



TEST REPORT

Report Number: R13541206-E9

Applicant : Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399
USA

Model : 1964

FCC ID : C3K1964

IC : 3048A-1964

EUT Description : Portable Computing Device

Test Standard(s) : FCC 47 CFR PART 15 SUBPART E
ISED RSS-247 ISSUE 2
ISED RSS-GEN ISSUE 5 + A2

Date Of Issue:
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REPORT REVISION HISTORY

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
v1	2021-06-02	Initial Issue	Niklas Haydon

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399
USA

EUT DESCRIPTION: Portable Computing Device

MODEL: 1964

SERIAL NUMBER: 0F0002Z211200C (radiated)
0F000AN211200C (radiated)
0F0008Z211200C (radiated)
0F0003K211200C (antenna port conducted)
0F0003W211200C (antenna port conducted)
0F0003V211200C (antenna port conducted)

SAMPLE RECEIPT DATE: 2021-04-12

DATE TESTED: 2021-04-13 to 2021-06-01

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart E	Complies
ISED RSS-247 Issue 2	Complies
ISED RSS-GEN Issue 5 + A2	Complies

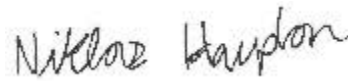
UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC 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 any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released For
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Prepared By:



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UL LLC

2. TEST RESULT SUMMARY

This report contains data provided by the applicant which can impact the validity of results. UL LLC is only responsible for the validity of results after the integration of the data provided by the customer.

FCC Clause	ISED Clause	Requirement	Result	Comment
See Comment		Duty Cycle	Reporting purposes only	Per ANSI C63.10, Section 12.2.
See Comment	RSS-GEN 6.7	26dB BW/99% OBW	Reporting purposes only	Per ANSI C63.10 Sections 6.9.2 and 6.9.3
15.407 (a) (2), (h) (1)	RSS-247 6.2	Output Power	Complies	None.
15.407 (a) (2, 12)	RSS-247 6.2	PSD	Complies	None.
15.209, 15.205, 15.407 (b)	RSS-GEN 8.9, 8.10, RSS-247 6.2	Radiated Emissions	Complies	None.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions	Complies	None.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with;

- FCC CFR 47 Part 2
- FCC CFR 47 Part 15
- FCC KDB 662911 D01 v02r01,
- FCC KDB 905462 D02 v02/D03 v01r02/D06 v02
- FCC KDB 789033 D02 v02r01,
- KDB 414788 D01 Radiated Test Site v01r01
- ANSI C63.10-2013
- RSS-GEN Issue 5 + A2
- RSS-247 Issue 2

4. FACILITIES AND ACCREDITATION

UL LLC is accredited by A2LA, certification #0751.06, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
<input checked="" type="checkbox"/>	Building: 12 Laboratory Dr RTP, NC 27709, U.S.A	US0067	2180C	703469
<input checked="" type="checkbox"/>	Building: 2800 Perimeter Park Dr Morrisville, NC 27560, U.S.A			

5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

5.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Radio Frequency (Spectrum Analyzer)	141.2 Hz
Occupied Channel Bandwidth	1.22%
RF output power, conducted	1.3 dB (PK) 0.45 dB (AV)
Power Spectral Density, conducted	2.47 dB
Unwanted Emissions, conducted	1.94 dB
All emissions, radiated	6.01 dB
Conducted Emissions (0.150-30MHz) - LISN	3.40 dB
Temperature	0.57%
Humidity	3.39%
DC Supply voltages	1.70%
Time	3.39%

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

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

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

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

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.

36.5 dBuV + 0 dB + 10.1 dB + 0 dB = 46.6 dBuV

6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a portable computing device. This report covers the 5.6 WLAN ax radio in the device.

6.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

5.6GHz BAND 802.11 ax MODE 1TX – ANT A

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.6 GHz band, 1TX			
5500-5720	802.11ax HE20 SU	19.00	79.43
	802.11ax HE20 OFDMA, 106-Tones	18.18	65.77
	802.11ax HE20 OFDMA, 52-Tones	15.21	33.19
	802.11ax HE20 OFDMA, 26-Tones	12.15	16.41
5510-5710	802.11ax HE40 SU	18.16	65.46
5530-5690	802.11ax HE80 SU	15.32	34.04
	802.11ax HE80 OFDMA, 484-Tones	18.16	65.46
	802.11ax HE80 OFDMA, 242-Tones	19.99	99.77
	802.11ax HE80 OFDMA, 106-Tones	18.47	70.31
	802.11ax HE80 OFDMA, 52-Tones	15.48	35.32
	802.11ax HE80 OFDMA, 26-Tones	12.17	16.48
5570	802.11ax HE160 SU	13.73	23.60
	802.11ax HE160 OFDMA, 242-Tones	18.73	74.64

5.6GHz BAND 802.11 ax MODE 1TX – ANT B

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.6 GHz band, 1TX			
5500-5720	802.11ax HE20 SU	15.94	39.26
	802.11ax HE20 OFDMA, 106-Tones	15.05	31.99
	802.11ax HE20 OFDMA, 52-Tones	13.97	24.95
	802.11ax HE20 OFDMA, 26-Tones	11.83	15.24
5510-5710	802.11ax HE40 SU	16.05	40.27
5530-5690	802.11ax HE80 SU	15.29	33.81
	802.11ax HE80 OFDMA, 484-Tones	16.23	41.98
	802.11ax HE80 OFDMA, 242-Tones	16.93	49.32
	802.11ax HE80 OFDMA, 106-Tones	15.49	35.40
	802.11ax HE80 OFDMA, 52-Tones	14.63	29.04
	802.11ax HE80 OFDMA, 26-Tones	12.14	16.37
5570	802.11ax HE160 SU	13.68	23.33
	802.11ax HE160 OFDMA, 242-Tones	16.53	44.98

5.6GHz BAND 802.11 ax MODE 2TX

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.6 GHz band, 2TX			
5500-5720	802.11ax HE20 SU	17.99	62.95
	802.11ax HE20 OFDMA, 106-Tones	17.45	55.59
	802.11ax HE20 OFDMA, 52-Tones	14.98	31.48
	802.11ax HE20 OFDMA, 26-Tones	12.37	17.26
5510-5710	802.11ax HE40 SU	18.01	63.24
5530-5690	802.11ax HE80 SU	17.26	53.21
	802.11ax HE80 OFDMA, 484-Tones	18.21	66.22
	802.11ax HE80 OFDMA, 242-Tones	18.84	76.56
	802.11ax HE80 OFDMA, 106-Tones	17.58	57.28
	802.11ax HE80 OFDMA, 52-Tones	15.49	35.40
	802.11ax HE80 OFDMA, 26-Tones	12.42	17.46
5570	802.11ax HE160 SU	15.73	37.41

6.3. TEST REDUCTIONS CASES

Due to preliminary tests completed on the EUT and to the power settings used by the manufacturer, the following was used to cover all test cases:

For low and middle of the 5.6GHz band:

- HE80 SU represents HE80 996T and HE160 996T.
- HE160 SU represents HE160 996T*2.
- HE80 484T represents HE40 SU/484T and HE160 484T.
- HE80 242T represents HE20 SU/242T and HE40 242T.
- HE80 26T/52T/106T represents HE20/40/160 26T/52T/106T.
- HE80 242T represents HE160 242T for all testing expect for output power and average power as these were set lower by the manufacturer.

For the high of the 5.6GHz band:

- HE20 SU represents HE20/HE40/HE80 242T.
- HE20 26T/52T/106T covers HE40/80/160 26T/52T/106T.
- HE40 SU represents HE40 484T.
- HE40 SU represents HE80/160 484T.
- HE80 SU represents HE80 996T.
- HE160 SU represents HE160 996T*2.
- HE20 SU represents HE160 242T for all testing expect for output power and average power as these were set lower by the manufacturer.

6.4. DESCRIPTION OF AVAILABLE ANTENNAS

The antenna(s) gain and type, as provided by the manufacturer' are as follows:

The radio utilizes two PIFA antennas, with the following gains:

Frequency	Antenna A	Antenna B
5470 to 5725MHz	6.4 dBi	6.9 dBi

6.5. SOFTWARE AND FIRMWARE

OS: Windows Build 19041.vb_release 191206-1406
Test tool version 22.35020.0.0-01924
WLAN driver 22.20.0.5
BT driver 22.30.0.4

6.6. WORST-CASE CONFIGURATION AND MODE

The fundamental of the EUT was investigated in the three available configurations (A, B and C as described in the test setup photos) for Antenna A. Where a configuration can be portable it was also investigated in three orthogonal orientations (X, Y, Z) modes. It was determined that C (portable) configuration in Y orientation was the worst-case configuration orientation; therefore, all final radiated testing was performed with the EUT in C (portable) configuration in Y orientation. for Antenna A.

The fundamental of the EUT was investigated in the three available configurations (A, B and C as described in the test setup photos) for Antenna B. Where a configuration can be portable it was also investigated in three orthogonal orientations (X, Y, Z) modes. It was determined that C (portable) configuration in Z orientation was the worst-case configuration orientation; therefore, all final radiated testing was performed with the EUT in C (portable) configuration in Z orientation. for Antenna B.

The fundamental of the EUT was investigated in the three available configurations (A, B and C as described in the test setup photos) for Antenna A + Antenna B. Where a configuration can be portable it was also investigated in three orthogonal orientations (X, Y, Z) modes. It was determined that A configuration was the worst-case configuration orientation; therefore, all final radiated testing was performed with the EUT in configuration A for Antenna A + Antenna B. All radios that can transmit simultaneously have been evaluated for radiated for all possible combinations of transmission and found to be in compliance.

