TEST REPORT

FCC UNII Test for TFJLEENN5E3
Certification

APPLICANT
LG Electronics Inc.

REPORT NO.
HCT-RF-2503-FC048-R1

DATE OF ISSUE
April 10, 2025

Tested by
Jeong Ho Kim

Technical Manager
Jong Seok Lee

Accredited by KOLAS, Republic of KOREA

HCT CO., LTD.
BongJai Huh / CEO

HCT CO., LTD. 2-6, 73, 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea Tel. +82 31 645 6300 Fax. +82 31 645 6401

HCT CO.,LTD.
2-6, 73, 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea
Tel. +82 31 645 6300 Fax. +82 31 645 6401

TEST REPORT

REPORT NO.
HCT-RF-2503-FC048-R1

DATE OF ISSUE
April 10, 2025

Applicant	**LG Electronics Inc.** 128, Yeoui-daero, Yeongdeungpo-gu, Seoul, Republic of Korea
Product Name Model Name	Telematics TFJLEENN5E3
FCC ID	BEJTFJLEENN5E3
Date of Test	January 24, 2025 ~ March 05, 2025
FCC Classification	Unlicensed National Information Infrastructure(NII)
Test Standard Used	FCC Rule Part(s): Part 15.407
Test Results	PASS
Location of Test	■ Permanent Testing Lab ☐ On Site Testing Lab (Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea)

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	March 11, 2025	Initial Release
1	April 10, 2025	Revised the Product Name.

Notice

Content
Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance. The laboratory is not accredited for the test results marked *. Information provided by the applicant is marked **. Test results provided by external providers are marked ***. The results shown in this test report only apply to the sample(s), as received, provided by the applicant, unless otherwise stated. The test results have only been applied with the test methods required by the standard(s). When confirmation of authenticity of this test report is required, please contact www.hct.co.kr This test report provides test result(s) under the scope accredited by the Korea Laboratory Accreditation Scheme (KOLAS), which signed the ILAC-MRA. (KOLAS (KS Q ISO/IEC 17025) Accreditation No. KT197) Data referencing : UNII Report (FCC ID: BEJTVJLPENN5E2, Report No. HCT-RF-2503-FC045)

CONTENTS

1. GENERAL INFORMATION

EUT DESCRIPTION

Model	TFJLEENN5E3	
Additional Model	-	
EUT Type	Telematics	
Power Supply	DC 12.0 V	
Modulation Type	OFDM : 802.11a, 802.11n, 802.11ac	
Frequency Range (MHz)	U-NII-1	20 MHz BW : 5180 - 5240 40 MHz BW : 5190 - 5230 80 MHz BW : 5210
	U-NII-3	20 MHz BW : 5745 - 5825 40 MHz BW : 5755 - 5795 80 MHz BW : 5775
Straddle channel	Supported	
TDWR Band	Supported	
Dynamic Frequency Selection	Slave without radar detection	
Antenna Specification	Type: PCB Antenna UNII1 Ant Gain: 6.38 dBi UNII3 Ant Gain: 4.42 dBi	
Serial number	Conducted : 501VIXV900164 Radiated : 501VIXV900166	

This device supports simultaneous transmission operation.

Simultaneous transmission Scenario	2.4 GHz WiFi	5 GHz WiFi	WWAN
2.4 GHz WiFi + WWAN	on	-	on
5 GHz WiFi + WWAN	-	on	on

2. MAXIMUM OUTPUT POWER

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

Band	Mode	Output power	
		(dBm)	(W)
UNII1	802.11a	7.16	0.005
	802.11n (HT20)	6.12	0.004
	802.11n (HT40)	4.78	0.003
	802.11ac (VHT20)	6.44	0.004
	802.11ac (VHT40)	5.66	0.004
	802.11ac (VHT80)	4.90	0.003
UNII3	802.11a	7.31	0.005
	802.11n (HT20)	5.92	0.004
	802.11n (HT40)	5.08	0.003
	802.11ac (VHT20)	6.62	0.005
	802.11ac (VHT40)	5.75	0.004
	802.11ac (VHT80)	5.46	0.004

3. TEST METHODOLOGY

The measurement procedure described in FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01 dated December 14, 2017 entitled “Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part15, Subpart E” and ANSI C63.10(Version : 2013) ‘the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices’ were used in the measurement.

EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.407 under the FCC Rules Part 15 Subpart E.

GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and average Measurement Typeor modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1 GHz. Above 1 GHz with 1.5 m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 6.6.5 of ANSI C63.10. (Version: 2013)

DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying

in continuous transmitting and receiving mode is programmed.

4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment's, which is traceable to recognized national standards.
Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.
Detailed description of test facility was submitted to the Commission and accepted dated March 11, 2024 (Registration Number: KR0032).

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak Measurement Typeors are used to perform radiated measurements.
Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

6. ANTENNA REQUIREMENTS

According to FCC 47 CFR § 15.203, § 15.407:

"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."

(1) The antennas of this E.U.T are permanently attached.

(2) The E.U.T Complies with the requirement of § 15.203, § 15.407

7. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence.

The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

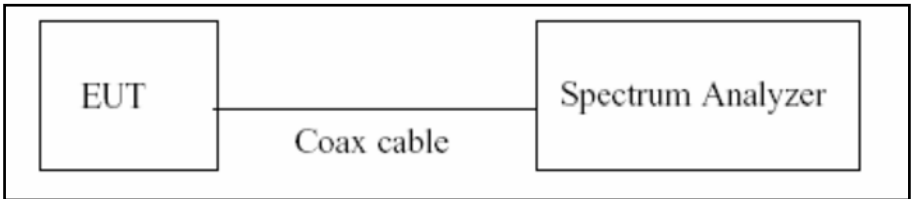
Parameter	Expanded Uncertainty (±kHz)
X dB, 99% Bandwidth	95 (Confidence level about 95 %, k=2)
Frequency stability	28 (Confidence level about 95 %, k=2)

Parameter	Expanded Uncertainty (±dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.98 (Confidence level about 95 %, k=2)
Conducted Output Power(Power Meter)	0.54 (Confidence level about 95 %, k=2)
Conducted Output Power(Signal Analyzer)	0.68 (Confidence level about 95 %, k=2)
Power Spectral Density	1.03 (Confidence level about 95 %, k=2)
Radiated Disturbance (9 kHz ~ 30 MHz)	4.36 (Confidence level about 95 %, k=2)
Radiated Disturbance (30 MHz ~ 1 GHz)	5.70 (Confidence level about 95 %, k=2)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.52 (Confidence level about 95 %, k=2)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.66 (Confidence level about 95 %, k=2)
Radiated Disturbance (Above 40 GHz)	5.58 (Confidence level about 95 %, k=2)

8. DESCRIPTION OF TESTS

8.1. Duty Cycle

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

We tested according to Procedure B.2 in KDB 789033 D02 v02r01.

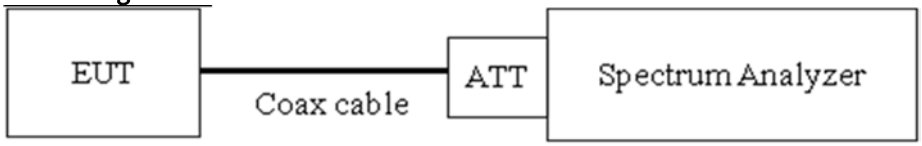
1. RBW = 8 MHz (the largest availble value)
2. VBW = 8 MHz (≥ RBW)
3. SPAN = 0 Hz
4. Measurement Typeor = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on}/ T_{total} and Duty Cycle Factor = 10log(1/Duty Cycle)

8.2. 6 dB Bandwidth & 26 dB Bandwidth

Limit

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

Test Configuration



Test Procedure(26 dB Bandwidth)

The transmitter output is connected to the Spectrum Analyzer.
We tested according to Procedure C.1 in KDB 789033 D02 v02r01.

1. RBW = approximately 1 % of the emission bandwidth
2. VBW > RBW
3. Measurement Type = Peak
4. Trace mode = max hold
5. Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.

Test Procedure (6 dB Bandwidth)

The transmitter output is connected to the Spectrum Analyzer.
We tested according to Procedure C.2 in KDB 789033 D02 v02r01.

1. RBW = 100 kHz
2. VBW ≥ 3 x RBW
3. Measurement Type = Peak
4. Trace mode = max hold
5. Allow the trace to stabilize
6. 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 lever measured in the fundamental emission.

Note:

1. We tested X dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer.
2. DFS test channels should be defined. So, We performed the OBW test to prove that no part of the fundamental emissions of any channels belong to UNII1 and UNII3 band for DFS.
3. The 99 % Bandwidth is used to determine the conducted power limits.

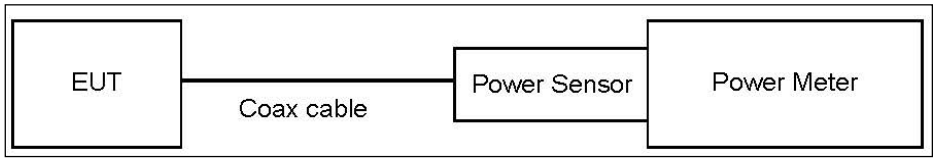
8.3. Output Power Measurement

Limit

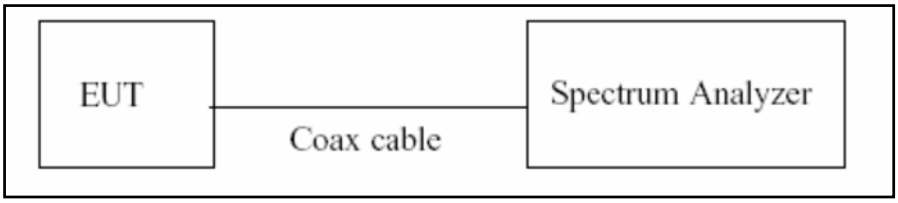
Band	Limit
UNII 1	- Master : Not exceed 1 W(=30 dBm) - Slave : Not exceed 250 mW(=23.98 dBm)
UNII 3	Not exceed 1 W(=30 dBm)

Test Configuration

Power Meter



Spectrum Analyzer(Only Straddle Channel)



Test Procedure(Power Meter)

We tested according to Procedure E.3.a in KDB 789033 D02 v02r01.

1. Measure the duty cycle.
2. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
3. 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.

Test Procedure (Spectrum Analyzer)

The transmitter output is connected to the Spectrum Analyzer.

We use the spectrum analyzer's integrated band power measurement function.

We tested according to Procedure E.2.d) in KDB 789033 D02 v02r01.

1. Measure the duty cycle.
2. Set span to encompass the 26 dB EBW of the signal.
3. RBW = 1 MHz.
4. VBW ≥ 3 MHz.
5. Number of points in sweep ≥ 2 x span/RBW.
6. Sweep time = auto.
7. Measurement Typeor = RMS.
8. Do not use sweep triggering. Allow the sweep to "free run".
9. Trace average at least 100 traces in power averaging(RMS) mode
10. Integrated bandwidth = OBW
11. Add 10log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

Sample Calculation

Total Power(dBm) = Measured Value(dBm) + ATT loss(dB) + Cable loss(dB) + Duty Cycle Factor(dB)

Note

1. Spectrum Measured Values are not plot data.
   The power results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Actual value of loss for the attenuator and cable combination is below table.

Band	Loss(dB)
UNII 1	13.95
UNII 3	14.18

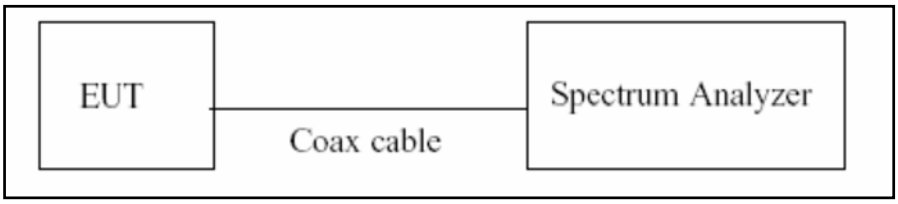
(Actual value of loss for the attenuator and cable combination)

8.4. Power Spectral Density

Limit

Band	Limit
UNII 1	11 dBm/MHz
UNII 3	30 dBm/500 kHz

Test Configuration



Test Procedure

We tested according to Procedure F in KDB 789033 D02 v02r01.

1. Set span to encompass the entire emission bandwidth(EBW) of the signal.
2. RBW = 1 MHz(510 kHz for UNII 3)
   ➔For portion within the NII-3 be used RBW 510kHz
3. VBW ≥ 3 MHz
4. Number of points in sweep ≥ 2 x span/RBW.
5. Sweep time = auto.
6. Measurement Typeor = RMS(i.e., power averaging), if available. Otherwise, use sample Measurement Typeor mode.
7. Do not use sweep triggering. Allow the sweep to “free run”.
8. Trace average at least 100 traces in power averaging(RMS) mode
9. Use the peak search function on the spectrum analyzer to find the peak of the spectrum.
10. If Method SA-2 was used, add 10 log(1/x), where x is the duty cycle, to the peak of the spectrum.

