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wowpen

Dates of Tests: November 06 ~ 13, 2006
Test Report S/N: LR500110611C
Test Site : LTA CO., LTD.

CERTIFICATION OF COMPLIANCE

FCC ID. **USZWP020**

APPLICANT **WoW Technology, Inc.**

FCC Classification	:	**FHSS Sequence Spread Spectrum (FHSS)**
Manufacturing Description	:	**Pen Type Wireless Optical Mouse**
Manufacturer	:	**WoW Technology, Inc.**
Model name	:	**WP020**
Test Device Serial No.:	:	**Identical prototype**
Rule Part(s)	:	**FCC Part 15.247 Subpart C; ANSI C-63.4-2003**
Frequency Range	:	**2402 ~ 2480MHz**
RF power	:	**0.078mW - Conducted**
Data of issue	:	**November 15, 2006**

This test report is issued under the authority of:

Dong –Min JUNG, Technical Manager

The test was supervised by:

Kyung-Taek LEE, Test Engineer

This test result only responds to the tested sample. It is not allowed to copy this report even partly without the allowance of the test laboratory. This report must not be used by the applicant to claim product endorsement by any agency.

NVLAP

NVLAP LAB Code.: 200723-0

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1. General information's

1-1 Test Performed

Company name : LTA Co., Ltd.
Address : 243, Jubug-ri,Yangji-Myeon,Youngin-Si, Kyunggi-Do, Korea. 449-822
Web site : http://www.ltalab.com
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Facsimile +82-31-323-6010

Quality control in the testing laboratory is implemented as per ISO/IEC 17025 which is the "General requirements for the competents of calibration and testing laboratory".

1-2 Accredited agencies

LTA Co., Ltd. is approved to perform EMC testing by the following agencies:

Agency	Country	Accreditation No.	Validity	Reference
NVLAP	U.S.A	200723-0	2007-09-30	ECT accredited Lab.
RRL	KOREA	KR0049	2007-07-13	EMC accredited Lab.
FCC	U.S.A	610755	2008-03-28	FCC filing
VCCI	JAPAN	R2133, C2307	2008-06-22	VCCI registration
IC	CANADA	IC5799	2008-04-23	IC filing

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2. Information's about test item

2-1 Client & Manufacturer

Company name	:	**WoW Technology, Inc.**
Address	:	#A-209 Ssangyong IT Twin Tower, 442-17 Sangdaewon 1-Dong, Jungwon-Gu, Seongnam-si, Gyeonggi-Do 462-723, Korea
TEL / FAX	:	+82-31-735-1380/ +82-31-735-1388

2-2 Equipment Under Test (EUT)

Trade name	:	Pen Type Wireless Optical Mouse
Model name	:	WP020
Serial No.:	:	Identical prototype
Date of receipt	:	November 02, 2006
EUT condition	:	Pre-production, not damaged
Frequency Range	:	2402 ~ 2480MHz
Type of transmitter	:	Only Transmitter
RF output power	:	0.078mW - Conducted
Antenna Gain	:	Max. -1.32 dBi Chip Antenna
Number of channels	:	15 CH
Channel Frequency (MHz)	:	2402 / 2408 / 2412 / 2414 / 2416 / 2420 / 2427 / 2435 2437 / 2439 / 2458 / 2464 / 2476 / 2478 / 2480
Channel spacing	:	1MHz
Channel Access Protocol	:	Frequency Hopping
Type of Modulation	:	QFSK
Duty cycle	:	5.3 %
Power Source(for EUT)	:	3.7V(Rechargable Li-Polymer Internal battery) AC Adaptor – M/N:ADC-240-G3 (INPUT: 100 ~ 240 V, 50/60Hz / OUTPUT: 5VDC, 500mA)

2-3 Tested frequency

	LOW	MID	HIGH
Frequency (MHz)	2402	2439	2480

2-4 Ancillary Equipment

Equipment	Model No.	Serial No.	Manufacturer
-	-	-	-

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3. Test Report

3.1 Summary of tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status (note 1)
15.247(a)	Carrier Frequency Separation	> 25 kHz	Conducted	C
15.247(a)	Number of Hopping Frequencies	≥ 15 hops		C
15.247(a)	20 dB Bandwidth	< 1 MHz		C
15.247	Dwell Time	< 0.4 seconds		C
15.247(b)	Transmitter Output Power	< 1Watt		C
15.247(d)	Conducted Spurious emission	> 20 dBc		C
15.247(d)	Band Edge	> 20 dBc		C
15.249 / 15.209	Field Strength of Harmonics	< 54 dBuV (at 3m)	Radiated	C
15.207 /15.107	AC Conducted Emissions	EN 55022	Line Conducted	C

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: The data in this test report are traceable to the national or international standards.

The sample was tested according to the following specification:

FCC Parts 15.247; ANSI C-63.4-2003

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3.2 Transmitter requirements

3.2.1 Carrier Frequency Separation

Procedure:

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

The spectrum analyzer is set to:

Span = 5 MHz (wide enough to capture the peaks of two adjacent channels)

RBW = 100 kHz (1% of the span or more) Sweep = auto

VBW = 100 kHz Detector function = peak

Trace = max hold

Measurement Data:

Test Results	
Carrier Frequency Separation (MHz)	**Result**
1.975	Complies

- See next pages for actual measured spectrum plots.

Minimum Standard:

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

Measurement Setup

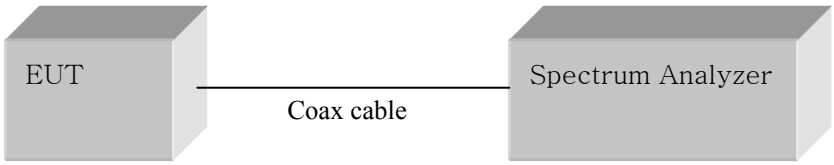
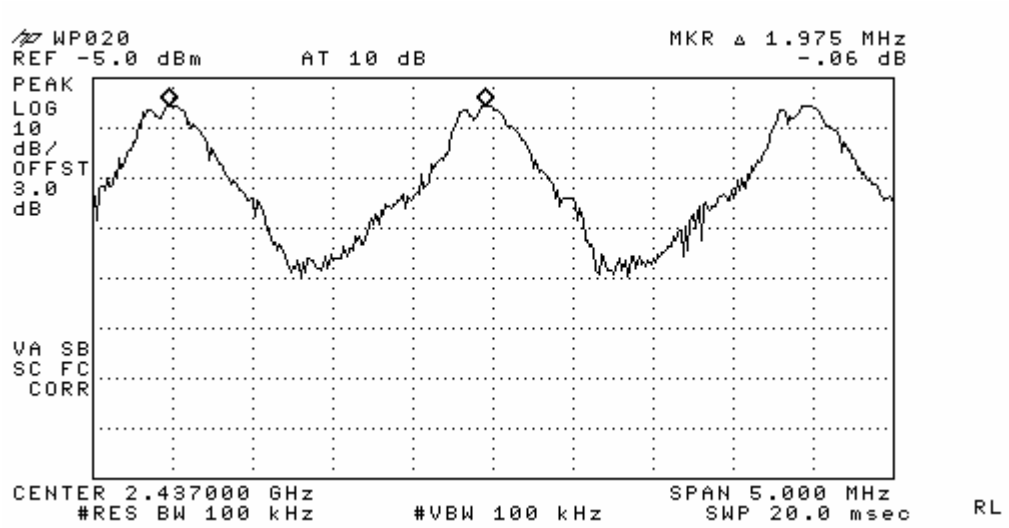


Figure 1: Measurement setup for the carrier frequency separation

Carrier Frequency Separation



3.2.2 Number of Hopping Frequencies

Procedure:

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

To get higher resolution, four frequency ranges within the 2400 ~ 2483.5 MHz FH band were examined.

The spectrum analyzer is set to:

Frequency range 1: Start = 2389MHz, Stop = 2440 MHz

4: Start = 2440MHz, Stop = 2490 MHz

RBW = 300 kHz (1% of the span or more) Sweep = auto

VBW = 300 kHz (VBW ≥ RBW) Detector function = peak

Trace = max hold

Measurement Data: Complies

Total number of Hopping Channels	15

- See next pages for actual measured spectrum plots.

