

APPLICATION FOR CERTIFICATION

On Behalf of

LG Electronics Inc.

WIRELESS Highbay Sensor

Model No.: 9SD751TVDA

FCC ID: BEJ9SD751TVDA

Brand: LG

Prepared for : LG Electronics Inc.
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TEST REPORT CERTIFICATION

Applicant : LG Electronics Inc.
Manufacturer : OHSUNG ELECTRONICS CO., LTD
EUT Description : WIRELESS Highbay Sensor
FCC ID : BEJ9SD751TVDA
(A) Model No. : 9SD751TVDA
(B) Serial No. : N/A
(C) Brand : LG
(D) Power Supply : DC 3.3V

Measurement Procedure Used:

FCC Rules and Regulations Part 15 Subpart C, Oct. 2013
(FCC CFR 47 Part 15C, §15.205, §15.207, §15.209 and §15.247)
AND ANSI C63.4:2003

The device described above was tested by AUDIX Technology Corporation to determine the maximum emission levels emanating from the device. The maximum emission levels were compared to the FCC Part 15 subpart C limits.

The measurement results are contained in this test report and AUDIX Technology Corporation is assumed full responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT to be technically compliant with the requirements of FCC standards.

This report applies to above tested sample only. This report shall not be reproduced in part without written approval of AUDIX Technology Corporation.

Date of Test: 2014. 05. 13 ~ 16

Date of Report: 2014. 05. 16

Producer : 
(Tina Huang/Administrator)

Signatory: 
(Ben Cheng/Manager)

1. DESCRIPTION OF REVISION HISTORY

Edition No.	Date of Rev.	Revision Summary	Report No.
0	2014. 05. 16	Original Report	EM-F140293

2. GENERAL INFORMATION

2.1. Description of Device (EUT)

Product	WIRELESS HIGHBAY SENSOR
Model Number	9SD751TVDA
Serial Number	N/A
Brand Name	LG
FCC ID	BEJ9SD751TVDA
Applicant	LG Electronics Inc. San4-1, Nakseongdeon-dong, Gwanak-gu, Seoul 151-919, Korea
Manufacturer	OHSUNG ELECTRONICS CO., LTD. 181, Gongdan-dong, Gumi-si, Gyeongbuk, Korea
The Equipment type	ZigBee (IEEE 802.15.4)
Fundamental Range	2405MHz ~ 2480MHz
Frequency Channel	16 channels
Radio Technology	DSSS Modulation (O-QPSK)
Data Transfer Rate	250Kbps
Date of Receipt of Sample	2014. 05. 07
Date of Test	2014. 05. 13 ~ 16

2.2. Antenna Information

Antenna Part Number	Manufacture	Antenna Type	Peak Gain	
			Frequency	Max Gain
PNCBC1228A	OHSUNG	PCB	2405-2480MHz	0.9073dBi

2.3. Tested Supporting System Details

2.3.1. Support Peripheral Unit

No.	Product	Brand	Model No.	Serial No.	FCC ID
1.	Notebook PC	acer	MS2362	N/A	PPD-AAR5B22
2.	LED Highbay Light	LG	H1240PA2N0A	N/A	By DoC

2.3.2. Cable Lists

No.	Cable Description Of The Above Support Units
1.	Adapter: Chicony, M/N CPA09-A065N1 DC Cord: Non-Shielded, Undetachable, 1.8m, Bonded a ferrite core AC Power Cord: Non-Shielded, Detachable, 1.8m
2.	AC Power Cord: Non-Shielded, Detachable, 1.8m

2.4. Description of Test Facility

Name of Firm : **AUDIX Technology Corporation**
EMC Department
No. 53-11, Dingfu, Linkou Dist.,
New Taipei City 244, Taiwan, R.O.C.

Test Site : **No. 8 Shielded Room**
(C8/Semi-AC) No. 53-11, Dingfu, Linkou Dist.,
New Taipei City 244, Taiwan, R.O.C.

Semi-Anechoic Chamber
No. 53-11, Dingfu, Linkou Dist.,
New Taipei City 244, Taiwan, R.O.C.
May 11, 2012 Renewal on
Federal Communication Commission
Registration Number: 90993

NVLAP Lab. Code : 200077-0

TAF Accreditation No : 1724

2.5. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty
Conduction Test	150kHz ~ 30MHz	$\pm 3.43\text{dB}$
Radiation Test (Distance: 3m)	30MHz~300MHz	$\pm 2.91\text{dB}$
	300MHz~1000MHz	$\pm 2.74\text{dB}$
	Above 1GHz	$\pm 5.02\text{dB}$

Remark : Uncertainty = $k u_c(y)$

Test Item	Uncertainty
6dB Bandwidth	$\pm 0.05\text{kHz}$
Maximum peak output power	$\pm 0.33\text{dBm}$
Emission Limitations	$\pm 0.13\text{dB}$
Band edges	$\pm 0.13\text{dB}$
Power spectral density	$\pm 0.13\text{dB}$

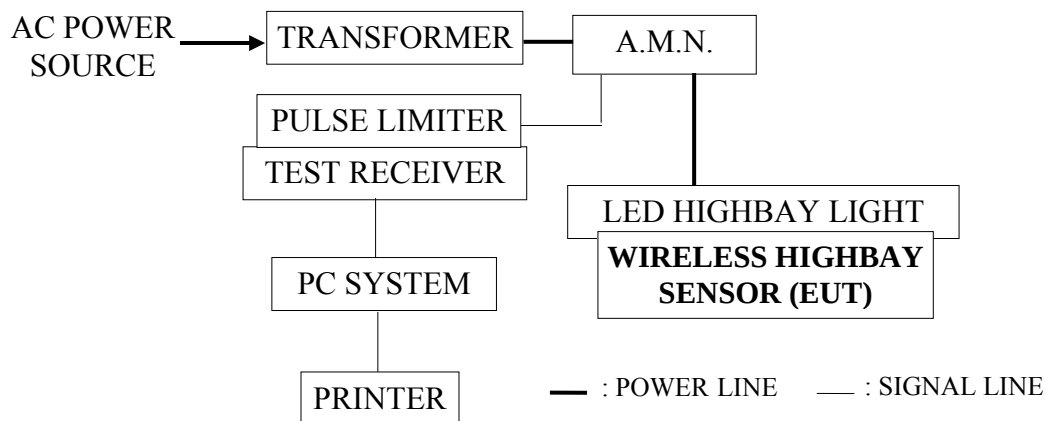
3. CONDUCTED EMISSION MEASUREMENT

3.1. Test Equipment

The following test equipment was used during the conducted emission measurement : (No. 8 Shielded Room)

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Due Date
1	Test Receiver	R&S	ESCS30	100265	2014. 08. 21
2	A.M.N.	R&S	ESH2-Z5	100366	2015. 06. 20
3	Pulse Limiter	Kyoritsu	KNW-407	8-855-9	2014. 12. 25

3.2. Block Diagram of Test Setup



3.3. Powerline Conducted Emission Limit [§15.207, Class B]

Frequency	Maximum RF Line Voltage	
	Quasi-Peak Level	Average Level
150kHz ~ 500kHz	66 ~ 56 dB μ V	56 ~ 46 dB μ V
500kHz ~ 5MHz	56 dB μ V	46 dB μ V
5MHz ~ 30MHz	60 dB μ V	50 dB μ V

Remark 1.: If the average limit is met when using a Quasi-Peak detector, the EUT shall be deemed to meet both limits and measurement with the average detector is unnecessary.

2.: The lower limit applies at the band edges.

3.4. Operating Condition of EUT

- 3.4.1. Setup the EUT (**WIRELESS HIGHBAY SENSOR**) and simulator as shown on 3.2.
- 3.4.2. Turn on the power of all equipment.
- 3.4.3. The EUT is designed for being embedded with LED HIGHBAY Light, we plug it into LED HIGHBAY Light for triggering device to receive command.

3.5. Test Procedure

The EUT plug into LED HIGHBAY Light was placed on the table which was above the ground by 80cm and LED HIGHBAY Light's power cord connected to the AC mains through an Artificial Mains Network (A.M.N.). This provided a 50 ohm coupling impedance for the measuring equipment. (Please refer to the block diagram of the test setup and photographs.)

Both sides of A.C. line were checked for maximum conducted interference. In order to find the maximum emission, the relative positions simulators of the interface cables should be manipulated according to ANSI C63.4-2003 regulation during conducted measurement.

The bandwidth of the R&S Test Receiver ESCS30 was set at 9kHz.

The frequency range from 150kHz to 30MHz was checked.

All the final readings from Test Receiver were measured with the Quasi-Peak detector and Average detector. Remark: If the Average limit is met when using a Quasi-Peak detector, the Average detector is unnecessary)

3.6. Conducted Emission Measurement Results

PASSED.

(All the emissions not reported below are too low against the prescribed limits.)

EUT was performed during this section testing and all the test results are attached in next pages.

EUT: WIRELESS HIGHBAY SENSOR Model No.: 9SD751TVDA

Test Date: 2014. 05. 16 Temperature: 23°C Humidity: 65%

The details are as follows :

Mode	Reference Test Data	
	Neutral	Line
1.	# 43	# 42

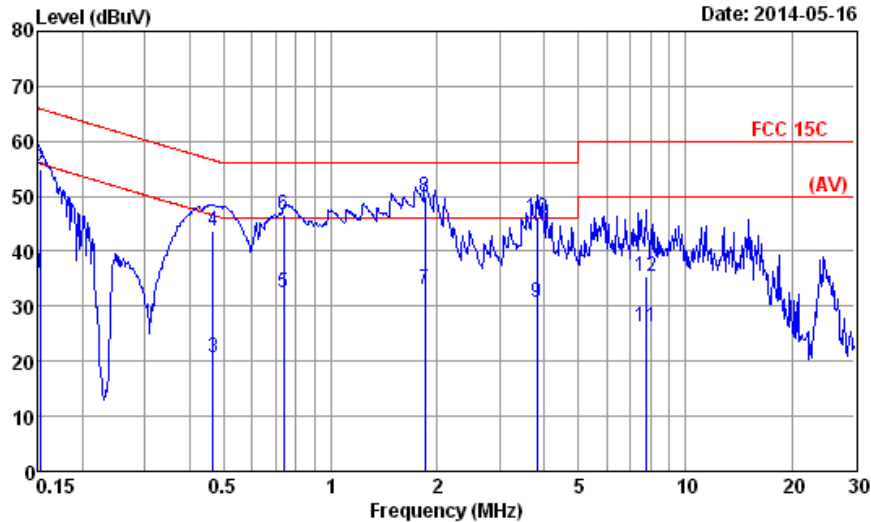


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Email: emc@audixtech.com

Data: 43

File: D:\test data\REPORT\2014\C1M1405XXX\C1M1405060-C-D.EM6 (49)

Date: 2014-05-16



Site no. : No.8 Shielded Room Data no. : 43
Condition : ESH2-Z5 366 LISN Phase : NEUTRAL
Limit : FCC 15C
Env. / Ins. : 23°C / 65% ESCS (265) Engineer : Hank
EUT : 9SD751TVDA
Power Rating : 120Vac/60Hz
Test Mode : Operating

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.152	0.21	0.03	9.85	25.94	36.03	55.91	19.88	Average
2	0.152	0.21	0.03	9.85	44.79	54.88	65.91	11.03	QP
3	0.466	0.23	0.03	9.85	10.48	20.59	46.58	25.99	Average
4	0.466	0.23	0.03	9.85	33.48	43.59	56.58	12.99	QP
5	0.739	0.23	0.04	9.84	22.27	32.38	46.00	13.62	Average
6	0.739	0.23	0.04	9.84	36.52	46.63	56.00	9.37	QP
7	1.848	0.25	0.07	9.84	22.99	33.15	46.00	12.85	Average
8	1.848	0.25	0.07	9.84	39.69	49.85	56.00	6.15	QP
9	3.820	0.33	0.12	9.86	20.34	30.65	46.00	15.35	Average
10	3.820	0.33	0.12	9.86	35.75	46.06	56.00	9.94	QP
11	7.728	0.43	0.17	9.87	15.70	26.17	50.00	23.83	Average
12	7.728	0.43	0.17	9.87	25.09	35.56	60.00	24.44	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.
2. If the average limit is met when using a quasi-peak detector, the EUT shall be deemed to meet both limits and measurement with average detector is unnecessary.

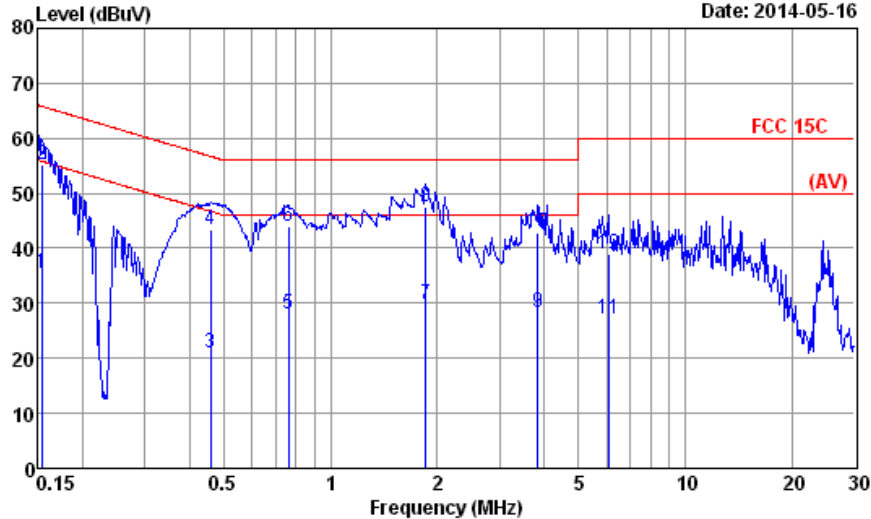


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Data: 42

File: D:\test data\REPORT\2014\1M1405XXX\1M1405060-C-D.EM6 (49)

Date: 2014-05-16



Site no. : No.8 Shielded Room Data no. : 42
Condition : ESH2-Z5 366 LISN Phase : LINE
Limit : FCC 15C
Env. / Ins. : 23°C / 65% ESCS (265) Engineer : Hank
EUT : 9SD751TVDA
Power Rating : 120Vac/60Hz
Test Mode : Operating

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.153	0.18	0.03	9.85	25.37	35.43	55.82	20.39	Average
2	0.153	0.18	0.03	9.85	45.21	55.27	65.82	10.55	QP
3	0.459	0.20	0.03	9.85	10.98	21.06	46.71	25.65	Average
4	0.459	0.20	0.03	9.85	33.28	43.36	56.71	13.35	QP
5	0.763	0.20	0.04	9.84	17.94	28.02	46.00	17.98	Average
6	0.763	0.20	0.04	9.84	33.92	44.00	56.00	12.00	QP
7	1.858	0.24	0.07	9.84	19.78	29.93	46.00	16.07	Average
8	1.858	0.24	0.07	9.84	37.29	47.44	56.00	8.56	QP
9	3.840	0.29	0.12	9.86	18.04	28.31	46.00	17.69	Average
10	3.840	0.29	0.12	9.86	32.61	42.88	56.00	13.12	QP
11	6.056	0.35	0.14	9.87	16.86	27.22	50.00	22.78	Average
12	6.056	0.35	0.14	9.87	28.75	39.11	60.00	20.89	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.
2. If the average limit is met when using a quasi-peak detector, the EUT shall be deemed to meet both limits and measurement with average detector is unnecessary.

