

ELECTROMAGNETIC EMISSIONS CLASS II & IV PERMISSIVE CHANGE REPORT



Applicant: Framework Computer Inc
447 Sutter St, PMB 135, San Francisco, CA, 94108-4618,
United States

Product Name: Portable Computer

Brand Name: Framework

Model No.: FRANPC0000

Report Number: TERF2207001060ER

FCC ID 2AZR6-FRANBBAT10

IC: 27217-FRANBBAT10

Issue Date: Sep. 14, 2022

Date of Test: Jul. 21, 2022

Date of EUT Received: Jul. 12, 2022

Jazz Huang

Approved By

Jazz Huang

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 comply with FCC rule part §15.247, ISED RSS-247.

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

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Revision History

Report Number	Revision	Description	Issue Date	Revised By	Remark
TERF2207001060ER	00	Original.	Sep. 14, 2022	Yi-Shan Tsai	

Note:

- The remark "*" indicates modification of the report upon requests from certification body.

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Portable Computer
Brand Name:	Framework
Model No.:	FRANPC0000
EUT Series No.:	FRANPCCP4B2213002E
Model No. of BT/WLAN Module:	AX211NGW
Power Supply:	15.4Vdc from Rechargeable Li-ion Polymer Battery 5 / 9 / 15 / 20Vdc from AC/DC Adapter
Test Software (Name/Version)	DRTU / DRTU_01026_22.130.0

1.2 RF Specification

Radio Technology:	BLE
Frequency Range:	2402 – 2480MHz
Channel number:	40 channels
Modulation type:	GFSK

1.3 Antenna Designation

Antenna Type	Supplier	Main / Aux	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)
PIFA	AWAN	Main	AYF6Y-200005 (DC33002SE00)	2402~2480	2.72

Note:

1. Pre-scanned was done on the above antennas, measurements were demonstrated by using the antenna with the highest gain as the worst case scenarios.
2. Antenna information is provided by the applicant.

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1.4 Test Methodology of Applied Standards

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

1.5 Test Facility

Laboratory	Test Site Address	Test Site Name	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.	SAC 1	TW0027	TW3702
		SAC 3		
		Conduction 1		
		Conducted 1		
		Conducted 2		
		Conducted 3		
		Conducted 4		
		Conducted 5		
	Conducted 6			
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C	TW0028	
		SAC C		
		SAC D		
		SAC G		
		Conducted A		
		Conducted B		
		Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
Conducted G				
Note: Test site name is remarked on the equipment list in each section of this report as an indication where measurements occurred in specific test site and address.				

1.6 Special Accessories

There are no special accessories used while test was conducted.

1.7 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.

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*6m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

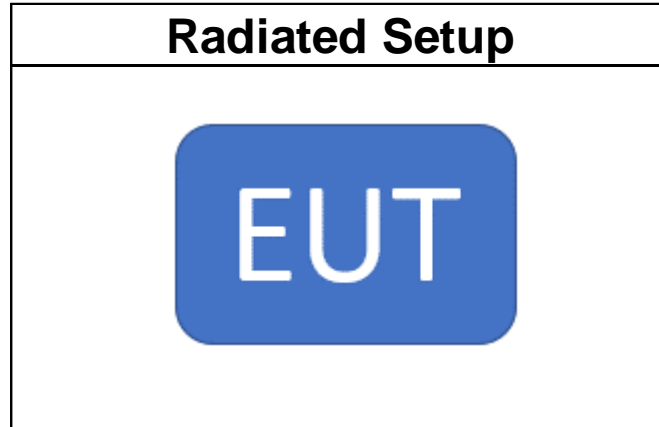
There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

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2.5 Test Configuration



2.6 Control Unit(s)

Radiated Emission Test Site: SAC 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Software	Audix	e3	Ver. 9.210322	N.C.R	N.C.R

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

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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

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. The field strength of radiated emission was measured as the EUT positioned in different orthogonal planes (E1/E2/H) based on actual usage of the EUT to pre-scan the emissions for determining the worst case scenario.
4. Investigation has been done on all the possible configurations for searching the worst case.

