FCC PART 15.407

TEST REPORT

For

Shenzhen Snapmaker Technologies Co., Ltd.

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FCC ID: 2AVDG-80018XHFW

Report Type:	**Product Type:**
Original Report	Snapmaker Modular 3D Printer

Report Number: RSZ200416002-00D

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TABLE OF CONTENTS

GENERAL INFORMATION **4**
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) 4
OBJECTIVE 4
TEST METHODOLOGY 5
MEASUREMENT UNCERTAINTY 5
TEST FACILITY 5
SYSTEM TEST CONFIGURATION **6**
DESCRIPTION OF TEST CONFIGURATION 6
EUT EXERCISE SOFTWARE 7
DUTY CYCLE 7
EQUIPMENT MODIFICATIONS 7
SUPPORT EQUIPMENT LIST AND DETAILS 8
EXTERNAL I/O CABLE 8
BLOCK DIAGRAM OF TEST SETUP 8
SUMMARY OF TEST RESULTS **9**
TEST EQUIPMENT LIST **10**
FCC§1.1307 (b) & §2.1093 – RF EXPOSURE **12**
APPLICABLE STANDARD 12
TEST RESULT 12
FCC §15.203 – ANTENNA REQUIREMENT **13**
APPLICABLE STANDARD 13
ANTENNA CONNECTOR CONSTRUCTION 13
FCC §15.407 (b) (6) §15.207 (a) – CONDUCTED EMISSIONS **14**
APPLICABLE STANDARD 14
EUT SETUP 14
EMI TEST RECEIVER SETUP 14
TEST PROCEDURE 14
TEST DATA 15
§15.205 & §15.209 & §15.407(B) (1), (4), (6), (7) – UNDESIRABLE EMISSION **18**
APPLICABLE STANDARD 18
EUT SETUP 18
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP 19
TEST PROCEDURE 19
CORRECTED AMPLITUDE & MARGIN CALCULATION 20
TEST DATA 20
FCC §15.407(a) (1) – 26 dB & 6dB EMISSION BANDWIDTH **32**
APPLICABLE STANDARD 32
TEST PROCEDURE 32
TEST DATA 33
FCC §15.407(a) (1) (3) – CONDUCTED TRANSMITTER OUTPUT POWER **34**
APPLICABLE STANDARD 34
TEST PROCEDURE 34
TEST DATA 35

FCC §15.407(a) (1) (3) - POWER SPECTRAL DENSITY 36
APPLICABLE STANDARD 36
TEST PROCEDURE 36
TEST DATA 37
APPENDIX 38
APPENDIX A1: EMISSION BANDWIDTH 38
APPENDIX A2: OCCUPIED CHANNEL BANDWIDTH 42
APPENDIX B: MAXIMUM CONDUCTED AVERAGE OUTPUT POWER 53

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	5G Wi-Fi: 5150-5250 MHz; 5725-5850 MHz
Maximum conducted output power	5150-5250 MHz: 10.16dBm (802.11a), 10.80dBm(802.11n20), 9.58dBm(802.11n40) 5725-5850 MHz: 10.75dBm (802.11a), 10.92dBm(802.11n20), 11.09dBm(802.11n40)
Modulation Technique	OFDM
Antenna Specification	3.40dBi (provided by the applicant)
Voltage Range	DC 24V from power module
Date of Test	2020-05-06 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 E of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart E, section 15.203, 15.205, 15.207, 15.209 and 15.407 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 KDB789033D02 General U-NII Test Procedures New Rules v02r01.

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 5150-5250MHz Band, 6 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
36	5180	44	5220
38	5190	46	5230
40	5200	48	5240

For 802.11a, 802.11n20 channel 36, 40, 48 were tested; For 802.11n40 channel 38, 46 were tested

For 5725-5850MHz Band, 7 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
149	5745	159	5795
151	5755	161	5805
153	5765	165	5825
157	5785	/	/

For 802.11a, 802.11n20 channel 149, 157, 165 were tested; For 802.11n40 channel 151, 159 were tested;

EUT Exercise Software

"QRCT"* exercise software was used.

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

U-NII	Mode	Frequency (MHz)	Rate (Mbps)	Power Level*
5150 – 5250MHz	802.11 a	5180	6	15
		5200	6	15
		5240	6	15
	802.11 n20	5180	MCS0	15
		5200	MCS0	15
		5240	MCS0	15
	802.11 n40	5190	MCS0	15
		5230	MCS0	15
5725 – 5850MHz	802.11 a	5745	6	15
		5785	6	15
		5825	6	15
	802.11 n20	5745	MCS0	15
		5785	MCS0	15
		5825	MCS0	15
	802.11 n40	5755	MCS0	15
		5795	MCS0	15

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

Duty cycle

Test Result: Pass. Please refer to the Appendix.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

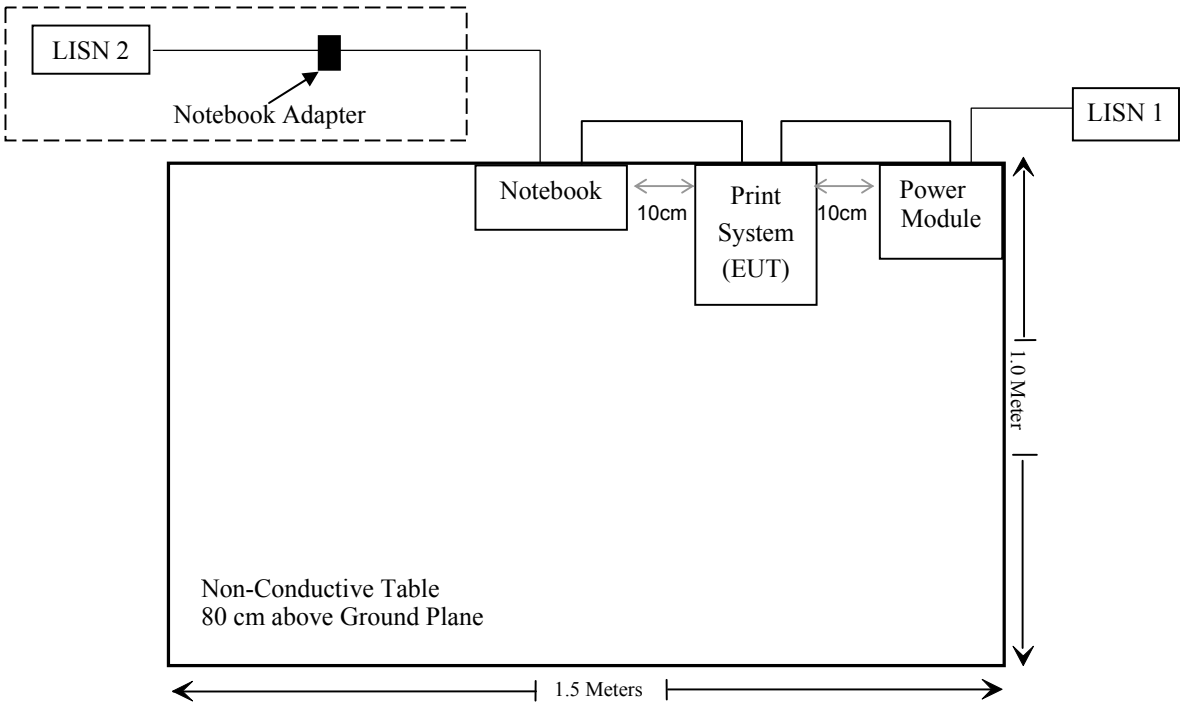
Manufacturer	Description	Model	Serial Number
DELL	Notebook	Latitude E6410	11429208685
DELL	Adapter	PA-10	0933 DMYD-AT59637-B
Snapmaker	Power Module	Unknown	78785
Snapmaker	Laser Module	71007	RSZ200416002-RF-S2

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

For conducted emission:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§1.1307 (b) & §2.1093	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.407(b)(6)& §15.207(a)	Conducted Emissions	Compliance
§15.205& §15.209 &§15.407(b) (1), (4),(7)	Undesirable Emission& Restricted Bands	Compliance
§15.407(a) (1), (5),(e)	26 dB Emission Bandwidth & 6dB Bandwidth	Compliance
§15.407(a)(1),(3)	Conducted Transmitter Output Power	Compliance
§15.407 (a)(1),(3)	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 (Below 1G)					
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
Radiated Emission Test (Above 1G)					
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
Ducommun technologies	RF Cable	RG-214	1	2019/11/12	2020/11/12
Ducommun technologies	RF Cable	RG-214	2	2019/11/12	2020/11/12
SNSD	Band Reject filter	BSF5150-5850MN-0899-004	5G filter	2020/04/20	2021/04/20
Ducommun Technolagies	Horn antenna	ARH-4223-02	1007726-02 1304	2017/12/06	2020/12/05
Ducommun Technologies	Horn Antenna	ARH-2823-02	1007726-03	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	2019/07/10	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§1.1307 (b) & §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 15.407 (a), if the transmitting antennas of directional gain greater than 6dBi are used, the transmit power and power spectral density 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 which was permanently attached and the antenna gain is 3.4dBi, fulfill the requirement of this section. Please refer to the EUT photos.

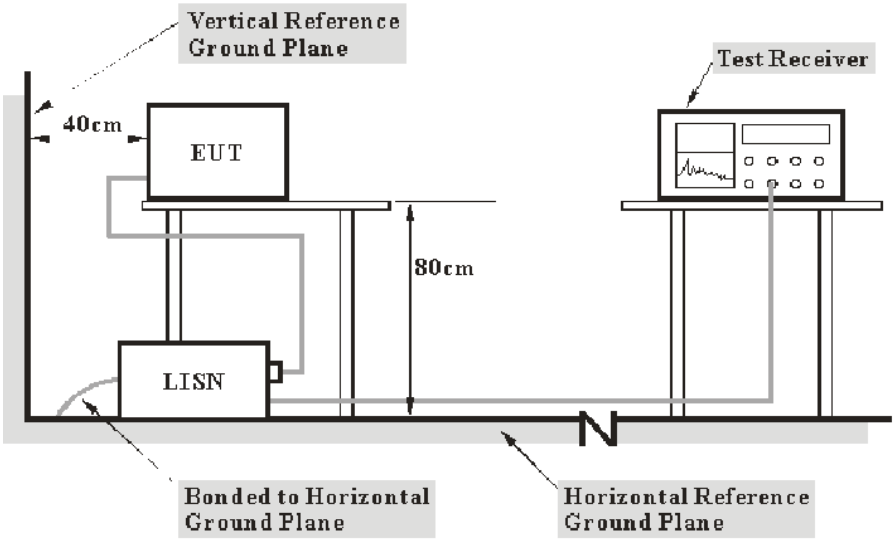
Result: Pass

FCC §15.407 (b) (6) §15.207 (a) – CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207, §15.407(b) (6)

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 LISN.

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

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

Test Data

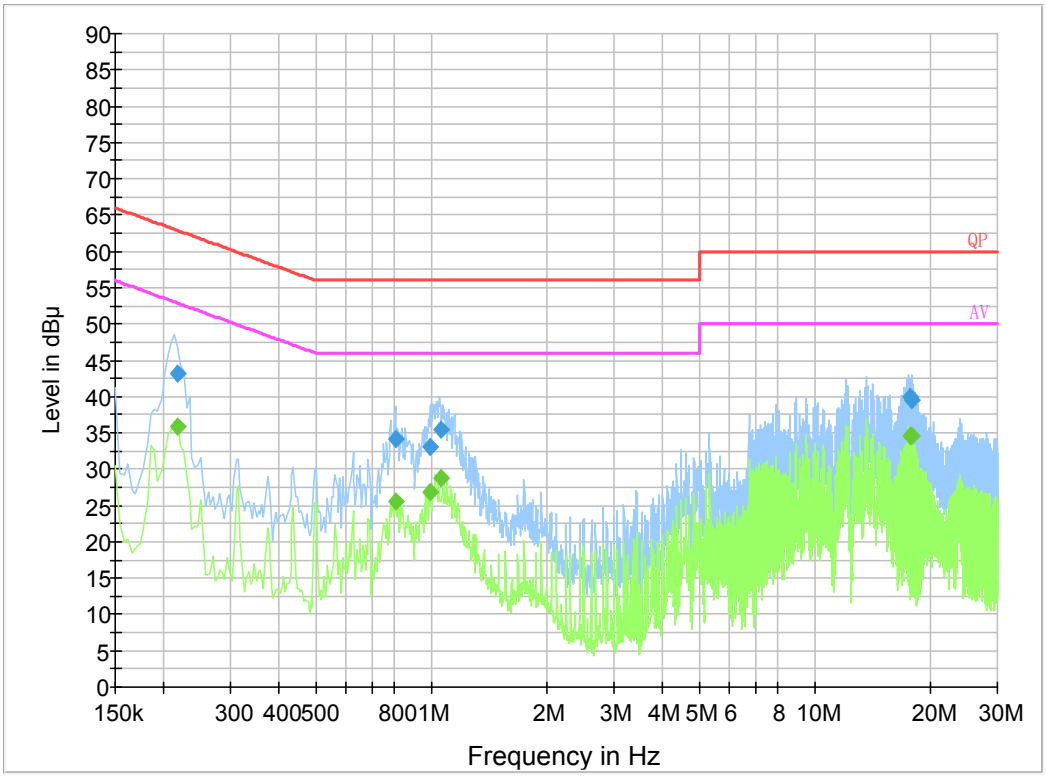
Environmental Conditions

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

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

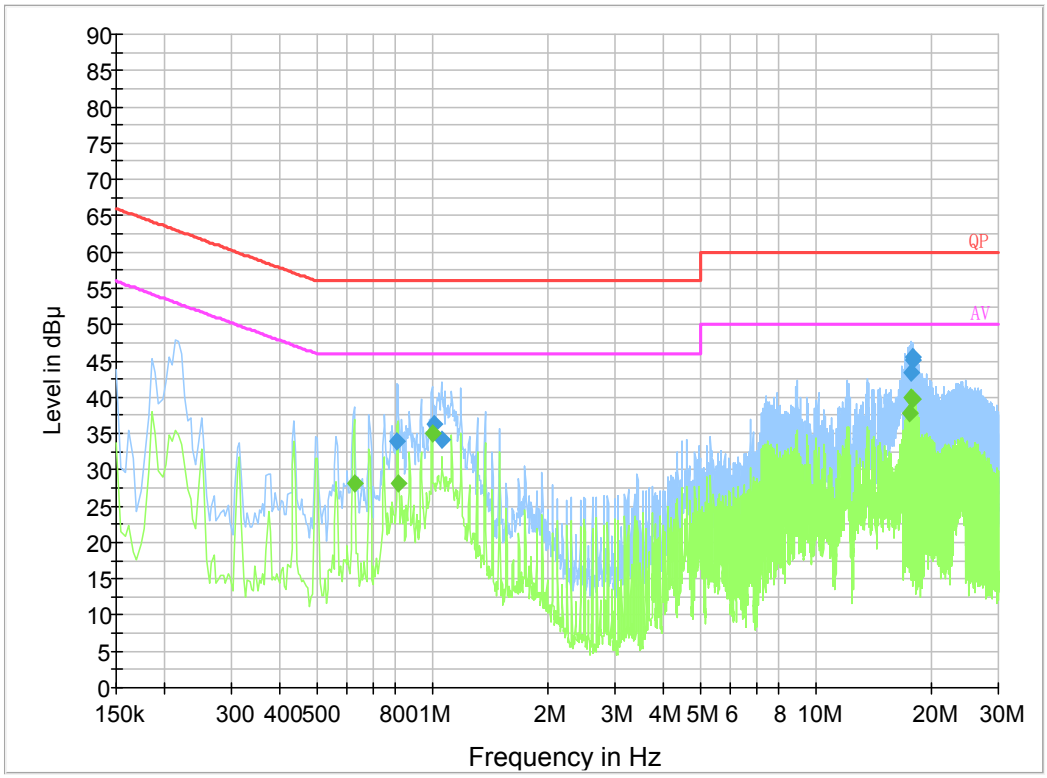
EUT operation mode: Transmitting

AC 120V/60 Hz, Line:



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.217500	43.1	19.8	62.9	19.8	QP
0.805910	34.1	19.8	56.0	21.9	QP
0.994970	33.0	19.9	56.0	23.0	QP
1.062190	35.3	19.9	56.0	20.7	QP
17.682690	40.0	20.3	60.0	20.0	QP
17.930010	39.6	20.3	60.0	20.4	QP
0.217500	35.9	19.8	52.9	17.0	Ave.
0.805910	25.5	19.8	46.0	20.5	Ave.
0.994970	26.8	19.9	46.0	19.2	Ave.
1.062190	28.8	19.9	46.0	17.2	Ave.
17.682690	34.6	20.3	50.0	15.4	Ave.
17.930010	34.6	20.3	50.0	15.4	Ave.

