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TEST REPORT

Part 15 Subpart C 15.247

Equipment under test 2.4 GHz Radio Control

Model name RP24RS5DX

FCC ID X6ZRP24RS5DX

Applicant Nextlink Co., Ltd.

Manufacturer Nextlink Co., Ltd.

Date of test(s) 2012.03.30 ~ 2012.04.09, 2012.04.19

Date of issue 2012.04.19

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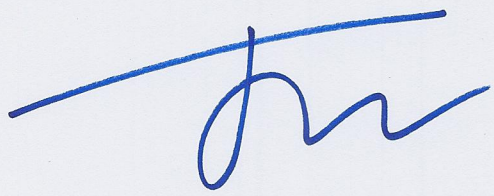
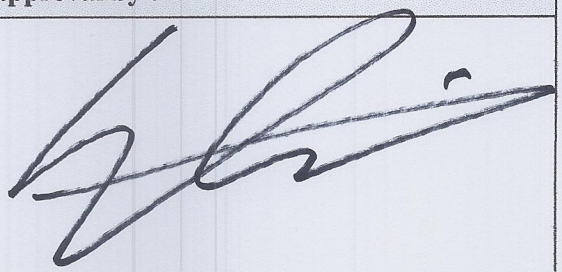
	
Jae Jun Lee Test engineer	Gyu-cheol Shin Technical manager

Revision history

Revision	Date of issue	Test report No.	Description
-	2012.04.13	KES-RF-120024	Initial
1	2012.04.19	KES-RF-120029	Retest the Maximum peak output power

TABLE OF CONTENTS

1.0 General product description 4
1.1 Test frequency 4
1.2 Model differences 4
1.3 Device modifications 4
1.4 Test facility 5
1.5 Laboratory accreditations and listings 5
2.0 Summary of tests 6
2.1 Test data 7
2.1.1 6 dB Bandwidth 7
2.1.2 Maximum peak output power 10
2.1.3 Power spectral density 13
2.1.6 Conducted spurious emission & band edge 16
2.1.7 Radiated spurious emission & band edge 21
Appendix A. Test equipment used for test 26
Appendix B. Test setup photo 27

1.0 General product description

Equipment under test	2.4 GHz Radio Control
Model name	RP24RS5DX
Serial number	Prototype
Frequency Range	2 405 ㎒ ~ 2 480 ㎒
Modulation technique	DSSS
Number of channels	76
Antenna type & gain	Connector Type(Wire antenna) / 1.83 dBi
Power source	DC 4.8 V

1.1 Test frequency

	Low channel	**Middle channel**	**High channel**
Frequency (㎒)	2 405	2 440	2 480

1.2 Model differences

N/A

1.3 Device modifications

N/A

1.4 Test facility

C3701 Dongil Techno Town, 889-1, Gwanyang 2-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
477-6, Hageo-ri, Yeoju-eup, Yeoju-gun, Gyeonggi-do, 469-803, Korea

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

1.5 Laboratory accreditations and listings

Country	Agency	Scope of accreditation	Logo
USA	FCC	3 & 10 meter Open Area Test Sites and one conducted site to perform FCC Part 15/18 measurements.	343818
KOREA	KC	EMI (10 meter Open Area Test Site and two conducted sites) Radio (3 & 10 meter Open Area Test Sites and one conducted site)	KR0100
Canada	IC	3 & 10 meter Open Area Test Sites and one conducted site	4769B-1

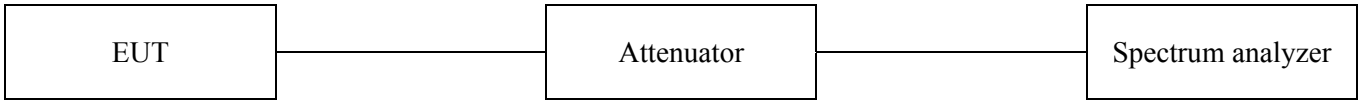
2.0 Summary of tests

Section in FCC Part 15	Parameter	Status
15.247(a)(2)	6 dB Bandwidth	C
15.247(b)(3)	Maximum peak output power	C
15.247(e)	Power spectral density	C
15.247(d)	Conducted spurious emission & band edge	C
15.209 15.205(a)	Radiated spurious emission & band edge	C
Note 1: C=Complies NC=Not complies NT=Not tested NA=Not applicable		

2.1 Test data

2.1.1 6 dB Bandwidth

Test setup



Test procedure

1. Place the EUT on the table and set it in the transmitting mode
.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer

3. Set the spectrum analyzer as RBW = 100 ㎑, VBW ≥ RBW, Span = 20 ㎒, Sweep = auto.

4. Mark the peak frequency and -6 dB (upper and lower) frequency.

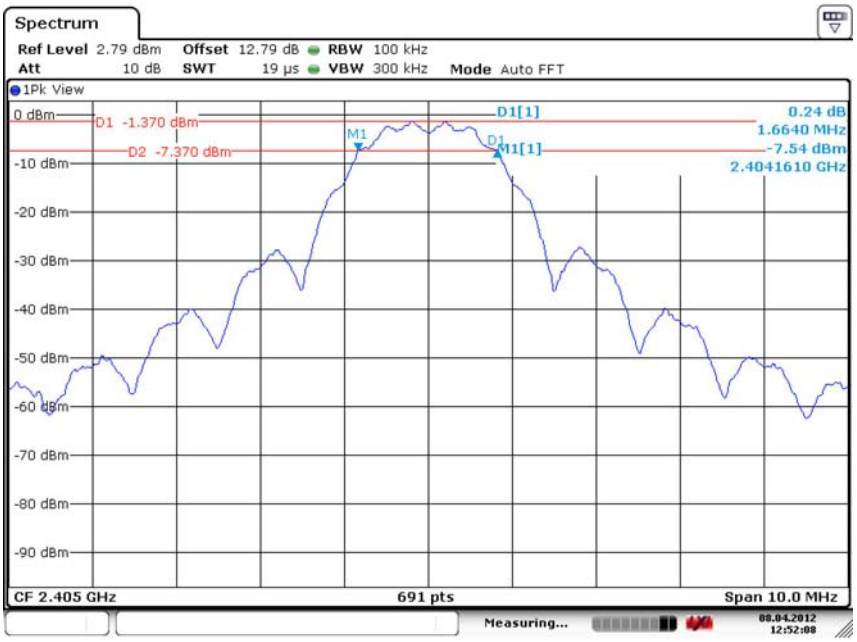
5. Repeat until all the rest channels are investigated

