

Certification of Compliance

CFR 47 Part 15 Subpart B, Subpart C

Order No. : CSTS-C1103-046
Test Report No. : CSTS-A11-FCC013
Applicant : CELLUON, INC.
Address of Applicant : Age High-End Tower 918 235-2, Guro-dong, Guro-gu, Seoul, Korea, 152-740

Equipment Under Test (EUT)

Kind of Product : Projection Keyboard
Model Name : Magic Cube
FCC ID : TCLMAGICCUBE

Standards : FCC CFR Part 15 Subpart B,C : 2008
ANSI C63.4:2003

Date of Receipt : 16 March, 2011
Date of Test : 18 March, 2011
Date of Issue : 24 March, 2011

Test Result : ☒ Positive

☐ Negative



Jae Yeon, Choi / Testing By Engineer



Chang Woo, Kim / General Manager

In the configuration tested, the EUT complied with the standards specified above.

Remarks :

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.
This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards.

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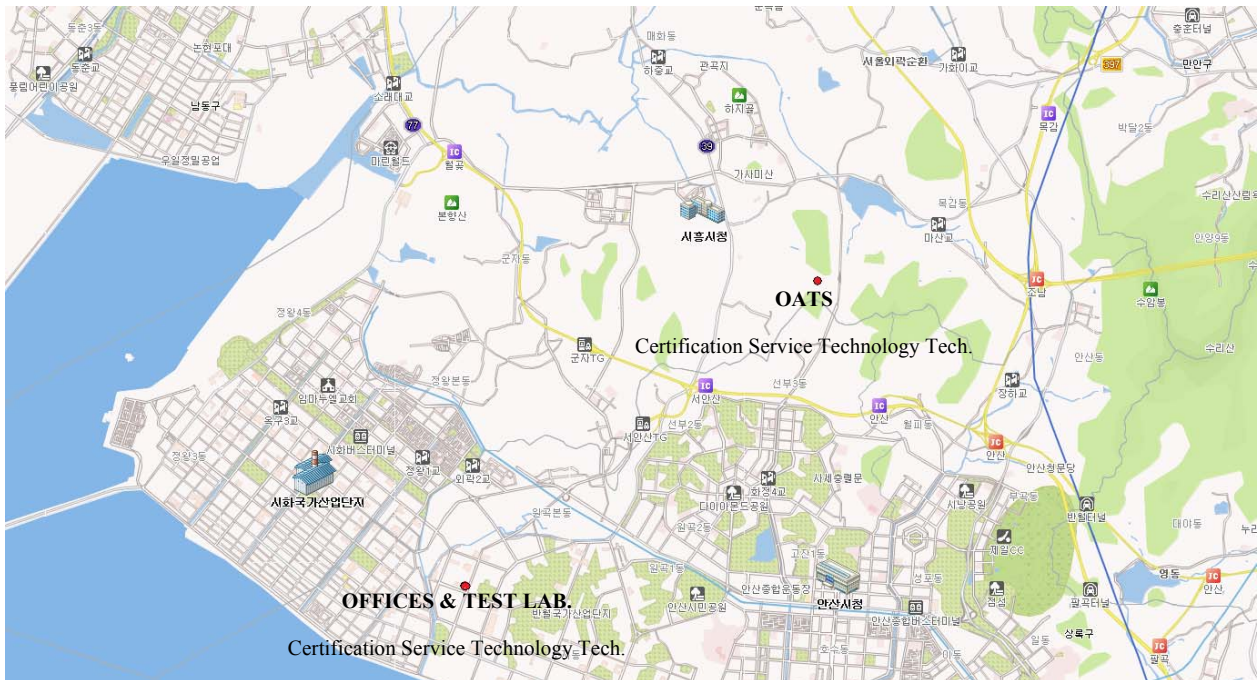
1. General Information

1.1 Information of Test Laboratory.

FCC E-Filing : Registration Number:289252

Name : Certification Service Technology Inc.
Address :
Radiated Emission : 2F/1055, Shingil-dong, Danwon-gu, Ansan-City,
(3m Full Chamber) : Gyeonggi-do Korea, 425-839
Conducted Emission :
Radiated Emission : 456 Sanhyeun-dong, Sihung-City,
(OATS) : Gyeonggi-do Korea
Tel/Fax : +82-31-493-2001 / +82-31-493-2055

Web site : <http://www.cstlab.co.kr> E-mail : [jychoi@cstlab.co.kr](mailto: jychoi@cstlab.co.kr)



We , Certification Service Technology Inc. are an independent EMC and RF consultancy that was established the whole facility in our laboratories. The test facility has been accredited by the following accreditation Bodies in compliance with ISO 17025:

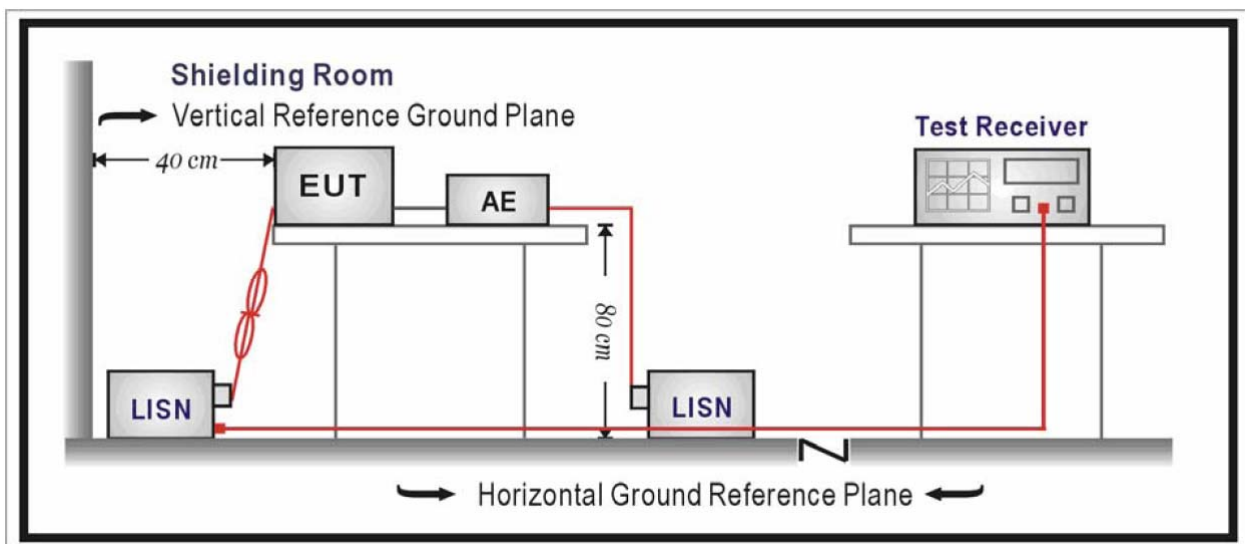
1.2 Description of Test

Conducted Emissions:

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50 uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50 ohm/50 uH coupling impedance with 50 ohm termination.(Please refers to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed on conducted measurement.

Conducted emissions were investigated over the frequency range from 0.15 MHz to 30 MHz using a receiver bandwidth of 9 kHz.



Limit Of Conducted Emission:

Test Specification

: According to FCC CFR Title 47 Part 15 Subpart B Section 15.107

According to FCC CFR Title 47 Part 15 Subpart C Section 15.207

FREQUENCY (MHz)	Limit	
	Quasi-peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5.0	56	46
5.0 to 30.0	60	50

*Decreases with the logarithm of the frequency.

Radiated Emissions:

The measurement was performed over the frequency range of 30 MHz to 1 GHz using antenna as the input transducer to a Spectrum analyzer or a Field Intensity Meter. The measurement was made with the detector set for "quasi-peak" within a bandwidth of 120 kHz.

Procedure of Test

Preliminary measurements were made at 3 meter using bi-log antennas, and spectrum analyzer to determine the frequency producing the max. emission in anechoic chamber. Appropriate precaution was taken to ensure that all emission from the EUT were maximized and investigated. The system configuration, mode of operation, turn-table azimuth and height with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 MHz to 1000 MHz using bi-log antenna. Above 1 GHz, linearly polarized double ridge horn antennas were used. Final measurements were made at open site with 3-meters test distance using bi-log antenna or horn antenna. The OATS have been verified in regular for its normalized site attenuation. The test equipment was placed on a wooden table. Sufficient time for the EUT, peripheral equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. Each frequency found during pre-scan measurements was re-examined by manual. The detector function was set to CISPR quasi-peak mode and the bandwidth of the receiver was set to 120 kHz or 1 MHz depending on the frequency of type of signal. The EUT, peripheral equipment and interconnecting cables were re-configured to the set-up producing the max. emission for the frequency and were placed on top of a 0.8-meter high nonmetallic 1 x 1.5 meter table. The EUT, peripheral equipment, and interconnecting cables were re-arranged and manipulated to maximize each emission. The turntable containing the system was rotated; the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission. Each emission was maximized by: varying the mode of operation to the EUT and/or peripheral equipment and changing the polarity of the antenna, whichever determined the worst-case emission.(The bandwidth below 1 GHz setting on the field strength meter is 120 kHz and above 1 GHz is 1 MHz.)

Radiated Emissions: , 9 kHz to 30 MHz(Magnetic Field Test)

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions at a distance of 3 meters according to Section 15.31(f)(2).
2. The EUT was placed on the top of the 0.8-meter height, 1 x 1.5 meter non-metallic table.
3. Emissions from the EUT are maximized by adjusting the orientation of the Loop antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions if applicable.
4. To obtain the final measurement data, each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector with specified bandwidth.

Limit Of Radiated Emission :

Test Specification

: According to FCC CFR Title 47 Part 15 Subpart B Section 15.109

According to FCC CFR Title 47 Part 15 Subpart C Section 15.209

: According to FCC CFR Title 47 Part 15 Subpart C Section 15.209, 15.247

Limits		
Frequency (MHz)	$\mu\text{V}/\text{meter}$	$\text{dB}\mu\text{V}/\text{meter}$
0.009 – 0.490	2400/F (kHz)	300
0.190 – 1.705	24000/F (kHz)	30
1.705 – 30.0	30	30
30 – 88	100	40
88 – 216	150	43.52
216 – 960	200	46.02
Above 960	500	53.98

Remarks :

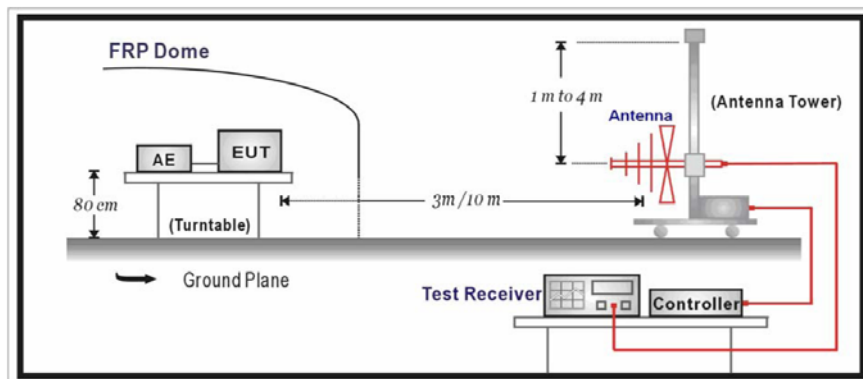
1. RF Voltage($\text{dB}\mu\text{V}$)= $20\log$ RF Voltage(μV)

2. In the Above Table, the tighter limit applies at the band edges.

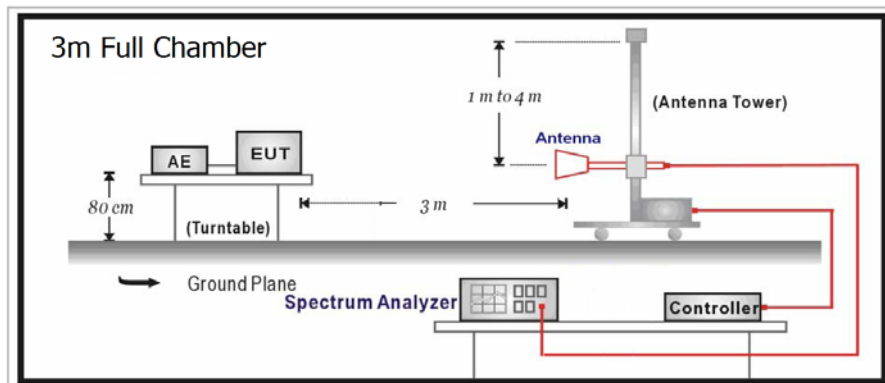
3. Distance refers to the distance in meters between the measuring

Instrument antenna and the closed point of any part of the device or System.

Below 1GHz Test Setup:



Above 1GHz Test Setup:



1.3 Measurement Uncertainty Calculations

Conducted Emissions

TYPE	Contribution	Probability Distribution	Uncertainty	Remark
B	LISN			
	Impedance	normal(k=2)	±1.3	CAL.
	Voltage Division Factor	normal(k=2)	±0.12	CAL.
	cable	normal (k=2)	±0.2	NONCAL.
	Receiver			
	Input Impedance	normal(k=1.64)	±0.0070	CAL.
	QP Sine-Wave Voltage Accuracy	normal(k=2)	±0.20 dB	
	QP-Pulse Amplitude Sensibility	normal(k=2)	±0.40 dB	
	QP-Pulse Frequency Response	normal(k=2)	±0.57 dB	
	Random Noise	normal(k=2)	±0.35 dB	
	Mismatch AMN to Receiver	U-Shaped	+0.7/-0.8	CISPR Theory
A	System Repeatability	Std deviation	±0.0721	
Combined Standard Uncertainty		normal	± 1.1155 [dB]	
Expanded Uncertainty U		normal(k=2)	± 2.23	95.45 %

Radiated Emission

TYPE	Contribution	Probability Distribution	Uncertainty 3/10m	Remark
B	Antenna			
	factor	normal(k=2)	±0.5 dB	NPL NAMAS NAMAS
	frequency interpolation			
	height variation	rectangular	±0.1039 dB	
	directivity difference	rectangular	+1.5/-2.6 dB	
	phase center location	rectangular	+0/-1.0 dB ±1.0 dB	
	Cable loss	normal(k=2)	±0.5 dB	
	Receiver			
	Input Impedance	normal(k=1.64)	±0.0070	
	QP Sine-Wave Voltage Accuracy	normal(k=2)	±0.20 dB	
	QP-Pulse Amplitude Sensibility	normal(k=2)	±0.40 dB	
	QP-Pulse Frequency Response	normal(k=2)	±0.57 dB	
	Random Noise	normal(k=2)	±0.35 dB	
	Mismatch : AMN – receiver $\Gamma_{\text{antenna}} = 0.33$ $\Gamma_{\text{receiver}} = 0.33$	U-Shaped	+0.9/-1.0 dB	CISPR
A	System repeatability	Std deviation	±0.1149 dB	
Combined standard Uncertainty		normal	±1.3193 [dB]	
Expanded Uncertainty U		normal(k=2)	± 2.63	95.45 %

1.4 Manufacturer Information

Manufacturer	:	CELLUON, INC.
Factory	:	Sound feel
Address	:	B-304, SungWoo Venture Vill, #332-33, Gocheon-dong, Uiwang-City, Gyeonggi-do, Korea.
Factory	:	Heilongjiang Celluon Electronic Product Developing Co., Ltd.
Address	:	No.99, Bamiantong Street, Jiangnan Develop District, Dongan District, Mudanjiang City, Heilongjiang Province, China

1.5 General Description of EUT

Name : Projection Keyboard
Model No. : Magic Cube
FCC ID : TCLMAGICCUBE
Serial No. : N/A

1.6 Details of EUT

Section	Specification
Operating Frequency	2 402 MHz ~ 2 480 MHz
The Number of Channels	79 Channels
Antenna	PCB Pattern Antenna
Interface	USB (Charging Mode & Keyboard Mode)
Power Source	DC 3.7 V (Rechargeable Lithium Battery)
Charging Power Source	DC 5.0 V (USB Type)
Operating Temperature.	0 °C ~ 35 °C
Modulation Method	FHSS (Frequency Hopping Spread Spectrum), GFSK
Communication Mode	Duplex

- Please refer to user's manual.

1.7 Description of Support Units

Product	Model No.	Serial No.	Manufacturer	Certification
Projection Keyboard.	Magic Cube	N/A	CELLUON, INC.	EUT
Personal Computer	DM-V189	ZW7C97AZC90312H	samsung Electronics	DoC
LCD Monitor	TGL 190G	717351805C2WY	LG Electronis Nanjing Display CO., Ltd.	DoC
USB Mouse	1113	N/A	MICROSOFT CORPORATION, FugangElectronic (Dongguan) Co.,Ltd.	DoC

1.8 Cable List

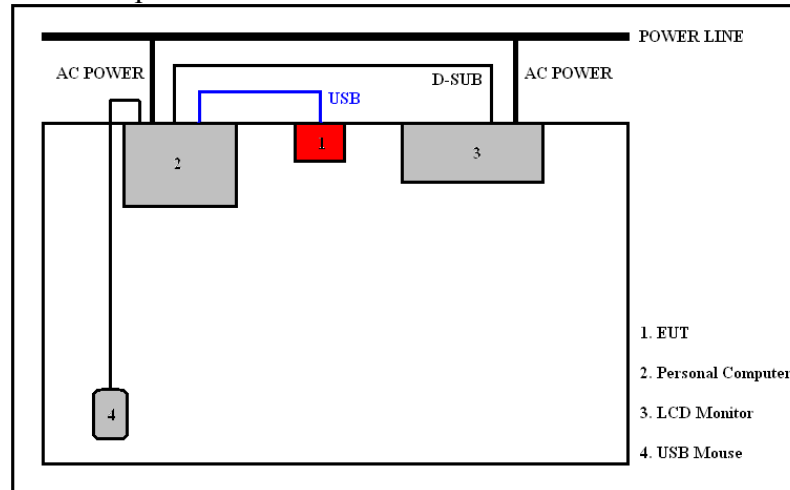
Start		END		Cable Spec	
Name	I/O Port	Name	I/O Port	Lenth	Shield
EUT	USB	Personal Compuer	USB	1.8	Shield
Personal Compuer	D-SUB	LCD Monitor	D-SUB	1.8	Shield
	USB	Mouse	-	1.8	Shield
	AC-IN	Power Line	AC-POWER	2.0	Unshield
LCD Monitor	AC-IN	Power Line	AC-POWER	2.0	Unshield

1.9 System Configuration

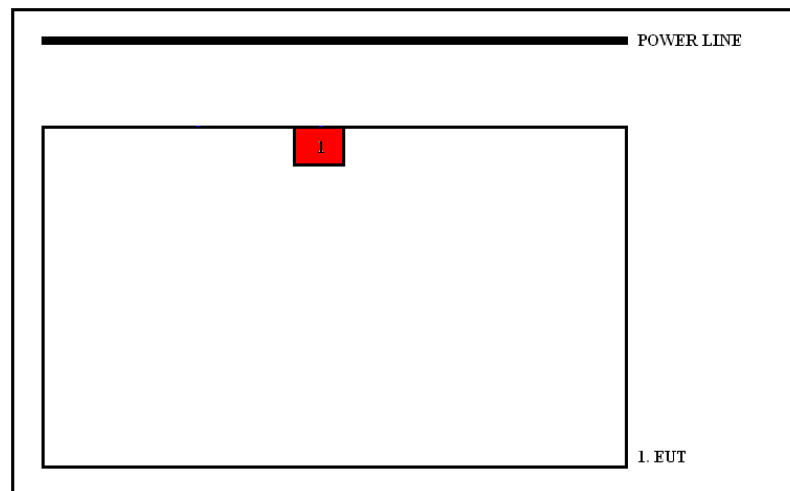
Description	Model	Serial No.	Manufacturer
-	-	-	-

1.10 Test Set-Up Configuration

1.10.1 Charging & Normal operation mode



1.10.2 Continuous Tx mode



1.11 Test Methodology And Configuration

1. Charging & Normal operation (wired keyboard) mode
2. Test Program used to control the EUT for staying in continuous Tx and Rx mode is programmed.

