




# TEST REPORT

Report No. .... : CHTEW21120123 Report Verification: 

Project No. .... : SHT2108128604EW

FCC ID ..... : 2A3QD-WB-HSTS61A01

Applicant's name ..... : Telecom Square, Inc.

Address ..... : 3F Homat Horizon Building, 6-2 Gobancho, Chiyoda-ku, Tokyo 102-0076

Test item description ..... : TS-61

Trade Mark ..... : -

Model/Type reference ..... : TS-61

Listed Model(s) ..... : -

Standard ..... : FCC CFR Title 47 Part 15 Subpart E Section 15.407

Date of receipt of test sample ..... : Sep.02, 2021

Date of testing ..... : Sep.03, 2021-Dec.17, 2021

Date of issue ..... : Dec.20, 2021

Result ..... : PASS

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## 1. TEST STANDARDS AND REPORT VERSION

### 1.1. Test Standards

The tests were performed according to following standards:

- [FCC Rules Part 15.407](#): General technical requirements.
- [ANSI C63.10:2013](#): American National Standard for Testing Unlicensed Wireless Devices
- [KDB789033 D02 v02r01](#): GUIDELINES FOR COMPLIANCE TESTING OF UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE (U-NII) DEVICES PART 15, SUBPART E

### 1.2. Report version

Revision No.	Date of issue	Description
N/A	2021-12-20	Original

## 2. TEST DESCRIPTION

Report clause	Test Items	Standard Requirement	Result
5.1	Antenna Requirement	15.203/15.247(c)	PASS
5.2	AC Conducted Emission	15.207	PASS
5.3	Maximum Conducted Output Power	15.407(a)	PASS
5.4	Maximum Power Spectral Density	15.407(a)	PASS
5.5	26dB Bandwidth and 99% Occupancy bandwidth	15.407(a)	PASS
5.6	6dB Bandwidth	15.407(a)	PASS
5.7	Band edge	15.407(b)	PASS
5.8	Radiated Spurious Emissions	15.209	PASS
5.9	Frequency Stability	15.407(g)	PASS

Note:

- The measurement uncertainty is not included in the test result.

### 3. SUMMARY

#### 3.1. Client Information

Applicant:	Telecom Square, Inc.
Address:	3F Homat Horizon Building, 6-2 Gobancho, Chiyoda-ku, Tokyo 102-0076
Manufacturer:	Skyroam Technology Co., Ltd.
Address:	No.902, 9th Floor, Weisheng Technology Building, No.9966, Shennan Avenue, Shenzhen, Guangdong, China

#### 3.2. Product Description

Name of EUT:	TS-61
Trade Mark:	-
Model No.:	TS-61
Listed Model(s):	-
Power supply:	DC 3.8V
Hardware version:	Y6154A-V1.1
Software version:	y6154a_a_skyroam_v01_2021062914

#### 3.3. Radio Specification Description

Support type <sup>*1</sup>	<input checked="" type="checkbox"/> 802.11a <input checked="" type="checkbox"/> 802.11n(HT20) <input checked="" type="checkbox"/> 802.11n(HT40) <input checked="" type="checkbox"/> 802.11ac(HT20) <input checked="" type="checkbox"/> 802.11ac(HT40) <input checked="" type="checkbox"/> 802.11ac(HT80)
Function:	<input type="checkbox"/> Outdoor AP <input type="checkbox"/> Indoor AP <input type="checkbox"/> Fixed P2P <input checked="" type="checkbox"/> Client
Modulation:	BPSK, QPSK, 16QAM, 64QAM
Operation frequency:	<input checked="" type="checkbox"/> Band I: 5150MHz~5250MHz <input checked="" type="checkbox"/> Band IV: 5725MHz~5850MHz
Supported Bandwidth	20MHz: 802.11ac,802.11n, 802.11a
	40MHz: 802.11ac,802.11n
	80MHz: 802.11ac
Antenna type:	FPC Antenna
Antenna gain:	1.4dBi

Note:

\*1: only show the RF function associated with this report.

### 3.4. Testing Laboratory Information

Laboratory Name	Shenzhen Huatongwei International Inspection Co., Ltd.	
Laboratory Location	1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China	
Connect information:	Phone: 86-755-26715499 E-mail: <a href="mailto:cs@szhtw.com.cn">cs@szhtw.com.cn</a> <a href="http://www.szhtw.com.cn">http://www.szhtw.com.cn</a>	
Qualifications	Type	Accreditation Number
	FCC	762235

## 4. TEST CONFIGURATION

### 4.1. Test frequency list

According to section 15.31(m), regards to the operating frequency range over 10 MHz, must select three channels which were tested. The Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, please see the below .

Band	Test Channel	20MHz		40MHz		80MHz	
		Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
I	CH <sub>L</sub>	36	5180	38	5190	-	-
	CH <sub>M</sub>	44	5220	-	-	42	5210
	CH <sub>H</sub>	48	5240	46	5230	-	-
IV	CH <sub>L</sub>	149	5745	151	5755	-	-
	CH <sub>M</sub>	157	5785	-	-	155	5775
	CH <sub>H</sub>	165	5825	159	5795	-	-

### 4.2. Descriptions of Test mode

Preliminary tests were performed in different data rates, final test modes are considering the modulation and worse data rates as below table.

Modulation	Data rate
802.11a	6Mbps
802.11n(HT20)/ 802.11ac(HT20)	MCS0
802.11n(HT40)/ 802.11ac(HT40)	MCS0
802.11ac(HT80)	MCS0

### 4.3. Test mode

For RF test items
The engineering test program was provided and enabled to make EUT continuous transmit.
For AC power line conducted emissions:
The EUT was set to connect with the WLAN AP under large package sizes transmission.
For Radiated spurious emissions test item:
The engineering test program was provided and enabled to make EUT continuous transmit. The EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data Recorded in the report.

#### 4.4. Support unit used in test configuration and system

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The following peripheral devices and interface cables were connected during the measurement:

Whether support unit is used?					
✓ No					
Item	Equipement	Trade Name	Model No.	FCC ID	Power cord
1					
2					

#### 4.5. Testing environmental condition

Type	Requirement	Actual
Temperature:	15~35°C	25°C
Relative Humidity:	25~75%	50%
Air Pressure:	860~1060mbar	1000mbar

#### 4.6. Measurement uncertainty

Test Item	Measurement Uncertainty
AC Conducted Emission (150kHz~30MHz)	3.00 dB
Radiated Emission (30MHz~1000MHz)	4.36 dB
Radiated Emissions (1GHz~25GHz)	5.10 dB
Peak Output Power	0.77dB
Power Spectral Density	0.77dB
Conducted Spurious Emission	0.77dB
6dB Bandwidth	70Hz for <1GHz 130Hz for >1GHz
Frequency error	70Hz for <1GHz 130Hz for >1GHz

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.



