



CERTIFICATION TEST REPORT

Report Number. : 4789247752-E7V1

Applicant : SAMSUNG ELECTRONICS CO., LTD.
129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI,
GYEONGGI-DO, 16677, KOREA

Model : SM-G980F/DS, SM-G980F

FCC ID : A3LSMG980F

EUT Description : GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax,
ANT+, NFC and WPT

Test Standard(s) : FCC 47 CFR PART 15 SUBPART E

Date Of Issue:

January 07, 2020

Prepared by:

UL Korea, Ltd.

26th floor, 152, Teheran-ro, Gangnam-gu Seoul, 06236, Korea

Suwon Test Site: UL Korea, Ltd. Suwon Laboratory

218 Maeyeong-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16675, Korea

TEL: (031) 337-9902

FAX: (031) 213-5433



ACCREDITED

Testing Laboratory

TL-637

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
V1	01/07/20	Initial issue	Yeonhee Lim

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	6
1.1. INTRODUCTION OF TEST DATA REUSE	7
1.2. DIFFERENCE	7
1.3. SPOT CHECK VERIFICATION DATA	7
1.4. REFERENCE DETAIL	8
2. TEST METHODOLOGY	9
3. FACILITIES AND ACCREDITATION	9
4. CALIBRATION AND UNCERTAINTY	9
4.1. MEASURING INSTRUMENT CALIBRATION	9
4.2. SAMPLE CALCULATION	9
4.3. MEASUREMENT UNCERTAINTY	10
4.4. DECISION RULE	10
5. EQUIPMENT UNDER TEST	11
5.1. DESCRIPTION OF EUT	11
5.2. DESCRIPTION OF AVAILABLE ANTENNAS	13
5.3. List of test reduction and modes covering other modes:	13
5.4. WORST-CASE CONFIGURATION AND MODE	15
5.5. DESCRIPTION OF TEST SETUP	16
6. TEST AND MEASUREMENT EQUIPMENT	18
7. SUMMARY TABLE	19
8. MEASUREMENT METHODS	20
9. REFERENCE MEASUREMENTS RESULTS	21
9.1. ON TIME AND DUTY CYCLE RESULTS	21
9.2. DUTY CYCLE PLOTS	21
9.3. 26 dB BANDWIDTH	23
9.3.1. 5.2 GHz BAND	24
9.3.2. 5.3 GHz BAND	24
9.3.3. 5.5 GHz BAND	25
9.3.4. STRADDLE CHANNEL	25
9.3.5. 26 dB BANDWIDTH PLOTS	26
10. ANTENNA PORT TEST RESULTS	38
10.1. 6 dB BANDWIDTH	38

10.1.1.	5.8 GHz BAND.....	38
10.1.2.	6 dB BANDWIDTH PLOTS	39
10.2.	OUTPUT POWER AND PPSD	42
10.2.1.	1Tx MODE IN THE 5.2 GHz BAND.....	43
10.2.2.	1Tx MODE IN THE 5.3 GHz BAND.....	44
10.2.3.	1Tx MODE IN THE 5.5 GHz BAND.....	46
10.2.4.	1Tx MODE IN THE 5.8 GHz BAND.....	48
10.2.5.	1Tx Mode Straddle channel IN THE 5.5 GHz BAND	49
10.2.6.	1Tx Mode Straddle channel IN THE 5.8 GHz BAND	50
10.2.7.	2Tx MODE IN THE 5.2 GHz BAND.....	51
10.2.8.	2Tx MODE IN THE 5.3 GHz BAND.....	52
10.2.9.	2Tx MODE IN THE 5.5 GHz BAND.....	54
10.2.10.	2Tx MODE IN THE 5.8 GHz BAND.....	55
10.2.11.	2Tx Mode Straddle channel IN THE 5.5 GHz BAND	56
10.2.12.	2Tx Mode Straddle channel IN THE 5.8 GHz BAND	57
10.2.13.	OUTPUT POWER AND PPSD PLOTS.....	59
11.	TRANSMITTER ABOVE 1 GHz.....	76
11.1.	5.2 GHz.....	79
11.1.1.	TX ABOVE 1GHz 802.11a 2Tx MODE IN THE 5.2GHz BAND	79
11.1.2.	TX ABOVE 1GHz 802.11n HT20 2Tx MODE IN THE 5.2GHz BAND	87
11.1.3.	TX ABOVE 1GHz 802.11n HT40 2Tx MODE IN THE 5.2GHz BAND	95
11.1.4.	TX ABOVE 1GHz 802.11ac VHT80 2Tx MODE IN THE 5.2GHz BAND	101
11.2.	5.3 GHz.....	105
11.2.1.	TX ABOVE 1 GHz 802.11a 2Tx MODE IN THE 5.3 GHz BAND	105
11.2.2.	TX ABOVE 1GHz 802.11n HT20 2Tx MODE IN THE 5.3GHz BAND	113
11.2.3.	TX ABOVE 1GHz 802.11n HT40 2Tx CDD MODE IN THE 5.3GHz BAND	121
11.2.4.	TX ABOVE 1GHz 802.11ac VHT80 2Tx MODE IN THE 5.3GHz BAND	127
11.3.	5.5-5.6 GHz.....	131
11.3.1.	TX ABOVE 1 GHz 802.11a 2Tx MODE IN THE 5.5 GHz BAND	131
11.3.2.	TX ABOVE 1GHz 802.11n HT20 2Tx MODE IN THE 5.5GHz BAND	141
11.3.3.	TX ABOVE 1GHz 802.11n HT40 2Tx MODE IN THE 5.5GHz BAND	151
11.3.4.	TX ABOVE 1GHz 802.11ac VHT80 2Tx MODE IN THE 5.5GHz BAND	161
11.4.	5.8 GHz.....	169
11.4.1.	TX ABOVE 1GHz 802.11a 2Tx MODE IN THE 5.8GHz BAND	169
11.4.2.	TX ABOVE 1GHz 802.11n HT20 2Tx MODE IN THE 5.8GHz BAND	179
11.4.3.	TX ABOVE 1GHz 802.11n HT40 2Tx MODE IN THE 5.8GHz BAND	189
11.4.4.	TX ABOVE 1GHz 802.11ac VHT80 2Tx MODE IN THE 5.8GHz BAND	197
12.	WORST-CASE BELOW 1 GHz	203
13.	AC POWER LINE CONDUCTED EMISSIONS	205
14.	DYNAMIC FREQUENCY SELECTION.....	208
14.1.	OVERVIEW.....	208
14.1.1.	LIMITS.....	208
14.1.2.	TEST AND MEASUREMENT SYSTEM.....	212
14.1.3.	SETUP OF EUT.....	215

14.1.4.	DESCRIPTION OF EUT	216
14.2.	RESULTS FOR 20 MHz BANDWIDTH.....	217
14.2.1.	TEST CHANNEL	217
14.2.2.	RADAR WAVEFORM AND TRAFFIC.....	217
14.2.3.	OVERLAPPING CHANNEL TESTS.....	219
14.2.4.	MOVE AND CLOSING TIME	219
14.3.	RESULTS FOR 40 MHz BANDWIDTH.....	222
14.3.1.	TEST CHANNEL	222
14.3.2.	RADAR WAVEFORM AND TRAFFIC.....	222
14.3.3.	OVERLAPPING CHANNEL TESTS.....	224
14.3.4.	MOVE AND CLOSING TIME	224
14.4.	RESULTS FOR 80 MHz BANDWIDTH.....	227
14.4.1.	TEST CHANNEL	227
14.4.2.	RADAR WAVEFORM AND TRAFFIC.....	227
14.4.3.	OVERLAPPING CHANNEL TESTS.....	229
14.4.4.	MOVE AND CLOSING TIME	229

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/ax, ANT+, NFC and WPT

MODEL NUMBER: SM-G980F/DS, SM-G980F

SERIAL NUMBER: 38b95f7950197ece, 39989048ab1f7ece (CONDUCTED, Original);
R3CMA0D7LNH, R3CMA0D7LQT, R3CMA0BVGW, R3CMA0BVGW, R3CMA0BVGW,
R3CM8106MBW (RADIATED, Original);
R38MBOAHJRL (RADIATED, Spot check)

DATE TESTED: OCT 31, 2019 – NOV 22, 2019 (Original)
NOV 05, 2019 – NOV 22, 2019 (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:



Yeonhee Lim
Suwon Lab Technician
UL Korea, Ltd.