RADIATED EMISSION TEST (BELOW 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	19	GFSK	1
RADIATED EMISSION TEST (ABOVE 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	0,19,39	GFSK	1

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5 MEASUREMENT UNCERTAINTY

Radiated Spurious Emission Measurement Uncertainty				
Polarization: Vertical	+/-	2.57	dB	9kHz~30MHz
	+/-	4.85	dB	30MHz - 1000MHz
	+/-	4.45	dB	1GHz - 18GHz
	+/-	4.24	dB	18GHz - 40GHz
Polarization: Horizontal	+/-	2.57	dB	9kHz~30MHz
	+/-	4.37	dB	30MHz - 1000MHz
	+/-	4.45	dB	1GHz - 18GHz
	+/-	4.24	dB	18GHz - 40GHz

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 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.

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6.2 Measurement Equipment Used

Radiated Emission Test Site: SAC 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Horn Antenna	SCHWARZBECK	BBHA9120D	D803	12/20/2021	12/19/2022
Bi-log Antenna	TESEO	CBL 6112D	35242 & AT-N0555	01/03/2022	01/02/2023
Horn Antenna	SCHWARZBECK	BBHA9170	184	12/16/2021	12/15/2022
Site Cal	SGS	SAC 1	N/A	01/01/2022	12/31/2022
Loop Antenna	ETS.LINDGREN	6502	148045	09/29/2021	09/28/2022
Spectrum Analyzer	Agilent	E4446A	MY51100003	10/26/2021	10/25/2022
EMI Test Receiver	R&S	ESCI 7	100759	08/26/2021	08/25/2022
Pre-Amplifier	EMC Instruments	EMC184045B	980135	10/27/2021	10/26/2022
Pre-Amplifier	HP	8449B	3008A01973	12/16/2021	12/15/2022
Pre-Amplifier	HP	8447D	2944A09469	12/16/2021	12/15/2022
Bandreject Filter 2400-2483.5	EWT	EWT-14-0166	M1	12/14/2021	12/13/2022
3.2GHz High Pass Filter	WI	WHKX10-2624-80SS	3	12/14/2021	12/13/2022
Coaxial Cable	Huber Suhner	succoflex 102	MY2622/2	12/16/2021	12/15/2022
Coaxial Cable	Huber Suhner	succoflex 104A	800086/4a	12/16/2021	12/15/2022
Coaxial Cable	Huber Suhner	EMC 104-SM-SM-2000	160123	12/16/2021	12/15/2022
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY2630/2	12/16/2021	12/15/2022
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY22962/2	12/16/2021	12/15/2022

