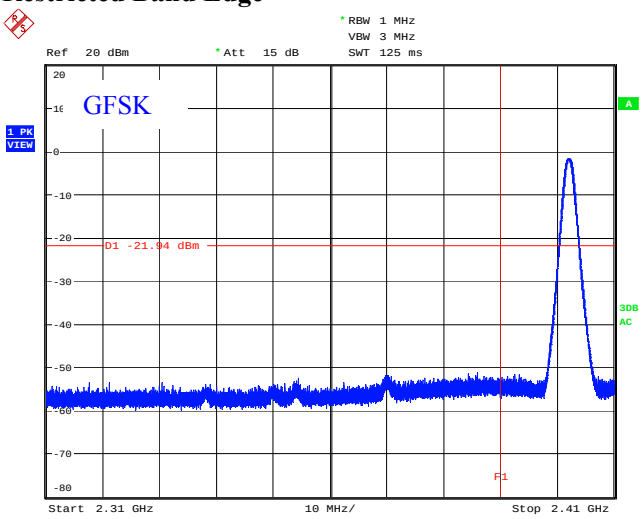
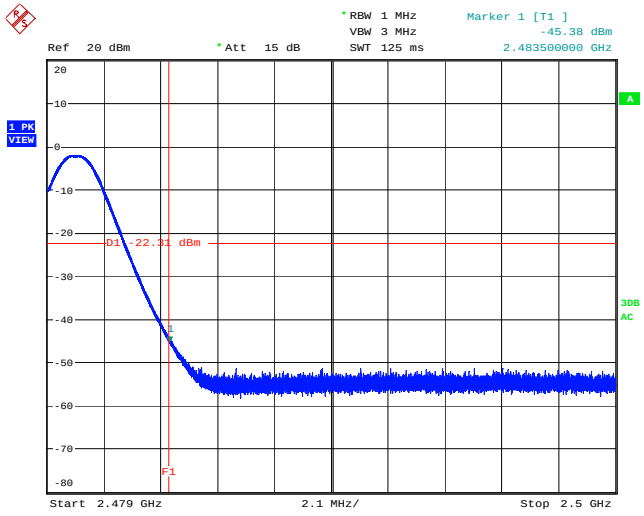
Test Data

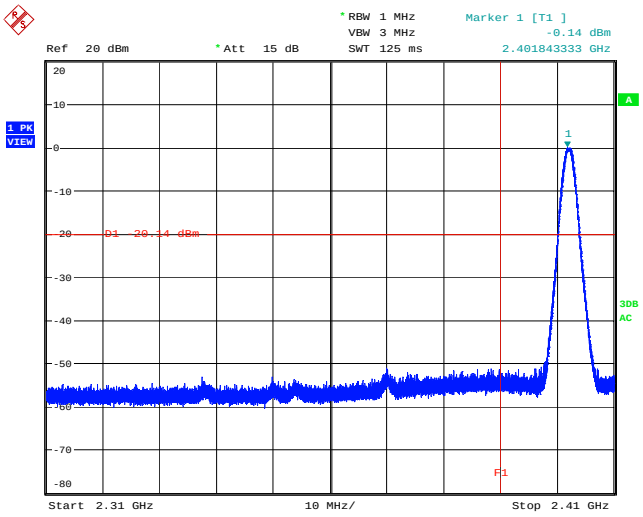
Tested Date: February 12, 2009

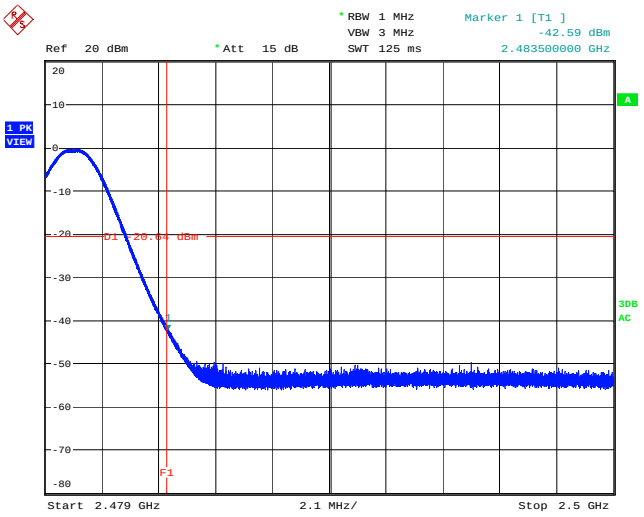
Temperature: 17 ˚C
Humidity: 30 %
Atmos. Press: 1015 hPa

