CERTIFICATION TEST REPORT

Report Number. : 4789746865-E6V3

Applicant	:	SAMSUNG ELECTRONICS CO., LTD. 129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI, GYEONGGI-DO, 16677, KOREA
Model	:	SM-A525F/DS, SM-A525F
FCC ID	:	A3LSMA525F
EUT Description	:	GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n/ac and NFC
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART E

Date Of Issue:
February 05, 2021

Prepared by:
UL Korea, Ltd.
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Suwon Test Site: UL Korea, Ltd. Suwon Laboratory
218 Maeyeong-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16675, Korea
TEL: (031) 337-9902
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IAS ACCREDITED
Testing Laboratory
TL-637

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	01/28/21	Initial issue	Hyunsik Yun
V2	02/02/21	Updated to address TCB's question	Hyunsik Yun
V3	02/05/21	Updated to address TCB's question	Hyunsik Yun

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	SAMSUNG ELECTRONICS CO., LTD.
EUT DESCRIPTION:	GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n/ac and NFC
MODEL NUMBER:	SM-A525F/DS, SM-A525F
SERIAL NUMBER:	R38NB02RCJH (CONDUCTED, Original); R38NB02RD9T, R38NB02S3WA, R38NB02S41F (RADIATED, Original); R38NC03HCYN (RADIATED, Spot check);
DATE TESTED:	DEC 01, 2020 – JAN 26, 2021(Original); JAN 21, 2021(Spot check);

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart E	Pass

UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Korea, Ltd. By:

Junwhan Lee
Suwon Lab Engineer
UL Korea, Ltd.

Tested By:

Hyunsik Yun
Suwon Lab Engineer
UL Korea, Ltd.

1.1. INTRODUCTION OF TEST DATA REUSE

This report referenced from the FCC ID: A3LSMA525M NII WLAN(FCC CFR 47 Part 15C). And the applicant takes full responsibility that the test data as referenced in this report represent compliance for this FCC ID.

1.2. DIFFERENCE

The FCC ID: A3LSMA525F shares the same enclosure and circuit board as FCC ID: A3LSMA525M. The WLAN antennas and surrounding circuitry and layout are identical between these two units.

After confirming through preliminary radiated emissions that the performance of the FCC ID: A3LSMA525M remains representative of FCC ID: A3LSMA525F. The test data of FCC ID: A3LSMA525M being submitted for this application to cover WLAN features.

The software used for DFS detection is the same as the parent model so it's clear the DFS features.

1.3. SPOT CHECK VERIFICATION DATA

(Worst case of the radiated spurious and band edge emissions)

Band	Test Item	Mode	Frequency	Test Limit	Original model	Spot check model	Deviation	Remark
					SM-A525M/DS Results	SM-A525F/DS Results		
					FCC ID : A3LSMA525M	FCC ID : A3LSMA525F		
UNII WLAN (5GHz)	Band Edge	5.2 GHz band, 802.11ac VHT80	5210 MHz	54 dBuV/m	49.57 dBuV/m	46.90 dBuV/m	-2.67 dB	
	RSE	5.2 GHz band, 802.11a	15600 MHz	68.2 dBuV/m	52.40 dBuV/m	51.31 dBuV/m	-1.09 dB	Noise Floor
	Band Edge	5.3 GHz band, 802.11ac VHT80	5290 MHz	54 dBuV/m	51.68 dBuV/m	50.12 dBuV/m	-1.56 dB	
	RSE	5.3 GHz band, 802.11a	21280 MHz	74 dBuV/m	55.97 dBuV/m	55.93 dBuV/m	-0.04 dB	Noise Floor
	Band Edge	5.5 GHz band, 802.11n HT20	5700 MHz	68.2 dBuV/m	66.02 dBuV/m	64.92 dBuV/m	-1.10 dB	
	RSE	5.5 GHz band, 802.11a	22320 MHz	68.2 dBuV/m	57.50 dBuV/m	57.17 dBuV/m	-0.33 dB	Noise Floor
	Band Edge	5.8 GHz band, 802.11a	5825 MHz	-27 dBm	-34.35 dBm	-33.92 dBm	0.43 dB	
	RSE	5.8 GHz band, 802.11a	3883 MHz	54 dBuV/m	39.91 dBuV/m	41.39 dBuV/m	1.48 dB	

Comparison of two models, upper deviation is within 3 dB range and all test results are under FCC Technical Limits.

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1.4. REFERENCE DETAIL

Reference application that contains the reused reference data in the individual test reports:

Equipment Class	Reference FCC ID (Parent)	Application Type	Reference Test report number	Exhibit Type	Variant Test Report Number	Data Re-used
PCE	A3LSMA525M	Original Grant	4789746830-E2	Test Report	4789746865-E2	All
DTS	A3LSMA525M	Original Grant	4789746830-E3 (802.11b,g,n)	Test Report	4789746865-E3 (802.11b,g,n)	All
			4789746830-E4 (Bluetooth LE)	Test Report	4789746865-E4 (Bluetooth LE)	All
DSS	A3LSMA525M	Original Grant	4789746830-E5 (Bluetooth)	Test Report	4789746865-E5 (Bluetooth)	All
NII	A3LSMA525M	Original Grant	4789746830-E6 (802.11a,n,ac)	Test Report	4789746865-E6 (802.11a,n,ac)	All
DXX	A3LSMA525M	Original Grant	4789746830-E7 (NFC)	Test Report	4789746865-E7 (NFC)	All

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with following methods.

1. FCC CFR 47 Part 2.
2. FCC CFR 47 Part 15.
3. KDB 789033 D02 General UNII Test Procedures New Rules v02r01
4. KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02
5. KDB 905462 D03 UNII Clients Without Radar Detection New Rules v01r02
6. ANSI C63.10-2013.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea. Line conducted emissions are measured only at the 218 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

218 Maeyeong-ro
☒ Chamber 1
☒ Chamber 2
☒ Chamber 3

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637. The full scope of accreditation can be viewed at https://www.iasonline.org/wp-content/uploads/2017/05/TL-637-cert-New.pdf.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.01 dB
Radiated Disturbance, 30 MHz to 1 GHz	4.26 dB
Radiated Disturbance, 1 GHz to 18 GHz	5.90 dB
Radiated Disturbance, 18 GHz to 40 GHz	5.49 dB

Uncertainty figures are valid to a confidence level of 95%.

4.4. DECISION RULE

Decision rule for statement(s) of conformity is based on Procedure 1, Clause 4.4.2 in IEC Guide 115:2007.

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n/ac and NFC.
This test report addresses the NII (UNII 802.11a/n/ac) operational mode.

This report covers the Samsung models SM-A525F/DS and SM-A525F.
These models are identical in hardware except SM-A525F has single SIM tray.
With some pre-scan, model SM-A525F/DS was set for final test.

WiFi operating mode

Frequency rage	Mode	WIFI 5G
5GHz (5180 MHz ~ 5825 MHz)	802.11a SISO	TX/RX
	802.11n SISO	TX/RX
	802.11ac SISO	TX/RX

MAXIMUM OUTPUT POWER

The transmitter has a maximum total conducted average output power as follows:

UNII-1

Frequency Range [MHz]	Mode	Output Power [dBm]	Output Power [mW]
5180 - 5240	802.11a SISO	17.75	59.57
	802.11n(HT20) SISO	17.60	57.54
5190 – 5230	802.11n(HT40) SISO	13.97	24.95
5210	802.11ac(VHT80) SISO	12.77	18.92

UNII-2A

Frequency Range [MHz]	Mode	Output Power [dBm]	Output Power [mW]
5260 - 5320	802.11a SISO	17.66	58.34
	802.11n(HT20) SISO	17.54	56.75
5270 - 5310	802.11n(HT40) SISO	13.30	21.38
5290	802.11ac(VHT80) SISO	12.68	18.54

UNII-2C

Frequency Range [MHz]	Mode	Output Power [dBm]	Output Power [mW]
5500 - 5720	802.11a SISO	17.67	58.48
	802.11n(HT20) SISO	17.53	56.62
5510 - 5710	802.11n(HT40) SISO	13.04	20.14
5530 - 5690	802.11ac(VHT80) SISO	12.89	19.45

UNII-3

Frequency Range [MHz]	Mode	Output Power [dBm]	Output Power [mW]
5745 - 5825	802.11a SISO	17.04	50.58
	802.11n(HT20) SISO	17.58	57.28
5755 - 5795	802.11n(HT40) SISO	15.01	31.70
5775	802.11ac(VHT80) SISO	12.75	18.84

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5.2. DESCRIPTION OF AVAILABLE ANTENNAS

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 internal antenna was Permanently attached.
Therefore this E.U.T Complies with the requirement of §15.203.

The radio utilizes a internal antenna, with a maximum gain of:

Frequency Band [MHz]	Antenna Gain [dBi]
UNII 1 5150 - 5250	1.91
UNII 2A 5250 - 5350	1.14
UNII 2C 5470 - 5725	-0.20
UNII 3 5725 - 5850	0.71

5.3. List of test reduction and modes covering other modes:

The output power on covered modes is equal to or less than one referenced.

Authorized Frequency Band			
Mode	**Antenna Stream**	**Mode**	**Covered by**
802.11a	SISO	802.11a 1TX	
802.11n HT20		802.11n HT20 1TX	
802.11ac VHT20		802.11ac VHT20 1TX	802.11n HT20 1TX
802.11n HT40		802.11n HT40 1TX	
802.11ac VHT40		802.11ac VHT40 1TX	802.11n HT40 1TX
802.11ac VHT80		802.11ac VHT80 1TX	

5.4. WORST-CASE CONFIGURATION AND MODE

Radiated emission below 1GHz and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Radiated emission above 1GHz was performed with the EUT set to transmit low/mid/high channels.

For SISO, the fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it was determined that Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y orientation

Based on the baseline scan, the worst-case data rates were:

802.11a mode: 6 Mbps 1Tx
802.11n HT20 mode: MCS0 1Tx
802.11n HT40 mode: MCS0 1Tx
802.11ac VHT80 mode: MCS0 1Tx

Note. All radiated and power line conducted tests were performed attached with travel adapter and earphone for the worst case condition mode.

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Charger	SAMSUNG	EP-TA200	R37N6KYPMH2SE3	N/A
Data Cable	SAMSUNG	EP-DR140AWE	N/A	N/A
Earphone	SAMSUNG	EHS64AVFWE	N/A	N/A

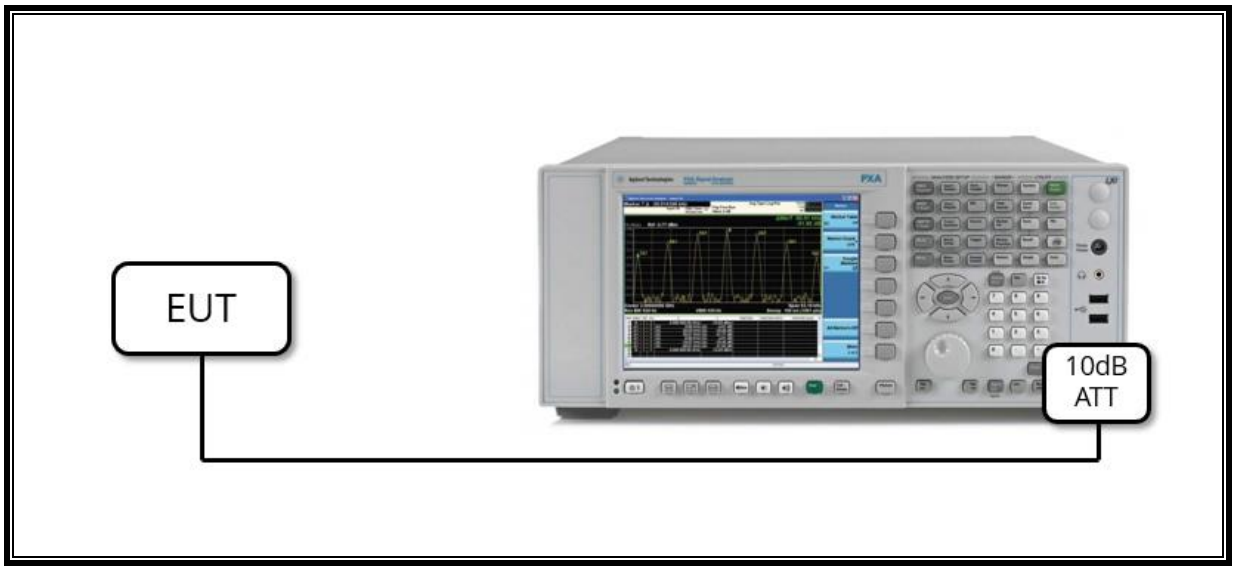
I/O CABLE

I/O Cable List						
Cable No.	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	DC Power	1	C Type	Shielded	1.0 m	N/A
2	Audio	2	Mini-Jack	Unshielded	1.2 m	N/A

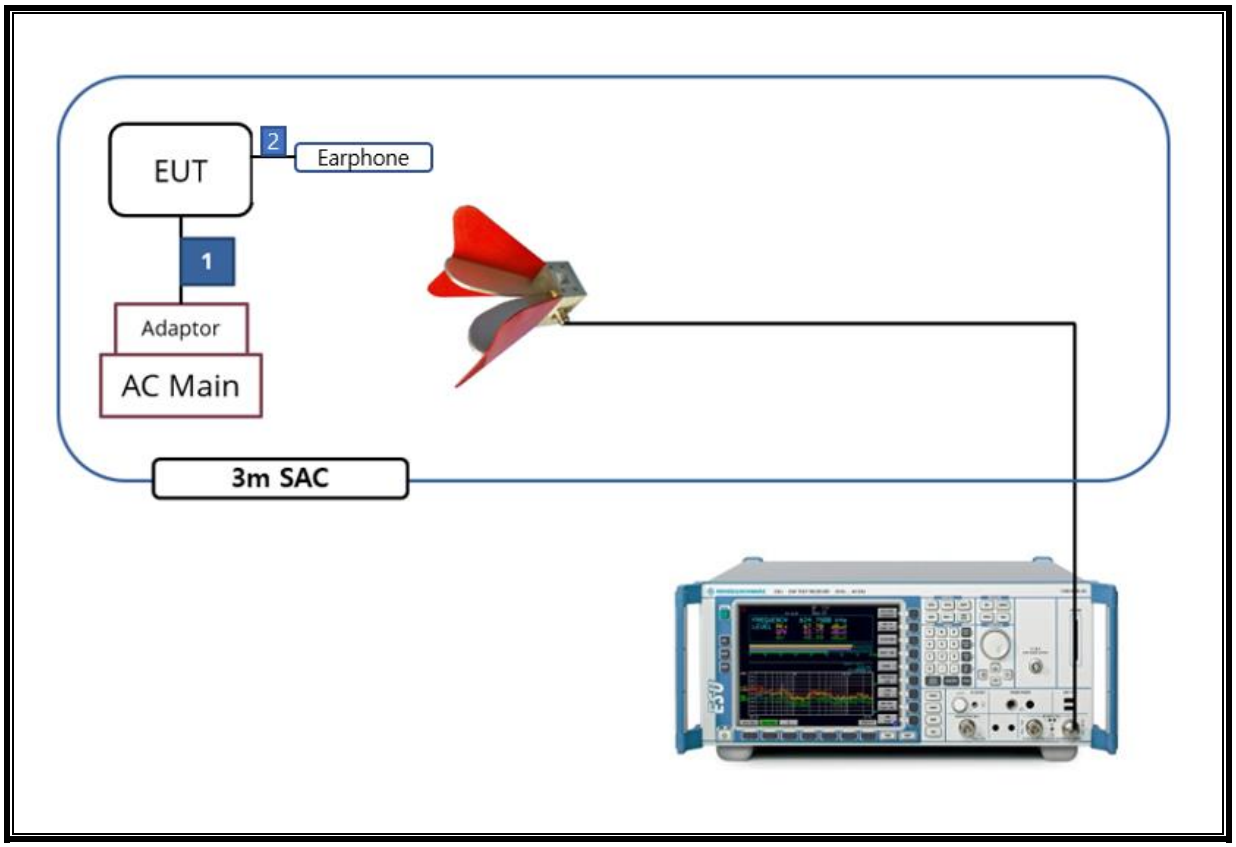
TEST SETUP

The EUT is a stand-alone unit during the tests.
Test software exercised the EUT to enable NII mode.

