TEST REPORT

FCC 802.11ah Test for WHM200A
Certification

APPLICANT
SJIT Co.,Ltd

REPORT NO.
HCT-RF-2401-FC001-R3

DATE OF ISSUE
March 19, 2025

Tested by
Kyung Jun Woo

Technical Manager
Jong Seok Lee

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-2401-FC001-R3

DATE OF ISSUE
March 19, 2025

Applicant	**SJIT Co.,Ltd** 54-11, Dongtanhana 1-gil, Hwaseong-si, Gyeonggi-do, Republic of Korea
Product Name Model Name	WIFI Halow Module WHM200A
Date of Test	December 26, 2023 ~ January 23, 2024
FCC ID	2BEK7WHM200A
Peak Output Power	29.60 dBm
FCC Classification	Digital Transmission System(DTS)
FCC Rule Part(s)	Part 15.247
Location of Test	■ Permanent Testing Lab ☐ On Site Testing (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	January 23, 2024	Initial Release
1	January 25, 2024	Page 8, Revised antenna requirements (1) Page 12, Revised ANSI section
2	January 31, 2024	Page 32, Added note.
3	March 19, 2025	Revised the Peak Power. (Page 2, 5, 29)

Notice

Content
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 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). 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 ***. When confirmation of authenticity of this test report is required, please contact www.hct.co.kr The test results in this test report are not associated with the ((KS Q) ISO/IEC 17025) accreditation by KOLAS (Korea Laboratory Accreditation Scheme) / A2LA (American Association for Laboratory Accreditation) that are under the ILAC (International Laboratory Accreditation Cooperation) Mutual Recognition Agreement (MRA).

CONTENTS

1. EUT DESCRIPTION

Model	WHM200A
Additional Model	-
EUT Type	WIFI Halow Module
Power Supply	DC 3.30 V
Frequency Range	1M Bandwidth : 903.5 MHz – 926.5 MHz 2M Bandwidth : 905 MHz – 925 MHz 4M Bandwidth : 906 MHz – 922 MHz
Max. RF Output Power	Peak Power: 29.60 dBm
	Average Power: 23.15 dBm
Modulation Type	OFDM
Number of Channels	1M Bandwidth : 24 Channels 2M Bandwidth : 11 Channels 4M Bandwidth : 5 Channels
Antenna Specification	Antenna type: Pattern Antenna Peak Gain : 3.03 dBi
EUT serial numbers	Radiated : WHM200A01 Conducted : WHM200A03

2. TEST METHODOLOGY

FCC KDB 558074 D01 15.247 Meas Guidance v05r02 dated April 02, 2019 entitled “guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices and the measurement procedure described in ANSI C63.10(Version : 2013) ‘the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices’.

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 15.247 under the FCC Rules Part 15 Subpart C.

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 detector 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.

3. 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).

4. FACILITIES AND ACCREDITATIONS

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 31, 2022 (CAB identifier: KR0032).

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 detectors 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."

5. ANTENNA REQUIREMENTS

According to FCC 47 CFR § 15.203

"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) This device is using Trace Antenna design

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

6. 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.

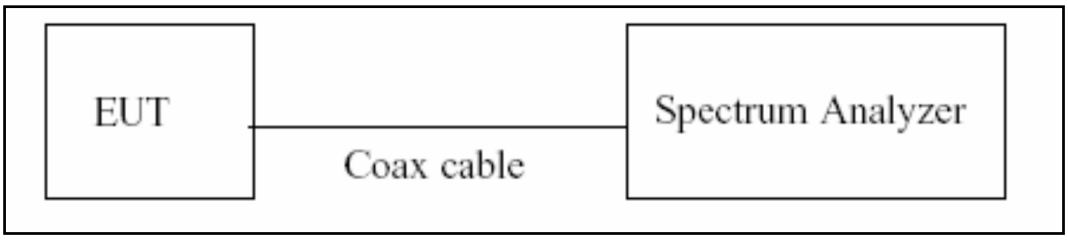
The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.90 (Confidence level about 95 %, k=2)
Radiated Disturbance (9 kHz ~ 30 MHz)	4.14 (Confidence level about 95 %, k=2)
Radiated Disturbance (30 MHz ~ 1 GHz)	5.82 (Confidence level about 95 %, k=2)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.74 (Confidence level about 95 %, k=2)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.76 (Confidence level about 95 %, k=2)
Radiated Disturbance (Above 40 GHz)	5.52 (Confidence level about 95 %, k=2)

7. DESCRIPTION OF TESTS

7.1. Duty Cycle

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

We tested according to the zero-span measurement method, 6.0)b) in KDB 558074 v05r02.

The largest available value of RBW is 8 MHz and VBW is 50 MHz.

The zero-span method of measuring duty cycle shall not be used if T ≤ 6.25 microseconds. (50/6.25 = 8)

The zero-span method was used because all measured T data are > 6.25 microseconds and both RBW and VBW are > 50/T.

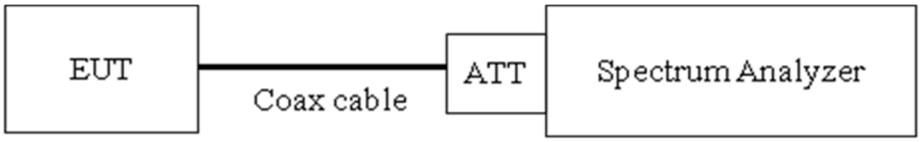
1. Set the center frequency of the instrument to the center frequency of the transmission.
2. RBW = 8 MHz(Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value.)
3. VBW = 8 MHz (≥ RBW)
4. SPAN = 0 Hz
5. Detector = Peak
6. Number of points in sweep > 100
7. Trace mode = Clear write
8. Measure T_{total} and T_{on}
9. Calculate Duty Cycle = T_{on}/ T_{total} and Duty Cycle Factor = 10log(1/Duty Cycle)

7.2. 6 dB Bandwidth

Limit

The minimum permissible 6 dB bandwidth is 500 kHz.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to (Procedure 11.8.1 in ANSI 63.10-2013)

1) RBW = 100 kHz
2) VBW ≥ 3 x RBW
3) Detector = Peak
4) Trace mode = Max hold
5) Sweep = auto couple
6) Allow the trace to stabilize
7) We tested 6 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 6 dB.

