TEST REPORT

For

Bluetooth Adapter Unit

In conformity with

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

Model: BU-2

FCC ID/ IC Certification No.: K660H464X10 / 511B- 0H464X10

Test Item: Bluetooth Adapter Unit

Report No: RY1106Z03R1

Issue Date: 3 June 2011

Prepared for

Vertex Standard Co., Ltd.
4-8-8, Nakameguro Meguro-ku, Tokyo 153-8644 Japan

Prepared by

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History

Report No.	Date	Revisions	Issued By
RY1106Z03R1	3 June, 2011	Initial Issue	K.Ohnishi

1 General information

1.1 Product description

Test item	: Bluetooth Adapter Unit
Manufacturer	: Vertex Standard Co., Ltd.
Address	: 4-8-8, Nakameguro Meguro-ku, Tokyo 153-8644 Japan
Model	: BU-2
FCC ID	: K660H464X10
IC Certification No	: 511B- 0H464X10
Serial numbers	: TP11, TP14
Fundamental Operated Frequency	: Tx/Rx Freq. (2402 - 2480 MHz)
Oscillator frequencies	: 26 MHz
Type of Modulation	: GFSK
RF Output Power	: 7.22dBm (measured at the antenna terminal)
Antenna Gain	: 1.9 dBi (Chip antenna)
Receipt date of EUT	: 20 April, 2011
Nominal power source voltages	: DC 4.0V

1.2 Test(s) performed/ Summary of test result

Test specification(s)	: FCC CFR 47. Part 15 (October 1, 2009) / RSS-210 Issue 8, RSS-Gen Issue 3
Test method(s)	: ANSI C63.4: 2003
Test(s) started	: 22 April, 2011
Test(s) completed	: 1 June, 2011
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
K.Ohnishi
EMC testing Department

Reviewer : T. Ikegami
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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 1, 2007.
The description of the test facilities has been filed under registration number 319924 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

Accredited by **National Voluntary Laboratory Accreditation Program** (NVLAP) for the emission tests stated in the scope of the certificate under Certificate Number 200780-0

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

NVLAP LAB CODE 200780-0

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;

RF Conducted level: +/- 1.10dB
Conducted emission: +/- 1.90dB (10kHz – 30MHz)
Radiated emission (9kHz - 30MHz): +/- 2.79dB
Radiated emission (30MHz - 1000 MHz): +/- 5.90dB
Radiated emission (1GHz - 18GHz): +/- 5.77dB
Radiated emission (18GHz - 26GHz): +/- 5.89dB

1.5 Summary of test results

1.5.1 Table of test summary

Requirement of;	Section in FCC15	Section in RSS210/ RSS-Gen	Result	Sample	Section in this report
1.5.1 Occupied Bandwidth (20 dB/99%)	15.247(a)(1)	A8.1(b)	Complied	A1	2.1
1.5.2 Hopping Carrier Frequency Separation	15.247(a)(1)	A8.1(b)	Complied	A1	2.2
1.5.3 Number of Hopping Channel	15.247(a)(1)(iii)	A8.1(d)	Complied	A1	2.3
1.5.4 Average Time of Occupancy	15.247(a)(1)(iii)	A8.1(d)	Complied	A1	2.4
1.5.5 Peak Output Power	15.247(a)(1)/(b)(1)	A8.4(2)	Complied	A1	2.5
1.5.6 Peak Power Spectral Density	15.247(e)	A8.2(b)	N/A	-	-
1.5.7 Conducted Spurious Emissions	15.247(d)	A8.5	Complied	A1	2.6
1.5.8 Transmitter Radiated Spurious Emissions	15.205(b)/15.209	RSS-Gen 7.2.2, 7.2.5	Complied	A2	2.7
1.5.9 Transmitter AC Power Line Conducted Emissions	15.207	RSS-Gen 7.2.4	Complied	A2	2.8
1.5.10 Receiver Radiated Spurious Emissions	15.109	RSS-Gen 6	Complied	A2	2.9
1.5.11 Receiver AC Power Line Conducted Emissions	15.107	RSS-Gen 7.2.4	Complied	A2	2.10

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.	Remark
A1	Bluetooth Adapter Unit	Vertex Standard Co., Ltd.	BU-2	TP11	For RF conducted test
A2	Bluetooth Adapter Unit	Vertex Standard Co., Ltd.	BU-2	TP14	For RF radiated test

Support Equipment(s):

	Item	Manufacturer	Model No.	Serial No.
B	Test Jig	Vertex Standard Co., Ltd.	-	-
C	DC power supply	KIKUSUI	PMC18-3A	DF002941
D	Personal Computer	DELL	VOSTRO 1520	08317
E	AC Adaptor	DELL	LA65NS1-00	CN-0YD637-71615-965-3E28

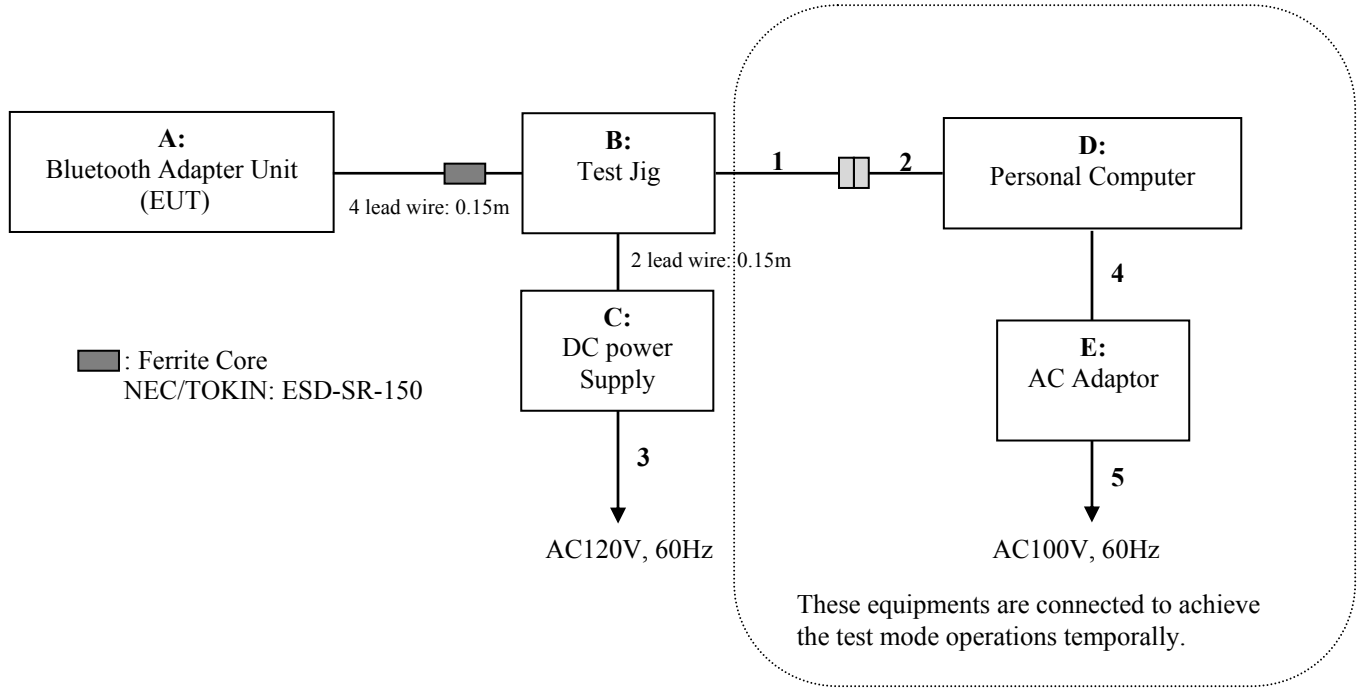
Connected cable(s):

No.	Item	Identification (Manu.e.t.c)	Shielded YES / NO	Ferrite Core YES / NO	Connector Type Shielded YES / NO	Length (m)
1	RS232C cable	-	No	No	Yes	2.05
2	USB-232C cable	ELECOM	Yes	No	Yes	0.50
3	AC power cable	-	No	No	No	1.50
4	DC power cable	DELL	No	No	No	1.80
5	AC power cable	DELL	No	No	No	0.90

1.6.2 Operating condition:

Operating mode:
The EUT was tested under the following test mode prepared by the applicant:
(1-1) GFSK modulation, Continuous transmission with DH5 PACKET at hopping off (2402MHz)
(1-2) GFSK modulation, Continuous transmission with DH5 PACKET at hopping off (2441MHz)
(1-3) GFSK modulation, Continuous transmission with DH5 PACKET at hopping off (2480MHz)
(1-4) π/4DQPSK modulation, Continuous transmission with DH5 PACKET at hopping off (2402MHz)
(1-5) π/4DQPSK modulation, Continuous transmission with DH5 PACKET at hopping off (2441MHz)
(1-6) π/4DQPSK modulation, Continuous transmission with DH5 PACKET at hopping off (2480MHz)
(1-7) 8DPSK modulation, Continuous transmission with DH5 PACKET at hopping off (2402MHz)
(1-8) 8DPSK modulation, Continuous transmission with DH5 PACKET at hopping off (2441MHz)
(1-9) 8DPSK modulation, Continuous transmission with DH5 PACKET at hopping off (2480MHz)
(1-10) Continuous transmission with DH5 PACKET at hopping on
(2-1) Continuous receiving

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.

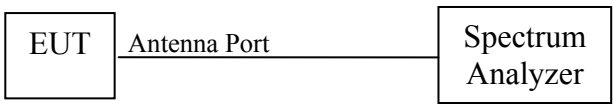
1.8 Deviation from the standard

No deviations from the standards described in clause 1.2.

