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

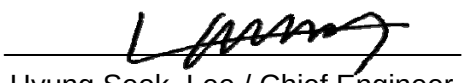
FCC Part 15 Certification Measurement

PRODUCT	:	Digital Satellite Receiver
MODEL/Serial No.	:	SO-5000ND / Proto type
FCC ID	:	PZ8SO-5000ND
APPLICANT	:	Hyundai Digital Technology Co., Ltd. 223-22, Sangdaewon-1dong Jungwon-Gu, Seongnam-Si, Kyoungki-Do, Korea 462-807 Attn.: Hyung-In Kim / General Manager
MANUFACTURER	:	Hyundai Digital Technology Co., Ltd. 223-22, Sangdaewon-1dong Jungwon-Gu, Seongnam-Si, Kyoungki-Do, Korea 462-807
FCC CLASSIFICATION	:	DSS: Spread Spectrum Transmitter
	:	DXT : Part 15 Low Power Transceiver, Rx Verified
RULE PART(S)	:	FCC Part 15 Subpart C Section 15.247, Section 15.249
FCC PROCEDURE	:	ANSI C63.4-2003
TEST REPORT No.	:	ETLE081031.834
DATES OF TEST	:	January 06, 2009 to January 28, 2009
REPORT ISSUE DATE	:	January 29, 2009
TEST LABORATORY	:	ETL Inc. (FCC Registration Number: KR0022)

This DIGITAL SATELLITE RECEIVER, Model SO-5000ND 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

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	**: Hyundai Digital Technology Co., Ltd.**
Address	**: 223-22, Sangdaewon-1dong Jungwon-Gu, Seongnam-Si, Kyoungki-Do, Korea 462-807**
Attention	**: Hyung-In Kim / General Manager**

- **EUT Type** : DIGITAL SATELLITE RECEIVER
- **Model Number** : SO-5000ND
- **S/N** : Proto type
- **RF Spec** : 2 402 MHz – 2 480 MHz, Number of channels 79 CH, FHSS
- : 2 402 MHz – 2 473 MHz, Number of channels 6 CH, GFSK
- **FCC Rule Part(s)** : FCC Part 15 Subpart C Section 15.247, Section 15.249
- **Test Procedure** : ANSI C63.4-2003
- **Dates of Tests** : January 08, 2009 to January 29, 2009
- **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
- **Test Report No.** : ETLE081031.834

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 tests were 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 the requirements of Section 2.948 FCC Rules according to the ANSI C63.4-2003 and registered to the Federal Communications Commission (FCC Designation Number : KR0022).

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 Hyundai Digital Technology Co., Ltd. Model: SO-5000ND

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 RF Transmitter by the Hyundai Digital Technology Co., Ltd. Model: SO-5000ND

This DIGITAL SATELLITE RECEIVER is designed for automobile. Enjoy the wide choice of more 8,000 different channels, broadcasting a large range of culture, sports, cinema, news, events, etc.

2.2 General Specification

Category	Specification
Flash Memory	32Mbyte
DDR Memory	128Mbyte
EEPROM	256Kbit (32Kbyte)
Front End	IMLM
Power Supply	
Input Voltage	Nominal 12VDC (10 to 28VDC range)
Swithch	On/Off Control
Cable	Detachable. three wires black / red/ yellow, 6m long, fuse protected
Mode	Operating / Standby Modes Standby = Video/Audio Off and iMLM power off via FET cntrol
Video	
CODEC	MPEG-4 AVC/H.264 - Baseline, main and extended profile, up to level 2 at least(Main only)
Transport stream	MPEG2-TS
Aspect Ratio	4:3, 16:9; pan & scan; letterbox
Output	2 x CVBS (S-Video is not used)
Audio	
CODEC	MPEG-4 (AAC-HE), MPEG-1 layers 1, 2 and 3 (MP3)
Output	Stereo Connector RCA jack - Female (two sets)
with Bluetooth	Stereo audio transmission over Bluetooth
Remote Control	
Type	2.4GHz ISM band (Nordic, nRF24L01) STB is receive only Actually, used frequency is 2.402~2.473GHz
Coverage	Current coverage = 13M
Key	30Key
Battey	CR2025 (3V)
Code	Address coded and support multi Mobile STB installation (pairing)

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

Category	Specification
USB	
Functional	USB2.0 Host
Speed	Hi-Speed rate of 480Mbps
Port	2-Port (1-port is at front panel, 1-port is for IMLM interface)
Smart Card	
	locking mechanism to resist vibration - push/push SIM Socket with cover
Front Pannel Interface	
RF connector	x 1 : SMA Female(mounted on IMLM)
LED	x 3 : standby/power-on (red/green), SW Dowload (Blinking Yellow), remote control (blinking red)
USB connector	x 1 : USB 2.0 Type A(Use the Firmware download)
Power Switch	x 1
Power connector	x 1
RCA connnector	x 2 : Female
S-Video connector	x 1 : Female
Smartcard Slot	x 1 : SIM Socket
IR Mouse	x 1 : 3P Male
Bluetooth	
Module	CSR solution(2.4GHz)
Version	Version 2.0
Class	Class 2
Profile	A2DP
	AVRCP
	SPP (upto 250kbps)
	DUN
Mechanicial Specification	
W x D x H	Less than 8" x6" x2" (195 * 151.8 * 46 mm)
Weight	Less than 5lbs
Operational and storage environment	
Operation	0℃ ~ 50℃
Storage	-35℃ ~ 80℃
Humidity	0 ~ 90%
RF Front End	
Input Frequency	950MHz ~ 2050MHz
RF Input Connector	SMA-Female 50ohm(Input Impedance 50ohm)
Input Level	-65dBm ~ -25dBm
Modulation Data rate	15MCPS / 22.5MCPS / 30MCPS
Channel Bandwidth	18MHz / 27MHz / 36MHz
Antenna Controller Output	
RF Output	315MHz or 333MHz
RF out level	-40dBm

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

1. BLUETOOTH: 79CH **Unit: MHz**

2 402	2 422	2 442	2 462
2 403	2 423	2 443	2 463
2 404	2 424	2 444	2 464
2 405	2 425	2 445	2 465
2 406	2 426	2 446	2 466
2 407	2 427	2 447	2 467
2 408	2 428	2 448	2 468
2 409	2 429	2 449	2 469
2 410	2 430	2 450	2 470
2 411	2 431	2 451	2 471
2 412	2 432	2 452	2 472
2 413	2 433	2 453	2 473
2 414	2 434	2 454	2 474
2 415	2 435	2 455	2 475
2 416	2 436	2 456	2 476
2 417	2 437	2 457	2 477
2 418	2 438	2 458	2 478
2 419	2 439	2 459	2 479
2 420	2 440	2 460	2 480
2 421	2 441	2 461	

2. 2.4 GHz ISN band: 6CH **Unit: MHz**

2 402
2 415
2 428
2 442
2 458
2 473

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, 15.209 and 15.247.

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 1000 MHz 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 1000 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: SO-5000ND) 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 25 GHz's worst case is in normal link mode.

1. Channel low (2 402 MHz), Mid (2 441 MHz) and High (2 480 MHz) were chosen for full testing.
2. Channel low (2 402 MHz), Mid (2 442 MHz) and High (2 473 MHz) were chosen for full testing.

4.3 Support Equipment Used

Description	Model Name	Serial No.	Manufacturer
LCD TV Monitor	HL-2610HQ	NONE	HASPER
USB Drive	NONE	NONE	NONE
Remote Control*	WR730-RaySat	NONE	YUWON TRONIX Co., Ltd.

