RFID MODULE

NFC MIFARE MODULE

SL060

User Manual

Version 1.2
July 2018
StrongLink

CONTENT

1. FEATURES

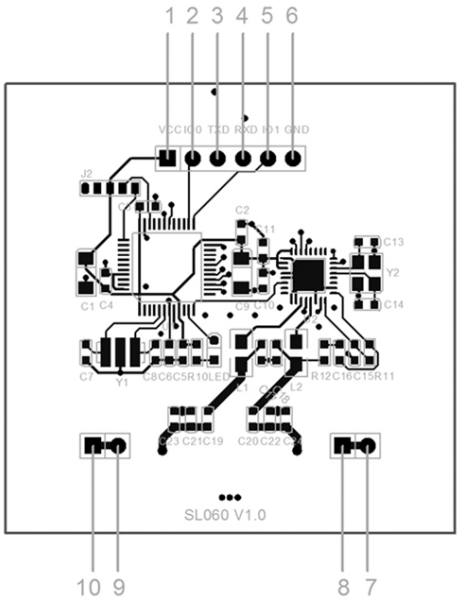
- Tags supported: Mifare 1k, Mifare 4k, Mifare UltraLight, Mifare UltraLight C, NTAG203, NTAG213, and NTAG216.
- Built-in antenna
- UART Interface, baud rate 9,600 ~ 115,200 bps(Default:9600bps)
- 13.56MHz RF Operating Frequency
- Protocol supported: ISO14443, ISO18092 NFCIP-1 mode(text&url)
- 2.5 ~3.6 VDC Operating, I/O supports 5.0 VDC
- Work current less than 50mA@3.3V
- Operating distance: Up to 50mm, depending on tag
- Storage Temperature Range: -40°C ~ +85°C
- Operating Temperature Range: -25°C ~ +70°C
- Dimension: 46 × 46 × 3 mm

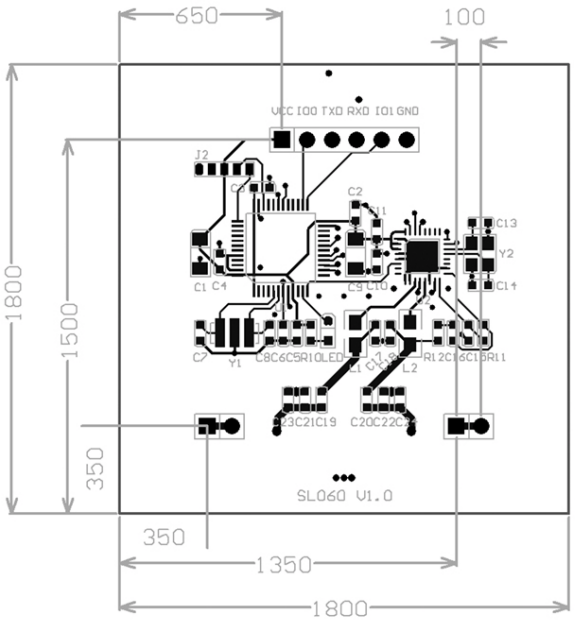
2. DESCRIPTION

Being developed based on NXP's NFC transponder IC, NFC Module SL060 is a mini NFC reader/writer. This RFID module supports MIFARETM Classic 1K, MIFARE™ Classic 4K, MIFARE Ultralight™, MIFARE DESFire™ and NFC NFCIP-1 mode. The maximum working current is less than 50mA. It integrates all necessary components and antenna in the PCB.

SL060 can offer NFCIP-1 functions. Users can send NFC message to NFC device to open a web URL or display text words in the window.

3. PINNING INFORMATION





Uint: mil

100 mil between two pads

PIN	SYMBOL	TYPE	DESCRIPTION
1	VCC	PWR	Power supply, 2.5 to 3.6VDC
2	IO0	NA	Reserved for future use
3	TXD	Output	UART TX
4	RXD	Input	UART RX
5	IO1	NA	Reserved for future use
6	GND	PWR	GND

4. Communication Protocol

4.1 Communication Setting

The communication protocol is byte oriented. Both sending and receiving bytes are in hexadecimal format. The communication parameters are as follows,

Baud rate: 9600bps(default)
Data: 8 bits
Stop: 1 bit
Parity: None
Flow control: None

4.2 Communication Format

Host to Reader:

Preamble	Len	DeviceID	Command	Data	Checksum

Preamble: 2 bytes equal to 0xAABB
Len: 2 bytes, indicating the number of bytes from DeviceID to Checksum

