

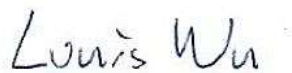


FCC RADIO TEST REPORT

FCC ID : UZ7TC7301
Equipment : Touch Computer
Brand Name : Zebra
Model Name : TC7301
Applicant : Zebra Technologies Corporation
1 Zebra Plaza, Holtsville, NY 11742
Manufacturer : Zebra Technologies Corporation
1 Zebra Plaza, Holtsville, NY 11742
Standard : FCC Part 15 Subpart E §15.407

The product was received on Jul. 15, 2022 and testing was performed from Aug. 18, 2022 to Sep. 13, 2022. We, Sporton International Inc. Wensan Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval from Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.



Approved by: Louis Wu

Sporton International Inc. Wensan Laboratory

No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)



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History of this test report

Report No.	Version	Description	Issue Date
FR271537E	01	Initial issue of report	Oct. 05, 2022

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.403(i)	26dB Bandwidth	Pass	-
3.1	2.1049	99% Occupied Bandwidth	Reporting only	-
3.2	15.407(a)	Maximum Conducted Output Power	Pass	-
3.3	15.407(a)	Power Spectral Density	Pass	-
3.4	15.407(b)	Unwanted Emissions	Pass	1.12 dB under the limit at 5353.200 MHz
3.5	15.207	AC Conducted Emission	Pass	15.36 dB under the limit at 0.184 MHz
3.6	15.203	Antenna Requirement	Pass	-

Declaration of Conformity:

- The test results (PASS/FAIL) with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
It's means measurement values may risk exceeding the limit of regulation standards, if measurement uncertainty is include in test results.
- The measurement uncertainty please refer to report "Uncertainty of Evaluation".

Comments and Explanations:

The product specifications of the EUT presented in the report are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Wei Chen

Report Producer: Ming Chen



1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Touch Computer
Brand Name	Zebra
Model Name	TC7301
FCC ID	UZ7TC7301
Sample 1	Lowell + Premium config
Sample 2	SE4720 + Base config
Sample 3	Lowell + Base config
EUT supports Radios application	NFC WLAN 11a/b/g/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80/VHT160 WLAN 11ax HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE
HW Version	EV2
SW Version	11-11-28.00-RG-U00-PRD-ATH-04 356 test-keys
FW Version	FUSION_QA_4_1.2.0.001_R
MFD	10Jun22
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer.

Specification of Accessories				
Adapter	Brand Name	Zebra	Part Number	PWR-WUA5V12W0US
Battery 1X	Brand Name	Zebra	Part Number	BT-000442-0020
Battery 1.5X	Brand Name	Zebra	Part Number	BT-000442-0820
Wireless Battery	Brand Name	Zebra	Part Number	BT-000442-002A
USB TYPE A to TYPE C cable	Brand Name	Zebra	Part Number	CBL-TC5X-USBC2A-01
USB TYPE C to 3.5mm audio connector	Brand Name	Zebra	Part Number	ADP-USBC-35MM1-01
3.5mm Earphone	Brand Name	Zebra	Part Number	HDST-35MM-PTVP-01
USB TYPE C Earphone	Brand Name	Zebra	Part Number	HPST-USBC-PTT1-01
Trigger Handle	Brand Name	Zebra	Part Number	TRG-NGTC5-ELEC-01
Soft Holster	Brand Name	Zebra	Part Number	SG-NGTC5TC7-HLSTR-01
TC53/TC58 RUGGED BOOT	Brand Name	Zebra	Part Number	SG-NGTC5EXO1-01

1.1.1 Antenna Gain

<For CDD Mode>

Follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01 F2)f)ii)

Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows:

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$.

G_{ANT} is set equal to the gain of the antenna having the highest gain.

For PSD measurements, the directional gain calculation.

$$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

where

Each antenna is driven by no more than one spatial stream;

N_{SS} = the number of independent spatial streams of data;

N_{ANT} = the total number of antennas

$g_{j,k} = 10^{G_k/20}$ if the k th antenna is being fed by spatial stream j , or zero if it is not;
 G_k is the gain in dBi of the k th antenna.

As minimum $N_{SS}=1$ is supported by EUT, the formula can be simplified as:

Directional gain = $10 \cdot \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{ANT}]$ dBi

Where $G_1, G_2, \dots, G_N$ denote single antenna gain.

The directional gain "DG" is calculated as following table.

			DG	DG	Power	PSD
			for	for	Limit	Limit
	Ant 1	Ant 2	Power	PSD	Reduction	Reduction
	(dBi)	(dBi)	(dBi)	(dBi)	(dB)	(dB)
Band I	0.02	1.66	1.66	3.89	0.00	0.00
Band II	0.50	1.90	1.90	4.24	0.00	0.00
Band III	0.60	1.76	1.76	4.21	0.00	0.00

Calculation example:

If a device has two antenna, $G_{ANT1} = 3.0\text{dBi}$; $G_{ANT2} = 3.2\text{dBi}$

Directional gain of power measurement = $\max(3.0, 3.2) + 0 = 3.2\text{ dBi}$

Directional gain of PSD derived from formula which is

$$10 \times \log \left\{ \left[10^{\frac{0.02\text{ dBi}}{20}} + 10^{\frac{1.66\text{ dBi}}{20}} \right]^2 / 2 \right\}$$

$$= 3.89\text{ dBi}$$

$$10 \times \log \left\{ \left[10^{\frac{0.50\text{ dBi}}{20}} + 10^{\frac{1.90\text{ dBi}}{20}} \right]^2 / 2 \right\}$$

$$= 4.24\text{ dBi}$$

$$10 \times \log \left\{ \left[10^{\frac{0.60\text{ dBi}}{20}} + 10^{\frac{1.76\text{ dBi}}{20}} \right]^2 / 2 \right\}$$

$$= 4.21\text{ dBi}$$

Power and PSD limit reduction = Composite gain – 6dBi, (min = 0)

<TXBF Modes>

The EUT supports beamforming modes , then

Follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01 F)2)e)ii)

Directional gain = GANT + 10 log(NANT/NSS) dBi,

where NSS = the number of independent spatial streams of data and GANT is the antenna gain in dBi

$$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

where

Each antenna is driven by no more than one spatial stream;

N_{SS} = the number of independent spatial streams of data;

N_{ANT} = the total number of antennas

$g_{j,k} = 10^{G_k / 20}$ if the k th antenna is being fed by spatial stream j , or zero if it is not;
 G_k is the gain in dBi of the k th antenna.

The directional gain “DG” is calculated as following table.

			DG	DG	Power	PSD
			for	for	Limit	Limit
	Ant 1	Ant 2	Power	PSD	Reduction	Reduction
	(dBi)	(dBi)	(dBi)	(dBi)	(dB)	(dB)
Band I	0.02	1.66	3.89	3.89	0.00	0.00
Band II	0.50	1.90	4.24	4.24	0.00	0.00
Band III	0.60	1.76	4.21	4.21	0.00	0.00

Calculation example:

Directional gain is derived from formula which is

$$10 \times \log \left\{ \left[10^{\frac{0.02 \text{ dBi}}{20}} + 10^{\frac{1.66 \text{ dBi}}{20}} \right]^2 / 2 \right\}$$

$$= 3.89 \text{ dBi}$$

$$10 \times \log \left\{ \left[10^{\frac{0.50 \text{ dBi}}{20}} + 10^{\frac{1.90 \text{ dBi}}{20}} \right]^2 / 2 \right\}$$

$$= 4.24 \text{ dBi}$$

$$10 \times \log \left\{ \left[10^{\frac{0.60 \text{ dBi}}{20}} + 10^{\frac{1.76 \text{ dBi}}{20}} \right]^2 / 2 \right\}$$

$$= 4.21 \text{ dBi}$$

Power and PSD limit reduction = Composite gain – 6dBi, (min = 0)

1.2 Product Specification of Equipment Under Test

Product Specification is subject to this standard	
Tx/Rx Frequency Range	5180 MHz ~ 5240 MHz 5260 MHz ~ 5320 MHz 5500 MHz ~ 5720 MHz
Maximum Output Power to Antenna <CDD Mode>	<5180 MHz ~ 5240 MHz> MIMO <Ant. 9+8> 802.11a: 20.66 dBm / 0.1164 W 802.11n HT20: 20.37 dBm / 0.1089 W 802.11n HT40: 19.37 dBm / 0.0865 W 802.11ac VHT20: 20.47 dBm / 0.1114 W 802.11ac VHT40: 19.47 dBm / 0.0885 W 802.11ac VHT80: 16.56 dBm / 0.0453 W 802.11ac VHT160: 15.41 dBm / 0.0348 W 802.11ax HE20: 20.57 dBm / 0.1140 W 802.11ax HE40: 19.57 dBm / 0.0906 W 802.11ax HE80: 16.66 dBm / 0.0463 W 802.11ax HE160: 15.51 dBm / 0.0356 W <5260 MHz ~ 5320 MHz> MIMO <Ant. 9+8> 802.11a: 20.52 dBm / 0.1127 W 802.11n HT20: 20.42 dBm / 0.1102 W 802.11n HT40: 19.67 dBm / 0.0927 W 802.11ac VHT20: 20.52 dBm / 0.1127 W 802.11ac VHT40: 19.77 dBm / 0.0948 W 802.11ac VHT80: 17.52 dBm / 0.0565 W 802.11ax HE20: 20.62 dBm / 0.1153 W 802.11ax HE40: 19.87dBm / 0.0971 W 802.11ax HE80: 17.62 dBm / 0.0578 W 802.11ax HE160: 12.21 dBm / 0.0166 W <5500 MHz ~ 5720 MHz> MIMO <Ant. 9+8> 802.11a: 21.22 dBm / 0.1324 W 802.11n HT20: 20.97 dBm / 0.1250 W 802.11n HT40: 21.06 dBm / 0.1276 W 802.11ac VHT20: 21.07 dBm / 0.1279 W 802.11ac VHT40: 21.16 dBm / 0.1306 W 802.11ac VHT80: 19.81 dBm / 0.0957 W 802.11ac VHT160: 16.12 dBm / 0.0409 W 802.11ax HE20: 21.17 dBm / 0.1309 W 802.11ax HE40: 21.26 dBm / 0.1337 W 802.11ax HE80: 19.91 dBm / 0.0979 W 802.11ax HE160: 16.22 dBm / 0.0419 W