AC120V, 60 Hz, Neutral:



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.809850	33.9	19.8	56.0	22.1	QP
1.017030	36.2	19.8	56.0	19.8	QP
1.058130	34.2	19.8	56.0	21.8	QP
17.804830	43.4	20.2	60.0	16.6	QP
17.865790	45.1	20.2	60.0	14.9	QP
17.866010	45.6	20.2	60.0	14.5	QP
0.626000	28.0	19.8	46.0	18.0	Ave.
0.814000	28.2	19.8	46.0	17.8	Ave.
1.002000	35.1	19.8	46.0	10.9	Ave.
17.614000	37.8	20.2	50.0	12.2	Ave.
17.742000	40.0	20.2	50.0	10.0	Ave.
17.866000	39.7	20.2	50.0	10.3	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

§15.205 & §15.209 & §15.407(B) (1), (4), (6), (7) – UNDESIRABLE EMISSION

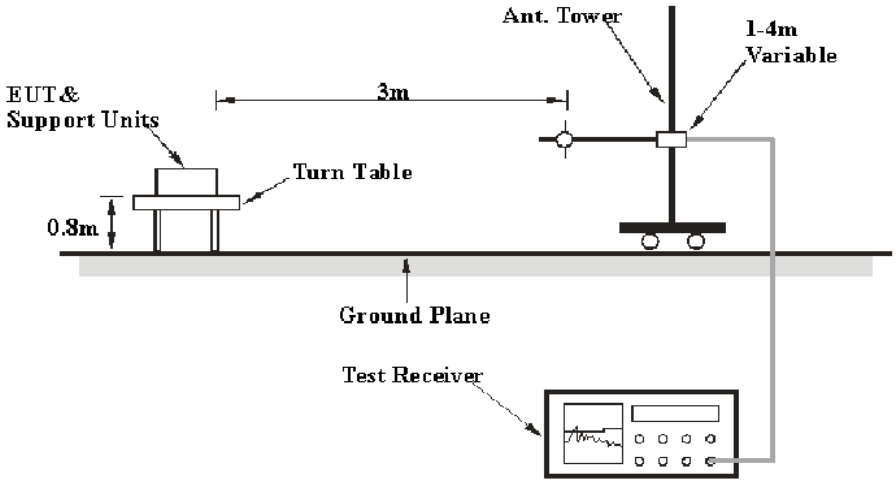
Applicable Standard

FCC §15.407 (b) (1), (4), (6), (7); §15.209; §15.205;

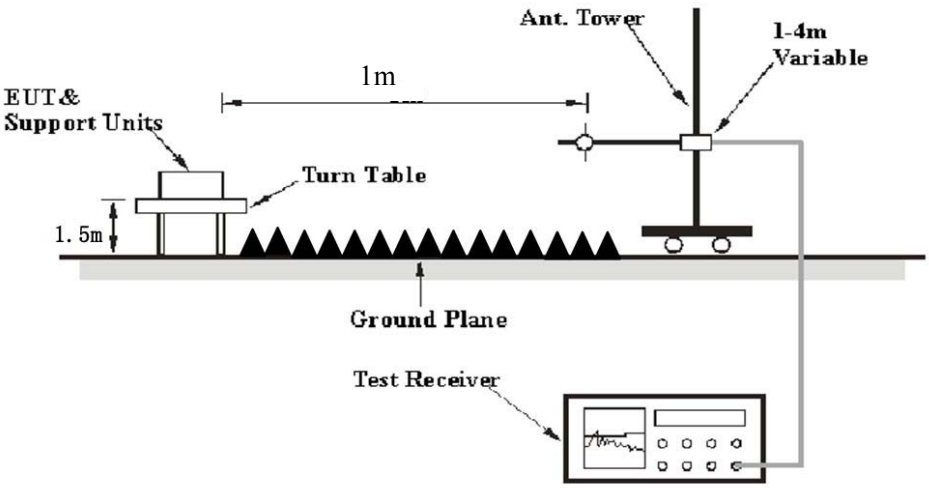
(b) Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:
(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.
(4) For transmitters operating in the 5.725-5.85 GHz band:
(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.
Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209.

EUT Setup

Below 1 GHz:



Above 1 GHz:



The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC 15.209 and FCC 15.407 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

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	1 MHz	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

Radiated Spurious Emission

During the radiated emission test, the adapter was connected to the AC floor outlet.

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

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

According to ANSI C63.10-2013,9.4: For field strength measurements made at other than the distance at which the applicable limit is specified,extrapolate the measured field strength to the field strength at the distance specified by the limit using an inverse distance correction factor (20 dB/decade of distance). In some cases, a different distance correction factor may be required;

$$E_{\mathrm{SpecLimit}} = E_{\mathrm{Meas}} + 20\log\left(\frac{d_{\mathrm{Meas}}}{d_{\mathrm{SpecLimit}}}\right)$$

where

$E_{\mathrm{SpecLimit}}$	is the field strength of the emission at the distance specified by the limit, in dBμV/m
E_{Meas}	is the field strength of the emission at the measurement distance, in dBμV/m
d_{Meas}	is the measurement distance, in m
$d_{\mathrm{SpecLimit}}$	is the distance specified by the limit, in m

So the extrapolation factor of 1m is 20*log(1/3)= -9.5 dB

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

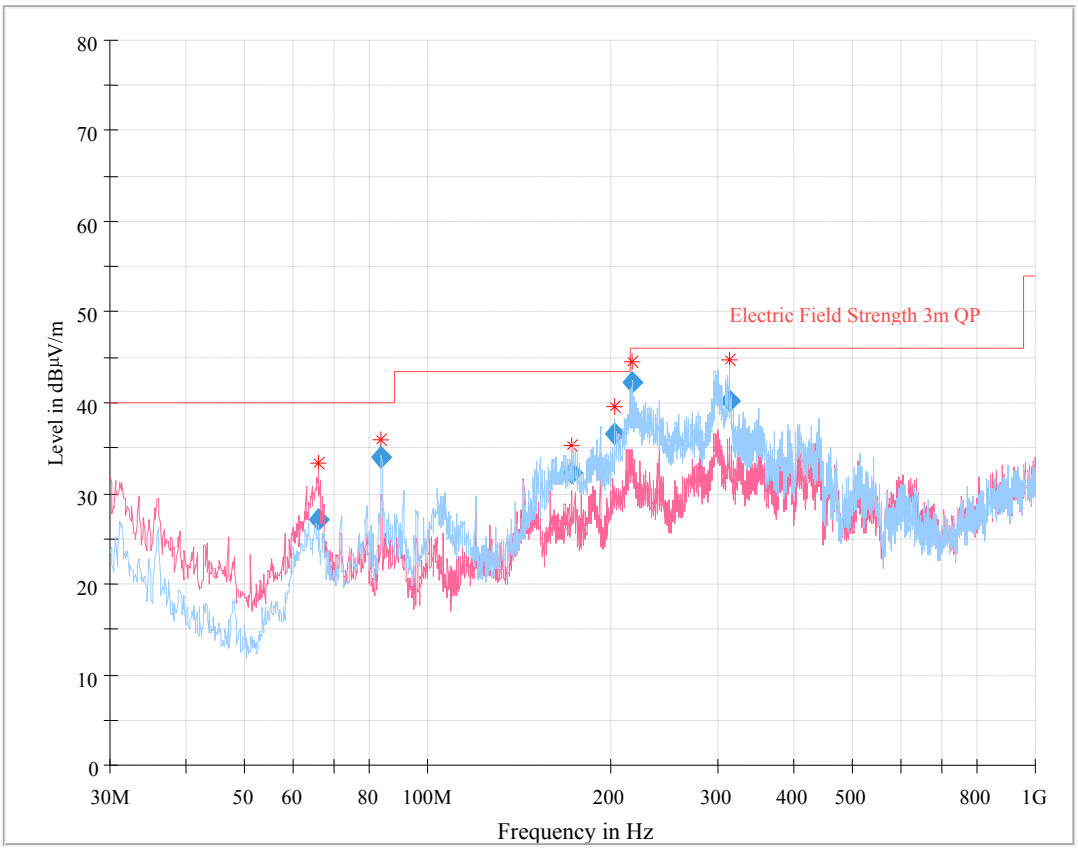
Environmental Conditions

Temperature:	26 ℃
Relative Humidity:	54~60 %
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 2020-05-06 for above 1GHz.

EUT operation mode: Transmitting

30 MHz~1 GHz: (*the worst case is Wi-Fi 802.11n40 mode, 5755MHz***)**



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
66.038250	27.15	102.0	V	252.0	-20.4	40.00	12.85
83.934375	34.02	400.0	H	154.0	-19.6	40.00	5.98
172.822750	32.29	129.0	H	333.0	-15.0	43.50	11.21
202.741500	36.53	151.0	H	144.0	-13.8	43.50	6.97
216.372250	42.09	151.0	H	173.0	-13.9	46.00	3.91
312.879375	40.29	113.0	H	143.0	-10.7	46.00	5.71

1 ~ 40 GHz:

Note: The test distance is 1m, so the correct factor from 3m to 1m is 20log(3/1)=9.5dB which was added into the final limit.

5150-5250 MHz:

Frequency (MHz)	Receiver		Turntable	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBµV/m)	FCC Part 15.407/205/209	
	Reading (dBµV)	PK/QP/Ave.	Degree	Height (m)	Polar (H / V)			Limit (dBµV/m)	Margin (dB)
802.11a									
5180 MHz									
5149.89	34.40	PK	138	1.3	V	38.36	72.76	83.5	10.74
5149.89	17.83	Ave.	138	1.3	V	38.36	56.19	63.5	7.31
5352.63	29.76	PK	287	2.1	V	39.09	68.85	83.5	14.65
5352.63	16.43	Ave.	287	2.1	V	39.09	55.52	63.5	7.98
10360.00	41.45	PK	42	1.3	V	17.42	58.87	77.7	18.83
5200 MHz									
10400.00	40.85	PK	268	1.0	V	17.52	58.37	77.7	19.33
5240 MHz									
5148.63	28.94	PK	131	2.3	V	38.36	67.30	83.5	16.20
5148.63	16.31	Ave.	131	2.3	V	38.36	54.67	63.5	8.83
5351.29	28.43	PK	168	1.4	V	39.09	67.52	83.5	15.98
5351.29	16.39	Ave.	168	1.4	V	39.09	55.48	63.5	8.02
10480.00	41.26	PK	205	2.0	V	17.25	58.51	77.7	19.19
802.11n20									
5180 MHz									
5149.67	32.40	PK	174	2.3	V	38.36	70.76	83.5	12.74
5149.67	16.60	Ave.	174	2.3	V	38.36	54.96	63.5	8.54
5352.86	28.73	PK	15	1.4	V	39.09	67.82	83.5	15.68
5352.86	16.32	Ave.	15	1.4	V	39.09	55.41	63.5	8.09
10360.00	40.82	PK	332	1.4	V	17.42	58.24	77.7	19.46
5200 MHz									
10400.00	41.10	PK	128	1.1	V	17.52	58.62	77.7	19.08
5240 MHz									
5148.93	28.66	PK	101	1.7	V	38.36	67.02	83.5	16.48
5148.93	16.35	Ave.	101	1.7	V	38.36	54.71	63.5	8.79
5350.54	28.52	PK	250	1.4	V	39.09	67.61	83.5	15.89
5350.54	16.27	Ave.	250	1.4	V	39.09	55.36	63.5	8.14
10480.00	41.46	PK	352	1.8	V	17.25	58.71	77.7	18.99

Frequency (MHz)	Receiver		Turntable	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBµV/m)	FCC Part 15.407/205/209	
	Reading (dBµV)	PK/QP/Ave.	Degree	Height (m)	Polar (H / V)			Limit (dBµV/m)	Margin (dB)
802.11n40									
5190 MHz									
5146.64	43.90	PK	159	2.1	V	38.36	82.26	83.5	1.24
5146.64	24.67	Ave.	159	2.1	V	38.36	63.03	63.5	0.47
5352.73	30.21	PK	189	1.6	V	39.09	69.30	83.5	14.20
5352.73	16.89	Ave.	189	1.6	V	39.09	55.98	63.5	7.52
10380.00	40.58	PK	315	2.1	V	17.42	58.00	77.7	19.70
5230 MHz									
5147.85	31.54	PK	162	2.4	V	38.36	69.90	83.5	13.60
5147.85	16.92	Ave.	162	2.4	V	38.36	55.28	63.5	8.22
5351.36	30.87	PK	267	2.2	V	39.09	69.96	83.5	13.54
5351.36	16.65	Ave.	267	2.2	V	39.09	55.74	63.5	7.76
10460.00	40.78	PK	97	1.4	V	17.15	57.93	77.7	19.77

5725-5850 MHz:

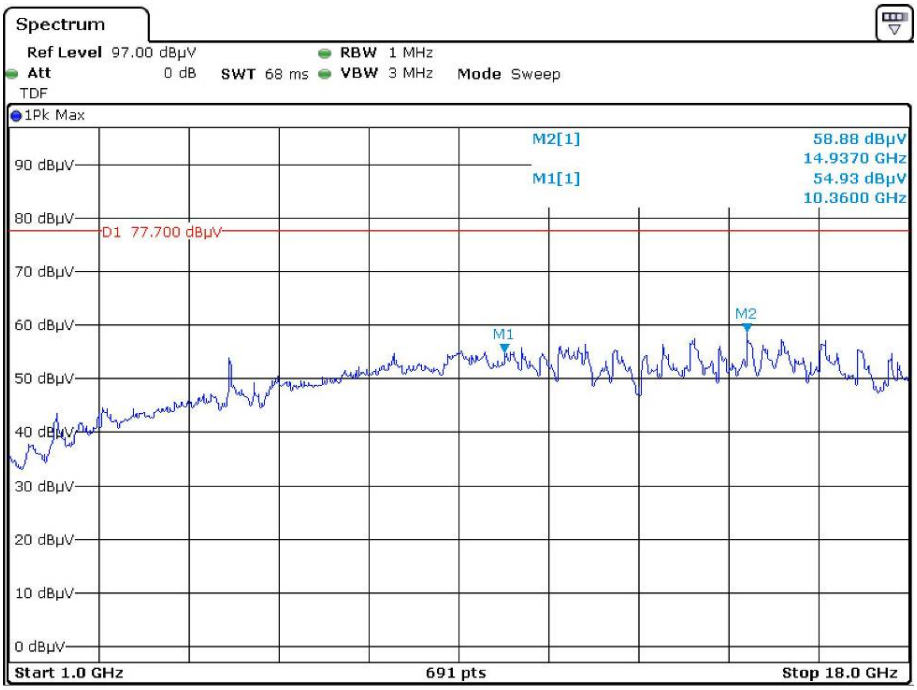
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	FCC Part 15.407/205/209	
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
802.11a									
5745 MHz									
5632.58	30.13	PK	24	2.0	V	39.46	69.59	77.7	8.11
5663.93	31.51	PK	130	1.0	V	39.49	71.00	88.01	17.01
5719.87	33.87	PK	1	1.4	V	39.49	73.36	120.26	46.90
5724.87	41.13	PK	306	2.5	V	39.49	80.62	131.4	50.78
11490.00	40.35	PK	295	1.1	V	17.47	57.82	83.5	25.68
11490.00	25.54	Ave.	295	1.1	V	17.47	43.01	63.5	20.49
5785 MHz									
11570.00	40.51	PK	61	1.9	V	17.51	58.02	83.5	25.48
11570.00	25.36	Ave.	61	1.9	V	17.51	42.87	63.5	20.63
5825 MHz									
5850.46	34.61	PK	232	2.5	V	39.87	74.48	130.65	56.17
5855.51	32.66	PK	181	2.3	V	39.87	72.53	120.16	47.63
5882.20	33.42	PK	120	2.0	V	39.87	73.29	109.37	36.08
5936.29	30.25	PK	216	1.7	V	39.97	70.22	77.7	7.48
11650.00	41.41	PK	245	2.0	V	16.18	57.59	83.5	25.91
11650.00	26.54	Ave.	245	2.0	V	16.18	42.72	63.5	20.78
802.11n20									
5745 MHz									
5618.79	30.12	PK	71	1.8	V	39.46	69.58	77.7	8.12
5650.00	27.30	PK	35	1.7	V	42.78	70.08	77.7	7.62
5719.93	35.58	PK	134	1.8	V	39.49	75.07	120.28	45.21
5724.69	44.10	PK	196	2.0	V	39.49	83.59	130.99	47.40
11490.00	40.33	PK	165	1.4	V	17.47	57.80	83.5	25.70
11490.00	25.25	Ave.	165	1.4	V	17.47	42.72	63.5	20.78
5785 MHz									
11570.00	40.31	PK	353	1.5	V	17.51	57.82	83.5	25.68
11570.00	25.29	Ave.	353	1.5	V	17.51	42.80	63.5	20.70
5825 MHz									
5850.26	38.36	PK	33	2.0	V	39.87	78.23	131.11	52.88
5856.17	35.98	PK	290	1.2	V	39.87	75.85	119.97	44.12
5882.63	32.89	PK	15	1.4	V	39.87	72.76	109.05	36.29
5941.33	30.08	PK	147	2.3	V	39.97	70.05	77.7	7.65
11650.00	40.54	PK	84	1.8	V	16.18	56.72	83.5	26.78
11650.00	25.43	Ave.	84	1.8	V	16.18	41.61	63.5	21.89

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBµV/m)	FCC Part 15.407/205/209	
	Reading (dBµV)	PK/QP/Ave.		Height (m)	Polar (H/V)			Limit (dBµV/m)	Margin (dB)
802.11n40									
5755 MHz									
5626.89	30.43	PK	219	1.3	V	39.46	69.89	77.7	7.81
5697.87	32.63	PK	21	1.8	V	39.49	72.12	113.12	41.00
5720.60	44.77	PK	150	1.1	V	39.49	84.26	120.47	36.21
5724.69	47.60	PK	204	1.6	V	39.49	87.09	130.99	43.90
11510.00	41.70	PK	133	2.5	V	17.47	59.17	83.5	24.33
11510.00	27.51	Ave.	133	2.5	V	17.47	44.98	63.5	18.52
5795 MHz									
5851.46	35.79	PK	139	2.1	V	39.87	75.66	128.37	52.71
5866.30	33.02	PK	346	2.1	V	39.87	72.89	117.14	44.25
5889.15	32.88	PK	149	1.1	V	39.87	72.75	104.23	31.48
5933.53	30.25	PK	139	1.9	V	39.97	70.22	77.7	7.48
11590.00	41.41	PK	204	2.4	V	17.51	58.92	83.5	24.58
11590.00	26.27	Ave.	204	2.4	V	17.51	43.78	63.5	19.72

Note:
Corrected Amplitude = Corrected Factor + Reading
Corrected Factor=Antenna factor (RX) + Cable Loss – Amplifier Factor
Margin = Limit- Corr. Amplitude
All other spurious emissions are 20 dB below the limit or are on the system noise floor level.

