

FCC EVALUATION REPORT FOR CERTIFICATION

Applicant : Byuckam Co., Ltd.

4th FL, 227-1, Yongdap-dong,

Songdong-gu, Seoul, Korea.

Attn : Mr. Won Tak, Oh / CEO

Date of Issue : January 15, 2010

Order Number: GETEC-C1-09-270

Test Report Number: GETEC-E3-09-166

Test Site: Gumi College EMC Center

FCC Registration Number: (100749, 443957)

FCC ID.: X2CBCX-300

Applicant: Byuckam 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 hands-free car kit

Type of Authority : Certification

Model Name : BCX-300

Trade Name : CYANICS

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 best 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,

Reviewed by,



Soon-Hoon Jeong, Engineer
GUMI College EMC center



Jae-Hoon Jeong, Senior Engineer
GUMI College EMC center



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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: Byuckam Co., Ltd.

Applicant address: 4th FL, 227-1, Yongdap-dong, Songdong-gu, Seoul, Korea.

Manufacturer: Byuckam Co., Ltd.

Manufacturer address : 4th FL, 227-1, Yongdap-dong, Songdong-gu, Seoul, Korea.

Contact person: Mr. Won Tak, Oh / CEO

Telephone number: +82-02-2212-2968 Fax number: +82-02-2212-5102

- **FCC ID.** X2CBCX-300
- **Equipment Class** Spread Spectrum Transmitter (DSS)
- **EUT Type** Bluetooth hands-free car kit
- **Power Source** DC 3.7 V supplied from the lithium polymer battery
- **Model Name** BCX-300
- **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** January 8 ~ 15, 2010
- **Place of Test** **Gumi College EMC Center** (FCC Registration No.: 100749, 443957)
407, Bugok-Dong, Gumi-si, Gyeongsangbuk-Do, Korea
- **Test Report Number** GETEC-E3-09-166
- **Dates of Issue** January 15, 2010

EUT Type: Bluetooth Hands-free car kit

FCC ID.: X2CBCX-300



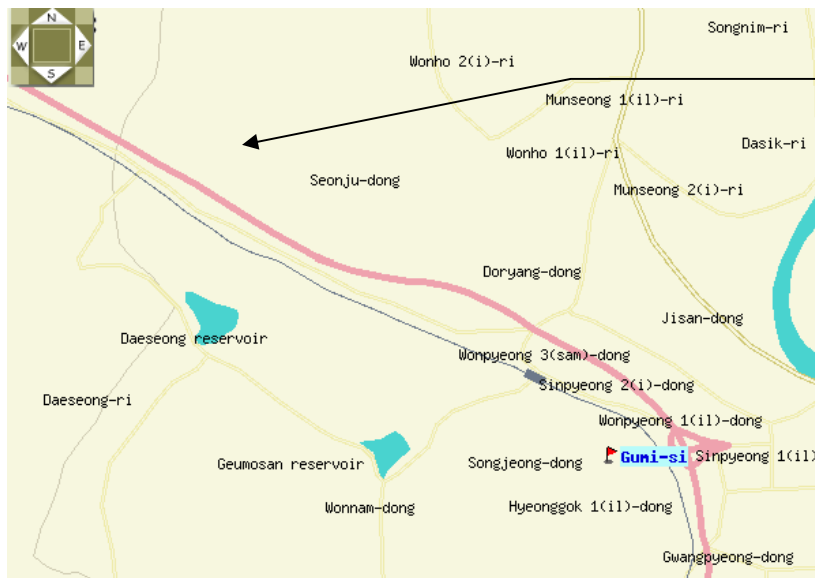
2. Introduction

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 **Byuckam Co., Ltd. Bluetooth Hands-free car kit (Model name: BCX-300)**

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 Daejeon 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



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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 **Byuckam Co., Ltd. Bluetooth Hands-free car kit (Model Name: BCX-300) FCC ID.: X2CBCX-300**

External connector	Charging port
--------------------	---------------

Frequency Band [MHz]	Channel	Freq. [MHz]	Channel	Freq. [MHz]	Channel	Freq. [MHz]	Channel	Freq. [MHz]
2400 ~ 2483.5	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 Name	S/N & FCC ID
Notebook PC	SAMSUNG	NT-Q45	S/N: CNBA4300168AI00682D5800 FCC ID: DoC

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

3.2.2 Used Cable(s)

Cable Name	Condition	Description
USB cable	Connected to the EUT and notebook PC	0.9 m shielded

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 (Charging mode)
- . DC 3.7 V supplied from the lithium polymer battery

- Test Mode(s)

- . Executed “Broadcom BlueTool (made by Broadcom)” to control the EUT continuously transmit RF signal

Test Software Version	Broadcom BlueTool (Ver. 1.1.4.9)		
Frequency	2 402 MHz	2 441 MHz	2 480 MHz
Transmit power table index (0 ~ 7)	2	2	2

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 **Byuckam Co., Ltd. Bluetooth Hands-free car kit** 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 m × 8 m × 2.5 m shielded enclosure. (FCC Registration No.: 100749)

The EUT was placed on a non-conducting 1.0 m by 1.5 m table, which is 0.8 m in height and 0.4 m 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 30 MHz 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 cm ~ 40 cm.

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

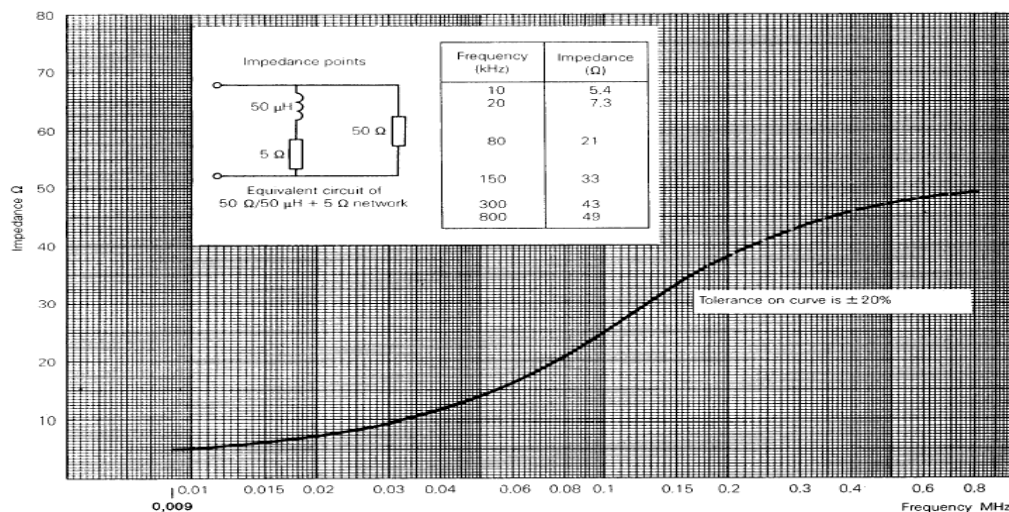


Fig 2. Impedance of LISN



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.

Final measurements were made 3 m chamber (FCC registration No.: 443957) and/or 10 m OATS (FCC registration No.: 100749).

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 1 MHz 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 m × 1.5 m 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

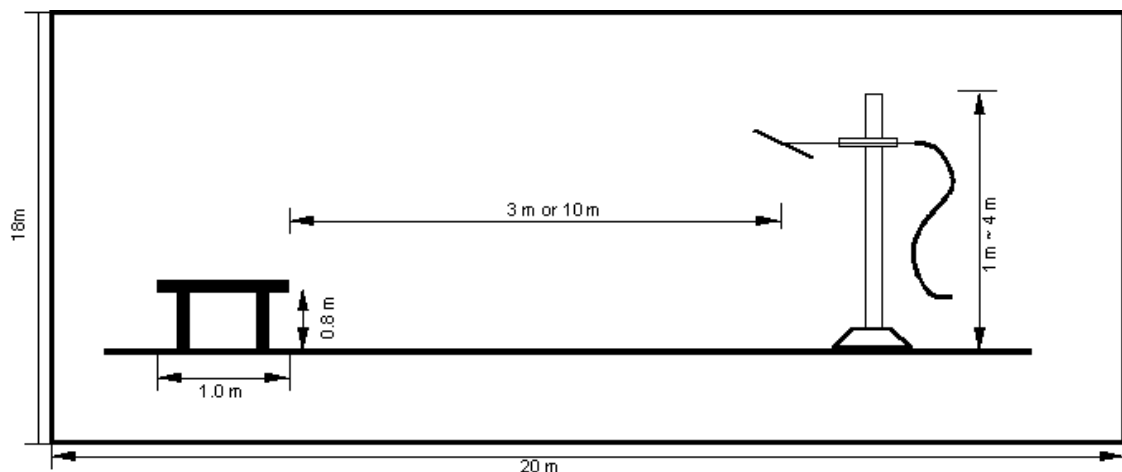


Fig 3. Dimensions of test site.



6. Conducted Emission

6.1 Operating Environment

Temperature : 27 °C
Relative Humidity : 43 % R.H.

6.2 Test Set-up

The conducted emission measurements were performed in the shielded room.

The EUT was placed on wooden table, 0.8 m heights above the floor, 0.4 m from the reference ground plane (GRP) wall and 0.8 m 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.