Product Specification is subject to this standard	
Maximum Output Power to Antenna <TXBF Mode>	<5180 MHz ~ 5240 MHz> MIMO <Ant. 9+8> 802.11n HT20: 20.16 dBm / 0.1038 W 802.11n HT40: 17.16 dBm / 0.0520 W 802.11n VHT20: 20.26 dBm / 0.1062 W 802.11n VHT40: 17.26 dBm / 0.0532W 802.11n VHT80: 14.71 dBm / 0.0296 W 802.11n VHT160: 13.26 dBm / 0.0212 W 802.11ax HE20: 20.36 dBm / 0.1086 W 802.11ax HE40: 17.36 dBm / 0.0545 W 802.11ax HE80: 14.81 dBm / 0.0303 W <5260 MHz ~ 5320 MHz> MIMO <Ant. 9+8> 802.11n HT20: 20.27 dBm / 0.1064 W 802.11n HT40: 17.56 dBm / 0.0570 W 802.11n VHT20: 20.37 dBm / 0.1089 W 802.11n VHT40: 17.66 dBm / 0.0583 W 802.11n VHT80: 15.92 dBm / 0.0391 W 802.11ax HE20: 20.47 dBm / 0.1114 W 802.11ax HE40: 17.76 dBm / 0.0597 W 802.11ax HE80: 16.02 dBm / 0.0400W <5500 MHz ~ 5720 MHz MIMO <Ant. 9+8> 802.11n HT20: 20.47 dBm / 0.1114 W 802.11n HT40: 19.86 dBm / 0.0986 W 802.11n VHT20: 20.57 dBm / 0.1140 W 802.11n VHT40: 19.96 dBm / 0.0991 W 802.11n VHT80: 18.97 dBm / 0.0789 W 802.11n VHT160: 15.71 dBm / 0.0372 W 802.11ax HE20: 20.91 dBm / 0.1233 W 802.11ax HE40: 20.76 dBm / 0.1191 W 802.11ax HE80: 19.07 dBm / 0.0807 W 802.11ax HE160: 15.81dBm / 0.0381 W
99% Occupied Bandwidth <CDD Mode>	MIMO <Ant. 9> 802.11a: 24.78 MHz 802.11ax HE20: 20.73 MHz 802.11ax HE40: 39.88 MHz 802.11ax HE80: 77.44 MHz 802.11ax HE160: 156.32MHz MIMO <Ant. 8> 802.11a: 27.77 MHz 802.11ax HE20: 25.18 MHz 802.11ax HE40: 45.97 MHz 802.11ax HE80: 77.56 MHz 802.11ax HE160: 156.08MHz

Product Specification is subject to this standard			
99% Occupied Bandwidth <TXBF Mode>	MIMO <Ant. 9> 802.11ax HE20: 19.33 MHz 802.11ax HE40: 39.16 MHz 802.11ax HE80: 78.04 MHz 802.11ax HE160: 157.52 MHz MIMO <Ant. 8> 802.11ax HE20: 19.93 MHz 802.11ax HE40: 39.56 MHz 802.11ax HE80: 77.92 MHz 802.11ax HE160: 157.52 MHz		
Antenna Type	Ant. 9 : PIFA Antenna Ant. 8 : PIFA Antenna		
Antenna Gain	<5180 MHz ~ 5240 MHz> Ant. 9 : 0.02 dBi Ant. 8 : 1.66 dBi		
	<5260 MHz ~ 5320 MHz> Ant. 9 : 0.50 dBi Ant. 8 : 1.90 dBi		
	<5500 MHz ~ 5720 MHz> Ant. 9 : 0.60 dBi Ant. 8 : 1.76 dBi		
Type of Modulation	802.11a/n: OFDM (BPSK/QPSK/16QAM/64QAM) 802.11ac: OFDM (BPSK/QPSK/16QAM/64QAM/256QAM) 802.11ax: OFDMA (BPSK/QPSK/16QAM/64QAM/256QAM/1024QAM)		
Antenna Function Description		Ant. 9	Ant. 8
	802.11 a/n/ac/ax MIMO	V	V
	802.11 n/ac/ax TXBF	V	V

Remark:

1. MIMO Ant. 9+8 Directional Gain is a calculated result from MIMO Ant. 9 and MIMO Ant. 8. The formula used in calculation is documented in section 1.1.1.
2. Power of MIMO Ant. 9 + Ant. 8 is a calculated result from sum of the power MIMO Ant. 9 and MIMO Ant. 8.
3. The EUT's information above is declared by manufacturer. Please refer to Comments and Explanations in report summary.

1.3 Modification of EUT

No modifications made to the EUT during the testing.

1.4 Testing Location

Test Site	Sporton International Inc. EMC & Wireless Communications Laboratory
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	Sporton Site No. CO05-HY (TAF Code: 1190)
Remark	The Conducted Emission test item subcontracted to Sporton International Inc. EMC & Wireless Communications Laboratory.

Note: The test site complies with ANSI C63.4 2014 requirement.

Test Site	Sporton International Inc. Wensan Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	Sporton Site No. TH05-HY, 03CH11-HY

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW1190 and TW3786

1.5 Applicable Standards

According to the specifications declared by the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC Part 15 Subpart E
- ♦ FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01.
- ♦ FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ♦ ANSI C63.10-2013

Remark:

1. All the test items were validated and recorded in accordance with the standards without any modification during the testing.
2. The TAF code is not including all the FCC KDB listed without accreditation.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and only the worst case emissions were reported in this report.
- b. AC power line Conducted Emission was tested under maximum output power.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5150-5250 MHz Band 1 (U-NII-1)	36	5180	44	5220
	38*	5190	46*	5230
	40	5200	48	5240
	42#	5210		
Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5250-5350 MHz Band 2 (U-NII-2A)	52	5260	60	5300
	54*	5270	62*	5310
	56	5280	64	5320
	58#	5290		
Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5470-5725 MHz Band 3 (U-NII-2C)	100	5500	112	5560
	102*	5510	116	5580
	104	5520	132	5660
	106#	5530	134*	5670
	108	5540	136	5680
	110*	5550	140	5700
Frequency Band	Channel		Freq. (MHz)	
5150-5350 MHz	50@		5250	
5470-5725 MHz	114@		5570	



Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
Straddle Channel	138 [#]	5690	144	5720
	142 [*]	5710		

Note:

1. The above Frequency and Channel with "*" are 802.11n HT40 and 802.11ac VHT40 and 802.11ax HE40.
2. The above Frequency and Channel with "#" are 802.11ac VHT80 and 802.11ax HE80.
3. The above Frequency and Channel with "@" are 802.11ac VHT160 and 802.11ax HE160.

2.2 Test Mode

This device support 26/52/106/242/484-tone RU but does not support 2x996-tone RU on 160MHz channel.

The 996-tone RU is covered by 80MHz channel.

The SISO mode conducted power is covered by MIMO mode per chain, so only the MIMO mode is tested.

The power for 802.11n and 802.11ac mode is smaller than 802.11ax mode, so all other conducted and radiated test is covered by 802.11ax mode.

The final test modes include the worst data rates for each modulation shown in the table below.

CDD Mode

Modulation	Data Rate
802.11a	6 Mbps
802.11n HT20 (Covered by HE20)	MCS0
802.11n HT40 (Covered by HE40)	MCS0
802.11ac VHT20 (Covered by HE20)	MCS0
802.11ac VHT40 (Covered by HE40)	MCS0
802.11ac VHT80 (Covered by HE80)	MCS0
802.11ax HE20	MCS0
802.11ax HE40	MCS0
802.11ax HE80	MCS0
802.11ax HE160	MCS0

Remark: The conducted power level of each chain in MIMO mode is equal or higher than SISO mode.

TXBF Mode

Modulation	Data Rate
802.11n HT20 (Covered by HE20)	MCS0
802.11n HT40 (Covered by HE40)	MCS0
802.11ac VHT20 (Covered by HE20)	MCS0
802.11ac VHT40 (Covered by HE40)	MCS0
802.11ac VHT80 (Covered by HE80)	MCS0
802.11ax HE20	MCS0
802.11ax HE40	MCS0
802.11ax HE80	MCS0
802.11ax HE160	MCS0

Remark: The conducted power level of each chain in MIMO mode is equal or higher than SISO mode.

Test Cases	
AC Conducted Emission	Mode 1 : WLAN (5GHz) Link + Bluetooth Link + NFC On + USB TYPE A to TYPE C cable (Charging with Adapter) + Battery 1X for Sample 1
Remark: For Radiated Test Cases, the tests were performed with Battery 1X.	

