TEST REPORT

FCC UNII Test for DA651ZZZGG
Certification

APPLICANT
Hyundai Mobis Co., Ltd

REPORT NO.
HCT-RF-2506-FC046

DATE OF ISSUE
June 11, 2025

Tested by
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Accredited by KOLAS, Republic of KOREA

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Additional Model
DA653ZZZGG, DA654ZZZGG, DA656ZZZGG

Applicant	Hyundai Mobis Co., Ltd 203, Teheran-ro, Gangnam-gu, Seoul, Republic of Korea
Product Name Model Name	Car infotainment system DA651ZZZGG
FCC ID	TQ8-DA651ZZZGG
Date of Test	February 25, 2025 ~ June 11, 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	June 11, 2025	Initial Release

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)

This test report provides test result(s) under the lab's valid Scope of Accreditation by A2LA (American Association for Laboratory Accreditation), signatory of the ILAC-MRA.
(A2LA (ISO/IEC 17025) Certificate No. 4114.01)

CONTENTS

1. GENERAL INFORMATION

EUT DESCRIPTION

Model	DA651ZZZGG	
Additional Model	DA653ZZZGG, DA654ZZZGG, DA656ZZZGG	
EUT Type	Car infotainment system	
Power Supply	DC 14.4 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 - 5805 40 MHz BW : 5755 - 5795 80 MHz BW : 5775
Dynamic Frequency Selection	Slave without radar detection	
Antenna Specification	Type: Pattern Antenna U-NII-1: 5.70 dBi, U-NII-2A: 6.00 dBi U-NII-2C: 4.60 dBi, U-NII-3: 3.60 dBi	
Serial number	Conducted : HC3P300147D Radiated : HC3P300101D	

This device supports simultaneous transmission operation.

Simultaneous transmission Scenario	2.4 GHz WiFi	5 GHz WiFi	BT	Test Case
Bluetooth + 2.4 GHz WiFi	on	-	on(BT)	Scenario1
Bluetooth + 5 GHz WiFi	-	on	on(BT)	Scenario2
Bluetooth + 2.4 GHz WiFi	on	-	on(BTLE)	Scenario3
Bluetooth + 5 GHz WiFi	-	on	on(BTLE)	Scenario4

2. MAXIMUM OUTPUT POWER

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

Band	Mode	RF Output Power (dBm)	RF Output Power (W)
U-NII-1	802.11a	1.96	0.002
	802.11n (HT20)	2.16	0.002
	802.11n (HT40)	1.98	0.002
	802.11ac (VHT20)	2.53	0.002
	802.11ac (VHT40)	2.58	0.002
	802.11ac (VHT80)	2.39	0.002
U-NII-3	802.11a	1.59	0.001
	802.11n (HT20)	1.45	0.001
	802.11n (HT40)	1.73	0.001
	802.11ac (VHT20)	2.14	0.002
	802.11ac (VHT40)	2.06	0.002
	802.11ac (VHT80)	1.84	0.002

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.

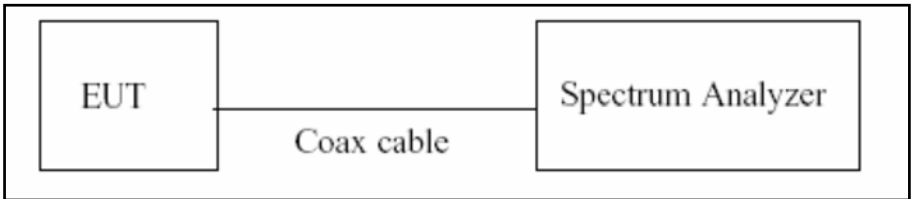
Parameter	Expanded Uncertainty (±kHz)
X dB, 99% Bandwidth	95 (Confidence level about 95 %, *k*=2)
Frequency stability	28 (Confidence level about 95 %, *k*=2)

Parameter	Expanded Uncertainty (±dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.54 (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)	5.68 (Confidence level about 95 %, *k*=2)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.75 (Confidence level about 95 %, *k*=2)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.82 (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.

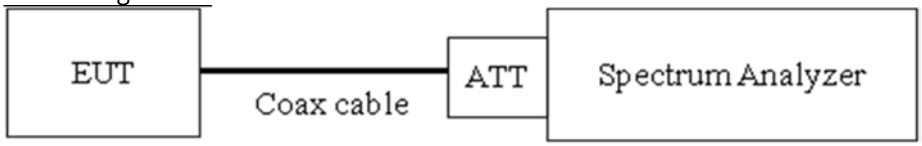
1. RBW = 8 MHz (the largest availble value)
2. VBW = 8 MHz (≥ RBW)
3. SPAN = 0 Hz
4. Measurement Typeor = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on}/ T_{total} and Duty Cycle Factor = 10log(1/Duty Cycle)

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.

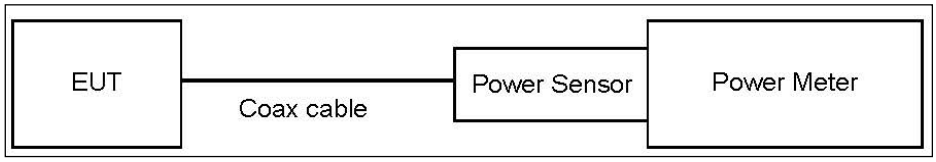
8.3. Output Power Measurement

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



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	11.46
UNII 3	11.46

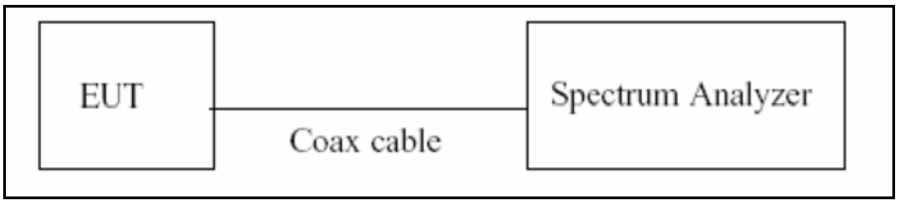
(Actual value of loss for the attenuator and cable combination)

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	11.46
UNII 3	11.46

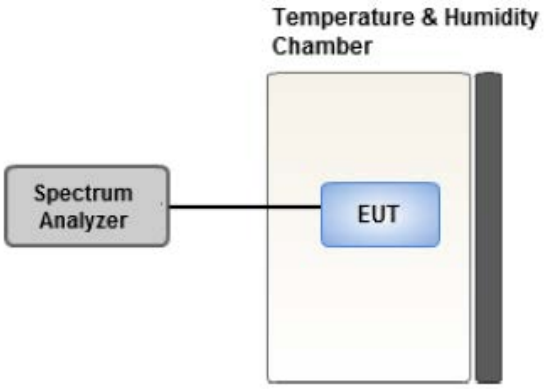
(Actual value of loss for the attenuator and cable combination)

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

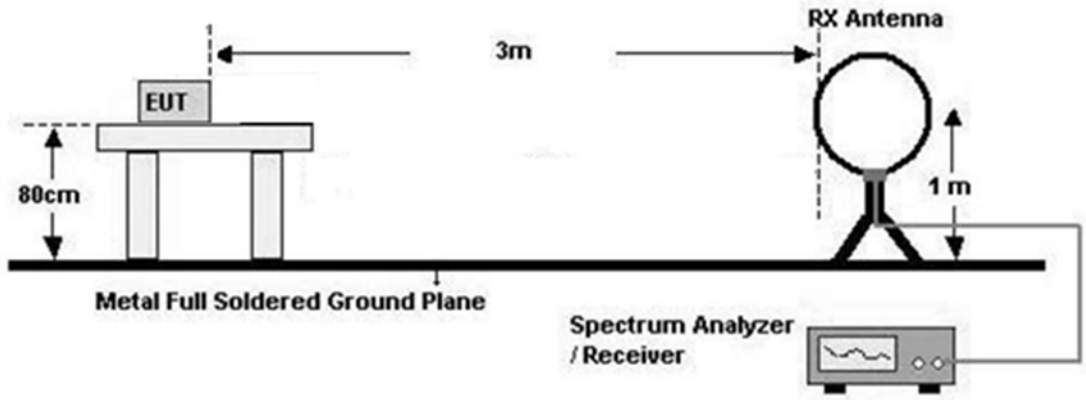
Limit

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 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.
3. 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.

