

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

CLASS II & IV PC REPORT

OF

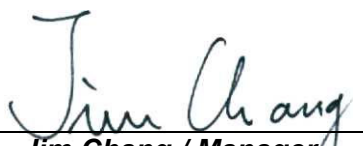
Applicant: Framework Computer Inc
1870 Ogden Dr, Burlingame, CA, 94010
Product Name: Intel WiFi 6 AX201
Brand Name: Framework
Model No.: AX201NGW
Model Difference: N/A
Report Number: ER/2021/40115
FCC ID 2AZR6-FRANBBAT16
IC: 27217-FRANBBAT16
FCC Rule Part: §15.247, Cat: DTS
IC RSS: RSS-247 issue 2 Feb 2017
Issue Date: June 28, 2021
Date of Test: April 29, 2021- June 25, 2021
Date of EUT Received: April 29, 2021

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

Approved By:


Jim Chang / Manager



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Revision History

Report Number	Revision	Description	Issue Date	Revised By
ER/2021/40115	Rev.00	Original.	June 28, 2021	Viola Su

Note:

- 1、Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

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1 GENERAL INFORMATION

1.1 Product Description

Product Name of Host:	Portable Computer
Brand Name of Host:	Framework
Marketing Name of Host:	Framework Laptop
Model No. of Host:	FRANBP0000
Hardware Version:	N/A
Software Version:	N/A
Model No. of BT/WLAN Module:	AX201NGW
Scope:	AX201NGW INSTALLED IN Notebook Computer
Class II & Class IV Permissive change:	The test report covers the radiated emissions requirements of the standards referenced in the report to allow system level approval of the module in this specific host.
EUT Series No.:	DDA03753-34E0-40BF-BE28-7768D36EEDC1
Power Supply:	17.6V DC from rechargeable Li-ion battery or 5.0V=3.0A 15.0W, 9.0V=3.0A 27.0W, 15.0V=3.0A 45.0W, 20.0V=3.0A 60.0W from adapter.

Radio Technology:	Bluetooth LE Single mode
Frequency Range:	2402 – 2480MHz
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	BLE 1M: 6.97dBm

1.2 Antenna Designation

Antenna Type	Brand	Main / Aux	Antenna Part No.	Freq.	Peak Antenna Gain (dBi)	Worst Antenna Gain
PIFA	AWAN	Main	AXF6Y200005(DC33002JW00)	2.4GHz	0.365	
		Aux		2.4GHz	2.178	V

Note: Investigation has been done to determine the worst case scenario for the above antennas demonstrated with measurements in this report.

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1.3 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247
FCC KDB 558074 D01 15.247 Meas Guidance v05r02
RSS-247 issue 2 Feb. 2017
RSS-Gen Issue 5, Amendment 2, February 2021
ANSI C63.10:2013

1.4 Test Facility

Laboratory	Test Site Address		FCC Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	☒	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	TW0027	TW3702
	☐	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	TW0028	

1.5 Special Accessories

There are no special accessories used while test was conducted.

1.6 Equipment Modifications

There was no modification incorporated into the EUT.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

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

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Radiated Emissions

The EUT is placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m 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 transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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2.4 Measurement Results Explanation Example

2.4.1 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m*9m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

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2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission



Table 2-1 Equipment Used in Tested System

Item	Equipment	MRF/Brand	Model/Type No.	Series No.	Version
1.	DRTU	N/A	N/A	N/A	21.350120.0.0-01117

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3 SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description Of Test	Result
§15.247(d) §15.209	RSS-247 §5.5 RSS-Gen §8.9	Radiated Spurious Emission	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operated in 2400 ~ 2483.5MHz Band

40 channels are provided for Bluetooth LE

ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY
1	2402 MHz	15	2430 MHz	29	2458 MHz
2	2404 MHz	16	2432 MHz	30	2460 MHz
3	2406 MHz	17	2434 MHz	31	2462 MHz
4	2408 MHz	18	2436 MHz	32	2464 MHz
5	2410 MHz	19	2438 MHz	33	2466 MHz
6	2412 MHz	20	2440 MHz	34	2468 MHz
7	2414 MHz	21	2442 MHz	35	2470 MHz
8	2416MHz	22	2444 MHz	36	2472 MHz
9	2418 MHz	23	2446 MHz	37	2474 MHz
10	2420 MHz	24	2448 MHz	38	2476 MHz
11	2422 MHz	25	2450 MHz	39	2478 MHz
12	2424 MHz	26	2452 MHz	40	2480 MHz
13	2426 MHz	27	2454 MHz		
14	2428 MHz	28	2456 MHz		

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4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3. Investigation has been done on all the possible configurations for searching the worst case.

