FCC Part 15 Subpart B&C§15.247

Test Report

Equipment Under Test	**Smart Bike Lock**
Model Name	**BS-LK-010-B**
Variant Model Name	**BS-LK-010-S**
Applicant	**BISECU INC**
Manufacturer	**BISECU INC**
Date of Test(s)	**2019. 03. 11 ~ 2019. 03. 21**
Date of Issue	**2019. 03. 29**

In the configuration tested, the EUT complied with the standards specified above.

Issue to	Issue by
BISECU INC 5th Floor, 12, Daewangpangyo-ro 645beon-gil Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea Tel.:+81-10-9030-4634	**MOVON CORPORATION** 498-2,Geumeo-ro, Pogok-eup, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17030 Tel.: +82-31-338-8837 Fax: +82-31-338-8847

Revision history

Revision	Date of issue	Description	Revised by
--	Mar 29, 2019	Initial	-

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1. Applicant Information

1.1. Details of applicant

Applicant	:	BISECU INC
Address	:	5th Floor, 12, Daewangpangyo-ro 645beon-gil Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea
Contact Person	:	Minsoo Jang
Telephone	:	+81-10-9030-4634
Applicant	:	BISECU INC

1.2. Manufacturer Information

Manufacturer	:	BISECU INC
Address	:	5th Floor, 12, Daewangpangyo-ro 645beon-gil Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea

2. Laboratory Information

Company name	:	MOVON CORPORATION
Test site number	:	FCC (KR0151)
Address	:	498-2, Geumeo-ro, Pogok-eup, Cheoin-gu, Yongin-si, Gyeonggi-do, South Korea

3. Summary of test results

The EUT has been tested according to the following specifications:

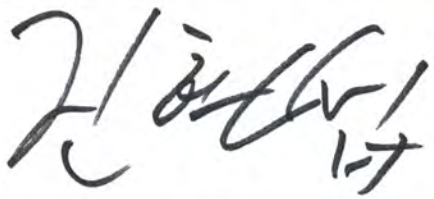
Section in FCC part 15	Description	Result
§15.205 §15.209 §15.247(d)	Transmitter radiated spurious emissions, Conducted spurious emission	C
§15.109(a)	Receiver radiated spurious emission	C
§15.247(a)(2)	6 dB Bandwidth and 99 % bandwidth	C
§15.247(b)(e)	Maximum peak conducted output power	C
§15.247(e)	Peak Power Spectral Density	C
§15.207(a)	AC Conducted power line test	C
§1.1307(b)(1)	RF exposure evaluation	C

※ Abbreviation

C Complied
N/A Not applicable
F Fail

The sample was tested according to the following specification:
FCC Parts 15.247; ANSI C63.4:2014, ANSI C63.10:2013
FCC Public Notice KDB 558074 D01v05
TEST SITE REGISTRATION NUMBER: **FCC(KR0151)**

Approval Signatories

Test and Report Completed by :	Report Approval by :
	
David park Test Engineer MOVON CORPORATION	Issac Jin Technical Manager MOVON CORPORATION

4. EUT Description

Kind of product	Smart Bike Lock
Model Name	BS-LK-010-B
Variant Model Name	BS-LK-010-S
FCC ID	2ASUR-BS-LK-010-B
Power supply	DC 3.7 V
Frequency range	2 402 MHz ~ 2 480 MHz (Bluetooth LE)
Modulation technique	GFSK
Number of channels	40 ch. (Bluetooth LE)
Antenna gain	-2.68 dBi (Max.)
Test Site Registration Number	FCC (KR0515)

4.1. Table for Test Modes and Frequency

Preliminary tests were performed in different data rate to find the worst radiated emission.
The data rate shown in the table below is the worst-case rate with respect to the specific test item.
Investigation has been done on all the possible configurations for searching the worst cases.
The following table is a list of the test modes shown in this test report.

Mode	Data rate (Worst case)	Frequency (Freq. MHz)
Bluetooth LE	1 Mbps	**Lowest** (2 402) / **Middle** (2 440) / **Highest** (2 480)

5. Measurement equipment

Equipment	Manufacturer	Model	Serial number	Calibration Interval	Calibration date	Calibration due.
Test Receiver	R&S	ESVS30	829673/015	1 year	2018-12-06	2019-12-06
Signal Generator	R&S	SMB100A	178128	1 year	2018-12-07	2019-12-07
Spectrum Analyzer	R&S	FSV-40	100832	1 year	2018-05-28	2019-05-28
Power Meter	Agilent	E4416A	GB41290645	1 year	2018-05-29	2019-05-29
Power Sensor	Agilent	9327A	US40441490	1 year	2018-05-29	2019-05-29
Horn Antenna	R&S	HF906	100236	2 year	2017-04-25	2019-04-25
Horn Antenna	AH Systems	SAS-572	269	2 year	2017-08-01	2020-08-01
Horn Antenna	AH Systems	SAS-573	164	2 year	2018-04-26	2020-04-26
Bi-Log Ant.	S/B	VULB 9161SE	4159	2 year	2018-06-11	2020-06-11
Loop Antenna	ETS LINDGREN	6502	00118166	2 year	2018-10-30	2020-10-30
Power Amplifier	TESTEK	TK-PA18H	170013-L	1 year	2018-05-28	2019-05-28
Power Amplifier	MITEQ	AFS43-01002600	2048519	1 year	2018-10-29	2019-10-29
Power Amplifier	MITEQ	AMF-6F-26004000-33-8P-HS	1511665	1 year	2018-12-10	2019-12-10
Power Amplifier	SONOMA INSTRUMENT	310N	185428	1 year	2018-12-07	2019-12-07
Step Attenuator	Agilent	8494B	US37181955	1 year	2018-05-29	2019-05-29
Controller	INNCO	CO2000	CO2000/064/6961003/L	N/A	N/A	N/A
Antenna Master	INNCO	MA4000	MA4000/038/6961003/L	N/A	N/A	N/A
Controller	INNCO	CO3000	CO3000/812/34240914/L	N/A	N/A	N/A
Antenna Master	INNCO	MA4640-XP-ET	None	N/A	N/A	N/A
WIDEBAND RADIO COMMUNICATION TESTER	R&S	CMW500	154160	1 year	2018-05-29	2019-05-29
TWO LINE-V-NETWORK	R&S	ESH3-Z5	100296	1 year	2018-12-06	2019-12-06
EMI TEST RECEVER	R&S	ESR3	101873	1 year	2018-05-28	2019-05-28
PULSE LIMITER	R&S	ESH3-Z2	100288	1 year	2018-05-28	2019-05-28
Power Divider	HP	11636B	12481	1 year	2018-05-31	2019-05-31
RF Cable	SUHNER	SUCOFLEX100	84047746	N/A	N/A	N/A
RF Cable	SUHNER	SUCOFLEX102	801270/2	N/A	N/A	N/A
RF Cable	SUHNER	SUCOFLEX102	801270/2	N/A	N/A	N/A

※Remark
Support equipment

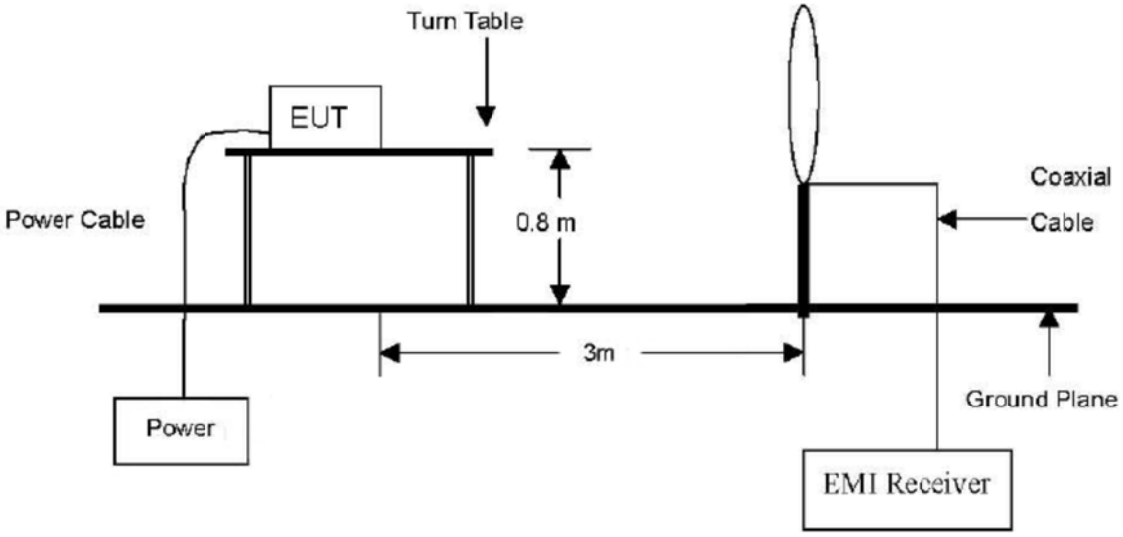
Description	Manufacturer	Model	Serial number
Notebook computer	DELL	Lattitude D510	-