Peak

Pre-scan with 802.11a 5180MHz
Horizontal



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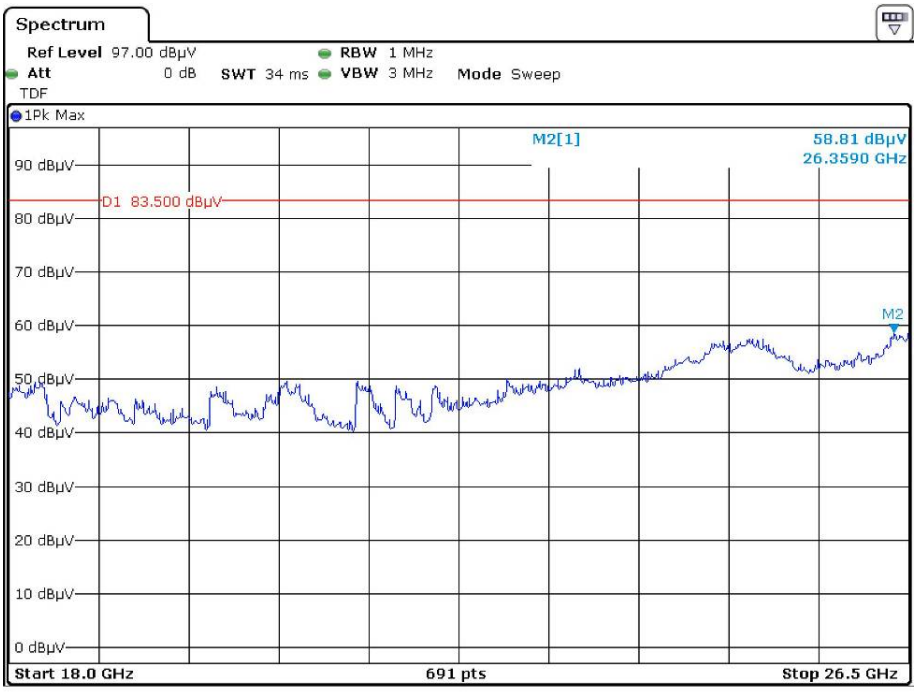

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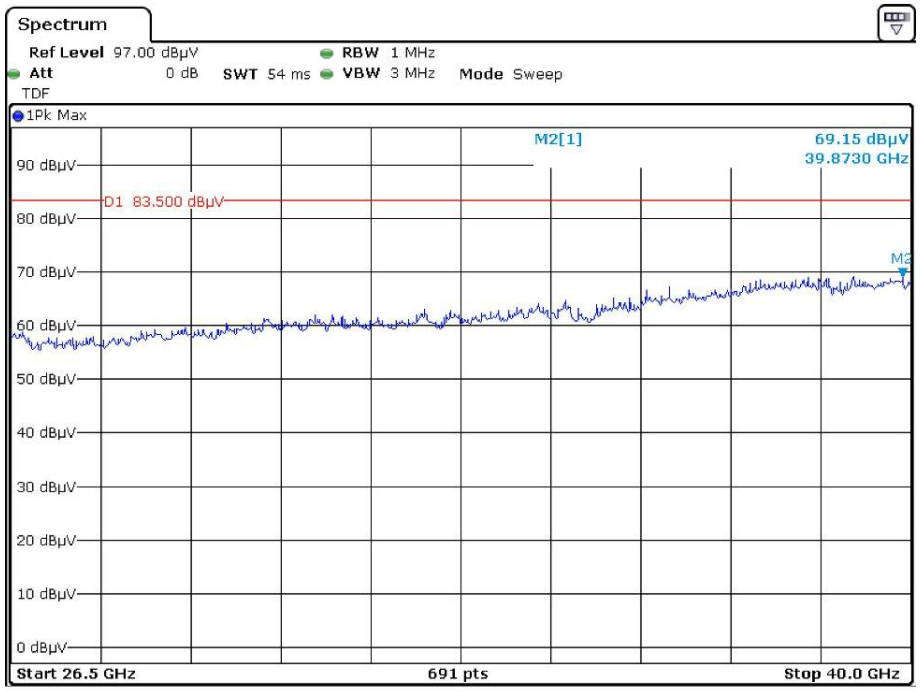

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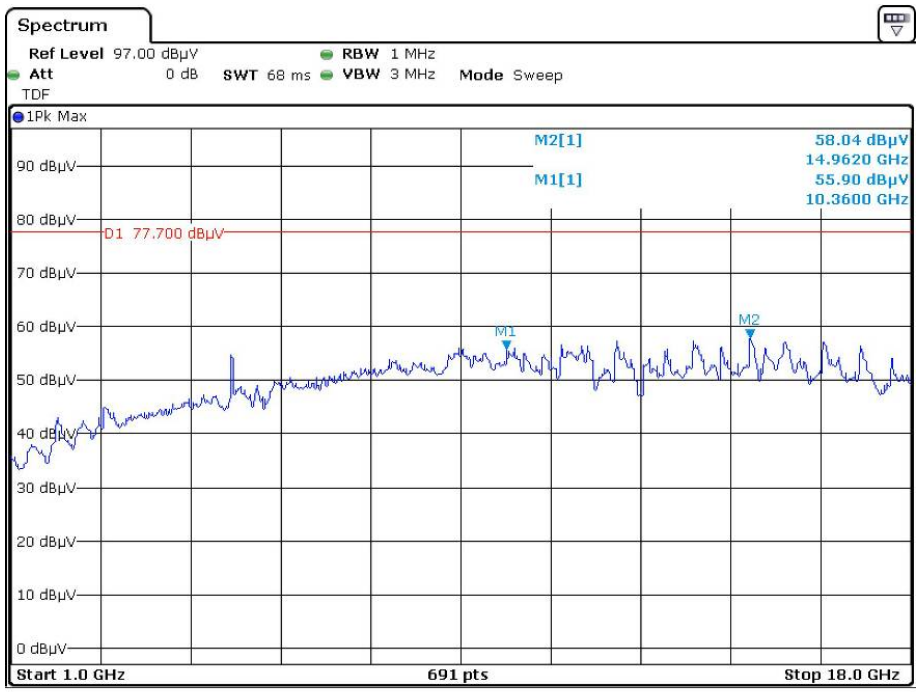
Vertical



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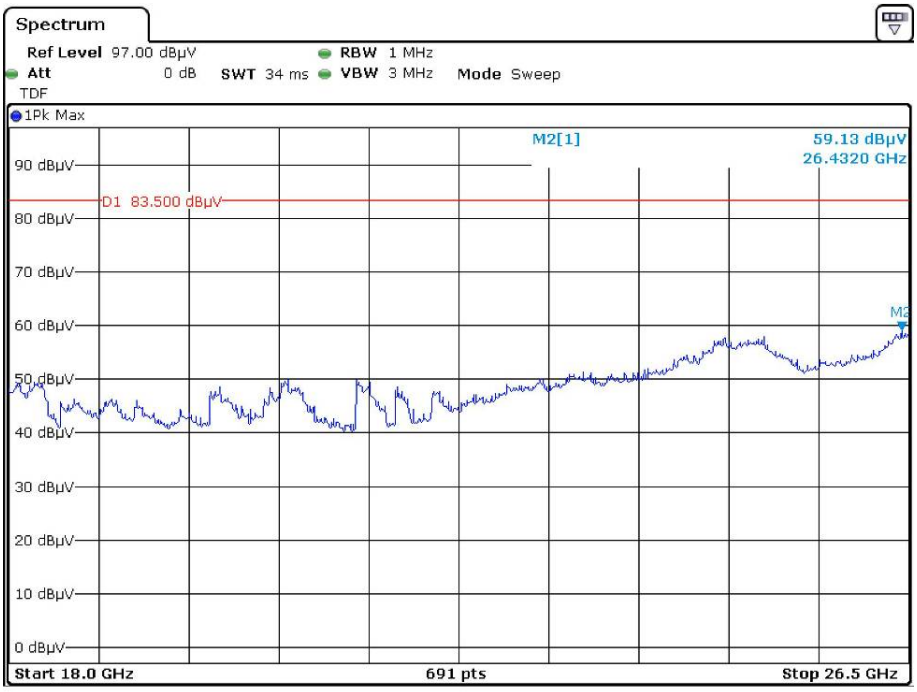

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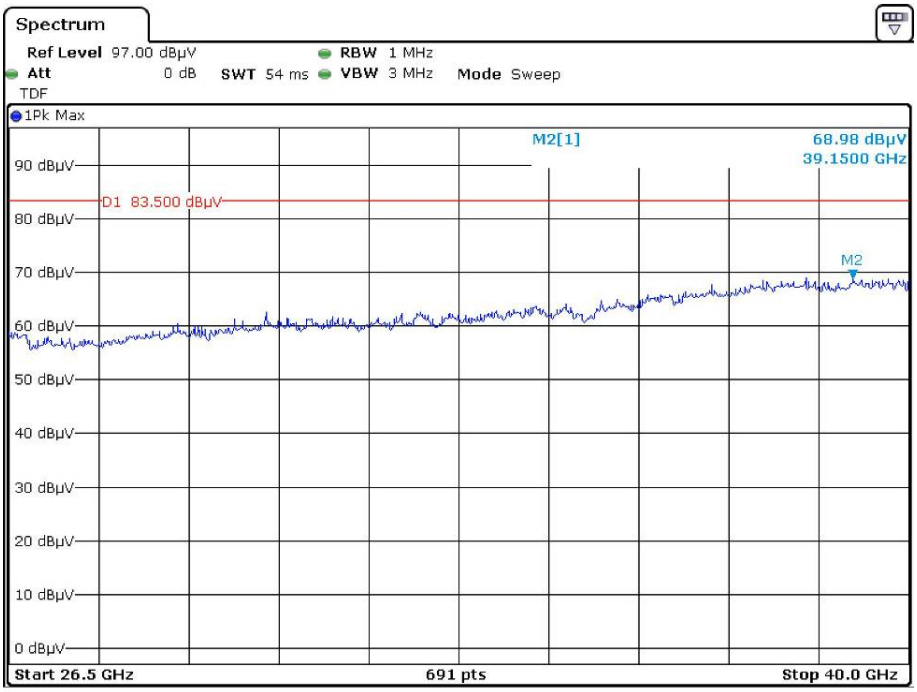

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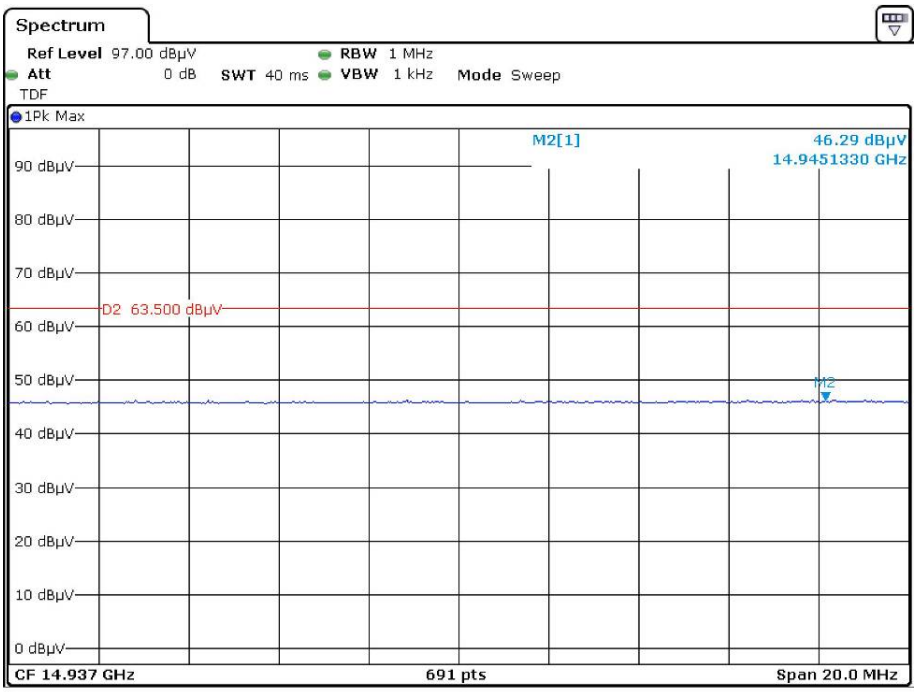
Average
Horizontal



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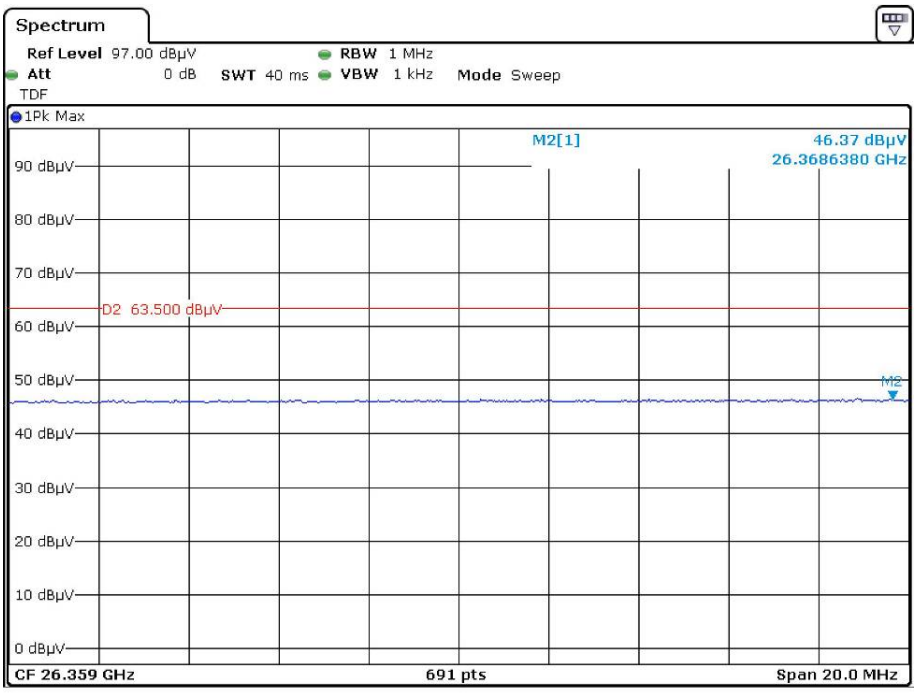

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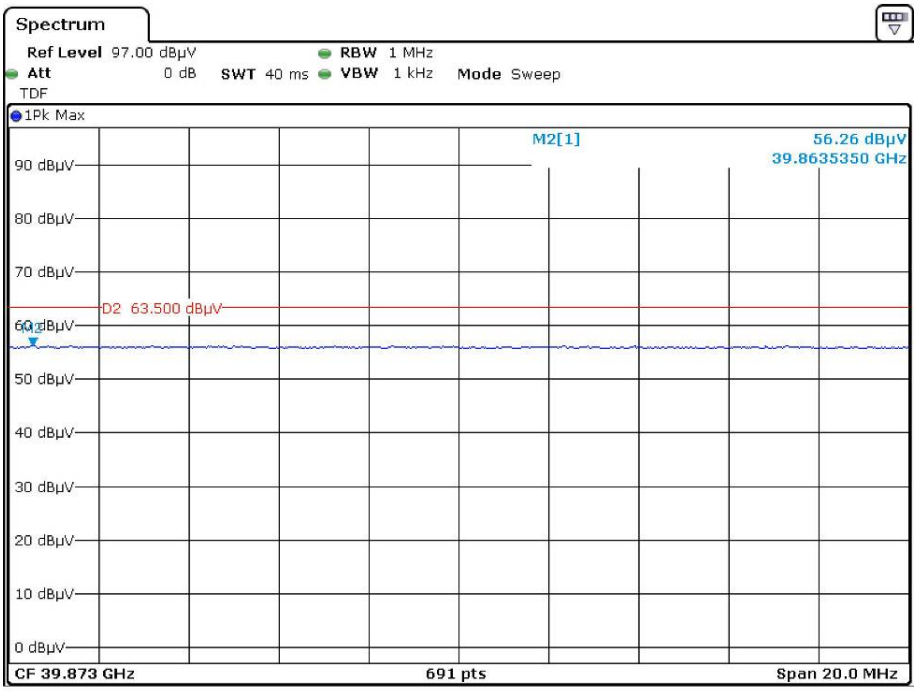