Limit

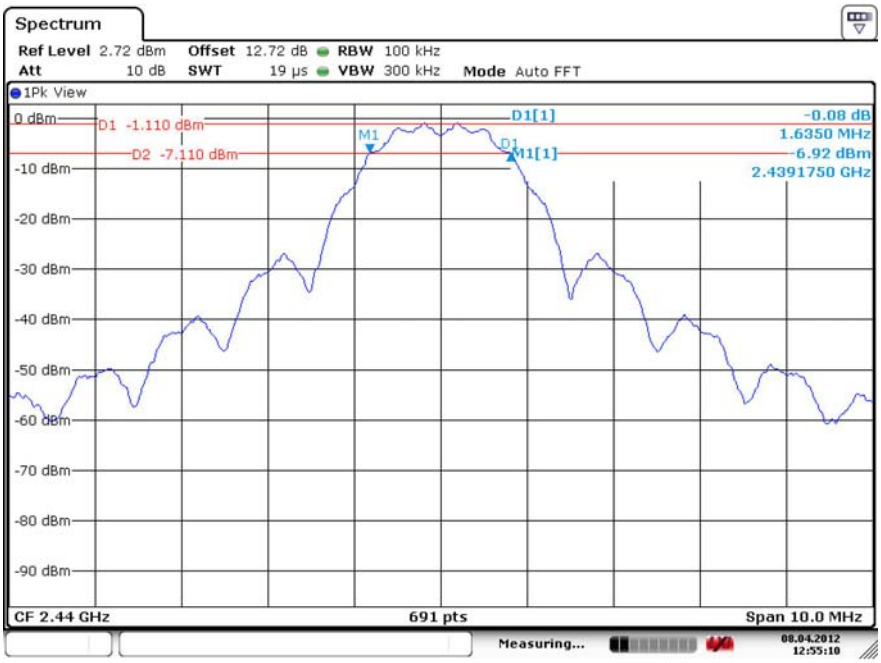
According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 ~928 ㎒, 2400 ~ 2483.5 ㎒, and 5725 ~ 5825 ㎒ bands. The minimum of 6 dB Bandwidth shall be at least 500 ㎑

Operating Mode	Frequency (㎒)	6 dB Bandwidth (㎒)	MinimumLimit (㎒)	Result
DSSS	2 405	1.664	0.5	Complies
	2 440	1.635		Complies
	2 480	1.650		Complies

