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	:	THERMAL PRINTER
MODEL/Serial No.	:	PORTI-SW40 / Proto type
Multi model	:	PORTI-SW45, NL1000
FCC ID	:	QDDPORTI-SW40
APPLICANT	:	Woosim System Inc. #501, Daerung Technotown 3th, 448, Gasan-dong, Geumcheon-gu, Seoul, Korea Attn. : Moo-Seoung Lim / Assistant Manager
MANUFACTURER	:	Woosim System Inc. #501, Daerung Technotown 3th, 448, Gasan-dong, Geumcheon-gu, Seoul, Korea
FCC CLASSIFICATION	:	DTS: Digital Transmission System
RULE PART(S)	:	FCC Part 15 Subpart B & C Section 15.247
FCC PROCEDURE	:	ANSI C63.4-2003
TEST REPORT No.	:	ETLE070911.633
DATES OF TEST	:	November 05, 2007 – November 12, 2007
REPORT ISSUE DATE	:	November 13, 2007
TEST LABORATORY	:	ETL Inc. (FCC Registration Number : 95422)

This THERMAL PRINTER, Model PORTI-SW40 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 B & 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

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EMC Lab : #584 Sangwhal-ri, Ganam-myeon, Yoju-gun, Gyounggi-do, 469-885, Korea

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	**: Woosim System Inc.**
Address	**: #501, Daerung Technotown 3th, 448, Gasan-dong, Geumcheon-gu, Seoul, Korea**
Attention	**: Moo-Seoung Lim / Assistant Manager**

- **EUT Type** : THERMAL PRINTER
- **Model Number** : PORTI-SW40
- **S/N** : Proto type
- **Freq. Range** : 2402 MHz – 2480 MHz
- **Number of Channels** : 79
- **Modulation Technique** : FHSS (Frequency Hopping Spread Spectrum)
- **FCC Rule Part(s)** : FCC Part 15 Subpart B & C Section 15.247
- **Test Procedure** : ANSI C63.4-2003
- **FCC Classification** : DTS: Digital Transmission System
- **Dates of Tests** : November 05, 2007 – November 12, 2007
- **Place of Tests** : ETL Inc. Testing Lab.

  Radiated Emission test;
  #584, Sangwhal-ri, Ganam-myeon, Yoju-gun,
  Gyeonggi-do, 469-885, Korea

  Conducted Emission test;
  ETL Inc. Testing Lab.
  371-51, Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea
- **Test Report No.** : ETLE070911.633

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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 (FCC Registration Number : 95422).

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 Woosim System Inc., Model: PORTI-SW40

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2. PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is RF Transmitter by the Woosim Systems Inc. Model: PORTI-SM40.
The PORTI-SM40 is the ideal solution for Mobile banking system, Retail, point of sales, credit card transaction, other traveling and mobile computing etc.

2.2 General Specification

Item	Specification	
Printing method	Direct thermal line printing	
Characters per line	64cpl	
Character size	Eng. : 9*24dots, 12*24dots Kor. : 16*24dots, [24*24dots]	
Resolution	203dpi, 8dots/mm	
Print width	3-inch (72mm, 576dots)	
Printing speed	40mm / sec	
Dimensions	107.5 * 88.5 * 45 mm	
Weight	360g (Including battery & roll paper)	
Interface	RS-232C or TTL / Bluetooth	
Paper supplied	Thermal roll paper (80mm wide, 38ø)	
Barcode supplied	PDF417(2-dimension), Code128, Code39, I2/5, Code93 UPC, EAN, KAN, JAN, CODABAR	
Receive buffer size	10K bytes	
Note	Printing speed may be slower, depending on the data transmission speed and the combination of control commands.	
Battery	Rechargeable 7.4V DC, 1400mAh(Li-ion)	
Battery duration	1 hour continuous printing	
Battery Charger	Input (100~250VAC, 50~60Hz) Output(8.4VDC/0.8A), 4hours full charge time	
Environment Conditions	Temperature	-10°C ~ 40°C (operating) -10°C ~ 70°C (storage)
	Humidity	30% - 80% (operating) 10% - 90% (storage)
MCBF (Mean Cycle Between failure)	Mechanical	37,000,000 lines
	Head	Approximately 50 Km

Category	Specification
Bluetooth Spec.	Bluetooth V1.1 / Class2 (10m)
Frequency Range	2.4GHz ISM BAND
Data Transmission Rate	57600bps Fixed.
Data bit	8 Data bit Fixed.
Parity bit	No parity Fixed.
Stop bit	1 Stop bit Fixed.

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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.

3.1 Conducted Emission Measurement

Conducted emissions measurements were made in accordance with section § 13 in ANSI C63.4-2003 "measurement of intentional radiators" The measurements were performed over the frequency range of 0,15 MHz to 30 MHz using a 50 Ω / 50 uH LISN as the input transducer to a Spectrum Analyzer or a Test Receiver. The measurements were made with the detector set for "Peak" amplitude within a bandwidth of 9 kHz or for "quasi-peak" within a bandwidth of 9 kHz.

The line-conducted emission test is conducted inside a shielded anechoic chamber room with 1 m x 1,5 m x 0,8 m wooden table which is placed 0,4 m away from the vertical wall and 1,5 m away from the side wall of the chamber room. Two LISN are bonded to the shielded room. The EUT is powered from the LISN and the support equipment is powered from the other LISN. Power to the LISNs are filtered by a noise cut power line filters. All electrical cables are shielded by braided tinned steel tubing with inner ϕ 1,2 cm. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and these supply lines will be connected to the LISN. Non-inductive bundling to a 1 m length shortened all interconnecting cables more than 1 m. Sufficient time for the 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 to determine the frequency producing the maximum emission from the EUT. The frequency producing the maximum level was reexamined using to set Quasi-Peak mode by manual, after scanned by automatic Peak mode from 0,15 MHz to 30 MHz. The bandwidth of the spectrum analyzer was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission.

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

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3.2 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.

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3.3 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.

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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: PORTI-SW40) 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 (2 042 MHz), Mid (2 441 MHz) and High (2 480 MHz) were chosen for full testing.

4.3 Support Equipment Used

Description	Model Name	Serial No.	Manufacturer
Notebook computer	SV10	958291CT300126	SAMSUNG
Adapter (for Notebook computer)	AD-6019	CNBA4400238AD2V H77G8142	Li Shin International Electronic Co., Ltd.

4.4 Type of Cables Used

Device from	Device to	Type of I/O port	Length(m)	Type of shield
EUT	Notebook computer	RS-232	0,4	Shielded
EUT	AC/DC adapter	DC Input	0,8	Shielded
Notebook computer	Adapter	DC Input	1,0	Shielded
Notebook computer	EUT	RS-232	0.4	Shielded

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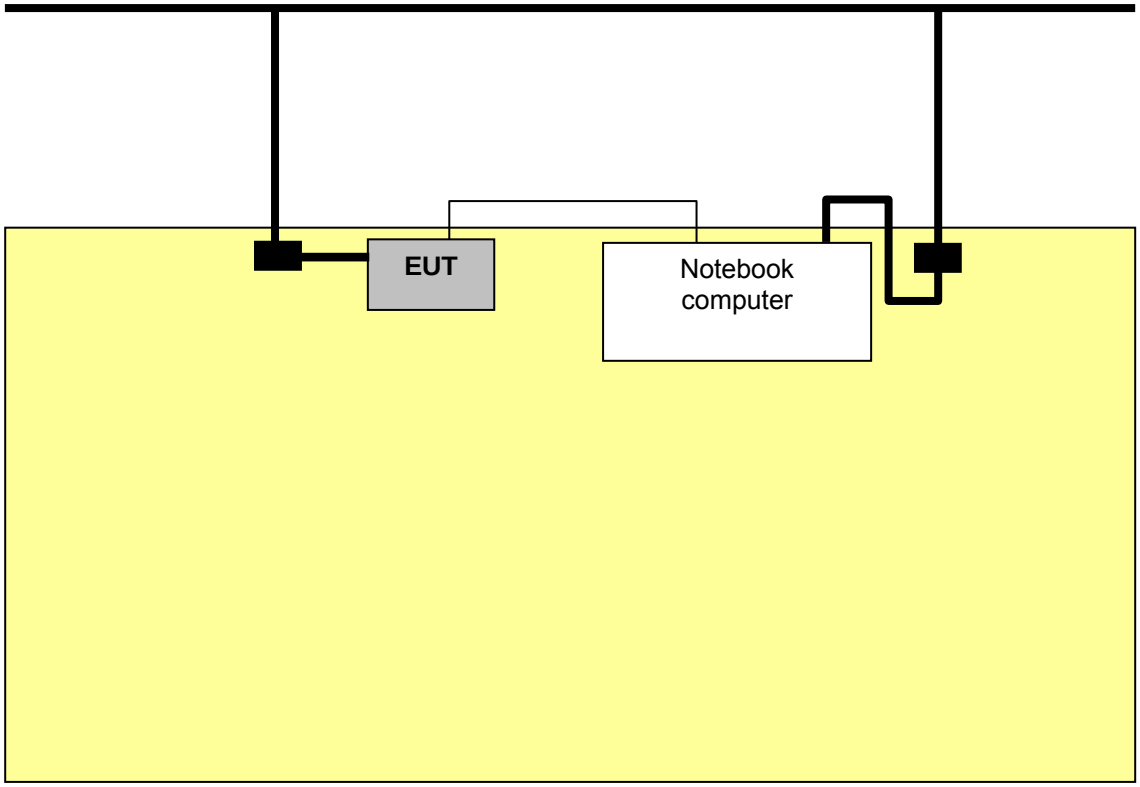
4.6 The setup drawing(s)



: Data Line

: Power Line

: Adapter

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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)	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**
15.207	Power line conducted Emissions	**Various**	**Pass**

The data collected shows that the **Woosim System Inc. / THERMAL PRINTER / PORTI-SW40** complied with technical requirements of above rules part 15.207, 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.