Worst-case data rates as provided by the client were:

802.11ax HE20 1Tx mode: MCS0
802.11ax HE20 2Tx mode: MCS0 NSS2
802.11ax HE40 1Tx mode: MCS0
802.11ax HE40 2Tx mode: MCS0 NSS2
802.11ax HE80 1Tx mode: MCS0
802.11ax HE80 2Tx mode: MCS0 NSS2
802.11ax HE160 1Tx mode: MCS0
802.11ax HE160 2Tx mode: MCS0 NSS2

Output power, average power, and power spectral density were performed with the EUT set to the max power setting of each modulation/channel/mode the EUT will be set at:

Frequency Band	2Tx 11ax HE20				
	Wi-Fi Channels	26T	52T	106T	SU
5470 to 5725 MHz	136	-	-	-	15
	140	9	12	14	14
	144	9	12	14	15

Frequency Band	2Tx 11ax HE40	
	Wi-Fi Channels	SU
5470 to 5725 MHz	126	15
	134	14
	142	15

Frequency Band	2Tx 11ax HE80						
	Wi-Fi Channels	26T	52T	106T	242T	484T	SU
5470 to 5725 MHz	106	9	12	14	RU 61, 14 RU 62-64, 15	RU 65, 12 RU 66, 15	13
	122	9	12	14	15	15	14
	138	9	12	14	RU 61-62, 15 RU 63, 14 RU 64, 15	RU 65, 14 RU 66, 15	14

Frequency Band	2Tx 11ax HE160	
	Wi-Fi Channels	SU
5470 to 5725 MHz	114	12

Frequency Band	1Tx 11ax HE20 ANT A				
	Wi-Fi Channels	26T	52T	106T	SU
5470 to 5725 MHz	136	-	-	-	19
	140	12	15	RU 53, 18 RU 54, 16	17
	144	12	15	18	19

Frequency Band	1Tx 11ax HE20 ANT B				
	Wi-Fi Channels	26T	52T	106T	SU
5470 to 5725 MHz	136	-	-	-	-
	140	12	14	15	16
	144	12	14	15	16

Frequency Band	1Tx 11ax HE40 ANT A	
	Wi-Fi Channels	SU
5470 to 5725 MHz	126	18
	134	15
	142	18

Frequency Band	1Tx 11ax HE40 ANT B	
	Wi-Fi Channels	SU
5470 to 5725 MHz	126	16
	134	15
	142	16

Frequency Band	1Tx 11ax HE80 ANT A						
	Wi-Fi Channels	26T	52T	106T	242T	484T	SU
5470 to 5725 MHz	106	12	15	RU 53, 16 RU 54-60, 18	RU 61, 16 RU 62-64, 18.5	RU 65, 14 RU 66, 18	13
	122	12	15	18	19	18	15
	138	12	15	RU 53-58, 18 RU 59, 16 RU 60, 18	19	RU 65, 15 RU 66, 18	15

Frequency Band	1Tx 11ax HE80 ANT B						
	Wi-Fi Channels	26T	52T	106T	242T	484T	SU
5470 to 5725 MHz	106	12	14	15	16	RU 65, 14 RU 66, 16	13
	122	12	14	15	16	16	15
	138	12	14	15	16	RU 65, 15 RU 66, 16	15

Frequency Band	1Tx 11ax HE160 ANT A		
	Wi-Fi Channels	242T	SU
5470 to 5725 MHz	114	RU 61, 16 RU62-S64, 18	13

Frequency Band	1Tx 11ax HE160 ANT B		
	Wi-Fi Channels	242T	SU
5470 to 5725 MHz	114	15.5	13

Radiated band edge emissions was performed with the EUT set to the max power setting of each modulation/channel/mode the EUT will be set at:

Frequency Band	2Tx 11ax HE20				
	Wi-Fi Channels	26T	52T	106T	SU
5470 to 5725 MHz	136	-	-	-	15
	140	9	12	14	14

Frequency Band	2Tx 11ax HE40	
	Wi-Fi Channels	SU
5470 to 5725 MHz	126	15
	134	14

Frequency Band	2Tx 11ax HE80						
	Wi-Fi Channels	26T	52T	106T	242T	484T	SU
5470 to 5725 MHz	106	9	12	14	RU 61, 14 RU 62-64, 15	RU 65, 12 RU 66, 15	13
	122	-	-	-	-	-	14

Frequency Band	2Tx 11ax HE160	
	Wi-Fi Channels	SU
5470 to 5725 MHz	114	12

Frequency Band	1Tx 11ax HE20 ANT A				
	Wi-Fi Channels	26T	52T	106T	SU
5470 to 5725 MHz	136	-	-	-	19
	140	12	15	RU 53, 16 RU 54, 18	17

Frequency Band	1Tx 11ax HE20 ANT B				
	Wi-Fi Channels	26T	52T	106T	SU
5470 to 5725 MHz	136	-	-	-	-
	140	12	15	15	16

Frequency Band	1Tx 11ax HE40 ANT A	
	Wi-Fi Channels	SU
5470 to 5725 MHz	126	18
	134	15

Frequency Band	1Tx 11ax HE40 ANT B	
	Wi-Fi Channels	SU
5470 to 5725 MHz	126	16
	134	15

Frequency Band	1Tx 11ax HE80 ANT A						
	Wi-Fi Channels	26T	52T	106T	242T	484T	SU
5470 to 5725 MHz	106	12	15	RU 53, 16 RU 54-60, 18	RU 61, 16 RU 62-64, 18.5	RU 65, 14 RU 66, 18	13
	122	-	-	-	-	-	15

Frequency Band	1Tx 11ax HE80 ANT B						
	Wi-Fi Channels	26T	52T	106T	242T	484T	SU
5470 to 5725 MHz	106	12	15	15	16	RU 65, 14 RU 66, 16	13
	122	-	-	-	-	-	15

Frequency Band	1Tx 11ax HE160 ANT A	
	Wi-Fi Channels	SU
5470 to 5725 MHz	114	13

Frequency Band	1Tx 11ax HE160 ANT B	
	Wi-Fi Channels	SU
5470 to 5725 MHz	114	13

26dB and 99% bandwidth were performed with the EUT set in 2Tx modes at 1Tx power levels:

Frequency Band	2Tx 11ax HE20				
	Wi-Fi Channels	26T	52T	106T	SU
5470 to 5725 MHz	136	-	-	-	19
	140	12	15	RU 53, 18 RU 54, 16	17
	144	12	15	18	19

Frequency Band	2Tx 11ax HE40	
	Wi-Fi Channels	SU
5470 to 5725 MHz	126	18
	134	15
	142	18

Frequency Band	2Tx 11ax HE80						
	Wi-Fi Channels	26T	52T	106T	242T	484T	SU
5470 to 5725 MHz	106	12	15	RU 53, 16 RU 54-60, 18	RU 61, 16 RU 62-64, 18.5	RU 65, 14 RU 66, 18	13
	122	12	15	18	19	18	15
	138	12	15	RU 53-58, 18 RU 59, 16 RU 60, 18	19	RU 65, 15 RU 66, 18	15

Frequency Band	2Tx 11ax HE160	
	Wi-Fi Channels	SU
5150 to 5350 MHz	114	13

Radiated spurious emissions between 1GHz and 18GHz outside of radiated band edge emissions, were performed with the EUT set to transmit on low, middle and high RUs on each modulation with the highest PSD and output power:

Frequency Band	2Tx 11ax HE80						
	Wi-Fi Channels	26T	52T	106T	242T	484T	SU
5470 to 5725 MHz	106	12	-	-	RU 61, 19 RU 62-64, 18	-	-
	122	12	-	-	18	-	-
	138	12	-	-	18	-	-

Frequency Band	1Tx 11ax HE80						
	Wi-Fi Channels	26T	52T	106T	242T	484T	SU
5470 to 5725 MHz	106	-	-	-	19	-	-
	122	-	-	-	19	-	-
	138	-	-	-	19	-	-

Radiated emissions below 1GHz, above 18GHz, and power line conducted emission were performed in UL LLC report R13541206-E7.

6.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
USB Hub	J5create	JCA374	AY2A1904000477	NA
USB Hub	J5create	JCA374	AY3A2010013253	NA
USB Hub	J5create	JCD383	DL3A1903011541	NA
USB Hub	J5create	JCD383	FY5A2010034764	NA
Earbuds	Sony	MDR-EX14AP	NA	NA
Earbuds	Sony	MDR-EX14AP	NA	NA
Earbuds	JVC	HA-FXL	NA	NA
Power Supply	Microsoft	1706	0D130U0HD210C	NA
Power Supply	Microsoft	1706	0D130U0GX310C	N/A
Power Supply	Microsoft	1706	0D130U0HD710C	N/A
Power Supply	Microsoft	1706	0D130U0GU310C	N/A
Power Supply	Microsoft	1706	0D130U0HDL10C	N/A

I/O CABLES

I/O Cable List						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Mains	1	12-pin	Mains	<3	Goes to ac/dc adapter
2	USB-C	2	USB-C	USB	<3	None

TEST SETUP

Test software on the EUT exercised the radio card.

SETUP DIAGRAMS

Please refer to R13541206-EP2 for setup diagrams.

7. MEASUREMENT METHOD

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

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

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

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

Power Spectral Density: KDB 789033 D02 v02r01, Section F

Unwanted emissions in restricted bands: KDB 789033 D02 v02r01, Sections G.1, G.3, G.4, G.5, and G.6.

Unwanted emissions in non-restricted bands: KDB 789033 D02 v02r01, Sections G.2, G.3, G.4, and G.5.

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4

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

8. TEST AND MEASUREMENT EQUIPMENT

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

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
Conducted Room 1					
SA0025	Spectrum Analyzer	Agilent	N9030A	2021-04-01	2022-04-01
PWM002 (PRE0137344)	RF Power Meter	Keysight Technologies	N1911A	2020-07-31	2021-07-31
PWS001 (PRE0137347)	Peak and Avg Power Sensor, 50MHz to 18GHz	Keysight Technologies	N1921A	2020-05-27	2021-05-27
PWS002 (PRE0137348)	Peak and Avg Power Sensor, 50MHz to 18GHz	Keysight Technologies	N1921A	2020-07-31	2021-07-31
HI0090 (PRE0191271)	Environmental Meter	Fisher Scientific	15-077-963	2020-06-26	2021-06-26
SOFTEMI	Antenna Port Software	UL	Version 2021.04.28	NA	NA
Conducted Room 2					
SA0027 (PRE0126407)	Spectrum Analyzer	Keysight Technologies	N9030A	2020-06-10	2021-06-10
PWM004 (PRE0137346)	RF Power Meter	Keysight Technologies	N1911A	2020-07-31	2021-07-31
PWS002 (PRE0137348)	Peak and Avg Power Sensor, 50MHz to 18GHz	Keysight Technologies	N1921A	2020-07-31	2021-07-31
HI0091	Environmental Meter	Fisher Scientific	15-077-963	2020-06-26	2021-06-26
SOFTEMI	Antenna Port Software	UL	Version 2021.4.28	NA	NA

Test Equipment Used - Line-Conducted Emissions – Voltage (Morrisville – Conducted 1)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL087	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3W06143-240	2021-04-05	2022-04-05
HI0090 (PRE0191271)	Environmental Meter	Fisher Scientific	15-077-963	2020-06-26	2021-06-26
LISN003	LISN, 50-ohm/50-uH, 250uH 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50/250-25-2-01	2020-08-18	2021-08-18
75141	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2020-08-18	2021-08-18
ATA222	Transient Limiter, 0.009-100MHz	Electro-Metrics	EM-7600	2021-04-05	2022-04-05
PS214	AC Power Source	Elgar	CW2501M (s/n 1523A02396)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5 (04 Mar 2021)		