4. RADIATED EMISSION MEASUREMENT

4.1. Test Equipment

The following test equipment was used during the radiated emission measurement:

4.1.1. For Frequency Range 30MHz~1000MHz (at Semi-Anechoic Chamber)

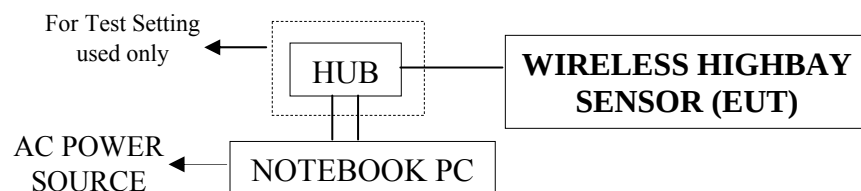
Item	Type	Manufacturer	Model No.	Serial No.	Cal. Due Date
1.	Spectrum Analyzer	Agilent	N9030A-544	US51350140	2014. 07. 29
2.	Test Receiver	R & S	ESCS30	100338	2014. 06. 30
3.	Amplifier	HP	8447D	2944A06305	2015. 02. 17
4.	Bilog Antenna	TESEQ	CBL6112D	33821	2014. 08. 07

4.1.2. For Frequency Above 1GHz (at Semi-Anechoic Chamber)

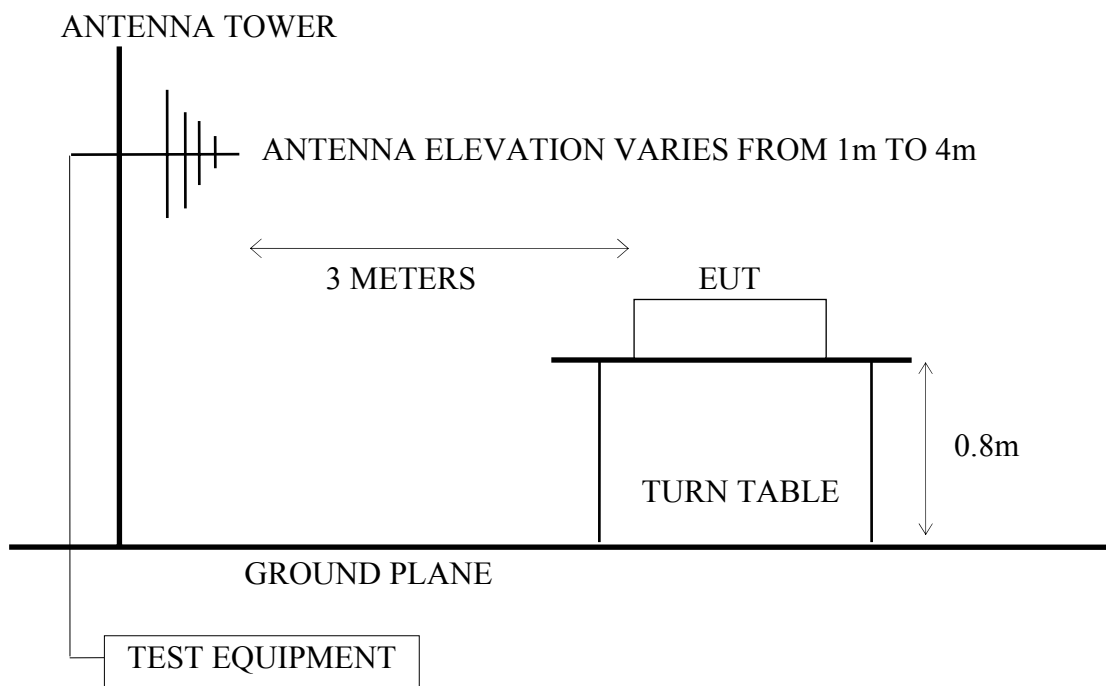
Item	Type	Manufacturer	Model No.	Serial No.	Cal. Due Date
1.	Spectrum Analyzer	Agilent	N9030A-544	US51350140	2014. 07. 29
2.	Test Receiver	R & S	ESCS30	100338	2014. 06. 30
3.	Pre-Amplifier	HP	8449B	3008A00529	2015. 01. 23
4.	2.4GHz Notch Filter	K&L	7NSL10-2441.5E 130.5-00	1	2014. 06. 12
5.	3G High Pass Filter	Microware Circuits	H3G018G1	484796	2014. 06. 12
6.	Horn Antenna	EMCO	3115	9609-4927	2014. 06. 16
7.	Horn Antenna	EMCO	3116	2653	2014. 10. 10

4.2. Test Setup

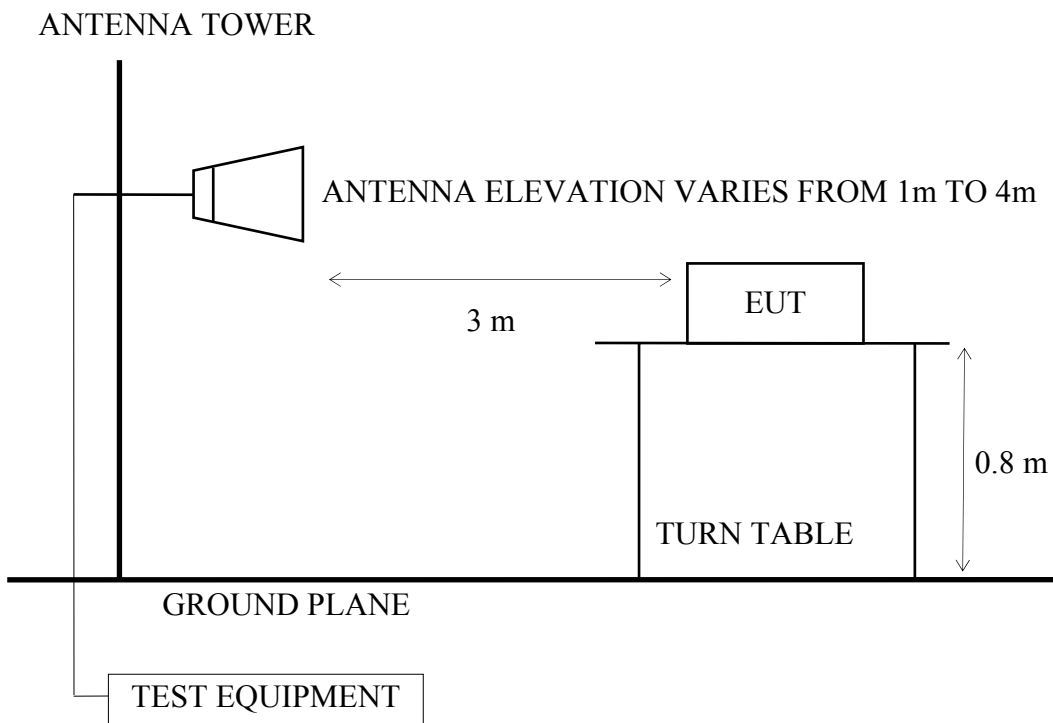
4.2.1. Block Diagram of connection between EUT and simulators



4.2.2. Semi-Anechoic Chamber (3m) Setup Diagram for 30-1000MHz



4.2.3. Semi-Anechoic Chamber (3m) Setup Diagram for above 1GHz



4.3. Radiated Emission Limits (§15.209)

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMITS	
		$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
Above 960	3	500	54.0
Above 1000	3	74.0 $\text{dB}\mu\text{V/m}$ (Peak) 54.0 $\text{dB}\mu\text{V/m}$ (Average)	

- Remark :
- (1) Emission level ($\text{dB}\mu\text{V/m}$) = $20 \log$ Emission level ($\mu\text{V/m}$)
 - (2) The tighter limit applies at the edge between two frequency bands.
 - (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.
 - (4) The limits in this table are based on CFR 47 Part 15.205(a)(b) and Part 15.209 (a).
 - (5) The over 1GHz limit, FCC limit is used based on CFR 47 Part 15.35(b) and Part 15.205(b) & Part 15.209(e) and Part 15.207(c).

4.4. Operating Condition of EUT

- 4.4.1. Set up the EUT (WIRELESS HIGHBAY SENSOR) and simulator as shown on 3.2.
- 4.4.2. To turn on the power of all equipments.
- 4.4.3. The Notebook PC was using test program “ember.desktop” to enable the EUT to transmit data at different channel frequency individually.

4.5. Test Procedure

The EUT and its simulators were placed on a turn table which was 0.8 meter above the ground. The turn table rotated 360 degrees to determine the position of the maximum emission level. EUT was set 3 meters away from the receiving antenna which was mounted on an antenna tower. The antenna moved up and down between 1 to 4 meters to find out the maximum emission level. Broadband antenna such as calibrated biconical and log-periodical antenna or horn antenna were used as a receiving antenna. Both horizontal and vertical polarization of the antenna were set on measurement. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.4-2003 regulation.

The bandwidth of the R&S Test Receiver was set at 120kHz. (For 30MHz to 1000MHz)

The resolution bandwidth and video bandwidth of test spectrum analyzer is 1MHz for peak detection (PK) at frequency above 1GHz.

The resolution bandwidth of test spectrum analyzer is 1MHz and the video bandwidth is 10Hz for average detection (AV) at frequency above 1GHz.

The frequency range from 30MHz to 25GHz (Up to 10th harmonics from fundamental frequency) was checked. 30MHz to 1000MHz was measured with Quasi-Peak detector.

Pursuant to ANSI C63.4 8.3.1.2, when peak value complies with the average limit, we didn't perform measurement in average detector.

4.6. Test Results

PASSED.

(All emissions not reported for there is no emission be found.)

For Frequency Range 30MHz~1000MHz:

The EUT with following test modes was performed during this section testing and all the test results are listed in section 4.6.1.

EUT: WIRELESS HIGHBAY SENSOR

M/N: 9SD751TVDA

Test Date: 2014. 05. 14 Temperature: 22°C Humidity: 35%

No.	Test Voltage	Channel	Frequency	Test Mode	Reference Test Data No.	
					Horizontal	Vertical
1	DC 3.3V (Via NB)	CH 11	2405MHz	Transmit	# 1	# 2
2		CH 18	2440MHz		# 13	# 14
3		CH 26	2480MHz		# 13	# 14

* Above all final readings were measured with Peak detector.

For Frequency above 1GHz:

The EUT with following test modes was performed during this section testing and all the test results are listed in section 4.6.2.

No.	Test Voltage	Channel	Frequency	Test Mode	Reference Test Data No.	
					Horizontal	Vertical
1	DC 3.3V (Via NB)	CH 11	2405MHz	Transmit	--(Note4)	--(Note4)
2		CH 18	2440MHz		--(Note2)	# 6
3		CH 26	2480MHz		# 5	# 6

Note: 1. Above all final readings were measured with Peak and Average detector.

2. For measurements above 4GHz to 5.5GHz, the peak measured value complies with the average limit, it is unnecessary to perform an average measurement. (According to ANSI C63.4-2003 section 8.3.1.2)

3. There is no signal be found at horizontal polarization above 1GHz.

4. The emissions (up to 25GHz) not reported are too low to be measured.

For Restricted Bands:

The EUT was tested in restricted bands and all the test results are listed in section 4.6.3. (The restricted bands defined in part 15.205(a))

No.	Test Voltage	Channel	Frequency	Test Mode	Reference Test Data No.	
					Horizontal	Vertical
1	DC 3.3V (Via NB)	CH 11	2405MHz	Transmit	# 1	# 3
2		CH 26	2480MHz		# 11	# 13

4.6.1. For 30-1000MHz Frequency Range Measurement Results

Transmit, Frequency: CH 11, 2405MHz

Site no. : Audix NO.1 Chamber
 Dis. / Ant. : 3m CBL6112D 33821
 Limit : 30M-1G
 Env. / Ins. : 22°C/35% N9030A(140)
 EUT : 9SD751TVDA
 Power Rating : DC 3.3V
 Test Mode : Tx 2405MHz Zigbee

Data no. : 1
 Ant. pol. : HORIZONTAL
 Engineer : An

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Remark
1	275.41	13.50	3.70	27.79	44.99	46.00	1.01	Peak
2	299.66	13.90	3.90	27.81	45.61	46.00	0.39	Peak
3	350.10	15.30	4.30	26.18	45.78	46.00	0.22	Peak
4	500.45	17.80	6.50	20.87	45.17	46.00	0.83	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

Site no. : Audix NO.1 Chamber
 Dis. / Ant. : 3m CBL6112D 33821
 Limit : 30M-1G
 Env. / Ins. : 22°C/35% N9030A(140)
 EUT : 9SD751TVDA
 Power Rating : DC 3.3V
 Test Mode : Tx 2405MHz Zigbee

Data no. : 2
 Ant. pol. : VERTICAL
 Engineer : An

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Remark
1	299.66	13.90	3.90	24.89	42.69	46.00	3.31	Peak
2	500.45	17.80	6.50	17.34	41.64	46.00	4.36	Peak
3	800.18	20.60	6.90	11.35	38.85	46.00	7.15	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

Transmit, Frequency: CH 18, 2440MHz

Site no. : Audix NO.1 Chamber
 Dis. / Ant. : 3m CBL6112D 33821
 Limit : 30M-1G
 Env. / Ins. : 22°C/35% N9030A(140)
 EUT : 9SD751TVDA
 Power Rating : DC 3.3V
 Test Mode : Tx 2440MHz Zigbee

Data no. : 13
 Ant. pol. : HORIZONTAL
 Engineer : An

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Remark
1	275.41	13.50	3.70	28.04	45.24	46.00	0.76	Peak
2	350.10	15.30	4.30	25.94	45.54	46.00	0.46	Peak
3	500.45	17.80	6.50	21.11	45.41	46.00	0.59	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

Site no. : Audix NO.1 Chamber
 Dis. / Ant. : 3m CBL6112D 33821
 Limit : 30M-1G
 Env. / Ins. : 22°C/35% N9030A(140)
 EUT : 9SD751TVDA
 Power Rating : DC 3.3V
 Test Mode : Tx 2440MHz Zigbee

Data no. : 14
 Ant. pol. : VERTICAL
 Engineer : An

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Remark
1	299.66	13.90	3.90	24.95	42.75	46.00	3.25	Peak
2	500.45	17.80	6.50	17.15	41.45	46.00	4.55	Peak
3	800.18	20.60	6.90	10.39	37.89	46.00	8.11	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

Transmit, Frequency: CH 26, 2480MHz

Site no. : Audix NO.1 Chamber
 Dis. / Ant. : 3m CBL6112D 33821
 Limit : 30M-1G
 Env. / Ins. : 22°C/35% N9030A(140)
 EUT : 9SD751TVDA
 Power Rating : DC 3.3V
 Test Mode : Tx 2480MHz Zigbee

Data no. : 13
 Ant. pol. : HORIZONTAL
 Engineer : An

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Remark
1	250.19	13.00	3.50	28.21	44.71	46.00	1.29	Peak
2	300.63	13.93	3.90	26.73	44.56	46.00	1.44	Peak
3	500.45	17.80	6.50	20.78	45.08	46.00	0.92	Peak
4	800.18	20.60	6.90	14.66	42.16	46.00	3.84	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

Site no. : Audix NO.1 Chamber
 Dis. / Ant. : 3m CBL6112D 33821
 Limit : 30M-1G
 Env. / Ins. : 22°C/35% N9030A(140)
 EUT : 9SD751TVDA
 Power Rating : DC 3.3V
 Test Mode : Tx 2480MHz Zigbee

Data no. : 14
 Ant. pol. : VERTICAL
 Engineer : An

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Remark
1	299.66	13.90	3.90	24.93	42.73	46.00	3.27	Peak
2	500.45	17.80	6.50	17.08	41.38	46.00	4.62	Peak
3	800.18	20.60	6.90	10.00	37.50	46.00	8.50	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

4.6.2. Above 1GHz Frequency Range Measurement Results

Transmit, Frequency: CH 18, 2440MHz

Site no. : Audix NO.1 Chamber
 Dis. / Ant. : 3m 3115(4927)
 Limit : ABOVE 1GHZ(PK)
 Env. / Ins. : 22°C/35% N9030A(140)
 EUT : 9SD751TVDA
 Power Rating : DC 3.3V
 Test Mode : Tx 2440MHz Zigbee

