



# FCC RADIO TEST REPORT

**FCC ID** : QYLAX201NG  
**Equipment** : WLAN Module  
**Brand Name** : Getac  
**Model Name** : AX201NGW  
**Applicant** : Getac Technology Corporation.  
5F., Building A, No. 209, Sec.1,  
Nangang Rd., Nangang Dist., Taipei  
City 11568, Taiwan, R.O.C.  
**Standard** : FCC Part 15 Subpart C §15.247

The product was received on Jan. 13, 2021 and testing was started from Jan. 27, 2021 and completed on Mar. 09, 2021. We, Sporton International Inc. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this partial report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

*Louis Wu*

Reviewed by: Louis Wu

**Sporton International Inc. EMC & Wireless Communications Laboratory**

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)



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## Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
-	15.247(a)(1)	Number of Channels	-	See Note
-	15.247(a)(1)	Hopping Channel Separation	-	See Note
-	15.247(a)(1)	Dwell Time of Each Channel	-	See Note
-	15.247(a)(1)	20dB Bandwidth	-	See Note
-	2.1049	99% Occupied Bandwidth	-	See Note
3.1	15.247(b)(1)	Peak Output Power	Pass	-
-	15.247(d)	Conducted Band Edges	-	See Note
-	15.247(d)	Conducted Spurious Emission	-	See Note
3.2	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	Pass	-
3.3	15.207	AC Conducted Emission	Pass	-
3.4	15.203 & 15.247(b)	Antenna Requirement	Pass	-

**Note:** The module (Model: AX201NGW) makes no difference after verifying output power, this report reuses test data from the module report.

**Declaration of Conformity:**

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

**Comments and Explanations:**

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

**Reviewed by: Wii Chang**

**Report Producer: Yimin Ho**



# 1 General Description

## 1.1 Product Feature of Equipment Under Test

Bluetooth, Wi-Fi 2.4GHz 802.11b/g/n/ac/ax and Wi-Fi 5GHz 802.11a/n/ac/ax.

Product Specification subjective to this standard	
Sample 1	EUT with Host 1
Sample 2	EUT with Host 2
Sample 3	EUT with Host 3
Antenna Type	<b>WLAN:</b> <Main> PIFA Antenna <Aux.> PIFA Antenna <b>Bluetooth:</b> PIFA Antenna

Antenna information		
2400 MHz ~ 2483.5 MHz	Peak Gain (dBi)	1.3

**Remark:** The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations in report summary.

The product was installed into Tablet (Brand Name: Getac, Model Name: F110, F110G6, F110-Ex, F110-621, F110-601) during test, and the host information was recorded in the following table.

Host Information	
Host 1	Host with SKU A
Host 2	Host with SKU B
Host 3	Host with SKU C

SKU	SKU A	SKU B	SKU C
CPU	i3-1115G7 (Non Vpro)	i5-1135G7 (Non Vpro)	i7-1165G7 (Vpro)
DDR	Kingston DDR4-3200 8GB	Kingston DDR4-3200 16GB	Kingston DDR4-3200 32GB
SSD	256GB	512GB	1TB
PANEL	Full HD AUO	Full HD AUO	Full HD AUO
DIGITIZER	EMRright Digitizer	N/A	EMRright Digitizer
OPTION BAY	Micro SD	2D Barcode Reader	RS232 + LAN
Expansion Bay	N/A	Smart Card	Smart Card
Right side option	Finger Print	NXP RFID(PN7462)	Finger Print
WLAN/BT	Intel AX201	Intel AX201	Intel AX201
WWAN(4G)	NA	EM7511	EM7511
GPS/GNSS	GPS/GNSS (MC-1010- V2b)	EM7511	EM7511
Rear 8M Camera	Support	Support	Support
Webcam FHD	Support	Not Support	Not Support
IR Webcam	Not Support	Support	Support
USB3.2 Gen2 x 1 Type-A	Support	Support	Support
Type-C (thunder bolt)	Support	Support	Support
Audio/MIC	Support	Support	Support



### 1.2 Modification of EUT

No modifications are made to the EUT during all test items.

### 1.3 Testing Location

<b>Test Site</b>	Sporton International Inc. EMC & Wireless Communications Laboratory
<b>Test Site Location</b>	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978
<b>Test Site No.</b>	<b>Sporton Site No.</b> TH05-HY, CO05-HY

**Note:** The test site complies with ANSI C63.4 2014 requirement.

<b>Test Site</b>	Sporton International Inc. Wensan Laboratory
<b>Test Site Location</b>	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
<b>Test Site No.</b>	<b>Sporton Site No.</b> 03CH15-HY (TAF Code: 3786)
<b>Remark</b>	The Radiated Spurious Emission test item subcontracted to Sporton International Inc. Wensan Laboratory.

**Note:** The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW1190 and TW0007

### 1.4 Applicable Standards

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

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01
- ♦ ANSI C63.10-2013

**Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.



## 2 Test Configuration of Equipment Under Test

### 2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	0	2402	27	2429	54	2456
	1	2403	28	2430	55	2457
	2	2404	29	2431	56	2458
	3	2405	30	2432	57	2459
	4	2406	31	2433	58	2460
	5	2407	32	2434	59	2461
	6	2408	33	2435	60	2462
	7	2409	34	2436	61	2463
	8	2410	35	2437	62	2464
	9	2411	36	2438	63	2465
	10	2412	37	2439	64	2466
	11	2413	38	2440	65	2467
	12	2414	39	2441	66	2468
	13	2415	40	2442	67	2469
	14	2416	41	2443	68	2470
	15	2417	42	2444	69	2471
	16	2418	43	2445	70	2472
	17	2419	44	2446	71	2473
	18	2420	45	2447	72	2474
	19	2421	46	2448	73	2475
	20	2422	47	2449	74	2476
	21	2423	48	2450	75	2477
	22	2424	49	2451	76	2478
	23	2425	50	2452	77	2479
	24	2426	51	2453	78	2480
	25	2427	52	2454	-	-
	26	2428	53	2455	-	-



## 2.2 Test Mode

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X plane) were recorded in this report, and the worst mode of radiated spurious emissions is Bluetooth 1Mbps mode, and recorded in this report.
- b. AC power line Conducted Emission was tested under maximum output power.