Minimum Standard:

At least 15 hopes

Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

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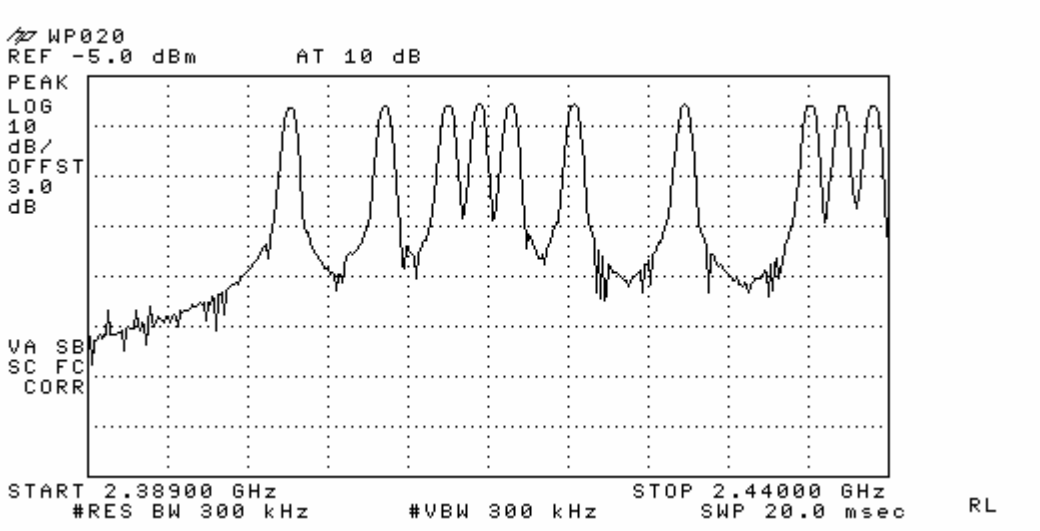
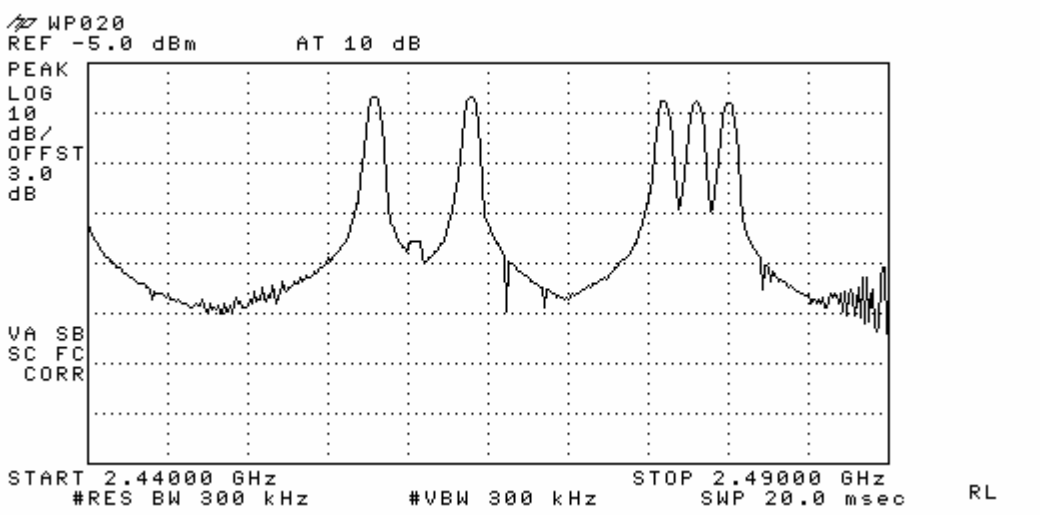
Number of Hopping Frequencies





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3.2.3 20 dB Bandwidth

Procedure:

The bandwidth at 20 dB below the highest inband spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels..

After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 30 kHz (1% of the 20 dB bandwidth)

VBW = 30 kHz (VBW ≥ RBW) Sweep = auto

Span = 3 MHz Detector function = peak

Trace = max hold

Measurement Data:

Frequency (MHz)	Test Results	
	Measured Bandwidth (MHz)	Result
2402	**0.728**	Complies
2439	**0.788**	Complies
2480	**0.698**	Complies

- See next pages for actual measured spectrum plots.

Minimum Standard:

The transmitter shall have a maximum 20dB bandwidth of 1 MHz.

Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

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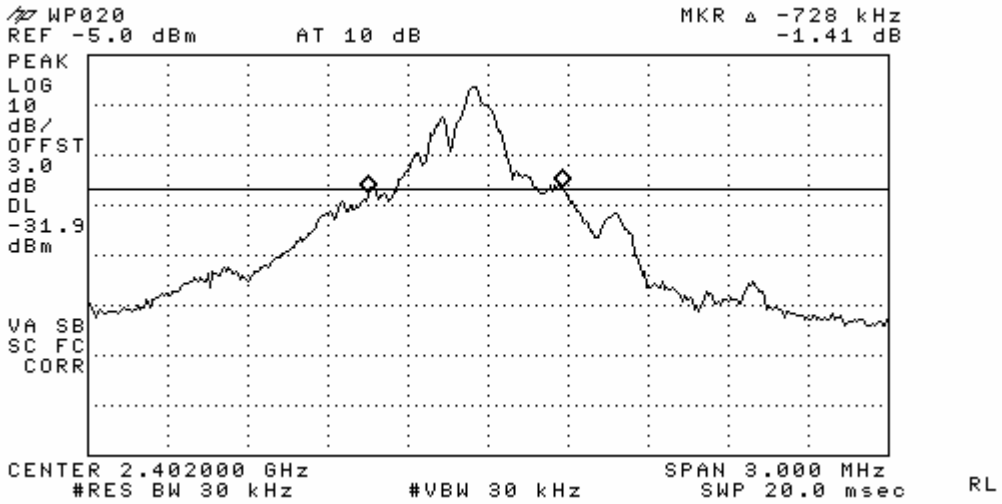
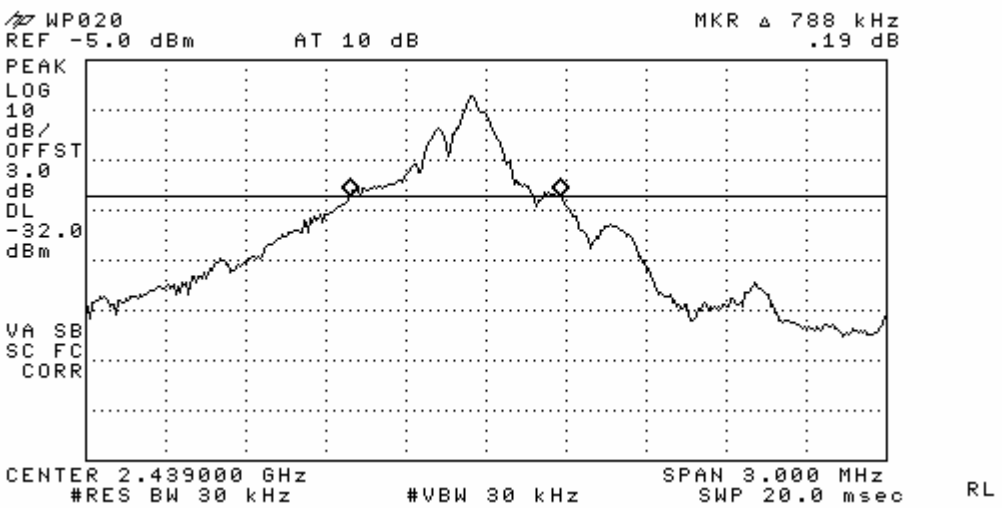
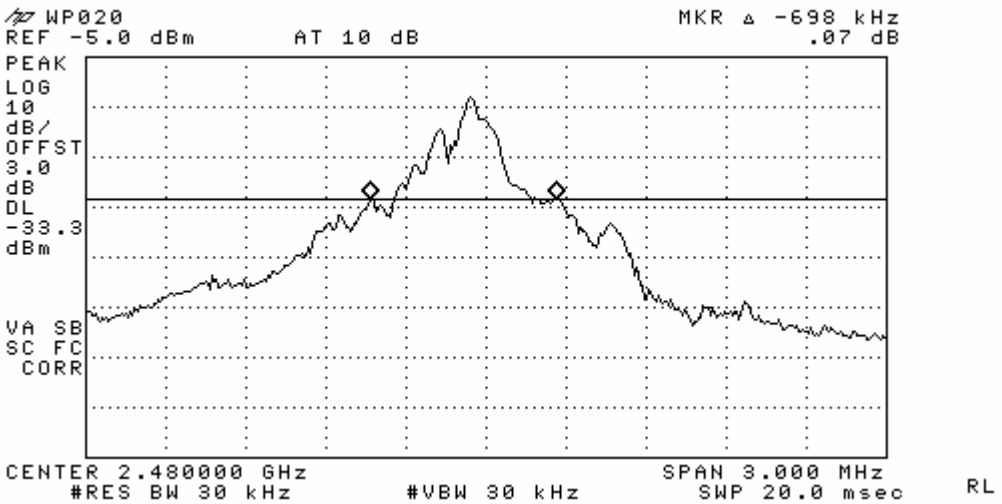
20 dB Bandwidth