RADIATED EMISSION TEST (BELOW 1 GHz)				
MODE	AVAILABLE FREQUENCY (MHz)	ER-2021-40115	MODULATION	DATA RATE (Mbps)
Bluetooth LE	2402 to 2480	2440	GFSK	1
RADIATED EMISSION TEST (ABOVE 1 GHz)				
MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	DATA RATE (Mbps)
Bluetooth LE	2402 to 2480	2402, 2440, 2480	GFSK	1

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.34 dB
Peak Output Power	+/- 1 dB
6dB Bandwidth	+/- 1.54 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 1.69 dB
Peak Power Density	+/- 1.54 dB
Temperature	+/- 0.4 °C
Humidity	+/- 3.5 %
DC / AC Power Source	DC= +/- 1%, AC= +/- 1%

Radiated Spurious Emission Measurement Uncertainty			
Polarization: Vertical	+/- 2.64 dB	9kHz~30MHz: +/-2.3dB	
	+/- 4.93 dB	30MHz - 1000MHz: +/- 3.37dB	
	+/- 4.81 dB	1GHz - 18GHz: +/- 4.04dB	
	+/- 4.52 dB	18GHz - 40GHz: +/- 4.04dB	
Polarization: Horizontal	+/- 2.64 dB	9kHz~30MHz: +/-2.3dB	
	+/- 4.45 dB	30MHz - 1000MHz: +/- 4.22dB	
	+/- 4.81 dB	1GHz - 18GHz: +/- 4.08dB	
	+/- 4.52 dB	18GHz - 40GHz: +/- 4.08dB	

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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6 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

6.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 and RSS-Gen §8.9 Table 5 and 6 limit as below. And according to §15.33(a) (1) & RSS-Gen §6.13.2.a for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

Frequency (MHz)	Field strength (microvolts/meter)	Distance (meters)
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

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (μV/m)

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6.2 Measurement Equipment Used

Radiated Emission Test Site: SAC 3					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Horn Antenna	Schwarzbeck	BBHA9170	184	12/11/2020	12/10/2021
Horn Antenna	Schwarzbeck	BBHA9120D	1441	10/16/2020	10/15/2021
Bi-log Antenna	SCHWAZBECK	VULB9168	378	08/06/2020	08/05/2021
Loop Antenna	ETS.LINDGREN	6502	148045	10/19/2020	10/18/2021
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/27/2021	04/26/2022
EMI Test Receiver	R&S	ESCI 7	100759	07/13/2020	07/12/2021
Pre-Amplifier	HP	8449B	3008A00578	12/16/2020	12/15/2021
Pre-Amplifier	EMC Instruments	EMC184045B	980135	12/16/2020	12/15/2021
Pre-Amplifier	HP	8447D	2944A07676	12/16/2020	12/15/2021
Attenuator	Mini-Circuit	BW-S10W2+	4	12/16/2020	12/15/2021
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M1	12/16/2020	12/15/2021
High Pass Filter	WI	WHKX4.0/18G-10SS	22	12/16/2020	12/15/2021
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY2636/2	12/16/2020	12/15/2021
Coaxial Cable	Huber Suhner	SUCOFLEX 104	340057/4	12/16/2020	12/15/2021
Coaxial Cable	Huber Suhner	SUCOFLEX 104PEA	800052/2	12/16/2020	12/15/2021
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY2621/2	12/16/2020	12/15/2021
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY2617/2	12/16/2020	12/15/2021
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY2630/2	12/16/2020	12/15/2021
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY22962/2	12/16/2020	12/15/2021
Site Cal	SGS	SAC III chamber	N/A	01/01/2021	12/31/2021
Test Software	audix	e3	Ver. 6.11-20180413	N.C.R	N.C.R

NOTE: N.C.R refers to Not Calibrated Required.