In this reader, the first byte is effective, the second byte keep 0

DeviceID: 2 bytes

Command: 2 bytes, Command code, see Table 3
Data: Variable length depends on the command code
Checksum: 1 byte, XOR of all the bytes from DeviceID to Data

Attention
If there is any byte equaling to AA occurs between Len and Checksum, one byte 00 will be added after this byte to differentiate preamble. However, the Len keeps unchanged.
Example, writing data (0x00112233445566778899AABBCCDDEEFF) to block 1
Host->SL060:AABB160000000902010011223344556677889 9AA**00**BBCCDDEEFF0A

Reader to Host:

Preamble	Len	DeviceID	Command	Status	Data	Checksum

Preamble: 2 bytes equal to 0xAABB
Len: 2 bytes, indicating the number of bytes from DeviceID to Checksum

In this reader, the first byte is effective, the second byte keep 0

DeviceID: 2 bytes

Command: 2 bytes
Status: 1 byte, 00 = success, Not 0 = fail
Data Range: Response data, may blank
Checksum: 1 byte, XOR of all the bytes from DeviceID to the last of the Command Sending data

Attention

If there is any byte equaling to AA occurs between Len and Checksum, one byte 00 will be added after this byte to differentiate preamble. However, the Len keeps unchanged.

Example, reading data (0x00112233445566778899AABBCCDDEEFF) from block 1

SL060 -> Host：ABB1600000009020000112233445566778899AA**00**BBCCDDEEFF0B

4.3 Command Overview

Table 1

Command	Description
0x0101	Set baud rate
0x0201	Initialize the Device ID
0x0303	Get device ID
0x0401	Get hardware vision
0x0701	Set the LED
0x0C01	Set the RF field
0x0102	Request(Card A)
0x0202	Anticollision (Card A)
0x0302	Select card(Card A)
0x0402	Halt(Card A)
0x0702	Authenticate
0x0802	Read block
0x0902	Write block
0x0A02	Initialize electronic purse
0x0B02	Read purse value
0x0C02	Decrease purse value (including Transfer)
0x0D02	Increase purse value (including Transfer)
0x0E02	Restore purse value
0x0F02	Transfer
0x1002	Get ATS of CPU A
0x1102	Exchange data between PICC and PCD according with T = CL protocol
0x1202	Ultralight card Anticoll and Select
0x1302	Write a page of data into ultralight and Ntag card
0x4002	Authenticate password of Ultralight_C
0x4102	
0x4202	Change password of Ultralight_C
0x2002	SHC1102 card check password
0x2102	Read data block of SHC1102 card
0x2202	Write data block of SHC1102 card
0x3002	Request DESFire and reset
0x5002	Get version of Ntag213/216
0x5102	Read page of data of Ntag213/216
0x5202	Fast read page of data of Ntag213/216
0x5302	Get NFC counter of Ntag213/216

0x5402	Authenticate password of Ntag213/216
0x5502	Get ECC signature of Ntag213/216
0x0D01	Set the NFC field
0x0E01	Send the NFC command

Status Overview

Table 2

Status	**Description**
0x00	Operation successes
0x01	NFC connect fails
0x0A	Operation fails
0x0B	Command is not supported
0x0C	Parameter is error
0x0D	No cards
0x0E	RF base station is damaged
0x14	Searching card fails
0x15	Reset card fails
0x16	Verifying key fails
0x17	Reading fails
0x18	Writing fails

4-4. Command List

4-4-1 System Function Command

4-4-1-1. Set baud rate

0xAA	0xBB	Len	DeviceID	0x01	0x01	Data	Checksum

Data: 0x00: BaudRate = 4800
0x01: BaudRate =9600(default)
0x02: BaudRate =14400
0x03: BaudRate =19200
0x04: BaudRate =28800
0x05: BaudRate =38400
0x06: BaudRate = 57600
0x07: BaudRate =115200

After changing the BaudRate, further communication must be set as the new BaudRate.