SETUP DIAGRAM FOR TESTS (CONDUCTED TEST SETUP)



SETUP DIAGRAM FOR TESTS (RADIATED TEST SETUP)



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6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List				
Description	**Manufacturer**	**Model**	**S/N**	**Cal Due**
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	750	08-19-22
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	08-13-22
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	845	08-13-22
Antenna, Horn, 18 GHz	ETS	3115	00167211	07-27-22
Antenna, Horn, 18 GHz	ETS	3115	00161451	08-15-22
Antenna, Horn, 18 GHz	ETS	3117	00168724	07-27-22
Antenna, Horn, 18 GHz	ETS	3117	00168717	08-15-22
Antenna, Horn, 18 GHz	ETS	3117	00218957	01-15-23
Antenna, Horn, 40 GHz	ETS	3116C	00166155	01-15-23
Antenna, Horn, 40 GHz	ETS	3116C	00168645	10-02-21
Preamplifier	ETS	3116C-PA	00168841	08-06-21
Preamplifier, 1000 MHz	Sonoma	310N	341282	08-03-21
Preamplifier, 1000 MHz	Sonoma	310N	351741	08-03-21
Preamplifier, 1000 MHz	Sonoma	310N	370599	08-06-21
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1876511	08-03-21
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	08-03-21
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	2029169	08-04-21
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	08-05-21
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54490312	08-05-21
Spectrum Analyzer, 43.5 GHz	R&S	FSW43	104089	08-06-21
EMI Test Receiver, 44 GHz	R&S	ESW44	101590	08-04-21
Average Power Sensor	Agilent / HP	U2000	MY54270007	08-05-21
Attenuator	PASTERNACK	PE7087-10	A001	08-03-21
Attenuator	PASTERNACK	PE7087-10	A008	08-03-21
Attenuator	PASTERNACK	PE7004-10	2	08-04-21
Attenuator	PASTERNACK	PE7087-10	A009	08-05-21
EMI Test Receive, 40 GHz	R&S	ESU40	100439	08-03-21
EMI Test Receive, 40 GHz	R&S	ESU40	100457	08-03-21
EMI Test Receive, 3 GHz	R&S	ESR3	101832	08-03-21
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	009	08-03-21
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	015	08-03-21
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	020	08-04-21
High Pass Filter 3GHz	Micro-Tronics	HPM17543	010	08-03-21
High Pass Filter 3GHz	Micro-Tronics	HPM17543	015	08-03-21
High Pass Filter 3GHz	Micro-Tronics	HPM17543	020	08-04-21
High Pass Filter 6GHz	Micro-Tronics	HPS17542	009	08-03-21
High Pass Filter 6GHz	Micro-Tronics	HPS17542	016	08-03-21
High Pass Filter 6GHz	Micro-Tronics	HPS17542	021	08-04-21
LISN	R&S	ENV-216	101837	08-06-21
Antenna, Loop, 9kHz-30MHz	R&S	HFH2-Z2	100418	10-02-21
Termination	WEINSCHEL	M1406A	T01	08-05-21
Attenuator	WEINSCHEL	WA76-30-21	A015	08-05-21
UL Software				
Description	**Manufacturer**	**Model**	**Version**	
Radiated software	UL	UL EMC	Ver 9.5	
AC Line Conducted software	UL	UL EMC	Ver 9.5	

7. SUMMARY TABLE

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result
15.407(e)	6dB Band width (5.8GHz)	500kHz	Condcuted	PASS
15.407 (a)(2)	TX Cond. Power 5.15-2.25, 5.25-5.35 & 5.47-5.725	< 24dBm or 11+10Log(26dB BW)		PASS
15.407 (a)(3)	TX Cond. Power 5.725-5.825	< 30dBm		PASS
15.407 (a)(5)	PSD (5.2,5.3,5.5GHz)	<11dBm		PASS
15.407 (a)(5)	PSD (5.8GHz)	30dBm per 500kHz		PASS
15.207 (a)	AC Power Line conducted emissions	Section 13	Radiated	PASS
15.407 (b) & 15.209	Radiated Spurious Emission	< 54dBuV/m		PASS
15.407 (h)(2)	Dynamic Frequency Selection	N/A	Condcuted	PASS

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8. MEASUREMENT METHODS

On-Time and Duty Cycle : KDB 789033 D02 v02r01, Section II.B.

6dB Emission BW : KDB 789033 D02 v02r01, Section II.C.2.

26dB Emission BW : KDB 789033 D02 v02r01, Section II.C.1.

99% Occupied BW : KDB 789033 D02 v02r01, Section II.D.

Conducted Output Power : KDB 789033 D02 v02r01, Section II.E.3.b(Method PM-G)

Conducted Output Power for Straddle Channel (ch144/142/138 for 20/40/80MHz BW):

KDB 789033 D02 v02r01, Section II.E.2.b(Method SA-1)

Power Spectral Density : KDB 789033 D02 v02r01, Section II.F.

Unwanted emissions in restricted bands : KDB 789033 D02 v02r01, Section II.G.3 – II.G.6.

Unwanted emissions in non-restricted bands : KDB 789033 D02 v02r01, Section II.G.3 – II.G.6.

AC Power Line Conducted Emission : ANSI C63.10-2013, Section 6.2.

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9. REFERENCE MEASUREMENTS RESULTS

9.1. ON TIME AND DUTY CYCLE RESULTS

Mode	On Time [ms]	Period [ms]	Duty Cycle X [Linear]	Duty Cycle X [%]	Duty Cycle Correction Factor[dB]
802.11a SISO	2.795	2.833	0.99	98.7	-
802.11n(HT20) SISO	2.597	2.637	0.98	98.5	-
802.11n(HT40) SISO	2.483	2.520	0.99	98.5	-
802.11ac(VHT80) SISO	2.504	2.540	0.99	98.6	-

Note. If the duty cycle is over 98%, compensation is not included in average measurement.

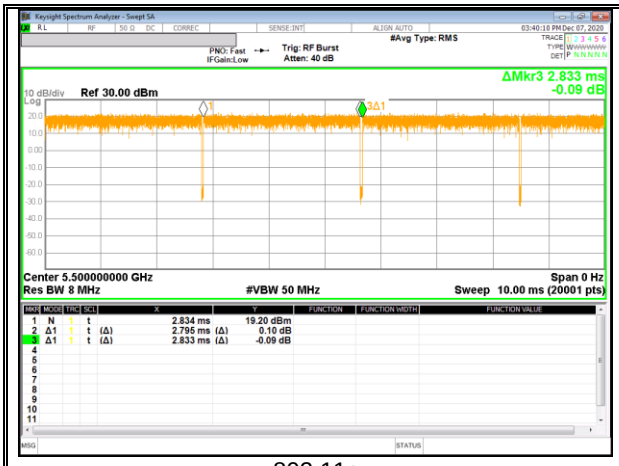
LIMITS

None; for reporting purposes only.

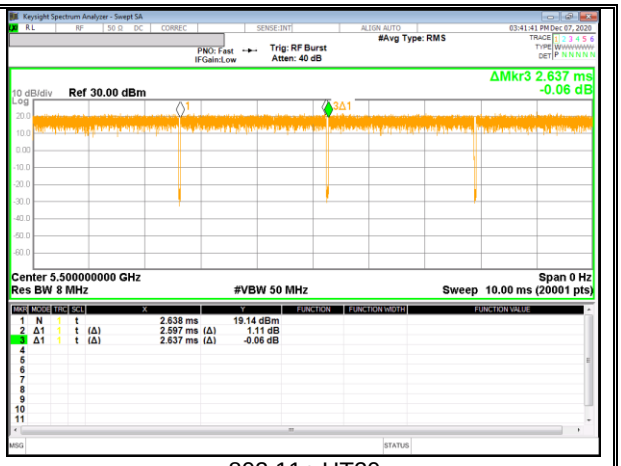
PROCEDURE

KDB 789033 D02 v02r01 Zero-Span Spectrum Analyzer Method.

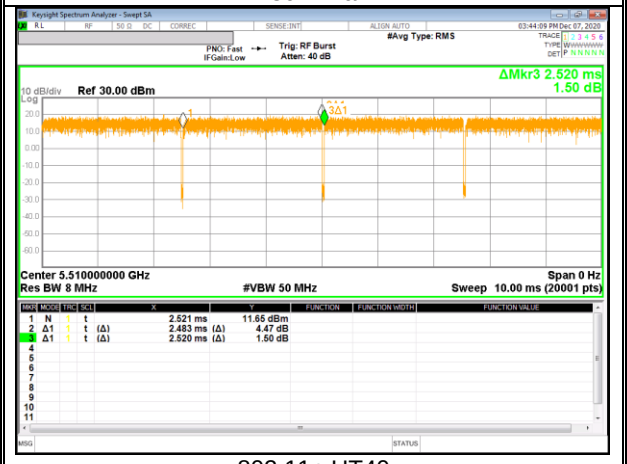
9.2. DUTY CYCLE PLOTS



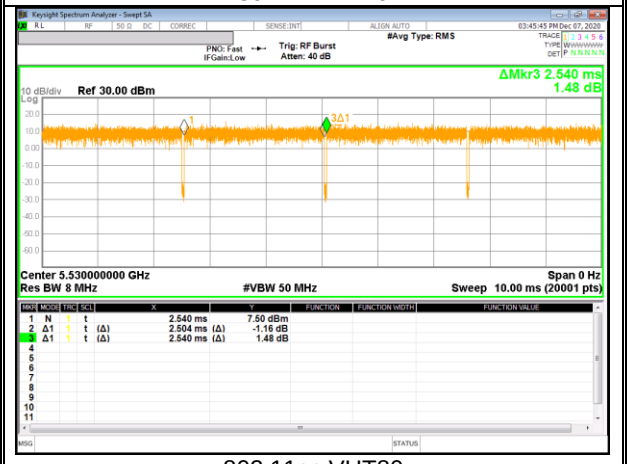
802.11a



802.11n HT20



802.11n HT40



802.11ac VHT80

9.3. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

Reference to 789033 D02 General UNII Test Procedures New Rules v02r01: The transmitter output is connected to a spectrum analyzer with the RBW set to approximately 1% of EBW, the VBW > RBW, peak detector and max hold.

RESULTS

9.3.1. 5.2 GHz BAND

Band	Mode	Channel	Center Freq. [MHz]	26 dB BW [MHz]	Worst	99% BW [MHz](Note1)
UNII-1	802.11a	Low	5180	20.02	19.47	16.36
		Mid	5200	19.57		16.37
		High	5240	19.47		16.36
	802.11n HT20	Low	5180	20.05	19.94	17.57
		Mid	5200	20.37		17.56
		High	5240	19.94		17.55
	802.11n HT40	Low	5190	39.46	39.46	35.96
		High	5230	40.56		35.93
	802.11ac VHT80	Mid	5210	79.65	79.65	75.09

Note1. As a result of 99% bandwidth test, the bandwidth of UNII-1 does not interfere with UNII-2A.

9.3.2. 5.3 GHz BAND

Band	Mode	Channel	Center Freq. [MHz]	26 dB BW [MHz]	Worst	99% BW [MHz](Note2)
UNII-2A	802.11a	Low	5260	19.10	18.99	16.34
		Mid	5300	18.99		16.34
		High	5320	19.76		16.37
	802.11n HT20	Low	5260	19.75	19.75	17.54
		Mid	5300	19.90		17.55
		High	5320	20.22		17.53
	802.11n HT40	Low	5270	39.80	39.80	35.97
		High	5310	39.89		35.93
	802.11ac VHT80	Mid	5290	81.38	81.38	75.22

Note2. As a result of 99% bandwidth test, the bandwidth of UNII-2A does not interfere with UNII-1.