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3.2.4 Time of Occupancy (Dwell Time)

Procedure:

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to:

Center frequency = 2439 MHz	Span = zero
RBW = 1 MHz	VBW = 1 MHz (VBW ≥ RBW)
Trace = max hold	Detector function = peak

Measurement Data:

Channel Frequency (MHz)	Test Results	
	Dwell Time (ms)	Result
2439	**350**	Complies

- See next pages for actual measured spectrum plots.

Minimum Standard:

0.4 seconds within a 30 second period per any frequency

Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

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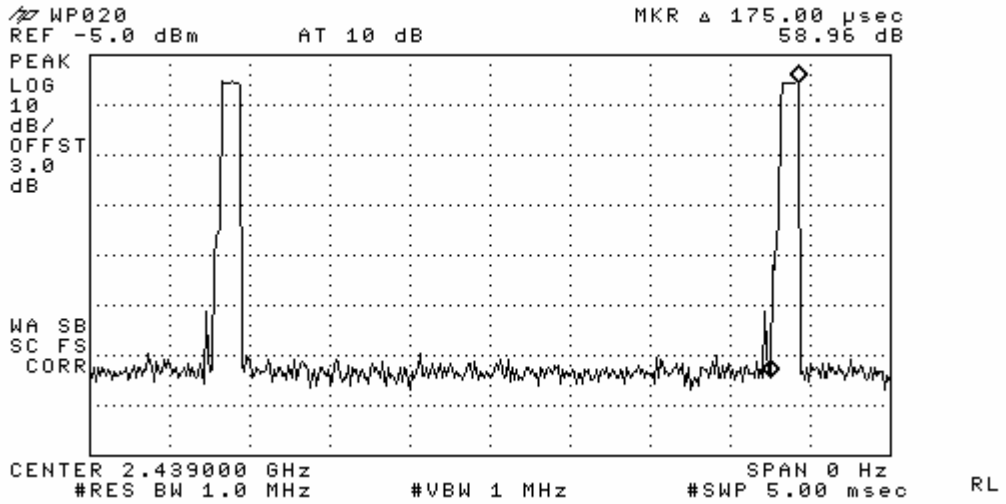
Time of Occupancy for PACKET

The system makes worst case 1000 hopes per second with 15 channels. So you have each channel 1000/15 = 66.67 times per second and so for a period of 0.4 x 15 = 6 seconds you have 66.67 x 6 = 400.02 times of appearance.

Each Tx-time per appearance is 158.3 us

So we have 400.02 x 175 us = 70.0 ms per 6 seconds.



3.2.5 Transmitter Output Power

Procedure:

The peak output power was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels..

After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

Span = 5 MHz (approximately 5 times of the 20 dB bandwidth)

RBW = 1 MHz (greater than the 20dB bandwidth of the emission being measured)

VBW = 1 MHz (VBW ≥ RBW) Detector function = peak

Trace = max hold Sweep = auto

Measurement Data:

Frequency (MHz)	Test Results		
	dBm	mW	Result
2402	**-11.21**	**0.076**	Complies
2439	**-11.06**	**0.078**	Complies
2480	**-12.97**	**0.050**	Complies

- See next pages for actual measured spectrum plots.

Minimum Standard:	< 1W

Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

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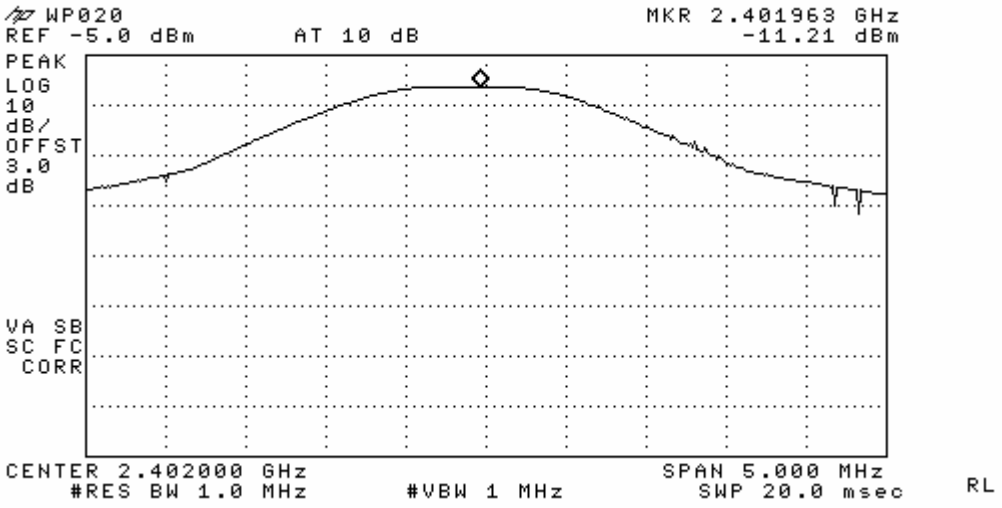
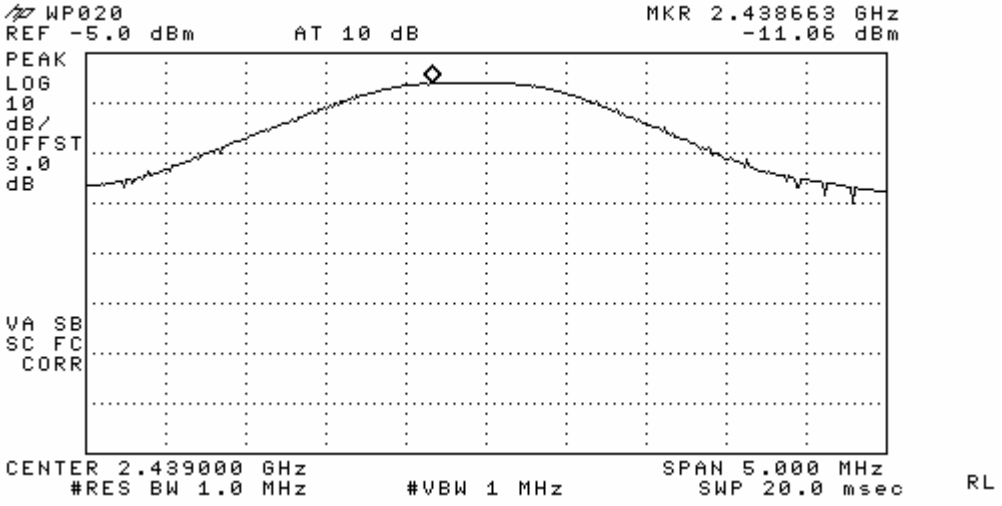
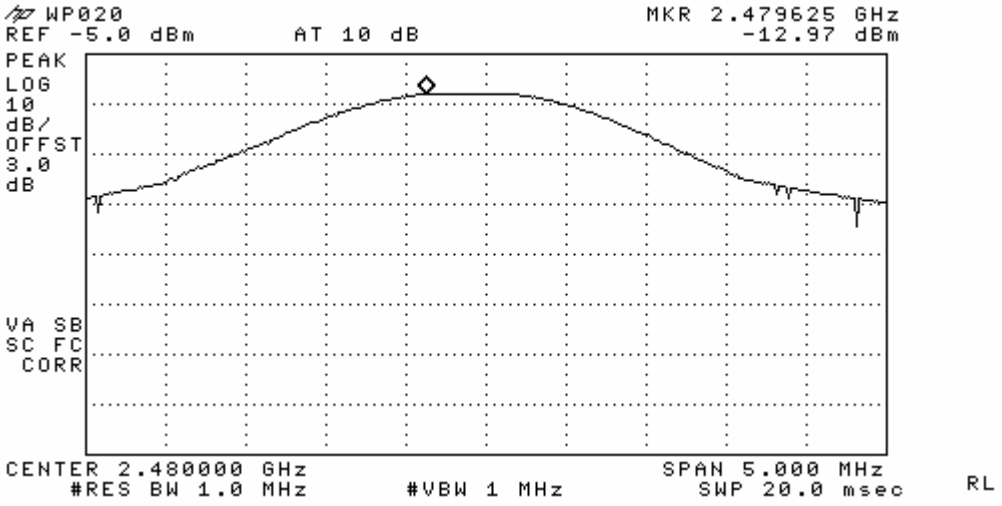
Peak Output Power