Response:

0xAA	0xBB	Len	DeviceID	0x01	0x01	Status	Checksum

Status: 0x00: Operation succeed
0x0C: Parameter error

4-4-1-2. Initialize the Device ID

0xAA	0xBB	Len	DeviceID	0x02	0x01	Data	Checksum

Data: 2 bytes device ID

Response:

0xAA	0xBB	Len	DeviceID	0x02	0x01	Status	Checksum

Status: 0x00: Operation succeed

Remark: SL060 only response to the command that Device ID is in accord with itself, and broadcast command that DeviceID equals to 0x0000

4-4-1-3. Get device ID

0xAA	0xBB	Len	DeviceID	0x03	0x01	Checksum

Response:

0xAA	0xBB	Len	DeviceID	0x03	0x01	Status	Data	Checksum

Data: 2 bytes device ID

Status: 0x00: Operation succeed

4-4-1-4. Get hardware vision

0xAA	0xBB	Len	DeviceID	0x04	0x01	Checksum

Response:

0xAA	0xBB	Len	DeviceID	0x04	0x01	Status	Data	Checksum

Data: Hardware vision

Status: 0x00: Operation succeed

4-4-1-5. Set the LED

0xAA	0xBB	Len	DeviceID	0x07	0x01	Data	Checksum

Data: 0: turn off the led

1-3: turn on the led

Response:

0xAA	0xBB	Len	DeviceID	0x07	0x01	Status	Checksum

Status: 0x00: Operation succeed

0x0C: Parameter is error

4-4-1-6. Set the RF field

0xAA	0xBB	Len	DeviceID	0x0C	0x01	Data	Checksum

Data: 0: turn off the RF field

1: turn on the RF field

Response:

0xAA	0xBB	Len	DeviceID	0x0C	0x01	Status	Checksum

Status: 0x00: Operation succeed

0x0A: Operation fails

4-4-2 ISO14443A - Mifare Function Command

4-4-2-1. Request(Card A)

0xAA	0xBB	Len	DeviceID	0x01	0x02	Data	Checksum

Data: 0x26 or 0x52

Response:

0xAA	0xBB	Len	DeviceID	0x01	0x02	Status	Data	Checksum

Data: ATQA

Status: 0x00: Operation succeed

0x14: Searching card fails

4-4-2-2. Anticollision(Card A)

0xAA	0xBB	Len	DeviceID	0x02	0x02	Checksum

Data: None

Response:

0xAA	0xBB	Len	DeviceID	0x02	0x02	Status	Data	Checksum

Data: UID

Status: 0x00: Operation succeed

0x0A: Operation fails

4-4-2-3. Select card (Card A)

0xAA	0xBB	Len	DeviceID	0x03	0x02	Data	Checksum

Data: UID

Response:

0xAA	0xBB	Len	DeviceID	0x03	0x02	Status	Data	Checksum

Data: SAK

Status: 0x00: Operation succeed

0x0A: Operation fails

4-4-2-4. Halt (Card A)

0xAA	0xBB	Len	DeviceID	0x04	0x02	Checksum

Response:

0xAA	0xBB	Len	DeviceID	0x04	0x02	Status	Checksum

Data: None

Status: 0x00: Operation succeed

0x0A: Operation fails

4-4-2-5. Authenticate

0xAA	0xBB	Len	DeviceID	0x07	0x02	Data	Checksum

Data**:** 1 byte authenticate mode + 1 byte absolute block number + 6bytes key

authenticate mode: 0x60—KeyA 0x61—KeyB

Response:

0xAA	0xBB	Len	DeviceID	0x07	0x02	Status	Checksum

Status: 0x00: Operation succeed

0x16: Verifying key fails

4-4-2-6. Read block

0xAA	0xBB	Len	DeviceID	0x08	0x02	Data	Checksum

Data**:** 1 byte absolute block number

Response:

0xAA	0xBB	Len	DeviceID	0x08	0x02	Status	Data	Checksum

Data: 16 bytes data

Status: 0x00: Operation succeed

0x17: Reading fails

4-4-2-7. Write block

0xAA	0xBB	Len	DeviceID	0x09	0x02	Data	Checksum

Data**:** 1 byte absolute block number+16 bytes data

Response:

0xAA	0xBB	Len	DeviceID	0x09	0x02	Status	Checksum

Status: 0x00: Operation succeed
0x18: Writing fails

4-4-2-8. Initialize electronic purse

0xAA	0xBB	Len	DeviceID	0x0A	0x02	Data	Checksum

Data**:** 1 byte absolute block number+4 bytes data

Response:

0xAA	0xBB	Len	DeviceID	0x0A	0x02	Status	Checksum

Status: 0x00: Operation succeed
0x18: Writing fails

4-4-2-9. Read purse value

0xAA	0xBB	Len	DeviceID	0x0B	0x02	Data	Checksum

Data**:** 1 byte absolute block numbe

Response:

