DA16200 DA16600 Host Interface and AT Command

This document describes how to use Host interfaces and AT commands in the DA16200 and DA16600.

Contents

Figures

Tables

1. Terms and Definitions

AP	Access Point
ASCII	American Standard Code for Information Interchange
AT	Attention
BSSID	Basic Service Set Identifier
CA	Certificate Authority
CCMP	Counter Mode Cipher Block Chaining Message Authentication Code Protocol
CCRNT	Concurrent
CID	Client ID
CMD	Command
COM	Communication Port
CRC	Cyclic Redundancy Check
CW	Continuous Wave
DHCP	Dynamic Host Configuration Protocol
DPM	Dynamic Power Management
EAP	Extensible Authentication Protocol
ESS	Extended Service Set
GPIO	General Purpose Input Output
HTTP	Hypertext Transfer Protocol
ICMP	Internet Control Message Protocol
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
JSON	JavaScript Object Notation
LE	Low Energy
LMAC	Low MAC
LSB	Least Significant Bit
MAC	Medium Access Control
MCU	Micro Controller Unit
MQTT	Message Queuing Telemetry Transport
MSB	Most Significant Bit
NVRAM	Non-Volatile RAM
OTA	Over the Air
OTP	One-Time Programmable
OWE	Opportunistic Wireless Encryption
PBC	Push Button Connection
PER	Packet Error Rate
PSK	Pre-Shared Key
QoS	Quality of Service
RTC	Real-Time Clock
RTOS	Real-Time Operating System
RTS	Request to Send
RX	Receive
SAE	Simultaneous Authentication of Equals
SDK	Software Development Kit
SDIO	Secure Digital Input Output
SNTP	Simple Network Time Protocol
SPI	Serial Peripheral Interface

SSID	Service Set Identifier
STA	Station
TCP	Transport Control Protocol
TIM	Traffic Indication Map
TKIP	Temporal Key Integrity Protocol
TLS	Transport Layer Security
TX	Transmit
UART	Universal Asynchronous Receiver-Transmitter
UDP	User Datagram Protocol
USB	Universal Serial Bus
URL	Universal Resource Locator
WEP	Wired Equivalent Privacy
WLAN	Wireless Local Area Network
WMM	Wi-Fi Multimedia
WPA	Wi-Fi Protected Access version 1
WPA2	Wi-Fi Protected Access version 2
WPS	Wi-Fi Protected Setup
XTAL	Crystal

2. References

[1] UM-WI-056, DA16200 DA16600 FreeRTOS Getting Started Guide, User Manual, Renesas Electronics.

[2] UM-WI-046, DA16200 DA16600 FreeRTOS SDK Programmer Guide, User Manual, Renesas Electronics.

[3] DA16200 Datasheet, Renesas Electronics.

[4] UM-WI-004, DA16200 AT GUI Tool, User Manual, Renesas Electronics.

[5] UM-WI-042, DA16200 DA16600 Provisioning Mobile App for Android/iOS, User Manual, Renesas Electronics.

[6] UM-WI-030, DA16200 DA16600 DPM User Manual, Renesas Electronics.

[7] UM-WI-011, DA16200 DA16600 Mass Production User Manual, Renesas Electronics.

Note 1 References are for the latest published version, unless otherwise indicated.

3. Host Interface

This document describes how an external processor system, "External Host", communicates with the DA16200 with SPI and SDIO physical interface protocols. It also includes the AT Command Protocol that can be used with the External Host.

3.1 UART Host Interface

3.1.1 Pin MUX Configuration

The DA16200 can use two interfaces, UART1 and UART2, and the DA16600 can use only UART2. UART1 can be assigned to GPIOA[1:0], GPIOA[3:2], GPIOA[5:4], or GPIOA[7:6], and UART2 is to GPIOA[11:10] or GPIOC[7:6]. UART1 can use the hardware flow control with GPIOA[5:4] PIN, but there is no available pin for UART2 hardware flow control.

Examples:

- Assign GPIOA[5:4] as UART1 interface.
  _da16x_io_pinmux(PIN_CMUX, CMUX_UART1d); //GPIOA_4: UART1 TXD, and GPIOA_5: UART1 RXD
- Assign GPIOC[7:6] as UART2 interface.
  _da16x_io_pinmux(PIN_UMUX, UMUX_UART2GPIO); //GPIOC_6: UART2 TXD, GPIOC_7: UART2 RXD, GPIOC_8(GPIO)

Table 1. Pin MUX configuration – UART

UART interface	GPIO	Signal name
UART1	GPIOA[0] (Note 1)	TXD
	GPIOA[1]	RXD
	GPIOA[2]	TXD
	GPIOA[3]	RXD
	GPIOA[4]	TXD
	GPIOA[5]	RXD
	GPIOA[6]	TXD
	GPIOA[7]	RXD
UART1 Hardware flow control	GPIOA[4]	RTS
	GPIOA[5]	CTS
UART2	GPIOA[10]	TXD
	GPIOA[11]	RXD
	GPIOC[6]	TXD
	GPIOC[7]	RXD

Note 1 See Ref. [3] for more information.

3.2 SPI Host Interface

3.2.1 Pin MUX Configuration

GPIOA[1:0], GPIOA[3:2], GPIOA[7:6], GPIOA[9:8] and GPIOA[11:10] can be assigned to SPI slave interface in the DA16200.

For example, assign GPIOA[3:2] and GPIOA[9:8] as SPI slave interface.

- _da16x_io_pinmux(PIN_BMUX, BMUX_SPIs); //GPIOA_2: CS, GPIOA_3: CLK
- _da16x_io_pinmux(PIN_EMUX, EMUX_SPIs); //GPIOA_8: MISO, GPIOA_9: MOSI

Table 2. Pin MUX configuration – SPI

GPIO	Signal name
GPIOA[0]	MISO
GPIOA[1]	MOSI
GPIOA[2]	CS
GPIOA[3]	CLK
GPIOA[6]	CS
GPIOA[7]	CLK
GPIOA[8]	MISO
GPIOA[9]	MOSI
GPIOA[10]	MISO
GPIOA[11]	MOSI

3.2.2 SPI Protocol

3.2.2.1 Message Format

The format of the messages sent/received to/from the external processor is the DA16200 protocol format over SPI physical interface. Message format and parameters included in the DA16200 are outlined in Figure 1.

Figure 1. Basic format – SPI

3.2.2.1.1 Address

Table 3 shows the address list used by External Host.

Table 3. SPI address list

Address type	Address
General Command (Write request)	0x50080254
AT Command	0x50080260
Response Command	0x50080258
Buffer Address	Received from slave in response message.

3.2.2.1.2 CMD

The format of CMD fields is outlined in Table 4.

Table 4. SPI CMD format

Bit	Field	Description
7	Auto_Inc	1: Internal address auto-increment. 0: Address fixed (Not used).
6	Read/Write	1: Read 0: Write
5:2		Not Used.
1:0	CHIP_ID[1:0]	00: CHIP #0 (Default).

3.2.2.1.3 Length

Payload length of the data field.

3.2.2.2 Write Sequence

Host to Slave write operations are performed in three SPI transactions as shown in Figure 2.

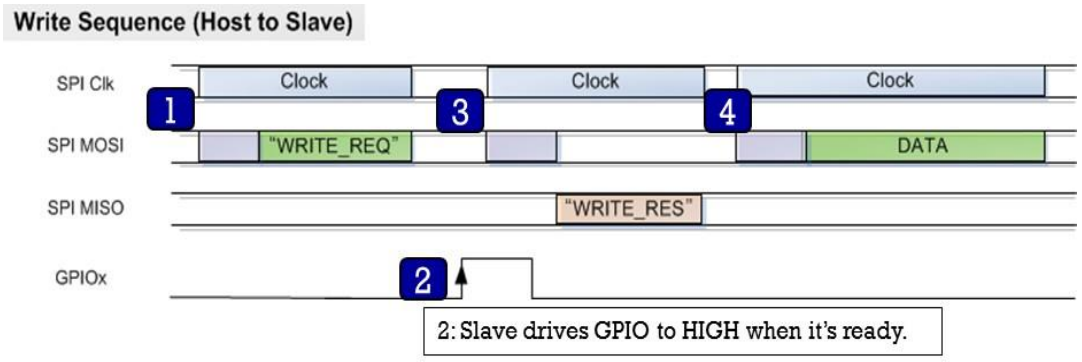


Figure 2. Write sequence

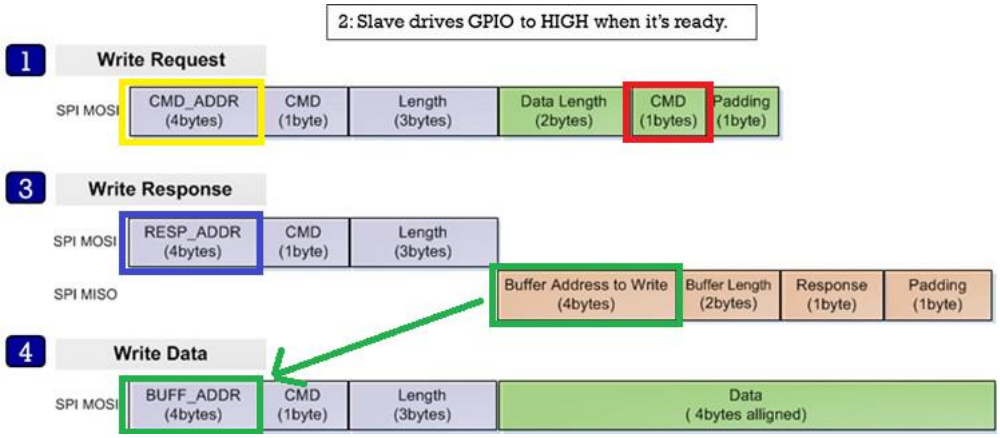


Figure 3. Write operation structure

1. The Host sends a WRITE_REQ command (0x80, red rectangle in Figure 3) to the General Command address (0x50080254) (yellow rectangle in Figure 3).
2. The Host should wait for GPIO interrupt line is High from slave.
3. The Host reads the Write Response message by Response Command address (0x50080258, blue rectangle in Figure 3) and parse it using struct _st_host_response (see Section 3.2.2).
4. The Host sends data to address (BUFF_ADDR) which is received from the Slave in the Write Response message (green rectangle in Figure 3).

NOTE
Buffer Length field contains the length of Data field, and it should be a multiple of 4. The padding field contains a number of padded bytes in the Data field because of the 4-byte aligned. For example, if the length of the actual data is 11 bytes, the Buffer Length is 12 (multiples of 4) and Padding field is 1. `Buffer Length (12) = Actual data length (11) + number of padded bytes (1)` The Host can get the length of actual data using Buffer Length and Padding fields. In addition, the usage of Padding field is applied to the SDK v3.2.8.0 or later.

An interval of several hundred microseconds is required between the "3" and "4" stages. If the interval between the two stages is too short, there is a possibility that two Interrupt Events are recognized as one. The interval depends on the type of application or CPU load. Roughly, when the CPU clock is 120 MHz, an interval of around 300 µs is required.

Example

When the host wants to write 8-byte data (0x8877665544332211) to the DA16200:

1. The Host sends (0x50-0x08-0x02-0x54)-(0x80)-(0x00-0x00-0x04)-(0x08-0x00-0x80-0x00).
2. The Host waits until GPIO interrupt line is high from the DA16200.
3. The Host sends (0x50-0x08-0x02-0x58)-(0xC0)-(0x00-0x00-0x08), then reads responses from the DA16200.
   Assume the buffer address from Slave is 0x12345678 for easy description.
   Then, the read data should be 0x78-0x56-0x34-0x12-0x08-0x00-0x81-0x00.
4. The Host sends (0x12-0x34-0x56-0x78)-(0x80)-(0x00-0x00-0x08)-(0x11-0x22-0x33-0x44-0x55-0x66-0x77-0x88).

NOTE
The payload data is transmitted MSB first and little-big endian system (see Figure 10).

3.2.2.3 Read Sequence and Structure

Figure 4 shows a Slave device transmitting data to the Host when payload is available. This sequence is performed in two SPI transactions.

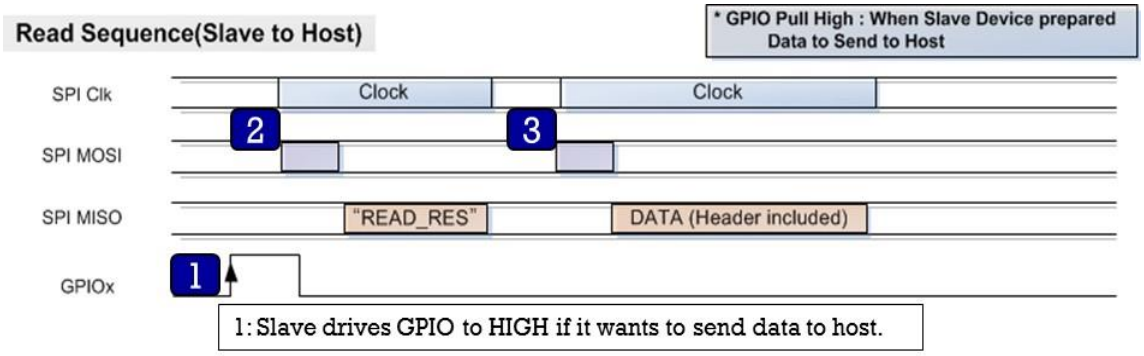


Figure 4. Read sequence

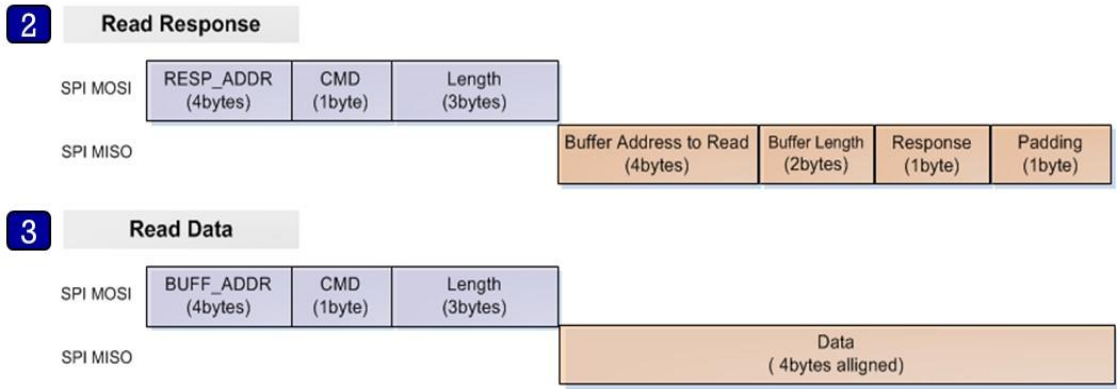


Figure 5. Read operation structure

1. The slave toggles the interrupt line high to inform the Host when data is available.
2. The Host reads the response message from Response Command address (0x50080258, blue rectangle in Figure 5) and parses it using struct _st_host_response (see Section 3.2.6).
3. The Host reads data from address (BUFF_ADDR) which is received from Slave in the response message (green rectangle in Figure 5).

NOTE
Buffer Length field contains the length of Data field, and it should be a multiple of 4. The padding field contains a number of padded bytes in the Data field because of the 4-byte aligned. For example, if the length of the actual data is 11 bytes, the Buffer Length is 12 (multiples of 4) and Padding field is 1. `Buffer Length (12) = Actual data length (11) + number of padded bytes (1)` The Host can get the length of actual data using Buffer Length and Padding fields. In addition, the usage of Padding field is applied to the SDK v3.2.8.0 or later.

There is a 200 ms timeout between reading the response after the interrupt occurs and reading the data after reading the response. If the Host requires more than 200 ms between each interval, change the timeout value accordingly.

An interval of several hundred microseconds is required between the "2" and "3" stages. If the interval between the two stages is too short, there is a possibility that two Interrupt Events are recognized as one. The interval differs depending on the type of application or CPU load. Roughly, when the CPU clock is 120 MHz, an interval of around 300 µs is required.

Example

1. When the Host becomes high on GPIO interrupt line from the DA16200, the Host sends:

   (0x50-0x08-0x02-0x58)-(0xC0)-(0x00-0x00-0x08), then reads response from the DA16200.

   Assume the buffer address from Slave is 0x12345678 for easy description and the data length to be sent from the DA16200 is 8 bytes.

2. The read data should be 0x78-0x56-0x34-0x12-0x08-0x00-0x83-0x00.

   The Host sends (0x12-0x34-0x56-0x78)-(0xC0)-(0x00-0x00-0x08), then reads data from the DA16200.

NOTE
The read data is transmitted MSB first and little-big endian system (see Figure 11).

3.2.3 AT Command – Sequences and Structures

AT commands are instructions used to control a modem. AT is the abbreviation of Attention. Every command line starts with **AT** or **at**. Start AT is the prefix that informs the modem about the start of a command line. It is not part of the AT command name.

Figure 6 shows how to use the AT Command through SPI on the DA16200. This is because AT command uses a predetermined address, and the maximum size of data is defined.

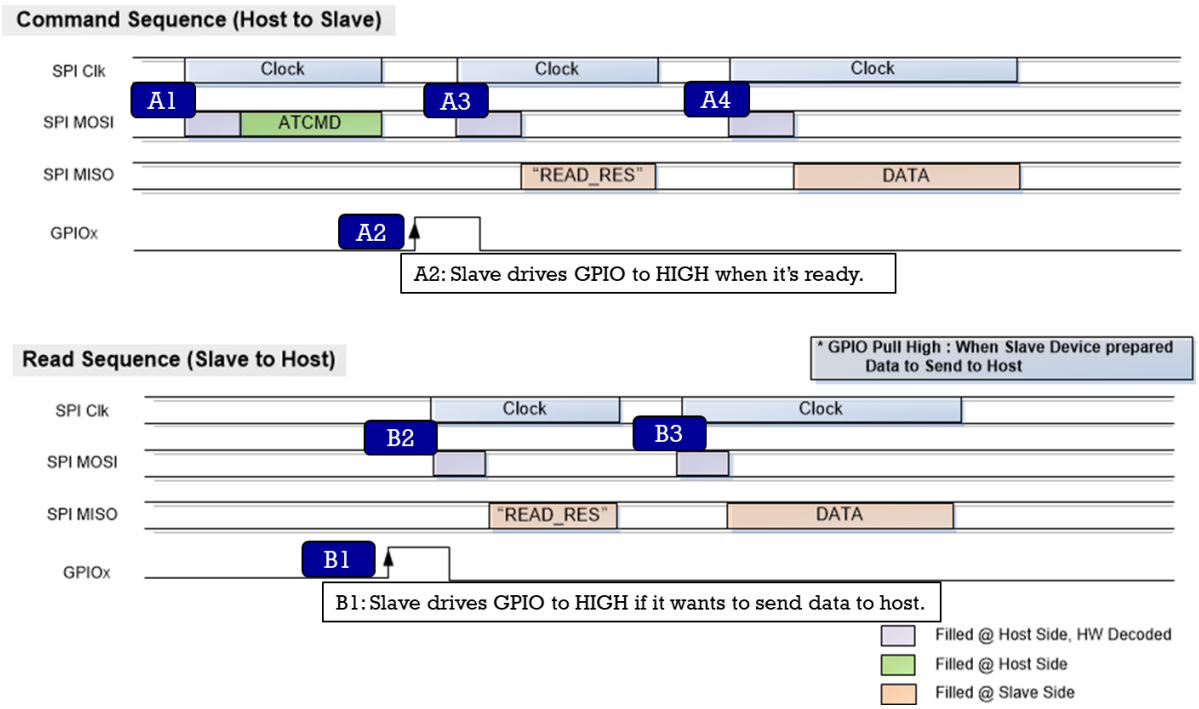


Figure 6. AT command sequence

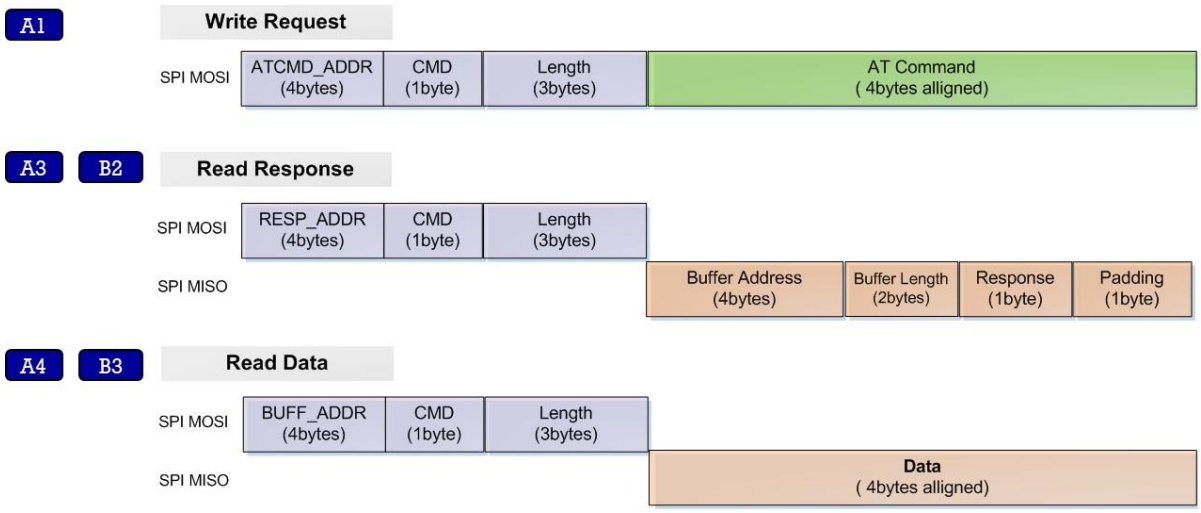


Figure 7. AT command structure

A1: The Host sends an AT command to AT Command address.

A2: The Host waits for GPIO interrupt line to go high.

A3: The Host reads the response message from address and parses it using struct _st_host_response.

A4: The Host reads OK/Error, or data from address (BUF_ADDR), depending on the command type.

Example

To write AT+VER command to the DA16200, the host sends:

(0x50-0x08-0x02-0x60)-(0x80)-(0x00-0x00-0x08)-('A'-'T'-'+'-'V'-'E'-'R'-0x00-0x00)

The read sequence after writing is the same as the following examples of B1~B3.

NOTE
The payload data is transmitted MSB first and little-big endian system (see Figure 10).

B1: The Slave toggles high the interrupt line to inform Host when data is available.

B2: The Host reads the response message from Response Command address and parses it using struct _st_host_response.

B3: The Host reads data from address (BUF_ADDR) parsed from the response message.

There is a 200 ms timeout between reading the response after the interrupt occurs and reading the data after reading the response. If the Host requires more than 200 ms between each interval, change the timeout value accordingly.

An interval of several hundred microseconds is required between the "A3" and "A4" stages, "B2" and "B3" stages. If the interval between the two stages is too short, there is a possibility that two Interrupt Events are recognized as one. The interval differs depending on the type of application or CPU load. Roughly, when the CPU clock is 120 MHz, an interval of around 300 µs is required.

Example

When the host becomes high on GPIO interrupt line from the DA16200, the host sends:

(0x50-0x08-0x02-0x58)-(0xC0)-(0x00-0x00-0x08), then read response from the DA16200.

Assume the buffer address from Slave is 0x12345678 for easy description and the data length to be sent from the DA16200 is 8 bytes.

The read data should be 0x78-0x56-0x34-0x12-0x08-0x00-0x83-0x00.

The Host sends: (0x12-0x34-0x56-0x78)-(0xC0)-(0x00-0x00-0x08), then read data from the DA16200.

NOTE
The read data is transmitted MSB first and little-big endian system (see Figure 11).

3.2.4 ESC Command – Sequences and Structures

Figure 8 shows how to use the ESC Command through SPI on the DA16200. This is because ESC command uses a predetermined address, and the maximum size of data is defined.

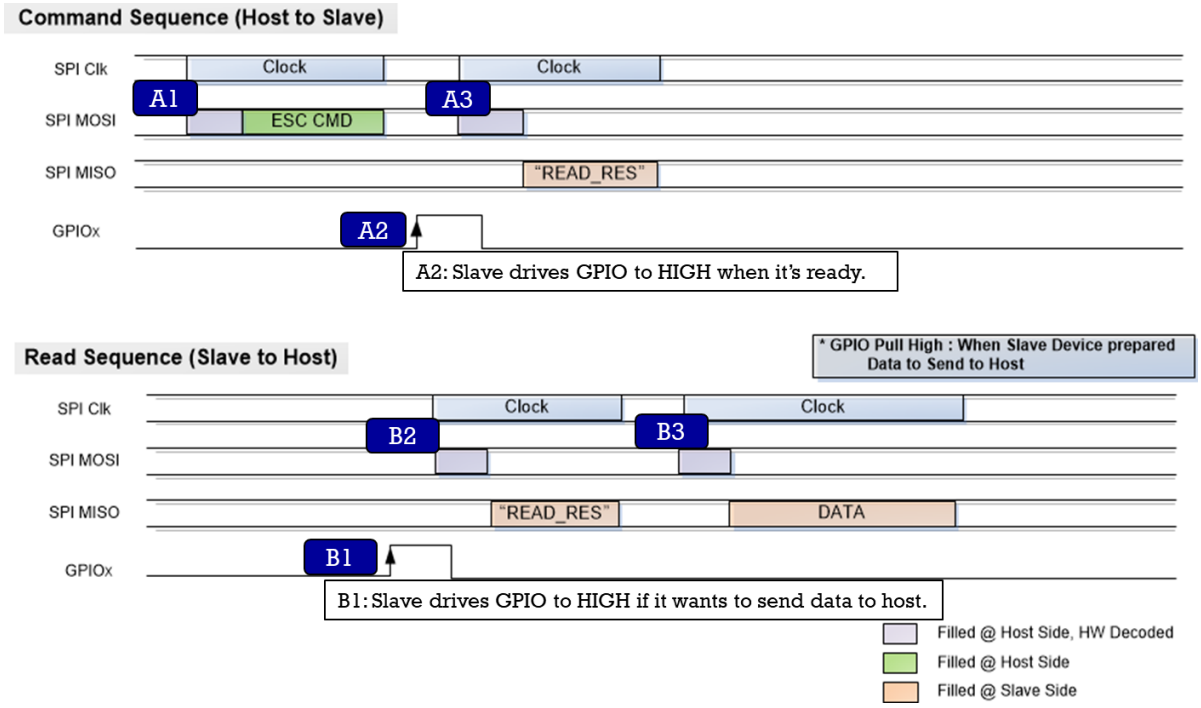


Figure 8. ESC command sequence

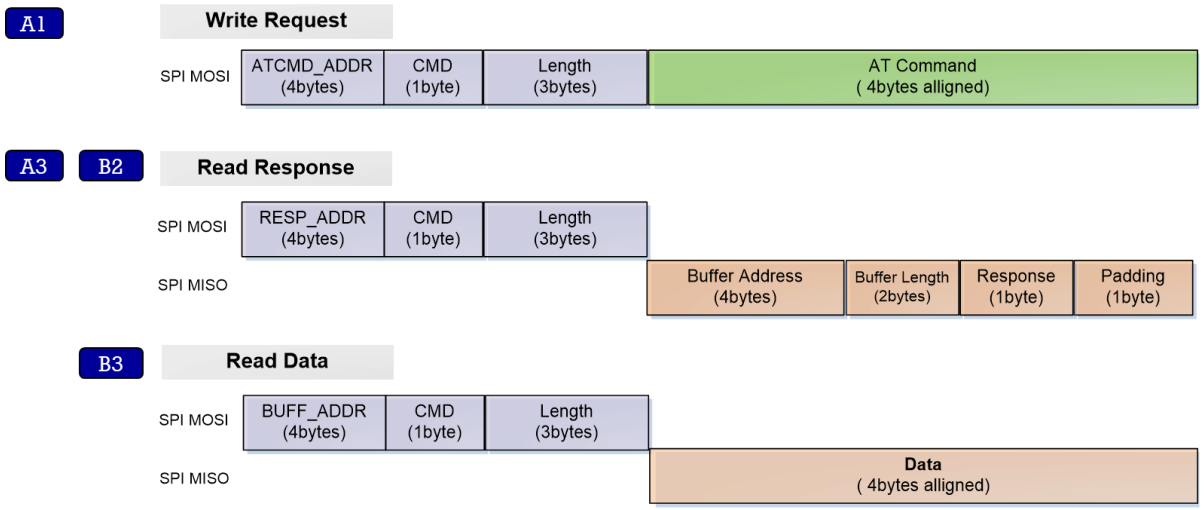


Figure 9. ESC command structure

A1: The Host sends an ESC command to AT command address.

A2: The Host waits for GPIO interrupt line to go high.

A3: The Host reads the response message from address and parses it using struct _st_host_response. The result for esc command is sent to the host as the response field of struct _st_host_response. The response field is a 1-byte decimal value. The value of 0x20 is a result of OK. All other values are ERROR. And in this case, the value of the buf_address field is read as 0xffffffff, and the value of the host_length field is read as 0x0. Therefore, the subsequent Read Sequence is not required.

Example

To write <ESC>S010,192.168.0.18,43310,abcde12345 command to the DA16200, the host sends:

(0x50-0x08-0x02-0x60)-(0x80)-(0x00-0x00-0x24)-(<ESC>-'S'-'0'-'1'-'0'-','-'1'-'9'-'2'-'.'-'1'-'6'-'8'-'.'-'0'-'.'-'1'-'8'-','-'4'-'3'-'3'-'1'-'0'-','-'a'-'b'-'c'-'d'-'e'-'1'-'2'-'3'-'4'-'5'-0x00)

The read sequence after writing is the same as the following examples of B1~B2.

NOTE
The payload data is transmitted MSB first and little-big endian system (see Figure 10).

B1: The Slave toggles high the interrupt line to inform the Host when data is available.

B2: The Host reads the response message from Response Command address and parses it using struct _st_host_response.

B3: The Host reads data from address (BUF_ADDR) parsed from the response message.

There is a 200 ms timeout between reading the response after the interrupt occurs and reading the data after reading the response. If the Host requires more than 200 ms between each interval, change the timeout value accordingly.

An interval of several hundred microseconds is required between the "B2" and "B3" stages. If the interval between the two stages is too short, there is a possibility that two Interrupt Events are recognized as one. The interval differs depending on the type of application or CPU load. When the CPU clock is 120 MHz, an interval of around 300 µs is required.

Example

When the Host becomes high on GPIO interrupt line from the DA16200, the Host sends:

(0x50-0x08-0x02-0x58)-(0xC0)-(0x00-0x00-0x08), then read response from the DA16200.

Assume the buffer address from Slave is 0x12345678 for easy description and the data length to be sent from the DA16200 is 8 bytes.

The read data should be 0x78-0x56-0x34-0x12-0x08-0x00-0x83-0x00.

The Host sends (0x12-0x34-0x56-0x78)-(0xC0)-(0x00-0x00-0x08), then reads data from the DA16200.

NOTE
The read data is transmitted MSB first and little-big endian system (see Figure 11).

3.2.5 Header Format

3.2.5.1 Write Request (Host to Slave)

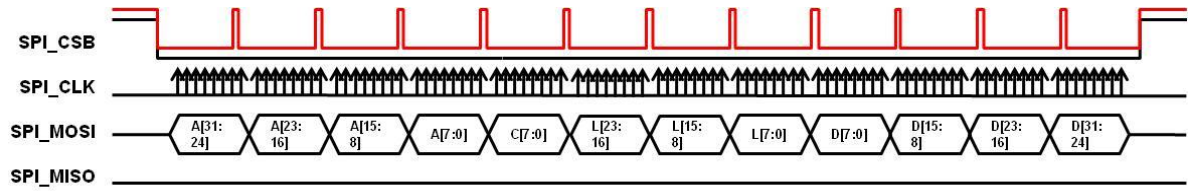
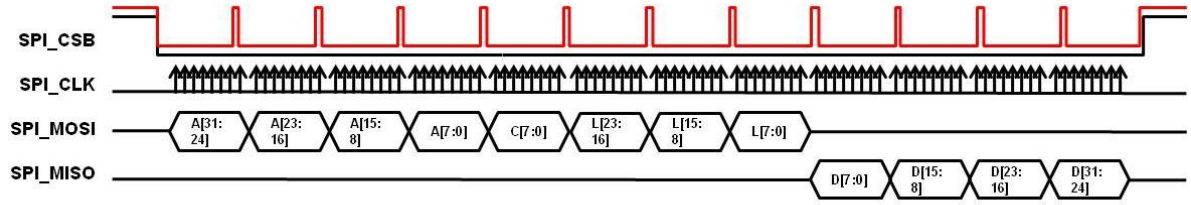


Figure 10. SPI signals for write request

3.2.5.2 Read Response (Slave to Host)



CMD Bit field	Abr.	Description
7	Auto_Inc	1 = internal Address auto-increment 0 = address fixed (not used)
6	Read/Write	1 = Read 0 = Write
5:2		Not used
1:0	CHIP_ID[1:0]	00 = Chip #0 (default)

Figure 11. SPI signals for read response

3.2.6 SPI Definition and Structure

3.2.6.1 SPI Definition

```
#define HOST_MEM_WRITE_REQ      (0x80)
#define HOST_MEM_WRITE_RES      (0x81)
#define HOST_MEM_READ_REQ               (0x82)
#define HOST_MEM_READ_RES               (0x83)
#define FC9K_GEN_CMD_ADDR               (0x50080254)  //Address to Write Command
#define FC9K_RESP_ADDR          (0x50080258)  //Address to Read Response
#define FC9K_ATCMD_ADDR         (0x50080260)  //Address to Send AT Command
```

3.2.6.2 SPI Response Structure

```
typedef struct _st_host_response
{
    u32 buf_address;
    u16 host_length;
    u8  resp;
    u8  dummy;
} st_host_response;
```

3.2.6.3 SPI Request Structure

```
typedef struct _st_host_request
{
    u16 host_write_length;
    u8  host_cmd;
    u8  dummy;
} st_host_request;
```

3.3 SDIO Host Interface

3.3.1 Pin MUX Configuration

SDIO slave is assigned to GPIOA[9:4] in the DA16200. For interruption, the D1 port of SDIO can be used, but in some cases, GPIO can also be used.

The following pin MUX initialization codes are used for SDIO interface.

```
_da16x_io_pinmux(PIN_CMUX, CMUX_SDs);          //GPIOA_4 : CMD, GIPOA_5 : CLK
_da16x_io_pinmux(PIN_DMUX, DMUX_SDs);          //GPIOA_6 : D3, GPIOA_7 : D2
_da16x_io_pinmux(PIN_EMUX, EMUX_SDs);          //GPIOA_8 : D1, GPIOA_9 : D0
```

If GPIO is used as interruption instead of SDIO D1, the following PAD MUX Setting is additionally required.

```
_da16x_io_pinmux(PIN_FMUX, FMUX_GPIO);          //GPIOA_10 : GPIO, GPIOA_11 : GPIO
```

Table 5. Pin MUX configuration – SDIO

GPIO	Signal name
GPIOA[4]	CMD
GPIOA[5]	CLK
GPIOA[6]	D3
GPIOA[7]	D2
GPIOA[8]	D1
GPIOA[9]	D0

3.3.2 SDIO Protocol

3.3.2.1 Message Format

The format of the messages sent/received to/from the external processor is the DA16200 protocol format over SDIOI physical interface. The format and the parameters included are outlined in Figure 12. For more information about SDIO header configuration, see its official SDIO specification. When using SDIO protocol of the DA16200, data should be aligned in units of 4-byte length.

Figure 12. Basic format – SDIO

3.3.2.1.1 Address (Included in Header)

Table 6 shows the address list used by External Host.

Table 6. Address list

Address type	Address
General Command (Write request)	0x50080254
AT Command	Received from slave in initial stage
Response Command	0x50080258
Buffer Address	Received from slave in response message

3.3.2.1.2 Length (Included in header)

Payload length to follow.

3.3.2.1.3 Interrupt

According to SDIO Specification, Slave can cause Interrupt to Host by using D1 port. However, if the host cannot receive an interrupt using the D1 port, it must use the GPIO to generate the interrupt. The interrupt line used in the sequence diagram of this document means that the D1 port or GPIO is used.

3.3.2.2 Write Sequence

Host to Slave write operations are performed in three SDIO transactions.

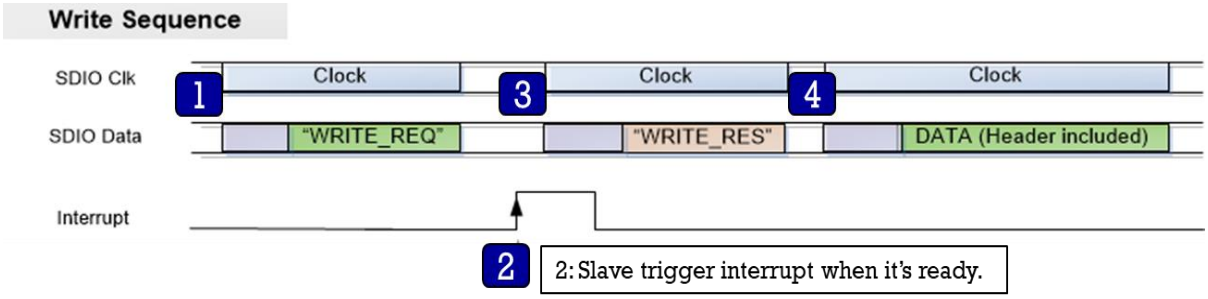


Figure 13. Write sequence

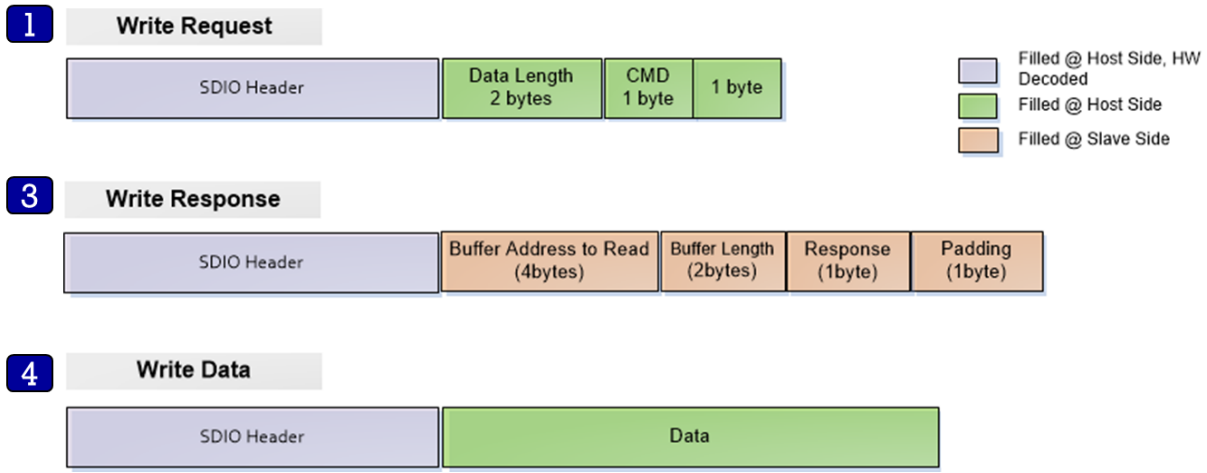


Figure 14. Structure

1. The Host sends a WRITE_REQ command (0x80, red rectangle in Figure 3) to the General Command address (0x50080254).
2. The Host should wait for Interrupt from slave.
3. The Host reads the Write Response Message by Response Command address (0x50080258) and parse it using struct _st_host_response (see Section 3.2.6).
4. The Host sends data to address (BUFF_ADDR) which is received from the Slave in the Write Response message (green rectangle in Figure 14).

There is a 200 ms timeout between reading the response after the interrupt occurs and reading the data after reading the response. If the host requires more than 200 ms between each interval, change the timeout value accordingly.

An interval of several hundred microseconds is required between the "3" and "4" stages. If the interval between the two stages is too short, there is a possibility that two Interrupt Events are recognized as one. The interval differs depending on the type of application or CPU load. Roughly, when the CPU clock is 120 MHz, an interval of around 300 µs is required.

Example

When the host wants to write 8-byte data (0x88776655,0x44332211) to the DA16200:

- The Host sends (SDIO Write-0x50080254, 4 bytes) - (0x08-0x00-0x80-0x00).
- The Host waits for interrupt triggering from the DA16200.
- The Host sends:
  - (SDIO Read-0x50080258, 8 bytes), and then read response from the DA16200.
  - Assume the buffer address from Slave is 0x12345678 for easy description.
  - Then, the read data should be 0x78-0x56-0x34-0x12-0x08-0x00-0x81-0x00.

- The Host sends (SDIO Write-0x12345678, 8 bytes)-(0x55-0x66-0x77-0x88-0x11-0x22-0x33-0x44).

3.3.2.3 Read Sequence and Structure

Figure 15 shows a Slave device transmitting data to the Host when payload is available. This sequence is performed in two SDIO transactions.

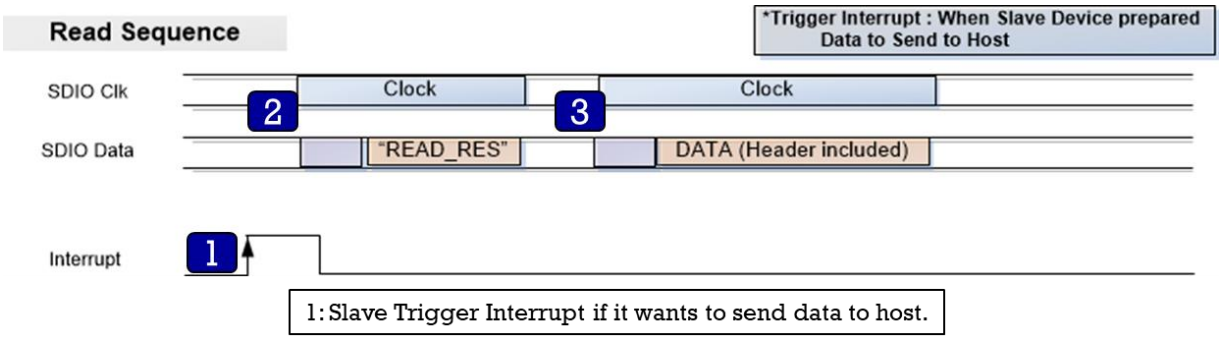


Figure 15. Read sequence

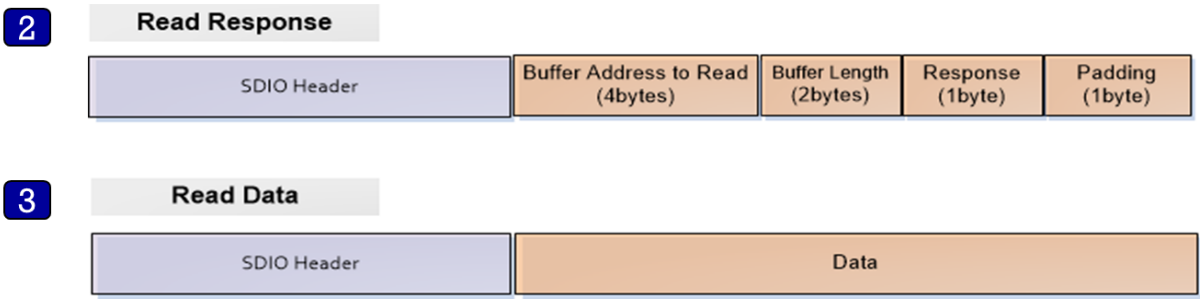


Figure 16. Structure

1. The Slave triggers interrupts to inform the Host when data is available.
2. The Host reads the response message from Response Command address (0x50080258, blue rectangle in Figure 16), and parse it using struct _st_host_response (see Section 3.2.6).
3. The Host reads data from address (BUFF_ADDR) which is received from Slave in the response message (green rectangle in Figure 16).

There is a 200 ms timeout between reading the response after the interrupt occurs and reading the data after reading the response. If the host requires more than 200 ms between each interval, change the timeout value accordingly.

An interval of several hundred microseconds is required between the "2" and "3" stages. If the interval between the two stages is too short, there is a possibility that two Interrupt Events are recognized as one. The interval differs depending on the type of application or CPU load. Roughly, when the CPU clock is 120 MHz, an interval of around 300 µs is required.

Example

When the host received an interrupt from the DA16200,

- Host sends:
  - (SDIO Read-0x50080258, 8 bytes) and then read response from the DA16200.
  - Assume the buffer address from Slave is 0x12345678 for easy description and the data length to be sent from the DA16200 is 8 bytes. The read data should be 0x78-0x56-0x34-0x12-0x08-0x00-0x83-0x00.
- Host sends (SDIO Read-0x12345678, 8 bytes) then reads data from the DA16200.

3.3.3 AT Command – Sequences and Structures

AT commands are instructions used to control a modem. AT is the abbreviation of Attention. Every command line starts with **AT** or **at**. The starting AT is the prefix that informs the modem about the start of a command line. It is not part of the AT command name.

To use AT commands, read the address of AT (ESC) Command Buffer in the initial stage. Therefore, read the value of address 0x50080264 after SDIO is initialized, and write the command to that address when sending AT command afterwards.

Figure 17 illustrates how to use the AT command through SDIO in the DA16200. This is because AT command uses a predetermined address, and the maximum size of data is defined.

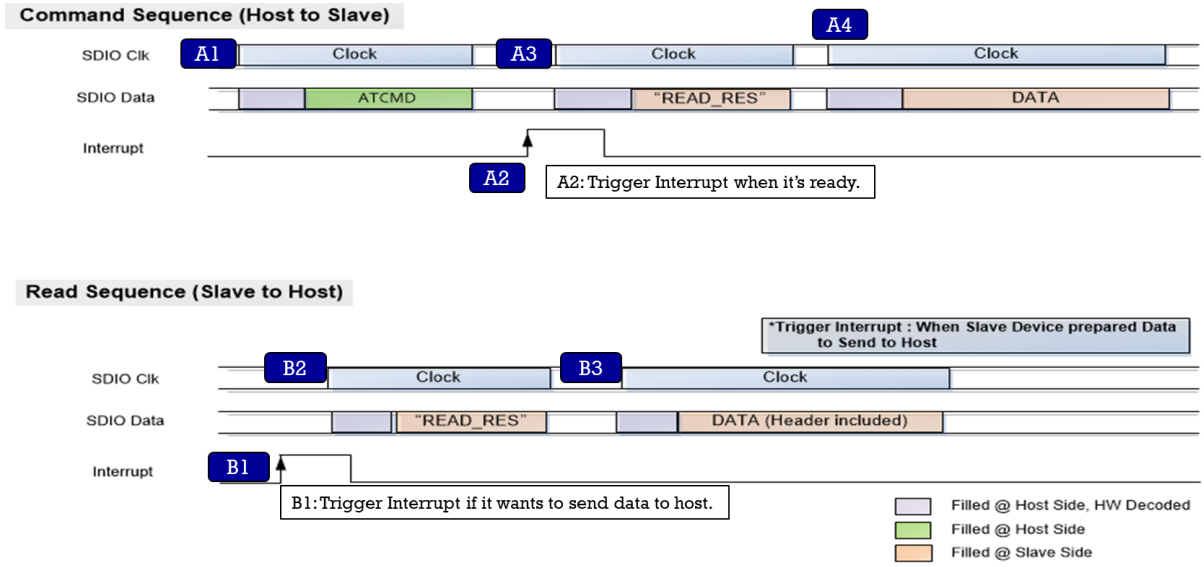


Figure 17. AT command sequence

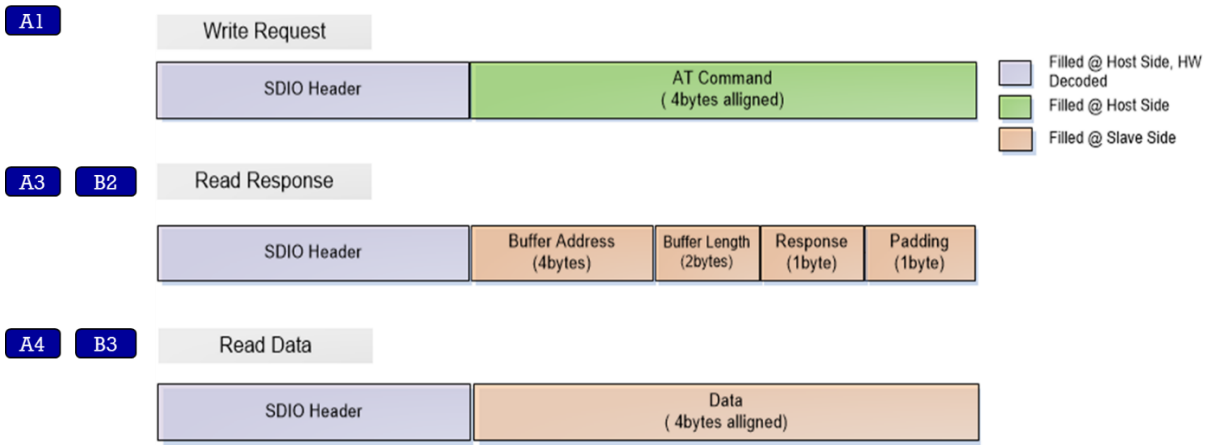


Figure 18. Structure

Descriptions of Figure 17 and Figure 18 are as follows.

