

FCC PART 15.247

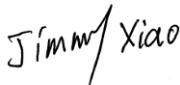
TEST REPORT

For

TECNO MOBILE LIMITED

ROOM 604 6/F SOUTH TOWER WORLD FINANCE CTR HARBOUR CITY 17 CANTON
ROAD TST KL, Hong Kong

FCC ID: 2ADYY-KE5J

Report Type: Original Report	Product Type: Mobile Phone
Report Number: <u>RSZ200723001-00C</u>	
Report Date: <u>2020-09-17</u>	
Jimmy Xiao 	
Reviewed By: <u>RF Engineer</u>	
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Mobile Phone
Tested Model	KE5j
Frequency Range	BLE 1M&2M: 2402-2480MHz Wi-Fi: 2412-2472MHz/2422-2462MHz
Maximum Conducted Output Peak Power	BLE: -6.79dBm(1M), -7.17dBm(2M) Wi-Fi: 10.39dBm(802.11b), 13.94dBm(802.11g) 13.65dBm(802.11n-HT20), 12.71dBm(802.11n-HT40)
Modulation Technique	BLE: GFSK Wi-Fi: DSSS, OFDM
Antenna Specification	1.0dBi
Voltage Range	DC 3.85V from battery or DC 5V from adapter
Date of Test	2020-07-27 to 2020-09-16
Sample serial number	RSZ200723001-RF-S1 (Assigned by BACL, Shenzhen)
Received date	2020-07-23
Sample/EUT Status	Good condition
Adapter information	Model: U100TSA Input: AC 100-240V, 50/60Hz, 0.3A Output: DC 5.0V, 2.0A

Objective

This report is prepared 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		$\pm 5\%$
RF Output Power with Power meter		$\pm 0.73\text{dB}$
RF conducted test with spectrum		$\pm 1.6\text{dB}$
AC Power Lines Conducted Emissions		$\pm 1.95\text{dB}$
Emissions, Radiated	Below 1GHz	$\pm 4.75\text{dB}$
	Above 1GHz	$\pm 4.88\text{dB}$
Temperature		$\pm 1^\circ\text{C}$
Humidity		$\pm 6\%$
Supply voltages		$\pm 0.4\%$

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 802.11 n-HT40 mode, EUT was tested with Channel 3, 7 and 11.

For BLE mode, 40 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

EUT was tested with Channel 0, 19 and 39.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

BLE & Wi-Fi test in the engineer mode.

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	11	11	11
802.11g	6 Mbps	11	11	11
802.11n-HT20	MCS0	11	11	11
802.11n-HT40	MCS0	11	11	11
BLE	Default	Default	Default	Default

Pre-scan with all the data rates, the above data rate is the worst case for Wi-Fi test.

Duty cycle

Please refer to the Appendix BLE & Appendix Wi-Fi.

Support Equipment List and Details

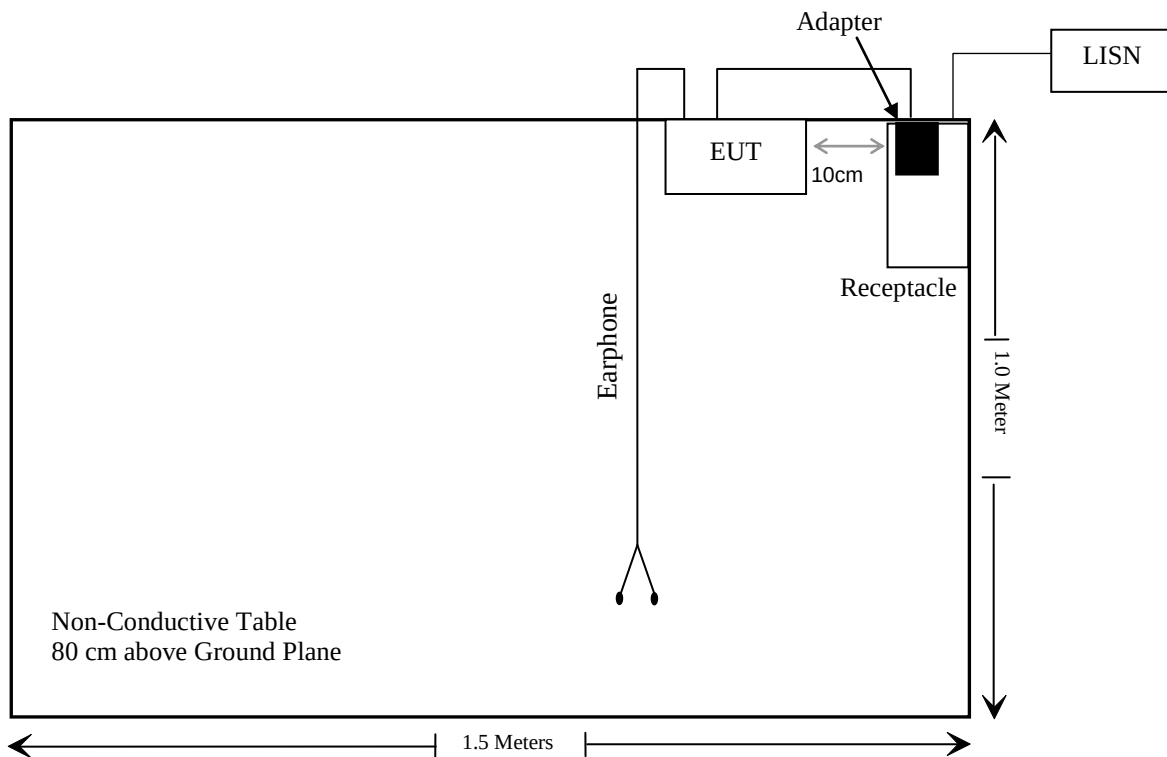
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shielding Detachable USB Cable	1.0	EUT	Adapter

Block Diagram of Test Setup

For conducted emission:



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	2019/08/04	2020/08/03
Rohde & Schwarz	LISN	ENV216	101613	2019/08/04	2020/08/03
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	2019/08/04	2020/08/03
Sonoma instrument	Pre-amplifier	310 N	186238	2019/08/04	2020/08/03
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	2019/08/04	2020/08/03
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

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Tonscend Corporation	RF control Unit	JS0806-2	19D8060154	2019/08/04	2020/08/03
Tonscend Corporation	RF control Unit	JS0806-2	19D8060154	2020/08/04	2021/08/03
Rohde & Schwarz	Signal and Spectrum Analyzer	FSV40	101473	2019/08/04	2020/08/03
Rohde & Schwarz	Signal and Spectrum Analyzer	FSV40	101473	2020/08/04	2021/08/03
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

According to FCC §2.1093 and §1.1307(b) (1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 D01 General RF Exposure Guidance

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

1. $f(\text{GHz})$ is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.
4. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test Exclusion.

Measurement Result

Worst case:

Mode	Frequency (MHz)	Max Tune-up Conducted Power (dBm)	Max Tune-up Conducted Power (mW)	Calculated Distance (mm)	Calculated value	Threshold (1-g SAR)	SAR Test Exclusion
BLE	2480	-6.5	0.22	5	0.1	3.0	Yes
Wi-Fi	2472	9.5	8.91	5	2.8	3.0	Yes

Result: No SAR test is required.

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 for Bluetooth and Wi-Fi, which was permanently attached and the antenna gain is 1.0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

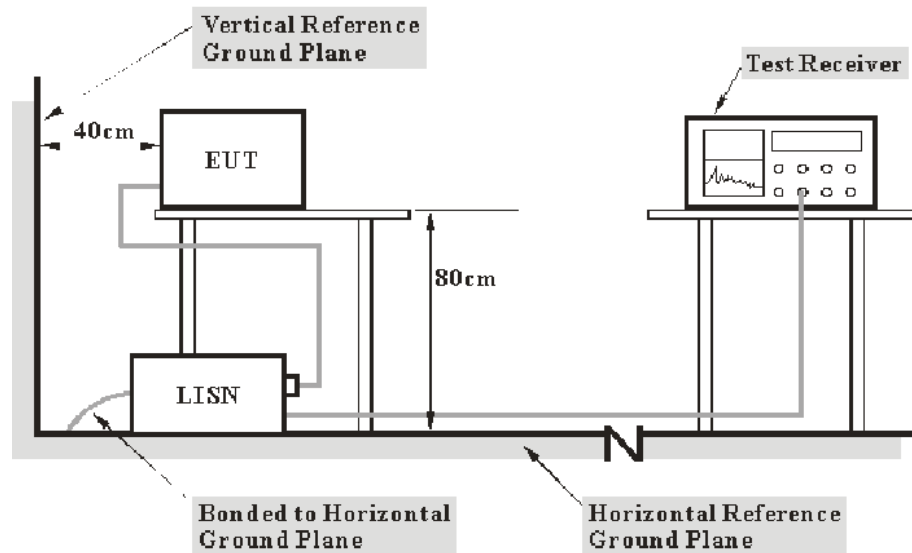
Result: Pass

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

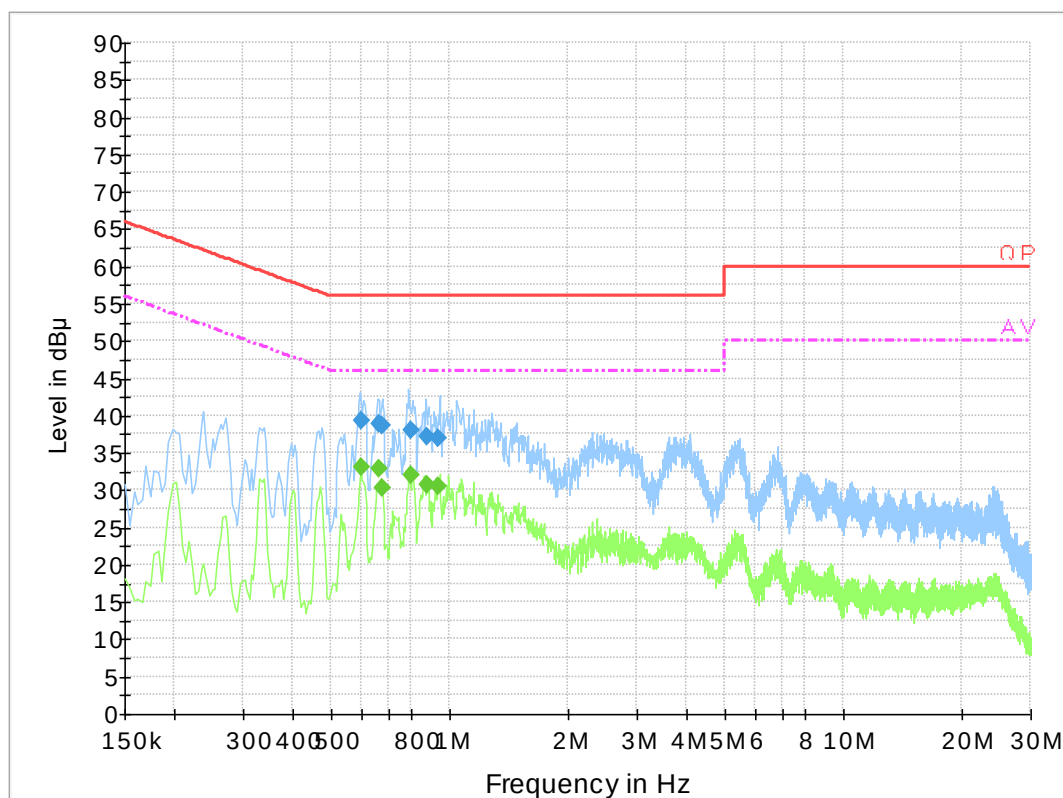
Temperature:	25 °C
Relative Humidity:	65 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2020-07-28.

EUT operation mode: Transmitting & Charging

BLE:

Line

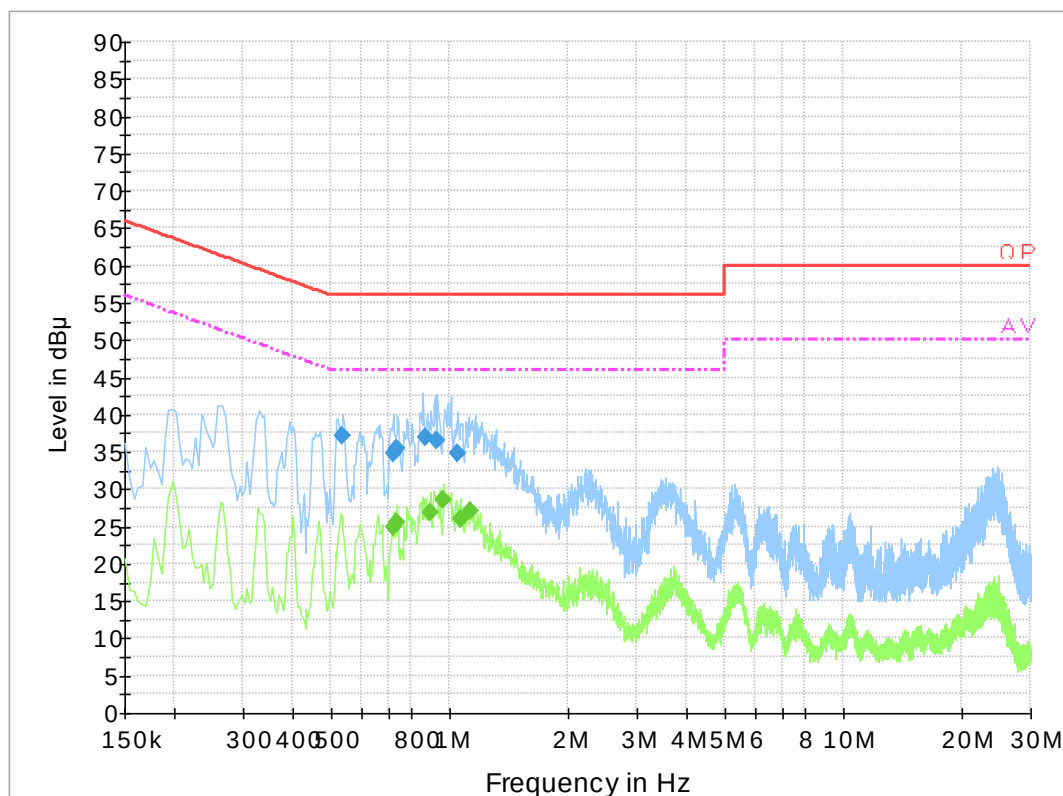


Final Result 1

Frequency (MHz)	QuasiPeak (dBμ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμ V)
0.597090	39.2	9.000	L1	19.8	16.8	56.0
0.664130	38.8	9.000	L1	19.8	17.2	56.0
0.679890	38.7	9.000	L1	19.8	17.3	56.0
0.798150	38.0	9.000	L1	19.8	18.0	56.0
0.880890	37.1	9.000	L1	19.8	18.9	56.0
0.935810	37.0	9.000	L1	19.8	19.0	56.0

Final Result 2

Frequency (MHz)	Average (dBμ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμ V)
0.597090	33.1	9.000	L1	19.8	12.9	46.0
0.664130	32.8	9.000	L1	19.8	13.2	46.0
0.679890	30.4	9.000	L1	19.8	15.6	46.0
0.798150	32.1	9.000	L1	19.8	13.9	46.0
0.880890	30.8	9.000	L1	19.8	15.2	46.0
0.935810	30.4	9.000	L1	19.8	15.6	46.0

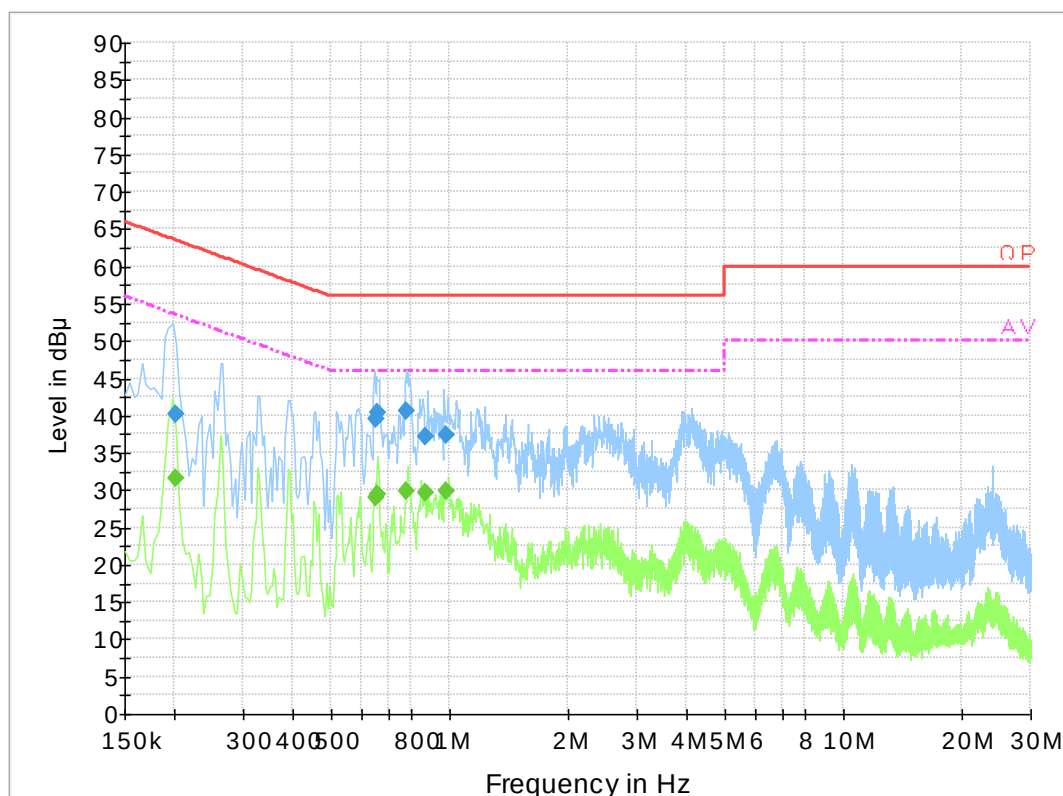
Neutral**Final Result 1**

Frequency (MHz)	QuasiPeak (dBμ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμ V)
0.537930	37.1	9.000	N	19.8	18.9	56.0
0.723170	34.7	9.000	N	19.8	21.3	56.0
0.738930	35.4	9.000	N	19.8	20.6	56.0
0.869130	36.9	9.000	N	19.7	19.1	56.0
0.931990	36.6	9.000	N	19.8	19.4	56.0
1.054250	34.9	9.000	N	19.8	21.1	56.0

Final Result 2

Frequency (MHz)	Average (dBμ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμ V)
0.722000	24.9	9.000	N	19.8	21.1	46.0
0.738000	25.6	9.000	N	19.8	20.4	46.0
0.898000	26.8	9.000	N	19.7	19.2	46.0
0.970000	28.6	9.000	N	19.8	17.4	46.0
1.070000	26.0	9.000	N	19.8	20.0	46.0
1.134000	27.1	9.000	N	19.8	18.9	46.0