1.1. INTRODUCTION OF TEST DATA REUSE

This report referenced from the FCC ID: A3LSMG981B NII WLAN(FCC CFR 47 Part 15E). 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: A3LSMG980F shares the same enclosure and circuit board as FCC ID: A3LSMG981B. 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: A3LSMG981B remains representative of FCC ID: A3LSMG980F. The test data of FCC ID: A3LSMG981B being submitted for this application to cover WLAN 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
					5M-G981B/DS	5M-G980F/DS		
					FCC ID : A3LSMG981B	FCC ID : A3LSMG980F		
UNII WLAN (5 GHz)	Band Edge	802.11n_HT40_5190_ALL	5190 MHz	54.00 dBuV/m	47.09 dBuV/m	47.95 dBuV/m	0.86 dB	-
	RSE	802.11n_HT20_5240_ALL	5240 MHz	68.20 dBuV/m	63.45 dBuV/m	61.27 dBuV/m	-2.18 dB	2nd Harmonic
	Band Edge	802.11n_HT40_5310_ALL	5310 MHz	74.00 dBuV/m	68.92 dBuV/m	49.89 dBuV/m	-19.03 dB	-
	RSE	802.11a_5260_ALL	5260 MHz	68.20 dBuV/m	64.30 dBuV/m	62.42 dBuV/m	-1.88 dB	2nd Harmonic
	Band Edge	802.11a_5700_ALL	5700 MHz	68.20 dBuV/m	64.24 dBuV/m	60.87 dBuV/m	-3.37 dB	-
	RSE	802.11n_HT20_5500_ALL	5500 MHz	54.00 dBuV/m	50.14 dBuV/m	44.28 dBuV/m	-5.86 dB	2nd Harmonic
	Band Edge	802.11a_5745_ALL	5745 MHz	-27.00 dBm	-38.39 dBm	-36.41 dBm	1.98 dB	-
	RSE	802.11a_5825_ALL	5825 MHz	54.00 dBuV/m	49.34 dBuV/m	49.74 dBuV/m	0.40 dB	2nd Harmonic

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

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	A3LSMG981B	Original Grant	4789230288-E2	Test Report	4789247752-E2	All
DTS	A3LSMG981B	Original Grant	4789230288-E3 (802.11b/g/n)	Test Report	4789247752-E3 (802.11b/g/n)	All
			4789230288-E4 (802.11ax)	Test Report	4789247752-E4 (802.11ax)	All
			4789230288-E5 Bluetooth LE	Test Report	4789247752-E5 Bluetooth LE	All
DSS	A3LSMG981B	Original Grant	4789230288-E6 (Bluetooth)	Test Report	4789247752-E6 (Bluetooth)	All
NII	A3LSMG981B	Original Grant	4789230288-E7 (802.11a/n/ac)	Test Report	4789247752-E7 (802.11a/n/ac)	All
			4789230288-E8 (802.11ax)	Test Report	4789247752-E8 (802.11ax)	All
DXX	A3LSMG981B	Original Grant	4789230288-E9 (ANT+)	Test Report	4789247752-E9 (ANT+)	All
			4789230288-E10 (NFC)	Test Report	4789247752-E10 (NFC)	All
DCD	A3LSMG981B	Original Grant	4789230288-E11 (WPT)	Test Report	4789247752-E11 (WPT)	All

** NII DFS testing was performed on model A3LSMG9861. As this is a client only device with no radar detection capabilities, and since all devices share the same firmware related to channel closing under control of a master device, testing on this model was considered representative for all models.

For this application the data reuse is summarized below for each equipment class:

Equipment Class	Reference FCC ID (Parent)	Application Type	Test Item	Data Re-used
PCE	A3LSMG981B	Original Grant	WWAN	All except SAR (full test), HAC (full test)
DTS	A3LSMG981B	Original Grant	BLE	All
			WLAN	All except SAR (full test), HAC (full test)
			WLAN 802.11ax	All except HAC (full test)
DSS	A3LSMG981B	Original Grant	BT	All except SAR (full test)
NII	A3LSMG981B	Original Grant	WLAN	All except SAR (full test), HAC (full test)
			WLAN 802.11ax	All except HAC (full test)
DXX	A3LSMG981B	Original Grant	ANT+	All
			NFC	All
DCD	A3LSMG981B	Original Grant	WPT	All except RF exposure

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. KDB 662911 D01 v02r01
7. 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	
<input checked="" type="checkbox"/>	Chamber 1
<input checked="" type="checkbox"/>	Chamber 2
<input type="checkbox"/>	Chamber 3

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

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

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	2.35 dB
Radiated Disturbance, 30 MHz to 1 GHz	3.49 dB
Radiated Disturbance, 1 GHz to 18 GHz	5.82 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.

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/ax, ANT+, NFC and WPT. This test report addresses the NII (UNII 802.11a/n/ac) operational mode.

This report covers the Samsung models SM-G980F/DS and SM-G980F. These models are identical in hardware except SM-G980F has single SIM tray and model. With some pre-scan, model SM-G980F/DS was set for spot check test.

WiFi operating mode

Frequency range	Mode	ANT1	ANT2
5GHz (5180 MHz ~ 5825 MHz)	802.11a SISO	TX/RX	TX/RX
	802.11a MIMO	TX/RX	TX/RX
	802.11n SISO	TX/RX	TX/RX
	802.11n MIMO	TX/RX	TX/RX
	802.11ac SISO	TX/RX	TX/RX
	802.11ac MIMO	TX/RX	TX/RX

Note. 802.11ax mode data is reported on the 4789247752-E8

Simultaneous TX Condition

Simultaneous Tx Condition - RSDB

Mode	# of TX	5GHz		2.4GHz		Test Case
		ANT1	ANT2	ANT1	ANT2	
2.4GHz + 5GHz RSDB Only	2	A	-	-	B	V
	2	-	A	B	-	V
	2	A	-	B	-	-
	2	-	A	-	B	-
2.4GHz + 5GHz RSDB & MIMO	3	A	A	B	-	-
	3	A	A	-	B	-
	3	A	-	B	B	-
	3	-	A	B	B	-
2.4GHz + 5GHz RSDB MIMO	4	A	A	B	B	V

Note. A = 13 dBm / B =15 dBm

Simultaneous Tx Condition - Bluetooth with 5GHz WLAN (Not RSDB)

Mode	# of TX	5GHz		2.4GHz Bluetooth	Test Case
		ANT1	ANT2	ANT1	
2.4GHz Bluetooth + 5GHz WLAN (Not RSDB)	2	A	-	C	-
	2	-	A	C	-
	3	A	A	C	V

Note1. A = 13 dBm, C = 16.5 dBm

Note2. Spurious Emissions for Simultaneous Transmission were reported on the UNII 802.11ax test report(4789247752-E8).

MAXIMUM OUTPUT POWER

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

Frequency Range [MHz]	Mode	Output Power [dBm]		Output Power [mW]	
		ANT1	ANT2	ANT1	ANT2
5180 - 5240	802.11a MIMO	19.21		83.37	
	802.11n(HT20) MIMO	19.22		83.56	
5190 - 5230	802.11n(HT40) MIMO	17.32		53.95	
5210	802.11ac(VHT80) MIMO	16.24		42.07	
5260 - 5320	802.11a MIMO	19.55		90.16	
	802.11n(HT20) MIMO	19.54		89.95	
5270 - 5310	802.11n(HT40) MIMO	17.14		51.76	
5290	802.11ac(VHT80) MIMO	16.54		45.08	
5500 - 5720	802.11a MIMO	17.05		50.70	
	802.11n(HT20) MIMO	16.95		49.55	
5510 - 5710	802.11n(HT40) MIMO	15.22		33.23	
5530 - 5690	802.11ac(VHT80) MIMO	14.90		30.90	
5745 - 5825	802.11a MIMO	19.09		81.10	
	802.11n(HT20) MIMO	19.05		80.35	
5755 - 5795	802.11n(HT40) MIMO	17.39		54.83	
5775	802.11ac(VHT80) MIMO	16.03		40.09	

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]	ANT1 Gain [dBi]	ANT2 Gain [dBi]	Correlated Chains Directional Gain [dBi]
UNII 1 5150 - 5250	-8.80	-8.10	-5.43
UNII 2A 5250 - 5350	-7.10	-8.10	-4.58
UNII 2C 5470 - 5725	-5.80	-6.20	-2.99
UNII 3 5725 - 5850	-7.70	-8.20	-4.94

“Sub3 WiFi1” and “Sub7 WiFi2” as indicated in antenna specification are written as ANT1 and ANT2 in this report.

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.

UNII 1

5150 – 5250 MHz RESTRICTED Frequency Band (Radiated Testing)	
Frequency Range [MHz]	Mode
5180 - 5240	802.11a Legacy 1TX / 2TX
5180 - 5240	802.11n HT20 1TX / 2TX
5180 - 5240	802.11ac VHT20 1TX / 2TX
5190 - 5230	802.11n HT40 1TX / 2TX
5190 - 5230	802.11ac VHT40 1TX / 2TX
5210	802.11ac VHT80 1TX / 2TX

UNII 2A

5250 – 5350 MHz RESTRICTED Frequency Band (Radiated Testing)	
Frequency Range [MHz]	Mode
5260 - 5320	802.11a Legacy 1TX / 2TX
5260 - 5320	802.11n HT20 1TX / 2TX
5260 - 5320	802.11ac VHT20 1TX / 2TX
5270 - 5310	802.11n HT40 1TX / 2TX
5270 - 5310	802.11ac VHT40 1TX / 2TX
5290	802.11ac VHT80 1TX / 2TX

UNII 2C

5470 – 5725 MHz RESTRICTED Frequency Band (Radiated Testing)	
Frequency Range [MHz]	Mode
5500 - 5720	802.11a Legacy 1TX / 2TX
5500 - 5720	802.11n HT20 1TX / 2TX
5500 - 5720	802.11ac VHT20 1TX / 2TX
5510 - 5710	802.11n HT40 1TX / 2TX
5510 - 5710	802.11ac VHT40 1TX / 2TX
5530 - 5690	802.11ac VHT80 1TX / 2TX

UNII 3

5725 – 5850 MHz RESTRICTED Frequency Band (Radiated Testing)	
Frequency Range [MHz]	Mode
5745 - 5825	802.11a Legacy 1TX / 2TX
5745 - 5825	802.11n HT20 1TX / 2TX
5745 - 5825	802.11ac VHT20 1TX / 2TX
5755 - 5795	802.11n HT40 1TX / 2TX
5755 - 5795	802.11ac VHT40 1TX / 2TX
5775	802.11ac VHT80 1TX / 2TX

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.

