Electromagnetic Emission

F C C M E A S U R E M E N T R E P O R T

CERTIFICATION OF COMPLIANCE

FCC Part 15 Certification Measurement

PRODUCT	:	R/C Transmitter
MODEL/Serial No.	:	SPECTRA 2.4 / Proto type
Multi model	:	NONE
FCC ID	:	IFHSPEC-24G
IC	:	3420A-SPEC24G
APPLICANT	:	Hitec RCD Inc. 12115 Paine Street, Poway, CA 92064, USA Attn.: Tony Ohm / Service Dept. Manager
MANUFACTURER	:	Hitec RCD PHILIPPINES, INC. Lot 6 and 8, Blk. 24, Phase 4 CEPZ, Rosario, Cavite, Philippines
TYPE OF MODULATION	:	AFHSS (GFSK)
FREQUENCY CHANNEL	:	2 405.6 MHz to 2 477.6 MHz and Channel (121 Channels)
ANTENNA TYPE	:	Integral (Dipole Antenna)
ANTENNA GAIN	:	0.91 dBi
RULE PART(S)	:	FCC Part 15 Subpart C RSS-210 Issue 7
FCC PROCEDURE	:	ANSI C63.4-2003
TEST REPORT No.	:	ETLE090413.03
DATES OF TEST	:	August 01, 2009 to August 07, 2009
REPORT ISSUE DATE	:	August 11, 2009
TEST LABORATORY	:	ETL Inc. (FCC Designation No. : KR0022, IC OATS number : 6473B-1)

The R/C Transmitter, Model SPECTRA 2.4 has been tested in accordance with the measurement procedures specified in ANSI C63.4-2003 at the ETL Test Laboratory and has been shown to be complied with the electromagnetic radiated emission limits specified in FCC Rule Part15 Subpart C section 15.247 and RSS-210 Issue 7 – Category I Equipment, Annex 8.
I attest to the accuracy of data. All measurement herein was performed by me or was made under my supervision and is 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.
The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Hyung Seok, Lee / Chief Engineer

ETL Inc.
#371-51, Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea
Tel: 82-2-858-0786 Fax: 82-2-858-0788

Table of Contents

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

FCC MEASUREMENT REPORT

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

General Information

Applicant Name	**: Hitec RCD Inc.**
Address	**: 12115 Paine Street, Poway, CA 92064, USA**
Attention	**: Tony Ohm / Service Dept. Manager**

- **EUT Type** : R/C Transmitter
- **Model Number** : SPECTRA 2.4
- **S/N** : Proto type
- **Freq. Range** : 2 405.6 MHz – 2 477.6 MHz
- **Number of Channels** : 121
- **Modulation Technique** : AFHSS (GFSK)
- **Antenna Type** : Integral (Dipole Antenna)
- **ANTENNA GAIN** : 0.91 dBi
- **Rule Part(s)** : FCC Part 15 Subpart C

  RSS-210 Issue 7
- **Test Procedure** : ANSI C63.4-2003
- **FCC Classification** : DSS: Part 15 Spread Spectrum Transmitter
- **IC Equipment Category** : RSS-210 Issue 7– Category I Equipment, Annex 8.
- **Place of Tests** : ETL Inc. Testing Lab.
  Radiated Emission test;
  #499-1, Sagot-ri, Seosin-myeon, Hwaseong-si,
  Gyeonggi-do, 445-882, Korea

  Conducted Emission test;
  ETL Inc. Testing Lab.
  371-51, Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

1. INTRODUCTION

The measurement test for radiated and conducted emission test was conducted at the ETL Inc. The site is constructed in conformance with the requirements of the ANSI C63.4-2003 and CISPR Publication 16. The ETL has site descriptions on file with the FCC for 3 m and 10 m site configurations. Detailed description of test facility was found to be in compliance with FCC Rules according to the ANSI C63.4-2003 and registered to the Federal Communications Commission

The measurement procedure described in American National Standard for Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2003) was used in determining radiated and conducted emissions from the Hitec RCD Inc. Model: SPECTRA 2.4

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

2. PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is R/C Transmitter

2.2 General Specification

*** Specification**

Model	**SPECTRA 2.4**
RF Frequency Range	**2.4056 GHz – 2.4776 GHz**
Modulation Method	**AFHSS**
Operating Temperature	**-20 ℃ - +60 ℃**
Power Source	**DC 9.6 V**
Size	**37.5 mm x 59.0 mm x 22.4 mm**
Weight	**33 g**

*** Frequency and channels (121 CH)**

Channel Number	Operating frequency (kHz)
1	2405600.000
2	2406200.000
3	2406800.000
...	...
59	2440400.000
60	2441000.000
61	2441060.000
...	...
119	2476400.000
120	2477000.000
121	2477600.000

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

3. DESCRIPTION OF TESTS

The tests documented in this report were performed in accordance with ANSI C63.4-2003 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, 15.207, 15.209 and 15.247.
IC Equipment Category: RSS-210 Issue 7 – Category I Equipment, Annex 8

3.1 Radiated Emission Measurement

Radiated emission measurements were made in accordance with § 13 in ANSI C63.4-2003 "Measurement of Intentional radiators" The measurements were performed over the frequency range of 30 MHz to 40 GHz using antenna as the input transducer to a Spectrum analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Peak, Quasi-peak, Average" within a bandwidth of 120 kHz and above 1GHz is 1 MHz.

Preliminary measurements were made at 3 m using broadband antennas, and spectrum analyzer to determine the frequency producing the maximum emission in shielded room. Appropriate precaution was taken to ensure that all emission from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth and height with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 MHz to 1 GHz using Log-Bicon antenna. Above 1 GHz, linearly polarized double ridge horn antennas were used. Final measurements were made open site at 3 m. The test equipment was laced on a wooden turn-table. 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 by manual. The detector function was set to CISPR Quasi-peak mode and the bandwidth of the receiver was set to 120 kHz or 1 MHz depending on the frequency of type of signal. The EUT, support equipment and interconnecting cables were re-configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0,8 m high nonmetallic 1m x 1.5 m table. The EUT, support equipment, and interconnecting cables were re-arranged and manipulated to maximize each emission. The turntable containing the system was rotated; the antenna height was varied 1 m to 4 m and stopped at the azimuth or height producing the maximum emission.

Varying the mode of operating frequencies of the EUT maximized each emission. The system was tested in all the three orthogonal planes and changing the polarity of the antenna. The worst-case emissions are recorded in the data tables. If necessary, the radiated emission measurement could be performed at a closer distance to ensure higher accuracy and the results were extrapolated to the specified distance using an inverse linear distance extrapolation factor (20 dB/decade) as per section 15.31(f).

Photographs of the worst-case emission can be seen in Photographs of the worst-case emission test setup can be seen in Appendix B.

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

3.2 FCC Part 15.205 Restricted Bands of Operations

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

[1]Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2] Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

4. TEST CONDITION

4.1 Test Configuration

The device was configured for testing in a typical fashion (as a customer would normally use it). During the tests, the following conditions and configurations were used.

4.2 Description of Test modes

The EUT(model: SPECTRA 2.4) has been tested under operating condition.
Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
After verification, all tests carried out are with the worst-case test modes as shown below except radiated spurious emission below 1 GHz's worst case is in normal link mode.
Channel low (2 405.6 MHz), Mid (2 441.0 MHz) and High (2 477.6 MHz) were chosen for full testing.

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5. TEST RESULTS

5.1 Summary of Test Results

The measurement results were obtained with the EUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum emission of the EUT are reported.

47 CFR Part 15, Subpart C	RSS Standards	Measurement Required	Result
15.247(a)(1)	RSS-210, A8.1(b)	Channel Bandwidth	**Pass**
15.247(b)(1)	RSS-210, A8.4(2)	Maximum peak conducted output power	**Pass**
15.247(d)	RSS-210, A8.5	Bandwidth of Frequency Band Edges	**Pass**
15.247(e)	RSS-210, A8.2	Power Spectral density	**Pass**
15.247(a)(1)	RSS-210, A8.1(b)	Frequency Separation	**Pass**
15.247(a)(1)(iii)	RSS-210, A8.1(d)	Number of Hopping Channels	**Pass**
15.247(a)	RSS-210, A8.1(d)	Time of Occupancy(Dwell time)	**Pass**
15.247(d) 15.209	RSS-210, A8.5	Spurious Emissions	**Pass**
-	RSS-Gen, 7.2.3	Receiver Spurious Emissions	**Pass**
15.247(i)	RSS-102, 2.5	Radio Frequency Exposure	**Pass**

The data collected shows that the **Hitec RCD Inc / R/C Transmitter / SPECTRA 2.4** complied with technical requirements of above rules part 15.209 and 15.247 Limits.

The equipment is not modified anything, mechanical or circuits to improve EMI status during a measurement. No EMI suppression device(s) was added and/or modified during testing.

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.2 Channel Bandwidth

5.2.1 20 dB Bandwidth

EUT	R/C Transmitter / SPECTRA 2.4
Limit apply to	FCC Part 15.247(a)(1)
Test Date	August 01, 2009
Operating Condition	RF transmitting continuously during the tested.
Result	Pass

Test Data

Frequency(MHz)	20 dB Bandwidth (MHz)	Limit
2 405.6	0.732	< Carrier frequency separation
2 441.0	0.744	
2 477.6	0.756	

NOTES:

1. **Measure frequency separation of relevant channel using spectrum analyzer.**
2. **Please see the measured plot in next page.**

Test Engineer: Kug Kyoung, Yoon

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Plots of 20 dB Bandwidth

[2 405.6 MHz]

[2 441.0 MHz]

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

[2 477.6 MHz]

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.2.2 Bandwidth (99% BW)

EUT	R/C Transmitter / SPECTRA 2.4
Limit apply to	RSS-210, A8.1(b)
Test Date	August 01, 2009
Operating Condition	RF transmitting continuously during the tested.
Result	Pass

Test Data

Frequency(MHz)	20 dB Bandwidth (MHz)	Limit
2 405.6	0.935	< Carrier frequency separation
2 441.0	1.080	
2 477.6	0.940	

NOTES:

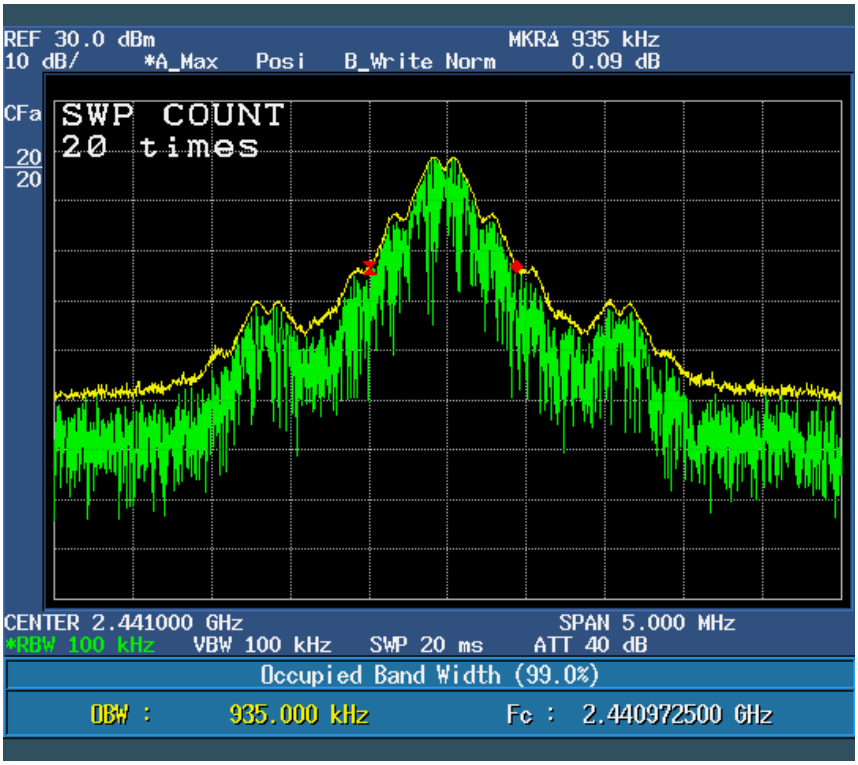
1. **Measure frequency separation of relevant channel using spectrum analyzer.**
2. **Please see the measured plot in next page.**

Test Engineer: Kug Kyoung, Yoon

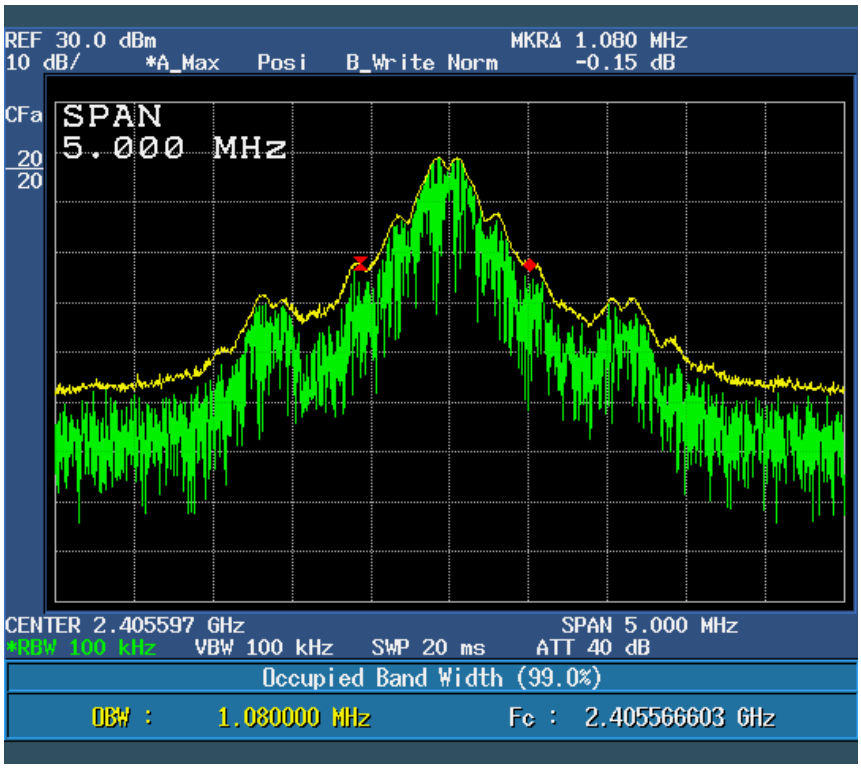
Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Plots of Bandwidth (99%)

[2 405.6 MHz]

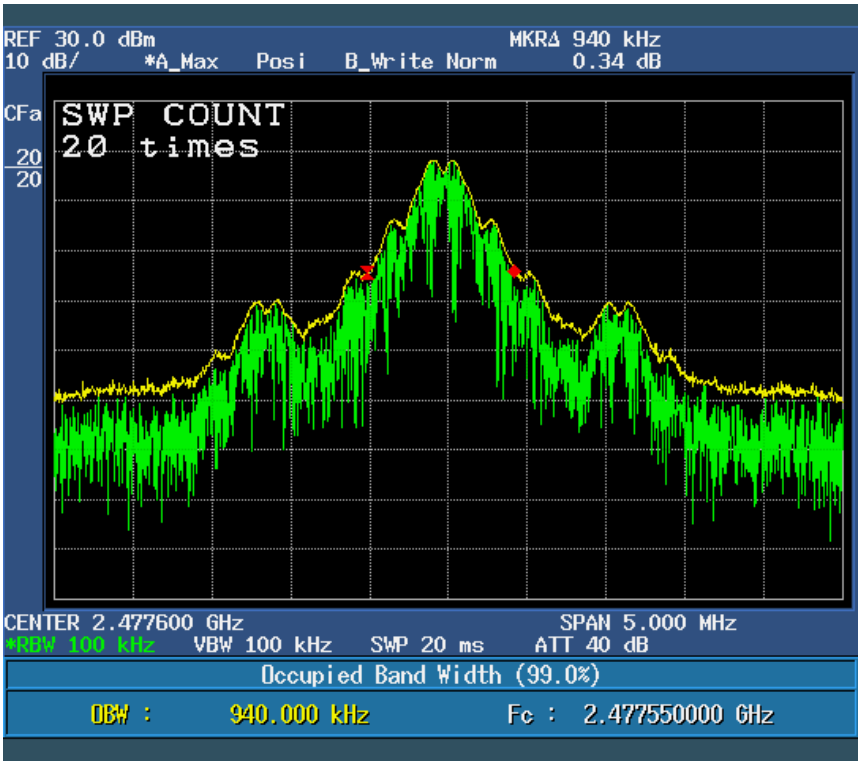


[2 441.0 MHz]



Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

[2 477.6 MHz]



Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.3 Maximum peak conducted output power

EUT	R/C Transmitter / SPECTRA 2.4
Limit apply to	FCC Part 15.247(b)(1), RSS-210, A8.4(2)
Test Date	August 03, 2009
Operating Condition	RF transmitting continuously during the tested.
Result	Pass

Limit

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

- For systems using digital modulation operating in the 2 400 MHz - 2 483.5 MHz band: 125 mW (20.97 dBm)

Test Data

Frequency(MHz)	Output Power (dBm)	Output Power (mW)	Limit
2 405.6	19.49	88.92	< 20.97 dBm(125 mW)
2 441.0	19.20	83.18	
2 477.6	18.70	74.13	

NOTES:

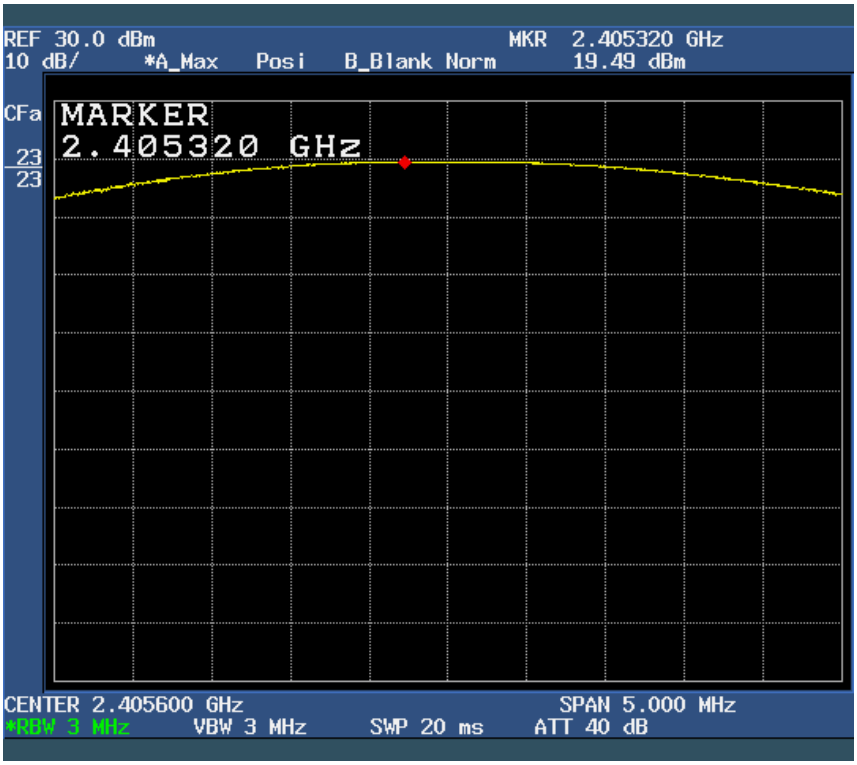
1. **Measure conducted maximum peak output of relevant channel using spectrum analyzer**

Test Engineer: Kug Kyoung, Yoon

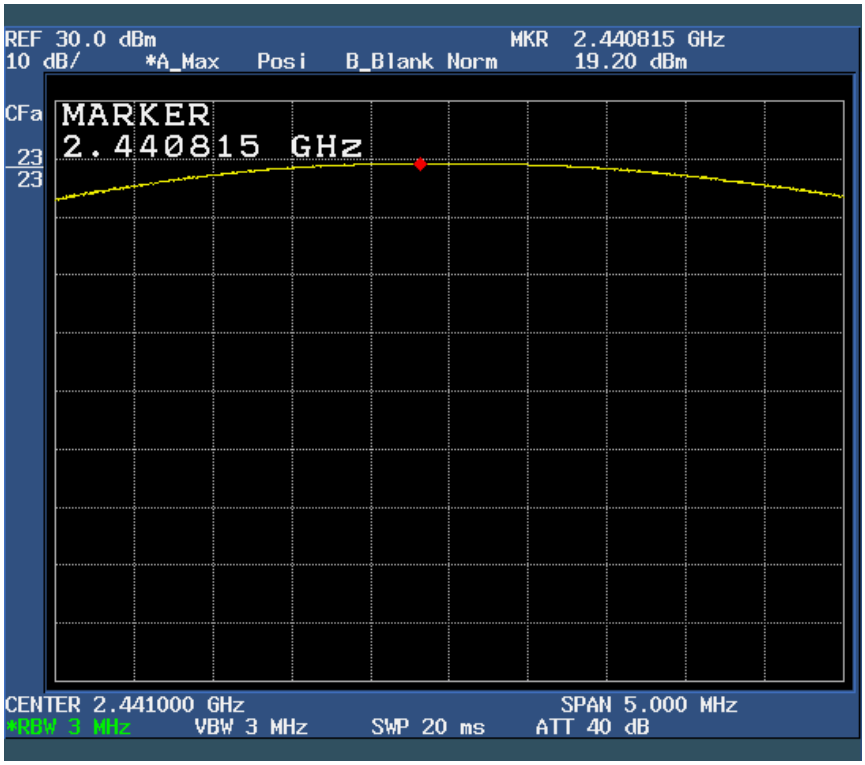
Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Plots of Maximum Peak Output Power