A1: The Host sends an AT or ESC command to AT Command address.

A2: The Host waits for interrupt trigger.

A3: The Host reads the response message from address and parses it using:

struct _st_host_response.

A4: The Host reads OK, Error or data from address (BUF_ADDR), depending on the type of command.

B1: The Slave toggles high the interrupt line to inform Host when data is available.

B2: The Host reads the response message from Response command address and parses it using:

struct _st_host_response.

B3: The Host reads data from address (BUF_ADDR) parsed from the response message.

There is a 200 ms timeout between reading the response after the interrupt occurs and reading the data after reading the response. If the host requires more than 200 ms between each interval, change the timeout value accordingly.

An interval of several hundred microseconds is required between the "A3" and "A4" stages, "B2" and "B3" stages. If the interval between the two stages is too short, there is a possibility that two Interrupt Events are recognized as one. The interval differs depending on the type of application or CPU load. When the CPU clock is 120 MHz, an interval of around 300 µs is required.

3.3.4 ESC Command – Sequences and Structures

To use ESC commands, read the address of AT (ESC) command Buffer in the initial stage. Therefore, read the value of address 0x50080264 after SDIO is initialized, and write the command to that address when sending AT command afterwards.

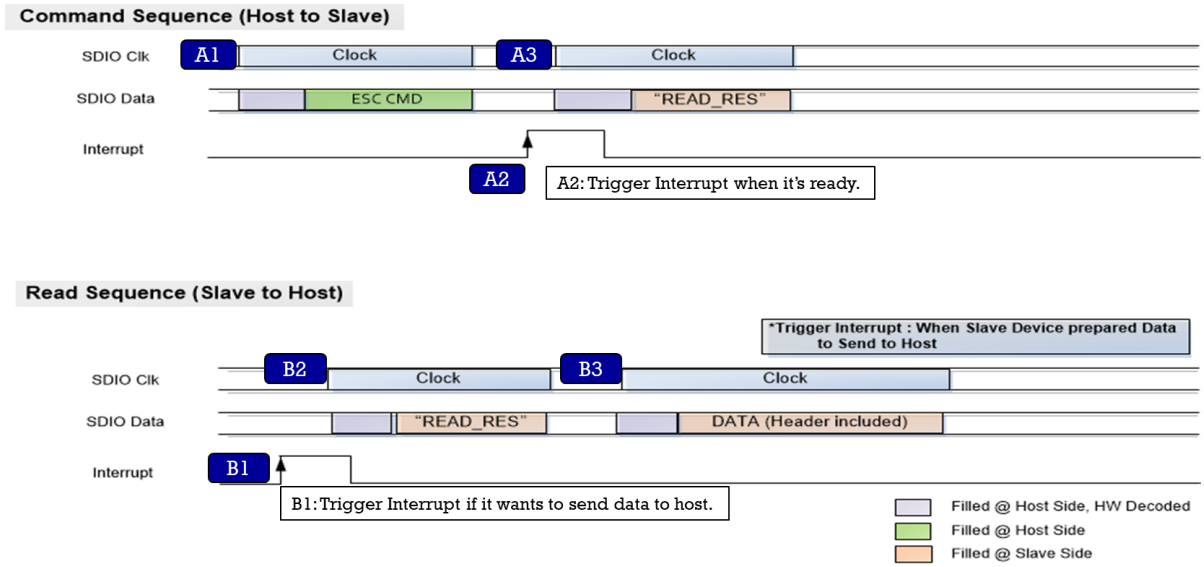


Figure 19. ESC command sequence

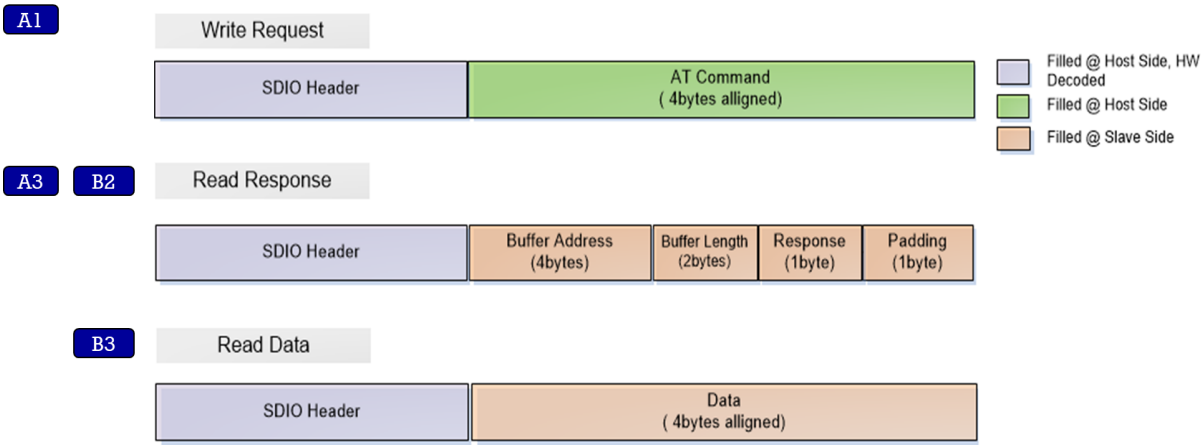


Figure 20. Structure

Descriptions of Figure 19 and Figure 20 are as follows.

A1: The Host sends an ESC command to AT (ESC) Command address.

A2: The Host waits for interrupt trigger.

A3: The Host reads the response message from address and parses it using:

struct _st_host_response.

The result for ESC command is sent to the host in the response field of struct _st_host_response. The response field is a 1-byte decimal value. The value of 0x20 is a result of OK. All other values are an ERROR. And in this case, the value of the buf_address field is read as 0xffffffff, and the value of the host_length field is read as 0x0. Therefore, the subsequent Read Sequence is not required.

B1: The Slave toggles high the interrupt line to inform Host when data is available.

B2: The Host reads the response message from Response Command address and parses it using:\

struct _st_host_response.

B3: The Host reads data from address (BUF_ADDR) parsed from the response message.

There is a 200 ms timeout between reading the response after the interrupt occurs and reading the data after reading the response. If the host requires more than 200 ms between each interval, change the timeout value accordingly.

An interval of several hundred microseconds is required between the "B2" and "B3" stages. If the interval between the two stages is too short, there is a possibility that two Interrupt Events are recognized as one. The interval differs depending on the type of application or CPU load. When the CPU clock is 120 MHz, an interval of around 300 µs is required.

3.3.5 SDIO Definition and Structures for Implementation

3.3.5.1 SDIO Definition

```
#define HOST_MEM_WRITE_REQ              (0x80)
#define HOST_MEM_WRITE_RES              (0x81)
#define HOST_MEM_READ_REQ               (0x82)
#define HOST_MEM_READ_RES               (0x83)
#define FC9K_GEN_CMD_ADDR               (0x50080254)  //Address to Write Command
#define FC9K_RESP_ADDR                  (0x50080258)  //Address to Read Response
```

3.3.5.2 SDIO Response Structure

```
typedef struct _st_host_response
{
    u32 buf_address;
    u16 host_length;
    u8  resp;
    u8  dummy;
} st_host_response;
```

3.3.5.3 SDIO Request Structure

```
typedef struct _st_host_request
{
    u16 host_write_length;
    u8  host_cmd;
    u8  dummy;
} st_host_request;
```

4. AT Commands

4.1 Overview

Configuration and control of the DA16200/DA16600 are provided through an ASCII based command string called "AT Command". AT command is a standard that was originally defined by Hayes Microcomputer for controlling smart modems and is widely used in many products.

AT is an abbreviation of "Attention", which means to take note of or fix one's sight upon something. An example of an AT command is "ATZ" which instructs a modem to become initialized and return to a state with no command input. An AT command has a very simple structure consisting of a prefix "AT" concatenated with a command string. This is a very convenient method for sending a series of commands over a serial interface such as UART. Commands may consist of capital letters, lowercase letters, spaces, and some special characters.

4.2 Add AT Command Feature in SDK

This section describes how to include AT command feature in SDK. In SDK, open the file ~/SDK/apps/da16x00/get_started/include/user_main/config_generic_sdk.h using the editor tool and search the string #undef __SUPPORT_ATCMD__.

To enable AT command feature in SDK, change `#undef` to `#define` and save the file. Rebuild the SDK package, and then, newly generated image works as AT command module.

```
//-----------------------
//AT Command Features
//-----------------------

    //
    //Enable/Disable AT command module
    //
    //When enabling this feature, more detailed sub-features are supported.
    //User can check all AT commands in ~/core/system/src/at_cmd/atcmd.c.
    //
    #undef  __SUPPORT_ATCMD__
```

For AT command module, the default interface type is UART1 as shown in the following example. If you want to use UART2, change `#undef __ATCMD_IF_UART2__` to `#define __ATCMD_IF_UART2__`.

```
  #if defined ( __SUPPORT_ATCMD__ )

    //
    //Default interface of DA16200 EVK is UART1.
    //User can change a type of host-interface among four types listed below.
    //
    #define __ATCMD_IF_UART1__                          //AT command over UART1
    #undef  __ATCMD_IF_UART2__                          //AT command over UART2
    #undef  __ATCMD_IF_SPI__                              //AT command over SPI
    #undef  __ATCMD_IF_SDIO__                           //AT command over SDIO
```

4.2.1 Execute AT Commands on SPI

AT command is configured to use the UART1 interface by default and can be configured to use the SPI interface. To enable the AT commands over SPI interface, modify config_generic_sdk.h:

```
...
      // AT command service
      #define   __SUPPORT_ATCMD__
...
      #if defined ( __SUPPORT_ATCMD__ )
                #undef  __ATCMD_IF_UART1__              // AT command over UART1
                #undef __ATCMD_IF_UART2__               // AT command over UART2
                ...
                #undef  __USER_UART_CONFIG__    // Support Customer's UART configuration
                #define __ATCMD_IF_SPI__          // AT command over SPI
```

```
            #undef  __ATCMD_IF_SDIO__              // AT command over SDIO
      #endif  /* __SUPPORT_ATCMD__ */
```

To configure and use the AT commands over SPI interface, see Section 3.2.

4.2.2 Execute AT Commands on SDIO

The AT command can also be configured to use the SDIO interface. To enable the AT commands over SDIO interface, modify config_generic_sdk.h:

```
...
      // AT command service
      #define   __SUPPORT_ATCMD__
...
      #if defined ( __SUPPORT_ATCMD__ )
            #undef  __ATCMD_IF_UART1__              // AT command over UART1
            #undef  __ATCMD_IF_UART2__              // AT command over UART2
            ...
            #undef  __USER_UART_CONFIG__    // Support Customer's UART configuration
            #undef  __ATCMD_IF_SPI__                // AT command over SPI
            #define__ATCMD_IF_SDIO__               // AT command over SDIO
       #endif  /* __SUPPORT_ATCMD__ */
```

To configure the AT commands over SDIO interface, see Section 3.3.

4.2.2.1 Example Sequence for SDIO Interface

An example of the sequence used to initiate a command through the SDIO interface is shown in Figure 21.

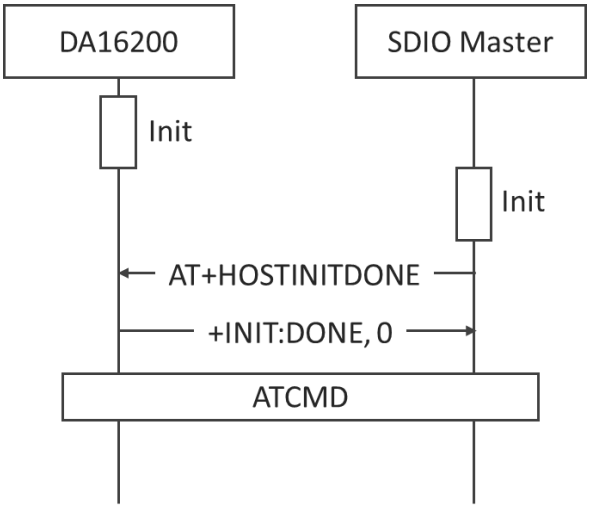


Figure 21. Example sequence to initiate AT command through SDIO interface

When using the SDIO interface, both the DA16200 and the SDIO master devices must be initialized before initiating an AT command. The SDIO master device must send **AT+HOSTINITDONE** immediately after initialization is completed.

NOTE
For details on how to use the SDK package, see Ref. [2].

4.3 AT Command Format

4.3.1 Basic Command

4.3.1.1 Set Command

The set command sets parameters or execute commands.

- Command format: ATXX
  - Example command: `ATZ`
  - Example response: `OK`

4.3.1.2 Get Command

The get command queries parameters or get status of the commands.

- Command format: ATXX=?
  - Example command: `ATQ=?`
  - Example response: `OK`

4.3.2 Extended Command

4.3.2.1 Set Command

The set command sets parameters or execute commands with additional parameters.

- Command format: AT+XXX=<param1>,<param2>,<param3>,<param4>…<paramN>
  - `Example command: AT+NWIP=0,172.16.0.100,255.255.255.0,172.16.0.1`
  - `Example response: OK`

If the SSID contains a comma or single quote, the SSID must be enclosed in single quotes.

For example:

```
SSID = MY,SSID'CS
sec = 4
idx = 2
Password = N12345678
```

Is encoded as:

```
AT+WFJAP='MY,SSID'CS',4,2,N12345678'
OK
```

NOTE
It is prohibited to use a single quote followed by a comma in a parameter. For example, AT+WFJAP='MY,SSID',CS',4,2,N12345678 is invalid.

4.3.2.2 Get Command

The get command queries parameters or get status of the commands with additional parameters.

- Command format: AT+XXX=?
  - Example command: `AT+NWIP=?`
  - Example response: `+ANIP:172.16.0.17,255.255.255.0,172.16.0.1`
    `OK`

NOTE
Not all commands support the AT+XXX=? query functions such as AT+RESTART and ATF. Check the command table for the valid operation of each command.

4.3.3 Response

4.3.3.1 Start-up Response

This code is received when the DA16200/DA16600 is rebooted.

```
<CR><LF>+INIT:DONE,<mode><CR><LF>
```

The AT command responses when the DA16200/DA16600 wakes up from DPM LPM.

4.3.3.2 Basic Response

Basic response gives the command result and is accompanied by a carriage return and a line feed.

```
<CR><LF>+INIT:WAKEUP,<type><CR><LF>
```

4.3.3.3 Normal Response

This code is received for normal operations.

```
<CR><LF>OK<CR><LF>
```

4.3.3.4 Error Response

This code is received when an operation fails for some reason.

```
<CR><LF>ERROR:<error code><CR><LF>
```

4.3.3.5 Extended Response

Extended response gives the command setting values and is followed by a basic response.

```
<CR><LF>+XXX:[value1],[value2],…
<CR><LF>OK<CR><LF>
```

NOTE
When an MCU (AT Command Host) waits for a response of a command (for those commands that give extended response as well) to take the next action, it should wait for both normal response (**OK** or **ERROR**) and extended response (also known as **Operation Result**).

Error response codes: See Appendix I.

NOTE
There are major changes in Error response code in SDK v3.2.5.0 and later versions. The examples in this document were updated based on the changes.

5. AT Command Sets

5.1 Basic Function Commands

Table 7. Basic function command list

Parameter	Description	Conditions
?	(none)	Show the usage of AT commands.
	Example ? AT Commands: ? - Commands list with brief and usage HELP=<command> - Print help message AT - Attention command AT+ - List available commands ATZ - Initialize AT commands ATF - Delete NVRAM data and certificates, and perform software reboot ATE - Command echo ATQ - Result Codes On/Off AT+RESTART - System restart --- Middle omission --- AT+TRSAVE - Save status of all sessions === User AT command ====== OK Note: Enabled by default in the SDK.	
HELP	<cmd_name>	AT command name to query the use of commands.
	(none)	Same as the "?" command.
	Example HELP AT Commands: ? - Commands list with brief and usage HELP=<command> - Print help message AT	

Parameter	Description	Conditions
	- Attention command AT+ - List available commands ATZ - Initialize AT commands ATF - Delete NVRAM data and certificates, and perform software reboot ATE - Command echo ATQ - Result Codes On/Off AT+RESTART - System restart … --- Middle omission --- OK HELP=ATE ATE - Command echo OK Note: Enabled by default in the SDK.	
AT+	(none)	Show a list of AT commands.
	Example AT+ AT AT+ ATZ ATF ATE ATQ AT+RESTART --- Middle omission --- AT+TRSAVE OK Note: Enabled by default in the SDK.	
ATZ	(none)	Initialize AT commands.
	Example ATZ Display result on Echo off OK Note: Enabled by default in the SDK.	

<table>
<tr><th>Parameter</th><th>Description</th><th>Conditions</th></tr>
<tr><td rowspan="2">ATF</td><td>(none)</td><td>The DA16200/DA16600 deletes NVRAM data and certificates and performs software reboot.
Response: "+INIT:DONE,0"</td></tr>
<tr><td colspan="2">Example
ATF

+INIT:DONE,0
Note:
▪ Enabled by default in the SDK.
▪ All NVRAM parameters that include Wi-Fi profile (Soft AP or STA) settings are deleted, DUT is restarted, and "+INIT:DONE,0" is received.</td></tr>
<tr><td rowspan="3">ATE</td><td>(none)</td><td>ECHO on/off.</td></tr>
<tr><td>?</td><td>Show Echo status – on/off.</td></tr>
<tr><td colspan="2">Example
ATE

Echo on
OK

ATE

Echo off
OK

ATE=?

Echo on
OK
Note: Enabled by default in the SDK.</td></tr>
<tr><td rowspan="3">ATQ</td><td>(none)</td><td>Turn on or off to display the result code.</td></tr>
<tr><td>?</td><td>Show the status whether to display result codes.</td></tr>
<tr><td colspan="2">Example
ATQ
Display results off

ATQ=?
Display result on
OK
Note: Enabled by default in the SDK.</td></tr>
<tr><td rowspan="3">ATB</td><td><baudrate>
[[,<databits>]
[,<parity>]
[,<stopbits>]</td><td>Set UART parameters (the main purpose is to change baud rate).
▪ <baudrate>: 9600/19200/38400/57600/115200/230400/460800/921600
▪ <databits>: [optional], 5/6/7/8 (Default)
▪ <parity>: [optional], n (None, Default)/e (Even)/o (Odd)
▪ <stopbits>: [optional], 1 (Default)/2</td></tr>
<tr><td>?</td><td>Show the current baud rate.</td></tr>
<tr><td colspan="2">Example</td></tr>
</table>

Parameter	Description	Conditions
	ATB=230400 OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ If __USER_UART_CONFIG__ is enabled in SDK (See Appendix C), this command should be disabled.	
AT+RESTART	(none)	System restart.
	Example AT+RESTART OK +INIT:DONE,0 Note: Enabled by default in the SDK.	
AT+RESET	(none)	System reset. Go to the Boot mode ([MROM] prompt).
	Example AT+RESET OK Note: ▪ Enabled by default in the SDK. ▪ When the system goes into MROM mode, AT command is not available. Therefore, the MCU needs to force POR booting or enter "boot" command through UART0 console.	
AT+CHIPNAME	(none)	Get a chip name, DA16200 or DA16600.
	Example AT+CHIPNAME +CHIPNAME:DA16200 OK Note: Enabled by default in the SDK.	
AT+VER	(none)	Get version information. Response: +VER:<main version>
	Example AT+VER +VER:FRTOS-GEN01-01-xxxxxxxxxx-xxxxxx OK Note: Enabled by default in the SDK.	
AT+SDKVER	(none)	Get the SDK version information. ▪ Response: +SDKVER:<major >.<minor >.<revision>.<eng_number> • <major>: SDK major number • <minor>: SDK minor number • <revision>: SDK Revision number • <eng_number>: SDK engineering number
	Example AT+SDKVER +SDKVER:3.2.8.0 OK	

Parameter	Description	Conditions
	Note: Enabled by default in the SDK.	
AT+TIME	<date>,<time>	Set the current time. <date>: yyyy-mm-dd <time>: hh:mm:ss Response: OK or ERROR
	?	Get the current time. Response: +TIME:<yyyy-mm-dd> <hh:mm:ss>
	Example AT+TIME=2021-07-15,16:14:30 OK AT+TIME=? +TIME:2021-07-15,16:14:32 OK Note: Enabled by default in the SDK.	
AT+RLT	(none)	Get system running time. Response: +RLT:<days>,<hh:mm.ss>
	Example AT+RLT +RLT:0,01:06.18 OK Note: Enabled by default in the SDK.	
AT+TZONE	<sec>	GMT time zone setting (-43200 ~ 43200). <sec>: Time zone setting parameter Response: OK or ERROR
	?	Get GMT time zone parameter. Response: +TZONE:<sec>
	Example AT+TZONE=? +TZONE:0 OK AT+TZONE=32400 OK AT+TZONE=? +TZONE:32400 OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ The <sec> parameter must be a multiple of 60 seconds. If the value for <sec> is not a multiple of 60 seconds, then the remainder is discarded.	
AT+DEFAP	(none)	All profiles in NVRAM are removed and set up in Soft AP mode with the default configuration. To initialize the Soft AP interface, the system reboots automatically. Response: OK or ERROR (reboot)

<table>
<tr><th>Parameter</th><th>Description</th><th>Conditions</th></tr>
<tr><td></td><td colspan="2">Example
AT+DEFAP
OK

+INIT:DONE,1
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.
▪ Default configuration:
• SSID: DA16200/DA16600_ XXXXXX (for example, 9FFCF3: the last three hexadecimal values of the board's MAC address)
• Authentication: WPA2/CCMP
• IP address: 10.0.0.1
• Netmask: 255.255.255.0
• Gateway: 10.0.0.1
• PSK: 12345678
• DHCP server started
○ DHCP range: 10.0.0.2 ~ 10.0.0.11
○ DHCP DNS: 8.8.8.8
• To query the configuration status, AT+WFSAP and/or AT+NWDHR can be used.</td></tr>
<tr><td rowspan="2">AT+DEFCCRNT</td><td>(none)</td><td>All profiles in NVRAM are removed and set up Concurrent mode:
Soft AP + STA with the default configuration. To initialize the Concurrent interfaces, the system reboots automatically.
Response: OK or ERROR (reboot)</td></tr>
<tr><td colspan="2">Example
AT+ DEFCCRNT
AT+WFJAP=AP_24G,4,2,12345678
Note:
▪ Enabled by default in the SDK.
▪ AT+ DEFCCRNT sets AT+DEFAP, AT+WFMODE=2, and AT+RESTART.
▪ To complete the process and connect the STA, "AT+WFJAP" should be used.</td></tr>
<tr><td rowspan="3">AT+BIDX</td><td><idx></td><td>Set Boot index.
<idx>: Boot index (0 or 1)
Response: OK or ERROR</td></tr>
<tr><td>?</td><td>Get the current Boot index.
Response: +BIDX:<0|1></td></tr>
<tr><td colspan="2">Example
AT+BIDX=?
+BIDX:0
OK

AT+BIDX=1
OK

AT+BIDX=?
+BIDX:1
OK</td></tr>
</table>

<table>
<tr><th>Parameter</th><th>Description</th><th>Conditions</th></tr>
<tr><td></td><td colspan="2">Note:
▪ Enabled by default in the SDK.
▪ System restart is required for changes to take effect. "AT+RESTART" command can be used to restart the system.</td></tr>
<tr><td rowspan="3">AT+DPM</td><td><dpm>
[,<nvm_only>]</td><td>Set DPM on/off. System restart is required for DPM mode (On/Off) to take effect.
<dpm>: 0 (Off), 1 (On)
<nvm_only>:
1 (write DPM mode to NVRAM only, and not reboot)
0 or not specified (change DPM mode and reboot)
Response: OK or ERROR</td></tr>
<tr><td>?</td><td>Get the current DPM setting.
Response: +DPM:<0|1></td></tr>
<tr><td colspan="2">Prerequisite
Station mode
Example
AT+DPM=?
+DPM:0
OK

AT+DPM=1 //DPM enabled, and system reboots automatically
OK

+INIT:DONE,0

AT+DPM=1,1 //DPM enabled without system reboots
OK

AT+DPM=?
+DPM:1
OK
Note:
▪ Enabled by default in the SDK.
▪ DPM configuration is stored in NVRAM.
▪ The DA16200/DA16600 is restarted if the "<nvram_only>" parameter is zero or not specified and AT command response is OK.
• +INIT:DONE,0 message is sent when the DA16200/DA16600 boots up.
• If the usage of the AT command is not valid, then the DA16200/DA16600 sends an ERROR message without restarting.
▪ If the "nvram_only" parameter is "1", then restart the system manually using "AT+RESTART".
▪ When the DA16200/DA16600 reboots, the DA16200/DA16600 tries to connect to the AP if the Wi-Fi connection information is available in the NVRAM.
• +WFJAP:0,<reason> or +WFJAP:1,'<SSID>',<IP Address> as result of Wi-Fi connection.
• If Wi-Fi connection fails during boot-up because of unexpected conditions (for example, AP is offline, temporary communication issue with AP, and wrong password is stored), +WFJAP:x may not be sent immediately and takes some time, in which case, wait until +WFJAP:x is received. When a timeout occurs, depending on the application use case, either cancel the connection trial (AT+WFQAP) or retry the connection with the right info (AT+WFJAP/AT+WFJAPA).</td></tr>
</table>

<table>
<tr><th>Parameter</th><th>Description</th><th>Conditions</th></tr>
<tr><td></td><td colspan="2">▪ If MQTT is configured, the DA16200/DA16600 tries to connect to the MQTT broker after a Wi-Fi connection is established. The Operation Result – +NWMQCL:0, +NWMQCL:1 or +NWMQCL:2 – is sent as a result.
▪ The DA16200/DA16600 operates DPM if it is set to 1 (TRUE).
• If Wi-Fi connection is NOT established in DPM mode, the DA16200/DA16600 enters the DPM connection retry state.
• DPM connection retry process:
While the DA16200/DA16600 operates in DPM mode, the DA16200/DA16600 executes the process for making connection reestablished if the DA16200/DA16600 is in a "disconnected" state with the specified AP for some reason. See Ref. [6] for more details.
If the Wi-Fi connection is established but MQTT connection is NOT established (if MQTT is enabled), the DA16200/DA16600 tries to connect to the MQTT broker several times and enters DPM LPM based on MQTT's abnormal DPM operation.</td></tr>
<tr><td rowspan="3">AT+DPMKA</td><td><period></td><td>Set DPM keepalive period.
<period>: Keepalive period (millisecond, 0 ~ 600000)
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get DPM keepalive period.
Response: +DPMKA=<millisecond></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Example
AT+DPMKA
+DPMKA:30000
OK

AT+DPMKA=5000
OK

AT+DPMKA=?
+DPMKA:5000
OK
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.
▪ System restart is required for changes to take effect.</td></tr>
<tr><td rowspan="4">AT+DPMTIMWU</td><td><count></td><td>Set DPM TIM wake-up count.
<count>: TIM wake-up count (1 ~ 6000)
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get DPM TIM wake-up count.
Response: +DPMTIMWU=<count></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Example
AT+DPMTIMWU
+DPMTIMWU:10
OK

AT+DPMTIMWU=20
OK

AT+DPMTIMWU=?
+DPMTIMWU:20</td></tr>
</table>

Parameter	Description	Conditions
	OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ System restart is required for changes to take effect.	
AT+DPMUSERWU	<time>	Set DPM user wake-up time. <time>: User wake-up period (millisecond, 0 ~ 86400000) Response: OK or ERROR
	?	Get DPM user wake-up time. Response: +DPMUSERWU=<millisecond>
	(none)	
	Example AT+DPMUSERWU +DPMUSERWU:0 OK AT+DPMUSERWU=300 OK AT+DPMUSERWU=? +DPMUSERWU:300 OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ System restart is required for changes to take effect.	
AT+CLRDPMSLPEXT	(none)	Set the user application not to enter DPM LPM. Response: OK or ERROR
	Prerequisite DPM enabled Example AT+CLRDPMSLPEXT OK Note: ▪ Enabled by default in the SDK. ▪ A host should execute this command within 200 ms after waking up the DA16200/DA16600 through the external wake-up pin, otherwise, the DA16200/DA16600 goes into DPM LPM.	
AT+SETDPMSLPEXT	(none)	Set the user application ready to enter DPM LPM. Response: OK or ERROR
	Prerequisite DPM enabled Example AT+SETDPMSLPEXT OK Note: ▪ Enabled by default in the SDK. ▪ If the DA16200/DA16600 is woken up by an external wake-up signal and the "AT+CLRDPMSLPEXT" command is executed, this command should be issued when every job is	

Parameter	Description	Conditions
	done. If this command is not run after the job is done, the DA16200/DA16600 does not enter DPM LPM. ▪ When joining AP is in progress, this command should be issued after getting "+WFJAP" response.	
AT+GETFASTCONN	(none)	Get the Wi-Fi Fast-reconnection mode status value. Response: +GETFASTCONN:<0|1>
	Example AT+GETFASTCONN +GETFASTCONN:0 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ See Appendix G for "Wi-Fi Fast-reconnect" for the DA16200/DA16600.	
AT+SETFASTCONN	<flag>	Enable/Disable the Wi-Fi Fast-reconnection mode. <mode>: 0 (Disable), 1 (Enable) Response: OK or ERROR
	Example AT+SETFASTCONN=1 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ The configuration is removed/stored from/in NVRAM. ▪ See Appendix G for "Wi-Fi Fast-reconnect" for the DA16200/DA16600.	
AT+MCUWUDONE	(none)	Notify that the MCU wakes up completely. When this command is received, the DA16200/DA16600 starts to send messages to the MCU (that is, MCU should send this command immediately after executing "External wake-up"). Response: OK or ERROR
	Example AT+MCUWUDONE OK Note: ▪ Enabled by default in the SDK. ▪ When the DA16200/DA16600 receives the command, it starts to send messages to the MCU. ▪ MCU should send this command immediately when it receives a notification like "+INIT:WAKEUP,UC". ▪ If the "__DPM_TEST_WITHOUT_MCU__" is defined, then MCU does not need to send this command which means it is assumed that MCU is always ready to read a message(response) from the DA16200/DA16600.	
AT+HOSTINITDONE	(none)	Notify the DA16200 that the MCU has completed initialization (For SDIO interface, the MCU must send this command immediately after initialization.). The DA16200 returns its initialization status as a response. See Table 8. Response: +INIT:DONE,<mode> or +INIT:WAKEUP,<type>)
	Example AT+HOSTINITDONE +INIT:DONE,0 Note: Enabled by default in the SDK.	

Parameter	Description	Conditions
AT+DPMABN	<connection_retry_state>	Enable or disable entering Sleep mode 3 followed by DPM connection retry process. <connection_retry_state>: 0 (Off), 1 (On) 1: Use the DPM connection retry state. See Ref. [6] for details. 0: Keep trying to scan the AP and make connection established without entering Sleep mode 3. Response: OK or ERROR
	?	Get the current DPM connection retry state.
	Prerequisite Station mode Example AT+DPMABN=? +DPMABN:0 OK AT+DPMABN=1 OK Note: ▪ Enabled by default in the SDK v3.2.8.0 or later. ▪ The configuration is removed/stored from/in NVRAM.	
AT+DPMABNWFCCNT	<count>	Set Wi-Fi Connection Retry counts until the system enters DPM Abnormal Sleep. <count>: 0 (This feature not used. DPM Abnormal sleep scheme is followed), 1 to 6 (Wi-Fi Connection Retry count) Response: OK or ERROR
	?	Get the current DPM Abnormal Wi-Fi Connection Retry counts set. Response: +DPMABNWFCCNT:<count>
	Example //If Wi-Fi connection trials are not successful two times in a row, the system goes to DPM Abnormal sleep. AT+DPMABNWFCCNT=2 OK AT+DPMABNWFCCNT=? +DPMABNWFCCNT:2 OK Note: ▪ Disabled by default in the SDK. ▪ If __WF_CONN_RETRY_CNT_ABN_DPM__ is enabled in the SDK (config_generic_sdk.h), this command should be enabled. ▪ The configuration is stored in NVRAM. ▪ If the cause of the Wi-Fi connection failure is "Wrong password" input, and if the application wants to cancel the auto-reconnect trial right away, __WIFI_CONN_RETRY_STOP_AT_WK_CONN_FAIL__ should be defined in sys_common_features.h.	

Table 8. Initiation response list

Parameter	Description	Conditions
+INIT	DONE,<mode>	The DA16200/DA16600 booting is complete: <mode>: 0 (STA), 1 (Soft AP) For example: +INIT:DONE,0
	WAKEUP,<type>	The DA16200/DA16600 wake-up is complete from DPM LPM. <type> wake-up type ▪ UC: Unicast packet received ▪ NOBCN: No beacon from the connected AP ▪ DEAUTH: Disconnected from the connected AP ▪ EXT: External wake-up ▪ RTC: By a timer registered For example: +INIT:WAKEUP,UC

5.2 Network Function Commands

Table 9. Network function command list

Parameter	Description	Conditions
AT+NWIP	<iface>,<ip_addr>, <netmask>,<gw>	Set the IP address. <iface>: WLAN interface. 0 (WLAN0, STA), 1 (WLAN1, Soft AP) <ip_addr>: IP Address <netmask>: Subnet mask <gw>: Gateway Response: OK or ERROR
	?	Get the IP address of the current WLAN interface. Response: +NWIP: <iface>,<ip_addr>,<netmask>,<gw>
	(none)	
	Example AT+NWIP=0,192.168.0.100,255.255.255.0,192.168.0.1 OK AT+NWIP +NWIP:0,192.168.0.100,255.255.255.0,192.168.0.1 OK At+NWIP=? +NWIP:0,192.168.0.100,255.255.255.0,192.168.0.1 OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ In Soft AP mode, after changing the IP address, DHCP server pool range should also be updated based on the class of the changed IP address. Use AT+NWDHR to re-define DHCP server pool range after running AT+NWIP. ▪ In Soft AP mode, if the IP configuration is changed while the DHCP server is running, then the DHCP server must be restarted using the AT+RESTART or AT+NWDHS=0 > AT+NWDHS=1 command.	
AT+NWDNS	<dns_ip>	Set the DNS server IP address of STA interface. <dns_ip>: DNS server IP address Response: OK or ERROR

<table>
<tr><th>Parameter</th><th>Description</th><th>Conditions</th></tr>
<tr><td rowspan="3"></td><td>?</td><td rowspan="2">Get the DNS server IP address of STA interface.
Response: +NWDNS:<dns_ip></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Example
AT+NWDNS=8.8.8.8
OK

AT+NWDNS
+NWDNS:8.8.8.8
OK
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.
▪ If AT+NWDNS=? is run under DHCP mode, it returns the DNS IP address from DHCP provision data regardless of any DNS IP address set with AT+NWDNS=<dns_ip>. ERROR:-7 ("No result" or "Not configured") can be returned if there is no DHCP provision data existing.
▪ If AT+NWDNS=? is run under Static IP mode, it returns the DNS IP address from AT+NWDNS=<dns_ip> that run previously or default one.
▪ If AT+NWDNS=<dns_ip> is run under DHCP mode and the changes to take effect in Static IP mode, it requires a system restart.</td></tr>
<tr><td rowspan="4">AT+NWDNS2</td><td><dns_ip></td><td>Set the 2nd DNS server IP address of STA interface.
<dns_ip>: DNS server IP address
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get the 2nd DNS server IP address of STA interface.
Response: +NWDNS2:<dns_ip></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Example
AT+NWDNS2=8.8.8.8
OK

AT+NWDNS2
+NWDNS2:8.8.8.8
OK
Note: Enabled by default in the SDK.</td></tr>
<tr><td>AT+NWHOST</td><td><name></td><td>Get the host IP address by name.
<name>: Domain name
Response: +NWHOST:<ip></td></tr>
<tr><td colspan="2">Example
at+nwhost=www. Renesas Electronics-semiconductor.com
+NWHOST:54.192.175.64
OK
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.</td></tr>
<tr><td>AT+NWPING</td><td><iface>,<dst_ip>,
<count></td><td>Ping test.
<iface>: WLAN interface. 0 (WLAN0), 1 (WLAN1)
<dst_ip>: Target IP address
<count>: The number of ICMP message transmissions
Response: +NWPING:<sent_count>,<recv_count>,</td></tr>
</table>

Parameter	Description	Conditions
		<avg_time>,<min_time>,<max_time>
	Example AT+NWPING=0,192.168.0.1,4 +NWPING:4,4,0,0,0 OK Note: Enabled by default in the SDK.	
AT+NWDHC	<dhcpc>	Start/Stop the DHCP client. <dhcpc>: 0 (stop), 1 (start) Response: OK or ERROR
	?	Get the DHCP client status. Response: +NWDHC:<dhcpc>
	(none)	
	Prerequisite The DA16200/DA16600 should be connected to AP. Example AT+NWDHC=1 OK AT+NWDHC +NWDHC:1 OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM.	
AT+NWDHCLT	(none)	Show the information of the DHCP lease time, renew time, and elapse time. Response: OK or ERROR When the response is OK, the following response comes first before OK. + NWDHCLT: <lease time>, <renew time>, <elapse Time> <lease time>: The total duration (in seconds) for which an IP address is assigned to a client by the DHCP server. <renew time>: The time at which the client begins the process of renewing its lease. <elapse Time>: How long the client was using the current lease.
	Prerequisite DHCP client connected to the DHCP server. Example AT+NWDHCLT +NWDHCLT:86400,43200,13 OK	
AT+NWDHCHN	<hostname>	Store the DHCP client host-name. <hostname> DHCP client host-name Response: OK or ERROR
	?	Get the DHCP client host-name which is stored by user. Response: +NWDHCHN=<hostname>
	(none)	
	Example at+nwdhchn=TEST_DHCP*HOSTNAME	

Parameter	Description	Conditions
	ERROR:-615 at+nwdhchn=TEST-DHCP-HOSTNAME OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ The hostname can contain only uppercase letters (A-Z), lowercase letters (a-z), numbers (0-9), and minus sign (-).	
AT+NWDHCHNDEL	(none)	Delete DHCP client host-name which was stored by user.
	Example at+nwdhchndel OK Note: Enabled by default in the SDK.	
AT+NWDHR	<start_ip>,<end_ip>	Set an IP address range of the DHCP server. <start_ip>: Starting IP address assigned by the DHCP server <end_ip>: Ending IP address assigned by the DHCP server Response: OK or ERROR
	?	Get an IP address range of the DHCP server. Response: +NWDHR:<start_ip>,<end_ip>
	(none)	
	Prerequisite Soft AP mode Example AT+NWDHR=10.0.0.2,10.0.0.11 OK AT+NWDHR +NWDHR:10.0.0.2,10.0.0.11 OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ DHCP server restart (AT+RESTART or AT+NWDHS=0 > AT+NWDHS=0) is required for changes to take effect.	
AT+NWDHLT	<lease_time>	Set an IP lease time (in seconds) of the DHCP server. <lease_time>: IP lease time (from 60 to 86400 seconds) Response: OK or ERROR
	?	Get an IP lease time of the DHCP server. Response: +NWDHLT:<lease_time>
	(none)	
	Prerequisite Soft AP mode Example AT+NWDHLT=1800 OK AT+NWDHLT +NWDHLT:1800 OK	

<table>
<tr><th>Parameter</th><th>Description</th><th>Conditions</th></tr>
<tr><td></td><td colspan="2">Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.
▪ DHCP server restart (AT+RESTART or AT+NWDHS=0 > AT+NWDHS=0) is required for changes to take effect.</td></tr>
<tr><td rowspan="4">AT+NWDHS</td><td><dhcpd></td><td>Start/Stop DHCP server.
<dhcpd>: 0 (stop), 1 (start)
Response: OK or ERROR</td></tr>
<tr><td><dhcpd>,
<start_ip>,<end_ip>,
<lease_time></td><td>Start the DHCP server with options.
<dhcpd>: 1 (start)
<start_ip>: Starting IP address for the DHCP client
<end_ip>: Ending IP address for the DHCP client
<lease_time>: IP lease time (optional, in second, default is 1800)
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get the DHCP client status.
Response: +NWDHS:<dhcpd></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Prerequisite
Soft AP mode
Example
AT+NWDHS=1
OK

AT+NWDHS=1,10.0.0.2,10.0.0.10,1800
OK

AT+NWDHS
+NWDHS:1,10.0.0.2,10.0.0.10,1800
OK
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.</td></tr>
<tr><td rowspan="2">AT+NWDHIP</td><td>(none)</td><td>Show the information of the DHCP Client(s) connected.
Response: OK or ERROR
When the response is OK, the following response comes first before OK.
+NWDHIP:<mac_addr_1>,<ip_addr_1>;<mac_addr_2>,<ip_addr_2>…</td></tr>
<tr><td colspan="2">Example
//When DHCP client is in a connected state.
AT+NWDHIP
+NWDHIP:80:35:c1:79:c1:da,10.0.0.2
OK

//Two DHCP clients are in a connected state.
AT+NWDHIP
+NWDHIP:80:35:c1:79:c1:da,10.0.0.2;b4:f1:da:b4:27:11,10.0.0.3
OK

//No DHCP client exists.</td></tr>
</table>

Parameter	Description	Conditions
	AT+NWDHIP ERROR:-622 //Clients are not connected Note: ▪ Enabled by default in the SDK. ▪ Use this command when DHCP server is running.	
AT+NWSNS AT+NWSNS1 AT+NWSNS2	<server_ip>	Set the SNTP server IP address/domain name. <server_ip>: SNTP server IP address/domain name Response: OK or ERROR
	?	Get the SNTP server IP address. Response: +NWSNS:<sntp>
	(none)	
	Example AT+NWSNS=8.8.8.8 OK AT+NWSNS +NWSNS:8.8.8.8 OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ Up to three SNTP servers can be specified by users; an SNTP server is contacted in round robin manner if the DA16200/DA16600 fails to synchronize the system time with a server. ▪ If not specified, default SNTP server is used.	
AT+NWSNUP	<period>	Set the SNTP client update period (in seconds). <period>: SNTP client update period (from 60 to 129600 seconds) Response: OK or ERROR
	?	Get the SNTP client update period. Response: +NWSNUP:<period>
	(none)	
	Example AT+NWSNUP=86400 OK AT+NWSNUP +NWSNUP:86400 OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM.	
AT+NWSNTP AT+NWSNTP1 AT+NWSNTP2	<sntp>	Start/Stop the SNTP Client. <sntp>: 0 (stop), 1 (start) Response: OK or ERROR
	<sntp>, <server_ip>, <period>	Start the SNTP client with options. <sntp>: 1 (start) <server_ip>: SNTP server IP address (or domain) <period>: SNTP client update period (optional, second, default is 86400) Response: OK or ERROR

<table>
<tr><th>Parameter</th><th>Description</th><th>Conditions</th></tr>
<tr><td rowspan="3"></td><td>?</td><td rowspan="2">Get the SNTP status.
Response: +NWSNTP:<sntp></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Example
AT+NWSNTP=0
OK

AT+NWSNTP=1,pool.ntp.org,86400
OK

AT+NWSNTP
+NWSNTP:1,pool.ntp.org,86400
OK
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in the NVRAM.
▪ If <sntp> is 1, SNTP client is started immediately and tries to do time sync with the server specified. <sntp>=1 also enables "auto start" of the SNTP client if the DA16200/DA16600 reboots. <sntp>=0 removes "auto start" flag from NVRAM, so the DA16200/DA16600 does not try to sync time when rebooted.</td></tr>
<tr><td rowspan="2">AT+NWCCRT</td><td>(none)</td><td>Check if certificates exist.
There are three sets of certificates:
▪ Set #1: for MQTT
Root CA (bit 2)/Cert (bit 1)/Key (bit 0)/DH param (bit 9)
▪ Set #2: for HTTPS client for OTA
Root CA (bit 5)/Cert (bit 4)/Key (bit 3)/DH param (bit 10)
▪ Set #3: for WPA Enterprise
Root CA (bit 8)/Cert (bit 7)/Key (bit 6)/DH param (bit 11)
For example: if the DA16200/DA16600 has the Root CA and Cert in Set #1, the return value is 6.
Response: +VER:<cert></td></tr>
<tr><td colspan="2">Example
AT+NWCCRT
+NWCCRT:6 //MQTT
OK

AT+NWCCRT
+NWCCRT:56 //HTTPS
OK
Note: Enabled by default in the SDK.</td></tr>
<tr><td rowspan="2">AT+NWDCRT</td><td>(none)</td><td>Delete all TLS certificates including private key.
Response: OK or ERROR</td></tr>
<tr><td colspan="2">Example
AT+NWDCRT
OK
Note: Enabled by default in the SDK.</td></tr>
</table>

Table 10. Certificate commands

Escape sequence	Parameters	Description
<ESC>C	<cert_id>,<content><ETX>	Store certificate or private key. <ESC>C: To enter certificate input mode, type in <ESC>(0x1B) and C keys together. <cert_id>: Certificate ID There are three sets of certificates: ▪ Set #1: for MQTT 0 (Root CA)/1 (Client Certificate)/2 (Private Key) ▪ Set #2: for HTTPS client for OTA 3 (Root CA)/4 (Client Certificate)/5 (Private Key) ▪ Set #3: for WPA Enterprise 6 (Root CA)/7 (Client Certificate)/8 (Private Key) <content>: Certificate data. Copy and paste cert ascii text. Max length is 2048. <ETX>: Indication of the end of content (Ctrl+C, 0x03) Response: OK or ERROR For example: <ESC>C1,----- BEGIN CERTIFICATE -----MIIodknvfano923nf/ ...<ETX>
	Example <ESC>C0,Root CA<ETX> OK <ESC>C1,Client CA<ETX> OK <ESC>C2,Provate Key<ETX> OK Note: Enabled by default in the SDK.	
<ESC>Cert	<module>, <certificate type>, <mode>[, <format>, <length>, <content>]	Store or delete certificate/CA/private key/DH params. <ESC>CERT: To enter certificate input mode: <module>: Module ID. 0 - MQTT, 1 - HTTPs client for OTA, 2 - WPA Enterprise <certificate type>: Certificate type, 0 - CA certificate, 1 - Certificate, 2 - Private key, 3 - DH params <mode>: Input mode. 0 - Store, 1 - Deletion <format>: Certificate format, 0 - DER, 1 - PEM if mode is 0 (Store) <length>: Length of certificate if mode is 0 (Store) <content>: Certificate data if mode is 0 (Store) Response: OK or ERROR For example: <ESC>CERT,0,1146,----- BEGIN CERTIFICATE -----MIIDFDCCAf...
	Example <ESC>CERT,0,0,0,1,980,-----BEGIN CERTIFICATE-----… OK <ESC>CERT,0,1,0,1,990,-----BEGIN CERTIFICATE-----… OK <ESC>CERT,0,2,0,1,31 AT+WFPBC	

Escape sequence	Parameters	Description
	0,-----BEGIN EC PRIVATE KEY-----… OK <ESC>CERT,0,3,0,1,432,-----BEGIN DH PARAMETERS-----… OK Note: Enabled by default in the SDK.	

