

FCC 15.247& RSS-247 2.4 GHz Report

for

LG Electronics Inc.

**222, LG-ro Jinwi-myeon, Pyeongtaek-Si,
Gyeonggi-Do, 451-713, Korea**

Product : VLC ZigBee Connector
Model : 9VS570V5DA
Brand : LG
FCC ID : BEJ9VS570V5DA
IC : 2703H-9VS570V5DA

**Prepared by : AUDIX Technology Corporation,
EMC Department**



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TEST REPORT CERTIFICATION

Applicant : LG Electronics Inc.
Manufacture : LG Electronics Inc.
Factory : YUYANG DNU
EUT Description
(1) Product : VLC ZigBee Connector
(2) Model : 9VS570V5DA
(3) Brand : LG

Applicable Standards:

47 CFR FCC Part 15 Subpart C
RSS-Gen (Issue 4), November 2014
RSS-247 (Issue 2), February 2017
ANSI C63.10:2013
KDB 558074 D01 DTS Meas Guidance v04

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 Report: 2017. 04. 20

Reviewed by:



(Sabrina Wang/Administrator)

Approved by:



(Ben Cheng/Manager)

1. REVISION RECORD OF TEST REPORT

Edition No	Issued Data	Revision Summary	Report Number
0	2017. 04. 20	Original Report	EM-F170237

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)(2)	RSS-247 §5.2(1)	6dB Bandwidth	PASS
15.247(b)(3)	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)	Peak Power Spectral Density	PASS
15.203	----	Antenna Requirement	PASS

3. GENERAL INFORMATION

3.1. Description of Application

Applicant	LG Electronics Inc. 222, LG-ro Jinwi-myeon, Pyeongtaek-Si, Gyeonggi-Do, 451-713, Korea
Manufacture	LG Electronics Inc. 222, LG-ro Jinwi-myeon, Pyeongtaek-Si, Gyeonggi-Do, 451-713, Korea
Factory	YUYANG DNU 223, Yuram-gil, Pltan-myeon, Hwaseong-si, Gyeonggi-do, Rep. of Korea
Product	VLC ZigBee Connector
Model	9VS570V5DA
Brand	LG

3.2. Description of EUT

Test Model	9VS570V5DA
Serial Number	N/A
Power Rating	DC 5V
RF Features	ZigBee (IEEE 802.15.4)
Date of Receipt	2017. 04. 12
Date of Test	2017. 04. 19
I/O Ports List	USB Port x1
Accessories	USB OTG

3.3. EUT Specifications Assessed in Current Report

Mode	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

3.4. Antenna Information

Antenna Part Number	Manufacture	Antenna Type	Frequency	Max Gain (dBi)
ALA621C4	MOTECH Co., Ltd.	Multilayer Chip Antenna	2400-2485MHz	3.5

3.5. Descriptions of Key Components

None

3.6. Test Configuration

Mode	Duty Cycle (x)	Duty Cycle Factor (dB)
ZigBee	1	0

Note: When duty cycle is less than 98% (0.98) that duty cycle factor $10\log(1/x)$ is needed to add in conducted test items measured in average detector.

AC Conduction	
Test Case	Normal operation

Item		Mode	Test Channel
Radiated Test Case	Spurious Emission ^{Note1}	ZigBee	11/18/26
	6dB Bandwidth	ZigBee	11/18/26
	Peak Output Power	ZigBee	11/18/26
	Band Edge	ZigBee	11/26
	Peak Power Spectral Density	ZigBee	11/18/26

Note 1:

☐ Mobile Device

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

☒ Lie

☐ Side

☐ Stand

3.7. Tested Supporting System List

3.7.1. Support Peripheral Unit

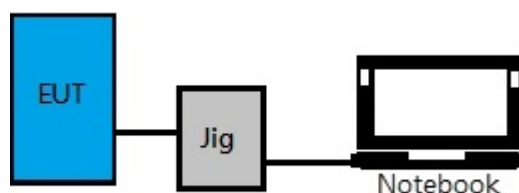
No.	Product	Brand	Model No.	Serial No.	FCC ID
1.	Notebook PC	acer	MS2362	N/A	PPD-AAR5B225
2.	Test Jig	N/A	N/A	N/A	N/A

3.7.2. Cable Lists

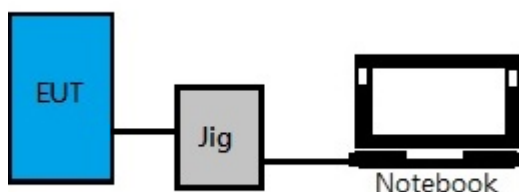
No.	Cable Description Of The Above Support Units
1.	USB Cable: Shielded, Detachable, 1.2m, Bonded two ferrite cores LAN Cable: Shielded, Detachable, 1.0m Adapter: Chicony, M/N CPA09-A065N1, DC Cord: Unshielded, Undetachable, 1.8m Bonded a ferrite core AC Power Cord: Unshielded, Detachable, 1.8m
2.	BUS Cable: Non-Shielded, Detachable, 0.15m

3.8. Setup Configuration

3.8.1. EUT Configuration for Power Line & Radiated Emission



3.8.2. EUT Configuration for RF Conducted Test Items



3.9. Operating Condition of EUT

Test program “ember.desktop” is used for enabling EUT RF function under continues transmitting and choosing data rate/ channel.

3.10. Description of Test Facility

Name of Test Firm	Audix Technology Corporation / EMC Department No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan Tel: +886-2-26092133 Fax: +886-2-26099303 Website : www.audixtech.com Contact e-mail: sales@audixtech.com
Accreditations	The laboratory is accredited by following organizations under ISO/IEC 17025:2005 (1) NVLAP(USA) NVLAP Lab Code 200077-0 (2) TAF(Taiwan) No. 1724 (3) FCC OET Designation No. TW1004 & TW1090
Test Facilities	(1) No. 8 Shielding Room (2) Semi-Anechoic Chamber (IC Test Site Registration No.: 5183B-1) (3) Fully Anechoic Chamber (IC Test Site Registration No.: 5183B-4) (4) RF Test Room

3.11. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty
Conduction Test	150kHz~30MHz	±3.50dB
Radiation Test (Distance: 3m)	30MHz~1000MHz	± 3.68dB
	Above 1GHz	± 5.82dB

Remark : Uncertainty = $ku_c(y)$

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	2017. 02. 07	1 Year
2.	A.M.N.	R&S	ENV4200	100169	2016. 04. 21	1 Year
3.	L.I.S.N.	Kyoritsu	KNW-407	8-855-9	2016. 12. 23	1 Year
4.	Pulse Limiter	R&S	ESH3-Z2	100354	2017. 01. 16	1 Year
5.	Test Software	Audix	e3	V.6.120424	N.C.R.	N.C.R.

4.2. Radiated Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-526	MY53400071	2016. 09. 19	1 Year
2.	Spectrum Analyzer	Keysight	N9010B-544	MY55460198	2016. 04. 20	1 Year
3.	Test Receiver	R & S	ESCS30	100338	2016. 06. 22	1 Year
4.	Amplifier	HP	8447D	2944A06305	2017. 02. 16	1 Year
5.	Amplifier	Agilent	8449B	3008A02678	2017. 03. 06	1 Year
6.	Bilog Antenna	CHASE	CBL6112D	33821	2017. 01. 21	1 Year
7.	Loop Antenna	R&S	HFH2-Z2	891847/27	2016. 12. 23	1 Year
8.	2.4GHz Notch Filter	K&L	7NSL10-244 1.5E130.5-00	1	2016. 07. 27	1 Year
9.	Horn Antenna	ETS-Lindgr en	3117	00135902	2017. 03. 08	1 Year
10.	Horn Antenna	EMCO	3116	2653	2016. 10. 24	1 Year
11.	Test Software	Audix	e3	V.6.110601	N.C.R.	N.C.R.
12.	Test Software	Audix	e3	V.120619C	N.C.R.	N.C.R.

4.3. RF Conducted Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-526	MY52220368	2016. 12. 01	1 Year
2.	Power Meter	Anritsu	ML2495A	1145008	2016. 10. 27	1 Year
3.	Power Sensor	Anritsu	MA2411B	1126096	2016. 10. 27	1 Year

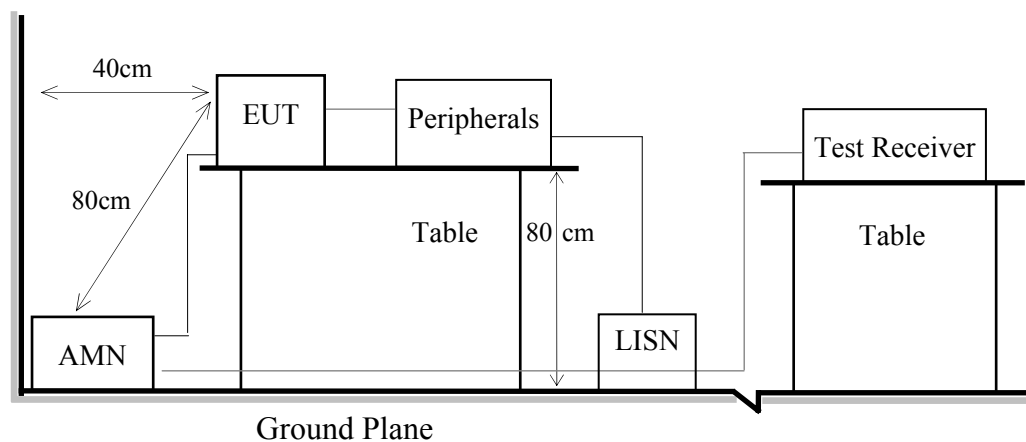
5. CONDUCTED EMISSION

5.1. Block Diagram of Test Setup

5.1.1. Block Diagram of EUT

Indicated as section 3.8

5.1.2. Shielded Room Setup Diagram



5.2. 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. Test Results

Please refer to Appendix A.

