

TEST REPORT

For

Digital Wireless Audio Transceiver Module

In conformity with

FCC CFR 47 Part15 (October 1, 2007) / RSS-210 Issue 7, RSS-Gen Issue 2

Model: DWAM81-IA

FCC ID/ IC Certification No.: ASIV5X004 / 2320A-V5X004

Test Item: Digital Wireless Audio Transceiver Module

Report No: RY0906J15R1

Issue Date: 15 June, 2009

Prepared for

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Prepared by

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History

Report No.	Date	Revisions	Revised By
RY0906J15R1	15 June, 2009	Initial Issue	R.Kojima

1 General information

1.1 Product description


Test item : Digital Wireless Audio Transceiver Module
Manufacturer : Victor Company of Japan, Limited
Address : Maebashi-Plant 1-10-1, Ohwatari-machi, Maebashi-shi, Gunma 371-8543,
Japan
Model : DWAM81-IA
FCC ID : ASIV5X004
IC Certification No : 2320A-V5X004
Serial numbers : A0917D81A00102 (for radiated), A0917D81A00106 (for conducted)
Fundamental Operated Frequency : Tx/Rx Freq. (2400 MHz – 2483.5 MHz)
Oscillator frequencies : 22 MHz, 3216 MHz, 3250.67MHz, 3285.33MHz
Type of Modulation : QPSK
RF Output Power : 10.91mW (measured at the antenna terminal)
Antenna Gain : 1.00dBi (Manufacturer declared)
Receipt date of EUT : 1 June, 2009
Nominal power source voltages : DC 3.3V

1.2 Test(s) performed/ Summary of test result

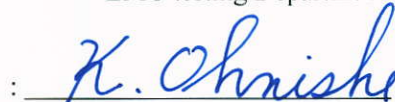
Test specification(s) : FCC CFR 47. Part 15 (October 1, 2007) / RSS-210 Issue 7, RSS-Gen Issue 2
Test method(s) : ANSI C63.4: 2003
Test(s) started : 2 June, 2009
Test(s) completed : 11 June, 2009
Purpose of test(s) : Grant for Certification of FCC / IC
Summary of test result : Complied

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


R. Kojima
Engineer
EMC testing Department

Reviewer


K. Ohnishi
Manager
EMC testing Department

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) Each registered facility number is as follows;

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

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;

Conducted emission: ± 1.9 dB (10 kHz – 30 MHz)

Radiated emission (9 kHz - 30MHz): ± 2.8 dB

Radiated emission (30MHz - 1000MHz): ± 5.7 dB

Radiated emission (1.0GHz – 18.0GHz): ± 5.8 dB

Radiated emission (18.0GHz – 26.0GHz): ± 5.9 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	Sample	Section in this report
1.5.1 Occupied Bandwidth (6 dB/99%)	15.247(a)(2)	A8.2(a)	Complied	A2	2.1
1.5.2 Peak Output Power	15.247(b)(3)	A8.4(4)	Complied	A2	2.2
1.5.3 Peak power spectral density	15.247(e)	A8.2(b)	Complied	A2	2.3
1.5.4 Conducted Spurious Emissions	15.247(d)	A8.5	Complied	A2	2.4
1.5.5 Transmitter Radiated Spurious Emissions	15.205(b)/15.209	A8.5	Complied	A1	2.5
1.5.6 Transmitter AC Power Line Conducted Emissions	15.207	RSS-Gen 7.2.2	Complied	A1	2.6
1.5.7 Receiver Radiated Spurious Emissions	15.109	RSS-Gen 6	Complied	A1	2.7
1.5.8 Receiver AC Power Line Conducted Emissions	15.107	RSS-Gen 7.2.2	Complied	A1	2.8

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	Digital Wireless Audio Transceiver Module	Victor Company Of Japan, Limited	DWAM81-IA	A0917D81A00102	For Radiated
A2	Digital Wireless Audio Transceiver Module	Victor Company Of Japan, Limited	DWAM81-IA	A0917D81A00106	For Conducted

Support Equipment(s):

	Item	Manufacturer	Model No.	Serial No.
B	DWAM81 4ch EVK	WSS	DWAM81 4CH EVK Lx	EK14091500081
C	AC Adapter	-	ADS6818-0610	-
D	Ferrite core (2 turn)	SIEWA	E04SR200932	-

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	26pin FFC cable	KOTOBO	No	No	No	0.08
2	DC power cable	-	No	YES	No	1.8

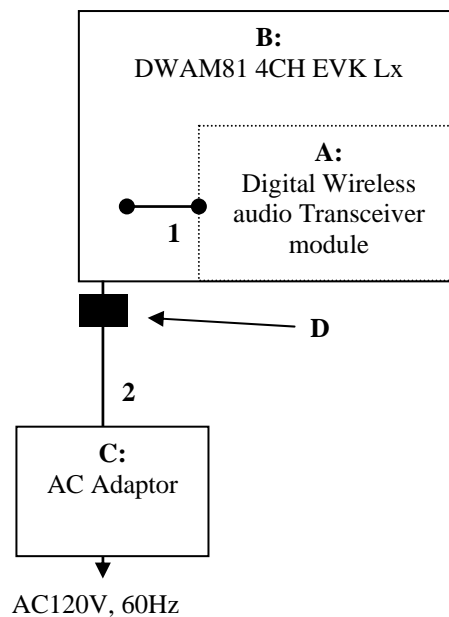
1.6.2 Operating condition:

Operating mode:

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

- (1-1) QPSK, Max Continuous transmitting with antenna A (2412MHz)
- (1-2) QPSK, Max Continuous transmitting with antenna B (2412MHz)
- (1-3) QPSK, Max Continuous transmitting with antenna A (2438MHz)
- (1-4) QPSK, Max Continuous transmitting with antenna B (2438MHz)
- (1-5) QPSK, Max Continuous transmitting with antenna A (2464MHz)
- (1-6) QPSK, Max Continuous transmitting with antenna B (2464MHz)
- (2-1) Continuous receiving with antenna A (2412MHz)
- (2-2) Continuous receiving with antenna B (2412MHz)
- (2-3) Continuous receiving with antenna A (2438MHz)
- (2-4) Continuous receiving with antenna B (2438MHz)
- (2-5) Continuous receiving with antenna A (2464MHz)
- (2-6) Continuous receiving with antenna B (2464MHz)

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

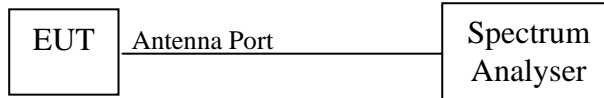
No deviations from the standards described in clause 1.2.

2 Test procedure and test data

2.1 Occupied Bandwidth (6 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.

When performed the measurement of 6dB OBW, The RBW is set to 100kHz. The VBW is set to 3 times of the RBW. The sweep time is coupled appropriate.

When performed the measurement of 99 % OBW, The RBW is set to 1% - 3% of the 99% bandwidth. The VBW is set to 3 times of the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

The sweep time is coupled appropriate.

Limitation

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

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

SA06	CL23				
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Test results

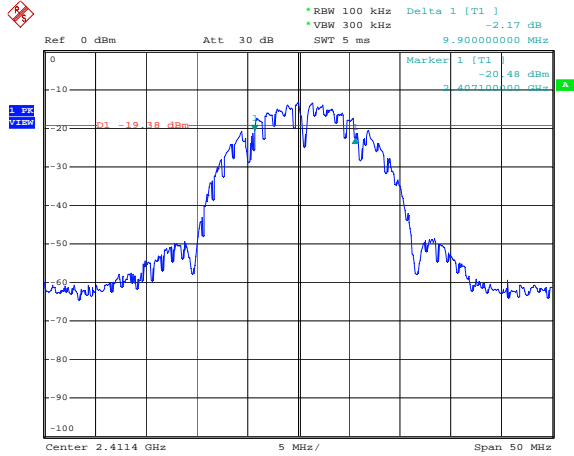
Antenna	Transmission Channel	Transmission Frequency [MHz]	Bandwidth [MHz]	
			6dB	99%
A	Low (2412MHz)	2412	9.9	16.1
	Middle (2438MHz)	2438	10.0	16.1
	High (2464MHz)	2464	10.0	16.1
B	Low (2412MHz)	2412	10.3	16.1
	Middle (2438MHz)	2438	10.0	16.1
	High (2464MHz)	2464	10.0	16.1