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5.2 Maximum peak conducted output power

EUT	THERMAL PRINTER / PORTI-SW40 (SN: N/A)
Limit apply to	FCC Part 15.247(b)(1)
Test Date	November 05, 2007
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)	Output Power (W)	Limit
Low	2402	-11.90	0.000065	< 1 W (< 30 dBm)
Mid	2440	-11.92	0.000064	
High	2480	-11.67	0.000068	

NOTES:

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

Test Engineer : **Kug Kyoung, Yoon**

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5.3 Bandwidth of Frequency Band Edges

EUT	THERMAL PRINTER / PORTI-SW40 (SN: N/A)
Limit apply to	FCC Part 15.247(d)
Test Date	November 05, 2007
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: (a)Peak: RBW 1 MHz, VBW 1 MHz, Sweep time Auto; (b) Average: RBW 1 MHz, VBW 10 Hz, Sweep time Auto.**
3. **Repeat the procedures until all the Peak and Average versus Polarization are measured.**

Test Engineer : **Kug Kyoung, Yoon**

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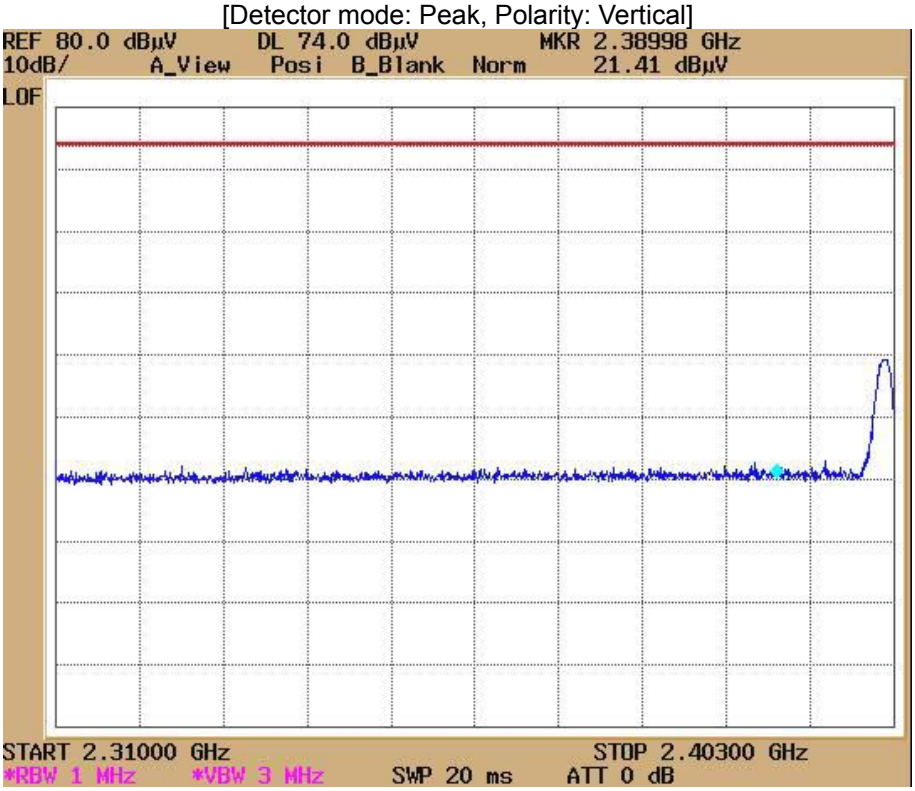
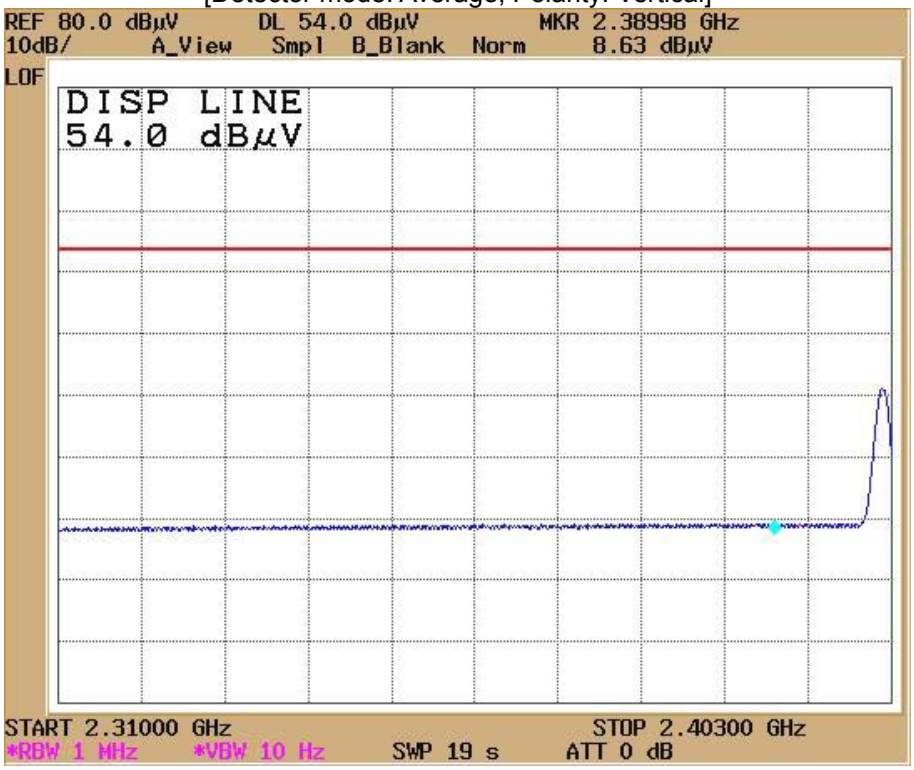
Bandwidth of Frequency Band Edges(CH Low)

[Detector mode: Peak, Polarity: Vertical]



[Detector mode: Average, Polarity: Vertical]



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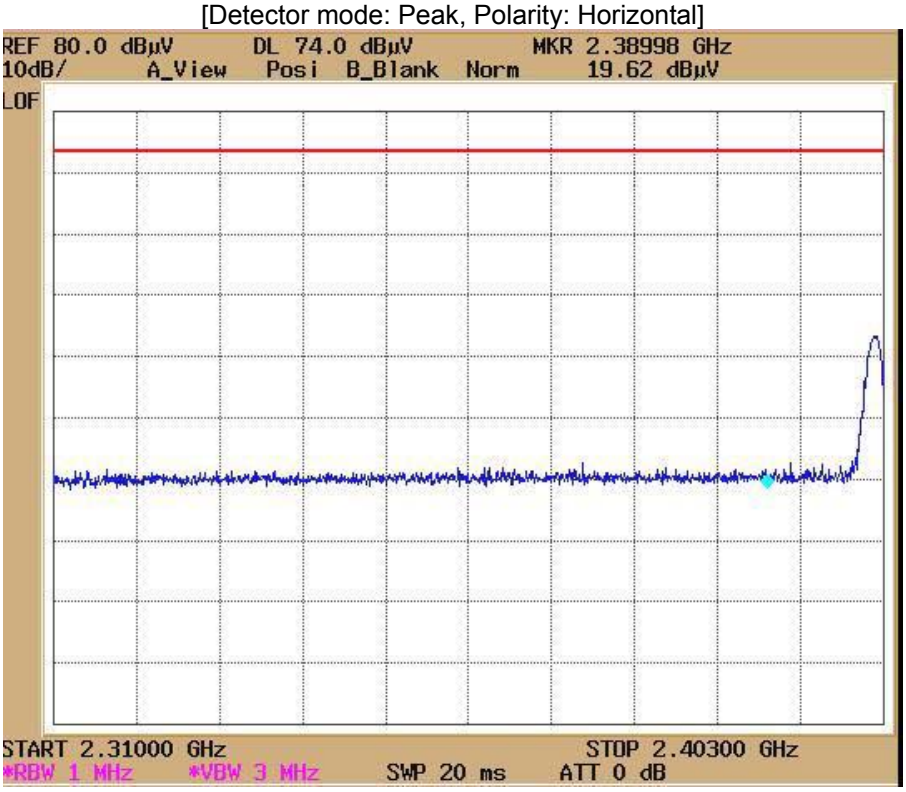
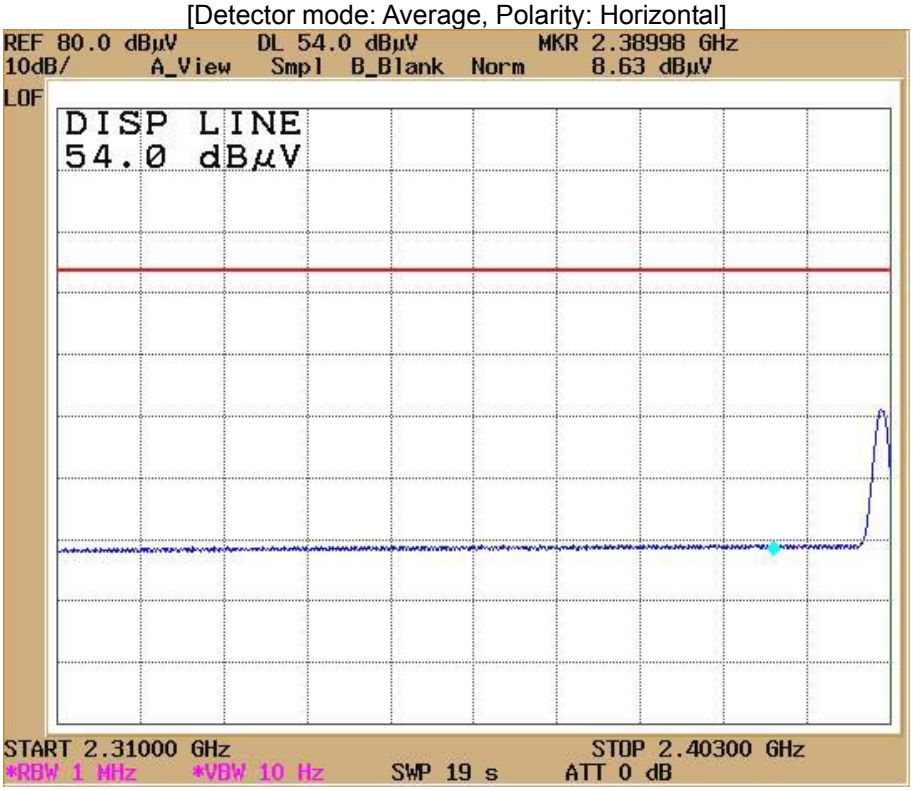
[Detector mode: Peak, Polarity: Horizontal]



[Detector mode: Average, Polarity: Horizontal]