0xAA	0xBB	Len	DeviceID	0x0B	0x02	Status	Data	Checksum

Data**:** 4 bytes data (low bytes in the former)
Status: 0x00: Operation succeed
0x17: Reading fails

4-4-2-10. Decrease purse value (including Transfer)

0xAA	0xBB	Len	DeviceID	0x0C	0x02	Data	Checksum

Data**:** 1 byte absolute block number+ 4 bytes decrement value

Response:

0xAA	0xBB	Len	DeviceID	0x0C	0x02	Status	Checksum

Status: 0x00: Operation succeed
0x18: Writing fails

4-4-2-11. Increase purse value (including Transfer)

0xAA	0xBB	Len	DeviceID	0x0D	0x02	Data	Checksum

Data**:** 1 byte absolute block number+ 4 bytes decrement value

Response:

0xAA	0xBB	Len	DeviceID	0x0D	0x02	Status	Checksum

Status: 0x00: Operation succeed
0x18: Writing fails

4-4-2-12. Restore purse value

0xAA	0xBB	Len	DeviceID	0x0E	0x02	Data	Checksum

Data**:** 1 byte absolute block number

Response:

0xAA	0xBB	Len	DeviceID	0x0E	0x02	Status	Checksum

Status: 0x00: Operation succeed
0x17: Reading fails

4-4-2-13. Transfer

0xAA	0xBB	Len	DeviceID	0x0F	0x02	Data	Checksum

Data**:** 1 byte absolute block number

Response:

0xAA	0xBB	Len	DeviceID	0x0F	0x02	Status	Checksum

Status: 0x00: Operation succeed
0x18: Writing fails

4-4-2-14. Get ATS of CPU A

0xAA	0xBB	Len	DeviceID	0x10	0x02	Checksum

Response:

0xAA	0xBB	Len	DeviceID	0x10	0x02	Status	Data	Checksum

Data: ATS
Status: 0x00: Operation succeed
0x18: Writing fails

4-4-2-15. Exchange data between PICC and PCD according with T = CL protocol

0xAA	0xBB	Len	DeviceID	0x11	0x02	Data	Checksum

Data: COS command

Response:

0xAA	0xBB	Len	DeviceID	0x11	0x02	Status	Data	Checksum

Data: COS response
Status: 0x00: Operation succeed
0x0A: Operation fails

4-4-2-16. Ultralight card Anticoll and Select

0xAA	0xBB	Len	DeviceID	0x12	0x02	Checksum

Response:

0xAA	0xBB	Len	DeviceID	0x12	0x02	Status	Data	Checksum

Data: 7 bytes ultralight UID
Status: 0x00: Operation succeed
0x0A: Operation fails

4-4-2-17. Write a page of data into ultralight card

0xAA	0xBB	Len	DeviceID	0x13	0x02	Data	Checksum

Data: 1 byte page address + 4 bytes written date

Response:

0xAA	0xBB	Len	DeviceID	0x13	0x02	Status	Checksum

Status: 0x00: Operation succeed
0x18: Writing fails

4-4-2-18. Authenticate password of Ultralight_C

0xAA	0xBB	Len	DeviceID	0x40	0x02	Checksum

Response:

0xAA	0xBB	Len	DeviceID	0x40	0x02	Status	Data	Checksum

Data: ek(RndB)
Status: 0x00: Operation succeed
0x16: Verifying key fails

0xAA	0xBB	Len	DeviceID	0x41	0x02	Data	Checksum

Data: ek(RndB)

Response:

0xAA	0xBB	Len	DeviceID	0x41	0x02	Status	Checksum

Status: 0x00: Operation succeed

0x16: Verifying key fails

4-4-2-19. Change password of Ultralight_C

0xAA	0xBB	Len	DeviceID	0x42	0x02	Data	Checksum

Data: 16 byte new password

Response:

0xAA	0xBB	Len	DeviceID	0x42	0x02	Status	Checksum

Status: 0x00: Operation succeed

0x18: Writing fails

4-4-2-20. SHC1102 card check password

0xAA	0xBB	Len	DeviceID	0x20	0x02	Data	Checksum

Data: 4 bytes password

Response:

0xAA	0xBB	Len	DeviceID	0x20	0x02	Status	Checksum

Status: 0x00: Operation succeed

0x16: Verifying key fails

4-4-2-21. Read data block of SHC1102 card

0xAA	0xBB	Len	DeviceID	0x21	0x02	Data	Checksum

Data: 1 bytes block address

Response:

