TESTING LABORATORY
CERTIFICATE # 4821.01

FCC PART 15.247

TEST REPORT

For

Tritech Technology Limited

Unit D, 15th Floor, Chinabest Internatioal Centre, No.8 Kwai On Road, Kwai Chung, New Territories, Hong Kong

FCC ID: 2AYEMBSZ-GW06G

Report Type:	**Product Type:**
Original Report	Lock Box

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Lock Box
Tested Model	BSZ-GW06G
Frequency Range	Wi-Fi: 2412~2472MHz ZigBee: 2405~2475MHz
Maximum Conducted Peak Power	Wi-Fi: 7.46dBm(802.11b), 5.94dBm(802.11g), 6.08dBm(802.11n-HT20) ZigBee: 0.39dBm
Modulation Technique	Wi-Fi: DSSS, OFDM ZigBee: OQPSK
Antenna Specification*	-1.0dBi(provided by the applicant)
Voltage Range	DC12.0V from adapter
Date of Test	2020-12-09 to 2020-12-19
Sample number	RSZ201127801-RF-S1(Assigned by BACL, Shenzhen)
Received date	2020-11-27
Sample/EUT Status	Good condition
Adapter information	Model: YTD-PW024001-01200200 Input: AC 100-240V, 50/60Hz, 0.8A Max Output: DC 12.0V, 2000mA

Objective

This report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Output Power with Power meter		±0.73dB
RF conducted test with spectrum		±1.6dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
Temperature		±1℃
Humidity		±6%
Supply voltages		±0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For 802.11b, 802.11g and 802.11n-HT20 mode, 13 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	12	2467
6	2437	13	2472
7	2442	/	/

For 802.11b, 802.11g, 802.11n-HT20 mode, EUT was tested with Channel 1, 7 and 13.

For ZigBee mode, 15 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
11	2405	19	2445
12	2410	…	…
…	…	…	…
…	…	…	…
…	…	25	2475
18	2440	/	/

EUT was tested with Channel 11, 19 and 25.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

"etfGuiTool" *software was use to the Wi-Fi tested.

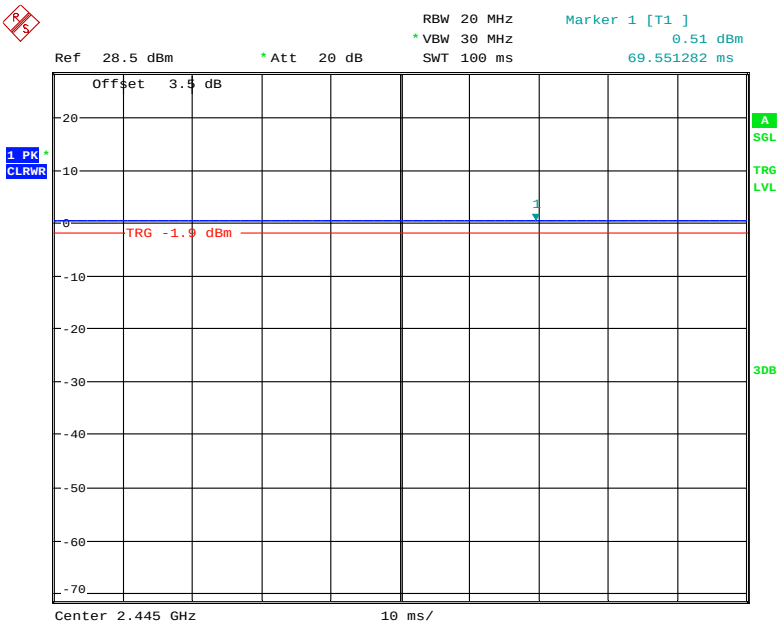
The device was tested with the worst case was performed as below:

Mode	Data rate	Power level*		
		Low channel	Middle channel	High channel
802.11b	1 Mbps	25	25	25
802.11g	6 Mbps	8	8	8
802.11n-HT20	6.5 Mbps	8	8	8
ZigBee	250 kbps	Default	Default	Default

Duty cycle

Test Result Compliant. Please refer to the Appendix Wi-Fi.

For ZigBee:



Mode	T_{on} (ms)	T_{on+off} (ms)	Duty Cycle (%)
ZigBee	-	-	100

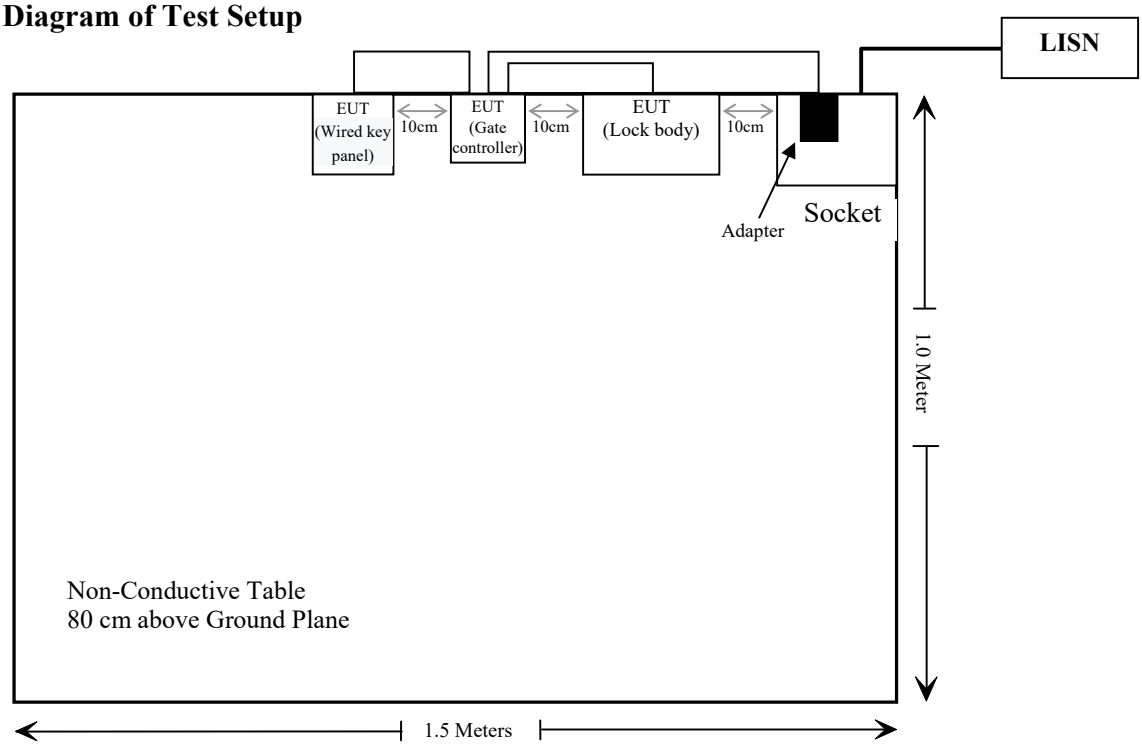
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
BULL	Socket	GN-212	A37209315081183

External I/O Cable

Cable Description	Length (m)	From Port	To
Unshielded Un-detachable AC Cable	1.0	Socket	LISN
Unshielded Un-detachable DC Cable	1.5	Adapter	EUT (Gate controller)
Unshielded Un-detachable DC Cable	8.0	EUT (Wired key panel)	EUT (Gate controller)
Unshielded Un-detachable DC Cable	8.0	EUT (Gate controller)	EUT (Lock body)

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §2.1091	Maximum Permissible Exposure(MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Conducted Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2020/08/04	2021/08/03
Rohde & Schwarz	LISN	ENV216	101613	2020/08/04	2021/08/03
Rohde & Schwarz	Transient Limitor	ESH3Z2	DE25985	2020/11/29	2021/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2020/11/29	2021/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2020/08/04	2021/08/03
Sonoma instrument	Pre-amplifier	310 N	186238	2020/08/04	2021/08/03
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017/12/22	2020/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2020/11/29	2021/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2020/11/29	2021/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2020/08/04	2021/08/03
COM-POWER	Pre-amplifier	PA-122	181919	2020/11/29	2021/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2020/11/29	2021/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017/12/22	2020/12/21
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2020/11/29	2021/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2020/11/29	2021/11/28
SNSD	Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2020/04/20	2021/04/20
Ducommun Technolagies	Horn antenna	ARH-4223-02	1007726-02 1304	2020/12/06	2023/12/05

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Tonscend Corporation	RF control Unit	JS0806-2	19D8060154	2020/08/04	2021/08/03
Rohde & Schwarz	Signal and Spectrum Analyzer	FSV40	101473	2020/08/04	2021/08/03
Unknown	RF Cable	Unknown	2301 276	2020/11/29	2021/11/28
WEINSCHEL	10dB Attenuator	5324	AU3842	2020/11/29	2021/11/28
WEINSCHEL	3dB Attenuator	Unknown	F-03-EM121	2020/11/29	2021/11/28
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2020/04/03	2021/04/02

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (Minutes)**
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Mode	Frequency (MHz)	Antenna Gain		Max Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
ZigBee	2405-2475	-1.0	0.79	1.0	1.26	20	0.0002	1
Wi-Fi	2412-2472	-1.0	0.79	8.0	6.31	20	0.0010	1

Note: 1. the tune up conducted power was declared by the applicant
2. the Wi-Fi can transmit at the same time with the Zigbee.

Simultaneous transmitting consideration:

The ratio=$MPE_{Wi\text{-}Fi}$/limit+MPE_{ZigBee}/limit=0.0010+0.0002=0.0012＜1.0

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliance

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.
And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has one internal PCB antenna for Wi-Fi and one internal PCB antenna for ZigBee arrangement which were permanently attached and the antenna gain is -1.0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

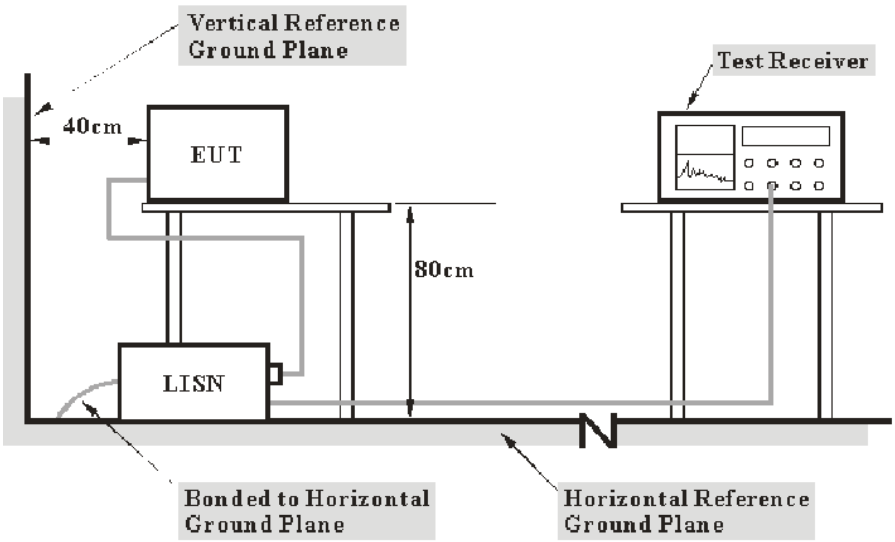
Result: Pass.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Correction Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Data

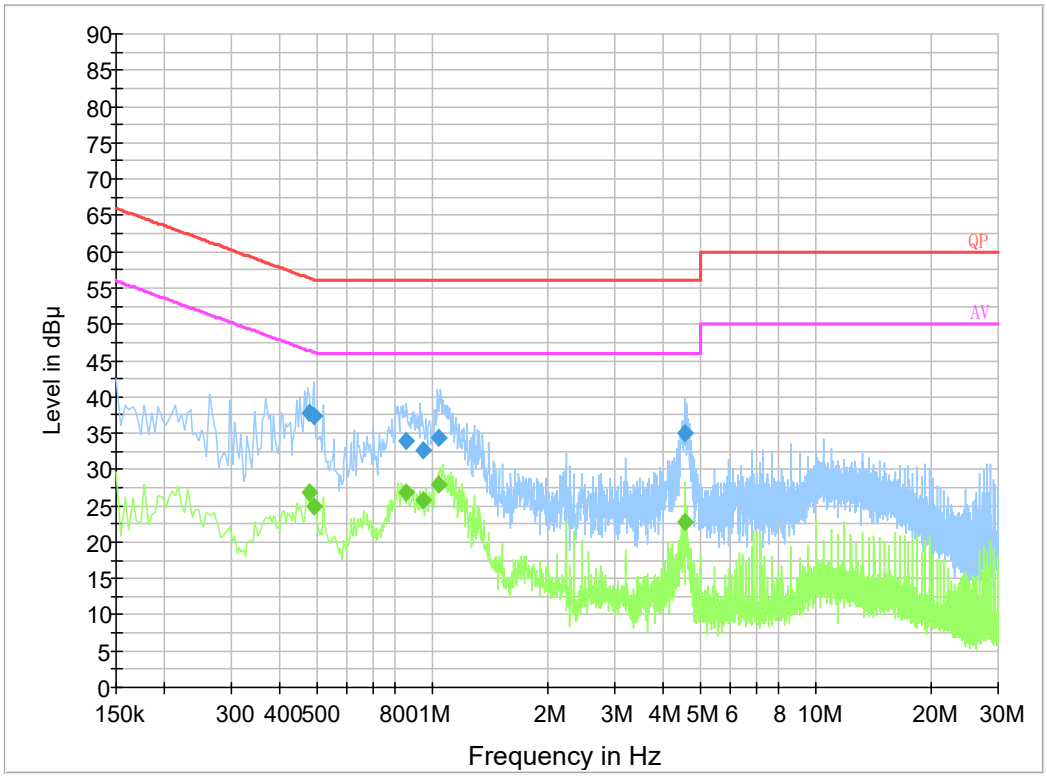
Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	65 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2020-12-14.

