

FCC Part 15 Subpart B&C §15.247

Test Report

Equipment Under Test	Bluetooth Stereo Headset
Model Name	SB01
Applicant	MOVON CORPORATION
FCC ID	TDU-SB01
Manufacturer	QINGDAO MOVON ELECTRONIC CORPORATION
Date of Test(s)	2013. 07. 10 ~ 2013. 07. 17
Date of Issue	2013. 07. 18

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

Issue to	Issue by
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Revision history

Revision	Date of issue	Description	Revised by
--	July 18, 2013	Initial	--

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1. Attestation of test results

1.1. Details of applicant

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1.2. Summary of test results

The EUT has been tested according to the following specifications;

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

The sample was tested according to the following specification:

FCC Parts 15.247; ANSI C-63.4-2003

FCC Public Notice KDB 558074

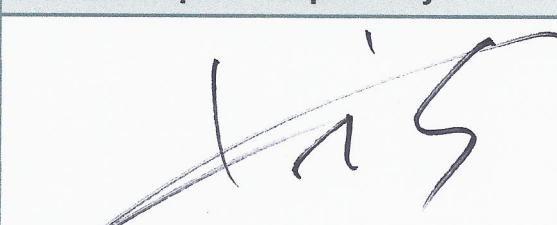
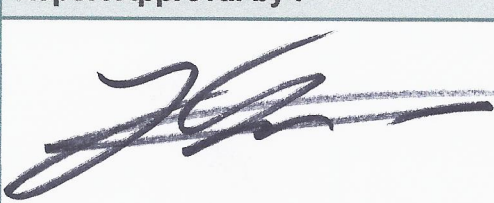
TEST SITE REGISTRATION NUMBER:

FCC(670686)

※ Abbreviation

C Complied
 N/A Not applicable
 F Fail

Approval Signatories

Test and Report Completed by :	Report Approval by :
	
Raymond Kim Test Engineer MOVON CORPORATION	Issac Jin Technical Manager MOVON CORPORATION

2. EUT Description

Kind of product	Bluetooth Acessory
Model Name	SB01
Serial Number	N/A
Power supply	DC 3.00 V
Frequency range	2 402 MHz ~ 2 480 MHz
Modulation technique	GFSK(1Mbps)
Number of channels	40
Antenna gain	1.926 dB i (Max.)
TEST SITE REGISTRATION NUMBER	FCC(670686)

2.1. Declarations by the manufacturer

None

2.2. Details of modification

None

3. Measurement equipment

Equipment	Manufacturer	Model	Serial number	Calibration Interval	Calibration due.
EMI Test Receiver	R&S	ESIB26	100196/026	1 year	2013-12-14
Signal Generator	R&S	SMR27	100089	1 year	2013-12-13
Spectrum Analyzer	R&S	FSV-40	100832	1 year	2013-10-04
Power Meter	Agilent	E4416A	GB41290645	1 year	2013-10-04
Power Sensor	Agilent	9327A	US40441490	1 year	2013-10-04
Double Redge Horn Antenna	R&S	HF906	100236	2 year	2015-02-28
Horn Antenna	A.H.SYSTEMS	SAS-572	269	2 year	2013-09-07
Ultra Broadband Antenna	R&S	HL562	100170	1 year	2013-12-13
Power Amplifier	MITEQ	AM-1431	1497315	1 year	2013-10-04
Power Amplifier	MITEQ	AFS43-01002600	1374382	1 year	2013-10-04
High Pass Filter	Wainwright	WHK3.0/18G-10SS	508	1 year	2013-10-04
DC Power Supply	HP	6674A	3637A01351	1 year	2013-10-04
Controller	INNCO	CO2000	co200/064/6961003/L	N/A	N/A
Antenna Master	INNCO	MA4000	MA4000/038/6961003/L	N/A	N/A
Loop Antenna	ETS LINDGREN	6502	00118166	2 year	2013-10-10

※ Remark;
Support equipment

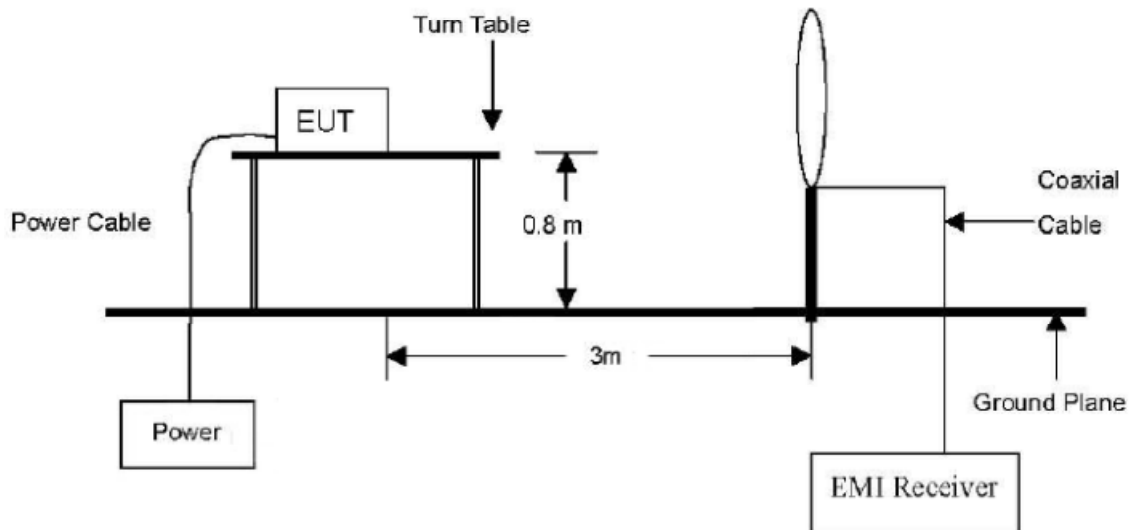
Description	Manufacturer	Model	Serial number
Notebook computer	Samsung Electronics.	SENS P30	W3179RFX300144N