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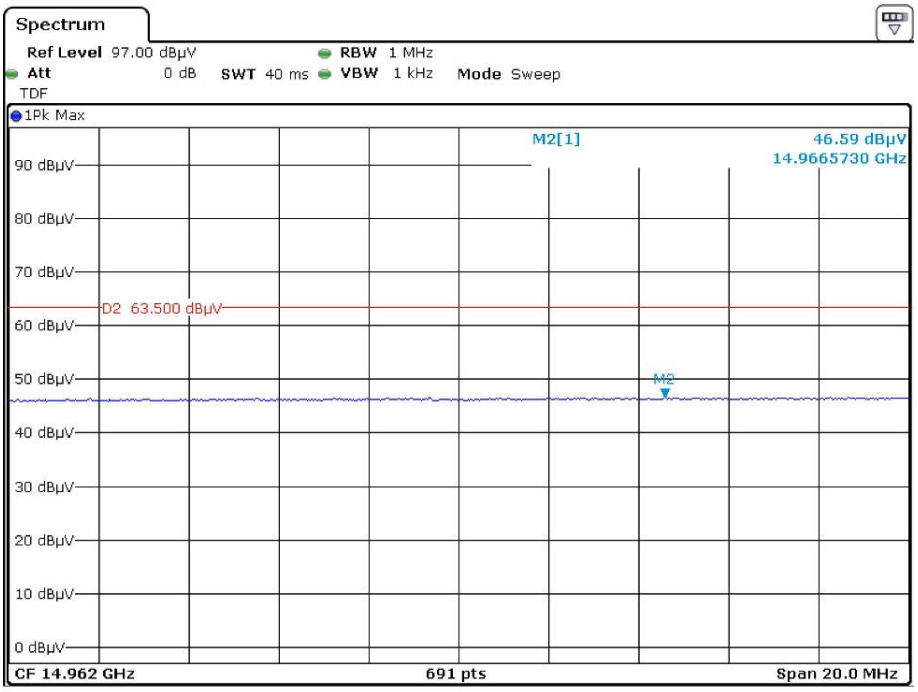
Vertical



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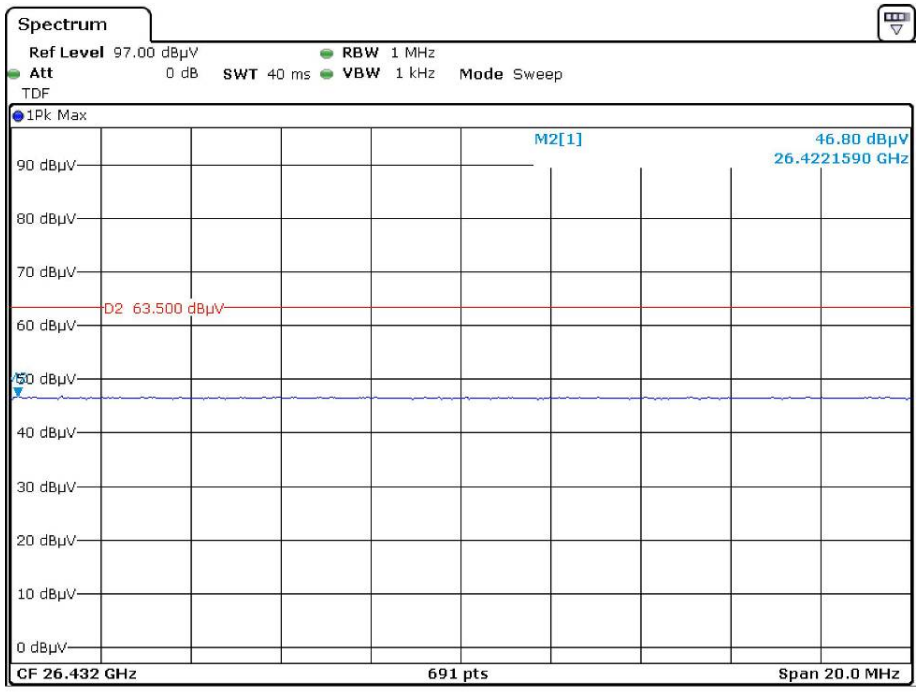

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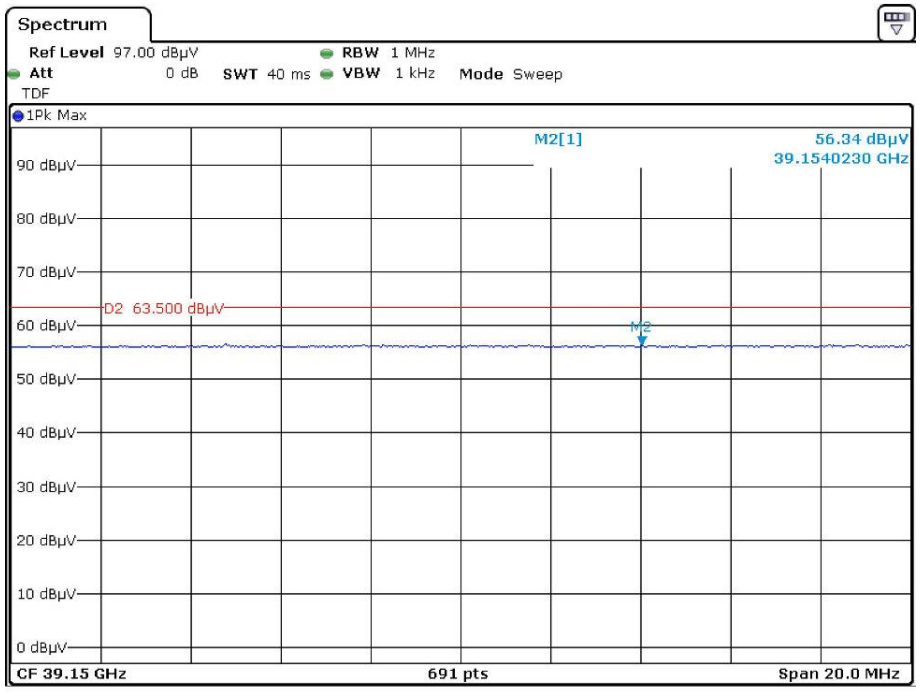


Date: 6.MAY.2020 16:49:21

FCC §15.407(a) (1) – 26 dB & 6dB EMISSION BANDWIDTH

Applicable Standard

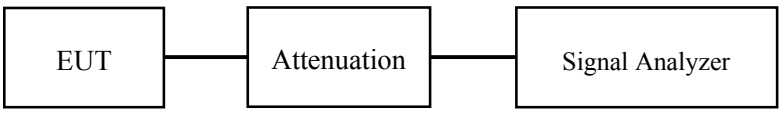
The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements in the 5.725-5.85 GHz band are made over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. Measurements in the 5.15-5.25 GHz, 5.25-5.35 GHz, and the 5.47-5.725 GHz bands are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

Test Procedure

1. Emission Bandwidth (EBW)
a) Set RBW = approximately 1% of the emission bandwidth.
b) Set the VBW > RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

2. **Minimum Emission Bandwidth for the band 5.725-5.85 GHz**
Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:
a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 × RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.



Test Data

Environmental Conditions

Temperature:	24 ℃
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 §15.407(a) (1) (3) – CONDUCTED TRANSMITTER OUTPUT POWER

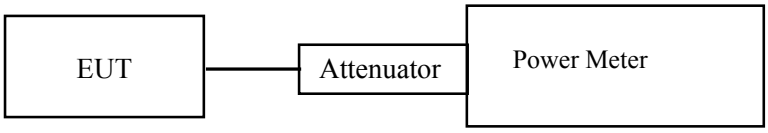
Applicable Standard

For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

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 ℃
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 §15.407(a) (1) (3) - POWER SPECTRAL DENSITY

Applicable Standard

For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

Test Procedure

For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, "provided that the measured power is integrated over the full reference bandwidth" to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 kHz bandwidth, the following adjustments to the procedures apply:

a) Set RBW ≥ 1/T, where T is defined in section II.B.l.a).
b) Set VBW ≥ 3 RBW.
c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10 log (500 kHz/RBW) to the measured result, whereas RBW (< 500 kHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add 10 log (1MHz/RBW) to the measured result, whereas RBW (< 1 MHz) is the reduced resolution bandwidth of spectrum analyzer set during measurement.
e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Test Data

Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by James Fu on 2020-05-29 and 2020-06-01.

EUT operation mode: Transmitting

Test Result: Pass

Please refer to the Appendix

APPENDIX

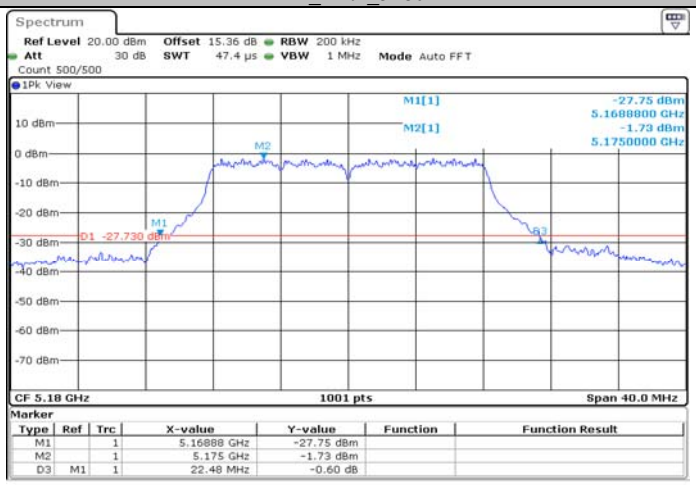
Appendix A1: Emission Bandwidth

Test Result

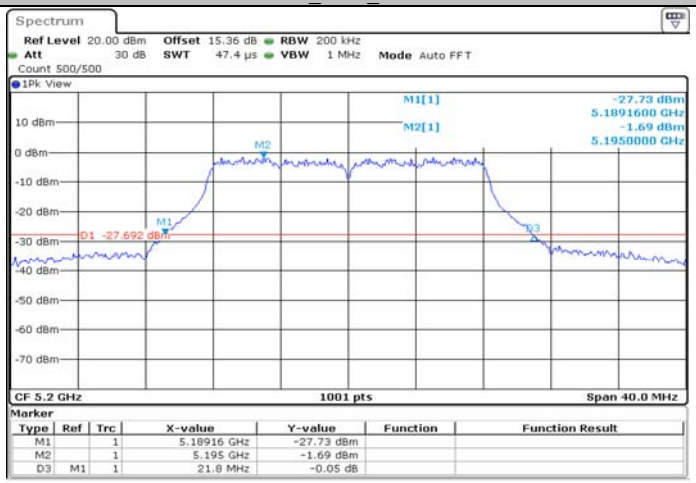
TestMode	Antenna	Channel	26db EBW [MHz]	Limit[MHz]	Verdict
11A	Ant1	5180	22.480	---	PASS
		5200	21.800	---	PASS
		5240	21.720	---	PASS
11N20	Ant1	5180	22.400	---	PASS
		5200	22.640	---	PASS
		5240	22.920	---	PASS
11N40	Ant1	5190	44.800	---	PASS
		5230	45.360	---	PASS