9.3.3. 5.5 GHz BAND

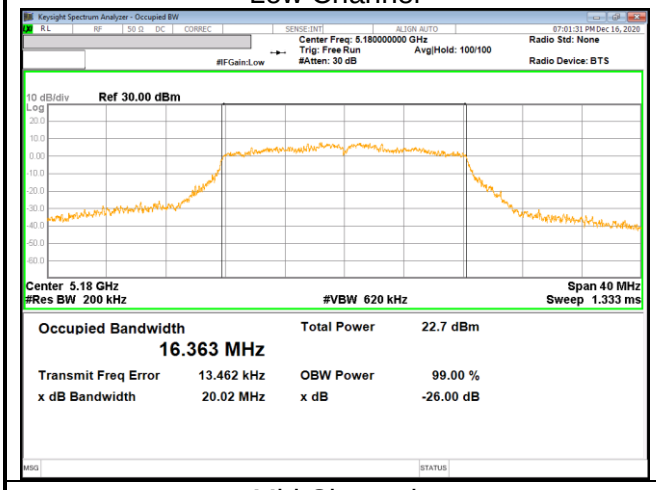
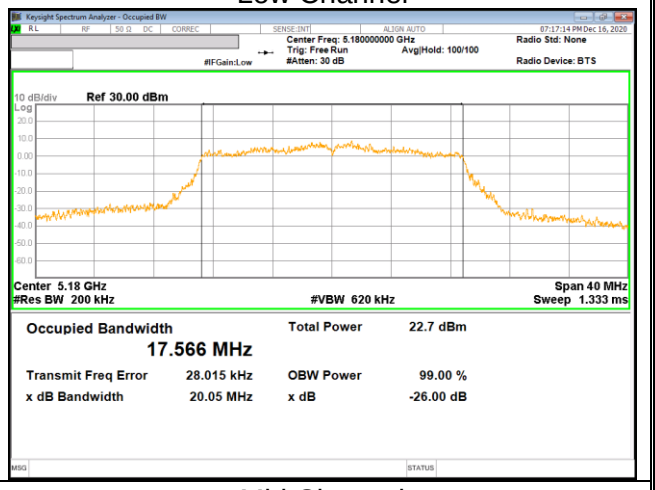
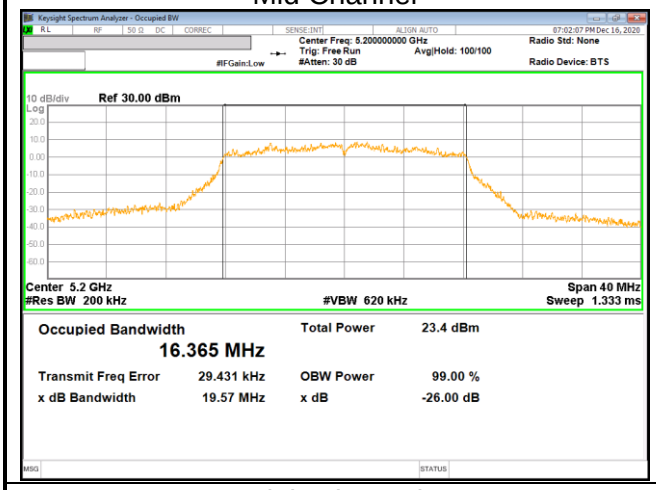
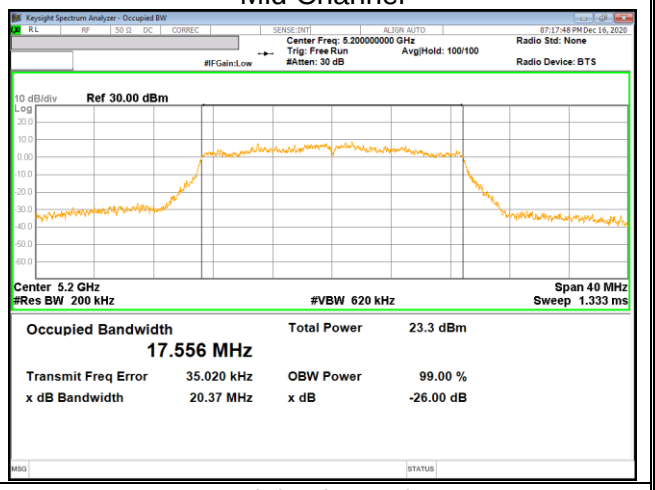
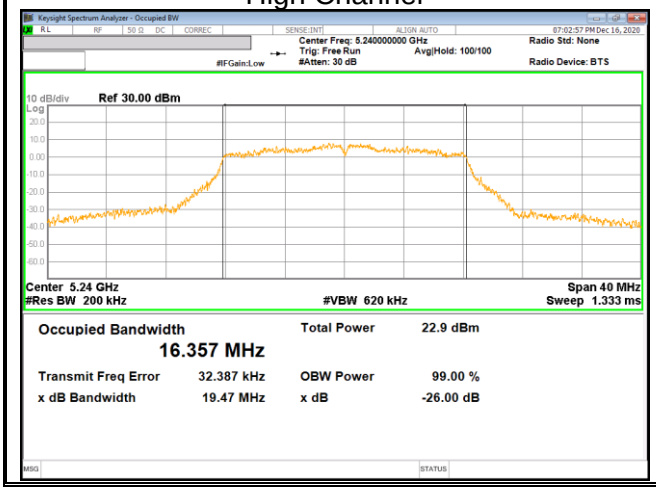
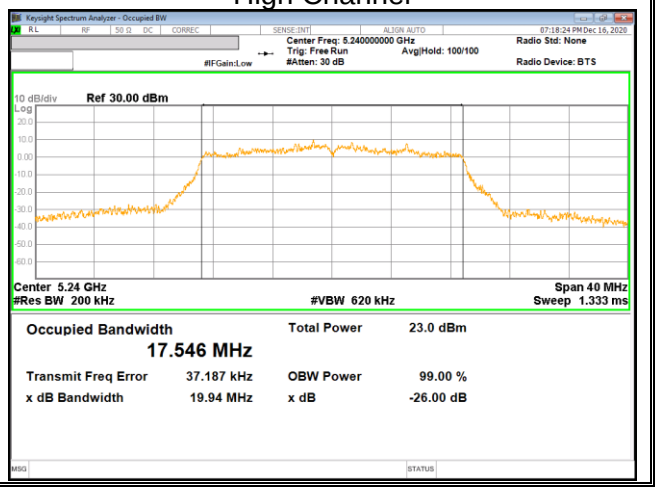
Band	Mode	Channel	Center Freq. [MHz]	26 dB BW [MHz]	Worst
UNII-2C	802.11a	Low	5500	19.50	19.08
		Mid	5580	19.40	
		High	5700	19.08	
	802.11n HT20	Low	5500	20.24	19.83
		Mid	5580	20.40	
		High	5700	19.83	
	802.11n HT40	Low	5510	40.11	39.63
		Mid	5590	39.63	
		High	5670	40.09	
	802.11ac VHT80	Low	5530	81.41	81.23
		High	5610	81.23	

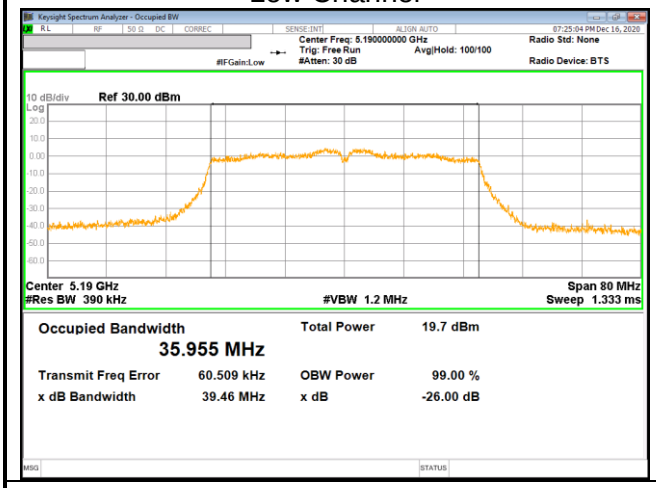
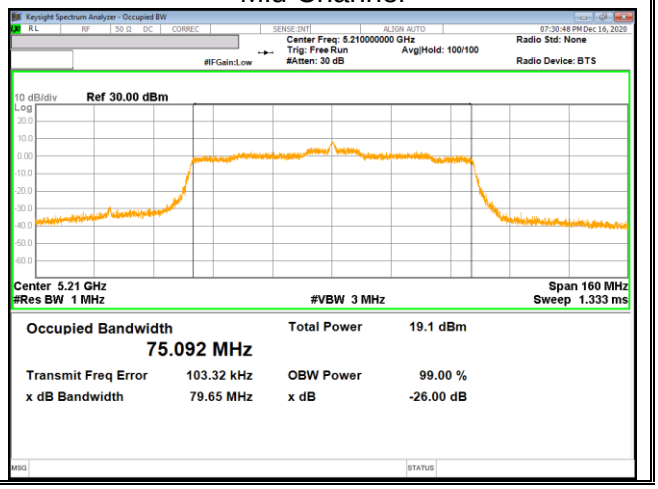
9.3.4. STRADDLE CHANNEL

Band	Mode	Channel	Center Freq. [MHz]	26 dB BW [MHz]	
				UNII-2C	UNII-3
Straddle Channel	802.11a	Straddle	5720	14.396	4.464
	802.11n HT20	Straddle	5720	15.020	5.184
	802.11n HT40	Straddle	5710	34.896	4.704
	802.11ac VHT80	Straddle	5690	75.264	5.776

9.3.5. 26 dB BANDWIDTH PLOTS

UNII 5.2 GHz Band

802.11a	802.11n HT20
Low Channel	Low Channel
	
Mid Channel	Mid Channel
	
High Channel	High Channel
	

802.11n HT40	802.11ac VHT80
Low Channel	Mid Channel
	
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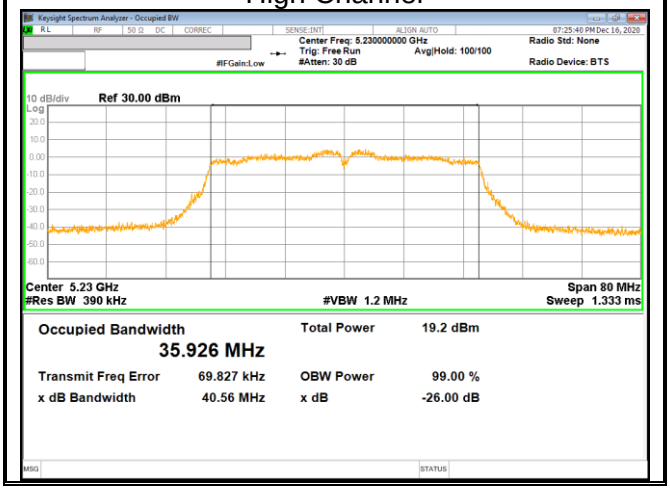
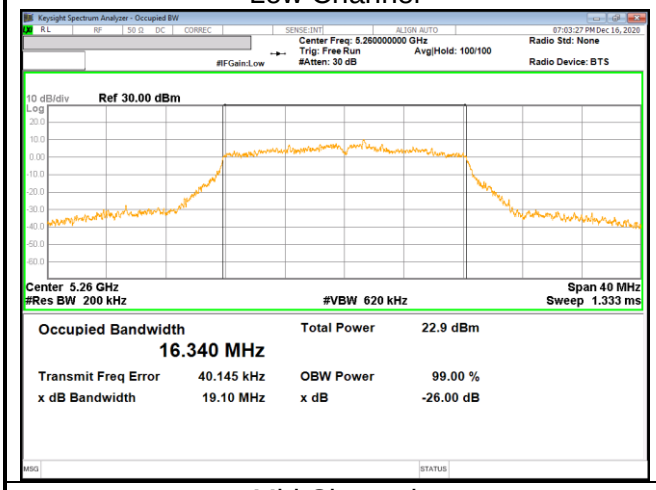
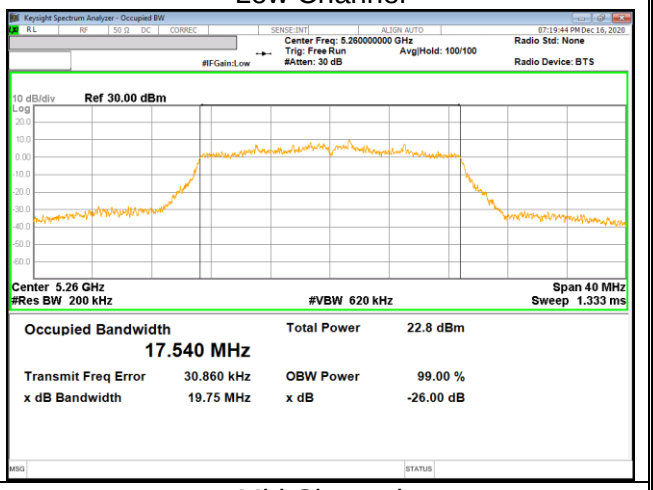
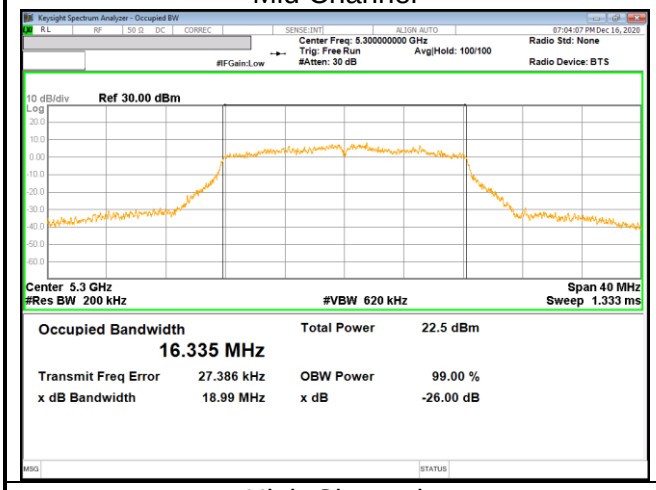
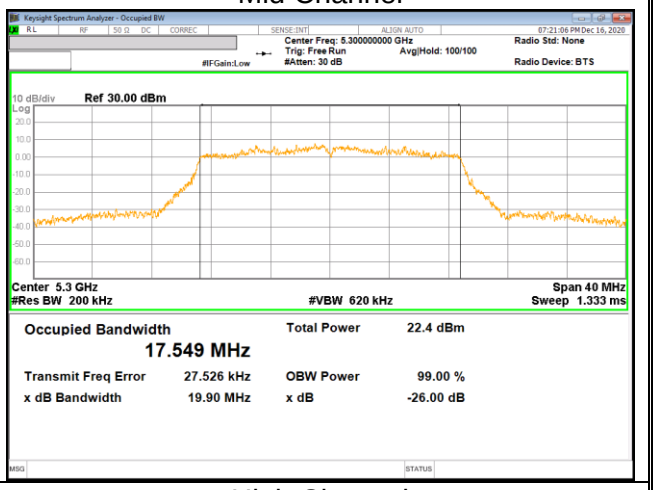
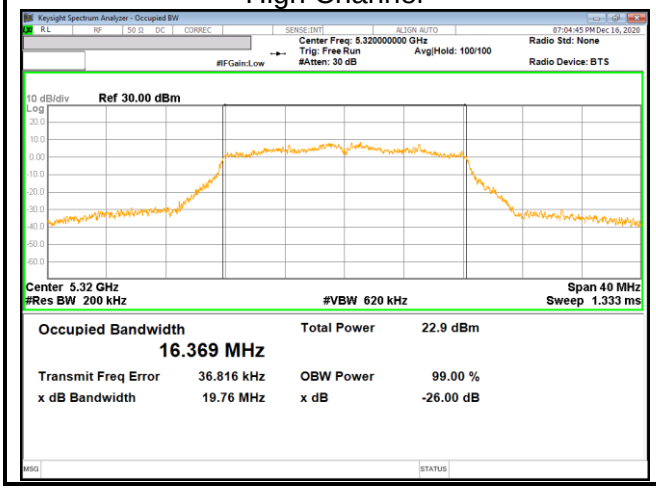
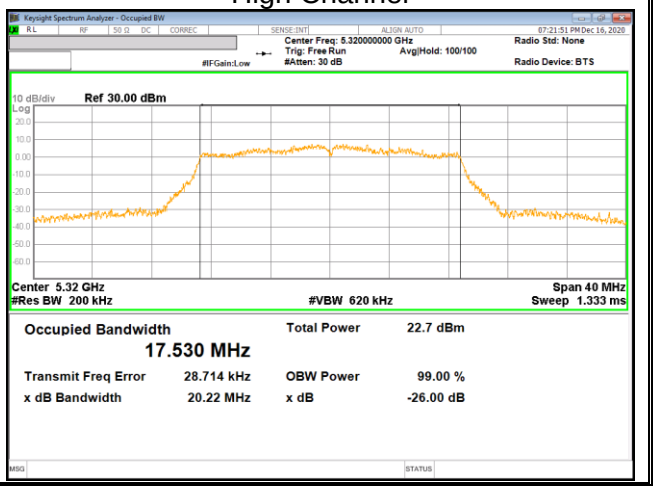
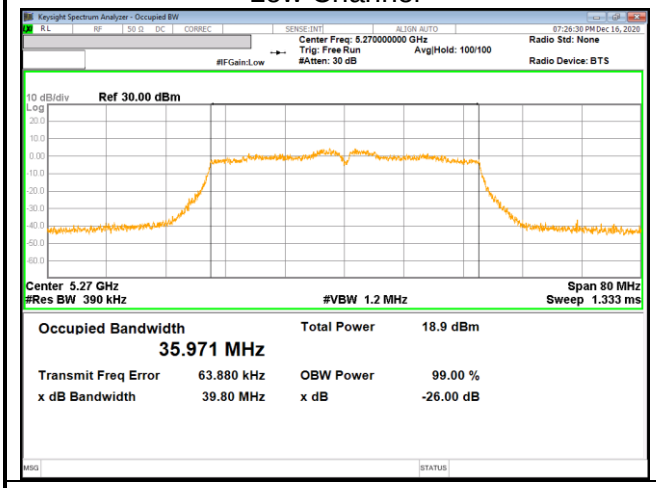
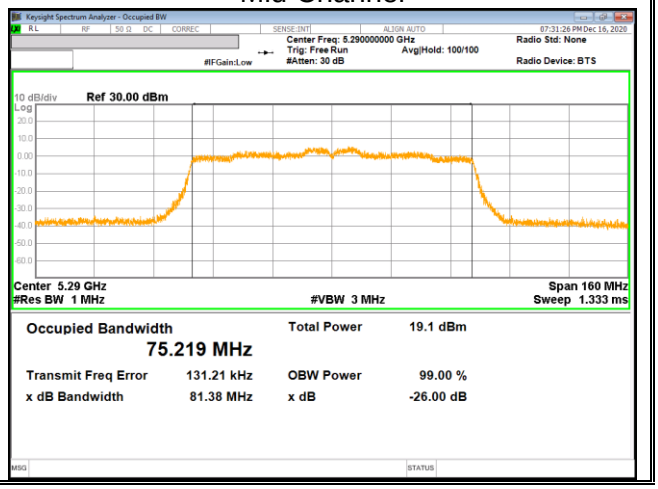
	