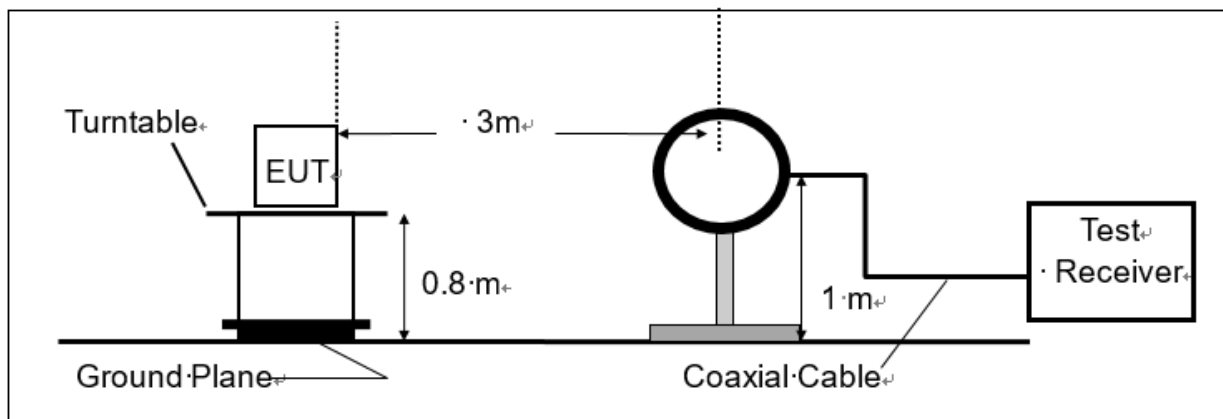
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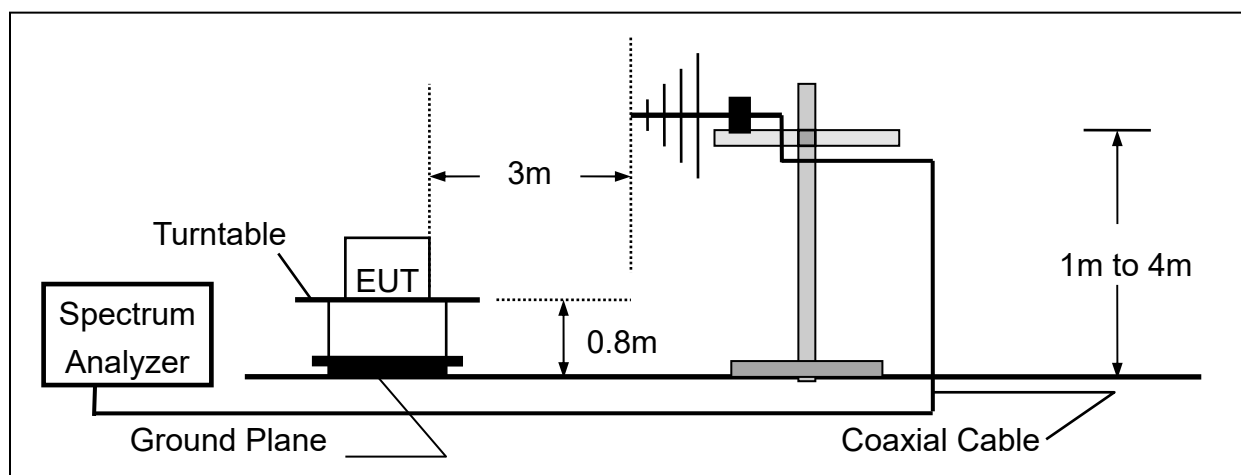
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6.3 Test SET-UP

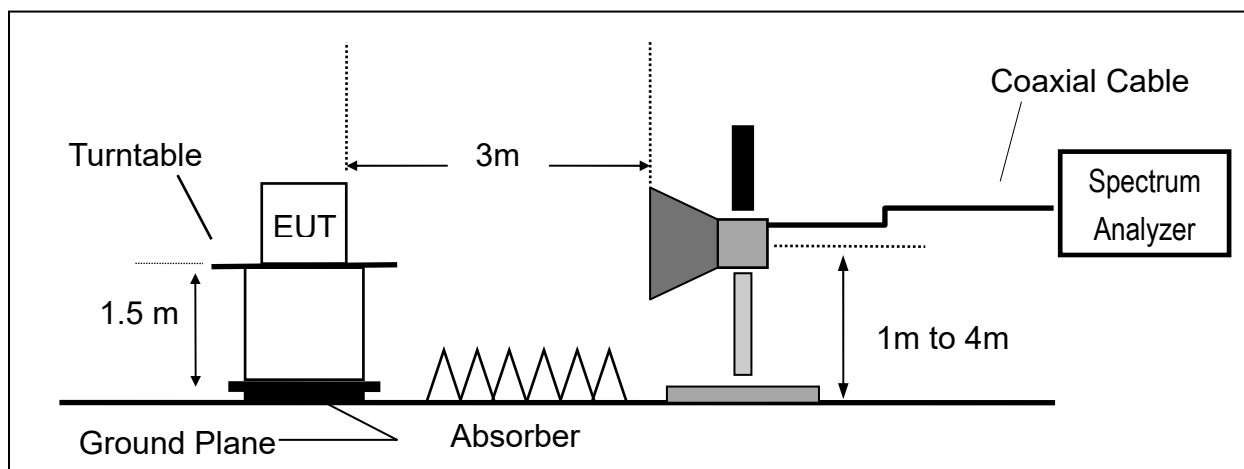
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(B) Radiated Emission Test Set-UP, Frequency form 30MHz to 1000MHz