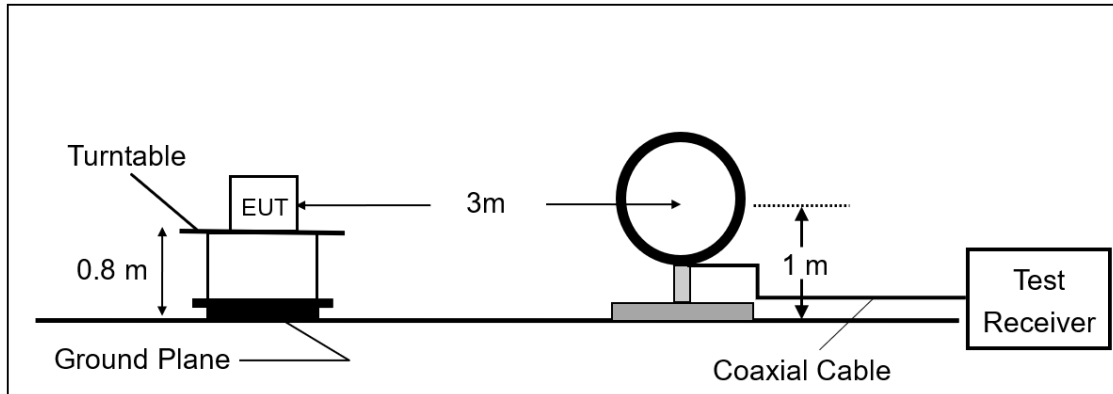
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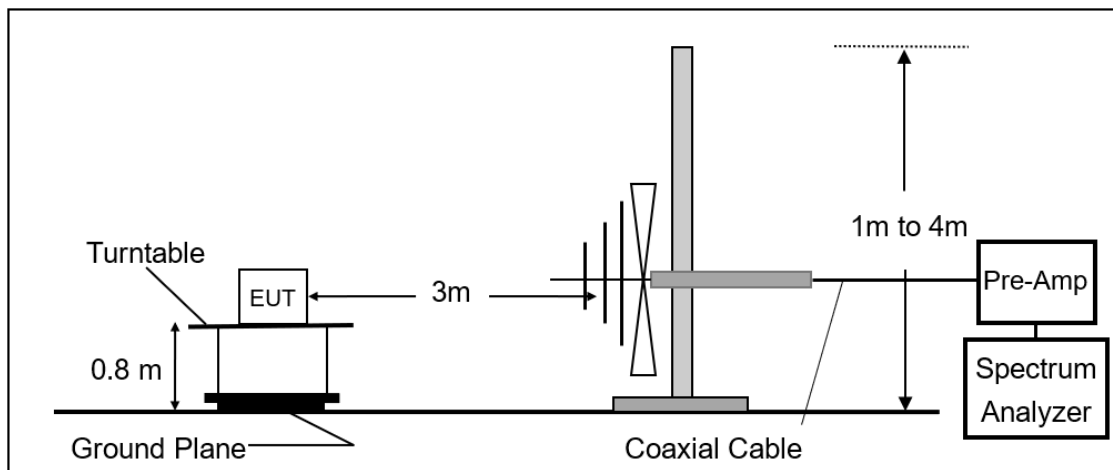
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6.3 Test SET-UP

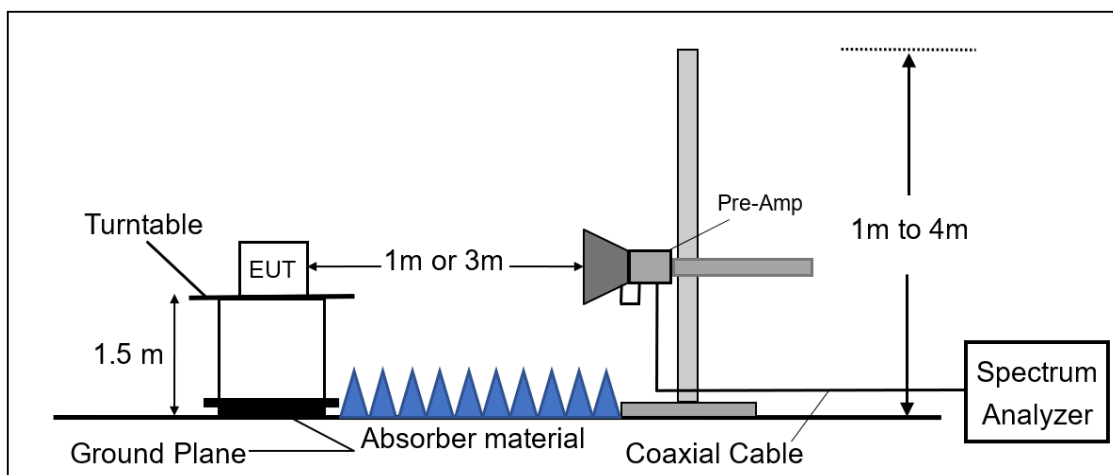
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz.



(B) Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz.



(C) Radiated Emission Test Set-Up, Frequency Above 1GHz.



