

FCC 15.247
2.4 GHz Report

for

Chungear Industrial Co., Ltd

106 Kanho Rd., Taichung, Taiwan

Product Name : Ceiling Fan Remote Controller
Model Name : MR101Z
FCC ID : KUJCE10406

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APPENDIX A TEST PHOTOGRAPHS

TEST REPORT CERTIFICATION

Applicant : Chungear Industrial Co., Ltd
Manufacturer #1 : Chungear Industrial Co., Ltd
Manufacturer #2 : Satellite Electronic (Zhongshan) Ltd.
Manufacturer #3 : Zhongshan Amity Electronic Ltd.
Product Name : Ceiling Fan Remote Controller
Model No. : MR101Z
Serial No. : N/A
Power Supply : AC 120V/60Hz
Applicable Standards:

FCC Rules and Regulations Part 15 Subpart C, Oct. 2014
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. 09. 16 ~ 10. 20

Date of Report: 2015. 10. 22

Producer: Sabrina Wang
(Sabrina Wang/Administrator)

Signatory: Ben Cheng
(Ben Cheng/Manager)

1. REPORT HISTORY

Revision	Date	Revision Summary	Report Number
0	2015. 10. 22	Original Report.	EM-F150636

2. SUMMARY OF TEST RESULTS

Rule	Description	Results
15.207	Conducted Emission	PASS
15.247(d)/ 15.205	Radiated Band Edge and Radiated Spurious Emission	PASS
15.247(a)	6dB Bandwidth	PASS
15.247(b)	Maximum Peak Output	PASS
15.247(d)	Conducted Band Edges and Conducted Spurious Emission	PASS
15.247 (e)	Power Spectral Density	PASS
15.203	Antenna Requirement	PASS

3. GENERAL INFORMATION

3.1. Description of EUT

Product	Ceiling Fan Remote Controller
Model Number	MR101Z
Serial Number	N/A
Brand Name	None
Applicant	Chungear Industrial Co., Ltd 106 Kanho Rd., Taichung, Taiwan
Manufacture#1	Chungear Industrial Co., Ltd 106 Kanho Rd., Taichung, Taiwan
Manufacture#2	Satellite Electronic (Zhongshan), Ltd. No.15, Torch Hi-Tech Industrial Development Zone, Zhong Shan City Guangdong Province China
Manufacture#3	Zhongshan Amity Electronic Ltd. No. 16 Torch Hi-Tech Industrial Development Zone, Zhong Shan City Guangdong Province China
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. 13

3.2. EUT Specifications Assessed in Current Report

RF Features	Fundamental Range (MHz)	Channel Number	Modulation	Data Rate (Mbps)
ZigBee (IEEE 802.15.4)	2405-2475	15	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		

3.3. Antenna Information

Antenna Part Number	Manufacture	Antenna Type	Frequency	Max Gain (dBi)
5002170	Ethertronics Inc.	PCB Antenna	2400~2500MHz	3.4

3.4. Test Configuration

Mode	Duty Cycle (x)	T (ms)	Duty Cycle Factor (dB)
ZigBee	0.98	N/A	N/A

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

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

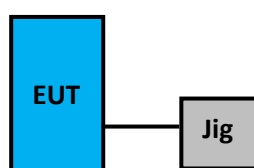
No.	Product	Manufacturer	Model No.	Serial No.	FCC ID
1	Ceiling Fan Remote Controller (Transmitter)	Chungear Industrial Co., Ltd.	TR227A	N/A	KUJCE10401
2.	Test Jig	N/A	N/A	N/A	N/A

3.5.2. Cable Lists

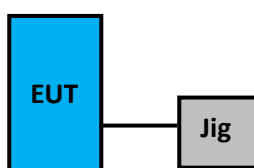
No.	Cable Description Of The Above Support Units
1.	N/A
2.	DC Cable: Unshielded, Detachable, 0.2m AC Power Cord: Unshielded, Detachable, 1.8m

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

The transmitter (TR227A) 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	:	Semi-Anechoic Chamber No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan Fully Anechoic Chamber No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan
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~1000MHz	± 4.70dB
	Above 1GHz	± 1.60dB

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-526	MY53400071	2015. 09. 14	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

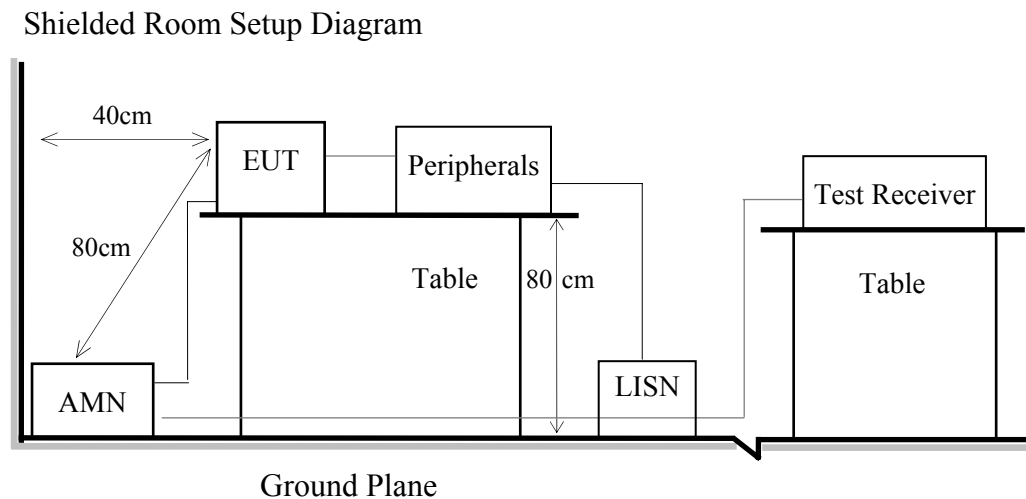
Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	E4446A	US44300366	2015. 08. 20	1 Year
2.	Amplifier	Sonoma	310N	187161	2015. 06. 17	1 Year
3.	2.4GHz Notch Filter	K&L	7NSL10-244 1.5E130.5-00	1	2015. 07. 22	1 Year
4.	3G High Pass Filter	Microwave Circuits	H3G018G1	484796	2014. 08. 25	1 Year
5.	Horn Antenna	ETS-Lindgren	3117	00135902	2015. 03. 06	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

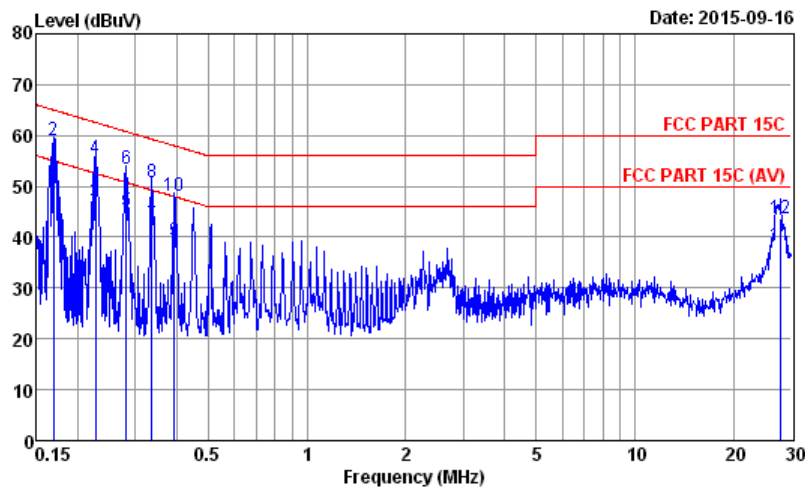
PASSED.

