RF MEASUREMENT REPORT

FCC ID	:	BKMAE-STI6290
APPLICANT	:	SEIKO EPSON CORPORATION
Product	:	WLAN / BT Module
Model No.	:	STI6290-D101
Brand Name	:	EPSON
FCC Classification	:	Unlicensed National Information Infrastructure (NII)
FCC Rule Part(s)	:	Part 15 Subpart E (Section 15.407)
Result	:	Complies
Received Date	:	January 30 ,2023
Test Date	:	February 2~ March 16 ,2023

Test By : Peter Syu
(Peter Syu)

Reviewed By : Paddy Chen
(Paddy Chen)

Approved By : Chenz Ker
(Chenz Ker)

Testing Laboratory
3261

The test results only relate to the tested samples.
This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB789033. Test results reported herein relate only to the item(s) tested.

Revision History

Report No.	Version	Description	Issue Date	Note
2301TW0110-U4	1.0	Original Report	2023-03-23	Valid

CONTENTS

General Information

Applicant	SEIKO EPSON CORPORATION
Applicant Address	3-3-5, Owa, Suwa-shi, Nagano-ken 392-8502 Japan
Manufacturer	SEIKO EPSON CORPORATION
Manufacturer Address	3-3-5, Owa, Suwa-shi, Nagano-ken 392-8502 Japan
Test Site	MRT Technology (Taiwan) Co., Ltd
Test Site Address	No. 38, Fuxing Second Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C)
MRT FCC Registration No.	291082
FCC Rule Part(s)	Part 15 Subpart E (Section 15.407)
Test Device Serial No.	41DC6005203 (Conducted) 41DC6005188 (Radiated)

Test Facility / Accreditations

1. MRT facility is a FCC registered (Reg. No. 291082) test facility with the site description report on file and is designated by the FCC as an Accredited Test Firm.
2. MRT facility is an IC registered (MRT Reg. No. 21723) test laboratory with the site description on file at Industry Canada.
3. MRT Lab is accredited to ISO 17025 by the Taiwan Accreditation Foundation (TAF Cert. No. 3261) in EMC, Telecommunications and Radio testing for FCC (Designation Number: TW3261), Industry Taiwan, EU and TELEC Rules.

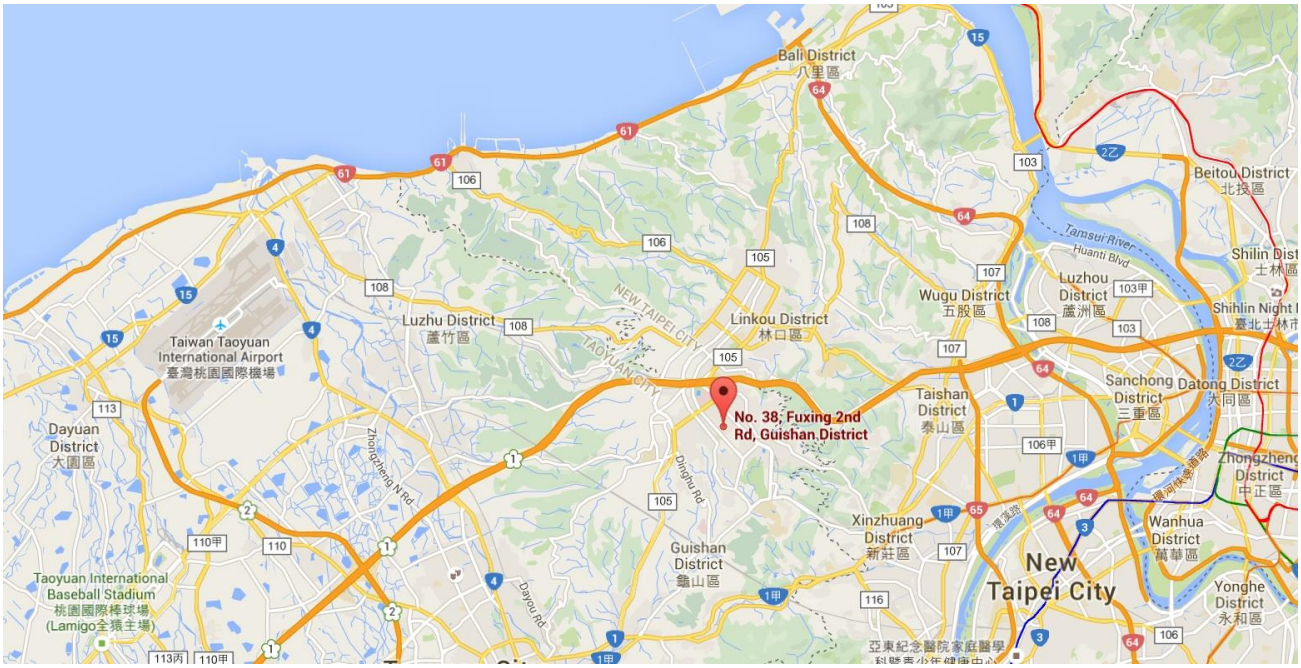
1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taoyuan City. These measurement tests were conducted at the MRT Technology (Taiwan) Co., Ltd. Facility located at No.38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 33377, Taiwan (R.O.C).



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name	WLAN / BT Module
Model No.	STI6290-D101
Brand Name	EPSON
Supports Radios Spec.	WLAN: 802.11a/b/g/n/ac WPAN: Bluetooth V5.0 (Dual Mode)
Working Voltage	DC 5V

2.2. Product Specification Subjective to this Report

Frequency Range	For 802.11a/n-HT20/ac-VHT20: 5180~5240MHz, 5745~5825MHz For 802.11n-HT40/ac-VHT40: 5190~5230MHz, 5755~5795MHz For 802.11ac-VHT80: 5210MHz, 5775MHz
Type of Modulation	802.11a/n/ac: OFDM
Data Rate	802.11a: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 300Mbps 802.11ac: up to 866.6Mbps

2.3. Operation Frequencies and Channel List

802.11a/n-HT20/ac-VHT20

Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180 MHz	40	5200 MHz	44	5220 MHz
48	5240 MHz	149	5745 MHz	153	5765 MHz
157	5785 MHz	161	5805 MHz	165	5825 MHz

802.11n-HT40/ac-VHT40

Channel	Frequency	Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz	151	5755 MHz
159	5795 MHz	--	--	--	--

802.11ac-VHT80

Channel	Frequency	Channel	Frequency	Channel	Frequency
42	5210 MHz	155	5775 MHz	--	--

2.4. Description of Available Antennas

Antenna Type	Frequency Band (MHz)	T_X Paths	Antenna Gain (dBi)		CDD Directional Gain (dBi)	
			Ant 1	Ant 2	For Power	For PSD
Wi-Fi Antenna						
PIFA Antenna	2412 ~ 2462	2	2.34	2.74	2.74	5.75
	5150 ~ 5250	2	3.58	3.39	3.58	6.59
	5725 ~ 5850	2	5.29	4.50	5.29	8.30

Note:

The EUT supports Cyclic Delay Diversity (CDD) mode, and CDD signals are correlated.

For CDD transmissions, directional gain is calculated as follows, $N_{ANT} = 2$, $N_{SS} = 1$.

If all antennas have the same gain, G_{ANT}, Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

- For power spectral density (PSD) measurements on all devices,
  Array Gain = 10 log (N_{ANT}/ N_{SS}) dB = 3.01;
- For power measurements on IEEE 802.11 devices,
  Array Gain = 0 dB for $N_{ANT} \leq 4$;

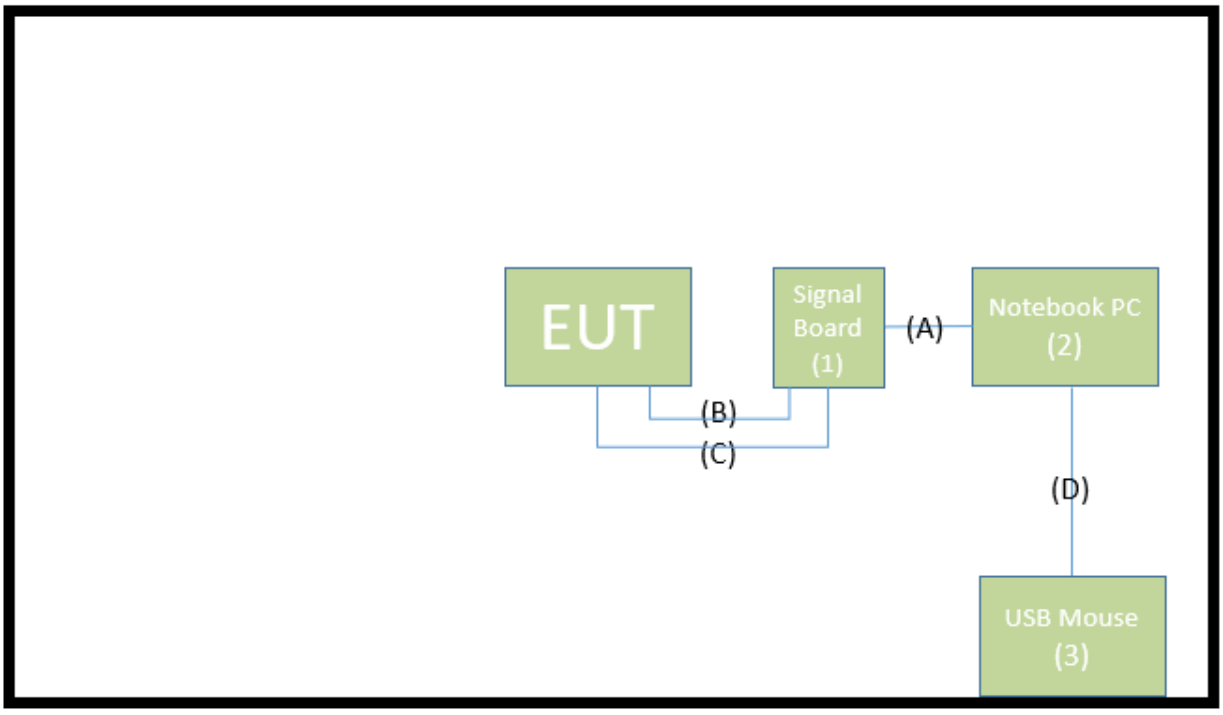
2.5. Test Mode

Mode 1: Transmit by 802.11a_N_{SS}=1 (6Mbps)
Mode 2: Transmit by 802.11n-HT20_N_{SS}=1 (MCS0)
Mode 3: Transmit by 802.11n-HT40_N_{SS}=1 (MCS0)
Mode 4: Transmit by 802.11ac-VHT20_N_{SS}=1 (MCS0)
Mode 5: Transmit by 802.11ac-VHT40_N_{SS}=1 (MCS0)
Mode 6: Transmit by 802.11ac-VHT80_N_{SS}=1 (MCS0)
Remark: 1. For Radiated emission, the modulation and the data rate picked for testing are determined by the Max. RF conducted power. 2. For CDD mode, this device supports 3 N_{SS} and power level is the same of spatial multiplexing. The worst case is N_{SS}=1. 3. As Designated by manufacturer, the lowest data rate was the worst condition, so all the tests were done with lowest data rate.

2.6. Test Configuration

This device was tested per the guidance of ANSI C63.10-2013. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

Connection Diagram



Signal Cable Type		Signal Cable Description
A	USB Cable	Non-Shielded, 1.0m
B	Signal Cable	Non-Shielded, 0.1m
C	Signal Cable	Non-Shielded, 0.1m
D	USB Mouse Cable	Shielded, 1.8m

2.7. Test System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

No.	Product	Manufacturer	Model No.	S/N	Cable Description
1	Signal Board	Askey	STI6290-D101(RoHS)-EVB	N/A	N/A
2	Notebook PC	Lenovo	20Y7-006KTW	N/A	Non-shielded, 0.8m
3	USB Mouse	Logitech	M90	N/A	N/A

2.8. Test Software

The test utility software used during testing was “Putty” and command that provided by the customer.
Note: Final power setting please refer to operational description.

