

TEST REPORT

For

Remote Signal Torque Wrench Transmitter

In conformity with

FCC CFR 47 Part 15 Subpart C / IC RSS-Gen, RSS-210

Model: T-FHSL5

FCC ID: UY6-TFHSL5

IC ID: 6561B-TFHSL5

Test Item: Remote Signal Torque Wrench Transmitter

Report No: ERY1307Z31R1

Issue Date: 31 July, 2013

Prepared for

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History

Report No.	Date	Revisions	Issued By
ERY1307Z29R1	29 July, 2013	Initial Issue	K. Ohnishi
ERY1307Z31R1	31 July, 2013	Correction of typographical error (1.5.1, 2.1)	K. Ohnishi

1.1 Product description

1.2 Test(s) performed/ Summary of test result

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.

Reviewer : T. Ikegami
T. Ikegami
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, 2010.

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: A-0045

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: $\pm 0.9\text{dB}$

Radiated emission (9 kHz - 30MHz): $\pm 2.9\text{ dB}$

Radiated emission (30MHz - 200MHz): $\pm 5.0\text{ dB}$

Radiated emission (200MHz - 1000MHz): $\pm 6.2\text{ dB}$

Radiated emission (1GHz - 26GHz): $\pm 5.1\text{ dB}$

1.5 Summary of test results

1.5.1 Table of test summary

Requirement of;	Section in FCC/IC	Result	Sample	Section in this report
1.5.1 Occupied Bandwidth (99%)	2.1049 RSS-Gen 4.6	-	A2	2.1
1.5.2 Transmitter Radiated Spurious Emissions	15.205(b), 15.209, 15.249 (a) RSS-210 A2.9	Complied	A1	2.2
1.5.3 Receiver Radiated Spurious Emissions	RSS-Gen 6	Complied	A1	2.3

1.6 Setup of equipment under test (EUT)

1.6.1 Test configuration of EUT

Equipment(s) under test:

	Item	Model No.	Serial No.	Remarks
A1	Remote Signal Torque Wrench Transmitter	T-FHSLs	0001	For radiated test
A2	Remote Signal Torque Wrench Transmitter	T-FHSLs	0002	For conducted test
B	Lithium Battery	CR2032-SPA	-	-

Support Equipment(s):

	Item	Manufacturer	Model No.	Serial No.

Connected cable(s):

No.	Item	Identification (Manu.e.t.c)	Shielded YES / NO	Ferrite Core YES / NO	Connector Type Shielded YES / NO	Length (m)

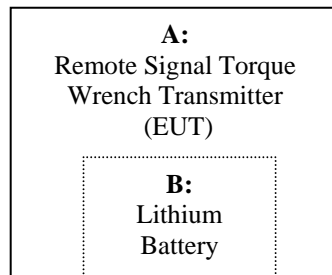
1.6.2 Operating condition:

Operating mode:

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

- (1-1) GFSK modulation, Continuous transmission at hopping off (2402MHz)
- (1-2) GFSK modulation, Continuous transmission at hopping off (2440MHz)
- (1-3) GFSK modulation, Continuous transmission at hopping off (2479MHz)
- (1-4) Continuous receiving mode (2440MHz)

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

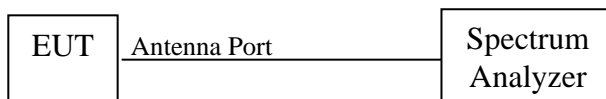
No deviations from the standards described in clause 1.2.

2 Test procedure and test data

2.1 Occupied Bandwidth (99%)

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 the measured bandwidth. The VBW is set to more than RBW. The sweep time is coupled appropriate.

Limitation

There are no limitations.

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

SA06	CL29				
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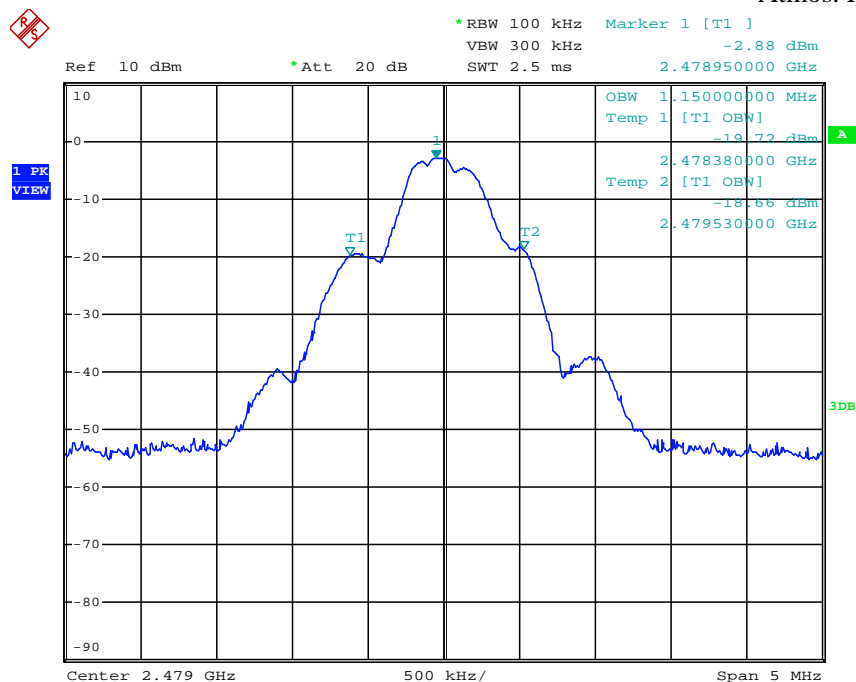
Test results

Operating Mode	Transmission Channel	Transmission Frequency [MHz]	99% Bandwidth [MHz]
GFSK (1Mbps)	Low	2402	1.13
	Middle	2440	1.14
	High	2479	1.15