## 4.7. Equipment Used during the Test

### ● Conducted Emission

Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Shielded Room	Albatross projects	HTWE0114	N/A	N/A	2018/09/28	2023/09/27
●	EMI Test Receiver	R&S	HTWE0111	ESCI	101247	2021/9/14	2022/9/13
●	Artificial Mains	SCHWARZBECK	HTWE0113	NNLK 8121	573	2021/9/17	2022/9/16
●	Pulse Limiter	R&S	HTWE0033	ESH3-Z2	100499	2021/9/13	2022/9/12
●	RF Connection Cable	HUBER+SUHNER	HTWE0113-02	ENVIROFLE X_142	EF-NM-BNCM-2M	2021/9/17	2022/9/16
●	Test Software	R&S	N/A	ES-K1	N/A	N/A	N/A

### ● Radiated emission-6th test site

Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Semi-Anechoic Chamber	Albatross projects	HTWE0127	SAC-3m-02	C11121	2018/09/30	2022/09/29
●	EMI Test Receiver	R&S	HTWE0099	ESCI	100900	2021/9/14	2022/9/13
●	Loop Antenna	R&S	HTWE0170	HFH2-Z2	100020	2021/04/06	2022/04/05
●	Ultra-Broadband Antenna	SCHWARZBECK	HTWE0123	VULB9163	538	2021/04/06	2022/04/05
●	Pre-Amplifier	SCHWARZBECK	HTWE0295	BBV 9742	N/A	2021/11/5	2022/11/4
●	RF Connection Cable	HUBER+SUHNER	HTWE0062-01	N/A	N/A	2021/02/26	2022/02/25
●	RF Connection Cable	HUBER+SUHNER	HTWE0062-02	SUCOFLEX104	501184/4	2021/02/26	2022/02/25
●	Test Software	R&S	N/A	ES-K1	N/A	N/A	N/A

### ● Radiated emission-7th test site

Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Semi-Anechoic Chamber	Albatross projects	HTWE0122	SAC-3m-01	N/A	2018/09/27	2022/09/26
●	Spectrum Analyzer	R&S	HTWE0098	FSP40	100597	2021/9/13	2022/9/12
●	Horn Antenna	SCHWARZBECK	HTWE0126	9120D	1011	2020/04/01	2023/03/31
●	Broadband Horn Antenna	SCHWARZBECK	HTWE0103	BBHA9170	BBHA9170472	2020/4/27	2023/4/27
●	Pre-amplifier	CD	HTWE0071	PAP-0102	12004	2021/11/5	2022/11/4
●	Broadband Pre-amplifier	SCHWARZBECK	HTWE0201	BBV 9718	9718-248	2021/03/05	2022/03/04
●	RF Connection Cable	HUBER+SUHNER	HTWE0120-01	6m 18GHz S Serisa	N/A	2021/02/26	2022/02/25
●	RF Connection Cable	HUBER+SUHNER	HTWE0120-02	6m 3GHz RG Serisa	N/A	2021/02/26	2022/02/25
●	RF Connection Cable	HUBER+SUHNER	HTWE0119-05	6m 3GHz RG Serisa	N/A	2021/02/26	2022/02/25
●	RF Connection Cable	HUBER+SUHNER	HTWE0120-04	6m 3GHz RG Serisa	N/A	2021/02/26	2022/02/25
●	RF Connection Cable	HUBER+SUHNER	HTWE0121-01	6m 18GHz S Serisa	N/A	2021/02/26	2022/02/25
●	Test Software	Audix	N/A	E3	N/A	N/A	N/A

● RF Conducted Method						
Used	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Signal and spectrum Analyzer	R&S	FSV40	100048	2021/9/13	2022/9/12
●	Spectrum Analyzer	Agilent	N9020A	MY50510187	2021/9/13	2022/9/12
●	Power Meter	Anritsu	ML249A	N/A	2021/9/13	2022/9/12
○	Radio communication tester	R&S	CMW500	137688-Lv	2021/9/13	2022/9/12

## 5. TEST CONDITIONS AND RESULTS

### 5.1. Antenna Requirement

#### Requirement

#### **FCC CFR Title 47 Part 15 Subpart C Section 15.203:**

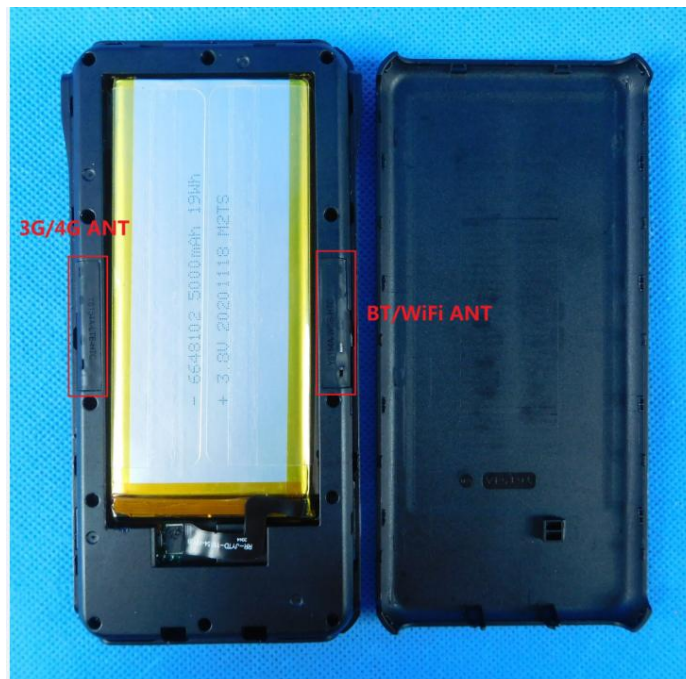
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

#### TEST RESULT

☒ **Passed**      ☐ **Not Applicable**

The antenna type is a FPC antenna, the directional gain of the antenna less than 6 dBi, please refer to the below antenna photo.

I



## 5.2. AC Conducted Emission

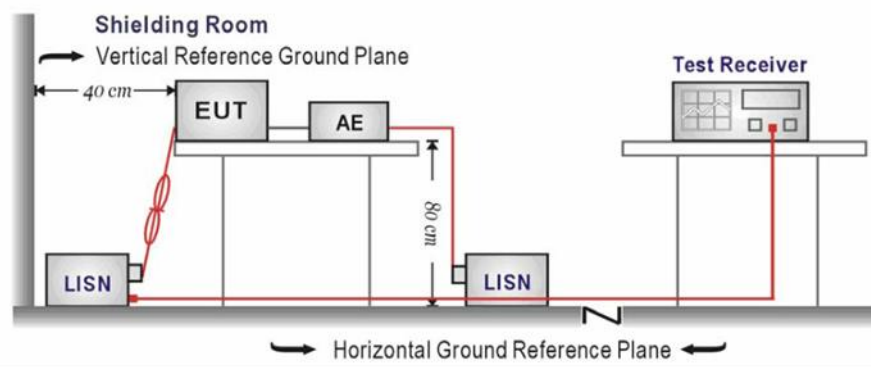
### LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.207

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\* Decreases with the logarithm of the frequency.

### TEST CONFIGURATION



### TEST PROCEDURE

1. The EUT was setup according to ANSI C63.10 requirements.
2. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface.
3. The EUT and simulators are connected to the main power through a line impedances stabilization network (LISN). The LISN provides a 50 ohm /50uH coupling impedance for the measuring equipment.
4. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs)
5. Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.
6. The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.
7. Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.
8. During the above scans, the emissions were maximized by cable manipulation.

