

FCC EVALUATION REPORT FOR CERTIFICATION

**Applicant: Seyoung Information &
Telecommunication Co., Ltd.**
298-2, Gongdan-dong, Gumi-Si,
Gyeongsangbuk-do, South Korea
Attn: Mr. Hee-Jin Lee / Researcher

Date of Issue: November 30, 2011
Order Number: GETEC-C1-11-249
Test Report Number: GETEC-E3-11-126
Test Site: Gumi College EMC Center
FCC Registration Number: (100749, 443957)

FCC ID. : ZABSH-320B

Applicant : Seyoung Information & Telecommunication 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	: Digital Wireless Audio Solution
Type of Authority	: Certification
Model Name	: SH-320


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,


Seung-Chul Lee, Associate Engineer
GUMI College EMC center


Jae-Hoon Jeong, Senior Engineer
GUMI College EMC center



CONTENTS

1. GENERAL INFORMATION	4
2. INTRODUCTION	5
3. PRODUCT INFORMATION	6
3.1 DESCRIPTION OF EUT.....	6
3.2 SUPPORT EQUIPMENT / CABLES USED	7
3.3 MODIFICATION ITEM(S)	7
4. DESCRIPTION OF TESTS.....	8
4.1 TEST CONDITION.....	8
5. ANTENNA REQUIREMENT - §15.203	8
5.1 DESCRIPTION OF ANTENNA.....	8
5.2 CONDUCTED EMISSION	9
5.3 RADIATED EMISSION.....	10
6. CONDUCTED EMISSION.....	11
6.1 OPERATING ENVIRONMENT	11
6.2 TEST SET-UP	11
6.3 MEASUREMENT UNCERTAINTY.....	11
6.4 LIMIT	12
6.5 TEST EQUIPMENT USED.....	12
6.6 TEST DATA FOR CONDUCTED EMISSION	12
7. NUMBER OF HOPPING FREQUENCY USED	14
7.1 OPERATING ENVIRONMENT	14
7.2 TEST SET-UP (LAYOUT)	14
7.3 LIMIT	14
7.4 TEST EQUIPMENT USED.....	14
7.5 TEST RESULT	14
8. DWELL TIME ON EACH CHANNEL.....	16
8.1 OPERATING ENVIRONMENT	16
8.2 TEST SET-UP (LAYOUT)	16
8.3 LIMIT	16
8.4 TEST EQUIPMENT USED.....	16
8.5 TEST RESULT	16
9. CHANNEL BANDWIDTH	18
9.1 OPERATING ENVIRONMENT.....	18
9.2 TEST SET-UP (LAYOUT)	18
9.3 LIMIT	18
9.4 TEST EQUIPMENT USED.....	18
9.5 TEST RESULT	18
10. LIMIT OF HOPPING CHANNEL SEPARATION	21
10.1 OPERATING ENVIRONMENT	21
10.2 TEST SET-UP (LAYOUT)	21
10.3 LIMIT	21
10.4 TEST EQUIPMENT USED.....	21
10.5 TEST RESULT	21



11. MAXIMUM PEAK OUTPUT POWER	24
11.1 OPERATING ENVIRONMENT	24
11.2 TEST SET-UP (LAYOUT)	24
11.3 LIMIT	24
11.4 TEST EQUIPMENT USED.....	24
11.5 TEST RESULT	24
12. BAND EDGES MEASUREMENT.....	25
12.1 OPERATING ENVIRONMENT	25
12.2 TEST SET-UP (LAYOUT)	25
12.3 LIMIT	25
12.4 TEST EQUIPMENT USED.....	25
12.5 TEST RESULT	25
13. RADIATED EMISSION	28
13.1 OPERATING ENVIRONMENT	28
13.2 TEST SET-UP	28
13.3 MEASUREMENT UNCERTAINTY.....	28
12.4 LIMIT	28
13.5 TEST EQUIPMENT USED.....	29
13.6 RADIATED EMISSION TEST DATA	29
 APPENDIX A – ATTESTATION STATEMENT	
APPENDIX B – LABELLING	
APPENDIX C – BLOCK DIAGRAM	
APPENDIX D – SCHEMATIC DIAGRAM	
APPENDIX E – TEST SETUP PHOTOGRAPH	
APPENDIX F – EXTERNAL PHOTOGRAPH	
APPENDIX G – INTERNAL PHOTOGRAPH	
APPENDIX H – USER’S MANUAL	
APPENDIX I – OPERATIONAL DESCRIPTION	
APPENDIX J – ANTENNA SPECIFICATION	
APPENDIX K – PART LIST	
APPENDIX L – RF EXPOSURE EVALUATION	



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: Seyoung Information & Telecommunication Co., Ltd.

Applicant address: 298-2, Gongdan-dong, Gumi-Si, Gyeongsangbuk-do, South Korea

Manufacturer: Seyoung Information & Telecommunication Co., Ltd.

Manufacturer address: 298-2, Gongdan-dong, Gumi-Si, Gyeongsangbuk-do, South Korea

Contact person: Mr. Hee-Jin Lee / Researcher

Telephone number: +82-53-815-5864 Fax number: +82-53-815-5862

- **FCC ID.** ZABSH-320B
- **Equipment Class** Spread Spectrum Transmitter (DSS)
- **EUT Type** Digital Wireless Audio Solution
- **Model Name** SH-320
- **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** November 17 ~ 21, 2011
- **Place of Test** **Gumi College EMC Center** (FCC Registration No.: 100749, 443957)
407, Bugok-Dong, Gumi-si, Gyeongsangbuk-Do, Korea
- **Test Report Number** GETEC-E3-11-126
- **Dates of Issue** November 30, 2011



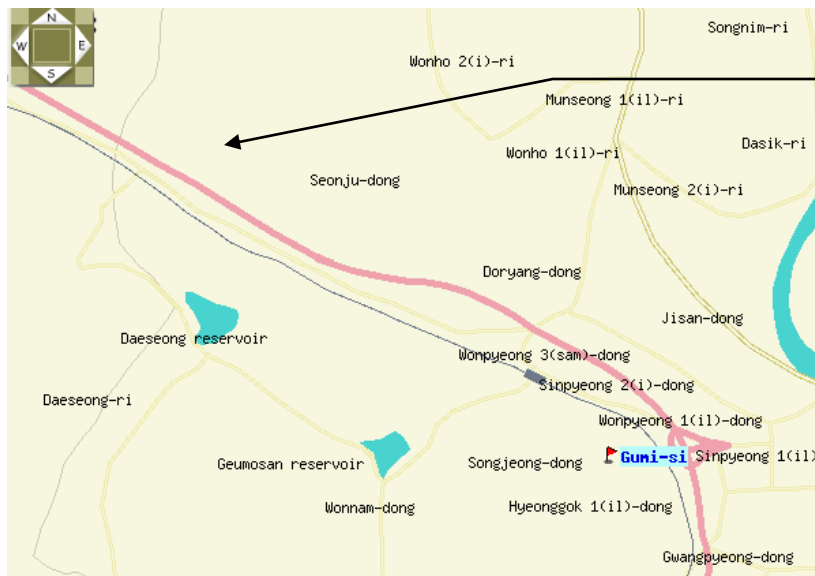
2. Introduction

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 **Seyoung Information & Telecommunication Co., Ltd. Digital Wireless Audio Solution (Model name: SH-320)**

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



GUMI COLLEGE EMC CENTER
407,Bugok-Dong, Gumi-si,
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 **Seyoung Information & Telecommunication Co., Ltd. Digital Wireless Audio Solution (Model Name: SH-320) FCC ID.: ZABSH-320B**

- . Frequency** : 2 408 MHz – 2 475 MHz
- . Service Coverage** : 30 m ~ 100 m (L.O.S)
- . Maximum Data Rate** : 800 kbps
- . Operation Time** : Max 13 hour (in slave mode)
Max 9 hour (in master mode)
- . Charging Time** : 2 hour
- . Battery Type** : Lithium-polymer
- . Power Requirement** : DC 5 V (USB port), DC 3.7 V supplied from the lithium polymer battery
- . Weight** : 39 g
- . Dimension (W × H × D)** : 65 mm × 32 mm × 22 mm

-. Frequency List

Channel	1 Group (MHz)	2 Group (MHz)	3 Group (MHz)	4 Group (MHz)
1	2 410	2 408	2 411	2 409
2	2 414	2 412	2 415	2 413
3	2 418	2 416	2 419	2 417
4	2 422	2 420	2 423	2 421
5	2 426	2 424	2 427	2 425
6	2 430	2 428	2 431	2 429
7	2 435	2 433	2 436	2 434
8	2 440	2 438	2 441	2 439
9	2 445	2 443	2 446	2 444
10	2 450	2 448	2 451	2 449
11	2 454	2 452	2 455	2 453
12	2 458	2 456	2 459	2 457
13	2 462	2 460	2 463	2 461
14	2 466	2 464	2 467	2 465
15	2 470	2 468	2 471	2 469
16	2 474	2 472	2 475	2 473



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 System configuration

Description	Manufacturer	Model Name	S/N & FCC ID.
None	-	-	S/N: - FCC ID.: -

3.2.3 Used Cable(s)

Cable Name	Condition	Description
USB(power) gender cable	Connected to the EUT and notebook PC	0.60 m 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 (Charging mode)
 - DC 3.7 V supplied from the lithium polymer battery
- Test Mode(s): Executed “Serial COM(RF setting value: 3(Manufacturer spec: 1 ~ 4))” to control the EUT continuously transmit RF signal

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 **Seyoung Information & Telecommunication Co., Ltd. Digital Wireless Audio Solution** comply with the requirement of §15.203 with a 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