Test Data

Tested Date: 17 June, 2013

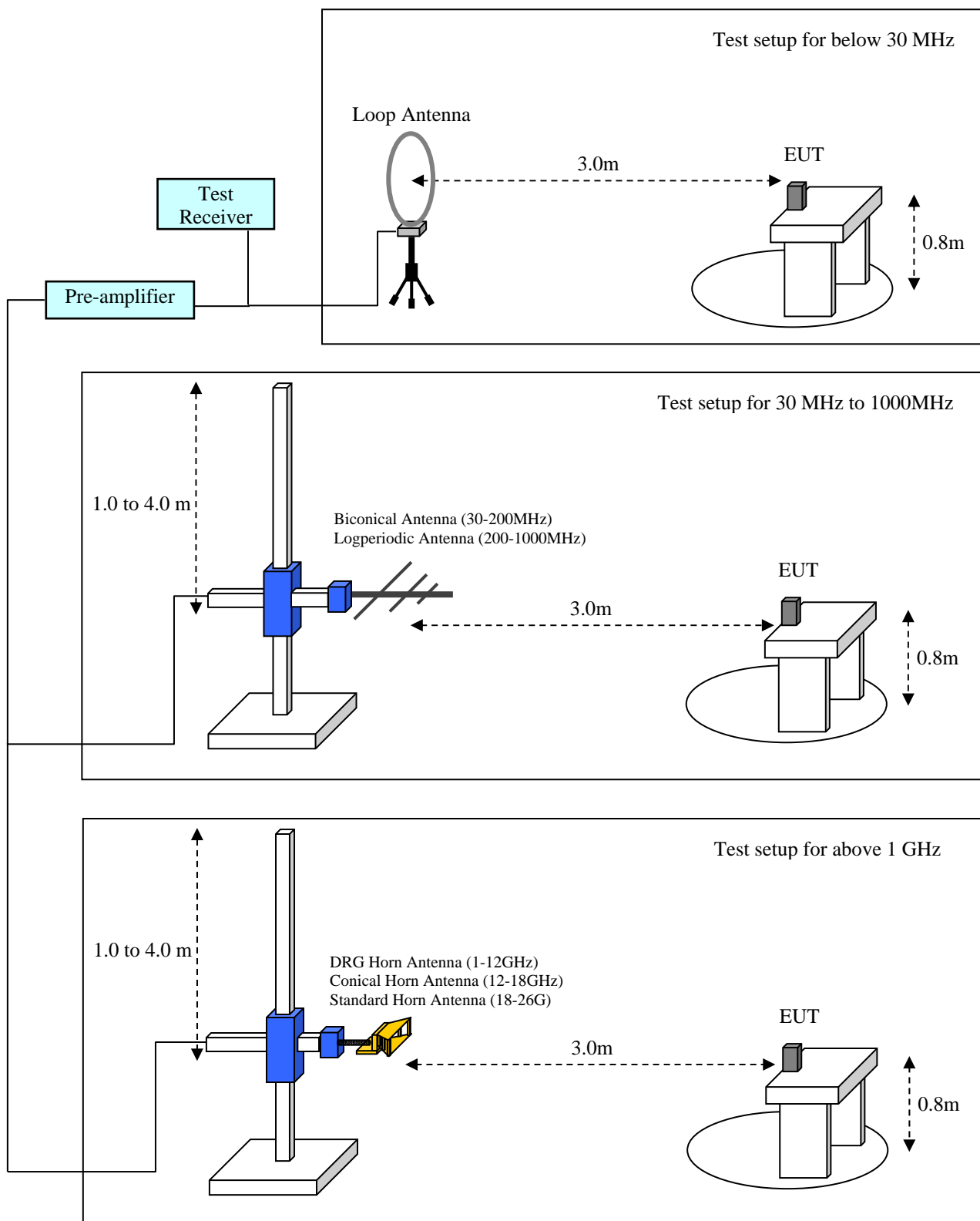
Temperature: 23 °C
Humidity: 55 %
Atmos. Press: 1005 hPa



2.2 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

FCC 15.205 / RSS-Gen 7.2.2 restricted bands of operation

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)

FCC 15.249 (a) / RSS-210 A2.9

The field strength measured at 3 meters shall not exceed the limits in the following table

Fundamental Frequency [MHz]	Field Strength [mV/m]	
	Fundamental	Harmonics
902-928	50	0.5
2400-2483.5	50	0.5
5725-5875	50	0.5

Note: The limits shown in the above table are based on measurements using an average detector, except for the fundamental emission in the frequency band 902-928 MHz, which is based on measurements using a CISPR quasi-peak detector.

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in FCC 15.209 / RSS-Gen 7.2.5, whichever is less stringent.

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

Test results - Complied with requirement.

2.2.1 Below 30 MHz

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

LP05	CL11	TR06	
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Tested Date: 29 March, 2013