EUT operation mode: Transmitting (Worst case: Wi-Fi 802.11b mode High channel)

AC 120V/60 Hz, Line



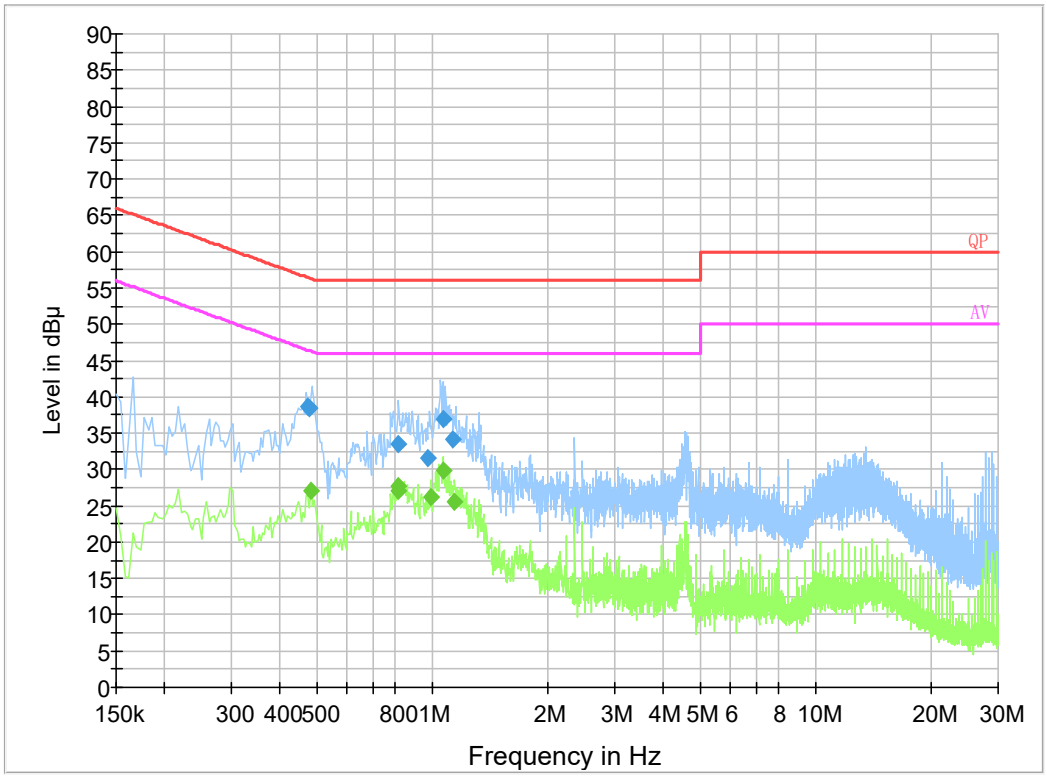
Final Result 1

Frequency (MHz)	QuasiPeak (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.478890	37.8	9.000	L1	19.8	18.6	56.4
0.490590	37.3	9.000	L1	19.8	18.9	56.2
0.853130	33.9	9.000	L1	19.8	22.1	56.0
0.947990	32.7	9.000	L1	19.8	23.3	56.0
1.042190	34.4	9.000	L1	19.9	21.6	56.0
4.553330	35.0	9.000	L1	19.9	21.0	56.0

Final Result 2

Frequency (MHz)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.478890	26.9	9.000	L1	19.8	19.5	46.4
0.490590	24.9	9.000	L1	19.8	21.3	46.2
0.853130	26.8	9.000	L1	19.8	19.2	46.0
0.947990	25.7	9.000	L1	19.8	20.3	46.0
1.042190	27.9	9.000	L1	19.9	18.1	46.0
4.553330	22.8	9.000	L1	19.9	23.2	46.0

AC 120V/60 Hz, Neutral:



Final Result 1

Frequency (MHz)	QuasiPeak (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.474950	38.7	9.000	N	19.8	17.7	56.4
0.478710	38.4	9.000	N	19.8	18.0	56.4
0.813730	33.4	9.000	N	19.8	22.6	56.0
0.971210	31.5	9.000	N	19.8	24.5	56.0
1.069810	37.0	9.000	N	19.8	19.0	56.0
1.136690	34.3	9.000	N	19.8	21.7	56.0

Final Result 2

Frequency (MHz)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.482000	27.0	9.000	N	19.8	19.3	46.3
0.814000	27.0	9.000	N	19.8	19.0	46.0
0.818000	27.7	9.000	N	19.8	18.3	46.0
0.998000	26.2	9.000	N	19.8	19.8	46.0
1.070000	30.0	9.000	N	19.8	16.0	46.0
1.146000	25.6	9.000	N	19.8	20.4	46.0

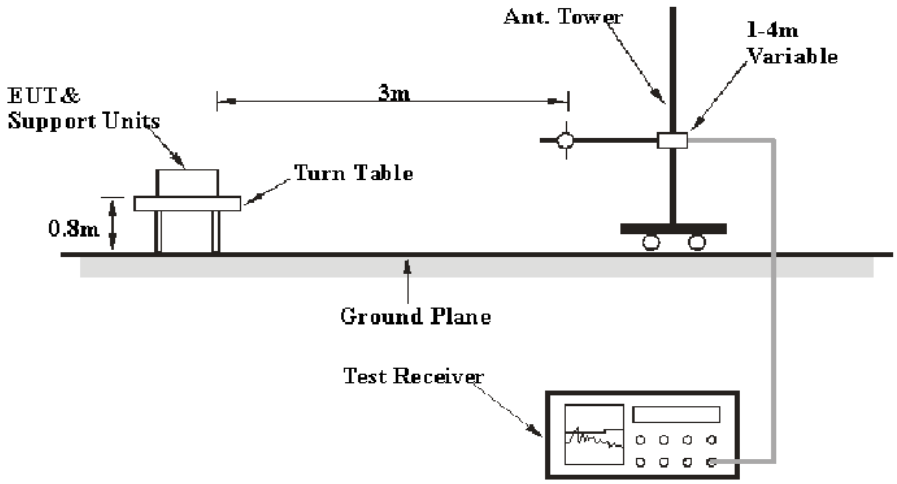
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

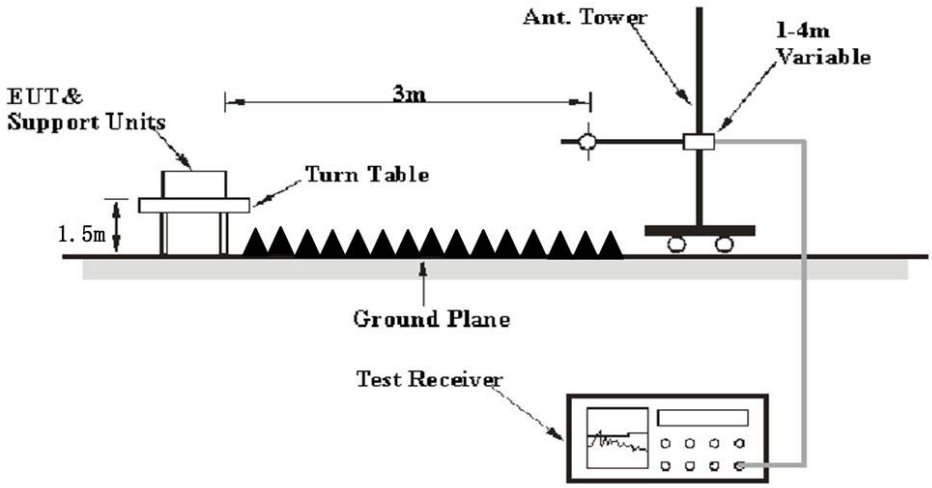
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz Note 1	/	Average
	1MHz	＞1/T Note 2	/	Average

Note 1: when duty cycle is no less than 98%
Note 2: when duty cycle is less than 98%

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Data

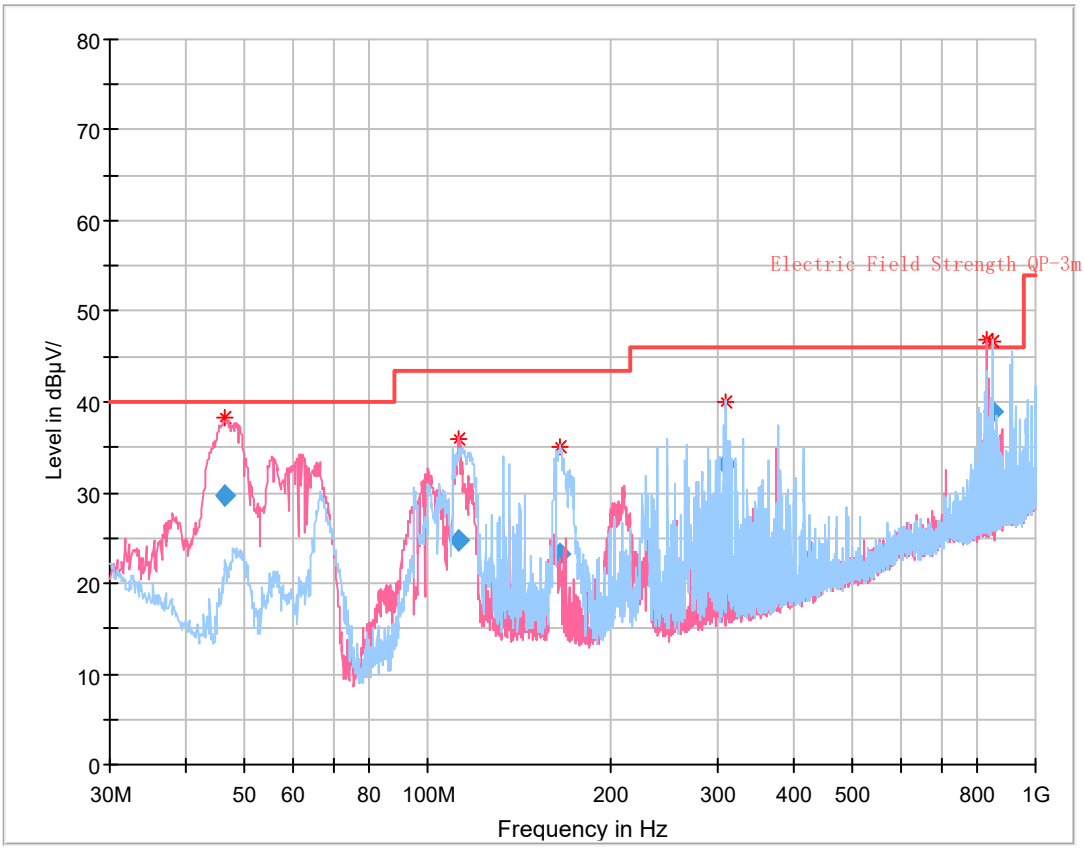
Environmental Conditions

Temperature:	20.1~29.8 ℃
Relative Humidity:	41~55 %
ATM Pressure:	101.0~101.1 kPa

The testing was performed by Charlie Cha on 2020-12-15 for below 1GHz and Leven Gan from 2020-12-10 to 2020-12-17 for above 1GHz.

EUT operation mode: Transmitting

30 MHz~1 GHz (Wi-Fi 802.11b mode, High channel was worst case):



Final_Result

Frequency (MHz)	QuasiPeak (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
46.238500	29.75	40.00	10.25	153.0	V	353.0	-14.7
112.085625	24.77	43.50	18.73	110.0	V	247.0	-11.8
164.719500	23.31	43.50	20.19	242.0	H	314.0	-11.4
310.089875	33.17	46.00	22.83	141.0	H	10.0	-9.0
831.554250	33.34	46.00	22.66	235.0	V	33.0	0.3
851.077000	38.86	46.00	17.14	195.0	H	53.0	0.6

1 GHz-25 GHz (Wi-Fi):

802.11b Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2389.59	29.50	PK	105	1.5	H	31.87	61.37	74	12.63
2389.59	15.38	Ave.	105	1.5	H	31.87	47.25	54	6.75
2489.68	32.76	PK	27	2.4	H	32.13	64.89	74	9.11
2489.68	19.21	Ave.	27	2.4	H	32.13	51.34	54	2.66
4824.00	44.72	PK	111	1.6	H	6.28	51.00	74	23.00
4824.00	35.43	Ave.	111	1.6	H	6.28	41.71	54	12.29
Middle Channel (2442 MHz)									
4884.00	44.45	PK	233	1.6	H	6.76	51.21	74	22.79
4884.00	34.70	Ave.	233	1.6	H	6.76	41.46	54	12.54
High Channel (2472 MHz)									
2388.47	28.45	PK	138	2.0	H	31.87	60.32	74	13.68
2388.47	16.08	Ave.	138	2.0	H	31.87	47.95	54	6.05
2492.11	30.63	PK	340	1.3	H	32.13	62.76	74	11.24
2492.11	16.75	Ave.	340	1.3	H	32.13	48.88	54	5.12
4944.00	44.30	PK	218	1.0	H	6.76	51.06	74	22.94
4944.00	34.73	Ave.	218	1.0	H	6.76	41.49	54	12.51

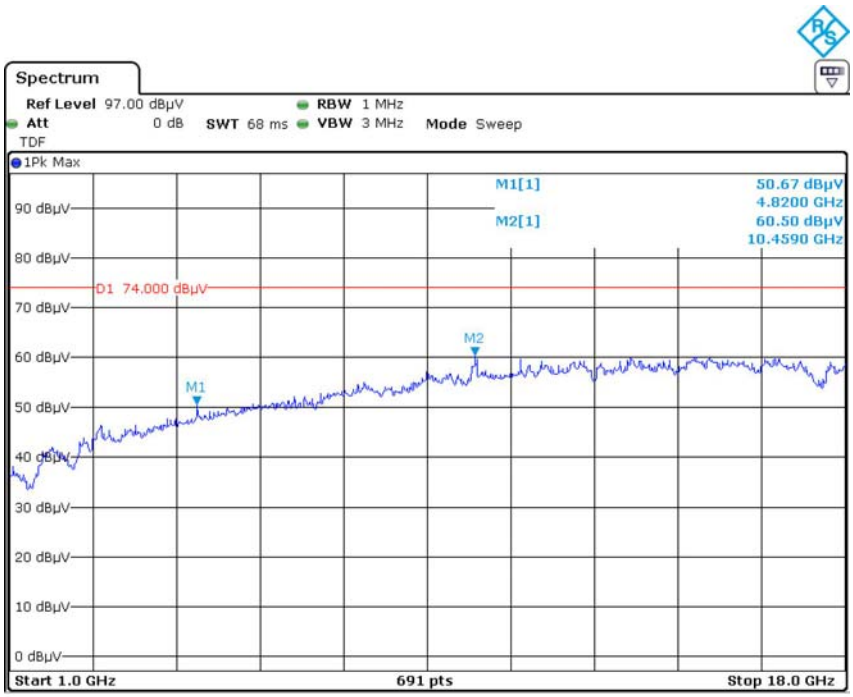
802.11g Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2388.67	29.40	PK	336	2.4	H	31.87	61.27	74	12.73
2388.67	16.18	Ave.	336	2.4	H	31.87	48.05	54	5.95
2499.53	31.35	PK	138	1.5	H	32.13	63.48	74	10.52
2499.53	19.30	Ave.	138	1.5	H	32.13	51.43	54	2.57
4824.00	44.19	PK	135	1.5	H	6.28	50.47	74	23.53
4824.00	31.46	Ave.	135	1.5	H	6.28	37.74	54	16.26
Middle Channel (2442 MHz)									
4884.00	43.94	PK	69	1.7	H	6.76	50.70	74	23.30
4884.00	31.39	Ave.	69	1.7	H	6.76	38.15	54	15.85
High Channel (2472 MHz)									
2388.49	28.75	PK	204	1.9	H	31.87	60.62	74	13.38
2388.49	16.26	Ave.	204	1.9	H	31.87	48.13	54	5.87
2483.99	31.48	PK	336	1.6	H	32.13	63.61	74	10.39
2483.99	17.59	Ave.	336	1.6	H	32.13	49.72	54	4.28
4944.00	44.05	PK	75	1.8	H	6.76	50.81	74	23.19
4944.00	31.51	Ave.	75	1.8	H	6.76	38.27	54	15.73