1.12 Standards Applicable for Testing

Table of tests to be carried out under FCC Part 15 Subpart B,C

Test Standards	Status
FCC Part 15 Subpart B,C	A
Deviation from Standard	No Deviation

Note) N/A : Indicates that the test is not applicable
A : Indicates that the test is applicable

2. SUMMARY

Test Descriptions

- Conducted Emission	
-Conducted Emission Result	PASS
- Radiated Emission	
Radiated Emission Result	PASS
- Number of Hopping Frequency Used	
Test Result	PASS
- Dwell Time in Each Channels	
Test Result	PASS
- Channel Bandwidth	
Test Result	PASS
- Hopping Channel Separation	
Test Result	PASS
- Maximum Peak Output Power Test Result	
Test Result	PASS
- Band Edge	
Test Result	PASS

3. Equipment Under Test

3.1 Conducted Emission

3.1.1 Test Instruments

Description	Manufacturer	Model No.	Serial No.	Next of Calibration
Test Receiver	LIG NEX1	ER-30	L0804A003	Sep. 17, 2011
LISN	EMCIS	LN2-16	LN10010	Apr. 13, 2011
LISN	EMCO	3825/2	9006-1666	Apr. 19, 2011
Transient Limiter	HAMEG	HZ560	N/A	Jul. 30, 2011
Shielded Room	BRADEN	N/A	DAC-60-005	-

Note : 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to RRL, KRISS, KTL and HCT.

2. The calibration interval of horn ant. and loop ant. is 24 months

3.1.2 Test Area

Conducted Room (Shielded Room)

3.1.3 Operation of EUT

Operating Environment

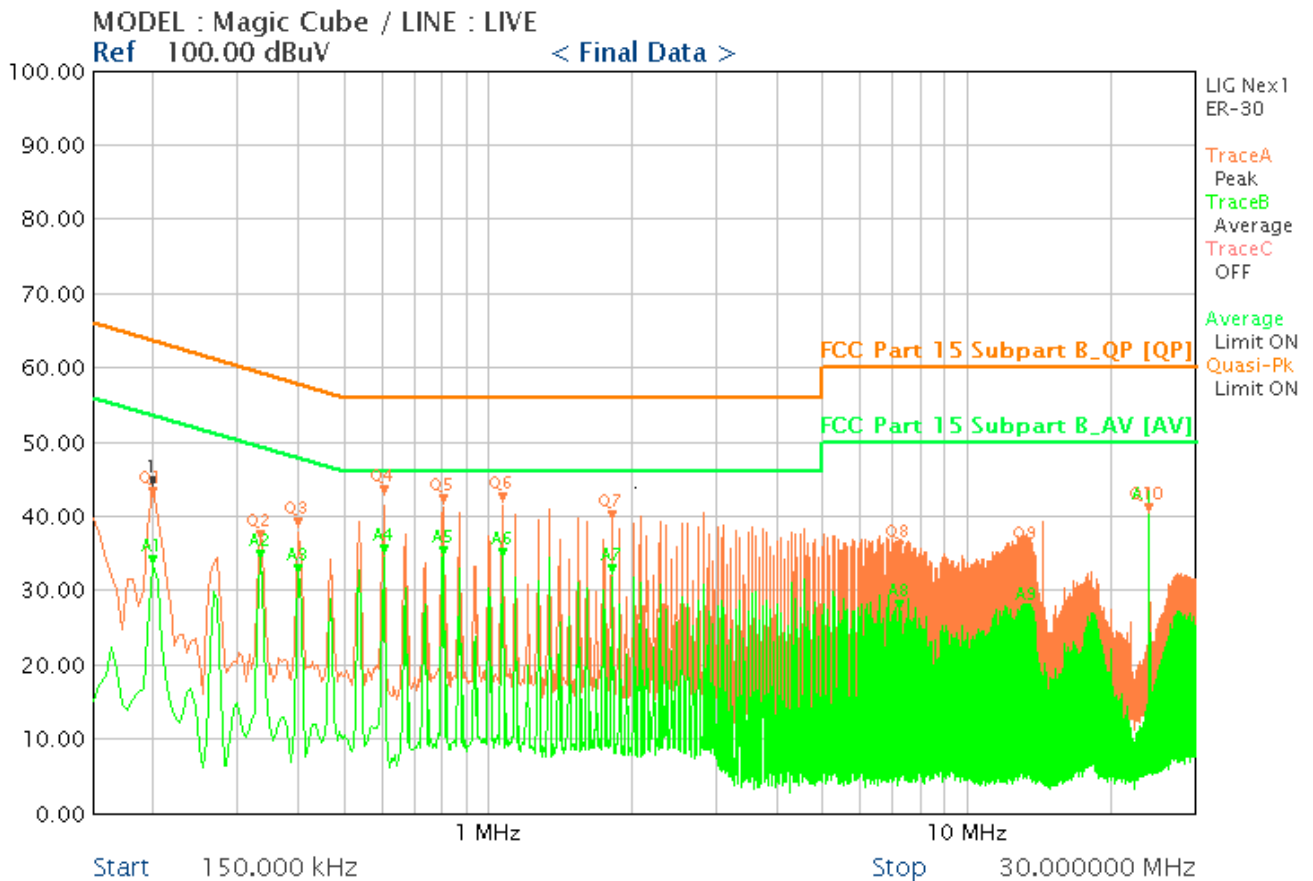
Temperature : 21.5 degree C
Humidity : 52 %RH
Atmospheric Pressure : 98.8 kPa

3.1.4 Test Date

18 March, 2011

3.1.5 Conducted Emissions Result

Phase : Live



Freq. [MHz]	Measurement [dBuV]		Limit [dBuV]		Insertion Loss [dB]	Cable Loss [dBuV]	Result [dBuV]		Margin [dB]	
	Q-peak	Average	Q-peak	Average			Q-peak	Average	Q-peak	Average
0.335	26.52	23.79	59.34	49.34	10.25	0.06	36.83	34.10	22.51	15.24
0.605	32.44	24.54	56.00	46.00	10.27	0.08	42.79	34.89	13.21	11.11
0.807	31.22	24.31	56.00	46.00	10.27	0.09	41.58	34.67	14.42	11.33
1.073	31.43	24.05	56.00	46.00	10.28	0.11	41.82	34.44	14.18	11.56
1.811	29.17	21.91	56.00	46.00	10.28	0.13	39.58	32.32	16.42	13.68
24.022	27.47	27.39	60.00	50.00	12.65	0.42	40.54	40.46	19.46	9.54

Note :

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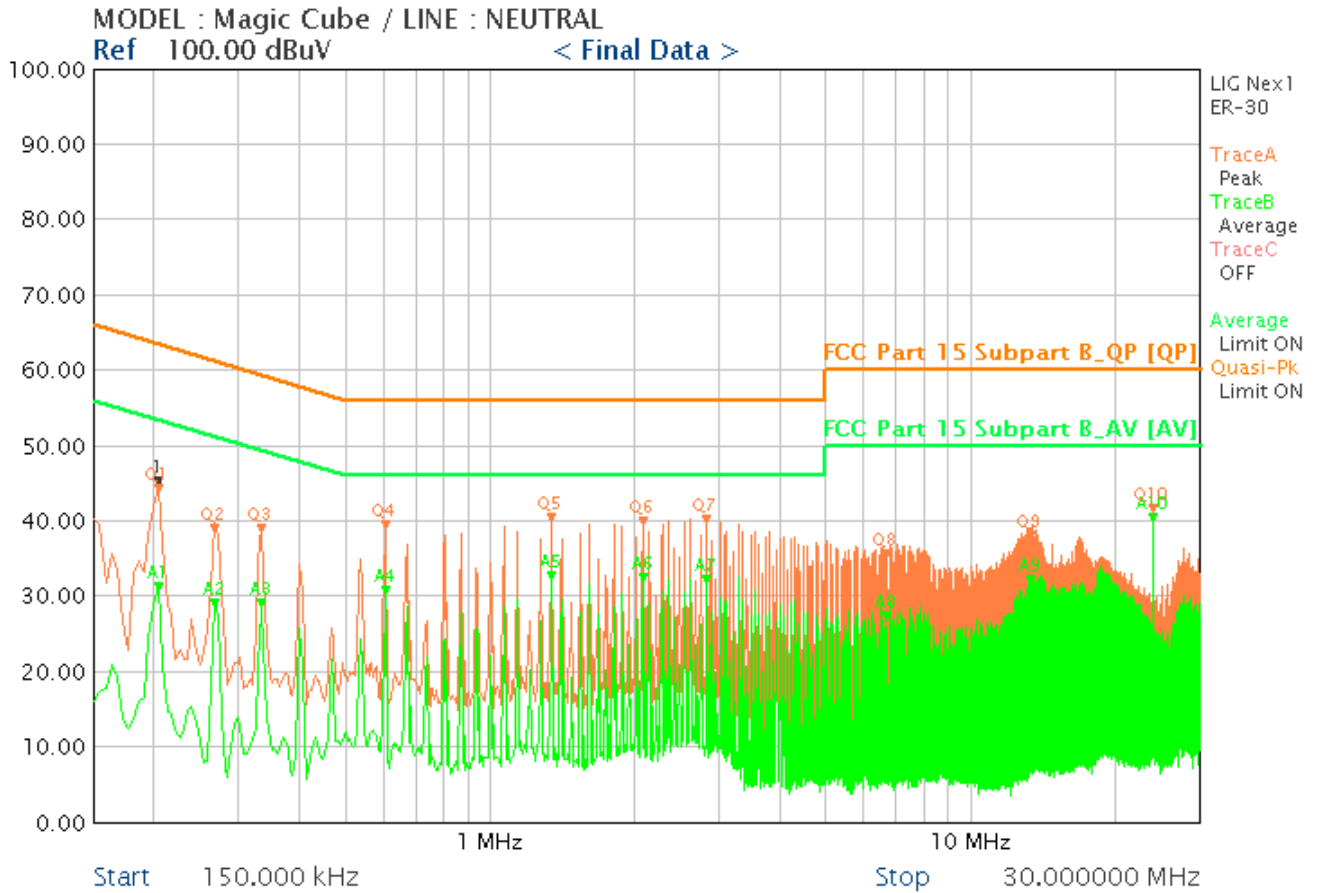
C.S.Tech., Ltd: 1055, Singil-dong, Danwon-gu, Ansan-si, Gyeonggi-do, Korea 425-839

Tel: +82 31 493 2001

Fax: +82 31 493 2055

www.cstlab.co.kr

Phase : Neutral



Freq. [MHz]	Measurement [dBuV]		Limit [dBuV]		Insertion Loss [dB]	Cable Loss [dBuV]	Result [dBuV]		Margin [dB]	
	Q-peak	Average	Q-peak	Average			Q-peak	Average	Q-peak	Average
0.605	28.38	19.63	56.00	46.00	10.27	0.08	38.73	29.98	17.27	16.02
1.343	29.26	21.63	56.00	46.00	10.26	0.12	39.64	32.01	16.36	13.99
2.081	28.92	21.44	56.00	46.00	10.31	0.13	39.36	31.88	16.64	14.12
2.819	28.94	21.15	56.00	46.00	10.33	0.15	39.42	31.63	16.58	14.37
13.353	25.78	19.99	60.00	50.00	11.33	0.23	37.34	31.55	22.66	18.45
24.022	27.84	26.69	60.00	50.00	12.65	0.42	40.91	39.76	19.09	10.24

Note :

3.2 Radiated Emission

3.2.1 Test Instruments

Description	Manufacturer	Model No.	Serial No.	Next of Calibration
Test Receiver	LIG NEX1	ER-265	L0804B002	Jul. 15, 2011
BICONILOG ANT.	EMCO	3142	9107-1128	Apr. 27, 2012
LOOP ANT.	Schwarz beck	HFH2-Z2	100187	Jul. 22, 2011
Horn Antenna	Schwarzbeck	BBHA9120D	0501	Aug. 31 2012
Horn Antenna	Schwarzbeck	BBHA9170	BBHA9170152	Aug. 31. 2012
BICONICAL ANT.	EMCO	3104C	9012-4380	Mar. 26, 2012
LOGPERIODIC ANT.	EMCO	3146	9008-2863	Mar. 28, 2012
Turn Table	EMCO	D-TT 06	N/A	-
Ant. Mast	EMCO	D-AM 06	N/A	-
Controller	EMCO	D-CTR 06	N/A	-
T-TABLE CONTROLLER	EMCO	1060-1.511	9101-1517	-
CHAMBER	BRADEN	RF Shielded door Assembly	DAC-60-004	-

Note : 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to RRL, KRISS, KTL and HCT.

2. The calibration interval of horn ant. and loop ant. is 24 months

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. For the limit is employed average value, therefore the peak value can be transferred to average value by subtracting the duty factor. The basic equation with a sample calculation is as follows:

$$\text{Peak} = \text{Reading} + \text{Corrected Factor}$$

Where

Corr. Factor = Antenna Factor + Cable Factor - Amplifier Gain (if any)

3.2.2 Test Area

3m Full Chamber

3.2.3 Operation of EUT

Operating Environment

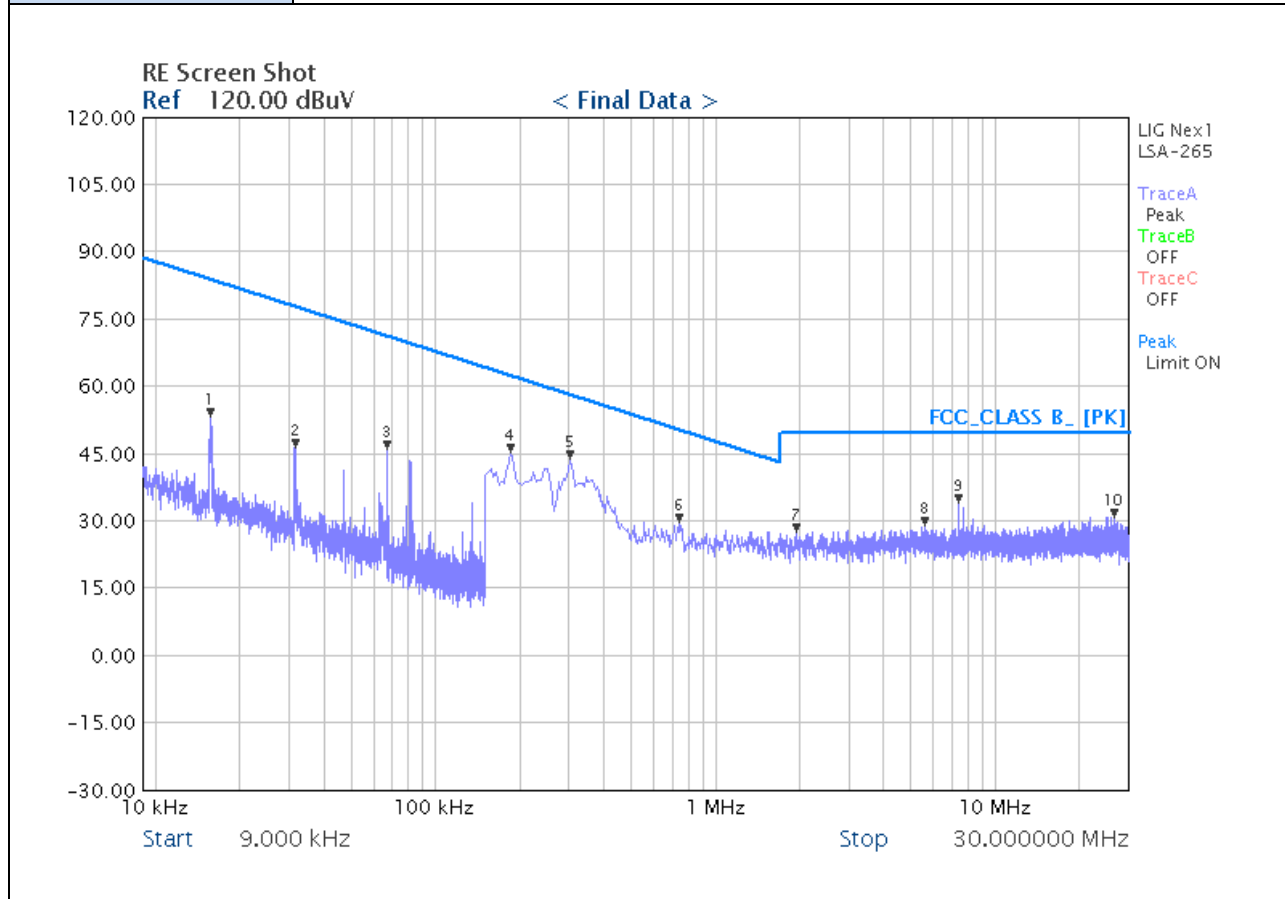
Temperature : 20.8 degree C
Humidity : 51 %RH
Atmospheric Pressure : 98.5 kPa

3.2.4 Test Date

21 March, 2011

3.2.5 Radiated Emission Result (9 kHz ~ 30 MHz)

Test Frequency	9 kHz to 30 MHz	Polarization	Horizontal
Test Mode	Normal Operating Mode	Test Channel	-
Test Result	PASS		



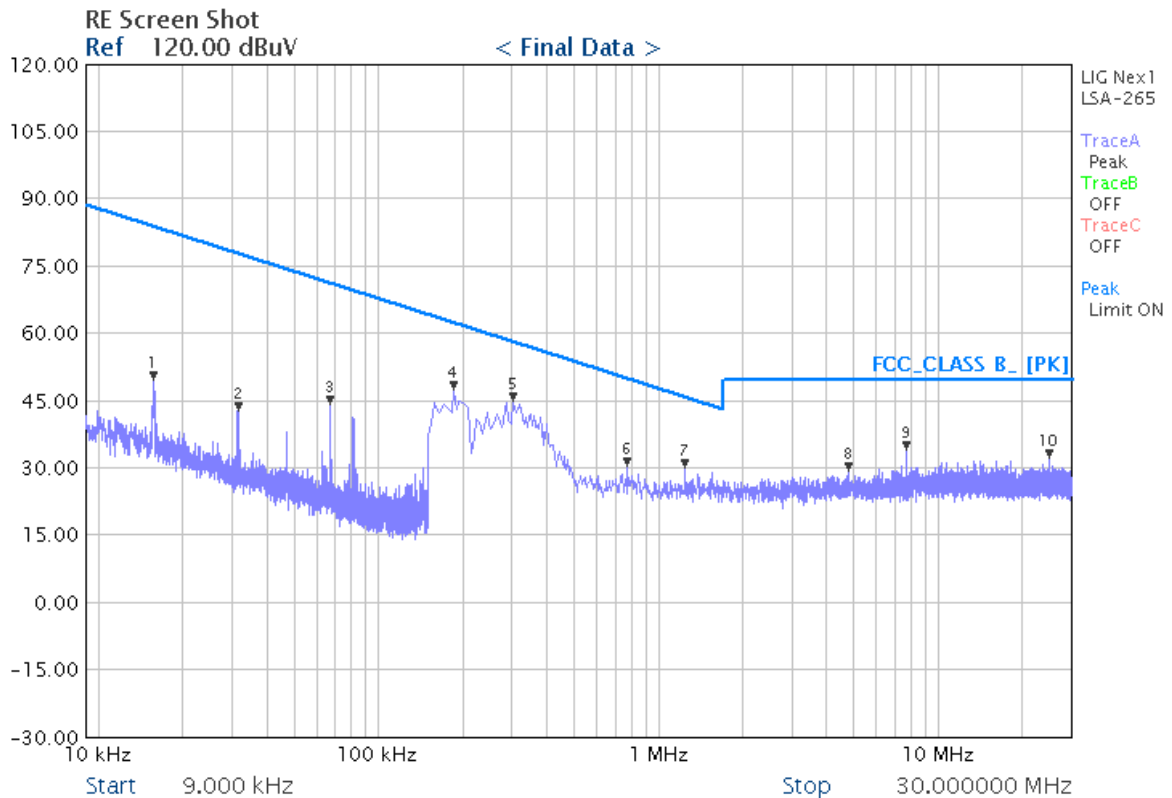
Frequency MHz	Reading dBuV	P (H, V)	Ant. Factor dB	Cable Loss dB	AMP GAIN dB	Limit dBuV	Total dBuV	Margin dB
0.186	26.19	H	18.90	0.12	-	62.19	45.21	16.98
0.303	24.60	H	18.86	0.15	-	57.97	43.61	14.36
7.409	14.37	H	18.68	1.07	-	49.54	34.12	15.42