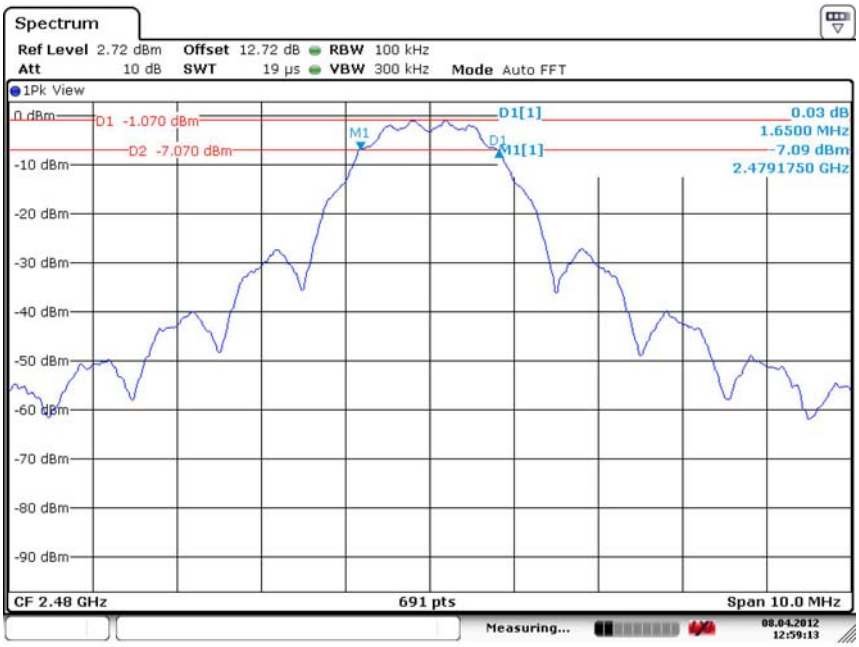
● Low Channel



● Middle Channel

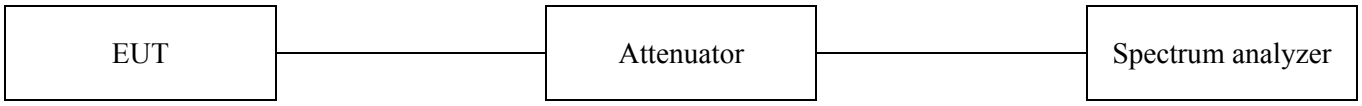


● High Channel



2.1.2 Maximum peak output power

Test setup



Test procedure

1. Place the EUT on the table and set it in the transmitting mode.

2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer

3. Set the Spectrum analyzer as RBW = 1 ㎒, VBW = 3 ㎒, Span = Auto, Channel BW = 26 ㏈Bandwidth.

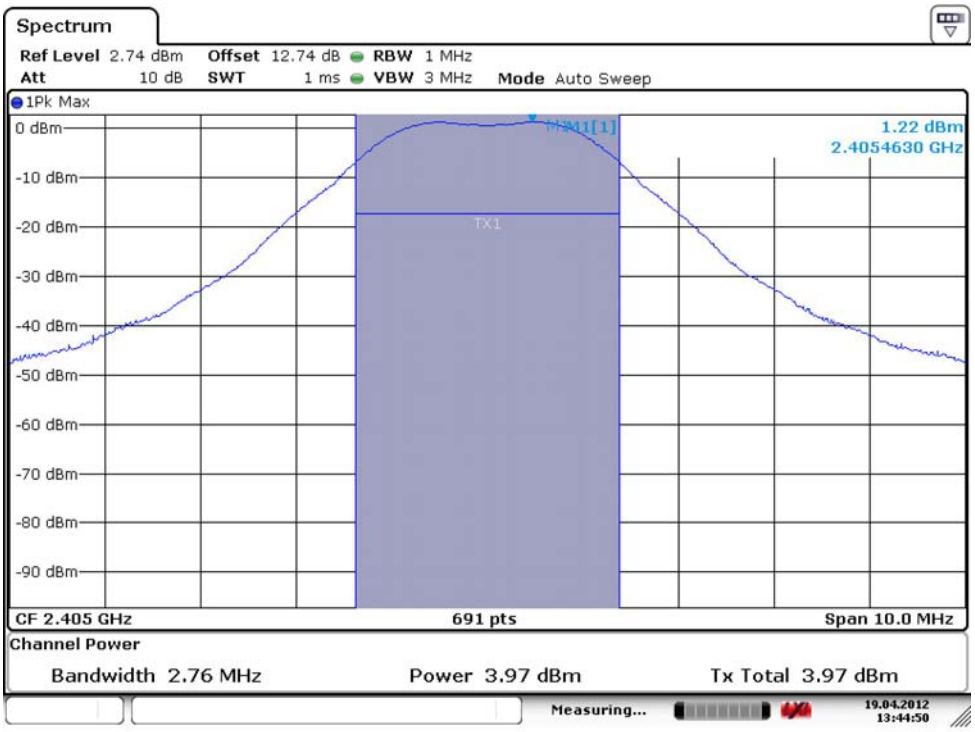
Limit

According to §15.247(b)(3), for systems using digital modulation in the 902 ~ 928 ㎒, 2400 ~2483.5 ㎒, and 5725 ~ 5850 ㎒ band: 1 Watt.
As an alternative to a peak power measurement, compliance with the one watt limit can be based on a measurement of the maximum conducted output power.
Maximum Conducted output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antenna elements.
The average must not include any intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maxium conducted output power is the highest total transmit power occurring in any mode.

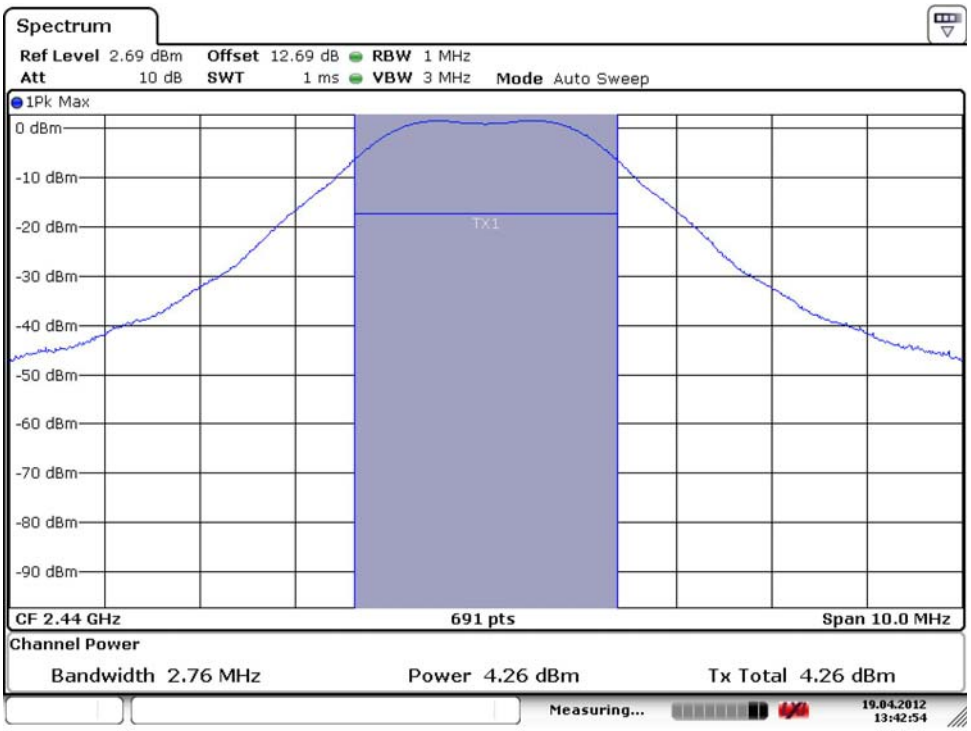
Test results

Operating Mode	Frequency (㎒)	Maximum peak output power (㏈m)	Peak power Limit (㏈m)	Result
DSSS	2 405	3.97	30	Complies
	2 440	4.26		Complies
	2 480	4.19		Complies