Test Date	2015/09/16	Temp./Hum.	28°C/61%
Test Voltage	AC 120V, 60Hz		



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Data: 2 File: D:\test data\REPORT\2015\C1M1509XXX\C1M1508198-C-D-RF-EM6 (2) Date: 2015-09-16



Site no. : No. 8 Shielded Room Data no. : 2
Condition : ENV4200 100169 Phase : NEUTRAL
Limit : FCC PART 15C
Env. / Ins. : 28°C / 61% ESR3 (1774) Engineer : Tim
EUT : MR101Z
Power Rating : 120Vac/60Hz
Test Mode : Operating

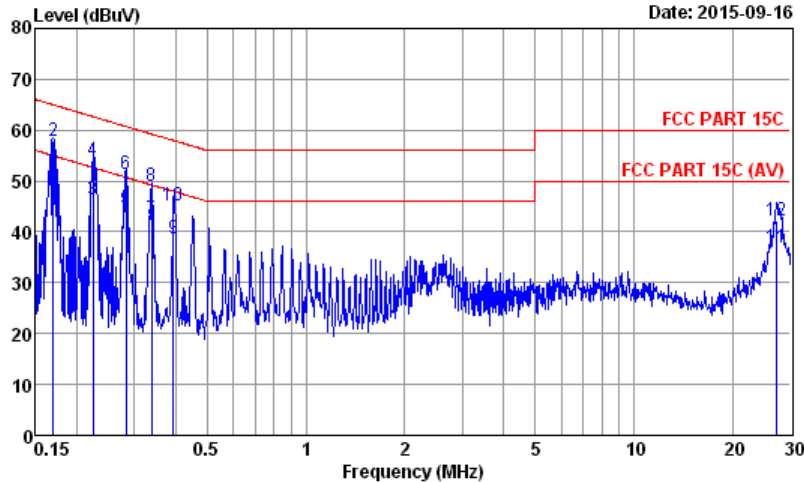
	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.169	11.36	0.03	9.87	28.33	49.59	55.03	5.44	Average
2	0.169	11.36	0.03	9.87	37.77	59.03	65.03	6.00	QP
3	0.227	11.20	0.03	9.87	25.72	46.82	52.57	5.75	Average
4	0.227	11.20	0.03	9.87	34.36	55.46	62.57	7.11	QP
5	0.282	11.13	0.03	9.87	24.10	45.13	50.76	5.63	Average
6	0.282	11.13	0.03	9.87	32.31	53.34	60.76	7.42	QP
7	0.337	11.06	0.03	9.87	21.57	42.53	49.27	6.74	Average
8	0.337	11.06	0.03	9.87	29.76	50.72	59.27	8.55	QP
9	0.393	11.01	0.03	9.87	18.46	39.37	47.99	8.62	Average
10	0.393	11.01	0.03	9.87	27.07	47.98	57.99	10.01	QP
11	27.708	16.26	0.31	10.00	11.90	38.47	50.00	11.53	Average
12	27.708	16.26	0.31	10.00	17.14	43.71	60.00	16.29	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: 1 File: D:\test data\REPORT\2015\C1M1509XXX\C1M1508198-C-D-RF-EM6 (2) Date: 2015-09-16



Site no. : No.8 Shielded Room Data no. : 1
Condition : ENV4200 100169 Phase : LINE
Limit : FCC PART 15C
Env. / Ins. : 28°C / 61% ESR3 (1774) Engineer : Tim
EUT : MR101Z
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	0.169	10.73	0.03	9.87	28.64	49.27	54.99	5.72	Average
2	0.169	10.73	0.03	9.87	37.35	57.98	64.99	7.01	QP
3	0.224	10.66	0.03	9.87	25.83	46.39	52.66	6.27	Average
4	0.224	10.66	0.03	9.87	33.37	53.93	62.66	8.73	QP
5	0.283	10.61	0.03	9.87	24.16	44.67	50.72	6.05	Average
6	0.283	10.61	0.03	9.87	30.93	51.44	60.72	9.28	QP
7	0.339	10.58	0.03	9.87	22.11	42.59	49.22	6.63	Average
8	0.339	10.58	0.03	9.87	28.45	48.93	59.22	10.29	QP
9	0.393	10.55	0.03	9.87	18.36	38.81	47.99	9.18	Average
10	0.393	10.55	0.03	9.87	24.85	45.30	57.99	12.69	QP
11	27.271	15.22	0.30	9.99	11.53	37.04	50.00	12.96	Average
12	27.271	15.22	0.30	9.99	16.74	42.25	60.00	17.75	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.

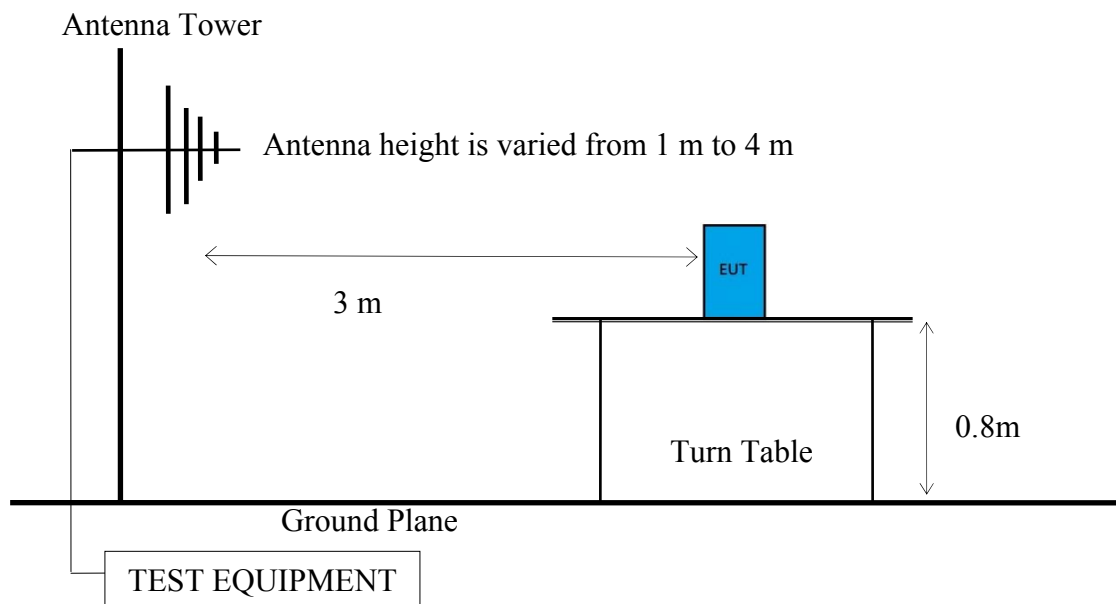
6. RADIATED EMISSION MEASUREMENT

6.1. Block Diagram of Test Setup

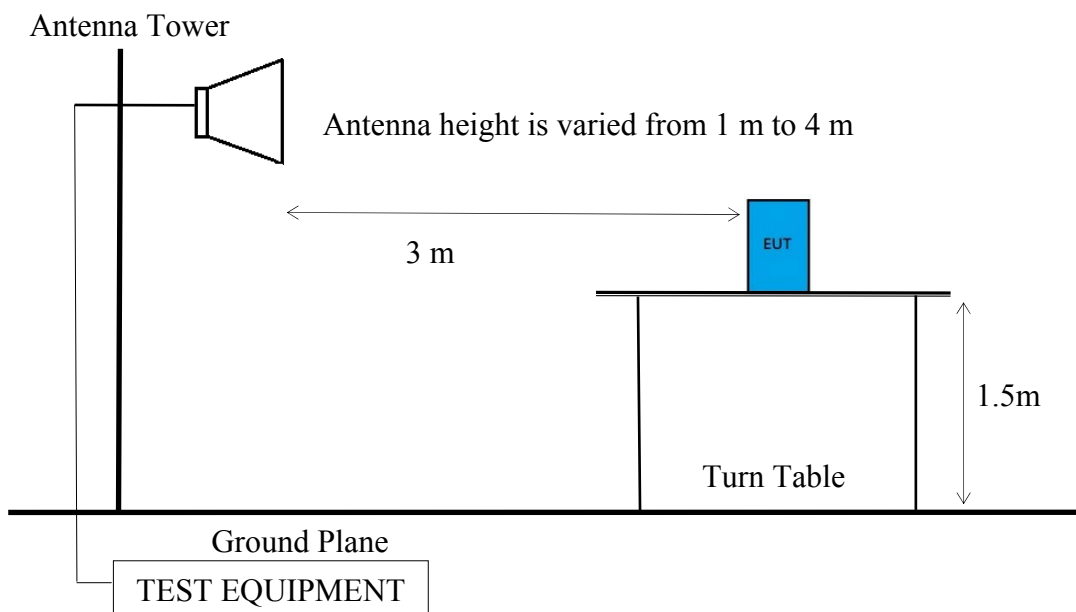
6.1.1. Block Diagram of EUT

Indicated as section 3.6

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



6.1.3. Fully 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, 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 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.