Note : 1. All reading levels are Quasi-peak value.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

3. Other emissions don't exceed the level of 20 dB below the applicable Limit.

Test Frequency	9 kHz to 30 MHz	Polarization	Vertical
Test Mode	Normal Operating Mode	Test Channel	-
Test Result	PASS		



Frequency MHz	Reading dBuV	P (H, V)	Ant. Factor dB	Cable Loss dB	AMP GAIN dB	Limit dBuV	Total dBuV	Margin dB
0.186	28.24	V	18.90	0.12	-	62.19	47.26	14.93
0.303	25.71	V	18.86	0.15	-	57.97	44.72	13.25
1.240	10.97	V	18.85	0.28	-	45.74	30.10	15.64

Note : 1. All reading levels are Quasi-peak value.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

3. Other emissions don't exceed the level of 20 dB below the applicable Limit.

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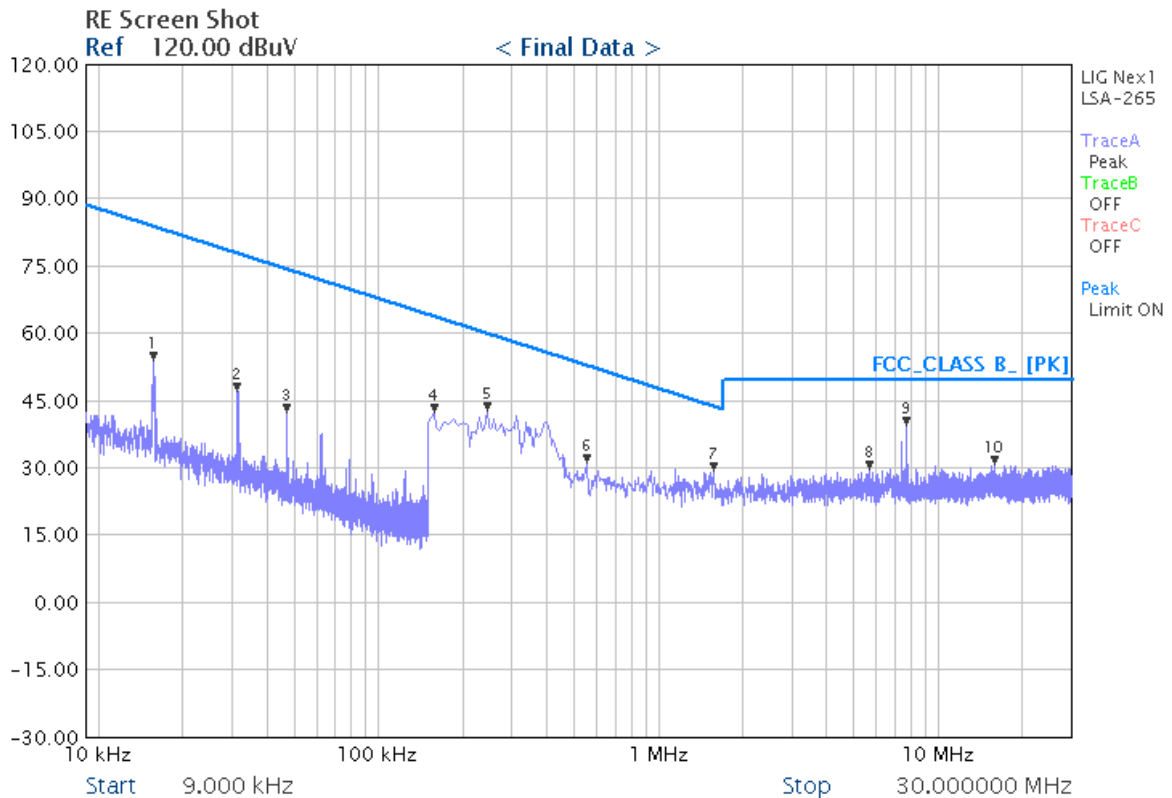
C.S.Tech., Ltd: 1055, Singil-dong, Danwon-gu, Ansan-si, Gyeonggi-do, Korea 425-839

Tel: +82 31 493 2001

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Test Frequency	9 kHz to 30 MHz	Polarization	Horizontal
Test Mode	Continuous Tx	Test Channel	-
Test Result	PASS		



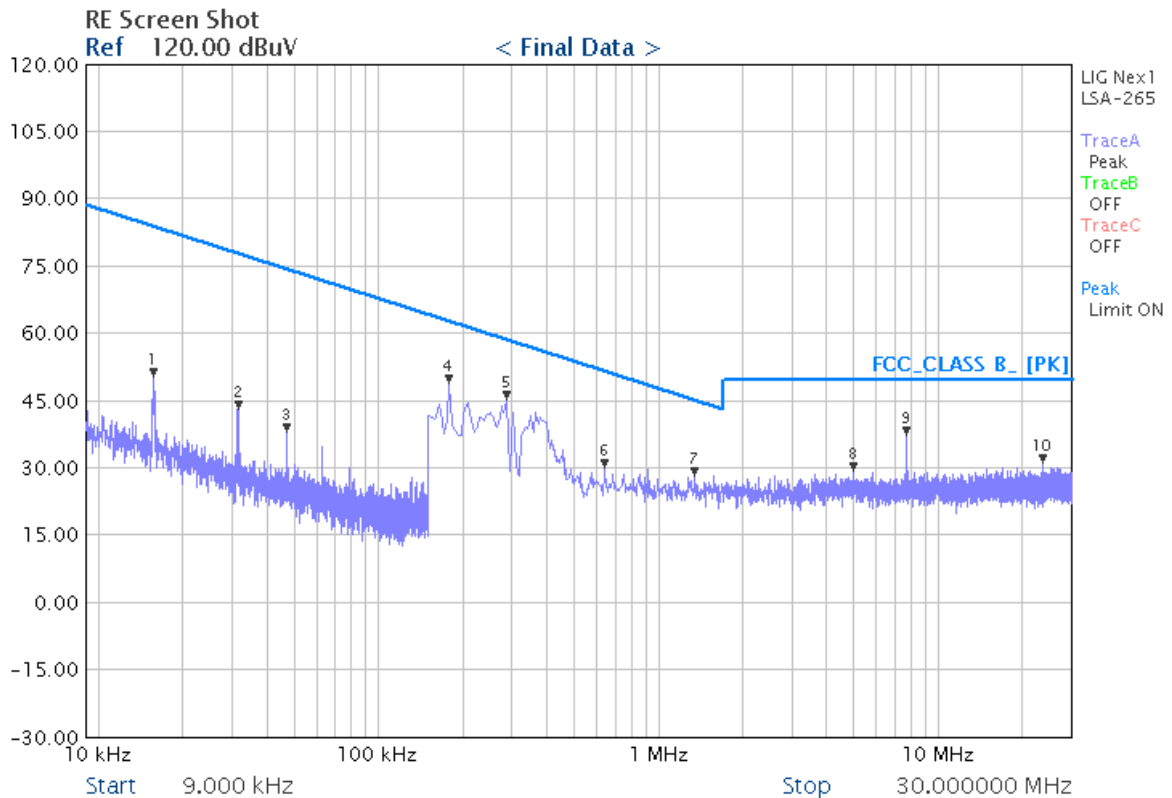
Frequency MHz	Reading dBuV	P (H, V)	Ant. Factor dB	Cable Loss dB	AMP GAIN dB	Limit dBuV	Total dBuV	Margin dB
0.245	23.47	H	18.88	0.13	-	59.83	42.48	17.35
1.579	10.03	H	18.85	0.29	-	43.64	29.17	14.47
7.697	19.78	H	18.67	1.09	-	49.54	39.54	10.00

Note : 1. All reading levels are Quasi-peak value.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

3. Other emissions don't exceed the level of 20 dB below the applicable Limit.

Test Frequency	9 kHz to 30 MHz	Polarization	Vertical
Test Mode	Continuous Tx	Test Channel	-
Test Result	PASS		



Frequency MHz	Reading dBuV	P (H, V)	Ant. Factor dB	Cable Loss dB	AMP GAIN dB	Limit dBuV	Total dBuV	Margin dB
0.179	29.88	V	18.90	0.12	-	62.54	48.9	13.64
0.288	26.00	V	18.87	0.14	-	58.4	45.01	13.39
7.697	17.29	V	18.67	1.09	-	49.54	37.05	12.49

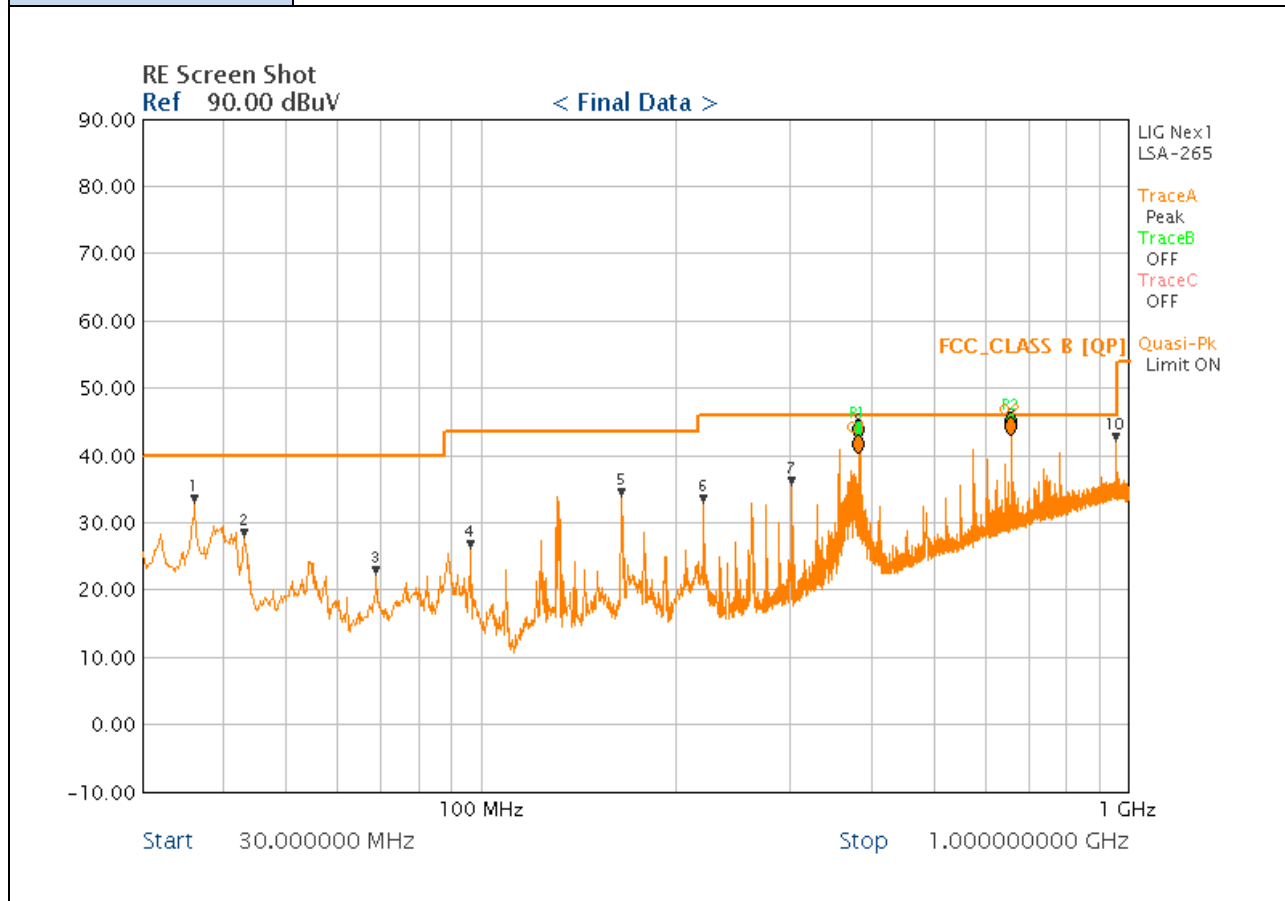
Note : 1. All reading levels are Quasi-peak value.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

3. Other emissions don't exceed the level of 20 dB below the applicable Limit.

3.2.6 Radiated Emission Result (30 MHz ~ 1000 MHz)

Test Frequency	30 MHz ~ 1000 MHz	Polarization	-
Test Mode	Normal Operating Mode	Test Channel	-
Test Result	PASS		

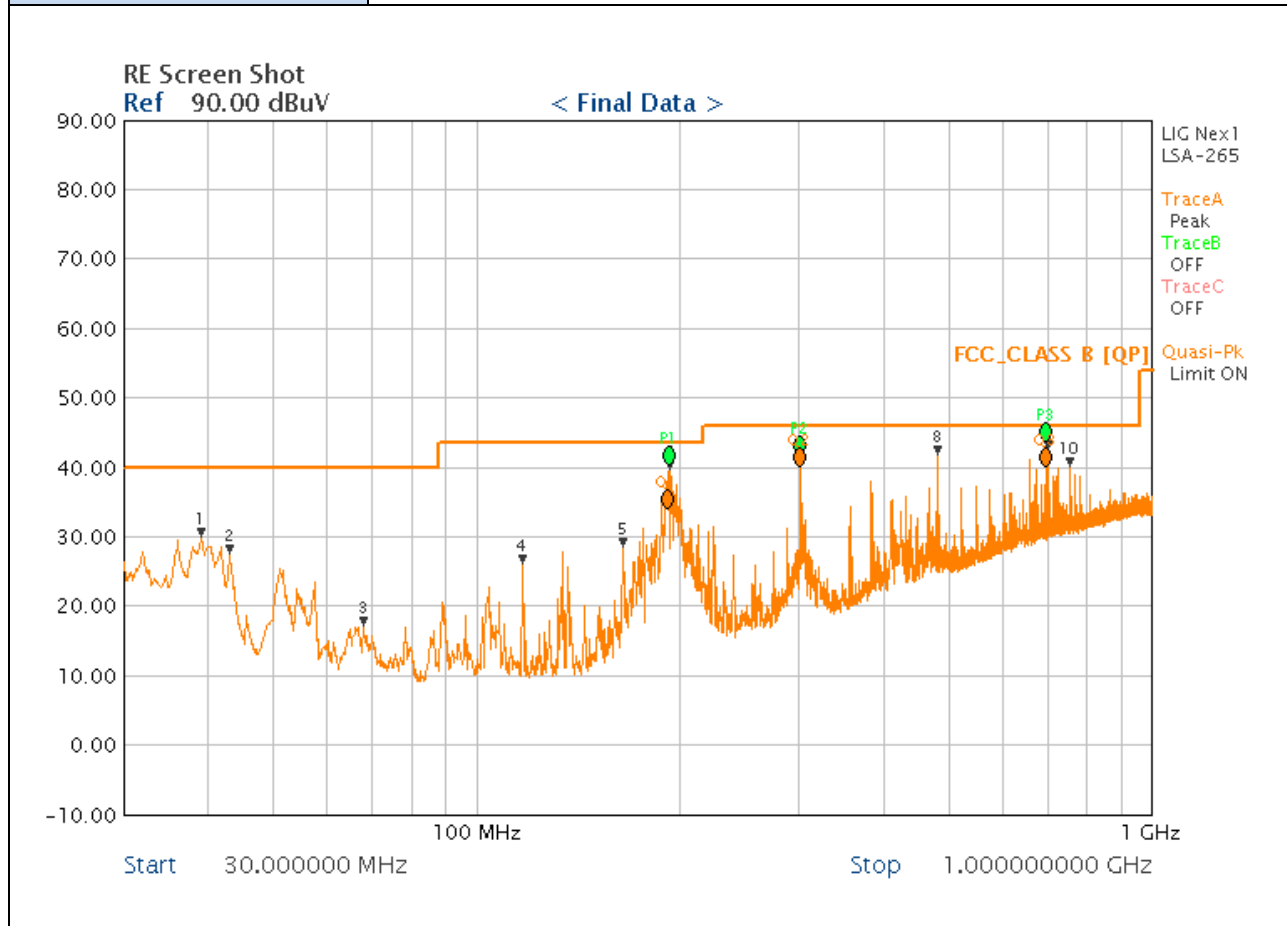


Frequency MHz	Reading dBuV	P (H, V)	Ant. Factor dB	Cable Loss dB	AMP GAIN dB	Limit dBuV	Total dBuV	Margin dB
384.08	22.98	H	15.51	3.12	-	46.02	41.61	4.41
658.40	18.27	H	20.96	3.72	-	46.02	42.95	3.07

Note : 1. All reading levels are Quasi-peak value.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

Test Frequency	30 MHz ~ 1000 MHz	Polarization	-
Test Mode	Continuous Tx	Test Channel	F1 (2402 MHz)
Test Result	PASS		

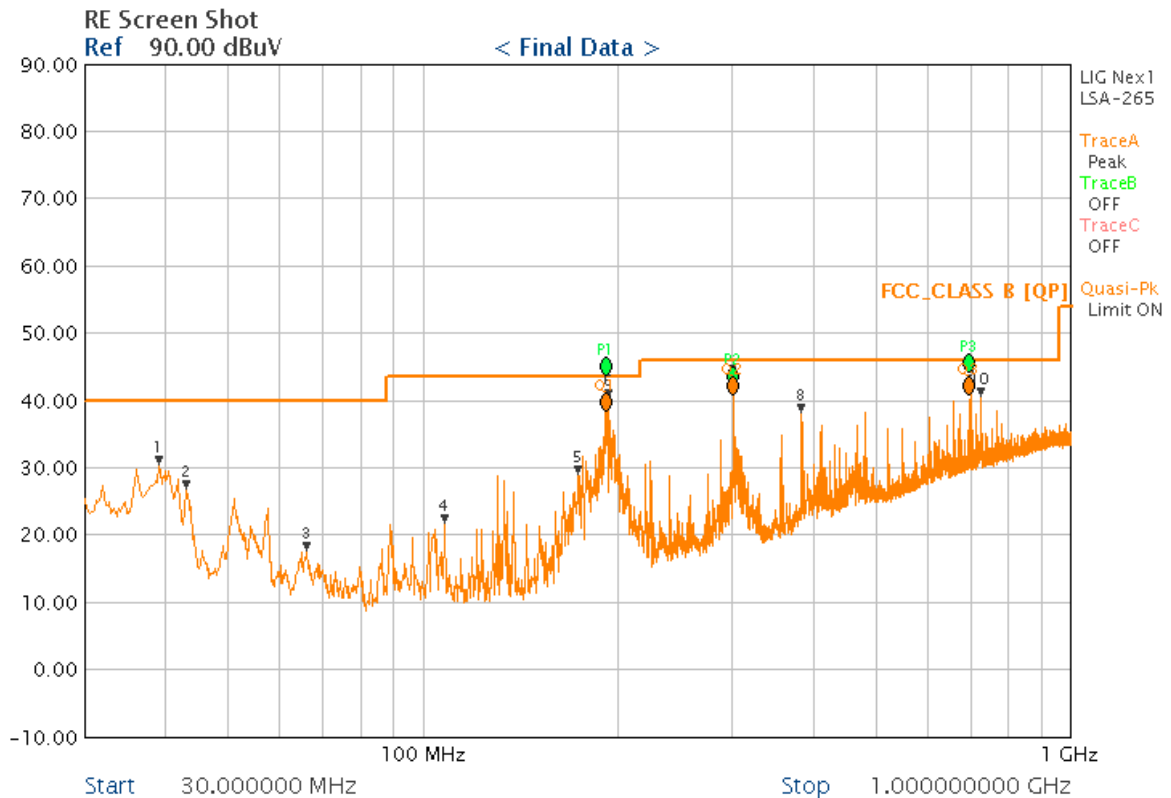


Frequency MHz	Reading dBuV	P (H, V)	Ant. Factor dB	Cable Loss dB	AMP GAIN dB	Limit dBuV	Total dBuV	Margin dB
191.96	23.27	V	9.90	2.12	-	43.52	35.29	8.23
301.78	25.63	H	12.96	2.62	-	46.02	41.21	4.81
699.56	15.74	H	21.49	4.07	-	46.02	41.30	4.72

Note : 1. All reading levels are Quasi-peak value.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