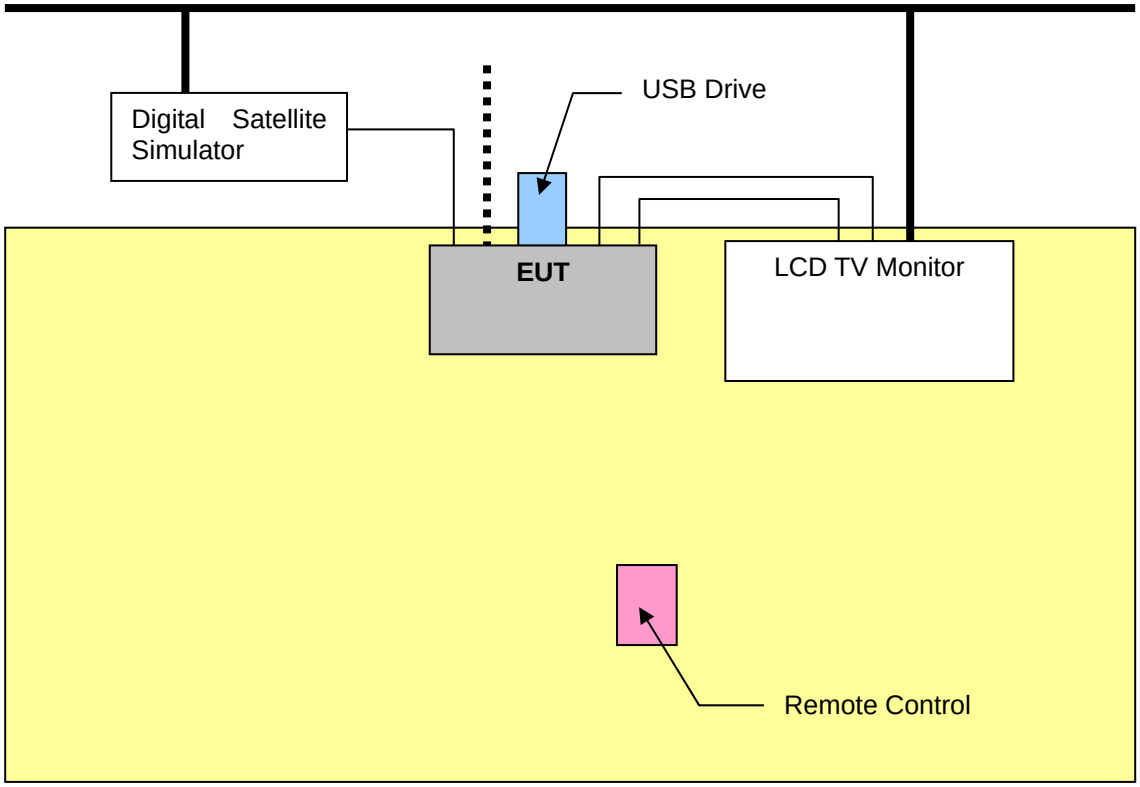
* Remote Control is FCC ID: WXRWR730-RAYSAT

4.4 Type of Cables Used

Device from	Device to	Type of I/O port	Length(m)	Type of shield
EUT	LCD TV Monitor	RCA	1.5	Shielded
EUT	USB Drive	USB	-	-
EUT	Digital Satellite Simulator	Signal Input	2.5	Shielded

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

4.5 The setup drawing(s)



: Data Line

: Power Line

: DC Power Line

: Adapter

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.

Applied Standard : 47 CFR Part 15, Subpart C			
FCC Rule	**Measurement Required**	**Limit**	**Result**
15.247(b)(1)	Maximum peak conducted output power	**< 1 W**	**Pass**
15.247(d)	Bandwidth of Frequency Band Edges	**More than 20 dBc**	**Pass**
15.247(e)	Power Spectral density	**More than 8 dBm**	**Pass**
15.247(a)(1)	Frequency Separation	**More than > 25 kHz**	**Pass**
15.247(a)(1)(iii)	Number of Hopping Channels	**More than 15 channels**	**Pass**
15.247(a)(1)(iii)	Time of Occupancy(Dwell time)	**< 0.4 s**	**Pass**
15.247(i)	Radio Frequency Exposure	**< 20 cm**	**Pass**
15.247(d) 15.209	Spurious Emissions	**Various**	**Pass**
15.249	Field Strength of Fundamental and Harmonics Emissions Measurement	**Various**	**Pass**
15.205	Restricted Bands	**Various**	**Pass**

The data collected shows that the **Hyundai Digital Technology Co., Ltd. / DIGITAL SATELLITE RECEIVER / SO-5000ND** complied with technical requirements of above rules part 15.209 and 15.247, 15.249, 15.205 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 Maximum peak conducted output power

EUT	DIGITAL SATELLITE RECEIVER / SO-5000ND (S/N: Proto type)
Limit apply to	FCC Part 15.247(b)(1)
Test Date	January 06, 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 frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.

Test Data

Channel	Frequency (MHz)	Output Power (dBm)	Limit
Low	2 402	-3.89	< 1 W (< 30 dBm)
Mid	2 441	-5.76	
High	2 480	-7.09	

NOTES:

1. **The transmitter output is connected to the Power Meter.**

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

5.3 Bandwidth of Frequency Band Edges

EUT	DIGITAL SATELLITE RECEIVER / SO-5000ND (S/N: Proto type)
Limit apply to	FCC Part 15.247(d)
Test Date	January 08, 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:

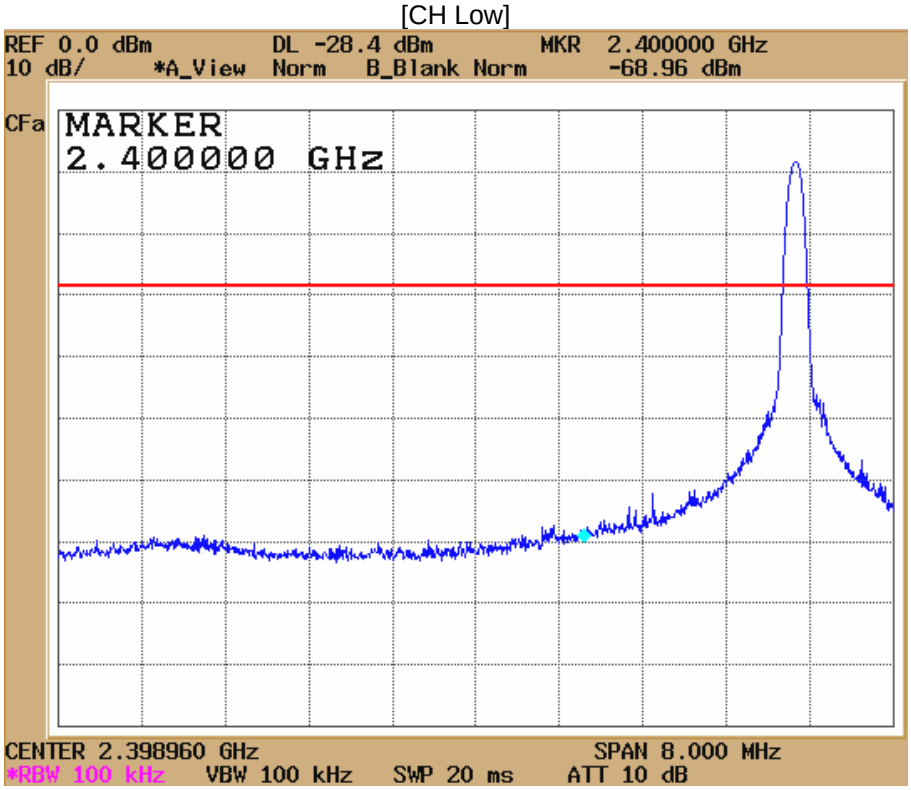
1. **The test was performed to make a direct field strength measurement at the band edge frequencies.**
2. **Set the spectrum analyzer in the following setting in order to capture the lower and upper band edges of the emission: RBW 100 kHz, VBW 100 kHz, Sweep time Auto**

Test Engineer: Kug Kyoung, Yoon

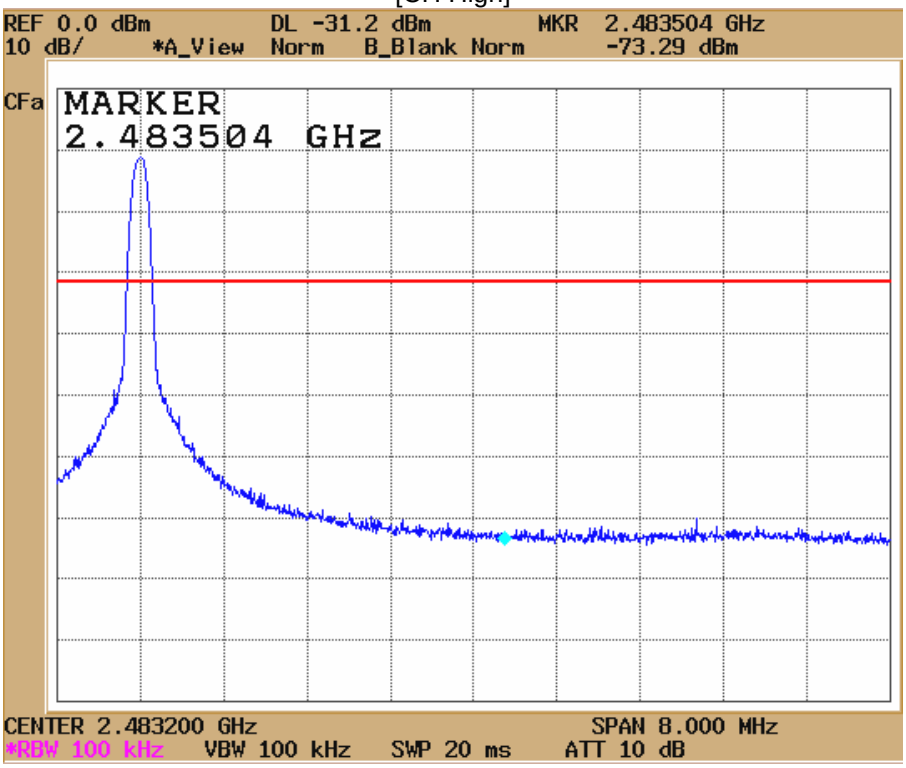
Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Bandwidth of Frequency Band Edges