Temperature: 18 °C
Humidity: 58 %
Atmos. Press: 1010 hPa

Result

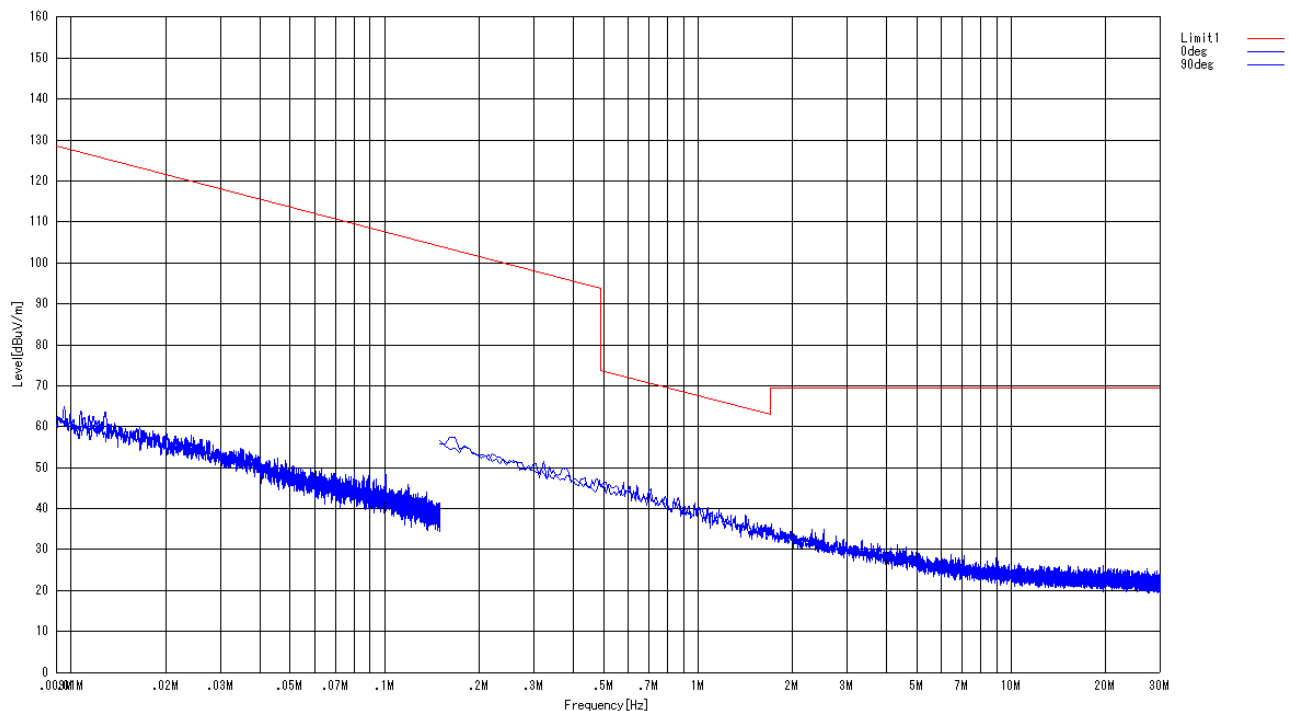
There were no spurious emissions greater than noise floor.

Graphical data of test result (9kHz - 30MHz)

Operating mode: Continuous Communication (GFSK, 2402MHz)

EUT position: X-plane

Measurement distance: 3 m



2.2.2 Between 30 – 1000 MHz

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

BI05	CL11	LA07	PR15	TR06
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Tested Date: 29 March, 2013

Temperature: 18 °C
Humidity: 58 %
Atmos. Press: 1010 hPa

Result

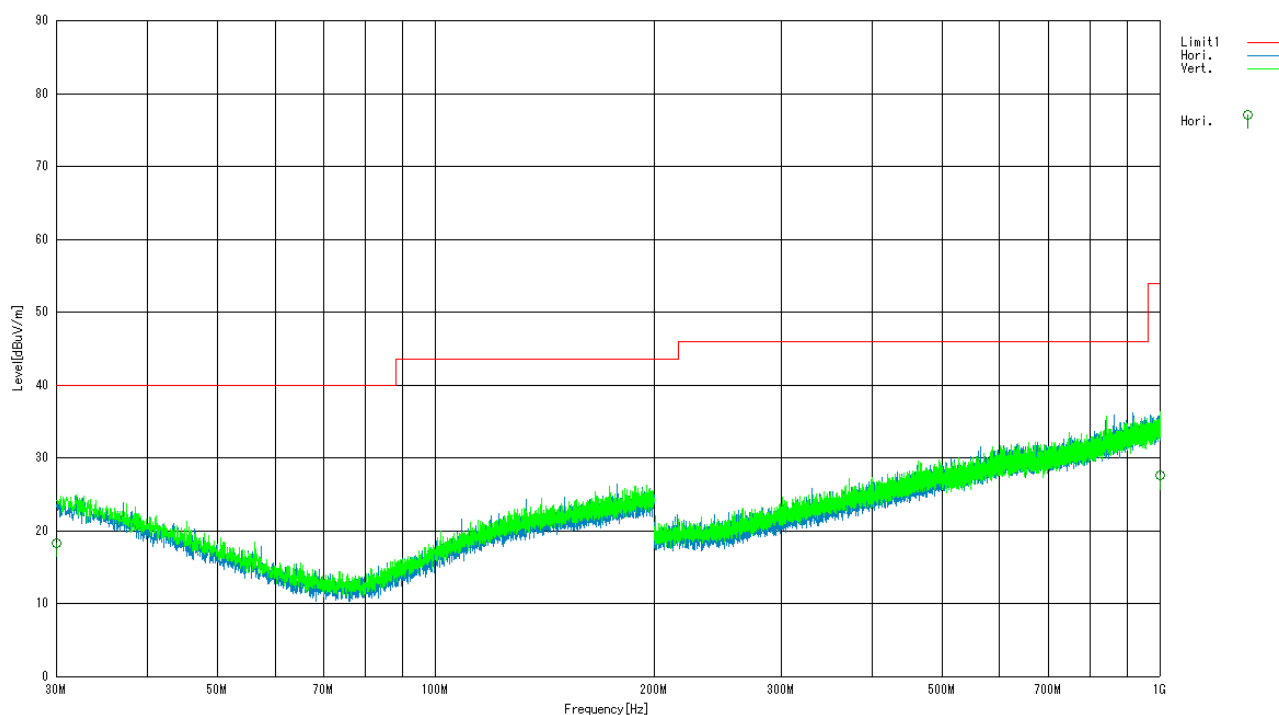
There were no spurious emissions greater than noise floor.

