FCC EVALUATION REPORT FOR CERTIFICATION

Manufacturer : VANNS Tech Co., Ltd.
Techno Business Center 2nd #309, Gondan-Dong
Gumi-Si, Gyeongsangbuk-Do, Republic of Korea
Attn : Mr. Sang-Yun Ban / CTO

Date of Issue : October 29, 2008
Test Report Number : GETEC-E3-08-047
Test Site : Gumi College EMC Center
FCC Registration No.: (100749)

FCC ID	**WS4VTUF-100HF**
APPLICANT	**VANNS Tech Co., Ltd.**

Rule Part(s)	**: FCC Part 15 Subpart C-Intentional Radiator § 15.247**
Test method	**: Public Notice DA 00-705** (Guidance on measurement for Frequency hopping spread spectrum system)
Equipment Class	**: Part 15 Spread Spectrum Transmitter (DSS)**
EUT Type	**: Bluetooth Loud Speaker**
Trade Name	**: UFO**
Model Name	**: VTUF-100HF**

This equipment has been shown to be in compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4-2003

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the vest of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Tested by,

Jae-Hoon Jeong, Senior Engineer
GUMI College EMC center

Reviewed by,

Tae-Sig Park, Technical Manger
GUMI College EMC center

CONTENTS

Scope: *Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and / or unintentional radiators for compliance with technical rules and regulations of the Federal Communications Commission.*

1. General Information

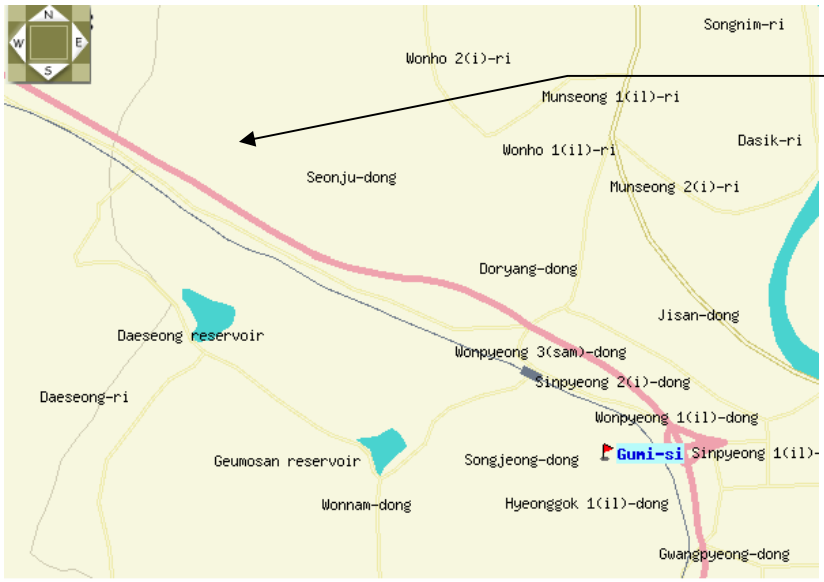
Applicant	**: VANNS Tech Co., Ltd.**
Applicant Address	**: Techno Business Center 2nd #309, Gongdan-Dong, Gumi-Si, Gyeongsangbuk-Do, Republic of Korea**
Manufacturer	**: VANNS Tech Co., Ltd.**
Manufacturer Address	**: Techno Business Center 2nd #309, Gongdan-Dong, Gumi-Si, Gyeongsangbuk-Do, Republic of Korea**
Contact Person	**: Sang-Yun Ban / CTO**
Telephone Number	**: +82-54-461-3386**
Fax Number	**: +82-54-461-3387**

- **FCC ID.** WS4VTUF-100HF
- **Equipment Class** Spread Spectrum Transmitter (DSS)
- **EUT Type** Bluetooth Loud Speaker
- **Power Source** AC 120 V/ 60 Hz, DC 3.7 V supplied from the lithium polymer battery.
- **Model Name** VTUF-100HF
- **Rule Part(s)** FCC Part 15, Subpart C-Intentional Radiator § 15.247
- **Test method** Public Notice DA 00-705 (Guidance on measurement for frequency hopping spread spectrum systems)
- **Type of Authority** Certification
- **Test Procedure(s)** ANSI C63.4 (2003)
- **Dates of Test** October 22 ~ 23, 2008
- **Place of Test** **Gumi College EMC Center** (FCC Registration No.: 100749) 407, Bugok-Dong, Gumi-si, Gyeongsangbuk-Do, Korea
- **Test Report Number** GETEC-E3-08-047
- **Dates of Issue** October 29, 2008

2. Introduction

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Nose Emissions From Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ASNI C63.4-2003) was used in determining radiated and conducted emissions emanating from **VANNS Tech Co., Ltd. Bluetooth Loud Speaker (Model Name: VTUF-100HF)**

These measurement tests were conducted at **Gumi College EMC Center**.
The site address is 407, Bugok-Dong, Gumi-si, Gyeongsangbuk-Do, Korea
This test site is one of the highest point of Gumi 1 college at about 200 kilometers away from Seoul city and 40 kilometers away from Daege city. It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures. The detailed description of the measurement facility was found to be in compliance with the requirements of §2.948 according to ANSI C63.4 on October 19, 1992



GUMI COLLEGE EMC CENTER
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Gyeongsangbuk-Do 730-711, Korea
Tel: +82-54-440-1195~8
Fax: +82-54-440-1199

Fig 1. The map above shows the Gumi College in vicinity area.

3. Product Information

3.1 Description of EUT

The Equipment Under Test (EUT) is the **VANNS Tech Co., Ltd. Bluetooth Loud Speaker (Model Name: VTUF-100HF) FCC ID.: WS4VTUF-100HF**

Power input	DC 3.7 V supplied from the lithium polymer battery
Used AC/DC adapter	TC-300 (Sunlin Electronics Co., Ltd) - Input: AC 100 V ~ 240 V, 50 / 60 Hz, 0.15 A - Output: DC 4.2 V, 0.75 A
External connector	24 pin connector, Speaker in / out

Frequency Band	Channel	Freq. [MHz]	Channel	Freq. [MHz]	Channel	Freq. [MHz]	Channel	Freq. [MHz]
2400-2483.5MHz	0	2402	20	2422	40	2442	60	2462
	1	2403	21	2423	41	2443	61	2463
	2	2404	22	2424	42	2444	62	2464
	3	2405	23	2425	43	2445	63	2465
	4	2406	24	2426	44	2446	64	2466
	5	2407	25	2427	45	2447	65	2467
	6	2408	26	2428	46	2448	66	2468
	7	2409	27	2429	47	2449	67	2469
	8	2410	28	2430	48	2450	68	2470
	9	2411	29	2431	49	2451	69	2471
	10	2412	30	2432	50	2452	70	2472
	11	2413	31	2433	51	2453	71	2473
	12	2414	32	2434	52	2454	72	2474
	13	2415	33	2435	53	2455	73	2475
	14	2416	34	2436	54	2456	74	2476
	15	2417	35	2437	55	2457	75	2477
	16	2418	36	2438	56	2458	76	2478
	17	2419	37	2439	57	2459	77	2479
	18	2420	38	2440	58	2460	78	2480
	19	2421	39	2441	59	2461		

3.2 Support Equipment / Cables used

3.2.1 Used Support Equipment

Description	Manufacturer	Model No.	S/N & FCC ID
None	-	-	

See "Appendix E – Test Setup Photographs" for actual system test set-up

3.2.2 Used Cable(s)

Cable Name	Condition	Description
24 pin cable	Connected to the EUT	1.8m Unshielded

3.3 Modification Item(s)

-. None

4. Description of tests

4.1 Test Condition

The EUT was installed, arranged and operated in a manner that is most representative of equipment as typically used. The measurements were carried out while varying operating modes and cable positions within typically arrangement to determine maximum emission level.
The representative and worst test mode(s) were noted in the test report.

Test Voltage / Frequency:
-. AC 120 V / 60 Hz, DC 3.7 V supplied from the lithium polymer battery

- Test Mode(s)
  -. Executed “Bluecore” to control the EUT continuously transmit RF signal

Test Software Version	Bluecore		
Frequency	2402MHz	2441MHz	2480MHz
IEEE 802.14.1	63	63	63

5. Antenna Requirement - §15.203

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the applicant can be used with the device. The use of permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with this requirement.

5.1 Description of Antenna

The **VANNS Tech Co., Ltd. Bluetooth Loud Speaker** comply with the requirement of §15.203 with a built-in monopole antenna permanently attached to the transmitter.

5.2 Conducted Emission

The Line conducted emission test facility is inside a 4×8×2.5 meter shielded enclosure.
The EUT was placed on a non-conducting 1.0 by 1.5 meter table, which is 0.8 meters in height and 0.4 meters away from the vertical wall of the shielded enclosure.
The EUT is powered from the Rohde & Schwarz LISN (ESH2-Z5) and the support equipment is powered from the Rohde & Schwarz LISN (ESH3-Z5). Powers to the LISN are filtered by high-current high insertion loss power line filter.
Sufficient time for EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.
The RF output of the LISN was connected to the EMI test receiver (Rohde & Schwarz, ESCS30).
The EMI test receiver was scanned from 150 kHz to 30MHz with 20 ms sweep time to determine the frequency producing the maximum EME from the EUT. The frequency producing the maximum level was re-examined using Quasi-Peak mode of the EMI test receiver.
The bandwidth of Quasi-peak mode was set to 9 kHz. Each emission was maximized consistent with typical applications by varying the configuration of the test sample. Interface cables were connected to the available interface ports of the test unit. The effect of varying the position of cables was investigated to find the configuration that produces maximum diagram emission. Excess cable lengths were bundled at center with 30 – 40 centi-meters.
Each EME reported was calibrated using the R/S signal generator

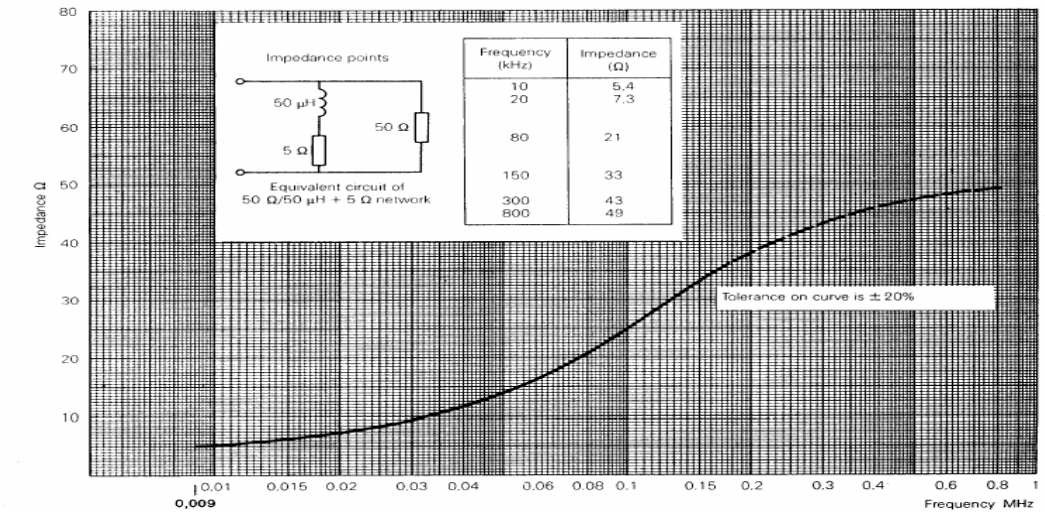


Fig 2. Impedance of LISN

5.3 Radiated Emission

Preliminary measurements were conducted 3 m semi anechoic chamber using broadband antennas to determine the frequency producing the maximum EME. Appropriate precaution was taken to ensure that all EME from the EUT were maximized and investigated. The technology configuration, mode of operation and turntable azimuth with respect to antenna was note for each frequency found.

The spectrum was scanned from 30 to 1000 MHz, using bicornical log antenna (Schwarzbeck, VULB9160).

Above 1 GHz, horn antenna (Schwarzbeck, BBHA9120D / EMCO 3160) was used.

Final measurements were made outdoors at 3m-test range.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.

Each frequency found during pre-scan measurements was re-examined and investigated using EMI test receiver. The detector function was set to CISPR quasi-peak mode average mode and the bandwidth of the receiver was set to 120 kHz or 1MHz depending on the frequency or type of signal.