Test Graphs

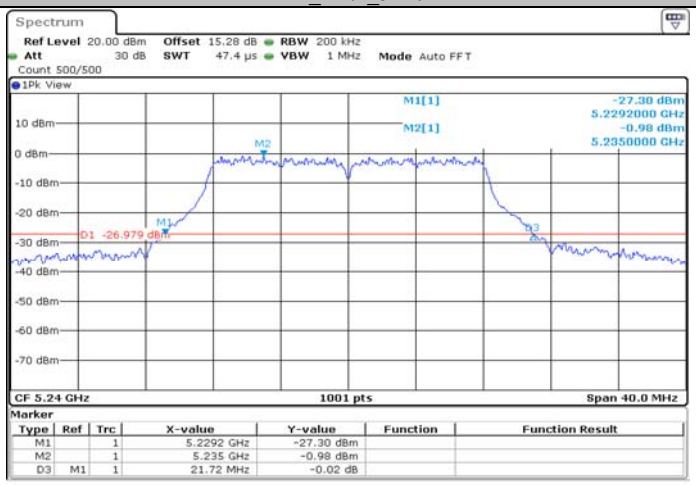
11A_Ant1_5180



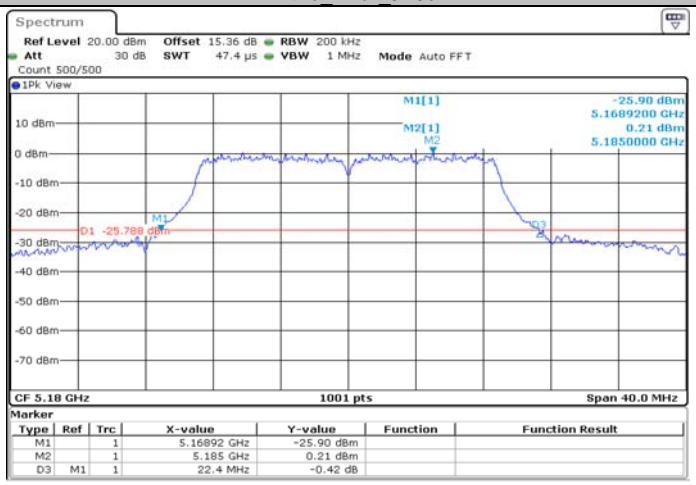
11A_Ant1_5200



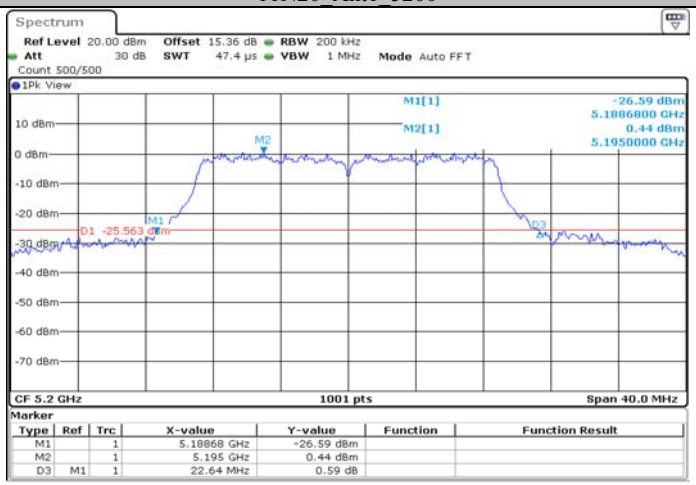
11A_Ant1_5240



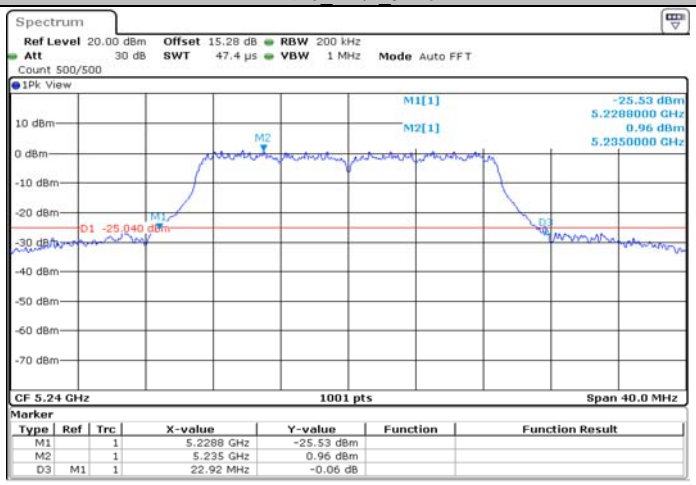
11N20_Ant1_5180



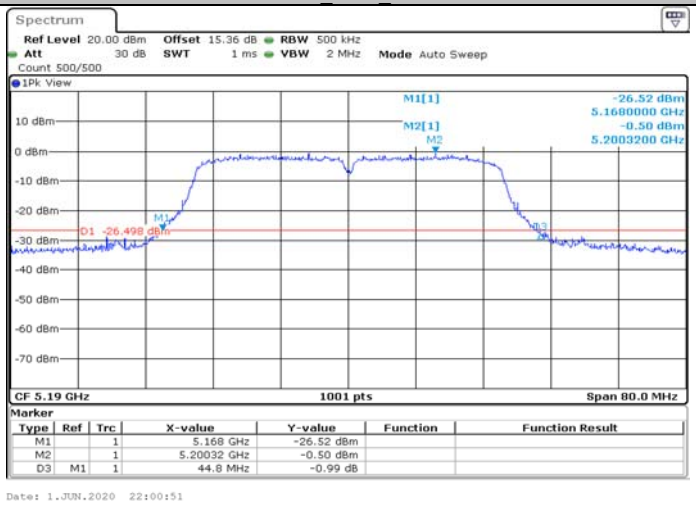
11N20_Ant1_5200



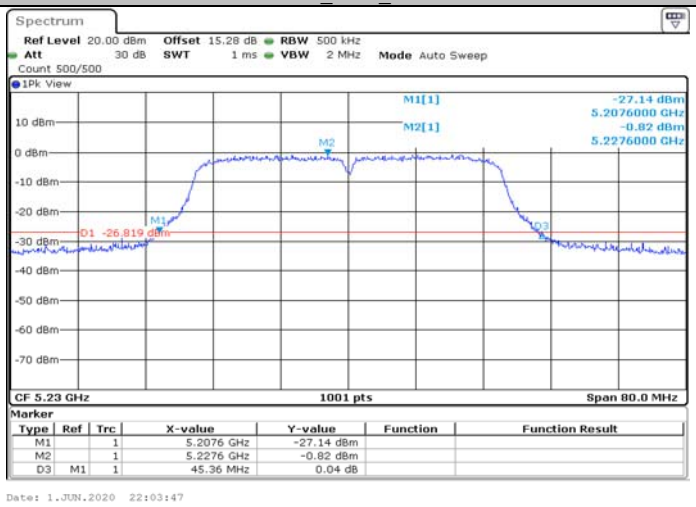
11N20_Ant1_5240



11N40_Ant1_5190



11N40_Ant1_5230



Appendix A2: Occupied channel bandwidth

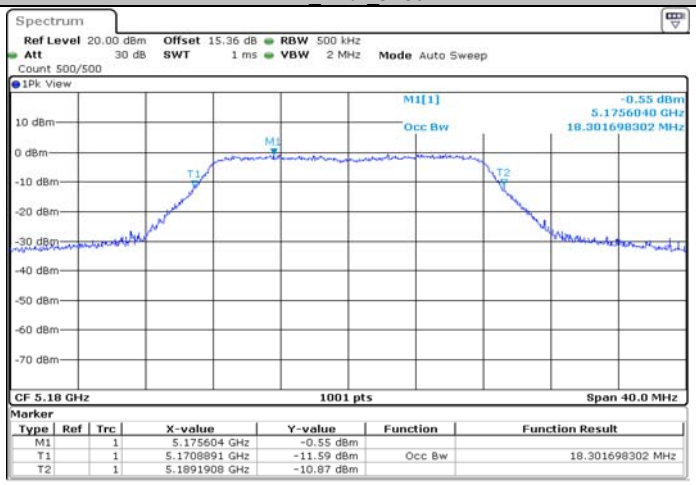
Test Result

TestMode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
11A	Ant1	5180	18.302	---	PASS
		5200	18.142	---	PASS
		5240	18.142	---	PASS
		5745	21.099	---	PASS
		5785	20.46	---	PASS
		5825	19.381	---	PASS
11N20	Ant1	5180	18.941	---	PASS
		5200	19.101	---	PASS
		5240	19.101	---	PASS
		5745	21.618	---	PASS
		5785	20.939	---	PASS
		5825	20.26	---	PASS
11N40	Ant1	5190	37.163	---	PASS
		5230	37.083	---	PASS
		5755	40.599	---	PASS
		5795	39.401	---	PASS

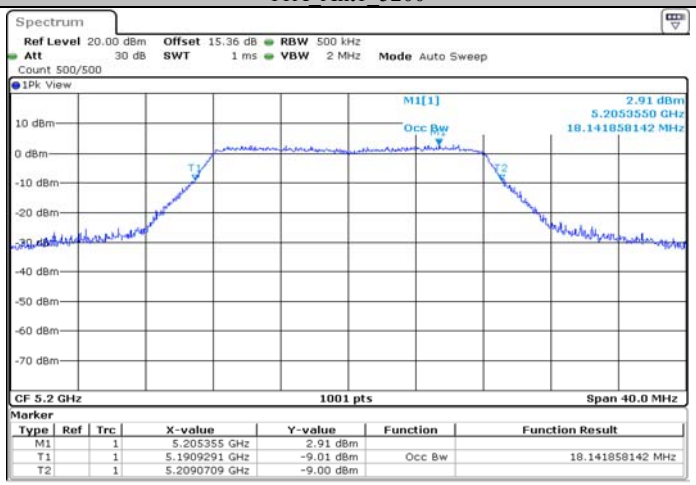
Note: No transmitted signal in the 99% bandwidth extends into the U-NII-2A band and U-NII-2C band.