6. Transmitter radiated spurious emissions and conducted spurious emissions

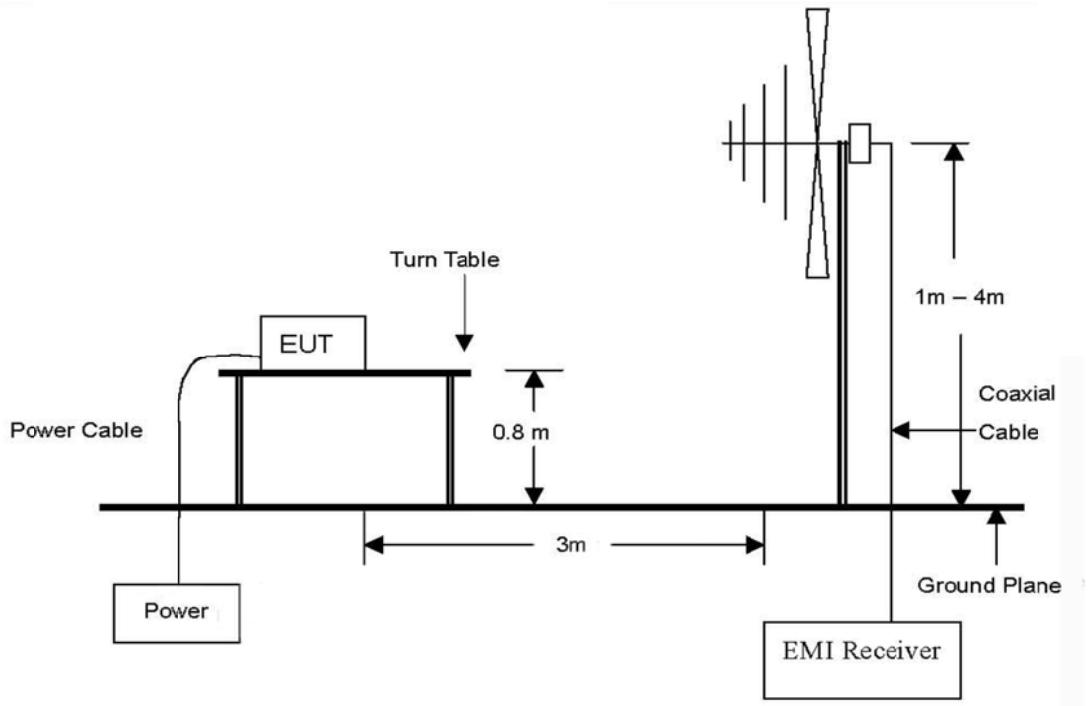
6.1. Test setup

6.1.1. Transmitter radiated spurious emissions

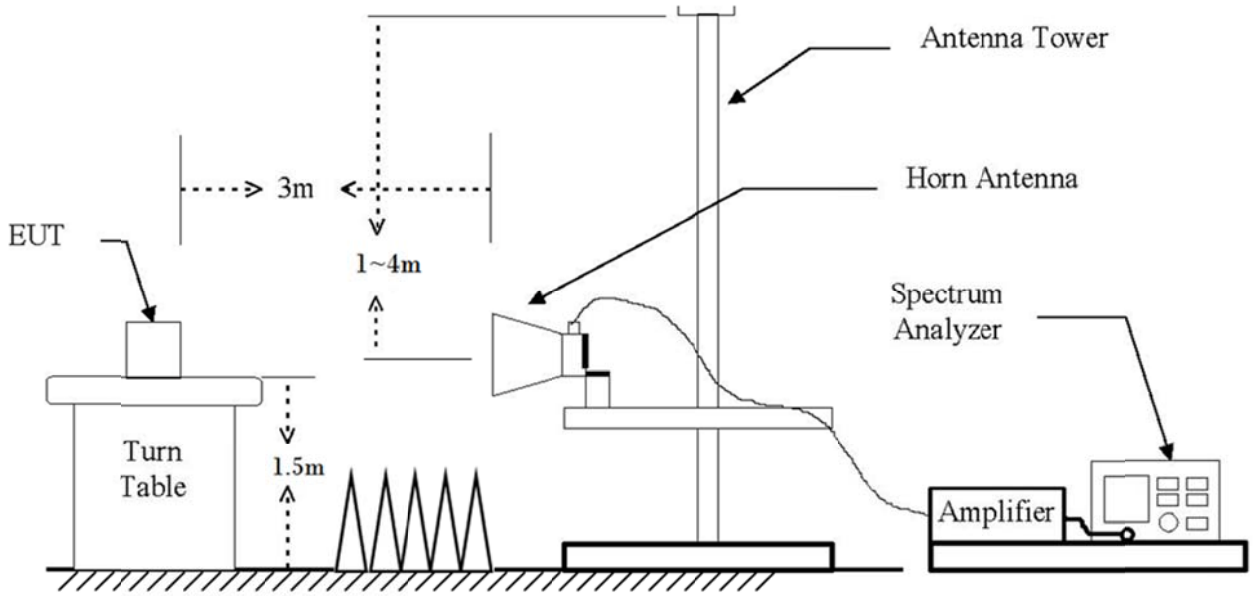
The diagram below shows the test setup that is utilized to make the measurements for emission from 9kHz to 30MHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to 40 ㎓ emissions.



6.2. Limit

According to §15.247(d), in any 100 ㎑ 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 ㏈ below that in the 100 ㎑ 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 ㏈ instead of 20 ㏈. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))
According to § 15.109(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

Frequency (㎒)	Distance (Meters)	Radiated at 3M (㏈㎶/m)	Radiated (㎶/m)
0.009–0.490	300	See the remark	2400/F(㎑)
0.490–1.705	30		24000/F(㎑)
1.705–30.0	30		30
30 - 88	3	40.0	100
88 – 216	3	43.52	150
216 – 960	3	46.02	200
Above 960	3	53.97	500

※Remark

1. Emission level in ㏈uV/m=20 log (uV/m)
2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
3. Distance extrapolation factor =40log(Specific distance/ test distance)(㏈)
   Limit line=Specific limits(㏈uV) + distance extrapolation factor.

6.3. Test procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.10:2013
In case of the air temperature of the test site is out of the range is 10 to 40°C before the testing proceeds the warm-up time of EUT maintain adequately

6.3.1. Test procedures for radiated spurious emissions

1. The EUT is placed on a turntable, which is 0.8 m (Below 1 ㎓.)/ 1.5 m (Above 1 ㎓) above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

※Remark

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 ㎑ for Peak detection (PK) at frequency below 30 ㎒
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 ㎑ for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 ㎓.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection and frequency above 1 ㎓.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 ㎒z and the video bandwidth is 10 ㎐ for Average detection (AV) at frequency above 1 ㎓.

6.3.2. Test procedures for conducted spurious emissions

All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

Per the guidance of KDB 558074, section 5.4.1.1, the reference level for out of band emissions is established from the plots of this section since the band edge emissions are measured with a RBW of 100 ㎑. This reference level is then used as the limit in subsequent plots for out of band spurious emissions shown in section 4.4.4. The limit for out of band spurious emission at the band edge is 30 ㏈ below the fundamental emission level measured in a 100 ㎑ bandwidth.