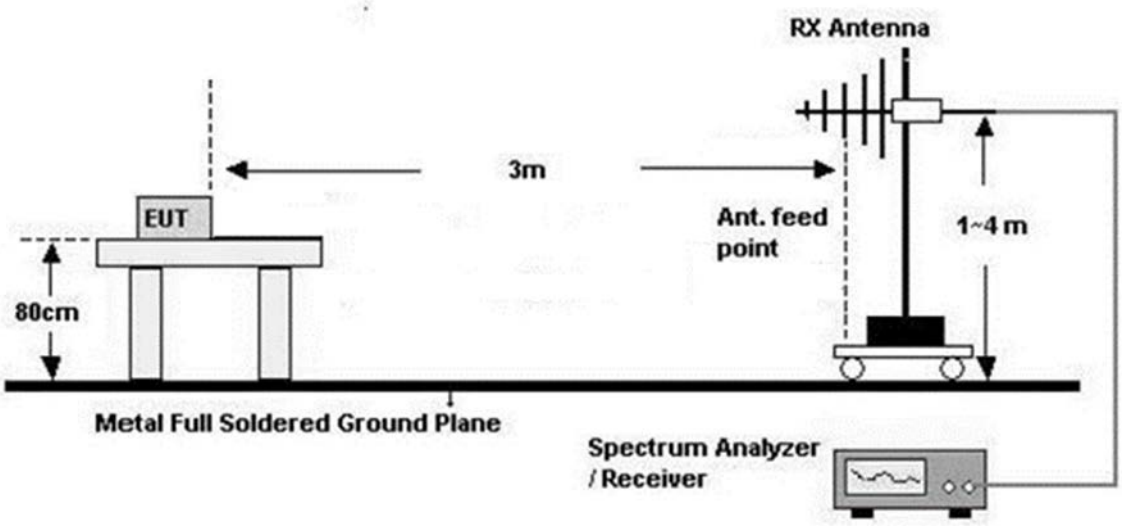
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

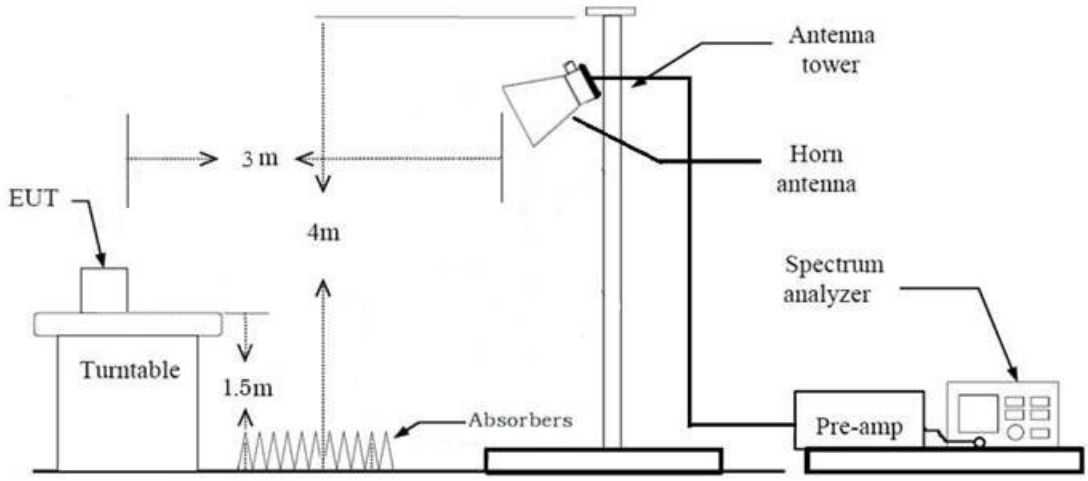
Below 30 MHz



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. 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.

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

9. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency

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)
+ 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. 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.
8. Measured Frequency Range :
   - 4 500 MHz ~ 5 150 MHz
   - 5 350 MHz ~ 5 460 MHz
   - 5 850 MHz ~ (75 MHz or more above the 5 850 MHz)
9. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
10. Total
   (1)Measurement(Peak)
      = Measured Value(Peak)
   (2)Measurement(Avg)
      = Measured Value (Avg)
   - We apply to the offset in the range 1 GHz - 18 GHz.
   - The offset = Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)– Amp. Gain(A.G) + Attenuator (ATT)

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	0.934	0.297	1 000
802.11n(HT20)	MCS0	0.930	0.317	1 000
802.11n(HT40)	MCS0	0.867	0.618	2 000
802.11ac(VHT20)	MCS0	0.930	0.315	1 000
802.11ac(VHT40)	MCS0	0.868	0.614	2 000
802.11ac(VHT80)	MCS0	0.768	1.148	5 000

8.8. Worst case configuration and mode

Conducted test

1. All modes of operation were investigated and the worst case configuration results are reported.
2. DA651ZZZGG, Additional Models were tested and the worst case results are reported.
   (Worst case : DA651ZZZGG)

Radiated test

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

2 EUT Axis
   - Radiated Spurious Emissions : X
   - 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.
   - Worst-case : 802.11a

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

6. DA651ZZZGG, Additional Models were tested and the worst case results are reported.
(Worst case : DA651ZZZGG)

AC Power line Conducted Emissions

1. We don’t perform powerline conducted emission test. The device only employ battery power for operation.

Radiated test(Simultaneous transmission Scenario)

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone + Shark Antenna, Stand alone + Shark Antenna + External accessories
   - Worstcase : Stand alone + Shark Antenna + External accessories
2. EUT Axis
   - Radiated Spurious Emissions : X
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	BT/BTLE	Test Case
Bluetooth + 2.4 GHz WiFi	on	-	on(BT)	Scenario1
Bluetooth + 5 GHz WiFi	-	on	on(BT)	Scenario2
Bluetooth + 2.4 GHz WiFi	on	-	on(BTLE)	Scenario3
Bluetooth + 5 GHz WiFi	-	on	on(BTLE)	Scenario4

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.
   - Radiated spurious emissions: cf. Section 10.7.

Scenario	Description	Bluetooth Emission	5 GHz Emission
2	Antenna	BT/BTLE ANT	WLAN ANT
	Channel	78	161
	Data Rate	1 Mbps	6 Mbps
	Mode	GFSK	802.11a

Note : BT Simultaneous transmission Scenario Data refer to [BT] Test Report

Scenario	Description	Bluetooth Emission	5 GHz Emission
4	Antenna	BT/BTLE ANT	WLAN ANT
	Channel	39	161
	Data Rate	1 Mbps	6 Mbps
	Mode	1 M Bit/s (255 Bytes)	802.11a

Note : BT LE Simultaneous transmission Scenario Data refer to [BT LE] Test Report

9. SUMMARY OF TEST RESULTS

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),(2),(3)	< 250 mW(5150-5250 MHz) <1 W (5725-5850 MHz)		PASS
Maximum Power Spectral Density	§ 15.407(a)(1),(2),(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 (Note1)
Undesirable Emissions	§ 15.407(b) (1),(2),(3),(4) § 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

1. The device only employ battery power for operation.
2. The decision rule applies 'simple acceptance'

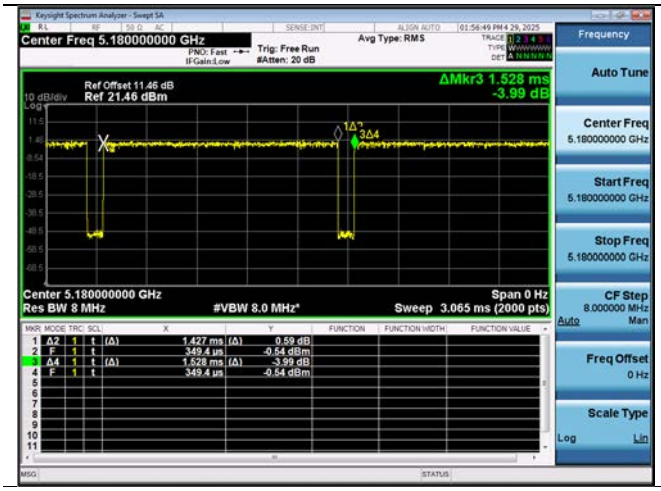
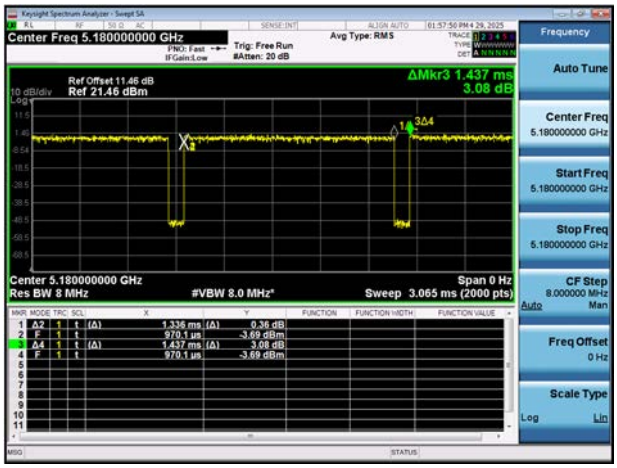
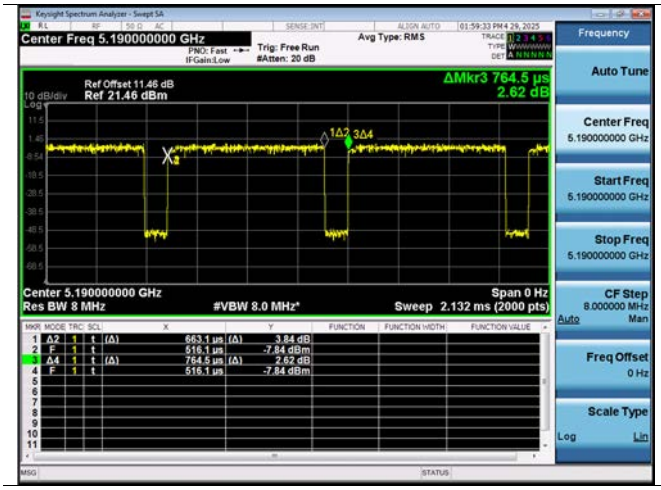
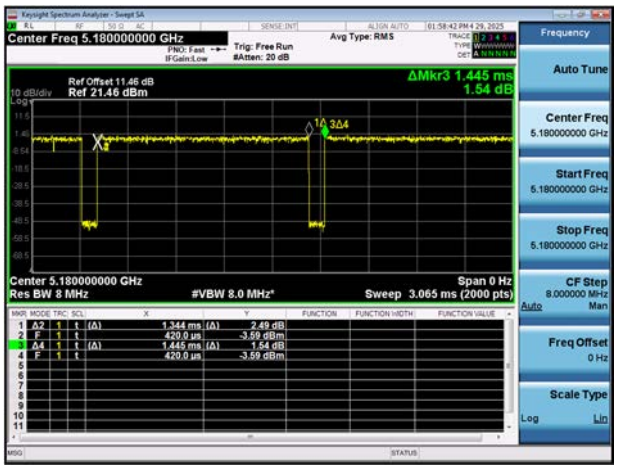
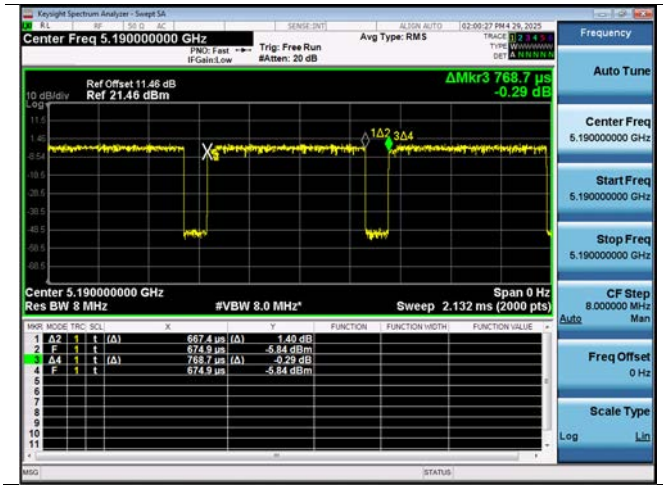
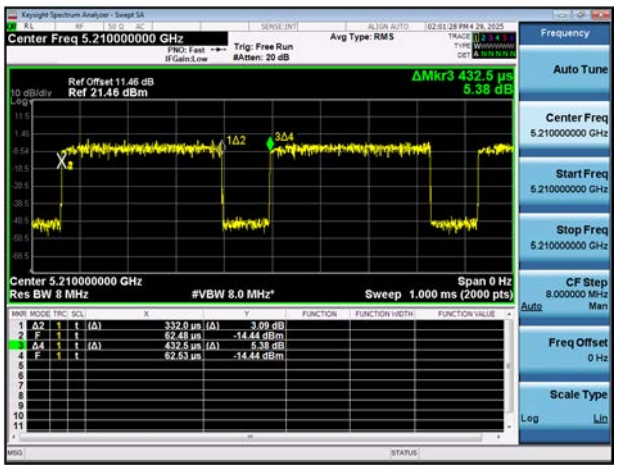
10. TEST RESULT