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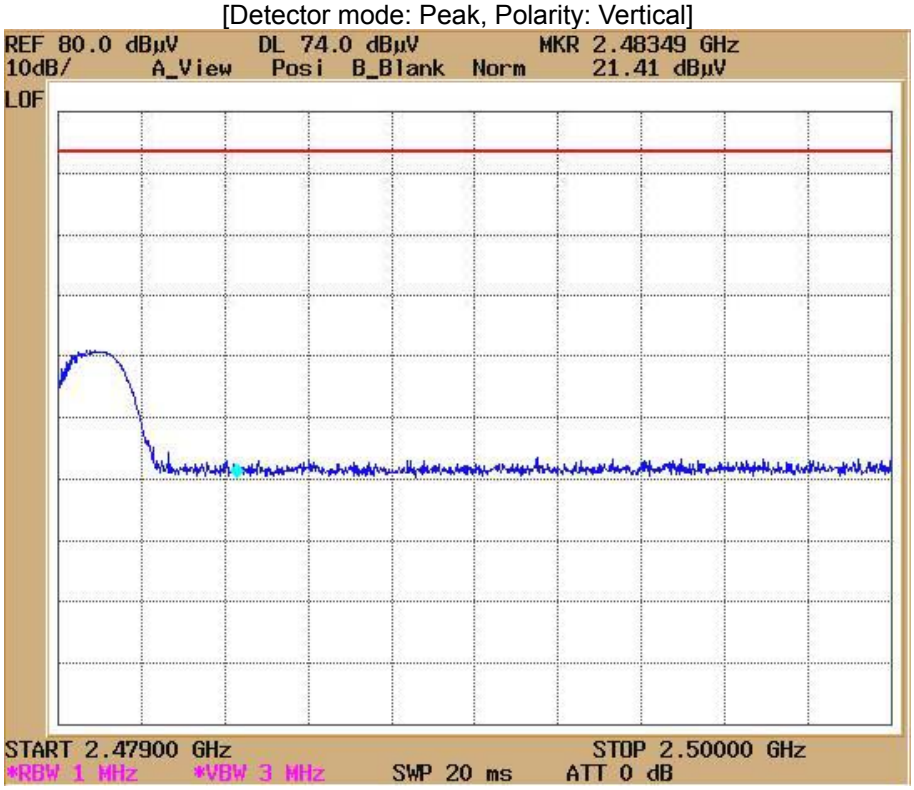
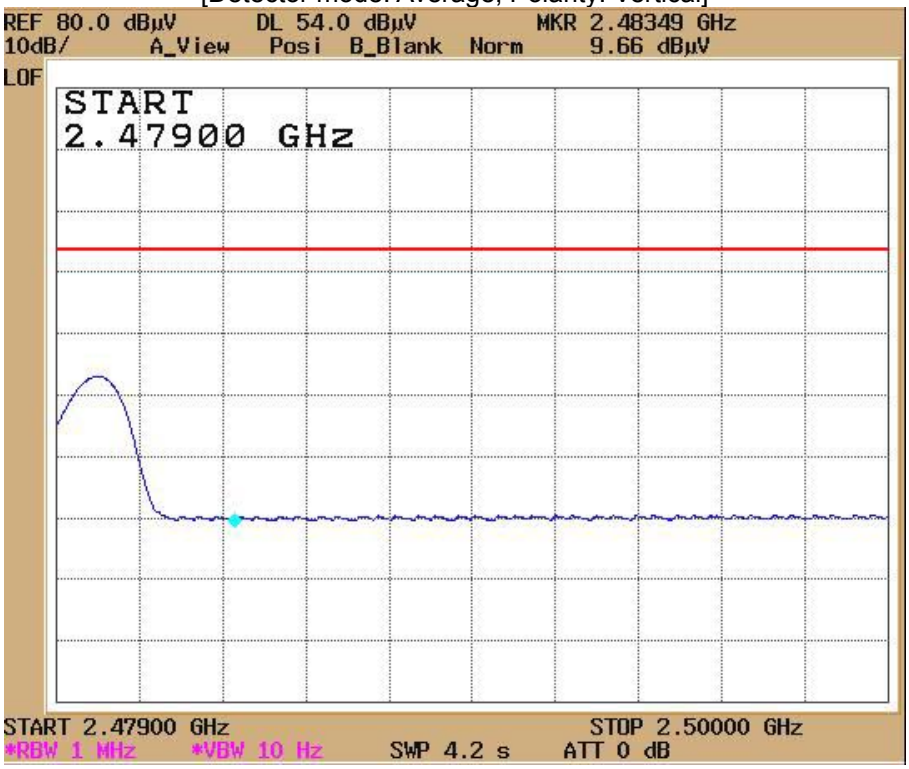
Bandwidth of Frequency Band Edges(CH High)

[Detector mode: Peak, Polarity: Vertical]



[Detector mode: Average, Polarity: Vertical]



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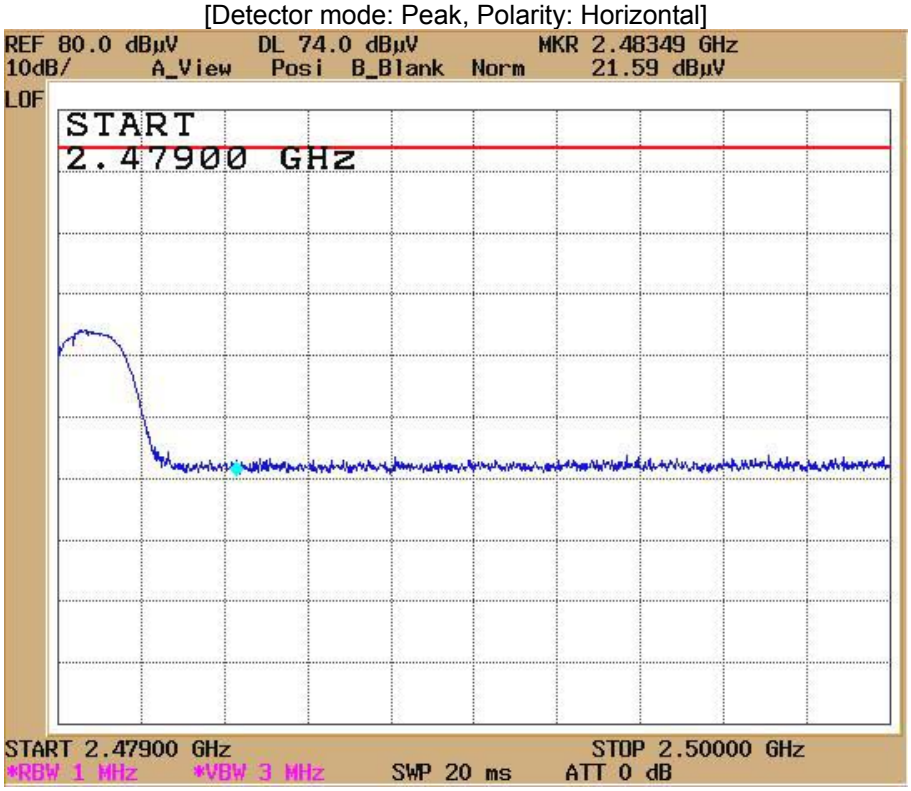
[Detector mode: Peak, Polarity: Horizontal]



[Detector mode: Average, Polarity: Horizontal]

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5.4 Power Spectral Density

EUT	THERMAL PRINTER / PORTI-SW40 (SN: N/A)
Limit apply to	FCC Part 15.247(e)
Test Date	November 05, 2007
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	2402	-16.532	8 dBm
Mid	2440	-15.969	
High	2480	-16.203	

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**

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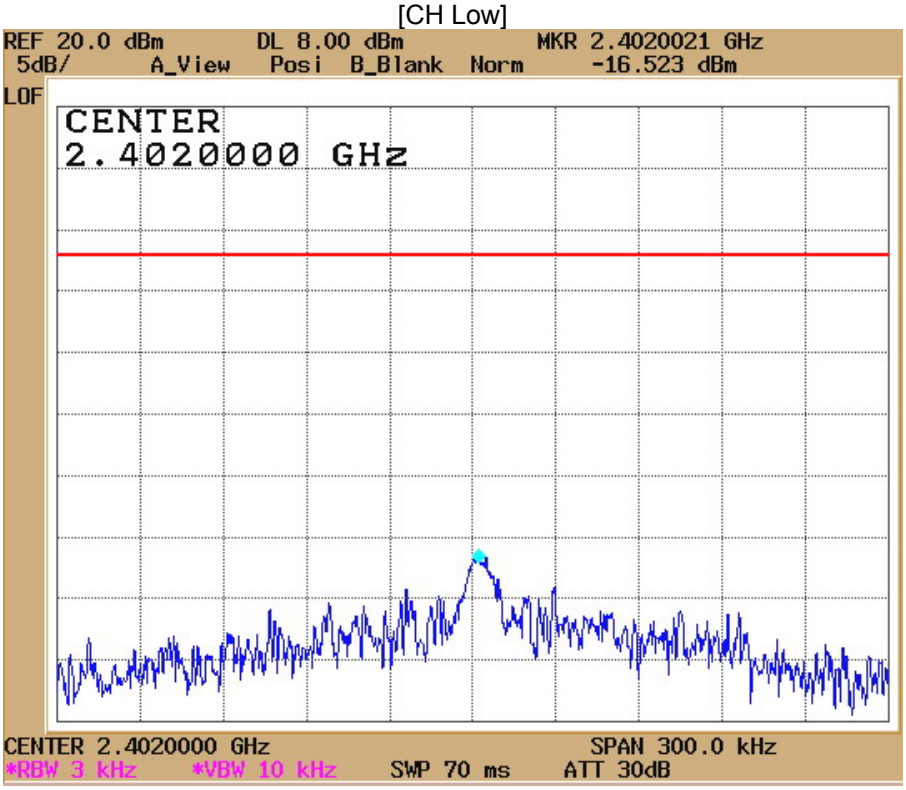
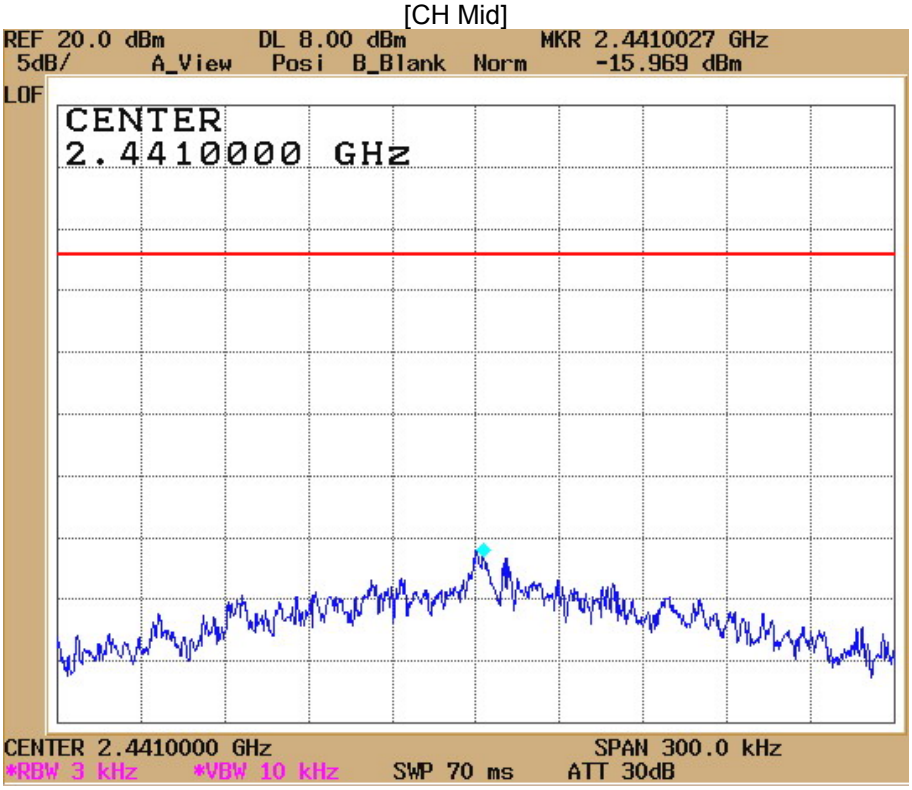
Power Spectral Density