6.4. Test results

6.4.1. Radiated spurious emissions (9 kHz to 30 MHz)

The frequency spectrum from 9㎑ to 30㎒ was investigated. Emission levels are not reported muchlower than the limits by over 20 ㏈. All reading values are peak values.
To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Test mode : Bluetooth LE

A. Lowest Ch. (2 402 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.									

B. Middle Ch. (2 440 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.									

C. Highest Ch. (2 480 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.									

※Remark

1. Actual = Reading + Ant. factor + CL (Cable loss)
2. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dBuV) + Distance extrapolation factor
4. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

6.4.2. Radiated spurious emissions (30 MHz to 1 000 MHz)

The frequency spectrum from 30 ㎒ to 1 000 ㎒ was investigated. Emission levels are not reported muchlower than the limits by over 20 ㏈. All reading values are peak values.
To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Test mode : Bluetooth LE

A. Lowest Ch. (2 402 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.									

B. Middle Ch. (2 440 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.									

C. Highest Ch. (2 480 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.									

※Remark

1. Actual = Reading + Ant. factor + CL (Cable loss)
2. 15.31 Measurement standards.
The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

6.4.3. Radiated spurious emissions & Bandedge (Above 1 000 MHz)

The frequency spectrum above 1 000 ㎒was investigated. Emission levels are not reported much lower thanthe limits by over 20 ㏈.
To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Test mode : Bluetooth LE

A. Lowest Ch. (2 402 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*2369.02	56.72	Peak	H	28.09	39.03	-	45.78	74.00	28.22
*2375.97	44.69	Average	H	28.09	39.03	-	33.75	54.00	20.25
*2318.59	56.29	Peak	V	28.09	39.03	-	45.35	74.00	28.65
*2374.93	46.05	Average	V	28.09	39.03	-	35.11	54.00	18.89
Above 3 000 MHz Not detected									

B. Middle Ch. (2 440 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.									

※Remark

1. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental Frequency.
2. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument usingpeak/average detector mode.
3. Average measurement did not take place because the peak data did not exceed Average Limit.
4. Actual = Reading + Ant. factor- Amp + CL (Cable loss)
5. 15.31 Measurement standards.
The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.
6. * is Restricted band.

C. Highest Ch. (2 480 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*2483.50	57.94	Peak	V	28.09	39.03	-	47.00	74.00	27.00
*2483.50	45.01	Average	V	28.09	39.03	-	34.07	54.00	19.93
*2483.50	65.70	Peak	H	28.09	39.03	-	54.76	74.00	19.24
*2483.50	50.58	Average	H	28.09	39.03	-	39.64	54.00	14.36
Above 3 000 MHz Not detected									

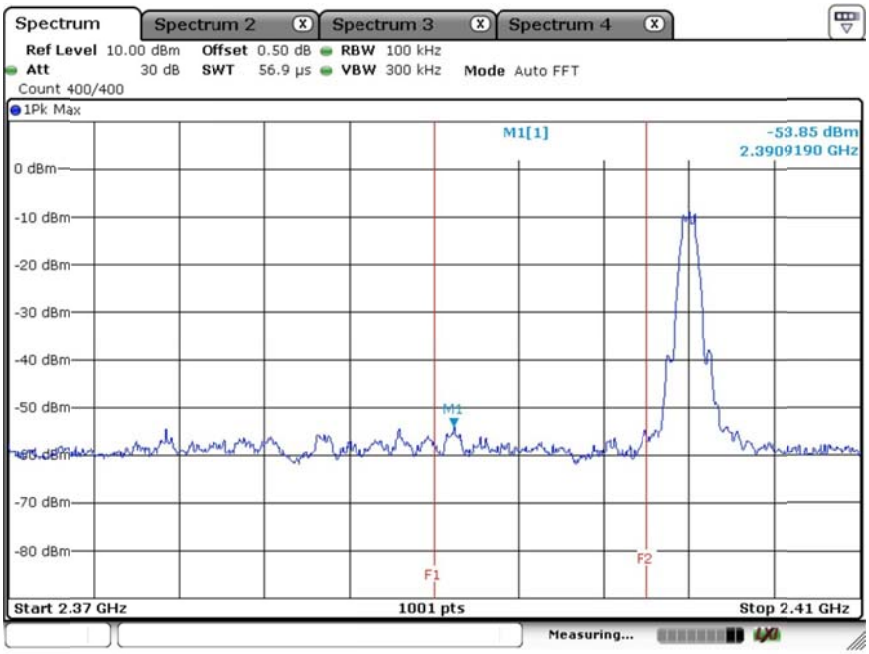
※Remark

1. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental Frequency.
2. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument usingpeak/average detector mode.
3. Average measurement did not take place because the peak data did not exceed Average Limit.
4. Actual = Reading + Ant. factor- Amp + CL (Cable loss)
5. 15.31 Measurement standards.
The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.
6. * is Restricted band.

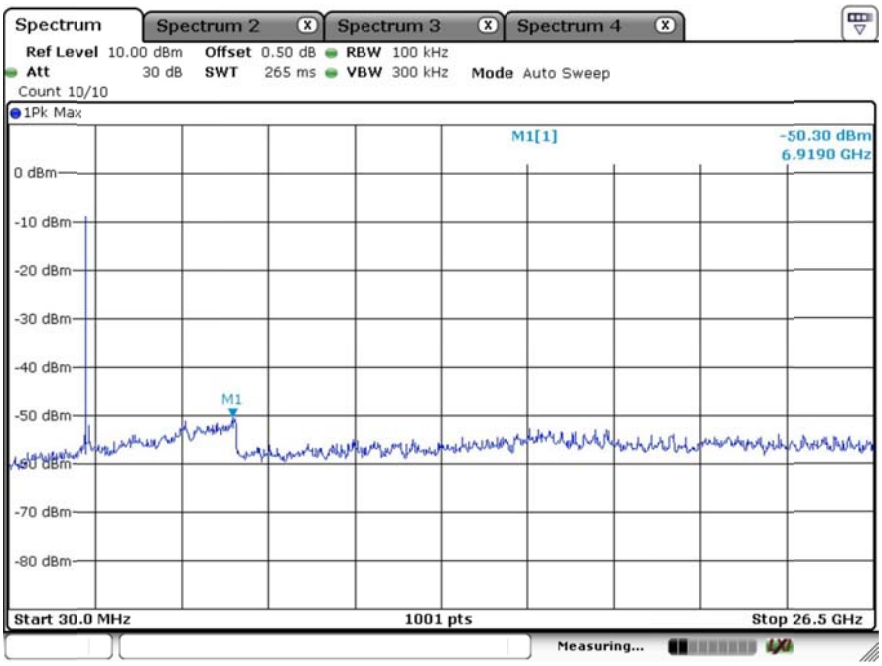
6.4.4. Test plot (Conducted spurious emissions & Bandedge)