The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Test Item	Data Rate / Modulation
Radiated Test Cases	Bluetooth BR 1Mbps GFSK
	Mode 1: CH78_2480 MHz
AC Conducted Emission	Mode 1 :WLAN (2.4GHz) Link + Bluetooth Link + H-Pattern + Earphone + Adapter for Sample 1
	Mode 2 :WLAN (2.4GHz) Link + Bluetooth Link + H-Pattern + Earphone + Adapter for Sample 2
	Mode 3 :WLAN (2.4GHz) Link + Bluetooth Link + H-Pattern + Earphone + Adapter for Sample 3
<b>Remark:</b> <ol style="list-style-type: none"> <li>For Radiated Test Cases, the worst mode data rate 1Mbps was reported only since the highest RF output power in the preliminary tests. The conducted spurious emissions and conducted band edge measurement for other data rates were not worse than 1Mbps, and no other significantly frequencies found in conducted spurious emission.</li> <li>The worst case of conducted emission is mode 2; only the test data of it was reported.</li> <li>For Radiated Test Cases, the tests were performed with Adapter 1, Battery 2 and Sample 2.</li> </ol>	



### 2.3 Connection Diagram of Test System



### 2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Bluetooth Earphone	Sony Ericsson	MW600	PY7DDA-2029	N/A	N/A
2.	WLAN AP	ASUS	RT-AC66U	MSQ-RTAC66U	N/A	Unshielded, 1.8m
3.	iPod Earphone	Apple	N/A	Verification	Unshielded, 1.0 m	N/A
4.	Notebook	DELL	Latitude 3400	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m

### 2.5 EUT Operation Test Setup

The RF test items, utility “DRTU\_Version 12.1947.0-10428” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

### **3 Test Result**

#### **3.1 Output Power Measurement**

##### **3.1.1 Limit of Output Power**

The maximum peak conducted output power of the intentional radiator shall not exceed the following:  
For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts.

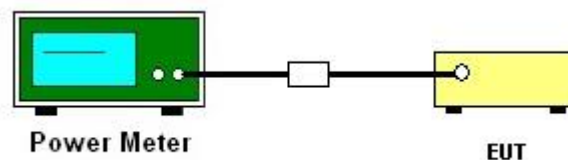
##### **3.1.2 Measuring Instruments**

See list of measuring equipment of this test report.

##### **3.1.3 Test Procedures**

1. The testing follows ANSI C63.10-2013 clause 7.8.5.
1. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
2. Set the maximum power setting and enable the EUT to transmit continuously.
3. Measure the conducted output power with cable loss and record the results in the test report.
4. Measure and record the results in the test report.

##### **3.1.4 Test Setup**



##### **3.1.5 Test Result of Peak Output Power**

Please refer to Appendix A.

##### **3.1.6 Test Result of Average Output Power (Reporting Only)**

Please refer to Appendix A.



### 3.2 Radiated Band Edges and Spurious Emission Measurement

#### 3.2.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics / spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

#### 3.2.2 Measuring Instruments

See list of measuring equipment of this test report.



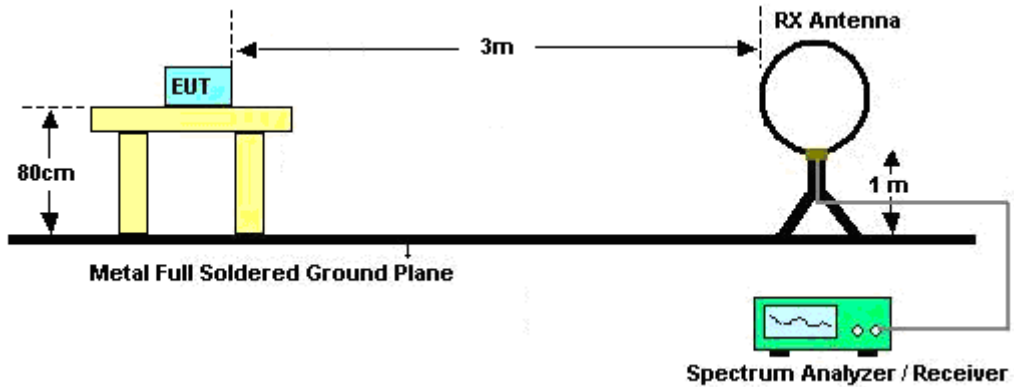
### 3.2.3 Test Procedures

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. 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.
4. Set the maximum power setting and enable the EUT to transmit continuously.
5. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Set RBW = 100 kHz for  $f < 1$  GHz, RBW = 1 MHz for  $f > 1$  GHz ; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
  - (3) For average measurement: use duty cycle correction factor method per 15.35(c).  
Duty cycle = On time/100 milliseconds  
On time =  $N_1 * L_1 + N_2 * L_2 + \dots + N_{n-1} * L_{n-1} + N_n * L_n$   
Where  $N_1$  is number of type 1 pulses,  $L_1$  is length of type 1 pulses, etc.  
Average Emission Level = Peak Emission Level +  $20 * \log(\text{Duty cycle})$
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
7. For testing below 1 GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
8. For testing above 1 GHz, the emission level of the EUT in peak mode was 20 dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

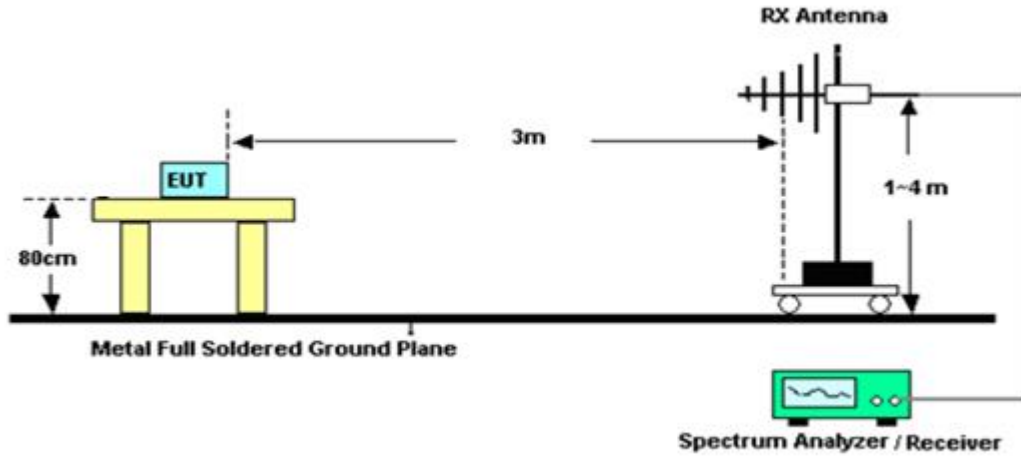
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.79dB) derived from  $20 \log(\text{dwell time}/100\text{ms})$ . This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