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3.2.6 Band - edge

Procedure:

The bandwidth at 20dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels.

After the trace being stable, Use the marker-to-peak function to measure 20 dB down both sides of the intentional emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz	VBW = 100 kHz
Span = 10 MHz	Detector function = peak
Trace = max hold	Sweep = auto

Measurement Data: Complies

- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.
- See next pages for actual measured spectrum plots.

Minimum Standard:	> 20 dBc

Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

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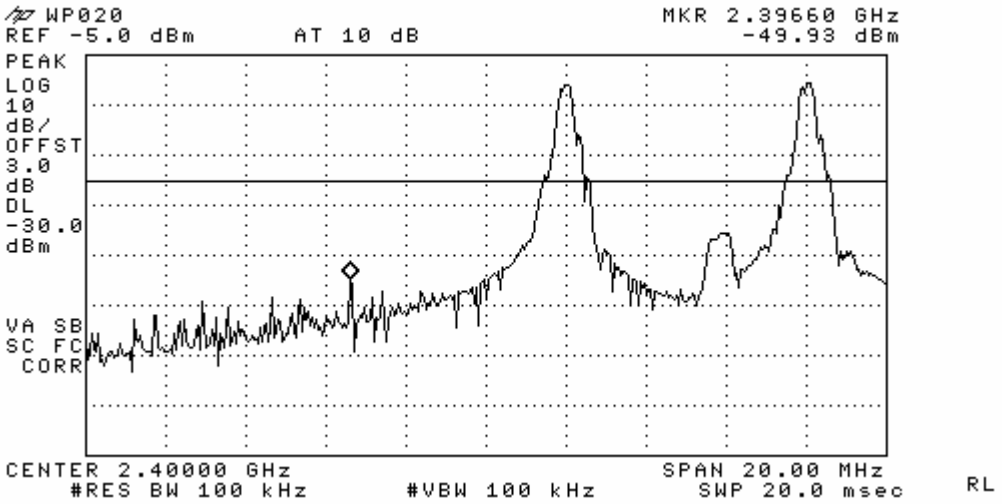
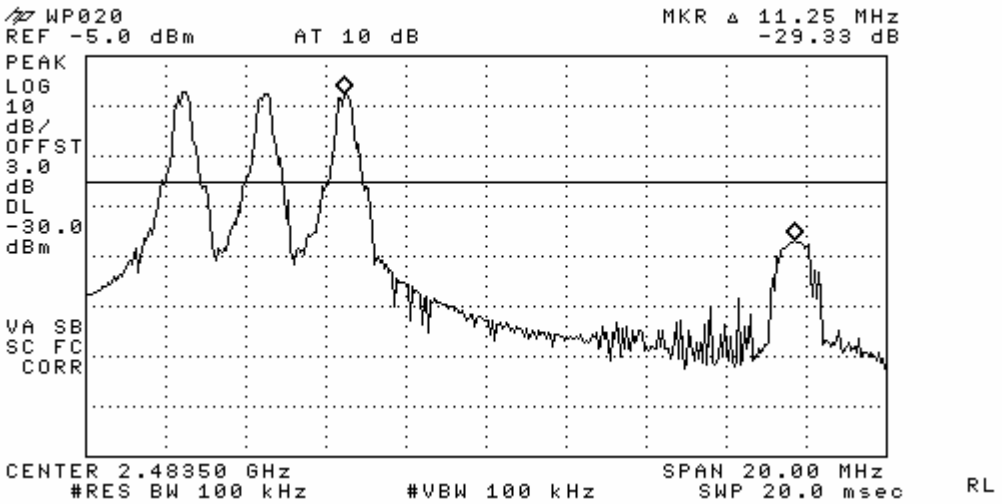
Band - edge (with Hopping)





Band-edges in the restricted band 2483.5 ~ 2500 MHz measurement

- **Document DA 00-705 Marker Delta Method**

Frequency (MHz)	Detect mode	Pol.	Reading (dBuV/m)	T.F (dB)	Step 1 Data	delta	Step 3 Data	Limit
2480	PK	H	64.0	34.6	98.6	29.33	69.27	74
	AV	H	46.4	34.6	81.0	29.33	51.67	54