10.1 DUTY CYCLE

Mode	Data Rate	T_{on} (ms)	T_{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11a	6M	1.427	1.528	0.934	0.297
802.11n(HT20)	MCS0	1.336	1.437	0.930	0.317
802.11n(HT40)	MCS0	0.663	0.765	0.867	0.618
802.11ac(VHT20)	MCS0	1.344	1.445	0.930	0.315
802.11ac(VHT40)	MCS0	0.667	0.769	0.868	0.614
802.11ac(VHT80)	MCS0	0.332	0.433	0.768	1.148

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	21.34	16.724
	5200	40	21.45	16.737
	5240	48	21.31	16.739
UNII3	5745	149	21.31	16.737
	5785	157	21.39	16.750
	5805	161	21.43	16.731

Mode : 802.11n(HT20)				
BAND	Freq. [MHz]	CH.	26 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
UNII1	5180	36	21.61	17.837
	5200	40	21.48	17.866
	5240	48	21.61	17.831
UNII3	5745	149	21.66	17.881
	5785	157	21.53	17.847
	5805	161	21.56	17.864

Mode : 802.11ac(VHT20)				
BAND	Freq. [MHz]	CH.	26 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
UNII1	5180	36	21.56	17.849
	5200	40	21.57	17.855
	5240	48	21.44	17.891
UNII3	5745	149	21.43	17.869
	5785	157	21.69	17.866
	5805	161	21.69	17.870

Mode : 802.11n(HT40)				
BAND	Freq. [MHz]	CH.	26 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
UNII1	5190	38	40.02	36.355
	5230	46	39.96	36.349
UNII3	5755	151	39.98	36.361
	5795	159	39.60	36.342

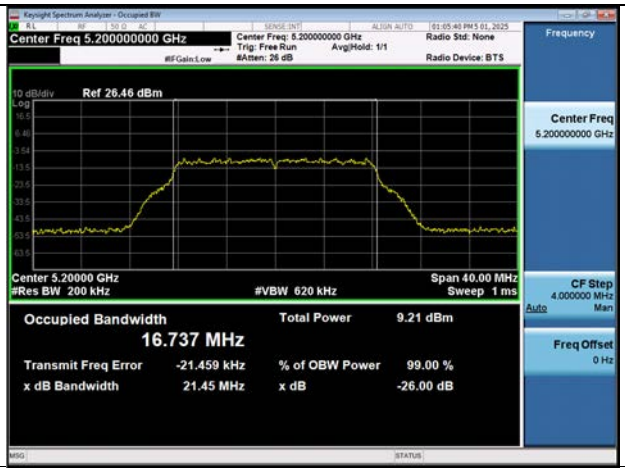
Mode : 802.11ac(VHT40)				
BAND	Freq. [MHz]	CH.	26 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
UNII1	5190	38	40.12	36.262
	5230	46	39.55	36.302
UNII3	5755	151	40.15	36.335
	5795	159	39.98	36.348

Mode : 802.11ac(VHT80)				
BAND	Freq. [MHz]	CH.	26 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
UNII1	5210	42	81.00	75.653
UNII3	5775	155	81.46	75.676

▣ Test Plots

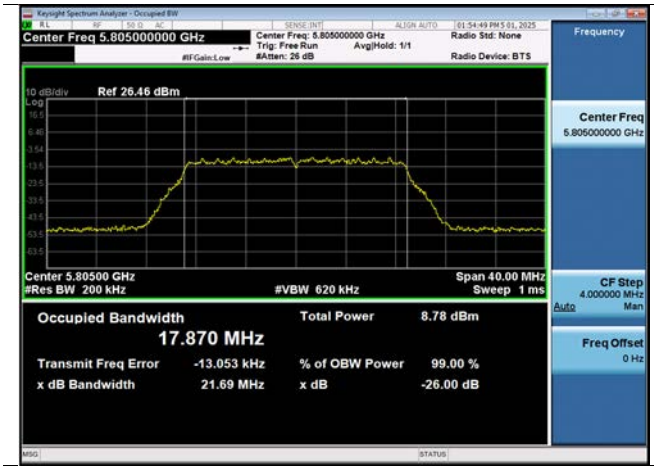
Note:In order to simplify the report, attached plots were only the widest channel per channel bandwidth.

802.11a 26 dB Bandwidth (CH 40)

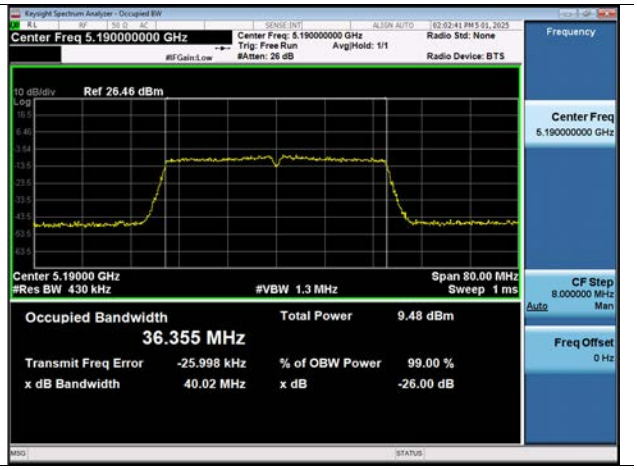


802.11n(HT20) 26 dB Bandwidth (CH 149)

802.11ac(VHT20) 26 dB Bandwidth (CH 161)



802.11n(HT40) 26 dB Bandwidth (CH 38)



802.11ac(VHT40) 26 dB Bandwidth (CH 151)

802.11ac(VHT80) 26 dB Bandwidth (CH 155)

10.3 6 dB BANDWIDTH

Mode : 802.11a				
BAND	Freq. [MHz]	CH.	6 dB Bandwidth [MHz]	Limit [MHz]
UNII3	5745	149	16.34	> 0.5
	5785	157	16.33	> 0.5
	5805	161	16.35	> 0.5

Mode : 802.11n(HT20)				
BAND	Freq. [MHz]	CH.	6 dB Bandwidth [MHz]	Limit [MHz]
UNII3	5745	149	17.59	> 0.5
	5785	157	17.57	> 0.5
	5805	161	17.58	> 0.5

Mode : 802.11ac(VHT20)				
BAND	Freq. [MHz]	CH.	6 dB Bandwidth [MHz]	Limit [MHz]
UNII3	5745	149	17.58	> 0.5
	5785	157	17.59	> 0.5
	5805	161	17.60	> 0.5