### 3.2.4 Test Setup

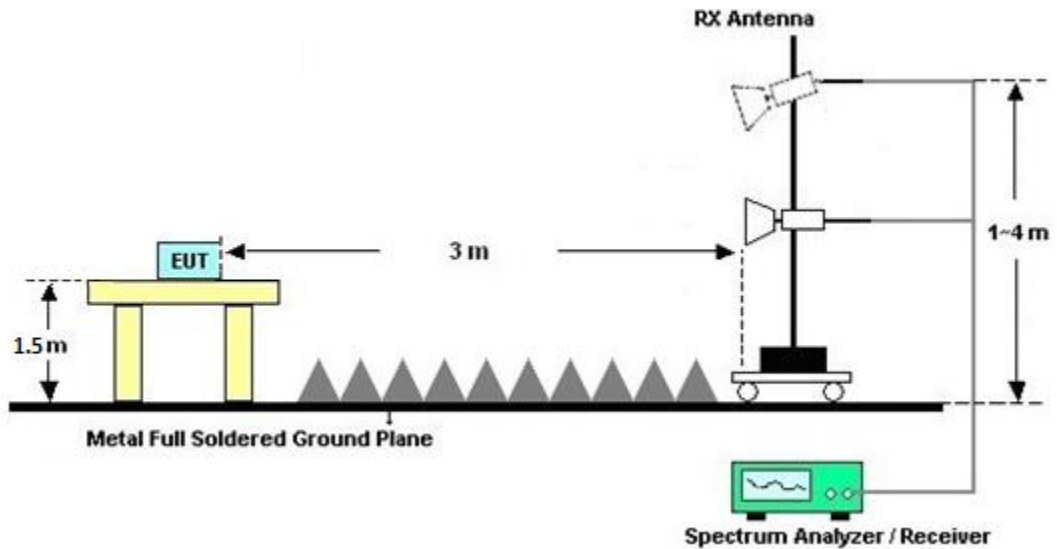
For radiated test below 30MHz



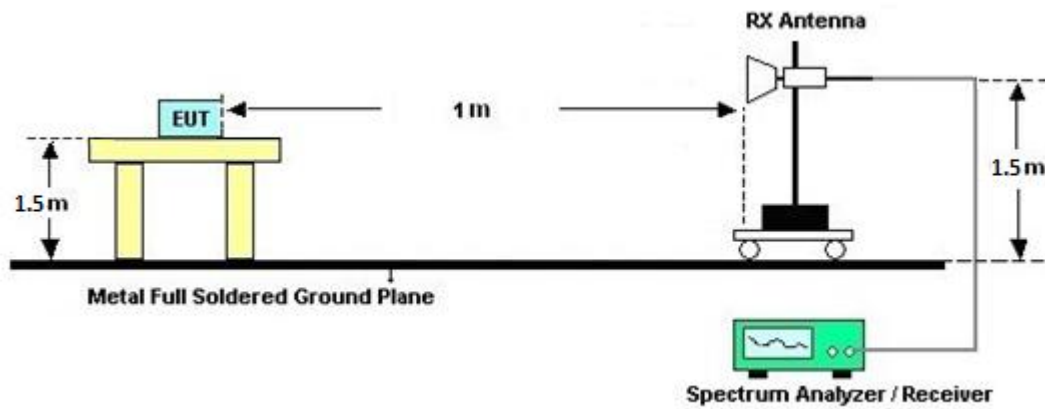
For radiated test from 30MHz to 1GHz



For radiated test from 1GHz to 18GHz



For radiated test above 18GHz



### 3.2.5 Test Results of Radiated Spurious Emissions (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 was not reported.

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

### 3.2.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C and D.

### 3.2.7 Duty Cycle

Please refer to Appendix E.

### 3.2.8 Test Result of Radiated Spurious Emission (30MHz ~ 10<sup>th</sup> Harmonic)

Please refer to Appendix C and D.



### 3.3 AC Conducted Emission Measurement

#### 3.3.1 Limit of AC Conducted Emission

For equipment 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.

Frequency of emission (MHz)	Conducted limit (dB $\mu$ V)	
	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.

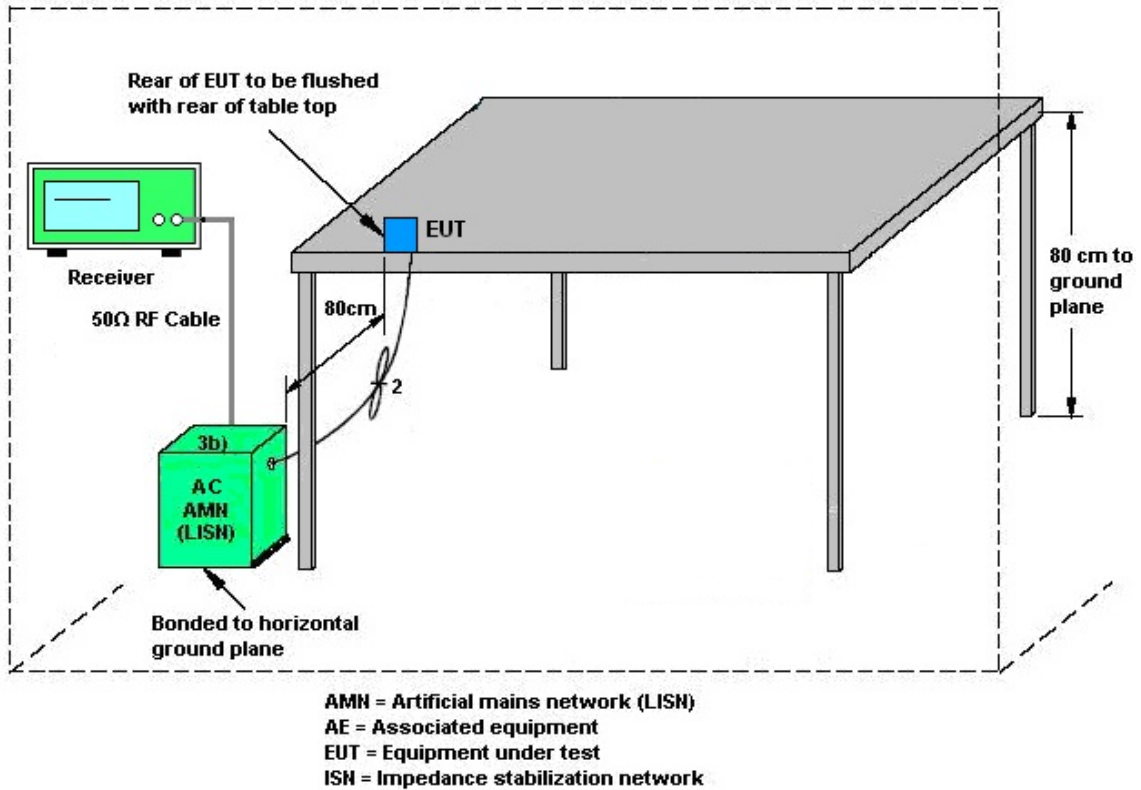
#### 3.3.2 Measuring Instruments

See list of measuring equipment of this test report.