2.9. Applied Standards

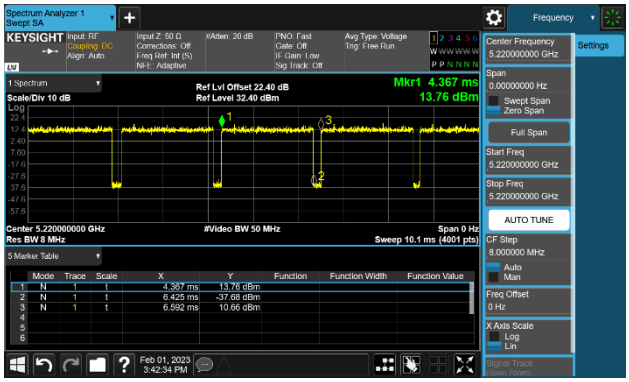
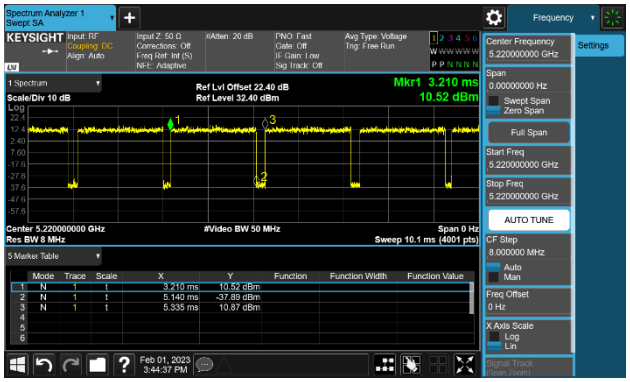
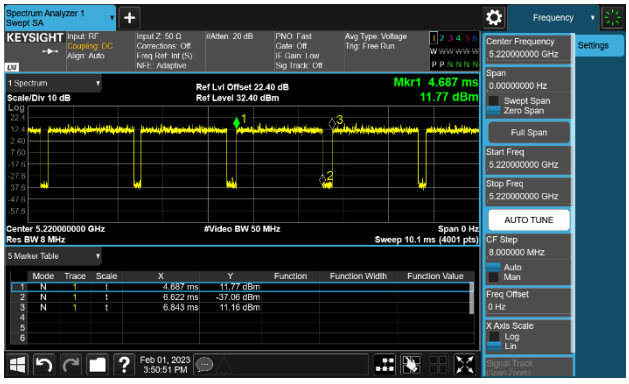
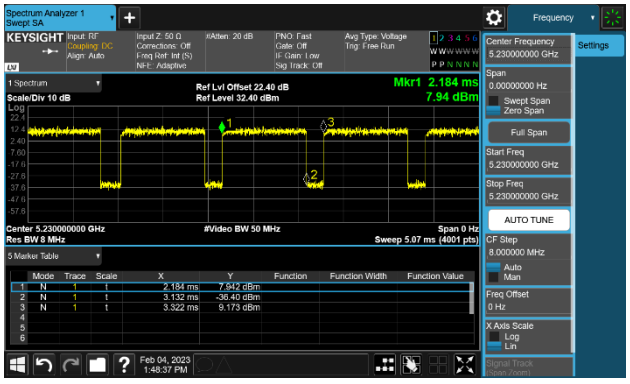
According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

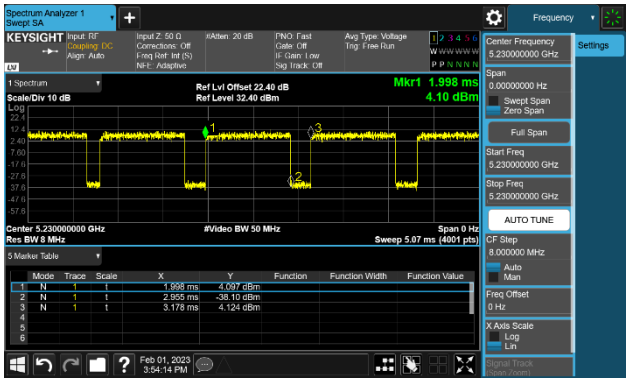
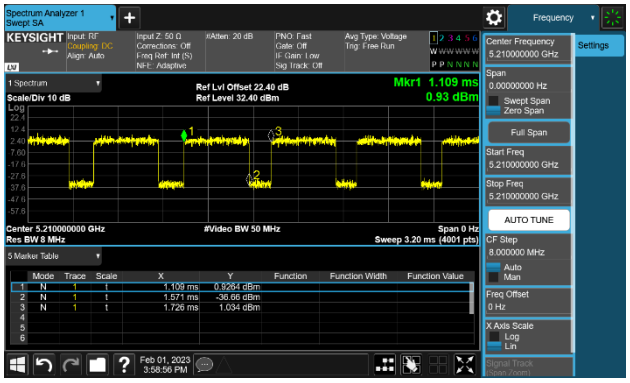
- FCC Part 15.247
- KDB 789033 D02v02r01,
- KDB 662911 D01v02r01
- ANSI C63.10-2013

2.10. Duty Cycle

5GHz (NII) operation is possible in 20MHz, 40MHz, and 80MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 10MHz, VBW = 10MHz. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Test Mode	Duty Cycle
802.11a	92.49%
802.11n-HT20	90.82%
802.11ac-VHT20	83.30%
802.11n-HT40	89.75%
802.11ac-VHT40	81.10%
802.11ac-VHT80	74.88%

802.11a	802.11 n20
	
802.11 ac20	**802.11 n40**
	

802.11 ac40	802.11 ac80
	

2.11. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.12. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

3. DESCRIPTION OF TEST

3.1. Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013), and the guidance provided in KDB 789033 D02v02r01 were used in the measurement.

3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an 8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.
The EUT is powered from one LISN and the support equipment is powered from the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.
Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150kHz to 30MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or data exchange speed, or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions are used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.
An extension cord was used to connect to a single LISN which powered by EUT. The extension cord was calibrated with LISN, the impedance and insertion loss are compliance with the requirements as stated in ANSI C63.10-2013.

3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. A MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An80cm high PVC support structure is placed on top of the turntable.
For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-40GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.
Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions. According to 3dB Beam-Width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

4. ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

“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 antenna of the device uses the unique **I-PEX** connector.

Conclusion:

The EUT unit complies with the requirement of §15.203.

5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions – SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Two-Line V-Network	R&S	ENV216	MRTTWA00019	1 year	2023/5/7
Cable	Rosnol	N1C50-RG400-B 1C50-500CM	MRTTWE00013	1 year	2023/6/19
EMI Test Receiver	R&S	ESR3	MRTTWA00009	1 year	2023/3/9

Radiated Emissions – AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Broadband TRILOG Antenna	SCHWARZBECK	VULB 9162	MRTTWA00001	1 year	2023/12/21
EMI Test Receiver	R&S	ESR3	MRTTWA00009	1 year	2023/5/9
Acitve Loop Antenna	Schwarzbeck	FMZB 1519B	MRTTWA00002	1 year	2023/5/24
Broadband Horn antenna	SCHWARZBECK	BBHA 9120D	MRTTWA00003	1 year	2023/3/30
Breitband Hornantenna	Schwarzbeck	BBHA 9170	MRTTWA00004	1 year	2023/3/29
Broadband Amplifier	Schwarzbeck	BBV 9721	MRTTWA00006	1 year	2023/3/30
Broadband Preamplifier	SCHWARZBECK	BBV 9718	MRTTWA00005	1 year	2023/3/30
Cable	HUBERSUHNER	SF106	MRTTWE00010	1 year	2023/6/14
Cable	Rosnol	K1K50-UP0264-K1K50-4M	MRTTWE00012	1 year	2023/6/19

Conducted Test Equipment –SR5

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EXA Signal Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2023/10/5
EXA Signal Analyzer	KEYSIGHT	N9010B	MRTTWA00074	1 year	2023/7/19
USB Wideband Power Sensor	KEYSIGHT	U2021XA	MRTTWA00015	1 year	2023/5/16

Test Software

Software	Version	Function
e3	9.160520a	EMI Test Software
EMI	V3	EMI Test Software

6. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Conducted Emission- Power Line
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 0.15MHz~30MHz: ± 2.53dB
Radiated Spurious Emission
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 9kHz~30MHz: ± 3.92dB 30MHz~1GHz: ± 4.25dB 1GHz~18GHz: ± 4.40dB 18GHz~40GHz: ± 4.45dB
Frequency Error
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): ±78.4Hz
Conducted Power
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): ± 0.84dB
Conducted Spurious Emission
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):± 2.65 dB
Occupied Bandwidth
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): ± 3.3%
Temp. / Humidity
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): ±0.82°C/ ±3%
DC Voltage
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): ±0.3%

7. TEST RESULT

7.1. Summary

FCC Section(s)	Test Description	Test Condition	Verdict
15.407(a)	26dB Bandwidth	Conducted	Pass
15.407(e)	6dB Bandwidth		Pass
15.407(a)(1)(iv), (3)(i)	Output Power		Pass
15.407(a)(1)(iv), (3)(i), (12)	Power Spectral Density		Pass
15.407(g)	Frequency Stability		Pass
15.205, 15.209 15.407(b)(1), (4)(i), (9), (10), (11)	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Radiated	Pass
15.207	AC Conducted Emissions 150kHz - 30MHz	Line Conducted	Pass

Notes:

1) Determining compliance is based on the test results met the regulation limits or requirements declared by clients, and the test results don't take into account the value of measurement uncertainty.
2) For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst case emissions.
3) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
4) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.

7.2. 26dB Bandwidth Measurement

7.2.1. Test Limit

N/A

7.2.2. Test Procedure used

KDB 789033 D02v02r01- Section II)C.1) (26dB Bandwidth)

KDB 789033 D02v02r01- Section II)D) (99% Bandwidth)

7.2.3. Test Setting

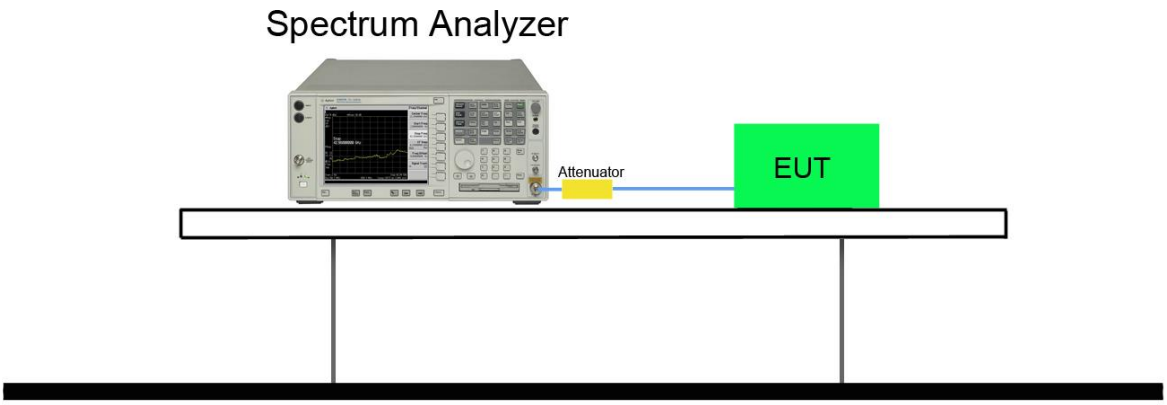
26dB Bandwidth

1. The analyzers' automatic bandwidth measurement capability was used to perform the 26dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 26. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediated power nulls in the fundamental emission.
2. RBW = Approximately 1% of the emission bandwidth.
3. VBW ≥ RBW.
4. Detector = Peak.
5. Trace mode = Max hold.
6. Sweep = Auto couple
7. Allow the trace to stabilize

99% Bandwidth

1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1% to 5% of the OBW
4. Set VBW ≥ 3 × RBW
5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.

