



CERTIFICATION TEST REPORT

Report Number. : 4789555428-E6V3

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

Model : SM-G781B/DS, SM-G781B

FCC ID : A3LSMG781B

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

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

Date Of Issue:
August 29, 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

Rev.	Issue Date	Revisions	Revised By
V1	08/14/20	Initial issue	Hyunsik Yun
V2	08/24/20	Updated to address TCB's question	Hyunsik Yun
V3	08/29/20	Updated to address TCB's question	Hyunsik Yun

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	6
2. TEST METHODOLOGY	7
3. FACILITIES AND ACCREDITATION	7
4. CALIBRATION AND UNCERTAINTY	7
4.1. MEASURING INSTRUMENT CALIBRATION	7
4.2. SAMPLE CALCULATION	7
4.3. MEASUREMENT UNCERTAINTY	8
4.4. DECISION RULE	8
5. EQUIPMENT UNDER TEST	9
5.1. DESCRIPTION OF EUT	9
5.2. DESCRIPTION OF AVAILABLE ANTENNAS	14
5.3. List of test reduction and modes covering other modes:	15
5.4. WORST-CASE CONFIGURATION AND MODE	16
5.5. DESCRIPTION OF TEST SETUP	19
6. TEST AND MEASUREMENT EQUIPMENT	21
7. SUMMARY TABLE	21
8. MEASUREMENT METHODS	23
9. REFERENCE MEASUREMENTS RESULTS	24
9.1. ON TIME AND DUTY CYCLE RESULTS	24
9.2. DUTY CYCLE PLOTS	25
9.3. 26 dB BANDWIDTH	30
9.3.1. 5.2 GHz BAND	31
9.3.2. 5.3 GHz BAND	31
9.3.3. 5.5 GHz BAND	32
9.3.4. STRADDLE CHANNEL	32
9.3.5. 802.11ax 5.2 GHz BAND(RU)	33
9.3.6. 802.11ax 5.3 GHz BAND(RU)	33
9.3.7. 802.11ax 5.5 GHz BAND(RU)	34
9.3.8. 802.11ax STRADDLE CHANNEL(RU)	34
9.3.9. 26 dB BANDWIDTH PLOTS	35
10. ANTENNA PORT TEST RESULTS	76
10.1. 6 dB BANDWIDTH	76
10.1.1. 5.8 GHz BAND	77

10.1.2.	802.11ax 5.8 GHz Band(RU)	77
10.1.3.	6 dB BANDWIDTH PLOTS	78
10.2.	OUTPUT POWER AND PPSD	85
10.2.1.	1Tx MODE IN THE 5.2 GHz BAND.....	86
10.2.2.	1Tx MODE IN THE 5.3 GHz BAND.....	88
10.2.3.	1Tx MODE IN THE 5.5 GHz BAND.....	90
10.2.4.	1Tx MODE IN THE 5.8 GHz BAND.....	92
10.2.5.	1Tx Mode Straddle channel IN THE 5.5 GHz BAND	93
10.2.6.	1Tx Mode Straddle channel IN THE 5.8 GHz BAND	94
10.2.7.	2Tx MODE IN THE 5.2 GHz BAND.....	95
10.2.8.	2Tx MODE IN THE 5.3 GHz BAND.....	97
10.2.9.	2Tx MODE IN THE 5.5 GHz BAND.....	99
10.2.10.	2Tx MODE IN THE 5.8 GHz BAND.....	101
10.2.11.	2Tx Mode Straddle channel IN THE 5.5 GHz BAND	102
10.2.12.	2Tx Mode Straddle channel IN THE 5.8 GHz BAND	103
10.2.13.	802.11ax 1Tx (SISO) MODE 5.2 GHz BAND	104
10.2.14.	802.11ax 1Tx (SISO) MODE 5.3 GHz BAND	108
10.2.15.	802.11ax 1Tx (SISO) MODE 5.5 GHz BAND	112
10.2.16.	802.11ax 1Tx (SISO) MODE STRADDLE CHANNEL	117
10.2.17.	802.11ax 1Tx (SISO) MODE 5.8 GHz BAND	119
10.2.18.	802.11ax 2Tx (MIMO) MODE 5.2 GHz BAND	123
10.2.19.	802.11ax 2Tx (MIMO) MODE 5.3 GHz BAND	127
10.2.20.	802.11ax 2Tx (MIMO) MODE 5.5 GHz BAND	131
10.2.21.	802.11ax 2Tx (MIMO) MODE STRADDLE CHANNEL	136
10.2.22.	802.11ax 2Tx (MIMO) MODE 5.8 GHz BAND	138
10.2.23.	OUTPUT POWER AND PPSD PLOTS	142
11.	TRANSMITTER ABOVE 1 GHz.....	200
11.1.	5.2 GHz.....	203
11.1.1.	TX ABOVE 1GHz 802.11a 2Tx MODE IN THE 5.2GHz BAND	203
11.1.2.	TX ABOVE 1GHz 802.11n HT20 2Tx MODE IN THE 5.2GHz BAND	208
11.1.3.	TX ABOVE 1GHz 802.11n HT40 2Tx MODE IN THE 5.2GHz BAND	213
11.1.4.	TX ABOVE 1GHz 802.11ac VHT80 2Tx MODE IN THE 5.2GHz BAND	217
11.2.	5.3 GHz.....	220
11.2.1.	TX ABOVE 1 GHz 802.11a 2Tx MODE IN THE 5.3 GHz BAND	220
11.2.2.	TX ABOVE 1GHz 802.11n HT20 2Tx MODE IN THE 5.3GHz BAND	225
11.2.3.	TX ABOVE 1GHz 802.11n HT40 2Tx MODE IN THE 5.3GHz BAND	230
11.2.4.	TX ABOVE 1GHz 802.11ac VHT80 2Tx MODE IN THE 5.3GHz BAND	234
11.3.	5.5-5.6 GHz.....	237
11.3.1.	TX ABOVE 1 GHz 802.11a 2Tx MODE IN THE 5.5 GHz BAND	237
11.3.2.	TX ABOVE 1GHz 802.11n HT20 2Tx MODE IN THE 5.5GHz BAND	244
11.3.3.	TX ABOVE 1GHz 802.11n HT40 2Tx MODE IN THE 5.5GHz BAND	251
11.3.4.	TX ABOVE 1GHz 802.11ac VHT80 2Tx MODE IN THE 5.5GHz BAND	258
11.4.	5.8 GHz.....	264
11.4.1.	TX ABOVE 1GHz 802.11a 2Tx MODE IN THE 5.8GHz BAND	264
11.4.2.	TX ABOVE 1GHz 802.11n HT20 2Tx MODE IN THE 5.8GHz BAND	271
11.4.3.	TX ABOVE 1GHz 802.11n HT40 2Tx MODE IN THE 5.8GHz BAND	278

11.4.4.	TX ABOVE 1GHz 802.11ac VHT80 2Tx MODE IN THE 5.8GHz BAND	284
11.5.	5.2 GHz(802.11ax RU mode)	289
11.5.1.	TX ABOVE 1GHz HE20(RU) MODE IN THE 5.2GHz BAND.....	289
11.5.2.	TX ABOVE 1GHz HE40(RU) MODE IN THE 5.2GHz BAND.....	292
11.5.3.	TX ABOVE 1GHz HE80(RU) MODE IN THE 5.2GHz BAND	294
11.6.	5.3 GHz(802.11ax RU mode)	295
11.6.1.	TX ABOVE 1 GHz HE20(RU) MODE IN THE 5.3 GHz BAND.....	295
11.6.2.	TX ABOVE 1GHz HE40(RU) MODE IN THE 5.3GHz BAND.....	298
11.6.3.	TX ABOVE 1GHz HE80(RU) MODE IN THE 5.3GHz BAND.....	300
11.7.	5.5-5.6 GHz(802.11ax RU mode)	301
11.7.1.	TX ABOVE 1 GHz HE20(RU) MODE IN THE 5.5 GHz BAND.....	301
11.7.2.	TX ABOVE 1GHz HE40(RU) MODE IN THE 5.5GHz BAND.....	304
11.7.3.	TX ABOVE 1GHz HE80(RU) MODE IN THE 5.5GHz BAND	307
11.8.	5.8 GHz(802.11ax RU mode)	309
11.8.1.	TX ABOVE 1GHz HE20(RU) MODE IN THE 5.8GHz BAND.....	309
11.8.2.	TX ABOVE 1GHz HE40(RU) MODE IN THE 5.8GHz BAND.....	312
11.8.3.	TX ABOVE 1GHz HE80(RU) MODE IN THE 5.8GHz BAND	314
11.9.	Spurious Emissions for Simultaneous Transmission	315
11.9.1.	Worst test case RSDB condition	315
11.9.2.	Worst test case non-DBS + Bluetooth condition.....	315
11.9.3.	Test Results.....	316
12.	WORST-CASE BELOW 1 GHz	320
13.	AC POWER LINE CONDUCTED EMISSIONS.....	321
14.	DYNAMIC FREQUENCY SELECTION.....	324
14.1.	OVERVIEW.....	324
14.1.1.	LIMITS.....	324
14.1.2.	TEST AND MEASUREMENT SYSTEM	328
14.1.3.	SETUP OF EUT.....	331
14.1.4.	DESCRIPTION OF EUT	332
14.1.	RESULTS FOR 80 MHz BANDWIDTH (UNII-2A BAND)	333
14.1.1.	TEST CHANNEL	333
14.1.2.	RADAR WAVEFORM AND TRAFFIC.....	333
14.1.3.	OVERLAPPING CHANNEL TESTS.....	334
14.1.4.	MOVE AND CLOSING TIME	334
14.2.	RESULTS FOR 80 MHz BANDWIDTH (UNII-2C BAND).....	337
14.2.1.	TEST CHANNEL	337
14.2.2.	RADAR WAVEFORM AND TRAFFIC.....	337
14.2.3.	OVERLAPPING CHANNEL TESTS.....	338
14.2.4.	MOVE AND CLOSING TIME	338

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, WPT and NFC

MODEL NUMBER: SM-G781B/DS, SM-G781B

SERIAL NUMBER: R3CN7038XSF, 437d2d4d431e7ece (CONDUCTED);
R3CN7038YAF, R3CN7038Y7L (RADIATED);

DATE TESTED: JUL 23, 2020 – AUG 14, 2020;

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.