0xAA	0xBB	Len	DeviceID	0x21	0x02	Status	Data	Checksum

Data: 4 bytes data

Status: 0x00: Operation succeed

0x17: Reading fails

4-4-2-22. Write data block of SHC1102 card

0xAA	0xBB	Len	DeviceID	0x22	0x02	Data	Checksum

Data: 1 bytes block address +4 bytes written data

Response:

0xAA	0xBB	Len	DeviceID	0x22	0x02	Status	Checksum

Status: 0x00: Operation succeed

0x18: Writing fails

4-4-2-23. Request DESFire and reset

0xAA	0xBB	Len	DeviceID	0x30	0x02	Data	Checksum

Data: 0x26 = REQ_STD

0x52 = REQ_ALL

Response:

0xAA	0xBB	Len	DeviceID	0x30	0x02	Status	Data	Checksum

Data: 7 bytes CSN + ATS information

Status: 0x00: Operation succeed

0x18: Writing fails

4-4-2-24. Get version of Ntag213/216

0xAA	0xBB	Len	DeviceID	0x50	0x02	Checksum

Response:

0xAA	0xBB	Len	DeviceID	0x50	0x02	Status	Data	Checksum

Data: 8 bytes Product version information
Status: 0x00: Operation succeed
0x17: Reading fails

4-4-2-25. Read page of data of Ntag213/216

0xAA	0xBB	Len	DeviceID	0x51	0x02	Data	Checksum

Data: 1 byte start page address

Response:

0xAA	0xBB	Len	DeviceID	0x51	0x02	Status	Data	Checksum

Data: 16 bytes Data content of the addressed pages
Status: 0x00: Operation succeed
0x17: Reading fails

4-4-2-26. Fast read page of data of Ntag213/216

0xAA	0xBB	Len	DeviceID	0x52	0x02	Data	Checksum

Data: 2 bytes start page address + end page address

Response:

0xAA	0xBB	Len	DeviceID	0x52	0x02	Status	Data	Checksum

Data: n*4 bytes max 200 bytes
Status: 0x00: Operation succeed
0x17: Reading fails

4-4-2-27. Get NFC counter of Ntag213/216

0xAA	0xBB	Len	DeviceID	0x53	0x02	Checksum

Response:

0xAA	0xBB	Len	DeviceID	0x53	0x02	Status	Data	Checksum

Data: 3 bytes counter value
Status: 0x00: Operation succeed
0x17: Reading fails

4-4-2-28. Authenticate password of Ntag213/216

0xAA	0xBB	Len	DeviceID	0x54	0x02	Data	Checksum

Data: 4 bytes password

Response:

0xAA	0xBB	Len	DeviceID	0x54	0x02	Status	Data	Checksum

Data: 2 bytes password authentication acknowledge
Status: 0x00: Operation succeed
0x16: Verifying key fails

4-4-2-29. Get ECC signature of Ntag213/216

0xAA	0xBB	Len	DeviceID	0x55	0x02	Checksum

Response:

0xAA	0xBB	Len	DeviceID	0x55	0x02	Status	Data	Checksum

Data: 32bytes ECC signature
Status: 0x00: Operation succeed

0x17: Reading fails

4-4-3 NFC Function Command

4-4-3-1. Set the NFC field

0xAA	0xBB	Len	DeviceID	0x0D	0x01	Data	Checksum

Data: 0: turn off the NFC field
1: turn on the NFC field

Response:

0xAA	0xBB	Len	DeviceID	0x0D	0x01	Status	Checksum

Status: 0x00: Operation succeed

4-4-3-2. Send the NFC command

0xAA	0xBB	Len	DeviceID	0x0E	0x01	Data	Checksum

Data: NFC command, see Table 3

Table 3

Text :	0x54—'T'	Language: 0: N/A 1:English 2:German 3:French	String
Uri:	0x55—'U'	Protocol: 0:N/A 1:http://www. 2:https://www 3:http:// 4:https:// 5:tel: 6:mailto: 7:ftp:anonymous:anonymous@ 8:ftp://ftp 9:ftps:// 10:sftp:// 11:smb:// 12:nfs:// 13:ftp:// 14:dav:// 15:news: 16:telnet:// 17:imap: 18:rtsp:// 19:urn: 20:pop: 21:sip: 22:sips:	String

		23:tftp: 24:btspp:// 25:btl2cap:// 26:btgoep:// 27:tcpobex:// 28:irdaobex:// 29:file:// 30:urn:epc:id: 31:urn:epc:tag: 32:urn:epc:pat: 33:urn:epc:raw: 34:urn:epc: 35:urn:nfc: 36-255:RFU	

Example:

aabb1f0000000e015401534e4550207465737420737472696e6720504e2d3531320074 means sending the text' SNEP test string PN-512'.