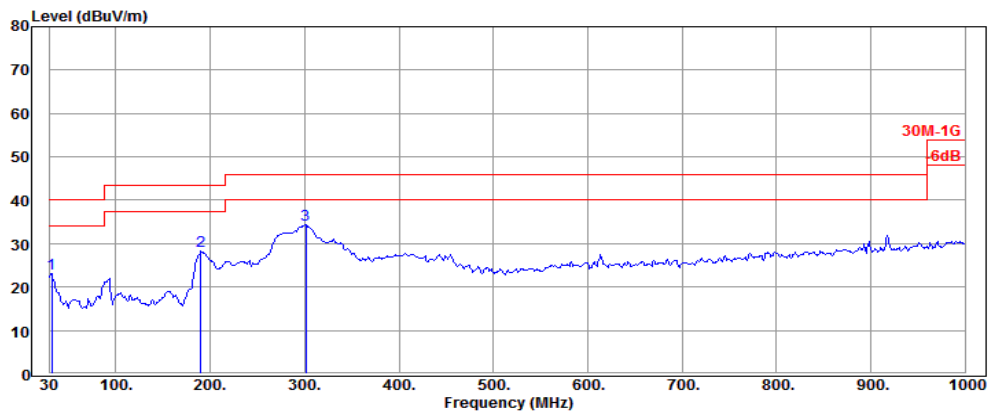
Test Date	2015. 10. 20	Temp./Hum.	25°C/51%
Test Voltage	AC 120V, 60Hz		

6.5.1. Emissions within Restricted Frequency Bands

6.5.1.1. Frequency Below 1 GHz

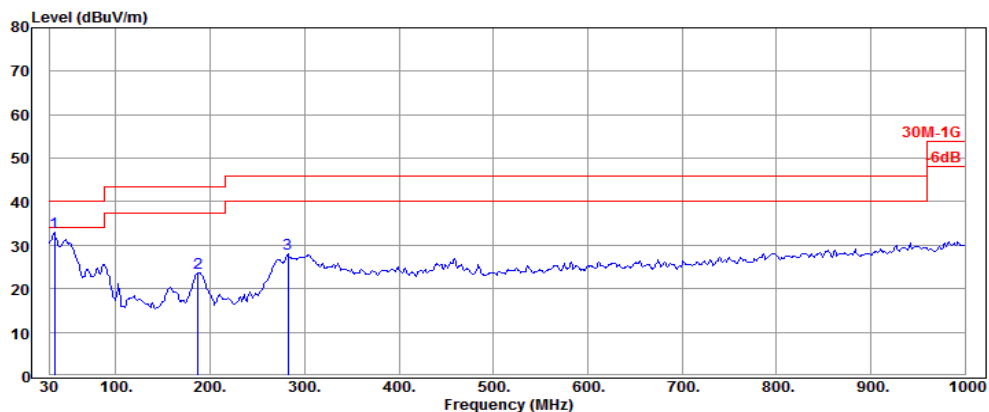
Mode	ZigBee	Frequency	TX 2405MHz
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Antenna at Horizontal Polarization



Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
31.94	17.52	2.37	3.21	23.10	40.00	16.90	Peak
190.05	9.19	3.90	15.10	28.19	43.50	15.31	Peak
301.60	13.16	4.67	16.47	34.30	46.00	11.70	Peak

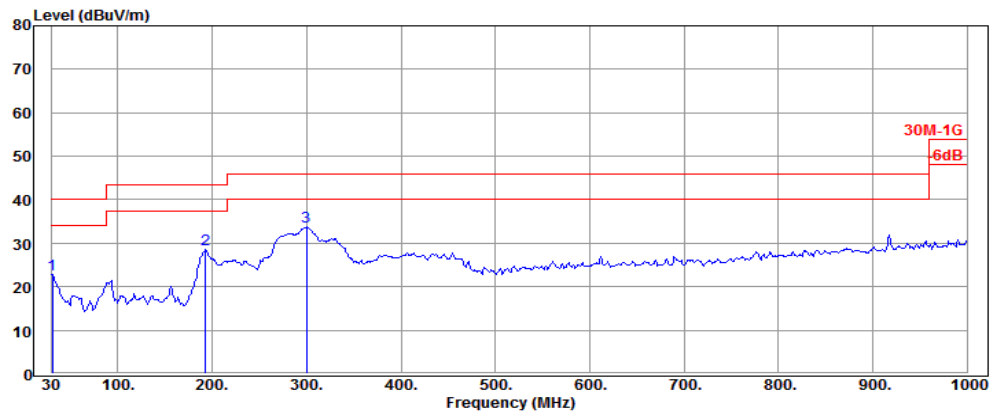
Antenna at Vertical Polarization



Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
34.85	16.00	2.43	14.44	32.87	40.00	7.13	Peak
187.14	9.18	3.88	10.70	23.76	43.50	19.74	Peak
282.20	12.88	4.55	10.49	27.92	46.00	18.08	Peak

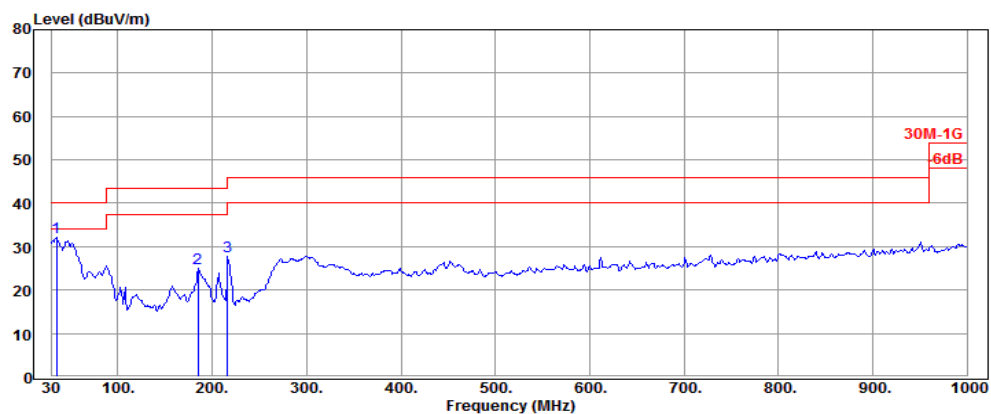
Mode	ZigBee	Frequency	TX 2440MHz
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Antenna at Horizontal Polarization



Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
30.97	18.07	2.34	2.34	22.75	40.00	17.25	Peak
192.96	9.22	3.93	15.45	28.60	43.50	14.90	Peak
299.66	13.12	4.65	15.91	33.68	46.00	12.32	Peak

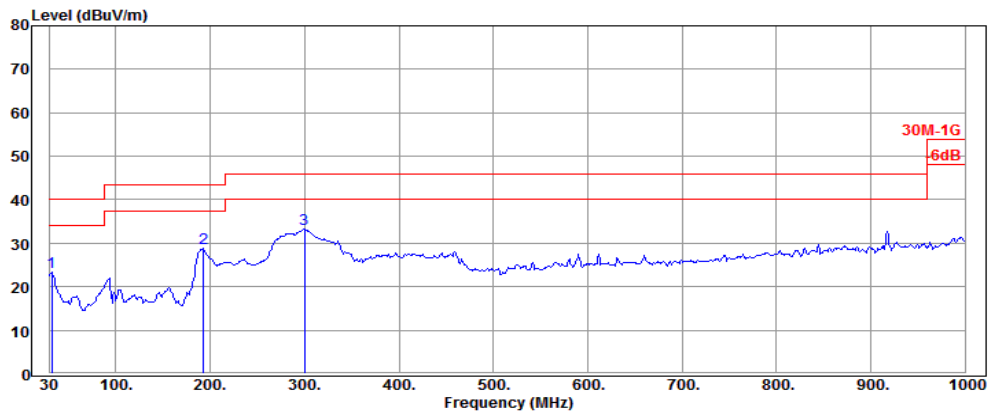
Antenna at Vertical Polarization



Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
34.85	16.00	2.43	13.75	32.18	40.00	7.82	Peak
185.20	9.16	3.87	12.06	25.09	43.50	18.41	Peak
216.24	10.35	4.10	13.21	27.66	46.00	18.34	Peak