5.3 Wi-Fi Function Commands

Table 11. Wi-Fi function command list

Command	Parameters	Description
AT+WFMODE	<mode>	Set the Wi-Fi mode. <mode>: 0 (STA), 1 (Soft AP), 2 (Concurrent Mode) Response: OK or ERROR
	?	Get the current Wi-Fi mode. Response: +WFMODE:<mode>
	(none)	
	Example AT+WFMODE=0 //Set Station mode OK AT+WFMODE=1 //Set Soft AP mode OK AT+WFMODE //Get current Wi-Fi mode +WFMODE:1 OK AT+WFMODE=? //Get current Wi-Fi mode +WFMODE:1 OK Note: ▪ Enabled by default in the SDK. ▪ Wi-Fi mode is stored in NVRAM. ▪ System restart is required for changes to take effect. ▪ To use the concurrent mode, complete the following steps: • AT+DEFAP • AT+WFMODE=2 • AT+RESTART • AT+WFJAPA=SSID,PASSWORD (or AT+WFJAPA=SSID,X,X,PASSWORD).	
AT+WFMAC	<mac>	Write a user MAC address in the NVRAM. Response: OK or ERROR
	?	Get the current MAC address of the activated WLAN interface. Response: +WFMAC:<mac>
	(none)	
	Example AT+WFMAC=EC:9F:0D:9F:FA:64 OK AT+WFMAC=? +WFMAC:EC:9F:0D:9F:FA:64 OK AT+WFMAC	

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">+WFMAC:EC:9F:0D:9F:FA:64
OK

AT+WFMAC=? //In Soft AP mode
+WFMAC:EC:9F:0D:9F:FA:65
OK
Note:
▪ The last digit should be an even number to be a valid MAC address.
▪ Enabled by default in the SDK.
▪ A user MAC address is stored in NVRAM, and a system restart is required for changes to take effect.
▪ The DA16200/DA16600 provides three types of MAC addresses, and the priority is in the following order: Spoofing MAC address, User MAC address, OTP MAC address.
▪ When reading the MAC address in Soft AP mode, it becomes the MAC address that was written + 1.</td></tr>
<tr><td rowspan="2">AT+WFMACERASE</td><td>(none)</td><td>Erase a user MAC address in NVRAM.
Response: OK or ERROR</td></tr>
<tr><td colspan="2">Example
AT+WFMACERASE
OK
Note:
▪ Enabled by default in the SDK (available from SDK v3.2.9.0 or later).
▪ The configuration is erased from NVRAM.</td></tr>
<tr><td rowspan="2">AT+WFSPF</td><td><mac></td><td>Write the spoofing MAC address in the NVRAM.
Response: OK or ERROR</td></tr>
<tr><td colspan="2">Example
AT+WFSPF=EC:9F:0D:90:00:48
OK

AT+WFSPF=?
+WFSPF:EC:9F:0D:90:00:48
OK
Note:
▪ Enabled by default in the SDK.
▪ Either odd or even number last digit of MAC address is accepted. Use this command only in STA mode.
▪ A spoofing MAC address is stored in NVRAM, and a system restart is required for changes to take effect.
▪ The DA16200/DA16600 provides three types of MAC addresses, and the priority is in the following order: Spoofing MAC address, User MAC address, OTP MAC address.
▪ The AT+WFMAC=? command can be used to read back the spoofing MAC address as this command does not support query.</td></tr>
<tr><td rowspan="2">AT+WFOTP</td><td><mac></td><td>Write the MAC address in the OTP memory.
Response: OK or ERROR
The MAC address written in the OTP is used as WLAN0 MAC address and MAC address + 1 is used as WLAN1 MAC address.</td></tr>
<tr><td colspan="2">Example
AT+WFOTP=EC:9F:0D:90:00:48
OK

AT+WFMAC=?
+WFOTP:EC:9F:0D:90:00:48
OK
Note:
▪ The last digit should be an even number to be a valid MAC address.</td></tr>
</table>

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">▪ Enabled by default in the SDK.
▪ An OTP MAC address is stored in OTP and system restart is required for changes to take effect.
▪ An old MAC address in the OTP is invalidated if it exists.
▪ There are four MAC address slots available in OTP. It is possible to write the OTP MAC address four times in total in production.
▪ The DA16200/DA16600 provides three types of MAC address, and the priority is in the following order: Spoofing MAC address, User MAC address, OTP MAC address.
▪ The AT+WFMAC=? command can be used to read back the OTP MAC address as this command does not support query.
▪ When reading the MAC address in Soft AP mode, it becomes the MAC address that was written + 1.</td></tr>
<tr><td rowspan="2">AT+WFSTAT</td><td>(none)</td><td>Get Wi-Fi configuration.
Response: +WFSTAT:<Wi-Fi interface><var>…</td></tr>
<tr><td colspan="2">Example
AT+WFSTAT

+WFSTAT:sta0
mac_address= ec:9f:0d:9f:fa:64
wpa_state=DISCONNECTED
disconnect_reason=0

OK

AT+WFSTAT

+WFSTAT:softap1
mac_address=ec:9f:0d:9f:fa:65
wpa_state=DISCONNECTED
disconnect_reason=0

OK

AT+WFSTAT

+WFSTAT:sta0
mac_address=ec:9f:0d:9f:fa:64
bssid=70:5d:cc:32:15:32
ssid=MY_AP_SSID
id=0
mode=STATION
key_mgmt=WPA2-PSK
pairwise_cipher=CCMP
group_cipher=CCMP
channel=3
wpa_state=COMPLETED

OK
Note:
▪ Enabled by default in the SDK.
▪ A response can be different depending on the current the DA16200/DA16600 status or mode.</td></tr>
<tr><td rowspan="2">AT+WFPBC</td><td>(none)</td><td>Run the WPS PBC method.
Response: OK or ERROR</td></tr>
<tr><td colspan="2">Example
AT+WFPBC

OK
+WFJAP:1,'MY_APS_SSID',192.168.0.3
Note:</td></tr>
</table>

Command	Parameters	Description
	▪ Enabled by default in the SDK. ▪ A WPS button can be pressed after issuing the command. ▪ A router should support WPS and PBC.	
AT+WFPIN	<pin>	Run the WPS PIN method. <pin>: PIN (eight digits) (none): Generate a random PIN Response: +WFPIN:<pin> OK or ERROR
	(none)	
	?	Get the current PIN. Response: +WFPIN:<pin>
	Example AT+WFPIN=13557799 +WFPIN:13557799 OK AT+WFPIN +WFPIN:36269112 //Generate random number. OK AT+WFPIN=? +WFPIN:36269112 OK Note: ▪ Enabled by default in the SDK. ▪ An AP should support WPS PIN.	
AT+WFCWPS	(none)	Cancel WPS (both PBC and PIN). Response: OK or ERROR
	Prerequisite WPS should be in progress. Example AT+WFCWPS OK Note: ▪ Enabled by default in the SDK. ▪ Return error if WPS is not in progress.	
AT+WFCC	<code>	Set a country code. <code>: Country code (defined by ISO 3166-1 alpha-2 standard) such as KR, US, JP, and CH Response: OK or ERROR
	?	Get the current country code. Response: AT+WFCC=<code>
	(none)	
	Example AT+WFCC=KR OK AT+WFCC	

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">+WFCC:KR
OK

AT+WFCC=?
+WFCC:KR
OK
Note:
▪ Enabled by default in the SDK.
▪ A country code is stored in the NVRAM.
▪ A country code consists of two characters.
▪ If a country is invalid, the DA16200/DA16600 returns an error code that is –113.
▪ System restart is required for changes to take effect.
▪ If this command is run in Soft AP mode with a new country code and the operating channel range of the new country does not cover the operating channel currently set, the operating channel is automatically switched to channel 1.</td></tr>
<tr><td rowspan="2">AT+WFRSSI</td><td>[<timeout>]</td><td>Get the current RSSI value within a timeout.
<timeout>: timeout in seconds
Response: +RSSI: -34</td></tr>
<tr><td colspan="2">Prerequisite
The DA16200/DA16600 should be connected to AP.
Example
AT+WFRSSI
+RSSI:-41
OK

AT+WFRSSI=2
+RSSI:-25
OK
….
(If there is no connection to an AP,)
AT+WFRSSI
+RSSI:NOT_CONN

ERROR:-400

(if there is no result within a timeout)
ERROR:-801

Note:
▪ Enabled by default in the SDK.
▪ The DA16200/DA16600 responds "+RSSI:NOT_CONN" with error (-400) if the connection is not established.
▪ The DA16200/DA16600 responds with error (-801) if the RSSI is not received within a timeout.</td></tr>
<tr><td rowspan="2">AT+WFSCAN</td><td>[<ssid>]</td><td>Scan APs.
<ssid>: Scan a hidden AP through direct probe request (optional)
Response: +WFSCAN:<bssid><\t><frequency><\t><signal strength><\t><flag><\t><ssid><LF>…</td></tr>
<tr><td colspan="2">Prerequisite</td></tr>
</table>

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">The country code should be set with AT+WFCC.
Example
AT+WFSCAN

+WFSCAN:70:5d:cc:32:15:32 2422 -30 [WPA2-PSK-CCMP][WPS][ESS] IPTIME_N604BLACK_SSID
b4:a9:4f:62:39:46 2422 -32 [WPA-PSK-CCMP+TKIP][WPA2-PSK-CCMP+TKIP][WPS][ESS] SK_WiFiGIGA0123

OK
Note:
▪ Enabled by default in the SDK.
▪ An SSID can be missed in case of hidden AP.</td></tr>
<tr><td rowspan="2">AT+WFPSCAN</td><td><channel time limit>, <ch>..<ch></td><td><channel time limit>: Channel scan time limit (should be more than 30000 microsecond)
<ch>: Carrier frequency (from 0 to14)
Response: BSSID Wi-Fi_Channel RSSI SSID Security Type</td></tr>
<tr><td colspan="2">Prerequisite
The country code should be set with AT+WFCC.
Station mode.
Example
AT+WFPSCAN=120000,1,3,5

70:5d:cc:8b:49:8e 2412 -47 Gen_Port_*.5_AP [WPA2-PSK-CCMP][WPS][ESS]
72:5d:cc:c0:9a:c4 2412 -47 IPTIME_A3004NS-M_Bell [WPS][ESS]
…
+PSCAN:TIMEOUT
Note:
▪ Enabled by default in the SDK v3.2.3.0 or later.
▪ Multiple parameters can be typed in <ch> as example ("0" means all channel).</td></tr>
<tr><td rowspan="3">AT+WFPCDTMIN</td><td><bssid>,
<min_threshold></td><td><bssid>: BSSID
<min_threshold>: minimum threshold (from -10 to -100)
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get the current condition.</td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Prerequisite
Station mode.
Example
AT+WFPCDTMIN=72:5d:cc:d0:82:bc,-80
OK

AT+WFPCDTMIN
+WFPCDTMIN: 72:5d:cc:d0:82:bc,-80
OK
Note: Enabled by default in the SDK v3.2.3.0 or later.</td></tr>
</table>

Command	Parameters	Description
AT+WFPCDTMAX	<bssid>, <max_threshold>	Set the passive scan maximum RSSI threshold condition. <bssid>: BSSID <max_threshold>: maximum threshold (from -10 to -100) Response: OK or ERROR
	?	Get the current condition.
	(none)	
	Prerequisite Station mode. Example AT+WFPCDTMAX=72:5d:cc:c0:82:bc,-20 OK AT+WFPCDTMAX +WFPCDTMAX: 72:5d:cc:c0:82:bc,-20 OK Note: Enabled by default in the SDK v3.2.3.0 or later.	
AT+WFPSTOP	(none)	Stop passive scan. Response: OK or ERROR
	Prerequisite Station mode. Example AT+WFPSTOP OK Note: Enabled by default in the SDK v3.2.3.0 or later.	
AT+WFJAP	<ssid>,<sec>[,<hidden>] (sec=0|5)	Connect to an AP. <ssid>: AP SSID <sec>: Security protocol. 0 (OPEN), 1 (WEP), 2 (WPA), 3 (WPA2), 4 (WPA+WPA2), 5 (WPA3 OWE), 6 (WPA3 SAE), 7 (WPA2 RSN & WPA3 SAE) <idx>: Key index for WEP. 0~3 <enc>: Encryption. 0 (TKIP), 1 (AES), 2 (TKIP+AES) <key>: Passphrase. 8 ~ 63 characters are allowed <hidden>: 1 (<ssid> is hidden), 0 or [not specified] (<ssid> is NOT hidden) Response: OK or ERROR Operation Results: +WFJAP:<OPS_RESULT>['<SSID>','<IP_ADDRESS>'] +WFJAP:<OPS_RESULT>,<REASON>,[<REASON_CODE>] <OPS_RESULT>: 1 (SUCCESS), 0 (FAILED) If <OPS_RESULT>: 1 <SSID>: The SSID is surrounded by single quotation mark <IP_ADDRESS>: Assigned IP address and format is xxx.xxx.xxx.xxx If <OPS_RESULT>: 0 <REASON>: well-known reason in text <REASON_CODE>: if < REASON > is OTHER, this shows the reason code For details about <REASON> or <REASON_CODE>, see Table 12.
	<ssid>,<sec>, <idx>,<key>[,<hidden>] (sec=1)	
	<ssid>,<sec>, <enc>,<key>[,<hidden>] (sec=2|3|4|6|7)	

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td rowspan="2"></td><td>?
(none)</td><td>Get the AP provisioning information.
Operation Results:
If provisioning data is available:
+WFJAP:'<SSID>',<sec>,<enc>,'<Passphrase>'
If provisioning data is not available:
ERROR:-410 (No SSID is found)</td></tr>
<tr><td colspan="2">Example
AT+WFJAP=MY_AP_SSID,0 //Open security
OK
+WFJAP:1,'MY_AP_SSID',192.168.43.32

AT+WFJAP=MY_AP_SSID,0,1 //Open security + hidden SSID
OK
+WFJAP:1,'MY_AP_SSID',192.168.43.32

AT+WFJAP=MY_AP_SSID,1,0,12345 //WEP security
OK
+WFJAP:1,'MY_AP_SSID',192.168.0.7

AT+WFJAP=MY_AP_SSID,1,0,12345,1 //WEP + hidden AP
OK
+WFJAP:1,'MY_AP_SSID',192.168.0.7

AT+WFJAP=MY_AP_SSID,4,2,N12345678 //WPA2 security
OK
+WFJAP:1,'MY_AP_SSID',192.168.0.7

AT+WFJAP=MY_AP_SSID,4,2,N12345678,1 //WPA2 + hidden AP
OK
+WFJAP:1,'MY_AP_SSID',192.168.0.7

AT+WFJAP=?
+WFJAP:'MY_AP_SSID',4,2,'N12345678'
OK
Note:
▪ Enabled by default in the SDK.
▪ The host should wait for both command response OK or ERROR and Operation Result; wait for OK, and +WFJAP:1,'<SSID>',<IP Address> for successful connection.
▪ Depending on the network condition, it may take more time to get an Operation Result because of internal connection re-trials.
▪ No system reboot happens after running this command.
▪ The AP configuration parameters (AP Profile) are stored in NVRAM.
▪ WPA3 Personal is enabled by default in the SDK v3.2.5.0 or later.
▪ If <sec> is set to 6 (WPA3 SAE) or 7 (WPA2 RSN & WPA3 SAE), 1 (AES) is only valid as <enc> because WPA3 SAE allows only CCMP.</td></tr>
<tr><td>AT+WFJAPBSSID</td><td><bssid>,<ssid>,<sec>
[,<hidden>]
(sec=0|5)</td><td>Connect to an AP that matches the given BSSID.
<bssid>: BSSID
<ssid>: AP SSID</td></tr>
</table>

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td rowspan="3"></td><td><bssid>,<ssid>,<sec>,
<idx>,<key>[,<hidden>]
(sec=1)

<bssid>,<ssid>,<sec>,
<enc>,<key>[,<hidden>]
(sec=2|3|4|6|7)</td><td><sec>: Security protocol. 0 (OPEN), 1 (WEP), 2 (WPA), 3 (WPA2), 4 (WPA+WPA2), 5 (WPA3 OWE), 6 (WPA3 SAE), 7 (WPA2 RSN & WPA3 SAE)
<idx>: Key index for WEP. 0~3
<enc>: Encryption. 0 (TKIP), 1 (AES), 2 (TKIP+AES)
<key>: Passphrase. 8 ~ 63 characters are allowed
<hidden>: 1 (<ssid> is hidden), 0 or [not specified] (<ssid> is NOT hidden)
Response: OK or ERROR
Operation Results:
+WFJAP:<OPS_RESULT>[,'<SSID>','<IP_ADDRESS>']
+WFJAP:<OPS_RESULT>,<REASON>,[<REASON_CODE>]
<OPS_RESULT>: 1 (SUCCESS), 0 (FAILED)
If <OPS_RESULT>: 1
<SSID>: The SSID is surrounded by single quotation mark
<IP_ADDRESS>: Assigned IP address and format is xxx.xxx.xxx.xxx
If <OPS_RESULT>: 0
<REASON>: well-known reason in text
<REASON_CODE>: if < REASON > is OTHER, this shows the reason code
For details about <REASON> or <REASON_CODE>, See Table 12.</td></tr>
<tr><td>?

(none)</td><td>Get the AP provisioning information.
Operation Results:
If provisioning data is available:
+WFJAPBSSID:'<SSID>',<sec>,<enc>,'<Passphrase>',<BSSID>.
If provisioning data is not available:
ERROR:-410 (No SSID is found).</td></tr>
<tr><td colspan="2">Example
AT+WFJAPBSSID=01:02:03:04:05:06,MY_AP_SSID,0 //Open security
OK
+WFJAP:1,'MY_AP_SSID',192.168.43.32

AT+WFJAPBSSID=01:02:03:04:05:06,MY_AP_SSID,0,1 //Open security + hidden SSID
OK
+WFJAP:1,'MY_AP_SSID',192.168.43.32

AT+WFJAPBSSID=01:02:03:04:05:06,MY_AP_SSID,1,0,12345 //WEP security
OK
+WFJAP:1,'MY_AP_SSID',192.168.0.7

AT+WFJAP=01:02:03:04:05:06,MY_AP_SSID,1,0,12345,1 //WEP + hidden AP
OK
+WFJAP:1,'MY_AP_SSID',192.168.0.7

AT+WFJAPBSSID=01:02:03:04:05:06,MY_AP_SSID,4,2,N12345678 //WPA2 security
OK
+WFJAP:1,'MY_AP_SSID',192.168.0.7</td></tr>
</table>

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">AT+WFJAPBSSID=01:02:03:04:05:06,MY_AP_SSID,4,2,N12345678,1 //WPA2 + hidden AP
OK
+WFJAP:1,'MY_AP_SSID',192.168.0.7

AT+WFJAPBSSID=?
+WFJAPBSSID:'MY_AP_SSID',4,2,'N12345678',01:02:03:04:05:06
OK
Note:
▪ Enabled by default in the SDK and this command is available in SDK v3.2.9.0 or later.
The host should wait for both command response OK or ERROR and Operation Result; wait for OK, and +WFJAP:1,'<SSID>',<IP Address> for successful connection.
▪ Depending on the network conditions, it may take more time to get an Operation Result because of internal connection re-trials.
▪ No system reboot happens after running this command.
▪ The AP configuration parameters (AP Profile) are stored in NVRAM.
▪ If <sec> is set to 6 (WPA3 SAE) or 7 (WPA2 RSN & WPA3 SAE), 1 (AES) is only valid as <enc> because WPA3 SAE allows only CCMP.</td></tr>
<tr><td rowspan="3">AT+WFJAPA</td><td><ssid>[,<key>][,<hidden>]</td><td>Connect to an AP.
If <key> exists, security protocol is WPA+WPA2 and encryption is TKIP+AES.
If <key> is omitted, security protocol is OPEN.
<hidden>: 1 (<ssid> is hidden), 0 or [not specified] (<ssid> is NOT hidden)
If <hidden> is omitted, <ssid> is not hidden.
<ssid>: AP SSID
<key>: Passphrase. 8 ~ 63 characters are allowed
Response: OK or ERROR
Operation Results:
+WFJAP:<OPS_RESULT>[,'<SSID>','<IP_ADDRESS>']
+WFJAP:<OPS_RESULT>,<REASON>,[<REASON_CODE>]
<OPS_RESULT>: 1 (SUCCESS), 0 (FAILED)
If <OPS_RESULT>: 1
<SSID>: The SSID is surrounded by single quotation mark
<IP_ADDRESS>: Assigned IP address and format is xxx.xxx.xxx.xxx
If <OPS_RESULT>: 0
<REASON>: Well-known reason in text
<REASON_CODE>: If < REASON > is OTHER, this shows the reason code.
For details about <REASON> or <REASON_CODE>, see Table 12
.</td></tr>
<tr><td>?
(none)</td><td>Get the AP provisioning information (SSID and Passphrase only).
Operation Results:
If Wi-Fi connection is success:
+WFJAPA:'<SSID>','<Passphrase>'
If Wi-Fi connection fails:
ERROR:-425 (No SSID found)</td></tr>
<tr><td colspan="2">Example
AT+WFJAPA=MY_AP_SSID //Open security
OK</td></tr>
</table>

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">+WFJAP:1,'MY_AP_SSID',192.168.43.32

AT+WFJAPA=MY_AP_SSID,1 //Open security + hidden SSID
OK
+WFJAP:1,'MY_AP_SSID',192.168.43.32

AT+WFJAPA=MY_AP_SSID,N12345678 //WPA2 security
OK
+WFJAP:1,'MY_AP_SSID',192.168.43.32

AT+WFJAPA=MY_AP_SSID,N12345678,1 //WPA2 security + hidden AP
OK
+WFJAP:1,'MY_AP_SSID',192.168.43.32

AT+WFJAPA=?
+WFJAPA:'MY_AP_SSID','N12345678'
OK
Note:
▪ Enabled by default in the SDK.
▪ The host should wait for both command response OK or ERROR and Operation Result; wait for OK, and +WFJAP:1,'<SSID>',<IP Address> for successful connection.
▪ Depending on the network condition, it may take more time to get an Operation Result because of internal connection re-tries.
▪ No system reboot is required after running this command.
▪ The AP configuration parameters (AP Profile) are stored in NVRAM.</td></tr>
<tr><td rowspan="2">AT+WFJAPABSSID</td><td><bssid>,<ssid>
[,<key>][,<hidden>]</td><td>Connect to an AP that matches the given BSSID.
If <key> exists, security protocol is WPA+WPA2 and encryption is TKIP+AES.
If <key> is omitted, security protocol is OPEN.
<hidden>: 1 (<ssid> is hidden), 0 or [not specified] (<ssid> is NOT hidden)
If <hidden> is omitted, <ssid> is not hidden.
<bssid>: BSSID
<ssid>: AP SSID
<key>: Passphrase. 8 ~ 63 characters are allowed
Response: OK or ERROR
Operation Results:
+WFJAP:<OPS_RESULT>['<SSID>','<IP_ADDRESS>']
+WFJAP:<OPS_RESULT>,<REASON>,[<REASON_CODE>]
<OPS_RESULT>: 1 (SUCCESS), 0 (FAILED)
If <OPS_RESULT>: 1
<SSID>: The SSID is surrounded by single quotation mark
<IP_ADDRESS>: Assigned IP address and format is xxx.xxx.xxx.xxx
If <OPS_RESULT>: 0
<REASON>: Well-known reason in text
<REASON_CODE>: If < REASON > is OTHER, this shows the reason code.
For details about <REASON> or <REASON_CODE>, see Table 12.</td></tr>
<tr><td>?</td><td>Get the AP provisioning information (SSID, Passphrase and BSSID).</td></tr>
</table>

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td>(none)</td><td>Operation Results:
If Wi-Fi connection is success:
+WFJAPABSSID:'<SSID>','<Passphrase>',<BSSID>
If Wi-Fi connection fails:
ERROR:-425 (No SSID found)</td></tr>
<tr><td></td><td colspan="2">Example
AT+WFJAPABSSID=01:02:03:04:05:06,MY_AP_SSID //Open security
OK
+WFJAP:1,'MY_AP_SSID',192.168.43.32

AT+WFJAPABSSID=01:02:03:04:05:06,MY_AP_SSID,1 //Open security + hidden SSID
OK
+WFJAP:1,'MY_AP_SSID',192.168.43.32

AT+WFJAPABSSID=01:02:03:04:05:06,MY_AP_SSID,N12345678 //WPA2 security
OK
+WFJAP:1,'MY_AP_SSID',192.168.43.32

AT+WFJAPABSSID=01:02:03:04:05:06,MY_AP_SSID,N12345678,1 //WPA2 security + hidden AP
OK
+WFJAP:1,'MY_AP_SSID',192.168.43.32

AT+WFJAPABSSID=?
+WFJAPABSSID:'MY_AP_SSID','N12345678',01:02:03:04:05:06
OK
Note:
▪ Enabled by default in the SDK and this command is available in SDK v3.2.9.0 or later.
▪ The host should wait for both command response OK or ERROR and Operation Result; wait for OK, and +WFJAP:1,'<SSID>',<IP Address> for successful connection.
▪ Depending on the network condition, it may take more time to get an Operation Result because of internal connection re-tries.
▪ No system reboot is required after running this command.
▪ The AP configuration parameters (AP Profile) are stored in NVRAM.</td></tr>
<tr><td>AT+WFCAP</td><td>(none)</td><td>Connect to an AP with the current WLAN0 interface configuration.
Response: OK or ERROR</td></tr>
<tr><td></td><td colspan="2">Prerequisite
AP profile parameters should exist in NVRAM.
Example
AT+WFCAP
OK
+WFJAP:1,'MY_AP_SSID',192.168.0.7

AT+WFCAP
ERROR:-503 //Failed to connect AP. (for example, No AP profile found)

AT+WFCAP
ERROR:-460 //Already connected
Note:</td></tr>
</table>

Command	Parameters	Description
	▪ Enabled by default in the SDK. ▪ An AP profile can be stored in NVRAM by issuing the "AT+WFJAPA" or "AT+WFJAP" command. ▪ If there is no AP profile found, the DA16200/DA16600 returns an error (-503). ▪ If the DA16200/DA16600 is already in connection with an AP, it returns an error (-460).	
AT+WFQAP	(none)	Disconnect from the currently associated AP. Response: OK or ERROR
	Prerequisite The DA16200/DA16600 should be connected to AP. Example AT+ WFQAP OK Note: ▪ Enabled by default in the SDK. ▪ No error returns if it is already disconnected from an AP.	
AT+WFSTA	(none)	Check Wi-Fi connection. Response: +WFSTA:<status> <status> 1 (Connected), 0 (disconnected)
	Prerequisite Station mode. Example AT+WFSTA +WFSTA:0 OK AT+WFSTA +WFSTA:1 OK Note: ▪ Enabled by default in the SDK. ▪ If the DA16200/DA16600 runs the command in Soft AP mode, it returns an error (-100).	
AT+WFROAP	<roam>	Operate the STA roaming. <roam>: 1 (run), 0 (stop) Response: OK or ERROR
	?	Get the roaming status. Response: +WFROAP:<roam>
	(none)	
	Prerequisite Station mode Example AT+WFROAP=1 OK AT+WFROAP=0 OK AT+WFROAP=? +WFROAP:1	

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">OK
Note:
▪ Enabled by default in SDK.
▪ This command enables "simple" roaming. The roaming configuration consists of one parameter called the roaming threshold (set to AT+WFROTH, -65 by). Assume that the DA16200/DA16600 is connected to an AP, and there are other APs that have the same SSID and security settings around the DA16200/DA16600. As the DA16200/DA16600 is not fixed, if the RSSI value of the currently connected AP is lower than the specified threshold, it tries to connect to an AP with a higher RSSI (same SSID and security). If the condition is met, the DA16200/DA16600 silently switches to the new AP without a disconnection event.
▪ The auto roaming start flag is stored in NVRAM when <roam> is set to 1, and roaming operation is enabled if the flag setting is not changed regardless of system reboot. If <roam> is 0, the roaming flag is removed from NVRAM, and roaming is disabled.
▪ "Simple" roaming is not supported in DPM mode. So, setting DPM mode with command "AT+DPM=1" disables "The auto roaming start flag."</td></tr>
<tr><td rowspan="4">AT+WFROTH</td><td><rssi></td><td>Set the STA roaming threshold.
<rssi>: Roaming threshold value (from 0 to -95 dBm)
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get the STA roaming threshold.
Response: +WFROTH:<rssi></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Prerequisite
Station mode
Example
AT+WFROTH=-55
OK
AT+WFROTH=?

+WFROTH:-55
OK
Note:
▪ Enabled by default in the SDK.
▪ This command writes a roaming threshold in NVRAM.
▪ When AT+WFROAP=1 is run, the roaming is enabled with the new threshold.</td></tr>
<tr><td rowspan="3">AT+WFDIS</td><td><disabled></td><td>Set the Wi-Fi STA profile unused. If set to 1, the DA16200/DA16600 does not start to connect to the configured AP when rebooting.
<disabled >: 1 (Unused), 0 (Used)
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get the status of the Wi-Fi profile.
Response: +WFDIS:<disabled></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Example
AT+WFDIS=1
OK

AT+WFDIS=?
+WFDIS:1
OK
Note:
▪ Enabled by default in the SDK.
▪ The "unused" flag is stored in the NVRAM.</td></tr>
</table>

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">▪ The flag affects the DA16200/DA16600 during boot-up procedure. System restart is required for changes to take effect.</td></tr>
<tr><td rowspan="3">AT+WFSAP</td><td><ssid>,<sec>,
<ch>,<code>
(sec=0|5)</td><td>Set up Soft AP interface.
<ssid>: AP SSID. Max 32 characters are allowed
<sec>: Security protocol. 0 (OPEN), 2 (WPA), 3 (WPA2), 4 (WPA+WPA2)), 5 (WPA3 OWE), 6 (WPA3 SAE), 7 (WPA2 RSN & WPA3 SAE)
<enc>: Encryption. 0 (TKIP), 1 (AES), 2 (TKIP+AES)
<key>: Passphrase. 8 ~ 63 characters are allowed
<ch>: Operating channel (optional). Default is 1 or uses the current channel if Soft AP is operating
<code>: Country code (optional). If exists, <ch> is essential
Response: OK or ERROR</td></tr>
<tr><td>?
(none)</td><td>Get the Soft AP interface configuration.
Response:
+WFSAP:'<ssid>',<auth>,<enc>,'<key>',<ch>,<code>
Operation Result:
+WFSAP:<ssid> is printed on success</td></tr>
<tr><td colspan="2">Example
AT+WFSAP=DA16200_MY_SSID,0,1,KR //Open mode
+WFSAP:DA16200_MY_SSID
OK

AT+WFSAP=?
+WFSAP:'DA16200_MY_SSID',0,1,KR
OK

AT+WFSAP=DA16200_MY_SSID,3,1,12345678,1,KR //WPA2-AES
+WFSAP:DA16200_MY_SSID
OK

AT+WFSAP=?
+WFSAP:'DA16200_MY_SSID',3,1,'12345678',1,KR
OK

AT+WFSAP='DA16200,MY_SSID',3,2,'12345678',1,KR //WPA2-AES
+WFSAP:DA16200,MY_SSID
OK

AT+WFSAP=?

+WFSAP:'DA16200,MY_SSID',3,1,'12345678',1,KR
OK
Note:
▪ Enabled by default in the SDK.
▪ The Soft AP configuration parameters are stored in NVRAM.
▪ If the command is issued in station mode, a reboot is required to start as Soft AP mode. (If the command is issued in Soft AP mode, then no system restart is required).</td></tr>
</table>

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">▪ The ',' (comma) is included in the SSID string and the SSID is enclosed with a single quotation mark.
▪ WPA3 Personal is enabled by default in the SDK v3.2.5.0 or later. See the example.
▪ If <sec> is set to 6 (WPA3 SAE) or 7 (WPA2 RSN & WPA3 SAE), 1 (AES) is only valid as <enc> because WPA3 SAE allows only CCMP.</td></tr>
<tr><td rowspan="2">AT+WFOAP</td><td>(none)</td><td>Operate Soft AP interface.
Response: OK or ERROR</td></tr>
<tr><td colspan="2">Prerequisite
A Soft AP profile should be stored in NVRAM.
Example
AT+WFOAP
OK
Note:
▪ Enabled by default in the SDK.
▪ Run this command in Soft AP mode.
▪ If there is no profile in NVRAM, it returns an error (-522).
▪ The DA16200/DA16600 returns an error (-522) if it already operates as Soft AP.</td></tr>
<tr><td rowspan="2">AT+WFTAP</td><td>(none)</td><td>Stop the Soft AP interface.
Response: OK or ERROR</td></tr>
<tr><td colspan="2">Prerequisite
Soft AP mode
Example
AT+WFTAP
OK
Note:
▪ Enabled by default in the SDK.
▪ This command is valid while the DA16200/DA16600 is running in Soft AP mode.</td></tr>
<tr><td colspan="3">Additional note for AT+WFSAP, AT+WFOAP, AT+WFTAP:
Example:
In STA mode after running ATF command
…
AT+WFSAP=DA16200_OPEN,0 //Set up Soft AP
AT+RESTART //Reboot to start in the configured Soft AP mode
…
DUT starts as Soft AP
….
AT+WFTAP //Stop Soft AP if required
AT+WFOAP //Start Soft AP if required</td></tr>
<tr><td rowspan="2">AT+WFRAP</td><td>(none)</td><td>Restart the Soft AP interface.
Response: OK or ERROR</td></tr>
<tr><td colspan="2">Prerequisite
A profile for Soft AP should be stored in NVRAM.
Example
AT+WFRAP

OK
Note:</td></tr>
</table>

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">▪ Enabled by default in the SDK.
▪ This command is valid in Soft AP mode.
▪ If it runs in station mode, the DA16200/DA16600 returns an error (-100).</td></tr>
<tr><td rowspan="2">AT+WFLCST</td><td>(none)</td><td>Get connected station information.
Response: +WFLCST:<mac><LF><flags><LF><var>…</td></tr>
<tr><td colspan="2">Example
AT+WFLCST

+WFLCST:a6:f2:7c:d4:53:1c
flags=[AUTH][ASSOC][AUTHORIZED][SHORT_PREAMBLE][WMM][MAYBE_WPS][HT]
aid=1
capability=0x421
listen_interval=10
wifi_mode=802.11n
timeout_next=NULLFUNC POLL
rx_packets=290
tx_packets=4
rx_bytes=29625
tx_bytes=10658
inact_cnt=0
connected_time=20
sta_count=1

OK

AT+WFLCST
+WFLCST:NOT_FOUND
OK
Note:
▪ Enabled by default in the SDK.
▪ If there is no station connected, then the DA16200/DA16600 returns "+WFLCST:NOT_FOUND".</td></tr>
<tr><td rowspan="4">AT+WFAPWM</td><td><mode></td><td>Set IEEE 802.11 Wi-Fi mode of Soft AP interface.
<mode>: 0 (B/G/N), 1 (G/N), 2 (B/G), 3 (N), 4 (G), 5 (B)
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get IEEE 802.11 Wi-Fi mode of Soft AP interface.
Response: +WFAPWM:<mode></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Example
AT+WFAPWM=0
OK

AT+WFAPWM=1
OK

AT+WFAPWM=?
+WFAPWM:1
OK
Note:</td></tr>
</table>

Command	Parameters	Description
	▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ System restart is required for changes to take effect.	
AT+WFAPCH	<ch>	Set the operating channel number for the Soft AP interface. <ch>: Operating channel (from 0 to 13, 0 is auto) Response: OK or ERROR
	?	Get the operating channel number for the Soft AP interface. Response: +WFAPCH:<ch>
	(none)	
	Example AT+WFAPCH=5 OK AT+WFAPCH=? +WFAPCH:5 OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ System restart is required for changes to take effect.	
AT+WFAPBI	<interval>	Set the AP beacon interval. <interval>: Beacon interval (ms) Response: OK or ERROR
	?	Get the AP beacon interval. Response: +WFAPBI:<interval>
	(none)	
	Example AT+WFAPBI=200 OK AT+WFAPBI=? +WFAPBI:200 OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ System restart is required for changes to take effect.	
AT+WFAPUI	<timeout>	Set station disconnection timeout in Soft AP mode. <timeout>: Disconnection timeout (sec) (from 30 to 86400, step = 10) If 0, the default value (300 seconds) is used Response: OK or ERROR
	?	Get station disconnection timeout in Soft AP mode. Response: +WFAPUI:<timeout>
	(none)	
	Example AT+WFAPUI=60UOK AT+WFAPUI=?	

Command	Parameters	Description
	+WFAPUI:60 OK Note: ▪ Enabled by default in the SDK. ▪ Within the specified time, if an STA does not send any frame, Soft AP sends a NULL frame after the timeout is expired to check STA's inactivity. If no ACK is received from the STA, Soft AP removes the STA. ▪ The configuration is stored in NVRAM. ▪ System restart is required for changes to take effect.	
AT+WFAPRT	<threshold>	Set the AP RTS threshold (octets). <threshold>: RTS threshold (from 1 to 2347) Response: OK or ERROR
	?	Get the AP RTS threshold. Response: +WFAPRT:<threshold>
	(none)	
	Example AT+WFAPRT=2100 OK AT+WFAPRT=? +WFAPRT:2100 OK Note: ▪ Enabled by default in the SDK. ▪ If a frame that is bigger than the RTS threshold specified is to be sent, RTS/CTS frames are sent first to avoid collision in the air. By default, the RTS threshold is 2347. ▪ The configuration is stored in NVRAM. ▪ System restart is required for changes to take effect.	
AT+WFAPDE	<mac>	Send de-authentication frame to the connected station. <mac>: MAC address of the connected station Response: OK or ERROR
	Prerequisite The DA16200/DA16600 should be connected to AP. Example AT+WFAPDE=E6:0D:E5:A5:5D:B3 +WFDST:e6:0d:e5:a5:5d:b3 OK Note: ▪ Enabled by default in the SDK. ▪ Use this command in Soft AP mode. ▪ Check the MAC address of an STA that needs to send de-authentication frame by using the command "AT+WFLCST". ▪ If the operation is not successful (for example, a wrong MAC address is specified), the operation result (+WFDST:<mac_addr>) does not come.	
AT+WFAPDI	<mac>	Send the disassociation frame to the connected station. <mac>: MAC address of the connected station Response: OK or ERROR
	Prerequisite The DA16200/DA16600 should be connected to AP.	

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">Example
AT+WFAPDI=E6:0D:E5:A5:5D:B3
+WFDST:e6:0d:e5:a5:5d:b3
OK
Note:
▪ Enabled by default in the SDK.
▪ Use this command in Soft AP mode.
▪ Check the MAC address of an STA that needs to send disassociation frame by using the command "AT+WFLCST".
▪ If the operation is not successful (for example, a wrong MAC address is specified), no operation results (+WFDST:<mac_addr>) are sent.</td></tr>
<tr><td rowspan="3">AT+WFWMM</td><td><wmm></td><td>Set WMM on/off.
<wmm>: 0 (off), 1 (on)
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get the WMM status.
Response: +WFWMM:<wmm></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Prerequisite
Soft AP mode.
Example
AT+WFWMM=1
OK

AT+WFWMM=?
+WFWMM:1
OK
Note:
▪ Enabled by default in the SDK.
▪ WMM is enabled by default. If WMM is enabled, Beacon/Probe Rsp/Assoc frames have WMM information. WMM enables QoS in the AC category.
▪ The configuration is stored in NVRAM.</td></tr>
<tr><td rowspan="3">AT+WFWMP</td><td><wmmps></td><td>Set WMM-PS (WMM Power Save) on/off.
<wmmps>: 0 (off), 1 (on)
Response: OK or ERROR</td></tr>
<tr><td>?</td><td>Get the WMM-PS status.
Response: +WFWMP:<wmmps></td></tr>
<tr><td colspan="2">Prerequisite
Soft AP mode.
Example
AT+WFWMM=0
OK

AT+WFWMM=?
+WFWMM:0
OK
Note:
▪ Enabled by default in the SDK.</td></tr>
</table>

Command	Parameters	Description
	▪ By default, WMM-PS is disabled. If WMM-PS is enabled, Beacon/Probe Rsp/Assoc Rsp frames sent from Soft AP have a U-APSD flag set. For WMM and WMM-PS to properly work, the STA should also have WMM and WMM-PS certified. ▪ The configuration is stored in NVRAM.	

Table 12. Wi-Fi function response list

Response	Parameters	Description
+WFJAP	<result>,<ssid>,<ip> <result>, <well-known-reason> [,<reason_code>]	The result of AP connection in STA mode (The result of AT+WFJAP or AT+WFJAPA or AT+WFCAP). <result>: 0 (failed), 1 (succeeded) For <result>: 1 <ssid>: SSID of the AP when succeeded <ip>: IP address of the station when succeeded For <result>: 0 <well-known-reason>: Connection trial failure reason in text format, TIMEOUT/WRONGPWD/ACCESSLIMIT/OTHER. ▪ TIMEOUT: Connection attempt failed after continuous connection attempts ▪ WRONGPWD: WPA 4-Way Handshake failed, pre-shared key (password) may be incorrect ▪ ACCESSLIMIT: Disconnected because the authorized access number limit was reached ▪ OTHER: Other reasons <reason_code>: If <well-known-reason> is OTHER, this field shows which reason caused the connection trial failure. See Appendix E. For example: +WFJAP:0,TIMEOUT +WFJAP:1,'ap_test',192.168.0.10 //The Wi-Fi connection is established, and the assigned IP address is 192.168.0.10.
+WFDAP	<reserved>, <well-known-reason> [,<reason_code>]	Disconnected from the AP. <reserved>: 0 <well-known-reason>: disconnection reason in text format, AUTH_NOT_VALID/DEAUTH/INACTIVITY/APBUSY/OTHER. ▪ AUTH_NOT_VALID: Previous authentication no longer valid ▪ DEAUTH: De-authenticated as STA is leaving ▪ INACTIVITY: Disassociated because of inactivity ▪ APBUSY: Disassociated because AP is unable to handle all currently associated STAs <reason_code>: If <well-known-reason> is OTHER, this field shows which reason caused the disconnection. See Appendix E. For example: +WFDAP:0,INACTIVITY +WFDAP:0,DEAUTH +WFDAP:0,OTHER,8 ◊ WLAN_REASON_CLASS2_FRAME_FROM_NONAUTH_STA (8)
+WFCST	<mac>	A Wi-Fi station connected in Soft AP mode. <mac>: MAC address of the connected station
+WFDST	<mac>	The Wi-Fi station disconnected in Soft AP mode.

Response	Parameters	Description
		<mac>: MAC address of the disconnected station

5.4 Wi-Fi Function Commands for WPA3

You can configure the DA16200/DA16600 as WPA3 STA or WPA3 Soft AP. WPA3 Personal is enabled by default in the SDK v3.2.5.0 or later. For older SDKs, WPA3 is not enabled by default, contact Renesas Electronics. Syntax of all the Wi-Fi function commands is the same as described in Table 13 apart from the following commands where it needs to specify WPA3 specific parameters.

Table 13. WPA3-related Wi-Fi function command list

Command	Parameters	Description
AT+WFJAP	See AT+WFJAP	
	Example AT+WFJAP=MY_AP_SSID,5 //WPA3 OWE OK +WFJAP:1,'MY_WPA3_AP_SSID',192.168.0.7 AT+WFJAP=MY_AP_SSID,5,1 //WPA3 OWE + hidden SSID OK +WFJAP:1,'MY_AP_SSID',192.168.43.32 AT+WFJAP=MY_AP_SSID,6,1,N12345678 //WPA3 SAE security OK +WFJAP:1,'MY_WPA3_AP_SSID',192.168.0.7 AT+WFJAP=MY_AP_SSID,6,1,12345678,1 //WPA3 SAE + hidden AP OK +WFJAP:1,'MY_AP_SSID',192.168.0.7 AT+WFJAP=MY_AP_SSID,7,1,N12345678 //WPA2(RSN)+WPA3 SAE security OK +WFJAP:1,'MY_WPA3_AP_SSID',192.168.0.7 AT+WFJAP=? +WFJAP:'MY_AP_SSID',6,1,'N12345678' OK	
AT+WFJAPBSSID	See AT+WFJAPBSSID	
	Example AT+WFJAPBSSID=01:02:03:04:05:06,MY_AP_SSID,5 //WPA3 OWE OK +WFJAP:1,'MY_WPA3_AP_SSID',192.168.0.7 AT+WFJAPBSSID=01:02:03:04:05:06,MY_AP_SSID,5,1 //WPA3 OWE + hidden SSID OK +WFJAP:1,'MY_AP_SSID',192.168.43.32 AT+WFJAPBSSID=01:02:03:04:05:06,MY_AP_SSID,6,1,N12345678 //WPA3 SAE security OK	

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">+WFJAP:1,'MY_WPA3_AP_SSID',192.168.0.7

AT+WFJAPBSSID=01:02:03:04:05:06,MY_AP_SSID,6,1,12345678,1 //WPA3 SAE + hidden AP
OK
+WFJAP:1,'MY_AP_SSID',192.168.0.7

AT+WFJAPBSSID=01:02:03:04:05:06,MY_AP_SSID,7,1,N12345678 //WPA2(RSN)+WPA3 SAE security
OK
+WFJAP:1,'MY_WPA3_AP_SSID',192.168.0.7

AT+WFJAPBSSID=?
+WFJAP:'MY_AP_SSID',6,1,'N12345678',01:02:03:04:05:06
OK</td></tr>
<tr><td rowspan="4">AT+WFJAPA3</td><td><wpa3_flag>,<ssid>[,<key>][,<hidden>]</td><td>Connect to an AP which includes WPA3 type.
▪ <wpa3_flag>: WPA2/WPA3 AP-type
If 1, WPA3-AP.
If 0, WPA/WPA2-AP.
▪ If <key> exists, security protocol is WPA+WPA2 and encryption is TKIP+AES.
▪ If <key> is omitted, security protocol is OPEN.
▪ <hidden>: 1 (<ssid> is hidden), 0 or [not specified] (<ssid> is NOT hidden)
▪ If <hidden> is omitted, <ssid> is not hidden.
• <ssid>: AP SSID
• <key>: Passphrase. 8 ~ 63 characters are allowed
Response: OK or ERROR
Operation Results:
+WFJAP:<OPS_RESULT>['<SSID>','<IP_ADDRESS>']
+WFJAP:<OPS_RESULT>,<REASON>,[<REASON_CODE>]
<OPS_RESULT>: 1 (SUCCESS), 0 (FAILED)
▪ If <OPS_RESULT>: 1
▪ <SSID>: The SSID is surrounded by single quotation mark
▪ <IP_ADDRESS>: Assigned IP address and format is xxx.xxx.xxx.xxx
▪ If <OPS_RESULT>: 0
▪ <REASON>: well-known reason in text
▪ <REASON_CODE>: if < REASON > is OTHER, this shows the reason code.
For an explanation of <REASON> or <REASON_CODE>, See Table 12.</td></tr>
<tr><td>?</td><td rowspan="2">Get the AP profile information (SSID and Passphrase only).
Operation Results:
If Wi-Fi connection is success:
+WFJAPA3:'<SSID>','<Passphrase>'
If Wi-Fi connection fails:
ERROR:-425 (No SSID found)</td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Example
AT+WFJAPA3=0,WPA2_AP_SSID //Open mode
OK
+WFJAP:1,'WPA2_AP_SSID',192.168.0.2</td></tr>
</table>

Command	Parameters	Description
		AT+WFJAPA3=0,WPA2_AP_SSID,1 //Open mode + hidden SSID OK +WFJAP:1,'WPA2_AP_SSID',192.168.0.2 AT+WFJAPA3=0,WPA2_AP_SSID,N12345678 //WPA2 security OK +WFJAP:1,'WPA2_AP_SSID',192.168.0.2 AT+WFJAPA3=0,WPA2_AP_SSID,N12345678,1 //WPA2 security + hidden AP OK +WFJAP:1,'WPA2_AP_SSID',192.168.0.2 AT+WFJAPA3=1,WPA3_AP_SSID //WPA3-OWE OK +WFJAP:1,'WPA3_AP_SSID',192.168.0.2 AT+WFJAPA3=1,WPA3_AP_SSID,N12345678 //WPA3-SAE security OK +WFJAP:1,'WPA3_AP_SSID',192.168.0.2 AT+WFJAPA3=1,WPA3_AP_SSID,N12345678,1 //WPA3-SAE + hidden AP OK +WFJAP:1,'WPA3_AP_SSID',192.168.0.2 AT+WFJAPA3=? +WFJAPA3:'MY_AP_SSID','N12345678' OK Note: ▪ Enabled by default in the SDK. ▪ The host should wait for both command response OK or ERROR and Operation Result; wait for OK, and +WFJAP:1,'<SSID>',<IP Address> for successful connection. ▪ Depending on the network condition, it may take more time to get an Operation Result because of internal connection re-trials. ▪ No system reboot happens after running this command. ▪ The AP configuration parameters (AP Profile) are stored in NVRAM. ▪ WPA3 Personal is enabled by default in the SDK v3.2.5.0 or later.
AT+WFJAPA3BSSID	<wpa3_flag>, <bssid>,<ssid> [,<key>][,<hidden>]	Connect to an AP which includes WPA3 type and matches the given BSSID. ▪ <wpa3_flag>: WPA2/WPA3 AP-type If 1, WPA3-AP. If 0, WPA/WPA2-AP. ▪ If <key> exists, security protocol is WPA+WPA2 and encryption is TKIP+AES. ▪ If <key> is omitted, security protocol is OPEN. ▪ <hidden>: 1 (<ssid> is hidden), 0 or [not specified] (<ssid> is NOT hidden) ▪ If <hidden> is omitted, <ssid> is not hidden. • <bssid>: BSSID

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td rowspan="3"></td><td></td><td>• <ssid>: AP SSID
• <key>: Passphrase. 8 ~ 63 characters are allowed
Response: OK or ERROR
Operation Results:
+WFJAP:<OPS_RESULT>[,'<SSID>','<IP_ADDRESS>']
+WFJAP:<OPS_RESULT>,<REASON>,[<REASON_CODE>]
<OPS_RESULT>: 1 (SUCCESS), 0 (FAILED)
▪ If <OPS_RESULT>: 1
▪ <SSID>: The SSID is surrounded by single quotation mark
▪ <IP_ADDRESS>: Assigned IP address and format is xxx.xxx.xxx.xxx
▪ If <OPS_RESULT>: 0
<REASON>: well-known reason in text
<REASON_CODE>: If < REASON > is OTHER, this shows the reason code.
For an explanation of <REASON> or <REASON_CODE>, See Table 12.</td></tr>
<tr><td>?</td><td rowspan="2">Get the AP profile information (SSID, Passphrase and BSSID).
Operation Results:
If Wi-Fi connection is success:
+WFJAPA3BSSID:'<SSID>','<Passphrase>',<BSSID>
If Wi-Fi connection fails:
ERROR:-425 (No SSID found)</td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Example
AT+WFJAPA3BSSID=0,01:02:03:04:05:06,WPA2_AP_SSID //Open mode
OK
+WFJAP:1,'WPA2_AP_SSID',192.168.0.2

AT+WFJAPA3BSSID=0,01:02:03:04:05:06,WPA2_AP_SSID,1 //Open mode + hidden SSID
OK
+WFJAP:1,'WPA2_AP_SSID',192.168.0.2

AT+WFJAPA3BSSID=0,01:02:03:04:05:06,WPA2_AP_SSID,N12345678 //WPA2 security
OK
+WFJAP:1,'WPA2_AP_SSID',192.168.0.2

AT+WFJAPA3BSSID=0,01:02:03:04:05:06,WPA2_AP_SSID,N12345678,1 //WPA2 security + hidden AP
OK
+WFJAP:1,'WPA2_AP_SSID',192.168.0.2

AT+WFJAPA3BSSID=1,01:02:03:04:05:06,WPA3_AP_SSID //WPA3-OWE
OK
+WFJAP:1,'WPA3_AP_SSID',192.168.0.2

AT+WFJAPA3BSSID=1,01:02:03:04:05:06,WPA3_AP_SSID,N12345678 //WPA3-SAE security
OK
+WFJAP:1,'WPA3_AP_SSID',192.168.0.2</td></tr>
</table>

Command	Parameters	Description
	AT+WFJAPA3BSSID=1,01:02:03:04:05:06,WPA3_AP_SSID,N12345678,1 //WPA3-SAE + hidden AP OK +WFJAP:1,'WPA3_AP_SSID',192.168.0.2 AT+WFJAPA3BSSID=? +WFJAPA3BSSID:'MY_AP_SSID','N12345678',01:02:03:04:05:06 OK Note: ▪ Enabled by default in the SDK and this command is available in SDK v3.2.9.0 or later. ▪ The host should wait for both command response OK or ERROR and Operation Result; wait for OK, and +WFJAP:1,'<SSID>',<IP Address> for successful connection. ▪ Depending on the network condition, it may take more time to get an Operation Result because of internal connection re-trials. ▪ No system reboot happens after running this command. ▪ The AP configuration parameters (AP Profile) are stored in NVRAM.	
AT+WFSAP	See AT+WFSAP	-
	Example AT+WFSAP=DA16200_MY_SSID,5,1,KR //WPA3 OWE +WFSAP:DA16200_MY_SSID OK AT+WFSAP=DA16200_MY_SSID,7,1,12345678,1,KR //WPA2 RSN & WPA3 SAE, AES +WFSAP:DA16200_MY_SSID OK AT+WFSAP=? +WFSAP:'DA16200_MY_SSID',7,1,'12345678',1,KR OK	

5.5 Wi-Fi Function Commands for WPA Enterprise

AT commands of the DA16200 provide Wi-Fi commands that can be used as STA in WPA-Enterprise environment. To connect to the WPA-Enterprise AP, the DA16200 needs to have profile information for the WPA-Enterprise AP and user account information.