Wi-Fi:
Line

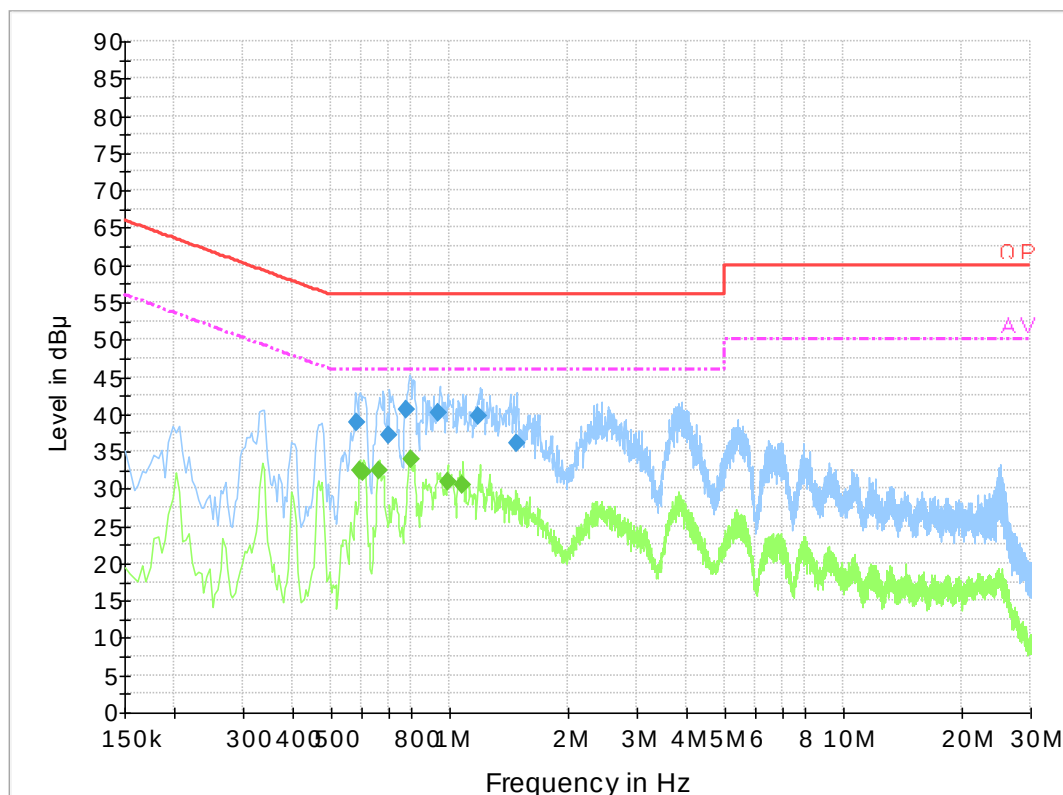


Final Result 1

Frequency (MHz)	QuasiPeak (dBμ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμ V)
0.201500	40.3	9.000	L1	19.8	23.3	63.5
0.652310	39.6	9.000	L1	19.8	16.4	56.0
0.660070	40.5	9.000	L1	19.8	15.5	56.0
0.782330	40.7	9.000	L1	19.8	15.3	56.0
0.868770	37.1	9.000	L1	19.8	18.9	56.0
0.983450	37.5	9.000	L1	19.9	18.5	56.0

Final Result 2

Frequency (MHz)	Average (dBμ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμ V)
0.201500	31.6	9.000	L1	19.8	22.0	53.5
0.652310	29.0	9.000	L1	19.8	17.0	46.0
0.660070	29.5	9.000	L1	19.8	16.5	46.0
0.782330	29.9	9.000	L1	19.8	16.1	46.0
0.868770	29.7	9.000	L1	19.8	16.3	46.0
0.983450	29.9	9.000	L1	19.9	16.1	46.0

Neutral**Final Result 1**

Frequency (MHz)	QuasiPeak (dBμ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμ V)
0.585330	38.9	9.000	N	19.8	17.1	56.0
0.703410	37.1	9.000	N	19.8	18.9	56.0
0.782090	40.6	9.000	N	19.8	15.4	56.0
0.935810	40.1	9.000	N	19.8	15.9	56.0
1.188030	39.7	9.000	N	19.8	16.3	56.0
1.479710	36.1	9.000	N	19.8	19.9	56.0

Final Result 2

Frequency (MHz)	Average (dBμ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμ V)
0.594000	32.4	9.000	N	19.8	13.6	46.0
0.606000	32.2	9.000	N	19.8	13.8	46.0
0.666000	32.5	9.000	N	19.8	13.5	46.0
0.798000	33.8	9.000	N	19.8	12.2	46.0
0.990000	30.9	9.000	N	19.8	15.1	46.0
1.086000	30.5	9.000	N	19.8	15.5	46.0

Note:

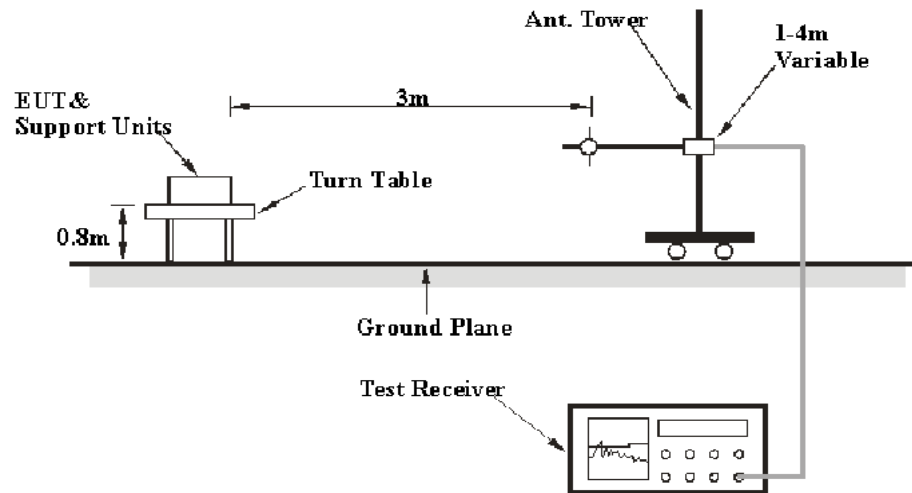
- 1) Correction Factor = LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
- 2) Corrected Amplitude = Reading + Correction Factor
- 3) Margin = Limit – Corrected Amplitude

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

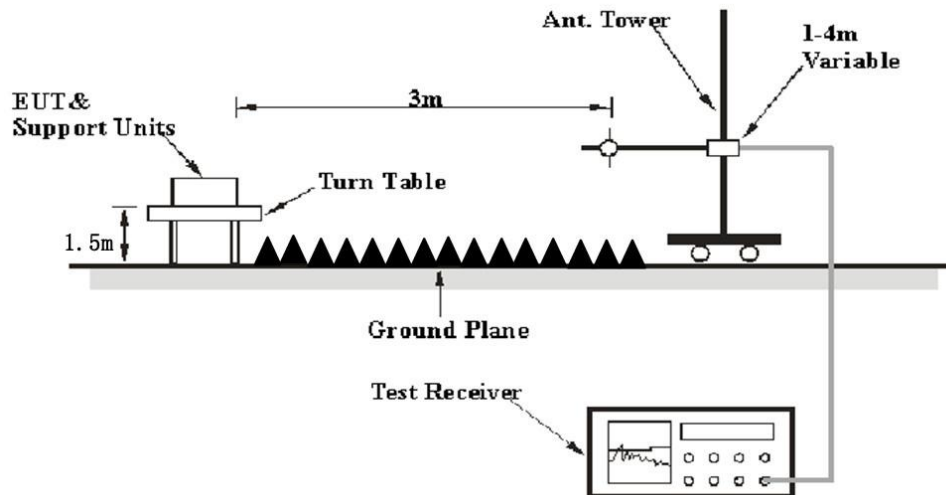
FCC §15.247 (d); §15.209; §15.205;

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

The system was investigated from 30 MHz to 25 GHz.

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

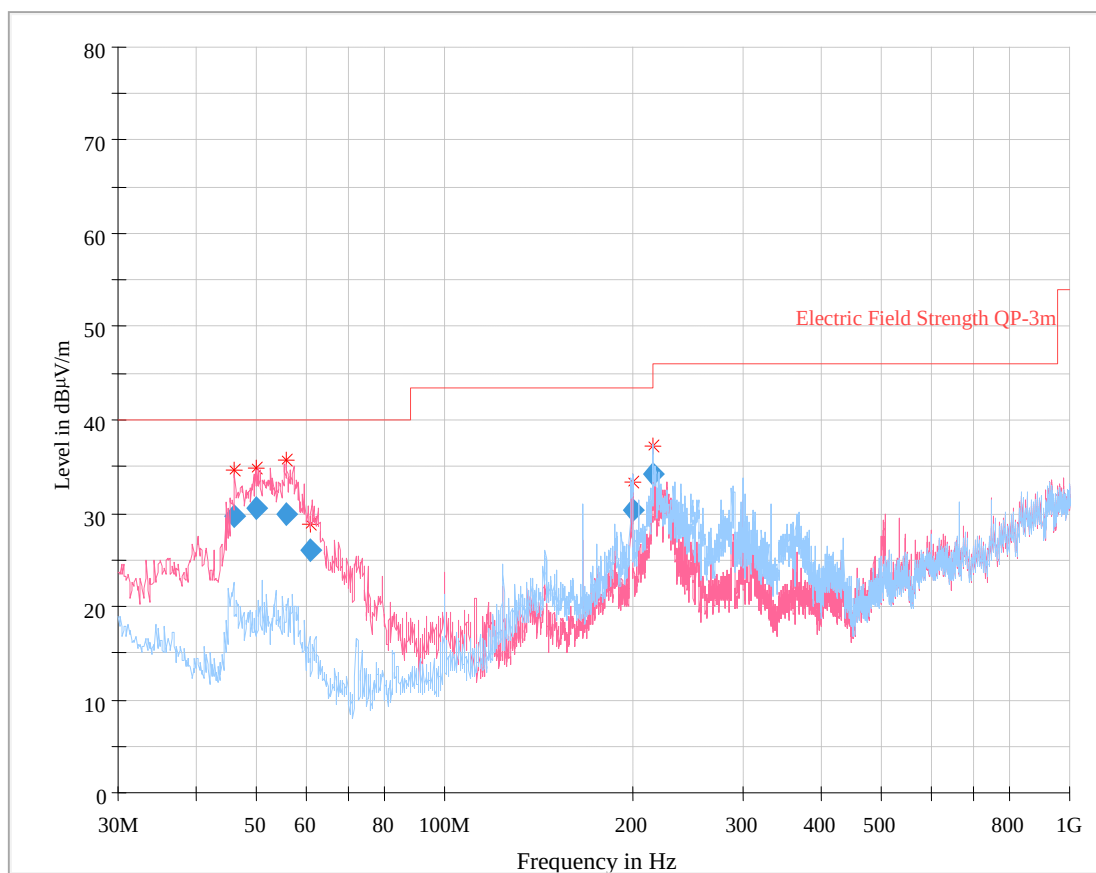
Environmental Conditions

Temperature:	26 °C
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

The testing was performed by Holland Yang on 2020-07-28 for below 1GHz and by Charlie Cha from 2020-07-27 to 2020-08-01 for above 1GHz.

EUT operation mode: Transmitting

30 MHz~1 GHz: (Worst case: Wi-Fi 802.11g Mode, Low channel)



Final_Result

Frequency (MHz)	QuasiPeak (dBμ V/m)	Limit (dBμ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
46.186125	29.66	40.00	10.34	135.0	V	272.0	-17.8
50.074875	30.47	40.00	9.53	102.0	V	348.0	-19.6
55.677875	29.91	40.00	10.09	109.0	V	318.0	-19.9
60.990000	26.07	40.00	13.93	112.0	V	71.0	-20.2
200.023625	30.42	43.50	13.08	170.0	H	120.0	-13.8
216.034125	34.17	46.00	11.83	186.0	H	87.0	-13.9

1 GHz-25 GHz (BLE, 1M):

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 (2402 MHz)									
2369.43	28.74	PK	94	1.3	H	31.87	60.61	74	13.39
2369.43	13.68	Ave.	94	1.3	H	31.87	45.55	54	8.45
2487.42	28.78	PK	6	1.9	H	32.13	60.91	74	13.09
2487.42	13.69	Ave.	94	1.9	H	32.13	45.82	54	8.18
4804.00	43.87	PK	333	2.4	H	5.40	49.27	74	24.73
4804.00	28.69	Ave.	333	2.4	H	5.40	34.09	54	19.91
Middle Channel (2440 MHz)									
4880.00	43.83	PK	267	2.0	H	6.76	50.59	74	23.41
4880.00	28.64	Ave.	267	2.0	H	6.76	35.40	54	18.60
High Channel (2480 MHz)									
2335.67	28.77	PK	356	2.0	H	31.64	60.41	74	13.59
2335.67	13.62	Ave.	94	2.0	H	31.64	45.26	54	8.74
2491.62	28.81	PK	277	1.4	H	32.13	60.94	74	13.06
2491.62	13.68	Ave.	94	1.4	H	32.13	45.81	54	8.19
4960.00	43.79	PK	221	1.4	H	6.80	50.59	74	23.41
4960.00	28.62	Ave.	221	1.4	H	6.80	35.42	54	18.58

1 GHz-25 GHz (BLE, 2M):

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 (2402 MHz)									
2342.67	28.77	PK	232	1.9	H	31.64	60.41	74	13.59
2342.67	13.62	Ave.	232	1.9	H	31.64	45.26	54	8.74
2495.52	28.83	PK	239	2.4	H	32.13	60.96	74	13.04
2495.52	13.68	Ave.	239	2.4	H	32.13	45.81	54	8.19
4804.00	43.87	PK	333	2.4	H	5.40	49.27	74	24.73
4804.00	28.69	Ave.	333	2.4	H	5.40	34.09	54	19.91
Middle Channel (2440 MHz)									
4880.00	43.82	PK	353	1.7	H	6.76	50.58	74	23.42
4880.00	28.65	Ave.	353	1.7	H	6.76	35.41	54	18.59
High Channel (2480 MHz)									
2361.57	28.78	PK	228	1.4	H	31.87	60.65	74	13.35
2361.57	13.69	Ave.	228	1.4	H	31.87	45.56	54	8.44
2494.42	28.89	PK	8	2.3	H	32.13	61.02	74	12.98
2494.42	13.76	Ave.	8	2.3	H	32.13	45.89	54	8.11
4960.00	43.77	PK	359	1.6	H	6.80	50.57	74	23.43
4960.00	28.61	Ave.	359	1.6	H	6.80	35.41	54	18.59

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)									
2333.42	28.78	PK	225	1.3	H	31.64	60.42	74	13.58
2333.42	13.71	Ave.	225	1.3	H	31.64	45.35	54	8.65
2488.63	28.81	PK	249	2.0	H	32.13	60.94	74	13.06
2488.63	13.72	Ave.	249	2.0	H	32.13	45.85	54	8.15
4824.00	43.82	PK	174	2.1	H	6.28	50.10	74	23.90
4824.00	28.56	Ave.	174	2.1	H	6.28	34.84	54	19.16
Middle Channel (2442MHz)									
4884.00	43.74	PK	254	1.8	H	6.76	50.50	74	23.50
4884.00	28.52	Ave.	254	1.8	H	6.76	35.28	54	18.72
High Channel (2472 MHz)									
2326.64	28.79	PK	254	1.3	H	31.64	60.43	74	13.57
2326.64	13.78	Ave.	254	1.3	H	31.64	45.42	54	8.58
2484.65	30.82	PK	168	1.1	H	32.13	62.95	74	11.05
2484.65	18.32	Ave.	168	1.1	H	32.13	50.45	54	3.55
4944.00	43.69	PK	275	2.2	H	6.76	50.45	74	23.55
4944.00	28.50	Ave.	275	2.2	H	6.76	35.26	54	18.74

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)									
2334.54	28.75	PK	32	1.5	H	31.64	60.39	74	13.61
2334.54	13.73	Ave.	32	1.5	H	31.64	45.37	54	8.63
2489.67	28.67	PK	203	2.5	H	32.13	60.80	74	13.20
2489.67	13.71	Ave.	203	2.5	H	32.13	45.84	54	8.16
4824.00	43.78	PK	306	2.4	H	6.28	50.06	74	23.94
4824.00	28.52	Ave.	306	2.4	H	6.28	34.80	54	19.20
Middle Channel (2442MHz)									
4884.00	43.71	PK	342	1.4	H	6.76	50.47	74	23.53
4884.00	28.51	Ave.	342	1.4	H	6.76	35.27	54	18.73
High Channel (2472 MHz)									
2371.32	28.75	PK	10	2.1	H	31.87	60.62	74	13.38
2371.32	13.71	Ave.	10	2.1	H	31.87	45.58	54	8.42
2483.87	35.42	PK	54	1.7	H	32.13	67.55	74	6.45
2483.87	18.88	Ave.	54	1.7	H	32.13	51.01	54	2.99
4944.00	43.67	PK	325	1.9	H	6.76	50.43	74	23.57
4944.00	28.49	Ave.	325	1.9	H	6.76	35.25	54	18.75

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)									
2341.16	28.77	PK	356	1.6	H	31.64	60.41	74	13.59
2341.16	13.61	Ave.	356	1.6	H	31.64	45.25	54	8.75
2488.62	28.78	PK	23	1.5	H	32.13	60.91	74	13.09
2488.62	13.68	Ave.	23	1.5	H	32.13	45.81	54	8.19
4824.00	43.79	PK	101	1.6	H	6.28	50.07	74	23.93
4824.00	28.54	Ave.	101	1.6	H	6.28	34.82	54	19.18
Middle Channel (2442MHz)									
4884.00	43.69	PK	98	2.4	H	6.76	50.45	74	23.55
4884.00	28.51	Ave.	98	2.4	H	6.76	35.27	54	18.73
High Channel (2472 MHz)									
2358.32	28.97	PK	124	1.2	H	31.77	60.74	74	13.26
2358.32	13.67	Ave.	124	1.2	H	31.77	45.44	54	8.56
2484.05	36.95	PK	306	1.8	H	32.13	69.08	74	4.92
2484.05	19.33	Ave.	306	1.8	H	32.13	51.46	54	2.54
4944.00	43.78	PK	182	2.1	H	6.28	50.06	74	23.94
4944.00	28.49	Ave.	182	2.1	H	6.28	34.77	54	19.23