[2 405.6 MHz]

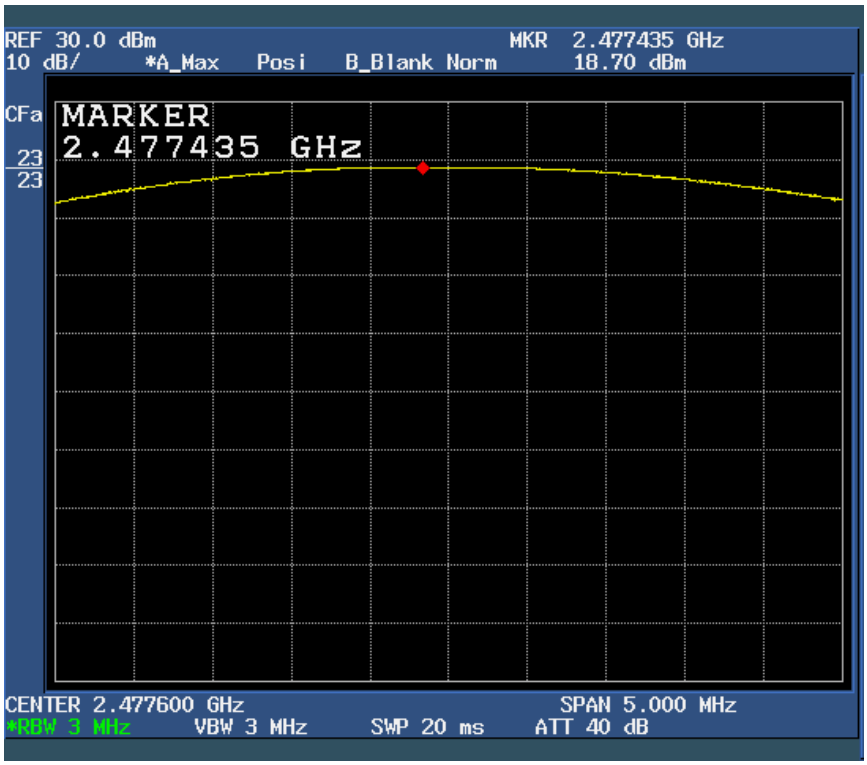


[2 441 MHz]



Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

[2 477.6 MHz]



Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.4 Bandwidth of Frequency Band Edges

EUT	R/C Transmitter / SPECTRA 2.4
Limit apply to	FCC Part 15.247(d), RSS-210, A8.5
Test Date	August 03, 2009
Operating Condition	RF transmitting continuously during the tested.
Result	Pass

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Test Results

- Refer to see the measured plot in next page.

NOTES:

1. **The test was performed to make a direct field strength measurement at the band edge frequencies.**

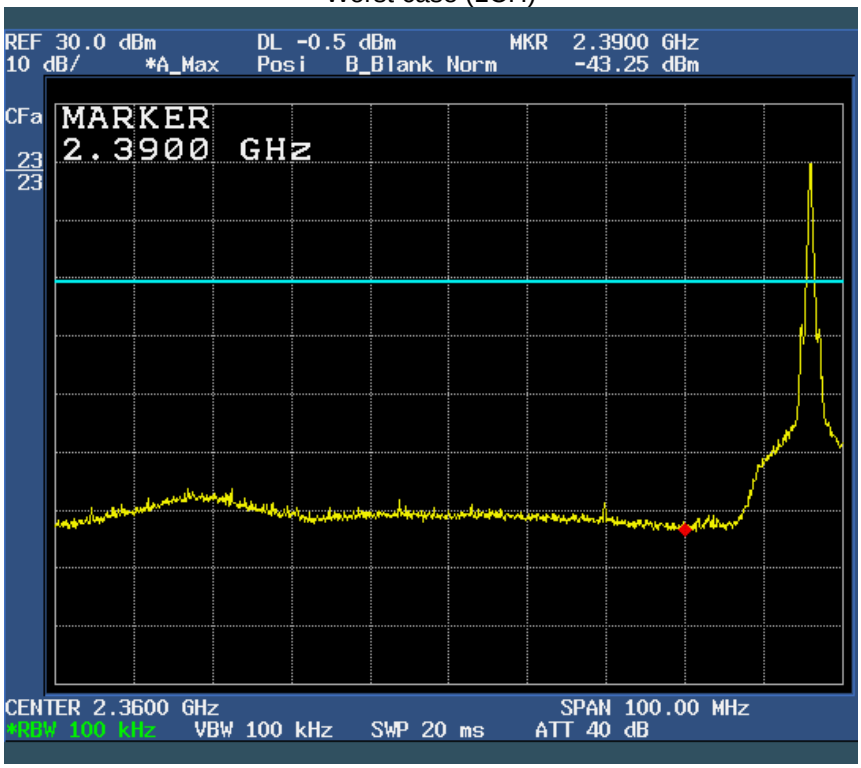
Test Engineer: Kug Kyoung, Yoon

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.4.1 Bandwidth of Frequency Band Edges

Conducted

Worst case (1CH)

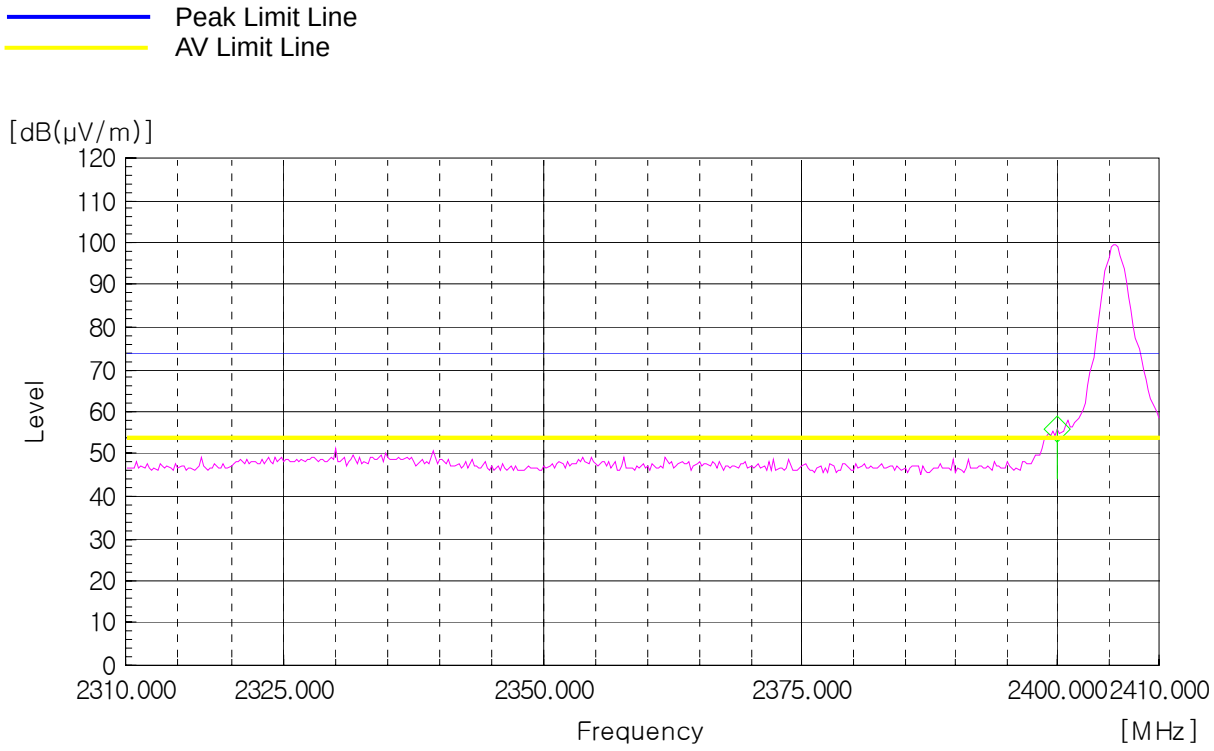


Worst case (121CH)

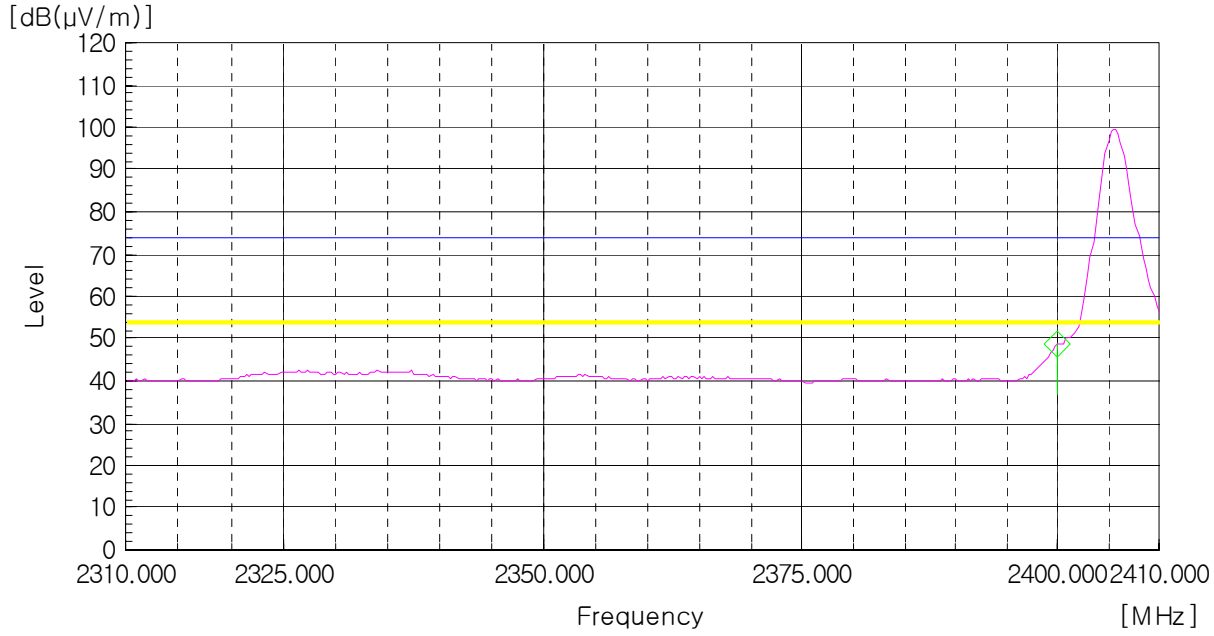
Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Radiated