#### 3.3.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN shall be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

### 3.3.4 Test Setup



### 3.3.5 Test Result of AC Conducted Emission

Please refer to Appendix B.





## **3.4 Antenna Requirements**

### **3.4.1 Standard Applicable**

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. 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 rule.

### **3.4.2 Antenna Anti-Replacement Construction**

An embedded-in antenna design is used.

### **3.4.3 Antenna Gain**

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



## 4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Jul. 14, 2020	Mar. 06, 2021~ Mar. 09, 2021	Jul. 13, 2021	Radiation (03CH15-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N -06	41912 & 05	30MHz~1GHz	Feb. 08, 2021	Mar. 06, 2021~ Mar. 09, 2021	Feb. 07, 2022	Radiation (03CH15-HY)
Amplifier	SONOMA	310N	363440	9kHz~1GHz	Dec. 28, 2020	Mar. 06, 2021~ Mar. 09, 2021	Dec. 27, 2021	Radiation (03CH15-HY)
Horn Antenna	SCHWARZB ECK	BBHA 9120 D	9120D-01620	1GHz~18GHz	Nov. 03, 2020	Mar. 06, 2021~ Mar. 09, 2021	Nov. 02, 2021	Radiation (03CH15-HY)
SHF-EHF Horn Antenna	SCHWARZB ECK	BBHA 9170	BBHA917025 1	18GHz~40GHz	Dec. 02, 2020	Mar. 06, 2021~ Mar. 09, 2021	Dec. 01, 2021	Radiation (03CH15-HY)
Preamplifier	Jet-Power	JPA0118-55-30 3	17100018000 55006	1GHz~18GHz	May 07, 2020	Mar. 06, 2021~ Mar. 09, 2021	May 06, 2021	Radiation (03CH15-HY)
Preamplifier	Keysight	83017A	MY53270195	1GHz~26.5GHz	Aug. 21, 2020	Mar. 06, 2021~ Mar. 09, 2021	Aug. 20, 2021	Radiation (03CH15-HY)
Preamplifier	EMEC	EM18G40G	0600789	18-40GHz	Oct. 27, 2020	Mar. 06, 2021~ Mar. 09, 2021	Oct. 26, 2021	Radiation (03CH15-HY)
EMI Test Receiver	Keysight	N9038A (MXE)	MY54130085	20MHz~8.4GHz	Nov. 02, 2020	Mar. 06, 2021~ Mar. 09, 2021	Nov. 01, 2021	Radiation (03CH15-HY)
Spectrum Analyzer	Agilent	E4446A	MY50180136	3Hz~44GHz	May 04, 2020	Mar. 06, 2021~ Mar. 09, 2021	May 03, 2021	Radiation (03CH15-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Mar. 06, 2021~ Mar. 09, 2021	N/A	Radiation (03CH15-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Mar. 06, 2021~ Mar. 09, 2021	N/A	Radiation (03CH15-HY)
Software	Audix	E3 6.2009-8-24 (k5)	RK-000451	N/A	N/A	Mar. 06, 2021~ Mar. 09, 2021	N/A	Radiation (03CH15-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104, 102E	MY36980/4, MY9838/4PE, 508405/2E	30MHz~18G	Nov. 16, 2020	Mar. 06, 2021~ Mar. 09, 2021	Nov. 15, 2021	Radiation (03CH15-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	505134/2	30MHz-40GHz	Feb. 22, 2021	Mar. 06, 2021~ Mar. 09, 2021	Feb. 21, 2022	Radiation (03CH15-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	800740/2	30MHz-40GHz	Feb. 22, 2021	Mar. 06, 2021~ Mar. 09, 2021	Feb. 21, 2022	Radiation (03CH15-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY24971-4	9kHz to 18GHz	Feb. 24, 2021	Mar. 06, 2021~ Mar. 09, 2021	Feb. 23, 2022	Radiation (03CH15-HY)
Filter	Wainwright	WLJ4-1000-15 30-6000-40ST	SN4	1.53GHz Low Pass Filter	Jul. 03, 2020	Mar. 06, 2021~ Mar. 09, 2021	Jul. 02, 2021	Radiation (03CH15-HY)
Filter	Wainwright	WHKX12-2700 -3000-18000-6 0ST	SN4	3GHz High Pass Filter	Sep. 16, 2020	Mar. 06, 2021~ Mar. 09, 2021	Sep. 15, 2021	Radiation (03CH15-HY)



Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Hygrometer	Testo	608-H1	34893241	N/A	Mar. 02, 2020	Jan. 27, 2021	Mar. 01, 2021	Conducted (TH05-HY)
Power Meter	Agilent	E4416A	GB412923 44	N/A	Jan. 14, 2021	Jan. 27, 2021	Jan. 13, 2022	Conducted (TH05-HY)
Power Sensor	Agilent	E9327A	US404415 48	50MHz~18GHz	Jan. 14, 2021	Jan. 27, 2021	Jan. 13, 2022	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101566	10Hz ~ 40GHz	Jul. 22, 2020	Jan. 27, 2021	Jul. 21, 2021	Conducted (TH05-HY)
Switch Box & RF Cable	EM Electronics	EMSW18SE	SW200302	N/A	Mar. 17, 2020	Jan. 27, 2021	Mar. 16, 2021	Conducted (TH05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Feb. 02, 2021	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102317	9kHz~3.6GHz	Sep. 11, 2020	Feb. 02, 2021	Sep. 10, 2021	Conduction (CO05-HY)
Hygrometer	Testo	608-H1	34913912	N/A	Nov. 18, 2020	Feb. 02, 2021	Nov. 17, 2021	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Nov. 16, 2020	Feb. 02, 2021	Nov. 15, 2021	Conduction (CO05-HY)
Software	Rohde & Schwarz	EMC32 V10.30	N/A	N/A	N/A	Feb. 02, 2021	N/A	Conduction (CO05-HY)
LISN Cable	MVE	RG-400	260260	N/A	Dec. 31, 2020	Feb. 02, 2021	Dec. 30, 2021	Conduction (CO05-HY)
Pulse Limiter	SCHWARZBECK	ESHVTSD 9561-F N3-Z2	109561-F N0037308 51	9kHz-200MHz	Nov. 02, 2020	Feb. 02, 2021	Nov. 01, 2021	Conduction (CO05-HY)