[CH Low]



[CH Mid]



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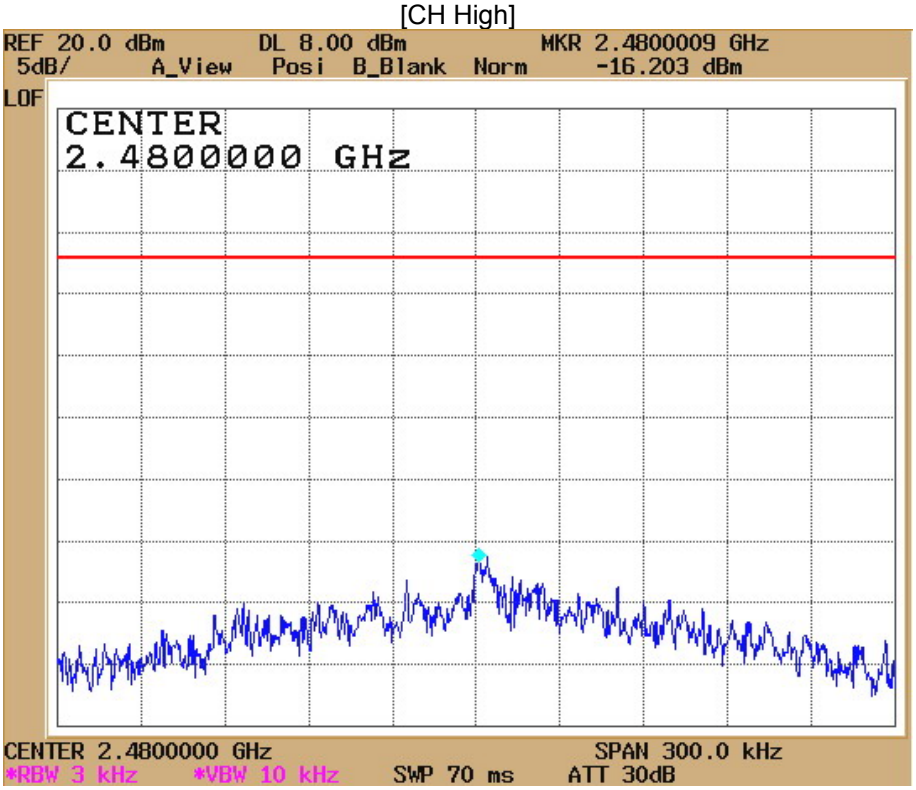
[CH High]



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5.5 Frequency Separation

EUT	THERMAL PRINTER / PORTI-SW40 (SN: N/A)
Limit apply to	FCC Part 15.247(a)(1)
Test Date	November 05, 2007
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 bandwith (kHz)	Limit
1.00	633	> 25 kHz

NOTES:

1. **Measure frequency separation of relevant channel using spectrum analyzer.**
2. **RBW 30 kHz, VBW 100 kHz, span 3 MHz, Sweep time Auto.**
3. **Please see the measured plot in next page.**

Test Engineer : **Kug Kyoung, Yoon**

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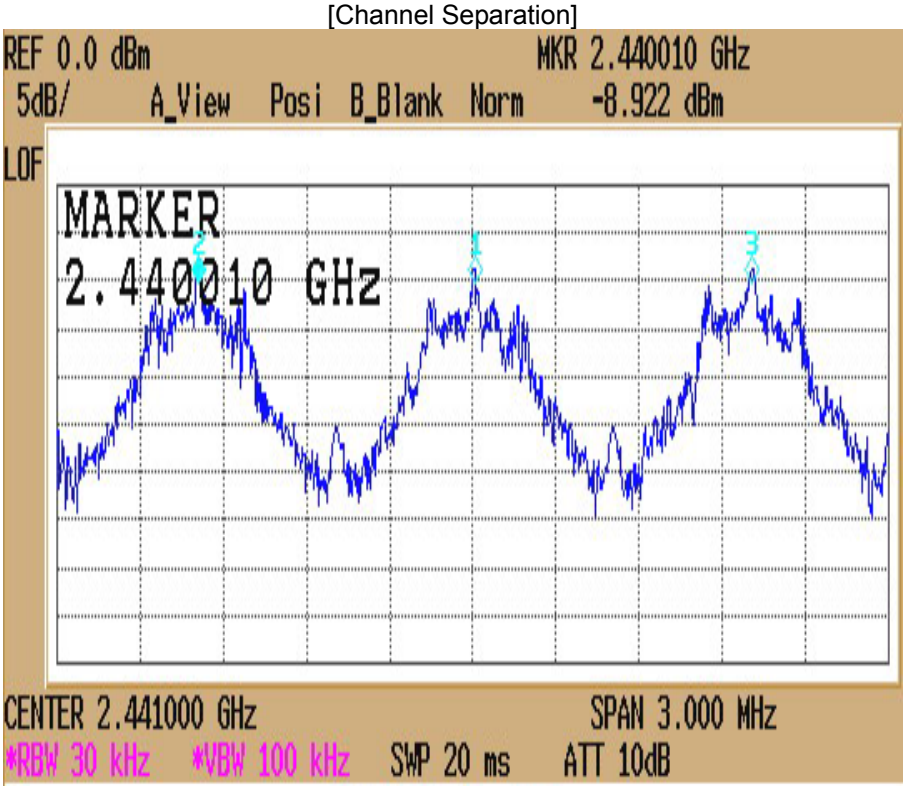
Frequency Separation

[Channel Separation]



[20 dB Bandwidth]

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5.6 Number of Hopping Channels

EUT	THERMAL PRINTER / PORTI-SW40 (SN: N/A)
Limit apply to	FCC Part 15.247(a)(1)(iii)
Test Date	November 05, 2007
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.**

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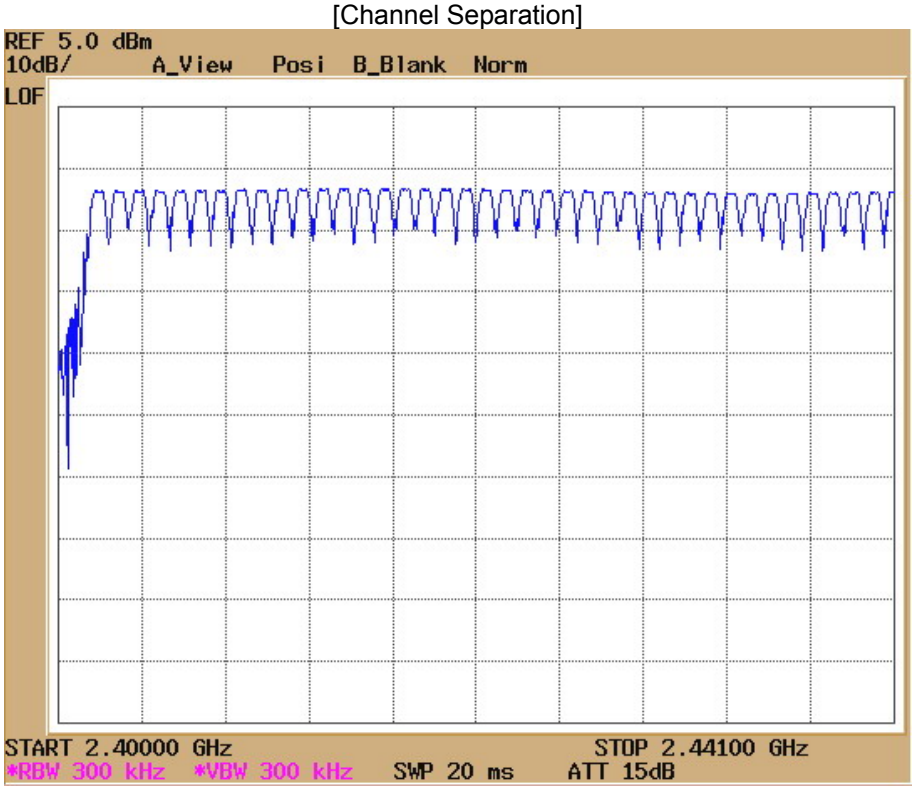
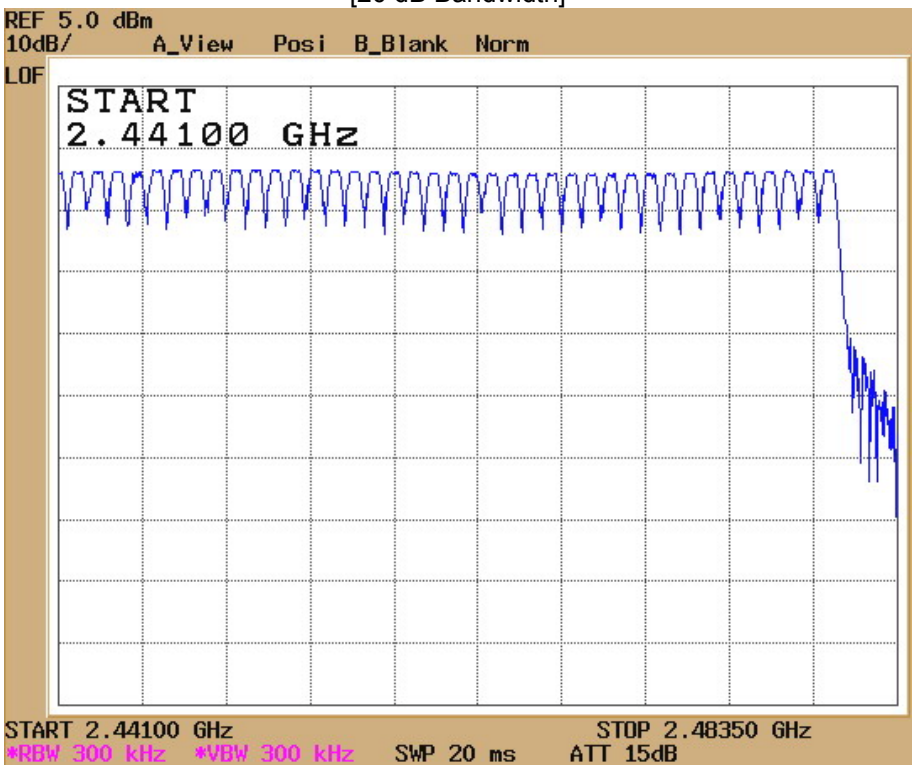
Number of Hopping Channels