Test Frequency	30 MHz ~ 1000 MHz	Polarization	-
Test Mode	Continuous Tx	Test Channel	F2 (2441 MHz)
Test Result	PASS		

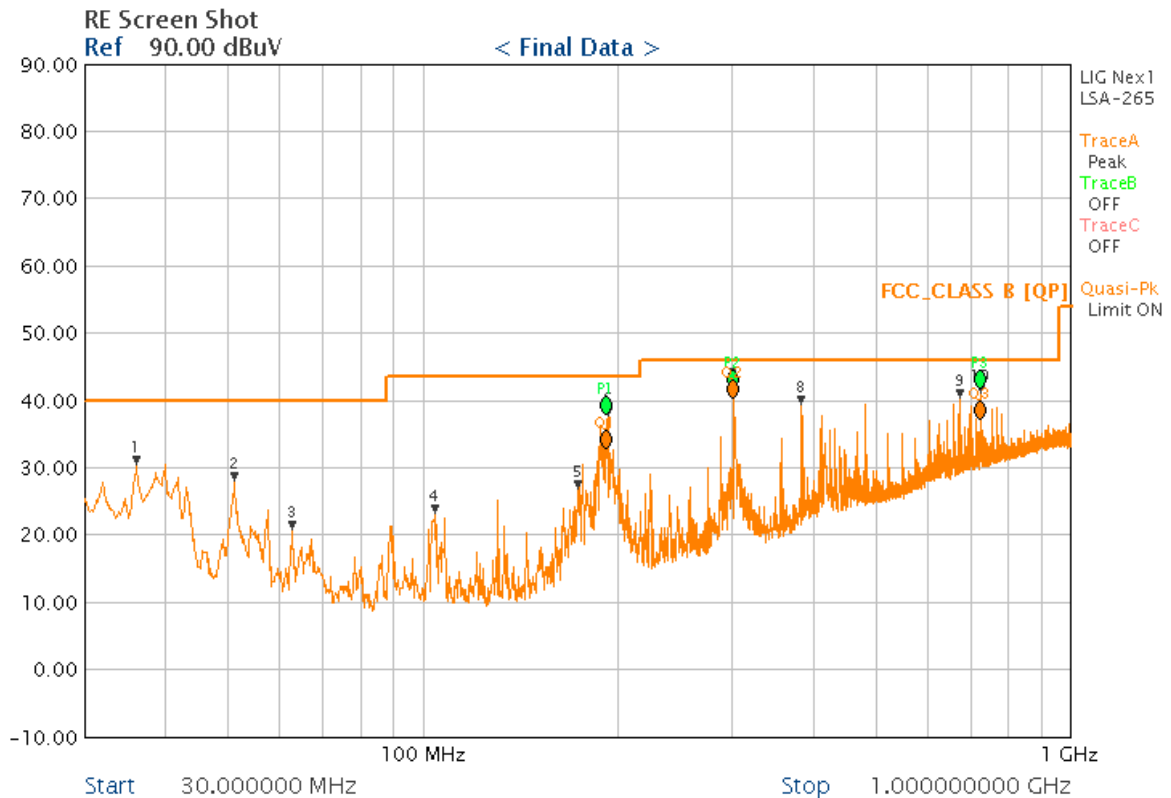


Frequency MHz	Reading dBuV	P (H, V)	Ant. Factor dB	Cable Loss dB	AMP GAIN dB	Limit dBuV	Total dBuV	Margin dB
192.07	27.66	V	9.90	2.12	-	43.52	39.68	3.84
301.77	26.44	H	12.95	2.62	-	46.02	42.01	4.01
699.58	16.56	H	21.49	4.07	-	46.02	42.12	3.90

Note : 1. All reading levels are Quasi-peak value.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

Test Frequency	30 MHz ~ 1000 MHz	Polarization	-
Test Mode	Continuous Tx	Test Channel	F3 (2480 MHz)
Test Result	PASS		

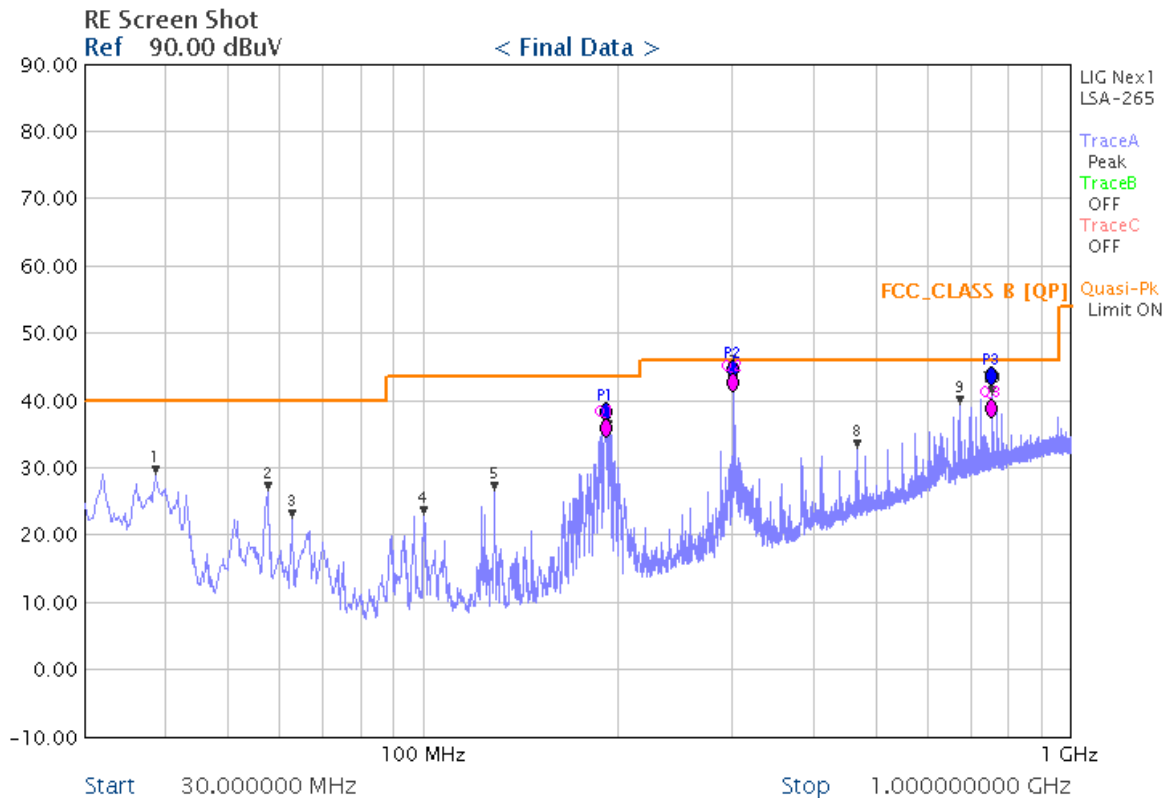


Frequency MHz	Reading dBuV	P (H, V)	Ant. Factor dB	Cable Loss dB	AMP GAIN dB	Limit dBuV	Total dBuV	Margin dB
192.15	22.04	V	9.90	2.12	-	43.52	34.06	9.46
301.77	26.04	H	12.95	2.62	-	46.02	41.61	4.41
727.00	12.52	H	21.66	4.15	-	46.02	38.33	7.69

Note : 1. All reading levels are Quasi-peak value.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

Test Frequency	30 MHz ~ 1000 MHz	Polarization	-
Test Mode	Continuous Rx	Test Channel	F1 (2402 MHz)
Test Result	PASS		

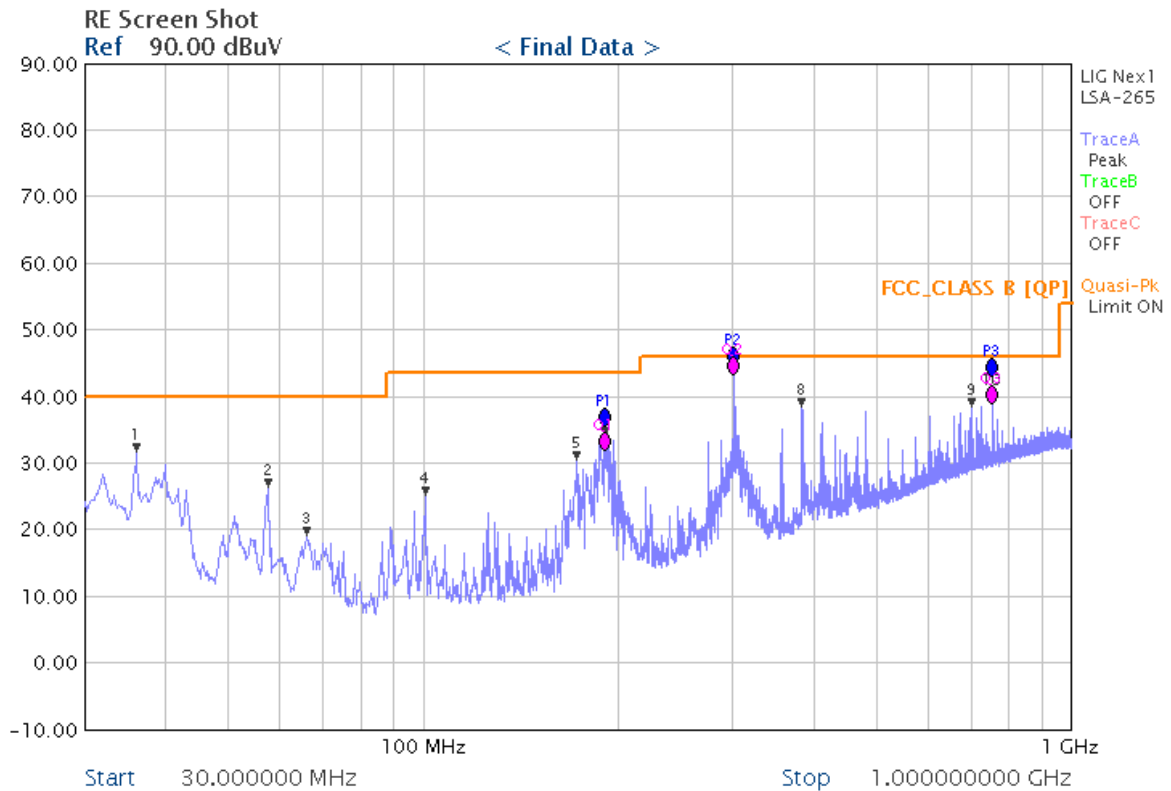


Frequency MHz	Reading dBuV	P (H, V)	Ant. Factor dB	Cable Loss dB	AMP GAIN dB	Limit dBuV	Total dBuV	Margin dB
192.35	23.80	V	9.90	2.12	-	43.52	35.82	7.70
301.78	26.98	H	12.96	2.62	-	46.02	42.56	3.46
754.42	12.65	H	21.83	4.19	-	46.02	38.67	7.35

Note : 1. All reading levels are Quasi-peak value.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

Test Frequency	30 MHz ~ 1000 MHz	Polarization	-
Test Mode	Continuous Rx	Test Channel	F2 (2441 MHz)
Test Result	PASS		

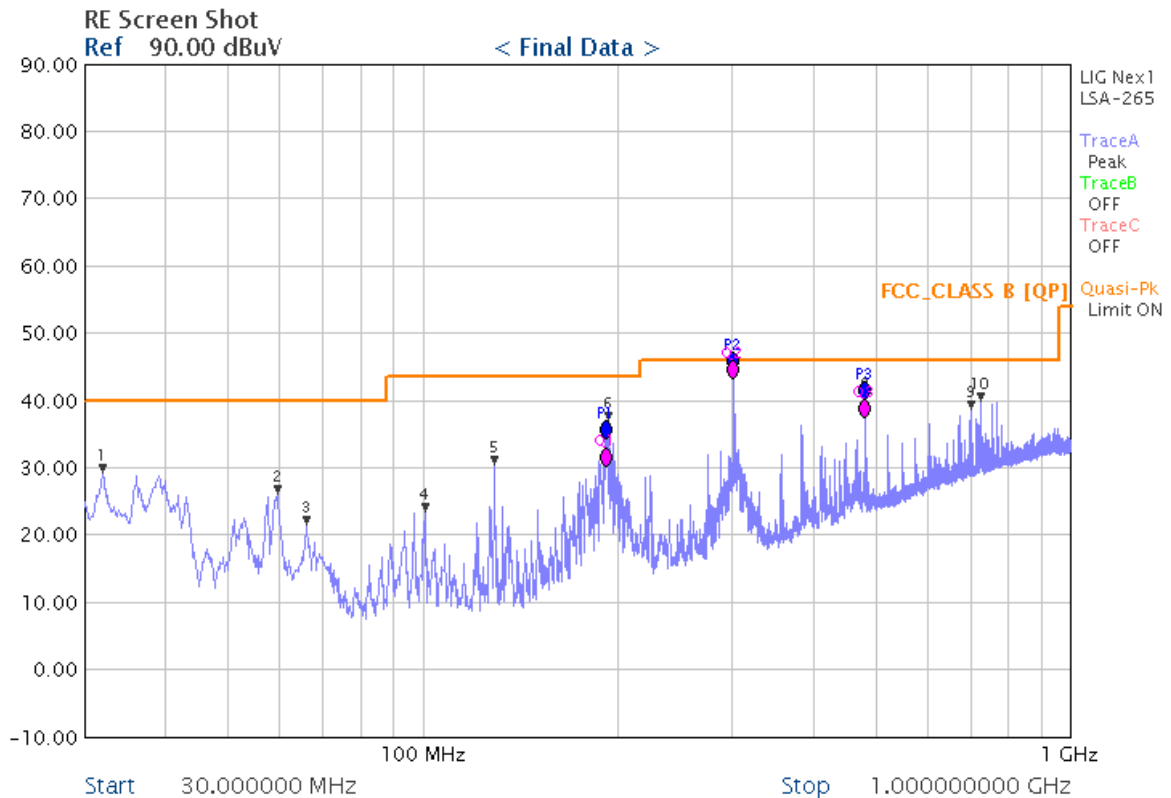


Frequency MHz	Reading dBuV	P (H, V)	Ant. Factor dB	Cable Loss dB	AMP GAIN dB	Limit dBuV	Total dBuV	Margin dB
190.64	21.21	V	9.90	2.10	-	43.52	33.21	10.31
301.77	27.28	H	12.95	2.62	-	46.02	42.85	3.17
754.42	14.01	H	21.83	4.19	-	46.02	40.03	5.99

Note : 1. All reading levels are Quasi-peak value.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

Test Frequency	30 MHz ~ 1000 MHz	Polarization	-
Test Mode	Continuous Rx	Test Channel	F3 (2480 MHz)
Test Result	PASS		



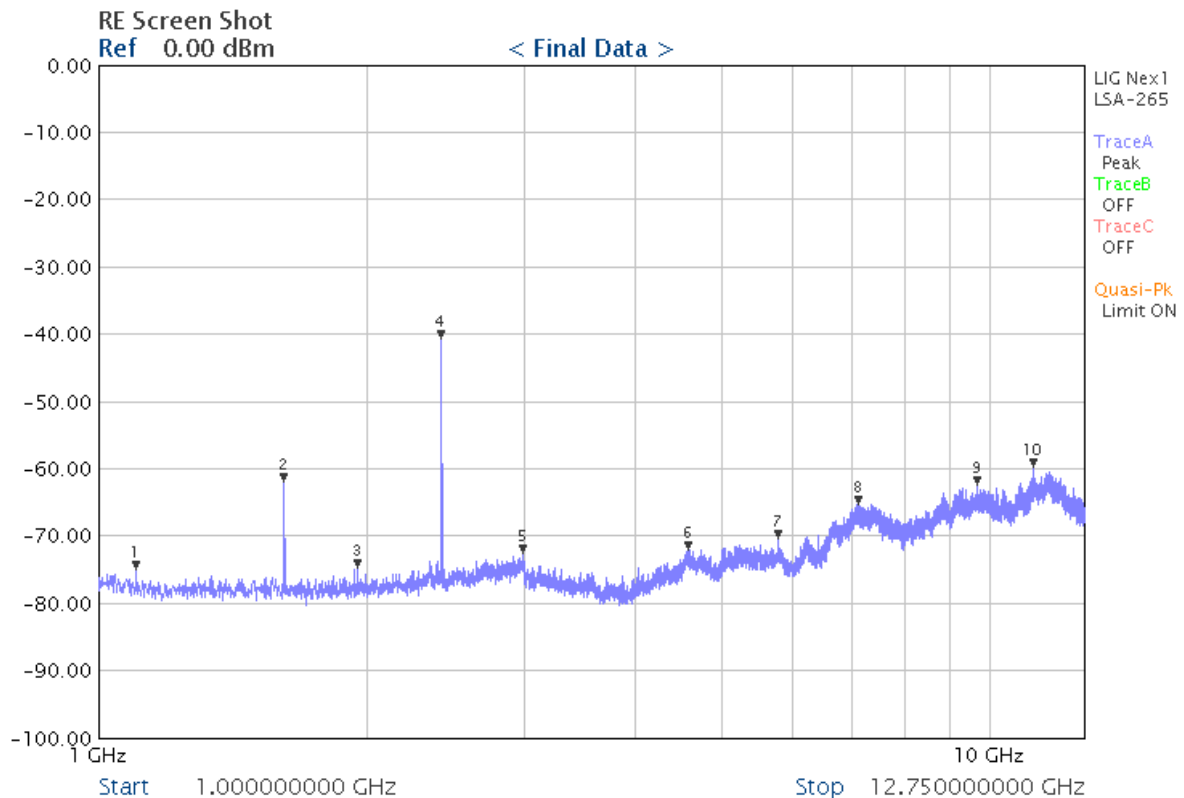
Frequency MHz	Reading dBuV	P (H, V)	Ant. Factor dB	Cable Loss dB	AMP GAIN dB	Limit dBuV	Total dBuV	Margin dB
192.19	19.51	V	9.90	2.12	-	43.52	31.53	11.99
301.77	26.80	H	12.95	2.62	-	46.02	42.37	3.65
480.09	17.26	H	17.76	3.63	-	46.02	38.65	7.37

Note : 1. All reading levels are Quasi-peak value.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

3.2.6 Fundamental & Harmonics Radiated Emission Result (1 GHz ~ 12.75 GHz)

Test Frequency	1 GHz ~ 12.75 GHz	Polarization	Horizontal
Test Mode	Continuous Tx	Test Channel	F1 (2402 MHz)
Test Result	PASS		