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - South Chamber)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	0.009-30MHz				
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2020-08-20	2021-08-20
	30-1000 MHz				
AT0075	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2020-10-27	2021-10-27
	1-18 GHz				
AT0067	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2020-04-28	2021-04-28
AT0069	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2020-05-26	2021-05-26
	18-40 GHz				
AT0063	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2020-10-30	2021-10-30
AT0061	Horn Antenna, 26-40GHz	ARA	MWH-2640/B	2020-10-30	2021-10-30
	Gain-Loss Chains				
S-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2020-07-10	2021-07-10
S-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2020-07-10	2021-07-10
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2020-07-06	2021-07-06
S-SAC04	Gain-loss string: 18-40GHz	Various	Various	2020-07-07	2021-07-07
	Receiver & Software				
197955	Spectrum Analyzer	Rohde & Schwarz	ESW44	2021-03-10	2022-03-10
SA0026	Spectrum Analyzer	Agilent	N9030A	2020-07-16	2021-07-16
SOFTEMI	EMI Software	UL	Version 9.5 (04 Mar 2021)		
	Additional Equipment used				
s/n 200037635	Environmental Meter	Fisher Scientific	06-662-4	2020-01-22	2022-01-22

Test Equipment Used - Radiated Disturbance Emissions (E-field) – Chamber C

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	1-18 GHz				
AT0062	HORN Antenna	ETS-Lindgren	3117	2021-02-03	2022-02-03
	Gain-Loss Chains				
C-SAC02	Gain-loss string: 1-18GHz	Various	Various	2021-04-15	2022-04-15
C-SAC02 Path 7	Gain-loss string 1-7GHz	Various	Various	2021-04-15	2022-04-15
	Receiver & Software				
206496	Spectrum Analyzer	Rohde & Schwarz	ESW44	2021-03-09	2022-03-09
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
HI0085	Temp/Humid/Pressure Meter	EXTECH	SD700	2020-04-20	2021-04-30

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - North Chamber)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	1-18 GHz				
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2020-04-27	2021-04-27
	Gain-Loss Chains				
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2020-07-28	2021-07-28
	Receiver & Software				
197954	Spectrum Analyzer	Rohde & Schwarz	ESW44	2021-03-30	2022-03-30
SOFTEMI	EMI Software	UL	Version 9.5 (04 Mar 2021)		
	Additional Equipment used				
s/n 181474341	Environmental Meter	Fisher Scientific	15-077-963	2020-08-06	2021-08-06

NOTES:

1. For equipment listed above that was calibrated during the testing period, please note the equipment was used for testing after calibration.
2. For equipment listed above that has a calibration due date during the testing period, the testing was completed before the equipment expiration date.

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 558074 D01 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Antenna A

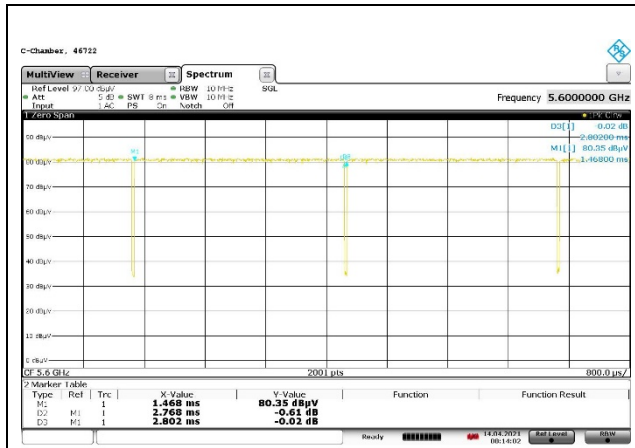
Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction - RMS (dB)	Duty Cycle Correction - Voltage (dB)	1/B Minimum VBW (kHz)
802.11ax HE20 OFDMA, SU	2.768	2.802	0.988	98.79%	0.00	0.00	0.010
802.11ax HE20 OFDMA, RU size 242T	3.870	3.918	0.988	98.77%	0.00	0.00	0.010
802.11ax HE20 OFDMA, RU size 106T	3.870	3.918	0.988	98.77%	0.00	0.00	0.010
802.11ax HE20 OFDMA, RU size 52T	3.876	3.924	0.988	98.78%	0.00	0.00	0.010
802.11ax HE20 OFDMA, RU size 26T	3.870	3.918	0.988	98.77%	0.00	0.00	0.010
802.11ax HE40 OFDMA, SU	19.770	20.022	0.987	98.74%	0.00	0.00	0.010
802.11ax HE40 OFDMA, RU size 484T	5.472	5.682	0.963	96.30%	0.16	0.33	0.183
802.11ax HE40 OFDMA, RU size 242T	5.465	5.675	0.963	96.30%	0.16	0.33	0.183
802.11ax HE40 OFDMA, RU size 106T	5.465	5.675	0.963	96.30%	0.16	0.33	0.183
802.11ax HE40 OFDMA, RU size 52T	5.465	5.675	0.963	96.30%	0.16	0.33	0.183
802.11ax HE40 OFDMA, RU size 26T	5.465	5.675	0.963	96.30%	0.16	0.33	0.183
802.11ax HE80 OFDMA, SU	9.475	9.738	0.973	97.30%	0.12	0.24	0.106
802.11ax HE80 OFDMA, RU size 484T	3.876	3.924	0.988	98.78%	0.00	0.00	0.010
802.11ax HE80 OFDMA, RU size 242T	3.876	3.918	0.989	98.93%	0.00	0.00	0.010
802.11ax HE80 OFDMA, RU size 106T	3.876	3.924	0.988	98.78%	0.00	0.00	0.010
802.11ax HE80 OFDMA, RU size 52T	3.876	3.918	0.989	98.93%	0.00	0.00	0.010
802.11ax HE80 OFDMA, RU size 26T	3.876	3.924	0.988	98.78%	0.00	0.00	0.010
802.11ax HE160 OFDMA, SU	4.770	5.025	0.949	94.93%	0.23	0.45	0.210

Antenna B

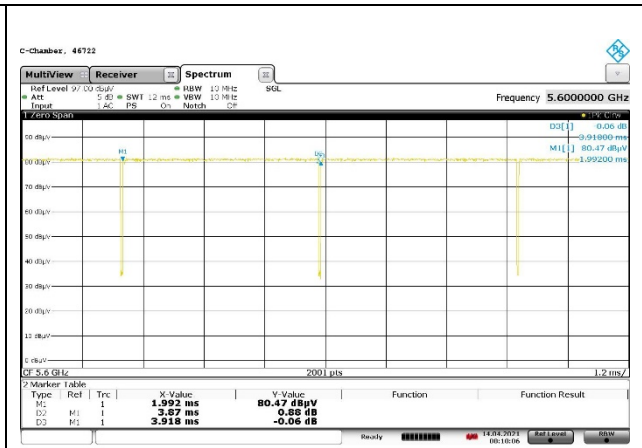
Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
802.11ax HE20 OFDMA, SU	2.764	2.802	0.986	98.64%	0.00	0.010
802.11ax HE20 OFDMA, RU size 242T	2.700	2.742	0.985	98.47%	0.00	0.010
802.11ax HE20 OFDMA, RU size 106T	2.696	2.742	0.983	98.32%	0.00	0.010
802.11ax HE20 OFDMA, RU size 52T	2.700	2.742	0.985	98.47%	0.00	0.010
802.11ax HE20 OFDMA, RU size 26T	3.876	3.924	0.988	98.78%	0.00	0.010
802.11ax HE40 OFDMA, SU	19.770	20.022	0.987	98.74%	0.00	0.010
802.11ax HE40 OFDMA, RU size 484T	5.472	5.682	0.963	96.30%	0.16	0.183
802.11ax HE40 OFDMA, RU size 242T	5.465	5.675	0.963	96.30%	0.16	0.183
802.11ax HE40 OFDMA, RU size 106T	5.472	5.682	0.963	96.30%	0.16	0.183
802.11ax HE40 OFDMA, RU size 52T	5.472	5.675	0.964	96.43%	0.16	0.183
802.11ax HE40 OFDMA, RU size 26T	5.472	5.682	0.963	96.30%	0.16	0.183
802.11ax HE80 OFDMA, SU	9.475	9.738	0.973	97.30%	0.12	0.106
802.11ax HE80 OFDMA, RU size 484T	3.876	3.924	0.988	98.78%	0.00	0.010
802.11ax HE80 OFDMA, RU size 242T	3.876	3.924	0.988	98.78%	0.00	0.010
802.11ax HE80 OFDMA, RU size 106T	3.876	3.918	0.989	98.93%	0.00	0.010
802.11ax HE80 OFDMA, RU size 52T	3.876	3.924	0.988	98.78%	0.00	0.010
802.11ax HE80 OFDMA, RU size 26T	3.882	3.924	0.989	98.93%	0.00	0.010
802.11ax HE160 OFDMA, SU	4.770	5.025	0.949	94.93%	0.23	0.210