4. Transmitter radiated spurious emissions and conducted spurious emissions

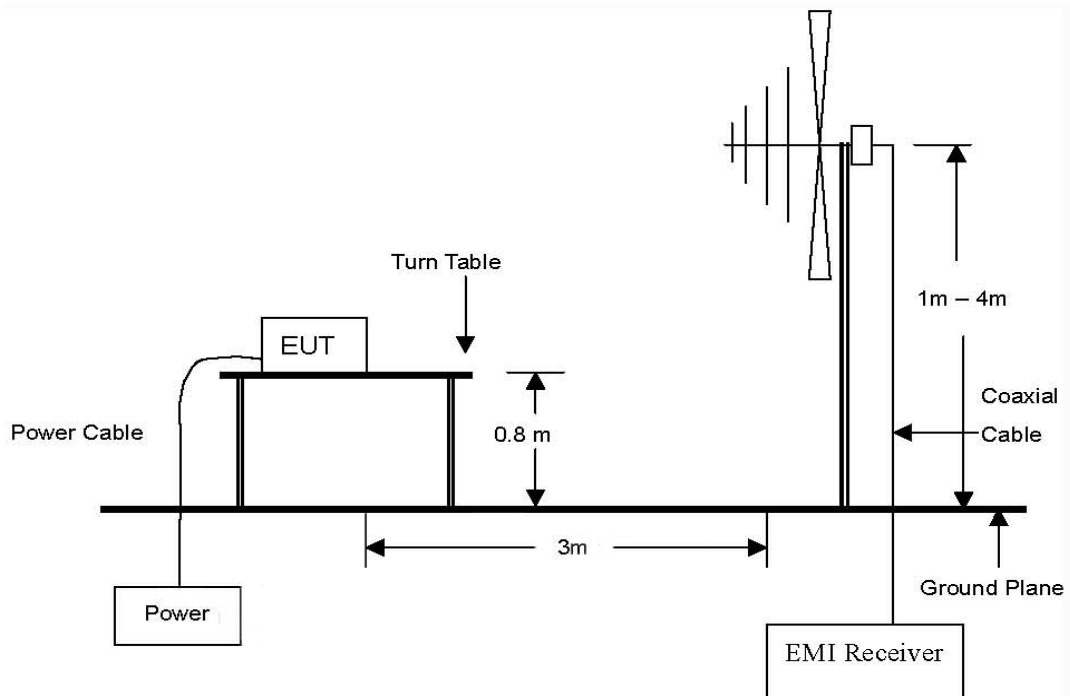
4.1. Test setup

4.1.1. Transmitter radiated spurious emissions

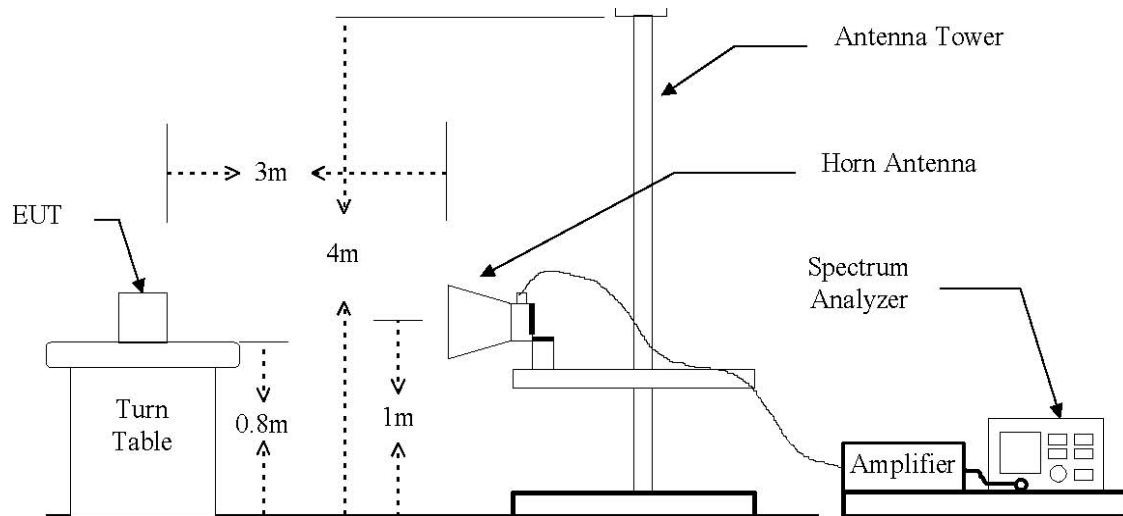
The diagram below shows the test setup that is utilized to make the measurements for emission from 9kHz to 30MHz Emissions.



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



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 24 GHz emissions.



4.2. Limit

According to §15.247(d), 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 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 (MHz)	Distance (Meters)	Radiated at 3M (dBμV/m)	Radiated (μV/m)
0.009–0.490	300	See the remark	2400/F(kHz)
0.490–1.705	30		24000/F(kHz)
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

*Remark

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

4.3. Test procedures

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

4.3.1. Test procedures for radiated spurious emissions

1. The EUT is placed on a turntable, which is 0.8 m 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 kHz for Peak detection (PK) at frequency below 30 MHz
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 GHz.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.

