

FCC 15.247 & RSS-247
2.4 GHz Report

for

LG Electronics Inc.

1, Gwanak-ro, Gwanak-gu, Seoul, 151-919,
Rep. of Korea

Brand : LG
Product Name : Wireless Comm.
Module
Model Name : AAX74688002
FCC ID : BEJAAX74688002
IC : 2703H-AAX74688002

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TEST REPORT CERTIFICATION

Applicant : LG Electronics Inc.
Manufacture : LG Electronics Inc.
Factory : Wisol Co., Ltd.
Product Name : Wireless Comm. Module
Model No. : AAX74688002
Serial No. : N/A
Brand : LG
Power Supply : DC 3.3V

Applicable Standards:

FCC Rules and Regulations Part 15 Subpart C, Oct. 2014
RSS-Gen (Issue 4), November 2014
RSS-247 (Issue 1), May 2015
ANSI C63.10:2013
KDB 558074 D01 DTS Meas Guidance v03r03

AUDIX Technology Corp. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report. **AUDIX Technology Corp.** does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens and samples.

Date of Test: 2015. 08. 05 ~ 12

Date of Report: 2015. 08. 12

Producer: Annie Yu
(Annie Yu/Administrator)

Signatory: Ben Cheng
(Ben Cheng/Manager)

1. REPORT HISTORY

Revision	Date	Revision Summary	Report Number
0	2015. 08. 12	Original Report.	EM-F150466

2. SUMMARY OF TEST RESULTS

Rule		Description	Results
FCC	IC		
15.207	RSS-Gen §8.8	Conducted Emission	PASS
15.247(d)/ 15.205	RSS-Gen §8.9 RSS-247 §5.5	Radiated Band Edge and Radiated Spurious Emission	PASS
15.247(a)	RSS-247 §5.2(1)	6dB Bandwidth	PASS
15.247(b)	RSS-247 §5.4(4)	Maximum Peak Output	PASS
15.247(d)	RSS-247 §5.5	Conducted Band Edges and Conducted Spurious Emission	PASS
15.247 (e)	RSS-247 §5.2(2)	Power Spectral Density	PASS
15.203	---	Antenna Requirement	PASS

3. GENERAL INFORMATION

3.1. Description of EUT

Product	Wireless Comm. Module
Model Number	AAX74688002
Serial Number	N/A
Brand Name	LG
Applicant	LG Electronics Inc. 1, Gwanak-ro, Gwanak-gu, Seoul, 151-919, Rep. of Korea
Manufacture	LG Electronics Inc. 1, Gwanak-ro, Gwanak-gu, Seoul, 151-919, Rep. of Korea
Factory	Wisol Co., Ltd. 531-7 Gajang-ro, Osan-si, Gyeonggi-do, Korea
RF Features	ZigBee (IEEE 802.15.4)
Transmit Type	1T1R
Device Category	☐ Outdoor Access Point ☐ Fixed point-to-point Access Point ☐ Indoor Access Point ☒ Mobile and Portable client device
Date of Receipt of Sample	2015. 08. 03

3.2. EUT Specifications Assessed in Current Report

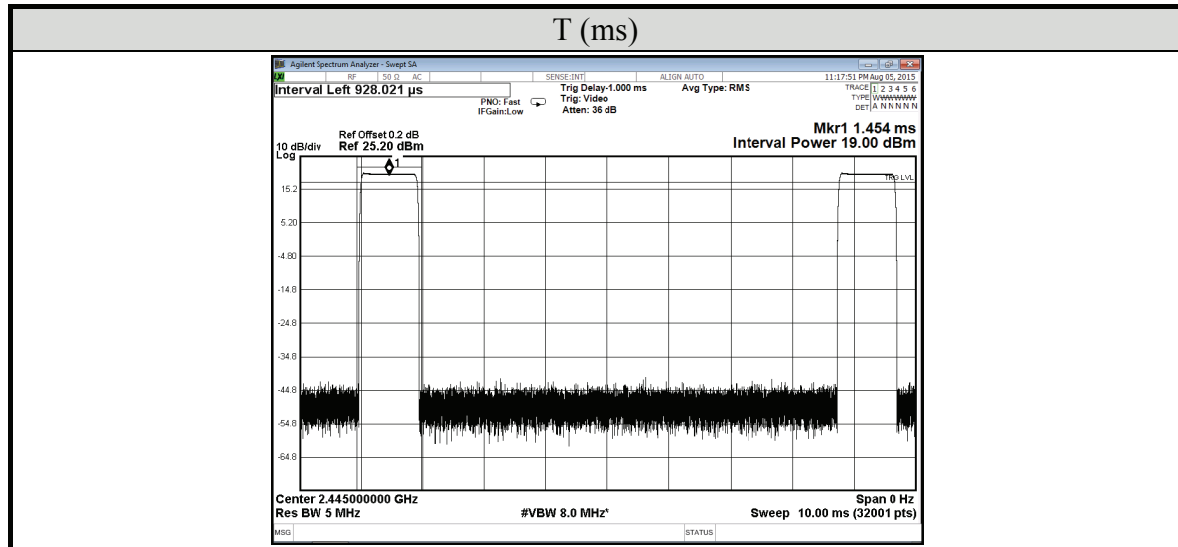
RF Features	Fundamental Range (MHz)	Channel Number	Modulation	Data Rate (Mbps)
ZigBee (IEEE 802.15.4)	2405-2480	16	DSSS (O-QPSK)	0.25

Channel List			
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
11	2405	19	2445
12	2410	20	2450
13	2415	21	2455
14	2420	22	2460
15	2425	23	2465
16	2430	24	2470
17	2435	25	2475
18	2440	26	2480

3.3. Antenna Information

Antenna Part Number	Manufacture	Antenna Type	Frequency	Max Gain (dBi)
ZGM400A-ANT01	WISOL	Monopole Antenna	2400~2483.5MHz	4.4

3.4. Test Configuration



Item		Test Channel
Radiated Test Case	Radiated Band Edge ^{Note1}	11/19/25/26
	Radiated Spurious Emission (30MHz-1GHz) ^{Note1}	11/18/19/25/26
	Radiated Spurious Emission (Above 1GHz) ^{Note1}	11/18/19/25/26
Conducted Test Case	6dB Bandwidth	11/18/19/25/26
	Peak Power Spectral Density	11/18/19/25/26
	Peak Output Power	11/18/19/25/26
	Band Edge	11/25/26
	Spurious Emission	11/18/19/25/26

Note 1:

☐ Mobile Device

☒ Portable Device, and 3 axis were assessed. The worst scenario for Radiated Spurious Emission as follow:

☒ Lie

☐ Side

☐ Stand

3.5. Tested Supporting System List

3.5.1. Support Peripheral Unit

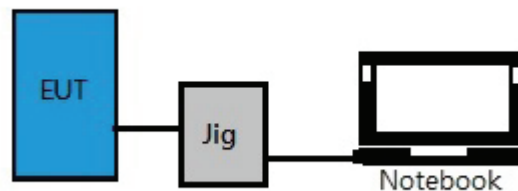
No.	Product	Brand	Model No.	Serial No.	FCC ID
1.	Notebook PC	ASUS	ASUS N20A	N/A	TLZ-BT253
2.	Test Jig	N/A	N/A	N/A	N/A

3.5.2. Cable Lists

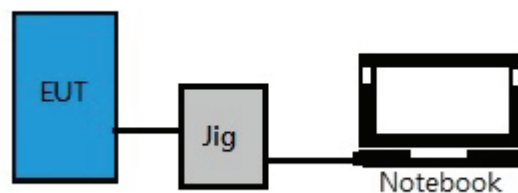
No.	Cable Description Of The Above Support Units
1.	Adapter: ACBEL, M/N AA90PM111, DC Cord: Shielded, Undetachable, 1.8m, Bonded a ferrite core AC Power Cord: Unshielded, Detachable, 1.8m
2.	USB Cable: Unshielded, Detachable, 0.6m

3.6. Setup Configuration

3.6.1. EUT Configuration for Radiated Emission



3.6.2. EUT Configuration for Conducted Test Items



3.7. Operating Condition of EUT

Test program “Tera Term” is used for enabling EUT RF function under continues transmitting and choosing channel.

3.8. Description of Test Facility

Test Firm Name	:	AUDIX Technology Corporation EMC Department No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan
Test Location & Facility	:	No. 8 Shielded Room No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan Semi-Anechoic Chamber No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan May 06, 2015 File on Federal Communication Commission Registration Number: 90993
NVLAP Lab. Code	:	200077-0
TAF Accreditation No	:	1724

3.9. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty
Conduction Test	150kHz~30MHz	±3.5dB
Radiation Test (Distance: 3m)	30MHz~300MHz	± 3.64dB
	300MHz~1000MHz	± 4.70dB
	Above 1GHz	± 2.94dB

Remark : Uncertainty = $k_{uc}(y)$

Test Item	Uncertainty
6dB Bandwidth	± 0.05kHz
Maximum peak output power	± 0.33dB
Power spectral density	± 0.13dB
Conducted Emission Limitations	± 0.13dB

4. MEASUREMENT EQUIPMENT LIST

4.1. Conducted Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Test Receiver	R&S	ESR3	101774	2015. 02. 06	1 Year
2.	A.M.N.	R&S	ENV4200	100169	2015. 05. 08	1 Year
3.	L.I.S.N.	Kyoritsu	KNW-407	8-855-9	2014. 12. 26	1 Year
4.	Pulse Limiter	R&S	ESH3-Z2	100354	2015. 01. 17	1 Year

4.2. Radiated Emission Measurement

4.2.1. Frequency Range 30MHz~1000MHz

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-503	MY52220119	2014. 12. 23	1 Year
2.	Test Receiver	R & S	ESCS30	100338	2015. 06. 24	1 Year
3.	Amplifier	HP	8447D	2944A06305	2015. 02. 12	1 Year
4.	Bilog Antenna	TESEQ	CBL6112D	33821	2015. 02. 27	1 Year

4.2.2. Frequency Range Above 1GHz

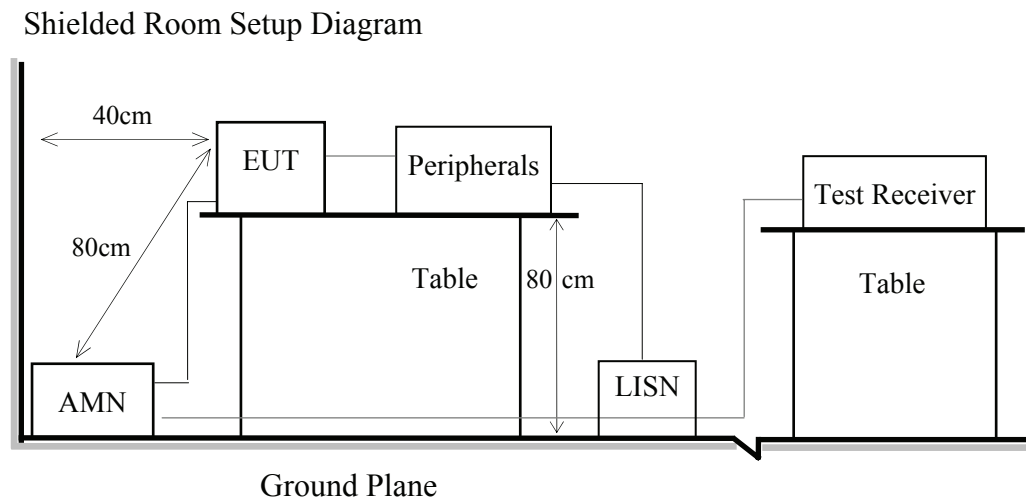
Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-503	MY52220119	2014. 12. 23	1 Year
2.	Test Receiver	R & S	ESCS30	100338	2015. 06. 24	1 Year
3.	Amplifier	Agilent	8449B	3008A02676	2015. 02. 11	1 Year
4.	2.4GHz Notch Filter	K&L	7NSL10-244 1.5E130.5-0 0	1	2015. 07. 22	1 Year
5.	3G High Pass Filter	Microwave Circuits	H3G018G1	484796	2014. 08. 25	1 Year
6.	Horn Antenna	EMCO	3115	9609-4927	2015. 06. 22	1 Year
7.	Horn Antenna	EMCO	3116	2653	2014. 10. 14	1 Year

4.3. RF Conducted Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9030A-526	MY53310269	2014. 11. 08	1 Year

5. CONDUCTED EMISSION MEASUREMENT

5.1. Block Diagram of Test Setup



5.2. Power Line Conducted Emission Limit

Frequency	Conducted Limit	
	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 measurement using the average detector is not required.