Sample Calculation

Total PSD(dBm) = Measured Value(dBm) + ATT loss(dB) + Cable loss(dB) + Duty Cycle Factor(dB)

Note

1. Spectrum Measured Levels are not plot data.
   The PSD results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Actual value of loss for the attenuator and cable combination is below table.

Band	Loss(dB)
UNII 1	13.95
UNII 3	14.18

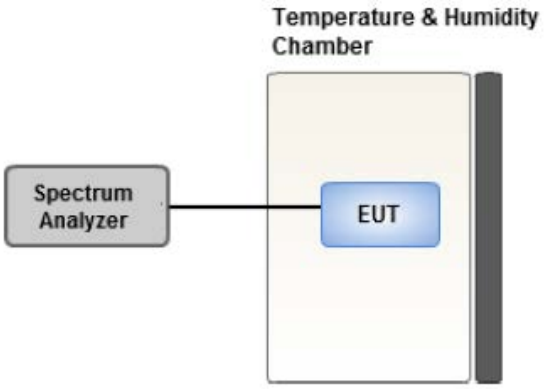
(Actual value of loss for the attenuator and cable combination)

8.5. Frequency Stability

Limit

Maintained within the band

Test Configuration



Test Procedure

1. The EUT was placed inside an environmental chamber as the temperature in the chamber was varied between -30 ℃ and 50 ℃.
2. The temperature was incremented by 10 ℃ intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded.
3. The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battety operating end point which shall be specified by the manufacturer.
4. While maintaining a constant temperature inside the environmental chamber, turn the EUT ON
   and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after
   the EUT is energized. Four measurements in total are made.

8.6. AC Power line Conducted Emissions

Limit

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56[a]	56 to 46[a]
0.50 to 5	56	46
5 to 30	60	50

[a]Decreases with the logarithm of the frequency.

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration

See test photographs attached in Annex A for the actual connections between EUT and support equipment.

Test Procedure

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Measurement Typeors : Quasi Peak and Average Measurement Typeor.

Sample Calculation

Quasi-peak(Final Result) = Measured Value + Correction Factor

8.7. Radiated Test

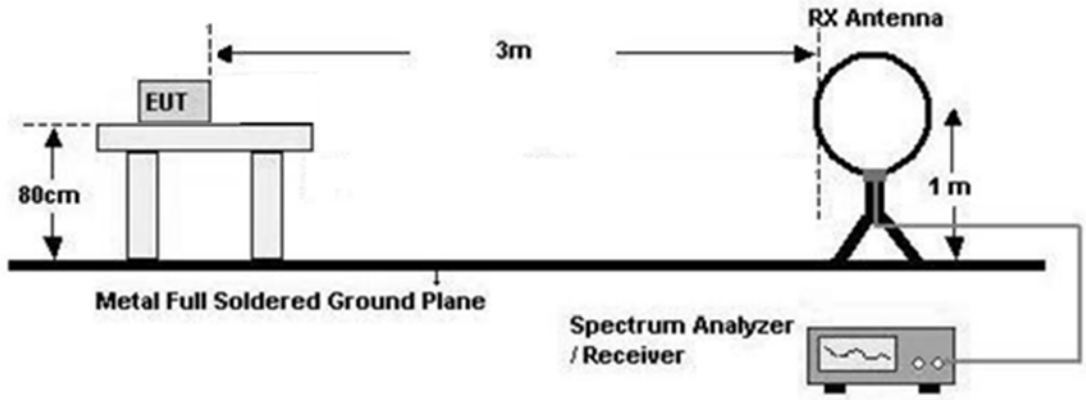
Limit

1. UNII 1: All emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of －27 dBm/MHz.
2. UNII 2A, 2C: All emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of －27 dBm/MHz.
3. UNII 3: All emissions shall be limited to a level of －27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.
4. All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Section 15.209.

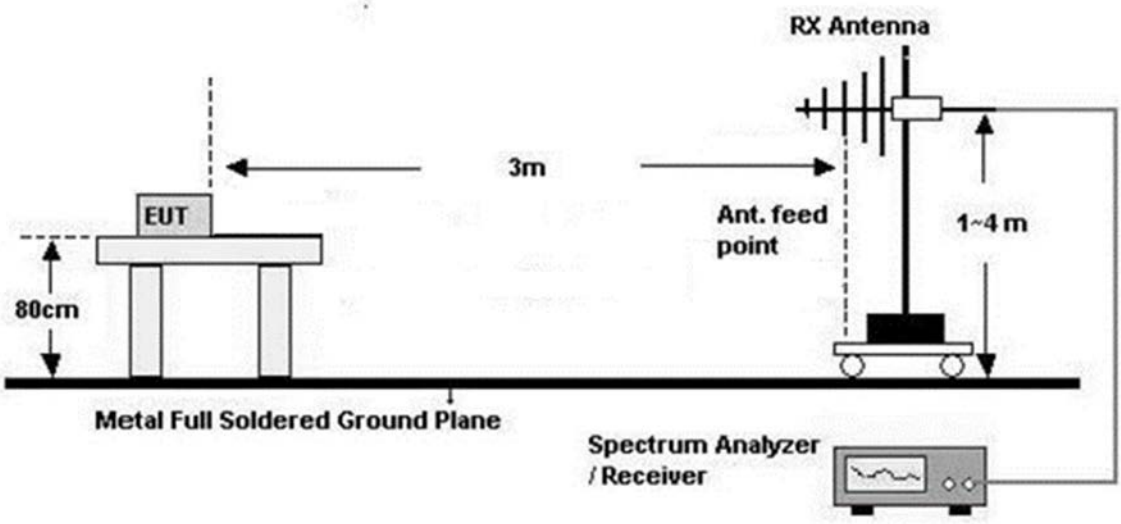
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

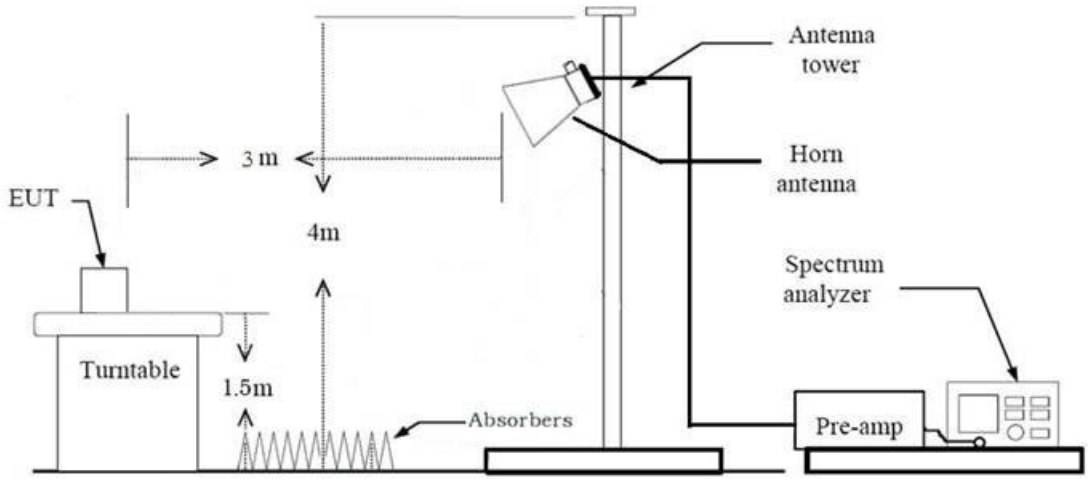
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



Test Procedure of Radiated spurious emissions (Below 30 MHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The loop antenna was placed at a location 3 m from the EUT
3. The EUT is placed on a turntable, which is 0.8m above ground plane.
4. .We have done x, y, z planes in EUT and horizontal and vertical polarization and Parallel to the ground plane in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Distance Correction Factor(0.009 MHz – 0.490 MHz) =40log(3 m/300 m)= - 80 dB
   Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) =40log(3 m/30 m)= - 40 dB
   Measurement Distance : 3 m
8. Spectrum Setting
   - Frequency Range = 9 kHz ~ 30 MHz
   - Detector = Peak
   - Trace = Max Hold
   - RBW = 9 kHz
   - VBW ≥ 3 x RBW
9. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)
10. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

KDB 414788 OFS and Chamber Correlation Justification

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in

the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

Test Procedure of Radiated spurious emissions (Below 1 GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8m above ground plane.
3. The Hybrid antenna was placed at a location 3 m from the EUT, which is varied from 1 m to 4 m to find out the highest emissions.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Spectrum Setting
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 30 MHz – 1 GHz
      - Detector = Peak
      - Trace = Max Hold
      - RBW = 100 kHz
      - VBW ≥ 3 x RBW
   (2) Measurement Type(Quasi-peak):
      - Measured Frequency Range : 30 MHz – 1 GHz
      - Detector = Quasi-Peak
      - RBW = 120 kHz

   ※In general, (1) is used mainly
7. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L)
8. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

Test Procedure of Radiated spurious emissions (Above 1 GHz)

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

7. The unit was tested with its standard battery.
8. Spectrum Setting
   (1) Measurement Type (Peak, G.5 in KDB 789033 v02r01):
   - RBW = 1 MHz
   - VBW ≥ 3 MHz
   - Detector = Peak
   - Sweep Time = auto
   - Trace mode = Max Hold
   - Allow sweeps to continue until the trace stabilizes.
     Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately 1/x, where x is the duty cycle.

   (2) Measurement Type (Average, G.6.d in KDB 789033 v02r01):
   - RBW = 1 MHz
   - VBW(Duty cycle ≥ 98 percent) = VBW ≤ RBW/100(i.e., 10 kHz) but not less than 10 Hz.
   - VBW(Duty cycle is < 98 percent) = VBW ≥ 1/T, where T is the minimum transmission duration.
   - The analyzer is set to linear detector mode.
   - Detector = Peak.
   - Sweep time = auto.
   - Trace mode = Max Hold.
   - Allow Max Hold to run for at least 50 traces if the transmitted signal is continuous or has at least 98 percent duty cycle. For lower duty cycles, increase the minimum number of traces by a factor of 1/x, where x is the duty cycle.
9. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor
10. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency
11. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
12. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F)

Test Procedure of Radiated Restricted Band Edge

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both

horizontal and vertical.

7. The unit was tested with its standard battery.
8. Spectrum Setting

(1) Measurement Type(Peak, G.5 in KDB 789033 v02r01):

- RBW = 1 MHz
- VBW ≥ 3 MHz
- Detector = Peak
- Sweep Time = auto
- Trace mode = Max Hold
- Allow sweeps to continue until the trace stabilizes.
  Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately 1/x, where x is the duty cycle.

(2) Measurement Type(Average, G.6.d in KDB 789033 v02r01):

- RBW = 1 MHz
- VBW(Duty cycle ≥ 98 percent) = VBW ≤ RBW/100(i.e., 10 kHz) but not less than 10 Hz.
- VBW(Duty cycle is < 98 percent) = VBW ≥ 1/T, where T is the minimum transmission duration.
- The analyzer is set to linear detector mode.
- Detector = Peak.
- Sweep time = auto.
- Trace mode = Max Hold.
- Allow Max Hold to run for at least 50 traces if the transmitted signal is continuous or has at least 98 percent duty cycle. For lower duty cycles, increase the minimum number of traces by a factor of 1/x, where x is the duty cycle.

9. Measured Frequency Range :
   - 4 500 MHz ~ 5 150 MHz
   - 5 350 MHz ~ 5 460 MHz
   - 5 460 MHz ~ 5 470 MHz
   - (75 MHz or more below the 5 725 MHz) ~ 5 725 MHz
   - 5 850 MHz ~ (75 MHz or more above the 5 850 MHz)
10. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
11. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F)

The actual setting value of VBW

Mode	Worst Data rate (Mbps)	Duty Cycle	Duty Cycle Factor (dB)	The actual setting value of VBW (Hz)
802.11a	6	0.951	0.218	1 000
802.11n(HT20)	MCS0	0.920	0.362	1 000
802.11n(HT40)	MCS0	0.878	0.564	2 000
802.11ac(VHT20)	MCS0	0.919	0.366	1 000
802.11ac(VHT40)	MCS0	0.908	0.418	2 000
802.11ac(VHT80)	MCS0	0.828	0.820	3 000

8.8. Worst case configuration and mode

Conducted test

1. All datarate of operation were investigated and the worst case datarate results are reported.

Radiated test

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone, Stand alone + External accessories(etc)
   - Worstcase : Stand alone

2 EUT Axis
   - Radiated Spurious Emissions : Y
   - Radiated Restricted Band Edge : Z

3. All datarate of operation were investigated and the worst case datarate results are reported.
   - 802.11a : 6 Mbps
   - 802.11n: MCS 0
   - 802.11ac: MCS 0

4. Radiated Spurious Emission
   - All modulation of operation were investigated and the worst case modulation results are reported.
   - 802.11a : 6 Mbps
   - 802.11n: MCS 0
   - 802.11ac: MCS 0
   - Worst-case : 802.11a : 6 Mbps

5. All position of loop antenna were investigated and the test result is a no critical peak found at all positions.
   - Position: Horizontal, Vertical, Parallel to the ground plane

AC Power line Conducted Emissions

1. We don’t perform powerline conducted emissions test. Because this EUT is used DC

Radiated test(Simultaneous transmission Scenario)

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone
2. EUT Axis
   - Radiated Spurious Emissions : Y
3. All of Simultaneous transmission Scenario were investigated and the worst case configuration results are reported.