The EUT, support equipment and interconnecting cables were reconfigured to the setup producing the maximum emission for the frequency and were placed on top of a 0.8 m high non-metallic 1.0×1.5 meter table.

The turntable containing the test sample was rotated; the antenna height was varied 1 to 4 meter and stopped at the azimuth or height producing the maximum emission.

Each EME reported was calibrated using the R/S signal generator

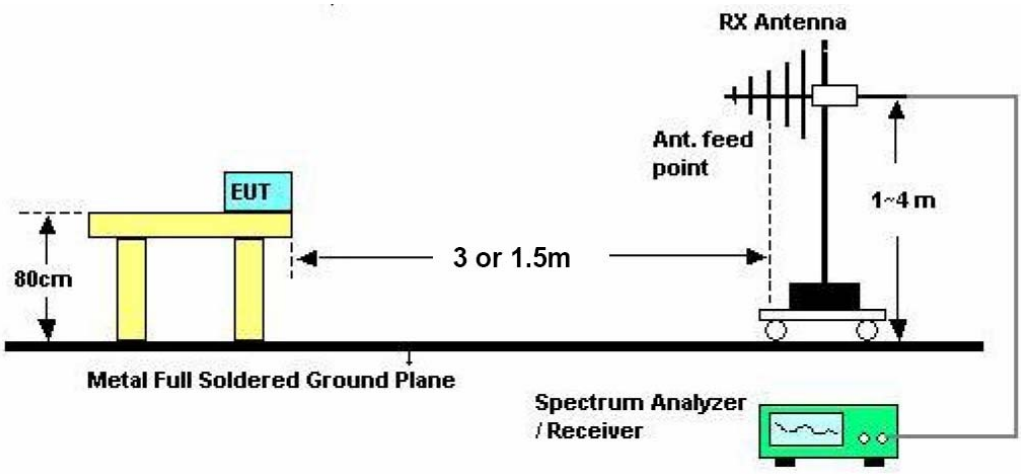


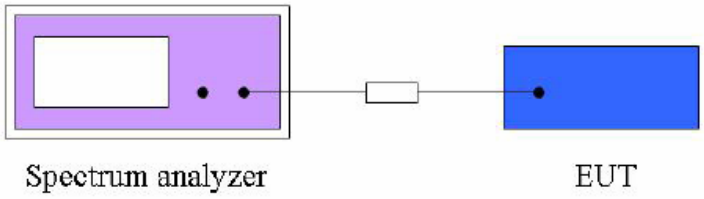
Fig 3. Dimensions of test site.

6. Number of Hopping Frequency Used

6.1 Operating environment

Temperature : 23.0 °C
Relative humidity : 56.0 % R.H.

6.2 Test set-up (Layout)



6.3 Limit

At least 15 channels frequencies, and should be equally spaced

6.4 Test equipment used

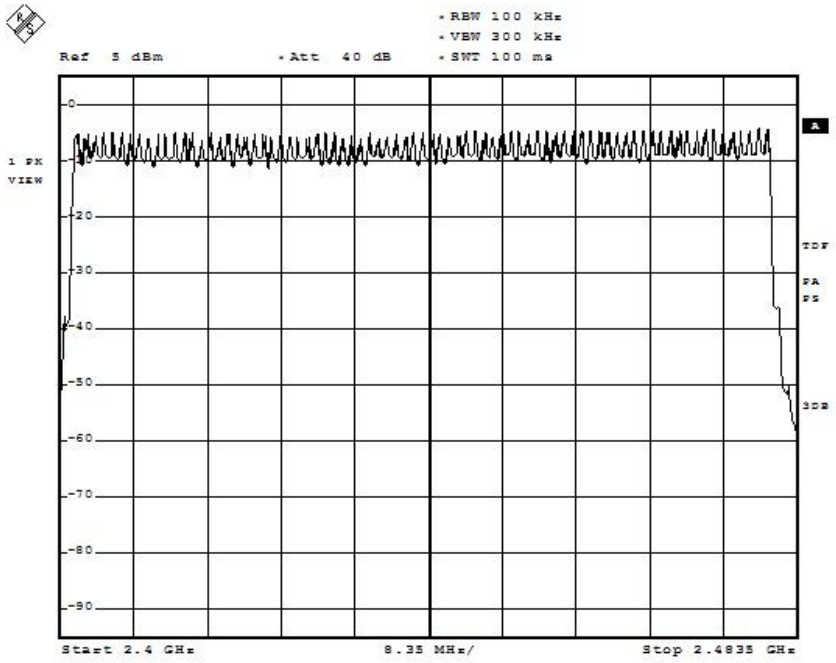
	Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ -	ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2008

6.5 Test result

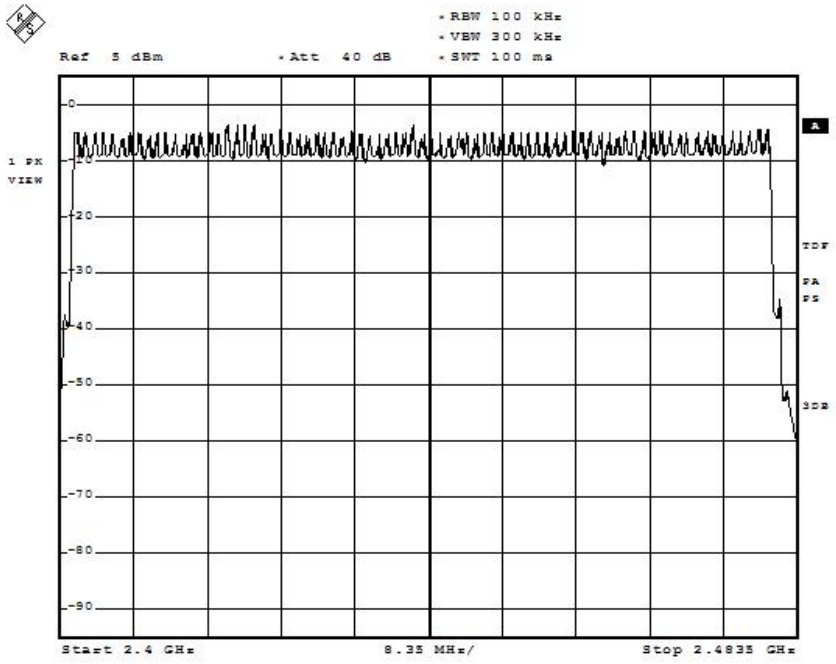
-. Test Date : October 23, 2008
-. Reference standard : Part 15 Subpart C, Sec. 15.247(a)(1)(iii)
-. Modulation : QPSK, 8DPSK
-. Operating condition : Bluetooth RF transmitting mode
-. Power Source : DC 3.7 V supplied from the lithium polymer battery

Modulation	Channel number	Limit	Result
QPSK	79	> 15	Complies
8 DPSK	79	> 15	Complies

Number of Hopping frequency used Plot on Configuration QPSK



Number of Hopping frequency used Plot on Configuration 8DPSK

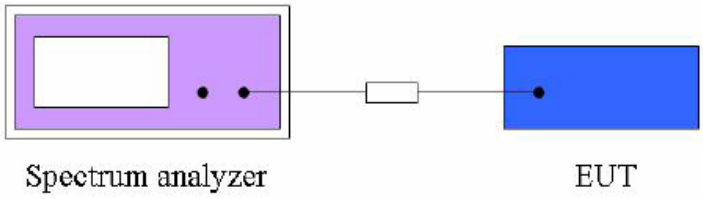


7. Dwell Time On Each Channel

7.1 Operating environment

Temperature : 23.0 °C
Relative humidity : 56.0 % R.H.

7.2 Test set-up (Layout)



7.3 Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

7.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ -	ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2008

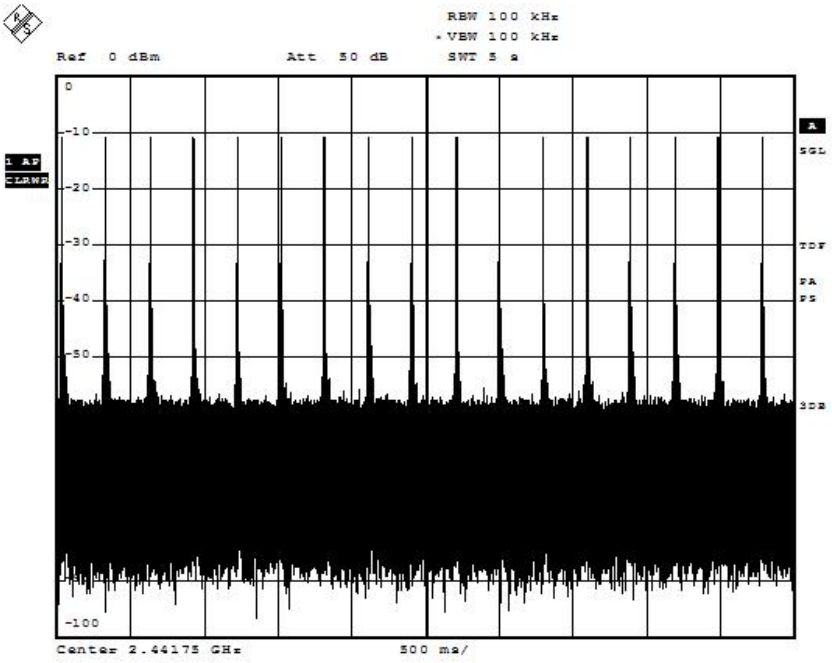
7.5 Test result

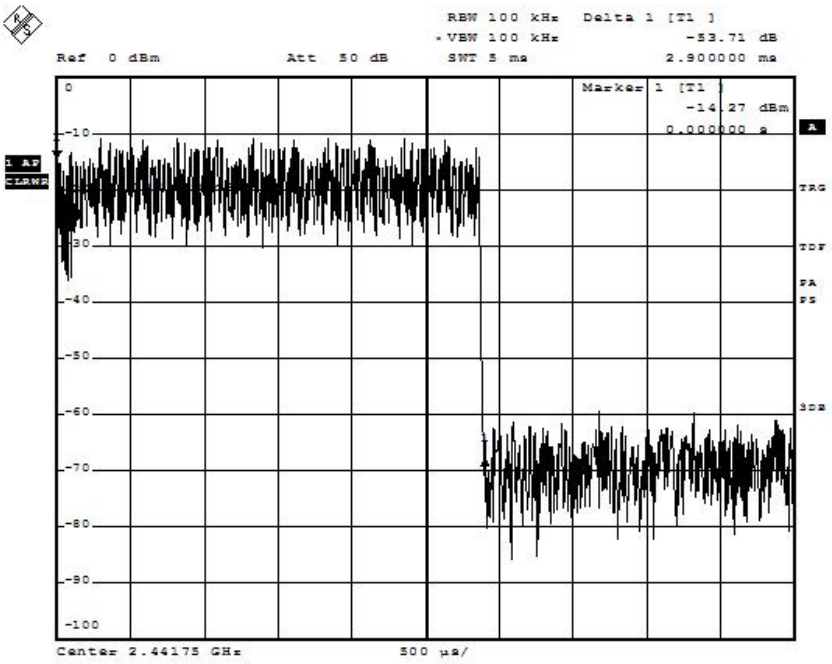
-. Test Date : October 23, 2008
-. Reference standard : Part 15 Subpart C, Sec. 15.247(a)(1)(iii)
-. Modulation : QPSK, 8DPSK
-. Operating condition : Bluetooth RF transmitting mode
-. Power Source : DC 3.7 V supplied from the lithium polymer battery

Spectrum Parameter
-. Attenuation : Auto
-. Span frequency : zero
-. Resolution band width : 100 kHz
-. Video band with : 300 kHz
-. Sweep time : 5 s