DUTY CYCLE PLOTS

Antenna A



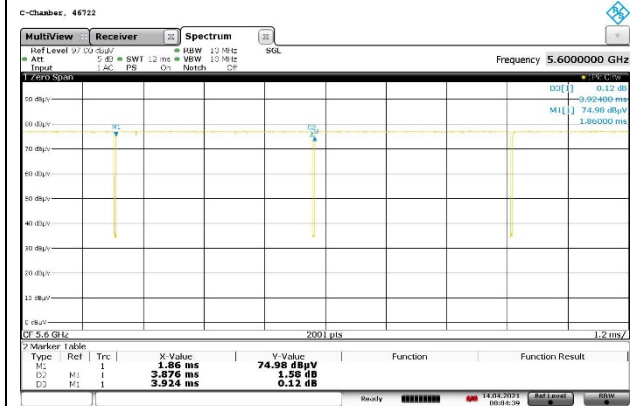
802.11ax HE20 OFDMA, OFDMA MODE: SU



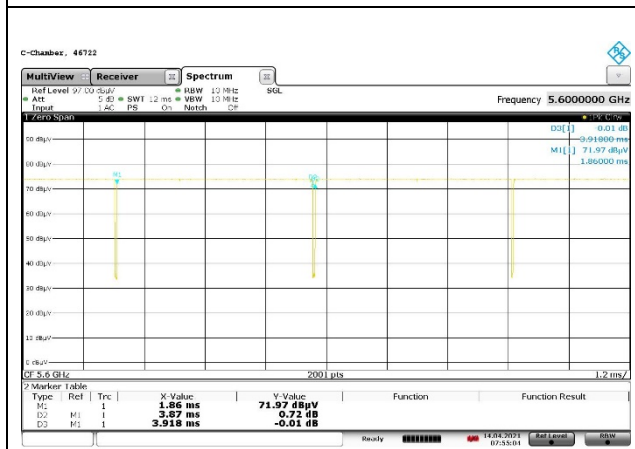
802.11ax HE20 OFDMA, RU size 242T MODE



802.11ax HE20 OFDMA, RU size 106T MODE

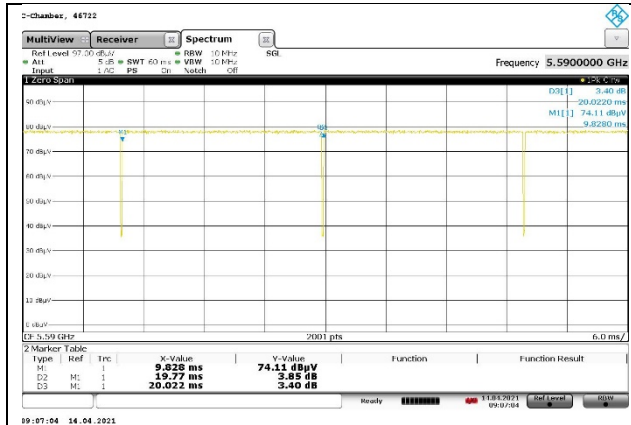


802.11ax HE20 OFDMA, RU size 52T MODE

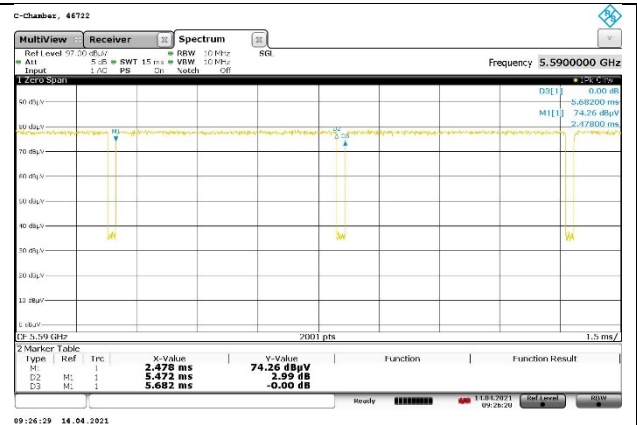


802.11ax HE20 OFDMA, RU size 26T MODE

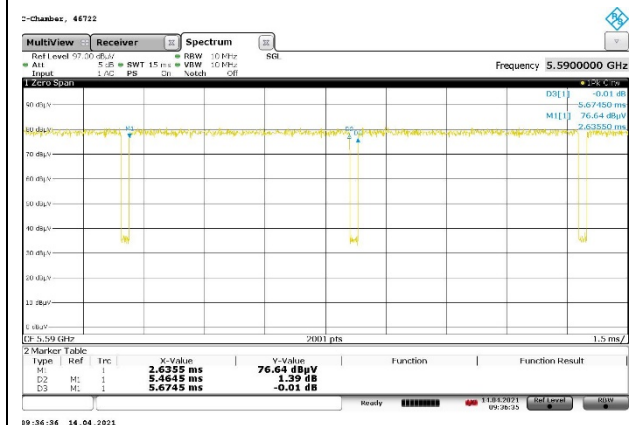
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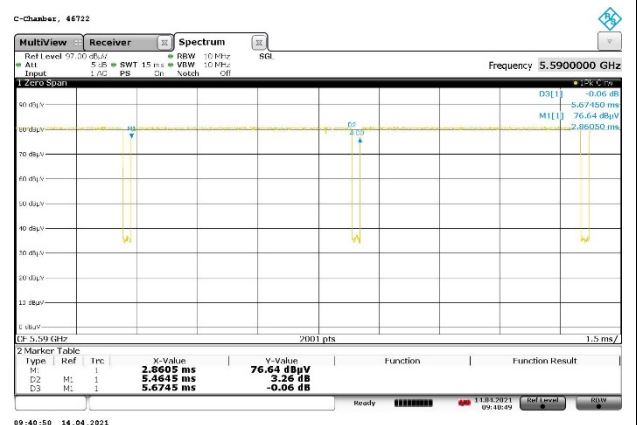
802.11ax HE40 OFDMA, OFDMA MODE: SU