Table 14. WPA-enterprise Wi-Fi function commands

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td rowspan="4">AT+WFENTAP</td><td><ssid>,<auth>,<enc>,
<phase1>,<phase2>
[,<hidden>]
(phase1=0|1|2|4)</td><td rowspan="2">Create Enterprise profile to NVRAM.
▪ <ssid>: Enterprise AP SSID
▪ <auth>: Authentication mode for WAP-Enterprise. 8 (WPA-EAP), 9 (WPA2-EAP), 10 (WPA/WPA2-EAP).
▪ <enc>: Encryption Type. 0 (TKIP), 1 (AES), 2 (TKIP+AES)
▪ <phase1>: Phase #1 EAP type. 0 (Mixed), 1 (PEAP0), 2 (PEAP1), 3 (FAST), 4 (TTLS), 5 (TLS)
▪ <pahse2>: Phase #2 EAP type. 0 (Mixed), 1 (MSCHAPV2), 2 (GTC). 3 (TLS)
▪ <hidden>: 1 (<ssid> is hidden), 0 or [not specified] (<ssid> is NOT hidden)
Response: OK or ERROR
Operation Results: +WFENTAP:<SSID></td></tr>
<tr><td><ssid>,<auth>,<enc>,
<phase1>[,<hidden>]
(phase1=3|5)</td></tr>
<tr><td>?</td><td rowspan="2">Get the WPA-Enterprise configuration.
Response:
+WFENTAP:<ssid>,<auth>,<enc>,<phase1>,<pahse2></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Example
AT+WFENTAP=MY_AP_SSID,10,2,0 //Phase#1 Mixed mode
OK
+WFENTAP:'MY_AP_SSID'

AT+WFENTAP=MY_AP_SSID,10,2,0,0 //Phase#1, #2 Mixed mode
OK
+WFENTAP:'MY_AP_SSID'

AT+WFENTAP=MY_AP_SSID,10,2,0,0,1 //Phase#1, #2 Mixed mode + hidden AP
OK
+WFENTAP:'MY_AP_SSID'

AT+WFENTAP=MY_AP_SSID,10,2,4,3 //Phase #1 (TTLS), #2 (TLS) mode
OK
+WFENTAP:'MY_AP_SSID'
Note:
▪ Enabled by default in the SDK v3.2.3.0 or later.
▪ WPA-Enterprise profile is stored in NVRAM.
▪ "EAP-FAST" type for <phase1> is not supported in SDK 3.2.3.0 and earlier SDK.
▪ If <phase1> is set to 5 (TLS) or <phase2> is set to 3 (TLS), the certificate for WPA enterprise is stored in SFlash (See Table 10).
▪ The mixed type of <phase1> selects one of Extensible Authentication Protocol (EAP) that is PEAP, FAST, or TTLS, except TLS.
▪ The mixed type of <phase2> selects one of EAP that is MSCHAPV2 or GTC, except TLS.
▪ If EAP-TLS or EAP-PEAP-TLS is required, it should be manually selected.
▪ Need user account to connect to WPA-Enterprise AP. See "AT+WFENTLI" command.</td></tr>
</table>

Command	Parameters	Description
	▪ System restart is required for changes to take effect.	
AT+WFENTLI	<id>[,<pw>]	Set User-ID/Password for WPA-Enterprise user account. <id>: Login-ID for WPA-Enterprise user account <pw>: Login-Password for WPA-Enterprise user account Response: OK or ERROR
	?	Get current saved User-ID/Password for WPA-enterprise user account. Response: OK or ERROR Operation Result: +WFENTLI:<id>,<pwd>
	(none)	
	Example AT+WFENTLI='USER_ACCOUNT_ID','USER_ACCOUNT_PWD' OK AT+WFENTLI +WFENTLI='USER_ACCOUNT_ID','USER_ACCOUNT_PWD' AT+WFENTLI=? +WFENTLI='USER_ACCOUNT_ID','USER_ACCOUNT_PWD' Note: ▪ Enabled by default in the SDK. ▪ User account ID and password are stored in NVRAM. ▪ System restart is required for changes to take effect.	

Table 15. WPA-enterprise network function command

Command	Parameters	Description
AT+NWTLSV	<ver>	Set the minimum accepted TLS protocol version when Phase#1 EAP type is TTLS or TLS of WPA Enterprise. The maximum accepted TLS protocol version is TLSv1.2. For example, If TLSv1.0 is set up, the version of TLS session can be TLSv1.0, TLSv1.1 or TLSv1.2. <ver>: Enterprise AP SSID. 0 <TLSv1.0>, 1 <TLSv1.1>, 2 <TLSv1.2> Response: OK or ERROR
	?	Get the currently saved TLS version. Response: +NWTLSV:<tls_version>
	(none)	
	Example AT+NWTLSV=NEW_TLS_VER OK AT+NWTLSV +NWTLSV:2 OK AT+NWTLSV=? +NWTLSV:2 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ TLS Version number is stored as internal value. ▪ The default minimum accepted TLS protocol version is TLSv1.2. ▪ System restart is required for changes to take effect.	

5.5.1 WPA-Enterprise Connection Example

Create WPA-Enterprise profile and restart the DA16200/DA16600 to start Wi-Fi connection. For all cases, WPA-Enterprise user account information is needed.

```
Case #1, "Mixed" mode for EAP-type.
In this case, Encryption-type is configured as "Mixed" mdoe.
EAP-type and Encryption type are selected automatically.
AT+WFENTAP='WPA-Ent-AP-SSID',10,2,0
AT+WFENTLI='WPA-Ent_User_ID','WPA-Ent_PWD'
AT+RESTART

Case #2, "Mixed" mode for EAP-type and Encryption type.
EAP-type and Encryption type are selected automatically.
AT+WFENTAP='WPA-Ent-AP-SSID',10,2,0,0
AT+WFENTLI='WPA-Ent_User_ID','WPA-Ent_PWD'
AT+RESTART

Case #3, in case of PEAP0 and MSCHAPV2 for WPA-Enterprise.
AT+WFENTAP='WPA-Ent-AP-SSID',10,2,1,1
AT+WFENTLI='WPA-Ent_User_ID','WPA-Ent_PWD'
AT+RESTART

Case #4, "Mixed" mode for EAP-type and set with TLS v1.0.
In this case, Encryption-type is configured as "Mixed" mdoe.
EAP-type and Encryption type are selected automatically.
AT+NWTLSV=1
AT+WFENTAP='WPA-Ent-AP-SSID',10,2,0
AT+WFENTLI='WPA-Ent_User_ID','WPA-Ent_PWD'
AT+RESTART

Case #5, "EAP-TLS mode" and set with TLS v1.0.
In this case, Encryption-type is configured as "TLS" mode(passwordless).
AT+NWTLSV=1
AT+WFENTAP='WPA-Ent-AP-SSID',10,2,5
AT+WFENTLI='WPA-Ent_User_ID'
AT+RESTART

Case #6, "EAP-PEAP0-TLS mode" and set with TLS v1.0.
In this case, EAP-Encryption types are configured as "PEAP0" and "TLS" mode(passwordless).
AT+NWTLSV=1
AT+WFENTAP='WPA-Ent-AP-SSID',10,2,1,3
AT+WFENTLI='WPA-Ent_User_ID'
AT+RESTART
```

5.6 Advanced Function Commands

5.6.1 MQTT Commands

The commands in Table 16 are for configuring MQTT Client parameters. Restart the MQTT client for the configuration to take effect after running the commands.

NOTE
In DPM mode, stop the MQTT Client (AT+NWMQCL=0) first before running the configuration commands. If any configuration commands are running in DPM mode without stopping MQTT Client, it returns ERROR:-635.

Table 16. MQTT configuration command list

Command	Parameters	Description
AT+NWMQBR	<host_name>,<port>	Set the host name (or IP address) and the port number of the MQTT Broker. <host_name>: Broker's domain name, or IP address <port>: Broker's port number

Command	Parameters	Description
		Response: OK or ERROR
	?	Get the host name or IP address and the port number of the MQTT Broker. Response: +NWMQBR:<host_name>,<port>
	(none)	
	Prerequisite MQTT client should be disabled (+NWMQCL:0). Example AT+NWMQBR=192.168.0.65,1884 OK AT+NWMQBR=? +NWMQBR:192.168.0.65,1884 OK Note: ▪ Enabled by default in the SDK. ▪ The broker host name (or IP address) and port configured are stored in the NVRAM. ▪ MQTT restart is required for the new configuration to take effect.	
AT+NWMQQOS	<qos>	Set the MQTT QoS level. <qos>: 0 (at most once), 1 (at least once), 2 (exactly once) Response: OK or ERROR
	?	Get the MQTT QoS level. Response: +NWMQQOS:<qos>
	(none)	
	Prerequisite MQTT client should be disabled (+NWMQCL:0). Example AT+NWMQQOS=1 OK AT+NWMQQOS +NWMQQOS:1 OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ MQTT restart is required for the new configuration to take effect.	
AT+NWMQTLS	<tls>	Enable/disable the MQTT TLS function. <tls>: 1 (enable), 0 (disable) Response: OK or ERROR
	?	Get MQTT TLS status. Response: +NWMQTLS:<tls>
	(none)	
	Prerequisite Certificate should be stored. See Table 10. MQTT client should be disabled (+NWMQCL:0). Example AT+NWMQTLS=1	

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">OK

AT+NWMQTLS
+NWMQQOS:1
OK
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.
▪ MQTT restart is required for the new configuration to take effect.</td></tr>
<tr><td rowspan="3">AT+NWMQCS</td><td><clean_session></td><td><clean_session>: 1(session cleared), 0(session retained)
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get clean session status.
Response: +NWMQCS:<clean_session></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Prerequisite
MQTT client should be disabled (+NWMQCL:0).
Example
AT+NWMQCS=1
OK

AT+NWMQCS=?
+NWMQCS:1
OK
Note:
▪ Enabled by default in SDK v3.2.3.0.
▪ The configuration is stored in NVRAM.
▪ To disable/enable this feature, use __MQTT_CLEAN_SESSION_MODE_SUPPORT__ in config_generic_sdk.h.
▪ If __MQTT_CLEAN_SESSION_MODE_SUPPORT__ is not defined, MQTT client always connects to a mqtt broker in CleanSession=1 mode.
▪ MQTT reconnection is required for this new configuration to take effect.
▪ See MQTT Example: Using CleanSession=0.</td></tr>
<tr><td rowspan="3">AT+NWMQTS</td><td><num>,<topic#1>,
<topic#2>,
…</td><td><num>: Number of topics
<topic#n>: MQTT subscriber topic(s). Max topic length = 64
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get the MQTT subscriber topic(s).
Response: +NWMQTS:<num>,<topic#1>,<topic#2>,…</td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Prerequisite
MQTT client should be disabled (+NWMQCL:0).
Example
AT+NWMQTS=?
ERROR:-654

AT+NWMQTS=1,da16k_sub
OK</td></tr>
</table>

Command	Parameters	Description
	AT+NWMQTS=? +NWMQTS:1,"da16k_sub" OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ Return "ERROR:-654" when there is no subscriber topic set. ▪ After this command is run, the previously configured subscriber topic(s) is(are) cleared and set to the new one(s). ▪ MQTT restart is required for the new configuration to take effect.	
AT+NWMQATS	<topic>	Add the specified topic to MQTT configuration.
	Prerequisite MQTT client should be disabled (+NWMQCL:0). Example AT+NWMQATS=ABCD OK AT+NWMQTS=? +NWMQTS:1,"ABCD" OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ Query command (AT+NWMQATS=?) not supported. If AT+NWMQATS=? Is run, "?" is added as a topic.	
AT+NWMQDTS	<topic>	Delete the specified topic from MQTT configuration.
	Prerequisite MQTT client should be disabled (+NWMQCL:0). Example AT+NWMQTS=? +NWMQTS:2,"ABCD","EFGH" OK AT+NWMQDTS=ABCD OK AT+NWMQTS=? +NWMQTS:1,"EFGH" OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is erased from NVRAM.	
AT+NWMQTP	<topic>	Set a topic of the MQTT publisher. <topic>: MQTT publisher topic Response: OK or ERROR
	?	Get the MQTT publisher topic. Response: +NWMQTP:<topic>
	(none)	

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">Prerequisite
MQTT client should be disabled (+NWMQCL:0).
Example
AT+NWMQTP=?
ERROR:-662

AT+NWMQTP=da16k_pub
OK

AT+NWMQTP=?
+NWMQTP:da16k_pub
OK
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.
▪ "ERROR:-662" means "No Publish topic exists".
▪ MQTT restart is required for the new configuration to take effect.
▪ There is one slot for storing a publish topic so that the stored topic is replaced with new one if the AT command is re-issued.</td></tr>
<tr><td rowspan="3">AT+NWMQV311</td><td><use_v311></td><td><use_v311>: 1 (v3.1.1)/0 (v3.1)</td></tr>
<tr><td>?</td><td>Show the MQTT protocol version currently set.</td></tr>
<tr><td colspan="2">Prerequisite
MQTT client should be disabled (+NWMQCL:0).
Example
AT+NWMQV311=?
+NWMQV311:0
OK

AT+NWMQV311=1
OK

AT+NWMQV311=?
+NWMQV311:1
OK
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.
▪ MQTT restart is required for the new configuration to take effect.</td></tr>
<tr><td rowspan="4">AT+NWMQPING</td><td><period></td><td>Set MQTT ping period.
<period>: Ping period (second)
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get the current MQTT ping period.
Response: +NWMQPING:<period></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Prerequisite
MQTT client should be disabled (+NWMQCL:0).
Example</td></tr>
</table>

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">AT+NWMQPING=?
+NWMQPING:600
OK

AT+NWMQPING=300
OK

AT+NWMQPING
+NWMQPING:300
OK
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.
▪ MQTT restart is required for the new configuration to take effect.</td></tr>
<tr><td rowspan="4">AT+NWMQCID</td><td><client_id></td><td><client_id>: Client ID
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get the current MQTT Client ID.
Response: +NWMQCID:<client_id></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Prerequisite
MQTT client should be disabled (+NWMQCL:0).
Example
AT+NWMQCID=?
+NWMQCID:da16x_CCA4 //Generate a default CID if there is no CID stored in NVRAM.

AT+NWMQCID=client-1
OK

AT+NWMQCID
+NWMQCID:client-1
OK
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.
▪ MQTT restart is required for the new configuration to take effect.</td></tr>
<tr><td rowspan="3">AT+NWMQLI</td><td><name>,<pw></td><td><name>: ID
<pw>: Password
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get the MQTT login information.
Response: +NWMQLI:<name>,<pw></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Prerequisite
MQTT client should be disabled (+NWMQCL:0).
Example
AT+NWMQLI=?
ERROR:-673</td></tr>
</table>

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">AT+NWMQLI=da16k_user,12345678
OK

AT+NWMQLI
+NWMQLI:da16k_user,12345678
OK
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.
▪ "ERROR:-673" means "No user name exists".
▪ MQTT restart is required for the new configuration to take effect.</td></tr>
<tr><td rowspan="4">AT+NWMQAUTO</td><td><auto></td><td>Enable/Disable auto-start of MQTT Client at reboot.
<auto>: 1 (Enable), 0 (Disable)</td></tr>
<tr><td>?</td><td rowspan="2">Get the MQTT Client's auto start configuration status.
Response: +NWMQAUTO:<auto></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Prerequisite
MQTT client should be disabled (+NWMQCL:0).
Example
AT+NWMQAUTO=?
+NWMQAUTO:0
OK

AT+NWMQAUTO=1
OK

AT+NWMQAUTO
+NWMQAUTO:1
OK
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.
▪ Default is 0 (disable).
▪ MQTT restart is required for the new configuration to take effect.</td></tr>
<tr><td rowspan="4">AT+NWMQWILL</td><td><topic>,<msg>,<qos></td><td>Set MQTT Will message.
<topic>: Will topic
<msg>: Will message
<qos>: Will QoS. 0 (at most once), 1 (at least once), 2 (exactly once)
Response: OK or ERROR</td></tr>
<tr><td>?</td><td rowspan="2">Get the MQTT Will message.
Response: +NWMQWILL:<topic>,<msg>,<qos></td></tr>
<tr><td>(none)</td></tr>
<tr><td colspan="2">Prerequisite
MQTT client should be disabled (+NWMQCL:0).
Example
AT+NWMQWILL=?
ERROR:-664</td></tr>
</table>

Command	Parameters	Description
	Or ERROR:-665 AT+NWMQWILL=da16k_will,bye,0 OK AT+NWMQWILL +NWMQWILL:da16k_will,bye,0 OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ "ERROR:-664 or -665" means topic or message is missing. ▪ MQTT restart is required for the new configuration to take effect.	
AT+NWMQDEL	(none)	Reset the MQTT configurations. Response: OK or ERROR
	Prerequisite MQTT client should be disabled (+NWMQCL:0). Example AT+NWMQDEL OK Note: ▪ This command resets all MQTT configurations. ▪ The configuration is erased from NVRAM. ▪ If the MQTT client is running, run this command after the MQTT client is disabled by AT+NWMQCL=0.	

Table 17. MQTT operation command list

Command	Parameters	Description
AT+NWMQCL	<mqtt_client>	Enable/disable the MQTT client. <mqtt_client>: 0 (disable), 1 (enable) Response: OK or ERROR
	?	Get the MQTT client status. Response: +NWMQCL:<mqtt_client>
	(none)	
	Prerequisite The DA16200/DA16600 should be connected to AP. Example AT+NWMQCL=1 OK (If MQTT connection is established) AT+NWMQCL +NWMQCL:1 OK (If MQTT connection under progressing) AT+NWMQCL +NWMQCL:2	

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">OK

(If MQTT connection failed)
AT+NWMQCL
+NWMQCL:0
OK
Note:
▪ Enabled by default in the SDK.
▪ If the system restarts, then the MQTT client is not started automatically as this command is just to start/stop the MQTT client.
▪ Setting MQTT configuration parameters such as MQTT broker IP, port number, and subscriber topic, are required to complete before issuing this command.</td></tr>
<tr><td rowspan="2">AT+NWMQMSG</td><td><msg>[,<topic>,<retain>]</td><td>Publish an MQTT message.
<msg>: Message to be published
<topic>: MQTT topic (optional)
<retain>: Retain flag (optional)
Response: OK or ERROR
Operation Results:
Send Success: +NWMQMSGSND:1
Send Failure: +NWMQMSGSND:0,<err_code></td></tr>
<tr><td colspan="2">Prerequisite
MQTT client should be enabled (+NWMQCL:1).
Example
AT+NWMQMSG=Hello world !!!
OK
+NWMQMSGSND:1

AT+NWMQMSG='{"car":"red", "type":"bus"}'
OK
+NWMQMSGSND:1

AT+NWMQMSG=Hello
OK
+NWMQMSGSND:0,-6 //Failed to send because MQTT is not in connected state
Note:
▪ Enabled by default in the SDK v3.2.3.0 or later.
▪ If a single quotation is used in a message, it is surrounded by double quotation marks.
▪ In the default AT command image, the maximum total combined string length allowed for <msg> + <topic> should be less than or equal to 2066. So, if it needs to send a max length <msg> (2048 bytes long) with an explicit <topic> specified, the <topic> length should be 18 characters long or less. If it needs to send a message with the maximum length topic allowed (which is 64), send 2002 bytes <msg> in maximum.
▪ About Operation Results (+NWMQMSGSND:1 or +NWMQMSGSND:0,<err_code>):
• Depending on network conditions, a message publishing transaction (Qos 0, 1, 2) may take some time if a network condition is not good.
• A new async response +NWMQMSGSND:1 or +NWMQMSGSND:0 that comes after "OK" indicates either completion of a publish transaction or failure.
• In CleanSession=1 mode, if mqtt is disconnected, the host can immediately get +NWMQMSGSND:0, but in CleanSession=0 mode, +NWMQMSGSND:0 is not sent but instead</td></tr>
</table>

Command	Parameters	Description
	the transaction resumes when MQTT client reconnects. See MQTT Example: Using CleanSession=0.	
AT+NWMQUTS	<topic>	Unsubscribe from the specified topic.
	Prerequisite MQTT client should be enabled (+NWMQCL:1). Example AT+NWMQUTS=ABCD OK Note: ▪ Enabled by default in the SDK (available from SDK v3.2.3.0 or later). ▪ The configuration is erased from NVRAM. ▪ This command should be run while the MQTT client is in a connected state with Broker.	
AT+NWMQTT	<host_name>,<port>, <sub_topic>, <pub_topic>, <qos>,<tls> [,<username>, <password>, <run_reboot>]	Run the MQTT Client with options. After entering this command, the system reboots automatically. At reboot, the DA16200/DA16600 tries to connect to the MQTT broker after the Wi-Fi connection is successfully established. ▪ <host_name>: Broker's domain name or IP address ▪ <port>: Broker's port number ▪ <sub_topic>: MQTT subscriber topic ▪ <pub_topic>: MQTT publisher topic ▪ <qos>: MQTT QoS level. ▪ <tls>: Enable/disable MQTT TLS. 1 (enable), 0 (disable) ▪ <username>: Login ID (optional) ▪ <password>: Login password (optional) ▪ <run_reboot>: Device reboot option enable/disable (optional). 1 (reboot), 0 (mqtt configuration reflected without reboot), default (reboot). Response: OK or ERROR
	Prerequisite MQTT client should be disabled (+NWMQCL:0). Example AT+NWMQTT=192.168.0.65,1884,da16k_sub,da16k_pub,0,0 //The following examples are logs after the DA16200 reboots. +INIT:DONE,0 +WFJAP:1,'test_ap_ssid',192.168.0.88 +NWMQCL:1 Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ After the system reboots, the operation result is sent, see "+NWMQCL" response.	

Table 18 shows optional MQTT configuration commands for the MQTT brokers that require TLS ALPN, SNI, or Cipher Suite information from MQTT Client at the connection stage. These commands are enabled by default in SDK v3.2.3.0 or later.

Table 18. MQTT optional configuration commands

Command	Parameters	Description
AT+NWMQALPN	<num>, <alpn#1>, <alpn#2>, <alpn#3>	Set the TLS ALPN protocol name for MQTT. <num>: Number of ALPNs. The maximum number of ALPN is three. <alpn#n>: TLS ALPN protocol name. The maximum length of each ALPN protocol name is 24. Response: OK or ERROR
	?	Get the TLS ALPN(s) that was set. Response: +NWMQALPN:<num>,<alpn#1>,<alpn#2>,<alpn#3>
	Prerequisite MQTT client should be disabled (+NWMQCL:0). Example AT+NWMQALPN=? ERROR:-644 AT+NWMQALPN=2,alpn-protrol-name-an,alpn-protocol-name-ax OK AT+NWMQALPN +NWMQALPN:2,"alpn-protrol-name-an","alpn-protocol-name-ax" OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ The configuration is stored in NVRAM. ▪ If __MQTT_TLS_OPTIONAL_CONFIG__ is enabled in the SDK, this command should be enabled ▪ "ERROR:-644" means "No ALPN is set".	
AT+NWMQSNI	<sni>	Set TLS SNI for MQTT. <sni>: Server Name Indication. The maximum length of SNI is 64. Response: OK or ERROR
	?	Get the TLS SNI that was set. Response: +NWMQSNI:<sni>
	Prerequisite MQTT client should be disabled (+NWMQCL:0). Example AT+NWMQSNI=?AERROR:-648 AT+NWMQSNI=a38a9rhiu3roqb-ats.myserver.com OK AT+NWMQSNI +NWMQSNI: a38a9rhiu3roqb-ats.myserver.com OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ The configuration is stored in NVRAM. ▪ If __MQTT_TLS_OPTIONAL_CONFIG__ is enabled in the SDK, this command should be enabled ▪ "ERROR:-648" means "No SNI is set".	
AT+NWMQCSUIT	<cipher suite 1>,	Set TLS Cipher suites.

Command	Parameters	Description
	<cipher suite 2>, …	<cipher suite>: A hex decimal value of cipher suite. See Appendix D. The maximum number of cipher suites is 17. Response: OK or ERROR
	?	Get TLS cipher suites that were set. Response: +NWMQSNI:<number of cipher suites>,<cipher suite 1>,<cipher suite 2>,…
	Prerequisite MQTT client should be disabled (+NWMQCL:0). Example AT+NWMQCSUIT=? ERROR:-650 or ERROR:-651 AT+NWMQCSUIT=c024,c023,c00a,c009,c00d,c032 OK AT+NWMQCSUIT +NWMQCSUIT:6,c024,c023,c00a,c009,c00d,c032 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ The configuration is stored in NVRAM. ▪ If __MQTT_TLS_OPTIONAL_CONFIG__ is enabled in the SDK, this command should be enabled. ▪ "ERROR:-650 or -651" means "No CSUIT info is set". ▪ The hex pre-fix "0x" should be removed when one is typed. ▪ The DA16200/DA16600 does not support all the cipher suites because of memory limitation. Contact Renesas Electronics for using other cipher suites that are not specified in Appendix D.	

Table 19. MQTT response list

Response	Parameters	Description
+NWMQCL	<result> [,TOO_LONG_MSG_RX]	The result of the MQTT client connection. <result>: 0 (disconnected), 1 (connected) For example: ▪ +NWMQCL:1 • MQTT connection to the MQTT broker is successfully established ▪ +NWMQCL:2 • MQTT connection to the MQTT broker is under progressing ▪ +NWMQCL:0 • The MQTT connection is NOT successfully established +NWMQCL:0,TOO_LONG_MSG_RX Can be sent when the MQTT is disconnected by unsupported message length only if the current MQTT connection is with clean_session=0 and QoS greater than or equal to 1.
	Example //When MQTT connection to the MQTT broker is successfully established, +NWMQCL:1	

Response	Parameters	Description
	//When MQTT broker is down, +NWMQCL:0 Note: ▪ The DA16200/DA16600 Debug Console log (UART0). • When MQTT connection to the MQTT broker is successfully established, the DA16200/DA16600 sends "+NWMQCL:1" message to MCU (or AT command console). At this moment, the following log appears: >>> MQTT Client connection OK • When the MQTT broker is down, the DA16200/DA16600 sends "+NWMQCL:0" message to MCU (or AT command console) after retrying connection. In the console log, the following logs appear: *Failed to receive pkt. (0x38)* *Failed to read pkt(0x7880)* *MQTT Client disconnected ... (state=6)* *[SUB] REQ mqtt_restart (count=1)* *Connecting FAIL (0x38)* *Unable to connect (The connection was refused.)* *…* *[SUB] REQ mqtt_restart (count=5)* *Connecting FAIL (0x38)* *Unable to connect (The connection was refused.)* *[SUB] MAX Retry (Retry Cnt=6).* ▪ To get this Operation Result, it may take more time if the DA16200/DA16600 connection retrial happens depending on the test network condition. ▪ This message is also sent after AT+NWMQTT is run or if any MQTT configuration command is run and then the system is restarted. • The DA16200/DA16600 restarts if the AT command format is OK. ○ +INIT:DONE,0 message is sent as the DA16200/DA16600 boots up. ○ If usage of the AT command is not valid, the DA16200/DA16600 sends an ERROR message without restarting. • The DA16200/DA16600 tries to connect to the AP after rebooting. ○ +WFJAP:0,<reason> or +WFJAP:1,'<SSID>',<IP Address> as result of the Wi-Fi connection. ○ If the Wi-Fi connection information such as SSID or key is NOT stored correctly in the DA16200/DA16600 NVRAM, +WFJAP:x response is NOT sent and the MQTT connection is NOT attempted as well. Because the MQTT connection needs a successful Wi-Fi connection first. • The DA16200/DA16600 tries to connect to the MQTT broker after the Wi-Fi connection is established. The MQTT broker information is stored in NVRAM. Connection result. ○ +NWMQCL:0 or +NWMQCL:1 – is sent over UART1 as a result. ▪ NWMQCL:0 is sent when the Wi-Fi Link goes down because of the following conditions. • Sometimes, the host can get an unsolicited +NWMQCL:0 message when DPM wake-up under poor signal conditions with the AP connected. An example is when Wi-Fi connection with AP becomes unstable – such as when DPM Keepalive fails, Beacon loss detected. In these cases, as STA, the DA16200/DA16600 tries to get "Wi-Fi link" down and up to reconnect with AP (while doing this, Wi-Fi is disconnected and then reconnected). MQTT client, when this kind of situation is detected, tries to reconnect to Broker after forcing disconnection. When MQTT disconnection occurs, +NWMQCL:0 is sent to the host. On receipt of this unsolicited message, the host should wait for +NWMQCL:1. ▪ +NWMQCL:0,TOO_LONG_MSG_RX • If the current mqtt_client connection with Broker is configured with clean_session=0 and qos is greater than or equal to 1, +NWMQCL:0,TOO_LONG_MSG_RX can be sent to the host (exceptional case). This message indicates that mqtt_client is disconnected by receiving a message that exceeds the message length limit (2048) of da16x MQTT client. What the host	

<table>
<tr><th>Response</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">should do, in this situation, is configure clean_session to 1 and connect to Broker to delete the message and then disconnect from Broker and reconnect with clean_session=0 again to start over (a kind of Recovery). According to MQTT Spec, Broker keeps sending a message that was not Acked by the client. In this case, the long message (valid for Broker, but not valid for da16x MQTT client) can repeatedly be sent to da16x MQTT client unless connection with clean_session=1 is made from da16x MQTT client.
○ This response message is enabled by default in SDK v3.2.3.0.
○ Example recovery flow on receipt of +NWMQCL:0,TOO_LONG_MSG_RX.
...
//MQTT client is disconnected by receiving a message with unsupported length
+NWMQCL:0,TOO_LONG_MSG_RX
AT+NWMQCS=1 //Set clean_session=1
OK
//Connect to Broker (to clear the invalid long message)
AT+NWMQCL=1
OKtable

+NWMQCL:1
AT+NWMQCL=0 //Disconnect from Broker
+NWMQCL:0

OK
AT+NWMQCS=0 //Set clean_session=0
OK
AT+NWMQCL=1 //Connect to Broker with clean_session=0
OK

+NWMQCL:1</td></tr>
<tr><td rowspan="2">+NWMQMSG</td><td><msg>,<topic>,<length></td><td>Receive the MQTT message.
▪ <msg>: Message data
▪ <topic>: Received topic
▪ <length>: Message length</td></tr>
<tr><td colspan="2">Example
//When the DA16200/DA16600 receives a message from the MQTT publisher, the following message is sent from the DA16200/DA16600 to AT command console:

+NWMQMSG:Hello world!!!!,da16k_sub,15
Note: MQTT client is in a connected state with the broker (+NWMQCL:1).</td></tr>
</table>

5.6.1.1 MQTT Client Connection Example

```
Configure the parameters and start the MQTT Client (After Wi-Fi Connection):
AT+NWMQBR=172.16.0.1,1884
AT+NWMQTS=1,da16k_sub
AT+NWMQTP=da16k_pub
AT+NWMQAUTO=1 (Optional, if DPM mode is used, setting this parameter is needed)
AT+NWMQCL=1
If the connection is successful, the following is shown:
+NWMQCL:1
If DA16K receives a PUBLISH from a broker, the following is shown:
+NWMQMSG:Hello World,da16k,11
DA16K can send a PUBLISH to a broker. Type the following command:
AT+NWMQMSG='Hello I'm DA16K'
```

5.6.1.2 MQTT TLS Connection Example

```
Configure the MQTT parameters:AT+NWMQBR=172.16.0.1,8883
AT+NWMQTS=1,da16k_sub
AT+NWMQTP=da16k_pub
AT+NWMQTLS=1
AT+NWMQAUTO=1 (Optional, if DPM mode is used, setting this parameter is needed)
To check the validity of a certificate, the DA16K should set the exact current time:
AT+TIME=yyyy-mm-dd,hh:mm:ss
And store the certificate and private key if needed. (See <ESC>C in Table 10)
After all settings are made, start the client:
AT+NWMQCL=1
```

5.6.1.3 MQTT Example with DPM

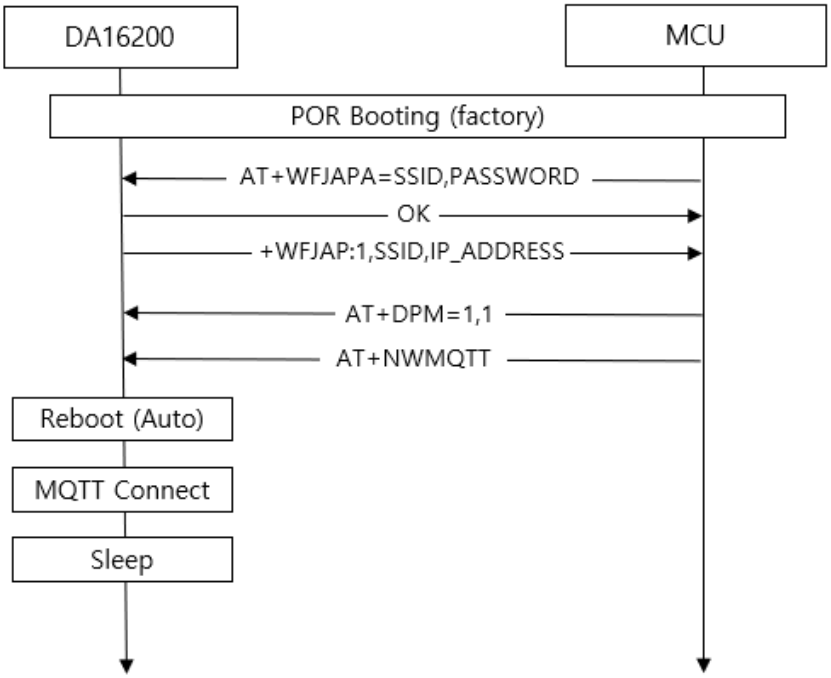


Figure 22. Example sequence to initiate MQTT protocol with DPM

Figure 22 is an example sequence to initiate the MQTT protocol with DPM in the DA16200/DA16600. In the normal BOOT state, connect to an AP (AT+WFJAPA) and change its run mode to DPM mode (AT+DPM=1,1. It is an optional parameter and "1" means writing DPM mode to NVRAM and does not reboot. To make DPM mode take effect, a reboot is required).

To configure the MQTT connection information, enter command AT+CLRDPMSLPEXT and type the following as an example:

```
AT+NWMQTT=test.mosquitto.org,1883,sub_topic,pub_topic,0,0
```

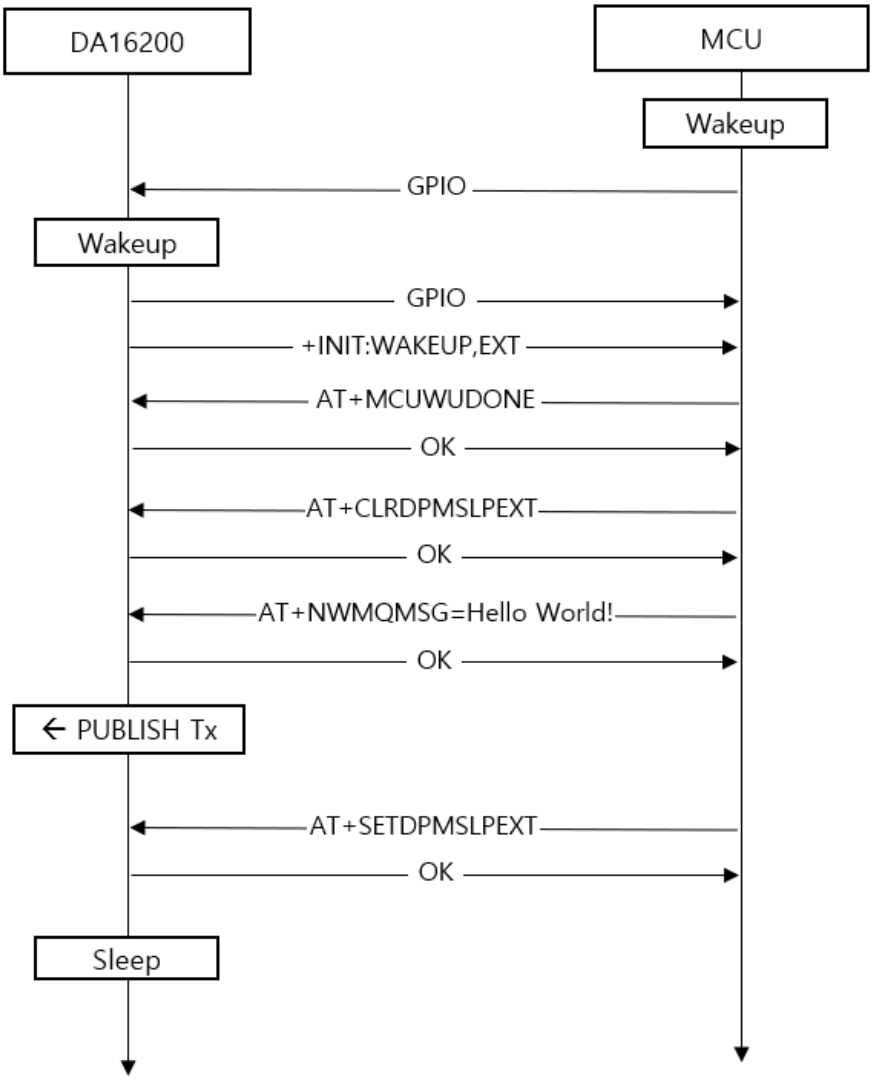


Figure 23. Procedure to send MQTT messages

Figure 23 shows the procedure to send an MQTT message in Sleep mode. When MCU wakes up the DA16200/DA16600, the response +INIT:WAKEUP,EXT is sent. The MCU sends the command AT+MCUWUDONE to inform that MCU is ready to operate. To prevent the DA16200/DA16600 entering DPM LPM, MCU should send command AT+CLRDPMSLPEXT before an MQTT PUBLISH is sent. To make the DA16200/DA16600 enter DPM LPM again, send a PUBLISH with command AT+NWMQMSG, and then enter command AT+SETDPMSLPEXT.

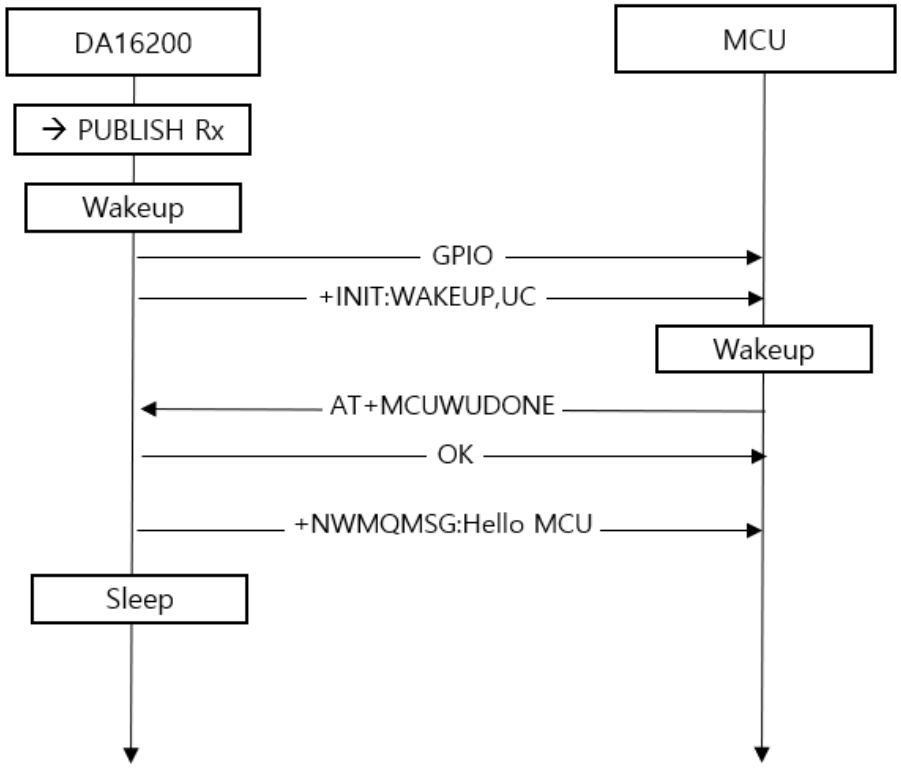


Figure 24. Procedure to process MQTT messages

Figure 24 shows how to process a received MQTT message while in Sleep mode. When the DA16200/DA16600 wakes up by a PUBLISH message from an MQTT broker, the response +INIT:WAKEUP,UC is sent. The MCU sends the AT+MCUWUDONE to inform that it is ready to operate. Next, the DA16200/DA16600 sends the received PUBLISH to the MCU and enters DPM LPM again.

5.6.1.4 MQTT Example: Changing Subscription Topic when Running

Assume that the Wi-Fi/MQTT connection is configured properly and DPM is set to 1 (TRUE). The following example is the recommended sequence and double quotation marks are used.

```
 Trigger RTC_WAKE_UP Event (by MCU)
 Wait for "+INIT:WAKEUP,EXT" Response. Send AT+MCUWUDONE, and wait for "OK"
 Run "AT+CLRDPMSLPEXT" command
 Wait for "OK" response
 loop running "AT+NWMQCL=?"
 if responses are "+NWMQCL:0" and "OK"
      then, goto E. to run "AT+NWMQCL=?" command
 else if responses are "+NWMQCL:1" and "OK"
      then, goto next, F.
 else if response is "ERROR:x"
      then, Run "AT+SETDPMSLPEXT"
            Wait for "OK" response
            return
 Run "AT+NWMQCL=0"
 Wait for "+NWMQCL:0" and "OK" response
 Run "AT+NWMQTS=<New MQTT Subscription Topic>"
 Wait for "OK" response
Run "AT+RESTART"
Wait for "+INIT:DONE,0" response
Wait for "+WFJAP:1,'<SSID>',<IP ADDRESS>"
Wait for "+NWMQCL:1" response
```

5.6.1.5 MQTT Example: Reading Subscription Topic when Running

Assume that the Wi-Fi/MQTT connection is configured properly and DPM is set to 1 (TRUE). The reading of the MQTT publishing topic should be similar. The following example is the recommended sequence and double quotation marks are used.

```
Trigger RTC_WAKE_UP Event
Wait for "+INIT:WAKEUP,EXT" Response. Send AT+MCUWUDONE, and wait for "OK"
Run "AT+CLRDPMSLPEXT" command
Wait for "OK" response
Run "AT+NWMQTS=?"
Wait for "+NWMQTS:<MQTT Subscription Topic>" and "OK" response
Note that there are possibilities to receive the ERROR response if the format of the command has some
errors.
Run "AT+SETDPMSLPEXT"
Wait for "OK" response
```

Assume that the Wi-Fi/MQTT connection is configured properly and DPM is set to 1 (TRUE). The reading of the MQTT publishing topic should be similar. The following example is the recommended sequence and double quotation marks are used.

```
Trigger RTC_WAKE_UP Event
Wait for "+INIT:WAKEUP,EXT" Response. Send AT+MCUWUDONE, and wait for "OK"
Run "AT+CLRDPMSLPEXT" command
Wait for "OK" response
Run "AT+NWMQTS=?"
Wait for "+NWMQTS:<MQTT Subscription Topic>" and "OK" response
Run "AT+SETDPMSLPEXT"
```

5.6.1.6 MQTT Example: Using CleanSession=0

5.6.1.6.1 CleanSession=0 Mode

When an MQTT Client (MQTTC) establishes connection with an MQTT Broker (Broker), there are two types of session: CleanSession=1 and CleanSession=0.

CleanSession=1: default session type. When Broker gets a connect request from an MQTTC that tries to connect with an option "CleanSession=1" (which is default config on DA16x), Broker treats the connection as a "new" session. If there is any existing session associated with the same client_id found, Broker clears that previous session and creates a new one with the client_id.

CleanSession=0: when Broker gets a connect request from an MQTTC that tries to connect with an option "CleanSession=0", Broker tries to find a session (session data) with the same client_id first. If it finds one, it keeps using that session for the new MQTTC.

While MQTTC is in operation with Broker, there may be times when the TCP connection gets unstable and disconnected (for example, MQTT ping failed) which may cause some messages that were published to Broker at that specific disconnected time may not be delivered to a subscriber. If new messages (with QoS > 0) are published to Broker and for sessions that were configured in "CleanSession=0", Broker retains and re-send them when the MQTTC is reconnected. MQTTC (if CleanSession=0 is enabled) also should retain the state of the unfinished/unacked messages until reconnection.

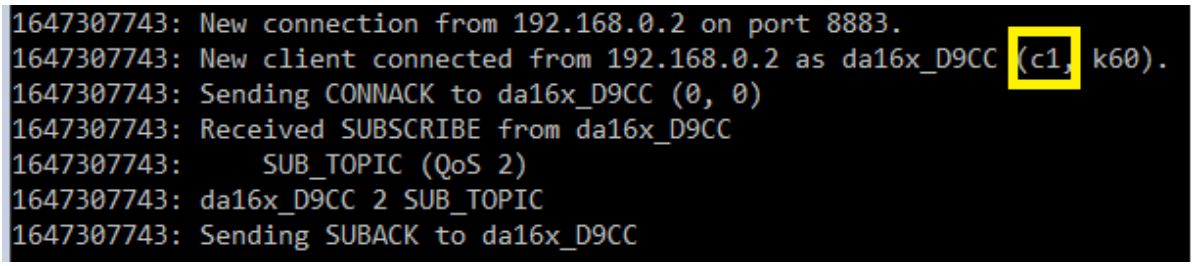


Figure 25. Broker console – CleanSession=1 connection

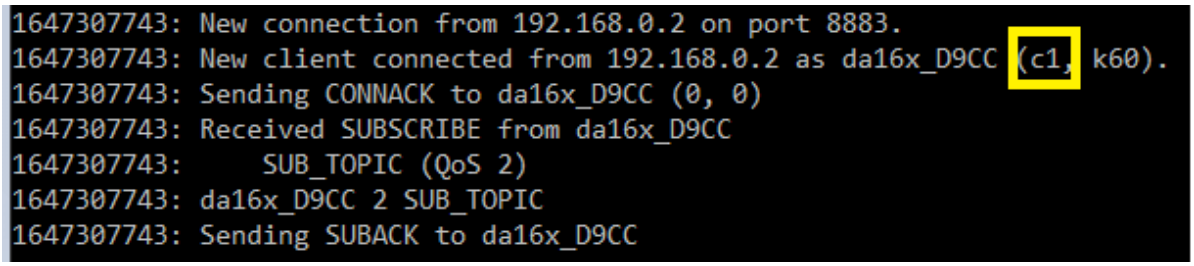


Figure 26. Broker console – CleanSession=0 connection

Even with CleanSession=0 connection, Broker does not maintain session data if MQTT is disconnected in the following cases.