Note) Step 1 = Reading + T.F

T.F = Ant.F + Cable loss Step 3 = Step 1 – Delta Value

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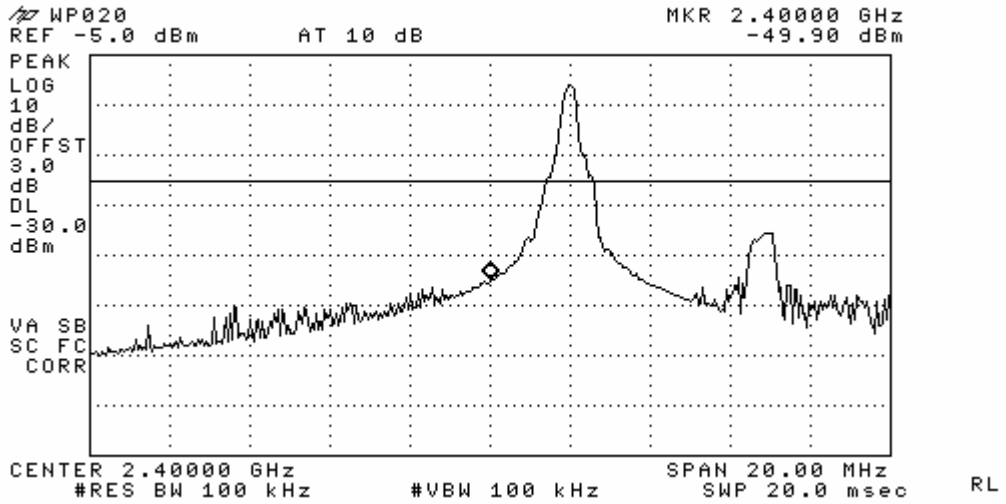
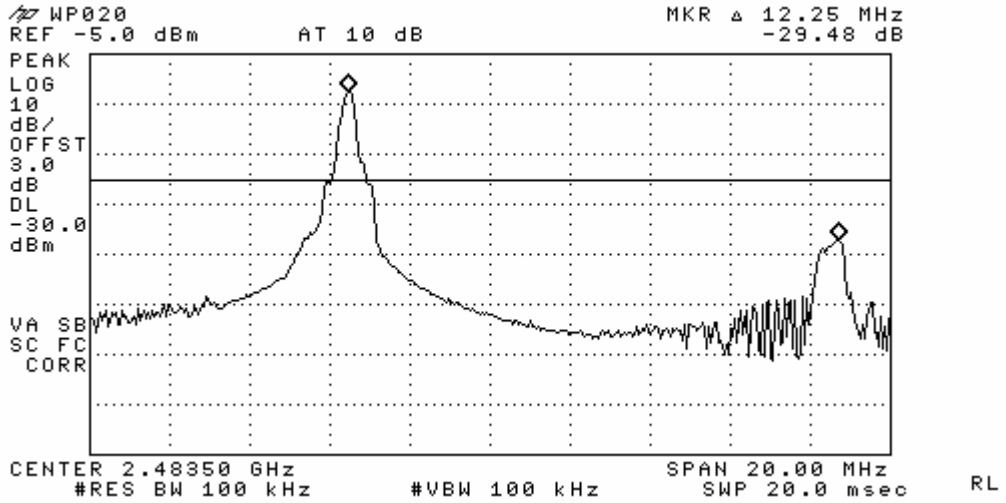
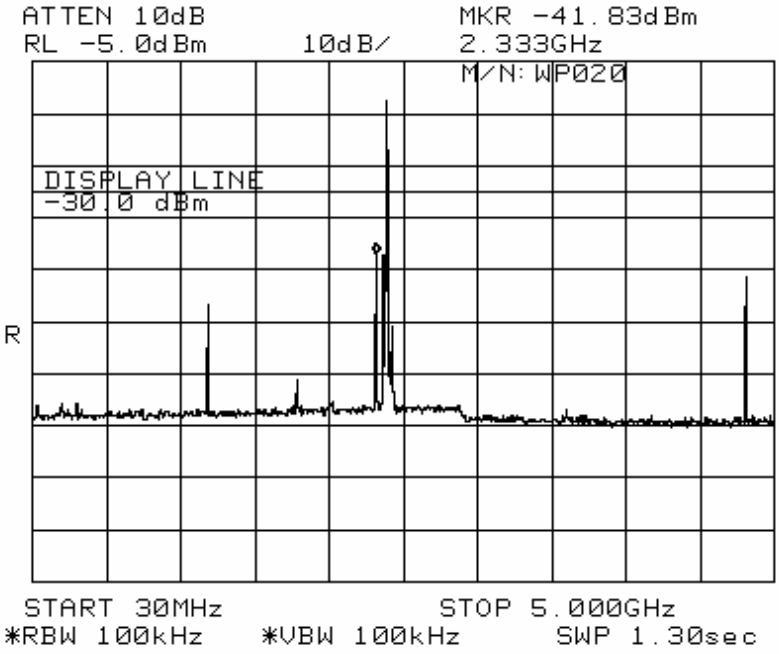
Band - edge (without Hopping)

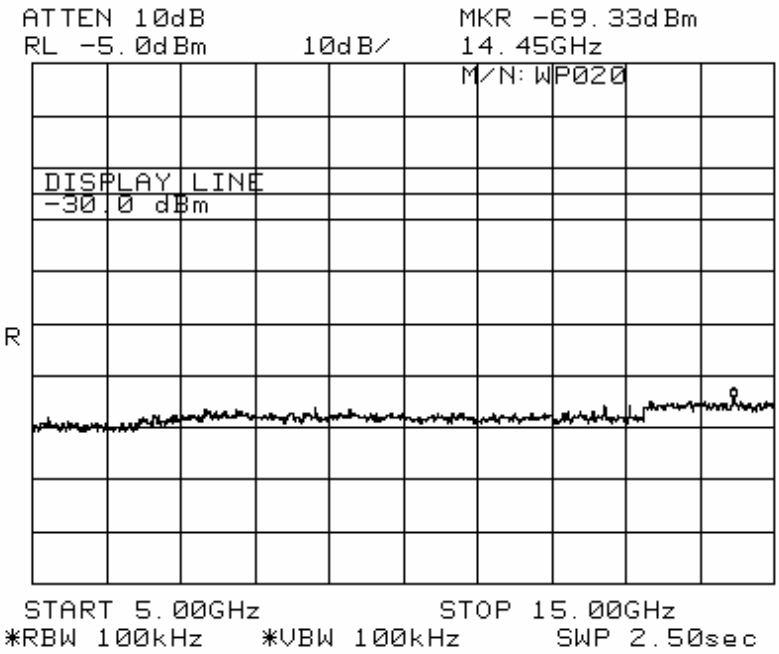




Band - edge (at 20 dB blow) – Low channel

Frequency Range = 30 MHz ~ 10th harmonic.





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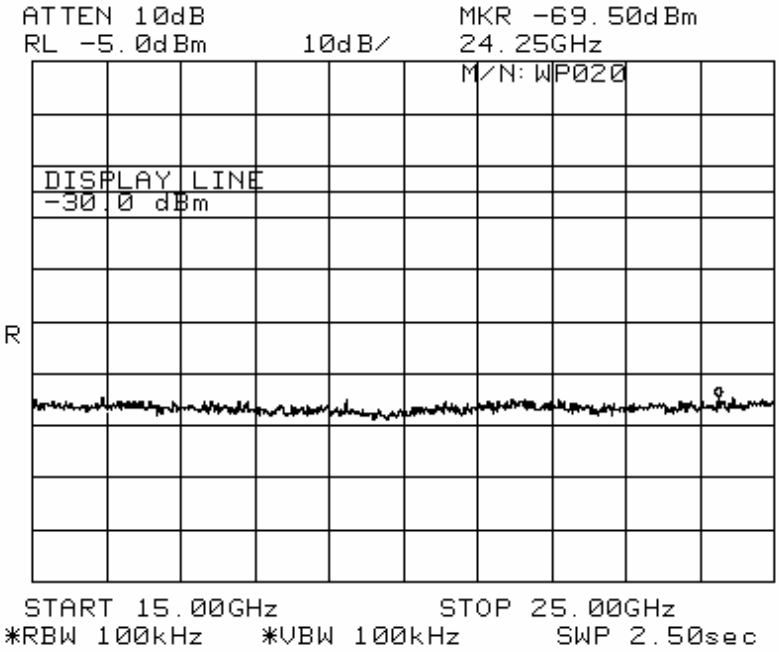
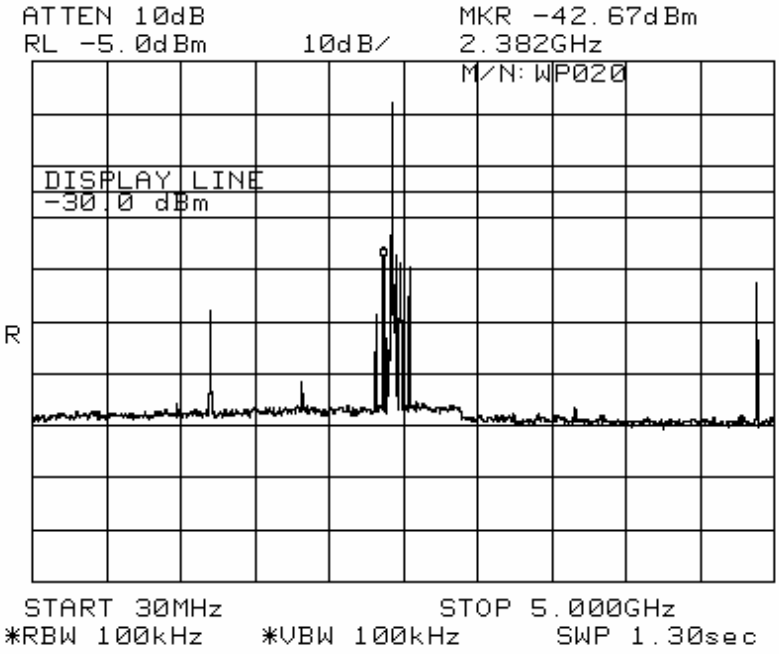
Band - edge (at 20 dB blow) – Low channel