### TEST MODE:

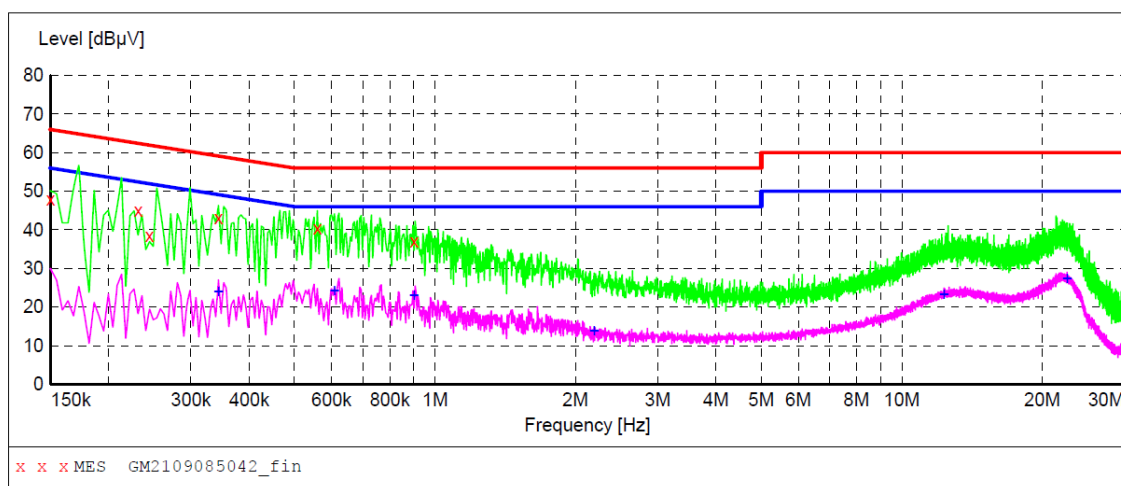
Please refer to the clause 4.3

### TEST RESULT

☒ Passed ☐ Not Applicable

Test Line:

L

**MEASUREMENT RESULT: "GM2109085042\_fin"**

9/8/2021 5:05PM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.150000	47.90	10.2	66	18.1	QP	L1	GND
0.231000	45.10	10.2	62	17.3	QP	L1	GND
0.244500	38.40	10.2	62	23.5	QP	L1	GND
0.343500	43.10	10.2	59	16.0	QP	L1	GND
0.559500	40.40	10.2	56	15.6	QP	L1	GND
0.901500	36.90	10.2	56	19.1	QP	L1	GND

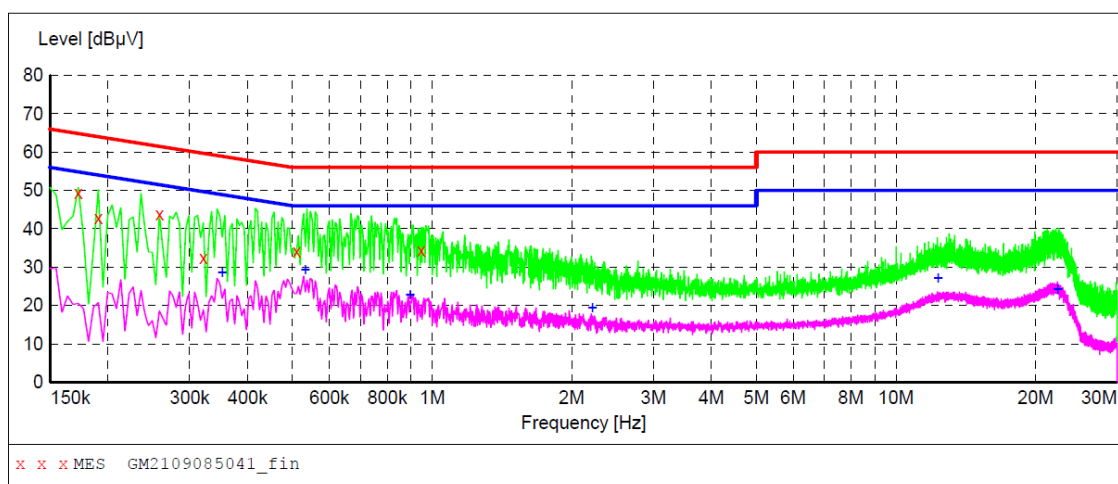
**MEASUREMENT RESULT: "GM2109085042\_fin2"**

9/8/2021 5:05PM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.343500	24.00	10.2	49	25.1	AV	L1	GND
0.609000	24.20	10.2	46	21.8	AV	L1	GND
0.901500	23.10	10.2	46	22.9	AV	L1	GND
2.193000	13.90	10.2	46	32.1	AV	L1	GND
12.304500	23.30	10.3	50	26.7	AV	L1	GND
22.605000	27.40	10.3	50	22.6	AV	L1	GND

Test Line:

N

**MEASUREMENT RESULT: "GM2109085041\_fin"**

9/8/2021 5:02PM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.172500	49.30	10.2	65	15.5	QP	N	GND
0.190500	42.70	10.2	64	21.3	QP	N	GND
0.258000	43.80	10.2	62	17.7	QP	N	GND
0.321000	32.30	10.2	60	27.4	QP	N	GND
0.510000	34.20	10.2	56	21.8	QP	N	GND
0.946500	34.30	10.2	56	21.7	QP	N	GND

**MEASUREMENT RESULT: "GM2109085041\_fin2"**

9/8/2021 5:02PM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.352500	28.60	10.2	49	20.3	AV	N	GND
0.532500	29.30	10.2	46	16.7	AV	N	GND
0.897000	22.70	10.2	46	23.3	AV	N	GND
2.215500	19.40	10.2	46	26.6	AV	N	GND
12.327000	27.00	10.3	50	23.0	AV	N	GND
22.326000	24.10	10.3	50	25.9	AV	N	GND

### 5.3. Maximum Conducted Output Power

#### LIMIT

#### FCC CFR Title 47 Part 15 Subpart E Section 15.407(a):

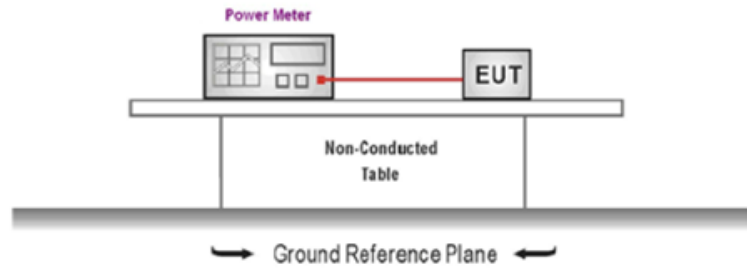
For the 5.15~5.25GHz band:

- Outdoor AP  
The maximum conducted output power ( $P_{out}$ ) shall not exceed the lesser of 1W (30dBm).  
if  $G_{TX} > 6\text{dBi}$ , then  $P_{out} = 30 - (G_{TX} - 6)$ . e.i.r.p. at any elevation angle above 30 degrees  $\leq 125\text{mW}$  (21dBm)
- Indoor AP  
The maximum conducted output power ( $P_{out}$ ) shall not exceed the lesser of 1W (30dBm).  
if  $G_{TX} > 6\text{dBi}$ , then  $P_{out} = 30 - (G_{TX} - 6)$ .
- Point-to-point AP  
The maximum conducted output power ( $P_{out}$ ) shall not exceed the lesser of 1W (30dBm).  
if  $G_{TX} > 23\text{dBi}$ , then  $P_{out} = 30 - (G_{TX} - 23)$ .
- Client devices  
The maximum conducted output power ( $P_{out}$ ) shall not exceed the lesser of 250W (24dBm).  
if  $G_{TX} > 6\text{dBi}$ , then  $P_{out} = 24 - (G_{TX} - 6)$ .

For the 5.725~5.85GHz band:

- Point-to-multipoint systems (P2M)  
The maximum conducted output power ( $P_{out}$ ) shall not exceed the lesser of 1W (30dBm).  
if  $G_{TX} > 6\text{dBi}$ , then  $P_{out} = 30 - (G_{TX} - 6)$ .
- Point-to-point systems (P2P)  
The maximum conducted output power ( $P_{out}$ ) shall not exceed the lesser of 1W (30dBm).