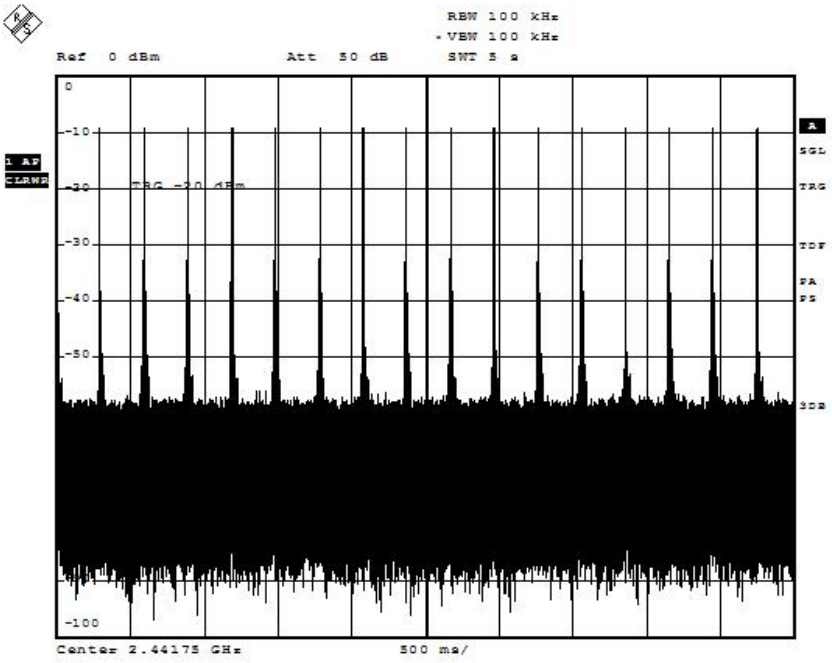
Mode	Number of transmission in a 31.6 (79 Hopping *0.4)	Length of transmission time (ms)	Measured (ms)	Limit (ms)	Result
QPSK DH5	17 (times / 5 s) * 6.32 = 107.44	2.90	311.57	400	Complies
8DPSK DH5	17 (times / 5 s) * 6.32 = 107.44	2.91	312.65	400	Complies

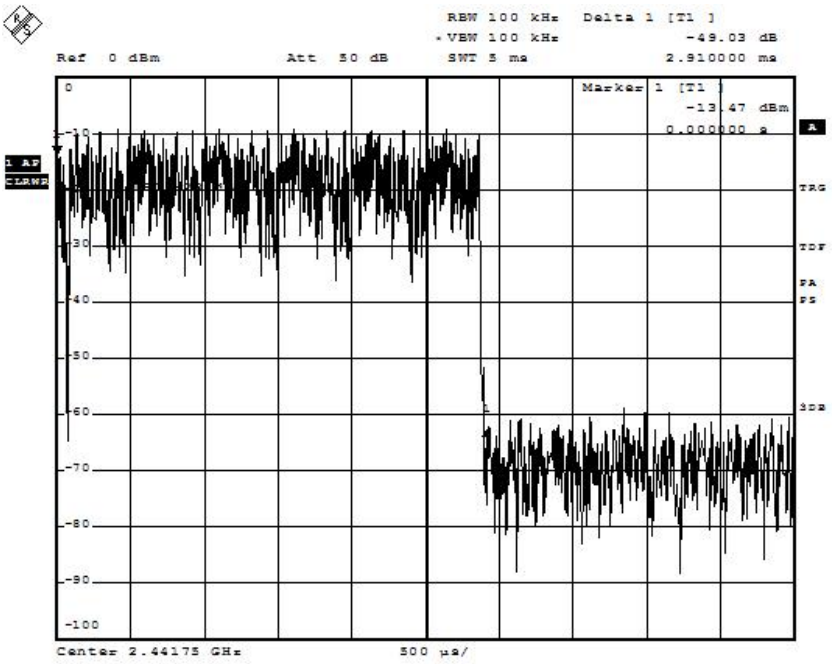
Dwell time on each time used Plot on Configuration QPSK





Dwell time on each time used Plot on Configuration 8DPSK



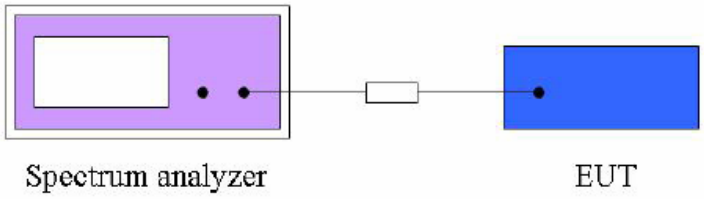


8. CHANNEL BANDWIDTH

8.1 Operating environment

Temperature : 23.0 °C
Relative humidity : 56.0 % R.H.

8.2 Test set-up (Layout)



8.3 Limit

For frequency hopping system operating in the 2 400 MHz ~ 2 483.5 MHz, If the 20 dB bandwidth of hopping channel is greater than 25 kHz, two-thirds 20 dB bandwidth of hopping channel shall be a minimum limit for the hopping channel separation.

8.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ -	ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2008

8.5 Test result

-. Test Date : October 23, 2008
-. Reference standard : Part 15 Subpart C, Sec. 15.247(a)(1)
-. Modulation : QPSK, 8DPSK
-. Operating condition : Bluetooth RF transmitting mode
-. Power Source : DC 3.7 V supplied from the lithium polymer battery

Spectrum Parameter
-. Attenuation : Auto
-. Span frequency : zero
-. Resolution band width : 100 kHz
-. Video band with : 100 kHz
-. Sweep time : 5 s

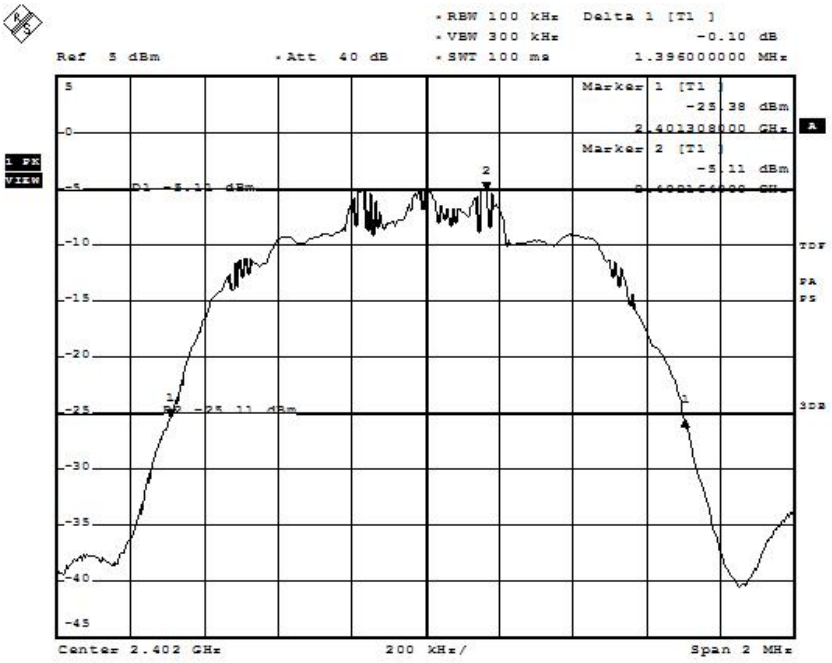
For QPSK

Channel	Channel frequency (MHz)	20 dB bandwidth (MHz)	Limit (MHz)	Result
0	2402	1.396	> 0.5	Complies
39	2441	1.400	> 0.5	Complies
78	2480	1.400	> 0.5	Complies

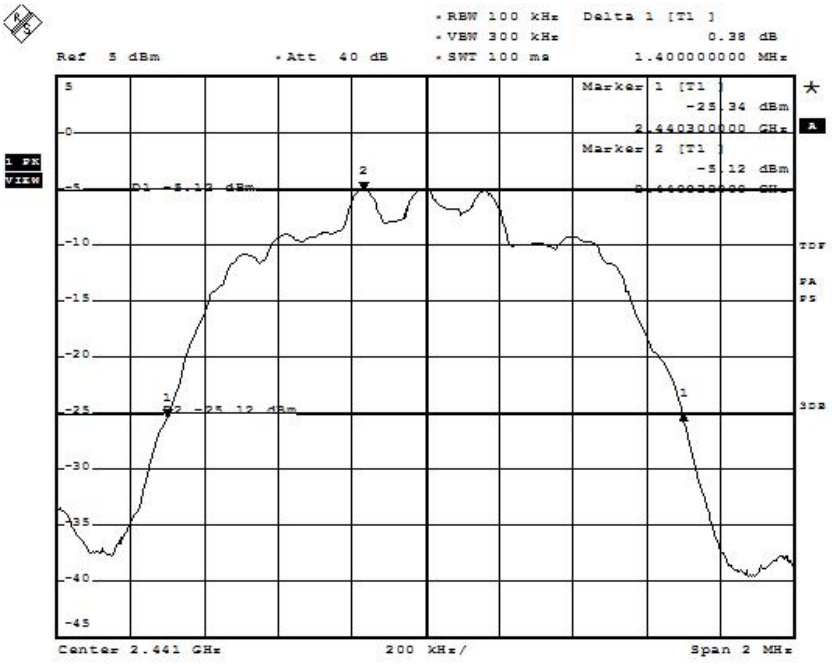
For 8DPSK

Channel	Channel frequency (MHz)	20 dB bandwidth (MHz)	Limit (MHz)	Result
0	2402	1.400	> 0.5	Complies
39	2441	1.396	> 0.5	Complies
78	2480	1.400	> 0.5	Complies

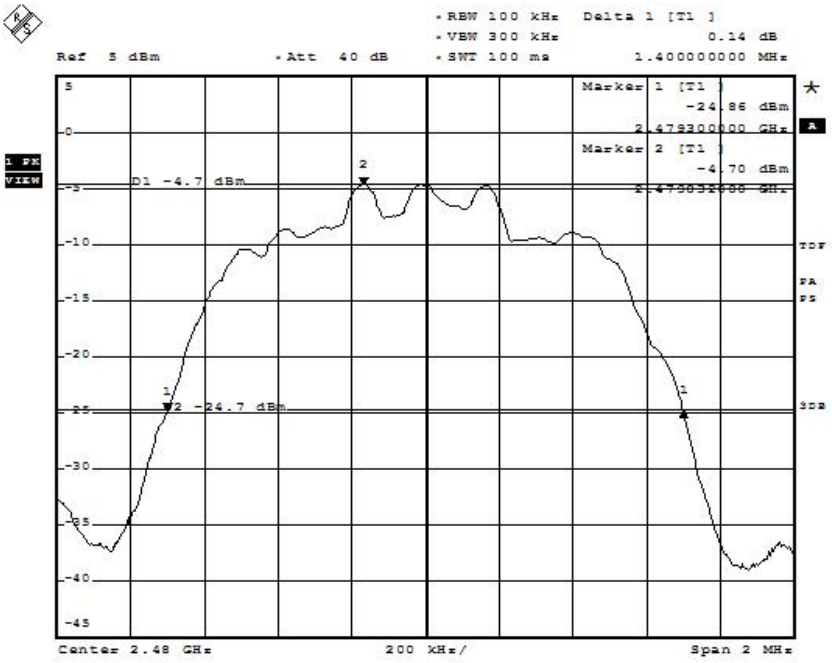
Channel bandwidth used Plot on Configuration QPSK/0 CH (2402 MHz)



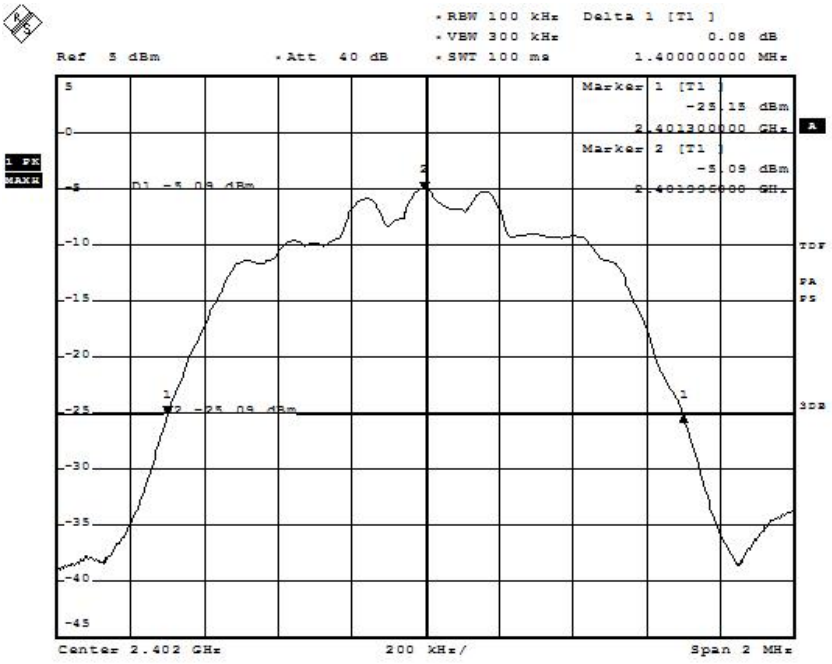
Channel bandwidth used Plot on Configuration QPSK/39 CH (2441 MHz)