4.3.2. Test procedures for conducted spurious emissions

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 kHz, VBW = 100 kHz.

4.4. Test result

Ambient temperature: 28 °C
Relative humidity: 58 % R.H.

4.4.1. Spurious radiated emission

The frequency spectrum from 9kHz to 30 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB. 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.

Operation mode

A. Low channel (2 402 MHz)

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

B. Middle channel (2 442 MHz)

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

C. High channel (2 480 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/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 (dB μ V) + 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.

4.4.2. Spurious radiated emission

The frequency spectrum from 30 MHz to 1 000 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB. 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.

Operation mode: BLE mode

A. Low channel (2 402 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
32.88	2.19	PK	V	15.99	1.66	19.84	40.00	20.16
404.55	2.83	PK	H	16.35	5.93	25.11	46.00	20.89
Above 500.00	Not detected							

B. Mid channel (2 442 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
32.88	2.02	PK	V	15.99	1.66	19.67	40.00	20.33
404.55	2.77	PK	H	16.35	5.93	25.05	46.00	20.95
Above 500.00	Not detected							

C. High channel (2 480 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
32.88	2.69	PK	V	15.99	1.66	20.34	40.00	19.66
404.55	3.77	PK	H	16.35	5.93	26.05	46.00	19.95
Above 500.00	Not detected							

※ 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.

4.4.3. Spurious radiated emission

The frequency spectrum above 1 000 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB.

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Operation mode: BLE mode

A. Low channel (2 402 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 804.00	67.44	Peak	H	33.20	42.74	57.90	74.00	16.10
4 804.00	62.07	Average	H	33.20	42.74	52.53	54.00	1.47
4 804.00	61.98	Peak	V	33.20	42.74	52.44	74.00	21.56
4 804.00	57.65	Average	V	33.20	42.74	48.11	54.00	5.89
7 206.00	64.82	Peak	H	36.40	40.45	60.77	74.00	13.23
7 206.00	56.42	Average	H	36.40	40.45	52.37	54.00	1.63
7 206.00	58.16	Peak	V	36.40	40.45	54.11	74.00	19.89
7 206.00	49.95	Average	V	36.40	40.45	45.90	54.00	8.10
Above 8 000.00	Not detected							

※ 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.

B. Middle channel (2 442 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 884.00	64.63	Peak	H	33.20	42.74	55.09	74.00	18.91
4 884.00	56.34	Average	H	33.20	42.74	46.80	54.00	7.20
4 884.00	59.26	Peak	V	33.20	42.74	49.72	74.00	24.28
4 884.00	52.98	Average	V	33.20	42.74	43.44	54.00	10.56
7 323.00	60.99	Peak	H	36.40	40.45	56.94	74.00	17.06
7 323.00	50.59	Average	H	36.40	40.45	46.54	54.00	7.46
7 323.00	54.00	Peak	V	36.40	40.45	49.95	74.00	24.05
7 323.00	44.56	Average	V	36.40	40.45	40.51	54.00	13.49
Above 8 000.00	Not detected							

※ **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.

C. High channel (2 480 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 960.00	57.07	Peak	H	33.20	42.74	47.53	74.00	26.47
4 960.00	50.89	Average	H	33.20	42.74	41.35	54.00	12.65
4 960.00	58.16	Peak	V	33.20	42.74	48.62	74.00	25.38
4 960.00	51.93	Average	V	33.20	42.74	42.39	54.00	11.61
7 440.00	54.57	Peak	V	36.40	40.45	50.52	74.00	23.48
7 440.00	43.71	Average	V	36.40	40.45	39.66	54.00	14.34
Above 8 000.00	Not detected							

※ **Remark**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.
 2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
 3. Average test would be performed if the peak result were greater than the 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.

4.4.4. Band Edge

Operation mode: BLE mode

A. 2 310 - 2 390 MHz measurement

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 390.00	57.45	Peak	H	28.36	43.87	41.94	74.00	32.06
2 390.00	45.82	Average	H	28.36	43.87	30.31	54.00	23.69
2 390.00	53.56	Peak	V	28.36	43.87	38.05	74.00	35.95
2 390.00	39.51	Average	V	28.36	43.87	24.00	54.00	30.00