Data no. : 6
 Ant. pol. : VERTICAL
 Engineer : An

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Remark
1	4879.00	33.18	9.15	38.25	46.01	54.00	7.99	Average
2	4879.00	33.18	9.15	46.31	54.07	74.00	19.93	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

Transmit, Frequency: CH 26, 2480MHz

Site no. : Audix NO.1 Chamber
 Dis. / Ant. : 3m 3115(4927)
 Limit : ABOVE 1GHZ(AV)
 Env. / Ins. : 22°C/35% N9030A(140)
 EUT : 9SD751TVDA
 Power Rating : DC 3.3V
 Test Mode : Tx 2480MHz Zigbee

Data no. : 5
 Ant. pol. : HORIZONTAL
 Engineer : An

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Remark
1	4958.50	33.34	9.10	9.29	51.73	54.00	2.27	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

Site no. : Audix NO.1 Chamber
 Dis. / Ant. : 3m 3115(4927)
 Limit : ABOVE 1GHZ(PK)
 Env. / Ins. : 22°C/35% N9030A(140)
 EUT : 9SD751TVDA
 Power Rating : DC 3.3V
 Test Mode : Tx 2480MHz Zigbee

Data no. : 6
 Ant. pol. : VERTICAL
 Engineer : An

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Remark
1	4960.00	33.34	9.12	42.49	50.36	54.00	3.64	Average
2	4960.00	33.34	9.12	51.22	59.09	74.00	14.91	Peak

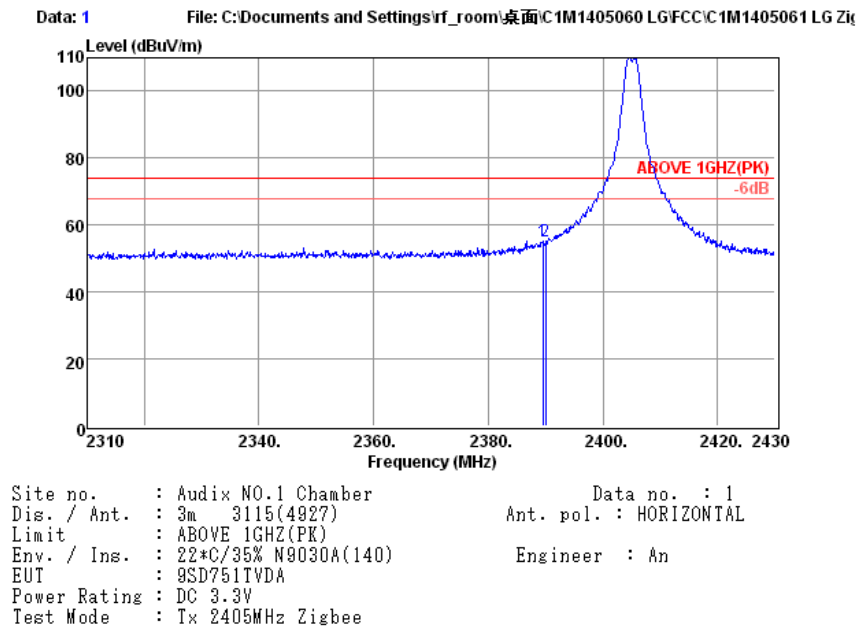
Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

4.6.3. Restricted Bands Measurement Results

Date of Test : 2014. 05. 14 Temperature: 22°C

EUT: WIRELESS Highbay Sensor Humidity: 35%

Test Mode: Transmit, Channel: 11, Frequency: 2405MHz



	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dB μV)	Emission Level (dB μV/m)	Limits (dB μV/m)	Margin (dB)	Remark
1	2389.56	28.47	6.34	20.46	55.27	74.00	18.73	Peak
2	2390.04	28.47	6.34	20.20	55.01	74.00	18.99	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

Emission Frequency	Peak Value	Duty Cycle Correction Factor	Average Value Vertical	Limit	Margin
(MHz)	(dB/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2389.56	55.27	-11.34	43.93	54.00	10.07

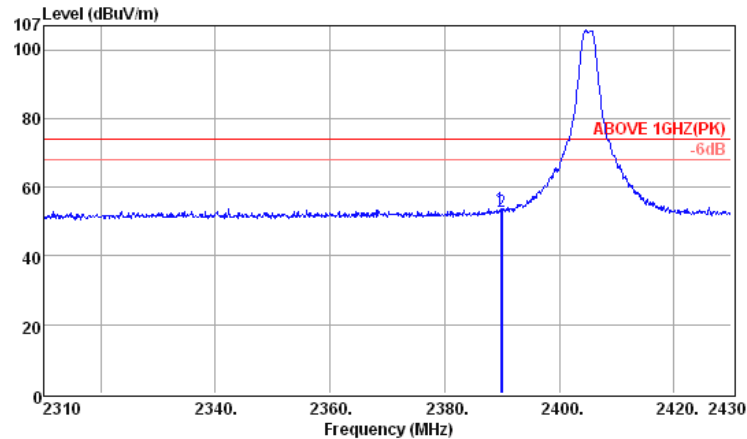
Remarks: 1. Duty Cycle Correction Factor is presented in section 4.6.4.
 2. Average value=Peak value+ Duty Cycle Correction Factor
 3. Low frequency section (spurious in the restricted band 2310-2430MHz).

Date of Test : 2014. 05. 14 Temperature: 22°C

EUT: WIRELESS HIGHBAY SENSOR Humidity: 35%

Test Mode: Transmit, Channel: 11, Frequency: 2405MHz

Data: 3 File: C:\Documents and Settings\rf_room\桌面\1M1405060 LG FCC\1M1405061 LG Zi



Site no. : Audix NO.1 Chamber Data no. : 3
 Dis. / Ant. : 3m 3115(4927) Ant. pol. : VERTICAL
 Limit : ABOVE 1GHZ(PK)
 Env. / Ins. : 22°C/35% N9030A(140) Engineer : An
 EUT : 9SD751TVDA
 Power Rating : DC 3.3V
 Test Mode : Tx 2405MHz Zigbee

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Remark
1	2389.80	28.47	6.34	18.88	53.69	74.00	20.31	Peak
2	2390.04	28.47	6.34	18.10	52.91	74.00	21.09	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

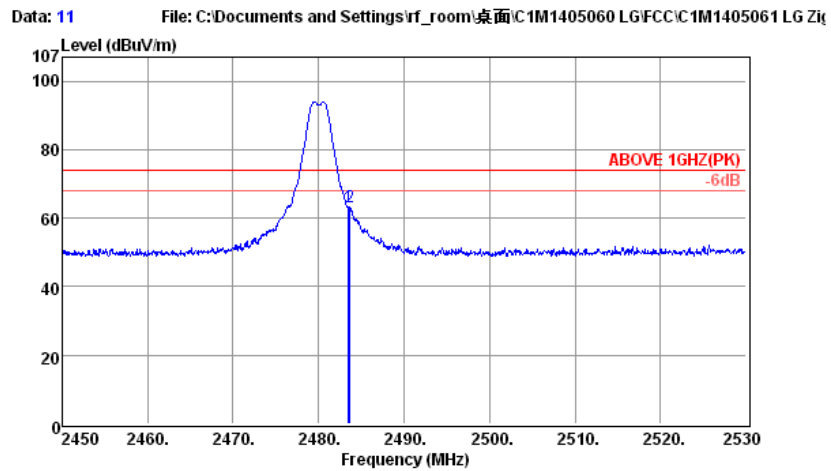
Emission Frequency	Peak Value	Duty Cycle Correction Factor	Average Value Vertical	Limit	Margin
(MHz)	(dB/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2389.80	53.69	-11.34	42.35	54.00	11.65

Remarks: 1. Duty Cycle Correction Factor is presented in section 4.6.4.
 2. Average value=Peak value+ Duty Cycle Correction Factor
 3. Low frequency section (spurious in the restricted band 2310-2430MHz).

Date of Test : 2014. 05. 14 Temperature: 22°C

EUT: WIRELESS Highbay Sensor Humidity: 35%

Test Mode: Transmit, Channel: 26, Frequency: 2480MHz



Site no. : Audix NO.1 Chamber Data no. : 11
 Dis. / Ant. : 3m 3115(4927) Ant. pol. : HORIZONTAL
 Limit : ABOVE 1GHZ(PK)
 Env. / Ins. : 22°C/35% N9030A(140) Engineer : An
 EUT : 9SD751TVDA
 Power Rating : DC 3.3V
 Test Mode : Tx 2480MHz Zigbee

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dB μV)	Emission Level (dB μV/m)	Limits (dB μV/m)	Margin (dB)	Remark
1	2483.52	28.66	6.45	28.00	63.11	74.00	10.89	Peak
2	2483.68	28.66	6.45	28.08	63.19	74.00	10.81	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

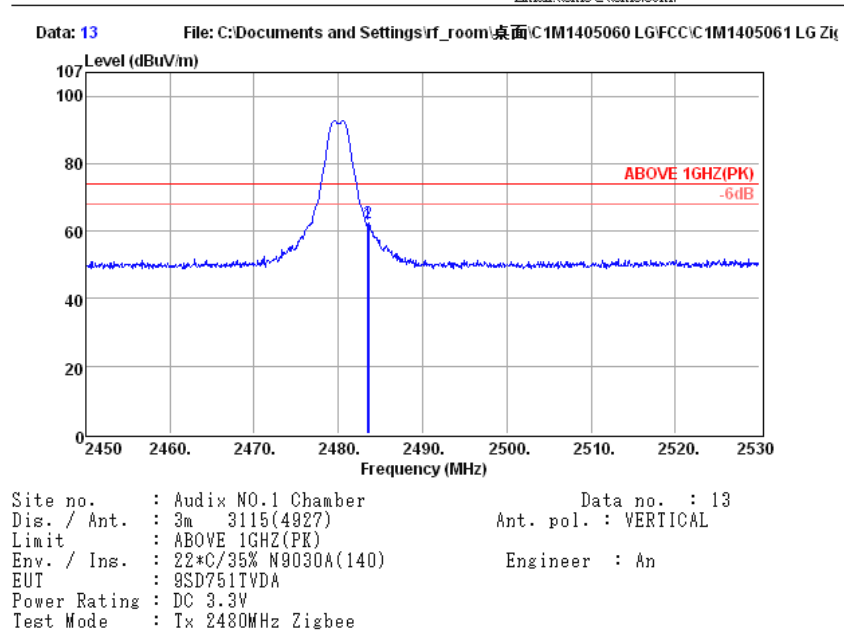
Emission Frequency	Peak Value	Duty Cycle Correction Factor	Average Value Vertical	Limit	Margin
(MHz)	(dB/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2483.68	63.19	-11.34	51.85	54.00	2.15

Remarks: 1. Duty Cycle Correction Factor is presented in section 4.6.4.
 2. Average value=Peak value+ Duty Cycle Correction Factor
 3. High frequency section (spurious in the restricted band 2450-2530MHz).

Date of Test : 2014. 05. 14 Temperature: 22°C

EUT: WIRELESS Highbay Sensor Humidity: 35%

Test Mode: Transmit, Channel: 26, Frequency: 2480MHz



	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Remark
1	2483.52	28.66	6.45	27.04	62.15	74.00	11.85	Peak
2	2483.60	28.66	6.45	27.30	62.41	74.00	11.59	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

Emission Frequency	Peak Value	Duty Cycle Correction Factor	Average Value Vertical	Limit	Margin
(MHz)	(dB/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2483.60	62.41	-11.34	51.07	54.00	2.93

Remarks: 1. Duty Cycle Correction Factor is presented in section 4.6.4.
 2. Average value=Peak value+ Duty Cycle Correction Factor
 3. High frequency section (spurious in the restricted band 2450-2530MHz).

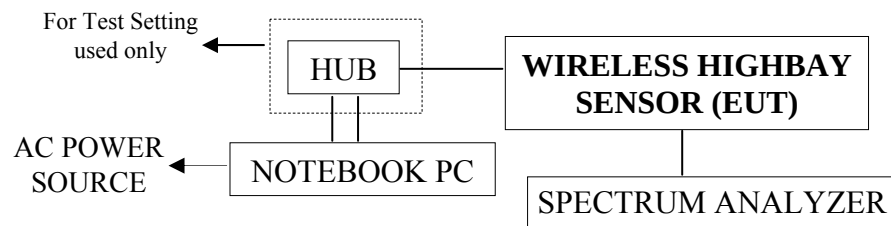
5. 6dB BANDWIDTH MEASUREMENT

5.1. Test Equipment

The following test equipment was used during the Emission Bandwidth measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Due Date
1.	Spectrum Analyzer	Agilent	N9030A-544	US51350140	Oct. 29, 14'

5.2. Block Diagram of Test Setup



5.3. Specification Limits [§15.247(a)(2)]

The minimum 6dB bandwidth shall be at least 500kHz.

5.4. Operating Condition of EUT

The Notebook PC was using test program “ember.desktop” to enable the EUT to transmit data at different channel frequency individually.

5.5. Test Procedure

The transmitter output was connected to the spectrum analyzer. The bandwidth of the fundamental frequency was measure by spectrum analyzer with 1.5% EBW, $VBW \geq 3 \times RBW$. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.

The measurement guideline was according to KDB 558074 D01 DTS Meas Guidance is v03r01.

5.6. Test Results

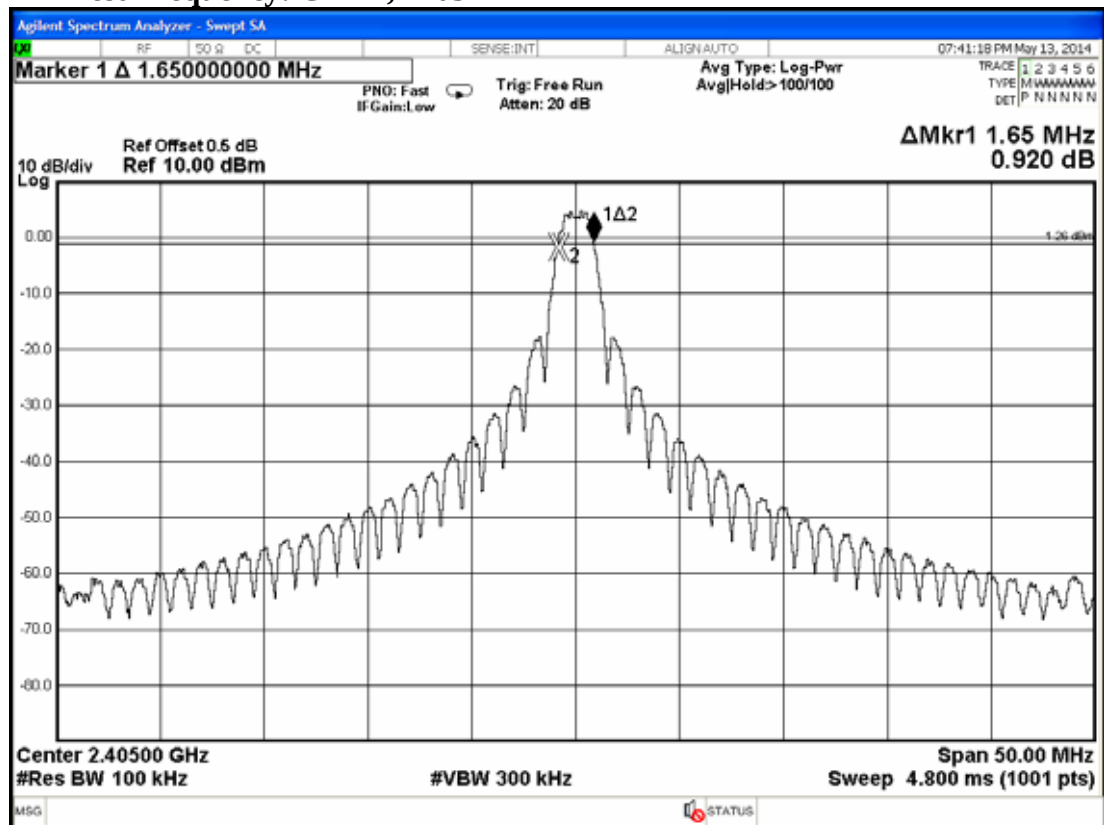
PASSED. All the test results are attached in next pages.