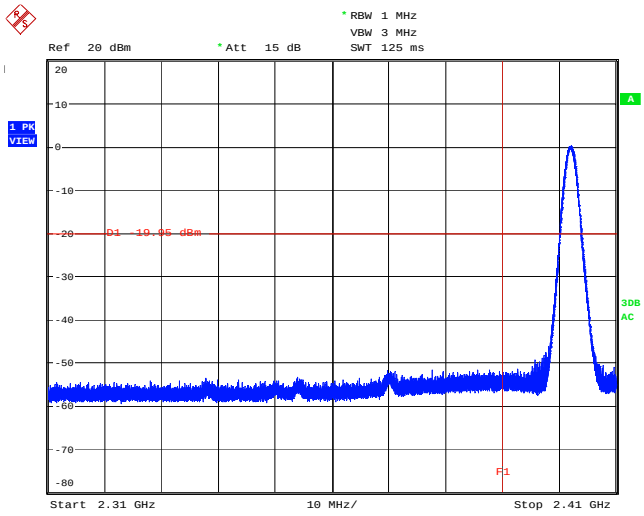
Restricted Band Edge

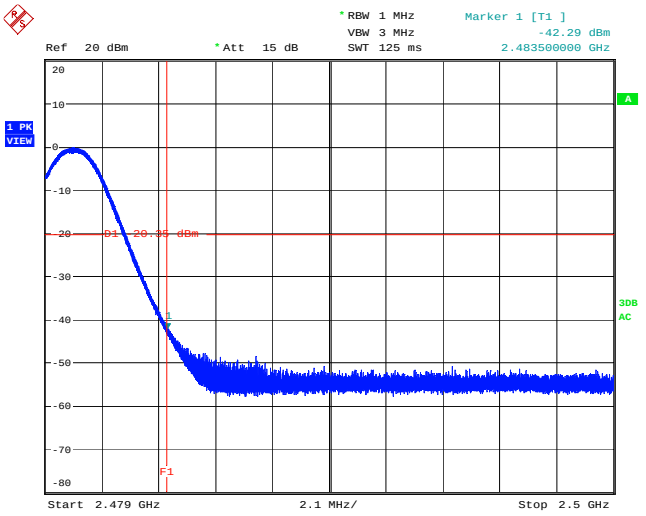




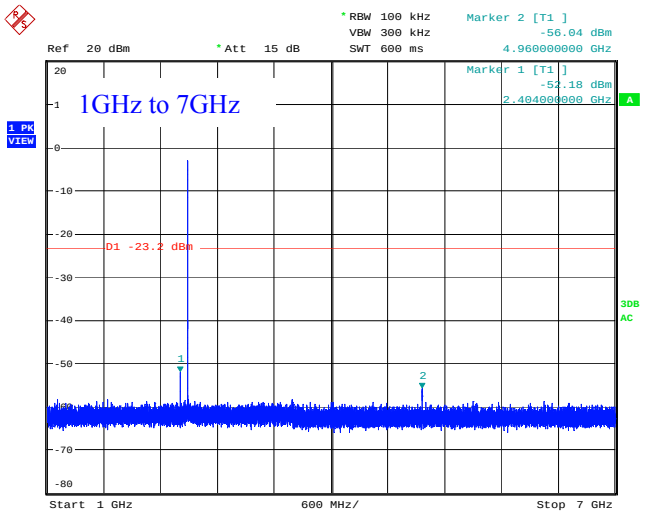


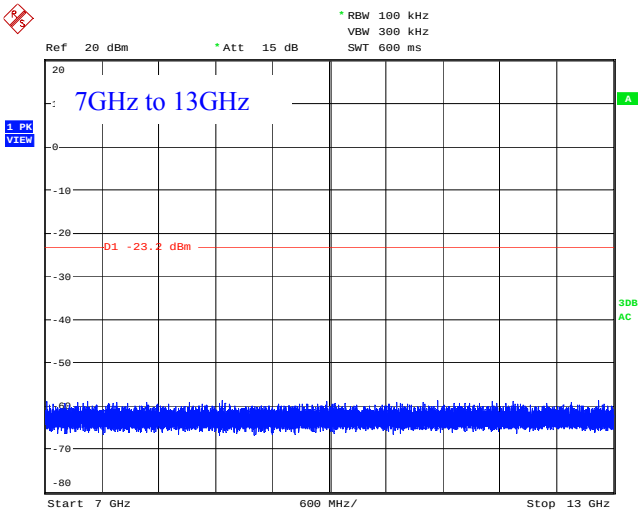


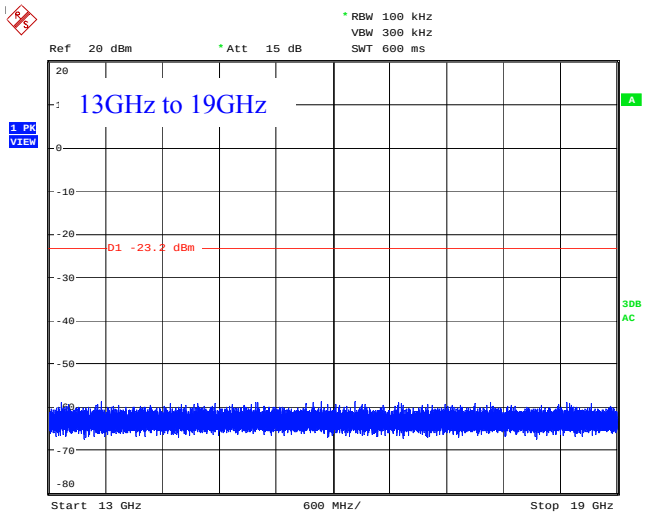


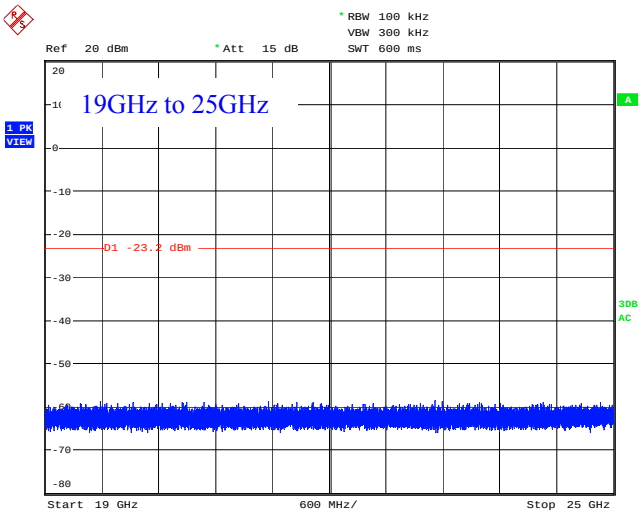


Worst Configuration (2480MHz, 8DPSK)



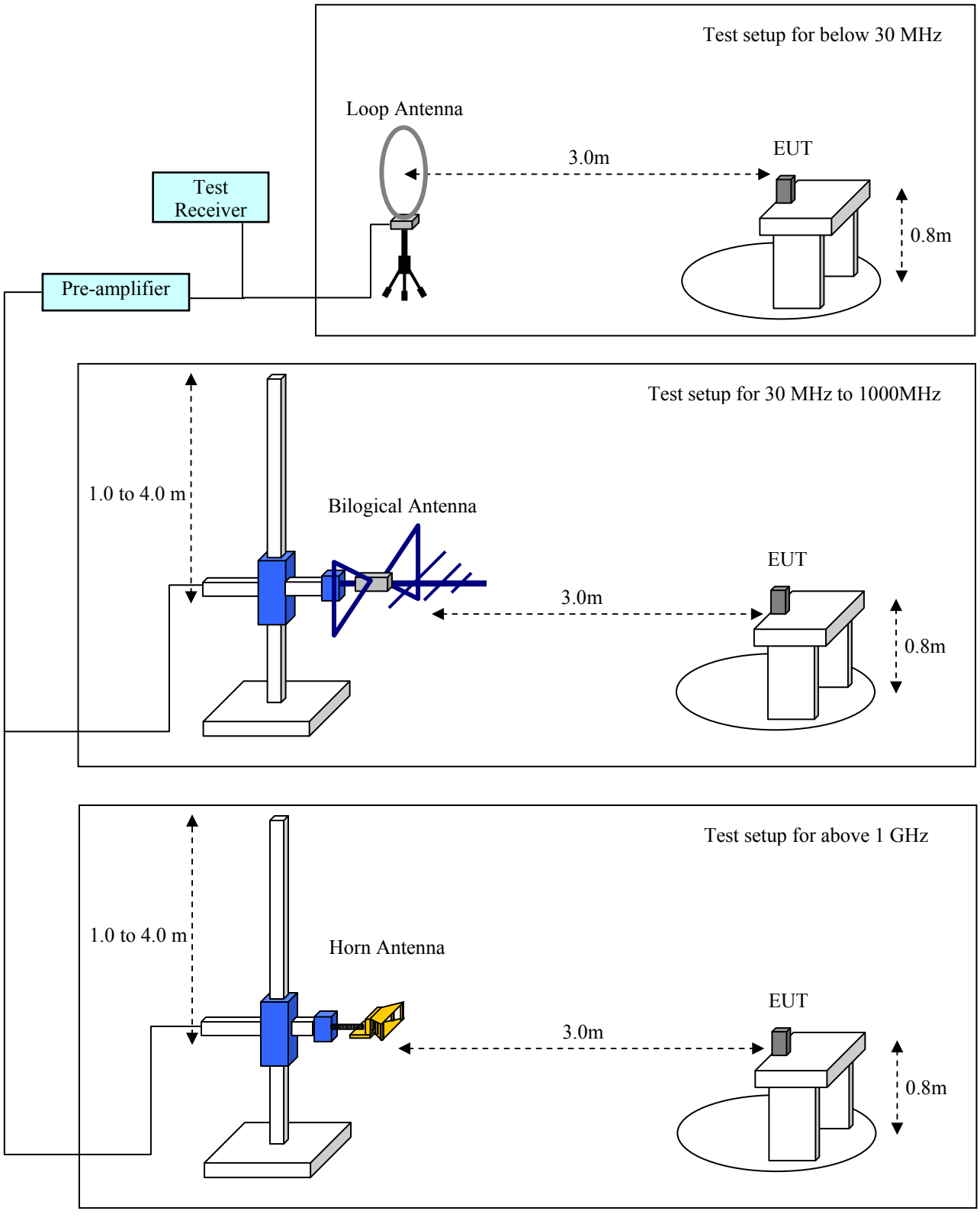






2.7 Transmitter Radiated spurious emissions

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	TR04	

Tested Date: February 24, 2009

Temperature: 19 ˚C
Humidity: 38 %
Atmos. Press: 1026 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)

BA03	CL11	PR03	TR04

Tested Date: February 24, 2009

Temperature: 19 ˚C
Humidity: 38 %
Atmos. Press: 1026 hPa

Operating mode: Continuous Communication (GFSK, 2441MHz: Worst configuration)
EUT position: Z-plane (Maximum position)
Setting: Configuration 1
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	**45.825**	**36.0**	**10.4**	**7.5**	**29.7**	**24.2**	**40.0**	**15.8**	**Vert.**

Calculation method

The Correction Factors and RESULT are calculated as followings.