802.11n-HT20 Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2387.48	28.69	PK	191	2.0	H	31.87	60.56	74	13.44
2387.48	16.22	Ave.	191	2.0	H	31.87	48.09	54	5.91
2497.62	31.73	PK	336	1.4	H	32.13	63.86	74	10.14
2497.62	19.37	Ave.	336	1.4	H	32.13	51.50	54	2.50
4824.00	45.31	PK	93	2.1	H	6.28	51.59	74	22.41
4824.00	31.35	Ave.	93	2.1	H	6.28	37.63	54	16.37
Middle Channel (2442 MHz)									
4884.00	44.89	PK	49	1.1	H	6.76	51.65	74	22.35
4884.00	31.28	Ave.	49	1.1	H	6.76	38.04	54	15.96
High Channel (2472 MHz)									
2387.48	28.91	PK	205	2.4	H	31.87	60.78	74	13.22
2387.48	16.33	Ave.	205	2.4	H	31.87	48.20	54	5.80
2484.78	30.12	PK	259	1.8	H	32.13	62.25	74	11.75
2484.78	17.97	Ave.	259	1.8	H	32.13	50.10	54	3.90
4944.00	45.12	PK	117	1.1	H	6.76	51.88	74	22.12
4944.00	31.33	Ave.	117	1.1	H	6.76	38.09	54	15.91

Pre-scan with 802.11b Mode, Low channel
Horizontal



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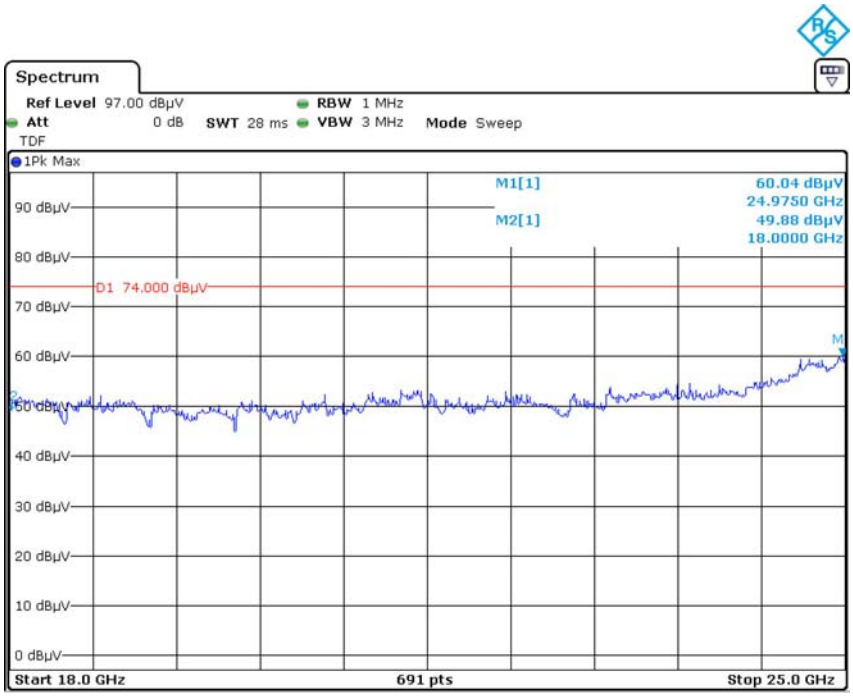

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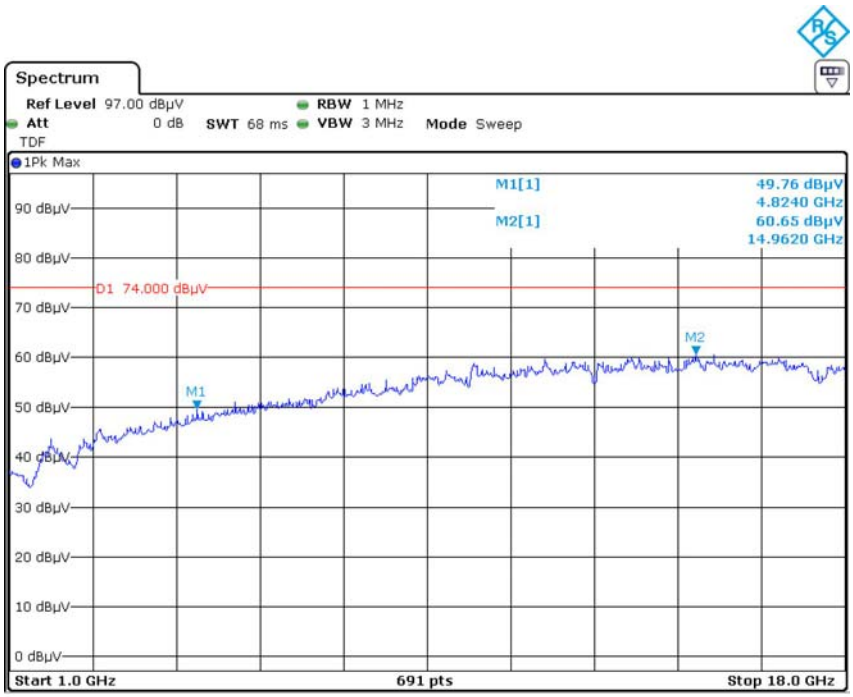
Vertical



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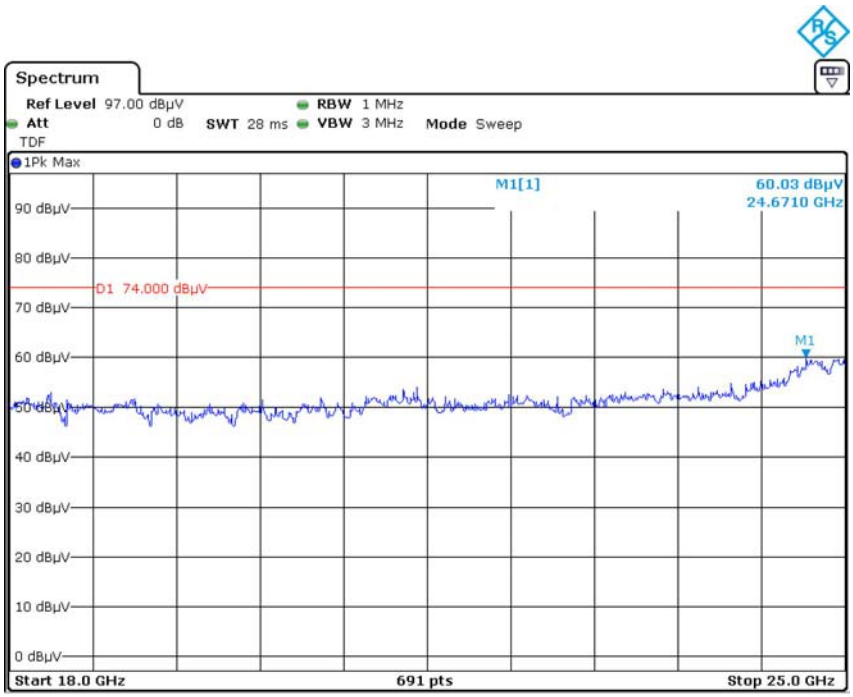

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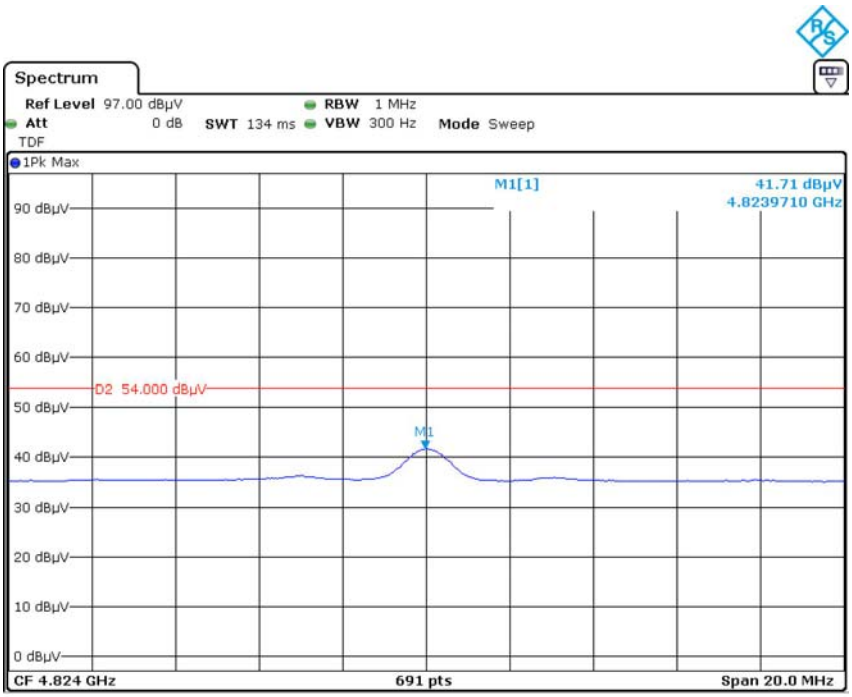
Average
Horizontal



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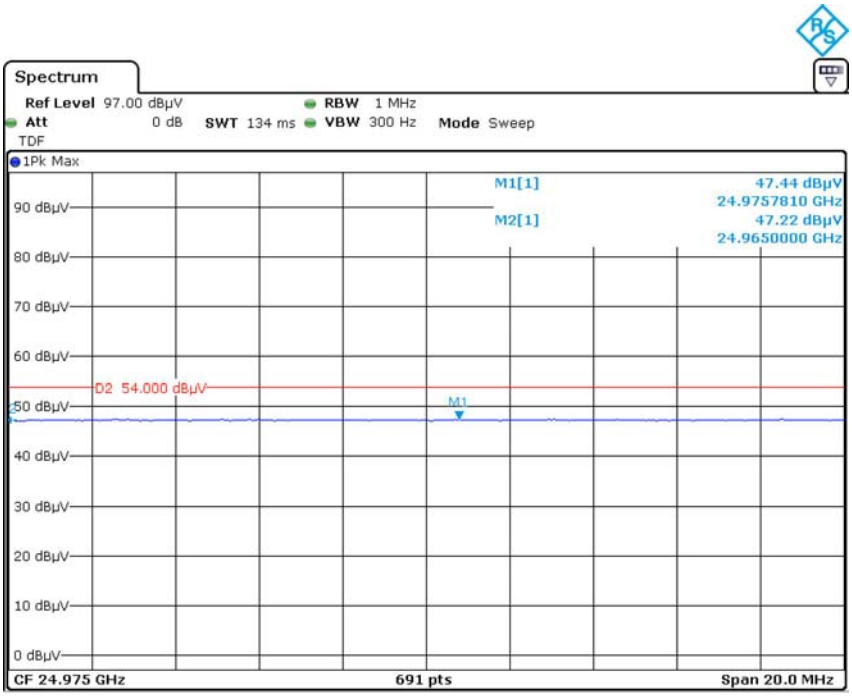

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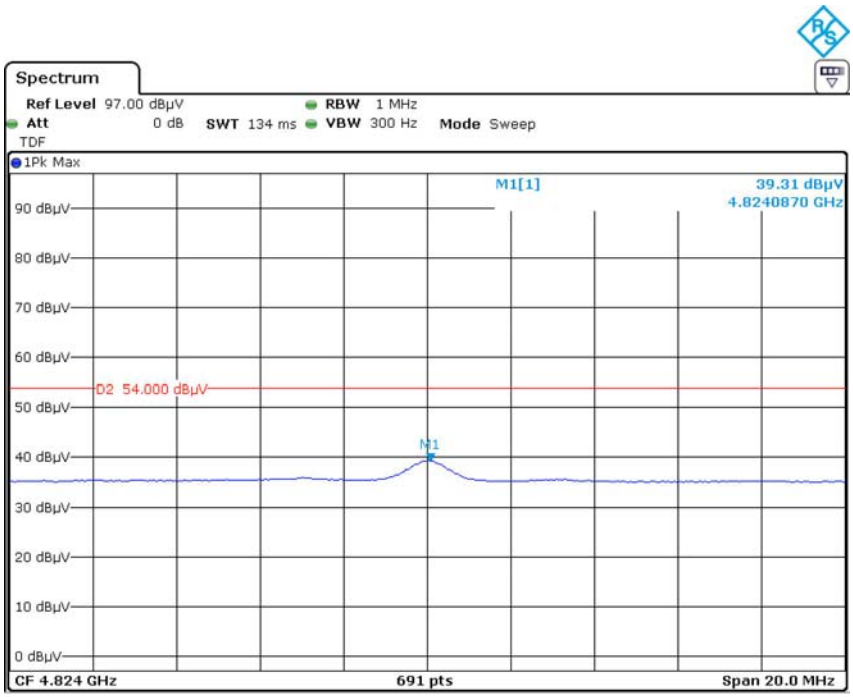
Vertical



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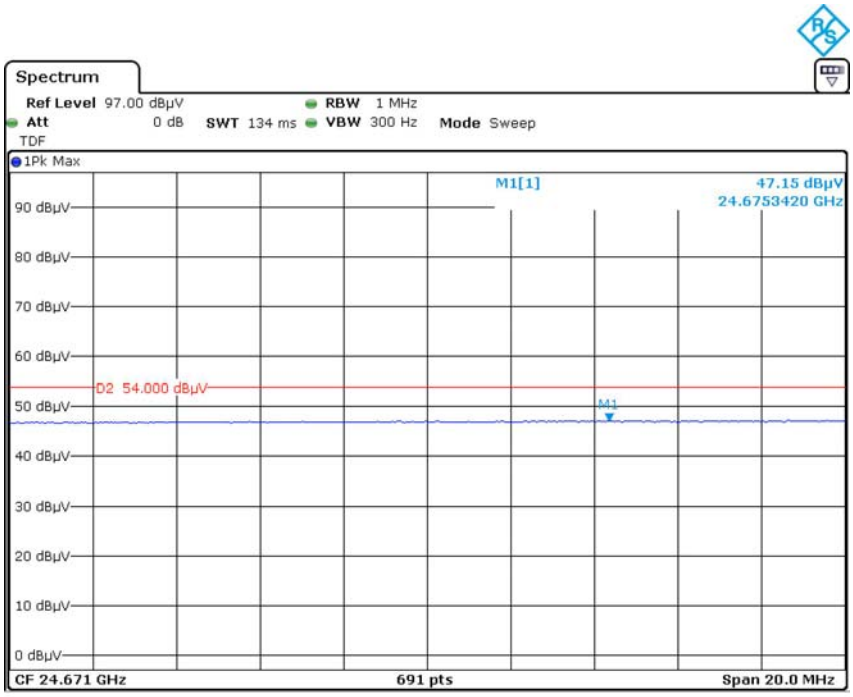