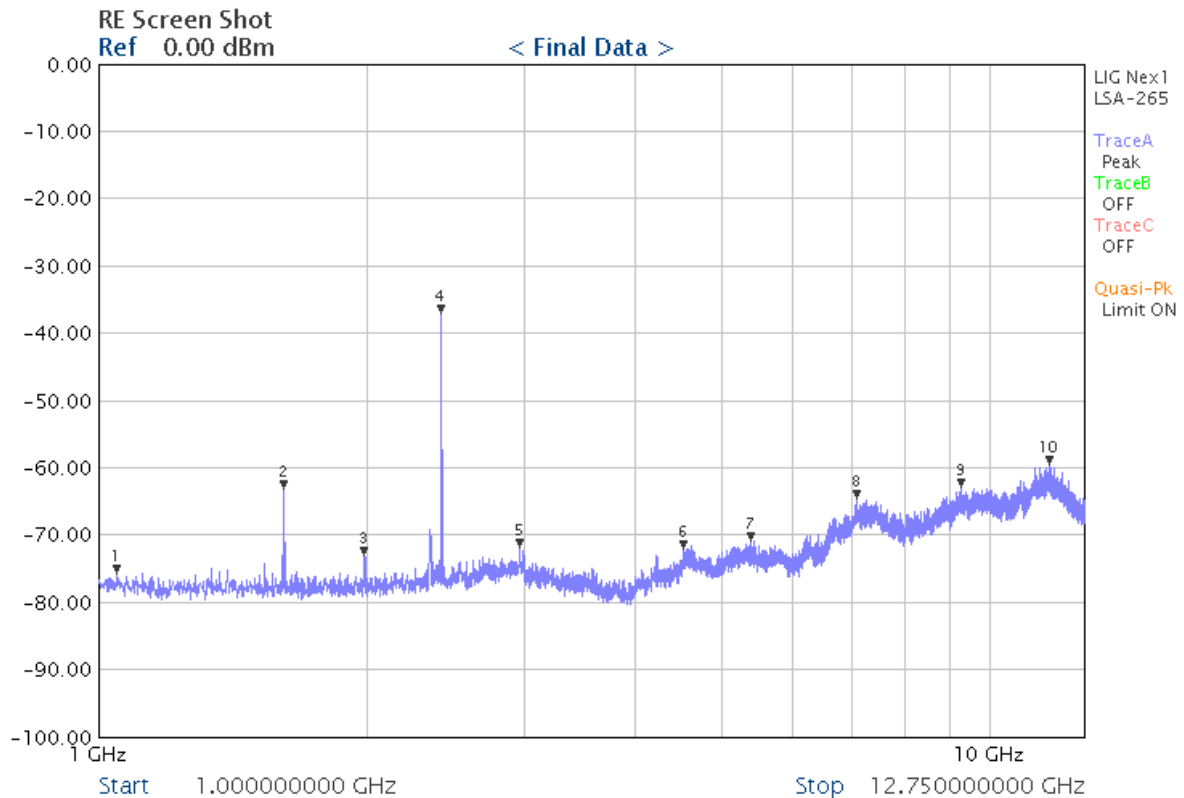


Frequency	Reading (PK/AV)	P	Ant. Factor	Cable Loss	Limit (PK/AV)	Total (PK/AV)	Margin (PK/AV)
MHz	dBuV	(H, V)	dB	dB	dBuV	dBuV	dB
1602.5	14.39/10.90	H	25.66	4.98	74/54	45.03/41.54	28.97/12.46
2402.0	32.78/12.62	H	27.16	6.27	114/94	66.21/46.05	47.79/47.95

Note : 1. Other emissions don't exceed the level of 20 dB below the applicable Limit.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

Test Frequency	1 GHz ~ 12.75 GHz	Polarization	Vertical
Test Mode	Continuous Tx	Test Channel	F1 (2402 MHz)
Test Result	PASS		

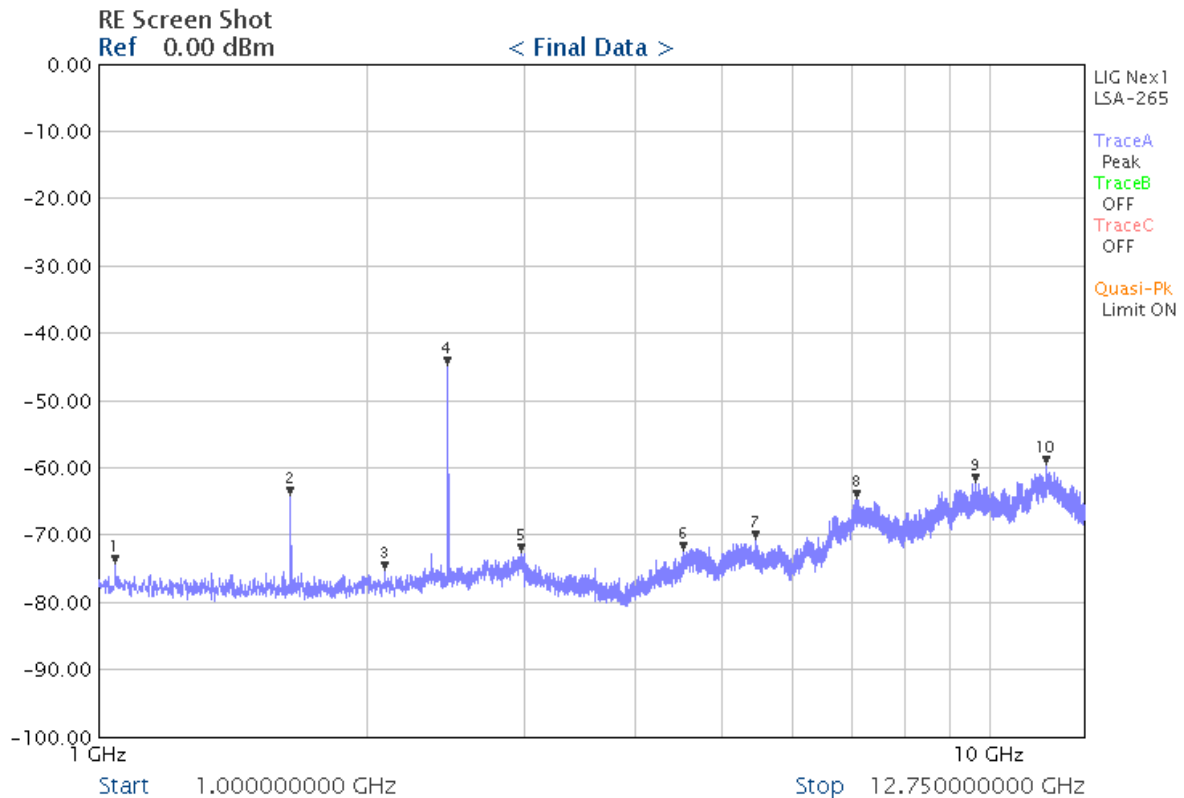


Frequency	Reading (PK/AV)	P	Ant. Factor	Cable Loss	Limit (PK/AV)	Total (PK/AV)	Margin (PK/AV)
MHz	dBuV	(H, V)	dB	dB	dBuV	dBuV	dB
1602.5	13.13/8.22	V	25.66	4.98	74/54	43.77/38.86	30.23/15.14
2402.0	36.49/26.01	V	27.16	6.27	114/94	69.92/59.44	44.08/34.56

Note : 1. Other emissions don't exceed the level of 20 dB below the applicable Limit.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

Test Frequency	1 GHz ~ 12.75 GHz	Polarization	Horizontal
Test Mode	Continuous Tx	Test Channel	F2 (2441 MHz)
Test Result	PASS		

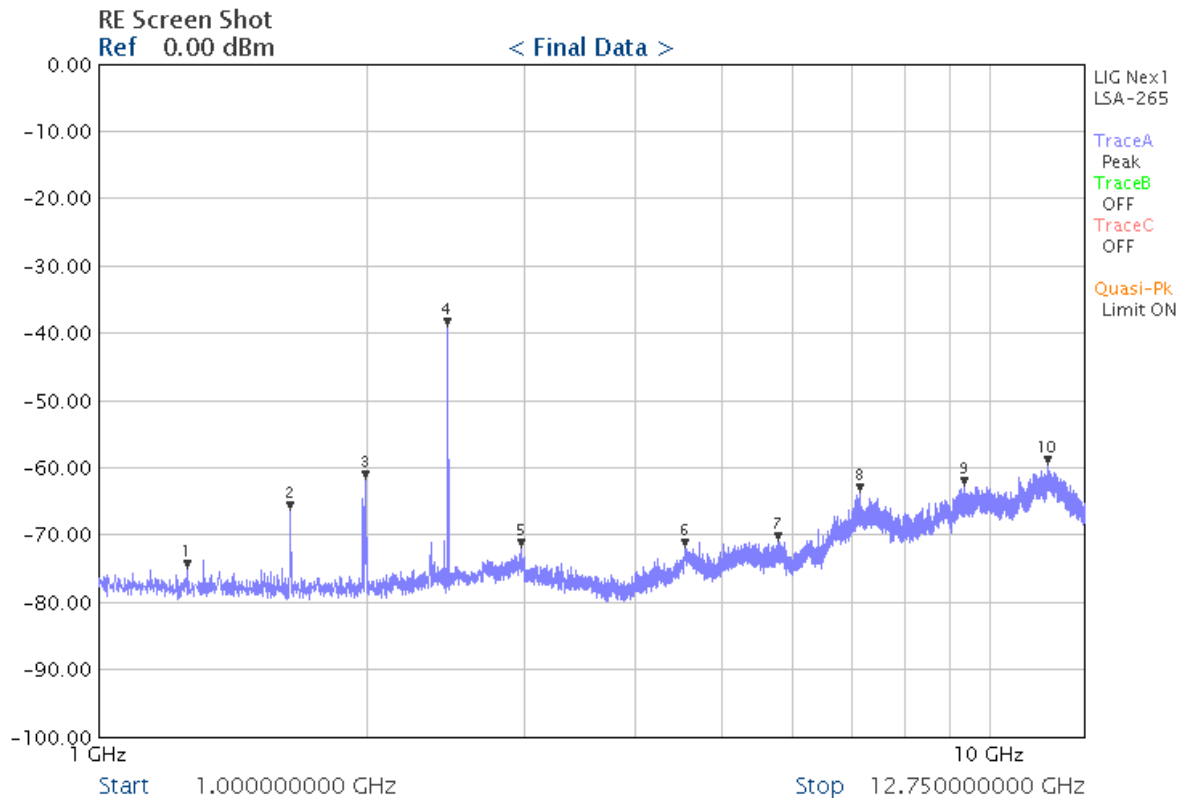


Frequency	Reading (PK/AV)	P	Ant. Factor	Cable Loss	Limit (PK/AV)	Total (PK/AV)	Margin (PK/AV)
MHz	dBuV	(H, V)	dB	dB	dBuV	dBuV	dB
1628.4	12.21/6.13	H	25.70	5.03	74/54	42.94/36.86	31.06/17.14
2441.0	28.67/13.12	H	27.25	6.32	114/94	62.24/46.69	51.76/47.31

Note : 1. Other emissions don't exceed the level of 20 dB below the applicable Limit.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

Test Frequency	1 GHz ~ 12.75 GHz	Polarization	Vertical
Test Mode	Continuous Tx	Test Channel	F2 (2441 MHz)
Test Result	PASS		

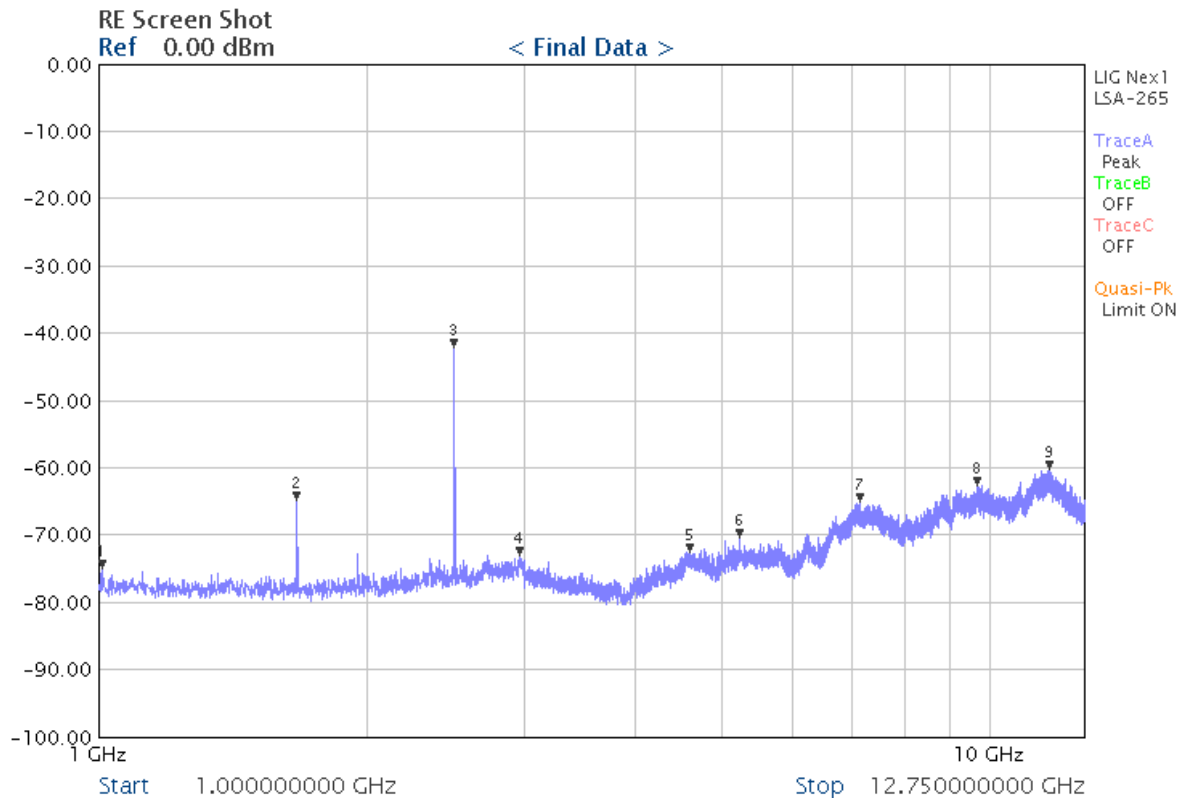


Frequency	Reading (PK/AV)	P	Ant. Factor	Cable Loss	Limit (PK/AV)	Total (PK/AV)	Margin (PK/AV)
MHz	dBuV	(H, V)	dB	dB	dBuV	dBuV	dB
1638.4	9.96/7.27	V	25.72	5.04	74/54	40.72/38.03	33.28/15.97
1989.8	13.32/8.29	V	26.24	5.68	74/54	45.24/40.21	28.76/13.79
2441.0	34.36/17.54	V	27.25	6.32	114/94	67.93/51.11	46.07/42.89

Note : 1. Other emissions don't exceed the level of 20 dB below the applicable Limit.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

Test Frequency	1 GHz ~ 12.75 GHz	Polarization	Horizontal
Test Mode	Continuous Tx	Test Channel	F3 (2480 MHz)
Test Result	PASS		

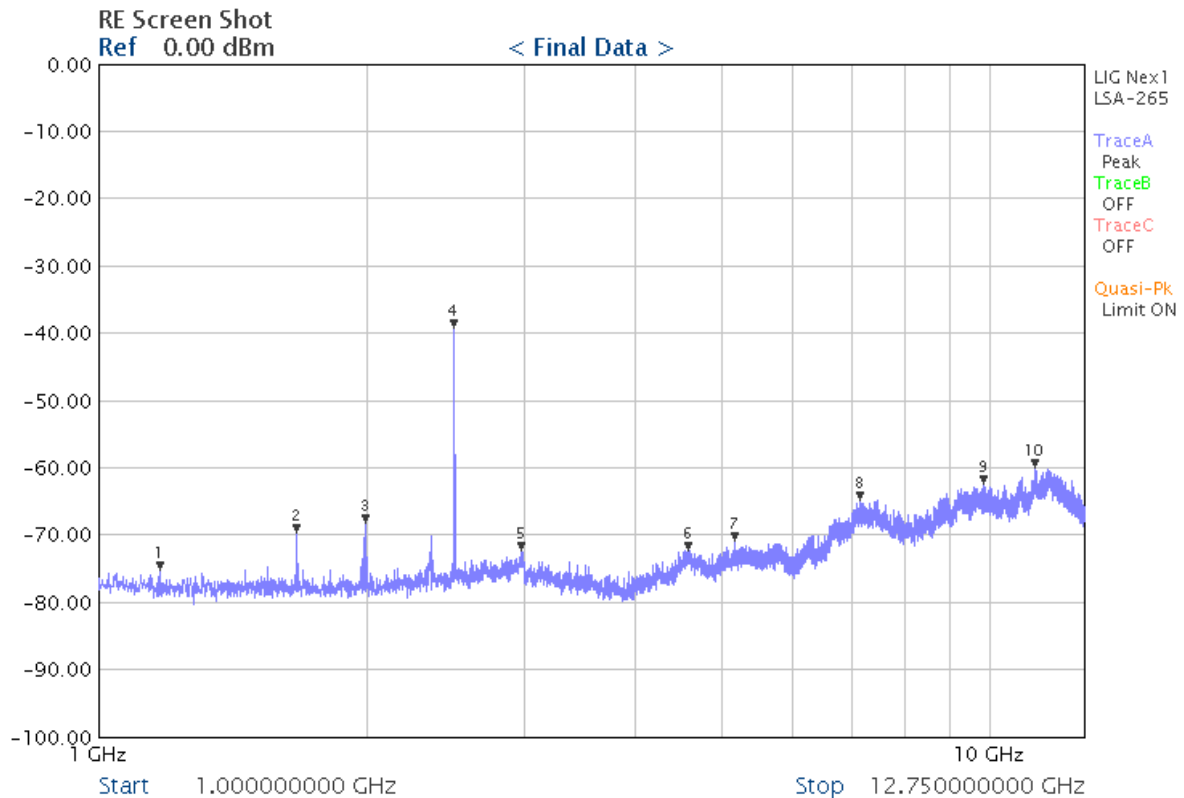


Frequency	Reading (PK/AV)	P	Ant. Factor	Cable Loss	Limit (PK/AV)	Total (PK/AV)	Margin (PK/AV)
MHz	dBuV	(H, V)	dB	dB	dBuV	dBuV	dB
1654.2	11.27/5.64	H	25.74	5.07	74/54	42.08/36.45	31.92/17.55
2480.0	31.19/14.18	H	27.34	6.38	114/94	64.91/47.90	49.09/46.10

Note : 1. Other emissions don't exceed the level of 20 dB below the applicable Limit.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

Test Frequency	1 GHz ~ 12.75 GHz	Polarization	Vertical
Test Mode	Continuous Tx	Test Channel	F3 (2480 MHz)
Test Result	PASS		



Frequency	Reading (PK/AV)	P	Ant. Factor	Cable Loss	Limit (PK/AV)	Total (PK/AV)	Margin (PK/AV)
MHz	dBuV	(H, V)	dB	dB	dBuV	dBuV	dB
1653.2	6.45/2.45	V	25.74	5.07	74/54	37.26/33.26	36.74/20.74
1986.9	6.94/4.91	V	26.24	5.67	74/54	38.85/36.82	35.15/17.18
2480.0	34.08/20.40	V	27.34	6.38	114/94	67.80/54.12	46.20/39.88

Note : 1. Other emissions don't exceed the level of 20 dB below the applicable Limit.

2. Measurement level = reading level + correct factor (Antenna Factor + Cable loss)

3.3 Number of Hopping Frequency Used

3.3.1 Test Instruments

Description	Manufacturer	Model No.	Serial No.	Next of Calibration
Spectrum Analyzer	Advantest	R3273	121100554	Jun. 14, 2011
RF Test Room	-	-	-	-

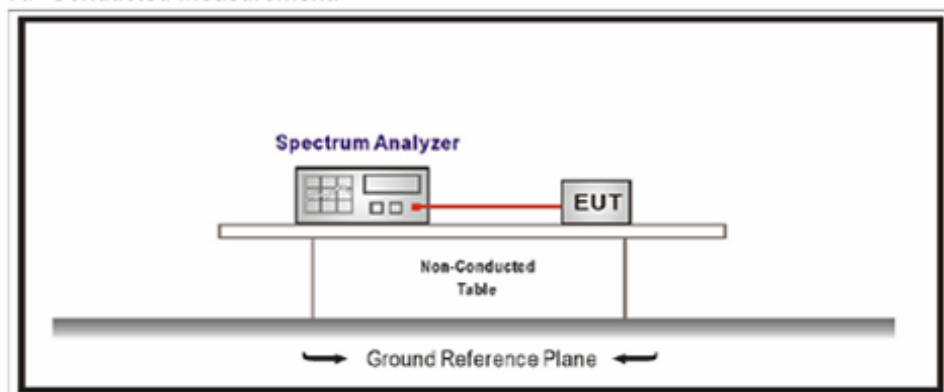
- Note :
1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to RRL, KRISS, KTL and HCT.
 2. The calibration interval of horn ant. and loop ant. is 24 months

3.3.2 Limit

At least 15 channels frequencies, and should be equally spaced.