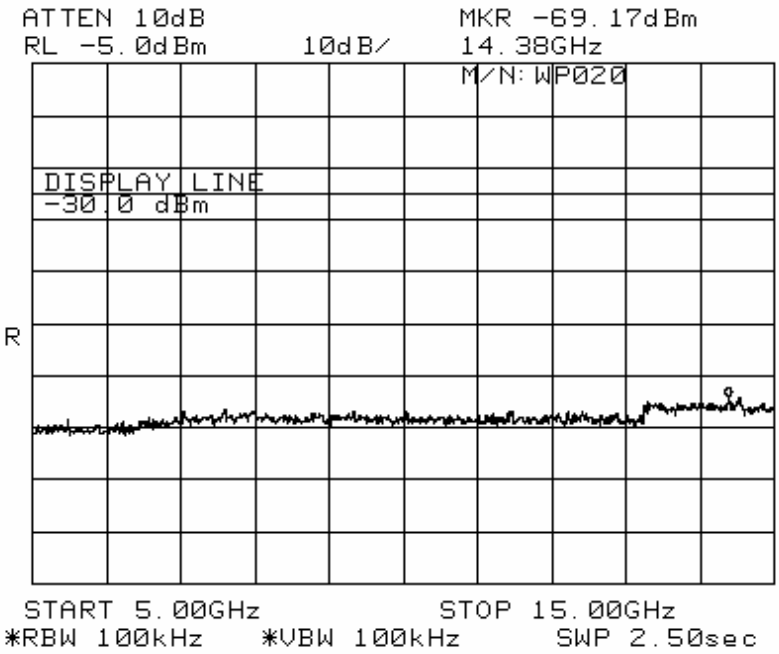
Frequency Range = 30 MHz ~ 10th harmonics. **- Continues**



Band - edge (at 20 dB blow) – Mid channel

Frequency Range = 30 MHz ~ 10th harmonic.





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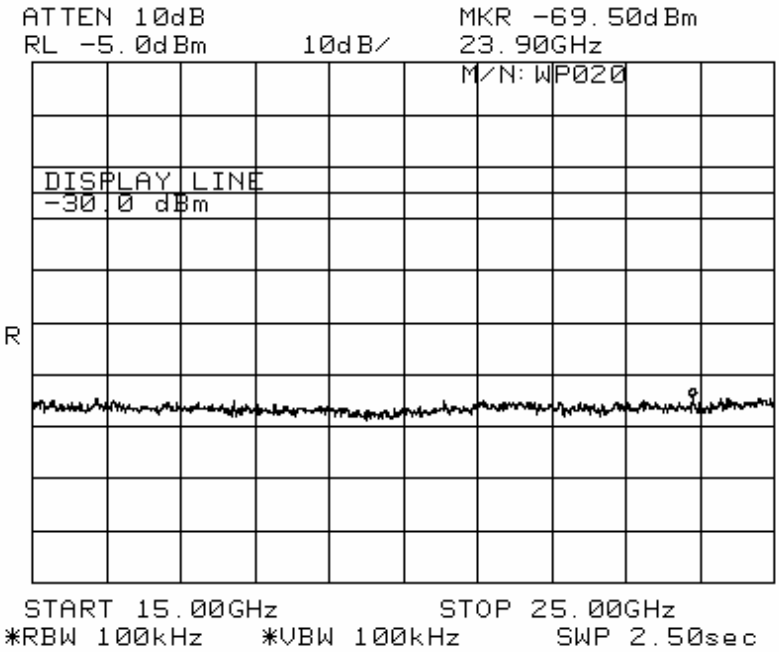
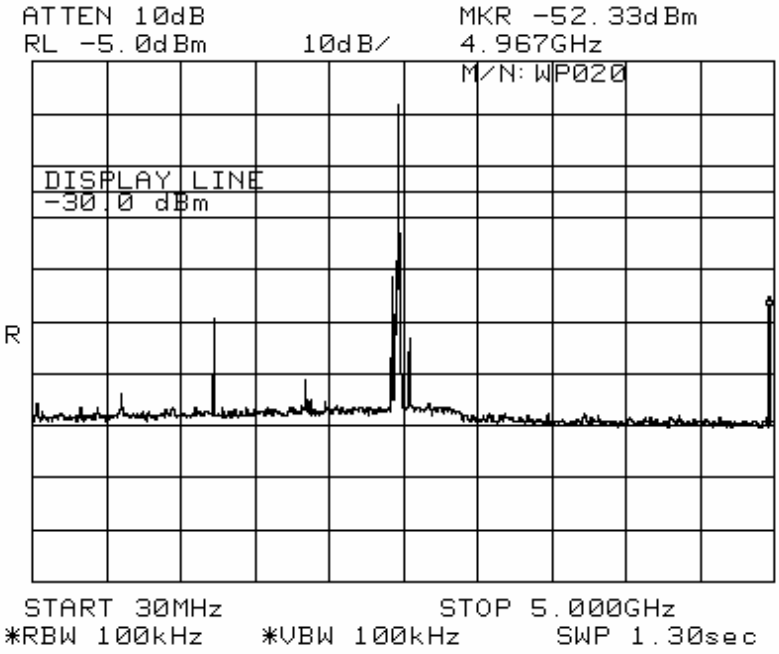
Band - edge (at 20 dB blow) – Mid channel

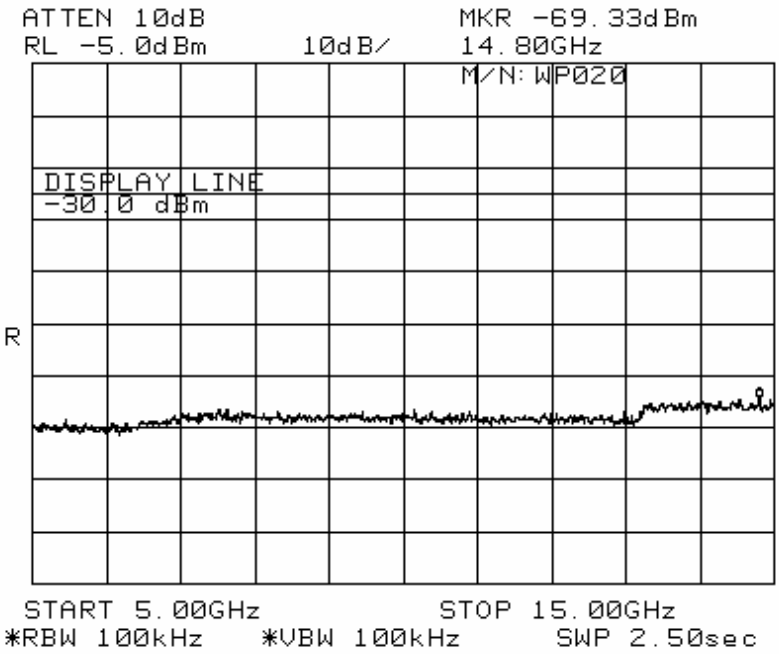
Frequency Range = 30 MHz ~ 10th harmonics. **- Continues**



Band - edge (at 20 dB blow) – High channel

Frequency Range = 30 MHz ~ 10th harmonic.