#### TEST CONFIGURATION



#### TEST PROCEDURE

1. The EUT was tested according to KDB789033 Section E-3-b)
2. The maximum conducted output power may be measured using a broadband AVG RF power meter.
3. Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor.
4. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter.
5. Record the measurement data.

#### 6. TEST MODE:

Please refer to the clause 4.3

#### TEST RESULT

☒ Passed      ☐ Not Applicable

#### TEST Data

Please refer to appendix A on the appendix report

## 5.4. Power Spectral Density

### LIMIT

FCC CFR Title 47 Part 15 Subpart E Section 15.407(a):

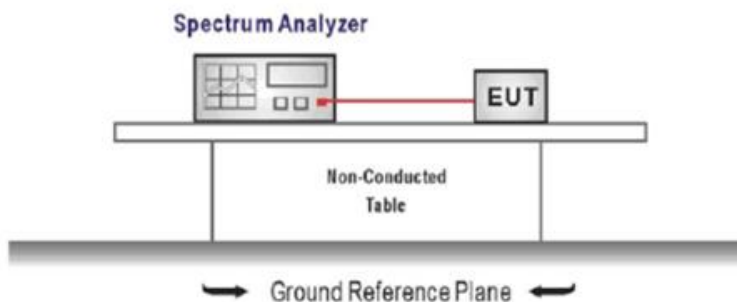
For the 5.15~5.25GHz band:

- Outdoor AP  
The peak power spectral density (PSD) shall not exceed the lesser of 17dBm/MHz.  
if  $G_{TX} > 6\text{dBi}$ , then  $\text{PSD} = 17 - (G_{TX} - 6)$ .
- Indoor AP  
The peak power spectral density (PSD) shall not exceed the lesser of 17dBm/MHz.  
if  $G_{TX} > 6\text{dBi}$ , then  $\text{PSD} = 17 - (G_{TX} - 6)$ .
- Point-to-point AP  
The peak power spectral density (PSD) shall not exceed the lesser of 17dBm/MHz.  
if  $G_{TX} > 23\text{dBi}$ , then  $\text{PSD} = 17 - (G_{TX} - 23)$ .
- Client devices  
The peak power spectral density (PSD) shall not exceed the lesser of 11dBm/MHz.  
if  $G_{TX} > 6\text{dBi}$ , then  $\text{PSD} = 11 - (G_{TX} - 6)$ .

For the 5.725~5.85GHz band:

- Point-to-multipoint systems (P2M)  
The peak power spectral density (PSD) shall not exceed the lesser of 30dBm/500kHz.  
if  $G_{TX} > 6\text{dBi}$ , then  $\text{PSD} = 30 - (G_{TX} - 6)$ .
- Point-to-point systems (P2P)  
The peak power spectral density (PSD) shall not exceed the lesser of 30dBm/500kHz.

### TEST CONFIGURATION



### TEST PROCEDURE

1. According KDB 789033 D02 – Section F
2. Analyzer was setting as follow:  
Center frequency: test channel  
Span was set to encompass the entire emission bandwidth of the signal  
RBW=1MHz for devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz  
RBW=500kHz for devices operating in the band 5.725-5.85 GHz  
VBW  $\geq$  3 RBW  
Number of sweep points  $> 2 \times (\text{span}/\text{RBW})$   
Sweep time = auto  
Detector = Peak  
Trigger was set to free run for all modes, trace was averaged over 100 sweeps
3. The peak search function of the spectrum analyzer was used to find the peak of the spectrum.



**TEST MODE:**

Please refer to the clause 4.3

**TEST RESULT**

☒ **Passed**      ☐ **Not Applicable**

**TEST Data**

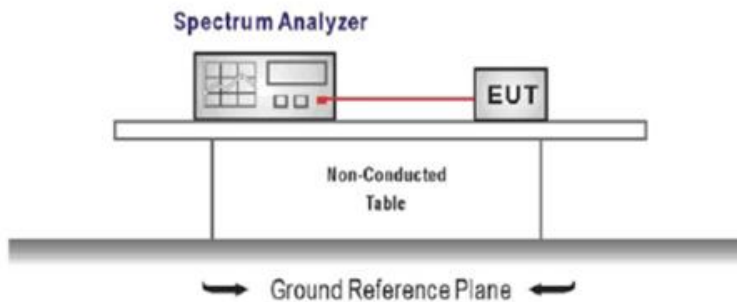
Please refer to appendix B on the appendix report

## 5.5. 26dB bandwidth and 99% Occupancy bandwidth

### LIMIT

The bandwidth at 26dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in KDB 789033 D02 , and at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 26dB bandwidth.

### TEST CONFIGURATION



### TEST PROCEDURE

1. According KDB 789033 D02 – Section C, 26dB bandwidth test as follow
  - a) Set RBW = approximately 1% of the emission bandwidth.
  - b) Set the VBW > RBW.
  - c) Detector = Peak.
  - d) Trace mode = max hold.
  - e) 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%.
2. According KDB 789033 D02 – Section D, 99% bandwidth test as follow
  - a). Set center frequency to the nominal EUT channel center frequency.
  - b). Set span = 1.5 times to 5.0 times the OBW.
  - c). Set RBW = 1% to 5% of the OBW
  - d). Set VBW  $\geq 3$  RBW
  - e). Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
  - f). Use the 99% power bandwidth function of the instrument

### TEST MODE:

Please refer to the clause 4.3

### TEST RESULT

☒ Passed ☐ Not Applicable

### TEST Data

Please refer to appendix C and D on the appendix report

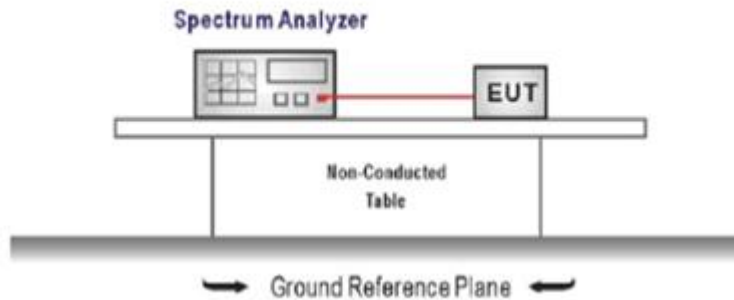
## 5.6. 6dB Bandwidth

### LIMIT

#### **FCC CFR Title 47 Part 15 Subpart E Section 15.407(e)**

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

1. C Connect the antenna port(s) to the spectrum analyzer input.
2. Configure the spectrum analyzer as shown below (enter all losses between the transmitter output and the spectrum analyzer).  
Center Frequency = test channel center frequency  
Span = 2 x emission bandwidth  
RBW = 100 kHz, VBW  $\geq 3 \times$  RBW  
Sweep time = auto couple  
Detector = Peak  
Trace mode = max hold
3. Place the radio in continuous transmit mode, allow the trace to stabilize, view the transmitter wave form on the spectrum analyzer.
4. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission, and record the pertinent measurements.