Test Date: 2014. 05. 13 Temperature: 25°C Humidity: 45%

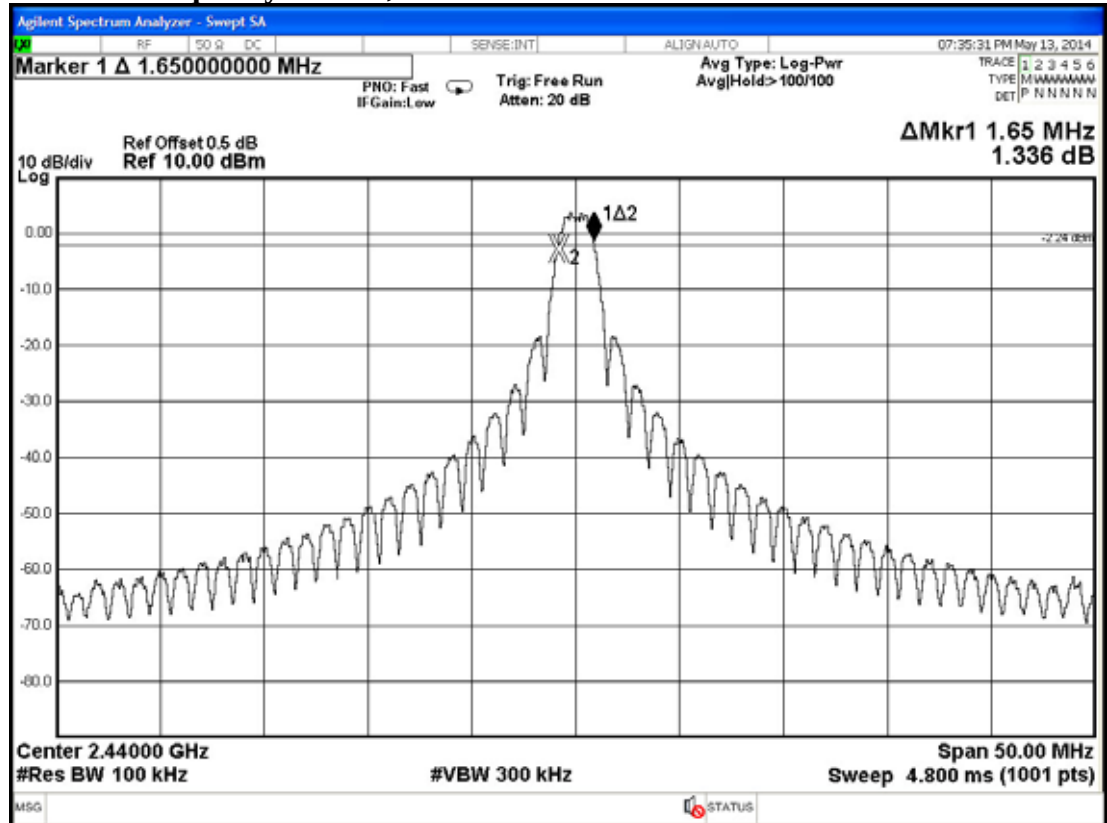
Mode	Channel	Test Frequency	6dB Bandwidth
1	CH 11	2405MHz	1.65 MHz
2	CH 18	2440MHz	1.65 MHz
3	CH 26	2480MHz	1.65 MHz

[Limit: least 500kHz]

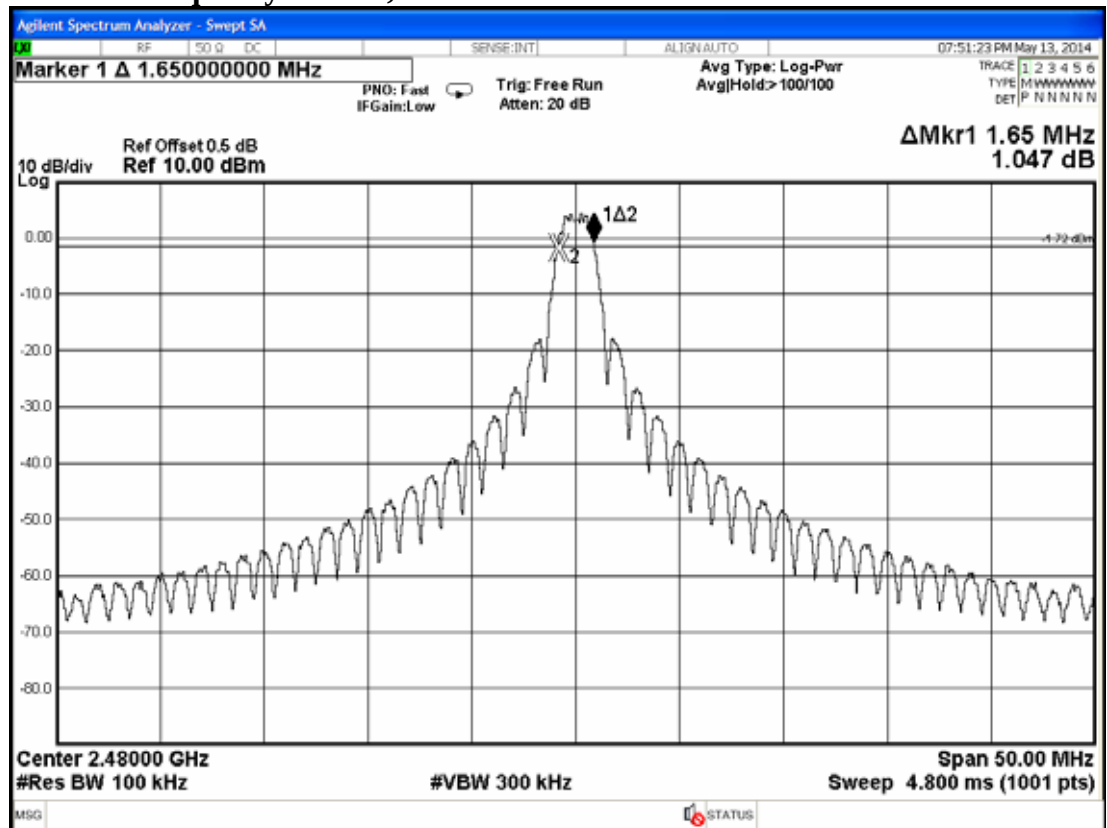
Test Frequency: CH 11, 2405MHz



Test Frequency: CH 18, 2440MHz



Test Frequency: CH 26, 2480MHz



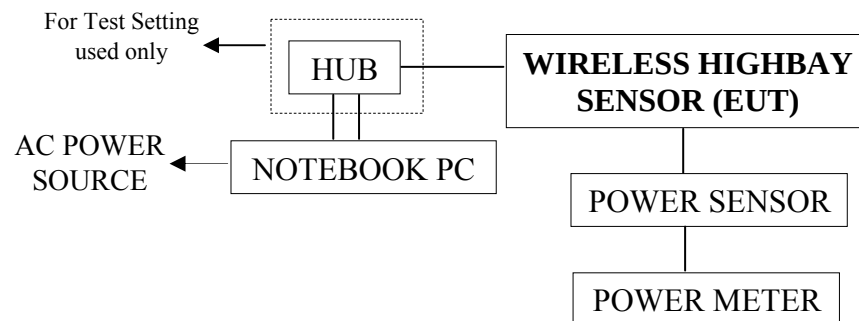
6. MAXIMUM PEAK OUTPUT POWER MEASUREMENT

6.1. Test Equipment

The following test equipment was used during the maximum peak output power measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Due Date
1.	Power Meter	Anritsu	ML2495A	1145008	2014. 10. 22
2.	Power Sensor	Anritsu	MA2411B	1126096	2014. 10. 22

6.2. Block Diagram of Test Setup



6.3. Specification Limits [§15.247(b)-(3)]

The Limits of maximum Peak Output Power for digital modulation in 2400-2483.5MHz is: 1Watt. (30dBm)

6.4. Operating Condition of EUT

The Notebook PC was using test program “ember.desktop” to enable the EUT to transmit data at different channel frequency individually.

6.5. Test Procedure

The transmitter output was connected to the power sensor and record the reading of power meter.

The measurement guideline was according to KDB 558074 D01 DTS Meas Guidance is v03r01.

6.6. Test Results

PASSED. All the test results are listed below.

Test Date: 2014. 05. 13 Temperature: 25°C Humidity: 45%

Mode	Channel	Test Frequency	Output Power(dBm)	
			Peak	Average
1	CH 11	2405MHz	8.04	7.89
2	CH 18	2440MHz	8.17	8.01
3	CH 26	2480MHz	-2.15	-3.86

[Limit: 1Watt. (30dBm)]

7. EMISSION LIMITATIONS MEASUREMENT

7.1. Test Equipment

The following test equipment was used during the emission limitations test :

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Due Date
1.	Spectrum Analyzer	Agilent	N9030A-544	US51350140	2014. 10. 29

7.2. Block Diagram of Test Setup

The same as section.5.2

7.3. Specification Limits (§15.247(c), RSS-210 A8.5)

7.3.1. In any 100kHz 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 20dB below that in the 100kHz 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 emissions which fall in 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)).(※This test result attaching to §4.6.3)

7.3.2. The reference level for determining limit of emission limitations is according to the value measured indicated in plots at section 9.6.

7.4. Operating Condition of EUT

The Notebook PC was using test program “ember.desktop” to enable the EUT to transmit data at different channel frequency individually.

7.5. Test Procedure

The RF output of EUT was connected to the spectrum analyzer. The bandwidth of the fundamental frequency was measure by spectrum analyzer with 100kHz RBW and 300kHz VBW.

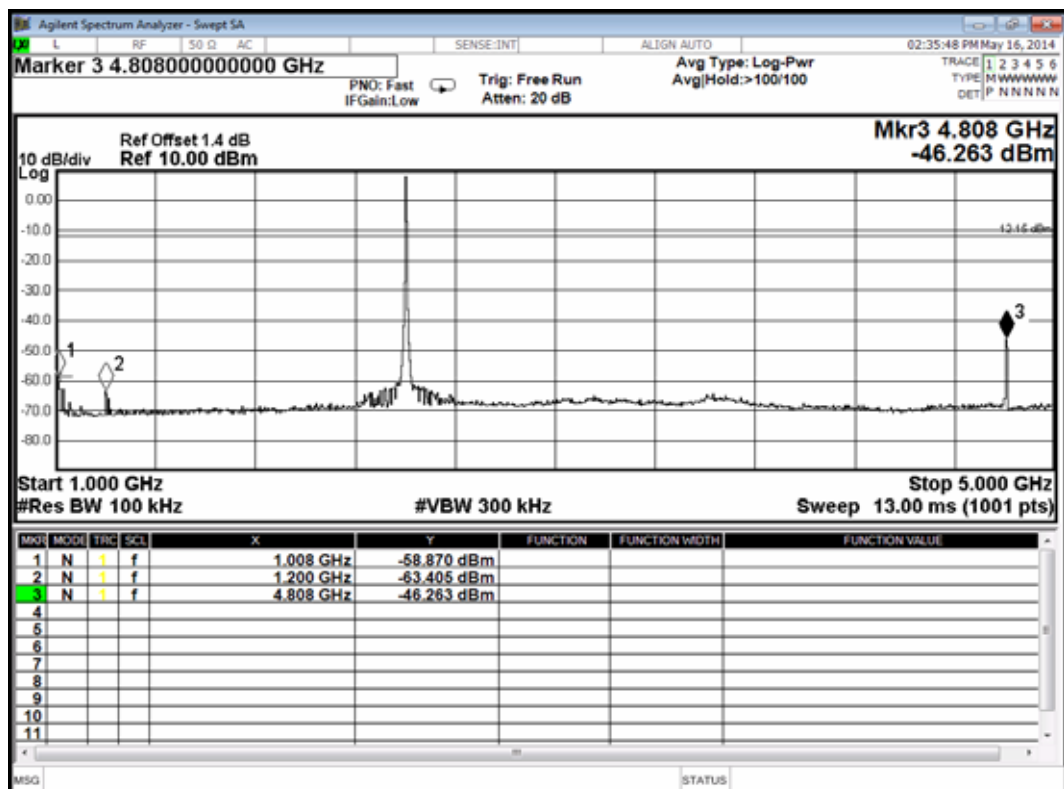
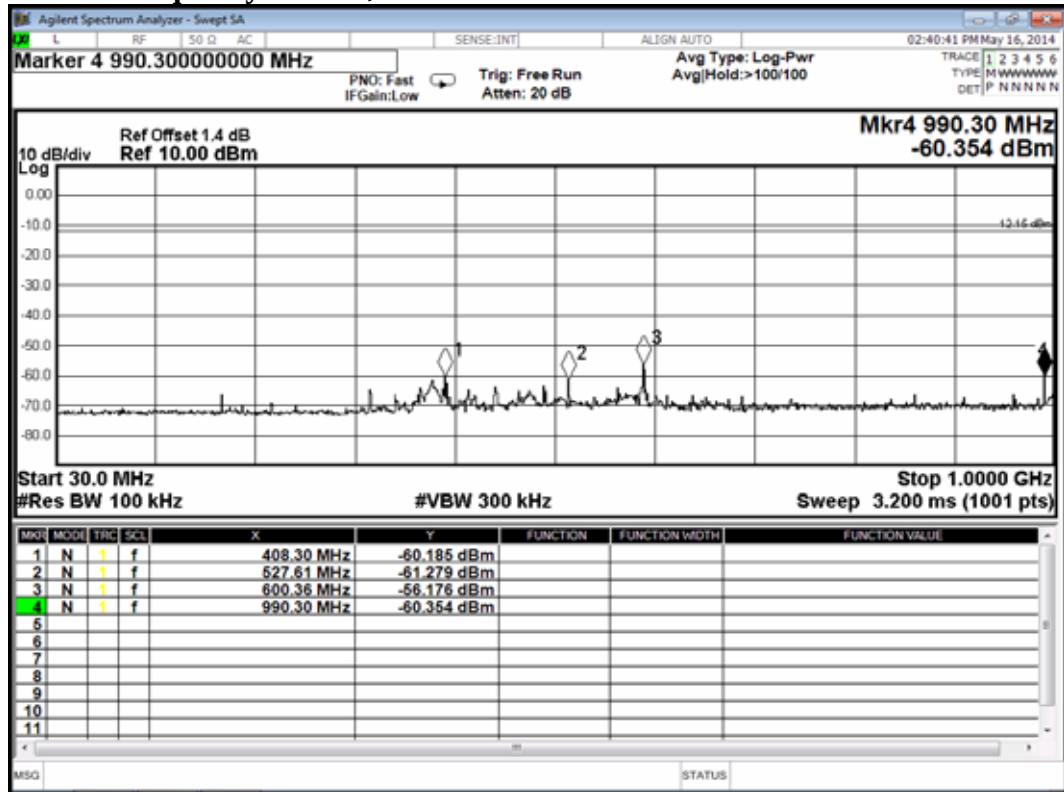
The measurement guideline was according to KDB 558074 D01 DTS Meas Guidance is v03r01.

