

TEST REPORT

For

2.4GHz BAND DATA COMMUNICATION MODULE

In conformity with

FCC CFR 47 Part15 / RSS-210, RSS-Gen

Model: RF-01

FCC ID/ IC Certification No.: H5PRF-01 / 6050A-RF01

Test Item: 2.4GHz BAND DATA COMMUNICATION MODULE

Report No: RY0711Z29R1

Issue Date: 29 November 2007

Prepared for

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Prepared by

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1 General information

1.1 Product description

Test item	: 2.4GHz BAND DATA COMMUNICATION MODULE
Manufacturer	: ALINCO INCORPORATED
Address	: Shin Dai Bldg. 9F, 1-2-6 Dojimahama, Kita-ku, Osaka 430-0004 Japan
Model	: RF-01
FCC ID	: H5PRF-01
IC Certification No.	: 6050A-RF01
Classification	: Certification
Serial numbers	: None
Type of Modulation	: FSK
Fundamental / Operated Frequency	: 20 MHz, 26 MHz, Tx/Rx Freq. (2401 - 2411.5 MHz)
RF Output Power	: -1.35 dBm (measured at the antenna terminal)
Antenna Gain	: 1.32 dBi (PCB Antenna: Peak Maximum Gain)
Receipt date of EUT	: 30 October 2007
Nominal power source voltages	: DC 3.5V (from AC Adaptor, Model: SA106A-0512-6 by Sino-American)

1.2 Test(s) performed/ Summary of test result

Test specification(s)	: FCC CFR 47. Part 15 / RSS-210 Issue 7, RSS-Gen Issue 2
Test method(s)	: ANSI C63.4: 2003
Test(s) started	: 30 October 2007
Test(s) completed	: 29 November 2007
Purpose of test(s)	: Grant for Certification of FCC / IC
Summary of test result	: Complied

Note: The above judgment is only based on the measurement data and it does not include the measurement uncertainty. Accordingly, the statement below is applied to the test result.
The EUT complies with the limit required in the standard in case that the margin is not less than the measurement uncertainty in the Laboratory.
Compliance of the EUT is more probable than non-compliance is case that the margin is less than the measurement uncertainty in the Laboratory.

Test engineer

: 
K. Ohnishi

Reviewer

: 
T. Ikegami

1.3 Test facility

The Federal Communications Commission has reviewed the technical characteristics of the test facilities at RF Technologies Ltd., located in 472, Nippa-cho, Kohoku-ku, Yokohama, 223-0057, Japan, and has found these test facilities to be in compliance with the requirements of 47 CFR Part 15, section 2.948, per October 23, 2000.

The description of the test facilities has been filed under registration number 879401 at the Office of the Federal Communications Commission. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

The list of all public test facilities is available on the Internet at <http://www.fcc.gov>.

Registered by Voluntary Control Council for Interference by Information Technology Equipment (VCCI);

Each registered facility number is as follows;

Test site (Semi-Anechoic chamber 3m) R-2393

Test site (Shielded room) C-2617

Registered by Industry Canada (IC); The registered facility number is as follows;

Test site No. 1 (Semi-Anechoic chamber 3m): 6974A

1.4 Measurement uncertainty

The treatment of uncertainty is based on the general matters on the definition of uncertainty in “Guide to the expression of uncertainty in measurement (GUM)” published by ISO. The Lab’s uncertainty is determined by referring UKAS Publication LAB34: 2002 “The Expression of Uncertainty in EMC Testing” and CISPR16-4-2: 2003 “Uncertainty in EMC Measurements”.

The uncertainty of the measurement result in the level of confidence of approximately 95% ($k=2$) is as follows;

Conducted emission: ± 3.5 dB (10 kHz – 150 kHz), ± 3.6 dB (150 kHz – 30 MHz)

Radiated emission (9 kHz - 30MHz): ± 3.2 dB

Radiated emission (30MHz - 1000MHz): ± 4.6 dB

Radiated emission (above 1000MHz): ± 4.6 dB

1.5 Summary of test results

1.5.1 Table of test summary

Requirement of;	Section in FCC15	Section in RSS210/ RSS-Gen	Result	Section in this report
1.5.1 Occupied Bandwidth (20 dB)	15.247(a)(1)	A8.1(1)	Complied	2.1
1.5.2 Hopping Carrier Frequency Separation	15.247(a)(1)	A8.1(2)	Complied	2.2
1.5.3 Number of Hopping Channel	15.247(a)(1)(iii)	A8.1(4)	Complied	2.3
1.5.4 Average Time of Occupancy	15.247(a)(1)(iii)	A8.1(4)	Complied	2.4
1.5.5 Peak Output Power	15.247(a)(1)/(b)(1)	A8.4(2)	Complied	2.5
1.5.6 Conducted Spurious Emissions	15.247(d)	A8.5	Complied	2.6
1.5.7 Transmitter Radiated Spurious Emissions	15.205(b)/15.209	A8.5	Complied	2.7
1.5.8 Transmitter AC Power Line Conducted Emissions	15.207	RSS-Gen 7.2.2	Complied	2.8
1.5.9 Receiver Radiated Spurious Emissions	15.109	RSS-Gen 6	Complied	2.9
1.5.10 Receiver AC Power Line Conducted Emissions	15.107	RSS-Gen 7.2.2	Complied	2.10
1.5.11 Maximum Permissible Exposure (Exposure of Humans to RF Fields)	15.247(i)/ 1.1307(b)(1)	RSS-Gen 5.5/ RSS-102	Complied	2.11

1.6 Setup of equipment under test (EUT)

1.6.1 Test configuration of EUT

Equipment(s) under test:

	Item	Manufacturer	Model No.	Serial No.	FCC ID/ IC Certification No.
A	2.4GHz Band Data Communication Module	ALINCO INCORPORATED.	RF-01	None	H5PRF-01 6050A-RF01

Support Equipment(s):

	Item	Manufacturer	Model No.	Serial No.	FCC ID
B	Test Kit	-	-	-	N/A
C	AC Adaptor	Sino-American	SA106A-0512-6	None	N/A
D	Personal Computer	EPSON	Endeavor NA102	530003248	None
E	AC Adaptor	DELTA ELECTRONIC, INC.	ADP-50HH	KIW0719003543	N/A

Connected cable(s):

No.	Item	Identification (Manu. etc...)	Shielded YES / NO	Ferrite Core YES / NO	Connector Type Shielded YES / NO	Length (m)
1	DC power cable	UNICAB	Yes	Yes	Yes	2.9
2	RS232C cable	SANWA SUPPLY	Yes	No	Yes	1.5
3	USB/RS232C exchange cable	-	Yes	No	Yes	0.4
4	DC power cable	LL82009	Yes	Yes	Yes	2.0
5	AC power cable	VCTFK	Yes	No	No	2.0

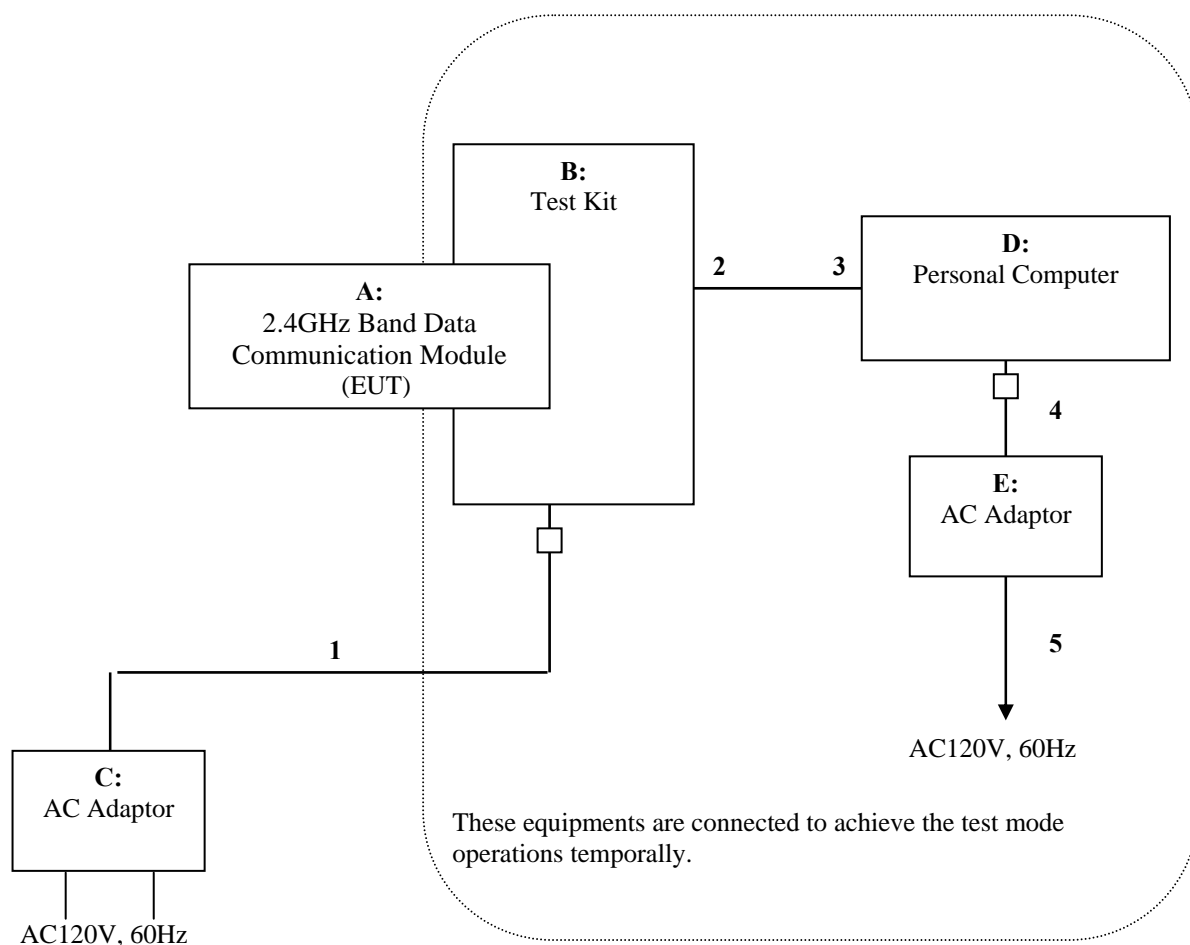
1.6.2 Operating condition:

Operating mode:

The EUT was tested under the following test mode prepared by the applicant::

- (1-1) Continuous transmission, hopping off (0ch: 2401MHz)
- (1-2) Continuous transmission, hopping off (11ch: 2406.5MHz)
- (1-3) Continuous transmission, hopping off (21ch: 2411.5MHz)
- (1-4) Continuous transmission, hopping on (Hopping Group 0)
- (1-5) Continuous transmission, hopping on (Hopping Group 11)
- (1-6) Continuous transmission, hopping on (Hopping Group 21)
- (2-1) Continuous receiving (Same as stand-by)

1.6.3 Setup diagram of tested system:



1.7 Equipment modifications

No modifications have been made to the equipment in order to achieve compliance with the applicable standards described in clause 1.2

1.8 Deviation from the standard

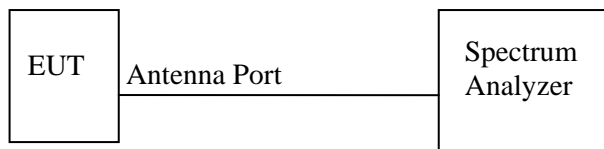
No deviations from the standards described in clause 1.2

2 Test procedure and test data

2.1 Occupied Bandwidth

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

Measurement procedures were implemented according to the method of ANSI C63.4: 2003 clauses 13.1.7. The EUT antenna port connected to the spectrum analyzer. The RBW is set to 1% or more of the measured 20dB bandwidth. The VBW is set to 3 times of the RBW. The sweep time is coupled appropriate.

Limitation

There are no limitations. The measurement value is used to calculation of the limitation of the channel separation and the emission designator.

Test equipment used (refer to List of utilized test equipment)

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Test results – Reporting purpose.

Transmission Channel	Transmission Frequency	20dB Bandwidth (KHz)	99 % (KHz)
Low (0ch)	2401.0	448.0	338.0
Middle (11ch)	2406.5	452.0	380.0
High (21ch)	2411.5	730.0	636.0

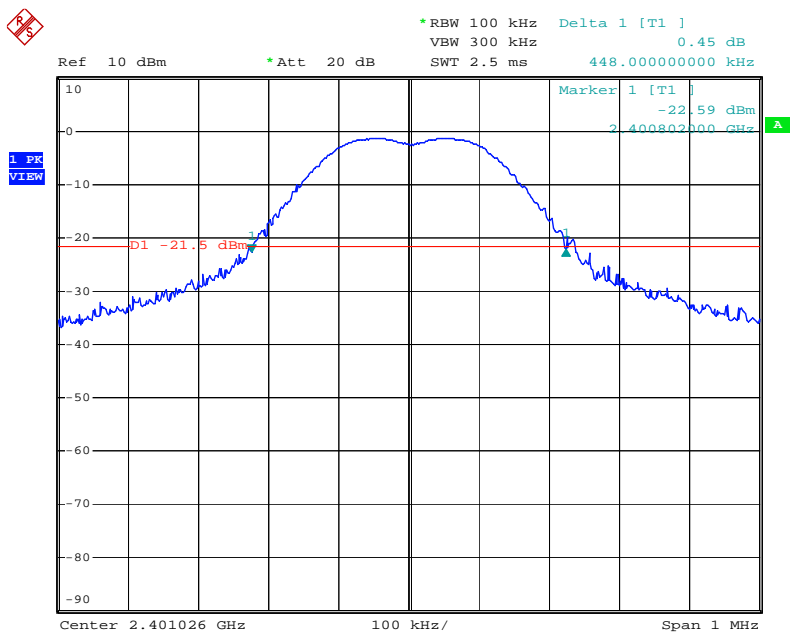
Test Data

Tested Date: November 9, 2007

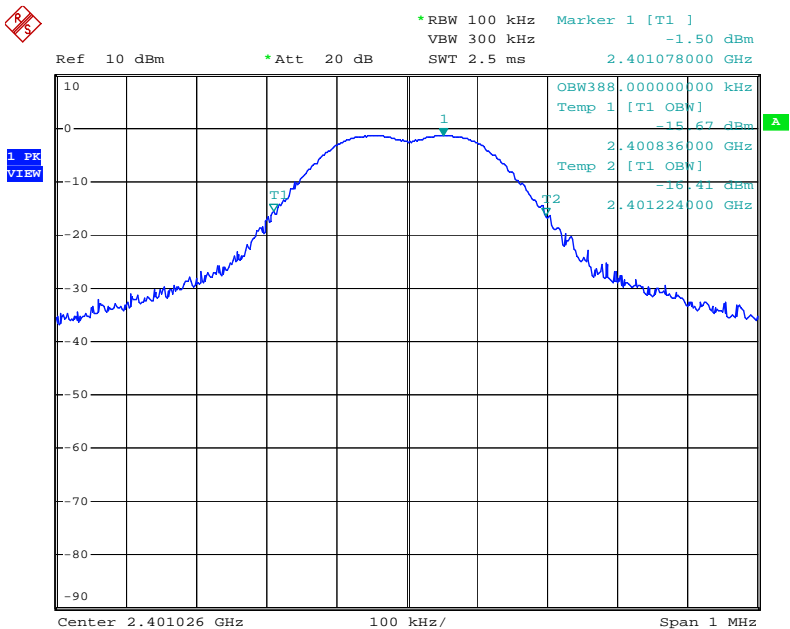
Temperature: 21 °C
Humidity: 43 %
Atmos. Press: 1015 hPa