## 5 Uncertainty of Evaluation

### Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	2.3
---	-----

### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	4.7
---	-----

### Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	5.3
---	-----

### Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	4.9
---	-----

**Appendix A. Test Result of Conducted Test Items**

Test Engineer:	Kai Liao	Temperature:	22.5	°C
Test Date:	2021/1/27	Relative Humidity:	55.1	%

**TEST RESULTS DATA****Peak Power Table**

DH	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
DH1	0	1	9.47	20.97	Pass
	39	1	<b>10.05</b>	20.97	Pass
	78	1	10.01	20.97	Pass
2DH1	0	1	9.42	20.97	Pass
	39	1	<b>10.00</b>	20.97	Pass
	78	1	<b>10.00</b>	20.97	Pass
3DH1	0	1	9.45	20.97	Pass
	39	1	10.01	20.97	Pass
	78	1	<b>10.02</b>	20.97	Pass

**TEST RESULTS DATA****Average Power Table*****(Reporting Only)***

DH	CH.	NTX	Average Power (dBm)	Duty Factor (dB)
DH1	0	1	9.33	5.18
	39	1	<b>9.97</b>	5.18
	78	1	9.90	5.18
2DH1	0	1	8.40	5.07
	39	1	<b>8.99</b>	5.07
	78	1	8.92	5.07
3DH1	0	1	8.40	5.08
	39	1	<b>9.04</b>	5.08
	78	1	8.99	5.08



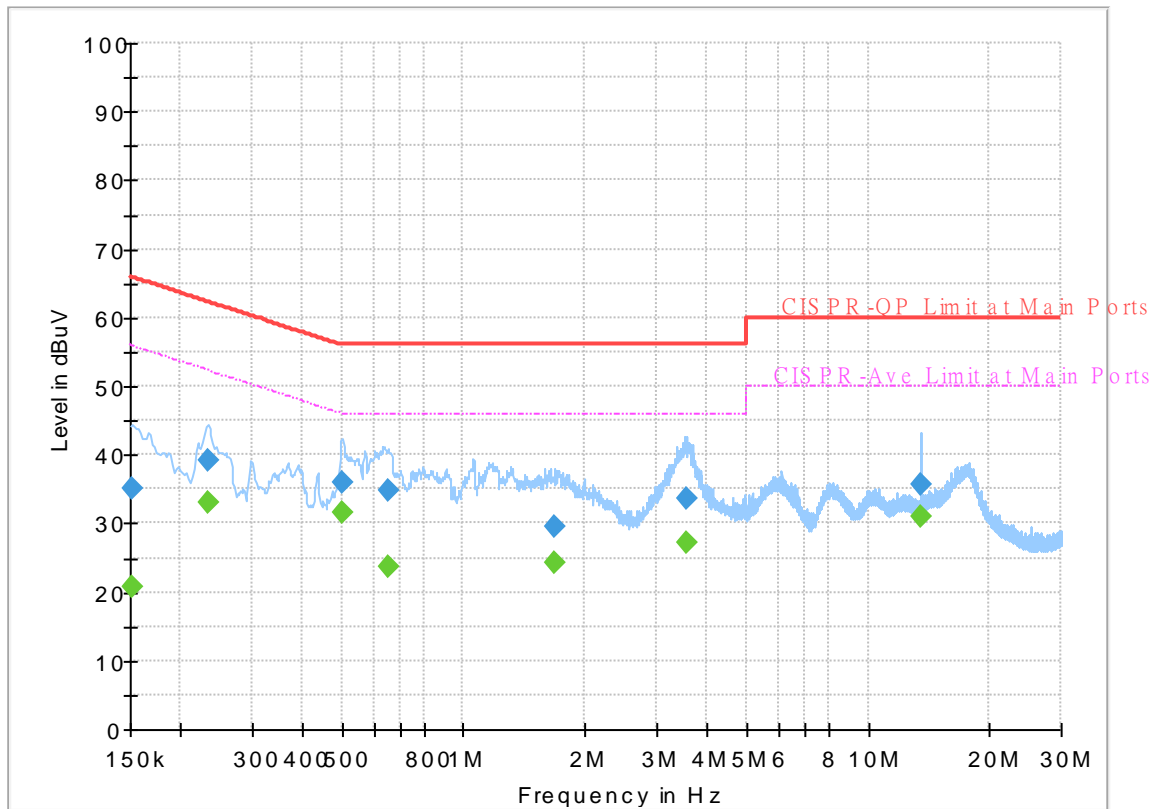
## Appendix B. AC Conducted Emission Test Results

Test Engineer :	Howard Huang	Temperature :	23~26°C
		Relative Humidity :	40~50%

## EUT Information

Report NO : 111325  
 Test Mode : Mode 2  
 Test Voltage : 120Vac/60Hz  
 Phase : Line

