

FCC PART 15.247

TEST REPORT

For

Shenzhen Snapmaker Technologies Co., Ltd.

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FCC ID: 2AVDG-80018XHFV

Report Type: Original Report	Product Type: Snapmaker Modular 3D Printer
Report Number: RSZ200416002-00B	
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Snapmaker Modular 3D Printer
Tested Model	A350
Multiple Models	A150, A250
Model Differences	Refer to the DoS letter
Frequency Range	Wi-Fi: 2412-2462MHz/2422-2452MHz
Maximum Conducted Peak Output Power	11.80dBm(802.11b), 14.93dBm(802.11g) 14.13dBm(802.11n20), 14.38dBm((802.11n40)
Modulation Technique	Wi-Fi: DSSS, OFDM
Antenna Specification	3.01dBi (provided by the applicant)
Voltage Range	DC 24V from power module
Date of Test	2020-05-11 to 2020-08-30
Sample serial number	RSZ200416002-RF-S1(Assigned by BACL, Shenzhen)
Received date	2020-04-16
Sample/EUT Status	Good condition

Note: Manufacturers can sell any of the three functions (3D Module, CNC Module, Laser Module).

Model	SKU Number
A350	80018
A250	80019
A150	80020
A350 (Single 3D printing function)	80021
A250 (Single 3D printing function)	80022
A150 (Single 3D printing function)	80023

Objective

This test 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 °C
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, 11 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	/	/
6	2437	/	/
7	2442	/	/

For 802.11b, 802.11g, 802.11n-HT20 mode, EUT was tested with Channel 1, 6 and 11

For 802.11n-HT40 mode, 7 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2422	6	2447
2	2427	7	2452
3	2432	/	/
4	2437	/	/
5	2442	/	/

EUT was tested with Channel 1, 4 and 7.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

Software “QRCT” * was used.

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	13	13	13
802.11g	6 Mbps	13	13	13
802.11n-HT20	MCS0	12	12	12
802.11n-HT40	MCS0	13	13	13

Note*: The software and power level was provided by the applicant.

Duty cycle

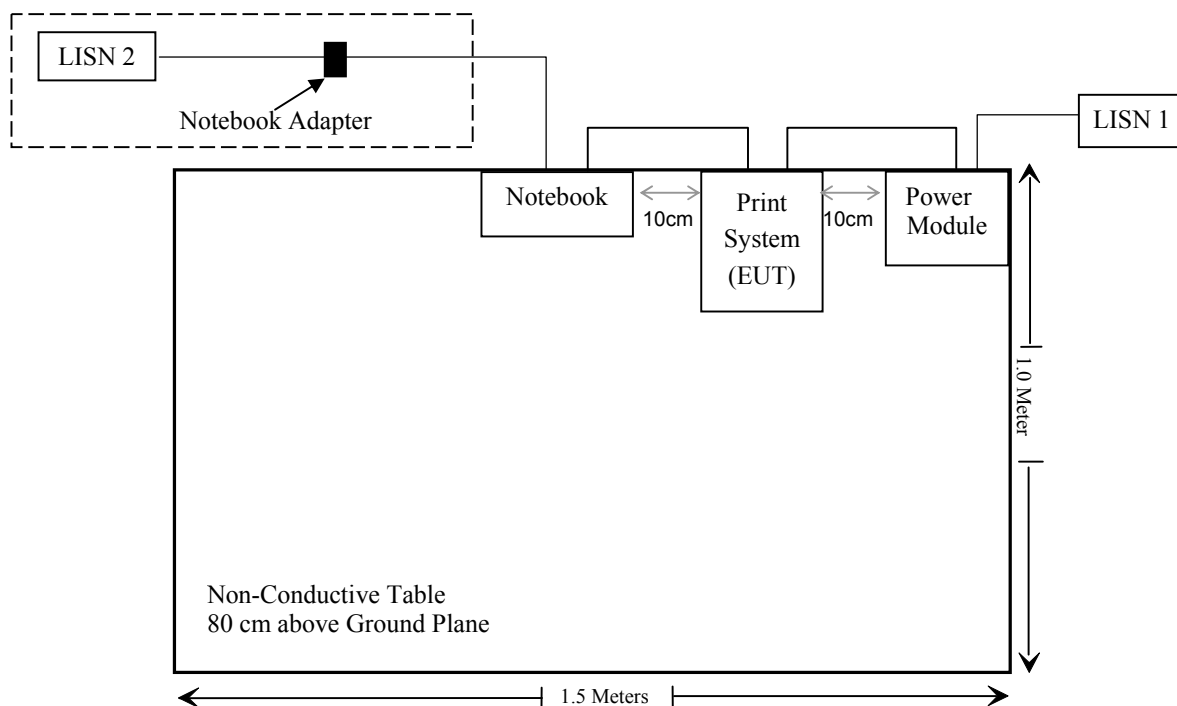
Test Result: Pass. Please refer to the Appendix.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
DELL	Notebook	Latitude E6410	11429208685
DELL	Adapter	PA-10	0933 DMYD-AT59637-B
Snapmaker	Power Module	Unknown	78785
Snapmaker	Laser Module	71007	RSZ200416002-RF-S2

External I/O Cable

Cable Description	Length (m)	From/Port	To
Un-Shielding Detachable AC Power Cable With Ferrite Core	1.5	Power Module	LISN 1
Un-Shielding Detachable DC Power Cable With Ferrite Core	1.0	EUT	Power Module
Shielding Detachable USB Cable With Ferrite Core	1.5	EUT	Notebook

Block Diagram of Test Setup

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (1)& §2.1093	RF Exposure	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	2019/11/29	2020/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2019/11/29	2020/11/28
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	2019/11/29	2020/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2019/11/29	2020/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2019/07/22	2020/07/21
COM-POWER	Pre-amplifier	PA-122	181919	2019/11/29	2020/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2019/11/29	2020/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017/12/22	2020/12/21
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2019/11/29	2020/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2019/11/29	2020/11/28
SNSD	Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2020/04/20	2021/04/20
Ducommun Technologies	Horn antenna	ARH-4223-02	1007726-021304	2017/12/06	2020/12/05
RF Conducted Test					
Tonscend Corporation	RF control Unit	JS0806-2	19D8060154	2019/07/10	2020/07/09
Rohde & Schwarz	Signal and Spectrum Analyzer	FSV40	101473	2019/07/22	2020/07/21
Unknown	RF Cable	Unknown	2301 276	2019/11/29	2020/11/28

* **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), §1.1307 (b) (1) & §2.1093 – RF EXPOSURE

Applicable Standard

FCC§1.1310 and §2.1093.

Test Result

Compliance, please refer to the SAR report: RSZ200416002-SAA.

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 antenna arrangement which was permanently attached and the antenna gain is 3.01 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

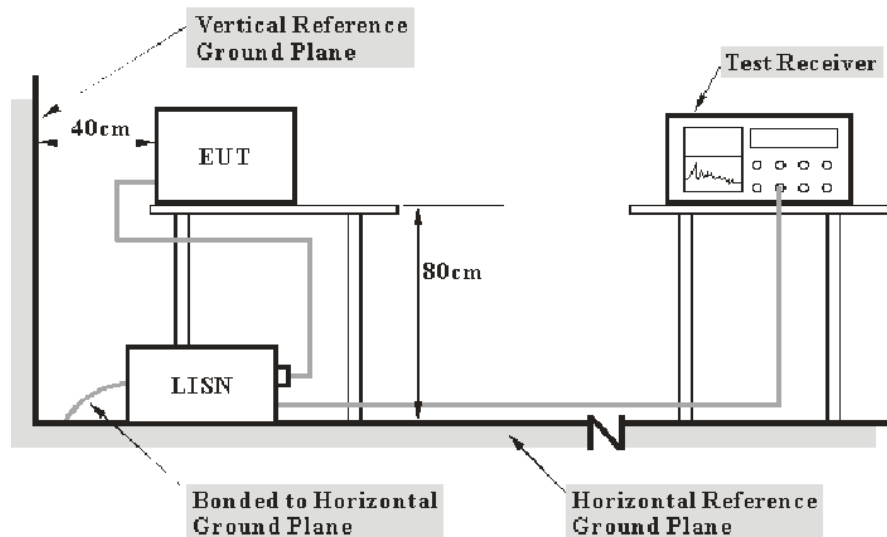
Result: Pass

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:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

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:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

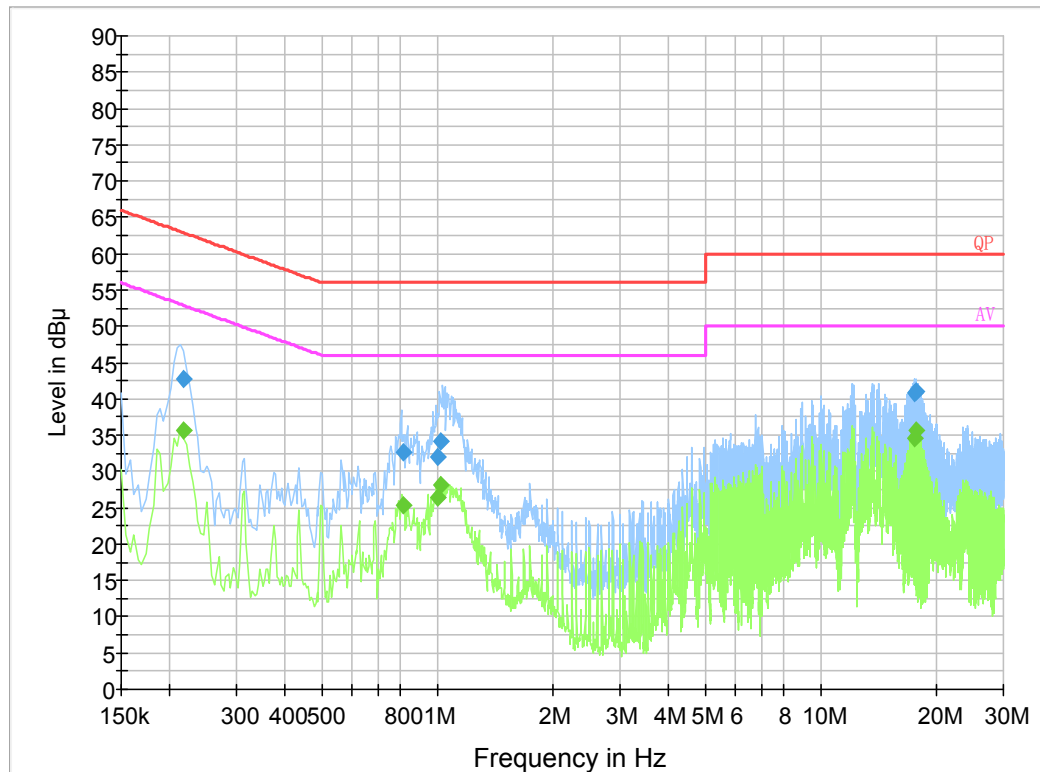
Test Data

Environmental Conditions

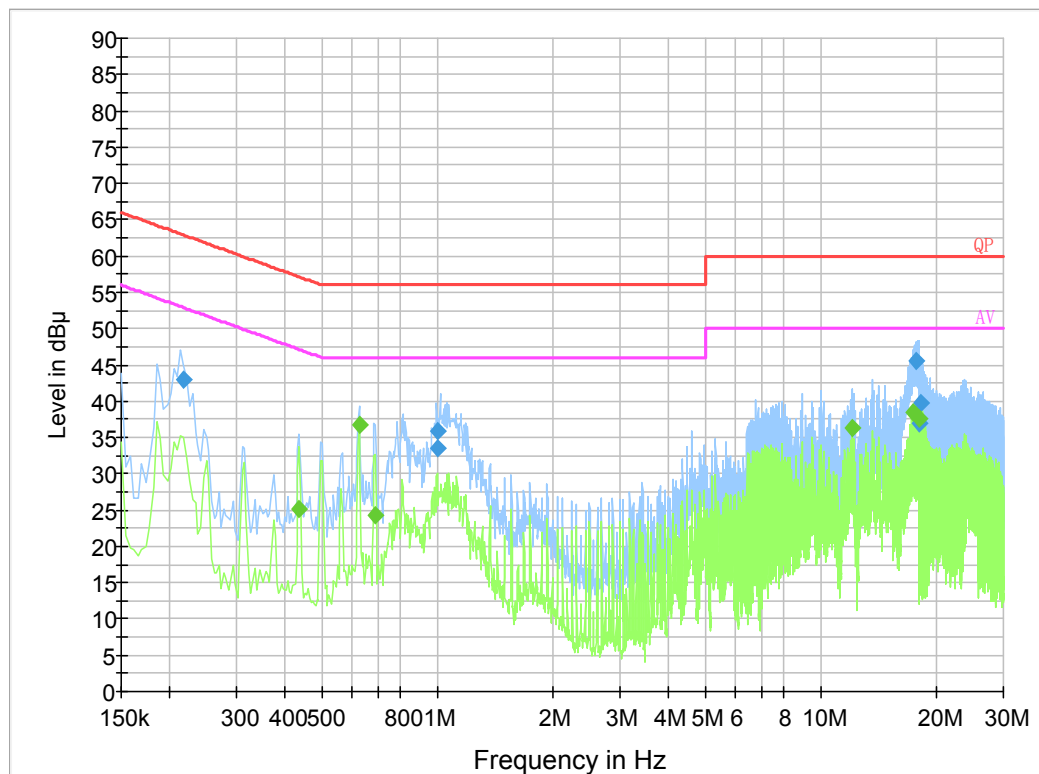
Temperature:	25 °C
Relative Humidity:	65 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2020-08-27.