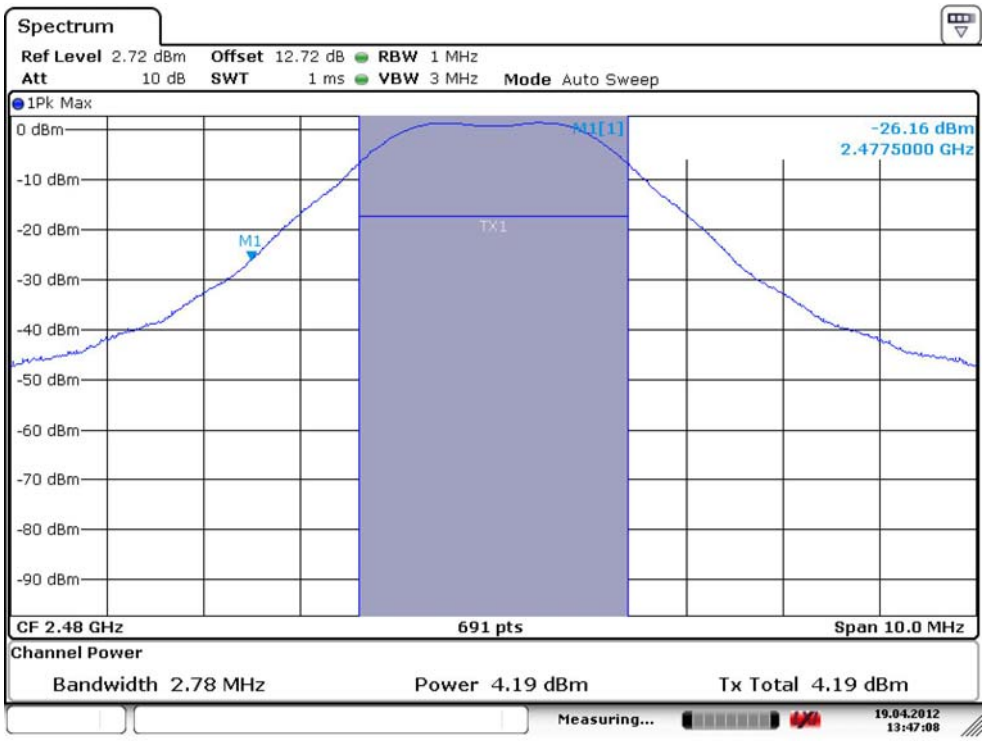
● Low Channel



● Middle Channel

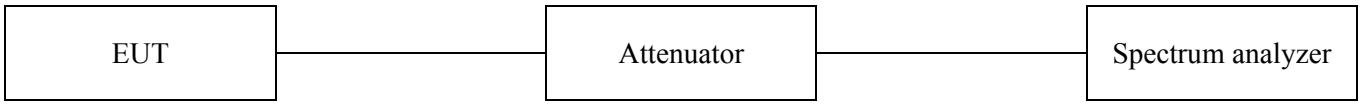


● High Channel



2.1.3 Power spectral density

Test setup



Test procedure

1. Place the EUT on the table and set it in transmitting mode
   Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

2. Set the spectrum analyzer as RBW = 3 ㎑, VBW = 10 ㎑, Span = 300 ㎑, Sweep = 100 s

3. Record the max reading.

4. Repeat the above procedure until the measurements for all frequencies are completed.

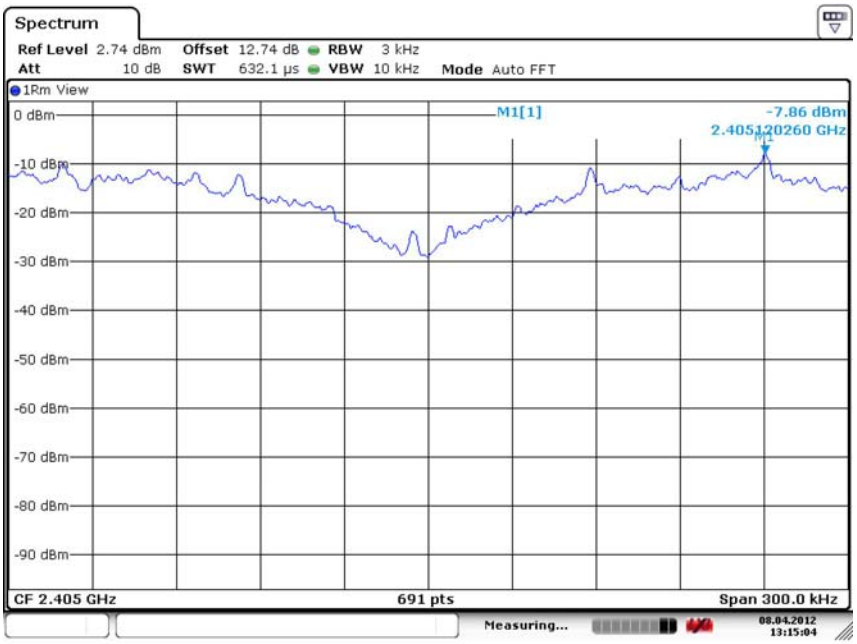
Limit

According to §15.247(e), For digitally modulated system, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 ㏈m in any 3 ㎑ band 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

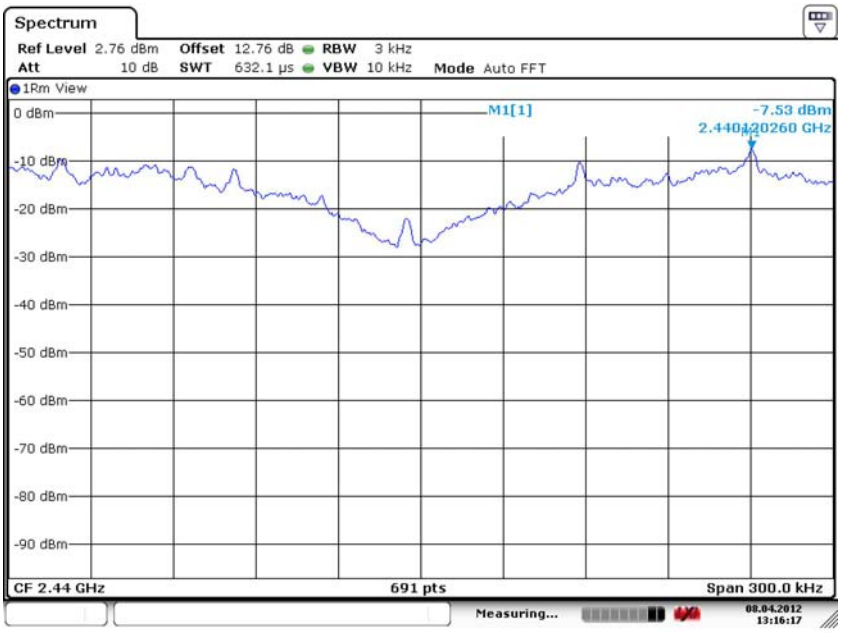
Test results

Operating Mode	Frequency (㎒)	Power spectral density (㏈m)	Maximum Limit (㏈m)	Result
DSSS	2 405	-7.86	8	Complies
	2 440	-7.53		Complies
	2 480	-7.83		Complies