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

Operating mode: Continuous Communication (GFSK, 2402MHz)

EUT position: X-plane

Measurement distance: 3 m



2.2.3 Above 1000 MHz

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

AC01	BRF12	CH01	CL23	CL24	CL28	DH01	HPF1	PR12
SH01	TR06							

Tested Date: 19 July, 2013

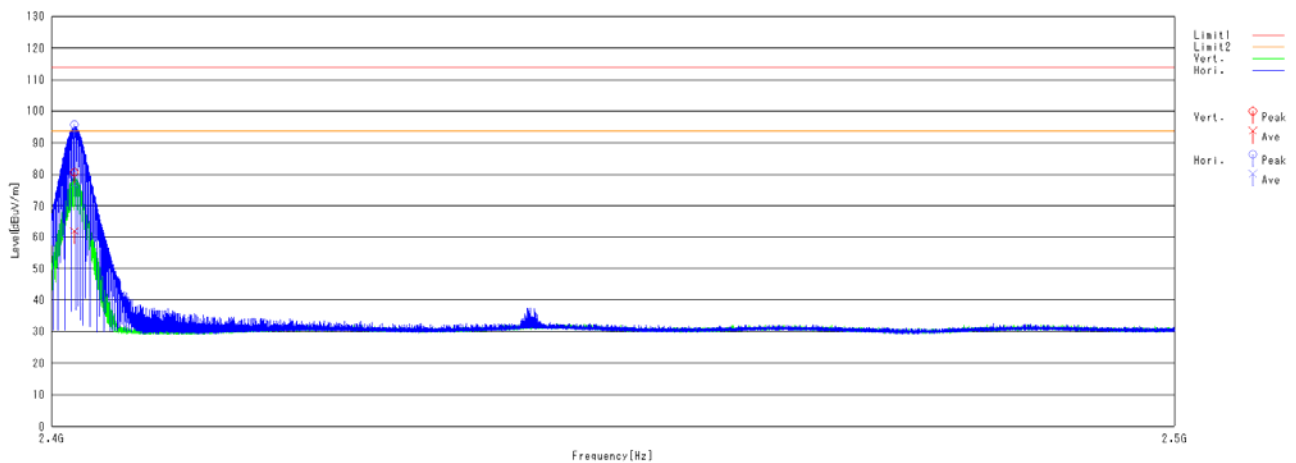
Temperature: 20 °C
Humidity: 59 %
Atmos. Press: 1010 hPa

Fundamental Frequency Radiated Emission

Operating mode: Continuous Communication (Worst configuration)

No.	Frequency [MHz]	Reading		C.F. [dB]	Result		Limit		Margin		Conditions
		Peak [dBuV]	Ave [dBuV]		Peak [dBuV]	Ave [dBuV]	Peak [dBuV]	Ave [dBuV]	Peak [dB]	Ave [dB]	
1	2402.000	99.8	81.0	-4.1	95.7	76.9	113.9	93.9	18.2	17.0	Hori., X-plane
2	2440.000	99.0	80.2	-3.8	95.2	76.4	113.9	93.9	18.7	17.5	Hori., X-plane
3	2479.000	97.6	78.8	-3.8	93.8	75.0	113.9	93.9	20.1	18.9	Hori., X-plane

Graphical data of test result (2402MHz, X-plane)