<CDD Mode>

<Sample 1>

Ch. #		Band I : 5150-5250 MHz	Band II : 5250-5350 MHz	Band III : 5470-5725MHz
		802.11a	802.11a	802.11a
L	Low	36	52	100
M	Middle	44	60	116
H	High	48	64	140
Straddle		-	-	144

Ch. #		Band I : 5150-5250 MHz	Band II : 5250-5350 MHz	Band III : 5470-5725MHz
		802.11ax HE20	802.11ax HE20	802.11ax HE20
L	Low	36	52	100
M	Middle	44	60	116
H	High	48	64	140
Straddle		-	-	144

Ch. #		Band I : 5150-5250 MHz	Band II : 5250-5350 MHz	Band III : 5470-5725MHz
		802.11ax HE40	802.11ax HE40	802.11ax HE40
L	Low	38	54	102
M	Middle	-	-	110
H	High	46	62	134
Straddle		-	-	142



Ch. #		Band I : 5150-5250 MHz	Band II : 5250-5350 MHz	Band III : 5470-5725MHz
		802.11ax HE80	802.11ax HE80	802.11ax HE80
L	Low	-	-	106
M	Middle	42	58	-
H	High	-	-	122
Straddle		-	-	138

BW160	5150-5350 MHz		5470-5725MHz	
	802.11ax HE160		802.11ac VHT160	
Ch. #	50		114	

<Sample 2>

Ch. #		Band I : 5150-5250 MHz	Band II : 5250-5350 MHz	Band III : 5470-5725MHz
		802.11a	802.11a	802.11a
L	Low	-	-	100
M	Middle	44	-	-
H	High	-	-	-
Straddle		-	-	-

Ch. #		Band I : 5150-5250 MHz	Band II : 5250-5350 MHz	Band III : 5470-5725MHz
		802.11ax HE40	802.11ax HE40	802.11ax HE40
L	Low	-	-	-
M	Middle	-	-	-
H	High	-	62	-
Straddle		-	-	-

<TXBF Mode>

<Sample 1>

Ch. #		Band I : 5150-5250 MHz	Band II : 5250-5350 MHz	Band III : 5470-5725MHz
		802.11ax HE20	802.11ax HE20	802.11ax HE20
L	Low	36	52	100
M	Middle	44	60	116
H	High	48	64	140
Straddle		-	-	144

Ch. #		Band I : 5150-5250 MHz	Band II : 5250-5350 MHz	Band III : 5470-5725MHz
		802.11ax HE40	802.11ax HE40	802.11ax HE40
L	Low	38	54	102
M	Middle	-	-	110
H	High	46	62	134
Straddle		-	-	142

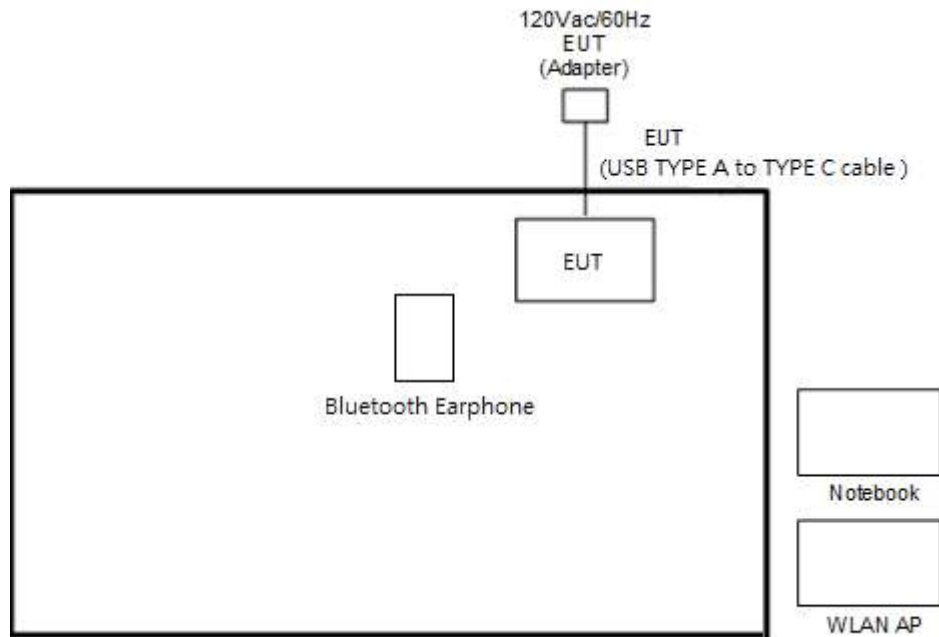
Ch. #		Band I : 5150-5250 MHz	Band II : 5250-5350 MHz	Band III : 5470-5725MHz
		802.11ax HE80	802.11ax HE80	802.11ax HE80
L	Low	-	-	106
M	Middle	42	58	-
H	High	-	-	122
Straddle		-	-	138

BW160		5150-5350 MHz	5470-5725MHz
		802.11ax HE160	802.11ac VHT160
Ch. #		50	114

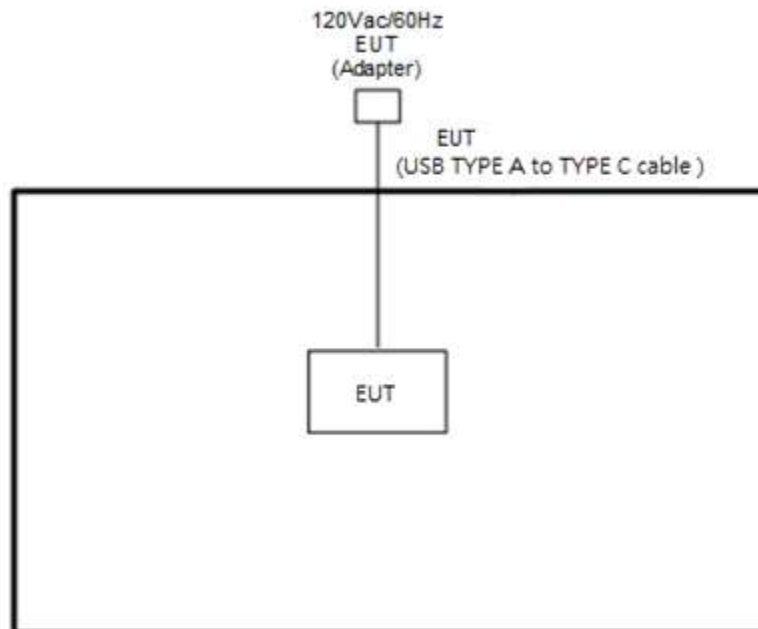
Remark: For radiation spurious emission, the modulation and the data rate picked for testing are determined by the Max. RF conducted power.

2.3 Connection Diagram of Test System

<AC Conducted Emission Mode>



<WLAN Tx Mode>



2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Bluetooth Earphone	Sony Ericsson	MW600	PY700A2029	N/A	N/A
2.	WLAN AP	ASUS	RT-AC66U	MSQ-RTAC66U	N/A	Unshielded, 1.8m
3.	Notebook	Dell	Latitude 3400	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
4.	SD Card	SanDisk	MicroSD HC	FCC DoC	N/A	N/A

2.5 EUT Operation Test Setup

The RF test items, utility “QRCT v4.0.00194.0” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

For TXBF mode, the modulation modes and data rates manipulated by the command lines in the engineering program made the EUT link to another EUT by power under the normal operation. The “QRCT v4.0.00194.0” software tool was used to enable the EUT to transmit signals continuously.

2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 4.2 dB and 10 dB attenuator.

$$\begin{aligned}
 \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)}. \\
 &= 4.2 + 10 = 14.2 \text{ (dB)}
 \end{aligned}$$

3 Test Result

3.1 26dB & 99% Occupied Bandwidth Measurement

3.1.1 Description of 26dB & 99% Occupied Bandwidth

This section is for reporting purpose only.

There is no restriction limits for bandwidth.

For Straddle Channel, according to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, if the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

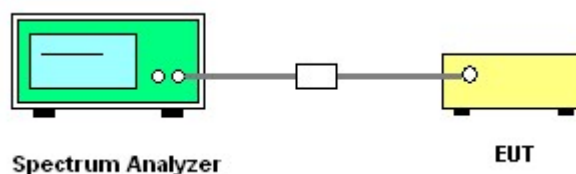
3.1.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.1.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section C) Emission bandwidth
2. Set RBW = approximately 1% of the emission bandwidth.
3. Set the VBW > RBW.
4. Detector = Peak.
5. Trace mode = max hold
6. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.
7. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW) $\geq 3 * RBW$.
8. Measure and record the results in the test report.

3.1.4 Test Setup



3.1.5 Test Result of 26dB & 99% Occupied Bandwidth

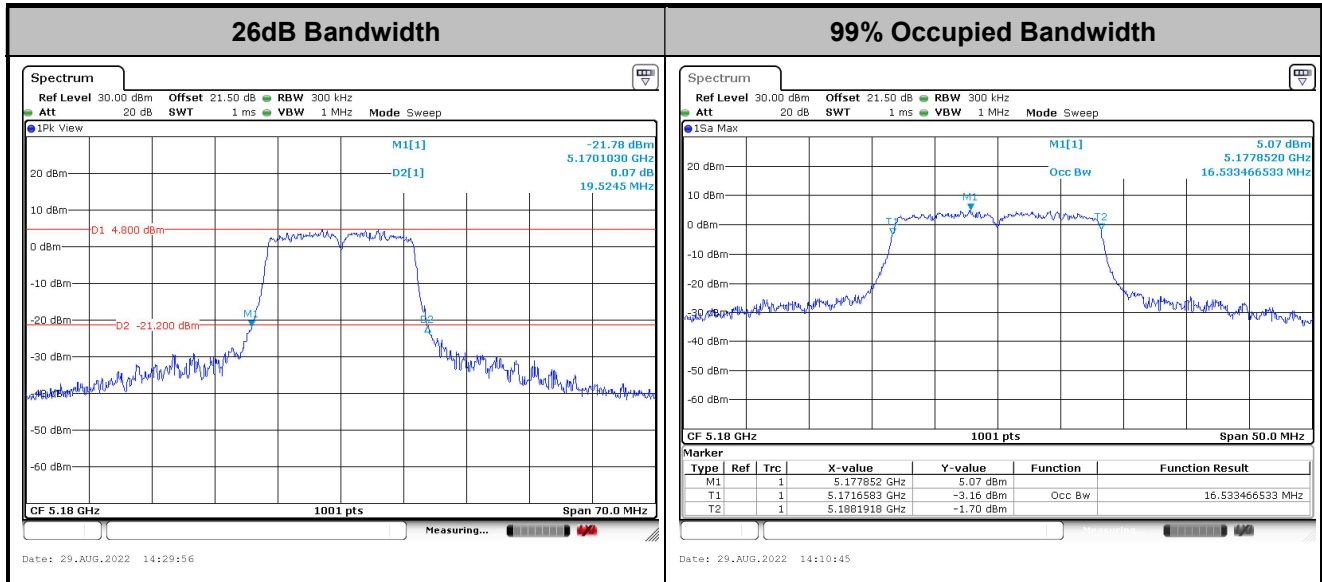
Please refer to Appendix A.