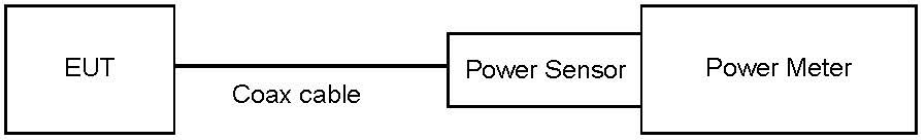
Note : We tested OBW using the automatic bandwidth measurement capability of a spectrum analyzer.

7.3. Output Power

Limit

The maximum permissible conducted output power is 1 Watt.

Test Configuration



Test Procedure

The transmitter output is connected to the Power Meter.

- Peak Power (Procedure 11.9.1.3 in ANSI 63.10-2013)
  : Measure the peak power of the transmitter.

- Average Power (Procedure 11.9.2.3 in ANSI 63.10-2013)
  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.

Sample Calculation

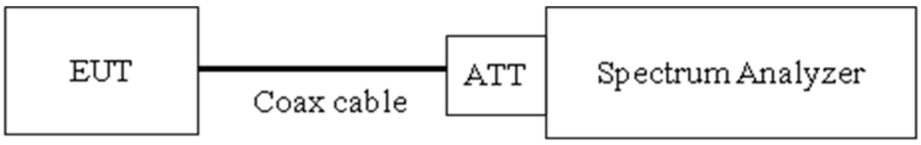
- Conducted Output Power(Peak) = Measured Value + ATT loss + Cable loss
- Conducted Output Power(Average) = Measured Value + ATT loss + Cable loss + Duty Cycle Factor

7.4. Power Spectral Density

Limit

The transmitter power density average over 1-second interval shall not be greater than 8 dBm in any 3 kHz BW.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

We tested according to Procedure 8.4 in KDB 558074 v05r02, Procedure 11.10 in ANSI 63.10-2013.

The spectrum analyzer is set to :

1) Set analyzer center frequency to DTS channel center frequency.
2) Span = 1.5 times the DTS channel bandwidth.
3) RBW = 3 kHz ≤ RBW ≤ 100 kHz.
4) VBW ≥ 3 x RBW.
5) Sweep = auto couple
6) Detector = power averaging (rms) or sample detector (when rms not available).
7) Ensure that the number of measurement points in the sweep ≥ [2 × span / RBW].
8) Employ trace averaging (rms) mode over a minimum of 100 traces
9) Use the peak marker function to determine the maximum amplitude level.
10) Use the peak marker function to determine the maximum amplitude level within the RBW.
    If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.
11) if then duty factor shall be added to adjust the result if the duty cycle is less than 98 %

Sample Calculation

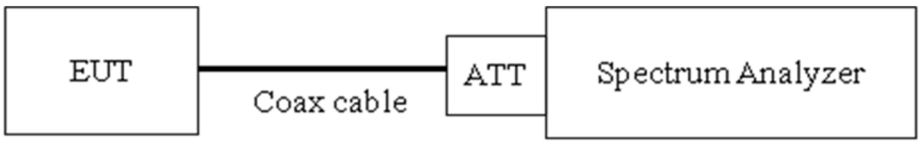
- Power Spectral Density = Measured Value + ATT loss + Cable loss + Duty Cycle Factor

7.5. Conducted Band Edge(Out of Band Emissions) & Conducted Spurious Emissions

Limit

The maximum conducted (Average) output power was used to demonstrate compliance, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least relative to the maximum in-band peak PSD level in 100 kHz.
[Conducted > 30 dBc]

Test Configuration



Test Procedure

The transmitter output is connected to the spectrum analyzer.
(Procedure 11.11 in ANSI 63.10-2013)

1) RBW = 100 kHz
2) VBW ≥ 3 x RBW
3) Set span to encompass the spectrum to be examined
4) Detector = Peak
5) Trace Mode = Max hold
6) Sweep time = auto couple
7) Ensure that the number of measurement points ≥ 2 x Span/RBW
8) Allow trace to fully stabilize.
9) Use peak marker function to determine the maximum amplitude level.

Measurements are made over the 30 MHz to 10 times the operating frequency range(10 GHz) with the transmitter set to the lowest, middle, and highest channels.

Factors for frequency

Freq(MHz)	Factor(dB)
30	20.10
100	20.15
200	20.19
300	20.24
400	20.30
500	20.30
600	20.31
700	20.32
800	20.33
900	20.35
902	20.35
928	20.35
1 000	20.40
2 000	20.65
2 400	20.74
2 500	20.74
3 000	20.89
4 000	21.13
5 000	21.65
5 700	21.74
5 800	21.74
6 000	21.83
7 000	21.96
8 000	21.96
9 000	22.04
10 000	22.14
11 000	22.23
12 000	22.32
13 000	22.33
14 000	22.36
15 000	22.46
16 000	22.54
17 000	22.75
18 000	22.88
19 000	22.80
20 000	22.47
21 000	22.60
22 000	22.59
23 000	22.60
24 000	22.61
25 000	22.71

Note :
1. 902 ~ 928 MHz is fundamental frequency range.
2. Factor = Cable loss + Attenuator