Low (CH: 0) 2401.0 MHz

20dB Bandwidth

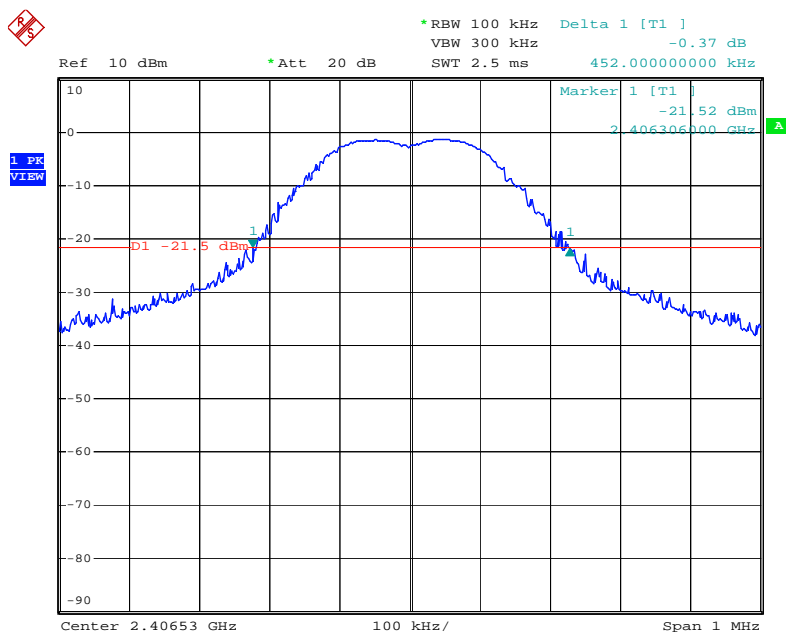


99% Bandwidth

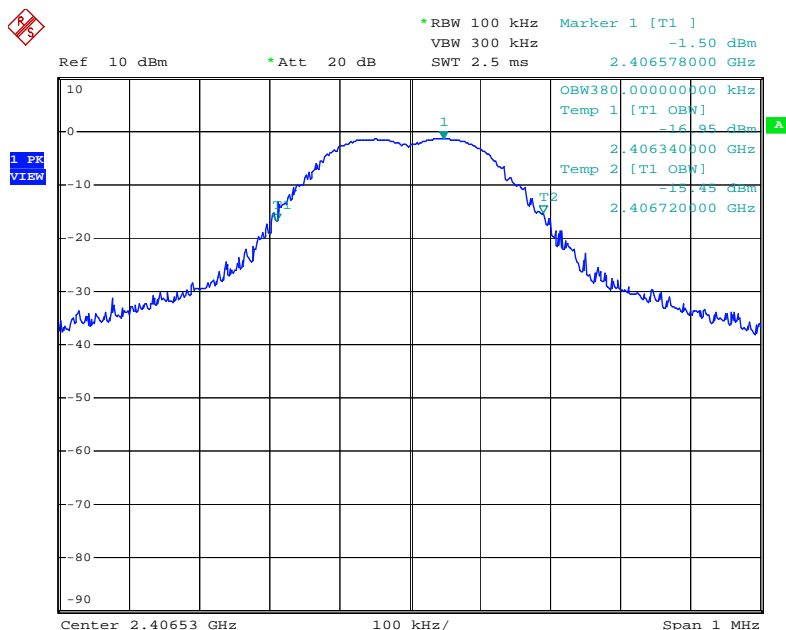


Middle (CH: 11) 2406.5 MHz

20dB Bandwidth

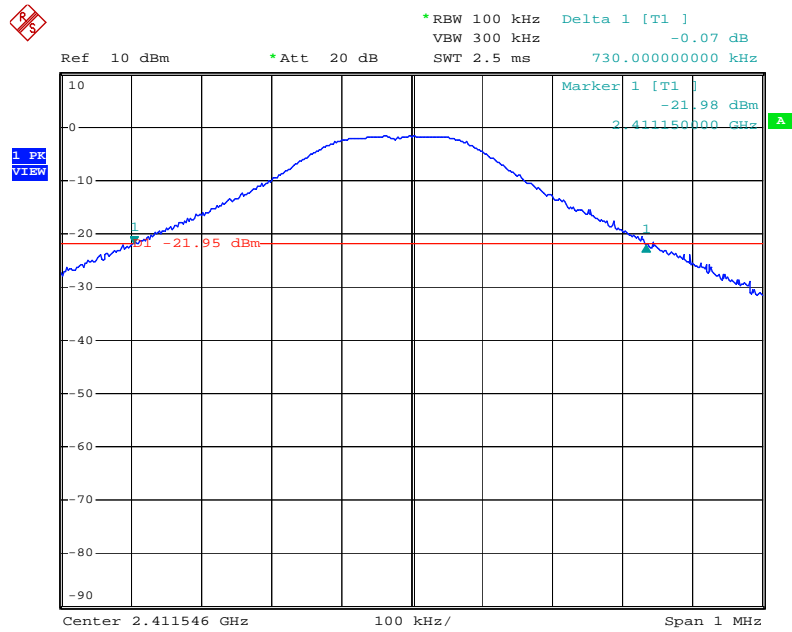


99% Bandwidth

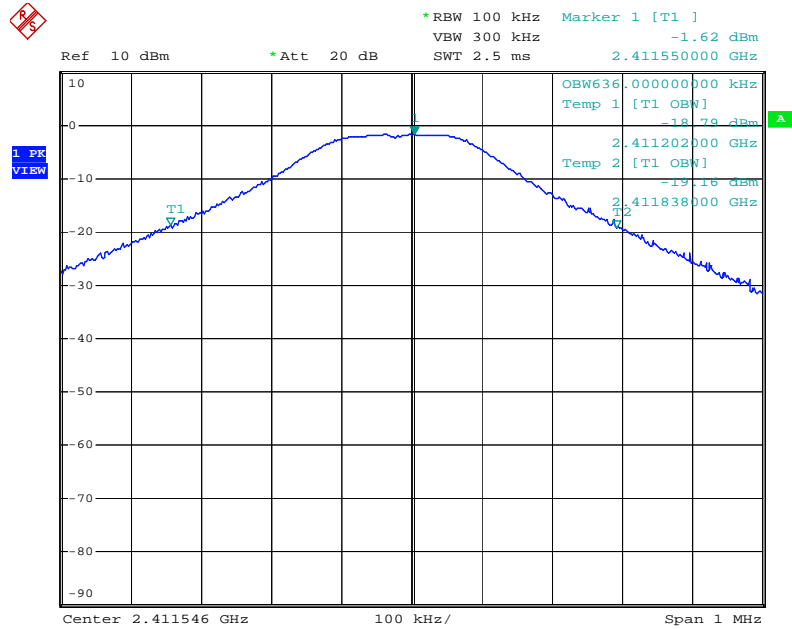


High (CH: 21) 2411.5 MHz

20dB Bandwidth



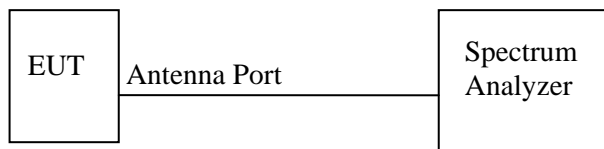
99% Bandwidth



2.2 Hopping Carrier Frequency Separation

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

The EUT antenna port connected to the spectrum analyzer. The RBW is set to 100 kHz. The VBW is set to appropriate in order to read carrier frequency separation. The sweep time is coupled appropriate.

Limitation

15.247(a)(1) frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. Therefore limitation value is grater than 486.7 kHz ($730 \text{ kHz} * 2 / 3$).

Test equipment used (refer to List of utilized test equipment)

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Test results – comply with the limitation.

The test was performed to the following three hopping group;

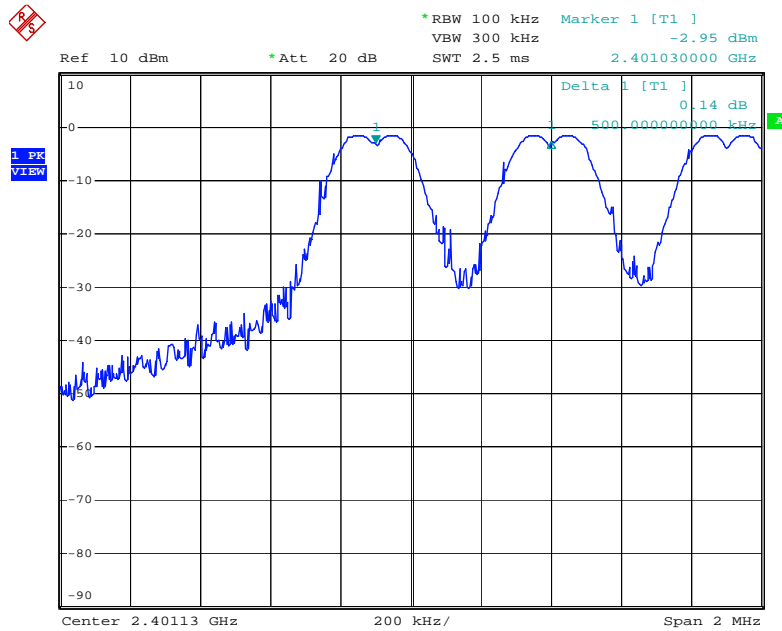
Hopping group	Measured Frequency (MHz)	Frequency Separation (kHz)
Group 0	2401.0	500
Group 11	2406.5	500
Group 21	2411.5	500

Test Data

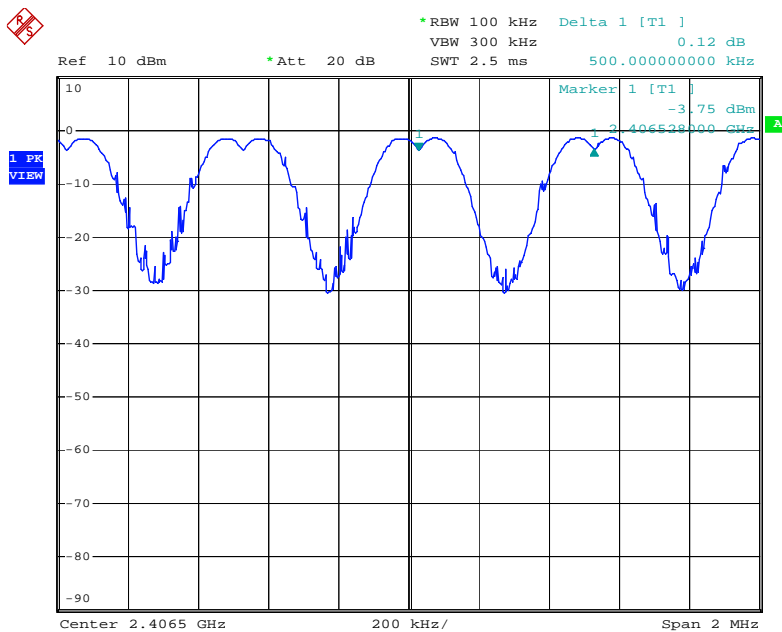
Tested Date: November 9, 2007

Temperature: 21 °C
Humidity: 43 %
Atmos. Press: 1015 hPa

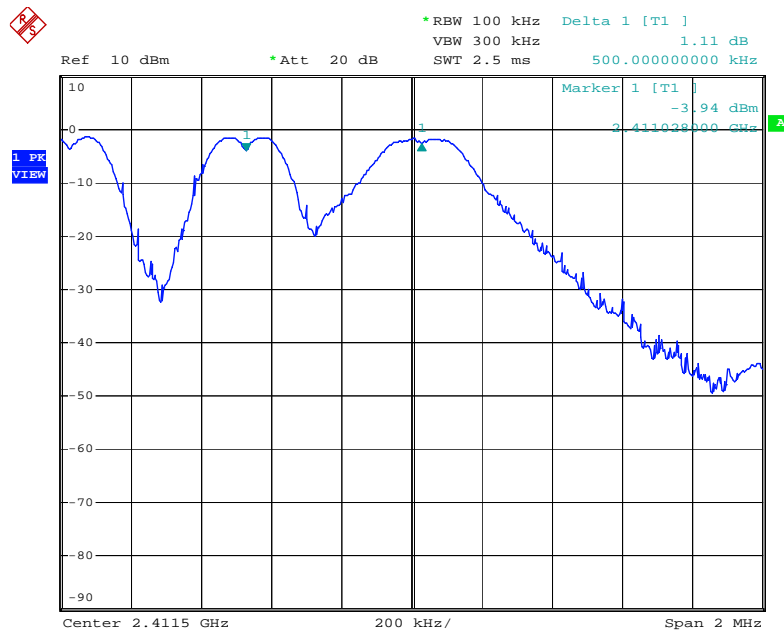
Hopping group 0 at 2401MHz



Hopping group 11 at 2406.5 MHz



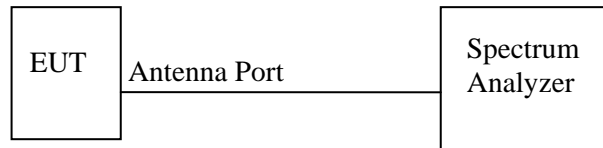
Hopping group 21 at 2411.5 MHz



2.3 Number of Hopping Channel

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

The EUT antenna port connected to the spectrum analyzer. The RBW is set to 100 kHz. The VBW is set to appropriate in order to read carrier frequency. The sweep time is coupled appropriate. The span is set to cover the authorized band. The analyzer is set to MAX HOLD. The EUT is hopping operation.