Test mode : Bluetooth LE

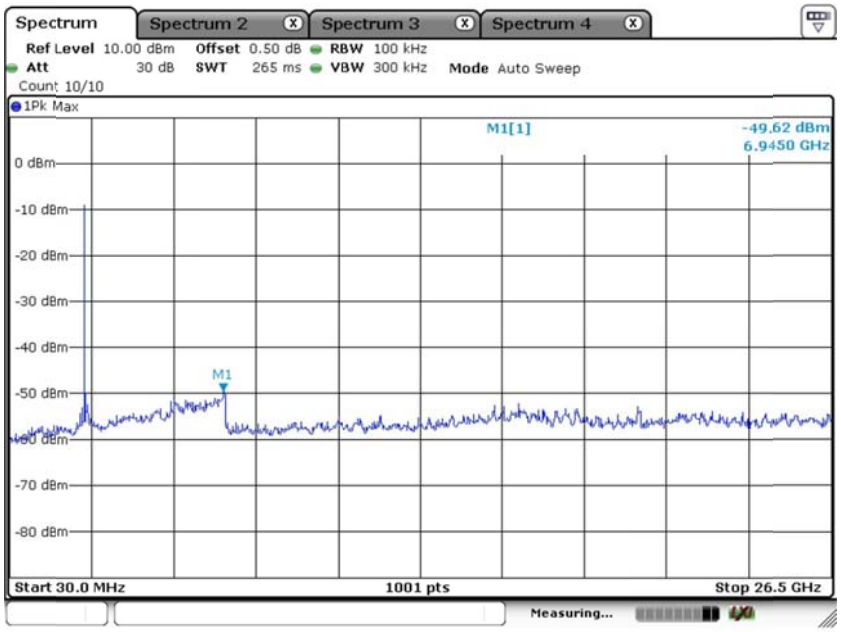
A.1. Lowest Ch. (2 402 MHz)_Band edge



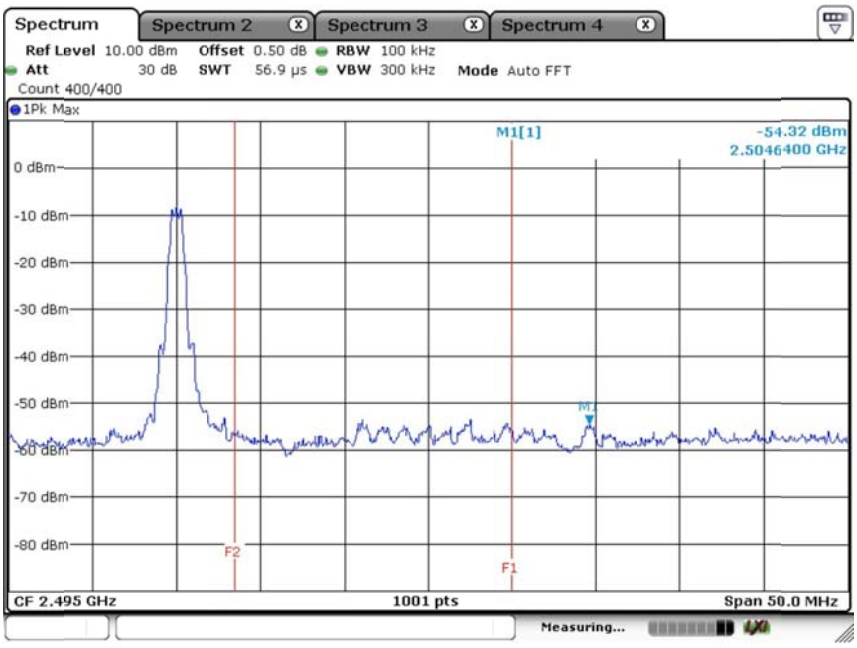
A.2. Lowest Ch. (2 402 MHz)_Spurious emissions



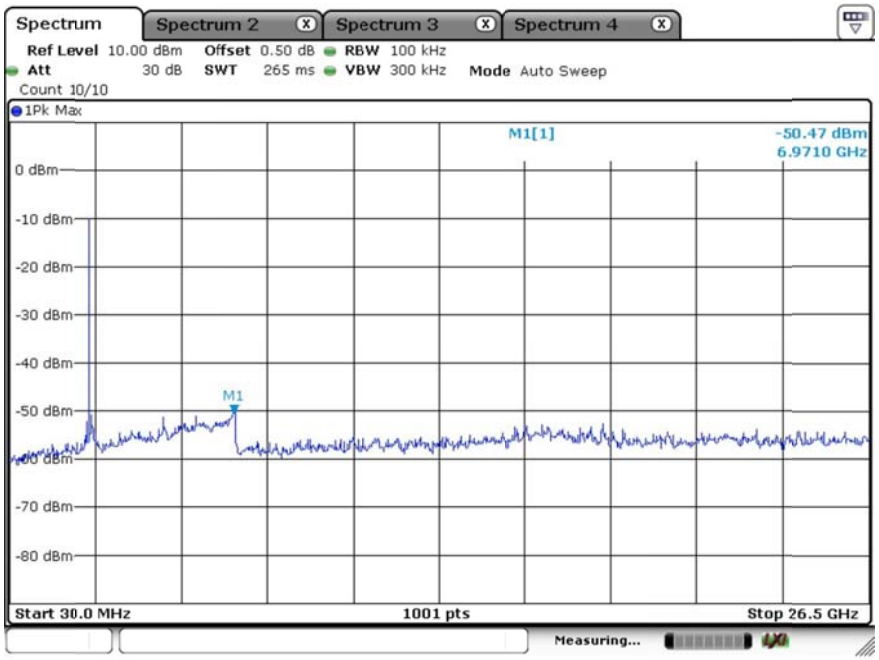
B.1. Lowest Ch. (2 440 MHz)_Spurious emissions



C.1. Lowest Ch. (2 480 MHz)_ Band edge



C.2. Lowest Ch. (2 480 MHz)_Spurious emissions



7. Receiver radiated spurious emissions

7.1. Test setup

Same as clause 6.1.

7.1.1. Receiver radiated spurious emissions

Same as clause 6.1.1

7.2. Limit

According to §15.109(a), Except for Class A digital devices, the field strength of radiated emission fromunintentional radiator at a distance of 3 m shall not exceed the following values:

Frequency (㎒)	Distance (Meters)	Radiated (dB㎶/m)	Radiated (㎶/m)
0.009–0.490	300	See the remark	2400/F(㎑)
0.490–1.705	30		24000/F(㎑)
1.705–30.0	30		30
30 - 88	3	40.0	100
88 – 216	3	43.5	150
216 – 960	3	46.0	200
Above 960	3	54.0	500

7.3. Test procedures

Same as clause 6.3.
Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003
In case of the air temperature of the test site is out of the range is 10 to 40°C before the testing proceeds the warm-up time of EUT maintain adequately

7.3.1. Test procedures for radiated spurious emissions

Same as clause 6.3.1.

7.4. Test results

7.4.1. Radiated spurious emissions

The frequency spectrum from 30 ㎒ to 26㎓ was investigated. Emission levels are not reported muchlower than the limits by over 30 ㏈. All reading values are peak values.

Test mode : Bluetooth LE

A. Lowest Ch. (2 402 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.									

B. Middle Ch. (2 440 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.									

C. Highest Ch. (2 480 MHz)

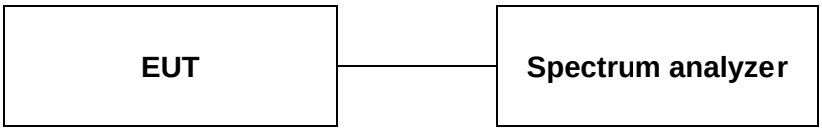
Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.									

※Remark

1. Actual = Reading + Ant. factor + CL (Cable loss)
2. 15.31 Measurement standards.
The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

8. 6 dB bandwidth& 99% bandwidth measurement

8.1. Test setup



8.2. Limit

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902~928 ㎒, 2 400~2 483.5 ㎒, and 5 725~5 825 ㎒ bands. The minimum of 6 ㏈ Bandwidth shall be at least 500 ㎑

8.3. Test procedure

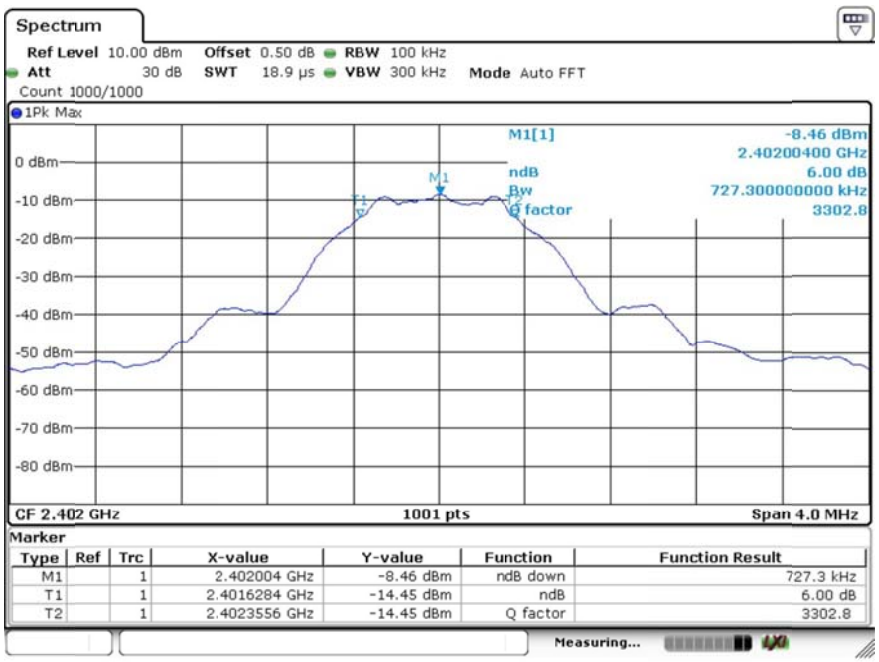
1. The 6㏈ band width was measured with a spectrum analyzer connected to RF antenna connector(conducted measurement) while EUT was operating in transmit mode at the appropriate centerfrequency. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.Display Line and Marker Delta functions, the 6㏈ band width of the emission was determined.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 100㎑,VBW≥ 3 x RBW, Span= 2times the DTS bandwidth
   Detector= peak, Trace = max hold, Sweep=auto couple