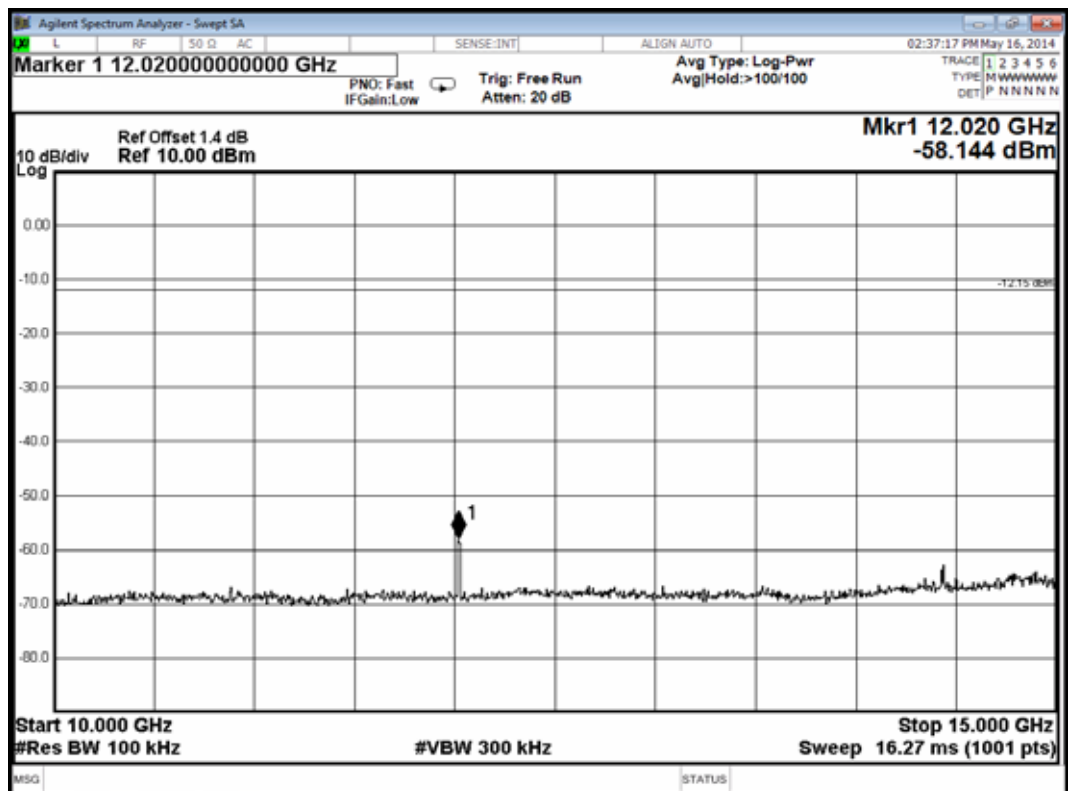
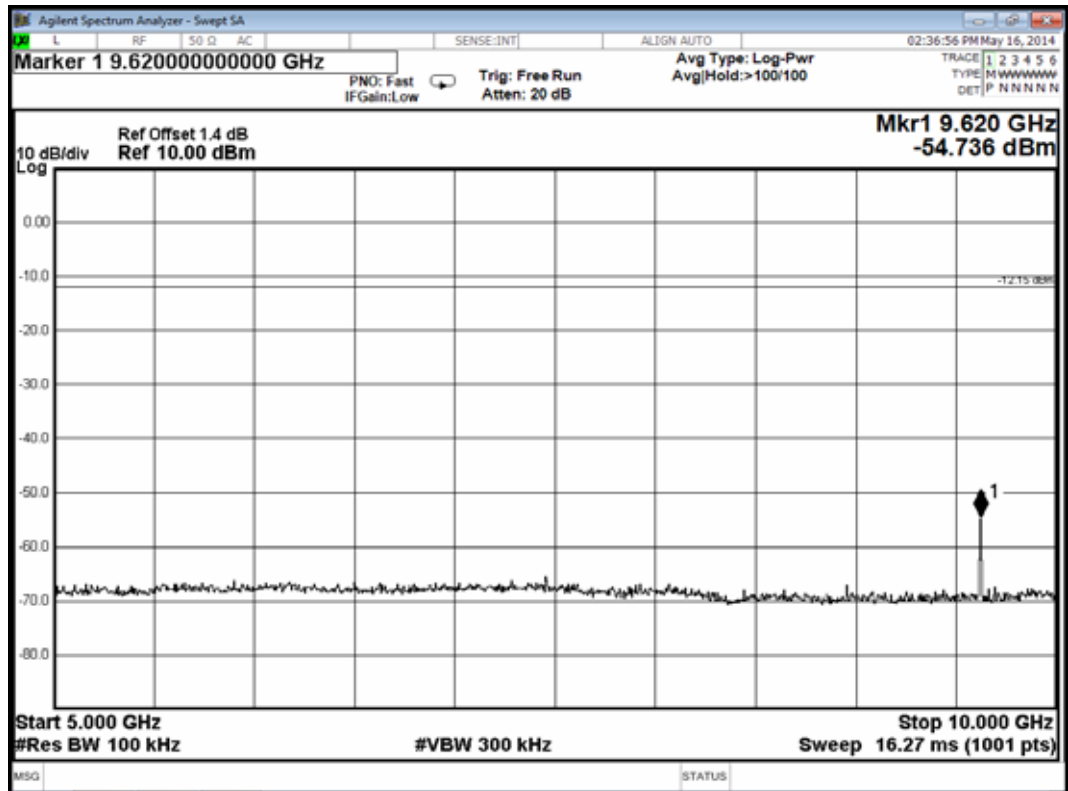
7.6. Test Results

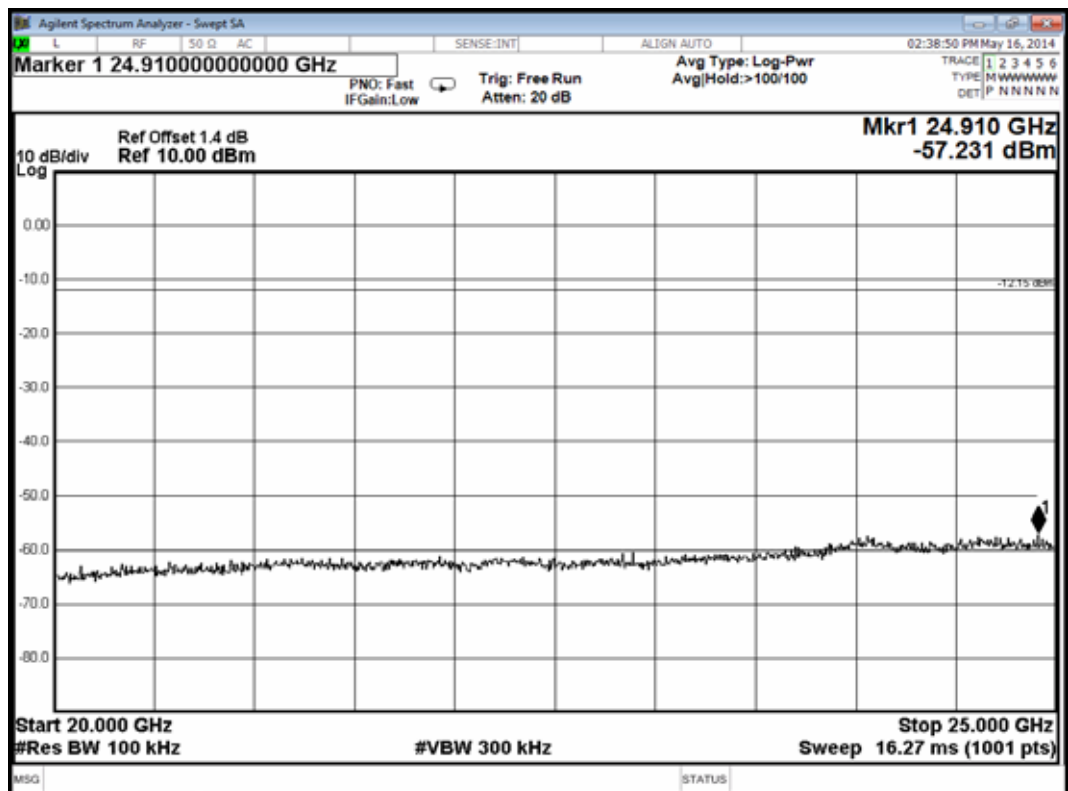
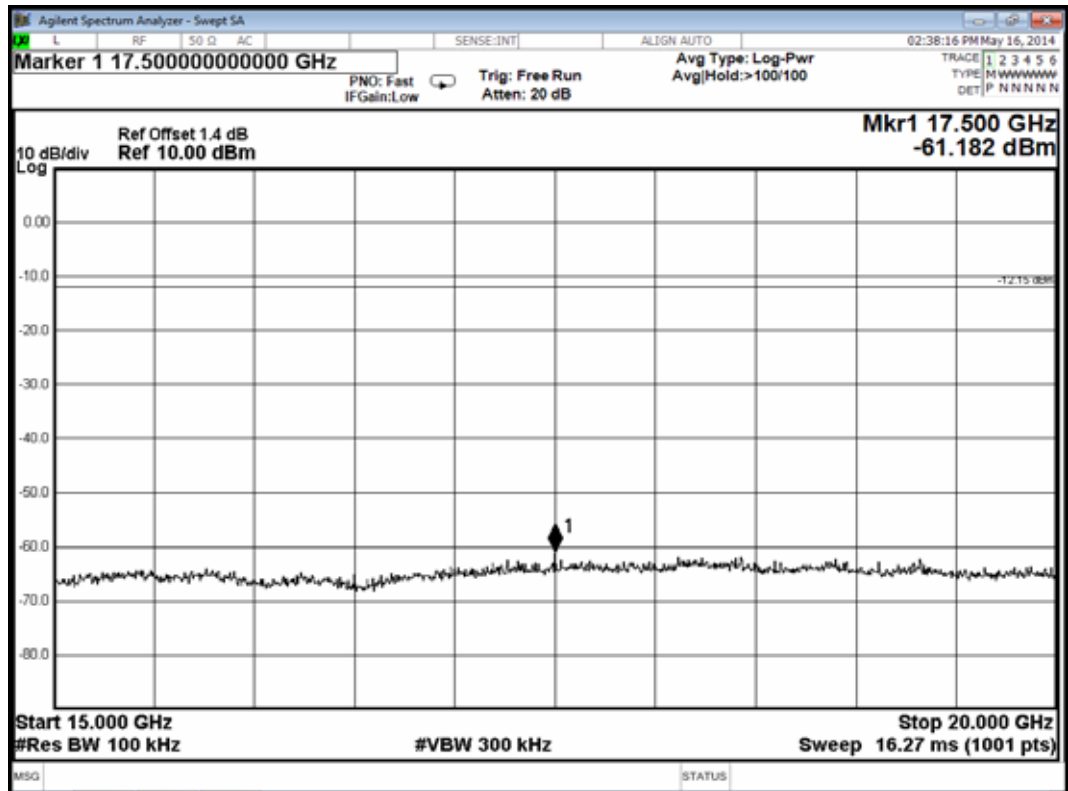
PASSED. The testing data was attached in the next pages.

Test Date: 2014. 05. 16 Temperature: 25°C Humidity: 42%

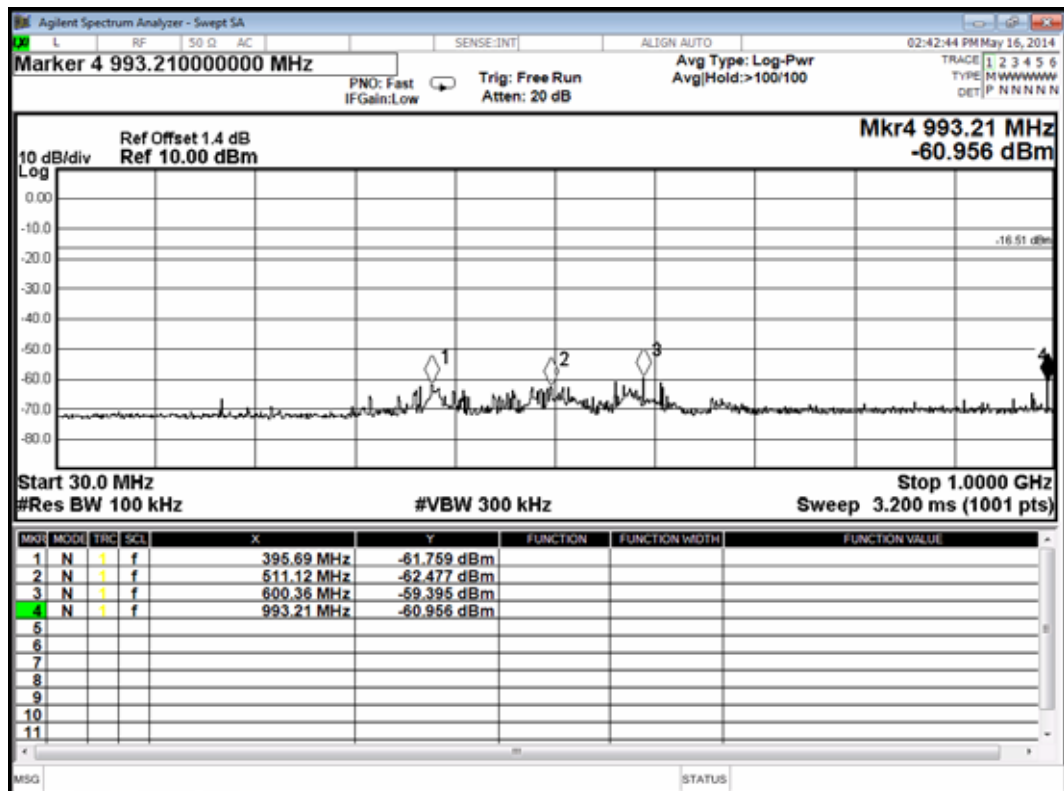
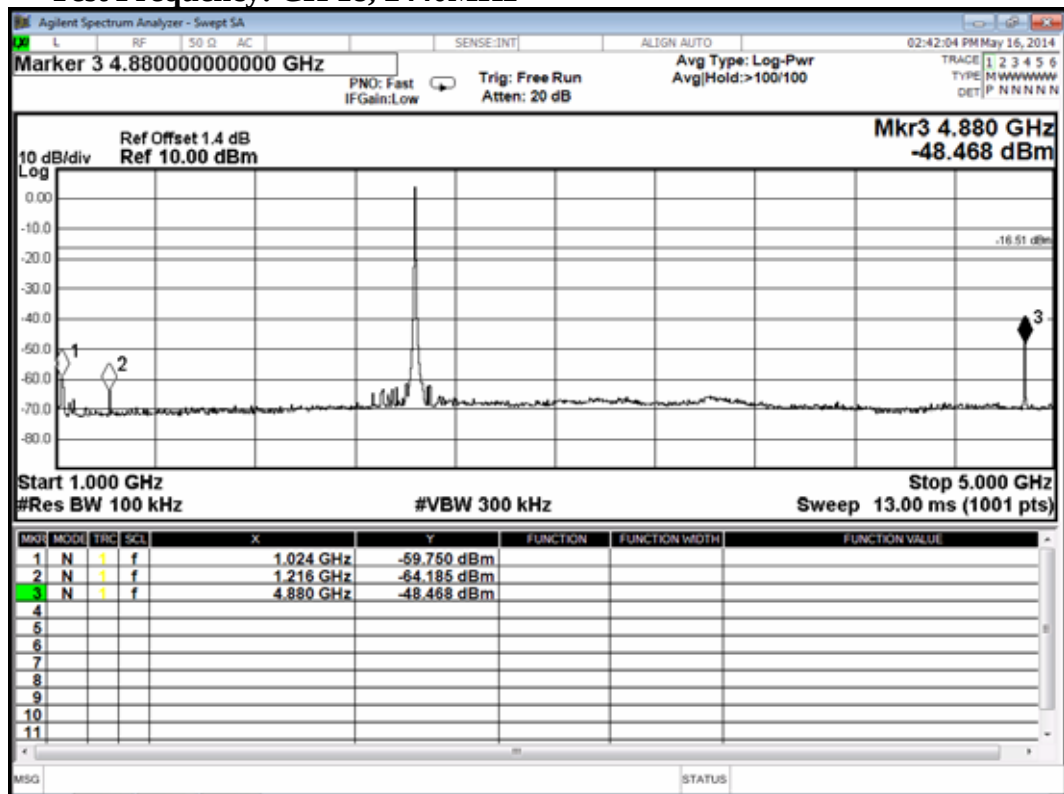
Test Frequency: CH 11, 2405MHz