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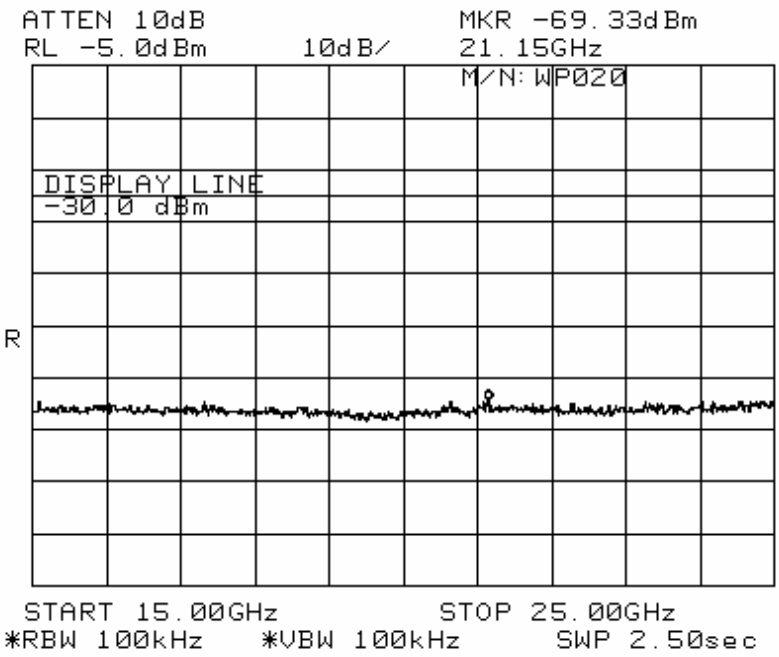
Band - edge (at 20 dB blow) – High channel

Frequency Range = 30 MHz ~ 10th harmonics. **- Continues**



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3.2.7 Field Strength of Harmonics

Procedure:

The EUT was placed on a 0.8m high wooden table inside a shielded enclosure. An antenna was placed near the EUT and measurements of frequencies and amplitudes of field strengths were recorded for reference during final measurements. For final radiated testing, measurements were performed in OATS. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst-case orientation for maximum emissions.

The spectrum analyzer is set to:

Center frequency = the worst channel

Frequency Range = 30 MHz ~ 10th harmonic.

RBW = 100 kHz (30MHz ~ 1 GHz) VBW ≥ RBW

= 1 MHz (1 GHz ~ 10th harmonic)

Span = 100 MHz Detector function = peak

Trace = max hold Sweep = auto

Measurement Data: Complies - Harmonics

Low channel		Mid channel		High channel	
Frequency (MHz)	**Level (dBuV)**	**Frequency (MHz)**	**Level (dBuV)**	**Frequency (MHz)**	**Level (dBuV)**
1201.0	39.3	1219.5	39.0	1240	37
2327.3	49.6	2379.8	49.5	2435.6	48.3
4803.9	45.0	2555.0	47.3	4967.0	38.7
-	-	4878.0	43.8	-	-
Measurement uncertainty		± 6 dB			

Note: No other emissions were detected at a level greater than 10dB below limit.

Minimum Standard: FCC Part 15.209(a)

Frequency (MHz)	Limit (uV/m) @ 3m
30 ~ 88	100 **
88 ~ 216	150 **
216 ~ 960	200 **
Above 960	500

** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88MHz, 174-216MHz or 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

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Measurement Data: Complies - Other Frequency

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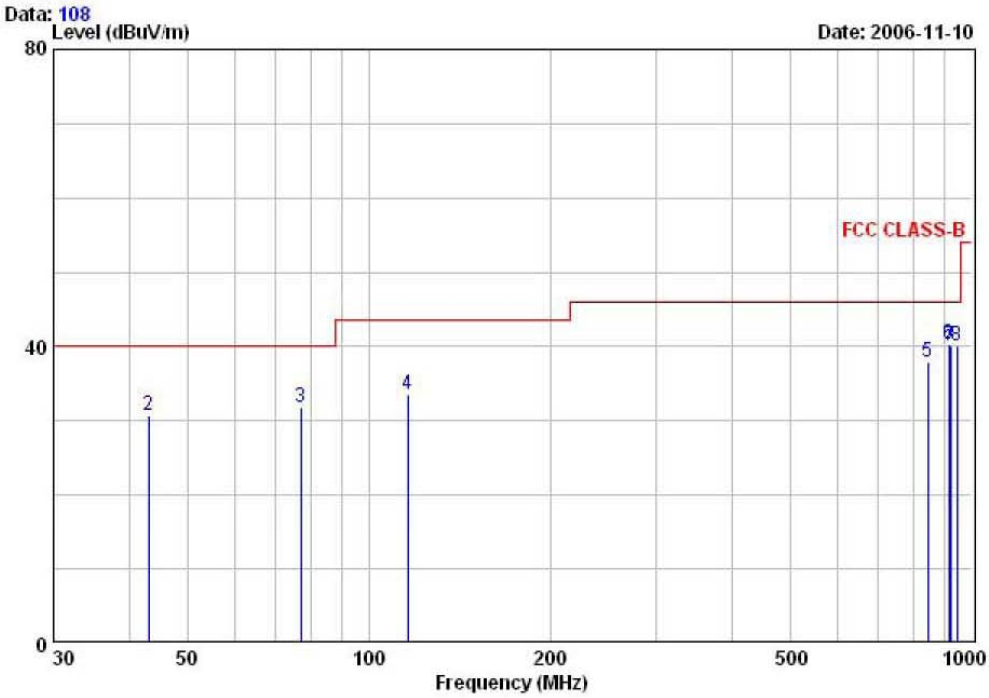
Gyeonggi-do 449-822 Korea
Tel :+82-31-3236008,9
Fax:+82-31-3236010

EUT/Model No.: WP020 Temp/Humi: 13 / 33

Test Mode : Tx mode Tested by: K.T.LEE



	Freq MHz	Reading(QP) dBuV	C.F dB	Result(QP) dBuV/m	Limit dBuV/m	Margin dB	Height cm	Angle deg	Polarity
1	30.05	48.30	-13.43	34.87	40.00	5.13	100	0	VERTICAL
2	43.20	43.60	-12.84	30.76	40.00	9.24	100	0	VERTICAL
3	77.05	47.70	-15.88	31.82	40.00	8.18	100	0	VERTICAL
4	116.13	46.90	-13.36	33.54	43.50	9.96	100	0	VERTICAL
5	845.09	35.80	2.20	38.00	46.00	8.00	100	0	VERTICAL
6	916.07	37.40	2.91	40.31	46.00	5.69	100	0	VERTICAL
7	922.52	37.10	3.05	40.15	46.00	5.85	100	0	VERTICAL
8	945.44	36.50	3.64	40.14	46.00	5.86	100	0	HORIZONTAL

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

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3.2.8 AC Conducted Emissions

Procedure:

The conducted emissions are measured in the shielded room with a spectrum analyzer in peak hold. While the measurement, EUT had its hopping function disabled at the middle channels in line with Section 15.31(m). Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation and Exerciser operation. The highest emissions relative to the limit are listed.

Measurement Data: Complies

- See next pages for actual measured spectrum plots.
- No other emissions were detected at a level greater than 10dB below limit.

Minimum Standard: FCC Part 15.207(a)/EN 55022

Frequency Range (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

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AC Conducted Emissions –Line

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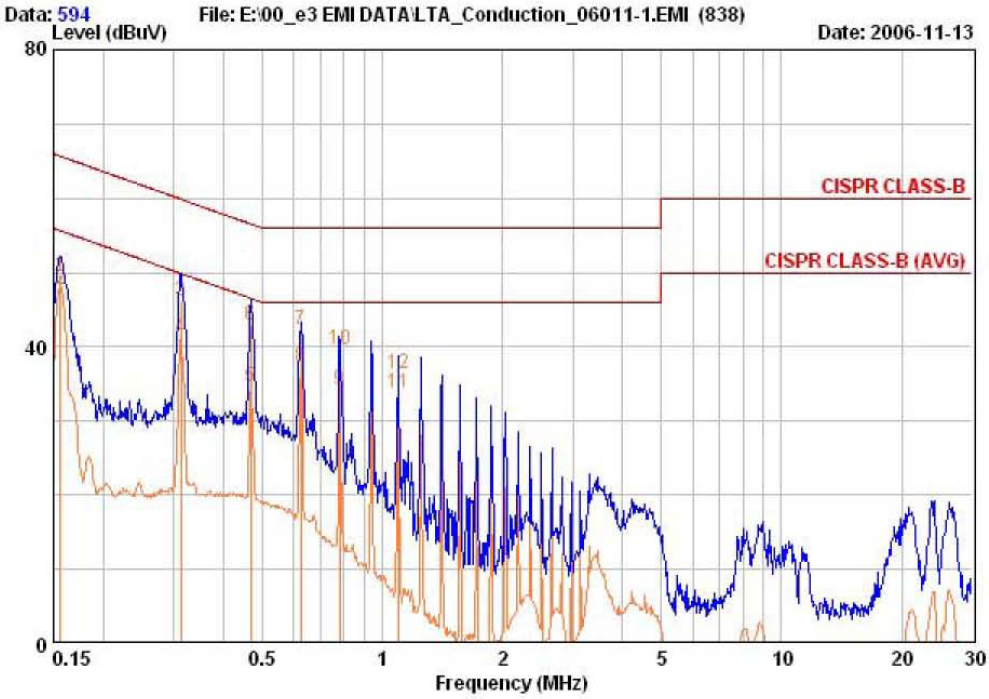
EUT / Model No.	: WP020	Phase	: LINE
Test Mode	: FCC_NORMAL mode	Test Power	: 120 / 60
Temp./Humi.	: 26 / 22	Test Engineer	: K.T. LEE