EUT operation mode: Transmitting

AC 120 V/60 Hz, Line:

Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
0.217500	42.8	19.8	62.9	20.1	QP
0.818090	32.7	19.8	56.0	23.3	QP
1.003090	32.0	19.9	56.0	24.0	QP
1.022490	34.2	19.9	56.0	21.8	QP
17.552830	40.8	20.3	60.0	19.2	QP
17.678690	41.0	20.3	60.0	19.0	QP
0.217500	35.6	19.8	52.9	17.3	Ave.
0.818090	25.2	19.8	46.0	20.8	Ave.
1.003090	26.5	19.9	46.0	19.5	Ave.
1.022490	28.2	19.9	46.0	17.8	Ave.
17.552830	34.6	20.3	50.0	15.4	Ave.
17.678690	35.6	20.3	50.0	14.4	Ave.

AC 120V/ 60 Hz, Neutral:

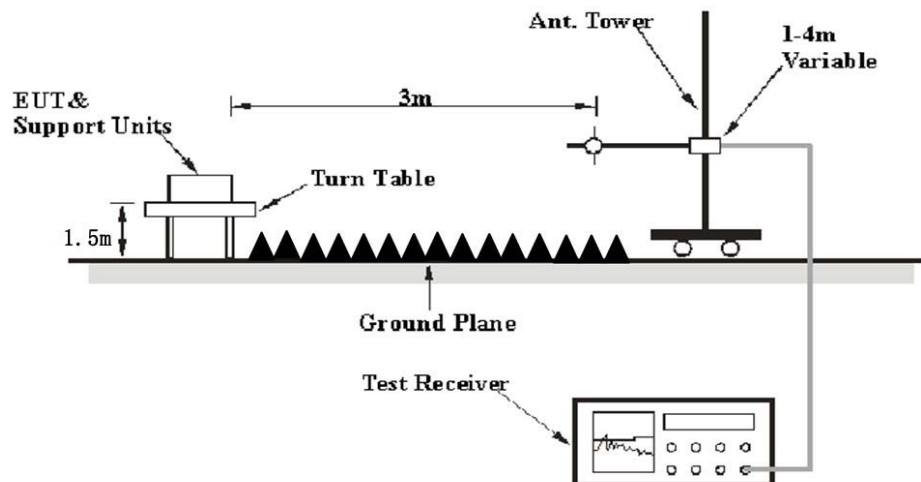
Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
0.217500	43.0	19.8	62.9	19.9	QP
0.999030	35.8	19.8	56.0	20.2	QP
1.006730	33.5	19.8	56.0	22.5	QP
17.677730	45.6	20.2	60.0	14.4	QP
18.121330	37.0	20.3	60.0	23.0	QP
18.182230	39.7	20.3	60.0	20.3	QP
0.438000	25.2	19.8	47.1	21.9	Ave.
0.626000	36.7	19.8	46.0	9.3	Ave.
0.690000	24.2	19.8	46.0	21.8	Ave.
12.074000	36.3	20.0	50.0	13.7	Ave.
17.494000	38.5	20.2	50.0	11.5	Ave.
18.118000	37.6	20.3	50.0	12.4	Ave.

Note:

- 1) Correction Factor = LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
- 2) Corrected Amplitude = Reading + Correction Factor
- 3) Margin = Limit – Corrected Amplitude

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.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

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:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

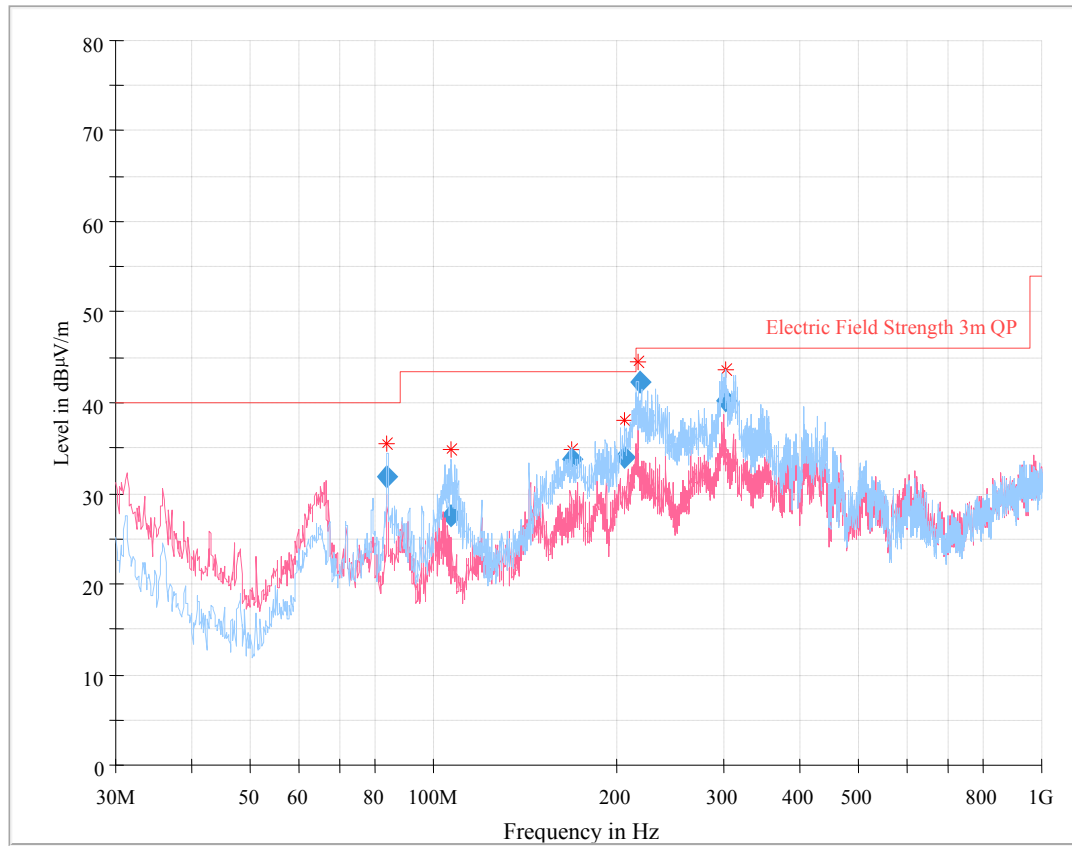
Test Data

Environmental Conditions

Temperature:	24~26 °C
Relative Humidity:	55~60 %
ATM Pressure:	100.9~101.0 kPa

The testing was performed by Harris He on 2020-08-30 for below 1GHz and by Leo Huang on 2020-05-11 for above 1GHz.

EUT operation mode: Transmitting

30 MHz~1 GHz: (802.11g mode, Low channel was worst case)

Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
83.890250	31.88	388.0	H	126.0	-19.6	40.00	8.12
106.631250	27.46	241.0	H	72.0	-16.0	43.50	16.04
168.915875	33.76	124.0	H	272.0	-14.9	43.50	9.74
206.259500	33.88	182.0	H	169.0	-13.9	43.50	9.62
216.378125	42.65	138.0	H	170.0	-13.9	46.00	3.35
301.581500	40.28	104.0	H	152.0	-10.6	46.00	5.72

1 GHz-25 GHz:**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)									
2389.85	27.53	PK	210	1.4	H	31.87	59.40	74	14.60
2389.85	13.45	Ave.	210	1.4	H	31.87	45.32	54	8.68
2483.76	27.54	PK	224	1.4	H	32.13	59.67	74	14.33
2483.76	13.38	Ave.	224	1.4	H	32.13	45.51	54	8.49
4824.00	42.87	PK	236	1.2	H	6.28	49.15	74	24.85
4824.00	28.54	Ave.	236	1.2	H	6.28	34.82	54	19.18
Middle Channel (2437MHz)									
4874.00	43.59	PK	205	1.4	H	6.76	50.35	74	23.65
4874.00	27.73	Ave.	205	1.4	H	6.76	34.49	54	19.51
High Channel (2462 MHz)									
2389.43	27.88	PK	210	2.0	H	31.87	59.75	74	14.25
2389.43	13.56	Ave.	210	2.0	H	31.87	45.43	54	8.57
2484.52	28.78	PK	83	2.1	H	32.13	60.91	74	13.09
2484.52	14.89	Ave.	83	2.1	H	32.13	47.02	54	6.98
4924.00	43.48	PK	156	1.7	H	6.76	50.24	74	23.76
4924.00	28.76	Ave.	156	1.7	H	6.76	35.52	54	18.48

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)									
2388.58	28.44	PK	240	2.4	H	31.87	60.31	74	13.69
2388.58	13.76	Ave.	240	2.4	H	31.87	45.63	54	8.37
2485.42	28.39	PK	16	1.4	H	32.13	60.52	74	13.48
2485.42	13.65	Ave.	16	1.4	H	32.13	45.78	54	8.22
4824.00	43.79	PK	318	1.2	H	6.28	50.07	74	23.93
4824.00	35.39	Ave.	318	1.2	H	6.28	41.67	54	12.33
Middle Channel (2437MHz)									
4874.00	42.87	PK	310	2.3	H	6.76	49.63	74	24.37
4874.00	28.35	Ave.	310	2.3	H	6.76	35.11	54	18.89
High Channel (2462 MHz)									
2388.67	28.26	PK	111	1.0	H	31.87	60.13	74	13.87
2388.67	13.51	Ave.	111	1.0	H	31.87	45.38	54	8.62
2483.99	38.84	PK	223	1.5	H	32.13	70.97	74	3.03
2483.99	19.79	Ave.	223	1.5	H	32.13	51.92	54	2.08
4924.00	43.50	PK	11	1.7	H	6.76	50.26	74	23.74
4924.00	28.89	Ave.	11	1.7	H	6.76	35.65	54	18.35

802.11n20 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	28.45	PK	229	1.9	H	31.87	60.32	74	13.68
2389.59	13.58	Ave.	229	1.9	H	31.87	45.45	54	8.55
2484.62	28.51	PK	220	2.0	H	32.13	60.64	74	13.36
2484.62	13.52	Ave.	220	2.0	H	32.13	45.65	54	8.35
4824.00	43.77	PK	13	1.2	H	6.28	50.05	74	23.95
4824.00	33.81	Ave.	13	1.2	H	6.28	40.09	54	13.91
Middle Channel (2437MHz)									
4874.00	43.18	PK	288	1.9	H	6.76	49.94	74	24.06
4874.00	28.26	Ave.	288	1.9	H	6.76	35.02	54	18.98
High Channel (2462 MHz)									
2388.84	28.32	PK	70	1.4	H	31.87	60.19	74	13.81
2388.84	13.46	Ave.	70	1.4	H	31.87	45.33	54	8.67
2483.92	41.18	PK	108	1.4	H	32.13	73.31	74	0.69
2483.92	21.18	Ave.	108	1.4	H	32.13	53.31	54	0.69
4924.00	43.13	PK	330	2.4	H	6.76	49.89	74	24.11
4924.00	28.43	Ave.	330	2.4	H	6.76	35.19	54	18.81

802.11n-HT40 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 (2422 MHz)									
2388.28	28.05	PK	201	1.5	H	31.87	59.92	74	14.08
2388.28	13.54	Ave.	201	1.5	H	31.87	45.41	54	8.59
2484.63	28.53	PK	55	2.4	H	32.13	60.66	74	13.34
2484.63	13.74	Ave.	55	2.4	H	32.13	45.87	54	8.13
4844.00	43.38	PK	336	1.6	H	6.28	49.66	74	24.34
4844.00	28.57	Ave.	336	1.6	H	6.28	34.85	54	19.15
Middle Channel (2437MHz)									
4874.00	43.21	PK	64	2.1	H	6.76	49.97	74	24.03
4874.00	28.39	Ave.	64	2.1	H	6.76	35.15	54	18.85
High Channel (2452 MHz)									
2388.76	28.43	PK	178	2.2	H	31.87	60.30	74	13.70
2388.76	13.52	Ave.	178	2.2	H	31.87	45.39	54	8.61
2488.57	36.60	PK	352	1.7	H	32.13	68.73	74	5.27
2488.57	17.74	Ave.	352	1.7	H	32.13	49.87	54	4.13
4904.00	43.23	PK	177	1.5	H	6.76	49.99	74	24.01
4904.00	28.42	Ave.	177	1.5	H	6.76	35.18	54	18.82

Note:

