher number, COM36 in this example) is used for ATCOMMAND. See Figure 4.

![Figure 4: Check COM ports on Device Manager](image)

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://ttssh2.osdn.jp. Run the teraterm-xy.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. Check if 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](image)

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`.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>From here on, the setup query statements will continue. So please answer the questions as follows:</td>
</tr>
</tbody>
</table>

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

![Figure 6: Easy Setup Start](image)

   
   See Figure 7.
4. **MODE?** [1/2/Quit] (Default Station): **type 1**  
   See Figure 8.

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.

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.

![Figure 10: Check Wi-Fi Configuration](image1)

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.

![Figure 11: Wi-Fi Configuration Completed](image2)
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/Quit] (Default Station): type 2
   
   See Figure 12.

3. SSID? (Default 16200_9FFFFF): TEST AP. See Figure 13.
   - Choose the SSID you want to use.

4. CHANNEL? [1-11, Auto:0/QUIT]: press [ENTER]

5. AUTHENTICATION? [1/3/4/5/QUIT]: type 4
   - WPA2-PSK is recommended

6. ENCRYPTION? [1/2/3/Quit]: type 2

7. PSK-KEY (ASCII characters 8~63 or hexadecimal characters 64)? [Quit]: ******** Enter the password you want to use.

8. Do you want to set advanced Wi-Fi configuration? [No/Yes/Quit] (Default No): type N
   
   See Figure 14.

9. WIFI CONFIGURATION CONFIRM? [Yes/No/Quit]: type Y

10. IP ADDRESS? [Quit] (Default 10.0.0.1): press [ENTER]

11. SUBNET? [Quit] (Default 255.255.255.0): press [ENTER]

12. GATEWAY? [Quit] (Default 10.0.0.1): press [ENTER]


14. IP CONFIGURATION CONFIRM? [Yes/No/Quit]: type Y

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

16. DHCP SERVER LEASE IP Count (MAX 10)? [Quit] (Default 10): press [ENTER]

17. DHCP SERVER LEASE TIME (60 ~ 86400 SEC)? [Quit] (Default 1800): press [ENTER]
18. DHCP SERVER CONFIGURATION CONFIRM? [Yes/No/Quit]: type Y

![Figure 14: AP Mode Selection](image)

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server IP</td>
<td>10.0.0.1</td>
</tr>
<tr>
<td>Subnet Mask</td>
<td>255.255.255.0</td>
</tr>
<tr>
<td>Gateway</td>
<td>10.0.0.1</td>
</tr>
<tr>
<td>DNS</td>
<td>8.8.8.8</td>
</tr>
</tbody>
</table>

DHCP SERVER LEASE TIME (default 1000): type Y

DHCP SERVER LEASE TIME (default 1000): type Y
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 the 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*102.4 = 1,024 ms = 1 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

   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

Figure 16: Setting DPM Factor with Default
3. **After reboot, DA16200 will enter DPM sleep.** The print message >>> Start DPM Power-Down!!! means that DA16200 has entered DPM Sleep. See Figure 18.