Test Data

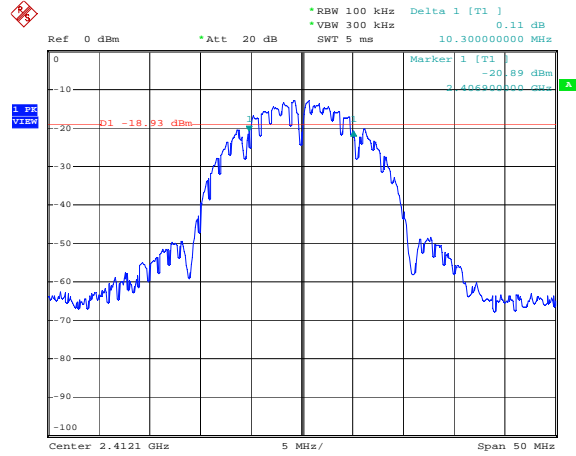
Tested Date: 8 June, 2009

Temperature: 25 °C
 Humidity: 55 %
 Atmos. Press: 1009 hPa

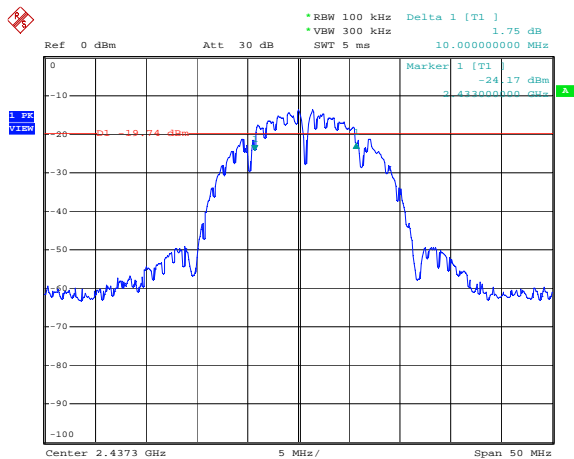
6dB Bandwidth



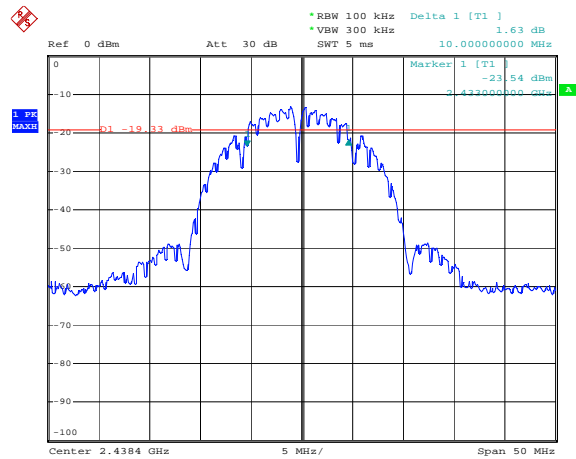
Antenna A Low Ch.



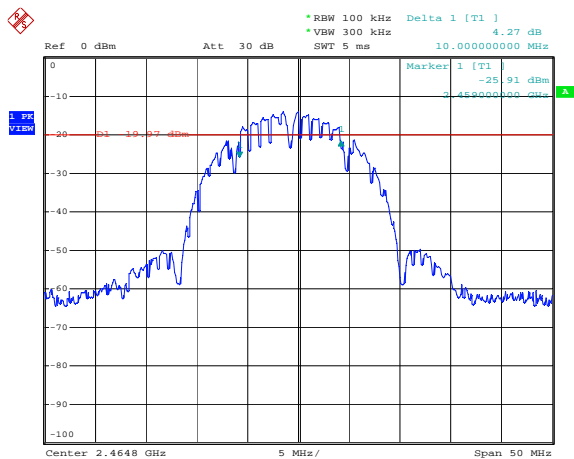
Antenna B Low Ch.



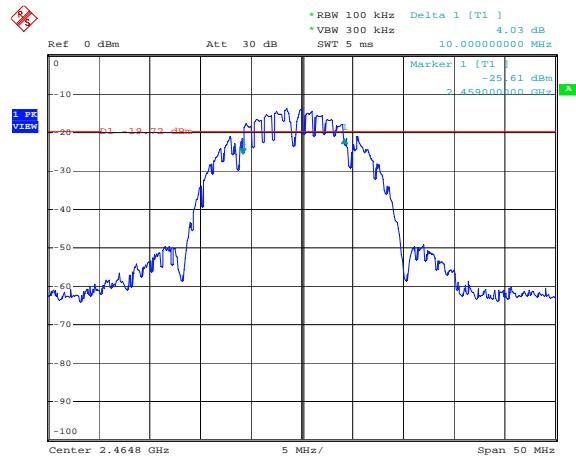
Antenna A Middle Ch.



Antenna B Middle Ch.

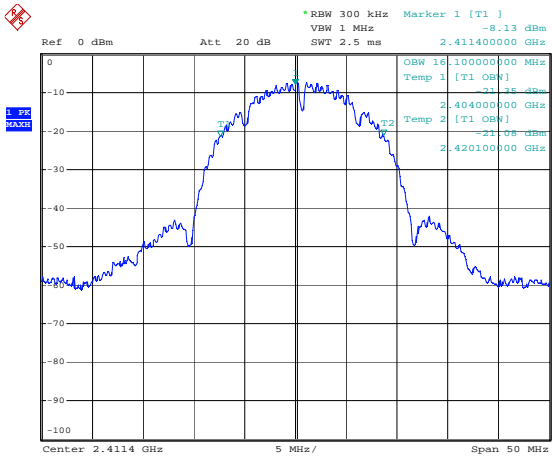


Antenna A High Ch.

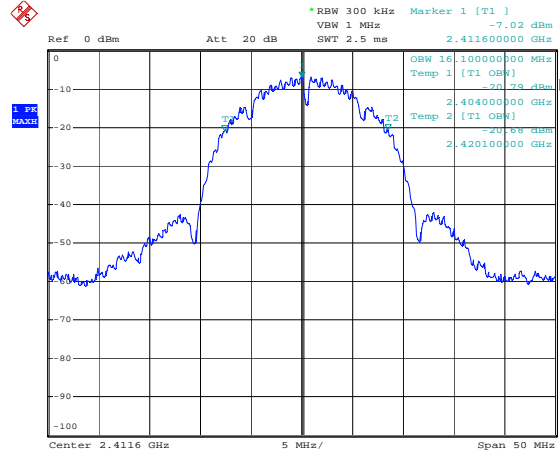


Antenna B High Ch.

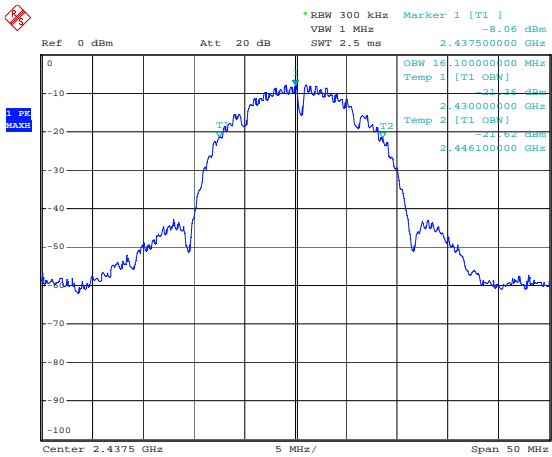
99% Occupied Bandwidth



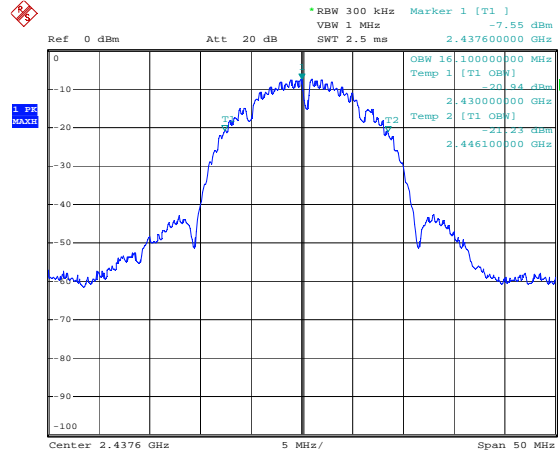
Antenna A Low Ch.



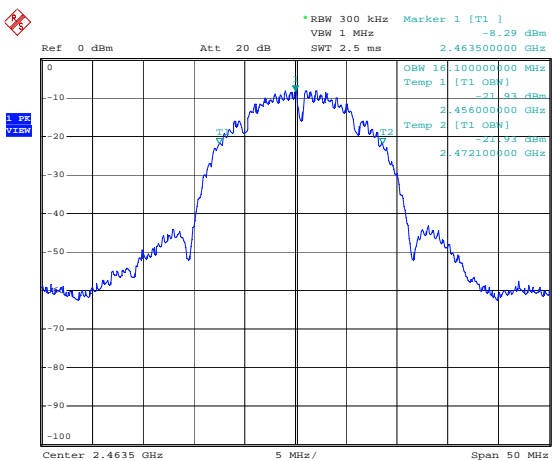
Antenna B Low Ch.



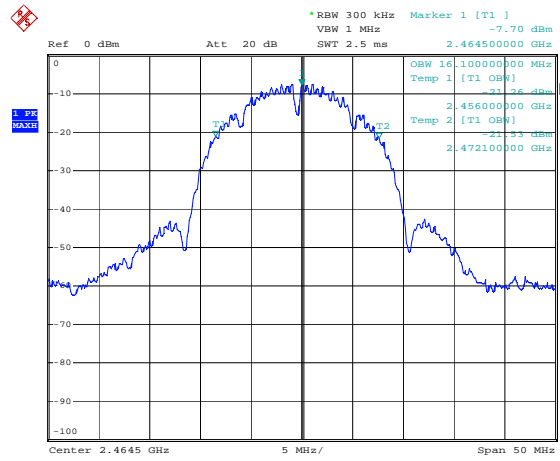
Antenna A Middle Ch.