<CDD Modes>

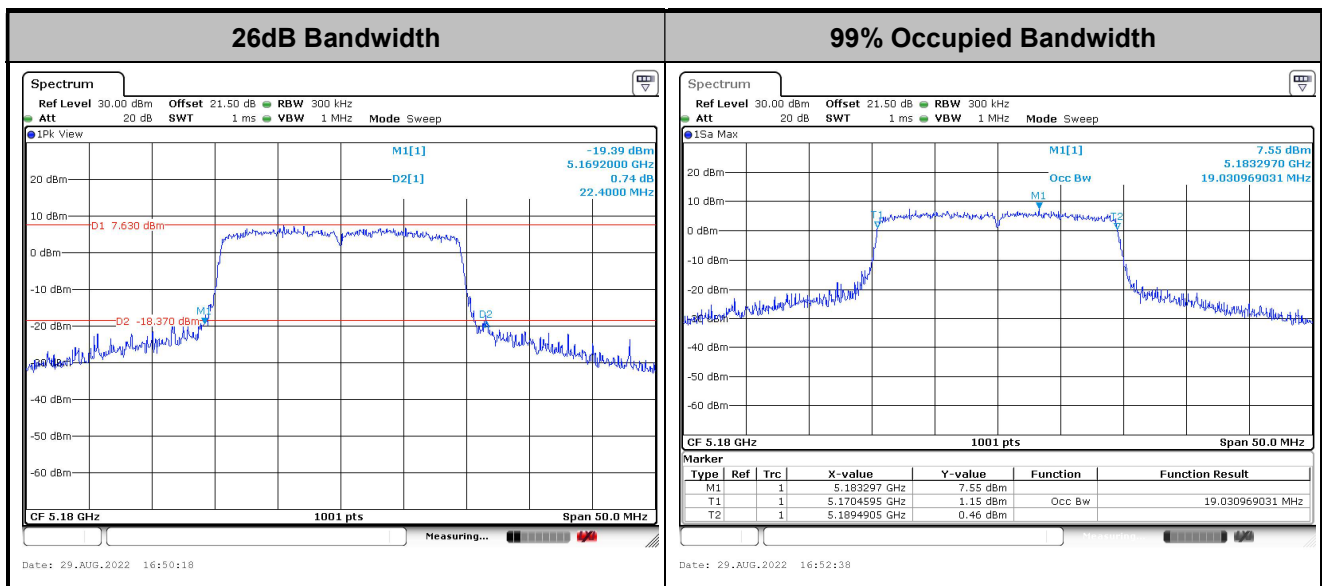
MIMO <Ant. 9+8>

<802.11a>



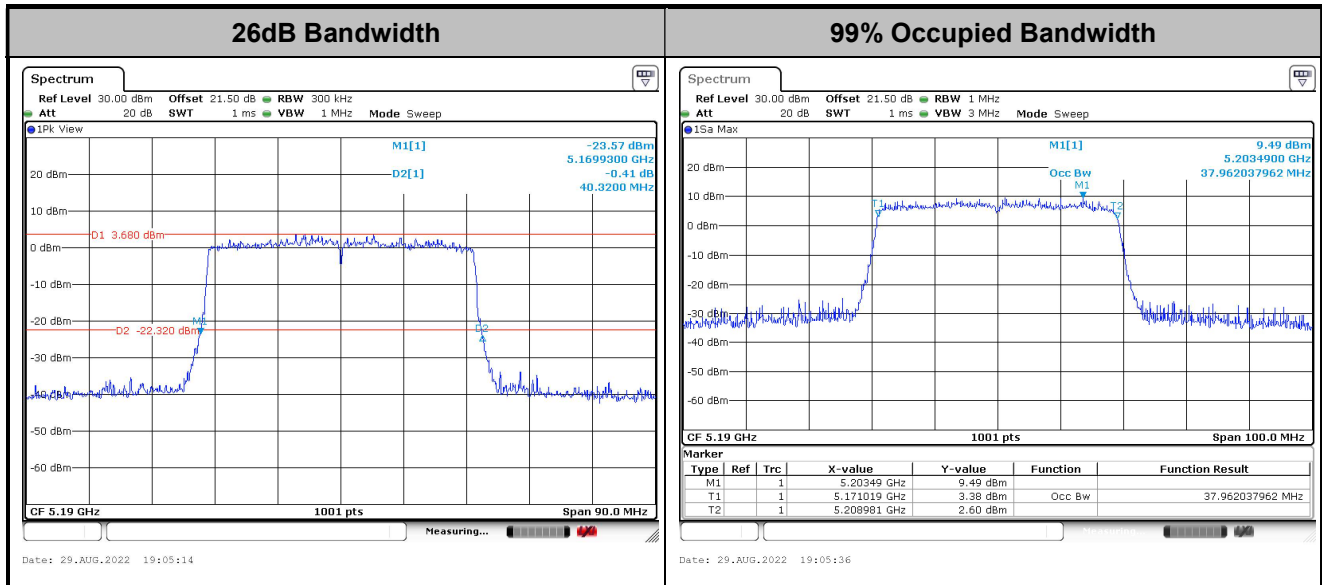
Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

<802.11ax HE20>



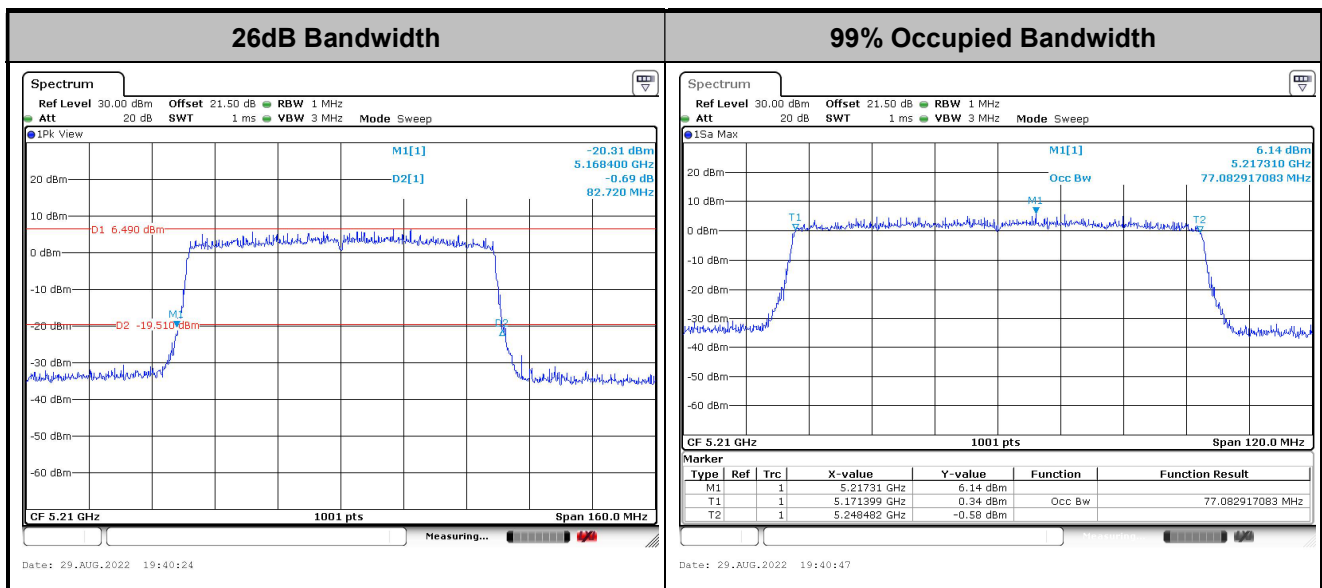
Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

<802.11ax HE40>



Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

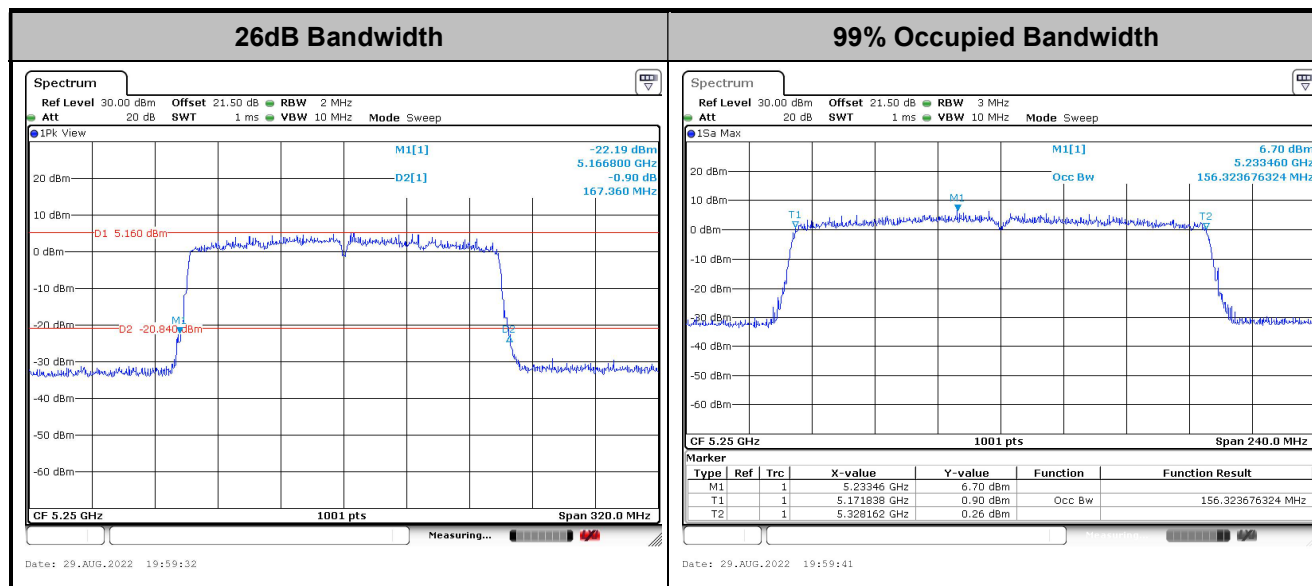
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Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