**Figure 17: Setting DPM factor with User Defined**

**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:

1. **Copy the string dpm hold to the clipboard.**
   a. For example: open Notepad, type dpm hold, and then copy (Ctrl + C) the command string.
2. **Use RTC_PWR_KEY to power off (move to OFF position).**
3. **Use RTC_PWR_KEY to power on (move to ON position).**
4. **Before the message >>> Start DPM Power-Down !!! is printed on the console, quickly do the following:**
   a. With the dpm hold string copied, right-click in the terminal window to paste the string.
   b. 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.**
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.
```bash
(dmi200) $ dpm off

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.

![Current Test Environment](image)

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. Type command `factory` to make DA16200 use the 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.
7.5 Current Measurement with PRO-SB Power Meter and SmartSnippets

7.5.1 Test Setup

Figure 23 shows a typical test setup environment with PRO-SB Power Meter kit and SmartSnippets WiFi IoT Power Profiler Tool.

Users can configure measurement parameters in the test setup. After configuring the settings, they can start the measurement and observe the power consumption in real-time.

Figure 22: Current Measurement with DPM

Figure 23: Hardware Setup with PRO-SB Power Meter Kit
7.5.2 PRO-SB Power Meter (504-02-A)

The actual component locations of the PRO SB of DA16200 are shown in Figure 24.

- PCI Connector: a connector on which to install the DA16200 EVK board
- UART MCU: provides communication between PRO-SB Power Meter Kit and PC. Also transfers the current measurement samples to the PC
- Current Sense Circuit: monitors the current of the DA16200 EVK board
- USB Hub: USB interfaces to the PC
7.5.3   SmartSnippets Wi-Fi IoT Power Profiler (504-02-A)

Wi-Fi IoT Power Profiler uses the SPI port of a device connected via USB for communication. The user is requested to select the SPI port to connect to before the Power Profiler tool is used.

To select an SPI port, simply click the checkbox next to the SPI port. The application remembers the SPI port selected the last time, so a port may already be preselected. If necessary, use the Refresh button to update the list of available SPI ports for the devices connected via USB. If a device is connected but not listed, the user is advised to use a different USB port, wait a few seconds and then click the Refresh button again. Problems in identifying the FTDI device may indicate an invalid installation of the FTDI drivers.

The  button can be used to access the application’s user guide, release notes, license and about info. When the user can click the OK button to launch the main application window (Figure 25), the SmartSnippets Wi-Fi IoT Power Profiler tool can be downloaded from the customer support portal. Direct link: windows.

![Figure 25: Virtual COM Port Selection Window](image)

7.5.4   Wi-Fi IoT Power Profiler Setup

When the proper COM port is selected (Figure 25), click OK and the main window of the Power Profiler application in SmartSnippets Wi-Fi IoT Power Profiler Toolbox will pop up (Figure 26). Click the Config button in the bottom right and check if the configuration is correct (Figure 27).
In a new profile, in the H/W Settings tab, the Voltage (1.1V - 3.3V) field is typically empty and the Calibration Offset (mA) field is zero. Apply the correct voltage as configured in the Power Meter LDO (typically, it is 3.3 V). The Calibration offset (mA) will be filled automatically with a calculated value. This value is good enough to be able to measure with ±2% accuracy, so in most cases we can leave it as is.

Check the multiplication factor. For DA16200 it should be 155.

Optionally, set a max scale for the waveform window, because typically there are large peaks on wake-up from sleep (charging capacitors), so the useful part of the signal is compressed to a very small area. To set a max scale for the waveform window, open the Chart Settings tab (Figure 28) and for Plot Current1, set the MAX scale of Current (mA) to 10 mA. Note that this does not affect in any way the accuracy of measurement. It only zooms in the waveform that is presented in the viewer window.
Click the **Apply** button and return to the measurement window.

![Figure 28: Power Profiler Chart Settings](image)

7.5.5 Measurements

In the measurement window (Figure 29), click the **Initialize** button in the bottom left (this step is only needed at the first communication with the A/D converter) and then click the **Start** button.

![Figure 29: Free Running Capture](image)
7.5.6 Manual Calibration

For an ultimate measurement accuracy, do the steps below for a manual calibration:

1. Remove the daughterboard, i.e. the load, by physically disconnecting the PRO-SB from the motherboard.

2. In the main window of the Power Profiler, click Config and temporarily set the Calibration Offset (mA) field to zero (Figure 31).

3. Run a free running capture for a few seconds and note down the number in the Avg Current (mA) field (Figure 32). Note that the last digits of the number keep changing slowly due to temperature drift. It is important to periodically do the calibration steps.

4. Finally, put this average value with a negative sign in the Calibration Offset (mA) field. CTRL-C and CTRL-V also works (Figure 32).
Figure 32: Setting Calibration Offset

The user manual can be downloaded from the customer support portal. Link: windows.
DA16200 Evaluation Kit

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 33. 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 33: Ping Test Environment**

5. Run the command window (CMD) as administrator.

6. Type command `ipconfig` to see what the IP address is of the laptop. See Figure 34. For example: the laptop’s IP is 192.168.0.65, and the Default Gateway IP is 192.168.0.1

![Ethernet IP Address Assign](image)

**Figure 34: Ethernet IP Address Assign**

7. 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 35.

![DA16200 IP Address Assign](image)