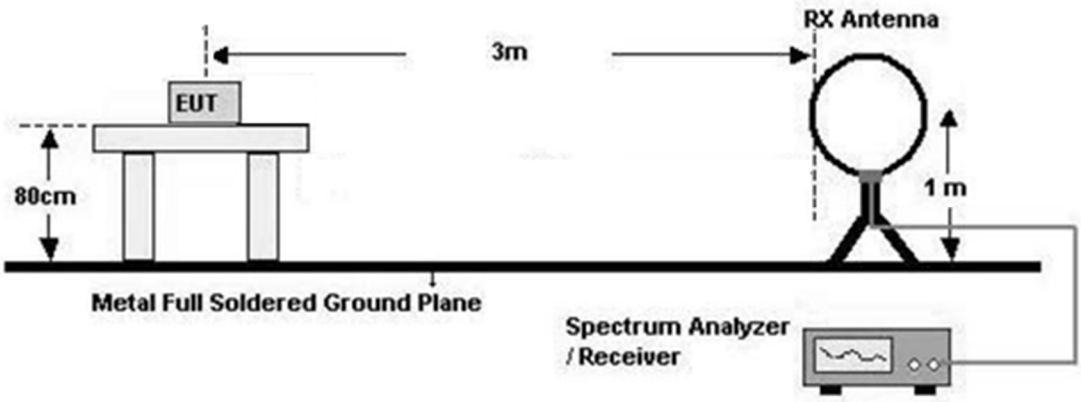
7.6. Radiated Test

Limit

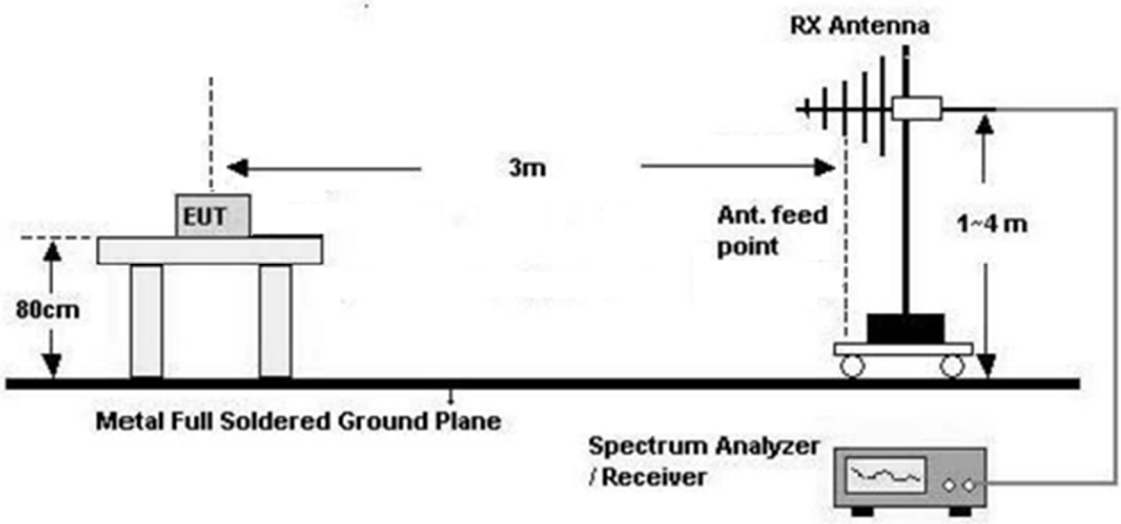
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

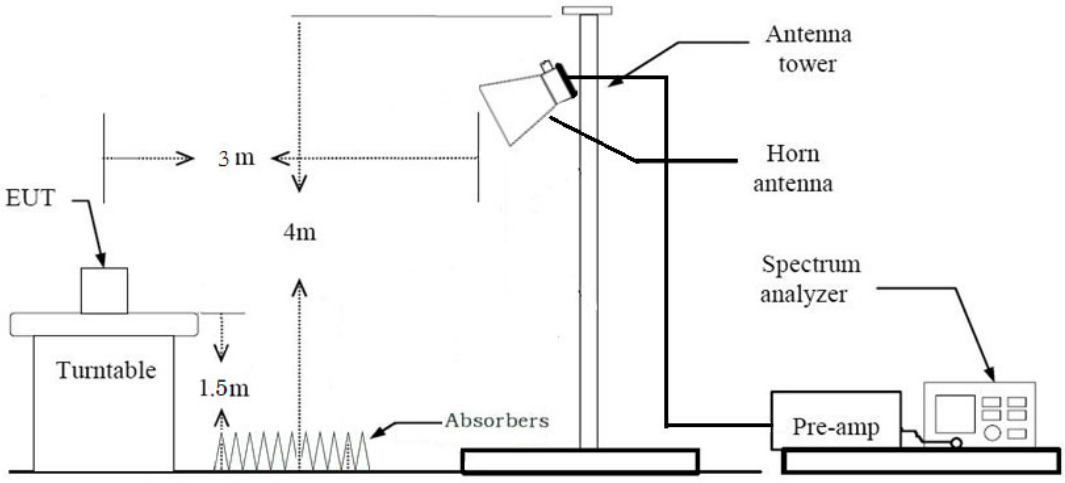
Below 30 MHz



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 0.8 m 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 0.8 m 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 (Method 8.6 in KDB 558074 v05r02, Procedure 11.12 in ANSI 63.10-2013)
   (1) Measurement Type(Peak):

- Measured Frequency Range : 1 GHz – 10th Harmonics
- Detector = Peak
- Trace = Max hold
- RBW = 1 MHz
- VBW ≥ 3 x RBW

(2) Measurement Type(Average): Duty cycle ≥ 98 %

- Measured Frequency Range : 1 GHz – 10th Harmonics
- Detector = RMS
- Averaging type = power (*i.e.*, RMS)
- RBW = 1 MHz
- VBW ≥ 3 x RBW
- Sweep time = auto.
- Trace mode = average (at least 100 traces).

(3) Measurement Type(Average): Duty cycle < 98 %, duty cycle variations are less than ±2 %

- Measured Frequency Range : 1 GHz – 10th Harmonics
- Detector = RMS
- Averaging type = power (*i.e.*, RMS)
- RBW = 1 MHz
- VBW ≥ 3 x RBW
- Sweep time = auto.
- Trace mode = average (at least 100 traces).
- Correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle.
- Duty Cycle Factor (dB) : Please refer to the please refer to section 9.1.