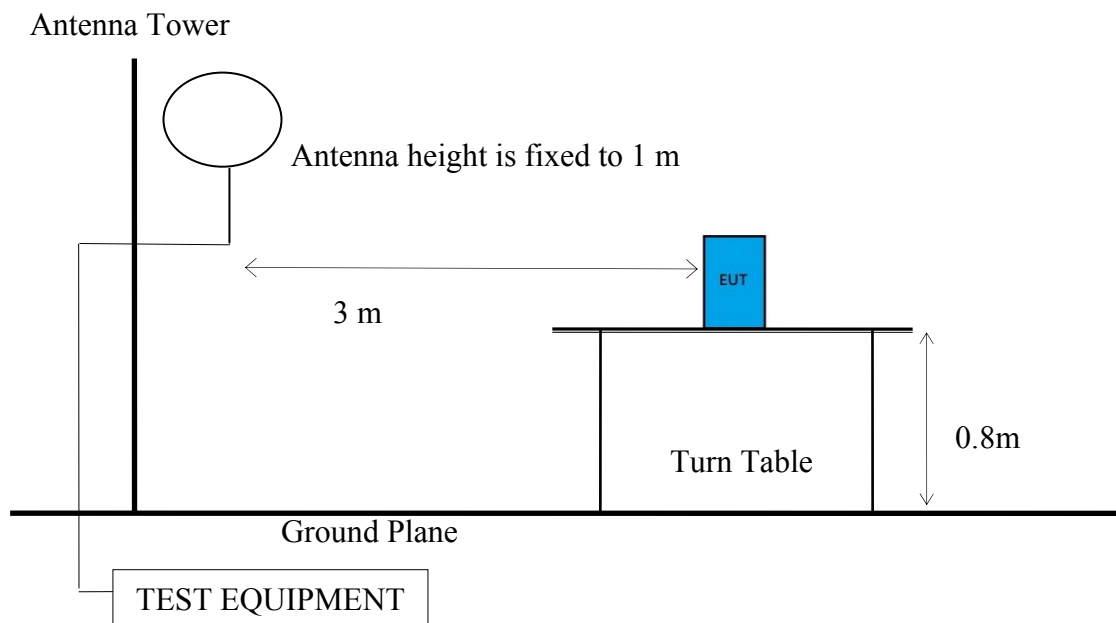
6. RADIATED EMISSION

6.1. Block Diagram of Test Setup

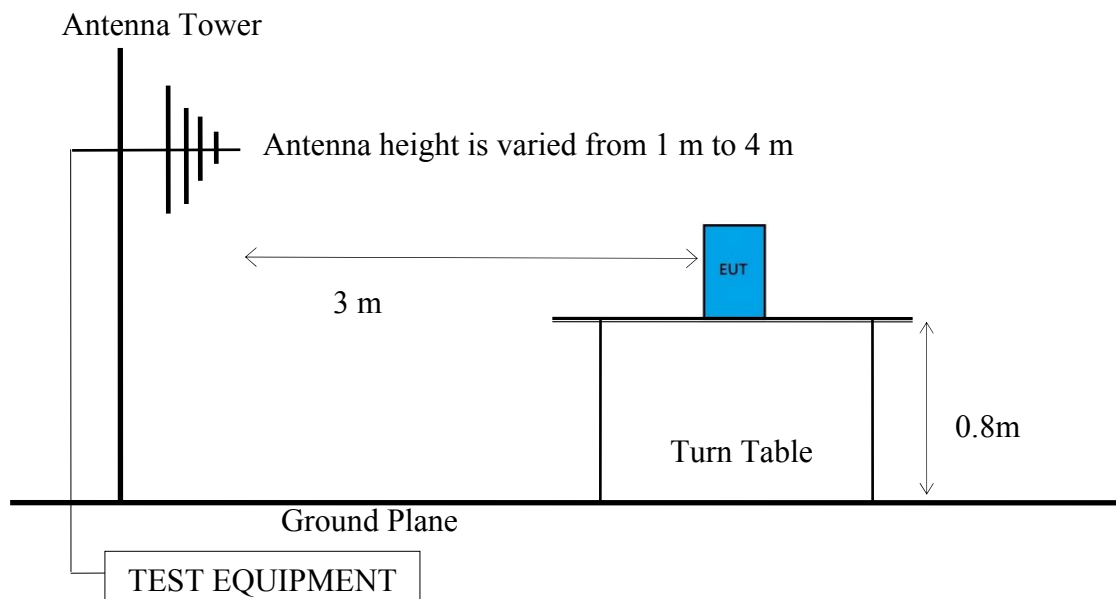
6.1.1. Block Diagram of EUT

Indicated as section 3.8

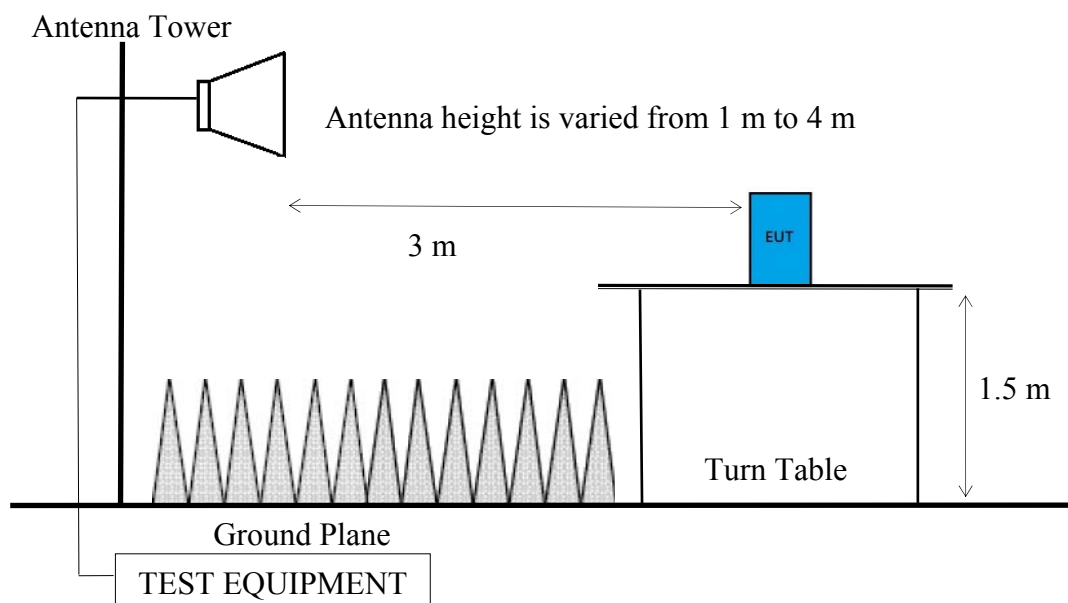
6.1.2. Setup Diagram for 9kHz-30MHz



6.1.3. Setup Diagram for 30-1000 MHz



6.1.4. 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 must also comply with the radiated emission limits specified as below.

Frequency (MHz)	Distance (m)	Limits	
		dBμV/m	μV/m
0.009 - 0.490	300	67.6	2400/kHz
0.490 - 1.705	30	87.6	24000/kHz
1.705 - 30	30	29.5	30
30 - 88	3	40.0	100
88- 216	3	43.5	150
216- 960	3	46.0	200
Above 960	3	54.0	500
Above 1000	3	74.0 dBμV/m (Peak) 54.0 dBμV/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

Frequency Range 9kHz~30MHz:

The EUT setup on the turn table which has 0.8 m height to the ground. The turn table rotated 360 degrees and antenna fixed to 1 m to find the maximum emission level. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

- (1) RBW = 9kHz with peak and average detector.
- (2) Detector: average and peak (9kHz-490kHz)
Q.P. (490kHz-30MHz)

Frequency Range 30MHz ~ 25GHz:

The EUT setup on the turn find table which has 80 cm (for 30-1000 MHz) and 1.5m (for above 1GHz) 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 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 (up to 25 GHz):

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 Detector:☒ **Option 1:**

(1) RBW = 1MHz

(2) VBW $\geq$ 1/ T.

Modulation Type	T (ms)	1/ T (kHz)	VBW Setting (kHz)
ZigBee			

N/A: 1/ T is not implemented when duty cycle presented in section 3.6 is $\geq$ 98 %.

(1) Detector = Peak.

(2) Sweep time = auto.

(3) Trace mode = max hold.

(4) Allow sweeps to continue until the trace stabilizes.

☐ **Option 2:**

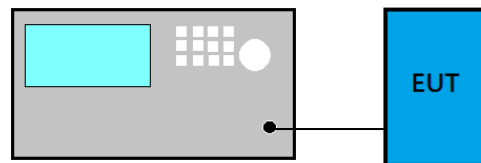
Average Emission Level= Peak Emission Level+ D.C.C.F.

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+ DCCFDuty Cycle Correction Factor (DCCF)= $20\log(TX_{on}/TX_{on+off})$ presented in section 3.6☐ ERP= Peak Emission Level-95.2dB-2.14dB**6.5. Test Results**

Please refer to Appendix A.

7. 6dB BANDWIDTH

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 v04:

- (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

Please refer to Appendix A

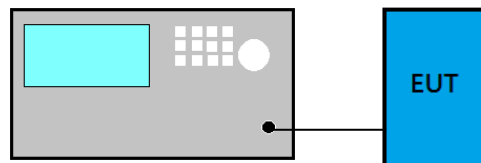
8. MAXIMUM PEAK OUTPUT POWER

8.1. Block Diagram of Test Setup

8.1.1. For WLAN Function



8.1.2. For BLE Function



8.2. Specification Limits

The Limits of maximum Peak Output Power for digital modulation in 2400-2483.5MHz is : 1Watt. (30dBm), and E.I.R.P.: 4Watt (36dBm)

8.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v04:

■ **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 3.6 is < 98%.