- If a new message is published with QoS 0 after MQTT is disconnected
- If MQTTC connection QoS is 0

DA16x supports CleanSession=0 mode in the following way.

- "CleanSession=0 feature" is enabled by default in SDK v3.2.3.0 or later.
- If a customer application decides that QoS 1 or QoS 2 and CleanSession=0 is used in their application, the message (payload) size (both TX and RX) should be pre-decided (because there is limitation in DPM user pool size). By default, 100 bytes are defined.

  ```
  #define MQTT_MSG_TBL_PRESVD_MAX_PLAYLOAD_LEN 100
  ```
- Depending on the application's expected maximum payload size while operation, other values can be defined.
- DPM User Pool has a limited amount (about 8K in total) in the system.
- Check available "free" DPM User Pool size first (by using the console command "dpm user_pool") and then calculate the max payload length and message number for the application if needed.
- The default configuration (payload_len: 100, max_count: 10) allocates about 1.9 kB of DPM user pool (Check mq_msg_tbl_presvd_t for more information).
- Search for the following compiler options in `config_generic_sdk.h`.

  ```
  //max payload length of a preserved message
  #define MQTT_MSG_TBL_PRESVD_MAX_PLAYLOAD_LEN 100
  //max number of preserved messages
  #define MQTT_MSG_TBL_PRESVD_MAX_MSG_CNT                    10
  ```
- Supported command to set CleanSession mode: AT+NWMQCS=<1|0>.

CleanSession and QoS Matrix Table for PUBLISH RX

Table 20. CleanSession and QoS matrix in message RX

Subscriber			Unacked message delivery (After MQTT reconnection)	QoS (Effective actual)	Publisher message's QoS
Case	Clean session	QoS			
1	1	0	X	0	0
2	1	1	X	0	0
3	1	2	X	0	0
4	1	0	X	0	1
5	1	1	X	1	1
6	1	2	X	1	1
7	1	0	X	0	2
8	1	1	X	1	2
9	1	2	X	2	2
10	0	0	X	0	0
11	0	1	X	0	0

Subscriber			Unacked message delivery (After MQTT reconnection)	QoS (Effective actual)	Publisher message's QoS
Case	Clean session	QoS			
12	0	2	X	0	0
13	0	0	X	0	1
14	0	1	O	1	1
15	0	2	O	1	1
16	0	0	X	0	2
17	0	1	O	1	2
18	0	2	O	2	2

With CleanSession=1, no unacked message delivery happens when MQTT reconnects occur (marked as x). With CleanSession=0, only case 14, 15, 17, and 18 make message redeliveries for messages that were delivered to Broker while the MQTTC was offline (marked as O).

CleanSession and QoS Matrix Table for PUBLISH TX

Expectation 1	An application assumes that it failed to send a message and waits until MQTT gets reconnected.
Behavior 1	An application sends messages again.
Expectation 2	An application assumes that it failed to send a message but resumes sending the message when MQTT reconnected.
Behavior 2	An application simply waits as MQTT sends the message automatically.

Table 21. CleanSession and QoS matrix in message TX

Publisher			Expectation if MQTT gets disconnected (while QoS 1/2 message is not fully acked or QoS 0 Send is being sent)	
Case	Clean Session	QoS		
1	1	0	Expectation 1	Behavior 1
2	1	1	Expectation 1	Behavior 1
3	1	2	Expectation 1	Behavior 1
4	0	0	Expectation 1	Behavior 1
5	0	1	Expectation 2	Behavior 2
6	0	2	Expectation 2	Behavior 2

When publishing a message from DA16x, the application's expectation and action/behavior may be different if CleanSession=0 and QoS 1 or 2 are used in some specific cases.

In normal network conditions, there is no difference in message send behavior between CleanSession=0 and CleanSession=1.

In some abnormal cases where QoS ½'s ACK message (PUBACK, PUBREC, PUBREL, or PUBCOMP) get lost because of some bad network conditions (which can cause MQTTC reconnection), CleanSession=0 can recover the previous message state and resume the communication with Broker.

However, if CleanSession=1 is used, when MQTTC is disconnected, it can safely re-transmit the message when MQTTC is reconnected. Depending on use cases of applications/host applications, either approach (CleanSession=0 or CleanSession=1) can be utilized.

5.6.1.6.2 How to Connect with CleanSession=0

```
AT+NWMQQOS=2
OK
AT+NWMQCS=0
OK
AT+NWMQCL=1
OK

+NWMQCL:1
```

To activate "CleanSession=0 support mode" in DA16x, QoS should be 1 or 2 and CleanSession option should be set to 0. If either option (CleanSession and QoS) is not set as above, CleanSession=0 support mode is disabled.

5.6.1.6.3 How to Restart CleanSession=0 Test

If it needs to re-test (fresh new test) with CleanSession=0 mode, depending on the previous session type, it may need Broker to clear the previous session.

The reason is that since MQTTC connects with CleanSession=0, Broker does not delete the session data until MQTTC reconnects with CleanSession=1.

Case 1: Previous session is CleanSession=1 and need to restart a new CleanSession=0 test.

```
AT+NWMQCL=0
OK
AT+NWMQCS=0
OK
AT+NWMQCL=1
OK

+NWMQCL:1
```

Case 2: Previous session is CleanSession=0 and needs to re-test another CleanSession=0 test run.

```
AT+NWMQCL=0
+NWMQCL:0

OK
AT+NWMQCS=1
OK
AT+NWMQCL=1
OK

+NWMQCL:1
AT+NWMQCL=0
+NWMQCL:0

OK
AT+NWMQCS=0
OK
AT+NWMQCL=1
OK

+NWMQCL:1
```

5.6.1.6.4 PUBLISH RX Test Steps

Test steps are as follows under Non-DPM and DPM mode.

Non-DPM Mode:

- DA16x: connect to Broker
- Publisher: send one or two messages
- DA16x: check if the messages are received

- DA16x: disconnect from Broker
- Publisher: send one or two messages (let say msg_A)
- DA16x: reconnect to Broker
- DA16x: check if msg_A (sent while DA16x is offline) is received.

DPM Mode:

- DA16x: connect to Broker. Enter DPM LPM
- Publisher: send one or two messages
- DA16x: check if the messages are received
- DA16x: turn off AP. Do not turn on AP, but wait for the MQTT keep alive period (to make sure Broker recognizes the MQTTC disconnection)
- Publisher: send one or two messages (let say msg_A)
- DA16x: turn on AP. Wait until DA16x is connected to AP
- DA16x: reconnected to AP and check if msg_A (sent while DA16x is offline) is received.

NOTE

- Mosquitto broker (Broker), Mosquitto publisher (Publisher), and DA16x (Subscriber) are used for the test.
- Message length from publisher should be less than or equal to 100. If longer messages are sent, they may not be restored properly when MQTT is reconnected.

5.6.1.6.5 PUBLISH RX Test Steps - Example 1 (Non-DPM)

The following examples are the test steps for case 15 (Non-DPM mode).

[DA16x] connect Mqttc with CleanSession=0 and QoS 2.

```
AT+NWMQQOS=2
OK
AT+NWMQCS=0
OK
AT+NWMQCL=1
OK

+NWMQCL:1
```

[Other Publisher] publish messages.

```
C:\mosquitto>mosquitto_pub -h 192.168.0.230 -p 8883 --cafile cas.pem --cert wifiuser.pem --key
wifiuser.key --tls-version tlsv1 --insecure -q 2 -t SUB_TOPIC -m "Hello_q2"

C:\mosquitto>mosquitto_pub -h 192.168.0.230 -p 8883 --cafile cas.pem --cert wifiuser.pem --key
wifiuser.key --tls-version tlsv1 --insecure -q 2 -t SUB_TOPIC -m "Hello_q2_2"
```

[DA16x] check that the messages are successfully received.

```
+NWMQMSG:Hello_q2,SUB_TOPIC,8

+NWMQMSG:Hello_q2_2,SUB_TOPIC,10
```

[DA16x] disconnect from Broker.

```
AT+NWMQCL=0
+NWMQCL:0

OK
```

[Other Publisher] publish two messages (while DA16x is in disconnected state)

```
C:\mosquitto>mosquitto_pub -h 192.168.0.230 -p 8883 --cafile cas.pem --cert wifiuser.pem --key
wifiuser.key --tls-version tlsv1 --insecure -q 2 -t SUB_TOPIC -m "Hello_q2_3"
```

```
C:\mosquitto>mosquitto_pub -h 192.168.0.230 -p 8883 --cafile cas.pem --cert wifiuser.pem --key
wifiuser.key --tls-version tlsv1 --insecure -q 2 -t SUB_TOPIC -m "Hello_q2_4"
```

[DA16x] reconnect to Broker and check if the two messages that were published while DA16x is in disconnected state are received successfully.

```
AT+NWMQCL=1
OK

+NWMQCL:1

+NWMQMSG:Hello_q2_3,SUB_TOPIC,10

+NWMQMSG:Hello_q2_4,SUB_TOPIC,10
```

5.6.1.6.6 PUBLISH RX Test Steps - Example 2 (DPM)

The following examples are the test steps for case 18 (DPM mode). Mosquitto broker and Mosquitto publisher are used for tests.

[DA16x] Connect with CleanSession=0 and QoS 2.

```
AT+NWMQQOS=2
OK
AT+NWMQCS=0
OK
AT+RESTART
OK

+INIT:DONE,0

+WFJAP:1,'SYN_TEST_AP',192.168.1.195

+ATPROV=STATUS 0

+NWMQCL:1
```

[Other Publisher] Publish messages.

```
C:\mosquitto>mosquitto_pub -h 192.168.0.230 -p 8883 --cafile cas.pem --cert wifiuser.pem --key
wifiuser.key --tls-version tlsv1 --insecure -q 2 -t SUB_TOPIC -m "Hello_q2_1"

C:\mosquitto>mosquitto_pub -h 192.168.0.230 -p 8883 --cafile cas.pem --cert wifiuser.pem --key
wifiuser.key --tls-version tlsv1 --insecure -q 2 -t SUB_TOPIC -m "Hello_q2_2"
```

[DA16x] check that the messages are successfully received.

```
+INIT:WAKEUP,UC

+ATPROV=STATUS 0

+NWMQMSG:Hello_q2_1,SUB_TOPIC,10

+INIT:WAKEUP,UC

+ATPROV=STATUS 0

+NWMQMSG:Hello_q2_2,SUB_TOPIC,10
```

NOTE
At wake-up time, the host should send AT+CLRDPMSLPEXT to get +NWMQMSG after which AT+SETDPMSLPEXT should be sent by the host to let DA16x enter DPM LPM.

[DA16x] Turn OFF AP.

```
+INIT:WAKEUP,NOBCN

+ATPROV=STATUS 0

+WFDAP:0,INACTIVITY
...
```

[Broker] make sure MQTTC is disconnected.

```
...
1647405247: Socket error on client da16x_D9CC, disconnecting.
...
```

[Other Publisher] publish two messages (while DA16x is in disconnected state).

```
C:\mosquitto>mosquitto_pub -h 192.168.0.230 -p 8883 --cafile cas.pem --cert wifiuser.pem --key
wifiuser.key --tls-version tlsv1 --insecure -q 2 -t SUB_TOPIC -m "Hello_q2_3"

C:\mosquitto>mosquitto_pub -h 192.168.0.230 -p 8883 --cafile cas.pem --cert wifiuser.pem --key
wifiuser.key --tls-version tlsv1 --insecure -q 2 -t SUB_TOPIC -m "Hello_q2_4"
```

[DA16x] Turn ON AP

[DA16x] Wait until AP is connected and see whether "hello_qos_3" and "hello_qos_4" are received.

```
+INIT:DONE,0

+WFJAP:1,'SYN_TEST_AP',192.168.1.195

+ATPROV=STATUS 0

+NWMQCL:1

+NWMQMSG:Hello_q2_3,SUB_TOPIC,10

+NWMQMSG:Hello_q2_4,SUB_TOPIC,10
```

5.6.1.6.7 PUBLISH Tx Test Steps

Test steps are as follows:

- DA16x: connect to Broker
- DA16x: send messages
- DA16x: check if the message sent is successful.

NOTE
Message length from the DA16200/DA16600 should be less than or equal to 100 bytes for case 5 and 6 configuration. Sending longer messages returns failure. For cases other than case 5 or 6, message length limit is 2048 bytes.

5.6.1.6.8 PUBLISH TX Test Steps – Example

The following examples are the test steps for case 6 (Non-DPM mode).

```
AT+NWMQQOS=2
OK
AT+NWMQCS=0
OK
AT+NWMQCL=1
OK

+NWMQCL:1
AT+NWMQMSG=hello_q2
OK
```

```
+NWMQMSGSND:1
```

5.6.2 HTTP-Client Commands

Table 22. HTTP-Client command list

Command	Parameters	Description
AT+NWHTC	<url>,<method>(,<body>)	Start the HTTP client with options. <url>: HTTP server address <method>: GET, POST or PUT <body>: Body for POST and PUT methods, omitted for other methods. For JSON type, enclose the message with the single quotation – <'body'>
	Prerequisite The DA16200/DA16600 should be connected to AP. Example 1: AT+NWHTC=http://httpbin.org/get,get OK Example 2: AT+NWHTC=http://httpbin.org/post,post,**HTTP-Client POST method sample test!** OK For JSON type, AT+NWHTC=http://httpbin.org/post,post,**'{ username: "aaa", password: "1234"}'** OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_HTTP_CLIENT_FOR_ATCMD__ is enabled in the SDK, this command should be enabled.	
	<url>,message,<'header+body'>	Users can directly input header and body as plain text. Line feeds and carriage returns are inserted as \r\n. <url>: HTTP server address message: Use the message as a fixed option (not the http method) <'header+body'>: Enter a plain text string in the form of 'header+body'
	Prerequisite The DA16200/DA16600 should be connected to AP. Example 1: GET method request (header). AT+NWHTC=http://httpbin.org/get,message,'GET /get HTTP/1.1\r\nHost: httpbin.org\r\nConnection: Close\r\n\r\n' OK Example 2: POST method request (header+body). AT+NWHTC=http://httpbin.org/post,message,'POST /postHTTP/1.1\r\nHost: httpbin.org\r\nAccept: */*\r\nContent-Length: 10\r\nConnection: Close\r\n\r\nHelloWorld\r\n' OK For JSON type, AT+NWHTC=http://httpbin.org/post,message,'POST /postHTTP/1.1\r\nHost: httpbin.org\r\nContent-Type: application/json\r\nContent-Length: 40\r\nConnection: Close\r\n\r\n{ username: "aaa", password: "1234"}\r\n' OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later.	

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">▪ If __SUPPORT_HTTP_CLIENT_FOR_ATCMD__ is enabled in the SDK, this command should be enabled.</td></tr>
<tr><td>AT+NWHTCH</td><td><url>,<method>(,<msg>)</td><td>AT+NWHTCH with H appended after AT+NWHTC.
All parameters and functions are the same as AT+NWHTC.
The difference is that data size is inserted in front of the received data and transmitted.
Start the HTTP client with options.
▪ <url>: HTTP server address
▪ <method>: GET, POST or PUT
▪ <msg>: Request message for POST and PUT methods</td></tr>
<tr><td></td><td colspan="2">Prerequisite
The DA16200/DA16600 should be connected to AP.
Example 1
AT+NWHTCH=https://httpbin.org/get,get
OK

+NWHTCDATA:225,HTTP/1.1 200 OK
Date: Fri, 02 Dec 2022 01:17:30 GMT
Content-Type: application/json
Content-Length: 297
Connection: close
Server: gunicorn/19.9.0
Access-Control-Allow-Origin: *
Access-Control-Allow-Credentials: true

+NWHTCDATA:297,{
"args": {},
"headers": {
"Accept": "*/*",
"Host":"httpbin.org",
"User-Agent": "lwIP/2.1.2 (http://savannah.nongnu.org/projects/lwip)",
"X-Amzn-Trace-Id": "Root=1-6389522a-4ceffbc701b0e20f348c5ecc"
},
"origin": "124.50.108.25",
"url": "https://httpbin.org/get"
}

+NWHTCSTATUS:0
Example 2
AT+NWHTCH=https://httpbin.org/post,post,HTTP-Client POST method sample test!
OK

+NWHTCDATA:225,HTTP/1.1 200 OK
Date: Fri, 02 Dec 2022 01:25:38 GMT
Content-Type: application/json
Content-Length: 426
Connection: close</td></tr>
</table>

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">Server: gunicorn/19.9.0
Access-Control-Allow-Origin: *
Access-Control-Allow-Credentials: true

+NWHTCDATA:426,{

"args": {},
"data": "HTTP-Client POST method sample test!"
,
"files": {},
"form": {},
"headers": {
"Accept": "*/*",
"Content-Length": "36",
"Host": "httpbin.org",
"User-Agent": "lwIP/2.1.2 (http://savannah.nongnu.org/projects/lwip)",
"X-Amzn-Trace-Id": "Root=1-63895412-4f92fb296482283c68e2155f"
},
"json": null,
"origin": "124.50.108.25",
"url": "https://httpbin.org/post"
}

+NWHTCSTATUS:0
Note:
▪ Enabled by default in the SDK v3.2.5.0 or later.
▪ If __SUPPORT_HTTP_CLIENT_FOR_ATCMD__ is enabled in the SDK, this command should be enabled.</td></tr>
<tr><td rowspan="2">AT+NWHTCSNI</td><td><sni></td><td>Set the server name indication.
<sni>: Server name</td></tr>
<tr><td colspan="2">Example
AT+NWHTCSNI=httpbin.org
OK
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.
▪ It must be set up before connecting to the server.</td></tr>
<tr><td rowspan="2">AT+NWHTCALPN</td><td><alpn_number>,<alpn1>,
<alpn2>,<alpn3></td><td>Set the application layer protocol negotiation.
<alpn_number>: Number of alps
▪ <alpn1>: First alpn
▪ <alpn2>: Second alpn
▪ <alpn3>: Third alpn</td></tr>
<tr><td colspan="2">Example
AT+NWHTCALPN=1,http/1.1
OK
Note:
▪ Enabled by default in the SDK.
▪ The configuration is stored in NVRAM.</td></tr>
</table>

Command	Parameters	Description
	▪ It must be set up before connecting to the server.	
AT+NWHTCSNIDEL	(none)	Delete the saved SNI
	Example AT+NWHTCSNIDEL OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is erased from NVRAM. ▪ It must be set up before connecting to the server.	
AT+NWHTCALPNDEL	(none)	Delete all saved ALPNs
	Example AT+NWHTCALPNDEL OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is erased from NVRAM. ▪ It must be set up before connecting to the server.	
AT+NWHTCTLSAUTH	<tls_auth_mode>	Set the certificate verification mode. #define MBEDTLS_SSL_VERIFY_NONE 0 #define MBEDTLS_SSL_VERIFY_OPTIONAL 1 #define MBEDTLS_SSL_VERIFY_REQUIRED 2
	Example AT+NWHTCTLSAUTH=1 OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM. ▪ It must be set up before connecting to the server.	

Table 23. HTTP-Client response list

Command	Parameters	Description
+NWHTCSTATUS	<status>	Return status along with the received payload according to the requested method. <status>: 0x00 is success See Appendix B. For example: +NWHTCSTATUS:0x00
+NWHTCDATA	<data size,>	Insert size information of data received only from AT+NWHTCH command. An integer data size and a comma are inserted, and the actual received data is after that. For example, +NWHTCDATA:426,

5.6.2.1 HTTP-Client Connection Example

GET method request:

```
AT+NWHTC=https://httpbin.org/get,get
OK
HTTP/1.1 200 OK
Date: Tue, 07 Dec 2021 01:19:49 GMT
Content-Type: application/json
```

```
Content-Length: 457
Connection: keep-alive
Server: gunicorn/19.9.0
Access-Control-Allow-Origin: *
Access-Control-Allow-Credentials: true

{
  "args": {},
  "headers": {
    "Accept": "*/*",
    "Accept-Encoding": "identity",
    "Accept-Language": "ko-KR,Ko;q=0.9,en-US;q=0.8,en;q=0.7",
    "Host": "httpbin.org",
    "User-Agent": "Mozilla/5.0 (windows NT 6.1; Win64; x64) AppleWebkit/537.36 (KHTML, like Gecko)
Chrome/64.0.3282.186 Safari/537.36",
    "X-Amzn-Trace-Id": "Root=1-61aeb6b5-67d7324c112a7f1631adcc72"
  },
  "origin": "124.50.108.25",
  "url": "https://httpbin.org/get"
}

+NWHTCSTATUS:0x00
```

POST method request:

```
AT+NWHTC=https://httpbin.org/post,post,HTTP-Client POST method sample test!
OK
HTTP/1.1 200 OK
Date: Tue, 07 Dec 2021 01:25:05 GMT
Content-Type: application/json
Content-Length: 586
Connection: keep-alive
Server: gunicorn/19.9.0
Access-Control-Allow-Origin: *
Access-Control-Allow-Credentials: true

{
  "args": {},
  "data": "HTTP-Client POST method sample test!",
  "files": {},
  "form": {},
  "headers": {
    "Accept": "*/*",
    "Accept-Encoding": "identity",
    "Accept-Language": "ko-KR,Ko;q=0.9,en-US;q=0.8,en;q=0.7",
    "Content-Length": "36",
    "Host": "httpbin.org",
    "User-Agent": "Mozilla/5.0 (windows NT 6.1; Win64; x64) AppleWebkit/537.36 (KHTML, like Gecko)
Chrome/64.0.3282.186 Safari/537.36",
    "X-Amzn-Trace-Id": "Root=1-61aeb7f1-341bbb8c3f3d6bc7484370e2"
  },
  "json": null,
  "origin": "124.50.108.25",
  "url": "https://httpbin.org/post"
}

+NWHTCSTATUS:0x00
```

PUT method request:

```
AT+NWHTC=https://httpbin.org/put,put,HTTP-Client PUT method sample test!
OK
HTTP/1.1 200 OK
Date: Tue, 07 Dec 2021 02:04:19 GMT
Content-Type: application/json
Content-Length: 584
Connection: keep-alive
Server: gunicorn/19.9.0
Access-Control-Allow-Origin: *
Access-Control-Allow-Credentials: true

{
  "args": {},
  "data": "HTTP-Client PUT method sample test!",
  "files": {},
  "form": {},
  "headers": {
    "Accept": "*/*",
    "Accept-Encoding": "identity",
    "Accept-Language": "ko-KR,Ko;q=0.9,en-US;q=0.8,en;q=0.7",
    "Content-Length": "35",
    "Host": "httpbin.org",
    "User-Agent": "Mozilla/5.0 (windows NT 6.1; Win64; x64) AppleWebkit/537.36 (KHTML, like Gecko)
Chrome/64.0.3282.186 Safari/537.36",
    "X-Amzn-Trace-Id": "Root=1-61aec123-4c3c5d390c6b31992bb803be"
  },
  "json": null,
  "origin": "124.50.108.25",
  "url": "https://httpbin.org/put"
}

+NWHTCSTATUS:0x00
```

5.6.3 HTTP-Server Commands

Table 24. HTTP-Server command list

Command	Parameters	Description
AT+NWHTS	<flag>	Start or stop the HTTP server depending on the option. <start>: 1 (start), 0 (stop) Response: OK or ERROR
	Prerequisite The DA16200/DA16600 should be connected to AP. Example AT+NWHTS=1 OK Note: Enabled by default in the SDK.	
AT+NWHTSS	<flag>	Start or stop the HTTPS server depending on the option. <start>: 1 (start), 0 (stop) Response: OK or ERROR
	Prerequisite The DA16200/DA16600 should be connected to AP. Example AT+NWHTSS=1 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_HTTP_SERVER_FOR_ATCMD__ is enabled in the SDK, this command should be enabled.	

5.6.3.1 HTTP/HTTPS-Server Start Example

HTTP start:

```
AT+NWHTS=1
```

HTTPS start:

```
AT+NWHTSS=1
```

5.6.4 WebSocket-Client Commands

Table 25. WebSocket-Client command list

Command	Parameters	Description
AT+NWWSC	<operation>, <uri> (<msg>), <subprotocol>	Start the WebSocket client with options. <operation> connect, send, or disconnect ▪ <uri>: WebSocket server address ▪ <msg>: Request message ▪ <subprotocol>: (optional) subprotocol field
	Prerequisite The DA16200/DA16600 should be connected to AP. Example 1 AT+NWWSC=connect,ws://192.168.86.182:8080 +NWWSC:1 Example 2 AT+NWWSC=send,Send Message Test OK Example 3 AT+NWWSC=disconnect +NWWSC:0 Option 1 AT+NWWSC= advanced_cfg,<ping_intv_sec>,<ping_time_out_sec>[,<buffer_size>] This command is optional, if not provided, it takes default values. <ping_intv_sec>: WebSocket ping interval, defaults to 10 seconds <ping_time_out_sec>: Period before connection is aborted because no PONGs received. Default is 120 seconds. <buffer_size>: WebSocket buffer size. Default is 4*1024 +NWWSC:0 Option 2 AT+NWWSC= header_ext,<header_length>[,<extended header>] This command is used for adding a WebSocket extension header. This is an optional configuration. <header_length>: length of the header extension. If 0, it clears the previously configured header extension. This command can only set one WebSocket extension header at a time, but it can be set multiple times to support multiple different WebSocket request headers. <extended header>: WebSocket additional headers +NWWSC:0 Option 3 AT+NWWSC=subprotocol,<set_flag>[,<subprotocol>] This command is used to configure the subprotocol. It is an optional command. <set_flag>: if 1, it adds the subprotocol provided in the command. If 0, it clears previously configured subprotocol. <subprotocol>: WebSocket subprotocol. This command can only set one subprotocol at a time, but it can be set multiple times to support multiple different WebSocket subprotocols. +NWWSC:0 Note: If __SUPPORT_WEBSOCKET_CLIENT__ is enabled in SDK, this command should be enabled.	

Table 26. Web Socket-Client response list

Response	Parameters	Description
+NWWSC	<status>(,<opcode>,<received msg length>,<received msg>)	Return status along with the received payload. <status> 0 is disconnected. 1 is connected. <opcode> Continuation Frame: 0x00 Text Frame: 0x01 Binary Frame: 0x02 Close Frame: 0x08 Ping Frame: 0x09 Pong Frame: 0x0a Example 1: +NWWSC:1 Example 2: +NWWSC:0 Example 3: +NWWSC:1,1,12,**Test Message**

5.6.5 OTA Commands

Table 27. OTA command list

Command	Parameters	Description
AT+NWOTADWSTART	<fw_type>,<uri>[,<fw_name>]	Start downloading firmware from an OTA server. ▪ <fw_type>: Set the type of firmware to be downloaded ▪ <uri>: Server URL where firmware exists ▪ <fw_name>: Optional. The maximum input size of fw_type is 7 bytes. MCU_FW is stored by default if not specified. (Only for MCU Firmware) Response: +NWOTADWSTART:0x00
	Prerequisite The DA16200/DA16600 should be connected to AP. Example //RTOS download AT+NWOTADWSTART=rtos,https://server/DA16200_RTOS-GEN01-01-1111-000000.img OK +NWOTADWSTART:0x00 //Bluetooth® LE firmware download (DA16600 only) AT+NWOTADWSTART=ble_fw,https://server/ble_firmware.img OK +NWOTADWSTART:0x00 //MCU firmware download AT+NWOTADWSTART=mcu_fw,https://server/mcu_firmware.img OK +NWOTADWSTART:0x00 //MCU firmware download (Enter the name of MCU firmware within 8 characters. Default is "MCU_FW") AT+NWOTADWSTART=mcu_fw,https://server/mcu_firmware.img,ver01	

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">OK
+NWOTADWSTART:0x00

//Bluetooth® LE firmware download
AT+NWOTADWSTART=ble_fw,https://server/pxr_sr_coex_ext_531_6_0_14_1114_2_ota.img
OK
+NWOTADWSTART:0x00

//Cert Key download:
AT+NWOTADWSTART=cert_key,https://server/ca.pem
OK
+NWOTADWSTART:0x00
Note:
▪ Enabled by default in the SDK.
▪ The parameter, fw_type should be lowercase.
▪ Bluetooth® LE firmware download is available on SDK V3.2.3.0 or later.</td></tr>
<tr><td rowspan="2">AT+NWOTARENEW</td><td>(none)</td><td>Reboot with updated firmware.</td></tr>
<tr><td colspan="2">Prerequisite
Download RTOS or Bluetooth® LE images.
Example
AT+NWOTARENEW
+NWOTARENEW:0x00
Note:
▪ Enabled by default in the SDK.
▪ System reboots automatically after renewing is completed.
▪ Bluetooth® LE image is supported in SDK V3.2.3.0 or later, either RTOS or Bluetooth® LE, or both can be supported.</td></tr>
<tr><td rowspan="2">AT+NWOTADWPROG</td><td><fw_type></td><td>Get progress status of firmware download.
<fw_type>: Set a firmware type among rtos, ble_fw, mcu_fw, or cert_key
Response: +NWOTADWPROG:100</td></tr>
<tr><td colspan="2">Example
//Progress status of downloading RTOS:
AT+NWOTADWPROG=rtos
+NWOTADWPROG:100
OK

//Progress status of downloading MCU firmware:
AT+NWOTADWPROG=mcu_fw
+NWOTADWPROG:100
OK

//Progress status of downloading Bluetooth® LE firmware (DA16600 only):
AT+NWOTADWPROG=ble_fw
+NWOTADWPROG:100
OK

//Progress status of downloading Cert Key:</td></tr>
</table>

Command	Parameters	Description
	AT+NWOTADWPROG=cert_key +NWOTADWPROG:100 OK Note: Enabled by default in the SDK.	
AT+NWOTADWSTOP	(none)	Stop while downloading firmware.
	Example AT+NWOTADWSTOP OK	
AT+NWOTAFWNAME	(none)	Read a name in the header of the MCU firmware (Only for MCU firmware).
	Example AT+NWOTAFWNAME +NWOTAFWNAME:MCU OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __OTA_UPDATE_MCU_FW__ is enabled in the SDK, this command should be enabled.	
AT+NWOTAFWSIZE	(none)	Read a size in the header of the MCU firmware (Only for MCU firmware).
	Example AT+NWOTAFWSIZE +NWOTAFWSIZE:4128 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __OTA_UPDATE_MCU_FW__ is enabled in the SDK, this command should be enabled.	
AT+NWOTAFWCRC	(none)	Read a CRC in the header of the MCU firmware (Only for MCU firmware).
	Example AT+NWOTAFWCRC +NWOTAFWCRC:5aa8b6c4 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __OTA_UPDATE_MCU_FW__ is enabled in the SDK, this command should be enabled.	
AT+NWOTAREADFW	<read addr>, <read_size>	Read the MCU firmware as much as the *read_size* from the *read_addr* and transmit it (Only for MCU firmware). <*read_addr*>: Hexadecimal without "0x" prefix <*read_size*>: Decimal MCU_FW default address - DA16200: 0x003A_D000 - DA16600: 0x003C_2000
	Example AT+NWOTAREADFW=3ad000,128 DA16FMCU¥123456789012345612345678901234561234567890123456123456789012345612345678901234561234567890123456123456789012345612345678901234561234567890123456 +NWOTAREADFW:COMPLETE	

Command	Parameters	Description
	OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __OTA_UPDATE_MCU_FW__ is enabled in the SDK, this command should be enabled.	
AT+NWOTATRANSFW	(none)	Transmit the downloaded MCU firmware to the MCU. Transmission is failed if no header (16 bytes) information exists (Only for MCU firmware).
	Example AT+NWOTATRANSFW MCU DA16FMCUy1234567890123456123456789012345612345678901234561234567890123456123456789012345612345678901234561234567890123456123456789012345612345678901234 …… +NWOTATRANSFW:COMPLETE OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __OTA_UPDATE_MCU_FW__ is enabled in the SDK, this command should be enabled.	
AT+NWOTAERASEFW	(none)	Erase the MCU firmware stored in a serial flash of the DA16200/DA16600. (Only for MCU firmware).
	Example AT+NWOTAERASEFW +NWOTAERASEFW:COMPLETE OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __OTA_UPDATE_MCU_FW__ is enabled in the SDK, this command should be enabled.	
AT+NWOTASETADDR	<sflash_addr>	Designate an address where data can be downloaded within the range SFlash area. MCU_FW/CERT_KEY default address ▪ DA16200: 0x003A_D000 ▪ DA16600: 0x003C_2000 CERT_KEY should be copied to the operating area if downloaded to the user area, which is the default address. CERT_KEY area address ▪ DA16200/DA16600: 0x003A_3000
	Example AT+NWOTASETADDR=3ad000 +NWOTASETADDR:0x00 OK Note: Enabled by default in the SDK.	
AT+NWOTAGETADDR	<fw_type>	Return the value set with NWOTASETADDR. MCU_FW/CERT_KEY default address. ▪ DA16200: 0x003A_D000 ▪ DA16600: 0x003C_2000
	Example AT+NWOTAGETADDR=mcu_fw +NWOTAGETADDR:3ad000 OK	

Command	Parameters	Description
	AT+NWOTAGETADDR=cert_key +NWOTAGETADDR:3ad000 OK Note: Enabled by default in the SDK.	
AT+NWOTAREADFLASH	<sflash_addr>,<size>	Read as much as size from sflash_addr. MCU_FW default address ▪ DA16200: 0x003A_D000 ▪ DA16600: 0x003C_2000
	Example AT+NWOTAREADFLASH=3ad000,128 MCU_FW ?¨ZDA16FMCU1234567890123456123456789012345612345678901234561234567890123456123456789 012345612345678901234561234567890123456 OK Note: Enabled by default in the SDK.	
AT+NWOTAERASEFLASH	<sflash_addr>,<size>	Delete as much as size from sflash_addr. MCU_FW default address ▪ DA16200: 0x003A_D000 ▪ DA16600: 0x003C_2000
	Example AT+NWOTAERASEFLASH=3ad000,1000 +NWOTAERASEFLASH:COMPLETE OK Note: ▪ Enabled by default in the SDK. ▪ It is erased in 4 kB increments.	
AT+NWOTACOPYFLASH	<dest_sflash_addr>,<src_sflash_addr>,<size>	Copy as much as size from src_sflash_addr to dest_sflash_addr. MCU_FW default address: ▪ DA16200: 0x003A_D000 ▪ DA16600: 0x003C_2000
	Example AT+NWOTACOPYFLASH=3c2000,3ad000,1000 +NWOTACOPYFLASH:COMPLETE OK Note: ▪ Enabled by default in the SDK. ▪ It is copied in 4 kB increments.	
AT+NWOTATLSAUTH	<tls_auth_mode>	Set the certificate verification mode. #define MBEDTLS_SSL_VERIFY_NONE 0 #define MBEDTLS_SSL_VERIFY_OPTIONAL 1 #define MBEDTLS_SSL_VERIFY_REQUIRED 2
	Example AT+NWOTATLSAUTH=1 OK Note: ▪ Enabled by default in the SDK v3.2.5.0 or later.	

Command	Parameters	Description
	▪ The configuration is stored in NVRAM.	
AT+NWOTABYMCU	rtos,<full_size>	Transmit the RTOS stored in the MCU to the DA16200/DA16600 when there is no network access. If the AT+NWOTABYMCU= rtos,<full_size> command is OK, RTOS is transmitted as much as the partial size with tx_size=<partial_size>,<binary data>. Every transmission sends "OK" as a response unless there is an error. If an error occurs or transmission is complete, it responds with +NWOTABYMCU:0x00 including status. Note: Only RTOS can be downloaded.
	Example AT+NWOTABYMCU=rtos,1335408 OK tx_size=4096,4643394BDA4F27840000000000000000000… OK … tx_size=112,00000000000000000000000001000000… +NWOTABYMCU:0x00 Note: ▪ Enabled by default in the SDK v3.2.5.0 or later. ▪ If __OTA_UPDATE_MCU_FW__ is enabled in the SDK, this command should be enabled.	

NOTE
When DPM mode is enabled and OTA update is in progress (firmware download is in progress), it does not enter DPM LPM because of SFlash write operation. After downloading the firmware, the DA16200 resumes to enter DPM LPM.

Table 28. OTA response list

Response	Parameters	Description
+NWOTADWSTART	<status>	Return the status of firmware download. <status>: 0x00 is success. See Table 29 for other status values. For example: +NWOTADWSTART:0x00
+NWOTARENEW	<status>	Return the status of firmware RENEW. <status>: 0x00 is success. See OTA Response Code List for others For example: +NWOTARENEW:0x00
+NWOTADWPROG	<progress>	Return the percentage value (%) of the firmware download progress. <progress>: Print download progress in percent For example: +NWOTADWPROG:100
+NWOTADWSTOP	<status>	Return the status of firmware download stop. <status>: 0x00 is success. See Table 29 for other status values For example: +NWOTADWSTOP:0x00
+NWOTATRANSFW	COMPLETE or FAIL	Return result of MCU firmware transmission (Only for MCU firmware). For example: +NWOTATRANSFW:COMPLETE
+NWOTAFWNAME	<name>	String entered by a user (Default is MCU_FW). Returns "(NULL)" if there is no MCU firmware. (Only for MCU firmware)
+NWOTAFWSIZE	<size>	Downloaded MCU firmware size. It returns 0 if there is no MCU firmware. (Only for MCU firmware)

Response	Parameters	Description
+NWOTAFWCRC	<crc>	Downloaded MCU Firmware CRC. It returns 0 if there is no MCU firmware. (Only for MCU firmware)
+NWOTAREADFW	COMPLETE or FAIL	Success: COMPLETE Failure: FAIL (Only for MCU firmware)
+NWOTAERASEFW	COMPLETE or FAIL	Success: COMPLETE Failure: FAIL (Only for MCU firmware)
+NWOTASETADDR	<status>	<status>: 0x00 is success See Table 29 for other status values.
+NWOTAGETADDR	<sflash_addr>	Return the value of sflash_addr.
(AT+NWOTAREADFLASH)	(Binary)	Return binary data as much as entered SFlash address and size.
+NWOTAERASEFLASH	COMPLETE or FAIL	Success: COMPLETE Failure: FAIL
+NWOTACOPYFLASH	COMPLETE or FAIL	Success: COMPLETE Failure: FAIL
+NWOTABYMCU	<status>	<status>: 0x00 is success See Table 29 for other status values.

Table 29. OTA response code list

Return value	Description
0x00	Return success.
0x01	Return fail.
0x02	SFlash address is wrong.
0x03	Firmware type is unknown.
0x04	Server URL is unknown.
0x05	Firmware size is too big.
0x06	CRC is not correct.
0x07	Firmware version is unknown.
0x08	Firmware version is incompatible.
0x09	Firmware not found on the server.
0x0A	Failed to connect to the server.
0x0B	All new Firmware were not downloaded.
0x0C	Failed to allocate memory.
0xA1	Bluetooth® LE firmware version is unknown.

5.6.5.1 OTA Download Example

```
RTOS download:
AT+NWOTADWSTART=rtos,https://server/DA16200_RTOS-GEN01-01-1111-000000.img
Bluetooth® LE FW download: (DA16600 only)
AT+NWOTADWSTART=ble_fw,https://server/ble_firmware.img
MCU FW download:
AT+NWOTADWSTART=mcu_fw,https://server/mcu_firmware.img
AT+NWOTADWSTART=mcu_fw,https://server/mcu_firmware.img,ver01
Cert Key download:
AT+NWOTADWSTART=cert_key,https://server/ca.pem
```

5.6.5.2 OTA Download Progress Example

```
RTOS download progress:
AT+NWOTADWPROG=rtos
Bluetooth® LE FW download progress: (DA16600 only)
AT+NWOTADWPROG=ble_fw
MCU FW download progress:
AT+NWOTADWPROG=mcu_fw
Cert Key download progress:
AT+NWOTADWPROG=cert_key
```

5.6.5.3 OTA Renew Example

```
Renew Firmware (reboot with updated FW):
AT+NWOTARENEW
```

5.6.5.4 MCU Firmware Transport Example

```
MCU FW transmission:
AT+NWOTATRANSFW
Get MCU FW name:
AT+NWOTAFWNAME
Get MCU FW size:
AT+NWOTAFWSIZE
Get MCU FW CRC:
AT+NWOTAFWCRC
Read MCU FW as much as specified size:
AT+NWOTAREADFW=3ad000,128
Delete MCU FW stored in the DA16200/DA16600 SFlash:
AT+NWOTAERASEFW
```

5.6.5.5 SFlash User Area Address Setting Example

```
SET ADDR:
AT+NWOTASETADDR=3ad000
GET ADDR:
AT+NWOTAGETADDR=mcu_fw
AT+NWOTAGETADDR=cert_key
```

5.6.5.6 SFlash READ/COPY/ERASE Example

```
SFlash Read:
AT+NWOTAREADFLASH=3ad000,128
SFlash Copy:
AT+NWOTACOPYFLASH=3ad000,0x3c2000,128
SFlash Erase:
AT+NWOTAERASEFLASH=0x1f2000,128
```

5.6.5.7 TLS Certificate Verification Mode Setting Example

```
SET  MBEDTLS_SSL_VERIFY_NONE:
AT+NWOTATLSAUTH=0
SET  MBEDTLS_SSL_VERIFY_OPTIONAL:
AT+NWOTATLSAUTH=1
SET  MBEDTLS_SSL_VERIFY_REQUIRED:
AT+NWOTATLSAUTH=2
```

5.6.5.8 RTOS by MCU Download Example

```
Initialization:
AT+NWOTABYMCU=rtos,1335408
Data transmission:
tx_size=4096,4643394BDA4F27840000000000000000…
```

5.6.6 Zeroconf Commands

Table 30. Zerocont command list

Command	Parameters	Description
AT+NWMDNSSTART	<Mode>	Start the mDNS module. The mDNS module is communicated through multicast. The DA16200/DA16600 could frequently be changed from/to DPM LPM and wake-up states. It may consume more power. <Mode>: The mode in which the WLAN interface is running, 0 (Station) or1 (Soft AP).
	Prerequisite The DA16200/DA16600 should be connected to AP. The host name of mDNS module should be set up. Example AT+NWMDNSSTART=1 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ The configuration is stored in NVRAM. ▪ If __SUPPORT_ZERO_CONFIG__ is enabled in the SDK, this command should be enabled.	
	?	Get the string representing the status of mDNS module, "started" or "not started".
	Example AT+NWMDNSSTART=? +NWMDNSSTART:started	
AT+NWMDNSHNREG	<Host name>	Register the host name in the mDNS module. mDNS supports one configured host name only, to change or set a new mDNS host name. mDNS service must be stopped and started again. <Host name>: The name of the host to be registered.
	Example AT+NWMDNSHNREG=da16x OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ The configuration is stored in NVRAM. ▪ If __SUPPORT_ZERO_CONFIG__ is enabled in the SDK, this command should be enabled.	
AT+NWMDNSSRVREG	<Instance name>,<Protocol>,	Register a service in the mDNS module. ▪ <Instance name>: The instance name of service to be registered.

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td><Port>[,<Text record>]</td><td>▪ <Protocol>: The protocol and the type of the service to be registered.
▪ <Port>: The port number of the service to be registered.
▪ <Text record>: The text record of the service that must be registered and mentioned in "Key=Value" format. Multiple pairs of text records should be separated using a ",".</td></tr>
<tr><td></td><td colspan="2">Prerequisite
The DA16200/DA16600 should be connected to AP.
The host name of mDNS module should be set up.
Example
AT+NWMDNSSRVREG=_WEBAPP,_http,_tcp,80,LIGHT=OFF,FAN=ON
OK
Note:
▪ Enabled by default in the SDK v3.2.3.0 or later.
▪ The configuration is stored in NVRAM.
▪ If __SUPPORT_ZERO_CONFIG__ is enabled in the SDK, this command should be enabled.</td></tr>
<tr><td>AT+NWMDNSSUPDATETXT</td><td><Text record></td><td>Update the text record of a service in the mDNS module.
<Text record>: The text record of the service to be updated.</td></tr>
<tr><td></td><td colspan="2">Example
AT+NWMDNSUPDATETXT=LIGHT=OFF,FAN=ON
OK
Note:
▪ Enabled by default in the SDK v3.2.3.0 or later.
▪ The configuration is stored in NVRAM.
▪ If __SUPPORT_ZERO_CONFIG__ is enabled in the SDK, this command should be enabled.</td></tr>
<tr><td>AT+NWMDNSSRVDEREG</td><td>(None)</td><td>Unregister a service in the mDNS module.
Response: OK or ERROR
For example: AT+NWMDNSSRVDEREG</td></tr>
<tr><td></td><td colspan="2">Prerequisite
The DA16200/DA16600 should be connected to AP.
The mDNS module should be running.
The service in the mDNS module should be registered.
Example
AT+NWMDNSSRVDEREG
OK
Note:
▪ Enabled by default in the SDK v3.2.3.0 or later.
▪ The configuration is erased from NVRAM.
▪ If __SUPPORT_ZERO_CONFIG__ is enabled in the SDK, this command should be enabled.</td></tr>
<tr><td>AT+NWMDNSSTOP</td><td>(None)</td><td>Stop the mDNS module.</td></tr>
<tr><td></td><td colspan="2">Prerequisite
The DA16200/DA16600 should be connected to an AP.
The mDNS module should be running.
Example
AT+NWMDNSSTOP
OK
Note:</td></tr>
</table>

Command	Parameters	Description
	▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ The configuration is erased from NVRAM. ▪ If __SUPPORT_ZERO_CONFIG__ is enabled in the SDK, this command should be enabled.	
	?	Get the string representing the status of the mDNS module, "stopped" or "running".
	Example AT+NWMDNSSTOP +NWMDNSSTOP:stopped	

5.6.6.1 Zeroconf Example

Configure the parameters and start the mDNS module (After Wi-Fi Connection):

AT+NWMDNSHNREG=da16x

AT+NWMDNSSTART=0

If the mDNS module is started successfully, the following response is shown:

OK

Register a service in the mDNS module:

AT+NWMDNSSRVREG=_WEBAPP,_http._tcp,80,LIGHT=OFF,FAN=ON

If the service is registered successfully, the following response is shown:

OK

Registered service and host name can be discovered by other mDNS services. In this example, Bonjour service (https://support.apple.com/kb/DL999?viewlocale=en_US&locale=zh_TW) on Windows is used to discover them.

To discover the DA16200/DA16600 mDNS, the "-G" option can be used:

```
C:> dns-sd -G v4 da16x.local
Timestamp     A/R Flags if Hostname               Address                                      TTL
18:04:04.474  Add     2 24 da16x.local.            192.168.0.4                                  120
```

To discover the service, the "-L" option can be used like the following:

```
C:>dns-sd -L _WEBAPP _http._tcp local
Lookup _WEBAPP._http._tcp.local
18:04:29.453  _WEBAPP._http._tcp.local. can be reached at da16x.local.:80 (interface 24)
 LIGHT=OFF FAN=ON
```

5.6.7 Provision Commands over Wi-Fi

The provision commands over Wi-Fi are used for starting to provision procedure and getting provisioning status. To use these commands, __PROVISION_ATCMD__ feature should be enabled in SDK.

Table 31. Provision command list

Command	Parameters	Description
AT+PROVSTART	(none)	Removed all profile data in NVRAM and configure appropriate profile such as Soft AP and concurrent profile and perform Software reboot. Response: "+INIT:DONE,2"
	Example AT+PROVSTART +INIT:DONE,2 Note: ▪ Enabled by default in the SDK v3.2.3.0 or later.	

Command	Parameters	Description
	▪ The configuration is stored in NVRAM. ▪ If __PROVISION_ATCMD__ is enabled in the SDK, this command should be enabled. ▪ After restarting, the system is ready for the provisioning procedure in concurrent mode for the SDK v3.2.6.0 or later, and Soft AP mode for SDK v3.2.4.0 and former versions (the response is "INIT:DONE,1"). ▪ This command supports Wi-Fi based provisioning. See Ref. [5] for provisioning over Bluetooth® LE.	
AT+PROVSTAT	(none)	Get status of provisioning. Response: OK or ERROR
	Example AT+PROVSTAT +ATPROV=STATUS 1 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __PROVISION_ATCMD__ is enabled in the SDK, this command should be enabled. ▪ The list of provision status can be found in the thread_atcmd.h. Check the atcmd_provision_stat enumeration.	