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. Distance extrapolation factor = 20log (test distance / specific distance) (dB)

10. Total(Measurement Type : Peak)

= Peak Measured Value

Total(Measurement Type : Average)

= Average Measured Value + Duty Cycle Factor

- We apply to the offset in range 1 GHz - 18 GHz
- The offset = Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F) - Amp.Gain(A.G)

7.7. 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. Detectors : Quasi Peak and Average Detector.
5. The EUT is the device operating below 30 MHz.
   - For unterminated the Antenna, the AC line conducted tests are performed with the antenna connected
   - For terminated the Antenna, the AC line conducted tests are performed with a dummy load connected to the EUT antenna output terminal.

Sample Calculation

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

7.8. Worst case configuration and mode

Radiated test

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 data rate of operation were investigated and the test results are worst case of each mode.
   Supported datarate
   - 1 M Bandwidth : MCS 10, MCS 0 ~ MCS 7, 2 M / 4 M Bandwidth : MCS 0 ~ MCS 7

   Worst case datarate
   - 1 M Bandwidth : MCS 10, 2M / 4 M Bandwidth : MCS 0
4. Test was performed with continuous Tx. (D ≥ 98 %)
5. All Banndwidth of operation were investigated and the test results are worst case of each mode.
   - 1 M Bandwidth, 2M / 4 M Bandwidth
   - Worst case : 1 M Bandwidth
6. 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. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone

Conducted test

1. All data rate of operation were investigated and the test results are worst case of each mode.
   Supported datarate
   - 1M Bandwidth : MCS 10, MCS 0 ~ MCS 7, 2M/4M Bandwidth : MCS 0 ~ MCS 7

   Worst case datarate
   - 1M Bandwidth : MCS 10, 2M/4M Bandwidth : MCS 0
2. Test was performed with continuous Tx. (D ≥ 98 %)

8. SUMMARY TEST OF RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	§ 15.247(a)(2)	> 500 kHz	Conducted	PASS
Conducted Maximum Output Power	§ 15.247(b)(3)	< 1 Watt		PASS
Power Spectral Density	§ 15.247(e)	< 8 dBm / 3 kHz Band		PASS
Band Edge (Out of Band Emissions)	§ 15.247(d)	Conducted > 30 dBc		PASS
AC Power line Conducted Emissions	§ 15.207	cf. Section 7.7		PASS
Radiated Spurious Emissions	§ 15.247(d), 15.205, 15.209	cf. Section 7.6	Radiated	PASS
Radiated Restricted Band Edge	§ 15.247(d), 15.205, 15.209	cf. Section 7.6		PASS

9. TEST RESULT

9.1 DUTY CYCLE

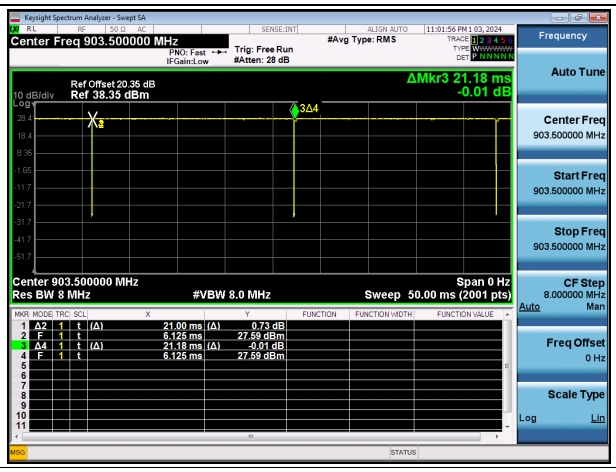
Bandwidth	Data rate	T_{on} (ms)	T_{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
1 M	MCS 10	21.000	21.180	0.992	0.037
	MCS 0	21.010	21.160	0.993	0.031
	MCS 1	21.000	21.180	0.992	0.037
	MCS 2	21.000	21.160	0.992	0.033
	MCS 3	21.010	21.180	0.992	0.035
	MCS 4	21.000	21.180	0.992	0.037
	MCS 5	21.010	21.160	0.993	0.031
	MCS 6	21.000	21.180	0.992	0.037
	MCS 7	21.020	21.180	0.992	0.033
2 M	MCS 0	20.680	20.850	0.992	0.036
	MCS 1	20.680	20.880	0.990	0.042
	MCS 2	20.690	20.850	0.992	0.033
	MCS 3	20.670	20.860	0.991	0.040
	MCS 4	20.680	20.850	0.992	0.036
	MCS 5	20.680	20.850	0.992	0.036
	MCS 6	20.690	20.860	0.992	0.036
	MCS 7	20.680	20.860	0.991	0.038
4 M	MCS 0	20.680	20.930	0.988	0.052
	MCS 1	20.680	20.920	0.989	0.050
	MCS 2	20.670	20.920	0.988	0.052
	MCS 3	20.680	20.930	0.988	0.052
	MCS 4	20.690	20.920	0.989	0.048
	MCS 5	20.680	20.930	0.988	0.052
	MCS 6	20.690	20.920	0.989	0.048
	MCS 7	20.680	20.920	0.989	0.050

Note:

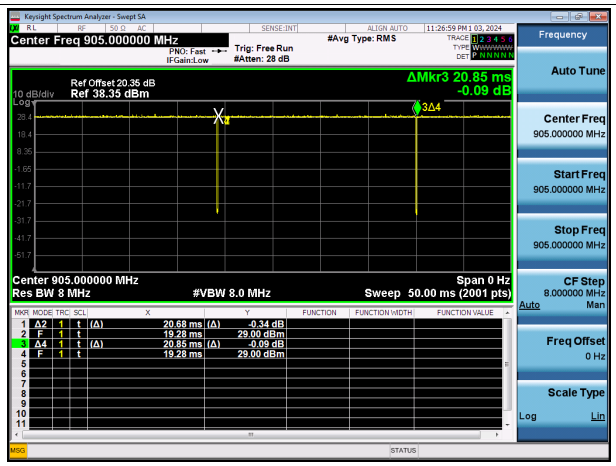
In order to simplify the report, attached plots were only the lowest data rate.