7.2.4. Test Setup



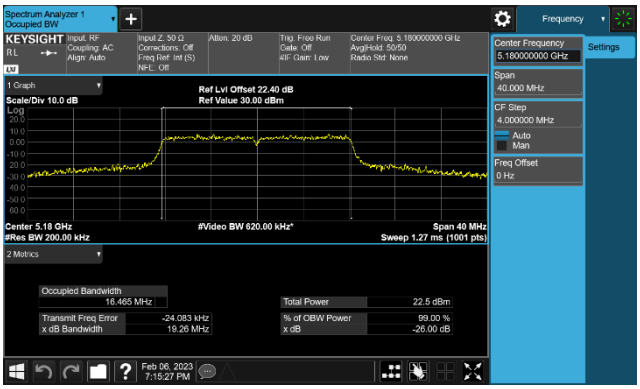
7.2.5. Test Result

Product	WLAN / BT Module	Test Engineer	Peter
Test Site	SR2	Test Date	2023/2/6

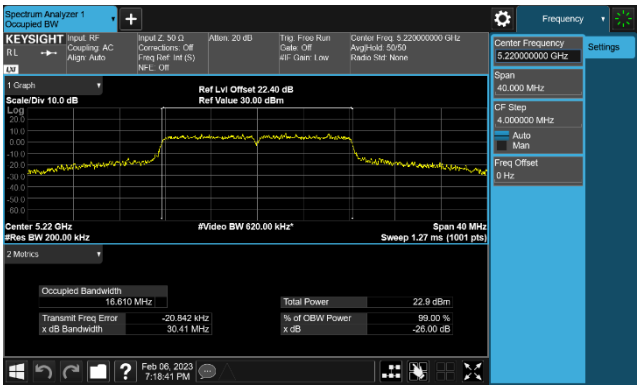
Test Mode	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
Ant 1				
802.11a	36	5180	19.260	16.465
802.11a	44	5220	30.410	16.610
802.11a	48	5240	19.170	16.494
802.11a	149	5745	18.330	16.436
802.11a	157	5785	18.510	16.420
802.11a	165	5825	19.470	16.453
802.11n-HT20	36	5180	19.680	17.643
802.11n-HT20	44	5220	23.730	17.669
802.11n-HT20	48	5240	19.450	17.629
802.11n-HT20	149	5745	19.570	17.623
802.11n-HT20	157	5785	19.090	17.600
802.11n-HT20	165	5825	19.320	17.615
802.11n-HT40	38	5190	40.610	36.124
802.11n-HT40	46	5230	40.860	36.220
802.11n-HT40	151	5755	40.150	36.091
802.11n-HT40	159	5795	39.740	36.048
802.11ac-HT20	36	5180	19.400	17.620
802.11ac-HT20	44	5220	19.500	17.598
802.11ac-HT20	48	5240	19.930	17.674
802.11ac-HT20	149	5745	19.510	17.619
802.11ac-HT20	157	5785	19.130	17.602
802.11ac-HT20	165	5825	19.170	17.600
802.11ac-HT40	38	5190	40.670	36.114
802.11ac-HT40	46	5230	43.290	36.188
802.11ac-HT40	151	5755	40.890	36.170
802.11ac-HT40	159	5795	40.250	36.094
802.11ac-VHT80	42	5210	81.180	75.366
802.11ac-VHT80	155	5775	80.570	75.230

802.11a 26dB Bandwidth & 99% Bandwidth - Ant 1

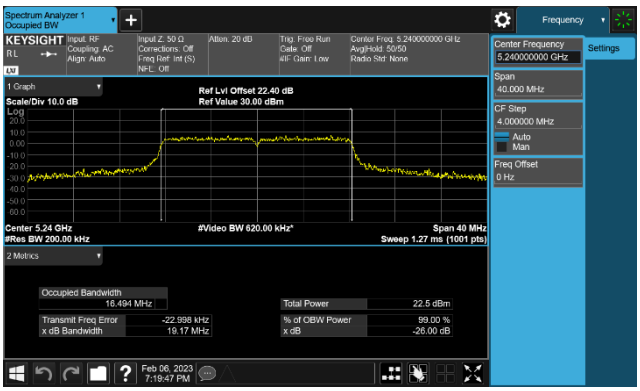
802.11 a CH36 (5180MHz)



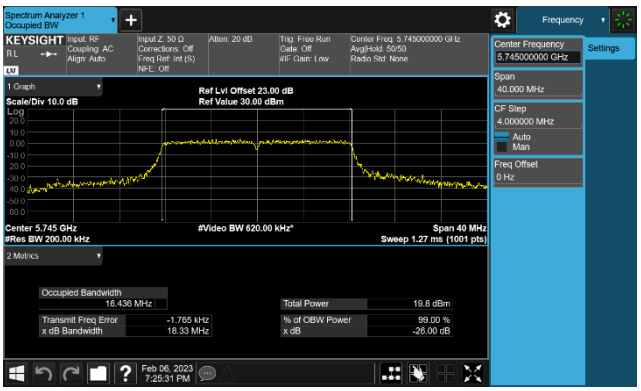
802.11 a CH44 (5220MHz)



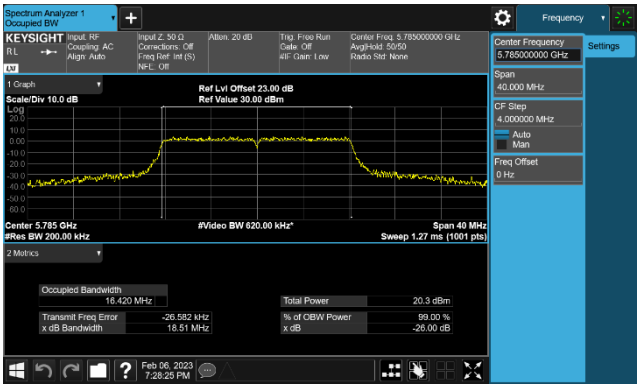
802.11 a CH48 (5240MHz)



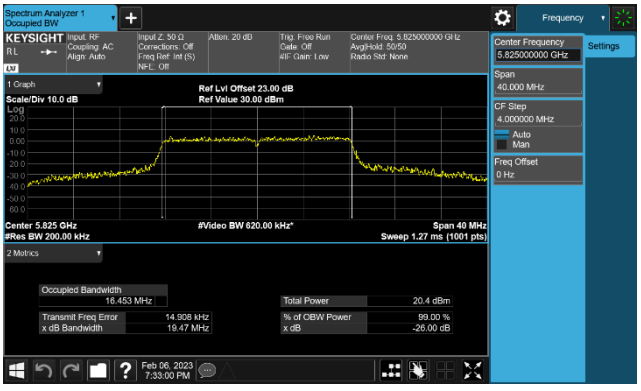
802.11 a CH149 (5745MHz)

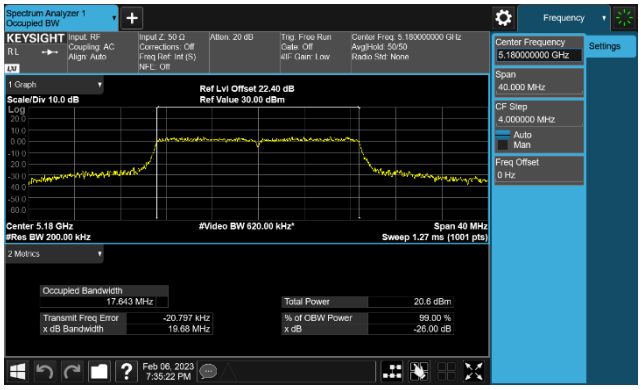
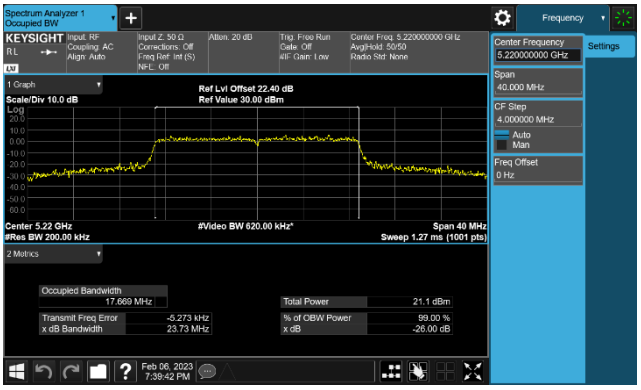
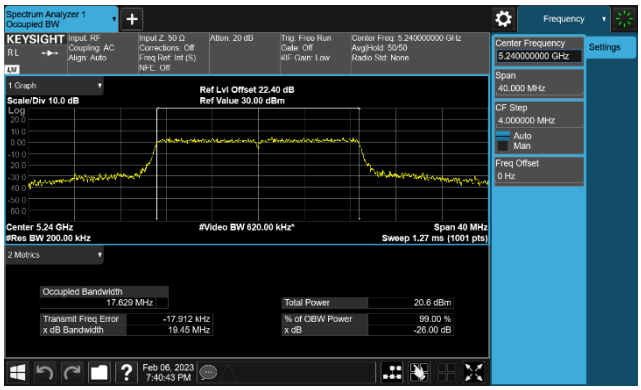
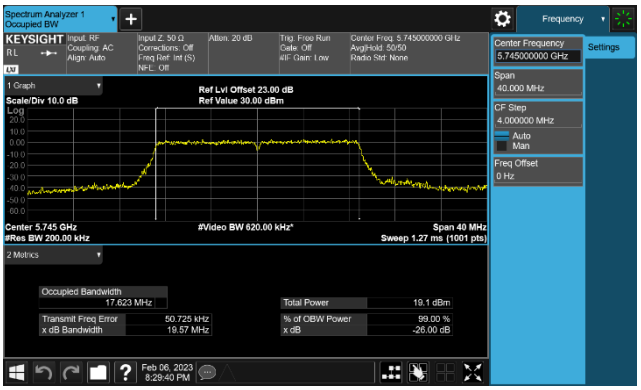
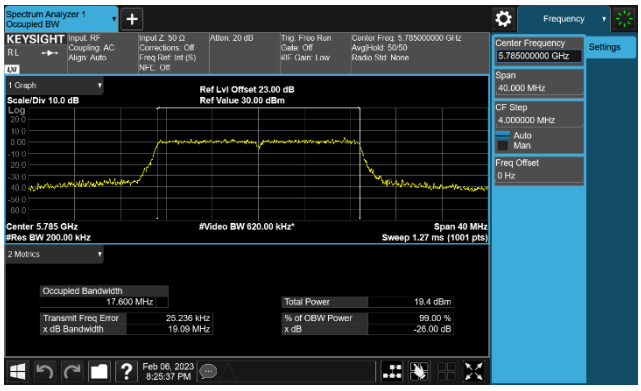
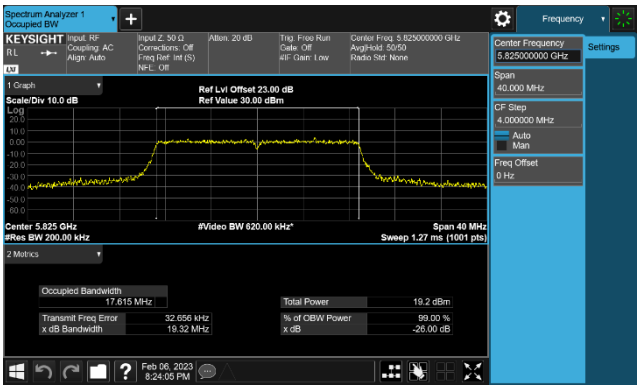