8.4. Test results

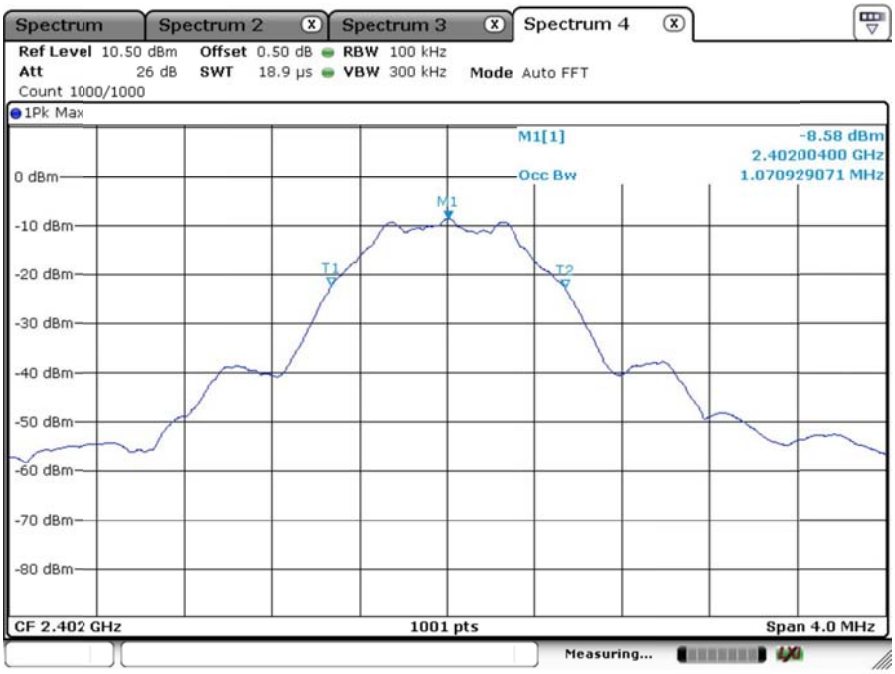
Frequency(㎒)	6 ㏈ bandwidth(㎒)	99% bandwidth(㎒)
2 402	0.73	1.07
2 440	0.71	1.07
2 480	0.72	1.07

8.4.1 Test plot

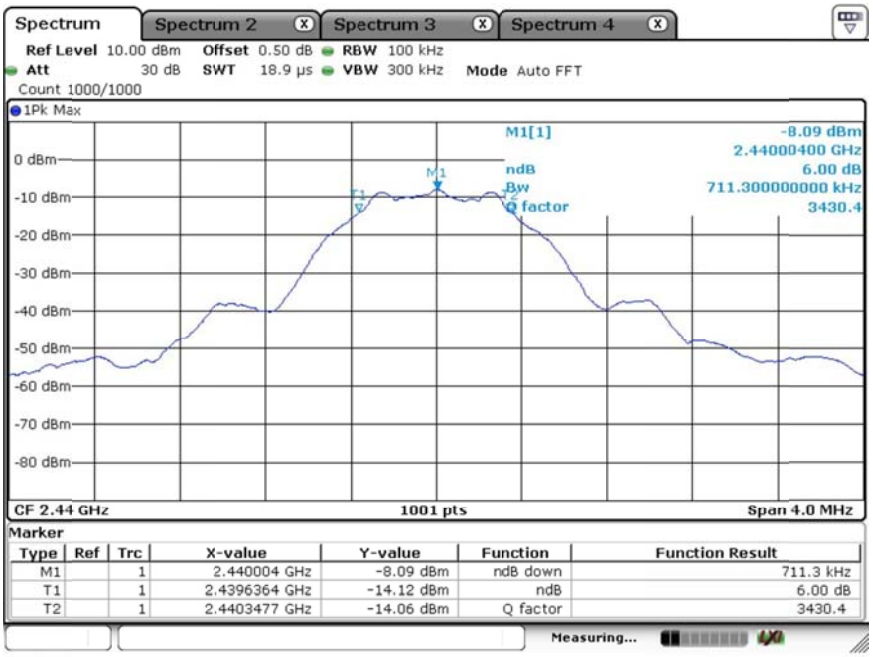
A.1. Lowest Ch. (2 402 MHz)_6dB Bandwidth



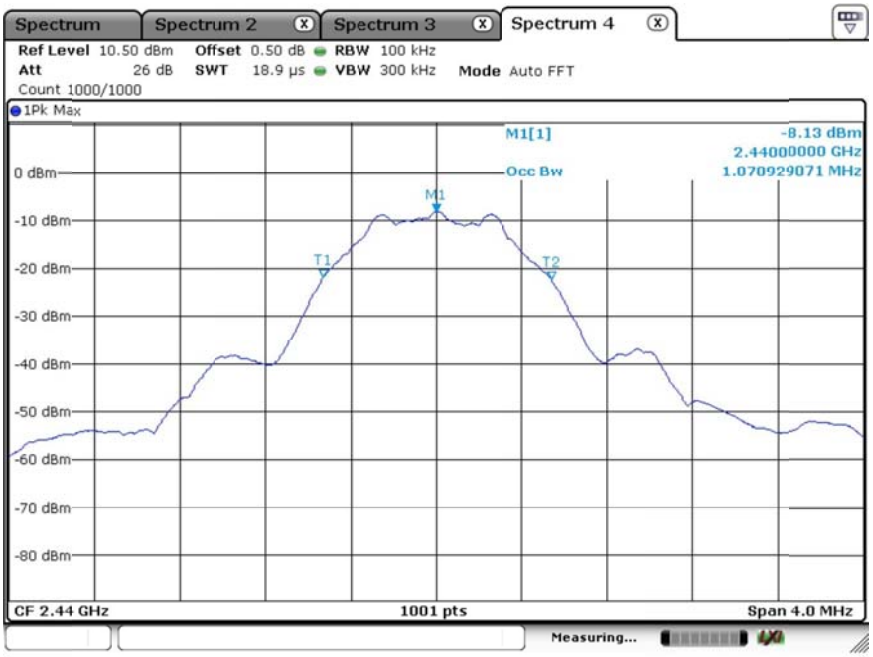
A.2. Lowest Ch. (2 402 MHz)_99% Bandwidth



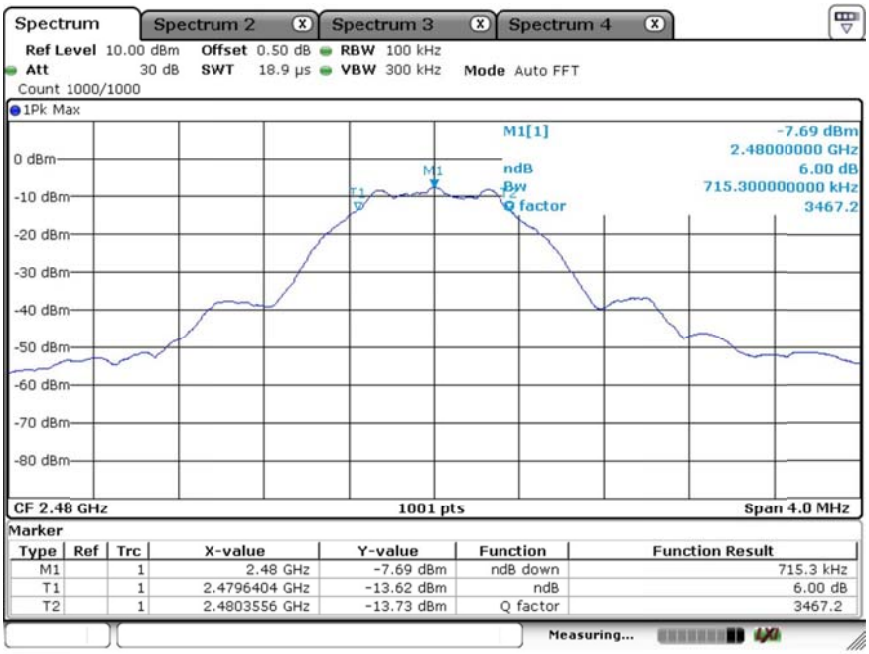
B.1. Middle Ch. (2 440 MHz)_6dB Bandwidth