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	
☒	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:

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

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

This report covers the Samsung models SM-G781B/DS and SM-G781B. These models are identical in hardware except SM-G781B has single SIM tray. With some pre-scan, model SM-G781B/DS was set for final test.

Note. This EUT does not support channel puncturing.

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
	802.11ax SISO	TX/RX	TX/RX
	802.11ax MIMO	TX/RX	TX/RX

Simultaneous TX Condition

Simultaneous Tx Condition - RSDB

Mode	# of TX	5GHz WLAN		2.4GHz WLAN		Test Case
		ANT1	ANT2	ANT1	ANT2	
2.4GHz + 5GHz RSDB MIMO	4	O	O	O	O	O

Simultaneous Tx Condition - RSDB + Bluetooth

Mode	# of TX	5GHz WLAN		2.4GHz Bluetooth	2.4GHz WLAN	Test Case
		ANT1	ANT2	ANT1	ANT2	
5GHz MIMO RSDB & Bluetooth	3	O	O	O	-	-
2.4GHz + 5GHz MIMO RSDB & Bluetooth	4	O	O	O	O	O

Test RU offset for tones in each modes

Mode	Tones	RU offset
HE20	26T	0
		4
		8
	52T	37
		38
		40
	106T	53
		54
	242T / SU ^{Note 1}	61 / -
HE40	26T	0
		9
		17
	52T	37
		41
		44
	106T	53
		54
		56
	242T	61
		62
	484T / SU ^{Note 1}	63 / -
HE80	26T	0
		18
		36
	52T	37
		45
		52
	106T	53
		57
		60
	242T	61
		62
		64
	484T	65
		66
	996T / SU ^{Note 1}	67 / -

Note: Full RU(Resource Unit) 242T mode and SU(Single Unit) mode have no difference in physical waveform. This report has been reported the SU mode with highest output power in SISO and the SU mode with highest output power in MIMO.

Band portion of RU allocation about straddle channels

Mode	Channel	Tones	RU offset	Portion
HE20	Straddle 5720 MHz	26T	6	UNII 2C & UNII 3
		242T / SU	61 / -	
HE40	Straddle 5710 MHz	26T	15	UNII 2C & UNII 3
		484T / SU	65 / -	
HE80	Straddle 5690 MHz	26T	34	UNII 2C & UNII 3
		996T / SU	67 / -	

Note: In case of RU straddle channel, test was performed overlapping RU position.

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]	
		ANT1	ANT2	ANT1	ANT2
5180 - 5240	802.11a SISO	16.47	16.89	44.36	48.87
	802.11a MIMO	19.65		92.26	
	802.11n(HT20) SISO	16.66	16.92	46.34	49.20
	802.11n(HT20) MIMO	19.35		86.10	
	802.11ax(HE20) SISO	15.48	15.07	35.32	32.14
	802.11ax(HE20) MIMO	18.19		65.92	
5190 - 5230	802.11n(HT40) SISO	16.66	16.97	46.34	49.77
	802.11n(HT40) MIMO	19.69		93.11	
	802.11ax(HE40) SISO	14.44	14.25	27.80	26.61
	802.11ax(HE40) MIMO	17.24		52.97	
5210	802.11ac(VHT80) SISO	13.47	13.71	22.23	23.50
	802.11ac(VHT80) MIMO	16.71		46.88	
	802.11ax(HE80) SISO	13.32	13.01	21.48	20.00
	802.11ax(HE80) MIMO	16.01		39.90	

UNII-2A

Frequency Range [MHz]	Mode	Output Power [dBm]		Output Power [mW]	
		ANT1	ANT2	ANT1	ANT2
5260 - 5320	802.11a SISO	16.87	16.97	48.64	49.77
	802.11a MIMO	19.60		91.20	
	802.11n(HT20) SISO	16.57	16.92	45.39	49.20
	802.11n(HT20) MIMO	19.58		90.78	
	802.11ax(HE20) SISO	15.16	15.23	32.81	33.34
	802.11ax(HE20) MIMO	18.20		66.07	
5270 - 5310	802.11n(HT40) SISO	16.72	16.96	46.99	49.66
	802.11n(HT40) MIMO	19.64		92.04	
	802.11ax(HE40) SISO	13.99	14.32	25.06	27.04
	802.11ax(HE40) MIMO	17.19		52.36	
5290	802.11ac(VHT80) SISO	13.34	13.78	21.58	23.88
	802.11ac(VHT80) MIMO	16.25		42.17	
	802.11ax(HE80) SISO	13.40	13.31	21.88	21.43
	802.11ax(HE80) MIMO	16.21		41.78	

UNII-2C

Frequency Range [MHz]	Mode	Output Power [dBm]		Output Power [mW]	
		ANT1	ANT2	ANT1	ANT2
5500 - 5720	802.11a SISO	16.49	16.92	44.57	49.20
	802.11a MIMO	19.59		90.99	
	802.11n(HT20) SISO	16.65	16.81	46.24	47.97
	802.11n(HT20) MIMO	19.26		84.33	
	802.11ax(HE20) SISO	15.56	15.73	35.97	37.41
	802.11ax(HE20) MIMO	18.29		67.45	
5510 - 5710	802.11n(HT40) SISO	16.63	16.59	46.03	45.60
	802.11n(HT40) MIMO	19.58		90.78	
	802.11ax(HE40) SISO	14.48	14.30	28.05	26.92
	802.11ax(HE40) MIMO	17.09		51.17	
5530 - 5690	802.11ac(VHT80) SISO	13.27	14.13	21.23	25.88
	802.11ac(VHT80) MIMO	16.25		42.17	
	802.11ax(HE80) SISO	13.39	13.43	21.83	22.03
	802.11ax(HE80) MIMO	16.25		42.17	

UNII-3

Frequency Range [MHz]	Mode	Output Power [dBm]		Output Power [mW]	
		ANT1	ANT2	ANT1	ANT2
5745 - 5825	802.11a SISO	16.71	16.98	46.88	49.89
	802.11a MIMO	19.74		94.19	
	802.11n(HT20) SISO	16.79	16.78	47.75	47.64
	802.11n(HT20) MIMO	19.56		90.36	
	802.11ax(HE20) SISO	15.72	15.43	37.33	34.91
	802.11ax(HE20) MIMO	18.42		69.50	
5755 - 5795	802.11n(HT40) SISO	16.81	16.71	47.97	46.88
	802.11n(HT40) MIMO	19.81		95.72	
	802.11ax(HE40) SISO	14.37	14.25	27.35	26.61
	802.11ax(HE40) MIMO	17.33		54.08	
5775	802.11ac(VHT80) SISO	13.46	13.99	22.18	25.06
	802.11ac(VHT80) MIMO	16.70		46.77	
	802.11ax(HE80) SISO	13.80	13.41	23.99	21.93
	802.11ax(HE80) MIMO	16.50		44.67	

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	-6.72	-6.31	-3.50
UNII 2A 5250 - 5350	-6.72	-6.31	-3.50
UNII 2C 5470 - 5725	-6.47	-6.27	-3.36
UNII 3 5725 - 5850	-8.36	-6.01	-4.10

“WIFI0” and “WIFI1” as indicated in antenna specification are written as ANT 1 and ANT 2 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.

Authorized Frequency Band			
Mode	Antenna Stream	Mode	Covered by
802.11a	SISO	802.11a 1TX	
	MIMO	802.11a 2TX	
802.11n HT20	SISO	802.11n HT20 1TX	
	MIMO	802.11n HT20 2TX	
802.11ac VHT20	SISO	802.11ac VHT20 1TX	802.11n HT20 1TX
	MIMO	802.11ac VHT20 2TX	802.11n HT20 2TX
802.11ax HE20(SU)	SISO	802.11ax HE20 RU(242T) 1TX	802.11ax HE20 SU 1TX
	MIMO	802.11ax HE20 RU(242T) 2TX	802.11ax HE20 SU 2TX
802.11n HT40	SISO	802.11n HT40 1TX	
	MIMO	802.11n HT40 2TX	
802.11ac VHT40	SISO	802.11ac VHT40 1TX	802.11n HT40 1TX
	MIMO	802.11ac VHT40 2TX	802.11n HT40 2TX
802.11ax HE40(SU)	SISO	802.11ax HE40 RU(484T) 1TX	802.11ax HE40 SU 1TX
	MIMO	802.11ax HE40 RU(484T) 2TX	802.11ax HE40 SU 2TX
802.11ac VHT80	SISO	802.11ac VHT80 1TX	
	MIMO	802.11ac VHT80 2TX	
802.11ax HE80(SU)	SISO	802.11ax HE80 RU(996T) 1TX	802.11ax HE80 SU 1TX
	MIMO	802.11ax HE80 RU(996T) 2TX	802.11ax HE80 SU 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.