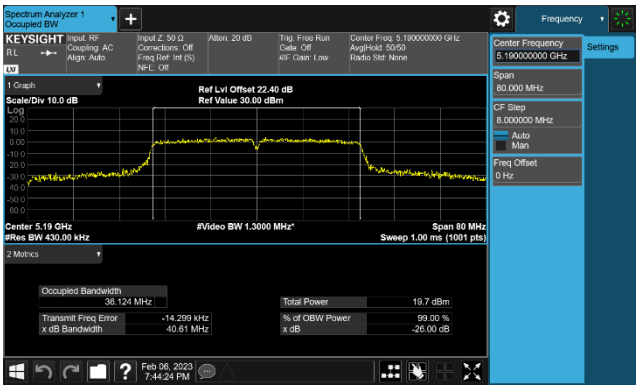
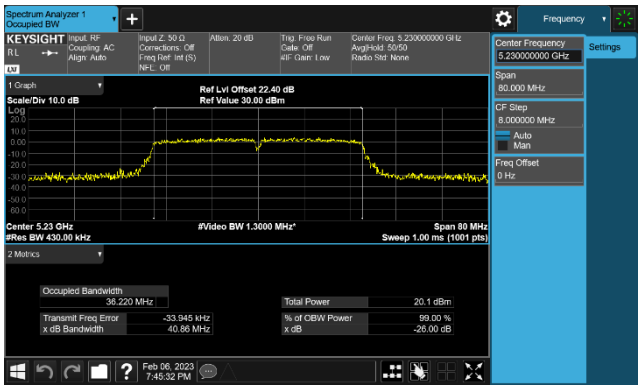
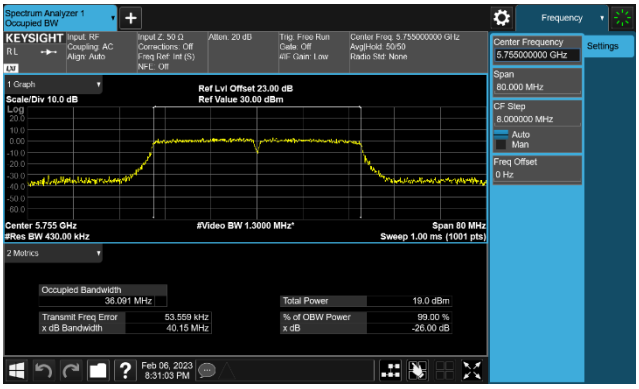
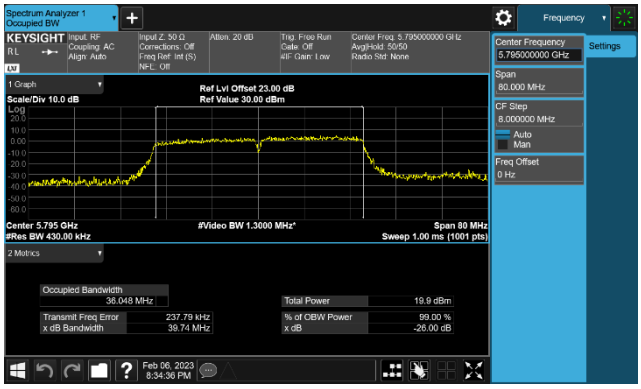
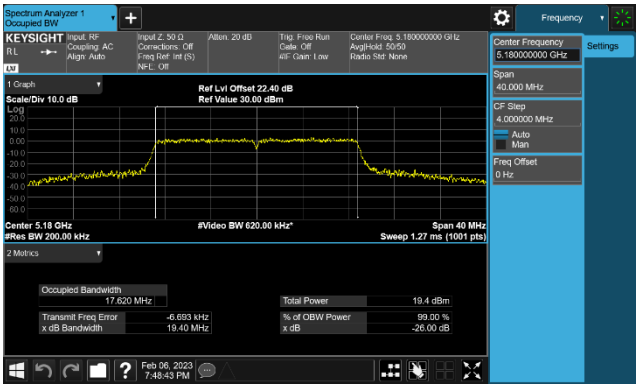
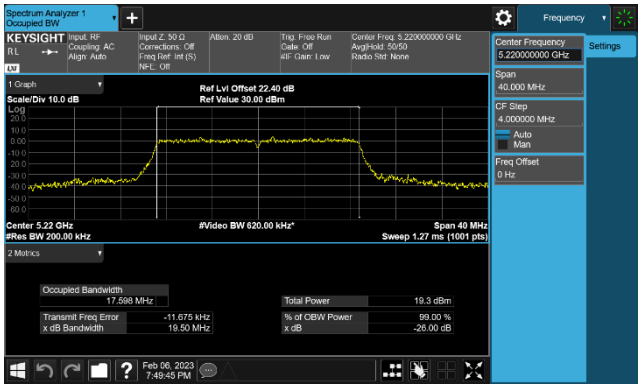
802.11 a CH157 (5785MHz)

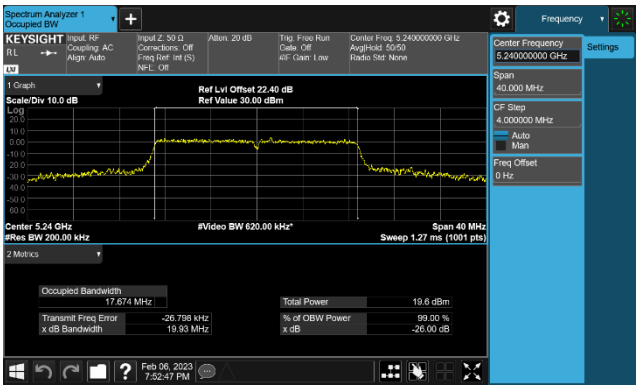
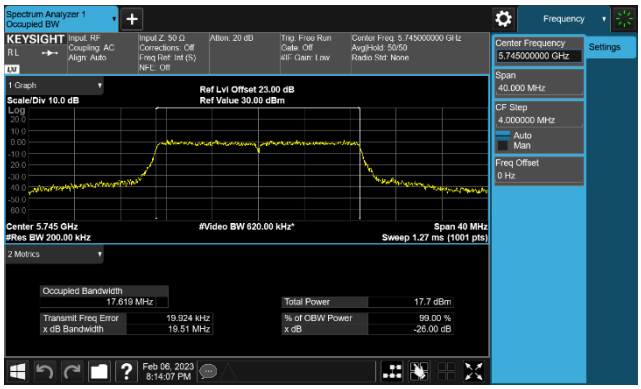
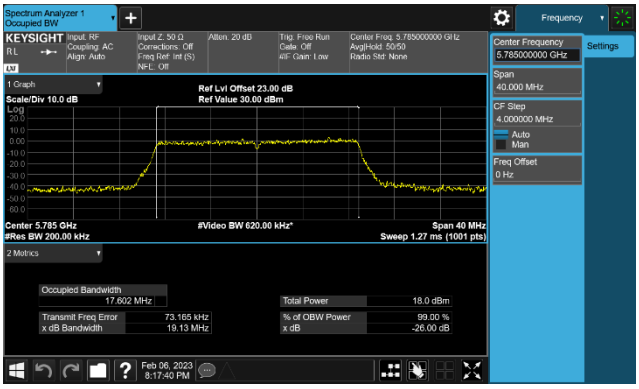
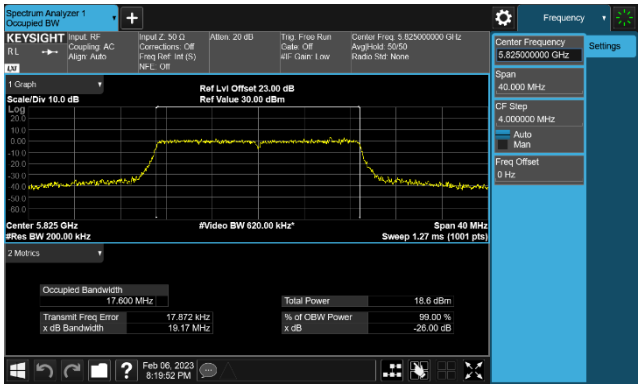
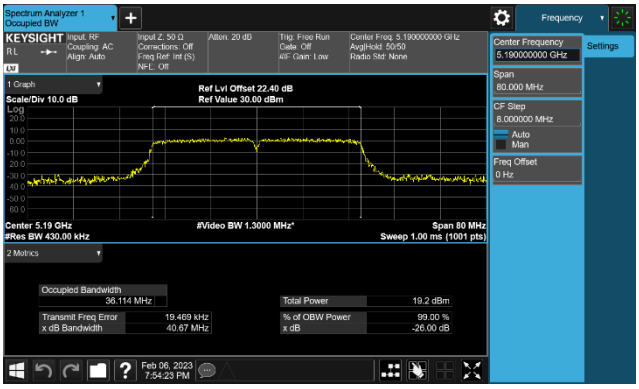
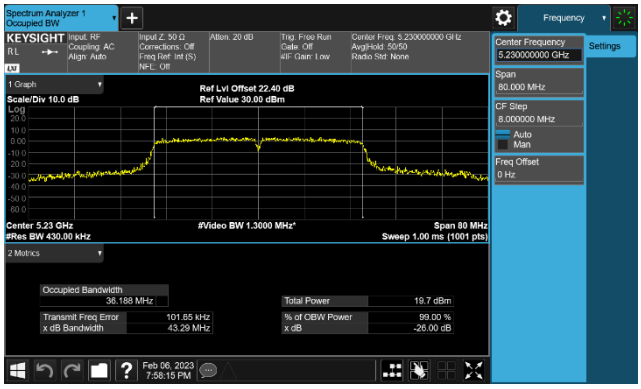


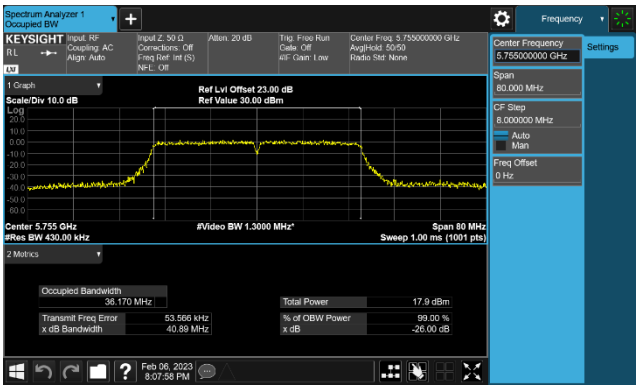
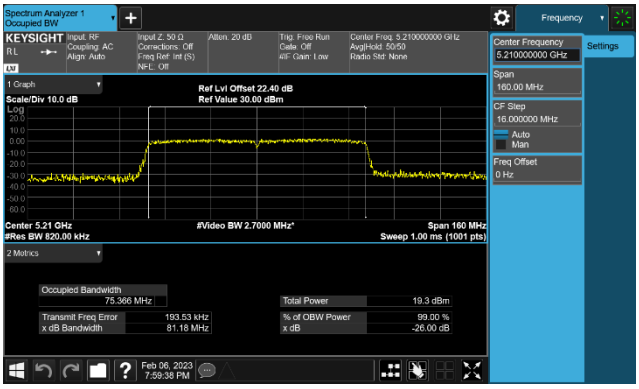
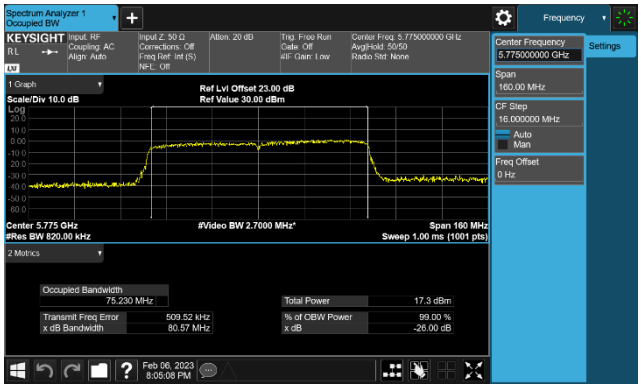
802.11 a CH165 (5825MHz)



802.11 n-HT20 CH36 (5180MHz)	802.11 n-HT20 CH44 (5220MHz)
	
802.11 n-HT20 CH48 (5240MHz)	**802.11 n-HT20 CH149 (5745MHz)**
	
802.11 n-HT20 CH157 (5785MHz)	**802.11 n-HT20 CH165 (5825MHz)**
	

802.11 n-HT40 CH38 (5190MHz)	802.11 n-HT40 CH46 (5230MHz)
	
802.11 n-HT40 CH151 (5755MHz)	**802.11 n-HT40 CH159 (5795MHz)**
	
802.11 ac-HT20 CH36 (5180MHz)	**802.11 ac-HT20 CH44 (5220MHz)**
	

802.11 ac-HT20 CH48 (5240MHz)	802.11 ac-HT20 CH149 (5745MHz)
	
802.11 ac-HT20 CH157 (5785MHz)	**802.11 ac-HT20 CH165 (5825MHz)**
	
802.11 ac-HT40 CH38 (5190MHz)	**802.11 ac-HT40 CH46 (5230MHz)**
	

802.11 ac-HT40 CH151 (5755MHz)	802.11 ac-HT40 CH159 (5795MHz)
	
