

FCC Test Plan

This module does not include shielding and independent power supply, therefore it is limited. The assignee will need to submit Class II license changes for each host specific installation. This should undergo the following tests to demonstrate ongoing compliance.

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1. Summary Of Standards And Results

1.1. Description of Standards and Results

The EUT have been tested according to the applicable standards as referenced below:

Test Item	Standards Paragraph	Result
Conducted Emission	FCC Part 15: 15.207 ANSI C63.10 :2013	
6dB Bandwidth	FCC PART 15:15.247(a)(2) ANSI C63.10 :2013	
Output Power	FCC Part 15: 15.247(b)(3) ANSI C63.10 :2013	
Radiated Spurious Emission	FCC Part 15: 15.209 FCC Part 15: 15.247(d) ANSI C63.10 :2013	
Conducted Spurious & Band Edge Emission	FCC Part 15: 15.247(d) ANSI C63.10 :2013	
Power Spectral Density	FCC PART 15:15.247(e) ANSI C63.10 :2013	
Radiated Band Edge Emission	FCC Part 15: 15.247(d) , ANSI C63.10 :2013	
Antenna Requirement	FCC Part 15: 15.203	

Note:

1. P is an abbreviation for Pass.
2. F is an abbreviation for Fail.
3. N/A is an abbreviation for Not Applicable.
4. Conclusion determination rules of this report: Unless there are clear provisions on measurement uncertainty in the standard or customer requirements, decision by actual test data without considering measurement uncertainty.
5. Measurement method usage KDB 558074 D01 15.247 Meas Guidance v05r02.

2. General Information

2.1. Description of Device (EUT)

Product Name	: BLE Transmission Modules
Model No.	: MX-01P, MX-35A, MX-02P
Diff	: There is no difference except the name of the model.
Power supply	: DC 1.8~3.6V
Note	If the module stops working under undervoltage or overvoltage, under heat or overheating, this will be considered acceptable. Maximum operating voltage: DC 1.8V Small operation voltage: DC 3.6V

Radio Technology	: Bluetooth V5.1 LE
Operation frequency	: 2402-2480MHz
Channel No.	: 40 channels
Channel Separation	: 2MHz
Rate	: 1Mbps/2Mbps
Modulation	: GFSK
Antenna Type	: PCB antenna, maximum gain is -0.5dBi.
PMN	: N/A
HVIN	: N/A
Software version	: V1.0
Hardware version/FVIN	: V1.0

2.2. Accessories of Device (EUT)

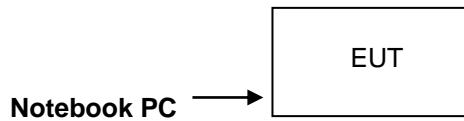
Accessories 1 : USB cable
Manufacturer : N/A
Model : N/A
Rating : N/A

2.3. Tested Supporting System Details

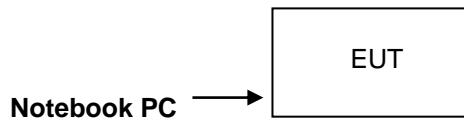
No.	Description	Manufacturer	Model	Serial Number
1	USB to TTL	Yunxin	CH340G	N/A
2	Notebook PC	Dell	Latitude 3490	N/A

2.4. Block Diagram of Connection Between EUT and Simulators

CE:



RSE:



2.5. Test Mode Description

The test software was used to control EUT work in Continuous TX mode, and select test channel, wireless mode

Tested mode, channel, and data rate information		
Mode	Channel	Frequency (MHz)
GFSK Tx Mode 1Mbps/2Mbps	CH0	2402
	CH19	2440
	CH39	2480