Simultaneous transmission Scenario	2.4 GHz WiFi	5 GHz WiFi	WWAN
2.4 GHz WiFi + WWAN	on	-	on
5 GHz WiFi + WWAN	-	on	on

4. The Simultaneous transmission mode test investigated both intermodulation and radiated spurious emissions. And the worst results were reported.
   - Worst result: Radiated spurious emissions
   - Intermodulation: No signals are generated.
   - WWAN: No signals are generated.
   - Radiated spurious emissions: cf. Section 9.6.

9. SUMMARY OF TEST RESULTS & DATA REFERENCING

9.1. Test result

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
26 dB Bandwidth	§ 15.407 (for Power Measurement)	N/A	Conducted	PASS
6 dB Bandwidth	§ 15.407(e)	>500 kHz (5725-5850 MHz)(UNII-3)		PASS
Maximum Conducted Output Power	§ 15.407(a)(1),(3)	< 250 mW(5150-5250 MHz) <1 W (5725-5850 MHz)		PASS
Maximum Power Spectral Density	§ 15.407(a)(1),(3)	<11 dBm/ MHz (5150-5250 MHz) <30 dBm/500 kHz(5725-5850 MHz)		PASS
Frequency Stability	§ 15.407(g) § 2.1055	Maintained within the band		PASS
AC Conducted Emissions 150 kHz-30 MHz	15.207 15.407(b)(8)	<FCC 15.207 limits		N/A (#Note)
Undesirable Emissions	§ 15.407(b) (1),(3) § 15.407(b)(5)(ii),(iii) § 15.35(b)	<-27 dBm/MHz EIRP (UNII1) cf. Section 8.6 (UNII 3)	Radiated	PASS
General Field Strength Limits(Restricted Bands and Radiated Emission Limits)	15.205, 15.407(b)(9),(10)	Emissions in restricted bands must meet the radiated limits detailed in 15.209		PASS

Note: #Not Tested.

1. The decision rule applies ‘simple acceptance’

9.2. Data Referencing

Equipment Class	Rule Part	Test item	Data Referencing	Comments
NII	§ 15.407 (for Power	26 dB Bandwidth	Y	-
	15.407(e)	6 dB Bandwidth	Y	-
	§ 15.407(a)(1),(3)	Maximum Conducted output power	Y	Spot-check
	§ 15.407(a)(1),(3)	Maximum Power Spectral Density	Y	-
	15.207 15.407(b)(8)	AC conducted Emission	N	Not Tested
	§ 15.407(g) § 2.1055	Frequency Stability	Y	-
	§ 15.407(b) (1),(3) § 15.407(b)(5)(ii),(iii) § 15.35(b)	Undesirable Emissions	Y	Spot-check
	15.205, 15.407(b)(9),(10)	General Field Strength (Restricted bands and Radiated	Y	Spot-check

Spot-Check Result

1. Data was leveraged from model TVJLPENN5E2 for the certification of TFJLEENN5E3.
2. Please refer to the [FCC Evaluation] Report.

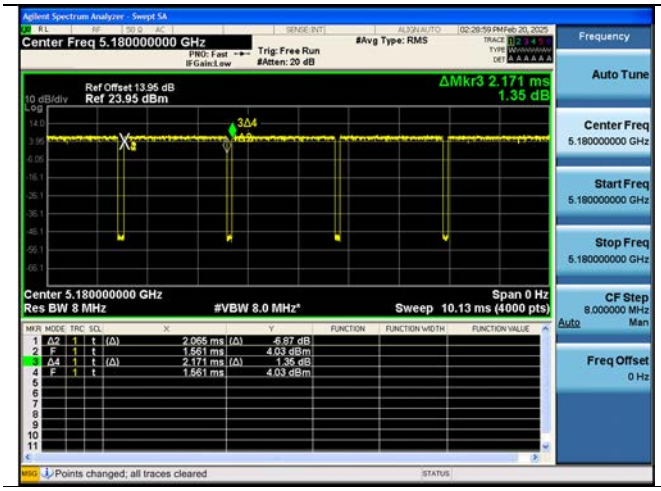
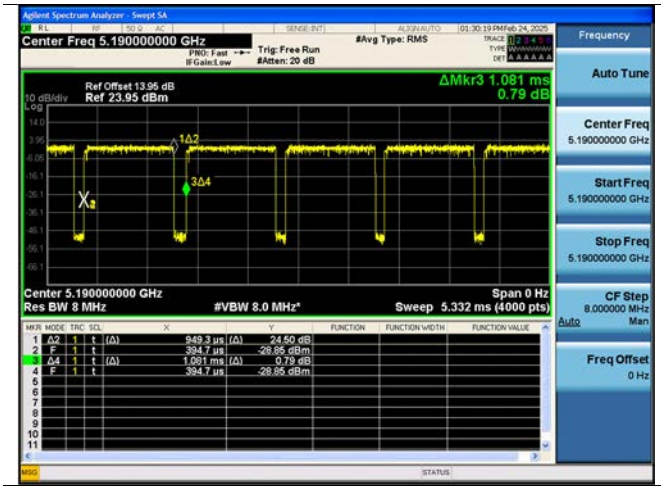
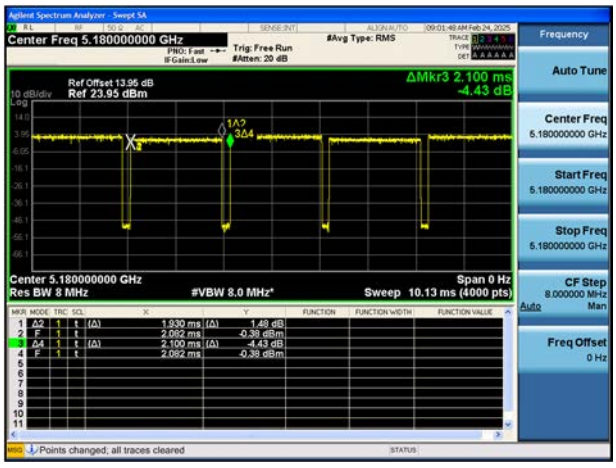
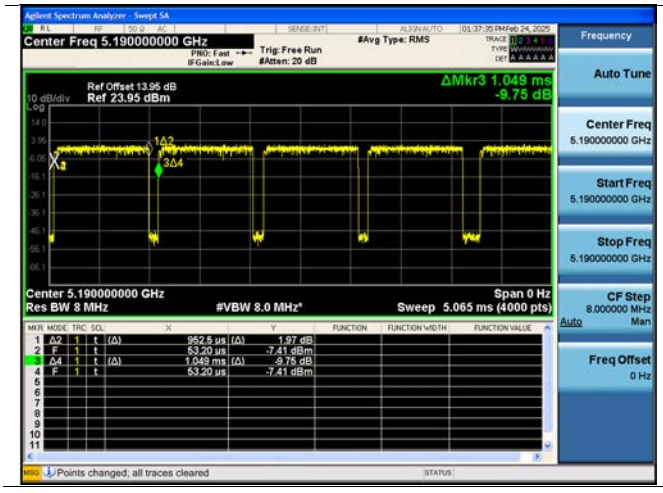
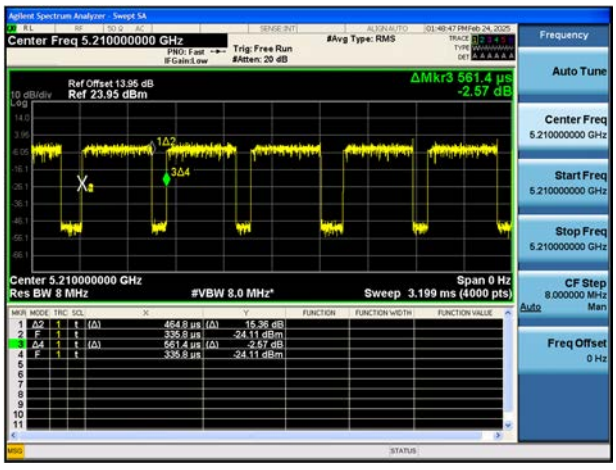
10. TEST RESULT

10.1 DUTY CYCLE

Mode	Data Rate	T_{on} (ms)	T_{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11a	6M	2.065	2.171	0.951	0.218
802.11n(HT20)	MCS0	1.925	2.093	0.920	0.362
802.11n(HT40)	MCS0	0.949	1.081	0.878	0.564
802.11ac(VHT20)	MCS0	1.930	2.100	0.919	0.366
802.11ac(VHT40)	MCS0	0.953	1.049	0.908	0.418
802.11ac(VHT80)	MCS0	0.465	0.561	0.828	0.820

Note:

In order to simplify the report, attached plots were only the lowest data rate.

802.11a	802.11n(HT20)
	
802.11n(HT40)	802.11ac(VHT20)
	
802.11ac(VHT40)	802.11ac(VHT80)
	

10.2 26 dB Bandwidth

Mode : 802.11a				
BAND	Freq. [MHz]	CH.	26 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
UNII1	5180	36	19.58	16.254
	5200	40	18.91	16.247
	5240	48	18.72	16.248
UNII3	5745	149	18.95	16.247
	5785	157	18.93	16.255
	5825	165	18.71	16.261

Mode : 802.11n(HT20)				
BAND	Freq. [MHz]	CH.	26 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
UNII1	5180	36	19.99	17.371
	5200	40	19.96	17.363
	5240	48	19.56	17.358
UNII3	5745	149	19.71	17.406
	5785	157	19.59	17.387
	5825	165	19.82	17.374

Mode : 802.11ac(VHT20)				
BAND	Freq. [MHz]	CH.	26 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
UNII1	5180	36	19.89	17.359
	5200	40	19.27	17.354
	5240	48	19.59	17.366
UNII3	5745	149	19.94	17.389
	5785	157	19.55	17.418
	5825	165	19.56	17.356