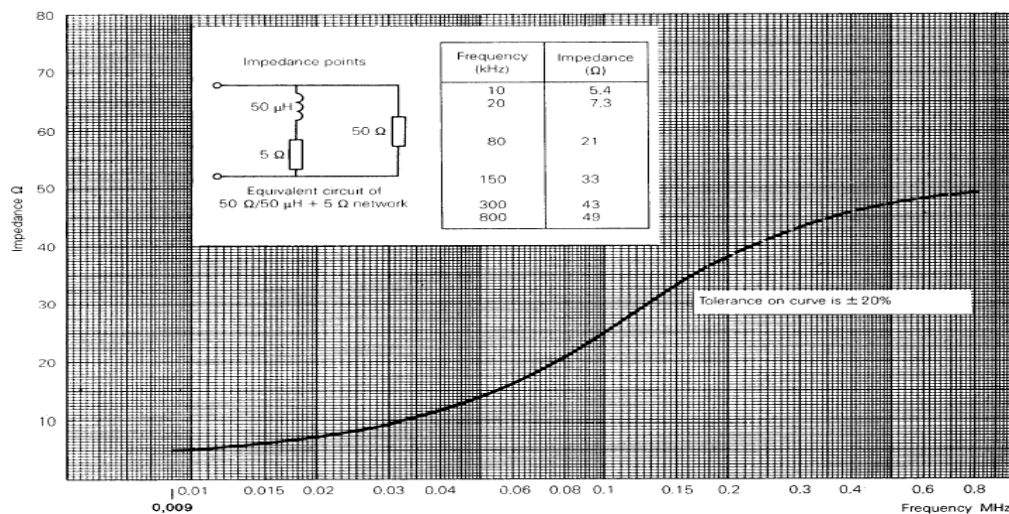


Fig 2. Impedance of LISN



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 \times 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

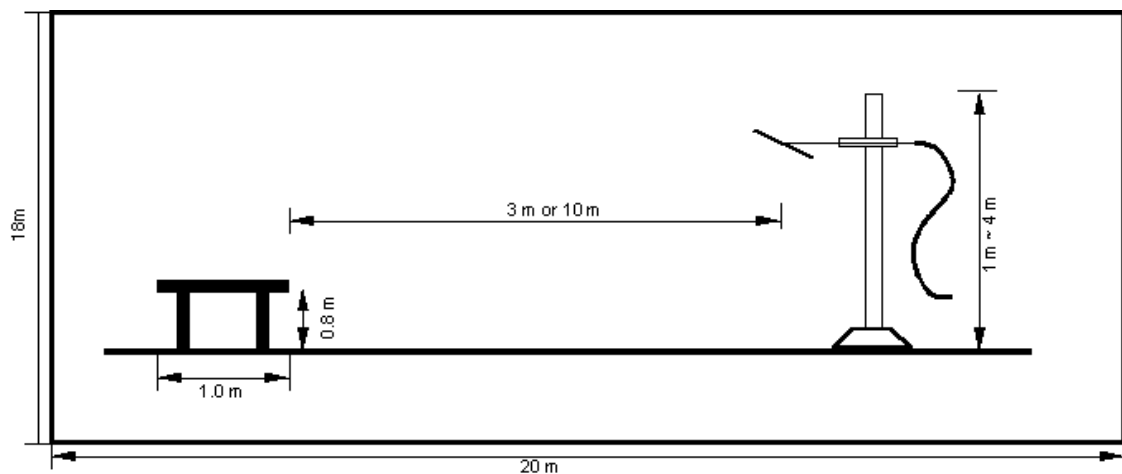


Fig 3. Dimensions of test site.



6. CONDUCTED EMISSION

6.1 Operating Environment

Temperature : 20.0 °C
Relative Humidity : 37.0 % 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 & ISN.

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)	± 2.71 dB	Confidence levels of 95 % ($k = 2$)
Conducted emission (150 kHz ~ 30 MHz)	± 3.34 dB	Confidence levels of 95 % ($k = 2$)



6.4 Limit

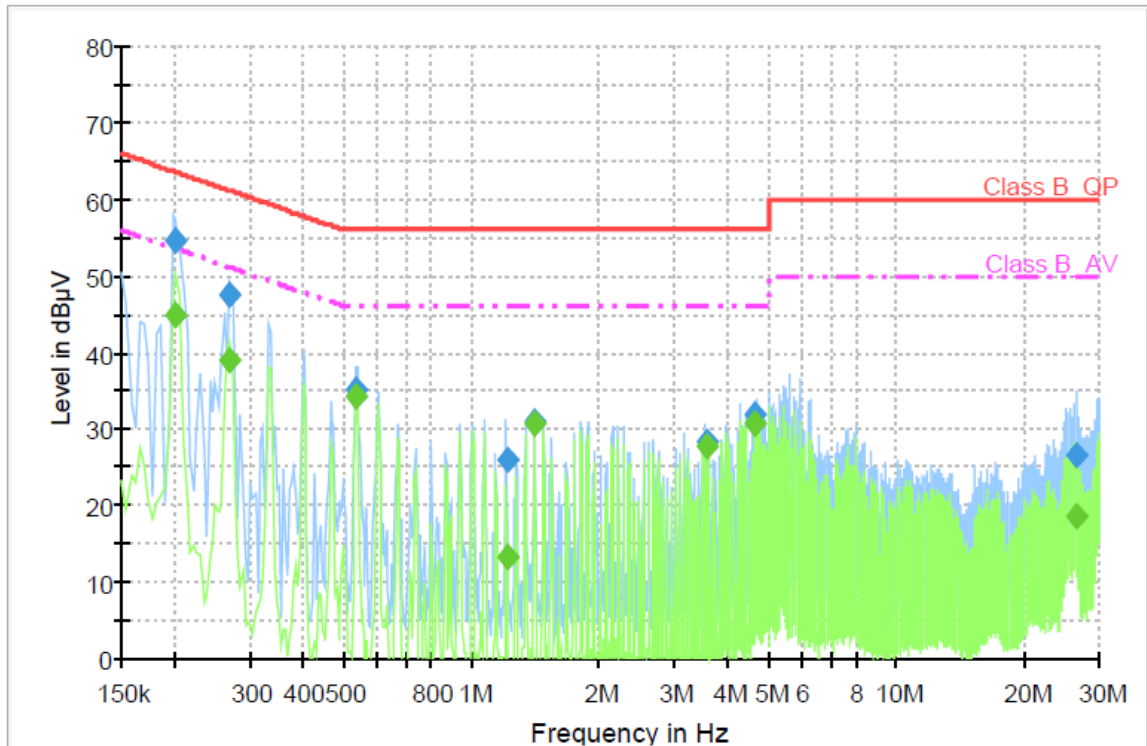
RFI Conducted	FCC Limit(dB μ V/m) Class B	
Freq. Range	Quasi-Peak	Average
150 kHz ~ 0.5 MHz	66 ~ 56*	56 ~ 46*
0.5 MHz ~ 5 MHz	56	46
5 MHz ~ 30 MHz	60	50
*Limits decreases linearly with the logarithm of frequency.		

6.5 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESCS30	Rohde & Schwarz	EMI Test Receiver	839809/003	12. 10. 2011
□ - ESH3-Z5	Rohde & Schwarz	LISN	838979/020	12. 10. 2011
■ - ESH2-Z5	Rohde & Schwarz	LISN	829991/009	12. 10. 2011
□ - ENY81-CA6	Rohde & Schwarz	ISN	101573	10. 27. 2011

6.6 Test data for Conducted Emission

- Test Date : November 21, 2011
- Resolution Bandwidth : 9 kHz
- Frequency Range : 0.15 MHz ~ 30 MHz
- Line : L1: Live line, N: Neutral line



Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.202000	54.5	1000.0	9.000	GND	L1	10.0	9.0	63.5	
0.268000	47.4	1000.0	9.000	GND	N	10.0	13.8	61.2	
0.536000	35.3	1000.0	9.000	GND	L1	10.0	20.7	56.0	
1.212000	26.0	1000.0	9.000	GND	N	10.1	30.0	56.0	
1.412000	30.9	1000.0	9.000	GND	L1	10.1	25.1	56.0	
3.568000	28.4	1000.0	9.000	GND	L1	10.2	27.6	56.0	
4.648000	32.0	1000.0	9.000	GND	N	10.2	24.0	56.0	
26.480000	26.5	1000.0	9.000	GND	N	10.8	33.5	60.0	

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.202000	44.9	1000.0	9.000	GND	L1	10.0	8.6	53.5	
0.268000	39.0	1000.0	9.000	GND	N	10.0	12.1	51.2	
0.536000	34.3	1000.0	9.000	GND	L1	10.0	11.7	46.0	
1.212000	13.3	1000.0	9.000	GND	N	10.1	32.7	46.0	
1.412000	30.6	1000.0	9.000	GND	L1	10.1	15.4	46.0	
3.568000	27.9	1000.0	9.000	GND	L1	10.2	18.1	46.0	
4.648000	30.7	1000.0	9.000	GND	N	10.2	15.3	46.0	
26.480000	18.5	1000.0	9.000	GND	N	10.8	31.5	50.0	