Mode : 802.11n(HT40)				
BAND	Freq. [MHz]	CH.	6 dB Bandwidth [MHz]	Limit [MHz]
UNII3	5755	151	36.16	> 0.5
	5795	159	36.35	> 0.5

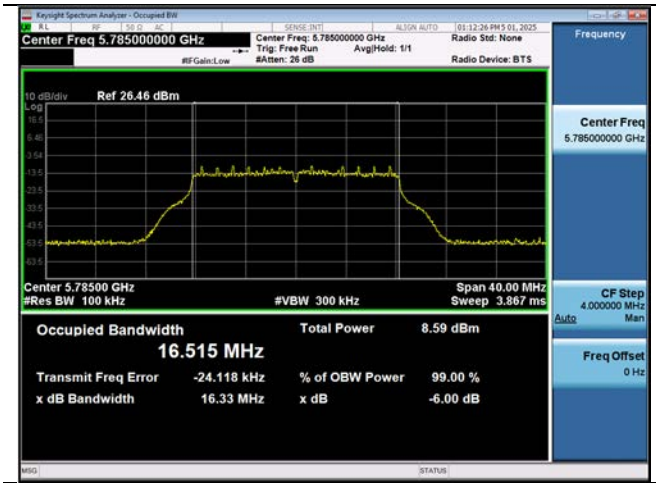
Mode : 802.11ac(VHT40)				
BAND	Freq. [MHz]	CH.	6 dB Bandwidth [MHz]	Limit [MHz]
UNII3	5755	151	36.33	> 0.5
	5795	159	36.17	> 0.5

Mode : 802.11ac(VHT80)				
BAND	Freq. [MHz]	CH.	6 dB Bandwidth [MHz]	Limit [MHz]
UNII3	5775	155	75.49	> 0.5

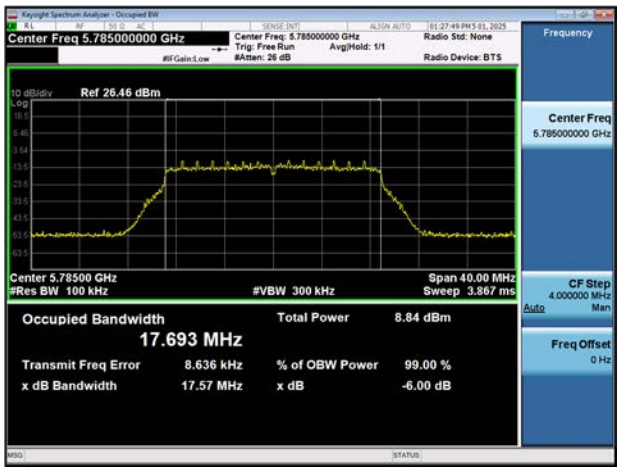
▣ Test Plots

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

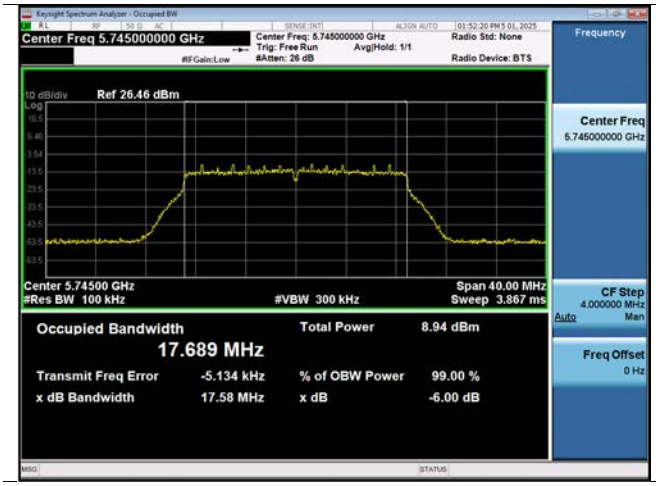
802.11a 6 dB Bandwidth (CH 157)



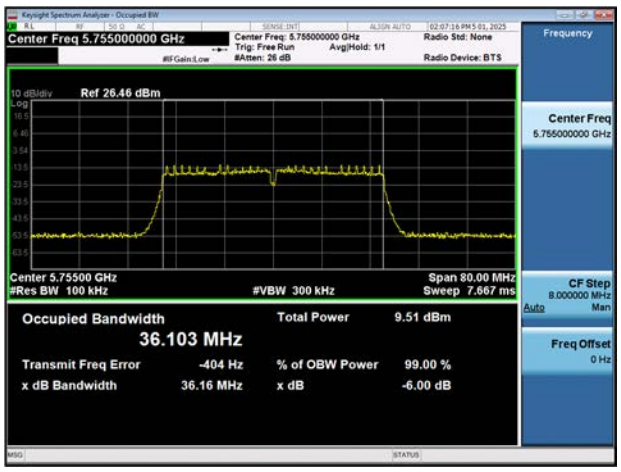
802.11n(HT20) 6 dB Bandwidth (CH 157)



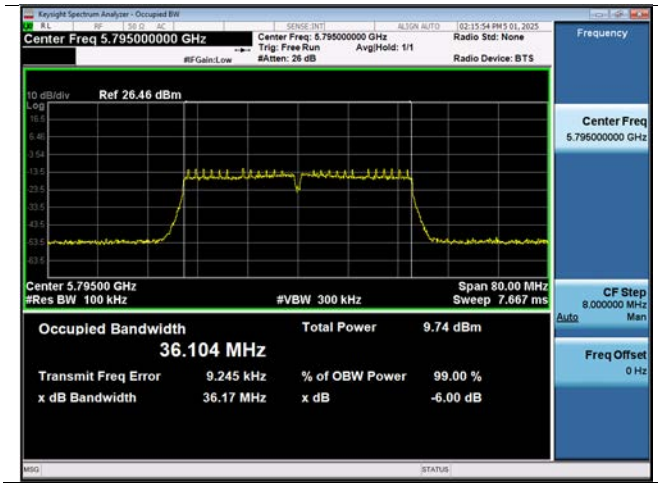
802.11ac(VHT20) 6 dB Bandwidth (CH 149)



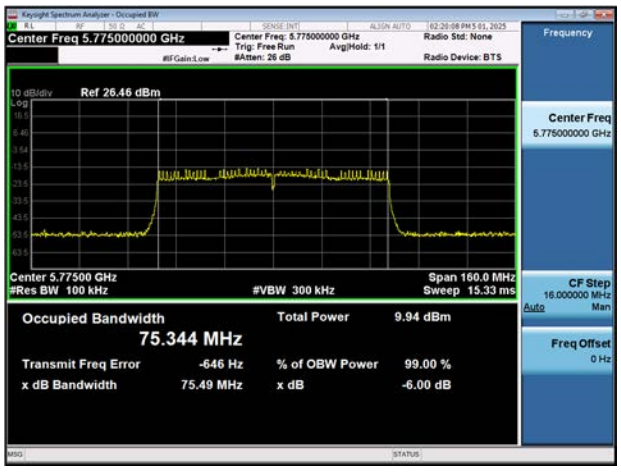
802.11n(HT40) 6 dB Bandwidth (CH 151)



802.11ac(VHT40) 6 dB Bandwidth (CH 159)



802.11ac(VHT80) 6 dB Bandwidth (CH 155)



10.4 OUTPUT POWER MEASUREMENT

Ant 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	1.66	0.30	1.96	23.98
	5200	40	6M	a	1.63	0.30	1.93	23.98
	5240	48	6M	a	1.48	0.30	1.78	23.98
UNII3	5745	149	6M	a	1.20	0.30	1.50	30.00
	5785	157	6M	a	1.25	0.30	1.55	30.00
	5805	161	6M	a	1.29	0.30	1.59	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	1.61	0.32	1.93	23.98
	5200	40	MCS0	n20	1.84	0.32	2.16	23.98
	5240	48	MCS0	n20	1.45	0.32	1.77	23.98
UNII3	5745	149	MCS0	n20	1.03	0.32	1.35	30.00
	5785	157	MCS0	n20	1.08	0.32	1.40	30.00
	5805	161	MCS0	n20	1.13	0.32	1.45	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	1.57	0.31	1.88	23.98
	5200	40	MCS0	ac20	1.67	0.31	1.98	23.98
	5240	48	MCS0	ac20	1.48	0.31	1.79	23.98
UNII3	5745	149	MCS0	ac20	0.93	0.31	1.24	30.00
	5785	157	MCS0	ac20	1.20	0.31	1.51	30.00
	5805	161	MCS0	ac20	1.42	0.31	1.73	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	1.91	0.62	2.53	23.98
	5230	46	MCS0	n40	1.73	0.62	2.35	23.98
UNII3	5755	151	MCS0	n40	1.13	0.62	1.75	30.00
	5795	159	MCS0	n40	1.52	0.62	2.14	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	1.65	0.61	2.26	23.98
	5230	46	MCS0	ac40	1.97	0.61	2.58	23.98
UNII3	5755	151	MCS0	ac40	1.45	0.61	2.06	30.00
	5795	159	MCS0	ac40	1.37	0.61	1.98	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	1.24	1.15	2.39	23.98
UNII3	5775	155	MCS0	ac80	0.69	1.15	1.84	30.00