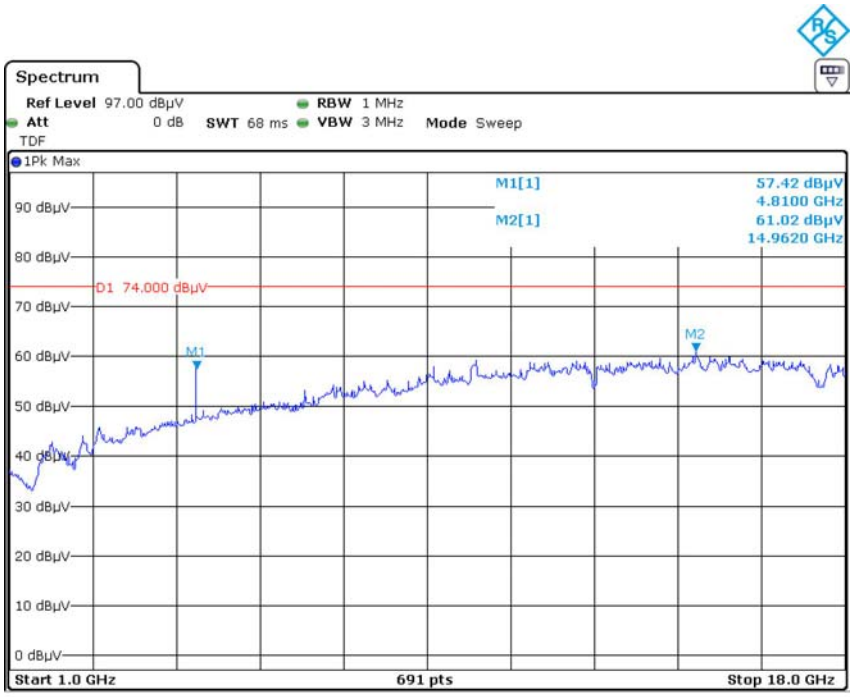
Date: 17.DEC.2020 17:52:07

1 GHz-25 GHz (ZigBee):

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2405 MHz)									
2389.64	29.15	PK	2	2.2	H	31.87	61.02	74	12.98
2389.64	14.56	Ave.	2	2.2	H	31.87	46.43	54	7.57
2485.12	28.78	PK	337	2.5	H	32.13	60.91	74	13.09
2485.12	14.54	Ave.	337	2.5	H	32.13	46.67	54	7.33
4810.00	52.62	PK	74	1.1	H	6.28	58.90	74	15.10
4810.00	41.92	Ave.	74	1.1	H	6.28	48.20	54	5.80
Middle Channel (2445 MHz)									
4890.00	50.71	PK	207	2.4	H	6.76	57.47	74	16.53
4890.00	40.46	Ave.	207	2.4	H	6.76	47.22	54	6.78
High Channel (2475 MHz)									
2388.47	28.34	PK	38	2.1	H	31.87	60.21	74	13.79
2388.47	14.52	Ave.	38	2.1	H	31.87	46.39	54	7.61
2484.19	28.97	PK	205	1.9	H	32.13	61.10	74	12.90
2484.19	14.55	Ave.	205	1.9	H	32.13	46.68	54	7.32
4950.00	49.66	PK	142	1.2	H	6.80	56.46	74	17.54
4950.00	38.89	Ave.	142	1.2	H	6.80	45.69	54	8.31

Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is 20dB to the limit was not recorded.

Pre-scan with Low channel
Horizontal



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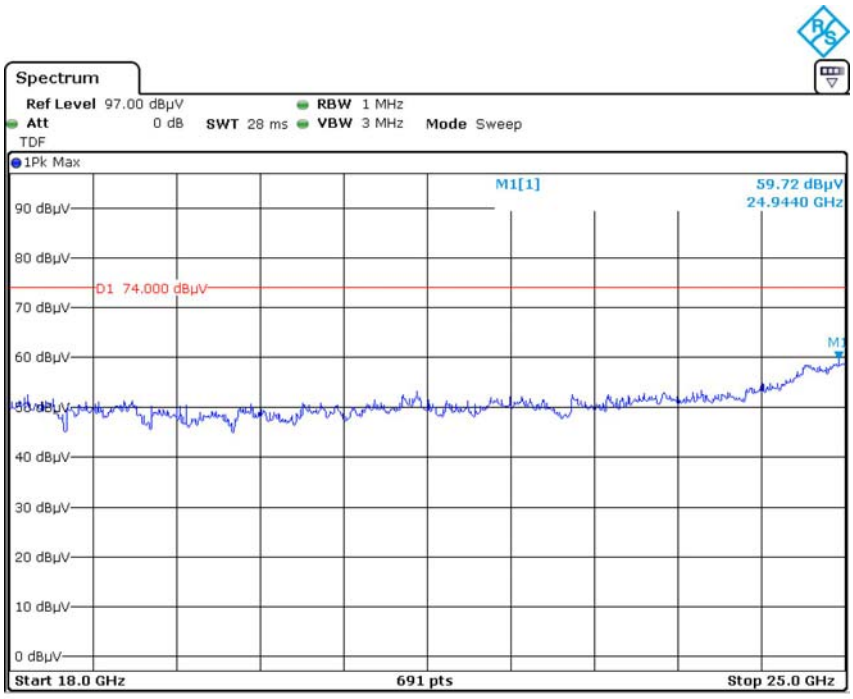

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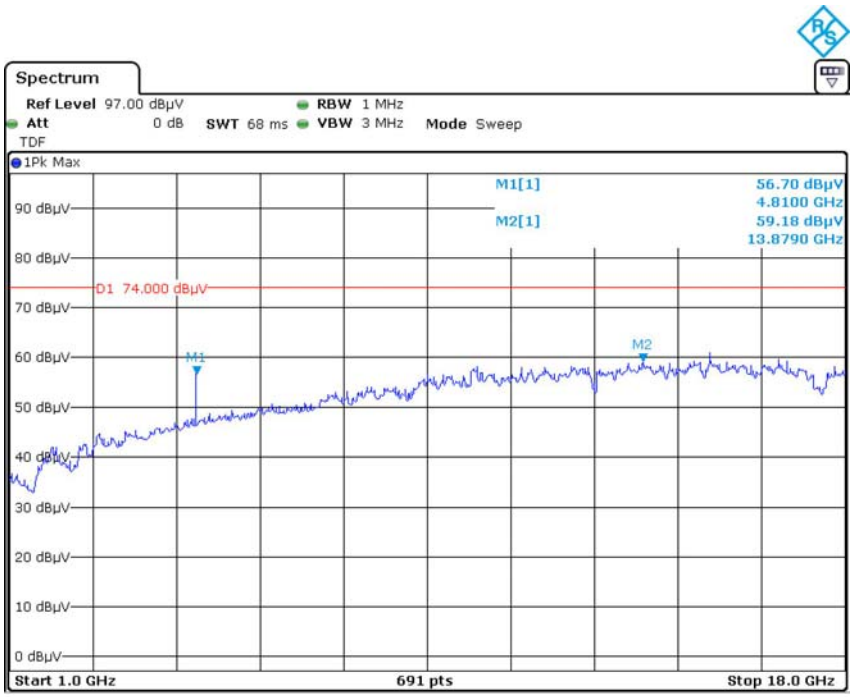
Vertical



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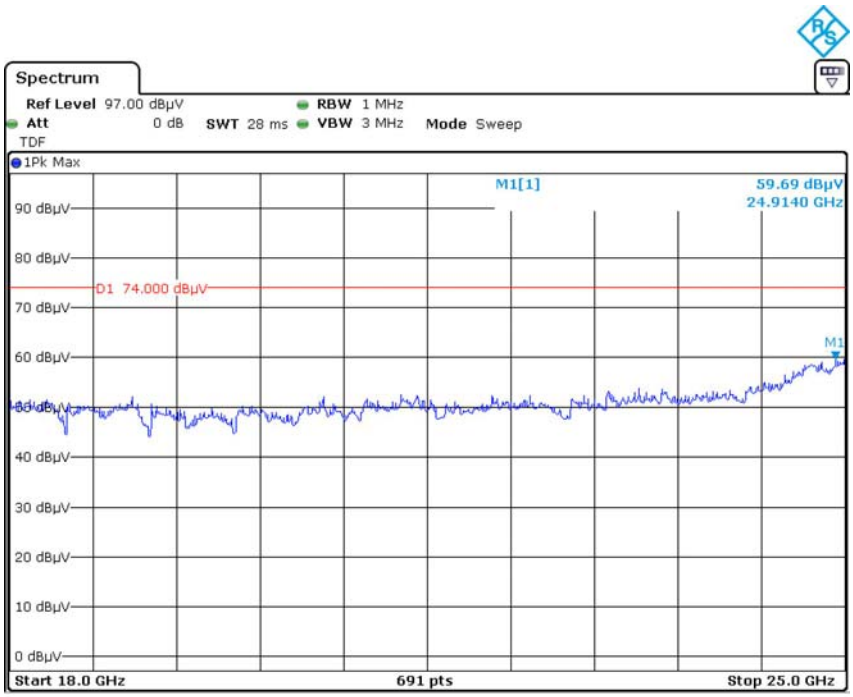
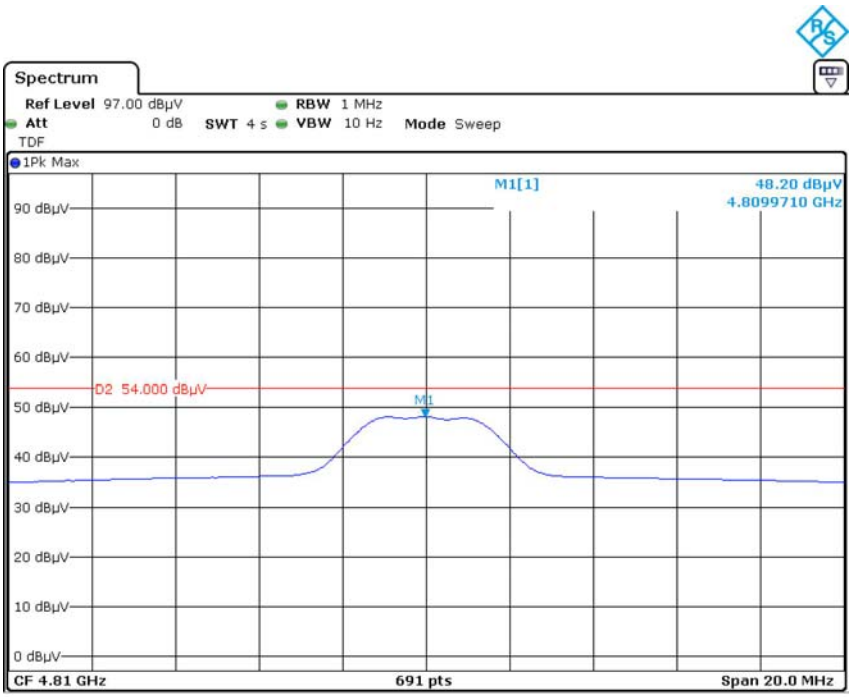


Date: 10.DEC.2020 18:40:47

Average
Horizontal



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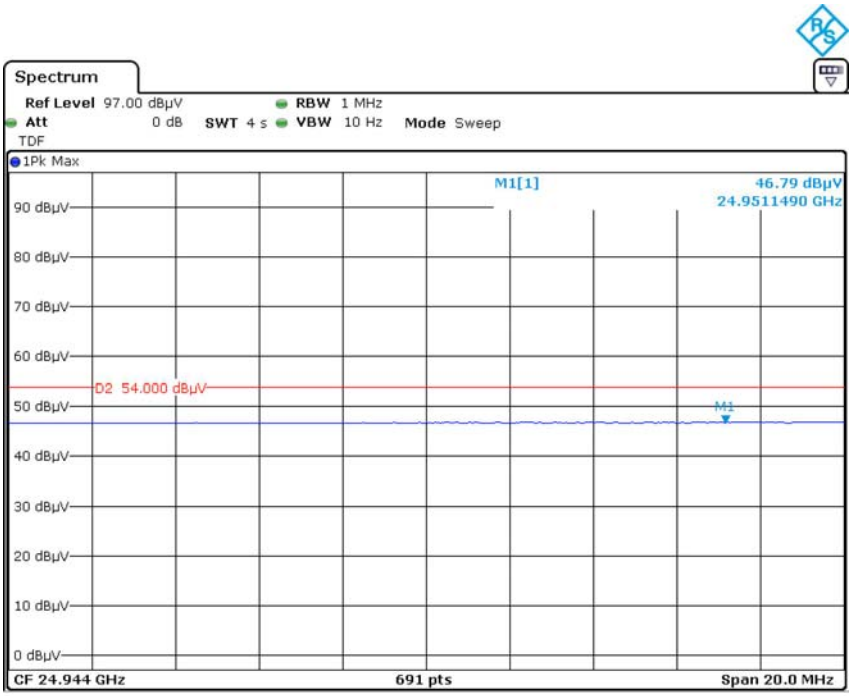