< Fig 4. Conducted emission result >

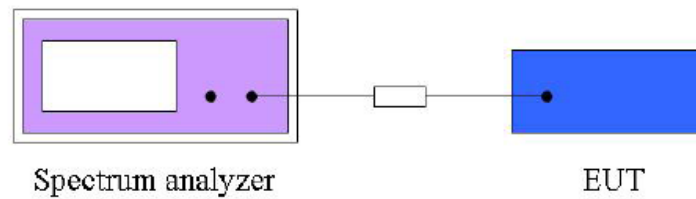


7. NUMBER OF HOPPING FREQUENCY USED

7.1 Operating Environment

Temperature : 22.0 °C
Relative Humidity : 48.0 % 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
■ - ESIB26	Rohde & Schwarz	EMI Test Receiver	830482/010	12. 10. 2011

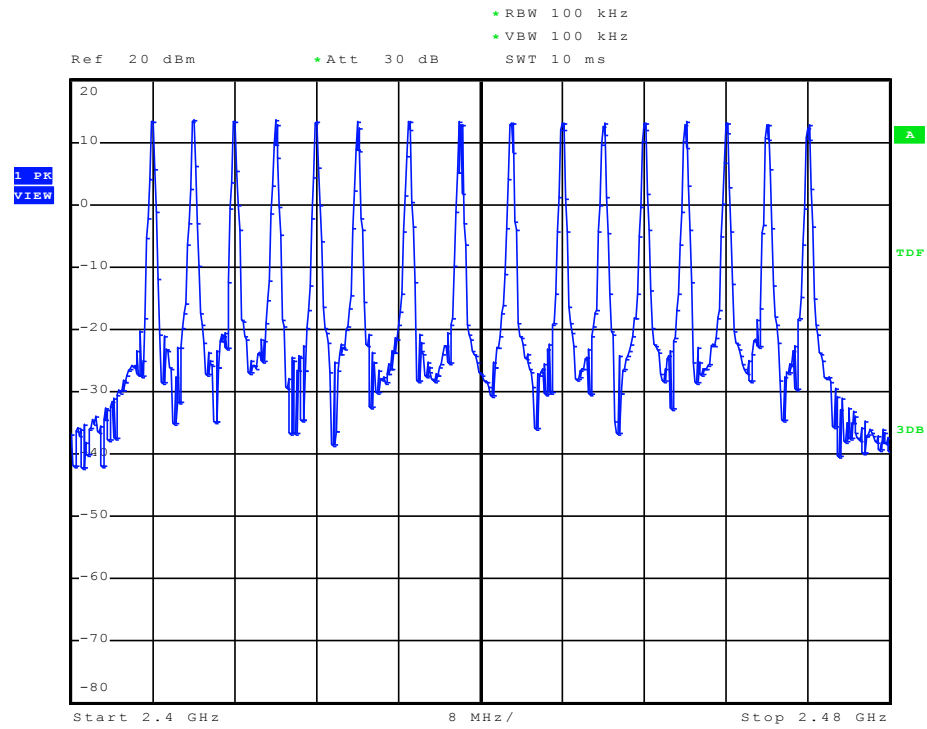
7.5 Test Result

- Test Date : November 20, 2011
- Reference Standard : Part 15 Subpart C, Sec. 15.247(a)(1)(iii)
- Modulation : GFSK
- Operating Condition : RF transmitting mode
- Power Source : DC 3.7 V supplied from the lithium polymer battery

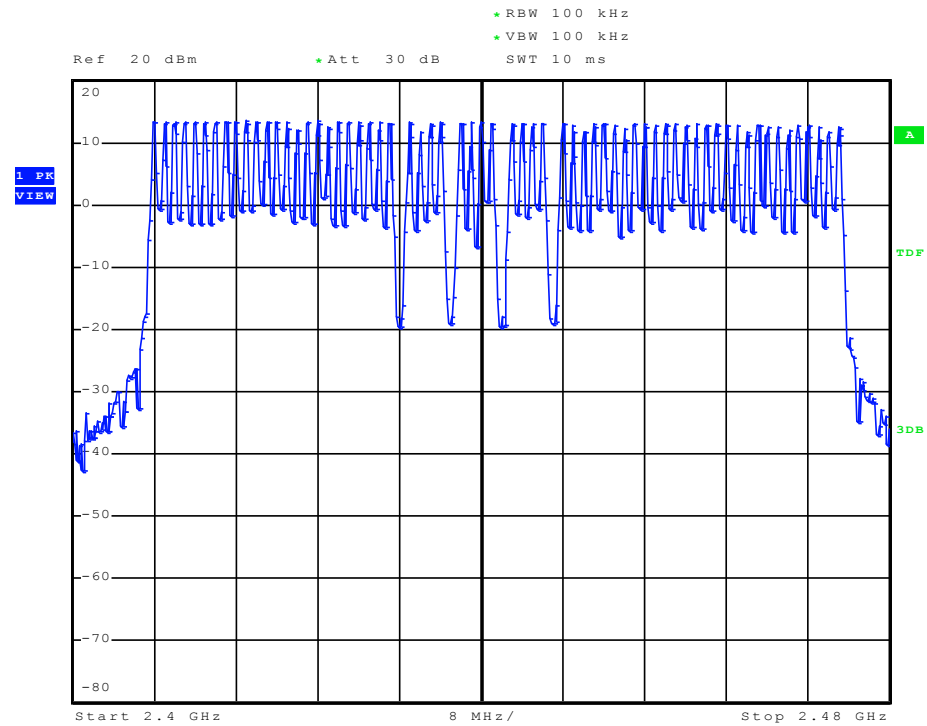
Modulation	Total channel No.	Hopping channel No.	Limit	Result
GFSK	64	16	> 15	Complies



Number of Hopping frequency used Plot on Configuration GFSK (3 Group / 16 channel hopping)



Number of Hopping frequency used Plot on Configuration GFSK (Total channel hopping)



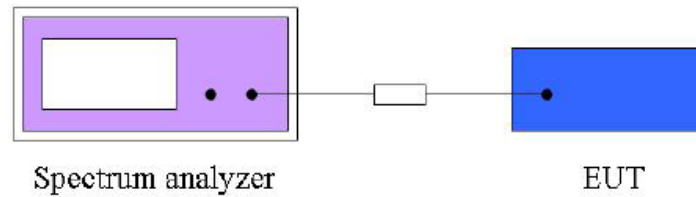


8. DWELL TIME ON EACH CHANNEL

8.1 Operating Environment

Temperature : 22.0 °C
Relative Humidity : 48.0 % 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
■ - ESIB26	Rohde & Schwarz	EMI Test Receiver	830482/010	12. 10. 2011

8.5 Test Result

- Test Date : November 20, 2011
- Reference Standard : Part 15 Subpart C, Sec. 15.247(a)(1)(iii)
- Modulation : GFSK
- Operating Condition : RF transmitting mode
- Power Source : DC 3.7 V supplied from the lithium polymer battery

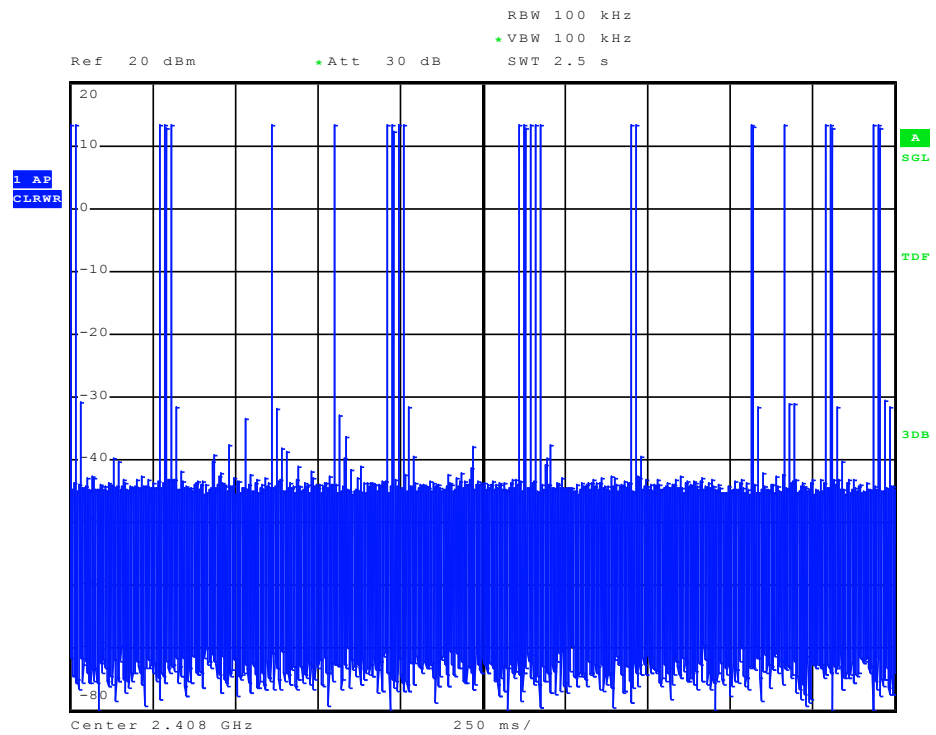
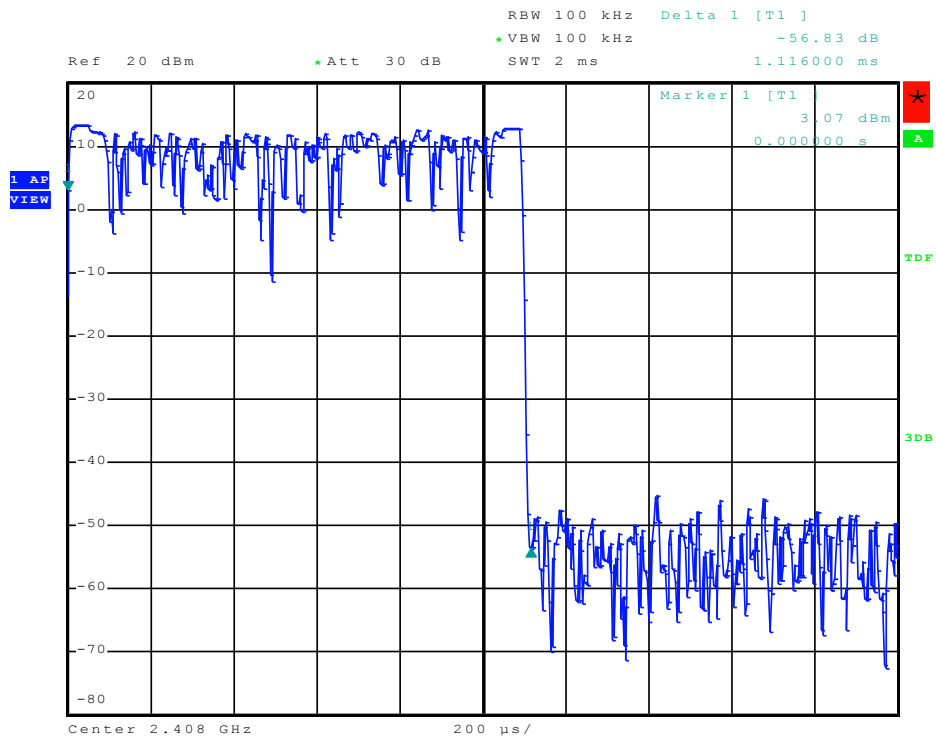
Spectrum Parameter