- Worst case condition

ANT1	ANT2	ANT ALL
Axis	Axis	Axis
Y	Y	Y

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

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

802.11ax HE20 mode: MCS0 2Tx
802.11ax HE40 mode: MCS0 2Tx
802.11ax HE80 mode: MCS0 2Tx

Depending on spot-check results for 802.11a / n HT20 & HT40 / ac VHT80 / ax HE20 & HE40 & HE80, MIMO mode is worst case than SISO (ANT1) and SISO (ANT2).
So radiation test for 802.11a / n HT20 & HT40 / ac VHT80 / ax HE20 & HE40 & HE80 were evaluated at MIMO mode.

Worst-case selection criteria for 802.11ax test items :

- For the 6dB Bandwidth, it was tested at the RU allocation with lowest tones number for each bandwidth.

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

Test case configuration for 802.11a, 802.11n HT20 & 40, 802.11ac VHT20 & 40 & 80, 802.11ax HE20 & 40 & 80 (SU) modes :

Mode	Band	SISO Target[dBm]				MIMO Target[dBm]			
		802.11a	802.11n	802.11ac	802.11ax (SU)	802.11a	802.11n	802.11ac	802.11ax (SU)
5GHZ (20 MHz)	UNII-1	16	16	16	15	19	19	19	18
	UNII-2A	16	16	16	15	19	19	19	18
	UNII-2C	16	16	16	15	19	19	19	18
	UNII-3	16	16	16	15	19	19	19	18
5GHZ (40 MHz)	UNII-1		16	14	14		19	17	17
	UNII-2A		16	14	14		19	17	17
	UNII-2C		16	14	14		19	17	17
	UNII-3		16	14	14		19	17	17
5GHZ (80 MHz)	UNII-1			13	13			16	16
	UNII-2A			13	13			16	16
	UNII-2C			13	13			16	16
	UNII-3			13	13			16	16

 Band-Edge & Spurious Emission

Note1. 802.11ac VHT20 & 802.11ac VHT40 mode are covered by 802.11n HT20 & 802.11n HT40.

Note2. 802.11ax HE20 & HE40 SU mode's target power(both of SISO, MIMO) is lower than or equal to 802.11n mode. Therefore, 802.11ax HE20 & HE40 SU mode is covered by 802.11n HT20 & HT40 mode.

Note3. 802.11ax HE80 SU mode's target power(both of SISO, MIMO) is equal to 802.11ac VHT80 mode. Therefore, 802.11ax HE80 SU mode is covered by 802.11ac VHT80 mode.

Test case configuration for 802.11ax HE20 & 40 & 80 (RU) modes :

802.11ax HE20 RU mode						
Band	Freq.	Tone	RU offset	Test Case		
				ANT1	ANT2	MIMO
UNII-1	5180	26T	0	-	-	
			4	-	-	O
			8	-	-	
	5200		0	-	-	
			4	-	-	O
			8	-	-	
	5240		0	-	-	
			4	-	-	O
			8	-	-	
UNII-2A	5260		0	-	-	
			4	-	-	O
			8	-	-	
	5300		0	-	-	
			4	-	-	O
			8	-	-	
	5320		0	-	-	
			4	-	-	O
			8	-	-	
UNII-2C	5500		0	-	-	
			4	-	-	O
			8	-	-	
	5580		0	-	-	
			4	-	-	O
			8	-	-	
	5700		0	-	-	
			4	-	-	O
			8	-	-	
UNII-3	5745		0	-	-	
			4	-	-	O
			8	-	-	
	5785		0	-	-	
			4	-	-	O
			8	-	-	
	5825		0	-	-	
			4	-	-	O
			8	-	-	

802.11ax HE40 RU mode						
Band	Freq.	Tone	RU offset	Test Case		
				ANT1	ANT2	MIMO
UNII-1	5190	26T	0	-	-	
			9	-	-	O
			17	-	-	
	5230		0	-	-	
			9	-	-	O
			17	-	-	
UNII-2A	5270		0	-	-	
			9	-	-	O
			17	-	-	
	5310		0	-	-	
			9	-	-	O
			17	-	-	
UNII-2C	5510		0	-	-	
			9	-	-	O
			17	-	-	
	5590		0	-	-	
			9	-	-	O
			17	-	-	
	5670		0	-	-	
			9	-	-	O
			17	-	-	
UNII-3	5755		0	-	-	
			9	-	-	O
			17	-	-	
	5795		0	-	-	
			9	-	-	O
			17	-	-	

802.11ax HE80 RU mode							
Band	Freq.	Tone	RU offset	Test Case			
				ANT1	ANT2	MIMO	
UNII-1	5210	26 T	0	-	-		
			18	-	-		
			36	-	-	O	
UNII-2A			5290	0	-	-	
				18	-	-	O
				36	-	-	
UNII-2C			5530	0	-	-	
				18	-	-	O
				36	-	-	
			5610	0	-	-	
				18	-	-	O
				36	-	-	
UNII-3	5775		0	-	-		
			18	-	-	O	
			36	-	-		

Note4. Radiated spurious test was performed on the lower tone(26T) with worst average power.

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Charger	SAMSUNG	EP-TA200	R37MCQS5HH1DK3	N/A
Data Cable	SAMSUNG	EP-DR140ABE	N/A	N/A