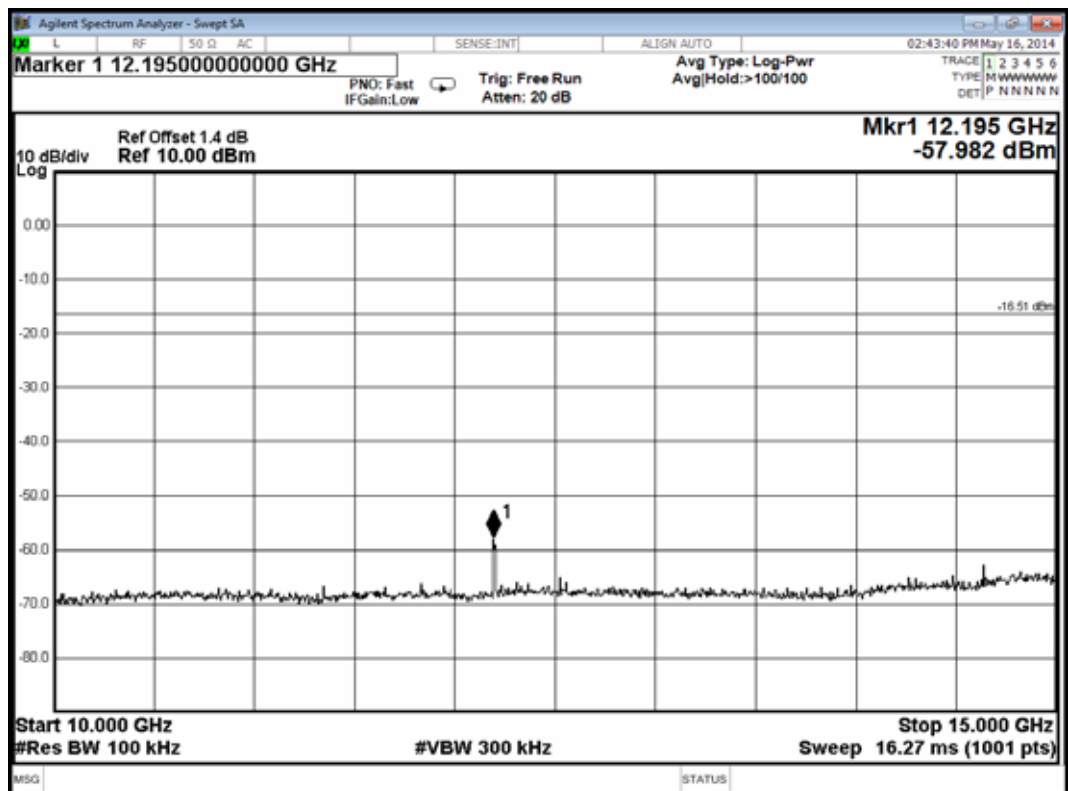
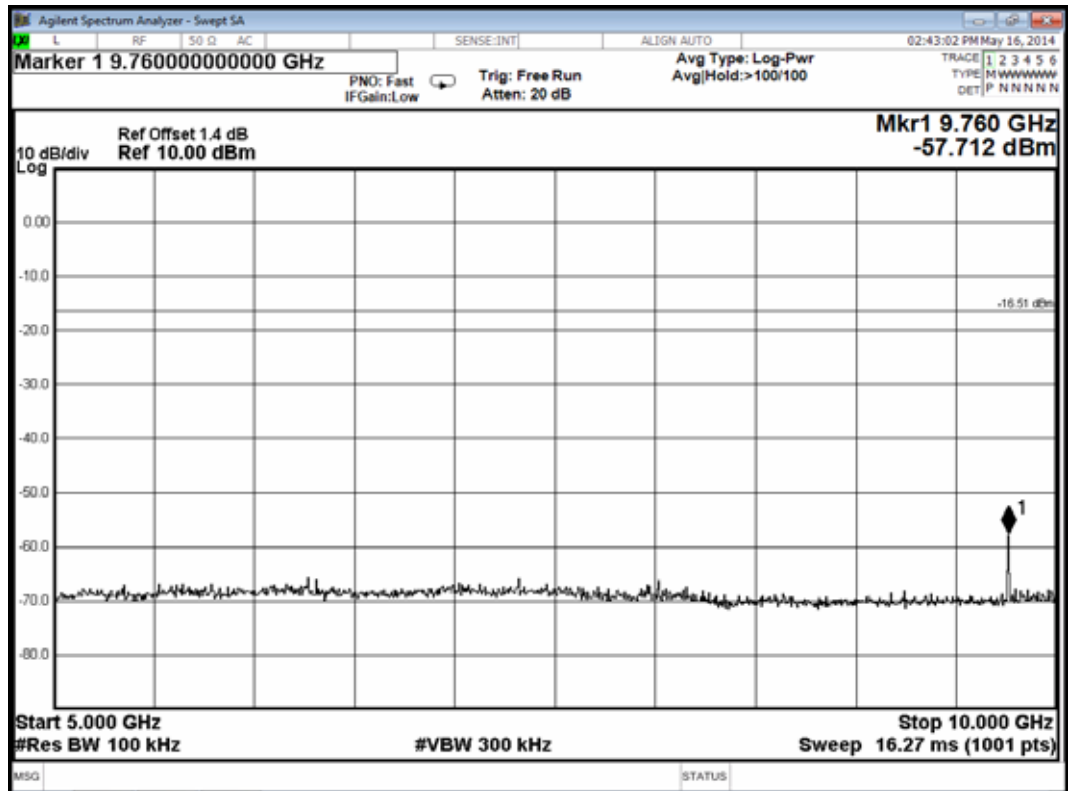


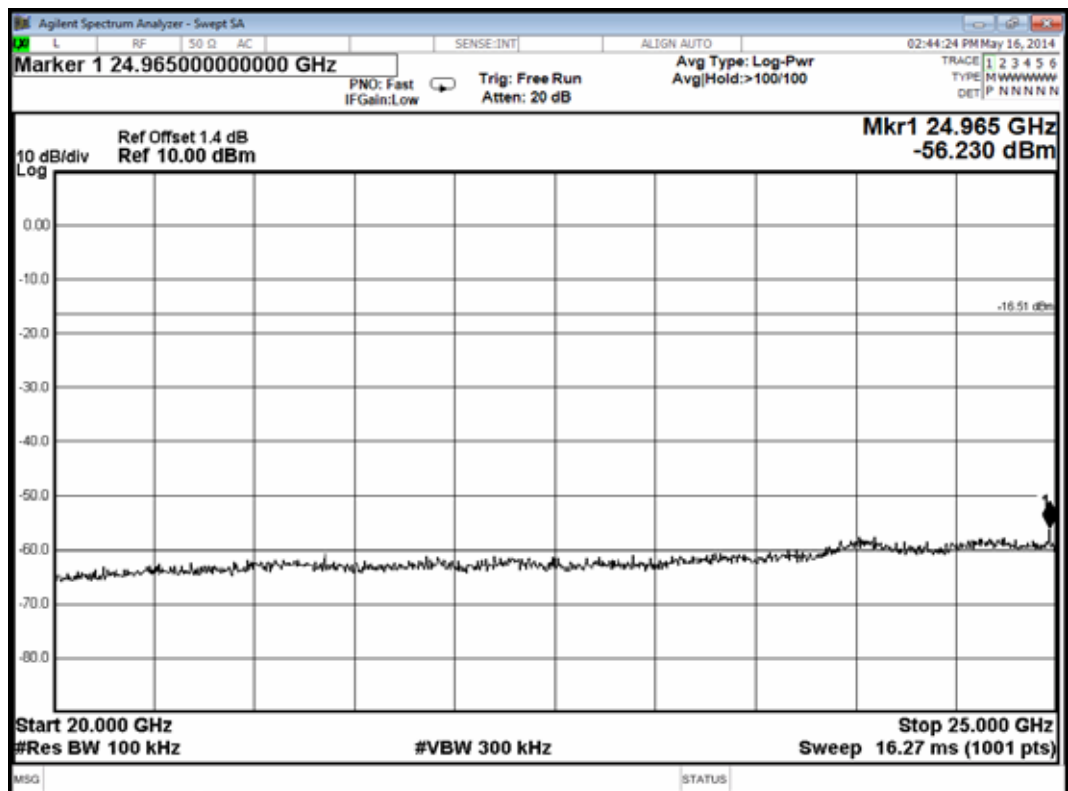
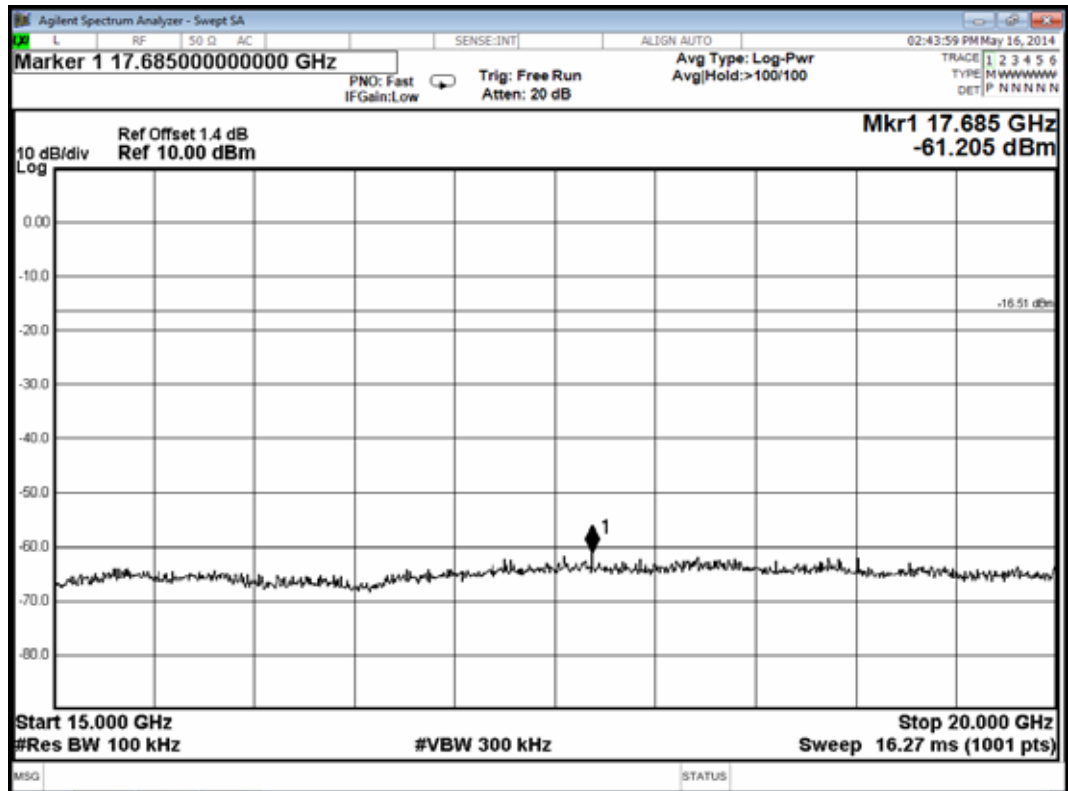




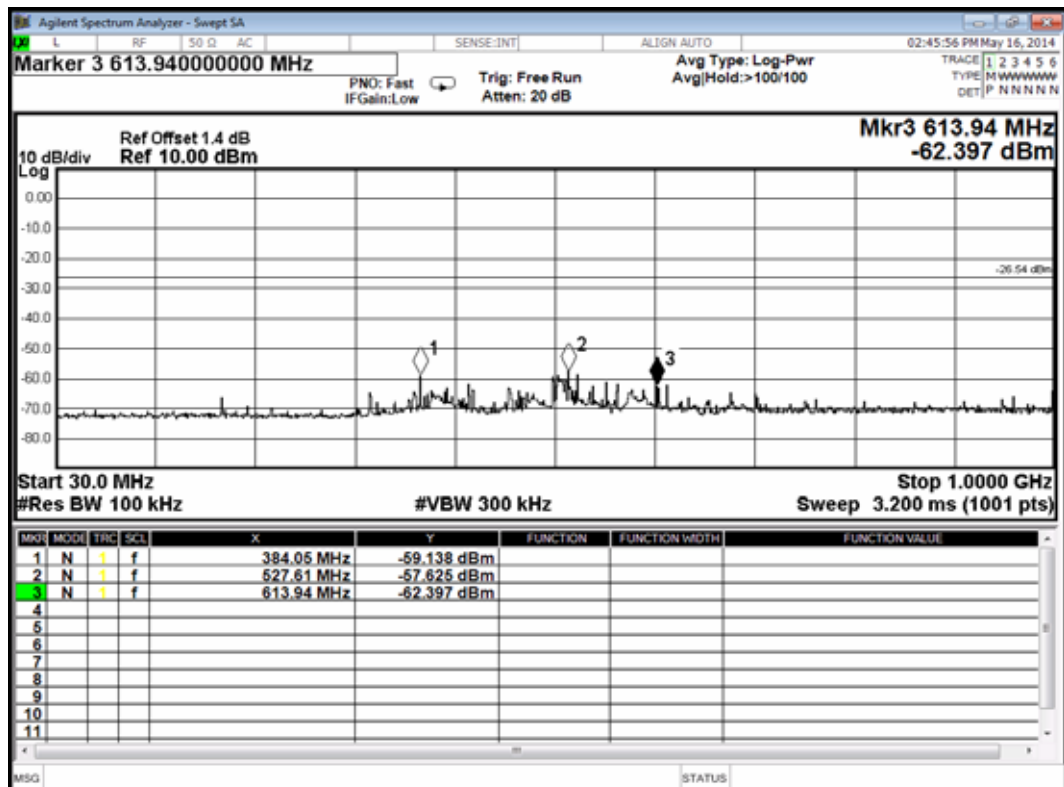
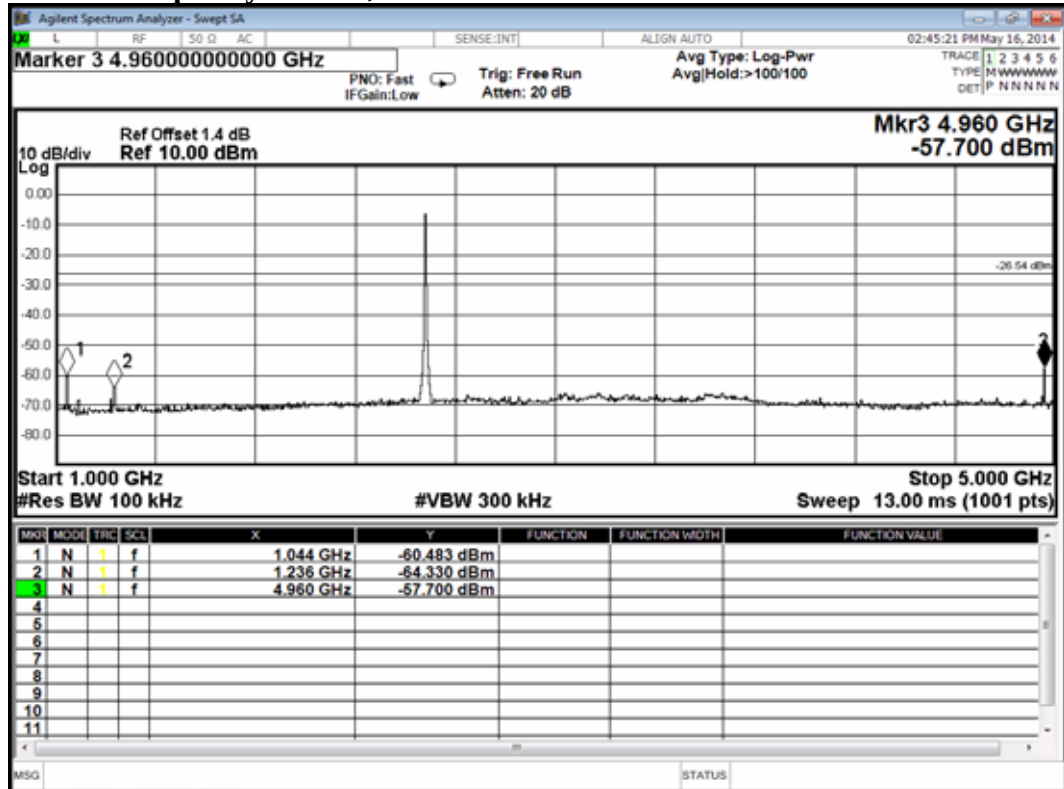
Test Frequency: CH 18, 2440MHz