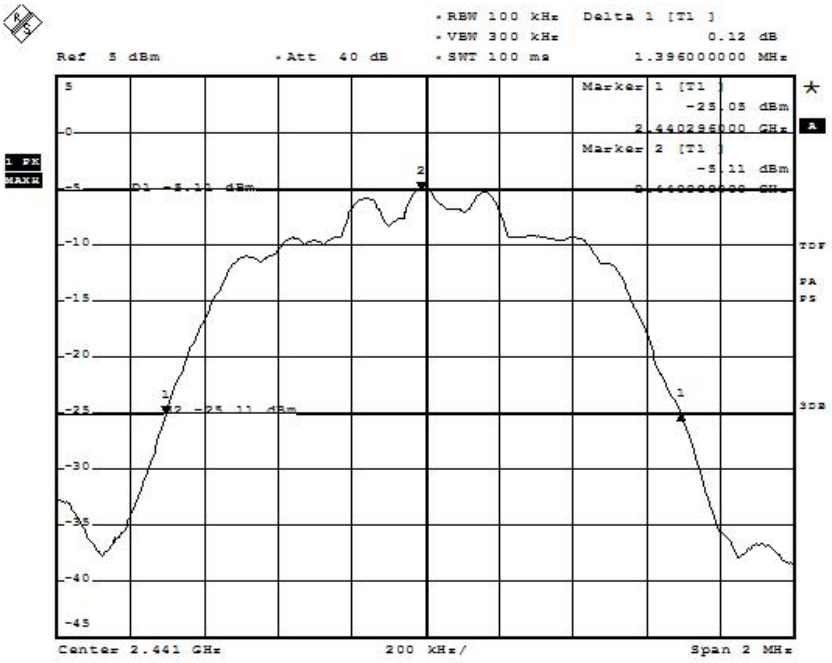
Channel bandwidth used Plot on Configuration QPSK/78 CH (2480 MHz)



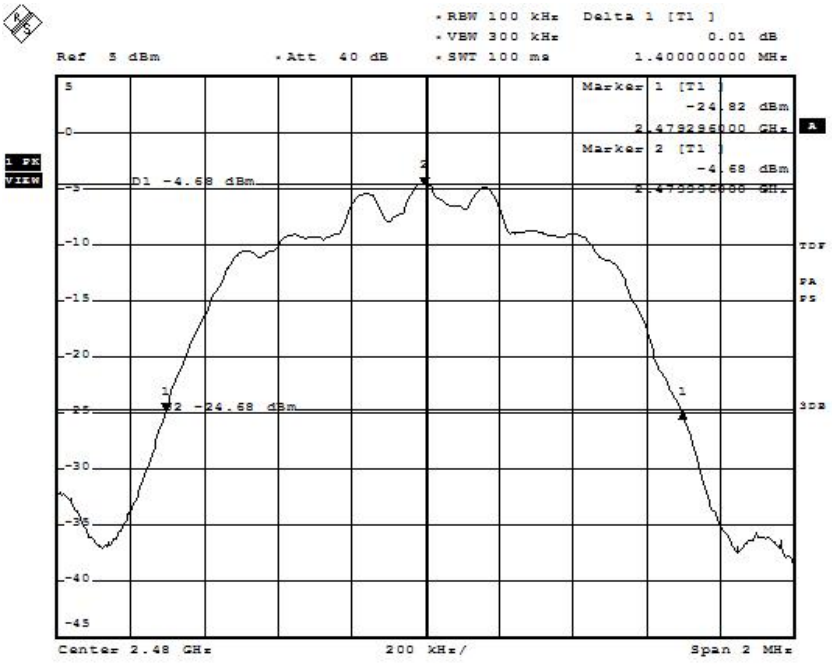
Channel bandwidth used Plot on Configuration 8DPSK/0 CH (2402 MHz)



Channel bandwidth used Plot on Configuration 8DPSK/39 CH (2441 MHz)



Channel bandwidth used Plot on Configuration 8DPSK/78 CH (2480 MHz)

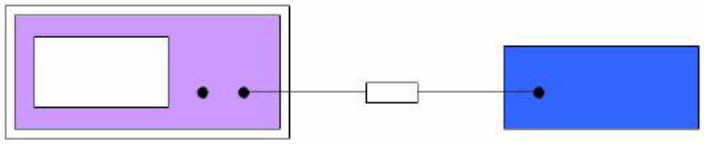


9. LIMIT OF HIPPING CHANNEL SEPARATION

9.1 Operating environment

Temperature : 23.0 °C
Relative humidity : 56.0 % R.H.

9.2 Test set-up (Layout)



9.3 Limit

For frequency hopping system operating in the 2 400 MHz ~ 2 483.5 MHz, If the 20 dB bandwidth of hopping channel is greater than 25 kHz, two-thirds 20 dB bandwidth of hopping channel shall be a minimum limit for the hopping channel separation.

9.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ -	ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2008

9.5 Test result

-. Test Date : October 23, 2008
-. Reference standard : Part 15 Subpart C, Sec. 15.247(a)(1)
-. Modulation : QPSK, 8DPSK
-. Operating condition : Bluetooth RF transmitting mode
-. Power Source : DC 3.7 V supplied from the lithium polymer battery

Spectrum Parameter
-. Attenuation : Auto
-. Span frequency : 2.5 MHz
-. Resolution band width : 100 kHz
-. Video band with : 100 kHz
-. Sweep time : 10 ms

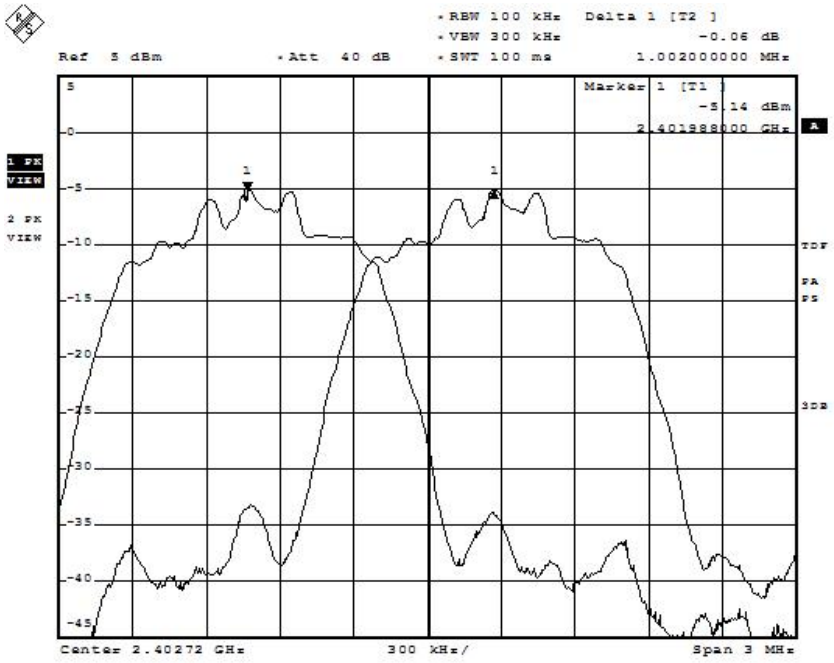
For QPSK

Channel	Channel frequency (MHz)	Adjacent channel separation (MHz)	Limit (MHz)	Result
0	2402	1.002	1.000	Complies
39	2441	1.000	1.000	Complies
78	2480	1.000	1.000	Complies

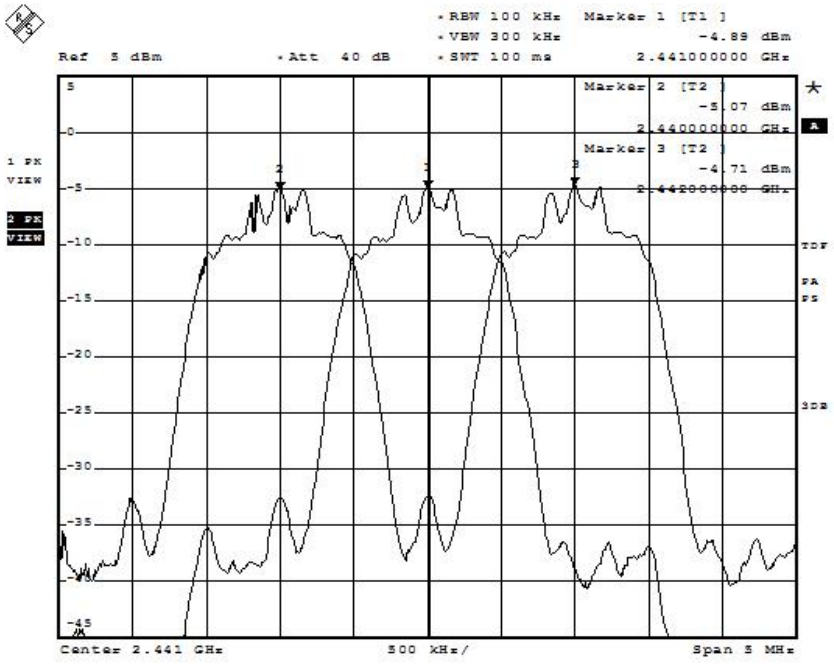
For 8DPSK

Channel	Channel frequency (MHz)	Adjacent channel separation (MHz)	Limit (MHz)	Result
0	2402	1.000	1.000	Complies
39	2441	1.000	1.000	Complies
78	2480	1.000	1.000	Complies

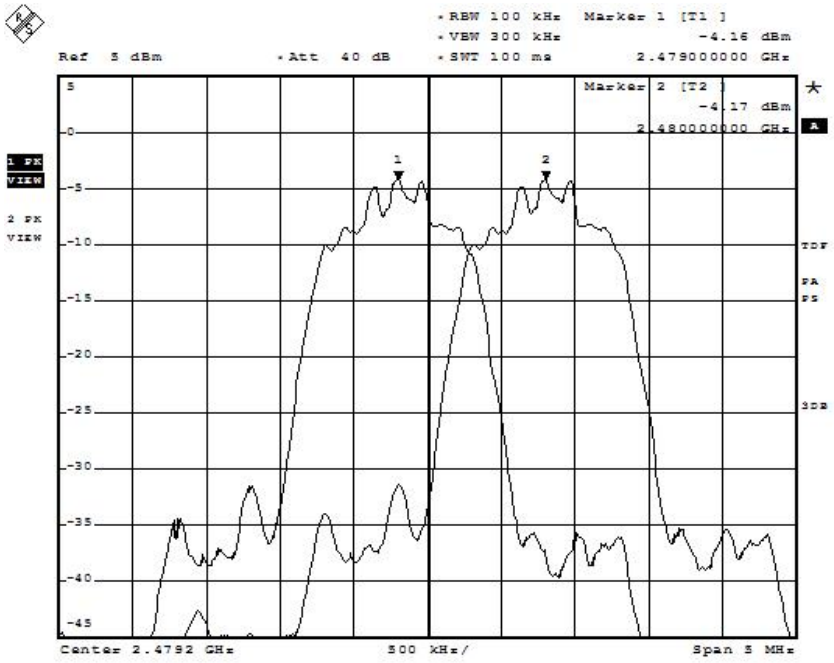
Channel separation used Plot on Configuration QPSK/0 CH (2402 MHz)