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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 plane.
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=100 kHz and VBW=300 kHz for Peak Detector (PK) at frequency between 30MHz and 1 GHz.
6. Use receiver mode as RBW=120 kHz for Quasi-peak (QP) at frequency between 30MHz and 1 GHz.
7. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
8. 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.
9. 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.
10. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
11. 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.
12. 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(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

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

6.6 Test Results of Radiated Spurious Emissions from 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.

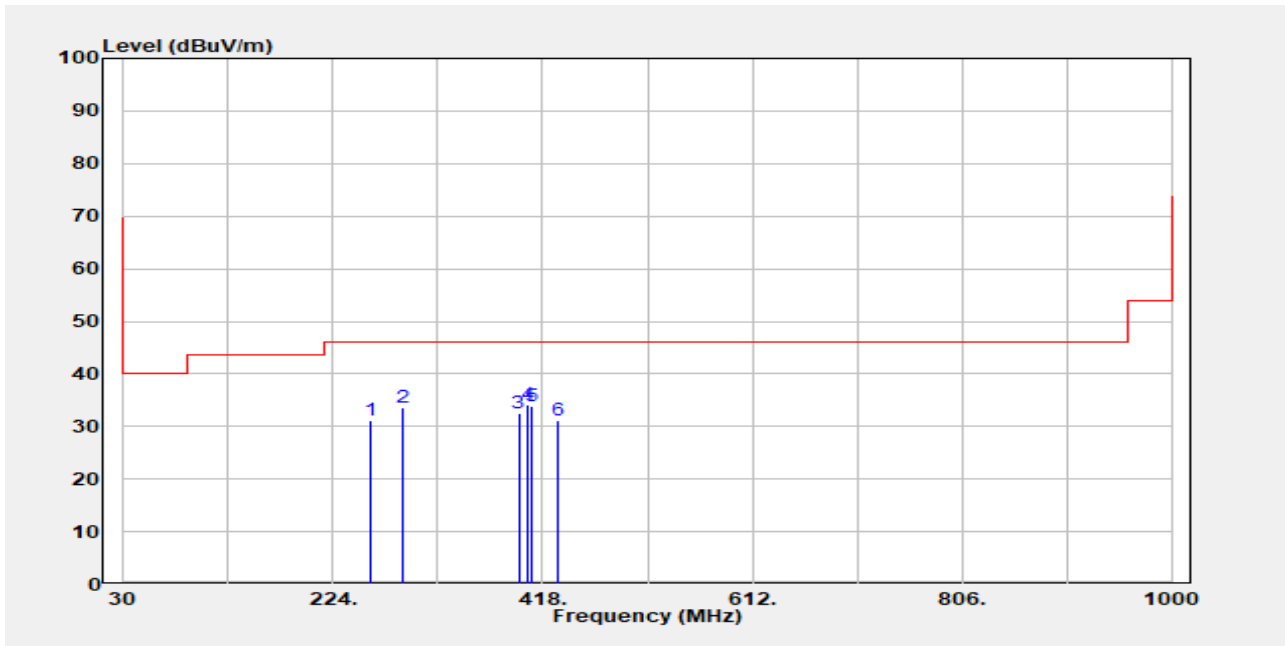
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6.7.1 Radiated Spurious Emission

Report Number	:TERF2207001060ER	Test Site	:SAC 1
Operation Mode	:BLE 1M	Test Date	:2022-07-21
Test Frequency	:2440 MHz	Temp./Humi.	:24.3/63
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:NB Plane	Engineer	:Jack Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBUV	Factor dB	Actual FS dBUV/m	Limit @3m dBUV/m	Margin dB
257.95	Peak	40.29	-9.21	31.09	46.00	-14.91
288.02	Peak	42.95	-9.41	33.53	46.00	-12.47
395.69	Peak	39.51	-6.87	32.63	46.00	-13.37
403.45	Peak	40.78	-6.58	34.20	46.00	-11.80
407.33	Peak	40.40	-6.46	33.94	46.00	-12.06
432.55	Peak	37.83	-6.69	31.15	46.00	-14.85