- Attenuation : Auto
- Span frequency : zero
- Resolution band width : 100 kHz
- Video band with : 100 kHz
- Sweep time : 2.5 s

Mode	Number of transmission in a 6.4 (16 Hopping * 0.4)	Length of transmission time (ms)	Measured (ms)	Limit (ms)	Result
GFSK	29 (times / 2.5 s) * 2.56 = 74.24	1.116	82.851	400	Complies



Dwell time on each time used Plot on Configuration GFSK



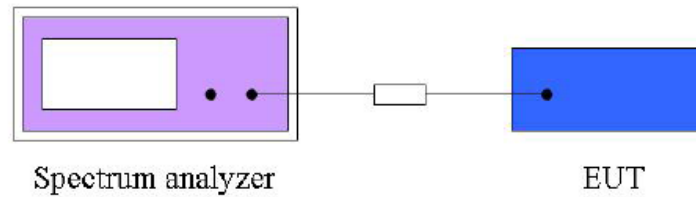


9. CHANNEL BANDWIDTH

9.1 Operating environment

Temperature : 22.0 °C
Relative Humidity : 48.0 % 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
■ - ESIB26	Rohde & Schwarz	EMI Test Receiver	830482/010	12. 10. 2011

9.5 Test result

- Test Date : November 20, 2011
- Reference Standard : Part 15 Subpart C, Sec. 15.247(a)(1)(iii)
- Modulation : GFSK
- Operating Condition : RF transmitting mode
- Power Source : DC 3.7 V supplied from the lithium polymer battery

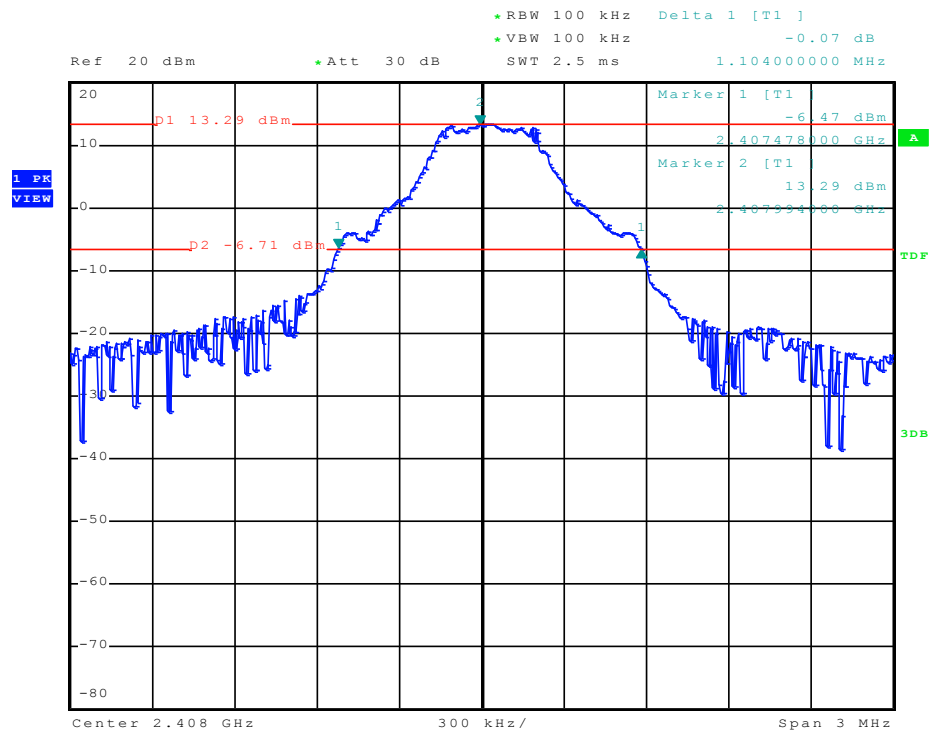
Spectrum Parameter

- Attenuation : Auto
- Span frequency : zero
- Resolution band width : 100 kHz
- Video band with : 100 kHz
- Sweep time : 2.5 ms

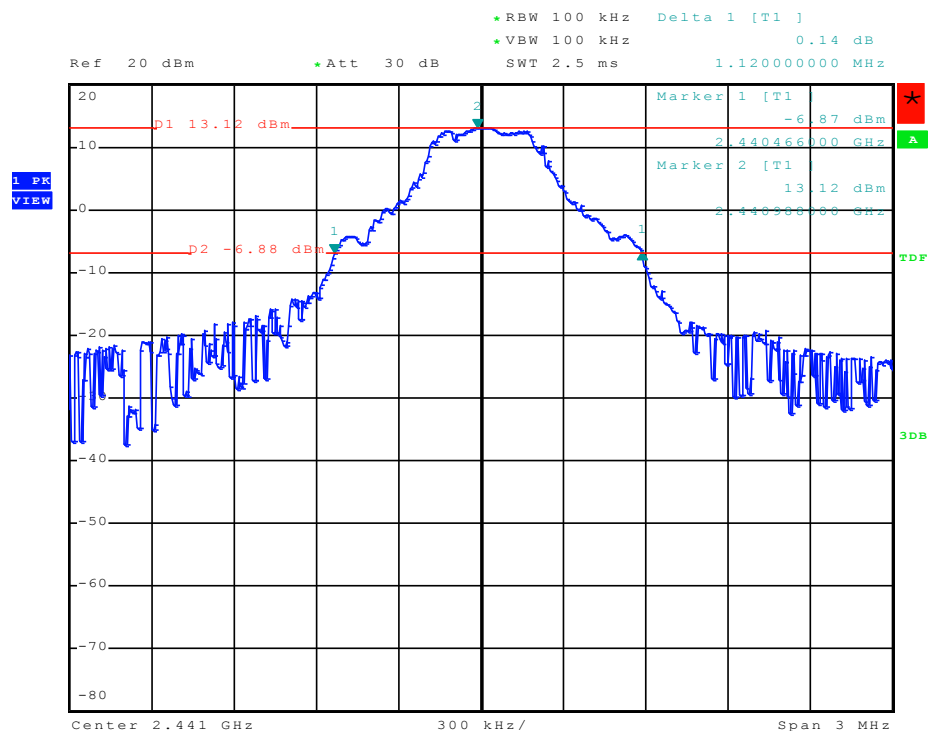
Group / Channel	Channel frequency (MHz)	20 dB bandwidth (MHz)	Result
2 Group / 1 CH	2 408	1.104	Complies
3 Group / 8 CH	2 441	1.120	Complies
3 Group / 16 CH	2 475	1.116	Complies



Channel bandwidth used Plot on Configuration GFSK/2 Group, 1 CH (2 408 MHz)

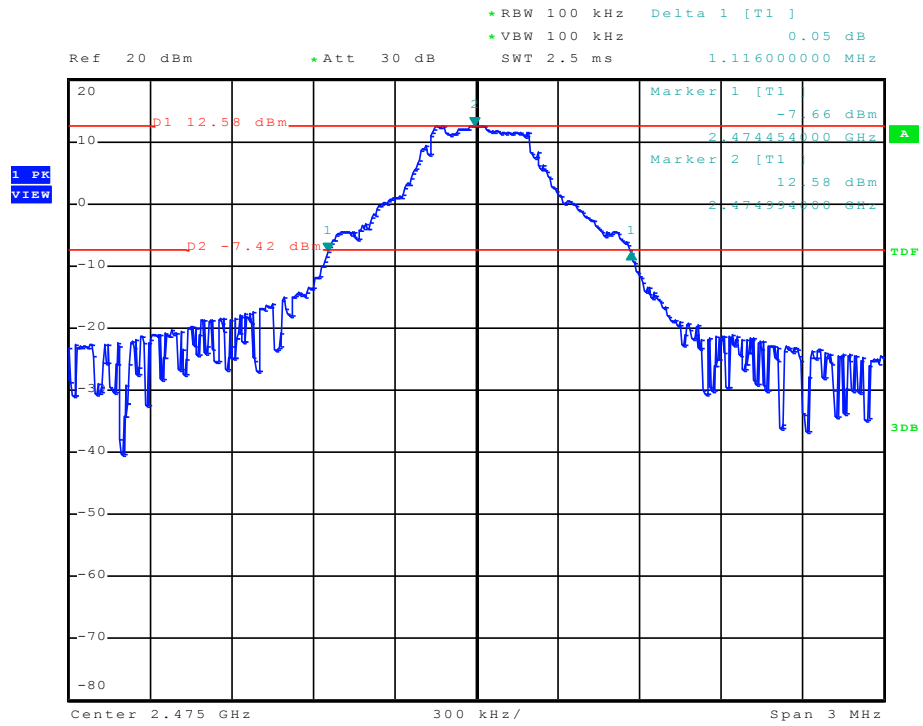


Channel bandwidth used Plot on Configuration GFSK/3 Group, 8 CH (2 441 MHz)