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

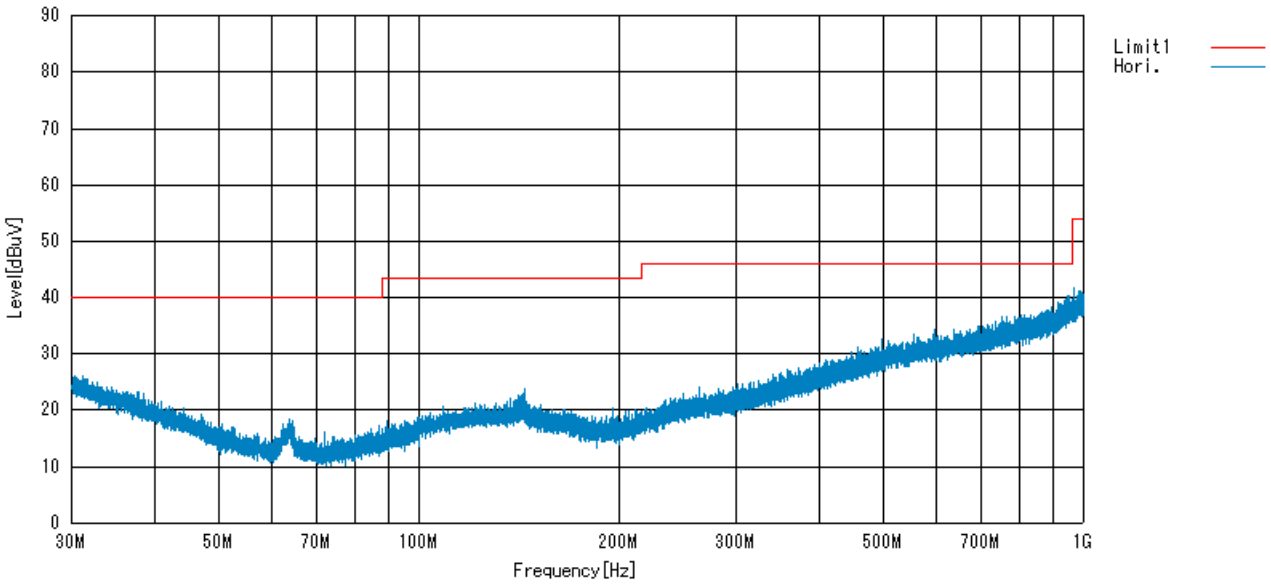
RESULT [dBuV/m] =READING [dBuV] + Correction Factor [dB]

Sample calculation at 45.825 MHz vertical result as follow:

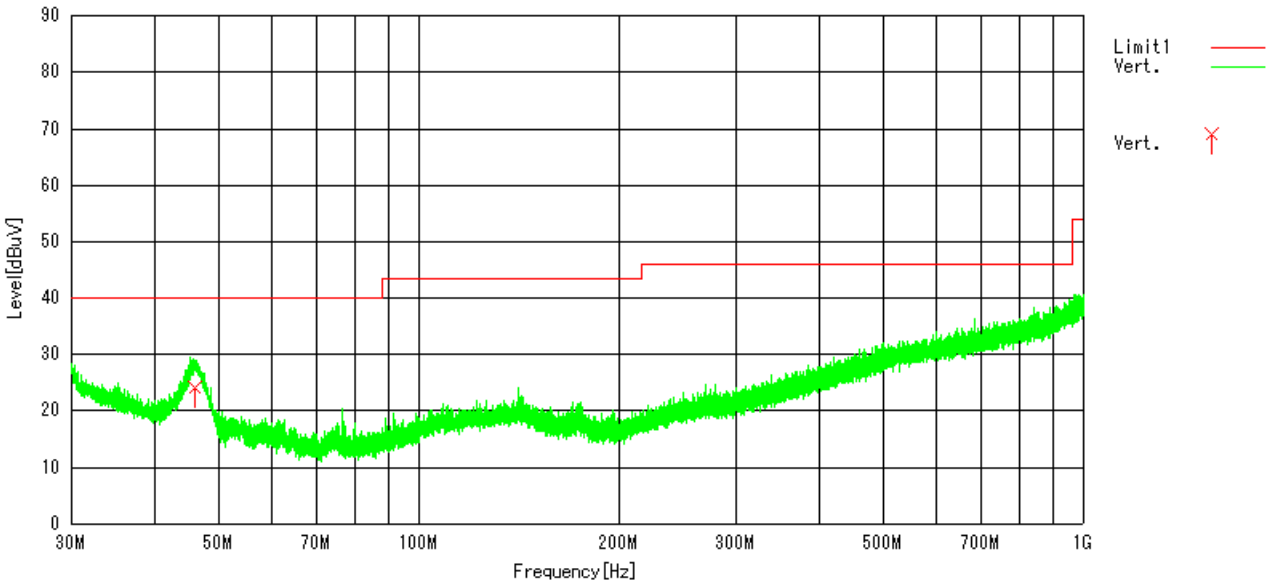
Result [dBuV/m] = Reading + C.F = 36.0 + 10.4 + 7.5 - 29.7 = 24.2
Margin = Limit – Result = 40.0 – 24.2 = 15.8 [dB]

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

Antenna polarization: Horizontal



Antenna polarization: Vertical



2.7.3 Above 1000 MHz

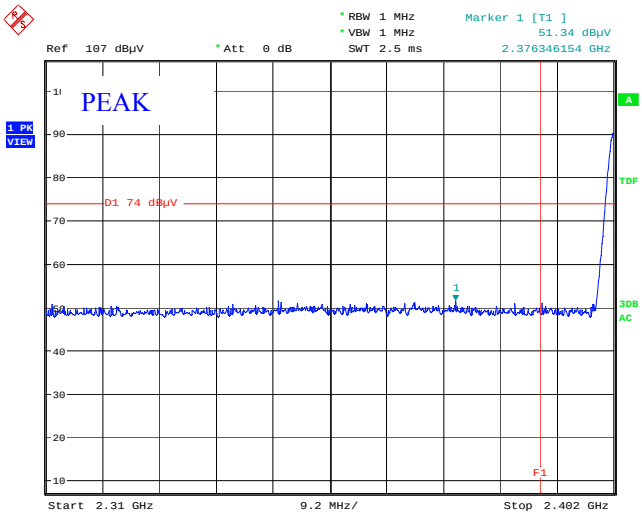
Test equipment used (refer to List of utilized test equipment)