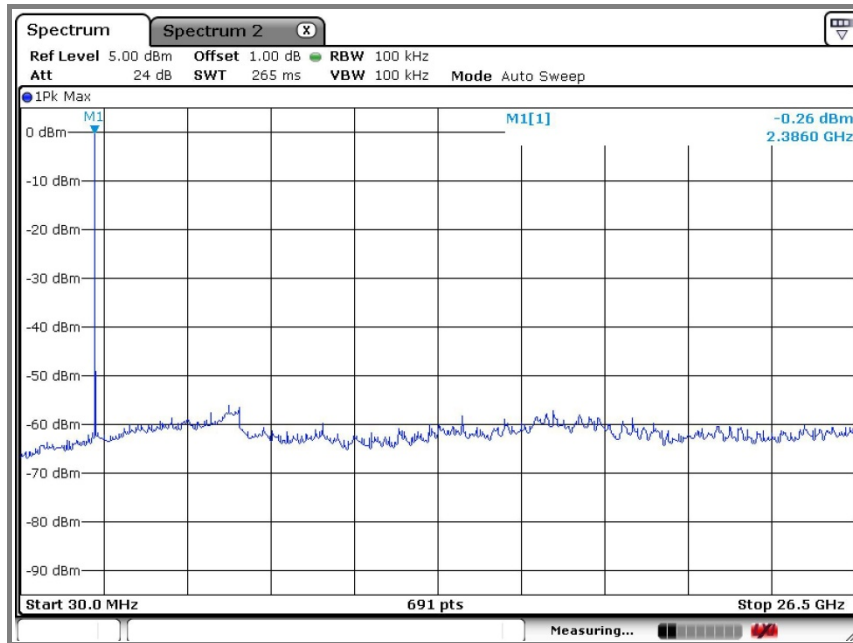
B. 2 483.5 – 2 500 MHz measurement

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 483.50	58.92	Peak	H	28.36	43.87	43.41	74.00	30.59
2 483.50	47.51	Average	H	28.36	43.87	32.00	54.00	22.00
2 483.50	59.34	Peak	V	28.36	43.87	43.83	74.00	30.17
2 483.50	47.97	Average	V	28.36	43.87	32.46	54.00	21.54

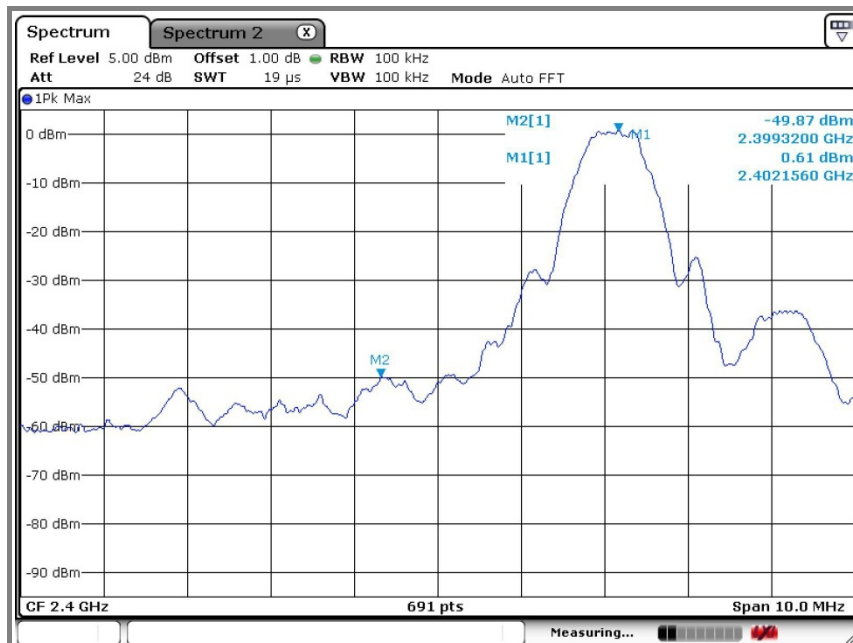
4.4.4. Spurious RF conducted emissions: Plot of spurious RF conducted emission Operation mode: BLE mode