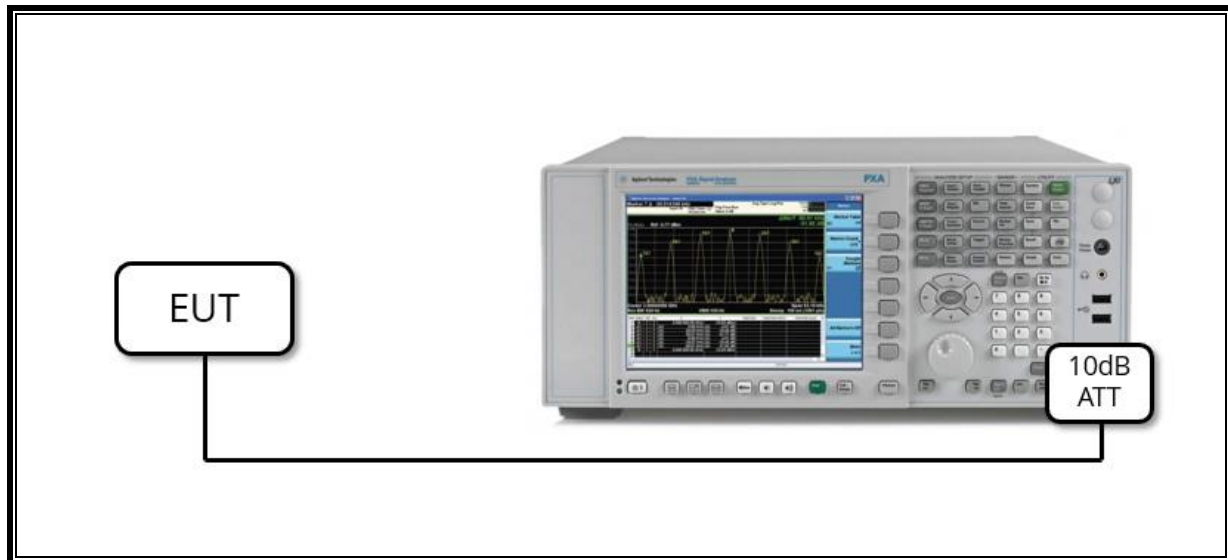
I/O CABLE

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	1.1m	N/A

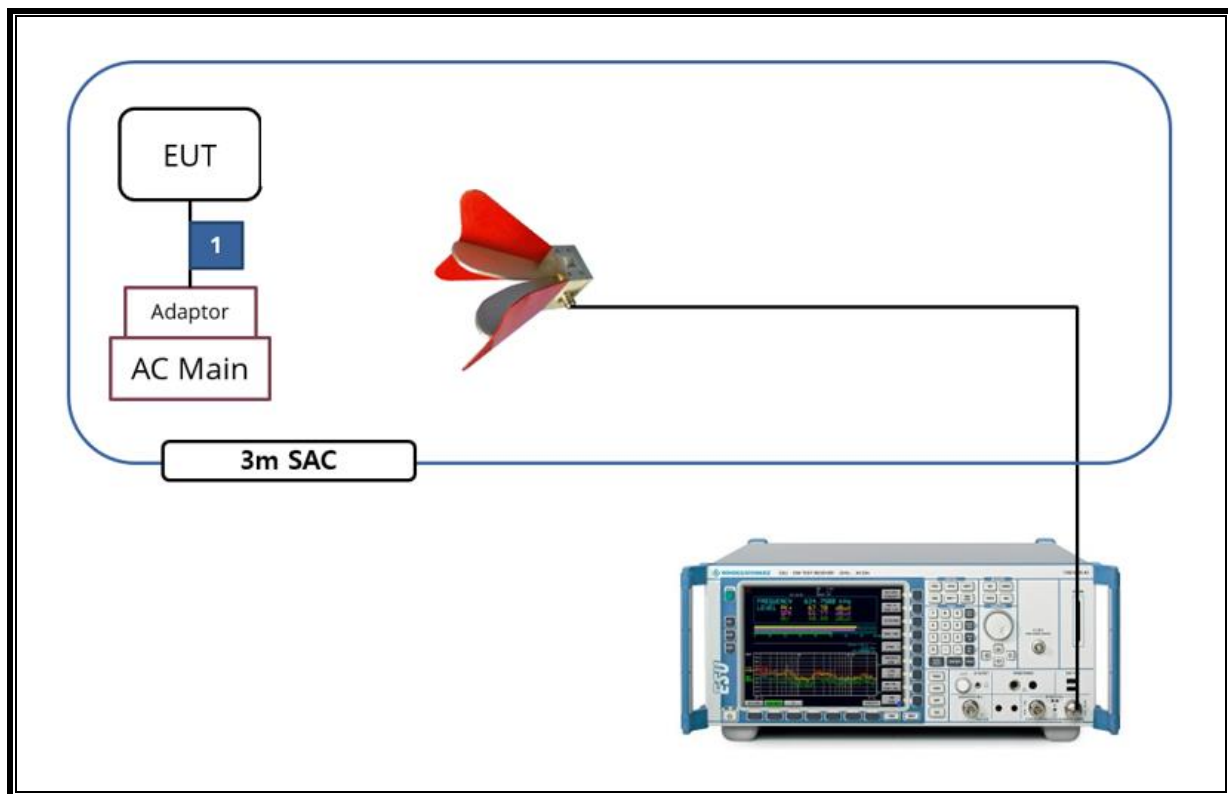
TEST SETUP

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	Next Cal. Date	
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	845(Note)	08-04-20	08-13-22
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749(Note)	08-04-20	08-13-22
Antenna, Horn, 18 GHz	ETS	3115	00167211	08-04-20	07-27-22
Antenna, Horn, 18 GHz	ETS	3117	00168724	08-04-20	07-27-22
Antenna, Horn, 40 GHz	ETS	3116C	00166155	08-13-20	08-04-22
Antenna, Horn, 40 GHz	ETS	3116C	00168645	10-02-21	
Preamplifier	ETS	3116C-PA	00168841	08-08-20	08-06-21
Preamplifier, 1000 MHz	Sonoma	310N	341282	08-05-20	08-03-21
Preamplifier, 1000 MHz	Sonoma	310N	351741	08-05-20	08-03-21
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1876511	08-06-20	08-03-21
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	08-06-20	08-03-21
Spectrum Analyzer, 44 GHz	Keysight	N9030B	MY57143717	01-20-21	
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	08-06-20	08-05-21
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54490312	08-06-20	08-05-21
Average Power Sensor	Agilent / HP	U2000	MY54270007	08-09-20	08-05-21
Attenuator	PASTERNAK	PE7087-10	A001	08-08-20	08-03-21
Attenuator	PASTERNAK	PE7087-10	A008	08-08-20	08-03-21
Attenuator	PASTERNAK	PE7087-10	A007	08-08-20	08-03-21
Attenuator	PASTERNAK	PE7087-10	A009	08-08-20	08-05-21
EMI Test Receive, 40 GHz	R&S	ESU40	100439	08-06-20	08-03-21
EMI Test Receive, 40 GHz	R&S	ESU40	100457	08-06-20	08-03-21
EMI Test Receive, 3 GHz	R&S	ESR3	101832	08-05-20	08-03-21
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	009	08-06-20	08-03-21
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	015	08-06-20	08-03-21
High Pass Filter 3GHz	Micro-Tronics	HPM17543	010	08-06-20	08-03-21
High Pass Filter 3GHz	Micro-Tronics	HPM17543	015	08-06-20	08-03-21
High Pass Filter 6GHz	Micro-Tronics	HPS17542	009	08-06-20	08-03-21
High Pass Filter 6GHz	Micro-Tronics	HPS17542	016	08-06-20	08-03-21
LISN	R&S	ENV-216	101837	08-09-20	08-06-21
Antenna, Loop, 9kHz-30MHz	R&S	HFH2-Z2	100418	10-02-21	
Termination	WEINSCHL	M1406A	T01	08-08-20	08-05-21
Attenuator	WEINSCHL	WA76-30-21	A015	08-08-20	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		

Note. The above antenna was not used for testing from August 4th to August 13th.

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	On Time [ms]	Period [ms]	Duty Cycle X [Linear]	Duty Cycle X [%]	Duty Cycle Correction Factor[dB]
802.11a SISO	1.464	1.481	0.989	98.852	-
802.11n(HT20) SISO	5.427	5.446	0.997	99.651	-
802.11n(HT40) SISO	5.427	5.445	0.997	99.669	-
802.11ac(VHT80) SISO	5.426	5.444	0.997	99.669	-
802.11a MIMO	1.464	1.482	0.988	98.785	-
802.11n(HT20) MIMO	5.429	5.446	0.997	99.688	-
802.11n(HT40) MIMO	5.427	5.445	0.997	99.669	-
802.11ac(VHT80) MIMO	5.427	5.443	0.997	99.706	-

Mode	ANT.	Tone	On Time [ms]	Period [ms]	Duty Cycle X [Linear]	Duty Cycle X [%]	Duty Cycle Correction Factor[dB]
802.11ax HE20	SISO	26T	5.080	5.105	0.995	99.510	-
		52T	5.072	5.094	0.996	99.568	-
		106T	4.768	4.786	0.996	99.624	-
		SU	5.446	5.462	0.997	99.707	-
	MIMO	26T	5.080	5.105	0.995	99.510	-
		52T	5.075	5.093	0.996	99.647	-
		106T	4.766	4.784	0.996	99.624	-
		SU	5.445	5.461	0.997	99.707	-
802.11ax HE40	SISO	26T	5.080	5.106	0.995	99.491	-
		52T	5.063	5.123	0.988	98.829	-
		106T	4.766	4.783	0.996	99.645	-
		242T	4.668	4.685	0.996	99.637	-
	MIMO	SU	5.445	5.462	0.997	99.689	-
		26T	5.059	5.086	0.995	99.469	-
		52T	5.050	5.095	0.991	99.117	-
		106T	4.740	4.762	0.995	99.538	-
802.11ax HE80	SISO	242T	4.667	4.684	0.996	99.637	-
		SU	5.444	5.462	0.997	99.670	-
	MIMO	26T	5.049	5.104	0.989	98.922	-
		52T	5.033	5.093	0.988	98.822	-
		106T	4.759	4.795	0.992	99.249	-
		242T	4.663	4.684	0.996	99.552	-
	MIMO	484T	4.663	4.680	0.996	99.637	-
		SU	5.444	5.460	0.997	99.707	-
		26T	5.048	5.104	0.989	98.903	-
		52T	5.048	5.085	0.993	99.272	-
		106T	4.742	4.772	0.994	99.371	-
		242T	4.662	4.684	0.995	99.530	-
		484T	4.662	4.679	0.996	99.637	-
		SU	5.445	5.461	0.997	99.707	-

