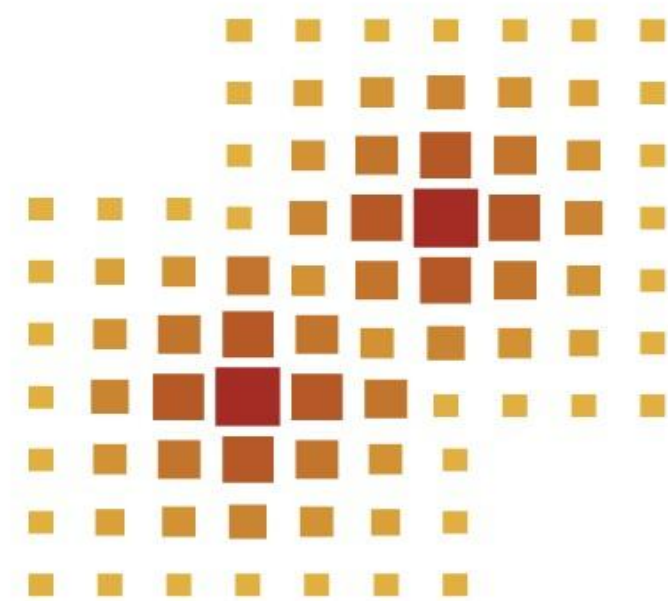


User's manual

FCC ID:2A75I5601L



MB5601L User's manual

BLE5.2 module

make	check	approve
Chen xia	Zeng xinsheng	Zeng xinsheng

Ver2.0

Release date :2022-05-10

Hua shu Communications (Shenzhen) Co., LTD



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Update resume:

version number	Modified date	update content	
		project	describe
V1.0	2021-03-11		Initial release
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1. 1 Product Introduction

MB5601L is a small-sized, low-cost , cost -effective Bluetooth low energy B LE5.2 I OT module developed by Wasu Communications . It consists of a highly integrated single-chip SoC solution, onboard PCB antenna and a small number of peripheral devices ; supports a wide voltage range from 1.7 V- 3.6 V ; supports up to 10 GPIOs (G PIOs can be multiplexed into U ART , PWM , SPI , I2C , etc.) port; adopt stamp hole (half hole) welding method. The package size is 16x 24x0.8mm . As shown in Figure 1, this SoC integrates MCU , baseband , radio frequency and storage parts. MCU main frequency up to 64 MHz , 96 KB system RAM , 512 KB on - system flash

such as IoT applications and cloud platform access can provide customers with a complete set of IoT solutions with excellent performance and high stability.

1.2MB5601L structure block diagram

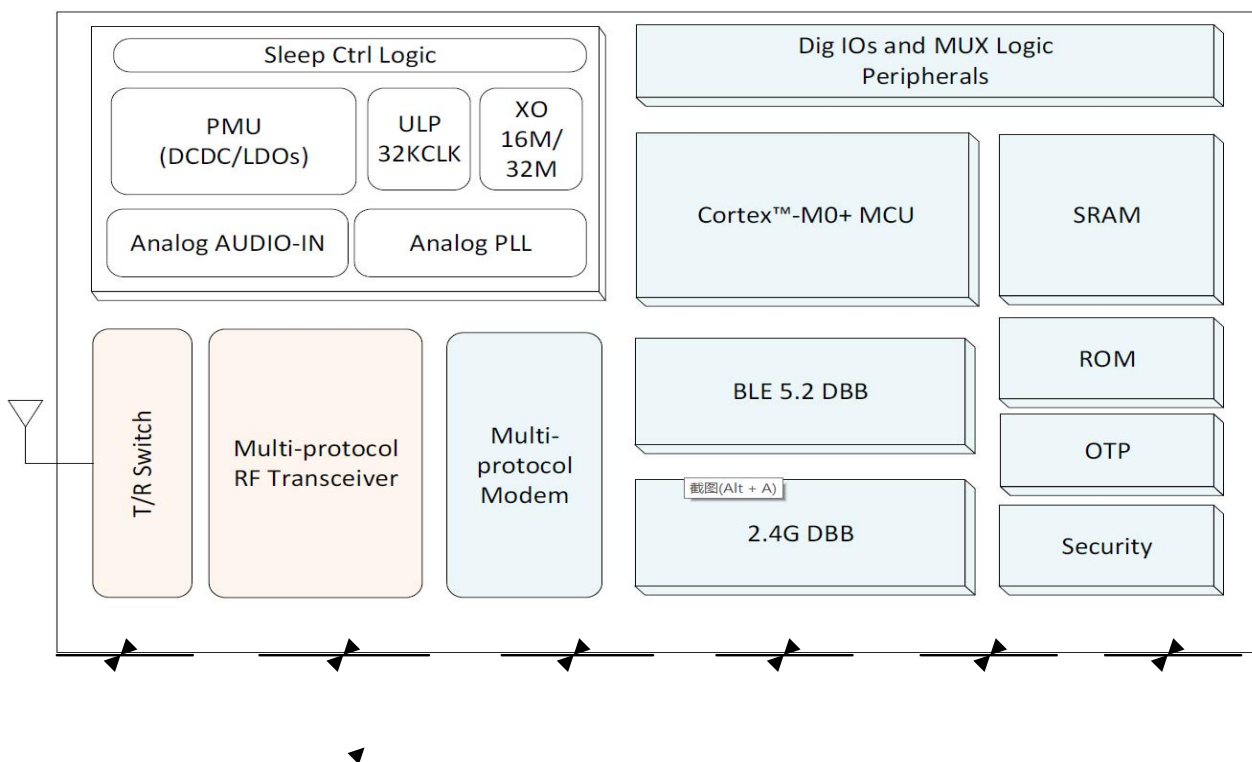


Figure 1 MB5601L Block diagram of module structure



1.3 Key Features

MCU : _

- ✧ ARM Cortex TM -M0+ MCUs
- ✧ Support 16 M / 64 MHz main frequency operation (software can set the desired main frequency)
- ✧ RAM size 96 KB
- ✧ Internally integrated 512 KB flash
- ✧ Support execute-in-place (XiP) mode
- ✧ Scalable external 4 M SPI NOR Flash