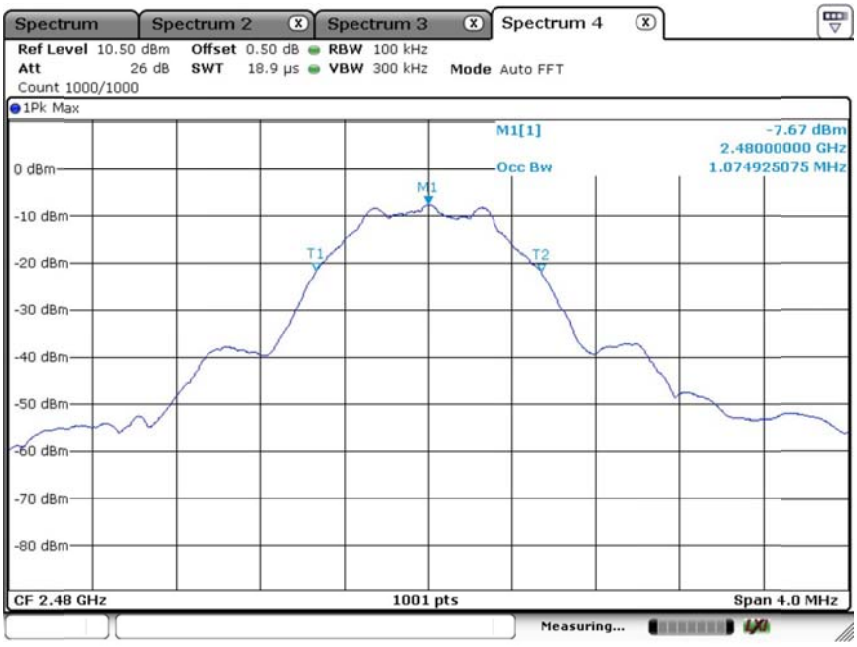
B.2. Middle Ch. (2 440 MHz)_99% Bandwidth



C.1. Highest Ch. (2 480 MHz)_6dB Bandwidth

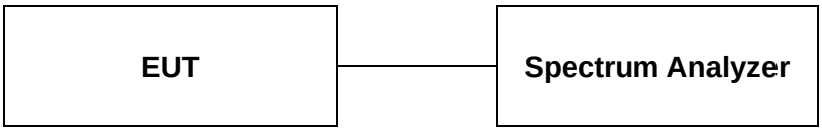


C.2. Highest Ch. (2 480 MHz)_99% Bandwidth



9. Maximum peak conducted output power

9.1. Test setup



9.2. Limit

The maximum peak output power of the intentional radiator shall not exceed the following:
1. §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by aminimum of 25 ㎑or the 6 ㏈ bandwidth of the hopping channel, whichever is greater, provided thesystems operate with an output power no greater than 125 ㎽
2. §15.247(b)(1), For frequency hopping systems operating in the 2400–2483.5 ㎒ employing atleast 75non-overlapping hopping channels, and all frequency hopping systems in the 5725–5 805 ㎒ band: 1Watt.

9.3. Test procedure

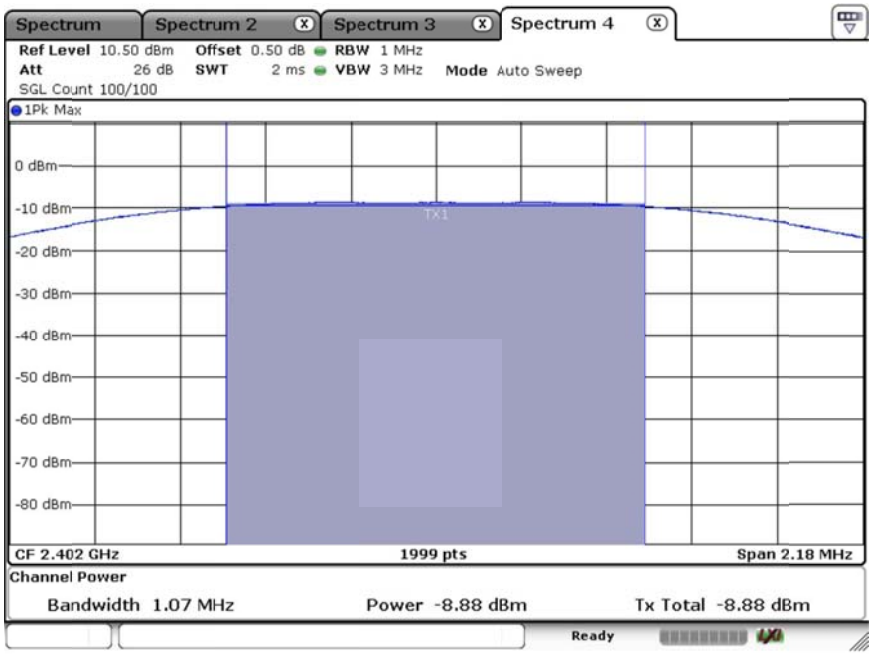
Maximum Peak Conducted Output Power is measured using the following procedure (RBW ≥ DTS bandwidth).
1. Set the RBW ≥ DTS bandwidth.
2. Set VBW ≥ 3 x RBW. / Set span ≥ 3 x RBW.
4. Sweep time = auto couple
5. Detector = peak
6. Trace mode = max hold
7. Allow trace to fully stabilize
8. Use peak marker function to determine the peak amplitude level.

9.4. Test results

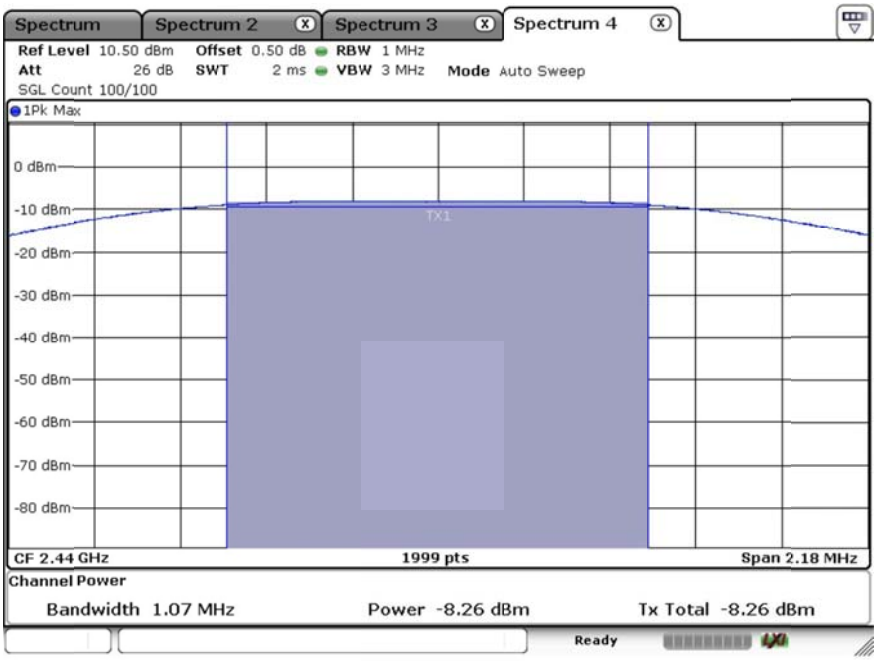
Frequency(㎒)	Conducted power (㏈m)	Limit (㏈m)
2 402	-8.88	30
2 440	-8.26	
2 480	-7.68	

9.4.1 Test plot

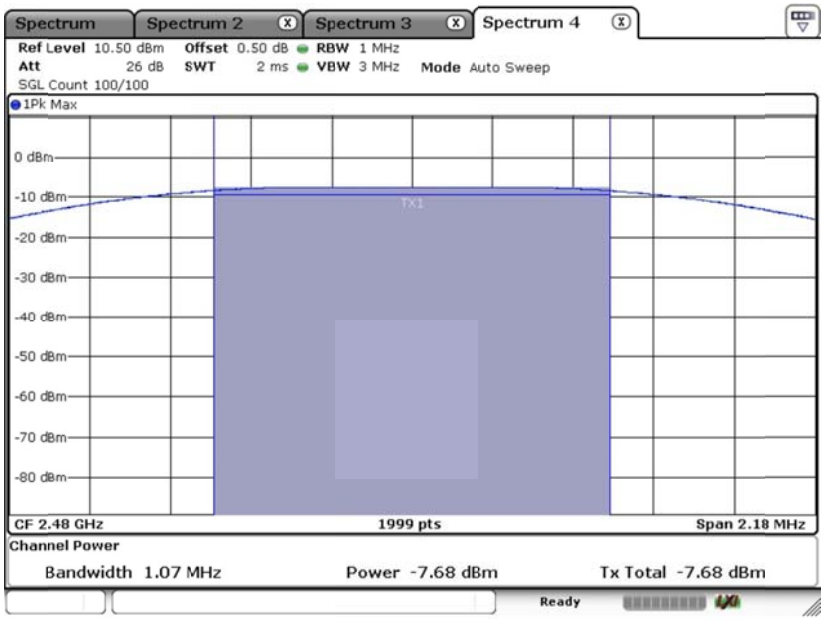
A. Lowest Ch. (2 402 MHz)