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

LIMITS

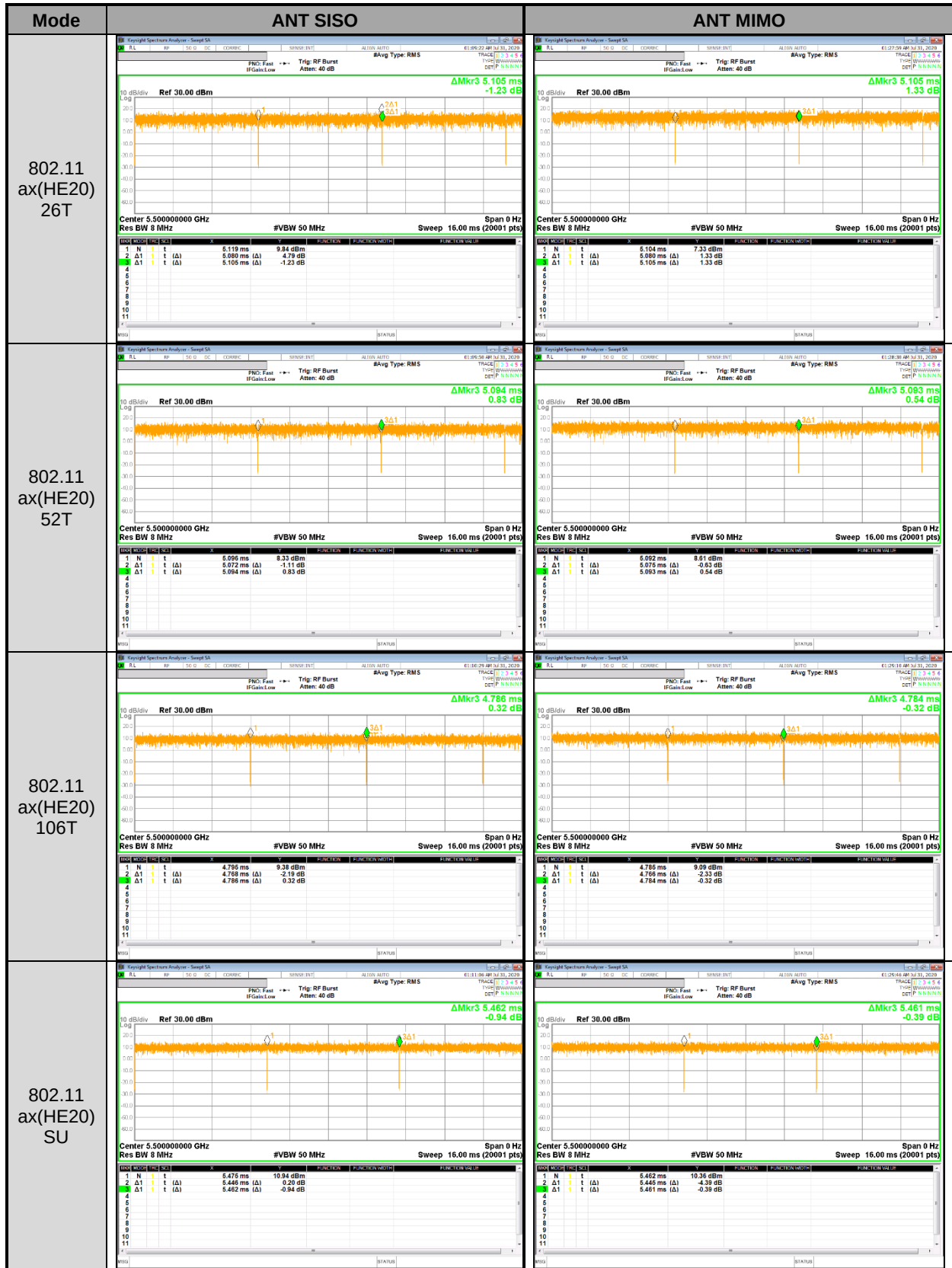
None; for reporting purposes only.

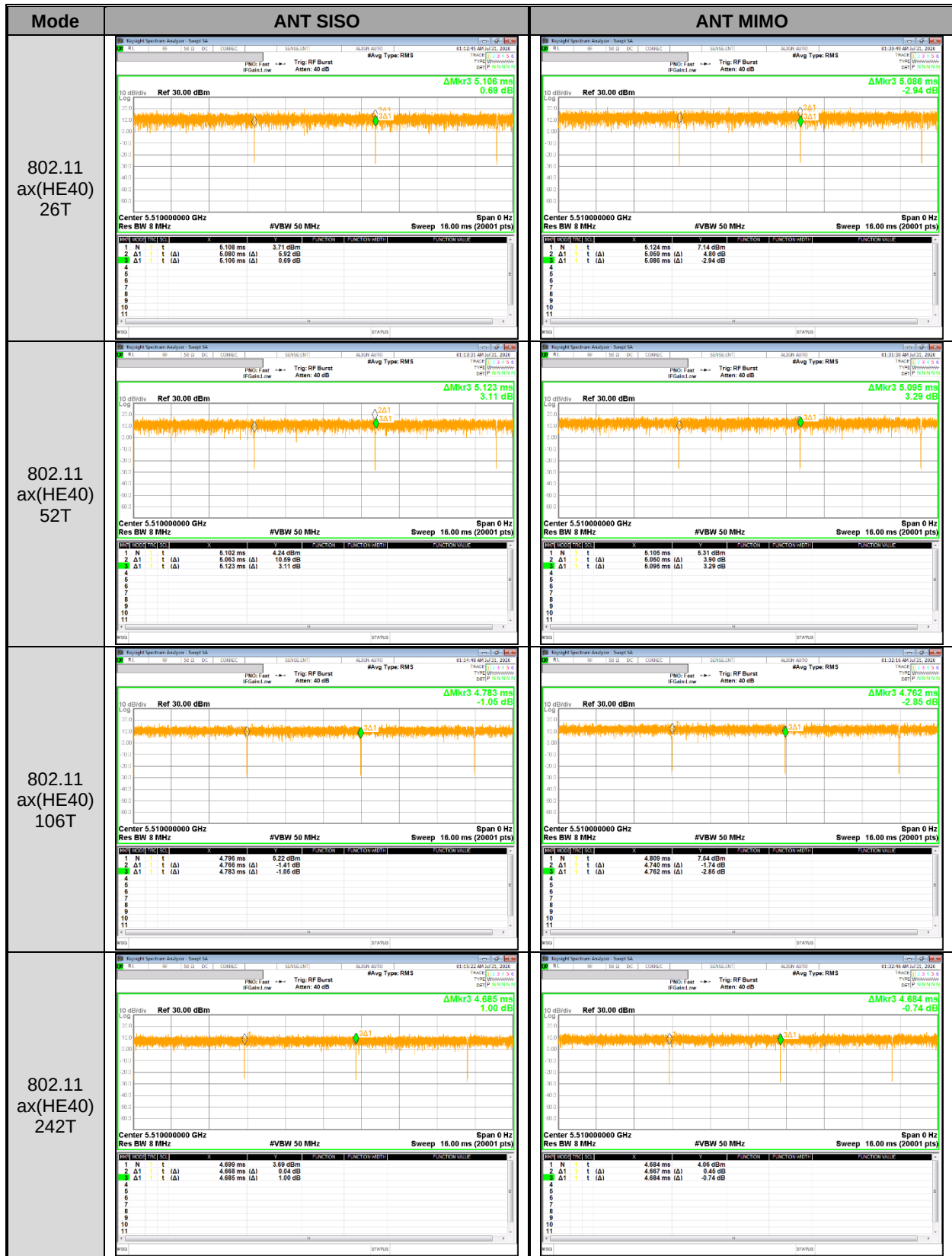
PROCEDURE

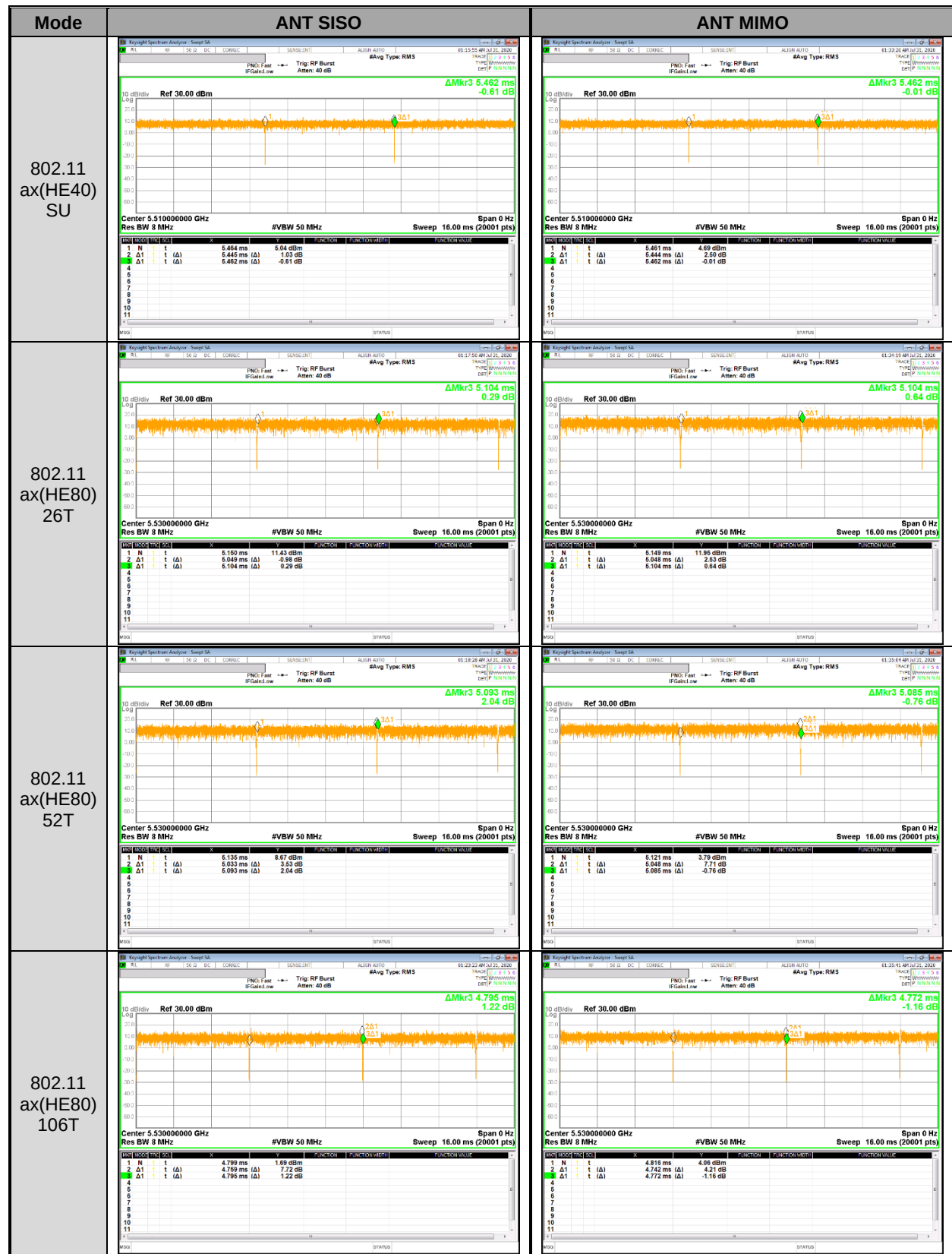
KDB 789033 D02 v02r01 Zero-Span Spectrum Analyzer Method.