■ **Method AVGSA-2 (Spectrum channel power)**

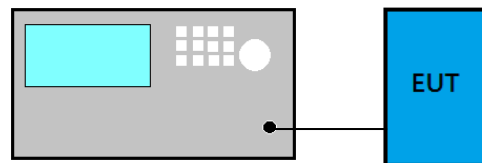
- (1) Set span to at least 1.5 times the OBW
- (2) Set RBW = 1 -5% of OBW
- (3) Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- (4) Detector = RMS.
- (5) Trace mode = trace average at least 100 traces
- (6) Sweep = auto couple.
- (7) Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges.
- (8) Duty cycle factor is added when duty cycle presented in section 3.6 is < 98%.

8.4. Test Results

Please refer to Appendix A

9. EMISSION LIMITATIONS

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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, that the required attenuation shall be 30 dB instead of 20 dB.

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)).

9.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v04:

■ 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

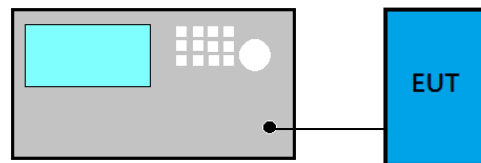
- (1) Set analyzer center frequency to DTS channel center frequency.
- (2) Set the span to 1.5 times the DTS bandwidth.
- (3) Set the RBW to: 100 kHz.
- (4) Set the VBW $\geq 3 \times$ RBW.
- (5) Detector = peak.
- (6) Sweep time = auto couple.
- (7) Trace mode = max hold.
- (8) Allow trace to fully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

9.4. Test Results

Please refer to Appendix A

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 v04:

☒ 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 < 98%.
- (7) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

10.4. Test Results

Please refer to Appendix A

11.DEVIATION TO TEST SPECIFICATIONS

【NONE】



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APPENDIX A

TEST DATA AND PLOTS

(Model: 9VS570V5DA)

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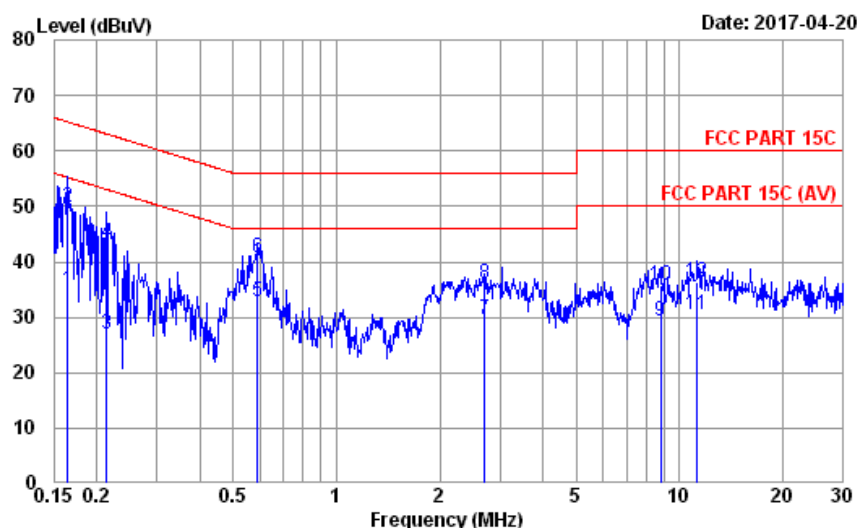
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A.1 CONDUCTED EMISSION

Test Date	2017/04/20	Temp./Hum.	22°C/57%
Test Voltage	AC 120V, 60Hz (Via Notebook PC)		



Site no. : No.8 Shielded Room Data no. : 1
Condition : ENV4200 100169 LISN Phase : NEUTRAL
Limit : FCC PART 15C
Env. / Ins. : 22°C / 57% ESR3 (1774) Engineer : Jemy
EUT : 9VS570V5DA
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	0.165	11.44	0.03	9.86	13.55	34.88	55.21	20.33	Average
2	0.165	11.44	0.03	9.86	28.60	49.93	65.21	15.28	QP
3	0.214	11.27	0.03	9.86	5.79	26.95	53.05	26.10	Average
4	0.214	11.27	0.03	9.86	22.07	43.23	63.05	19.82	QP
5	0.589	11.04	0.05	9.86	12.00	32.95	46.00	13.05	Average
6	0.589	11.04	0.05	9.86	19.75	40.70	56.00	15.30	QP
7	2.707	11.12	0.09	9.87	8.37	29.45	46.00	16.55	Average
8	2.707	11.12	0.09	9.87	14.87	35.95	56.00	20.05	QP
9	8.822	12.01	0.18	9.88	7.22	29.29	50.00	20.71	Average
10	8.822	12.01	0.18	9.88	13.59	35.66	60.00	24.34	QP
11	11.257	12.50	0.20	9.89	7.74	30.33	50.00	19.67	Average
12	11.257	12.50	0.20	9.89	13.89	36.48	60.00	23.52	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.

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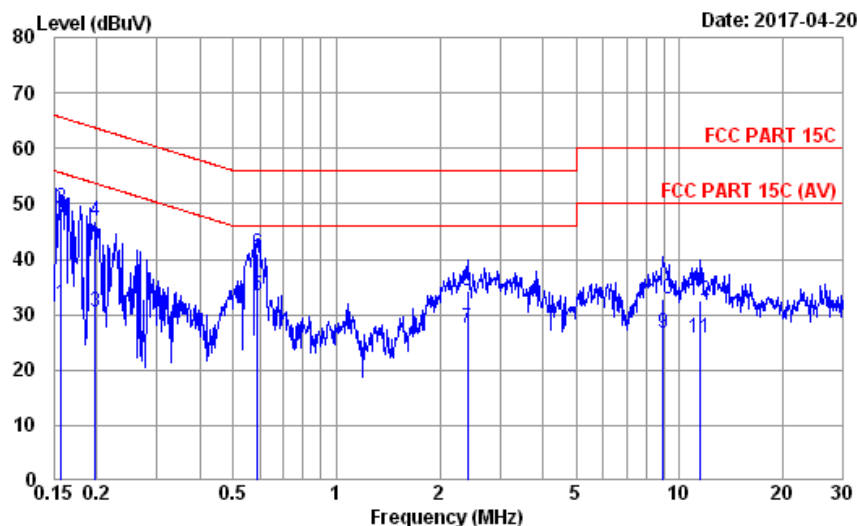
No. 53-11, Dingfu, Linkou, Dist.,

New Taipei City 244, Taiwan

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Test Date	2017/04/20	Temp./Hum.	22°C/57%
Test Voltage	AC 120V, 60Hz (Via Notebook PC)		



Site no. : No.8 Shielded Room Data no. : 2
Condition : ENV4200 100169 LISN Phase : LINE
Limit : FCC PART 15C
Env. / Ins. : 22°C / 57% ESR3 (1774) Engineer : Jemy
EUT : 9VS570V5DA
Power Rating : 120Vac/60Hz
Test Mode : mPAD-7-CHT4-I

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.157	10.78	0.03	9.86	11.13	31.80	55.60	23.80	Average
2	0.157	10.78	0.03	9.86	28.44	49.11	65.60	16.49	QP
3	0.198	10.75	0.03	9.86	9.96	30.60	53.71	23.11	Average
4	0.198	10.75	0.03	9.86	26.38	47.02	63.71	16.69	QP
5	0.589	10.62	0.05	9.86	12.82	33.35	46.00	12.65	Average
6	0.589	10.62	0.05	9.86	20.53	41.06	56.00	14.94	QP
7	2.409	10.62	0.09	9.86	7.04	27.61	46.00	18.39	Average
8	2.409	10.62	0.09	9.86	13.70	34.27	56.00	21.73	QP
9	8.964	11.21	0.18	9.88	5.45	26.72	50.00	23.28	Average
10	8.964	11.21	0.18	9.88	11.58	32.85	60.00	27.15	QP
11	11.498	11.66	0.21	9.89	4.07	25.83	50.00	24.17	Average
12	11.498	11.66	0.21	9.89	10.80	32.56	60.00	27.44	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.

A.2 RADIATED EMISSION

Test Date	2017/04/19	Temp./Hum.	23°C/53%
Test Voltage	DC 5V		

A.2.1 Emissions within Restricted Frequency Bands

A.2.1.1 Frequency 9kHz~30MHz

The emissions (9kHz~30MHz) not reported for there is no emission be found.

A.2.1.2 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
125.06	18.47	2.56	17.48	38.51	43.50	4.99	Peak
350.10	21.38	4.98	17.87	44.23	46.00	1.77	Peak
499.48	23.75	6.42	13.63	43.80	46.00	2.20	Peak
828.31	26.71	7.77	8.59	43.07	46.00	2.93	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
108.57	17.93	2.38	14.32	34.63	43.50	8.87	Peak
250.19	18.91	3.81	17.22	39.94	46.00	6.06	Peak
499.48	23.75	6.42	11.44	41.61	46.00	4.39	Peak
827.34	26.71	7.77	9.38	43.86	46.00	2.14	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
125.06	18.47	2.56	18.48	39.51	43.50	3.99	Peak
250.19	18.91	3.81	21.80	44.52	46.00	1.48	Peak
500.45	23.77	6.43	13.83	44.03	46.00	1.97	Peak
829.28	26.73	7.78	8.85	43.36	46.00	2.64	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
125.06	18.47	2.56	14.83	35.86	43.50	7.64	Peak
250.19	18.91	3.81	20.20	42.92	46.00	3.08	Peak
499.48	23.75	6.42	13.63	43.80	46.00	2.20	Peak
827.34	26.71	7.77	8.38	42.86	46.00	3.14	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
125.06	18.47	2.56	15.05	36.08	43.50	7.42	Peak
250.19	18.91	3.81	21.03	43.75	46.00	2.25	Peak
500.45	23.77	6.43	10.94	41.14	46.00	4.86	Peak
827.34	26.71	7.77	5.28	39.76	46.00	6.24	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
125.06	18.47	2.56	13.95	34.98	43.50	8.52	Peak
250.19	18.91	3.81	18.22	40.94	46.00	5.06	Peak
500.45	23.77	6.43	10.07	40.27	46.00	5.73	Peak
829.28	26.73	7.78	9.05	43.56	46.00	2.44	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
125.06	18.47	2.56	18.87	39.90	43.50	3.60	Peak
300.63	19.79	4.31	20.40	44.50	46.00	1.50	Peak
499.48	23.75	6.42	12.44	42.61	46.00	3.39	Peak
828.31	26.71	7.77	8.21	42.69	46.00	3.31	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
125.06	18.47	2.56	14.01	35.04	43.50	8.46	Peak
250.19	18.91	3.81	17.09	39.81	46.00	6.19	Peak
499.48	23.75	6.42	13.37	43.54	46.00	2.46	Peak
831.22	26.73	7.78	9.39	43.90	46.00	2.10	Peak