Channel list:					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
CH0	2402	CH14	2430	CH28	2458
CH1	2404	CH15	2432	CH29	2460
CH2	2406	CH16	2434	CH30	2462
CH3	2408	CH17	2436	CH31	2464
CH4	2410	CH18	2438	CH32	2466
CH5	2412	CH19	2440	CH33	2468
CH6	2414	CH20	2442	CH34	2470
CH7	2416	CH21	2444	CH35	2472
CH8	2418	CH22	2446	CH36	2474
CH9	2420	CH23	2448	CH37	2476
CH10	2422	CH24	2450	CH38	2478
CH11	2424	CH25	2452	CH39	2480
CH12	2426	CH26	2454	--	--
CH13	2428	CH27	2456	--	--

2.6. Software test version and power setting information

Software testing version	RF_Test.exe REV 1.0.0.0		
Mode	The client's preset testing software is used to control the operation of EUT in continuous transmission mode and select the testing channel, wireless mode:		
Power level setup by client			
Mode	Channel	Frequency (MHz)	Soft Set
GFSK Tx Mode 1Mbps/2Mbps	CH0	2402	TX level is set as defaults value.
	CH19	2440	TX level is set as defaults value.
	CH39	2480	TX level is set as defaults value.

3. Spurious Emission

3.1. Test Limits

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

15.205 Restricted frequency band

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)

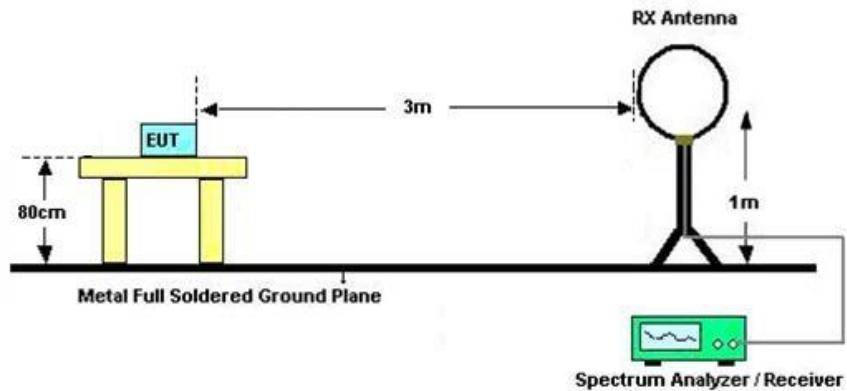
15.209 Limit

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		μ V/m	dB(μ V)/m
0.009-0.490	300	2400/F(KHz)	/
0.490-1.705	30	24000/F(KHz)	/
1.705-30	30	30	29.5
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above	1000	3	74.0 dB(μ V)/m (Peak) 54.0 dB(μ V)/m (Average)

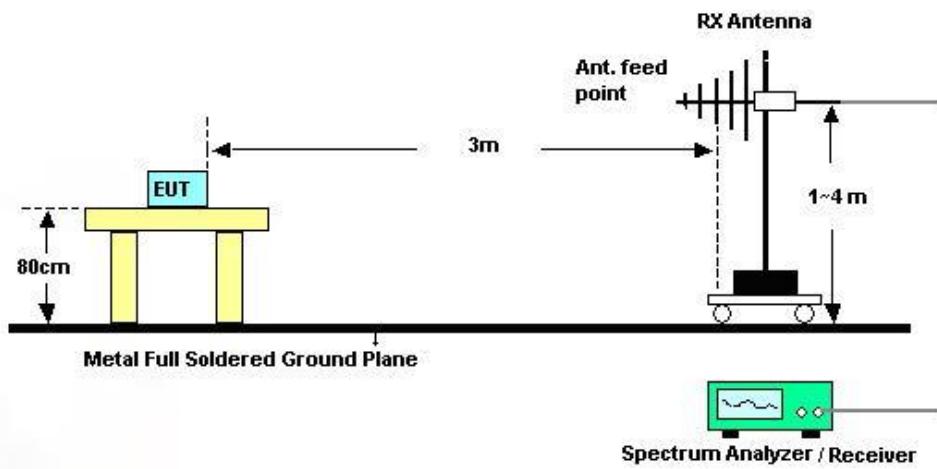
Note: The peak limit is 20 dB higher than the average limit