3.3.3 Test Configuration

RF Conducted Measurement:

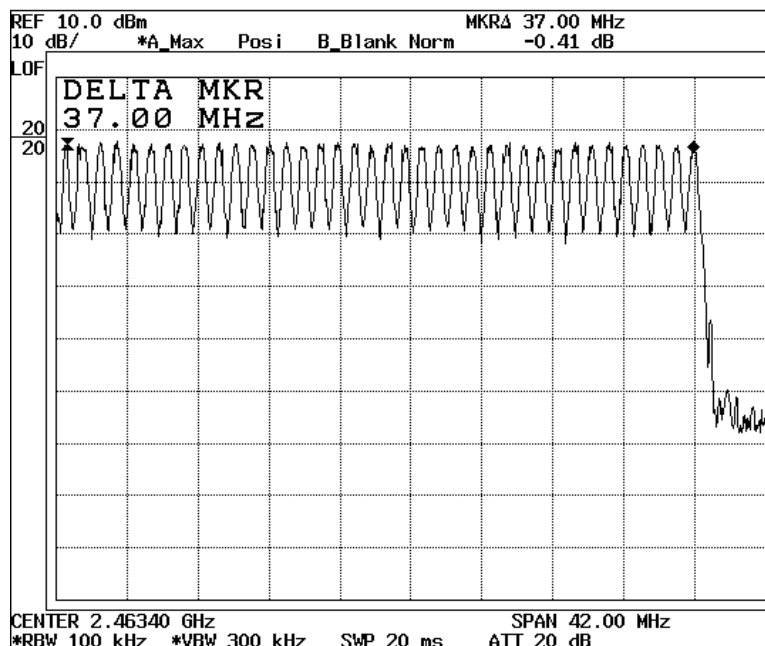
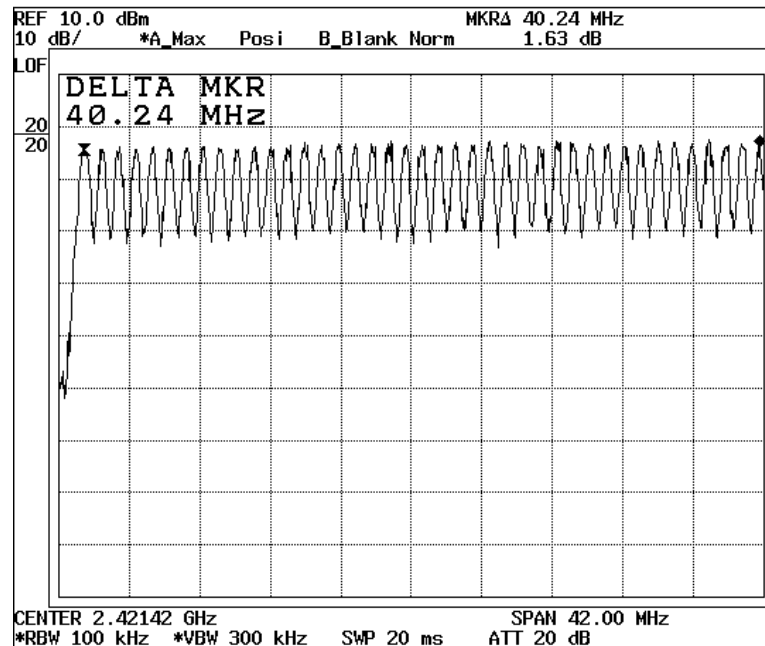


3.3.4 Test Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Turn off the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operating range and make sure the instrument is operated in its linear range.
3. Set the SA on MaxHold Mode, and keep the EUT hopping mode. Record all the signals from each channel until each one has been recorded.
4. Set the SA on View Mode and plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

3.3.5 Number of Hopping Frequency Test Result

Test Mode	GFSK	Test Site	RF Test Room
Test Result	PASS		



3.4 Dwell Time On Each Channel

3.4.1 Test Instruments

Description	Manufacturer	Model No.	Serial No.	Next of Calibration
Spectrum Analyzer	Advantest	R3273	121100554	Jun. 14, 2011
RF Test Room	-	-	-	-

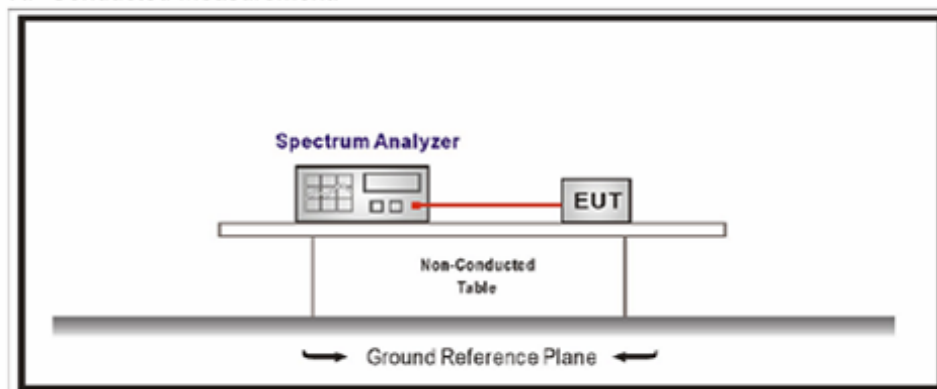
- Note :
1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to RRL, KRISS, KTL and HCT.
 2. The calibration interval of horn ant. and loop ant. is 24 months

3.4.2 Limit

The average time of occupancy on any channel shall not be greater the 0.4 seconds within a period fo 04. Seconds multiplied by the number of hopping channels employed.

3.4.3 Test Configuration

RF Conducted Measurement:



3.4.4 Test Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal
2. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. The set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency to be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Measure the time duration of one transmission in the measured frequency. And then plot the result with time difference of this time duration.
5. Repeat above procedures until all different time-slot modes have been completed.

3.4.5 Dwell Time Test Result

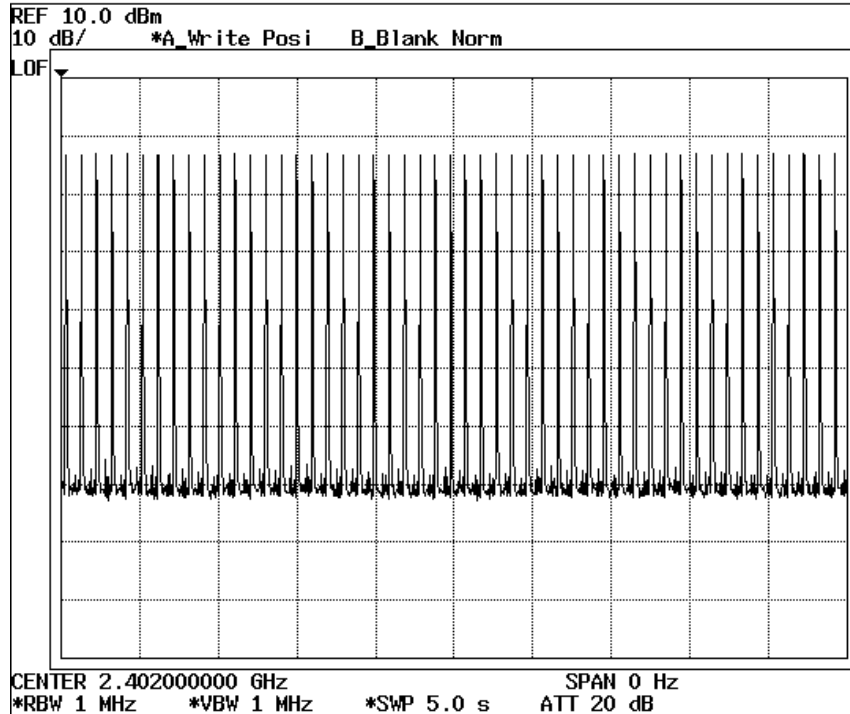
Test Mode	GFSK	Test Site	RF Test Room
Test Result	PASS		

Mode	Number of transmission in a 31.6 (79 Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
DH1	51 (times / 5 sec)*6.32 = 322.32times	0.440	141.82	400
DH3	26 (times / 5 sec)*6.32 = 164.32times	1.690	277.70	400
DH5	17 (times / 5 sec)*6.32 = 107.44times	2.938	315.66	400

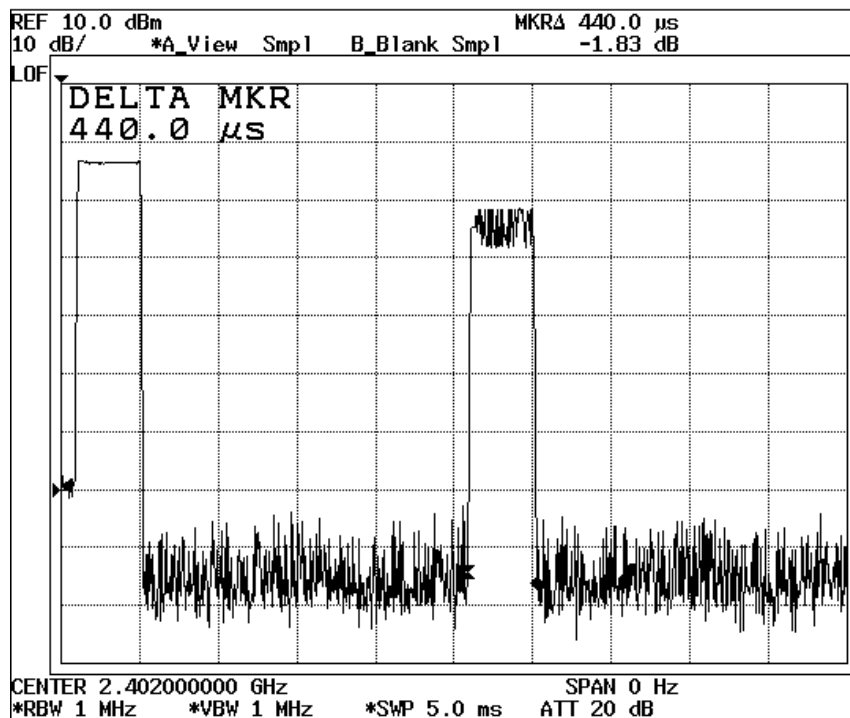
Note) 1. Test plots of the transmitting time slot are shown on next 3 pages.

2. Dwell Time = $79(\text{Channels}) \times 0.4(\text{s}) \times \text{average hopping channel} \times \text{package transfer time}$

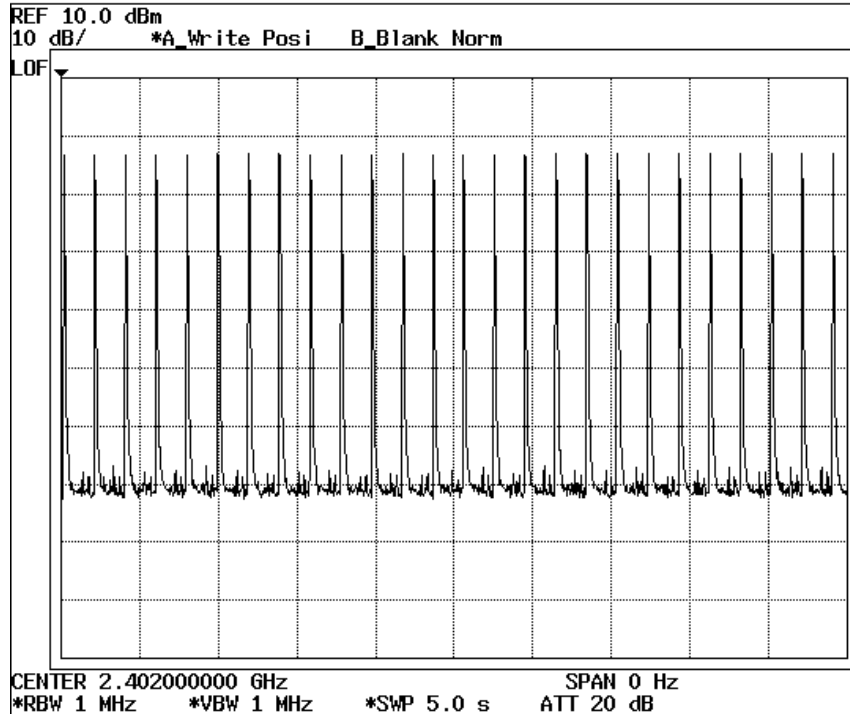
DH1



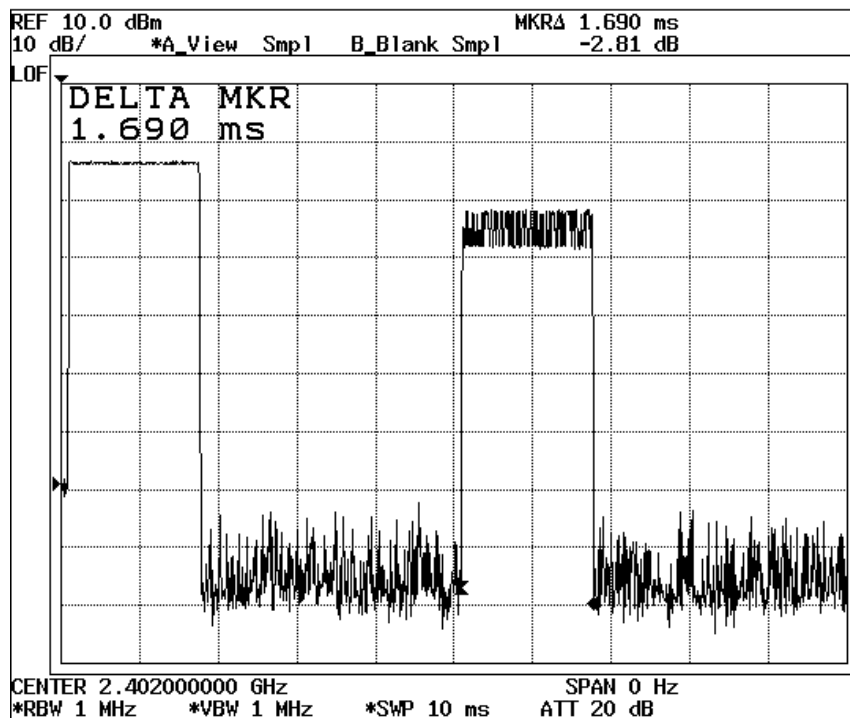
Dwell Time



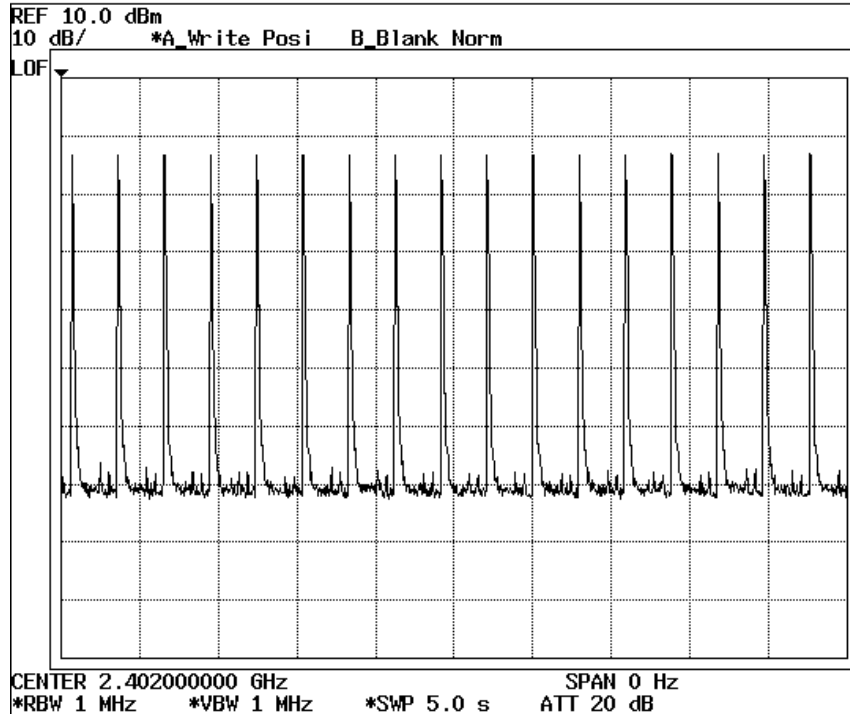
DH3



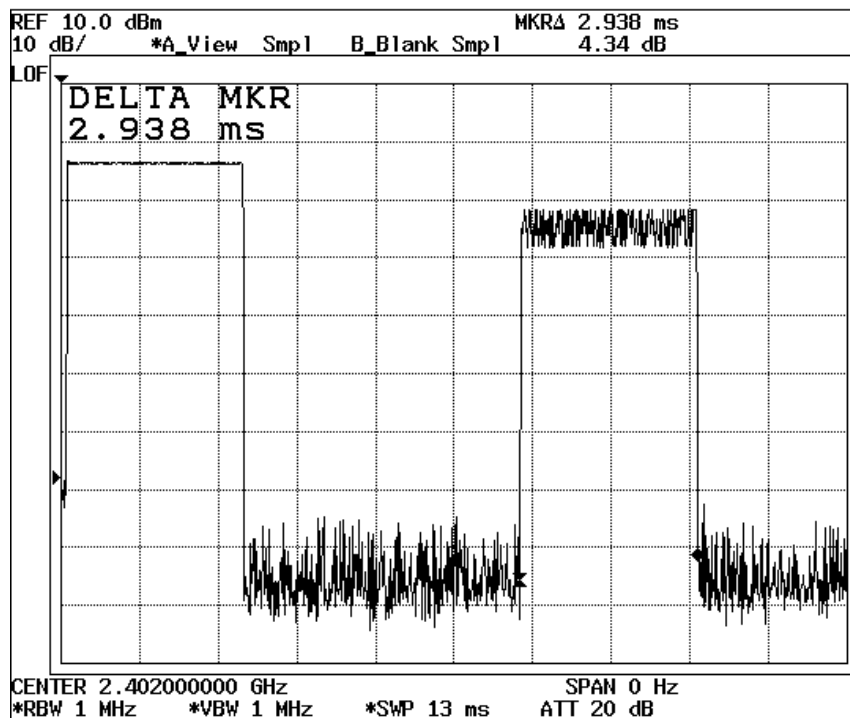
Dwell Time



DH5



Dwell Time



3.5 Channel Bandwidth

3.5.1 Test Instruments

Description	Manufacturer	Model No.	Serial No.	Next of Calibration
Spectrum Analyzer	Advantest	R3273	121100554	Jun. 14, 2011
RF Test Room	-	-	-	-

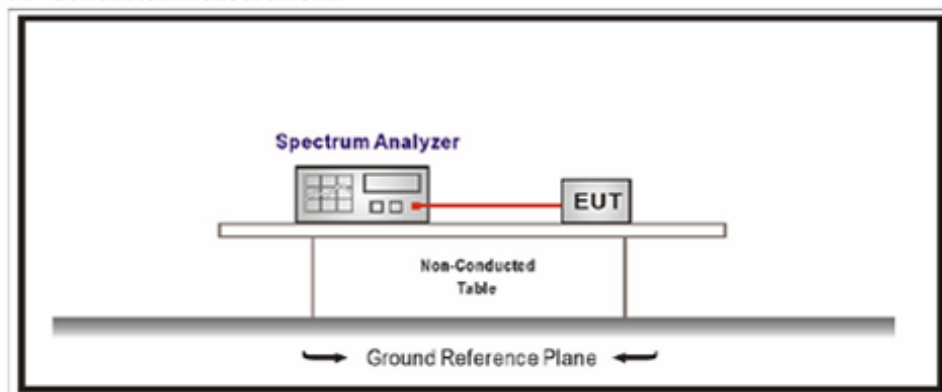
- Note :*
- 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to RRL, KRISS, KTL and HCT.*
 - 2. The calibration interval of horn ant. and loop ant. is 24 months*

3.5.2 Limit

For frequency hopping system operating in the 2400-2483.5 MHz, if the 20 dB bandwidth of hopping channel is greater than 25 kHz, tow-thirds 20 dB bandwidth of hopping channel shell be a minimum limit for the hopping channel separation.