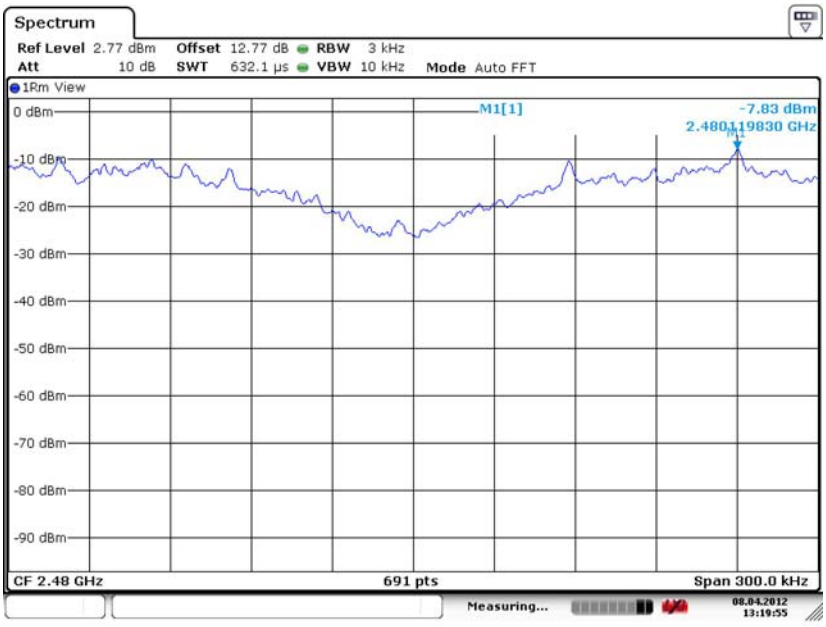
● Low Channel



● Middle Channel

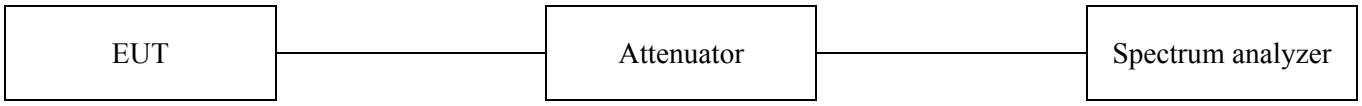


● High Channel



2.1.6 Conducted spurious emission & band edge

Test setup



Test procedure for band edge

1. Use the following spectrum analyzer setting
   Center frequency: Low, middle and high channel.
   Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
   RBW = 100 ㎑
   VBW = 100 ㎑ (≥ RBW)
   Sweep = auto
   Detector function = peak
   Trace = max hold
2. Allow the trace to stabilize. Set the marker on the emission at the band edge, or on the highest modulation on product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission

Test procedure for spurious emission

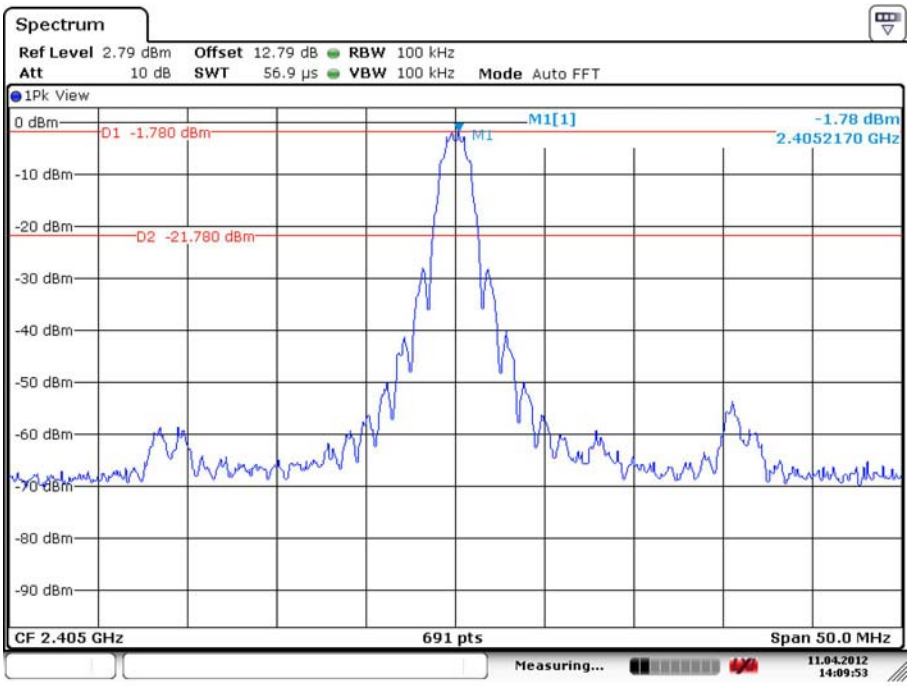
1. Use the following spectrum analyzer setting
   Center frequency: Low, middle and high channel.
   Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
   RBW = 100 ㎑
   VBW = 100 ㎑ (≥ RBW)
   Sweep = auto
   Detector function = peak
   Trace = max hold
2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.

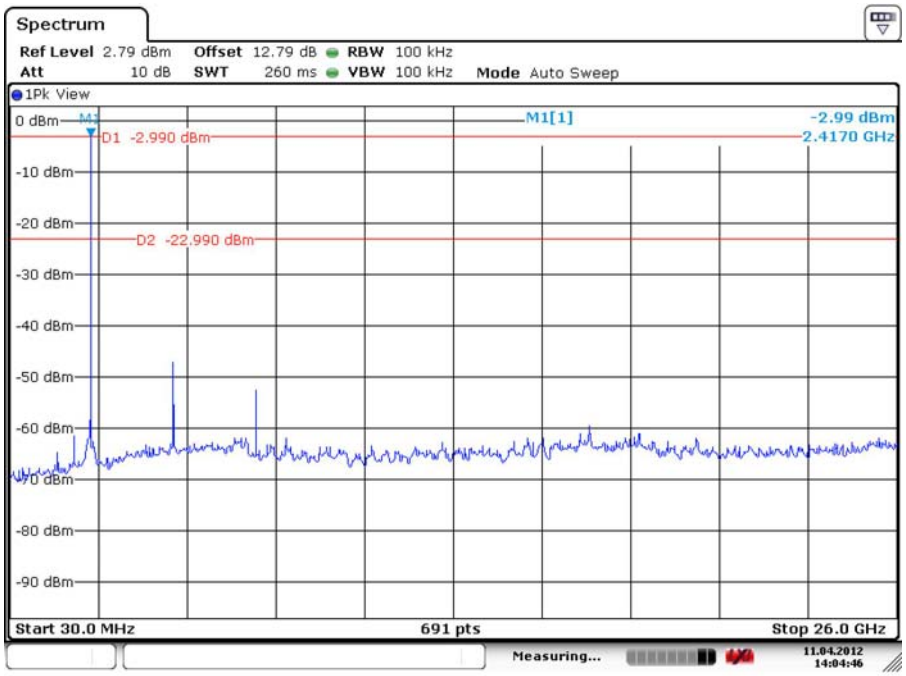
Limit

According to 15.247(d), in any 100 ㎑ 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 ㏈ below that in the 100 ㎑ 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 ㏈ instead of 20 ㏈. Attenuation below the general limits specified in section 15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section 15.205(a), must also comply the radiated emission limits specified in section 15.209(a) (see section 15.205(c))