10.5 POWER SPECTRAL DENSITY

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

Mode : 802.11a							
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	-9.174	0.297	-8.877	11.00
	5200	40	6M	-9.332	0.297	-9.035	11.00
	5240	48	6M	-9.369	0.297	-9.072	11.00
UNII3	5745	149	6M	-12.481	0.297	-12.184	30 dBm/500kHz
	5785	157	6M	-12.842	0.297	-12.545	30 dBm/500kHz
	5805	161	6M	-12.631	0.297	-12.334	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	-9.376	0.317	-9.059	11.00
	5200	40	MCS0	-9.839	0.317	-9.522	11.00
	5240	48	MCS0	-10.019	0.317	-9.702	11.00
UNII3	5745	149	MCS0	-13.334	0.317	-13.017	30 dBm/500kHz
	5785	157	MCS0	-13.388	0.317	-13.071	30 dBm/500kHz
	5805	161	MCS0	-13.300	0.317	-12.983	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	-9.770	0.315	-9.455	11.00
	5200	40	MCS0	-9.692	0.315	-9.377	11.00
	5240	48	MCS0	-9.944	0.315	-9.629	11.00
UNII3	5745	149	MCS0	-13.162	0.315	-12.847	30 dBm/500kHz
	5785	157	MCS0	-13.150	0.315	-12.835	30 dBm/500kHz
	5805	161	MCS0	-13.083	0.315	-12.768	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	-12.103	0.618	-11.485	11.00
	5230	46	MCS0	-12.638	0.618	-12.020	11.00
UNII3	5755	151	MCS0	-15.608	0.618	-14.990	30 dBm/500kHz
	5795	159	MCS0	-16.009	0.618	-15.391	30 dBm/500kHz

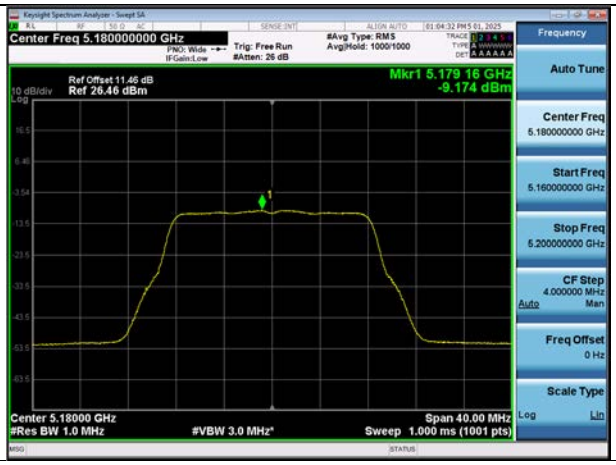
Mode : 802.11ac(VHT40)							
Band	Freq. [MHz]	CH.	Worstcase Datarate	Measured PSD [dBm/MHz]	Duty cycle Fcator [dB]	Total PSD [dBm/MHz]	Limit [dBm/MHz]
UNII1	5190	38	MCS0	-12.005	0.614	-11.391	11.00
	5230	46	MCS0	-12.507	0.614	-11.893	11.00
UNII3	5755	151	MCS0	-15.822	0.614	-15.208	30 dBm/500kHz
	5795	159	MCS0	-15.672	0.614	-15.058	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	-15.674	1.148	-14.526	11.00
UNII3	5775	155	MCS0	-19.126	1.148	-17.978	30 dBm/500kHz

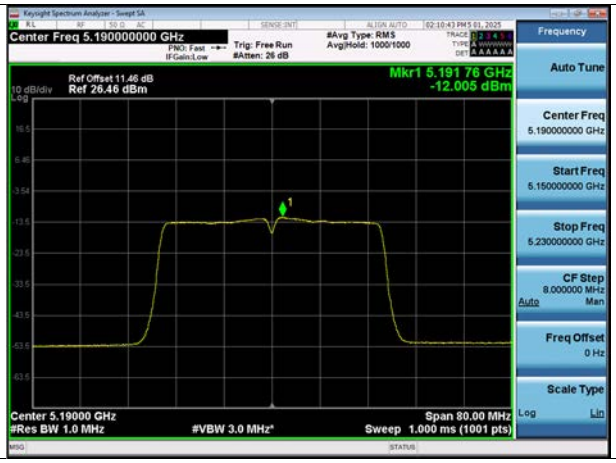
▣ Test Plots

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

Bandwidth 20M, 802.11a (Ch. 36)



Bandwidth 40M, 802.11ac(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: 14.40 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%	14.40	+20(Ref)	5210041.94	41.94	5775047.89	47.89
100%		-30	5210043.68	43.68	5775044.04	44.04
100%		-20	5210042.59	42.59	5775047.96	47.96
100%		-10	5210061.39	61.39	5775056.37	56.37
100%		0	5210054.84	54.84	5775055.87	55.87
100%		+10	5210053.11	53.11	5775057.64	57.64
100%		+30	5210055.83	55.83	5775053.35	53.35
100%		+40	5210051.99	51.99	5775060.92	60.92
100%		+50	5210070.13	70.13	5775078.81	78.81
High	16.00	+20	5210062.83	62.83	5775075.02	75.02
Low	9.00	+20	5210071.39	71.39	5775077.11	77.11

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%	14.40	+20(Ref)	5210045.82	45.82	5775049.55	49.55
100%		-30	5210041.56	41.56	5775048.67	48.67
100%		-20	5210041.40	41.40	5775042.27	42.27
100%		-10	5210063.18	63.18	5775052.84	52.84
100%		0	5210068.03	68.03	5775058.06	58.06
100%		+10	5210058.56	58.56	5775066.62	66.62
100%		+30	5210059.55	59.55	5775061.09	61.09
100%		+40	5210054.16	54.16	5775066.27	66.27
100%		+50	5210065.78	65.78	5775071.13	71.13
High	16.00	+20	5210077.10	77.10	5775075.52	75.52
Low	9.00	+20	5210069.43	69.43	5775063.76	63.76

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%	14.40	+20(Ref)	5210042.64	42.64	5775044.53	44.53
100%		-30	5210041.53	41.53	5775049.16	49.16
100%		-20	5210044.77	44.77	5775045.75	45.75
100%		-10	5210053.59	53.59	5775068.51	68.51
100%		0	5210055.53	55.53	5775061.02	61.02
100%		+10	5210051.08	51.08	5775068.73	68.73
100%		+30	5210065.48	65.48	5775055.45	55.45
100%		+40	5210058.27	58.27	5775067.08	67.08
100%		+50	5210065.92	65.92	5775060.98	60.98
High	16.00	+20	5210071.90	71.90	5775061.93	61.93
Low	9.00	+20	5210068.07	68.07	5775060.89	60.89

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%	14.40	+20(Ref)	5210046.16	46.16	5775040.01	40.01
100%		-30	5210046.14	46.14	5775043.13	43.13
100%		-20	5210043.24	43.24	5775041.34	41.34
100%		-10	5210056.53	56.53	5775062.74	62.74
100%		0	5210069.23	69.23	5775060.15	60.15
100%		+10	5210051.31	51.31	5775063.58	63.58
100%		+30	5210050.05	50.05	5775064.72	64.72
100%		+40	5210059.44	59.44	5775055.69	55.69
100%		+50	5210065.14	65.14	5775077.98	77.98
High	16.00	+20	5210066.04	66.04	5775076.82	76.82
Low	9.00	+20	5210062.64	62.64	5775073.47	73.47

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 :		6 Mbps		
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	48.11	5.79	V	53.90	68.20	14.30	PK
15540	47.58	6.58	V	54.16	73.98	19.82	PK
15540	33.47	6.58	V	40.05	53.98	13.93	AV
10360	48.15	5.79	H	53.94	68.20	14.26	PK
15540	47.96	6.58	H	54.54	73.98	19.44	PK
15540	33.49	6.58	H	40.07	53.98	13.91	AV

Band :	UNII 1		Operation Mode :		802.11a		
CH.40	5200 MHz		Transfer Rate :		6 Mbps		
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	48.15	5.60	V	53.75	68.20	14.45	PK
15600	47.29	6.35	V	53.64	73.98	20.34	PK
15600	33.30	6.35	V	39.65	53.98	14.33	AV
10400	48.17	5.60	H	53.77	68.20	14.43	PK
15600	47.45	6.35	H	53.80	73.98	20.18	PK
15600	33.37	6.35	H	39.72	53.98	14.26	AV

Band :	UNII 1		Operation Mode :		802.11a		
CH.48	5240 MHz		Transfer Rate :		6 Mbps		
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	48.14	6.05	V	54.19	68.20	14.01	PK
15720	47.67	5.76	V	53.43	73.98	20.55	PK
15720	33.33	5.76	V	39.09	53.98	14.89	AV
10480	48.58	6.05	H	54.63	68.20	13.57	PK
15720	47.99	5.76	H	53.75	73.98	20.23	PK
15720	33.42	5.76	H	39.18	53.98	14.80	AV

Band :	UNII 3		Operation Mode :		802.11a		
CH.149	5745 MHz		Transfer Rate :		6 Mbps		
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	47.05	5.88	V	52.93	73.98	21.05	PK
11490	33.13	5.88	V	39.01	53.98	14.97	AV
17235	46.71	10.22	V	56.93	68.20	11.27	PK
11490	47.23	5.88	H	53.11	73.98	20.87	PK
11490	33.96	5.88	H	39.84	53.98	14.14	AV
17235	46.98	10.22	H	57.20	68.20	11.00	PK