▣ Test Plots

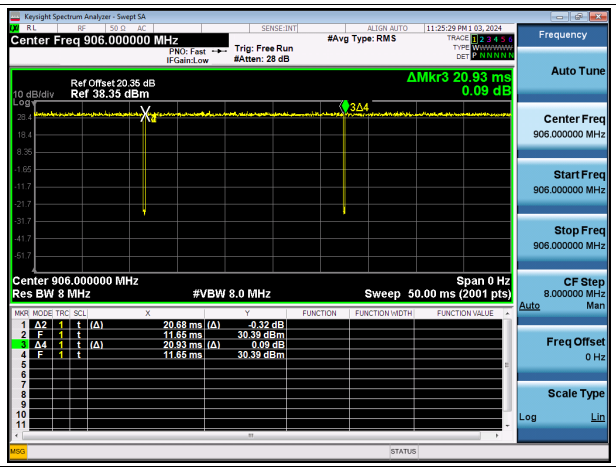
1 M Bandwidth (MCS 10)



2 M Bandwidth (MCS 0)



4 M Bandwidth (MCS 0)



9.2 6 dB BANDWIDTH

Bandwidth	Frequency [MHz]	6 dB Bandwidth [kHz]	Minimum Bandwidth [MHz]
1 M	903.5	871.0	> 0.5
	915.5	865.3	> 0.5
	926.5	866.2	> 0.5
2 M	905.0	1.792	> 0.5
	915.0	1.786	> 0.5
	925.0	1.791	> 0.5
4 M	906.0	3.633	> 0.5
	914.0	3.637	> 0.5
	922.0	3.638	> 0.5

Note:

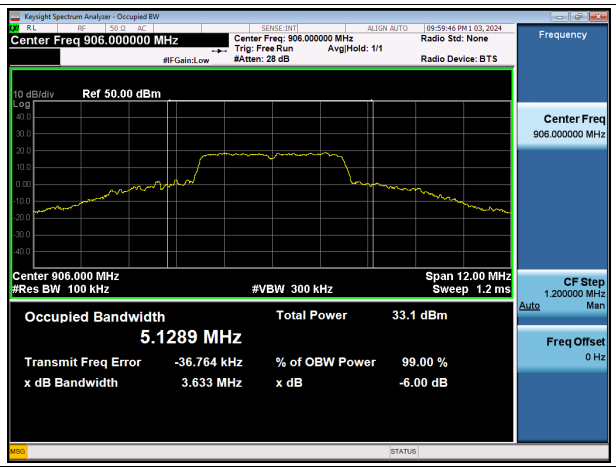
In order to simplify the report, attached plots were only the most narrow 6 dB BW channel.

▣ Test Plots

1 M Bandwidth_903.5 MHz

2 M Bandwidth_915.0 MHz

4 M Bandwidth_906.0 MHz



9.3 OUTPUT POWER

Peak Power

Bandwidth	Frequency [MHz]	Peak Power(dBm)	Limit (dBm)
1 M	903.5	29.31	30
	915.5	29.35	
	926.5	29.28	
2 M	905.0	29.44	
	915.0	29.52	
	925.0	29.60	
4 M	906.0	29.33	
	914.0	29.51	
	922.0	29.59	

Average Power

Bandwidth	Frequency [MHz]	Max. Avg Ouput Power (dBm)			Limit (dBm)
		Measured Power [dBm]	Duty Cycle Factor [dB]	Total Power [dBm]	
1 M	903.5	23.13	0.00	23.13	30
	915.5	23.15	0.00	23.15	
	926.5	22.98	0.00	22.98	
2 M	905.0	23.04	0.00	23.04	
	915.0	22.99	0.00	22.99	
	925.0	22.89	0.00	22.89	
4 M	906.0	21.13	0.00	21.13	
	914.0	23.01	0.00	23.01	
	922.0	22.85	0.00	22.85	

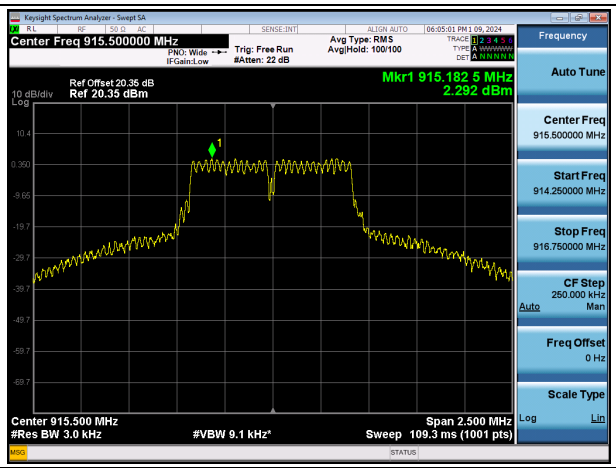
9.4 POWER SPECTRAL DENSITY

Bandwidth	Frequency [MHz]	Max. Power Spectral Density			Limit (dBm/3kHz)
		Measured PSD (dBm/3 kHz)	Duty Cycle Factor [dB]	Total PSD (dBm/3 kHz)	
1 M	903.5	2.201	0.00	2.201	8
	915.5	2.292	0.00	2.292	
	926.5	2.173	0.00	2.173	
2 M	905.0	-1.362	0.00	-1.362	
	915.0	-1.322	0.00	-1.322	
	925.0	-1.403	0.00	-1.403	
4 M	906.0	-7.089	0.00	-7.089	
	914.0	-4.296	0.00	-4.296	
	922.0	-4.452	0.00	-4.452	

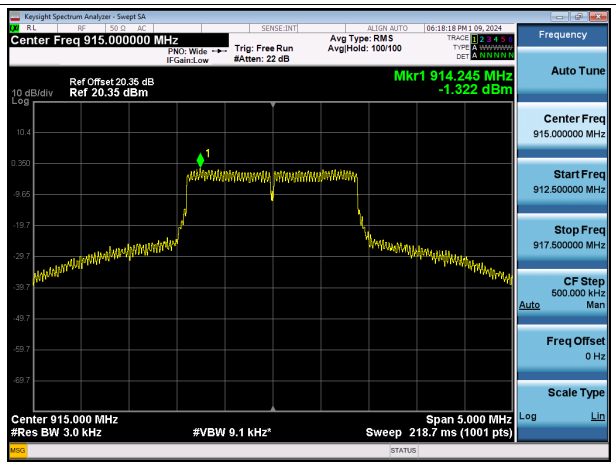
Note : In order to simplify the report, attached plots were only the worst case PSD channel.