**Figure 35: 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 `netsh` to view ARP table of the network interface. See Figure 36.
   
   ○ For example: `C:\WINDOWS\system32>arp -a`

   ![Figure 36: Check ARP Record](image)

3. Use command `netsh interface show interface` to find the interface name. See Figure 37.
   
   ○ For example: `C:\WINDOWS\system32>netsh interface show interface`

   ![Figure 37: Interface name for ARP Record](image)

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 38.
   
   ○ For example: `C:\WINDOWS\system32> netsh interface ip add neighbors "Ethernet" "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 38.
   
   ○ For example: `C:\WINDOWS\system32>arp -a`

   ○ DA16200’s IP address 192.168.0.66 is added to ARP table as a static type.
6. Use command `arp -d` or `netsh interface ip delete arpcache` 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 39.

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.

![Figure 38: Success ARP Record for DA16200](image)

**Figure 38: Success ARP Record for DA16200**

### 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`

![Figure 39: Ping Test with DPM](image)

**Figure 39: Ping Test with DPM**
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 40: Iperf Test Environment](image)

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

Do the following steps to setup Iperf tool:

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 41.
   - For example: `[/DA16200/NET] # iperf`

   ![Figure 41: Iperf Test Command](image)
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 42.

![Figure 42: Check IP address](image)

**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 43.

![Figure 43: Disable Firewall for Iperf Test](image)

4. In the CMD window, move to the directory where Iperf is installed, and type `iperf -s` to configure the TCP server.
5. In the DA16200 console window, run the Iperf test with Client mode. See Figure 45.
   - 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]

   ![Figure 45: Run iperf Client on the DA16200](image)

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 46.

   ![Figure 46: Check the IP address of DA16200](image)

2. Run the Iperf test with Server mode on the DA16200 console window. See Figure 47.
   - For example: [/DA16200/NET] # iperf -I wlan0 -s
3. In the CMD window, run the Iperf test with Client mode. See Figure 48.
   ○ For example: `C:\iperf>iperf -c 192.168.123.6 -t 5 -i 1`

![Figure 47: Run Iperf Server on Terminal](image)

![Figure 48: Run Iperf Client on the Laptop](image)
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] #`
- **nvram**
  - `[/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`, `nvram`, `net`): move to the category. To run each command 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

<table>
<thead>
<tr>
<th>Command</th>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>help /?</td>
<td>(none)</td>
<td>Display help information for the corresponding category</td>
</tr>
<tr>
<td>up</td>
<td>(none)</td>
<td>Move up one rank category</td>
</tr>
<tr>
<td>top</td>
<td>(none)</td>
<td>Move to the Root category</td>
</tr>
<tr>
<td>factory</td>
<td>(none)</td>
<td>Factory reset for all settings</td>
</tr>
<tr>
<td>ps</td>
<td>(none)</td>
<td>Display thread information</td>
</tr>
<tr>
<td>setup</td>
<td>(none)</td>
<td>DA16200 general function setting wizard (Easy Setup) Make step-by-step configuration settings for elements such as SYSMODE, WI-FI, and NETWORK</td>
</tr>
<tr>
<td>reboot</td>
<td>(none)</td>
<td>Reboot</td>
</tr>
<tr>
<td></td>
<td>[mode]</td>
<td>● por: POR rebooting</td>
</tr>
<tr>
<td>reset</td>
<td>(none)</td>
<td>Reset to the Bootloader prompt</td>
</tr>
<tr>
<td>ver</td>
<td>(none)</td>
<td>Display SDK version &amp; system information</td>
</tr>
</tbody>
</table>
| 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 |
  For example: setwlanmac aa:bb:cc:00:00:02 | aa-cc-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

<table>
<thead>
<tr>
<th>Command</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| ifconfig | (none)    | Display or set the basic network setting and status  
|          | [interface wlan0|wlan1] [options] | - ifconfig: display basic network settings information  
|          |             | - ifconfig -a: display details of all network interfaces  
|          |             | - ifconfig wlan0|wlan1] [options]: display details of a network interface  
|          |             | - ifconfig wlan0|wlan1] [ipaddress] [subnet] [gateway] [option]: set static IP addresses to a network interface  
|          |             | - ifconfig wlan0|wlan1] dhcp: enable/Disable DCHP to a network interface  
|          |             | - ifconfig wlan0|wlan1] [up|down]: go Up/Down a network interface  
|          |             | - ifconfig wlan0|wlan1] [start|stop|renew|release]: DHCP client command  
|          |             | - ifconfig wlan0|wlan1] [dns] [DNS ServerIP]: set DNS server address (static IP) to a network interface  
|          |             | - ifconfig help: 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: ping 172.16.0.1 -I wlan0 -l 1024 -n 10 -w 1000 -i 1000 ping -6 fe80::1:2 -I wlan0  
| arp      | [interface] [options] | Display the ARP table of a network interface  
|          |             | - a: display the ARP table of every interface  
|          |             | - d: delete all of ARP table  
|          |             | - Help: Help display  
| arpsend  | [interface] [dst ipaddress] | Transmit the ARP request message of the target IP  
|          |             | For example: arpsend wlan0 10.0.0.1  
| garpsend | [interface] [option] | Transmit a GARP message with option:  
|          |             | - 0: normal garp  
|          |             | - 1: check IP conflict  
<p>|          |             | For example: arpsend wlan0 |</p>
<table>
<thead>
<tr>
<th>Command</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| dhcpd    | [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  
- dhcpd [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 49.

![Figure 49: CLI Check](image-url)
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] <VALUE>
    ```

- **Execution Parameter (Type D)**
  - ```
    [/DA16200/NET] # cli [CLI] or cli [CLI] < OPTION>
    ```