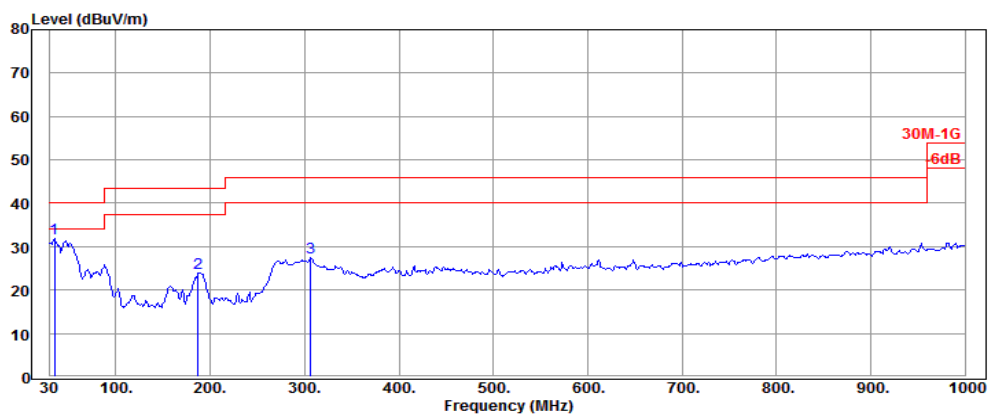
Mode	ZigBee	Frequency	TX 2475MHz
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Antenna at Horizontal Polarization



Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
31.94	17.52	2.37	3.51	23.40	40.00	16.60	Peak
192.96	9.22	3.93	15.67	28.82	43.50	14.68	Peak
299.66	13.12	4.65	15.53	33.30	46.00	12.70	Peak

Antenna at Vertical Polarization

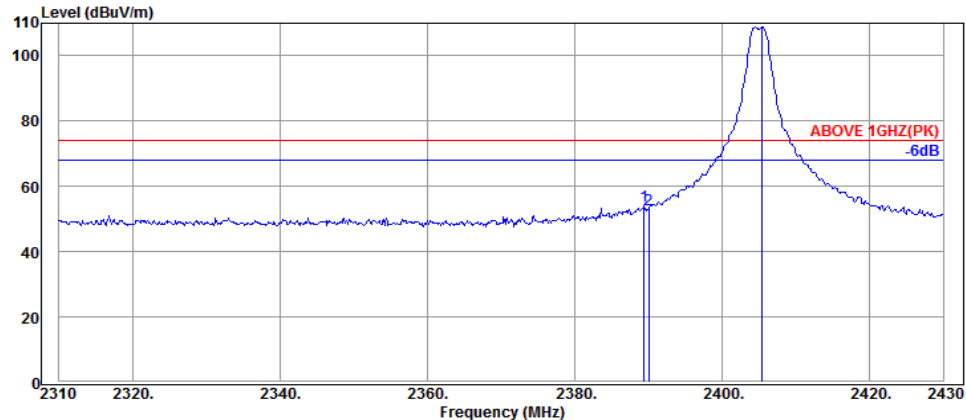


Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
34.85	16.00	2.43	13.48	31.91	40.00	8.09	Peak
187.14	9.18	3.88	10.86	23.92	43.50	19.58	Peak
306.45	13.31	4.73	9.54	27.58	46.00	18.42	Peak

6.5.1.2. Frequency Above 1 GHz to 10th harmonics

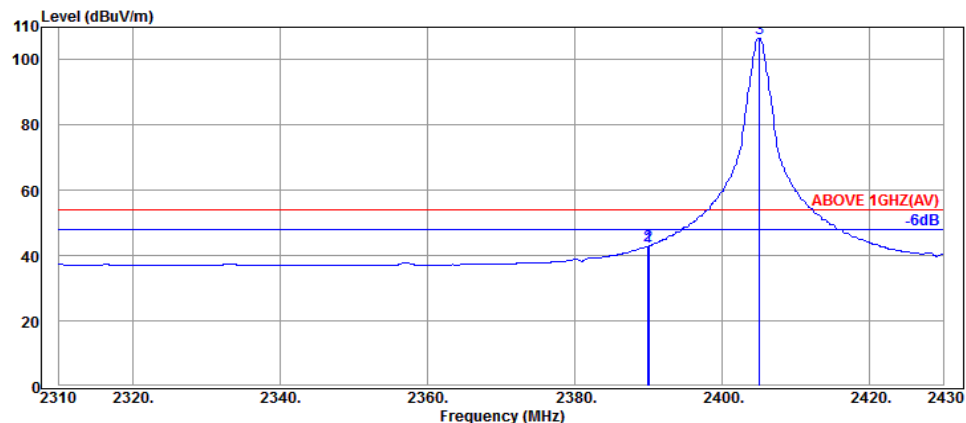
Band Edge:

Mode	ZigBee	Frequency	TX 2405MHz
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Antenna at Horizontal Polarization

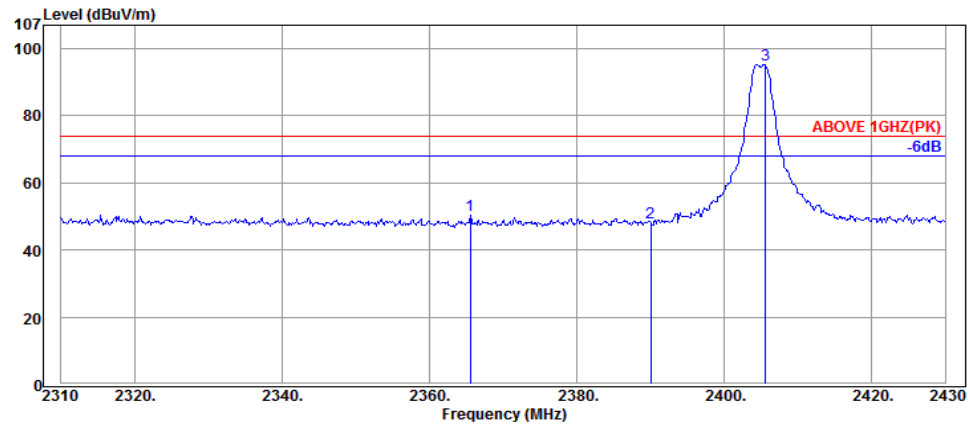
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2389.44	32.16	5.72	16.21	54.09	74.00	19.91	Peak
2390.04	32.16	5.72	15.19	53.07	74.00	20.93	Peak
2405.40	32.18	5.74	70.82	108.74	---	---	Peak



Antenna at Horizontal Polarization

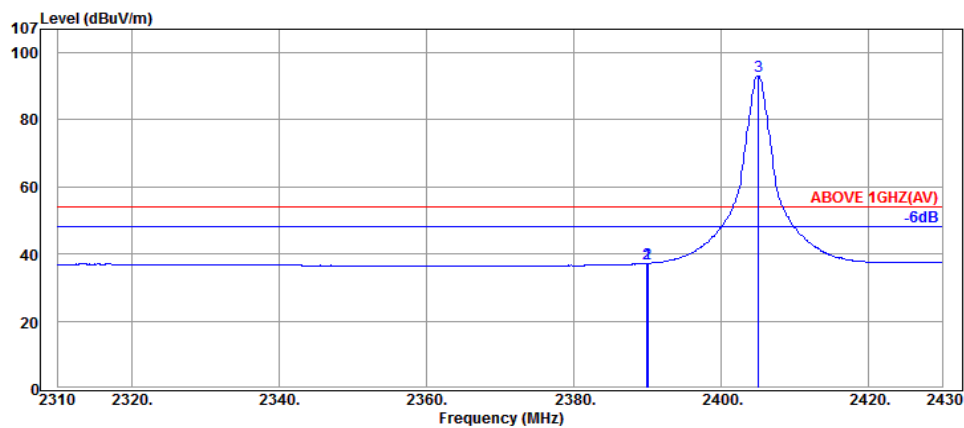
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2389.92	32.16	5.72	5.02	42.90	54.00	11.10	Average
2390.04	32.16	5.72	5.05	42.93	54.00	11.07	Average
2405.04	32.18	5.74	68.68	106.60	---	---	Average

Mode	ZigBee	Frequency	TX 2405MHz
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Antenna at Vertical Polarization