Power Management:

- Internal integrated D CDC and L DO power management circuits
- Support wide voltage input 1.7~3.6 V
- Built -in 32 KHz RC oscillator circuit for low power consumption
- Support external 32.768 KHz single-ended input

RF:

- BLE5.2 , supports common 2M bps and 1 Mb ps rates
- Output power range -30dB m ~10dB m (software can be set, the default setting is 4dB m)
- -95 dBm sensitivity at BLE 2 Mbps GFSK
- -98 dBm sensitivity at BLE 1 Mbps GFSK
- -103 dBm sensitivity at BLE 500 Kbps GFSK
- -107 dBm sensitivity at BLE 125 Kbps GFSK
- RX mode current , 5.2 mA at 3 V VBAT with -98 dBm sensitivity 1 Mbps BLE
- TX mode current , 4.7 mA at 3 V VBAT with 0 dBm output power
- TX mode current , 18 mA at 3 V VBAT with +8 dBm output power
- Deep sleep current less than 200 nA
- Supports star network topology with 1 master node and up to 8 slave nodes

Peripheral interface:

- Integrated UART/PWM/I2C/SPI/I2S/ADC/GPIO interface
- Integrated USB2.0 full rate device

Safety:

- ✧ Integrate true random number generator (TRNG)
- ✧ Integrated OTP for key data storage and verification
- ✧ Support flash image encryption/decryption
- ✧ Support hardware dynamic encryption/decryption for customer data (AES-CCM)

1.4 Main application areas

- Smart Home / Appliances
- Smart sockets, smart lights
- Industrial Wireless Control
- Health equipment



2. Module pin description

2.1 pin definition

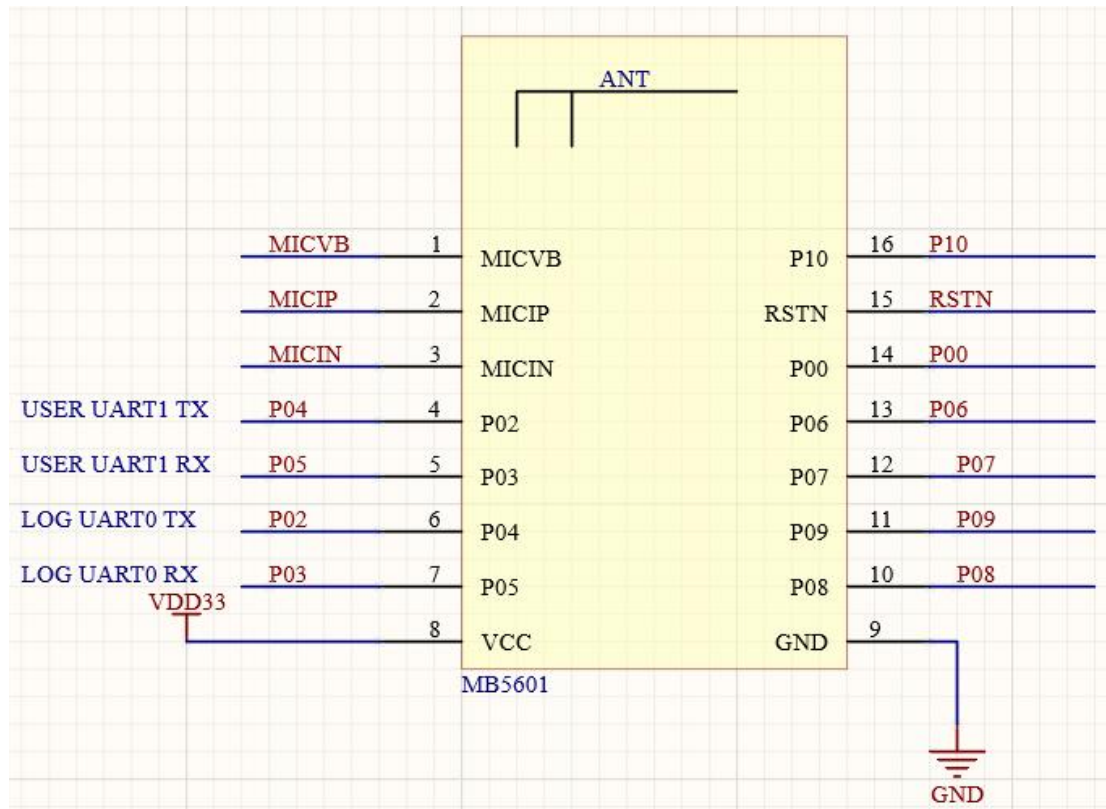


图 2. MB5601L 模组引脚图



2.2 Module pin definition

Table 1 Pin Definition of MB5601L Version

pin number	pin name	Function 1	Feature 2	Feature 3	Feature 4	Feature 5	Feature 6	Default function
1	MICVB							microphone bias voltage
2	MICIP							microphone positive
3	MICIN							microphone negative
4	P04	UART1_TXD	SPI0_TXD	I2C1_SCL	PWM2	I2C0_SCL	UART0_CTS	Communication port TX
5	P05	UART1_RXD	SPI0_RXD	I2C1_SCL	PWM3	I2C0_SDA	UART0_RTS	Communication port RX
6	P02	UART0_TXD	SPI0_CS	I2C0_SCL	PWM0	I2S_DI		LOG TX
7	P03	UART0_RXD	SPI0_CLK	I2C0_SDA	PWM1	I2S_MCLK		LOG RX
8	VCC							1.7 ~ 3.6V
9	GND							land
10	P08	UART2_TXD	SPI1_TXD	I2S_DI	PWM6	USB_DP	ADC2	GPIO pin
11	P09	UART2_RXD	SPI1_RXD	I2S_MCLK	PWM7	USB_DM	ADC3	GPIO pin
12	P07	UART3_RXD	SPI1_CLK	I2S_LRCK	PWM5	SWCLK	ADC1	GPIO pin
13	P06	UART3_TXD	SPI1_CS	I2S_SCLK	PWM4	SWDIO	ADC0	GPIO pin
14	P00	UART2_TXD			PWM10			SEL0 function control pin
15	RSTN	UART2_RXD						reset pin
16	P10	UART3_TXD	IR1	I2S_DO	PWM8		ADC4	GPIO pin

Note: If SEL0 is low at the moment of power-on, it will enter the normal working mode (the internal default is low); if SEL0 is high, it will enter the burning mode (the external is raised).