UNII 5.3 GHz Band

802.11a	802.11n HT20
Low Channel	Low Channel
	
Mid Channel	Mid Channel
	
High Channel	High Channel
	

802.11n HT40	802.11ac VHT80
Low Channel	Mid Channel
	
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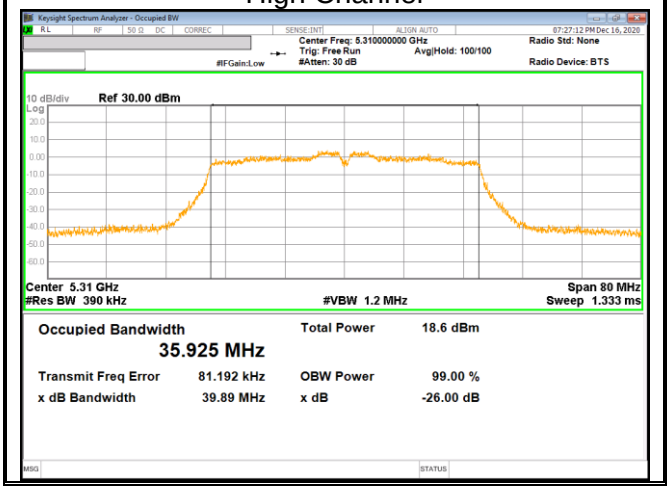
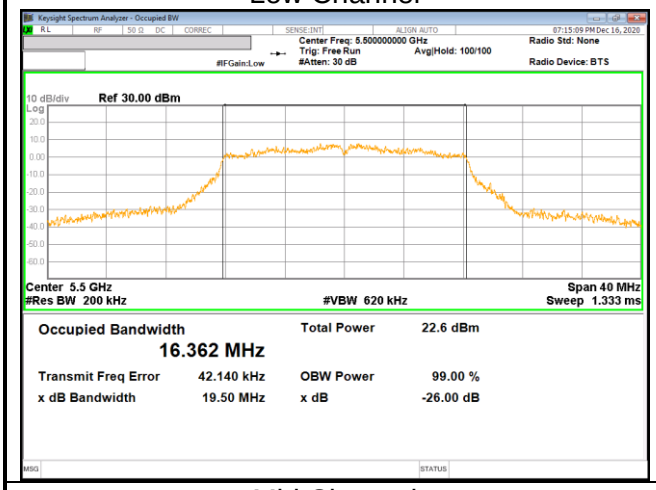
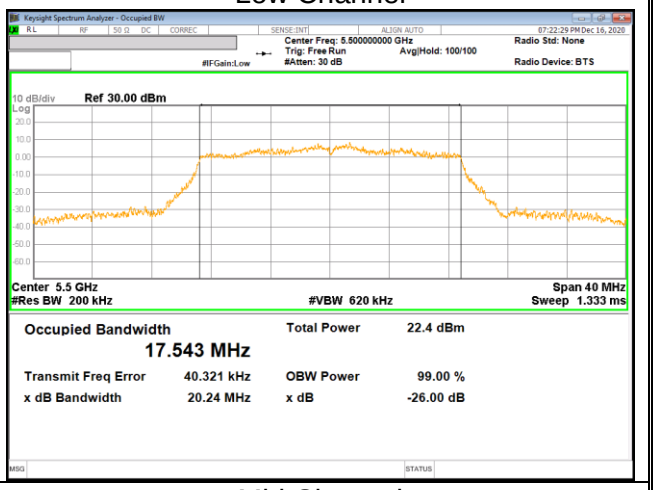
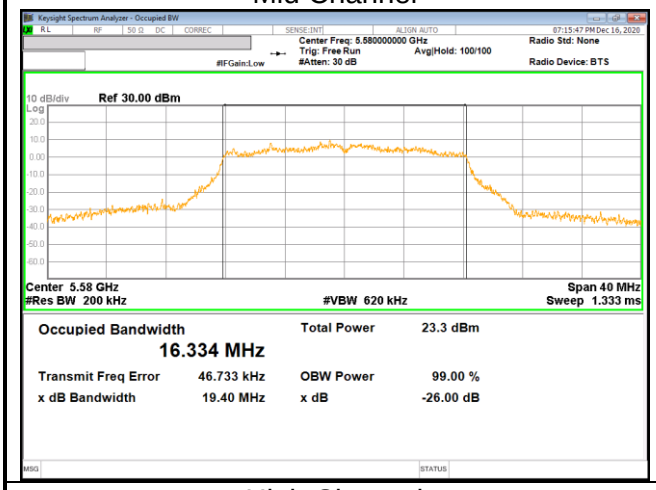
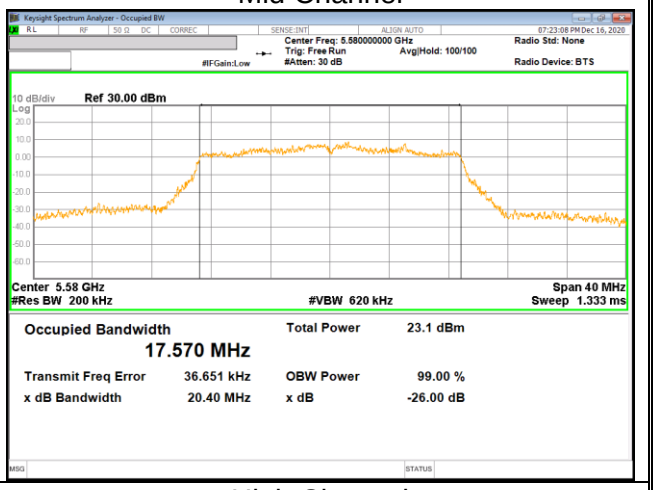
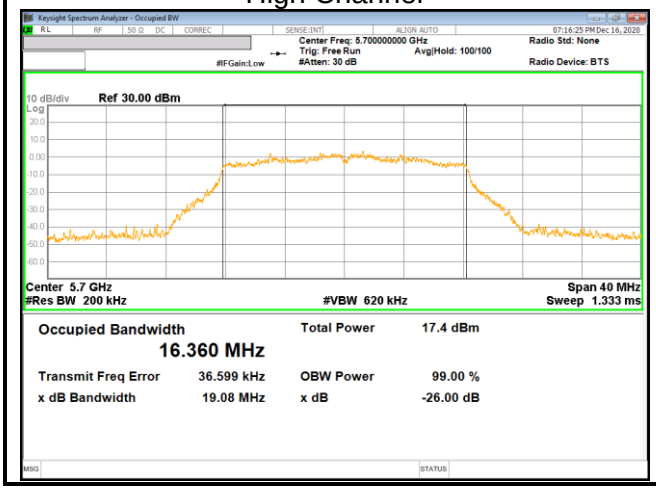
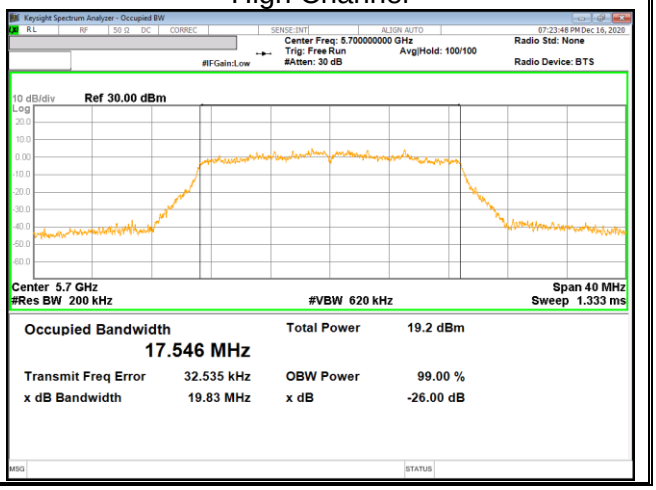
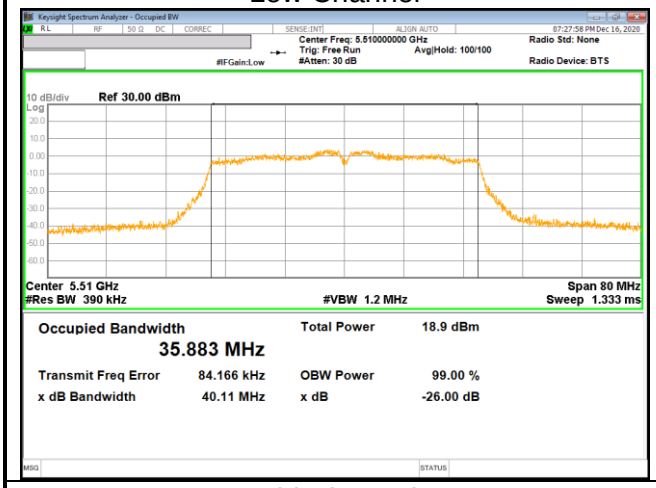
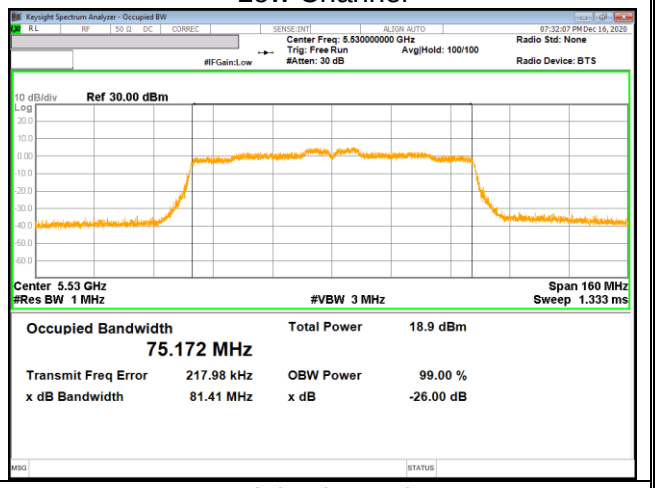
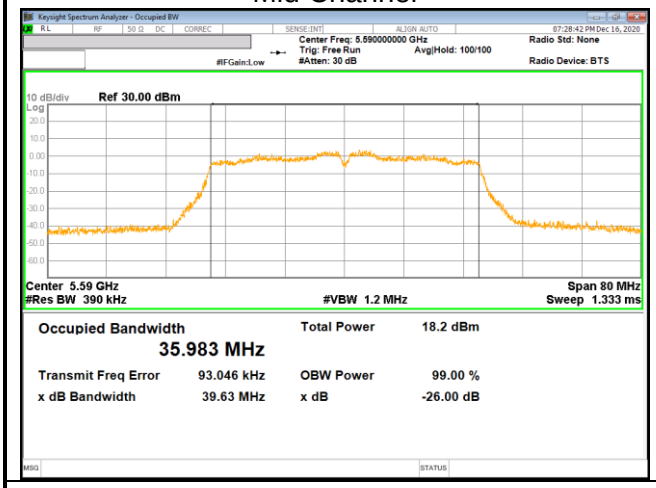
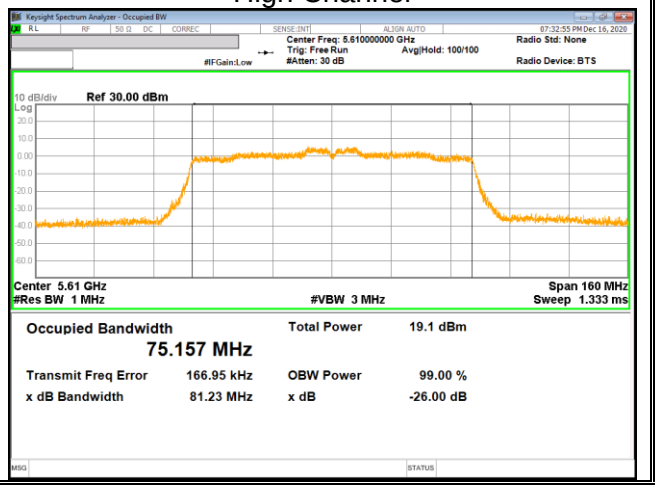
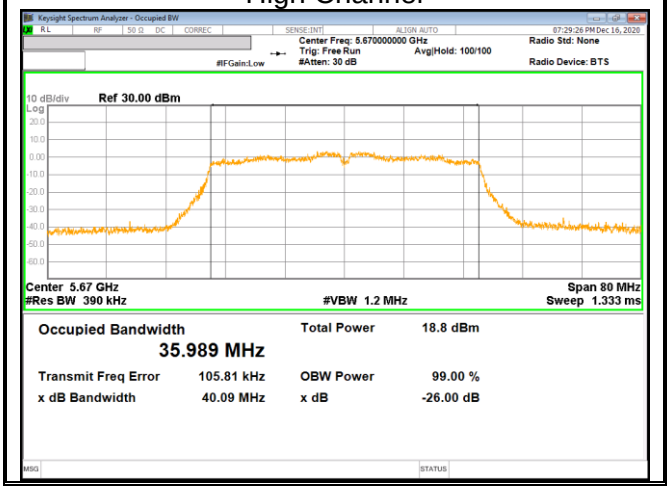
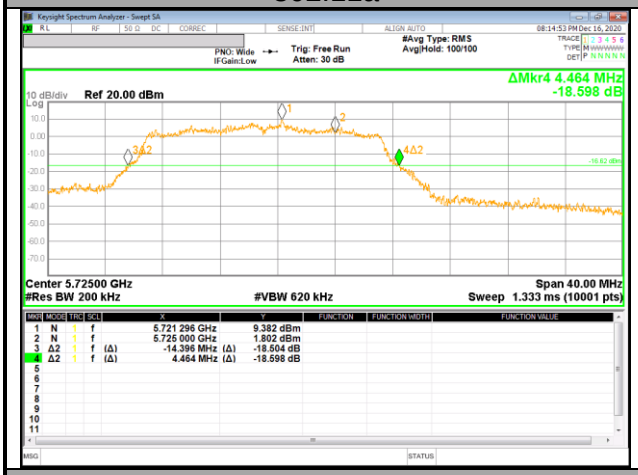
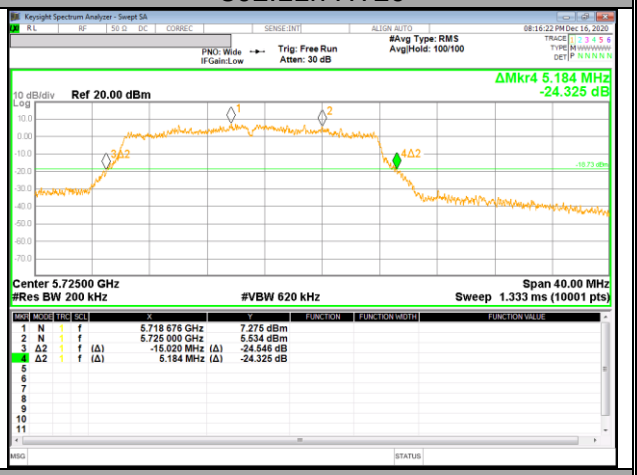
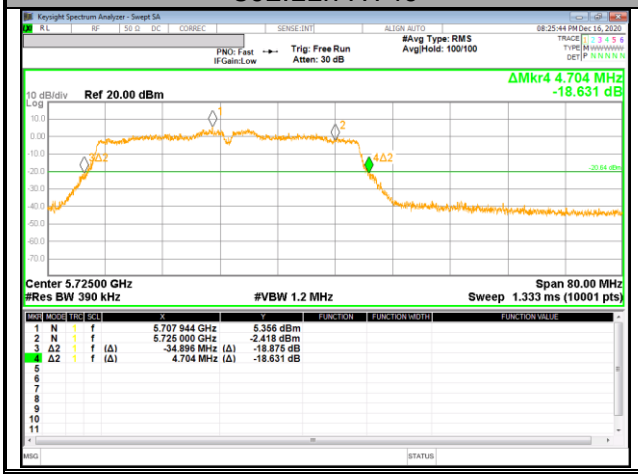
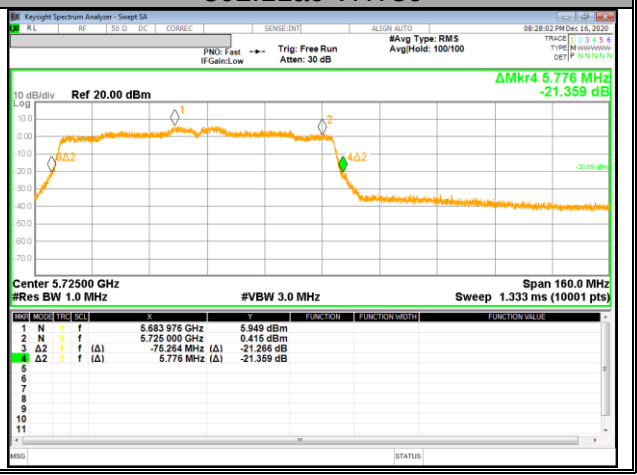
	