▣ Test Plots

1 M Bandwidth_915.5 MHz



2 M Bandwidth_915.0 MHz



4 M Bandwidth_914.0 MHz

9.5 BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS

[BAND EDGE]

Bandwidth	Frequency [MHz]	Band Edge Position	Test Result		
			Measured Level (dB)	Limit (dBc)	Pass / Fail
1 M	903.5	Lower	34.745	30	Pass
	926.5	Upper	31.068		
2 M	905.0	Lower	32.468		
	925.0	Upper	32.231		
4 M	906.0	Lower	30.686		
	922.0	Upper	35.467		

Note :

At the 910 MHz of 4 MHz Bandwidth, The conducted bandedge measurement result at maximum power is sufficiently low compared to the limit.

▣ Test Plots(Band Edge)

1 M Bandwidth _903.5 MHz

1 M Bandwidth _926.5 MHz

1 M Bandwidth _905.0 MHz

2 M Bandwidth _925.0 MHz

4 M Bandwidth _906.0 MHz

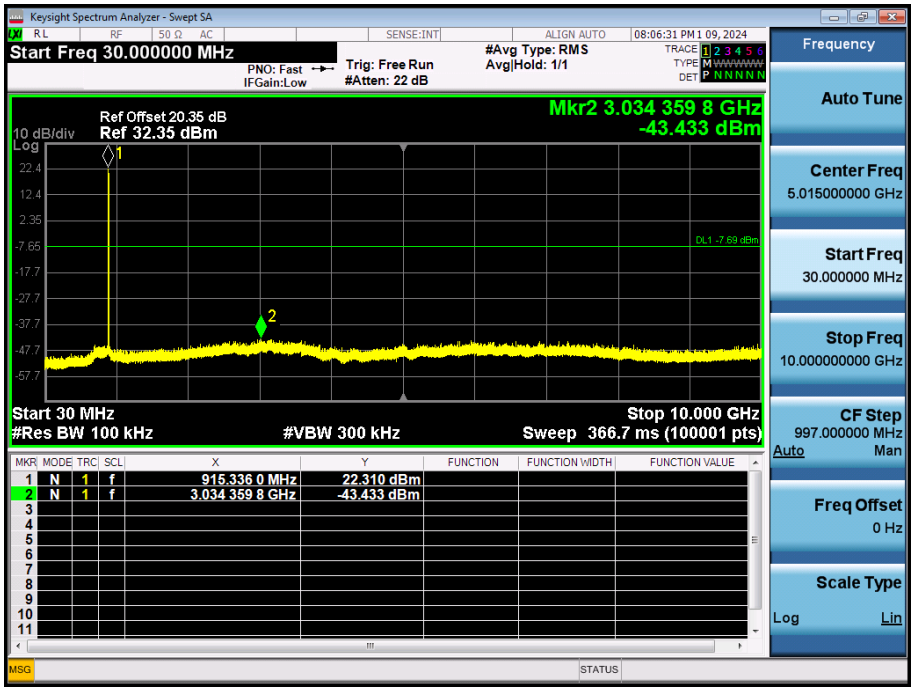
4 M Bandwidth _922.0 MHz

▣ Test Plots(Conducted Spurious Emission)

In order to simplify the report, attached plots were only the worst case channel and data rate.

- Worst case : 1 M Bandwidth_915.5 MHz

Spurious Emission (30 MHz – 10 GHz)



Note:

Limit : -7.69 dBm

9.6 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30 MHz

Frequency	Measured Level	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
[MHz]	[dBμV/m]	[dB/m]	[dB]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]
No Critical peaks found							

Note:

1. The Measured Level 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 Level	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
[MHz]	[dBμV/m]	[dB/m]	[dB]	[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

1 M Bandwidth_ 903.5 MHz

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBµV]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	
2 710.50	51.11	H	51.11	73.98	22.87	PK
2 710.50	38.58	H	38.58	53.98	15.40	AV
3 614.00	51.12	H	51.12	73.98	22.86	PK
3 614.00	40.47	H	40.47	53.98	13.51	AV
4 517.50	56.75	H	56.75	73.98	17.23	PK
4 517.50	43.71	H	43.71	53.98	10.27	AV
5 421.00	65.33	H	65.33	73.98	8.65	PK
5 421.00	50.00	H	50.00	53.98	3.98	AV
8 131.50	57.94	H	57.94	73.98	16.04	PK
8 131.50	44.28	H	44.28	53.98	9.70	AV
9 035.00	61.36	H	61.36	73.98	12.62	PK
9 035.00	43.65	H	43.65	53.98	10.33	AV

Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (30 dBc)

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBµV]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	
2 710.50	54.22	V	54.22	73.98	19.76	PK
2 710.50	40.51	V	40.51	53.98	13.47	AV
3 614.00	54.57	V	54.57	73.98	19.41	PK
3 614.00	43.93	V	43.93	53.98	10.05	AV
4 517.50	55.72	V	55.72	73.98	18.26	PK
4 517.50	43.49	V	43.49	53.98	10.49	AV
5 421.00	58.47	V	58.47	73.98	15.51	PK
5 421.00	44.80	V	44.80	53.98	9.18	AV
8 131.50	59.01	V	59.01	73.98	14.97	PK
8 131.50	45.37	V	45.37	53.98	8.61	AV
9 035.00	62.57	V	62.57	73.98	11.41	PK
9 035.00	43.32	V	43.32	53.98	10.66	AV

Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (30 dBc)