3. Electrical parameters

3.1 Absolute Maximum Ratings

Table 2 Voltage Absolute Maximum Ratings

symbol	illustrate	minimum	Typical value	unit
VDD	Module power input voltage	-0.3	3.6 _	V
Tstg	storage temperature	-40	125	° C

Note: The use environment exceeding the rated value will damage the IC .

3.2 Recommended working conditions

Table 3 Input Voltage Range

symbol	illustrate	condition	detailed			
			minimum	Typical value	maximum value	unit
V CC	voltage		1.7	3.3	3.6	V
Top r	Working temperature		- 40		8 5	° C

3.3 Power consumption parameters

Table 4 Power consumption

model	current		Remark
	A VG	R MS	
broadcast	0.35 mA _	1.94mA _	Broadcast interval period 200m s
connect	0.84mA _	2.16mA _	Mobile phone APP and blue night connection
Sleep D S3	3.526uA _ _	5.082uA _	DS3 mode supports GPIO, RTC Timer, LPUART and BLE Timer wakeup. This mode can maintain one BLE connection.

Table 5 Electrostatic discharge parameters

symbol	name	standard	grade	maximum	unit
VESD (HBM)	Electrostatic discharge voltage (manikin)	TA= +25 °C Comply with JESD22-A114	2	2000	V
VESD (CDM)	Electrostatic discharge voltage (discharge device model)	TA = +25 °C Complies with JESD22-C101	II	500	



4. RF Parameters

4.1 BLE transmission characteristics

Table 6 BLE transmission characteristics

Specification		Min.	Typ.	Max.	Unit
Maximum RF transmit power		2	4	6	dBm
Peak power - Average power		0.34	0.35	0.38	dB
In-band emissions	-3 MHz	-47	-42	-40	dBm
	-2 MHz	-43	-40	-36	dBm
	+2 MHz	-43	-40	-36	dBm
	+3 MHz	-47	-42	-40	dBm
Modulation Characteristics	F1(avg)	245	255	260	KHz
	F2(max) 99.9%	100	100	100	%
	F2(avg)/F1(avg)	0.85	0.88	0.9	
Center freq. deviation, F_n ($n = 0, 1, 2, \dots, k$)		-1	10	15	KHz
Freq. drift, $ F_0 - F_n $ ($n = 2, 3, 4, \dots, k$)			6		KHz
Initial freq. drift, $ F_1 - F_0 $			3		KHz
Max. freq. drift rate, $ F_n - F_{n-5} $ ($n = 6, 7, 8, \dots, k$)			5		KHz/50 μ s
Harmonics (cable mode)		-40	-45	-50	dBm

Note: The maximum transmit power is 10dBm (can be set by software), and the firmware default setting is 4dBm.



4.2 BLE receiving characteristics

Table 7 BLE receiving characteristics

Parameter	Description	Min.	Typ.	Max.	Unit
Frequency Range		2402		2480	MHz
BLE 1Mbps Rate	Sensitivity at 1Mbps	-98.5	-98	-96.5	dBm
	Sensitivity at 2Mbps	-96	-95	-94	dBm
	Maximum input level	0	10	11	dBm
	C/I Co-channel	4	4.5	5	dB
	C/I 1MHz	-13	-11	-10	dB
	C/I 2MHz	-36	-35	-33	dB
	C/I >2MHz	-52	-46	-37	dB
	C/I Image	-37	-36	-30	dB
	C/I Image 1MHz	-52	-49	-46	dB
BLE 500Kbps Rate	Sensitivity with dirty off	-103.5	-103	-102	dBm
	Sensitivity with dirty on	-102.5	-102	-101	dBm
	Maximum input level	0	10	11	dBm
	C/I Co-channel	3	3.5	5	dB
	C/I 1MHz	-17	-16	-14	dB
	C/I 2MHz	-37	-36	-34	dB
	C/I >2MHz	-52	-51	-41	dB
	C/I Image	-41	-40	-36	dB
	C/I Image 1MHz	-52	-51	-50	dB
BLE 125Kbps Rate	Sensitivity with dirty off	-107.5	-107	-105	dBm
	Sensitivity with dirty on	-106	-105.5	-103.5	dBm
	Maximum input level	0	10	11	dBm
	C/I Co-channel	0.5	1	5	dB
	C/I 1MHz	-20	-19	-18	dB
	C/I 2MHz	-39	-38	-36	dB
	C/I >2MHz	-52	-51	-41	dB
	C/I Image	-41	-40	-36	dB
	C/I Image 1MHz	-52	-51	-50	dB

5. Antenna characteristics

MB5601L uses the PCB on - board antenna that comes with the PCB, the antenna size is 16x 5.715mm , the antenna efficiency is 60%, and the maximum antenna gain is 2dB i.

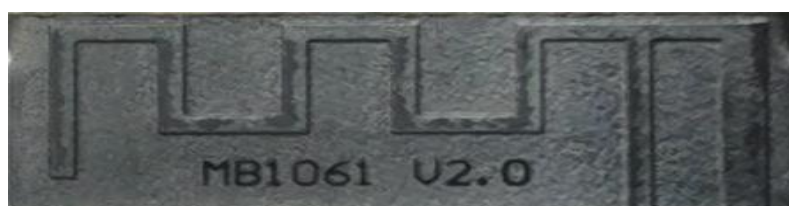


Figure 3. MB5601L Antenna Size diagram (TOP)



6. AT command function definition

6.1 Working Mode

The Bluetooth module has two working modes :

Master Mode and Slave Mode

Note: The default factory working mode of the module is the slave device mode, which can be searched by the mobile phone and the master device mode module and connect.