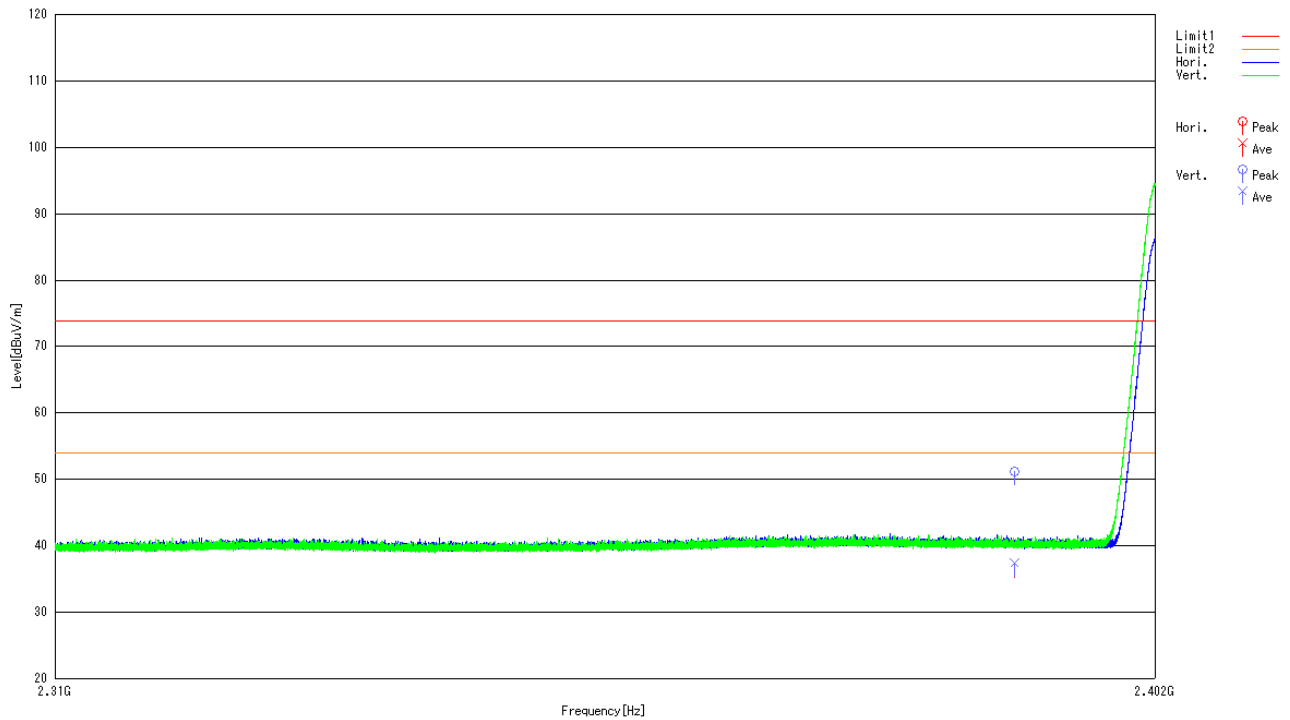


Tested Date: 29 March, 2013

Temperature: 18 °C
Humidity: 58 %
Atmos. Press: 1015 hPa

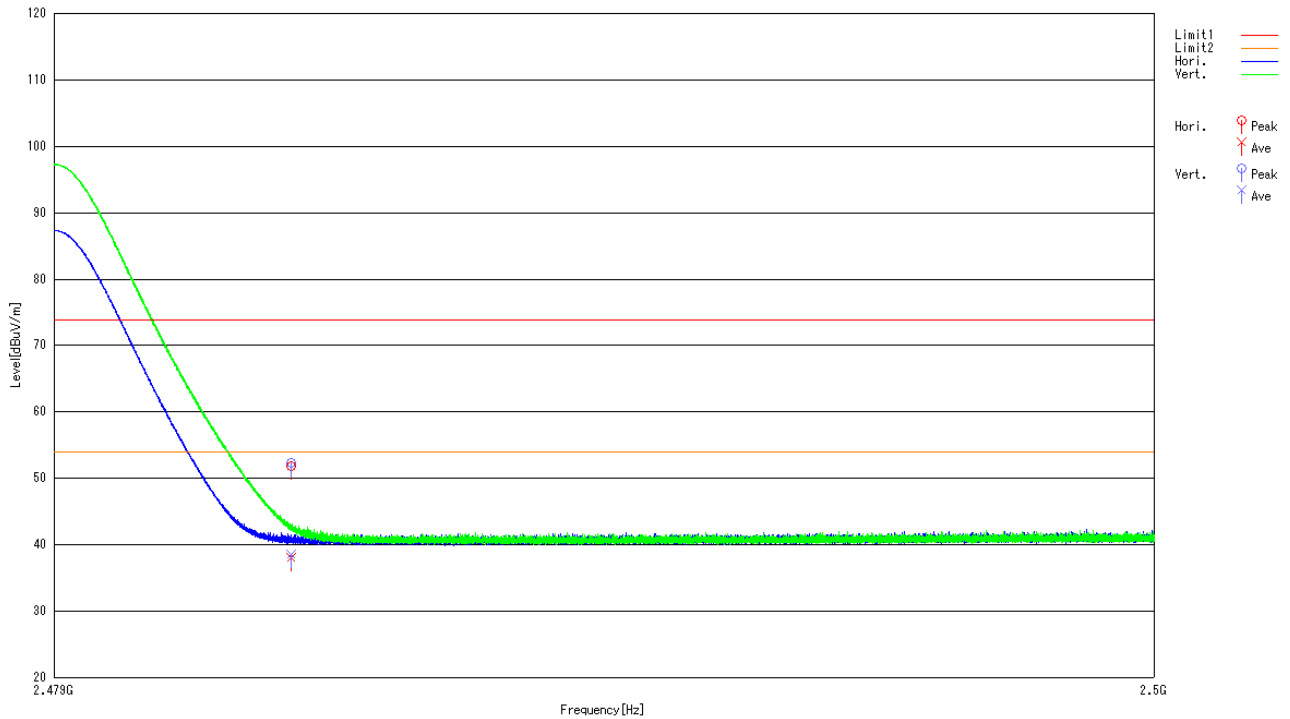
Restricted Band Edge (Worst configuration)

Operating mode: Continuous Communication (GFSK, 2402MHz)
EUT position: Y-plane
Measurement distance: 3 m



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	2390.000	45.5	31.6	5.7	51.2	37.3	73.9	53.9	22.7	16.6	Hori.
2	2390.000	45.5	31.7	5.7	51.2	37.4	73.9	53.9	22.7	16.5	Vert.

Operating mode: Continuous Communication (GFSK, 2479MHz)
EUT position: Y-plane
Measurement distance: 3 m



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	2483.500	45.8	31.9	6.1	51.9	38.0	73.9	53.9	22.0	15.9	Hori.
2	2483.500	46.2	32.4	6.1	52.3	38.5	73.9	53.9	21.6	15.4	Vert.

Harmonics and Spurious Emission above 1000 MHz

Operating mode: Continuous Communication (GFSK, 2402MHz: Worst configuration)

No.	Frequency [MHz]	Reading		C.F. [dB]	Result		Limit		Margin		Conditions
		Peak [dBuV]	Ave [dBuV]		Peak [dBuV]	Ave [dBuV]	Peak [dBuV]	Ave [dBuV]	Peak [dB]	Ave [dB]	
1	4804.000	51.8	48.7	2.9	54.7	51.6	73.9	53.9	19.2	2.3	Hori., X-plane

Operating mode: Continuous Communication (GFSK, 2440MHz: Worst configuration)

No.	Frequency [MHz]	Reading		C.F. [dB]	Result		Limit		Margin		Conditions
		Peak [dBuV]	Ave [dBuV]		Peak [dBuV]	Ave [dBuV]	Peak [dBuV]	Ave [dBuV]	Peak [dB]	Ave [dB]	
1	4880.000	49.2	45.6	3.2	52.4	48.8	73.9	53.9	21.5	5.1	Hori., X-plane
2	7320.000	42.9	33.7	7.9	50.8	41.6	73.9	53.9	23.1	12.3	Hori., X-plane
3	9760.000	42.5	32.2	8.5	51.0	40.7	73.9	53.9	22.9	13.2	Hori., X-plane
4	12200.000	42.1	32.2	4.0	46.1	36.2	73.9	53.9	27.8	17.7	Hori., X-plane

Operating mode: Continuous Communication (GFSK, 2479MHz: Worst configuration)