Limitation

15.247(a) (1) (iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

Test equipment used (refer to List of utilized test equipment)

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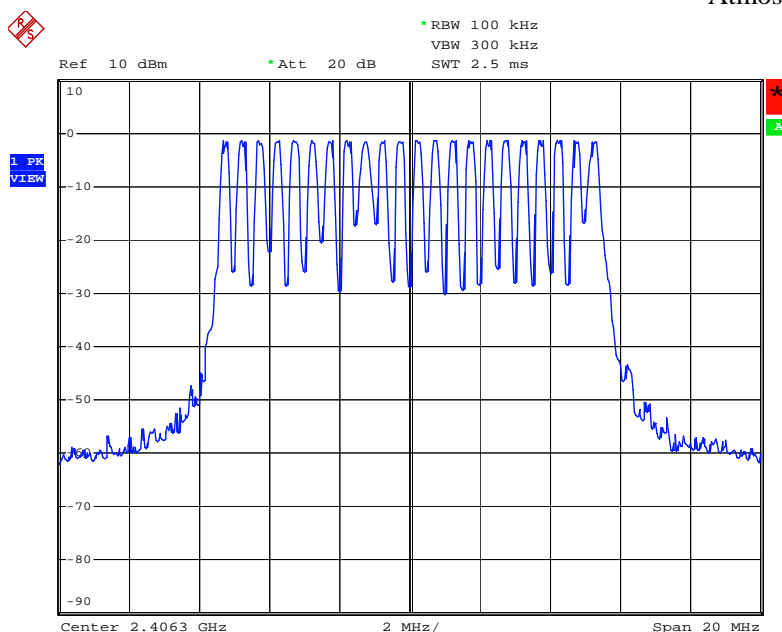
Test results – Comply with the limitation

Number of hopping channel: 22 channels

Test Data

Tested Date: November 9, 2007

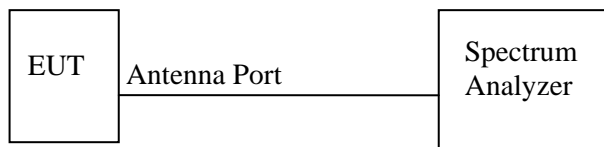
Temperature: 21 °C
Humidity: 43 %
Atmos. Press: 1015 hPa



2.4 Average Time of Occupancy

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

The EUT antenna port connected to the spectrum analyzer. The RBW is set to 1 MHz. The VBW is set to appropriate in order to read the plus duration. The sweep time is coupled appropriate. The span is set to 0 MHz and single sweep with video triggered. The EUT is hopping operation.

Limitation

15.247(a)(1)(iii) 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 measurement time is 8.8 seconds (22ch * 0.4 = 8.8 sec). The transmission pulse appears one pulse within 8.8 seconds; therefore pulse width is the average time of occupancy.

Test equipment used (refer to List of utilized test equipment)

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Test results – comply with the limitation.

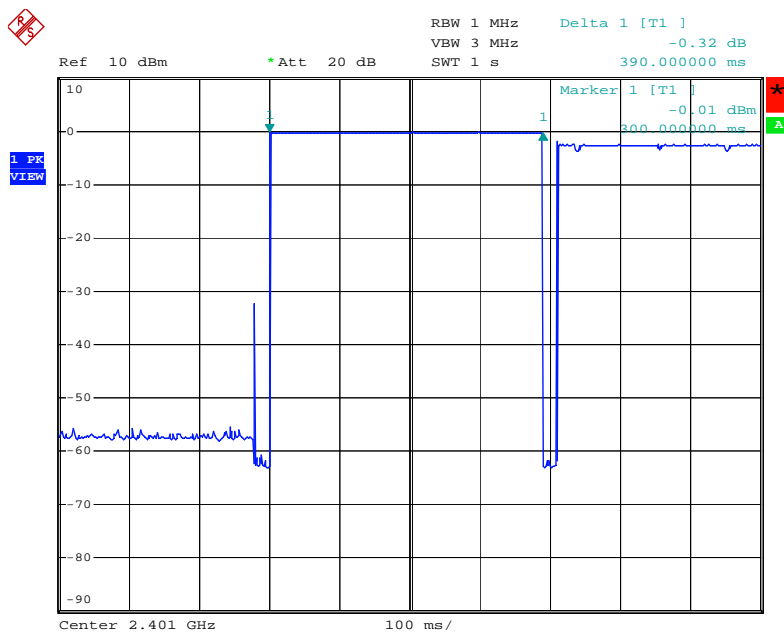
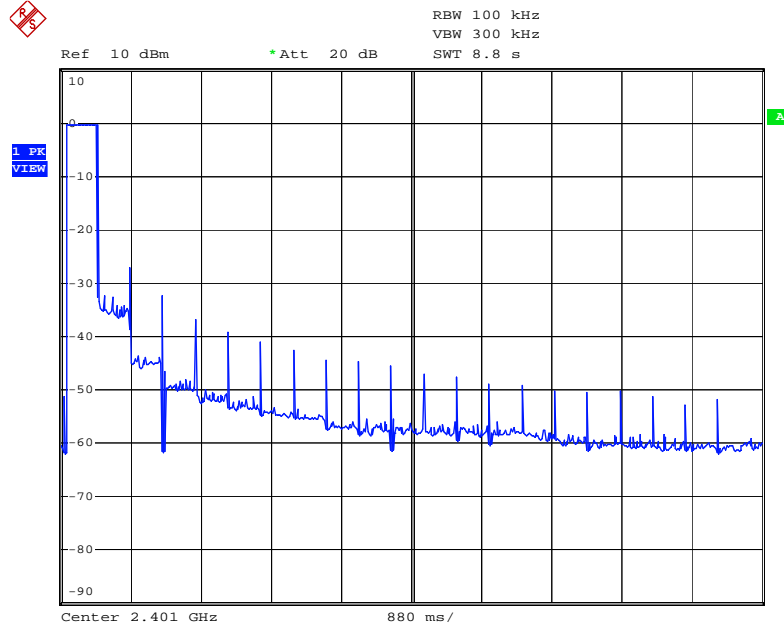
Measured Frequency (MHz)	Time of occupancy (msec)
2401.0	390.00
2406.5	390.00
2411.5	390.00

Test Data

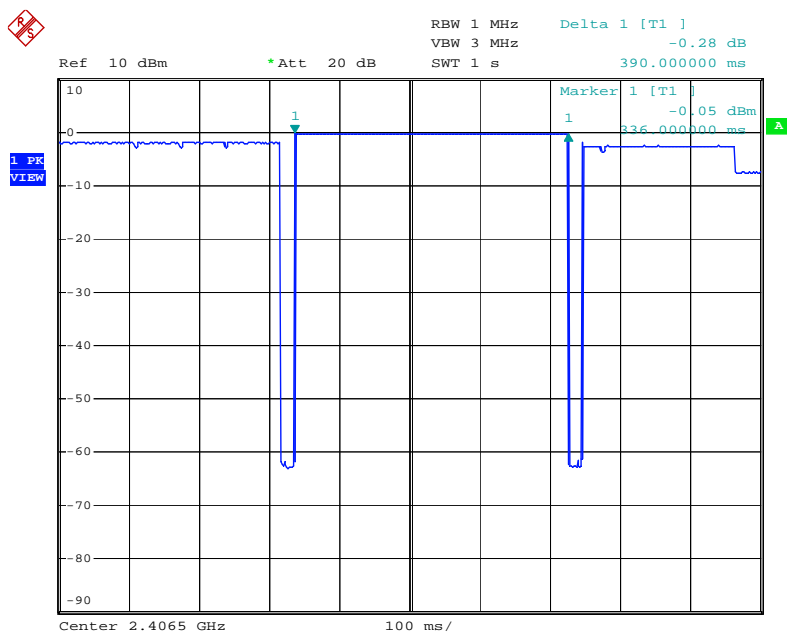
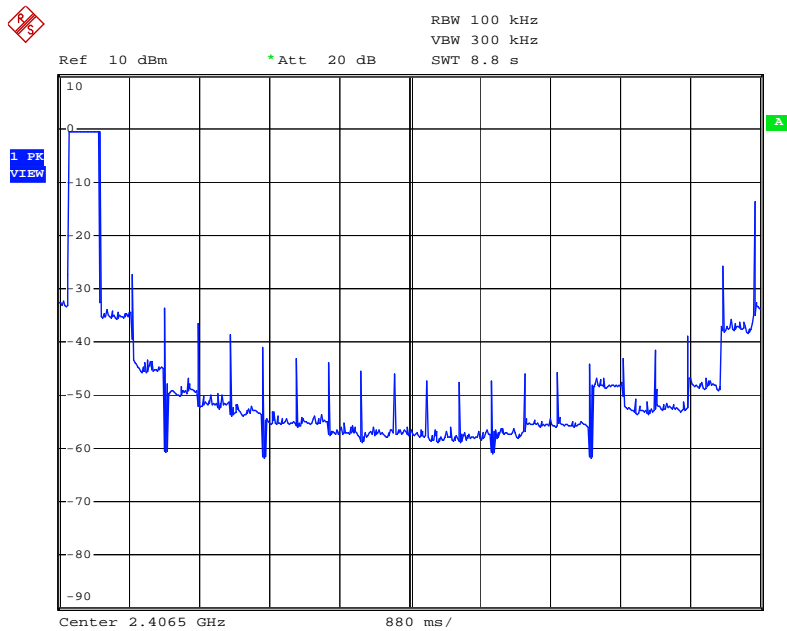
Tested Date: November 29, 2007

Temperature: 15 °C
Humidity: 31 %
Atmos. Press: 1012 hPa

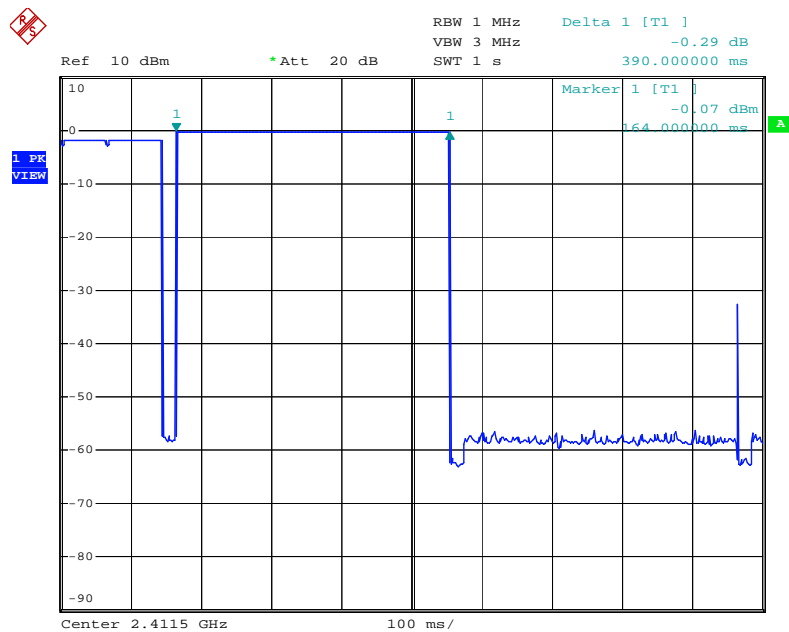
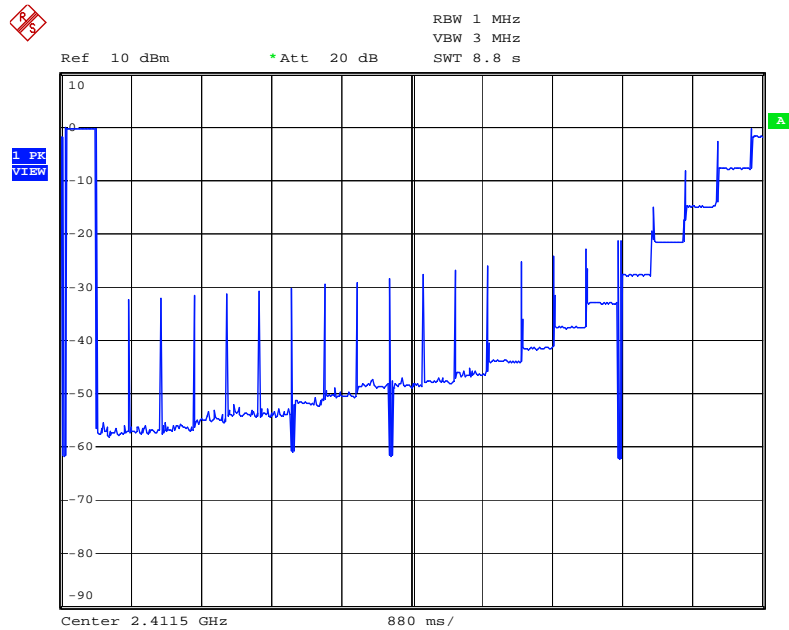
Low channel (2401MHz)



Middle channel (2406.5MHz)



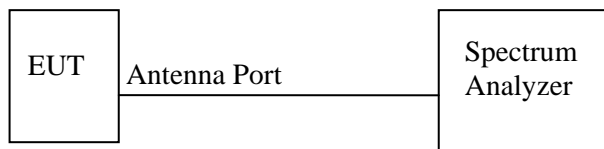
High channel (2411.5MHz)



2.5 Peak Output Power

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

The EUT antenna port connected to the spectrum analyzer. The RBW is set to the greater than 20dB bandwidth. The VBW is set to three times of RBW. The sweep time is coupled appropriate. The span is set to cover the carrier output spectrum. The analyzer is set to MAX HOLD. The EUT is set measured transmission channel under hopping off mode.