Peak Detector: RBW: 1MHz, VBW: 1MHz (2310 MHz – 2390 MHz), Worst case (1CH, Horizontal)

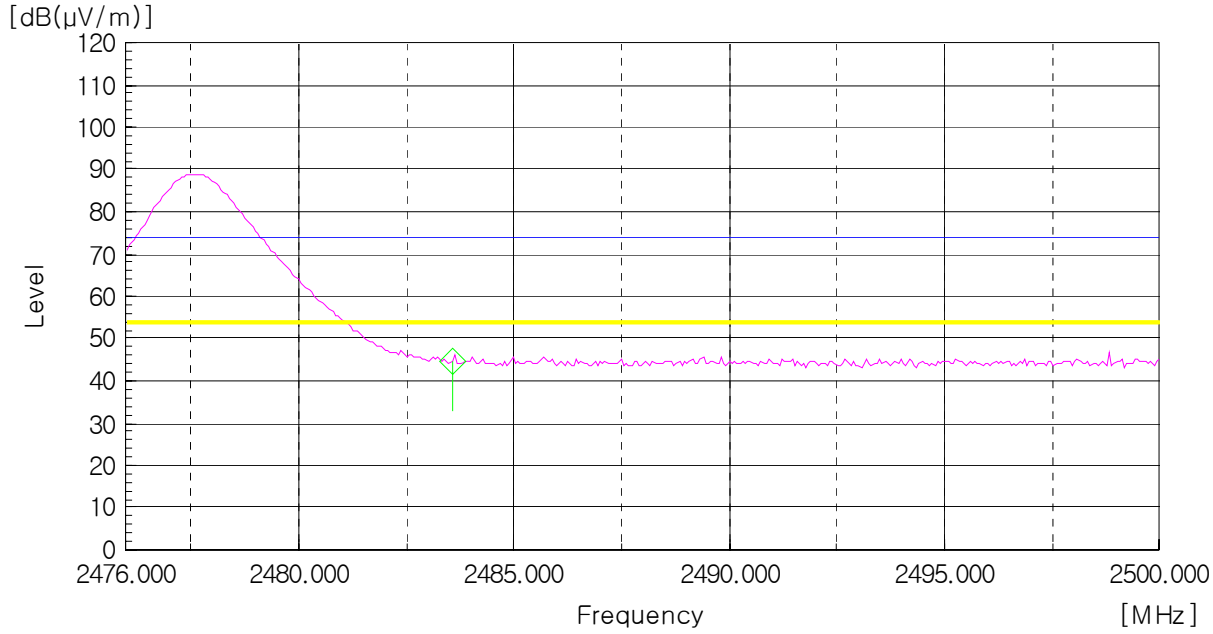


AV Detector: RBW: 1MHz, VBW: 10Hz (2310 MHz – 2390 MHz)

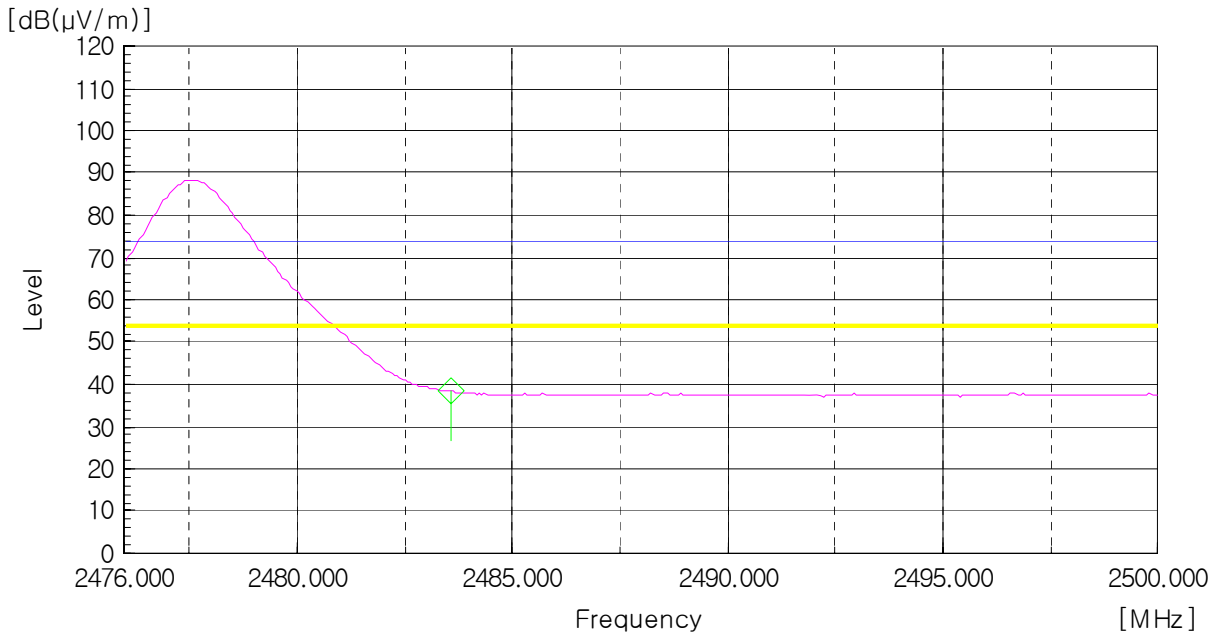


Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Peak Detector: RBW: 1MHz, VBW: 1MHz (2483.5 MHz – 2500 MHz), Worst case (121CH, Horizontal)



Peak Detector: RBW: 1MHz, VBW: 10Hz (2483.5 MHz – 2500 MHz), Worst case (121CH, Horizontal)



Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.5 Power Spectral Density

EUT	R/C Transmitter/ SPECTRA 2.4
Limit apply to	FCC Part 15.247(e) , RSS-210, A8.2
Test Date	August 03, 2009
Operating Condition	RF transmitting continuously during the tested.
Result	Pass

Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test Data

802.11b mode

Channel	Frequency (MHz)	PSD (dBm)	Limit
Low	2 405.6	7.42	8 dBm
Mid	2 441.0	7.42	
High	2 477.6	7.17	

NOTES:

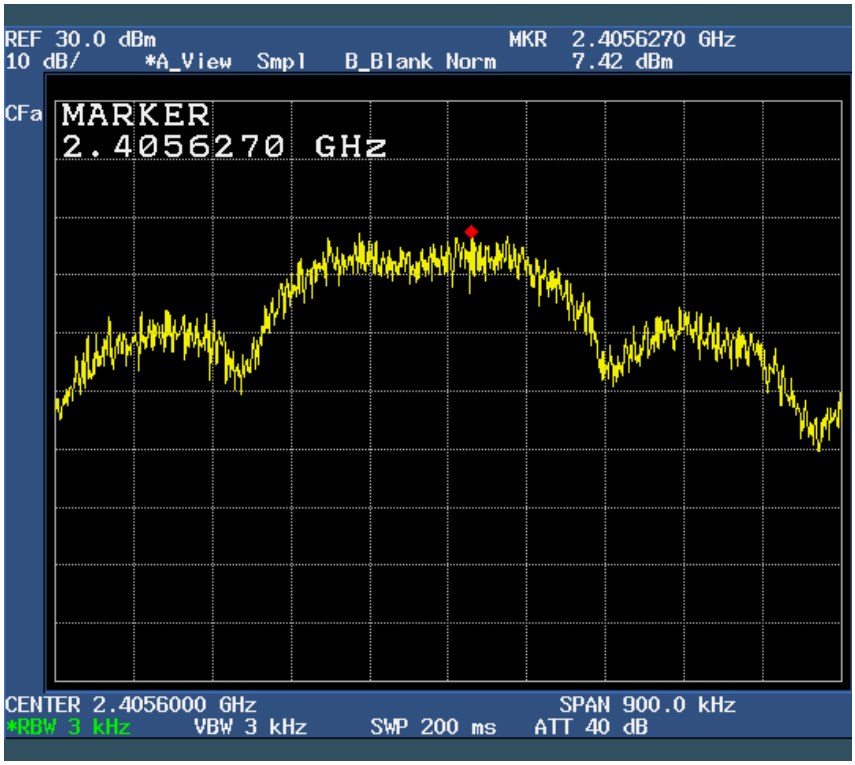
1. **Measure power spectral density of relevant channel using spectrum analyzer.**
2. **Please see the measured plot in next page.**

Test Engineer: Kug Kyoung, Yoon

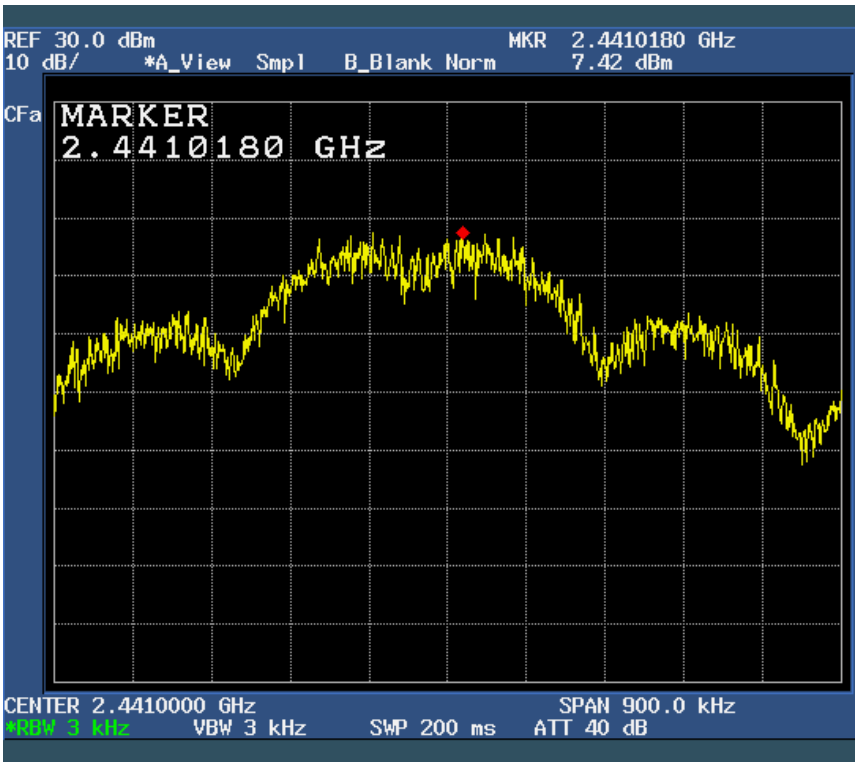
Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Power Spectral Density