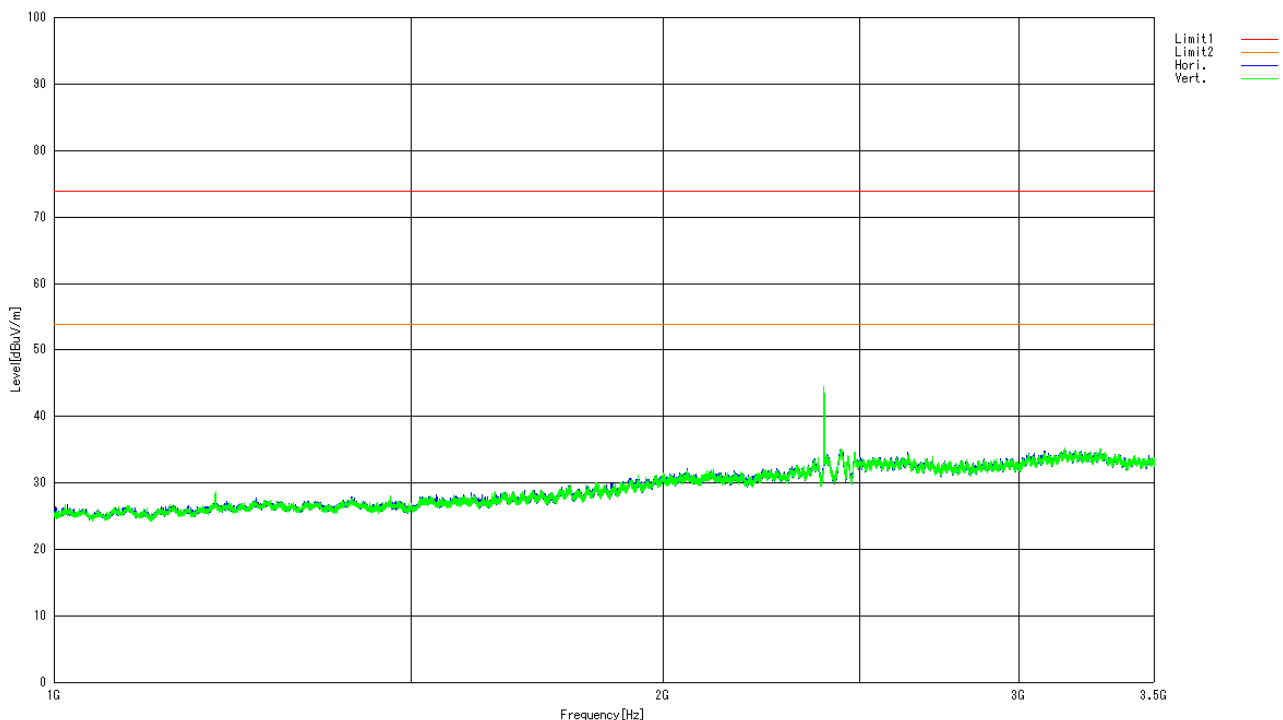
No.	Frequency [MHz]	Reading		C.F. [dB]	Result		Limit		Margin		Conditions
		Peak [dBuV]	Ave [dBuV]		Peak [dBuV]	Ave [dBuV]	Peak [dBuV]	Ave [dBuV]	Peak [dB]	Ave [dB]	
1	4958.000	43.6	36.1	3.5	47.1	39.6	73.9	53.9	26.8	14.3	Vert., Z-plane
2	7437.000	44.0	36.0	7.7	51.7	43.7	73.9	53.9	22.2	10.2	Hori., Z-plane
3	9916.000	44.1	35.4	8.8	52.9	44.2	73.9	53.9	21.0	9.7	Vert., Y-plane
4	12395.000	42.1	32.3	4.3	46.4	36.6	73.9	53.9	27.5	17.3	Hori., X-plane