UNII 5.5 GHz Band

802.11a	802.11n HT20
Low Channel	Low Channel
	
Mid Channel	Mid Channel
	
High Channel	High Channel
	

802.11n HT40	802.11ac VHT80
Low Channel	Low Channel
	
Mid Channel	High Channel
	
High Channel	
	

UNII Straddle Channel IEEE 802.11a / n HT20 / n HT40 / ac VHT80 mode

802.11a	802.11n HT20
	
802.11n HT40	**802.11ac VHT80**
	

10. ANTENNA PORT TEST RESULTS

10.1. 6 dB BANDWIDTH

LIMITS

FCC §15.407

The minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

Reference to 789033 D02 General UNII Test Procedures New Rules v02r01: The transmitter output is connected to a spectrum analyzer with the RBW set to100KHz, the VBW >= 3 x RBW, peak detector and max hold.

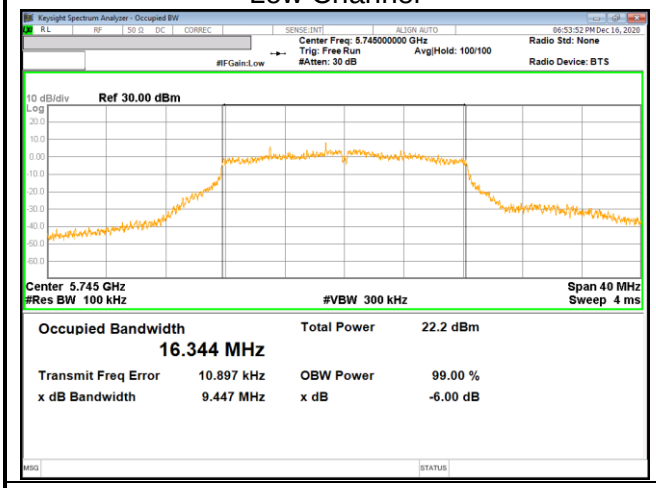
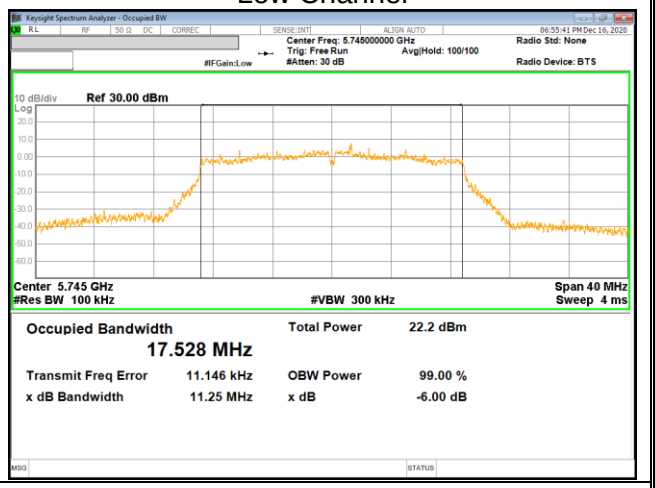
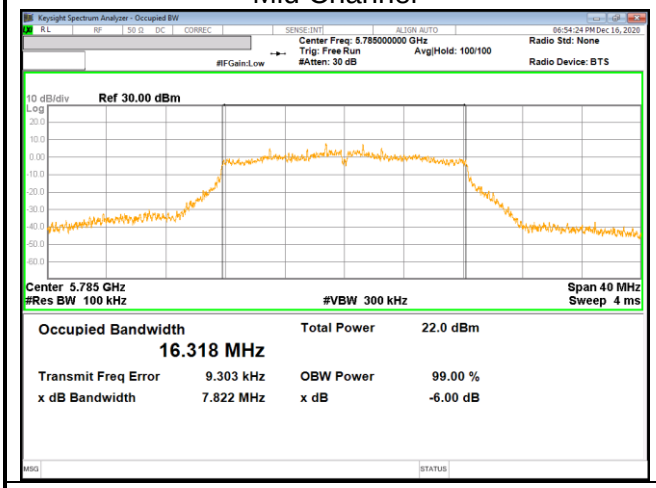
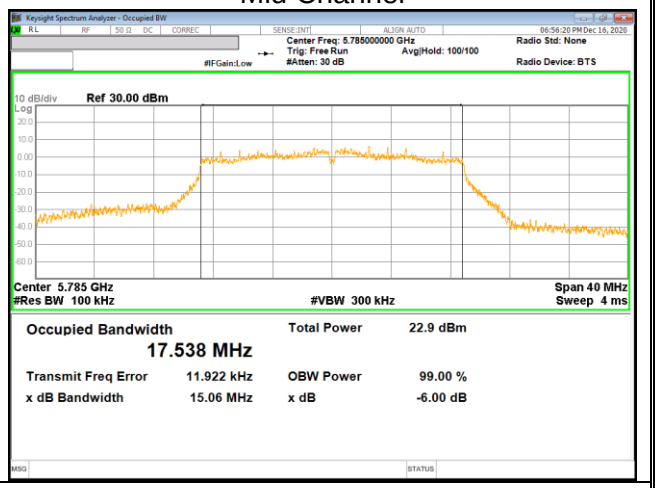
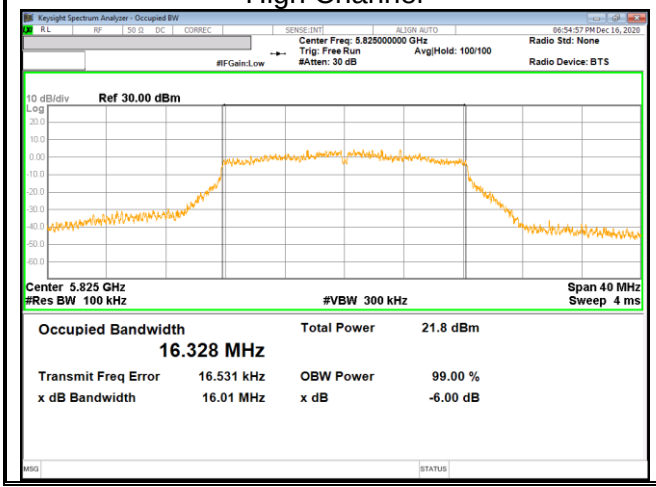
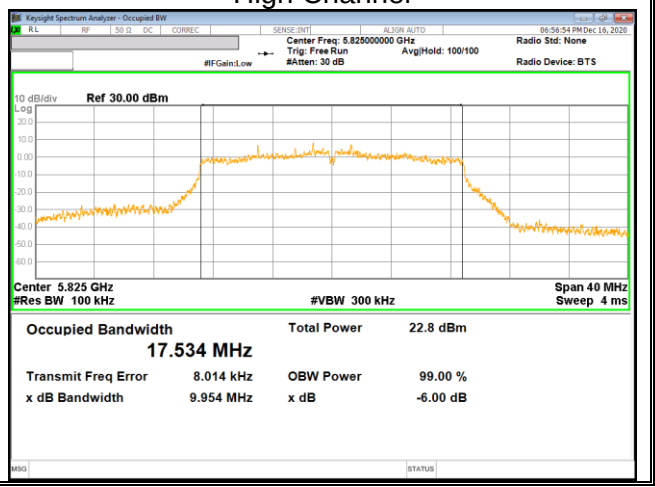
RESULTS

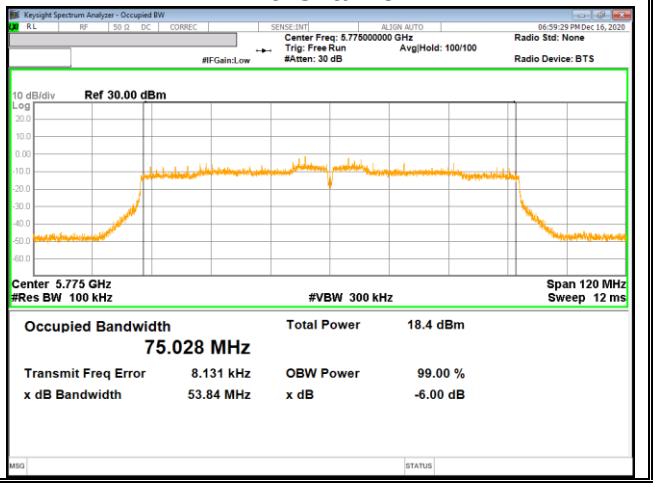
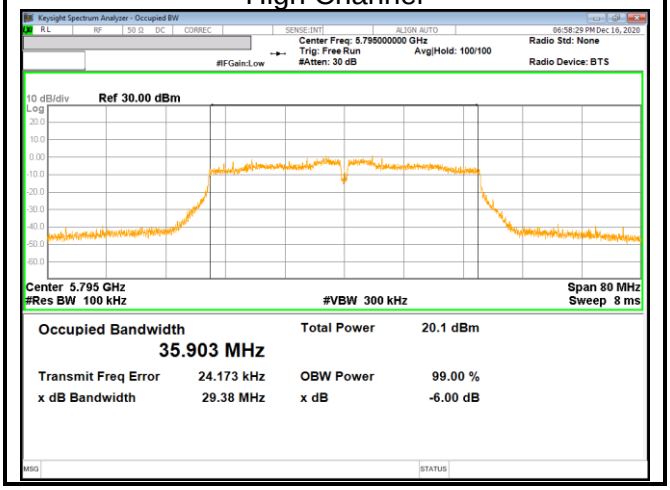
10.1.1. 5.8 GHz BAND

Band	Mode	Channel	Center Freq. [MHz]	6 dB BW [MHz]	Worst	Minimum Limit [MHz]
UNII-3	802.11a	Low	5745	9.45	7.82	0.5
		Mid	5785	7.82		
		High	5825	16.01		
	802.11n HT20	Low	5745	11.25	9.95	
		Mid	5785	15.06		
		High	5825	9.95		
	802.11n HT40	Low	5755	29.38	29.38	
		High	5795	29.38		
	802.11ac VHT80	Mid	5775	53.84	53.84	

10.1.2. 6 dB BANDWIDTH PLOTS

UNII 5.8 GHz Band

802.11a	802.11n HT20
Low Channel	Low Channel
	
Mid Channel	Mid Channel
	
High Channel	High Channel
	

802.11n HT40	802.11ac VHT80
Low Channel	Mid Channel
	
High Channel	
	

10.2. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (1) (2) (3)

FCC

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 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. 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.