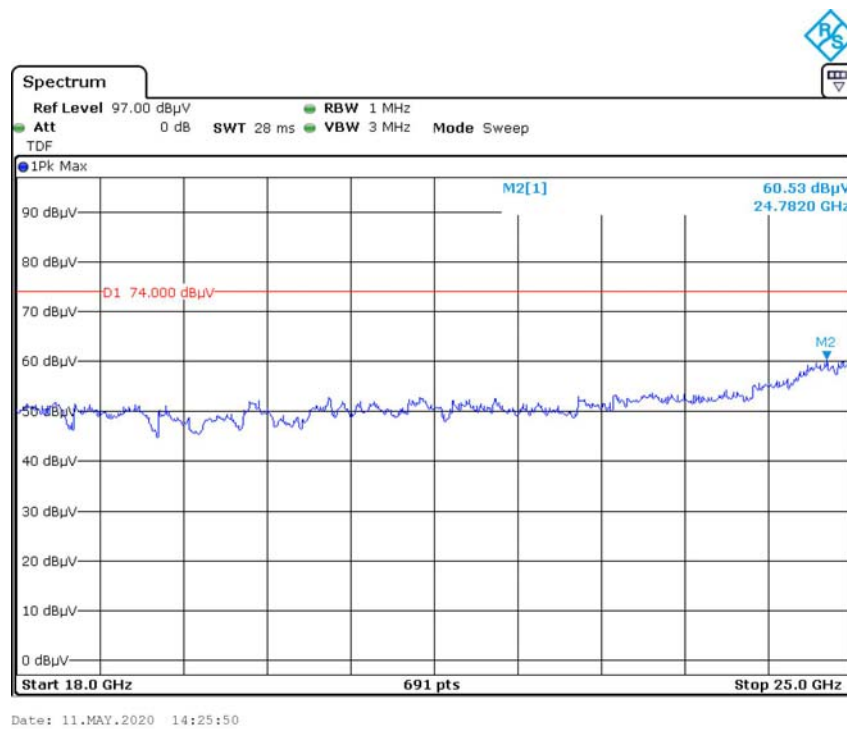
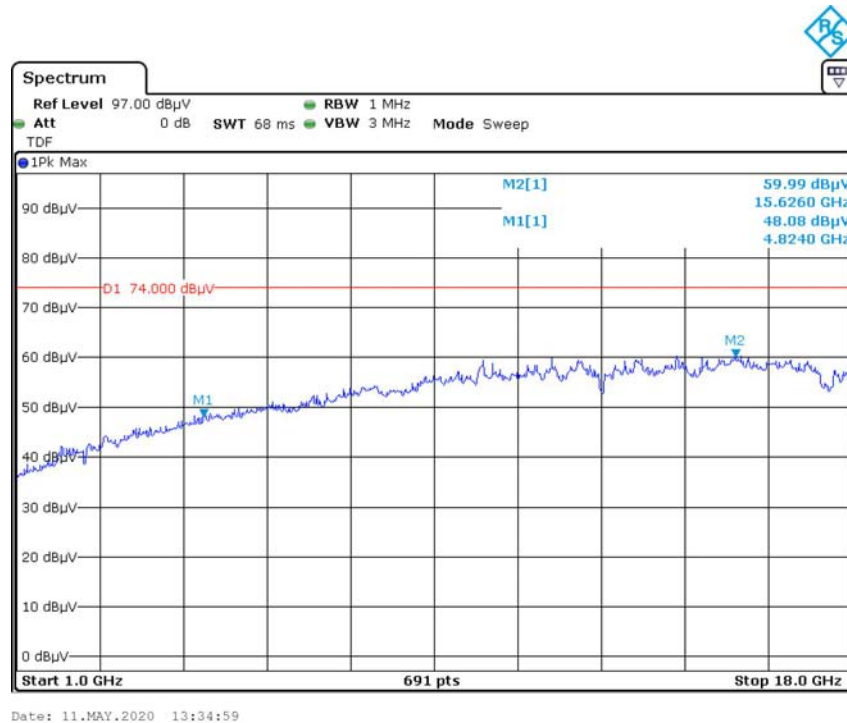
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

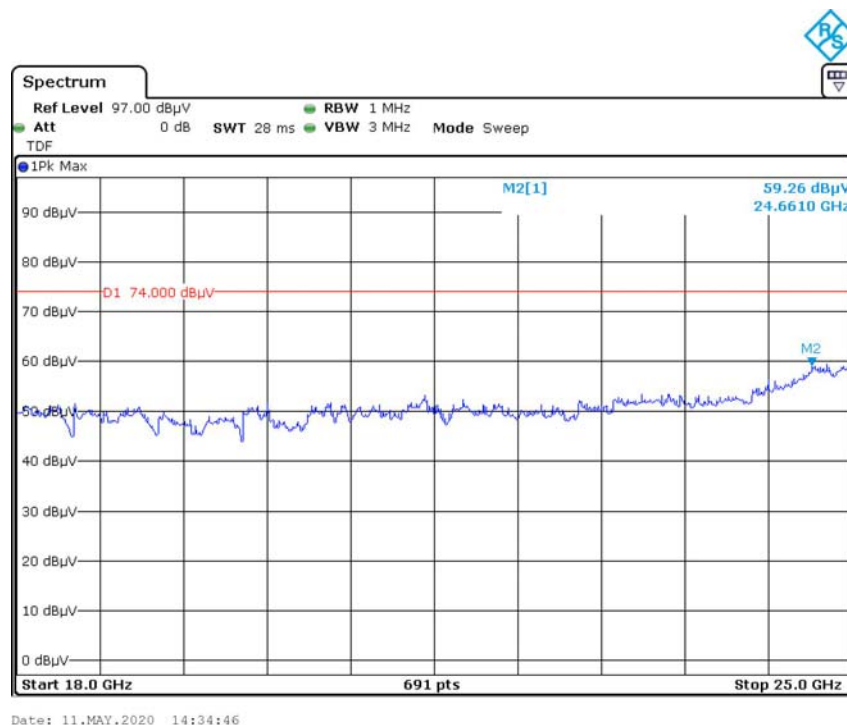
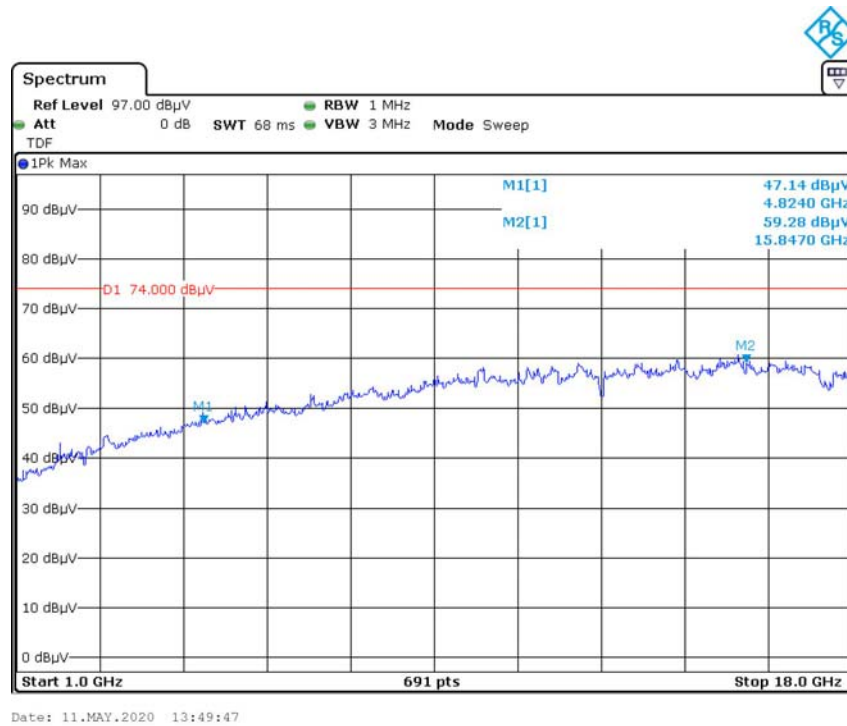
Margin = Limit - Corrected. Amplitude

The other spurious emission which is 20dB to the limit was not recorded.

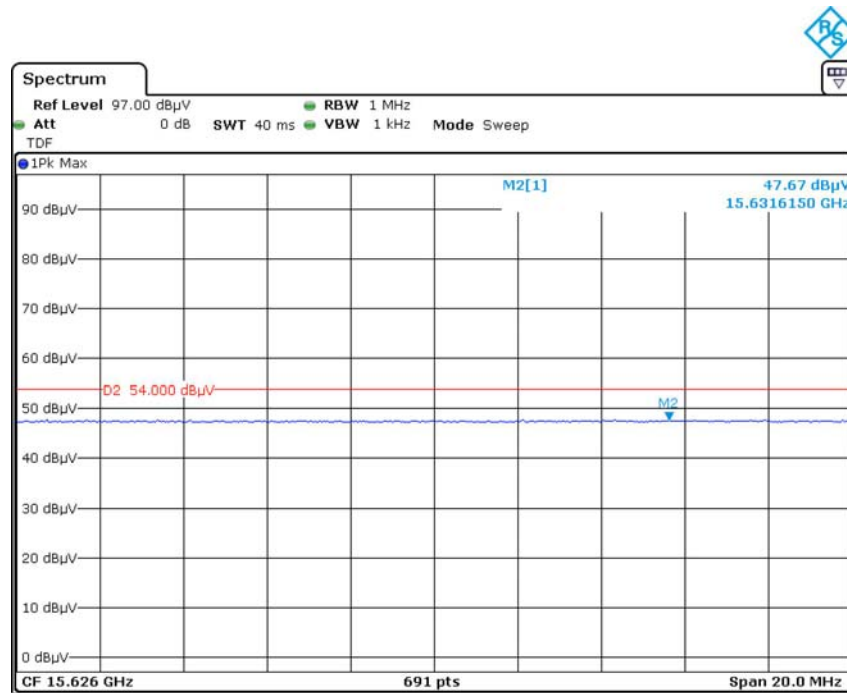
**Pre-scan with 802.11g Mode, Low channel
Horizontal**