[Channel Separation]



[20 dB Bandwidth]



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5.7 Time of Occupancy

EUT	THERMAL PRINTER / PORTI-SW40 (SN: N/A)
Limit apply to	FCC Part 15.247(a)(1)(iii)
Test Date	November 05, 2007
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.

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 1	Low	0.38	121.60	31.60	400.00
	Mid	0.38	121.60	31.60	
	High	0.38	121.60	31.60	
DH 3	Low	1.64	262.40	31.60	
	Mid	1.64	262.40	31.60	
	High	1.66	267.20	31.60	
DH 5	Low	2.92	311.47	31.60	
	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.**

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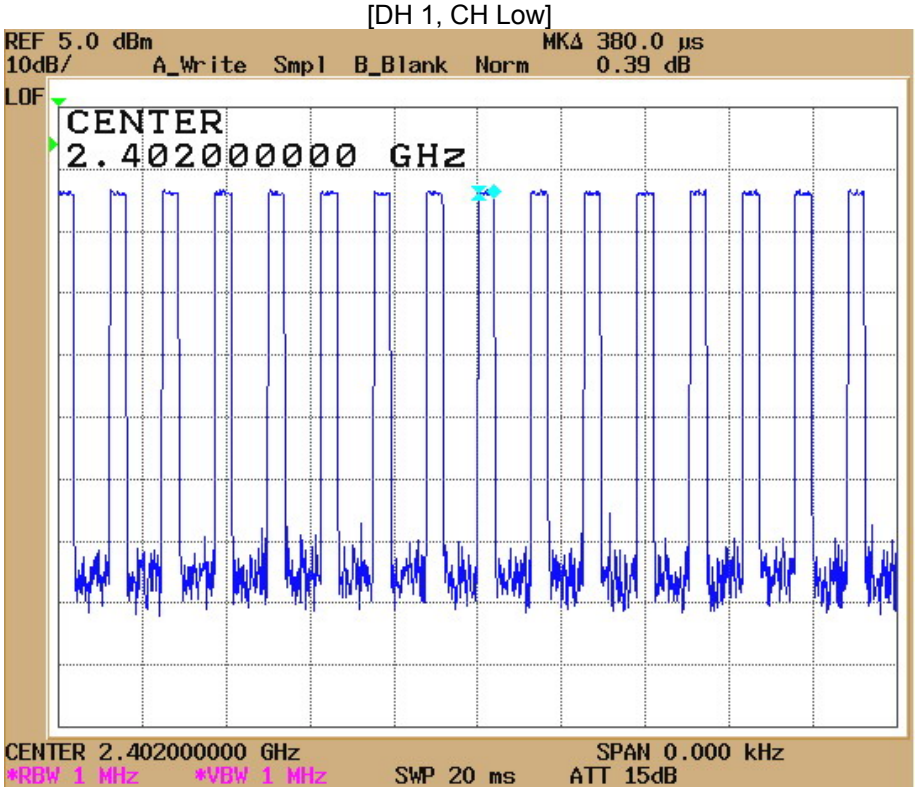
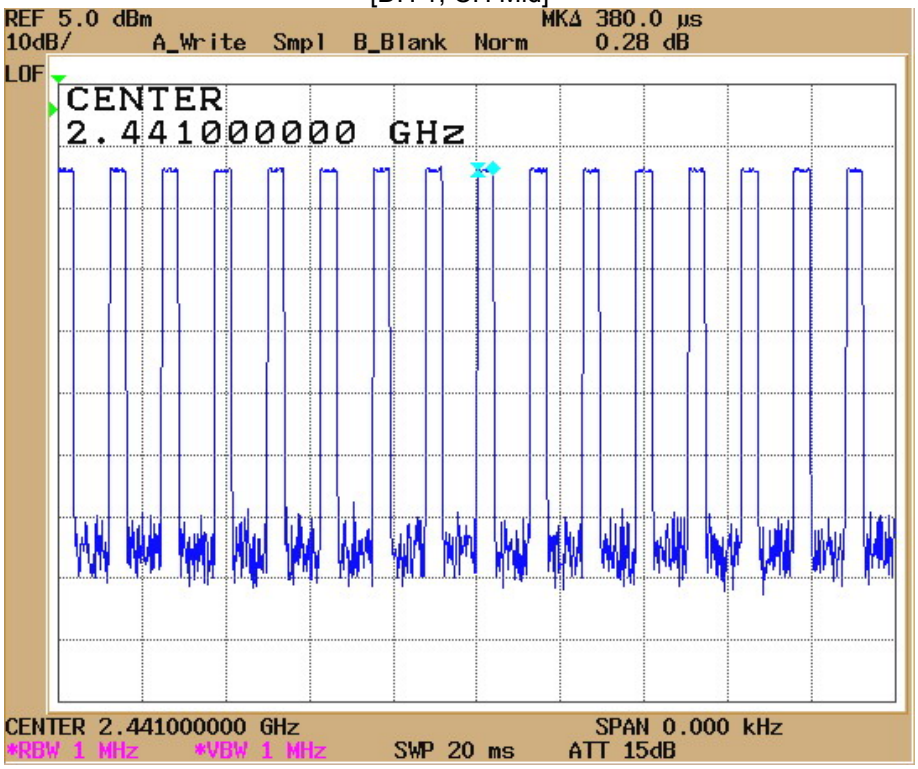
Time of Occupancy

[DH 1, CH Low]



[DH 1, CH Mid]



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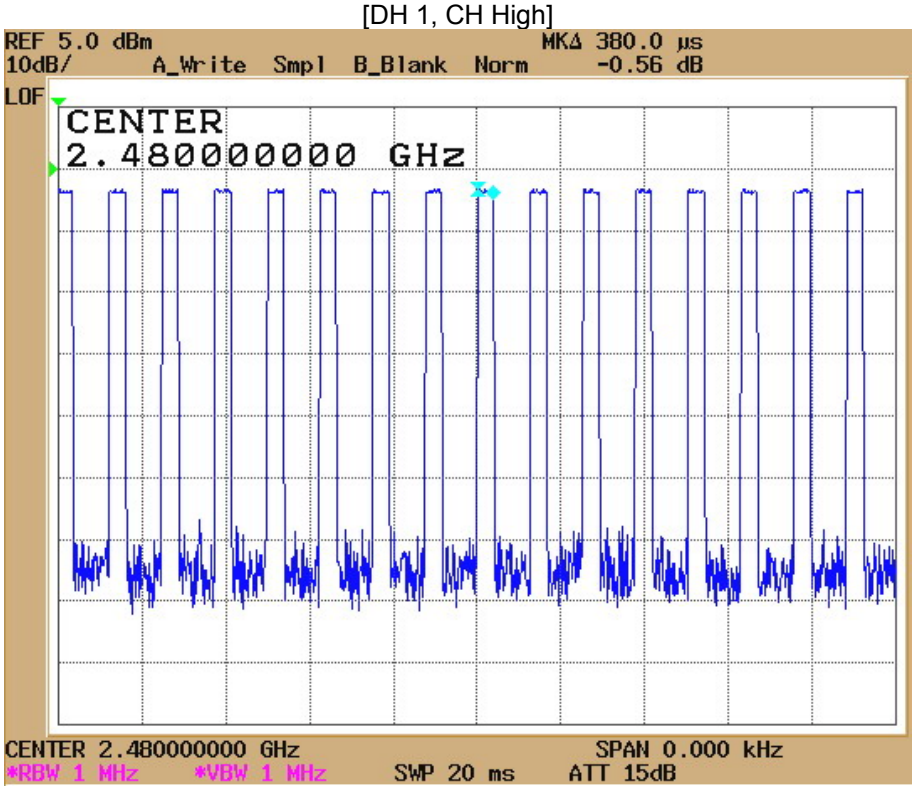
[DH 1, CH High]