1 M Bandwidth_ 915.5 MHz

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBµV]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	
2 746.50	53.90	H	53.90	73.98	20.08	PK
2 746.50	40.95	H	40.95	53.98	13.03	AV
3 662.00	56.30	H	56.30	73.98	17.68	PK
3 662.00	44.53	H	44.53	53.98	9.45	AV
4 577.50	56.54	H	56.54	73.98	17.44	PK
4 577.50	45.81	H	45.81	53.98	8.17	AV
7 324.00	69.97	H	69.97	73.98	4.01	PK
7 324.00	50.05	H	50.05	53.98	3.93	AV

Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (30 dBc)

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBµV]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	
2 746.50	53.46	V	53.46	73.98	20.52	PK
2 746.50	41.27	V	41.27	53.98	12.71	AV
3 662.00	54.58	V	54.58	73.98	19.40	PK
3 662.00	42.91	V	42.91	53.98	11.07	AV
7 324.00	69.77	V	69.77	73.98	4.21	PK
7 324.00	49.84	V	49.84	53.98	4.14	AV
8 239.50	57.60	V	57.60	73.98	16.38	PK
8 239.50	43.91	V	43.91	53.98	10.07	AV
9 155.00	65.38	V	65.38	73.98	8.60	PK
9 155.00	49.78	V	49.78	53.98	4.20	AV

Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (30 dBc)

1 M Bandwidth_ 926.5 MHz

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBµV]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	
2 779.50	54.55	H	54.55	73.98	19.43	PK
2 779.50	42.17	H	42.17	53.98	11.81	AV
4 632.50	54.26	H	54.26	73.98	19.72	PK
4 632.50	43.67	H	43.67	53.98	10.31	AV
7 412.00	70.92	H	70.92	73.98	3.06	PK
7 412.00	50.76	H	50.76	53.98	3.22	AV
8 338.50	59.95	H	59.95	73.98	14.03	PK
8 338.50	44.49	H	44.49	53.98	9.49	AV

Note :

1. Non Restricted Band refer to Conducted Spurious emission test result (30 dBc)

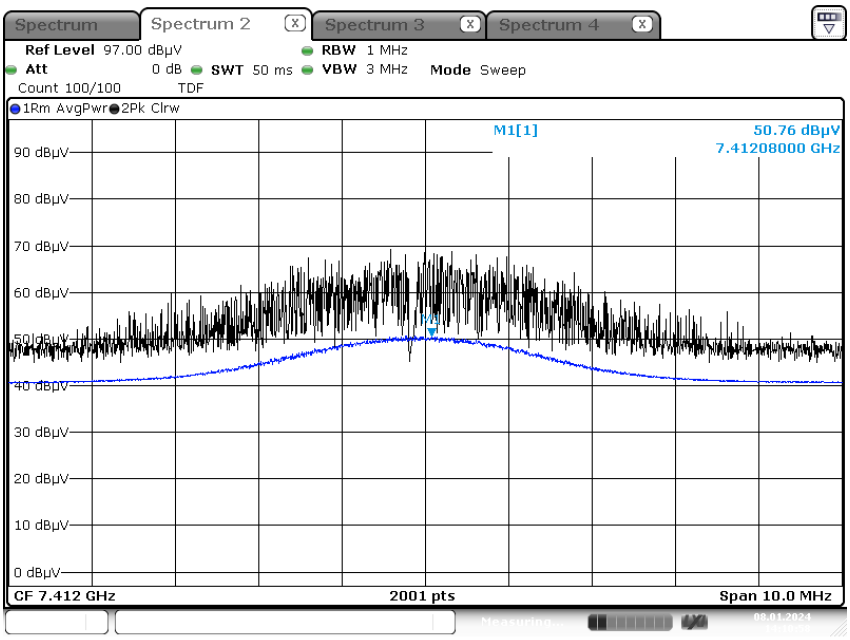
Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Detect
[MHz]	[dBµV]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	
2 779.50	55.56	V	55.56	73.98	18.42	PK
2 779.50	43.47	V	43.47	53.98	10.51	AV
3 706.00	59.03	V	59.03	73.98	14.95	PK
3 706.00	46.91	V	46.91	53.98	7.07	AV
4 632.50	53.56	V	53.56	73.98	20.42	PK
4 632.50	42.27	V	42.27	53.98	11.71	AV
7 412.00	70.57	V	70.57	73.98	3.41	PK
7 412.00	49.58	V	49.58	53.98	4.40	AV
8 338.50	58.90	V	58.90	73.98	15.08	PK
8 338.50	41.12	V	41.12	53.98	12.86	AV

Note :

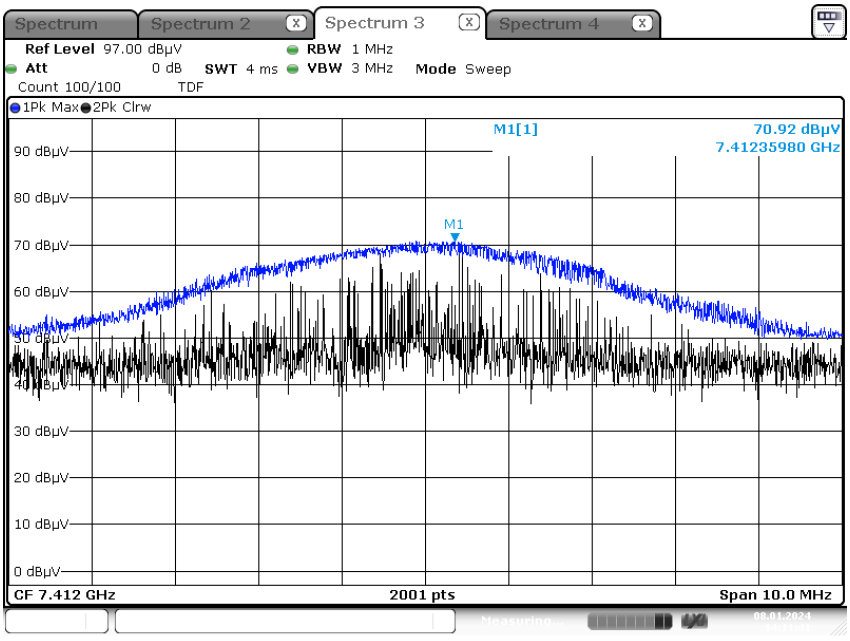
1. Non Restricted Band refer to Conducted Spurious emission test result (30 dBc)

▣ Test Plots (Worst case : Y-H)

Radiated Spurious Emissions plot – Average Result (926.5 MHz 8th Harmonic)



Radiated Spurious Emissions plot – Peak Result (926.5 MHz 8th Harmonic)



Note:

Plots of worst case are only reported.