6.3 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)	± 2.69 dB	Confidence levels of 95 % (k=2)
Conducted emission (150 kHz ~ 30 MHz)	± 4.16 dB	Confidence levels of 95 % (k=2)



6.4 Limit

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

6.5 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESCS30	Rohde & Schwarz	EMI test receiver	839809/003	12. 10. 2010
■ - ESH3-Z5	Rohde & Schwarz	LISN	838979/020	12. 10. 2010
■ - ESH2-Z5	Rohde & Schwarz	LISN	829991/009	12. 10. 2010
□ - ISN T8	TESEQ. GmbH	ISN	24568	10. 16. 2010

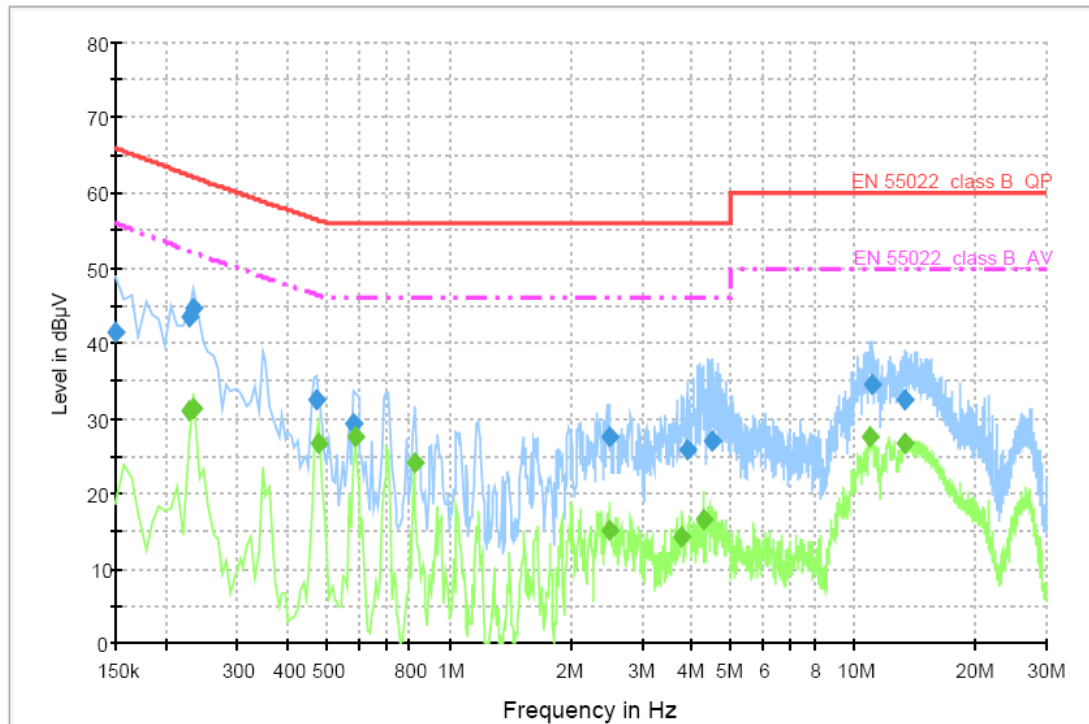
6.6 Test data for Conducted Emission

- . Test Date : January 15, 2010
- . Resolution Bandwidth : 9 kHz
- . Frequency Range : 0.15 MHz ~ 30 MHz



◆ Operating condition: Charging mode

Voltage with 4-Line-LISN_L1



Final Measurement Detector 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.150000	41.4	1000.000	9.000	GND	L1	10.0	24.6	66.0	
0.227000	43.4	1000.000	9.000	GND	L1	10.0	19.0	62.4	
0.234000	44.8	1000.000	9.000	GND	L1	10.0	17.3	62.1	
0.472000	32.5	1000.000	9.000	GND	L1	10.0	23.9	56.4	
0.584000	29.4	1000.000	9.000	GND	L1	10.0	26.6	56.0	
2.488000	27.5	1000.000	9.000	GND	L1	10.1	28.5	56.0	
3.895000	25.8	1000.000	9.000	GND	L1	10.2	30.2	56.0	
4.497000	26.9	1000.000	9.000	GND	L1	10.2	29.1	56.0	
11.098000	34.6	1000.000	9.000	GND	L1	10.5	25.4	60.0	
13.464000	32.5	1000.000	9.000	GND	L1	10.6	27.5	60.0	

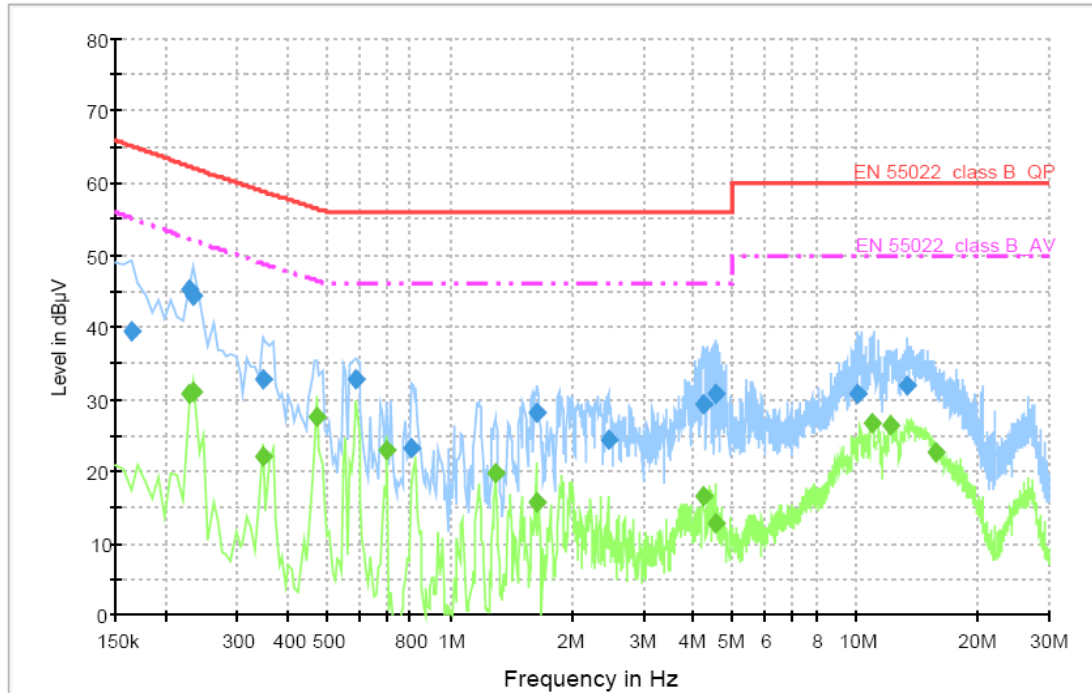
Final Measurement Detector 2

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.227000	31.1	1000.000	9.000	GND	L1	10.0	21.2	52.3	
0.234000	31.2	1000.000	9.000	GND	L1	10.0	20.9	52.1	
0.479000	26.6	1000.000	9.000	GND	L1	10.0	19.7	46.3	
0.591000	27.5	1000.000	9.000	GND	L1	10.0	18.5	46.0	
0.822000	24.2	1000.000	9.000	GND	L1	10.0	21.8	46.0	
2.502000	15.1	1000.000	9.000	GND	L1	10.1	30.9	46.0	
3.776000	14.3	1000.000	9.000	GND	L1	10.2	31.7	46.0	
4.287000	16.5	1000.000	9.000	GND	L1	10.2	29.5	46.0	
11.035000	27.5	1000.000	9.000	GND	L1	10.5	22.5	50.0	
13.401000	26.6	1000.000	9.000	GND	L1	10.6	23.4	50.0	

< Fig 4. Conducted emission result (Live line)>



Voltage with 4-Line-LISN_N



Final Measurement Detector 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.164000	39.6	1000.000	9.000	GND	N	10.0	25.6	65.2	
0.227000	45.2	1000.000	9.000	GND	N	10.0	17.2	62.4	
0.234000	44.4	1000.000	9.000	GND	N	10.0	17.7	62.1	
0.346000	32.7	1000.000	9.000	GND	N	10.0	26.2	58.9	
0.591000	32.6	1000.000	9.000	GND	N	10.0	23.4	56.0	
0.801000	23.1	1000.000	9.000	GND	N	10.0	32.9	56.0	
1.648000	28.1	1000.000	9.000	GND	N	10.1	27.9	56.0	
2.460000	24.3	1000.000	9.000	GND	N	10.1	31.7	56.0	
4.203000	29.4	1000.000	9.000	GND	N	10.2	26.6	56.0	
4.546000	30.8	1000.000	9.000	GND	N	10.2	25.2	56.0	
10.167000	30.8	1000.000	9.000	GND	N	10.4	29.2	60.0	
13.415000	31.8	1000.000	9.000	GND	N	10.5	28.2	60.0	

Final Measurement Detector 2

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.227000	30.8	1000.000	9.000	GND	N	10.0	21.5	52.3	
0.234000	30.9	1000.000	9.000	GND	N	10.0	21.2	52.1	
0.346000	22.0	1000.000	9.000	GND	N	10.0	26.9	48.9	
0.472000	27.7	1000.000	9.000	GND	N	10.0	18.7	46.4	
0.703000	23.0	1000.000	9.000	GND	N	10.0	23.0	46.0	
1.305000	19.7	1000.000	9.000	GND	N	10.1	26.3	46.0	
1.634000	15.8	1000.000	9.000	GND	N	10.1	30.2	46.0	
4.231000	16.6	1000.000	9.000	GND	N	10.2	29.4	46.0	
4.539000	12.7	1000.000	9.000	GND	N	10.2	33.3	46.0	
11.000000	26.6	1000.000	9.000	GND	N	10.4	23.4	50.0	
12.246000	26.3	1000.000	9.000	GND	N	10.5	23.7	50.0	
15.872000	22.5	1000.000	9.000	GND	N	10.6	27.5	50.0	

< Fig 5. Conducted emission result (Neutral line)>

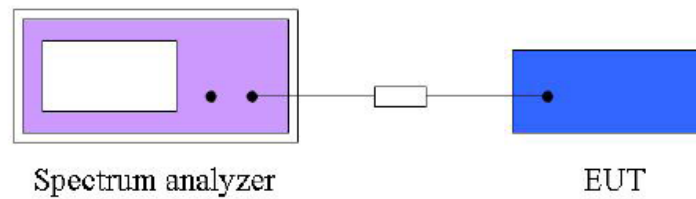


7. Number of Hopping Frequency Used

7.1 Operating Environment

Temperature : 22.0 °C
Relative Humidity : 41.0 % R.H.