Table 32. atcmd_provision_stat enumeration

Value	Name	Description
0	ATCMD_PROVISION_IDLE	Not running or finishing
1	ATCMD_PROVISION_START	Start
101	ATCMD_PROVISION_SELECTED_AP_SUCCESS	Receive AP information
102	ATCMD_PROVISION_SELECTED_AP_FAIL	
103	ATCMD_PROVISION_WORNG_PW	AP connection fails because of the wrong PW
104	ATCMD_PROVISION_NETWORK_INFO	Get network information from Mobile App
105	ATCMD_PROVISION_AP_FAIL	AP connection fails
106	ATCMD_PROVISION_DNS_FAIL_SERVER_FAIL	Check network connection
107	ATCMD_PROVISION_DNS_FAIL_SERVER_OK	
108	ATCMD_PROVISION_NO_URL_PING_FAIL	
109	ATCMD_PROVISION_NO_URL_PING_OK	
110	ATCMD_PROVISION_DNS_OK_PING_FAIL_N_SERVER_OK	
113	ATCMD_PROVISION_DNS_OK_PING_N_SERVER_FAIL	
111	ATCMD_PROVISION_DNS_OK_PING_OK	
112	ATCMD_PROVISION_REBOOT_ACK	Reboot after provisioning

While provisioning over Wi-Fi with the mobile application as described in Ref. [5], the DA16200 provides responses to MCU regarding provisioning status. See the following examples.

```
+ATPROV=STATUS 0
+ATPROV=STATUS 1
+WFCST:<MAC Address>
+ATPROV=STATUS 101
+WFDST:<MAC Address>
+WFJAP:1,'<SSID>',<IP Address>
```

For the DA16600, the following responses are provided to MCU regarding provisioning status while provisioning over Bluetooth® LE. See the following examples.

```
+ATPROV=STATUS 104
+ATPROV=STATUS 101
+WFJAP:1,'<SSID>',<IP Address>
+ATPROV=STATUS 111
+ATPROV=STATUS 112
+INIT:DONE,0
```

NOTE
See Table 12 for details of +WFCST, +WFDST, and +WFJAP response.

5.6.8 Bluetooth® LE Commands

The Bluetooth® LE commands are available when the DA16600 is running the Bluetooth enabled version of the firmware. Select and build the DA16600 project from the SDK to use these commands.

Table 33. Bluetooth® LE command list

Command	Parameters	Description
AT+BLENAME	<device name>	Change the device name of the DA16600/Bluetooth® LE device. Response: OK or ERROR
	?	Get the device name of the DA16600/Bluetooth® LE device. Response: +BLENAME:<device name>
	(none)	
	Example AT+BLENAME=DA16600-BLE OK AT+BLENAME +BLENAME:DA16600-BLE OK AT+BLENAME=? +BLENAME:DA16600-BLE Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ Enabled getting the device name by default in the SDK v3.2.5.0 or later.	
AT+ADVSTOP	(none)	Stop advertising of DA16600/Bluetooth® LE device. Response: OK or ERROR
	Example AT+ADVSTOP OK Note: Enabled by default in the SDK v3.2.3.0 or later.	
AT+ADVSTART	(none)	Start advertising of DA16600/Bluetooth® LE device. Response: OK or ERROR
	Example	

Command	Parameters	Description
	AT+ADVSTART OK Note: Enabled by default in the SDK v3.2.3.0 or later.	

5.6.9 Transfer Function Commands

5.6.9.1 Socket Commands

Table 34. Socket command list

Command	Parameters	Description
AT+TRTS	<local_port>[,<max allowed connection>]	Open a TCP server socket. <local_port>: Local port number of the socket. <max allowed connection>: It is optional. Set maximum allowed TCP session. Response: OK (with '+TRCTS:*** ' See Table 35 or ERROR. Async message: CID(+TRTS:<Assigned CID>)
	Prerequisite The DA16200/DA16600 should be connected to AP. Example //Open first TCP server AT+TRTS=10194 +TRTS:0 OK //Open second TCP server AT+TRTS=10195 +TRTS:3 OK Note: ▪ Enabled by default in the SDK. ▪ CID number 0 (TCP server), 1 (TCP client), and 2 (UDP) are pre-assigned numbers. The new CID started from 3 is assigned in the order of opening TCP session. ▪ The <max allowed connection> parameter is supported by SDK v3.2.5.0 or later. ▪ Multiple TCP server and async message with assigned CID are supported by SDK v3.2.5.0 or later. A total of eight sessions can be created for the transfer function. But it depends on the DA16200/DA16600 SDK configuration. Basically, the DA16200/DA16600 can be created eight TCP sockets.	
AT+TRTC	<server_ip>, <server_port>[, <local_port>]	Open a TCP client socket and connect to a TCP server. ▪ <server_ip>: IP address of TCP server to be accessed ▪ <server_port>: Port number of TCP server ▪ <local_port>: Local port number of the socket (optional, 0: auto) Response: OK or ERROR Async message: CID(+TRTC:<Assigned CID>)
	Prerequisite The DA16200/DA16600 should be connected to AP. Example AT+TRTC=192.168.0.18,1025,1024 +TRTC:1	

Command	Parameters	Description
	OK AT+TRTC=192.168.0.18,1025,1025 +TRTC:3 OK Note: ▪ Enabled by default in the SDK. ▪ CID number 0 (TCP server), 1 (TCP client), and 2 (UDP) are pre-assigned numbers. The new CID started from 3 is assigned in the order of opening TCP session. ▪ Multiple TCP client and async message with assigned CID can be supported by SDK v3.2.5.0 or later. A total of eight sessions can be created for the transfer function. But it depends on the DA16200/DA16600 SDK configuration. Basically, the DA16200/DA16600 can be created eight TCP sockets.	
AT+TRUSE	<local_port>	Open a UDP socket. <local_port>: Local port number of the socket Response: OK or ERROR Async message: CID(+TRUSE:<Assigned CID>)
	Example AT+TRTALL (optional, run this first if "ERROR" is responded) AT+TRUSE=10195 +TRUSE:2 OK AT+TRUSE=10196 +TRUSE:3 OK Note: ▪ Enabled by default in the SDK. ▪ CID number 0 (TCP server), 1 (TCP client), and 2 (UDP) are pre-assigned numbers. The new CID started from 3 is assigned in the order of opening TCP session. ▪ Multiple UDP sockets and async message with assigned CID can be supported by SDK v3.2.5.0 or later. A total of eight sessions can be created for the transfer function. But it depends on the DA16200/DA16600 SDK configuration. Basically, the DA16200/DA16600 can be created eight UDP sockets.	
AT+TRUR	<remote_ip>, <remote_port>	Set remote IP and port of the UDP socket. <remote_ip>: Remote IP address <remote_port>: Remote port number Response: OK or ERROR Async message: CID(+TRUR:2)
	Example AT+TRUR=192.168.0.18,1027 +TRUR:2 OK Note: ▪ Enabled by default in the SDK. ▪ It is only for the CID 2.	
AT+TRPRT	<cid>	Get session information by CID. <cid>: Assigned CID Response: <cid>,[TCP|UDP],<remote_ip>,<remote_port>,

Command	Parameters	Description
		<local_port>
	Prerequisite A UDP socket should be opened (AT+TRUSE). Example AT+TRPRT=2 +TRPRT:2,UDP,192.168.0.18,10194,10195 OK Note: ▪ Enabled by default in the SDK. ▪ CID number 0 (TCP server), 1 (TCP client), and 2 (UDP) are pre-assigned numbers. The new CID started from 3 is assigned in the order of opening TCP session.	
AT+TRPALL	(none)	Get all session information. Response: <cid>,[TCP|UDP],<remote_ip>,<remote_port>, <local_port><LF>…
	Prerequisite The target system should be connected to any UDP or TCP server. Example AT+TRPALL +TRPALL:2,UDP,192.168.0.18,10194,10195 OK Note: Enabled by default in the SDK.	
AT+TRTRM	<cid> [,<remote_ip> ,<remote_port>]	Close (terminate) a session by CID. If CID is 0 (TCP server), remote_ip, and remote_port are input, the session with the specific remote is closed. ▪ <cid>: Assigned CID ▪ <remote_ip>: Remote IP address connected to TCP server. It is only allowed in TCP server ▪ <remote_port>: Remote port number connected to TCP server. It is only allowed in TCP server Response: OK or ERROR
	Prerequisite The target system should be connected to any UDP or TCP server. Example AT+TRTRM=2 OK AT+TRTRM=0,192.168.0.18,10194 OK Note: ▪ Enabled by default in the SDK. ▪ The remote_ip and remote_port parameters are only supported in SDK v3.2.3.0 or later.	
AT+TRTALL	(none)	Close (terminate) all sessions. Response: OK or ERROR
	Example AT+TRTALL OK Note: Enabled by default in the SDK.	
AT+TRSAVE	(none)	Save status of all sessions to NVRAM.

Command	Parameters	Description
		Response: OK or ERROR
	Example AT+TRSAVE OK Note: ▪ Enabled by default in the SDK. ▪ The configuration is stored in NVRAM.	
AT+TCPDATAMODE	<mode>	Set the mode of the received TCP data. <mode> 0: text mode (default) 1: hex string mode In text mode, data is returned as an ascii string: "0123ABCD" In hex mode, the data is returned as a hex encoded text string "3031323341424344" Response: OK or ERROR
	Example AT+TCPDATAMODE=1 OK Note: Enabled by default in the SDK v3.2.2.1 or later.	

Table 35. Socket connection response list

Response	Parameters	Description
+TRCTS	<cid>, <remote_ip>, <remote_port>	When sending the AT command (AT+TRTS=40000), receive this response if there is no error. ▪ <cid>: Assigned CID for TCP server ▪ <remote_ip>: TCP client IP address ▪ <remote_port>: TCP client port number
	Example +TRCTS:0,192.168.0.18,41014	
+TRXTS	<cid>, <remote_ip>, <remote_port>	A remote TCP client is disconnected from the TCP server that was opened by AT+TRTS. ▪ <cid>: Assigned CID for TCP server ▪ <remote_ip>: TCP client IP address ▪ <remote_port>: TCP client port number
	Example //When a remote peer is disconnected +TRXTS:0,192.168.0.18,41014	
+TRXTC	<cid>, <remote_ip>, <remote_port>	The TCP client socket that was opened by AT+TRTC is disconnected. ▪ <cid>: Assigned CID for TCP client ▪ <remote_ip>: TCP server IP address ▪ <remote_port>: TCP server port number
	Example //When the TCP client socket is disconnected +TRXTC:1,192.168.0.18,1025	

5.6.9.1.1 Data Transfer Commands

Table 36. Data transmission command

Escape sequence	Parameters	Description
<ESC>S	<cid><length>, <remote_ip >, <remote_port >,[<mode>,]<data>	Transmit data through a socket with the CID specified. ▪ <ESC>S: To enter data input mode, type in <ESC> (0x1B) and S keys together ▪ <cid>: Assigned CID ▪ <length>: Data length. Data length can be 0 in only text mode. If this is 0, data is read until "\r" or "\n" is met. In raw mode, data is read until the length ▪ <remote_ip>: Remote IP address ▪ <remote_port>: Remote port number For TCP Server, <remote_ip> and <remote_port> of a TCP Client should be given. A maximum of four TCP Clients can be connected to the TCP Server. For TCP Client, 0,0 is given (as the destination is the server). For UDP: if 0,0 is given, the data is sent to the destination that AT+TRUR has specified. if non-0 <remote_ip> and <remote_port> are given, UDP temporarily sends to the destination <remote_ip> and <remote_port> specifies. ▪ <mode>: Mode to transmit data in raw or text mode. It is optional. If there is no option, data is transmitted in text mode. This option is allowed only for UART communication. • r: The raw mode is active. In raw mode, Data is read until data length. The data length is specified in <length> parameter. • t: The text mode is active. In text mode, the data can be affected if it has unprintable control codes like backspace(0x08). Response: OK or ERROR
	Prerequisite The target system should be connected to any UDP or TCP server/client. Example1 – To send data to TCP client <ESC>S010,192.168.0.18,43110,abcde12345 OK Example2 – To send data to TCP server <ESC>S110,192.168.0.18,1025,abcde12345 OK Example3 – To send data to TCP server with "0, 0" as the destination/server <ESC>S110,0,0,abcde12345 OK Example4 – To send data to UDP receiver <ESC>S210,192.168.0.18,1024,abcde12345 OK Note: ▪ Enabled by default in the SDK. ▪ The maximum length of data depends on TX_PAYLOAD_MAX_SIZE definition. It is defined in atcmd.h for SDK v3.x. TX_PAYLOAD_MAX_SIZE includes all parameters of AT command. Therefore, the maximum length of 'length' parameter depends on length of other parameters. ▪ TX_PAYLOAD_MAX_SIZE is defined 4,096 bytes in the SDK v3.2.3.0 or later. ▪ For ATCMD over SPI or SDIO:	

<table>
<tr><th>Escape sequence</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">• The result for this command is sent to the host as the "response" field of "struct _st_host_response". The "response" field is a 1-byte decimal value. A value of 0x20 is a result of "OK". All other values are an "ERROR".
▪ Recommended to use <ESC>H command if UART baud rate is over 230400 bps. There might be data loss during the DA16200/DA16600 parses this AT command.</td></tr>
<tr><td rowspan="2"><ESC>M</td><td><cid>,<length>,
<remote_ip >,
<remote_port >,[<mode>,]<data></td><td>Transmit data through a socket with the CID specified.
<ESC>M: To enter data input mode, type in <ESC>(0x1B) and M key together
▪ <cid>: Assigned CID
▪ <length>: Data length. Data length can be 0 in only text mode. If this is 0, data is read until "\r" or "\n" is met. In raw mode, data is read until the length
▪ <remote_ip>: Remote IP address
▪ <remote_port>: Remote port number
For TCP Server, <remote_ip> and <remote_port> of a TCP Client should be given.
For TCP Client, 0,0 is given (as the destination is the server).
For UDP: if 0,0 is given, the data is sent to the destination that AT+TRUR has specified. if non-0 <remote_ip> and <remote_port> are given, UDP temporarily sends to the destination <remote_ip> and <remote_port> specifies.
Response: OK or ERROR</td></tr>
<tr><td colspan="2">Prerequisite
The target system should be connected to any UDP or TCP server/client.
Example1 – To send data to TCP client
<ESC>M0,10,192.168.0.18,43110,abcde12345
OK
Example2 – To send data to TCP server
<ESC>M1,10,192.168.0.18,1025,abcde12345
OK
Example3 – To send data to TCP server with "0, 0" as the destination/server
<ESC>M1,10,0,0,abcde12345
OK
Example4 – To send data to UDP receiver
<ESC>M2,10,192.168.0.18,1024,abcde12345
OK
Note:
▪ Enabled by default in the SDK.
▪ The maximum length of data depends on TX_PAYLOAD_MAX_SIZE definition. It is defined in atcmd.h for SDK v3.x, TX_PAYLOAD_MAX_SIZE includes all parameters of AT command. Therefore, the maximum length of 'length' parameter depends on length of other parameters.
▪ TX_PAYLOAD_MAX_SIZE is defined 4,096 bytes in the SDK v3.2.3.0 or later.
▪ For ATCMD over SPI or SDIO:
The result for this command is sent to the host as the "response" field of "struct _st_host_response". The "response" field is a 1-byte decimal value. A value of 0x20 is a result of "OK". All other values are an "ERROR".
▪ Recommended to use <ESC>H command if UART baud rate is over 230400 bps. There might be data loss during the DA16200/DA16600 parses this AT command.</td></tr>
<tr><td><ESC>H</td><td><cid>,<length>,
<remote_ip >,</td><td>Transmit data through a socket with the CID specified. The host must send data after getting a response OK.</td></tr>
</table>

Escape sequence	Parameters	Description
	<remote_port >	<ESC>H: To enter data input mode, type in <ESC>(0x1B) and H key together <cid>: Assigned CID <length>: Data length. Data is read until the length after getting OK response <remote_ip>: Remote IP address <remote_port>: Remote port number ▪ For TCP Server, <remote_ip> and <remote_port> of a TCP Client should be given. ▪ For TCP Client, 0,0 is given (as the destination is the server). ▪ For UDP: if 0,0 is given, the data is sent to the destination that AT+TRUR has specified. if non-0 <remote_ip> and <remote_port> are given, UDP temporarily sends to the destination <remote_ip> and <remote_port> specifies. Response: OK or ERROR
	Prerequisite The target system should be connected to any UDP or TCP server/client. Example1 – To send data to TCP client <ESC>H0,10,192.168.0.18,43110 OK abcde12345 OK Example2 – To send data to TCP server <ESC>H1,10,192.168.0.18,1025 OK abcde12345 OK Example3 – To send data to TCP server with "0, 0" as the destination/server <ESC>H1,10,0,0 OK abcde12345 OK Example4 – To send data to UDP receiver <ESC>H2,10,192.168.0.18,1024 OK abcde12345 OK Note: ▪ Enabled by default in the SDK. ▪ The maximum length of data depends on TX_PAYLOAD_MAX_SIZE definition. It is defined in atcmd.h for SDK v3.x, TX_PAYLOAD_MAX_SIZE includes all parameters of AT command. Therefore, the maximum length of 'length' parameter depends on length of other parameters. ▪ TX_PAYLOAD_MAX_SIZE is defined 4,096 bytes in the SDK v3.2.3.0 or later. ▪ Not supported over SPI or SDIO.	

Table 37. Data reception responses

Response	Parameters	Description
+TRDTS	<cid>, <src_ip>,<src_port>,	Receive data through TCP server socket. <cid>: Assigned CID

Response	Parameters	Description
	<length>,<data>	<src_ip>: Source IP address <src_port>: Source port number <length>: Data length <data>: Received data
	Example //When data is sent from a TCP client +TRDTC:1,192.168.0.18,1025,4,test	
+TRDTC	<cid>, <src_ip>,<src_port>, <length>,<data>	Receive data through TCP client socket. ▪ <cid>: Assigned CID ▪ <src_ip>: Source IP address ▪ <src_port>: Source port number ▪ <length>: Data length ▪ <data>: Received data
	Example //When TCP client receives data, +TRDTC:1,192.168.0.18,1025,4,test	
+TRDUS	<cid>, <src_ip>,<src_port>, <length>,<data>	Receive data through UDP socket. ▪ <cid>: Assigned CID ▪ <src_ip>: Source IP address ▪ <src_port>: Source port number ▪ <length>: Data length ▪ <data>: Received data
	Example //When UDP session receives data, +TRDUS:2,192.168.0.18,10194,4,test	

5.6.9.1.2 Data Transfer with DPM

TCP Server

After a connection to an AP is made in the normal BOOT state, open a TCP server socket, and save the config to NVRAM.

```
AT+TRTS=32000
AT+TRSAVE
```

The TCP server socket that was opened should be closed before switching to DPM mode.

```
AT+TRTRM=0
```

Change the DA16200/DA16600 state to DPM mode (AT+DPM=1). When the DA16200/DA16600 starts the session on DPM mode successfully, the following is shown:

```
+INIT:DONE,0
+WFJAP:1,'WI-FI_AP',192.168.5.19
+TRPALL:0,TCP,0.0.0.0,0,32000
```

When a TCP client connects to the DA16200/DA16600, the following is shown:

```
+INIT:WAKEUP,UC
```

To receive +TRCTS message, send AT+MCUWUDONE immediately after "+INIT:WAKEUP,UC"

```
+TRCTS:0,192.168.0.1,42000
```

When the DA16200/DA16600 receives a message from a client, the following is shown:

+INIT:WAKEUP,UC

+TRDTS:0,192.168.0.1,42000,10,1234567890

To send a TCP message, send AT+MCUWUDONE immediately after "external wake-up" is triggered (+INIT:WAKEUP,EXT). To prevent that the DA16200/DA16600 entering DPM LPM, MCU should send AT+CLRDPMSLPEXT before a message is sent. The DA16200/DA16600 can send data to a TCP client with the command "<ESC>S". Finally, to enter DPM LPM, send "AT+SETDPMSLTEXT".

```
+INIT:WAKEUP,EXT  //External wake-up
AT+MCUWUDONE
AT+CLRDPMSLPEXT
…
<ESC>S…
…
AT+SETDPMSLPEXT
```

When a TCP client disconnects from the DA16200/DA16600, the following is shown:

+INIT:WAKEUP,UC

To receive +RTXTS message, send AT+MCUWUDONE immediately after "+INIT:WAKEUP,UC"

+TRXTS:0,192.168.0.1,42000

TCP Client

After a connection is made to an AP in the normal BOOT state, connect the TCP client of the DA16200/DA16600 to a TCP server and save the config to NVRAM. (To save TCP client config information, the DA16200/DA16600 should connect to the server successfully beforehand.)

AT+TRTC=192.168.5.1,34000

AT+TRSAVE

Before switching to DPM mode, disconnect the TCP Client:

AT+TRTRM=1

Change the DA16200/DA16600 state to DPM mode (AT+DPM=1). When the DA16200/DA16600 starts the session on DPM mode successfully, the following is shown:

+INIT:DONE,0

+WFJAP:1,'WI-FI_AP',192.168.5.19

+TRPALL:1,TCP,192.168.5.1,34000,30000

The procedure to exchange TCP data is the same as in Section 5.6.9.1.2. When the DA16200/DA16600 receives a message from the server, the following is shown:

+INIT:WAKEUP,UC

+TRDTC:1,192.168.5.1,34000,10,1234567890

UDP Session

After a connection is made to an AP in the normal BOOT state, open a UDP socket and save the config to NVRAM:

AT+TRUSE=48000

AT+TRSAVE

Before switching to DPM mode, disconnect TCP Client:

AT+TRTRM=2

Change the DA16200/DA16600 state to DPM mode. When the DA16200/DA16600 starts the session in DPM mode successfully, the following is shown:

+INIT:DONE,0

+WFJAP:1,'WI-FI_AP',192.168.5.19

+TRPALL:2,UDP,0.0.0.0,0,48000

The procedure to exchange UDP data is the same as in Section 5.6.9.1.2. When the DA16200/DA16600 receives a message from the server, the following is shown:

+INIT:WAKEUP,UC

+TRDUS:2,192.168.5.23,35000,10,1234567890

5.6.9.2 Secure Socket Commands

Table 38. Secure socket command list

Command	Parameters	Description
AT+TRSSLINIT	<Role>	Initialize the SSL module. The DA16200/DA16600 allows to create a module of TLS client. <Role>: The role of SSL, 1 – Client
	Example AT+TRSSLINIT=1 +TRSSLINIT:0 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_ATCMD_TLS__ is enabled in the SDK, this command should be enabled.	
AT+TRSSLCFG	<CID>,<Configuration ID>,<Configuration value>	Configure SSL connection. <CID>: The CID obtained after issuing the AT+TRSSLINIT command <Configuration ID>: The configuration ID available in the following list of configurations: ▪ 0, 1 – Invalid configuration parameter ▪ 2 – To set SSL CA Certificate ▪ 3 – To set SSL Certificate ▪ 6 – To set the SNI ▪ 9 – To enable/disable server validation ▪ 10 – To set the Incoming buffer length ▪ 11 - To set the Outgoing buffer length <Configuration value>: Value to the configuration provided in configuration ID CONF_ID:CONF_VAL ▪ 0, 1 - Invalid ▪ 2 - SSL CA Certificate Name ▪ 3 - SSL Certificate Name ▪ 6 - To Set the SNI (supported only for TLS client) ▪ 9 - To enable/disable server validation • 0: Disables server validation (Default) • 1: Enables server validation ▪ 10 - To set the Incoming buffer length ▪ 11 - To set the outgoing buffer length
	Prerequisite CID should be obtained (AT+TRSSLINT). SSL CA certificate and SSL certificate should be set up. Example AT+TRSSLCFG=0,2,CA_CERT OK	

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">AT+TRSSLCFG=0,3,CERT
OK
AT+TRSSLCFG=0,6,da16x
OK
AT+TRSSLCFG=0,9,0
OK
AT+TRSSLCFG=0,10,6144
OK
AT+TRSSLCFG=0,11,6144
OK
Note:
▪ Enabled by default in the SDK v3.2.3.0 or later.
▪ If __SUPPORT_ATCMD_TLS__ is enabled in the SDK, this command should be enabled.</td></tr>
<tr><td rowspan="2">AT+TRSSLCO</td><td><CID>,<Server IP Address>,<Server Port number></td><td>Connect to an SSL server.
▪ <CID>: The CID obtained after issuing the AT+TRSSLINIT command.
▪ <Server IP Address>: The IP Address of the server to connect. Only supported IPv4 address.
▪ <Server Port>: The port number of the SSL server to connect.</td></tr>
<tr><td colspan="2">Prerequisite
CID should be obtained (AT+TRSSLINT).
Example
AT+TRSSLCO=0,192.168.0.11,30000
OK
Note:
▪ Enabled by default in the SDK v3.2.3.0 or later.
▪ If __SUPPORT_ATCMD_TLS__ is enabled in the SDK, this command should be enabled.</td></tr>
<tr><td rowspan="2">AT+TRSSLWR</td><td><CID>,[<Server IP Address>,<Server Port number>,<mode>,]<Data length>,<Data></td><td>Send the data to the SSL server that is already established.
▪ <CID>: The CID obtained after issuing the AT+TRSSLINIT command.
▪ <Server IP Address>: The IP Address of the SSL server is already established. If there is no input, the IP address internally is used to the SSL server IP address.
▪ <Server Port number>: The port number of the SSL server is already established. If there is no input, the Port number is internally used to the SSL server port number.
▪ <mode>: Transmit data in raw or text mode. It is optional. If there is no option, data is transmitted in text mode.
• r: The raw mode is active. In raw mode, Data is read until data length. The data length is specified in <length> parameter.
• t: The text mode is active. In text mode, the data can be affected if it has unprintable control codes like backspace (0x08).
▪ <Data length>: The length of data to send.
▪ <Data>: The data to send. The input can be closed by <Ctrl>+C or reaching data length.</td></tr>
<tr><td colspan="2">Prerequisite
CID should be obtained (AT+TRSSLINT).
Example
AT+TRSSLWR=0,10,0123456789<Ctrl> + C
OK
Note:
▪ Enabled by default in the SDK v3.2.3.0 or later.</td></tr>
</table>

Command	Parameters	Description
	▪ If __SUPPORT_ATCMD_TLS__ is enabled in the SDK, this command should be enabled. ▪ The maximum length of data depends on TX_PAYLOAD_MAX_SIZE definition. It is defined in atcmd.h for SDK v3.x. TX_PAYLOAD_MAX_SIZE includes all parameters of AT command. Therefore, the maximum length of 'length' parameter depends on the length of other parameters.	
AT+TRSSLCL	<CID>	Close the SSL connection. <CID>: The CID obtained after issuing AT+TRSSLINIT command
	Prerequisite CID should be obtained (AT+TRSSLINT). Example AT+TRSSLCL=0 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_ATCMD_TLS__ is enabled in the SDK, this command should be enabled.	
AT+TRSSLCERTLIST	<Certificate Type>	Show a list of certificates or a list of CA data available in SFlash memory. <Certificate Type>: The value of the certificate. 0 – CA Certificates, 1 – Client/Server Certificates
	Example AT+TRSSLCERTLIST=0 +TRSSLCERTLIST=0,CA_CERT Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_ATCMD_TLS__ is enabled in the SDK, this command should be enabled.	
AT+TRSSLCERTSTORE	<Certificate Type>, <Sequence>, <Format>, <Name>, [<Data length>,]<Data>	Store a certificate and CA list data in SFlash memory. <Certificate Type>: The value of the certificate. 0 – CA Certificates, 1 – Client/Server Certificates. <Sequence>: If the value of certificate type is 0 (CA), the number of certificates in the sequence is 1-5. If the certificate type is 1 (Client/Server certificate), then several certificates in a sequence is 1-SSL cert or 2-SSL key. <Format>: The value of the CA/Certificate/Key0 – DER, 1 – PEM. <Name>: The name of the certificate. While loading certificate and key file separately, the same name should be used in both commands. <Data length>: The length of certificate data. If certificate is DER format, data length parameter is mandatory. <Data>: The certificate data to be stored.
	Example AT+TRSSLCERTSTORE=0,1,1,CA_CERT, -----BEGIN CERTIFICATE----- … -----END CERTIFICATE-----<Ctrl>+C OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_ATCMD_TLS__ is enabled in the SDK, this command should be enabled.	
AT+TRSSLCERTDELETE	<Certificate Type>,<Name>	Delete a certificate or CA list data in SFlash memory. <Certificate Type>: The type of the certificate. 0 – CA Certificates, 1 – Client/Server Certificates. <Name>: The name of the certificate.

Command	Parameters	Description
	Example AT+TRSSLCERTDELETE=0,CA_CERT OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_ATCMD_TLS__ is enabled in the SDK, this command should be enabled.	
AT+TRSSLSAVE	(none)	Store the current SSL module's configuration in NVRAM.
	Example AT+TRSSLSAVE OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ The configuration is stored in NVRAM. ▪ If __SUPPORT_ATCMD_TLS__ is enabled in the SDK, this command should be enabled.	
AT+TRSSLDELETE	(none)	Delete the stored SSL module's configuration in NVRAM
	Example AT+TRSSLDELETE OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ The configuration is erased from NVRAM. ▪ If __SUPPORT_ATCMD_TLS__ is enabled in the SDK, this command should be enabled.	

Table 39. Secure socket response list

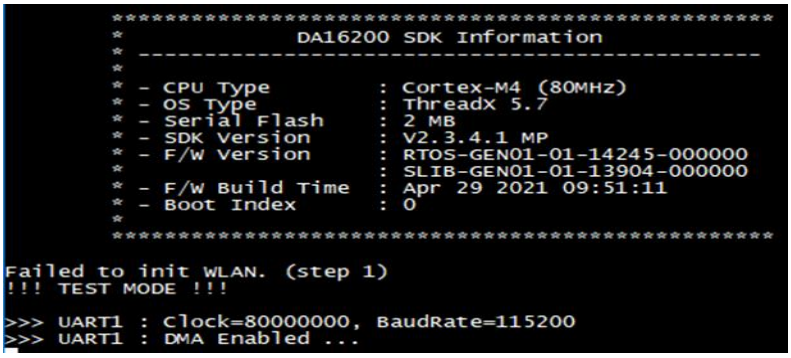
Response	Parameters	Description
+TRSSLDTC	<CID>, <remote_ip>, <local_port>, <length>, <data>	It sends the response when receiving data from SSL server. ▪ <CID>: The CID obtained after issuing the AT+TRSSLINIT command. ▪ <remote_ip>: SSL server IP address. ▪ <local_port>: Local port number of the secure socket. ▪ <length>: Data length. ▪ <data>: Received data.
	Example // When SSL client received data from secure server +TRSSLDTC:0,192.168.0.3,31200,5,Hello	
+TRSSLXTC	<CID>, <remote_ip>, <local_port>	It sends the response when secure socket connection is closed. ▪ <CID>: The CID obtained after issuing the AT+TRSSLINIT command. ▪ <remote_ip>: SSL server IP address. ▪ <local_port>: Local port number of the secure socket.
	Example // When secure socket connection is closed +TRSSLXTC:0,192.168.0.3,31200	

5.6.10 RF Test Function Commands

Table 40. RF test command list

Command	Parameters	Description
AT+TMRFNOINIT	<flag>	Set boot mode.

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td rowspan="2"></td><td></td><td><flag>: 0 (normal boot), 1 (RF test mode boot)
Response: OK or ERROR</td></tr>
<tr><td colspan="2">Example
AT+TMRFNOINIT=1
OK

AT+RESTART
OK
Note:
▪ Enabled by default in the SDK v3.2.3.0 or later.
▪ The configuration is stored in NVRAM.
▪ To test RF performance, set the boot mode as RF test mode (AT+TMRFNOINIT=1) and restart the DA16200/DA16600 (AT+RESTART).
▪ After the DA16200/DA16600 is restarted, "!!! TEST MODE !!!" log is displayed.
 
</td></tr>
<tr><td rowspan="2">AT+TMLMACINIT</td><td>(none)</td><td>Initialize LMAC (for test mode).
▪ Response: OK or ERROR</td></tr>
<tr><td colspan="2">Prerequisite
Boot as RF test mode (AT+TMRFNOINIT=1).
Example
AT+TMLMACINIT
OK
Note: Enabled by default in the SDK v3.2.3.0 or later.</td></tr>
<tr><td rowspan="2">AT+RFTESTSTART</td><td>(none)</td><td>Start RF test mode.</td></tr>
<tr><td colspan="2">Prerequisite
Boot as RF test mode (AT+TMRFNOINIT=1).
Example
AT+RFTESTSTART
OK
Note: Enabled by default in the SDK v3.2.3.0 or later.</td></tr>
<tr><td>AT+RFTX</td><td><Ch>,
<BW>,
<numFrames>,
<frameLen>,
<txRate>,
<txPower>,
<destAddr>,
<bssid>,</td><td>Start RF TX test.
<Ch>: Carrier frequency (2412 ~ 2484 MHz)
<BW>: [0]: Fixed. Carrier bandwidth. 20 MHz fixed
<numFrames>: Number of frames to transmit
<frameLen>: Length of frame (bytes)
<txRate>: Data rate
b1: 11b DSSS 1 Mbps
b2: 11b DSSS 2 Mbps</td></tr>
</table>

Command	Parameters	Description
	<htEnable>, <GI>, <greenField>, <preambleType>, <qosEnable>, <ackPolicy>, <scrambler>, <aifsnVal>, <ant>	b5_5: 11b DSSS 5.5 Mbps b11: 11b DSSS 11 Mbps g6: 11g 6 Mbps g9: 11g 9 Mbps g12: 11g 12 Mbps g18: 11g 18 Mbps g24: 11g 24 Mbps g36: 11g 36 Mbps g48: 11g 48 Mbps g54: 11g 54 Mbps n6_5: 11n 6.5 Mbps (7.2 Mbps @ Short GI) n13: 11n 13 Mbps (14.4 Mbps @ Short GI) n19_5: 11n 19.5 Mbps (21.7 Mbps @ Short GI) n26: 11n 26 Mbps (28.9 Mbps @ Short GI) n39: 11n 39 Mbps (43.3 Mbps @ Short GI) n52: 11n 52 Mbps (57.8 Mbps @ Short GI) n58_5: 11n 58.5 Mbps (65 Mbps @ Short GI) n65: 11n 65 Mbps (72.2 Mbps @ Short GI) <txPower>: TX power (0 ~ 15), 0.8 dB step <destAddr>: MAC address to send packet <bssid>: BSSID <htEnable>: N/A <GI>: [short|long]. Guad interval. 11n mode only <greenField>: [on|off]. Set greenfield mode on/off <preambleType>: [short|long]. Preamble type @ DSSS mode <qosEnable>: [on|off]. MAC header QoS control <ackPolicy>: [NO|NORM|BA|CBA] <scrambler>: N/A <aifsnVal>: [0 ~ 15]. Indicate the AIFS in units of slots after SIFS that hardware should wait for before starting backoff, for access category <ant>: [0]. Fixed Response: OK or ERROR
	Prerequisite Start RF test mode (AT+RFTESTSTART). Example //TX test with 11N MCS7, 2412 MHz and power grade as "0" (max power) AT+RFTX 2412,0,0,1000,n65,0 OK Note: Enabled by default in the SDK v3.2.3.0 or later.	
AT+RFTXSTOP	(none)	Stop RF TX test
	Prerequisite Start RF TX test (AT+RFTX). Example AT+RFTX 2412,0,0,1000,n65,0 OK AT+RFTXSTOP OK	

Command	Parameters	Description
	AT+RFTX 2442,0,0,1000,n65,0 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ AT+RFTXSTOP is required before testing other items.	
AT+RFCWTEST	<Ch>, <BW>, <txPower>, <ant>, <CWCycle>	Start CW test. <Ch>: Carrier frequency (2412 ~ 2484 MHz) <BW>: [0]: Fixed. Carrier bandwidth. 20 MHz fixed <txPower>: TX power (0 ~ 15), 0.8 dB step <ant>: [0]. Fixed <CWCycle>: 1 MHz fixed Response: OK or ERROR
	Prerequisite Start RF test mode (AT+RFTESTSTART). Example AT+RFCWTEST 2442,0,2 OK CW TX test with 2442 MHz and power grade as 2 Note: Enabled by default in the SDK v3.2.3.0 or later.	
AT+RFCWSTOP	(none)	Stop CW tests. Response: OK or ERROR
	Prerequisite Start RF CW test (AT+RFCWTEST). Example AT+RFCWTEST 2442,0,2 OK AT+RFCWSTOP OK AT+RFCWTEST 2472,0,2 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ AT+RFCWSTOP is required before testing other items.	
AT+RFCONTSTART	<txRate>, <txPower>, <Ch>	Start RF continuous TX test. ▪ <txRate>: Data rate. See the AT+RFTX command ▪ <txPower>: TX power (0 ~ 15), 0.8 dB step ▪ <Ch>: Carrier frequency (2412 ~ 2484 MHz) Response: OK or ERROR
	Prerequisite Start RF test mode (AT+RFTESTSTART). Example //Continuous TX test with 11G 54 MHz, 2472 MHz and power grade as 2 AT+RFCONTSTART g54,2,2472 OK	

Command	Parameters	Description
	Note: Enabled by default in the SDK v3.2.3.0 or later.	
AT+RFCONTSTOP	(none)	Stop RF continuous TX test. Response: OK or ERROR
	Prerequisite Start RF continuous TX test (AT+RFCONTSTART). Example AT+RFCONTSTART g54,2,2412 OK AT+RFCONTSTOP OK AT+RFCONTSTART g54,2,2472 OK Note: Enabled by default in the SDK v3.2.3.0 or later.	
AT+RFCHANNEL	<Ch>	Change RF channel for PER test. <Ch>: Carrier frequency (2412 ~ 2484 MHz) Response: OK or ERROR
	Prerequisite Start RF test mode (AT+RFTESTSTART). Example AT+RFCHANNEL 2412 OK Note: Enabled by default in the SDK v3.2.3.0 or later.	
AT+RFPERRESET	(none)	Reset PER count. Response: OK or ERROR
	Prerequisite Start RF test mode (AT+RFTESTSTART). Example AT+RFPERRESET OK Note: Enabled by default in the SDK v3.2.3.0 or later.	
AT+RFPER	(none)	Display PER state. Indicate the number of Valid packets, FCS Errors packets, PHY Errors packets, and Overflow Errors. Response: OK or ERROR
	Prerequisite Start RF test mode (AT+RFTESTSTART). Example AT+RFPER 20 0 0 0 OK Note: Enabled by default in the SDK v3.2.3.0 or later.	
AT+RFTESTSTOP	(none)	Stop RF test mode.
	Example AT+RFTESTSTOP	

Command	Parameters	Description
	OK Note: Enabled by default in the SDK v3.2.3.0 or later.	

Table 41. RF test examples

Test step	Command	Description
ECHO on	ATE	ECHO on
Set boot mode	AT+TMRFNOINIT=1	Set boot mode as RF test mode
Restart DA16200/ DA16600	AT+RESTART	Reboot as RF test mode
ECHO on	ATE	ECHO on
Start RF test mode	AT+RFTESTSTART	Start RF test mode
TX Test @ 11B 1 Mbps	AT+RFTX 2412,0,0,200,b1,0	11B 1 Mbps/Channel 1
	AT+RFTXSTOP	Stop TX
	AT+RFTX 2442,0,0,200,b1,0	11B 1 Mbps/Channel 7
	AT+RFTXSTOP	Stop TX
	AT+RFTX 2472,0,0,200,b1,0	11B 1 Mbps/Channel 13
	AT+RFTXSTOP	Stop TX
TX Test @ 11G 54 Mbps	AT+RFTX 2412,0,0,1000,g54,0	11G 54 Mbps/Channel 1
	AT+RFTXSTOP	Stop TX
	AT+RFTX 2442,0,0,1000,g54,0	11G 54 Mbps/Channel 7
	AT+RFTXSTOP	Stop TX
	AT+RFTX 2472,0,0,1000,g54,0	11G 54 Mbps/Channel 13
	AT+RFTXSTOP	Stop TX
TX Test @ 11N MCS7	AT+RFTX 2412,0,0,1000,n65,0	11N MCS7/Channel 1
	AT+RFTXSTOP	Stop TX
	AT+RFTX 2442,0,0,1000,n65,0	11N MCS7/Channel 7
	AT+RFTXSTOP	Stop TX
	AT+RFTX 2472,0,0,1000,n65,0	11N MCS7/Channel 13
	AT+RFTXSTOP	Stop TX
RX Test	AT+RFCHANNEL 2412	Change RF channel to 1
	AT+RFPERRESET	Reset PER count
	AT+RFPER	Display PER state
	AT+RFCHANNEL 2442	Change RF channel to 7
	AT+RFPERRESET	Reset PER count
	AT+RFPER	Display PER state

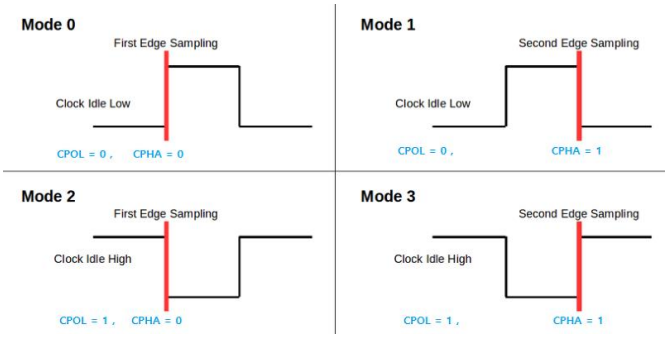
Test step	Command	Description
	AT+RFCHANNEL 2472	Change RF channel to 13
	AT+RFPERRESET	Reset PER count
	AT+RFPER	Display PER state
Stop RF test mode	AT+RFTESTSTOP	Stop RF test mode

NOTE
Renesas Electronics provides the AT-GUI tool to test RF performance easily. The tool and manual are available on the Renesas website (https://www.renesas.com/us/en/products/wireless-connectivity/wi-fi/low-power-wi-fi). See Ref. [4]. The 2.4 GHz band is divided into 14 channels at 5 MHz intervals centered at 2.412 GHz, starting with channel 1. The last channel (CH 14) has additional restrictions or cannot be used for use in all regulatory areas. ▪ TX power setting value range: 0x0 ~ 0xB ▪ Setting value for unsupported channel: 0xF

5.6.11 System and Peripheral Function Commands

5.6.11.1 SPI Commands

Table 42. SPI command list

Command	Parameters	Description
AT+SPICONF	<clockpol>, <clockpha>	Configure SPI. <clockpol>: Clock polarity [0|1] <clockpha>: Clock phase [0|1]
	Example AT+SPICONF=1,1 OK AT+SPICONF=0,1 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_PERI_CMD__ is enabled in the SDK, this command should be enabled. ▪ The <clockpol> sets the polarity of the clock signal during the idle state. The idle state is defined as the period when CS is high and transitioning to low at the start of the transmission and when CS is low and transitioning to high at the end of the transmission. The <clockpha> selects the clock phase. Depending on the <clockpha>, the rising or falling clock edge is used to sample the data. The default values of the DA16200/DA16600 are clockpol,0 and clockpha 0. 

5.6.11.2 OTP Commands

Table 43. OTP command list

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td rowspan="2">AT+UOTPRDASC</td><td><addr>,<cnt></td><td>Read OTP data.
<addr>: OTP address to read 4-byte aligned
<cnt>: Bytes to read
Response: OK or Error
A string of four-bit HEXA value represented by the ASCII code.</td></tr>
<tr><td colspan="2">Example
//Reading 4 bytes at offset h180 (h180 * 4 = h600).
//If data "12345678" is written to 0x600, can read the values.
AT+UOTPRDASC=600,4
12345678
OK
Note:
▪ Enabled by default in the SDK v3.2.3.0 or later.
▪ If __SUPPORT_PERI_CMD__ is enabled in the SDK, this command should be enabled.
▪ The physical OTP offset range of the DA16200/DA16600 is h0~h1FF; at each offset, 4 bytes are stored or read.
▪ For accessing OTP using this command, a 4-byte aligned address should be given. For example: h0, h4, h8...</td></tr>
<tr><td rowspan="2">AT+UOTPWRASC</td><td><addr>,<cnt>,<value></td><td>Write OTP data.
<addr>: OTP address to write 4-byte aligned
<cnt>: Bytes to write
<value>: A string of four-bit HEXA value represented by the ASCII code
Response: OK or Error
Important
For MAC address read or write, AT+WFOTP (write) and AT+WFMAC (read) must be used. Do not use AT+UOTPRDASC or AT+UOTPWRASC for this purpose.
OTP offset from 0x00 ~ 0x2b should not be written as this section is for "secure" boot.</td></tr>
<tr><td colspan="2">Example
//Writing h12345678 to OTP Address 0x600:
//To write "12345678" data into the 0x600,
AT+UOTPWRASC=600,4,12345678
OK

//To read written Data with UOTPRDASC
AT+UOTPRDASC=600,4
12345678
OK
Note:
▪ Enabled by default in the SDK v3.2.3.0 or later.
▪ If __SUPPORT_PERI_CMD__ is enabled in the SDK, this command should be enabled.
▪ Physical OTP offset range of the DA16200/DA16600 is h0~h1FF; at each offset, 4 bytes are stored or read.
▪ For accessing OTP using this command, a 4-byte aligned address should be given. For example: h0, h4, h8...</td></tr>
</table>

The DA16200/DA16600 provides four (4) slots to store MAC addresses, and 8 bytes are allocated for each slot.

Table 44. OTP address for XTAL offset

Slot	OTP address	Description	Size (Byte)
MAC Address #0	0x100	MAC Address Low	4
	0x101	MAC Address High	4
MAC Address #1	0x102	MAC Address Low	4
	0x103	MAC Address High	4
MAC Address #2	0x104	MAC Address Low	4
	0x105	MAC Address High	4
MAC Address #3	0x106	MAC Address Low	4
	0x107	MAC Address High	4

The DA16200/DA16600 provides two slots to store XTAL offset in the OTP memory. Slot #0 is the primary slot while Slot#1 is for back-up, which is used when overriding Slot #0.

Table 45. Memory size by XTAL offset

Slot	OTP address	Description	Size (Byte)
XTAL Offset #0	0x10A	XTAL Offset #0 value	1
XTAL Offset #1	0x10B	XTAL Offset #1 value	1

5.6.11.3 XTAL Commands

These commands are used for XTAL calibration, and the usage is described in the DA16200/DA16600 Mass Production Guide. See Ref. [7].

Table 46. XTAL command list

Command	Parameters	Description
AT+XTALWR	<value>	Write XTAL Offset to the DA16200/DA16600 system register. <value>: Seven-bits to write [h'1 ~ h'7f] Response: OK or Error
	Example AT+XTALWR=7f OK AT+XTALWR=80 ERROR Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_PERI_CMD__ is enabled in the SDK, this command should be enabled.	
AT+XTALRD	(none)	Read XTAL offset from the DA16200/DA16600 system. Response: <CR><LF><A string of seven-bit HEXA value represented by the ASCII Code><CR><LF>OK<CR><LF> or Error
	Example AT+XTALRD 0x7f OK Note:	

Command	Parameters	Description
	▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_PERI_CMD__ is enabled in the SDK, this command should be enabled.	

5.6.11.4 Flash Dump Commands

Table 47. Flash dump command list

Command	Parameters	Description
AT+FLASHDUMP	<address>, <length>	Dump serial flash data. <address>: Start address [h'0 ~ h'3fffff] <length>: Data length [d'] Response: <CR><LF> <dump data> <CR><LF>OK<CR><LF> or Error
	Example //The following example reads 32 kB from 0x00, (1024*32 = 32768) AT+FLASHDUMP=0,32768 Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_PERI_CMD__ is enabled in the SDK, this command should be enabled.	