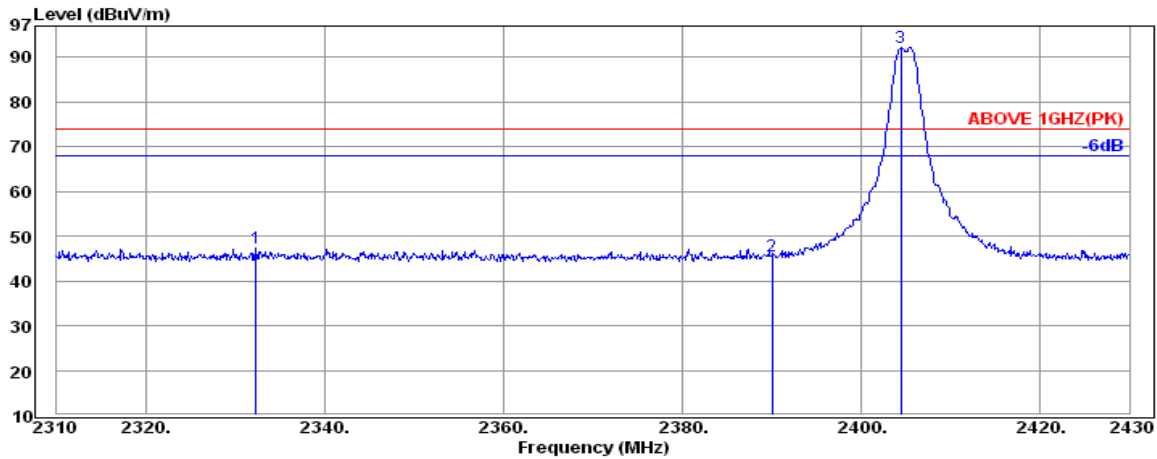
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A.2.1.3 Frequency Above 1 GHz to 10th harmonics

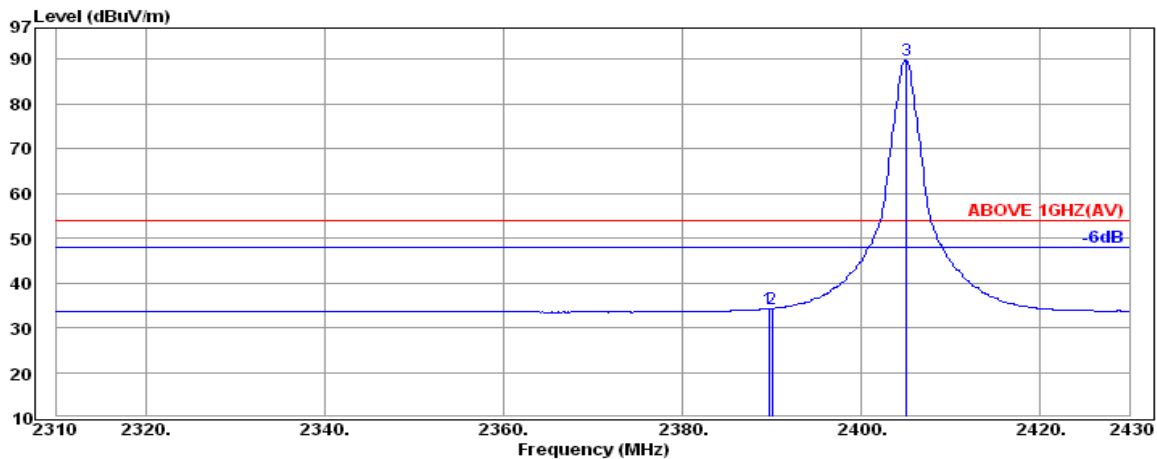
Band Edge:

Mode	ZigBee	Frequency	TX 2405MHz
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Antenna at Horizontal Polarization

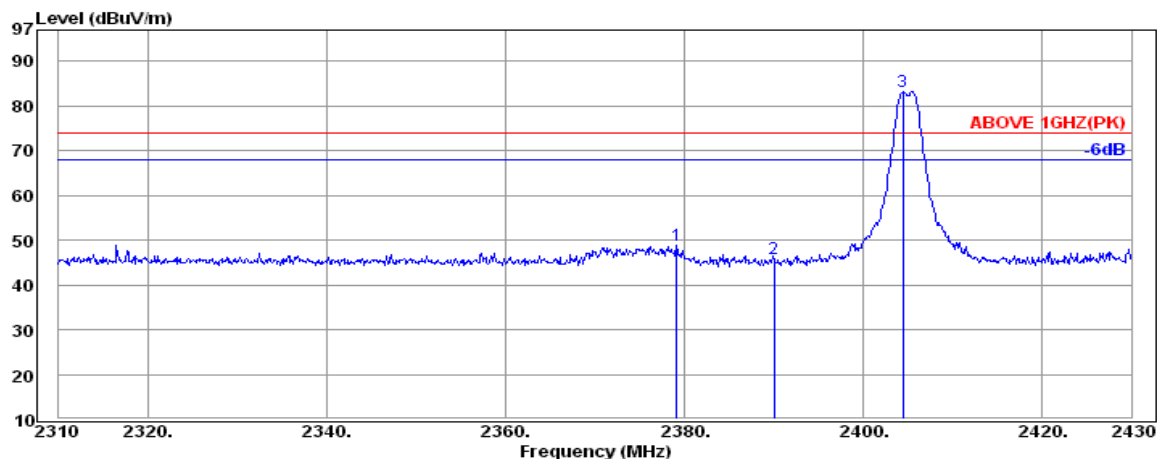
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2332.32	32.06	6.00	9.28	47.34	74.00	26.66	Peak
2390.04	32.16	6.08	7.20	45.44	74.00	28.56	Peak
2404.44	32.18	6.10	53.80	92.08	---	---	Peak



Antenna at Horizontal Polarization

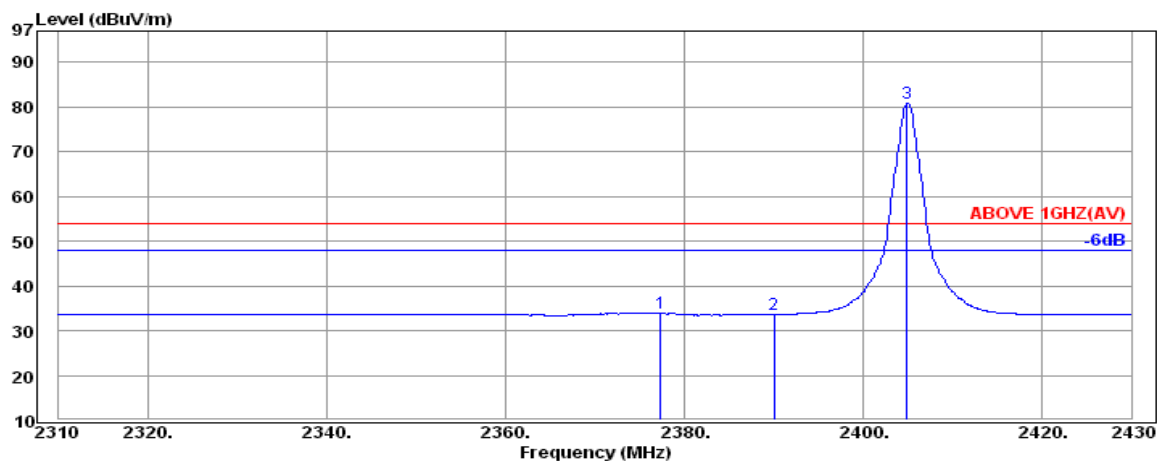
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2389.68	32.16	6.08	-3.99	34.25	54.00	19.75	Average
2390.04	32.16	6.08	-3.98	34.26	54.00	19.74	Average
2405.04	32.18	6.10	51.54	89.82	---	---	Average

Mode	ZigBee	Frequency	TX 2405MHz
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Antenna at Vertical Polarization

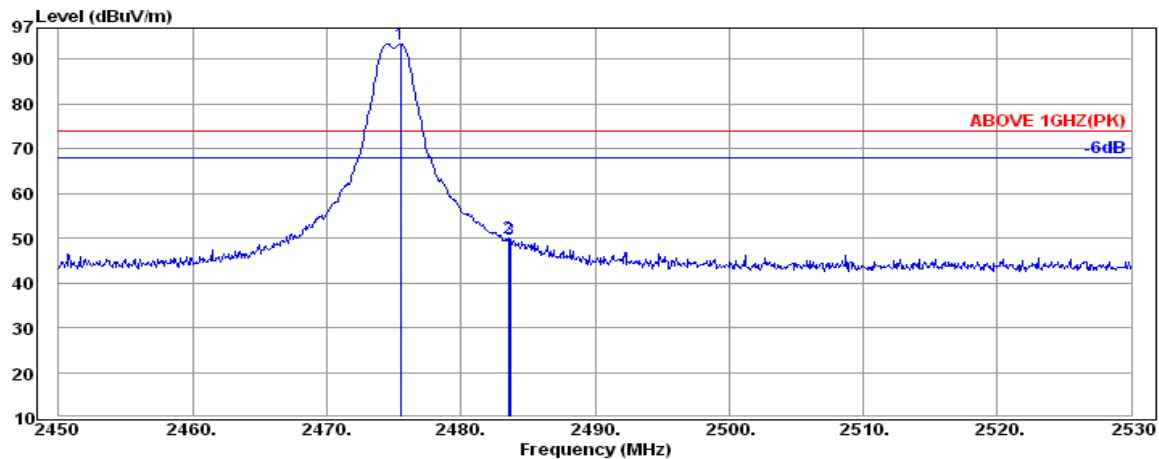
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2379.12	32.13	6.06	10.71	48.90	74.00	25.10	Peak
2390.04	32.16	6.08	7.67	45.91	74.00	28.09	Peak
2404.44	32.18	6.10	44.89	83.17	---	---	Peak