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

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

802.11a mode: 6 Mbps 1Tx
802.11a mode: 6 Mbps 2Tx
802.11n HT20 mode: MCS0 1Tx
802.11n HT20 mode: MCS0 2Tx
802.11n HT40 mode: MCS0 1Tx
802.11n HT40 mode: MCS0 2Tx
802.11ac VHT80 mode: MCS0 1Tx
802.11ac VHT80 mode: MCS0 2Tx

Depending on spot-check results for 802.11a / n HT20 & HT40 / ac VHT80, MIMO mode is worst case than SISO (ANT1) and SISO (ANT2). So radiation test for 802. 11a / n HT20 & HT40 / ac VHT80 were evaluated at MIMO mode.

Note : All radiated and power line conducted tests were performed connected with charger for evaluation of worst case mode.

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Charger	SAMSUNG	EP-TA800	R37M5WSB411SE3	N/A
Data Cable	SAMSUNG	EP-DG977	N/A	N/A

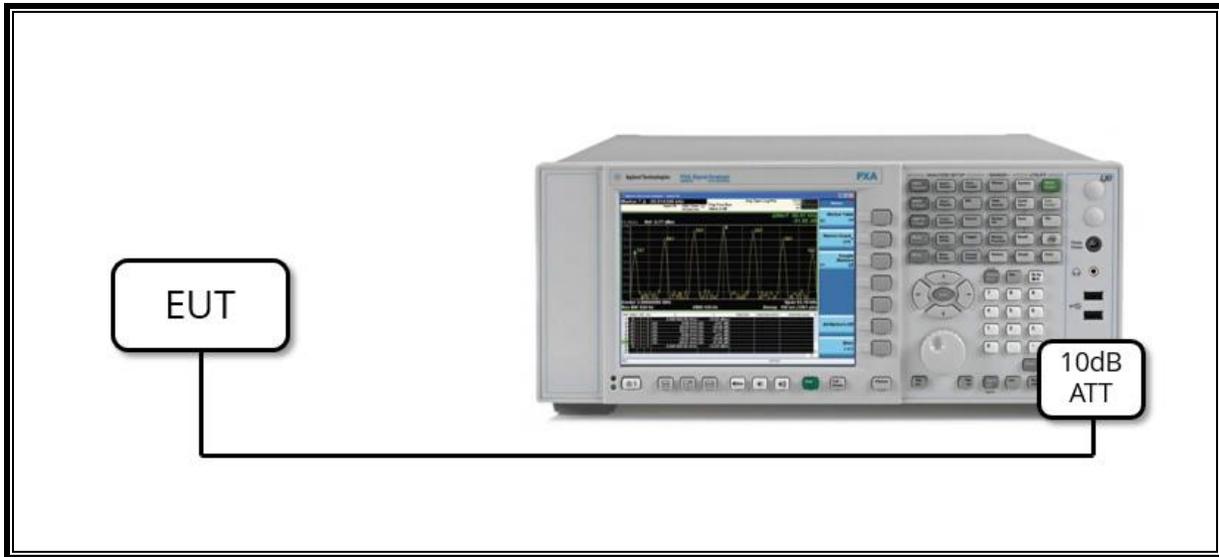
I/O CABLE

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	1.0m	N/A

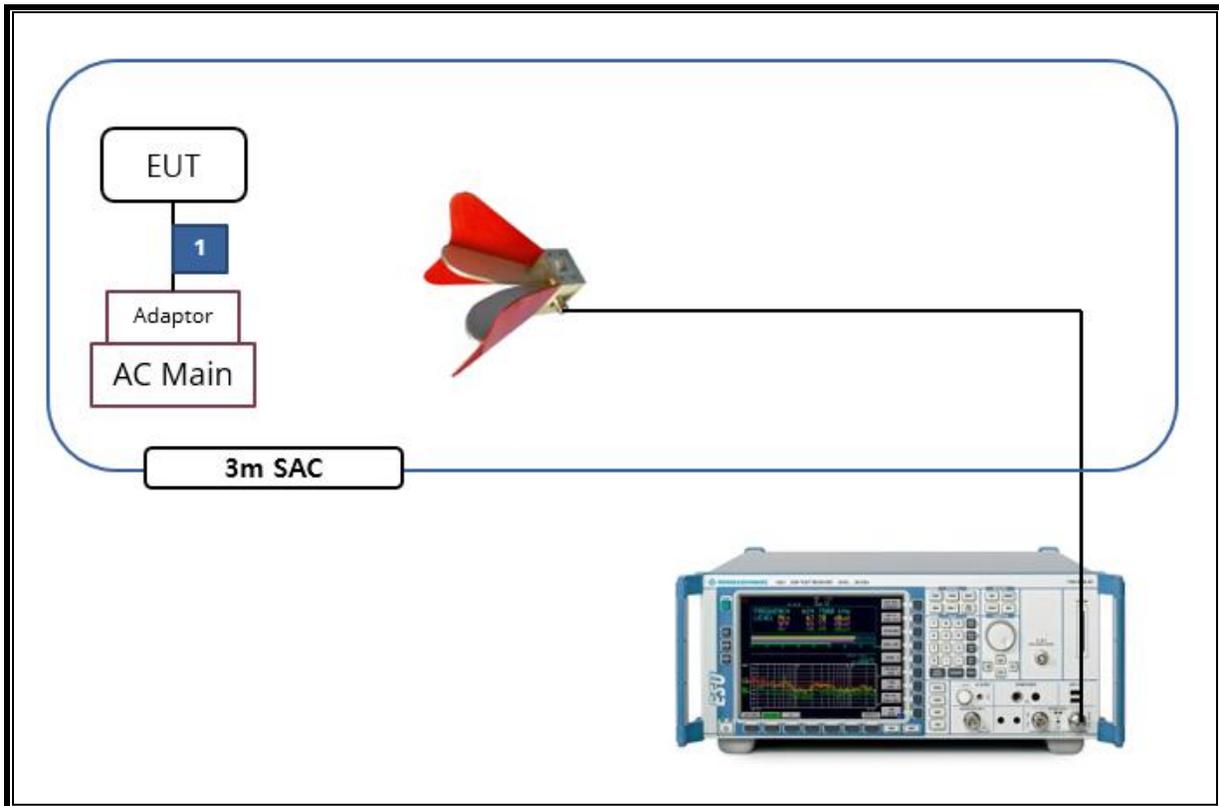
TEST SETUP

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)



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	08-04-20
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	08-04-20
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	845	08-04-20
Antenna, Horn, 18 GHz	ETS	3115	00167211	08-04-20
Antenna, Horn, 18 GHz	ETS	3115	00161451	08-04-20
Antenna, Horn, 18 GHz	ETS	3117	00168724	08-04-20
Antenna, Horn, 18 GHz	ETS	3117	00168717	08-04-20
Antenna, Horn, 18 GHz	ETS	3117	00205959	08-04-20
Antenna, Horn, 40 GHz	ETS	3116C	00166155	08-14-20
Antenna, Horn, 40 GHz	ETS	3116C	00168645	10-02-21
Preamplifier	ETS	3116C-PA	00168841	08-08-20
Preamplifier, 1000 MHz	Sonoma	310N	341282	08-05-20
Preamplifier, 1000 MHz	Sonoma	310N	351741	08-05-20
Preamplifier, 1000 MHz	Sonoma	310N	370599	08-05-20
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1876511	08-06-20
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	08-06-20
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	2029169	08-06-20
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	08-06-20
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54490312	08-06-20
Spectrum Analyzer, 43.5 GHz	R&S	FSW43	104089	08-06-20
Average Power Sensor	Agilent / HP	U2000	MY54270007	08-09-20
Attenuator	PASTERNAK	PE7087-10	A001	08-08-20
Attenuator	PASTERNAK	PE7087-10	A008	08-08-20
Attenuator	PASTERNAK	PE7004-10	2	08-06-20
Attenuator	PASTERNAK	PE7087-10	A009	08-08-20
EMI Test Receive, 40 GHz	R&S	ESU40	100439	08-06-20
EMI Test Receive, 40 GHz	R&S	ESU40	100457	08-06-20
EMI Test Receive, 44 GHz	R&S	ESW44	101590	08-05-20
EMI Test Receive, 3 GHz	R&S	ESR3	101832	08-05-20
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	009	08-06-20
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	015	08-06-20
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	020	08-06-20
High Pass Filter 3GHz	Micro-Tronics	HPM17543	010	08-06-20
High Pass Filter 3GHz	Micro-Tronics	HPM17543	015	08-06-20
High Pass Filter 3GHz	Micro-Tronics	HPM17543	020	08-06-20
High Pass Filter 6GHz	Micro-Tronics	HPS17542	009	08-06-20
High Pass Filter 6GHz	Micro-Tronics	HPS17542	016	08-06-20
High Pass Filter 6GHz	Micro-Tronics	HPS17542	021	08-06-20
LISN	R&S	ENV-216	101837	08-09-20
Antenna, Loop, 9kHz-30MHz	R&S	HFH2-Z2	100418	10-02-21
Termination	WEINSCHL	M1406A	T01	08-08-20
Attenuator	WEINSCHL	WA76-30-21	A015	08-08-20
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 10	Radiated	PASS
15.407 (b) & 15.209	Radiated Spurious Emission	< 54dBuV/m		PASS
15.407 (h)(2)	Dynamic Frequency Selection	N/A	Condcuted	PASS

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.