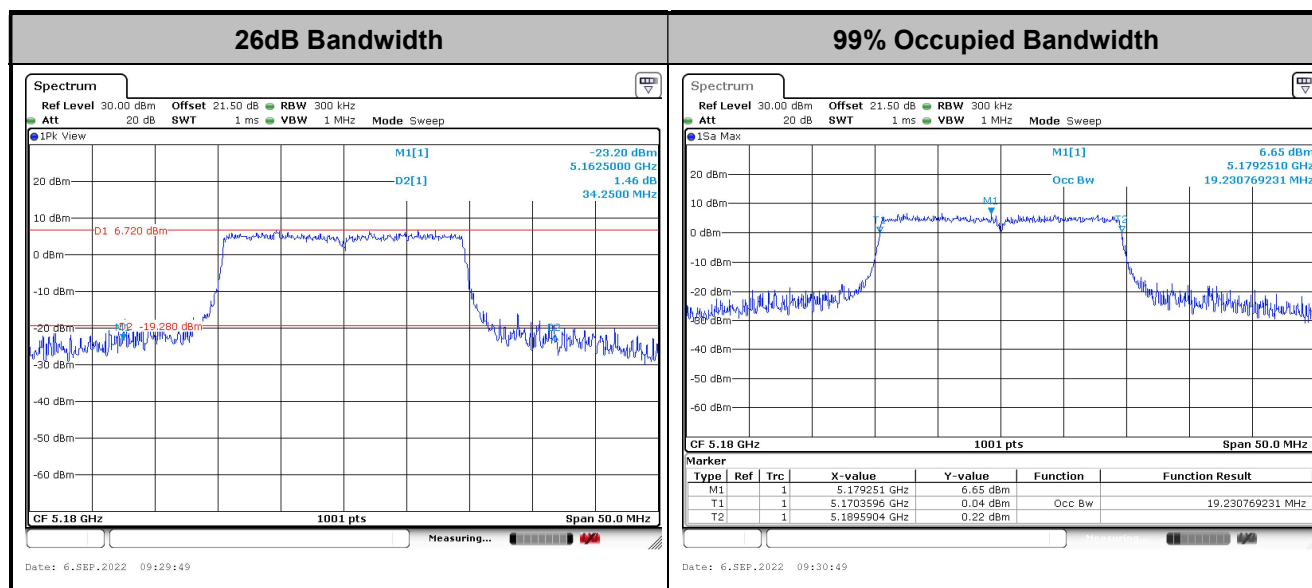


<802.11ax HE160>



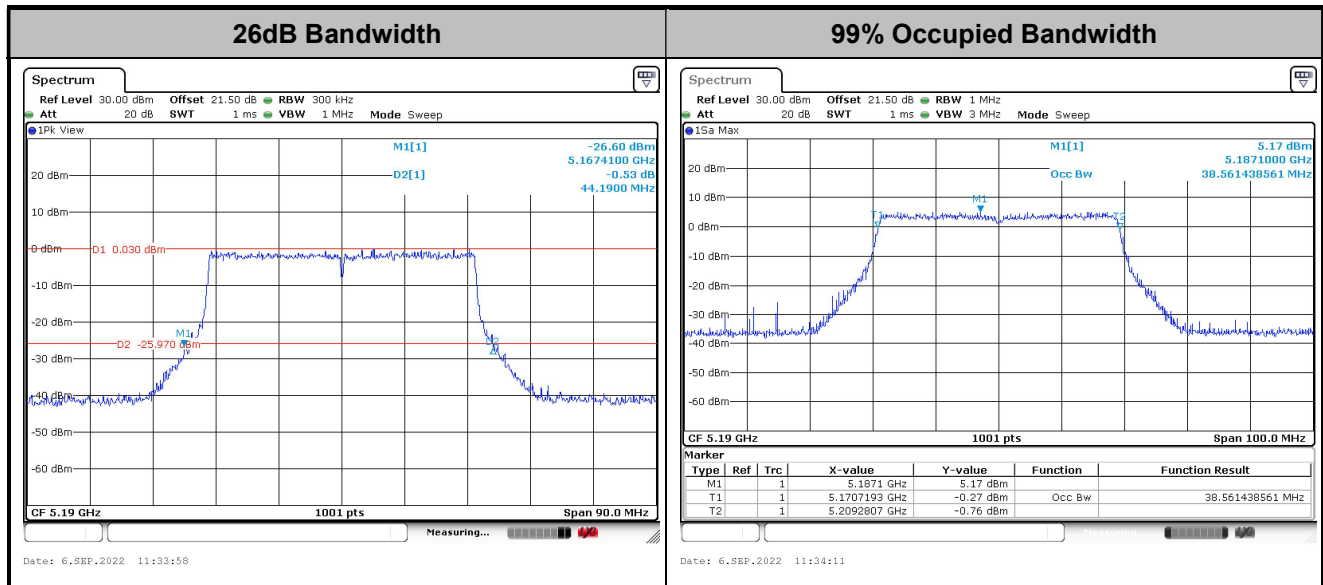
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<802.11ax HE20>



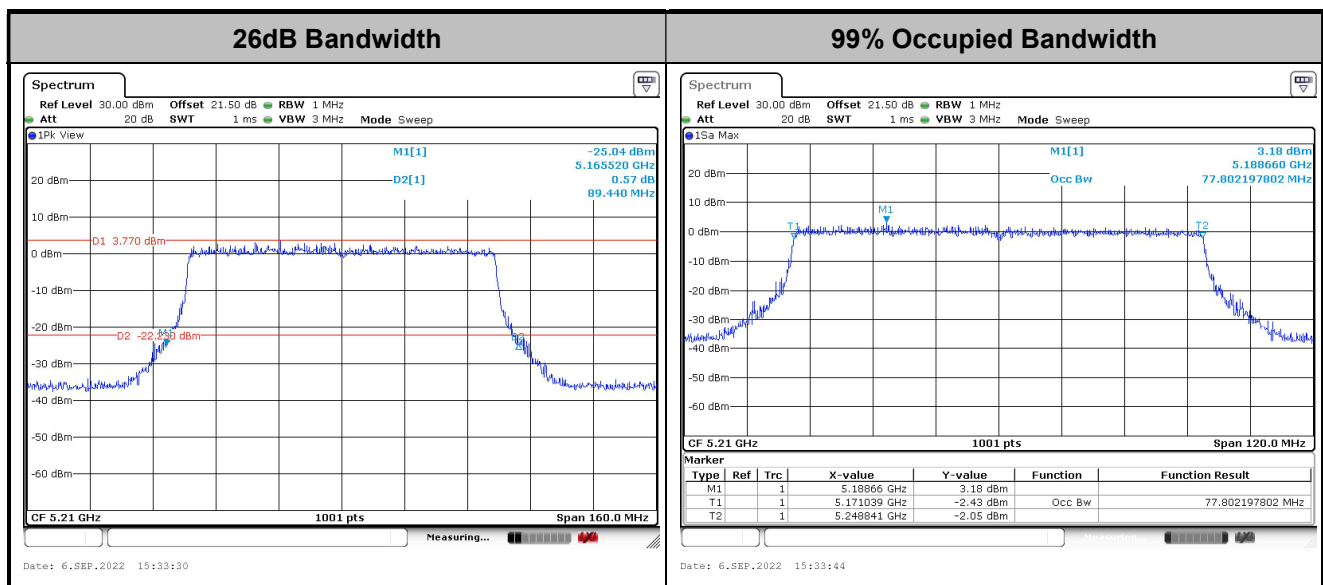


<802.11ax HE40>



Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

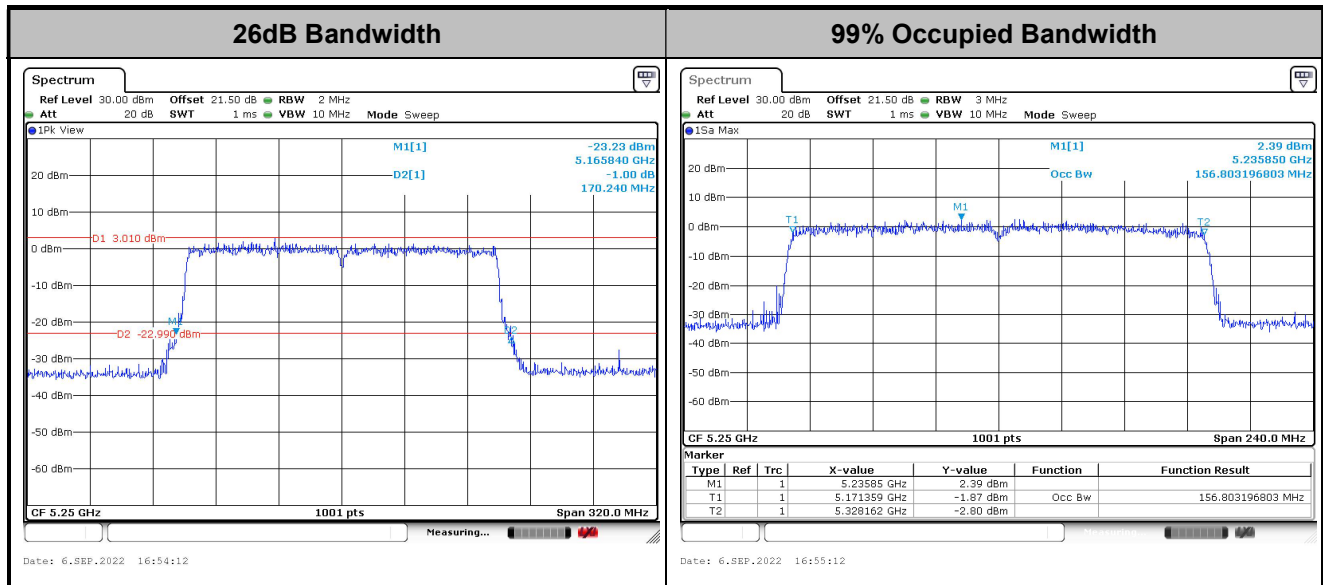
<802.11ax HE80>



Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.