TEST PROCEDURE

KDB 789033 Method PM is used for output power.

KDB 789033 Method SA-2 is used for only power of straddle Ch. and PPSD. RBW set to 1MHz (500kHz for the band 5.725-5.85 GHz, the VBW >= 3 x RBW, RMS detector and trace averaging). Band power function used for power and peak marker value of the spectrum is used for PSD.

DIRECTIONAL ANTENNA GAIN

For OUTPUT POWER and PSD: The TX chains are correlated and the antenna gains are unequal among the chains. The directional gain is:

Frequency Band [MHz]	Antenna Gain [dBi]
UNII 1 (5150 – 5250)	1.91
UNII 2A (5250 – 5350)	1.14
UNII 2C (5470 – 5725)	-0.20
UNII 3 (5725 – 5850)	0.71

RESULTS

10.2.1. 1Tx MODE IN THE 5.2 GHz BAND

Bandwidth and Antenna Gain, Limits

Band	Mode	Channel	Center Freq. [MHz]	Min 26 dB BW [MHz]	Directional Gain [dBi]	Power Limit [dBm]	PPSD Limit [dBm/MHz]
UNII-1	802.11a	Low	5180	19.47	1.91	23.98	11.00
		Mid	5200				
		High	5240				
	802.11n HT20	Low	5180	19.94		23.98	11.00
		Mid	5200				
		High	5240				
	802.11n HT40	Low	5190	39.46		23.98	11.00
		High	5230				
	802.11ac VHT80	Mid	5210	79.65		23.98	11.00

Included in Calculations of Corr'd Power & PPSD			
Duty Cycle CF [dB]	802.11a	0.00	dB
	802.11n HT20	0.00	dB
	802.11n HT40	0.00	dB
	802.11ac VHT80	0.00	dB

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Output Power Results

Band	Mode	Channel	Center Freq. [MHz]	Corr'd Power [dBm]	Power Limit [dBm]
UNII-1	802.11a	Low	5180	17.14	23.98
		Mid	5200	17.75	
		High	5240	17.20	
	802.11n HT20	Low	5180	17.10	23.98
		Mid	5200	17.60	
		High	5240	17.09	
	802.11n HT40	Low	5190	13.97	23.98
		High	5230	13.35	
	802.11ac VHT80	Mid	5210	12.77	23.98

* Calculation of Output Power : Corr'd Power = Meas Power [dBm] + Duty CF [dB]

PPSD Results

Band	Mode	Channel	Center Freq. [MHz]	Meas PPSD [dBm/MHz]	Total Corr'd PPSD [dBm/MHz]	PPSD Limit [dBm/MHz]
UNII-1	802.11a	Low	5180	8.391	8.391	11.00
		Mid	5200	9.029	9.029	
		High	5240	8.796	8.796	
	802.11n HT20	Low	5180	8.133	8.133	
		Mid	5200	8.981	8.981	
		High	5240	8.283	8.283	
	802.11n HT40	Low	5190	2.340	2.340	
		High	5230	1.702	1.702	
	802.11ac VHT80	Mid	5210	-1.618	-1.618	

* Calculation of PPSD result : Corr'd PPSD = Meas PPSD + Duty CF + Corr'd factor [dB]

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10.2.2. 1Tx MODE IN THE 5.3 GHz BAND

Bandwidth and Antenna Gain, Limits

Band	Mode	Channel	Center Freq. [MHz]	Min 26 dB BW [MHz]	Directional Gain [dBi]	Power Limit [dBm]	PPSD Limit [dBm/MHz]
UNII-2A	802.11a	Low	5260	18.99	1.14	23.79	11.00
		Mid	5300				
		High	5320				
	802.11n HT20	Low	5260	19.75		23.96	11.00
		Mid	5300				
		High	5320				
	802.11n HT40	Low	5270	39.80		24.00	11.00
		High	5310				
	802.11ac VHT80	Mid	5290	81.38		24.00	11.00

Included in Calculations of Corr'd Power & PPSD			
Duty Cycle CF [dB]	802.11a	0.00	dB
	802.11n HT20	0.00	dB
	802.11n HT40	0.00	dB
	802.11ac VHT80	0.00	dB

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Output Power Results

Band	Mode	Channel	Center Freq. [MHz]	Corr'd Power [dBm]	Power Limit [dBm]
UNII-2A	802.11a	Low	5260	17.09	23.79
		Mid	5300	17.15	
		High	5320	17.66	
	802.11n HT20	Low	5260	17.02	23.96
		Mid	5300	17.05	
		High	5320	17.54	
	802.11n HT40	Low	5270	13.23	24.00
		High	5310	13.30	
	802.11ac VHT80	Mid	5290	12.68	24.00

* Calculation of Output Power : Corr'd Power = Meas Power [dBm] + Duty CF [dB]

PPSD Results

Band	Mode	Channel	Center Freq. [MHz]	Meas PPSD [dBm/MHz]	Corr'd PPSD [dBm/MHz]	PPSD Limit [dBm/MHz]
UNII-2A	802.11a	Low	5260	8.655	8.655	11.00
		Mid	5300	8.569	8.569	
		High	5320	8.496	8.496	
	802.11n HT20	Low	5260	8.198	8.198	
		Mid	5300	7.886	7.886	
		High	5320	8.460	8.460	
	802.11n HT40	Low	5270	1.555	1.555	
		High	5310	1.409	1.409	
	802.11ac VHT80	Mid	5290	-1.935	-1.935	

* Calculation of PPSD result : Corr'd PPSD = Meas PPSD + Duty CF + Corr'd factor [dB]

10.2.3. 1Tx MODE IN THE 5.5 GHz BAND

Bandwidth and Antenna Gain, Limits

Band	Mode	Channel	Center Freq. [MHz]	Min 26 dB BW [MHz]	Directional Gain [dBi]	Power Limit [dBm]	PPSD Limit [dBm/MHz]
UNII-2C	802.11a	Low	5500	19.08	-0.20	23.81	11.00
		Mid	5580				
		High	5700				
	802.11n HT20	Low	5500	19.83		23.97	11.00
		Mid	5580				
		High	5700				
	802.11n HT40	Low	5510	39.63		24.00	11.00
		Mid	5590				
		High	5670				
	802.11ac VHT80	Low	5530	81.23		24.00	11.00
		High	5610				

Included in Calculations of Corr'd Power & PPSD			
Duty Cycle CF [dB]	802.11a	0.00	dB
	802.11n HT20	0.00	dB
	802.11n HT40	0.00	dB
	802.11ac VHT80	0.00	dB

Output Power Results

Band	Mode	Channel	Center Freq. [MHz]	Corr'd Power [dBm]	Power Limit [dBm]
UNII-2C	802.11a	Low	5500	17.09	23.81
		Mid	5580	17.67	
		High	5700	11.87	
	802.11n HT20	Low	5500	17.05	23.97
		Mid	5580	17.53	
		High	5700	13.67	
	802.11n HT40	Low	5510	12.51	24.00
		Mid	5590	12.90	
		High	5670	13.04	
	802.11ac VHT80	Low	5530	11.54	24.00
		High	5610	12.60	

* Calculation of Output Power : Corr'd Power = Meas Power [dBm] + Duty CF [dB]

PPSD Results

Band	Mode	Channel	Center Freq. [MHz]	Meas PPSD [dBm/MHz]	Corr'd PPSD [dBm/MHz]	PPSD Limit [dBm/MHz]
UNII-2C	802.11a	Low	5500	8.145	8.145	11.00
		Mid	5580	8.799	8.799	
		High	5700	2.950	2.950	
	802.11n HT20	Low	5500	8.056	8.056	
		Mid	5580	8.510	8.510	
		High	5700	4.645	4.645	
	802.11n HT40	Low	5510	1.477	1.477	
		Mid	5590	0.868	0.868	
		High	5670	1.435	1.435	
	802.11ac VHT80	Low	5530	-2.133	-2.133	
		High	5610	-2.034	-2.034	

* Calculation of PPSD result : Corr'd PPSD = Meas PPSD + Duty CF + Corr'd factor [dB]

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10.2.4. 1Tx MODE IN THE 5.8 GHz BAND

Bandwidth and Antenna Gain, Limits

Included in Calculations of Corr'd Power & PPSD			
Duty Cycle CF [dB]	802.11a	0.00	dB
	802.11n HT20	0.00	dB
	802.11n HT40	0.00	dB
	802.11ac VHT80	0.00	dB

Output Power Results

Band	Mode	Channel	Center Freq. [MHz]	Corr'd Power [dBm]	Power Limit [dBm]
UNII-3	802.11a	Low	5745	17.04	30.00
		Mid	5785	16.80	
		High	5825	16.74	
	802.11n HT20	Low	5745	16.74	
		Mid	5785	17.58	
		High	5825	17.56	
	802.11n HT40	Low	5755	15.01	
		High	5795	14.80	
	802.11ac VHT80	Mid	5775	12.75	

* Calculation of Output Power : Corr'd Power = Meas Power [dBm] + Duty CF [dB]

PPSD Results

Band	Mode	Channel	Center Freq. [MHz]	Meas PPSD [dBm/500kHz]	Corr'd PPSD [dBm/500kHz]	PPSD Limit [dBm/500kHz]
UNII-3	802.11a	Low	5745	5.142	5.142	30.00
		Mid	5785	5.438	5.438	
		High	5825	5.142	5.142	
	802.11n HT20	Low	5745	4.728	4.728	
		Mid	5785	6.102	6.102	
		High	5825	5.927	5.927	
	802.11n HT40	Low	5755	0.516	0.516	
		High	5795	0.501	0.501	
	802.11ac VHT80	Mid	5775	-4.623	-4.623	

* Calculation of PPSD result : Corr'd PPSD = Meas PPSD + Duty CF + Corr'd factor [dB]

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10.2.5. 1Tx Mode Straddle channel IN THE 5.5 GHz BAND

Bandwidth and Antenna Gain, Limits

Band	Mode	Channel	Center Freq. [MHz]	Min 26 dB BW [MHz]	Directional Gain [dBi]	Power Limit [dBm]	PPSD Limit [dBm/MHz]
UNII-2C	802.11a	Straddle	5720	14.396	-0.20	22.58	11.00
	802.11n HT20	Straddle	5720	15.020		22.77	11.00
	802.11n HT40	Straddle	5710	34.896		24.00	11.00
	802.11ac VHT80	Straddle	5690	75.264		24.00	11.00
Included in Calculations of Corr'd Power & PPSD							
Duty Cycle CF [dB]			802.11a			0.00	dB
			802.11n HT20			0.00	dB
			802.11n HT40			0.00	dB
			802.11ac VHT80			0.00	dB

Output Power Results

Band	Mode	Channel	Center Freq. [MHz]	Meas Power [dBm]	Corr'd Power [dBm]	Power Limit [dBm]
UNII-2C	802.11a	Straddle	5720	16.024	16.024	22.58
	802.11n HT20	Straddle	5720	15.816	15.816	22.77
	802.11n HT40	Straddle	5710	13.015	13.015	24.00
	802.11ac VHT80	Straddle	5690	12.888	12.888	24.00

* Calculation of Output Power : Corr'd Power = Meas Power [dBm] + Duty CF [dB]

PPSD Results

Band	Mode	Channel	Center Freq. [MHz]	Meas PPSD [dBm/MHz]	Corr'd PPSD [dBm/MHz]	PPSD Limit [dBm/MHz]
UNII-2C	802.11a	Straddle	5720	8.096	8.096	11.00
	802.11n HT20	Straddle	5720	7.899	7.899	
	802.11n HT40	Straddle	5710	1.461	1.461	
	802.11ac VHT80	Straddle	5690	-1.540	-1.540	

* Calculation of PPSD result : Corr'd PPSD = Meas PPSD + Duty CF + Corr'd factor [dB]

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10.2.6. 1Tx Mode Straddle channel IN THE 5.8 GHz BAND

Bandwidth and Antenna Gain, Limits

Band	Mode	Channel	Center Freq. [MHz]	Min 26 dB BW [MHz]	Directional Gain [dBi]	Power Limit [dBm]	PPSD Limit [dBm/500kHz]
UNII-3	802.11a	Straddle	5720	4.464	0.71	30.00	30.00
	802.11n HT20	Straddle	5720	5.184			
	802.11n HT40	Straddle	5710	4.704			
	802.11ac VHT80	Straddle	5690	5.776			
Included in Calculations of Corr'd Power & PPSD							
Duty Cycle CF [dB]			802.11a			0.00	dB
			802.11n HT20			0.00	dB
			802.11n HT40			0.00	dB
			802.11ac VHT80			0.00	dB

Output Power Results

Band	Mode	Channel	Center Freq. [MHz]	Meas Power [dBm]	Corr'd Power [dBm]	Power Limit [dBm]
UNII-3	802.11a	Straddle	5720	7.929	7.929	30.00
	802.11n HT20	Straddle	5720	8.284	8.284	
	802.11n HT40	Straddle	5710	0.636	0.636	
	802.11ac VHT80	Straddle	5690	-2.460	-2.460	

* Calculation of Output Power : Corr'd Power = Meas Power [dBm] + Duty CF [dB]