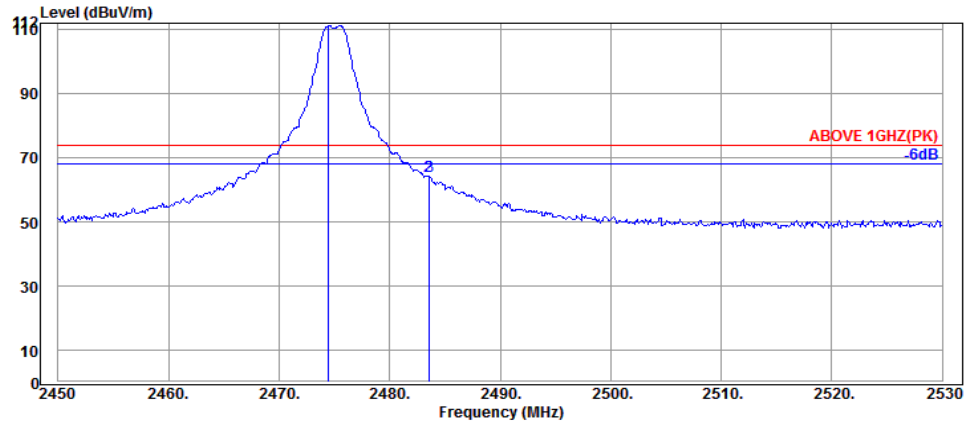
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2365.56	32.11	5.69	12.59	50.39	74.00	23.61	Peak
2390.04	32.16	5.72	10.33	48.21	74.00	25.79	Peak
2405.64	32.18	5.74	57.41	95.33	---	---	Peak



Antenna at Vertical Polarization

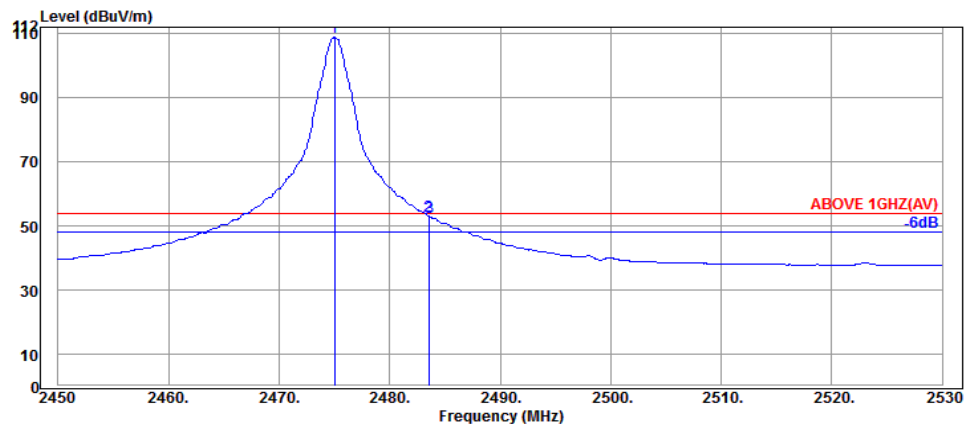
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2389.92	32.16	5.72	-0.67	37.21	54.00	16.79	Average
2390.04	32.16	5.72	-0.66	37.22	54.00	16.78	Average
2405.04	32.18	5.74	55.14	93.06	---	---	Average

Mode	ZigBee	Frequency	TX 2475MHz
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Antenna at Horizontal Polarization

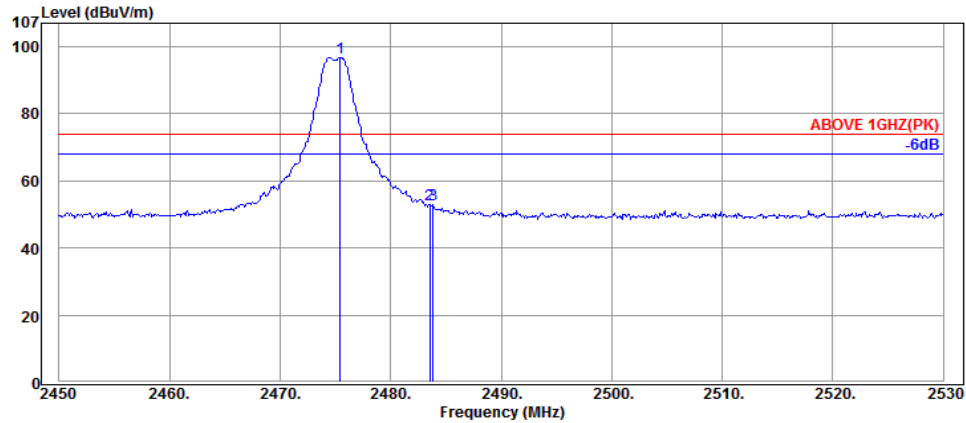
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2474.40	32.28	5.82	73.12	111.22	---	---	Peak
2483.52	32.28	5.82	26.17	64.27	74.00	9.73	Peak
2483.60	32.28	5.82	26.04	64.14	74.00	9.86	Peak



Antenna at Horizontal Polarization

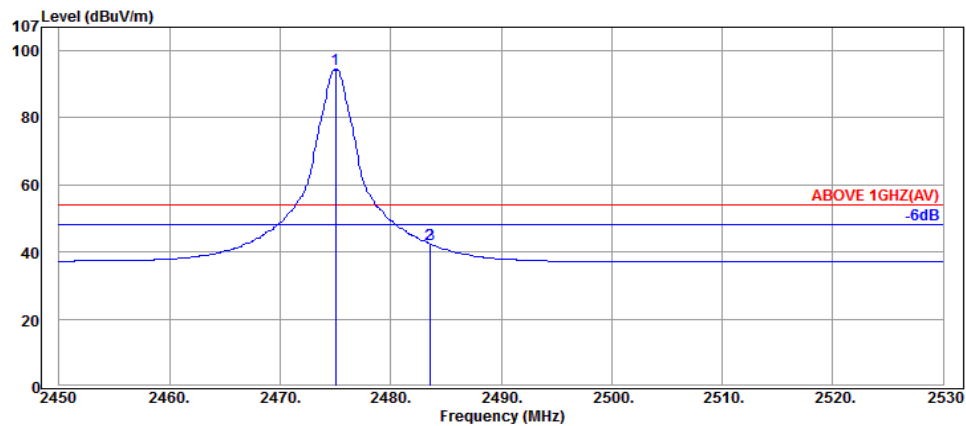
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2475.04	32.28	5.82	70.68	108.78	---	---	Average
2483.52	32.28	5.82	14.83	52.93	54.00	1.07	Average
2483.60	32.28	5.82	14.62	52.72	54.00	1.28	Average

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	5.82	58.71	96.81	---	---	Peak
2483.52	32.28	5.82	14.72	52.82	74.00	21.18	Peak
2483.84	32.28	5.82	14.87	52.97	74.00	21.03	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	32.28	5.82	56.29	94.39	---	---	Average
2483.52	32.28	5.82	4.28	42.38	54.00	11.62	Average
2483.60	32.28	5.82	4.16	42.26	54.00	11.74	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
4810.00	34.22	7.86	13.54	55.62	74.00	18.38	Peak
4810.00	34.22	7.86	4.56	46.64	54.00	7.36	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	7.86	7.58	49.66	54.00	4.34	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
4875.00	34.25	8.35	13.67	56.27	74.00	17.73	Peak
4875.00	34.25	8.35	3.93	46.53	54.00	7.47	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
4875.00	34.25	8.35	9.80	52.40	54.00	1.60	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 (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
4950.00	34.28	8.62	13.92	56.82	74.00	17.18	Peak
4950.00	34.28	8.62	4.35	47.25	54.00	6.75	Average

Antenna at Vertical Polarization

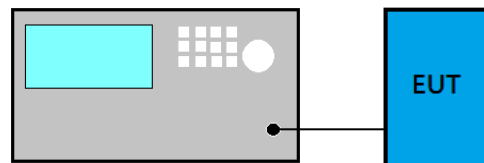
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
4950.00	34.28	8.62	10.61	53.51	54.00	0.49	Peak

6.5.3. Emissions in Non-restricted Frequency Bands

Pursuant to KDB 558074 D01 v03r03 that emission levels below the 15.209 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.