6.1.1 master mode

Bluetooth module in master mode:

1. It can be connected with a slave device module. In this mode, you can search and connect to the surrounding slave devices.
2. You can set the MAC address of the slave device, and the master device module will automatically search for the MAC address when it is powered on .address of the slave device and connect.
3. Support to open the disconnection and reconnection function. When the working environment of the module returns to normal, the master device will automatically search for the slave device that has just been disconnected.

6.1.2 slave mode

This mode includes a serial port transceiver service , the user can pass UUIDFind it, there are two channels in it, respectivelyare read (RX) and write (TX) Users can operate these two channels for data transmission.

If the user uses the Bluetooth master device to connect with the slave device, the user does not need to pay attention to the internal protocol, the serial ports of the two devices directlyData can be transparently communicated.

Module UUIDas follows:

Main service UUID: FF50 (0000FF50-0000-1000-8000-00805F9B34FB)

Transparent data UUID: FF51 (0000FF51-0000-1000-8000-00805F9B34FB)



6. 2 Module parameter setting AT command

1. When sending AT commands, carriage return and line feed are required. AT commands can only take effect when the module is not connected .
2. Once the Bluetooth module is connected to the device, the Bluetooth module will enter the data transparent transmission mode. After entering the transparent transmission mode ,UART0 receives +++\0, the module exits the transparent transmission mode and enters the command mode.
3. AT commands are not case sensitive .
4. The command input port and the log output port use different serial ports to make the display clearer. The log uses UART1, and the dataAccording to transparent transmission and AT commands use UART0 .
5. Set the relevant data, if the setting is successful, it will return to "OK\r\n", and it will be valid after restarting.Realized, not automatically restarted by the system .
- 6.command is sent , it returns FAIL:-1 if it is unsuccessful, and the set parameter value range is unreasonable ; FAIL:-2, the number of parameters is notMatch; FAIL:-3, the command setting failed, or the information acquisition failed, please confirm the current status or mode .



6.3 Instruction set

Command function:

serial number	Function Description	AT command format	parameter
1	test instruction	AT	none
2	The software clears all settings and the system restarts	AT+RESET	none
3	Software reset, system restart	AT+REBOOT	none
4	Query the software version number	AT+VERSION	none
5	Query—Bluetooth MAC	AT+LADDR	none
	Settings—Bluetooth MAC	AT+LADDR=<Param>	Param: MAC address with colon
6	Query—Bluetooth Name	AT+NAME	none
	Settings—Bluetooth Name	AT+NAME=<Param>	Param: Bluetooth device name Default name: ASR-BLE-M
7	Query—serial port baud rate	AT+BAUD	none
	Set serial port baud rate	AT+BAUD=<Param>	Param: Baud rate 0---4800 1---9600 2---19200 3---38400 4---57600 5---115200 6---230400 Default: 5---115200
8	Query — BLE transparent channel UUID	AT+UUID	none
	Settings: — BLE passthrough channel UUID	AT+UUID=<Param>	Param : UUID default FF51
9	Query—Pairing Code	AT+PIN	none
	Settings - Pairing Code	AT+PIN=<Param>	Param: Pairing code default name: "1234"
10	Query - automatic reconnection after disconnection	AT+AUTOCONN	none
	Settings - Automatically reconnect when disconnected	AT+AUTOCONN=<Param>	Param: Mode 0---Do not reconnect automatically (default) 1---Reconnect automatically



serial number	Function Description	AT command format	parameter
11	Scan all BLE devices	AT+SCAN=<Param>	Param: mode 0---stop scanning 1---start scanning
12	Connect to the specified bluetooth device	AT+CONN=<Param>	Param: Mode slave MAC address plus address type Address type: 0---local address 1---random address
13	Query the status of the connected device,	AT+CHINFO	Param: Mode slave MAC address plus address type Address type: 0---local address 1---random address
14	Send data to the specified bluetooth channel	AT+LESEND=<Param1>, <Param2>,<Param3>	Param1: channel number; Param2: sent data length Param3: sent data content
15	The serial port receives the data received by the bluetooth air port	AT+DATA=<Param1>, <Param2>,< Param3>	Param1: Channel number Param2: Received data length Param3: Received data content
16	Disconnect the specified bluetooth channel	AT+LEDISC=<Param1>	Param1: single connection: channel number (0)
17	Turn on/off NTF notifications	AT+NTF=<Param1>, <Param2>,< Param3>	Param1: channel number; Param2: event Param3: switch 0/1
18	Turn on/off IND notification	AT+IND=<Param1>, <Param2>,< Param3>	Param1: channel number; Param2: event Param3: switch 0/1
19	Broadcast on and off	AT+ADV=<Param1>	Param1: switch 0/1
20	Send NTF data	AT+THROUGHPUT=<Param1>	Param1: NTF data
	end notice	AT+THROUGHPUT	none
21	Find	AT+DISCOVERY=<Param1>, <Param2>	Param1: channel number; Param2: found type 0--all, 1--svc, 2--char, 3--desc, used after successful connection