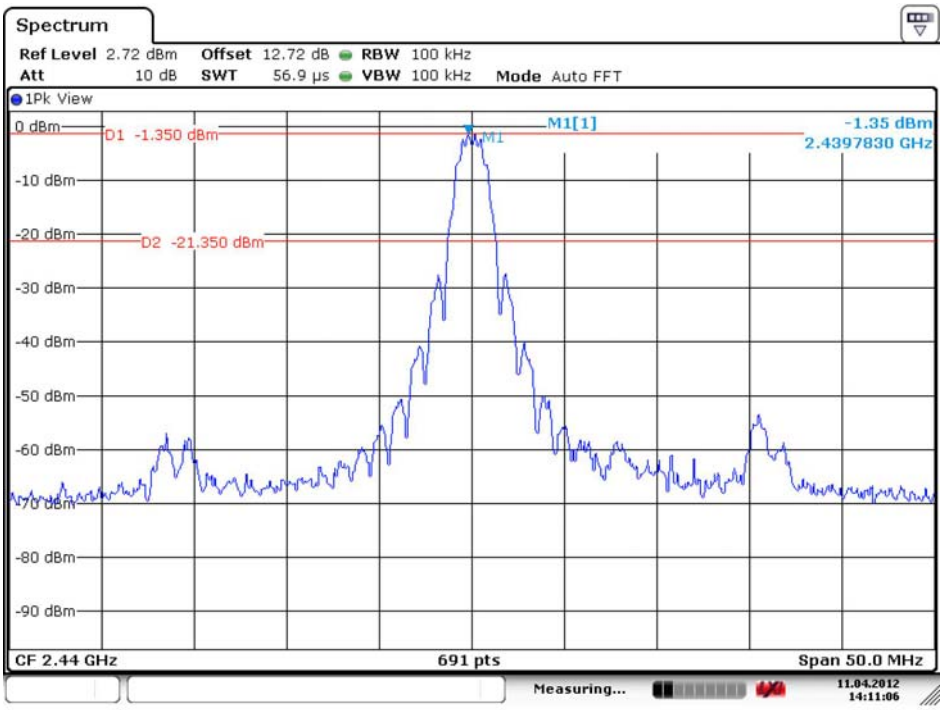
Test results

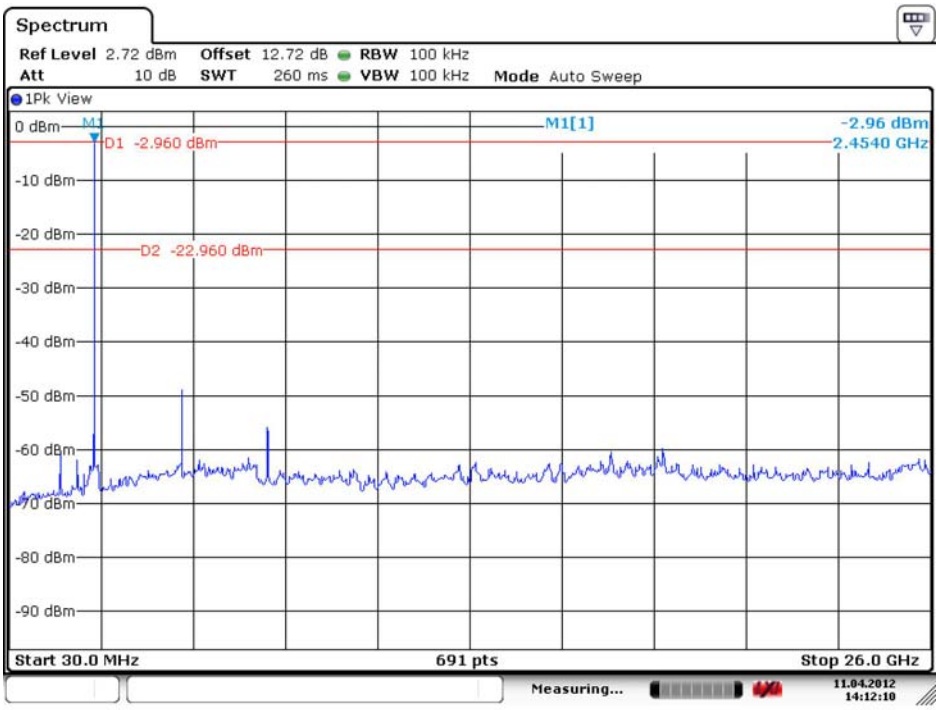
● Low Channel



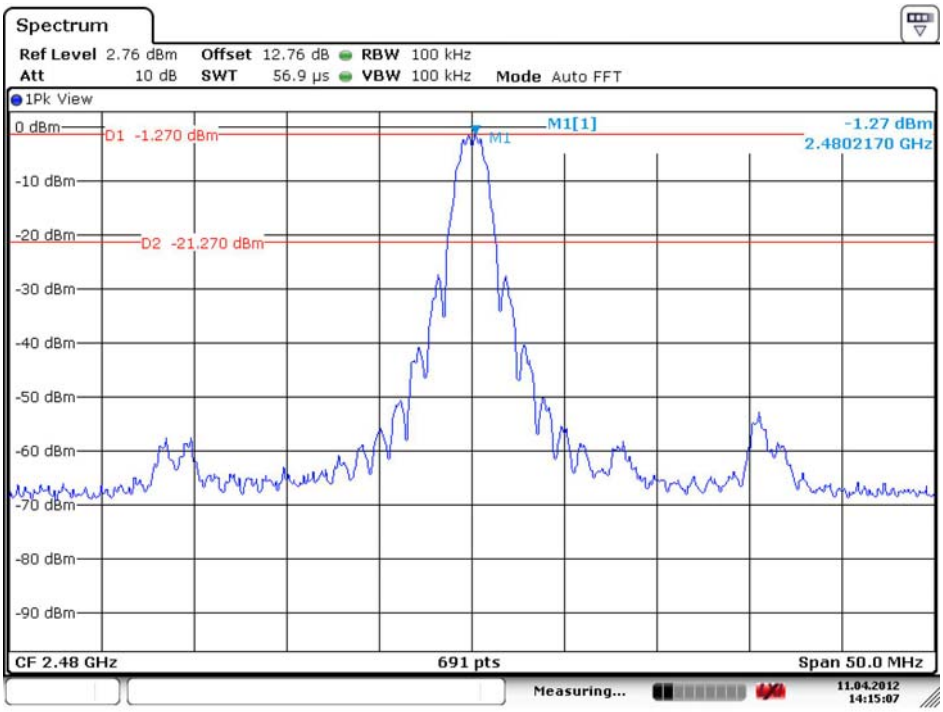


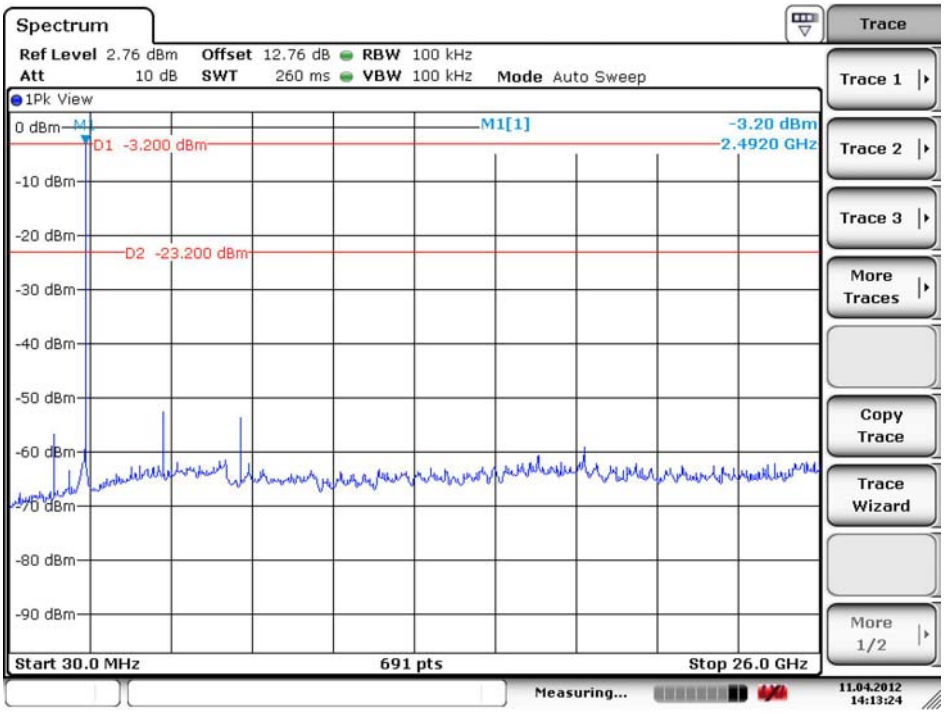
● Mid Channel





● High Channel





2.1.7 Radiated spurious emission & band edge

Test location
Testing was performed at a test distance of 3 meter Open Area Test Site

Test procedures
Radiated emissions from the EUT were measured according to the dictates of KDB55874.

[9 ㎑ to 30 ㎒]
The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to Quasi-peak function and specified bandwidth with maximum hold mode.

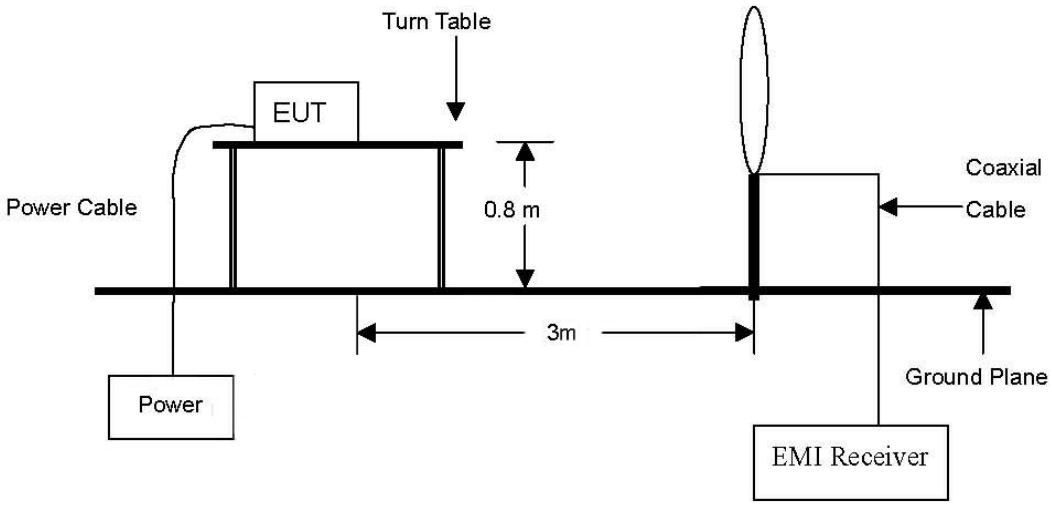
The spectrum analyzer is set to:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 200 ㎐ for Quasi-peak detection (QP) at frequency below 9 ㎑~ 150 ㎑.