B. Middle Ch. (2 440 MHz)

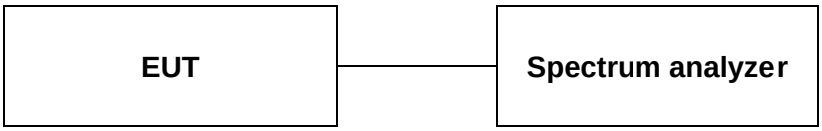


C. Highest Ch. (2 480 MHz)



10. Peak power spectral density

10.1. Test setup



10.2. Limit

< 8dBm @ 3kHz BW

10.3. Test procedure (PKPSD)

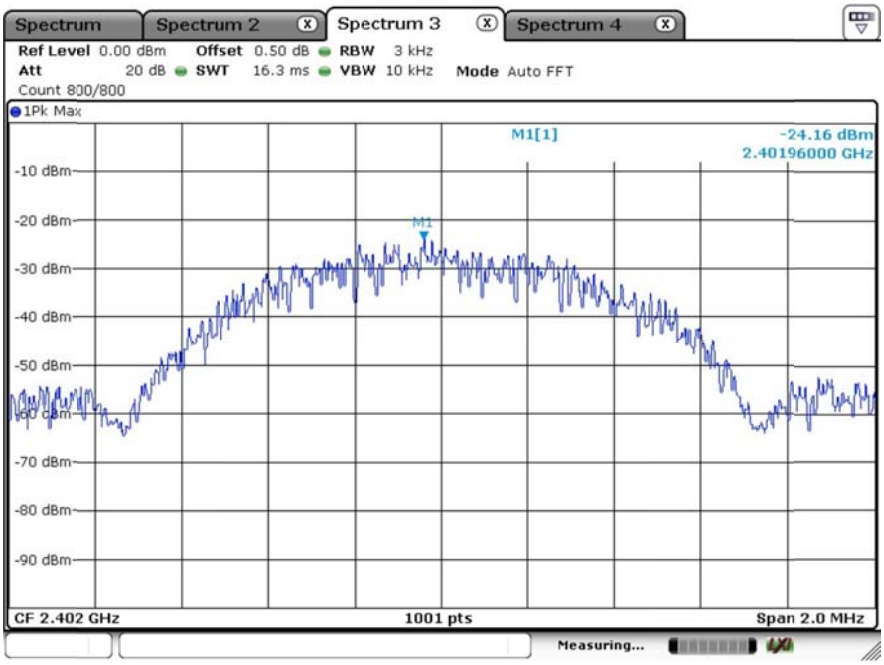
1. The RF power output was measured with a Spectrum analyzer connected to the RF Antenna connector(conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency,A spectrum analyzer was used to record the shape of the transmit signal.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using;
   Span = 1.5 times the DTS bandwidth
   RBW = 3㎑ ≤ RBW ≤100㎑
   VBW ≥ 3 x RBW,Sweep = Auto couple
   Detectorfunction = peak, Trace = max hold

10.4. Test results

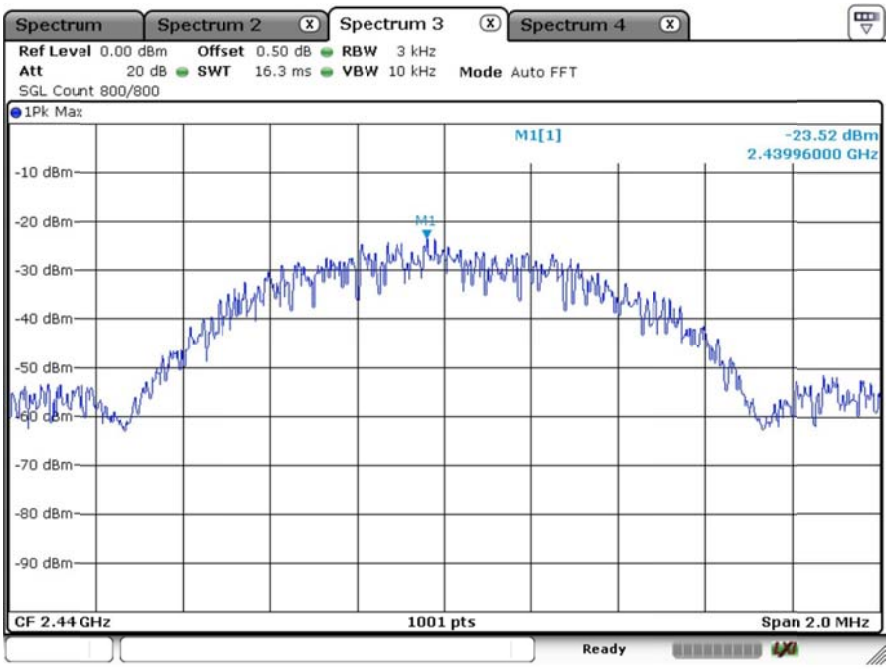
Frequency(㎒)	Peak output power(dBm)	Limit (dBm)
2 402	-24.16	8
2 440	-24.40	
2 480	-24.80	

10.4.1 Test plot

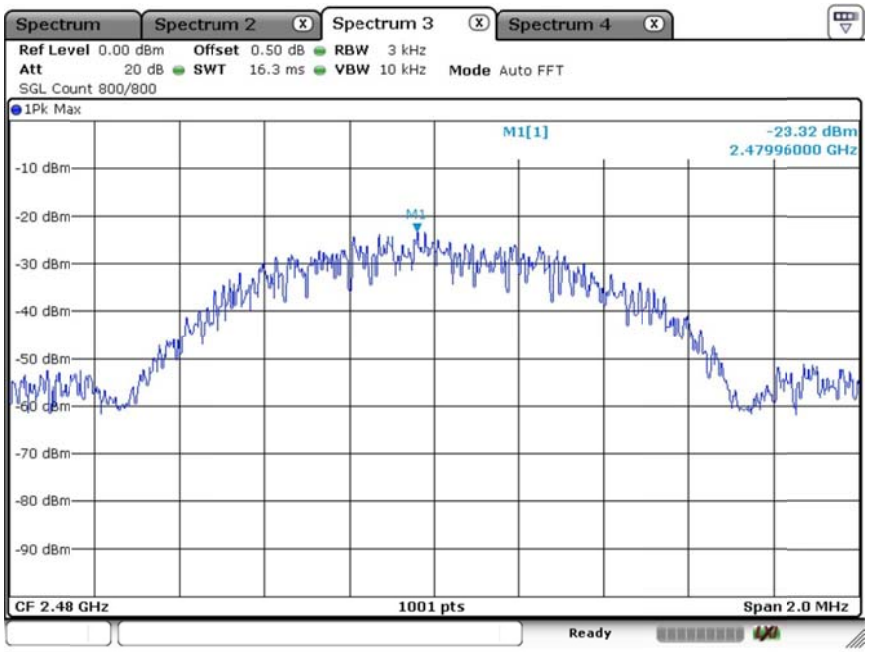
A. Lowest Ch. (2 402 MHz)



B. Middle Ch. (2 440 MHz)

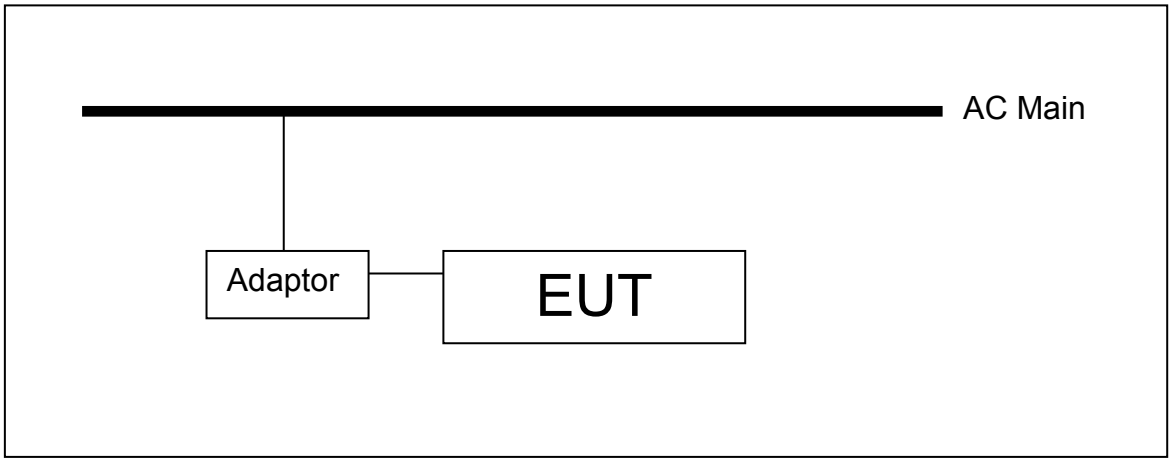


C. Highest Ch. (2 480 MHz)



11. AC Conducted power line test

11.1. Test setup



11.2. Limit

According to §15.107(a) for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power lineon any frequency or frequencies, within the band 150 ㎑ to 30 ㎒, shall not exceed the limitsin the following table, as measured using a 50 uH/50ohm line impedance stabilization network(LISN).
Compliance with the provision of this paragraph shall on the measurement of the radio frequencyvoltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

Frequency of Emission (㎒)	Conducted limit (dB㎶/m)	
	Quasi-peak	Average
0.15 – 0.50	66-56*	56-46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

※Remark

Decreases with the logarithm of the frequency.