3.5.3 Test Configuration

RF Conducted Measurement:



3.5.4 Test Procedure

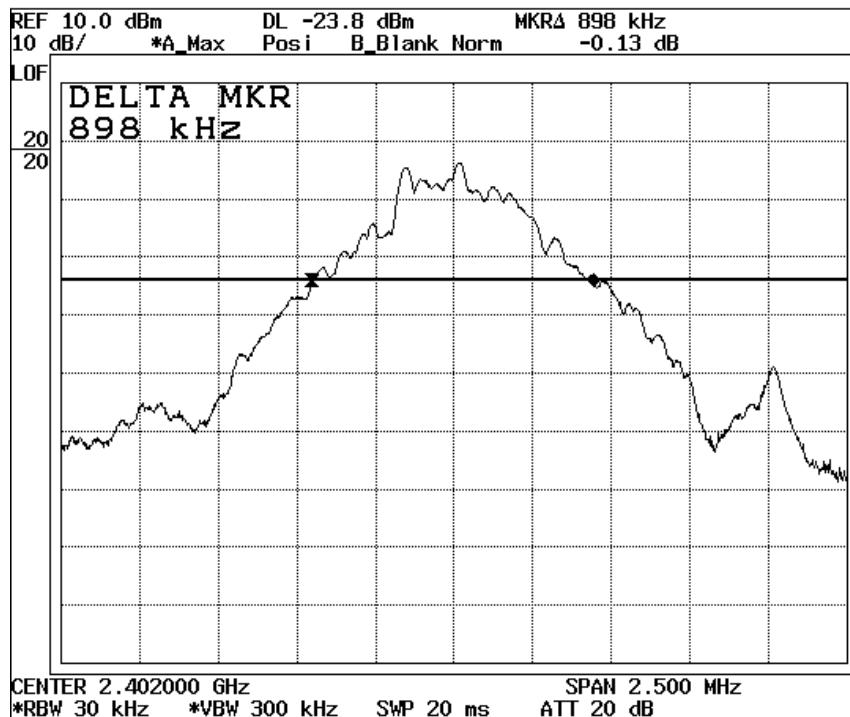
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that wre attenuated 20 dB from the reference level. Record the the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

3.5.5 Channel Bandwidth Test Result

Test Mode	GFSK	Test Site	RF Test Room
Test Result	PASS		

Channels	CHANNEL FREQUENCY (MHz)	20 dB bandwidth (MHz)
0	2402	0.898
39	2441	0.900
78	2480	0.893

CH 0 (2402 MHz)



CH 39 (2441 MHz)



CH 78 (2480 MHz)



3.6 Hopping Channel Separation

3.6.1 Test Instruments

Description	Manufacturer	Model No.	Serial No.	Next of Calibration
Spectrum Analyzer	Advantest	R3273	121100554	Jun. 14, 2011
RF Test Room	-	-	-	-

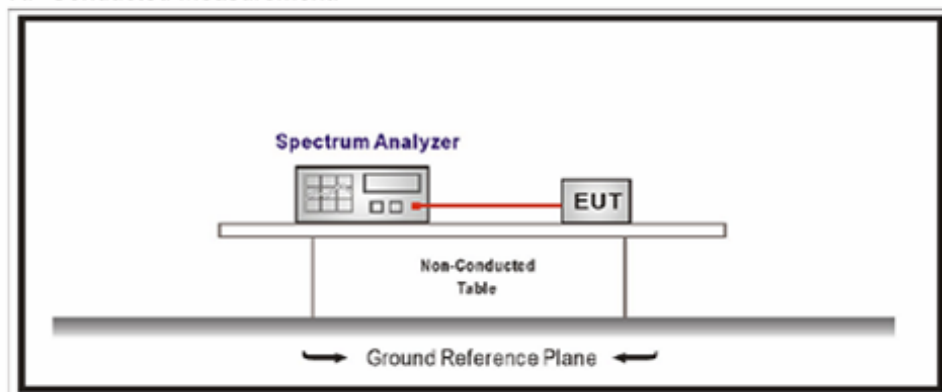
- Note :*
- 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to RRL, KRISS, KTL and HCT.*
 - 2. The calibration interval of horn ant. and loop ant. is 24 months*

3.6.2 Limit

At least 25 kHz or two-third of 20 dB hopping Channel bandwidth (whichever is greater).

3.6.3 Test Configuration

RF Conducted Measurement:



3.6.4 Test Procedure

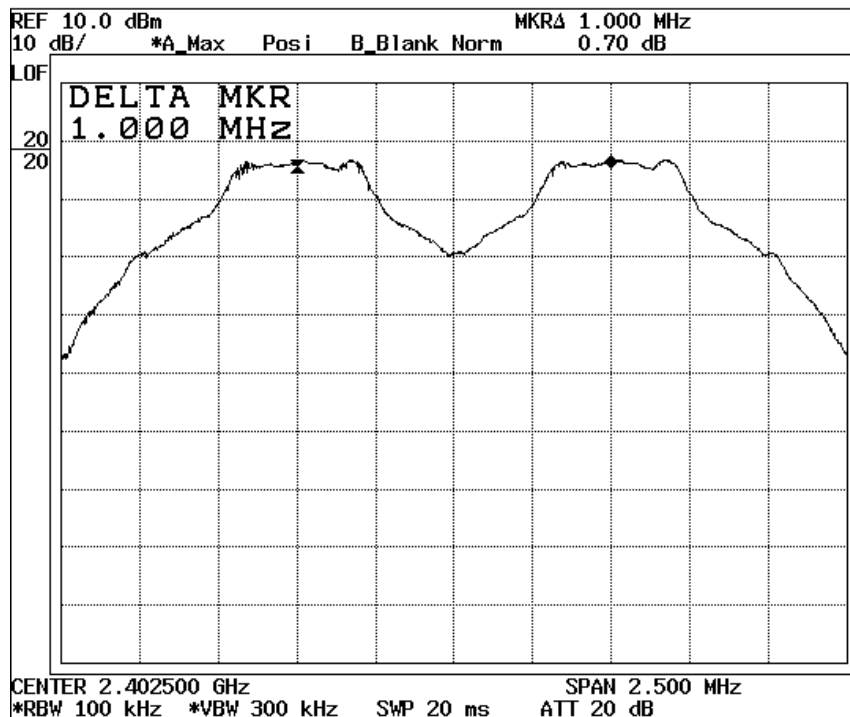
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. By using the Maxhold function record the separation of two adjacent channels.
4. Measure the frequency difference of these two adjacent channels by SA mark function. And then plot the result on SA screen.

3.6.5 Hopping Channel Separation Test Result

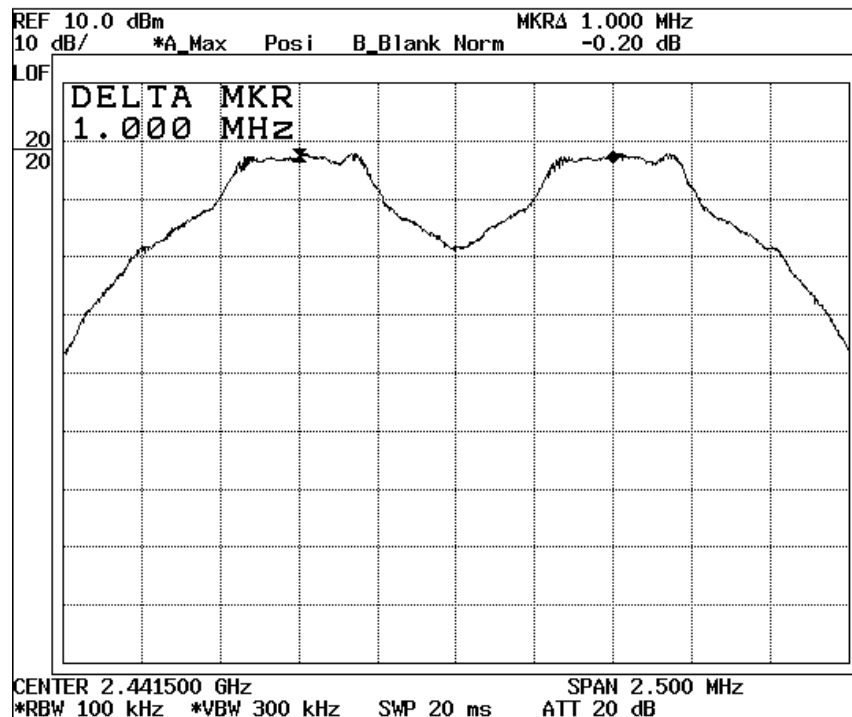
Test Mode	GFSK	Test Site	RF Test Room
Test Result	PASS		

Channels	FREQUENCY (MHz)	ADJACENT CHANNEL SEPARATION (MHz)	Result
0	2402	1.000	PASS
39	2441	1.000	PASS
78	2480	1.000	PASS

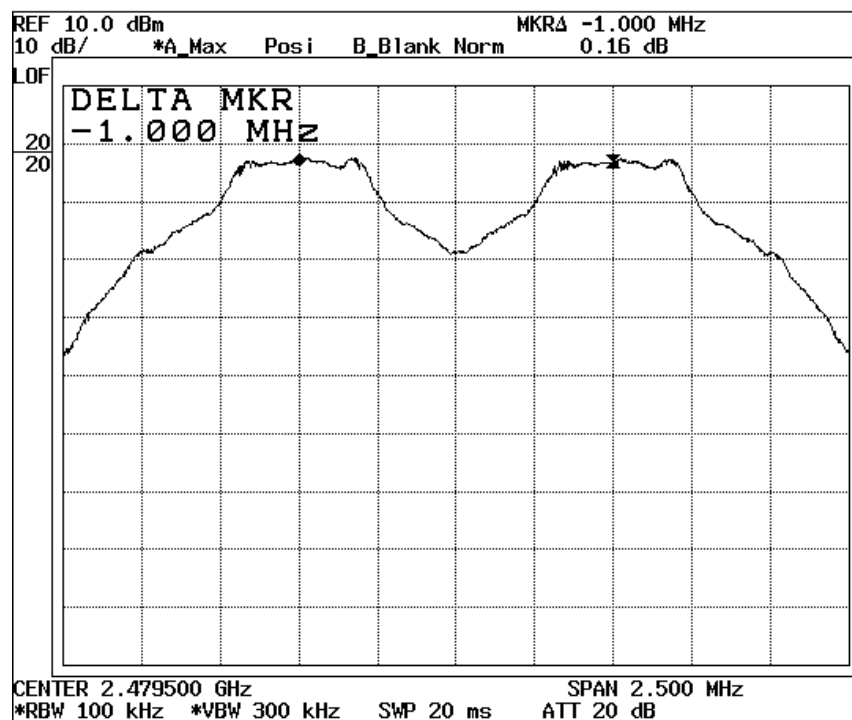
CH 0 (2402 MHz)



CH 39 (2441 MHz)



CH 78 (2480 MHz)



3.7 Maximum Peak Output Power

3.7.1 Test Instruments

Description	Manufacturer	Model No.	Serial No.	Next of Calibration
Spectrum Analyzer	Advantest	R3273	121100554	Jun. 14, 2011
RF Test Room	-	-	-	-

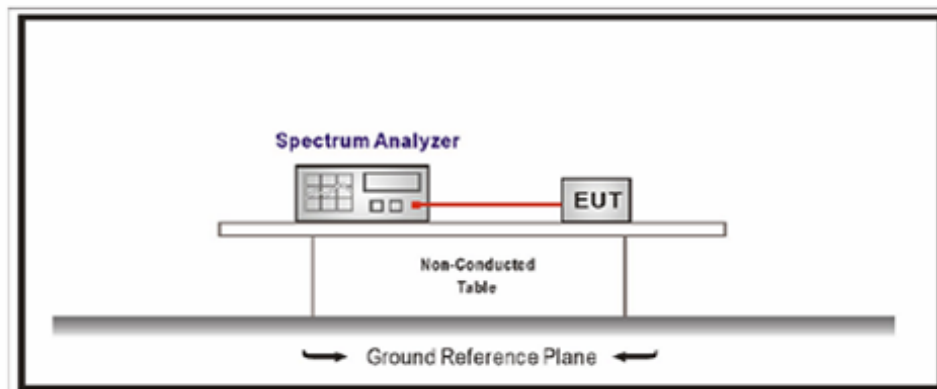
- Note :
1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to RRL, KRISS, KTL and HCT.
 2. The calibration interval of horn ant. and loop ant. is 24 months

3.7.2 Limit

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

3.7.3 Test Configuration

RF Conducted Measurement:



3.7.4 Test Procedure

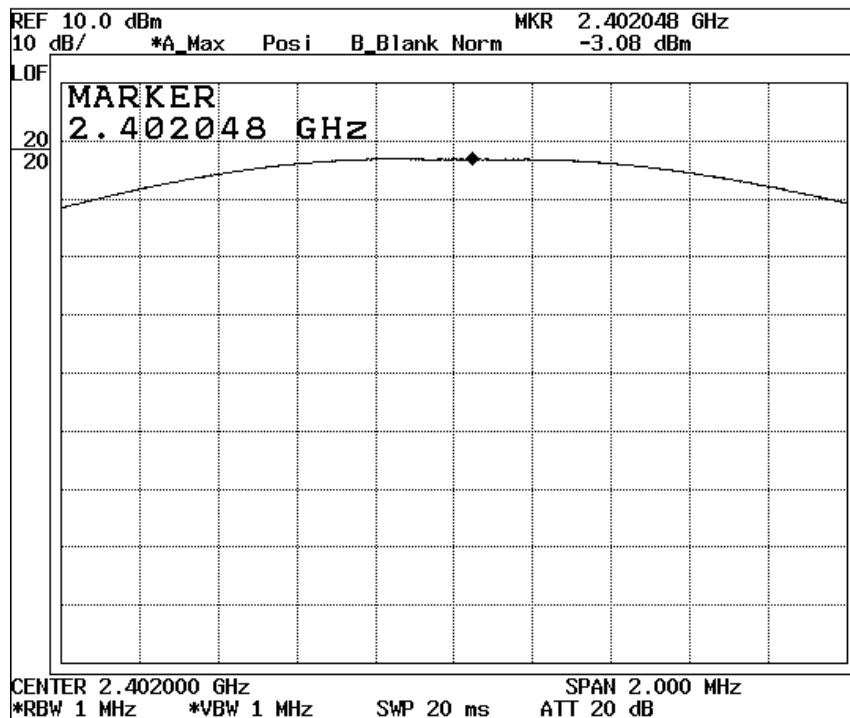
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operation range. Set a reference level on the measuring instrument equal to the highest peak value.
3. The center frequency of the spectrum analyzer is set to the fundamental frequency and using 1 MHz RBW and 1 MHz VBW.
4. Measure the captured power within the band and recording the plot.
5. Repeat above procedures until all frequencies required were complete.

3.7.5 Maximum Peak Output Power Test Result

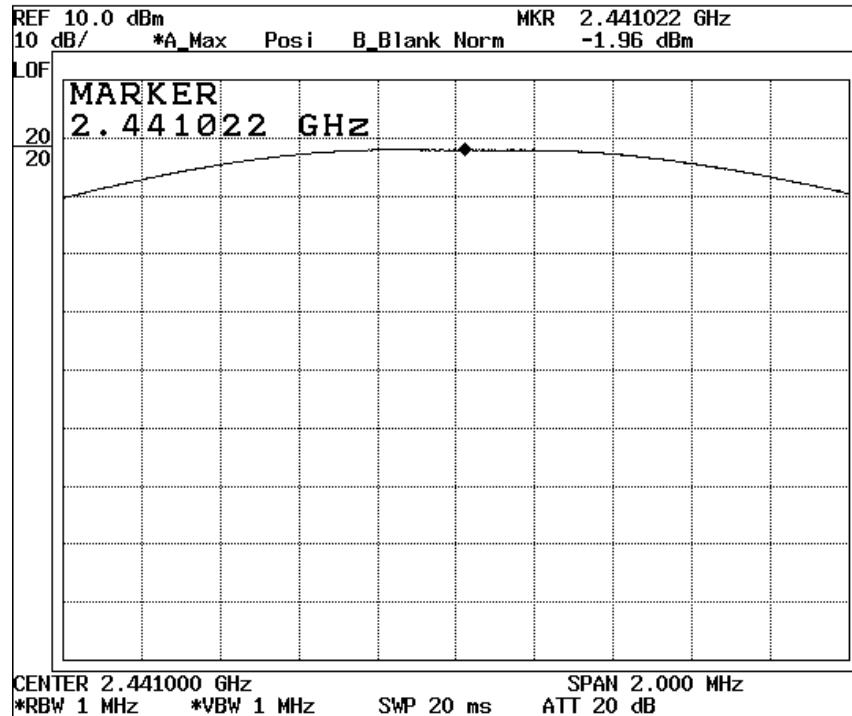
Test Mode	GFSK	Test Site	RF Test Room
Test Result	PASS		

Channel No.	Frequency (MHz)	Measue Leve (dBm)	Limit (dBm)	Result
0	2402	-3.08	1 Watt = 30 dBm	PASS
39	2441	-1.96	1 Watt = 30 dBm	PASS
78	2480	-2.27	1 Watt = 30 dBm	PASS

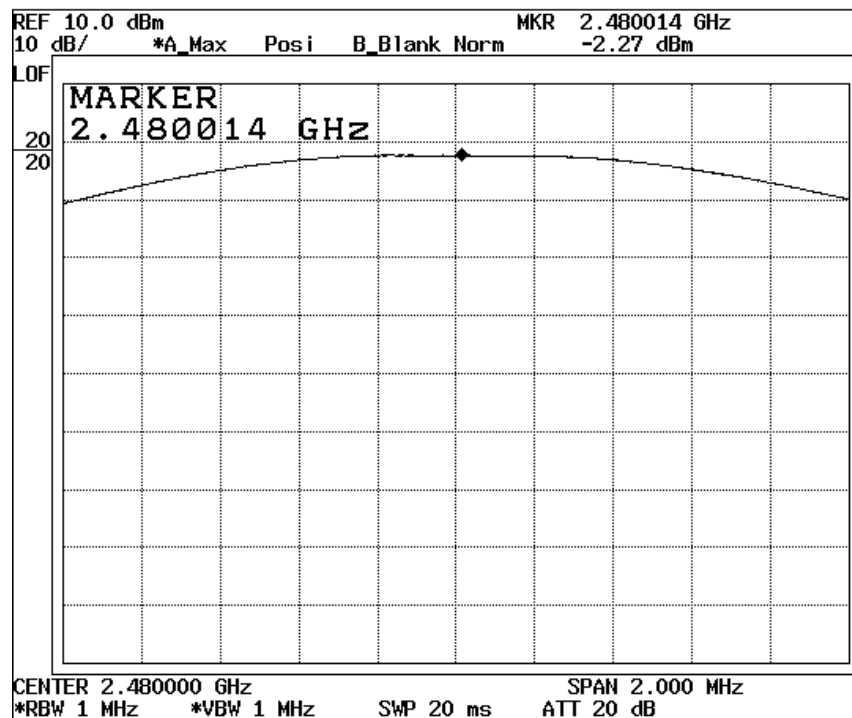
CH 0 (2402 MHz)



CH 39 (2441 MHz)



CH 78 (2480 MHz)



3.8 Band Edge

3.8.1 Test Instruments

Description	Manufacturer	Model No.	Serial No.	Next of Calibration
Test Receiver	LIG NEX1	ER-265	L0804B002	Jul. 15, 2011
Horn Antenna	Schwarzbeck	BBHA9120D	0501	Aug. 31 2012
Horn Antenna	Schwarzbeck	BBHA9170	BBHA9170152	Aug. 31. 2012

Note : 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to RRL, KRISS, KTL and HCT.

 2. The calibration interval of horn ant. and loop ant. is 24 months

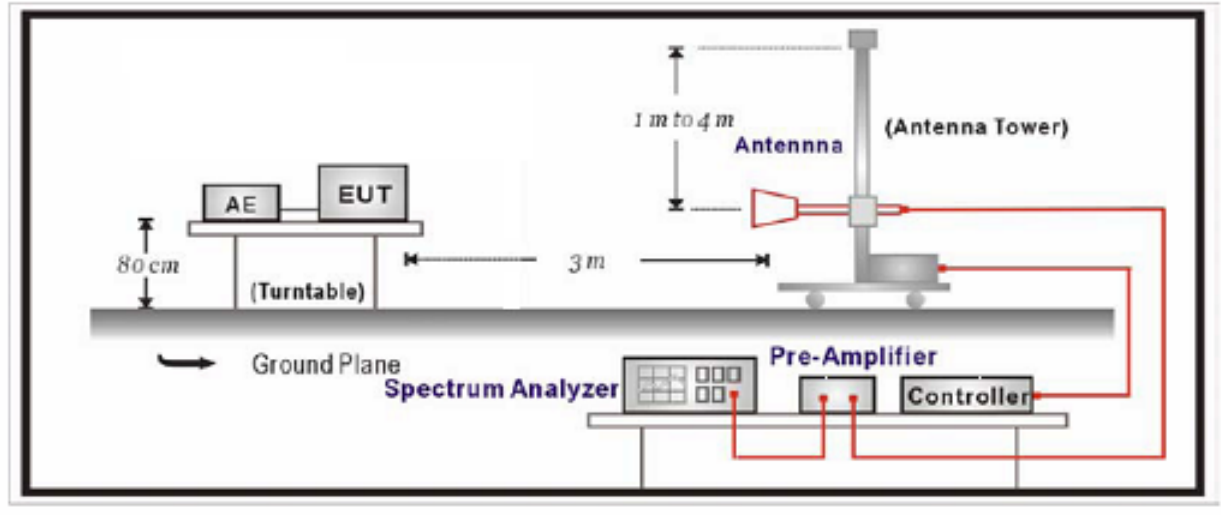
3.8.2 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

Attenuation below the general limits specified in section 15.209(a) is not required. In addition, radiated emission which fall in the restricted bands, as defined in section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a)(see Section 15.205(c)).