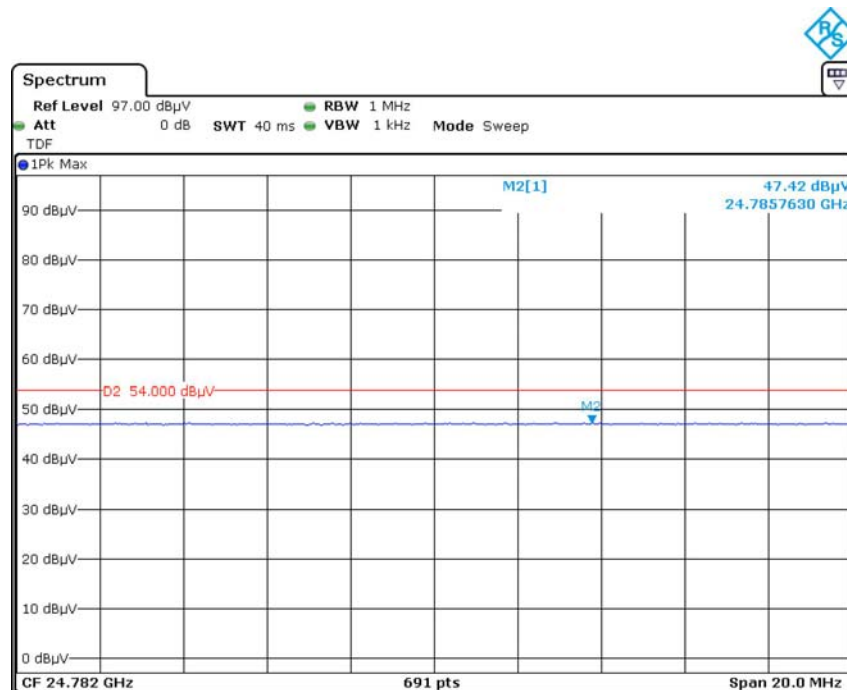
Vertical



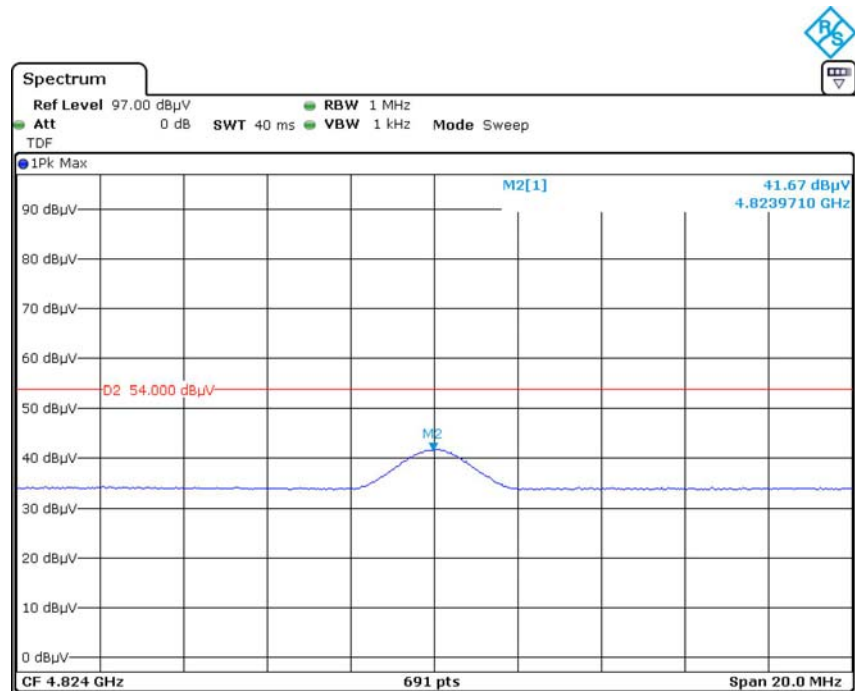
Average Horizontal



Date: 11.MAY.2020 13:40:33

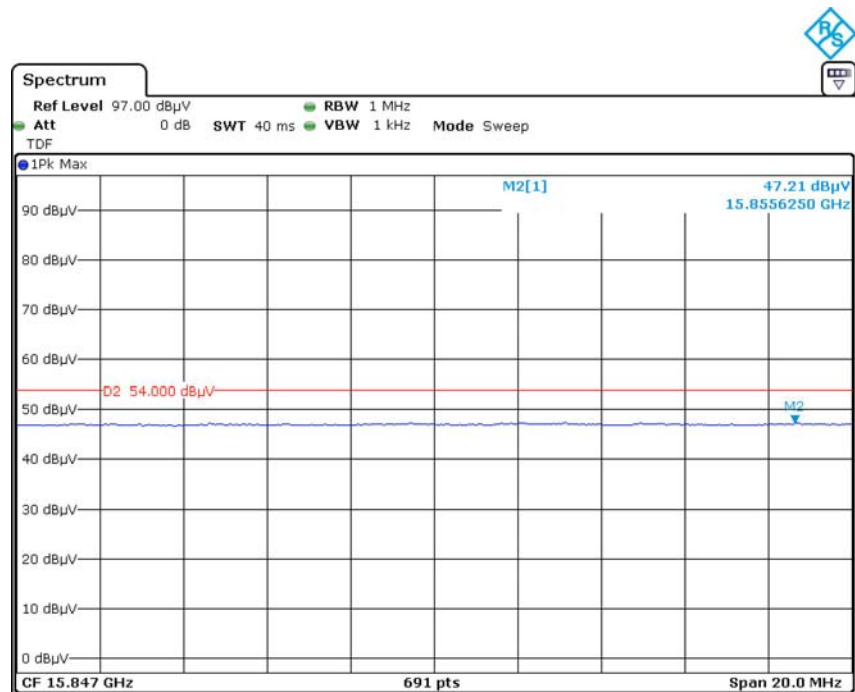


Date: 11.MAY.2020 14:30:59

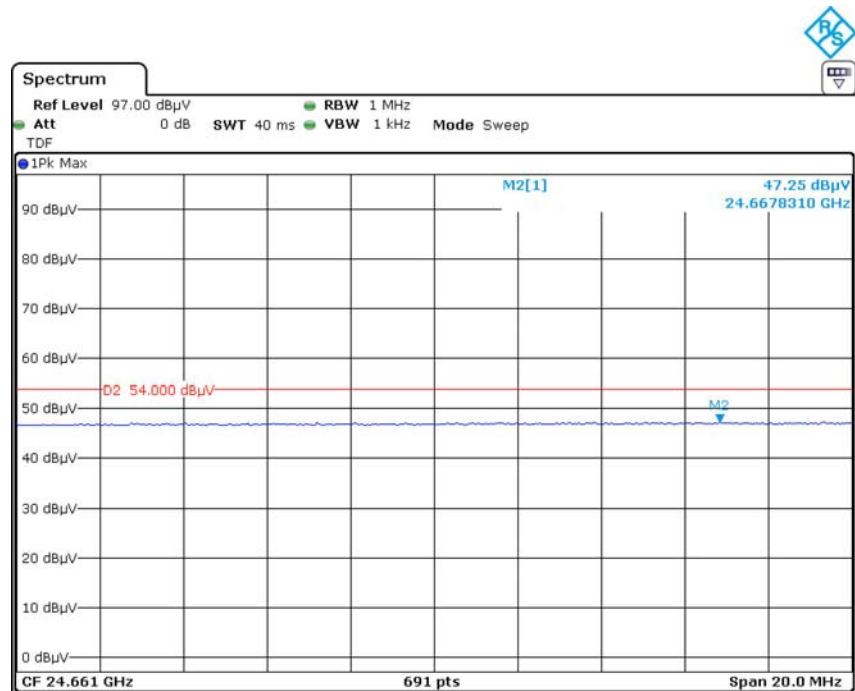


Date: 11.MAY.2020 13:45:10

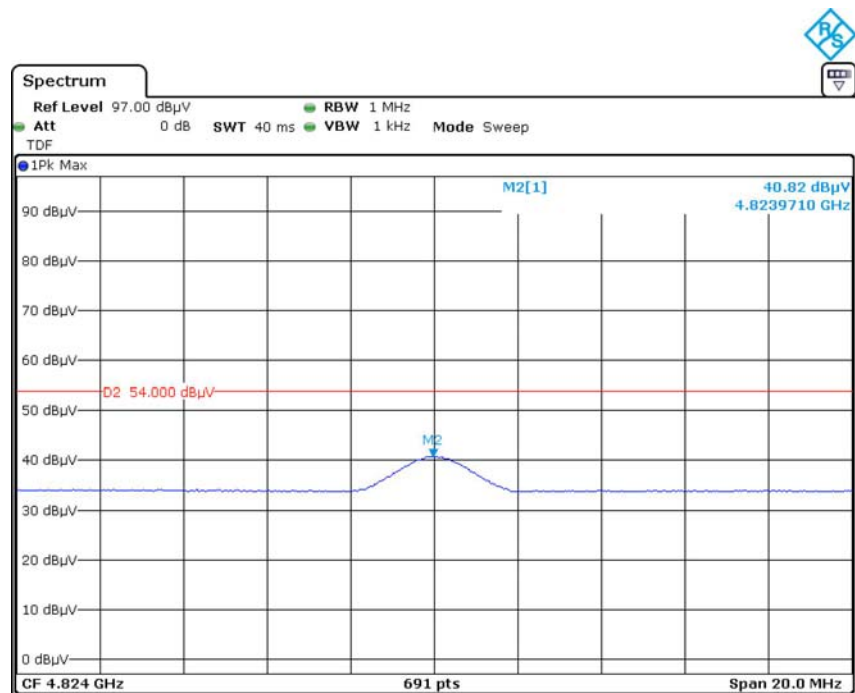
Vertical



Date: 11.MAY.2020 13:53:29



Date: 11.MAY.2020 14:39:11



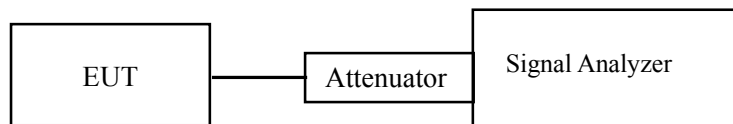
Date: 11.MAY.2020 13:55:16

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:	24 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by James Fu on 2020-06-01 and 2020-06-28.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

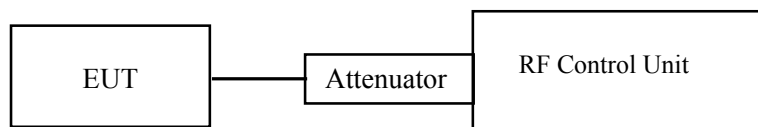
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

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:	24 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by James Fu on 2020-06-01.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

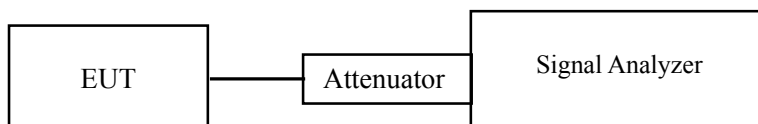
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

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:	24 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by James Fu on 2020-06-01.

EUT operation mode: Transmitting

Test Result: Pass

Please refer to the Appendix.

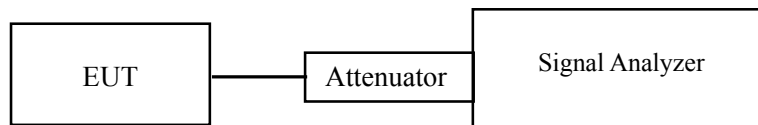
FCC §15.247(e) - POWER SPECTRAL DENSITY

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: $3\text{ kHz} \leq \text{RBW} \leq 100\text{ kHz}$.
3. Set the VBW $\geq 3 \times \text{RBW}$.
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:	24 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by James Fu on 2020-06-01.

EUT operation mode: Transmitting

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

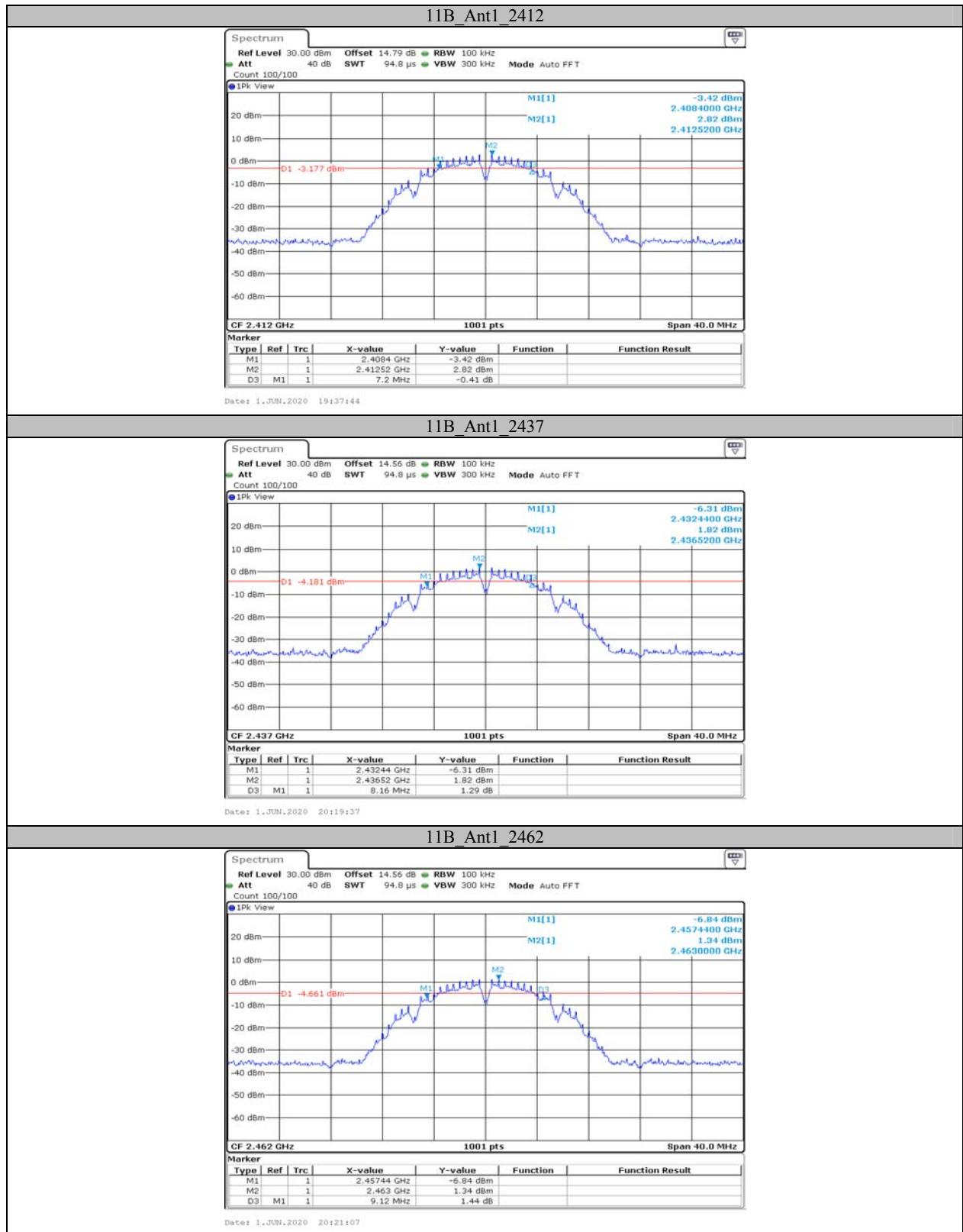
APPENDIX

Appendix A: DTS Bandwidth

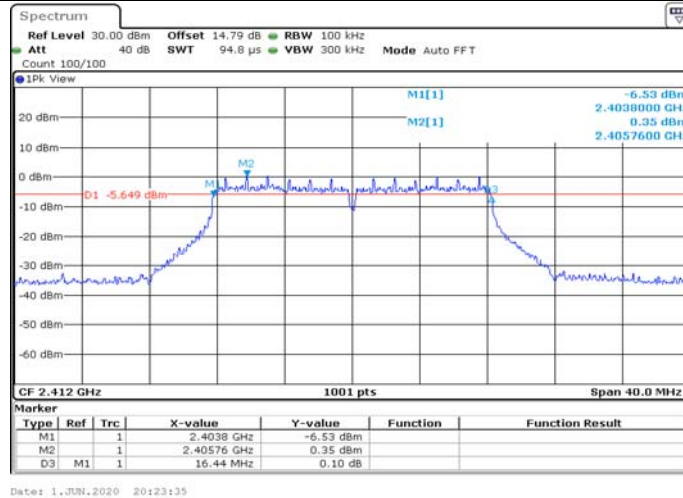
Test Result

Test Mode	Antenna	Channel	DTS BW [MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	7.200	0.5	PASS
		2437	8.160	0.5	PASS
		2462	9.120	0.5	PASS
11G	Ant1	2412	16.440	0.5	PASS
		2437	16.400	0.5	PASS
		2462	16.440	0.5	PASS
11N20	Ant1	2412	17.680	0.5	PASS
		2437	17.640	0.5	PASS
		2462	17.640	0.5	PASS
11N40	Ant1	2422	35.280	0.5	PASS
		2437	35.280	0.5	PASS
		2452	35.600	0.5	PASS