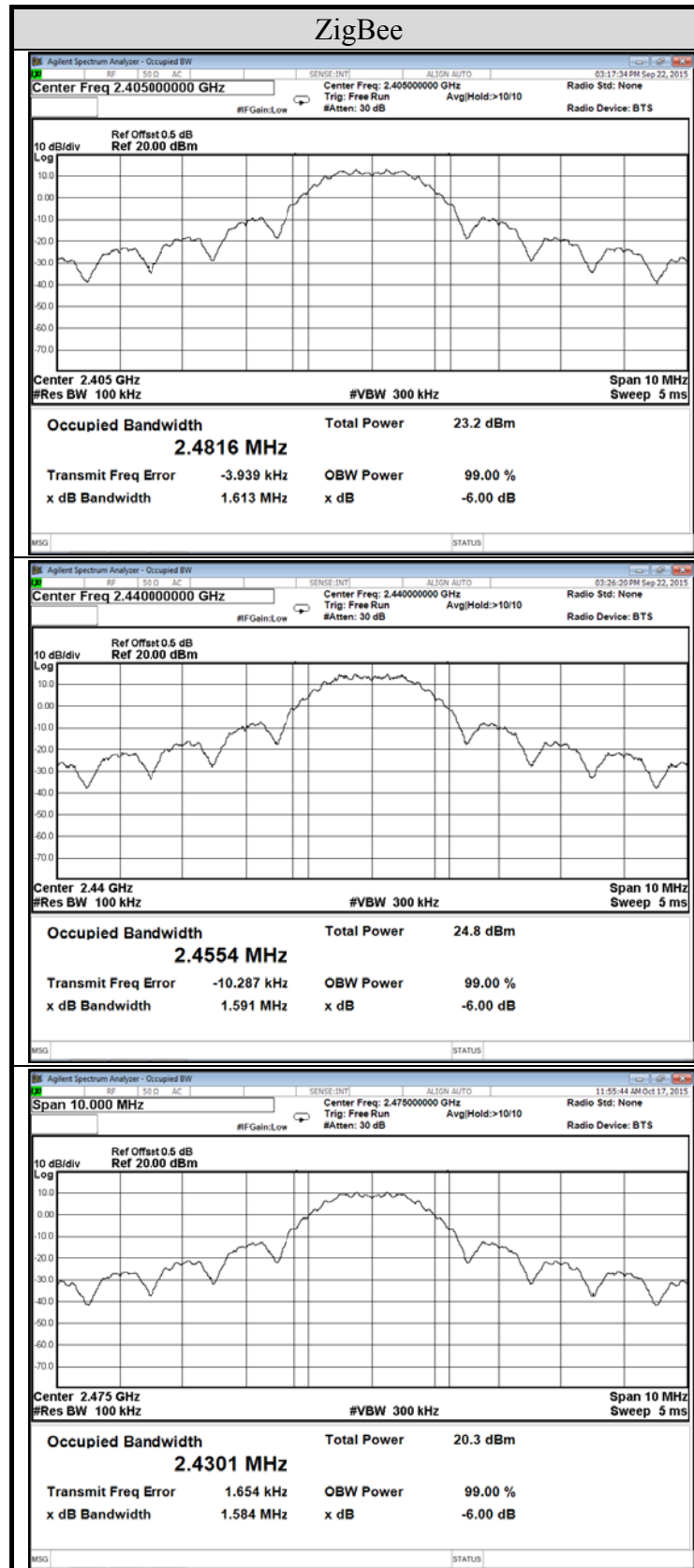
7.4. Test Results

Test Date	2015. 09. 22	Temp./Hum.	25°C/40%
Cable Loss	0.5dB	Test Voltage	AC 120V, 60Hz

7.4.1. 6dB Bandwidth Result

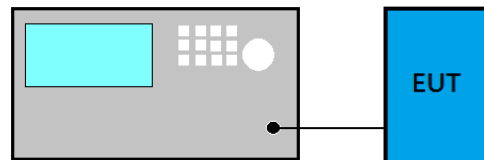
Modulation Type	Centre Frequency (MHz)	6 dB Bandwidth (MHz)
ZigBee	2405	1.613
	2440	1.591
	2475	1.584

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

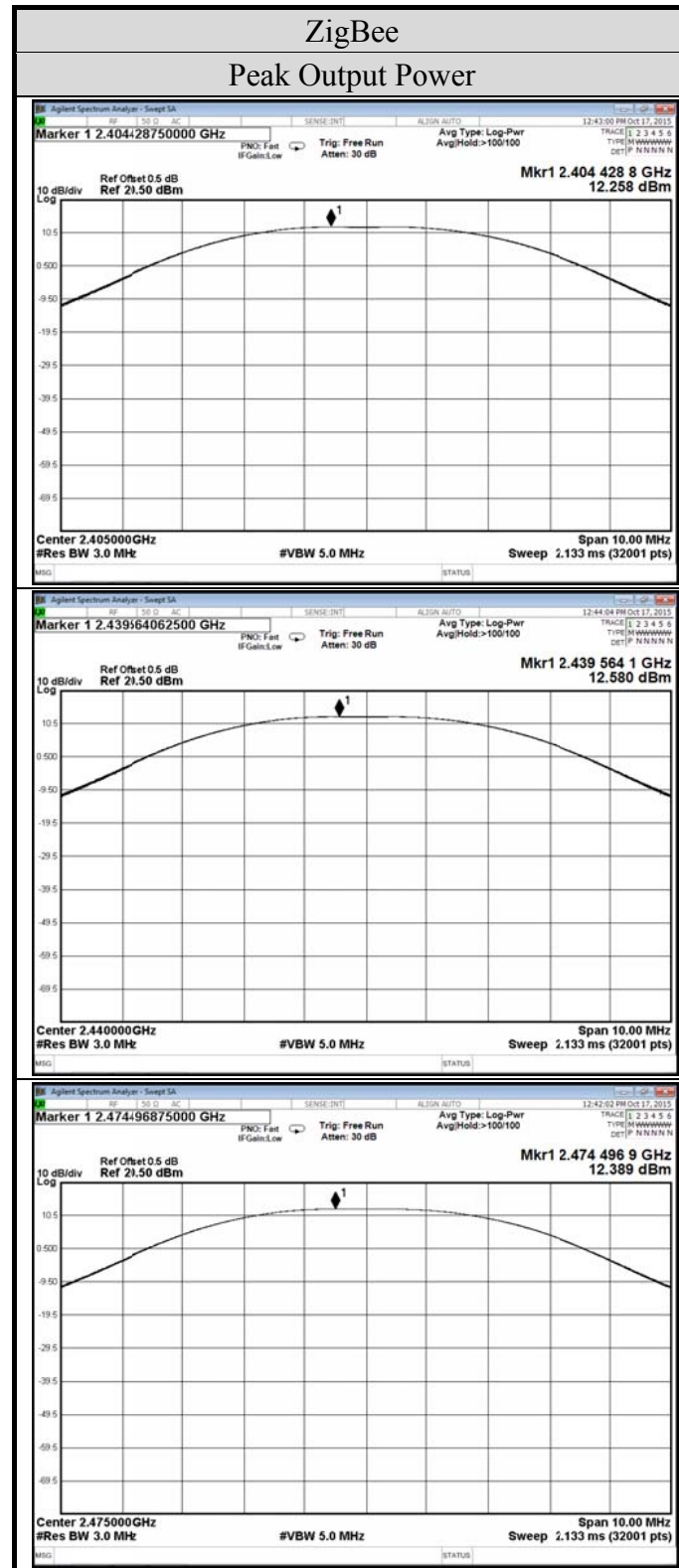
Test Date	2015. 09. 22	Temp./Hum.	25°C/40%
Cable Loss	0.5dB	Test Voltage	AC 120V, 60Hz

8.4.1. Output Power Result

Modulation Type	Centre Frequency (MHz)	Peak Output Power		Limit
		(dBm)	(W)	
ZigBee	2405	12.258	0.016819	< 30 dBm (1 W)
	2440	12.580	0.018113	
	2445	12.389	0.017334	

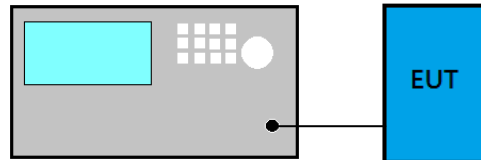
Note: The results have been included cable loss.