Channel bandwidth used Plot on Configuration GFSK/3 Group, 16 CH (2 475 MHz)



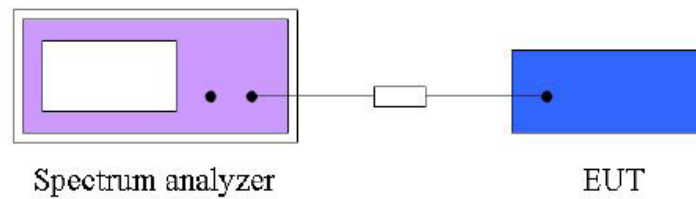


10. LIMIT OF HOPPING CHANNEL SEPARATION

10.1 Operating Environment

Temperature : 22.0 °C
Relative Humidity : 48.0 % 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
■ - ESIB26	Rohde & Schwarz	EMI Test Receiver	830482/010	12. 10. 2011

10.5 Test Result

- Test Date : November 20, 2011
 - Reference Standard : Part 15 Subpart C, Sec. 15.247(a)(1)
 - Modulation : GFSK
 - Operating Condition : RF transmitting mode
 - Power Source : DC 3.7 V supplied from the lithium polymer battery

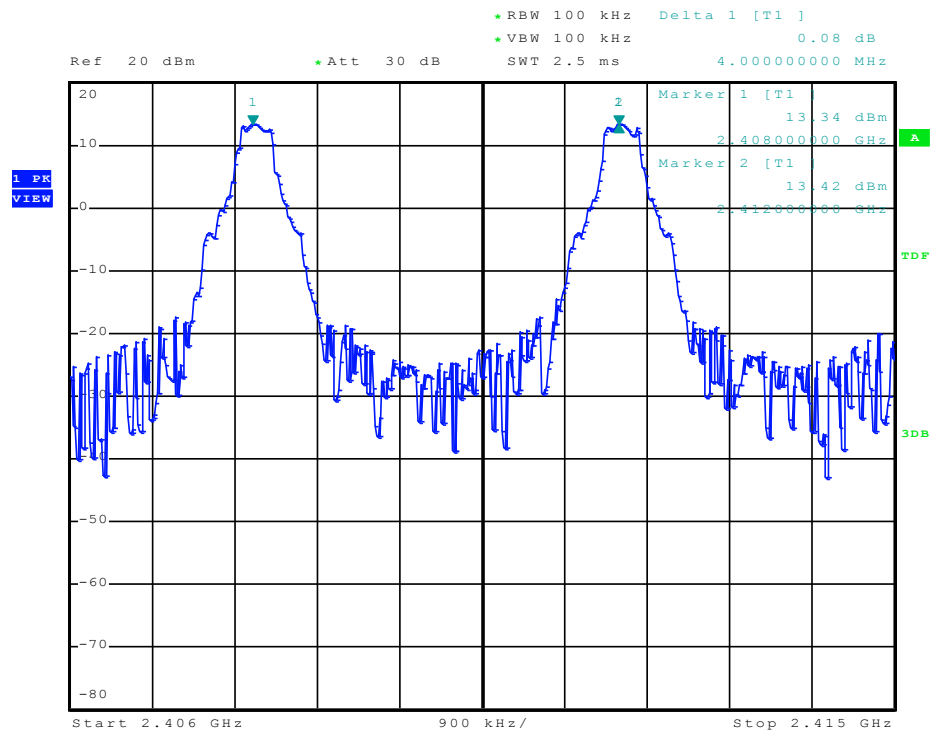
Spectrum Parameter

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

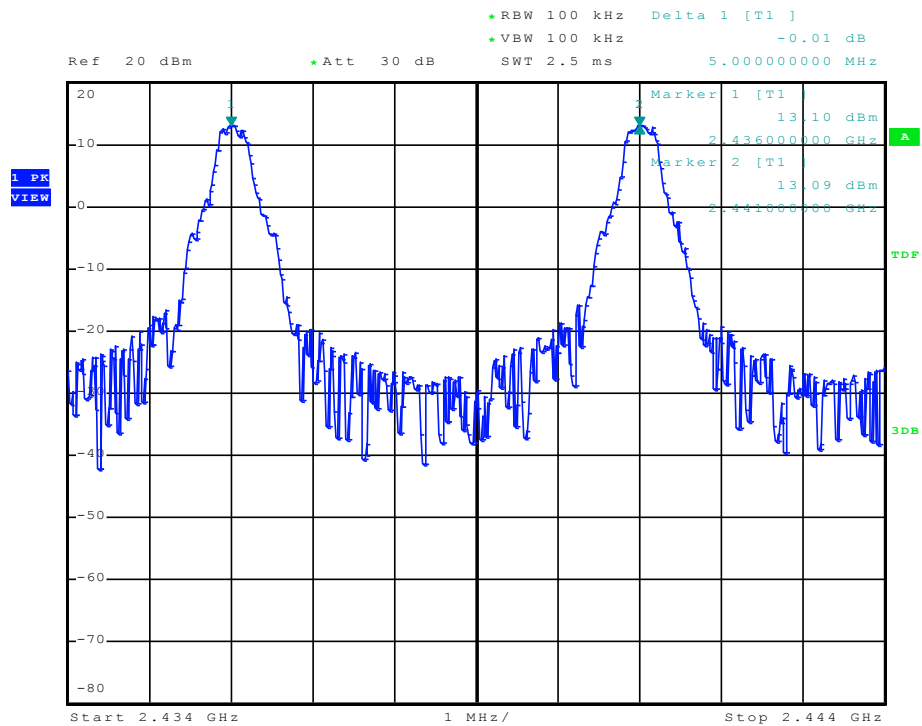
Group / Channel	Channel frequency (MHz)	Adjacent channel Separation (MHz)	Limit (MHz) [2/3 of 20 dB bandwidth]	Result
2 Group / 1 CH	2 408	4	> 0.736	Complies
3 Group / 8 CH	2 441	5	> 0.747	Complies
3 Group / 16 CH	2 475	4	> 0.744	Complies



Channel separation used Plot on Configuration GFSK/2 Group, 1 CH (2 408 MHz)

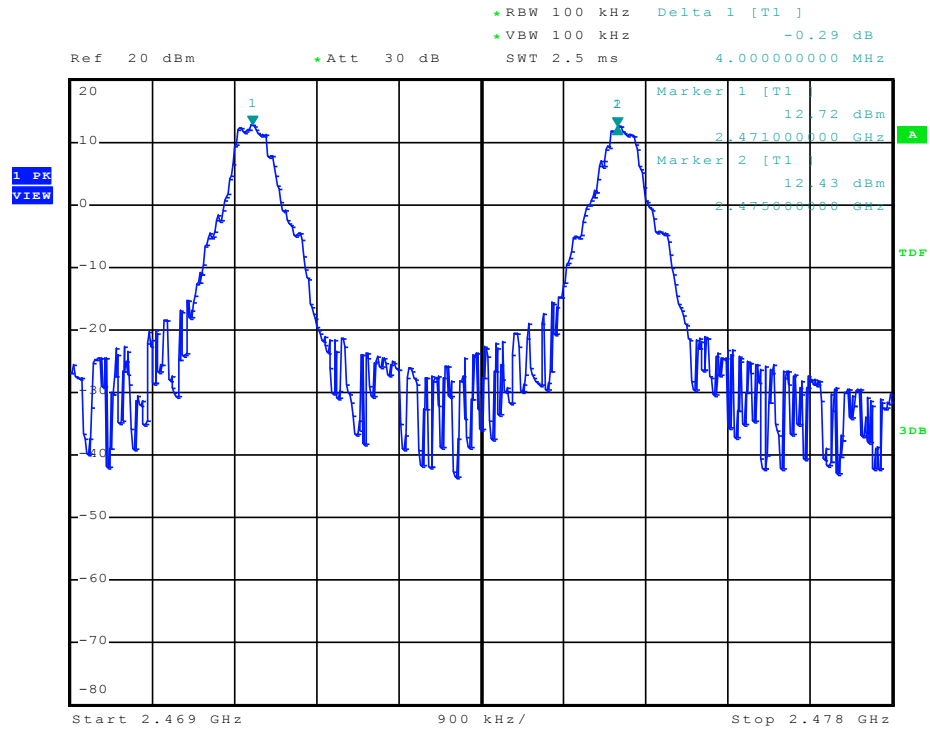


Channel separation used Plot on Configuration GFSK/3 Group, 8 CH (2 441 MHz)





Channel separation used Plot on Configuration GFSK/3 Group, 16 CH (2 475 MHz)