9. REFERENCE MEASUREMENTS RESULTS

9.1. ON TIME AND DUTY CYCLE RESULTS

Mode	ANT	ON Time [msec]	Period [msec]	Duty Cycle X [linear]	Duty Cycle [%]	Duty Cycle Correction Factor [dB]
802.11a	Single	5.483	5.582	0.982	98.2%	0.00
802.11n HT20		5.079	5.178	0.981	98.1%	0.00
802.11n HT40		5.479	5.578	0.982	98.2%	0.00
802.11ac VHT80		5.228	5.328	0.981	98.1%	0.00
802.11a	ALL	5.484	5.582	0.982	98.2%	0.00
802.11n HT20		5.078	5.178	0.980	98.0%	0.00
802.11n HT40		5.479	5.578	0.982	98.2%	0.00
802.11ac VHT80		4.995	5.095	0.980	98.0%	0.00

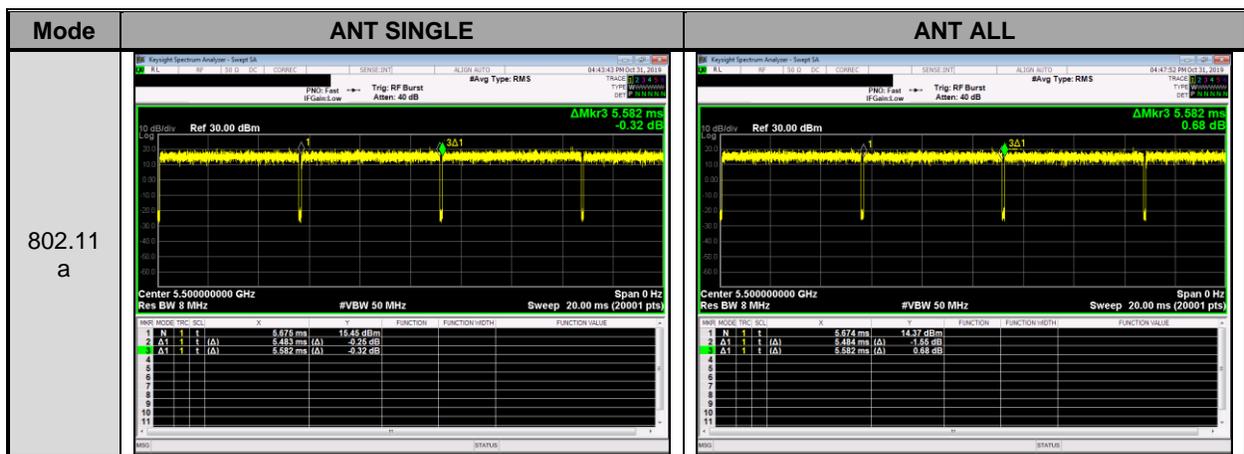
LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 789033 D02 v02r01 Zero-Span Spectrum Analyzer Method.

9.2. DUTY CYCLE PLOTS





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.

NOTE

- Calculation for 26dB Bandwidth of UNII-2C and UNII-3 Straddle Channel
 - ex) Fundamental frequency : 5720MHz
 - 26dB BW : 20.58MHz
 - Turning Frequency : 5725MHz
 - 26dB Bandwidth of UNII-2C band Portion
= $(5725 - (5720 - (20.58 / 2))) = 15.29$ MHz
 - 26dB Bandwidth of UNII-3 band Portion
= $(5720 + (20.58 / 2) - 5725) = 5.29$ MHz

RESULTS

9.3.1. 5.2 GHz BAND

Band	Mode	Channel	Center Freq. [MHz]	26 dB BW [MHz]		Worst
				ANT1	ANT2	
UNII-1	802.11a	Low	5180	21.73	21.15	21.73
		Mid	5200	20.96	21.18	
		High	5240	21.23	21.48	
	802.11n HT20	Low	5180	21.78	21.37	21.78
		Mid	5200	21.27	21.60	
		High	5240	21.33	21.30	
	802.11n HT40	Low	5190	39.66	39.92	40.00
		High	5230	39.54	40.00	
	802.11ac VHT80	Mid	5210	81.20	81.30	81.30

9.3.2. 5.3 GHz BAND

Band	Mode	Channel	Center Freq. [MHz]	26 dB BW [MHz]		Worst
				ANT1	ANT2	
UNII-2A	802.11a	Low	5260	21.50	21.29	21.50
		Mid	5300	21.18	21.34	
		High	5320	21.10	21.31	
	802.11n HT20	Low	5260	21.31	21.71	21.71
		Mid	5300	21.40	21.53	
		High	5320	21.63	21.61	
	802.11n HT40	Low	5270	39.96	39.75	39.96
		High	5310	39.76	39.76	
	802.11ac VHT80	Mid	5290	81.96	81.47	81.96

9.3.3. 5.5 GHz BAND

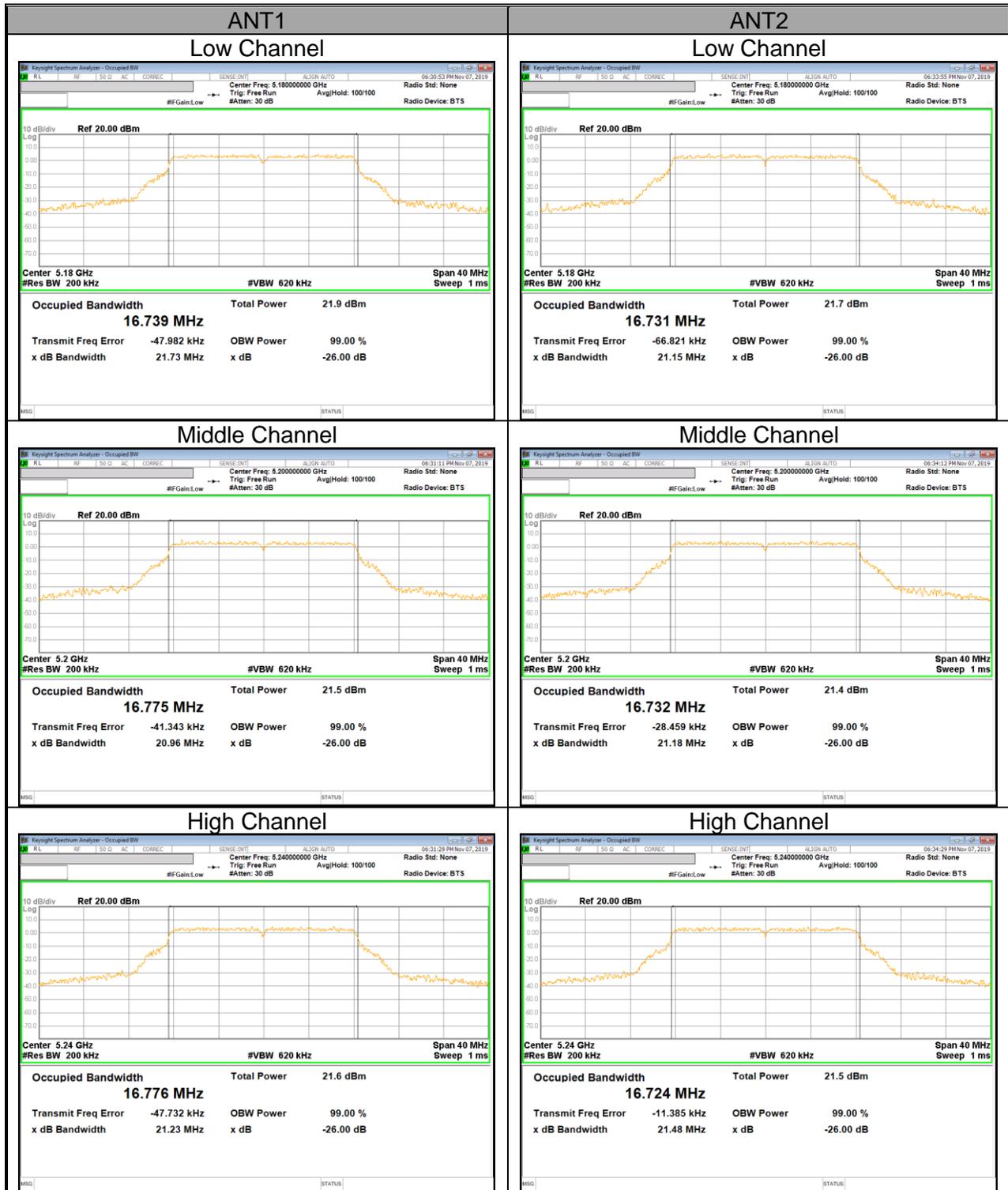
Band	Mode	Channel	Center Freq. [MHz]	26 dB BW [MHz]		Worst
				ANT1	ANT2	
UNII-2C	802.11a	Low	5500	21.36	21.34	21.55
		Mid	5580	21.00	21.32	
		High	5700	21.55	21.53	
	802.11n HT20	Low	5500	21.67	21.38	21.67
		Mid	5580	21.63	21.58	
		High	5700	21.46	21.65	
	802.11n HT40	Low	5510	39.54	39.21	40.07
		Mid	5590	39.77	40.07	
		High	5670	39.84	39.81	
	802.11ac VHT80	Low	5530	81.73	81.84	81.84
		High	5610	81.71	81.06	