Antenna B Middle Ch.



Antenna A High Ch.

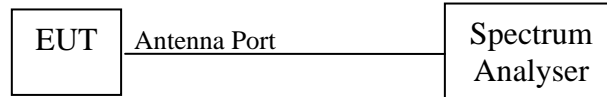


Antenna B High Ch.

2.2 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 and the analyzer's internal channel power integration function is used.

The test is performed in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005. The transmitter operations continuously therefore Power Output Option 2, Method #3 is used.

Limitation

15.247(b) (3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 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 antennas and antenna elements. The average must not include any time 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 *maximum conducted output power* is the highest total transmit power occurring in any mode

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

SA06	CL23				
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Test results – comply with the limitation.

Test Data

Tested Date: 10 June, 2009

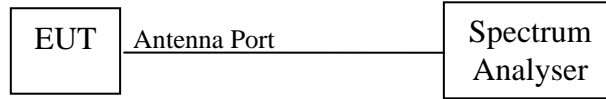
Temperature: 22 °C
 Humidity: 65 %
 Atmos. Press: 1003 hPa

Antenna	Transmission Channel (Frequency: MHz)	Cable loss (dB)	Output power (dBm) [Reading]	Output power (dBm) [Result]	Output power (mW) [Result]
A	Low (2412)	0.70	9.20	9.90	9.77
	Middle (2438)	0.70	8.82	9.52	8.95
	High (2464)	0.70	8.56	9.26	8.43
B	Low (2412)	0.70	9.68	10.38	10.91
	Middle (2438)	0.70	9.22	9.92	9.82
	High (2464)	0.70	9.06	9.76	9.46

2.3 Peak power spectral density

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 maximum level in a 3kHz bandwidth. The measured with the spectrum analyzer set to RBW = 3kHz and VBW = 10 kHz, Sweep time = automatic Used peak detector. The PPSD is the highest level found across the emission in any 3kHz band.

Limitation

15.247(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

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

SA06	CL23				
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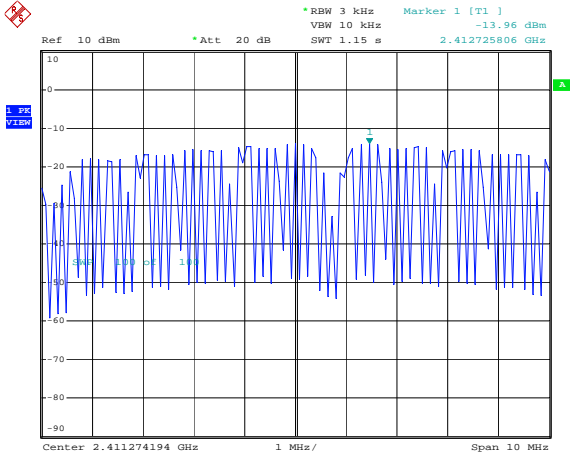
Test results – Comply with the limitation

Antenna	Transmission Channel (Frequency: MHz)	Cable loss (dB)	Output power (dBm) [Reading]	Output power (dBm) [Result]
A	Low (2412)	0.70	-13.96	-13.26
	Middle (2438)	0.70	-14.48	-13.78
	High (2464)	0.70	-14.67	-13.97
B	Low (2412)	0.70	-14.10	-13.40
	Middle (2438)	0.70	-14.59	-13.89
	High (2464)	0.70	-14.68	-13.98

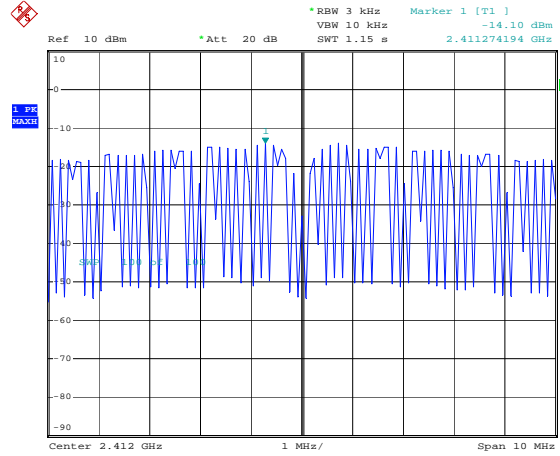
Test Data

Tested Date: 11 June, 2009

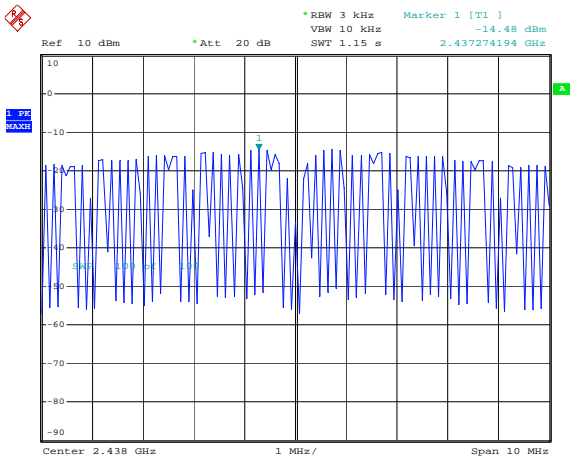
Temperature: 23 °C
Humidity: 65 %
Atmos. Press: 997 hPa



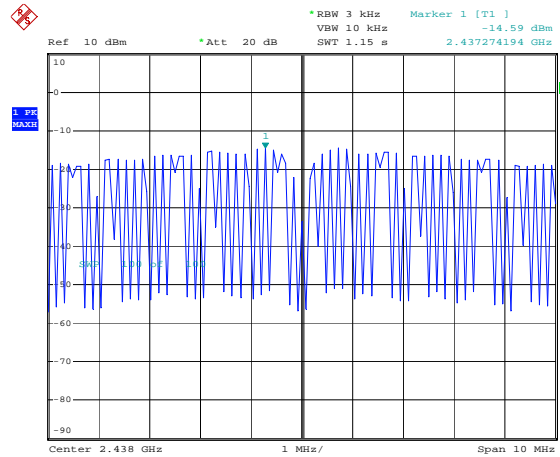
Antenna A Low Ch.



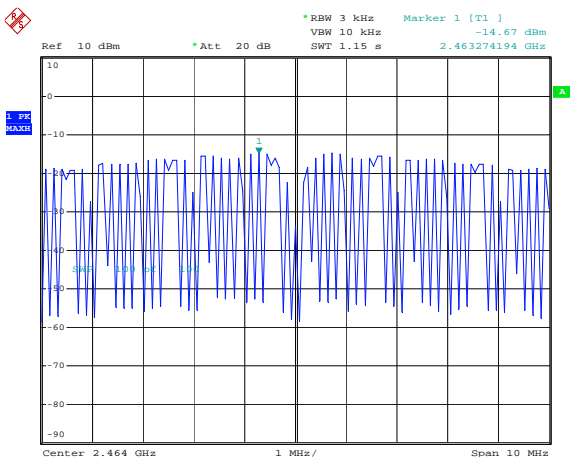
Antenna B Low Ch.



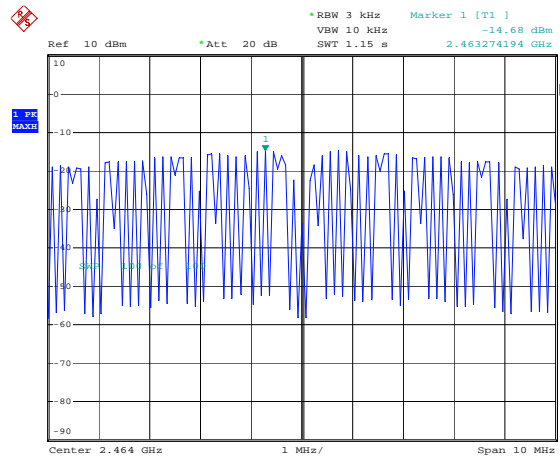
Antenna A Middle Ch.



Antenna B Middle Ch.



Antenna A High Ch.

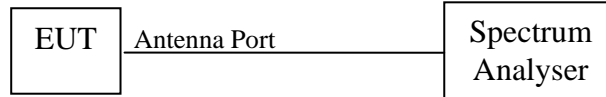


Antenna B High Ch.

2.4 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)

SA06	CL23				
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Test results – comply with the limitation.