The correction factor is set to the spectrum analyzer in order to correct of the connected cable loss.

Limitation

15.247(a)(1) / (b)(1) Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW (21dBm).

Test equipment used (refer to List of utilized test equipment)

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Test results – comply with the limitation.

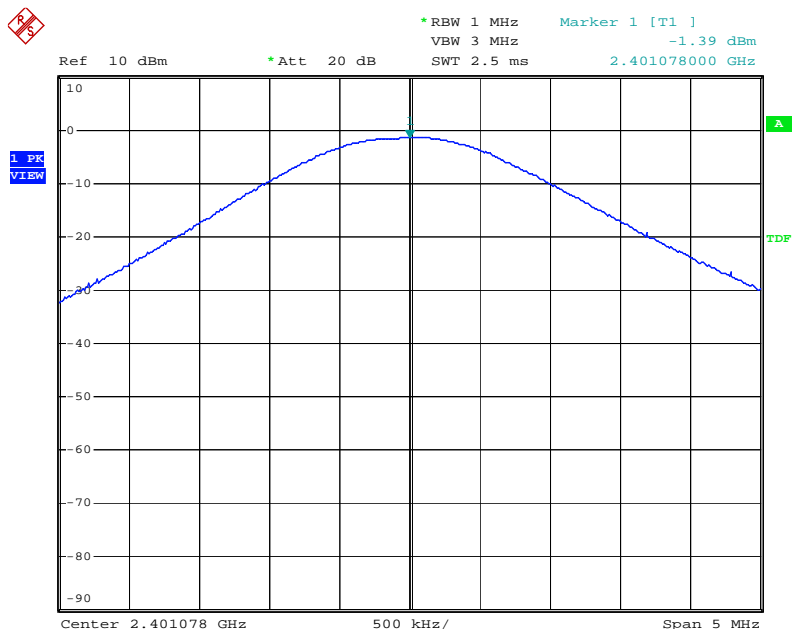
Transmission Channel	Transmission Frequency (MHz)	Output power (dBm)	Output power (mW)
Low (0ch)	2401.0	-1.39	0.726
Middle (11ch)	2406.5	-1.35	0.732
High (21ch)	2411.5	-1.41	0.723

Test Data

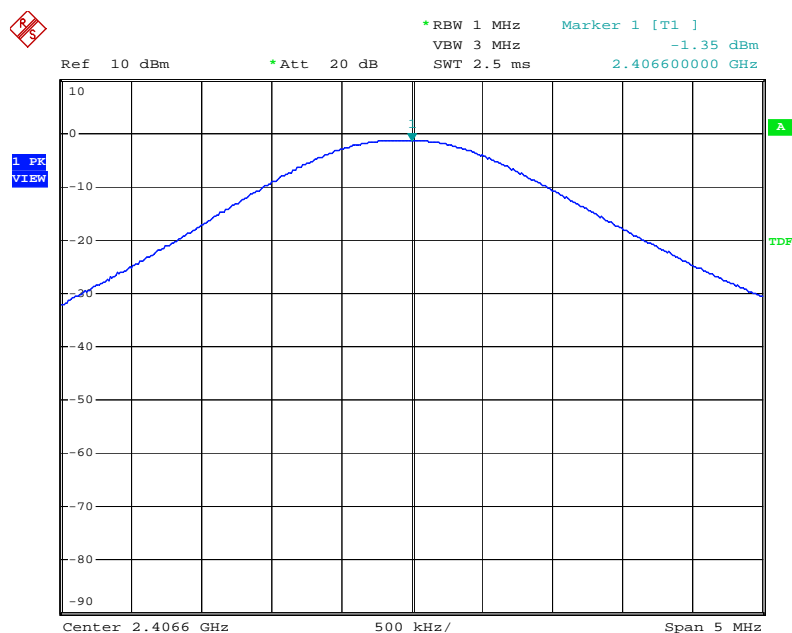
Tested Date: November 9, 2007

Temperature: 21 °C
Humidity: 43 %
Atmos. Press: 1015 hPa

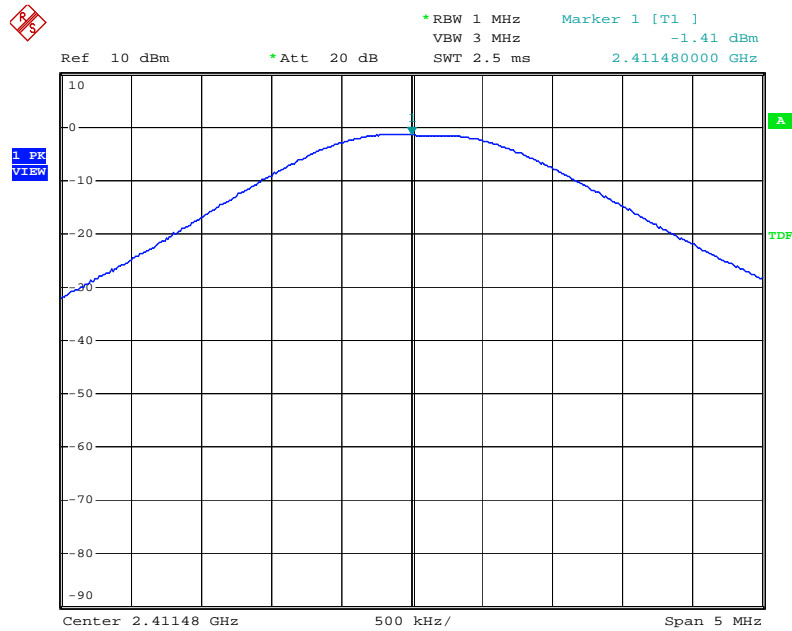
Low (CH: 0) 2401.0 MHz



Middle (CH: 11) 2406.5 MHz



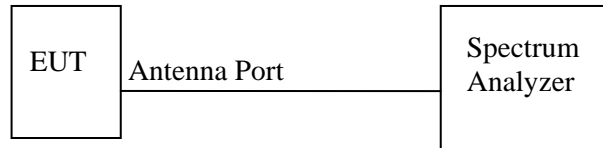
High (CH: 21) 2411.5 MHz



2.6 Conducted Spurious Emissions (Antenna Port)

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

The EUT antenna port connected to the spectrum analyzer. The RBW is set to 100 kHz. The VBW is set to 300 kHz. The sweep time is set to the coupled. The spectrum is checked from 30 MHz to 26 GHz. The EUT is set measured transmission channel under hopping off mode.

Limitation

15.247(d) 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.

Test equipment used (refer to List of utilized test equipment)

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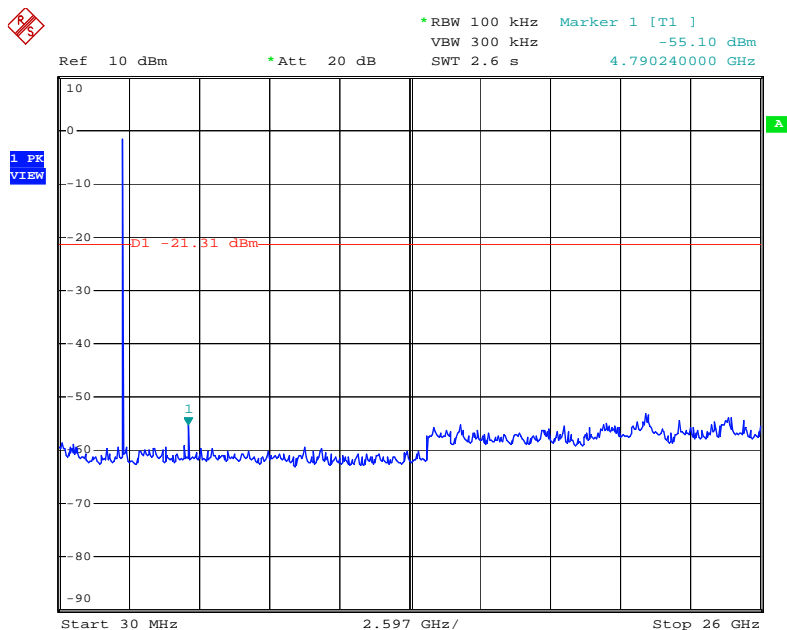
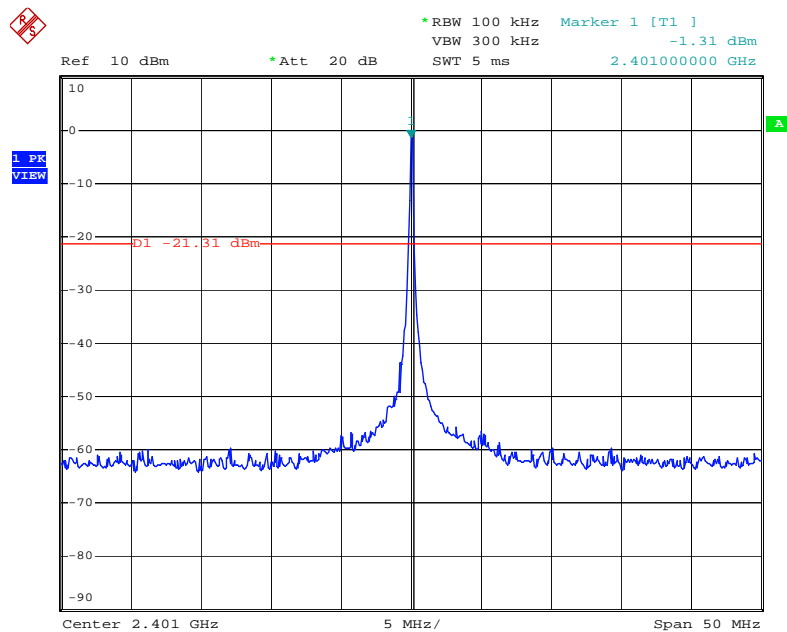
Test results – comply with the limitation.

Test Data

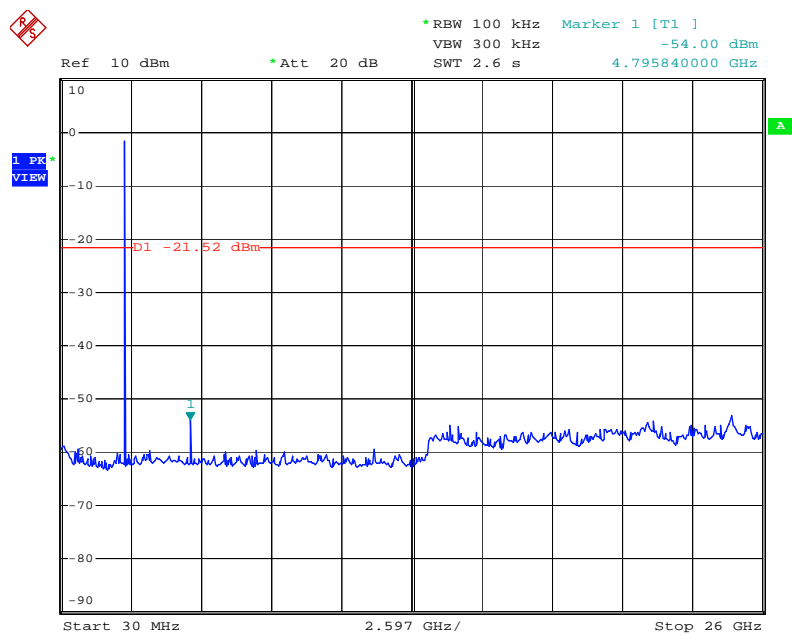
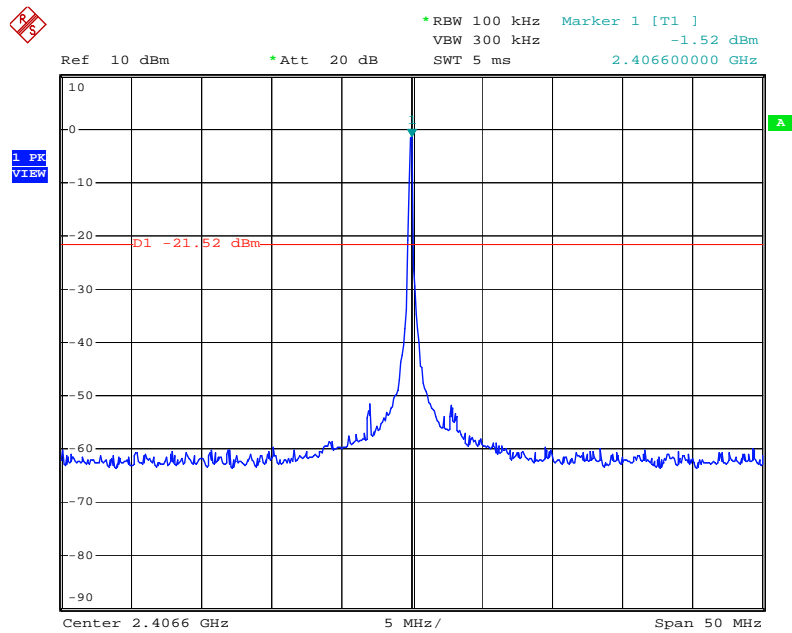
Tested Date: November 9 2007