### TEST MODE:

Please refer to the clause 4.3

### TEST RESULT

☒ Passed      ☐ Not Applicable

### TEST Data

Please refer to appendix E on the appendix report

## 5.7. Band edge

### LIMIT

FCC CFR Title 47 Part 15 Subpart E Section 15.407(b)

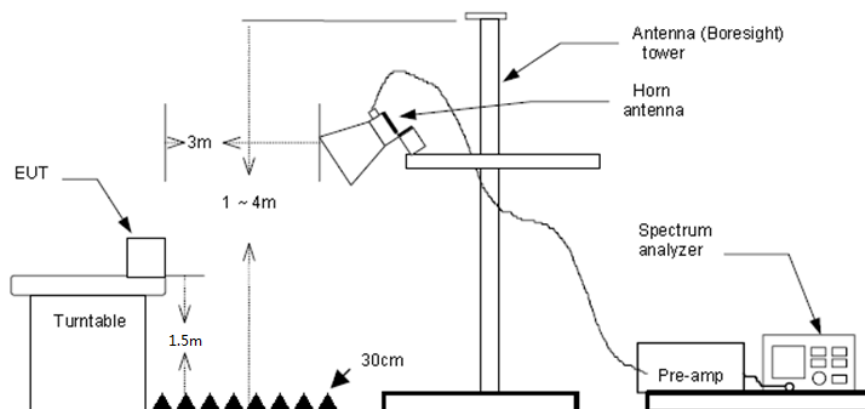
Un-restricted band emissions above 1GHz			
Operating Band	Frequency	EIRP Limit	Value
5150-5250MHz	Above 1GHz	-27dBm/MHz(68.2dBuV/m)@3m	Peak
5250-5350MHz	Above 1GHz	-27dBm/MHz(68.2dBuV/m)@3m	Peak
5470-5725MHz	Above 1GHz	-27dBm/MHz(68.2dBuV/m)@3m	Peak
5725-5850 MHz	1GHz-5.65GHz	-27 dBm/MHz(68.2dBuV/m)@3m	Peak
	5.65GHz-5.7GHz	-27*dBm/MHz to 10dBm/MHz (68.2* dBuV/m to 105.6dBuV/m)	Peak
	5.7GHz-5.72GHz	10*dBm/MHz to 15.6dBm/MHz (105.6*dBuV/m to 110.8dBuV/m)	Peak
	5.72GHz-5.725GHz	15.6*dBm/MHz to 27dBm/MHz (110.8dBuV/m to* 122.2dBuV/m)	Peak
	5.85GHz-5.855GHz	27dBm/MHz to 15.6*dBm/MHz (122.2dBuV/m to110.8* dBuV/m)	Peak
	5.855GHz-5.875GHz	15.6dBm/MHz to 10*dBm/MHz (110.8dBuV/m to 105.6* dBuV/m)	Peak
	5.875GHz-5.925GHz	10dBm/MHz to -27*dBm/MHz (105.6dBuV/m to 68.2* dBuV/m)	Peak
	Above 5.925GHz	-27 dBm/MHz(68.2dBuV/m)@3m	Peak

\* Increase/Decreases with the linearly of the frequency.

For emission above 1GHz and in restricted band, according to FCC KDB 789033 D02 General UNII Test Procedure, all emission that complies with both the average and peak limits of Section 15.209 is not required to satisfy the -27 dBm/MHz peak emission limit.  $E[dBuV/m] = EIRP[dBm] + 95.2$ , for  $d = 3$  meters.

### TEST CONFIGURATION

Radiated:



**TEST PROCEDURE**

1. The EUT was setup and tested according to ANSI C63.10:2013 requirements.
2. The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.
5. The receiver set as follow:  
RBW=1MHz, VBW=3MHz PEAK detector for Peak value.  
RBW=1MHz, VBW=3MHz RMS detector for Average value.

**TEST MODE:**

Please refer to the clause 4.3

**TEST RESULTS**

☒ Passed ☐ Not Applicable

**Radiated Band Edge Test Data**

Band: I		Worst mode: 802.11a				Test channel: CH <sub>L</sub>	
Frequency (MHz)	Read (dB/m)	Level [dBμV/m]	Limit Line (dBuV/m)	Margin[dB]	Factor[dB]	Test value	Polarization
5150.00	25.39	34.28	68.20	33.92	8.89	Vertical	Peak
5150.00	19.78	28.67	54.00	25.33	8.89	Vertical	Average
5150.00	27.24	36.13	68.20	32.07	8.89	Horizontal	Peak
5150.00	20.39	29.28	54.00	24.72	8.89	Horizontal	Average
Band: I		Worst mode: 802.11a				Test channel: CH <sub>H</sub>	
Frequency (MHz)	Read (dB/m)	Level [dBμV/m]	Limit Line (dBuV/m)	Margin[dB]	Factor[dB]	Test value	Polarization
5250.00	26.24	34.96	68.20	33.24	8.72	Vertical	Peak
5250.00	18.54	27.26	54.00	26.74	8.72	Vertical	Average
5350.00	23.05	31.59	68.20	36.61	8.54	Vertical	Peak
5350.00	17.89	26.43	54.00	27.57	8.54	Vertical	Average
5250.00	26.15	34.87	68.20	33.33	8.72	Horizontal	Peak
5250.00	18.95	27.67	54.00	26.33	8.72	Horizontal	Average
5350.00	24.50	33.04	68.20	35.16	8.54	Horizontal	Peak
5350.00	18.90	27.44	54.00	26.56	8.54	Horizontal	Average

Band: IV		Worst mode: 802.11a				Test channel: CH <sub>L</sub>	
Frequency (MHz)	Read (dB/m)	Level [dBμV/m]	Limit Line (dBuV/m)	Margin[dB]	Factor[dB]	Test value	Polarization
5725.00	23.40	32.40	68.20	35.80	9.00	Vertical	Peak
5725.00	16.98	25.98	54.00	28.02	9.00	Vertical	Average
5725.00	24.18	33.18	68.20	35.02	9.00	Horizontal	Peak
5725.00	17.86	26.86	54.00	27.14	9.00	Horizontal	Average
Band: IV		Worst mode: 802.11a				Test channel: CH <sub>H</sub>	
Frequency (MHz)	Read (dB/m)	Level [dBμV/m]	Limit Line (dBuV/m)	Margin[dB]	Factor[dB]	Test value	Polarization
5850.00	22.78	32.55	68.20	35.65	9.77	Vertical	Peak
5850.00	18.53	28.30	54.00	25.70	9.77	Vertical	Average
5850.00	24.12	33.89	68.20	34.31	9.77	Horizontal	Peak
5850.00	17.95	27.72	54.00	26.28	9.77	Horizontal	Average

*Remark:*

1. *Final Level = Receiver Read level + Factor*
2. *The emission levels of other frequencies are very lower than the limit and not show in test report.*
3. *Test 802.11a, 802.11n, 802.11ac mode, all modulations have been tested, only worst case is reported*

## 5.8. Radiated Spurious Emissions

### LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.209 and Part 15 Subpart E Section 15.407

Frequency	Limit (dBuV/m)	Value
0.009 MHz ~0.49 MHz	2400/F(kHz) @300m	Quasi-peak
0.49 MHz ~ 1.705 MHz	24000/F(kHz) @30m	Quasi-peak
1.705 MHz ~30 MHz	30 @30m	Quasi-peak

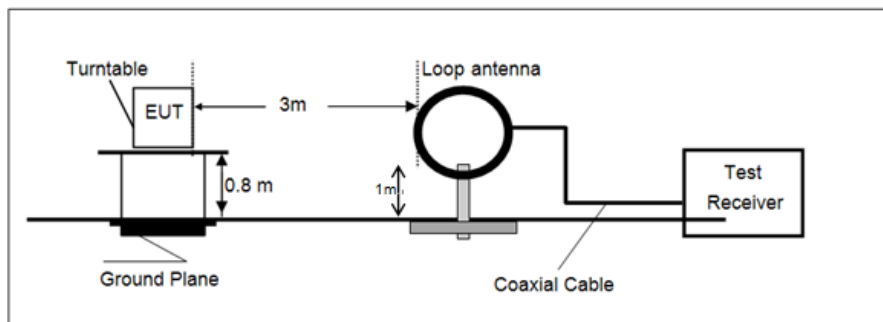
Note: Limit dBuV/m @3m = Limit dBuV/m @300m + 40\*log(300/3)= Limit dBuV/m @300m +80,

Limit dBuV/m @3m = Limit dBuV/m @30m +40\*log(30/3)= Limit dBuV/m @30m + 40.