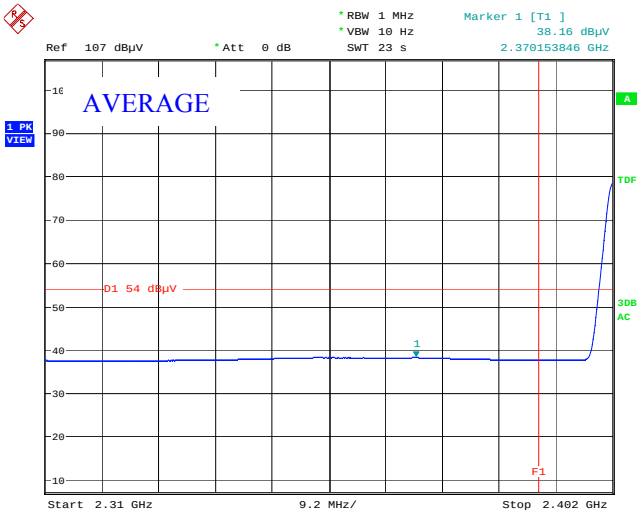
PR12	SH01	TR06	CL23	CL24	HPF1	DH01	AC01

Tested Date: February 25, 2009

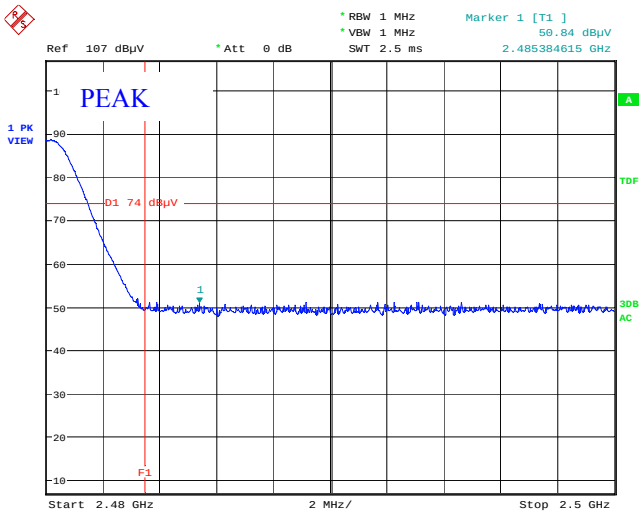
Temperature: 18 ˚C
Humidity: 42 %
Atmos. Press: 1013 hPa

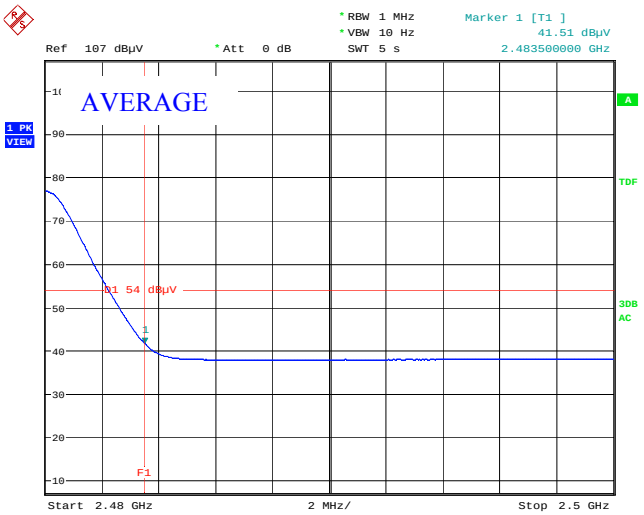
Restricted Band Edge (GFSK, Low channel, Vertical (Worst))



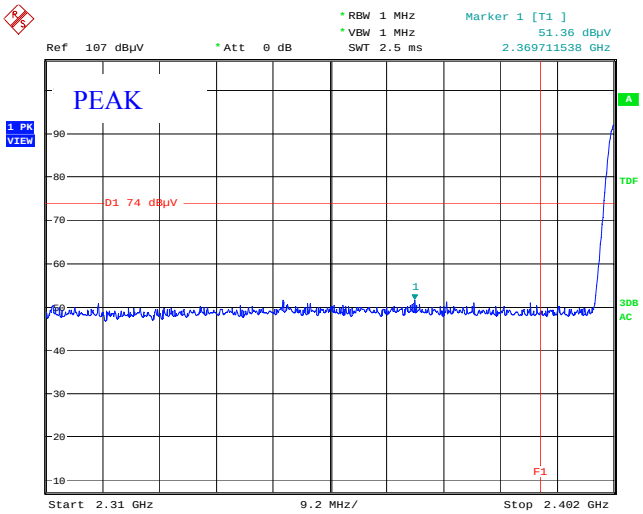


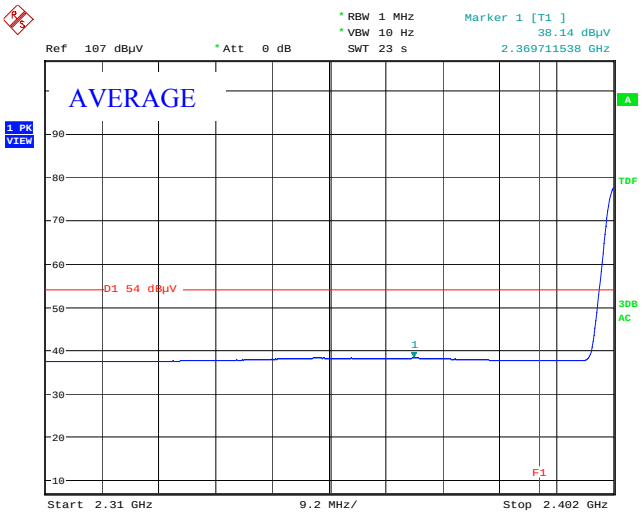
Restricted Band Edge (GFSK, High channel, Horizontal (Worst))



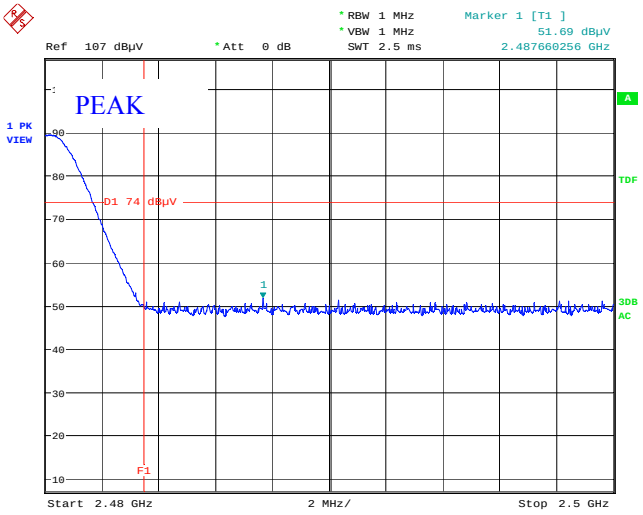


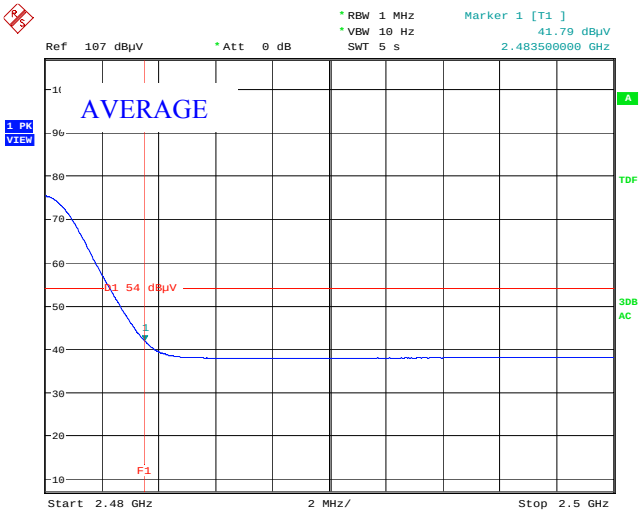
Restricted Band Edge (π/4DQPSK, Low channel, Horizontal (Worst))