Temperature: 21 °C
Humidity: 43 %
Atmos. Press: 1015 hPa

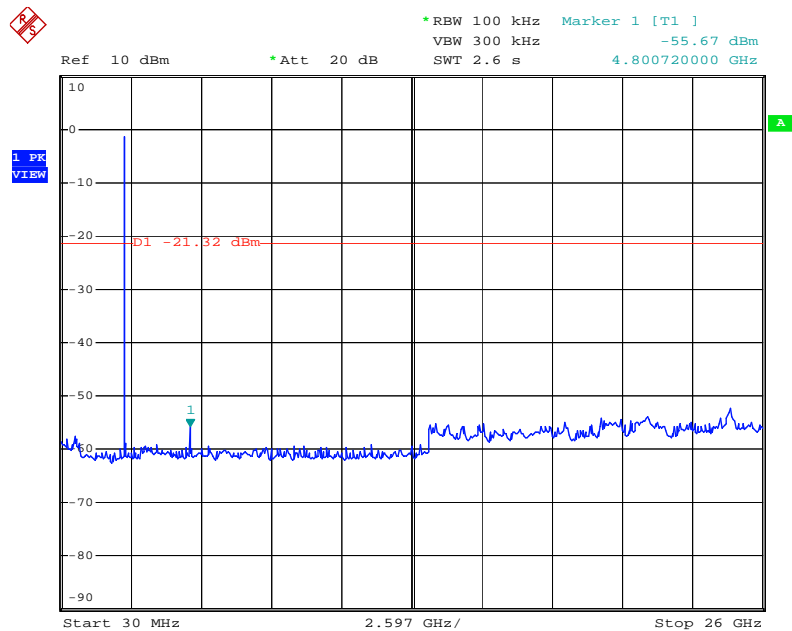
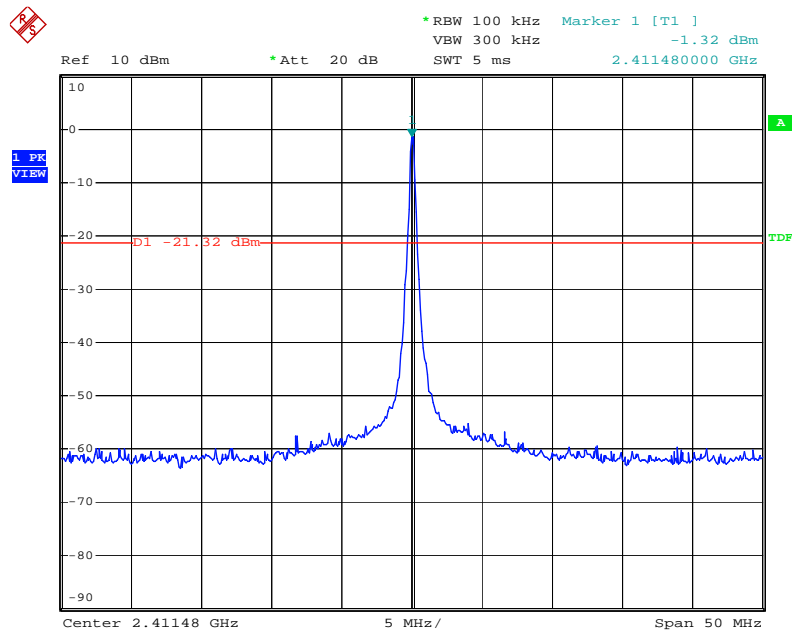
Low (CH: 0) 2401.0 MHz



Middle (CH: 11) 2406.5 MHz



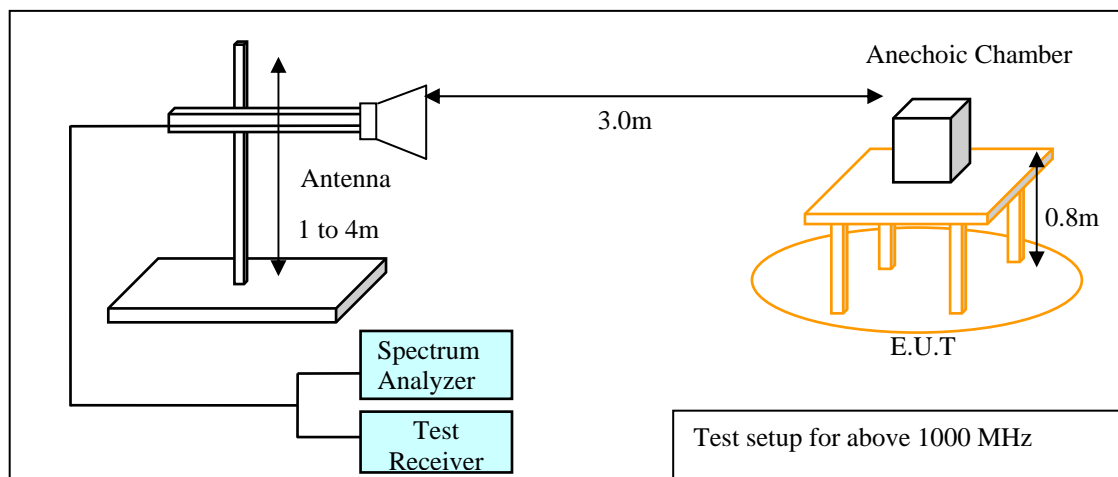
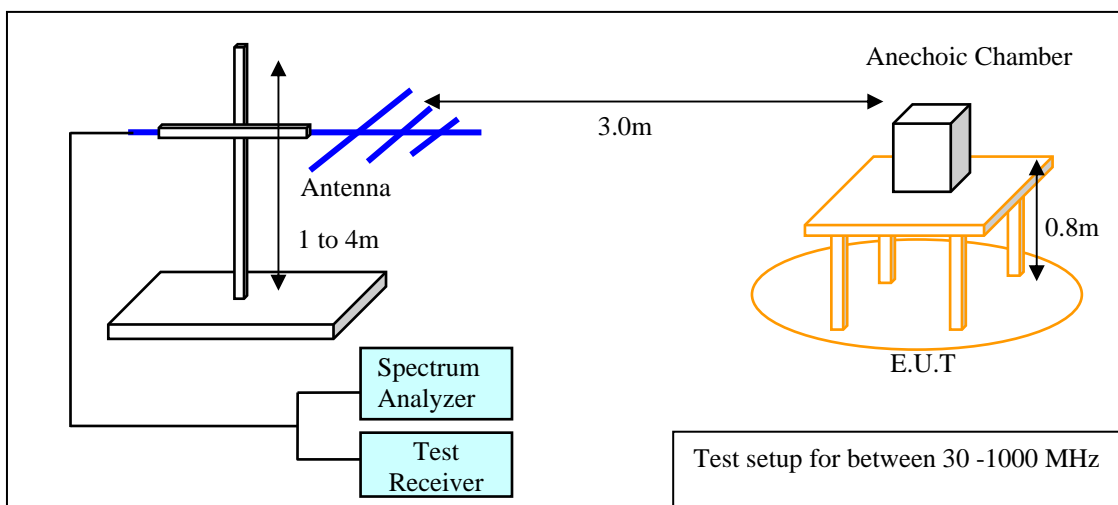
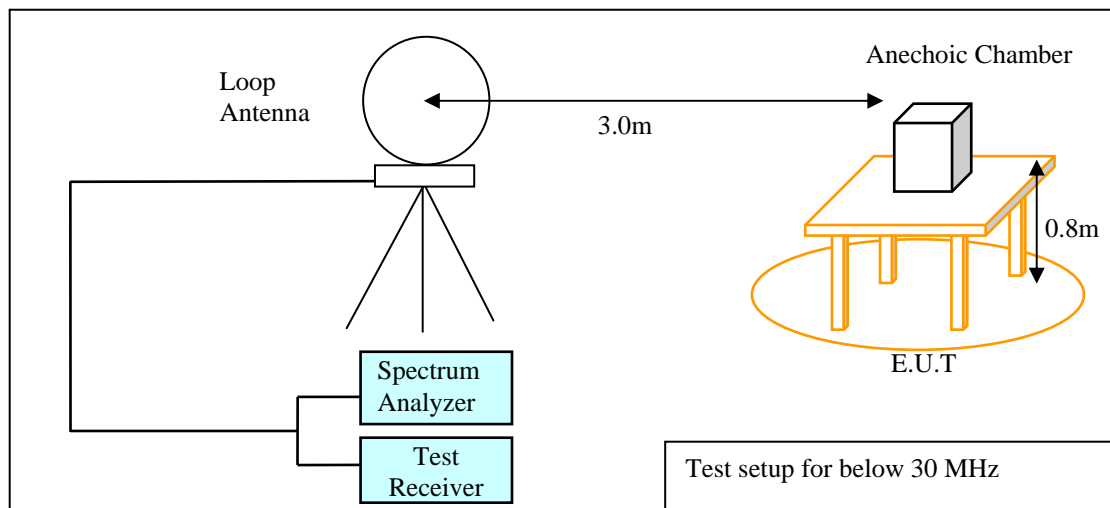
High (CH: 21) 2411.5 MHz



2.7 Transmitter Radiated spurious emissions

Test setup

Test setup was implemented according to the method of ANSI C63.4: 2003 clause 6 “General requirements for EUT equipment arrangements and operation”, clause 8.2 and Annex H.3 “Radiated emission measurements setup”.



Test procedure

Measurement procedures were implemented according to the method of ANSI C63.4: 2003 clauses 8.2.

The EUT is placed on a non-conducted table which is 0.8m height from a ground plane and the measurement antenna to EUT distance is 3 meters. The turn table is rotated for 360 degrees to determine the maximum emission level.

In the frequency range of 9 kHz to 30 MHz, a calibrated loop antenna was positioned with its plane vertical at the distance 3m from the EUT with an extrapolation of corrected distance factor and rotated about its vertical axis for maximum response at each azimuth about the EUT. For certain applications, the loop antenna also needs to be positioned horizontally. The center of the loop shall be 1 m above the ground.

In the frequency above 30 MHz, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

EUT is placed at three different orientations (X, Y and Z axis) in order to find the worst orientation.

The spectrum analyzer and receiver is set to the followings;

- Below 30 MHz: RBW=10 kHz, VBW= 30 kHz
Final measurement is carried out receiver RBW=9 kHz QP
- Between 30 - 1000 MHz: RBW=100 kHz, VBW= 300 kHz
Final measurement is carried out receiver RBW=120 kHz QP
- Above 1000 MHz: Peak measurement- RBW=1 MHz, VBW= 1 MHz
Average measurement – RBW=1 MHz, VBW=10 Hz

Applicable rule and limitation

§15.205 restricted bands of operation

Except as shown in paragraph 15.205 (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
0.490 - 0.510	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	(1)

15.205(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.

15.209(a) 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

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F (kHz)	300
0.490 - 1.705	24000/F (kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

In the emission table above, the tighter limit applies at the band edges.

The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission.

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz.

Radiated emission limits in the above bands are based on measurements employing an average detector.

Test results - Complied with requirement.

Test Data

2.7.1 Below 30 MHz

Test equipment used (refer to List of utilized test equipment)

AC01	LP01	CL11	SA06	TR04
------	------	------	------	------

Tested Date: November 5 2007

Temperature: 23 °C

Humidity: 52 %

Atmos. Press: 1030 hPa

Result

There is no spurious emissions grater than noise floor.

Note: The lowest oscillator in the EUT is 20 MHz, therefore the spectrum was checked from the 20 MHz to 30 MHz. The noise floor is about 30dBuV/m at 3 meters (-10dBuV/m at 30 meters).

2.7.2 Between 30 – 1000 MHz**Test equipment used (refer to List of utilized test equipment)**

AC01	BA03	CL11	PR03	SA06	TR04
------	------	------	------	------	------

Tested Date: November 12 2007

Temperature: 23 °C
Humidity: 52 %
Atmos. Press: 1030 hPa

No.	Frequency [MHz]	Reading [dBuV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Antenna Polarization
1	50.878	46.2	8.3	4.4	29.8	29.1	40	10.9	Vert.
2	74.295	38.6	6.6	4.8	29.8	20.2	40	19.8	Vert.
3	111.847	32.8	11.5	5.3	29.8	19.8	43.5	23.7	Vert.

Calculation method

The Correction Factors and RESULT are calculated as followings.

$$\text{Correction Factor [dB]} = \text{FACTOR [dB/m]} + \text{LOSS [dB]} - \text{GAIN [dB]}$$

$$\text{RESULT [dBuV/m]} = \text{READING [dBuV]} + \text{Correction Factor [dB]}$$

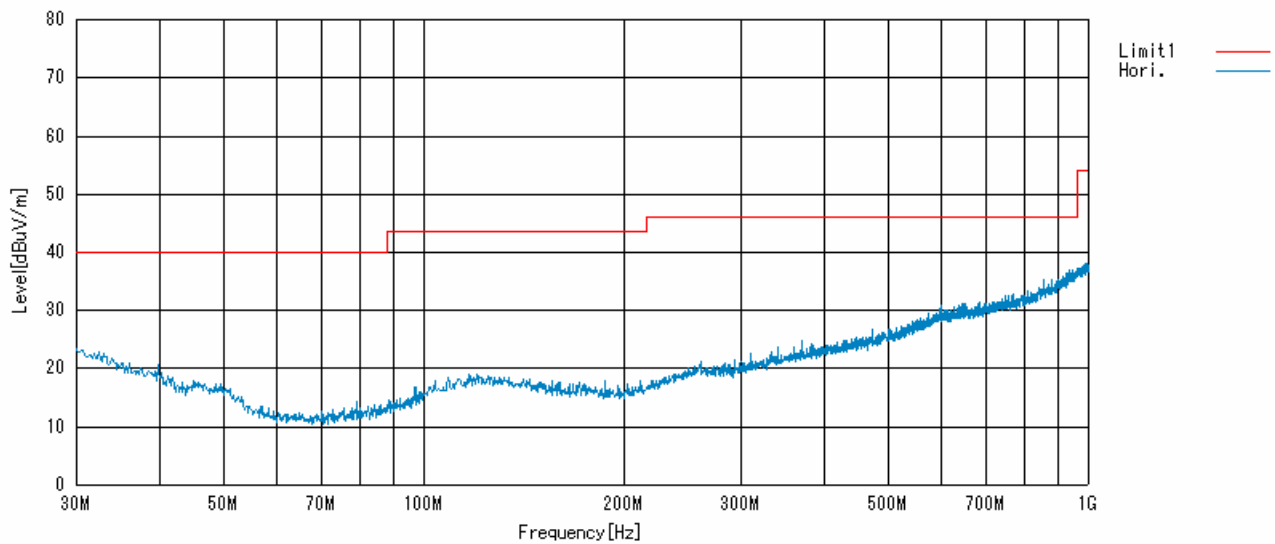
Sample calculation at 50.878 MHz vertical result as follow:

$$\text{Result [dBuV/m]} = \text{Reading} + \text{C.F} = 46.2 + 8.3 + 4.4 - 29.8 = 29.1$$