Test Graphs

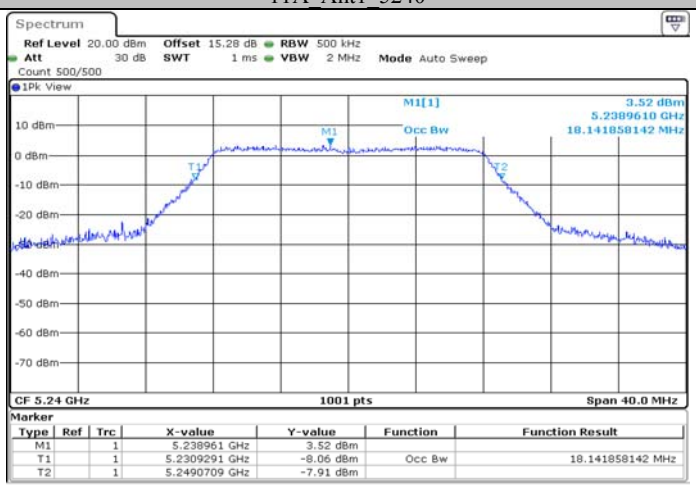
11A_Ant1_5180



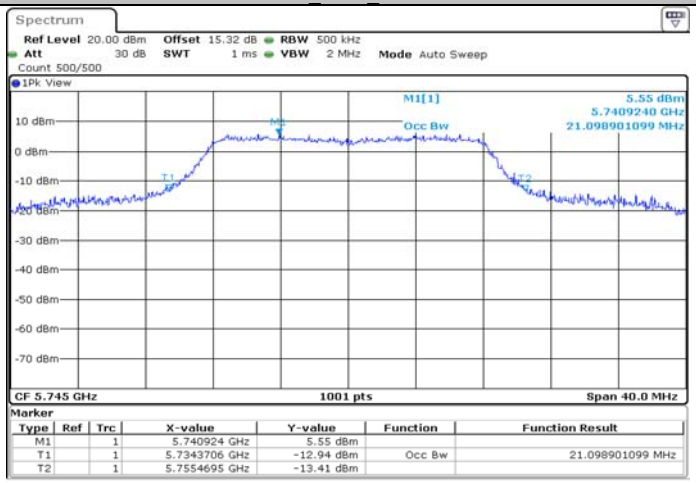
11A_Ant1_5200



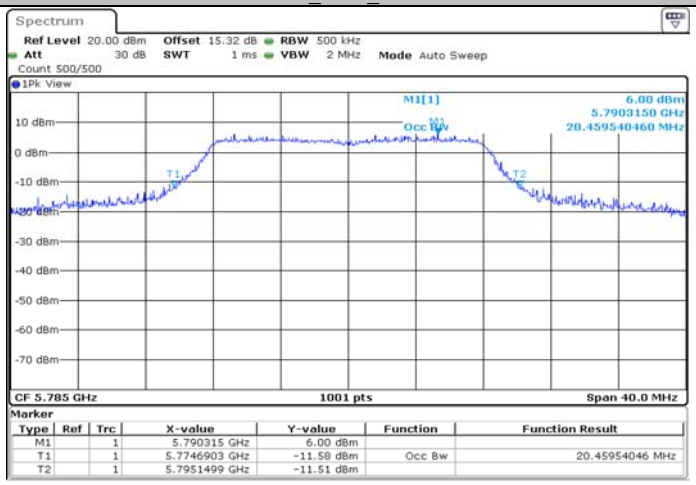
11A_Ant1_5240



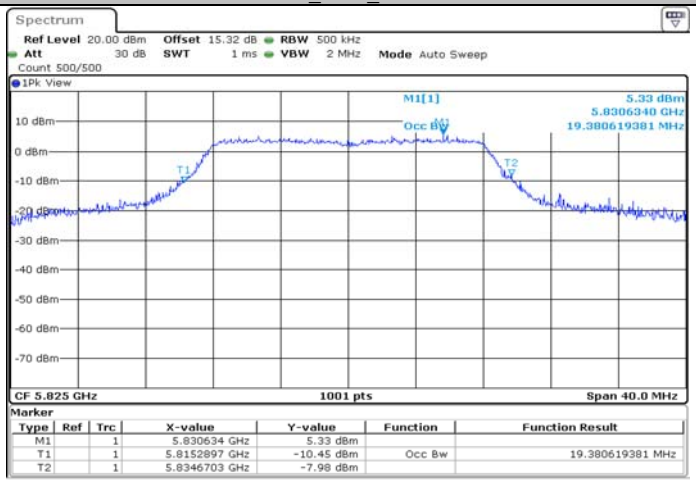
11A_Ant1_5745



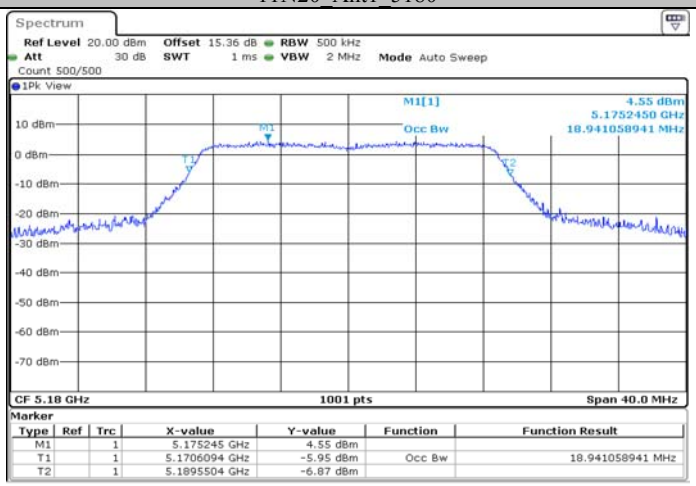
11A_Ant1_5785



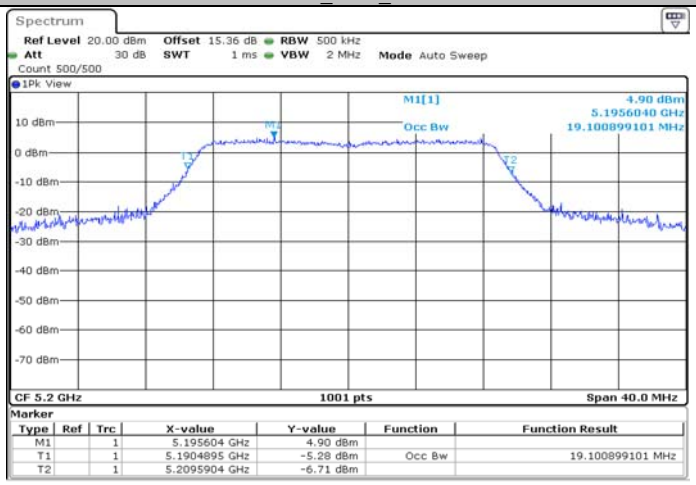
11A_Ant1_5825



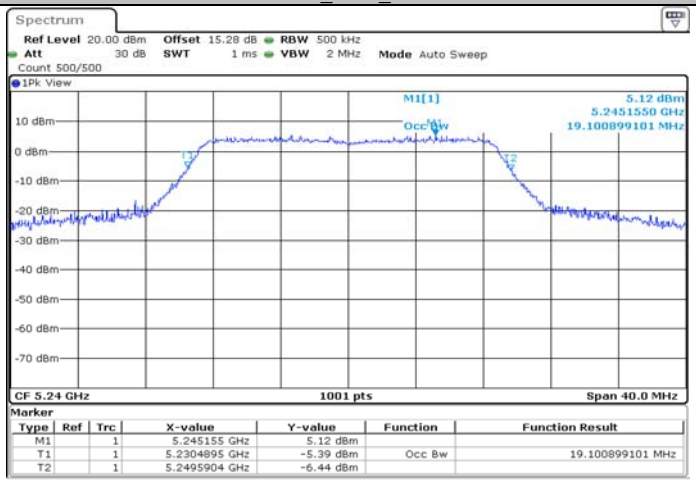
11N20_Ant1_5180



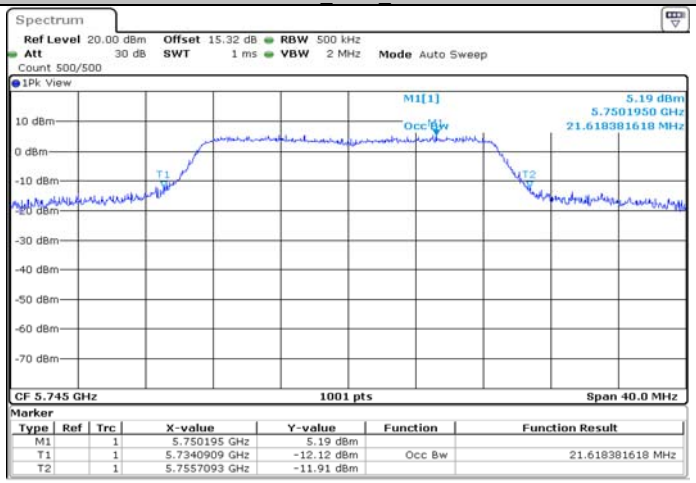
11N20_Ant1_5200



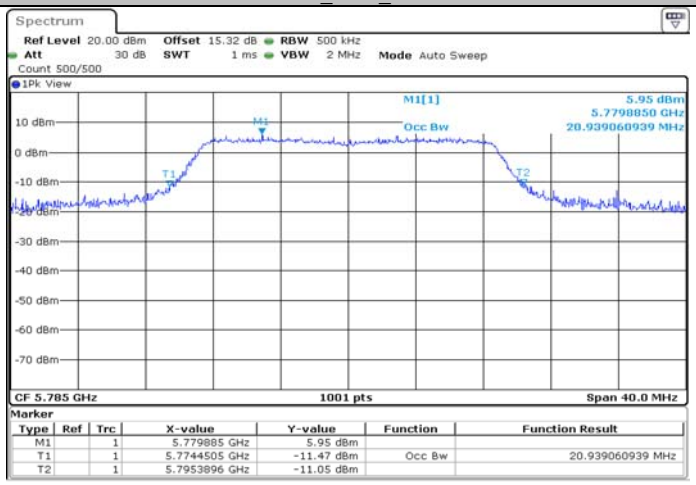
11N20_Ant1_5240



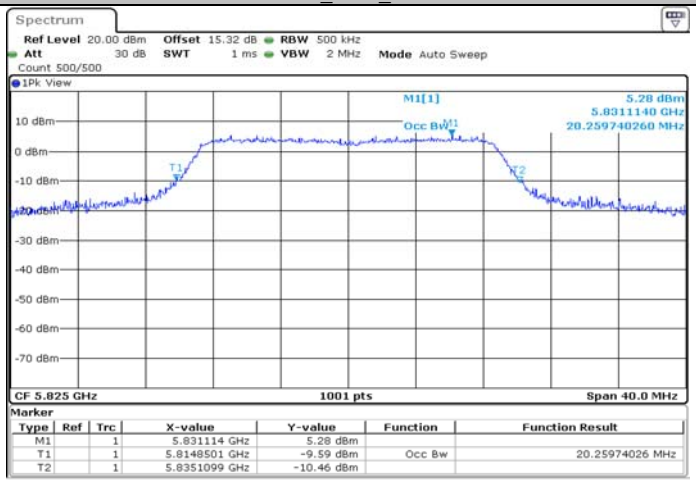
11N20_Ant1_5745



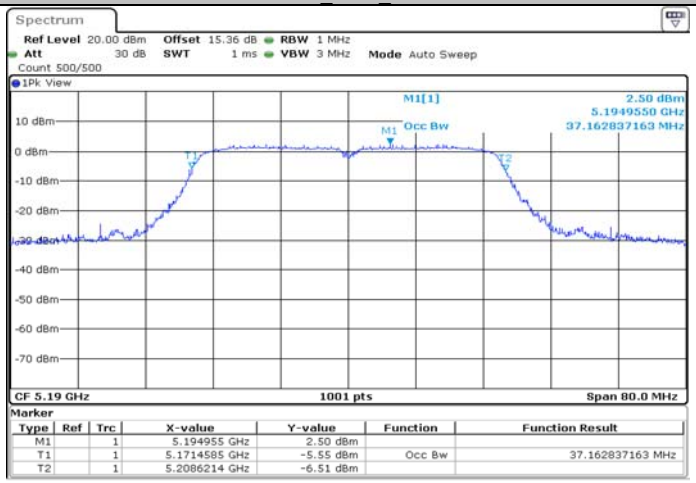
11N20_Ant1_5785



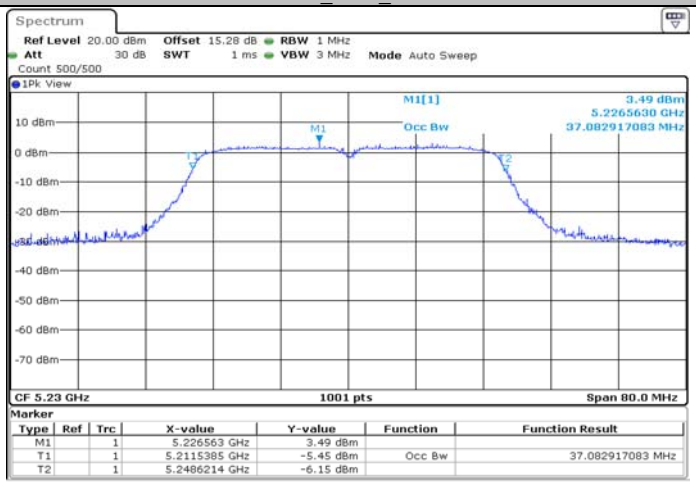
11N20_Ant1_5825



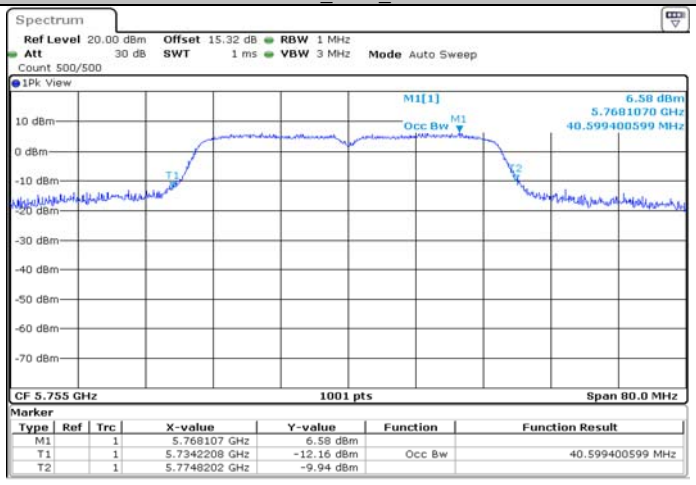
11N40_Ant1_5190



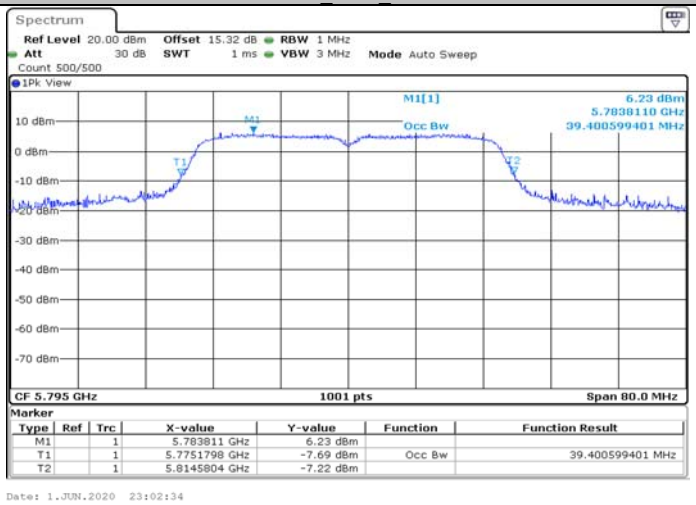
11N40_Ant1_5230



11N40_Ant1_5755



11N40_Ant1_5795



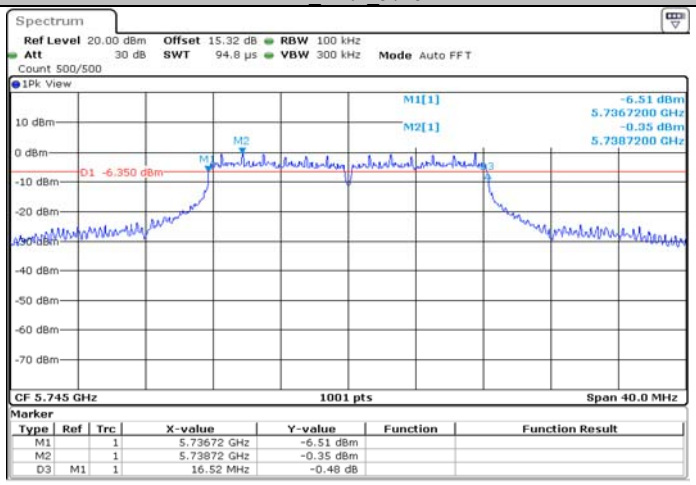
Appendix A3: Minimum emission bandwidth

Test Result

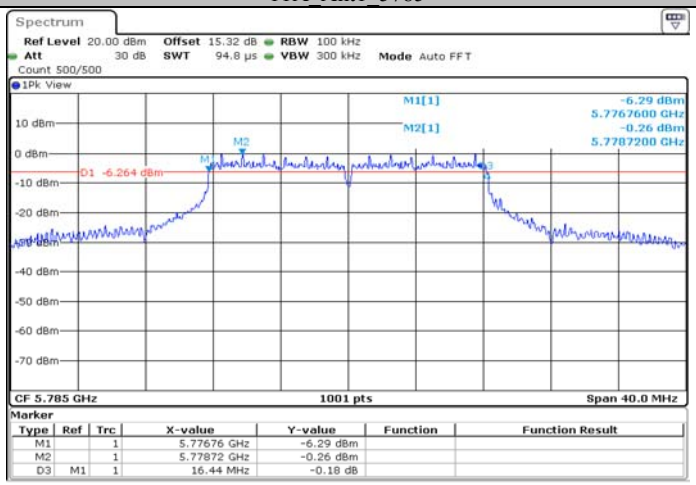
TestMode	Antenna	Channel	6db EBW [MHz]	Limit[MHz]	Verdict
11A	Ant1	5745	16.520	0.5	PASS
		5785	16.440	0.5	PASS
		5825	16.520	0.5	PASS
11N20	Ant1	5745	17.680	0.5	PASS
		5785	17.680	0.5	PASS
		5825	17.680	0.5	PASS
11N40	Ant1	5755	35.280	0.5	PASS
		5795	35.280	0.5	PASS

Test Graphs

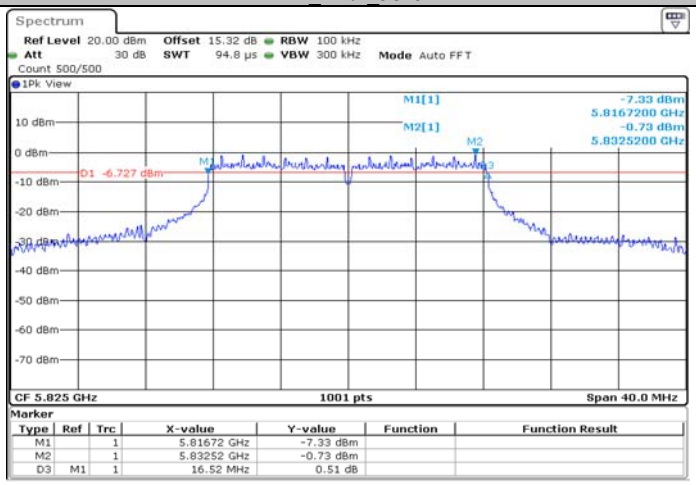
11A_Ant1_5745



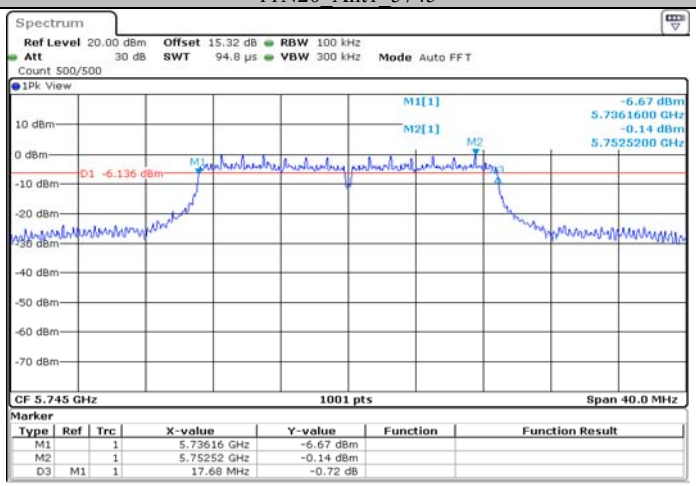
11A_Ant1_5785



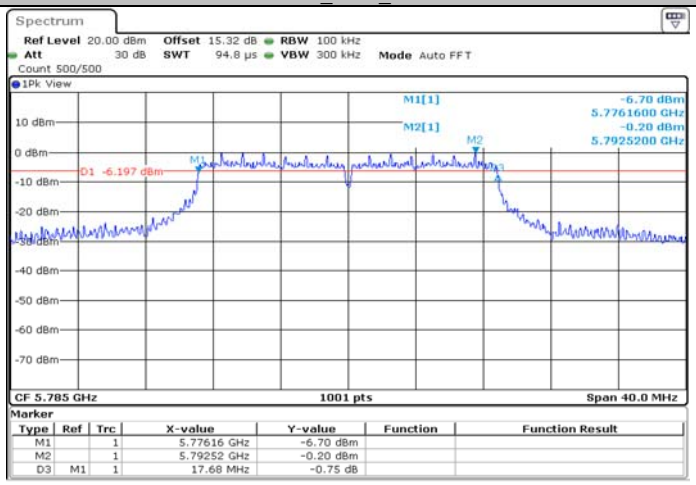
11A_Ant1_5825



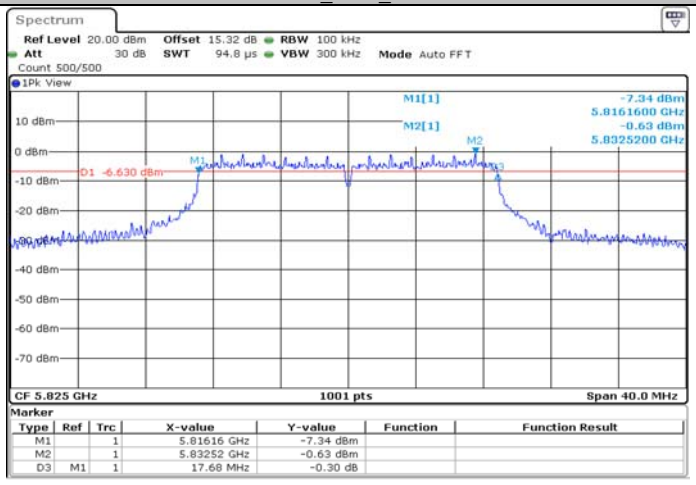
11N20_Ant1_5745



11N20_Ant1_5785

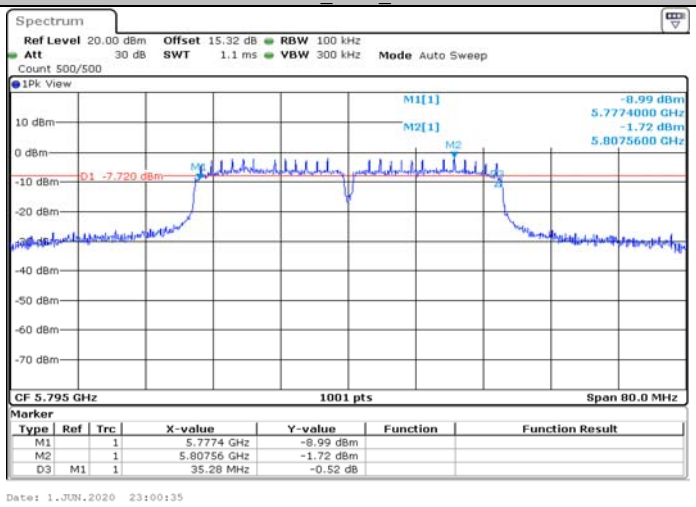


11N20_Ant1_5825



11N40_Ant1_5755

11N40_Ant1_5795



Appendix B: Maximum conducted Average output power

Test Result

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
11A	Ant1	5180	10.01	<=23.98	PASS
		5200	10.16	<=23.98	PASS
		5240	9.37	<=23.98	PASS
		5745	10.69	<=30	PASS
		5785	10.75	<=30	PASS
		5825	10.18	<=30	PASS
11N20	Ant1	5180	10.74	<=23.98	PASS
		5200	10.80	<=23.98	PASS
		5240	10.21	<=23.98	PASS
		5745	10.92	<=30	PASS
		5785	10.84	<=30	PASS
		5825	10.18	<=30	PASS
11N40	Ant1	5190	9.58	<=23.98	PASS
		5230	9.41	<=23.98	PASS
		5755	11.09	<=30	PASS
		5795	10.98	<=30	PASS

Note：The Duty Cycle Factor is compensated in the final result.

Appendix C: Maximum power spectral density

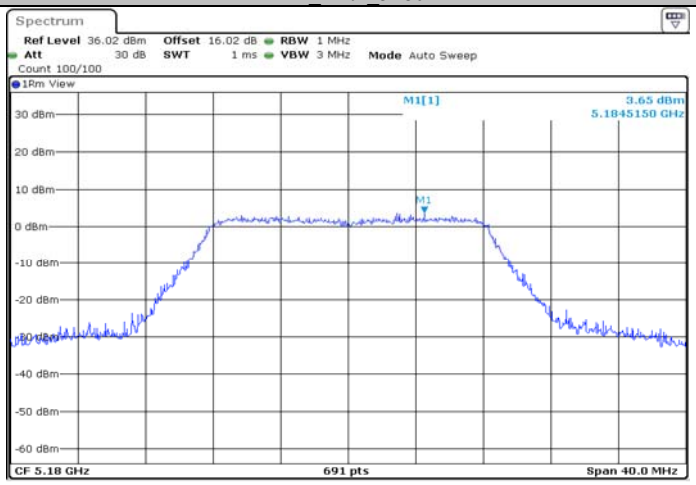
Test Result

TestMode	Antenna	Channel	Result [dBm/MHz]*	Limit[dBm/MHz]*	Verdict
11A	Ant1	5180	3.65	<=11	PASS
		5200	3.51	<=11	PASS
		5240	4.27	<=11	PASS
		5745	4.34	<=30	PASS
		5785	4.19	<=30	PASS
		5825	4.08	<=30	PASS
11N20	Ant1	5180	5.37	<=11	PASS
		5200	5.09	<=11	PASS
		5240	5.60	<=11	PASS
		5745	4.18	<=30	PASS
		5785	4.34	<=30	PASS
		5825	4.29	<=30	PASS
11N40	Ant1	5190	-0.15	<=11	PASS
		5230	0.55	<=11	PASS
		5755	2.50	<=30	PASS
		5795	2.44	<=30	PASS

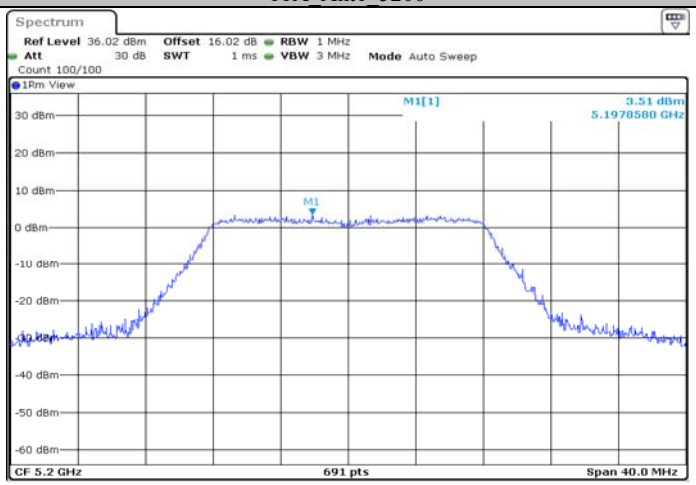
Note: *1. The Result and Limit Unit is dBm/500 kHz in the band 5.725–5.85 GHz.
2. The Duty Cycle Factor is compensated in the final result.