[CH Low]

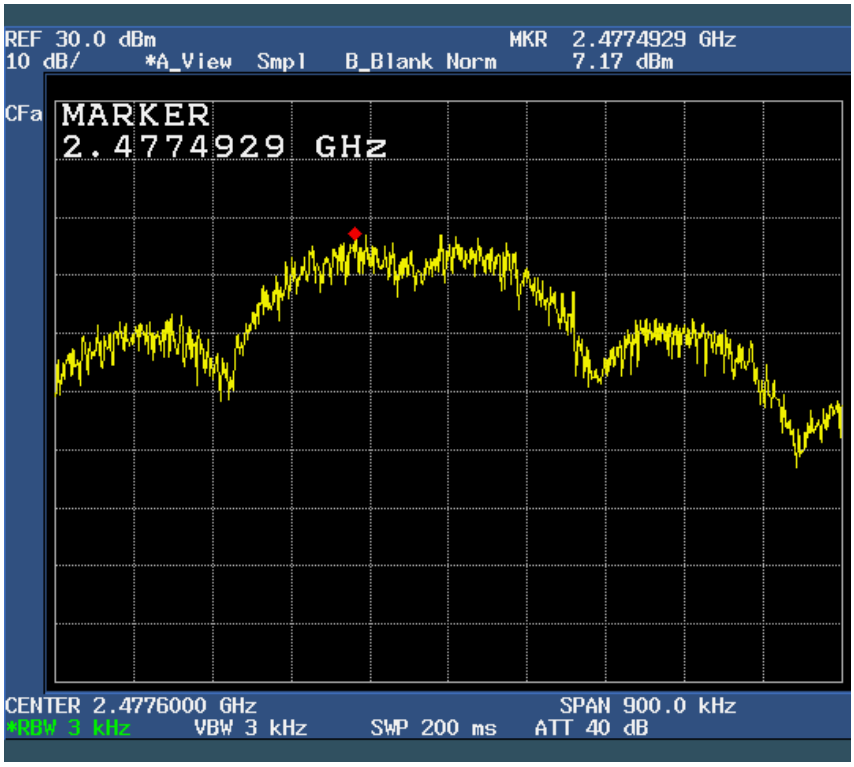


[CH Mid]



Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

[CH High]



Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.6 Frequency Separation

EUT	R/C Transmitter/ SPECTRA 2.4
Limit apply to	FCC Part 15.247(a)(1) , RSS-210, A8.1(b)
Test Date	August 03, 2009
Operating Condition	RF transmitting continuously during the tested.
Result	Pass

Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Test Data

EUT Channel Separation (MHz)	20 dB bandwidth (kHz)	Limit
1.89 (Worst)	732 (Worst)	> 25 kHz

NOTES:

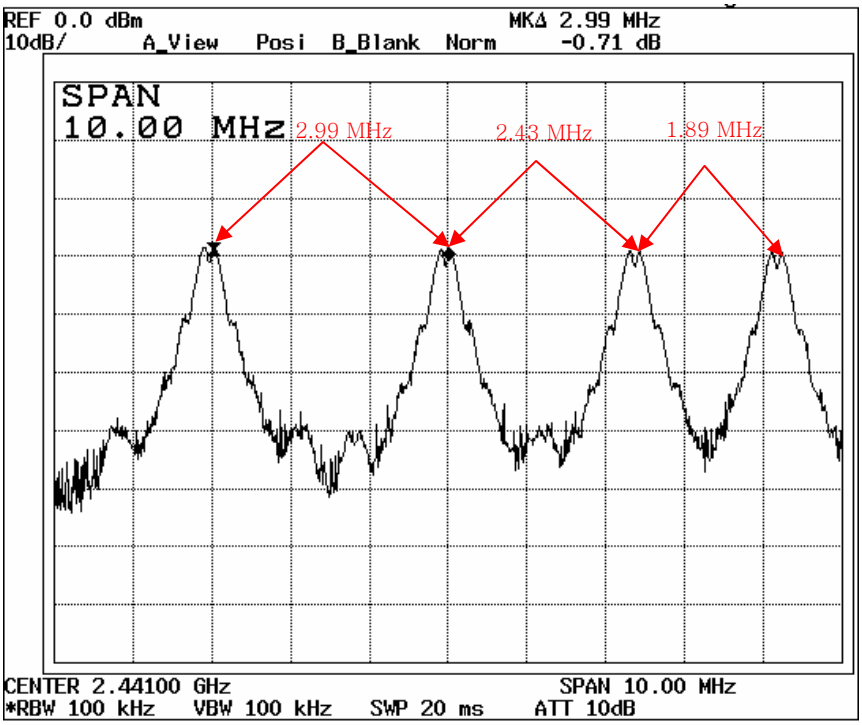
1. **Measure frequency separation of relevant channel using spectrum analyzer.**
2. **Please see the measured plot in next page.**

Test Engineer: Kug Kyoung, Yoon

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Frequency Separation

[Channel Separation]



[20 dB Bandwidth]

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.7 Number of Hopping Channels

EUT	R/C Transmitter/ SPECTRA 2.4
Limit apply to	FCC Part 15.247(a)(1)(iii) , RSS-210, A8.1(d)
Test Date	August 03, 2009
Operating Condition	RF transmitting continuously during the tested.
Result	Pass

Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

Test Data

Result	Limit
121	> 15 Channel

NOTES:

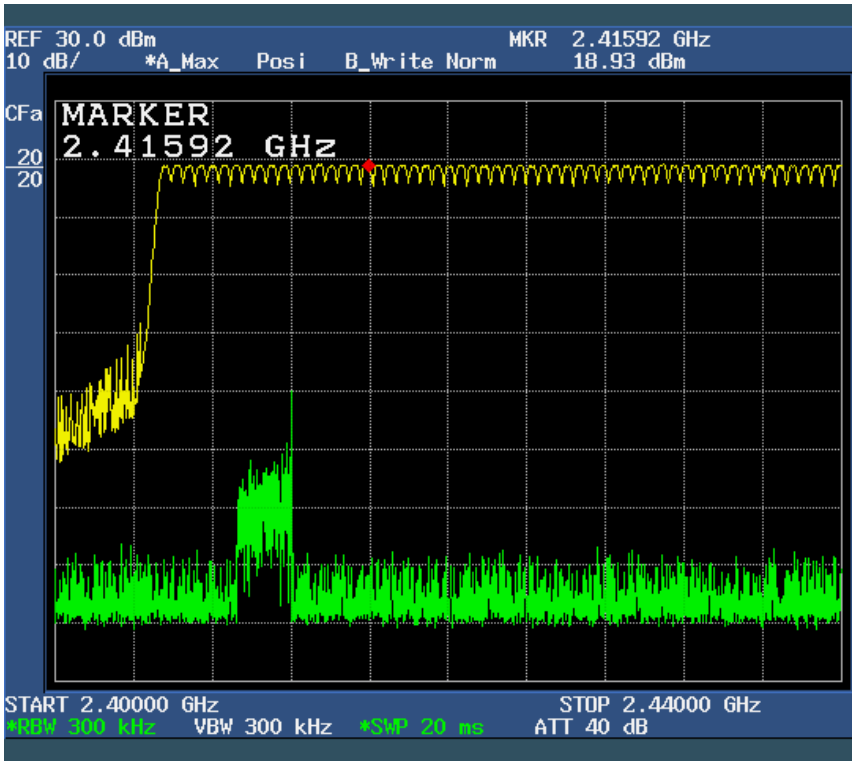
1. **Measure number of hopping channel of relevant channel using spectrum analyzer.**
2. **Please see the measured plot in next page.**

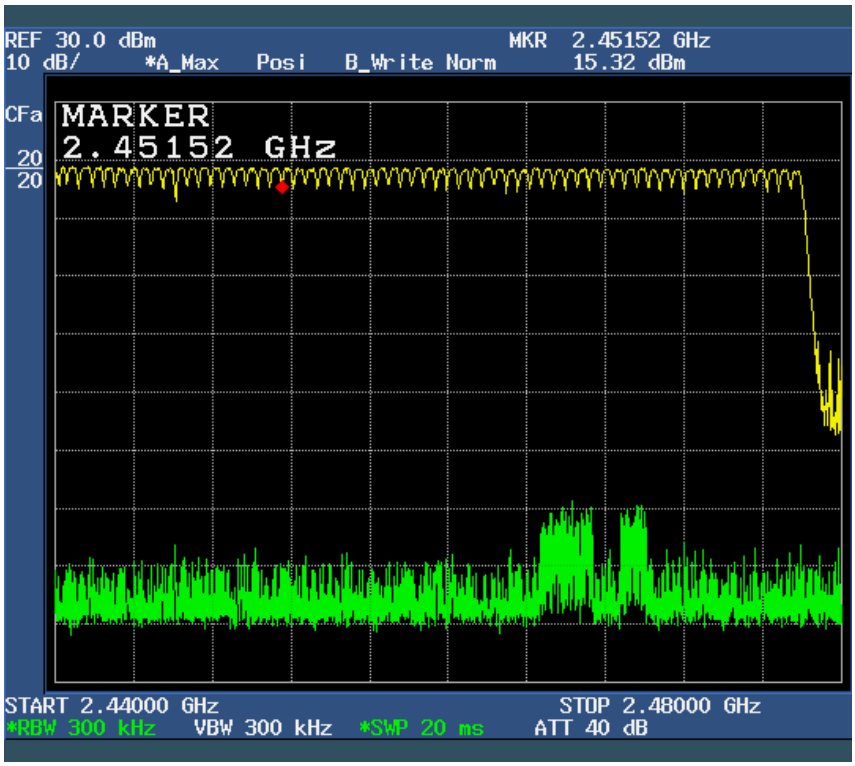
Test Engineer: Kug Kyoung, Yoon

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Number of Hopping Channels

[Channel Separation]





Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.8 Time of Occupancy

EUT	R/C Transmitter/ SPECTRA 2.4
Limit apply to	FCC Part 15.247(a)(1)(iii) , RSS-210, A8.1(d)
Test Date	August 04, 2009
Operating Condition	RF transmitting continuously during the tested.
Result	Pass

Limit

Frequency hopping systems in the 2400-2483.5 MHz band. 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.