3.8.3 Test Configuration

Radiated Measurement : 3 m Full Chamber



3.8.4 Test Procedure

The EUT and its simulators are placed on a turn table which is 0.8 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters. The antenna can move up and down between 1 meter and 4 meters to fine out the maximum emission level.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.4:2003 on radiated measurement.

The bandwidth below 1 GHz setting on the field strength meter is 100 kHz, above 1GHz are 1MHz.

3.8.5 Test Result Method of Band Edge Test Result of Radiated Test.

Emission Level(dBuV/m) = Reading Level + Correct Factor.

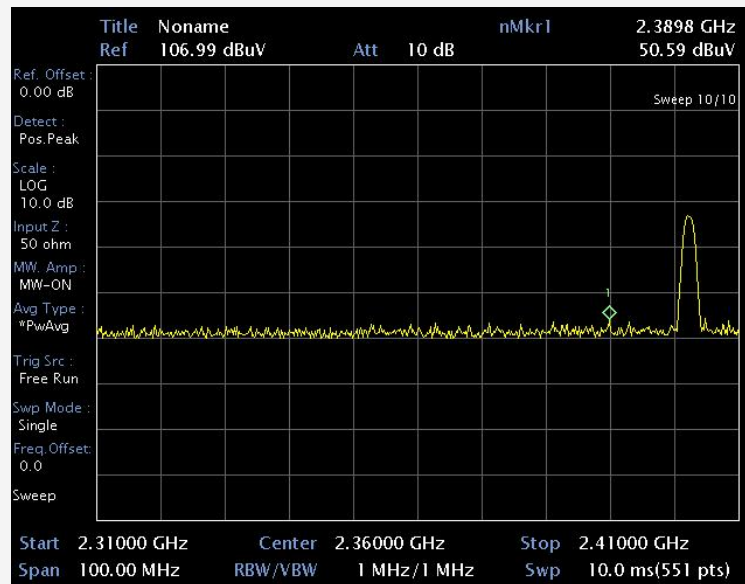
Note : Correct Factor = AF + CL

AF – Antenna Factor , CL-Cable Loss

3.8.6 Band Edge Test Result

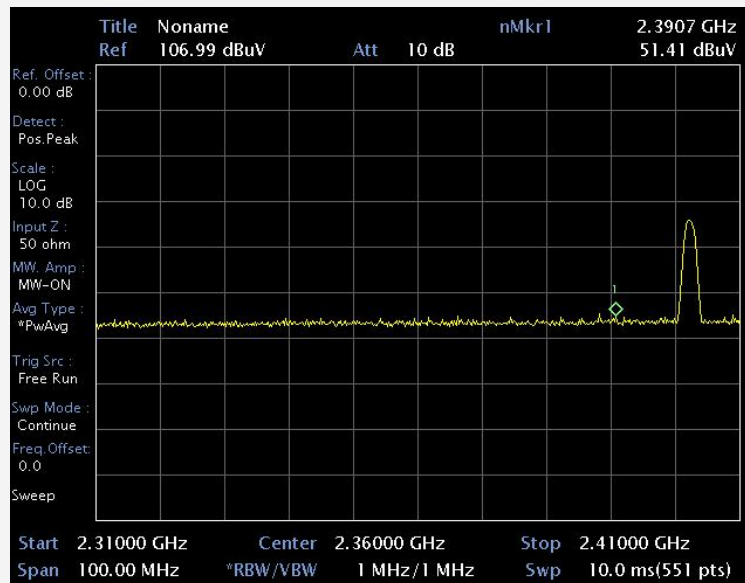
Detect mode	Peak	Mode	Continuous Tx
Note	F1 (2402 MHz)		

HOR



Frequency (MHz)	Reading PK (dBuV/m)	Factor(dB) CL+AF	Limits PK (dBuV/m)	Result PK (dBuV/m)	Margin PK (dB)
2390	17.20	33.39	74	50.59	23.41

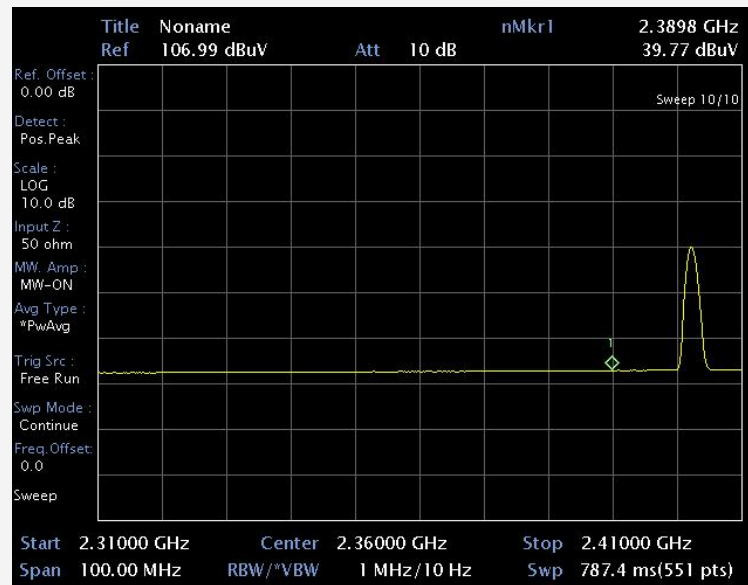
VER



Frequency (MHz)	Reading PK (dBuV/m)	Factor(dB) CL+AF	Limits PK (dBuV/m)	Result PK (dBuV/m)	Margin PK (dB)
2390	18.02	33.39	74	51.41	22.59

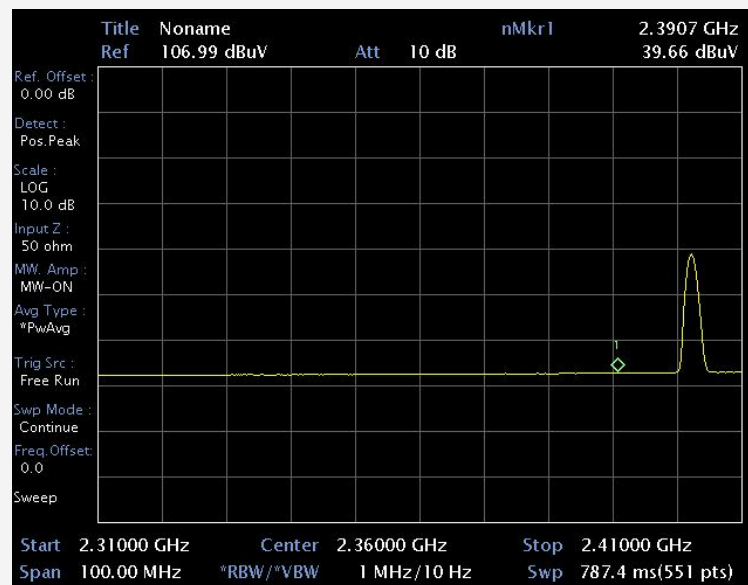
Detect mode	Average	Mode	Continuous Tx
Note	F1 (2402 MHz)		

HOR



Frequency (MHz)	Reading PK (dBuV/m)	Factor(dB) CL+AF	Limits PK (dBuV/m)	Result PK (dBuV/m)	Margin PK (dB)
2390	6.38	33.39	54	39.77	14.23

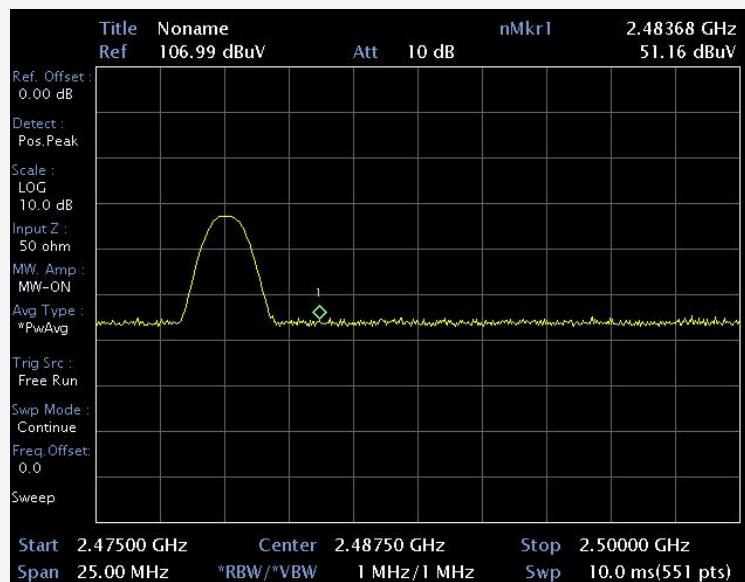
VER



Frequency (MHz)	Reading PK (dBuV/m)	Factor(dB) CL+AF	Limits PK (dBuV/m)	Result PK (dBuV/m)	Margin PK (dB)
2390	6.27	33.39	54	39.66	14.34

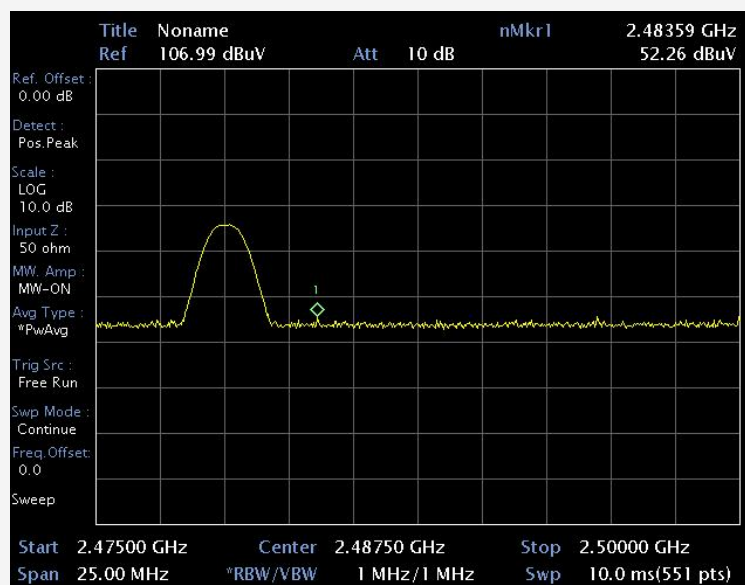
Detect mode	Peak	Mode	Continuous Tx
Note	F3 (2480 MHz)		

HOR



Frequency (MHz)	Reading PK (dBuV/m)	Factor(dB) CL+AF	Limits PK (dBuV/m)	Result PK (dBuV/m)	Margin PK (dB)
2483.5	17.43	33.73	74	51.16	22.84

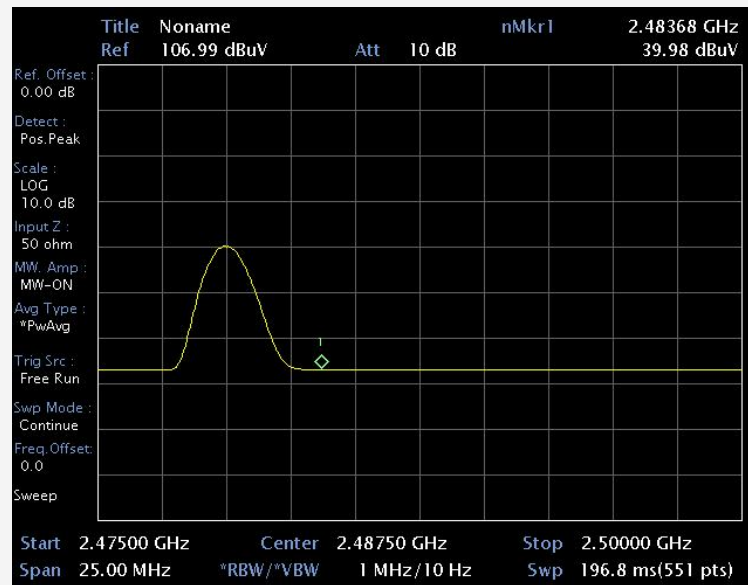
VER



Frequency (MHz)	Reading PK (dBuV/m)	Factor(dB) CL+AF	Limits PK (dBuV/m)	Result PK (dBuV/m)	Margin PK (dB)
2483.5	18.53	33.73	74	52.26	21.74

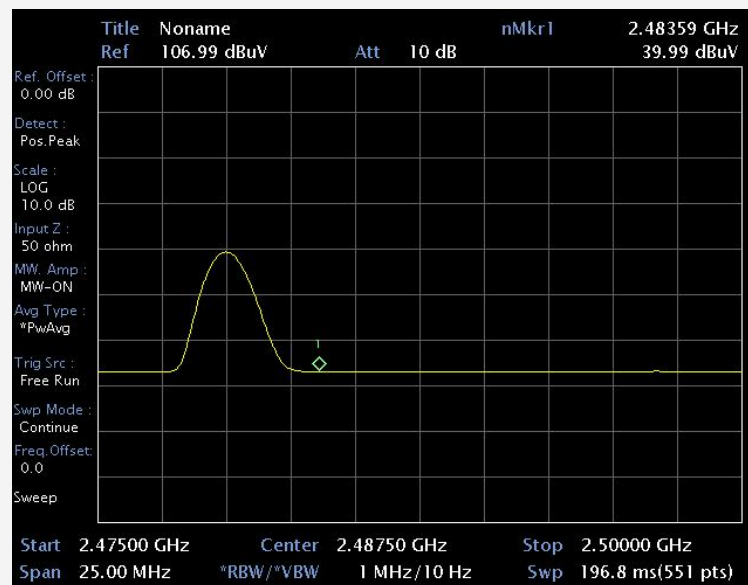
Detect mode	Average	Mode	Continuous Tx
Note	F3 (2480 MHz)		

HOR



Frequency (MHz)	Reading PK (dBuV/m)	Factor(dB) CL+AF	Limits PK (dBuV/m)	Result PK (dBuV/m)	Margin PK (dB)
2483.5	6.25	33.73	54	39.98	14.02

VER



Frequency (MHz)	Reading PK (dBuV/m)	Factor(dB) CL+AF	Limits PK (dBuV/m)	Result PK (dBuV/m)	Margin PK (dB)
2483.5	6.26	33.73	54	39.99	14.01

4.0 Antenna Requirement

Applicable Standard

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The antenna type used in this product is PCB Printed Antenna without connector and it is considered to meet antenna requirement. The antenna peak gain of EUT is less than 6 dBi. The antenna peak gain is -2.0 dBi.

Test Result : Pass

Appendix A. The Photo of Test Setup

Front View of Conducted Emission



Rear View of Conducted Emission



Radiated Emission (Below 30 MHz) – Charging & Normal Operating Mode



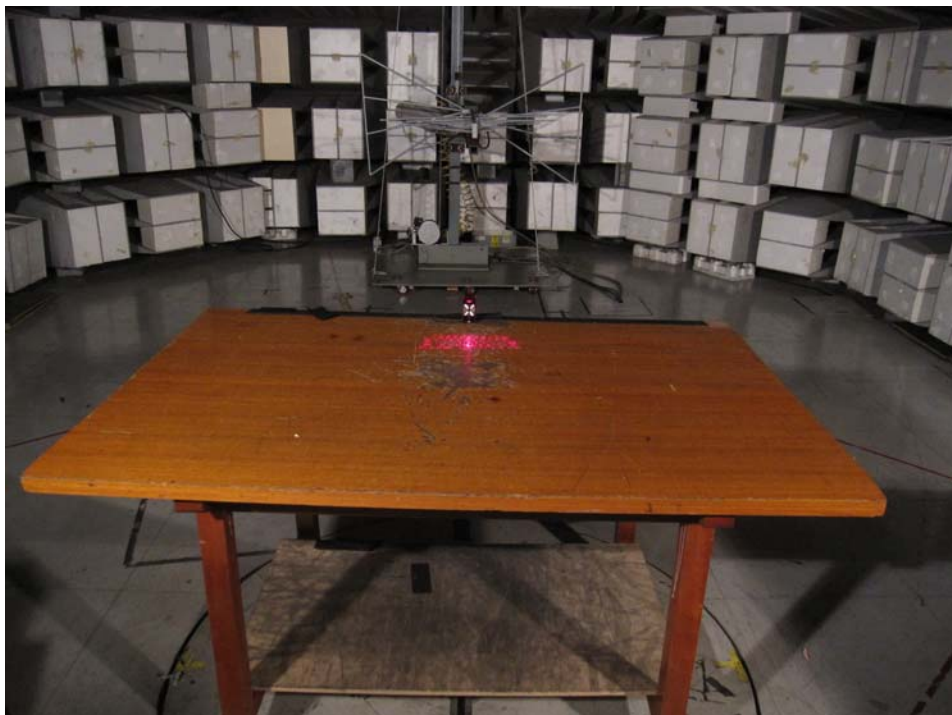
Radiated Emission (Below 30 MHz) – Continuous Tx Mode



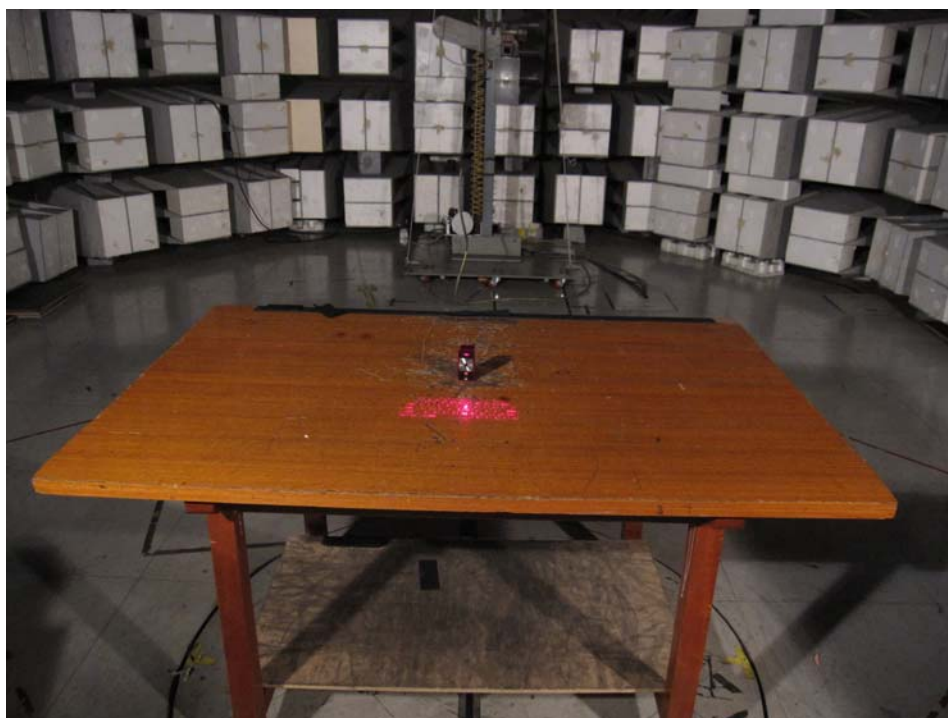
Radiated Emission (Below 1 GHz) – Charging & Normal Operating Mode



Radiated Emission (Below 1 GHz) – Continuous Tx Mode



Radiated Emission (Above 1 GHz)



Appendix B. The Photo of Equipment Under Test

Front View of EUT



Rear View of EUT



Inside View of EUT