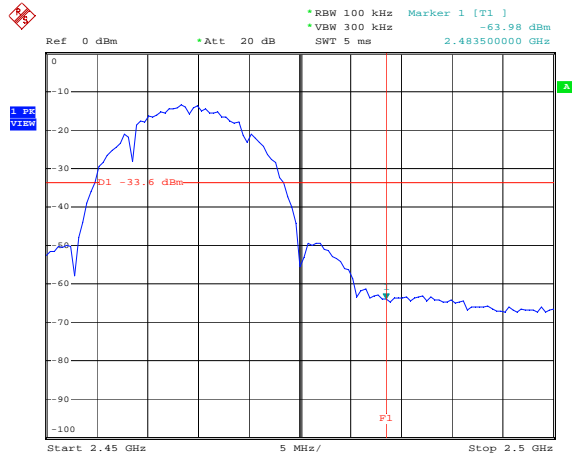
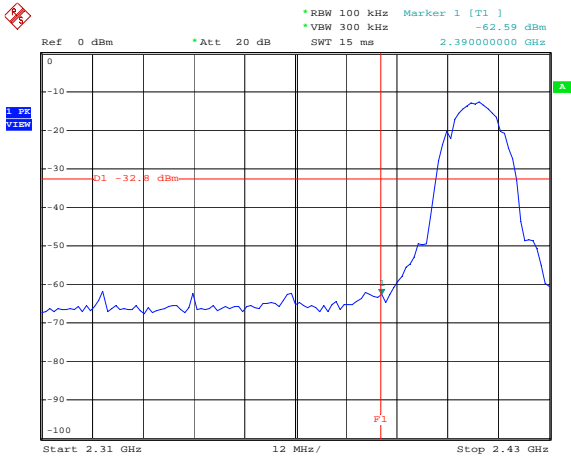
There were no conducted spurious emissions greater than noise floor or 20dB below the limit.

Test Data

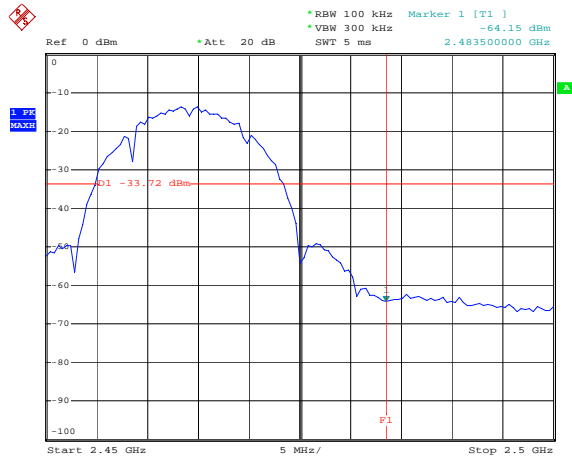
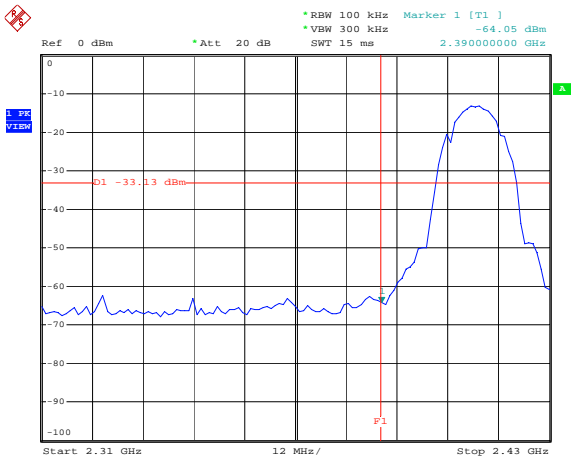
Tested Date: 10 June, 2009

Temperature: 22 °C
 Humidity: 65 %
 Atmos. Press: 1003 hPa

Restricted Band Edge

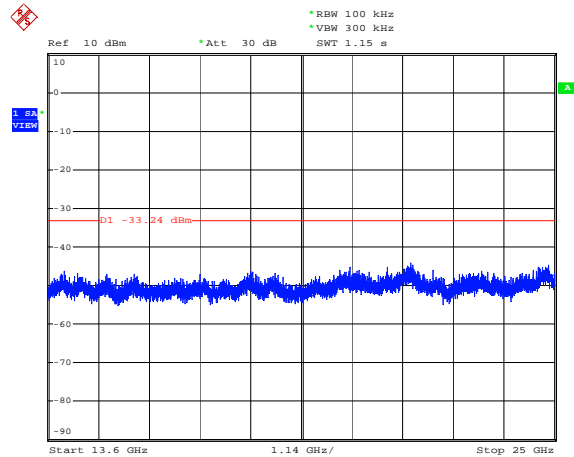
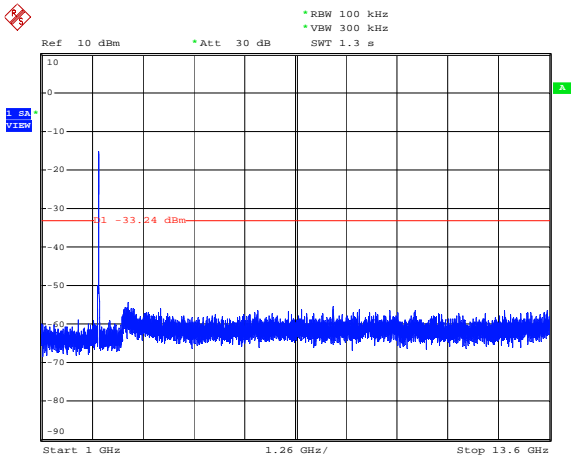


Antenna A

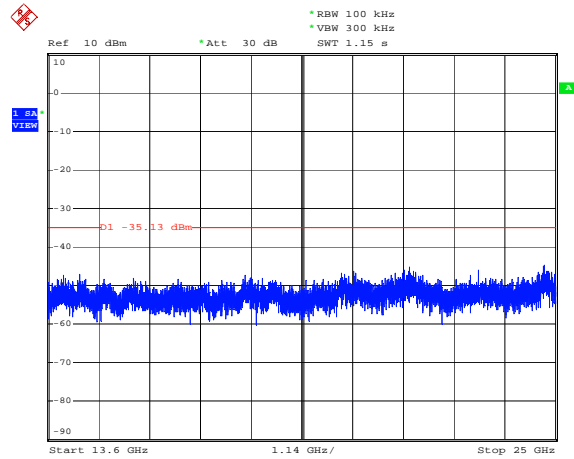
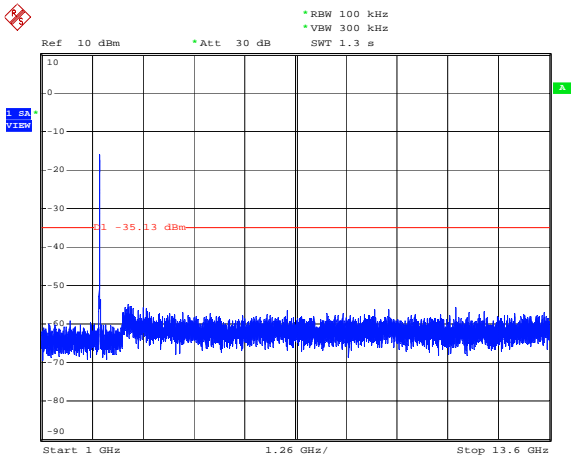


Antenna B

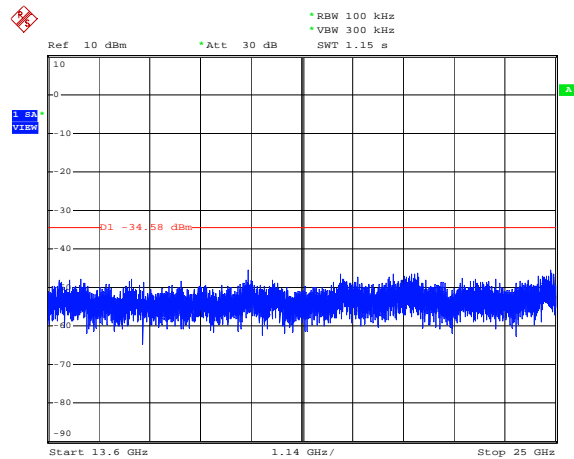
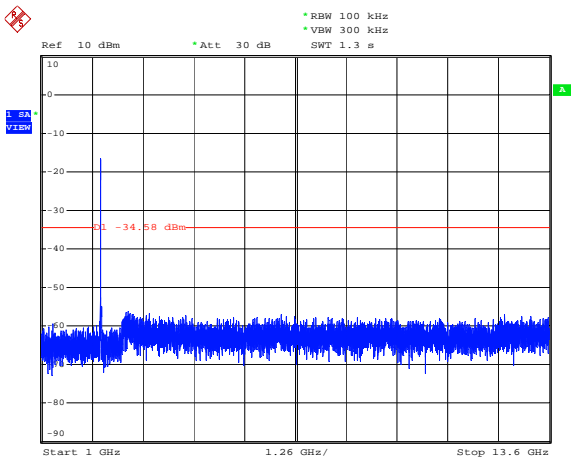
Worst Configuration (Antenna A)



Low Ch.(2412MHz)



Middle Ch.(2438MHz)