Band :	UNII 3		Operation Mode :		802.11a		
CH.157	5785 MHz		Transfer Rate :		6 Mbps		
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	47.54	6.03	V	53.57	73.98	20.41	PK
11570	34.29	6.03	V	40.32	53.98	13.66	AV
17355	45.97	11.36	V	57.33	68.20	10.87	PK
11570	47.74	6.03	H	53.77	73.98	20.21	PK
11570	34.46	6.03	H	40.49	53.98	13.49	AV
17355	46.29	11.36	H	57.65	68.20	10.55	PK

Band :	UNII 3		Operation Mode :		802.11a		
CH.161	5805 MHz		Transfer Rate :		6 Mbps		
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
11610	47.25	5.42	V	52.67	73.98	21.31	PK
11610	33.96	5.42	V	39.38	53.98	14.60	AV
17415	47.18	11.65	V	58.83	68.20	9.37	PK
11610	47.83	5.42	H	53.25	73.98	20.73	PK
11610	34.31	5.42	H	39.73	53.98	14.25	AV
17415	47.39	11.65	H	59.04	68.20	9.16	PK

[Simultaneous transmission Scenario]

Scenario 2

Bluetooth DH5_Ch.78 + WLAN 5 GHz 802.11a_Ch. 161

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
11610	48.06	5.42	V	53.48	73.98	20.50	PK
11610	34.19	5.42	V	39.61	53.98	14.37	AV
17415	47.02	11.65	V	58.67	68.20	9.53	PK
11610	48.18	5.42	H	53.60	73.98	20.38	PK
11610	34.26	5.42	H	39.68	53.98	14.30	AV
17415	47.18	11.65	H	58.83	68.20	9.37	PK

Scenario 4

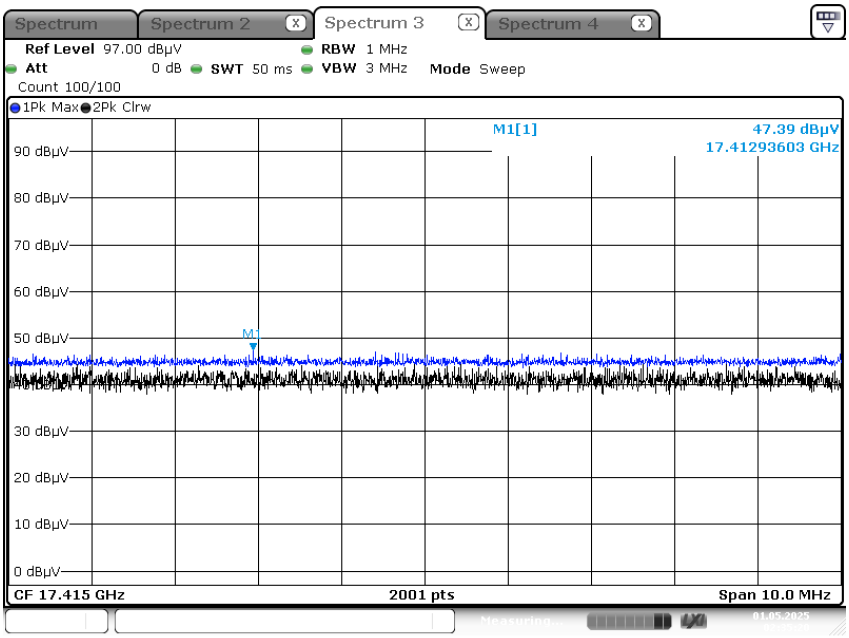
BTLE_Ch.39, 1 M Bit/s (255 Bytes) + WLAN 5 GHz 802.11a_Ch. 161

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
11610	48.57	5.42	V	53.99	73.98	19.99	PK
11610	34.29	5.42	V	39.71	53.98	14.27	AV
17415	47.05	11.65	V	58.70	68.20	9.50	PK
11610	48.61	5.42	H	54.03	73.98	19.95	PK
11610	34.49	5.42	H	39.91	53.98	14.07	AV
17415	47.13	11.65	H	58.78	68.20	9.42	PK

▣ Test Plots

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

Radiated Spurious Emissions plot – Peak Result (802.11a, Ch.161 Spurious Emissions, X-H)

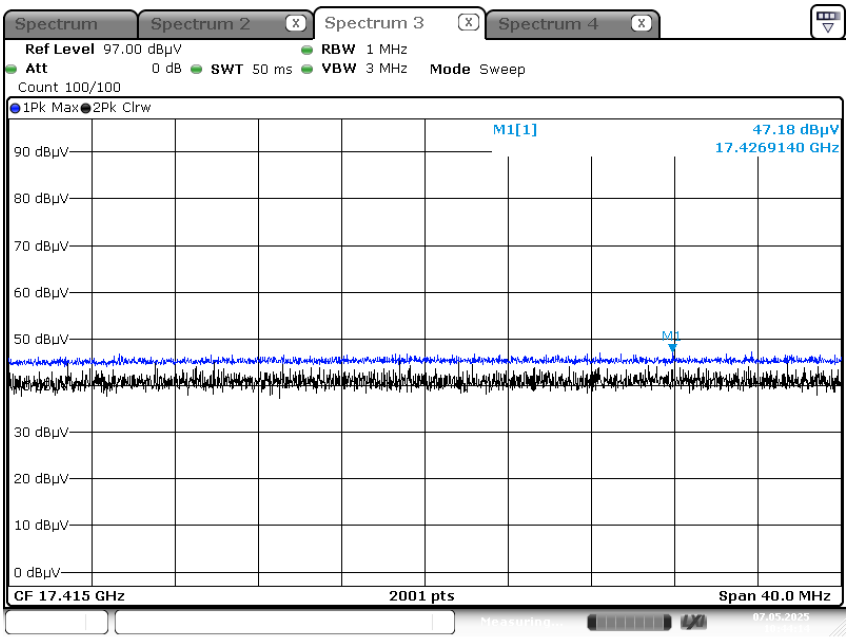


[Simultaneous transmission Scenario]

Scenario 2

Bluetooth DH5_Ch.78 + WLAN 5 GHz 802.11a_Ch. 161

Radiated Spurious Emissions plot – Peak Result (3rd, Spurious Emissions, X-H)

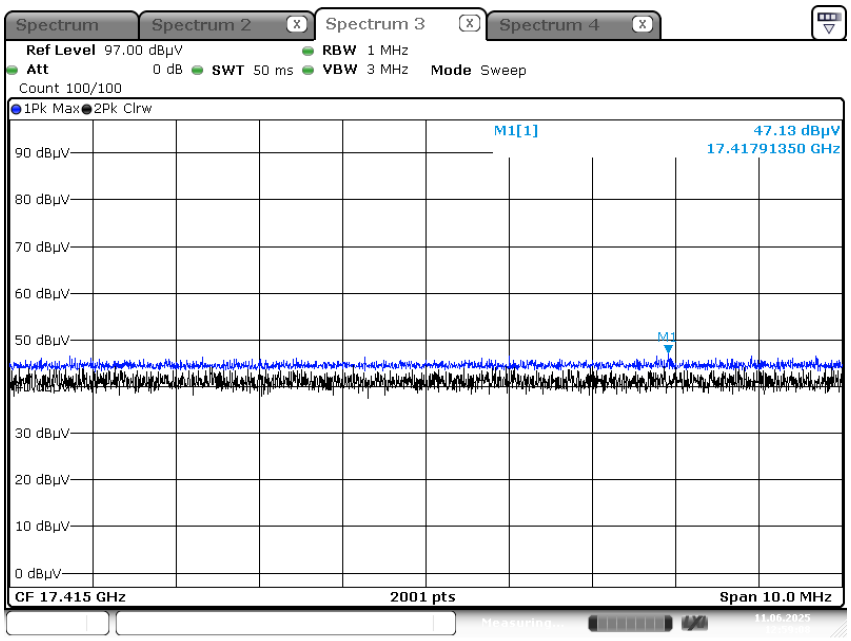


Date: 7.MAY.2025 10:44:14

Scenario 4

BTLE_Ch.39, 1 M Bit/s (255 Bytes) + WLAN 5 GHz 802.11a_Ch. 161

Radiated Spurious Emissions plot – Peak Result (3rd, Spurious Emissions, X-H)



Date: 11.JUN.2025 12:59:09

10.8 RADIATED RESTRICTED BAND EDGE

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	60.44	-	V	60.44	73.98	13.54	PK
5150	45.86	-	V	45.86	53.98	8.12	AV

802.11 a		Transfer Rate: 6 Mbps					
Channel	Ch. 48	5240 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
5350	57.05	-	V	57.05	73.98	16.93	PK
5350	43.39	-	V	43.39	53.98	10.59	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	60.50	-	V	60.50	73.98	13.48	PK
5150	45.49	-	V	45.49	53.98	8.49	AV

802.11 n_HT20		Transfer MCS Index: MCS 0					
Channel	Ch. 48	5240 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
5350	56.80	-	V	56.80	73.98	17.18	PK
5350	43.46	-	V	43.46	53.98	10.52	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	58.71	-	V	58.71	73.98	15.27	PK
5150	45.42	-	V	45.42	53.98	8.56	AV