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)									
2364.15	28.76	PK	75	2.2	H	31.87	60.63	74	13.37
2364.15	13.71	Ave.	75	2.2	H	31.87	45.58	54	8.42
2497.68	28.79	PK	54	1.6	H	32.13	60.92	74	13.08
2497.68	13.87	Ave.	54	1.6	H	32.13	46.00	54	8.00
4844.00	43.87	PK	247	1.7	H	5.40	49.27	74	24.73
4844.00	28.78	Ave.	247	1.7	H	5.40	34.18	54	19.82
Middle Channel (2442MHz)									
4884.00	43.72	PK	238	1.3	H	6.76	50.48	74	23.52
4884.00	28.53	Ave.	238	1.3	H	6.76	35.29	54	18.71
High Channel (2462 MHz)									
2339.12	28.78	PK	22	1.3	H	31.64	60.42	74	13.58
2339.12	13.78	Ave.	22	1.3	H	31.64	45.42	54	8.58
2483.59	32.24	PK	186	1.6	H	32.13	64.37	74	9.63
2483.59	15.94	Ave.	186	1.6	H	32.13	48.07	54	5.93
4924.00	43.68	PK	50	1.1	H	6.76	50.44	74	23.56
4924.00	28.41	Ave.	50	1.1	H	6.76	35.17	54	18.83

Note:

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

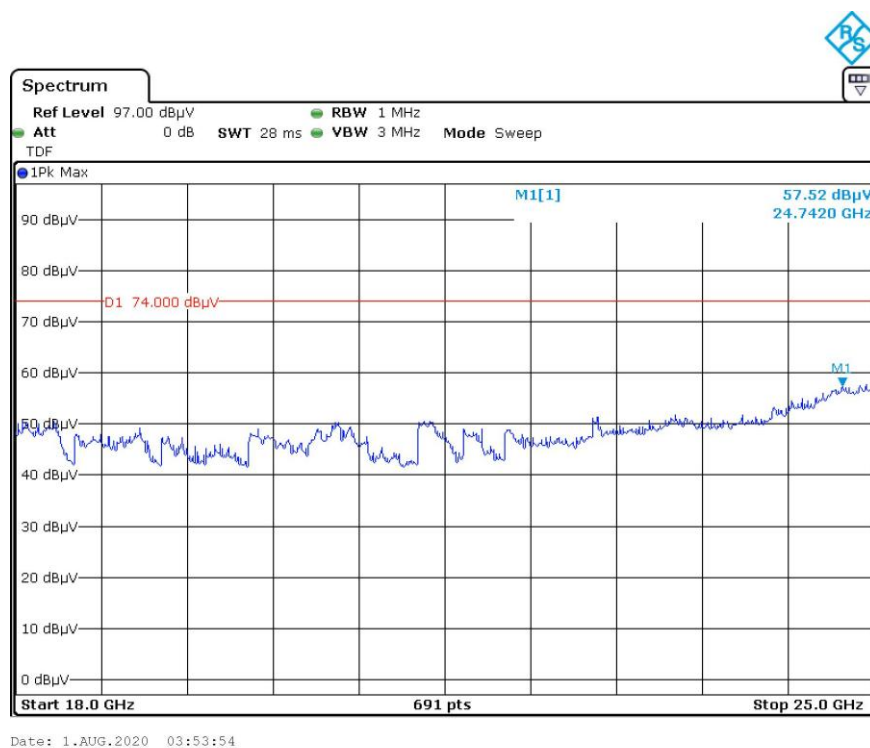
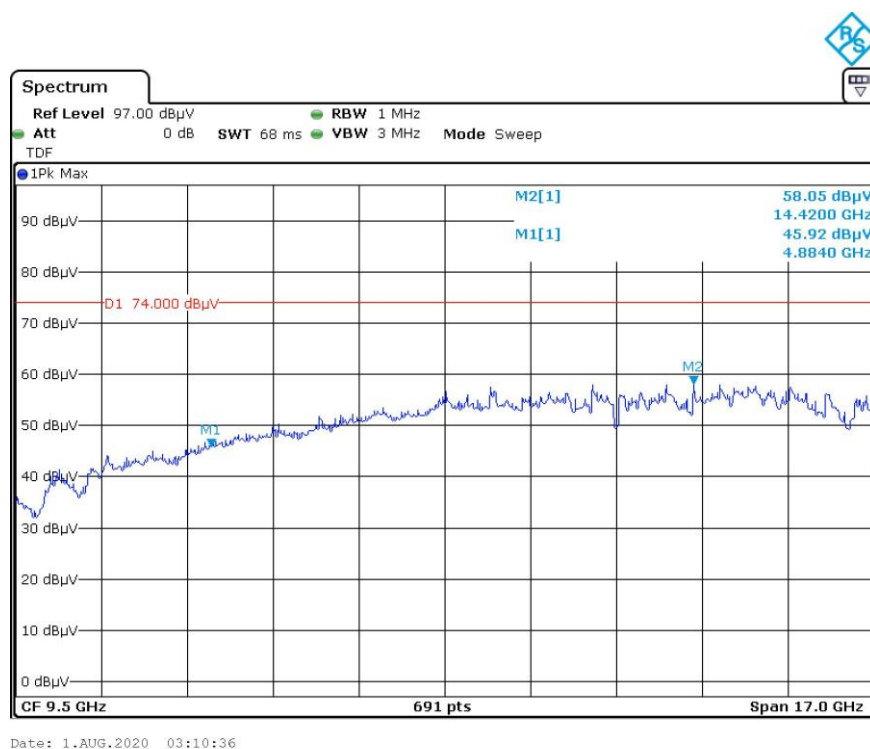
Corrected Amplitude = Corrected Factor + Reading

Margin = Limit - Corrected. Amplitude

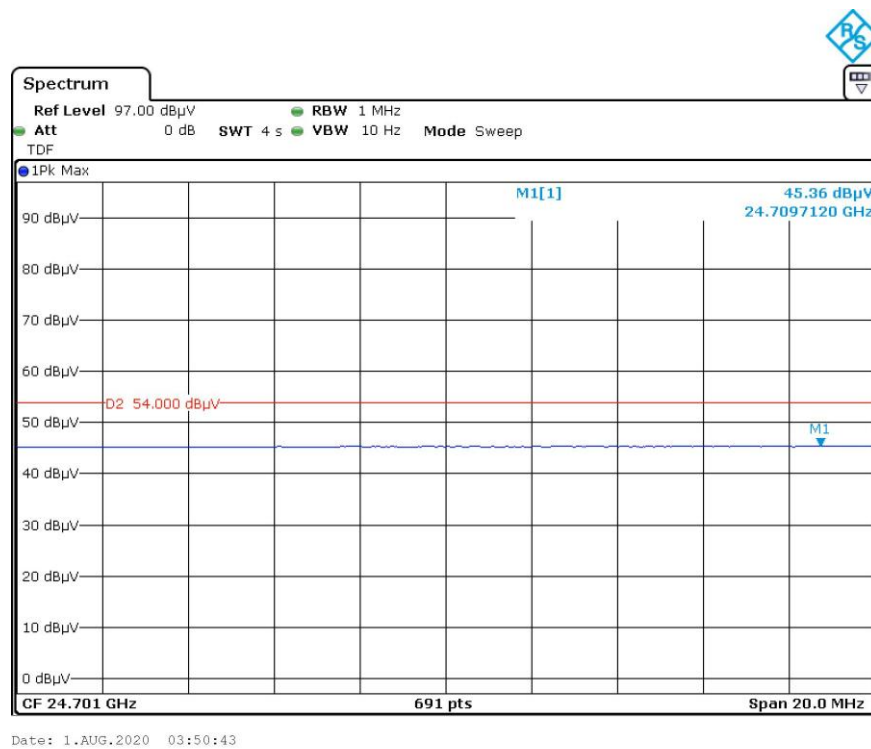
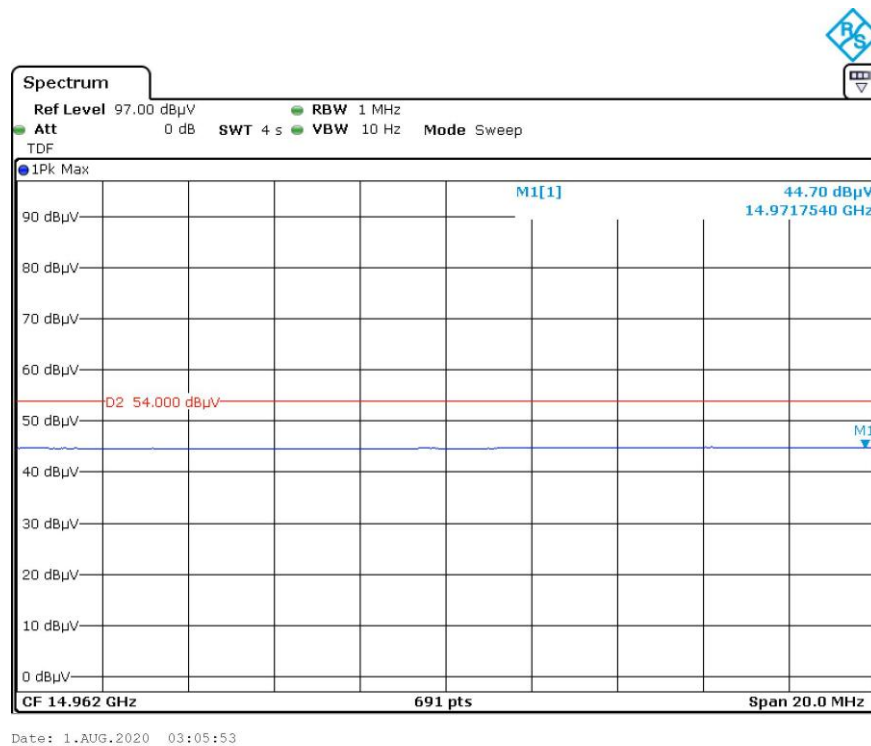
The other spurious emission which is 20dB to the limit was not recorded.



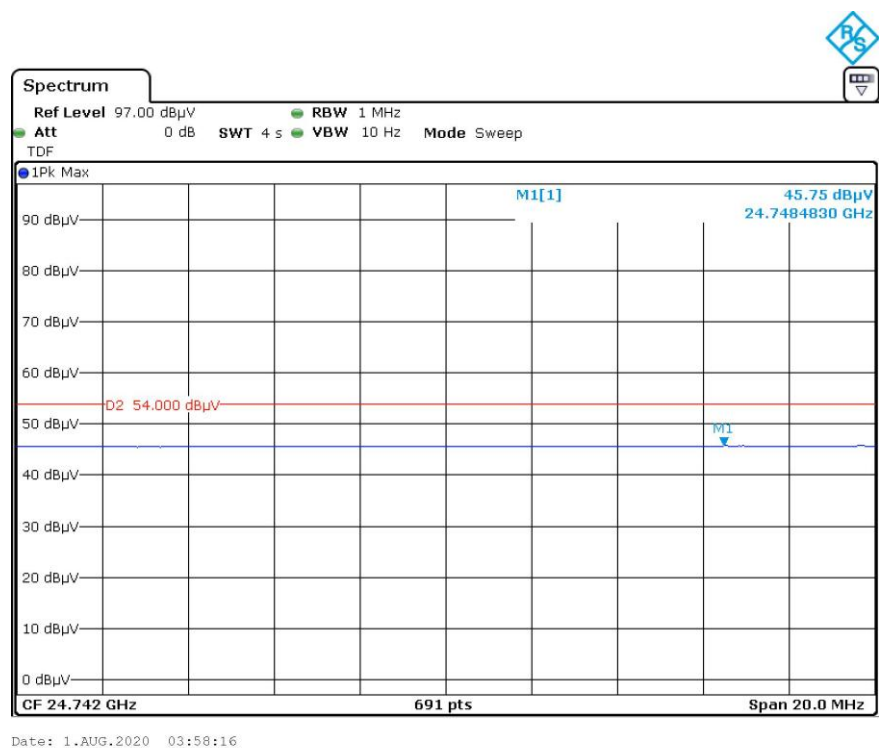
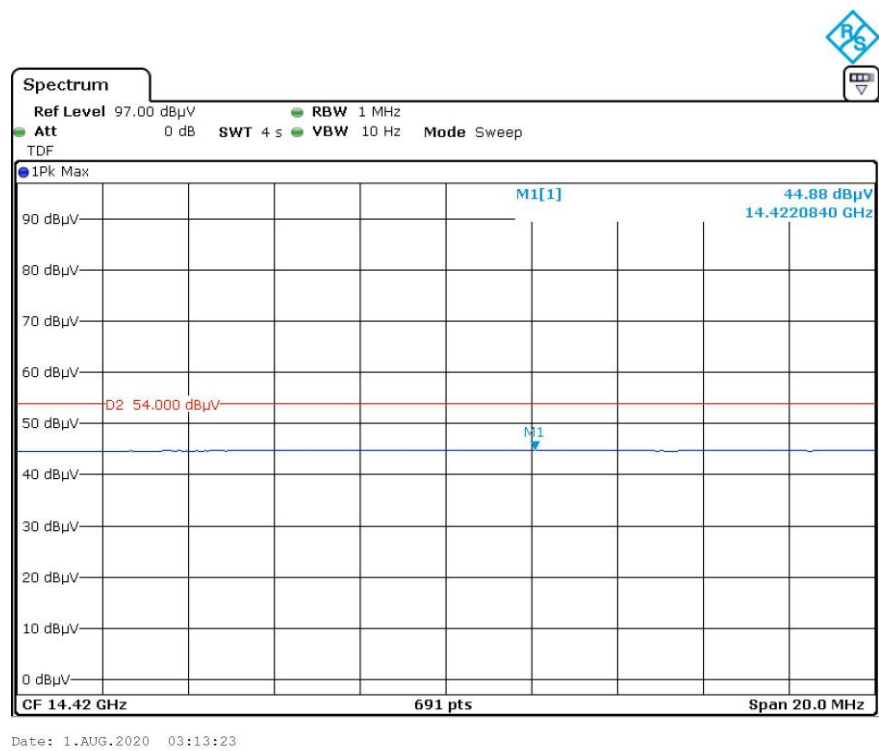
Vertical



Average Horizontal



Vertical



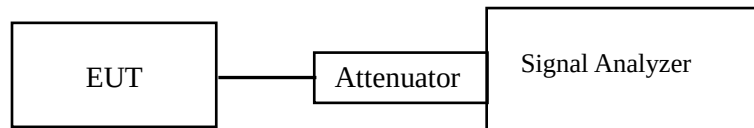
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

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 Geogre Zhong on 2020-07-27.

EUT operation mode: Transmitting

Test Result: Pass

Please refer to the Appendix BLE & Appendix Wi-Fi.

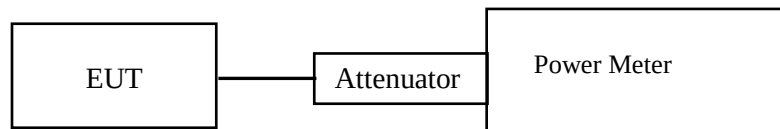
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

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 Geogre Zhong on 2020-07-27.

EUT operation mode: Transmitting

Test Result: Pass

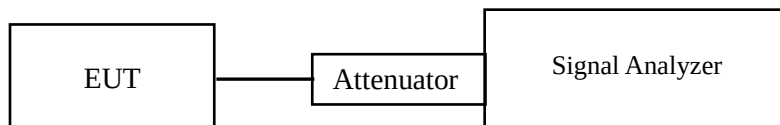
Please refer to the Appendix BLE & Appendix Wi-Fi.

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 Geogre Zhong on 2020-07-27.

EUT operation mode: Transmitting

Test Result: Pass

Please refer to the Appendix BLE & Appendix Wi-Fi.

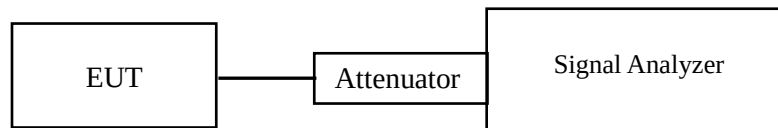
FCC §15.247(e) - POWER SPECTRAL DENSITY

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 Geogre Zhong from 2020-07-27 to 2020-09-16.

EUT operation mode: Transmitting

Test Result: Pass

Please refer to the Appendix BLE & Appendix Wi-Fi.