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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6.4 Measurement Procedure

1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
2. The EUT was placed on a turn table with 0.8m for frequency < 1GHz and 1.5m for frequency > 1GHz above ground plan.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
6. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
7. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
8. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
9. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
10. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
11. Repeat above procedures until all default test channel measured were complete.

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6.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where *FS* = Field Strength

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

The limit of the emission level is expressed in dBuV/m, which converts $20 \cdot \log(uV/m)$

Actual FS(dBuV/m) = SPA. Reading level(dBuV) + Factor(dB)

Factor(dB) = Antenna Factor(dBuV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

6.6 Test Results of Radiated Spurious Emissions form 9 kHz to 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 per 15.31(o) & RSS-GEN §6.13.2 was not reported.

6.7 Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

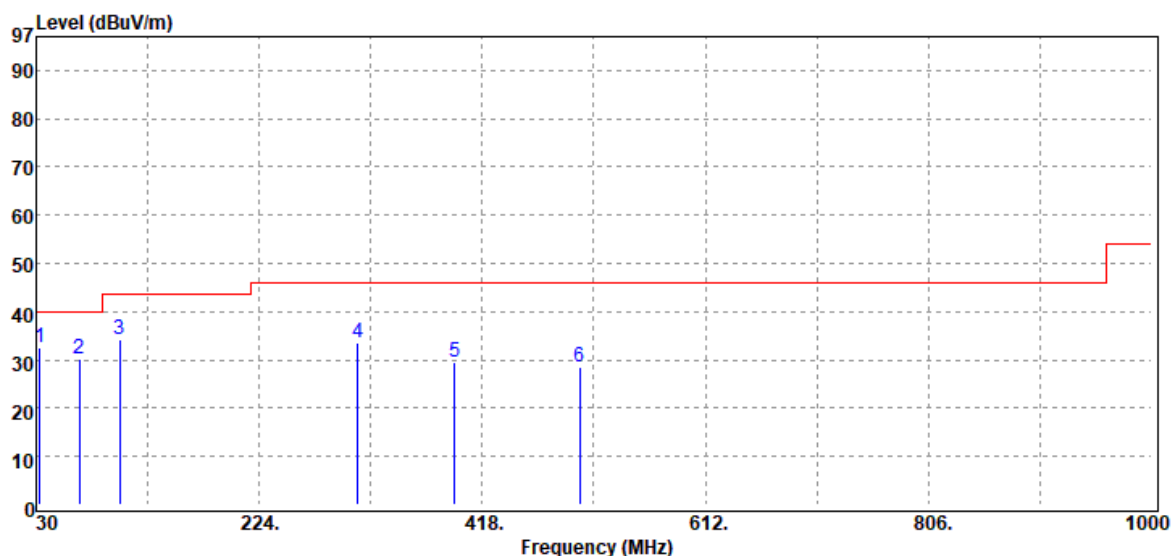
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6.7.1 Radiated Spurious Emission from 30MHz to 1000MHz

Report Number	:ER-2021-40115	Test Site	:SAC III Chamber
Operation Mode	:BLE(1M)	Test Date	:2021-05-14
Test Frequency	:2440 MHz	Temp./Humi.	:25.0/62
Test Mode	:Tx CH Mid	Antenna Pol.	:VERTICAL
EUT Pol	:NB Plane	Engineer	:Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
32.91	Peak	42.20	-9.67	32.53	40.00	-7.47
67.83	QP	40.16	-9.89	30.27	40.00	-9.73
102.75	Peak	46.83	-12.63	34.20	43.50	-9.30
309.36	Peak	39.89	-6.49	33.40	46.00	-12.60
393.75	Peak	34.73	-5.05	29.68	46.00	-16.32
502.39	Peak	32.01	-3.45	28.56	46.00	-17.44