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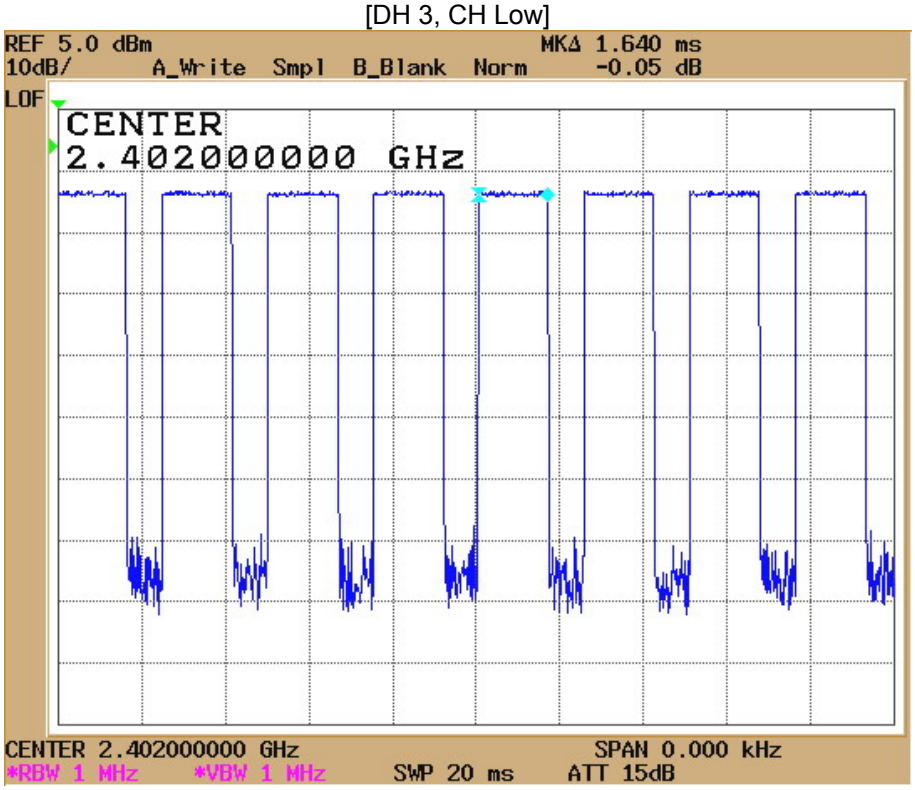
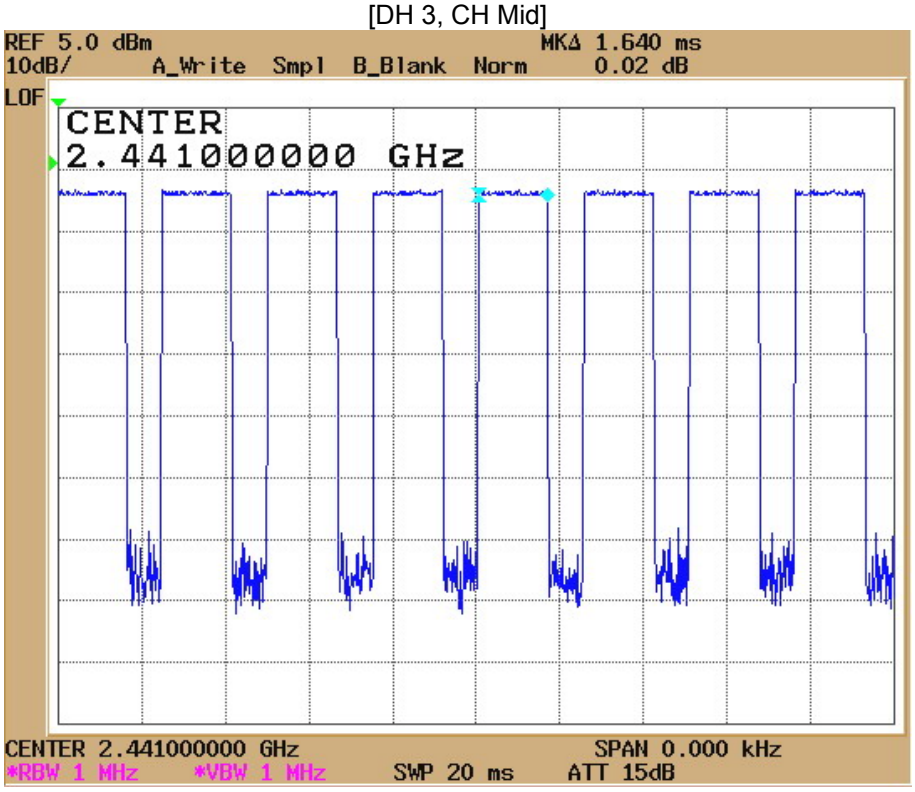
[DH 3, CH Low]



[DH 3, CH Mid]



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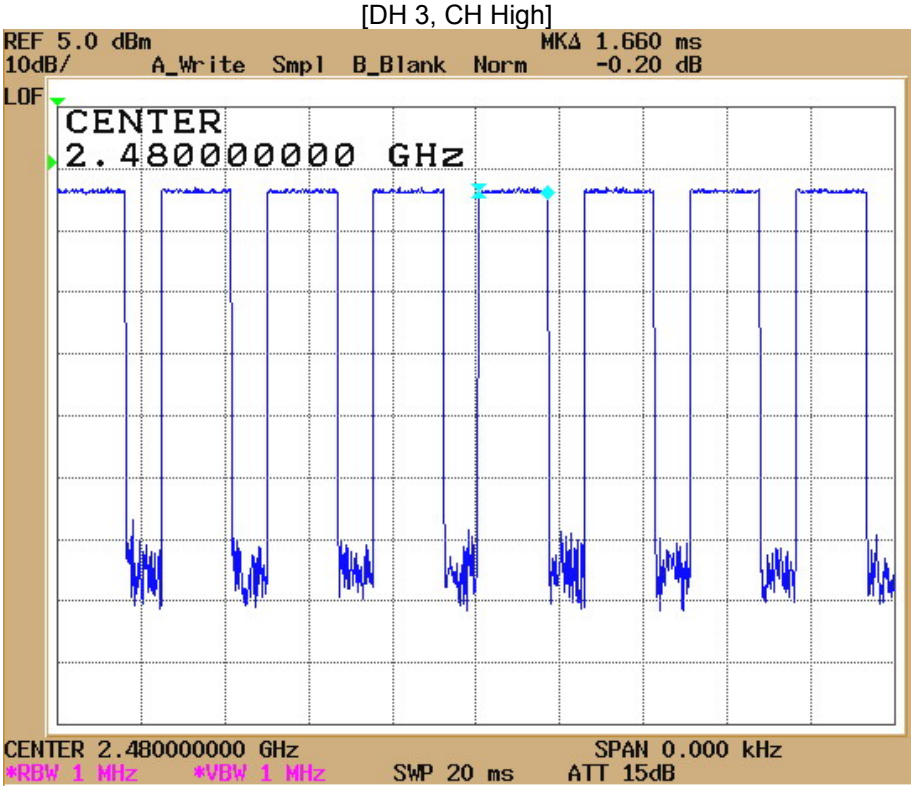
[DH 3, CH High]



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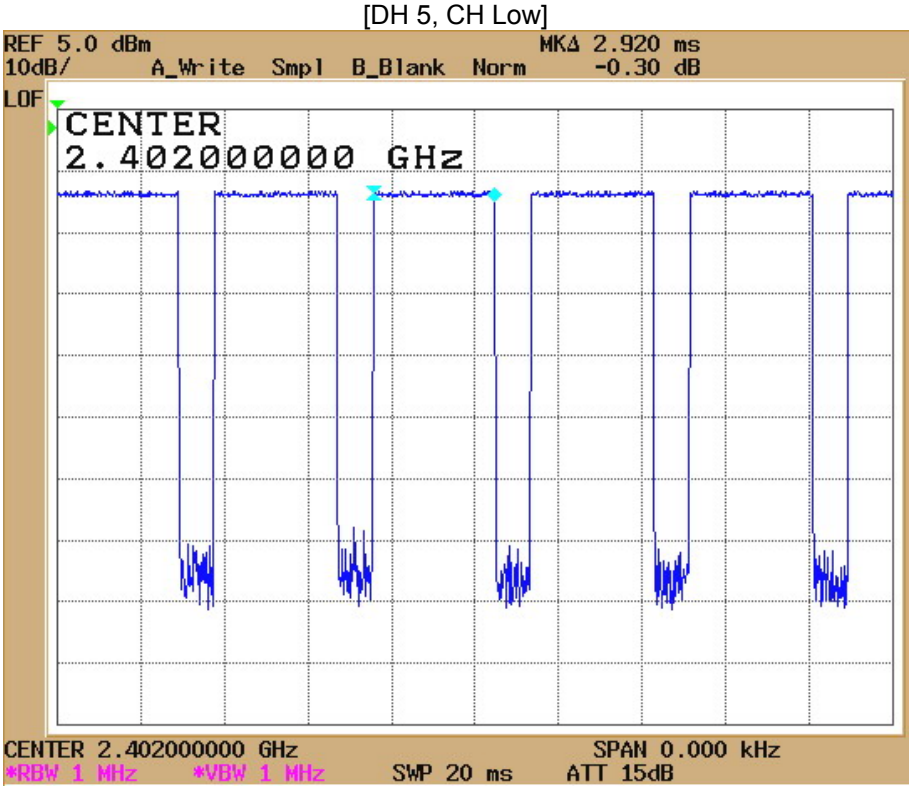
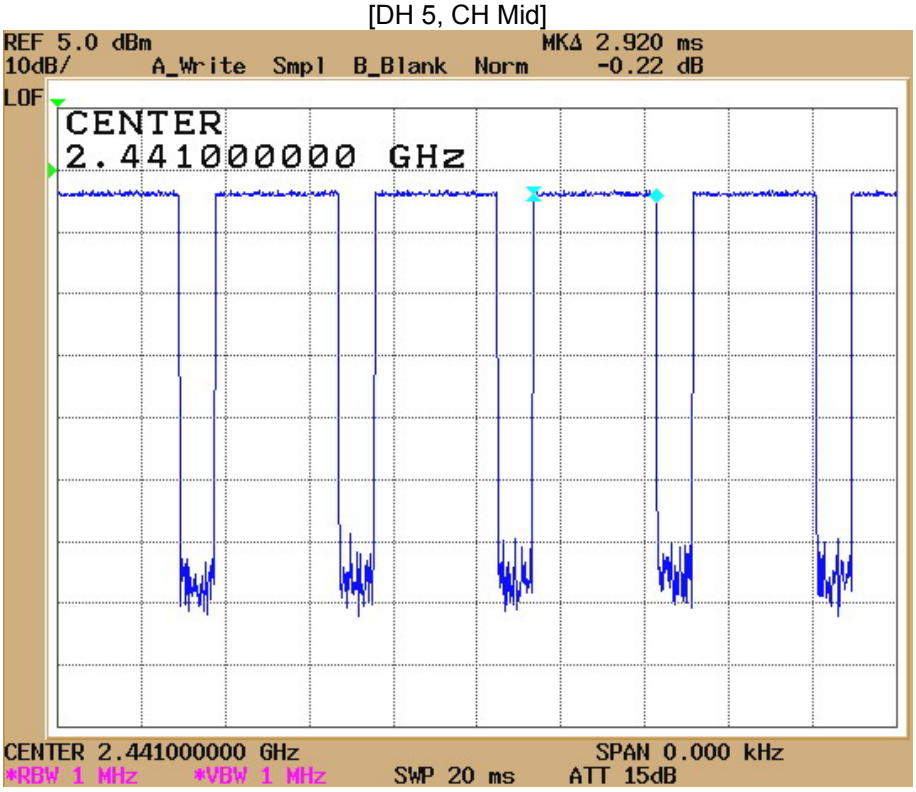
[DH 5, CH Low]