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

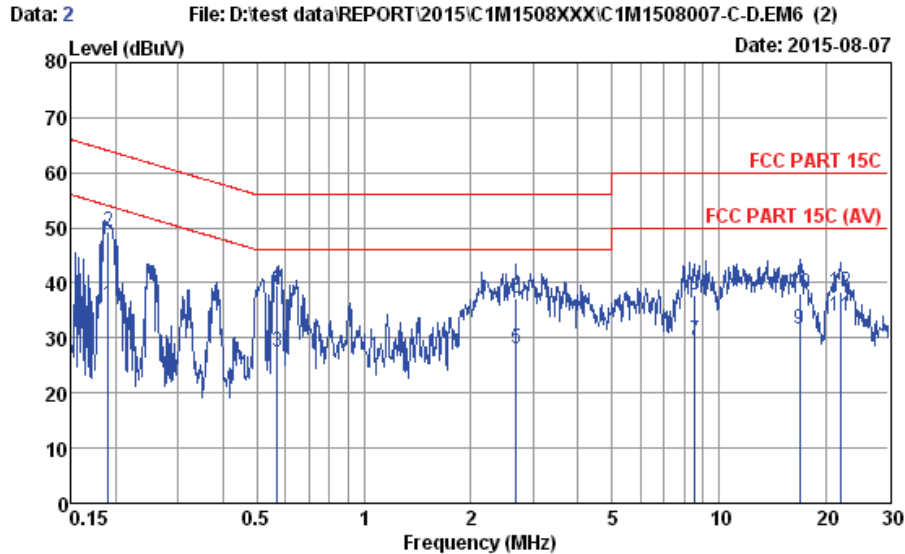
5.3. Test Procedure

- 5.3.1. To set up the EUT as indicated in ANSI C 63.10. The EUT was placed on the table which has 80 cm height to the ground and 40 cm distance to the conducting wall.
- 5.3.2. Power supplier of the EUT was connected to the AC mains through an Artificial Mains Network (A.M.N.).
- 5.3.3. The AC power supplies to all peripheral devices must be provided through line impedance stabilization network (L.I.S.N.)
- 5.3.4. Checking frequency range from 150 kHz to 30 MHz and record the emission which does not have 20 dB below limit.

5.4. Conducted Emission Measurement Results

PASSED.

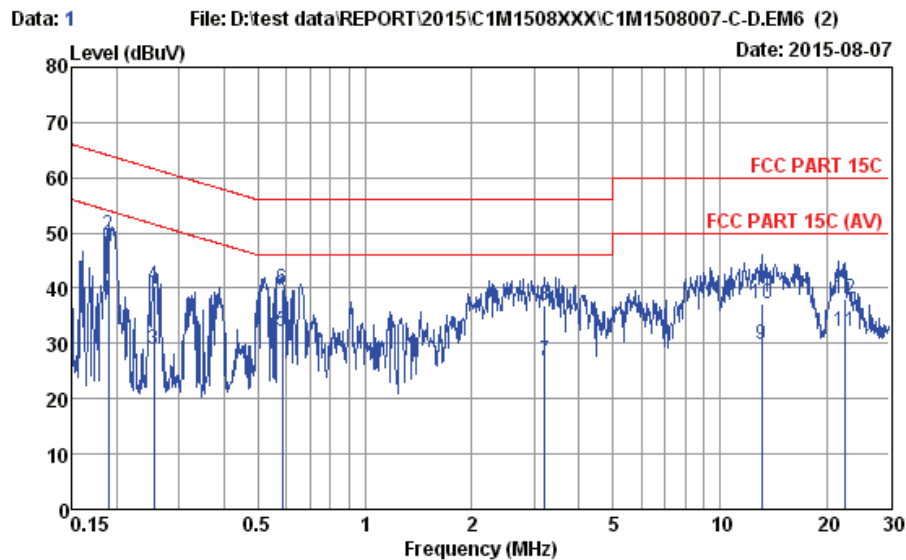
Test Date	2015/08/07	Temp./Hum.	26°C/57%
Test Voltage	DC 3.3V (Via test jig powered by USB)		



Site no. : No.8 Shielded Room Data no. : 2
Condition : ENV4200 100169 Phase : NEUTRAL
Limit : FCC PART 15C
Env. / Ins. : 26°C / 57% ESR3 (1774) Engineer : Tim
EUT : AAX74688002
Power Rating : DC 3.3V
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	0.190	11.28	0.03	9.87	14.97	36.15	54.02	17.87	Average
2	0.190	11.28	0.03	9.87	28.04	49.22	64.02	14.80	QP
3	0.570	10.98	0.04	9.88	6.45	27.35	46.00	18.65	Average
4	0.570	10.98	0.04	9.88	18.65	39.55	56.00	16.45	QP
5	2.678	11.07	0.10	9.88	7.09	28.14	46.00	17.86	Average
6	2.678	11.07	0.10	9.88	16.13	37.18	56.00	18.82	QP
7	8.546	11.92	0.20	9.90	7.62	29.64	50.00	20.36	Average
8	8.546	11.92	0.20	9.90	15.62	37.64	60.00	22.36	QP
9	16.839	13.69	0.26	9.93	7.59	31.47	50.00	18.53	Average
10	16.839	13.69	0.26	9.93	14.10	37.98	60.00	22.02	QP
11	21.946	14.81	0.28	9.96	8.85	33.90	50.00	16.10	Average
12	21.946	14.81	0.28	9.96	13.18	38.23	60.00	21.77	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.



Site no. : No.8 Shielded Room Data no. : 1
Condition : ENV4200 100169 Phase : LINE
Limit : FCC PART 15C
Env. / Ins. : 26°C / 57% ESR3 (1774) Engineer : Tim
EUT : AAX74688002
Power Rating : DC 3.3V
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	0.189	10.69	0.03	9.87	17.14	37.73	54.06	16.33	Average
2	0.189	10.69	0.03	9.87	28.90	49.49	64.06	14.57	QP
3	0.255	10.63	0.03	9.87	8.45	28.98	51.60	22.62	Average
4	0.255	10.63	0.03	9.87	20.01	40.54	61.60	21.06	QP
5	0.585	10.55	0.04	9.88	11.85	32.32	46.00	13.68	Average
6	0.585	10.55	0.04	9.88	19.25	39.72	56.00	16.28	QP
7	3.207	10.62	0.11	9.88	6.28	26.89	46.00	19.11	Average
8	3.207	10.62	0.11	9.88	16.21	36.82	56.00	19.18	QP
9	13.057	11.94	0.23	9.91	7.81	29.89	50.00	20.11	Average
10	13.057	11.94	0.23	9.91	15.21	37.29	60.00	22.71	QP
11	22.535	13.93	0.28	9.96	8.00	32.17	50.00	17.83	Average
12	22.535	13.93	0.28	9.96	13.91	38.08	60.00	21.92	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.

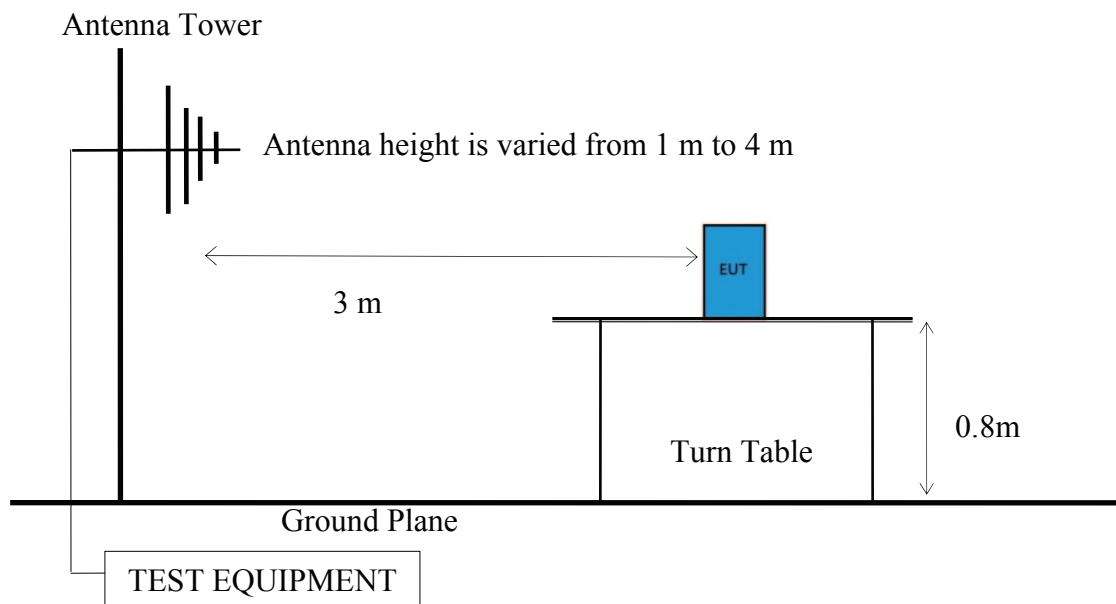
6. RADIATED EMISSION MEASUREMENT

6.1. Block Diagram of Test Setup

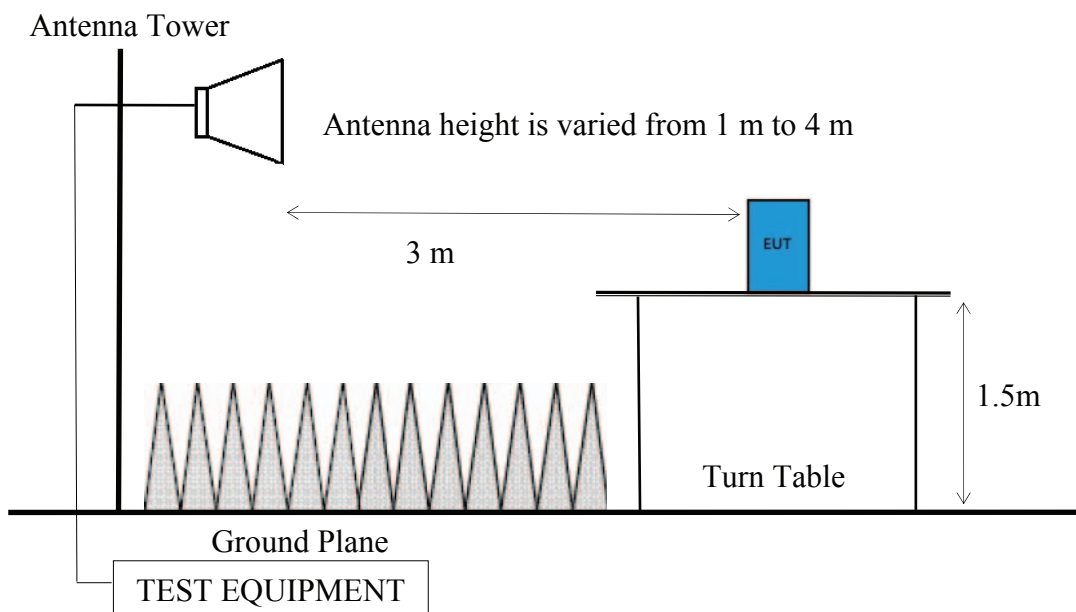
6.1.1. Block Diagram of EUT

Indicated as section 3.6

6.1.2. Setup Diagram for 30-1000 MHz



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



6.2. Radiated Emission Limits

In any 100kHz bandwidth outside the frequency band, the radio frequency power produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205 and RSS-Gen Section 8.10 table 6, must also comply with the radiated emission limits specified as below.

Frequency (MHz)	Distance (m)	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) $\text{dB}\mu\text{V/m} = 20 \log (\mu\text{V/m})$

- (2) The tighter limit applies to 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) Fundamental and emission fall within operation band are exempted from this section.
- (5) Pursuant to ANSI C63.10: 6.6.4.3, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

6.3. Test Procedure

The EUT setup on the turn table which has 1.5m height to the ground. The turn table rotated 360 degrees and antenna varied from 1 m to 4 m to find the maximum emission level. Both horizontal and vertical polarization are required. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013, RSS-Gen and RSS-247 regulation.

Frequency below 1 GHz:

Spectrum Analyzer is used for pre-testing with following setting:

- (1) RBW = 120KHz
- (2) VBW $\geq 3 \times$ RBW.
- (3) Detector = Peak.
- (4) Sweep time = auto.
- (5) Trace mode = max hold.
- (6) Allow sweeps to continue until the trace stabilizes.
- (7) When peak-detected value is lower than limit that the measurement using the Q.P. detector is not required. Otherwise using Q.P. for finally measurement.

Frequency above 1GHz to 10th harmonic:

Peak Detector:

- (1) RBW = 1MHz
- (2) VBW $\geq 3 \times$ RBW.
- (3) Detector = Peak.
- (4) Sweep time = auto.
- (5) Trace mode = max hold.
- (6) Allow sweeps to continue until the trace stabilizes.
- (7) When peak-detected value is lower than limit that the measurement using the average detector is not required. Otherwise using average detector for finally measurement.

Average Measurement:

☒ **Option 1:**

- (1) RBW = 1 MHz
- (2) VBW = $1/T$, where T is Tx-on presented in section 3.4.
- (3) Detector = Peak.
- (4) Sweep time = auto.
- (5) Trace mode = max hold.
- (6) Allow sweeps to continue until the trace stabilizes.

☐ **Option 2:**

Average Emission Level = Peak Emission Level + D.C.C.F.

6.4. Measurement Result Explanation

☒ Peak Emission Level = Antenna Factor + Cable Loss + Meter Reading

☒ Average Emission Level = Antenna Factor + Cable Loss + Meter Reading

☐ Average Emission Level = Peak Emission Level + DCCF

Duty Cycle Correction Factor (DCCF) = $20\log(TX_{on}/TX_{on+off})$ presented in section 3.4

☐ EPR = Peak Emission Level - 95.2dB - 2.14dBi

6.5. Test Results

PASSED.