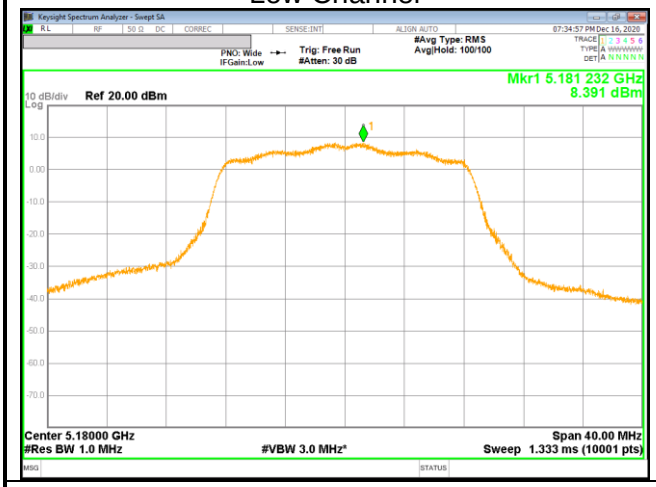
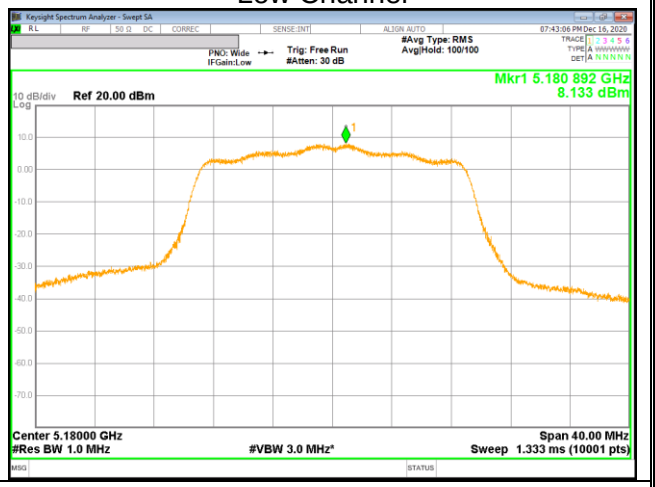
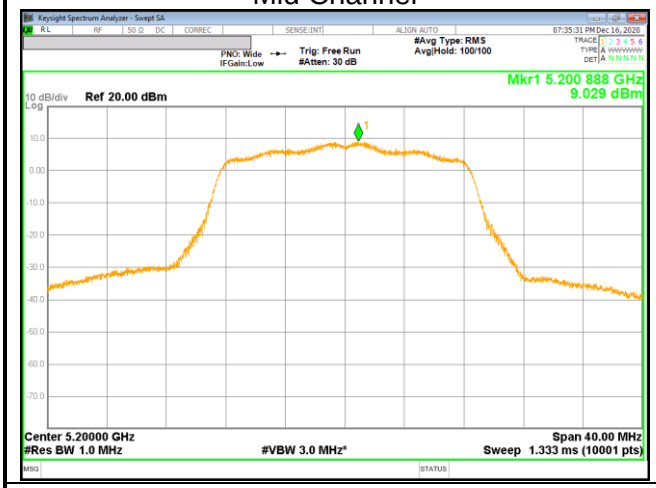
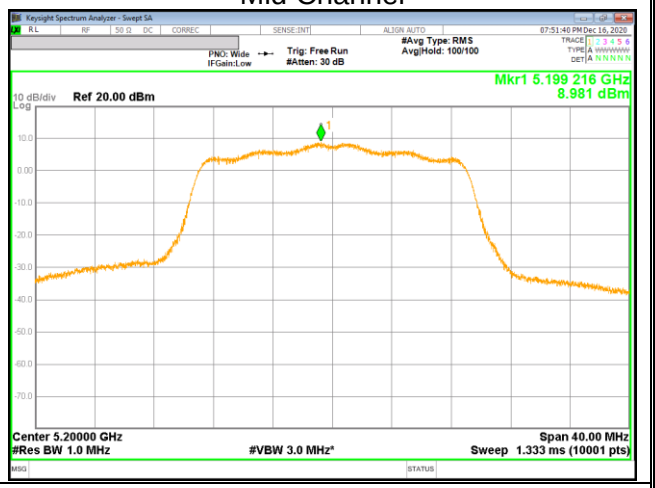
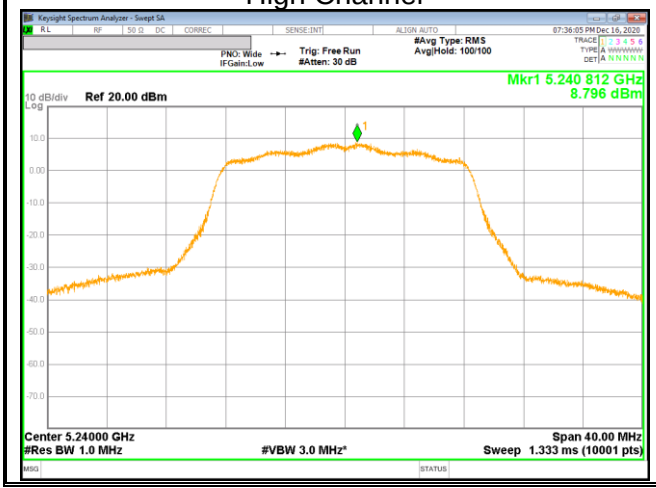
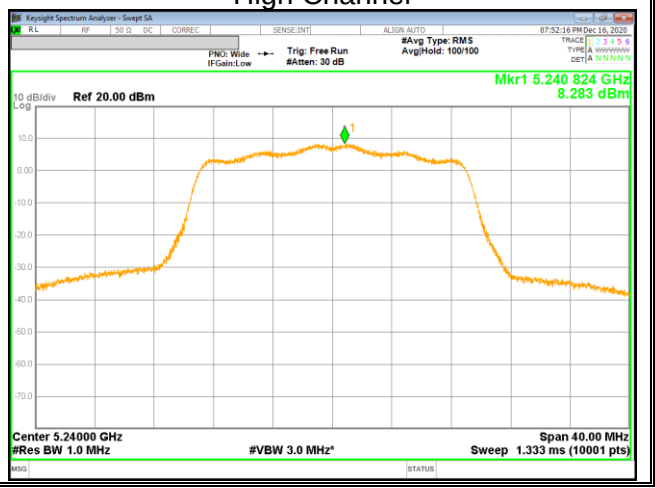
PPSD Results

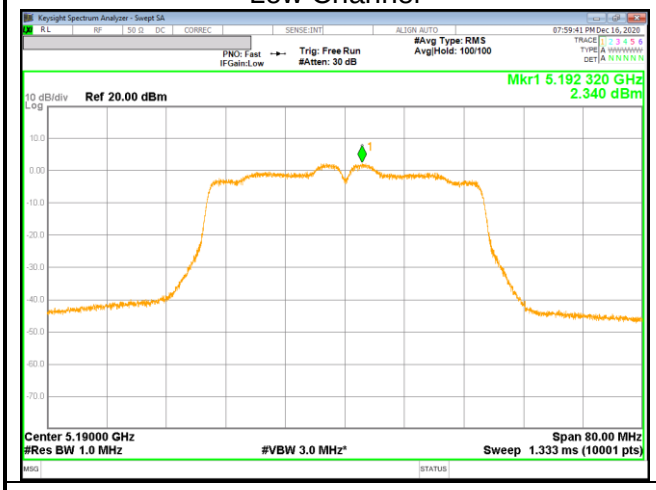
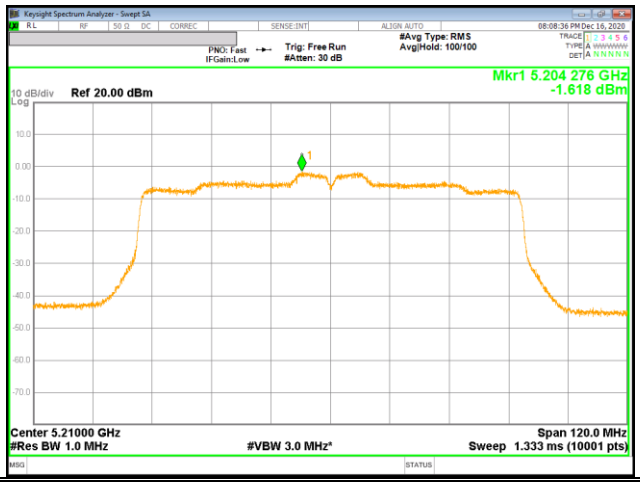
Band	Mode	Channel	Center Freq. [MHz]	Meas PPSD [dBm/500kHz]	Corr'd PPSD [dBm/500kHz]	PPSD Limit [dBm/500kHz]
UNII-3	802.11a	Straddle	5720	2.772	2.772	30.00
	802.11n HT20	Straddle	5720	2.166	2.166	
	802.11n HT40	Straddle	5710	-6.521	-6.521	
	802.11ac VHT80	Straddle	5690	-9.267	-9.267	

* Calculation of PPSD result : Corr'd PPSD = Meas PPSD + Duty CF + Corr'd factor [dB]