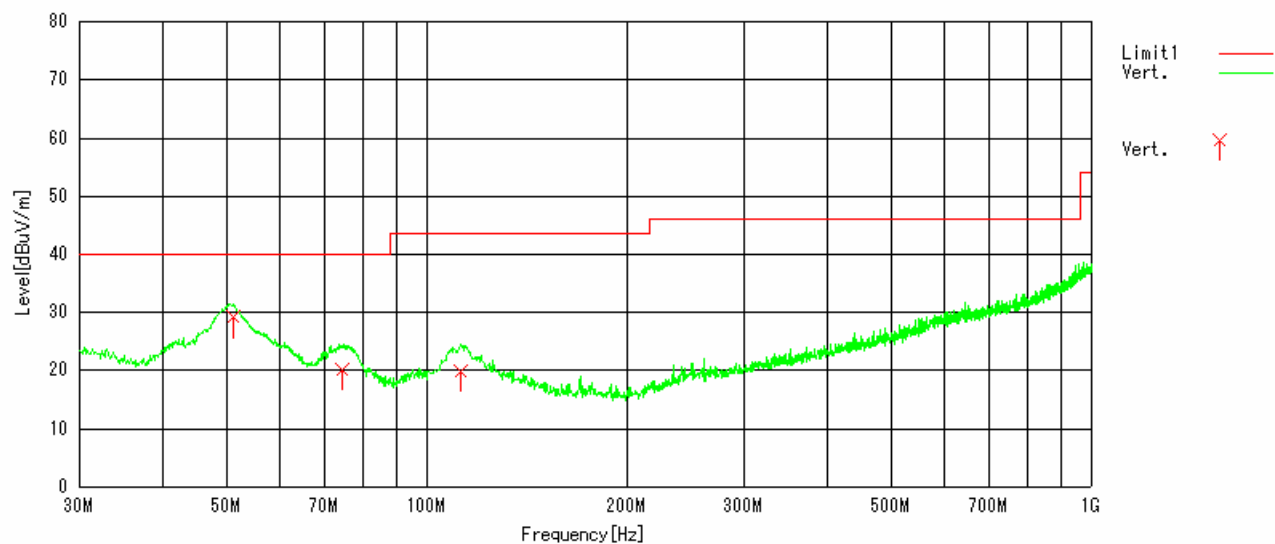
$$\text{Margin} = \text{Limit} - \text{Result} = 40.0 - 29.1 = 10.9 \text{ [dB]}$$

Graphical express of test result (30MHz-1000MHz)

Antenna polarization: **Horizontal**



Antenna polarization: **Vertical**



2.7.3 Above 1000 MHz

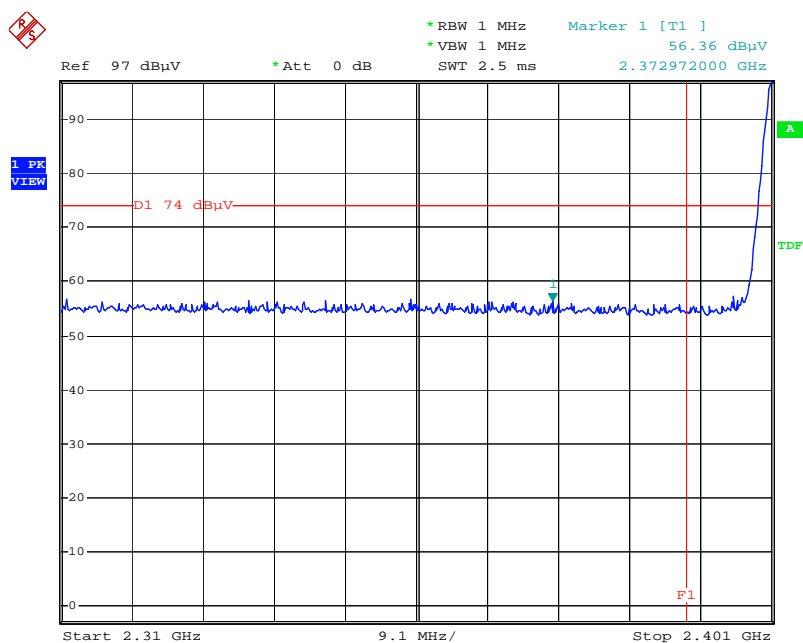
Test equipment used (refer to List of utilized test equipment)

AC01	HPF1	PR04	SH01	SA06	CL21	CL22	DH01
------	------	------	------	------	------	------	------

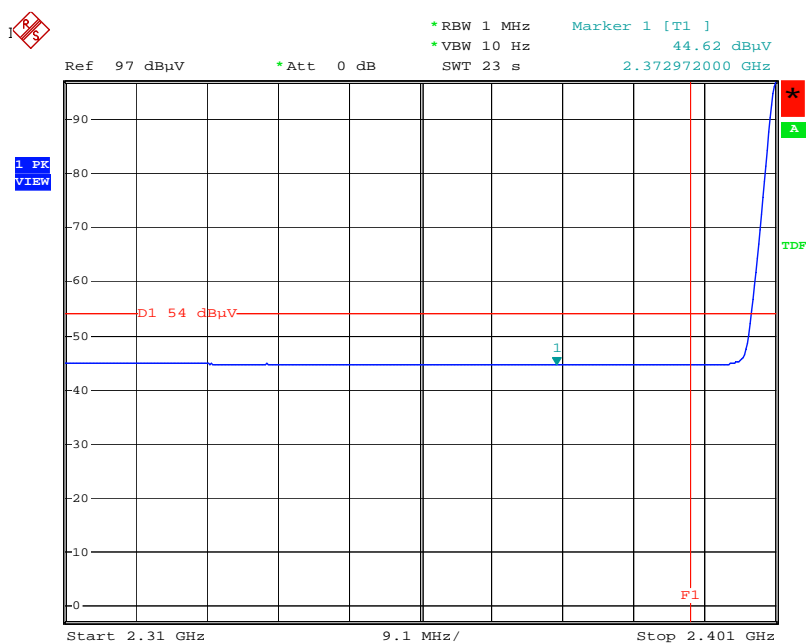
Tested Date: November 5 2007

Temperature: 23 °C
Humidity: 52 %
Atmos. Press: 1030 h

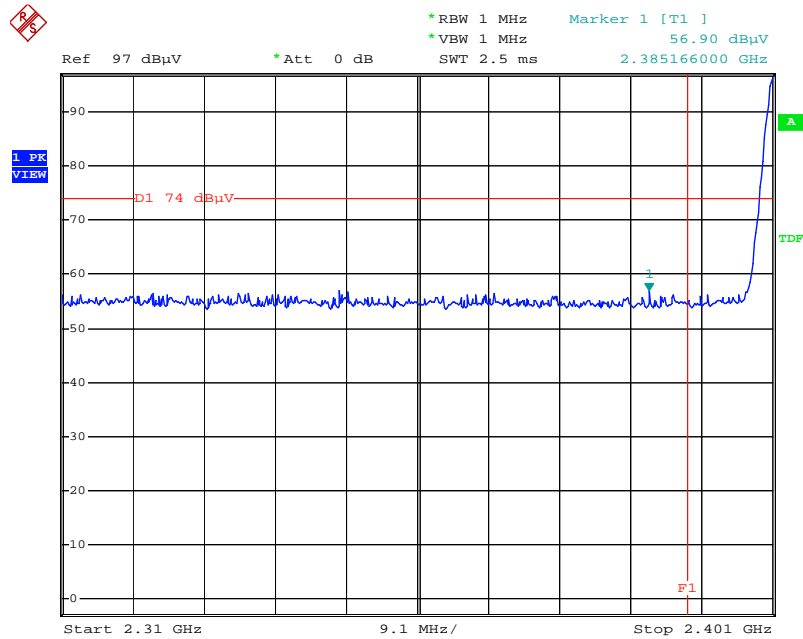
Restricted Band Edge (Low channel, Horizontal, Peak)



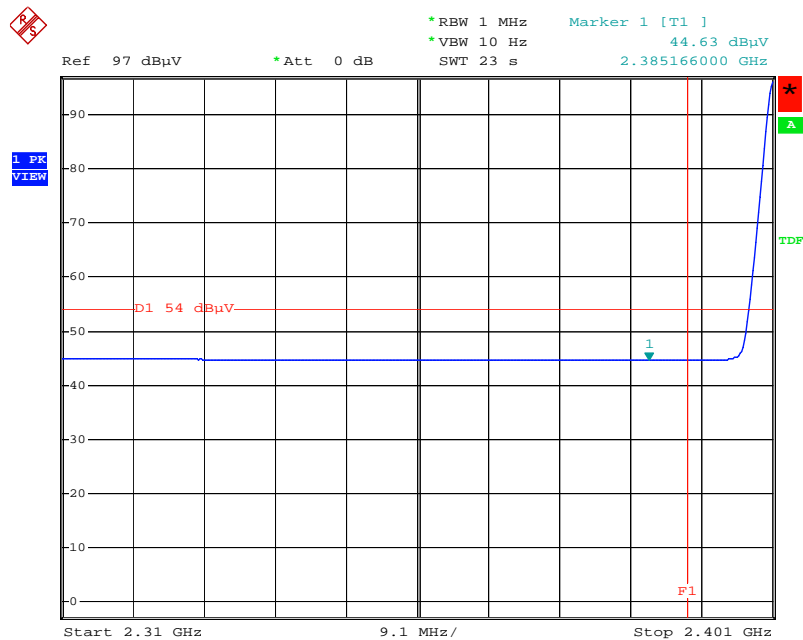
Restricted Band Edge (Low channel, Horizontal, Average)



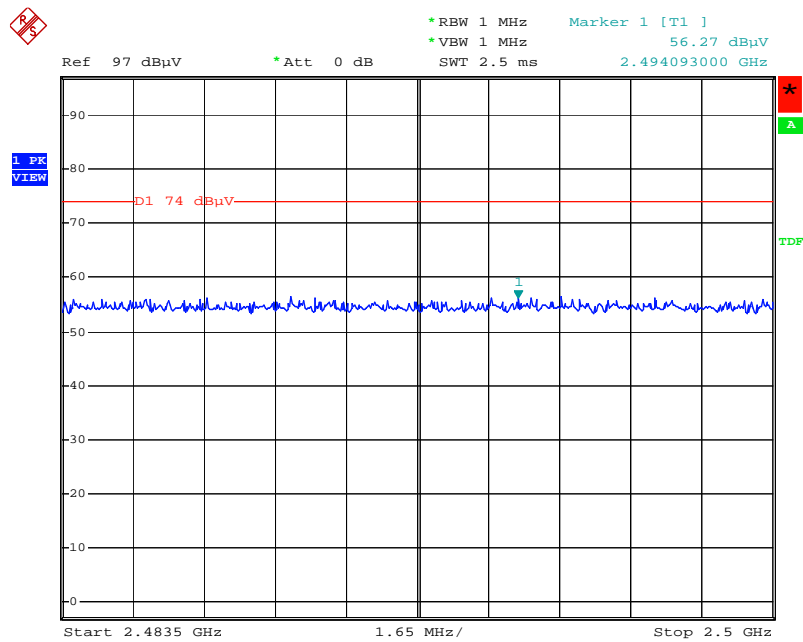
Restricted Band Edge (Low channel, Vertical, Peak)



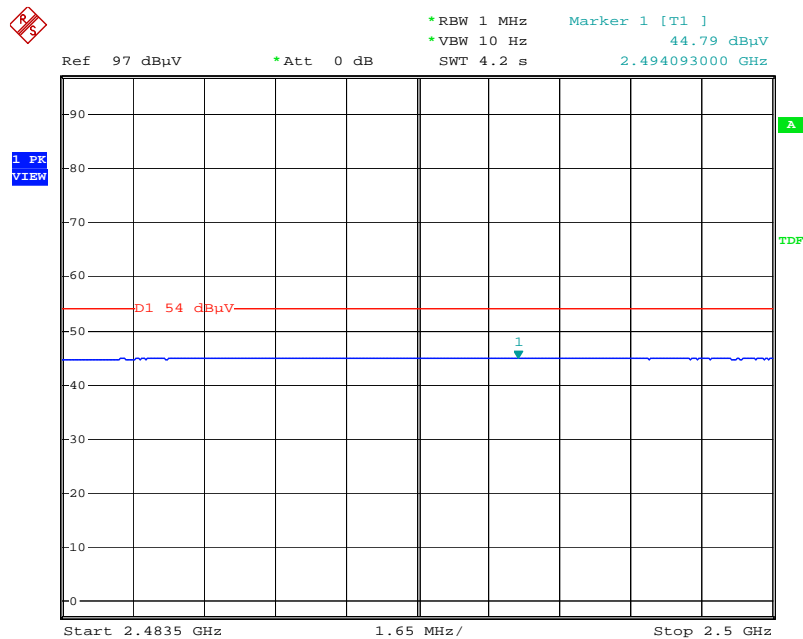
Restricted Band Edge (Low channel, Vertical, Average)



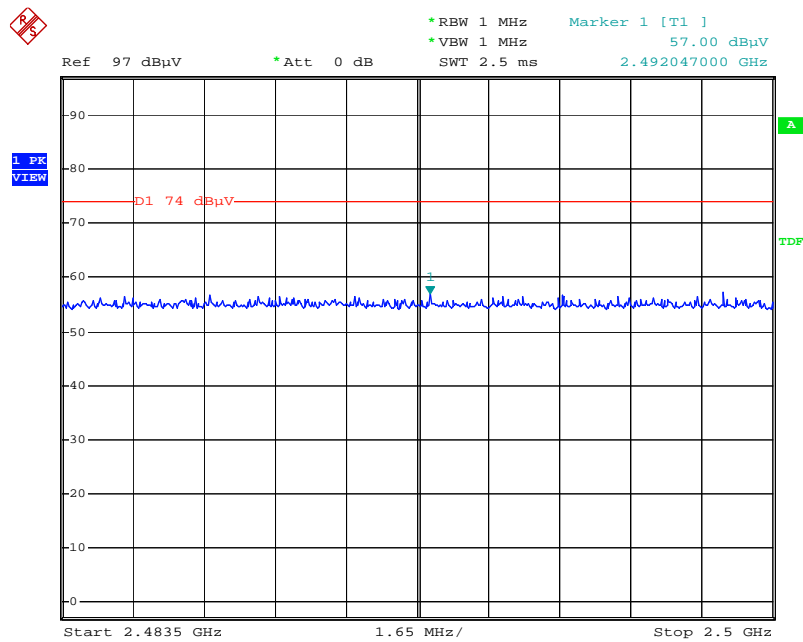
Restricted Band Edge (High channel, Horizontal, Peak)