[CH Low]



[CH High]



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

5.4 Power Spectral Density

EUT	DIGITAL SATELLITE RECEIVER / SO-5000ND (S/N: Proto type)
Limit apply to	FCC Part 15.247(e)
Test Date	January 09, 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

Channel	Frequency (MHz)	PSD (dBm)	Limit
Low	2 402	-18.28	8 dBm
Mid	2 441	-20.45	
High	2 480	-22.45	

NOTES:

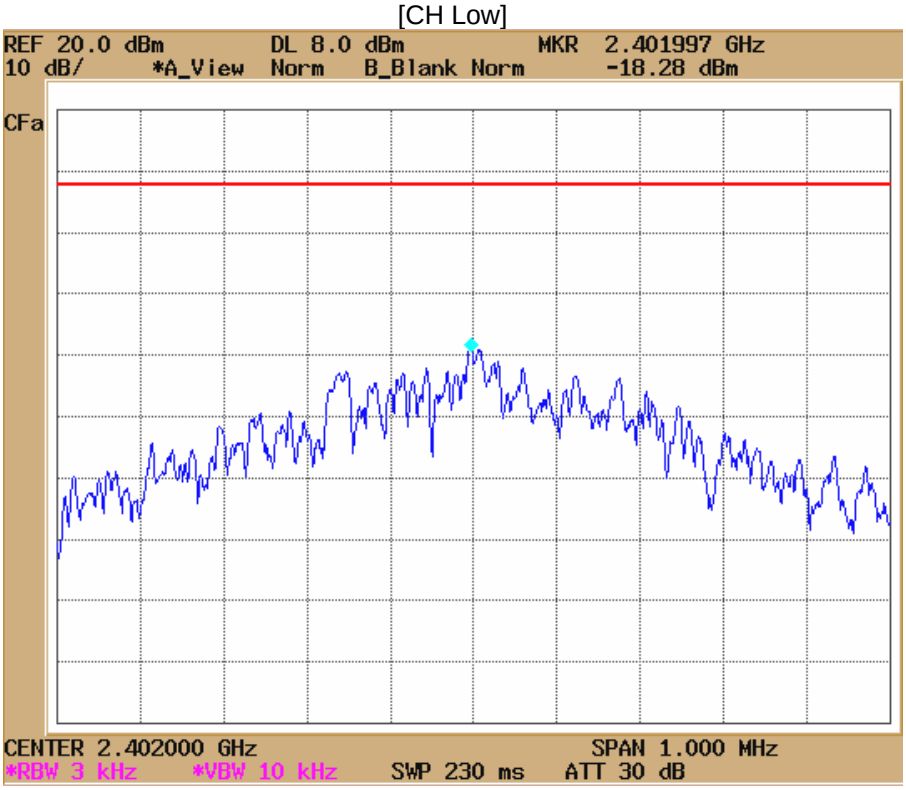
1. **Measure power spectral density of relevant channel using spectrum analyzer.**
2. **RBW 3 kHz, VBW 10 kHz, span 300 kHz, Sweep time Auto.**
3. **Please see the measured plot in next page.**

Test Engineer: Kug Kyoung, Yoon

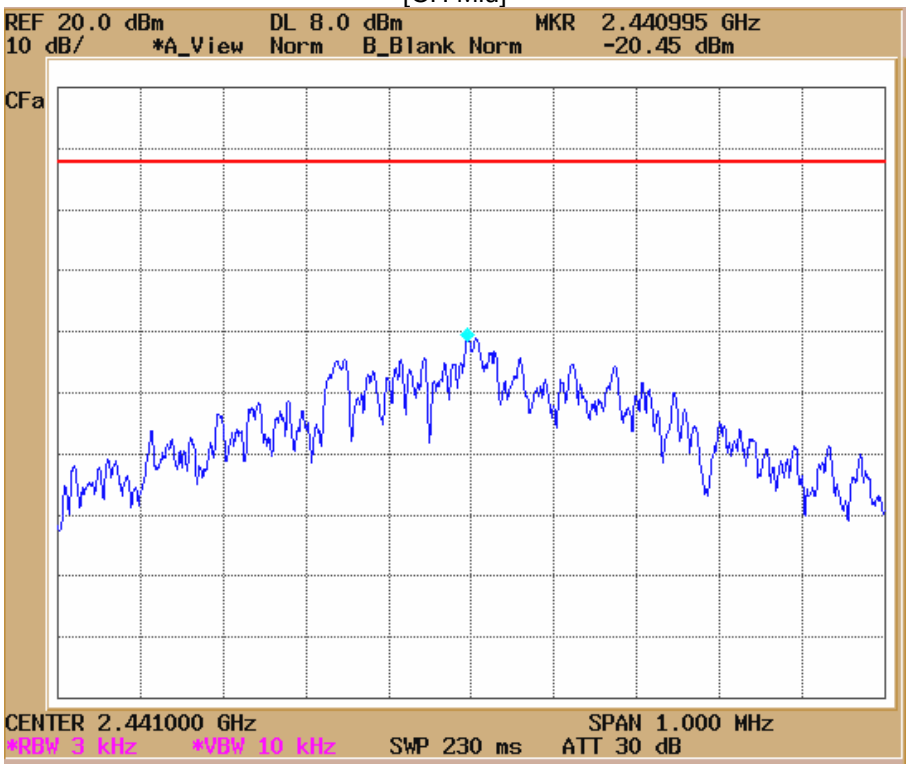
Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Power Spectral Density

[CH Low]

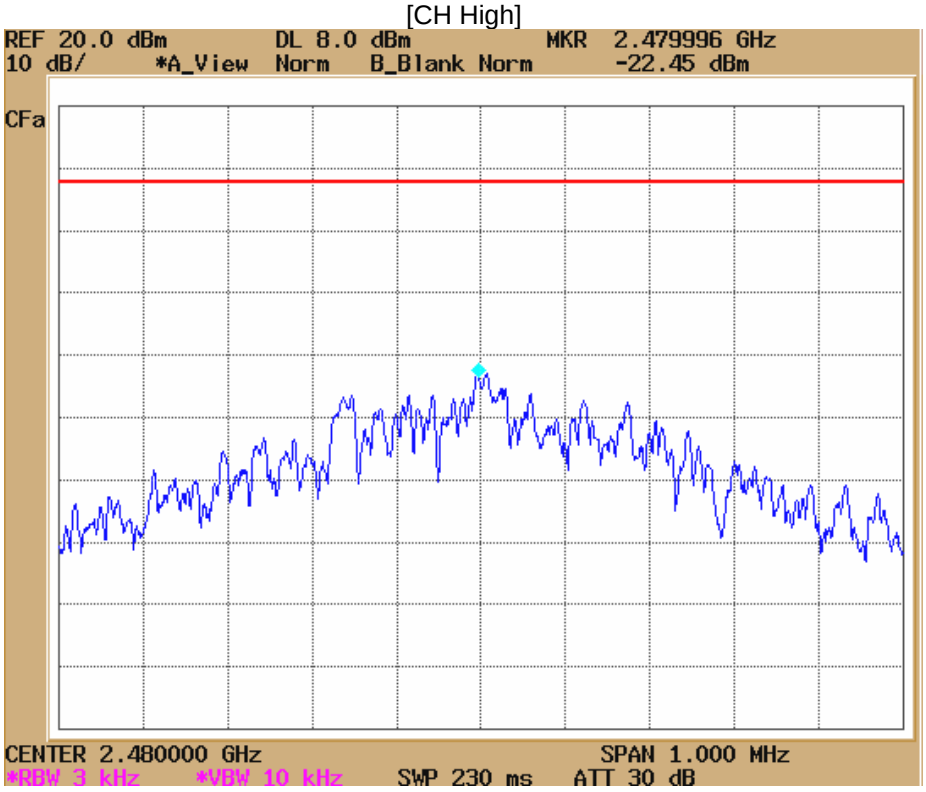


[CH Mid]