Test Data

Pulse Time (us)	Total of Dwell (ms)	Limit (ms)
1.386	3.07	400.000

NOTES:

1. **Measure time of occupancy of relevant channel using spectrum analyzer.**
2. **Please see the measured plot in next page.**

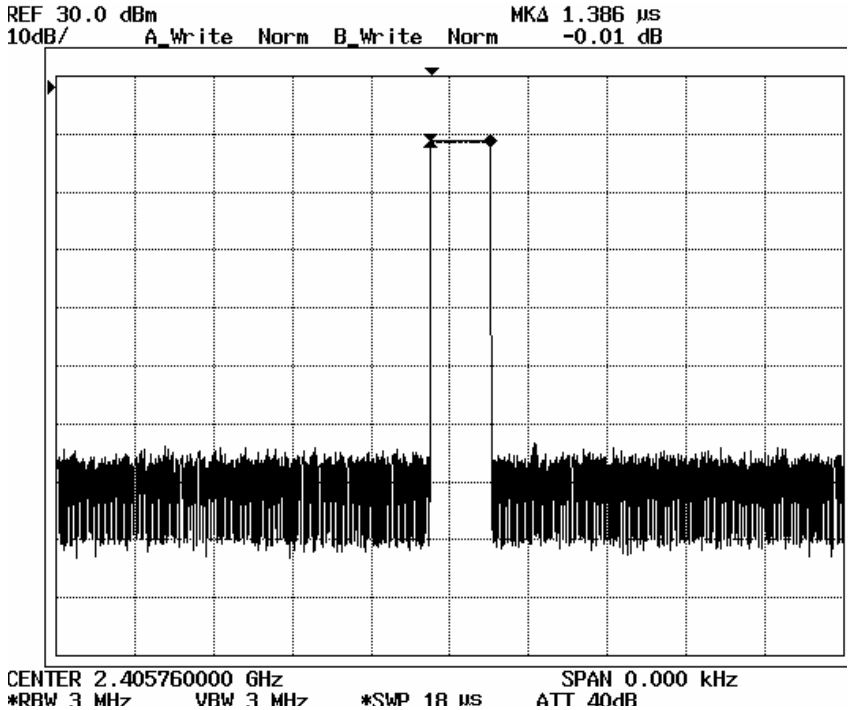
Test Engineer: Kug Kyoung, Yoon

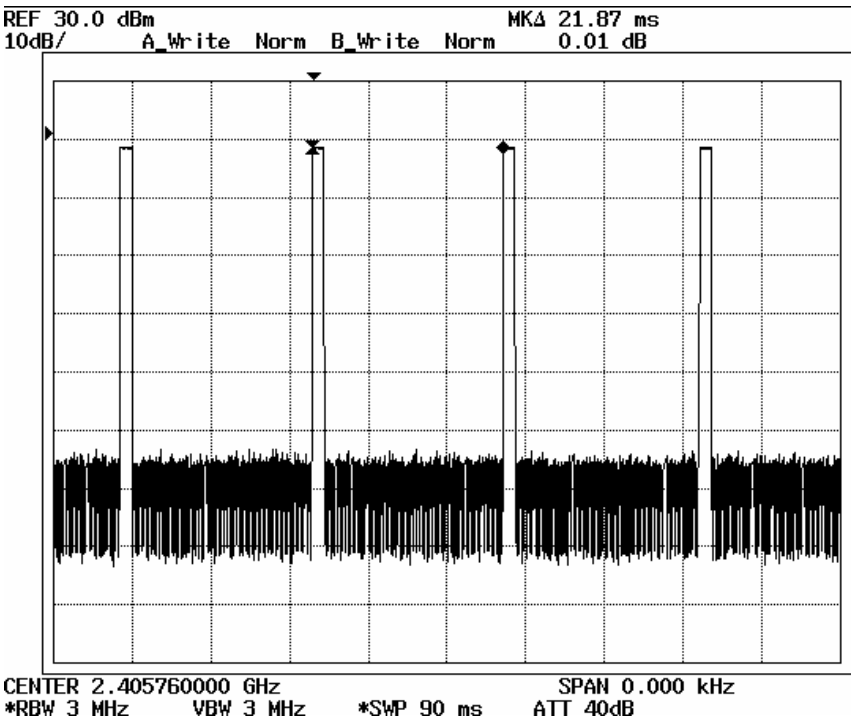
Time of Occupancy

0.4 s x 121(CH) = 48.4s
(1/21.87 ms) x 48.4s x 1.386 us = 3.07 ms

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Time of Occupancy





Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.9 Spurious Emissions

5.9.1 Radiated Emissions (TX)

EUT	R/C Transmitter / SPECTRA 2.4
Limit apply to	FCC Part 15.209, RSS-210, A8.5
Test Date	August 07, 2009
Operating Condition	Low CH, Middle CH, High CH Transmission
Result	Pass

Limit

Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequencies (MHz)	Field Strength (μN/m)	Field Strength (dB μN/m)	Measurement Distance (m)
30 – 88	100	40	3
88 – 216	150	43.5	3
216 – 960	200	46	3
Above 960	500	54	3

* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

Test Results

- Refer to see the measured plot in next page.

Test Engineer: Kug Kyoung, Yoon

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Radiated Emissions Test data

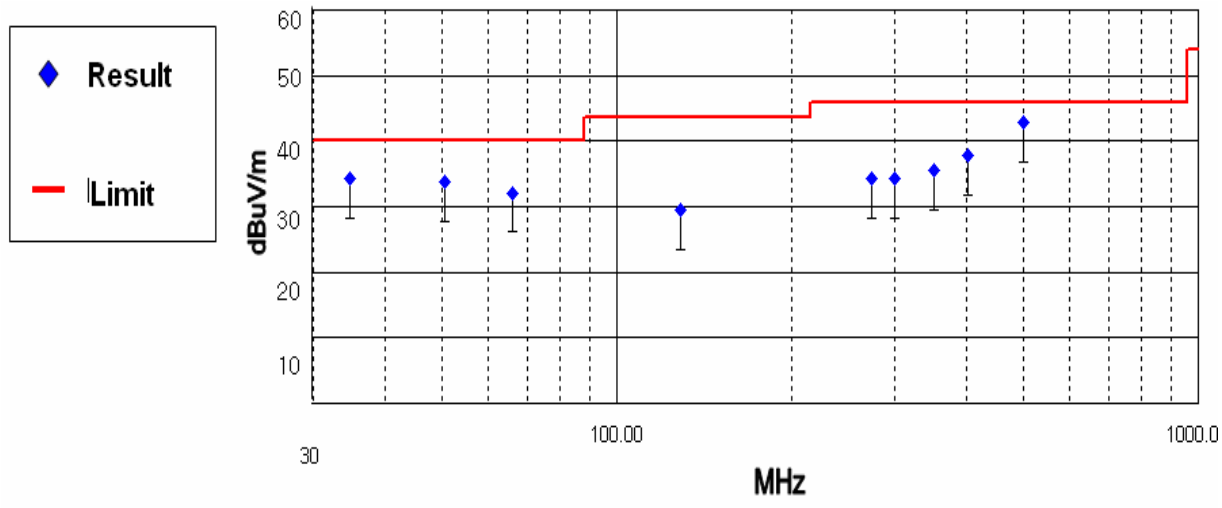
- Below 1 GHz

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.
Detector mode: CISPR Quasi – Peak mode (6 dB Bandwidth: 120 kHz)

Frequency [MHz]	Reading [dBμV]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]
34.77	22.09	V	11.22	0.89	34.20	40.00	5.80
50.45	20.39	V	12.21	1.20	33.80	40.00	6.20
66.13	20.47	V	10.27	1.36	32.10	40.00	7.90
128.85	15.32	V	11.79	2.29	29.40	43.50	14.10
274.75	19.06	H	11.69	3.45	34.20	46.00	11.80
300.25	18.03	H	12.47	3.70	34.20	46.00	11.80
351.25	17.85	H	13.64	4.11	35.60	46.00	10.40
400.75	18.64	H	14.56	4.60	37.80	46.00	8.20
500.25	20.75	H	16.65	5.40	42.80	46.00	3.20

NOTES:

1. *** H : Horizontal polarization , ** V : Vertical polarization**
2. **Result = Reading + Antenna factor + Cable loss**
3. **Margin value = Limit - Result**
4. **The measurement was performed for the frequency range above 30 MHz according to FCC Part 15.209.**



Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

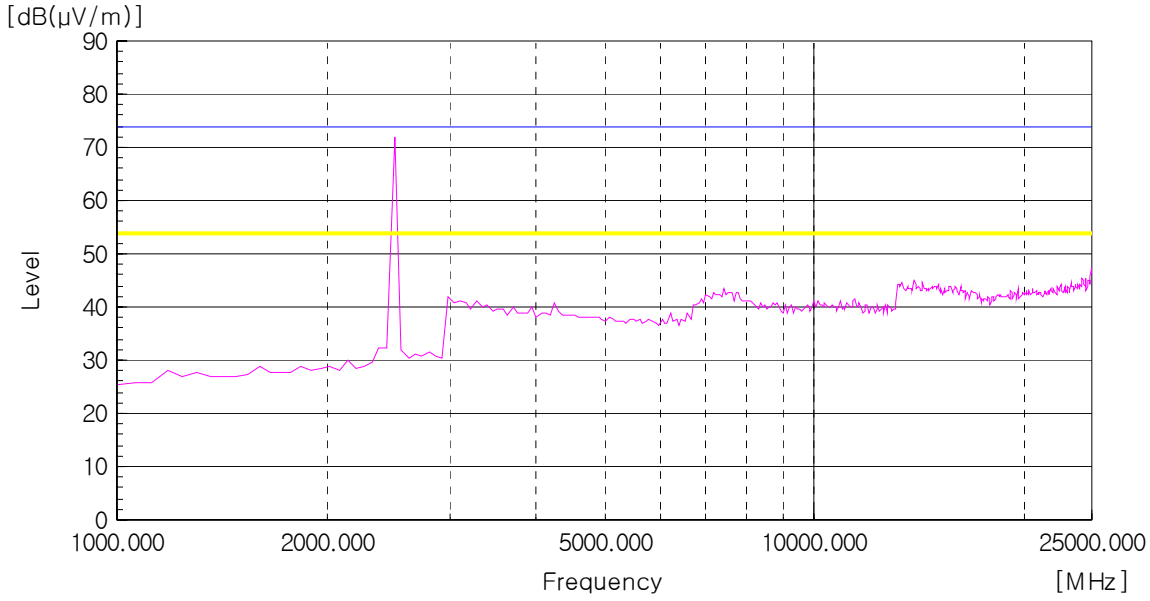
- Above 1 GHz

- Operating mode: TX / CH: Low, Mid, High

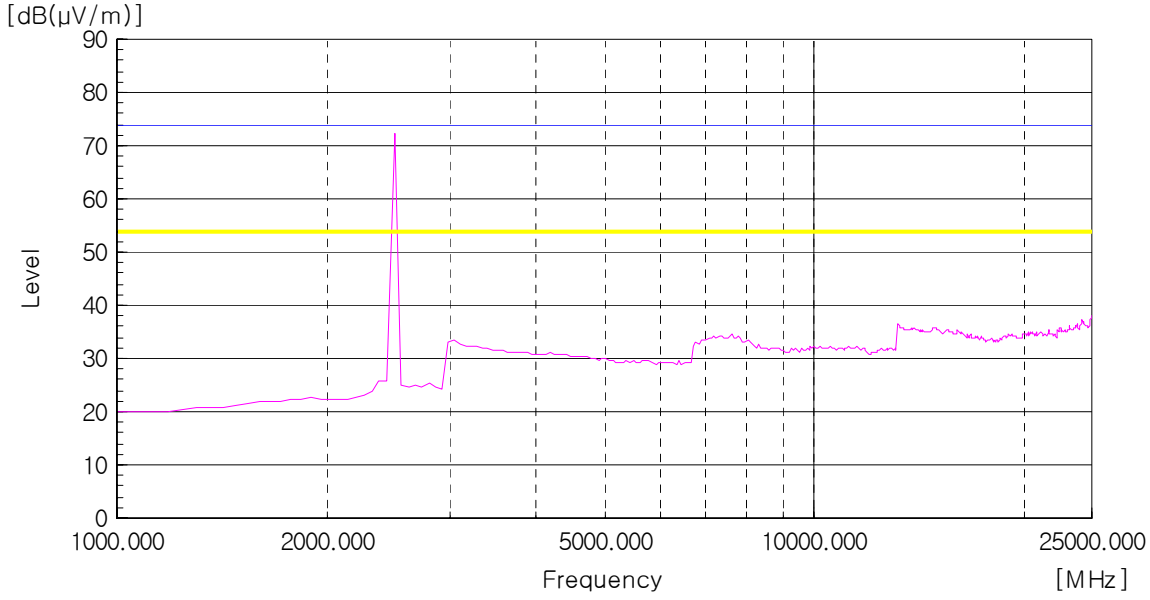
The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.

Peak Limit Line
AV Limit Line

Final data Peak



Final data AV



Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

1. Low CH

Detector mode: Peak mode

Frequency [MHz]	Reading [dBμN]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dBμN]	Preamp [dB]	Result [dBμN/m]	Limit [dBμN/m]	Margin [dB]
-	-	-	-	-	-	-	74.00	-
-	-	-	-	-	-	-	74.00	-

Detector mode: Average mode

Frequency [MHz]	Reading [dBμN]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dBμN]	Preamp [dB]	Result [dBμN/m]	Limit [dBμN/m]	Margin [dB]
-	-	-	-	-	-	-	54.00	-
-	-	-	-	-	-	-	54.00	-

2. Middle CH

Detector mode: Peak mode

Frequency [MHz]	Reading [dBμN]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dBμN]	Preamp [dB]	Result [dBμN/m]	Limit [dBμN/m]	Margin [dB]
-	-	-	-	-	-	-	74.00	-
-	-	-	-	-	-	-	74.00	-

Detector mode: Average mode

Frequency [MHz]	Reading [dBμN]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dBμN]	Preamp [dB]	Result [dBμN/m]	Limit [dBμN/m]	Margin [dB]
-	-	-	-	-	-	-	54.00	-
-	-	-	-	-	-	-	54.00	-

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

3. High CH

Detector mode: Peak mode

Frequency [MHz]	Reading [dBμV]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dBμV]	Preamp [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]
-	-	-	-	-	-	-	74.00	-
-	-	-	-	-	-	-	74.00	-

Detector mode: Average mode

Frequency [MHz]	Reading [dBμV]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dBμV]	Preamp [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]
-	-	-	-	-	-	-	54.00	-
-	-	-	-	-	-	-	54.00	-

Result: All emissions below noise floor of 20 dBμV/m

NOTES:

1. *** H : Horizontal polarization , ** V : Vertical polarization**
2. **Result = Reading + Antenna factor + Cable loss - Preamp**
3. **Margin value = Limit - Result**
4. **Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.**
5. **Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded(ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.**
6. **Spectrum setting:**
   a. Peak Setting 1 GHz to 10th harmonics of fundamental, RBW = 1 MHz, VBW = 1 MHz, Sweep = Auto
   b. AV Setting 1 GHz to 10th harmonics of fundamental, RBW = 1 MHz, VBW = 30 Hz, Sweep = Auto
7. **Considered that's already beyond the background noise floor.**

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.9.2 Radiated Emissions (RX)

EUT	R/C Transmitter / SPECTRA 2.4
Limit apply to	RSS-210, 7.2.3
Test Date	August 07, 2009
Operating Condition	Low CH, Middle CH, High CH RX Mode.
Result	Pass

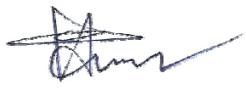
Limit

Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequencies (MHz)	Field Strength (μV/m)	Field Strength (dB μV/m)	Measurement Distance (m)
30 – 88	100	40	3
88 – 216	150	43.5	3
216 – 960	200	46	3
Above 960	500	54	3

Test Results

- Refer to see the measured plot in next page.



Test Engineer: Kug Kyoung, Yoon

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Radiated Emissions Test data

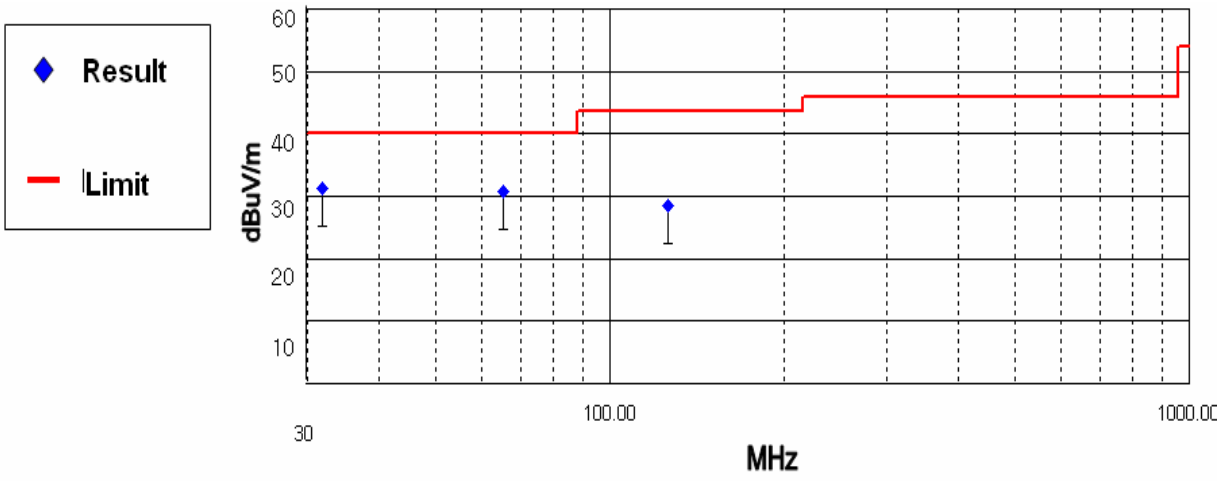
- Below 1 GHz

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.
Detector mode: CISPR Quasi – Peak mode (6 dB Bandwidth: 120 kHz)

Frequency [MHz]	Reading [dBμV]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]
31.80	19.10	V	11.28	0.82	31.20	40.00	8.80
65.34	19.06	V	10.39	1.35	30.80	40.00	9.20
125.90	14.64	V	11.60	2.26	28.50	43.50	15.00

NOTES:

1. *** H : Horizontal polarization , ** V : Vertical polarization**
2. **Result = Reading + Antenna factor + Cable loss**
3. **Margin value = Limit - Result**



Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

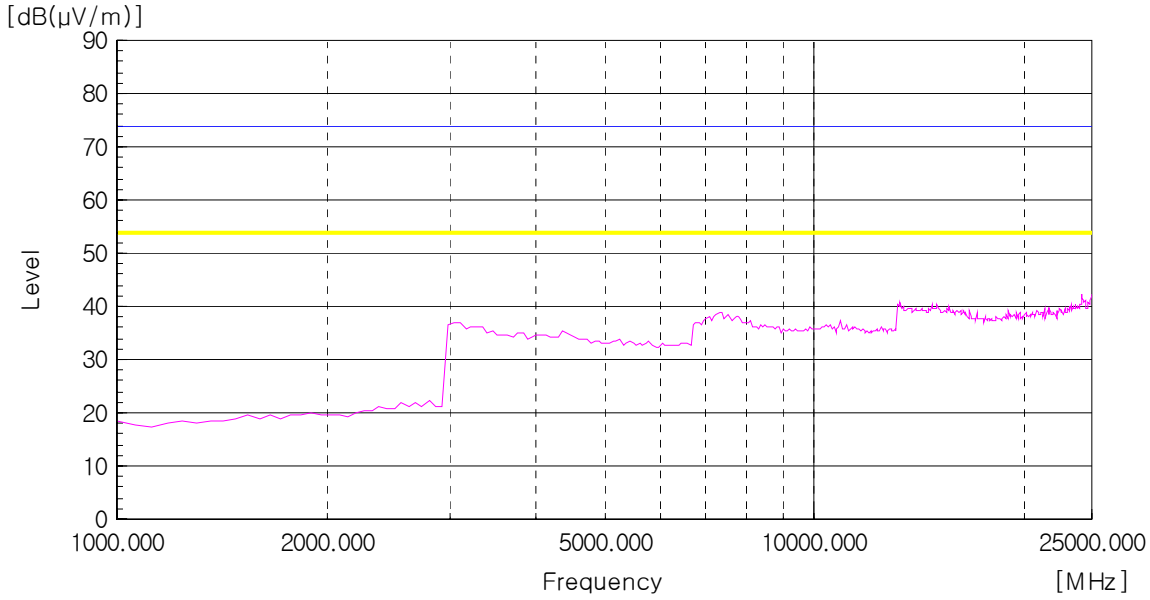
- Above 1 GHz

- Operating mode: RX / CH: Low, Mid, High

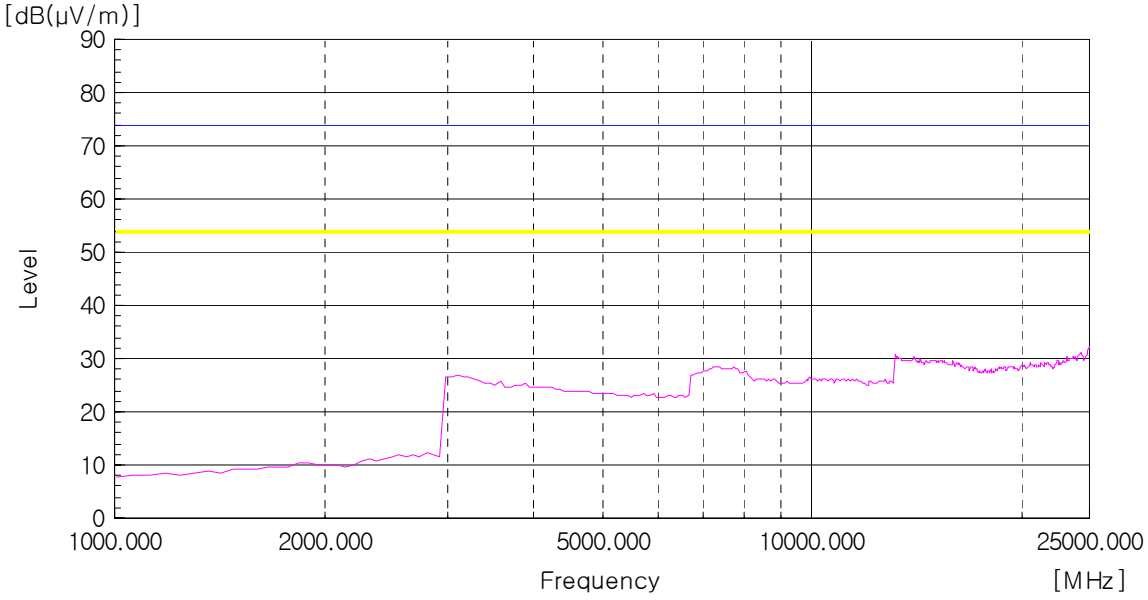
The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.

Peak Limit Line
AV Limit Line

Final data Peak



Final data AV



Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.9.3 Conducted Measurement

EUT	R/C Transmitter / R/C Transmitter
Limit apply to	FCC Part 15.247(d)
Test Date	August 07, 2009
Operating Condition	RF transmitting continuously during the tested.
Result	Pass

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Test Results

- Refer to see the measured plot in next page.

NOTES:

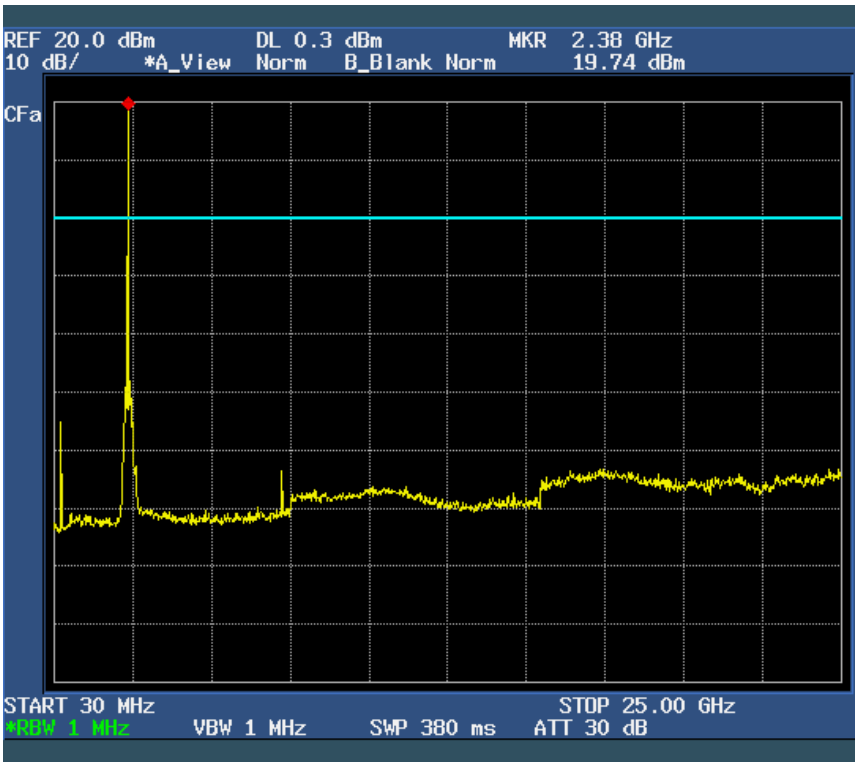
1. **Measure conducted measurement channel using spectrum analyzer.**

Test Engineer: Kug Kyoung, Yoon

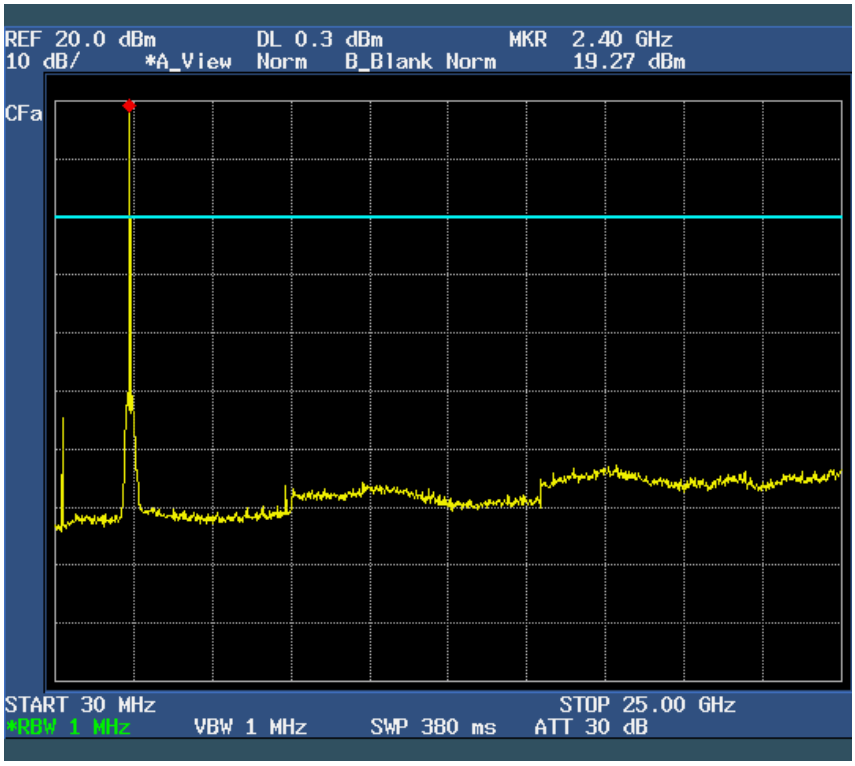
Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Spurious Emissions (Conducted Measurement)

[CH Low]



[CH Mid]



Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

[CH High]

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.10 Radio Frequency Exposure

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this Chapter.

Limit

Limits for general population/Uncontrolled exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)	30
1.34-30	824/f	2.19/f	($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100 000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

MPE Prediction

Predication of MPE limit at a given distance.

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Maximum peak output power at antenna input	:	7.42 dBm (5.521 mW)
Prediction distance	:	20 cm
Predication frequency	:	2 405.6 MHz
Antenna gain(Max)	:	0.91 dBi (1.233 numeric)
Power density at predication frequency at 20 cm	:	0.00135435 mW/cm^2
MPE Limit for	:	1.0 mW/cm^2

Test Result

The power density level at 20 cm is **0.00135435 mW/cm^2**

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

6. SAMPLE CALCULATION

Sample Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor.
The basic equation with a sample calculation is as follows:

FS = RA + AF + CF

Where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor

$dB(\mu V) = 20 \log_{10} (uV)$: Equation

Example : @ 500.25 MHz

Class B Limit = 46.00 dBuV/m

Reading = 20.75 dBuV

Antenna Factor + Cable Loss = 16.65 + 5.40 = 22.05 dBuV/m

Total = 42.80 dBuV/m

Margin = 46.00 – 42.80 = 3.20 dB

= 3.20 dB below Limit

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

7. List of test equipments used for measurements

Test Equipment		Model	Mfg.	Serial No.	Cal. Due Date
■	EMI Test Receiver	ESVS 10	R & S	835165/001	10-04-02
■	Spectrum Analyzer	E7405A	H.P	US41160290	09-10-02
■	LogBicon Antenna	VULB9160	Schwarzbeck	3082	10-01-25
■	Broad band Horn antenna	BBHA 9120D	Schwarz Beck	227	11-03-16
■	Broad band Horn antenna	BBHA 9120D	Schwarz Beck	285	11-03-16
■	Preamplifier	8447D	H.P	3307A02865	09-10-02
■	System Power Supply	Agilent	6030A	1036546	10-04-02
■	Power Meter	NRVS	R & S	834053/060	09-10-02
■	Controller	HD2000	HD GmbH	C/125	N/A
■	Antenna Master	MA2400	HD GmbH	N/A	N/A
■	Turn-Table	MFT-120S	Max-Full Antenna Corp	N/A	N/A
■	Antenna Master	MFA-440E	Max-Full Antenna Corp	N/A	N/A

Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788