9.3.4. STRADDLE CHANNEL

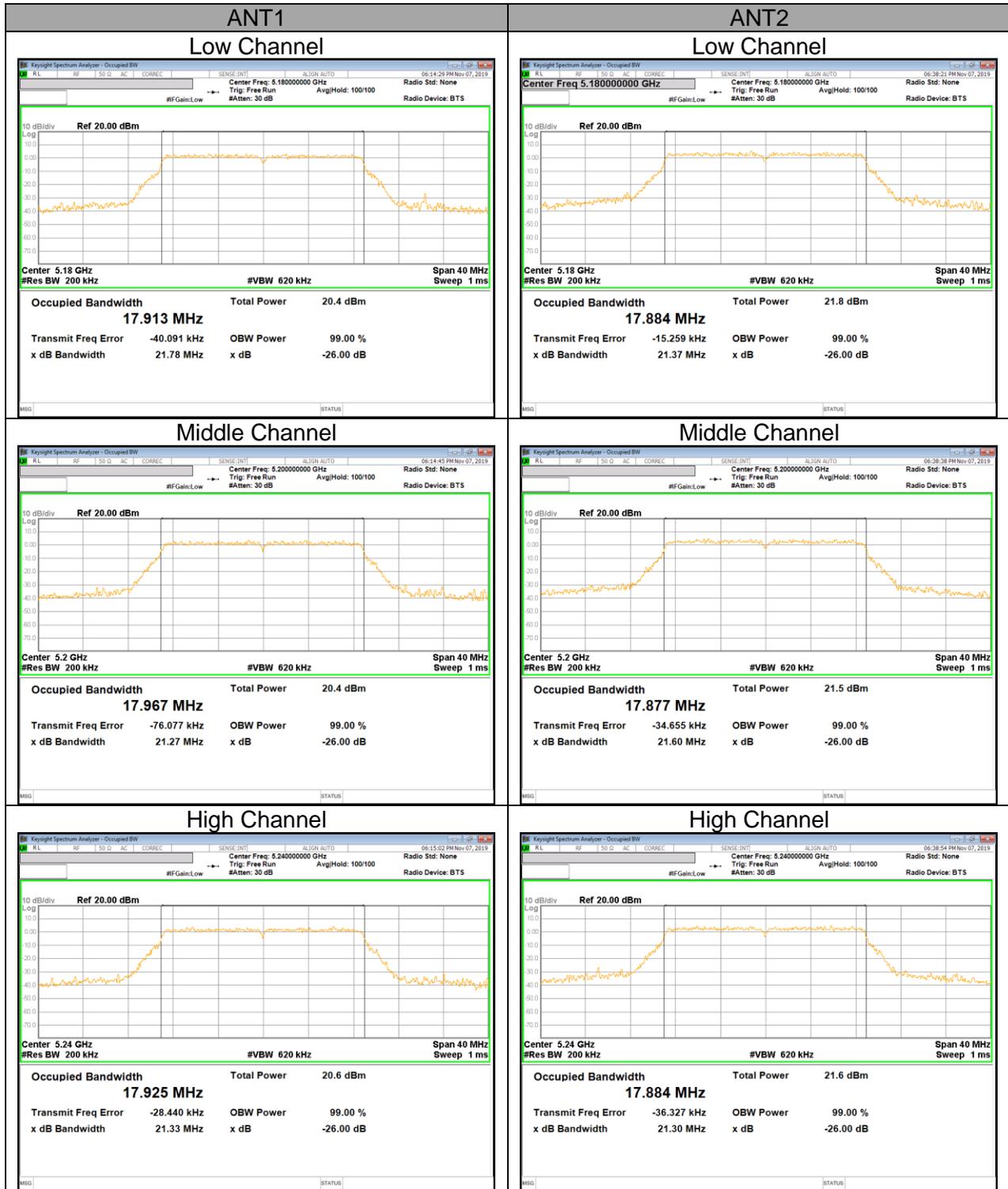
Band	Mode	Channel	Center Freq. [MHz]	26 dB BW [MHz]			
				ANT1		ANT2	
				UNII-2C	UNII-3	UNII-2C	UNII-3
Straddle Channel	802.11a	Straddle	5720	15.67	5.67	15.89	5.89
	802.11n HT20	Straddle	5720	15.64	5.64	15.88	5.88
	802.11n HT40	Straddle	5710	34.76	4.76	34.77	4.77
	802.11ac VHT80	Straddle	5690	75.67	5.67	75.78	5.78