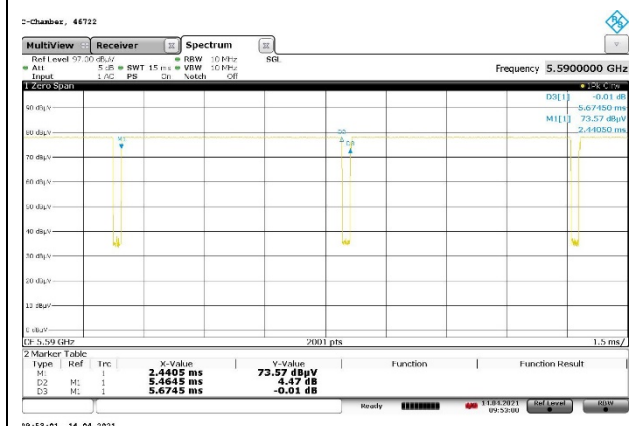
802.11ax HE40 OFDMA, RU size 484T MODE



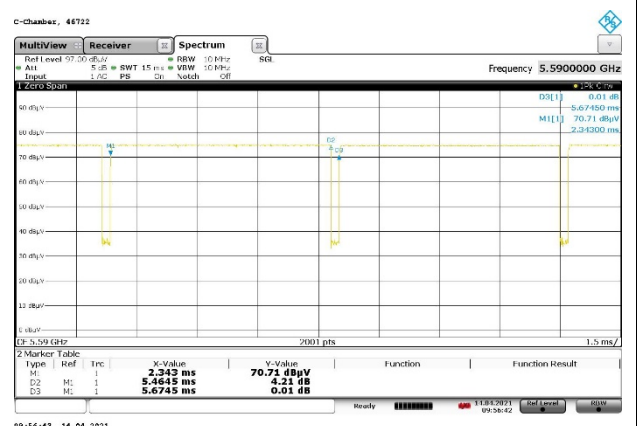
802.11ax HE40 OFDMA, RU size 242T MODE



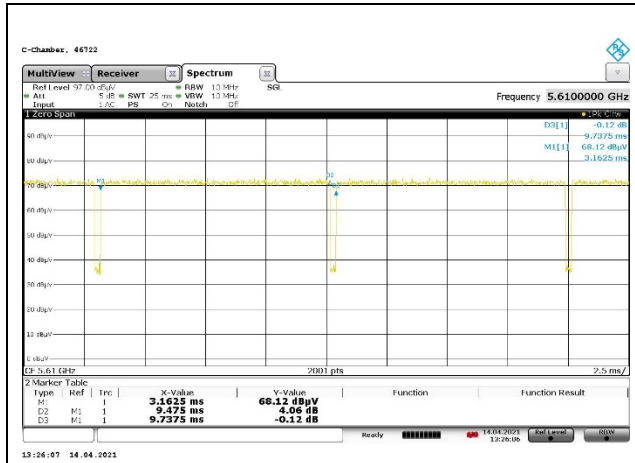
802.11ax HE40 OFDMA, RU size 106T MODE



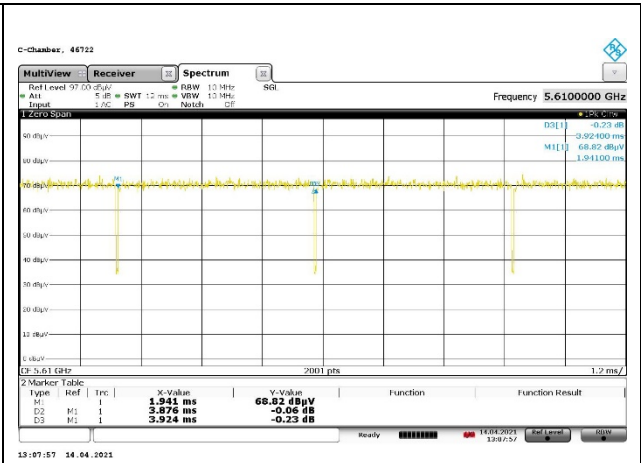
802.11ax HE40 OFDMA, RU size 52T MODE



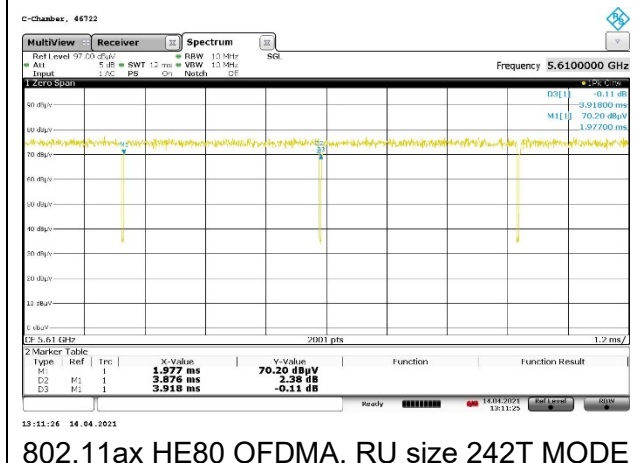
802.11ax HE40 OFDMA, RU size 26T MODE



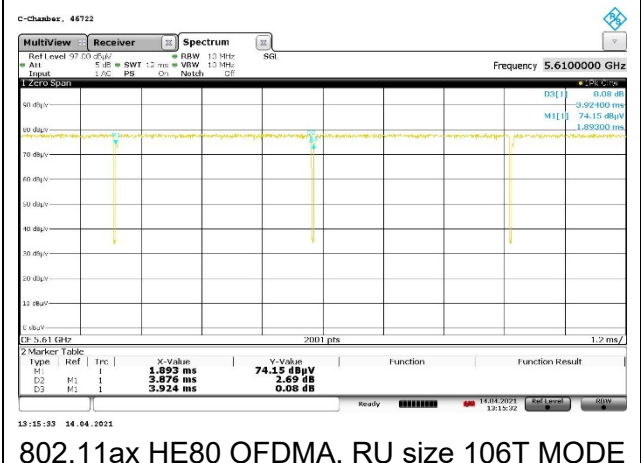
802.11ax HE80 OFDMA, OFDMA MODE: SU



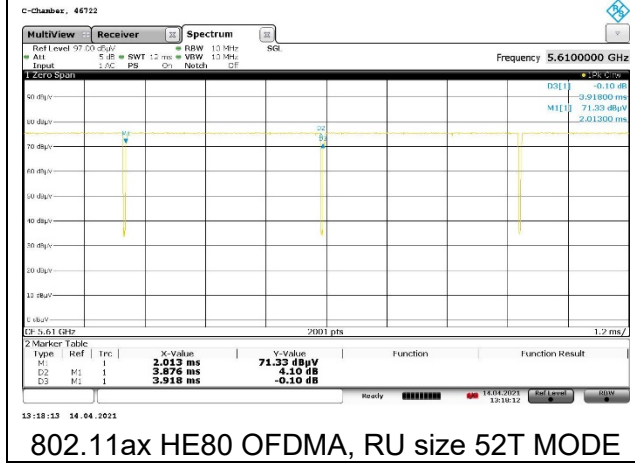
802.11ax HE80 OFDMA, RU size 484T MODE



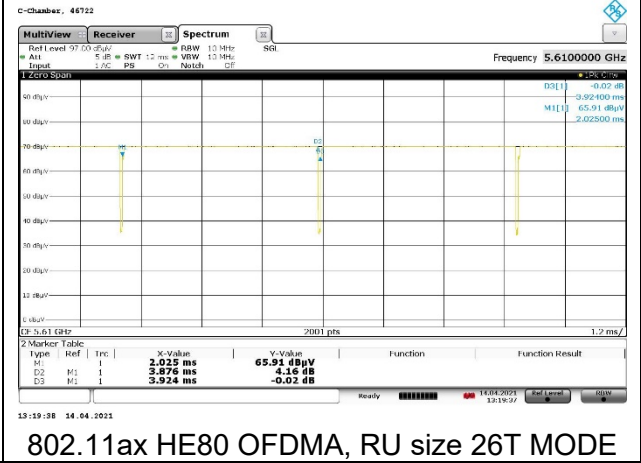
802.11ax HE80 OFDMA, RU size 242T MODE



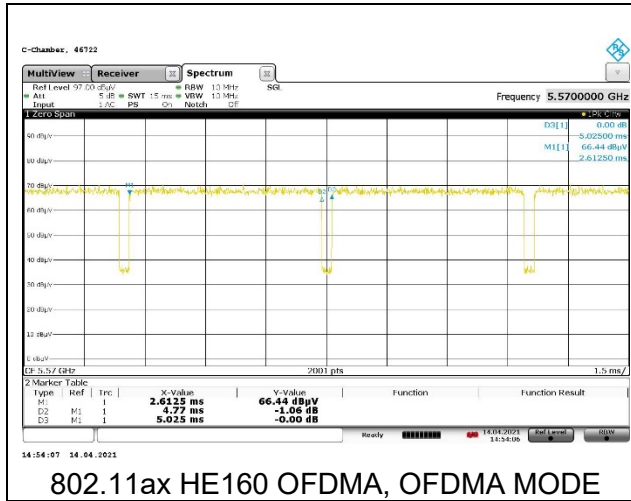
802.11ax HE80 OFDMA, RU size 106T MODE



802.11ax HE80 OFDMA, RU size 52T MODE

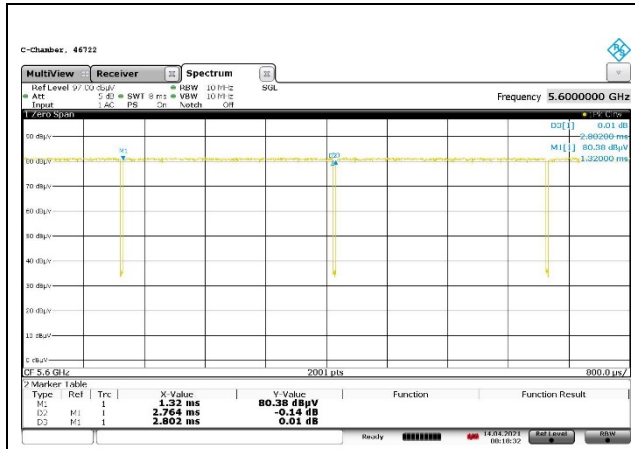


802.11ax HE80 OFDMA, RU size 26T MODE

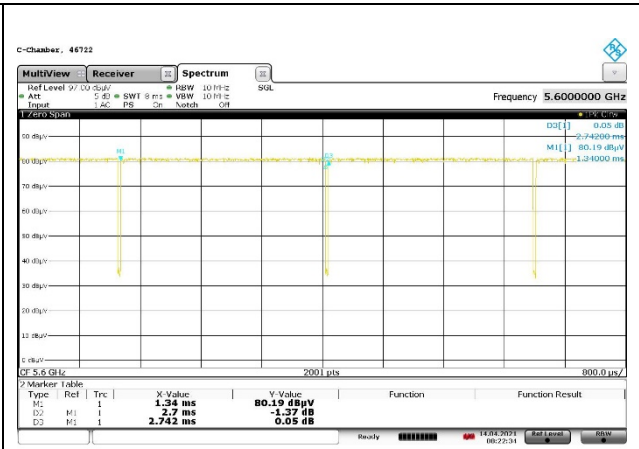


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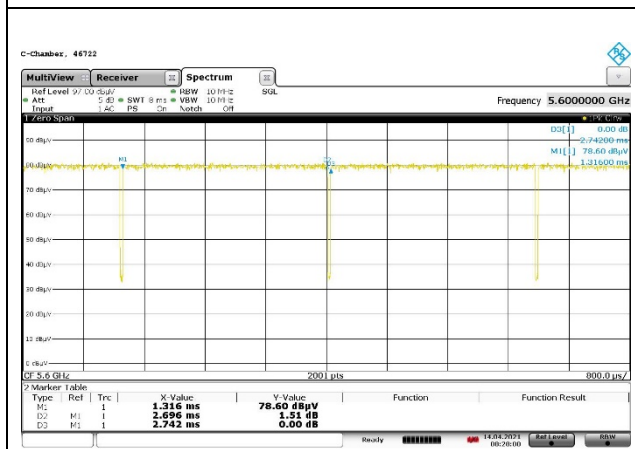
Antenna B



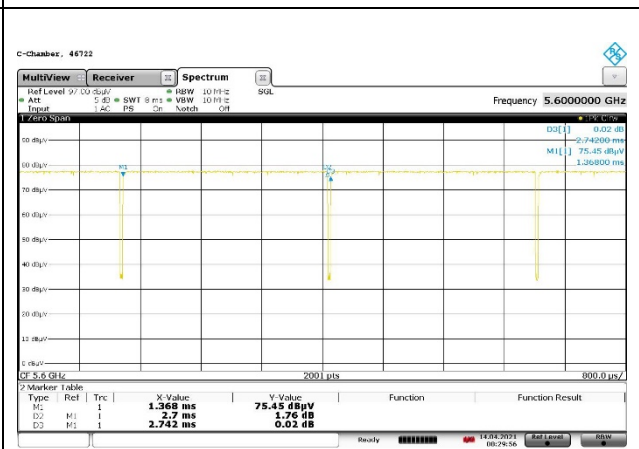
802.11ax HE20 OFDMA, OFDMA MODE: SU



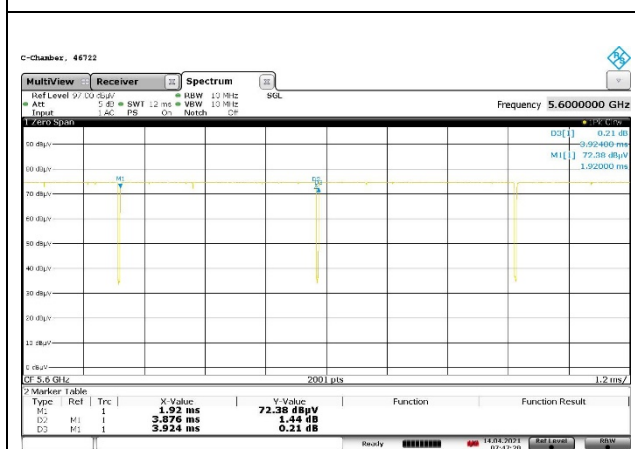
802.11ax HE20 OFDMA, RU size 242T MODE



802.11ax HE20 OFDMA, RU size 106T MODE



802.11ax HE20 OFDMA, RU size 52T MODE

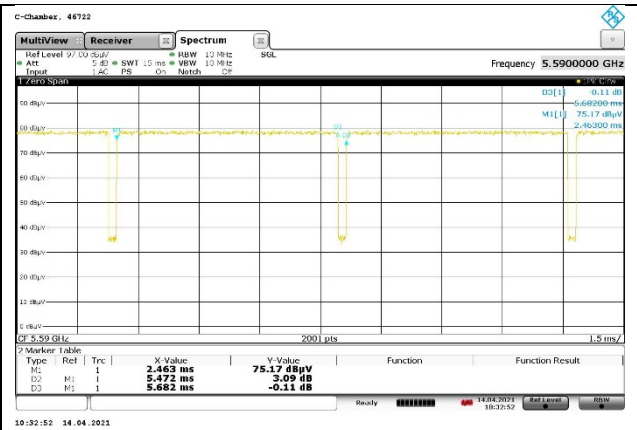


802.11ax HE20 OFDMA, RU size 26T MODE

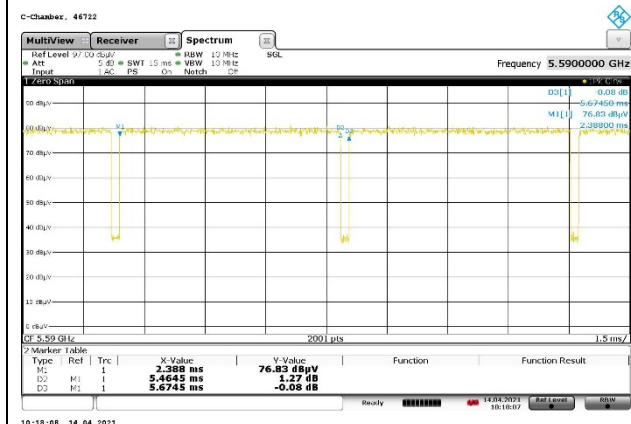
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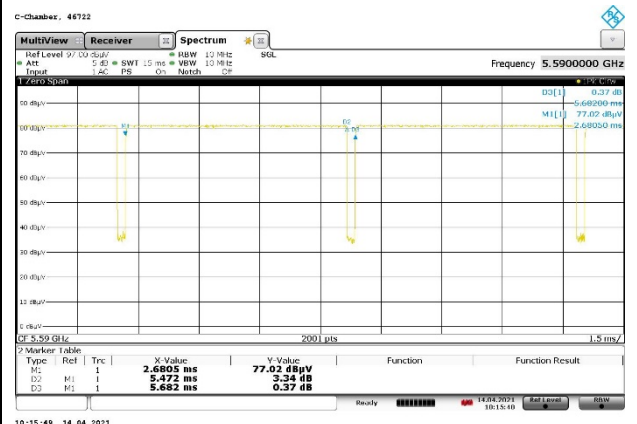
802.11ax HE40 OFDMA, OFDMA MODE: SU