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) 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).

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

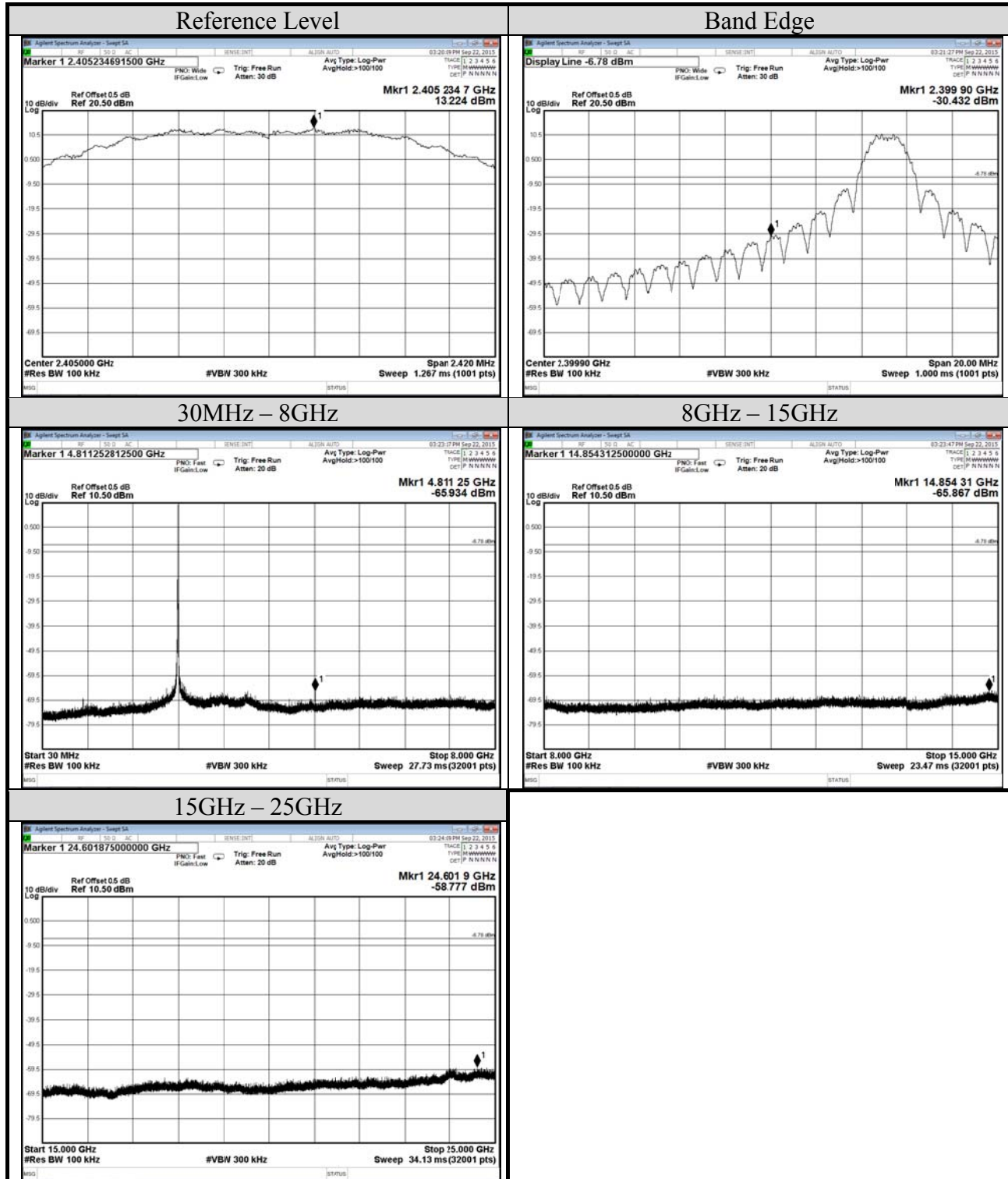
- (1) Set analyzer center frequency to DTS channel center frequency.
- (2) Set the span to 1.5 times the DTS bandwidth.
- (3) Set the RBW to: 100 kHz.
- (4) Set the VBW $\geq 3 \times$ RBW.
- (5) Detector = peak.
- (6) Sweep time = auto couple.
- (7) Trace mode = max hold.
- (8) Allow trace to fully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

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9.4. Test Results

Test Date	2015. 09. 22	Temp./Hum.	25°C/40%
Mode	ZigBee	Frequency	TX 2405MHz
Cable Loss	0.5dB	Test Voltage	AC 120V, 60Hz