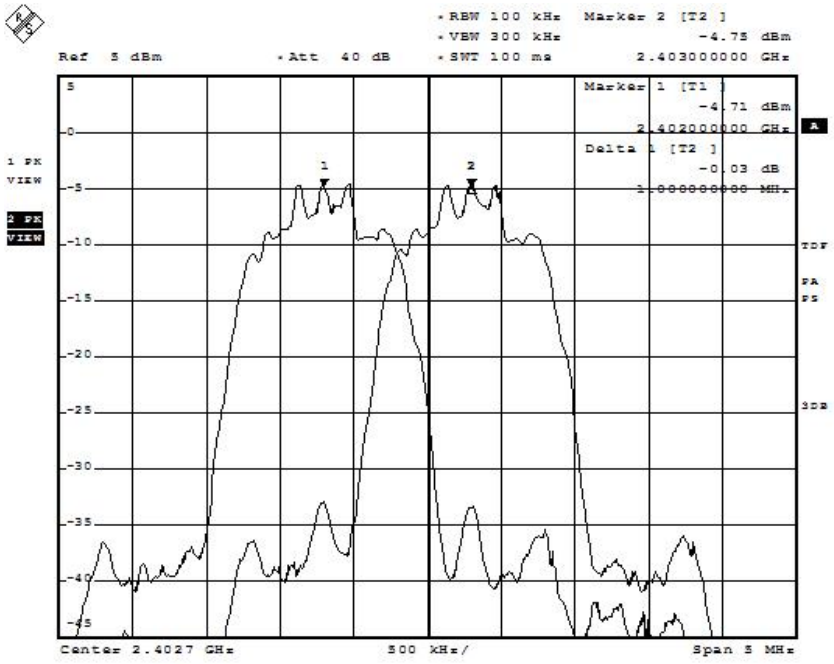
Channel separation used Plot on Configuration QPSK/39 CH (2441 MHz)



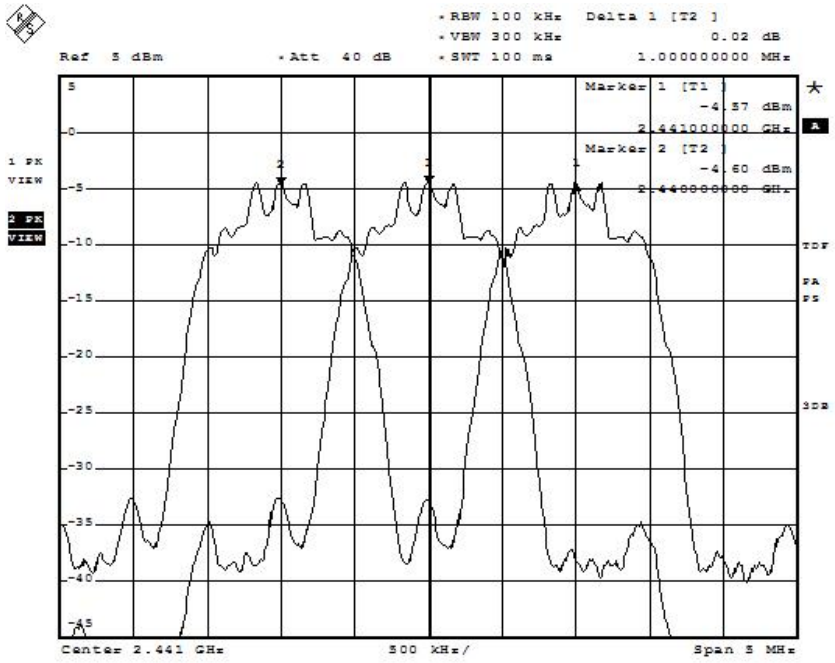
Channel separation used Plot on Configuration QPSK/78 CH (2480 MHz)



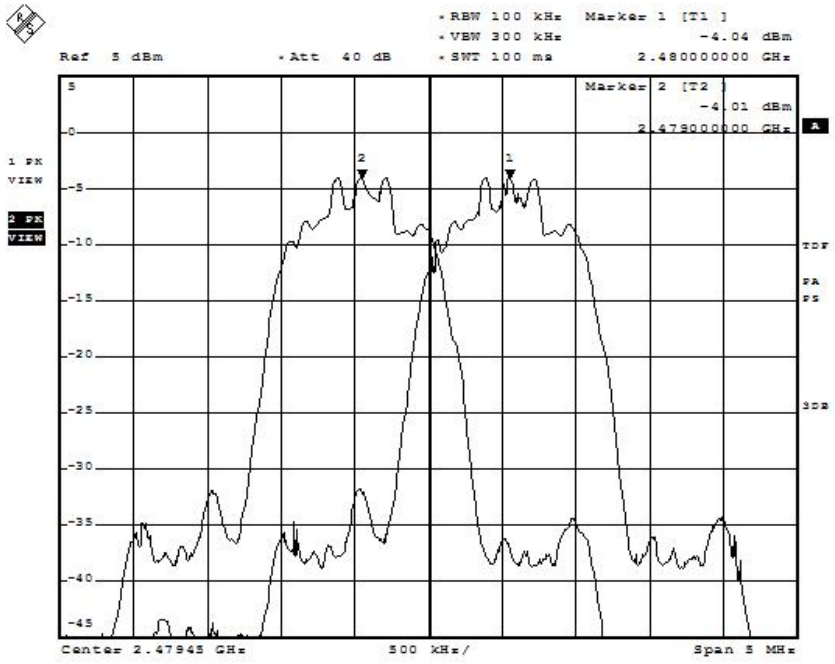
Channel separation used Plot on Configuration 8DPSK/0 CH (2402 MHz)



Channel separation used Plot on Configuration 8DPSK/39 CH (2441 MHz)



Channel separation used Plot on Configuration 8DPSK/78 CH (2480 MHz)

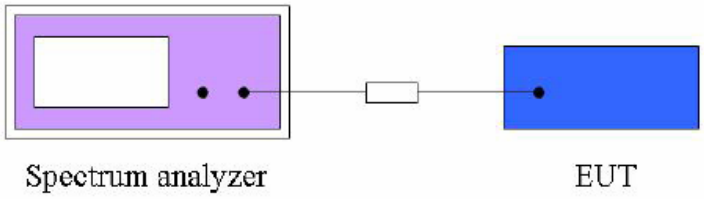


10. MAXIMUM PEAK OUTPUT POWER

10.1 Operating environment

Temperature : 23.0 °C
Relative humidity : 56.0 % R.H.

10.2 Test set-up (Layout)



10.3 Limit

The maximum peak output power measurement is 125 mW

10.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ -	ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2008

10.5 Test result

-. Test Date : October 23, 2008
-. Reference standard : Part 15 Subpart C, Sec. 15.247(b)
-. Modulation : QPSK, 8DPSK
-. Operating condition : Bluetooth RF transmitting mode
-. Power Source : DC 3.7 V supplied from the lithium polymer battery

Spectrum Parameter
-. Attenuation : Auto
-. Span frequency : 40 MHz
-. Resolution band width : 3 MHz
-. Video band with : 10 MHz
-. Sweep time : 300 ms

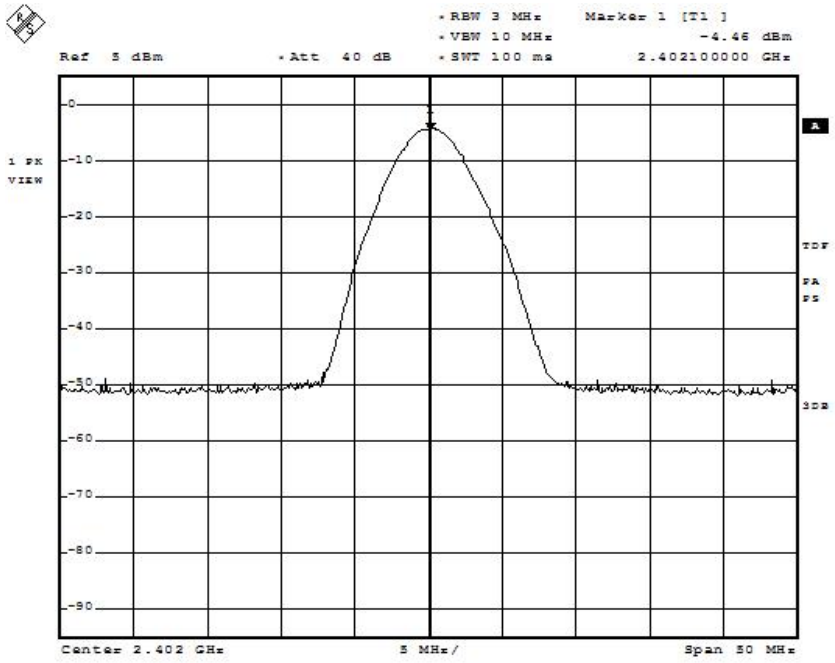
For QPSK

Channel	Channel frequency (MHz)	Peak output power (dBm)	Peak output power (mW)	Limit (mW)	Result
0	2402	-4.46	0.358	125	Complies
39	2441	-4.28	0.373	125	Complies
78	2480	-3.76	0.420	125	Complies

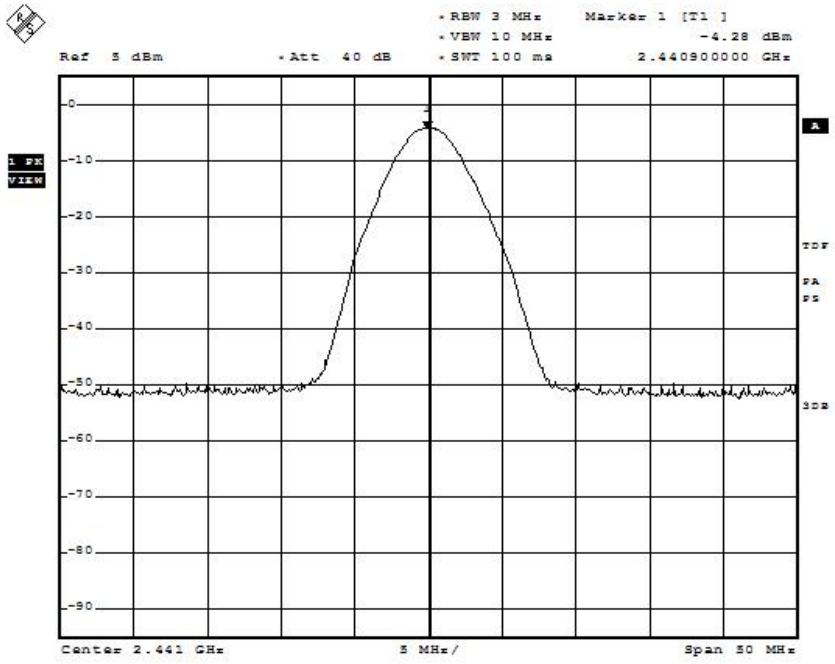
For 8DPSK

Channel	Channel frequency (MHz)	Peak output power (dBm)	Peak output power (mW)	Limit (mW)	Result
0	2402	-4.40	0.363	125	Complies
39	2441	-4.34	0.368	125	Complies
78	2480	-3.73	0.423	125	Complies

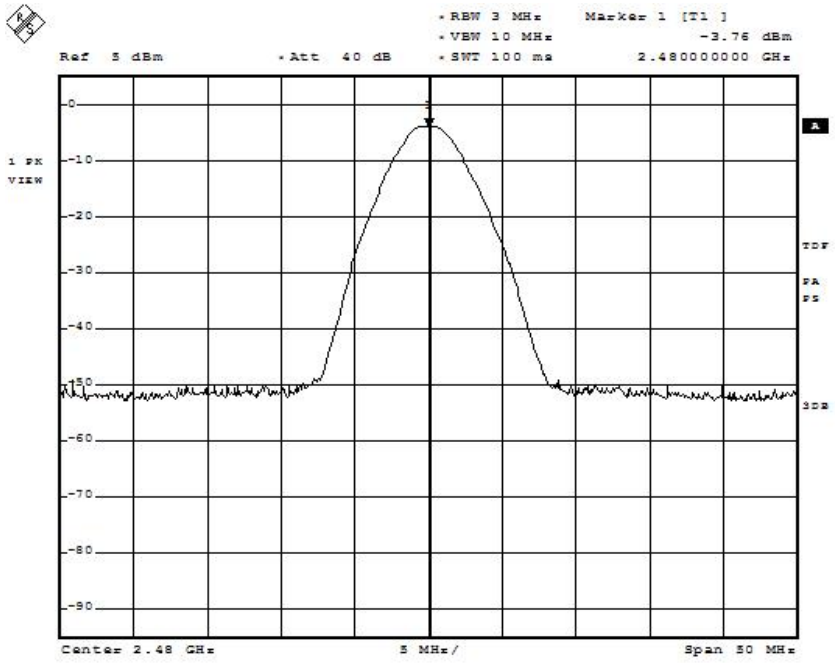
Maximum peak output power used Plot on Configuration QPSK/0 CH (2402 MHz)