Antenna at Vertical Polarization

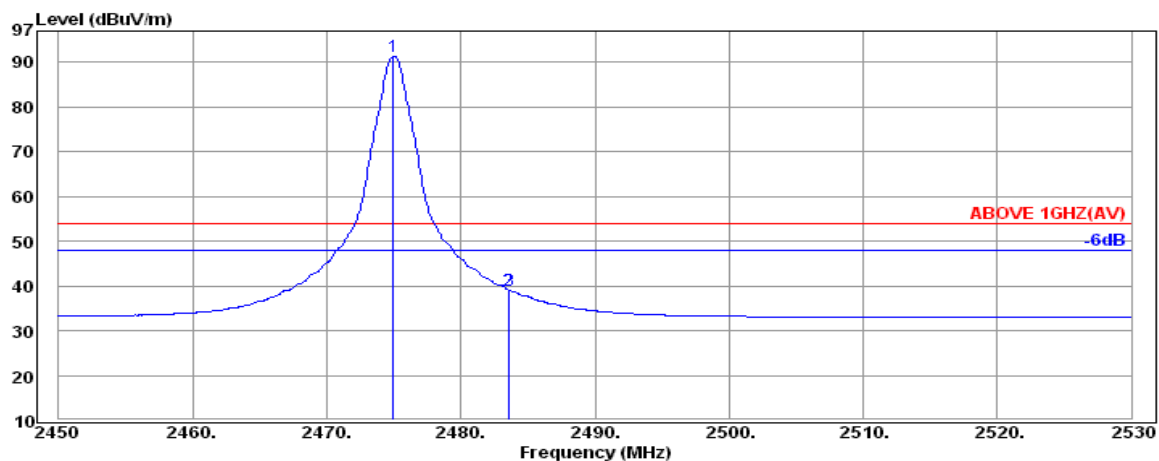
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2377.32	32.13	6.06	-4.32	33.87	54.00	20.13	Average
2390.04	32.16	6.08	-4.62	33.62	54.00	20.38	Average
2404.92	32.18	6.10	42.59	80.87	---	---	Average

Mode	ZigBee	Frequency	TX 2475MHz
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Antenna at Horizontal Polarization

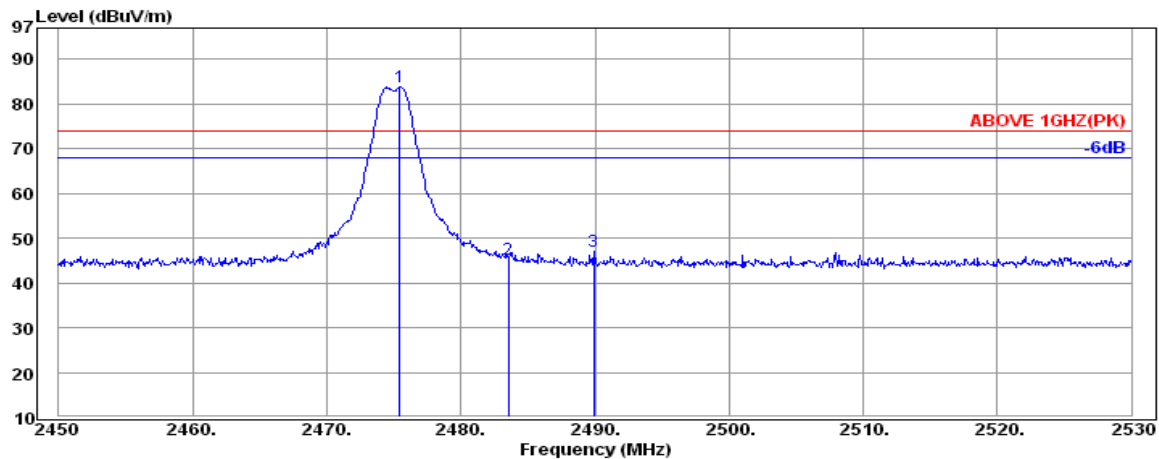
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2475.52	32.28	6.18	55.00	93.46	---	---	Peak
2483.52	32.28	6.19	11.57	50.04	74.00	23.96	Peak
2483.68	32.28	6.19	11.43	49.90	74.00	24.10	Peak



Antenna at Horizontal Polarization

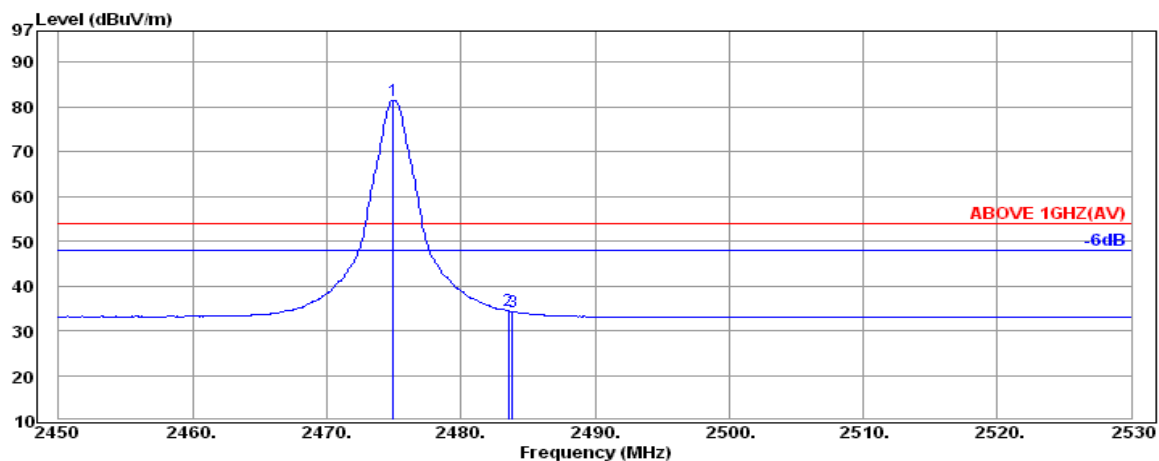
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2474.96	32.28	6.18	52.87	91.33	---	---	Average
2483.52	32.28	6.19	0.59	39.06	54.00	14.94	Average
2483.60	32.28	6.19	0.48	38.95	54.00	15.05	Average

Mode	ZigBee	Frequency	TX 2475MHz
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Antenna at Vertical Polarization

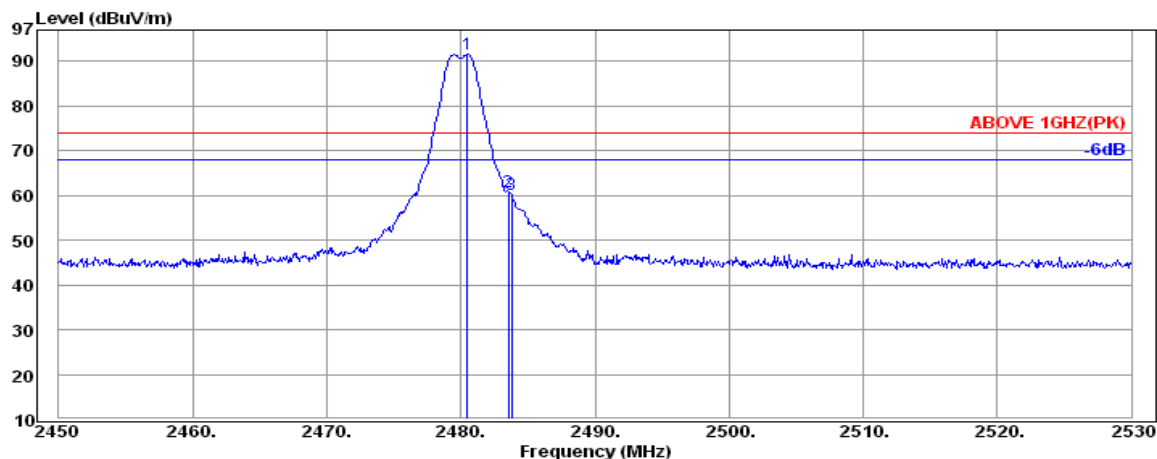
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2475.44	32.28	6.18	45.30	83.76	---	---	Peak
2483.52	32.28	6.19	6.94	45.41	74.00	28.59	Peak
2489.92	32.30	6.19	8.54	47.03	74.00	26.97	Peak