[DH 5, CH Mid]



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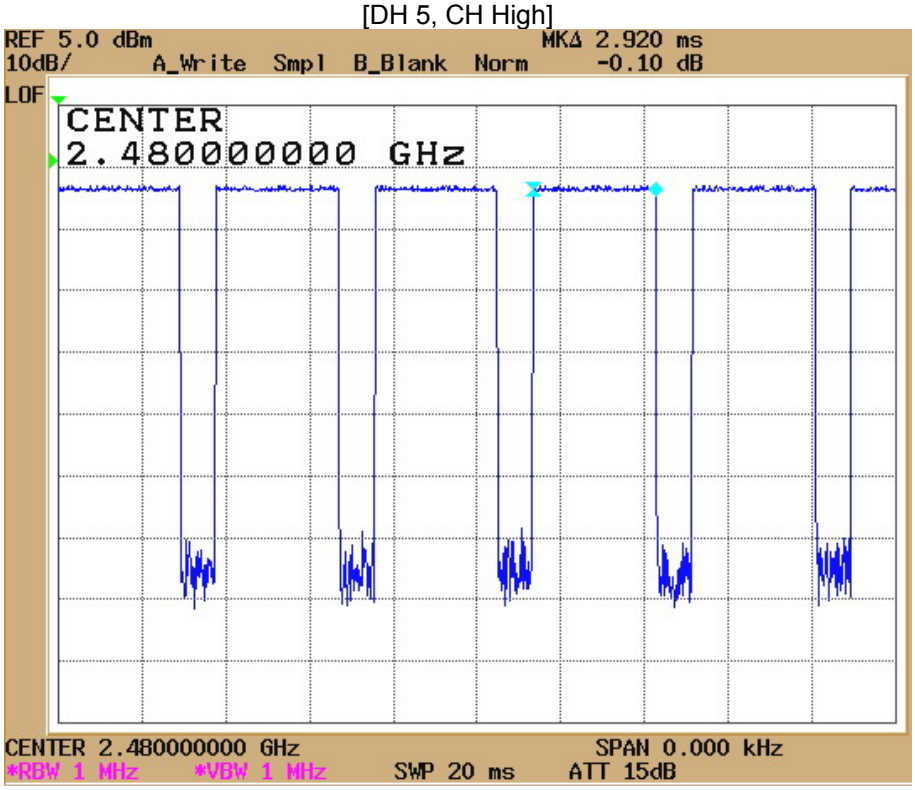
[DH 5, CH High]



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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	:	-11.67 dBm (0.065 mW)
Prediction distance	:	20 cm
Predication frequency	:	2 480 MHz
Antenna gain(Max)	:	1.84 dBi (1.53 numeric)
Power density at predication frequency at 20 cm	:	0.00002 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 0.00002 mW/cm^2, which is below the uncontrolled exposure limit of 1.0 mW/cm^2 at 2 480 MHz.

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5.9 Spurious Emissions

5.9.1 Conducted Measurement

EUT	THERMAL PRINTER / PORTI-SW40 (SN: N/A)
Limit apply to	FCC Part 15.247(d)
Test Date	November 12, 2007
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**

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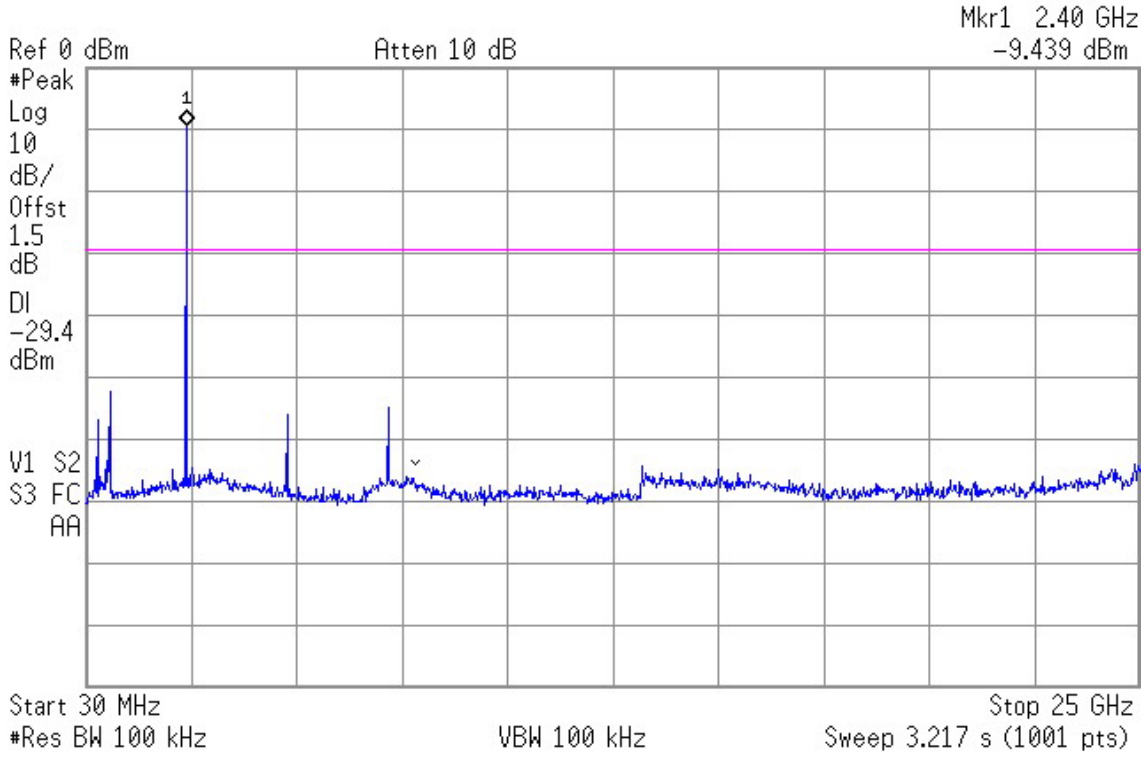
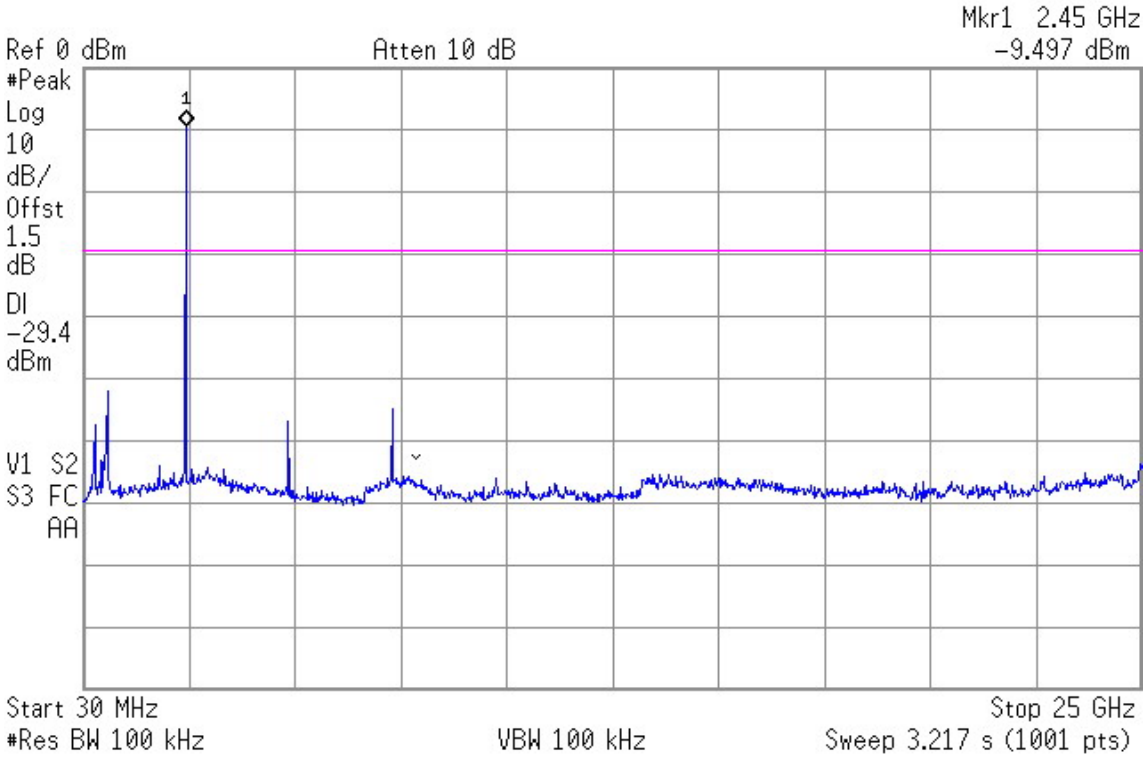
Spurious Emissions (Conducted Measurement)

[CH Low]



[CH Mid]



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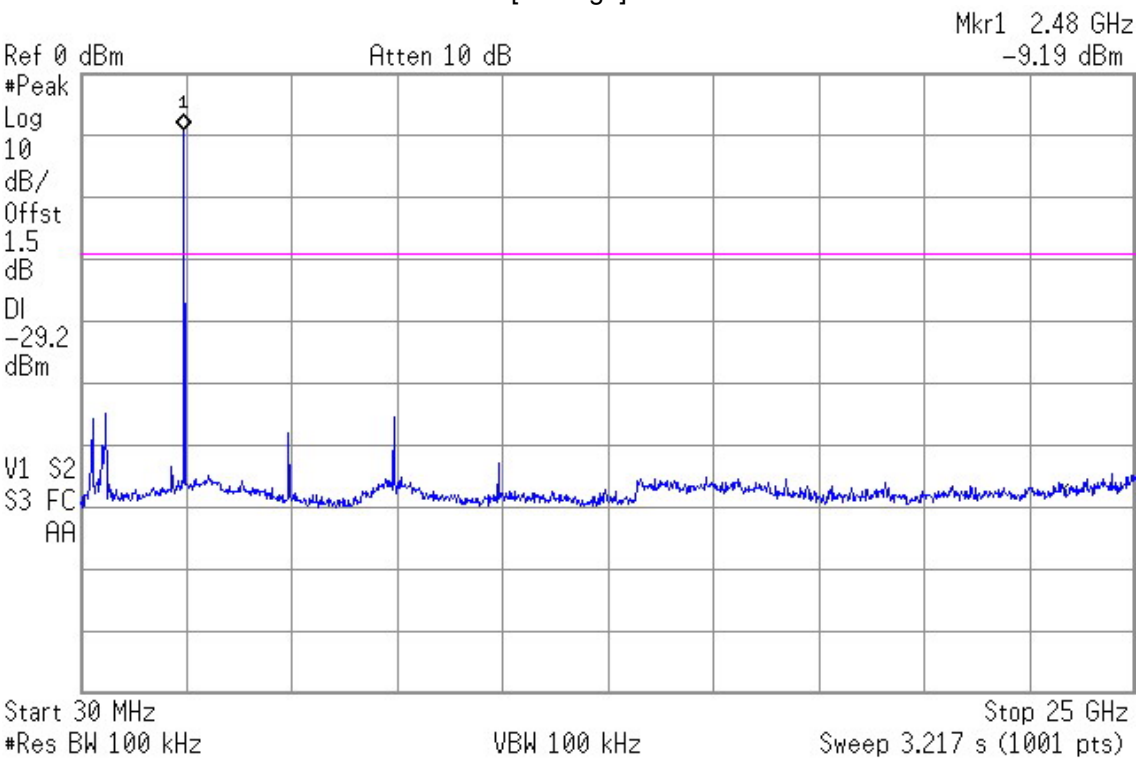
[CH High]