3.2. Block Diagram of Test setup

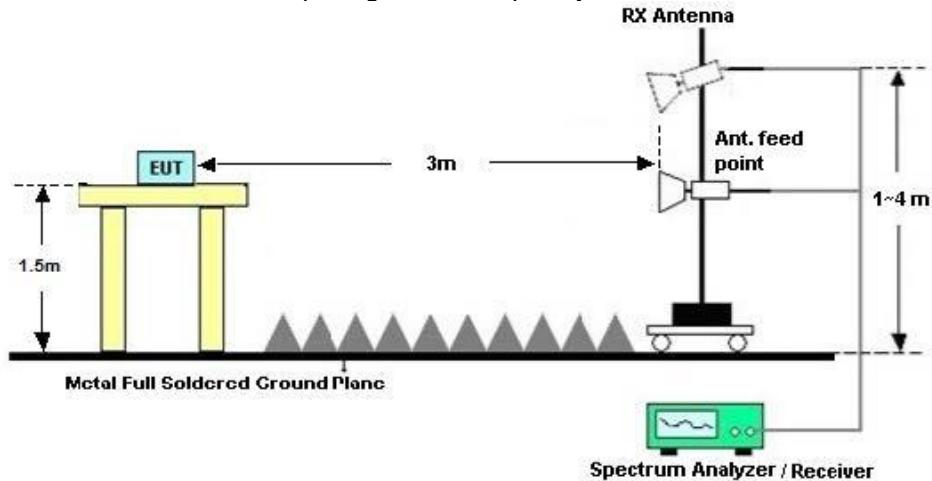
3.2.1 In 3m Anechoic Chamber Test Setup Diagram for below 30MHz



3.2.2 In 3m Anechoic Chamber Test Setup Diagram for below 1GHz



3.2.3 In 3m Anechoic Chamber Test Setup Diagram for frequency above 1GHz



3.3. Test Procedure

- (1) EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber.
- (2) Setup EUT and simulator
- (3) Test antenna was located 3m from the EUT on an adjustable mast. Below pre-scan procedure was first performed in order to find prominent radiated emissions.
 - (a) Change work frequency or channel of device if practicable.
 - (b) Change modulation type of device if practicable.
 - (c) Rotated EUT though three orthogonal axes to determine the attitude of EUT arrangement produces highest emissions
- (4) Spectrum frequency from 9KHz to 25GHz (tenth harmonic of fundamental frequency) was investigated
- (5) For final emissions measurements at each frequency of interest, the EUT were rotated and the antenna height was varied between 1m and 4m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. In order to find the maximum emission, the relative positions of equipments and all of the interface cables were changed according to ANSI C63.10:2013 on Radiated Emission test.
- (6) For emissions above 1GHz, both Peak and Average level were measured with Spectrum Analyzer, and the I_W is set at 1MHz, VBW is set at 3MHz for Peak measure; RBW is set at 1MHz, VBW is set at 10Hz for Average measure.

Test setup information:

9KHz~150KHz	RBW200Hz	VBW1KHz
150KHz~30MHz	RBW9KHz	VBW 30KHz
30MHz~1GHz	RBW120KHz	VBW 300KHz
Above1GHz	RBW1MHz	VBW 3MHz