<802.11ax HE160>



Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Maximum Conducted Output Power Measurement

3.2.1 Limit of Maximum Conducted Output Power

<FCC 14-30 CFR 15.407>

For the 5.15–5.25 GHz bands:

■ For mobile and portable 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. For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

For the 5.25–5.725 GHz bands:

■ The maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz.

For Straddle Channel, according to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, if the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note that U-NII-2 band, devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

3.2.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.2.3 Test Procedures

<CDD Modes>

The testing follows Method PM-G of FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

Method PM-G (Measurement using a gated RF average power meter):

1. Measurement is performed using a wideband RF power meter.
2. The EUT is configured to transmit at its maximum power control level.
3. Measure the average power of the transmitter.
4. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.
5. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01

<TXBF Modes>

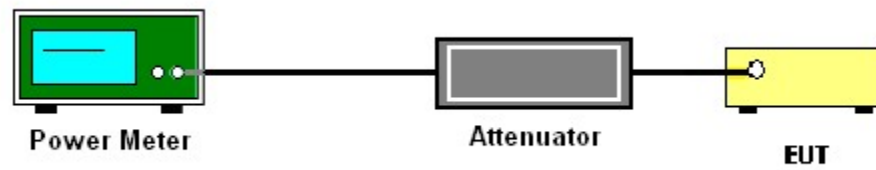
The testing follows Method PM-G of FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

Method PM-G (Measurement using a gated RF average power meter):

1. Measurement is performed using a wideband RF power meter.
2. The EUT is configured to transmit at its maximum power control level.
3. Measure the average power of the transmitter
4. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.
5. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

For Straddle Channel, according to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, if the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

3.2.4 Test Setup



3.2.5 Test Result of Maximum Conducted Output Power

Please refer to Appendix A.



3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

<FCC 14-30 CFR 15.407>

For the 5.15–5.25 GHz bands:

For mobile and portable client devices in the 5.15–5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1.0 MHz band. For an indoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1.0 MHz band.

For the 5.25–5.725 GHz bands:

The maximum power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

For Straddle Channel, according to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, if the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.3.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.3.3 Test Procedures

The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

Section F) Maximum power spectral density.

<CDD Modes>

Method SA-2

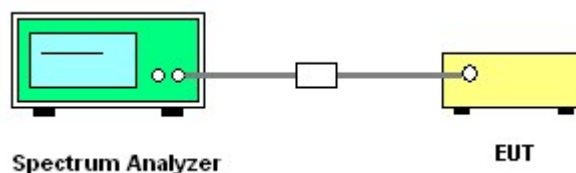
(trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).

- Measure the duty cycle.
 - Set span to encompass the entire emission bandwidth (EBW) of the signal.
 - Set RBW = 1 MHz.
 - Set VBW $\geq$ 3 MHz.
 - Number of points in sweep $\geq$ 2 Span / RBW.
 - Sweep time = auto.
 - Detector = RMS
 - Trace average at least 100 traces in power averaging mode.
 - Add $10 \log(1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times. For example, add $10 \log(1/0.25) = 6$ dB if the duty cycle is 25 percent.
1. The RF output of EUT is connected to the spectrum analyzer by a low loss cable.
 2. Each plot has already offset with cable loss, and attenuator loss. Measure the PPSD and record it.
 3. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

Method (a): Measure and sum the spectra across the outputs.

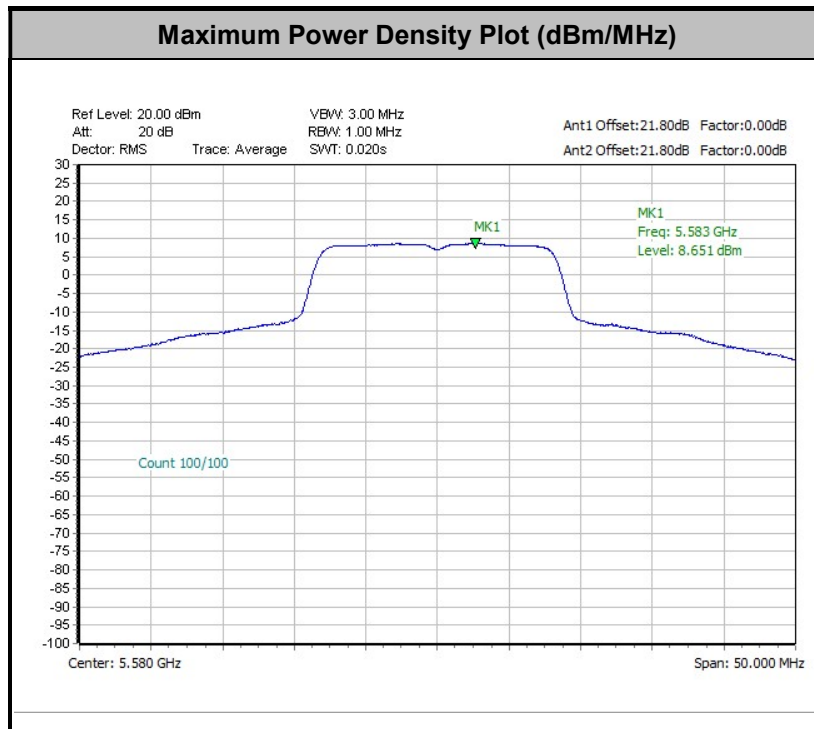
The total final Power Spectral Density is from a device with 2 transmitter outputs. The spectrum measurements of the individual outputs are all performed with the same span and number of points; the spectrum value in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 to obtain the value for the first frequency bin of the summed spectrum.