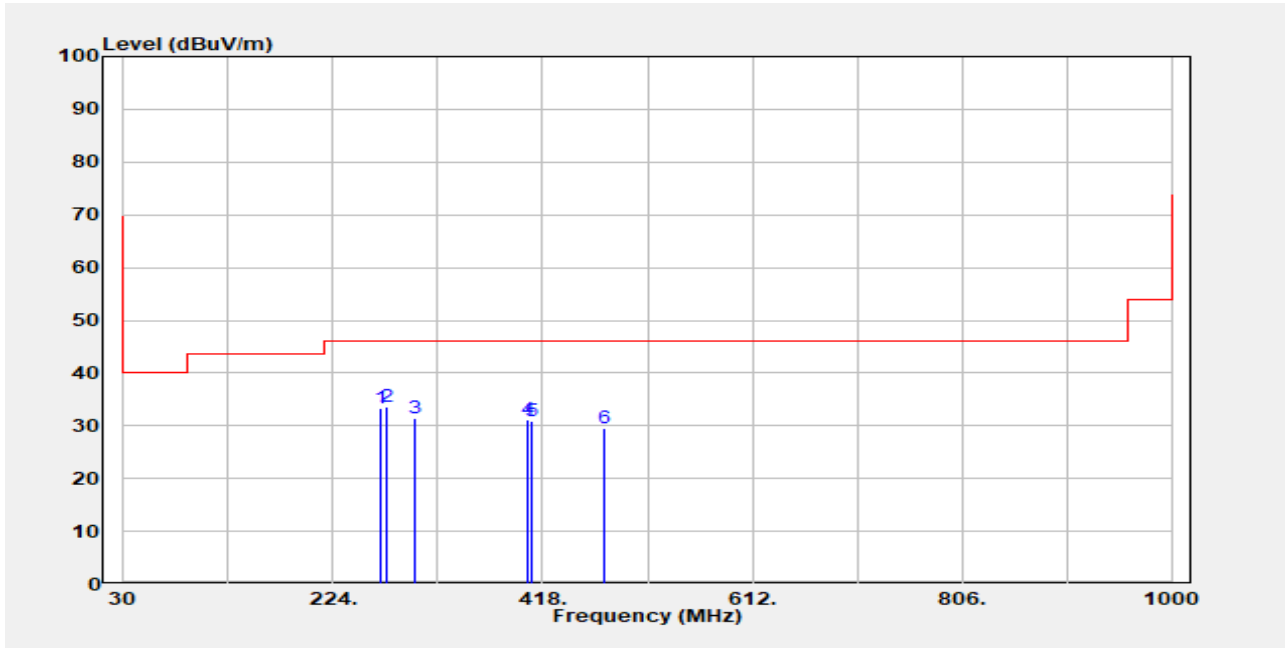
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Report Number :TERF2207001060ER
 Operation Mode :BLE 1M
 Test Frequency :2440 MHz
 Test Mode :Tx
 EUT Pol :NB Plane

Test Site :SAC 1
 Test Date :2022-07-21
 Temp./Humi. :24.3/63
 Antenna Pol. :Horizontal
 Engineer :Jack Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
268.62	Peak	42.94	-9.58	33.36	46.00	-12.64
274.44	Peak	43.45	-9.77	33.68	46.00	-12.32
299.66	Peak	40.72	-9.26	31.47	46.00	-14.53
403.45	Peak	37.72	-6.58	31.14	46.00	-14.86
407.33	Peak	37.34	-6.46	30.88	46.00	-15.12
474.26	Peak	35.19	-5.71	29.47	46.00	-16.53