10.2.3 Common Commands

<table>
<thead>
<tr>
<th>CLI</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| 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
```

| select_network | <mode>    | Execute a motion in a certain mode (STA access, AP operation, etc.) (D).
For example: 
```
    [/DA16200/NET] # cli select_network 0
```
* 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).
For example: 
```
    [/DA16200/NET] # cli add_network 1
```
* Generate a profile for AP Mode
<table>
<thead>
<tr>
<th>CLI</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>remove_network</td>
<td>&lt;mode&gt;</td>
<td>Set parameter values for a specific mode (STA, AP) (B)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;mode&gt;: 0(STA)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;variable&gt;: a specific parameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- ssid: [STA] Operation SSID for AP SSID / [AP] AP interface to be connected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- psk: passphrase or PSK values</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- proto: for WPA use, set up the version (&lt;WPA(=WPA1)&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- key_mgmt: key management mode (&lt;NONE&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- pairwise: unicast data message encryption mode (&lt;TKIP&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- group: broadcast data message encryption mode (&lt;TKIP&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- wep_key#: WEP key (#:0~3) values</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- wep_tx_keyidx: WEP key index to be used</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- frequency: [AP] Operation Frequency (MHz)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- mode: Operation Mode &lt;0(STA)&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Wi-Fi_mode: &lt;0(BGN)&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- beacon_int: [AP] Beacon transport interval</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- dtim_period: [AP] DTIM interval</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- ap_power: [AP] Output Power (dBm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- isolate: ‘Isolate’ Use (&lt;0(off)&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- disabled: automatic profiling prevented upon rebooting (&lt;0(off)&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;value&gt;: settings for a certain variable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [:DA16200/NET] # cli set_network 1 ssid ‘DA16200_AP’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- For DA16200 AP operation, SSID= DA16200_AP setting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [:DA16200/NET] # cli set_network 1 beacon_int 200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- For DA16200 AP operation, Beacon interval 20 ms setting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [:DA16200/NET] # cli set_network 0 key_mgmt WPA_PSK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- For DA16200 STA operation, access in the WPA PSK security mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* A profile needs to be generated with command add_network so that a profile</td>
</tr>
<tr>
<td></td>
<td></td>
<td>can be set with command set_network (with no profile, ‘FAIL’)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [:DA16200/NET] # cli set_network 0 ssid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Inquiry of an object subject to DA16200 STA access (“TEST_BED_AP”)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [:DA16200/NET] # cli set_network 1 psk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- For DA16200 AP operation, inquiry of the PSK password setting</td>
</tr>
<tr>
<td>get_network</td>
<td>&lt;mode&gt;</td>
<td>Get specific parameter values for a specific mode (STA, AP) (C)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;mode&gt;: 0(STA)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;variable&gt;: a specific parameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [:DA16200/NET] # cli set_network 0 ssid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Inquiry of an object subject to DA16200 STA access (“TEST_BED_AP”)</td>
</tr>
<tr>
<td>CLI</td>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>-----</td>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>country</td>