5.6.11.5 GPIO Commands

Table 48. GPIO command list

Command	Parameters	Description
AT+GPIOSTART	<port>, <pin >, <direction>	Configure the GPIO pin MUX and the direction of a GPIO. ▪ <port>: GPIO port number • 0: GPIOA • 2: GPIOC ▪ <pin>: GPIO pin number. This is a hexadecimal value and indicates a GPIO bitmap • GPIOA: GPIOA0 ~ GPIOA11 • GPIOC: GPIOC6 ~ GPIOC8 ▪ <direction>: GPIO pin direction • 0: Set the pin as an input • 1: Set the pin as an output Response: OK or Error
	Example //To configure GPIOA [3:0] output with UART interface: //GPIO (0, 1, 2, 3) is set to binary 1 (0000 0000 0000 1111). AT+GPIOSTART=0,f,1 OK //To configure GPIOA [3:0] output with using SPI interface: //Avoid reassigning default SPI-pin. //GPIO (4, 5, 6, 7) is set to binary 1 (0000 0000 1111 0000). AT+GPIOSTART=0,f0,1 OK	

<table>
<tr><th>Command</th><th>Parameters</th><th>Description</th></tr>
<tr><td></td><td colspan="2">//To configure GPIOC [8:6] input:
//GPIO (6, 7, 8) is set to binary 1 (0000 0001 1100 0000).
AT+GPIOSTART=2,1c0,0
OK
Note:
▪ Enabled by default in the SDK v3.2.3.0 or later.
▪ If __SUPPORT_PERI_CMD__ is enabled in the SDK, this command should be enabled.</td></tr>
<tr><td rowspan="3">AT+GPIORD</td><td><port>,
<pin></td><td>Read the GPIO input level.
▪ <port>: GPIO port number
• 0: GPIOA
• 2: GPIOC
▪ <pin>: GPIO pin number. This is a hexadecimal value and indicates a GPIO bitmap
Response:
<Read value>: [h'0 ~ h'1fff]
OK or Error</td></tr>
<tr><td colspan="2">Example
//Configure GPIOC[8:6] as output and set to High.
AT+GPIOSTART=2,1c0,1
OK

AT+GPIOWR=2,1c0,1
OK

//Read back the status of the pins:
AT+GPIORD=2,1c0
0x01c0
OK
Note:
▪ Enabled by default in the SDK v3.2.3.0 or later.
▪ If __SUPPORT_PERI_CMD__ is enabled in the SDK, this command should be enabled.
▪ The read value indicates GPIO bitmap. If the value is 0x1c0, it means GPIO #6, #7, and #8 are High.</td></tr>
<tr><td rowspan="2">AT+GPIOWR</td><td><port>,
<pin>,
<level></td><td>Configures the output level of GPIO pins.
▪ <port>: GPIO port number
• 0: GPIOA
• 2: GPIOC
▪ <pin>: GPIO pin number. This is a hexadecimal value and indicates a GPIO bitmap
▪ <level>: GPIO output level
• 0: Low
• 1: High
Response: OK or Error</td></tr>
<tr><td colspan="2">Prerequisite
Change the direction of GPIO to output (AT+GPIOSTART).
Example
//Configure GPIOC[8:6] as output and set to High.</td></tr>
</table>

Command	Parameters	Description
	AT+GPIOSTART=2,1c0,1 OK AT+GPIOWR=2,1c0,1 OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_PERI_CMD__ is enabled in the SDK, this command should be enabled.	
AT+SAVE_PININFO	(none)	Save pin MUX information. Response: OK or Error
	Example AT+SAVE_PININFO OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_PERI_CMD__ is enabled in the SDK, this command should be enabled. ▪ It saves the current pin MUX configuration.	
AT+RESTORE_PININFO	(none)	Restore pin MUX information. Response: OK or Error
	Example AT+RESTORE_PININFO OK Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_PERI_CMD__ is enabled in the SDK, this command should be enabled. ▪ It restores the pin multiplexing status saved through the AT+SAVE_PININFO command.	

5.6.11.6 LED Commands

Table 49. LED command list

Command	Parameters	Description
AT+LEDINIT	<none>	Configure GPIOC_6 (LED1), GPIOC_7 (LED2), and GPIOC_8 (LED3) pins to GPIO output. Response: OK or Error
	Example AT+LEDINIT +OK Note: Enabled by default in the SDK v3.2.2.1 or later.	
AT+LEDCTRL	<port >, <status>	Set LED1/2/3 (GPIOC_6/7/8) pin to output High or Low. <port>: GPIO port number 1: GPIOC_6 2: GPIOC_7 3: GPIOC_8 <status>: LED status off: LED off on: LED on Response: OK or Error

Command	Parameters	Description
	Example AT+LEDCTRL=1,off OK Note: Enabled by default in the SDK v3.2.2.1 or later.	

5.6.11.7 PWM Commands

Table 50. PWM command list

Command	Parameters	Description
AT+PWMINIT	<none>	Configure GPIOA_10 pin to PWM output. Response: OK or Error
	Example AT+PWMINIT +OK Note: ▪ Enabled by default in the SDK v3.2.2.1 or later. ▪ If __ATCMD_IF_UART1__ is enabled in the SDK, this command should be enabled.	
AT+PWMSTART	<channel >, <period>, <duty> <mode cycle>	Start PWM output (GPIOA_10) with given period and duty. ▪ <channel>: PWM channel, fixed as 0 ▪ <period>: period of one clock (microsecond) ▪ <duty>: duty as percentage ▪ <mode cycle>: fixed as 0 Response: OK or Error
	Example AT+PWMSTART=0,40,50,0 OK Note: ▪ Enabled by default in the SDK v3.2.2.1 or later. ▪ If __ATCMD_IF_UART1__ is enabled in the SDK, this command should be enabled.	
AT+PWMSTOP	<none>	Stop PWM output. Response: OK or Error
	Example AT+PWMSTOP OK Note: ▪ Enabled by default in the SDK v3.2.2.1 or later. ▪ If __ATCMD_IF_UART1__ is enabled in the SDK, this command should be enabled.	

5.6.11.8 ADC Commands

Table 51. ADC command list

Command	Parameters	Description
AT+ADCINIT	<none>	Configure GPIOA_0, GPIOA_1, GPIOA_2, GPIOA_3 to analog input pins for ADC. GPIOA_0: ADC channel 0 GPIOA_1: ADC channel 1 GPIOA_2: ADC channel 2 GPIOA_3: ADC channel 3

Command	Parameters	Description
		Response: OK or Error
	Example AT+ADCINIT OK Note: ▪ Enabled by default in the SDK v3.2.2.1 or later. ▪ If __ATCMD_IF_UART1__ is enabled in the SDK, this command should be enabled.	
AT+ADCCHEN	<channel >, < resolution >	Enable given ADC channel. <channel>: ADC channel number [0|1|2|3] <resolution>: ADC resolution. fixed as 12-bit Response: OK or Error
	Example AT+ADCCHEN=0,12 OK Note: ▪ Enabled by default in the SDK v3.2.2.1 or later. ▪ If __ATCMD_IF_UART1__ is enabled in the SDK, this command should be enabled.	
AT+ADCSTART	<divider>	Start ADC function. <divider>: divider ADC sampling rate For example, when divider is 1, 1 MHz/(divider (1) + 1) = 500 kHz. Response: OK or Error
	Example AT+ADCSTART=1 OK Note: ▪ Enabled by default in the SDK v3.2.2.1 or later. ▪ If __ATCMD_IF_UART1__ is enabled in the SDK, this command should be enabled.	
AT+ADCREAD	<channel>, <sample count>	Read ADC value. <channel>: ADC channel number [0|1|2|3] <sample count>: count of sample to read Response: <Read value>: [sample count] Response: OK or Error
	Example AT+ADCREAD=0,16 [279 275 269 271 270 268 268 274 274 277 276 269 271 276 264 274] OK Note: ▪ Enabled by default in the SDK v3.2.2.1 or later. ▪ If __ATCMD_IF_UART1__ is enabled in the SDK, this command should be enabled.	
AT+ADCSTOP	(none)	Stop ADC function. Response: OK or Error
	Example AT+ADCSTOP OK Note:	

Command	Parameters	Description
	▪ Enabled by default in the SDK v3.2.2.1 or later. ▪ If __ATCMD_IF_UART1__ is enabled in the SDK, this command should be enabled.	

5.6.11.9 I2C Commands

Table 52. I2C command list

Command	Parameters	Description
AT+I2CINIT	<none>	Configure GPIOA_8 (I2C_SDA), GPIOA_9 (I2C_SCL) pins to I2C pins. Response: OK or Error
	Example AT+I2CINIT OK Note: Enabled by default in the SDK v3.2.2.1 or later.	
AT+I2CREAD	<slave address>, <register>, <length>	Read values from registers of I2C device. ▪ <slave address>: 8-bit slave address of I2C device (hex) ▪ <register>: register value to read (hex) ▪ <length>: data length to read (decimal) Response: <Read values> (hex) Response: OK or Error
	Example AT+I2CREAD=d0,10,1 66 OK Note: Enabled by default in the SDK v3.2.2.1 or later.	
AT+ I2CWRITE	<slave address>, <register>, <length>, <values>	Write values to I2C register of I2C device. ▪ <slave address>: 8-bit slave address of I2C device (hex) ▪ <register>: register value to write (hex) ▪ <length>: data length to write (decimal) ▪ <values>: data to write (hex) Response: OK or Error
	Example AT+I2CWRITE=d0,10,3,670292 OK Note: Enabled by default in the SDK v3.2.2.1 or later.	

5.6.11.10 Sleep Commands

Table 53. Sleep command list

Command	Parameters	Description
AT+SETSLEEP2EXT	<period>,<use_retention_memory>	Enter Sleep mode 2 for the period specified. <period>: wake-up timeout, in millisecond. Min. period: 1000 msec. Max. period: 2097151000 (about 24 days) <use_retention_memory>: 1 (retain), 0 (not retain) Response: OK or ERROR
	Example AT+SETSLEEP2EXT=10000,0 OK	

Command	Parameters	Description
	+INIT:DONE,0 Note: ▪ Enabled by default in the SDK. ▪ The DA16200/DA16600 can be woken up by RTC_WAKE_UP while in sleep by AT+SETSLEEP2EXT. ▪ The DA16200/DA16600 sends "+INIT:DONE,0" when it wakes up. ▪ A value of 0 for the <period> parameter sets the system to wake up only when an RTC_WAKE_UP event occurs. ▪ This command should be run in Non-DPM mode only, therefore, if you want to run this command in DPM mode, disable DPM first (AT+DPM=0,1), and run this command. When this command is run in DPM mode enabled, it returns ERROR (-316). ▪ The use of 1 as <use_retention_memory> is obsolete. If you want to use 1 as <use_retention_memory>, use AT+SETSLEEP3EXT command instead.	
AT+SETSLEEP3EXT	<period>	Enter Sleep mode 3 for the period specified. <period>: wake-up timeout, in millisecond. Min. period: 1000 msec. Max. period: 2097151000 (about 24 days)
	Example AT+SETSLEEP3EXT=10000 OK +INIT:DONE,0 Note: ▪ Enabled by default in the SDK. ▪ Retention memory is ON during Sleep mode 3. ▪ The DA16200/DA16600 can be woken up by RTC_WAKE_UP while in sleep by AT+SETSLEEP3EXT. ▪ The DA16200/DA16600 sends "+INIT:DONE,0" or "+INIT:WAKEUP,…" when it wakes up. ▪ A value of 0 for the <period> parameter sets the system to wake up only when an RTC_WAKE_UP event occurs. ▪ This command can be used in DPM mode or Non-DPM mode.	
AT+SETSLEEP1EXT	Deprecated	
	<retain_dpm_memory>	Enter Sleep mode 2. <retain_dpm_memory>: 1 (retain), 0 (not retain) Response: OK or ERROR
	Example AT+SETSLEEP1EXT=1 OK +INIT:DONE,0 Note: ▪ This command is the same as AT+SETSLEEP2EXT with the period set to 0. ▪ It recommends using the AT+SETSLEEP2EXT command instead of this one. ▪ Enabled by default in the SDK. ▪ The DA16200/DA16600 can only be woken up by RTC_WAKE_UP or GPIO which was assigned as a wake-up source. ▪ The DA16200/DA16600 sends "+INIT:DONE:0" when it wakes up.	
AT+SLEEPMS	Deprecated	
	<period>	Force the DA16200/DA16600 enter Sleep mode 3 and wake up after <period> milliseconds. <period>: Wake-up time in milliseconds. Max period: 2097151000 (about 24 days)

Command	Parameters	Description
	Example AT+SLEEPMS=5000 +INIT:DONE,0 Note: ▪ Enabled by default in the SDK v3.2.3.0 or later. ▪ If __SUPPORT_PERI_CMD__ is enabled in the SDK, this command should be enabled.	

5.6.11.11 CALWL Commands

Table 54. CALWL command list

Command	Parameters	Description
AT+CALWR	<gmode_tx_rf_proc>, <txpga_gmode_cal>	Change RF TX GAIN Calibration register for test. <gmode_tx_rf_proc> 7 bits hexadecimal without "0x" prefix Offset = bit[5:0] x 0.8 dB MSB[6] bits 0 then TX gain is decreased MSB[6] bits 1 then TX gain is increased <txpga_gmode_cal> 0: 0 dB offset 1: -0.2 dB offset 2: -0.4 dB offset 3: -0.6 dB offset
	Example 1. TX measured +14 dBm and changed to +13 dBm. AT+CALWR=1,1 OK gmade_tx_rf_proc = 1, -0.8 dB txpga_gmode_cal = 1, -0.2 dB Changed TX Gain: 14 dBm - 0.8 dB - 0.2 dB = 13.0 dBm 2. TX measured +13 dBm and changed to +13.6 dBm. AT+CALWR=41,3 OK gmade_tx_rf_proc = 41, +0.8 dB txpga_gmode_cal = 1, -0.2 dB Changed TX Gain: 13 dBm + 0.8 dB - 0.2 dB = 13.6 dBm Note: ▪ This setting is not saved to the system and changed when system reboots. ▪ If __SUPPORT_PERI_CMD__ is enabled in the SDK, this command should be enabled.	

6. AT Command Example

6.1 Data Transfer Test

This section describes how to test the transfer function commands with a data terminal emulator. Some of the terminal applications to be used for this purpose are:

- Hercules for Windows: https://www.hw-group.com/software/hercules-setup-utility
- Packet Sender for Windows/Linux/MacOS: https://packetsender.com/
- TCP UDP Server & Client for Android: TCP UDP Server & Client - Apps on Google Play
- UDP/TCP/REST Network Utility for iOS: UDP/TCP/REST Network Utility on the App Store

The following sections describe test procedures for socket communication between the DA16200/DA16600 and a PC with Hercules. Run the DA16200/DA16600 AT commands on a serial terminal application on the local PC. The terminal must be connected to the UART1 interface of the DA16200/DA16600.

6.1.1 TCP Server Socket Test

1. DA16200/DA16600 AT command:
   a. AT+TRTS=1234 ← Open a TCP server socket with the port number 1234.
2. Hercules Software:
   a. Select TCP Client (#1, Figure 27).
   b. Enter the IP address and the port number of DA16200/DA16600 (#2, Figure 27).
   c. Click Connect to connect the socket (#3, Figure 27).
3. DA16200/DA16600 AT command:
   a. +TRCTS:0,192.168.0.2,50166 ← A TCP client socket connected, and IP address is 192.168.0.2 and port is 50166.
4. Hercules Software:
   a. Send data (#4, Figure 27).
5. DA16200/DA16600 AT command:
   a. +TRDTS:0,192.168.0.2,50166,24,Renesas IoT WiFi DA16200 ← Received 24 bytes of data: Renesas IoT WiFi DA16200.

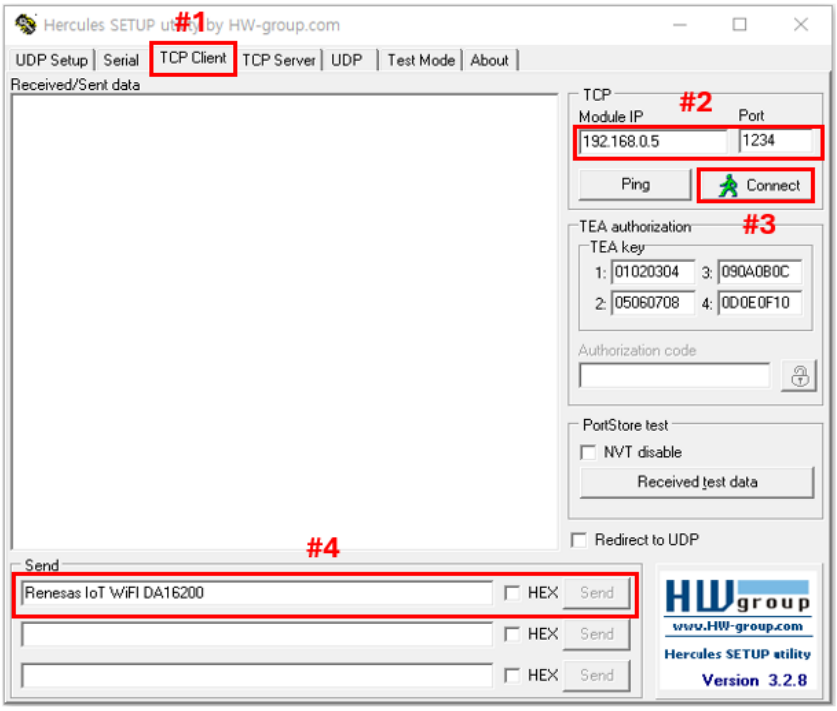


Figure 27. Hercules – TCP client socket setting

6.1.2 TCP Client Socket Test

1. Hercules Software:
   a. Select TCP Server (#1, see Figure 28).
   b. Enter the port number to be used (#2, see Figure 28).
   c. Click Listen to start to Listen (#3, see Figure 28).
2. DA16200/DA16600 AT command:
   a. AT+TRTC=192.168.0.2,1234,2300 ← Open a TCP client socket and set the server IP (192.168.0.2), port (1234), and the local port (2300).
   b. <ESC>S18,0,0,12345678 ← Send 8 bytes of data: 12345678.
3. Hercules Software:
   a. Receive 8 bytes data.
   b. Send data (#4, see Figure 28).
4. DA16200/DA16600 AT command:
   a. `+TRDTC:1,192.168.0.2,1234,24,Renesas IoT WiFi DA16200` ← Received 24 bytes of data: Renesas IoT WiFi DA16200.

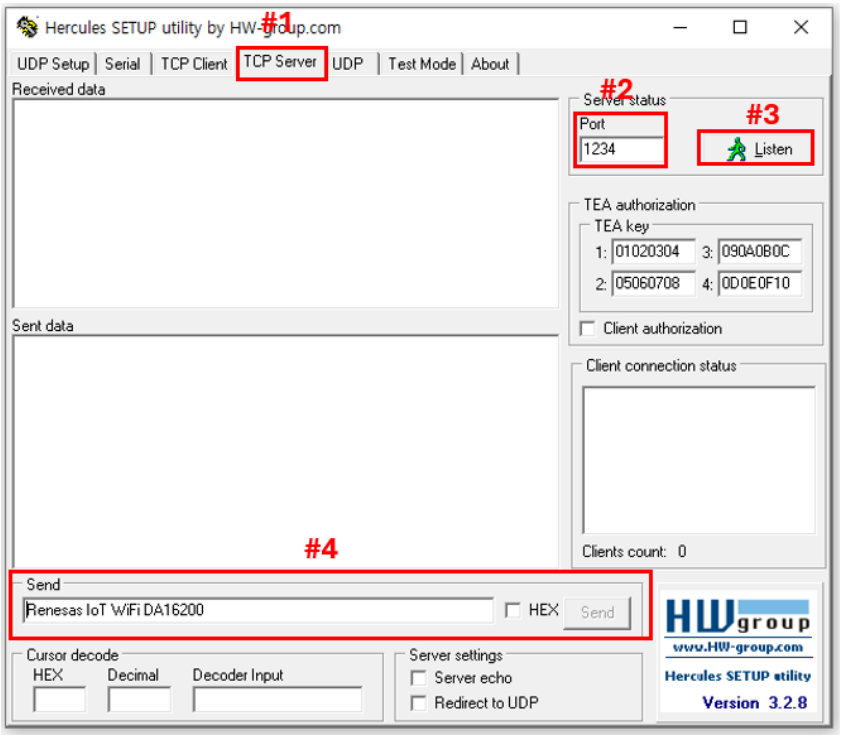


Figure 28. Hercules – TCP server socket setting

6.1.3 UDP Socket Test

1. Hercules Software:
   a. Select UDP (#1, see Figure 29).
   b. Enter the IP address and port of the counterpart's UDP socket (#2, see Figure 29).
   c. Enter the port number to be used and click Listen to open the socket (#3, see Figure 29).
   d. Enter data and click Send to transmit (#4, see Figure 29).
2. DA16200/DA16600 AT command:
   a. AT+TRUSE=4567 ← Open a UDP socket and set the local port (4567).
   b. AT+TRUR=192.168.0.2,1234 ← Set the remote IP (192.168.0.2) and port (1234).
   c. <ESC>S210,0,0,1234567890 ← Send 10 bytes of data: 1234567890.
   d. +TRDUS:2,192.168.0.2,1234,25,Renesas IoT Wi-Fi DA16200 ← Received 25 bytes of data: Renesas IoT Wi-Fi DA16200.

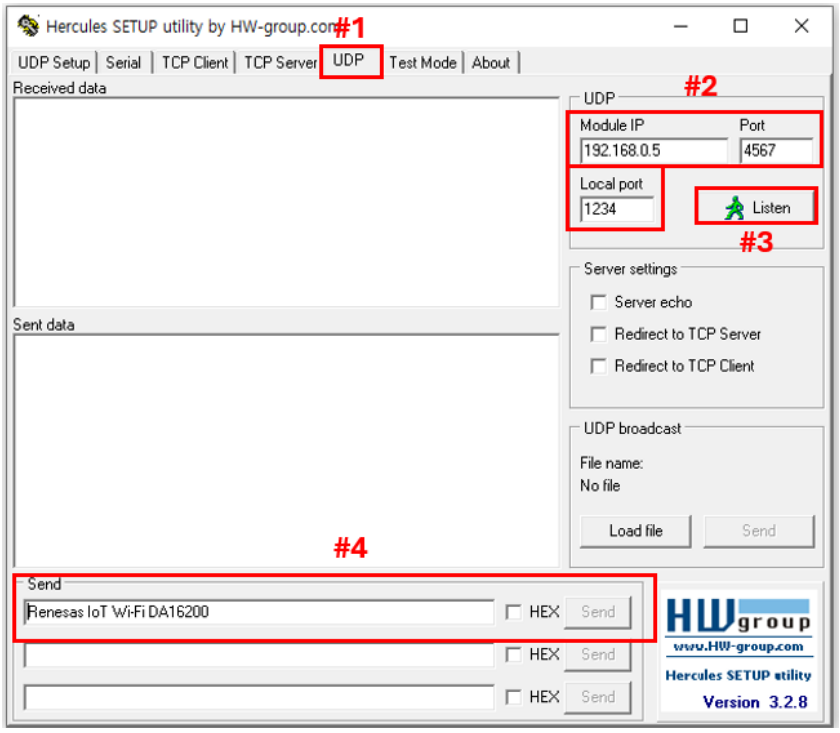


Figure 29. Hercules – UDP socket setting

Appendix A License Information

```
Mosquitto1.4.14 License
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POSSIBILITY OF SUCH DAMAGE.
-------------------------------------------------------------------------------------------------------
-----------------------------
UMAC GPL License
Linux kernel 3.9.0 rc3 version (backport 4.2.6-1)
```

Appendix B HTTP Client Return Values

B.1 Return Value as Defined by HTTP Client

Table 55. Return value as defined by HTTP Client

Define	Value
HTTPC_RESULT_OK	0
HTTPC_RESULT_ERR_UNKNOWN	1
HTTPC_RESULT_ERR_CONNECT	2
HTTPC_RESULT_ERR_HOSTNAME	3
HTTPC_RESULT_ERR_CLOSED	4
HTTPC_RESULT_ERR_TIMEOUT	5
HTTPC_RESULT_ERR_SVR_RESP	6
HTTPC_RESULT_ERR_MEM	7
HTTPC_RESULT_LOCAL_ABORT	8
HTTPC_RESULT_ERR_CONTENT_LEN	9

B.2 Return Value as Defined by LWIP HTTP

Table 56. Return value as defined by LWIP HTTP

Define	Value
ERR_OK	0
ERR_MEM	-1
ERR_BUF	-2
ERR_TIMEOUT	-3
ERR_RTE	-4
ERR_INPROGRESS	-5
ERR_VAL	-6
ERR_WOULDBLOCK	-7
ERR_USE	-8
ERR_ALREADY	-9
ERR_ISCONN	-10
ERR_CONN	-11
ERR_IF	-12
ERR_ABRT	-13
ERR_RST	-14
ERR_CLSD	-15
ERR_ARG	-16
ERR_UNKNOWN	-17
ERR_NOT_FOUND	-18

Appendix C User UART Configuration

C.1 How to Run AT Command on UART2

AT command is configured to use the UART1 interface by default and can be configured to use the UART2 interface. To configure AT command to use the UART2 interface, modify config_generic_sdk.h as shown in the following example.

```
      //AT command service
      #define   __SUPPORT_ATCMD__
...
      #if defined ( __SUPPORT_ATCMD__ )
                #undef  __ATCMD_IF_UART1__              //AT command over UART1
                #define __ATCMD_IF_UART2__              //AT command over UART2
                ...
                #undef  __USER_UART_CONFIG__    //Support Customer's UART configuration
                #undef  __ATCMD_IF_SPI__                //AT command over SPI
                #undef  __ATCMD_IF_SDIO__               //AT command over SDIO
        #endif  /* __SUPPORT_ATCMD__ */
...
```

C.2 User UART Configuration

There is a feature called User UART Configuration that is enabled by __USER_UART_CONFIG__. When the SDK is built with __USER_UART_CONFIG__ defined, the UART settings for the AT command interface can be configured. In this case, ATB is not available. For example, to run AT command on UART2 with a static baud rate of 230400, the SDK should be configured as shown in the following example.

```
//config_generic_sdk.h
...
      //AT command service
      #define   __SUPPORT_ATCMD__
...
      #if defined ( __SUPPORT_ATCMD__ )
                #undef  __ATCMD_IF_UART1__      //AT command over UART1
                #define __ATCMD_IF_UART2__      //AT command over UART2
                ...
                #define __USER_UART_CONFIG__ //Support Customer's UART configuration
                ...
        #endif  /* __SUPPORT_ATCMD__ */
...

//user_interface.c
...
#if defined ( __USER_UART_CONFIG__ )
/*
 * Customer configuration for AT command UART
 */
uart_info_t ATCMD_UART_config_info =
{
      UART_BAUDRATE_230400,             /* baud */
      UART_DATABITS_8,          /* bits */
      UART_PARITY_NONE,         /* parity */
      UART_STOPBITS_1,          /* stopbit */
      UART_FLOWCTL_OFF          /* flow control */
};
#endif// __USER_UART_CONFIG__
...
```

With the changes, when the DA16200/DA16600 boots, AT command is initialized in baud rate of 230400 by default and cannot be changed at run time.

C.3 Use Case

// __USER_UART_CONFIG__ disabled

- Baud rate (and other parameters) configurable by NVRAM.
- ATB available, UART Setting can change at run-time without SDK rebuild.
- Example Use case
  - MCU: Run on UART in baud rate of 115200.
  - MCU: Run ATF
  - DA16200/DA16600: AT command is initialized in 115200.
  - MCU: ATB=230400
  - MCU: Now it should change its UART baud rate to 230400 to communicate with the DA16200/DA16600.

// __USER_UART_CONFIG__ enabled

- AT Command UART's baud rate (and other parameters) is configurable statically.
- ATB NOT available
- Example Use Case
  - DA16200/DA16600: The DA16200/DA16600 boots and AT command is initialized in 230400 by default.
  - MCU: Start on UART in baud rate of 230400.
  - MCU: AT command operation.

Appendix D DA16200/DA16600 Cipher Suites

Table 57. DA16200/DA16600 cipher suites

No.	Cipher suite supported by DA16200/DA16600	Hex code
1	TLS_RSA_WITH_AES_128_CBC_SHA	2F
2	TLS_RSA_WITH_AES_256_CBC_SHA	35
3	TLS_RSA_WITH_AES_128_CBC_SHA256	3C
4	TLS_RSA_WITH_AES_256_CBC_SHA256	3D
5	TLS_RSA_WITH_AES_128_GCM_SHA256	9C
6	TLS_RSA_WITH_AES_256_GCM_SHA384	9D
7	TLS_RSA_WITH_AES_128_CCM	C09C
8	TLS_RSA_WITH_AES_256_CCM	C09D
9	TLS_RSA_WITH_AES_128_CCM_8	C0A0
10	TLS_RSA_WITH_AES_256_CCM_8	C0A1
11	TLS_RSA_WITH_DES_CBC_SHA	9
12	TLS_DHE_RSA_WITH_AES_128_CBC_SHA	33
13	TLS_DHE_RSA_WITH_AES_256_CBC_SHA	39
14	TLS_DHE_RSA_WITH_AES_128_CBC_SHA256	67
15	TLS_DHE_RSA_WITH_AES_256_CBC_SHA256	6B
16	TLS_DHE_RSA_WITH_AES_128_GCM_SHA256	9E
17	TLS_DHE_RSA_WITH_AES_256_GCM_SHA384	9F
18	TLS_DHE_RSA_WITH_AES_128_CCM	C09E
19	TLS_DHE_RSA_WITH_AES_256_CCM	C09F
20	TLS_DHE_RSA_WITH_AES_128_CCM_8	C0A2
21	TLS_DHE_RSA_WITH_AES_256_CCM_8	C0A3
22	TLS_DHE_RSA_WITH_3DES_EDE_CBC_SHA	16
23	TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA	C011
24	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA	C014
25	TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256	C027
26	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384	C028
27	TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256	C02F
28	TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384	C030
29	TLS_ECDHE_RSA_WITH_3DES_EDE_CBC_SHA	C012
30	TLS_ECDH_RSA_WITH_AES_128_CBC_SHA	C00E
31	TLS_ECDH_RSA_WITH_AES_256_CBC_SHA	C00F
32	TLS_ECDH_RSA_WITH_AES_128_CBC_SHA256	C029
33	TLS_ECDH_RSA_WITH_AES_256_CBC_SHA384	C02A
34	TLS_ECDH_RSA_WITH_AES_128_GCM_SHA256	C031
35	TLS_ECDH_RSA_WITH_AES_256_GCM_SHA384	C032
36	TLS_ECDH_RSA_WITH_3DES_EDE_CBC_SHA	C00D
37	TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA	C009
38	TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA	C00A

No.	Cipher suite supported by DA16200/DA16600	Hex code
39	TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256	C023
40	TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA384	C024
41	TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256	C02B
42	TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384	C02C
43	TLS_ECDHE_ECDSA_WITH_AES_128_CCM	C0AC
44	TLS_ECDHE_ECDSA_WITH_AES_256_CCM	C0AD
45	TLS_ECDHE_ECDSA_WITH_AES_128_CCM_8	C0AE
46	TLS_ECDHE_ECDSA_WITH_AES_256_CCM_8	C0AF
47	TLS_ECDHE_ECDSA_WITH_3DES_EDE_CBC_SHA	C008
48	TLS_ECDH_ECDSA_WITH_AES_128_CBC_SHA	C004
49	TLS_ECDH_ECDSA_WITH_AES_256_CBC_SHA	C005
50	TLS_ECDH_ECDSA_WITH_AES_128_CBC_SHA256	C025
51	TLS_ECDH_ECDSA_WITH_AES_256_CBC_SHA384	C026
52	TLS_ECDH_ECDSA_WITH_AES_128_GCM_SHA256	C02D
53	TLS_ECDH_ECDSA_WITH_AES_256_GCM_SHA384	C02E
54	TLS_ECDH_ECDSA_WITH_3DES_EDE_CBC_SHA	C003

Appendix E Reason Code for Wi-Fi Connection Failure or Disconnection

SDK v3.x.x.x: core\wifistack\supplicant\src\common\ieee802_11_defs.h.

```
/* Reason codes (IEEE Std 802.11-2016, 9.4.1.7, Table 9-45) */
#define WLAN_REASON_UNSPECIFIED                                 1
#define WLAN_REASON_PREV_AUTH_NOT_VALID                         2
#define WLAN_REASON_DEAUTH_LEAVING                              3
#define WLAN_REASON_DISASSOC_DUE_TO_INACTIVITY                  4
#define WLAN_REASON_DISASSOC_AP_BUSY                            5
#define WLAN_REASON_CLASS2_FRAME_FROM_NONAUTH_STA               6
#define WLAN_REASON_CLASS3_FRAME_FROM_NONASSOC_STA              7
#define WLAN_REASON_DISASSOC_STA_HAS_LEFT                       8
#define WLAN_REASON_STA_REQ_ASSOC_WITHOUT_AUTH                  9
/* IEEE 802.11h */
#define WLAN_REASON_PWR_CAPABILITY_NOT_VALID                    10
#define WLAN_REASON_SUPPORTED_CHANNEL_NOT_VALID                 11
#define WLAN_REASON_BSS_TRANSITION_DISASSOC                     12
/* IEEE 802.11i */
#define WLAN_REASON_INVALID_IE                                  13
#define WLAN_REASON_MICHAEL_MIC_FAILURE                         14
#define WLAN_REASON_4WAY_HANDSHAKE_TIMEOUT                      15
#define WLAN_REASON_GROUP_KEY_UPDATE_TIMEOUT                    16
#define WLAN_REASON_IE_IN_4WAY_DIFFERS                          17
#define WLAN_REASON_GROUP_CIPHER_NOT_VALID                      18
#define WLAN_REASON_PAIRWISE_CIPHER_NOT_VALID                   19
#define WLAN_REASON_AKMP_NOT_VALID                              20
#define WLAN_REASON_UNSUPPORTED_RSN_IE_VERSION                  21
#define WLAN_REASON_INVALID_RSN_IE_CAPAB                        22
#define WLAN_REASON_IEEE_802_1X_AUTH_FAILED                     23
#define WLAN_REASON_CIPHER_SUITE_REJECTED                       24
#define WLAN_REASON_TDLS_TEARDOWN_UNREACHABLE                   25
#define WLAN_REASON_TDLS_TEARDOWN_UNSPECIFIED                   26
#define WLAN_REASON_SSP_REQUESTED_DISASSOC                      27
#define WLAN_REASON_NO_SSP_ROAMING_AGREEMENT                    28
#define WLAN_REASON_BAD_CIPHER_OR_AKM                           29
#define WLAN_REASON_NOT_AUTHORIZED_THIS_LOCATION                30
#define WLAN_REASON_SERVICE_CHANGE_PRECLUDES_TS                 31
#define WLAN_REASON_UNSPECIFIED_QOS_REASON                      32
#define WLAN_REASON_NOT_ENOUGH_BANDWIDTH                        33
#define WLAN_REASON_TDLS_TEARDOWN_UNSPECIFIED                   26
/* IEEE 802.11e */
#define WLAN_REASON_DISASSOC_LOW_ACK                            34
#define WLAN_REASON_EXCEEDED_TXOP                               35
#define WLAN_REASON_STA_LEAVING                                 36
#define WLAN_REASON_END_TS_BA_DLS                               37
#define WLAN_REASON_UNKNOWN_TS_BA                               38
#define WLAN_REASON_TIMEOUT                                     39
#define WLAN_REASON_PEERKEY_MISMATCH                            45
#define WLAN_REASON_AUTHORIZED_ACCESS_LIMIT_REACHED             46
#define WLAN_REASON_EXTERNAL_SERVICE_REQUIREMENTS               47
#define WLAN_REASON_INVALID_FT_ACTION_FRAME_COUNT               48
#define WLAN_REASON_INVALID_PMKID                               49
#define WLAN_REASON_INVALID_MDE                                 50
#define WLAN_REASON_INVALID_FTE                                 51
#define WLAN_REASON_MESH_PEERING_CANCELLED                      52
#define WLAN_REASON_MESH_MAX_PEERS                              53
#define WLAN_REASON_MESH_CONFIG_POLICY_VIOLATION                54
#define WLAN_REASON_MESH_CLOSE_RCVD                             55
#define WLAN_REASON_MESH_MAX_RETRIES                            56
#define WLAN_REASON_MESH_CONFIRM_TIMEOUT                        57
#define WLAN_REASON_MESH_INVALID_GTK                            58
#define WLAN_REASON_MESH_INCONSISTENT_PARAMS                    59
#define WLAN_REASON_MESH_INVALID_SECURITY_CAP                   60
```

```
#define WLAN_REASON_MESH_PATH_ERROR_NO_PROXY_INFO              61
#define WLAN_REASON_MESH_PATH_ERROR_NO_FORWARDING_INFO         62
#define WLAN_REASON_MESH_PATH_ERROR_DEST_UNREACHABLE           63
#define WLAN_REASON_MAC_ADDRESS_ALREADY_EXISTS_IN_MBSS         64
#define WLAN_REASON_MESH_CHANNEL_SWITCH_REGULATORY_REQ         65
#define WLAN_REASON_MESH_CHANNEL_SWITCH_UNSPECIFIED            66
#define WLAN_REASON_IP_NOT_ASSIGN                              67
```

Appendix F Fast Reconnect Function

When Wi-Fi STA tries to connect to an AP again after waking up from Sleep Mode 2, it needs time to establish a Wi-Fi connection. To shorten the time of reconnection, simply use Fast Reconnect function, which is available without additional setup when AT command feature is enabled.

F.1 Technical Overview

F.1.1 Direct Probe Request for Wi-Fi SCAN

During the Wi-Fi SETUP processing after running ATF command, associated channel number is saved in NVRAM automatically after success Wi-Fi connect.

After saving the connected channel number to NVRAM, when reconnecting to Wi-Fi is attempted, the total Wi-Fi SCAN time to connect is reduced because only the registered channel number is scanned without performing full-channel scan for Wi-Fi connection.

F.1.2 Network Address without DHCP Client Procedure

The DA16200/DA16600 obtains an IP address by DHCP Client procedure when the first Wi-Fi connection is completed after running ATF command. The DHCP Client operation may take a lot of time in some cases.

To reduce DHCP Client procedure time, the DA16200/DA16600 saves the IP address, subnet mask, gateway address, and DNS address information in NVRAM after a successful DHCP client procedure, and changes to STATIC IP mode internally. STATIC IP mode removes DHCP processing time and improves connection speed.

Appendix G Bluetooth® LE Coexistence Feature

The Bluetooth® LE Coexistence feature is defined as follows:

- DA16200 AT command image: Bluetooth® LE Coexistence feature is disabled
- DA16600 AT command image: Bluetooth® LE Coexistence feature is enabled (3-pin interface).

If the Bluetooth® LE Coexistence feature or the 1-pin interface are required, the SDK must be rebuilt. For more information, see Ref. [2].

Appendix H Wi-Fi Passive-Scan

A client can use two scanning methods: active and passive. During an active scan, the client radio sends a probe request and receives a probe response from an AP. With a passive scan, the client radio listens to beacons periodically sent by the AP on each channel. A passive scan generally takes more time, since the client must listen and wait for a beacon, than actively probing to find an AP. Another limitation with a passive scan is that if the client does not wait long enough on a channel, then the client may miss an AP beacon.

The DA16200/DA16600 supports active scan and passive scan. It accepts both probe responses and beacons. The DA16200 passive scan consists of frequency and time remaining on the channel, and the result is delivered to the host firmware within 10 ms.

H.1 Passive-Scan with Specified Channel and Scan-Time Limit

The Wi-Fi component should be able to perform a passive Wi-Fi scan that only scans a given list of channels in given time limit. The DA16200 provides passive scan command with ATCMD.

- Related command is AT+WFPSCAN

H.2 Passive-Scan Result

During a passive scan, the Wi-Fi component should be able to report each beacon signal to the host firmware within 10 ms received because of the passive scan. The format which is reported to host firmware is:

- BSSID SSID RSSI Security Type Wi-Fi Channel

H.3 Passive-Scan Stop

The Wi-Fi component should be able to stop an ongoing passive Wi-Fi scan, and any power use associated with the scan within 100 ms of receiving a Wi-Fi beacon signal that meets the following criteria. Beacon BSSID matches the given pattern AND either of the following:

- Beacon RSSI is greater than the minimum threshold

  OR
- Beacon RSSI is less than the maximum threshold

When it stops scanning by condition, it prints out "+PSCAN:CONDITIONMET".

Related commands are "AT+WFPCDTMIN", "AT+WFCDTMAX" and "AT+WFPSTOP".

H.4 Passive-Scan Sequence

This section describes basic procedure for passive scan between the DA16200/DA16600 and a personal computer. Run the DA16200 AT commands on a serial terminal application on the local PC. The terminal must be connected to the UART1 interface of the DA16200.

1. Enable ATCMD feature in "config_generic_sdk.h":

   #define __SUPPORT_ATCMD__
2. Set passive scan condition using ATCMD:

   ATCMD: AT+WFPCDTMIN=72:5d:cc:d0:82:bc,-80
3. Start passive scan using ATMD:

   ATCMD: AT+WFPSCAN=120000,1,3,5
4. Stop passive scan using ATMD:

   ATCMD: AT+WFPSTOP
5. Check passive scan report; see Figure 30.

Figure 30. Passive-scan result

Appendix I Detailed Error Codes for AT Command

Table 58. AT command error codes

Category	Value	Error code	Description
Common	0	AT_CMD_ERR_CMD_OK	OK, no error
	-1	AT_CMD_ERR_UNKNOWN_CMD	Unknown command
	-2	AT_CMD_ERR_INSUFFICENT_ARGS	Insufficient parameter
	-3	AT_CMD_ERR_TOO_MANY_ARGS	Too many parameters
	-4	AT_CMD_ERR_WRONG_ARGUMENTS	Wrong parameter value
	-5	AT_CMD_ERR_NOT_SUPPORTED	Unsupported function
	-6	AT_CMD_ERR_NOT_CONNECTED	Not connected to an AP
	-7	AT_CMD_ERR_NO_RESULT	No result
	-8	AT_CMD_ERR_TOO_LONG_RESULT	Response buffer overflow
	-9	AT_CMD_ERR_INSUFFICENT_CONFIG	Function is not configured
	-10	AT_CMD_ERR_TIMEOUT	Command timeout
	-11	AT_CMD_ERR_NVR_WRITE	NVRAM write failure
	-12	AT_CMD_ERR_RTM_WRITE	Retention memory write failure
	-13	AT_CMD_ERR_SYS_BUSY	System busy
	-14	AT_CMD_ERR_MEM_ALLOC	Memory allocation failure
	-20	AT_CMD_ERR_DATA_TX	Data TX failure
	-22	AT_CMD_ERR_IP_ADDRESS	IP address get failure
	-100	AT_CMD_ERR_COMMON_SYS_MODE	Wrong system running mode
	-110	AT_CMD_ERR_COMMON_ARG_TYPE	Wrong argument type
	-111	AT_CMD_ERR_COMMON_ARG_RANGE	Argument int-value range error
	-112	AT_CMD_ERR_COMMON_ARG_LEN	Argument value length error
	-113	AT_CMD_ERR_COMMON_WRONG_CC	Wrong country-code
	-114	AT_CMD_ERR_COMMON_WRONG_MAC_ADDR	Wrong MAC address
	-999	AT_CMD_ERR_UNKNOWN	Undefined Error
Flash	-170	AT_CMD_ERR_SFLASH_READ	SFlash driver read failure
	-171	AT_CMD_ERR_SFLASH_WRITE	SFlash driver write failure
	-172	AT_CMD_ERR_SFLASH_ERASE	SFlash driver erase failure
	-173	AT_CMD_ERR_SFLASH_ACCESS	SFlash driver access failure
NVRAM	-180	AT_CMD_ERR_NVRAM_READ	NVRAM driver read failure
	-181	AT_CMD_ERR_NVRAM_WRITE	NVRAM driver write failure
	-182	AT_CMD_ERR_NVRAM_ERASE	NVRAM driver erase failure
	-183	AT_CMD_ERR_NVRAM_DIGIT	
	-184	AT_CMD_ERR_NVRAM_SAME_M AC	
	-185	AT_CMD_ERR_NVRAM_CANCEL ED	
	-186	AT_CMD_ERR_NVRAM_INVALID	
	-187	AT_CMD_ERR_NVRAM_UNKNO WN	
	-188	AT_CMD_ERR_NVRAM_NOT_SAVED_VALUE	NVRAM name does not exist

Category	Value	Error code	Description
Basic	-200	AT_CMD_ERR_BASIC_ARG_NULL_PTR	Not used in AT command module
	-201	AT_CMD_ERR_BASIC_ARG_DATE	Argument "Date" format failure
	-202	AT_CMD_ERR_BASIC_ARG_TIME	Argument "Time" format failure
	-203	AT_CMD_ERR_BASIC_ARG_TIME_ETC	Argument Time value failure
UART	-220	AT_CMD_ERR_UART_INTERFACE	Not defined UART type
	-221	AT_CMD_ERR_UART_BAUDRATE	Argument "BaudRate" failure
	-222	AT_CMD_ERR_UART_DATABITS	Argument "DataBits" failure
	-223	AT_CMD_ERR_UART_PARITY	Argument "Parity" failure
	-224	AT_CMD_ERR_UART_STOPBIT	Argument "StopBits" failure
	-225	AT_CMD_ERR_UART_FLOWCTRL	Argument "FlowCtrl" failure
	-226	AT_CMD_ERR_UART_BAUDRATE_NV_WR	NVRAM Write failure - Baudrate
	-227	AT_CMD_ERR_UART_DATABITS_NV_WR	NVRAM Write failure - DataBits
	-228	AT_CMD_ERR_UART_PARITY_NV_WR	NVRAM Write failure - Parity
	-229	AT_CMD_ERR_UART_STOPBIT_NV_WR	NVRAM Write failure - StopBit
	-230	AT_CMD_ERR_UART_FLOWCTRL_NV_WR	NVRAM Write failure - FlowCtrl
DPM	-300	AT_CMD_ERR_DPM_MODE_DISABLED	DPM operation is not enabled
	-301	AT_CMD_ERR_DPM_SLEEP_STARTED	DPM LPM is already running
	-302	AT_CMD_ERR_DPM_FAST_CONN_EN	Fast-connection function is enabled
	-303	AT_CMD_ERR_DPM_USER_RTM_ALLOC	Failed to allocate memory in user area of RTM
	-304	AT_CMD_ERR_DPM_USER_RTM_DUP	Same task name already exists
	-305	AT_CMD_ERR_DPM_MODE_ARG	Wrong argument type: DPM flag
	-306	AT_CMD_ERR_DPM_NVRAM_FLAG_ARG	Wrong argument type: NVRSM flag
	-309	AT_CMD_ERR_DPM_SLP2_PERIOD_TYPE	Wrong argument type: Period
	-310	AT_CMD_ERR_DPM_SLP2_PERIOD_RANGE	Wrong argument value range: Period
	-311	AT_CMD_ERR_DPM_SLP2_RTM_FLAG_ARG	Wrong argument type: RTM flag
	-312	AT_CMD_ERR_DPM_SLP1_RTM_FLAG_RANGE	Wrong argument value range: RTM flag
	-313	AT_CMD_ERR_DPM_SLP1_RTM_FLAG_ARG	Wrong argument type: RTM flag
	-314	AT_CMD_ERR_DPM_SLP1_RTM_FLAG_RANGE	Wrong argument value range: RTM flag
	-315	AT_CMD_ERR_DPM_ABN_ARG	Wrong argument type: DPMABN

Category	Value	Error code	Description
	-316	AT_CMD_ERR_DPM_SLP2_DPM_MODE_ENABLED	Wrong system mode: DPM mode
	-317	AT_CMD_ERR_DPM_SLP3_PERIOD_TYPE	Wrong argument t type: Period
	-318	AT_CMD_ERR_DPM_SLP3_PERIOD_RANGE	Wrong argument value range: Period
Wi-Fi	-400	AT_CMD_ERR_WIFI_NOT_CONNECTED	Not connected to AP
	-401	AT_CMD_ERR_WIFI_RUN_MODE_TYPE	Wrong argument type
	-402	AT_CMD_ERR_WIFI_RUN_MODE_RANGE	Wrong argument value range
	-403	AT_CMD_ERR_WIFI_MAC_ADDR	Wrong string type for MAC address
	-404	AT_CMD_ERR_WIFI_WPS_PIN_NUM	Wrong PIN number for WPS connection
	-406	AT_CMD_ERR_WIFI_SCAN_UNSUPPORTED	SCAN command not supported
	-407	AT_CMD_ERR_WIFI_PSCAN_FREQ_RANGE	Wrong argument value range: Frequency
	-408	AT_CMD_ERR_WIFI_PSCAN_CMAX_RANGE	Wrong argument value: Max RSSI threshold
	-409	AT_CMD_ERR_WIFI_PSCAN_CMIN_RANGE	Wrong argument value: Min RSSI threshold
	-410	AT_CMD_ERR_WIFI_JAP_SSID_NO_VALUE	SSID information not found in NVRAM
	-411	AT_CMD_ERR_WIFI_JAP_SSID_LEN	Too long SSID string (Max length: 32 bytes)
	-412	AT_CMD_ERR_WIFI_JAP_SECU_ARG_TYPE	Wrong argument type: Auth
	-413	AT_CMD_ERR_WIFI_JAP_SECU_ARG_RANGE	Wrong argument value range: Auth
	-414	AT_CMD_ERR_WIFI_JAP_OPEN_TOO_MANY_ARG	Too many arguments for OPEN-mode
	-415	AT_CMD_ERR_WIFI_JAP_OPEN_HIDDEN_TYPE	Wrong argument type (OPEN): Hidden flag
	-416	AT_CMD_ERR_WIFI_JAP_OPEN_HIDDEN_RANGE	Wrong argument value (OPEN): Hidden flag
	-417	AT_CMD_ERR_WIFI_JAP_SECU_HIDDEN_TYPE	Wrong argument type (Security): Hidden flag
	-418	AT_CMD_ERR_WIFI_JAP_SECU_HIDDEN_RANGE	Wrong argument value (Security): Hidden flag
	-419	AT_CMD_ERR_WIFI_JAP_WEP_IDX_TYPE	Wrong argument type: WEP Index
	-420	AT_CMD_ERR_WIFI_JAP_WEP_IDX_RANGE	Wrong argument value range: WEP Index
	-421	AT_CMD_ERR_WIFI_JAP_WEP_KEY_LEN	Wrong argument: WEP key length
	-422	AT_CMD_ERR_WIFI_JAP_WPA_MODE_TYPE	Wrong argument type: Encrypt
	-423	AT_CMD_ERR_WIFI_JAP_WPA_MODE_RANGE	Wrong argument value range: Encrypt