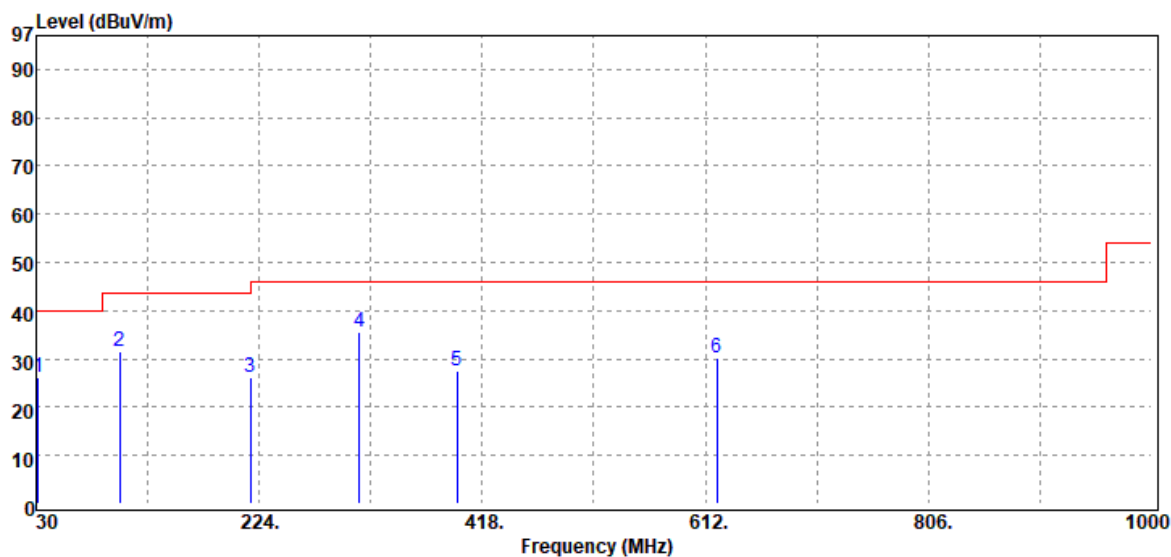
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Report Number :ER-2021-40115
 Operation Mode :BLE(1M)
 Test Frequency :2440 MHz
 Test Mode :Tx CH Mid
 EUT Pol :NB Plane

Test Site :SAC III Chamber
 Test Date :2021-05-14
 Temp./Humi. :25.0/62
 Antenna Pol. :HORIZONTAL
 Engineer :Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
31.94	Peak	35.89	-9.86	26.03	40.00	-13.97
102.75	Peak	44.34	-12.63	31.71	43.50	-11.79
216.24	Peak	36.95	-10.93	26.02	46.00	-19.98
311.30	Peak	41.91	-6.41	35.50	46.00	-10.50
395.69	Peak	32.60	-5.04	27.56	46.00	-18.44
621.70	Peak	30.54	-0.37	30.17	46.00	-15.83

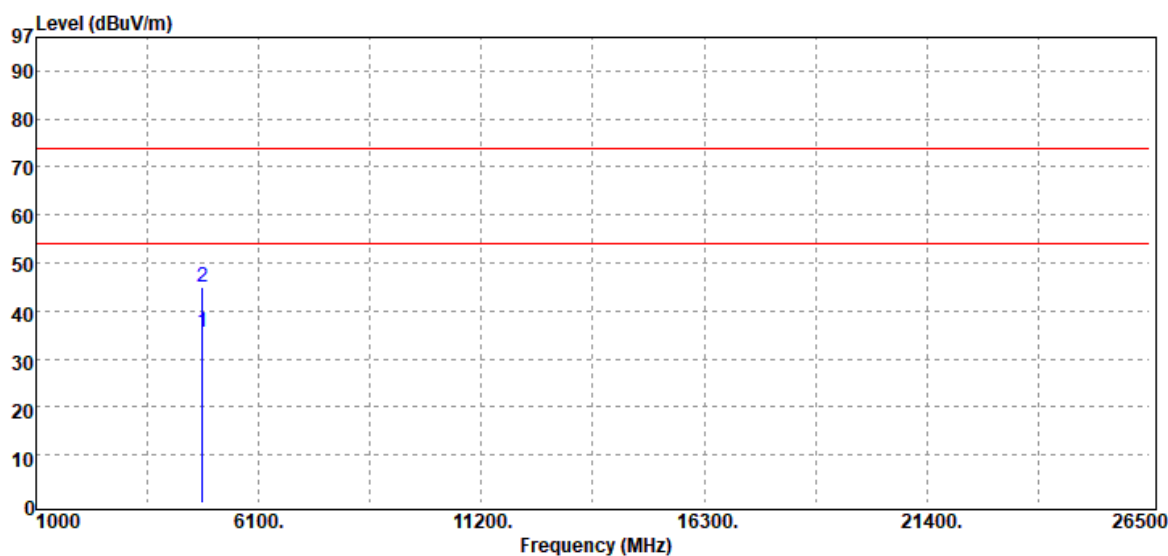
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6.7.2 Radiated Spurious Emission above 1GHz