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

5.5 Frequency Separation

EUT	DIGITAL SATELLITE RECEIVER / SO-5000ND (S/N: Proto type)
Limit apply to	FCC Part 15.247(a)(1)
Test Date	January 10, 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
1.00	866	> 25 kHz

NOTES:

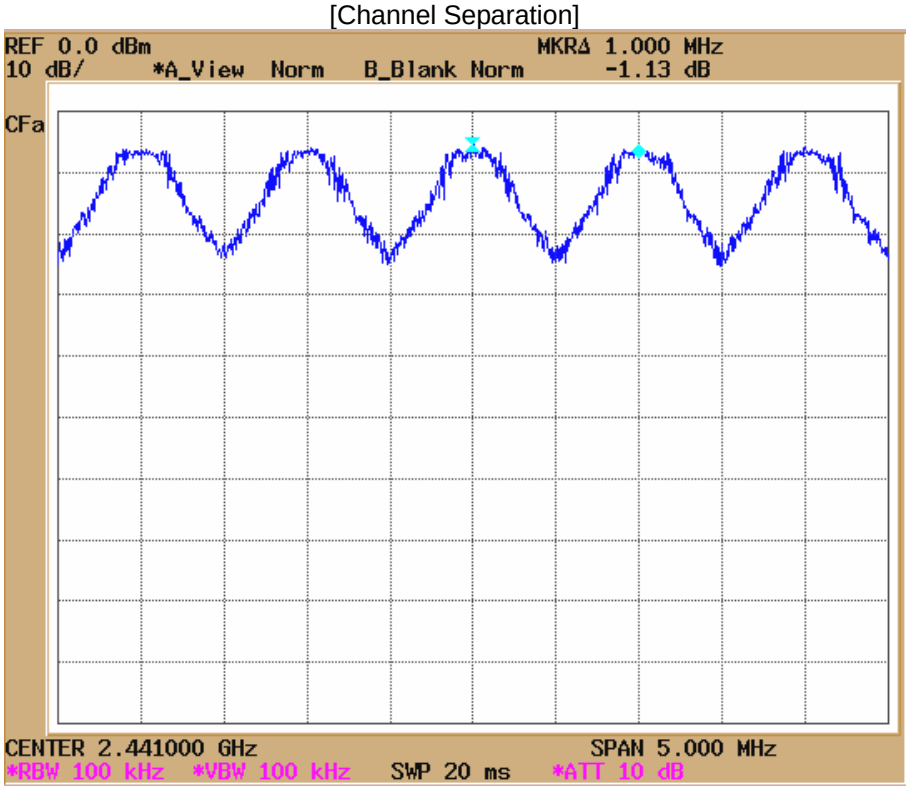
1. **Measure frequency separation of relevant channel using spectrum analyzer.**
2. **RBW 100 kHz, VBW 100 kHz, span 5 MHz, Sweep time Auto.**
3. **Please see the measured plot in next page.**

Test Engineer: Kug Kyoung, Yoon

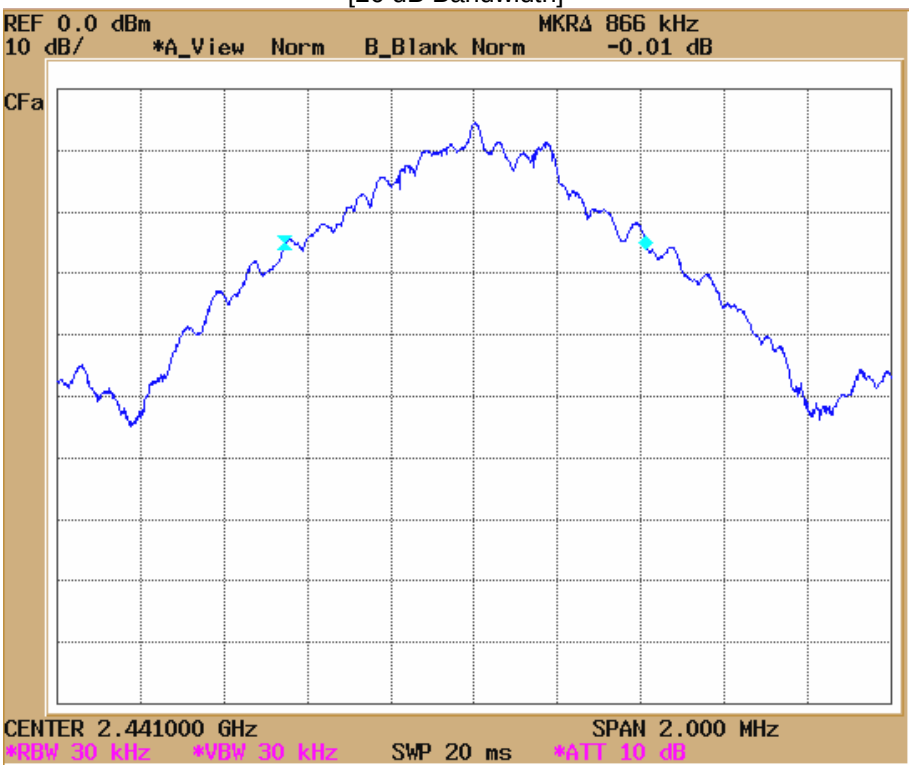
Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

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

5.6 Number of Hopping Channels

EUT	DIGITAL SATELLITE RECEIVER / SO-5000ND (S/N: Proto type)
Limit apply to	FCC Part 15.247(a)(1)(iii)
Test Date	January 10, 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
79	> 15 Channel

NOTES:

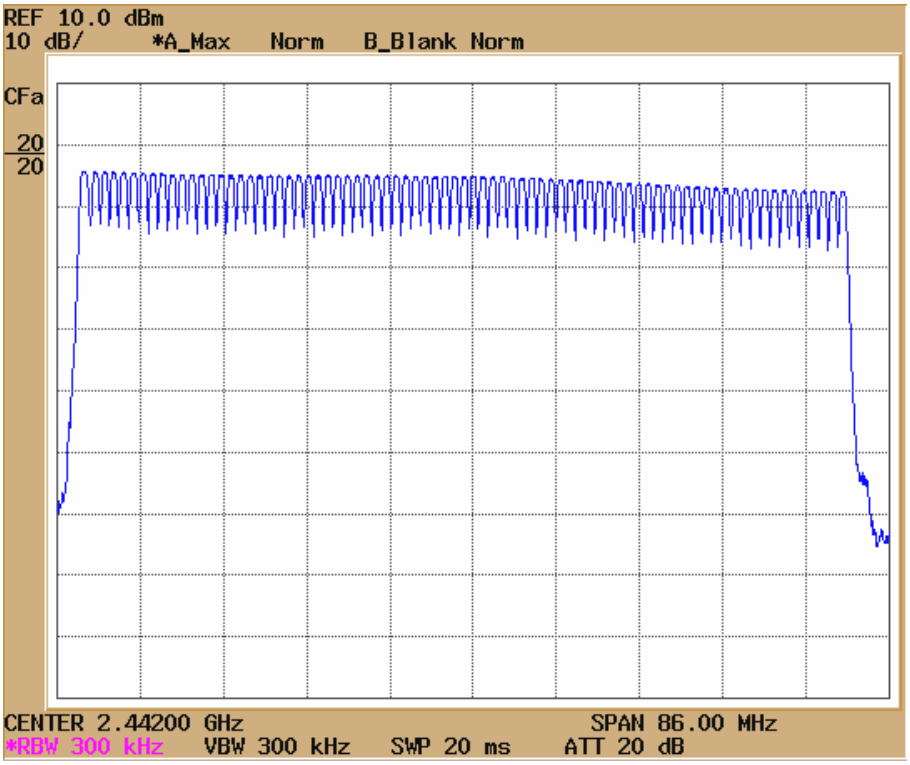
1. **Measure number of hopping channel of relevant channel using spectrum analyzer.**
2. **Set spectrum analyzer Start 2 400 MHz at 2 4835 MHz.**
3. **RBW 300 kHz, VBW 300 kHz.**
4. **Please see the measured plot in next page.**

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

5.7 Time of Occupancy

EUT	DIGITAL SATELLITE RECEIVER / SO-5000ND (S/N: Proto type)
Limit apply to	FCC Part 15.247(a)(1)(iii)
Test Date	January 13, 2009
Operating Condition	RF transmitting continuously during the tested.
Result	Pass

Limit

Frequency hopping systems in the 2 400 MHz – 2 483.5 MHz band, The average time of occupancy on any channel shall not be greater than 0.4 s within a period of 0.4 s multiplied by the number of hopping channels employed.