Test Graphs

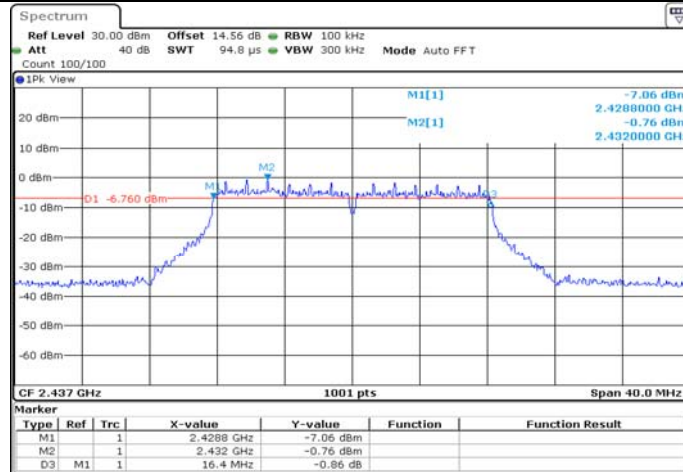


11G Ant1 2412



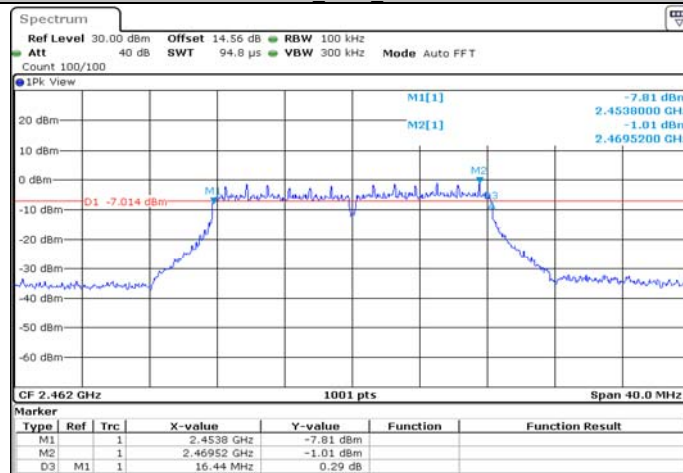
Date: 1.JUN.2020 20:23:35

11G Ant1 2437

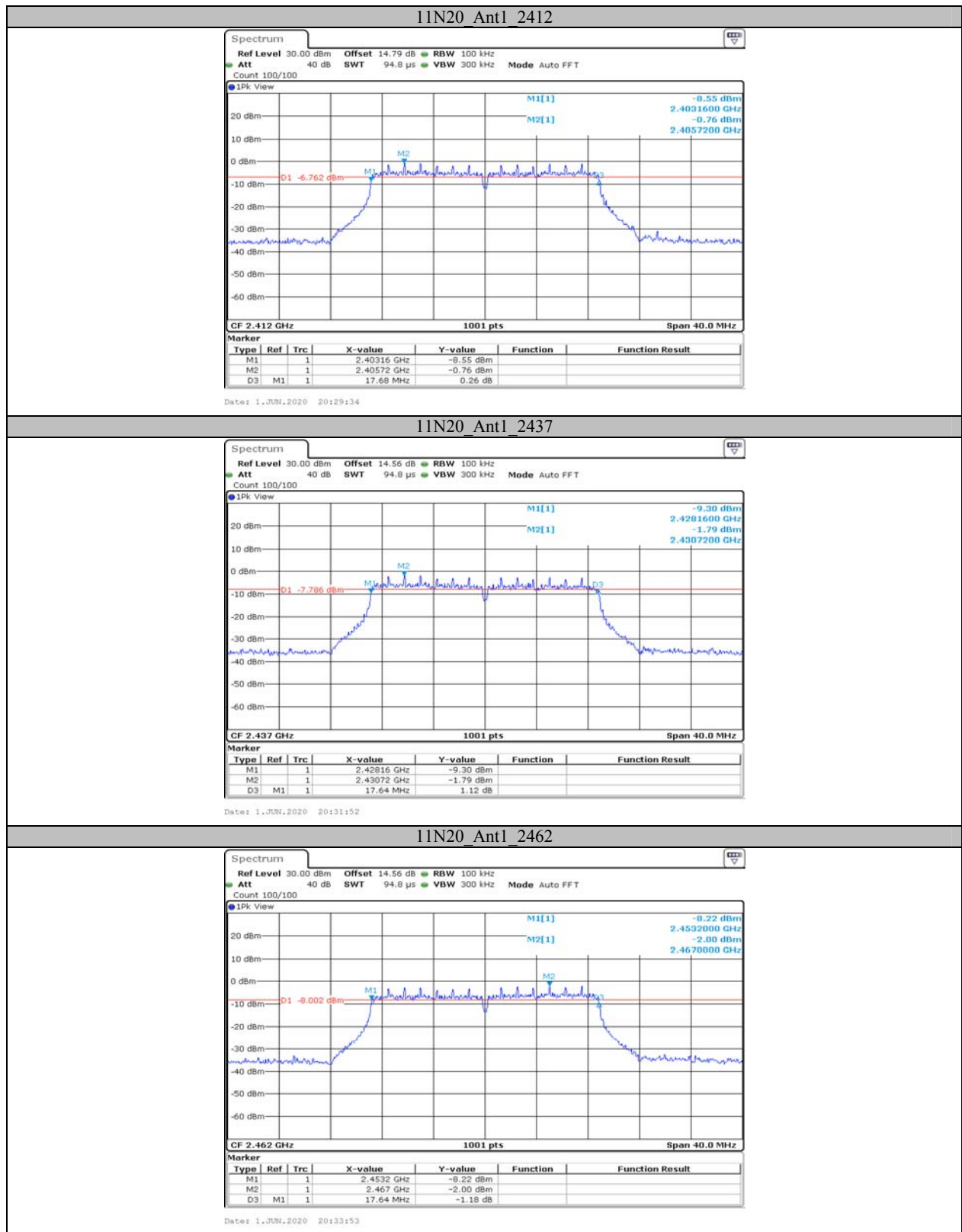


Date: 1.JUN.2020 20:25:48

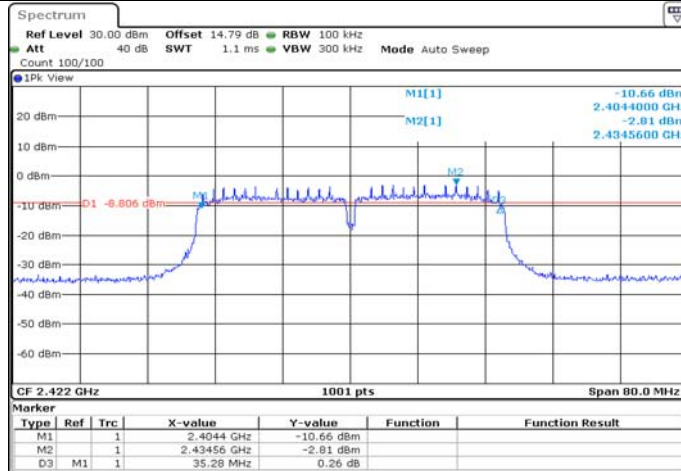
11G Ant1 2462



Date: 1.JUN.2020 20:27:13

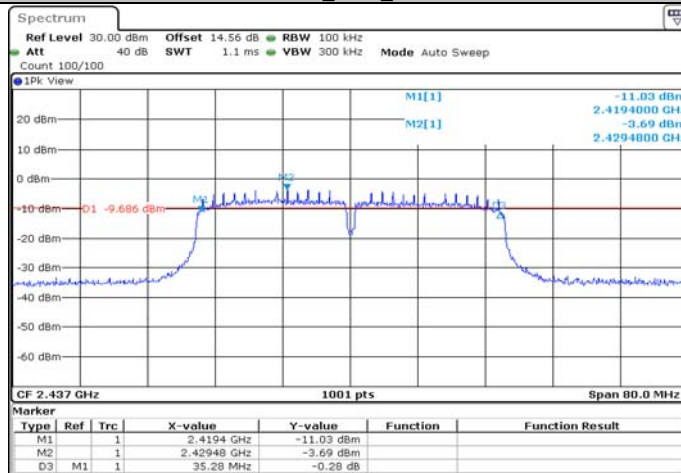


11N40 Ant1 2422



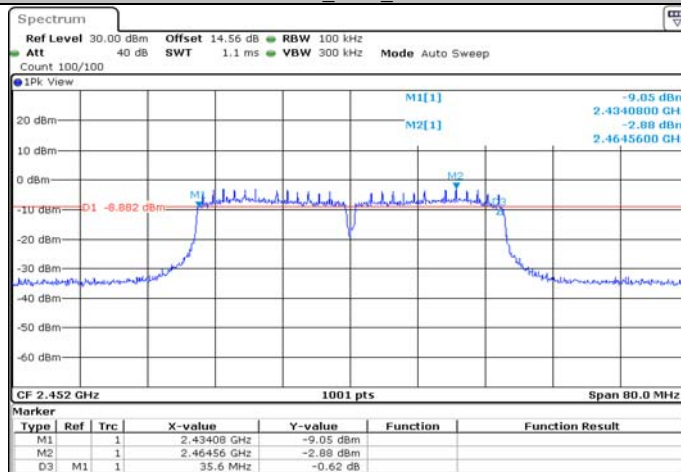
Date: 1.JUN.2020 20:37:00

11N40 Ant1 2437



Date: 1.JUN.2020 20:40:04

11N40 Ant1 2452



Date: 1.JUN.2020 20:42:49

Appendix B: Occupied Channel Bandwidth**Test Result**

Test Mode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	14.066	---	PASS
		2437	14.545	---	PASS
		2462	13.986	---	PASS
11G	Ant1	2412	18.102	---	PASS
		2437	18.302	---	PASS
		2462	17.902	---	PASS
11N20	Ant1	2412	18.901	---	PASS
		2437	18.941	---	PASS
		2462	18.741	---	PASS
11N40	Ant1	2422	36.444	---	PASS
		2437	36.843	---	PASS
		2452	36.763	---	PASS