Test Graphs

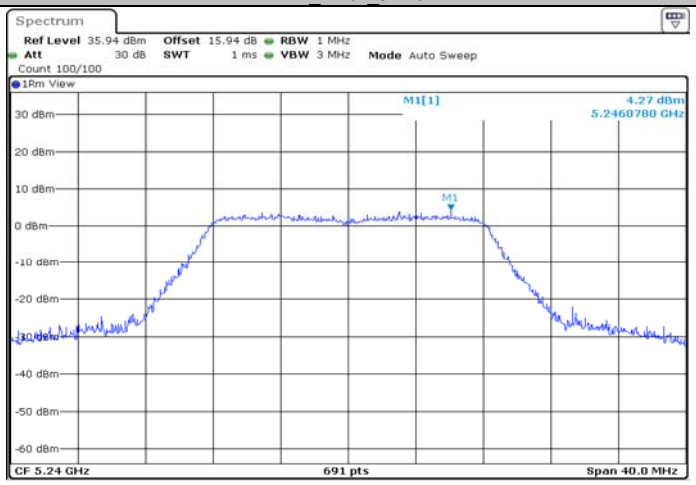
11A_Ant1_5180



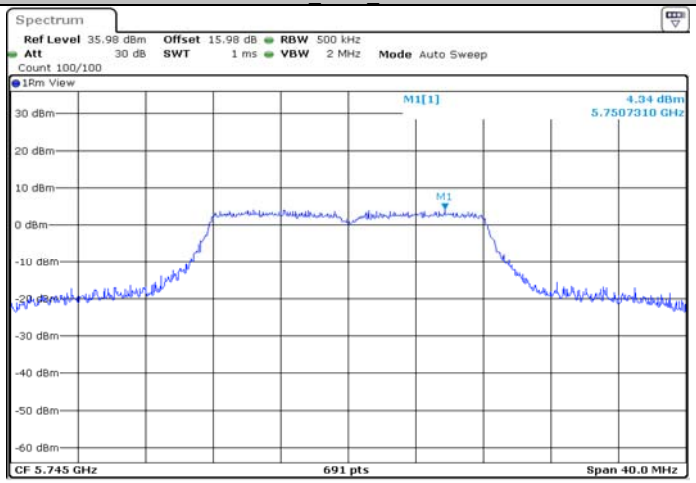
11A_Ant1_5200



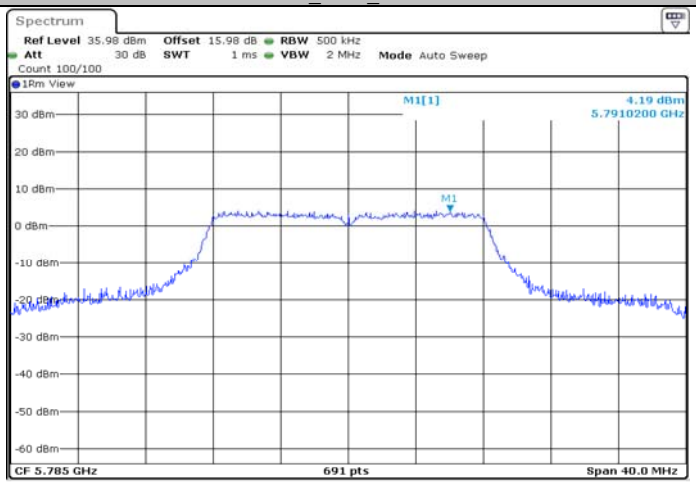
11A_Ant1_5240



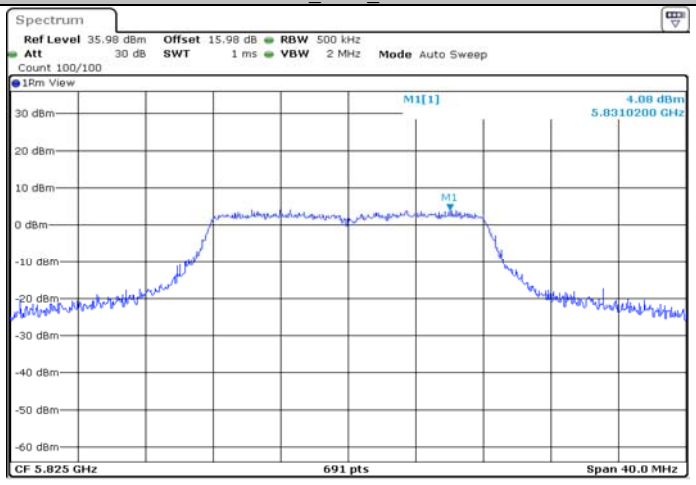
11A_Ant1_5745



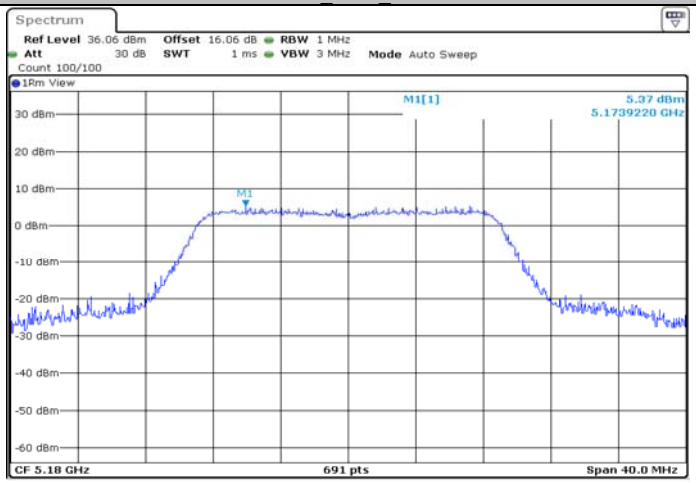
11A_Ant1_5785



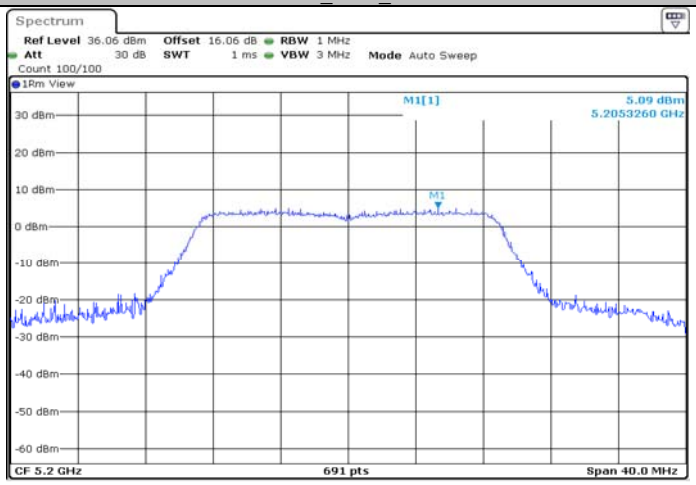
11A_Ant1_5825



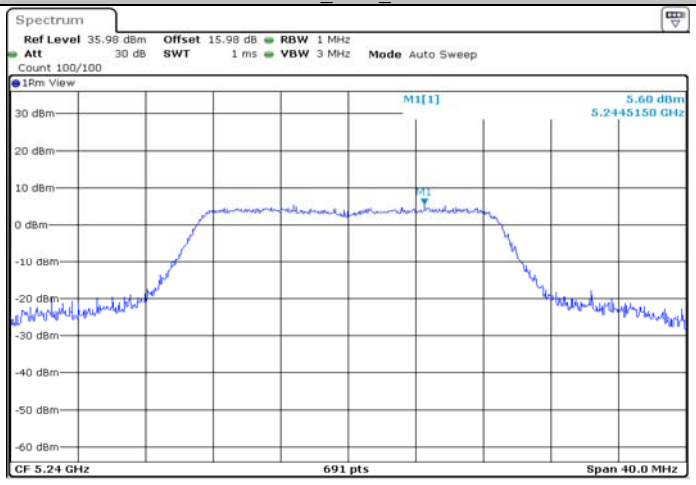
11N20_Ant1_5180



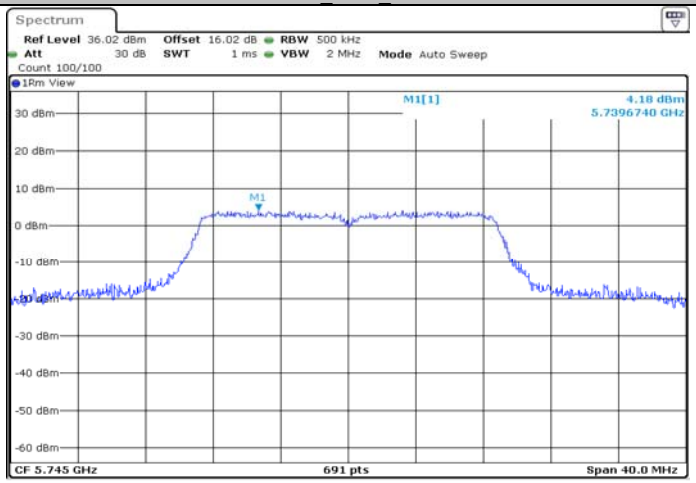
11N20_Ant1_5200



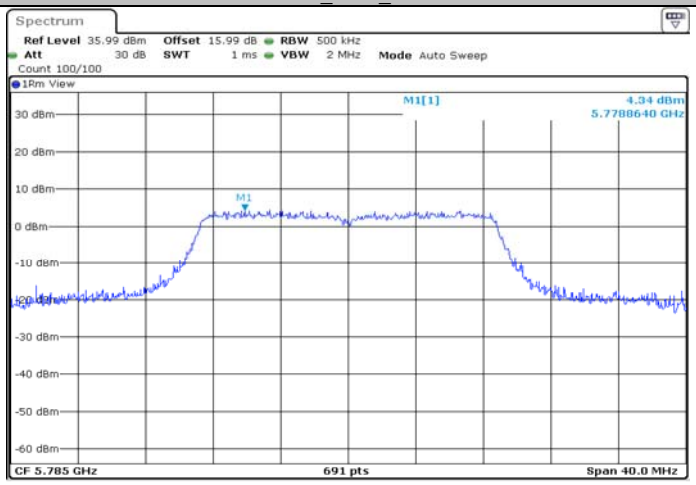
11N20_Ant1_5240



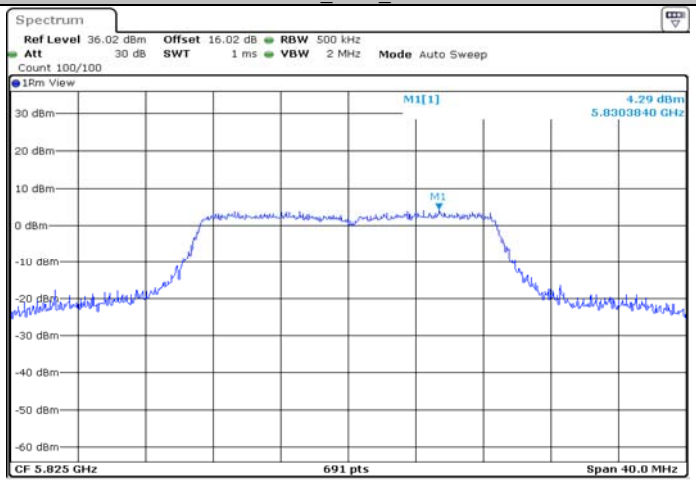
11N20_Ant1_5745



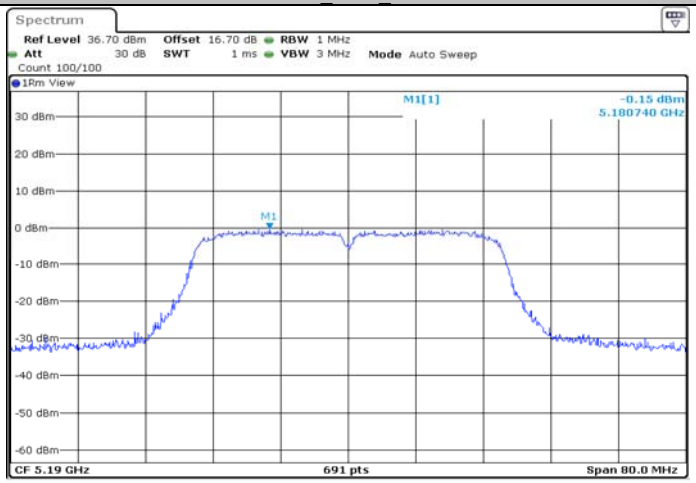
11N20_Ant1_5785



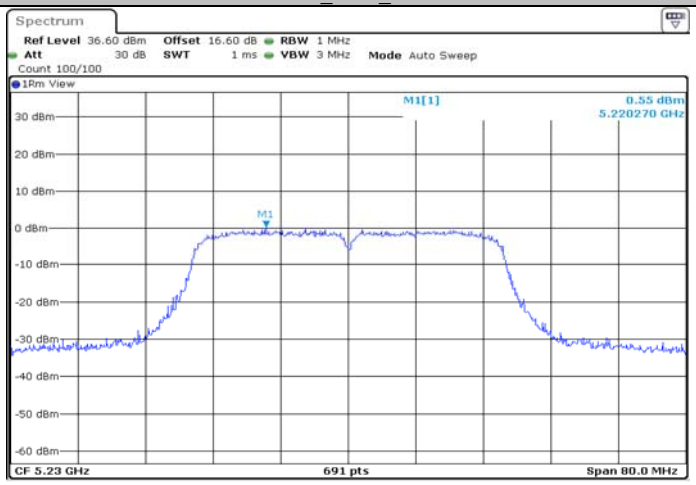
11N20_Ant1_5825



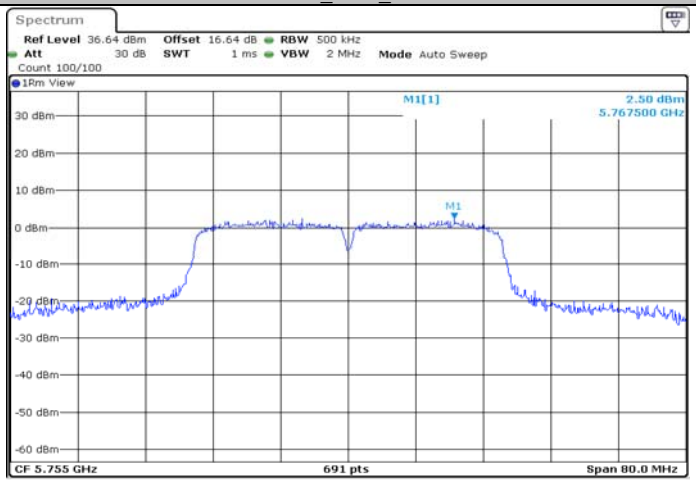
11N40_Ant1_5190

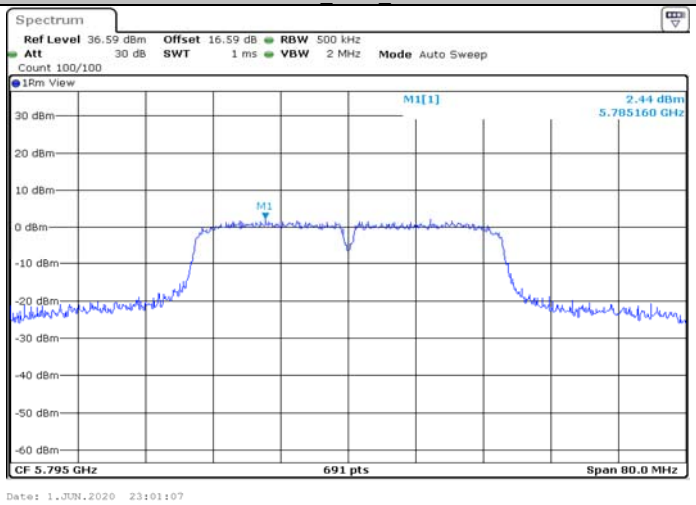


11N40_Ant1_5230



11N40_Ant1_5755



11N40_Ant1_5795


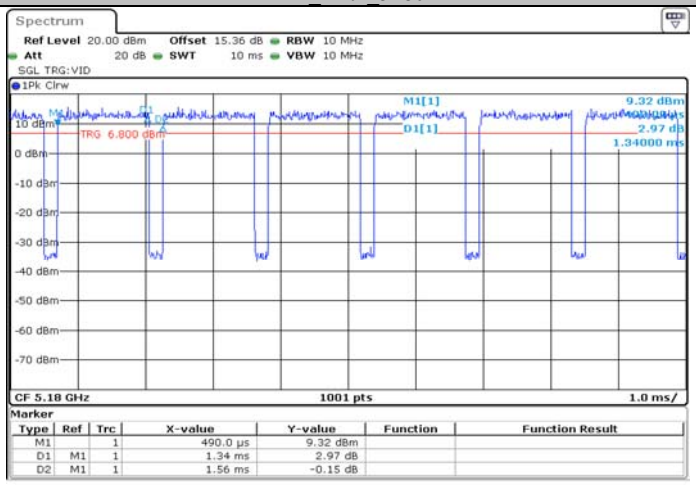
Appendix D: Duty Cycle

Test Result

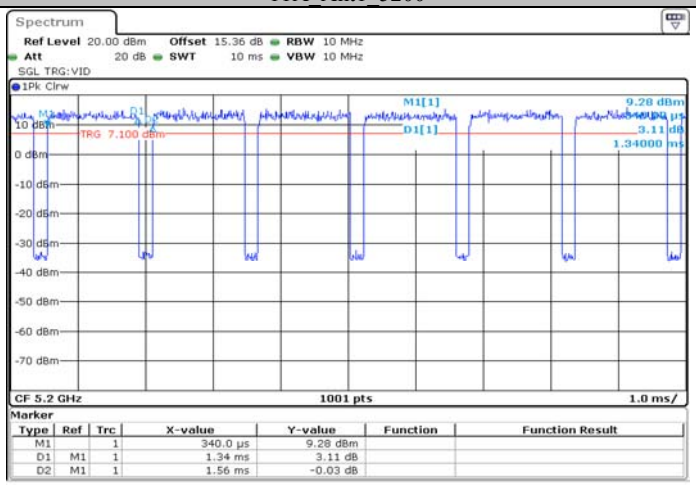
TestMode	Antenna	Channel	TransmissionDuration [ms]	Transmission Period [ms]	Duty Cycle [%]
11A	Ant1	5180	1.34	1.56	85.90
		5200	1.34	1.56	85.90
		5240	1.34	1.56	85.90
		5745	1.35	1.57	85.99
		5785	1.35	1.57	85.99
		5825	1.34	1.56	85.90
11N20	Ant1	5180	1.25	1.47	85.03
		5200	1.26	1.48	85.14
		5240	1.26	1.48	85.14
		5745	1.25	1.47	85.03
		5785	1.26	1.47	85.71
		5825	1.25	1.47	85.03
11N40	Ant1	5190	0.61	0.83	73.49
		5230	0.62	0.84	73.81
		5755	0.62	0.84	73.81
		5795	0.62	0.83	74.70