3.3.4 Test Setup

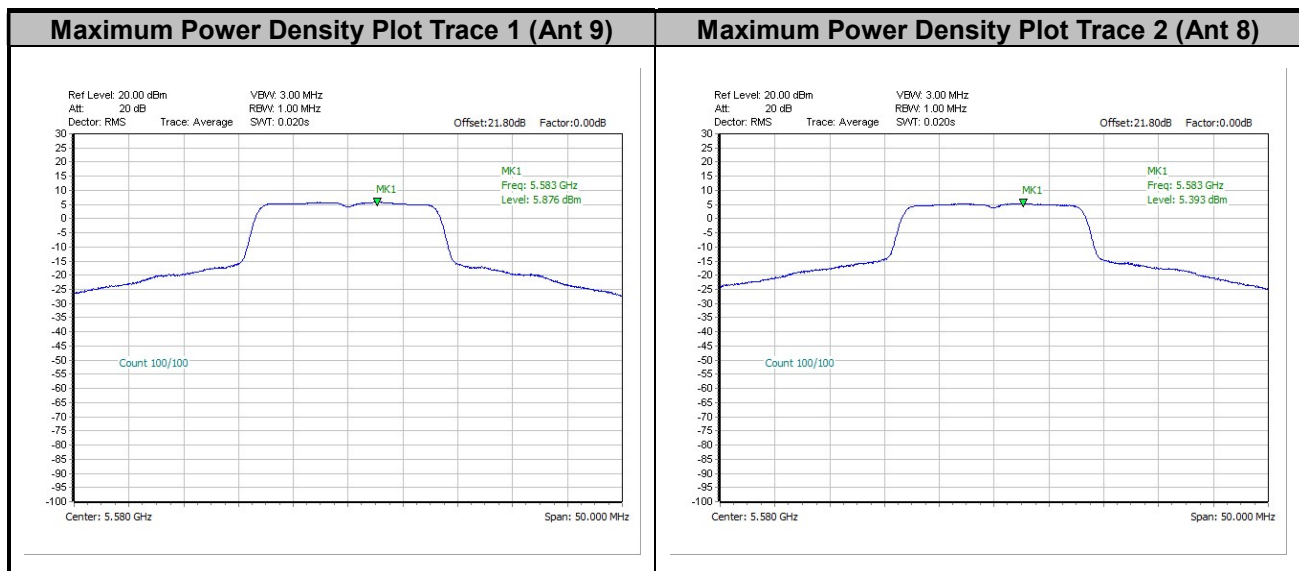


3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

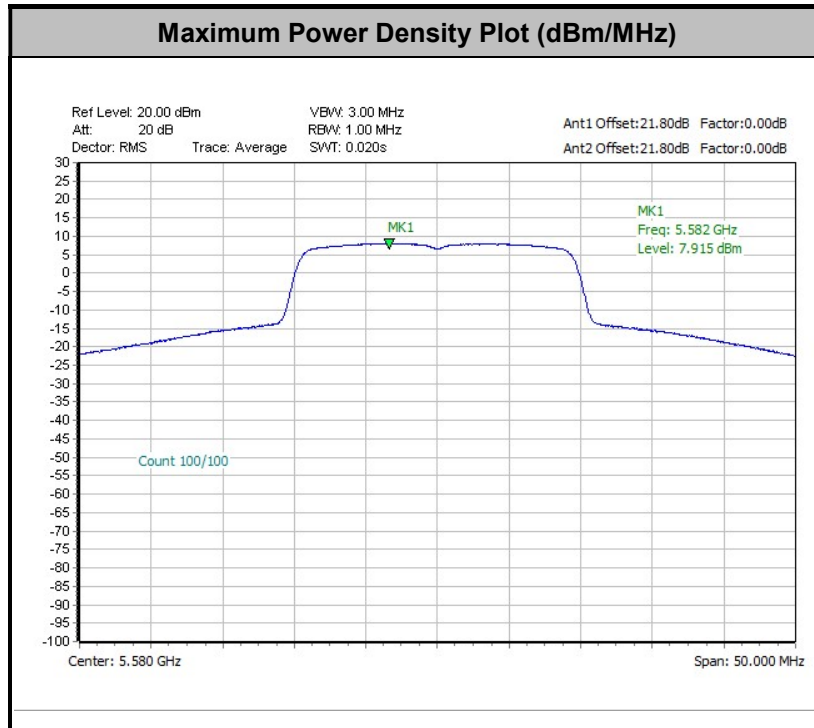
**<CDD Modes>****<802.11a>**

Remark: The test plot is showing a bin by bin combined result mathematically adds two traces.

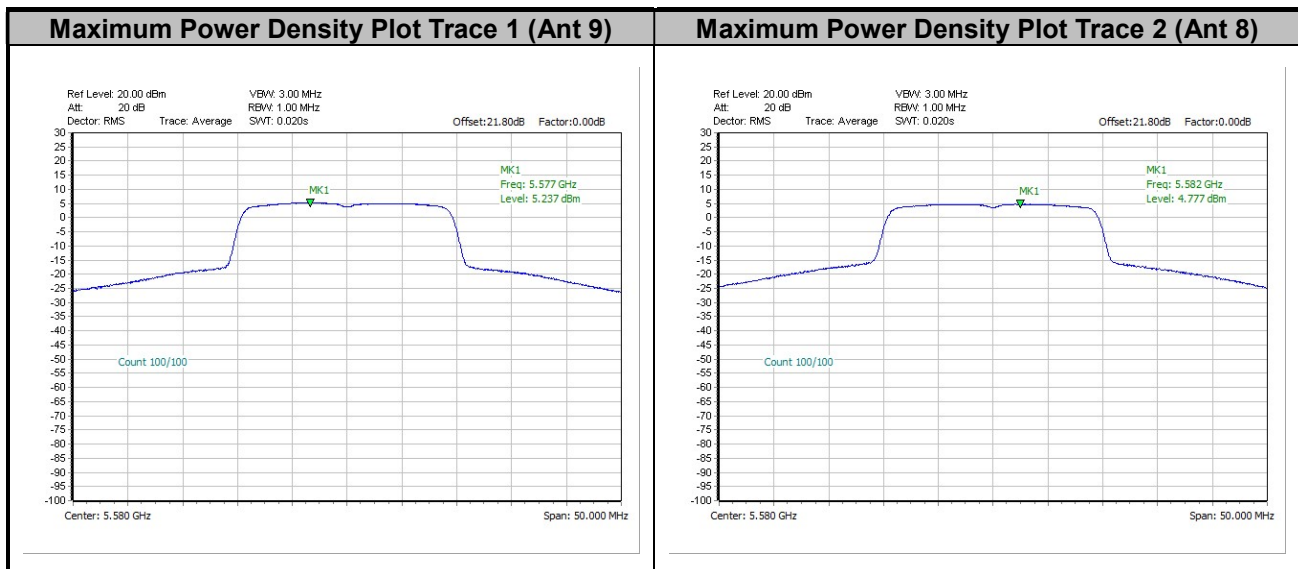


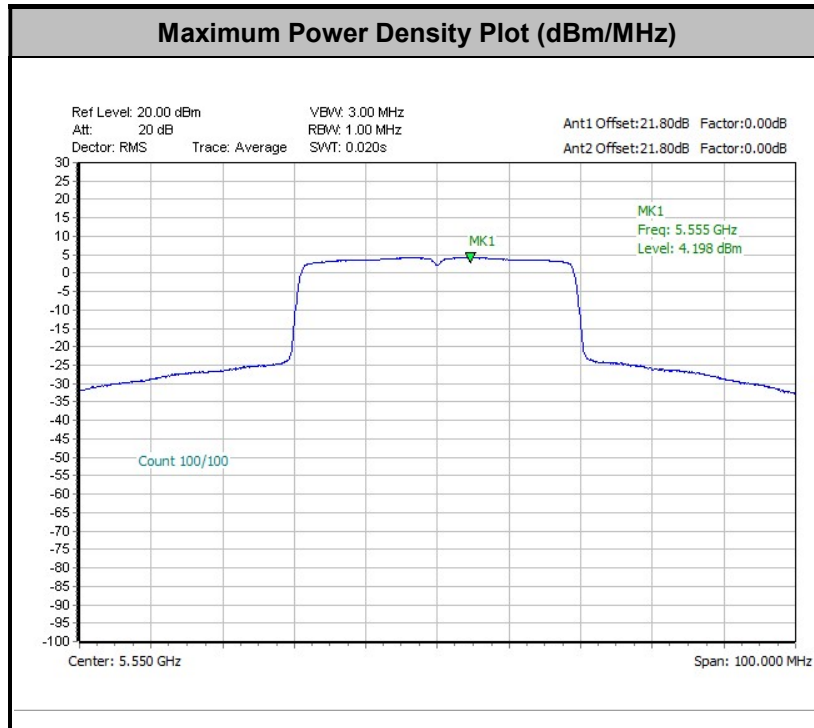


<802.11ax HE20>

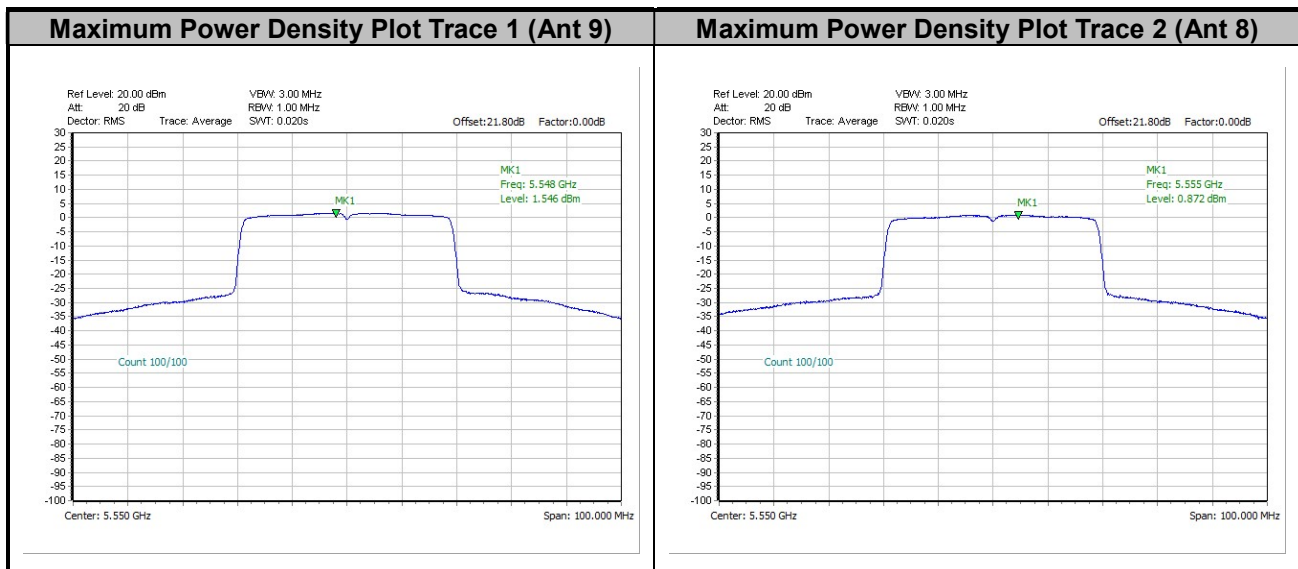


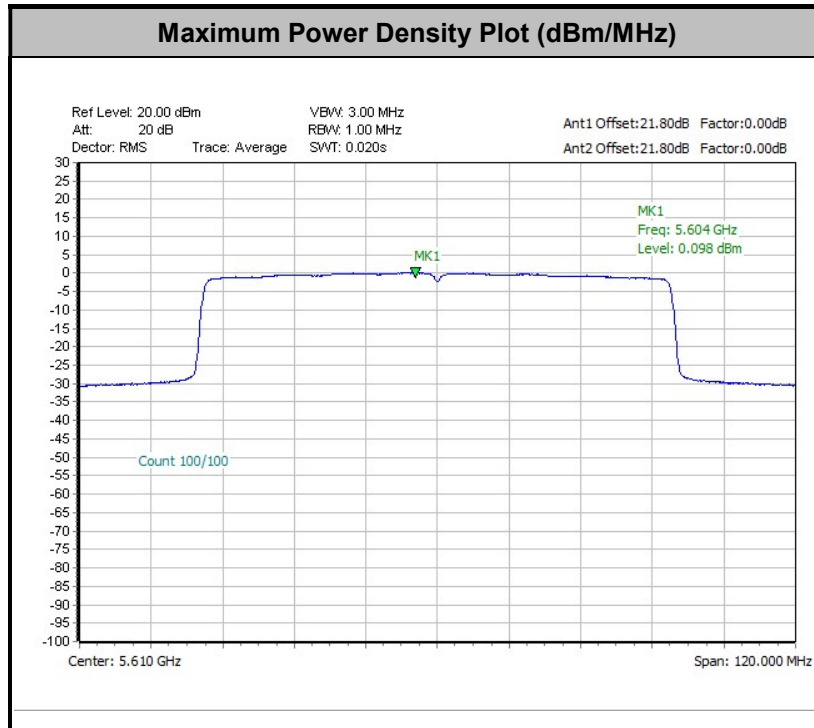
Remark: The test plot is showing a bin by bin combined result mathematically adds two traces.