Full Spectrum



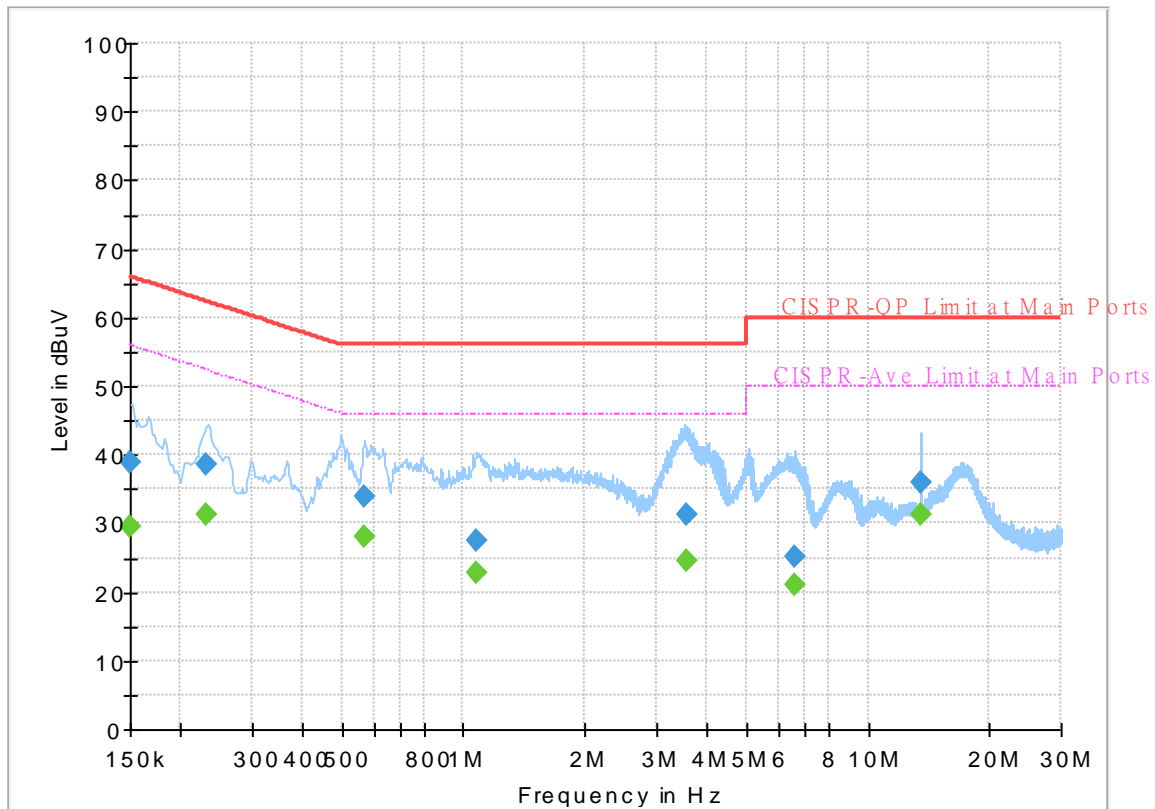
## Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.152250	---	20.72	55.88	35.16	L1	OFF	19.7
0.152250	35.12	---	65.88	30.76	L1	OFF	19.7
0.233250	---	33.09	52.33	19.24	L1	OFF	19.7
0.233250	39.05	---	62.33	23.28	L1	OFF	19.7
0.501000	---	31.68	46.00	14.32	L1	OFF	19.9
0.501000	35.85	---	56.00	20.15	L1	OFF	19.9
0.649500	---	23.76	46.00	22.24	L1	OFF	20.0
0.649500	34.91	---	56.00	21.09	L1	OFF	20.0
1.684500	---	24.19	46.00	21.81	L1	OFF	20.2
1.684500	29.44	---	56.00	26.56	L1	OFF	20.2
3.545250	---	27.08	46.00	18.92	L1	OFF	20.0
3.545250	33.51	---	56.00	22.49	L1	OFF	20.0
13.560000	---	31.12	50.00	18.88	L1	OFF	20.0
13.560000	35.79	---	60.00	24.21	L1	OFF	20.0

## EUT Information

Report NO : 111325  
 Test Mode : Mode 2  
 Test Voltage : 120Vac/60Hz  
 Phase : Neutral

Full Spectrum



## Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.150000	---	29.60	56.00	26.40	N	OFF	19.7
0.150000	38.95	---	66.00	27.05	N	OFF	19.7
0.231000	---	31.19	52.41	21.22	N	OFF	19.7
0.231000	38.62	---	62.41	23.79	N	OFF	19.7
0.568500	---	27.99	46.00	18.01	N	OFF	19.9
0.568500	33.83	---	56.00	22.17	N	OFF	19.9
1.079250	---	22.71	46.00	23.29	N	OFF	20.2
1.079250	27.57	---	56.00	28.43	N	OFF	20.2
3.545250	---	24.43	46.00	21.57	N	OFF	20.0
3.545250	31.24	---	56.00	24.76	N	OFF	20.0
6.614250	---	20.93	50.00	29.07	N	OFF	20.0
6.614250	25.16	---	60.00	34.84	N	OFF	20.0
13.560000	---	31.22	50.00	18.78	N	OFF	20.0
13.560000	35.94	---	60.00	24.06	N	OFF	20.0





### Appendix C. Radiated Spurious Emission

Test Engineer :	Leo Lee, Mancy Chou and Bigshow Wang	Temperature :	22.8~23.2°C
		Relative Humidity :	44~50%

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency ( MHz )	Level ( dBμV/m )	Over Limit ( dB )	Limit Line ( dBμV/m )	Read Level ( dBμV )	Antenna Factor ( dB/m )	Path Loss ( dB )	Preamp Factor ( dB )	Ant Pos ( cm )	Table Pos ( deg )	Peak Avg. ( P/A )	Pol. ( H/V )	
BT CH 78 2480MHz	*	2480	103.68	-	-	100.34	27.44	6.78	30.88	339	327	P	H	
	*	2480	78.89	-	-	-	-	-	-	-	-	A	H	
		2483.52	52.42	-21.58	74	49.08	27.43	6.79	30.88	339	327	P	H	
		2483.52	27.63	-26.37	54	-	-	-	-	-	-	A	H	
													H	
													H	
	*	2480	101.16	-	-	97.82	27.44	6.78	30.88	312	19	P	V	
	*	2480	76.37	-	-	-	-	-	-	-	-	-	A	V
		2487.28	49.55	-24.45	74	46.2	27.43	6.8	30.88	312	19	P	V	
		2487.28	24.76	-29.24	54	-	-	-	-	-	-	A	V	
													V	
													V	
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.													