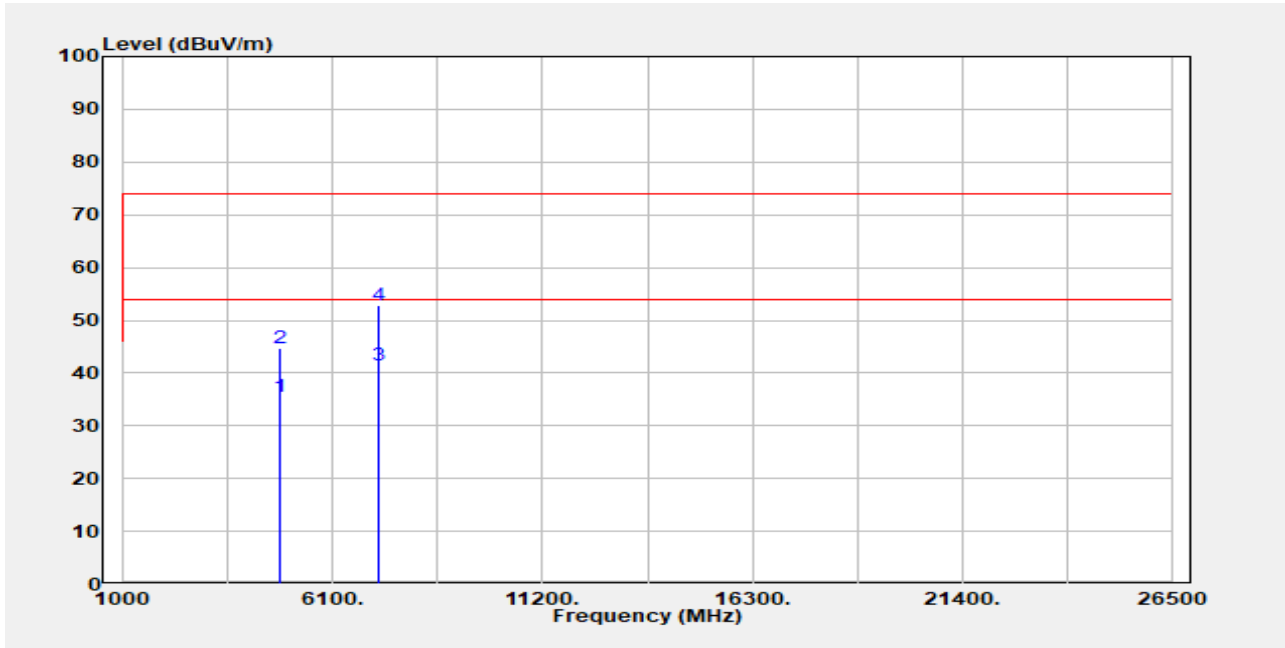
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Report Number :TERF2207001060ER
 Operation Mode :BLE 1M
 Test Frequency :2402 MHz
 Test Mode :Tx
 EUT Pol :NB Plane

Test Site :SAC 1
 Test Date :2022-07-21
 Temp./Humi. :24.3/63
 Antenna Pol. :Vertical
 Engineer :Jack Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
4804.00	Average	27.46	8.11	35.57	54.00	-18.43
4804.00	Peak	36.64	8.11	44.75	74.00	-29.25
7206.00	Average	26.42	15.01	41.43	54.00	-12.57
7206.00	Peak	37.73	15.01	52.74	74.00	-21.26