Test Date	2015/08/07 ~ 2015/08/12	Temp./Hum.	23°C/41%
Test Voltage	DC 3.3V (Via test jig powered by USB)		

6.5.1. Emissions within Restricted Frequency Bands

6.5.1.1. Frequency Below 1 GHz

Mode	ZigBee	Frequency	TX 2405MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
144.46	10.93	3.56	25.49	39.98	43.50	3.52	Peak
288.02	12.96	4.58	22.59	40.13	46.00	5.87	Peak
384.05	15.20	5.51	17.80	38.51	46.00	7.49	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
30.97	18.07	2.34	15.26	35.67	40.00	4.33	Peak
95.96	10.23	3.19	23.66	37.08	43.50	6.42	Peak
398.60	15.53	5.65	17.10	38.28	46.00	7.72	Peak

Mode	ZigBee	Frequency	TX 2440MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
144.46	10.93	3.56	23.19	37.68	43.50	5.82	Peak
239.52	11.76	4.26	23.02	39.04	46.00	6.96	Peak
384.05	15.20	5.51	18.05	38.76	46.00	7.24	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
30.97	18.07	2.34	14.71	35.12	40.00	4.88	Peak
120.21	12.28	3.37	21.84	37.49	43.50	6.01	Peak
399.57	15.53	5.65	17.11	38.29	46.00	7.71	Peak

Mode	ZigBee	Frequency	TX 2445MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
238.55	11.72	4.25	27.62	43.59	46.00	2.41	Peak
288.02	12.96	4.58	24.45	41.99	46.00	4.01	Peak
900.09	20.58	7.54	10.06	38.18	46.00	7.82	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
47.46	9.56	2.61	24.64	36.81	40.00	3.19	Peak
95.96	10.23	3.19	25.57	38.99	43.50	4.51	Peak
800.18	20.02	7.16	5.89	33.07	46.00	12.93	Peak

Mode	ZigBee	Frequency	TX 2475MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
144.46	10.93	3.56	24.16	38.65	43.50	4.85	Peak
288.02	12.96	4.58	22.98	40.52	46.00	5.48	Peak
384.05	15.20	5.51	17.62	38.33	46.00	7.67	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
30.97	18.07	2.34	14.96	35.37	40.00	4.63	Peak
120.21	12.28	3.37	21.05	36.70	43.50	6.80	Peak
399.57	15.53	5.65	16.78	37.96	46.00	8.04	Peak

Mode	ZigBee	Frequency	TX 2480MHz
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Antenna at Horizontal Polarization

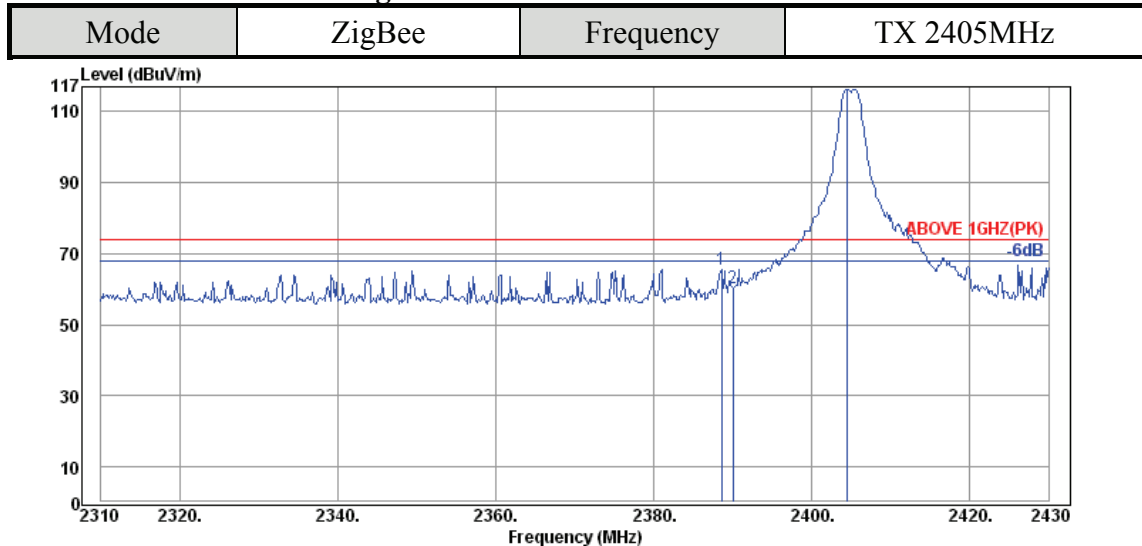
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
120.21	12.28	3.37	22.31	37.96	43.50	5.54	Peak
263.77	12.61	4.43	21.67	38.71	46.00	7.29	Peak
384.05	15.20	5.51	18.51	39.22	46.00	6.78	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
30.97	18.07	2.34	14.41	34.82	40.00	5.18	Peak
95.96	10.23	3.19	24.85	38.27	43.50	5.23	Peak
484.93	16.77	6.34	15.02	38.13	46.00	7.87	Peak

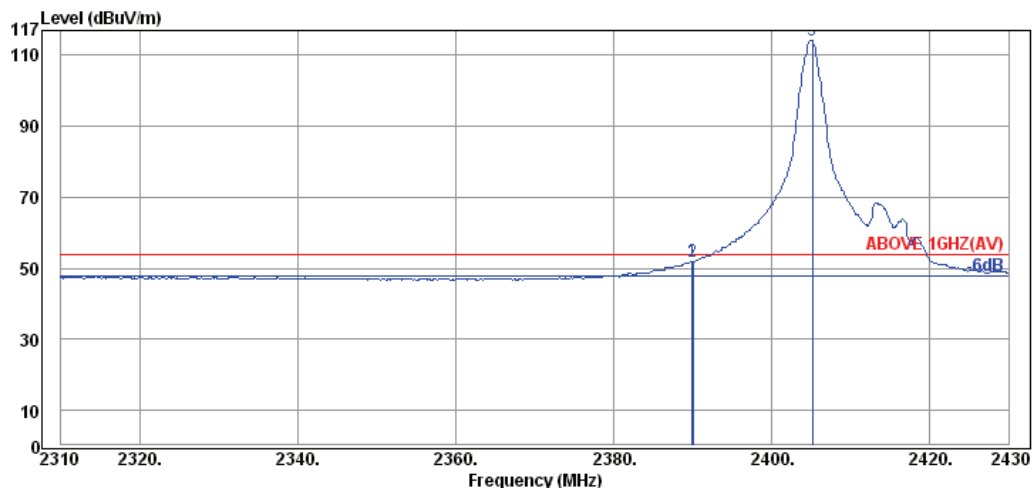
6.5.1.2. Frequency Above 1 GHz to 10th harmonics

Band Edge:



Antenna at Horizontal Polarization

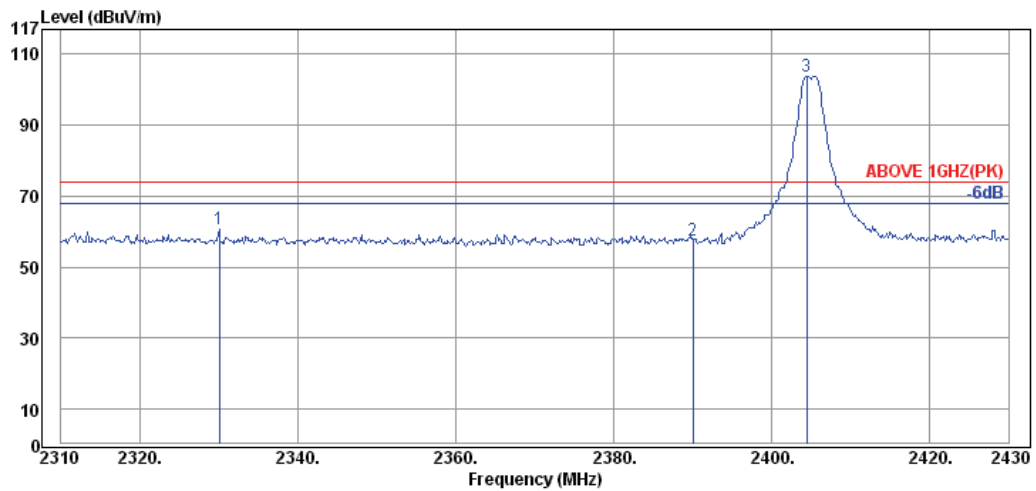
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2388.60	31.68	6.08	27.76	65.52	74.00	8.48	Peak
2390.04	31.68	6.08	22.73	60.49	74.00	13.51	Peak
2404.56	31.70	6.10	78.52	116.32	---	---	Peak



Antenna at Horizontal Polarization

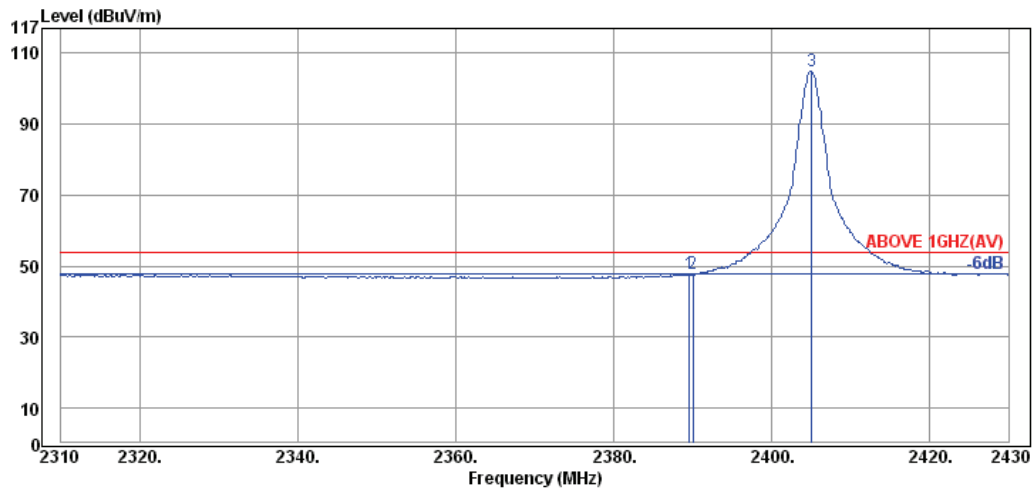
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2389.92	31.68	6.08	14.20	51.96	54.00	2.04	Average
2390.04	31.68	6.08	14.27	52.03	54.00	1.97	Average
2405.16	31.70	6.10	76.42	114.22	---	---	Average

Mode	ZigBee	Frequency	TX 2405MHz
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Antenna at Vertical Polarization

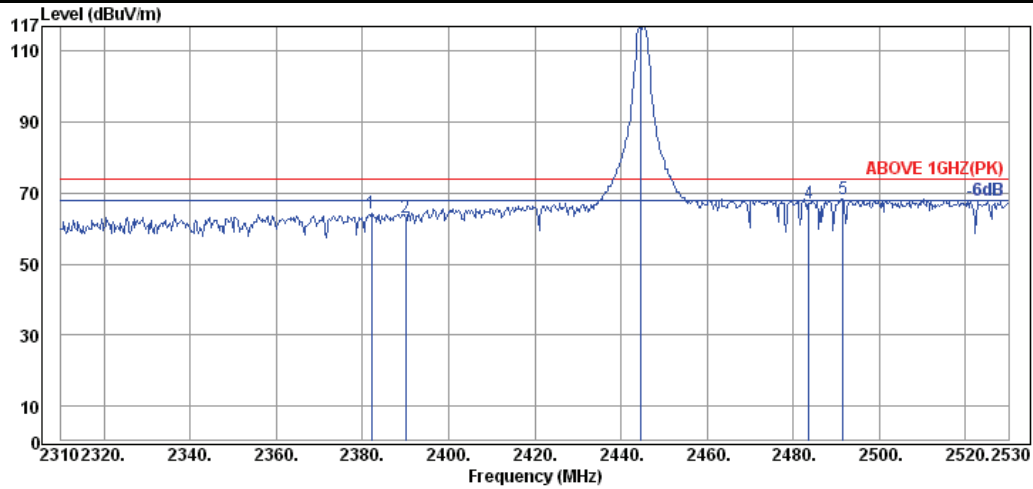
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2330.04	31.61	6.00	23.03	60.64	74.00	13.36	Peak
2390.04	31.68	6.08	19.86	57.62	74.00	16.38	Peak
2404.44	31.70	6.10	66.10	103.90	---	---	Peak