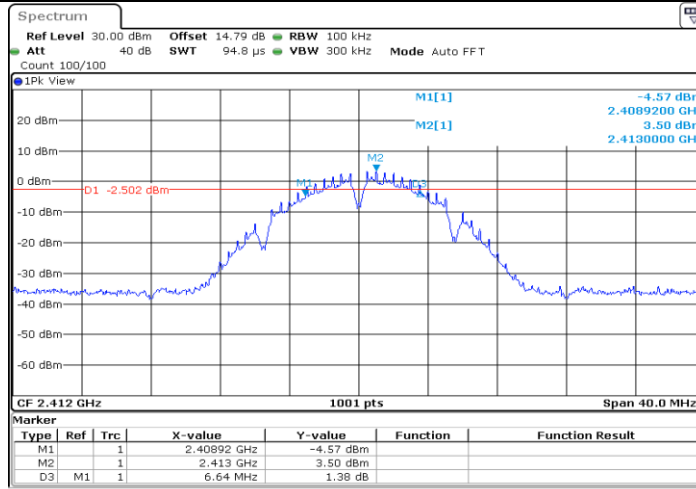
APPENDIX Wi-Fi

Appendix A: DTS Bandwidth Test Result

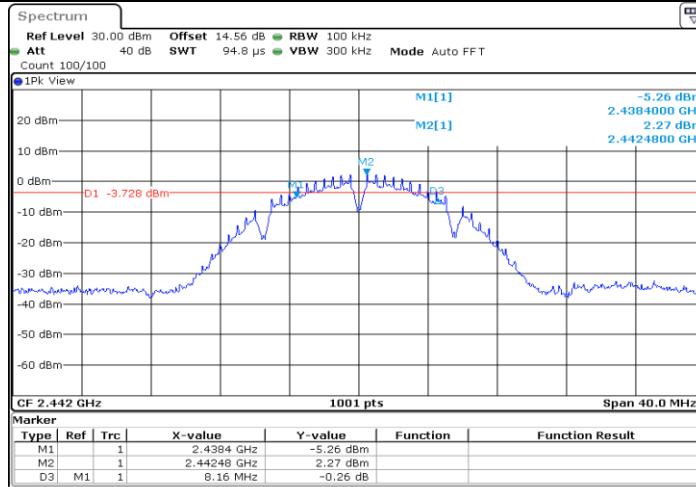
Test Mode	Antenna	Channel	DTS BW [MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	6.640	0.5	PASS
		2442	8.160	0.5	PASS
		2472	8.120	0.5	PASS
11G	Ant1	2412	11.360	0.5	PASS
		2442	16.520	0.5	PASS
		2472	11.480	0.5	PASS
11N20	Ant1	2412	12.120	0.5	PASS
		2442	17.760	0.5	PASS
		2472	12.520	0.5	PASS
11N40	Ant1	2422	17.120	0.5	PASS
		2442	36.640	0.5	PASS
		2462	15.280	0.5	PASS

Test Graphs

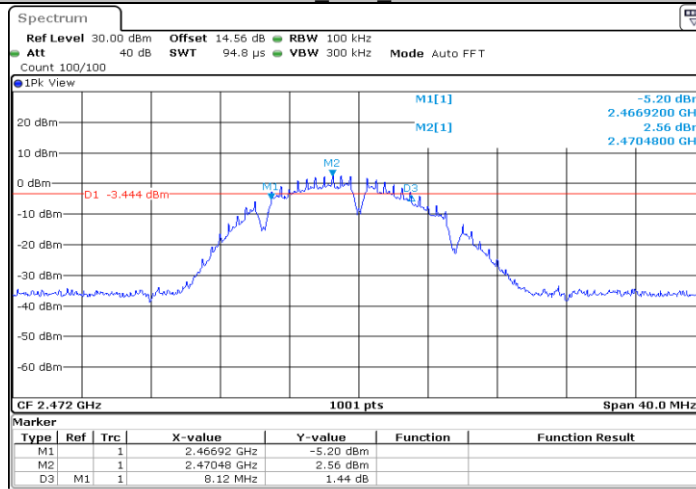
11B_Ant1_2412



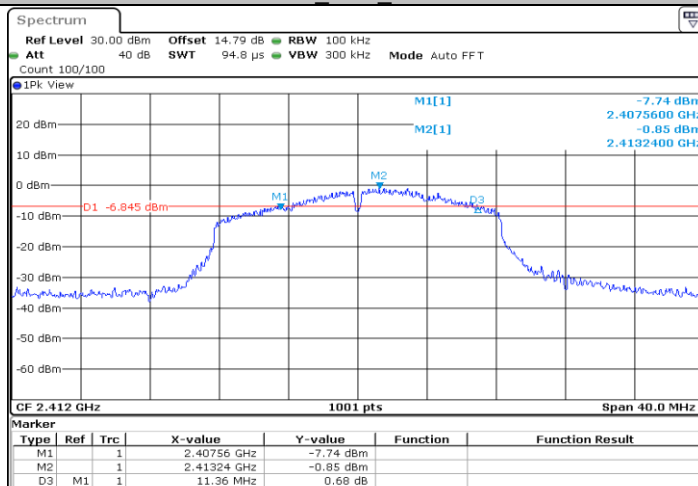
11B_Ant1_2442



11B_Ant1_2472

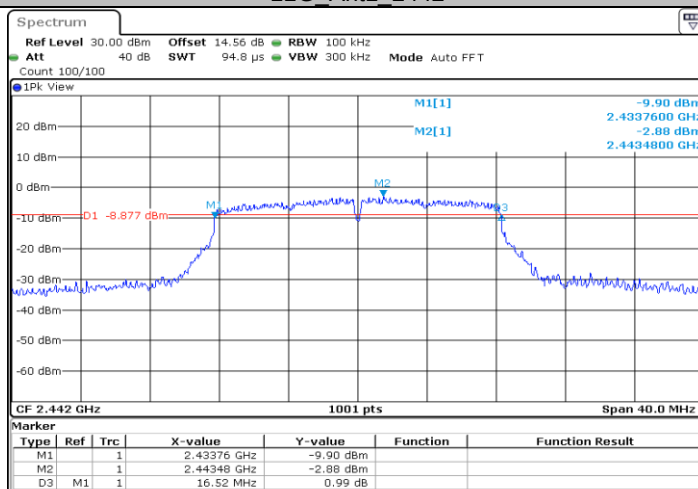


11G Ant1_2412



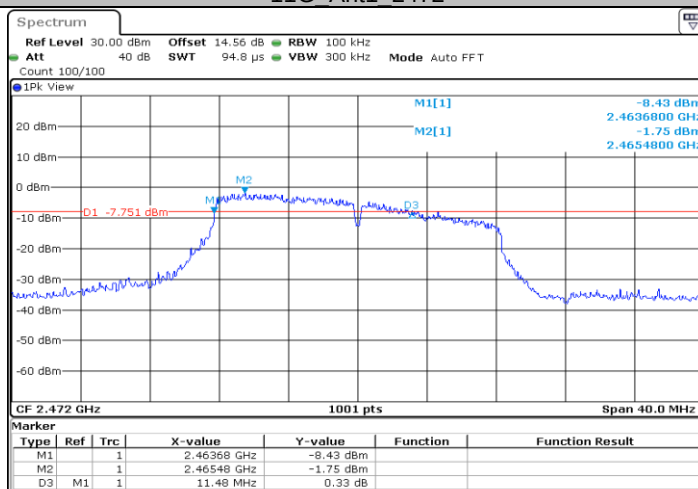
Date: 27.JUL.2020 23:30:27

11G Ant1_2442



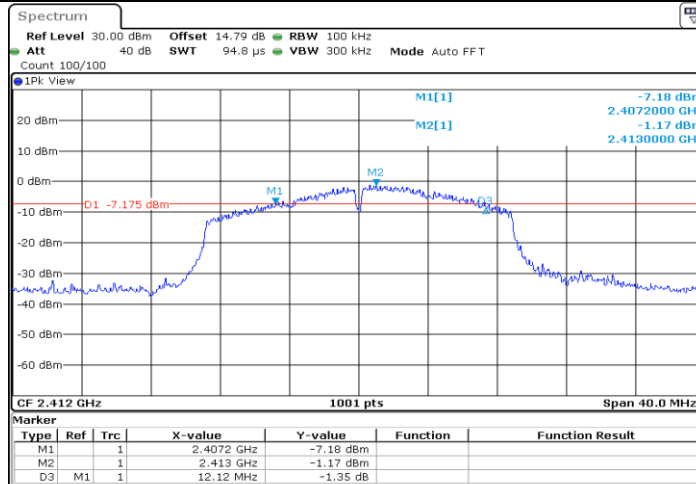
Date: 27.JUL.2020 23:32:34

11G Ant1_2472



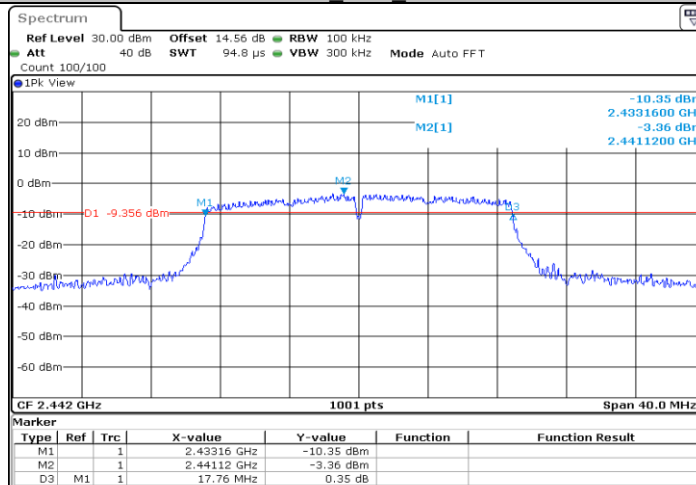
Date: 27.JUL.2020 23:33:49

11N20 Ant1_2412



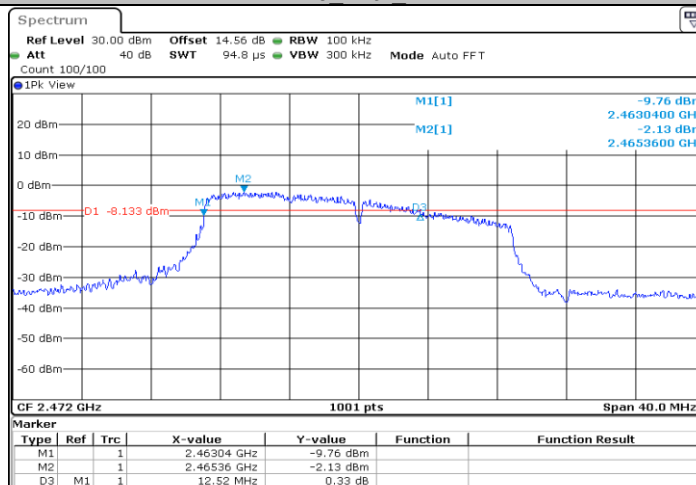
Date: 27.JUL.2020 23:19:39

11N20 Ant1_2442



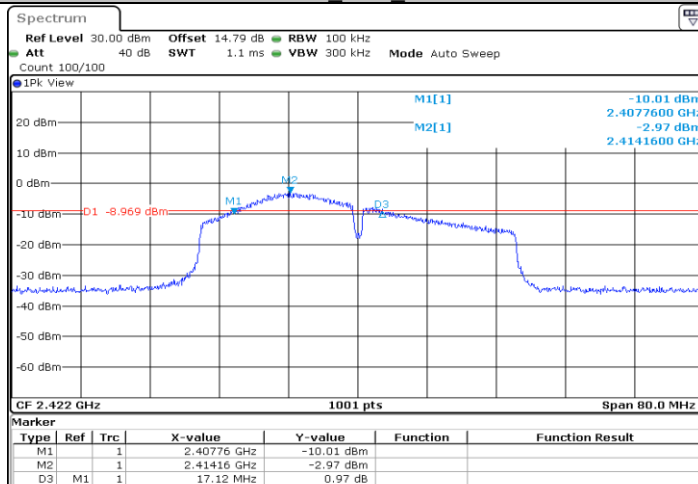
Date: 27.JUL.2020 23:21:42

11N20 Ant1_2472



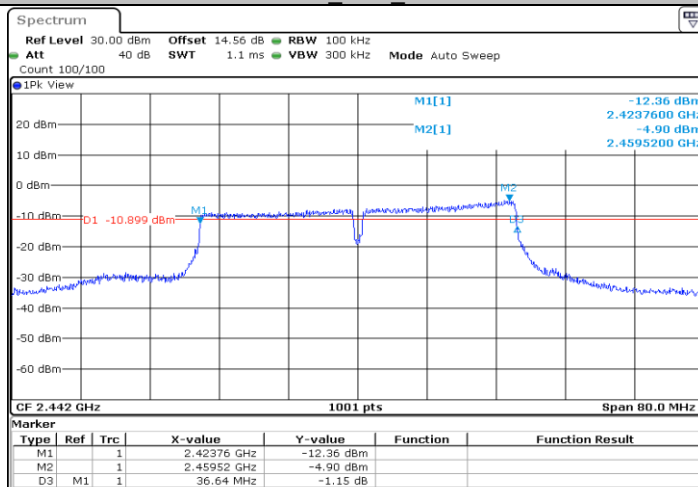
Date: 27.JUL.2020 23:23:35

11N40_Ant1_2422



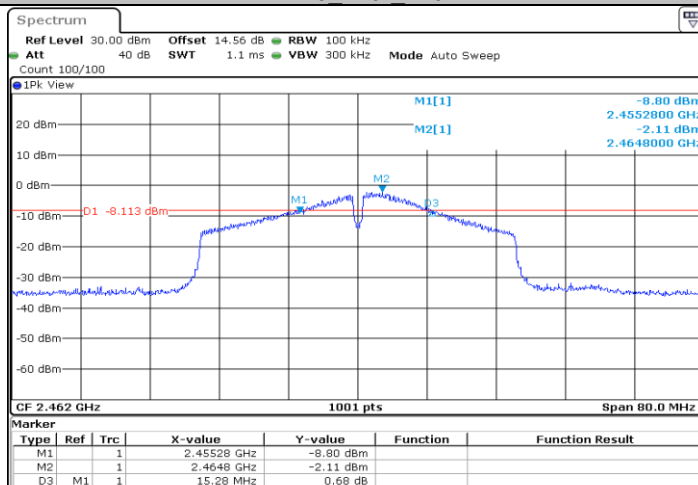
Date: 27.JUL.2020 23:17:54

11N40_Ant1_2442



Date: 27.JUL.2020 23:15:56

11N40_Ant1_2462



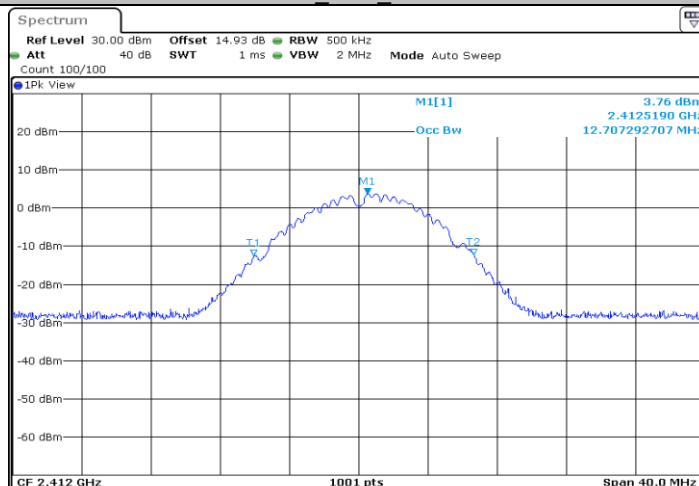
Date: 27.JUL.2020 23:13:49

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

Test Mode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	12.707	---	PASS
		2442	14.346	---	PASS
		2472	13.906	---	PASS
11G	Ant1	2412	16.663	---	PASS
		2442	17.982	---	PASS
		2472	17.223	---	PASS
11N20	Ant1	2412	17.463	---	PASS
		2442	18.621	---	PASS
		2472	18.102	---	PASS
11N40	Ant1	2422	35.405	---	PASS
		2442	37.802	---	PASS
		2462	35.005	---	PASS