7.2 Test Set-up (Layout)



7.3 Limit

At least 15 channels frequencies, and should be equally spaced

7.4 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESCI	Rohde & Schwarz	EMI test receiver	100237	12. 11. 2010

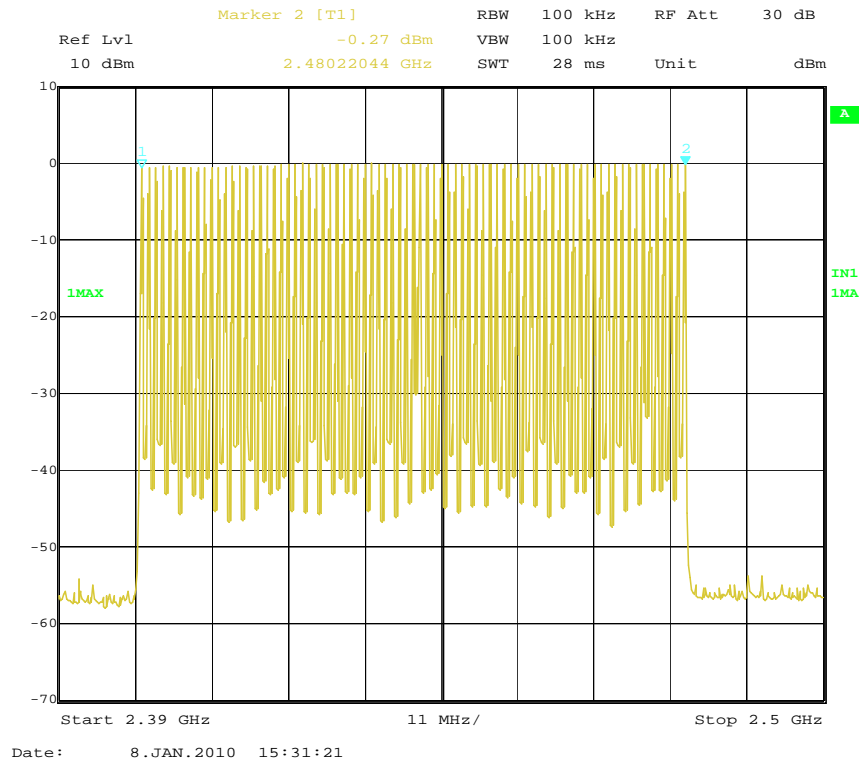
7.5 Test Result

- . Test Date : January 8, 2010
- . Reference Standard : Part 15 Subpart C, Sec. 15.247(a)(1)(iii)
- . Modulation : GFSK,
- . Operating Condition : Bluetooth RF transmitting mode
- . Power Source : DC 3.7 V supplied from the lithium polymer battery

Modulation	Channel number	Limit	Result
GFSK DH5	79	> 15	Complies



Number of Hopping frequency used Plot on Configuration GFSK



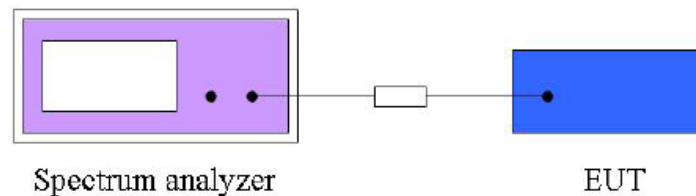


8. Dwell Time On Each Channel

8.1 Operating Environment

Temperature : 22.0 °C
Relative Humidity : 41.0 % R.H.

8.2 Test Set-up (Layout)



8.3 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.

8.4 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 11. 2010

8.5 Test Result

- Test Date : January 8, 2010
- Reference Standard : Part 15 Subpart C, Sec. 15.247(a)(1)(iii)
- Modulation : GFSK
- Operating Condition : Bluetooth RF transmitting mode
- Power Source : DC 3.7 V supplied from the lithium polymer battery

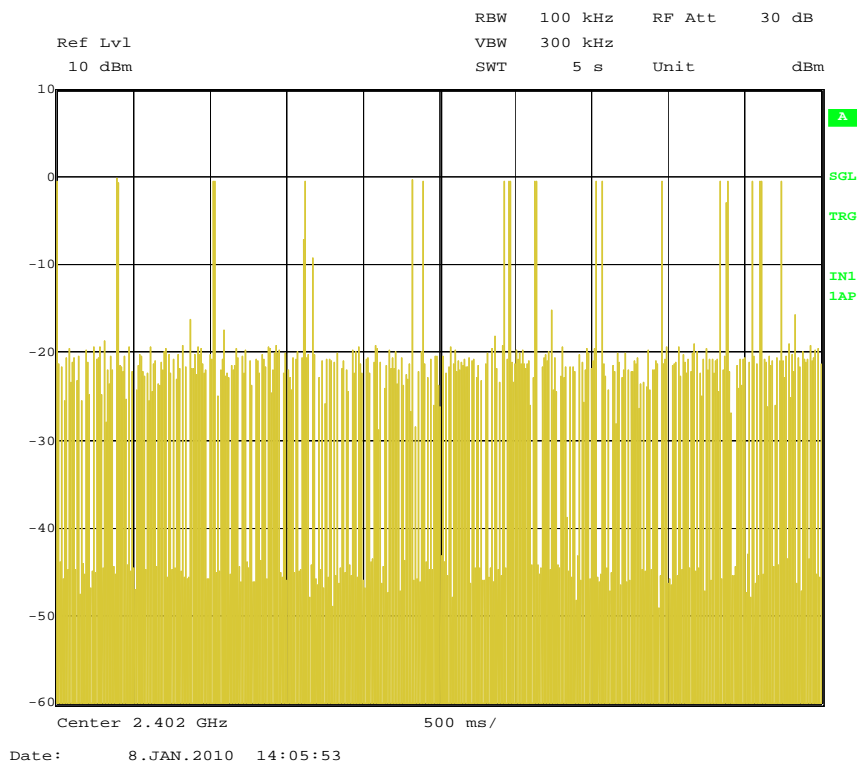
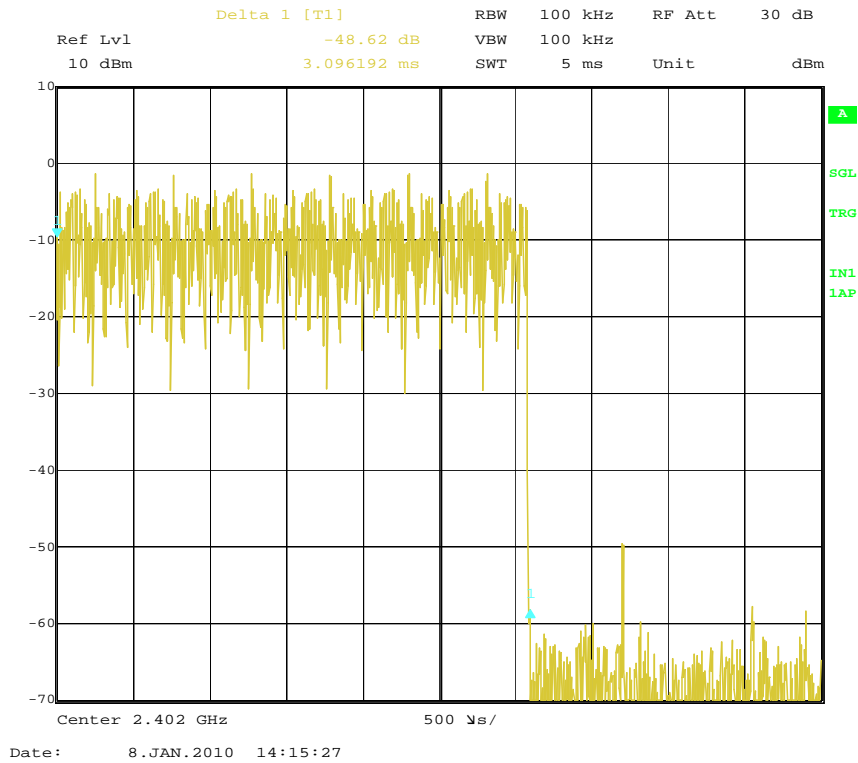
Spectrum Parameter

- 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
GFSK DH5	17 (times / 5 s) * 6.32 = 107.44	3.09	331.98	400	Complies



Dwell time on each time used Plot on Configuration GFSK



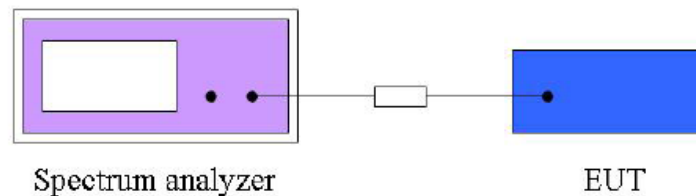


9. CHANNEL BANDWIDTH

9.1 Operating environment

Temperature : 22.0 °C
Relative Humidity : 41.0 % 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 Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 11. 2010

9.5 Test result

- Test Date : January 8, 2010
- Reference Standard : Part 15 Subpart C, Sec. 15.247(a)(1)(iii)
- Modulation : GFSK
- 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