A. Low channel (2 402 MHz)

Unwanted Emission data

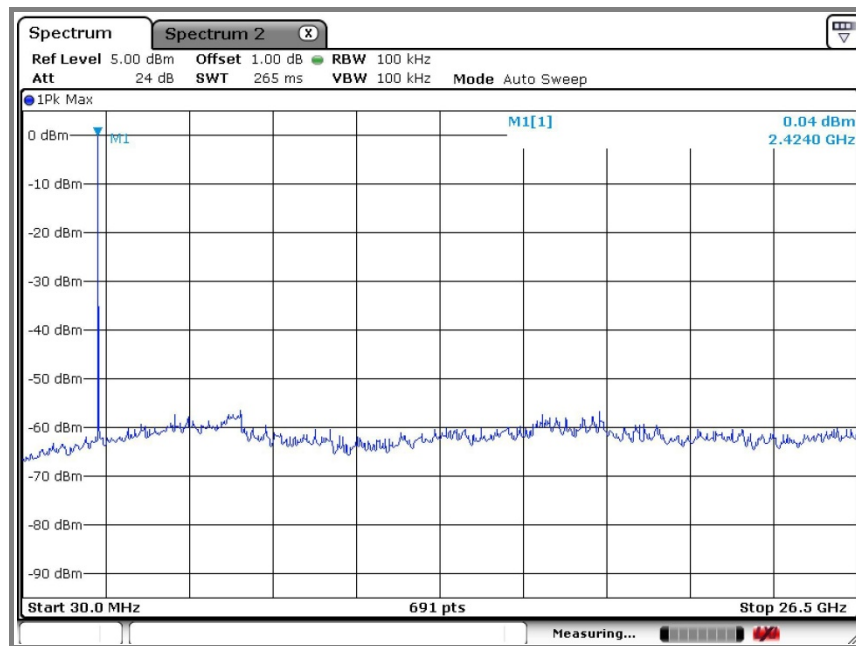


Band-edge data



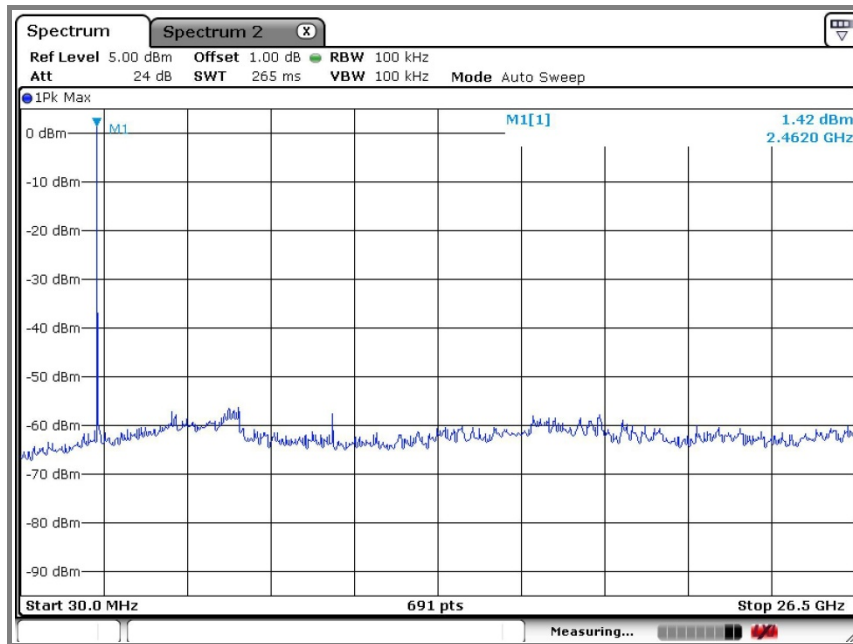
B. Middle channel (2 442 MHz)

Unwanted Emission data

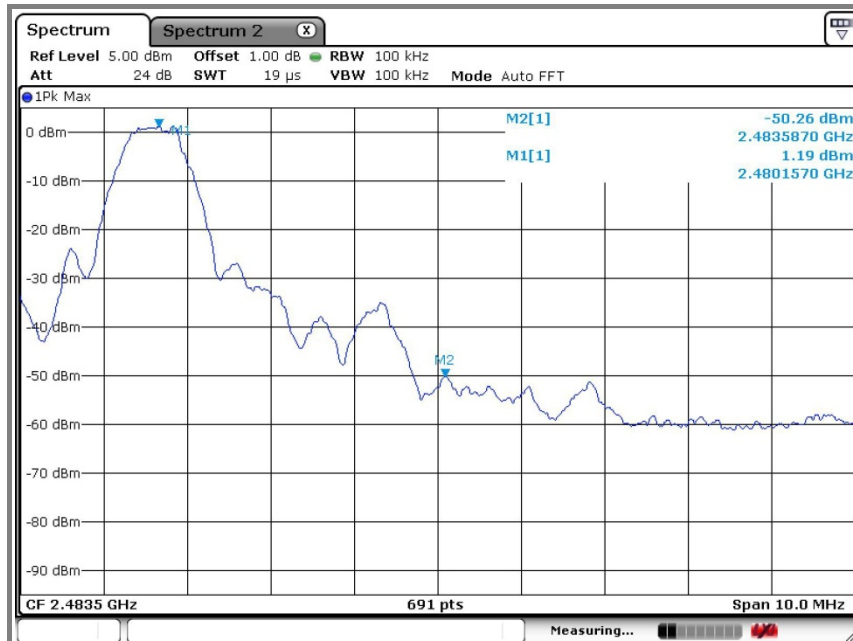


C. High channel (2 480 MHz)

Unwanted Emission data

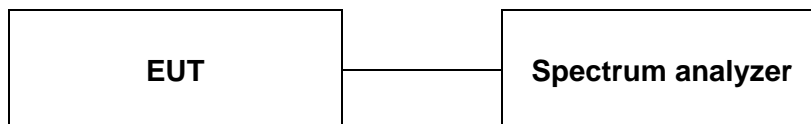


Band-edge data



5. 6 dB bandwidth measurement

5.1. Test setup



5.2. Limit

6 dB Bandwidth > 500kHz

5.3. Test procedure

1. The 6 dB 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 center frequency. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer. Display Line and Marker Delta functions, the 6 dB band width of the emission was determined.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 kHz, VBW = 100 kHz, Span = 5 MHz.

5.4. Test results

Ambient temperature: 25 °C

Relative humidity: 54 % R.H.

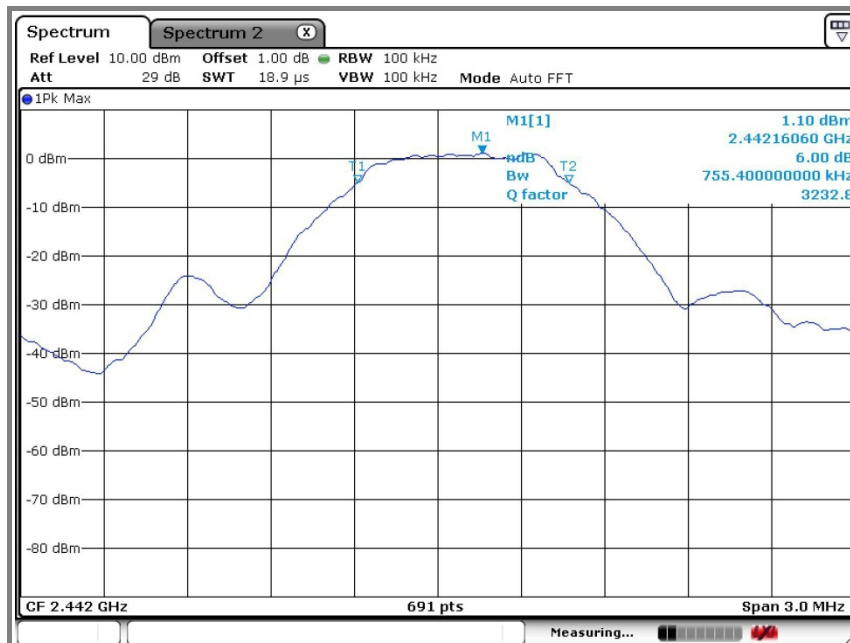
Operation mode	Frequency(MHz)	6 dB bandwidth(MHz)
BLE	2 402	0.751
	2 442	0.755
	2 480	0.760