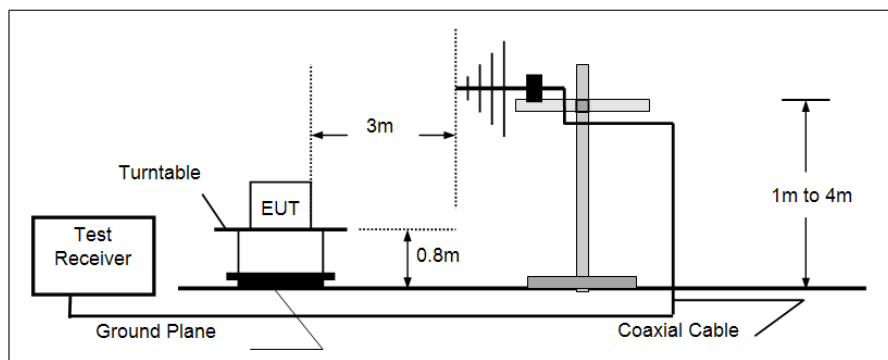
Unwanted emissions below 1GHz and Restricted band emissions above 1GHz		
Frequency	Limit (dBuV/m @3m)	Value
30MHz-88MHz	40.00	Quasi-peak
88MHz-216MHz	43.50	Quasi-peak
216MHz-960MHz	46.00	Quasi-peak
960MHz-1GHz	54.00	Quasi-peak
Above 1GHz	54.00	Average
	74.00	Peak

### TEST CONFIGURATION

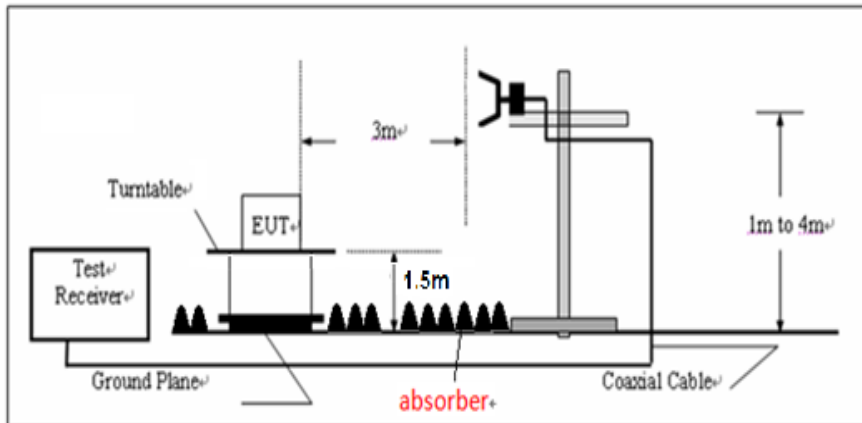
- 9KHz ~30MHz



- 30MHz ~ 1GHz



## ➤ Above 1GHz

**TEST PROCEDURE**

1. The EUT was setup and tested according to ANSI C63.10:2013
2. The EUT is placed on a turn table which is 0.8 meter above ground for below 1 GHz, and 1.5 m for above 1 GHz. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was set 3 meters from the receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Use the following spectrum analyzer settings
  - a) Span shall wide enough to fully capture the emission being measured;
  - b) Below 1 GHz:  
RBW=120 kHz, VBW=300 kHz, Sweep=auto, Detector function=peak, Trace=max hold;  
If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
  - c) From 1 GHz to 10<sup>th</sup> harmonic:  
RBW=1MHz, VBW=3MHz Peak detector for Peak value.  
RBW=1MHz, VBW=3MHz RMS detector for Average value.

**TEST MODE:**

Please refer to the clause 4.3

**TEST RESULT**

☒ Passed ☐ Not Applicable



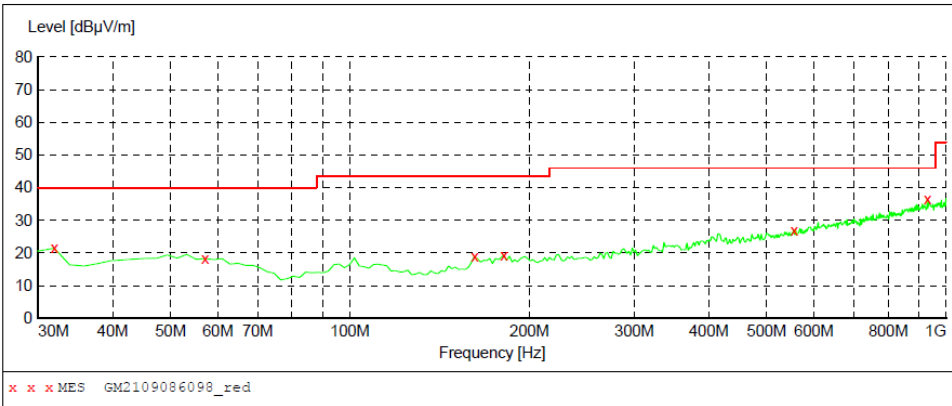
**TEST Data****TEST DATA FOR 9 kHz ~ 30 MHz**

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

**TEST DATA FOR 30MHz-1GHz**

Polarization:

Horizontal



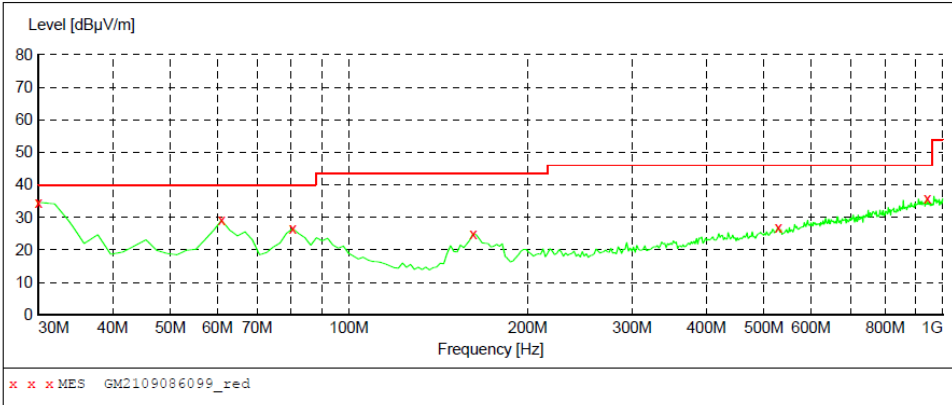
**MEASUREMENT RESULT: "GM2109086098\_red"**