Report Number	:ER-2021-40115	Test Site	:SAC III Chamber
Operation Mode	:BLE(1M)	Test Date	:2021-05-14
Test Frequency	:2402 MHz	Temp./Humi.	:25.0/62
Test Mode	:Tx CH Low	Antenna Pol.	:VERTICAL
EUT Pol	:NB Plane	Engineer	:Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.00	Average	28.02	7.48	35.50	54.00	-18.50
4804.00	Peak	37.48	7.48	44.96	74.00	-29.04

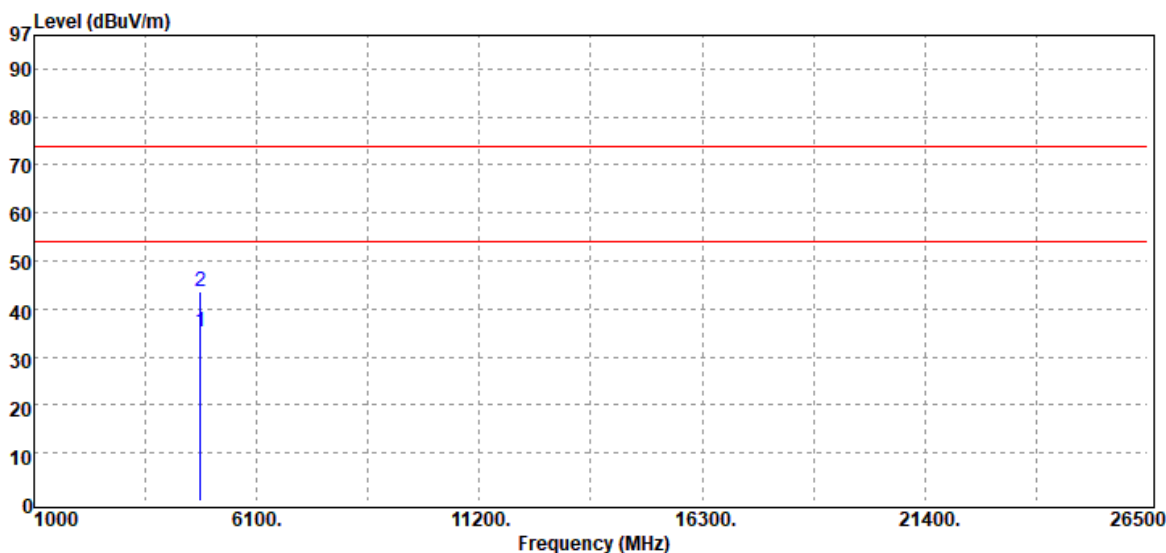
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Report Number :ER-2021-40115
 Operation Mode :BLE(1M)
 Test Frequency :2402 MHz
 Test Mode :Tx CH Low
 EUT Pol :NB Plane

Test Site :SAC III Chamber
 Test Date :2021-05-14
 Temp./Humi. :25.0/62
 Antenna Pol. :HORIZONTAL
 Engineer :Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.00	Average	27.82	7.48	35.30	54.00	-18.70
4804.00	Peak	36.07	7.48	43.55	74.00	-30.45

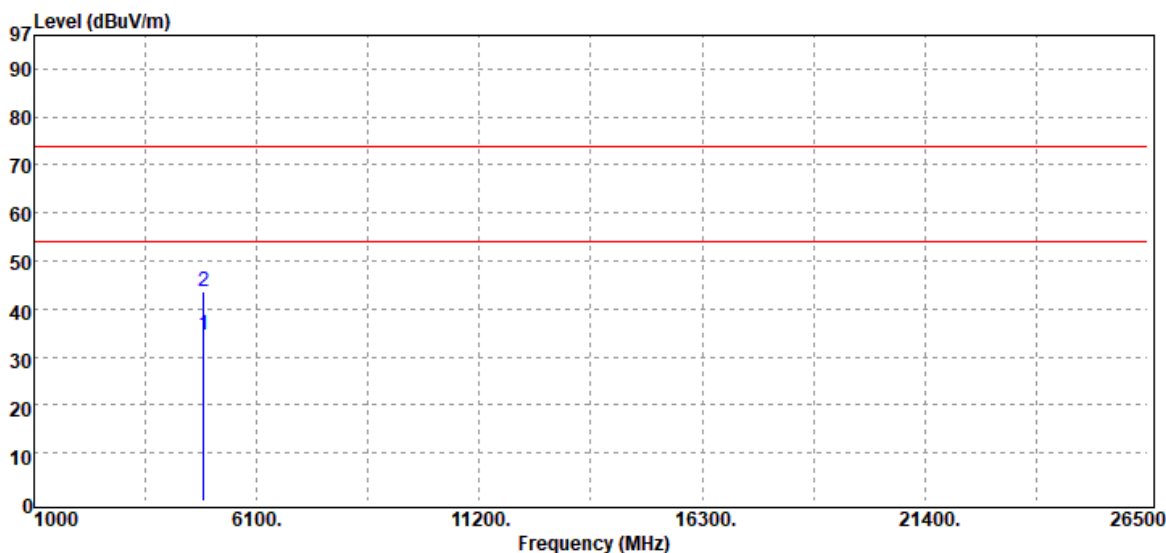
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Report Number :ER-2021-40115
 Operation Mode :BLE(1M)
 Test Frequency :2440 MHz
 Test Mode :Tx CH Mid
 EUT Pol :NB Plane