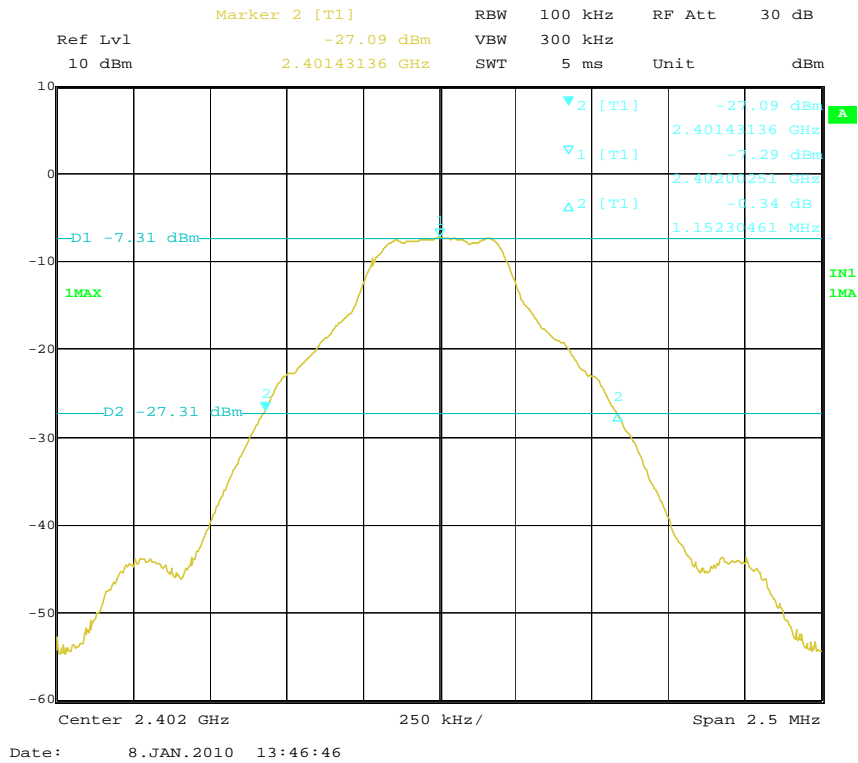


For GFSK (DH5)

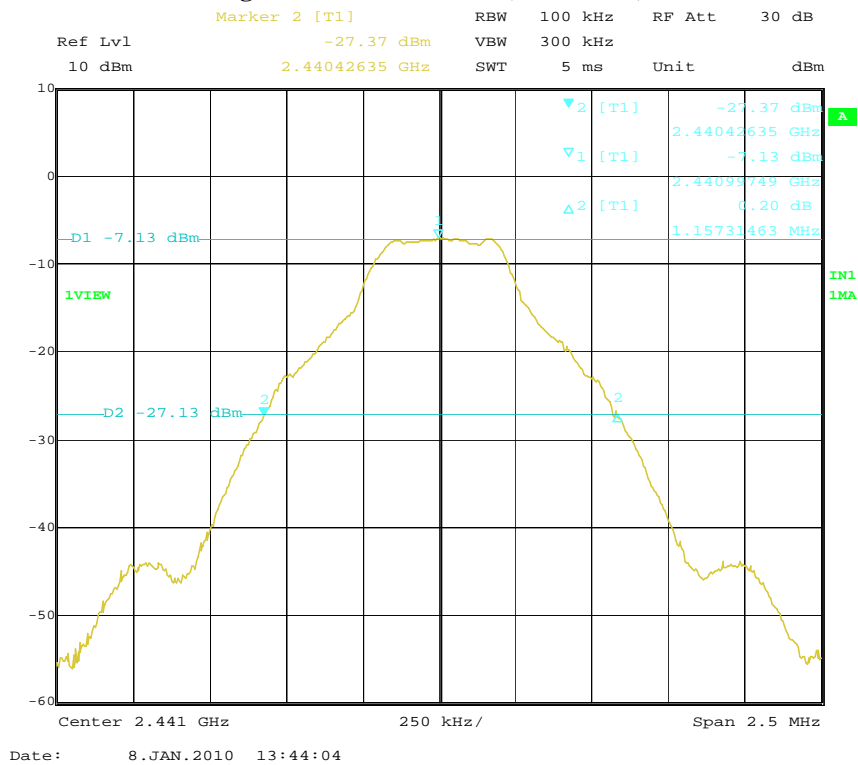
Channel	Channel frequency (MHz)	20 dB bandwidth (MHz)	Result
0	2 402	1.152	Complies
39	2 441	1.157	Complies
78	2 480	1.152	Complies



Channel bandwidth used Plot on Configuration GFSK/0 CH (2 402 MHz)

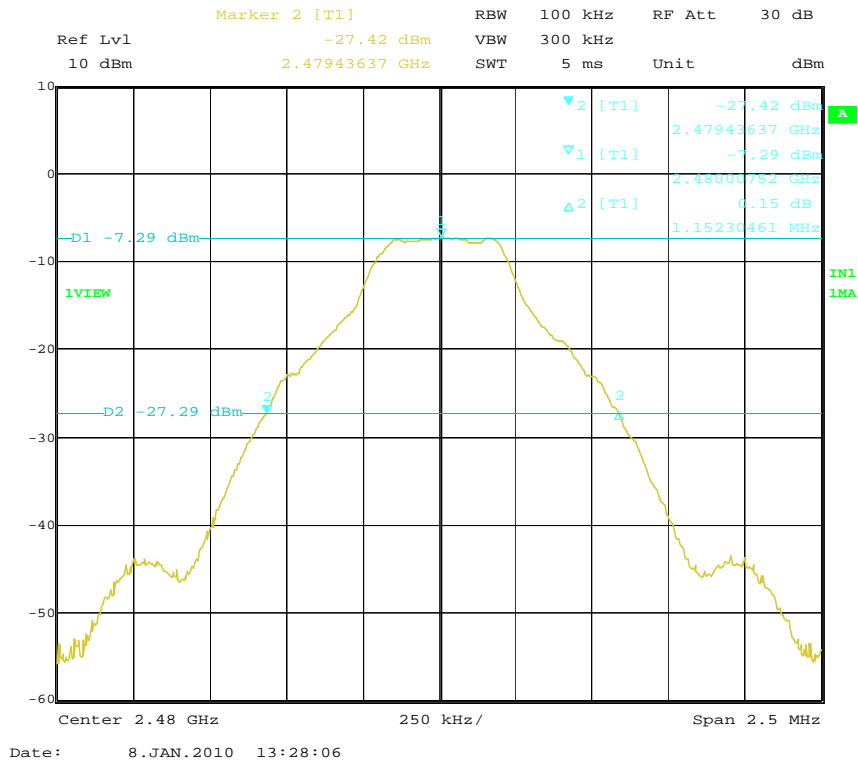


Channel bandwidth used Plot on Configuration GFSK/39 CH (2 441 MHz)





Channel bandwidth used Plot on Configuration GFSK/78 CH (2 480 MHz)



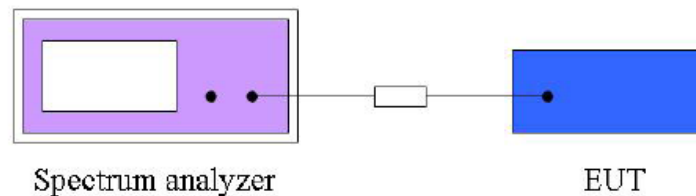


10. LIMIT OF HOPPING CHANNEL SEPARATION

10.1 Operating Environment

Temperature : 22.0 °C
Relative Humidity : 41.0 % R.H.

10.2 Test Set-up (Layout)



10.3 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.

10.4 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 11. 2010

10.5 Test Result

- Test Date : January 8, 2010
- Reference Standard : Part 15 Subpart C, Sec. 15.247(a)(1)
- Modulation : GFSK
- 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

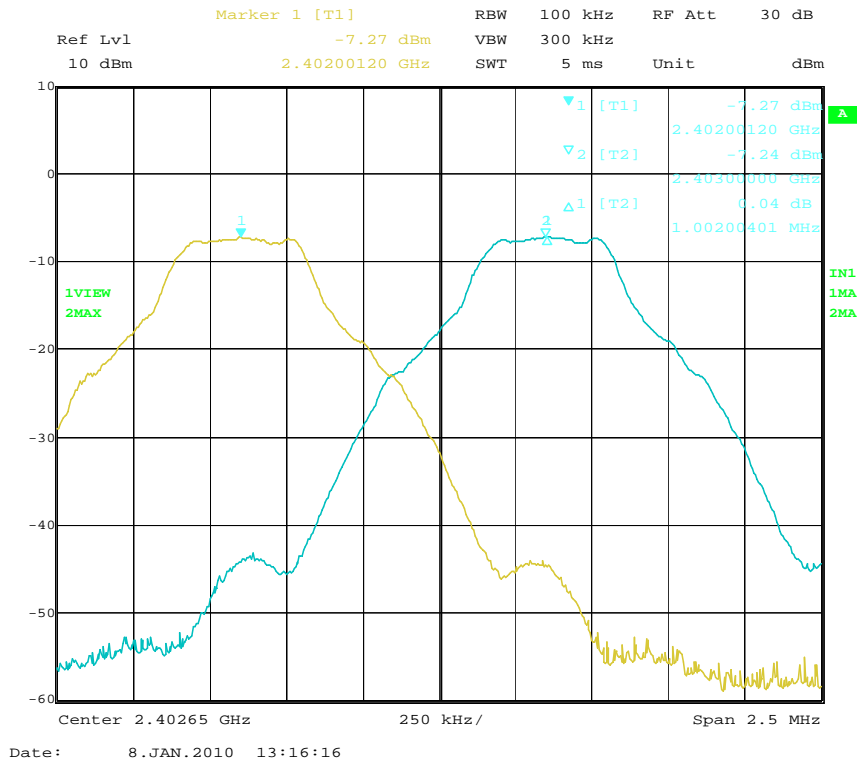


For GFSK (DH5)