Test Graphs

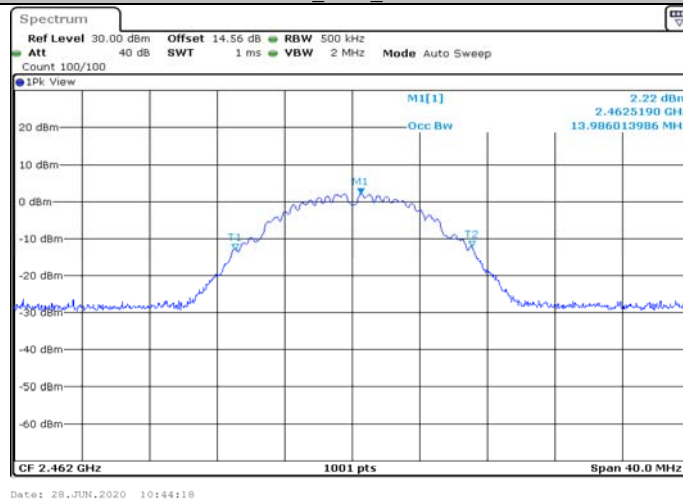
11B_Ant1_2412



11B_Ant1_2437



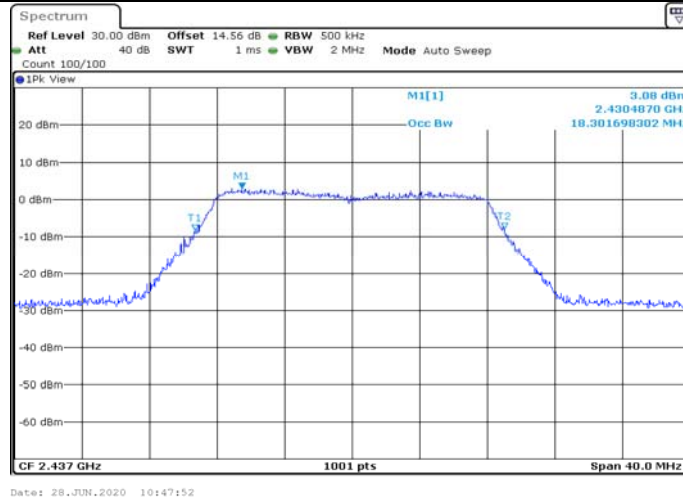
11B_Ant1_2462



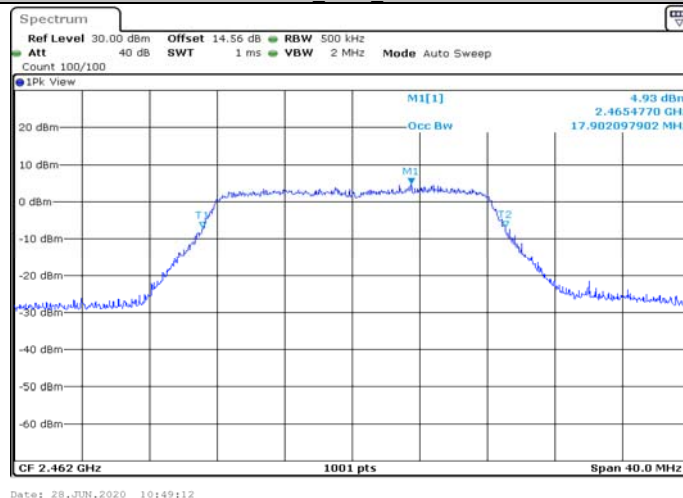
11G Ant1_2412

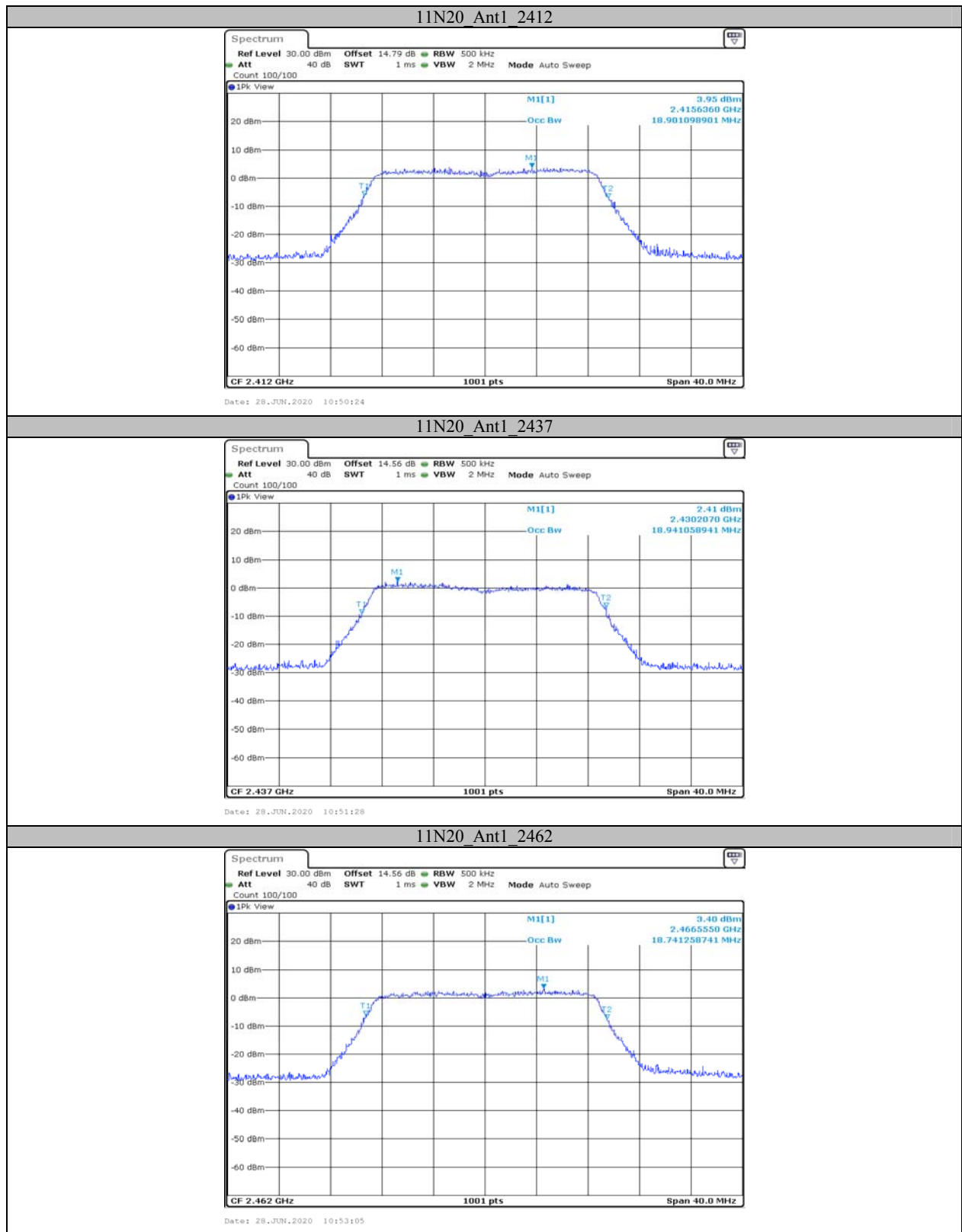


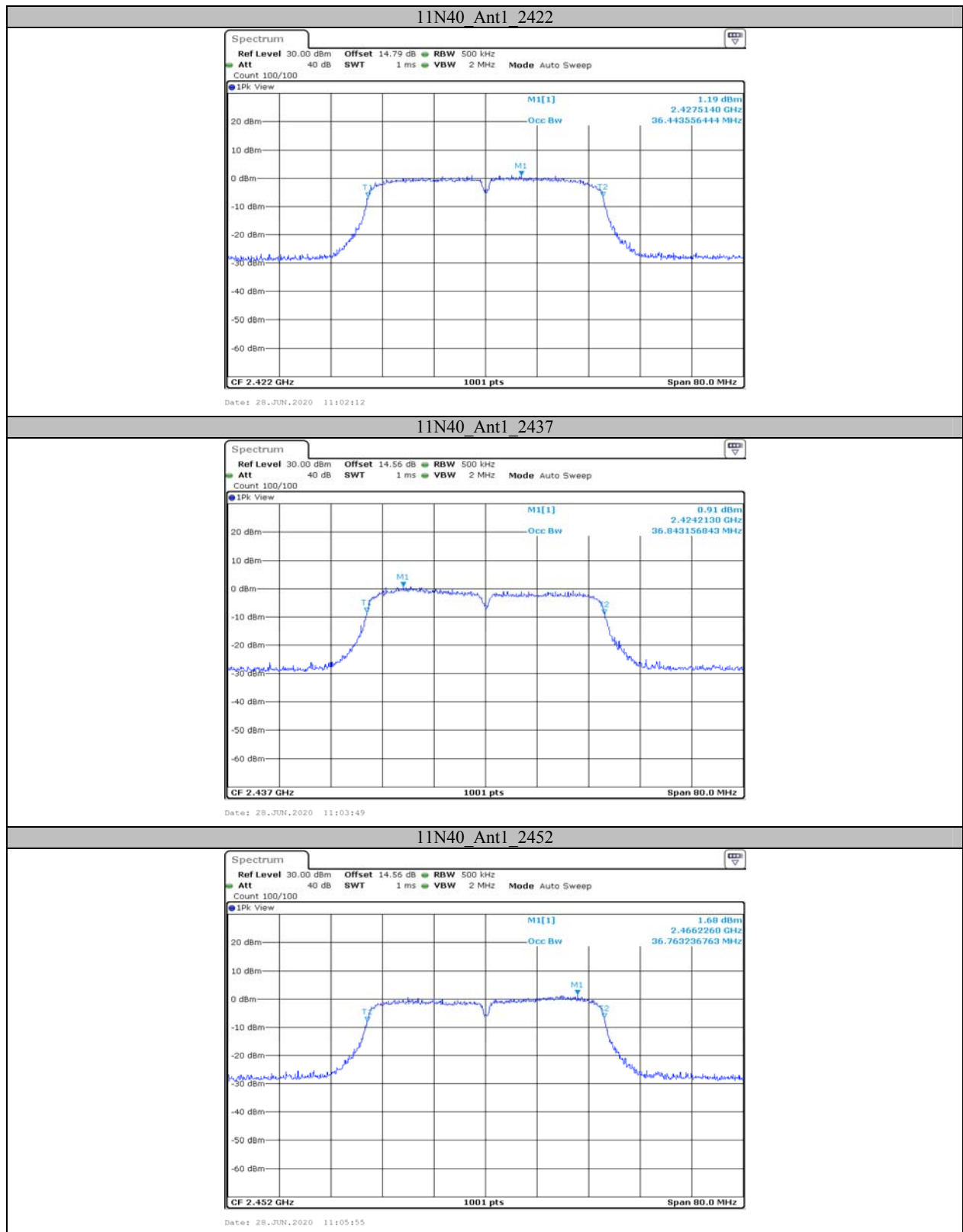
11G Ant1_2437



11G Ant1_2462







Appendix C1: Maximum conducted Average output power**Test Result**

Test Mode	Antenna	Channel	Average Result[dBm]	Limit[dBm]	Verdict
11B	Ant1	2412	9.85	<=30	PASS
		2437	8.91	<=30	PASS
		2462	9.18	<=30	PASS
11G	Ant1	2412	9.93	<=30	PASS
		2437	9.13	<=30	PASS
		2462	9.17	<=30	PASS
11N20	Ant1	2412	9.09	<=30	PASS
		2437	8.12	<=30	PASS
		2462	8.18	<=30	PASS
11N40	Ant1	2422	9.41	<=30	PASS
		2437	8.97	<=30	PASS
		2452	9.84	<=30	PASS

Appendix C2: Maximum conducted Peak output power**Test Result**

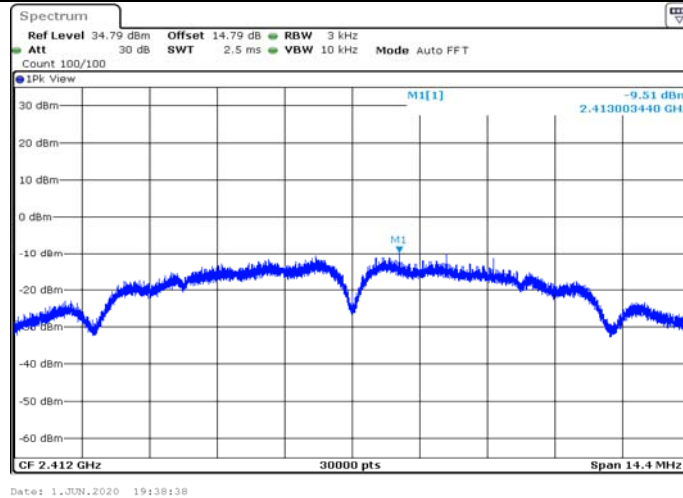
Test Mode	Antenna	Channel	Peak Result [dBm]	Limit[dBm]	Verdict
11B	Ant1	2412	11.80	<=30	PASS
		2437	11.02	<=30	PASS
		2462	11.21	<=30	PASS
11G	Ant1	2412	14.93	<=30	PASS
		2437	14.00	<=30	PASS
		2462	13.91	<=30	PASS
11N20	Ant1	2412	14.13	<=30	PASS
		2437	13.25	<=30	PASS
		2462	13.36	<=30	PASS
11N40	Ant1	2422	13.81	<=30	PASS
		2437	13.46	<=30	PASS
		2452	14.38	<=30	PASS

Appendix D: Maximum power spectral density**Test Result**

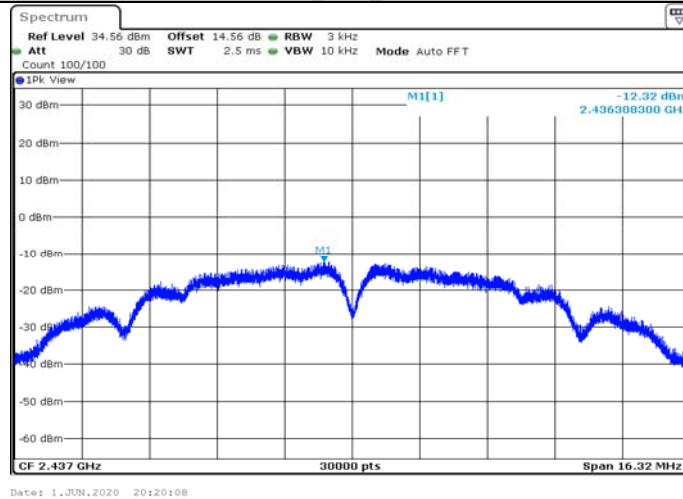
Test Mode	Antenna	Channel	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
11B	Ant1	2412	-9.51	<=8	PASS
		2437	-12.32	<=8	PASS
		2462	-11.53	<=8	PASS
11G	Ant1	2412	-12.29	<=8	PASS
		2437	-15.14	<=8	PASS
		2462	-14.98	<=8	PASS
11N20	Ant1	2412	-13.78	<=8	PASS
		2437	-15.5	<=8	PASS
		2462	-14.36	<=8	PASS
11N40	Ant1	2422	-16.85	<=8	PASS
		2437	-17.58	<=8	PASS
		2452	-17.45	<=8	PASS