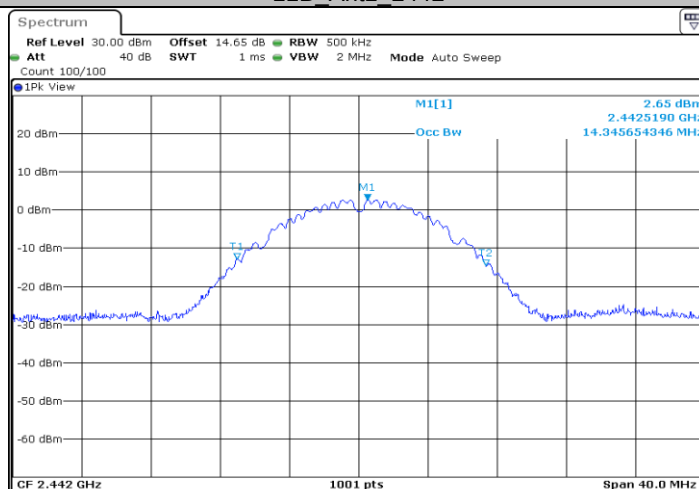
Test Graphs

11B_Ant1_2412



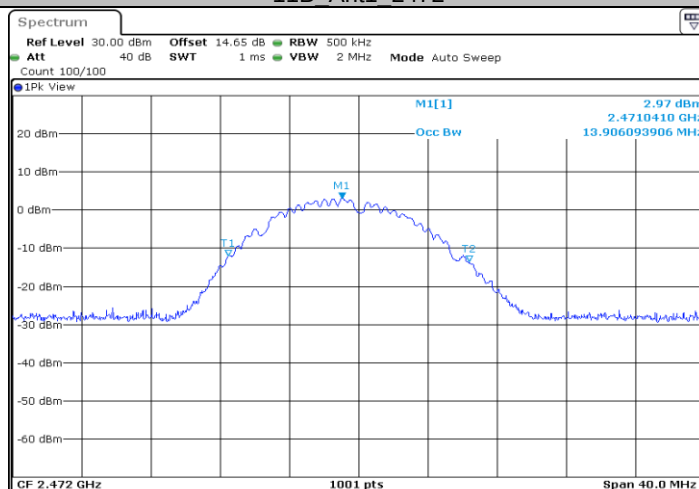
Date: 27.JUL.2020 22:27:35

11B_Ant1_2442



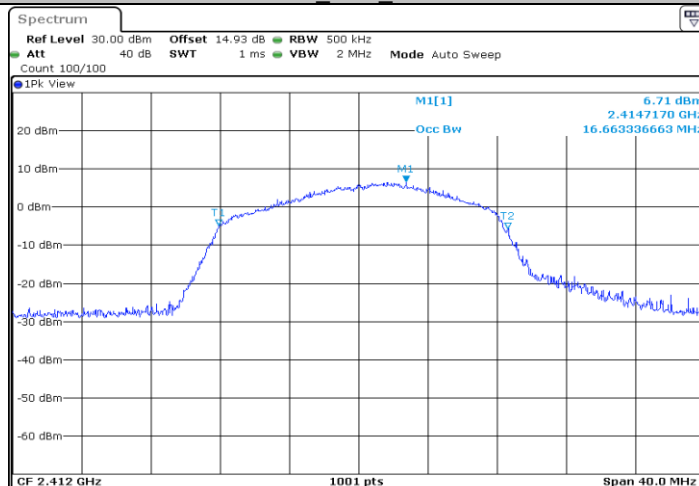
Date: 27.JUL.2020 22:35:43

11B_Ant1_2472



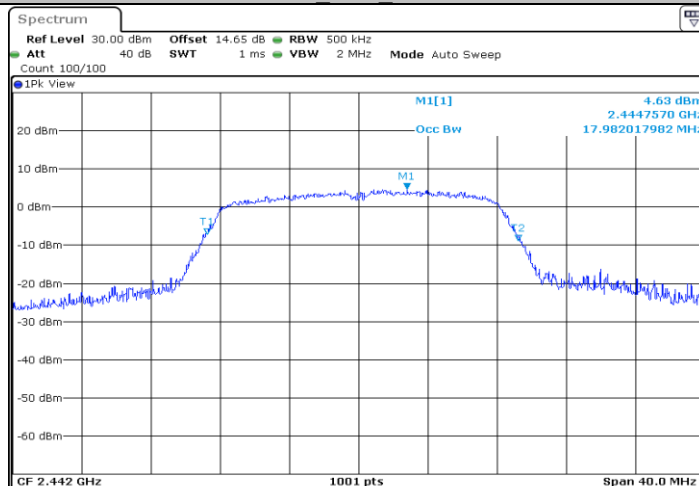
Date: 27.JUL.2020 22:37:18

11G_Ant1_2412



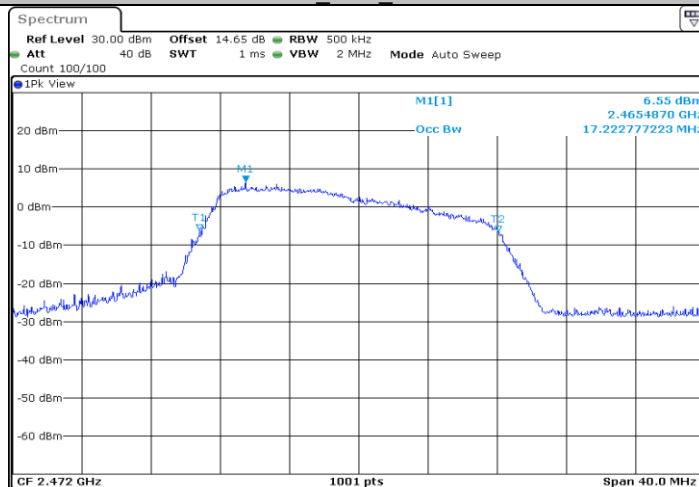
Date: 27.JUL.2020 22:47:04

11G_Ant1_2442



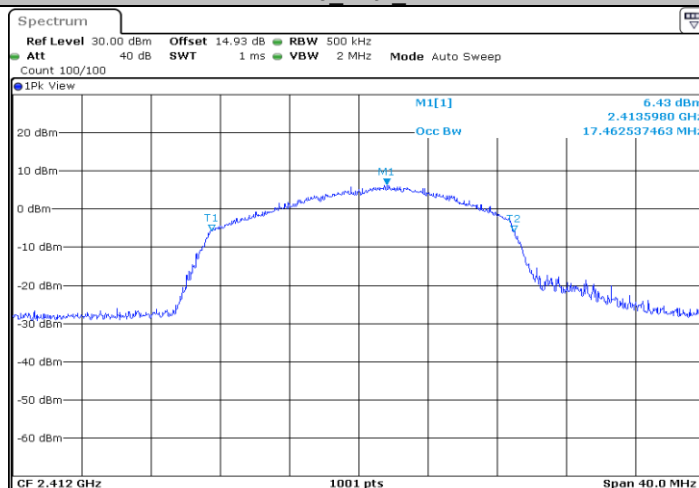
Date: 27.JUL.2020 22:45:33

11G_Ant1_2472



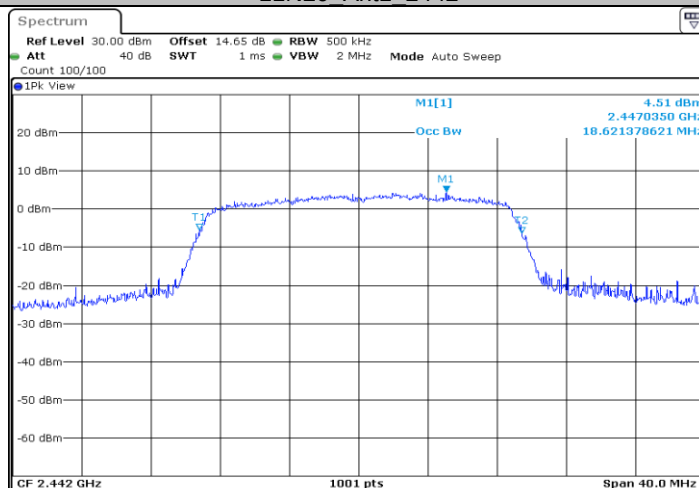
Date: 27.JUL.2020 22:48:39

11N20_Ant1_2412



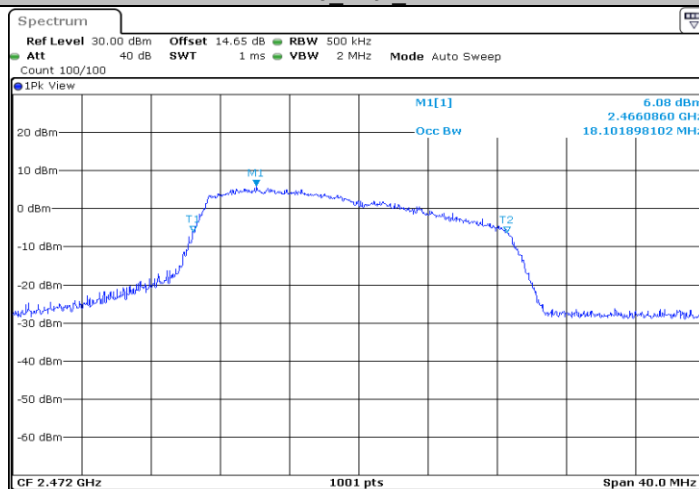
Date: 27.JUL.2020 22:50:25

11N20_Ant1_2442



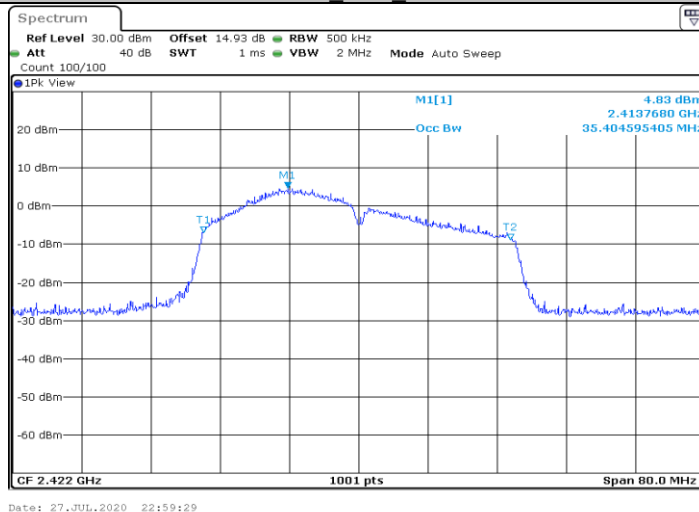
Date: 27.JUL.2020 22:52:18

11N20_Ant1_2472

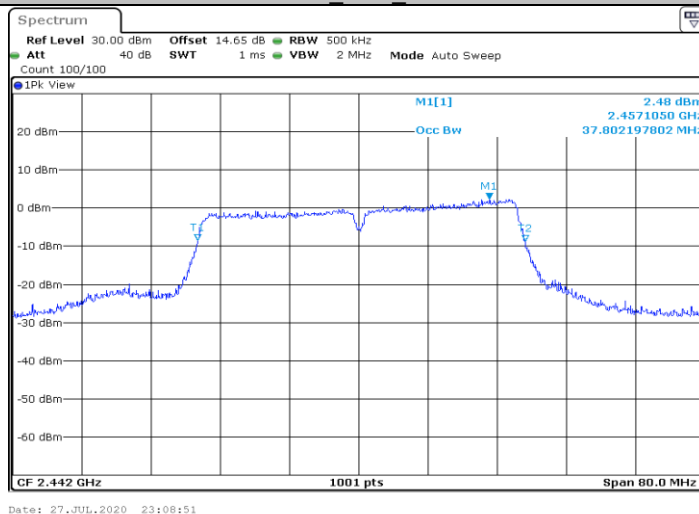


Date: 27.JUL.2020 22:53:40

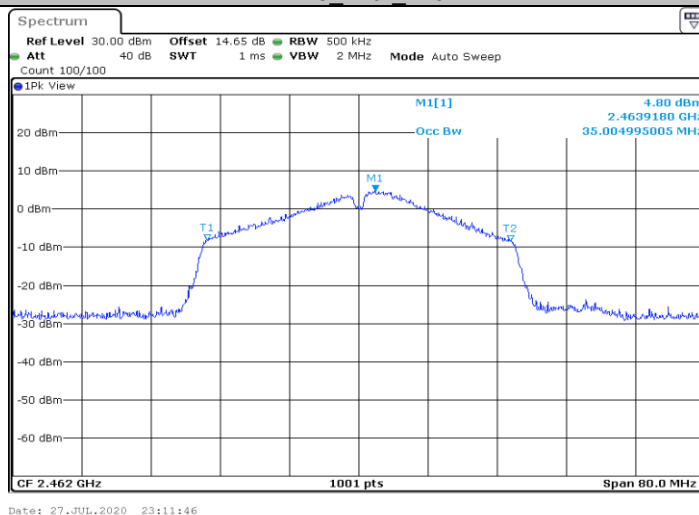
11N40_Ant1_2422



11N40_Ant1_2442



11N40_Ant1_2462



Appendix C: Maximum conducted output power Test Result

Average Power

Test Mode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
11B	Ant1	2412	8.38	<=30	PASS
		2442	8.63	<=30	PASS
		2472	8.87	<=30	PASS
11G	Ant1	2412	8.50	<=30	PASS
		2442	8.51	<=30	PASS
		2472	8.50	<=30	PASS
11N20	Ant1	2412	8.16	<=30	PASS
		2442	8.43	<=30	PASS
		2472	8.44	<=30	PASS
11N40	Ant1	2422	8.63	<=30	PASS
		2442	8.95	<=30	PASS
		2462	8.99	<=30	PASS

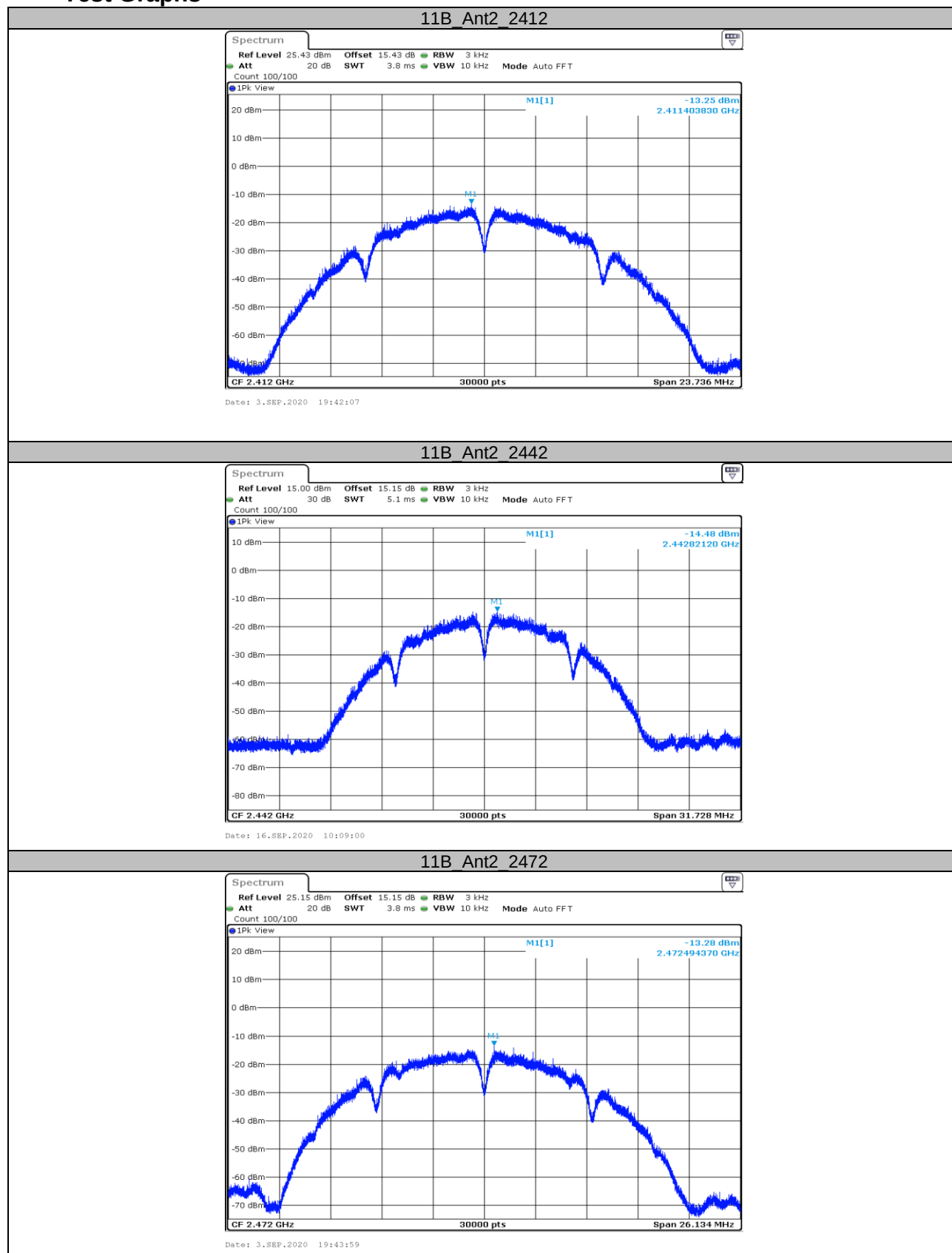
Peak Power

Test Mode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
11B	Ant1	2412	10.39	<=30	PASS
		2442	10.02	<=30	PASS
		2472	10.21	<=30	PASS
11G	Ant1	2412	13.94	<=30	PASS
		2442	13.09	<=30	PASS
		2472	13.13	<=30	PASS
11N20	Ant1	2412	13.42	<=30	PASS
		2442	12.74	<=30	PASS
		2472	13.65	<=30	PASS
11N40	Ant1	2422	12.71	<=30	PASS
		2442	12.17	<=30	PASS
		2462	12.71	<=30	PASS

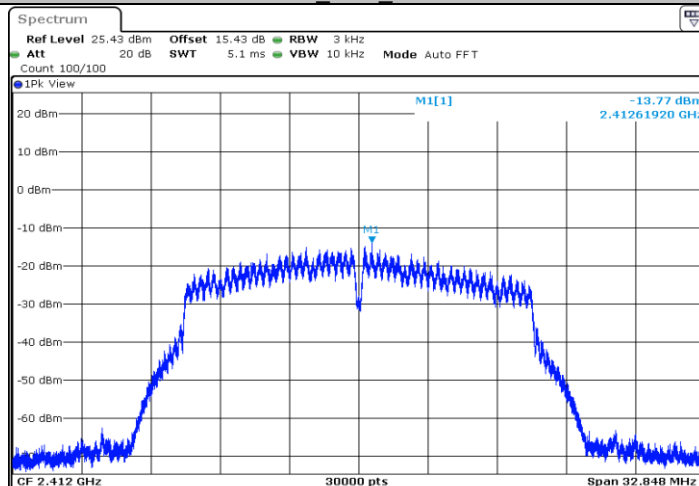
**Appendix D: Maximum power spectral density
Test Result**

Test Mode	Antenna	Channel	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
11B	Ant1	2412	-13.25	<=8	PASS
		2442	-14.48	<=8	PASS
		2472	-13.28	<=8	PASS
11G	Ant1	2412	-13.77	<=8	PASS
		2442	-16.41	<=8	PASS
		2472	-16.02	<=8	PASS
11N20SISO	Ant1	2412	-14.74	<=8	PASS
		2442	-15.88	<=8	PASS
		2472	-16.72	<=8	PASS
11N40SISO	Ant1	2422	-17.22	<=8	PASS
		2442	-18.88	<=8	PASS
		2462	-17.42	<=8	PASS