<td>&lt;value&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Set a country related to channel operation (A)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;value&gt;: Country Code that meets ISO 3166-1 alpha-2 standards</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Default: KR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: <code>[/DA16200/NET] # cli country US</code></td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ Set the Country Code to US</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: <code>[/DA16200/NET] # cli country</code></td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ KR</td>
</tr>
<tr>
<td></td>
<td>flush</td>
<td>(none)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For every interface (STA, AP), DA16200 deletes the Profile and closes DA16200 service operation (D)</td>
</tr>
</tbody>
</table>
## 10.2.4 STA Commands

Table 5: CLI Commands on STA mode

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

### 10.2.5 Soft-AP Commands

Table 6: CLI Commands on Soft-AP mode

<table>
<thead>
<tr>
<th>Command</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ap</td>
<td>&lt;option&gt;</td>
<td>AP interface beginning/closing/restarting (Applicable with no reboot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>after main info. modification of AP interface SSID, PSK, etc.) (D)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;option&gt;: start</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [/DA16200/NET] # cli ap start</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ AP interface initiating (If it is being operated, 'FAIL')</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [/DA16200/NET] # cli ap stop</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ AP interface closing (If not being operated, 'FAIL')</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [/DA16200/NET] # cli set_network 1 ssid 'DA16200_AP2'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [/DA16200/NET] # cli ap restart</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ Modify SSID of the interface of AP being operated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [/DA16200/NET] # cli set_network 1 pairwise TKIP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [/DA16200/NET] # cli ap restart</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ Modify the AP interface encryption mode to TKIP</td>
</tr>
<tr>
<td>Command</td>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td>-------------</td>
</tr>
</tbody>
</table>
| ap_chan_switch | <Ch.>     | Modify the AP interface operation channel (B)  
  \(<\text{Ch.}>\): AP operation channel (1~14) or frequency (MHz)  
  For example: \([/\text{DA16200/NET}]\) \# cli ap_chan_switch 3  
  \(\quad\) o Modify the AP interface channel to 3 (242 MHz)  
  For example: \([/\text{DA16200/NET}]\) \# cli ap_chan_switch 11 2462  
  \(\quad\) o Modify the AP interface channel to 11 (2462 MHz) |
| ap_status    | (none)    | Get main information about the interface at DA16200 (C)  
  For example: \([/\text{DA16200/NET}]\) \# cli ap_status  
  \(\quad\) \text{state=ENABLED}  
  \(\quad\) \text{phy=fc9k_phy0}  
  \(\quad\) \text{freq=2472}  
  \(\quad\) \text{num_sta_no_short_slot_time=0}  
  \(\quad\) \text{num_sta_no_short_preamble=0}  
  \(\quad\) \text{olbc=0}  
  \(\quad\) \text{num_sta_ht_no_gf=0}  
  \(\quad\) \text{num_sta_no_ht=0}  
  \(\quad\) \text{num_sta_ht_20_mhz=0}  
  \(\quad\) \text{num_sta_vector_intolerant=0}  
  \(\quad\) \text{olbc_ht=0}  
  \(\quad\) \text{ht_op_mode=0x0}  
  \(\quad\) \text{cac_time_seconds=0}  
  \(\quad\) \text{cac_time_1} |
| all_sta      | (none)    | Output the list information of STA being accessed to the AP interface (C)  
  For example: \([/\text{DA16200/NET}]\) \# cli all_sta  
  \(\quad\) \text{50:77:05:DB:C4:3E}  
  \(\quad\) \text{flags=AUTH ASSOC AUTHORIZED [SHORT_PREAMBLE] [VNM]}  
  \(\quad\) \text{aid=1}  
  \(\quad\) \text{capability=0x431}  
  \(\quad\) \text{listen_interval=10}  
  \(\quad\) \text{mode = 802.11n}  
  \(\quad\) \text{timeout_next=0}  
  \(\quad\) \text{rx_packets=632}  
  \(\quad\) \text{tx_packets=9}  
  \(\quad\) \text{rx_bytes=67451}  
  \(\quad\) \text{tx_bytes=4767}  
  \(\quad\) \text{connected_time=77}  
  \(\quad\) \text{sta_count=1} |
| deauthenticate | <addr> | The \textit{deauthenticate} message is transmitted to the access STA with a certain MAC address to cancel the access (D)  
  For example: \([/\text{DA16200/NET}]\) \# cli deauthenticate  
  \(\quad\) \text{aa:ff:01:00:00:00}  
  \(\quad\) \(\quad\) o Transmit the de-authentication message to STA whose MAC address is AA:FF:01:00:00:00 |
| disassociate  | <addr>   | The \textit{disassociate} message is transmitted to the access STA with a certain MAC address to cancel the access (D)  
  For example: \([/\text{DA16200/NET}]\) \# cli disassociate  