Test Graphs

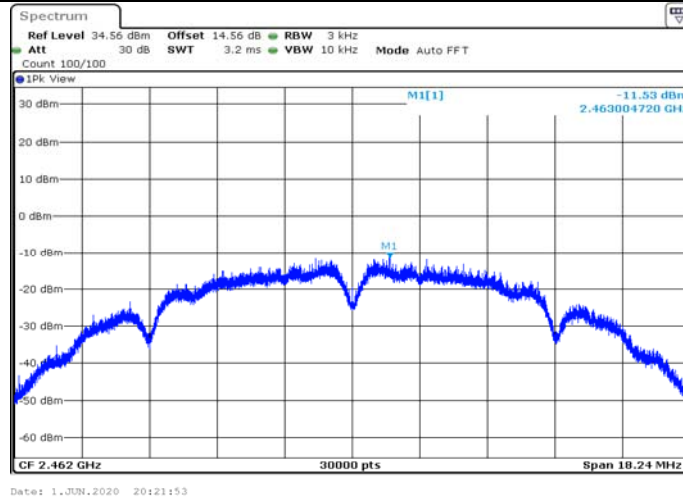
11B_Ant1_2412



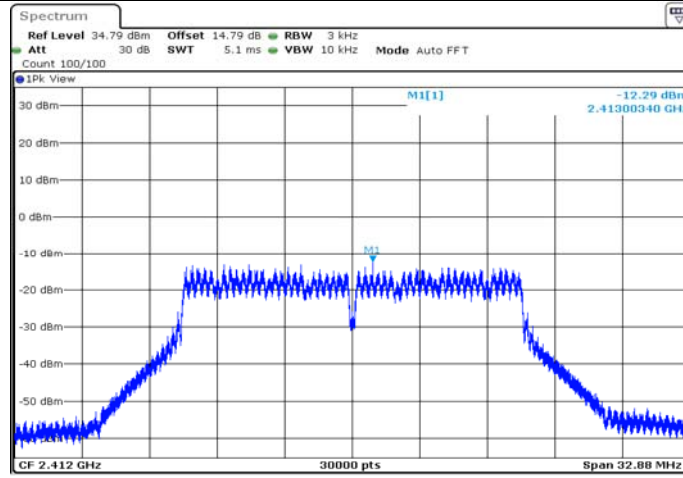
11B_Ant1_2437



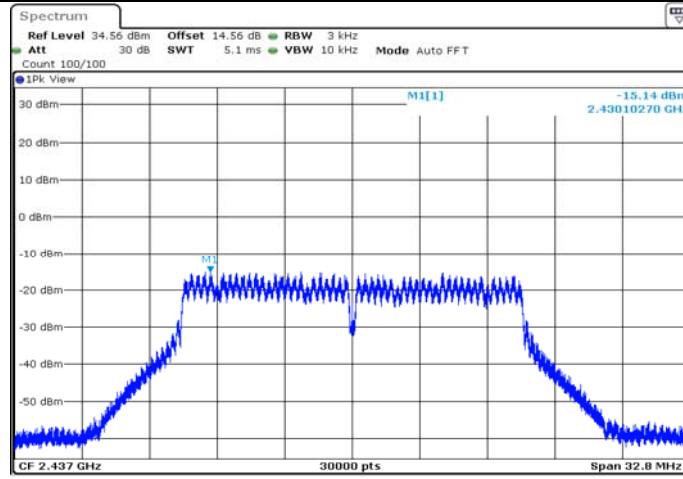
11B_Ant1_2462



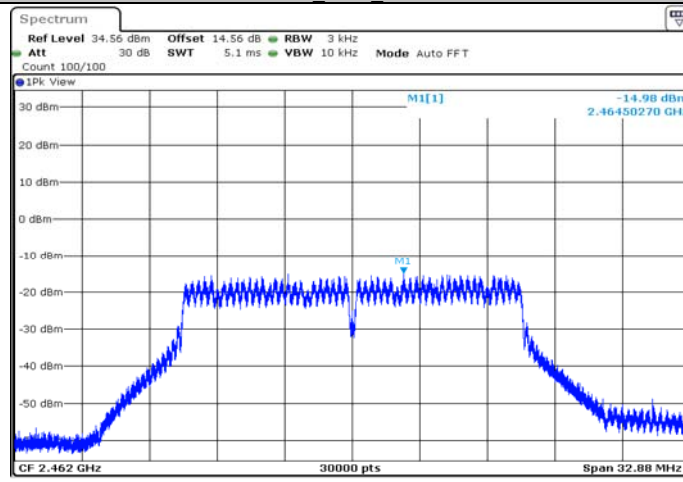
11G Ant1_2412



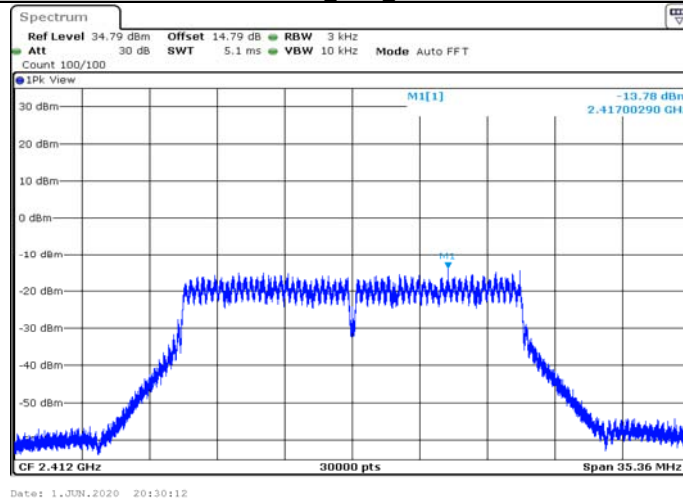
11G Ant1_2437



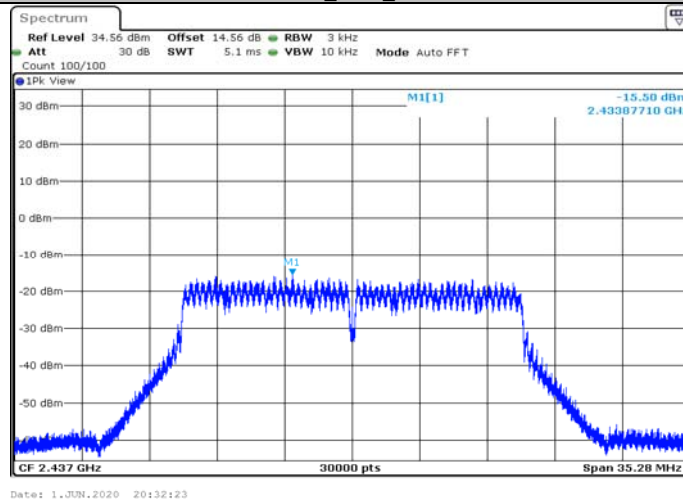
11G Ant1_2462



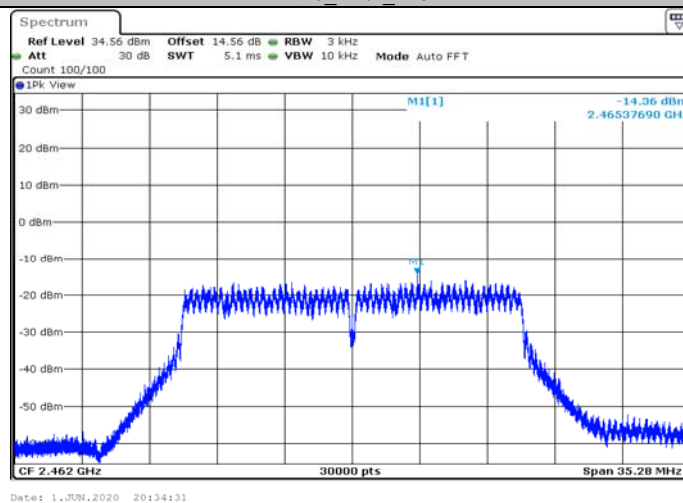
11N20_Ant1_2412

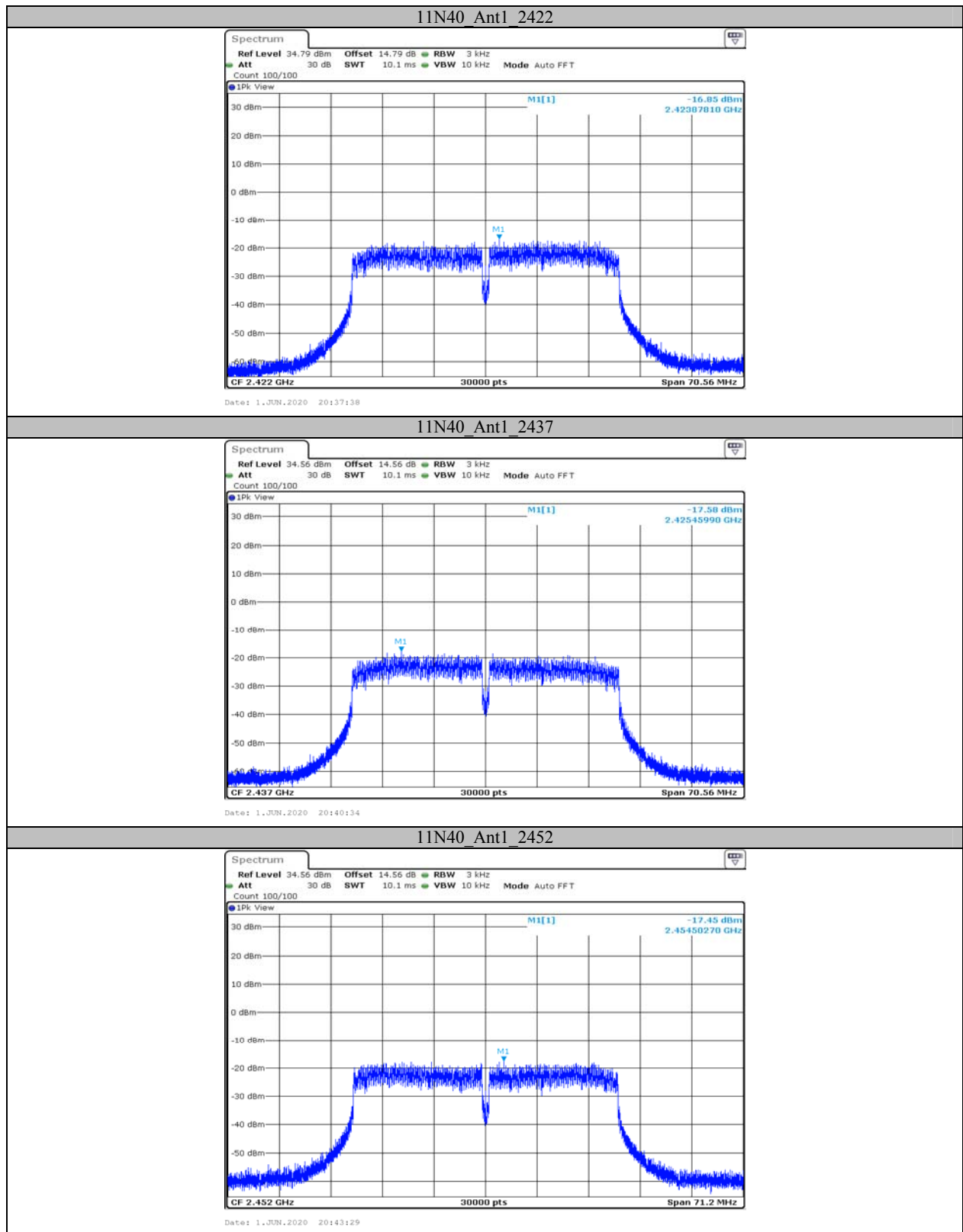


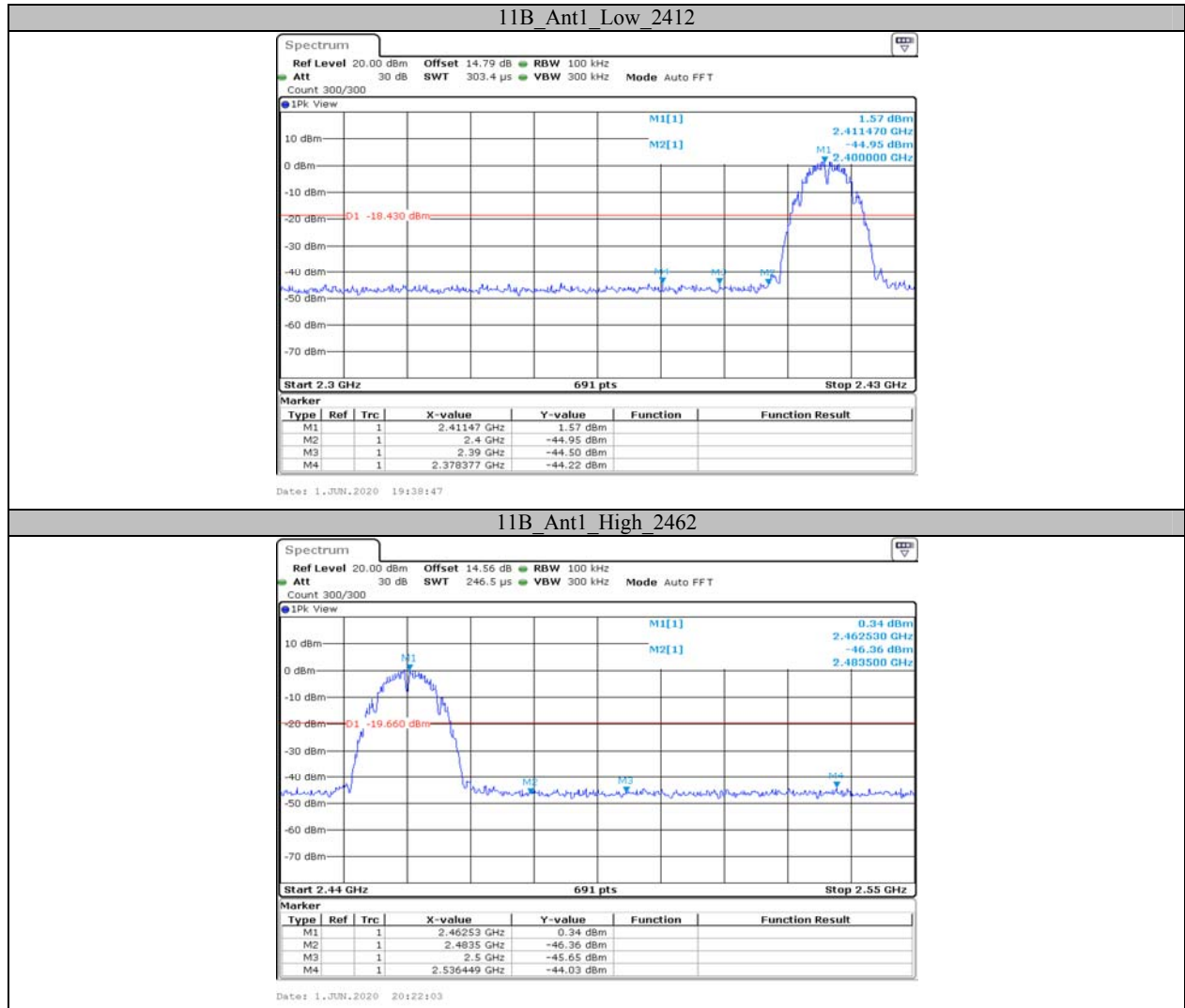
11N20_Ant1_2437



11N20_Ant1_2462





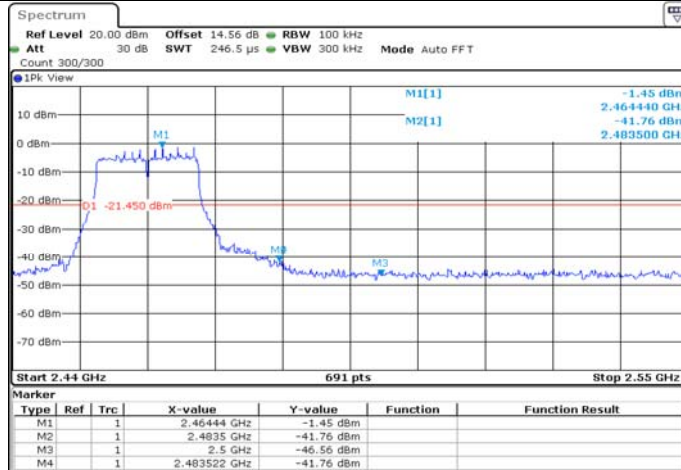
Appendix E: Band edge measurements**Test Graphs**

11G Ant1 Low 2412



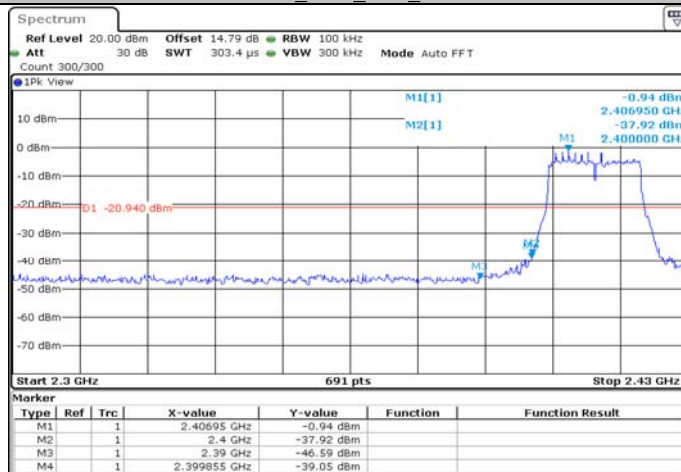
Date: 1.JUN.2020 20:24:22