9.3.5. 26 dB BANDWIDTH PLOTS

UNII 5.2 GHz IEEE 802.11a mode



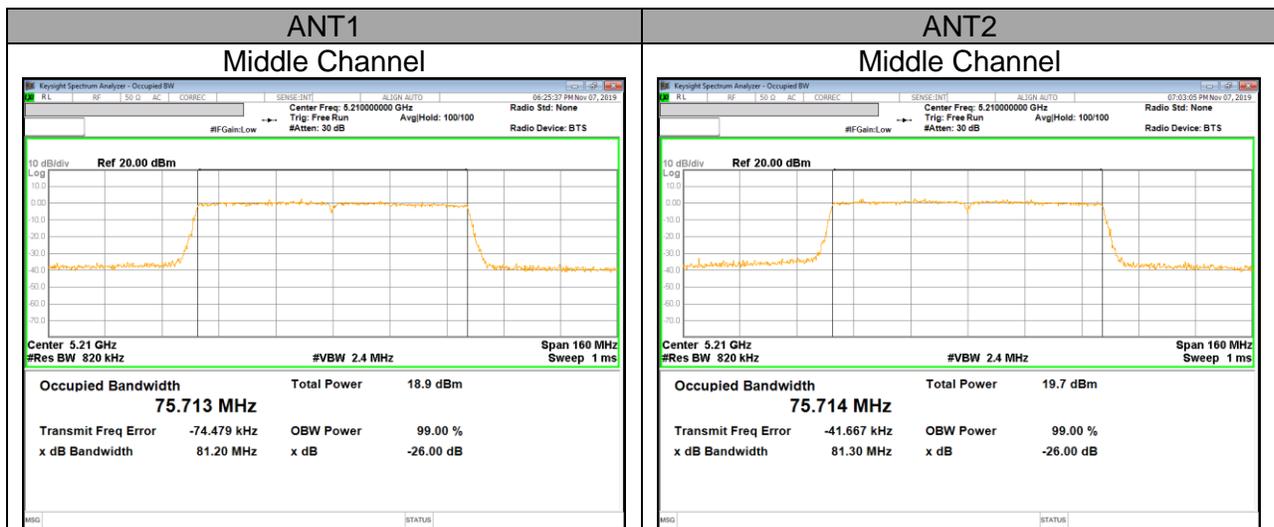
UNII 5.2 GHz IEEE 802.11n HT20 mode



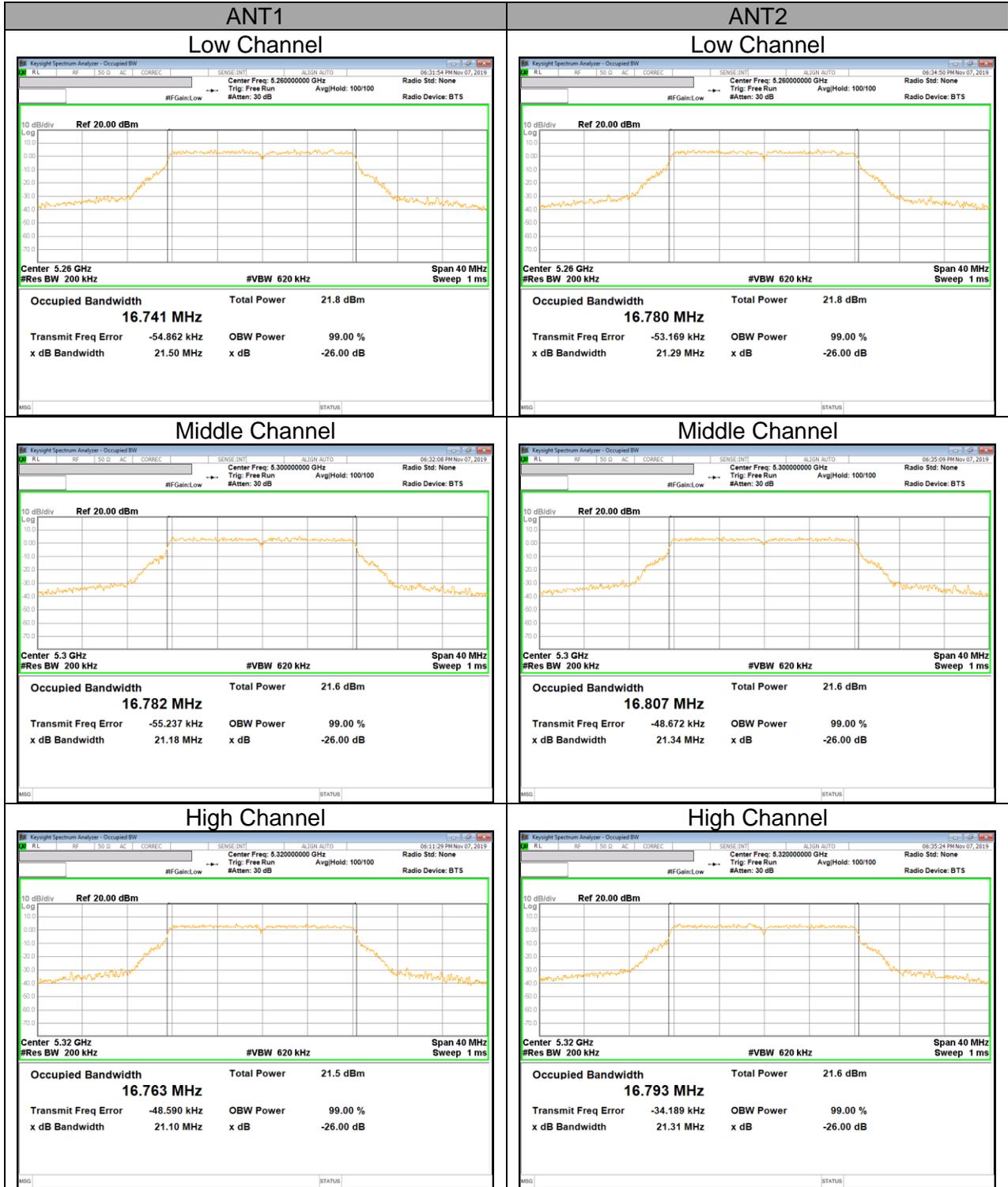
UNII 5.2 GHz IEEE 802.11n HT40 mode



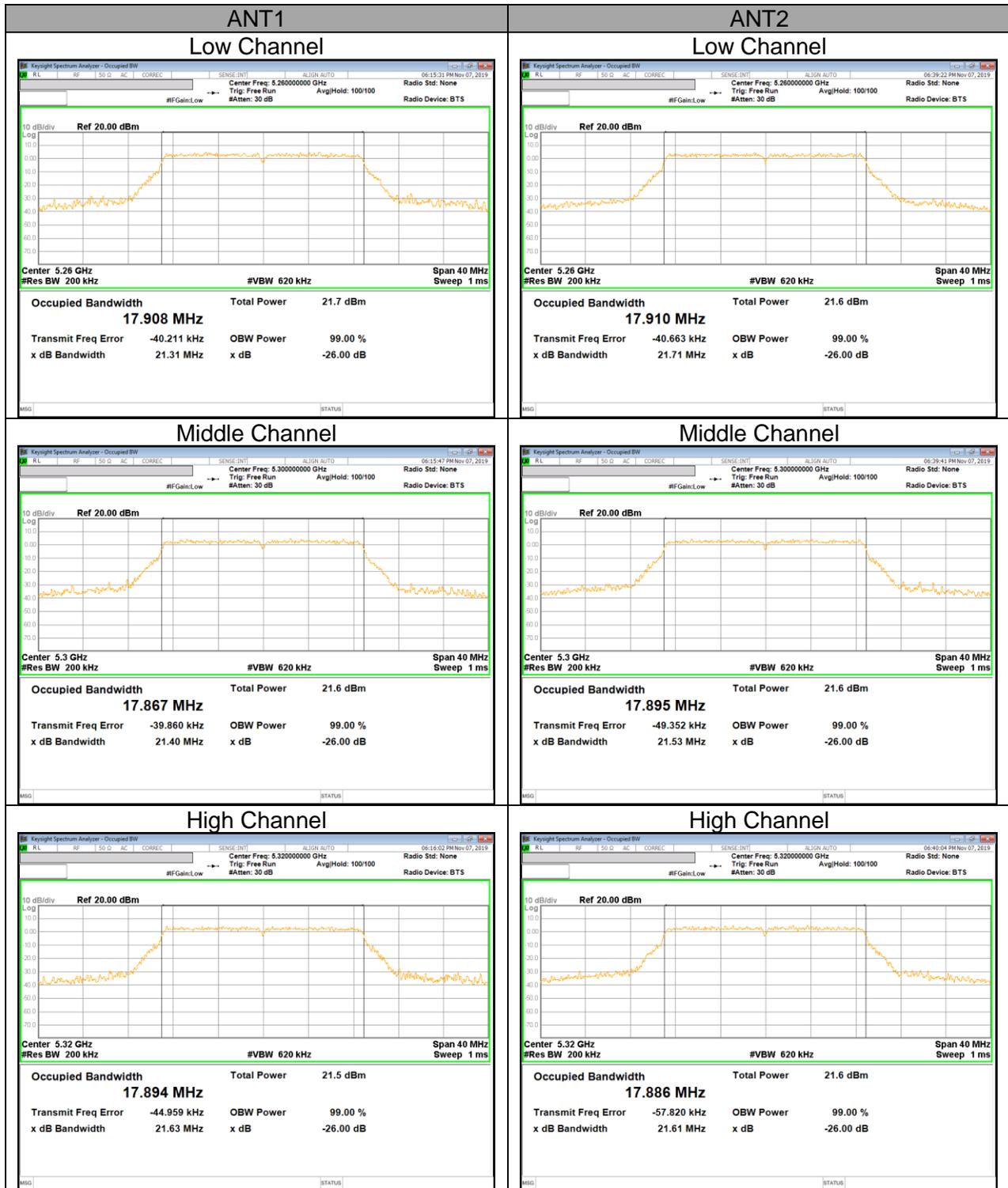
UNII 5.2 GHz IEEE 802.11ac VHT80 mode



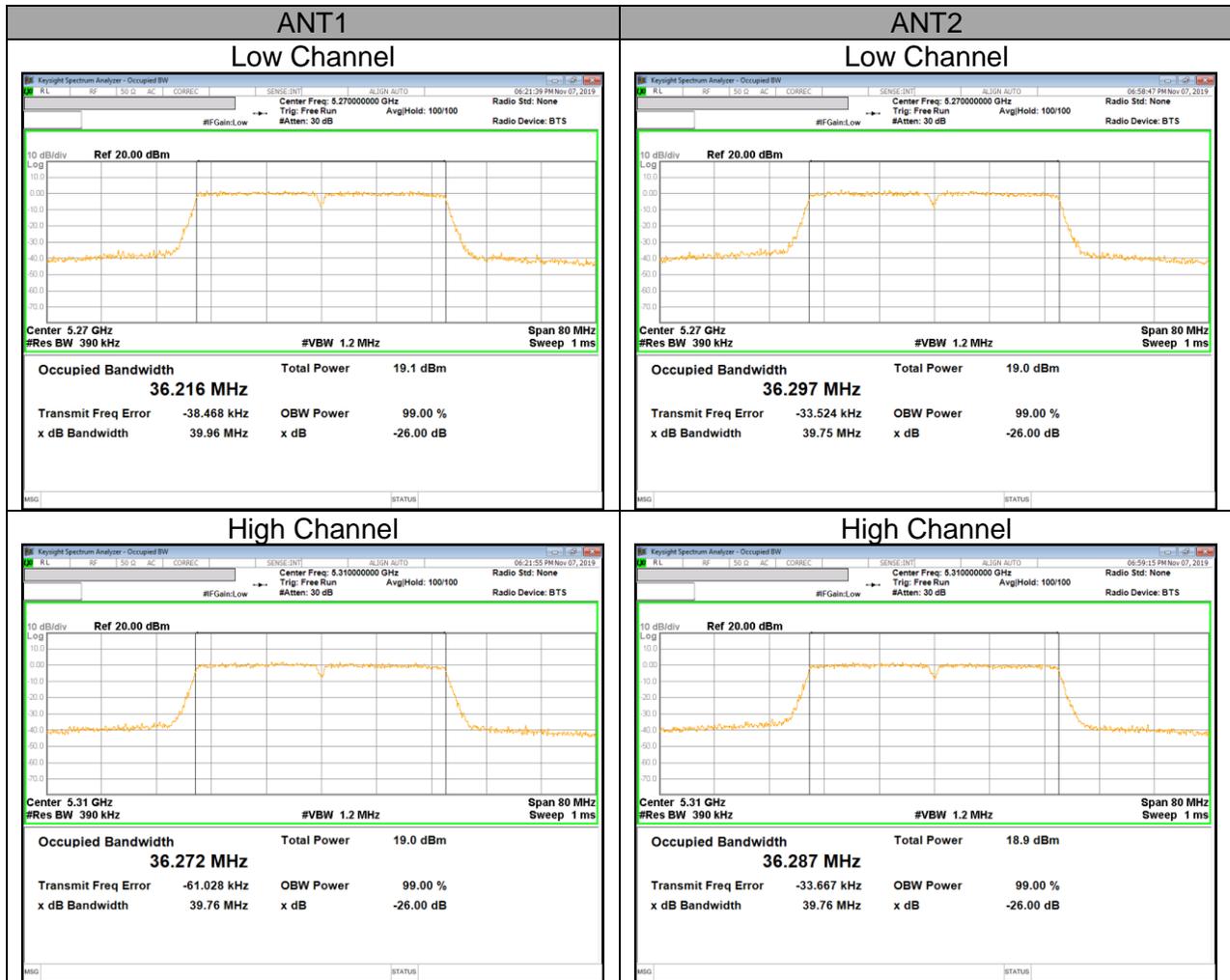
UNII 5.3 GHz IEEE 802.11a mode



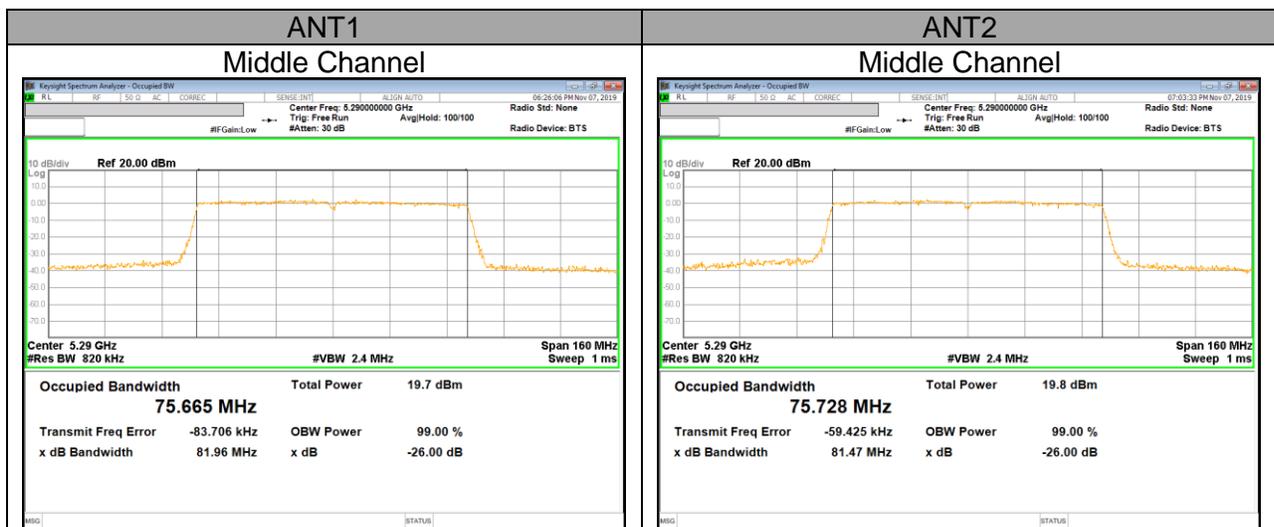
UNII 5.3 GHz IEEE 802.11n HT20 mode



UNII 5.3 GHz IEEE 802.11n HT40 mode



UNII 5.3 GHz IEEE 802.11ac VHT80 mode



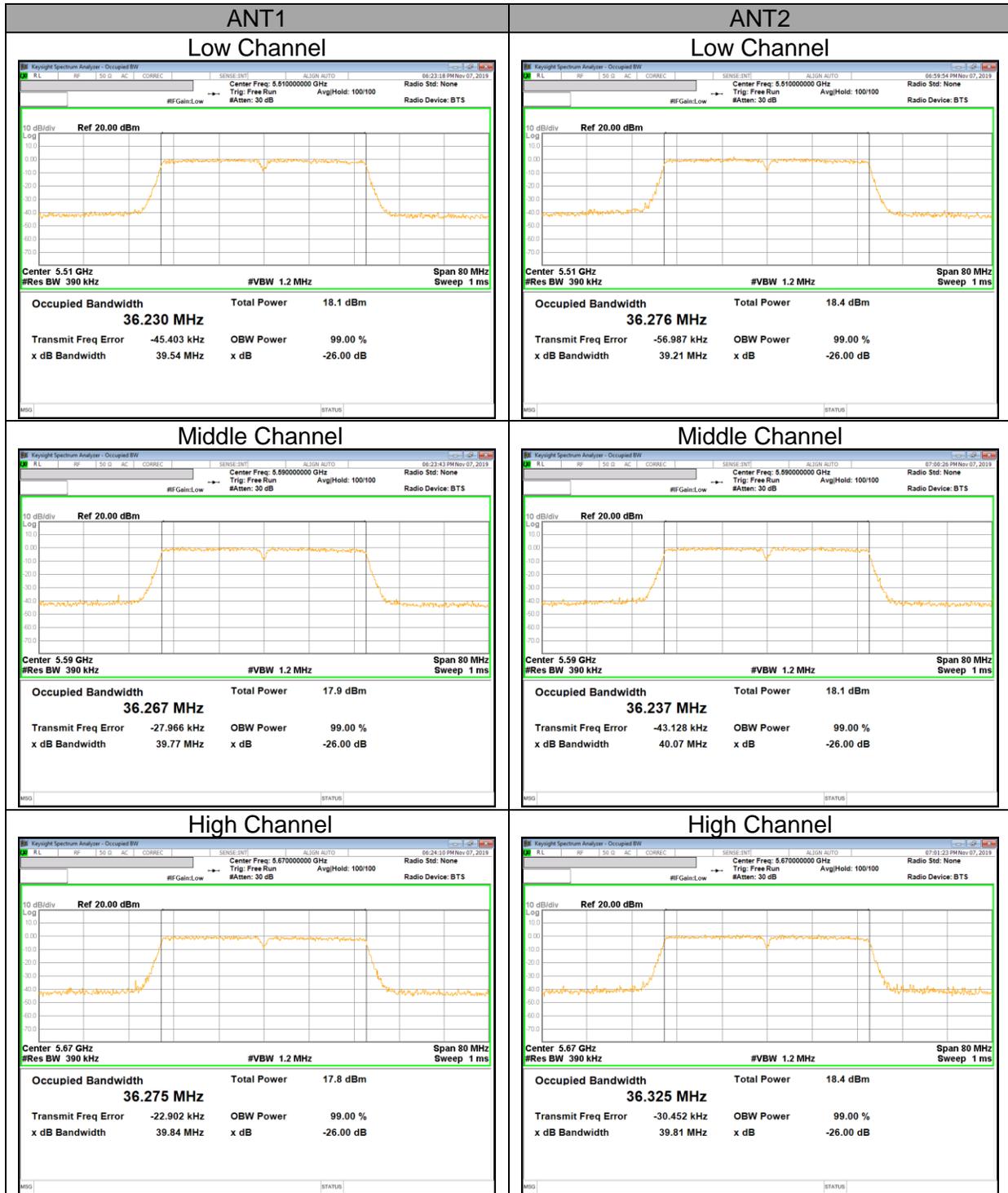
UNII 5.5 GHz IEEE 802.11a mode