802.11 ac-HT80 CH42 (5210MHz)	**802.11 ac-HT80 CH155 (5775MHz)**
	

7.3. 6dB Bandwidth Measurement

7.3.1. Test Limit

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

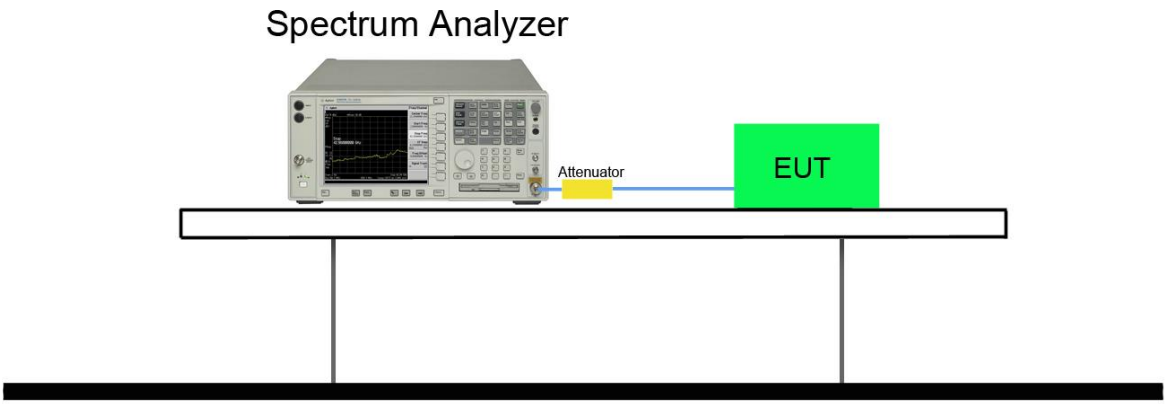
7.3.2. Test Procedure used

KDB 789033 D02v02r01 - Section II) C.2

7.3.3. Test Setting

1. Set center frequency to the nominal EUT channel center frequency.
2. RBW = 100 kHz.
3. VBW ≧ 3 × RBW.
4. Detector = Peak.
5. Trace mode = max hold.
6. Sweep = auto couple.
7. Allow the trace to stabilize.
8. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

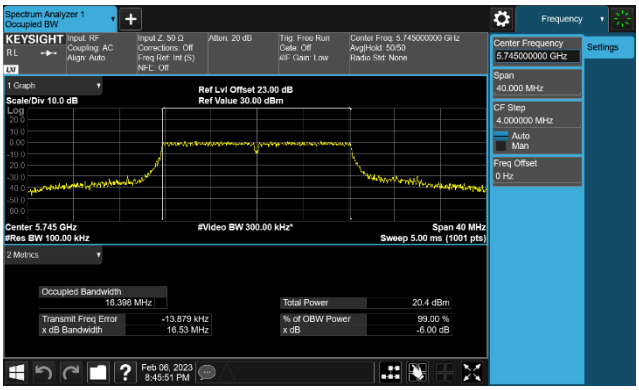
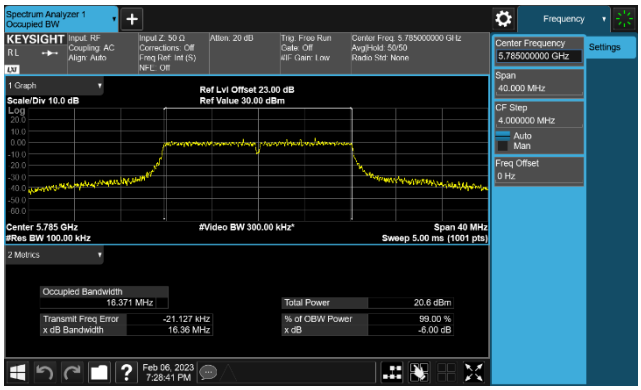
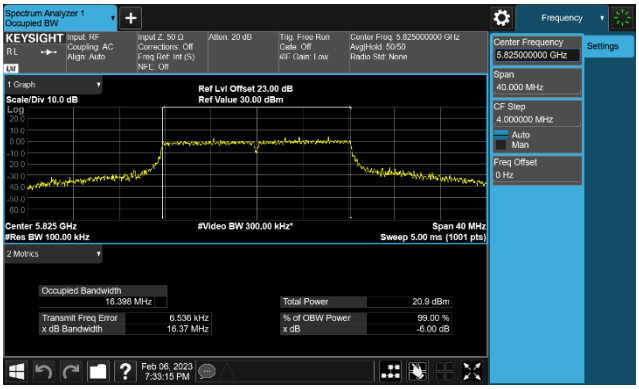
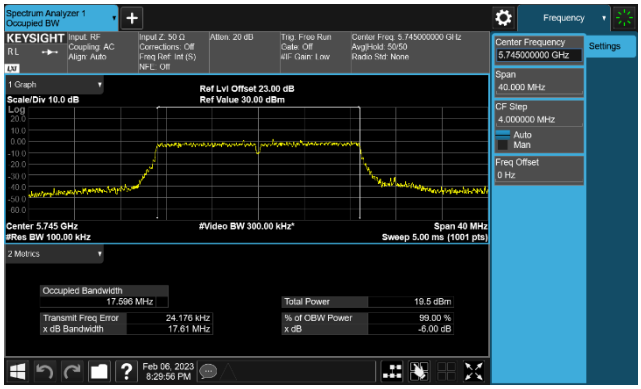
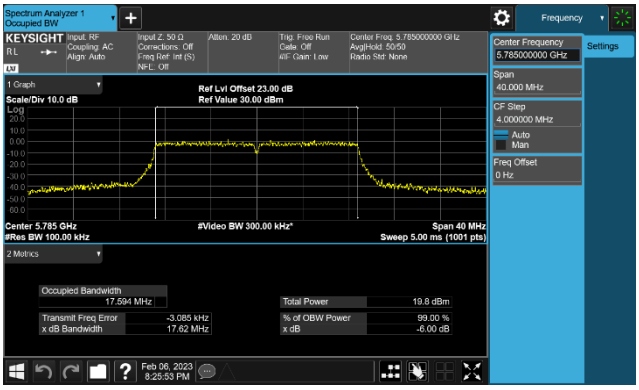
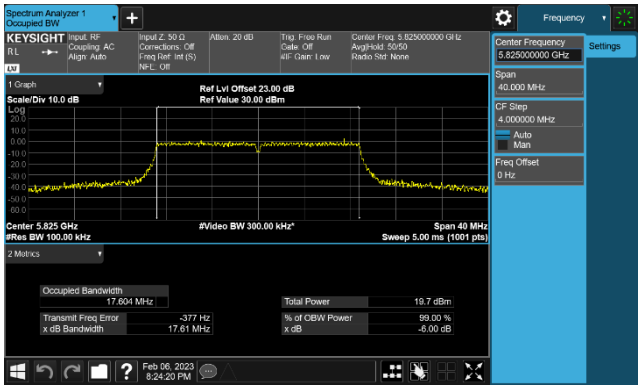
7.3.4. Test Setup

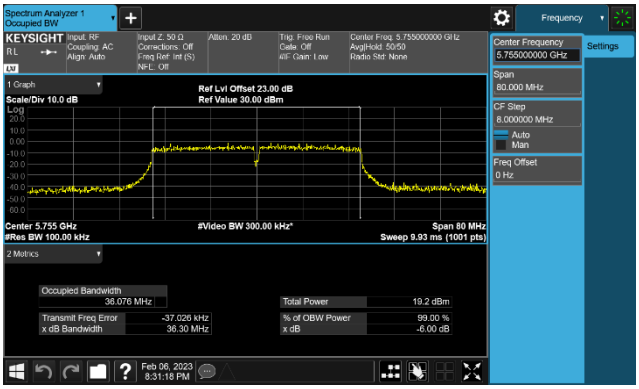
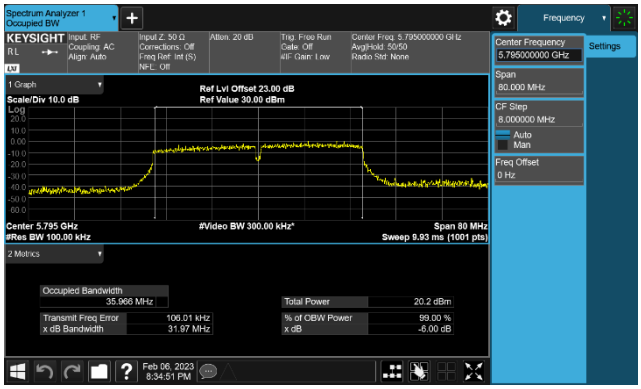
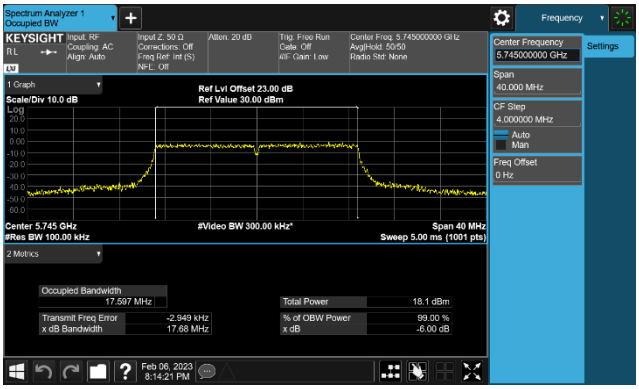
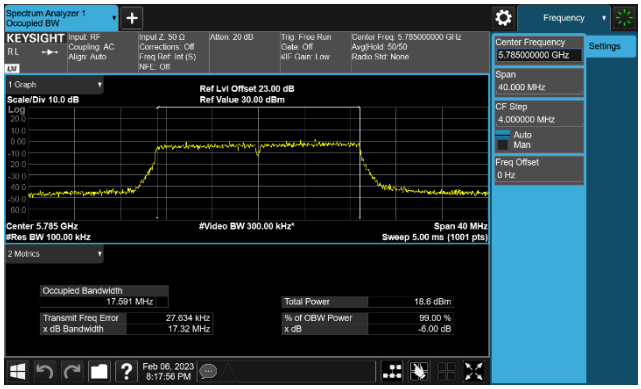
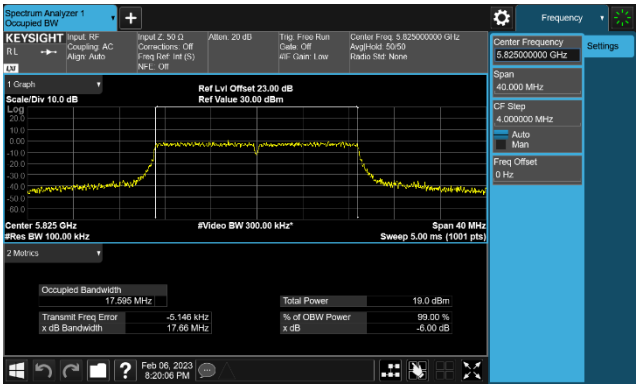
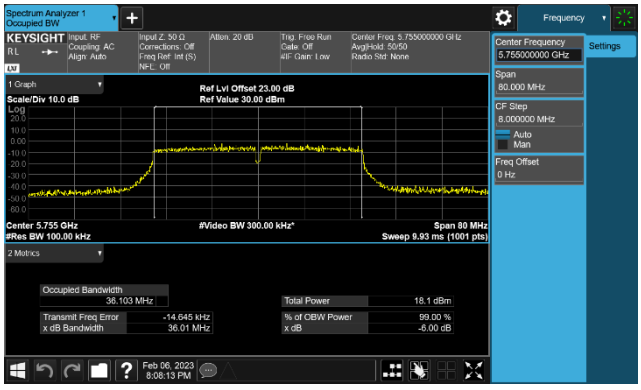