Antenna at Vertical Polarization

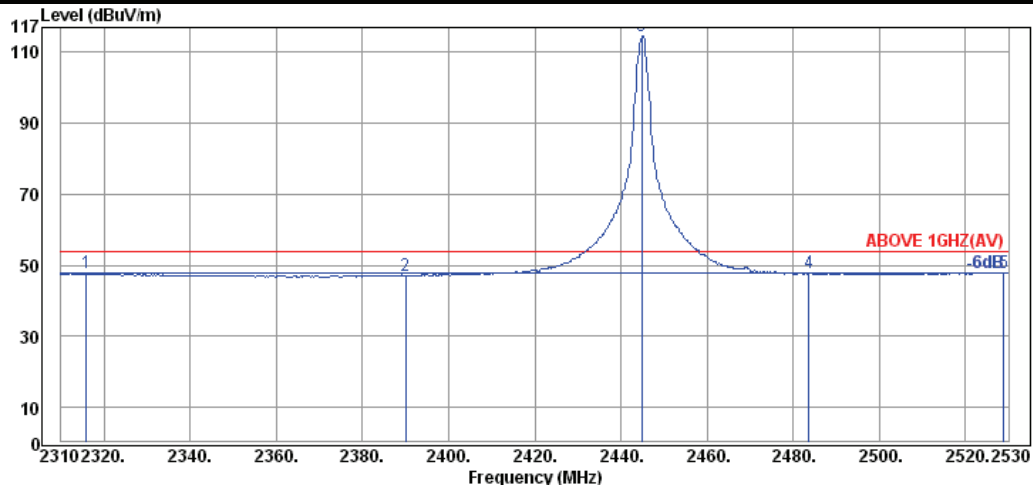
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2389.56	31.68	6.08	9.93	47.69	54.00	6.31	Average
2390.04	31.68	6.08	9.93	47.69	54.00	6.31	Average
2405.04	31.70	6.10	67.32	105.12	---	---	Average

Mode	ZigBee	Frequency	TX 2445MHz
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Antenna at Horizontal Polarization

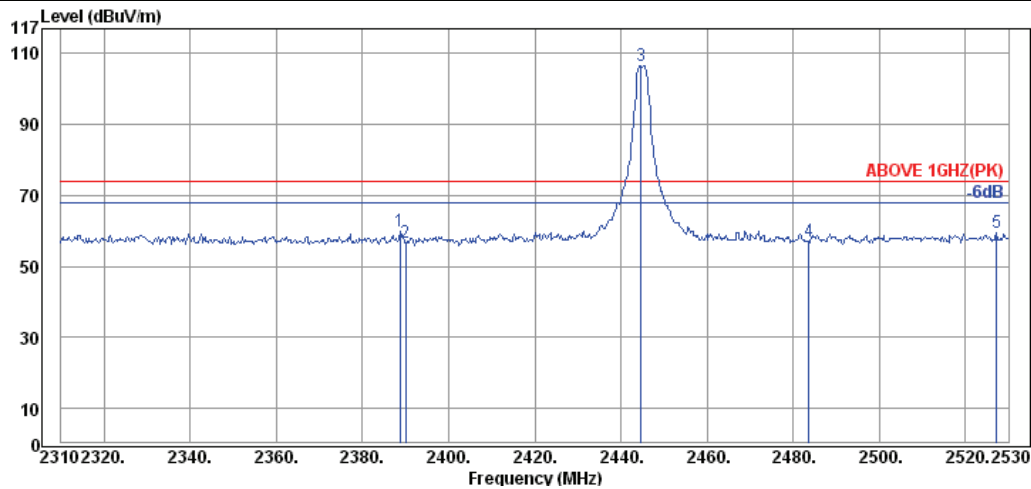
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2382.16	31.67	6.07	26.62	64.36	74.00	9.64	Peak
2390.08	31.68	6.08	25.17	62.93	74.00	11.07	Peak
2444.64	31.74	6.14	79.01	116.89	---	---	Peak
2483.58	31.78	6.19	29.11	67.08	74.00	6.92	Peak
2491.50	31.79	6.20	30.29	68.28	74.00	5.72	Peak



Antenna at Horizontal Polarization

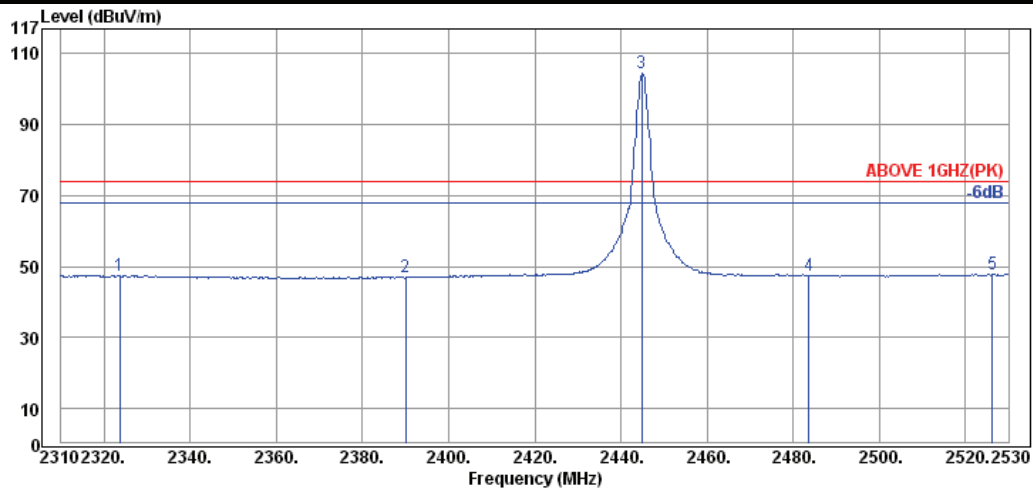
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2315.94	31.60	5.98	10.16	47.74	54.00	6.26	Average
2390.08	31.68	6.08	9.28	47.04	54.00	6.96	Average
2444.86	31.74	6.14	76.71	114.59	---	---	Average
2483.58	31.78	6.19	9.70	47.67	54.00	6.33	Average
2528.90	31.83	6.25	9.81	47.89	54.00	6.11	Average

Mode	ZigBee	Frequency	TX 2445MHz
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Antenna at Vertical Polarization

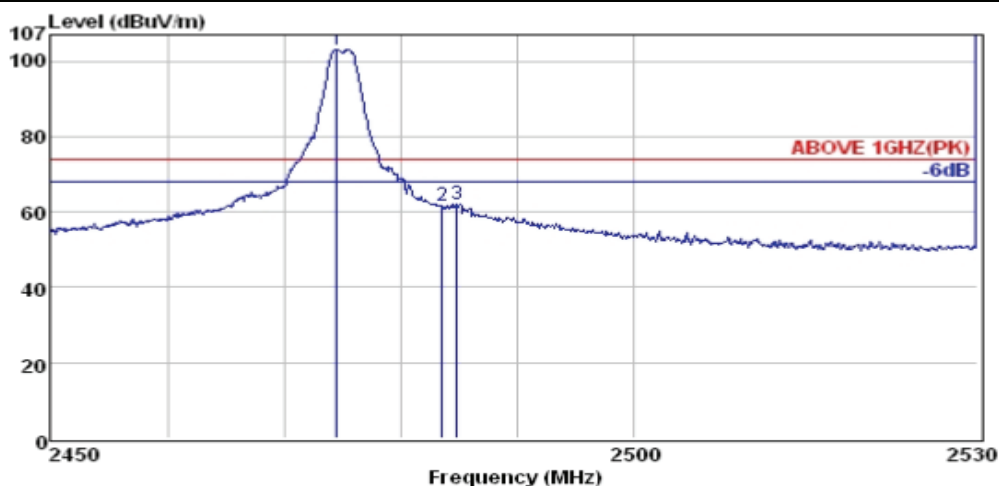
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2388.76	31.68	6.08	22.26	60.02	74.00	13.98	Peak
2390.08	31.68	6.08	19.12	56.88	74.00	17.12	Peak
2444.64	31.74	6.14	68.81	106.69	---	---	Peak
2483.58	31.78	6.19	19.02	56.99	74.00	17.01	Peak
2527.14	31.83	6.25	21.31	59.39	74.00	14.61	Peak



Antenna at Vertical Polarization

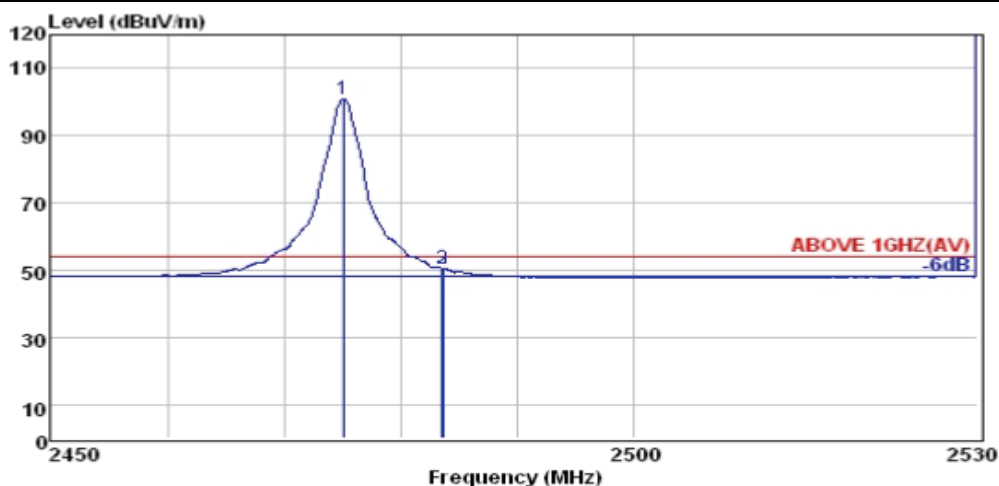
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2323.64	31.61	5.99	9.94	47.54	54.00	6.46	Average
2390.08	31.68	6.08	9.15	46.91	54.00	7.09	Average
2444.86	31.74	6.14	66.57	104.45	---	---	Average
2483.58	31.78	6.19	9.38	47.35	54.00	6.65	Average
2526.26	31.83	6.25	9.82	47.90	54.00	6.10	Average

Mode	ZigBee	Frequency	TX 2475MHz
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Antenna at Horizontal Polarization

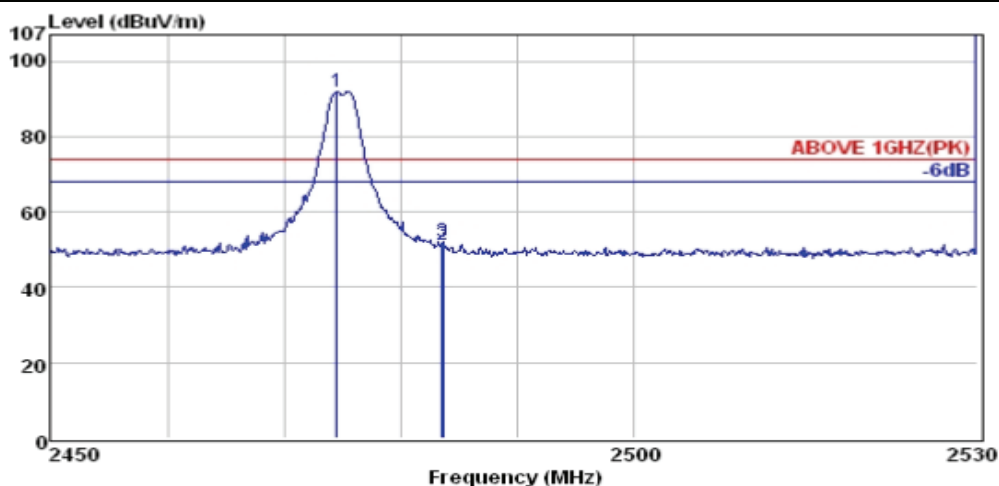
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBUV/m)	Limits (dBUV/m)	Margin (dB)	Detector
2475.44	31.78	6.18	65.03	102.99	---	---	Peak
2483.52	31.78	6.19	22.89	60.86	74.00	13.14	Peak
2484.24	31.78	6.19	22.90	60.87	74.00	13.13	Peak



Antenna at Horizontal Polarization

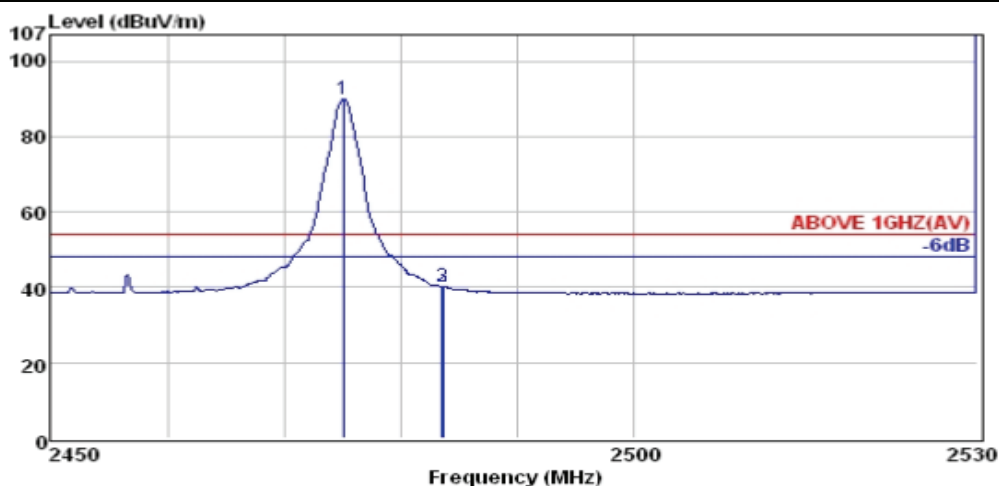
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBUV/m)	Limits (dBUV/m)	Margin (dB)	Detector
2475.04	31.78	6.18	62.73	100.69	---	---	Average
2483.52	31.78	6.19	12.56	50.53	54.00	3.47	Average
2483.60	31.78	6.16	12.59	50.56	54.00	3.44	Average