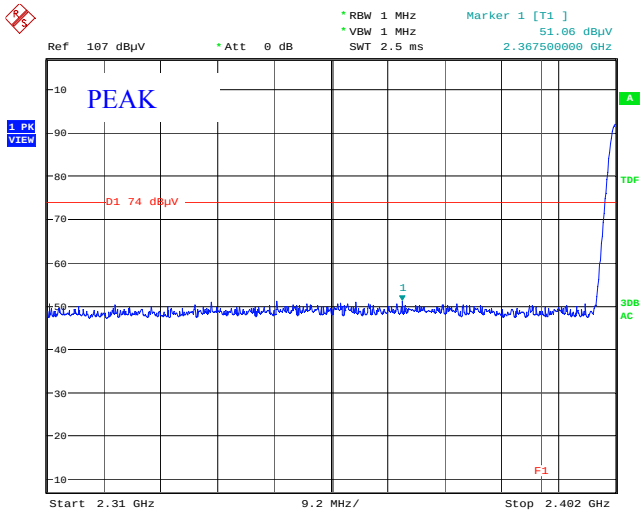


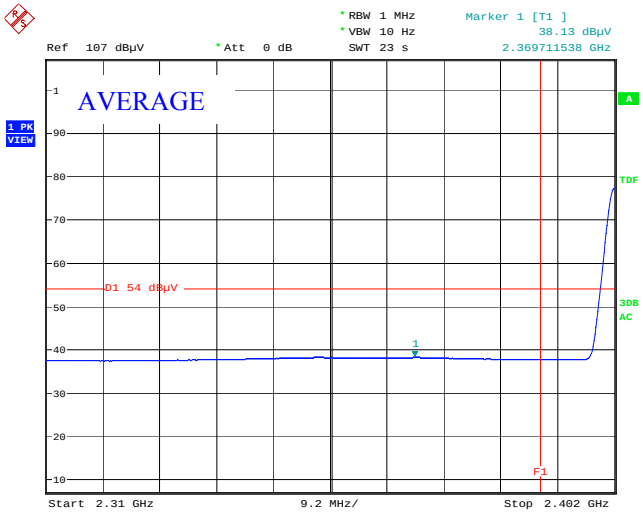
Restricted Band Edge (π/4DQPSK, High channel, Horizontal (Worst))



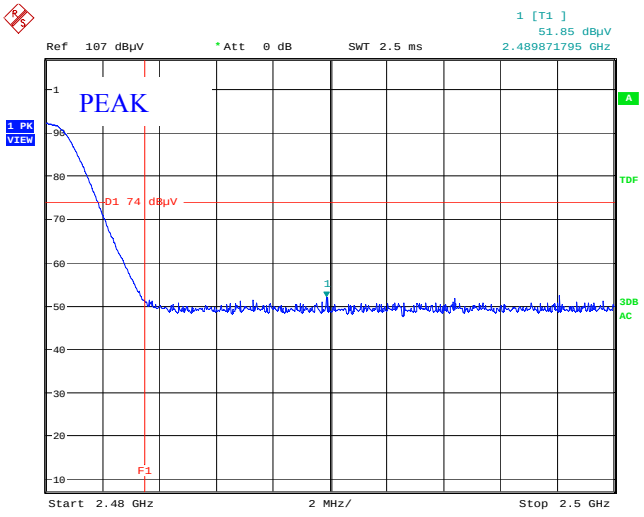


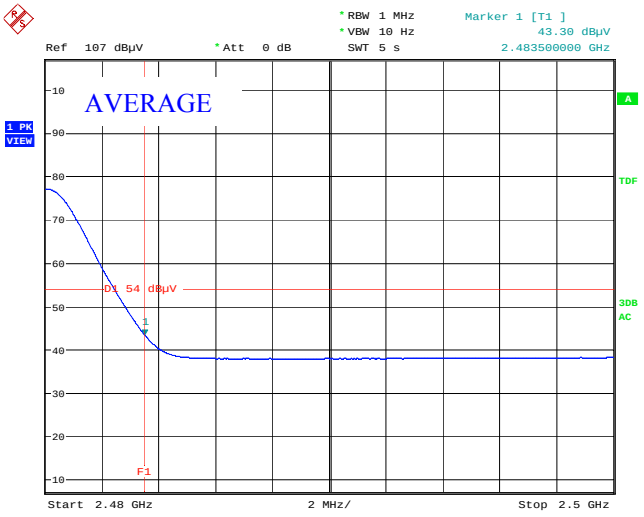
Restricted Band Edge (8DPSK, Low channel, Horizontal (Worst))





Restricted Band Edge (8DPSK, High channel, Horizontal (Worst))





Harmonics and Spurious Emission above 1000 MHz

Measurement distance: 3 m

Operating mode: Continuous Communication (GFSK, π/4DQPSK 8DPSK)

There were no spurious emissions greater than noise floor.

TX CH (MHz)	Freq. (MHz)	Result (dBuV/m)				Limit (dBuV/m)		Margin (dB)	
		Peak		Ave.					
		Hori.	Vert.	Hori.	Vert.	Peak	Ave.	Peak	Ave.
1ch 2402	4804	<47.2		<32.8		73.9	53.9	>26.7	>21.1
	7206	<49.4		<36.0		69.6	-	>20.2	-
	9608	<52.4		<38.3		69.6	-	>17.2	-
	12010	<55.5		<41.6		73.9	53.9	>18.4	>12.3
	14412	<59.0		<44.3		69.6	-	>10.6	-
	16814	<60.6		<46.9		69.6	-	>9.0	-
	19216	<47.8		<34.3		73.9	53.9	>26.1	>19.6
	21618	<49.1		<35.5		69.6	-	>20.5	-
	24020	<49.6		<36.0		69.6	-	>20.0	-

TX CH (MHz)	Freq. (MHz)	Result (dBuV/m)				Limit (dBuV/m)		Margin (dB)	
		Peak		Ave.					
		Hori.	Vert.	Hori.	Vert.	Peak	Ave.	Peak	Ave.
39ch 2441	4882	<46.7		<32.8		73.9	53.9	>27.2	>21.1
	7323	<50.0		<36.4		73.9	53.9	>23.9	>17.5
	9764	<52.6		<38.9		69.9	-	>17.3	-
	12205	<55.3		<41.7		73.9	53.9	>18.6	>12.2
	14646	<58.8		<44.4		73.9	53.9	>15.1	>9.5
	17087	<60.6		<47.2		69.9	-	>9.3	-
	19528	<47.9		<34.5		73.9	53.9	>26.0	>19.4
	21969	<48.7		<35.4		69.9	-	>21.2	-
	24410	<50.6		<36.3		69.9	-	>19.3	-