2 Test procedure and test data

2.1 Occupied Bandwidth (20 dB / 99%)

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% to 3% 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)

SA06	CL22				

Test results

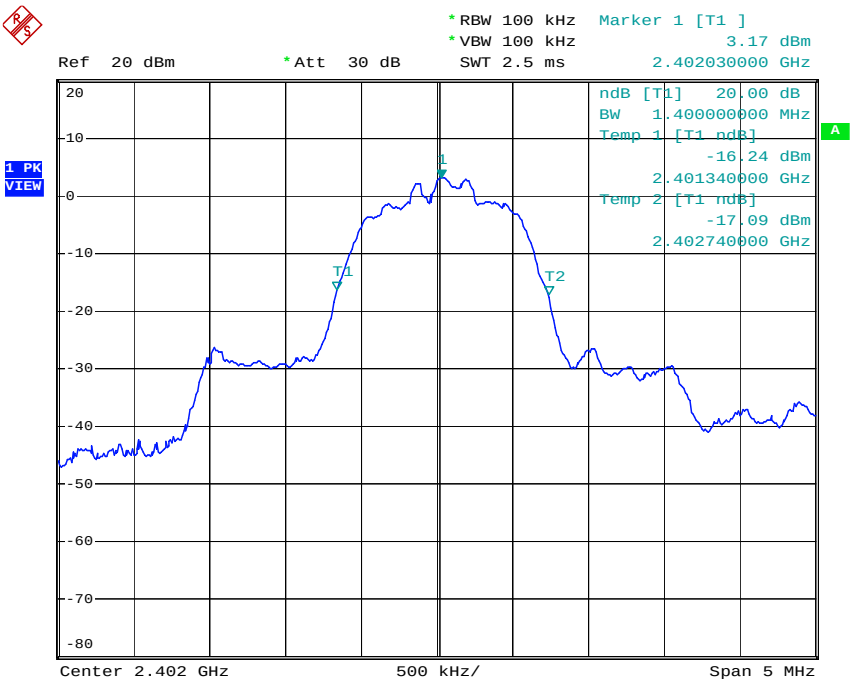
Operating Mode	Transmission Channel	Transmission Frequency	Bandwidth [MHz]	
			20dB	99%
GFSK (1Mbps)	Low (0ch)	2402	1.110	0.950
	Middle (39ch)	2441	1.120	0.950
	High (78ch)	2480	1.090	0.920
π/4DQPSK (2Mbps)	Low (0ch)	2402	**1.400**	**1.240**
	Middle (39ch)	2441	1.390	**1.240**
	High (78ch)	2480	1.370	1.220
8DPSK (3Mbps)	Low (0ch)	2402	1.390	**1.240**
	Middle (39ch)	2441	1.390	1.230
	High (78ch)	2480	1.380	1.230

Test Data

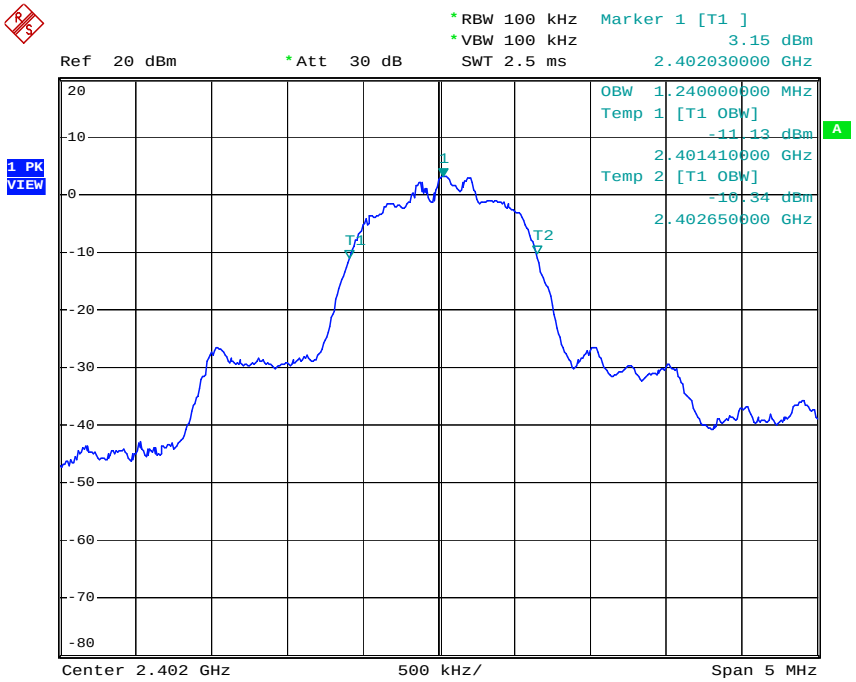
Tested Date: 22 April, 2011

Temperature: 21 ˚C
Humidity: 49 %
Atmos. Press: 1021 hPa

20dB Bandwidth

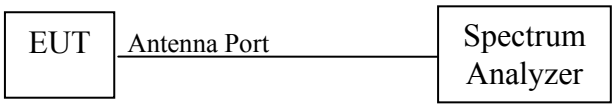


99% Occupied Bandwidth



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 more than 1% of its span. The VBW is set to more than RBW. 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.

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

SA06	CL22				

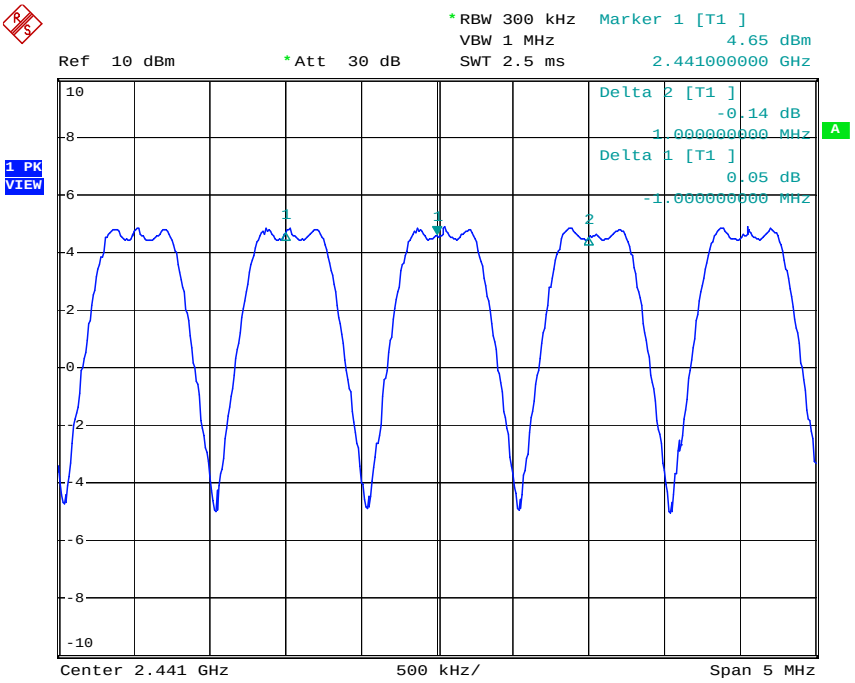
Test results – comply with the limitation

Operating Mode	Measured Channel	Measured Frequency (MHz)	Two-third of the 20dB bandwidth (MHz)	Frequency Separation (MHz)
GFSK	Middle (39ch)	2441	0.747	1.0
π/4DQPSK	Middle (39ch)	2441	0.934	1.0
8DPSK	Middle (39ch)	2441	0.927	1.0

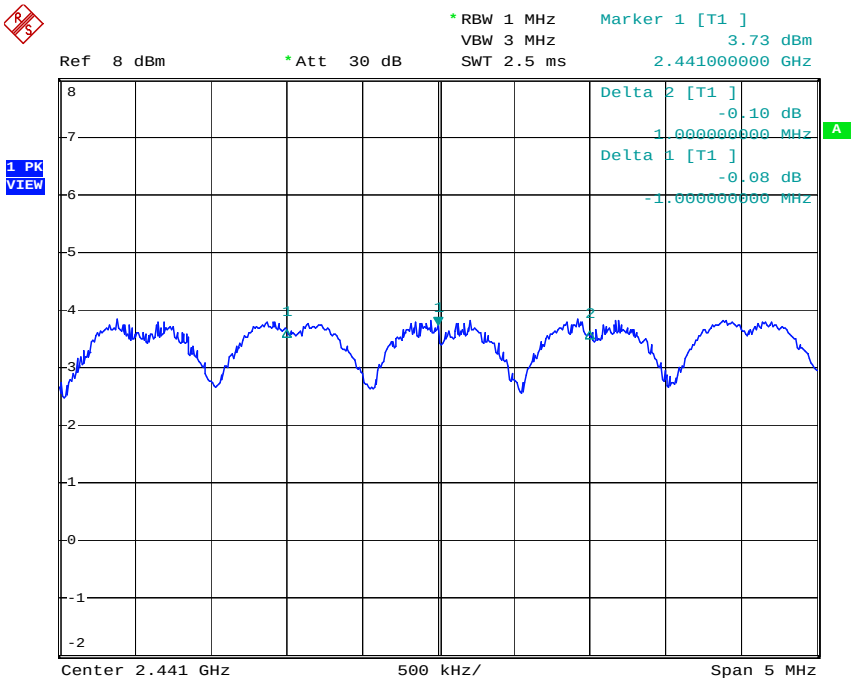
Test Data
Tested Date: 22 April, 2011

Temperature: 21 ˚C
Humidity: 49 %
Atmos. Press: 1021 hPa

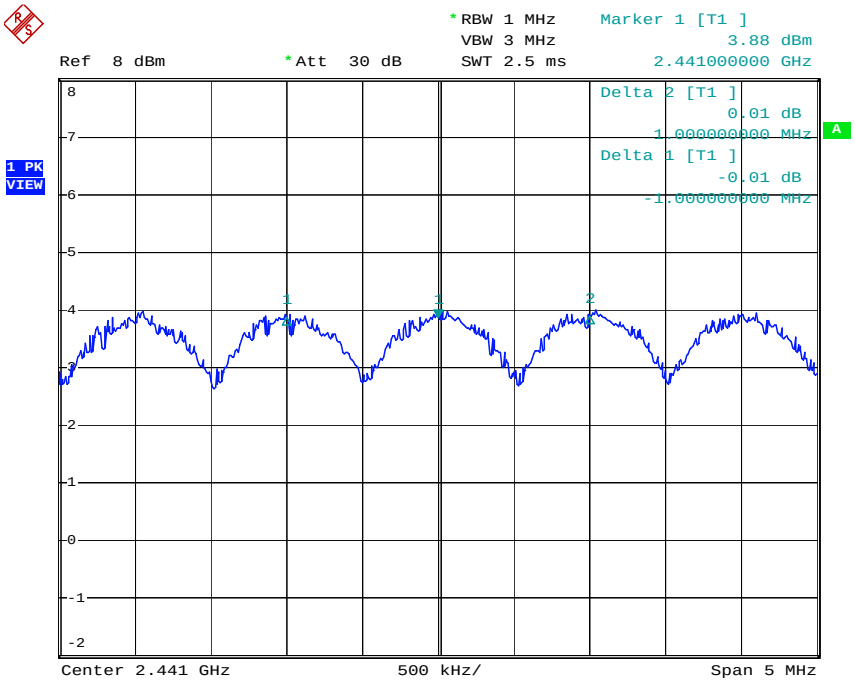
Operating mode: GFSK



Operating mode: π/4DQPSK

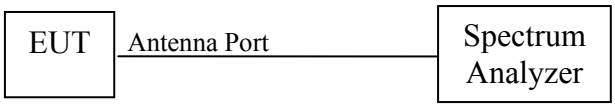


Operating mode: 8DPSK



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 more than 1% of its span. The VBW is set to more than RBW. 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) (iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