Antenna at Vertical Polarization

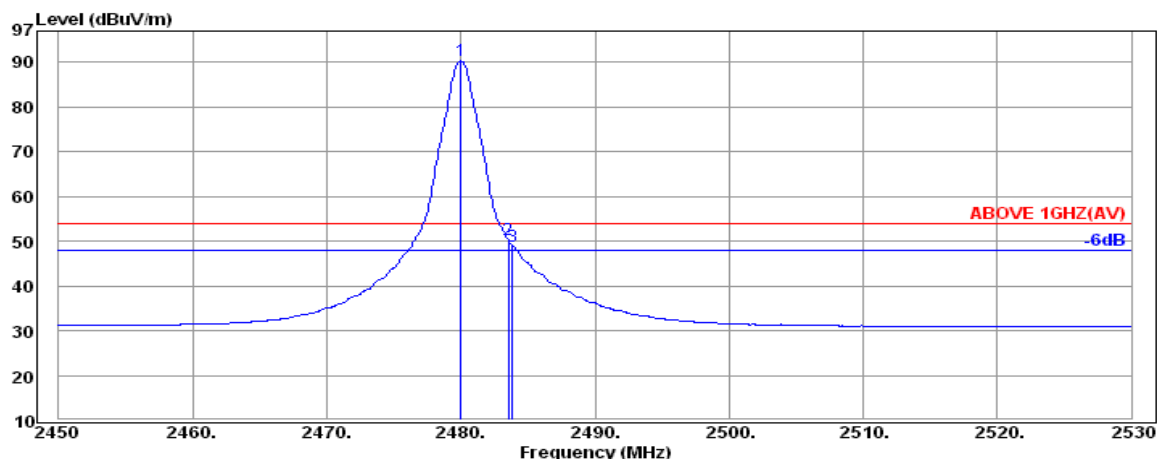
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2474.96	32.28	6.18	43.13	81.59	---	---	Average
2483.52	32.28	6.19	-4.03	34.44	54.00	19.56	Average
2483.84	32.28	6.19	-4.25	34.22	54.00	19.78	Average

Mode	ZigBee	Frequency	TX 2480MHz
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Antenna at Horizontal Polarization

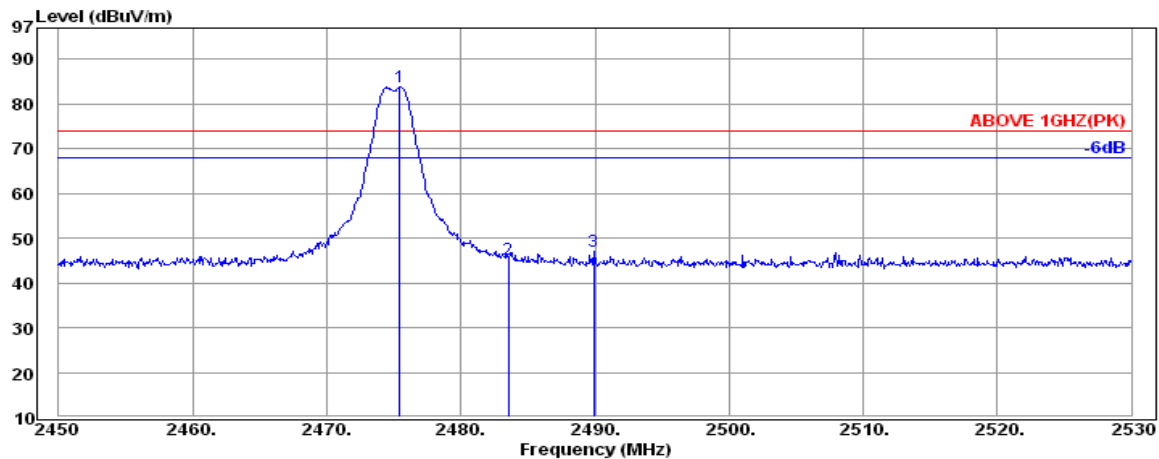
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.48	32.28	6.18	53.17	91.63	---	---	Peak
2483.52	32.28	6.19	22.32	60.79	74.00	13.21	Peak
2483.76	32.28	6.19	21.66	60.13	74.00	13.87	Peak



Antenna at Horizontal Polarization

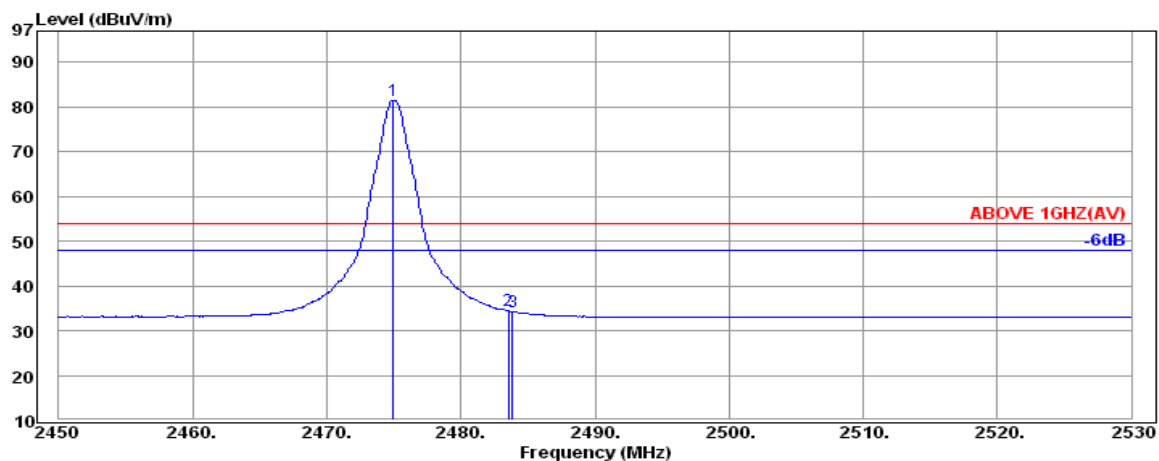
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.00	32.28	6.18	51.83	90.29	---	---	Average
2483.52	32.28	6.19	11.89	50.36	54.00	3.64	Average
2483.84	32.28	6.19	10.54	49.01	54.00	4.99	Average

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
2475.44	32.28	6.18	45.30	83.76	---	---	Peak
2483.52	32.28	6.19	6.94	45.41	74.00	28.59	Peak
2489.92	32.30	6.19	8.54	47.03	74.00	26.97	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
2474.96	32.28	6.18	43.13	81.59	---	---	Average
2483.52	32.28	6.19	-4.03	34.44	54.00	19.56	Average
2483.84	32.28	6.19	-4.25	34.22	54.00	19.78	Average

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A.2.2 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
4810.00	34.22	8.87	17.60	60.69	74.00	13.31	Peak
4810.00	34.22	8.87	8.19	51.28	54.00	2.72	Average
7215.00	35.80	11.27	9.28	56.35	74.00	17.65	Peak
7215.00	35.80	11.27	0.63	47.70	54.00	6.30	Average

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
4810.00	34.22	8.87	12.80	55.89	74.00	18.11	Peak
4810.00	34.22	8.87	3.66	46.75	54.00	7.25	Average
7215.00	35.80	11.27	8.82	55.89	74.00	18.11	Peak
7215.00	35.80	11.27	0.24	47.31	54.00	6.69	Average

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
4880.00	34.25	9.14	18.35	61.74	74.00	12.26	Peak
4880.00	34.25	9.14	8.54	51.93	54.00	2.07	Average
7320.00	35.80	11.80	9.20	56.80	74.00	17.20	Peak
7320.00	35.80	11.80	0.36	47.96	54.00	6.04	Average

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
4880.00	34.25	9.14	13.23	56.62	74.00	17.38	Peak
4880.00	34.25	9.14	4.46	47.85	54.00	6.15	Average
7320.00	35.80	11.80	10.09	57.69	74.00	16.31	Peak
7320.00	35.80	11.80	1.36	48.96	54.00	5.04	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 (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4950.00	34.28	9.35	18.78	62.41	74.00	11.59	Peak
4950.00	34.28	9.35	8.89	52.52	54.00	1.48	Average
7425.00	35.80	12.56	8.42	56.78	74.00	17.22	Peak
7425.00	35.80	12.56	0.16	48.52	54.00	5.48	Average

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
4950.00	34.28	9.35	14.30	57.93	74.00	16.07	Peak
4950.00	34.28	9.35	5.61	49.24	54.00	4.76	Average
7425.00	35.80	12.56	8.74	57.10	74.00	16.90	Peak
7425.00	35.80	12.56	-0.30	48.06	54.00	5.94	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
4960.00	34.29	9.40	15.50	59.19	74.00	14.81	Peak
4960.00	34.29	9.40	7.28	50.97	54.00	3.03	Average
7440.00	35.80	12.56	8.20	56.56	74.00	17.44	Peak
7440.00	35.80	12.56	-0.51	47.85	54.00	6.15	Average

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
4960.00	34.29	9.40	11.23	54.92	74.00	19.08	Peak
4960.00	34.29	9.40	1.86	45.55	54.00	8.45	Average
7440.00	35.80	12.56	8.84	57.20	74.00	16.80	Peak
7440.00	35.80	12.56	0.28	48.64	54.00	5.36	Average

A.2.3 Emissions in Non-restricted Frequency Bands:

Pursuant to KDB 558074 D01 DTS Meas Guidance v04 that emission levels below the 15.209 general radiated emissions limits is not required.