Mode	ZigBee	Frequency	TX 2475MHz
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Antenna at Vertical Polarization

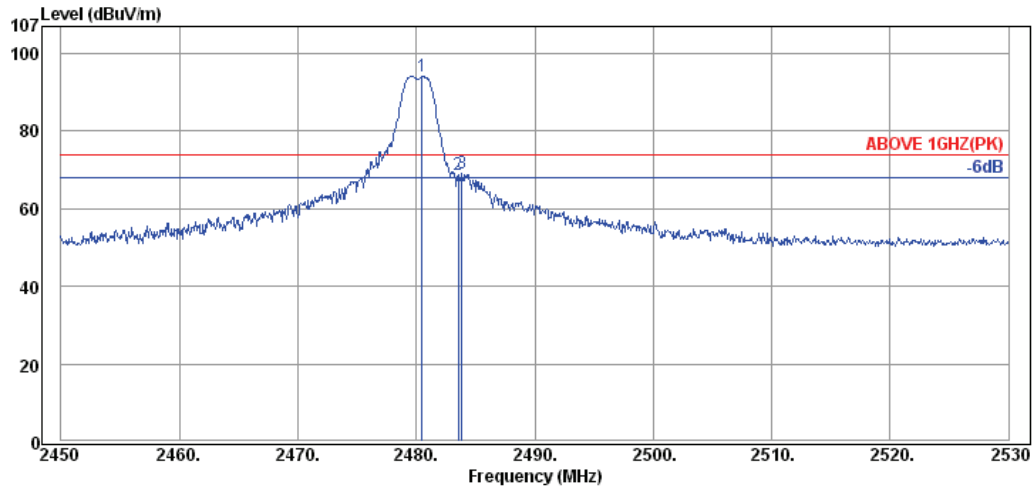
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2475.44	31.78	6.18	63.13	101.09	---	---	Peak
2483.52	31.78	6.19	21.24	59.21	74.00	14.79	Peak
2484.80	31.78	6.19	21.15	59.12	74.00	14.88	Peak



Antenna at Vertical Polarization

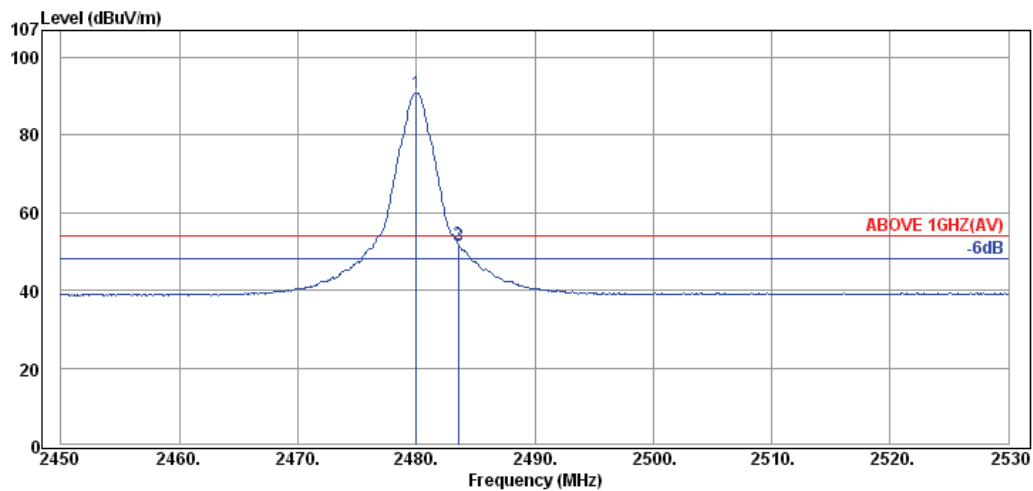
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2475.04	31.78	6.18	60.80	98.76	---	---	Average
2483.52	31.78	6.19	7.61	45.58	54.00	8.42	Average
2483.60	31.78	6.19	7.45	45.42	54.00	8.58	Average

Mode	ZigBee	Frequency	TX 2480MHz
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Antenna at Horizontal Polarization

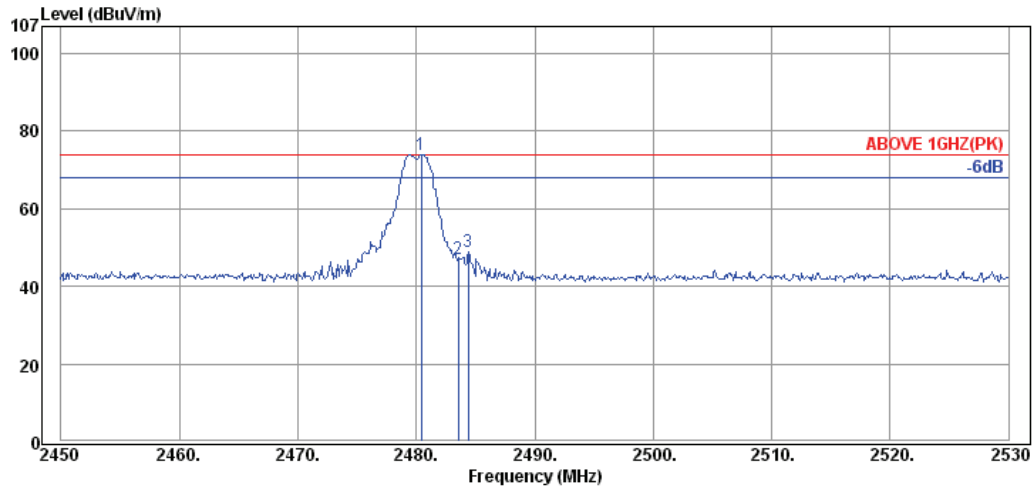
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.48	31.78	6.18	56.18	94.14	---	---	Peak
2483.52	31.78	6.19	30.83	68.80	74.00	5.20	Peak
2483.84	31.78	6.19	31.13	69.10	74.00	4.90	Peak



Antenna at Horizontal Polarization

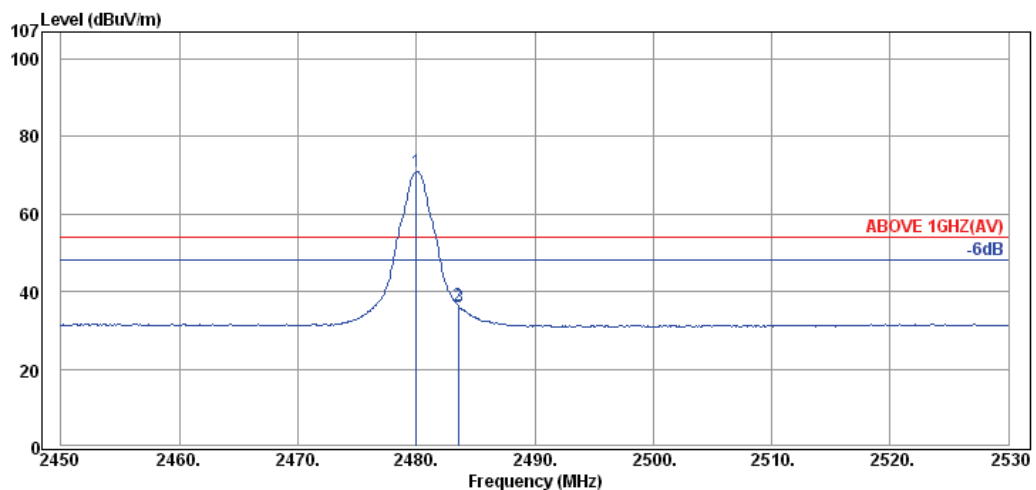
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.00	31.78	6.18	53.03	90.99	---	---	Average
2483.52	31.78	6.19	13.87	51.84	54.00	2.16	Average
2483.60	31.78	6.19	13.54	51.51	54.00	2.49	Average

Mode	ZigBee	Frequency	TX 2480MHz
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Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.40	31.78	6.18	36.06	74.02	---	---	Peak
2483.52	31.78	6.19	9.07	47.04	74.00	26.96	Peak
2484.40	31.78	6.19	10.88	48.85	74.00	25.15	Peak



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.00	31.78	6.18	33.03	70.99	---	---	Average
2483.52	31.78	6.19	-1.62	36.35	54.00	17.65	Average
2483.60	31.78	6.19	-1.95	36.02	54.00	17.98	Average

6.5.2. Emissions outside the frequency band:

The emissions (up to 25GHz) not reported for there is no emission be found.

Mode	ZigBee	Frequency	TX 2405MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4811.50	33.83	8.87	4.70	47.40	54.00	6.60	Peak
9610.50	36.61	12.50	3.11	52.22	54.00	1.78	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4811.50	33.83	8.87	2.52	45.22	54.00	8.78	Peak
9610.50	36.61	12.50	3.74	52.85	54.00	1.15	Peak

Mode	ZigBee	Frequency	TX 2440MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4882.00	33.86	9.14	3.28	46.28	54.00	7.72	Peak
9757.50	36.75	13.48	2.67	52.90	54.00	1.10	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4882.00	33.86	9.14	2.76	45.76	54.00	8.24	Peak
9757.50	36.75	13.48	2.02	52.25	54.00	1.75	Peak

Mode	ZigBee	Frequency	TX 2445MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4891.00	33.86	9.14	3.64	46.64	54.00	7.36	Peak
9778.50	36.78	13.48	2.57	52.83	54.00	1.17	Peak

Antenna at Vertical Polarization

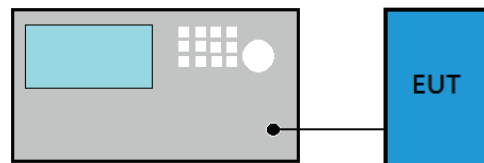
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4891.00	33.86	9.14	4.27	47.27	54.00	6.73	Peak
9778.50	36.78	13.48	3.35	53.61	54.00	0.39	Peak

6.5.3. Emissions in Non-restricted Frequency Bands

Pursuant to KDB 558074 D01 v03r03 that emission levels below the 15.209 RSS-Gen Section 8.9 table 4 general radiated emissions limits is not required.

7. 6dB BANDWIDTH MEASUREMENT

7.1. Block Diagram of Test Setup



7.2. Specification Limits

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

7.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v03r03:

■ Option 2

- (1) Set RBW = 100 kHz.
- (2) Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- (3) Detector = Peak.
- (4) Trace mode = max hold.
- (5) Sweep = auto couple.
- (6) Allow the trace to stabilize.
- (7) Setting channel bandwidth function x dB to -6 dB to record the final bandwidth.