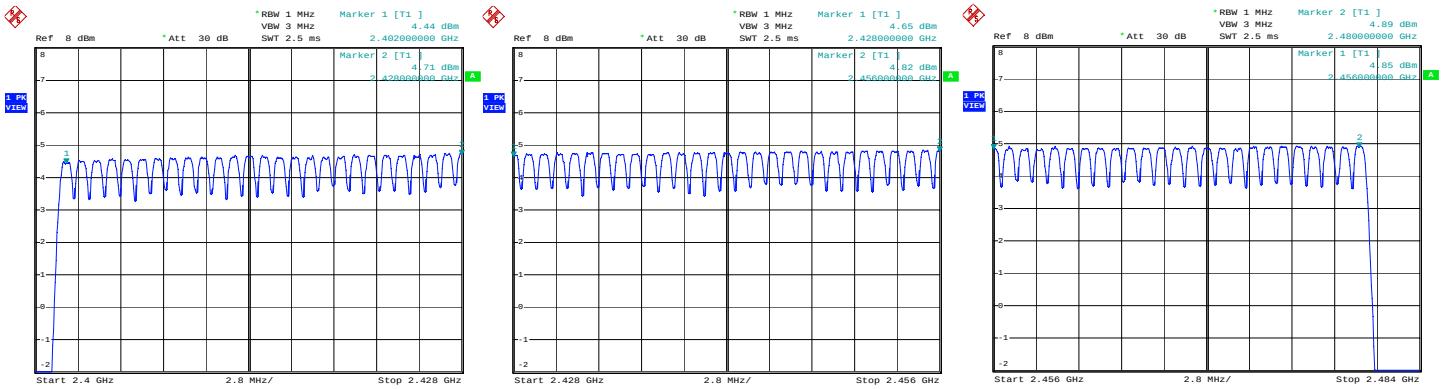
Test equipment used (refer to List of utilized test equipment)

SA06	CL22				

Test results – Comply with the limitation
Hopping channel: 79 channels

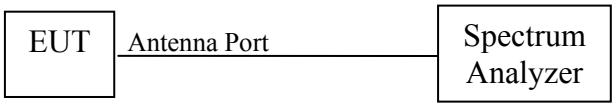
Test Data
Tested Date: 22 April, 2011

Temperature: 21 ˚C
Humidity: 49 %
Atmos. Press: 1021 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 more than RBW. The sweep time is coupled appropriate. The span is set to 0 MHz and single sweep with video triggered. The EUT is hopping operation.
The average time of occupancy within the 31.6 seconds (79 channels * 0.4) is calculated as follows in accordance with Bluetooth formula;
In case of DH5: (average time of occupancy) = (pulse width) * (1600 / 6) / 79 * 31.6

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.

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

SA06	CL22				

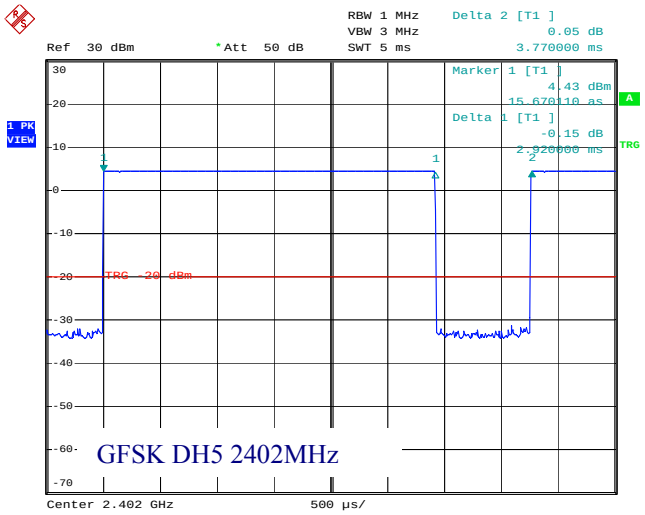
Test results – comply with the limitation.

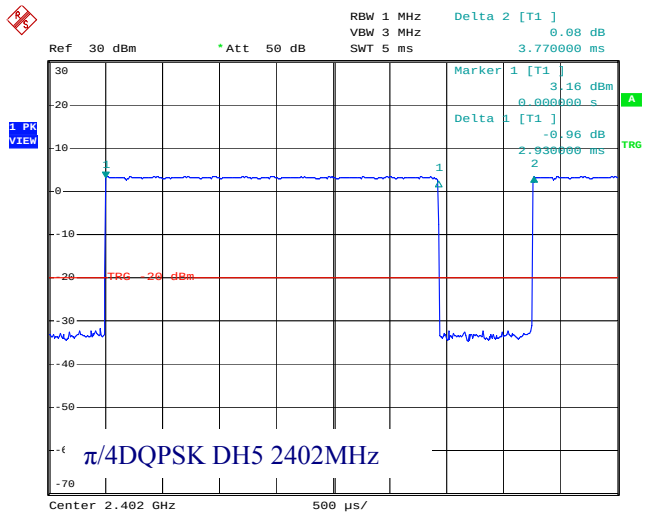
Operating Mode	Frequency [MHz]	Transmission Packet Type	Pulse width (msec)	Time of occupancy (msec)
GFSK	2402	DH5	2.920	309.495
	2441	DH5	2.920	309.495
	2480	DH5	2.920	309.495
π/4DQPSK	2402	DH5	**2.930**	**310.555**
	2441	DH5	**2.930**	**310.555**
	2480	DH5	**2.930**	**310.555**
8DPSK	2402	DH5	**2.930**	**310.555**
	2441	DH5	**2.930**	**310.555**
	2480	DH5	**2.930**	**310.555**

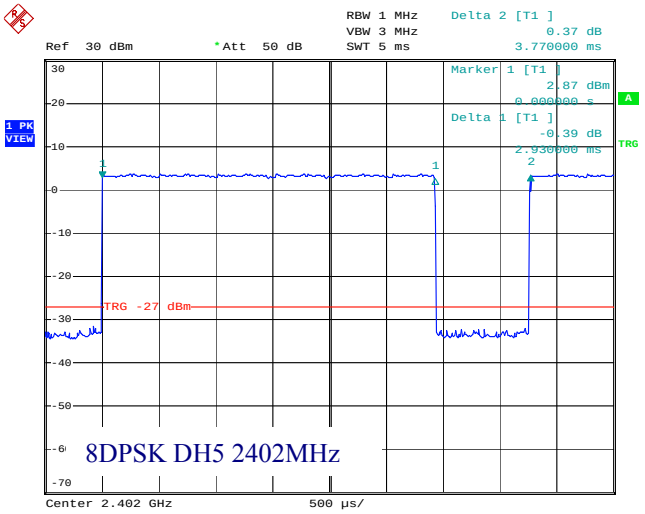
Test Data

Tested Date: 22 April, 2011

Temperature: 21 ˚C
Humidity: 49 %
Atmos. Press: 1021 hPa

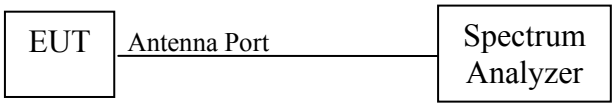






2.5 Peak Output Power

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.

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(21dBm).

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

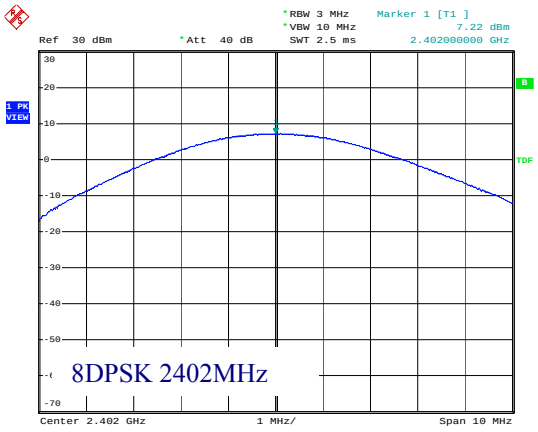
SA06	CL22				

Test results – comply with the limitation.

Operating Mode	Transmission Channel (Frequency: MHz)	Output power (dBm) [Result]	Output power (mW) [Result]
GFSK	Low (2402)	5.59	3.62
	Middle (2441)	5.82	3.82
	High (2480)	5.91	3.90
π/4DQPSK	Low (2402)	7.03	5.05
	Middle (2441)	6.40	4.37
	High (2480)	6.17	4.14
8DPSK	**Low (2402)**	**7.22**	**5.27**
	Middle (2441)	6.62	4.59
	High (2480)	6.23	4.20

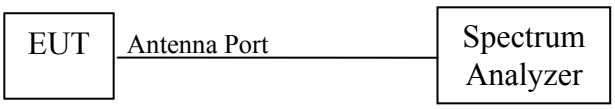
Test Data
Tested Date: 1 June, 2011

Temperature: 21 ˚C
Humidity: 45 %
Atmos. Press: 1019 hPa



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 (Band Edge)
Use the following spectrum analyzer settings:
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 ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

Test procedure (Conducted spurious emissions)
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 cheated from 30 MHz to 25 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)

SA06	CL22				

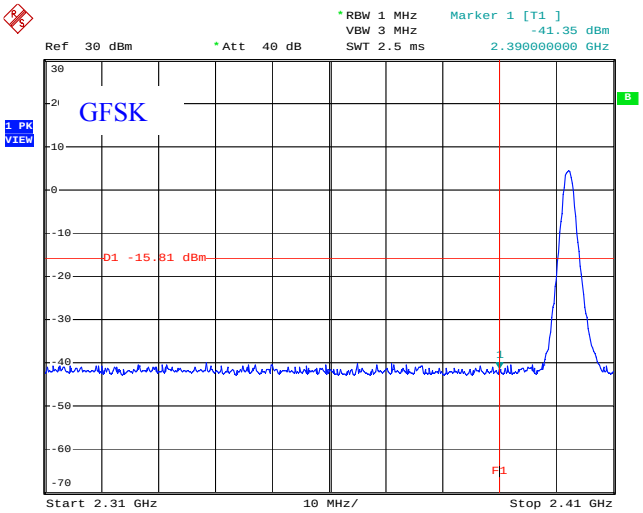
Test results – comply with the limitation.