File Number: C1M1508198

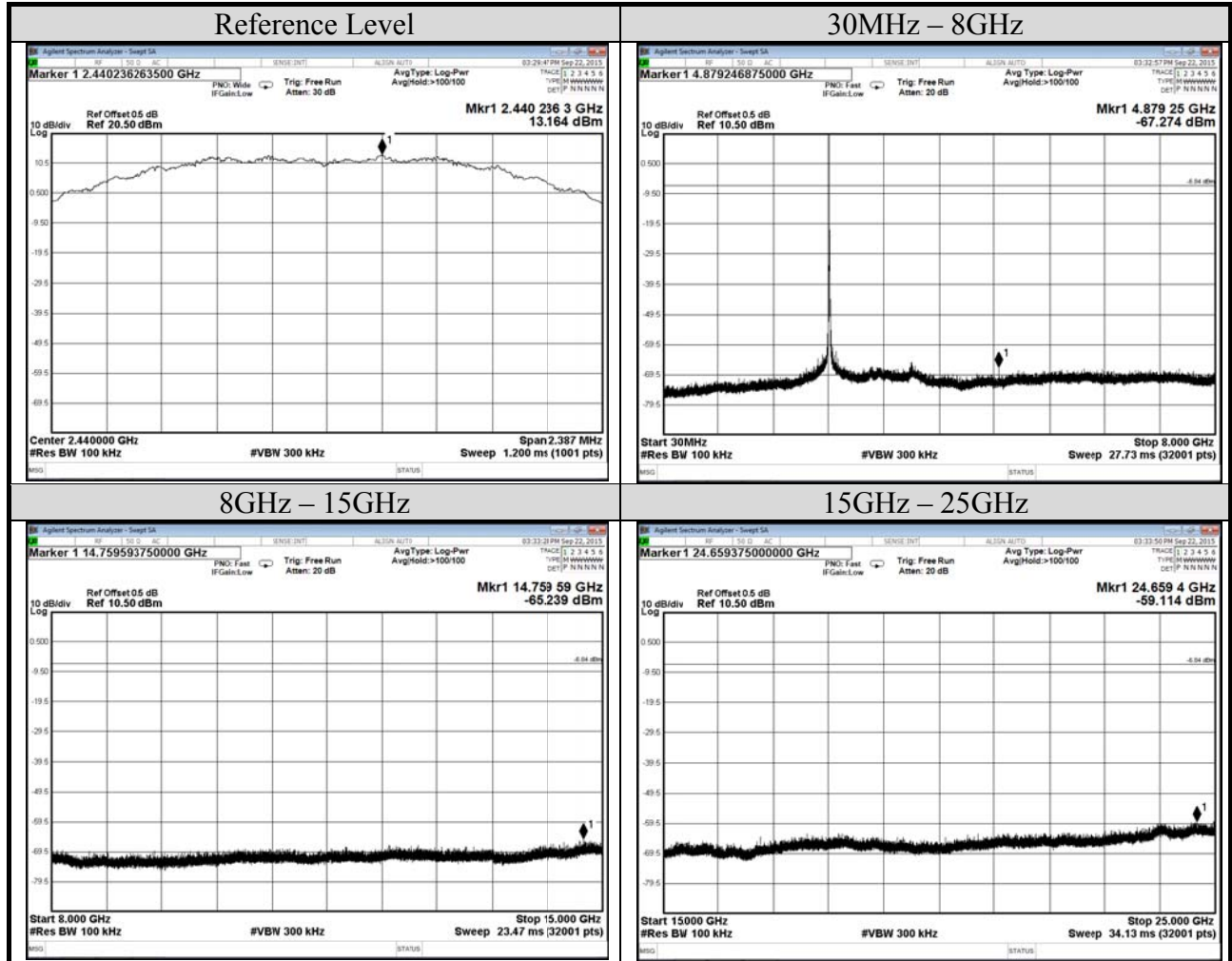
Report Number: EM-F150636

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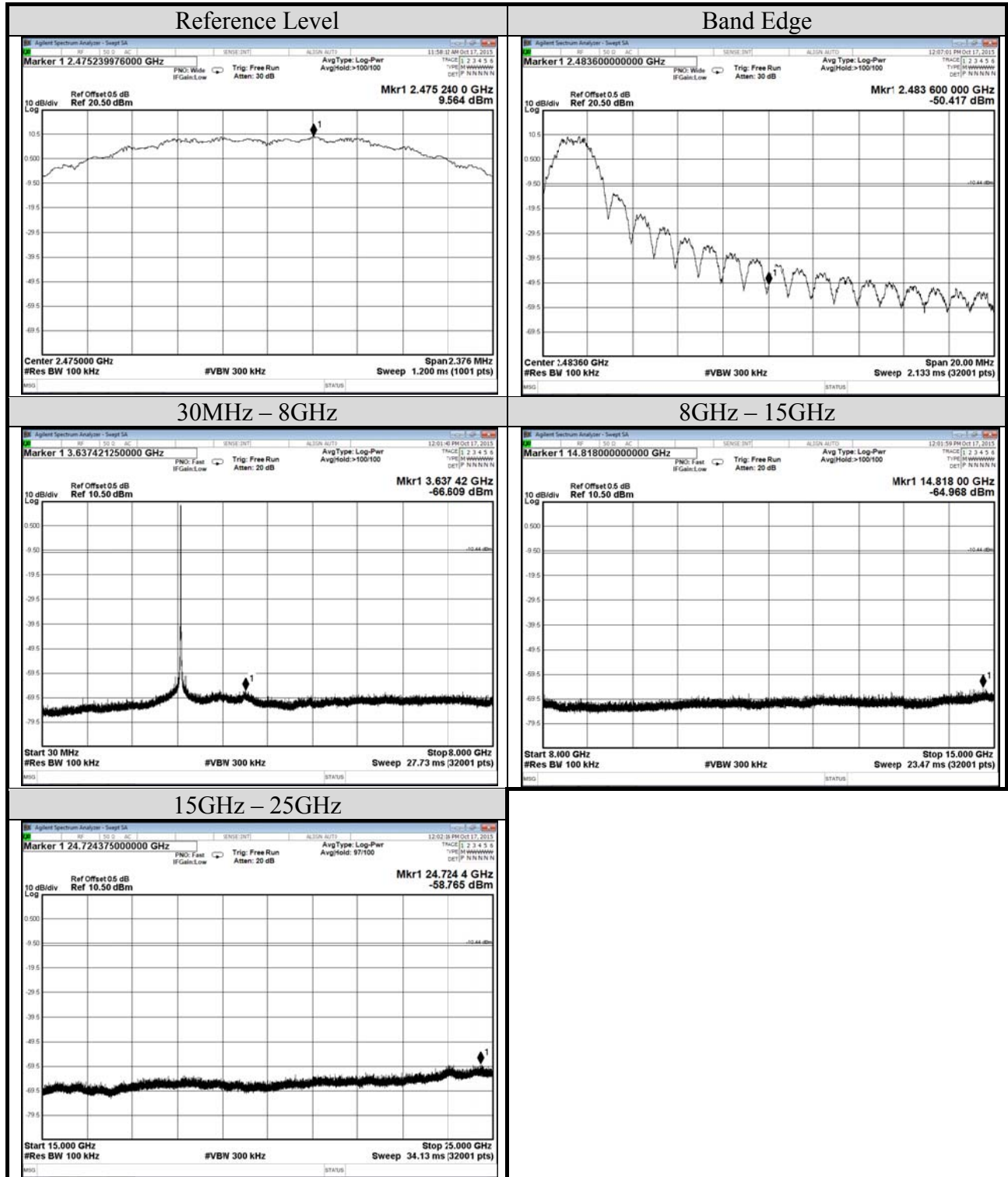
Test Date	2015. 09. 22	Temp./Hum.	25°C/40%
Mode	ZigBee	Frequency	TX 2440MHz
Cable Loss	0.5dB	Test Voltage	AC 120V, 60Hz



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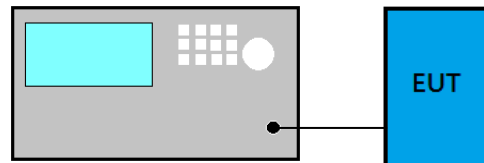
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Test Date	2015. 09. 22	Temp./Hum.	25°C/40%
Mode	ZigBee	Frequency	TX 2475MHz
Cable Loss	0.2dB	Test Voltage	AC 120V, 60Hz



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)

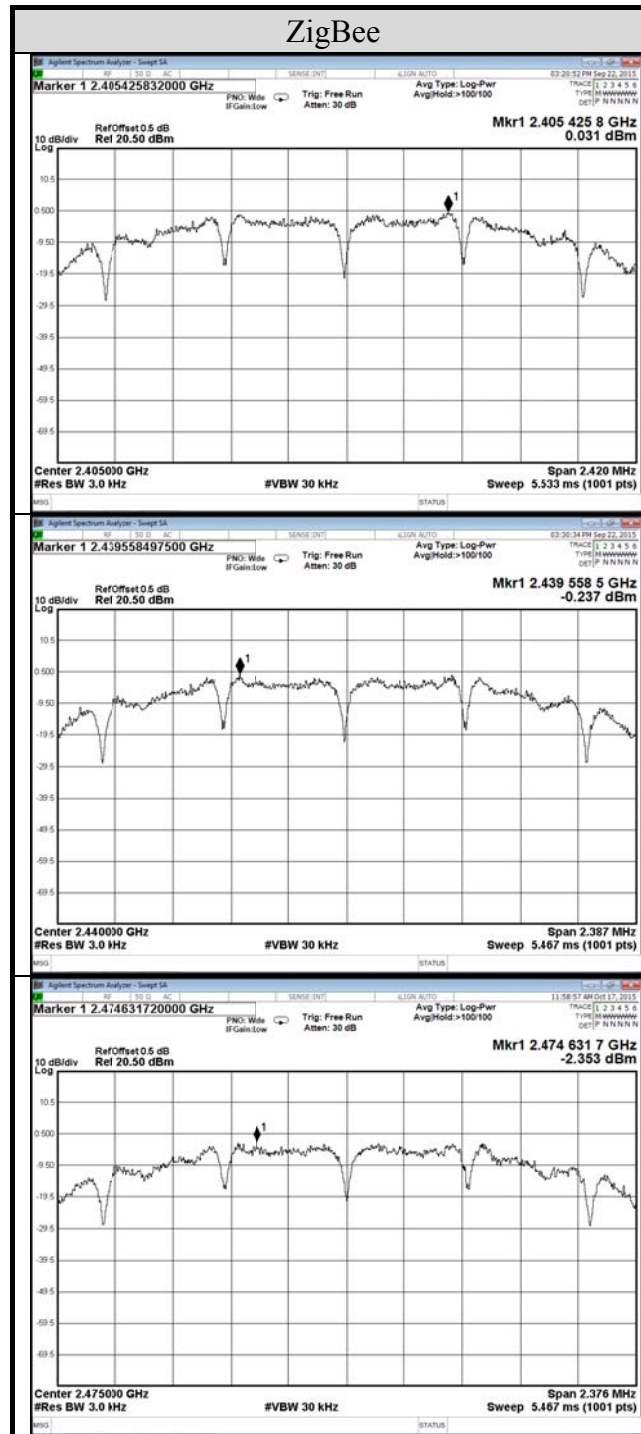
- (1) Set analyzer center frequency to DTS channel center frequency.
- (2) Set the span to 1.5 times the DTS bandwidth.
- (3) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- (4) Set the VBW $\geq 3 \times \text{RBW}$.
- (5) Detector = peak.
- (6) Sweep time = auto couple.
- (7) 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. 09. 22	Temp./Hum.	25°C/40%
Cable Loss	0.5dB	Test Voltage	AC 120V, 60Hz



11.DEVIATION TO TEST SPECIFICATIONS

【NONE】