3.4. Test Data

4. Power Line Conducted Emission

4.1. Test Limits

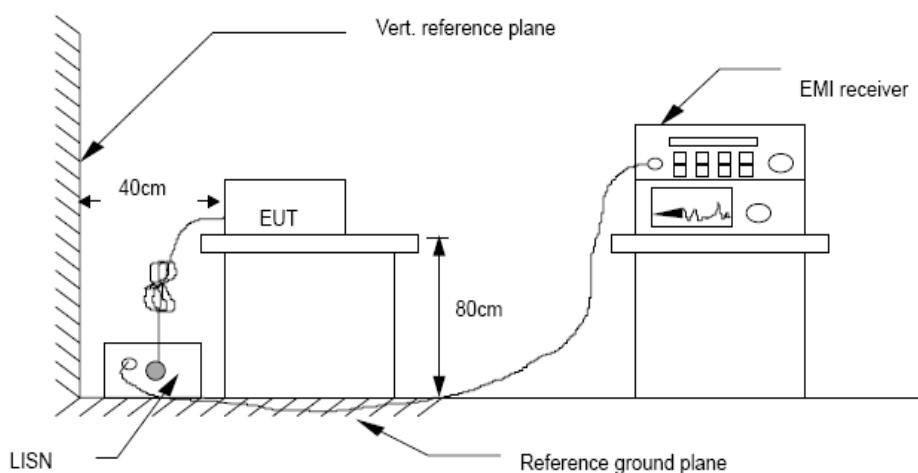
Frequency	Limits dB(μ V)	
MHz	Quasi-peak Level	Average Level
0.15 -0.50	66 -56*	56 - 46*
0.50 -5.00	56	46
5.00 -30.00	60	50

Notes: 1. *Decreasing linearly with logarithm of frequency.
 2. The lower limit shall apply at the transition frequencies.
 3. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.

4.2. Test Procedure

The EUT is put on the plane 0.8m high above the ground by insulating support and is connected to the power mains through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm coupling impedance for the EUT system. Please refer the block diagram of the test setup and photographs. Both sides of AC lines are checked to find out the maximum conducted emission. In order to find the maximum emission levels, the relative positions of equipment and all of the interface cables shall be changed according to ANSI C63.10:2013 on Conducted Emission Measurement. The bandwidth of test receiver is set at 9 kHz.

4.3. Test Setup



4.4. Test Data

5. Out-of-band Emissions

5.1. Test Limits

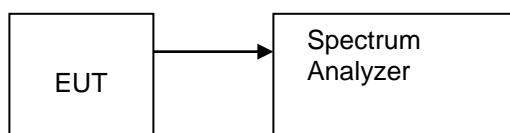
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in FCC Part 15.209(a) is not required.

Please refer section 15.247.

5.2. Test Procedure

Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector, and max hold. Measurements utilizing these setting are made of the in-band reference level, band edge and out-of-band emissions.

5.3. Test Setup



5.4. Test Data

6. Conducted Maximum Output Power

6.1. Test limits

Please refer FCC PART 15: 15.247.

Regulation 15.247(b) The limit of Maximum Peak Output Power Measurement is 1 W(30dBm)

6.2. Test Procedure

Details see the KDB558074 D01 Meas Guidance v05r02

1 Place the EUT on the table and set it in transmitting mode.

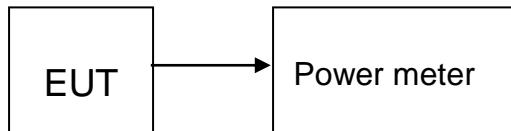
2 Connected the EUT's antenna port to peak power meter by 20dB attenuator.

3 Measure out each mode and each bands Peak output power of EUT.

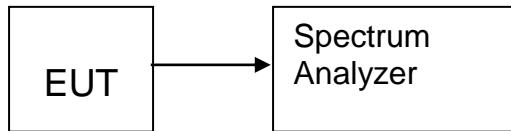
Note: The cable loss and attenuator loss were offset into measure device as amplitude offset.

6.3. Test Setup

Conducted Power:



Duty cycle:



6.4. Test Data

7. Peak Power Spectral Density

7.1. Test limits

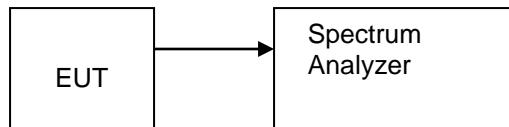
- 1 Please refer FCC PART 15.247.
- 2 For direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.
- 3 The direct sequence operating of the hybrid system, with the frequency hopping operation turned off, shall comply with the power density requirements of paragraph (d) of this section.