Operation mode: BLE mode

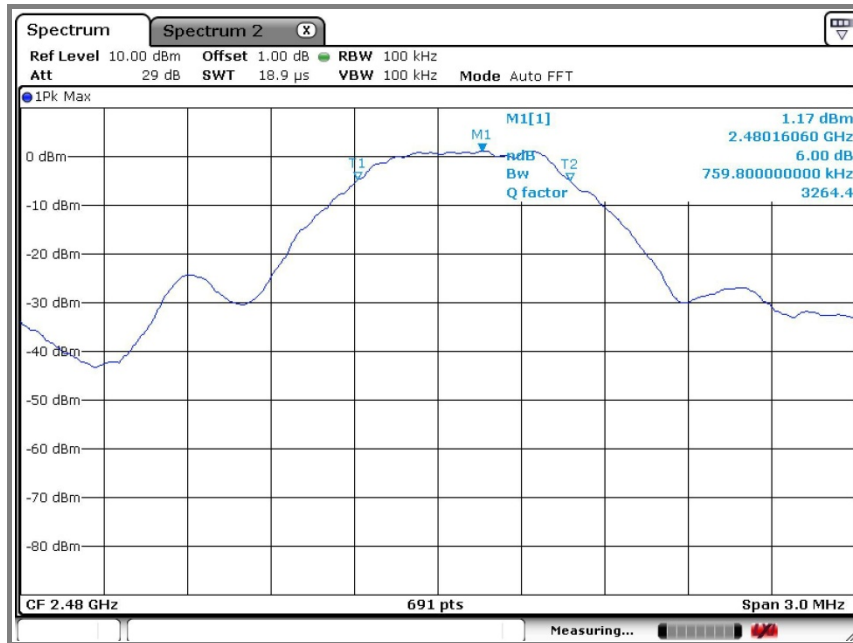
A. Low channel (2 402 MHz) – 6 dB bandwidth



B. Middle channel (2 442 MHz) – 6 dB bandwidth



C. High channel (2 480 MHz) – 6 dB bandwidth



6. Maximum peak output power measurement

6.1. Test setup.



6.2. Limit

The maximum peak output power of the intentional radiator shall not exceed the following:

- §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 6 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW
- §15.247(b)(1), For frequency hopping systems operating in the 2 400 – 2 483.5 MHz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 – 5 805 MHz band: 1 Watt.

6.3. Test procedure

- 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.
- The bandwidth of the fundamental frequency was measured with the spectrum analyzer using;
Span = auto
RBW = 1MHz, VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold

6.4. Test results

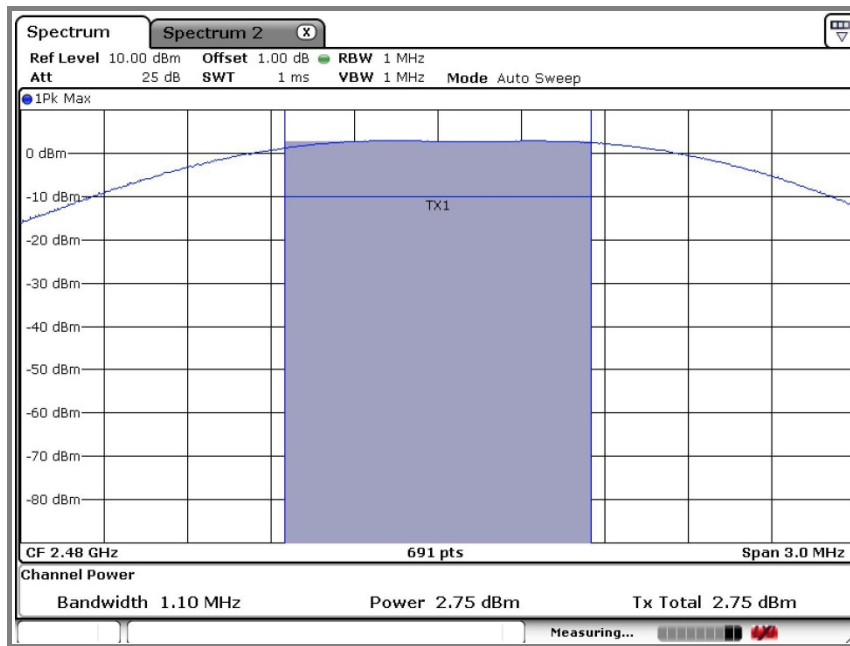
Ambient temperature: 25 °C

Relative humidity: 54 % R.H.