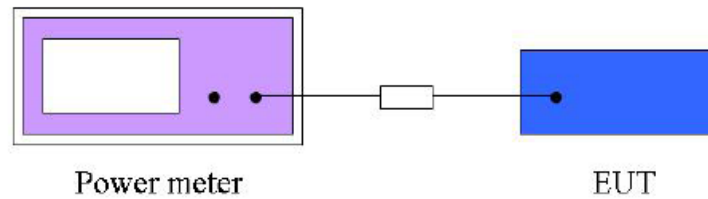


11. MAXIMUM PEAK OUTPUT POWER

11.1 Operating Environment

Temperature : 22.0 °C
Relative Humidity : 48.0 % 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
■ - FSP	Rohde & Schwarz	Spectrum Analyzer	101431	04.17.2012

11.5 Test Result

- Test Date : November 20, 2011
- Reference Standard : Part 15 Subpart C, Sec. 15.247(b)
- Modulation : GFSK
- Operating Condition : RF transmitting mode
- Power Source : DC 3.7 V supplied from the lithium polymer battery

Group / Channel	Channel Frequency (MHz)	Peak output power (dBm)	Peak output power (mW)	Limit (mW)	Result
2 Group / 1 CH	2 408	13.32	21.5	125	Complies
3 Group / 8 CH	2 441	13.27	21.2	125	Complies
3 Group / 16 CH	2 475	12.39	21.8	125	Complies

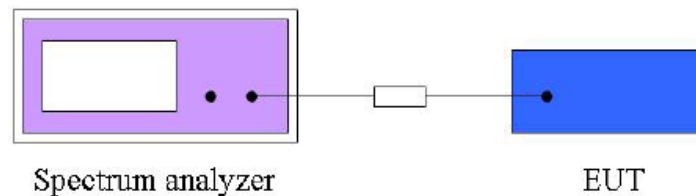


12. BAND EDGES MEASUREMENT

12.1 Operating Environment

Temperature : 22.0 °C
Relative Humidity : 48.0 % 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
■ - ESIB26	Rohde & Schwarz	EMI Test Receiver	830482/010	12. 10. 2011

12.5 Test Result

- Test Date : November 20, 2011
- Reference Standard : Part 15 Subpart C, Sec. 15.247(b)
- Modulation : GFSK
- Operating Condition : RF transmitting mode
- Power Source : DC 3.7 V supplied from the lithium polymer battery

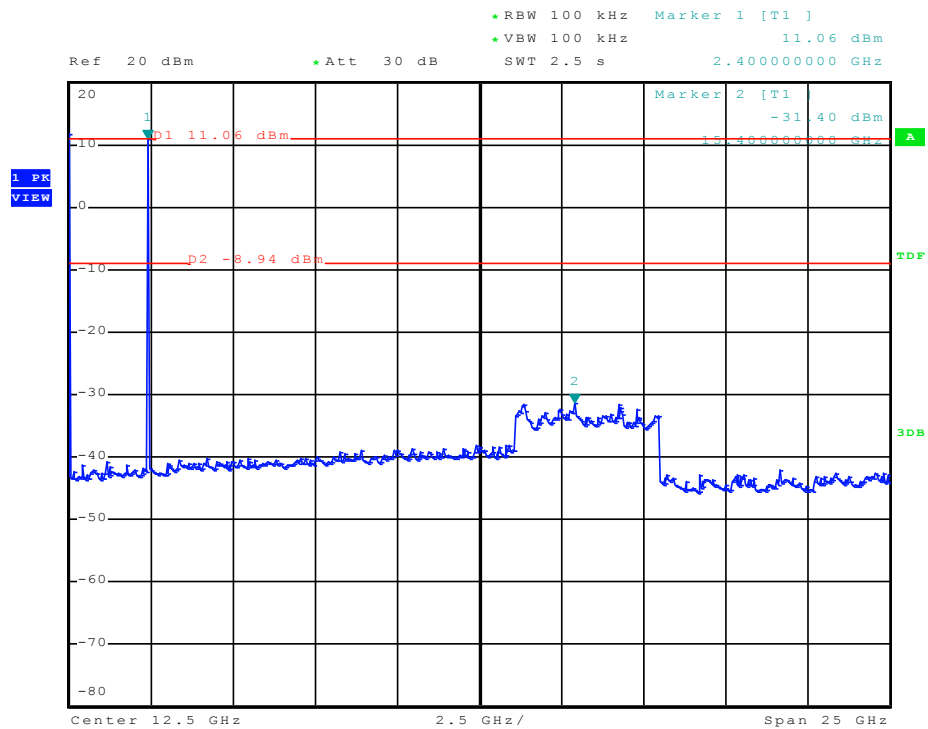
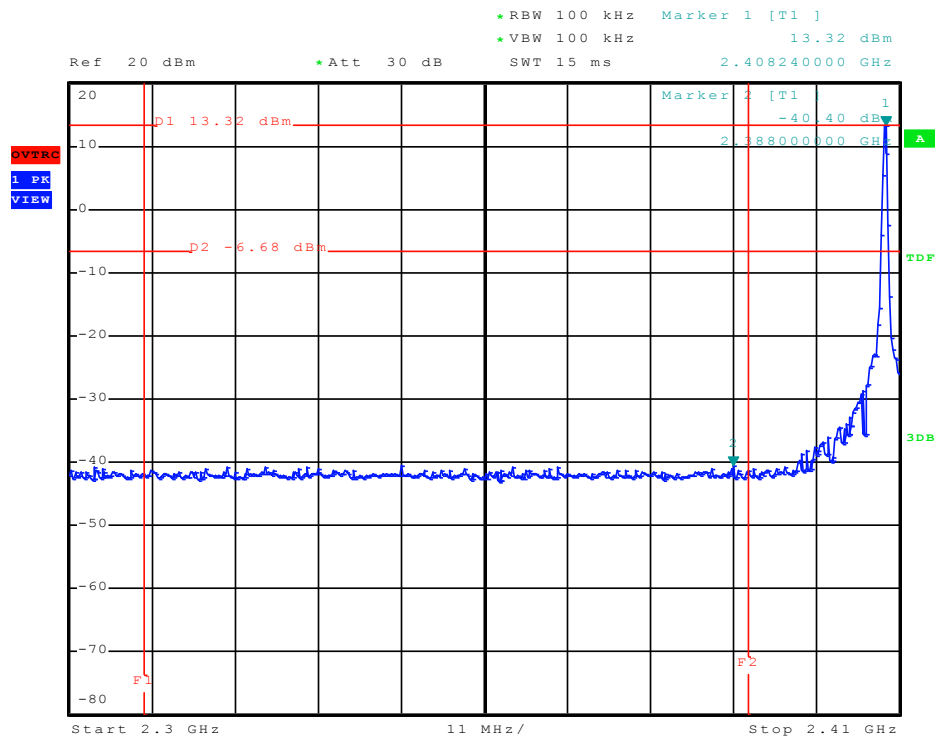
The spectrum plots are attached on the following 8 images, D1 line indicates the highest level, D2 line indicates the 20 dB offset below D1. It shows compliance with the requirement in part 15.247(d)

Spectrum Parameter

- Attenuation : Auto
- Resolution bandwidth : 100 kHz
- Video bandwidth : 100 kHz

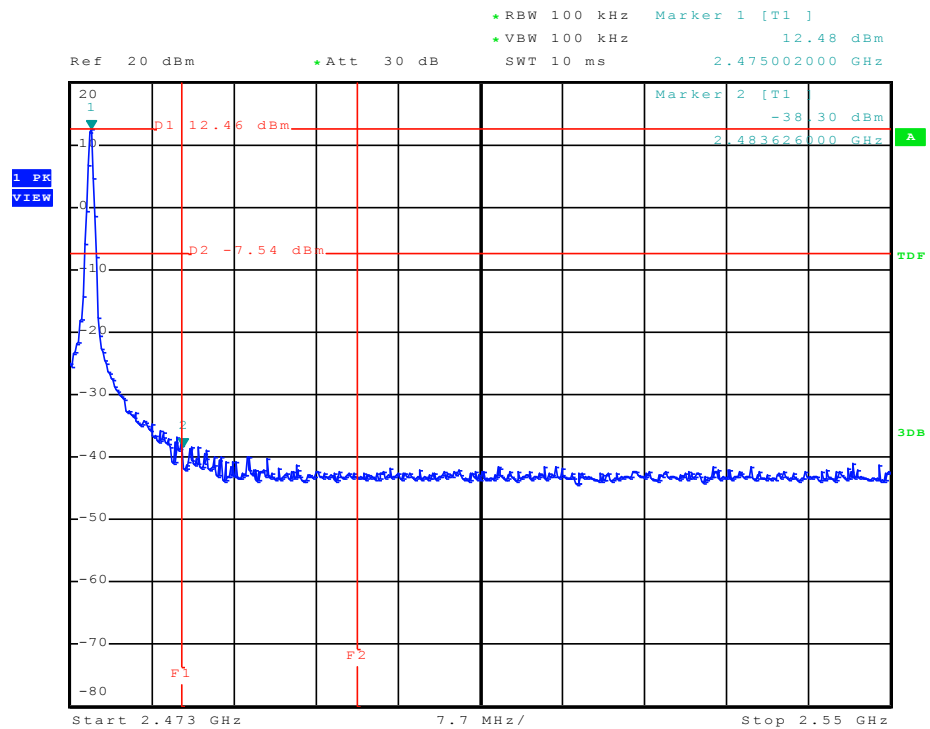
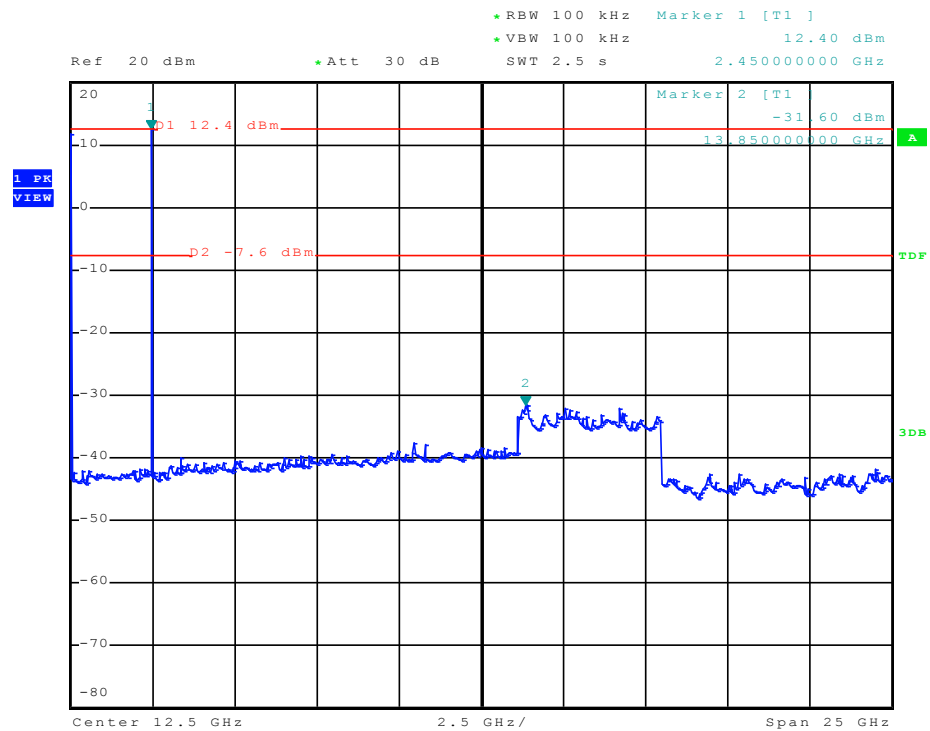