7.2. Test Procedure

Details see the KDB558074 D01 Meas Guidance v05r02

- 1 Place the EUT on the table and set it in transmitting mode.
- 2 Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 3 Set the spectrum analyzer as RBW = 3kHz(Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$), VBW = 10kHz(Set the VBW $\geq 3 \times \text{RBW}$), span $\geq 1.5 \times \text{DTS}$ bandwidth., detail see the test plot.
- 4 Record the max reading.
- 5 Repeat the above procedure until the measurements for all frequencies are completed.

7.3. Test Setup



7.4. Test Data

8. Bandwidth

8.1. Test limits

Please refer FCC PART 15.247

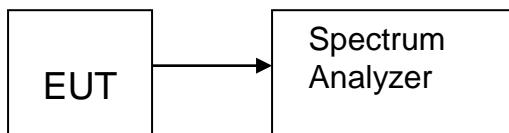
For direct sequence systems, the minimum 6dB bandwidth shall be at least 500 kHz.

8.2. Test Procedure

Details see the KDB558074 D01 Meas Guidance v05r02

- a) The bandwidth is measured at an amplitude level reduced 6dB from the reference level. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.
- b) The test receiver set RBW = 100kHz, VBW \geq 3*RBW =300kHz,, Peak Detector, Sweep time set auto, detail see the test plot.

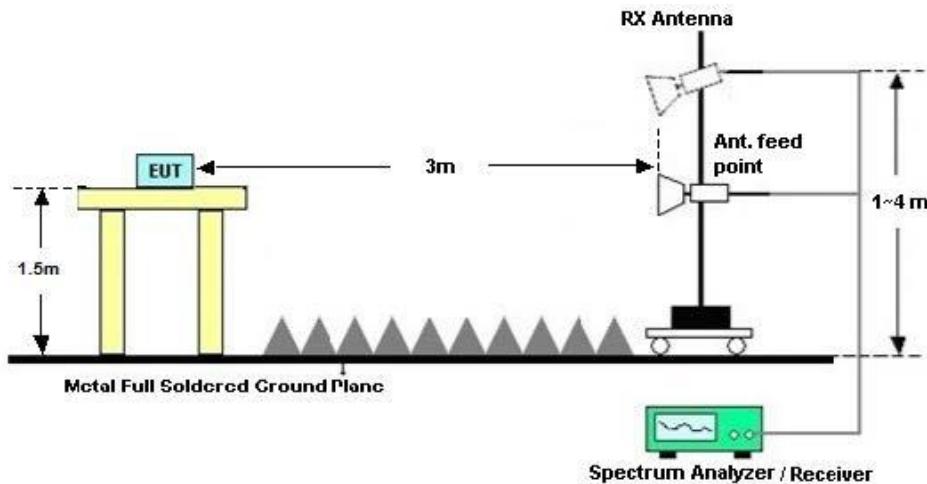
8.3. Test Setup



8.4. Test Data

9. Band Edge Test

9.1. Block Diagram of Test Setup



9.2. Test Limit

radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c))

Please refer section 15.247.

9.3. Test Procedure

Refer to ANSI C 63.10, Clause 6.10.

All restriction band and non- restriction band have been tested, only worse case is reported.

Details see the KDB558074 D01 Meas Guidance v05r02

1. Put the EUT on a 0.1m high table, power on the EUT. Emissions were scanned and measured rotating the EUT to 360 degrees, Find the maximum Emission
2. Check the spurious emissions out of band.
3. RBW 1MHz, VBW 3MHz, peak detector for peak value, RBW 1MHz, VBW 10Hz, RMS detector for AV value.

9.4. Test Data

10. Antenna Requirement

10.1. Standard Requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

10.2. Antenna Connected Construction

The antenna connector is unique antenna and no consideration of replacement. Please see EUT photo for details.

10.3. Results

The EUT antenna is PCB antenna. It complies with the standard requirement.