Test Graphs

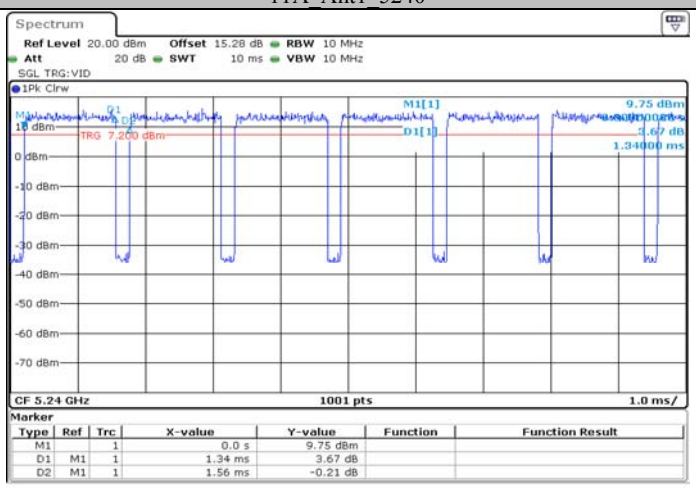
11A_Ant1_5180



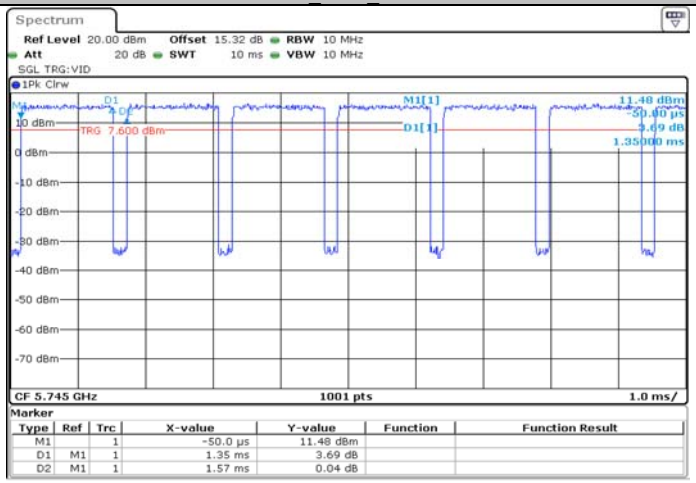
11A_Ant1_5200



11A_Ant1_5240



11A_Ant1_5745



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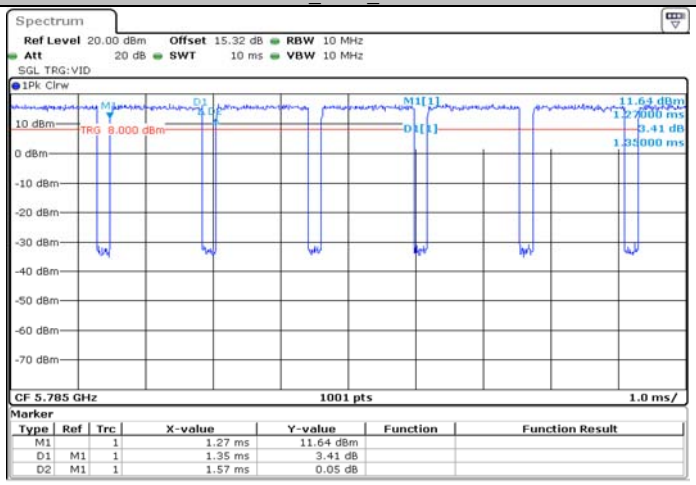

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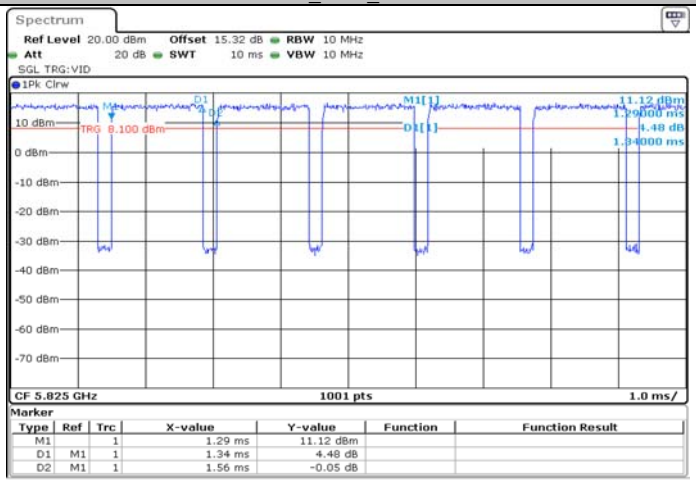

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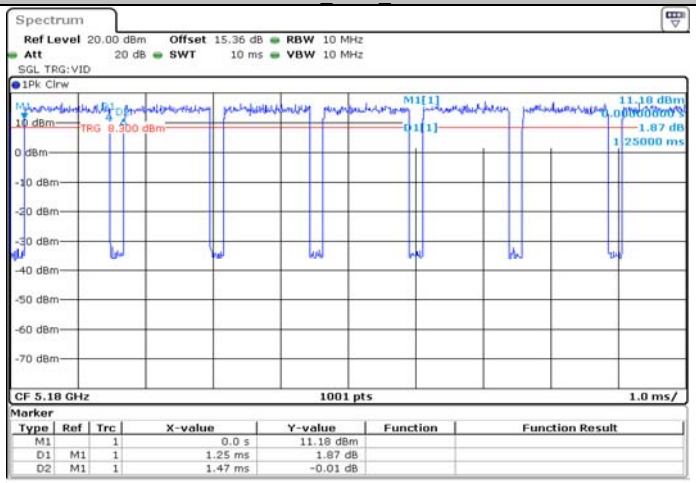

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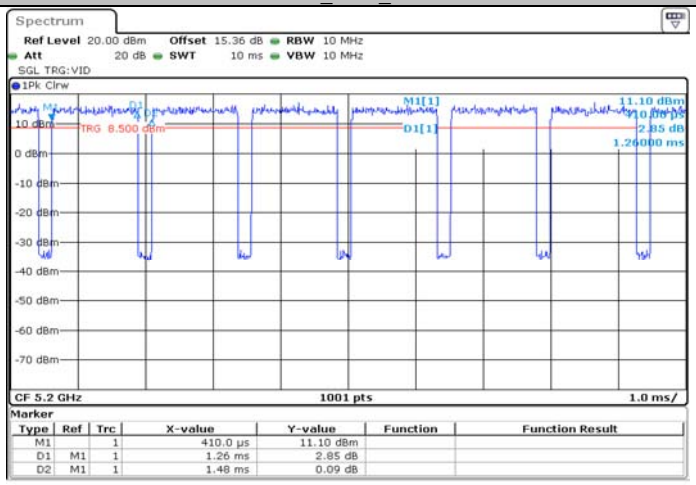

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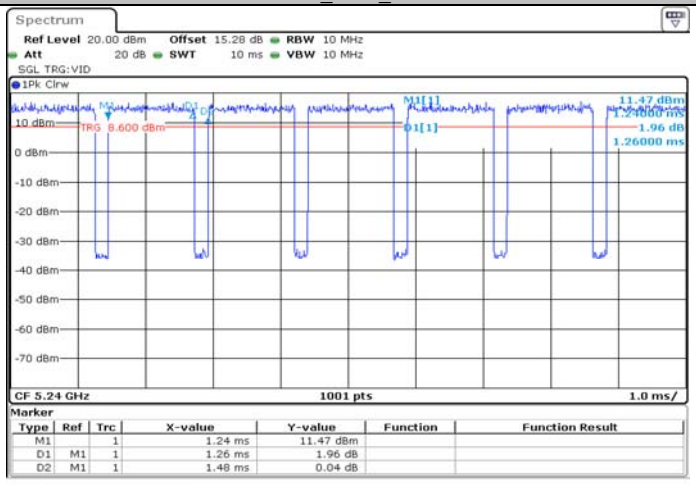

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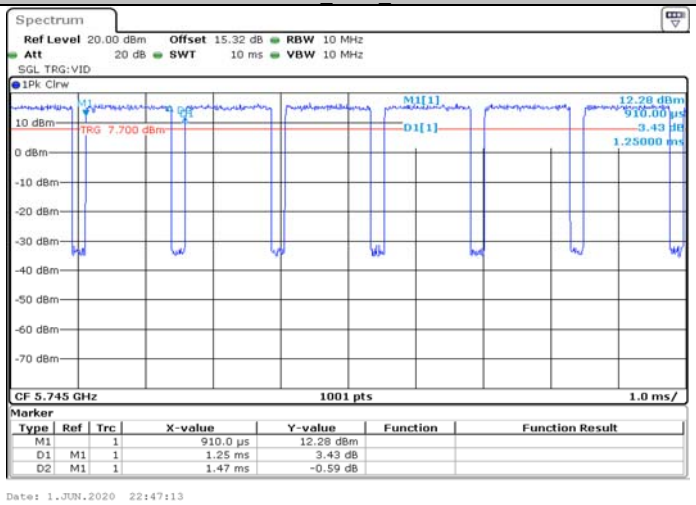

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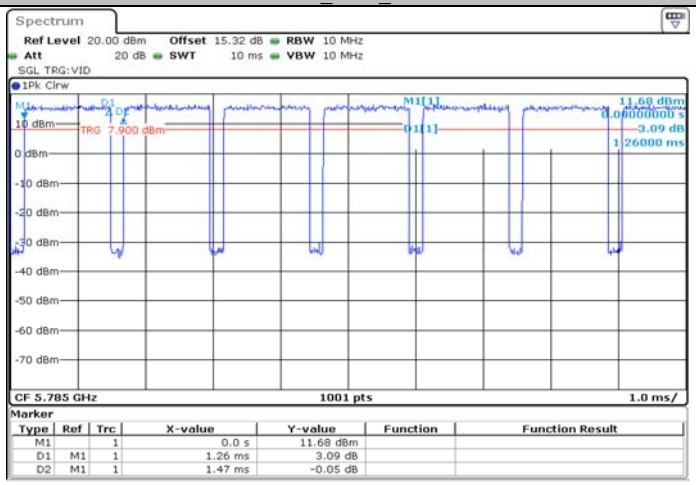
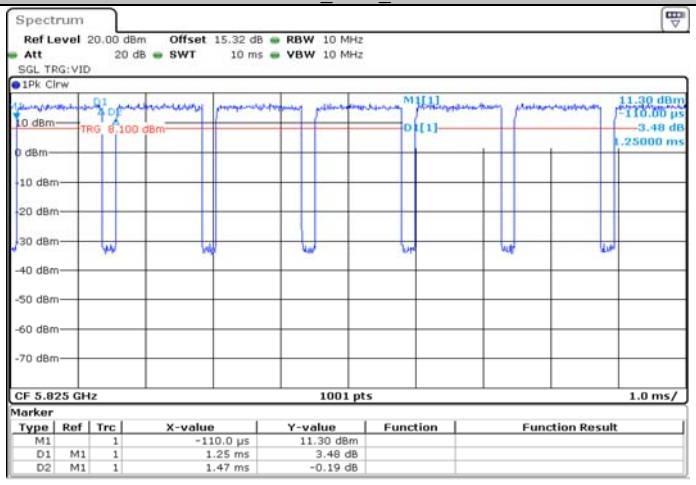


11N20_Ant1_5825



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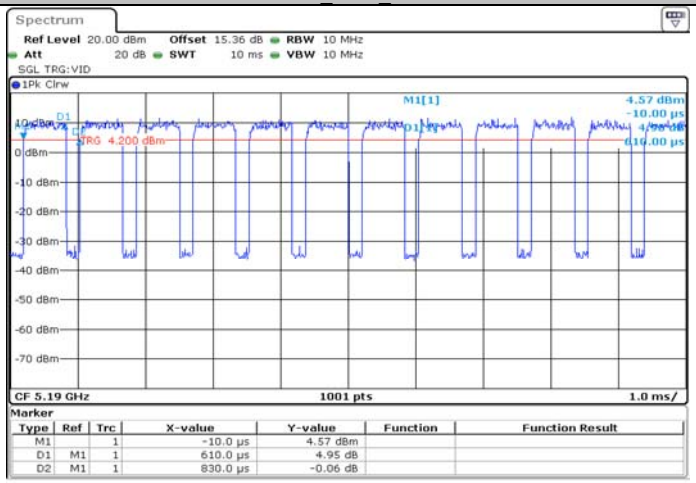

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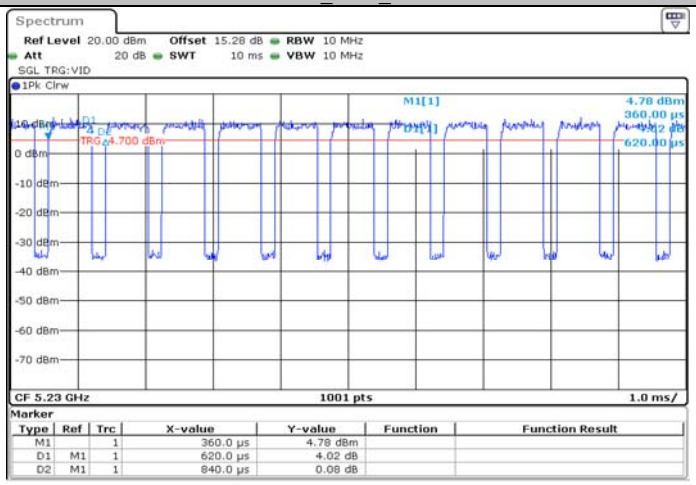

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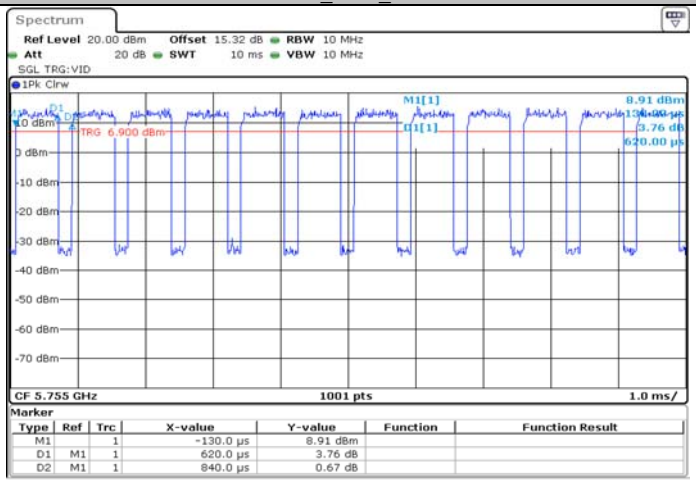

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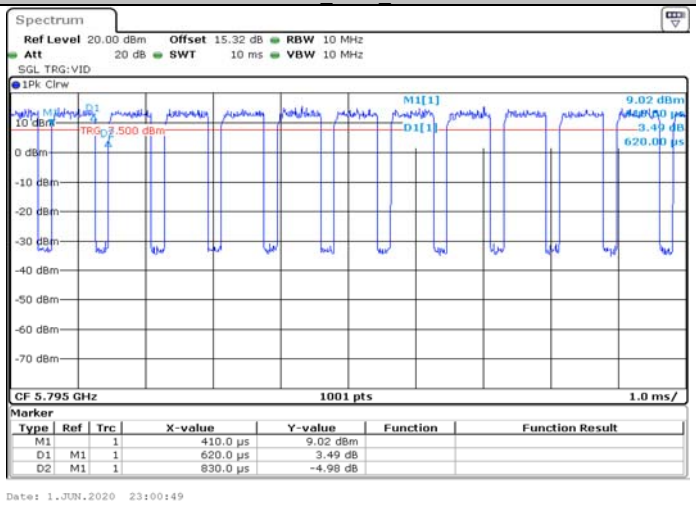

******* END OF REPORT *******