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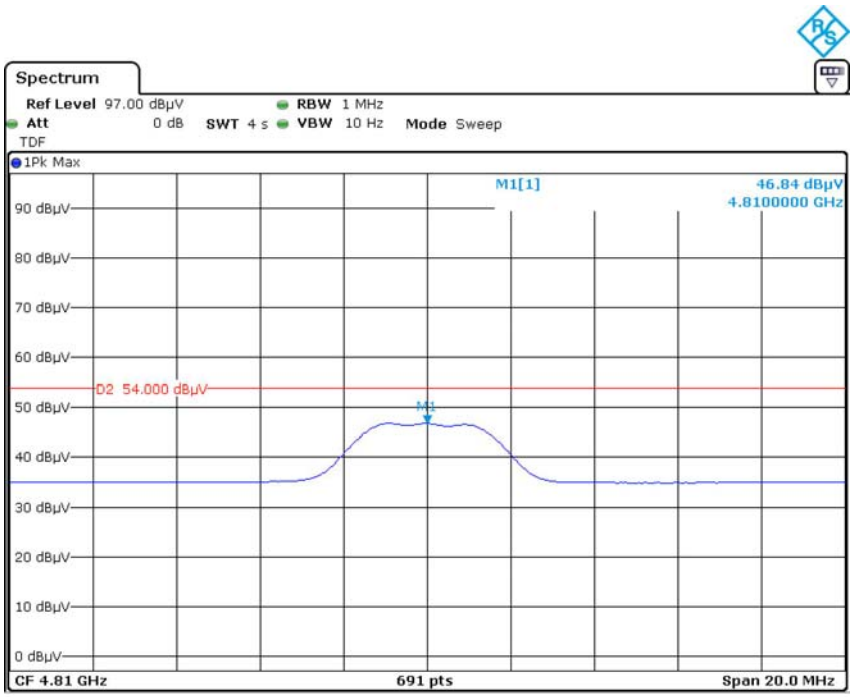
Vertical



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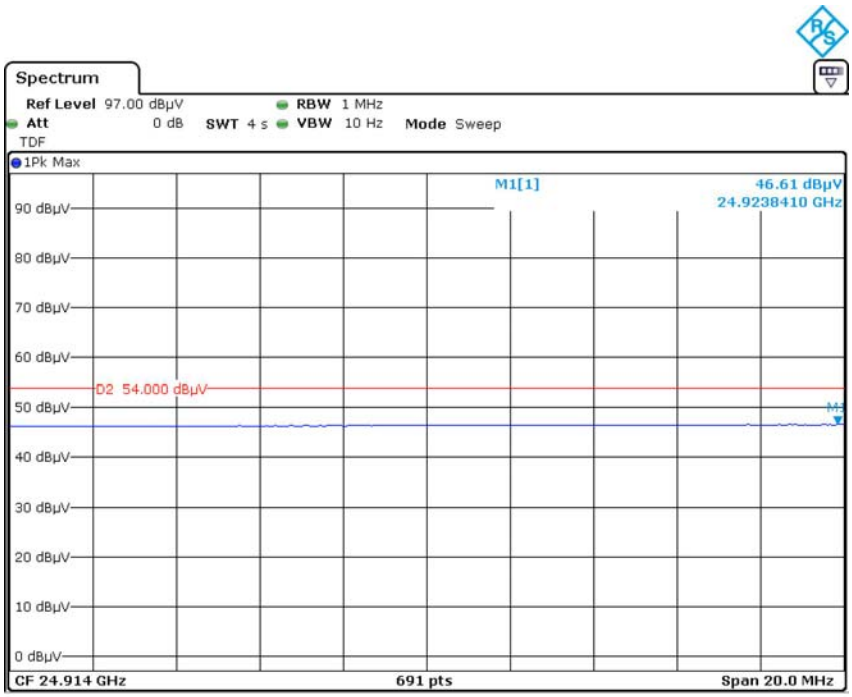


Date: 10.DEC.2020 18:44:08

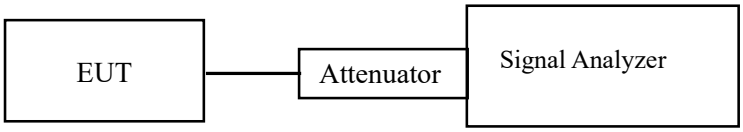
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.



Test Data

Environmental Conditions

Temperature:	23~24 ℃
Relative Humidity:	54~55 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo from 2020-12-09 to 2020-12-19.

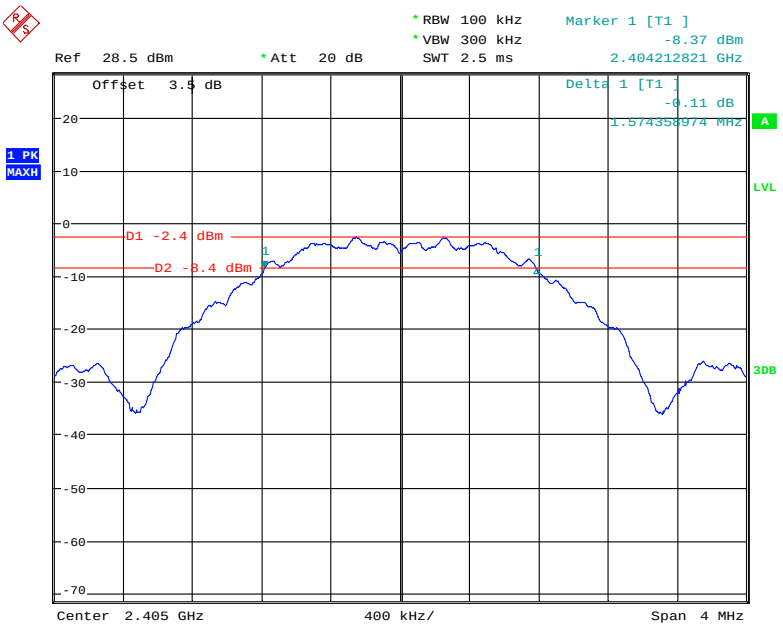
EUT operation mode: Transmitting

Test Result Compliant. The data of Wi-Fi please refer to the Appendix.

The data of ZigBee as below:

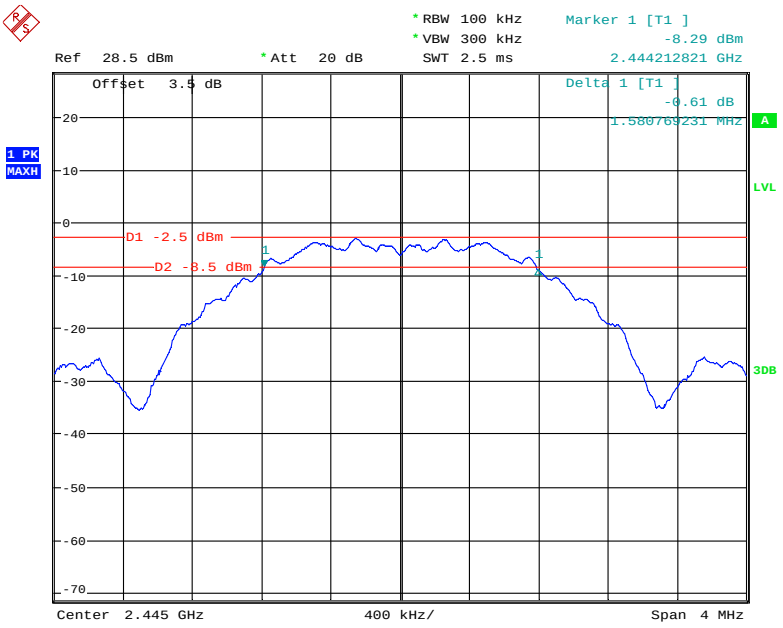
Frequency (MHz)	DTS BW (MHz)	Limit (kHz)	Verdict
2405	1.574	≥500	PASS
2445	1.581	≥500	PASS
2475	1.583	≥500	PASS

Low channel



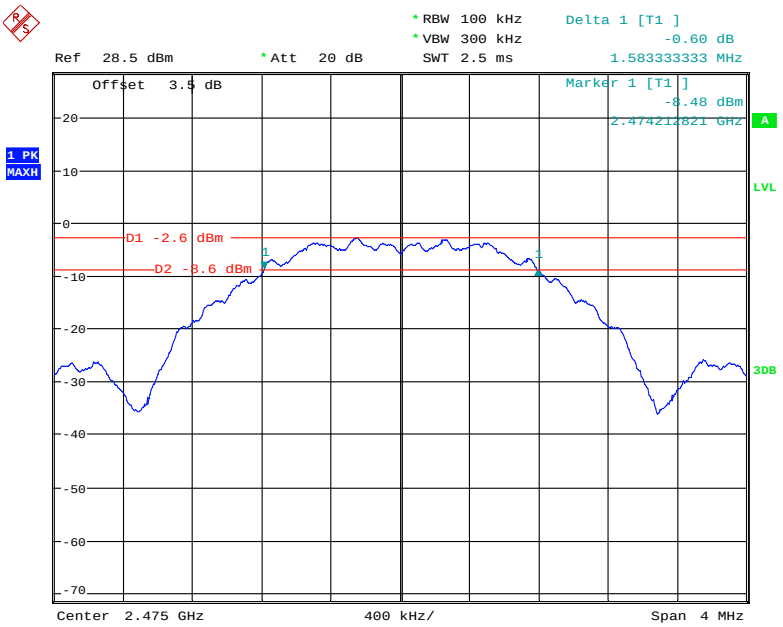
Date: 9.DEC.2020 18:05:46

Middle channel



Date: 9.DEC.2020 18:07:14

High channel



Date: 9.DEC.2020 18:04:16

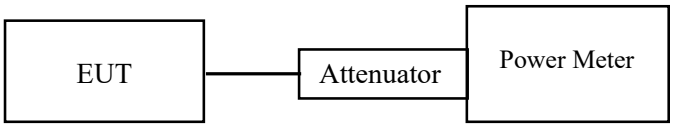
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



Test Data

Environmental Conditions

Temperature:	23~24 ℃
Relative Humidity:	54~55 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo from 2020-12-09 to 2020-12-19.

EUT operation mode: Transmitting

Test Result Compliant. The data of Wi-Fi please refer to the Appendix.

The data of ZigBee as below:

Frequency (MHz)	Conducted Peak Output Power (dBm)	Limit (dBm)	Verdict
2405	0.39	<=30	PASS
2445	0.28	<=30	PASS
2475	0.23	<=30	PASS

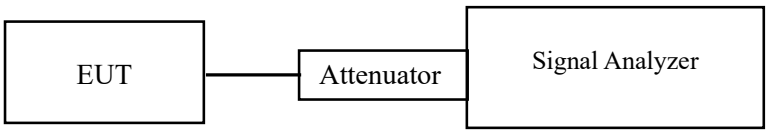
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

Applicable Standard

In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.



Test Data

Environmental Conditions

Temperature:	23~24 ℃
Relative Humidity:	54~55 %
ATM Pressure:	101.0 kPa

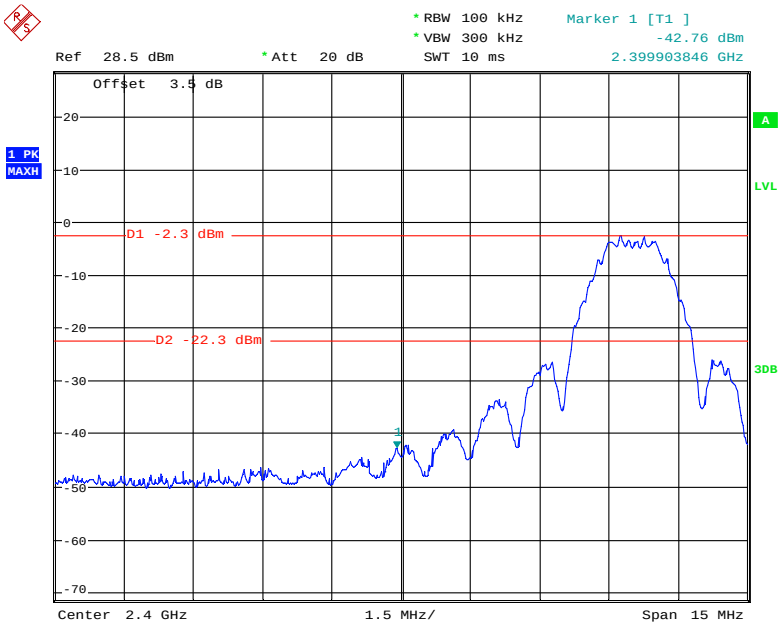
The testing was performed by Gavin Guo from 2020-12-09 to 2020-12-19.

EUT operation mode: Transmitting

Test Result Compliant. The data of Wi-Fi please refer to the Appendix.

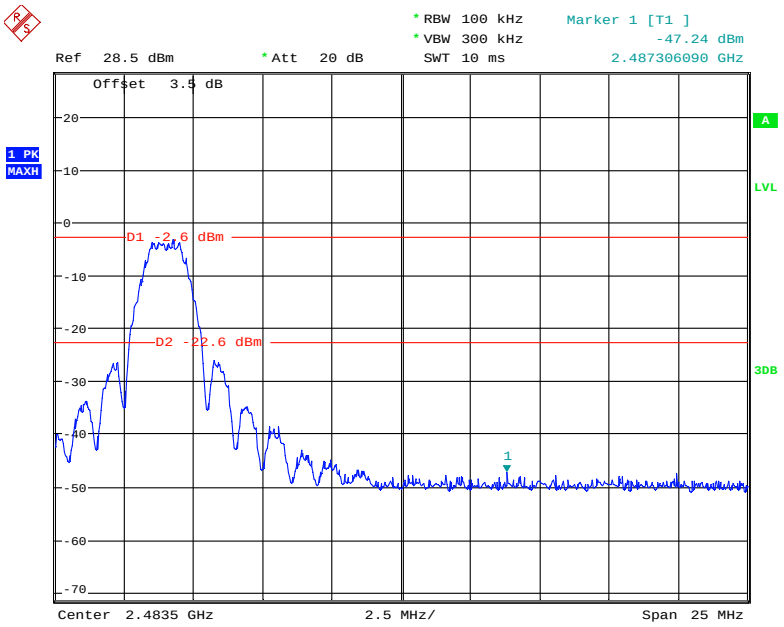
The data of ZigBee as below:

Band Edge, Left Side



Date: 9.DEC.2020 18:01:01

Band Edge, Right Side



Date: 9.DEC.2020 18:02:35

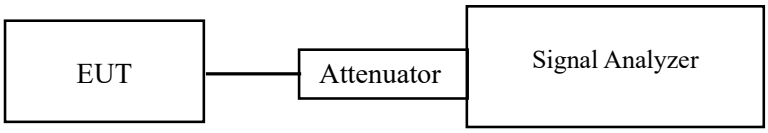
FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to: 3kHz≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 1.5 times the DTS bandwidth.
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 within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



Test Data

Environmental Conditions

Temperature:	23~24 ℃
Relative Humidity:	54~55 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo from 2020-12-09 to 2020-12-19.