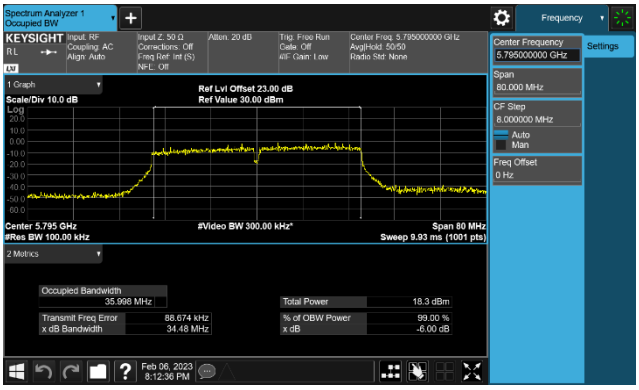
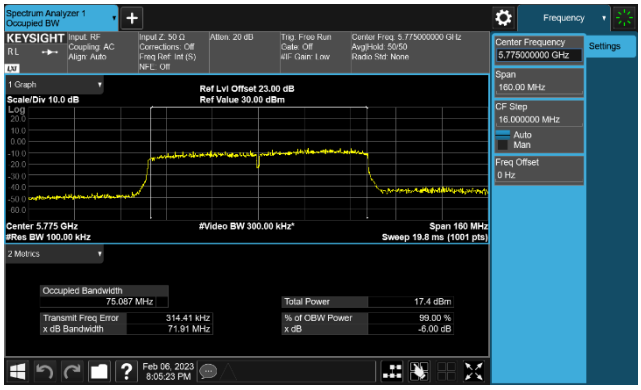
7.3.5. Test Result

Product	WLAN / BT Module	Test Engineer	Peter
Test Site	SR2	Test Date	2023/2/6

Test Mode	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.11a	149	5745	16.530	≥ 0.5	Pass
802.11a	157	5785	16.360	≥ 0.5	Pass
802.11a	165	5825	16.370	≥ 0.5	Pass
802.11n-HT20	149	5745	17.610	≥ 0.5	Pass
802.11n-HT20	157	5785	17.620	≥ 0.5	Pass
802.11n-HT20	165	5825	17.610	≥ 0.5	Pass
802.11n-HT40	151	5755	36.300	≥ 0.5	Pass
802.11n-HT40	159	5795	31.970	≥ 0.5	Pass
802.11ac-VHT20	149	5745	17.680	≥ 0.5	Pass
802.11ac-VHT20	157	5785	17.320	≥ 0.5	Pass
802.11ac-VHT20	165	5825	17.660	≥ 0.5	Pass
802.11ac-VHT40	151	5755	36.010	≥ 0.5	Pass
802.11ac-VHT40	159	5795	34.480	≥ 0.5	Pass
802.11ac-VHT80	155	5775	71.910	≥ 0.5	Pass

Ant 1	
802.11 a CH149 (5745MHz)	**802.11 a CH157 (5785MHz)**
	
802.11 a CH165 (5825MHz)	**802.11 n-HT20 CH149 (5745MHz)**
	
802.11 n-HT20 CH157 (5785MHz)	**802.11 n-HT20 CH165 (5825MHz)**
	

802.11 n-HT40 CH151 (5755MHz)	802.11 n-HT40 CH159 (5795MHz)
	
802.11 ac-HT20 CH149 (5745MHz)	**802.11 ac-HT20 CH157 (5785MHz)**
	
802.11 ac-HT20 CH165 (5825MHz)	**802.11 ac-HT40 CH151 (5755MHz)**
	

802.11 ac-HT40 CH159 (5795MHz)	802.11 ac-HT80 CH155 (5775MHz)
	

7.4. Output Power Measurement

7.4.1. Test Limit

For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW (24dBm) provided the maximum antenna gain does not exceed 6 dBi.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W (30dBm).

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

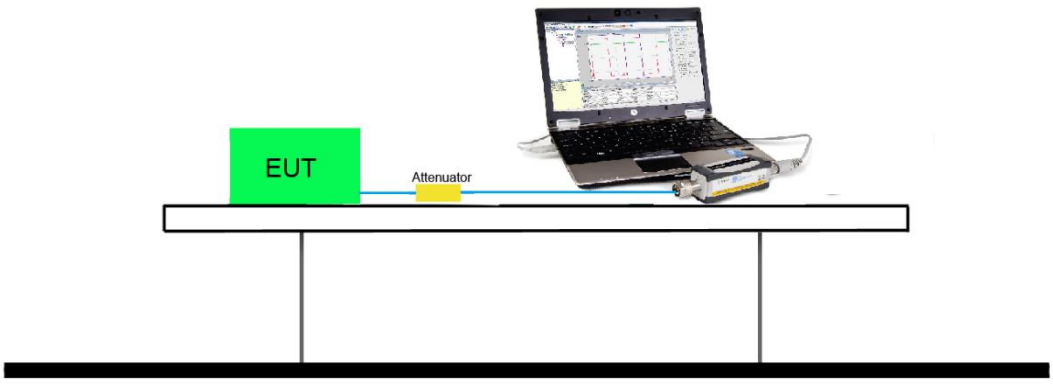
7.4.2. Test Procedure Used

KDB 789033 D02v02r01 - Section II) E) 3) b) Method PM-G

7.4.3. Test Setting

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

7.4.4. Test Setup



7.4.5. Test Result

Product	WLAN / BT Module	Test Engineer	Marvin
Test Site	SR2	Test Date	2023/2/7

Mode	Rate	Ch.	Freq. (MHz)	Ant 1 Average Power (dBm)	Ant 2 Average Power (dBm)	Total Average Power (dBm)	Power Limit (dBm)
11a	6Mbps	36	5180	16.57	18.08	20.40	≤ 24.00
11a	6Mbps	44	5220	17.22	17.39	20.32	≤ 24.00
11a	6Mbps	48	5240	17.91	16.94	20.46	≤ 24.00
11a	6Mbps	149	5745	16.36	17.89	20.20	≤ 30.00
11a	6Mbps	157	5785	16.76	17.73	20.28	≤ 30.00
11a	6Mbps	165	5825	17.28	17.13	20.22	≤ 30.00
11n-HT20	MCS0	36	5180	16.55	16.08	19.33	≤ 24.00
11n-HT20	MCS0	44	5220	16.27	15.70	19.00	≤ 24.00
11n-HT20	MCS0	48	5240	15.82	16.87	19.39	≤ 24.00
11n-HT20	MCS0	149	5745	16.02	17.00	19.55	≤ 30.00
11n-HT20	MCS0	157	5785	16.05	16.47	19.28	≤ 30.00
11n-HT20	MCS0	165	5825	16.15	16.13	19.15	≤ 30.00
11n-HT40	MCS0	38	5190	16.16	16.56	19.37	≤ 24.00
11n-HT40	MCS0	46	5230	16.13	16.74	19.46	≤ 24.00
11n-HT40	MCS0	151	5755	16.16	16.71	19.45	≤ 30.00
11n-HT40	MCS0	159	5795	16.18	16.89	19.56	≤ 30.00
11ac-VHT20	MCS0	36	5180	14.88	15.48	18.20	≤ 24.00
11ac-VHT20	MCS0	44	5220	15.02	15.73	18.40	≤ 24.00
11ac-VHT20	MCS0	48	5240	14.69	15.65	18.21	≤ 24.00
11ac-VHT20	MCS0	149	5745	14.84	15.92	18.42	≤ 30.00
11ac-VHT20	MCS0	157	5785	14.98	15.73	18.38	≤ 30.00
11ac-VHT20	MCS0	165	5825	15.61	14.99	18.32	≤ 30.00
11ac-VHT40	MCS0	38	5190	15.51	15.55	18.54	≤ 24.00
11ac-VHT40	MCS0	46	5230	14.61	15.50	18.09	≤ 24.00
11ac-VHT40	MCS0	151	5755	15.35	15.33	18.35	≤ 30.00
11ac-VHT40	MCS0	159	5795	14.90	15.44	18.19	≤ 30.00
11ac-VHT80	MCS0	42	5210	15.23	15.53	18.39	≤ 24.00
11ac-VHT80	MCS0	155	5775	14.38	15.97	18.26	≤ 30.00

Note: The Total Average Power (dBm) = $10*\log\{10^{(\text{Ant 1 Average Power }/10)} + 10^{(\text{Ant 2 Average Power }/10)}\}$.

7.5. Power Spectral Density Measurement

7.5.1. Test Limit

For client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

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

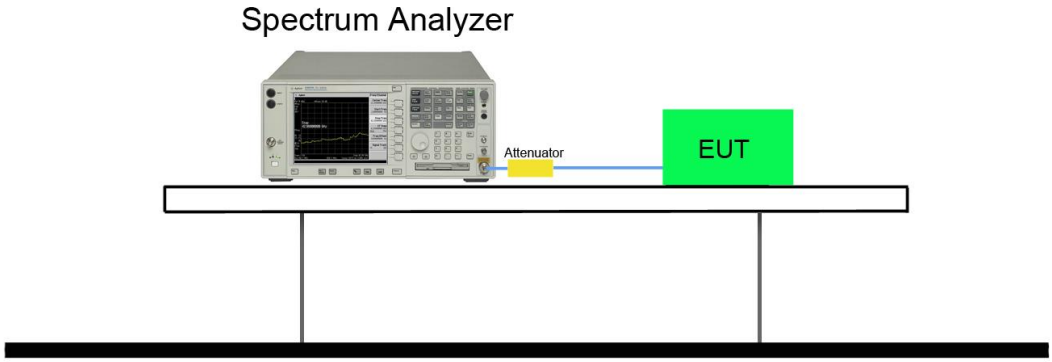
7.5.2. Test Procedure Used

KDB 789033 D02v02r01 – Section II) F

7.5.3. Test Setting

1. Analyzer was set to the center frequency of the UNII channel under investigation
2. Span was set to encompass the entire 26dB EBW of the signal.
3. RBW = 1MHz, if measurement bandwidth of Maximum PSD is specified in 500 kHz,
4. RBW = 100 kHz
5. VBW = 3MHz
6. Number of sweep points ≥ 2 × (span / RBW)
7. Detector = power averaging (Average)
8. Sweep time = auto
9. Trigger = free run
10. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
11. 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 (because the measurement represents an average over both the on and off times of the transmission). For example, add 10*log(1/0.25) = 6 dB if the duty cycle is 25 percent.

7.5.4. Test Setup



7.5.5. Test Result

Product	WLAN / BT Module	Test Engineer	Peter
Test Site	SR2	Test Date	2023/2/17
Test Mode	For FCC UNII-1 (5150-5250MHz)		

Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	Ant 1 PSD (dBm/MHz)	Ant 2 PSD (dBm/MHz)	Duty Cycle (%)	Total PSD (dBm/ MHz)	PSD Limit (dBm/ MHz)	Result
11a	6Mbps	36	5180	4.832	5.293	92.49	8.418	≤ 10.41	Pass
11a	6Mbps	44	5220	4.320	4.873	92.49	7.955	≤ 10.41	Pass
11a	6Mbps	48	5240	4.671	5.408	92.49	8.404	≤ 10.41	Pass
11n-HT20	MCS0	36	5180	3.462	3.821	90.82	7.074	≤ 10.41	Pass
11n-HT20	MCS0	44	5220	3.058	4.375	90.82	7.195	≤ 10.41	Pass
11n-HT20	MCS0	48	5240	3.970	4.596	90.82	7.723	≤ 10.41	Pass
11n-HT40	MCS0	38	5190	0.386	0.996	83.30	4.506	≤ 10.41	Pass
11n-HT40	MCS0	46	5230	0.388	1.565	83.30	4.820	≤ 10.41	Pass
11ac-HT20	MCS0	36	5180	1.851	2.841	89.75	5.854	≤ 10.41	Pass
11ac-HT20	MCS0	44	5220	2.517	2.888	89.75	6.186	≤ 10.41	Pass
11ac-HT20	MCS0	48	5240	2.394	3.258	89.75	6.327	≤ 10.41	Pass
11ac-HT40	MCS0	38	5190	-0.755	0.045	81.10	3.583	≤ 10.41	Pass
11ac-HT40	MCS0	46	5230	-1.276	-0.257	81.10	3.183	≤ 10.41	Pass
11ac-VHT80	MCS0	42	5210	-3.744	-3.763	74.88	0.513	≤ 10.41	Pass

Note 1: When EUT duty cycle < 98%,

the total PSD (dBm/MHz) = 10*log {10(Ant 0 PSD/10) + 10(Ant 1 PSD/10) + 10(Ant 2 PSD/10)} + 10*log (1/Duty Cycle)(dBm/MHz).