802.11 ac_VHT20		Transfer MCS Index: MCS 0					
Channel	Ch. 48	5240 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
5350	56.34	-	V	56.34	73.98	17.64	PK
5350	43.42	-	V	43.42	53.98	10.56	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	57.72	-	V	57.72	73.98	16.26	PK
5150	45.40	-	V	45.40	53.98	8.58	AV

802.11 n_HT40		Transfer MCS Index: MCS 0					
Channel	Ch. 46	5230 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
5350	57.09	-	V	57.09	73.98	16.89	PK
5350	44.01	-	V	44.01	53.98	9.97	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	59.70	-	V	59.70	73.98	14.28	PK
5150	46.88	-	V	46.88	53.98	7.10	AV

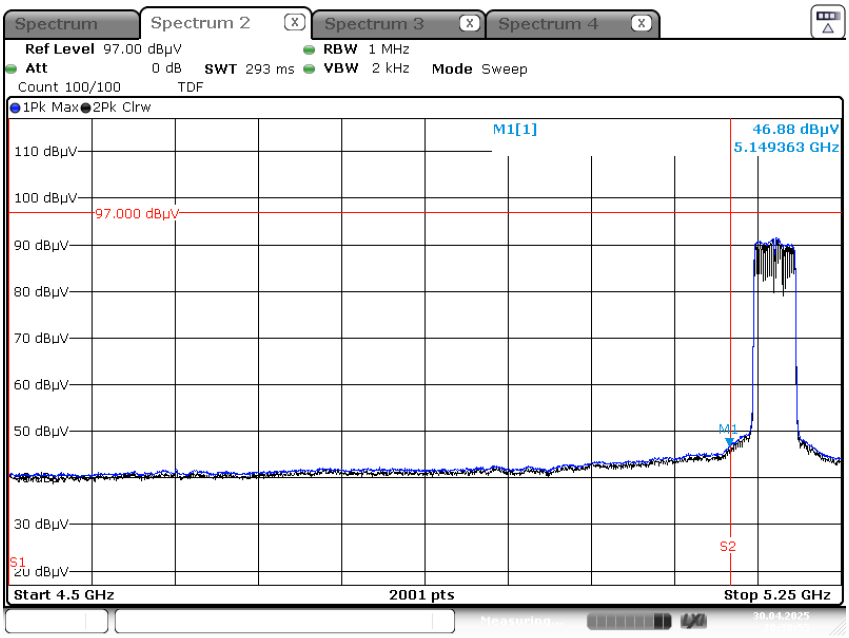
802.11 ac_VHT40		Transfer MCS Index: MCS 0					
Channel	Ch. 46	5230 MHz	UNII 1				
Frequency	Measured Value	C.L+A.F+D.F-A.G+ATT	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	Type
5350	56.25	-	V	56.25	73.98	17.73	PK
5350	44.02	-	V	44.02	53.98	9.96	AV

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	57.73	-	V	57.73	73.98	16.25	PK
5150	46.12	-	V	46.12	53.98	7.86	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
5350	57.91	-	V	57.91	73.98	16.07	PK
5350	45.45	-	V	45.45	53.98	8.53	AV

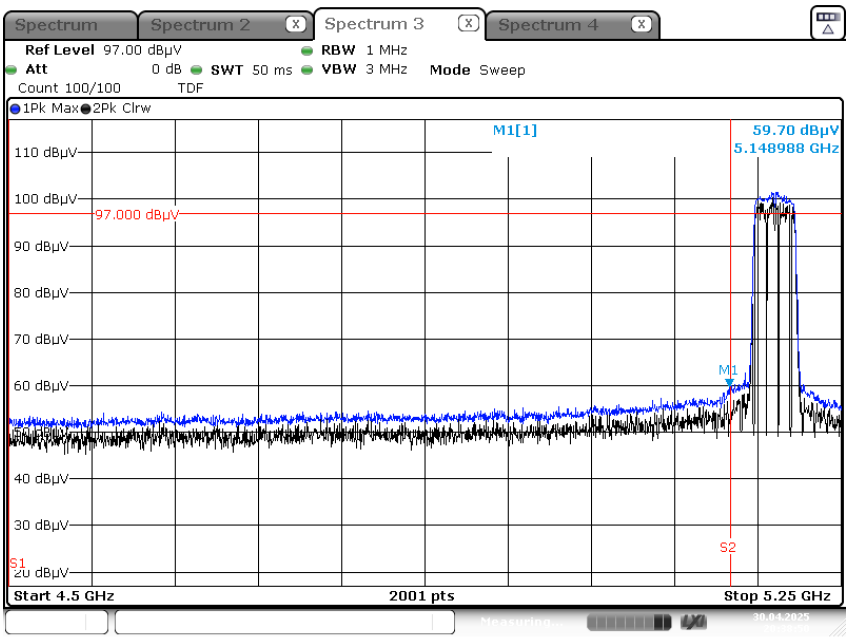
▣ Test Plots(UNII 1, 2A, 2C)

Average Result (802.11 ac_VHT40_ MCS0, Ch.38, Z-V)



Date: 30.APR.2025 20:39:55

Peak Result (802.11 ac_VHT40_ MCS0, Ch.38, Z-V)

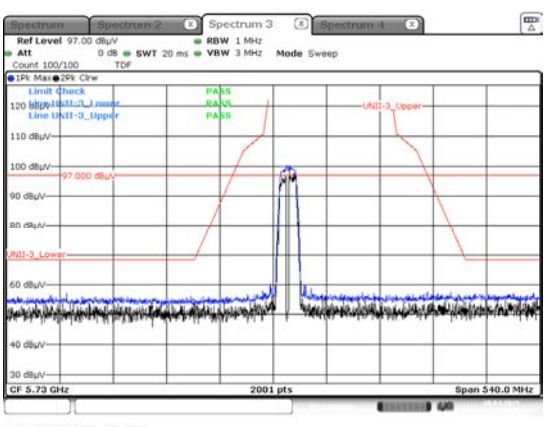
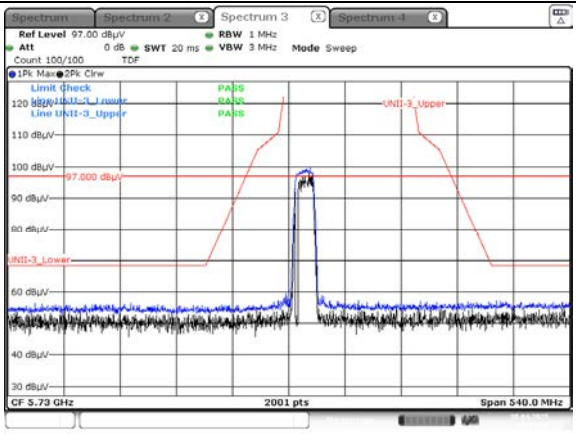
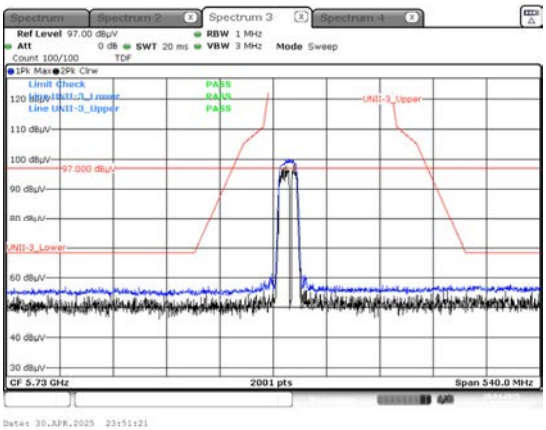
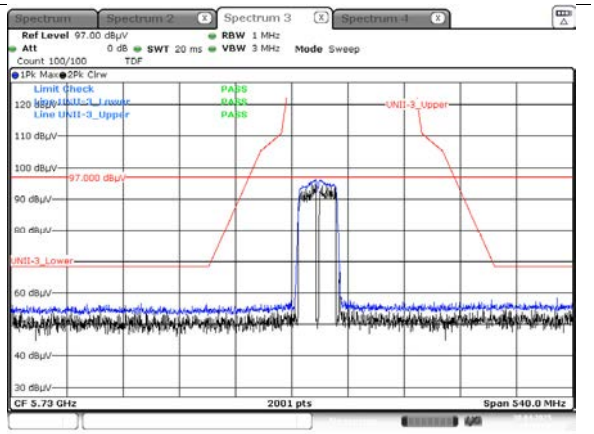
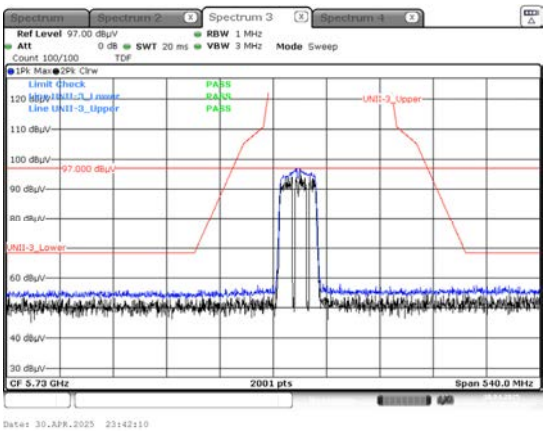
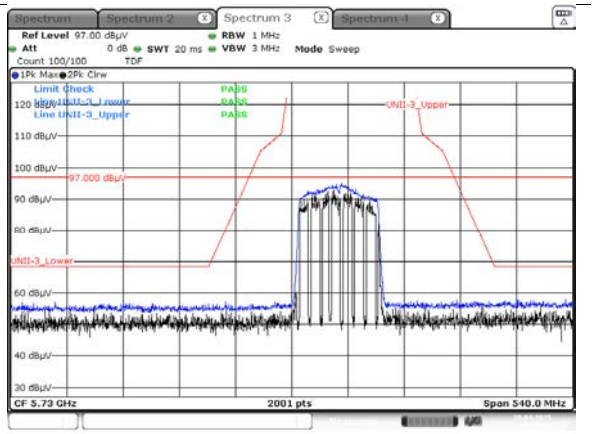