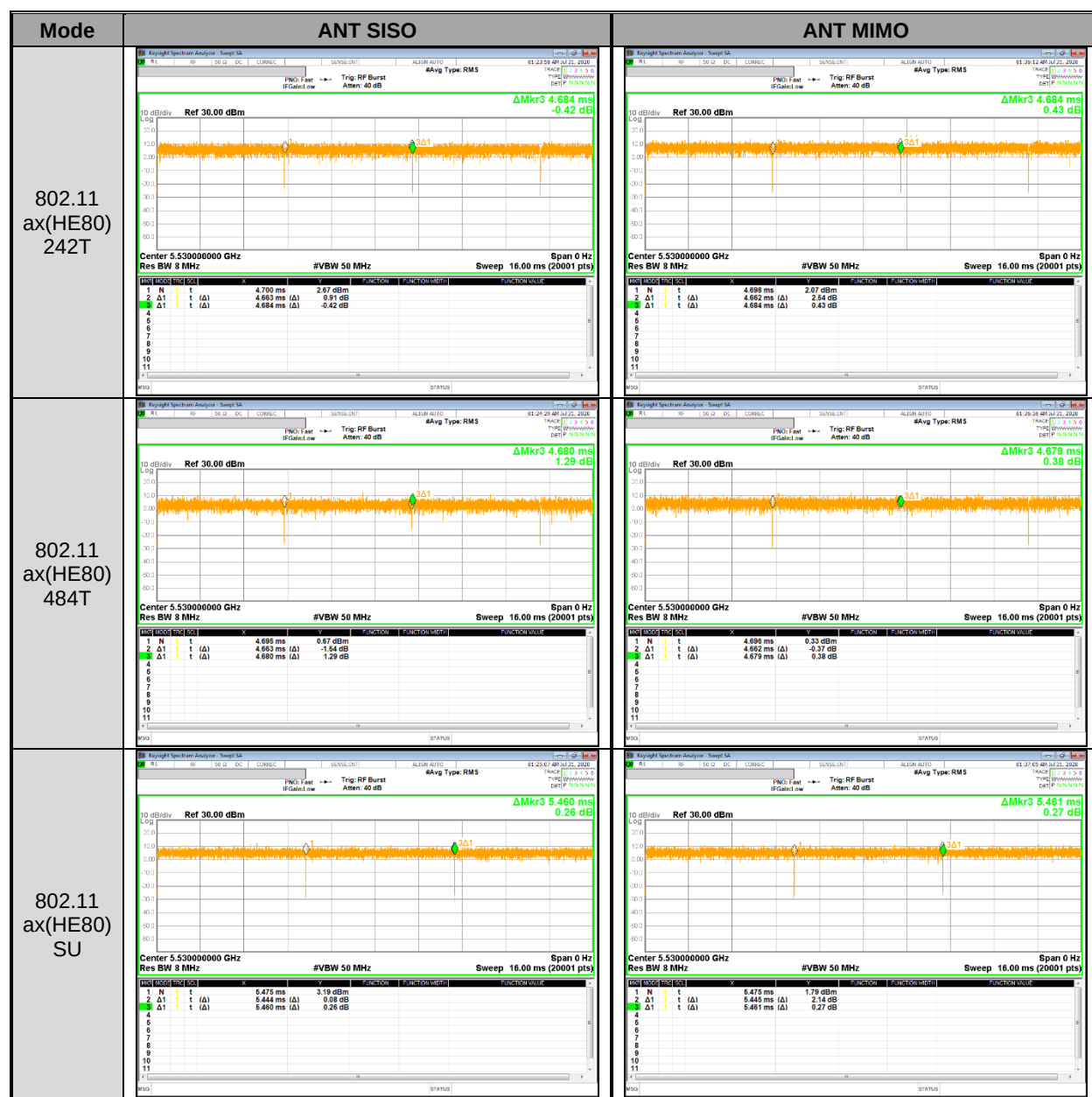
9.2. DUTY CYCLE PLOTS











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
				ANT1	ANT2	
UNII-1	802.11a	Low	5180	18.94	18.64	18.60
		Mid	5200	18.91	18.60	
		High	5240	18.88	18.62	
	802.11n HT20	Low	5180	19.74	20.40	19.74
		Mid	5200	19.88	19.97	
		High	5240	19.95	19.92	
	802.11n HT40	Low	5190	39.12	39.55	39.12
		High	5230	39.51	39.13	
	802.11ac VHT80	Mid	5210	81.52	81.22	81.22
	802.11ax HE20(SU)	Low	5180	20.61	20.47	20.34
		Mid	5200	20.34	20.49	
		High	5240	20.72	20.93	
	802.11ax HE40(SU)	Low	5190	39.80	39.52	39.52
		High	5230	39.77	39.97	
	802.11ax HE80(SU)	Mid	5210	81.56	81.20	81.20

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	19.37	18.87	18.49
		Mid	5300	18.55	18.49	
		High	5320	18.70	19.10	
	802.11n HT20	Low	5260	19.63	19.98	19.63
		Mid	5300	19.82	20.09	
		High	5320	20.07	19.89	
	802.11n HT40	Low	5270	39.06	39.15	39.06
		High	5310	39.40	39.12	
	802.11ac VHT80	Mid	5290	81.80	81.41	81.41
	802.11ax HE20(SU)	Low	5260	20.69	20.75	20.55
		Mid	5300	20.79	20.55	
		High	5320	20.78	20.67	
	802.11ax HE40(SU)	Low	5270	39.84	40.36	39.84
		High	5310	39.96	40.21	
	802.11ax HE80(SU)	Mid	5290	81.83	81.78	81.78

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	18.67	19.55	18.67
		Mid	5580	19.12	19.60	
		High	5700	19.66	19.30	
	802.11n HT20	Low	5500	20.53	19.53	19.53
		Mid	5580	20.14	19.89	
		High	5700	19.90	19.61	
	802.11n HT40	Low	5510	39.47	39.25	39.16
		Mid	5590	39.19	39.16	
		High	5670	39.56	39.23	
	802.11ac VHT80	Low	5530	81.34	81.05	81.05
		High	5610	81.69	81.43	
	802.11ax HE20(SU)	Low	5500	20.75	20.69	20.19
		Mid	5580	20.81	20.19	
		High	5700	20.55	20.54	
	802.11ax HE40(SU)	Low	5510	39.67	39.83	39.67
		Mid	5590	40.17	39.93	
		High	5670	39.83	39.90	
	802.11ax HE80(SU)	Low	5530	81.25	81.29	80.69
		High	5610	81.39	80.69	

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	15.186	4.294	15.180	4.580
	802.11n HT20	Straddle	5720	14.974	4.826	14.988	4.858
	802.11n HT40	Straddle	5710	34.722	4.726	34.476	4.564
	802.11ac VHT80	Straddle	5690	75.756	5.440	75.714	5.374
	802.11ax HE20(SU)	Straddle	5720	15.316	5.372	15.264	5.288
	802.11ax HE40(SU)	Straddle	5710	34.868	4.982	34.796	5.080
	802.11ax HE80(SU)	Straddle	5690	75.836	5.574	74.996	5.460

9.3.5. 802.11ax 5.2 GHz BAND(RU)

Band	Mode	Center Freq. [MHz]	Tones	RU offset	26 dB BW [MHz]		
					ANT1	ANT2	
UNII-1	HE20	5180	26T	0	17.24	18.49	
				4	16.46	16.01	
				8	18.75	16.08	
		5200		0	18.59	19.26	
				4	15.40	17.52	
				8	17.07	18.03	
		5240		0	19.53	19.29	
				4	15.01	17.52	
				8	19.39	19.05	
	HE40	5190		0	38.97	38.03	
				9	37.80	32.99	
				17	37.14	39.59	
		5230		0	39.27	33.26	
				9	33.15	31.07	
				17	35.71	19.57	
	HE80	5210		0	73.97	78.20	
				18	53.93	63.06	
				36	78.51	53.75	

9.3.6. 802.11ax 5.3 GHz BAND(RU)