serial number	Function Description	AT command format	parameter
22	service change event	AT+SVCCHANGE=<Param1>,<Param2>,<Param3>,<Param4>	Param1: Channel number; Conidx connection index for multiple connections. For a single connection, set it to 0; Param2: handle handle id; Param3: start_handle start handle; Param4: end_handle end handle;
23	Query multiple connections	AT+MCONN	
	Set up multiple connections	AT+MCONN=<Param1>,<Param2>,<Param3>...	Up to 3 MAC; MAC is no colon
24	send notifications;	AT+NTFSEND=<Param1>,<Param2>,<Param3>	<Param1>: UUID (default FF51) <Param2>: Data length, <Param3>: Data (ASCII)
25	Query the mtu size of the data exchange packet	AT+MTUD=<Param1>	Param1: channel number;
26	Set connection parameters	AT+CONNPARAM=<Param1>,<Param2>,<Param3>,<Param4>,<Param5>,<Param6>	<Param1>,<conidx> connection index for multiple connections. For a single connection, set it to 0. <Param2>,<intv_min> connection interval minimum value (6~3200 means 7.5ms~4S) <Param3>,<intv_max> connection interval maximum value (6~3200 means 7.5ms~4S) delay delay (0 ~ 499) <Param4>,<latency> Delay (0 ~ 499) <Param5>,<time_out> supervision timeout (10~3200 means 100ms~32S) <Param6>,<ce_len_min> connection event minimum duration <Param7>,<ce_len_max> connection event maximum duration
27	Automatically reconnect when disconnected	AT+AUTOADV=<Param1>	<Param1> 0:--Off 1:--On
28	stop all active events,	AT+CLEARACTIVE	
29	Exit broadcast state	AT+EXTADV=<Param1>	<Param1> 0-- Exit broadcast 1--Configure extended broadcast



serial number	Function Description	AT command format	parameter
30	search handle	AT+ATTHDL=<Param1>	<Param1> UUID
31	Set the packet size of a channel	AT+DLE=<Param1>	<Param1> conidx join index is used for multiple joins. For a single connection, set it to 0
32	log	AT+LOG=<Param1>	<Param1> 1--
33	Set transmit power	AT+TXPWR=<Param1>	<Param1> -43,-38,-33,-31,-30, --->(-70~-90) -25,-20, --->(-60~-63) -19,- 16,-13,-10, --->(-50~-56) -8,-6,-4,-5,-3,-1,0, --->(-43~-48) 2,4,6,7,8,9,10, --->(-28~-38)
34	Clear the bond link aggregation list	AT+BONDCLEAR	
35	Set up Bond link aggregation	AT+BOND=<Param1>	<Param1> conidxi link number connection index, for multiple connections. For a single connection, set it to 0
36	Read value of Conidx link hdl event via GATT handler	AT+GATTREAD=<Param1>, <Param2>	<Param1> Conidx join index for multiple joins. Set this to 0 for a single connection <Param2> event
37	Query bond link aggregation information,	AT+BONDINFO	
38	Establish Secure Link Aggregation	AT+ENCRYPT=<Param1>, <Param2>	<Param1> conidx connection number; <Param2> targetAddr target address (mac without :)
39	In order to compare and exchange the number, send the bond link aggregation request confirmation	AT+NCOMPARE=<Param1>, <Param2>	<Param1> conidx connection number; <Param2> value of reply



serial number	Function Description	AT command format	parameter
40	generate mac address,	AT+GENADDR=<Param1>,<Param2>	<Param1>: Generation type: 0--Static random address 1--Private unresolvable address 2--Private address resolution <Param2>: 6-digit routing address
41	mac address resolution	AT+RESOLVADDR=<Param1>	<Param1> MAC address used for sec secure connection (mac with colon)
42	Set the identity resolution key	AT+SETIRK=<Param1>	<Param1> key 16 bits, the default key without parameters: 1234567812345678, used for Sec secure connection,
43	query parsing list	AT+RALLIST=<Param1>	<Param1> mac with colon with parameters: set the content of the resolution list; without parameters: get local address resolution information; only one resolution list is supported, and the local irk and peer irk should be the same
44	query parsing information;	AT+GETRAL=<Param1>	<Param1> 6-digit parsed address
45	switch traditional radio,	AT+DIRECTADV=<Param1>	<Param1> 0--off 1--on
46	Switch short broadcast	AT+PERIODADV=<Param1>	<Param1> 0--off 1--on
47	Switching cycle synchronization	AT+PERIODSYNC=<Param1>	<Param1> 0--off 1--on



6.4 Instructions

6.4.1 test instruction

Downlink	response	parameter
AT	OK\r\n	none

6.4.2 Module restart

Function: software reset, system restart.

Downlink	response	parameter
AT+REBOOT	OK\r\n	none

6.4.3 Get the software version number

Downlink	response	parameter
AT+VERSION	+VERSION=<Param>\r\n OK\r\n	Param : software version number

example:

```
AT+VERSION\r\n
```

```
+VERSION=1.0-20200201\r\n
```

```
OK\r\n
```

6.4.4 Setup/Query— Bluetooth MAC

Downlink	response	parameter
AT+LADDR=<Param>	OK\r\n	Param : address code
AT+LADDR	+LADDR=<Param>\r\n OK\r\n	

example:

```
AT+LADDR=11:22:33:44:55:66\r\n
```

```
+LADDR=11:22:33:44:55:66\r\n
```

```
OK\r\n
```

At this time, the Bluetooth address code is changed to 11:22:33:44:55:66. Parameters support power-down save.



6.4.5 set/query—set name

Downlink	response	parameter
AT+NAME=<Param>	OK\r\n	Param : Bluetooth device name Default name: ""HUSU-BLE-M""
AT+NAME	+NAME=<Param>\r\n OK\r\n	

example:

```
AT+NAME=123\r\n
```

```
Return +NAME=123\r\n
```

Parameters support power-down save.

6.4.6 Module restart

Function: The software clears all settings.

Downlink	response	parameter
AT+RESET	OK\r\n	none

6.4.7 Setting/Query—Serial Baud Rate

Downlink	response	parameter
AT+BAUD=<Param>	OK\r\n	Param : baud rate 0---4800 1---9600 2---19200 3---38400 4---57600 5---115200 6---230400 Default: 5---115200
AT+BAUD	+BAUD=<Param>\r\n OK\r\n	

example:

```
AT+BAUD=6\r\n
```

```
+BAUD=6\r\nOK\r\n
```

At this point the baud rate is 230400

Note: After the baud rate is changed, if it is not the default 115200, in the future parameter setting or data communication, you need to use the set baud rate.