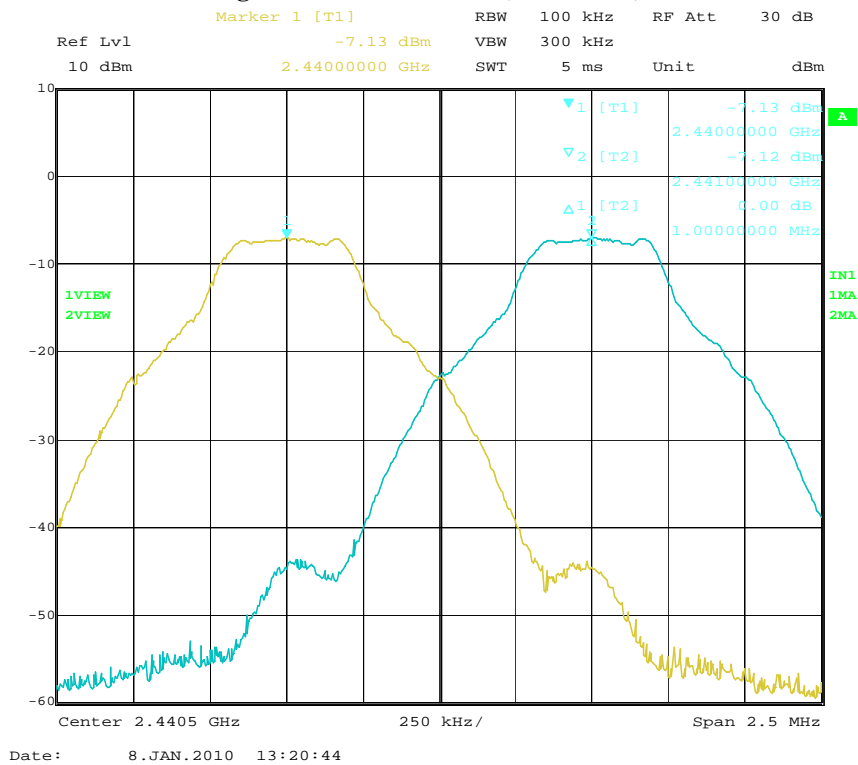
Channel	Channel frequency (MHz)	Adjacent channel separation (MHz)	Limit (MHz)	Result
0	2 402	1.002	> 0.5	Complies
39	2 441	1.000	> 0.5	Complies
78	2 480	1.000	> 0.5	Complies



Channel separation used Plot on Configuration GFSK/0 CH (2 402 MHz)

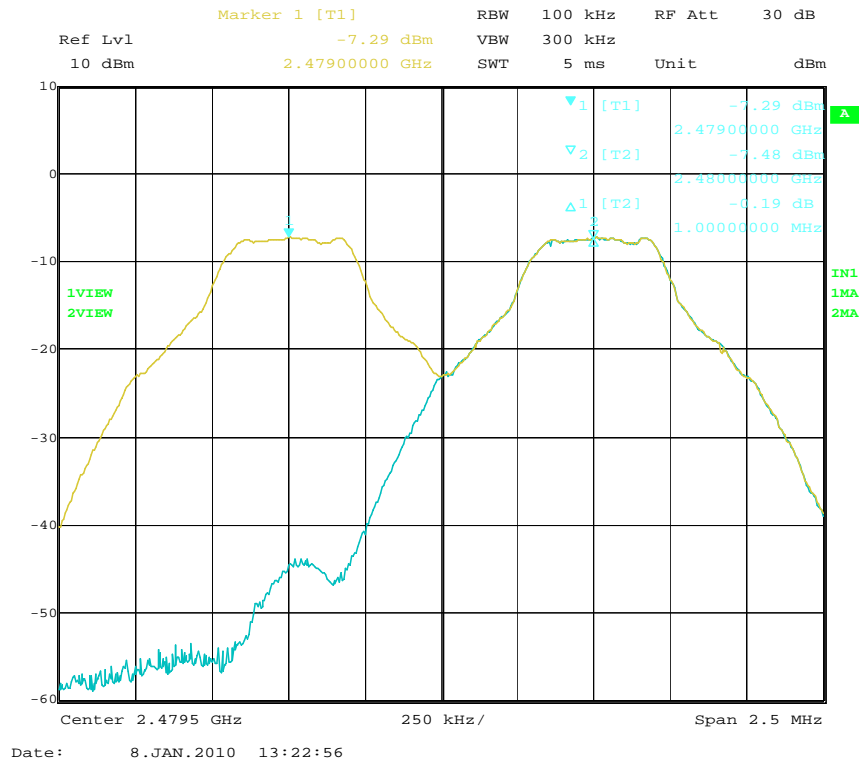


Channel separation used Plot on Configuration GFSK/39 CH (2 441 MHz)





Channel separation used Plot on Configuration GFSK/78 CH (2 480 MHz)



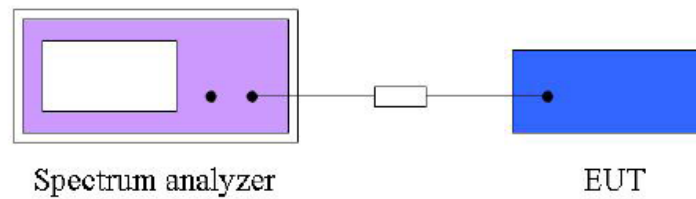


11. MAXIMUM PEAK OUTPUT POWER

11.1 Operating Environment

Temperature : 22.0 °C
Relative Humidity : 41.0 % R.H.

11.2 Test Set-up (Layout)



11.3 Limit

The maximum peak output power measurement is 125 mW

11.4 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 11. 2010

11.5 Test Result

- . Test Date : January 8, 2010
- . Reference Standard : Part 15 Subpart C, Sec. 15.247(b)
- . Modulation : GFSK, QPSK, 8-DPSK
- . 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

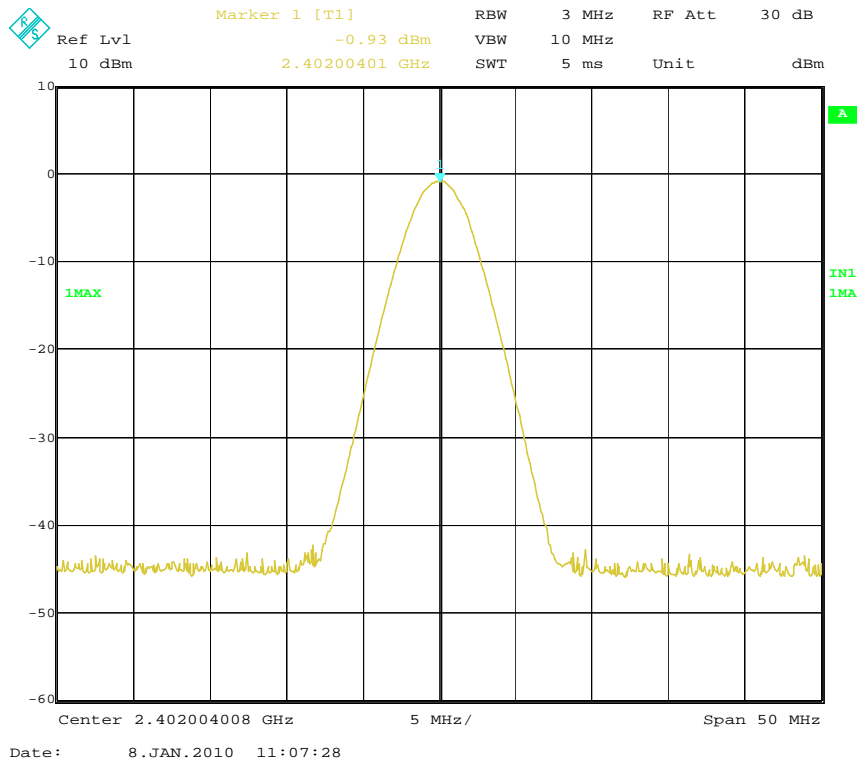


For GFSK (DH5)

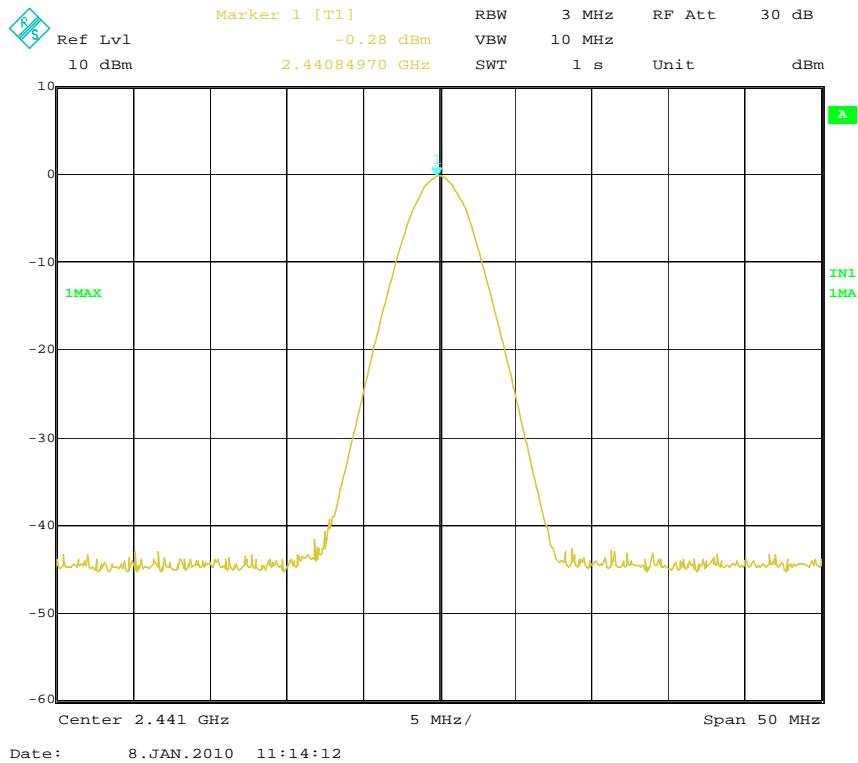
Channel	Channel frequency (MHz)	Peak output power (dBm)	Peak output power (mW)	Limit (mW)	Result
0	2 402	- 0.98	0.80	125	Complies
39	2 441	- 0.28	0.93	125	Complies
78	2 480	- 0.28	0.93	125	Complies