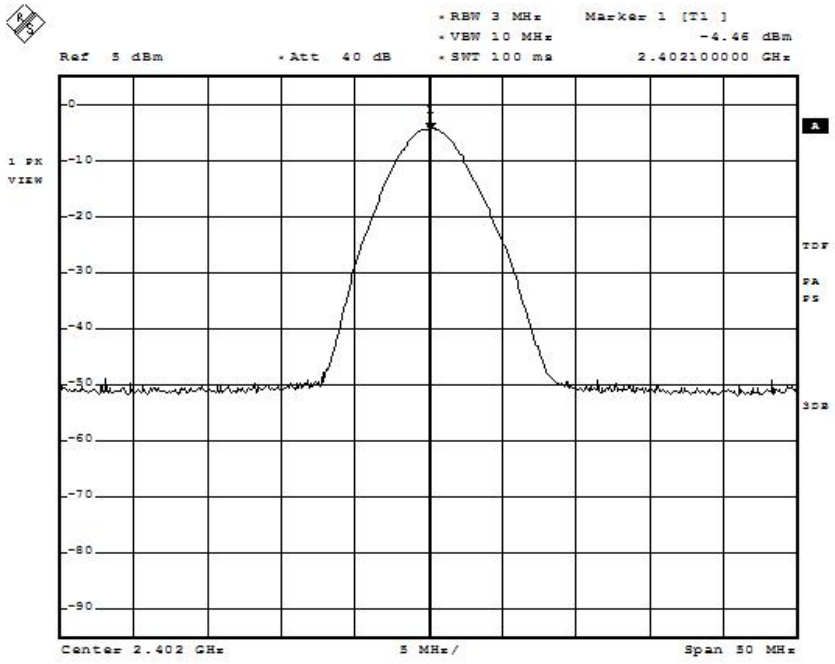
Maximum peak output power used Plot on Configuration QPSK/39 CH (2441 MHz)



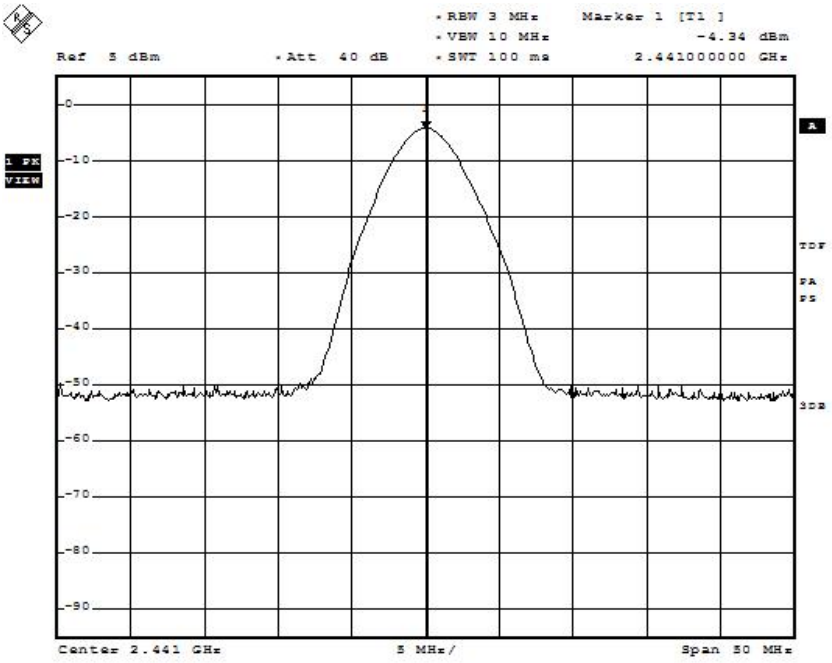
Maximum peak output power used Plot on Configuration QPSK/78 CH (2480 MHz)



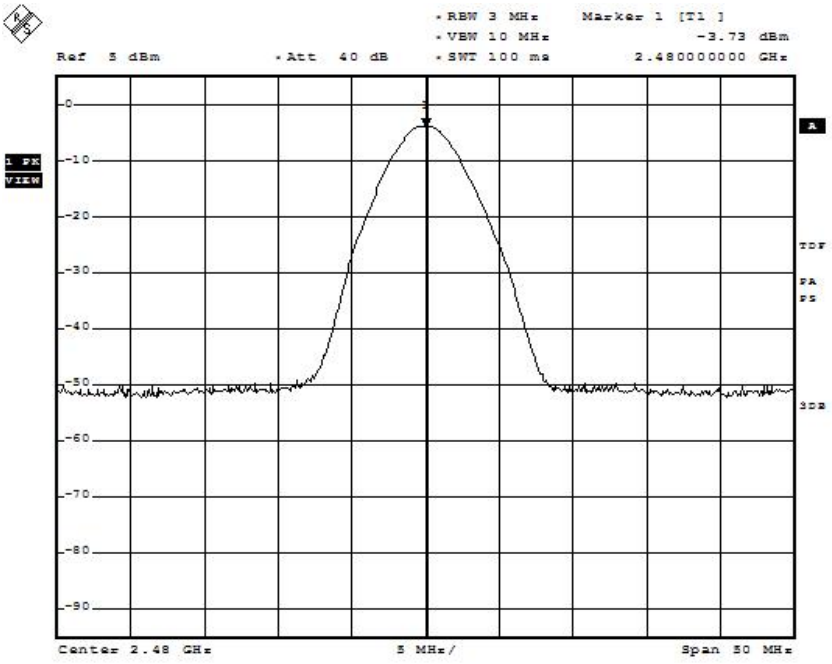
Maximum peak output power used Plot on Configuration 8DPSK/0 CH (2402 MHz)



Maximum peak output power used Plot on Configuration 8DPSK/39 CH (2441 MHz)



Maximum peak output power used Plot on Configuration 8DPSK/78 CH (2480 MHz)

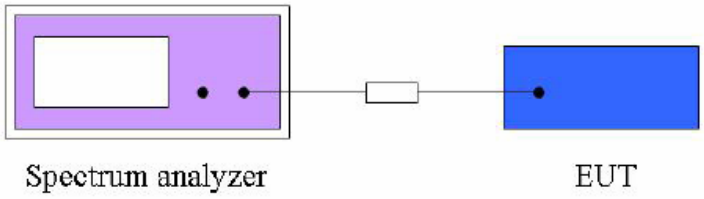


11. BAND EDGES MEASUREMENT

11.1 Operating environment

Temperature : 23.0 °C
Relative humidity : 56.0 % R.H.

11.2 Test set-up (Layout)



11.3 Limit

Below -20 dB of the highest emission level of operating band (in 100 kHz resolution band width)

11.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ -	ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2008
■ -	ESCI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2008

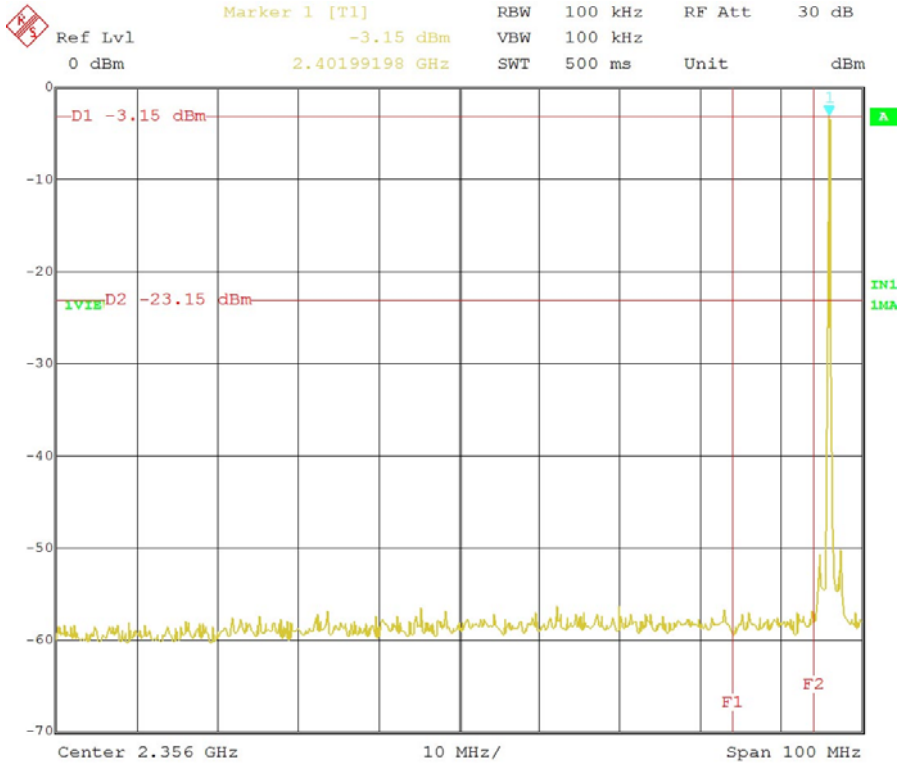
11.5 Test result

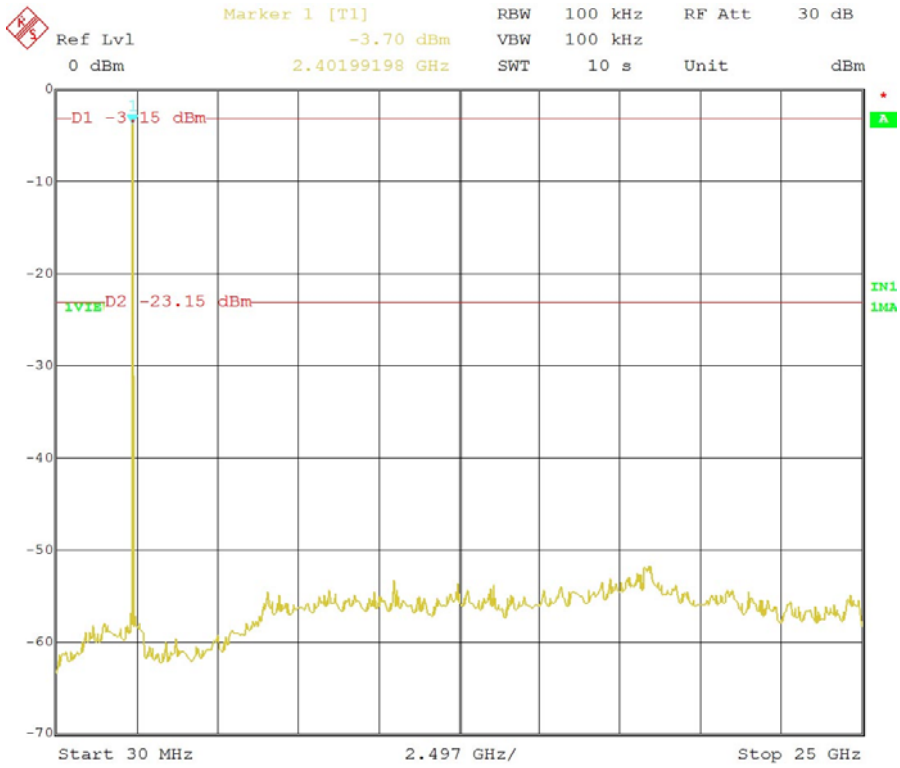
-. Test Date : September 8, 2008
-. Reference standard : Part 15 Subpart C, Sec. 15.247(d)
-. Modulation : QPSK, 8DPSK
-. Operating condition : Bluetooth RF transmitting mode
-. Power Source : DC 3.7 V supplied from the lithium polymer battery