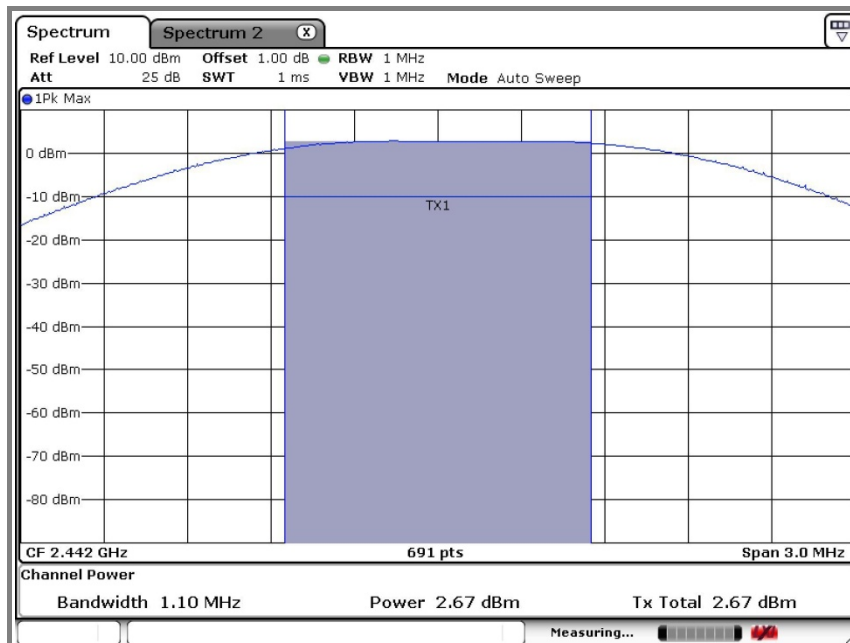
Operation mode	Frequency(MHz)	Peak output power(dBm)	Limit(dBm)
BLE	2 402	2.75	30
	2 442	2.67	30
	2 480	2.23	30

Operation mode: BLE mode

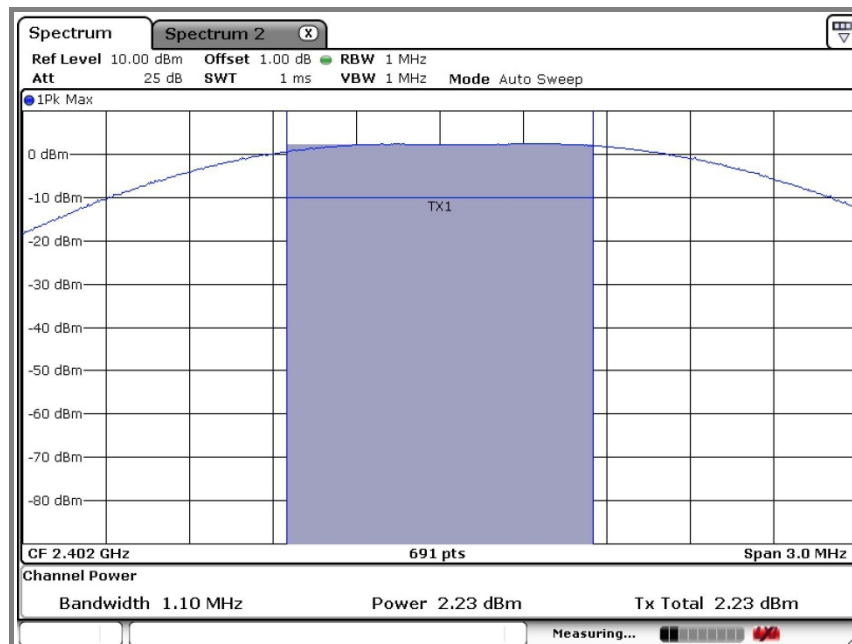
A. Low channel (2 402 MHz)



B. Middle channel (2 442 MHz)

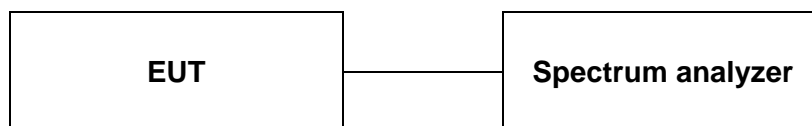


C. High channel (2 480 MHz)



7. Power Spectral Density

7.1. Test setup.



7.2. Limit

< 8dBm @ 3kHz BW

7.3. Test procedure

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 = 300kHz
RBW = 3kHz, VBW = 3kHz, Sweep = 100sec, Detector function = peak, Trace = max hold

7.4. Test results

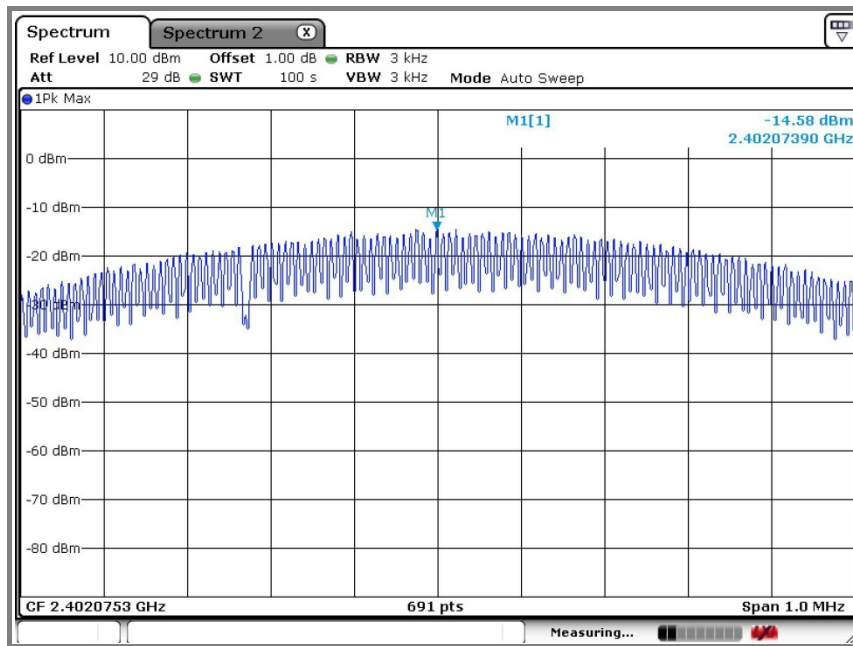
Ambient temperature: 25 °C

Relative humidity: 54 % R.H.