Note 2: PSD Limit (dBm/MHz) = 11 - (6.59 - 6) = 10.41dBm/MHz.

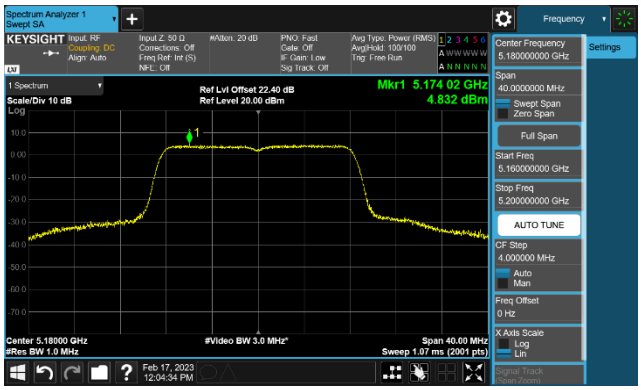
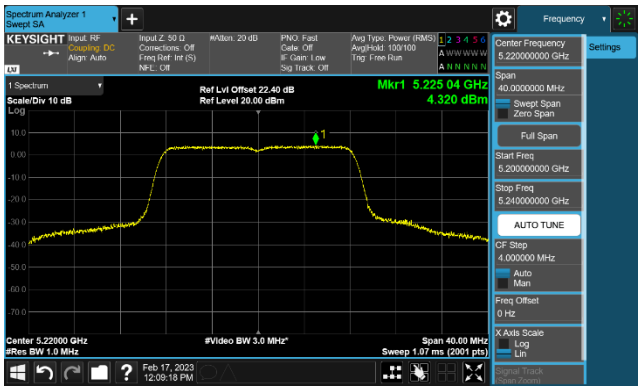
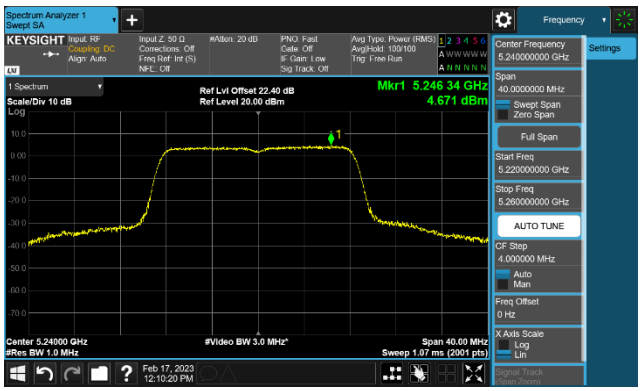
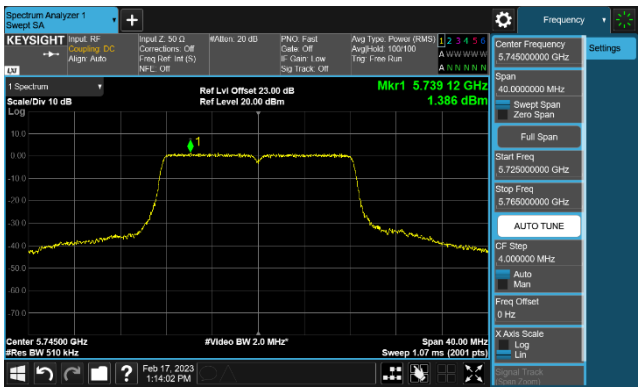
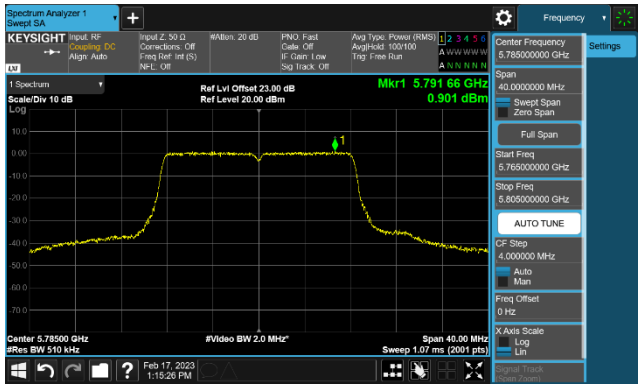
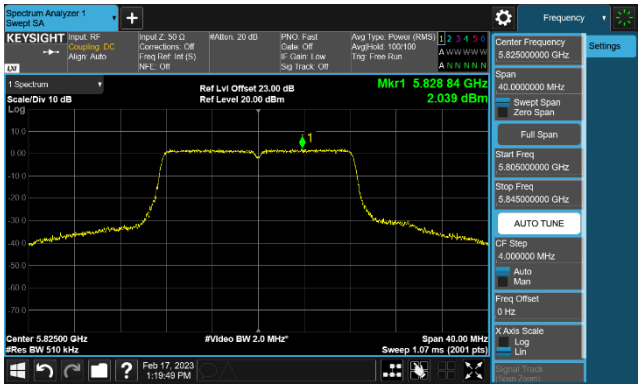
Product	WLAN / BT Module	Test Engineer	Peter
Test Site	SR2	Test Date	2023/2/17
Test Mode	For FCC UNII-3 (5725-5850MHz)		

Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	Ant 1 PSD (dBm/ 510kHz)	Ant 2 PSD (dBm/ 510kHz)	Duty Cycle (%)	Total PSD (dBm/ 510kHz)	Limit (dBm/ 500kHz)	Result
11a	6Mbps	149	5745	1.386	1.738	92.49%	4.915	≤ 27.70	Pass
11a	6Mbps	157	5785	0.901	2.140	92.49%	4.914	≤ 27.70	Pass
11a	6Mbps	165	5825	2.039	1.921	92.49%	5.330	≤ 27.70	Pass
11n-HT20	MCS8	149	5745	0.260	0.529	90.82%	3.825	≤ 27.70	Pass
11n-HT20	MCS8	157	5785	0.087	0.406	90.82%	3.678	≤ 27.70	Pass
11n-HT20	MCS8	165	5825	0.546	1.051	90.82%	4.234	≤ 27.70	Pass
11n-HT40	MCS8	151	5755	-2.372	-1.405	83.30%	1.942	≤ 27.70	Pass
11n-HT40	MCS8	159	5795	-2.144	-1.639	83.30%	1.920	≤ 27.70	Pass
11ac-HT20	MCS0	149	5745	-0.295	-0.376	89.75%	3.145	≤ 27.70	Pass
11ac-HT20	MCS0	157	5785	-1.045	0.338	89.75%	3.181	≤ 27.70	Pass
11ac-HT20	MCS0	165	5825	0.193	-0.056	89.75%	3.550	≤ 27.70	Pass
11ac-HT40	MCS0	151	5755	-3.412	-2.726	81.10%	0.865	≤ 27.70	Pass
11ac-HT40	MCS0	159	5795	-4.073	-2.345	81.10%	0.796	≤ 27.70	Pass
11ac-VHT80	MCS0	155	5775	-6.944	-6.355	74.88%	-2.373	≤ 27.70	Pass

Note 1: When EUT duty cycle < 98%,

the total PSD (dBm/510kHz) = 10*log {10(Ant 0 PSD/10) + 10(Ant 1 PSD/10) + 10(Ant 2 PSD/10)} + 10*log (1/Duty Cycle)(dBm/510kHz).

Note 2: PSD Limit (dBm/500kHz) = 30 - (8.30 - 6) = 27.70dBm/500kHz.

Ant 1	
802.11 a CH36 (5180MHz)	**802.11 a CH44 (5220MHz)**
	
802.11 a CH48 (5240MHz)	**802.11 a CH149 (5745MHz)**
	
802.11 a CH157 (5785MHz)	**802.11 a CH165 (5825MHz)**
	

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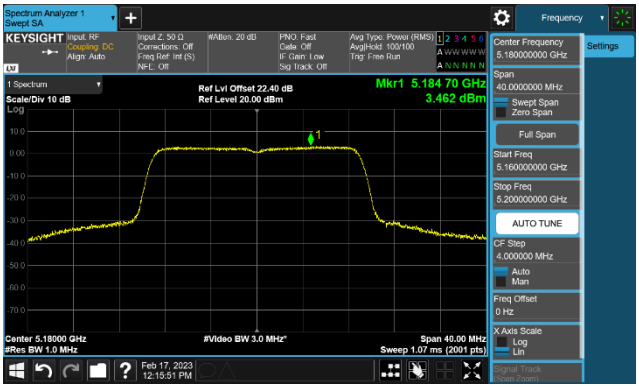	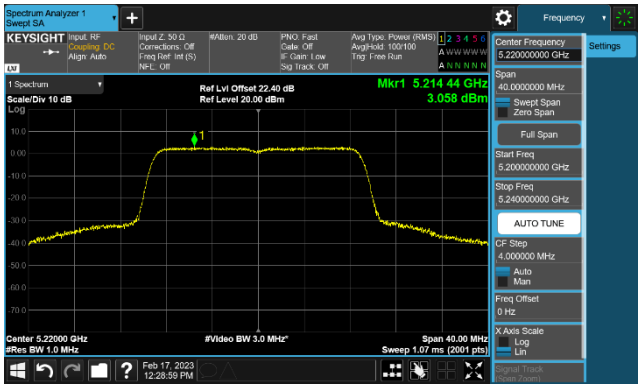
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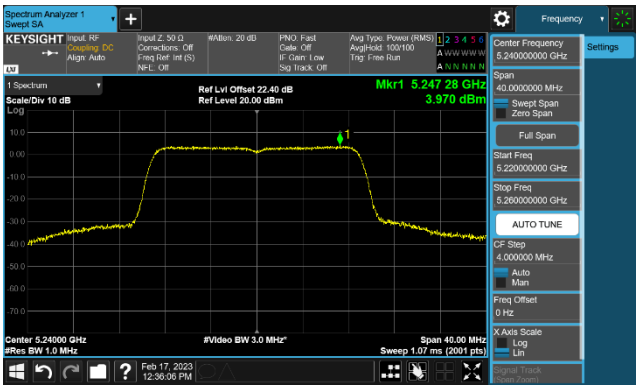	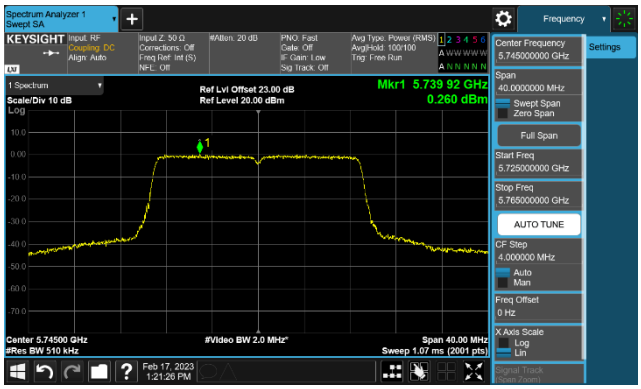
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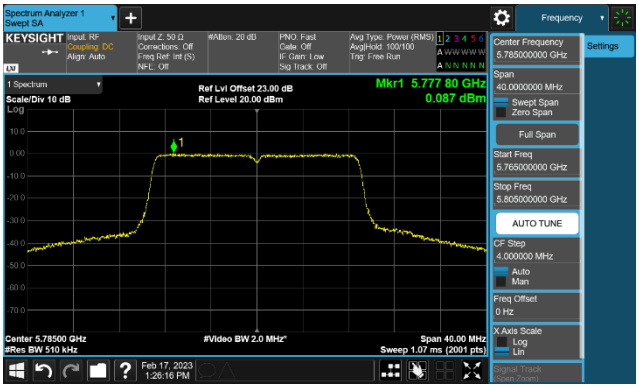
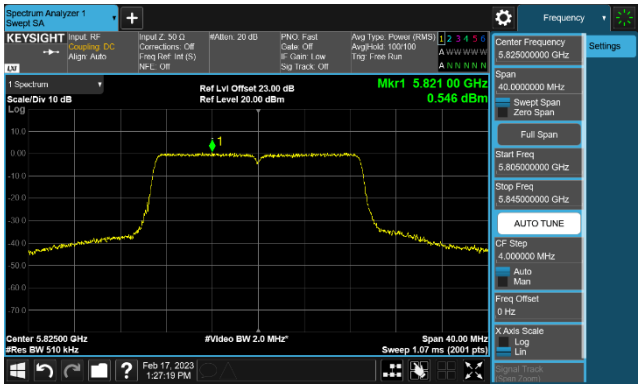
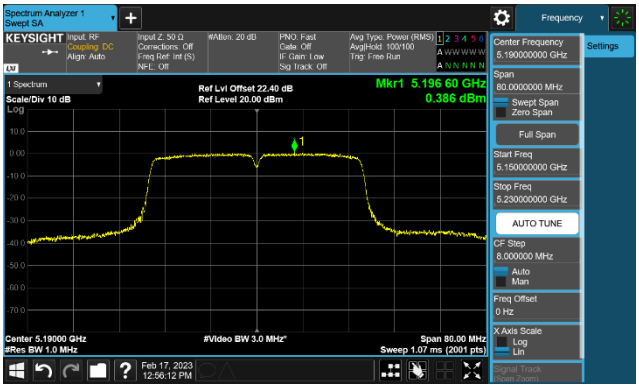
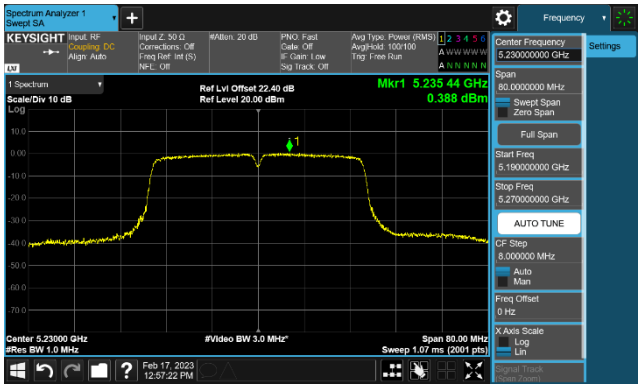
	