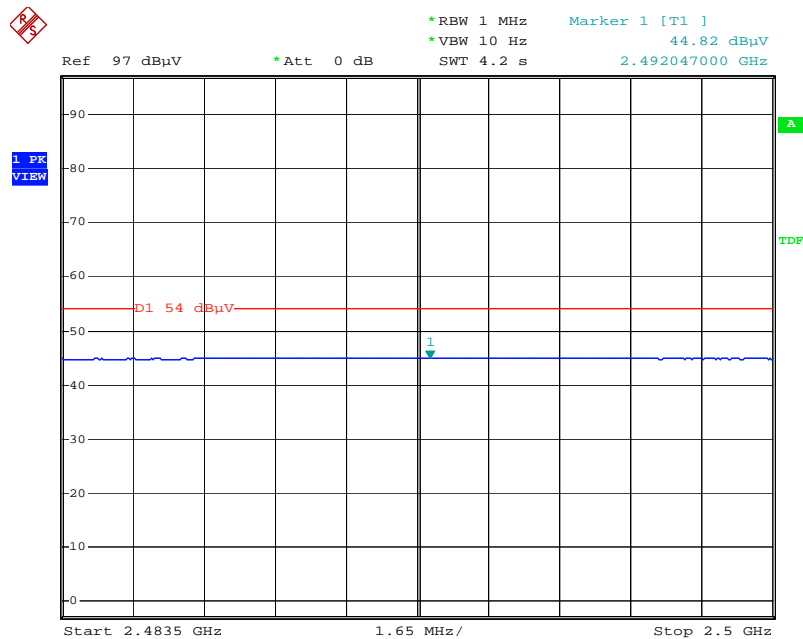
Restricted Band Edge (High channel, Horizontal, Average)



Restricted Band Edge (High channel, Vertical, Peak)



Restricted Band Edge (High channel, Vertical, Average)



Harmonics and Spurious Emission above 1000 MHz

TX CH (MHz)	Freq. (MHz)	Factor (dB)	Meter Reading (dBuV)				Limit (dBuV)		Result (dBuV/m)		Margin (dB)	
			Ave.		Peak							
			Hori.	Vert.	Hori.	Vert.	Ave.	Peak.	Ave.	Peak.	Ave.	Peak
0ch 2401.0 (Low)	4802	6.7	32.54	30.45	42.9	43.22	54.0	74.0	39.24	49.92	14.76	24.08
	7203	10.8	-	-	42.27	44.26		77.1		55.06		22.07
	9604	14.6	-	-	40.86	41.05		77.1		55.65		21.45
	12005	16.8	<27.5	<27.5	<41.7	<41.7	54.0	74.0	<44.3	<58.5	>9.7	>15.5
11ch 2406.5 (Mid)	4813	6.7	36.76	33.49	43.8	42.11	54.0	74.0	43.46	50.5	10.54	23.50
	7219.5	10.8	-	-	41.59	42.1		77.2		52.9		24.30
	9626	14.6	-	-	37.58	39.15		77.2		53.75		23.45
	12032.5	16.8	<27.5	<27.5	<41.7	<41.7	54.0	74.0	<44.3	<58.5	>9.7	>15.5
22ch 2411.5 (High)	4823	6.7	33.53	32.15	43.55	41.86	54.0	74.0	40.23	50.25	13.77	23.75
	7234.5	10.8	-	-	40.63	42.81		76.1		53.61		22.49
	9646	14.6	-	-	39.79	38.77		76.1		53.37		22.73
	12057.5	16.8	<27.5	<27.5	<41.7	<41.7	54.0	74.0	<44.3	<58.5	>9.7	>15.5

Note1: This frequency is in the restriction band therefore it is applied the 15.209 Radiated emission limits, general requirements.

Note2: This frequency is not in the restriction band therefore this spurious emission 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 (15.247 (d)).

The radiated carrier level of each frequency is follows (RBW = 100 kHz);

- < 97.1 dBuV/m at 2401 MHz
- < 97.2 dBuV/m at 2406.5 MHz
- < 96.1 dBuV/m at 2411.5 MHz

Calculation method

The RESULT is calculated as followings.

$$\text{Factor [dB]} = \text{Antenna Factor [dB/m]} + \text{Cable Loss [dB]} - \text{Amp gain [dB]}$$

$$\text{RESULT [dBuV/m]} = \text{READING [dBuV]} + \text{Factor [dB]}$$

Sample calculation at 4802 MHz result on the Ave. as follow:

$$\text{Result [dBuV/m]} = \text{Reading} + \text{Factor} = 32.54 + 6.7 = 39.24$$

$$\text{Margin} = \text{Limit} - \text{Result} = 54.0 - 39.24 = 14.76 \text{ [dB]}$$

2.8 Transmitter AC power line conducted emissions

Test setup

Test setup was implemented according to the method of ANSI C63.4: 2003 clause 6 “General requirements for EUT equipment arrangements and operation” and Annex H.1 “AC power line conducted emission measurements setup”.

Test procedure

Measurement procedures were implemented according to the method of ANSI C63.4: 2003 clauses 7, clause 13.1.3 and Annex H.2 “AC power line conducted emission measurements”.

Exploratory measurements were used the spectrum analyzer to identify the frequency of the emission that has the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable positions, and with a typical system equipment configuration and arrangement.

Final ac power line conducted emission measurements were performed based on the exploratory tests.

The EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit are selected for the final measurement.

When the measurement value is greater than average limitation the average detection measurements were performed.

Applicable rule and limitation

§15.207 (a) AC power line conducted limits

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.

The lower limit applies at the band edges.

Test equipment used (refer to List of utilized test equipment)

TR04	PL01	LN05 for EUT	SA06	CL11
------	------	--------------	------	------

Test results - Complied with requirement.

Test Data

Tested Date: November 7 2007

Temperature: 21 °C
Humidity: 50 %
Atmos. Press: 1014hPa

Continuous Transmission (Worst case configuration)

No	Frequency [MHz]	Reading		C.F. [dB]	Result		Limit		Margin		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]	
1	0.181	29.1	23.8	0.2	29.3	24.0	64.4	54.4	35.1	30.4	N
2	0.181	29.6	23.0	0.2	29.8	23.2	64.4	54.4	34.6	31.2	N
3	0.503	37.7	27.1	0.1	37.8	27.2	56.0	46.0	18.2	18.8	L
4	0.506	39.2	29.8	0.1	39.3	29.9	56.0	46.0	16.7	16.1	N
5	2.500	15.2	9.6	0.3	15.5	9.9	56.0	46.0	40.5	36.1	L
6	2.515	18.9	12.8	0.3	19.2	13.1	56.0	46.0	36.8	32.9	N

The power line conducted emission voltage is calculated by adding the LISN factor and Cable loss attenuation from the measured reading. The calculation is as follows:

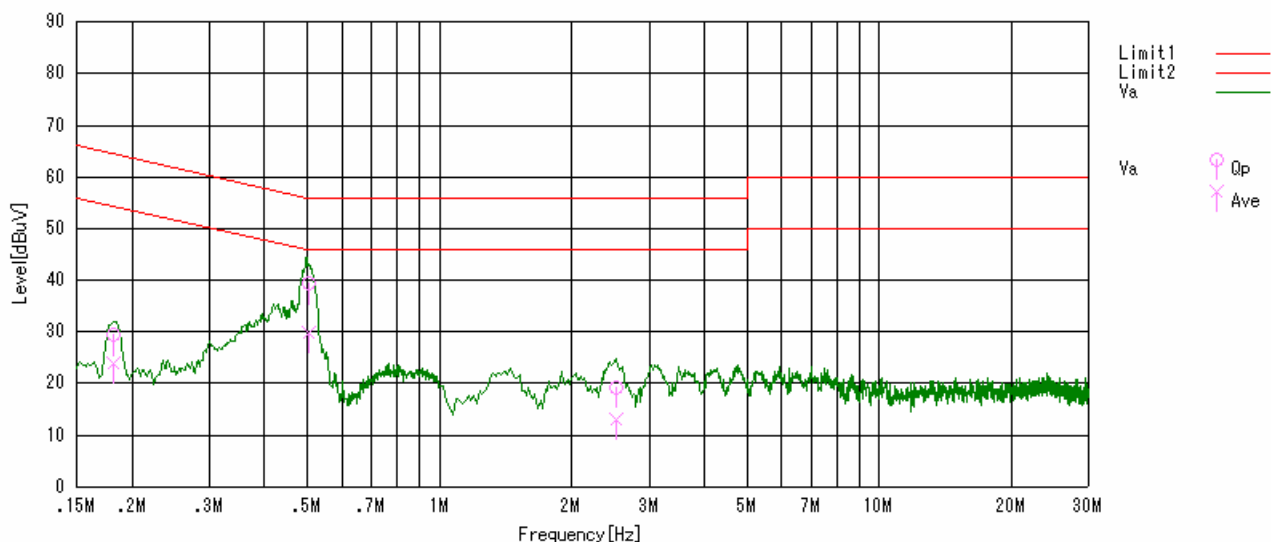
Result = Reading + C. F
where C.F = LISN Factor + Cable Loss [dB]

Sample calculation at 0.506 MHz Ave. result as follow:

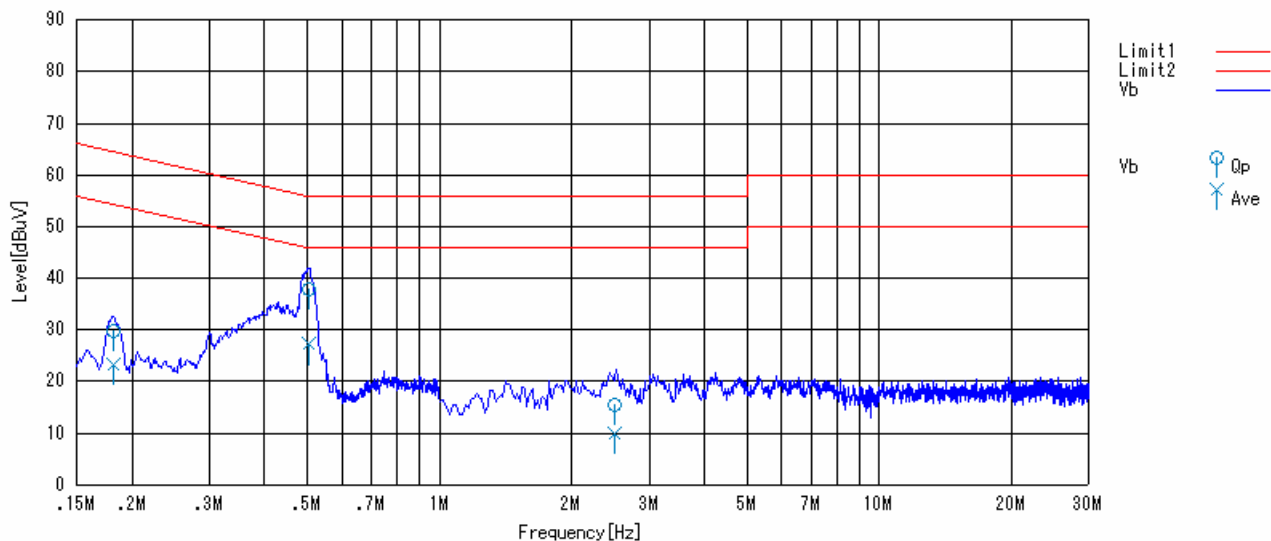
Result [dBuV] = Reading + C.F = 29.8 + 0.1 = 29.9 [dBuV]
Margin = Limit – Result = 46.0 – 29.9 = 16.1 [dBuV]

Graphical express of test result (0.15 MHz-30MHz)

AC Power line conducted emission. (Phase N)



AC Power line conducted emission. (Phase L)



2.9 Receiver Radiated spurious emissions

Test setup - Same as clause 2.7

Test procedure - Same as clause 2.7

Applicable rule and limitation at 3m

§15.109 radiated emission limitation

Frequency (MHz)	Measurement Distance (m)	Field Strength (uV/m)	Field Strength (dBuV/m)
30 – 88	3	100	40.0
88 – 216	3	150	43.5
216 – 960	3	200	46.0
Above 960	3	500	54.0

In the emission table above, the tighter limit applies at the band edges.

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector.

Test results - Complied with requirement.

2.9.1 Between 30 – 1000 MHz

Test equipment used (refer to List of utilized test equipment)

AC01	BA03	CL11	PR03	SA06	TR04
------	------	------	------	------	------

Test Data

Tested Date: November 2 2007

Temperature: 23 °C
Humidity: 54 %
Atmos. Press: 1015 hPa

No.	Frequency [MHz]	Reading [dBuV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Antenna Polarization
1	46.94	27.2	9.8	4.3	29.8	11.5	39.0	27.5	Hori.
2	48.10	44.0	9.3	4.3	29.8	27.8	39.0	11.2	Vert.
3	92.04	35.6	8.7	5.0	29.8	19.5	43.5	24.0	Vert.
4	107.64	34.7	11.0	5.2	29.8	21.1	43.5	22.4	Vert.