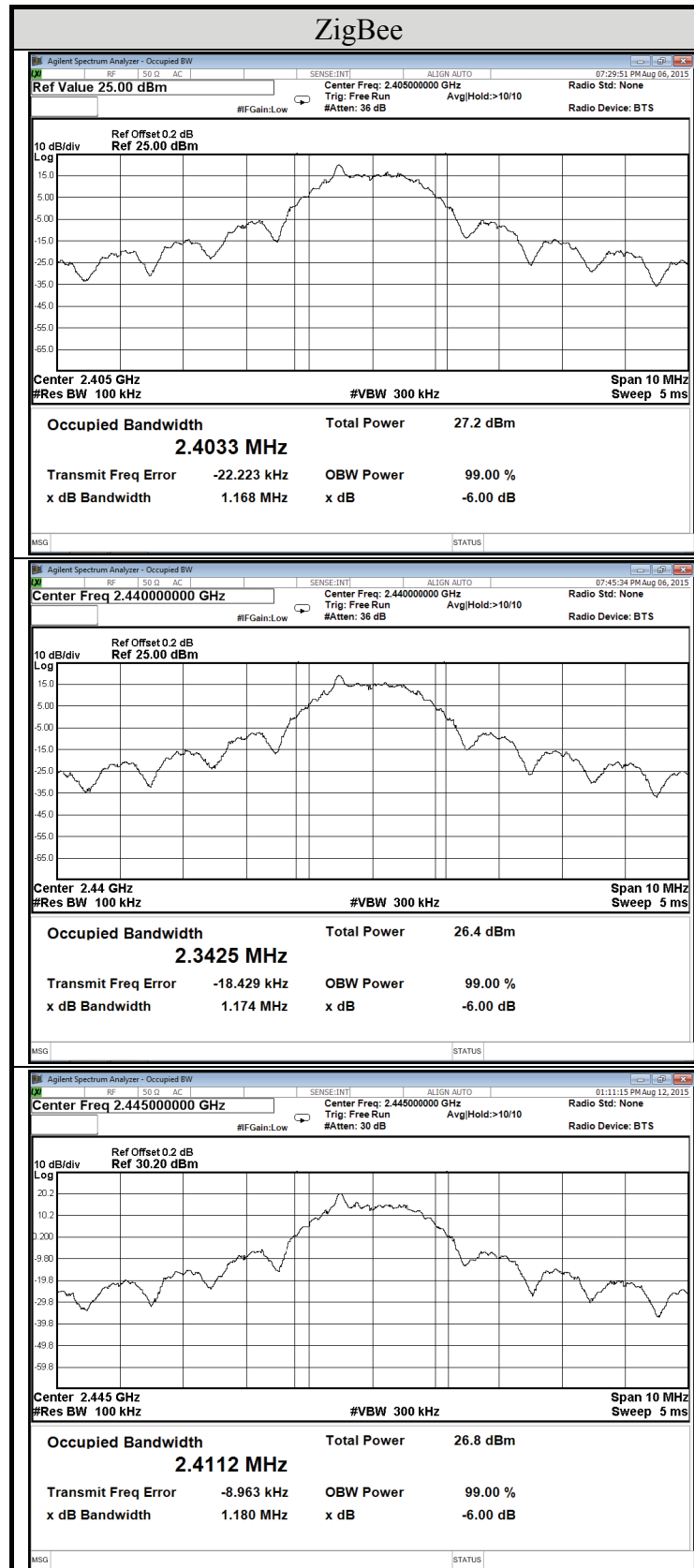
7.4. Test Results

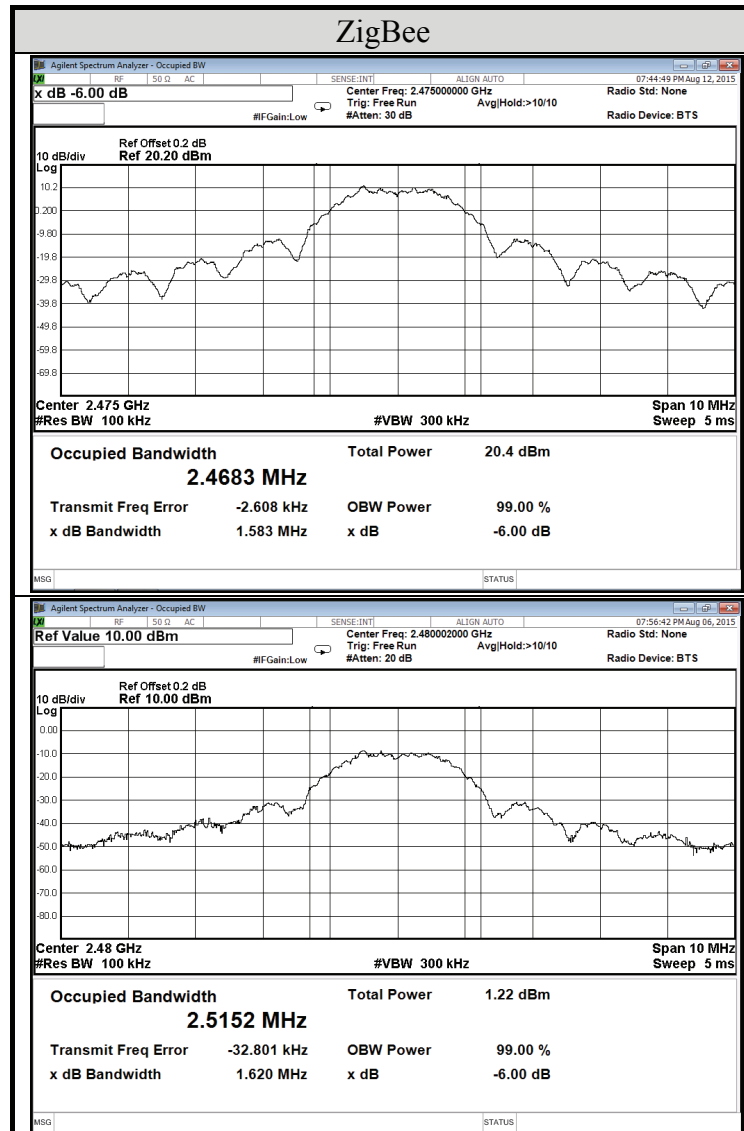
Test Date	2015/08/06~2015/08/12	Temp./Hum.	25°C/40%
Cable Loss	0.2dB	Test Voltage	DC 3.3V (Via test jig powered by USB)

7.4.1. 6dB Bandwidth Result

Modulation Type	Centre Frequency (MHz)	6 dB Bandwidth (MHz)
ZigBee	2405	1.168
	2440	1.174
	2445	1.180
	2475	1.583
	2480	1.620

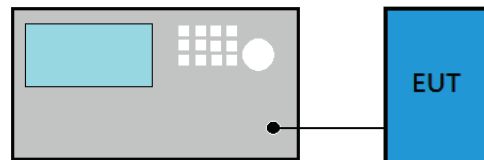
7.4.2. Measurement Plots





8. MAXIMUM PEAK OUTPUT POWER MEASUREMENT

8.1. Block Diagram of Test Setup



8.2. Specification Limits

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

8.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v03r03:

☐ **PKPM1 Peak power meter method:**

EUT is connected to power sensor and record the maximum output power.

☐ **Method AVGPM (Measurement using an RF average power meter):**

EUT is connected to power sensor and record the maximum average output power and duty cycle factor is added when duty cycle presented in section 3.5.1 is < 98%.

☒ **RBW ≥ DTS bandwidth**

- (1) Set span to at least 3 times the OBW
- (2) Set $RBW \geq OBW$
- (3) Set the video bandwidth (VBW) $\geq 3 \times RBW$.
- (4) Detector = Peak
- (5) Trace mode = max hold
- (6) Sweep = auto couple.
- (7) To find the peak amplitude level.

8.4. Test Results

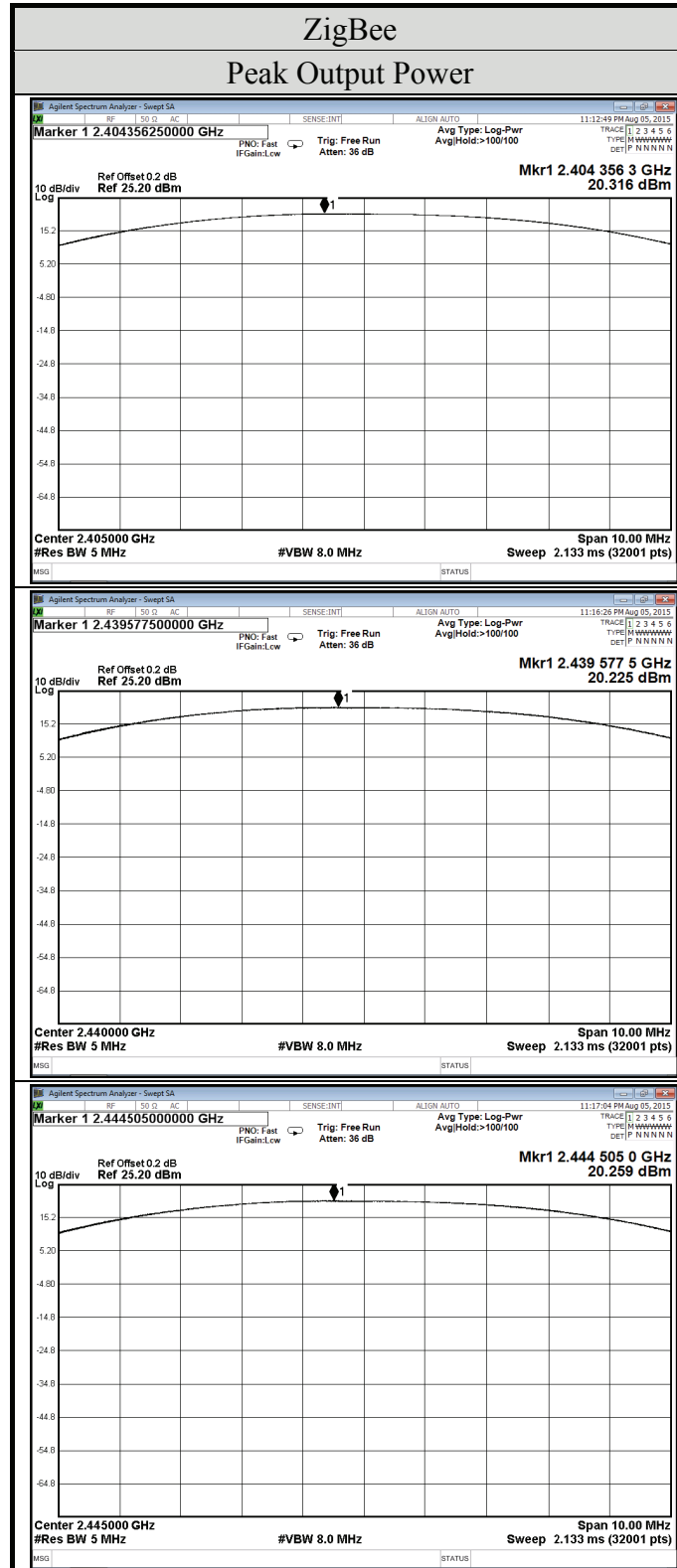
Test Date	2015/08/05~2015/08/12	Temp./Hum.	25°C/40%
Cable Loss	0.2dB	Test Voltage	DC 3.3V (Via test jig powered by USB)

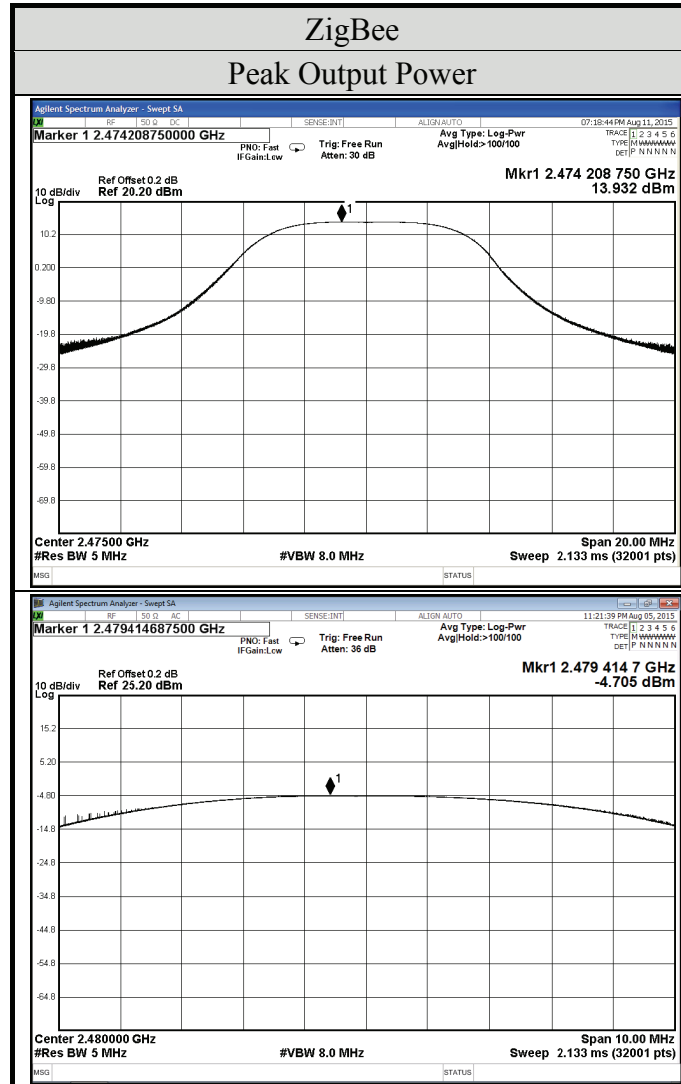
8.4.1. Output Power Result

Modulation Type	Centre Frequency (MHz)	Peak Output Power		Limit
		(dBm)	(W)	
ZigBee	2405	20.316	0.107547	< 30 dBm (1 W)
	2440	20.225	0.105317	
	2445	20.259	0.106145	
	2475	13.932	0.024729	
	2480	-4.705	0.000338	

Note: The results have been included cable loss.

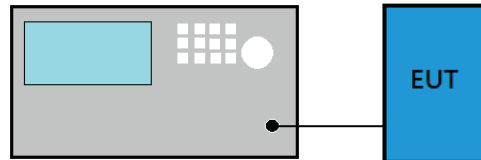
8.4.2. Measurement Plots





9. EMISSION LIMITATIONS MEASUREMENT

9.1. Block Diagram of Test Setup



9.2. Specification Limits

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)/RSS-Gen Section 8.9 table 4 is not required. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205(a)/RSS-Gen Section 8.10 table 6, must also comply with the radiated emission limits specified in Section 15.209(a)/RSS-Gen Section 8.9 table 4 (See Section 15.205(c)).

9.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v03r03:

■ Reference Level

- (1) Set analyzer center frequency to DTS channel center frequency.
- (2) Set the span to 1.5 times the DTS bandwidth.
- (3) Set the RBW to: 100 kHz.
- (4) Set the VBW $\geq 3 \times$ RBW.
- (5) Detector = peak.
- (6) Sweep time = auto couple.
- (7) Trace mode = max hold.
- (8) Allow trace to fully stabilize to find the max PSD as reference level.