2.4GHz 2400~2483.5MHz

BT (Harmonic @ 3m)

BT	Note	Frequency ( MHz )	Level ( dBμV/m )	Over Limit ( dB )	Limit Line ( dBμV/m )	Read Level ( dBμV )	Antenna Factor ( dB/m )	Path Loss ( dB )	Preamp Factor ( dB )	Ant Pos ( cm )	Table Pos ( deg )	Peak Avg. ( P/A )	Pol. ( H/V )
BT CH 78 2480MHz		4960	39.77	-34.23	74	57.56	31.22	10.17	59.18	100	0	P	H
		4960	14.98	-39.02	54	-	-	-	-	-	-	A	H
		7440	45.47	-28.53	74	55.16	36.3	12.39	58.38	100	0	P	H
		7440	20.68	-33.32	54	-	-	-	-	-	-	A	H
		17985	58.88	-15.12	74	49.19	48.73	18.88	57.92	100	0	P	H
		17985	34.09	-19.91	54	-	-	-	-	-	-	A	H
		4960	39.2	-34.8	74	56.99	31.22	10.17	59.18	100	0	P	V
		4960	14.41	-39.59	54	-	-	-	-	-	-	A	V
		7440	45.55	-28.45	74	55.24	36.3	12.39	58.38	100	0	P	V
		7440	20.76	-33.24	54	-	-	-	-	-	-	A	V
		17985	58.86	-15.14	74	49.17	48.73	18.88	57.92	100	0	P	V
		17985	34.07	-19.93	54	-	-	-	-	-	-	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Emission above 18GHz

2.4GHz BT (SHF)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )
2.4GHz BT SHF		23192	41.62	-32.38	74	44.55	38.64	12.49	54.06	150	0	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
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													H
													H
			20712	37.69	-36.31	74	42.69	38.6	11.22	54.82	150	0	P
													V
													V
													V
													V
													V
													V
													V
													V
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													V
<b>Remark</b>	1. No other spurious found. 2. All results are PASS against limit line.												



Emission below 1GHz

2.4GHz BT (LF)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.		
		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )		
2.4GHz BT LF		57.16	25.93	-14.07	40	45.4	12.07	1.02	32.56	-	-	P	H		
		140.58	24.58	-18.92	43.5	37.95	17.44	1.69	32.5	-	-	P	H		
		299.66	27.79	-18.21	46	38.75	19.13	2.4	32.49	-	-	P	H		
		548.95	31.4	-14.6	46	36.08	24.75	3.21	32.64	-	-	P	H		
		721.61	38.7	-7.3	46	40.58	26.93	3.64	32.45	100	0	P	H		
		903.97	37.64	-8.36	46	36.05	29.01	4.18	31.6	-	-	P	H		
														H	
															H
															H
															H
															H
															H
															H
			46.49	26.22	-13.78	40	41.96	15.99	0.86	32.59	-	-	P	V	
			103.72	23.94	-19.56	43.5	38.71	16.28	1.46	32.51	-	-	P	V	
			158.04	23.15	-20.35	43.5	37.23	16.62	1.8	32.5	-	-	P	V	
			603.27	30.57	-15.43	46	34.06	25.55	3.4	32.44	-	-	P	V	
			719.67	36.16	-9.84	46	38.12	26.85	3.64	32.45	100	0	P	V	
			899.12	36.01	-9.99	46	34.58	28.9	4.16	31.63	-	-	P	V	
															V
														V	
														V	
														V	
														V	
														V	
Remark	1. No other spurious found. 2. All results are PASS against limit line.														



**Note symbol**

*	<b>Fundamental Frequency</b> which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is <b>over limit</b> line.
P/A	<b>Peak</b> or <b>Average</b>
H/V	<b>Horizontal</b> or <b>Vertical</b>



A calculation example for radiated spurious emission is shown as below:

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )
BT CH 00 2402MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =  
Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
3. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

**For Peak Limit @ 2390MHz:**

1. Level(dBμV/m)  
= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)  
= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)  
= 55.45 (dBμV/m)
2. Over Limit(dB)  
= Level(dBμV/m) – Limit Line(dBμV/m)  
= 55.45(dBμV/m) – 74(dBμV/m)  
= -18.55(dB)

**For Average Limit @ 2390MHz:**

1. Level(dBμV/m)  
= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)  
= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)  
= 43.54 (dBμV/m)
2. Over Limit(dB)  
= Level(dBμV/m) – Limit Line(dBμV/m)  
= 43.54(dBμV/m) – 54(dBμV/m)  
= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is “PASS”.



## Appendix D. Radiated Spurious Emission Plots

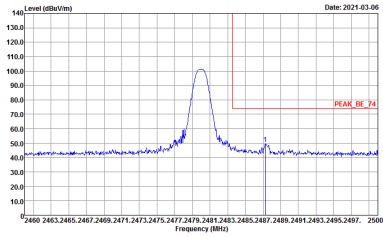
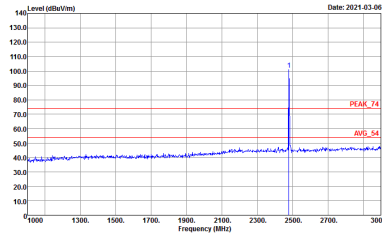
Test Engineer :	Leo Lee, Mancy Chou and Bigshow Wang	Temperature :	22.8~23.2°C
		Relative Humidity :	44~50%

### 2.4GHz 2400~2483.5MHz

### BT (Band Edge @ 3m)

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Horizontal	Fundamental
Peak	<p>Site : 03CH15-HY            Condition : PEAK_BE_74 3m 91200_15_1620 HORIZONTAL            RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 111325</p>	<p>Site : 03CH15-HY            Condition : PEAK_74 3m 91200_15_1620 HORIZONTAL            RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 111325</p>



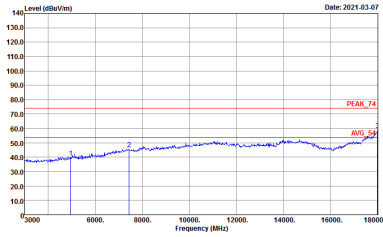
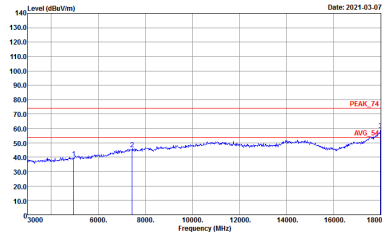
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BT CH78 2480MHz		
Vertical		Fundamental
<b>Peak</b>	 <p>Date: 2021-03-06</p> <p>Site : 03CH15-HY Condition : PEAK_BE_74 3m 91200_15_1620 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 111325</p>	 <p>Date: 2021-03-06</p> <p>Site : 03CH15-HY Condition : PEAK_74 3m 91200_15_1620 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 111325</p>