Freq MHz	RD QP dBuV	RD AV dBuV	C.F dB	Result QP dBuV	Result AV dBuV	Limit QP dBuV	Limit AV dBuV	Margin QP dB	Margin AV dB
0.156	49.20	47.10	0.54	49.74	47.64	65.67	55.67	15.94	8.04
0.313	46.00	40.80	0.30	46.30	41.10	59.89	49.89	13.59	8.79
0.468	42.70	34.30	0.32	43.02	34.62	56.55	46.55	13.53	11.93
0.624	42.00	37.00	0.30	42.30	37.30	56.00	46.00	13.70	8.70
0.781	39.20	33.80	0.38	39.58	34.18	56.00	46.00	16.42	11.82
1.094	36.00	33.50	0.32	36.32	33.82	56.00	46.00	19.68	12.18

Remarks: C.F (Correction Factor) = Insertion loss + Cable loss

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AC Conducted Emissions -Neutral

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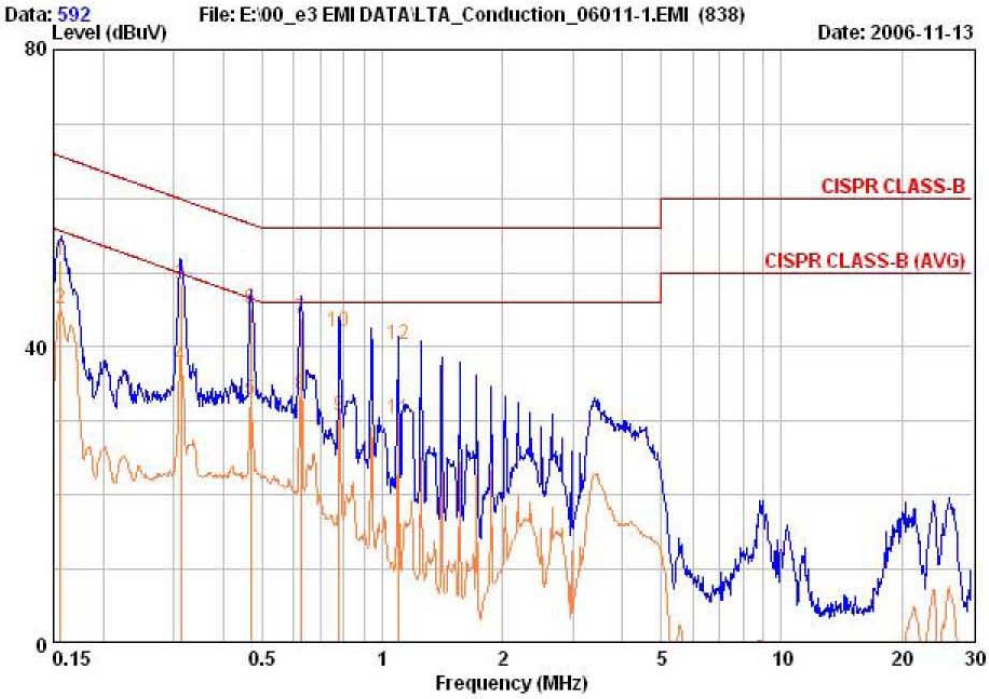
EUT / Model No.	: WP020	Phase	: NEUTRAL
Test Mode	: FCC_NORMAL mode	Test Power	: 120 / 60
Temp./Humi.	: 25 / 24	Test Engineer	: K.T. LEE



Freq MHz	RD QP dBuV	RD AV dBuV	C.F dB	Result QP dBuV	Result AV dBuV	Limit QP dBuV	Limit AV dBuV	Margin QP dB	Margin AV dB
0.156	51.20	44.60	0.53	51.73	45.13	65.67	55.67	13.95	10.55
0.313	48.00	37.10	0.29	48.29	37.39	59.89	49.89	11.60	12.50
0.467	44.90	32.50	0.31	45.21	32.81	56.57	46.57	11.35	13.75
0.626	43.60	33.30	0.29	43.89	33.59	56.00	46.00	12.11	12.41
0.779	41.60	30.30	0.37	41.97	30.67	56.00	46.00	14.03	15.33
1.094	40.00	29.90	0.31	40.31	30.21	56.00	46.00	15.69	15.79

Remarks: C.F (Correction Factor) = Insertion loss + Cable loss

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APPENDIX

TEST EQUIPMENT USED FOR TESTS

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	Description	Model No.	Serial No.	Manufacturer	Next Cal. Date
1	Spectrum Analyzer	8594E	3649A03649	HP	Dec-06
2	Signal Generator	8657A	3430U02049	HP	Dec-06
3	Attenuator (3dB)	8491A	37822	HP	Dec-06
4	Attenuator (3dB)	8491A	28881	HP	Dec-06
5	EMI Test Receiver	ESVD	843748/001	R&S	Dec-06
6	Spectrum Analyzer	8591E	3649A05888	HP	Jan-07
7	Spectrum Analyzer	8563E	3425A02505	HP	Jan-07
8	RF Amplifier	8447D	2949A02670	HP	Jan-07
9	RF Amplifier	8447D	2439A09058	HP	Jan-07
10	RF Amplifier	8449B	3008A02126	HP	Jun-07
11	TRILOG Antenna	VULB 9160	9160-3172	SCHWARZBECK	Feb-07
12	Log.-Per. Antenna	VULP 9118	9118 A 401	SCHWARZBECK	Feb-07
13	Biconical Antenna	BBA 9106	VHA 9103-2315	SCHWARZBECK	Feb-07
14	Horn Antenna	3115	00055005	ETS LINDGREN	Jun-07
15	Horn Antenna	BBHA 9120D	0499	Schwarzbeck	Jun-07
16	Hygro-Thermograph	THB-36	0041557-01	ISUZU	Feb-07
17	Splitter (BNC)	ZFM-150	15542	Mini-Circuits	-
18	Splitter (SMA)	ZFSC-2-2500	SF617800326	Mini-Circuits	-
19	Power Divider	11636A	6243	HP	Apr-07
20	DC Power Supply	6622A	3448A03079	HP	Apr-07
21	Attenuator (30dB)	8498A	1801A06689	HP	Apr-07
22	Attenuator (10dB)	8491A	63196	HP	Apr-07
23	Power Meter	EPM-441A	GB32481702	HP	Apr-07
24	Power Sensor	8481A	2702A64048	HP	Apr-07
25	Audio Analyzer	8903B	3729A18901	HP	May-07
26	Modulation Analyzer	8901B	3749A05878	HP	May-07
27	Dipole Antenna	VHA9103	2116	Schwarzbeck	Nov-07
28	Dipole Antenna	VHA9103	2117	Schwarzbeck	Nov-07
29	Dipole Antenna	UHA9105	2261	Schwarzbeck	Nov-07
30	Dipole Antenna	UHA9105	2262	Schwarzbeck	Nov-07
31	Digital Multimeter	34401A	US36062141	HP	Apr-07
32	LISN	KNW-407	8-1430-1	Kyoritsu	Jan-07
33	Two-Line V-Network	ESH3-Z5	893045/017	R&S	Jan-07
34	Test Receiver	ESHS10	828404009	R&S	Jan-07
35	TEMP & HUMIDITY Chamber	YJ-500	L05022	JinYoung Tech	-

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