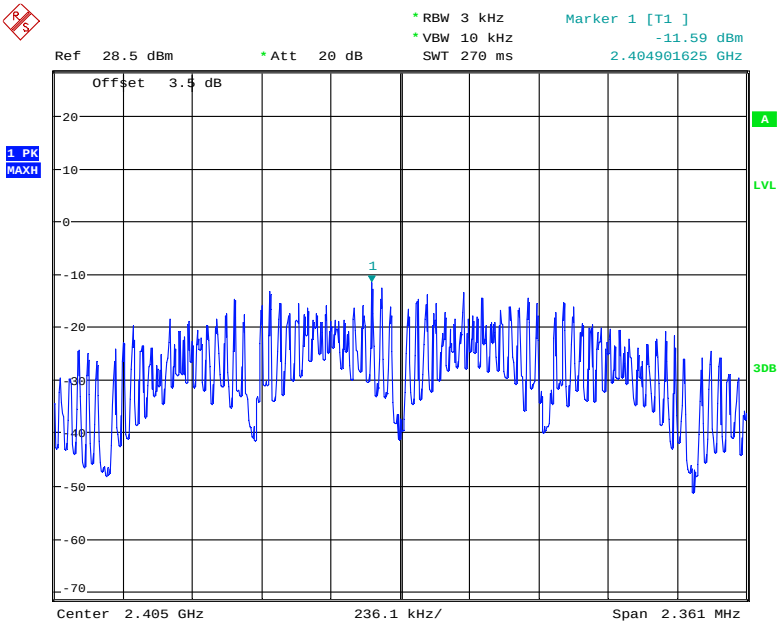
EUT operation mode: Transmitting

Test Result Compliant. The data of Wi-Fi please refer to the Appendix.

The data of ZigBee as below:

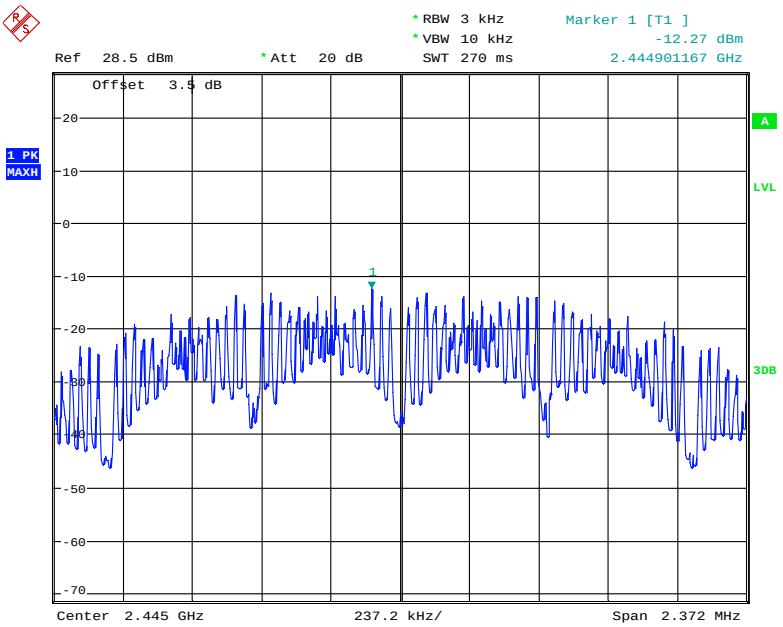
Frequency (MHz)	Result (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
2405	-11.59	<=8	PASS
2445	-12.27	<=8	PASS
2475	-12.61	<=8	PASS

Low channel



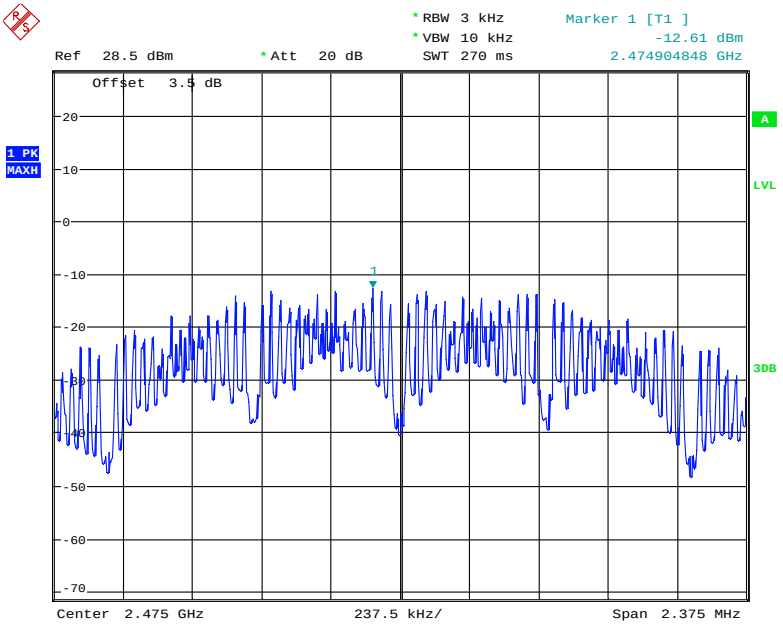
Date: 9.DEC.2020 18:30:10

Middle channel



Date: 9.DEC.2020 18:27:42

High channel



Date: 9.DEC.2020 18:28:28

APPENDIX

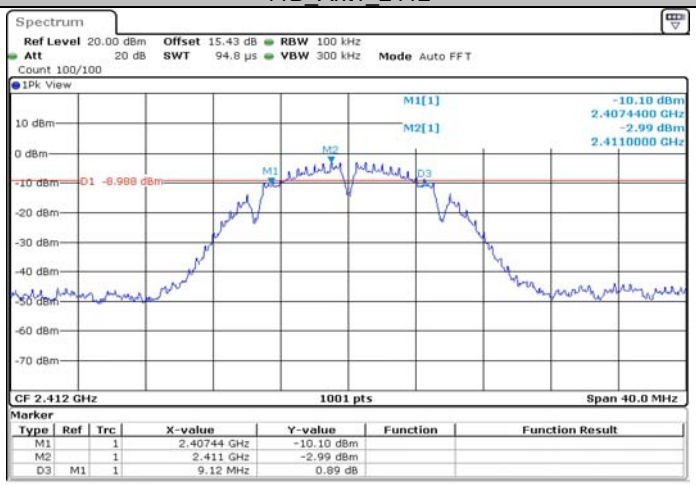
Appendix A: DTS Bandwidth

Test Result

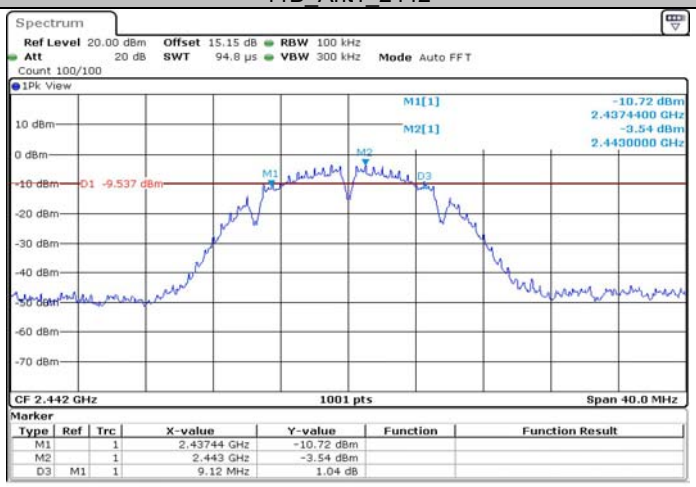
Test Mode	Antenna	Channel	DTS BW [MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	9.120	0.5	PASS
		2442	9.120	0.5	PASS
		2472	9.120	0.5	PASS
11G	Ant1	2412	16.400	0.5	PASS
		2442	16.440	0.5	PASS
		2472	16.440	0.5	PASS
11N20	Ant1	2412	17.640	0.5	PASS
		2442	17.640	0.5	PASS
		2472	17.640	0.5	PASS