  \(\quad\) \text{aa:ff:01:00:00:00}  
  \(\quad\) \(\quad\) o Transmit the disassociation message to STA whose MAC address is AA:FF:01:00:00:00 |
### Command: WMM

<table>
<thead>
<tr>
<th>Command</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| 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 |

### Command: WMM_PARAMS

<table>
<thead>
<tr>
<th>Command</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| 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 |

### Command: all_wmm

<table>
<thead>
<tr>
<th>Command</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| 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 |

### Command: ACL

<table>
<thead>
<tr>
<th>Command</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| acl           | <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  
  For example: `/DA16200/NET` # cli acl  
  ○ 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 |
<table>
<thead>
<tr>
<th>Command</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ap_max_inactivity</td>
<td>&lt;value&gt;</td>
<td>If there is no data frame exchange of accessed STA during the time setting, disconnect the STA (A)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;value&gt;: inactivity timeout (sec)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Default: 300 (sec.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [/DA16200/NET] # cli ap_max_inactivity 600</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ Disconnect the access STA with no data frame exchange for 600 seconds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ Uncheck data frame exchange of the accessed STA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [/DA16200/NET] # cli ap_max_inactivity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ Read ap_max_inactivity value</td>
</tr>
</tbody>
</table>

| 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

<table>
<thead>
<tr>
<th>Command</th>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>wps_pbc</td>
<td>(none)</td>
<td>Run WPS PBC (Push Button Configuration)</td>
</tr>
<tr>
<td>wps_pin</td>
<td>&lt;pin&gt;</td>
<td>Run WPS PIN method</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;pin&gt; pin code (any: generate a random code)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [/DA16200/NET] # cli wps_pin 27833513</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: [/DA16200/NET] # cli wps_pin any</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Address</th>
<th>Item</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0000_0000</td>
<td>2nd Bootloader</td>
<td>36 kB</td>
</tr>
<tr>
<td>0x0000_9000</td>
<td>Boot Index</td>
<td>4 kB</td>
</tr>
<tr>
<td>0x0000_A000</td>
<td>RTOS #0</td>
<td>924 kB</td>
</tr>
<tr>
<td>0x000F_1000</td>
<td>SLIB #0 (RamLib + TIM)</td>
<td>52 kB</td>
</tr>
<tr>
<td>0x000F_E000</td>
<td>RTOS #1</td>
<td>924 kB</td>
</tr>
<tr>
<td>0x001E_5000</td>
<td>SLIB #1 (RamLib + TIM)</td>
<td>52 kB</td>
</tr>
</tbody>
</table>
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 50.

3. At the [MROM] prompt, type loady boot. See Figure 51.

4. Choose menu File > Transfer > YMODEM > Send to select the image file for the Bootloader. See Figure 52.
   - For example: DA16200_BOOT_GEN01-01-XXXX-000000_IS25WP016D.img

Table 9: 4 MB Serial Flash Memory Map

<table>
<thead>
<tr>
<th>Address</th>
<th>Item</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0000_0000</td>
<td>2nd Bootloader</td>
<td>36 kB</td>
</tr>
<tr>
<td>0x0000_9000</td>
<td>Boot Index</td>
<td>4 kB</td>
</tr>
<tr>
<td>0x0000_A000</td>
<td>RTOS #0</td>
<td>1536 kB</td>
</tr>
<tr>
<td>0x0018_A000</td>
<td>SLIB #0 (RamLib + TIM)</td>
<td>64 kB</td>
</tr>
<tr>
<td>0x0020_0000</td>
<td>RTOS #1</td>
<td>1536 kB</td>
</tr>
<tr>
<td>0x0038_0000</td>
<td>SLIB #1 (RamLib + TIM)</td>
<td>64 kB</td>
</tr>
</tbody>
</table>
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 53.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>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 0x0f1000 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].</td>
</tr>
</tbody>
</table>

![Figure 53: System Library Prompt on Command Window](image)

2. Choose menu File > Transfer > YMODEM > Send to select the <System Library image> file. See Figure 54.

   ○ For example: DA16200_SLIB_GEN01-XX-YYYY-ZZZZZZ.img
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 55.

   **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].

2. Choose menu **File > Transfer > YMODEM > Send** to select the <Main image> file. See Figure 56.

   ○ For example: `DA16200_RTOS_GEN01-XX-YYYY-ZZZZZZ.img`
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 57.