The average time of occupancy;

a(ms)*(1600/b)c*d = e(ms)

(a=pulse time, b=DH packet size type, c=total channel, d=period time, e=total of dwell)

Test Data

Packet size	CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)
DH 5	Low	2.92	311.47	31.60	400
	Mid	2.92	311.47	31.60	
	High	2.92	311.47	31.60	

NOTES:

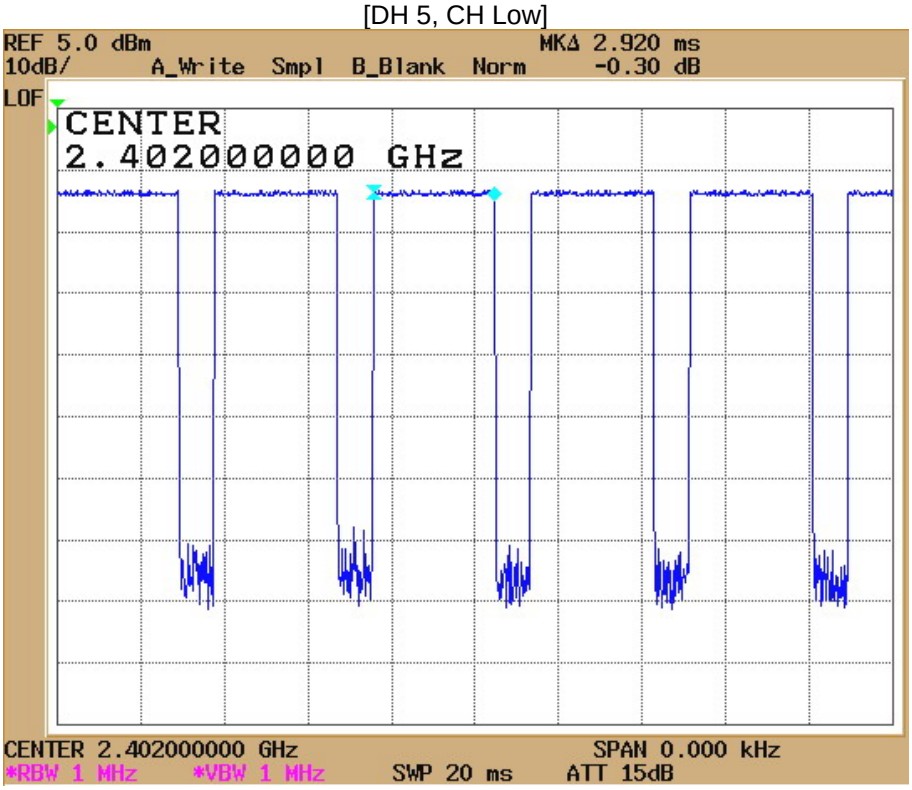
1. **Measure time of occupancy of relevant channel using spectrum analyzer.**
2. **RBW 1 MHz, VBW 1 MHz, Span 0 Hz, Sweep time Auto.**
3. **Please see the measured plot in next page.**

Test Engineer: Kug Kyoung, Yoon

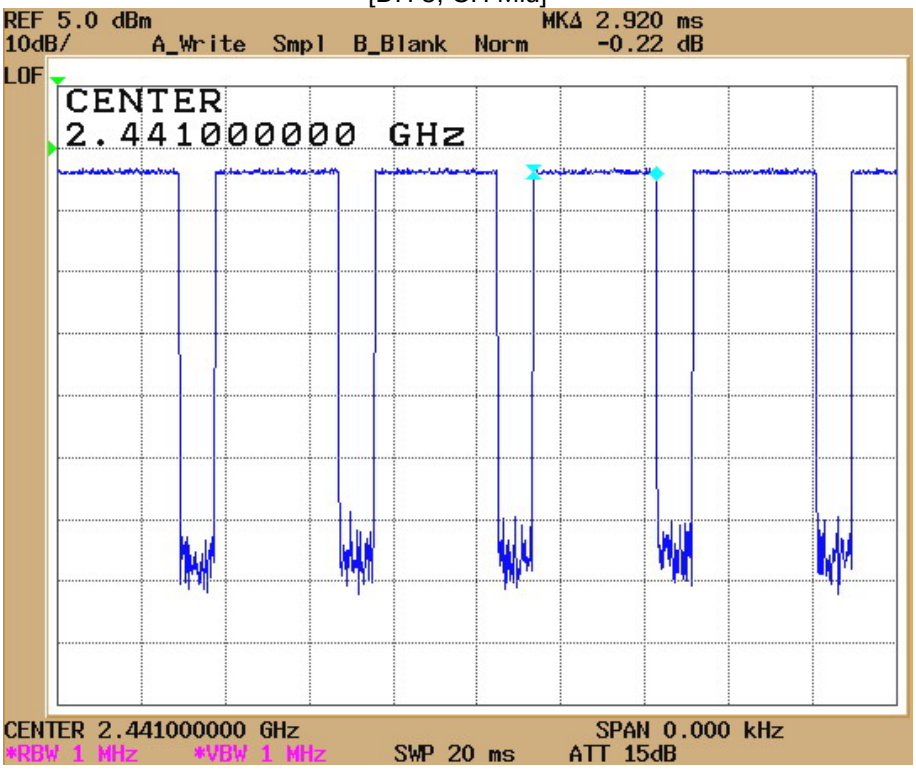
Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Time of Occupancy

[DH 5, CH Low]

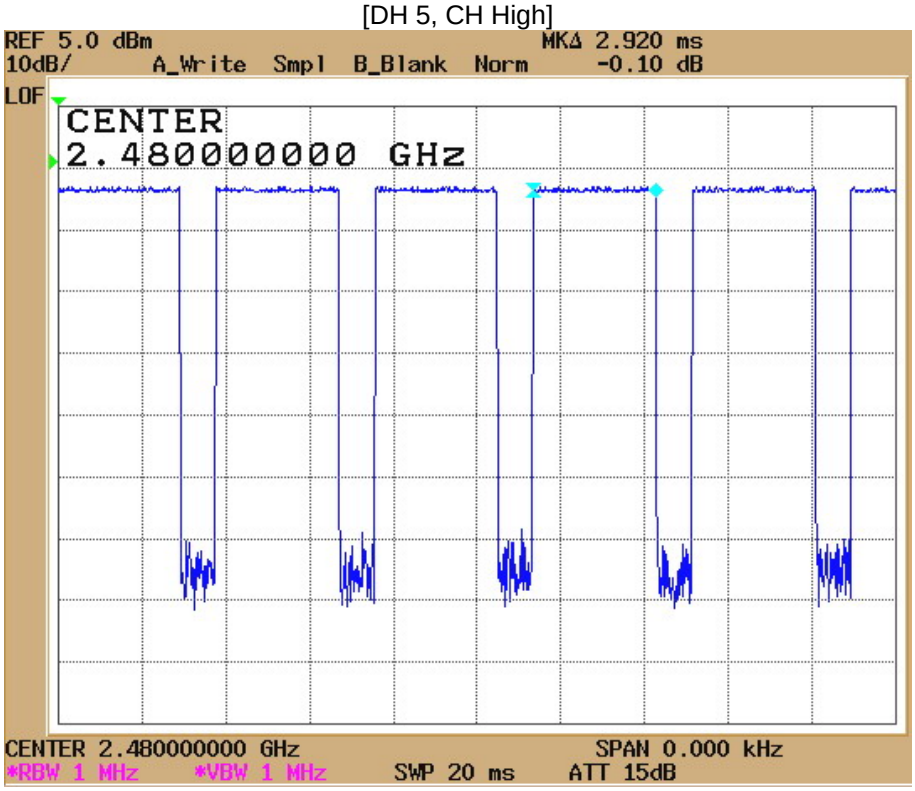


[DH 5, CH Mid]



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

[DH 5, CH High]



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

5.8 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	:	-3.89 dBm (0.41 mW)
Prediction distance	:	20 cm
Predication frequency	:	2 402 MHz
Antenna gain(Max)	:	-1.0 dBi (0.79 numeric)
Power density at predication frequency at 20 cm	:	0.000 064 5 mW/cm^2
MPE Limit for	:	1.0 mW/cm^2

Test Result

The EUT is a portable device. The power density level at 20 cm is 0.000 064 5 mW/cm^2, which is below the uncontrolled exposure limit of 1.0 mW/cm^2 at 2 402 MHz.