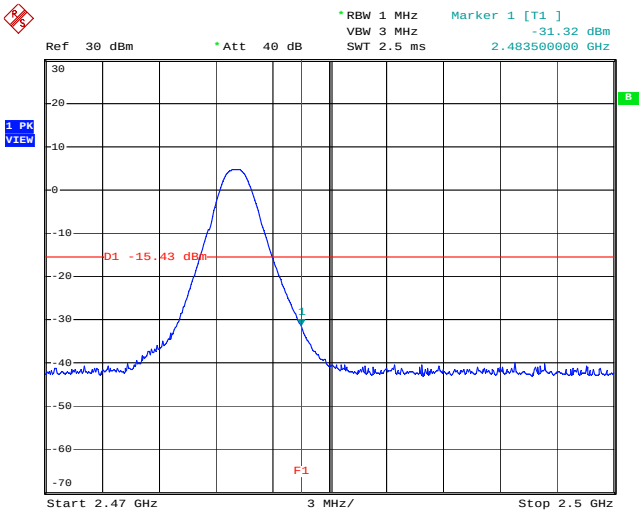
Test Data

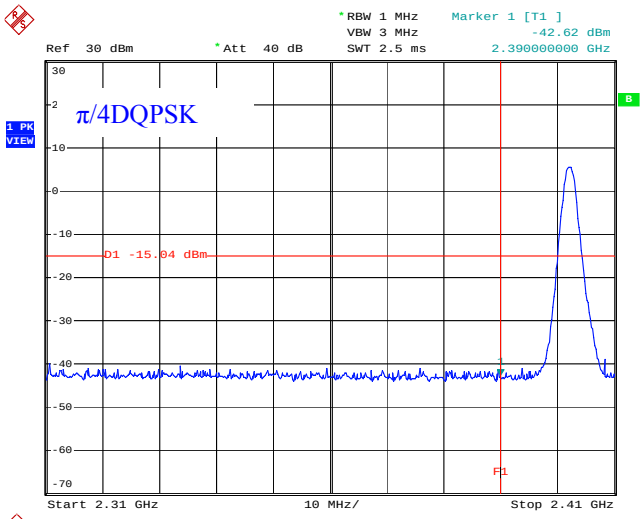
Tested Date: 1 June, 2011

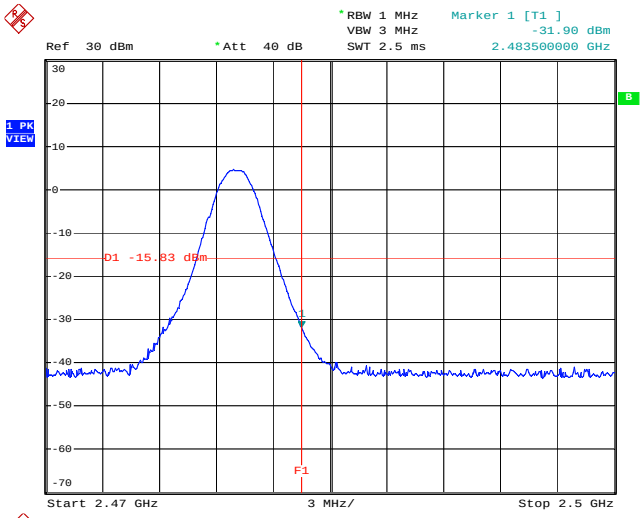
Temperature: 21 ˚C
Humidity: 45 %
Atmos. Press: 1019 hPa

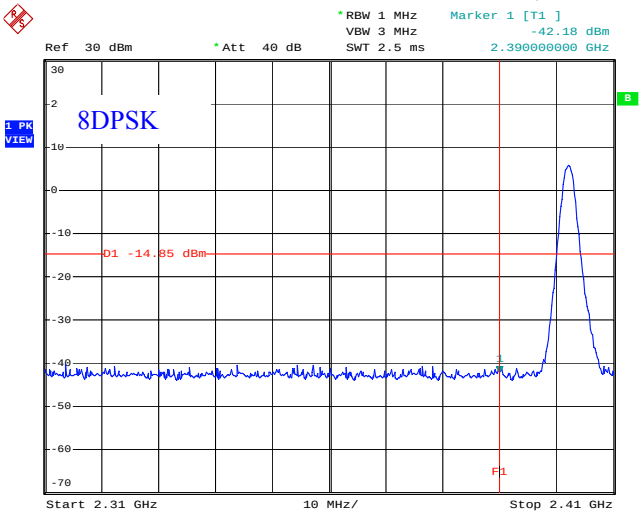
Restricted Band Edge

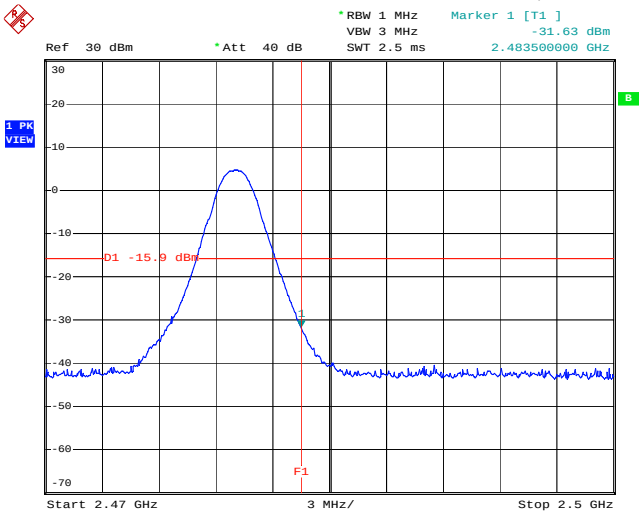




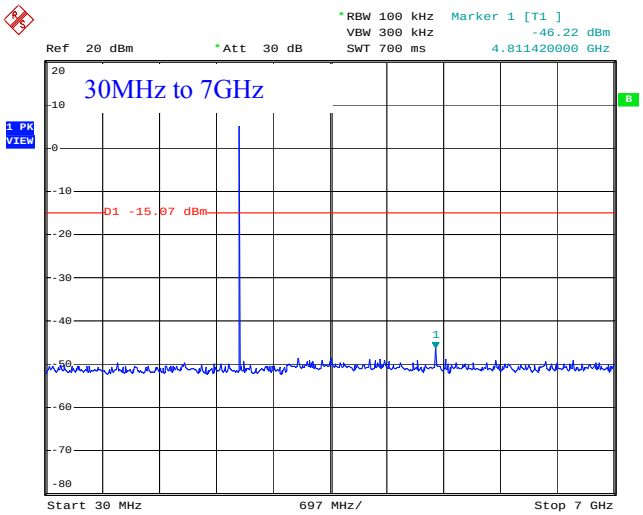


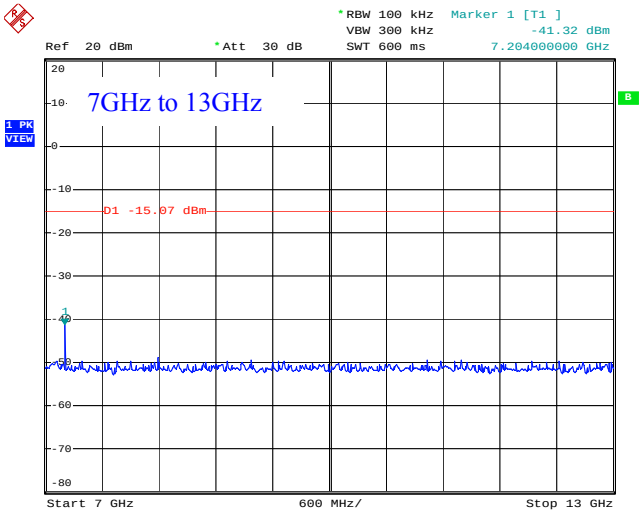


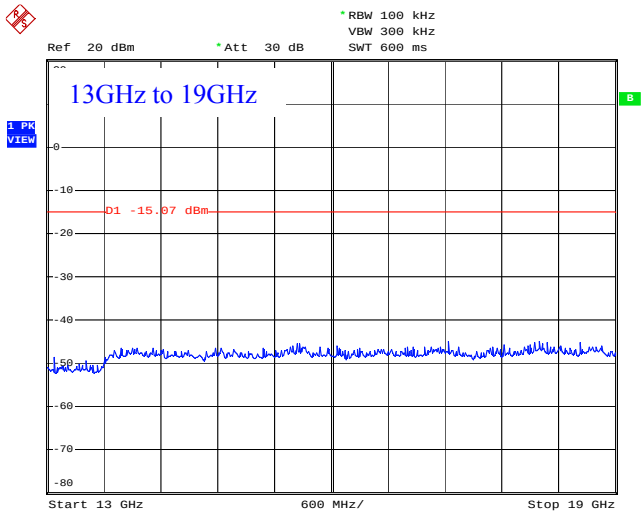


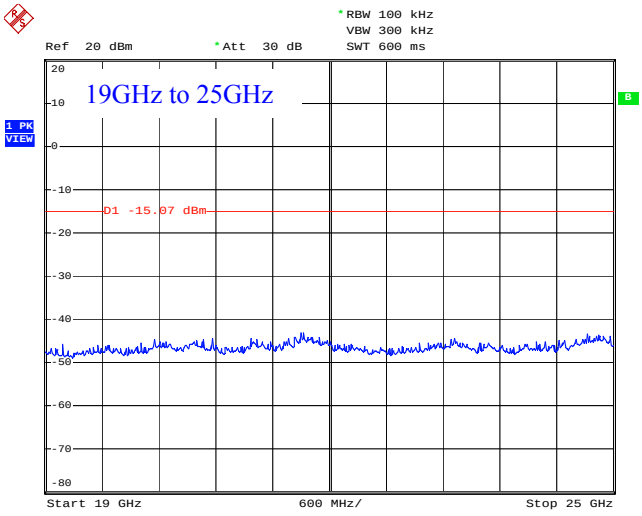


Worst Configuration (2402MHz, 8DPSK)