Test Site :SAC III Chamber
 Test Date :2021-05-14
 Temp./Humi. :25.0/62
 Antenna Pol. :VERTICAL
 Engineer :Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4880.00	Average	27.43	7.04	34.47	54.00	-19.53
4880.00	Peak	36.46	7.04	43.50	74.00	-30.50

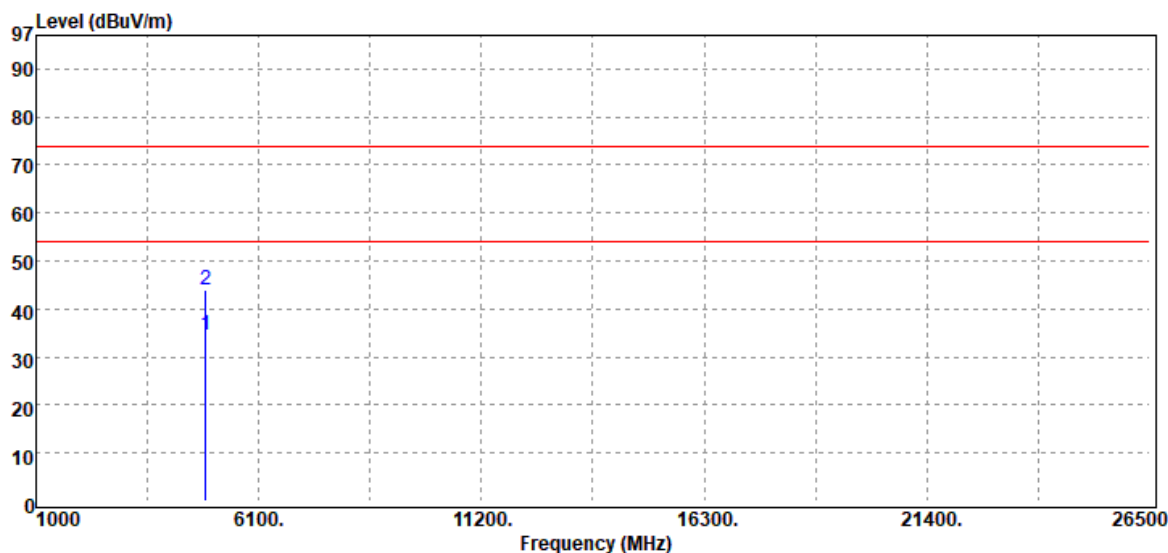
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Report Number :ER-2021-40115
 Operation Mode :BLE(1M)
 Test Frequency :2440 MHz
 Test Mode :Tx CH Mid
 EUT Pol :NB Plane

Test Site :SAC III Chamber
 Test Date :2021-05-14
 Temp./Humi. :25.0/62
 Antenna Pol. :HORIZONTAL
 Engineer :Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
4880.00	Average	27.36	7.04	34.40	54.00	-19.60
4880.00	Peak	36.80	7.04	43.84	74.00	-30.16