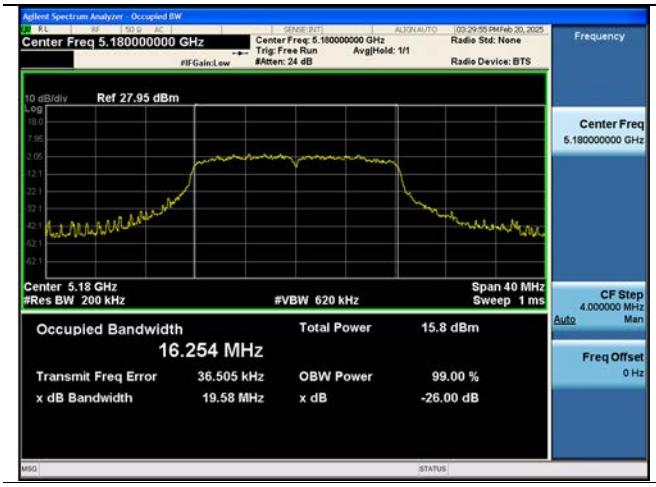
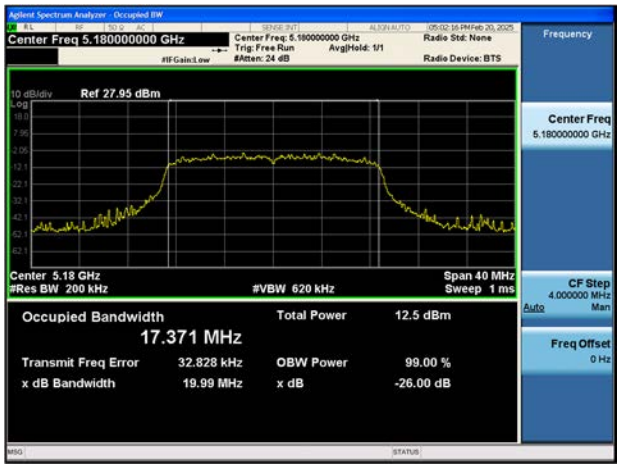
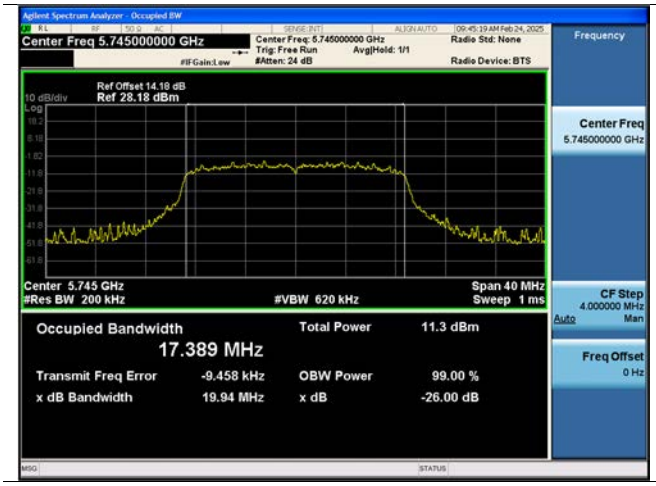
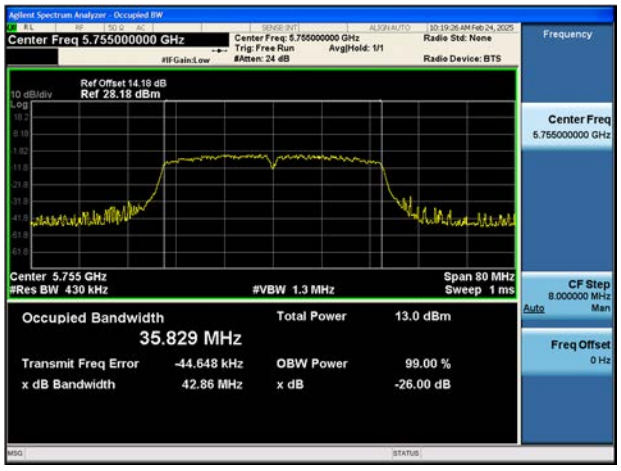
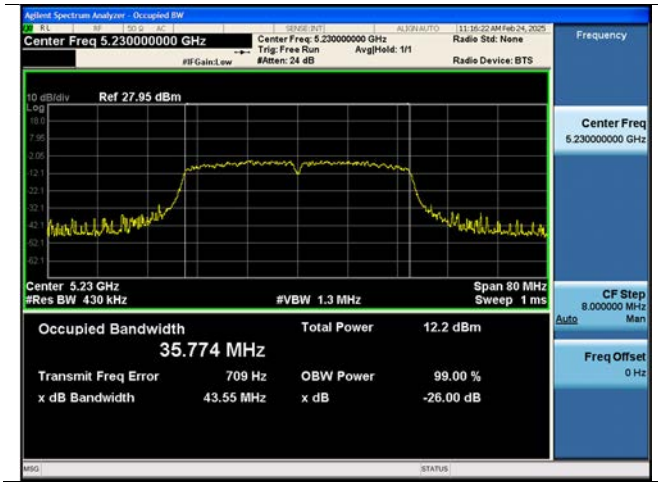
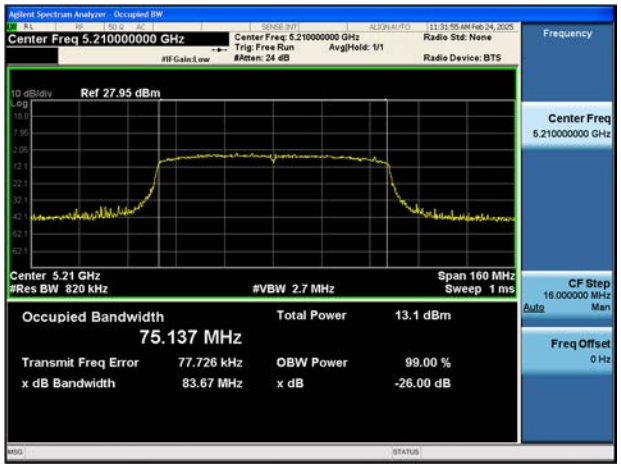
Mode : 802.11n(HT40)				
BAND	Freq. [MHz]	CH.	26 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
UNII1	5190	38	40.51	35.789
	5230	46	40.09	35.788
UNII3	5755	151	42.86	35.829
	5795	159	40.35	35.867

Mode : 802.11ac(VHT40)				
BAND	Freq. [MHz]	CH.	26 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
UNII1	5190	38	40.19	35.768
	5230	46	43.55	35.774
UNII3	5755	151	40.56	35.774
	5795	159	40.89	35.802

Mode : 802.11ac(VHT80)				
BAND	Freq. [MHz]	CH.	26 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
UNII1	5210	42	83.67	75.137
UNII3	5775	155	82.48	75.075

▣ Test Plots

Note:In order to simplify the report, attached plots were only the widest channel per channel bandwidth.

802.11a 26 dB Bandwidth (CH 36)	802.11n(HT20) 26 dB Bandwidth (CH 36)
	
802.11ac(VHT20) 26 dB Bandwidth (CH 149)	**802.11n(HT40) 26 dB Bandwidth (CH 151)**
	
802.11ac(VHT40) 26 dB Bandwidth (CH 46)	**802.11ac(VHT80) 26 dB Bandwidth (CH 42)**
	

10.3 6 dB BANDWIDTH

Mode : 802.11a				
BAND	Freq. [MHz]	CH.	6 dB Bandwidth [MHz]	Limit [MHz]
UNII3	5745	149	15.19	> 0.5
	5785	157	15.19	> 0.5
	5825	165	15.36	> 0.5

Mode : 802.11n(HT20)				
BAND	Freq. [MHz]	CH.	6 dB Bandwidth [MHz]	Limit [MHz]
UNII3	5745	149	15.14	> 0.5
	5785	157	15.45	> 0.5
	5825	165	15.17	> 0.5

Mode : 802.11ac(VHT20)				
BAND	Freq. [MHz]	CH.	6 dB Bandwidth [MHz]	Limit [MHz]
UNII3	5745	149	15.16	> 0.5
	5785	157	15.15	> 0.5
	5825	165	15.11	> 0.5

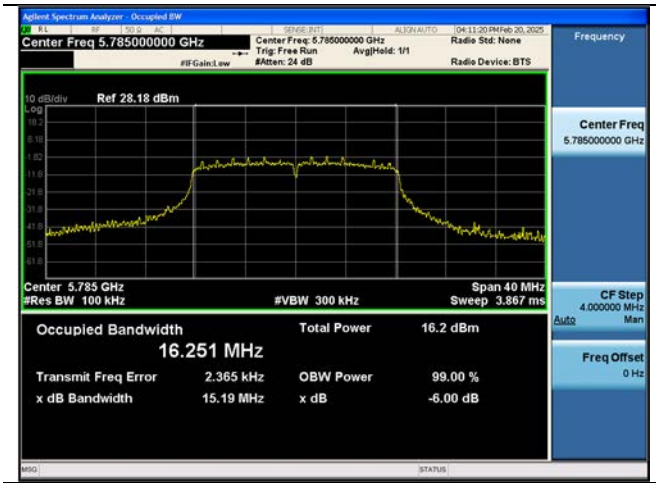
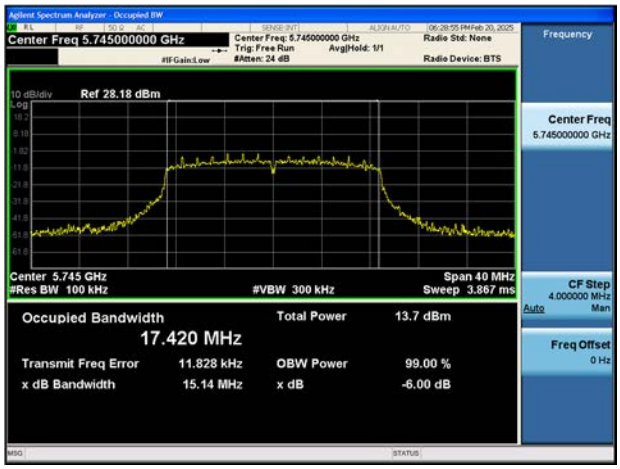
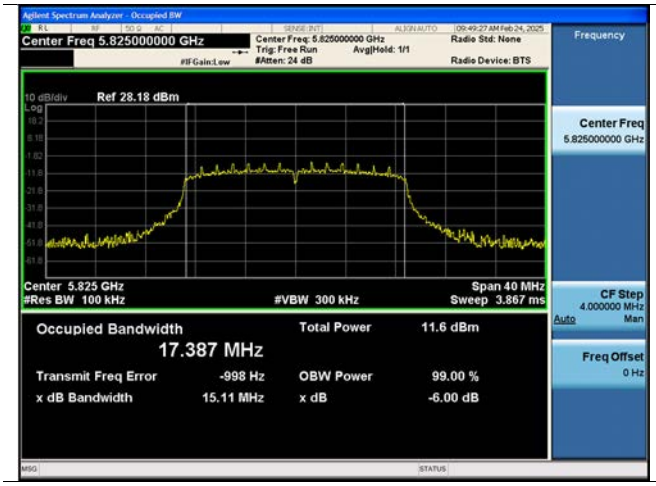
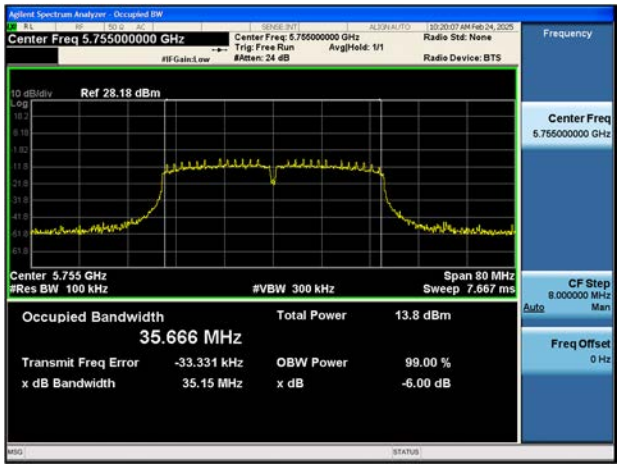
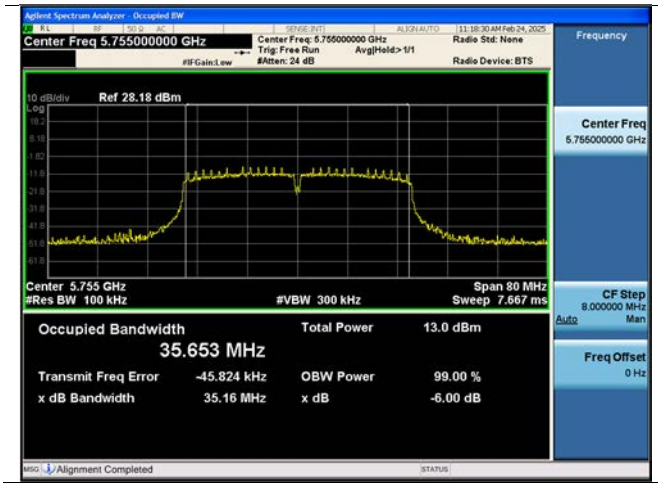
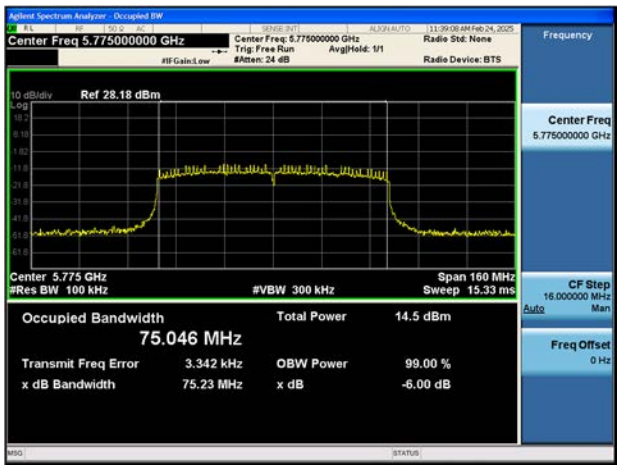
Mode : 802.11n(HT40)				
BAND	Freq. [MHz]	CH.	6 dB Bandwidth [MHz]	Limit [MHz]
UNII3	5755	151	35.15	> 0.5
	5795	159	35.17	> 0.5

Mode : 802.11ac(VHT40)				
BAND	Freq. [MHz]	CH.	6 dB Bandwidth [MHz]	Limit [MHz]
UNII3	5755	151	35.16	> 0.5
	5795	159	35.17	> 0.5

Mode : 802.11ac(VHT80)				
BAND	Freq. [MHz]	CH.	6 dB Bandwidth [MHz]	Limit [MHz]
UNII3	5775	155	75.23	> 0.5

▣ Test Plots

Note: In order to simplify the report, attached plots were only the narrowest channel.