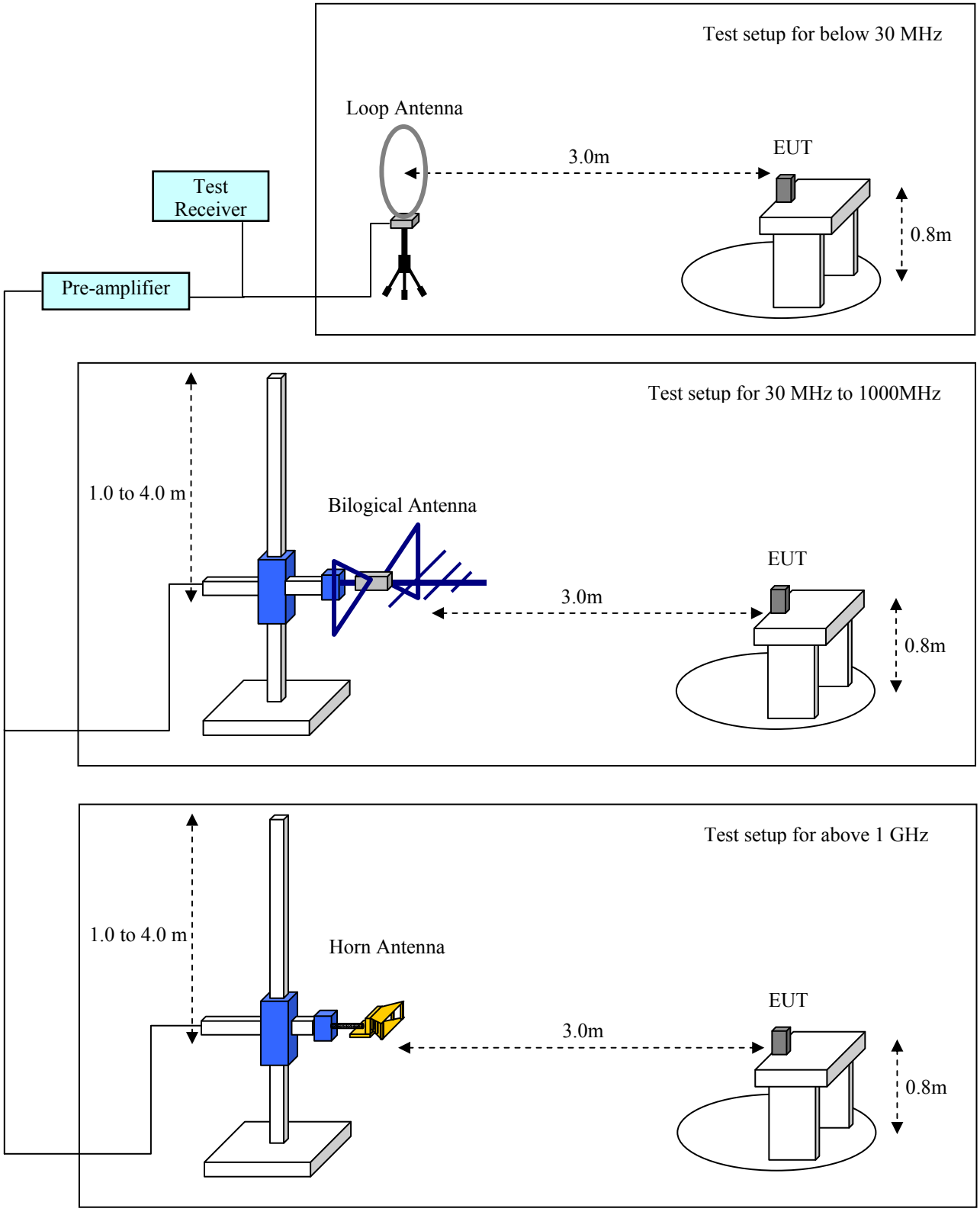




2.7 Transmitter Radiated spurious emissions

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 place 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 with a receiver RBW of 9 kHz (QP)
Between 30 - 1000 MHz:	RBW=100 kHz, VBW= 300 kHz Final measurement is carried out with a receiver RBW of 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)

LP01	CL11	TR06	

Tested Date: 1 June, 2011

Temperature: 21 ˚C
Humidity: 45 %
Atmos. Press: 1019 hPa

Result

There is no spurious emission with levels of more than 20 dB below the applicable limit

2.7.2 Between 30 – 1000 MHz

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

BA04	CL11	PR08	TR06

Tested Date: 1 June, 2011

Temperature: 21 ˚C
Humidity: 45 %
Atmos. Press: 1019 hPa

Operating mode: Continuous Communication (GFSK, 2480MHz: Worst configuration)
EUT position: Z-plane (Maximum position)
Measurement distance: 3 m

No.	Frequency [MHz]	Reading [dBuV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Antenna Polarization
1	76.507	58.9	6.9	7.6	49.8	23.6	40.0	16.4	Hori.
2	**76.527**	**59.8**	**6.9**	**7.6**	**49.8**	**24.5**	**40.0**	**15.5**	**Vert.**
3	1000.000	36.3	21.7	13.6	49.7	21.9	53.9	32.0	Hori.
4	1000.000	36.3	21.7	13.6	49.7	21.9	53.9	32.0	Vert.

Calculation method

The Correction Factors and RESULT are calculated as followings.

Correction Factor [dB/m] = FACTOR [dB/m] + LOSS [dB] – GAIN [dB]

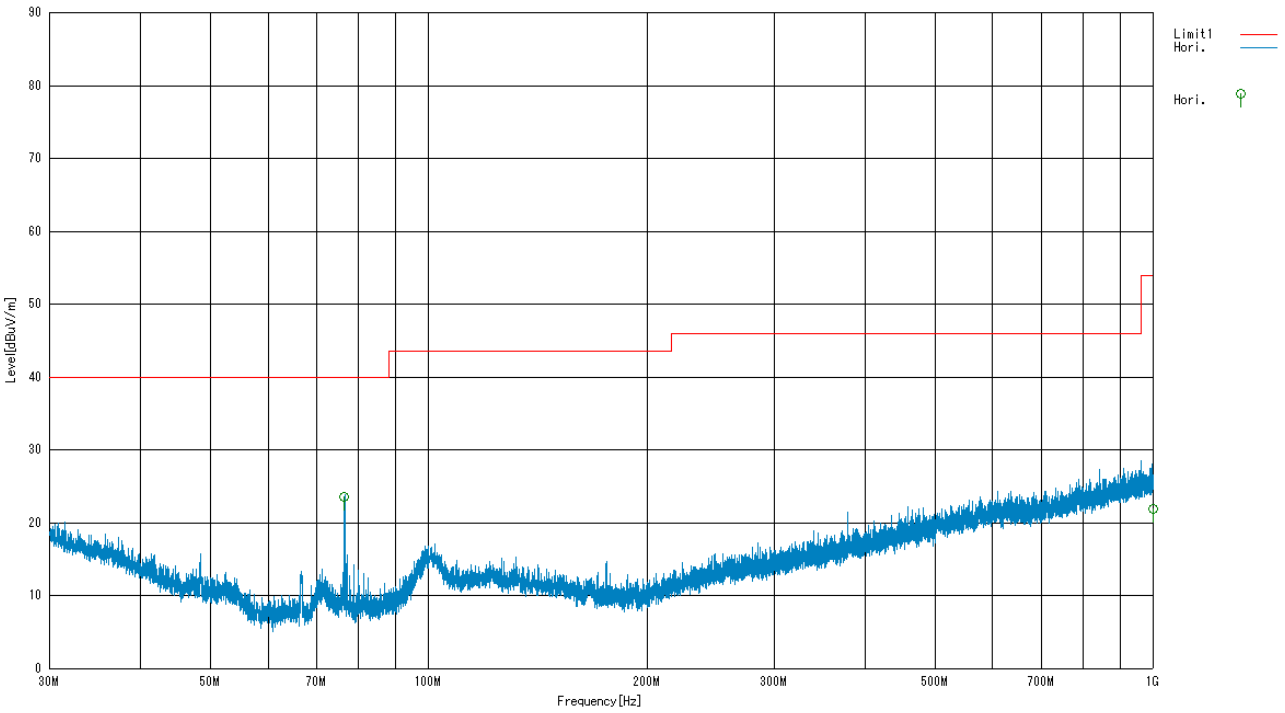
RESULT [dBuV/m] =READING [dBuV] + Correction Factor [dB/m]

Sample calculation at 76.527 MHz vertical result as follow:

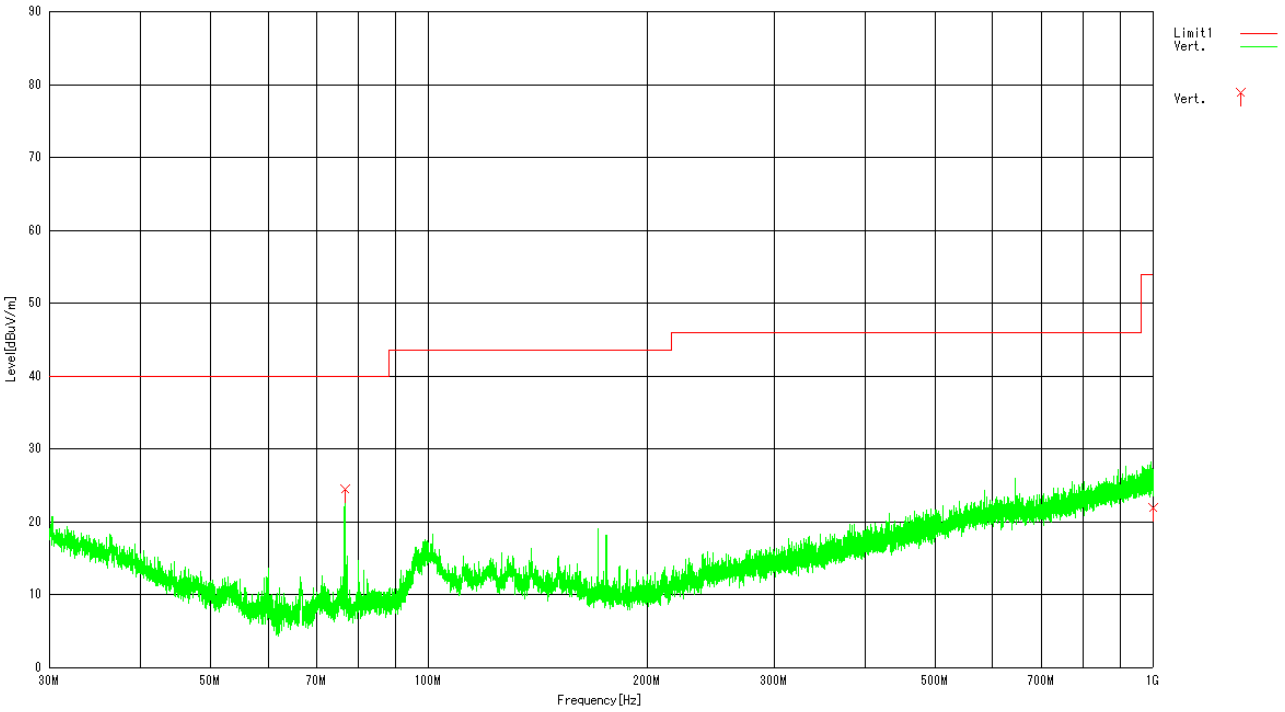
Result [dBuV/m] = Reading + C.F = 59.8 + 6.9 + 7.6 - 49.8 = 24.5
Margin = Limit – Result = 40.0 – 24.5 = 15.5 [dB]