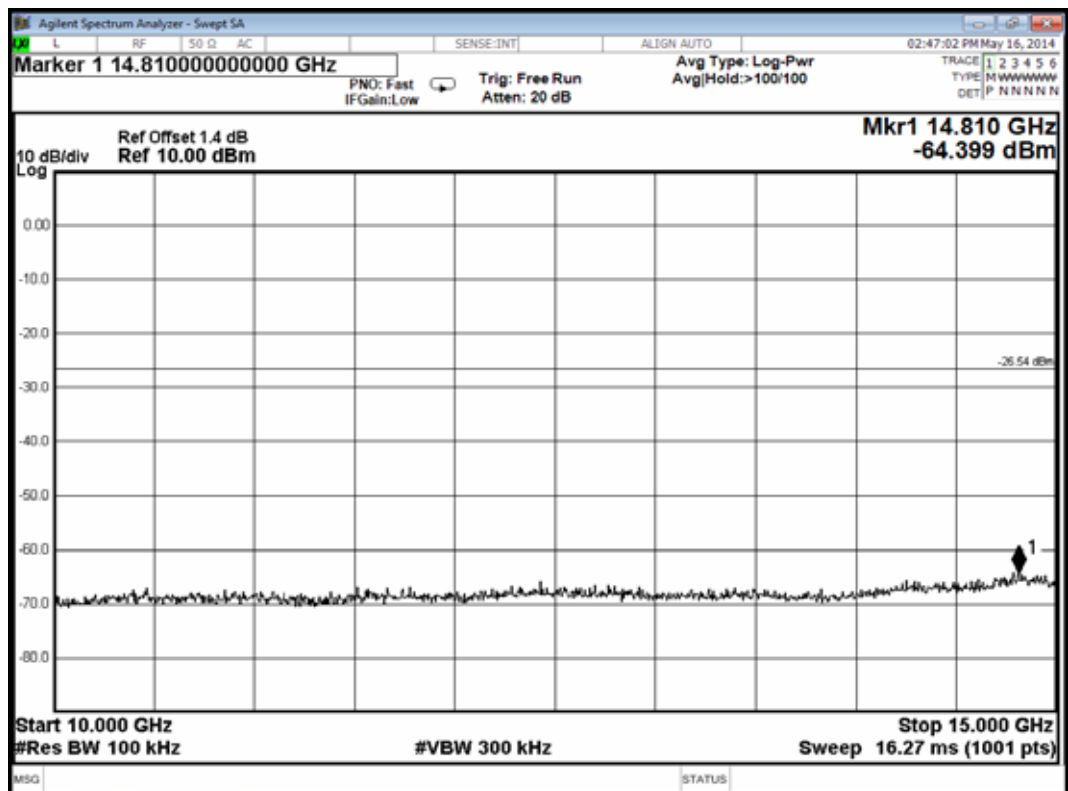
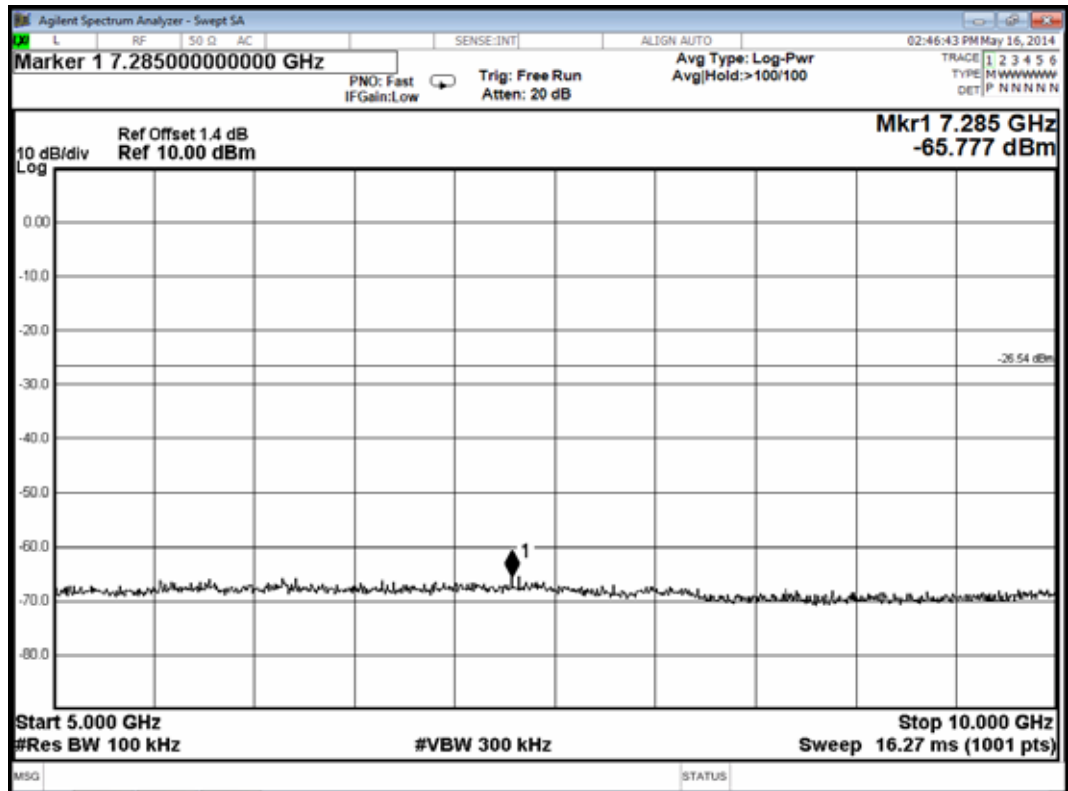


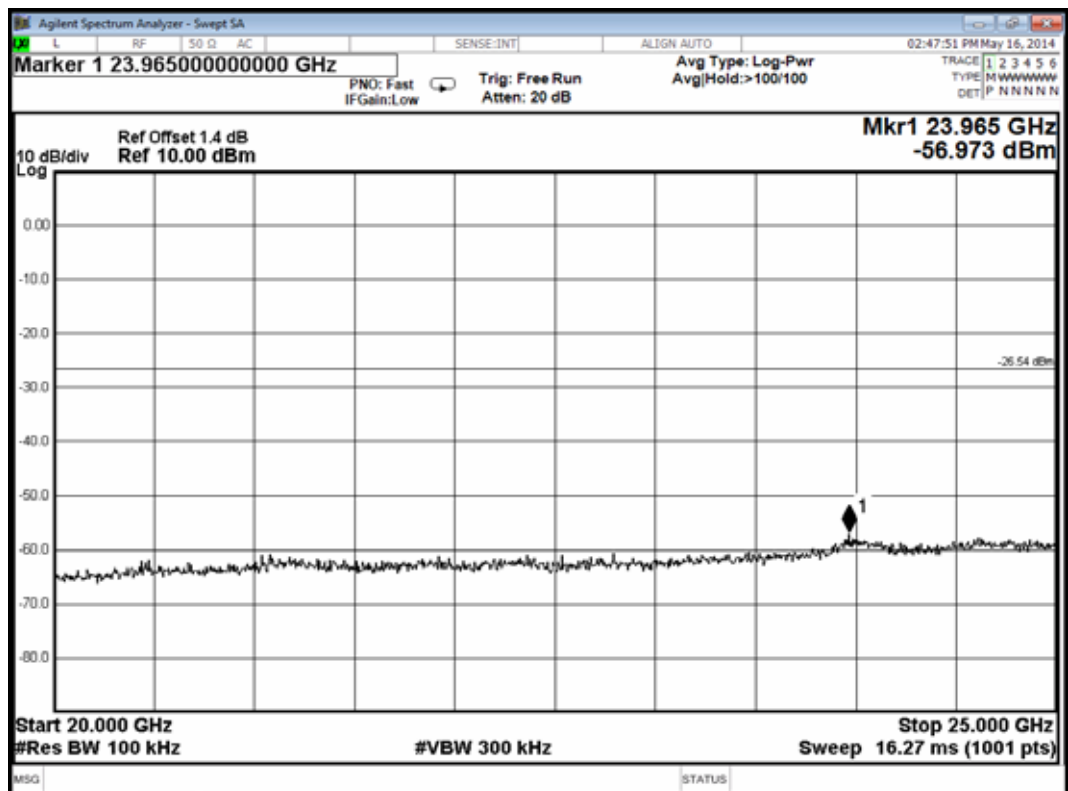
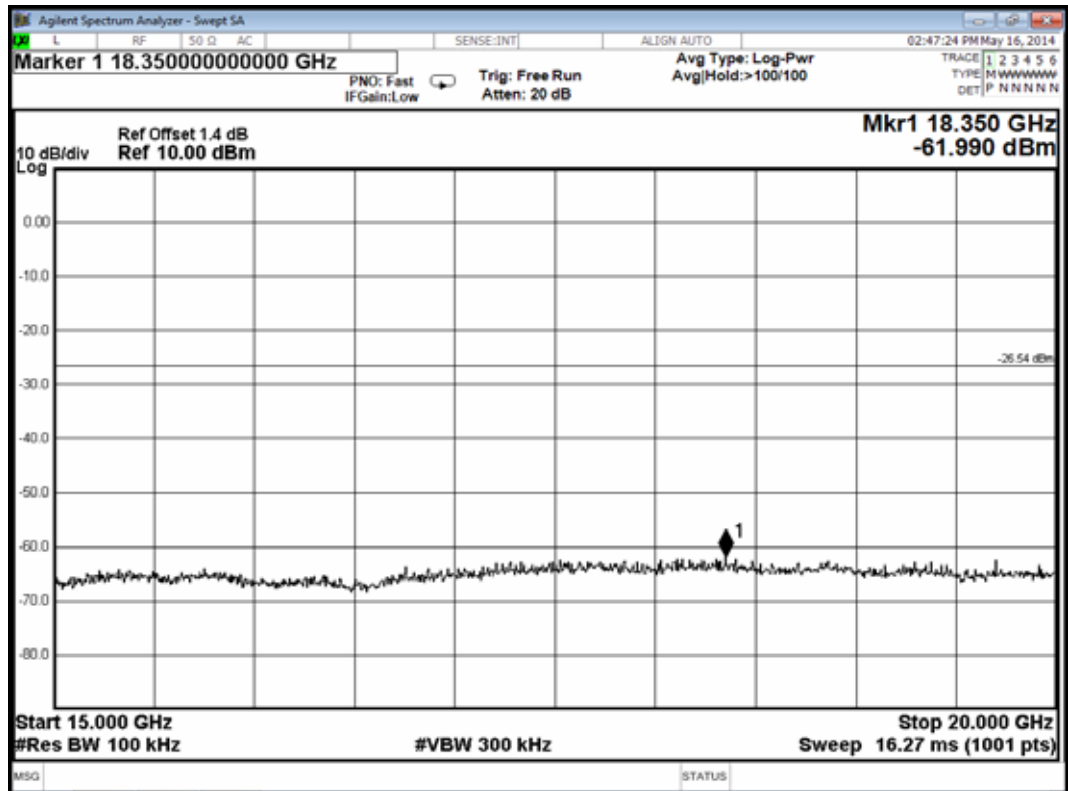




Test Frequency: CH 26, 2480MHz







8. BAND EDGES MEASUREMENT

8.1. Test Equipment

The following test equipment was used during the band edges measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Due Date
1.	Spectrum Analyzer	Agilent	N9030A-544	US51350140	2014. 10. 29

8.2. Block Diagram of Test Setup

The same as section.5.2.

8.3. Specification Limits [§15.247(c)]

8.3.1. In any 100kHz 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 20dB below that in the 100kHz 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 emissions which fall in 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)).(※This test result attaching to §4.6.3)

8.3.2. The reference level for determining limit of emission limitations is according to the value measured indicated in plots at section 9.6.

8.4. Operating Condition of EUT

The Notebook PC was using test program “ember.desktop” to enable the EUT to transmit data at different channel frequency individually.

8.5. Test Procedure

The transmitter output was connected to the spectrum analyzer. Set both RBW=100 kHz and VBW to 300kHz with suitable frequency span including 100kHz bandwidth from band edge.

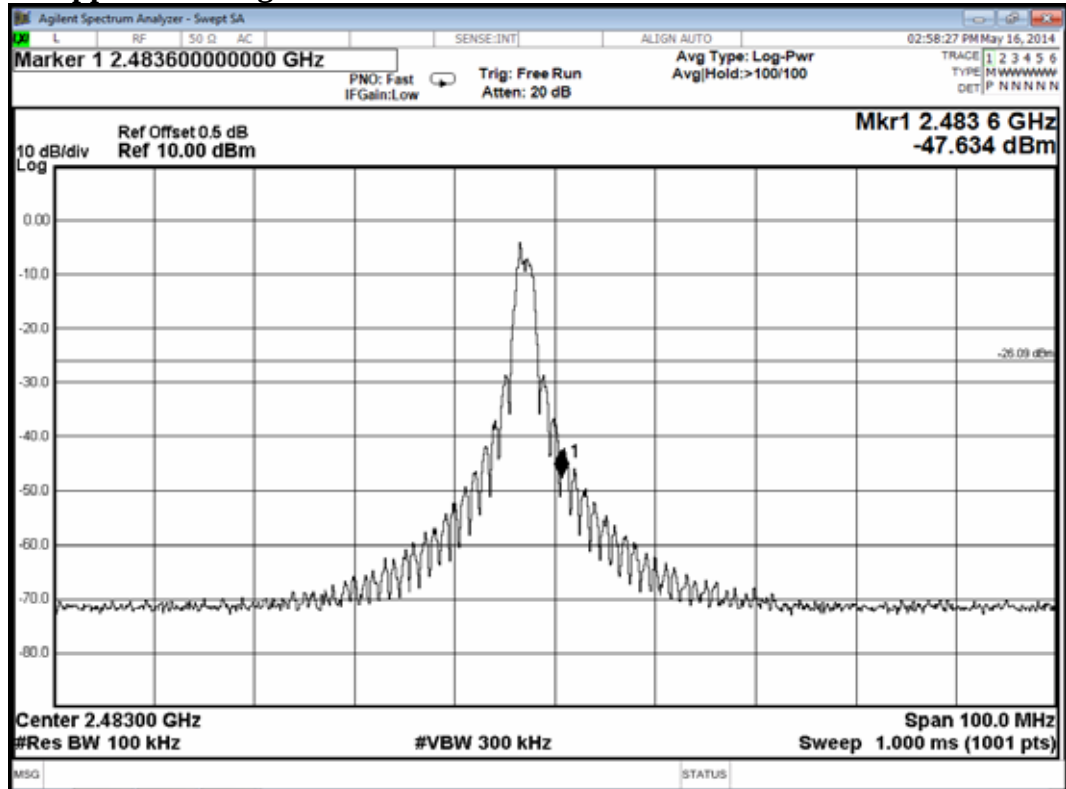
The measurement guideline was according to KDB 558074 D01 DTS Meas Guidance is v03r01.