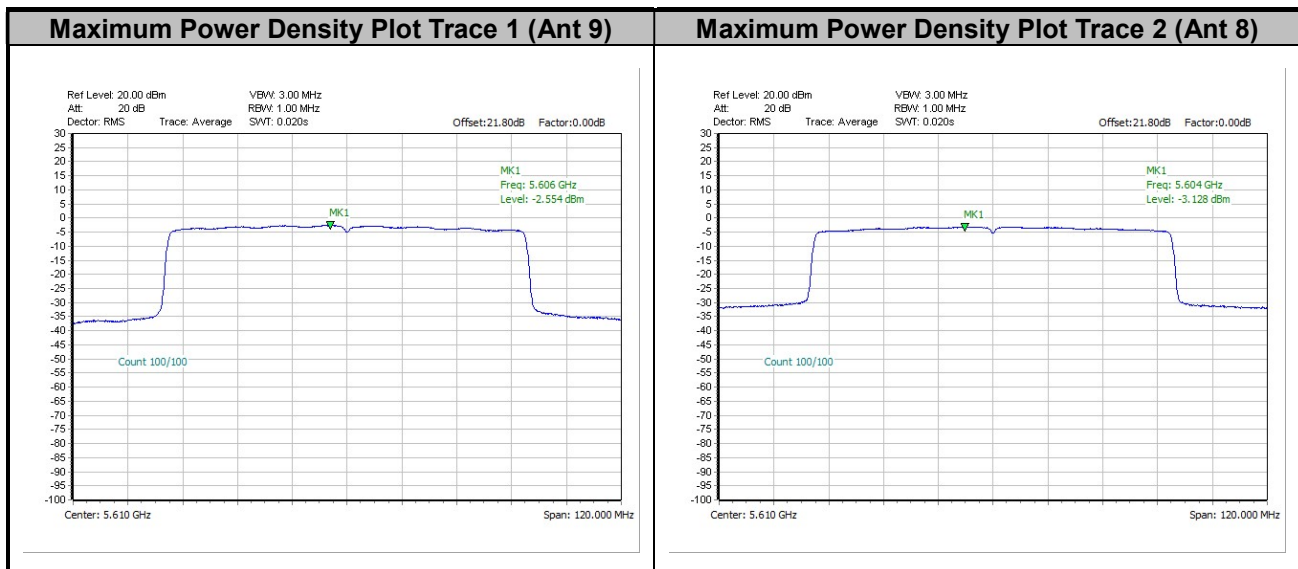
**<802.11ax HE40>**

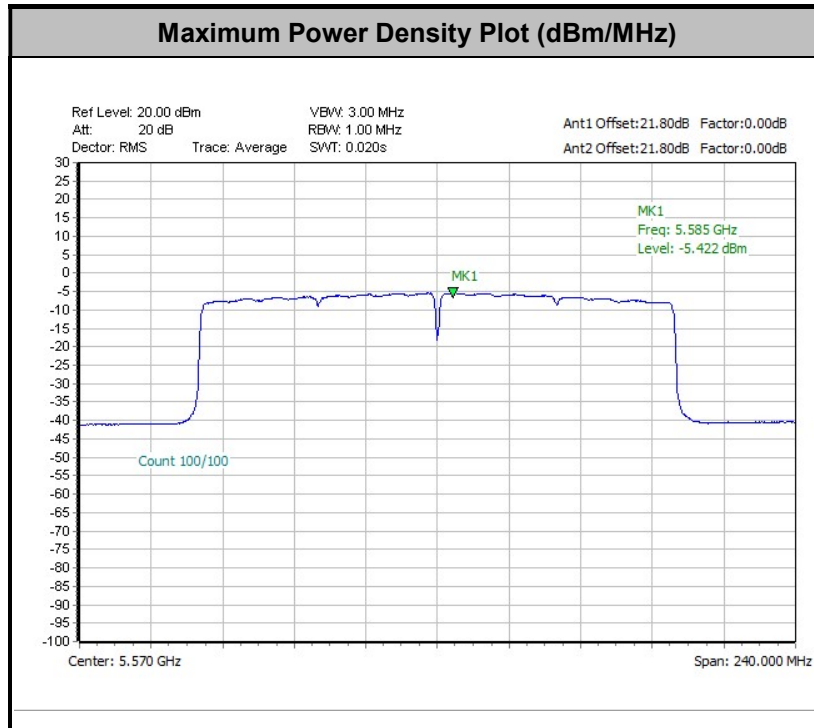
Remark: The test plot is showing a bin by bin combined result mathematically adds two traces.



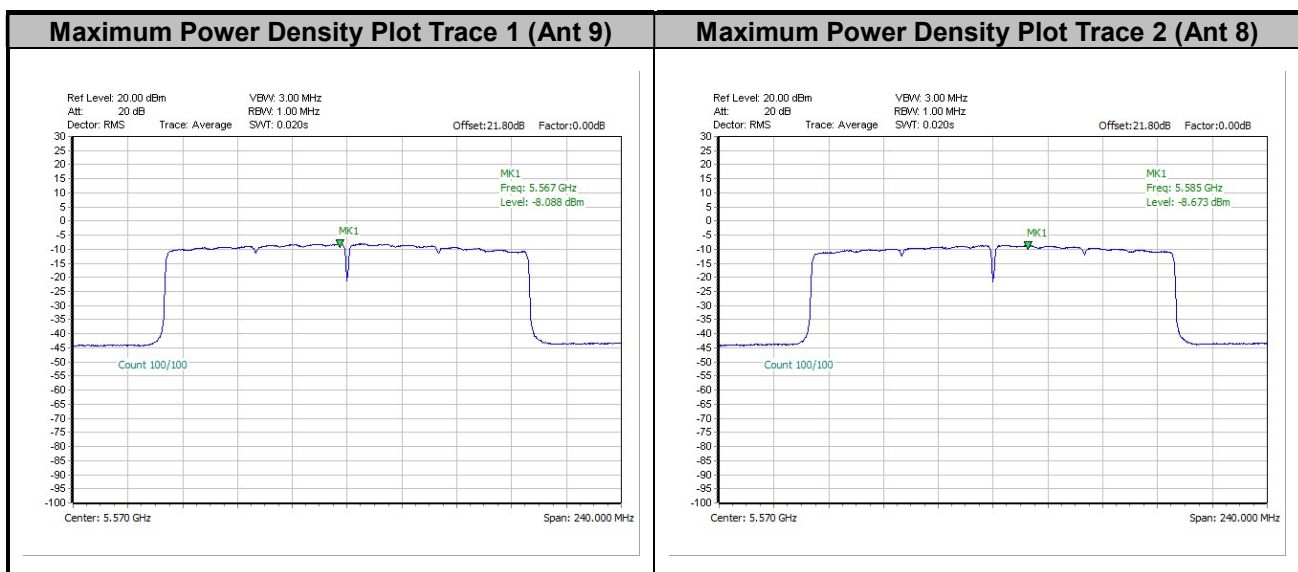
**<802.11ax HE80>**

Remark: The test plot is showing a bin by bin combined result mathematically adds two traces.



**<802.11ax HE160>**

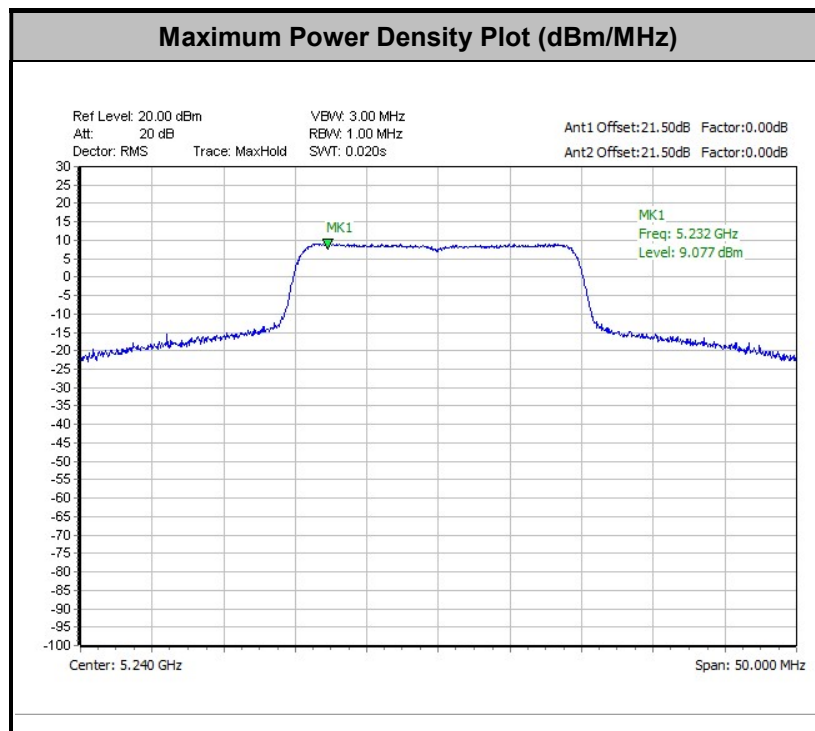
Remark: The test plot is showing a bin by bin combined result mathematically adds two traces.





<TXBF Modes>

<802.11ax HE20>



Remark: The test plot is showing a bin by bin combined result mathematically adds two traces.