Band	Mode	Center Freq. [MHz]	Tones	RU offset	26 dB BW [MHz]	
					ANT1	ANT2
UNII-2A	HE20	5260	26T	0	17.45	15.93
				4	16.95	16.30
				8	19.82	19.62
		5300		0	16.25	18.41
				4	18.20	17.12
				8	18.53	18.91
		5320		0	18.92	19.05
				4	16.10	18.12
				8	19.45	17.27
	HE40	5270		0	39.43	23.61
				9	34.03	23.61
				17	30.96	38.58
		5310		0	38.93	34.46
				9	33.98	31.90
				17	38.66	38.81
	HE80	5290		0	55.97	80.55
				18	76.18	78.03
				36	76.01	75.12

9.3.7. 802.11ax 5.5 GHz BAND(RU)

Band	Mode	Center Freq. [MHz]	Tones	RU offset	26 dB BW [MHz]	
					ANT1	ANT2
UNII-2C	HE20	5500	26T	0	19.47	17.62
				4	17.01	16.96
				8	19.56	19.54
		5580		0	17.46	19.00
				4	15.29	17.91
				8	19.31	19.78
		5700		0	19.73	18.13
				4	17.61	17.33
				8	18.90	18.54
	HE40	5510		0	33.69	39.10
				9	33.62	28.83
				17	38.75	39.59
		5590		0	39.43	37.64
				9	31.72	34.47
				17	36.31	37.90
		5670		0	39.60	29.84
				9	29.67	32.48
				17	39.41	39.38
	HE80	5530		0	80.92	71.35
				18	77.49	77.68
				36	80.16	81.50
		5610		0	80.82	80.28
				18	78.11	70.76
				36	77.37	74.57

9.3.8. 802.11ax STRADDLE CHANNEL(RU)

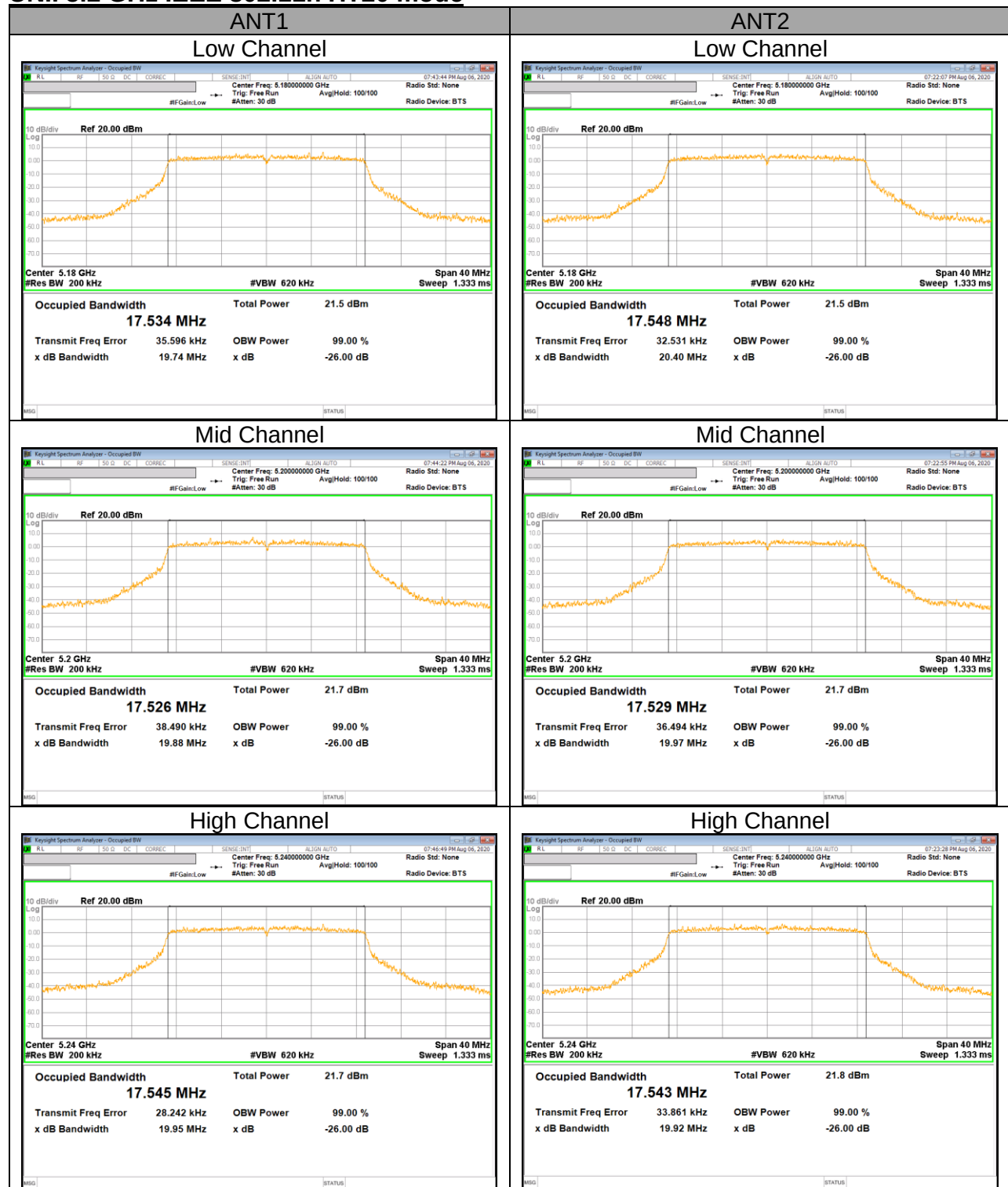
Band	Mode	Center Freq. [MHz]	Tones	RU offset	26 dB BW [MHz]			
					ANT1		ANT2	
					UNII-2C	UNII-3	UNII-2C	UNII-3
Straddle Channel	HE20	5720	26T	6	14.140	4.182	14.024	4.268
	HE40	5710		15	32.484	2.152	32.364	3.556
	HE80	5690		34	74.068	4.630	74.852	4.652