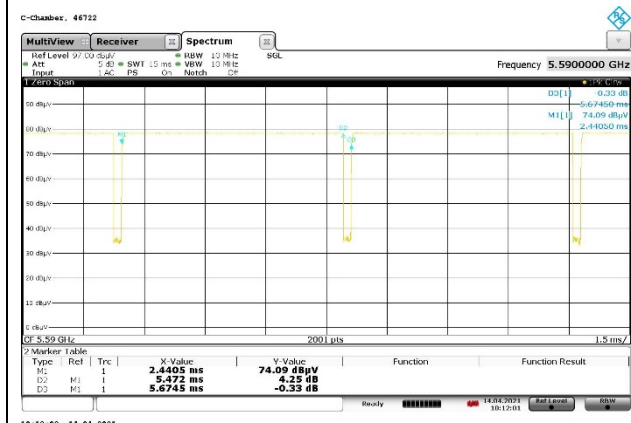
802.11ax HE40 OFDMA, RU size 484T MODE



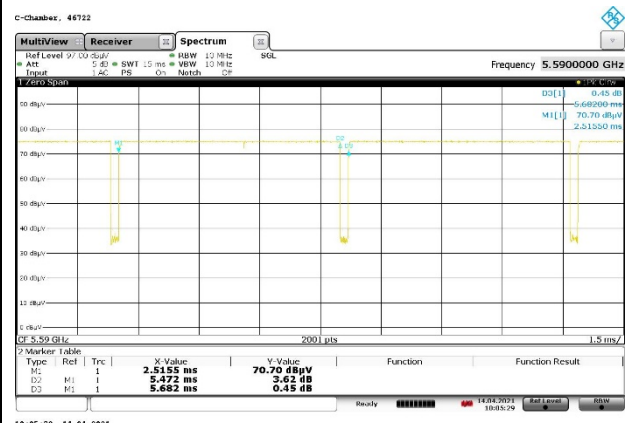
802.11ax HE40 OFDMA, RU size 242T MODE



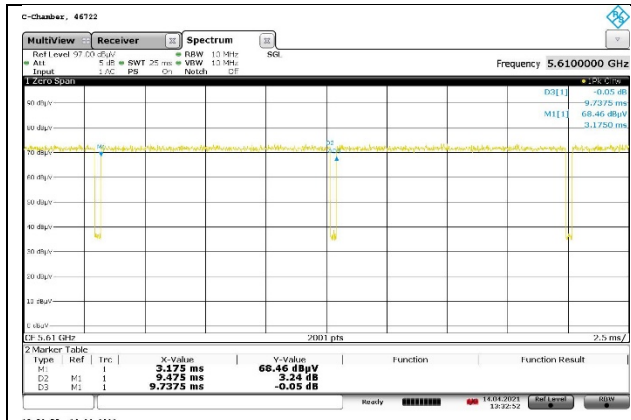
802.11ax HE40 OFDMA, RU size 106T MODE



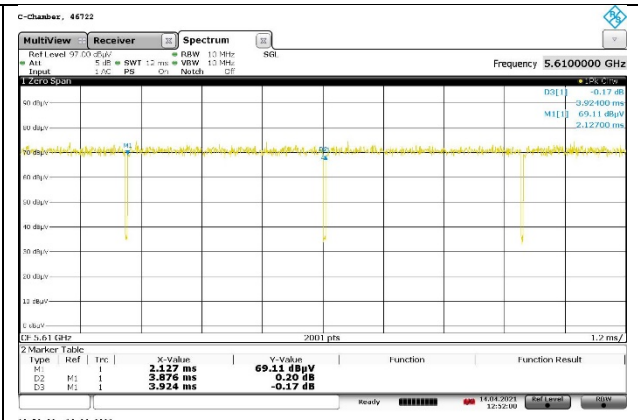
802.11ax HE40 OFDMA, RU size 52T MODE



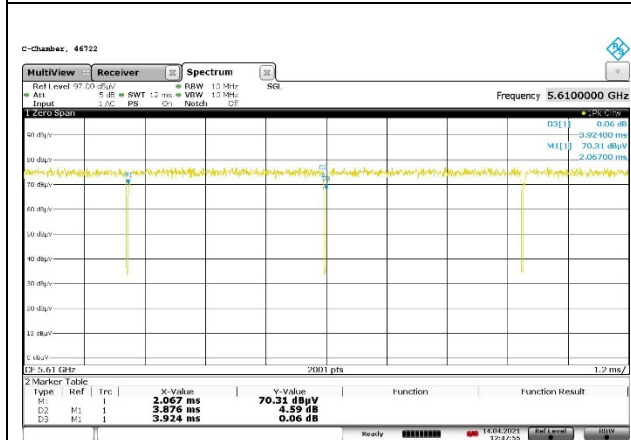
802.11ax HE40 OFDMA, RU size 26T MODE



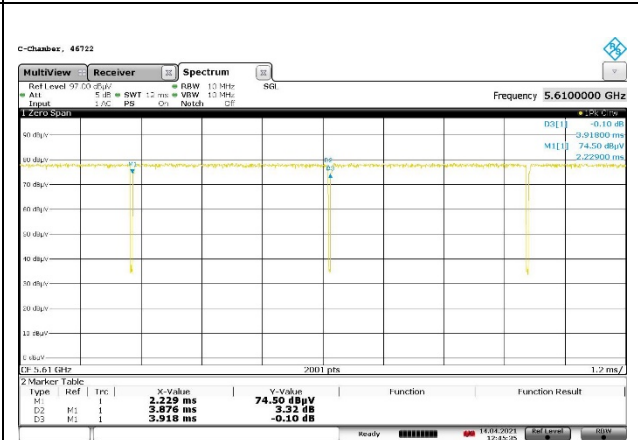
802.11ax HE80 OFDMA, OFDMA MODE: SU



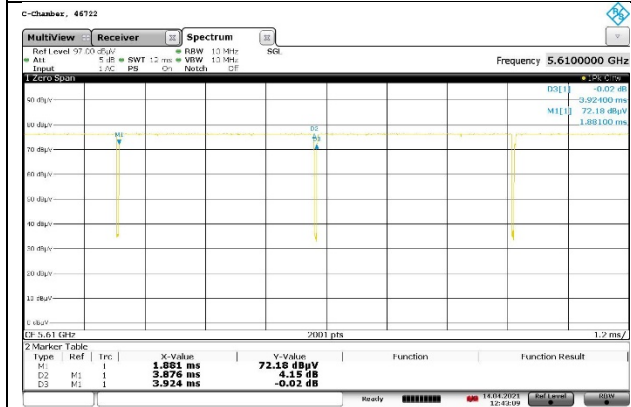
802.11ax HE80 OFDMA, RU size 484T MODE



802.11ax HE80 OFDMA, RU size 242T MODE



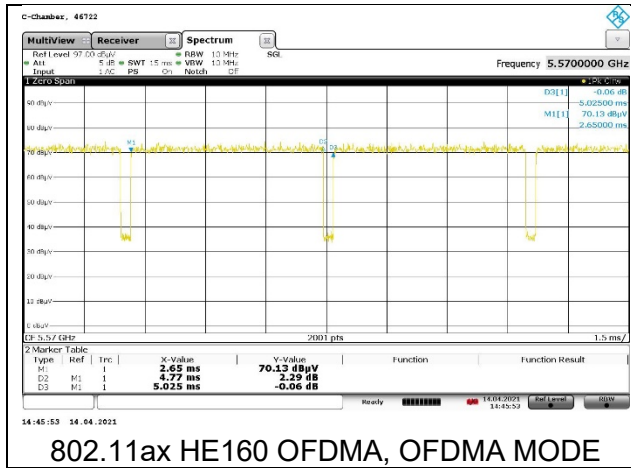
802.11ax HE80 OFDMA, RU size 106T MODE



802.11ax HE80 OFDMA, RU size 52T MODE



802.11ax HE80 OFDMA, RU size 26T MODE



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9.2. 26 dB BANDWIDTH LIMITS

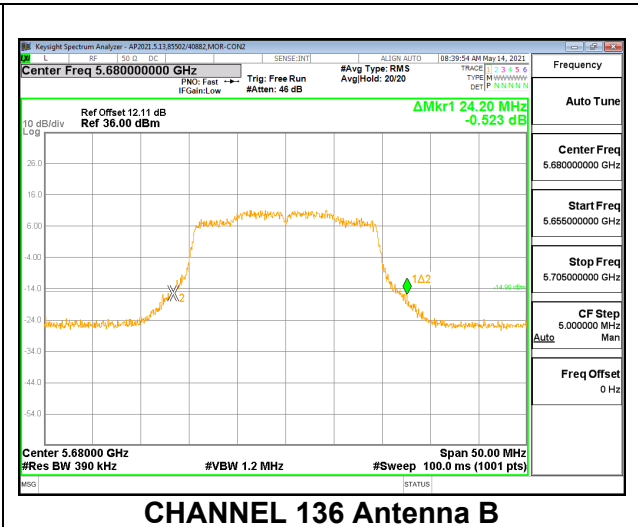
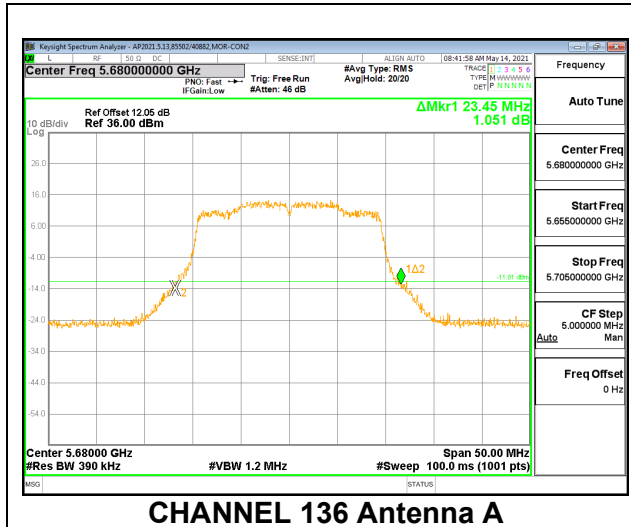
None; for reporting purposes only.