11.3. Test procedure

The test procedure is performed in a 6.5 m × 3.6 m × 3.6 m (L×W×H) shielded room. The EUTalong with its peripherals were placed on a 1.0m(W)× 1.5m(L) and 0.8m in heightwooden table and the EUT was adjusted to maintain a 0.4 meter space from a verticalreference plane.
The EUT was connected to power mains through a line impedancestabilization network (LISN) which provides 50 ohm coupling impedance for measuringinstrument and the chassis ground was bounded to the horizontal ground plane of shieldedroom. All peripherals were connected to the second LISN and the chassis ground alsobounded to the horizontal ground plane of shielded room. The excess power cablebetween the EUT and the LISN was bundled. The power cables of peripherals wereunbundled. All connecting cables of EUT and peripherals were moved to find themaximum emission.

11.4. Test results

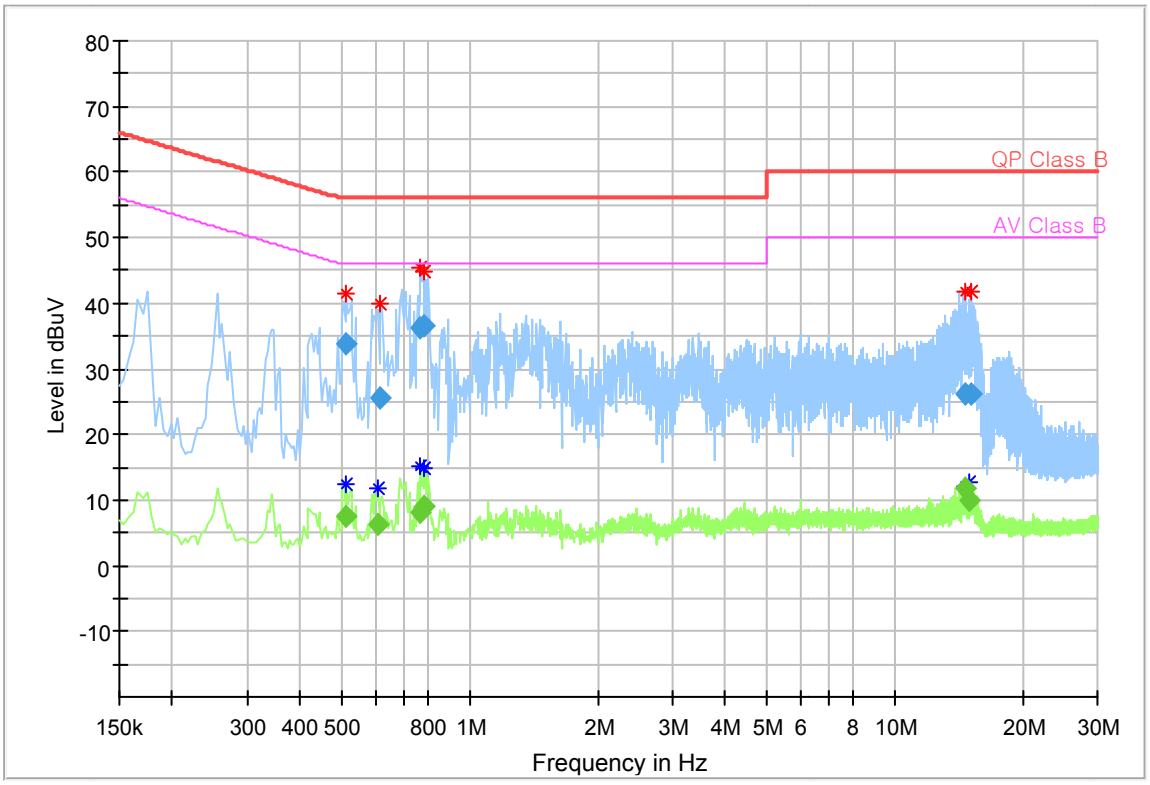
Frequency range: 0.15 ㎒ ~ 30 ㎒
Measured bandwidth: 9 ㎑

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.51	33.72	---	56.00	22.28	7000.0	9.00	N	GND	9.99
0.51	---	7.58	46.00	38.42	7000.0	9.00	N	GND	9.99
0.61	---	6.25	46.00	39.75	7000.0	9.00	N	GND	10.00
0.62	25.42	---	56.00	30.58	7000.0	9.00	N	GND	10.00
0.77	36.14	---	56.00	19.86	7000.0	9.00	L1	GND	10.01
0.77	---	8.22	46.00	37.78	7000.0	9.00	N	GND	10.00
0.78	---	8.95	46.00	37.05	7000.0	9.00	N	GND	10.00
0.78	36.49	---	56.00	19.51	7000.0	9.00	L1	GND	10.01
14.62	---	11.90	50.00	38.10	7000.0	9.00	L1	GND	11.28
14.71	26.12	---	60.00	33.88	7000.0	9.00	N	GND	10.95
15.04	---	9.97	50.00	40.03	7000.0	9.00	L1	GND	11.32
15.13	26.12	---	60.00	33.88	7000.0	9.00	N	GND	10.97

※Remark

Line(L1): Hot
Line(N): Neutral

11.5 Test plot



12. Antenna requirement

12.1. Standard applicable

For intentional device, according to FCC 47 CFR Section §15.203, 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. And according to FCC 47 CFR Section §15.247 (b) if transmitting antennas of directional gain greater than 6dBi are used.

12.2. Antenna connected construction

Antenna used in this product is PCB antenna,
Antenna gain is -2.68 dBi.

13. RF exposure evaluation

13.1. 10.1 Environmental evaluation and exposure limit according to FCC CFR 47 part 1, 1.1307(b), 1.1310

According to §15.247(e)(i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines. According to KDB 447498 (2)(a)(i)

Limits for maximum permissible exposure (MPE)

Frequency range (㎒)	Electric field strength(V/m)	Magnetic field strength (A/m)	Power density (㎽/㎠)	Average time
(A) Limits for Occupational / Control exposures				
300 – 1 500	--	--	F/300	6
1 500 – 100 000	--	--	5	6
(B) Limits for General Population / Uncontrol Exposures				
300 – 1 500	--	--	F/1 500	6
1 500 – 100 000	--	--	1	30

13.2. Friis transmission formula : Pd=(Pout*G)\(4*pi*R2)

Where
Pd= Power density in ㎽/㎠
Pout=output power to antenna in ㎽
G= Numeric gain of the antenna relative to isotropic antenna
Pi=3.1416
R= distance between observation point and center of the radiator in cm
Pd the limit of MPE, 1 ㎽/㎠. If we know the maximum gain of the antenna and total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

13.3 Test result of RF exposure evaluation

Test Item : RF Exposure evaluation data
Test Mode : Normal operation

13.4 Output power into antenna & RF exposure evaluation distance

Antenna gain: -2.68 dBi (BLE)

Frequency (㎒)	Output Peak power to antenna (dBm)	Antenna gain (dBi)	Antenna Gain (dBi) Numeric	Power density at 20 ㎝ (㎽/㎠)	e.i.r.p. (mW)	e.i.r.p. Limits (W)	Power density Limits (㎽/㎠)
2 402	-8.88	-2.68	0.54	0.000 014	0.07	5	1
2 440	-8.26			0.000 016	0.08		
2 480	-7.68			0.000 018	0.09		

※ Remark
The power density Pd (5th column) at a distance of 20 ㎝ calculated from the friis transmission formula is far below the limit of 1 ㎽/㎠ .