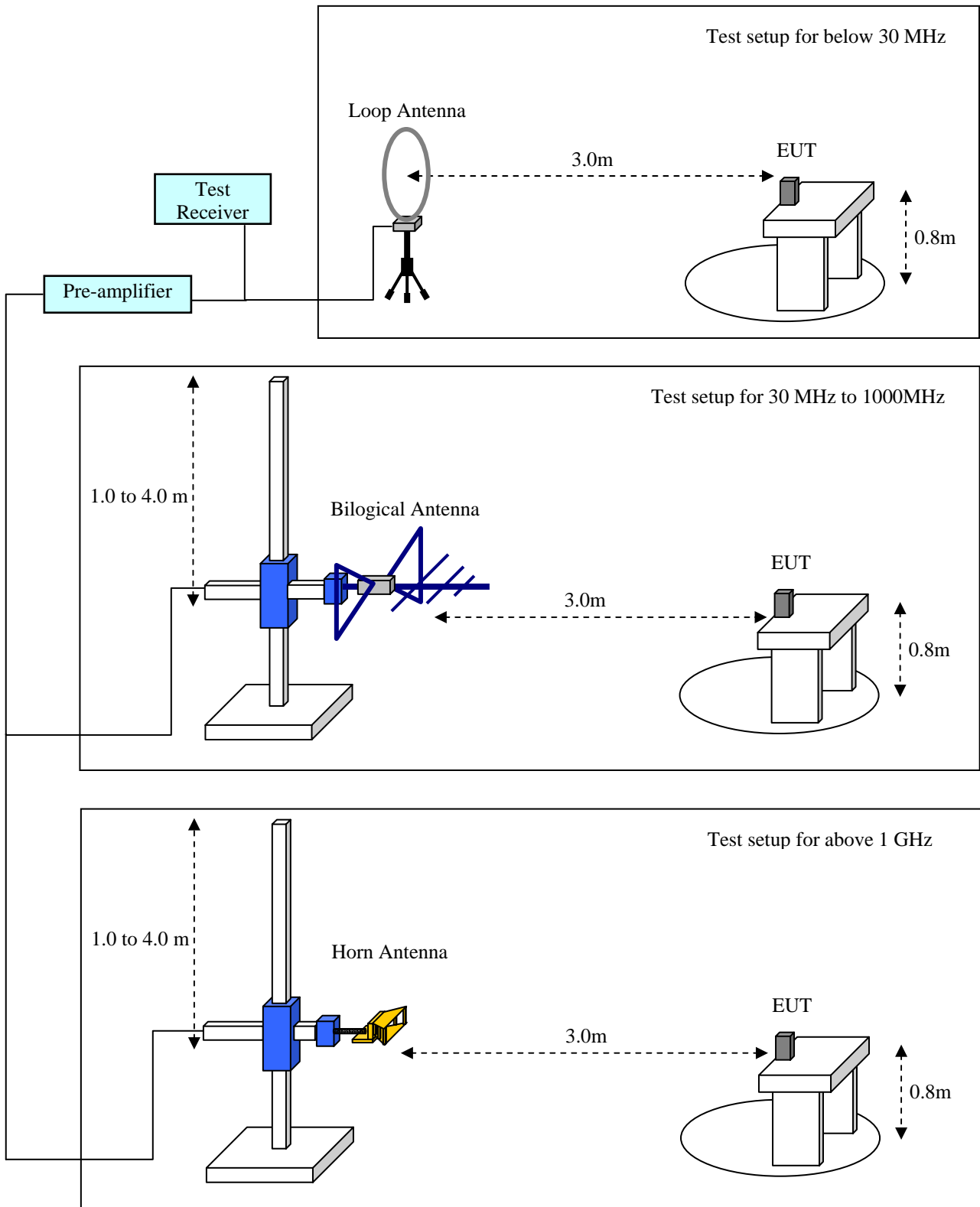


High Ch.(2464MHz)

2.5 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 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.

Test results - Complied with requirement.

Test Data

2.5.1 Below 30 MHz

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

LP01	CL11	TR06	
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Tested Date: 5 June , 2009

Temperature: 21 °C
Humidity: 64 %
Atmos. Press: 1007 hPa

Result

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

2.5.2 Between 30 – 1000 MHz

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

BA04	CL11	PR03	TR06
------	------	------	------

Tested Date: 5 June , 2009

Temperature: 21 °C
 Humidity: 64 %
 Atmos. Press: 1007 hPa

Operating mode: Continuous transmitting with antenna A (2438MHz)

EUT position: X-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	61.439	42.0	6.6	7.8	29.6	26.8	40.0	13.2	Ver
2	86.015	39.9	8.1	8.1	29.6	26.5	40.0	13.5	Ver
3	483.998	36.2	17.3	14.5	29.7	38.3	46.0	7.7	Hori
4	483.998	33.1	17.3	14.5	29.7	35.2	46.0	10.8	Ver
5	527.998	38.8	18.0	14.4	29.7	41.5	46.0	4.5	Hori
6	527.998	38.4	18.0	14.4	29.7	41.1	46.0	4.9	Ver

Calculation method

The Correction Factors and RESULT are calculated as followings.

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

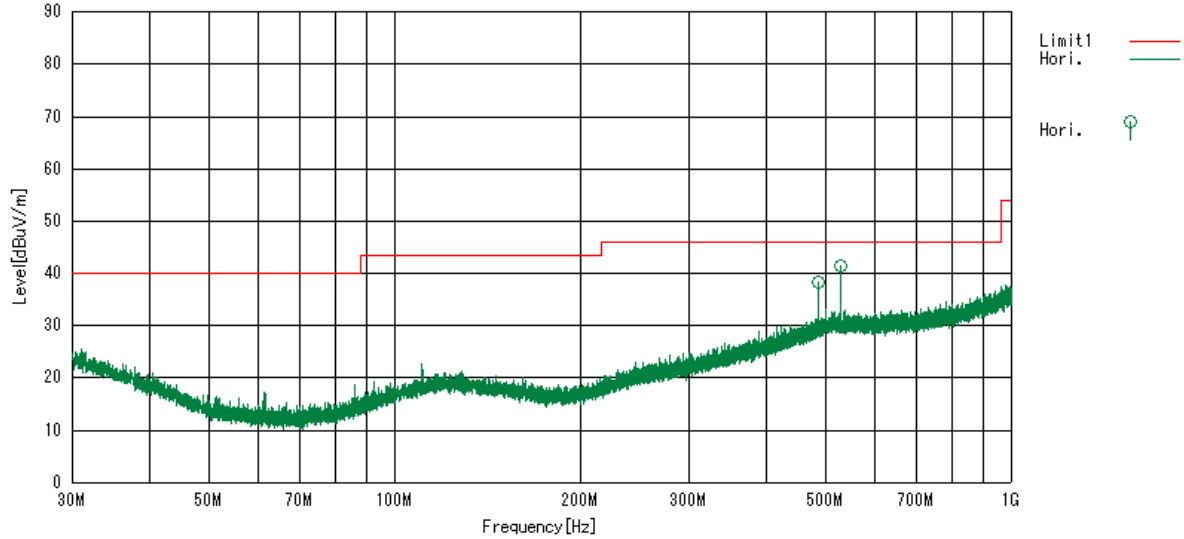
$$\text{RESULT [dBuV/m]} = \text{READING [dBuV]} + \text{Correction Factor [dB/m]}$$

Sample calculation at 527.998 MHz Horizontal result as follow:

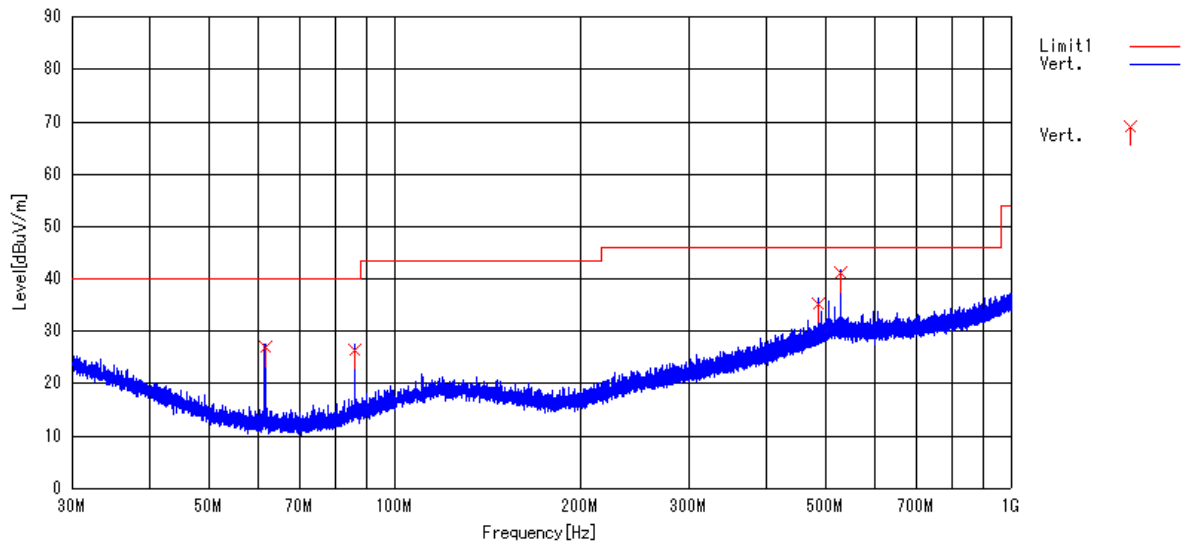
$$\begin{aligned} \text{Result [dBuV/m]} &= \text{Reading} + \text{C.F} = 38.8 + 18.0 + 14.4 - 29.7 = 41.5 \\ \text{Margin} &= \text{Limit} - \text{Result} = 46.0 - 41.5 = 4.5 \text{ [dB]} \end{aligned}$$