Calculation method

The Correction Factors and RESULT are calculated as followings.

$$\text{Correction Factor [dB/m]} = \text{FACTOR [dB/m]} + \text{LOSS [dB]} - \text{GAIN [dB]}$$

$$\text{RESULT [dBuV/m]} = \text{READING [dBuV]} + \text{Correction Factor [dB/m]}$$

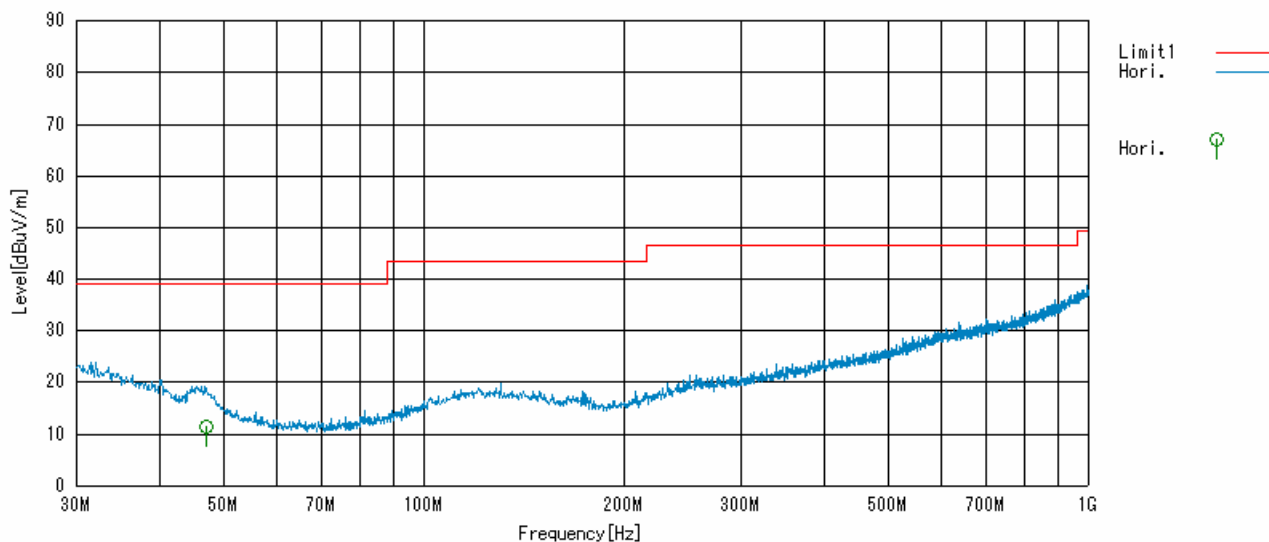
Sample calculation at 48.10 MHz Vertical result as follow:

$$\text{Result [dBuV/m]} = \text{Reading} + \text{C.F} = 44.0 + 9.3 + 4.3 - 29.8 = 27.8$$

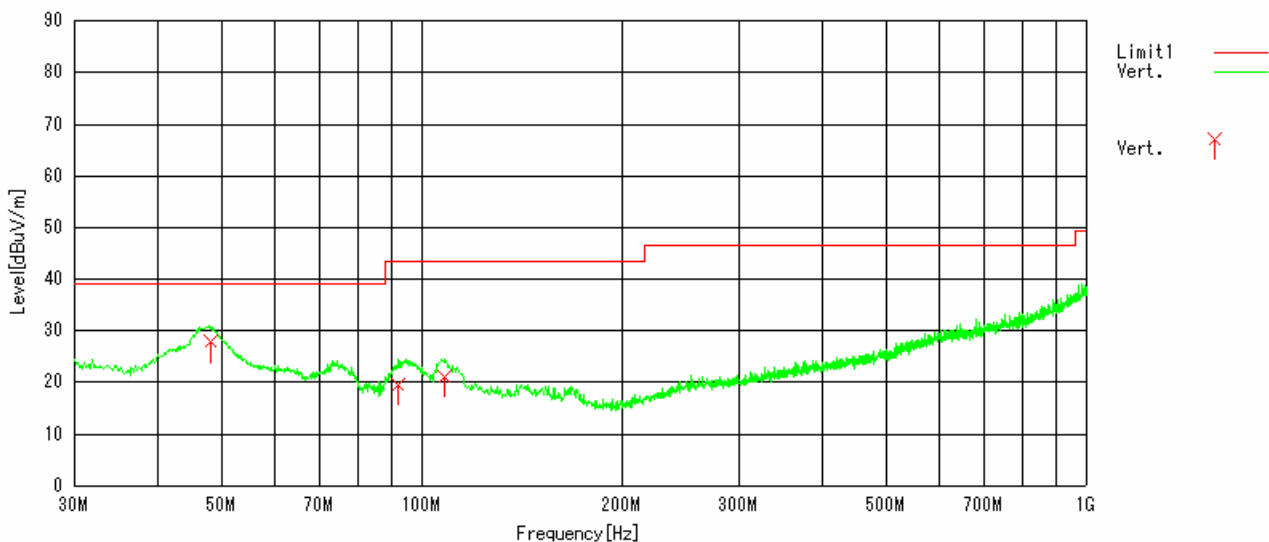
$$\text{Margin} = \text{Limit} - \text{Result} = 40.0 - 27.8 = 11.2 \text{ [dBuV/m]}$$

Graphical express of test result (30MHz-1000MHz)

Antenna polarization: **Horizontal**



Antenna polarization: **Vertical**



2.9.2 Above 1000 MHz

Test equipment used (refer to List of utilized test equipment)

AC01	PR04	SH01	SA06	CL21	CL22	DH01	
------	------	------	------	------	------	------	--

Tested Date: November 6 2007

Temperature: 25 °C
Humidity: 54 %
Atmos. Press: 1012 hPa

Result

There are no spurious emissions greater than noise floor.

2.10 Receiver AC power line conducted emissions

Test setup - Same as clause 2.8

Test procedure - Same as clause 2.8

Applicable rule and limitation

§15.107 (a) AC power line conducted limits

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.
The lower limit applies at the band edges.

Test equipment used (refer to List of utilized test equipment)

TR04	PL01	LN05 for EUT	SA06	CL11
------	------	-----------------	------	------

Test results - Complied with requirement.

Test Data

Tested Date: November 7 2007

Temperature: 21 °C
Humidity: 50 %
Atmos. Press: 1014 hPa

Operating Mode: Continuous Reception (Worst case configuration)

No	Frequency [MHz]	Reading		C.F. [dB]	Result		Limit		Margin		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]	
1	0.181	28.7	23.4	0.2	28.9	23.6	64.4	54.4	35.5	30.8	N
2	0.181	28.4	22.5	0.2	28.6	22.7	64.4	54.4	35.8	31.7	L
3	0.497	37.8	26.7	0.1	37.9	26.8	56.0	46.0	18.1	19.2	L
4	0.501	39.5	29.7	0.1	39.6	29.8	56.0	46.0	16.4	16.2	N
5	5.472	11.6	6.2	0.5	12.1	6.7	60.0	50.0	47.9	43.3	L
6	7.213	13.5	8.0	0.5	14.0	8.5	60.0	50.0	46.0	41.5	N

The power line conducted emission voltage is calculated by adding the LISN factor and Cable loss attenuation from the measured reading. The calculation is as follows:

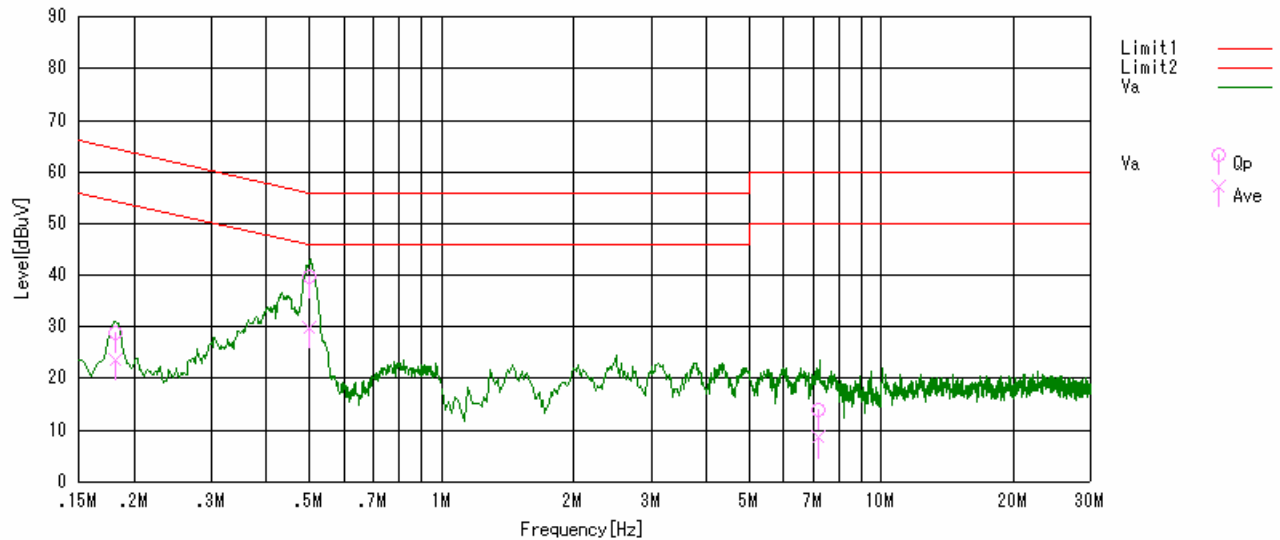
Result = Reading + C. F
where C.F = LISN Factor + Cable Loss [dB]

Sample calculation at 0.501 MHz Ave. result as follow:

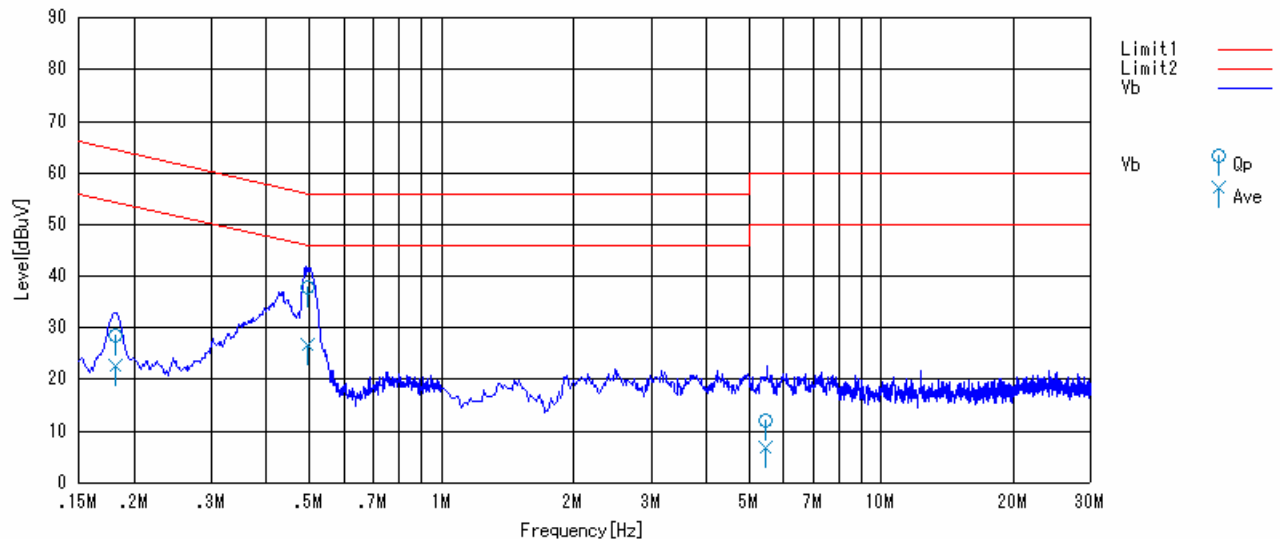
Result (dBuV) = Reading + C.F = 29.7 + 0.1 = 29.8 [dBuV]
Margin = Limit – Result = 50.0 – 29.8 = 16.2 [dBuV]

Graphical express of test result (0.15 MHz-30MHz)

AC Power line conducted emission. (Phase N)



AC Power line conducted emission. (Phase L)



2.11 Maximum Permissible Exposure (Exposure of Humans to RF Fields)

Limitation

15.247(i) 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.

1.1310 The criteria of "General Population/ Uncontrolled Exposure" listed in the below table shall be used to evaluate the environmental impact of human exposure to radio-frequency radiation as specified in 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of 2.1093 of this chapter.

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

NOTE 2: **General population/uncontrolled** exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

The MPE distance calculations:

The Maximum Permissible Exposure (MPE) distance between the EUT's antenna and human body is calculated in accordance with FCC OET Bulletin 65 and Safety Code 6 of IC.

The MPE distance where the exposure level reaches the permitted exposure level can be calculated as below;

$$S = P * G / 4\pi R^2$$

Rearranging terms to calculate the MPE Distance

$$R = (P * G / 4\pi S)^{1/2}$$

Where:

In case of printed half wave dipole antenna

R = MPE Distance in cm

**P = Power in dBm (0.732 mW, Refer to page 19 in this report) at 2406.5 MHz
(worst case)**

G = Antenna Gain in numeric

(1.355 = 1.32dBi, Max. Antenna Gain, Refer to the submitted antenna spec.)

S = Power Density Limit in mW/cm²

(1.0 mW/cm², Max. permissible exposure limit above)

Then MPE Distance is 0.281 cm.

Test results - Complied with requirement.

4 List of utilized test equipment/ calibration

RFT ID No.	Kind of Equipment and Precision	Manufacturer	Model No.	Serial Number	Calibration Date	Calibrated until
AC01	Anechoic Chamber	Japan Shiled Closure	203397C	-	2007/5/8	2008/5/6
BA03	Biological Antenna	CAHSE	CBL6111	1309	2007/5/14	2008/5/12
CL11	Antenna Cable	RFT	-	-	2007/6/12	2008/6/10
HPF1	High Pass Filter (3500MHz)	TOKIMEC	TF323DCA	603	2007/6/8	2008/6/6
LN05	LISN	Kyoritsu	KNW-407	8-1773-2	2007/5/14	2008/5/12
LP01	Loop Antenna	EMCO	6502	3436	2007/6/8	2008/6/6
PL01	Pulse Limiter	PMM	PL-01	0000J10109	2007/1/30	2008/1/29
PM03	Power Meter	Anritsu	ML2438A	99070001	2007/8/7	2008/8/5
PR04	Pre. Amplifier (1-26G)	RFT	LNP126	060208-01	2007/6/8	2008/6/6
SA06	Spectrum Analyzer (F/W: 3.60 SP1)	Rohde & Schwarz	FSP40	100071	2006/11/13	2007/11/12
SH01	Standard Horn Antenna (18-26G)	A.H. Systems	SAS-572	208	2006/5/3	2008/5/1
TR04	Test Receiver (F/W : 3.82 SP1)	Rohde & Schwarz	ESCI	100447	2007/9/19	2008/9/17

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.