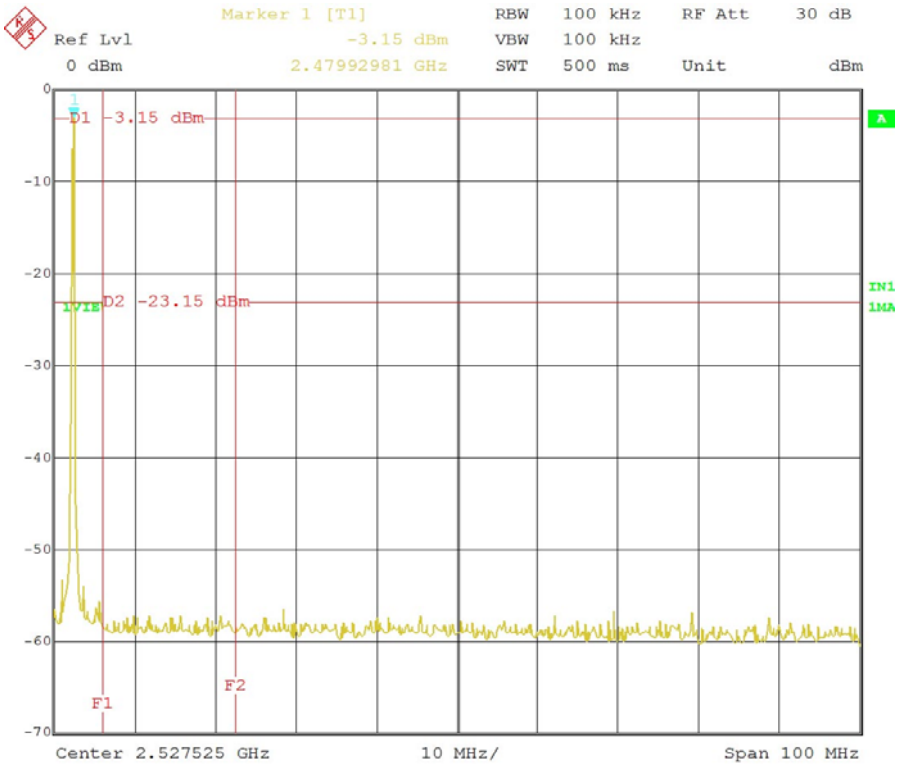
The spectrum plots are attached on the following 8 images. D1 line indicates the highest level, D2 line indicates the 20 dB offset below D1. It shows compliance with the requirement in part 15.247(d)

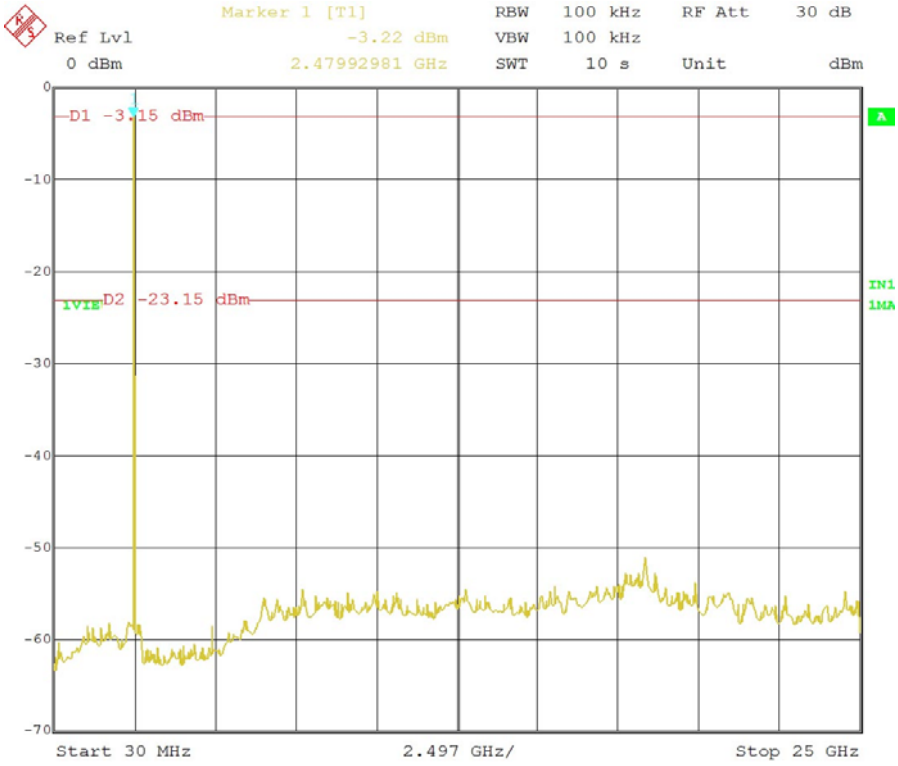
Spectrum Parameter
-. Attenuation : Auto
-. Resolution band width : 100 kHz
-. Video band with : 100 kHz

Bandedge used Plot on Configuration






Marker 1 [T1]
RBW 100 kHz
RF Att 30 dB
Ref Lvl
-3.15 dBm
VBW 100 kHz
0 dBm
2.47992981 GHz
SWT 500 ms
Unit dBm
D1 -3.15 dBm
D2 -23.15 dBm
F1
F2
Center 2.527525 GHz
10 MHz/
Span 100 MHz


Marker 1 [T1]
RBW 100 kHz
RF Att 30 dB
Ref Lvl
-3.22 dBm
VBW 100 kHz
0 dBm
2.47992981 GHz
SWT 10 s
Unit dBm
D1 -3.15 dBm
D2 -23.15 dBm
Start 30 MHz
2.497 GHz/
Stop 25 GHz

12. Radiated Emission

12.1 Operating environment

Temperature : 25.0 °C
Relative humidity : 57.0 % R.H.

12.2 Test set-up

A preliminary scan with peak mode was performed in the semi anechoic chamber using the procedure in ANSI C63.4/2003 13.1.4.1 and found frequency for open area test site.
The formal radiated emission was measured at 3 m distance open area test site.
The EUT was placed on a non-conductive turntable approximately 0.8 meters above the ground plane.
The turntable with EUT was rotated 360°, and the antenna was varied in height between 1.0 and 4.0 meters in order to determine the maximum emission levels.
This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

12.3 Measurement uncertainty

The measurement uncertainty was calculated in accordance with ISO “Guide to the expression of uncertainty in measurement”.
The measurement uncertainty was given with a confidence of 95 %.

Test items	Uncertainty	Remark
Radiated emission (30 MHz ~ 300 MHz, 3 m, Vertical)	± 3.54 dB	Confidence levels of 95 % (k=2)
Radiated emission (30 MHz ~ 300 MHz, 3 m, Horizontal)	± 3.49 dB	Confidence levels of 95 % (k=2)
Radiated emission (300 MHz ~ 1 000 MHz, 3 m, Vertical)	± 3.85 dB	Confidence levels of 95 % (k=2)
Radiated emission (300 MHz ~ 1 000 MHz, 3 m, Horizontal)	± 3.76 dB	Confidence levels of 95 % (k=2)
Radiated emission (30 MHz ~ 300 MHz, 10 m, Vertical)	± 3.21 dB	Confidence levels of 95 % (k=2)
Radiated emission (30 MHz ~ 300 MHz, 10 m, Horizontal)	± 3.32 dB	Confidence levels of 95 % (k=2)
Radiated emission (300 MHz ~ 1 000 MHz, 10 m, Vertical)	± 3.77 dB	Confidence levels of 95 % (k=2)
Radiated emission (300 MHz ~ 1 000 MHz, 10 m, Horizontal)	± 3.84 dB	Confidence levels of 95 % (k=2)

12.4 Limit

20dB in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (microvolt/meter)	Measurement Distance (meters)
0.009~0.490	2400/F (kHz)	300
0.490~1.705	2400/F (kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

12.5 Test equipment used

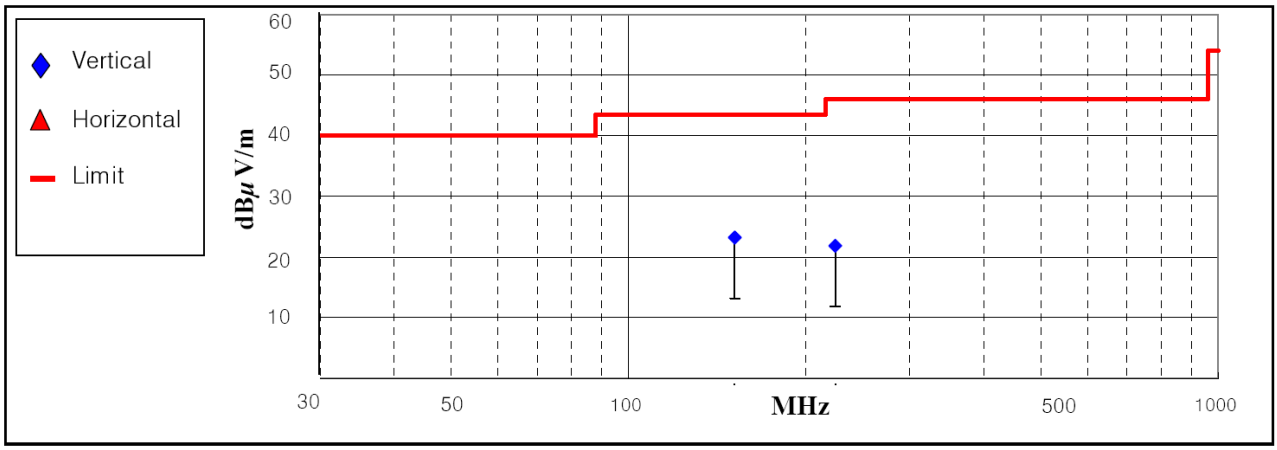
	Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ -	ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2008
■ -	HK116	Rohde & Schwarz	Biconical ANT	832639/007	12. 28. 2009
■ -	HL223	Rohde & Schwarz	Log-periodic antenna	835998/004	12. 28. 2009
■ -	HD100	HD GmbH	Position Controller	100/692/01	N/A
■ -	DS415S	HD GmbH	Turntable	415/657/01	N/A
■ -	MA240	HD GmbH	Antenna Mast	240/565/01	N/A
■ -	BBHA9120D	Schwarzbeck	Horn antenna	597	04.01. 2009
■ -	3160	EMCO	Horn antenna	6741	12.26. 2009
■ -	AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258943	N/A
■ -	8449B	Agient	Amplifier	3008A01828	N/A

12.6 Radiated emission test data

-. Test Date : October 23, 2008
-. Reference standard : Part 15 Subpart C, Sec. 15.247(d)
-. Modulation / Channel : QPSK (0 CH / 39 CH / 78 CH), 8DPSK (0 CH / 39 CH / 78 CH)
-. Operating condition : Bluetooth RF transmitting mode
-. Measuring distance : 3m
-. Spectrum resolution bandwidth(6dB) : 120 kHz / 1 MHz
-. Detector mode : Peak detector mode / Quasi Peak detector mode / Average detector mode
-. Power Source : DC 3.7 V supplied from the lithium polymer battery
-. Note : The EUT was tested with new battery

Worst case result of radiated emission (30 MHz to 1 000 MHz): QPSK

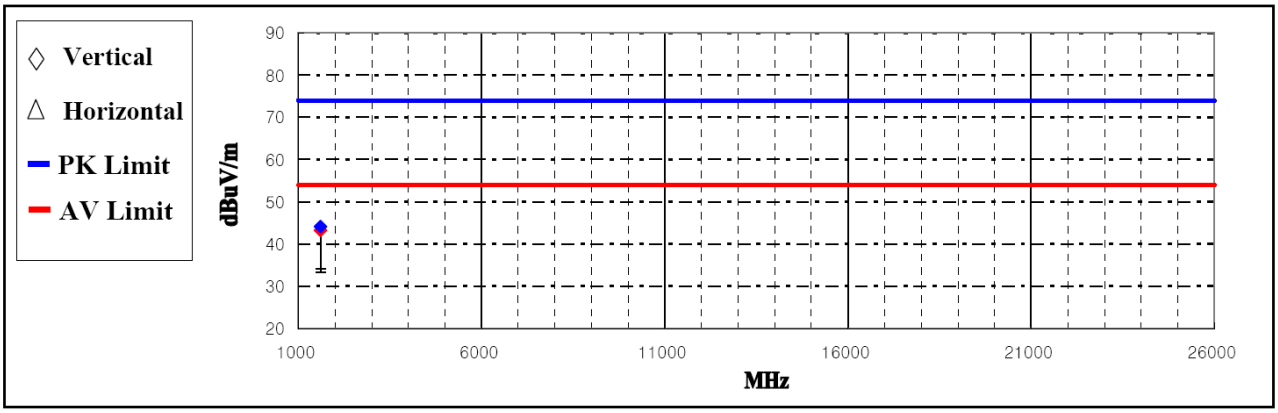
Frequency (MHz)	Measurement Level				Limit (dBμ V/m)	Margin (dBμ V/m)	Positioning System		
	Reading Value(dBμ V)	Antenna Factor(dB)	Cable Loss(dB)	Test Result (dBμ V/m)			Pol. (H/V)	Height (cm)	Angle (°)
151.35	8.14	11.68	3.39	**23.21**	**43.50**	**20.29**	**V**	**123**	**93**
224.03	3.24	14.43	4.19	**21.86**	**46.00**	**24.14**	V	**143**	**102**