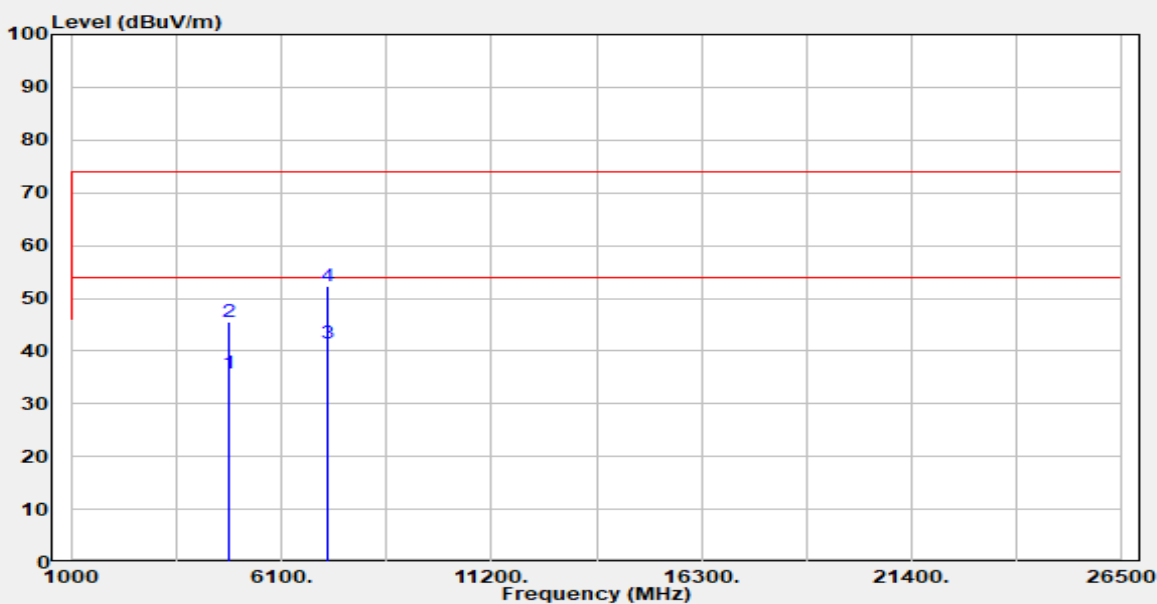
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Report Number :TERF2207001060ER
 Operation Mode :BLE 1M
 Test Frequency :2402 MHz
 Test Mode :Tx
 EUT Pol :NB Plane

Test Site :SAC 1
 Test Date :2022-07-21
 Temp./Humi. :24.3/63
 Antenna Pol. :Horizontal
 Engineer :Jack Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
4804.00	Average	27.61	8.11	35.72	54.00	-18.28
4804.00	Peak	37.31	8.11	45.42	74.00	-28.58
7206.00	Average	26.43	15.01	41.44	54.00	-12.56
7206.00	Peak	37.23	15.01	52.24	74.00	-21.76

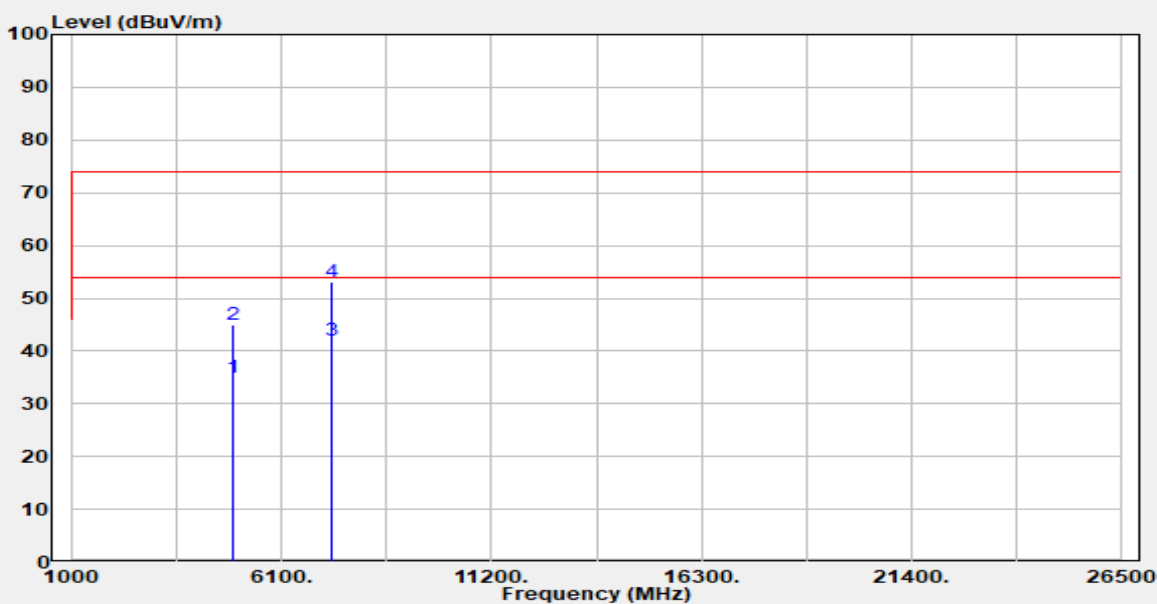
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Report Number :TERF2207001060ER
 Operation Mode :BLE 1M
 Test Frequency :2440 MHz
 Test Mode :Tx
 EUT Pol :NB Plane