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

Antenna polarization: Horizontal



Antenna polarization: Vertical



2.5.3 Above 1000 MHz

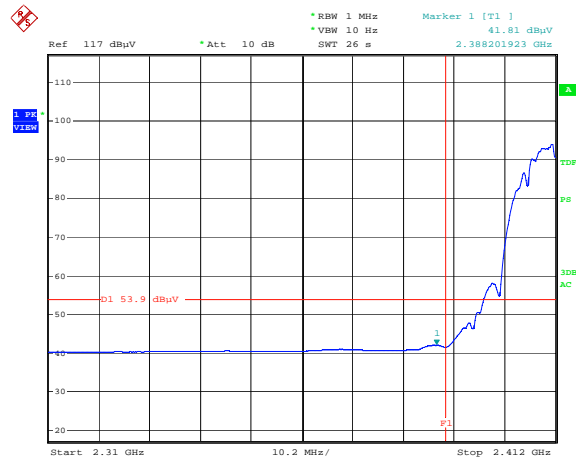
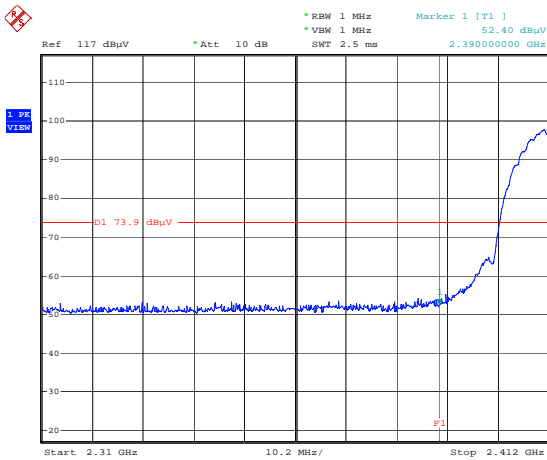
Test equipment used (refer to List of utilized test equipment)

PR12	SH01	TR06	CL23	CL24	HPF1	DH02	AC01
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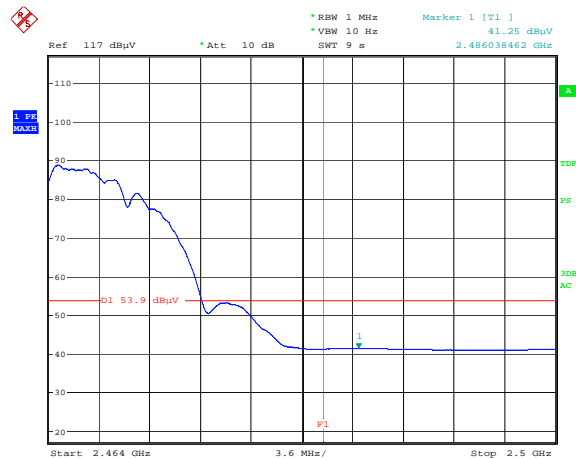
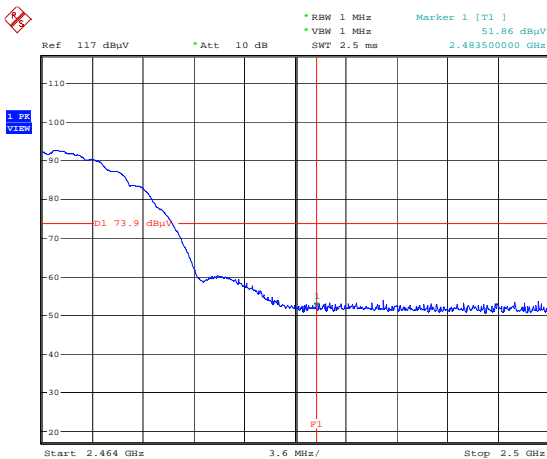
Tested Date: 4 June, 2009

Temperature: 21 °C
 Humidity: 60 %
 Atmos. Press: 1007 hPa

Restricted Band Edge Worst configuration (antenna B Vertical, Z axis)



Worst configuration (antenna A Vertical, Z axis)



Harmonics and Spurious Emission above 1000 MHz

Operating mode: Continuous transmitting with antenna A (2438MHz)

EUT position: X-plane (Maximum position)

Measurement distance: 3 m

No	Frequency MHz	Reading[Pk] dBuV	Reading[Av] dBuV	C.Fac dB	Result[Pk] dBuV/m	Result[Av] dBuV/m	Limit[Pk] dBuV/m	Limit[Av] dBuV/m	Margin[Pk] dB	Margin[Av] dB	PHASE
1	14472	35.6	24.4	14.4	50.0	38.8	73.9	53.9	23.9	15.1	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 14472 MHz Average, vertical result as follow:

$$\text{Result [dBuV/m]} = \text{Reading} + \text{C.F} = 24.4 + 14.4 = 38.8$$

$$\text{Margin} = \text{Limit} - \text{Result} = 53.9 - 38.8 = 15.1 \text{ [dB]}$$

2.6 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 grater 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)

TR06	PL06	LN05	CL11
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Test results - Complied with requirement.

Test Data

Tested Date: 5 June, 2009

Temperature: 21 °C
 Humidity: 64 %
 Atmos. Press: 1007 hPa

Operating mode: Continuous Communication

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	0.18294	36.2	26.7	0.3	36.5	27.0	64.4	54.4	27.9	27.4	N
2	0.36558	36.8	23.4	0.1	36.9	23.5	58.6	48.6	21.7	25.1	N
3	0.36896	38.7	24.9	0.1	38.8	25.0	58.5	48.5	19.7	23.5	L
4	0.45792	37.2	21.0	0.1	37.3	21.1	56.7	46.7	19.4	25.6	L
5	0.55338	33.8	18.8	0.1	33.9	18.9	56.0	46.0	22.1	27.1	L
6	0.64099	34.8	17.9	0.2	35.0	18.1	56.0	46.0	21.0	27.9	L
7	0.64382	31.6	18.6	0.2	31.8	18.8	56.0	46.0	24.2	27.2	N
8	0.73090	32.4	16.9	0.2	32.6	17.1	56.0	46.0	23.4	28.9	N
9	0.82500	30.5	17.0	0.2	30.7	17.2	56.0	46.0	25.3	28.8	N
10	1.00904	31.1	16.8	0.2	31.3	17.0	56.0	46.0	24.7	29.0	N
11	12.27784	27.5	25.1	1.0	28.5	26.1	60.0	50.0	31.5	23.9	N
12	12.28788	30.0	26.8	1.0	31.0	27.8	60.0	50.0	29.0	22.2	L
13	27.64776	22.8	18.7	1.5	24.3	20.2	60.0	50.0	35.7	29.8	N
14	27.64776	27.6	24.1	1.5	29.1	25.6	60.0	50.0	30.9	24.4	L

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:

$$\text{Result} = \text{Reading} + \text{C.F}$$

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

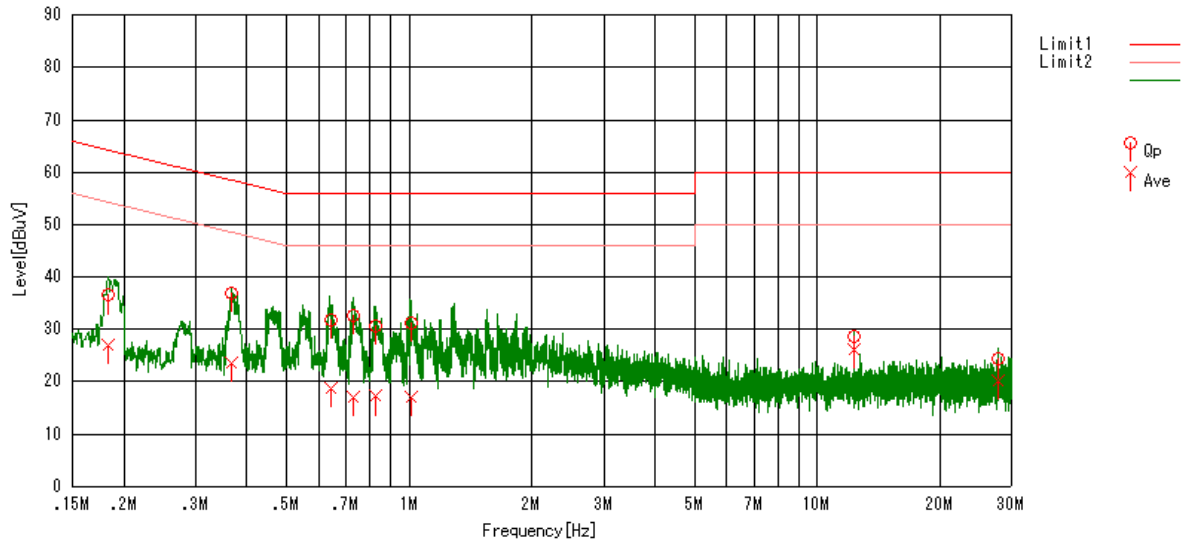
Sample calculation at 0.45792 MHz QP result as follow:

$$\text{Result [dBuV]} = \text{Reading} + \text{C.F} = 37.2 + 0.1 = 37.3 \text{ [dBuV]}$$