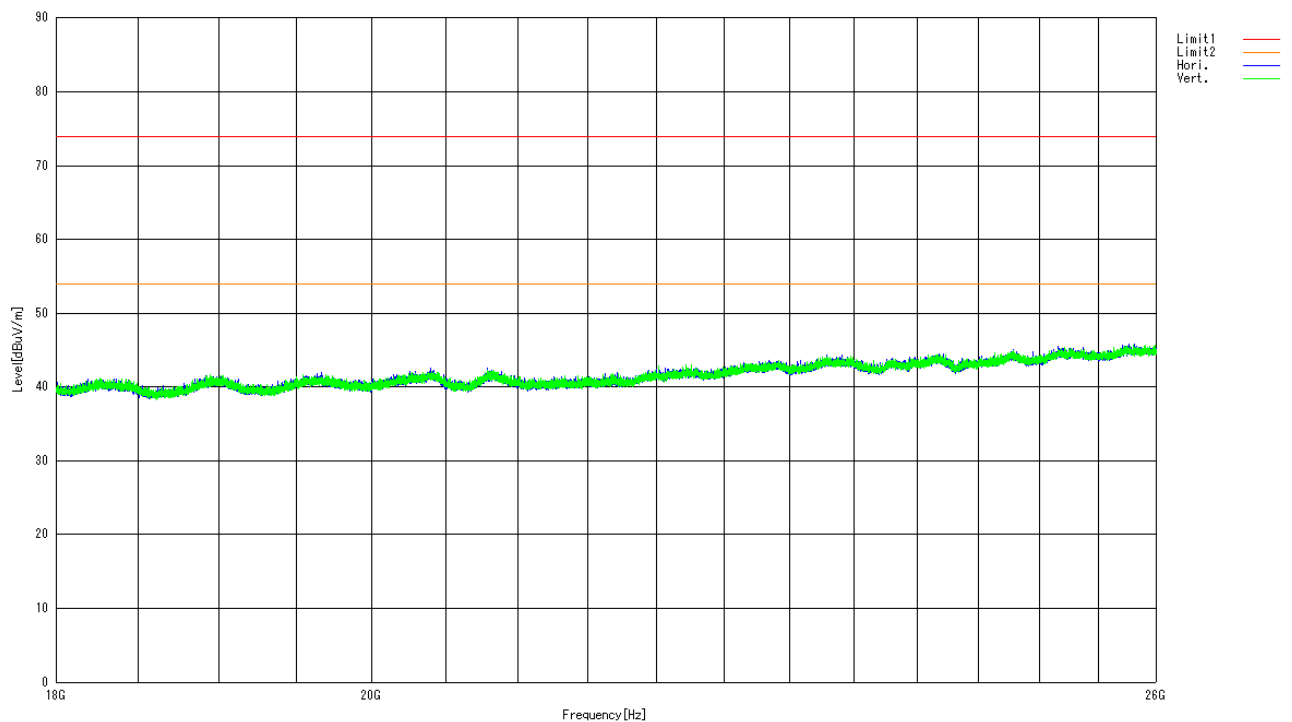
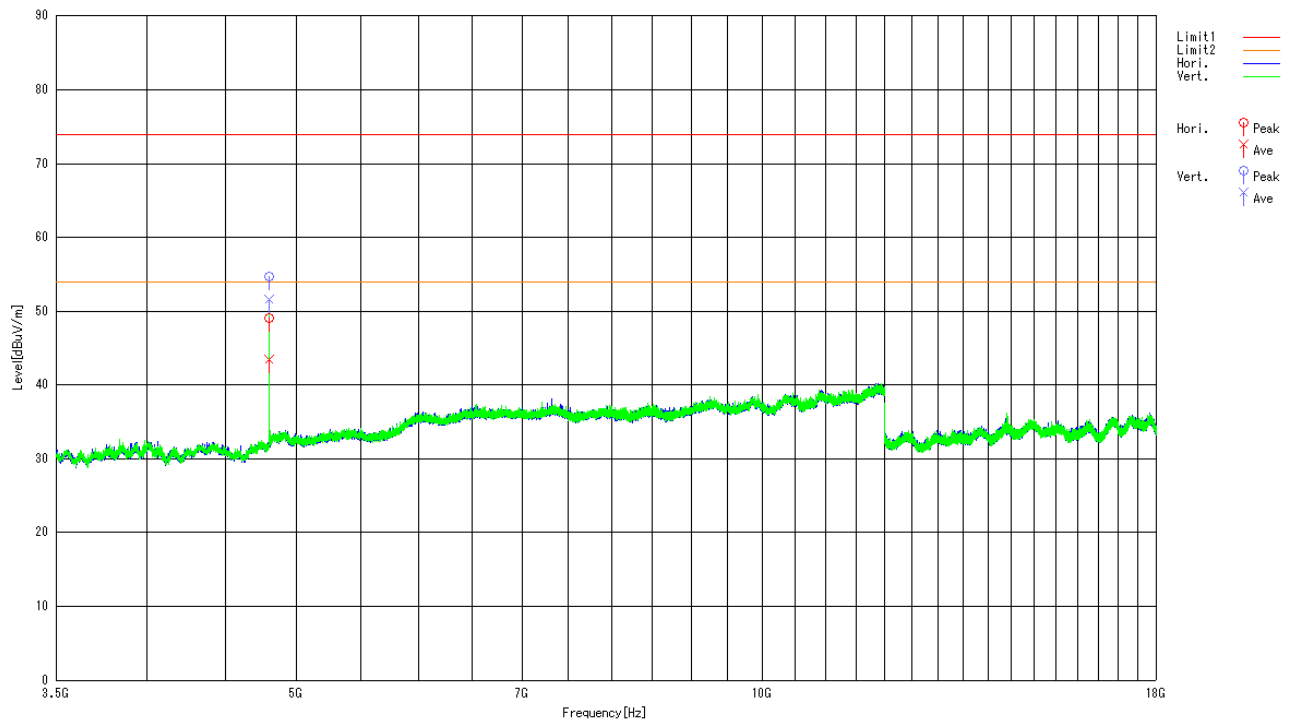
Graphical data of test result (1GHz-26MHz)

Operating mode: Continuous Communication (GFSK, 2402MHz: Worst configuration)

EUT position: X-plane

Measurement distance: 3 m





2.3 Receiver Radiated spurious emissions

Test setup - Same as clause 2.2

Test procedure - Same as clause 2.2

Applicable rule and limitation at 3m

RSS-Gen 6 Radiated Spurious Emission Limits

Frequency (MHz)	Field Strength (uV/m)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

Test results - Complied with requirement.

2.3.1 Between 30 – 1000 MHz

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

BI05	CL11	LA07	PR15	TR06
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Tested Date: 29 June, 2013

Temperature: 22 °C
Humidity: 62 %
Atmos. Press: 1012 hPa

Result

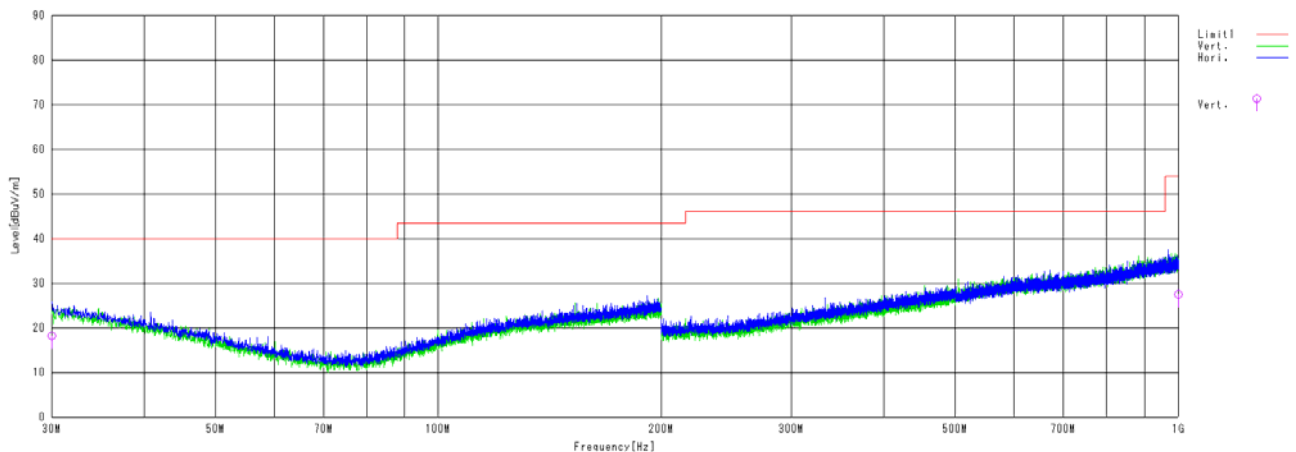
There were no spurious emissions greater than noise floor.