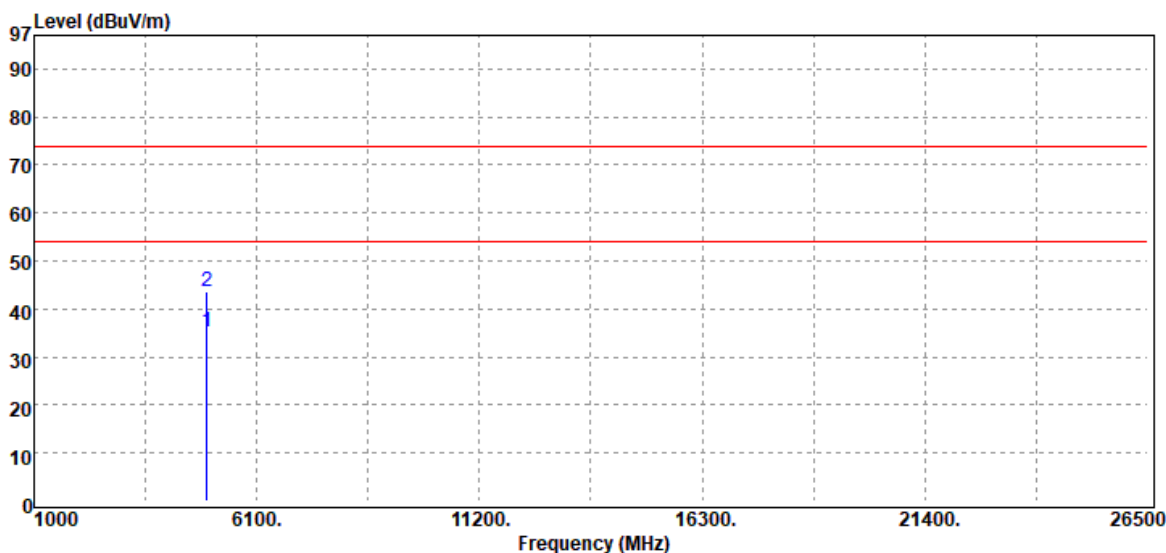
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Report Number :ER-2021-40115
 Operation Mode :BLE(1M)
 Test Frequency :2480 MHz
 Test Mode :Tx CH High
 EUT Pol :NB Plane

Test Site :SAC III Chamber
 Test Date :2021-05-14
 Temp./Humi. :25.0/62
 Antenna Pol. :VERTICAL
 Engineer :Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.00	Average	27.90	7.40	35.30	54.00	-18.70
4960.00	Peak	36.36	7.40	43.76	74.00	-30.24

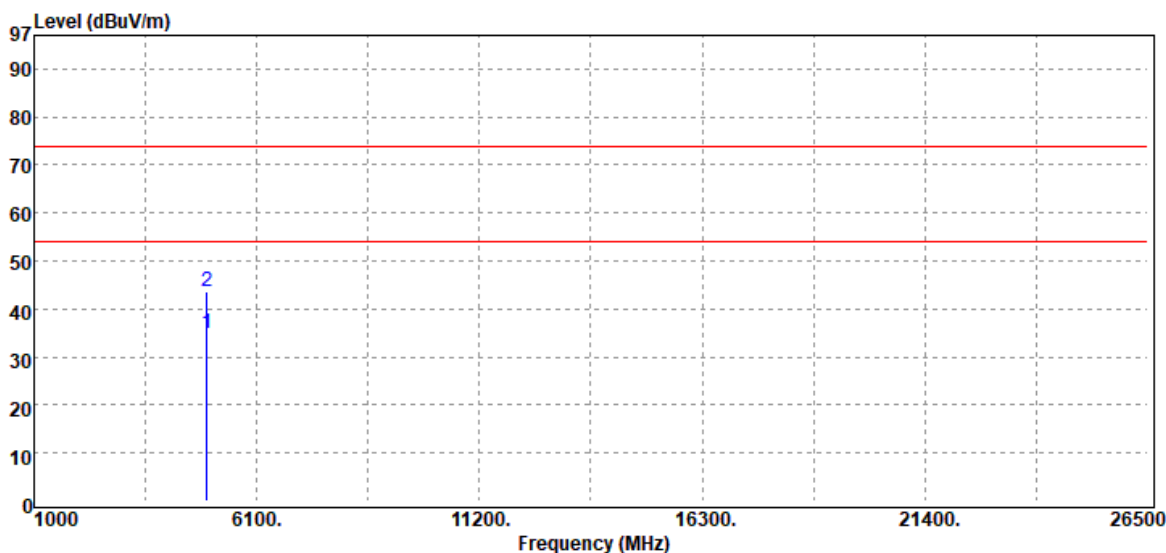
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 Test Mode :Tx CH High
 EUT Pol :NB Plane

Test Site :SAC III Chamber
 Test Date :2021-05-14
 Temp./Humi. :25.0/62
 Antenna Pol. :HORIZONTAL
 Engineer :Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.00	Average	27.56	7.40	34.96	54.00	-19.04
4960.00	Peak	36.40	7.40	43.80	74.00	-30.20

~ End of Report ~

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