Parameters support power-down save.



6.4.8 Set/Query—UUID

Downlink	response	parameter
AT+UUID=<Param>	OK \r\n	Param : UUIDDefault FF51
AT+UUID	+UUID=<Param>\r\n OK \r\n	

example:

```
AT+ UUID =FF00\r\n
```

```
+ UUID =FF00\r\n
```

```
OK\r\n
```

Modified UUID: 0x0000 **FF00** -0000-1000-8000-00805F9B34FB

Parameters support power-down save.

6.4.9 Setting/Query - Working Mode

Downlink	response	parameter
AT+MODE=<Param>	OK \r\n	Param : mode 0 --- slave mode (default) 1--- Main mode
AT+MODE	+MODE=<Param>\r\n	
	OK \r\n	

example:

```
AT+MODE \r\n
```

```
+MODE=0 \r\nOK \r\n
```

```
AT+MODE=0\r\nOK \r\n
```

Parameters support power-down save.

6.4.10 Setup/Query—Pairing Code

Downlink	response	parameter
AT+PIN=<Param>	OK \r\n	Param : pairing code Default name: "1234 "
AT+PIN	+PIN=<Param>\r\n OK \r\n	



example:

AT+PIN \r\n

+PIN =1234 \r\nOK \r\n

AT+PIN=8888\r\n

OK \r\n

AT+PIN \r\n

+PIN=8888 \r\nOK \r\n

Parameters support power-down save.

6.4.11 Settings/Query—Auto Reconnect

Downlink	response	parameter
AT+AUTOCONN=<Param>	OK \r\n	Param : mode 0 --- do not automatically reconnect (default) 1--- Auto reconnect
AT+AUTOCONN	+AUTOCONN=<Param>\r\nOK \r\n	

example:

AT+AUTOCONN \r\n

+AUTOCONN=0 \r\n

OK \r\n

AT+AUTOCONN=0\r\n

OK \r\n

Parameters support power-down save.

6.4.12Scan (Main Mode)

Function: Scan all BLEequipment

Downlink	response	parameter
AT+SCAN=<Param>	OK \r\n	Param : mode 0 --- stop scanning 1 --- start scan

Example :

AT+SCAN=1 \r\n

+SCAN{\r\n

BLEequipment1MACaddress , address type (random or public),

device name \r\nBLEequipment2MACaddress , address type

(random or public), device name ok \r\n

...

+SCAN}



6.4.13 Establish a connection (main mode)

Function: connect to the specified bluetooth device;

Downlink	response	parameter
AT+CONN=<Param>	+GATTSTAT=0,2\r\n represents channel 0connecting +GATTSTAT=0,3\r\n represents channel 0connected	Param : mode SlaveMACAddress plus address type Address type: 0--- local address 1--- random address

Example:

```
AT+CONN=1122334455661\r\n
```

"112233445566 " connect MACSlave with address ,"1 " random address

```
+GATTSTAT=0,2\r\n
```

6.4.14Query Status (Main Mode)

Function: Query connected device status

Downlink	response	parameter
AT+CHINFO		Param : mode SlaveMACAddress plus address type
		Address type: 0--- local address 1--- random address

Example :

```
AT+CHINFO\r\n
```

```
+CHINFO {\r\n
```

connectedBLEequipment1MAC _address , channel number (0,1,2,3) 3 \r \nconnectedBLEequipment

2MAC address ,

Channel number (0,1 , 2,3) 3 \r \nconnectedBLEequipment3MAC address ,

Channel number (0,1 , 2,3) 3 \r \nconnectedBLEequipment4MAC address ,

channel number (0,1 , 2,3) 3 \r \n

```
+CHINFO }\r\n
```

```
\r\nOK
```



6.4.15 Data Transmission (Master Mode)

Function: Send data to the specified Bluetooth channel

Downlink	response	parameter
AT+LESEND=<Param1>,<Param2>,<Param3>	none	Param 1 : channel number; Param 2 : The length of the data to be sent Param 3 : The content of the data to be sent

example:

```
AT+LESEND=0,10,0123456789\r\n
```

Delegate to channel 0 send 012345678910 into a characters.

6.4.16 Data reception (main mode)

Function: serial port receives data received by bluetooth air port

Downlink	response	parameter
+DATA=<Param1>,<Param2>,<Param3>	none	Param 1 : Channel number Param 2 : Received data length Param 3 : Received data content

example:

```
+DATA=1,10,0123456789
```

Delegate to channel 1 send 012345678910 into a string.

6.4.17 Disconnect (Master Mode)

Function: Disconnect the specified bluetooth channel

Downlink	response	parameter
AT+LEDISC=<Param1>	+CATTSTAT=0,1\r\n represents channel 0 Disconnect	Param 1 : Channel number