Test Graphs

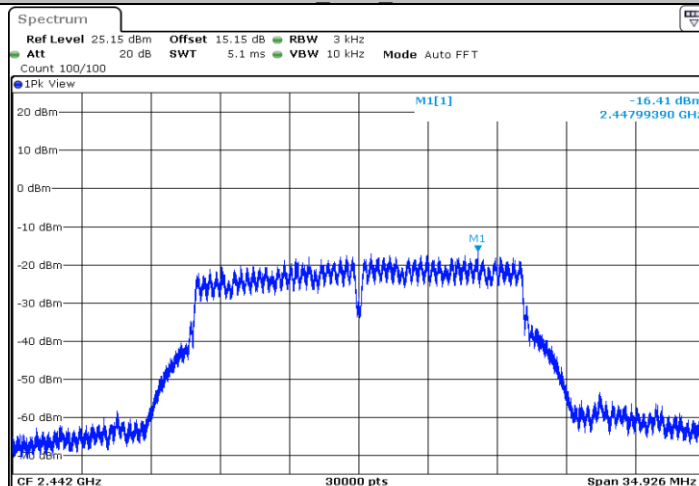


11G Ant2_2412



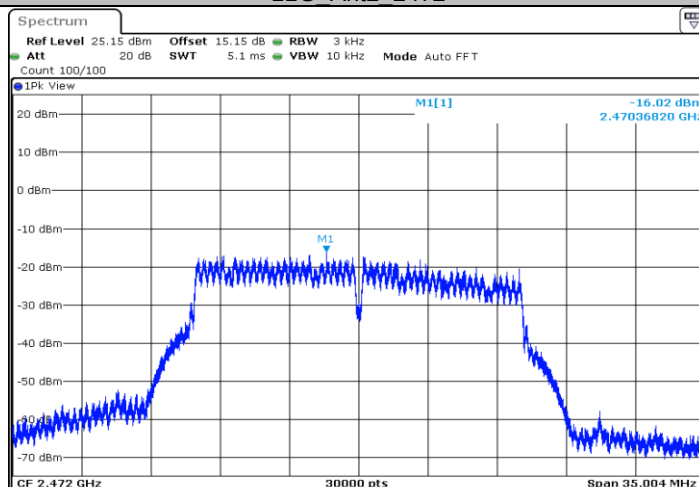
Date: 3.SEP.2020 19:47:10

11G Ant2_2442



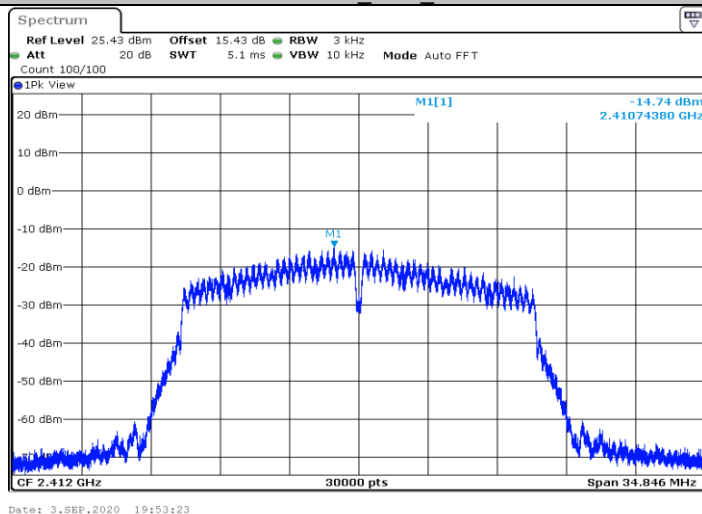
Date: 3.SEP.2020 19:49:30

11G Ant2_2472

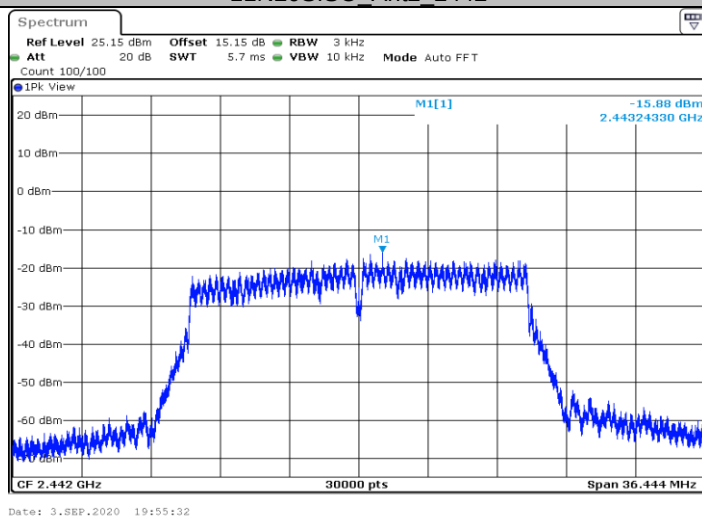


Date: 3.SEP.2020 19:51:02

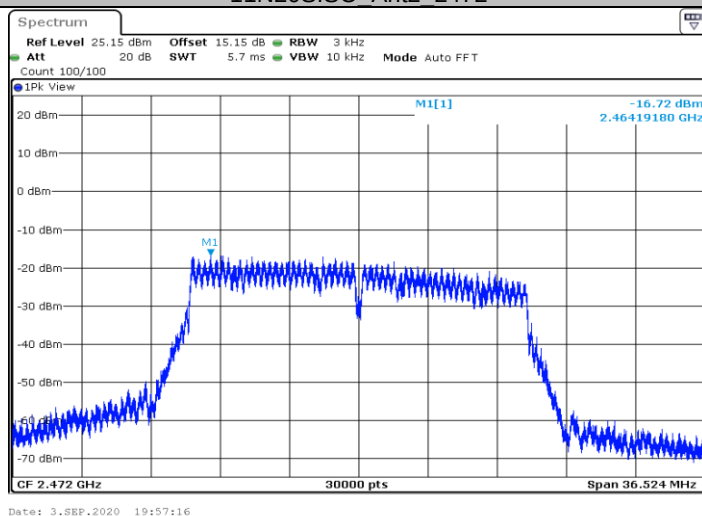
11N20SISO_Ant2_2412



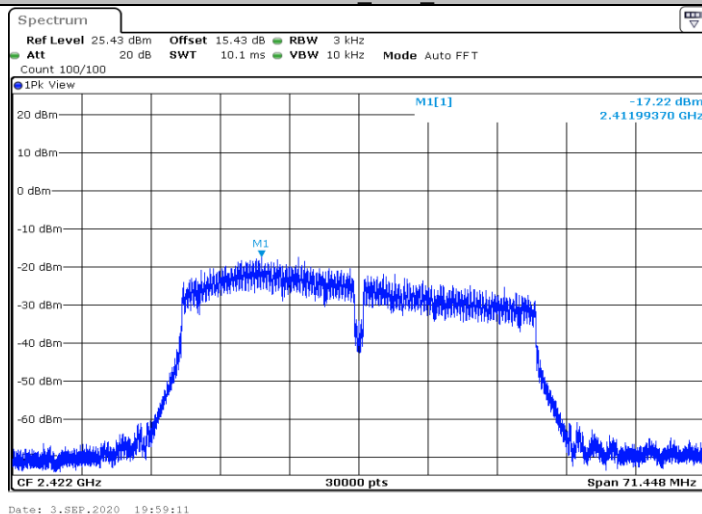
11N20SISO_Ant2_2442



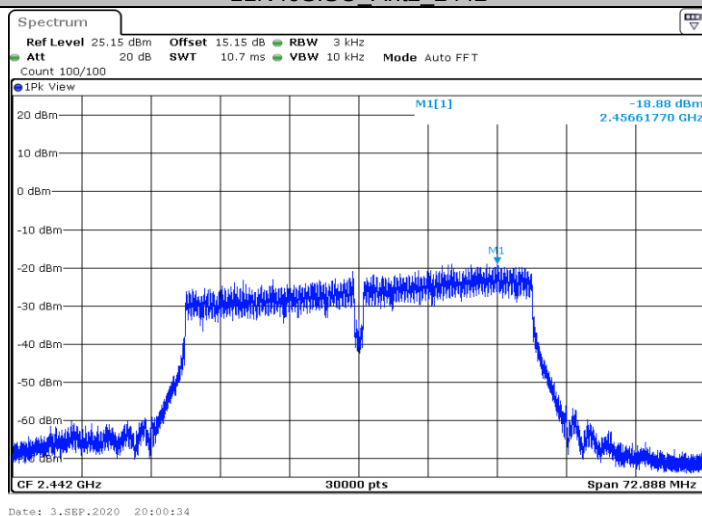
11N20SISO_Ant2_2472



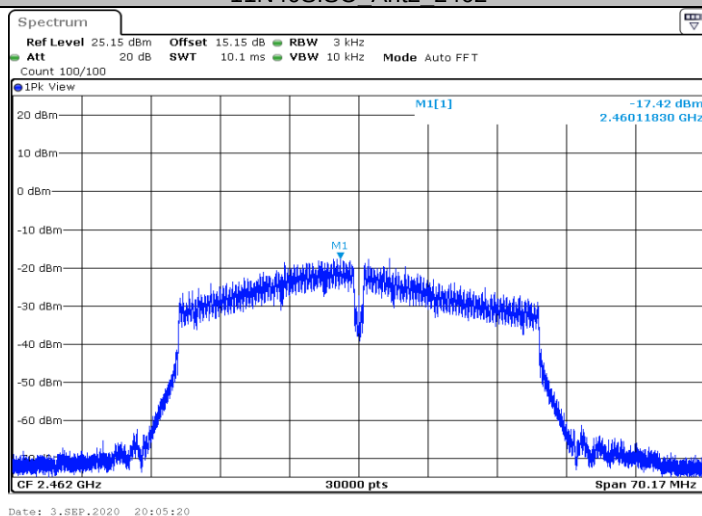
11N40SISO_Ant2_2422



11N40SISO_Ant2_2442

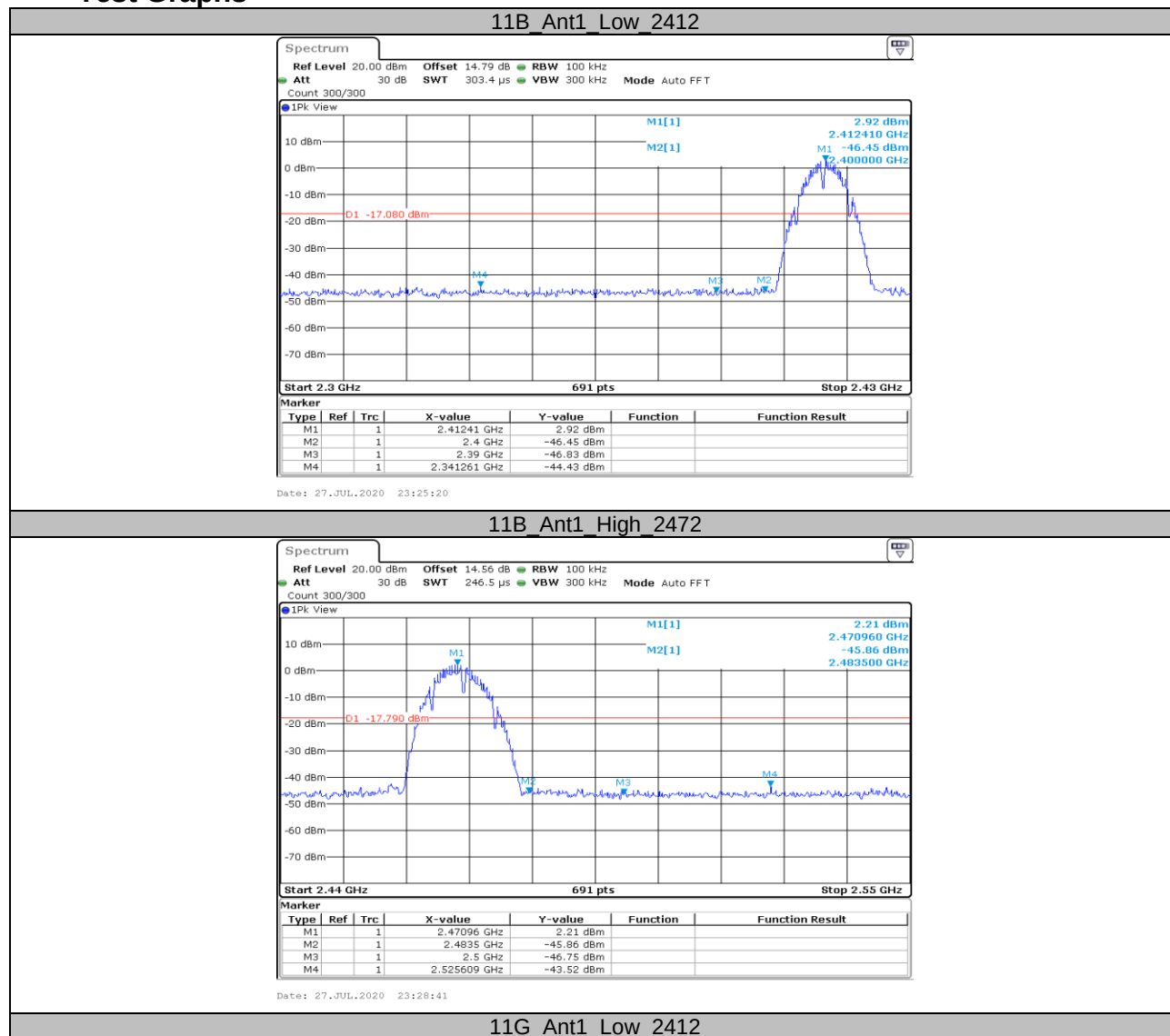


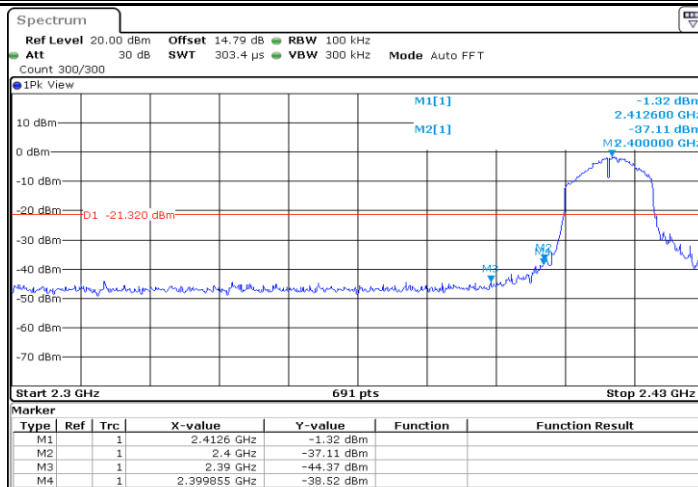
11N40SISO_Ant2_2462



Appendix E: Band edge measurements

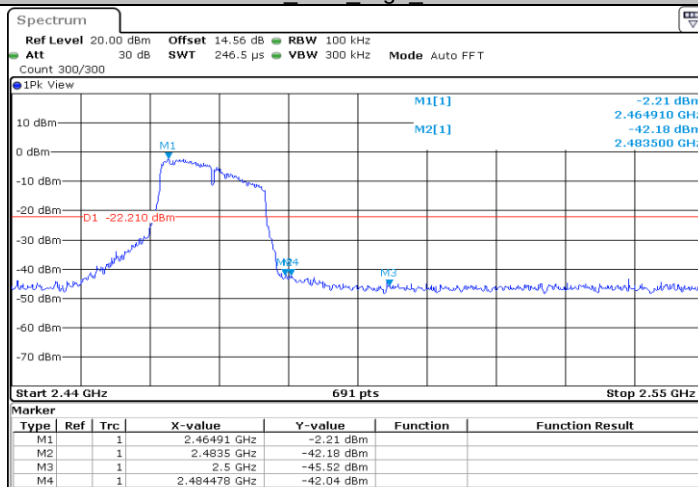
Test Graphs





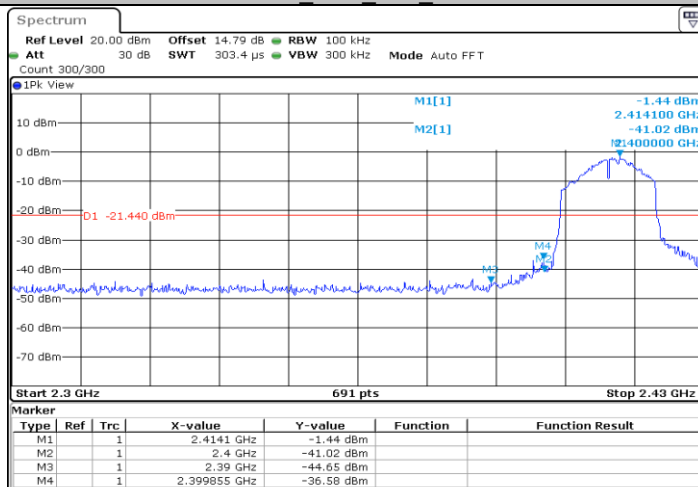
Date: 27.JUL.2020 23:30:43

11G Ant1 High 2472



Date: 27.JUL.2020 23:34:05

11N20 Ant1 Low 2412



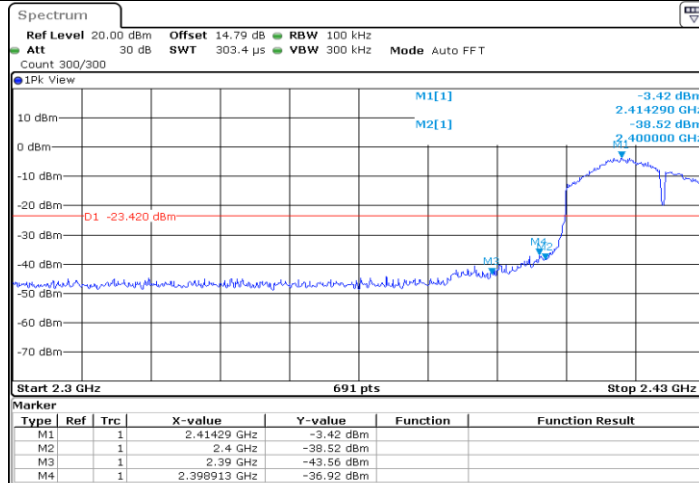
Date: 27.JUL.2020 23:19:55

11N20 Ant1 High 2472



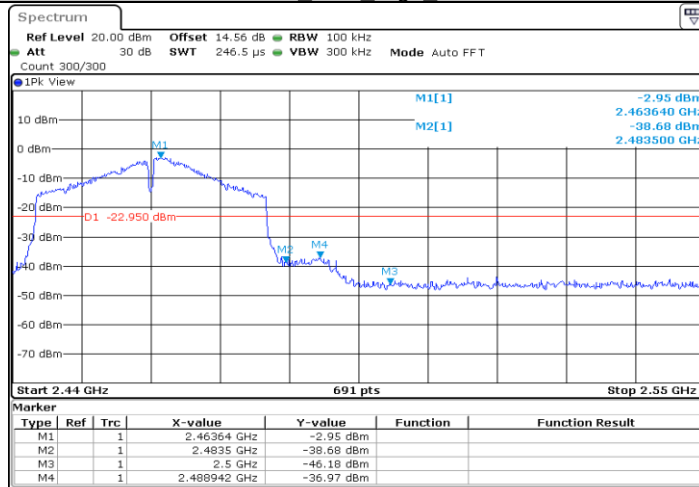
Date: 27.JUL.2020 23:23:51

11N40 Ant1 Low 2422



Date: 27.JUL.2020 23:18:09

11N40 Ant1 High 2462

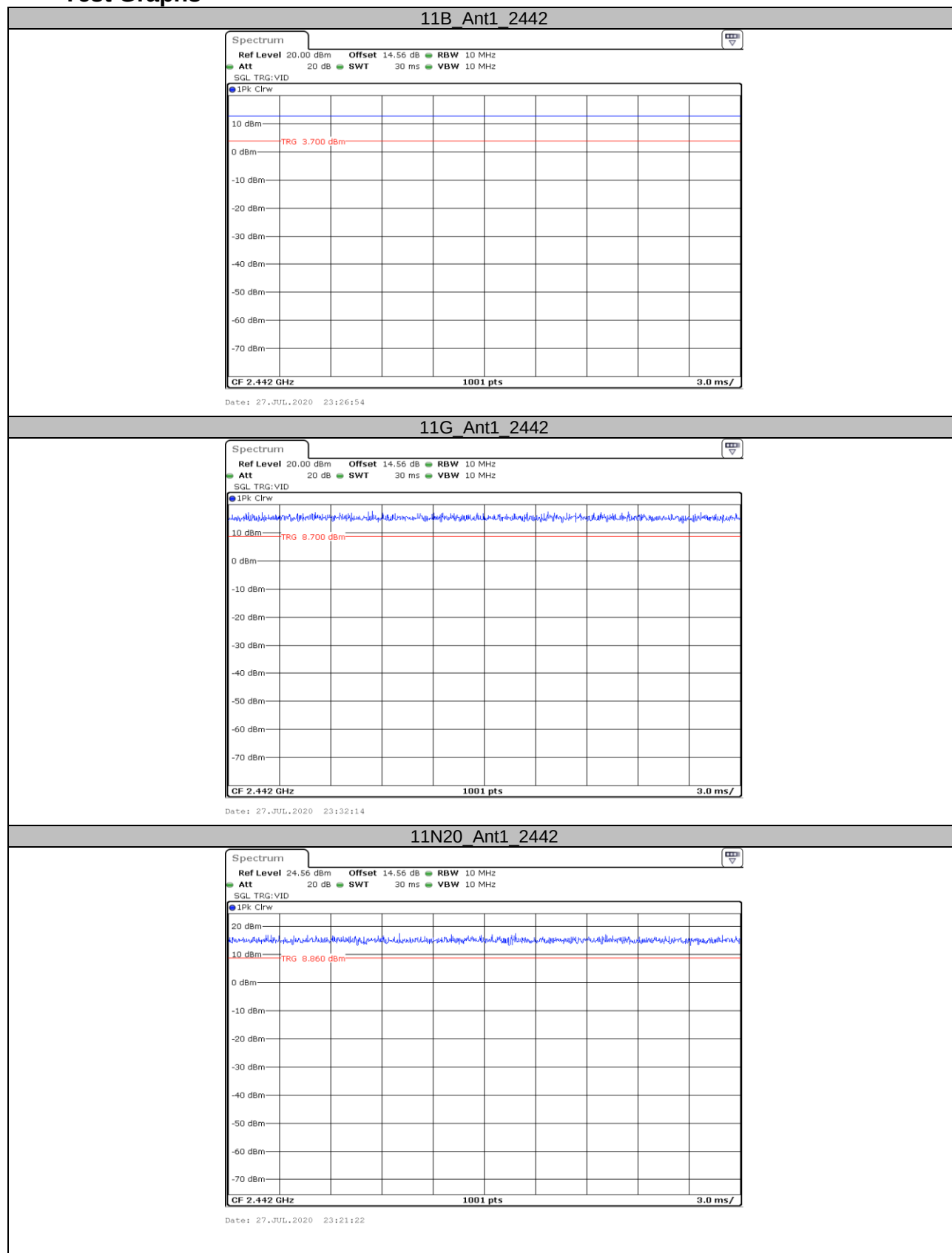


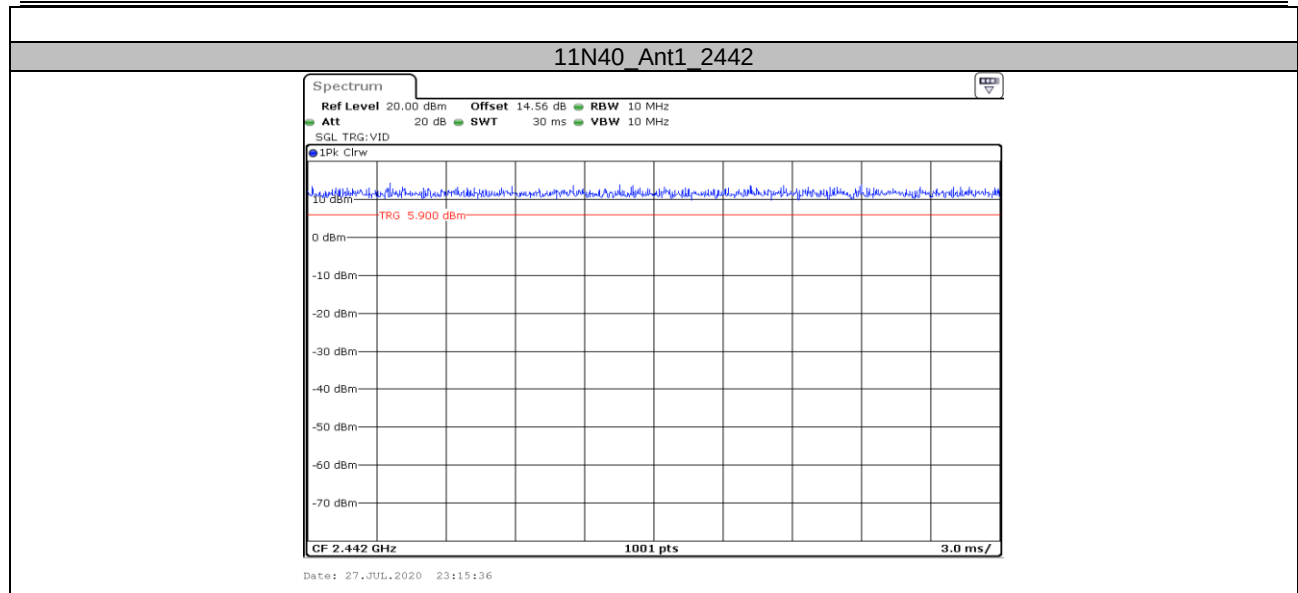