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 Conducted Measurement

EUT	DIGITAL SATELLITE RECEIVER / SO-5000ND (S/N: Proto type)
Limit apply to	FCC Part 15.247(d)
Test Date	January 14, 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:

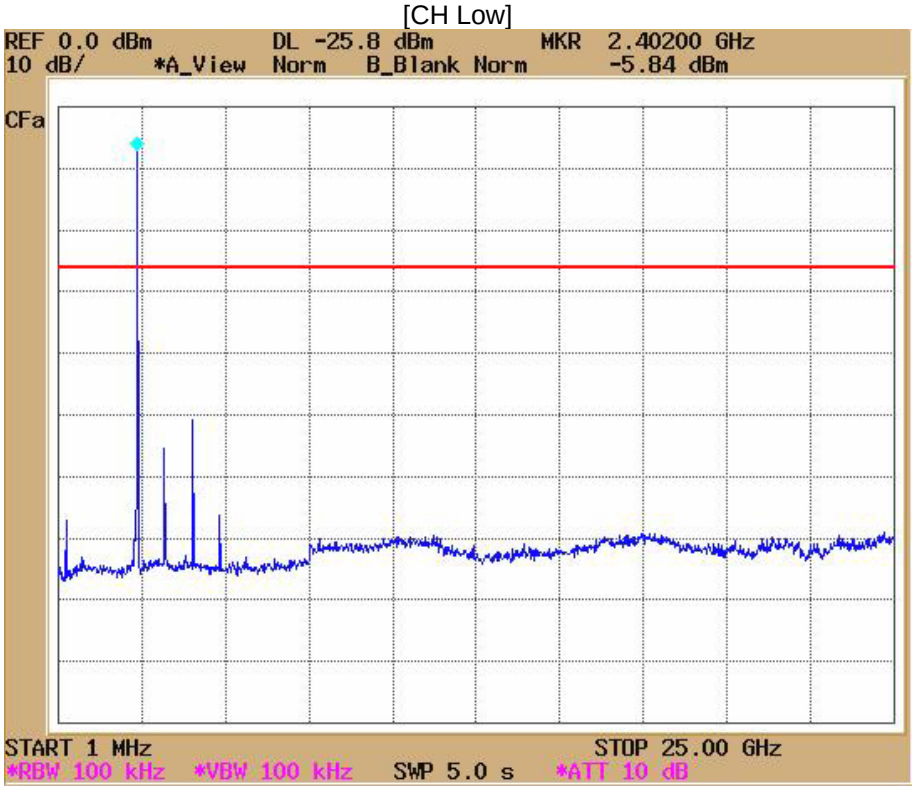
1. **Measure conducted measurement channel using spectrum analyzer.**
2. **RBW 100 kHz, VBW 100 kHz, Frequency range 30 MHz to 25 GHz.**

Test Engineer: Kug Kyoung, Yoon

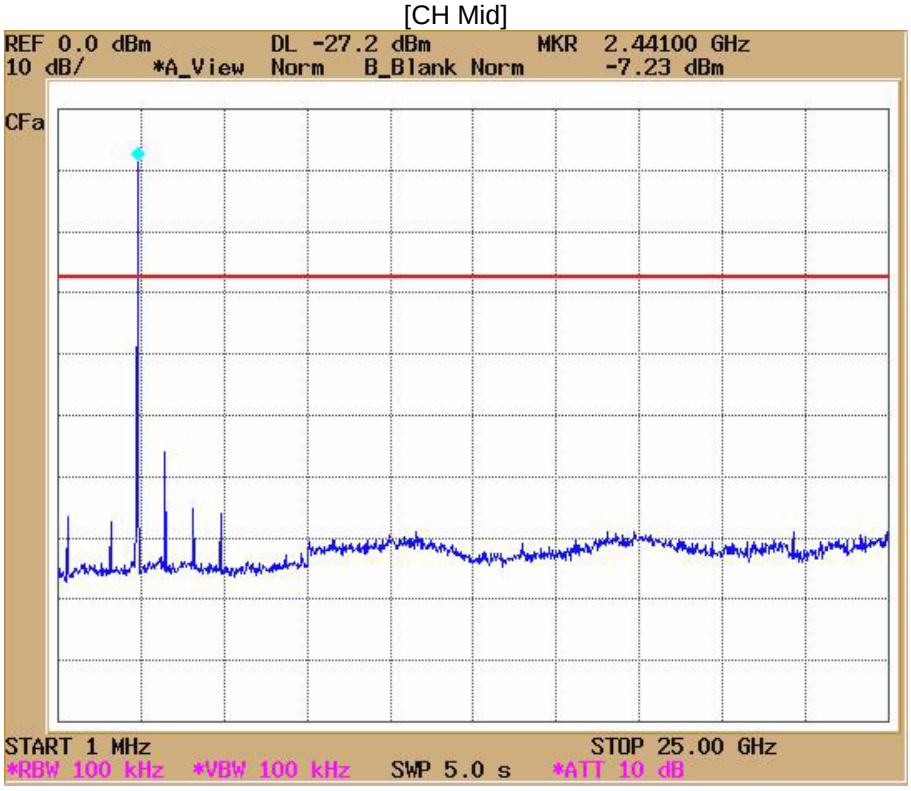
Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

Spurious Emissions (Conducted Measurement)

[CH Low]

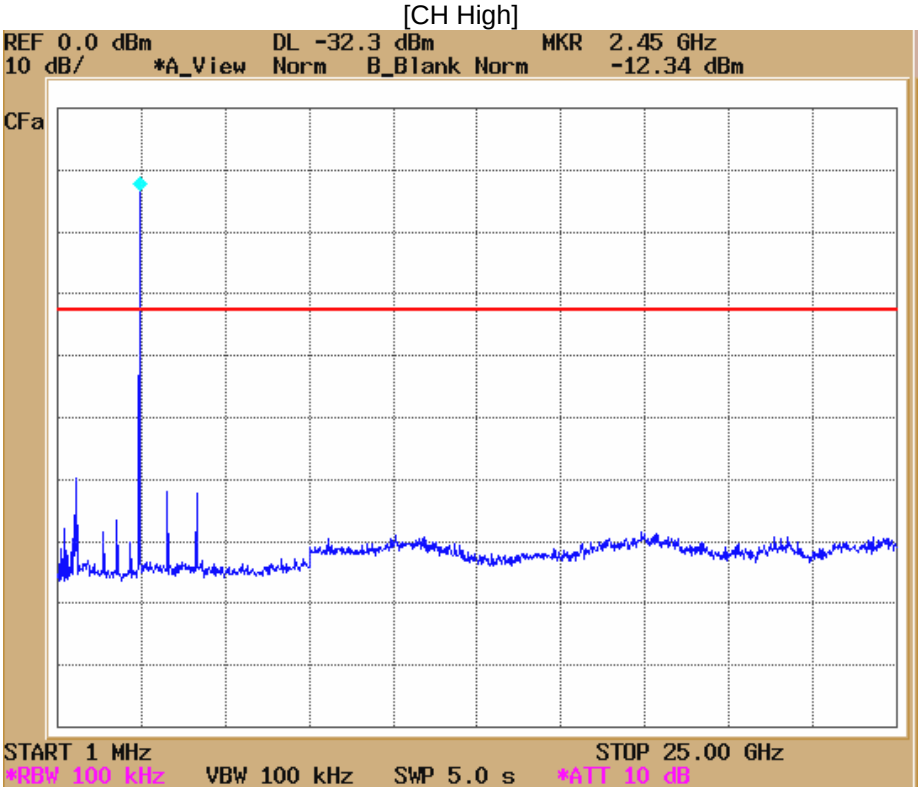


[CH Mid]



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

5.9.2 Radiated Emissions

EUT	DIGITAL SATELLITE RECEIVER / SO-5000ND (S/N: Proto type)
Limit apply to	FCC Part 15.209
Test Date	January 15 - 23, 2009
Operating Condition	Continues transmitter(2.402 MHz, 2.442 MHz, 2.473 MHz): 2.4GHz RF Continues transmitter(2.402 MHz, 2.441 MHz, 2.480 MHz): Bluetooth
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

* 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]
59.70	22.09	V	11.21	1.30	34.60	40.00	5.40
135.30	16.65	V	12.20	2.35	31.20	43.50	12.30
189.30	24.84	H	10.00	2.86	37.70	43.50	5.80
250.00	26.47	H	10.93	3.20	40.60	46.00	5.40
300.00	25.04	H	12.46	3.70	41.20	46.00	4.80
399.75	20.46	H	14.54	4.60	39.60	46.00	6.40
420.75	21.58	H	15.20	4.72	41.50	46.00	4.50
513.50	18.03	H	16.99	5.48	40.50	46.00	5.50

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.**
5. ***Worst case Bluetooth test mode.***

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, Rx / CH: Low, Mid, High

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

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

NOTES:

1. *** H : Horizontal polarization , ** V : Vertical polarization**
2. **Result = Reading + Antenna factor + Cable loss**
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 = 10 Hz, Sweep = Auto**