Test Graphs

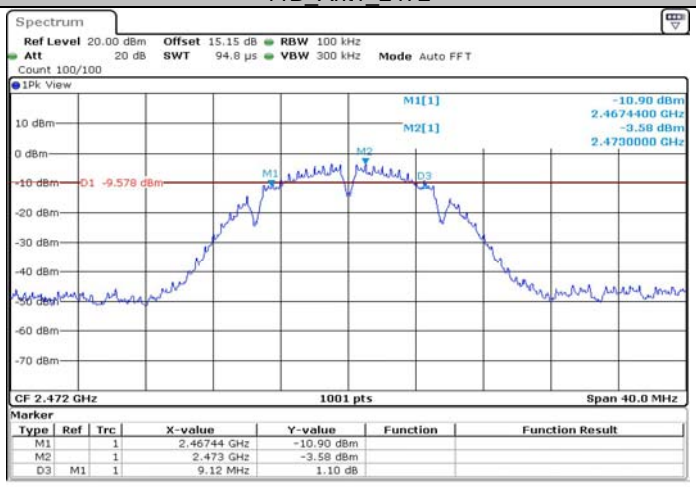
11B_Ant1_2412



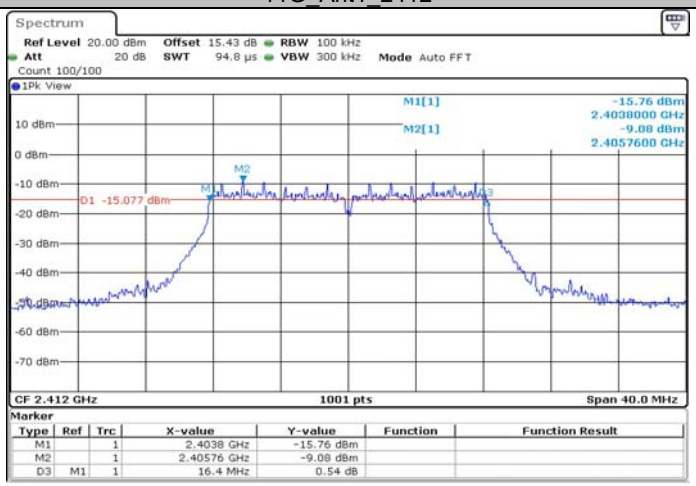
11B_Ant1_2442



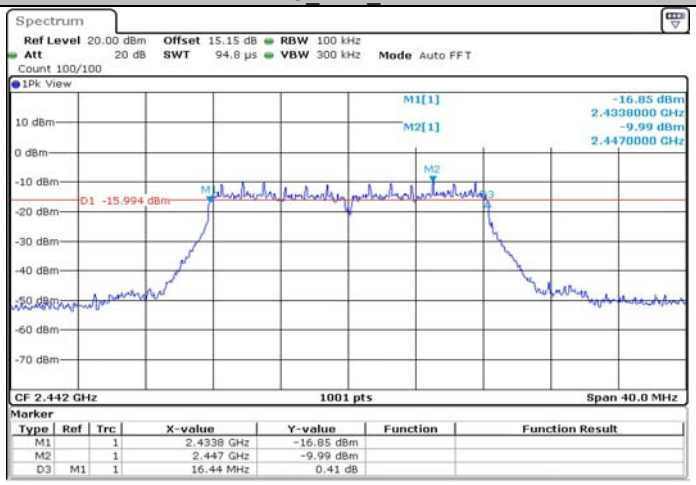
11B_Ant1_2472



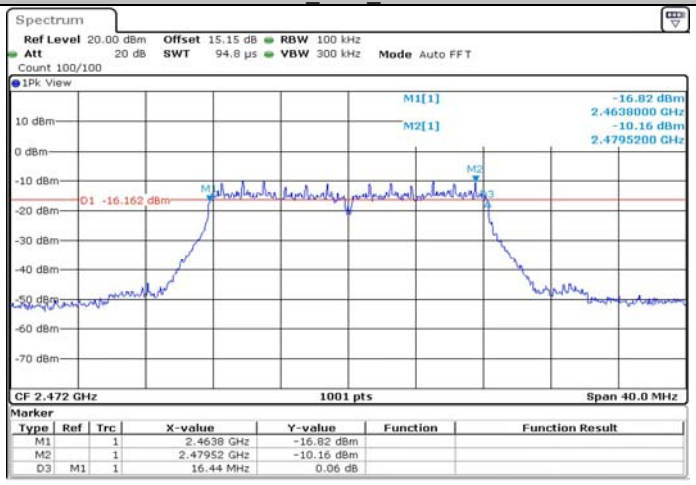
11G_Ant1_2412



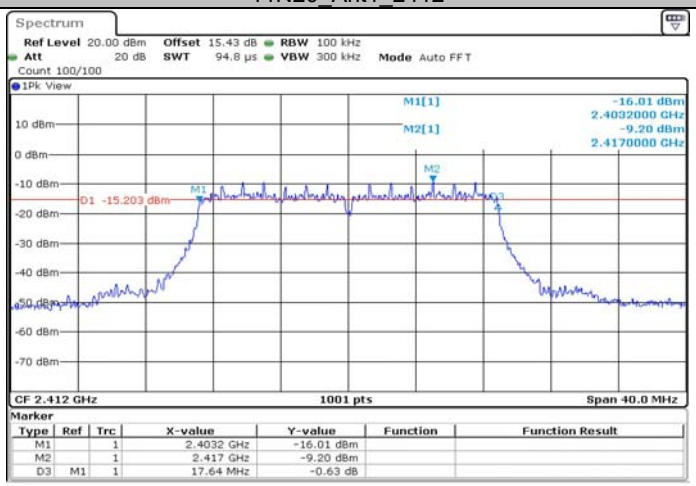
11G_Ant1_2442



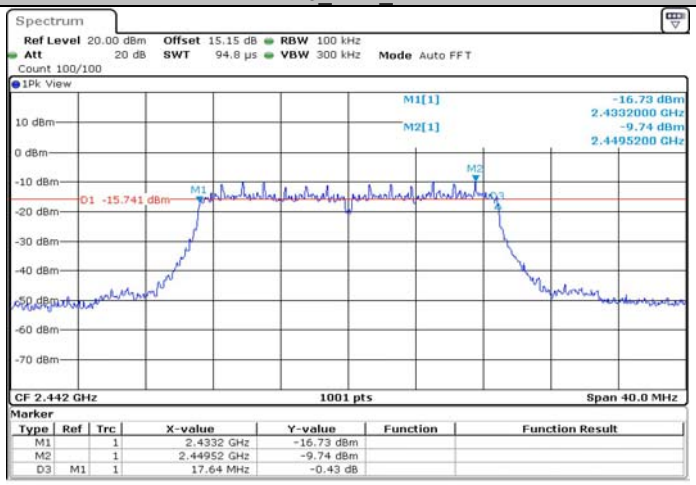
11G_Ant1_2472



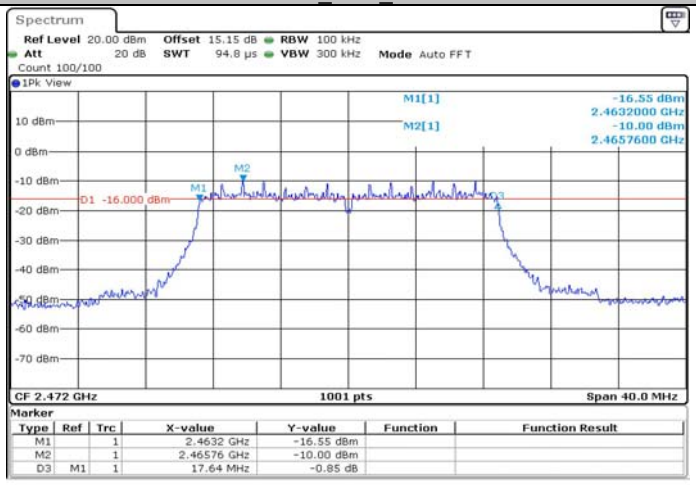
11N20_Ant1_2412



11N20_Ant1_2442



11N20_Ant1_2472



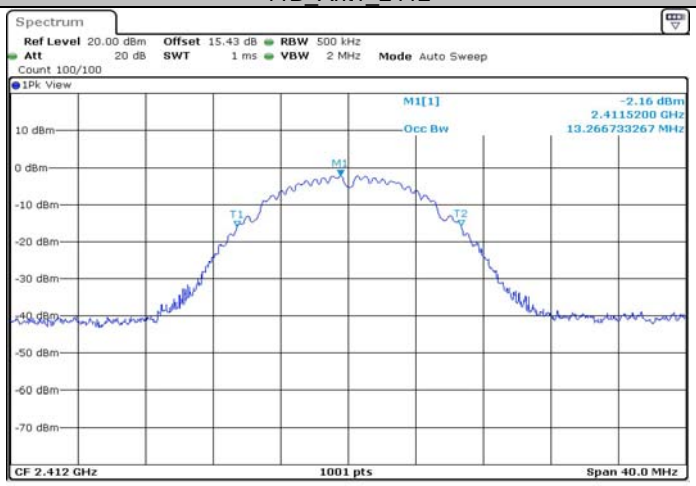
Appendix B: Occupied Channel Bandwidth

Test Result

Test Mode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	13.267	---	PASS
		2442	13.267	---	PASS
		2472	13.307	---	PASS
11G	Ant1	2412	17.622	---	PASS
		2442	17.622	---	PASS
		2472	17.622	---	PASS
11N20	Ant1	2412	18.182	---	PASS
		2442	18.182	---	PASS
		2472	18.182	---	PASS

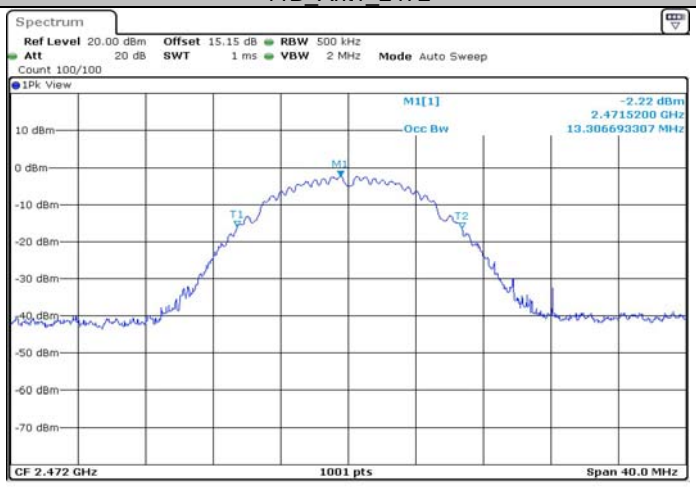
Test Graphs

11B_Ant1_2412

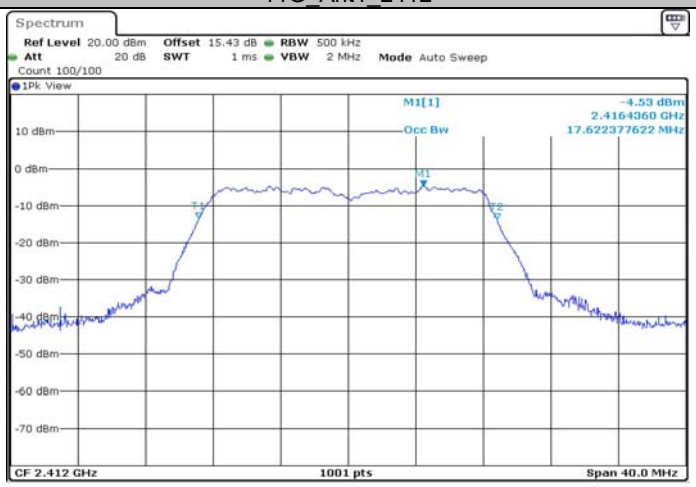


11B_Ant1_2442

11B_Ant1_2472

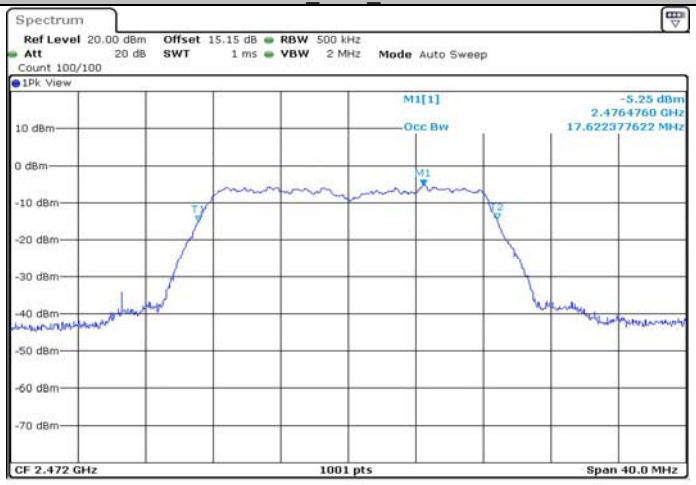


11G_Ant1_2412



11G_Ant1_2442

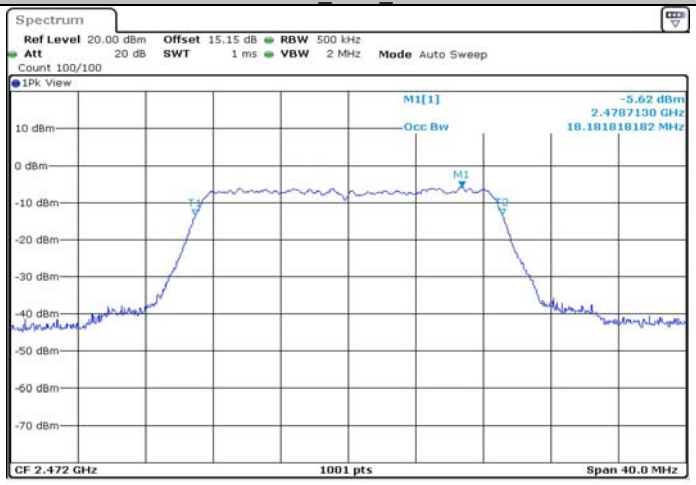
11G_Ant1_2472



11N20_Ant1_2412

11N20_Ant1_2442

11N20_Ant1_2472



Appendix C: Maximum conducted peak output power

Test Result

Test Mode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
11B	Ant1	2412	7.15	<=30	PASS
		2442	7.32	<=30	PASS
		2472	7.46	<=30	PASS
11G	Ant1	2412	5.94	<=30	PASS
		2442	5.27	<=30	PASS
		2472	5.63	<=30	PASS
11N20	Ant1	2412	6.08	<=30	PASS
		2442	5.84	<=30	PASS
		2472	6.02	<=30	PASS

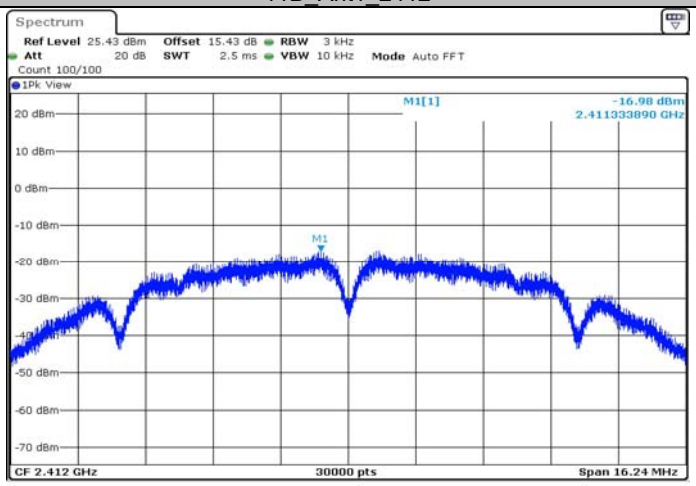
Appendix D: Maximum power spectral density

Test Result

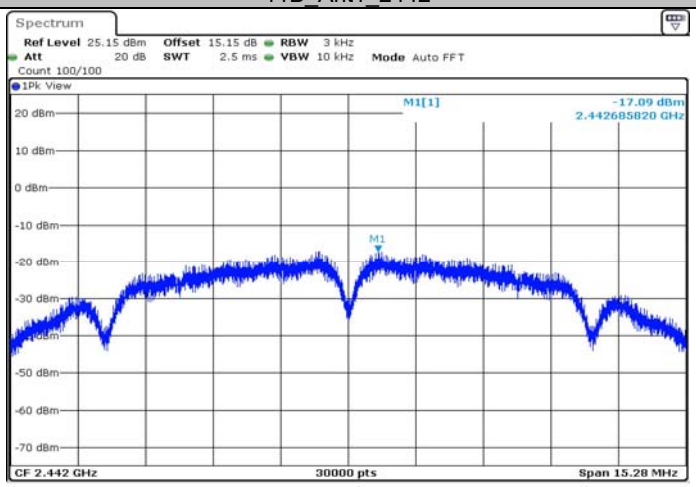
Test Mode	Antenna	Channel	Result[dBm/3Hz]	Limit[dBm/3kHz]	Verdict
11B	Ant1	2412	-16.98	<=8	PASS
		2442	-17.09	<=8	PASS
		2472	-17.11	<=8	PASS
11G	Ant1	2412	-24.11	<=8	PASS
		2442	-24.80	<=8	PASS
		2472	-25.00	<=8	PASS
11N20	Ant1	2412	-24.51	<=8	PASS
		2442	-25.21	<=8	PASS
		2472	-25.30	<=8	PASS