Maximum peak output power used Plot on Configuration GFSK/0 CH (2 402 MHz)

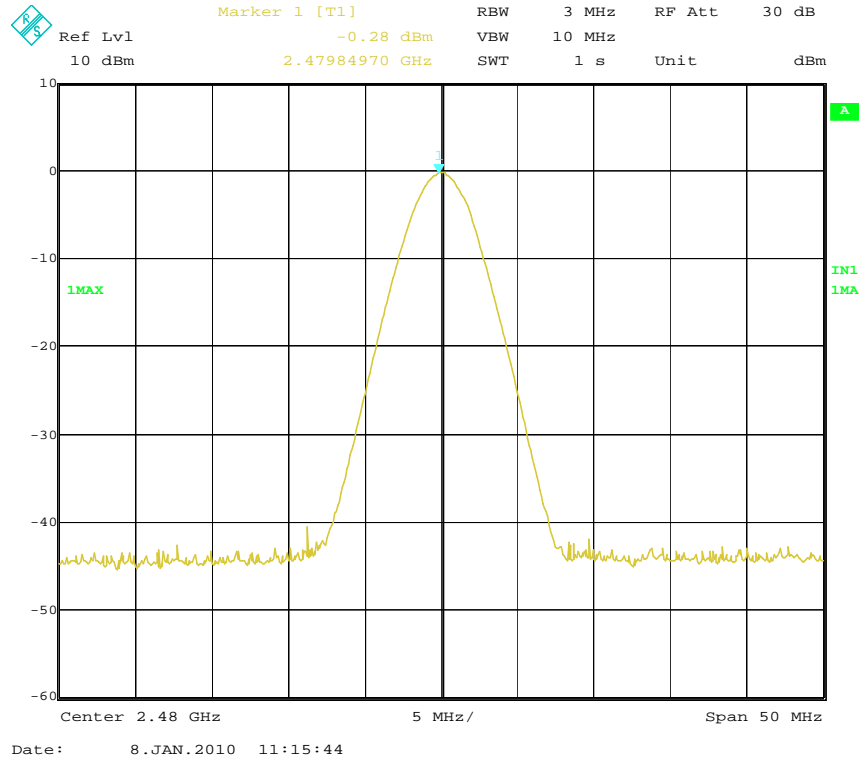


Maximum peak output power used Plot on Configuration GFSK/39 CH (2 441 MHz)





Maximum peak output power used Plot on Configuration GFSK/78 CH (2 480 MHz)



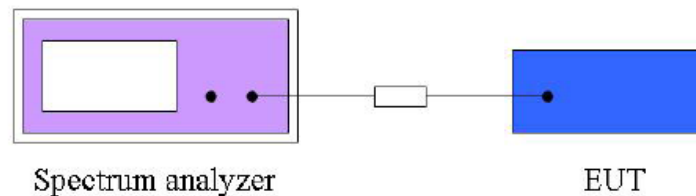


12. BAND EDGES MEASUREMENT

12.1 Operating Environment

Temperature : 22.0 °C
Relative Humidity : 41.0 % R.H.

12.2 Test Set-up (Layout)



12.3 Limit

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

12.4 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 11. 2010

12.5 Test Result

- . Test Date : January 8, 2010
- . Reference Standard : Part 15 Subpart C, Sec. 15.247(d)
- . Modulation : GFSK, QPSK, 8-DPSK
- . Operating Condition : Bluetooth RF transmitting mode
- . Power Source : DC 3.7 V supplied from the lithium polymer battery

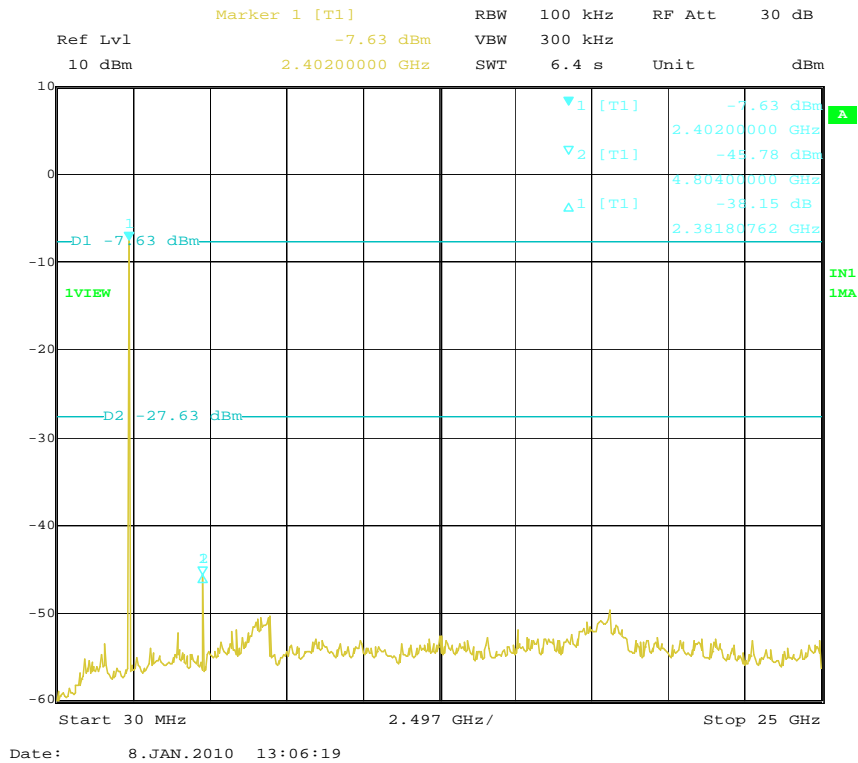
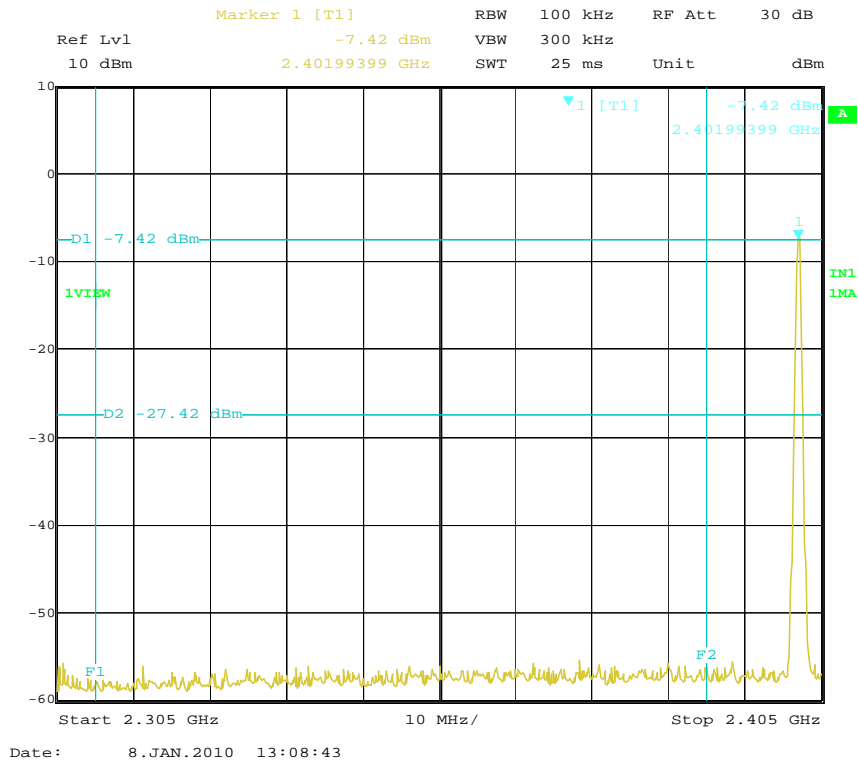
The spectrum plots are attached on the following 8 images. D1 line indicates the highest level, D2 line indicates the 20 dB offset below D1. It shows compliance with the requirement in part 15.247(d)