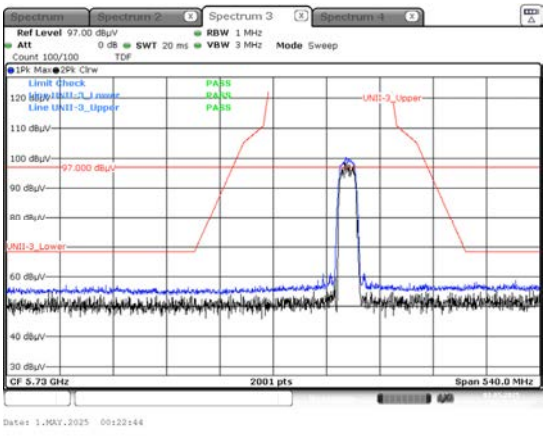
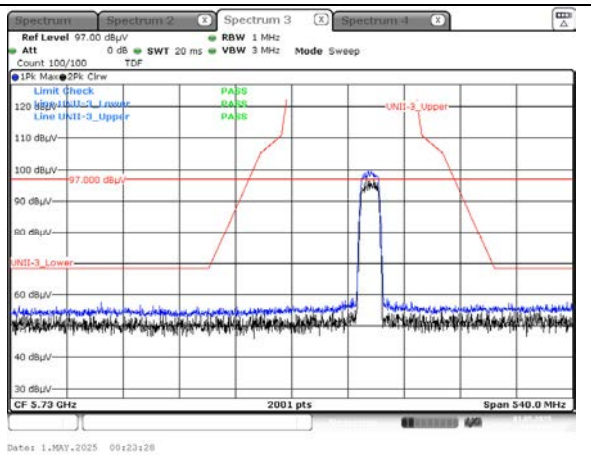
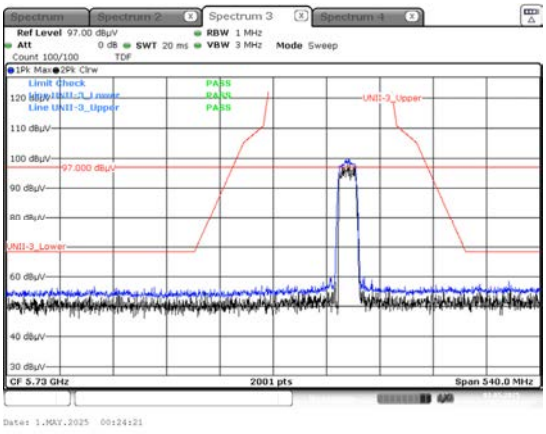
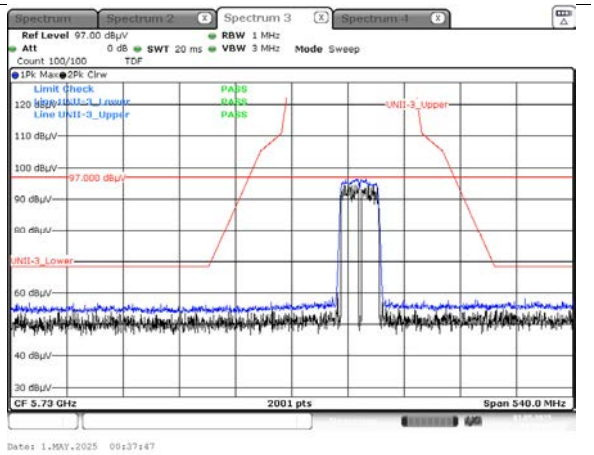
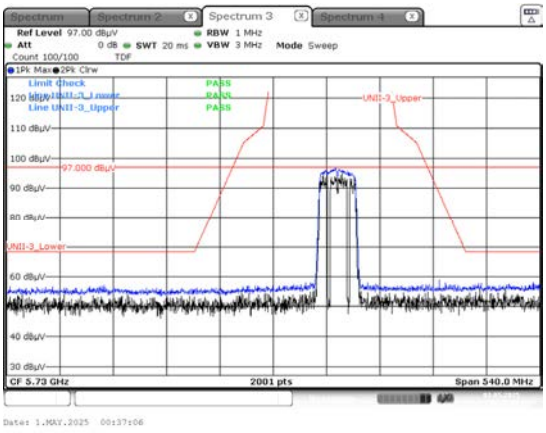
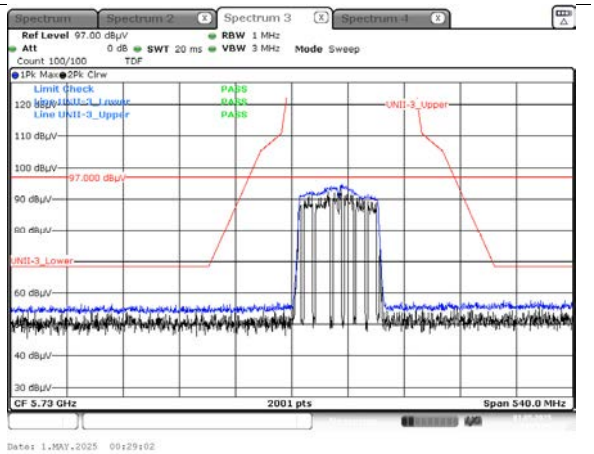
Date: 30.APR.2025 20:38:50

Note:

Only the worst case plots for Radiated Restricted Band Edge.

▣ Test Plots(UNII 3)

Peak Result (802.11a, Ch.149, Z-V)	Peak Result (802.11n_HT20, Ch.149, Z-V)
	
Peak Result (802.11ac_VHT20, Ch.149, Z-V)	Peak Result (802.11n_HT40, Ch.151, Z-V)
	
Peak Result (802.11ac_VHT40, Ch.151, Z-V)	Peak Result (802.11ac_VHT80, Ch.155, Z-V)
	

Peak Result (802.11a, Ch.161, Z-V)	Peak Result (802.11n_HT20, Ch.161, Z-V)
	
Peak Result (802.11ac_VHT20, Ch.161, Z-V)	Peak Result (802.11n_HT40, Ch.159, Z-V)
	
Peak Result (802.11ac_VHT40, Ch.159, Z-V)	Peak Result (802.11ac_VHT80, Ch.155, Z-V)
	

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	93022487	06/27/2025	Annual
Signal Analyzer	N9030A	Keysight	MY55410508	08/23/2025	Annual
Power Measurement Set	OSP 120	Rohde & Schwarz	100935	08/01/2025	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	10545	01/23/2026	Annual
DC Power Supply	E3632A	Agilent	KR75305528	12/24/2025	Annual
Attenuator(10 dB)(DC-26.5 GHz)	8493C-010	Agilent	08285	05/19/2026	Annual
Attenuator(20 dB)	18N-20dB	Rohde & Schwarz	8	02/18/2026	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
Bluetooth Tester	CBT	Rohde & Schwarz	100752	12/27/2025	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.

Radiated Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
Controller	CO3000	Innco system	CO3000-4p	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	S3AM	07/30/2025	Annual
Turn Table	DS1500-S-1t	Innco system	N/A	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-333	03/07/2026	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	9168-0895	08/28/2026	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-1191	11/07/2025	Biennial
Horn Antenna(15 GHz ~ 40 GHz)	BBHA9170	Schwarzbeck	BBHA9170124	03/28/2025	Biennial
Band Reject Filter	WRCJV2400/2483.5-2370/2520-60/12SS	Wainwright Instruments	2	12/26/2025	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	5	05/27/2026	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	6	05/27/2026	Annual
Band Reject Filter	WRCJV5100/5850-40/50-8EEK	Wainwright Instruments	1	01/09/2026	Annual
Amp & Filter Bank Switch Controller	FBSM-01A	TNM system	0	N/A	N/A
RF Switching System	FBSR-03A (3G HPF+LNA)	T&M SYSTEM	S3L1	10/31/2025	Annual
RF Switching System	FBSR-03A (10dB ATT+LNA)	T&M SYSTEM	S3L2	10/31/2025	Annual
RF Switching System	FBSR-03A (7G HPF+LNA)	T&M SYSTEM	S3L3	10/31/2025	Annual
RF Switching System	FBSR-03A (3dB ATT+LNA)	T&M SYSTEM	S3L4	10/31/2025	Annual
Power Amplifier	CBL18265035	CERNEX	22966	11/07/2025	Annual
Power Amplifier	CBL26405040	CERNEX	25956	02/19/2026	Annual
Bluetooth Tester	TC-3000C	TESCOM	3000C000175	03/12/2026	Annual
Spectrum Analyzer	FSV40 (9 kHz ~ 40 GHz)	Rohde & Schwarz	100900	08/27/2025	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-2506-FC046-P