Note:
The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.
Emission level (dBμV/m)= 20 log Emission level(μV/m).
Corrected Reading: Antenna Factor + Cable Loss + Read value = Test result

Worst case result of radiated emission (1 GHz to 26 GHz): QPSK

Frequency (MHz)	Measurement Level						Limit (dBμ V/m)		Margin (dBμ V/m)		Positioning System		
	Reading Value (dBμ V/m)		AF	AMP / CL	Test Result (dBμ V/m)						Pol.	Height	Angle
	Peak	Average	(dB)	(dB)	Peak	Average	Peak	Average	Peak	Average	(H/V)	(cm)	(°)
1602.00	57.60	56.72	25.85	-39.31	44.14	43.26	74.00	54.00	29.86	10.74	V	143	92

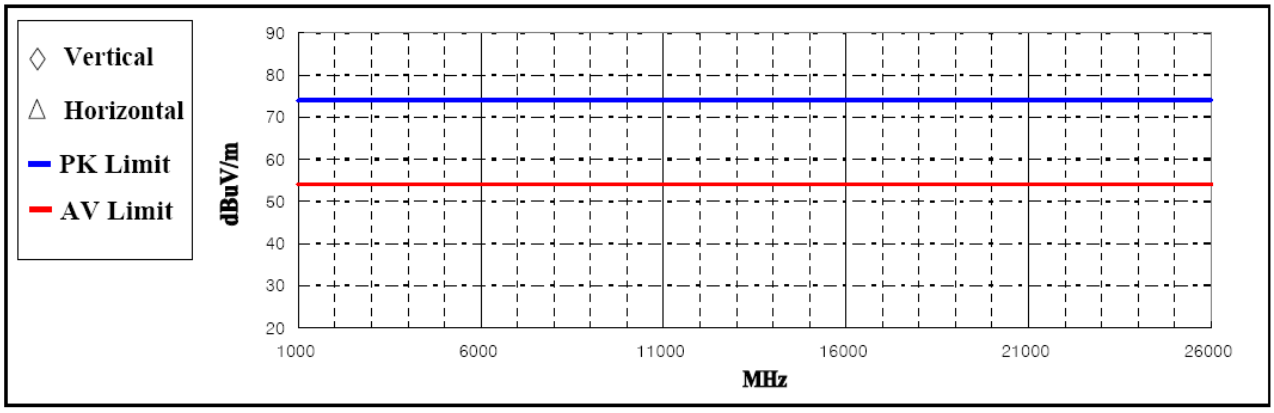


*Comment : AMP/CL_Cable loss value + AMP gain value
AF : Antenna factor value
Pol. : H(Horizontal), V(Vertical)

Result of radiated emission (1 GHz to 10th harmonics)

***QPSK (0 CH / 39 CH / 78 CH), 8DPSK (0 CH / 39 CH / 78 CH)**

Frequency (MHz)	Measurement Level						Limit (dBμ V/m)		Margin (dBμ V/m)		Positioning System		
	Reading Value (dBμ V/m)		AF	AMP / CL	Test Result (dBμ V/m)						Pol.	Height	Angle
	Peak	Average	(dB)	(dB)	Peak	Average	Peak	Average	Peak	Average	(H/V)	(cm)	(°)
					No Emissions Found.								



*Comment : AMP/CL_Cable loss value + AMP gain value
AF : Antenna factor value
Pol. : H(Horizontal), V(Vertical)

13. Conducted Emission

13.1 Operating environment

Temperature : 23.0 °C
Relative humidity : 54.0 % R.H.

13.2 Test set-up

The conducted emission measurements were performed in the shielded room.
The EUT was placed on wooden table, 0.8m heights above the floor, 0.4m from the reference ground plane (GRP) wall and 0.8m from AMN.
AMN is bonded on horizontal reference ground plane.
The ground plane, which was electrically bonded to the shield room, ground system and all power lines entering the shield room, were filtered.

13.3 Measurement uncertainty

The measurement uncertainty was calculated in accordance with ISO “Guide to the expression of uncertainty in measurement.”
The measurement uncertainty was given with a confidence of 95 %.

Test items	Uncertainty	Remark
Conducted emission (9 kHz ~ 150 kHz)	± 2.97 dB	Confidence levels of 95 % (k=2)
Conducted emission (150 kHz ~ 30 MHz)	± 4.05 dB	Confidence levels of 95 % (k=2)

13.4 Limit

RFI Conducted	FCC Limit(dB) Class B	
Freq. Range	Quasi-Peak	Average
150kHz – 0.5MHz	66 – 56*	56 – 46*
0.5MHz – 5MHz	56	46
5MHz – 30MHz	60	50
*Limits decreases linearly with the logarithm of frequency.		

13.5 Test equipment used

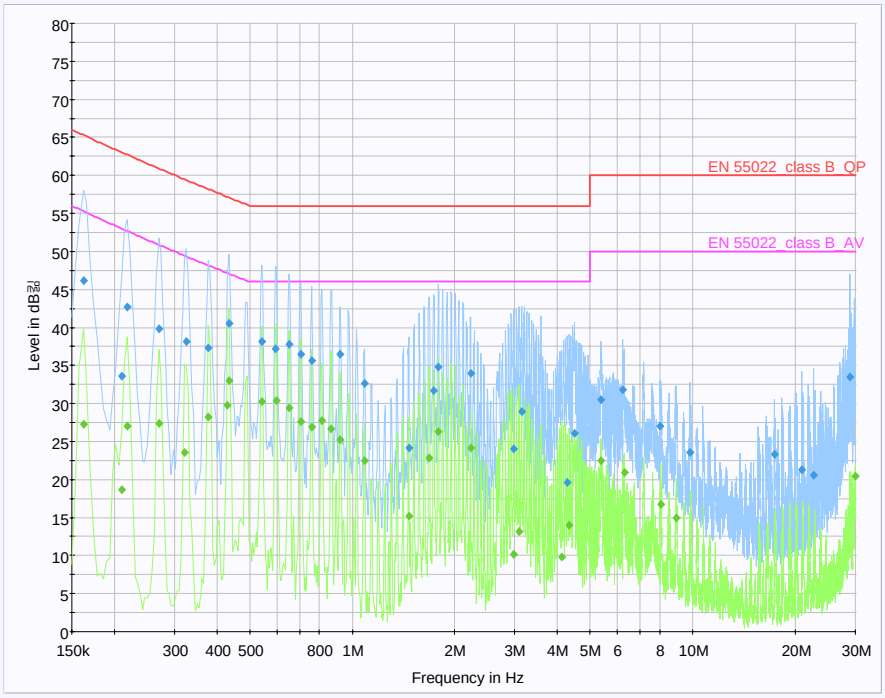
	Model Number	Manufacturer	Description	Serial Number	Due to calibration
■ -	ESCS30	Rohde & Schwarz	EMI test receiver	839809/003	12. 14. 2008
■ -	ESH2-Z5	Rohde & Schwarz	Artificial mains network	829991/009	12. 13. 2008
□ -	ESH3-Z5	Rohde & Schwarz	Artificial mains network	838979/020	12. 13. 2008

13.6 Test data for power line conducted emission

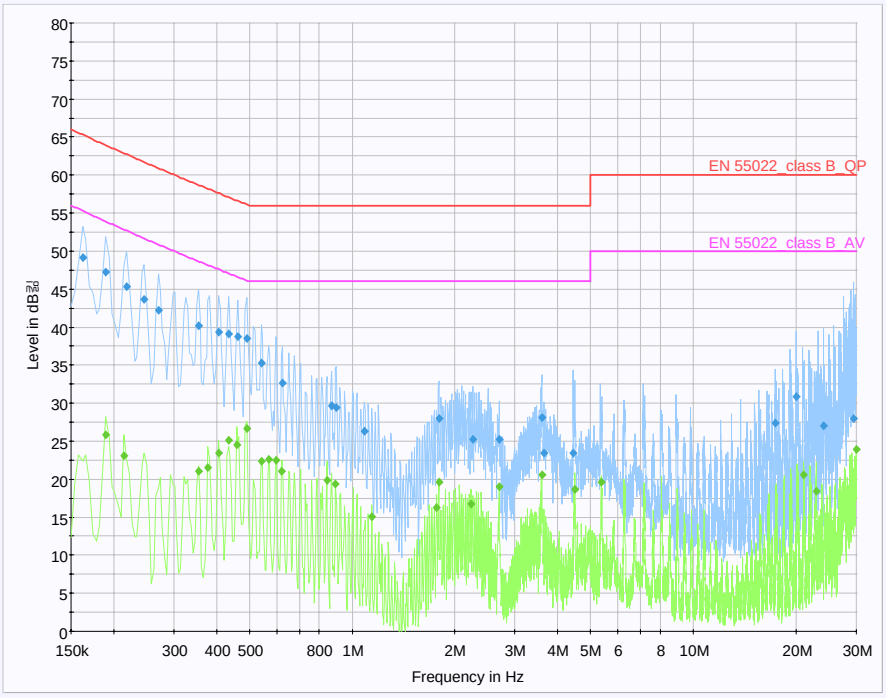
-. Test Date : October 22, 2008
-. Reference standard : Part 15 Subpart C, Sec. 15.207
-. Channel : QPSK / 0 Channel
-. Operating condition : Bluetooth RF transmitting mode
-. Resolution bandwidth : 9 kHz
-.Frequency range : 0.15 MHz ~ 30 MHz

Frequency (MHz)	Insertion Loss	Cable Loss	Line	Q.P[dBμV]			A.V[dBμV]			Margin[dBμV]	
				Limit	Reading	Result	Limit	Reading	Result	Q.P	A.V
0.218	0.12	-0.22	N	62.89	45.40	**45.30**	52.89	23.20	**23.10**	**17.59**	**29.79**
0.354	0.15	-0.15	N	58.86	40.20	**40.20**	48.86	21.10	**21.10**	**18.66**	**27.76**
0.434	0.14	-0.14	L1	57.17	40.60	**40.60**	47.17	33.00	**33.00**	**16.57**	**14.17**
0.542	0.15	-0.20	L1	56.00	38.15	**38.10**	46.00	30.35	**30.30**	**17.90**	**15.70**
0.650	0.14	-0.23	L1	56.00	37.89	**37.80**	46.00	29.59	**29.50**	**18.20**	**16.50**
1.086	0.15	-0.24	L1	56.00	32.69	**32.60**	46.00	22.49	**22.40**	**23.40**	**23.60**
1.790	0.17	-0.30	L1	56.00	34.93	**34.80**	46.00	26.43	**26.30**	**21.20**	**19.70**
2.222	0.19	-0.28	L1	56.00	34.09	**34.00**	46.00	24.29	**24.20**	**22.00**	**21.80**
4.498	0.25	-0.15	L1	56.00	25.90	**26.00**	46.00	13.90	**14.00**	**30.00**	**32.00**
5.362	0.27	-0.17	L1	60.00	30.40	**30.50**	50.00	22.40	**22.50**	**29.50**	**27.50**
23.994	0.94	0.00	N	60.00	26.06	**27.00**	50.00	17.56	**18.50**	**33.00**	**31.50**
28.886	1.18	0.12	L1	60.00	32.20	**33.50**	50.00	19.10	**20.40**	**26.50**	**29.60**

***Comment :** **Line : L1(line 1), L2(line2), L3(line 3), N(neutral)**
Q.P:Quasi-peak, A.V : Average
Insertion Loss : Insertion Loss of LISN
Cable Loss : Cable Loss + Pulse Limiter Insertion loss value
"<<" : The margin is more than 30 dB



(Phase: Line)



(Phase: Neutral)