UNII 5.5 GHz IEEE 802.11n HT20 mode



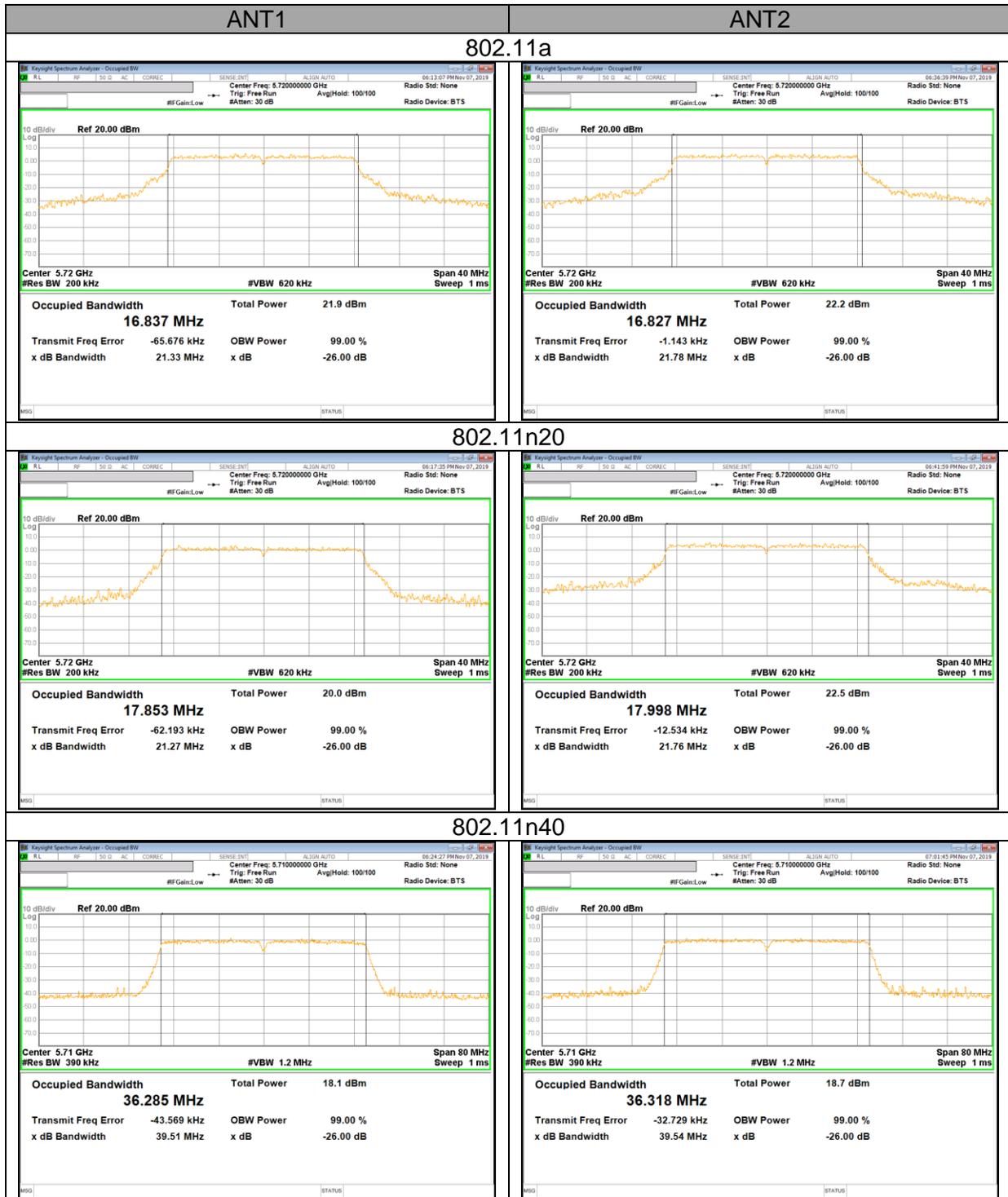
UNII 5.5 GHz IEEE 802.11n HT40 mode

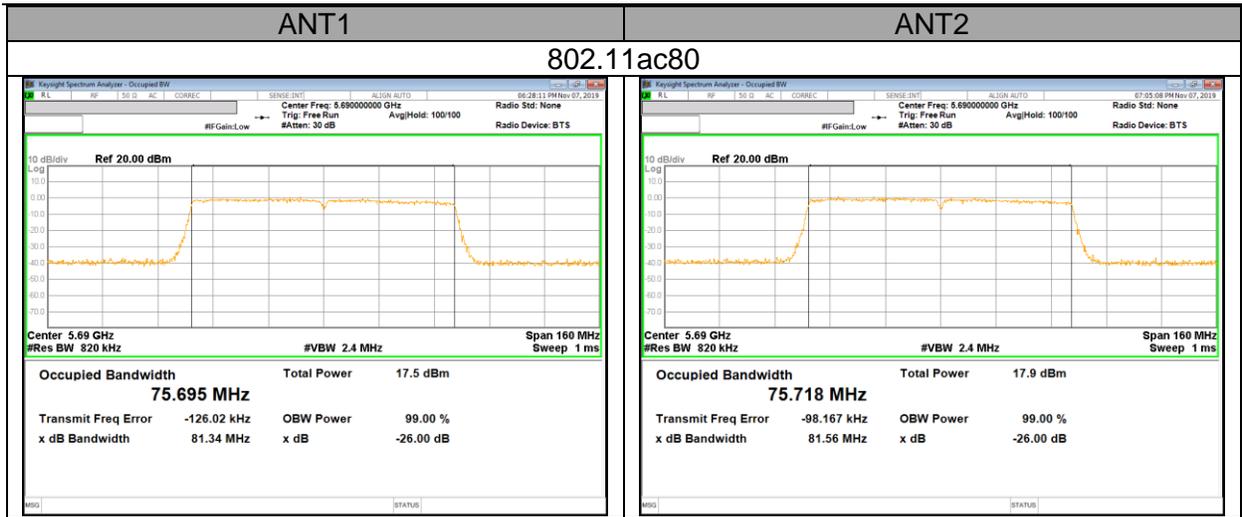


UNII 5.5 GHz IEEE 802.11ac VHT80 mode



UNII Straddle Channel IEEE 802.11a / n20 / n40 / ac80 mode





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 to 100KHz, the VBW $\geq 3 \times$ RBW, peak detector and max hold.

NOTE

- Calculation for 6dB Bandwidth of UNII-3 Straddle Channel

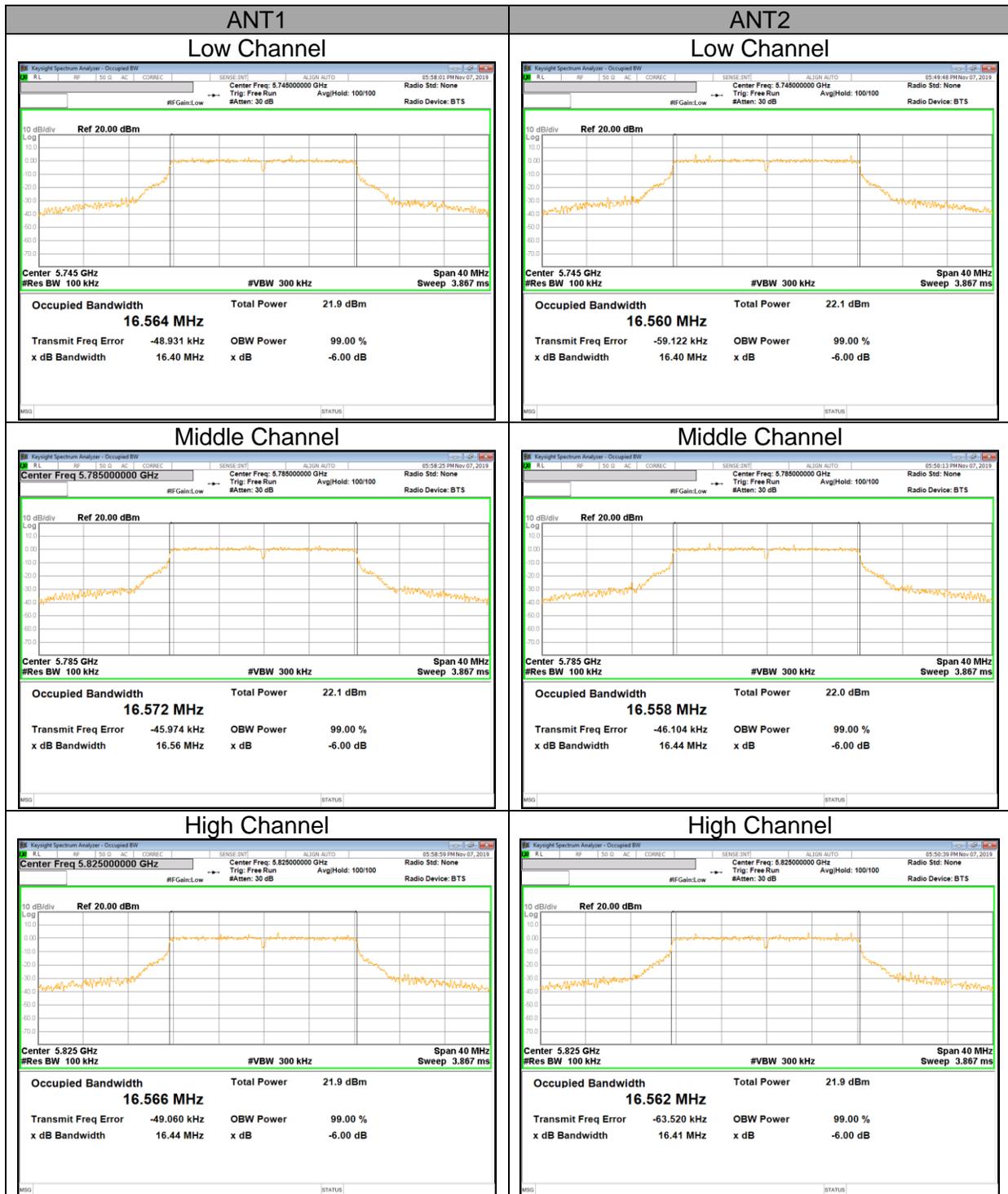
- ex) Fundamental frequency : 5720MHz
- 6dB BW : 16.350MHz
 - Starting Frequency of UNII-3 band : 5725MHz
 - 6dB Bandwidth of UNII-3 band Portion
 $= (5720 + (16.350 / 2) - 5725) = 3.175 \text{ MHz}$

RESULTS

10.1.1. 5.8 GHz BAND

Band	Mode	Channel	Center Freq. [MHz]	6 dB BW [MHz]		Worst	Minimum Limit [MHz]
				ANT1	ANT2		
UNII-3	802.11a	Low	5745	16.40	16.40	16.40	0.5
		Mid	5785	16.56	16.44		
		High	5825	16.44	16.41		
	802.11n HT20	Low	5745	17.76	17.67	17.64	
		Mid	5785	17.74	17.64		
		High	5825	17.66	17.65		
	802.11n HT40	Low	5755	36.36	36.40	36.30	
		High	5795	36.44	36.30		
	802.11ac VHT80	Middle	5775	75.78	75.66	75.66	

10.1.2. 6 dB BANDWIDTH PLOTS
IEEE 802.11a mode



IEEE 802.11n HT20 mode