Date: 27.JUL.2020 23:14:05

**Appendix G: Duty Cycle
Test Result**

Test Mode	Antenna	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
11B	Ant1	2442	30.00	30.00	100.00
11G	Ant1	2442	30.00	30.00	100.00
11N20	Ant1	2442	30.00	30.00	100.00
11N40	Ant1	2442	30.00	30.00	100.00

Test Graphs



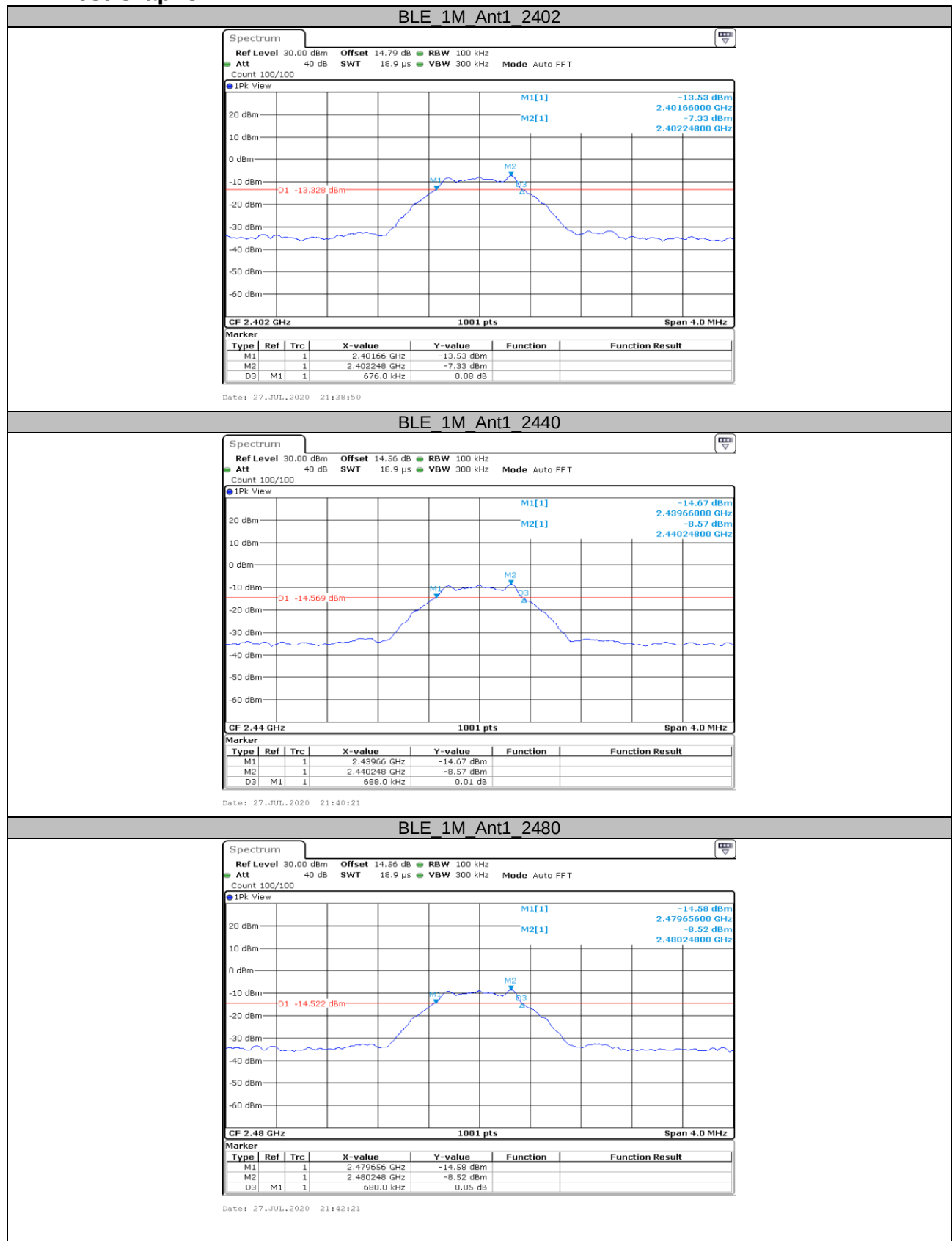


APPENDIX BLE

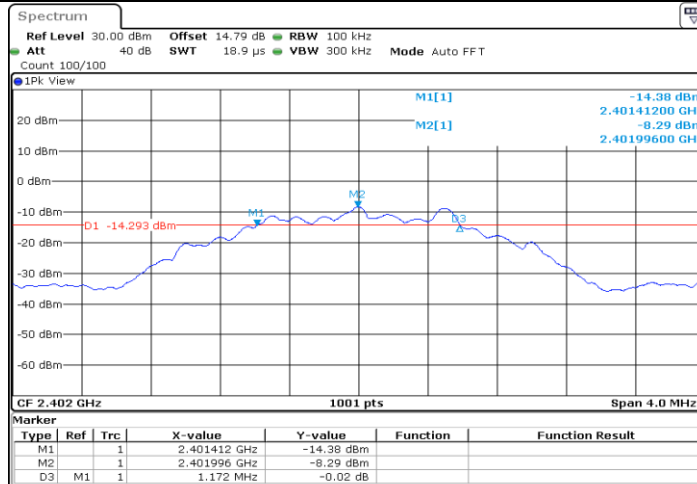
Appendix A: DTS Bandwidth Test Result

Test Mode	Antenna	Channel	DTS BW [MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	0.676	0.5	PASS
		2440	0.688	0.5	PASS
		2480	0.680	0.5	PASS
BLE_2M	Ant1	2402	1.172	0.5	PASS
		2440	1.176	0.5	PASS
		2480	1.228	0.5	PASS

Test Graphs

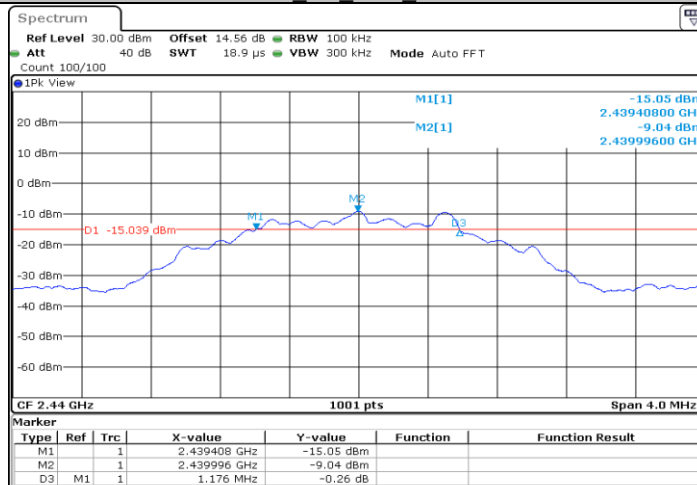


BLE 2M Ant1 2402



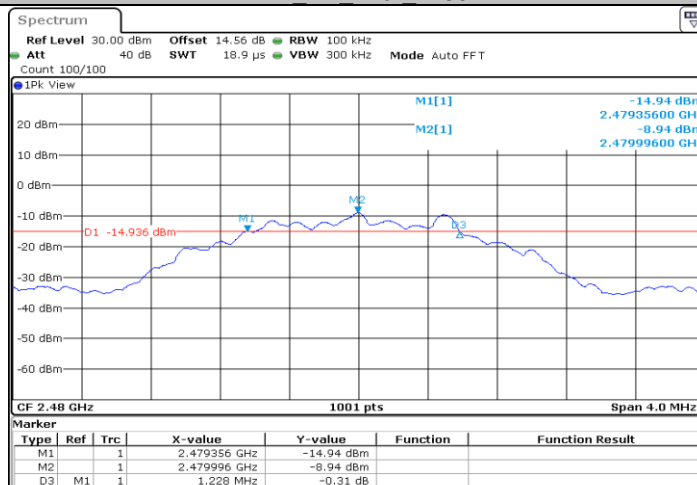
Date: 27.JUL.2020 21:43:32

BLE 2M Ant1 2440



Date: 27.JUL.2020 21:45:09

BLE 2M Ant1 2480

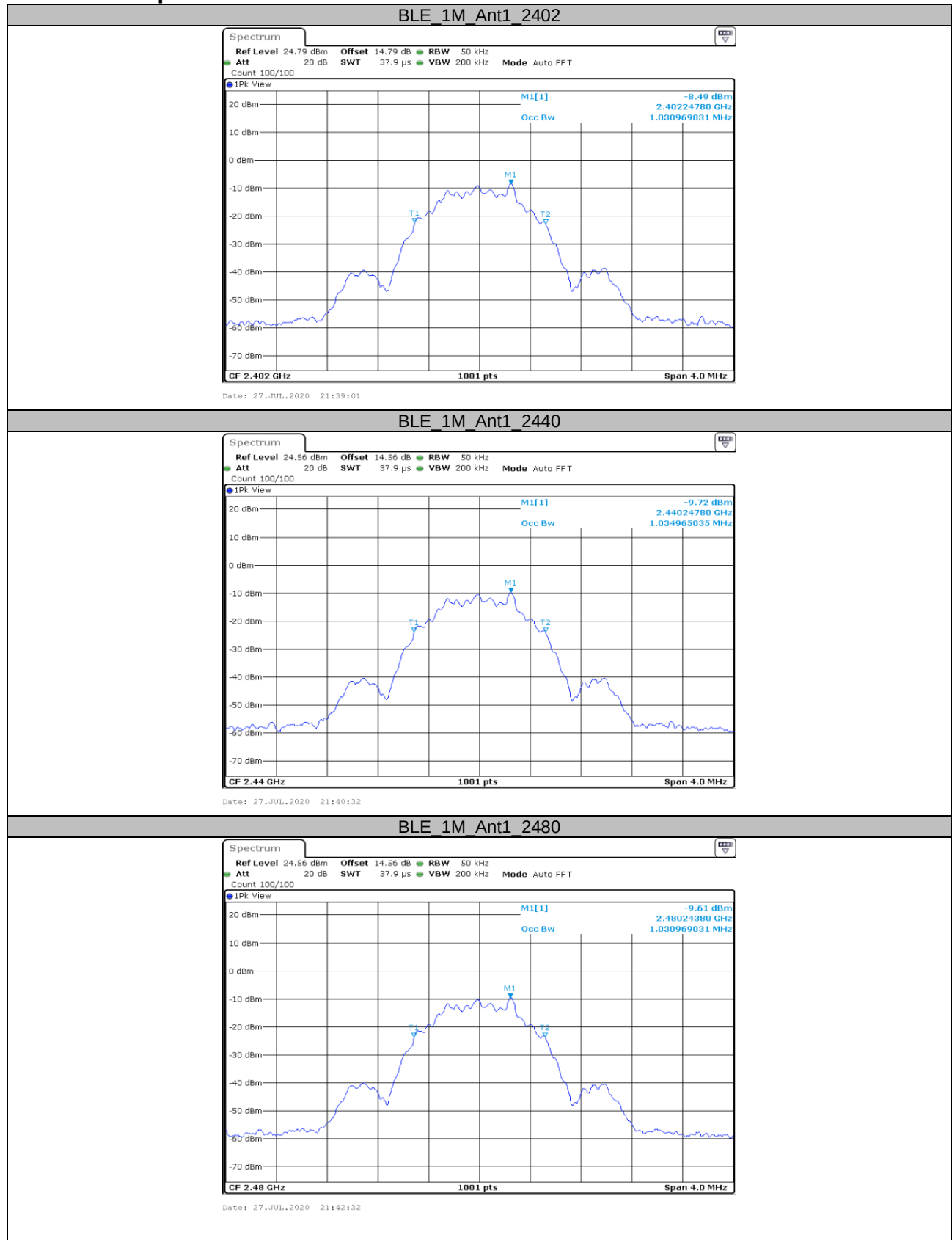


Date: 27.JUL.2020 21:46:12

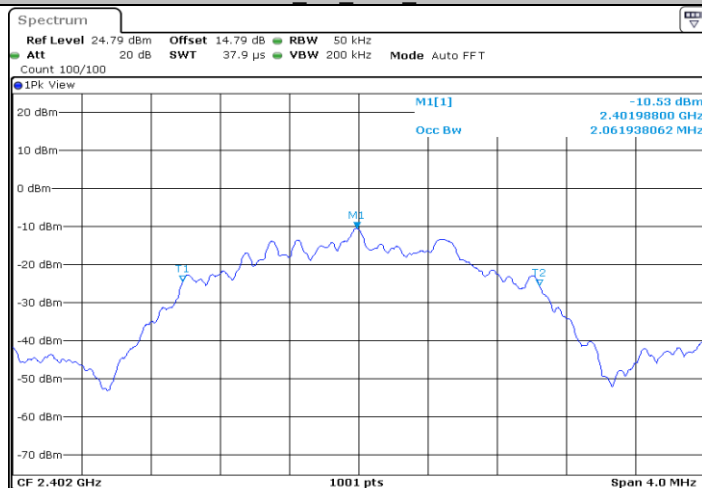
**Appendix B: Occupied Channel Bandwidth
Test Result**

Test Mode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	1.031	---	PASS
		2440	1.035	---	PASS
		2480	1.031	---	PASS
BLE_2M	Ant1	2402	2.062	---	PASS
		2440	2.062	---	PASS
		2480	2.062	---	PASS