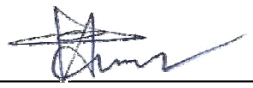
Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.10 Field Strength of Fundamental and Harmonics Emissions Measurement

EUT	DIGITAL SATELLITE RECEIVER / SO-5000ND (S/N: Proto type)
Limit apply to	FCC Part 15.249
Test Date	January 21 - 16, 2009
Operating Condition	Continues transmitter(2.402 MHz, 2.442 MHz, 2.473 MHz)
Result	Pass

Fundamental Frequency (MHz)	Field Strength of Fundamental microvolts/meter(dBμN/m@3 m)	Field Strength of Harmonics Emission microvolts/meter(dBμN/m@3 m)
902-928	50 000μN/m (94dBμN/m)	500μN/m (54dBμN/m)
2 400-2 483.5	50 000μN/m (94dBμN/m)	500μN/m (54dBμN/m)
5 725-5 875	50 000μN/m (94dBμN/m)	500μN/m (54dBμN/m)
24 000.00-24 000.25	250 000μN/m (108dBμN/m)	2 500μN/m (68dBμN/m)

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

5.10.1 Radiated Emissions of Fundamental

Peak Mode Test Data

Frequency [MHz]	Polarization (*H/**V)	Result [dBμV/m]	Peak Limit [dBμV/m]	Margin [dB]
2 402	H	68.80	114.00	45.20
2 402	V	60.60	114.00	53.40
2 442	H	72.30	114.00	41.70
2 442	V	60.80	114.00	53.20
2 473	H	79.70	114.00	34.30
2 473	V	60.40	114.00	53.60

Average Mode Test Data

Frequency [MHz]	Polarization (*H/**V)	Result [dBμV/m]	Average Limit [dBμV/m]	Margin [dB]
2 402	H	67.70	94.00	26.30
2 402	V	59.90	94.00	34.10
2 442	H	71.10	94.00	22.90
2 442	V	59.90	94.00	34.10
2 473	H	78.90	94.00	15.10
2 473	V	59.60	94.00	34.40

NOTES:

1. **Above 1 GHz = Ant factor + cable loss + AMP gain**

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

5.10.2 Radiated Emissions of Harmonics

Test mode is 2 402 MHz, 2 442 MHz, 2 473 MHz Frequecy.

Frequency [MHz]	Polarization (*H/**V)	Result [dBμV/m]	Peak Limit [dBμV/m]	Margin [dB]
-	H,V	-	-	-
-	H,V	-	-	-
-	H,V	-	-	-

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

1. *** H : Horizontal polarization , ** V : Vertical polarization**
2. **Result = Reading + Antenna factor + Cable loss**
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.**

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

5.11 Restricted Bands

EUT	Remote Control / WR730-RaySat
Limit apply to	FCC Part 15.249
Test Date	January 28, 2009
Operating Condition	Continues transmitter(2.402 MHz: 1ch, 2.473 MHz: 6ch)
Result	Passed
Notes	The emission of the carrier radiated field strength is measured for (Peak and AV)as following: 1. The transmitter was then configured with the worst case antenna and setup to transmit at the lowest channel (ch1). Then the field strength was measured at 2 310-2 390 MHz. 2. The transmitter was configured with the worst case antenna and setup to transmit at the highest channel (ch6). Then the field strength was measured at 2 483.5-2 500 MHz.

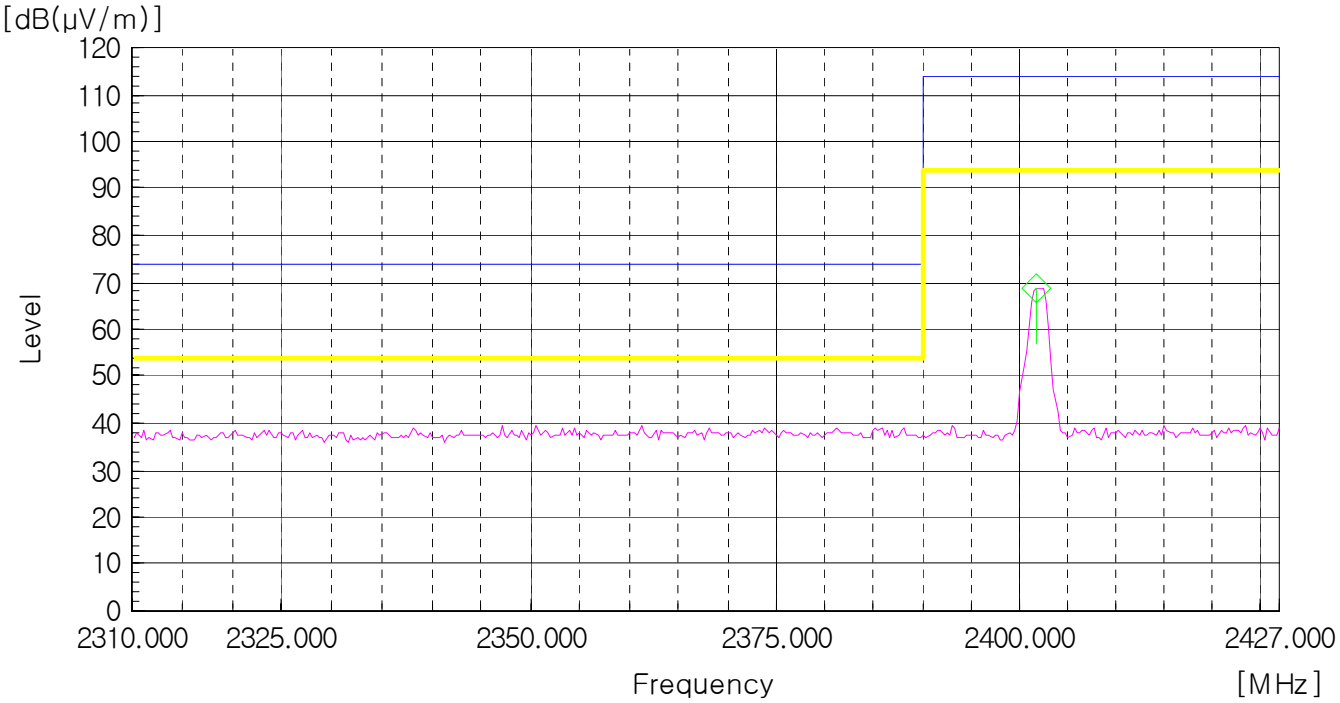
Test Results
- Refer to see the measured plot in next page.

Test Engineer : Kug Kyoung, Yoon

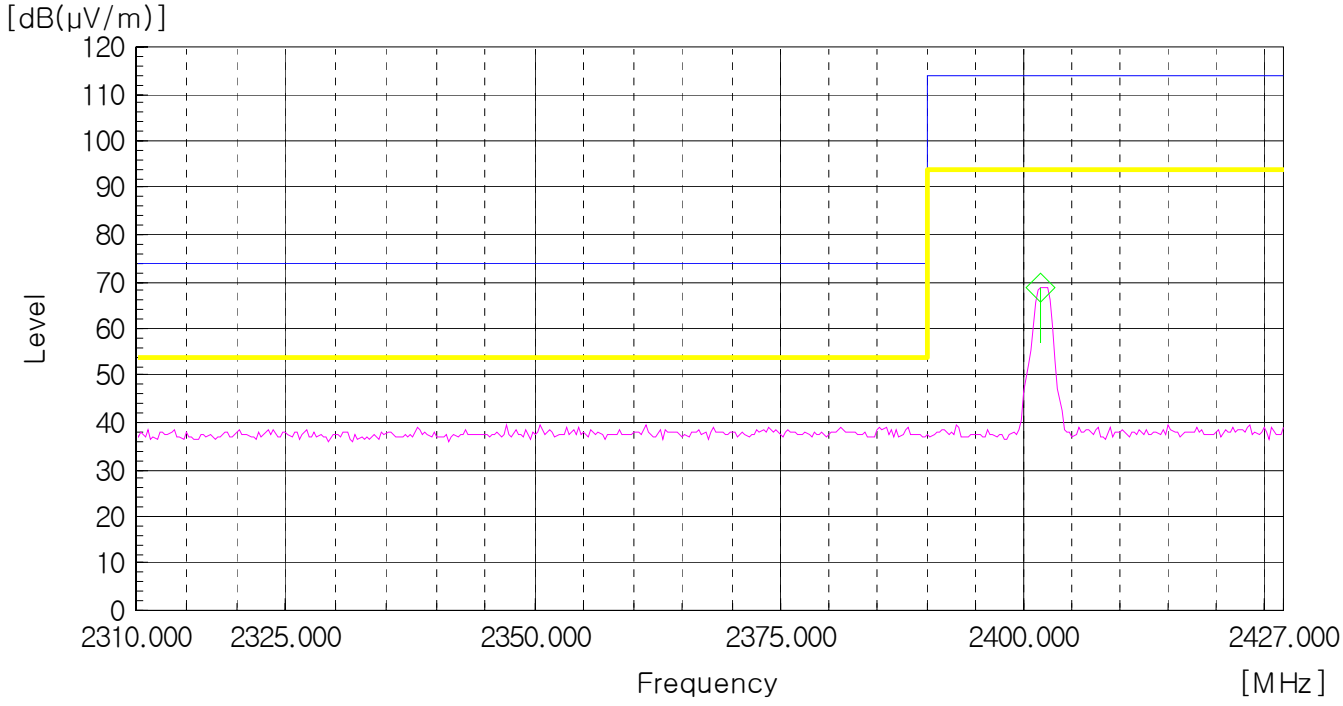
Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.11.1 Restricted Bands data.