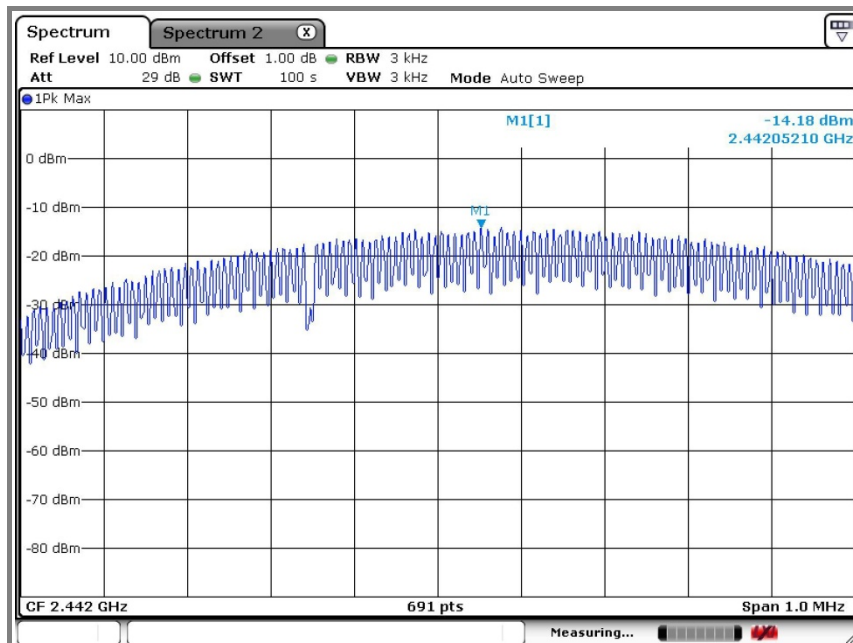
Operation mode	Frequency(MHz)	Peak output power(dBm)	Limit(dBm)
BLE	2 402	-14.58	8
	2 442	-14.18	8
	2 480	-14.07	8

Operation mode: BLE mode

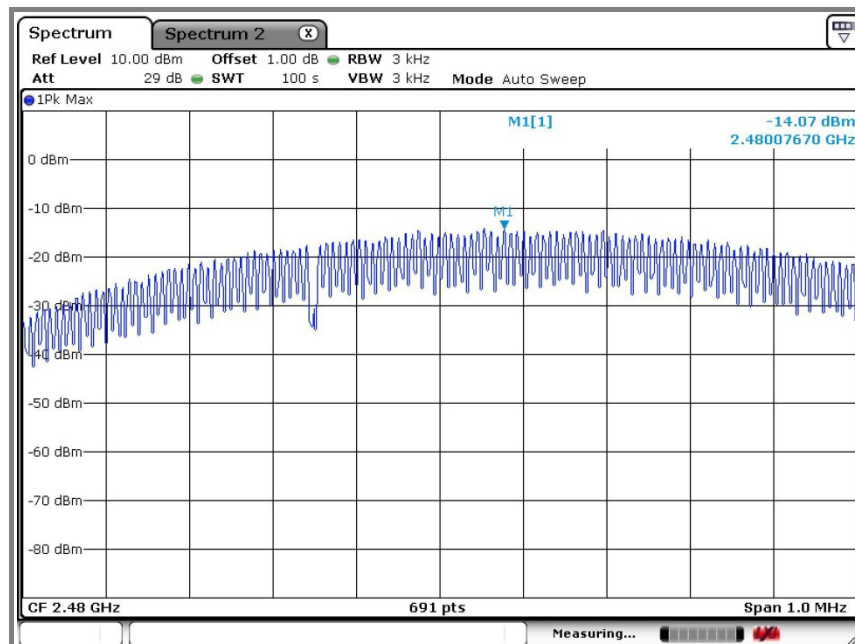
A. Low channel (2 402 MHz)



B. Middle channel (2 442 MHz)



C. High channel (2 480 MHz)



8. Antenna requirement

8.1. 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 6 dBi are used, the power shall be reduced by the amount in dB that the gain of the antenna exceeds 6 dBi.

8.2. Antenna Connected Construction

Antenna used in this product is Integral type (Chip Antenna) gain of 1.926 dBi.

9. RF exposure evaluation

9.1. 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 (MHz)	Electric field strength(V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	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
<u>1 500 – 100 000</u>	--	--	<u>1</u>	<u>30</u>

9.2. Friis transmission formula : $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where

P_d = Power density in mW/cm²

P_{out} =output power to antenna in mW

G = Numeric gain of the antenna relative to isotropic antenna

π =3.1416

R = distance between observation point and center of the radiator in cm

P_d the limit of MPE, 1 mW/cm². 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.

9.2. Test result of RF exposure evaluation

Test Item : RF Exposure evaluation data

Test Mode : Normal operation

9.3. Output power into antenna & RF exposure evaluation distance

Antenna gain: 1.926 dBi

Frequency (MHz)	Output Peak power to antenna (dBm)	Antenna gain (dBi)	Antenna Gain (dBi) Numeric	Power density at 20 cm (mW/cm ²)	Power density Limits (mW/cm ²)
2 402	2.75	1.237	1.33	0.000 5	1
2 442	2.67	1.926	1.56	0.000 6	
2 480	2.23	1.926	1.56	0.000 5	

※ Remark

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

10. Test setup photo of EUT

Photo of radiated spurious emission at below 30 MHz



Photo of radiated spurious emission at 30 MHz ~ 1 000 MHz



Photo of radiated spurious emission at above 1 000 MHz