Test Graphs

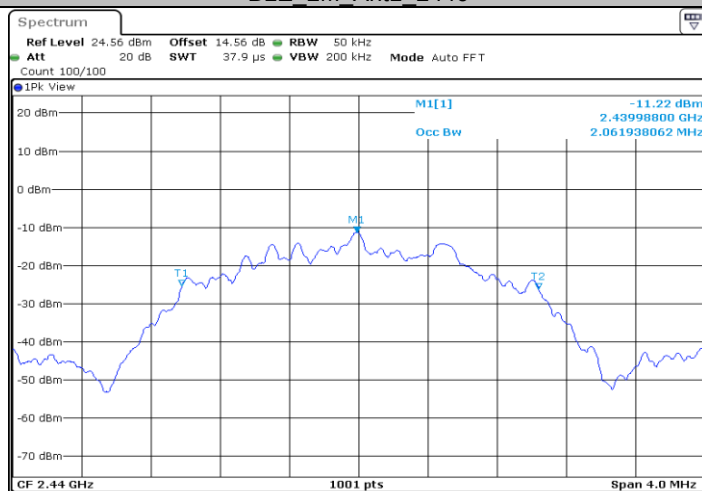


BLE 2M Ant1 2402



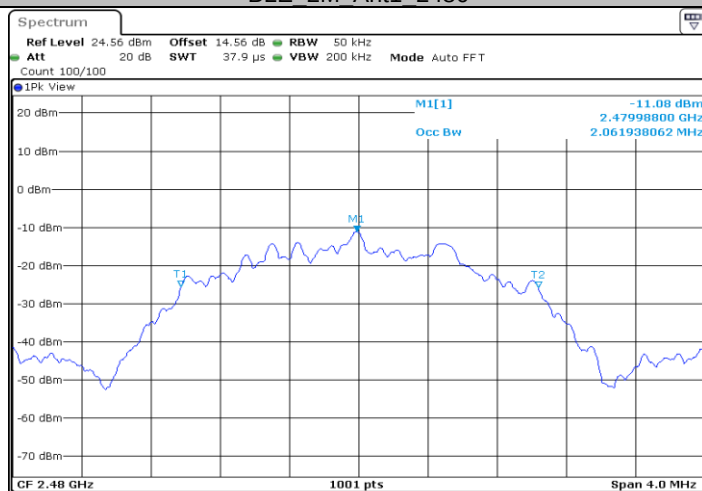
Date: 27.JUL.2020 21:43:43

BLE 2M Ant1 2440



Date: 27.JUL.2020 21:45:20

BLE 2M Ant1 2480



Date: 27.JUL.2020 21:46:23

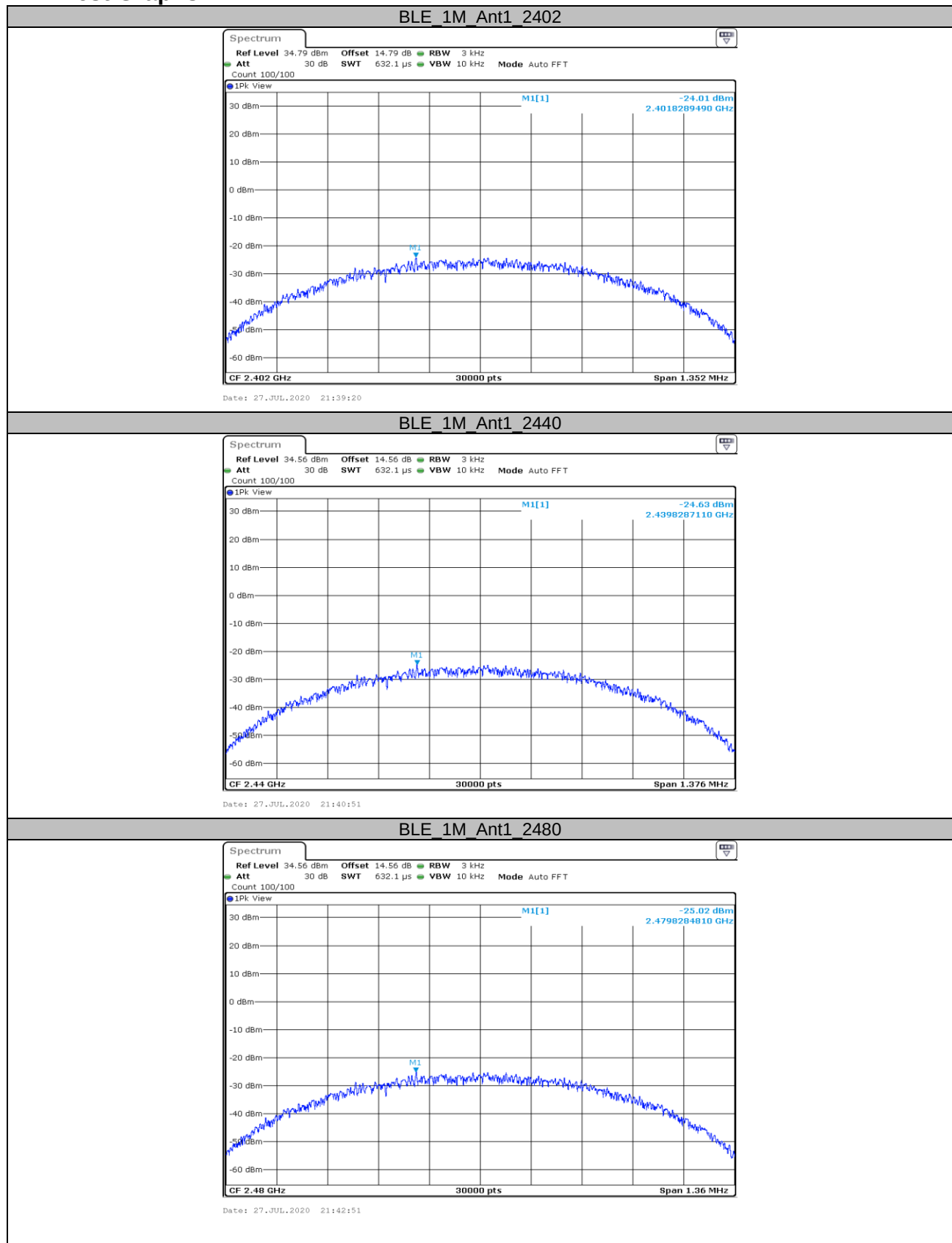
Appendix C: Maximum conducted Peak output power**Test Result**

Test Mode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	-6.79	<=30	PASS
		2440	-6.79	<=30	PASS
		2480	-7.17	<=30	PASS
BLE_2M	Ant1	2402	-7.17	<=30	PASS
		2440	-7.17	<=30	PASS
		2480	-7.17	<=30	PASS

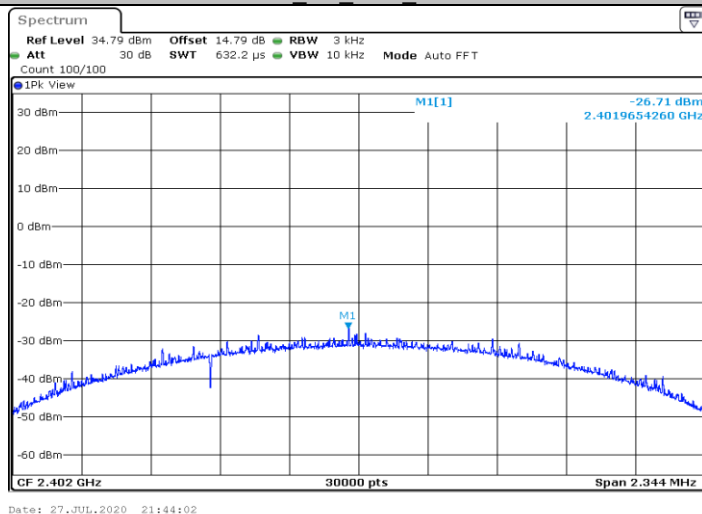
**Appendix D: Maximum power spectral density
Test Result**

Test Mode	Antenna	Channel	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-24.01	<=8	PASS
		2440	-24.63	<=8	PASS
		2480	-25.02	<=8	PASS
BLE_2M	Ant1	2402	-26.71	<=8	PASS
		2440	-26.84	<=8	PASS
		2480	-27.22	<=8	PASS

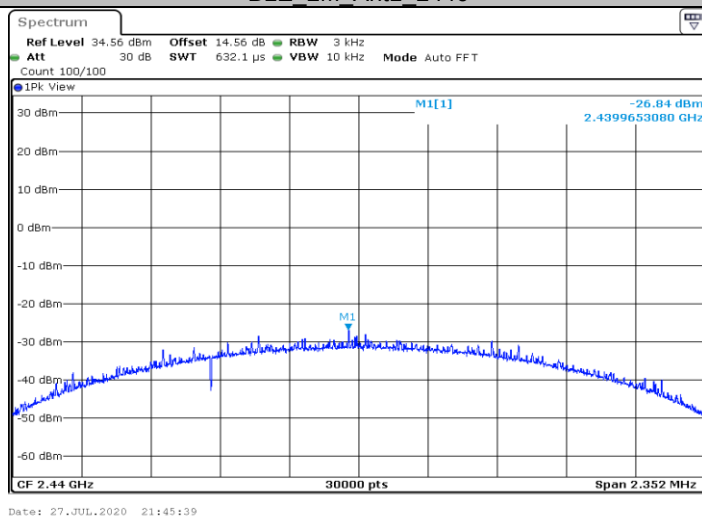
Test Graphs



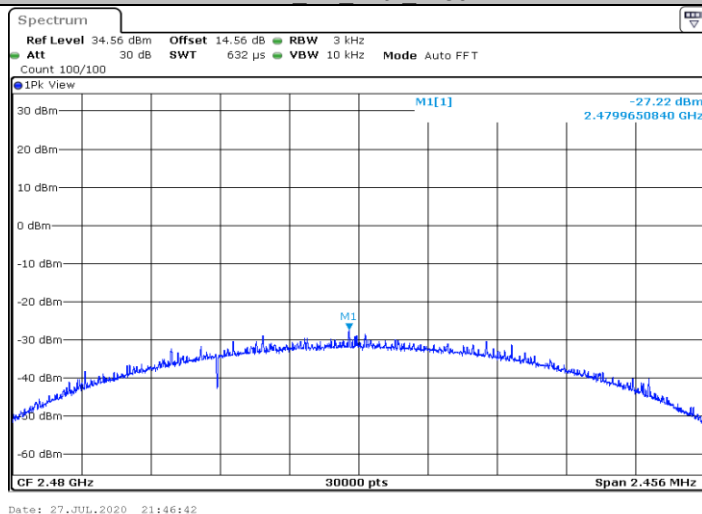
BLE 2M Ant1 2402



BLE 2M Ant1 2440

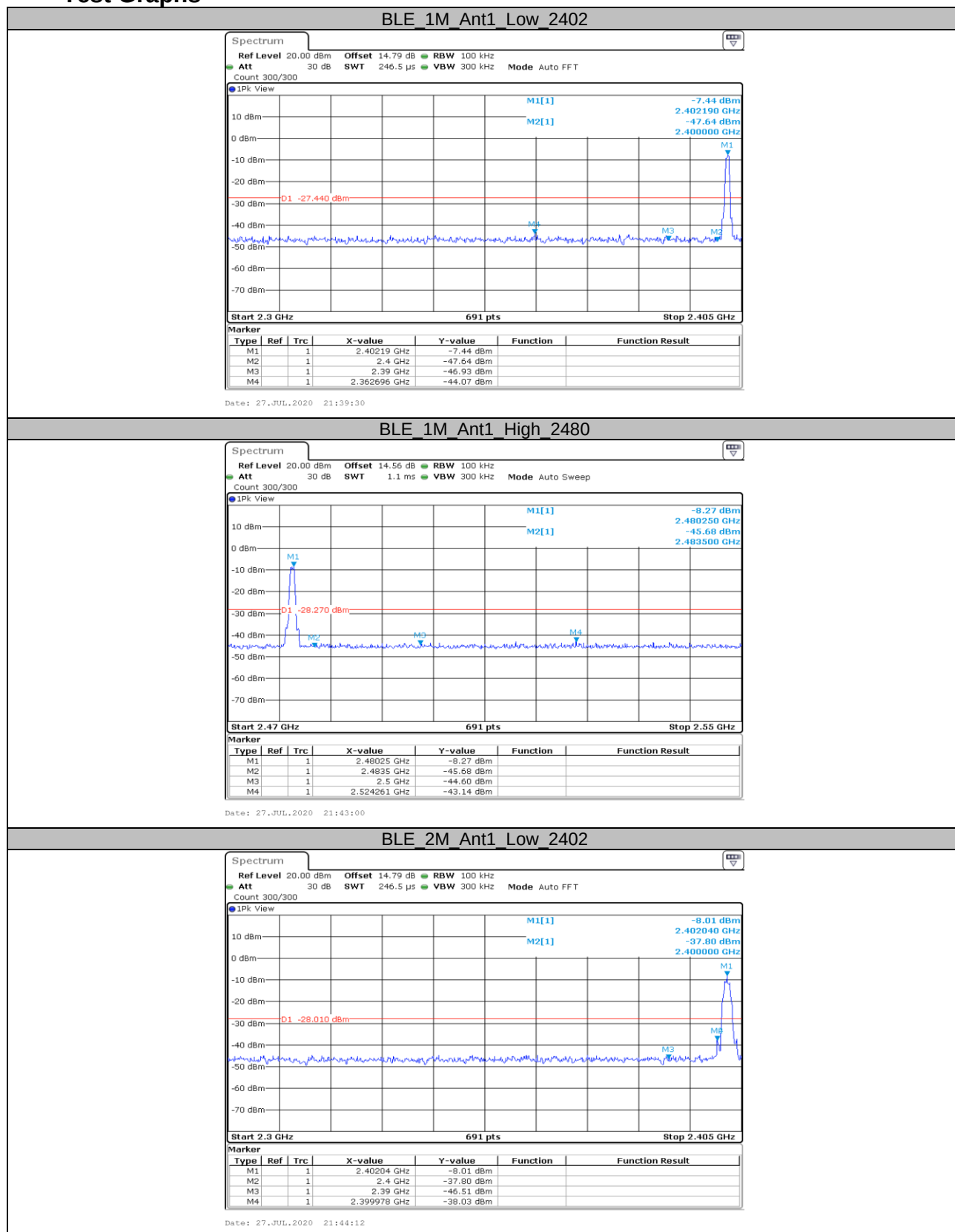


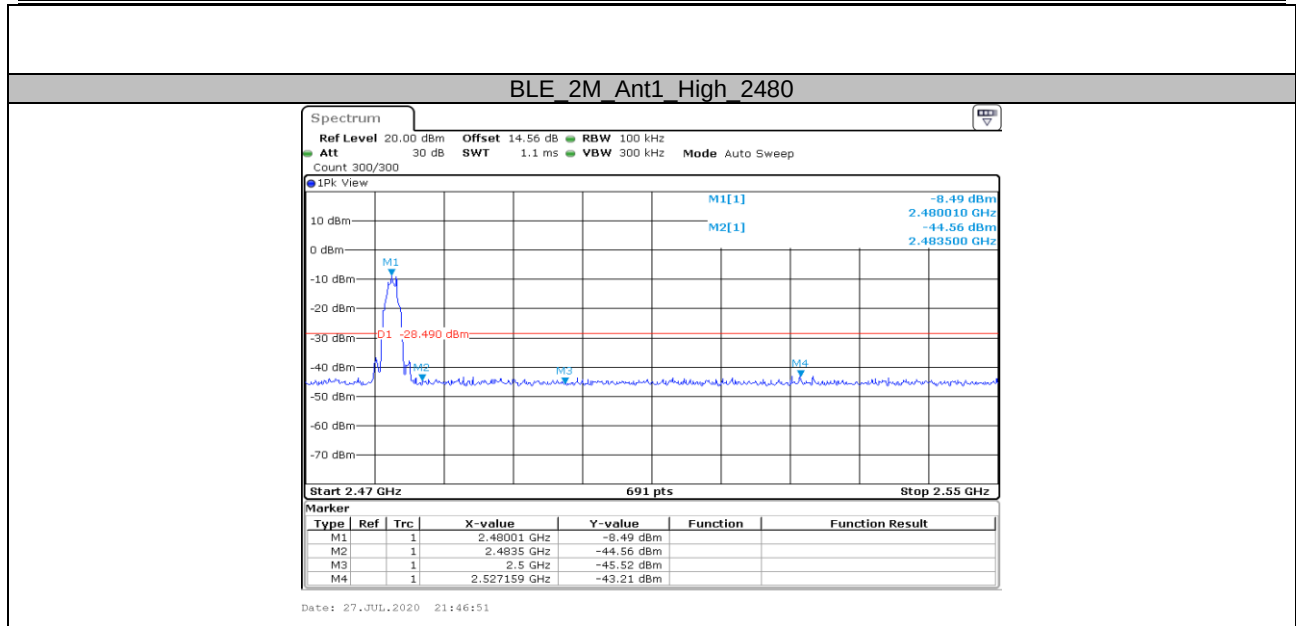
BLE 2M Ant1 2480



Appendix E: Band edge measurements

Test Graphs

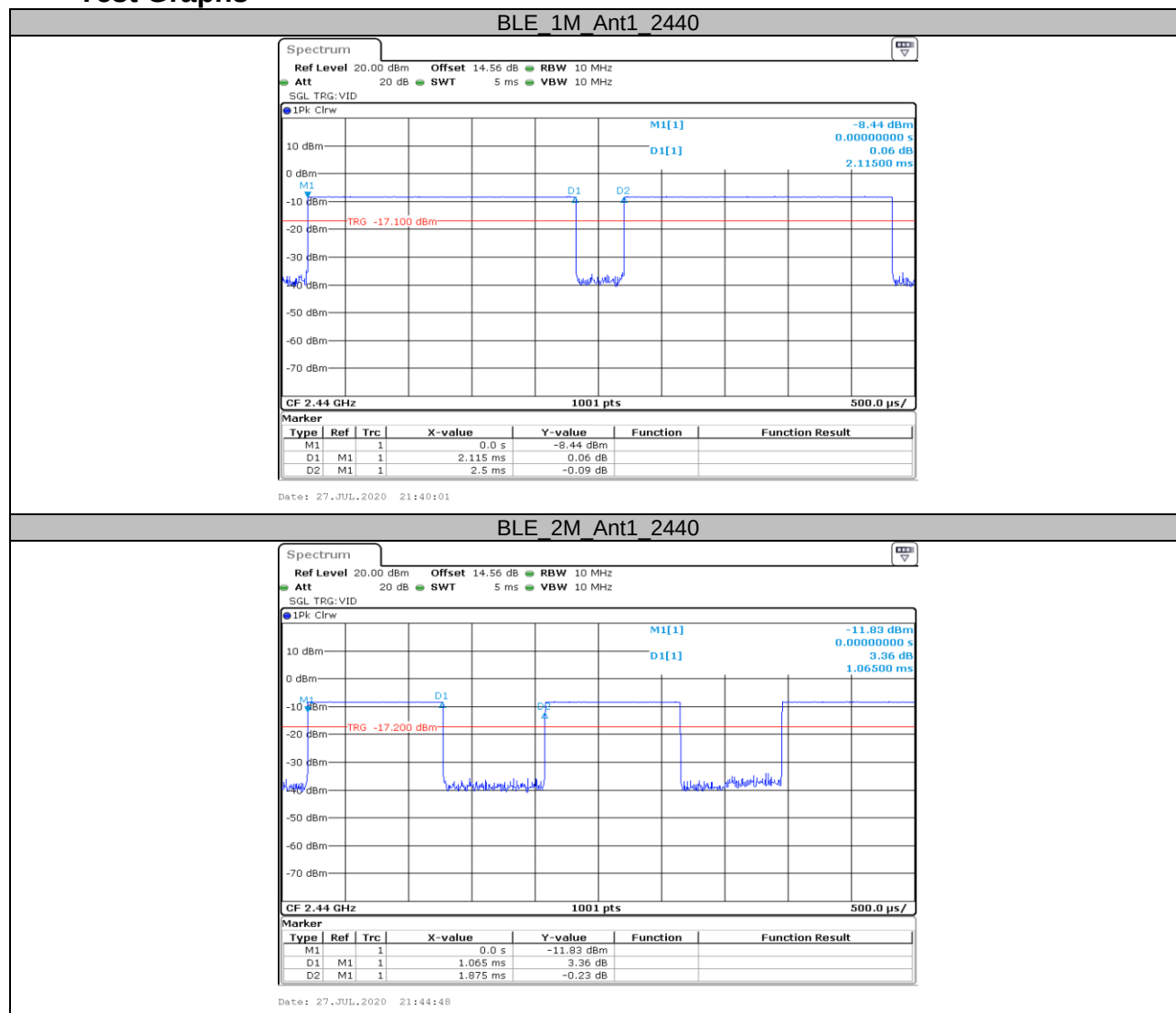




**Appendix G: Duty Cycle
Test Result**

Test Mode	Antenna	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
BLE_1M	Ant1	2440	2.11	2.50	84.60
BLE_2M	Ant1	2440	1.07	1.88	56.80

Test Graphs



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