9.3.9. 26 dB BANDWIDTH PLOTS

UNII 5.2 GHz IEEE 802.11a mode



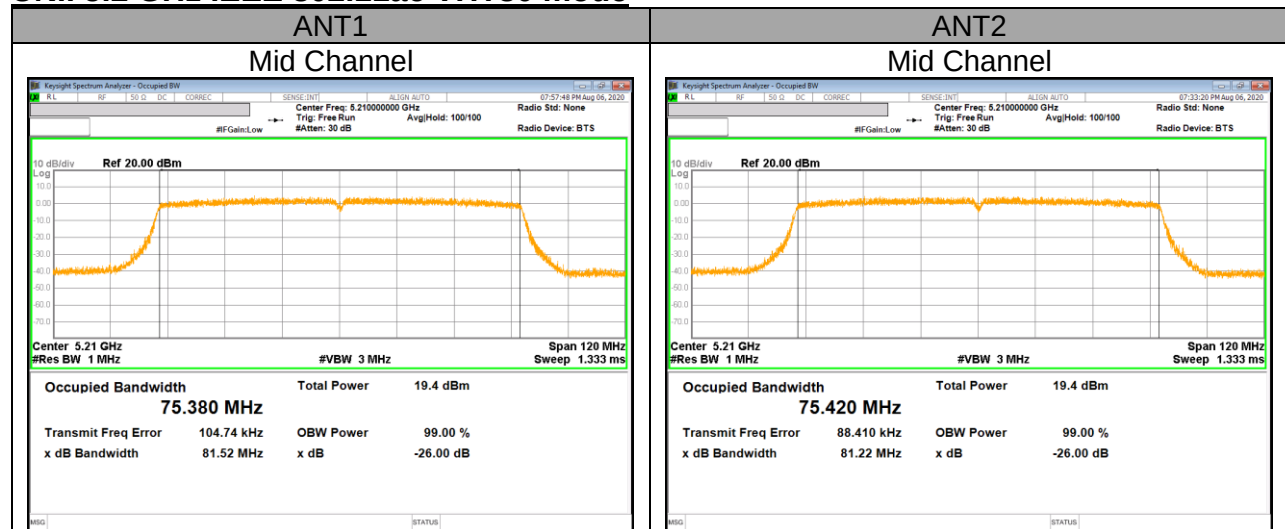
UNII 5.2 GHz IEEE 802.11n HT20 mode



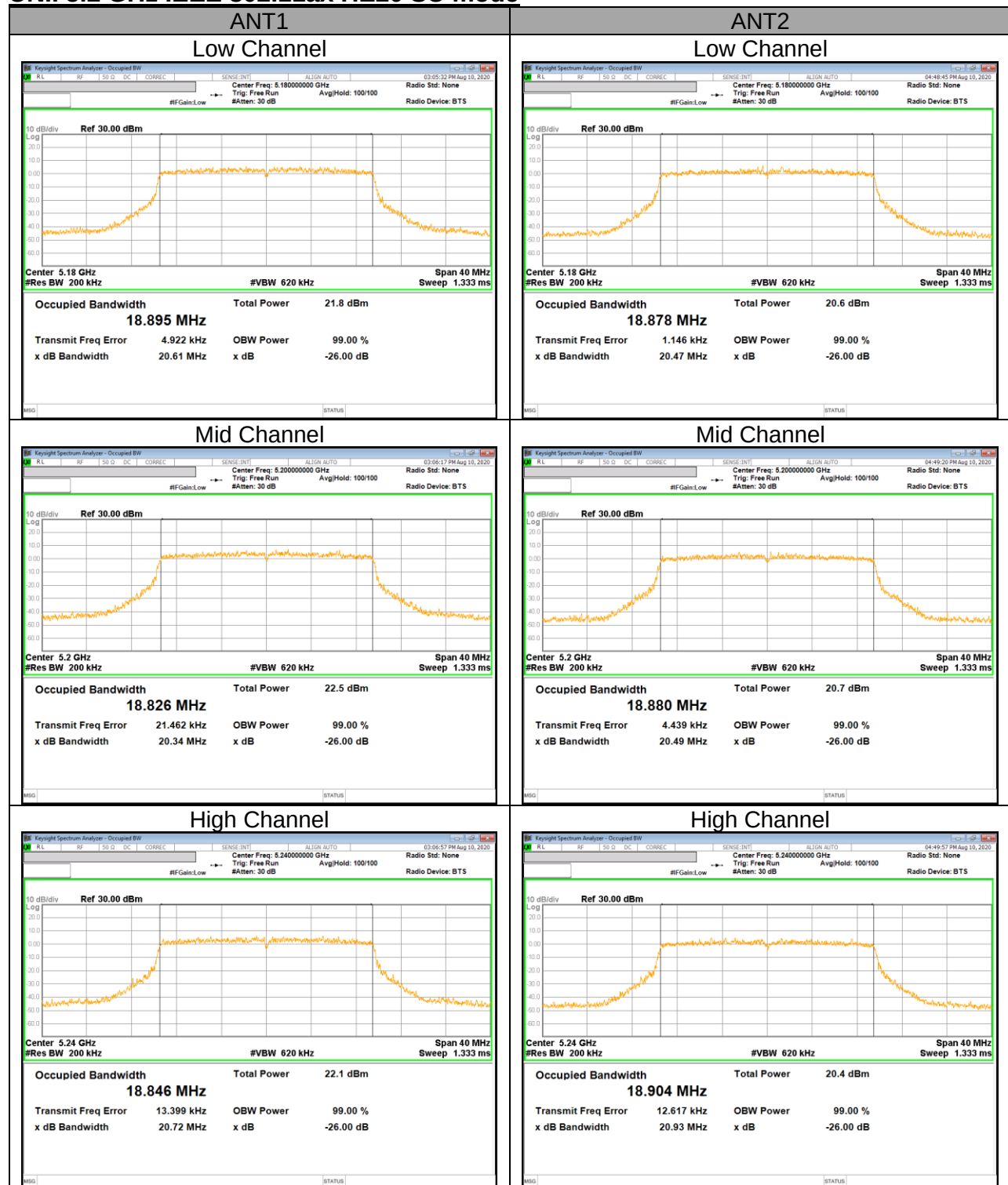
UNII 5.2 GHz IEEE 802.11n HT40 mode



UNII 5.2 GHz IEEE 802.11ac VHT80 mode



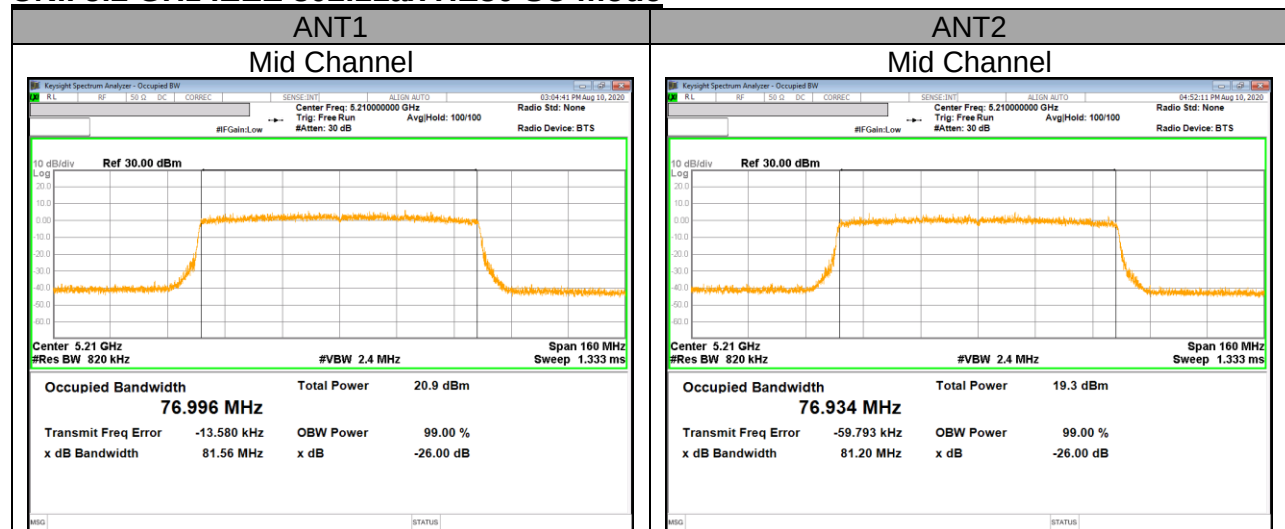
UNII 5.2 GHz IEEE 802.11ax HE20 SU mode



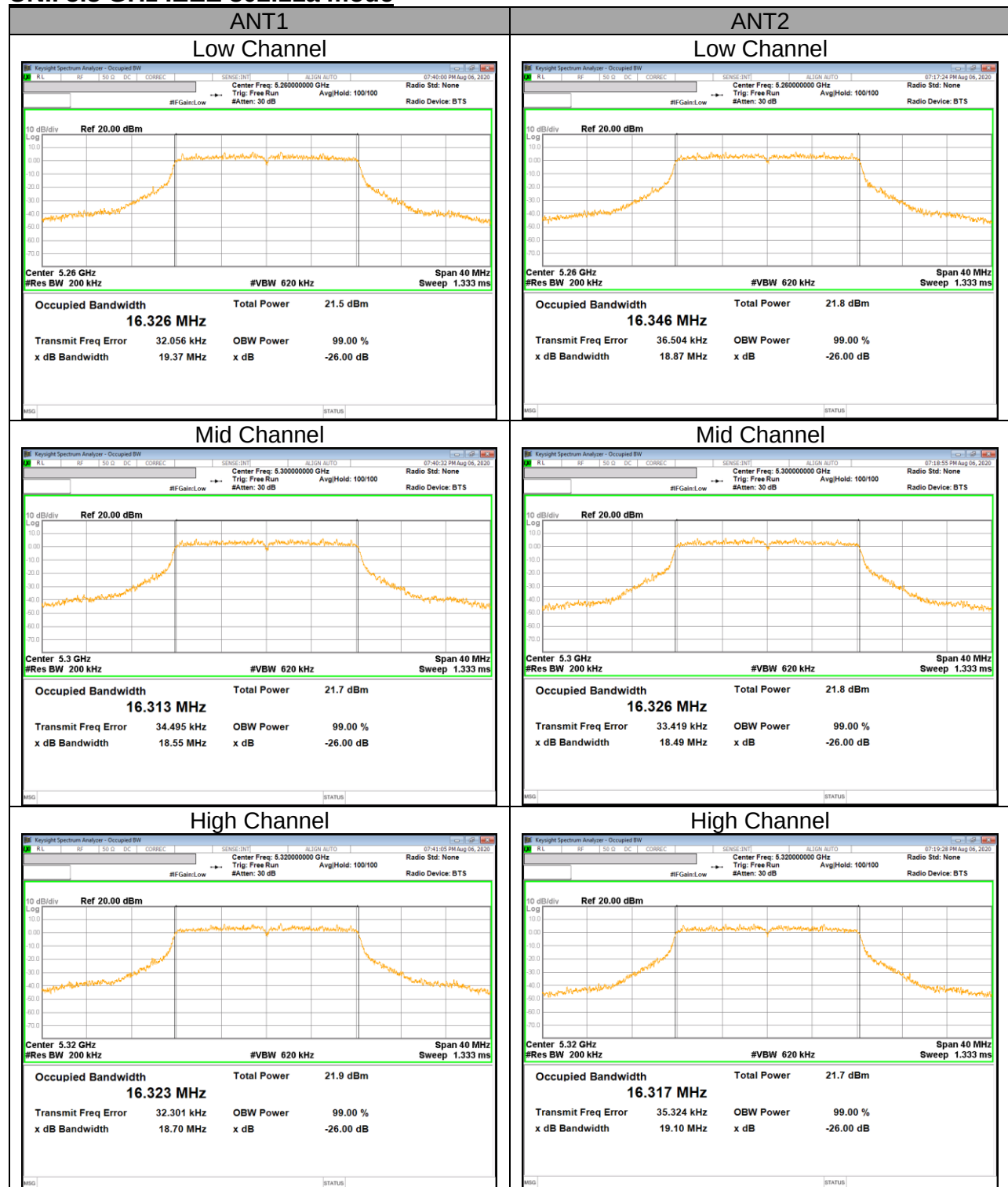
UNII 5.2 GHz IEEE 802.11ax HE40 SU mode



UNII 5.2 GHz IEEE 802.11ax HE80 SU mode



UNII 5.3 GHz IEEE 802.11a mode



UNII 5.3 GHz IEEE 802.11n HT20 mode