9.7 POWERLINE CONDUCTED EMISSIONS

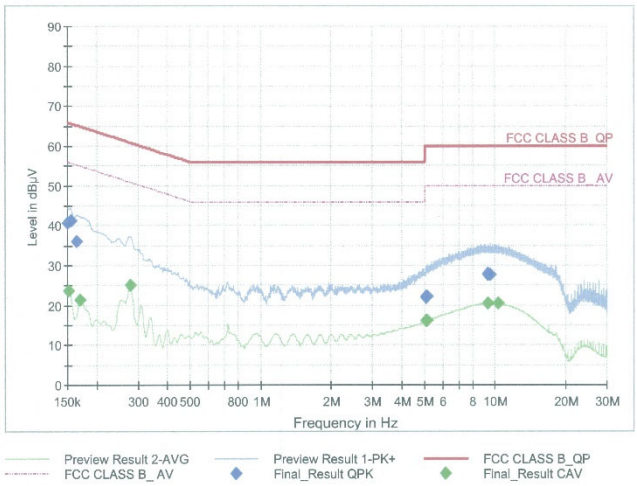
Test 1 / 1

Test Report

Common Information

EUT : WHM200A
Operating Conditions : 802.11ah Mode
Comment :

Full Spectrum



Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.1500	40.81	66.00	25.19	9.000	N	9.6
0.1545	41.22	65.75	24.54	9.000	N	9.6
0.1635	36.19	65.28	29.10	9.000	N	9.6
5.0900	22.16	60.00	37.84	9.000	L1	9.8
5.0990	21.96	60.00	38.04	9.000	L1	9.8
5.1035	22.26	60.00	37.74	9.000	L1	9.8
9.3110	27.66	60.00	32.34	9.000	L1	10.0
9.3583	27.84	60.00	32.16	9.000	L1	10.0
9.5000	27.79	60.00	32.21	9.000	L1	10.0

Final_Result_CAV

Frequency (MHz)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.1523	23.65	55.88	32.23	9.000	L1	9.6
0.1703	21.30	54.95	33.65	9.000	L1	9.6
0.2783	25.23	50.87	25.63	9.000	L1	9.6
5.0968	16.05	50.00	33.95	9.000	L1	9.8
5.1148	16.13	50.00	33.87	9.000	L1	9.8
5.1418	16.08	50.00	33.92	9.000	L1	9.8
9.2998	20.49	50.00	29.51	9.000	L1	10.0
9.3110	20.49	50.00	29.51	9.000	L1	10.0
10.3460	20.39	50.00	29.61	9.000	L1	10.1

2024-01-16 오전 9:03:38

10. LIST OF TEST EQUIPMENT

Conducted Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
LISN	ENV216	Rohde & Schwarz	102245	08/02/2024	Annual
EMI Test Receiver	ESR	Rohde & Schwarz	101910	05/26/2024	Annual
Temperature Chamber	SU-642	ESPEC	93008124	02/22/2024	Annual
Signal Analyzer	N9030A	Keysight	MY55410508	09/04/2024	Annual
Power Meter	N1911A	Agilent	MY45100523	03/06/2024	Annual
Power Sensor	N1921A	Agilent	MY57820067	03/06/2024	Annual
Directional Coupler	87300B	Agilent	3116A03621	10/30/2024	Annual
Power Splitter	11667B	Hewlett Packard	10545	02/06/2024	Annual
DC Power Supply	E3632A	Agilent	KR75305528	01/02/2025	Annual
Attenuator(10 dB)(DC-26.5 GHz)	8493C-010	Agilent	08285	06/02/2024	Annual
Attenuator(20 dB)	18N-20dB	Rohde & Schwarz	8	03/08/2024	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	100808	02/16/2024	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(Antenna mast)	CO3000	Innco system	CO3000-4p	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	S3AM	08/03/2025	Biennial
Controller	EM2090	Emco	060520	N/A	N/A
Turn Table	N/A	Ets	N/A	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-333	03/17/2024	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	9168-0895	08/16/2024	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
Amp & Filter Bank Switch Controller	FBSM-01A	TNM system	0	N/A	N/A
Band Reject Filter	WRCJV2400/2483.5-2370/2520-60/12SS	Wainwright Instruments	2	01/02/2025	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	5	06/12/2024	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	6	06/12/2024	Annual
Band Reject Filter	WRCJV5100/5850-40/50-8EEK	Wainwright Instruments	1	02/09/2024	Annual
RF Switching System	FBSR-03A (3G HPF+LNA)	T&M SYSTEM	S3L1	11/17/2024	Annual
RF Switching System	FBSR-03A (10dB ATT+LNA)	T&M SYSTEM	S3L2	11/17/2024	Annual
RF Switching System	FBSR-03A (7G HPF+LNA)	T&M SYSTEM	S3L3	11/17/2024	Annual
RF Switching System	FBSR-03A (3dB ATT+LNA)	T&M SYSTEM	S3L4	11/17/2024	Annual
Power Amplifier	CBL18265035	CERNEX	22966	11/17/2024	Annual
Power Amplifier	CBL26405040	CERNEX	25956	03/02/2024	Annual
Bluetooth Tester	TC-3000C	TESCOM	3000C000175	03/28/2024	Annual
Spectrum Analyzer	FSVA40 (10 Hz ~ 40 GHz)	Rohde & Schwarz	101502	03/17/2024	Annual
Spectrum Analyzer	FSV40 (10 Hz ~ 40 GHz)	Rohde & Schwarz	100900	12/06/2024	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).

11. ANNEX A_ TEST SETUP PHOTO

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

No.	Description
1	HCT-RF-2401-FC001-P