A.3 6dB BANDWIDTH

Test Date	2017/04/19	Temp./Hum.	23°C/53%
Cable Loss	1dB	Test Voltage	DC 5V

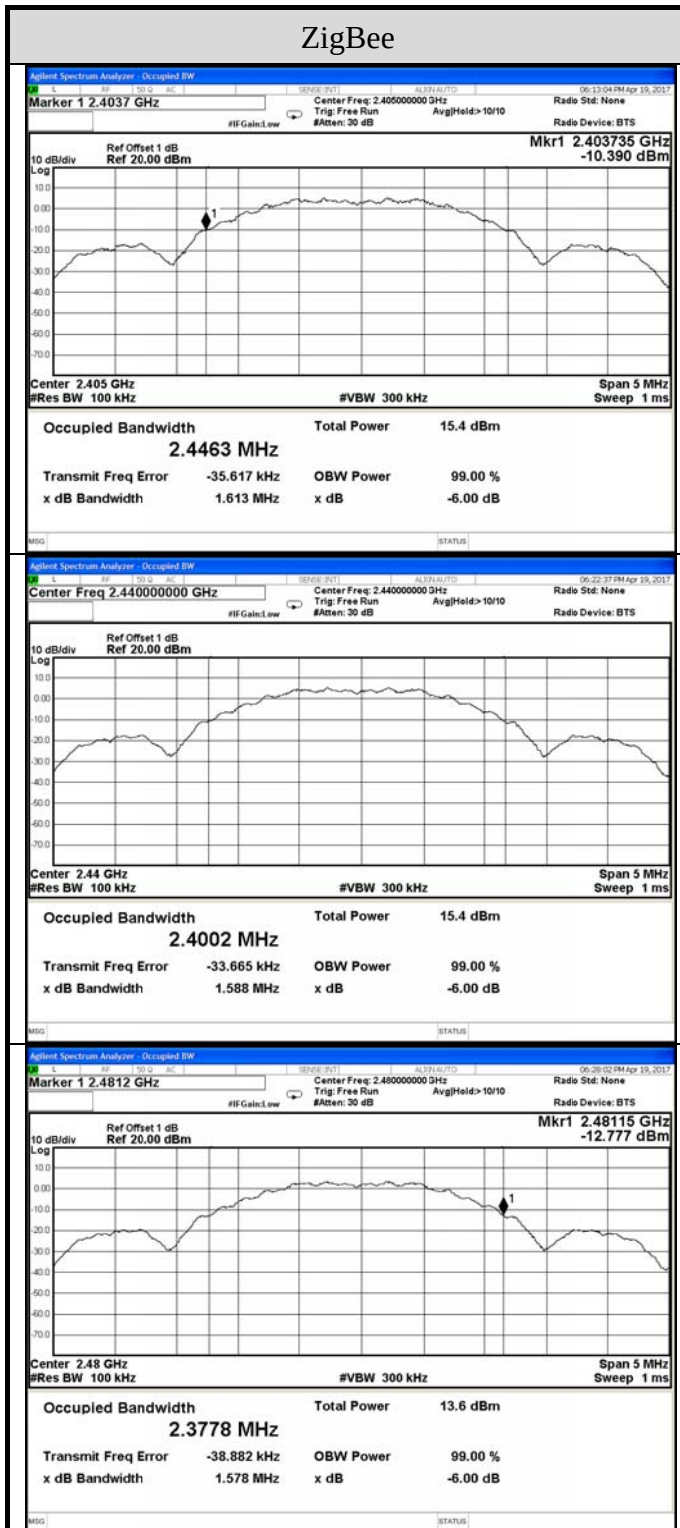
A.3.1 6dB Bandwidth Result

Mode	Centre Frequency (MHz)	6 dB Bandwidth (MHz)	Limit
ZigBee	2405	1.613	>500kHz
	2440	1.588	
	2480	1.578	

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A.3.2 Measurement Plots



A.4 MAXIMUM PEAK OUTPUT POWER

Test Date	2017/04/19	Temp./Hum.	23°C/53%
Cable Loss	1dB	Test Voltage	DC 5V

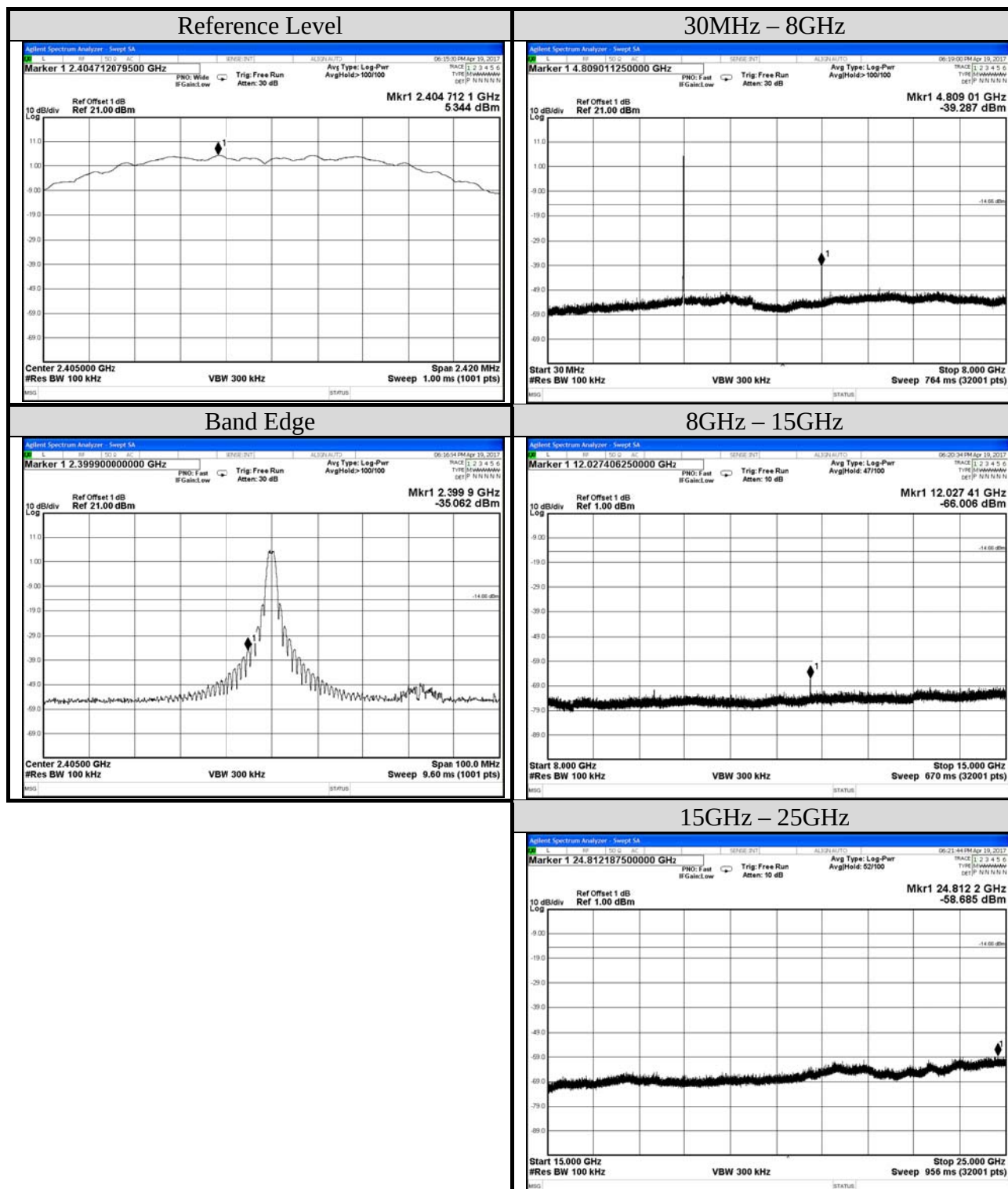
A.4.1 Peak Output Power

Mode	Centre Frequency (MHz)	MAX Output Power		Limit
		(dBm)	(W)	
ZigBee	2405	8.76	0.007516	< 30dBm (1W)
	2410	8.76	0.007516	
	2415	8.75	0.007499	
	2420	8.72	0.007447	
	2425	8.70	0.007413	
	2430	8.67	0.007362	
	2435	8.62	0.007278	
	2440	8.52	0.007112	
	2445	8.52	0.007112	
	2450	8.45	0.006998	
	2455	8.40	0.006918	
	2460	8.32	0.006792	
	2465	8.27	0.006714	
	2470	8.21	0.006622	
	2475	8.12	0.006486	
	2480	4.37	0.002735	

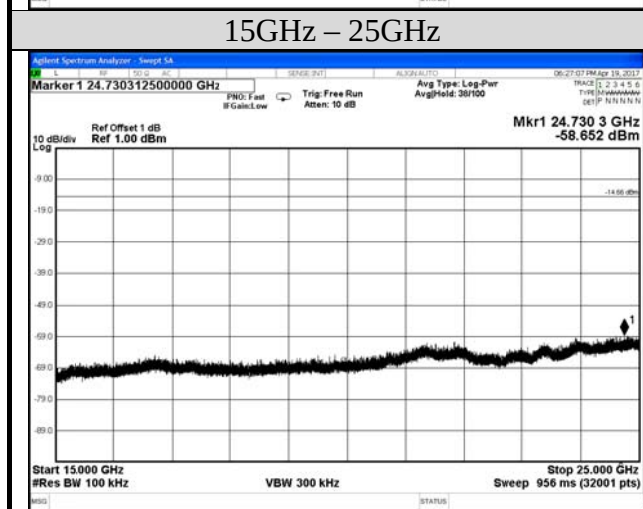
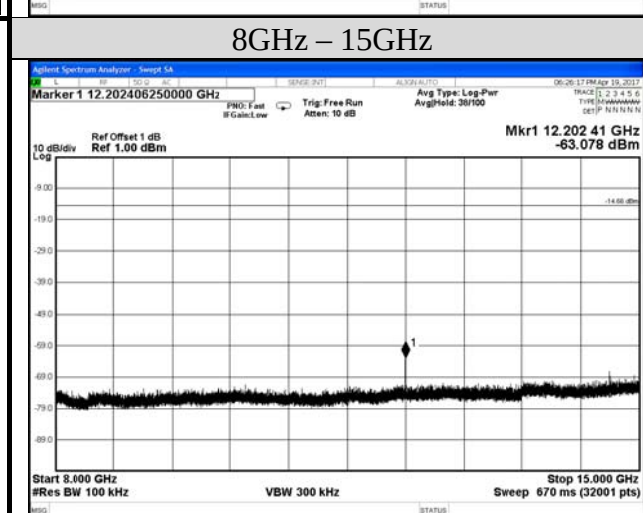
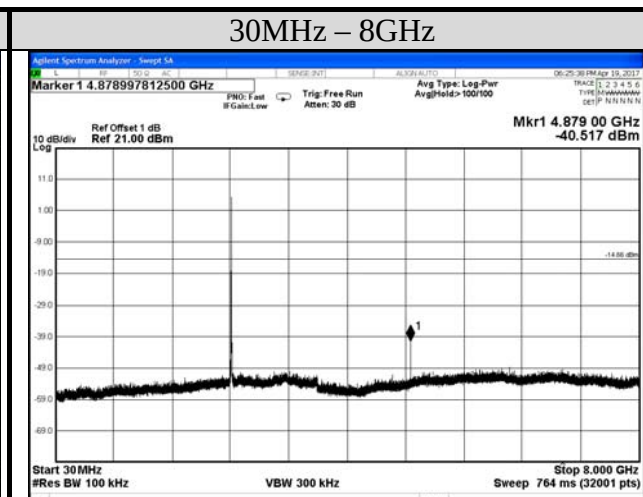
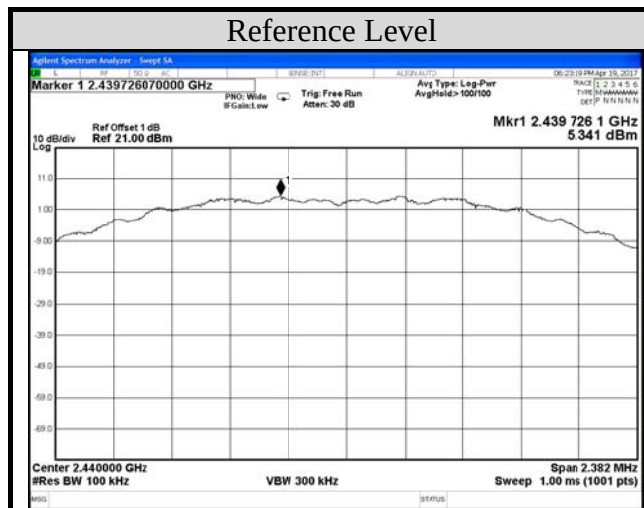
Note: The results have been included cable loss.