Ch1: 2 402 MHz, Vertical



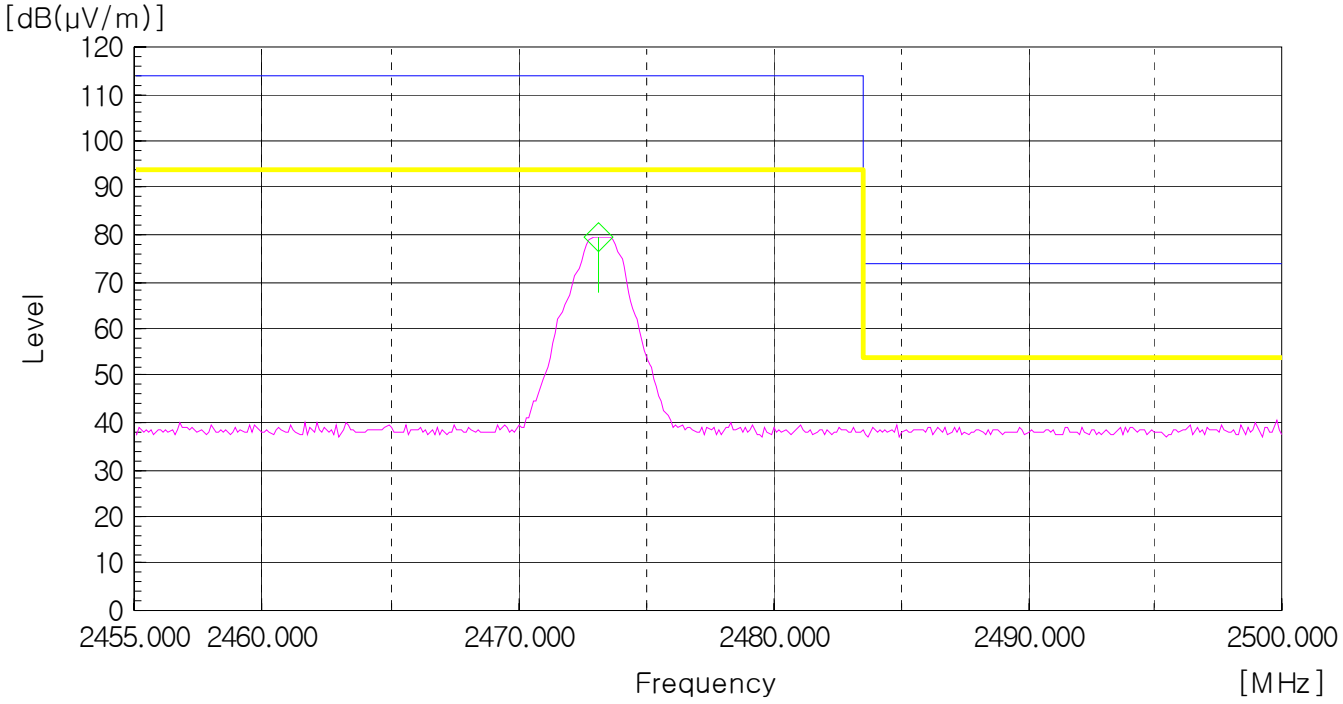
Ch1: 2 402 MHz, Horizontal



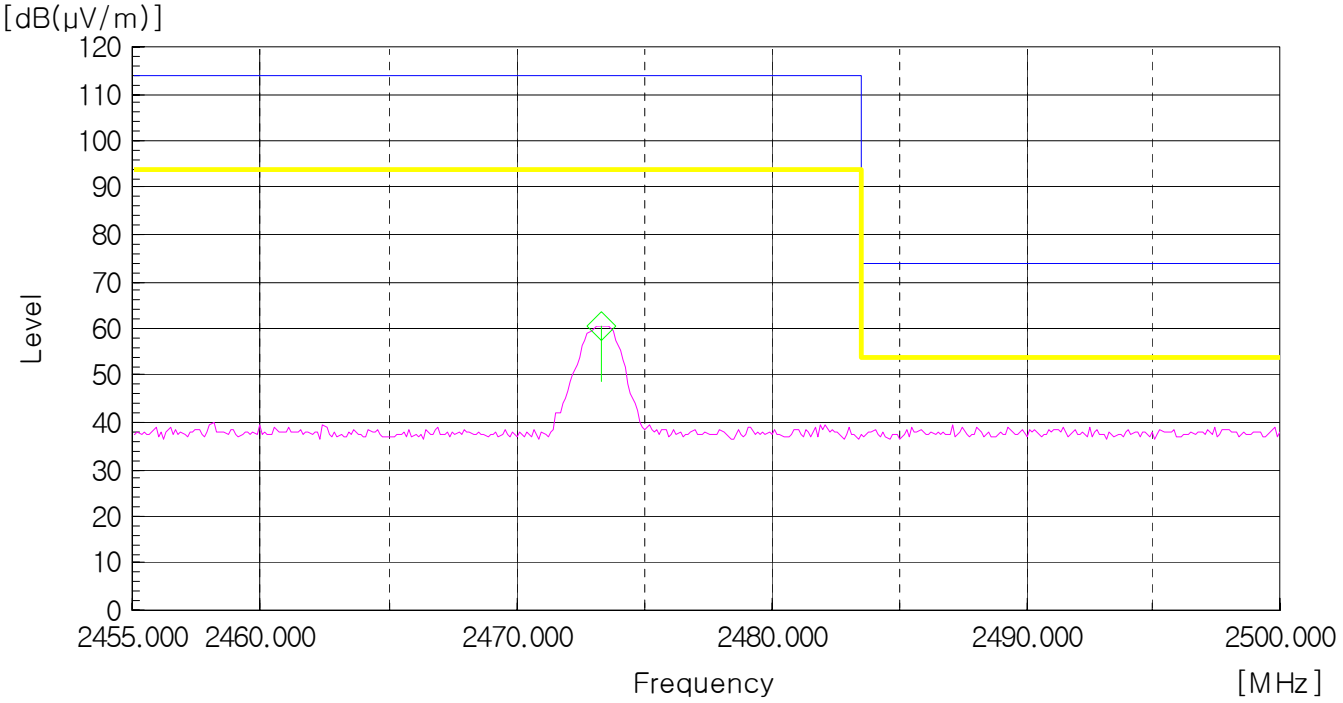
Head Office: # 371-51 Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea Tel : 82-2-858-0786 Fax : 82-2-858-0788

5.11.1 Restricted Bands data.

Ch6: 2 473 MHz, Vertical



Ch6: 2 473 MHz, Horizontal



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 : @ 470.75 MHz

Class B Limit = 46.00 dBuV/m

Reading = 21.58 dBuV

Antenna Factor + Cable Loss = 15.20 + 4.72 = 19.92 dBuV/m

Total = 41.50 dBuV/m

Margin = 46.00 – 41.50 = 4.50 dB

= 4.50 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
☒	Spectrum Analyzer	E7405A	H.P	US41160290	09.10.02
☒	Spectrum Analyzer	R3273	Advantest	95090411	09.06.24
☒	EMI TEST Receiver	ESVS10	R&S	835165/001	09.04.04
☒	Turn-Table	MFT-120S	Max-Full Antenna Corp	-	N/A
☒	Antenna Master	MFA-440E	Max-Full Antenna Corp	-	N/A
☒	LogBicon Antenna	VULB9160	Schwarzbeck	3082	10.01.25
☒	Broad band Horn antenna	BBHA 9120D	Schwarzbeck	227	09.03.15
☒	Preamplifier	8447D	H.P	3307A02865	09.10.02

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