Test Graphs

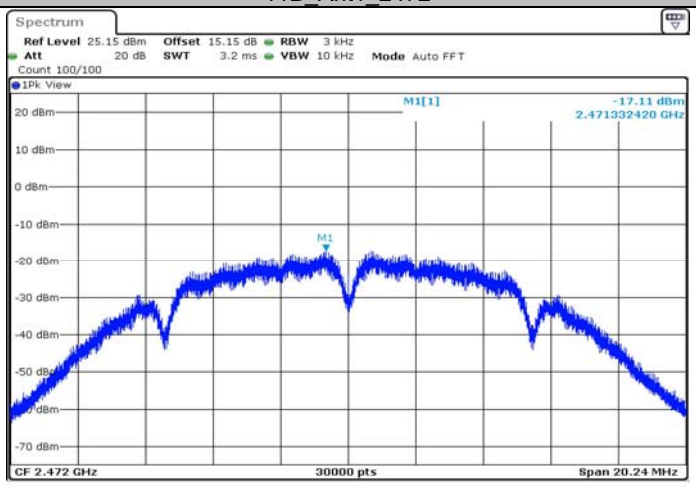
11B_Ant1_2412



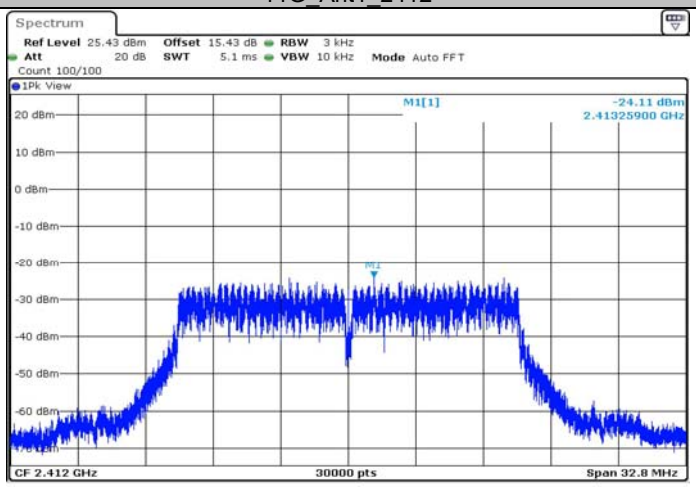
11B_Ant1_2442



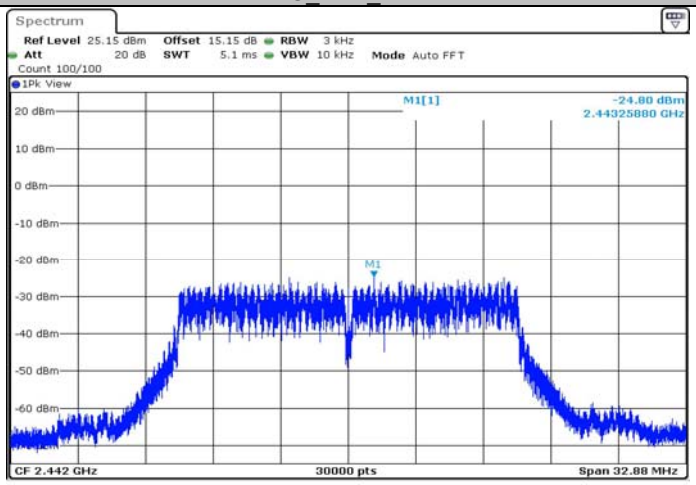
11B_Ant1_2472



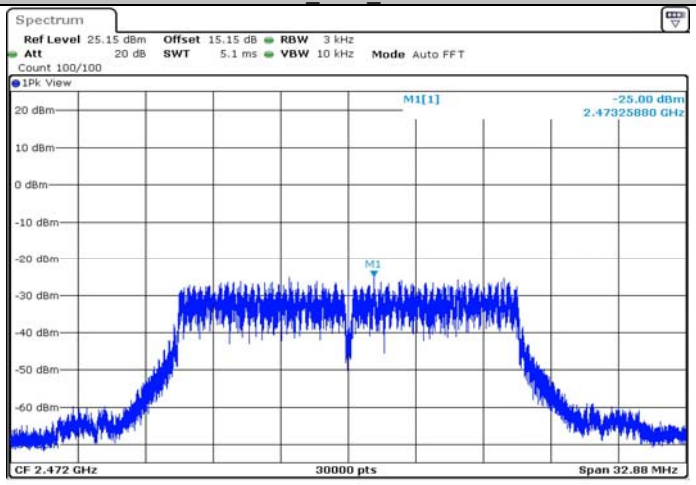
11G_Ant1_2412



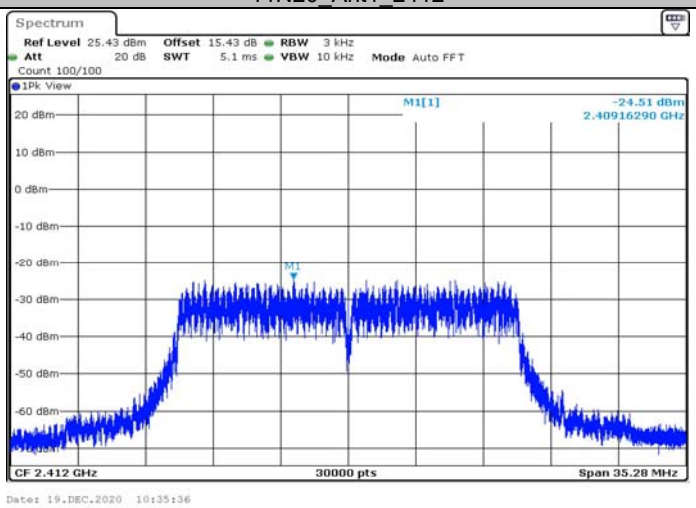
11G_Ant1_2442



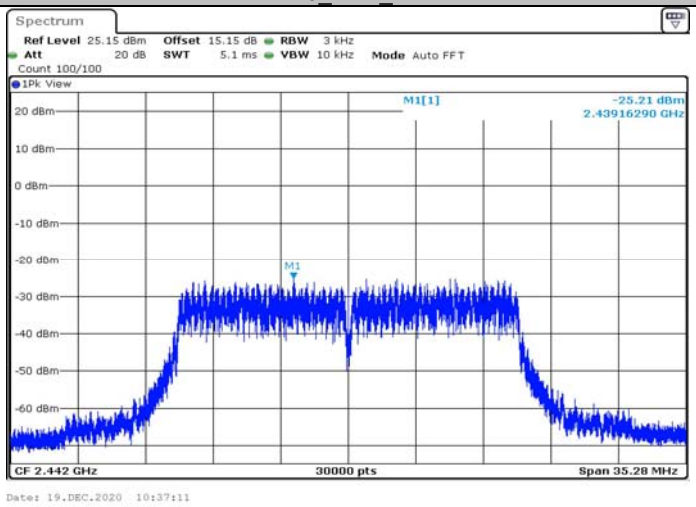
11G_Ant1_2472



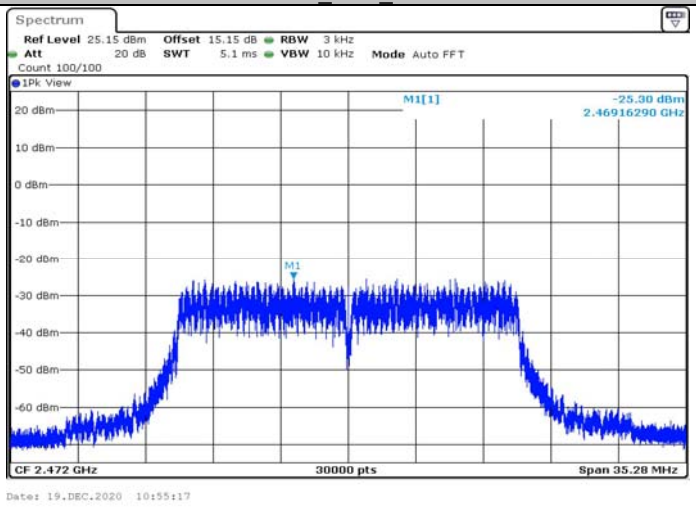
11N20_Ant1_2412



11N20_Ant1_2442



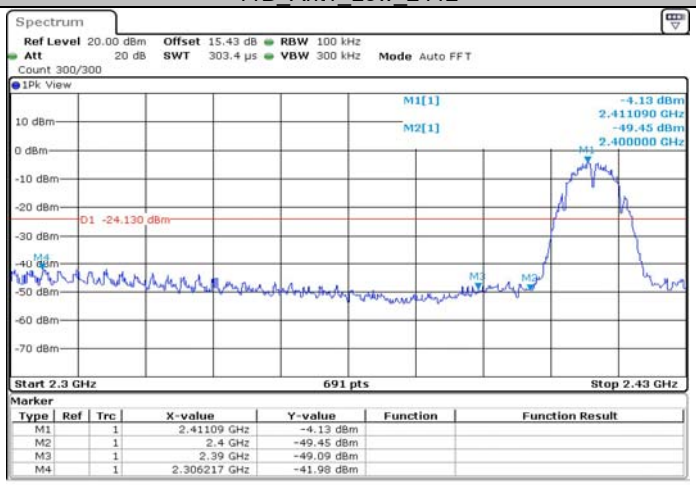
11N20_Ant1_2472



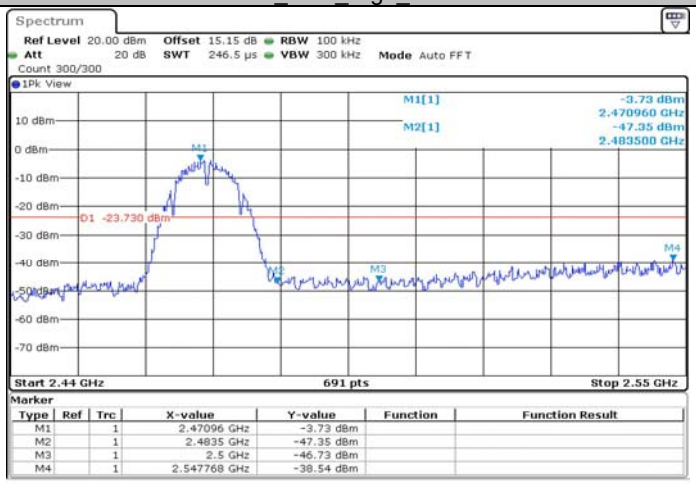
Appendix E: Band edge measurements

Test Graphs

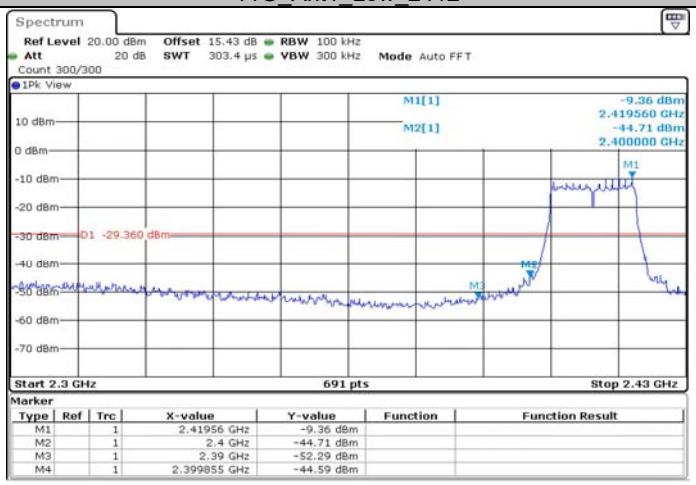
11B_Ant1_Low_2412



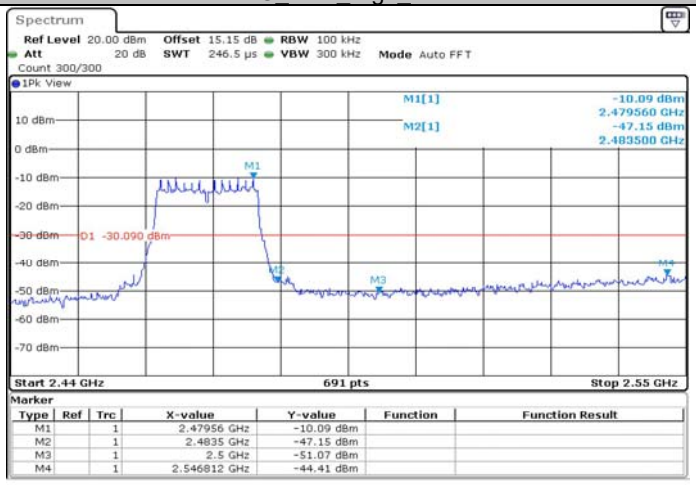
11B_Ant1_High_2472



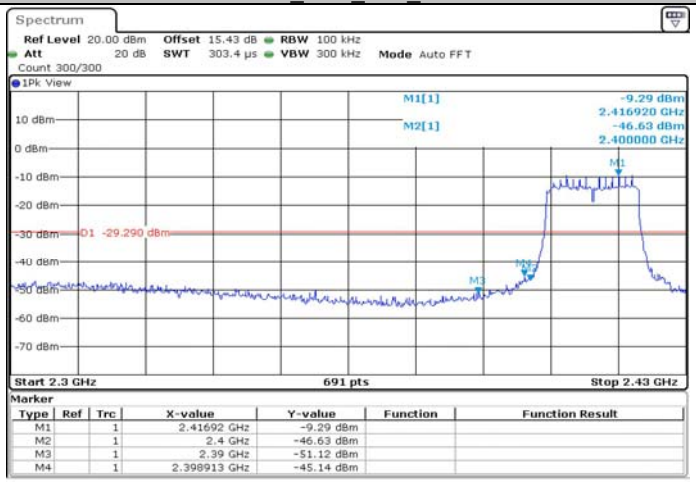
11G_Ant1_Low_2412



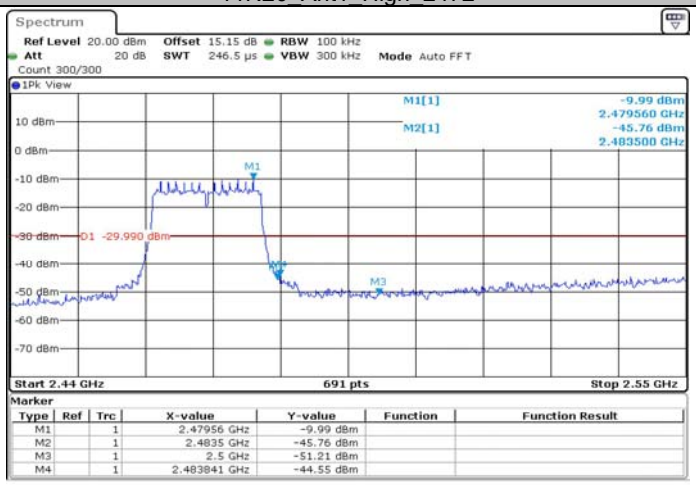
11G_Ant1_High_2472



11N20_Ant1_Low_2412



11N20_Ant1_High_2472



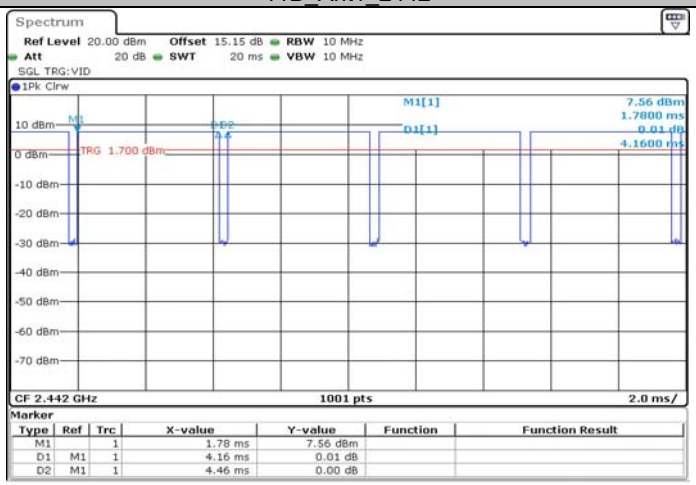
Appendix F: Duty Cycle

Test Result

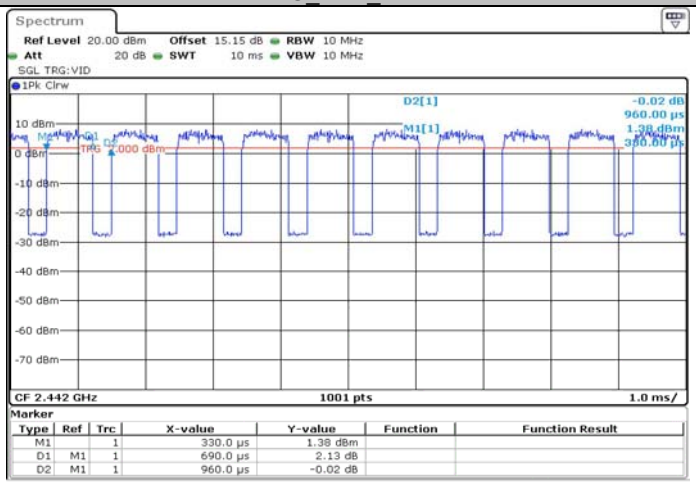
Test Mode	Antenna	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
11B	Ant1	2442	4.16	4.46	93.27
11G	Ant1	2442	0.69	0.96	71.88
11N20	Ant1	2442	0.63	0.93	67.74

Test Graphs

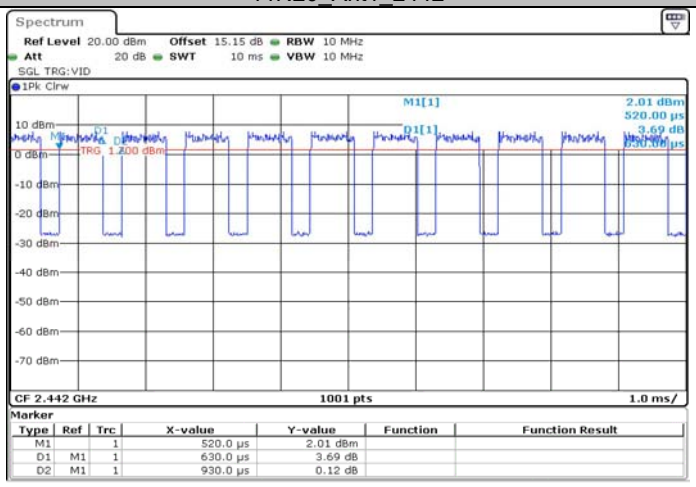
11B_Ant1_2442



11G_Ant1_2442



11N20_Ant1_2442



******* END OF REPORT *******