11G_Ant1_High_2462



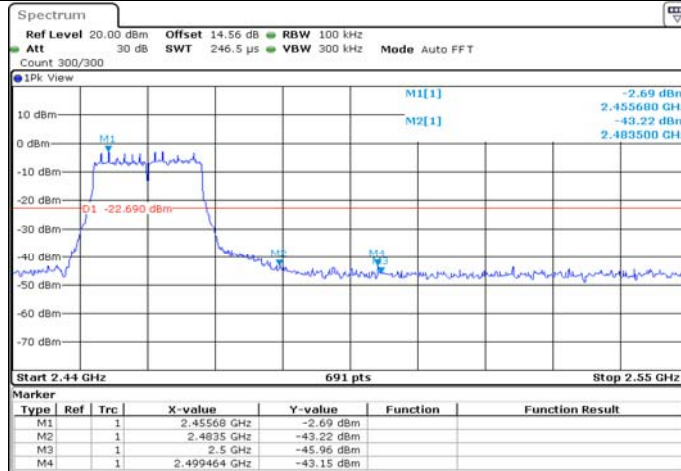
Date: 1.JUN.2020 20:28:00

11N20 Ant1 Low 2412



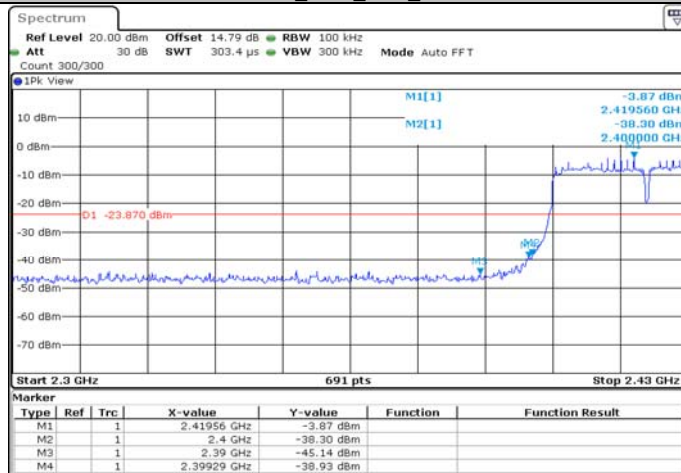
Date: 1.JUN.2020 20:30:21

11N20 Ant1_High 2462



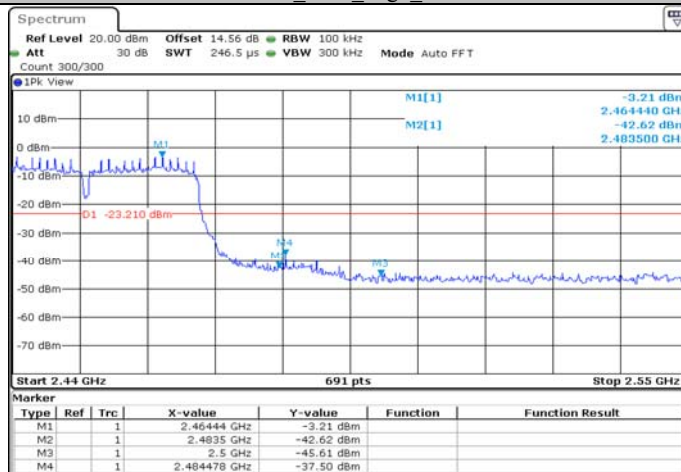
Date: 1.JUN.2020 20:34:40

11N40_Ant1_Low 2422



Date: 1.JUN.2020 20:37:47

11N40 Ant1_High 2452

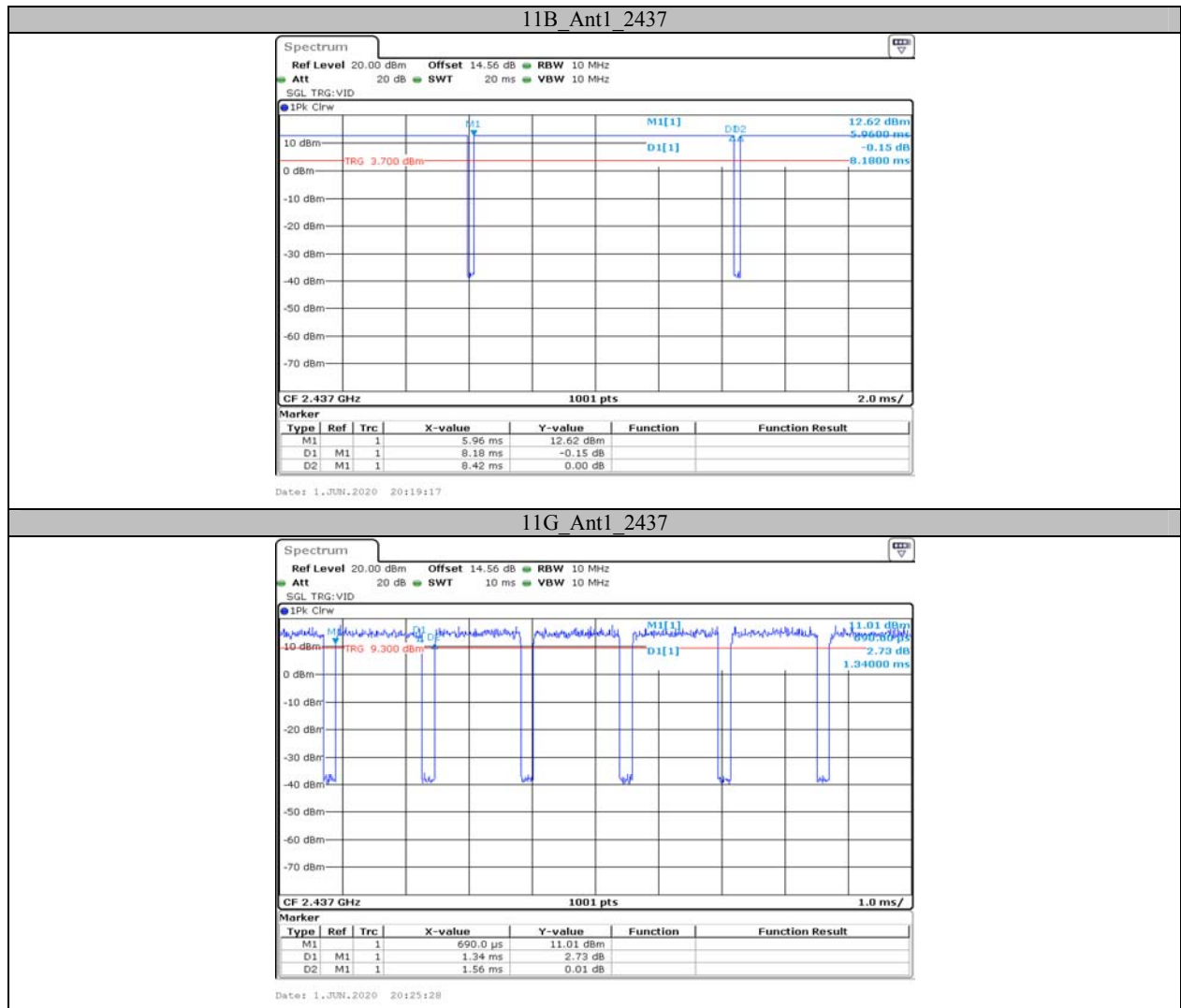


Date: 1.JUN.2020 20:43:39

Appendix F: Duty Cycle**Test Result**

Test Mode	Antenna	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
11B	Ant1	2437	8.18	8.42	97.15
11G	Ant1	2437	1.34	1.56	85.90
11N20	Ant1	2437	1.25	1.47	85.03
11N40	Ant1	2437	0.61	0.83	73.49

Test Graphs





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