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5.9.2 Radiated Emissions

EUT	THERMAL PRINTER / PORTI-SW40 (SN: N/A)
Limit apply to	FCC Part 15.209
Test Date	November 12, 2007
Operating Condition	Normal Link
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 (uV/m)	Field Strength (dBuV/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**

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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]
47.72	17.81	V	9.63	2.05	29.49	40.0	10.51
126.13	12.37	V	10.74	3.19	26.30	43.5	17.20
156.12	11.01	H	11.35	3.64	26.00	43.5	17.50
168.40	11.91	H	10.81	3.78	26.50	43.5	17.00
182.03	11.35	H	10.04	3.91	25.30	43.5	18.20
216.11	13.70	H	10.29	4.40	28.40	46.0	17.60
240.00	12.62	H	10.98	4.70	28.30	46.0	17.70
288.38	11.74	H	12.38	5.38	29.50	46.0	16.50
360.10	14.49	H	13.71	6.20	34.40	46.0	11.60
372.46	10.07	H	13.91	6.32	30.30	46.0	15.70
409.58	12.26	H	14.63	6.71	33.60	46.0	12.40
443.17	8.91	H	15.57	7.12	31.60	46.0	14.40

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.**

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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 1GHz 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**

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5.10 Power line Conducted Emissions

EUT	THERMAL PRINTER / PORTI-SW40 (SN: N/A)
Limit apply to	FCC Part 15.207
Test Date	November 12, 2007
Operating Condition	RF transmitting continuously during the tested.
Result	Pass

Limit

for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

Test Results

- Refer to see the measured plot in next page.

Test Engineer : **Kug Kyoung, Yoon**

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Power line Conducted Emissions

Test data

The following table shows the highest levels of conducted emissions on both polarizations of hot and neutral line.
Detector mode: CISPR Quasi-Peak mode (6 dB Bandwidth : 9 kHz)

Frequency [MHz]	Result [dBμN]		Phase (*H/**N)	Limit [dBμN]		Margin [dB]	
	Quasi-peak	Average		Quasi-peak	Average	Quasi-peak	Average
0,504	42,7	–	N	56,0	46,0	13,3	–
0,704	45,0	–	N	56,0	46,0	11,0	–
1,312	35,6	–	H	56,0	46,0	20,4	–
1,913	41,7	–	H	56,0	46,0	14,3	–
2,116	35,3	–	H	56,0	46,0	10,9	–
7,187	40,8	–	H	60,0	50,0	19,2	–
7,468	39,4	–	N	60,0	50,0	20,6	–

NOTES: **1. * H: HOT Line, **N: Neutral Line**
2. Margin value = Limit – Result
3. Measurement were performed at the AC Power Inlet in the frequency band of 150 kHz ~ 30 MHz according to the FCC Part 15.207

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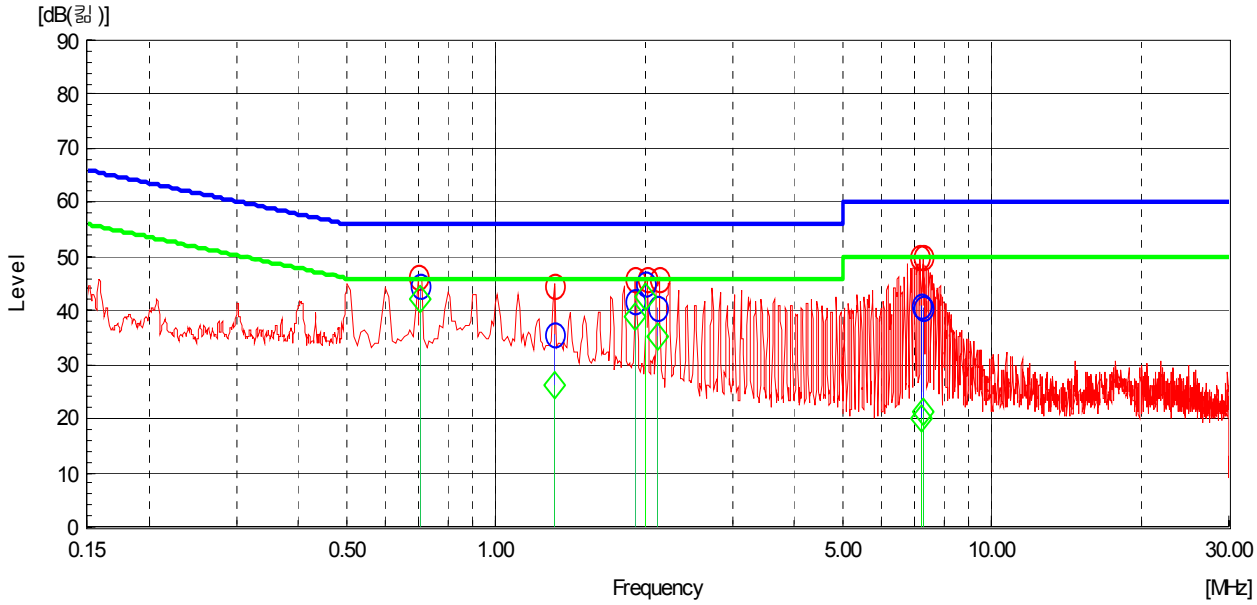
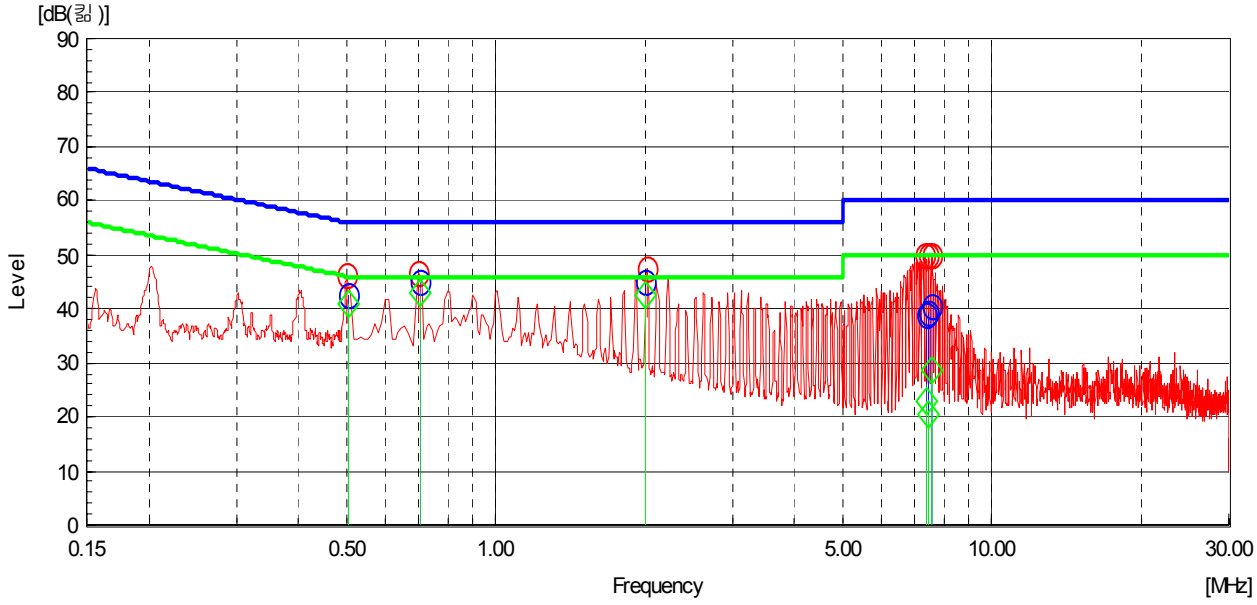
Test plots

Hot



Neutral



Quasi-peak Average

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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 : @ 47,72 MHz

Class B Limit = 40,00 dBuV/m

Reading = 17,81 dBuV

Antenna Factor + Cable Loss = 9,63 + 2,05 = 11,68 dBuV/m

Total = 29,49 dBuV/m

Margin = 40,00 – 29,49 = 10,51 dB

= 10,51 dB below Limit

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7. List of test equipments used for measurements

Test Equipment		Model	Mfg.	Serial No.	Cal. Due Date
☒	EMI TEST Receiver	ESVS10	R & S	835165/001	08.05.03
☒	EMI TEST Receiver	ESPI3	R & S	100478	08-10-04
☒	Spectrum Analyzer	E7405A	H.P	US41160290	08-10-05
☒	Spectrum Analyzer	R3132	Advantest	110401685	08-10-05
☒	LogBicon Antenna	VULB9165	Schwarz Beck	2023	08.08.28
☒	Broad band Horn antenna	BBHA 9120D	Schwarz Beck	227	08-03-15
☒	Broad band Horn antenna	BBHA 9120D	Schwarz Beck	285	08-03-15
☒	Preamplifier	8447D	H.P	3307A02865	08-10-05
☒	LISN	3816-2	EMCO	1001	08-10-05
☒	LISN	3816-2	EMCO	1002	08-10-05
☒	Turn-Table	DETT-03	Daeil EMC	-	N/A
☒	Antenna Master	DEAM-03	Daeil EMC	-	N/A

End of test report

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