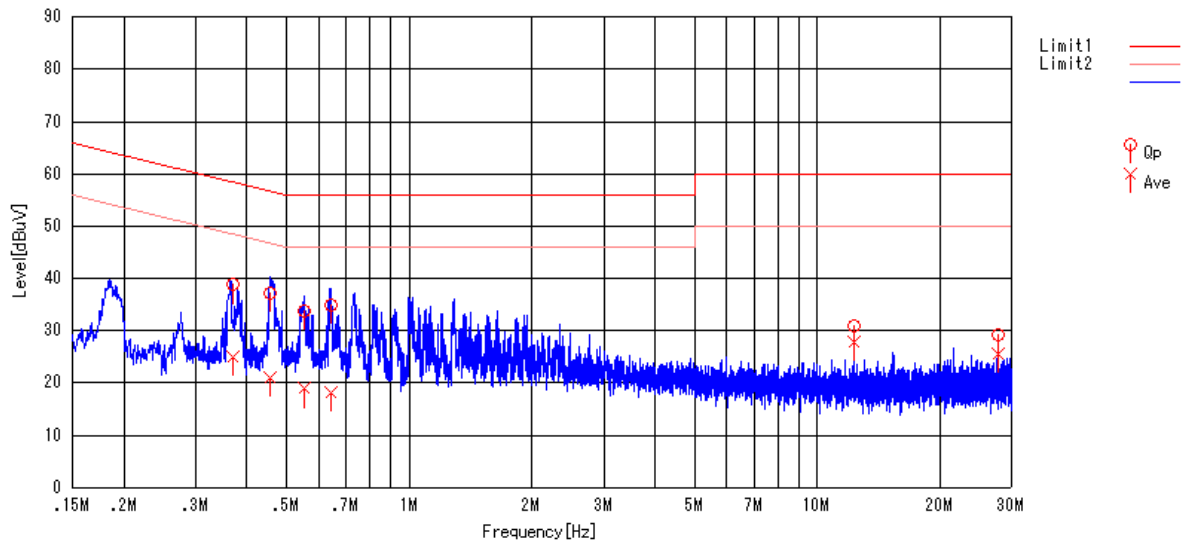
$$\text{Margin} = \text{Limit} - \text{Result} = 56.7 - 37.3 = 19.4 \text{ [dB]}$$

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

AC Power line conducted emission. (Phase N)



AC Power line conducted emission. (Phase L)



2.7 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	3.0	100	40.0
88 – 216	3.0	150	43.5
216 – 960	3.0	200	46.0
Above 960	3.0	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. Radiated emission limits in the above bands are based on measurements employing an average detector.

Test results - Complied with requirement.

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

BA04	CL11	PR03	TR06
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Tested Date: 5 June , 2009

Temperature: 21 °C
Humidity: 64 %
Atmos. Press: 1007 hPa

Operating mode: Continuous transmitting with antenna A (2438MHz)

EUT position: X-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	61.438	42.0	6.6	7.8	29.6	26.8	40.0	13.2	Vert.
2	86.015	38.9	8.1	8.1	29.6	25.5	40.0	14.5	Vert.
3	483.999	36.9	17.3	14.5	29.7	39.0	46.0	7.0	Hori.
4	483.999	34.5	17.3	14.5	29.7	36.6	46.0	9.4	Vert.
5	527.999	39.7	18.0	14.4	29.7	42.4	46.0	3.6	Hori.
6	527.999	39.0	18.0	14.4	29.7	41.7	46.0	4.3	Vert.

Calculation method

The Correction Factors and RESULT are calculated as followings.

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

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

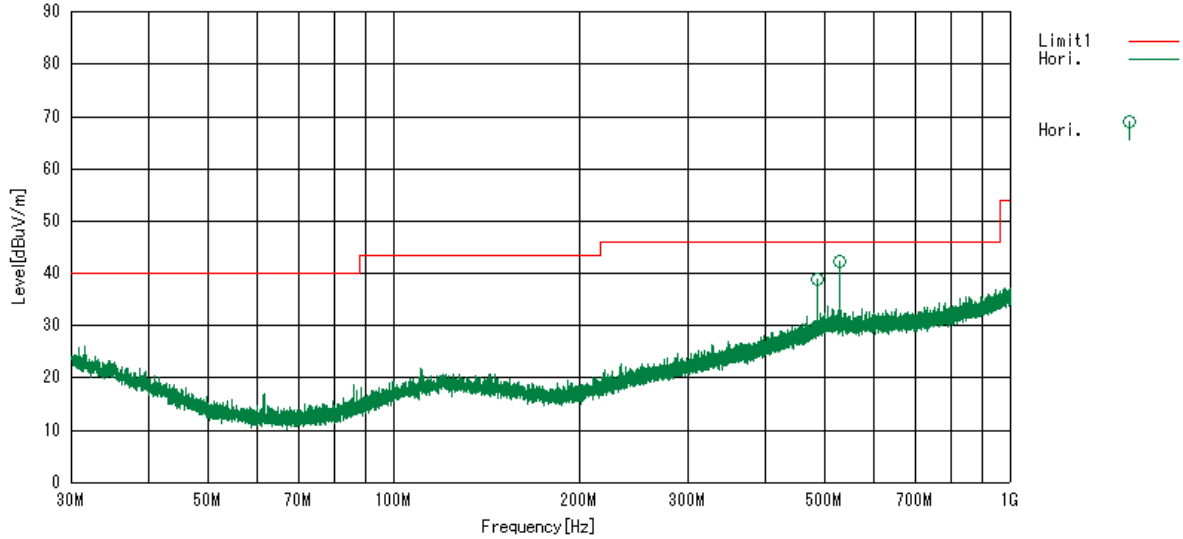
Sample calculation at 527.999 MHz Horizontal result as follow:

$$\text{Result [dBuV/m]} = \text{Reading} + \text{C.F} = 39.7 + 18.0 + 14.4 - 29.7 = 42.4$$

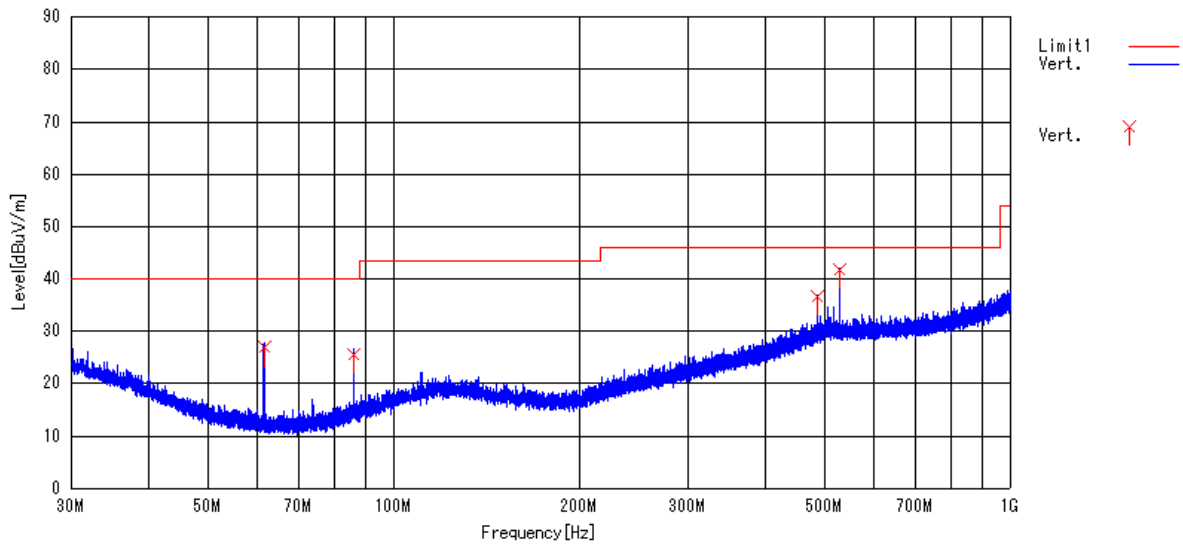
$$\text{Margin} = \text{Limit} - \text{Result} = 46.0 - 42.4 = 3.6 \text{ [dB/m]}$$

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

Antenna polarization: Horizontal



Antenna polarization: Vertical



2.7.2 Above 1000 MHz

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

PR12	TR06	CL23	CL24	DH02		
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Tested Date: 3 June, 2009

Temperature: 21 °C
 Humidity: 60 %
 Atmos. Press: 1010 hPa

Operating mode: Receiving with antenna A (2438MHz)
 EUT position: Y-plane (Maximum position)
 Setting: Configuration 1
 Measurement distance: 3 m

There are no spurious emissions other than listed below;

No.	Frequency [MHz]	Reading [dBuV]	C.F. [dB/m]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Antenna Polarization
1	3250.57	39.6	-2.4	37.2	53.9	16.7	Ver.