8.6. Test Results

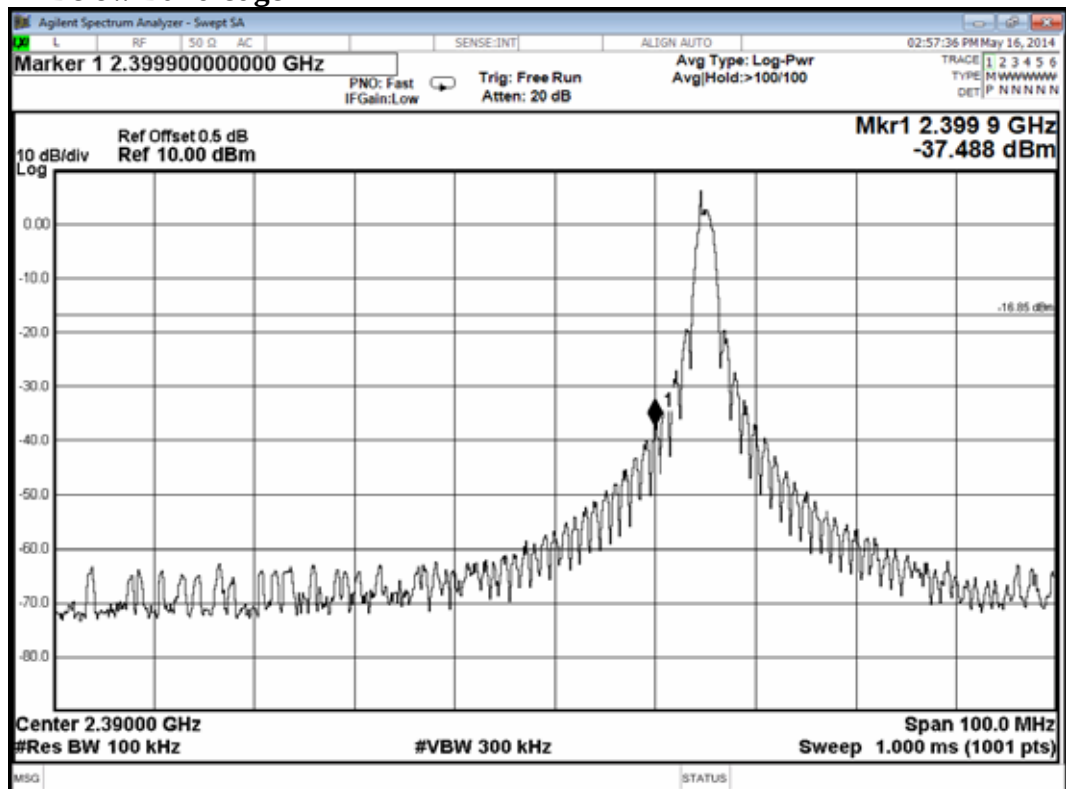
PASSED. All the test results are attached in next pages.

Test Date: 2014. 05. 16 Temperature: 25°C Humidity: 42%

Upper Band edge



Below Band edge



9. POWER SPECTRAL DENSITY MEASUREMENT

9.1. Test Equipment

The following test equipment was used during the power spectral density measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Due Date
1.	Spectrum Analyzer	Agilent	N9030A-544	US51350140	2014. 10. 29

9.2. Block Diagram of Test Setup

The same as section.5.2.

9.3. Specification Limits [§15.247(d)]

The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band.

9.4. Operating Condition of EUT

The Notebook PC was using test program “ember.desktop” to enable the EUT to transmit data at different channel frequency individually.

9.5. Test Procedure

The transmitter output was connected to the spectrum analyzer. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using 100kHz RBW and ≥ 300 kHz VBW, set sweep time = Auto.

The measurement guideline was according to KDB 558074 D01 DTS Meas Guidance is v03r01.

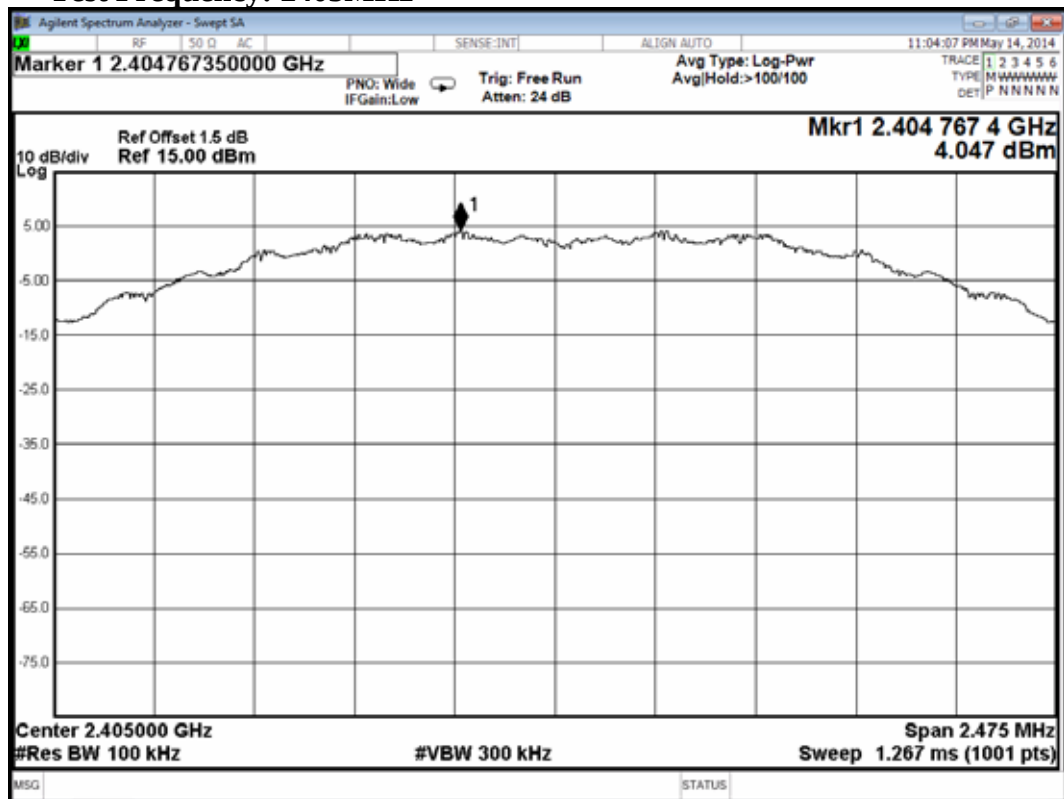
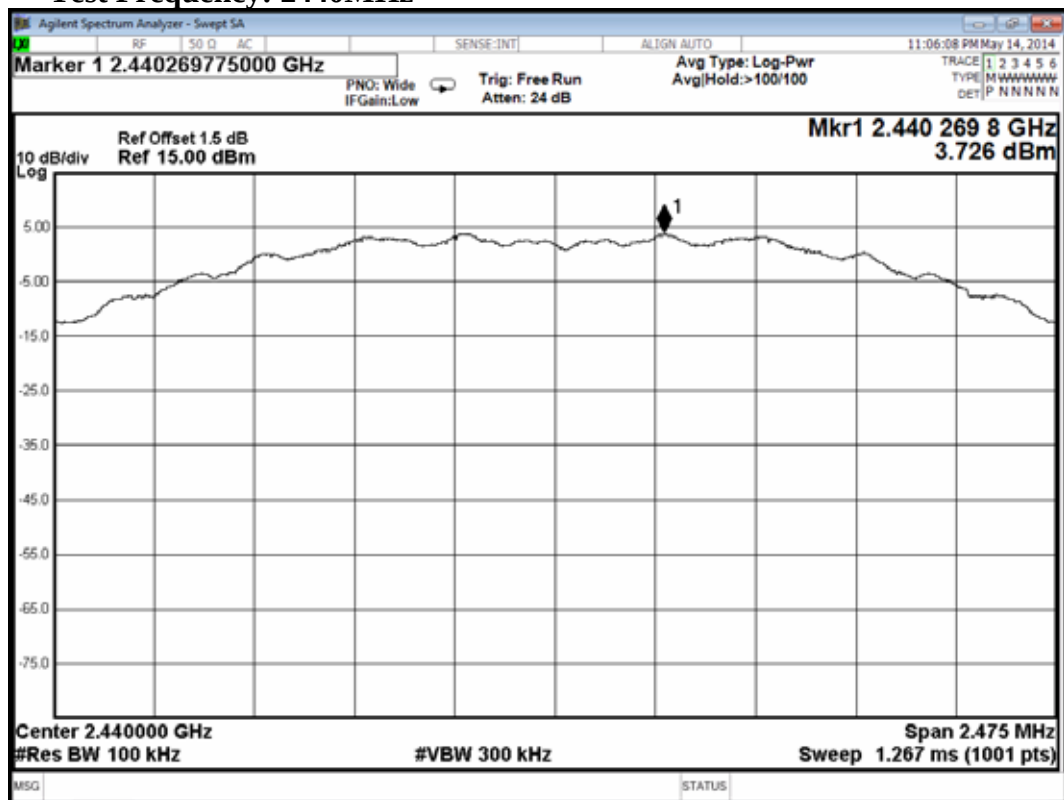
9.6. Test Results

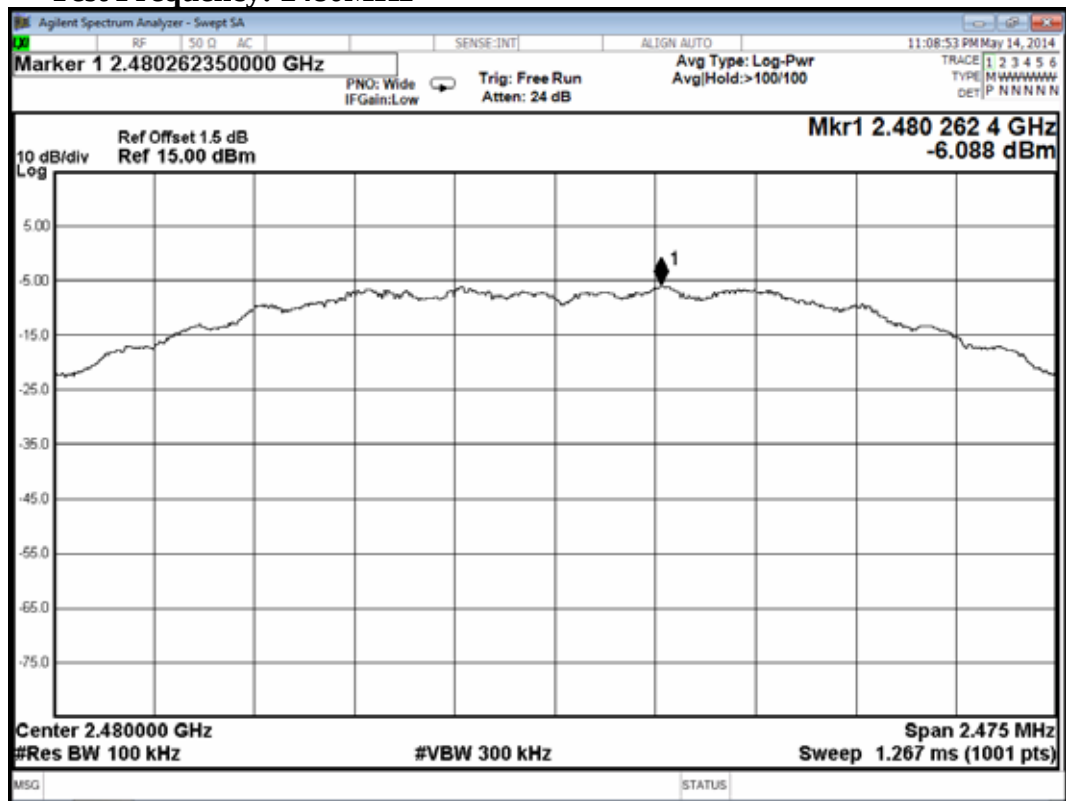
PASSED. All the test results are attached in next pages.

Test Date: 2014. 05. 14 Temperature: 24°C Humidity: 43%

Mode	Channel	Test Frequency	Power Spectral Density
1	CH 11	2405MHz	4.047 dBm
2	CH 18	2440MHz	3.726 dBm
3	CH 26	2480MHz	-6.088 dBm

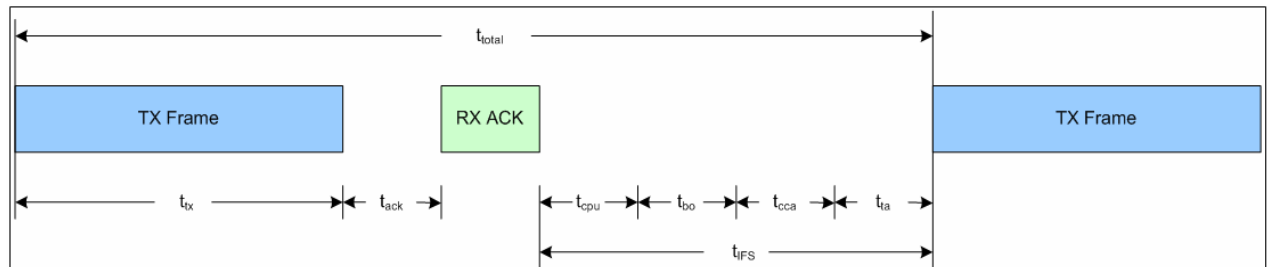
[Limit: 8dBm]

Test Frequency: 2405MHz**Test Frequency: 2440MHz**

Test Frequency: 2480MHz

10.DUTY CYCLE CORRECTION FACTOR

IEEE 802.15.4-2003 MAC Constants		
maxBE	5	IEEE 802.15.4 specifies 5, ZigBee specifies 8
a Max Frame Response Time	1220	symbols
a Max Frame Retries	3	
a Unit Back off Period	20	symbols
mac Ack Wait Duration	54	symbols
mac Batt Life Ext Periods	6	Backoff periods
mac Max CSMA Back offs	4	
mac Min BE	3	IEEE 802.15.4 specifies 3, ZigBee specifies 5
a Min LIFS Period	40	symbols
a Min SIFS Period	12	symbols
a Min CAP Length	440	symbols
NB	0	
CW	2	
BE	3	



MAC-Level Calculation (SIFS)

Short Frame Scenario:	
1) TX Frame	Assume Frame is Data Frame
2) Wait for ACK	
3) RX ACK	
4) CPU Processing of ACK	
5) Wait for Back off	
6) Repeat 1)	

MAC-Level Calculation (SIFS)

Short Frame Scenario:		
1) TX Frame	Assume Frame is Data Frame	Assume Frame is Data Frame
2) Wait for ACK		
3) RX ACK		
4) CPU Processing of ACK		
5) Wait for Back off		
6) Repeat 1)		

Short Inter Frame Spacing (Slotted w/ ACK)

Short Frame	18	bytes
Data Frame Payload	18	bytes
ACK Frame	5	bytes
tack	12	sym
SIFS	12	sym
Back off Period	20	sym
Maximum Back off	7	
Back off Required	2	
Back off Time	70	sym

Transmit Time

TX Time (Packet)	0.000768	
Total TX Time (sec)	0.000768	

NOT Transmit time (RX or Idle)

Wait for ACK (tack)	0.000192	
RX Time (ACK)	0.000352	
Back off Time (tbo)	0.00112	(Backoff Time * Backoff Period)
CPU Processing (tcpu)	0.0002	(0.2ms average on EM2xx running EmberZNet)
CCA Assessment (tcca)	0.000128	(averaged over 8 symbols in RX Mode)
Turn Around Time (RX to TX)	0.000192	(After CCA, Radio turns over to TX in 12 symbols)
Total Off Time (sec)	0.002184	

Total Time (ttotal)	0.002952
Number of periods in 100ms Window	33.87533875
Worse Case (100ms window)	
TX Frame 15 times	0.01152
RX or IDLE 15 Times	0.03276
Sum	0.04428

Duty Cycle correction= $20 \cdot \log[0.01152/(0.01152+0.03276)] = -11.34\text{dB}$

11.DEVIATION TO TEST SPECIFICATIONS

【NONE】