TX CH (MHz)	Freq. (MHz)	Result (dBuV/m)				Limit (dBuV/m)		Margin (dB)	
		Peak		Ave.					
		Hori.	Vert.	Hori.	Vert.	Peak	Ave.	Peak	Ave.
79ch 2480	4960	<46.9		<33.5		73.9	53.9	>27.0	>20.4
	7440	<49.4		<36.4		73.9	53.9	>24.5	>17.5
	9920	<52.8		<39.2		69.5	-	>16.7	-
	12400	<55.3		<42.0		73.9	53.9	>18.6	>11.9
	14880	<58.8		<45.1		69.5	-	>10.7	-
	17360	<61.8		<48.4		69.5	-	>7.7	-
	19840	<47.4		<34.8		73.9	53.9	>26.5	>19.1
	22320	<49.7		<36.0		73.9	53.9	>24.2	>17.9
	24800	<50.6		<37.0		69.5	-	>18.9	-

Note1: 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);
< 89.6 dBuV/m at 2402 MHz
< 89.9 dBuV/m at 2441 MHz
< 89.5 dBuV/m at 2480 MHz

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 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)

TR04	PL06	LN05	CL11

Test results - Complied with requirement.

Test Data

Tested Date: February 24, 2009

Temperature: 19 ˚C
Humidity: 38 %
Atmos. Press: 1026 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	0.168	47.9	36.6	0.3	48.2	36.9	65.1	55.1	16.9	18.2	N
2	**0.168**	**48.2**	37.3	**0.3**	**48.5**	37.6	**65.1**	55.1	**16.6**	17.5	L
3	1.406	34.4	28.2	0.3	34.7	28.5	56.0	46.0	21.3	17.5	L
4	1.491	34.7	26.5	0.3	35.0	26.8	56.0	46.0	21.0	19.2	L
5	1.520	34.8	27.7	0.3	35.1	28.0	56.0	46.0	20.9	18.0	N
6	1.593	33.7	27.9	0.3	34.0	28.2	56.0	46.0	22.0	17.8	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:

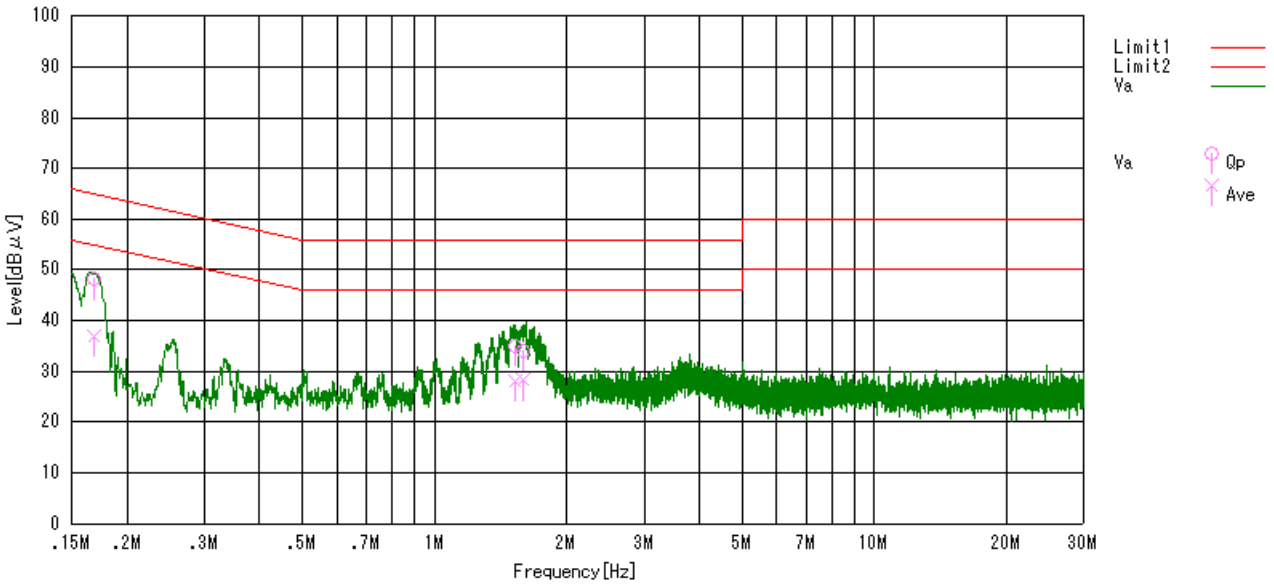
Result = Reading + C. F
where C.F = LISN Factor + Cable Loss [dB]

Sample calculation at 0.168 MHz QP result as follow:

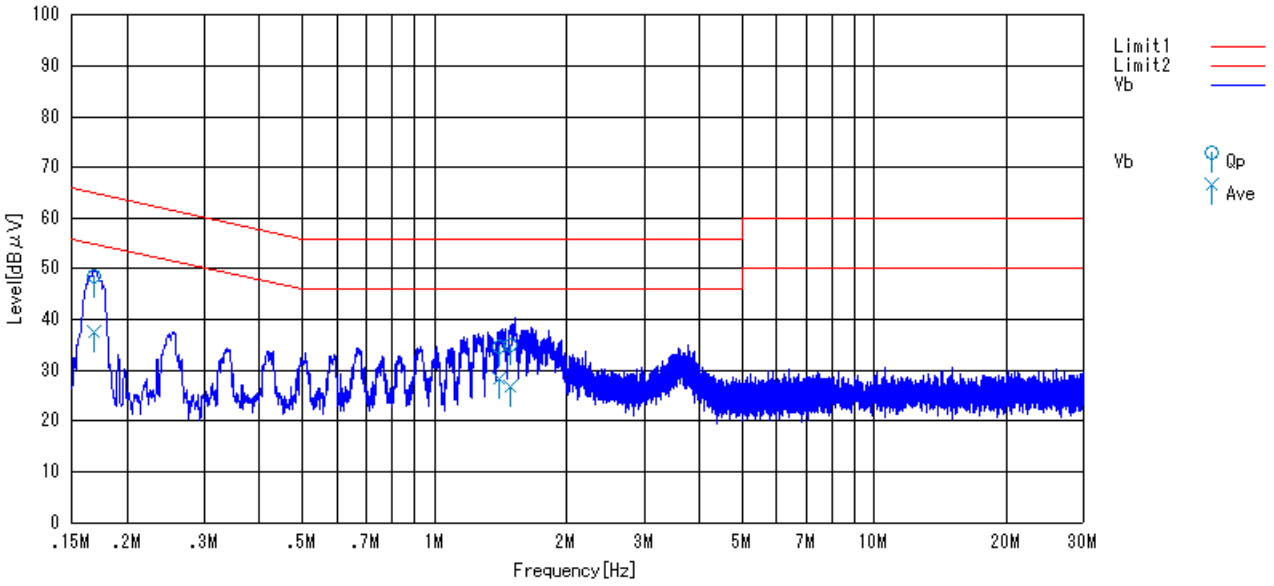
Result [dBuV] = Reading + C.F = 48.2 + 0.3 = 48.5 [dBuV]
Margin = Limit – Result = 65.1 – 48.5 = 16.6 [dB]

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

AC Power line conducted emission. (Phase N)



AC Power line conducted emission. (Phase L)



2.9 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)