Response:

0xAA	0xBB	Len	DeviceID	0x0E	0x01	Status	Checksum

Status: 0x00: Operation succeed

0x01: NFC connect fails

Remark: Uri must be lowercase letters.

Federal Communications Commission (FCC) Interference Statement

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION.

NOTE: THE GRANTEE IS NOT RESPONSIBLE FOR ANY CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY THE PARTY RESPONSIBLE FOR COMPLIANCE. SUCH MODIFICATIONS COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.

For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module. The host must meet the necessary requirements to satisfy the module limiting conditions: shield and power supply regulation.

The module is limited to OEM installation ONLY**.** The OEM integrator is responsible for ensuring the end-user has no manual instructions to remove or install module

Regulatory Module Integration Instructions

This module has been granted modular approval for mobile applications. OEM integrators for host products may use the module in their final products without additional FCC certification if they meet the following conditions. Otherwise, additional FCC approvals must be obtained.

- The host product with the module installed must be evaluated for simultaneous transmission requirements.
- The users manual for the host product must clearly indicate the operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines.
- To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation.
- A label must be affixed to the outside of the host product with the following statements:

This device contains FCC ID: *2ADI8-SL060*

The final host / module combination may also need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

If the final host / module combination is intended for use as a portable device (see classifications below) the host manufacturer is responsible for separate approvals for the SAR requirements from FCC Part 2.1093.

Device Classifications

Since host devices vary widely with design features and configurations module integrators shall follow the guidelines below regarding device classification and simultaneous transmission, and seek guidance from their preferred regulatory test lab to determine how regulatory guidelines will impact the device compliance. Proactive management of the regulatory process will minimize unexpected schedule delays and costs due to unplanned testing activities.

The module integrator must determine the minimum distance required between their host device and the user's body. The FCC provides device classification definitions to assist in making the correct determination. Note that these classifications are guidelines only; strict adherence to a device classification may not satisfy the regulatory requirement as near-body device design details may vary widely. Your preferred test lab will be able to assist in determining the appropriate device category for your host product and if a KDB or PBA must be submitted to the FCC.

Note, the module you are using has been granted modular approval for mobile applications. Portable applications may require further RF exposure (SAR) evaluations. It is also likely that the host / module combination will need to undergo testing for FCC Part 15 regardless of the device classification. Your preferred test lab will be able to assist in determining the exact tests which are required on the host / module combination.

FCC Definitions

Portable: (§2.1093) — A portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is / are within 20 centimeters of the body of the user.

Mobile: (§2.1091) (b) — A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. Per §2.1091d(d)(4) In some cases (for example, modular or desktop transmitters), the potential conditions of use of a device may not allow easy classification of that device as either Mobile or Portable. In these cases, applicants are responsible for determining minimum distances for compliance for the intended use and installation of the device based on evaluation of either specific absorption rate (SAR), field strength, or power density, whichever is most appropriate.

Simultaneous Transmission Evaluation

This module has **not** been evaluated or approved for simultaneous transmission as it is impossible to determine the exact multi-transmission scenario that a host manufacturer may choose. Any simultaneous transmission condition established through module integration into a host product **must** be evaluated per the requirements in KDB447498D01(8) and KDB616217D01,D03 (for laptop, notebook, netbook, and tablet applications).

These requirements include, but are not limited to:

- Transmitters and modules certified for mobile or portable exposure conditions can be incorporated in mobile host devices without further testing or certification when:

- The closest separation among all simultaneous transmitting antennas is ≥20 cm,

Or

- Antenna separation distance and MPE compliance requirements for **ALL** simultaneous transmitting antennas have been specified in the application filing of at least one of the certified transmitters within the host device. In addition, when transmitters certified for portable use are incorporated in a mobile host device, the antenna(s) must be ≥5 cm from all other simultaneous transmitting antennas.

- All antennas in the final product must be at least 20 cm from users and nearby persons.