Category	Value	Error code	Description
	-424	AT_CMD_ERR_WIFI_JAP_WPA_KEY_LEN	Wrong argument: WPA PSK length
	-425	AT_CMD_ERR_WIFI_JAPA_SSID_NO_VALUE	SSID information not found in NVRAM
	-426	AT_CMD_ERR_WIFI_JAPA_SSID_LEN	Too long SSID string (Max length: 32 bytes)
	-427	AT_CMD_ERR_WIFI_JAPA_PSK_LEN	Wrong argument: WPA PSK length
	-428	AT_CMD_ERR_WIFI_JAPA_WEP_NOT_SUPPORT	Not supported security mode: WEP-mode
	-429	AT_CMD_ERR_WIFI_JAPA_HIDDEN_TYPE	Wrong argument type: Hidden flag
	-430	AT_CMD_ERR_WIFI_JAPA_HIDDEN_RANGE	Wrong argument value range: Hidden flag
	-431	AT_CMD_ERR_WIFI_JAPA_WPA3_MODE_TYPE	Wrong argument type: WPA3 flag
	-432	AT_CMD_ERR_WIFI_JAPA_WPA3_MODE_RANGE	Wrong argument value range: WPA3 flag
	-433	AT_CMD_ERR_WIFI_JAPA_WPA3_HIDDEN_TYPE	Wrong argument type: Hidden flag
	-434	AT_CMD_ERR_WIFI_JAPA_WPA3_HIDDEN_RANGE	Wrong argument value range: Hidden flag
	-435	AT_CMD_ERR_WIFI_ROAP_ROAM_TYPE	Wrong argument type
	-436	AT_CMD_ERR_WIFI_ROAP_ROAM_RANGE	Wrong argument value range
	-437	AT_CMD_ERR_WIFI_ENTAP_SSID_NO_VALUE	SSID information not found in NVRAM
	-438	AT_CMD_ERR_WIFI_ENTAP_SSID_LEN	Too long SSID string (Max length: 32 bytes)
	-439	AT_CMD_ERR_WIFI_ENTAP_AUTH0_UNSUPPORT	Unsupported security mode
	-440	AT_CMD_ERR_WIFI_ENTAP_ENC0_UNSUPPORT	Unsupported encrypt mode
	-441	AT_CMD_ERR_WIFI_ENTAP_EAP_PHASE1	Unsupported EAP Phase #1 value
	-442	AT_CMD_ERR_WIFI_ENTAP_EAP_PHASE2	Wrong argument value range: EAP Phase #2
	-443	AT_CMD_ERR_WIFI_ENTAP_SECU_MODE	Wrong argument value range: Auth
	-444	AT_CMD_ERR_WIFI_ENTAP_ENC_MODE	Wrong argument value range: Encrypt
	-445	AT_CMD_ERR_WIFI_ENTAP_EAP_MODE	Wrong argument value range: EAP Phase #1
	-446	AT_CMD_ERR_WIFI_ENTAP_EAP_ID_NO_VALUE	Login ID information not found in NVRAM
	-447	AT_CMD_ERR_WIFI_ENTAP_EAP_ID_LEN	Too long ID string (Max length: 64 bytes)
	-448	AT_CMD_ERR_WIFI_ENTAP_EAP_PWD_LEN	Too long PWD string (Max length: 64 bytes)
	-449	AT_CMD_ERR_WIFI_SOFTAP_SSID_NO_VALUE	SSID for Soft AP not found in NVRAM

Category	Value	Error code	Description
	-450	AT_CMD_ERR_WIFI_SOFTAP_SECU_MODE	Wrong argument value: Security
	-451	AT_CMD_ERR_WIFI_SOFTAP_ENC_MODE	Wrong argument value range: Encrypt
	-452	AT_CMD_ERR_WIFI_SOFTAP_CH_VALUE_TYPE	Wrong argument type: Channel
	-453	AT_CMD_ERR_WIFI_SOFTAP_CH_VALUE_RANGE	Wrong argument value range: Channel
	-454	AT_CMD_ERR_WIFI_SOFTAP_OPEN_TOO_MANY_ARG	Too many arguments for OPEN-mode
	-455	AT_CMD_ERR_WIFI_SOFTAP_CH_TX_PWR_VALUE	Wrong channel Tx-power value
	-456	AT_CMD_ERR_WIFI_SOFTAP_WEP_NOT_SUPPORT	Unsupported security mode on Soft AP
	-457	AT_CMD_ERR_WIFI_SOFTAP_ENC_MODE_TYPE	Wrong argument type: Encrypt
	-458	AT_CMD_ERR_WIFI_SOFTAP_ENC_MODE_RANGE	Wrong argument value range: Encrypt
	-459	AT_CMD_ERR_WIFI_SOFTAP_PASSKEY_LEN	Too short/long PSK length (Length: 8 ~ 63 bytes)
	-460	AT_CMD_ERR_WIFI_ALREADY_CONNECTED	Wi-Fi session already connected
	-461	AT_CMD_ERR_WIFI_CONCURRENT_NO_PROFILE	Concurrent-mode profile information not found in NVRAM
	-462	AT_CMD_ERR_WIFI_PSCAN_DURATION	Duration value out of range
	-463	AT_CMD_ERR_WIFI_JAPA_WPA3_PSK_LEN	Too short/long PSK length (Length: 8 ~ 63 bytes)
	-464	AT_CMD_ERR_WIFI_SOFTAP_OWE_TOO_MANY_ARG	Too many arguments for OWE
	-465	AT_CMD_ERR_WIFI_SOFTAP_SSID_LEN	Too long SSID string (Max length: 32 bytes)
	-466	AT_CMD_ERR_WIFI_ENTAP_WPA_HIDDEN_TYPE	Wrong argument type: Hidden flag
	-467	AT_CMD_ERR_WIFI_ENTAP_WPA_HIDDEN_RANGE	Wrong argument value range: Hidden flag
CLI	-500	AT_CMD_ERR_WIFI_CLI_STATUS	Failed to run "cli status" command
	-501	AT_CMD_ERR_WIFI_CLI_SET_NETWORK	Failed to run "cli set_network 0"
	-502	AT_CMD_ERR_WIFI_CLI_SET_NETWORK_HIDDEN	Failed to run "cli set_network 0" w/hidden flag
	-503	AT_CMD_ERR_WIFI_CLI_SELECT_NETWORK	Failed to run "cli select_network 0"
	-504	AT_CMD_ERR_WIFI_CLI_SAVE_CONF	Failed to run "cli save_config"
	-505	AT_CMD_ERR_WIFI_CLI_SAVE_CONF_HIDDEN	Failed to run "cli save_config" w/hidden flag
	-506	AT_CMD_ERR_WIFI_CLI_DISCONNECT	Failed to run "cli disconnect"
	-507	AT_CMD_ERR_WIFI_CLI_DEAUTHENTICATE	Failed to run "cli deauthenticate"

Category	Value	Error code	Description
	-508	AT_CMD_ERR_WIFI_CLI_DISASSOCIATE	Failed to run "cli disassociate"
	-510	AT_CMD_ERR_WIFI_CLI_WPS_PBC_ANY	Failed to run "cli wps_pbc any"
	-511	AT_CMD_ERR_WIFI_CLI_WPS_PIN_GET	Failed to run "cli wps_pin get"
	-512	AT_CMD_ERR_WIFI_CLI_WPS_PIN_ANY	Failed to run "cli wps_pin any"
	-513	AT_CMD_ERR_WIFI_CLI_WPS_PIN_NUM	Wrong argument: PIN value (Length: 8 bytes)
	-514	AT_CMD_ERR_WIFI_CLI_WPS_CANCEL	Failed to run "cli wps_cancel"
	-515	AT_CMD_ERR_WIFI_CLI_COUNTRY	Failed to run "cli country"
	-516	AT_CMD_ERR_WIFI_CLI_PSCAN_CH_TL	Failed to run "cli passive_scan chan_time_limit"
	-517	AT_CMD_ERR_WIFI_CLI_PSCAN_STOP	Failed to run "cli passive_scan_stop"
	-518	AT_CMD_ERR_WIFI_CLI_PSCAN_CMAX_GET	Failed to run "cli passive_scan_condition_max"
	-519	AT_CMD_ERR_WIFI_CLI_PSCAN_CMAX_SET	Failed to run "cli passive_scan_condition_max …"
	-520	AT_CMD_ERR_WIFI_CLI_PSCAN_CMIN_GET	Failed to run "cli passive_scan_condition_min"
	-521	AT_CMD_ERR_WIFI_CLI_PSCAN_CMIN_SET	Failed to run "cli passive_scan_condition_min …"
	-522	AT_CMD_ERR_WIFI_CLI_SOFTAP_START	Failed to run "cli ap start"
	-523	AT_CMD_ERR_WIFI_CLI_SOFTAP_STOP	Failed to run "cli ap stop"
	-524	AT_CMD_ERR_WIFI_CLI_SOFTAP_RESTART	Failed to run "cli ap restart"
Network basic	-600	AT_CMD_ERR_NW_NET_IF_NOT_INITIALIZE	Network interface does not initialize
	-601	AT_CMD_ERR_NW_NET_IF_IS_DOWN	Network interface is DOWN
	-602	AT_CMD_ERR_NW_IP_IFACE_TYPE	Wrong argument type: interface
	-603	AT_CMD_ERR_NW_IP_IFACE_RANGE	Wrong argument value range: interface
	-604	AT_CMD_ERR_NW_IP_ADDR_CLASS	Invalid IP address class
	-605	AT_CMD_ERR_NW_IP_INVALID_ADDR	Invalid IP address type
	-606	AT_CMD_ERR_NW_IP_NETMASK	Invalid Netmask address type
	-607	AT_CMD_ERR_NW_IP_GATEWAY	Invalid Gateway address type
	-608	AT_CMD_ERR_NW_DNS_A_QUERY_FAIL	Failed to get IP address by DNS Query
	-609	AT_CMD_ERR_NW_PING_IFACE_ARG_TYPE	Wrong argument type: Interface
	-610	AT_CMD_ERR_NW_PING_IFACE_ARG_RANGE	Wrong argument value range: Interface
	-611	AT_CMD_ERR_NW_PING_DST_ADDR	Invalid destination IP address
	-612	AT_CMD_ERR_NW_PING_TX_COUNT	Wrong argument: Ping TX count
DHCP	-613	AT_CMD_ERR_NW_DHCPC_START_FAIL	Failed to start DHCP client

Category	Value	Error code	Description
client	-614	AT_CMD_ERR_NW_DHCPC_HOSTNAME_LEN	Too long DHCP hostname (Max length: 32 bytes)
	-615	AT_CMD_ERR_NW_DHCPC_HOSTNAME_TYPE	Wrong format for DHCP hostname
DHCP server	-616	AT_CMD_ERR_NW_DHCPS_START_ADDR_NOT_EXIST	IP pool start-address not found in NVRAM
	-617	AT_CMD_ERR_NW_DHCPS++_END_ADDR_NOT_EXIST	IP pool end-address not found in NVRAM
	-618	AT_CMD_ERR_NW_DHCPS_WRONG_START_IP_CLASS	Invalid start IP address class
	-619	AT_CMD_ERR_NW_DHCPS_WRONG_END_IP_CLASS	Invalid end IP address class
	-620	AT_CMD_ERR_NW_DHCPS_IPADDR_RANGE_MISMATCH	Mismatch IP address class range
	-621	AT_CMD_ERR_NW_DHCPS_IPADDR_RANGE_OVERFLOW	Exceed IP address pool count (Max. 10)
	-622	AT_CMD_ERR_NW_DHCPS_NO_CONNECTED_CLIENT	No connected client information to DHCP server
	-623	AT_CMD_ERR_NW_DHCPS_RUN_FLAG_TYPE	Wrong argument type: dhcpd flag
	-624	AT_CMD_ERR_NW_DHCPS_RUN_FLAG_VAL	Wrong argument value range: dhcpd flag
	-625	AT_CMD_ERR_NW_DHCPS_LEASE_TIME_TYPE	Wrong argument type: dhcpd lease_time
	-626	AT_CMD_ERR_NW_DHCPS_LEASE_TIME_RANGE	Wrong argument value range: dhcpd lease_time
SNTP client	-629	AT_CMD_ERR_NW_SNTP_NOT_SUPPORTED	SNTP client does not supported
	-630	AT_CMD_ERR_NW_SNTP_FLAG_TYPE	Wrong argument type: SNTP flag
	-631	AT_CMD_ERR_NW_SNTP_FLAG_VAL	Wrong argument value range: SNTP flag
	-632	AT_CMD_ERR_NW_SNTP_PERIOD_TYPE	Wrong argument type: SNTP period
	-633	AT_CMD_ERR_NW_SNTP_PERIOD_RANGE	Wrong argument value range: SNTP period
MQTT client	-634	AT_CMD_ERR_NW_MQTT_NOT_CONNECTED	MQTT client is currently not connected
	-635	AT_CMD_ERR_NW_MQTT_NEED_TO_STOP	Need to disconnect the already connected MQTT session
	-636	AT_CMD_ERR_NW_MQTT_UNKNOWN_OP_ID	Input not supported
	-637	AT_CMD_ERR_NW_MQTT_CLIENT_TASK_START	MQTT client start failed by unknown reason
MQTT broker	-638	AT_CMD_ERR_NW_MQTT_BROKER_NAME_NOT_FOUND	MQTT broker name not found
	-639	AT_CMD_ERR_NW_MQTT_BROKER_PORT_NUM_TYPE	Wrong argument type: MQTT Broker port
	-640	AT_CMD_ERR_NW_MQTT_BROKER_PORT_NUM_RANGE	Wrong argument value range: MQTT Broker port

Category	Value	Error code	Description
	-641	AT_CMD_ERR_NW_MQTT_BROKER_NAME_LEN	MQTT Broker name string: max length (MQTT_BROKER_MAX_LEN) exceeded
MQTT TLS	-642	AT_CMD_ERR_NW_MQTT_TLS_TYPE	Wrong argument type: tls
	-643	AT_CMD_ERR_NW_MQTT_TLS_RANGE	Wrong argument value range: tls
	-644	AT_CMD_ERR_NW_MQTT_TLS_ALPN_NOT_EXIST	ALPN information not found in NVRAM
	-645	AT_CMD_ERR_NW_MQTT_TLS_ALPN_COUNT_TYPE	Wrong argument type: count
	-646	AT_CMD_ERR_NW_MQTT_TLS_ALPN_COUNT_RANGE	Wrong argument value range: count (1 ~ 3)
	-647	AT_CMD_ERR_NW_MQTT_TLS_ALPN_NAME_LEN	Too long ALPN name length (Max: 24 bytes)
	-648	AT_CMD_ERR_NW_MQTT_TLS_SNI_NOT_EXIST	SNI information not found in NVRAM
	-649	AT_CMD_ERR_NW_MQTT_TLS_SNI_LEN	Too long SNI string length (Max: 64 bytes)
	-650	AT_CMD_ERR_NW_MQTT_TLS_CSUITE_NUM_NOT_EXIST	CipherSuite count value not found in NVRAM
	-651	AT_CMD_ERR_NW_MQTT_TLS_CSUITE_NOT_EXIST	CipherSuite information not found in NVRAM
	-652	AT_CMD_ERR_NW_MQTT_TLS_CSUITE_NUM_NVRAM_WR	Failed to write Cipher Suit count info to NVRAM
	-653	AT_CMD_ERR_NW_MQTT_TLS_CSUITE_NVRAM_WR	Failed to write Cipher Suit info to NVRAM
MQTT sub-topic	-654	AT_CMD_ERR_NW_MQTT_SUBS_TOPIC_NOT_EXIST	Sub-topic does not exist in NVRAM
	-655	AT_CMD_ERR_NW_MQTT_SUBS_TOPIC_NUM_TYPE	Wrong argument type: count
	-656	AT_CMD_ERR_NW_MQTT_SUBS_TOPIC_NUM_RANGE	Wrong argument value range: count (1~4)
	-657	AT_CMD_ERR_NW_MQTT_SUBS_TOPIC_LEN	Too long topic string length (Max: 64 bytes)
	-658	AT_CMD_ERR_NW_MQTT_SUBS_TOPIC_DUP	Duplicate Sub-topic string
	-659	AT_CMD_ERR_NW_MQTT_SUBS_TOPIC_NUM_NVRAM_WR	Failed to write topic count to NVRAM
	-660	AT_CMD_ERR_NW_MQTT_SUBS_TOPIC_NUM_OVERFLOW	Adding a topic exceeds the max topic count (4)
	-661	AT_CMD_ERR_NW_MQTT_SUBS_TOPIC_ALREADY_EXIST	Subscribe topic already exists
MQTT pub-topic	-662	AT_CMD_ERR_NW_MQTT_PUB_TOPIC_NOT_EXIST	PUB topic not found in NVRAM
	-663	AT_CMD_ERR_NW_MQTT_PUB_TOPIC_LEN	Too long topic string length (Max: 64 bytes)
MQTT WILL message	-664	AT_CMD_ERR_NW_MQTT_WILL_TOPIC_NOT_EXIST	WILL topic does not exist in NVRAM
	-665	AT_CMD_ERR_NW_MQTT_WILL_MESSAGE_NOT_EXIST	WILL message not existing in NVRAM

Category	Value	Error code	Description
	-666	AT_CMD_ERR_NW_MQTT_WILL_TOPIC_LEN	Too long WILL topic length (Max: 64 bytes)
	-667	AT_CMD_ERR_NW_MQTT_WILL_MESSAGE_LEN	Too long WILL message length (Max: 64 bytes)
	-668	AT_CMD_ERR_NW_MQTT_WILL_QOS_TYPE	Wrong argument type: qos
	-669	AT_CMD_ERR_NW_MQTT_WILL_QOS_RANGE	Wrong argument value range: qos
MQTT common	-670	AT_CMD_ERR_NW_MQTT_PROTOCOL	Network protocol error occurred with Broker
	-671	AT_CMD_ERR_NW_MQTT_PING_PERIOD_TYPE	Invalid Ping Period value is invalid
	-672	AT_CMD_ERR_NW_MQTT_PING_PERIOD_RANGE	Wrong argument value range: (0 ~ 86400)
	-673	AT_CMD_ERR_NW_MQTT_USERNAME_NOT_EXIST	User name does not exist in NVRAM
	-674	AT_CMD_ERR_NW_MQTT_USERNAME_LEN	Too long username length (Max: 64 bytes)
	-675	AT_CMD_ERR_NW_MQTT_PASSWORD_LEN	Too long password length (Max: 160 bytes)
	-676	AT_CMD_ERR_NW_MQTT_PUB_MESSAGE_LEN	Too long message length (Max: 2048 bytes)
	-677	AT_CMD_ERR_NW_MQTT_PUB_TX_IN_PROGRESS	Previous message TX is still in progress
	-678	AT_CMD_ERR_NW_MQTT_REBOOT	Invalid value for reboot parameter
HTTP(s) server	-680	AT_CMD_ERR_NW_HTS_TASK_CREATE_FAIL	Failed to create HTTP server task
	-681	AT_CMD_ERR_NW_HTSS_TASK_CREATE_FAIL	Failed to create HTTPs server task
HTTP client	-682	AT_CMD_ERR_NW_HTC_TASK_CREATE_FAIL	Failed to create HTTP client task
	-683	AT_CMD_ERR_NW_HTC_ALPN_CNT_TYPE	Wrong argument type: alpn_number
	-684	AT_CMD_ERR_NW_HTC_ALPN_CNT_RANGE	Wrong argument value range: alpn_number
	-685	AT_CMD_ERR_NW_HTC_ALPN1_STR_LEN	Too long ALPN #1 string length (Max 24 bytes)
	-686	AT_CMD_ERR_NW_HTC_ALPN2_STR_LEN	Too long ALPN #2 string length (Max 24 bytes)
	-687	AT_CMD_ERR_NW_HTC_ALPN3_STR_LEN	Too long ALPN #3 string length (Max 24 bytes)
	-688	AT_CMD_ERR_NW_HTC_SNI_LEN	Too long SNI string length (Max 64 bytes)
Web-Socket client	-689	AT_CMD_ERR_NW_WSC_URL_STR_LEN	Too short URL string length (Min 1 byte)
	-690	AT_CMD_ERR_NW_WSC_INVALID_URL	Invalid URL string
	-691	AT_CMD_ERR_NW_WSC_TASK_ALREADY_EXIST	WebSocket session already exists

Category	Value	Error code	Description
	-692	AT_CMD_ERR_NW_WSC_CB_FUNC_DOES_NOT_EXIST	Not registered user Websocket cb-function
	-693	AT_CMD_ERR_NW_WSC_INVALID_STATE	No connected session to disconnect
	-694	AT_CMD_ERR_NW_WSC_TASK_CREATE_FAIL	Failed to create WebSocket client task
	-695	AT_CMD_ERR_NW_WSC_CLOSE_FAIL	Failed to send "Session-Close" frame
	-696	AT_CMD_ERR_NW_WSC_SESS_NOT_CONNECTED	No connected session to send message
	-697	AT_CMD_ERR_NW_WSC_UNKNOW_CMD	Unknown WebSocket internal error
	-698	AT_CMD_ERR_NW_WSC_INVALID_VALUE	Websocket ping timeout error
OTA	-700	AT_CMD_ERR_NW_OTA_WRONG_FW_TYPE	Wrong argument: fw_type
	-701	AT_CMD_ERR_NW_OTA_DOWN_OK_AND_WAIT_RENEW	Already downloaded
	-702	AT_CMD_ERR_NW_OTA_FLASH_READ_SIZE_TYPE	Wrong argument type: read_addr
	-703	AT_CMD_ERR_NW_OTA_FLASH_COPY_SIZE_TYPE	Wrong argument type: size
	-704	AT_CMD_ERR_NW_OTA_FLASH_ERASE_SIZE_TYPE	Wrong argument type: size
	-705	AT_CMD_ERR_NW_OTA_BY_MCU_INIT	Failed to initialize MCU configuration for OTA
	-706	AT_CMD_ERR_NW_OTA_SET_TLS_AUTH_MODE_NVRAM	Failed to save TLS certificate in NVRAM
	-707	AT_CMD_ERR_NW_OTA_SET_MCU_FW_NAME	Failed to set MCU_FW name. (Max length: 8 bytes)
Zero config	-710	AT_CMD_ERR_NW_MDNS_WRONG_FLAG	Wrong argument: flag of MDNS
	-711	AT_CMD_ERR_NW_MDNS_WRONG_MODE	Wrong argument: mode of MDNS
	-712	AT_CMD_ERR_NW_MDNS_NOT_RUNNING	MDNS is not running
	-713	AT_CMD_ERR_NW_MDNS_ALREADY_RUN	MDNS is already running
	-714	AT_CMD_ERR_NW_MDNS_IN_PROCESS	Progressing Probing and Announcing on MDNS
	-715	AT_CMD_ERR_NW_MDNS_UNKNOW_FAULT	Unknown MDNS internal error
	-716	AT_CMD_ERR_NW_MDNS_START_RUN_MODE_VAL	Invalid interface
	-717	AT_CMD_ERR_NW_MDNS_SOCKET_FAIL	Failed to initialize socket
	-718	AT_CMD_ERR_NW_DNS_SD_NOT_RUNNING	DNS-SD is not running
	-719	AT_CMD_ERR_NW_DNS_SD_ALREADY_RUN	Already DNS-SD is running
	-720	AT_CMD_ERR_NW_DNS_SD_IN_PROCESS	Progressing Probing and Announcing of DNS-SD
	-721	AT_CMD_ERR_NW_DNS_SD_SVC_CREATE_FAIL	Failed to register service of DNS-SD
	-722	AT_CMD_ERR_NW_DNS_SD_SVC_PARAMS	Invalid parameters to register service
	-723	AT_CMD_ERR_NW_DNS_SD_SVC_INST_NAME_NVRAM_WR	Failed to write service name to NVRAM

Category	Value	Error code	Description
	-724	AT_CMD_ERR_NW_DNS_SD_SVN_PROTOCOL_NVRAM_WR	Failed to write service protocol to NVRAM
	-725	AT_CMD_ERR_NW_DNS_SD_SVC_PORT_NO_NVRAM_WR	Failed to write service port to NVRAM
	-726	AT_CMD_ERR_NW_DNS_SD_SVC_TEXT_NVRAM_WR	Failed to write service TXT to NVRAM
Transport function (TCP/UDP)	-730	AT_CMD_ERR_TCP_SERVER_LOCAL_PORT_TYPE	Wrong argument: local port of TCP server
	-731	AT_CMD_ERR_TCP_SERVER_MAX_PEER_TYPE	Wrong argument: max allowed peer
	-732	AT_CMD_ERR_TCP_SERVER_TASK_CREATE	Failed to start TCP server
	-733	AT_CMD_ERR_TCP_CLIENT_SVR_PORT_TYPE	Wrong argument: TCP server port of TCP client
	-734	AT_CMD_ERR_TCP_CLIENT_LOCAL_PORT_TYPE	Wrong argument: local port of TCP client
	-736	AT_CMD_ERR_TCP_CLIENT_TASK_CREATE	Failed to start TCP client
	-737	AT_CMD_ERR_UDP_SESS_LOCAL_PORT_TYPE	Wrong argument: local port of UDP session
	-738	AT_CMD_ERR_UDP_SESS_LOCAL_PORT_RANGE	Invalid range of local port of UDP session
	-739	AT_CMD_ERR_UDP_SESS_TASK_CREATE	Failed to start UDP session
	-740	AT_CMD_ERR_UDP_CID2_SESS_NOT_EXIST	UDP session, CID 2, does not exist
	-741	AT_CMD_ERR_UDP_CID2_ALREADY_EXIST	UDP session, CID 2, already exists
	-742	AT_CMD_ERR_UDP_CID2_SESS_INFO	Invalid UDP session, CID 2, information
	-743	AT_CMD_ERR_UDP_CID2_REMODE_PORT_TYPE	Invalid remote port of UDP session, CID 2
	-744	AT_CMD_ERR_NO_CONNECTED_SESSION_EXIST	No session information
	-745	AT_CMD_ERR_NO_FOUND_REQ_CID_SESSION	No assigned CID to terminate session
	-746	AT_CMD_ERR_CONTEXT_CID_TYPE	Wrong argument type: cid
	-747	AT_CMD_ERR_CONTEXT_DELETE	Failed to terminate session
	-748	AT_CMD_ERR_CONTEXT_TYPE_IS_NOT_TCP_SVR	Wrong CID value: Not TCP server session
	-749	AT_CMD_ERR_CONTEXT_INVALID_SESS_TYPE	Invalid session type to save session information
	-750	AT_CMD_ERR_TRTRM_CID_TYPE	Wrong argument: CID to terminate session
	-751	AT_CMD_ERR_TRTRM_REMOTE_PORT_NUM_TYPE	Wrong argument type: remote_port
	-752	AT_CMD_ERR_TRTRM_TCP_SVR_REMOTE_SESS_DISCON	Failed to disconnect TCP client from TCP server
	-753	AT_CMD_ERR_TCP_SERVER_TERMINATE	Failed to terminate TCP server
	-754	AT_CMD_ERR_TCP_CLIENT_TERMINATE	Failed to terminate TCP client

Category	Value	Error code	Description
	-755	AT_CMD_ERR_UDP_SESSION_TERMINATE	Failed to terminate UDP session
	-756	AT_CMD_ERR_MULTI_SESSION_CID_TERMINATE	No assigned CID to terminate session
	-757	AT_CMD_ERR_NO_SESSOIN_TO_SAVE_NVRAM	No session information to save
SSL/TLS	-760	AT_CMD_ERR_SSL_ROLE_NOT_SUPPORT	Not supported role of TLS session
	-761	AT_CMD_ERR_SSL_CONF_CID_TYPE	Wrong argument: CID of TLS session
	-762	AT_CMD_ERR_SSL_CONTEXT_NOT_FOUND	No assigned CID of TLS session
	-763	AT_CMD_ERR_SSL_CONTEXT_ALREADY_EXIST	TLS session is already running to configure
	-764	AT_CMD_ERR_SSL_CONF_ID_NOT_SUPPORTED	Not supported configuration
	-765	AT_CMD_ERR_SSL_SAVE_CLR_ALL_NV	Failed to erase TLS session from NVRAM
	-766	AT_CMD_ERR_SSL_SAVE_FAIL_NV	Failed to save TLS session to NVRAM
	-767	AT_CMD_ERR_SSL_CONF_ID_TYPE	Wrong argument: configuration ID
	-768	AT_CMD_ERR_SSL_CONF_ID_RANGE	Invalid range of configuration ID
	-769	AT_CMD_ERR_SSL_CONF_CID_CA_CERT	CA certification does not exist for assigned CID
	-770	AT_CMD_ERR_SSL_CONF_CID_CERT	Certification does not exist for assigned CID
	-771	AT_CMD_ERR_SSL_CONF_CID_SNI	Failed to configure SNI of assigned CID
	-772	AT_CMD_ERR_SSL_CONF_CID_SVR_VALID_TYPE	Wrong argument: auth mode of assigned CID
	-773	AT_CMD_ERR_SSL_CONF_CID_SVR_VALID_RANGE	Invalid range of auth mode of assigned CID
	-774	AT_CMD_ERR_SSL_CONF_CID_RX_BUF_LEN	Wrong argument: RX buffer length of CID
	-775	AT_CMD_ERR_SSL_CONF_CID_TX_BUF_LEN	Wrong argument: TX buffer length of CID
	-776	AT_CMD_ERR_SSL_CONF_CID_TYPE	Wrong argument: CID to configure TLS session
	-777	AT_CMD_ERR_SSL_CONN_ALREADY_CONNECTED	Already TLS session is connected
	-778	AT_CMD_ERR_SSL_CONN_PORT_NUM_TYPE	Wrong argument: peer_port of TLS client
	-779	AT_CMD_ERR_SSL_CONN_UNKNOWN_HOSTNAME	Unknown hostname to connect TLS server
	-780	AT_CMD_ERR_SSL_CONN_CFG_SETUP_FAIL	Failed to setup TLS client
	-781	AT_CMD_ERR_SSL_CONN_TLS_CLIENT_RUN_FAIL	Failed to connect TLS client
SSL	-782	AT_CMD_ERR_SSL_CERT_TYPE	Wrong argument: type

Category	Value	Error code	Description
certificate	-783	AT_CMD_ERR_SSL_CERT_RANGE	Invalid range of certificate type
	-784	AT_CMD_ERR_SSL_CERT_STO_SEQ_TYPE	Wrong argument: sequence type
	-785	AT_CMD_ERR_SSL_CERT_STO_SEQ_RANGE	Invalid range of sequence type
	-786	AT_CMD_ERR_SSL_CERT_STO_FORMAT_TYPE	Wrong argument: format type
	-787	AT_CMD_ERR_SSL_CERT_STO_FORMAT_RANGE	Invalid range of format type
	-788	AT_CMD_ERR_SSL_CERT_STO_ALREADY_EXIST	Certificate already exists
	-789	AT_CMD_ERR_SSL_CERT_STO_NO_SPACE	Not enough space to save certificate
	-790	AT_CMD_ERR_SSL_CERT_DEL_LIST_NOT_FOUND	Not found certificate to delete
	-791	AT_CMD_ERR_SSL_CERT_MODULE	Invalid module
	-792	AT_CMD_ERR_SSL_CERT_FORMAT	Invalid format
	-793	AT_CMD_ERR_SSL_CERT_LENGTH	Invalid length
	-794	AT_CMD_ERR_SSL_CERT_FLASH_ADDR	Invalid address of SFlash memory
	-795	AT_CMD_ERR_SSL_CERT_EMPTY_CERT	No certificate
	-796	AT_CMD_ERR_SSL_CERT_INTERNAL	Internal error
	-797	AT_CMD_ERR_SSL_CONN_TIMEOUT_RANGE	Invalid timeout value
	-801	AT_CMD_ERR_RSSI_TIMEOUT	RSSI value not received within a timeout

Appendix J AT Command Development Environment Configuration

J.1 How to Connect DA16200/DA16600 Board

This section describes the installation procedure for the drivers, the configuration of the serial port, and all necessary steps to set up and check the connection with computer.

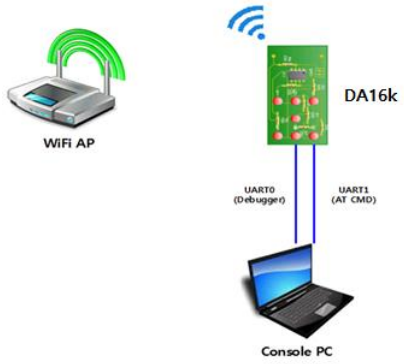

Figure 31. AT command development environment

When connecting to a host computer with Microsoft Windows as operating system, the system detects several devices and installs automatically all necessary drivers. If the driver is 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, COM69 in Figure 32) provides a UART interface for debugging or firmware download between the PC and the DA161200. The second (higher number, COM70 in Figure 32 is used for AT command.

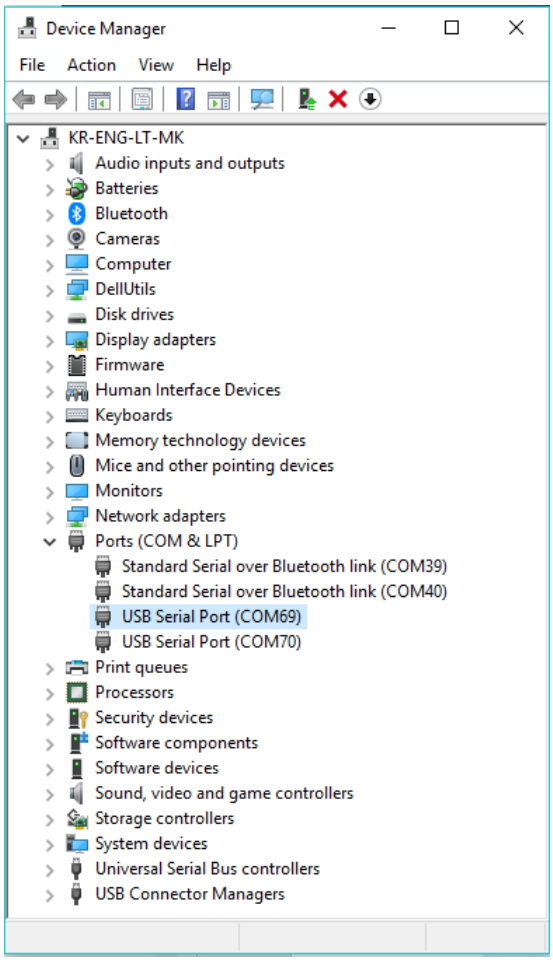

Figure 32. Check COM ports on device manager

J.2 Configure Serial Port for UART

On a Windows Host, the utility Tera Term is used to connect. See Ref. [1].

Tera Term is a free terminal emulator (communication program) that supports multiple communication including serial port connections.

1. Download Tera Term from https://ttssh2.osdn.jp.
2. Run the teraterm-x.yy.exe.
3. Follow the installation wizard.

To make sure that the communication between the DA16200/DA16600 EVK and the host PC is established correctly, check the UART connection between the two nodes. Do the following steps:

1. Use a USB cable to connect the DA16200/DA16600 EVK to the PC.
2. Make sure that the PC discovered the two serial ports in Windows Device Manager as shown in Figure 32. The higher COM port number is connected to UART1.
3. Open Tera Term from the Windows Start menu.
4. In the Tera Term: New connection Renesas Electronics:
   a. Select Serial.
   b. Select the COM Port to use.
   c. Click OK.
5. Select Setup > Serial Port and configure the UART port with the parameters as shown in Figure 33. Select the higher COM port number as discovered in step 2.

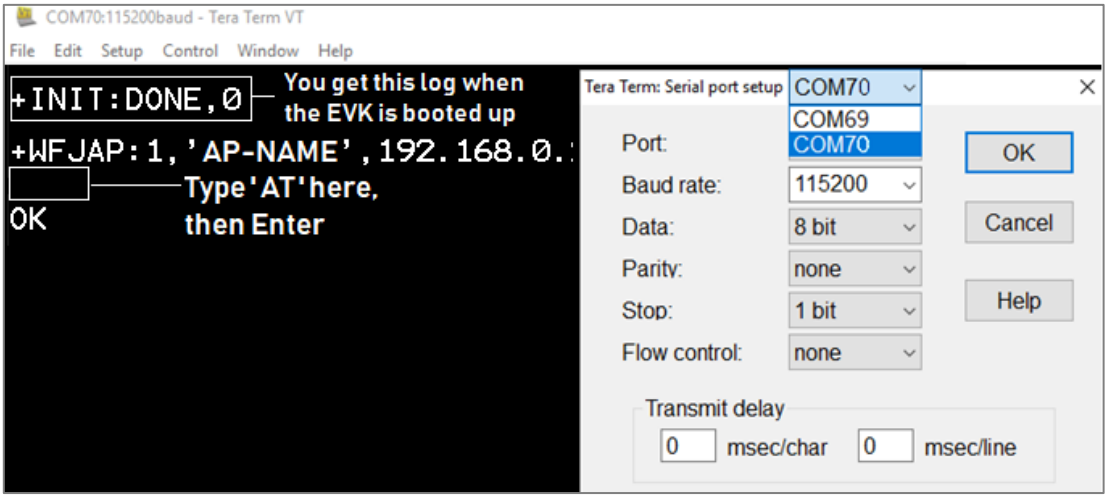

Figure 33. Initial setup to start with AT command

J.3 Configuration for MCU Wake-Up (Optional)

Depending on the application scenarios, both MCU and the DA16200/DA16600 may want to be in the Sleep state and MCU wants to awake (by the DA16200/DA16600) when the DA16200/DA16600 wakes up from DPM LPM. This can be achieved with the MCU wake-up feature of the DA16200/DA16600.

To use the MCU wake-up feature, connect pin GPIO_11 of the DA16200/DA16600 to the wake-up pin on the MCU. Then, when the DA16200/DA16600 wakes up, GPIO_11 becomes an Output and is set to High (Active High) to trigger the wake-up of the MCU. The wake-up pin of MCU should be configured to detect the rising edge of GPIO_11 for wake-up.

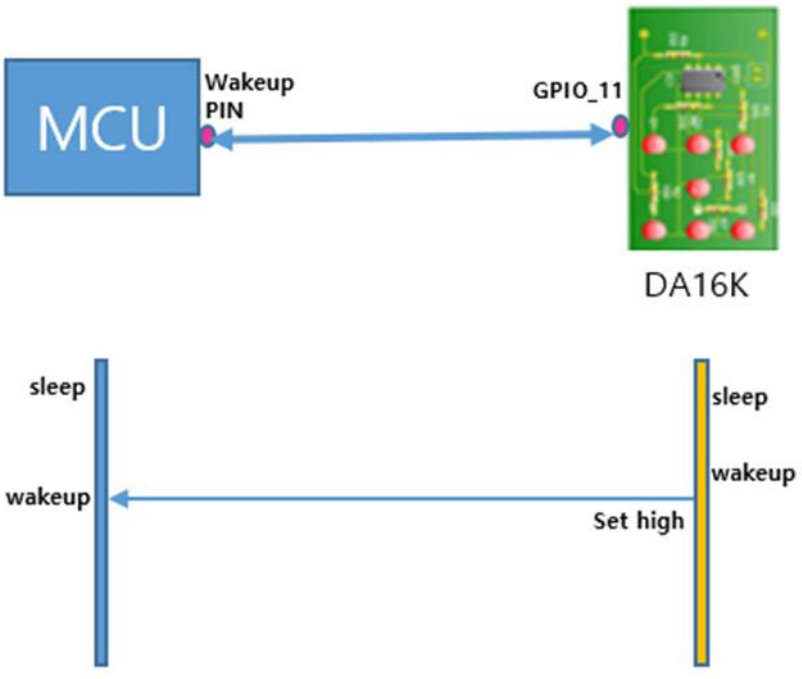

Figure 34. GPIO wake-up

7. Revision History

Revision	Date	Description
3.5	Feb 7, 2025	▪ Updated sleep commands and Appendix B ▪ Added AT+DEFCCRNT, AT+WFMACERASE, AT+WFJAPBSSID, AT+WFJAPABSSID and AT+WFJAPA3BSSID commands. ▪ Updated parameter for AT+WFSCAN command. ▪ Updated notes for AT commands that have NVRAM or SFlash write/erase operation. ▪ Added note for AT+SETDPMSLPEXT command. ▪ Added the description of phase 2 TLS types in WPA enterprise. ▪ Added the examples for EAP-TLS and EAP-PEAP0-TLS mode. ▪ Updated and added error codes for AT commands. ▪ Updated AT+TRSSLCFG command as SSL version configuration is invalid. ▪ Added table for secure socket response list.
3.4	June 21, 2024	▪ Updated the description in AT+PROVSTART and AT+DPMABN
3.3	May 29, 2024	▪ Changed TCP/UDP test tool from IO Ninja to Hercules ▪ Added free TCP/UDP test tool for Linux/MacOS/Android/iOS ▪ Updated AT command error codes ▪ Updated description for ATF/factory reset, AT+WFMODE and AT+NWMQTP ▪ AT+TRSSLCFG: Updated SSL protocol version settings ▪ AT+SETSLEEP2EXT, AT+SETSLEEP3EXT: updated minimum value for <period>
3.2	Sept 18, 2023	Updated AT command error codes
3.1	Aug 18, 2023	▪ Updated AT+GPIOSTART and AT+LEDCTRL examples ▪ Added error code to Detailed Error Codes for AT Command ▪ AT+SETSLEEP2EXT, AT+DPMUSERWU: changed the time input unit from seconds to milliseconds ▪ AT+WFENTAP: updated hidden AP settings ▪ AT+TRSSLCERTSTORE: added data length parameter ▪ AT+TRSSLWR: fixed incorrect optional parameter ▪ AT+WFENTLI: fixed incorrect optional parameter ▪ AT+NWCCRT: added DH param for Set #1 and 2, and Set #3 for WPA Enterprise ▪ <ESC>C: added Set #3 for WPA Enterprise ▪ <ESC>CERT: added new AT command in Certificate Command table ▪ AT+SETSLEEP2EXT: description updated ▪ AT+SETSLEEP3EXT added ▪ Updated the usage of padding field in SPI protocol
3.0	June 30, 2023	▪ Updated OTA commands and descriptions in Secure Socket Command List table ▪ AT+WFCC: additional note added ▪ AT+WFJAP, AT+WFSAP: additional note added on <sec> <enc> for WPA3
2.17	Apr 10, 2023	Corrected examples and descriptions of OTA commands
2.16	Feb 10,2023	Corrected the range of AT+SETSLEEP2EXT command
2.15	Jan 27, 2023	Added ESC Command Sequence
2.14	Jan 12, 2023	Merged user guides and changed the titles. ▪ UM-WI-003, DA16200 DA16600 AT Command

Revision	Date	Description
		▪ UM-WI-020, DA16200 SPI Host Interface ▪ UM-WI-053, DA16200 SDIO Host Interface
2.13	Dec 16, 2022	▪ AT+NWHTCH added ▪ AT+NWHTCTLSAUTH added ▪ AT+WFCC: note is added ▪ AT+NWMQMSG: note updated on max length ▪ AT+WFAPUI: description updated ▪ AT+NWIP: note added ▪ AT+WFAPCH: valid range changed ▪ AT+WFWMP: note updated ▪ AT+BLENAME: added to get the BLENAME. ▪ AT+WFJAPA3: added to connect to the WPA3-AP ▪ MQTT Commands re-arranged: split to MQTT configuration command and MQTT operation commands. ▪ Pre-requisite added for MQTT Configuration commands. ▪ Updated DA16200/DA16600 Cipher Suites ▪ New added Appendix J AT commands error codes Typo fixed in the example - AT+WFSPF, AT+WFOTP, <ESC>S
2.12	Aug 08, 2022	▪ Updated Appendix for running AT command through SDIO or SPI. ▪ Added the section of Wi-Fi Function Commands for WPA Enterprise
2.11	June 14, 2022	▪ AT+SDKVER added ▪ Added the Command Format section ▪ Added AT+HOSTINITDONE ▪ Added Appendix E ▪ Added more info on AT+TZONE ▪ Info updated or typo fixed: ATQ, ATB, AT+NWDHIP, AT+WFRSSI ▪ Changed default status by some features are enabled ▪ Added AT+CHIPNAME, AT+CALWR ▪ AT+NWMQMSG : operation response added (+NWMQMSGSND) ▪ Updated +WFJAP:0 and +WFDAP:0 (reason parameter is added) ▪ Updated AT+NWMQBR, AT+NWMQTT ▪ Updated MQTT optional configuration commands (enabled by default in SDK v3.2.3.0) ▪ Added AT+NWMQCS, and CleanSession=0 Guide. ▪ AT+WFJAP/AT+WFJAPA/AT+WFSAP : passphrase range added ▪ AT+TRTS example updated ▪ Added AT+NWMQUTS ▪ Updated Note : AT+NWIP, AT+NWDHR, AT+NWDHLT, AT+NWMQMSG, <ESC>S ▪ +NWMQCL updated ▪ Added Appendix H ▪ Added AT+NWWSC ▪ Added note for <ESC>S : for ATCMD on SPI
2.10	Mar 22, 2022	▪ Updated logo, disclaimer, and copyright. ▪ Added AT+TCPDATAMODE ▪ Added LED/PWM/ADC/I2C related AT commands
2.9	Dec 14, 2021	▪ AT+NWMQMSG, AT+NWMQTS: updated max length info on topic and added message

Revision	Date	Description
		▪ Added AT+NWDNS, HELP, ATE, and ATQ information
2.8	Dec 08, 2021	▪ Updated OTP Size Reduced (changed 8 kB to 2 kB) in OTA section ▪ Updated Data Transfer Commands section ▪ Updated AT+TRSSLWR ▪ Added AT+NWMQATS, AT+NWMQDTS, AT+NWMQV311, and AT+NWDHIP ▪ Added AT+ NWHTCSNI, AT+ NWHTCALPN, AT+NWHTCSNIDEL, and AT+NWHTCALPNDEL
2.7	Nov 25, 2021	Changed the title
2.6	Oct 28, 2021	▪ Added AT+WFAPUI: <timeout> valid value range ▪ Updated TCP Client Socket Test section ▪ Updated TCP Server section ▪ Updated: 5th parameter removed from AT+NWDHS ▪ Added: AT+NWDNS2 ▪ AT+XTALRD, AT+FLASHDUMP: <CR><LF> is appended to data
2.5	Sept 07, 2021	▪ Updated table format of ATCMD (Prerequisite, example, note added) ▪ Added Zeroconf Commands ▪ Added Secure Socket Commands
2.4	June 17, 2021	▪ Updated MQTT commands (MQTT Client Connection Example and MQTT TLS Connection Example) ▪ AT+NWDHDNS deleted (not needed as WAN Port is not available in Soft AP mode) ▪ Added AT+NWMQALPN, AT+NWMQSNI, AT+NWMQCSUIT, AT+SETDPMSLP1EXT, AT+DPMABNWFCCNT ▪ Updated AT+WFJAP, AT+WFJAPA : Optional parameter <hidden> added
2.3	Apr 01, 2021	▪ Added OTA update command ▪ Added support for SDK V3.x.x.x
2.2	Mar 15, 2021	▪ Added Appendix B HTTP API Return Values ▪ Added Appendix C ▪ Added AT+NWMQAUTO and ATB
2.1	Jan 13, 2021	Added Wi-Fi Function Commands for WPA3, and updated minor changes
2.0	Dec 08, 2020	▪ Added additional description on the following commands: ▪ AT+WFSAP, AT+WFOAP, AT+WFTAP, ATF, AT+WFJAPA, AT+NWMQTT, +NWMQCL, AT+DPM ▪ Added new sections: ▪ Added MQTT Example: Changing Subscription Topic while running ▪ Added MQTT Example: Reading Subscription Topic while running
1.9	Nov 11, 2020	▪ AT+NWCCRT, <ESC>C updated ▪ AT+NWSNS updated ▪ AT+NWHTS updated ▪ AT+NWHTSS updated
1.8	Aug 18, 2020	▪ Added SNTP commands in Network Function Commands ▪ Added HTTP-client command in HTTP-Client Commands ▪ Added MCU firmware update command using OTA in OTA Commands
1.7	June 30, 2020	▪ Added Configuration for MCU Wake-up ▪ Correct typos and wordings
1.6	Apr 29, 2020	▪ Added AT+WFDIS and AT+SETDPMSLP2EXT

Revision	Date	Description
		▪ Updated MQTT commands to operate with one-port ▪ Updated to process the comma in the parameters
1.5	Apr 03, 2020	▪ Added AT+BIDX for changing boot index ▪ Added example code of MQTT commands ▪ Updated RF Test function commands ▪ Updated GPIO commands
1.4	Oct 21, 2019	▪ Updated Serial Port configuration steps ▪ Removed draft status
1.3	Oct 15, 2019	▪ Error correction Added explanation to serial program
1.2	Oct 07, 2019	Editorial review and add code: UM-B-111
1.1	July 25, 2019	Added OTP Memory Address for writing MAC address
1.0	July 03, 2019	Preliminary DRAFT Release

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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