2.4GHz 2400~2483.5MHz

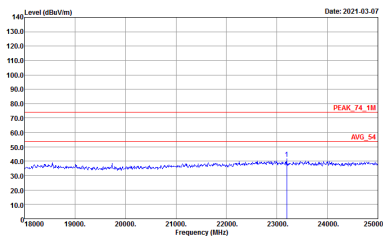
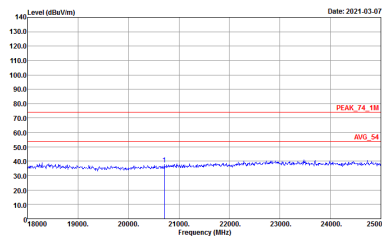
BT (Harmonic @ 3m)

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH78 2480MHz	
	Horizontal	Vertical
<p>Peak Avg.</p>	 <p>Site : 03CH15-HY Condition : PEAK_74 3m 91200_15_1620 HORIZONTAL Detector : Peak Project : 111325</p>	 <p>Site : 03CH15-HY Condition : PEAK_74 3m 91200_15_1620 VERTICAL Detector : Peak Project : 111325</p>



Emission above 18GHz

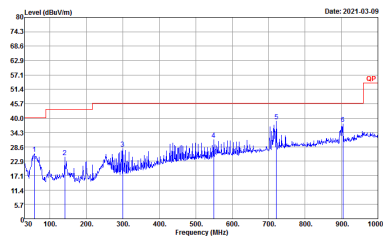
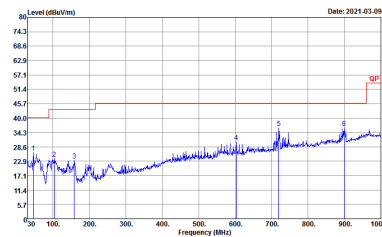
2.4GHz BT (SHF)

BT	2.4GHz 2400~2483.5MHz	
	BT SHF	
	Horizontal	Vertical
<p>QP / Peak</p>	 <p>Site : 03CH16-HY            Condition : PEAK_74_1M 1m SHF HORN BBH49170576 HORIZONTAL            Detector : Peak            Project : 111325</p>	 <p>Site : 03CH16-HY            Condition : PEAK_74_1M 1m SHF HORN BBH49170576 VERTICAL            Detector : Peak            Project : 111325</p>



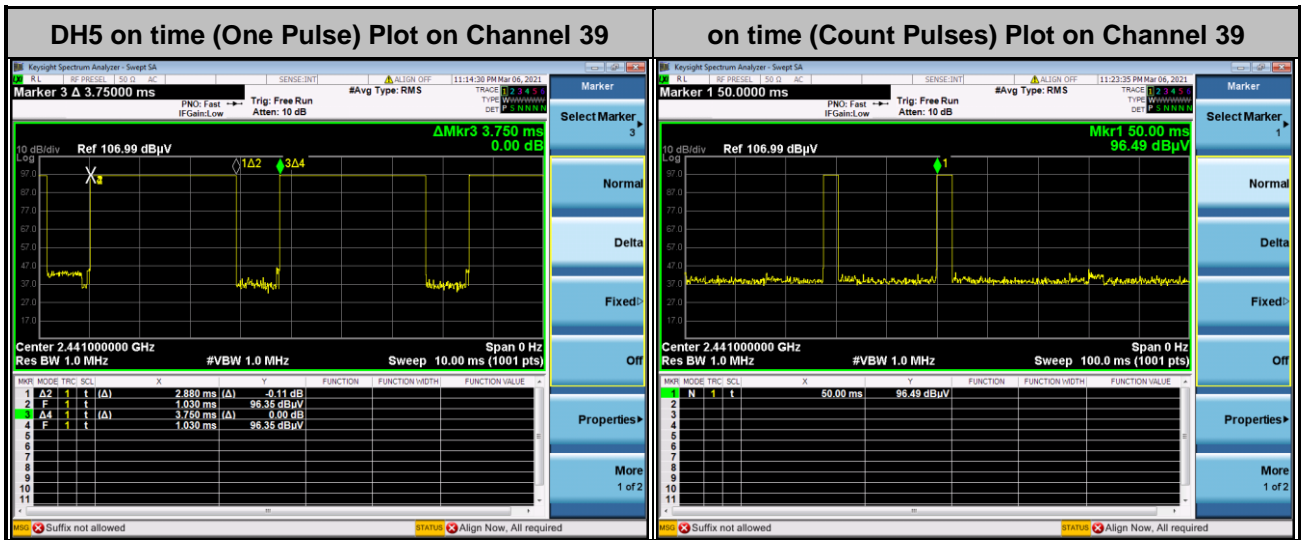
Emission below 1GHz

2.4GHz BT (LF)

BT	2.4GHz 2400~2483.5MHz	
BT LF		
Horizontal		Vertical
QP / Peak	 <p data-bbox="430 873 813 929">Site : 03CH15-HY Condition : QP 3m BTL06_41912_20210208 HORIZONTAL Detector : Peak Project : 111325</p>	 <p data-bbox="901 873 1284 929">Site : 03CH15-HY Condition : QP 3m BTL06_41912_20210208 VERTICAL Detector : Peak Project : 111325</p>



### Appendix E. Duty Cycle Plots



**Note:**

1. Worst case Duty cycle = on time/100 milliseconds = 2 \* 2.88 / 100 = 5.76 %
2. Worst case Duty cycle correction factor = 20\*log(Duty cycle) = -24.79 dB
3. DH5 has the highest duty cycle worst case and is reported.

**Duty Cycle Correction Factor Consideration for AFH mode:**

Bluetooth normal hopping rate is 1600Hz and reduced to 800Hz in AFH mode; due to the reduced number of hopping frequencies, with the same packet configuration the dwell time in each channel frequency within 100msec period is longer in AFH mode than normal mode.

In AFH mode, the minimum hopping frequencies are 20, to get the longest dwell time DH5 packet is observed; the period to have DH5 packet completing one hopping sequence is

$$2.88 \text{ ms} \times 20 \text{ channels} = 57.6 \text{ ms}$$

There cannot be 2 complete hopping sequences within 100ms period, considering the random hopping behavior, maximum 2 hops can be possibly observed within the period. [100 ms / 57.6 ms ] = 2 hops

Thus, the maximum possible ON time:

$$2.88 \text{ ms} \times 2 = 5.76 \text{ ms}$$

Worst case Duty Cycle Correction factor, which is derived from the maximum possible ON time,

$$20 \times \log(5.76 \text{ ms}/100 \text{ ms}) = -24.79 \text{ dB}$$