■ Emission Level Measurement

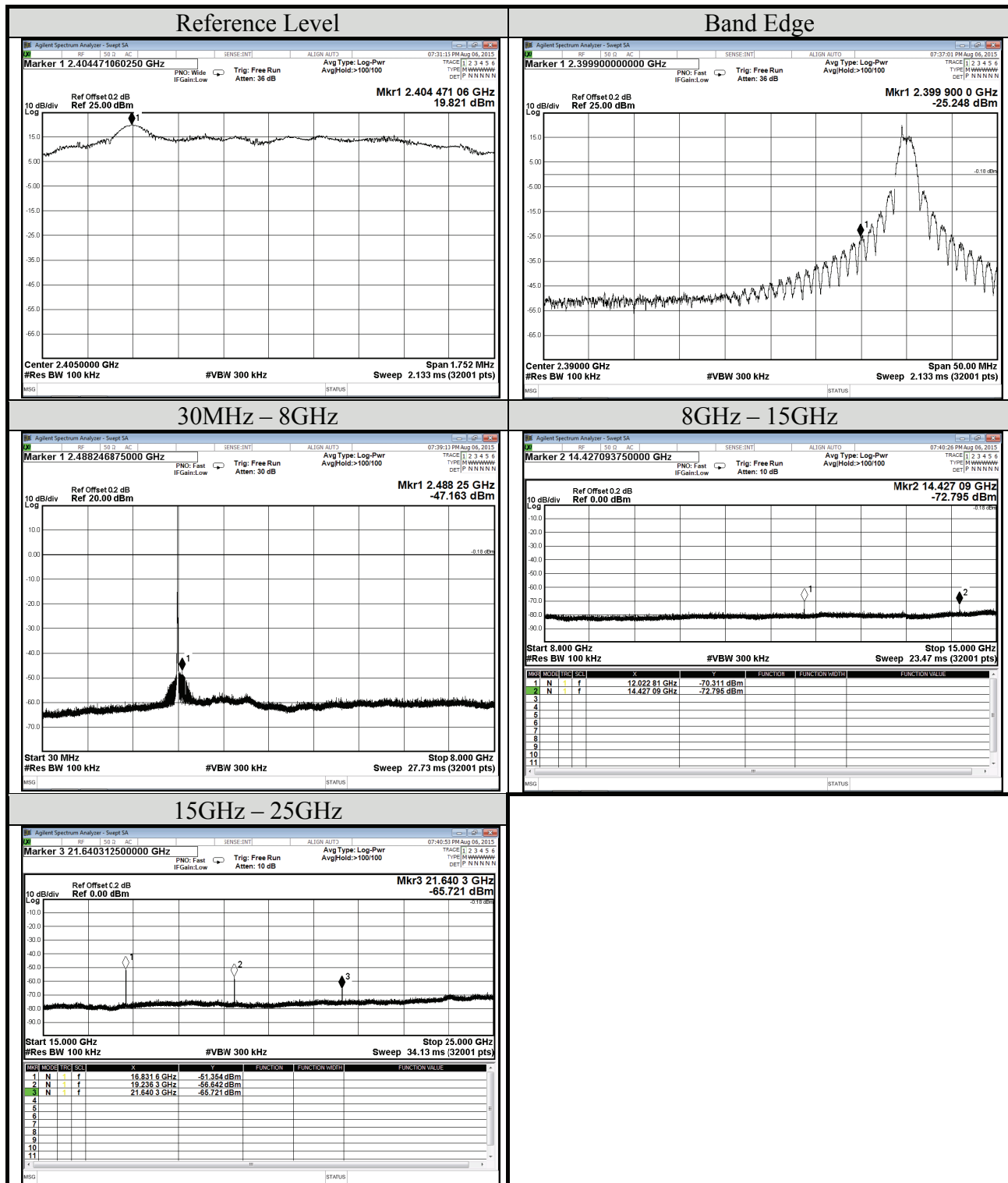
- (1) Set analyzer center frequency to DTS channel center frequency.
- (2) Set the span to 1.5 times the DTS bandwidth.
- (3) Set the RBW to: 100 kHz.
- (4) Set the VBW $\geq 3 \times$ RBW.
- (5) Detector = peak.
- (6) Sweep time = auto couple.
- (7) Trace mode = max hold.
- (8) Allow trace to fully stabilize to find the max level.

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9.4. Test Results

Test Date	2015/08/06	Temp./Hum.	25°C/40%
Mode	ZigBee	Frequency	TX 2405MHz
Cable Loss	0.2dB	Test Voltage	DC 3.3V (Via test jig powered by USB)

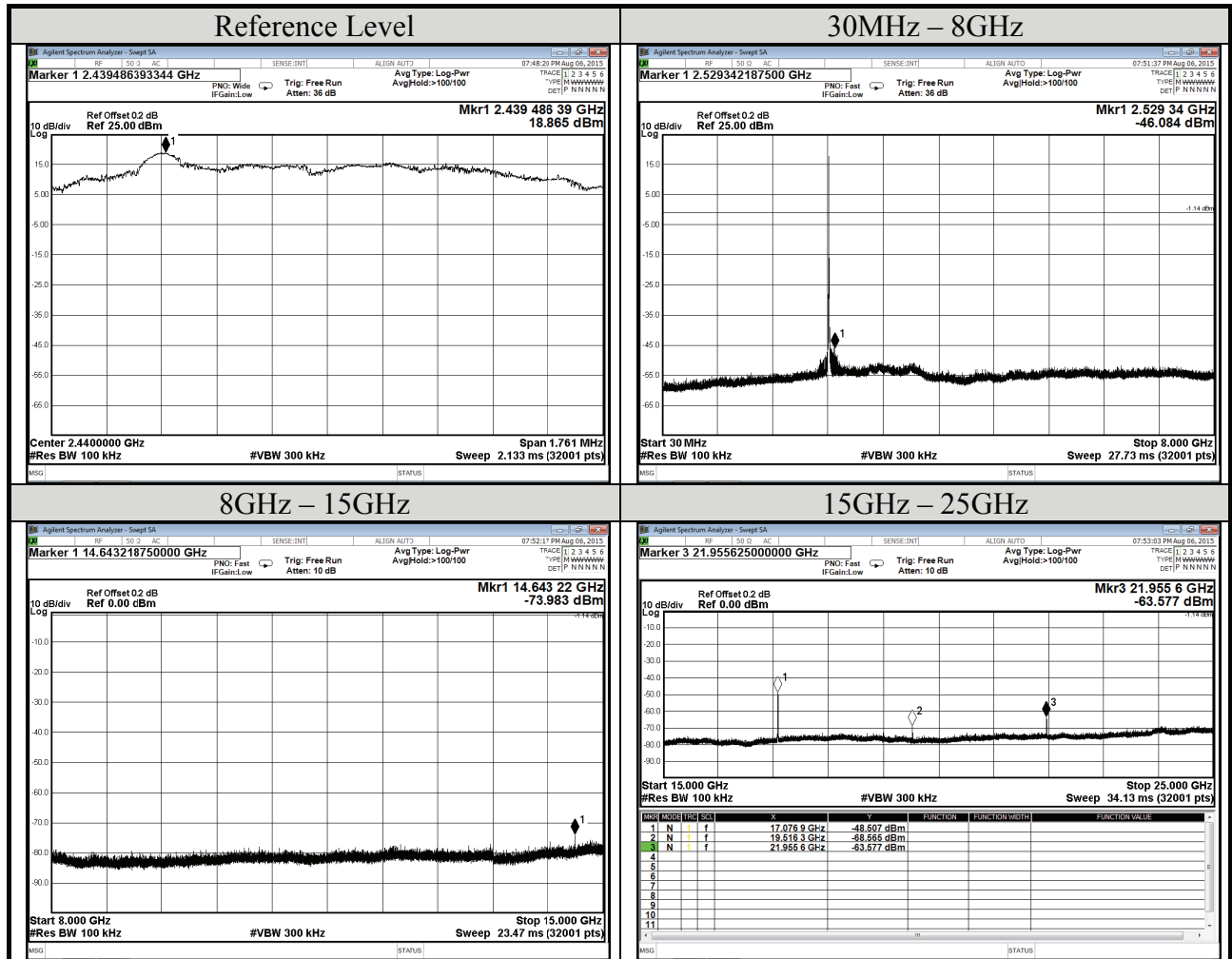


File Number: CIM1508007

Report Number: EM-F150466

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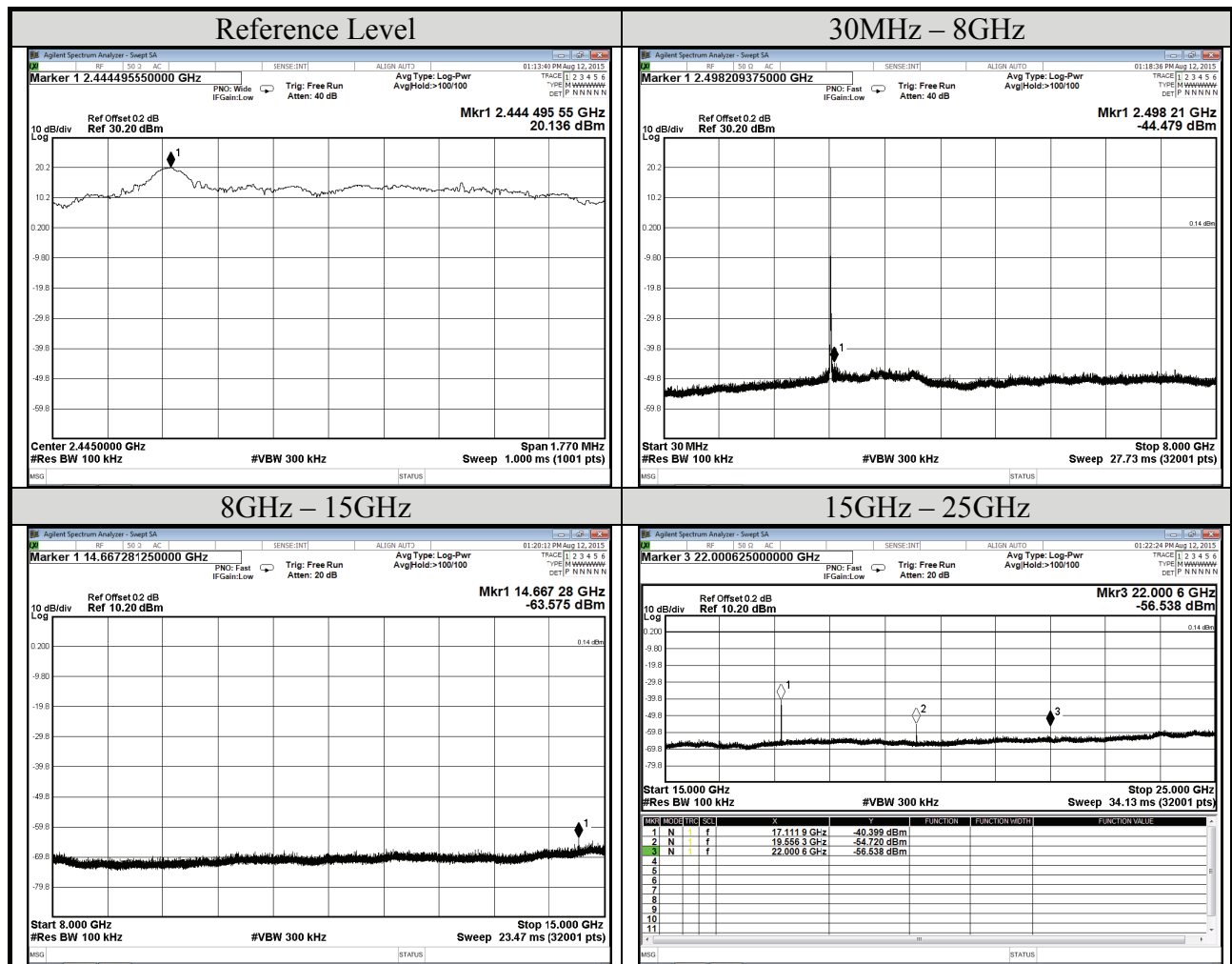
Test Date	2015/08/06	Temp./Hum.	25°C/40%
Mode	ZigBee	Frequency	TX 2440MHz
Cable Loss	0.2dB	Test Voltage	DC 3.3V (Via test jig powered by USB)