example:

```
AT+LEDISC=0\r\n
```

```
+CATTSTAT=0,1\r\n
```



7. Packaging Information and Reflow Soldering

7.1 Mechanical Dimensions

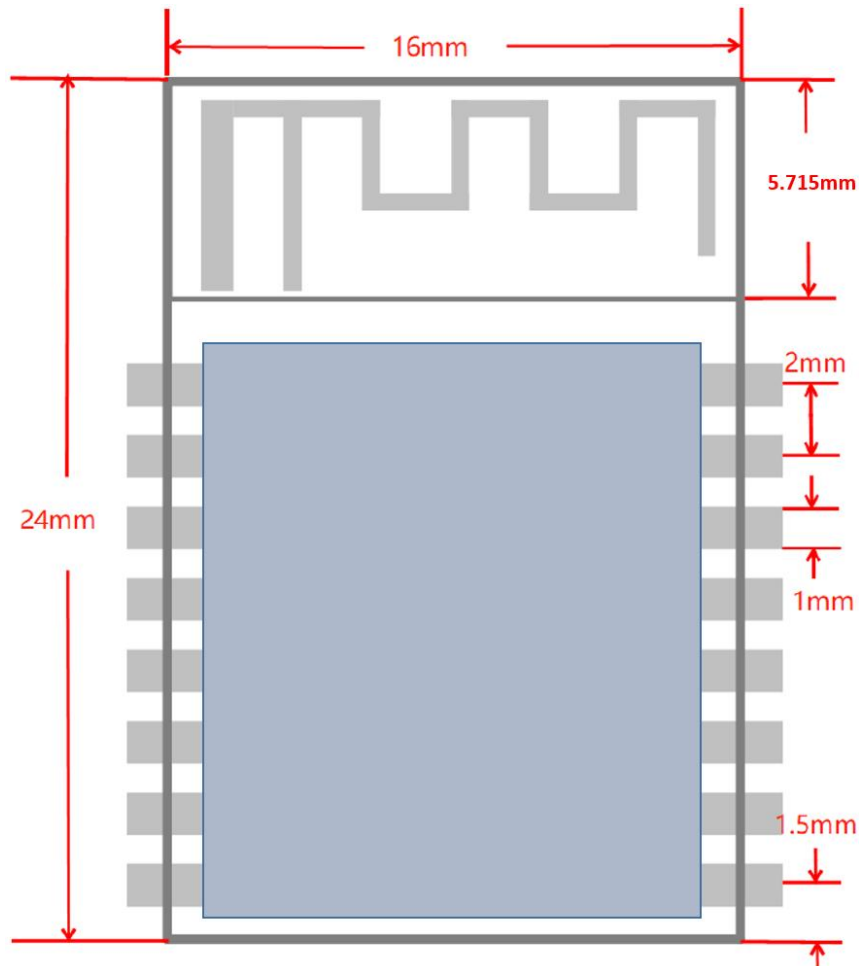


Figure 5. MB5601L Module Size diagram (TOP)

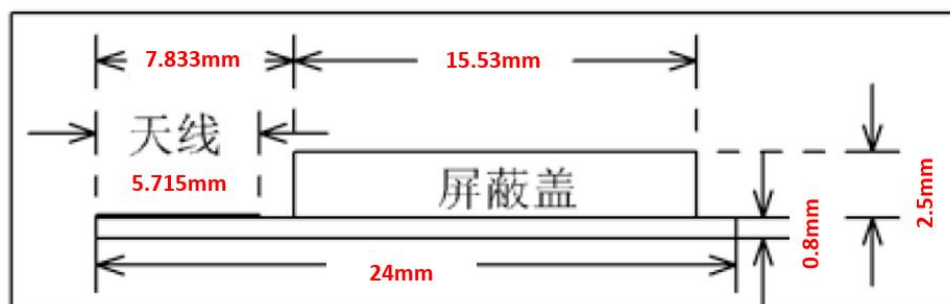


Figure 6. MB5601L Module Size diagram (SIDE)



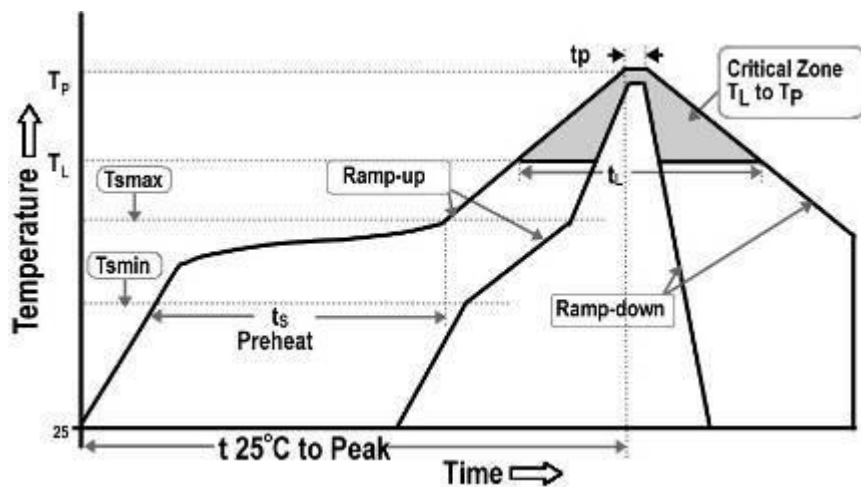
7.2 Reflow profile

Refer to IPC/JEDEC standards.

Peak temperature: <250°C

Reflow soldering times: ≤ 2 times

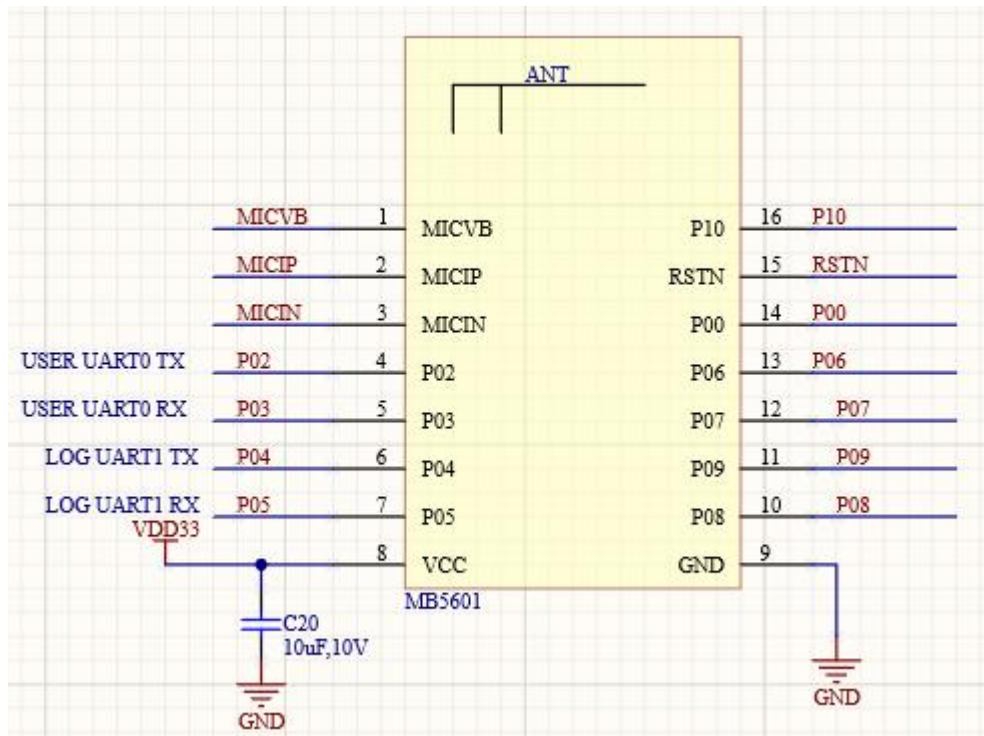
Profile Feature		Specification*
Average ramp-up rate (t_{smax} to t_p)		2°C/second max.
Pre-heat	Minimal temperature (T_{smin})	150°C
	Maximal temperature (T_{smax})	200°C
	Time (t_s)	60~120 seconds
Time maintained above	Temperature (T_L)	217°C
	Time (t_L)	40~60 seconds
Peak/Classification temperature (T_p)		250°C
Time within 5°C of actual peak temperature (t_p)		10~20 seconds
Ramp-down rate		2.5°C/second max.
Time 25°C to peak temperature		8 minutes max.