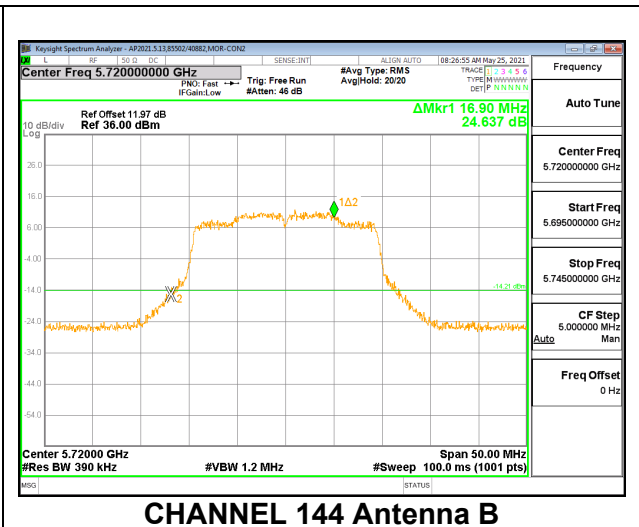
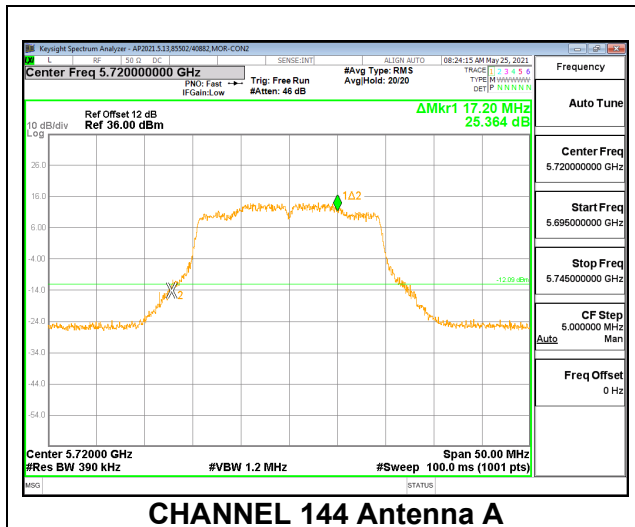
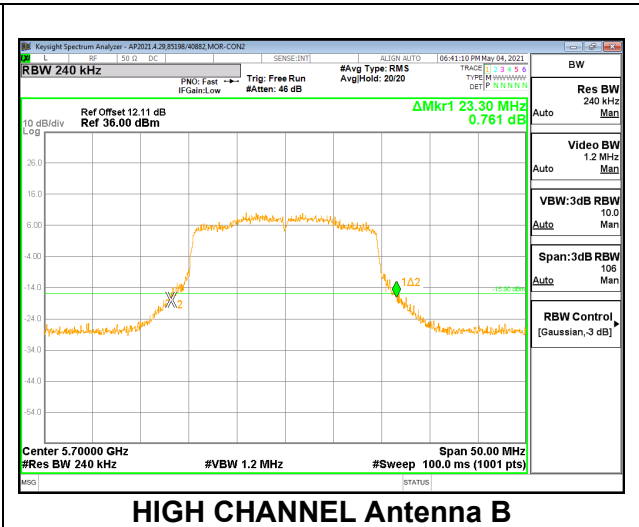
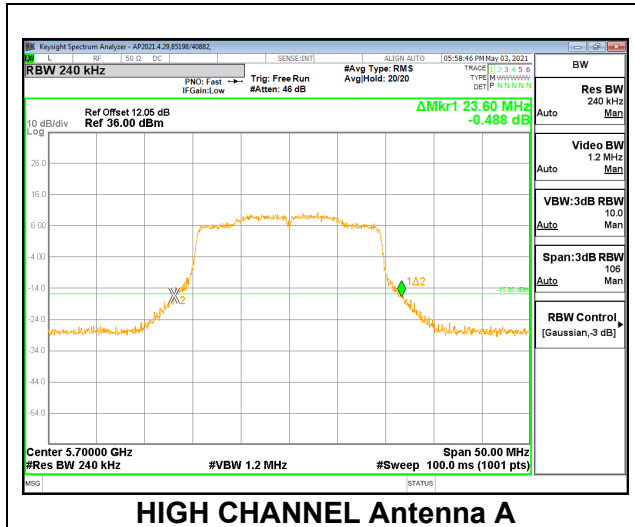
RESULTS

9.2.1. 802.11ax HE20 MODE 2TX IN THE 5.6GHz BAND

2TX Antenna A + Antenna B SDM OFDMA MODE: SU, Single User

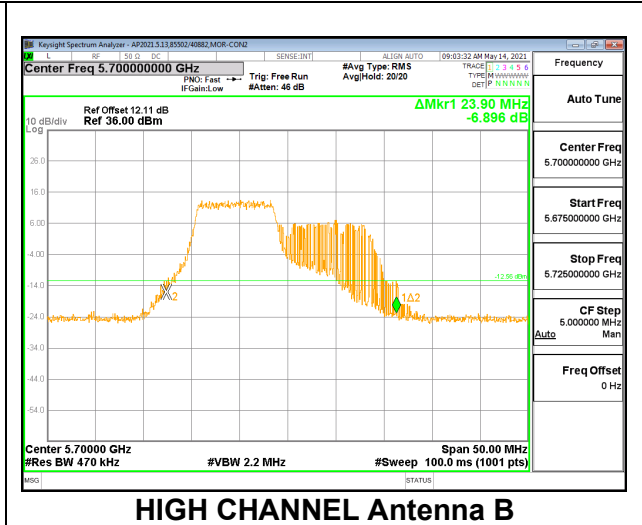
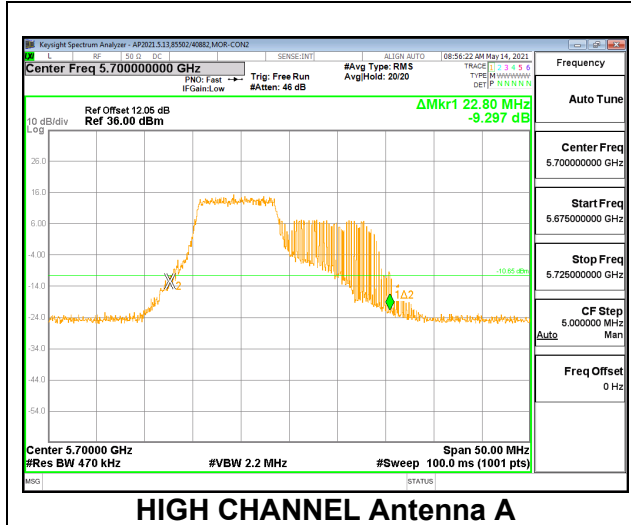
Channel	Frequency (MHz)	26 dB Bandwidth Antenna A (MHz)	26 dB Bandwidth Antenna B (MHz)
136	5680	23.45	24.20
High	5700	23.60	23.30
144	5720	17.20	16.90





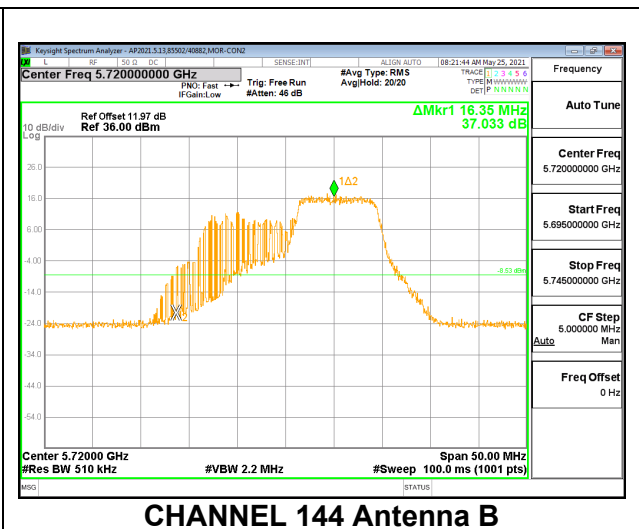
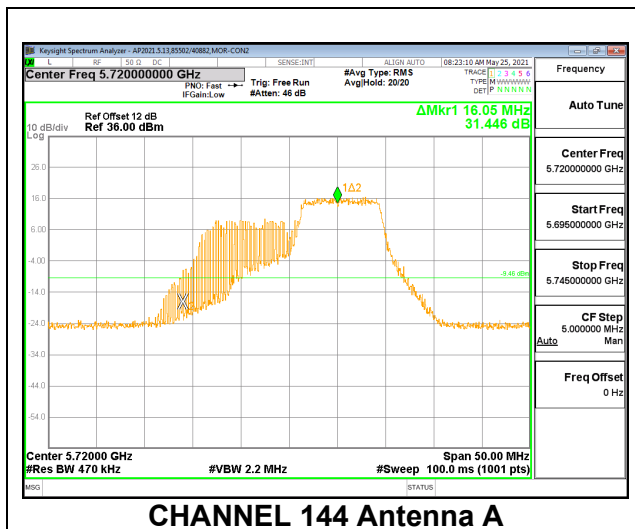
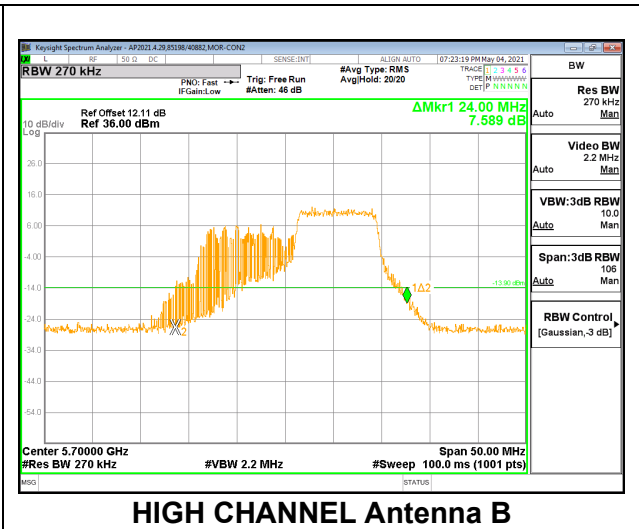
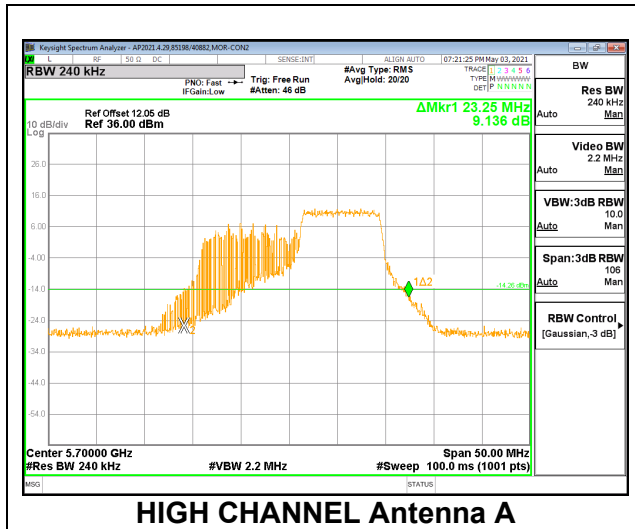
2TX Antenna A + Antenna B SDM OFDMA MODE: 106-Tones, RU Index 53