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

Operating mode: Continuous Communication (2440MHz)

EUT position: X-plane

Measurement distance: 3 m



2.3.2 Above 1000 MHz

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

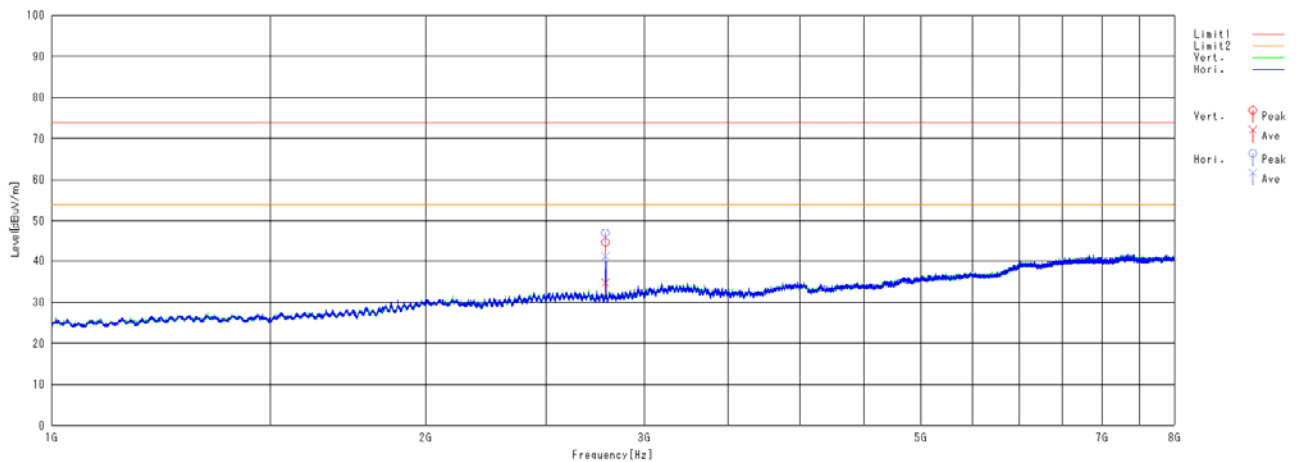
AC01	CL24	CL28	DH01	PR12	TR06			

Tested Date: 29 June, 2013

Temperature: 22 °C
Humidity: 62 %
Atmos. Press: 1012 hPa

Operating mode: Continuous Communication (GFSK, 2440MHz: Worst configuration)

No.	Frequency [MHz]	Reading		C.F. [dB]	Result		Limit		Margin		Conditions
		Peak [dBuV]	Ave [dBuV]		Peak [dBuV]	Ave [dBuV]	Peak [dBuV]	Ave [dBuV]	Peak [dB]	Ave [dB]	
1	2790.880	48.0	38.0	-3.4	44.6	34.6	73.9	53.9	29.3	19.3	Vert., X-plane
2	2790.880	50.3	44.6	-3.4	46.9	41.2	73.9	53.9	27.0	12.7	Hori., X-plane



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	-	2013/04/20	2014/04/30
AC01(EG)	Anechoic Chamber (1st test room)	JSE	203397C	-	2012/11/17	2013/11/30
BI05	Biconical Antenna	SCHWARZBECK	VHA9103 & BBA9106	91032894	2012/12/03	2013/12/31
BRF12	Band Reject Filter (2400MHz)	M-City	BRF2440-01	RF0012-02	2013/02/19	2014/02/28
CH01	Conical Horn Antenna (12-18GHz)	ETS-Lindgren	3163-05	00126641	2012/07/13	2014/07/31
CL11	Antenna Cable for RE	RFT	-	-	2012/10/01	2013/10/31
CL23	RF Cable 0.5m	SUHNER	SUCOFLEX104PE	48773	2013/06/11	2014/06/30
CL24	RF Cable 5.0m	SUHNER	SUCOFLEX104PE	48775	2013/06/11	2014/06/30
CL28	RF Cable 1.0m	SUHNER	SUCOFLEX104PE	75769	2012/08/24	2013/08/31
CL29	RF Cable 2m	SUHNER	SUCOFLEX104PE	94709	2013/01/15	2014/01/31
DH01	DRG Horn Antenna	A.H. Systems	SAS-571	785	2012/01/27	2014/01/31
HPF1	High Pass Filter (3500MHz)	TOKIMEC	TF323DCA	603	2013/06/11	2014/06/30
LA07	Logperiodic Antenna	SCHWARZBECK	VUSLP9111B	102	2012/12/03	2013/12/31
LP05	Loop Antenna	ETS-Lindgren	6502	00143302	2013/01/24	2014/01/31
PR12	Pre. Amplifier (1-26G)	Agilent Technologies	8449B	3008A02513	2013/01/15	2014/01/31
PR15	Pre. Amplifier	Anritsu	MH648A	6201156141	2013/06/11	2014/06/30
SA06	Spectrum Analyzer (F/W: 4.50 SP4)	Rohde & Schwarz	FSP40	100071	2012/11/6	2013/11/30
SH01	Standard Horn Antenna (18-26G)	A.H. Systems	SAS-572	208	2012/07/26	2014/07/31
TR06	Test Receiver (F/W : 3.93 SP2)	Rohde & Schwarz	ESU26	100002	2012/09/27	2013/09/30

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.