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)

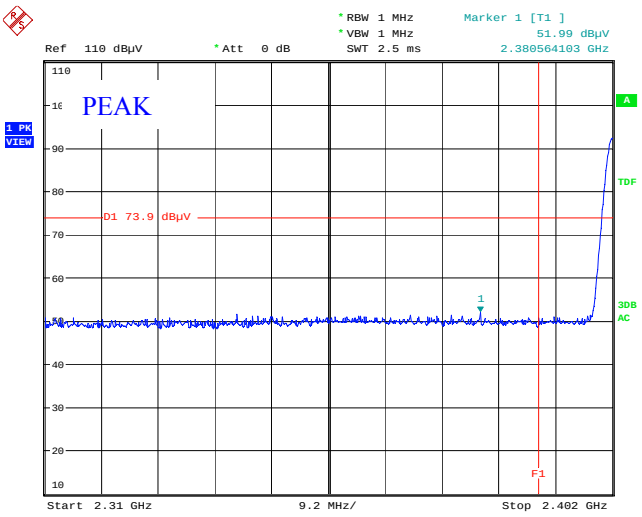
PR12	SH01	TR06	CL23	CL24	AT33	HPF1	DH01	AC01
CL28								

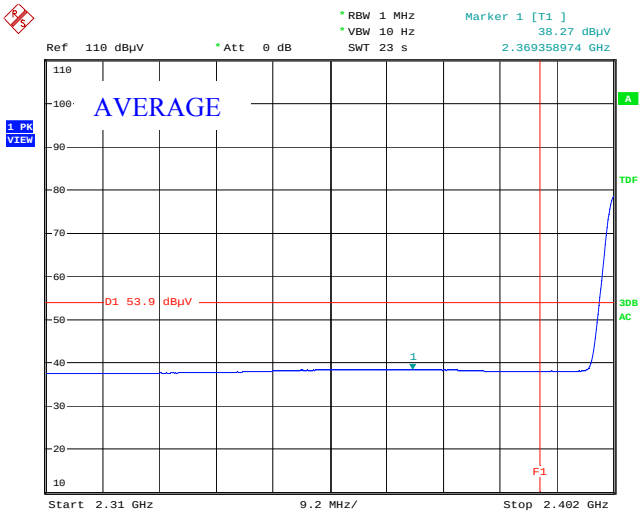
Tested Date: 26 April, 2011

Temperature: 20 ˚C
Humidity: 38 %
Atmos. Press: 1014 hPa

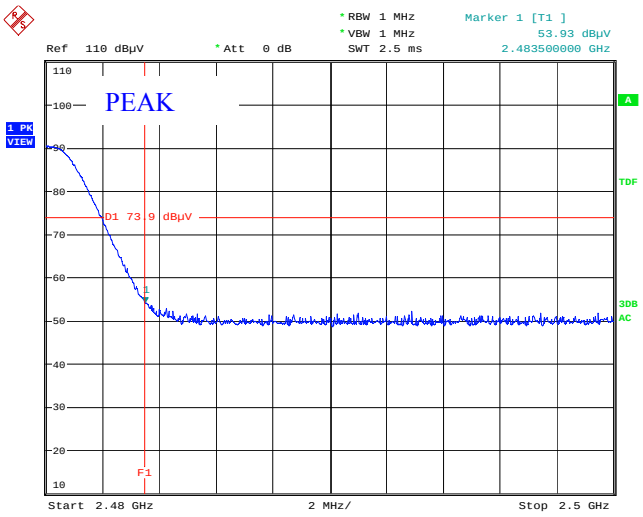
Restricted Band Edge (Worst Configuration)

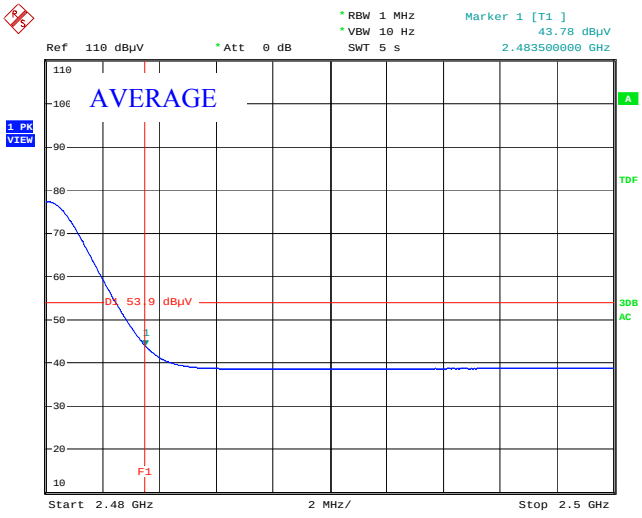
Low channel (π/4DQPSK, X-plane, Horizontal)





High channel (8DPSK, X-plane, Horizontal)





Harmonics and Spurious Emission above 1000 MHz

Tested Date: 18 May, 2011

Temperature: 22 ˚C
Humidity: 53 %
Atmos. Press: 1016 hPa

Operating mode: Continuous Communication (GFSK, 2480MHz: Worst Configuration)
EUT position: Y-plane (Maximum position)
Measurement distance: 3 m

There are no spurious emissions other than listed below;

No.	Frequency [MHz]	Reading		C.F. [dB]	Result		Limit		Margin		Polarization
		Peak [dBuV]	Ave [dBuV]		Peak [dBuV]	Ave [dBuV]	Peak [dBuV]	Ave [dBuV]	Peak [dB]	Ave [dB]	
1	**4960.000**	54.3	**46.0**	**3.0**	57.3	**49.0**	73.9	**53.9**	16.6	**4.9**	**Hori.**
2	4960.000	48.4	40.1	3.0	51.4	43.1	73.9	53.9	22.5	10.8	Vert.

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	LN06	CL18

Test results - Complied with requirement.

Test Data

Tested Date: 1 June, 2011

Temperature: 21 ˚C
Humidity: 45 %
Atmos. Press: 1019 hPa

Operating mode: Continuous Communication (GFSK, 2480MHz: Worst 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	0.151	29.6	7.1	10.2	39.8	17.3	65.9	55.9	26.1	38.6	Va
2	**0.153**	**30.6**	6.9	**10.2**	**40.8**	17.1	**65.8**	55.8	**25.0**	38.7	**Vb**
3	0.159	26.3	5.2	10.2	36.5	15.4	65.5	55.5	29.0	40.1	Vb
4	0.164	28.3	5.6	10.2	38.5	15.8	65.3	55.3	26.8	39.5	Vb
5	0.165	28.3	5.7	10.2	38.5	15.9	65.2	55.2	26.7	39.3	Va
6	0.175	25.8	4.5	10.2	36.0	14.7	64.7	54.7	28.7	40.0	Va

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:

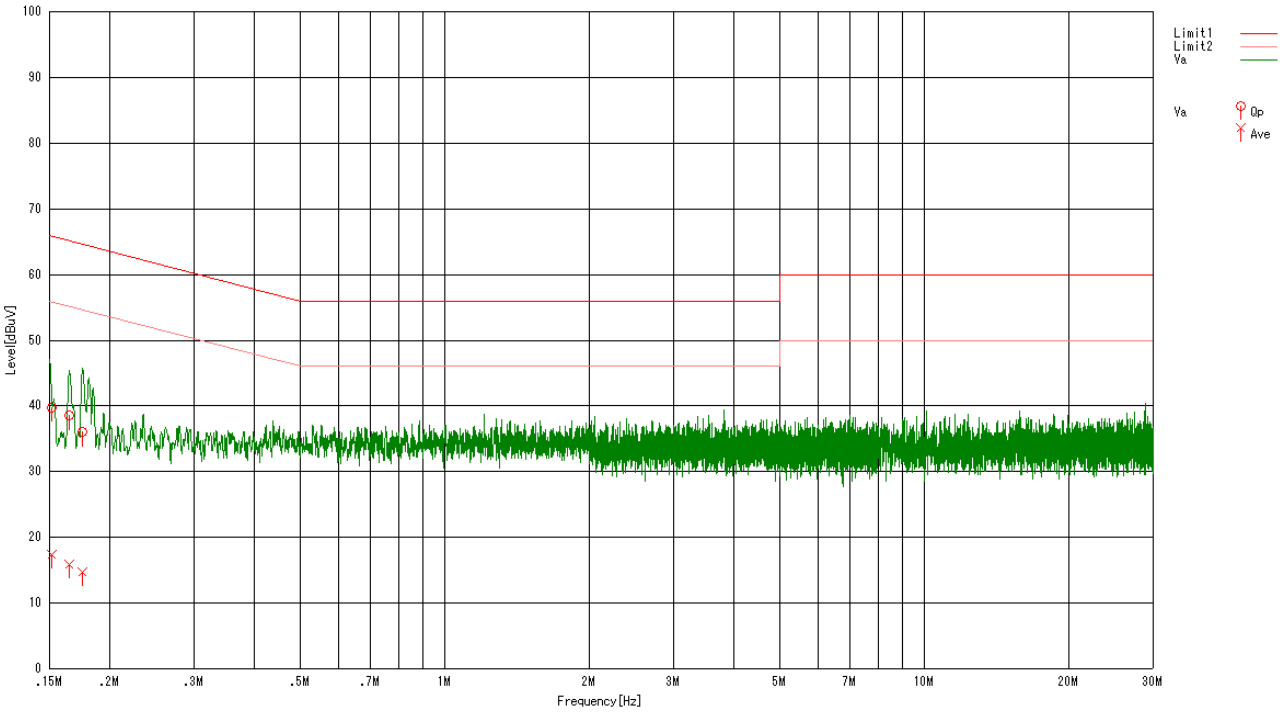
Result = Reading + C. F
where C.F = LISN Factor + Cable Loss [dB]

Sample calculation at 0.153 MHz QP result as follow:

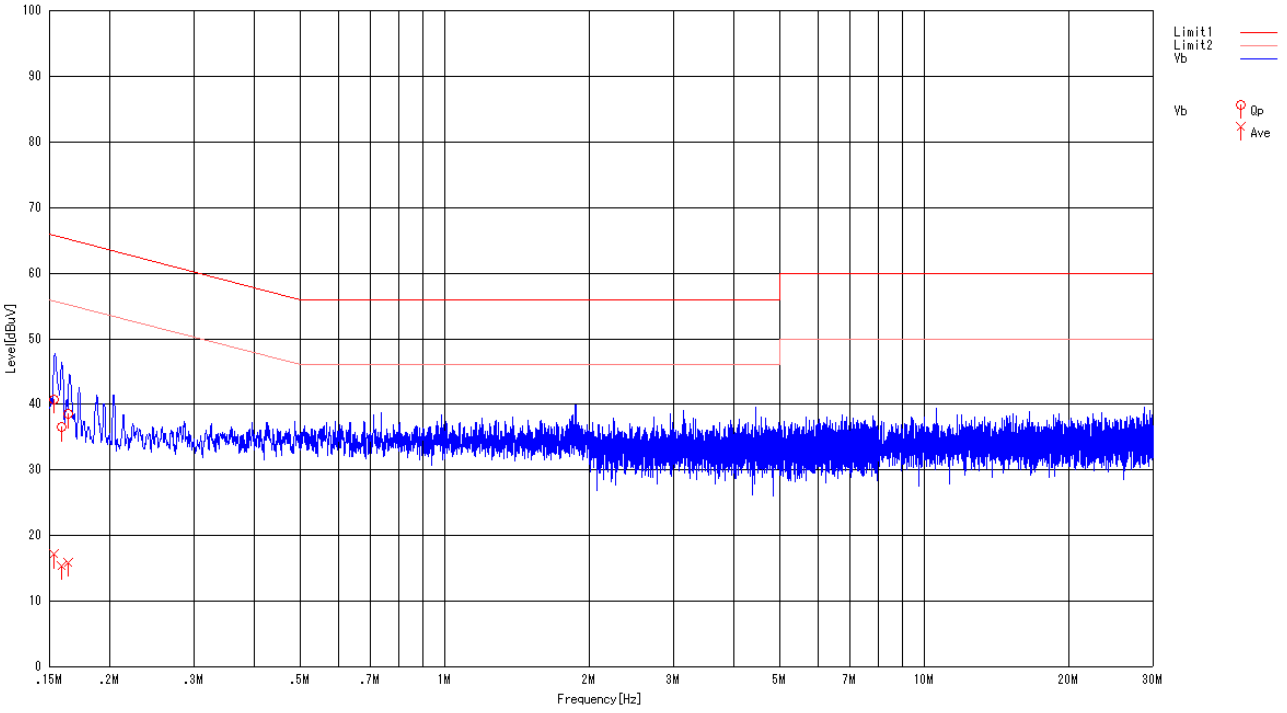
Result [dBuV] = Reading + C.F = 30.6 + 10.2 = 40.8 [dBuV]
Margin = Limit – Result = 65.8 – 40.8 = 25.0 [dB]

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

AC Power line conducted emission. (Phase Va)



AC Power line conducted emission. (Phase Vb)



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	53.9

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)

BA04	CL11	PR08	TR06

Test Data

Tested Date: 1 June, 2011

Temperature: 21 ˚C
Humidity: 45 %
Atmos. Press: 1019 hPa

Operating mode: Continuous Receiving (2480MHz)
EUT position: Z-plane (Maximum position)
Measurement distance: 3 m

No.	Frequency [MHz]	Reading [dBuV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Antenna Polarization
1	76.505	54.8	6.9	7.6	49.8	19.5	40.0	20.5	Hori.
2	**76.526**	**55.3**	**6.9**	**7.6**	**49.8**	**20.0**	**40.0**	**20.0**	**Vert.**
3	1000.000	36.2	21.7	13.6	49.7	21.8	53.9	32.1	Hori.
4	1000.000	36.2	21.7	13.6	49.7	21.8	53.9	32.1	Vert.

Calculation method

The Correction Factors and RESULT are calculated as followings.

Correction Factor [dB] = FACTOR [dB/m] + LOSS [dB] – GAIN [dB]

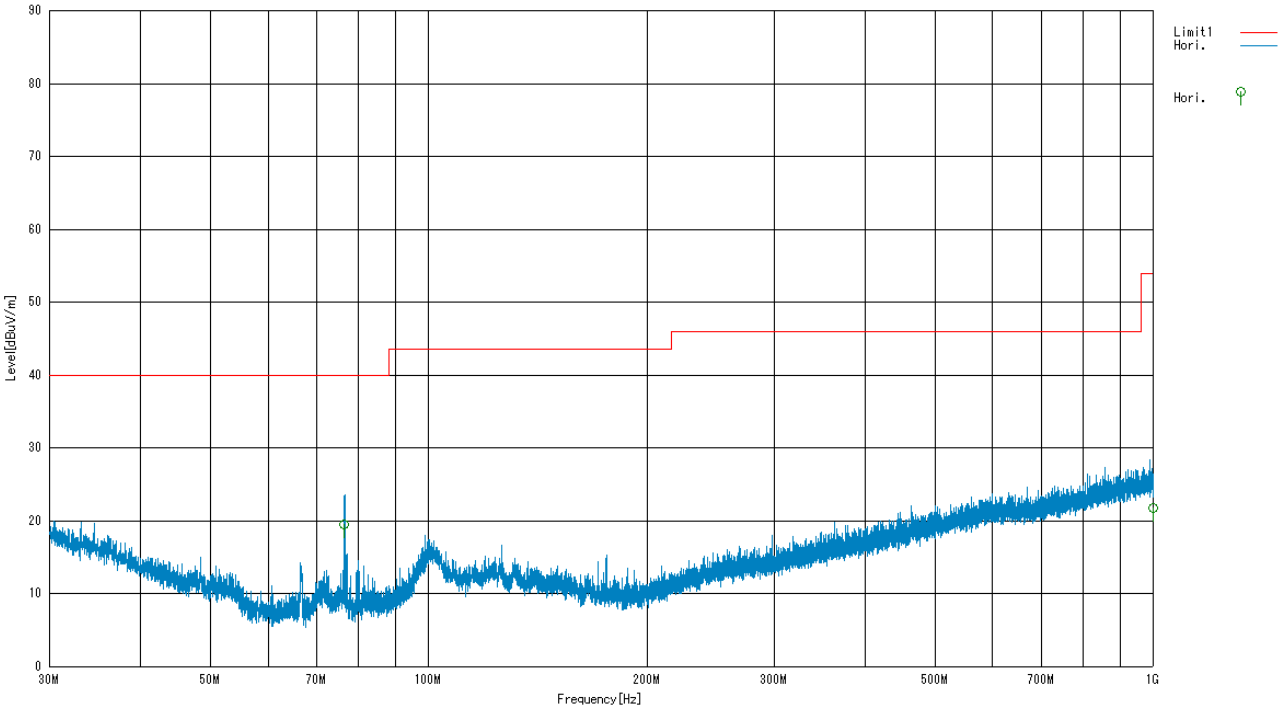
RESULT [dBuV/m] =READING [dBuV] + Correction Factor [dB]

Sample calculation at 76.526 MHz vertical result as follow:

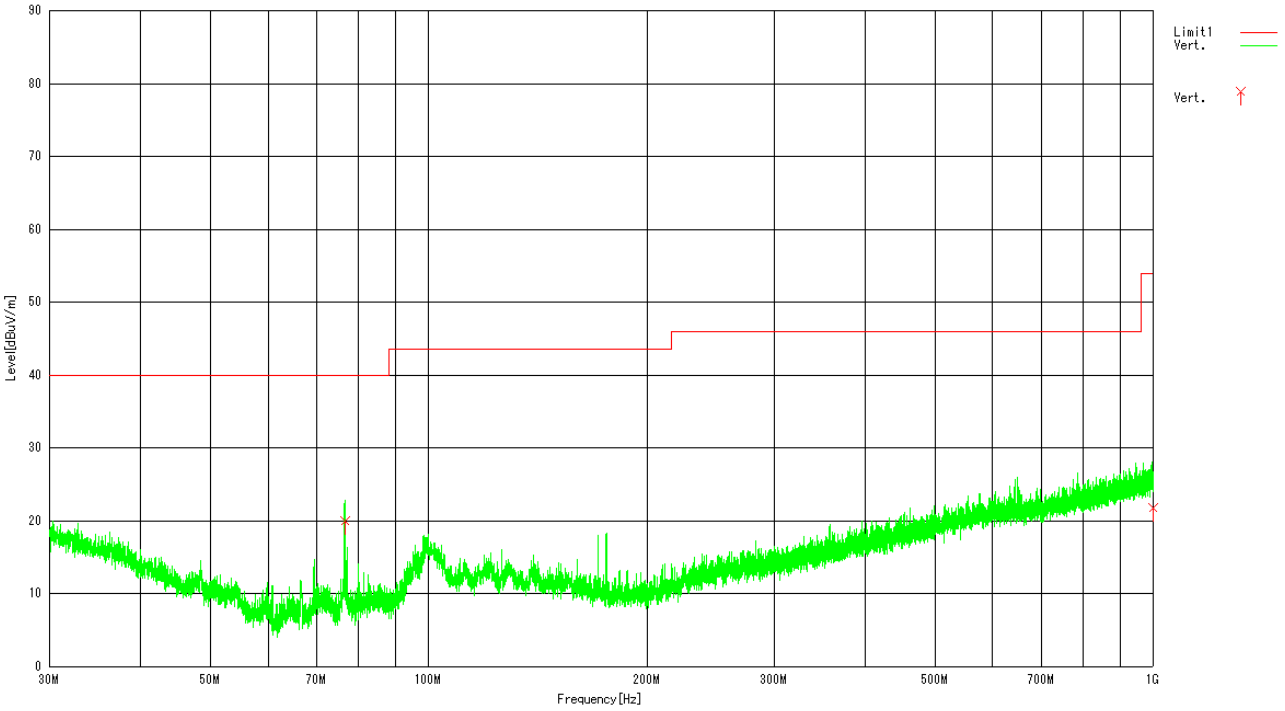
Result [dBuV/m] = Reading + C.F = 55.3 + 6.9 + 7.6 - 49.8 = 20.0
Margin = Limit – Result = 40.0 – 20.0 = 20.0 [dBuV/m]

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)

PR12	TR06	CL23	CL24	DH01		

Tested Date: 20 May, 2011

Temperature: 23 ˚C
Humidity: 53 %
Atmos. Press: 1016 hPa

Operating mode: Continuous Receiving (2441MHz: Worst configuration)
EUT position: Y-plane (Maximum position)
Measurement distance: 3 m

There are no spurious emissions other than listed below;

No.	Frequency [MHz]	Reading		C.F. [dB]	Result		Limit		Margin		Polarization
		Peak [dBuV]	Ave [dBuV]		Peak [dBuV]	Ave [dBuV]	Peak [dBuV]	Ave [dBuV]	Peak [dB]	Ave [dB]	
1	**2167.076**	48.7	**37.2**	**-5.5**	43.2	**31.7**	73.9	**53.9**	30.7	**22.2**	**Vert.**
2	12205.000	40.2	26.2	11.3	51.5	37.5	73.9	53.9	22.4	16.4	Hori.
3	12205.000	39.3	26.2	11.3	50.6	37.5	73.9	53.9	23.3	16.4	Vert.