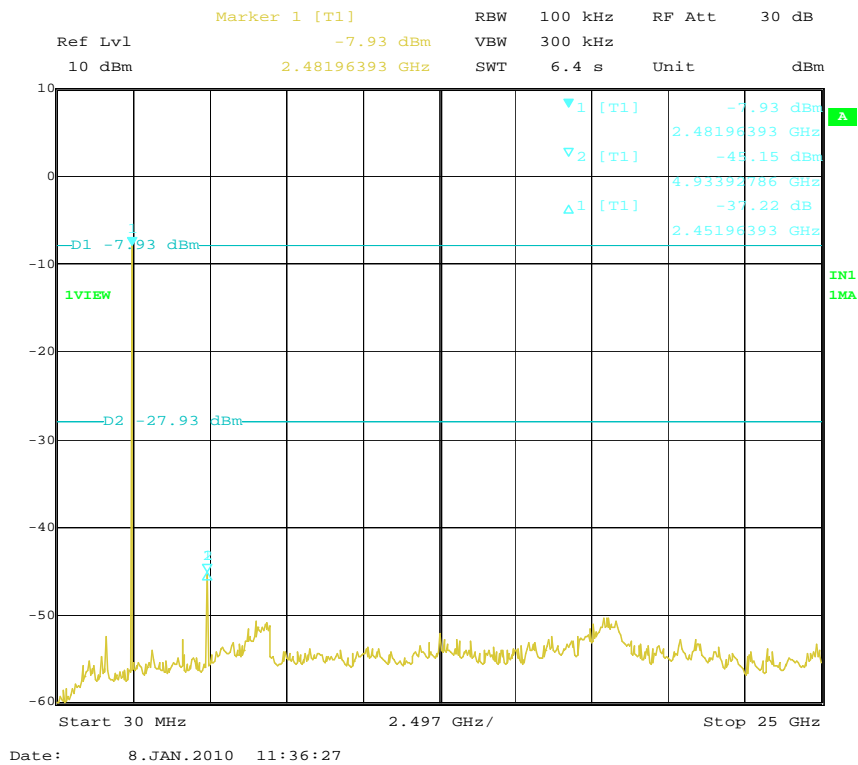
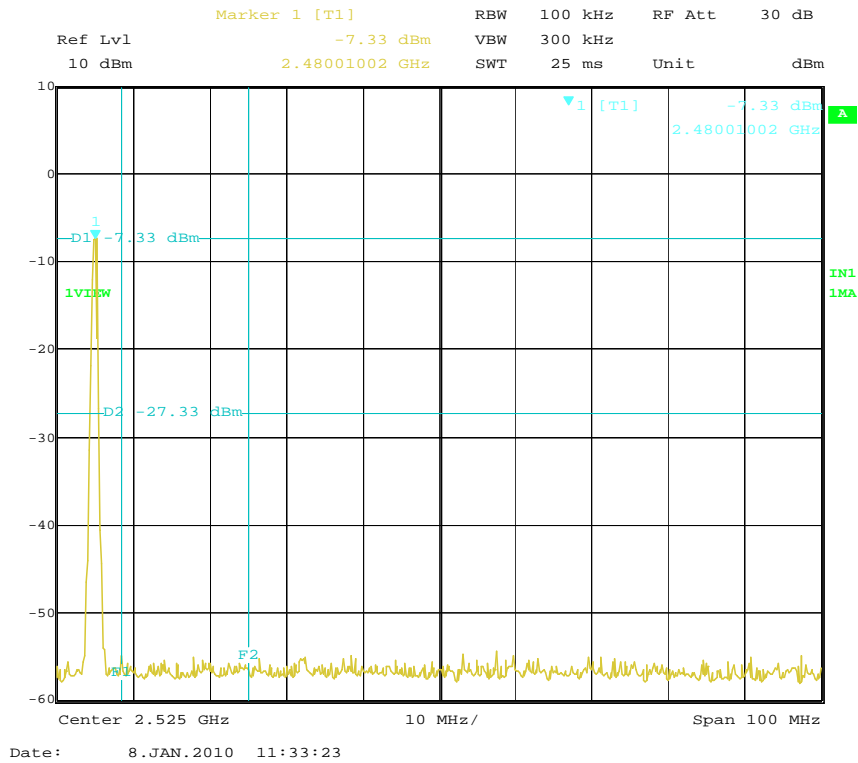
Spectrum Parameter

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



Band edge used Plot on Configuration GFSK







13. Radiated Emission

13.1 Operating Environment

Temperature : 21.0 °C
Relative Humidity : 45.0 % R.H.

13.2 Test Set-up

The formal radiated emission was measured at 3 m distance anechoic chamber.

The EUT was placed on a non-conductive turntable approximately 0.8 m above the ground plane.

The turntable with EUT was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels.

This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

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
Radiated emission (30 MHz ~ 300 MHz, 3m, Vertical)	± 3.54 dB	Confidence levels of 95 % (k=2)
Radiated emission (30 MHz ~ 300 MHz, 3m, Horizontal)	± 3.49 dB	Confidence levels of 95 % (k=2)
Radiated emission (300 MHz ~ 1 000 MHz, 3m, Vertical)	± 3.70 dB	Confidence levels of 95 % (k=2)
Radiated emission (300 MHz ~ 1 000 MHz, 3m, Horizontal)	± 3.61 dB	Confidence levels of 95 % (k=2)
Radiated emission (30 MHz ~ 300 MHz, 10m, Vertical)	± 3.21 dB	Confidence levels of 95 % (k=2)
Radiated emission (30 MHz ~ 300 MHz, 10m, Horizontal)	± 3.32 dB	Confidence levels of 95 % (k=2)
Radiated emission (300 MHz ~ 1 000 MHz, 10m, Vertical)	± 3.63 dB	Confidence levels of 95 % (k=2)
Radiated emission (300 MHz ~ 1 000 MHz, 10m, Horizontal)	± 3.69 dB	Confidence levels of 95 % (k=2)



13.4 Limit

20 dB 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



13.5 Test Equipment used

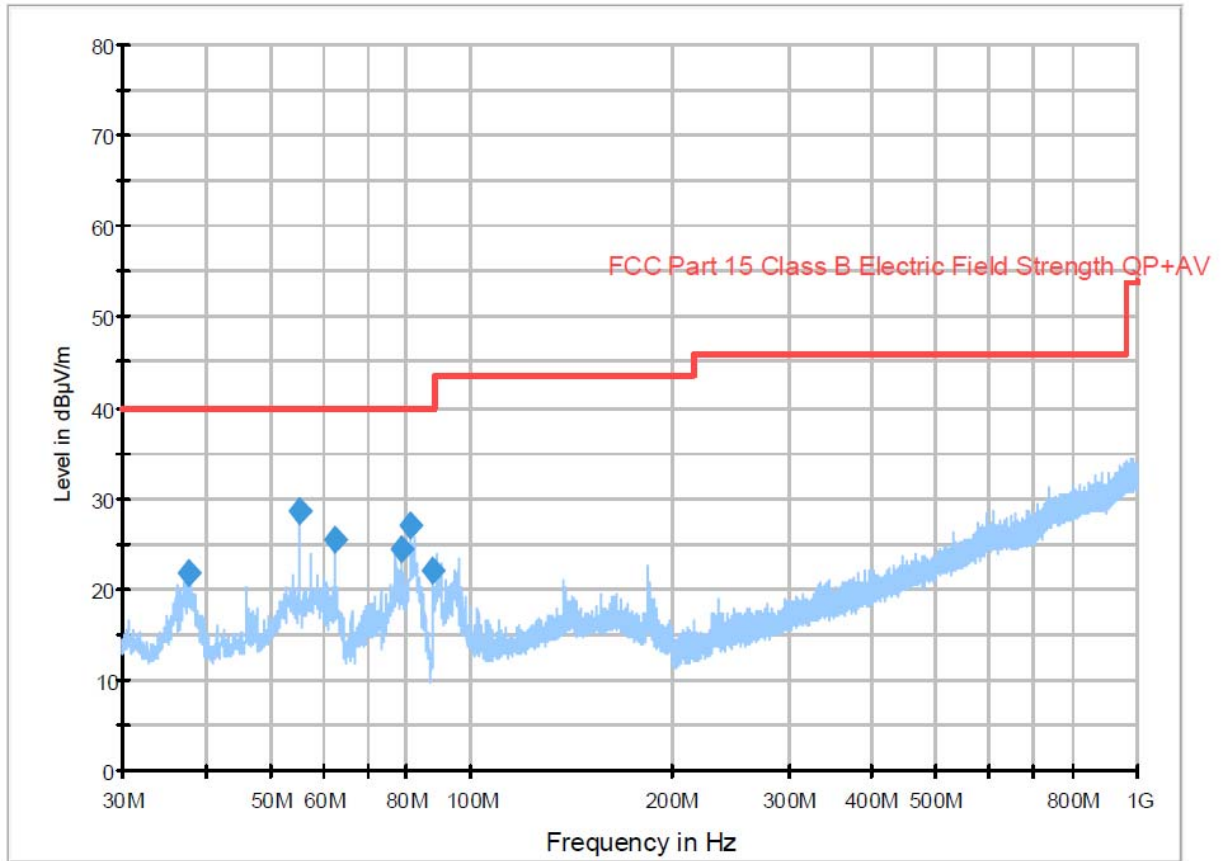
Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 11. 2010
■ - VULB9160	Schwarzbeck	Broadband test antenna	3099	07. 21. 2011
■ - MCU066	Maturo GmbH	Position Controller	1390306	N/A
■ - TT2.5SI	Maturo GmbH	Turntable	1390307	N/A
■ - AM4.0	Maturo GmbH	Antenna Mast	1390308	N/A
■ - BBHA9120D	Schwarzbeck	Horn antenna	597	12. 18. 2010
■ - 3160-09	ETS LINDGREN	Horn antenna	LM3423	04. 06. 2011
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258942	11. 12. 2010
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258943	11. 12. 2010

12.6 Radiated emission test data

- Test Date : January 13, 2010
- Reference Standard : Part 15 Subpart C, Sec. 15.247(d)
- Modulation / Channel : GFSK (0 CH / 39 CH / 78 CH)
- Operating Condition : Bluetooth RF transmitting mode
- Measuring Distance : 3 m
- 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 : 1. Through three orthogonal axes were investigated and the worst case is report
2. The EUT was tested with new battery.



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



Final Result 1

Frequency (MHz)	MaxPeak-MaxHold (dBμV/m)	Quasi-Peak (dBuB/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
37.640000	21.8	17.9	122.0	V	279.0	12.2	22.1	40.0
55.280000	28.6	25.6	125.0	V	265.0	13.1	14.4	40.0
62.680000	25.5	23.0	100.0	V	90.0	12.2	17.0	40.0
78.480000	24.4	20.9	144.0	V	255.0	9.6	19.1	40.0
81.160000	27.1	24.8	122.0	V	270.0	9.3	15.2	40.0
87.880000	22.1	19.4	100.0	V	90.0	9.4	20.6	40.0

Note:

The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.