Band edge used Plot on Configuration GFSK/2 Group, 1 CH (2 408 MHz)





Band edge used Plot on Configuration GFSK/3 Group, 16 CH (2 475 MHz)





13. RADIATED EMISSION

13.1 Operating Environment

Temperature : 23.0 °C
Relative Humidity : 44.0 % 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(Anechoic Chamber)	Uncertainty	Remark
Radiated emission (30 MHz ~ 300 MHz, 3 m, Vertical)	± 4.38 dB	Confidence levels of 95 % ($k = 2$)
Radiated emission (30 MHz ~ 300 MHz, 3 m, Horizontal)	± 3.50 dB	Confidence levels of 95 % ($k = 2$)
Radiated emission (300 MHz ~ 1 000 MHz, 3 m, Vertical)	± 3.75 dB	Confidence levels of 95 % ($k = 2$)
Radiated emission (300 MHz ~ 1 000 MHz, 3 m, Horizontal)	± 3.59 dB	Confidence levels of 95 % ($k = 2$)

12.4 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	2 400/F (kHz)	300
0.490 ~ 1.705	2 400/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

[Limit at 3 m] = [Limit at 300 m] -40 × log (3 [m] / 300 [m])

[Limit at 3 m] = [Limit at 30 m] -40 × log (3 [m] / 30 [m])



13.5 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESIB26	Rohde & Schwarz	EMI Test Receiver	830482/010	12. 11. 2011
■ - BBHA9120D	Schwarzbeck	Horn Antenna	207	12. 22. 2011
■ - HFH2-Z2	Rohde & Schwarz	Loop Antenna	100041	12. 15. 2011
■ - MCU066	maturo GmbH	Position Controller	1390306	N/A
■ - TT2.5SI	maturo GmbH	Turntable	1390307	N/A
■ - AM 4.0	maturo GmbH	Antenna Mast	1390308	N/A
■ - 3160-09	ETS LINDGREN	Horn antenna	LM3423	04. 06. 2012
■ - AFS 44 00101800-25-10P-44	MITEQ	Preamplifier	1258942	11. 12. 2011
■ - AFS 44 00101800-25-10P-44	MITEQ	Preamplifier	1258943	11. 12. 2011

13.6 Radiated emission test data

- Test Date : November 17 ~ 21, 2011
- Reference Standard : Part 15 Subpart C, Sec. 15.247(d)
- Modulation / Channel : GFSK
- Operating Condition : RF transmitting mode
- Measuring Distance : 3 m
- Power Source : DC 3.7 V supplied from the lithium polymer battery
- Measurement

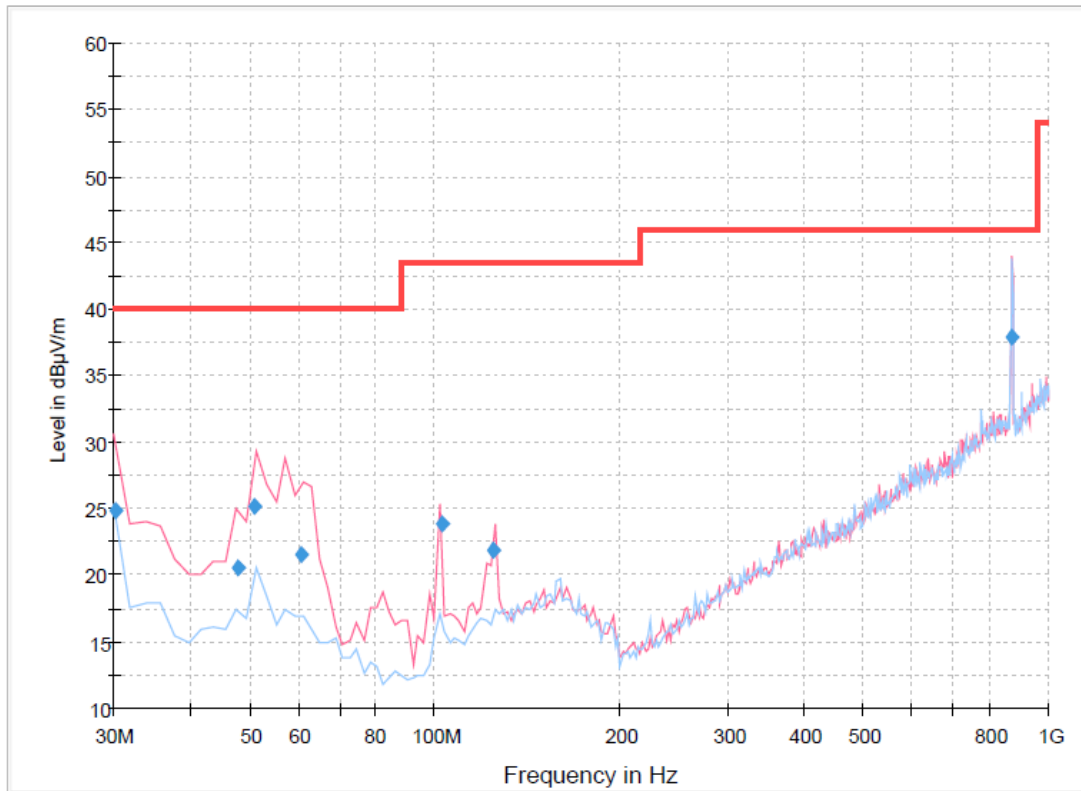
Frequency range	9 kHz ~ 90 kHz, 110 kHz ~ 150 kHz	90 kHz ~ 110 kHz	150 kHz ~ 490 kHz	490 kHz ~ 30 MHz	30 MHz ~ 1 GHz	Above 1 GHz
Detector type	Peak / Average	Quasi peak	Peak / Average	Quasi peak	Quasi peak	Peak / Average
IF bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz	1 MHz



Result of radiated emission (9 kHz to 30 MHz)

No emission found between lowest internal used/generated frequency to 30 MHz.

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

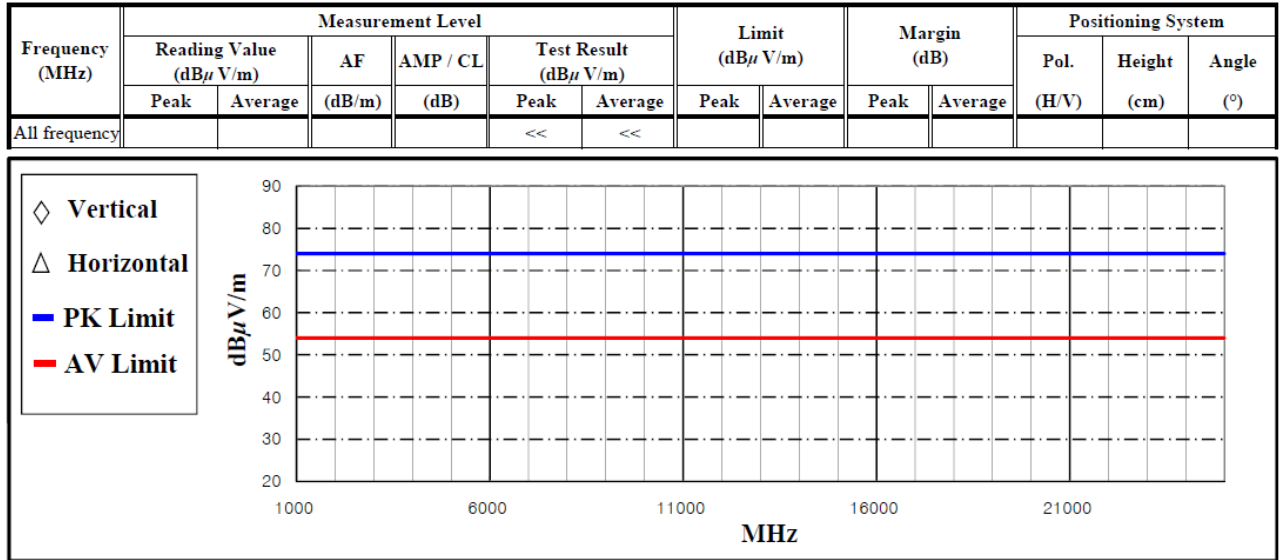


Final Result 1

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
30.160000	24.9	1000.0	120.000	100.0	V	15.0	11.1	15.1	40.0
47.994990	20.5	1000.0	120.000	100.0	V	138.0	12.8	19.5	40.0
50.922766	25.2	1000.0	120.000	100.0	V	261.0	13.0	14.8	40.0
60.882204	21.5	1000.0	120.000	100.0	V	143.0	12.4	18.5	40.0
103.103848	23.8	1000.0	120.000	115.0	V	58.0	11.3	19.7	43.5
124.990501	21.8	1000.0	120.000	100.0	V	104.0	13.4	21.7	43.5
871.587295	37.9	1000.0	120.000	150.0	V	337.0	27.3	8.1	46.0