Note: No. 2, 3 is noise floor.

Calculation method

The RESULT is calculated as followings.

RESULT [dBuV/m] = READING [dBuV] + Antenna Factor [dB/m] + Cable Loss [dB] – AMP Gain [dB]

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	LN06	CL11

Test results - Complied with requirement.

Test Data

Tested Date: 1 June, 2011

Temperature: 21 ˚C
Humidity: 45 %
Atmos. Press: 1019 hPa

Operating mode: Continuous Receiving (2480MHz: Worst 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 [dBuV]	AV [dBuV]	
1	**0.151**	**30.4**	7.1	**10.2**	**40.6**	17.3	**65.9**	55.9	**25.3**	38.6	**Vb**
2	**0.151**	**30.4**	7.3	**10.2**	**40.6**	17.5	**65.9**	55.9	**25.3**	38.4	**Va**
3	0.158	26.8	5.6	10.2	37.0	15.8	65.6	55.6	28.6	39.8	Va
4	0.159	26.5	5.3	10.2	36.7	15.5	65.5	55.5	28.8	40.0	Vb
5	0.171	24.1	3.8	10.2	34.3	14.0	64.9	54.9	30.6	40.9	Vb
6	0.180	24.7	5.5	10.2	34.9	15.7	64.5	54.5	29.6	38.8	Va

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:

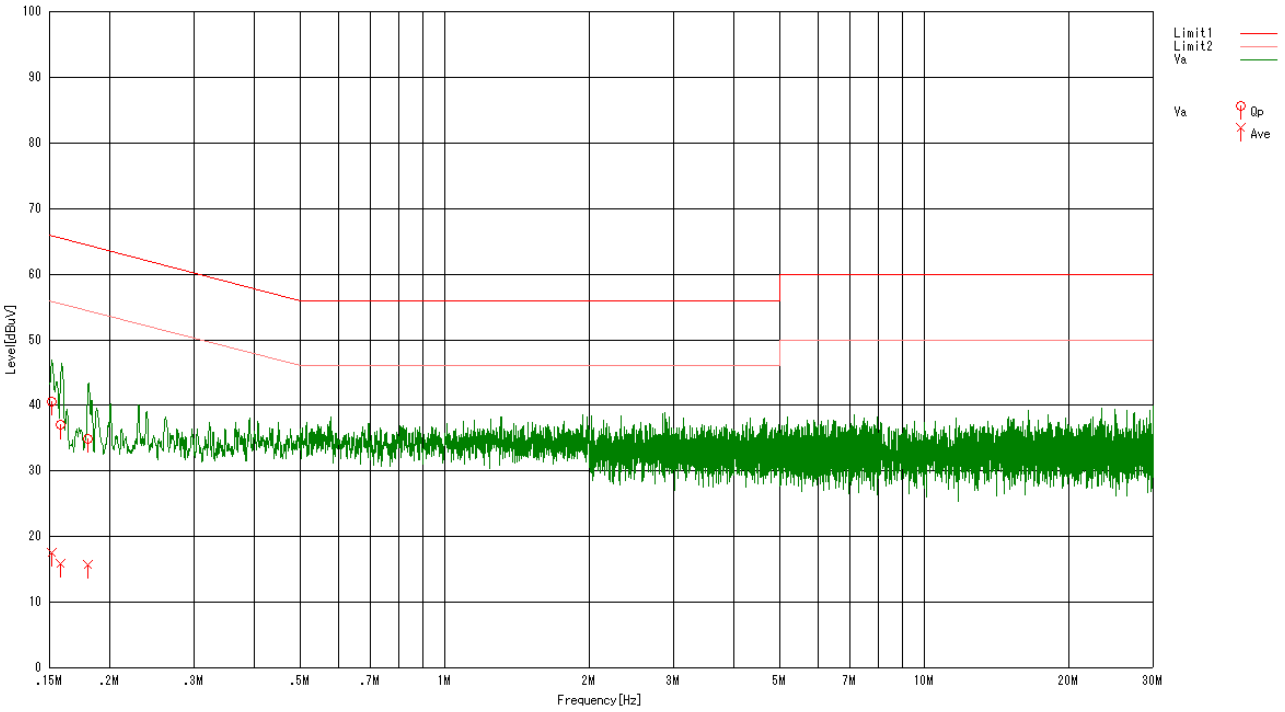
Result = Reading + C. F
where C.F = LISN Factor + Cable Loss [dB]

Sample calculation at 0.151MHz QP result as follow:

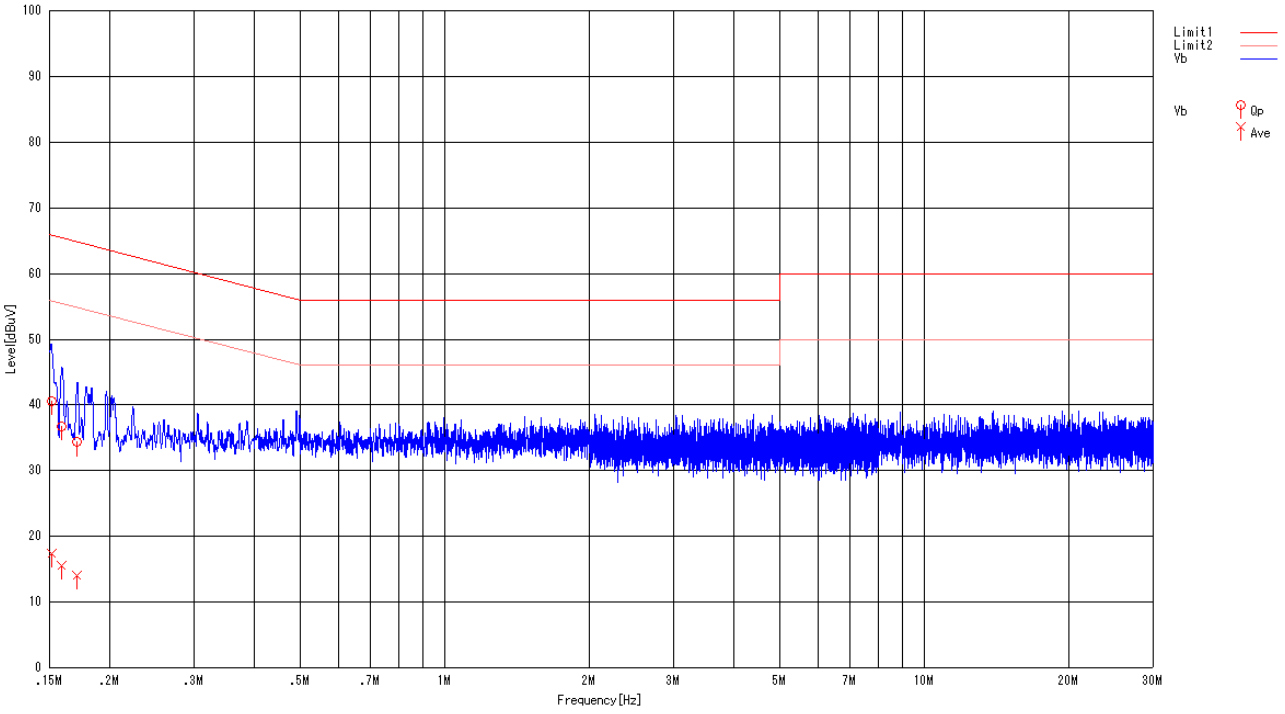
Result [dBuV] = Reading + C.F = 30.4 + 10.2 = 40.6 [dBuV]
Margin = Limit – Result = 65.9 – 40.6 = 25.3 [dBuV]

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

AC Power line conducted emission. (Phase Va)



AC Power line conducted emission. (Phase Vb)



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(EM)	Anechoic Chamber (1st test room)	JSE	203397C	-	2011/04/23	2012/04/30
AC01(EG)	Anechoic Chamber (1st test room)	JSE	203397C	-	2010/11/13	2011/11/30
AT33	Attenuator 10dB 26GHz	INMET	26A-10	FT2075	2010/07/14	2011/07/31
BA04	Bilogical Antenna	SCHAFFNER	CA2855	2903	2011/01/26	2012/01/31
CL11	Antenna Cable for RE	RFT	-	-	2010/10/19	2011/10/31
CL18	Antenna Cable for CE	RFT	-	-	2011/05/13	2012/05/31
CL22	RF Cable 2.0m	SUHNER	SUCOFLEX104	274755	2011/03/10	2012/03/31
CL23	RF Cable 0.5m	SUCOFLEX	SF104PE	48773/4PE	2010/06/15	2011/06/30
CL24	RF Cable 5.0m	SUCOFLEX	SF104PE	48775/4PE	2010/06/15	2011/06/30
CL28	RF Cable 1.0m	SUHNER	SUCOFLEX104PE	75769	2010/08/04	2011/08/31
DH01	DRG Horn Antenna	A.H. Systems	SAS-571	785	2010/01/20	2012/01/31
HPF1	High Pass Filter (3500MHz)	TOKIMEC	TF323DCA	603	2010/06/15	2011/06/30
LN06	LISN	Kyoritsu	KNW-407F	8-1773-3	2011/05/17	2012/05/31
PR08	Pre. Amplifier	Sonoma Instrument	315	263504	2011/01/12	2012/01/31
PR12	Pre. Amplifier (1-26G)	Agilent Technologies	8449B	3008A02513	2011/01/18	2012/01/31
SA06	Spectrum Analyzer (F/W: 3.60 SP1)	Rohde & Schwarz	FSP40	100071	2010/11/15	2011/11/30
SH01	Standard Horn Antenna (18-26G)	A.H. Systems	SAS-572	208	2008/07/23	2011/07/22
TR04	Test Receiver (F/W : 4.32)	Rohde & Schwarz	ESCI	100447	2010/09/21	2011/09/30
TR06	Test Receiver (F/W : 3.93 SP2)	Rohde & Schwarz	ESU26	100002	2010/09/02	2011/09/30

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.