A.5 EMISSION LIMITATIONS

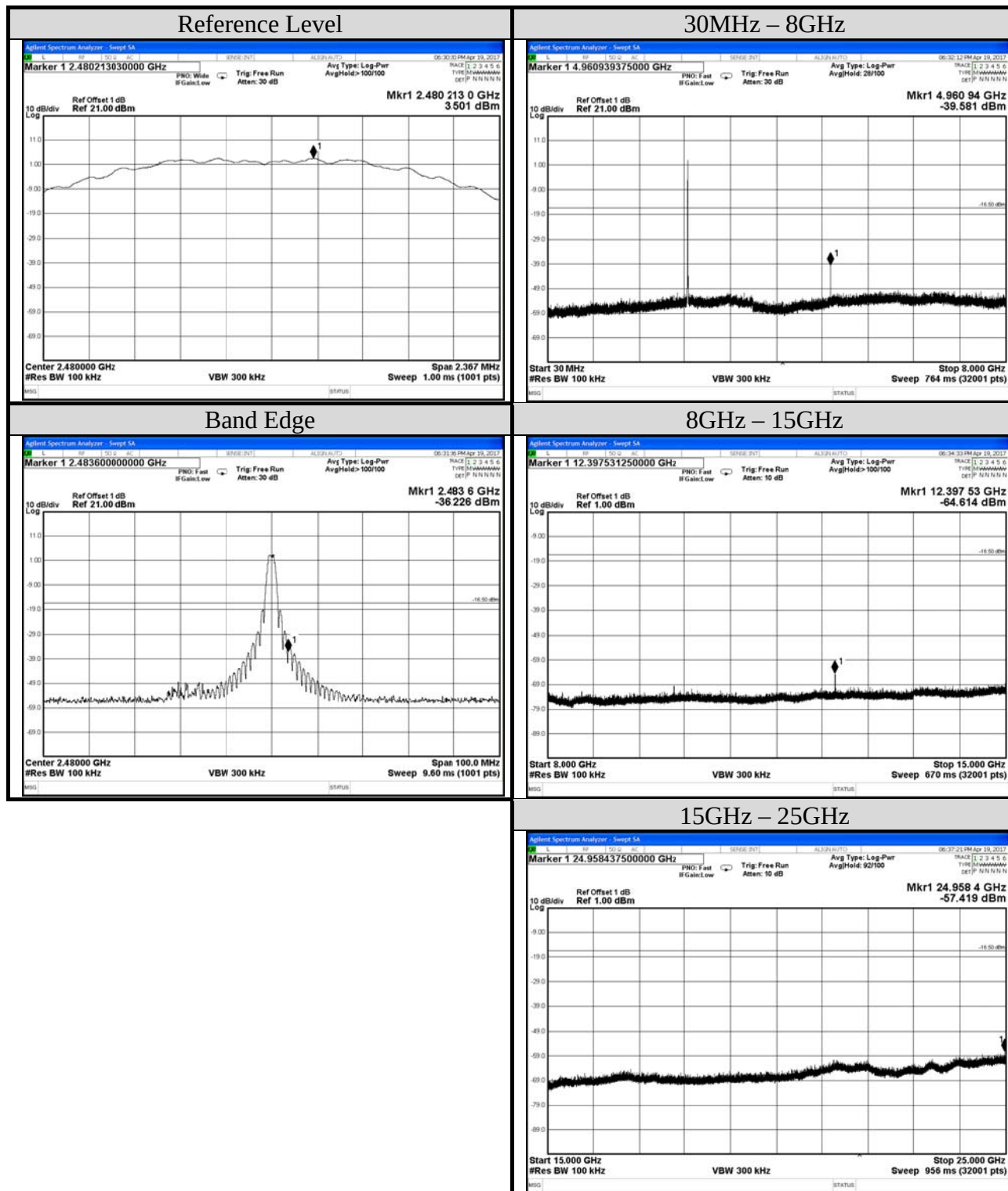
Test Date	2017/04/19	Temp./Hum.	23°C/53%
Cable Loss	1dB	Test Voltage	DC 5V
Mode	ZigBee	Frequency	TX 2405MHz



Test Date	2017/04/19	Temp./Hum.	23°C/53%
Cable Loss	1dB	Test Voltage	DC 5V
Mode	ZigBee	Frequency	TX 2440MHz



Test Date	2017/04/19	Temp./Hum.	23°C/53%
Cable Loss	1dB	Test Voltage	DC 5V
Mode	ZigBee	Frequency	TX 2480MHz



A.6 POWER SPECTRAL DENSITY

Test Date	2017/04/19	Temp./Hum.	23°C/53%
Cable Loss	1dB	Test Voltage	DC 5V

A.6.1 Power Spectral Density Result

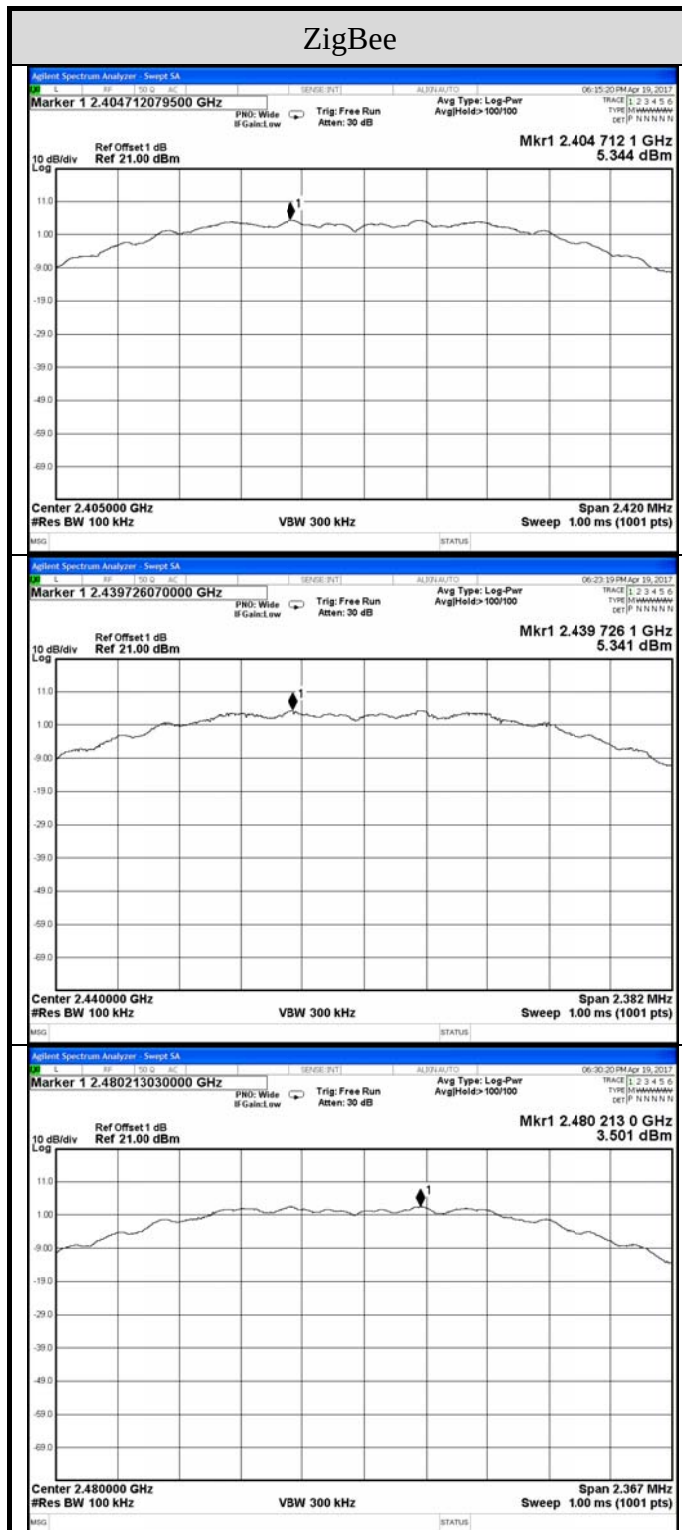
Mode	Centre Frequency (MHz)	Power Spectral Density (dBm)	Limit
ZigBee	2405	5.344	< 8 dBm/3kHz
	2440	5.341	
	2480	3.501	

Note: All results have been included cable loss and Simultaneous Factor.

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A.6.2 Measurement Plots



Note: All results have been included cable loss and Simultaneous Factor.