10.2.7. OUTPUT POWER AND PPSD PLOTS

UNII 5.2 GHz Band

802.11a	802.11n HT20
Low Channel	Low Channel
	
Mid Channel	Mid Channel
	
High Channel	High Channel
	

802.11n HT40	802.11ac VHT80
Low Channel	Mid Channel
	
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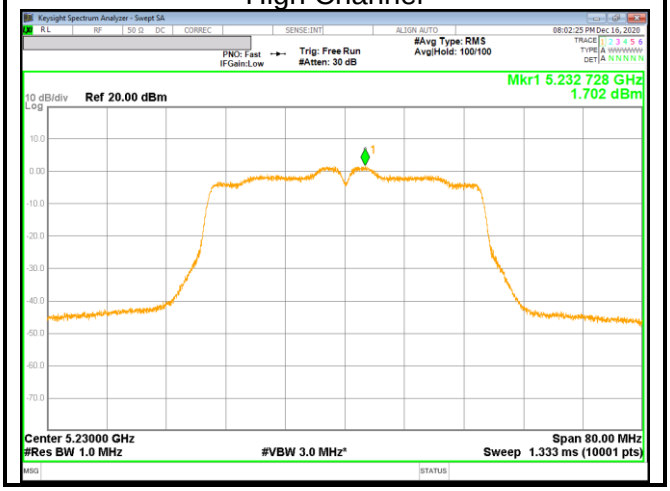
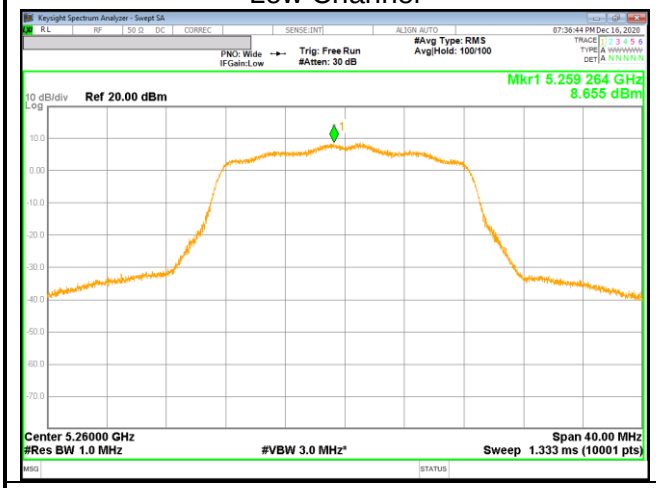
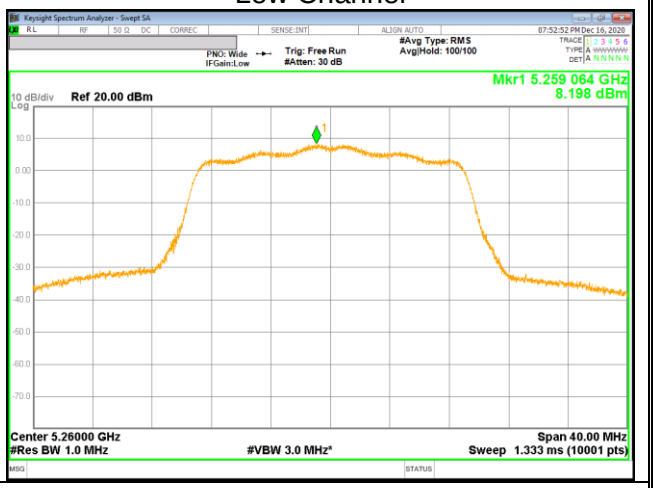
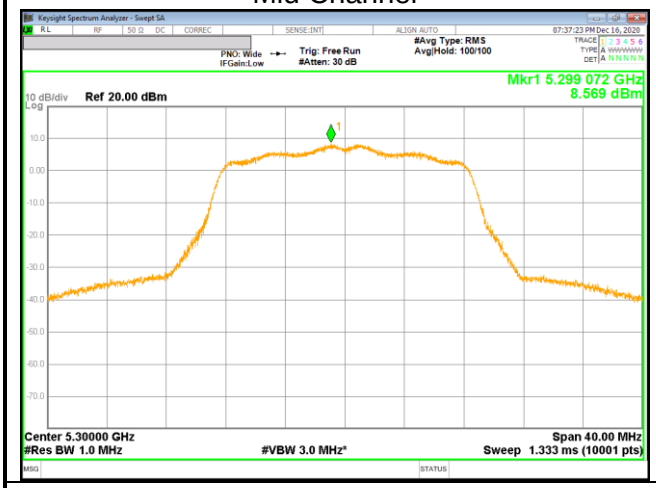
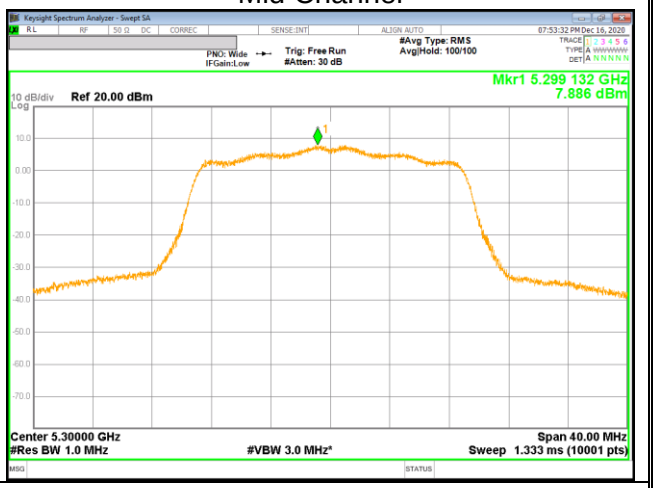
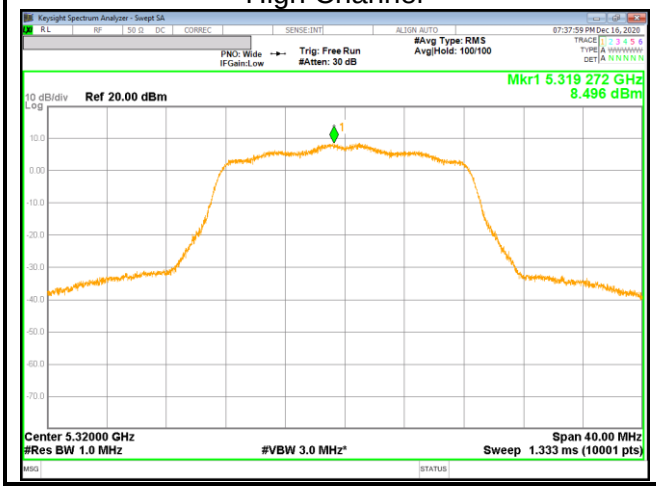
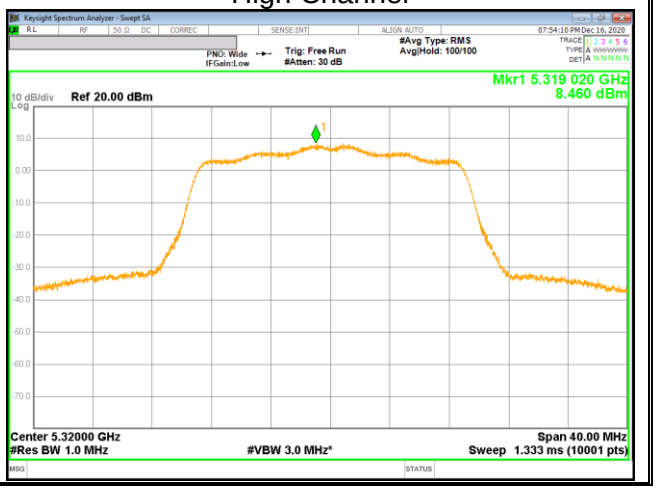
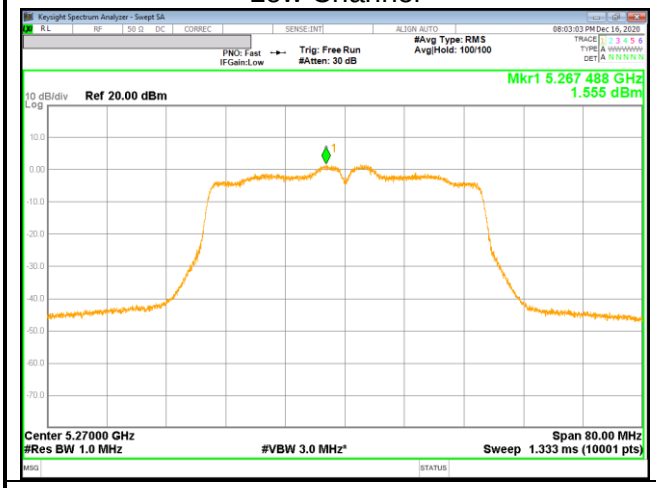
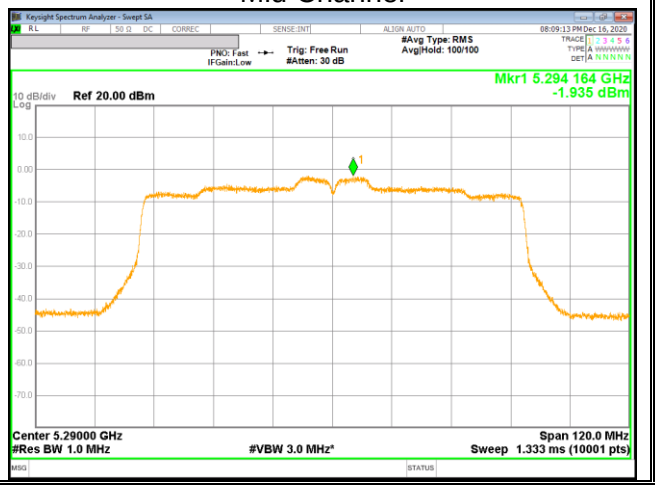
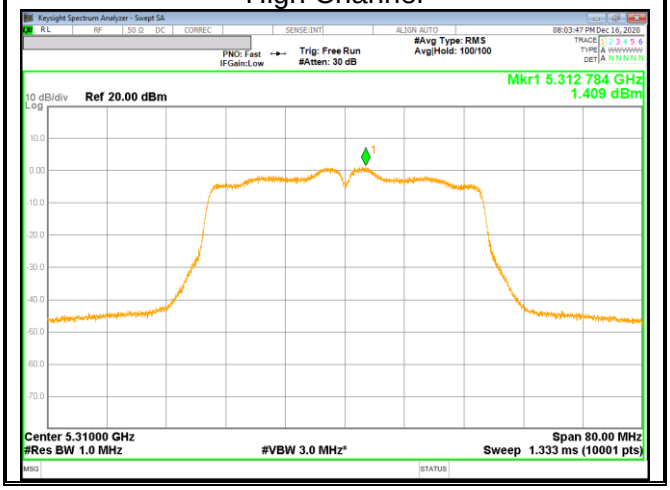
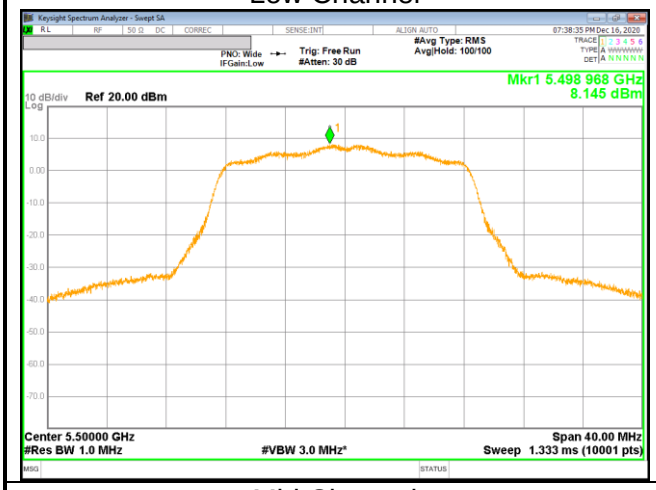
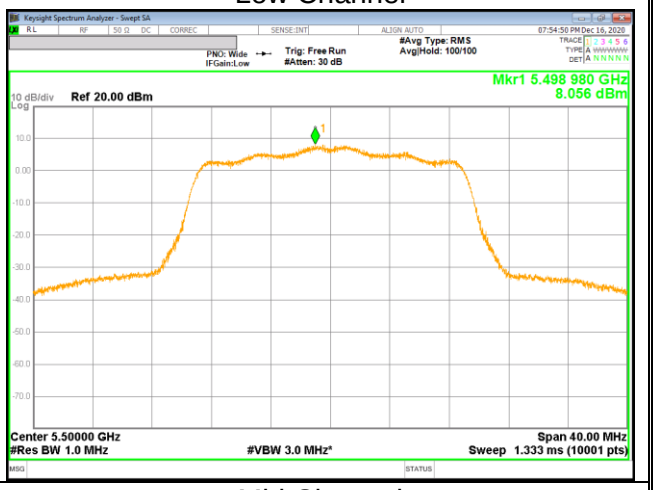
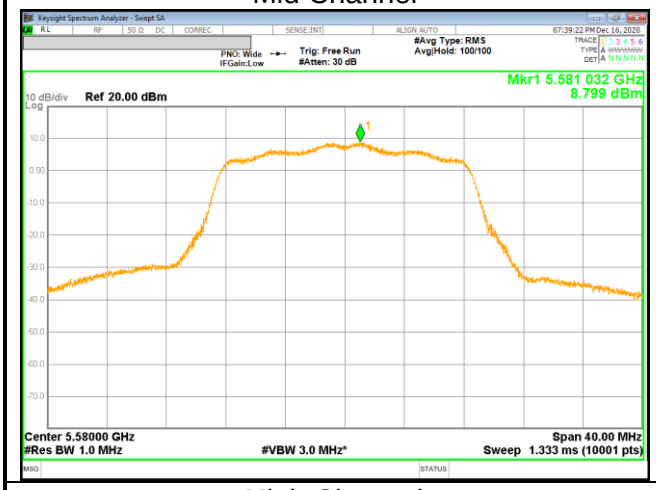
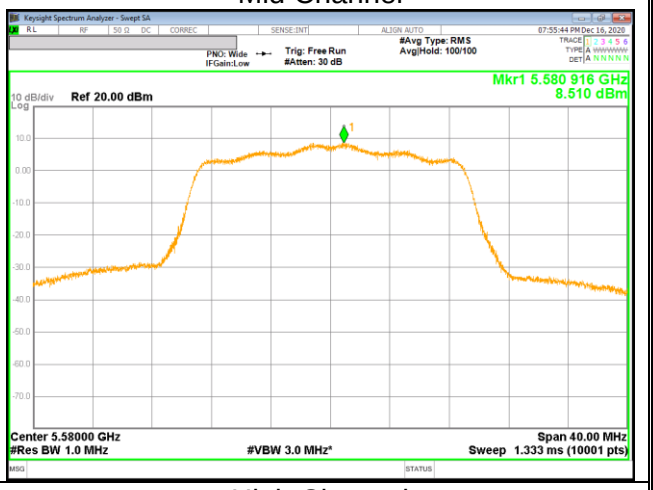
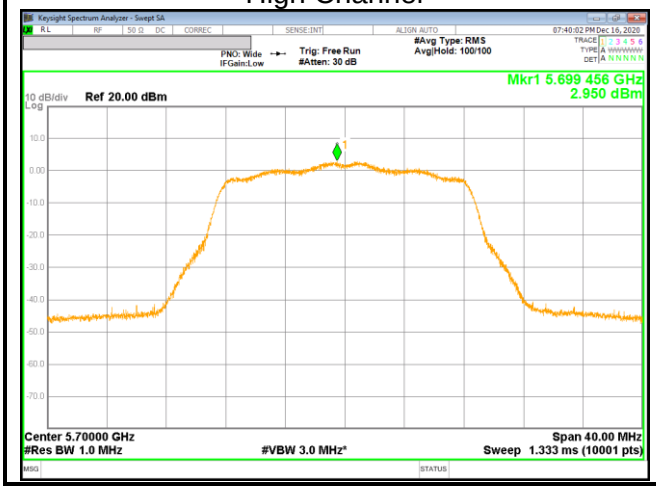
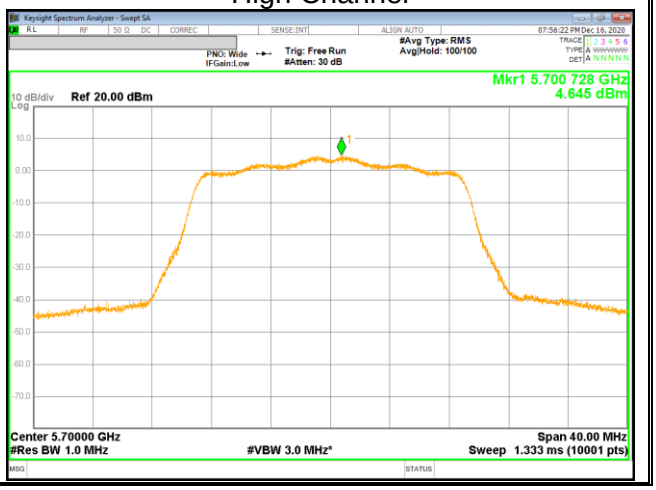
	

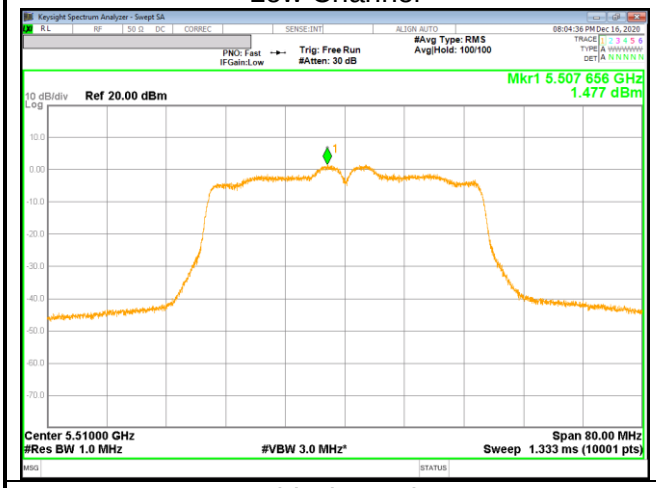
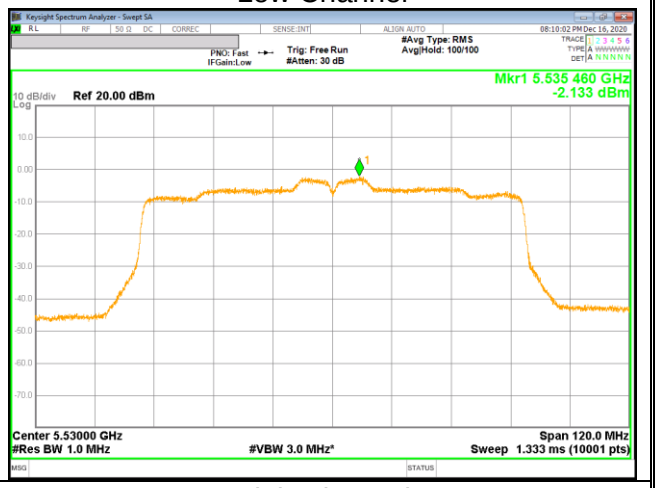
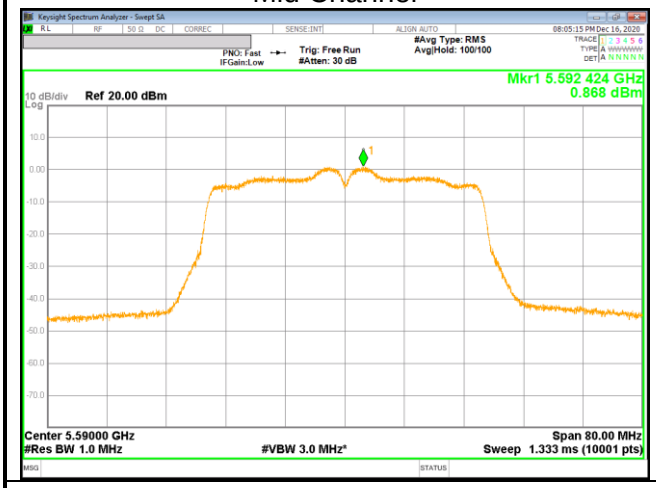
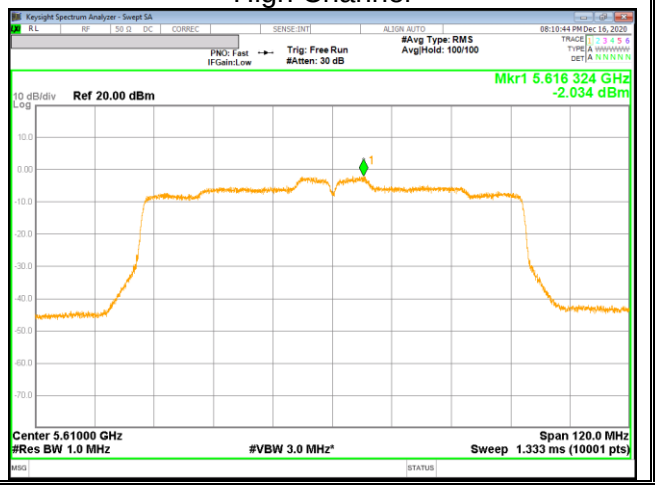
UNII 5.3 GHz Band

802.11a	802.11n HT20
Low Channel	Low Channel
	
Mid Channel	Mid Channel
	
High Channel	High Channel
	

802.11n HT40	802.11ac VHT80
Low Channel	Mid Channel
	
High Channel	
	

UNII 5.5 GHz Band

802.11a	802.11n HT20
Low Channel	Low Channel
	
Mid Channel	Mid Channel
	
High Channel	High Channel
	

802.11n HT40	802.11ac VHT80
Low Channel	Low Channel
	
Mid Channel	High Channel
	
High Channel