8. Reference circuit design

8.1 The most basic connection method of the module

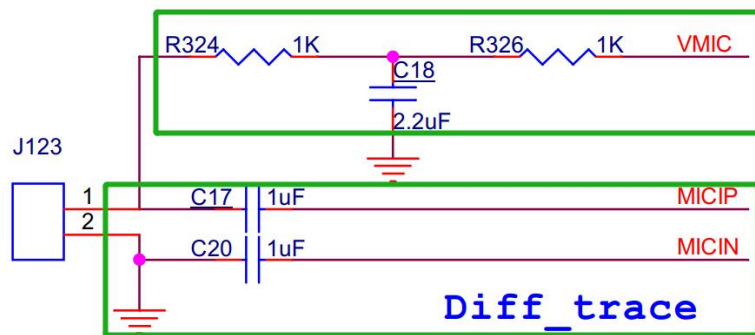




8.2 MIC circuit design

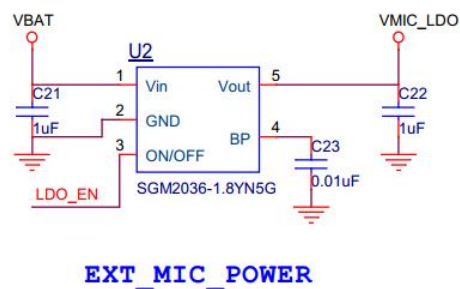
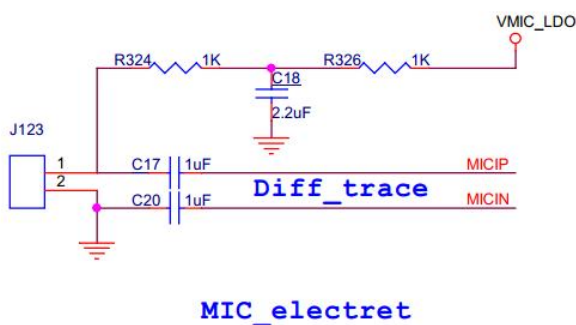
MB5601L supports two common MIC connection methods: differential and single-ended. The following points should be paid attention to when designing the circuit:

1. The T-shaped RC filter circuit needs to be placed close to the MIC power input pin;
2. Whether it is a single-ended or differential MIC device, the MIC_IN/IP signal line must be routed to the MIC lead according to the differential line. For the pin end, pay attention to isolation protection. When connecting to a single-ended MIC, the capacitance of MIC_IN near the MIC end is grounded, as shown in the figure below;



If the noise floor of the analog MIC is required to be high, an external LDO can be used to supply power to the MIC. Can control the use of idle GPIO;

1. The LDO should be placed as close to the MIC as possible;
2. The positive and negative audio lines of the MIC, MICIP/N, are differential lines;





9. Packaging Information

Part No	MOQ(pcs)	Shipping packaging (pallet / tape)	Modules per pallet (pcs)	Number of pallets per small box (pcs)	Number of modules per small box (pcs)
MB5601L	1200	tray	60	20	1200

FCC Statement

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help

The device must not be co-located or operating in conjunction with any other antenna or transmitter.

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.

The minimum separation generally be used is at least 20 cm.

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2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.

Explanation: this module meets all the requirements of FCC part 15 -247



2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

Explanation: The EUT uses an unchangeable PCB antenna with a maximum gain of 2dbi. There is no restriction on the installation method.

2.4 Limited module procedures

If a modular transmitter is approved as a "limited module," then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval. This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. 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.

Explanation: this module is a Single Modular, not limited module.

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

- a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
- b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
- c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
- d) Appropriate parts by manufacturer and specifications;
- e) Test procedures for design verification; and
- f) Production test procedures for ensuring compliance.

Explanation: YES. this module without trace antenna designs, use fixed-length PCB antenna



2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This module is designed to comply with the FCC statement, fcc id is:2A75I5601L

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an “omnidirectional antenna” is not considered to be a specific “antenna type”)).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: This module use PCB antenna. Antenna Gain:2dBi

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating “Contains FCC ID” with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: On the metal shielding shell, there is space for printing basic information such as the name and model of the product, and the id :2A75I5601L is included.

2.9 Information on test modes and additional testing requirements

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.

Explanation: Data transfer module demo board can control the EUT work in RF test mode at specified test channel.



2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Explanation: The module without unintentional-radiator digital circuitry, so the module do not require an evaluation by FCC part15 subpart B. The host should be evaluated by the FCC subpart B.