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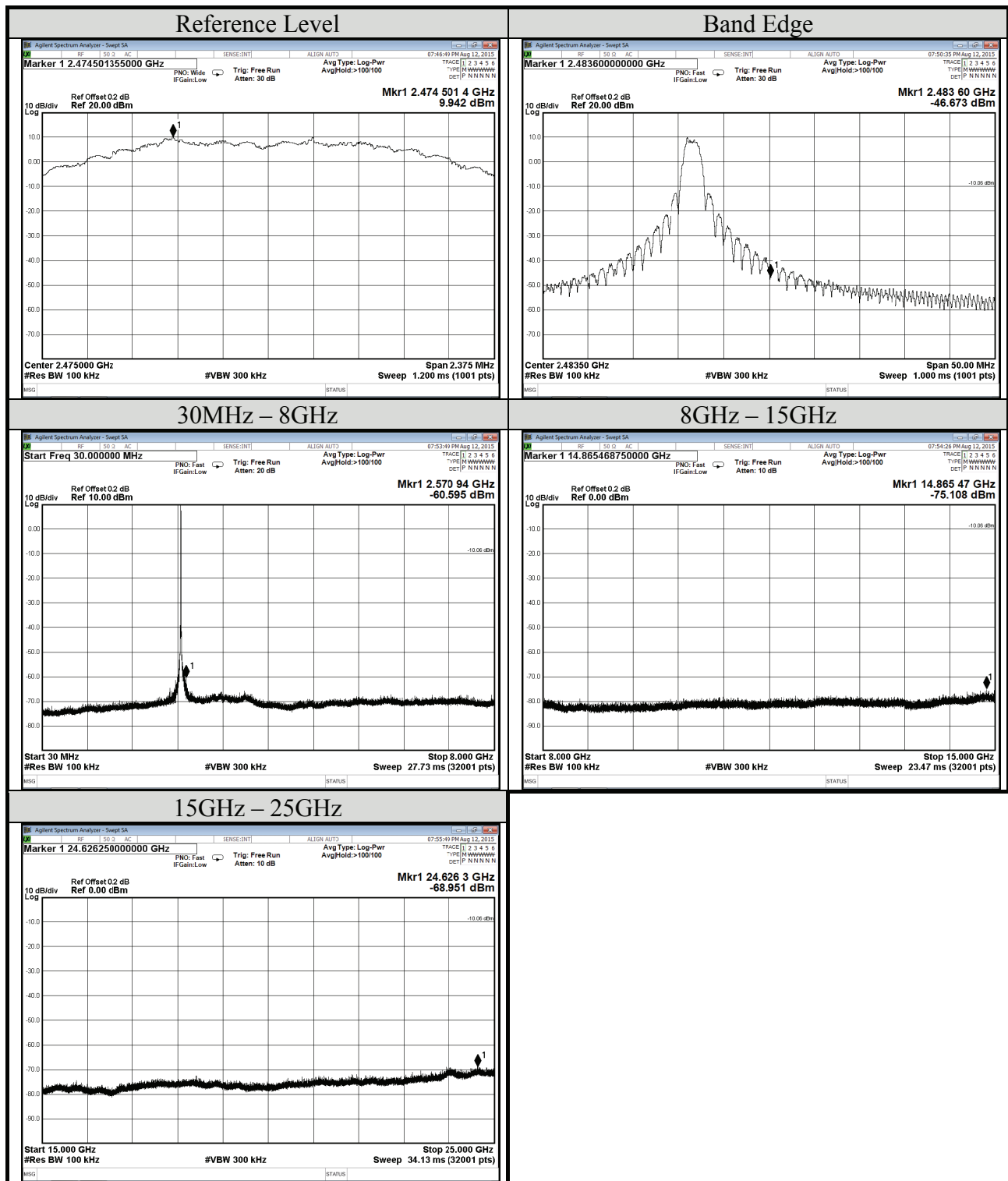
Test Date	2015/08/12	Temp./Hum.	25°C/40%
Mode	ZigBee	Frequency	TX 2445MHz
Cable Loss	0.2dB	Test Voltage	DC 3.3V (Via test jig powered by USB)



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Test Date	2015/08/12	Temp./Hum.	25°C/40%
Mode	ZigBee	Frequency	TX 2475MHz
Cable Loss	0.2dB	Test Voltage	DC 3.3V (Via test jig powered by USB)

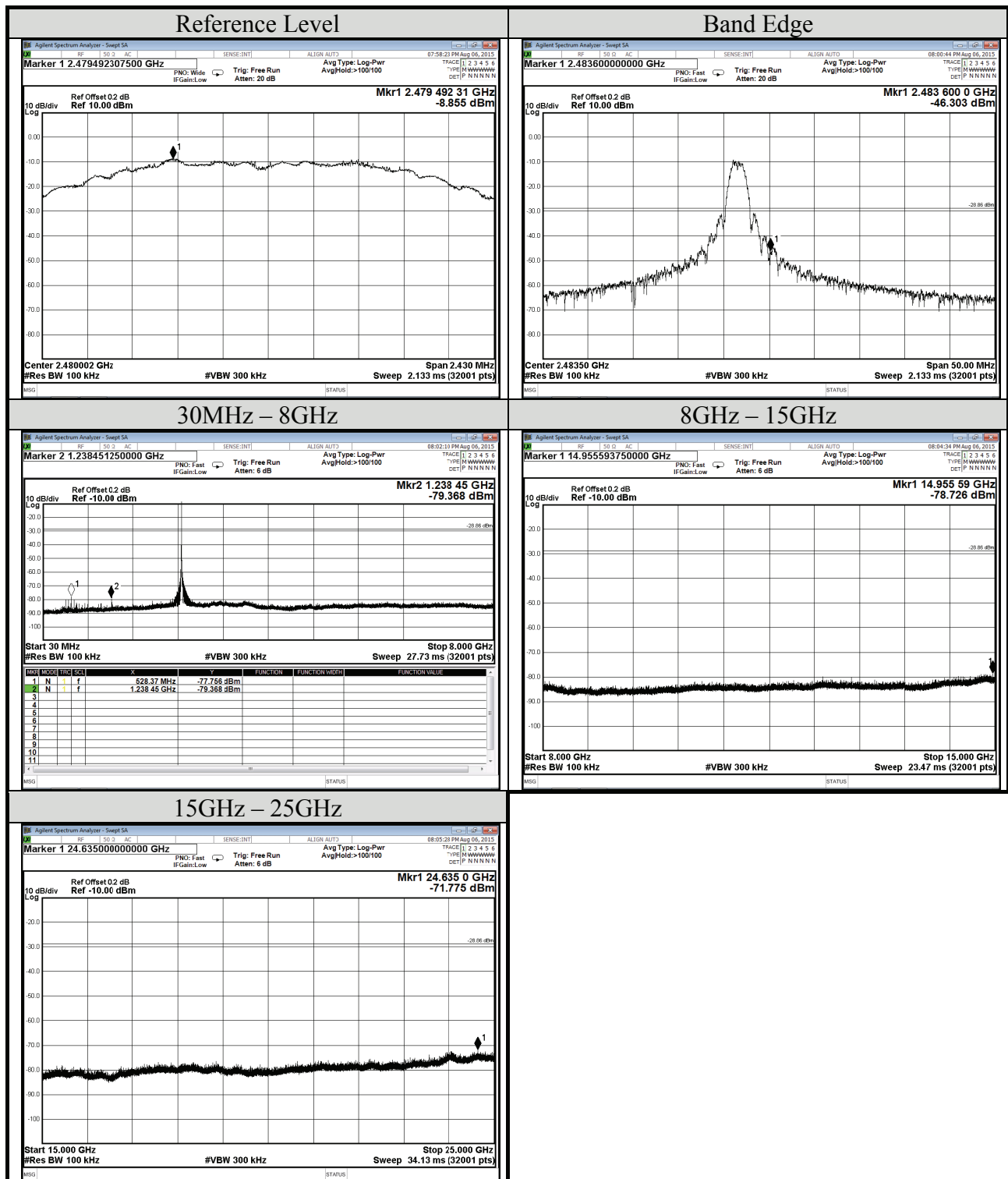


File Number: C1M1508007

Report Number: EM-F150466

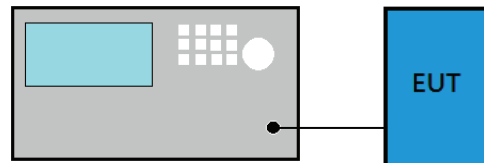
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Test Date	2015/08/06	Temp./Hum.	25°C/40%
Mode	ZigBee	Frequency	TX 2480MHz
Cable Loss	0.2dB	Test Voltage	DC 3.3V (Via test jig powered by USB)



10. POWER SPECTRAL DENSITY

10.1. Block Diagram of Test Setup



10.2. Specification Limits

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

10.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v03r03:

■ Method PKPSD (peak PSD)

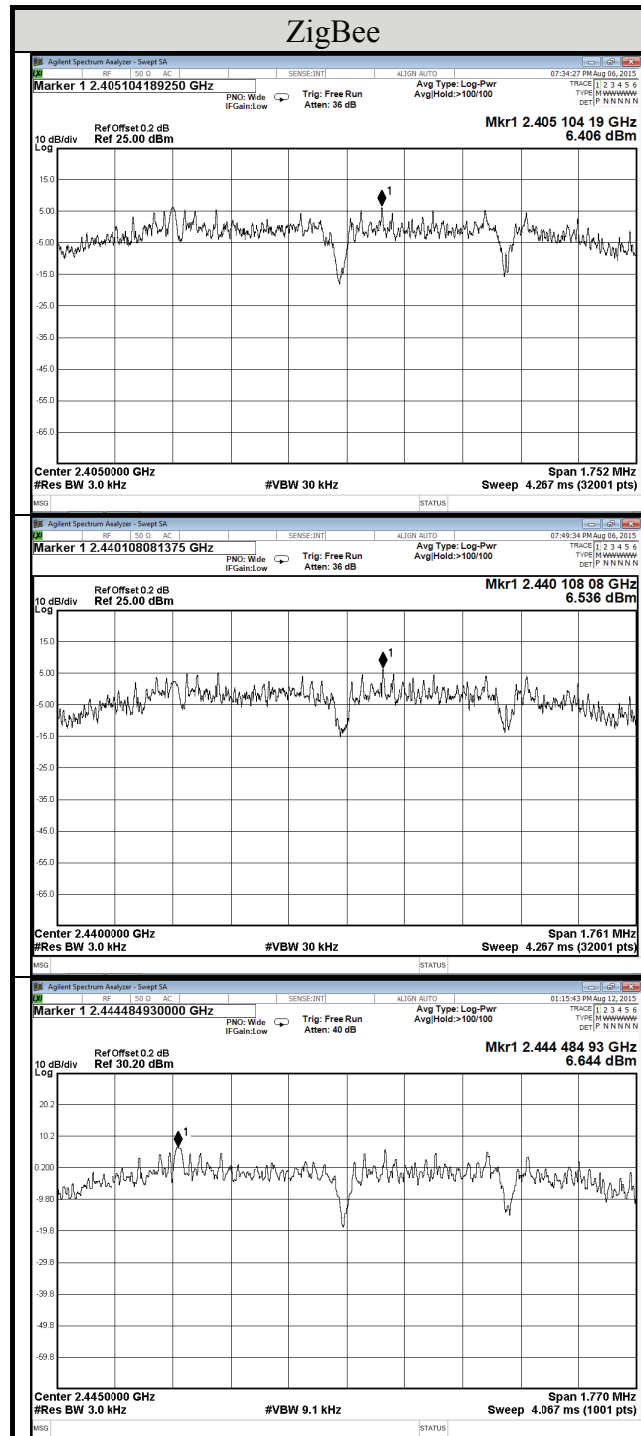
- (1) Set analyzer center frequency to DTS channel center frequency.
- (2) Set the span to 1.5 times the DTS bandwidth.
- (3) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- (4) Set the VBW $\geq 3 \times \text{RBW}$.
- (5) Detector = peak.
- (6) Sweep time = auto couple.
- (7) Trace mode = max hold.
- (8) Allow trace to fully stabilize.
- (9) Use the peak marker function to determine the maximum amplitude level.
- (10) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

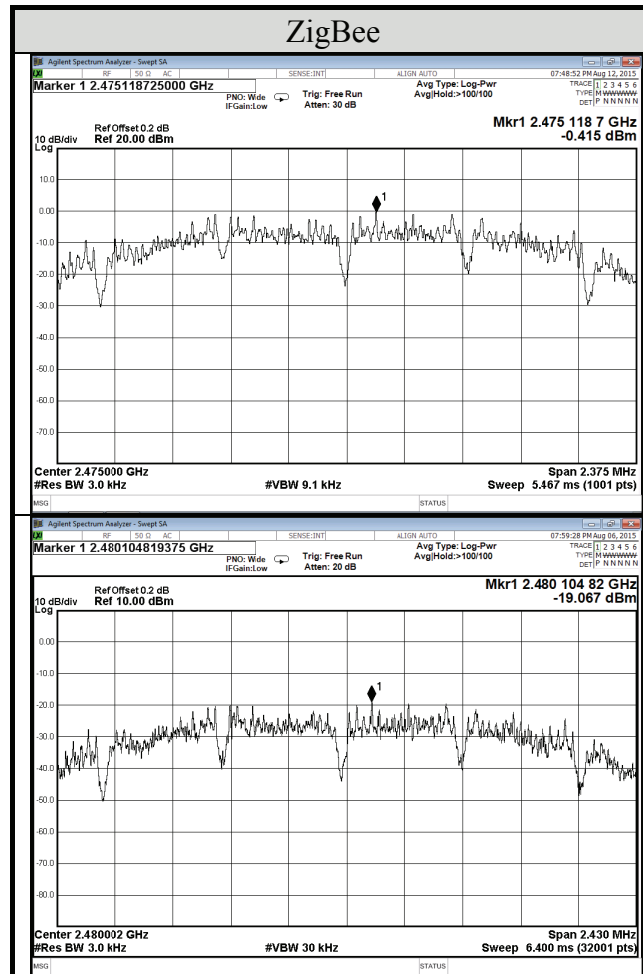
□ Method AVGPSD-2

- (1) Using peak PSD procedure step 1 to step 4.
- (2) Detector = RMS detector
- (3) Sweep time = auto couple
- (4) Trace mode = trace averaging over a minimum of 100 traces
- (5) Use the peak marker function to determine the maximum amplitude level.
- (6) Duty cycle factor is added when duty cycle presented in section 3.5.1. < 98%.
- (7) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

10.4. Test Results

Test Date	2015/08/06~2015/08/12	Temp./Hum.	25°C/40%
Cable Loss	0.2dB	Test Voltage	DC 3.3V (Via test jig powered by USB)





11.DEVIATION TO TEST SPECIFICATIONS

【NONE】