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 9 ㎑ for Quasi-peak detection (QP) at frequency below 150 ㎑~ 30 ㎒.

[30 ㎒ to 1 ㎓ and 1 ㎓ to 24 ㎓]
The height of the measuring antenna was varied between 1 to 4 m and the table was rotated a full revolution in order to obtain maximum values of the electric field intensity.
The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

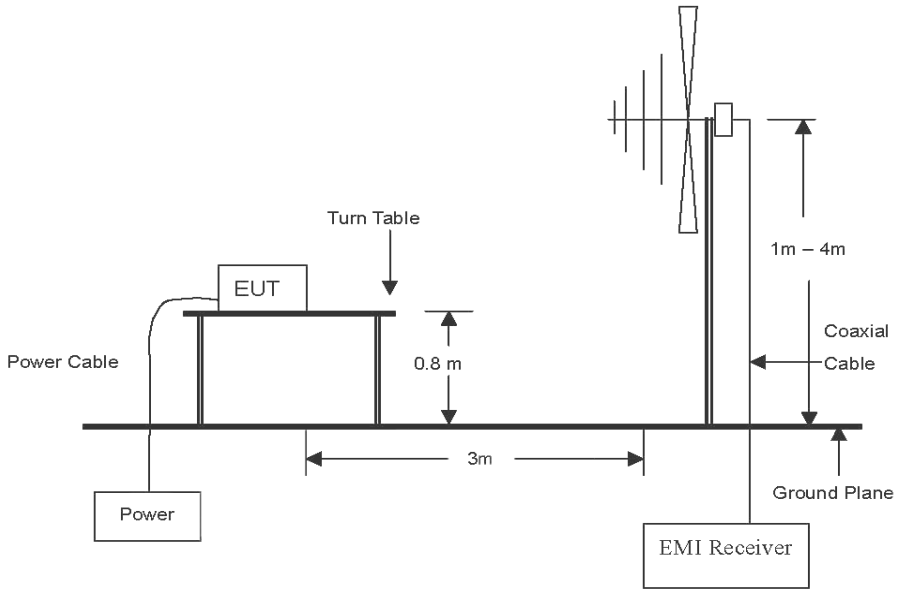
The spectrum analyzer is set to:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 120 ㎑ for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 ㎓.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection at frequency above 1 ㎓.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 ㎒ and the video bandwidth is 10 ㎐ for Average detection (AV) at frequency above 1 ㎓.