BA03	CL11	PR03	TR04

Test Data

Tested Date: February 24, 2009

Temperature: 19 ˚C
Humidity: 38 %
Atmos. Press: 1026 hPa

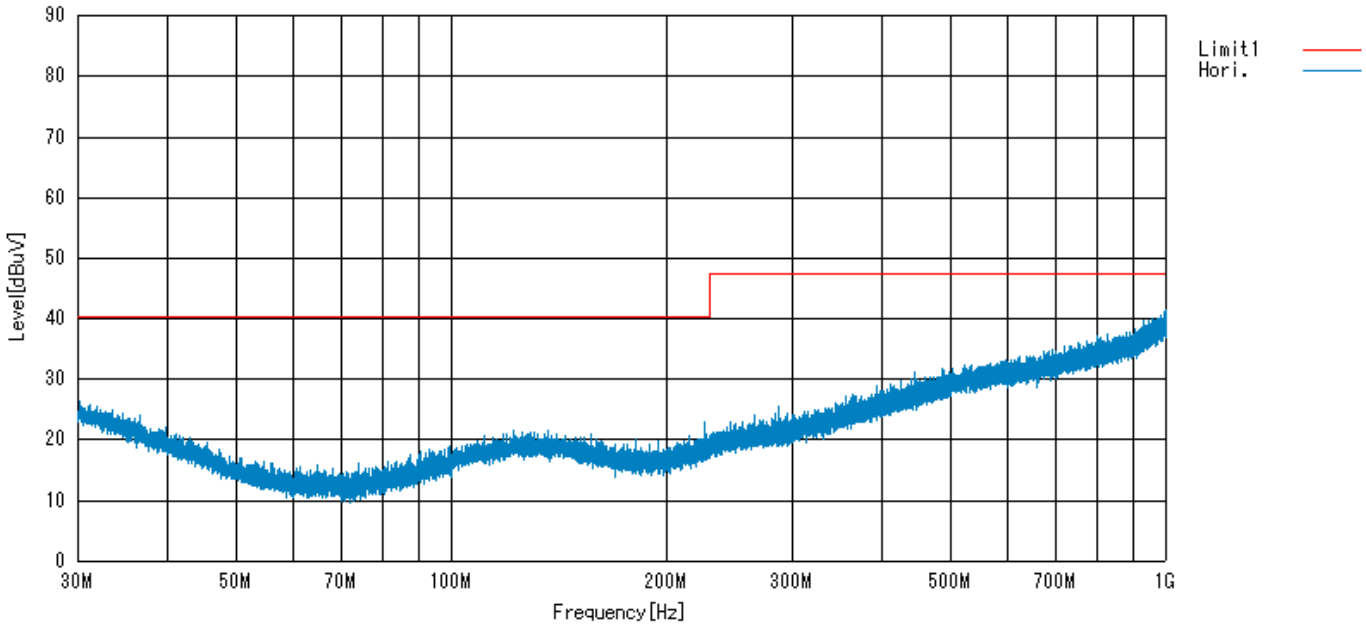
Operating mode: Receiving
Measurement distance: 3 m

Result

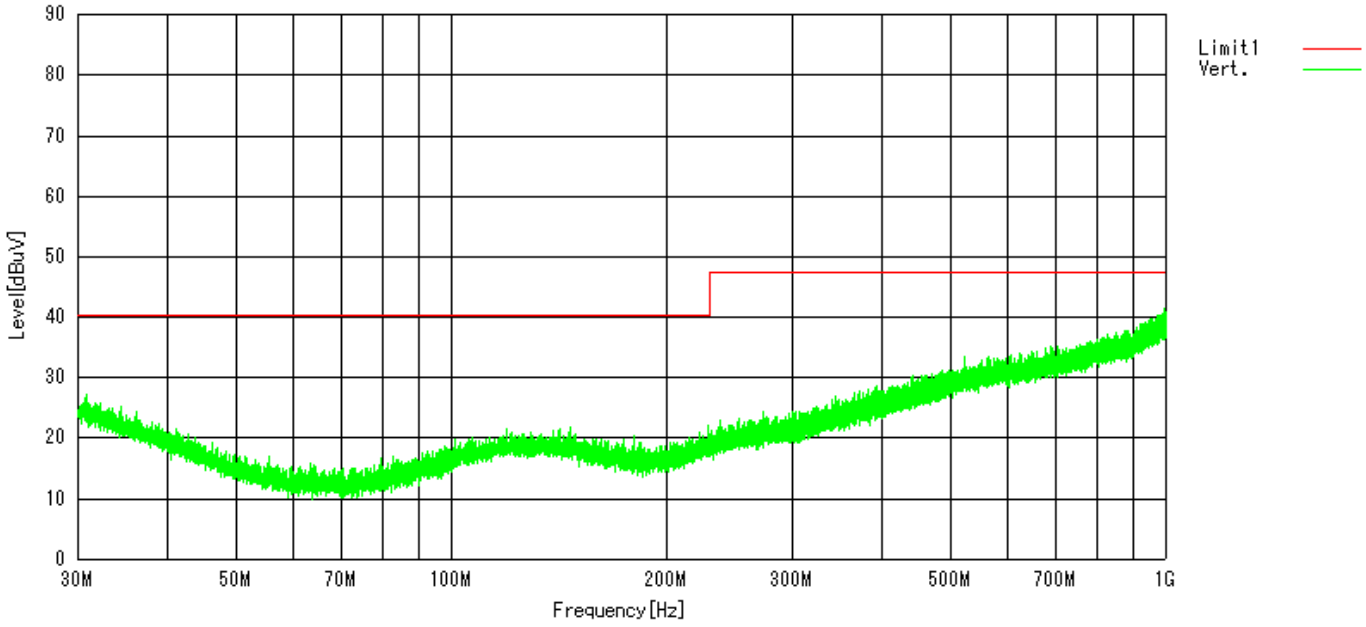
There were no spurious emissions greater than noise floor or 20dB below the limit.

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: February 25, 2009

Temperature: 18 ˚C
Humidity: 42 %
Atmos. Press: 1013 hPa

Operating mode: Receiving (2402MHz: Worst configuration)
EUT position: Z-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	**2404.003**	**45.2**	**-5.1**	**40.1**	**53.9**	**13.8**	**Hori.**
2	2404.003	43.9	-5.1	38.8	53.9	15.1	Vert.

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

Calculation method

The RESULT is calculated as followings.

RESULT [dBuV/m] = READING [dBuV] + C.F. [dB/m]

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	PL06	LN05	CL11

Test results - Complied with requirement.