802.11 n-HT40 CH38 (5190MHz)	802.11 n-HT40 CH46 (5230MHz)
	
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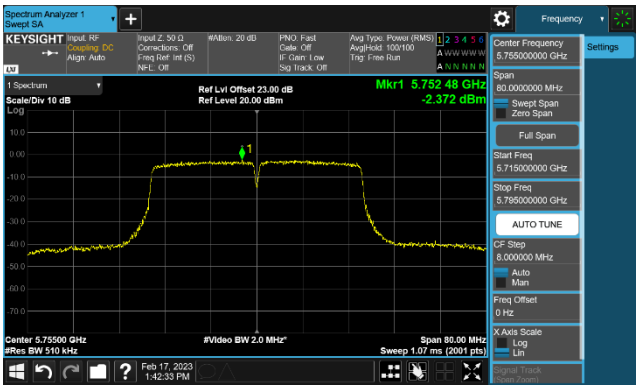	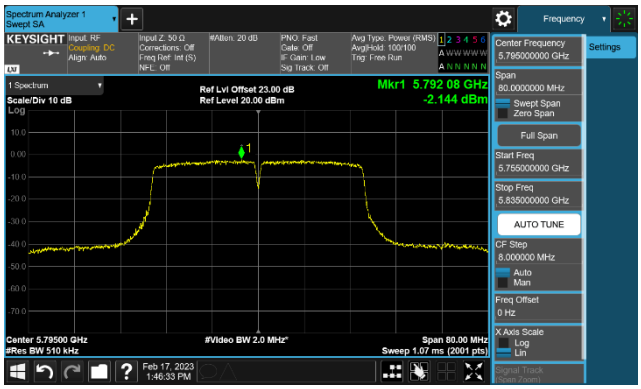
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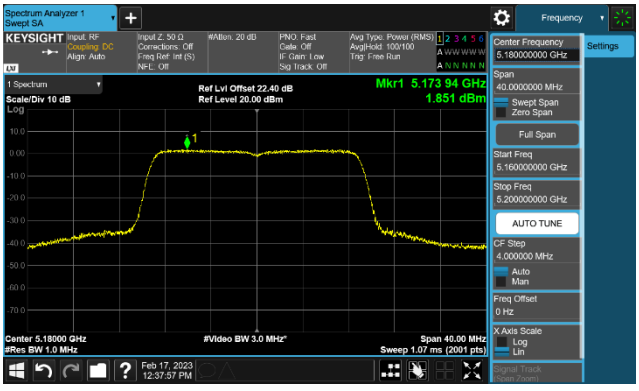	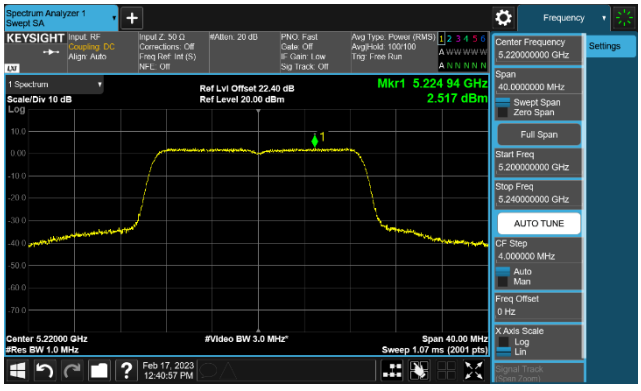

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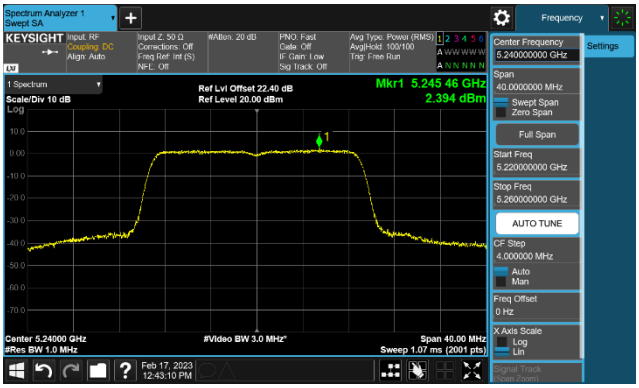	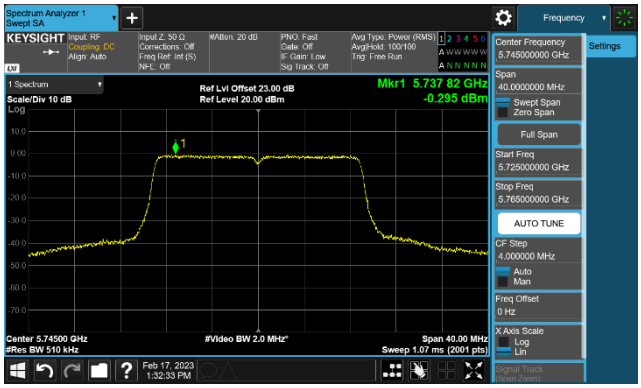
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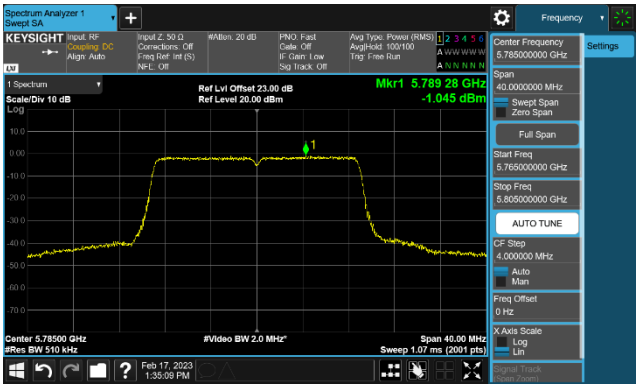
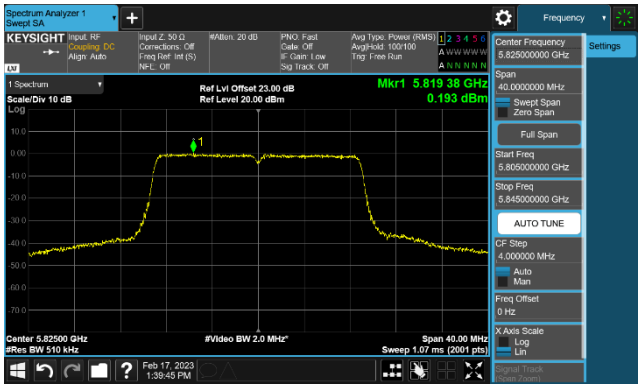
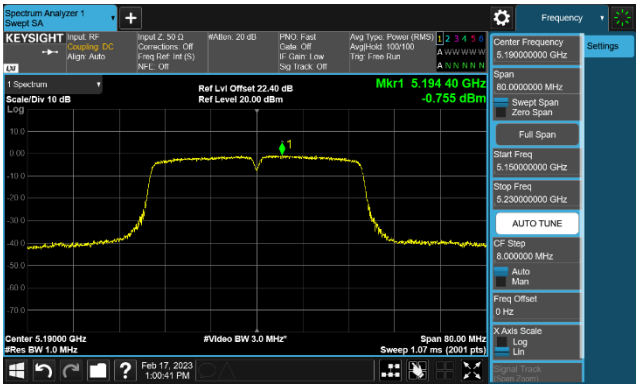
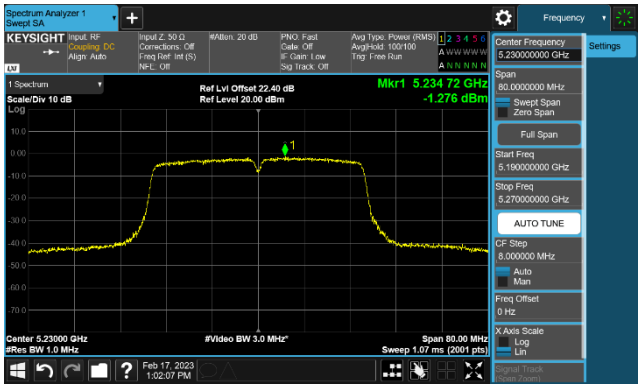
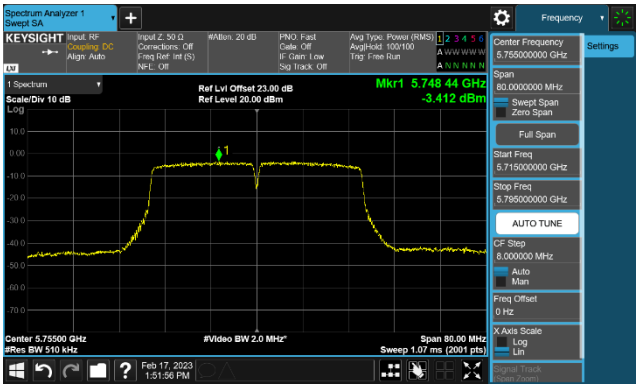
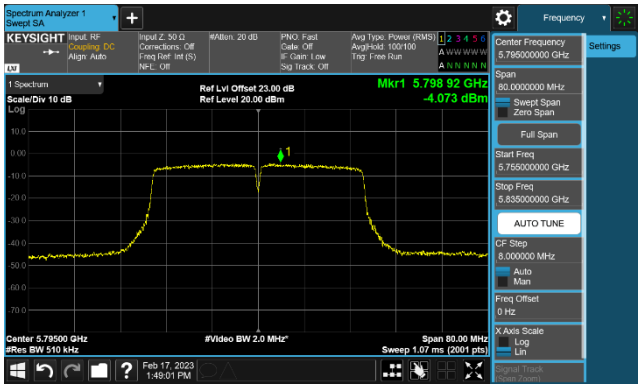
	
802.11 n-HT40 CH38 (5190MHz)	**802.11 n-HT40 CH46 (5230MHz)**
	

802.11 n-HT40 CH151 (5755MHz)	802.11 n-HT40 CH159 (5795MHz)
	
802.11 ac-VHT80 CH42 (5210MHz)	**802.11 ac-VHT80 CH155 (5775MHz)**