The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.

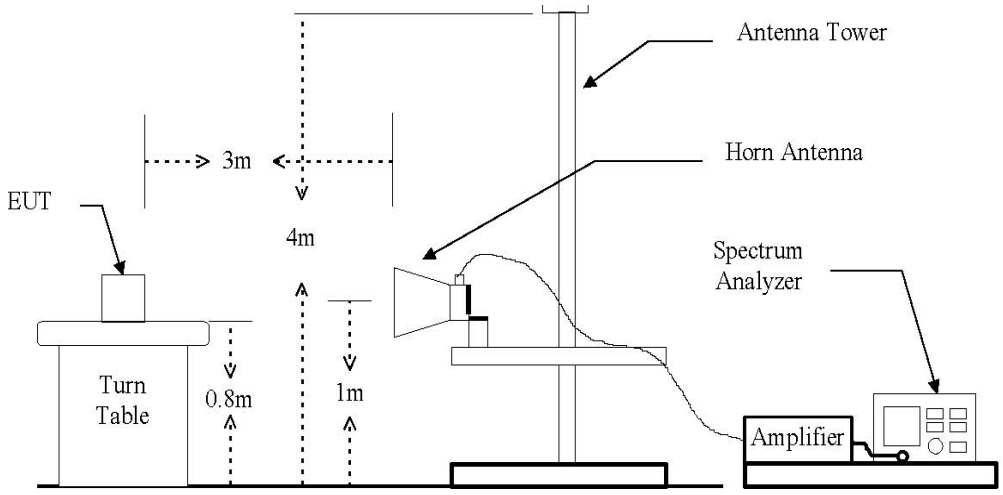
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to 24 ㎓ emissions.



Limit

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

Frequency (㎒)	Distance (Meters)	Radiated (㎶/m)
0.009 ~ 0.490	300	2400 / F(㎑)
0.490 ~ 1.705	30	24000 / F(㎑)
1.705 ~ 30.0	30	30
30 ~ 88	3	100
88 ~ 216	3	150
216 ~ 960	3	200
Above 960	3	500

Test results (Below 30 ㎒)

The frequency spectrum from 9 ㎑ to 30 ㎒ was investigated. Emission levels are not reported much lower than the limits by over 20 ㏈.

Radiated emissions		Ant.	Correction factors			Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Pol.	Ant. factor (㏈/m)	Cable loss (㏈)	F_d (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
No emissions were detected at a level greater than 20 ㏈ below limit.								

※ Remark

1. All spurious emission at channels are almost the same below 30 ㎒, so that high channel was chosen at representative in final test.
2. Actual = Reading + Ant. factor + Cable loss + F_d
3. $F_d = 40\log(D_m / D_s)$
   Where:
   F_d = Distance factor in ㏈
   D_m = Measurement distance in meters
   D_s = Specification distance in meters

Test results (Below 1 000 ㎒)

The frequency spectrum from 30 ㎒ to 1 000 ㎒ was investigated. Emission levels are not reported much lower than the limits by over 20 ㏈.

Radiated emissions		Ant.	Correction factors			Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Pol.	Ant. factor (㏈/m)	Cable loss (㏈)	F_d (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
No emissions were detected at a level greater than 20 ㏈ below limit.								

※ Remark

1. All spurious emission at channels are almost the same below 1 ㎓, so that high channel was chosen at representative in final test.
2. Actual = Reading + Ant. factor + Cable loss
3. Detector mode: Quasi peak
4. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

Test results (Above 1 000 ㎒)

Low channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
2390.0*	47.45	Peak	H	28.31	-38.02	37.74	74.00	36.26
2390.0*	40.09	Average	H	28.31	-38.02	30.38	54.00	23.62
2390.0*	43.42	Peak	V	28.31	-38.02	33.71	74.00	40.29
2390.0*	36.53	Average	V	28.31	-38.02	26.82	54.00	27.18
4811.1	52.44	Peak	H	33.93	-34.09	52.28	74.00	21.72
4811.1	45.74	Average	H	33.93	-34.09	45.08	54.00	8.92
4811.1	49.82	Peak	V	33.93	-34.09	49.66	74.00	24.34
4811.1	42.00	Average	V	33.93	-34.09	41.84	54.00	12.16

Middle channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
No emissions were detected at a level greater than 20 ㏈ below limit.								

High channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
2483.5*	51.57	Peak	H	28.50	-37.81	42.26	74.00	31.74
2483.5*	36.95	Average	H	28.50	-37.81	27.64	54.00	26.36
2483.5*	50.84	Peak	V	28.50	-37.81	41.53	74.00	32.47
2483.5*	37.07	Average	V	28.50	-37.81	27.76	54.00	26.24
Above 2483.5	No emissions were detected at a level greater than 20 ㏈ below limit.							

※ Remark

1. "*" means the restricted band.
2. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental frequency.
3. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument using peak/average detector mode.
4. Average test would be performed if the peak result were greater than the average limit.
5. Actual = Reading + Ant. factor + Amp + CL (Cable loss)
6. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

Appendix A. Test equipment used for test

Equipment	Manufacturer	Model	Calibration due.
Spectrum Analyzer	R&S	FSV30	2013.01.10
Vector Signal Generator	R&S	SMBV2100A	2013.01.10
DC Power Supply	Agilent	6632B	2012.05.06
Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	2013.10.25
Horn Antenna	A.H. System	SAS-571	2013.03.22
Loop Antenna	R&S	HFH2-Z2.335.4711.52	2013.03.10
High Pass Filter	Wainwright Instrument	WHJS3000-10TT	2013.01.10
Attenuator	HP	8495B	2012.05.04
Attenuator	HP	8494B	2012.05.04
Preamplifier	A.H. System	PAM-0118	2012.05.04

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Netbook	Lenovo	S10-2	2957N5K

Appendix B. Test setup photo

Radiated field emissions