Test Data

Tested Date: February 24, 2009

Temperature: 19 ˚C
Humidity: 38 %
Atmos. Press: 1026 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	0.165	48.6	36.5	0.3	48.9	36.8	65.2	55.2	16.3	18.4	N
2	**0.169**	**48.6**	36.9	**0.3**	**48.9**	37.2	**65.0**	55.0	**16.1**	17.8	**L**
3	1.420	34.1	28.3	0.3	34.4	28.6	56.0	46.0	21.6	17.4	L
4	1.511	34.7	28.8	0.3	35.0	29.1	56.0	46.0	21.0	16.9	N
5	1.514	34.9	28.0	0.3	35.2	28.3	56.0	46.0	20.8	17.7	L
6	1.606	34.1	26.2	0.3	34.4	26.5	56.0	46.0	21.6	19.5	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:

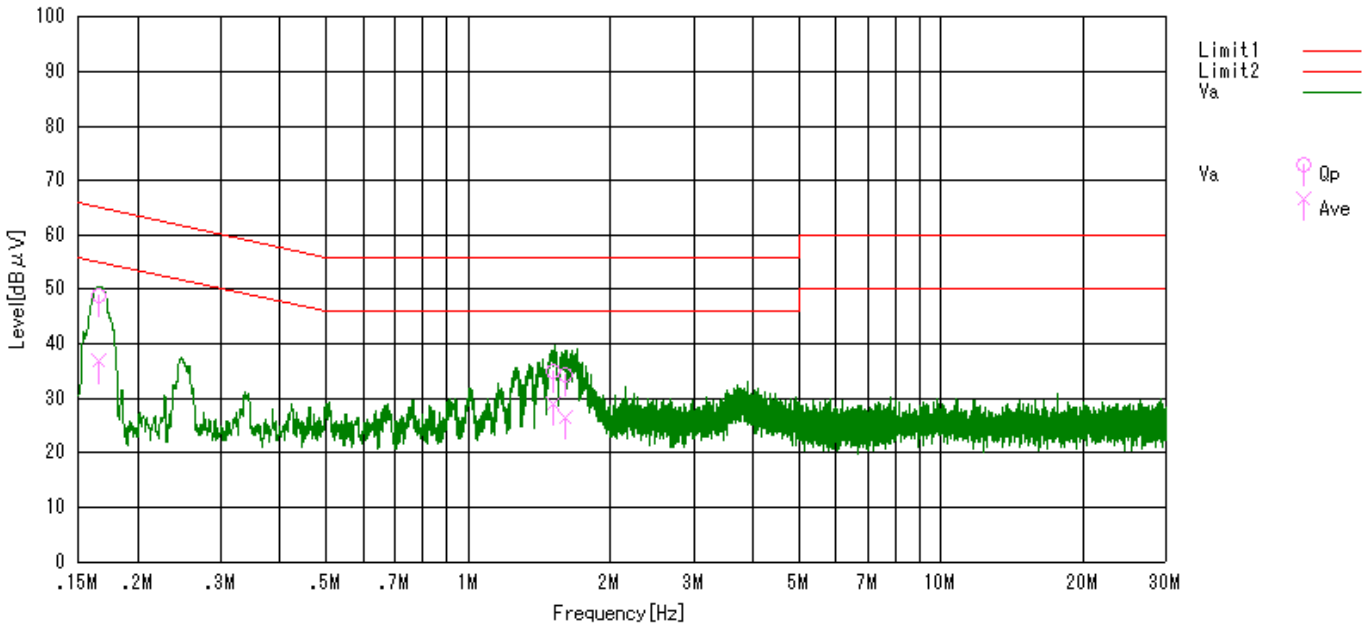
Result = Reading + C. F
where C.F = LISN Factor + Cable Loss [dB]

Sample calculation at 0.169 MHz QP result as follow:

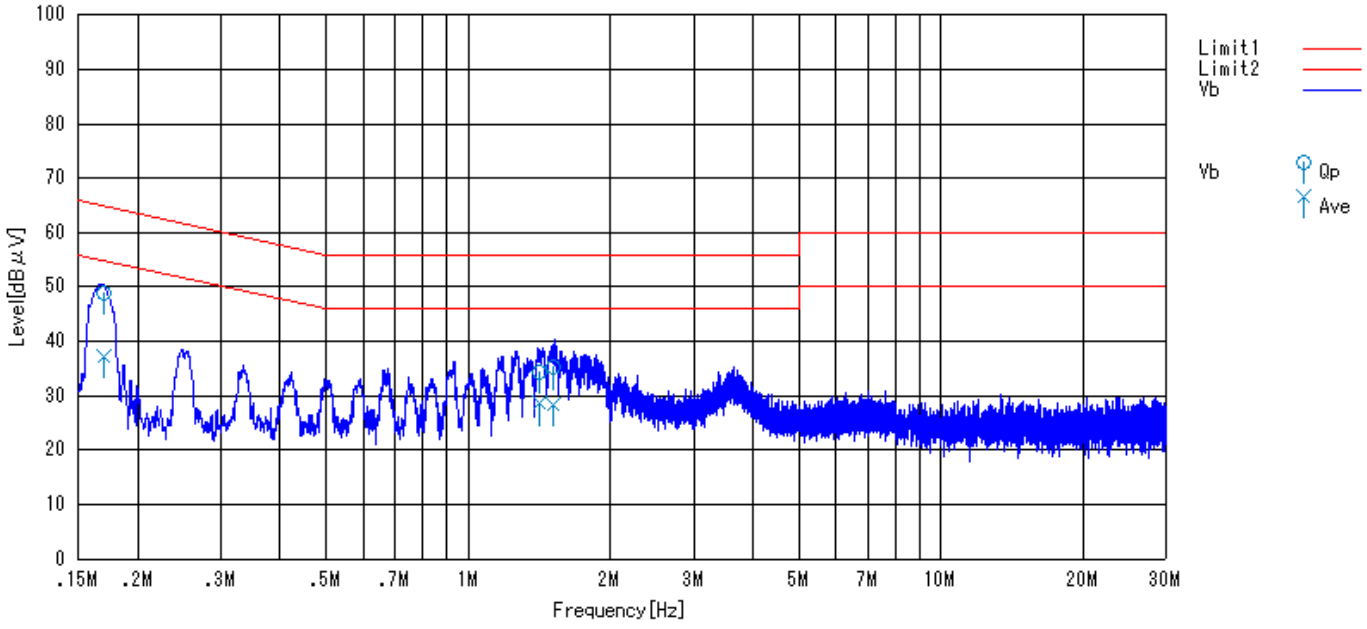
Result [dBuV] = Reading + C.F = 48.6 + 0.3 = 48.9 [dBuV]
Margin = Limit – Result = 65.0 – 48.9 = 16.1 [dB]

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
BA03	Bilogical Antenna	CHASE	CBL6111	1309	2008/05/07	2009/05/06
CL11	Antenna Cable	RFT	-	-	2008/06/11	2009/06/10
CL23	RF Cable 0.5m	SUCOFLEX	SF104PE	48773/4PE	2008/06/10	2009/06/09
CL24	RF Cable 5.0m	SUCOFLEX	SF104PE	48775/4PE	2008/06/10	2009/06/09
LN05	LISN	Kyoritsu	KNW-407	8-1773-2	2008/05/21	2009/05/20
PL06	Pulse Limiter	PMM	PL-01	0000J10109	2009/01/05	2010/01/31
PR03	Pre. Amplifier	Anritsu	MH648A	M41984	2008/05/12	2009/05/11
PR12	Pre. Amplifier (1-26G)	Agilent Technologies	8449B	3008A02513	2009/01/13	2010/01/31
HPF1	High Pass Filter (3500MHz)	TOKIMEC	TF323DCA	603	2008/06/09	2009/06/08
TR06	Test Receiver (F/W : 3.93 SP2)	Rohde & Schwarz	ESU26	100002	2008/09/02	2009/09/01
SH01	Standard Horn Antenna (18-26G)	A.H. Systems	SAS-572	208	2008/07/23	2011/07/22
TR04	Test Receiver (F/W : 3.82 SP1)	Rohde & Schwarz	ESCI	100447	2008/09/16	2009/09/15
DH01	DRG Horn Antenna	A.H. Systems	SAS-571	785	2008/01/31	2010/01/29

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.