802.11a 6 dB Bandwidth (CH 157)	802.11n(HT20) 6 dB Bandwidth (CH 149)
	
802.11ac(VHT20) 6 dB Bandwidth (CH 165)	**802.11n(HT40) 6 dB Bandwidth (CH 151)**
	
802.11ac(VHT40) 6 dB Bandwidth (CH 151)	**802.11ac(VHT80) 6 dB Bandwidth (CH 155)**
	

10.4 OUTPUT POWER MEASUREMENT

 # Limit

(UNII 1) : 23.60 dBm (# Antenna Gain 6.38 dB ➔ Test limt : 23.98 - 0.38 = 23.60 dBm)

Total Power [dBm] = Measured Power [dBm] + Duty Cycle Factor [dB]

Band	Freq. [MHz]	CH.	Worstcase Datarate	Mode (802.11)	Measured Power [dBm]	Duty cycle Fcator [dB]	Total Power [dBm]	Limit [dBm]
UNII1	5180	36	6M	a	6.90	0.22	7.12	23.60
	5200	40	6M	a	6.91	0.22	7.13	23.60
	5240	48	6M	a	6.94	0.22	7.16	23.60
UNII3	5745	149	6M	a	6.83	0.22	7.05	30.00
	5785	157	6M	a	7.09	0.22	7.31	30.00
	5825	165	6M	a	6.87	0.22	7.09	30.00

Band	Freq. [MHz]	CH.	Worstcase Datarate	Mode (802.11)	Measured Power [dBm]	Duty cycle Fcator [dB]	Total Power [dBm]	Limit [dBm]
UNII1	5180	36	MCS0	n20	5.72	0.36	6.08	23.60
	5200	40	MCS0	n20	5.71	0.36	6.07	23.60
	5240	48	MCS0	n20	5.75	0.36	6.12	23.60
UNII3	5745	149	MCS0	n20	5.52	0.36	5.88	30.00
	5785	157	MCS0	n20	5.56	0.36	5.92	30.00
	5825	165	MCS0	n20	5.19	0.36	5.55	30.00

Band	Freq. [MHz]	CH.	Worstcase Datarate	Mode (802.11)	Measured Power [dBm]	Duty cycle Fcator [dB]	Total Power [dBm]	Limit [dBm]
UNII1	5180	36	MCS0	ac20	4.42	0.37	4.78	23.60
	5200	40	MCS0	ac20	4.36	0.37	4.73	23.60
	5240	48	MCS0	ac20	4.36	0.37	4.72	23.60
UNII3	5745	149	MCS0	ac20	4.30	0.37	4.67	30.00
	5785	157	MCS0	ac20	4.71	0.37	5.08	30.00
	5825	165	MCS0	ac20	4.01	0.37	4.38	30.00

Band	Freq. [MHz]	CH.	Worstcase Datarate	Mode (802.11)	Measured Power [dBm]	Duty cycle Fcator [dB]	Total Power [dBm]	Limit [dBm]
UNII1	5190	38	MCS0	n40	5.87	0.56	6.43	23.60
	5230	46	MCS0	n40	5.88	0.56	6.44	23.60
UNII3	5755	151	MCS0	n40	5.88	0.56	6.44	30.00
	5795	159	MCS0	n40	6.06	0.56	6.62	30.00

Band	Freq. [MHz]	CH.	Worstcase Datarate	Mode (802.11)	Measured Power [dBm]	Duty cycle Fcator [dB]	Total Power [dBm]	Limit [dBm]
UNII1	5190	38	MCS0	ac40	5.25	0.42	5.66	23.60
	5230	46	MCS0	ac40	5.03	0.42	5.45	23.60
UNII3	5755	151	MCS0	ac40	5.01	0.42	5.43	30.00
	5795	159	MCS0	ac40	5.34	0.42	5.75	30.00

Band	Freq. [MHz]	CH.	Worstcase Datarate	Mode (802.11)	Measured Power [dBm]	Duty cycle Fcator [dB]	Total Power [dBm]	Limit [dBm]
UNII1	5210	42	MCS0	ac80	4.08	0.82	4.90	23.60
UNII3	5775	155	MCS0	ac80	4.64	0.82	5.46	30.00

10.5 POWER SPECTRAL DENSITY

Limit(UNII 1) : 10.62 dBm/MHz (# Antenna Gain 6.38 dB ➔ Test limt : 11 - 0.38 = 10.62 dBm/MHz)

Total PSD [dBm/MHz] = Measured PSD [dBm/MHz] + Duty Cycle Factor [dB]

Band	Freq. [MHz]	CH.	Worstcase Datarate	Measured PSD [dBm/MHz]	Duty cycle Fcator [dB]	Total PSD [dBm/MHz]	Limit [dBm/MHz]
UNII1	5180	36	6M	-3.927	0.218	-3.709	10.62
	5200	40	6M	-3.979	0.218	-3.761	10.62
	5240	48	6M	-3.856	0.218	-3.638	10.62
UNII3	5745	149	6M	-6.768	0.218	-6.550	30 dBm/500kHz
	5785	157	6M	-5.942	0.218	-5.724	30 dBm/500kHz
	5825	165	6M	-6.322	0.218	-6.104	30 dBm/500kHz

Mode : 802.11n(HT20)

Band	Freq. [MHz]	CH.	Worstcase Datarate	Measured PSD [dBm/MHz]	Duty cycle Fcator [dB]	Total PSD [dBm/MHz]	Limit [dBm/MHz]
UNII1	5180	36	MCS0	-5.343	0.362	-4.981	10.62
	5200	40	MCS0	-5.320	0.362	-4.958	10.62
	5240	48	MCS0	-5.360	0.362	-4.998	10.62
UNII3	5745	149	MCS0	-8.009	0.362	-7.647	30 dBm/500kHz
	5785	157	MCS0	-8.084	0.362	-7.722	30 dBm/500kHz
	5825	165	MCS0	-8.058	0.362	-7.696	30 dBm/500kHz

Mode : 802.11ac(VHT20)

Band	Freq. [MHz]	CH.	Worstcase Datarate	Measured PSD [dBm/MHz]	Duty cycle Fcator [dB]	Total PSD [dBm/MHz]	Limit [dBm/MHz]
UNII1	5180	36	MCS0	-6.581	0.366	-6.215	10.62
	5200	40	MCS0	-6.490	0.366	-6.124	10.62
	5240	48	MCS0	-6.644	0.366	-6.278	10.62
UNII3	5745	149	MCS0	-9.252	0.366	-8.886	30 dBm/500kHz
	5785	157	MCS0	-8.545	0.366	-8.179	30 dBm/500kHz
	5825	165	MCS0	-9.421	0.366	-9.055	30 dBm/500kHz

Mode : 802.11n(HT40)

Band	Freq. [MHz]	CH.	Worstcase Datarate	Measured PSD [dBm/MHz]	Duty cycle Fcator [dB]	Total PSD [dBm/MHz]	Limit [dBm/MHz]
UNII1	5190	38	MCS0	-8.049	0.564	-7.485	10.62
	5230	46	MCS0	-8.102	0.564	-7.538	10.62
UNII3	5755	151	MCS0	-10.884	0.564	-10.320	30 dBm/500kHz
	5795	159	MCS0	-10.606	0.564	-10.042	30 dBm/500kHz

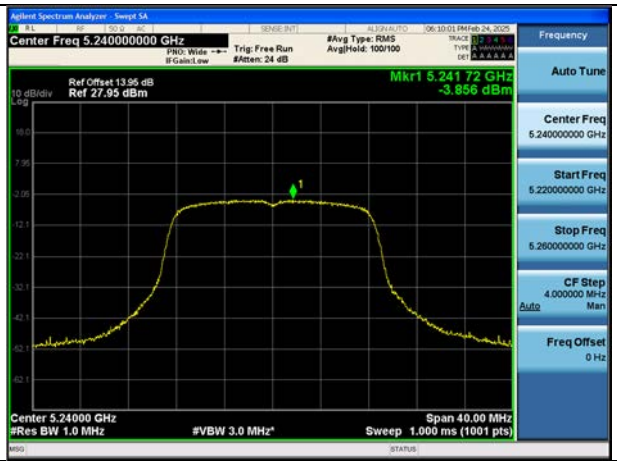
Mode : 802.11ac(VHT40)							
Band	Freq. [MHz]	CH.	Worstcase Datarate	Measured PSD [dBm/MHz]	Duty cycle Fcator [dB]	Total PSD [dBm/MHz]	Limit [dBm/MHz]
UNII1	5190	38	MCS0	-8.532	0.418	-8.114	10.62
	5230	46	MCS0	-8.897	0.418	-8.479	10.62
UNII3	5755	151	MCS0	-11.615	0.418	-11.197	30 dBm/500kHz
	5795	159	MCS0	-11.327	0.418	-10.909	30 dBm/500kHz

Mode : 802.11ac(VHT80)							
Band	Freq. [MHz]	CH.	Worstcase Datarate	Measured PSD [dBm/MHz]	Duty cycle Fcator [dB]	Total PSD [dBm/MHz]	Limit [dBm/MHz]
UNII1	5210	42	MCS0	-12.678	0.820	-11.858	10.62
UNII3	5775	155	MCS0	-15.153	0.820	-14.333	30 dBm/500kHz

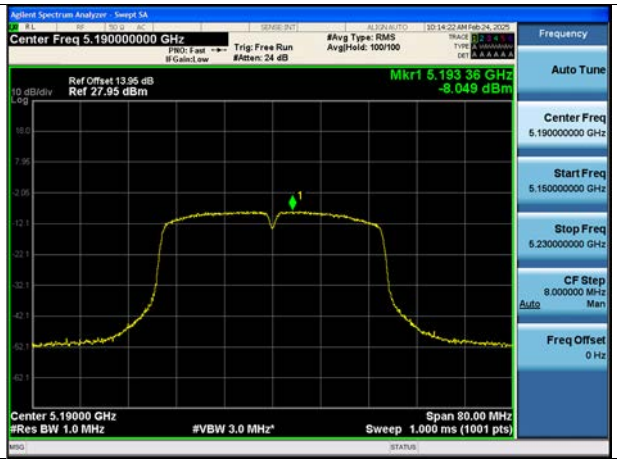
▣ Test Plots

Note: In order to simplify the report, attached plots were only channel of the highest PSD.

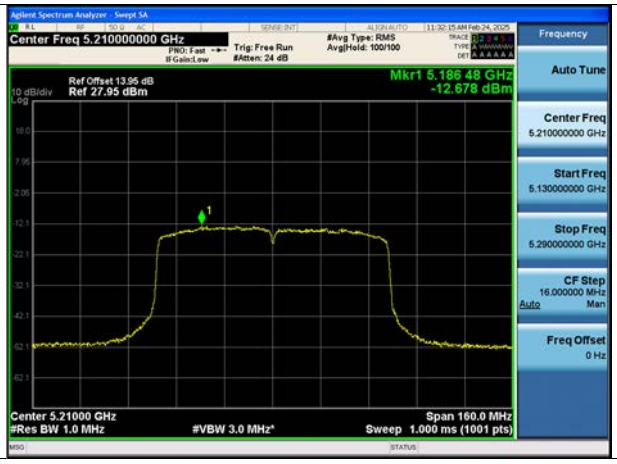
Bandwidth 20M, 802.11a(Ch. 48)



Bandwidth 40M, 802.11n(HT40) (Ch. 38)



Bandwidth 80M, 802.11ac(VHT80) (Ch. 42)



10.6 FREQUENCY STABILITY

Note:

1. All modes of operation were investigated and the worst case configuration results are reported.
2. Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

10.6.1 80 MHz BW

REFERENCE VOLTAGE: 12.0 VDC

Startup after the EUT is energized

OPERATING BAND:			UNII Band 1		UNII Band 3	
OPERATING FREQUENCY:			5,210,000,000 Hz		5,775,000,000 Hz	
CHANNEL:			42		155	
Voltage	Power	Temp.	Frequency	Frequency Error	Frequency	Frequency Error
(%)	(VDC)	(°C)	(kHz)	(kHz)	(kHz)	(kHz)
100%	12.00	+20(Ref)	5210033.35	33.35	5775031.15	31.15
100%		-30	5210009.05	9.05	5775009.82	9.82
100%		-20	5210010.13	10.13	5775012.54	12.54
100%		-10	5210015.48	15.48	5775020.79	20.79
100%		0	5210022.79	22.79	5775025.46	25.46
100%		+10	5210030.32	30.32	5775029.18	29.18
100%		+30	5210039.54	39.54	5775038.83	38.83
100%		+40	5210042.91	42.91	5775048.97	48.97
100%		+50	5210060.92	60.92	5775060.57	60.57
High	13.80	+20	5210030.38	30.38	5775030.44	30.44
Low	10.20	+20	5210033.93	33.93	5775033.36	33.36