C. F. [dB/m] = FACTOR [dB/m] + LOSS [dB] – GAIN [dB]

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 3250.57 MHz vertical result as follow:

$$\text{Result [dBuV/m]} = \text{Reading} + \text{C.F} = 39.6 + -2.4 = 37.2$$

$$\text{Margin} = \text{Limit} - \text{Result} = 53.9 - 37.2 = 16.7 \text{ [dB]}$$

2.8 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)

TR06	PL06	LN05	CL11
------	------	------	------

Test results - Complied with requirement.

Test Data

Tested Date: 5 June, 2009

Temperature: 21 °C
 Humidity: 64 %
 Atmos. Press: 1007 hPa

Operating mode: Receiving (2441MHz: 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	0.25918	39.8	29.6	0.2	40.0	29.8	61.5	51.5	21.5	21.7	L
2	0.26138	37.2	31.6	0.2	37.4	31.8	61.4	51.4	24.0	19.6	N
3	0.51831	36.6	24.1	0.1	36.7	24.2	56.0	46.0	19.3	21.8	L
4	0.52242	34.0	25.8	0.1	34.1	25.9	56.0	46.0	21.9	20.1	N
5	0.64573	34.6	21.0	0.2	34.8	21.2	56.0	46.0	21.2	24.8	L
6	0.64844	32.5	22.6	0.2	32.7	22.8	56.0	46.0	23.3	23.2	N
7	0.78064	34.0	21.9	0.2	34.2	22.1	56.0	46.0	21.8	23.9	L
8	0.78222	32.2	24.0	0.2	32.4	24.2	56.0	46.0	23.6	21.8	N
9	1.16082	30.9	17.1	0.2	31.1	17.3	56.0	46.0	24.9	28.7	L
10	1.17588	29.5	21.4	0.2	29.7	21.6	56.0	46.0	26.3	24.4	N
11	12.28788	27.2	24.6	1.0	28.2	25.6	60.0	50.0	31.8	24.4	N
12	12.28788	29.6	26.3	1.0	30.6	27.3	60.0	50.0	29.4	22.7	L

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:

$$\text{Result} = \text{Reading} + \text{C. F}$$

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

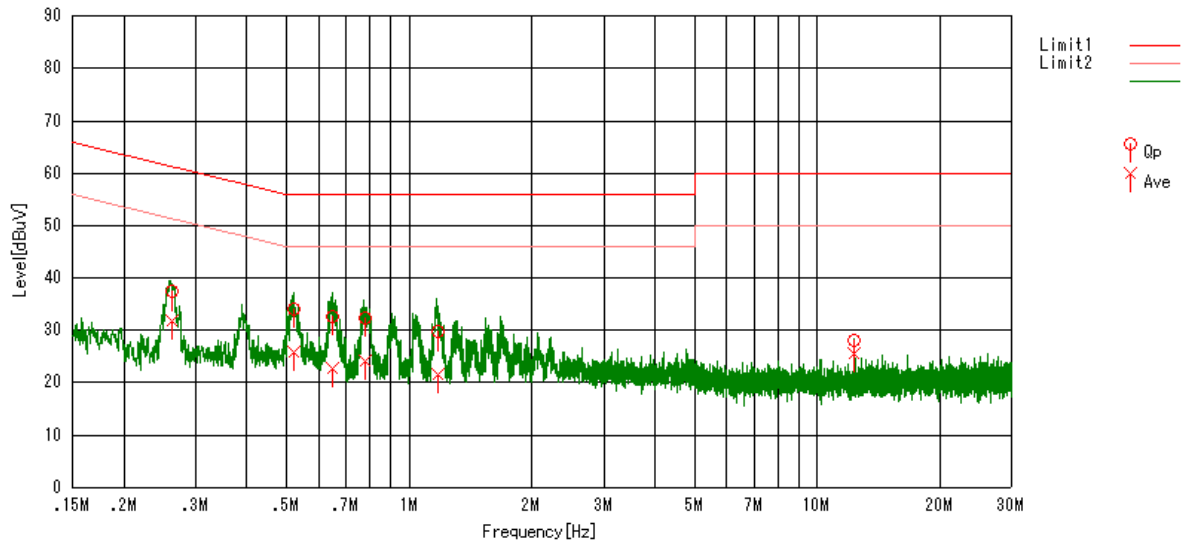
Sample calculation at 0.51831 MHz QP result as follow:

$$\text{Result [dBuV]} = \text{Reading} + \text{C.F} = 36.6 + 0.1 = 36.7 \text{ [dBuV]}$$

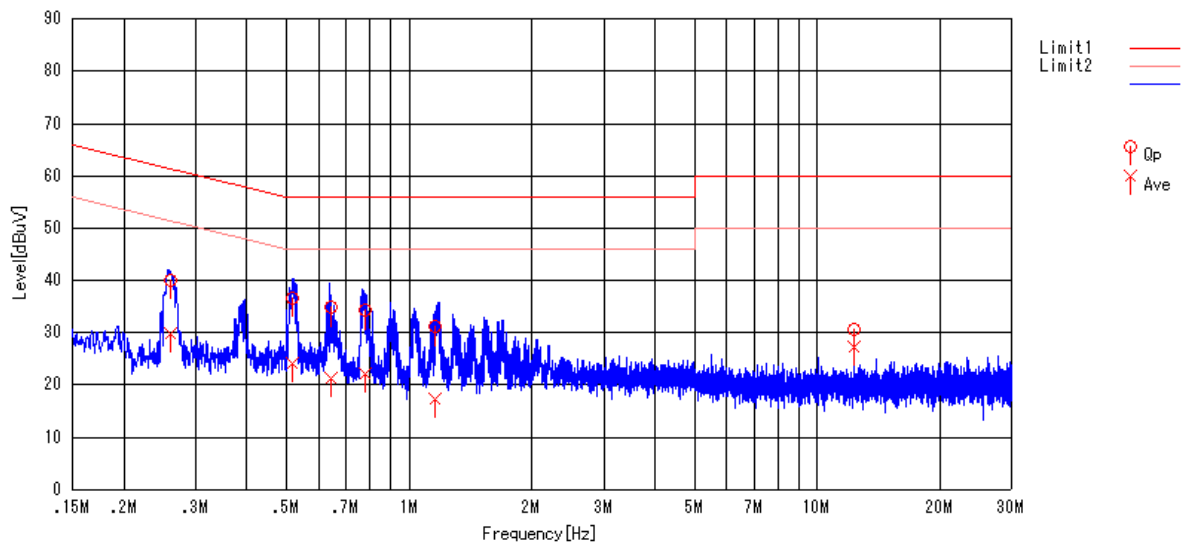
$$\text{Margin} = \text{Limit} - \text{Result} = 56.0 - 36.7 = 19.3 \text{ [dB]}$$

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

AC Power line conducted emission. (Phase N)



AC Power line conducted emission. (Phase L)



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 (1st test room)	JSE	203397C	-	2008/07/04	2009/07/03
BA04	Biological Antenna	CHAFFBER	CA2855	2903	2009/01/27	2010/01/31
CL11	Antenna Cable	RFT	-	-	2009/04/13	2010/04/30
CL22	RF Cable 2.0m	SUCOFLEX	SF104	274755/4	2008/06/10	2009/06/30
CL23	RF Cable 0.5m	SUCOFLEX	SF104PE	48773/4PE	2008/06/10	2009/06/30
CL24	RF Cable 5.0m	SUCOFLEX	SF104PE	48775/4PE	2008/06/10	2009/06/30
PR03	Pre. Amplifier	Anritsu	MH648A	M41984	2009/05/26	2010/05/31
PR12	Pre. Amplifier (1-26G)	Agilent Technologies	8449B	3008A02513	2009/01/13	2010/01/12
SG05	Signal Generator	Rohde & Schwarz	SMR20	100905	2008/06/10	2009/06/30
TR06	Test Receiver (F/W : 3.93 SP2)	Rohde & Schwarz	ESU26	100002	2008/09/02	2009/09/01
DH02	DRG Horn Antenna	A.H. Systems	SAS-200/571	239	2009/04/13	2011/04/30
TC01	Temperature Chamber	ESPEC	SH-641	92000964	2008/11/17	2009/11/30
SA06	Spectrum Analyzer (F/W: 3.60 SP1)	Rohde & Schwarz	FSP40	100071	2008/10/31	2009/10/31

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.