9/8/2021 8:54PM

Frequency MHz	Level dBuV/m	Transd dB	Limit dBuV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
31.940000	21.50	-12.4	40.0	18.5	QP	100.0	103.00	HORIZONTAL
57.160000	18.30	-9.4	40.0	21.7	QP	100.0	134.00	HORIZONTAL
161.920000	19.00	-13.2	43.5	24.5	QP	100.0	103.00	HORIZONTAL
181.320000	19.40	-12.1	43.5	24.1	QP	100.0	192.00	HORIZONTAL
555.740000	27.00	-0.2	46.0	19.0	QP	100.0	0.00	HORIZONTAL
930.160000	36.60	7.7	46.0	9.4	QP	100.0	224.00	HORIZONTAL

Polarization:

Vertical



**MEASUREMENT RESULT: "GM2109086099\_red"**

9/8/2021 8:57PM

Frequency MHz	Level dBuV/m	Transd dB	Limit dBuV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
30.000000	34.60	-12.4	40.0	5.4	QP	100.0	248.00	VERTICAL
61.040000	29.10	-10.1	40.0	10.9	QP	100.0	31.00	VERTICAL
80.440000	26.50	-15.6	40.0	13.5	QP	100.0	188.00	VERTICAL
161.920000	24.90	-13.2	43.5	18.6	QP	100.0	138.00	VERTICAL
528.580000	26.90	-1.0	46.0	19.1	QP	100.0	0.00	VERTICAL
941.800000	35.80	7.7	46.0	10.2	QP	100.0	81.00	VERTICAL

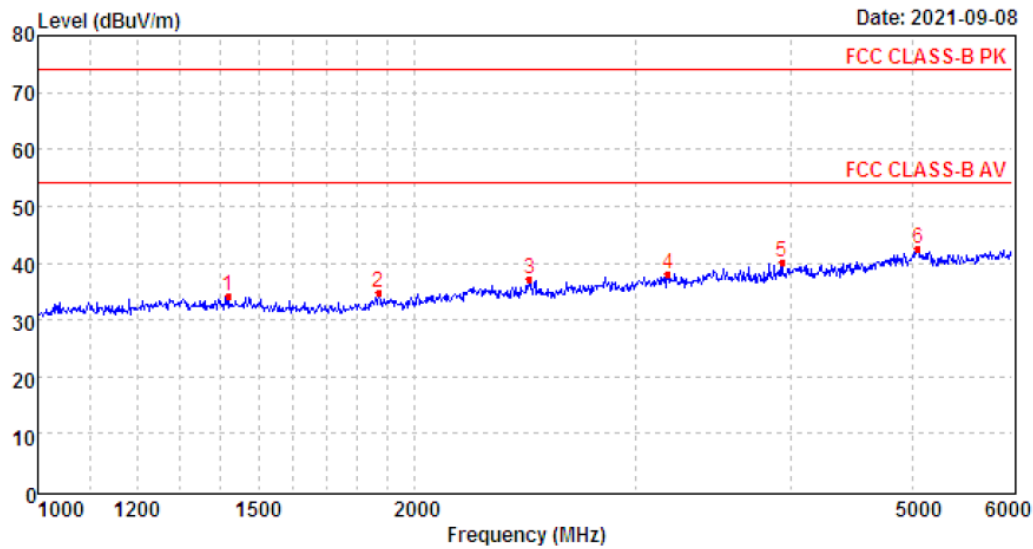
Remark:

Transd=Cable lose+ Antenna factor- Pre-amplifier; Margin=Limit –Level

**TEST DATA FOR 1-6GHz**

Polarization:

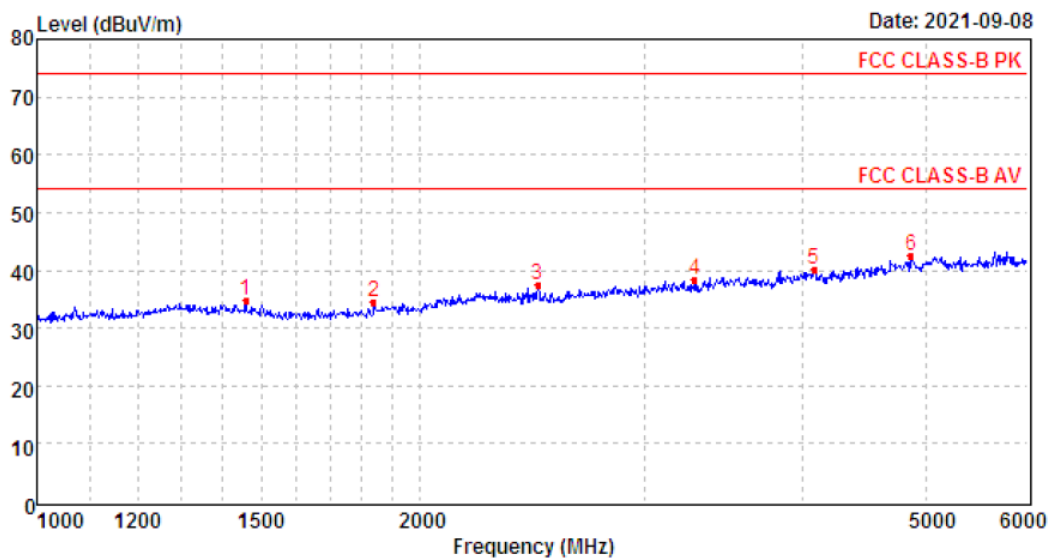
Horizontal



Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1418.21	40.68	26.10	4.20	36.66	34.32	74.00	-39.68	Peak
2	1872.20	41.17	25.69	4.85	36.98	34.73	74.00	-39.27	Peak
3	2471.53	41.25	27.46	5.63	37.27	37.07	74.00	-36.93	Peak
4	3187.60	39.64	28.92	6.44	37.04	37.96	74.00	-36.04	Peak
5	3931.04	39.41	29.86	7.36	36.58	40.05	74.00	-33.95	Peak
6	5042.79	36.80	32.16	8.86	35.36	42.46	74.00	-31.54	Peak

Polarization:

Vertical



Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1459.45	41.33	26.06	4.26	36.80	34.85	74.00	-39.15	Peak
2	1838.96	41.03	25.56	4.81	37.03	34.37	74.00	-39.63	Peak
3	2475.97	41.56	27.45	5.63	37.27	37.37	74.00	-36.63	Peak
4	3286.19	40.15	28.55	6.56	36.83	38.43	74.00	-35.57	Peak
5	4081.77	38.90	30.00	7.46	36.31	40.05	74.00	-33.95	Peak
6	4865.28	37.79	31.40	8.62	35.14	42.67	74.00	-31.33	Peak

Remark:

Transd=Cable lose+ Antenna factor- Pre-amplifier; Margin=Limit -Level

**TEST DATA FOR Above 1GHz**

Band: I		Worst mode: 802.11a				Test channel: CH <sub>L</sub>	
Frequency (MHz)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin Limit (dB)	Factor (dB)	Test value	Polarization
1368.66	22.26	16.68	74.00	57.32	-5.58	Vertical	Peak
3571.78	29.05	30.39	74.00	43.61	1.34	Vertical	Peak
5720.56	27.93	36.90	74.00	37.10	8.97	Vertical	Peak
6224.34	28.46	39.37	74.00	34.63	10.91	Vertical	Peak
1660.94	22.23	16.06	74.00	57.94	-6.17	Horizontal	Peak
4633.69	27.53	33.51	74.00	40.49	5.98	Horizontal	Peak
7995.66	29.62	45.82	74.00	28.18	16.20	Horizontal	Peak
8665.41	28.81	44.87	74.00	29.13	16.06	Horizontal	Peak
Band: I		Worst mode: 802.11a				Test channel: CH <sub>M</sub>	
Frequency (MHz)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin Limit (dB)	Factor (dB)	Test value	Polarization
1735.84	22.54	16.55	74.00	57.45	-5.99	Vertical	Peak
2721.38	23.96	24.87	74.00	49.13	0.91	Vertical	Peak
3861.13	28.32	30.73	74.00	43.27	2.41	Vertical	Peak
5428.28	27.97	36.74	74.00	37.26	8.77	Vertical	Peak
1781.38	23.04	17.18	74.00	56.82	-5.86	Horizontal	Peak
3830.28	28.63	30.83	74.00	43.17	2.20	Horizontal	Peak
6233.16	27.64	38.56	74.00	35.44	10.92	Horizontal	Peak
7571.19	28.97	44.71	74.00	29.29	15.74	Horizontal	Peak
Band: I		Worst mode: 802.11a				Test channel: CH <sub>H</sub>	
Frequency (MHz)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin Limit (dB)	Factor (dB)	Test value	Polarization
1470.00	21.99	16.37	74.00	57.63	-5.62	Vertical	Peak
3001.91	28.11	28.00	74.00	46.00	-0.11	Vertical	Peak
5108.09	26.92	35.73	74.00	38.27	8.81	Vertical	Peak
5416.53	27.92	36.63	74.00	37.37	8.71	Vertical	Peak
1603.66	22.24	15.97	74.00	58.03	-6.27	Horizontal	Peak
2739.00	23.51	24.69	74.00	49.31	1.18	Horizontal	Peak
3263.34	28.79	28.88	74.00	45.12	0.09	Horizontal	Peak
5215.31	28.71	37.61	74.00	36.39	8.90	Horizontal	Peak

**Remark:**

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. The emission levels of other frequencies are very lower than the limit and not show in test report.
3. Measuring frequencies from 1 GHz to 40GHz.
4. Test 802.11a, 802.11n, 802.11ac mode, all modulations have been tested, only worst case is reported

Band: IV		Worst mode: 802.11a			Test channel: CH <sub>L</sub>		
Frequency (MHz)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin Limit (dB)	Factor (dB)	Test value	Polarization
1383.34	21.52	15.94	74.00	58.06	-5.58	Vertical	Peak
4106.41	26.65	29.94	74.00	44.06	3.29	Vertical	Peak
7941.31	28.14	44.40	74.00	29.60	16.26	Vertical	Peak
9671.50	29.65	46.81	74.00	27.19	17.16	Vertical	Peak
1815.16	22.20	16.40	74.00	57.60	-5.80	Horizontal	Peak
4005.06	27.83	30.86	74.00	43.14	3.03	Horizontal	Peak
6427.03	27.14	38.76	74.00	35.24	11.62	Horizontal	Peak
8105.81	29.36	45.68	74.00	28.32	16.32	Horizontal	Peak

Band: IV		Worst mode: 802.11a			Test channel: CH <sub>M</sub>		
Frequency (MHz)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin Limit (dB)	Factor (dB)	Test value	Polarization
1361.31	22.11	16.53	74.00	57.47	-5.58	Vertical	Peak
2266.06	21.89	19.34	74.00	54.66	-2.55	Vertical	Peak
4666.00	26.04	32.21	74.00	41.79	6.17	Vertical	Peak
8029.44	27.90	44.13	74.00	29.87	16.23	Vertical	Peak
1265.84	22.58	16.92	74.00	57.08	-5.66	Horizontal	Peak
3182.56	29.92	30.67	74.00	43.33	0.75	Horizontal	Peak
7145.25	27.92	42.60	74.00	31.40	14.68	Horizontal	Peak
9483.50	28.96	46.86	74.00	27.14	17.90	Horizontal	Peak

Band: IV		Worst mode: 802.11a			Test channel: CH <sub>H</sub>		
Frequency (MHz)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin Limit (dB)	Factor (dB)	Test value	Polarization
1198.28	23.12	17.27	74.00	56.73	-5.85	Vertical	Peak
3665.78	29.85	31.39	74.00	42.61	1.54	Vertical	Peak
7913.41	27.77	44.06	74.00	29.94	16.29	Vertical	Peak
9323.41	28.55	46.34	74.00	27.66	17.79	Vertical	Peak
1361.31	22.13	16.55	74.00	57.45	-5.58	Horizontal	Peak
4746.78	26.76	33.45	74.00	40.55	6.69	Horizontal	Peak
7521.25	27.85	43.36	74.00	30.64	15.51	Horizontal	Peak
10919.94	28.02	45.79	74.00	28.21	17.77	Horizontal	Peak

## Remark:

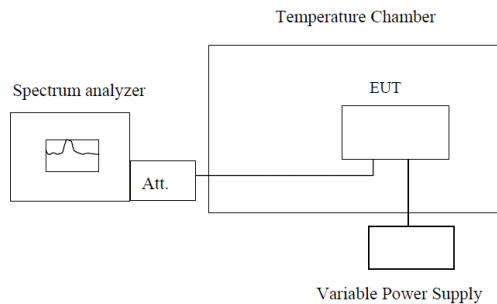
1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. The emission levels of other frequencies are very lower than the limit and not show in test report.
3. Measuring frequencies from 1 GHz to 40GHz.
4. Test 802.11a, 802.11n, 802.11ac mode, all modulations have been tested, only worst case is reported

## 5.9. Frequency stability

### LIMIT

Within Operation Band

### TEST CONFIGURATION



Note : Measurement setup for testing on Antenna connector

### TEST PROCEDURE

1. The equipment under test was connected to an external power supply.
2. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators.
3. The EUT was placed inside the temperature chamber.
4. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 25°C operating frequency as reference frequency.
5. Turn EUT off and set the chamber temperature to -20°C. After the temperature stabilized for approximately 30 minutes recorded the frequency.
6. Repeat step measure with 10°C increased per stage until the highest temperature of +50°C reached..

### TEST MODE:

Please refer to the clause 4.3

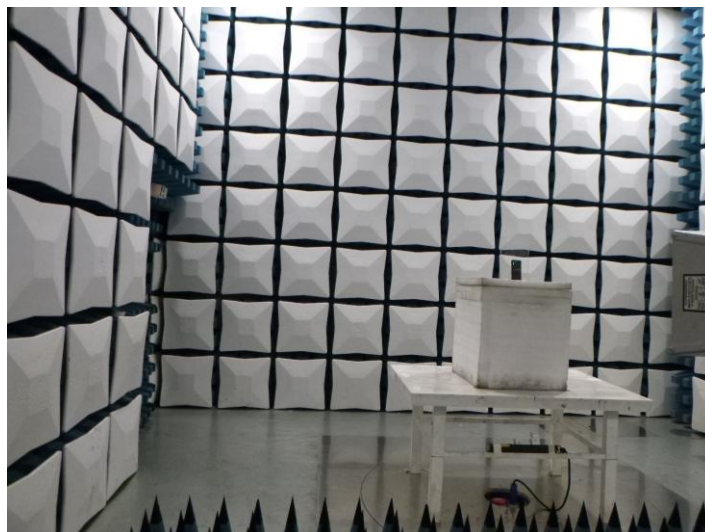
### TEST RESULT

☒ Passed ☐ Not Applicable

Please refer to appendix G on the appendix report

## 6. TEST SETUP PHOTOS

### Radiated Emission







AC Conducted Emission



## 7. EXTERANAL AND INTERNAL PHOTOS

Reference to the test report No. : CHTEW21120120.

## 8. APPENDIX REPORT