2 minutes after the EUT is energized

OPERATING BAND:			UNII Band 1		UNII Band 3	
OPERATING FREQUENCY:			5,210,000,000 Hz		5,775,000,000 Hz	
CHANNEL:			42		155	
Voltage	Power	Temp.	Frequency	Frequency Error	Frequency	Frequency Error
(%)	(VDC)	(°C)	(kHz)	(kHz)	(kHz)	(kHz)
100%	12.00	+20(Ref)	5210031.19	31.19	5775030.97	30.97
100%		-30	5210006.90	6.90	5775010.30	10.30
100%		-20	5210011.54	11.54	5775014.19	14.19
100%		-10	5210020.29	20.29	5775020.09	20.09
100%		0	5210020.21	20.21	5775020.36	20.36
100%		+10	5210026.86	26.86	5775030.73	30.73
100%		+30	5210037.79	37.79	5775038.59	38.59
100%		+40	5210040.42	40.42	5775046.24	46.24
100%		+50	5210050.93	50.93	5775055.59	55.59
High	13.80	+20	5210034.96	34.96	5775032.78	32.78
Low	10.20	+20	5210035.46	35.46	5775030.92	30.92

5 minutes after the EUT is energized

OPERATING BAND:			UNII Band 1		UNII Band 3	
OPERATING FREQUENCY:			5,210,000,000 Hz		5,775,000,000 Hz	
CHANNEL:			42		155	
Voltage	Power	Temp.	Frequency	Frequency Error	Frequency	Frequency Error
(%)	(VDC)	(°C)	(kHz)	(kHz)	(kHz)	(kHz)
100%	12.00	+20(Ref)	5210030.04	30.04	5775032.19	32.19
100%		-30	5210007.43	7.43	5775010.74	10.74
100%		-20	5210011.49	11.49	5775013.37	13.37
100%		-10	5210015.17	15.17	5775019.27	19.27
100%		0	5210022.35	22.35	5775024.37	24.37
100%		+10	5210027.84	27.84	5775025.57	25.57
100%		+30	5210035.28	35.28	5775037.45	37.45
100%		+40	5210047.42	47.42	5775040.38	40.38
100%		+50	5210050.92	50.92	5775060.59	60.59
High	13.80	+20	5210034.28	34.28	5775035.84	35.84
Low	10.20	+20	5210030.65	30.65	5775034.18	34.18

10 minutes after the EUT is energized

OPERATING BAND:			UNII Band 1		UNII Band 3	
OPERATING FREQUENCY:			5,210,000,000 Hz		5,775,000,000 Hz	
CHANNEL:			42		155	
Voltage	Power	Temp.	Frequency	Frequency Error	Frequency	Frequency Error
(%)	(VDC)	(°C)	(kHz)	(kHz)	(kHz)	(kHz)
100%	12.00	+20(Ref)	5210030.15	30.15	5775031.81	31.81
100%		-30	5210010.52	10.52	5775006.83	6.83
100%		-20	5210012.60	12.60	5775011.87	11.87
100%		-10	5210016.29	16.29	5775020.15	20.15
100%		0	5210024.59	24.59	5775022.95	22.95
100%		+10	5210030.61	30.61	5775028.12	28.12
100%		+30	5210039.75	39.75	5775035.90	35.90
100%		+40	5210044.18	44.18	5775049.70	49.70
100%		+50	5210053.26	53.26	5775052.06	52.06
High	13.80	+20	5210034.89	34.89	5775032.92	32.92
Low	10.20	+20	5210030.48	30.48	5775034.56	34.56

10.7 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30 MHz

Frequency	Measured Value	CL+AF+DF-AG	ANT. POL	Total	Limit	Margin
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]
No Critical peaks found						

Note:

1. The Measured Val;ue of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
2. Distance extrapolation factor = 40log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dBμV) + Distance extrapolation factor

Frequency Range : Below 1 GHz

Frequency	Measured Value	A.F+C.L	ANT. POL	Total	Limit	Margin
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]
No Critical peaks found						

Note:

1. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode

Frequency Range : Above 1 GHz

Band :	UNII 1		Operation Mode :		802.11a		
CH.36	5180 MHz		Transfer Rate :		6Mbps		
Frequency [MHz]	Measured value [dBµV]	CL+AF+DF-AG [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
10360	**62.72**	**-2.83**	**V**	**59.89**	**68.20**	**8.31**	**PK**
15540	52.98	-0.82	V	52.16	73.98	21.82	PK
15540	39.03	-0.82	V	38.21	53.98	15.77	AV
10360	61.82	-2.83	H	58.99	68.20	9.21	PK
15540	51.86	-0.82	H	51.04	73.98	22.94	PK
15540	38.79	-0.82	H	37.97	53.98	16.01	AV
6906	**50.84**	**12.16**	**H**	**63.00**	**68.20**	**5.20**	**PK**
6906	50.26	12.16	V	62.42	68.20	5.78	PK

Band :	UNII 1		Operation Mode :		802.11a		
CH.40	5200 MHz		Transfer Rate :		6Mbps		
Frequency [MHz]	Measured value [dBµV]	CL+AF+DF-AG [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
10400	61.61	-2.79	V	58.82	68.20	9.38	PK
15600	53.88	-1.30	V	52.58	73.98	21.40	PK
15600	40.50	-1.30	V	39.20	53.98	14.78	AV
10400	60.37	-2.79	H	57.58	68.20	10.62	PK
15600	52.74	-1.30	H	51.44	73.98	22.54	PK
15600	40.27	-1.30	H	38.97	53.98	15.01	AV
6933	49.26	12.06	H	61.32	68.20	6.88	PK
6933	48.52	12.06	V	60.58	68.20	7.62	PK

Band :	UNII 1		Operation Mode :		802.11a		
CH.48	5240 MHz		Transfer Rate :		6Mbps		
Frequency [MHz]	Measured value [dBµV]	CL+AF+DF-AG [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
10480	60.74	-3.15	V	57.59	68.20	10.61	PK
15720	53.18	-1.57	V	51.61	73.98	22.37	PK
15720	40.19	-1.57	V	38.62	53.98	15.36	AV
10480	60.42	-3.15	H	57.27	68.20	10.93	PK
15720	52.15	-1.57	H	50.58	73.98	23.40	PK
15720	30.98	-1.57	H	29.41	53.98	24.57	AV
6986	50.32	11.62	H	61.99	68.20	6.21	PK
6986	49.68	11.62	V	61.35	68.20	6.85	PK

Band :	UNII 3		Operation Mode :		802.11a		
CH.149	5745 MHz		Transfer Rate :		6Mbps		
Frequency [MHz]	Measured value [dBµV]	CL+AF+DF-AG [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
11490	56.20	-2.65	V	53.55	73.98	20.43	PK
11490	43.43	-2.65	V	40.78	53.98	13.20	AV
17235	53.92	-1.84	V	52.08	68.20	16.12	PK
11490	55.29	-2.65	H	52.64	73.98	21.34	PK
11490	43.07	-2.65	H	40.42	53.98	13.56	AV
17235	53.57	-1.84	H	51.73	68.20	16.47	PK

Band :	UNII 3		Operation Mode :		802.11a		
CH.157	5785 MHz		Transfer Rate :		6Mbps		
Frequency [MHz]	Measured value [dBµV]	CL+AF+DF-AG [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
11570	56.18	-3.00	V	53.18	73.98	20.80	PK
11570	43.31	-3.00	V	40.31	53.98	13.67	AV
17355	53.69	-1.56	V	52.13	68.20	16.07	PK
11570	55.74	-3.00	H	52.74	73.98	21.24	PK
11570	43.02	-3.00	H	40.02	53.98	13.96	AV
17355	53.36	-1.56	H	51.80	68.20	16.40	PK

Band :	UNII 3		Operation Mode :		802.11a		
CH.165	5825 MHz		Transfer Rate :		6Mbps		
Frequency [MHz]	Measured value [dBµV]	CL+AF+DF-AG [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
11650	56.54	-3.48	V	53.06	73.98	20.92	PK
11650	42.67	-3.48	V	39.19	53.98	14.79	AV
17475	53.72	-0.28	V	53.44	68.20	14.76	PK
11650	54.57	-3.48	H	51.09	73.98	22.89	PK
11650	41.57	-3.48	H	38.09	53.98	15.89	AV
17475	53.51	-0.28	H	53.23	68.20	14.97	PK

[Simultaneous transmission Scenario]

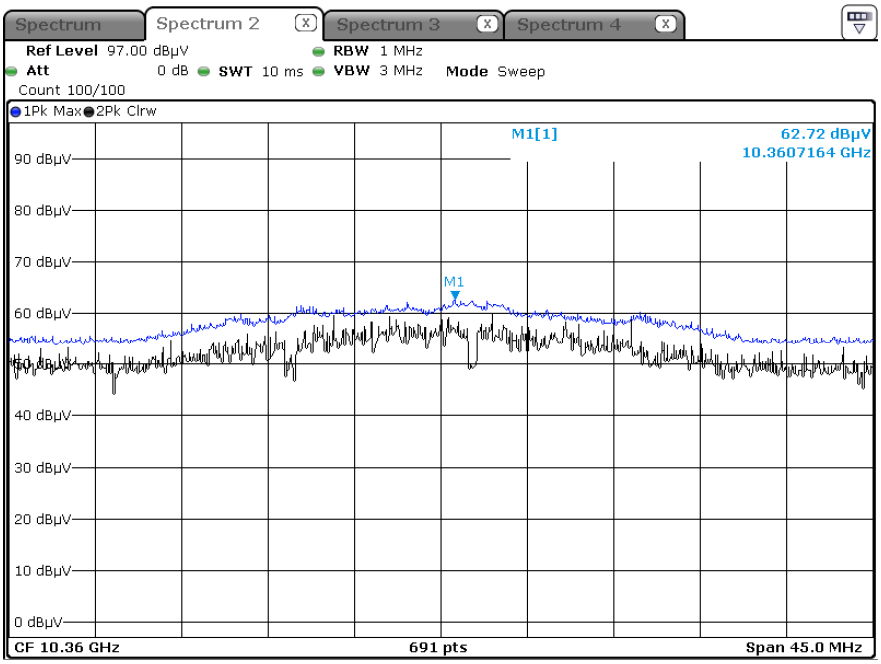
5 GHz 802.11a 6 Mbps (Ch. 36) + WWAN

Band :	UNII 1		Operation Mode :		802.11a_6Mbps		
CH.36	5180 MHz		Transfer Rate :		6Mbps		
Frequency [MHz]	Measured value [dBµV]	CL+AF+DF-AG [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
10360	**60.83**	**-2.83**	**V**	**58.00**	**68.20**	**10.20**	**PK**
15540	52.36	-0.82	V	51.54	73.98	22.44	PK
15540	39.11	-0.82	V	38.29	53.98	15.69	AV
10360	60.64	-2.83	H	57.81	68.20	10.39	PK
15540	52.41	-0.82	H	51.59	73.98	22.39	PK
15540	39.16	-0.82	H	38.34	53.98	15.64	AV
6906	**51.05**	**12.16**	**H**	**63.21**	**68.20**	**4.99**	**PK**
6906	50.44	12.16	V	62.30	68.20	5.60	PK

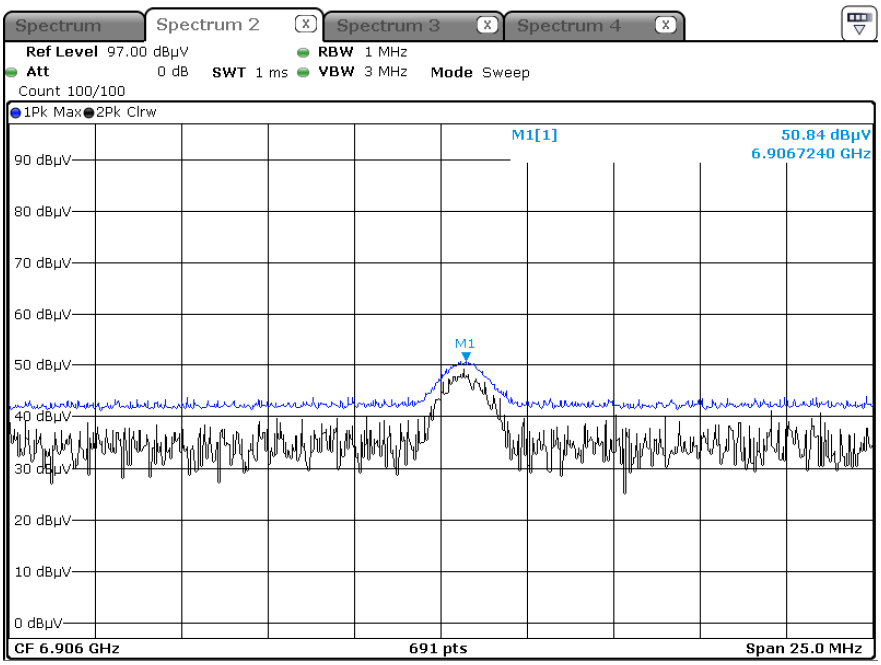
▣ Test Plots

Note: Only the worst case plots for Radiated Spurious Emissions.