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



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

Result of radiated emission (Band Edge)

2 Group / 1 CH (2 408 MHz)

Frequency (MHz)	Measurement Level						Limit (dBμ V/m)		Margin (dB)		Positioning System		
	Reading Value (dBμ V)		AF	AMP / CL	Test Result (dBμ V/m)						Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average	Peak	Average	Peak	Average	(H/V)	(cm)	(°)
2390.00	70.17	37.77	26.96	-36.93	60.20	27.80	74.00	54.00	13.80	26.20	-	-	-

3 Group / 16 CH (2 475 MHz)

Frequency (MHz)	Measurement Level						Limit (dBμ V/m)		Margin (dB)		Positioning System		
	Reading Value (dBμ V)		AF	AMP / CL	Test Result (dBμ V/m)						Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average	Peak	Average	Peak	Average	(H/V)	(cm)	(°)
2483.50	82.17	37.47	27.21	-36.78	72.60	27.90	74.00	54.00	1.40	26.10	-	-	-

Note:

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

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

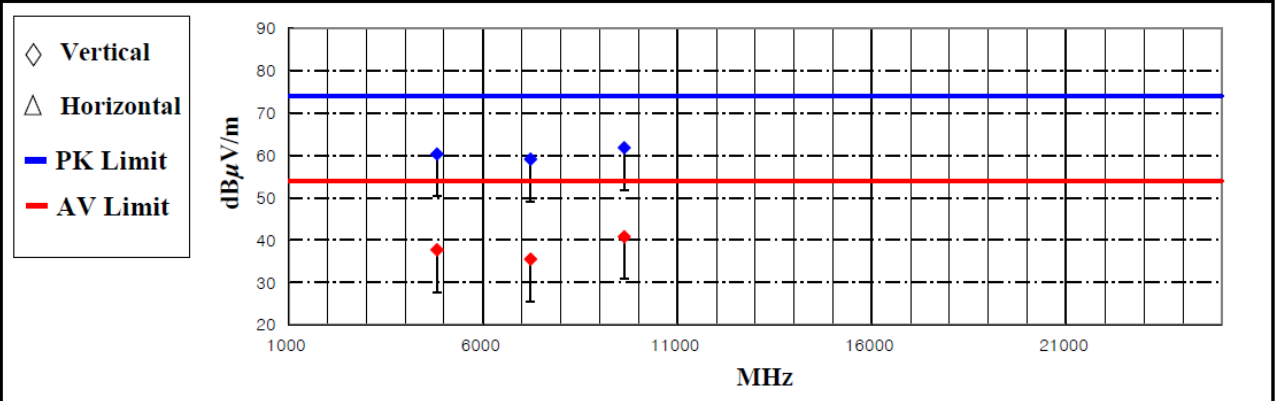
Corrected reading: Antenna factor + Cable loss + Preamplifier gain + Read value = Test result



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

(GFSK, 2 Group, 1 CH / 2 408 MHz)

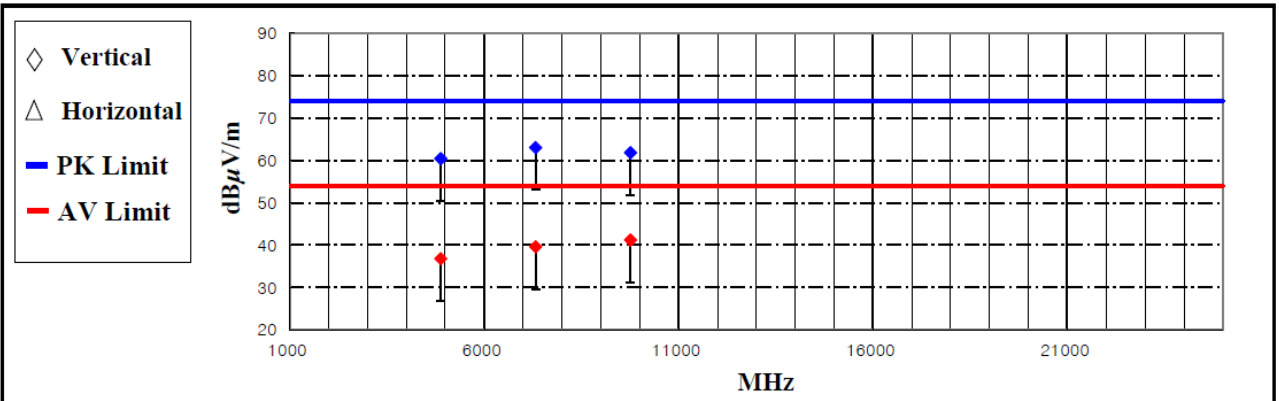
Frequency (MHz)	Measurement Level						Limit (dBμ V/m)		Margin (dB)		Positioning System		
	Reading Value (dBμ V/m)		AF	AMP / CL	Test Result (dBμ V/m)						Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average	Peak	Average	Peak	Average	(H/V)	(cm)	(°)
4816.21	61.90	39.30	31.22	-32.82	60.30	37.70	74.00	54.00	13.70	16.30	V	150	6
7223.42	50.69	27.09	35.78	-27.37	59.10	35.50	74.00	54.00	14.90	18.50	V	166	-5
9632.69	45.64	24.64	38.80	-22.64	61.80	40.80	74.00	54.00	12.20	13.20	V	150	31



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

(GFSK, 3 Group, 8 CH / 2 441 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	Peak	Average	(H/V)	(cm)	(°)
4882.33	61.83	38.23	31.34	-32.77	60.40	36.80	74.00	54.00	13.60	17.20	V	165	15
7322.86	54.20	30.80	35.97	-27.17	63.00	39.60	74.00	54.00	11.00	14.40	V	188	20
9764.53	45.10	24.50	39.02	-22.32	61.80	41.20	74.00	54.00	12.20	12.80	V	166	35

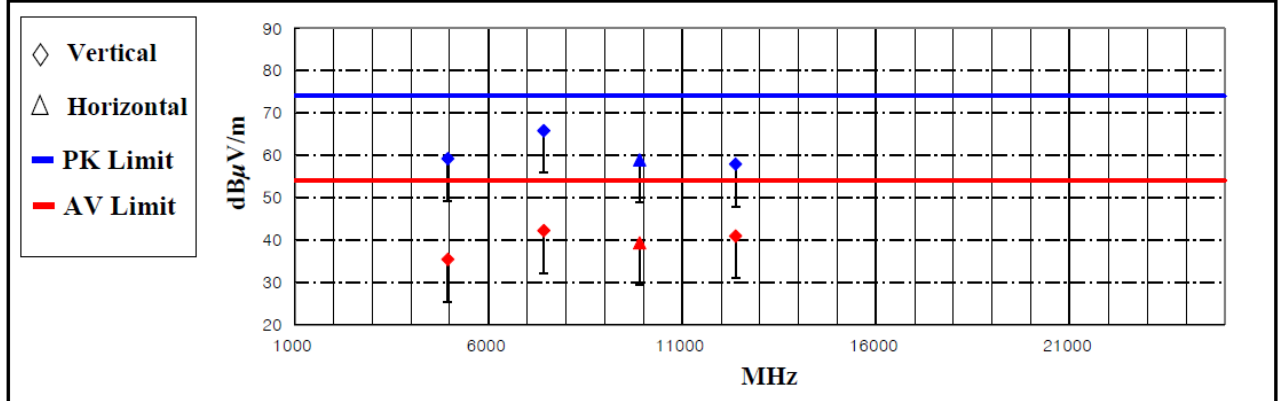


*Comment : AMP/CL_Cable loss value + AMP gain value
AF : Antenna factor value
Pol. : H(Horizontal), V(Vertical)



(GFSK, 3 Group, 16 CH / 2 475 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	Peak	Average	(H/V)	(cm)	(°)
4949.71	60.45	36.65	31.46	-32.71	59.20	35.40	74.00	54.00	14.80	18.60	V	150	55
7425.04	56.62	33.02	36.16	-26.98	65.80	42.20	74.00	54.00	8.20	11.80	V	165	255
9900.03	41.65	22.05	39.25	-22.00	58.90	39.30	74.00	54.00	15.10	14.70	H	177	203
12374.56	40.25	23.25	39.16	-21.51	57.90	40.90	74.00	54.00	16.10	13.10	V	150	192



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

Note:

Emission level (dBμ V/m) = 20 log Emission level (μ V/m).

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