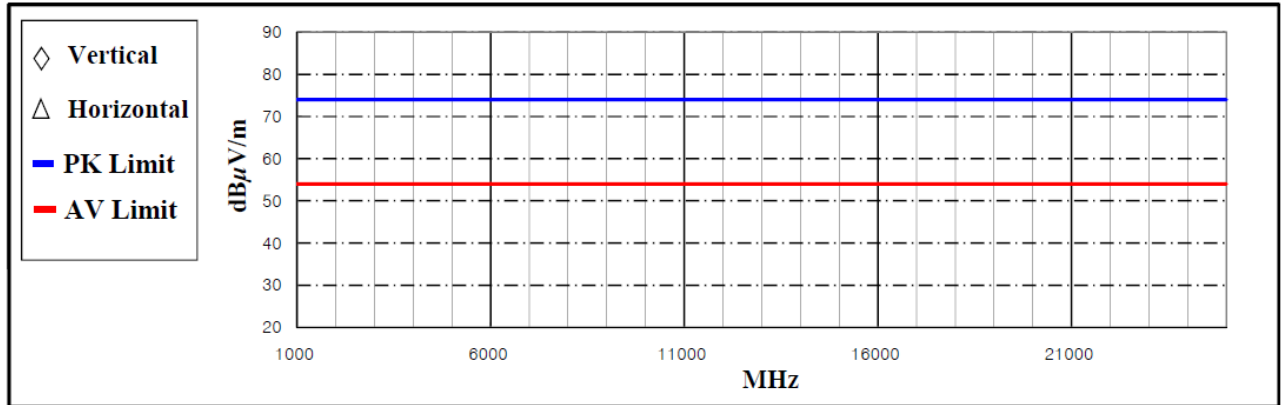
Emission level (dBμV/m) = 20 log Emission level (μV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read value = Test result



Worst case result of radiated emission (1 GHz to 25 GHz): GFSK

Frequency (MHz)	Measurement Level					Limit (dBμ V/m)		Margin (dB)		Positioning System		
	Reading Value (dBμ V/m)		AF	AMP / CL	Test Result (dBμ V/m)					Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average	Peak	Average	(H/V)	(cm)	(°)	
	All frequency				<<	<<						



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

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).

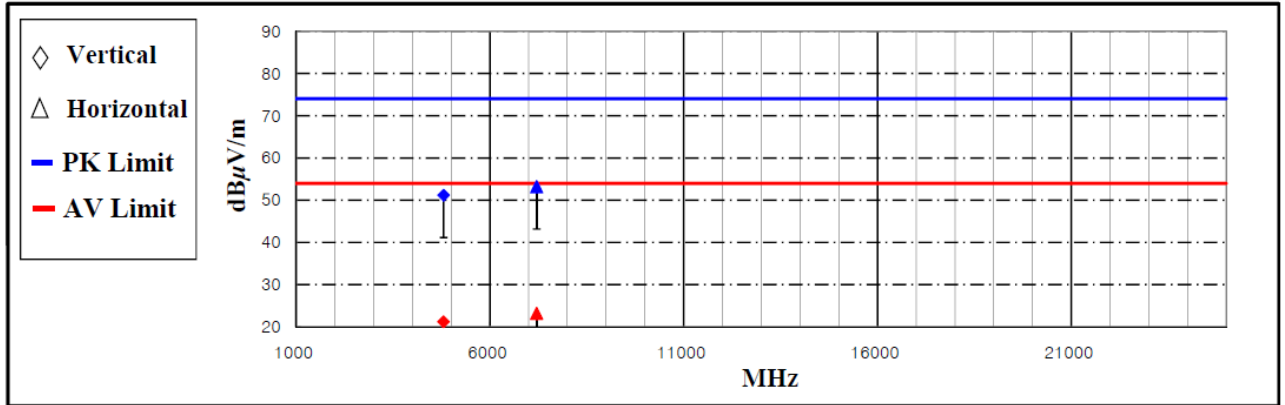
Corrected reading: Antenna factor + Cable loss + Preamplifier gain + Read value = Test result



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

(GFSK, 0 CH / 2402 MHz)

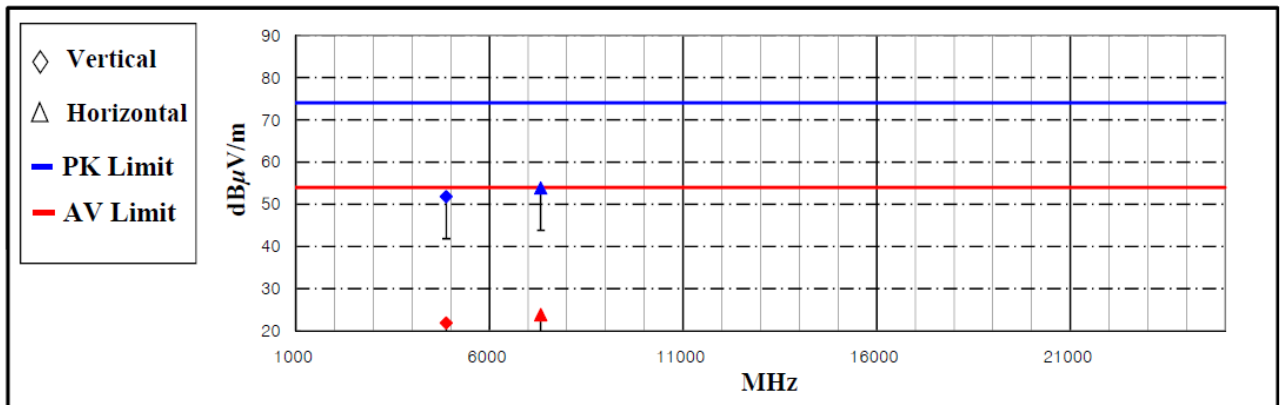
Frequency (MHz)	Measurement Level						Limit (dBμ V/m)		Margin (dB)		Positioning System		
	Reading Value (dBμ V/m)		AF	AMP / CL	Test Result (dBμ V/m)						Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average	Peak	Average	(H/V)	(cm)	(°)		
4804.00	53.62	23.62	31.35	-33.77	51.20	21.20	74.00	54.00	22.80	32.80	V	112	180
7206.00	45.74	15.74	36.18	-28.72	53.20	23.20	74.00	54.00	20.80	30.80	H	154	277



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

(GFSK, 39 CH / 2441 MHz)

Frequency (MHz)	Measurement Level						Limit (dB μ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB μ V/m)		AF	AMP / CL	Test Result (dB μ V/m)						Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average	(H/V)	(cm)	(°)				
4882.00	54.49	24.49	31.52	-34.16	51.85	21.85	74.00	54.00	22.15	32.15	V	115	198
7323.00	45.90	15.90	36.34	-28.39	53.85	23.85	74.00	54.00	20.15	30.15	H	157	260

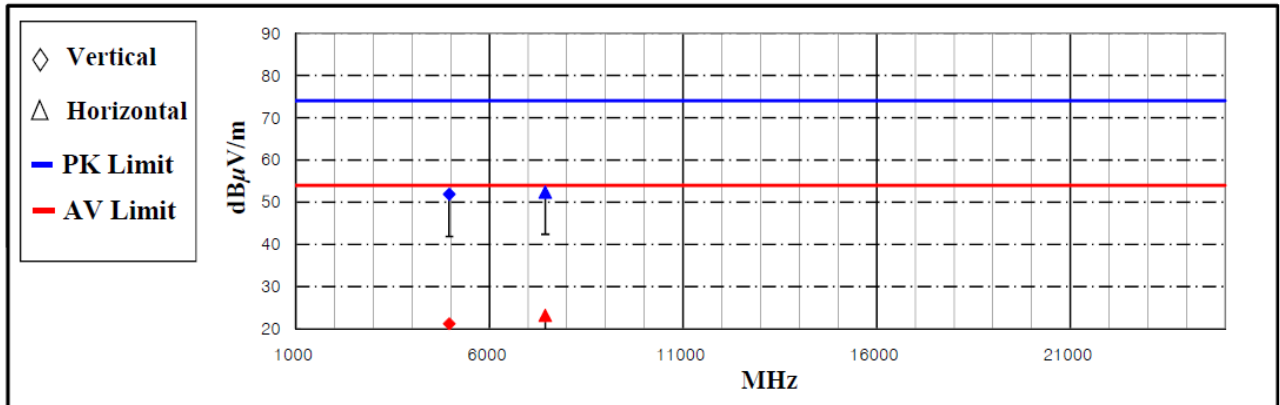


*Comment : AMP/CL_Cable loss value + AMP gain value
AF : Antenna factor value
Pol. : H(Horizontal), V(Vertical)



(GFSK, 78 CH / 2480 MHz)

Frequency (MHz)	Measurement Level						Limit (dBμ V/m)		Margin (dB)		Positioning System		
	Reading Value (dBμ V/m)		AF	AMP / CL	Test Result (dBμ V/m)						Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average	Peak	Average	(H/V)	(cm)	(°)		
4960.00	54.41	23.71	31.70	-34.21	51.90	21.20	74.00	54.00	22.10	32.80	V	110	175
7440.00	43.96	14.76	36.50	-28.06	52.40	23.20	74.00	54.00	21.60	30.80	H	145	266



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

Note:

The DH5 packet was the worse case duty for a transmit dwell time on a each channel, based upon Bluetooth theory the transmitter is on 0.625 * 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor is equal to:

$$20\log(3.125/100) = -30 \text{ dB.}$$

$$\text{Average value} = \text{peak reading} - 20\log(\text{duty cycle}) = \text{peak value} - 30 \text{ dB}$$

$$\text{Emission level (dB}\mu\text{V/m)} = 20 \log \text{Emission level } (\mu\text{V/m}).$$

$$\text{Corrected Reading: Reading value} + \text{AF (Antenna Factor)} + \text{AMP/CL (Cable Loss + Preamp factor)} = \text{Test result}$$