Radiated Spurious Emissions plot – Peak Result (802.11a, Ch.36 Spurious Emissions, Y-V)



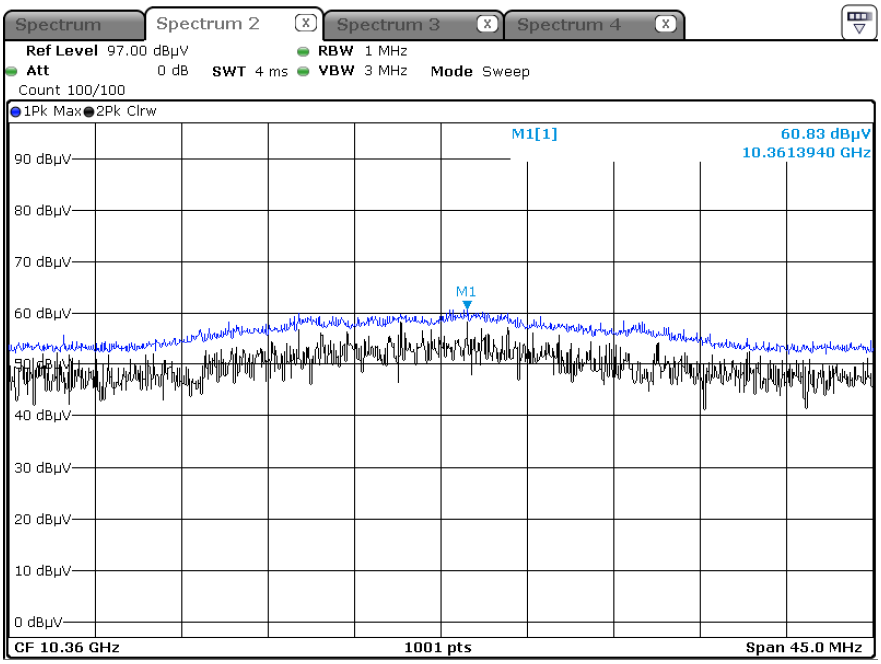
Radiated Spurious Emissions plot – Peak Result (802.11a, Ch.36 Spurious Emissions, Y-V)



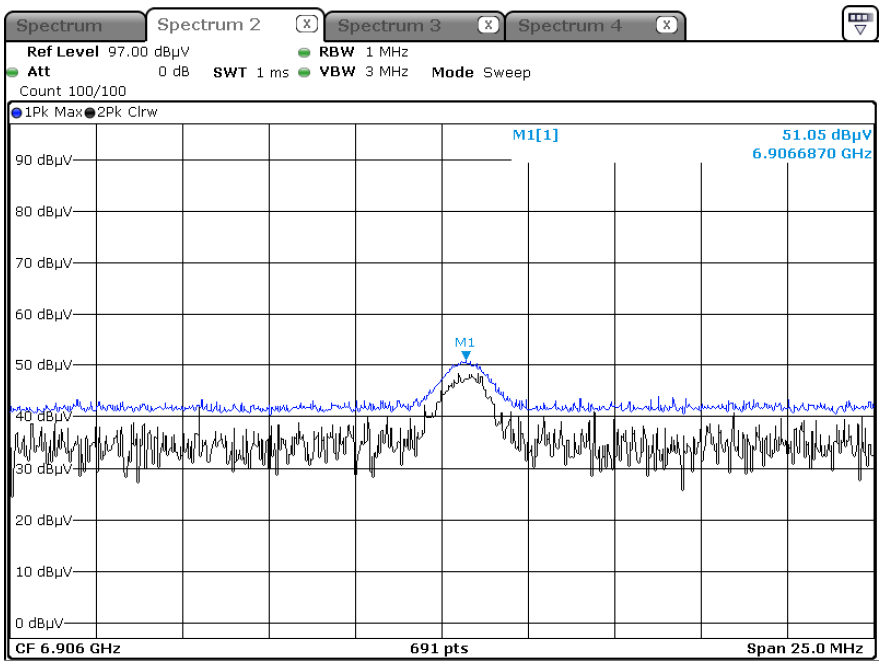
[Simultaneous transmission Scenario]

5 GHz 802.11a 6 Mbps (Ch. 36) + WWAN

Radiated Spurious Emissions plot – Peak Result (Spurious Emissions, Y-V)



Radiated Spurious Emissions plot – Peak Result (Spurious Emissions, Y-V)



10.8 RADIATED RESTRICTED BAND EDGE

Note : integration method Used (KDB 789033 D02 v02r01 Section 3) d) (ii))

802.11 a		Transfer Rate: 6 Mbps					
Channel	Ch.36	5180 MHz	UNII 1				
Frequency	Measured Value	C.L+A.F+D.F-A.G+ATT	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBµV]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	Type
5150	56.25	13.10	H	69.35	73.98	4.63	PK
5150	34.34	13.10	H	47.44	53.98	6.54	AV

802.11 n_HT20		Transfer MCS Index: MCS 0					
Channel	Ch. 36	5180 MHz	UNII 1				
Frequency	Measured Value	C.L+A.F+D.F-A.G+ATT	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBµV]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	Type
5150	54.04	13.10	H	67.14	73.98	6.84	PK
5150	34.26	13.10	H	47.36	53.98	6.62	AV

802.11 ac_VHT20		Transfer MCS Index: MCS 0					
Channel	Ch. 36	5180 MHz	UNII 1				
Frequency	Measured Value	C.L+A.F+D.F-A.G+ATT	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBµV]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	Type
5150	51.92	13.10	H	65.02	73.98	8.96	PK
5150	34.41	13.10	H	47.51	53.98	6.47	AV

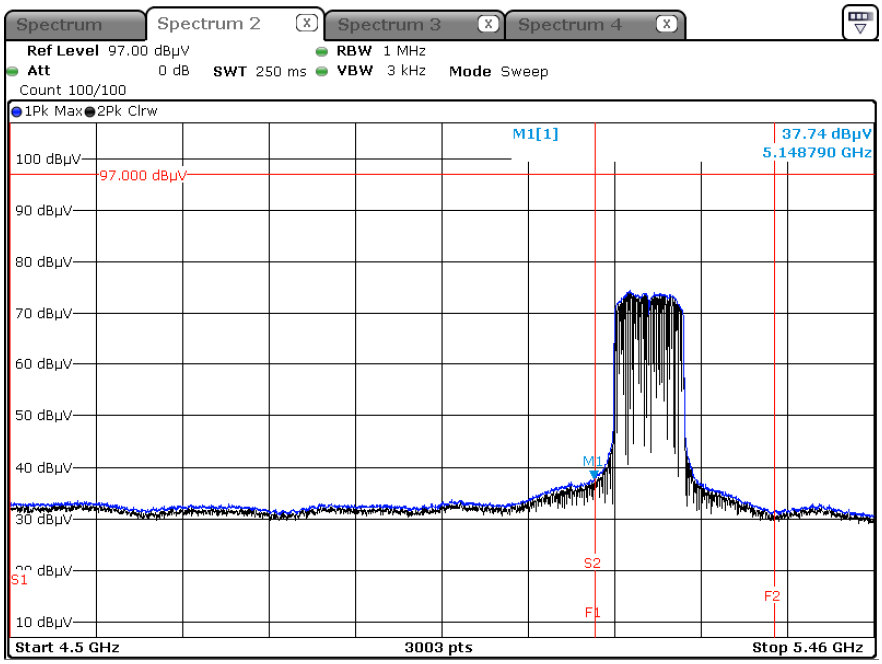
802.11 n_HT40		Transfer MCS Index: MCS 0					
Channel	Ch. 38	5190 MHz	UNII 1				
Frequency	Measured Value	C.L+A.F+D.F-A.G+ATT	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBµV]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	Type
5150	56.35	13.10	H	69.45	73.98	4.53	PK
5150	36.18	13.10	H	49.28	53.98	4.70	AV

802.11 ac_VHT40		Transfer MCS Index: MCS 0					
Channel	Ch. 38	5190 MHz	UNII 1				
Frequency	Measured Value	C.L+A.F+D.F-A.G+ATT	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBµV]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	Type
5150	53.45	13.10	H	66.55	73.98	7.43	PK
5150	35.33	13.10	H	48.43	53.98	5.55	AV

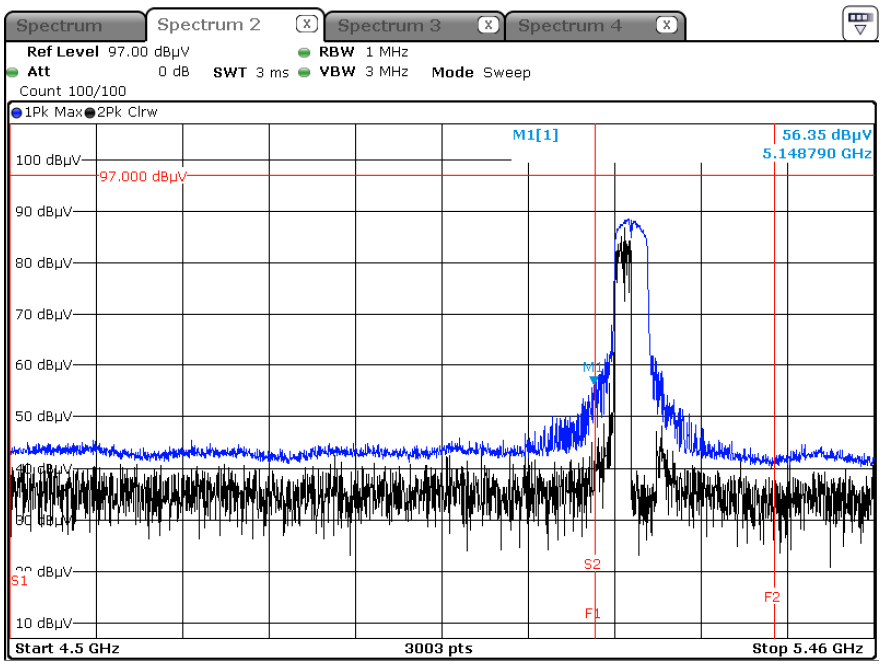
802.11 ac_VHT80		Transfer MCS Index: MCS 0					
Channel	Ch. 42	5210 MHz	UNII 1				
Frequency	Measured Value	C.L+A.F+D.F-A.G+ATT	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	Type
5150	53.15	13.10	H	66.25	73.98	7.73	PK
5150	37.74	13.10	H	50.84	53.98	3.14	AV

▣ Test Plots(UNII 1)

Average Result (802.11 ac_VHT80_ MCS0, Ch.42, Z-H)



Peak Result (802.11 n_HT40_ MCS0, Ch.38, Z-H)

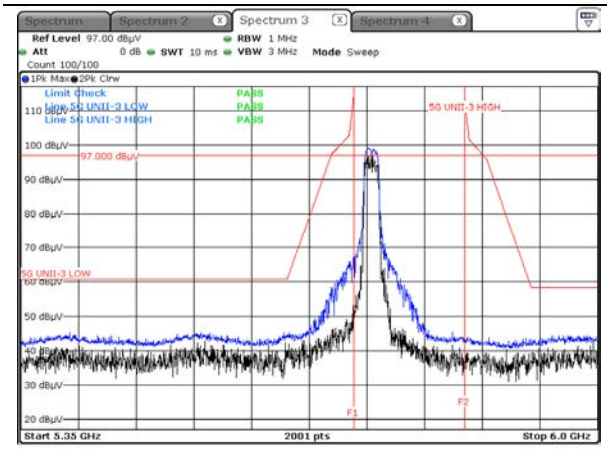


Note:

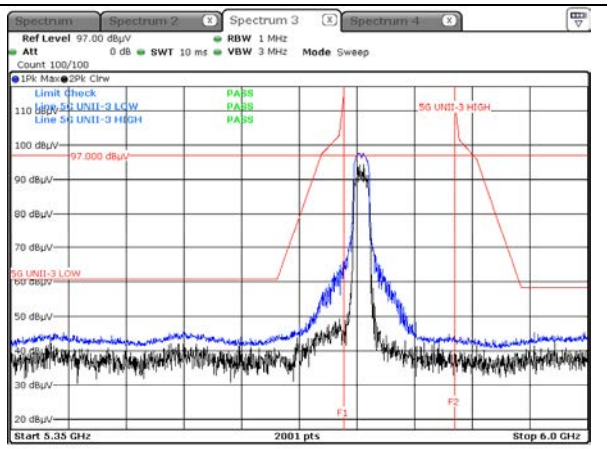
Only the worst case plots for Radiated Restricted Band Edge.