```
[[DA16200]] # factory
FACTORY RESET [N/Y/?] y
Start Factory-Reset...
Rebooting...

RtlIS is relocated to RETNEM (20C0:41C, 587, 18736114, 18756114)  
P TIN is relocated to RETNEM (CONF030, 2)  
dm_init_rememory::326 DFM INIT CONFIGURATION(1)  
Makeup source is 0x0

******************************************************************************
* DA16200 SDK Information                                                     *
*                                                                            *
*  - CPU Type : Cortex-M4 (80MHZ)                                           *
*  - BG Type : ThreadX 5.7                                                 *
*  - Serial Flash : 16 Mbits (2 Mbytes)                                    *
*  - SDK Type : Manufacturer v1.0.0                                         *
*  - F/W Version : RTOS-GENB1-01-T48-00000                                  *
*  - Board Type : Combined-Image                                            *
*  - F/W Build Time : Aug 8 2019 10:26:18                                  *
*  - Boot Index : 0                                                         *
******************************************************************************
```

Figure 57: 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 58.

![Figure 58. Load Macro](image)

3. The download starts with the bootloader image. See Figure 59.

![Figure 59. Download Bootloader](image)

4. Download RTOS image. See Figure 60.
5. Download the SLIB Image. See Figure 61.

6. DA16200 will boot automatically after all images are downloaded.
### 11.6 SFDP 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 62.

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

- `/DA16200` # brd f80000 100

![Figure 62: SFDP](image)

### 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`
DA16200 Evaluation Kit

3. 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.
   W25Q32JW/NQI: ef601615
   IS25W0P016D: 9d701514
   IS25LQ032B: 9d401615

4. Run command ymodem sfdp

5. In the build\SBOOT\SDFP folder, find Flash SDFP file which is corresponding to Flash ID as W25Q32JW.bin.

6. 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.

7. Re-load all images in the specified order for serial flash recovery.
   ○ [MROM] loady boot
   ○ [MROM] loady f1000
   ○ [MROM] loady a000

8. Run command boot to boot DA16200. The image version is printed.

9. Initialize NVRAM for Serial Flash Recovery with following commands:

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

   Figure 63: 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.

1. 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 64
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 65.
4. At the [BOOT] # prompt, run command reset.
5. Do the steps in section 11.7 from step 3.

Figure 64: Recovery Point in the EVK

![Recovery Point in the EVK](image)

Figure 65: Run with BOOT mode

![Run with BOOT mode](image)
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
```

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.
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<td>Small textual changes and updated figures based on SDK v2.1.1.0</td>
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<td>Add boot index configuration in Section 11.1, 11.3, 11.4 and 11.8</td>
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