Channel	Frequency (MHz)	26 dB Bandwidth Antenna A (MHz)	26 dB Bandwidth Antenna B (MHz)
High	5700	22.80	23.90



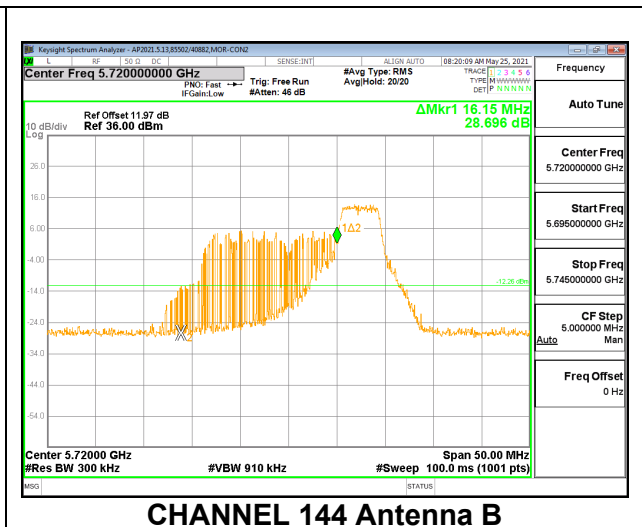
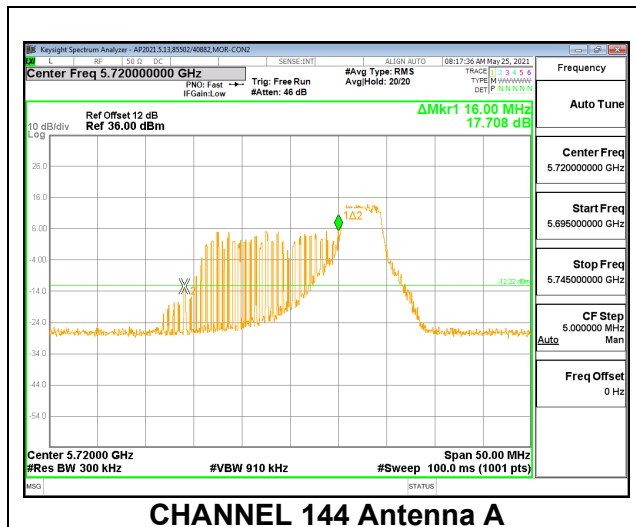
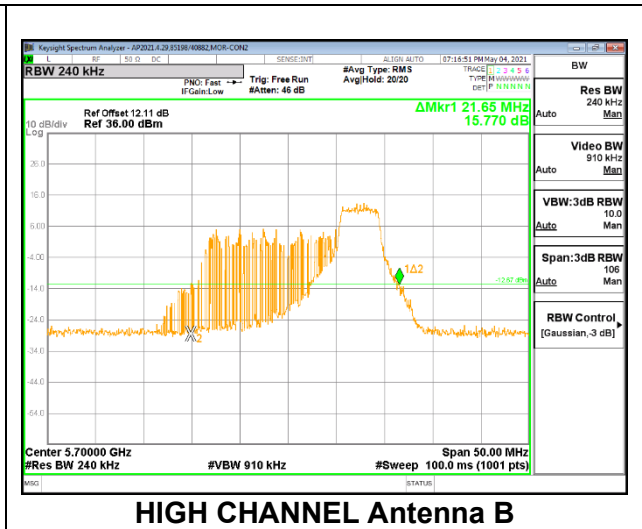
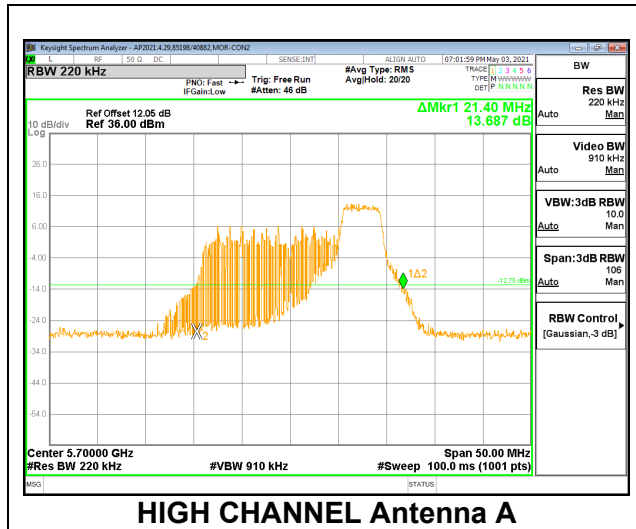
2TX Antenna A + Antenna B SDM OFDMA MODE: 106-Tones, RU Index 54

Channel	Frequency (MHz)	26 dB Bandwidth Antenna A (MHz)	26 dB Bandwidth Antenna B (MHz)
High	5700	23.25	24.00
144	5720	16.05	16.35



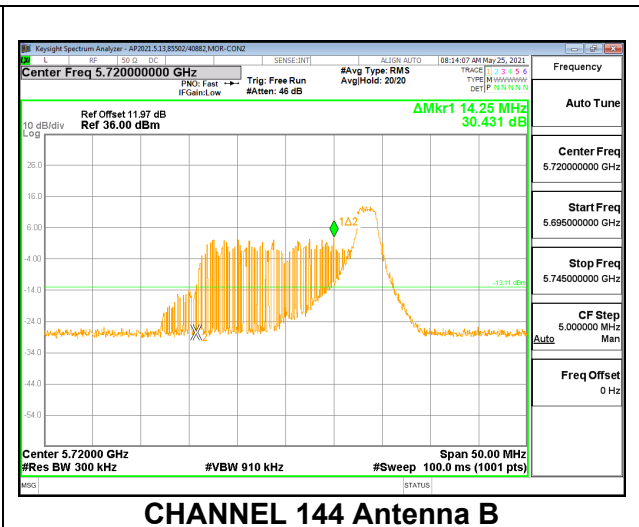
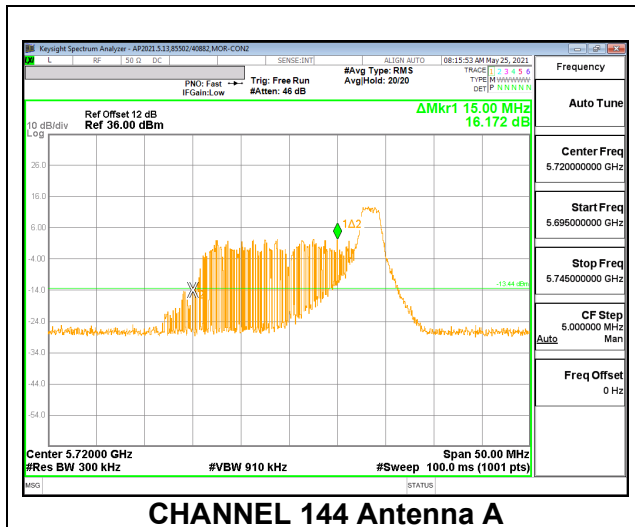
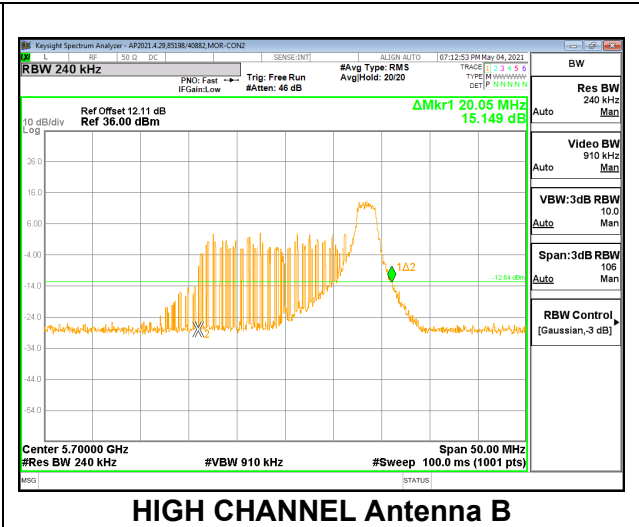
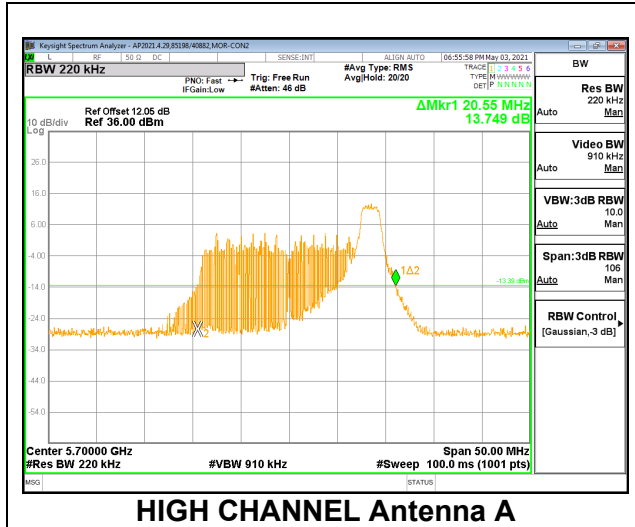
2TX Antenna A + Antenna B SDM OFDMA MODE: 52-Tones, RU Index 40

Channel	Frequency (MHz)	26 dB Bandwidth Antenna A (MHz)	26 dB Bandwidth Antenna B (MHz)
High	5700	21.40	21.65
144	5720	16.00	16.15



2TX Antenna A + Antenna B SDM OFDMA MODE: 26-Tones, RU Index 8

Channel	Frequency (MHz)	26 dB Bandwidth Antenna A (MHz)	26 dB Bandwidth Antenna B (MHz)
High	5700	20.55	20.05
144	5720	15.00	14.25



9.2.2. 802.11ax HE40 MODE 2TX IN THE 5.6GHZ BAND

2TX Antenna A + Antenna B SDM OFDMA MODE: SU, Single User

Channel	Frequency (MHz)	26 dB Bandwidth Antenna A (MHz)	26 dB Bandwidth Antenna B (MHz)
126	5630	42.70	42.20
High	5670	42.30	43.50
142	5710	36.40	36.50