▣ Test Plots(UNII 3)

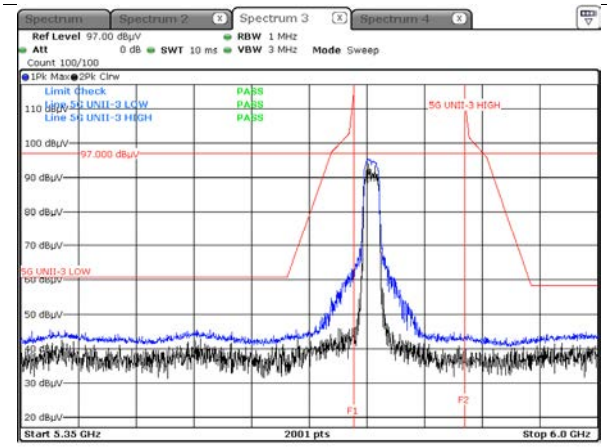
Peak Result (802.11a, Ch.149, Z-H)



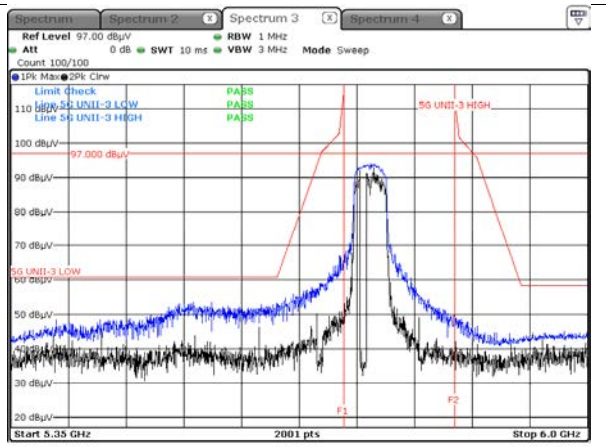
Peak Result (802.11n_HT20, Ch.149, Z-H)



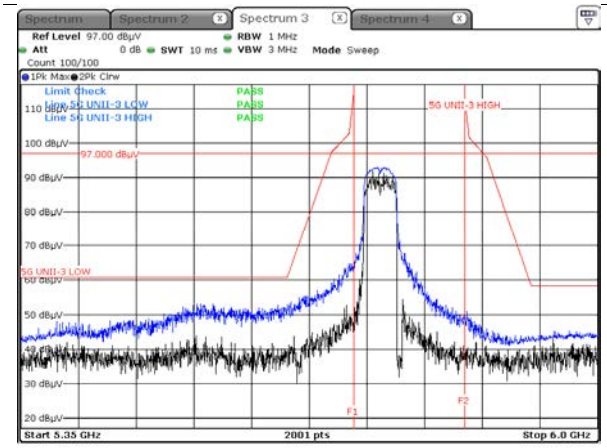
Peak Result (802.11ac_VHT20, Ch.149, Z-H)



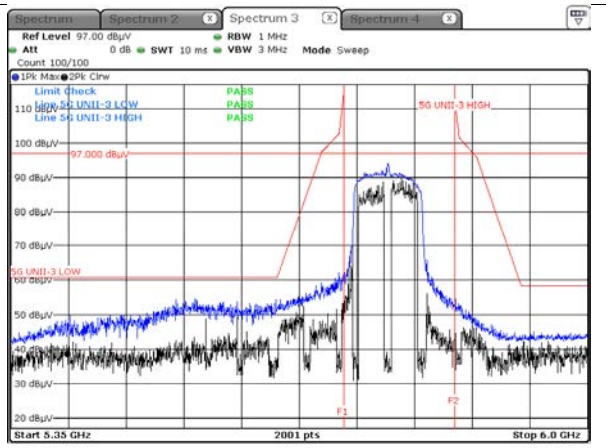
Peak Result (802.11n_HT40, Ch.151, Z-H)



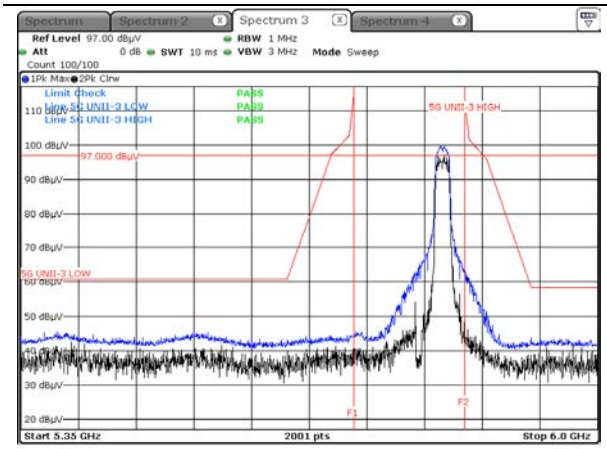
Peak Result (802.11ac_VHT40, Ch.151, Z-H)



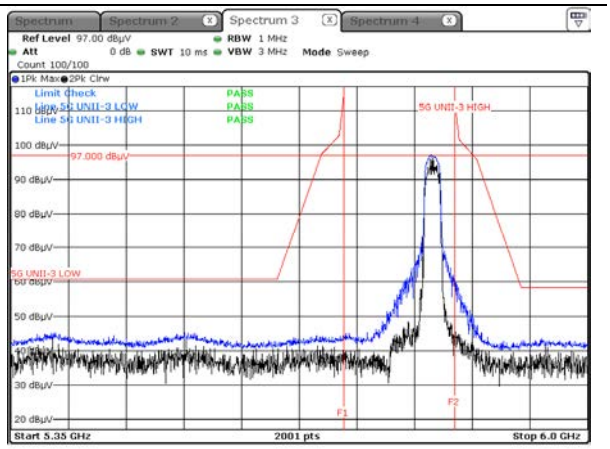
Peak Result (802.11ac_VHT80, Ch.155, Z-H)



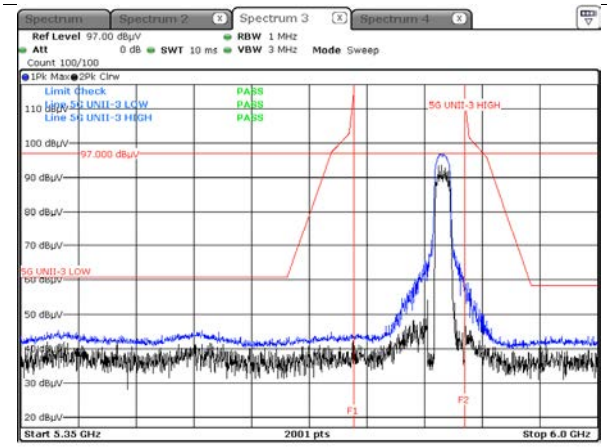
Peak Result (802.11a, Ch.165, Z-H)



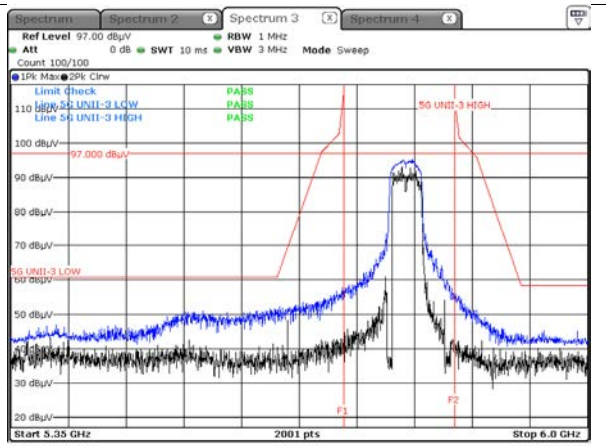
Peak Result (802.11n_HT20, Ch.165, Z-H)



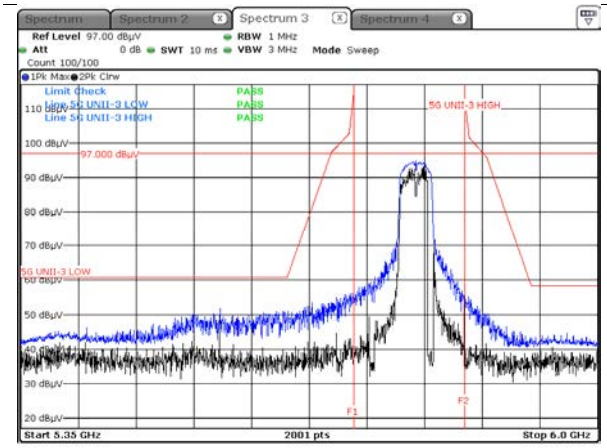
Peak Result (802.11ac_VHT20, Ch.165, Z-H)



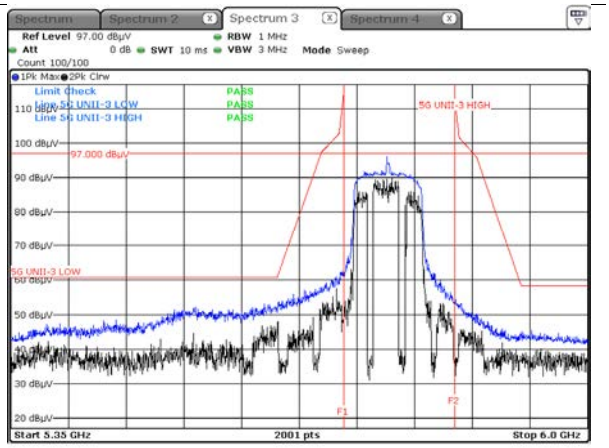
Peak Result (802.11n_HT40, Ch.159, Z-H)



Peak Result (802.11ac_VHT40, Ch.159, Z-H)



Peak Result (802.11ac_VHT80, Ch.155, Z-H)



Note :

1. Only the worst case plots for U-NII-3 Out of Band e.i.r.p Emission.
2. U-NII-3 Low & High Band Edge RedLine is Final Test Limit about factor value compensation.

11. LIST OF TEST EQUIPMENT

Conducted Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
LISN	ENV216	Rohde & Schwarz	102245	07/17/2025	Annual
EMI Test Receiver	ESR	Rohde & Schwarz	101910	07/02/2025	Annual
Temperature Chamber	SU-642	ESPEC	0093008124	02/11/2026	Annual
Signal Analyzer	N9030A	Agilent	MY49431210	12/12/2025	Annual
Power Measurement Set	OSP 120	Rohde & Schwarz	101231	10/17/2025	Annual
Power Meter	N1911A	Agilent	MY45100523	02/21/2026	Annual
Power Sensor	N1921A	Agilent	MY57820067	02/04/2026	Annual
Directional Coupler	87300B	Agilent	3116A03621	10/21/2025	Annual
Power Splitter	11667B	Hewlett Packard	05001	04/17/2025	Annual
DC Power Supply	E3632A	H.P	KR75303243	04/19/2025	Annual
Attenuator(10 dB)	8493C	Hewlett Packard	07560	06/05/2025	Annual
Software	EMC32	Rohde & Schwarz	N/A	N/A	N/A
FCC WLAN&BT&BLE Conducted Test Software v3.0	N/A	HCT CO., LTD.	N/A	N/A	N/A

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

Radiated Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
Controller(Antenna mast)	CO3000	Innco system	CO3000-4p	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	N/A	N/A	N/A
Controller	EM1000	Audix	060520	N/A	N/A
Turn Table	N/A	Audix	N/A	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-333	03/07/2026	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	760	02/17/2027	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	02299	01/29/2026	Biennial
Horn Antenna (15GHz ~ 40 GHz)	BBHA9170	Schwarzbeck	BBHA9170342	09/20/2026	Biennial
Spectrum Analyzer	FSV40	Rohde & Schwarz	100901	02/21/2026	Annual
Signal Analyzer	N9030A	Agilent	MY49431210	12/12/2025	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	5	06/04/2025	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	6	06/04/2025	Annual
Band Reject Filter	WRCJV2400/2483.5-2370/2520-60/12SS	Wainwright Instruments	2	12/26/2025	Annual
Band Reject Filter	WRCJV5100/5850-40/50-8EEK	Wainwright Instruments	1	01/09/2026	Annual
RF Switching System	FMSR-04B (3G HPF+LNA)	T&M SYSTEM	S2L1	12/23/2025	Annual
RF Switching System	FMSR-04B (10dB ATT+LNA)	T&M SYSTEM	S2L2	12/23/2025	Annual
RF Switching System	FMSR-04B (3dB ATT+LNA)	T&M SYSTEM	S2L3	12/23/2025	Annual
RF Switching System	FMSR-04B (LNA)	T&M SYSTEM	S2L4	12/23/2025	Annual
RF Switching System	FMSR-04B (7G HPF+LNA)	T&M SYSTEM	S2L5	12/23/2025	Annual
Power Amplifier	CBL18265035	CERNEX	22966	11/07/2025	Annual
Power Amplifier	CBL26405040	CERNEX	25956	02/19/2026	Annual

Note:
1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.
3. Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5(Version : 2017).

12. ANNEX A_ TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-2503-FC048-P