Test Site :SAC 1
 Test Date :2022-07-21
 Temp./Humi. :24.3/63
 Antenna Pol. :Vertical
 Engineer :Jack Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
4880.00	Average	27.05	7.91	34.96	54.00	-19.04
4880.00	Peak	37.16	7.91	45.07	74.00	-28.93
7320.00	Average	26.76	15.28	42.04	54.00	-11.96
7320.00	Peak	37.87	15.28	53.15	74.00	-20.85

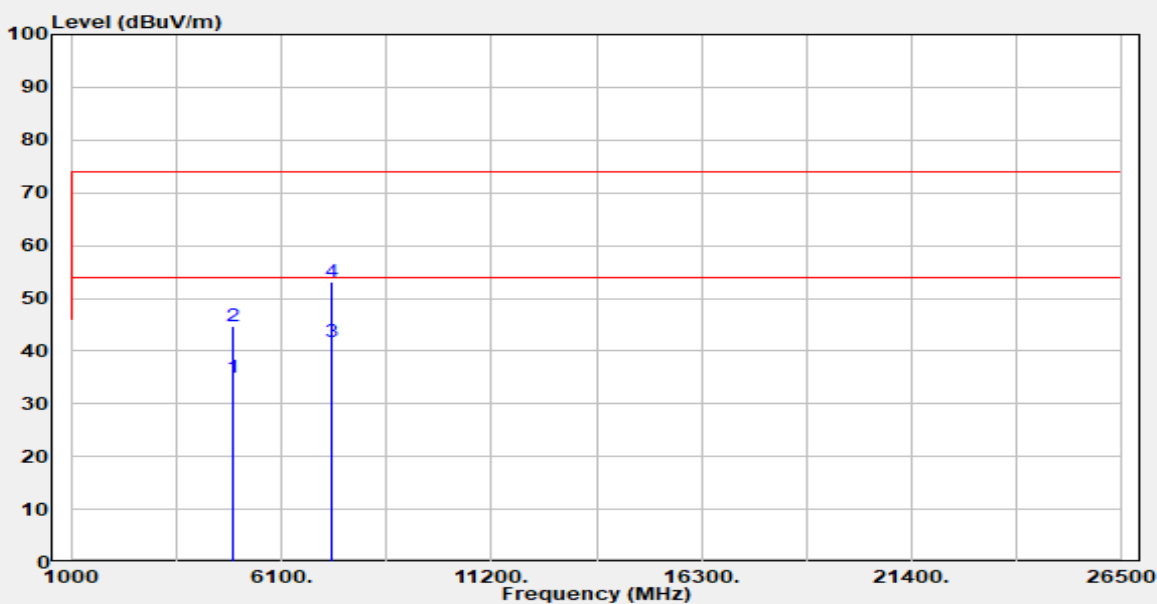
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Report Number :TERF2207001060ER
 Operation Mode :BLE 1M
 Test Frequency :2440 MHz
 Test Mode :Tx
 EUT Pol :NB Plane

Test Site :SAC 1
 Test Date :2022-07-21
 Temp./Humi. :24.3/63
 Antenna Pol. :Horizontal
 Engineer :Jack Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
4880.00	Average	27.11	7.91	35.02	54.00	-18.98
4880.00	Peak	36.94	7.91	44.85	74.00	-29.15
7320.00	Average	26.59	15.28	41.87	54.00	-12.13
7320.00	Peak	37.77	15.28	53.05	74.00	-20.95

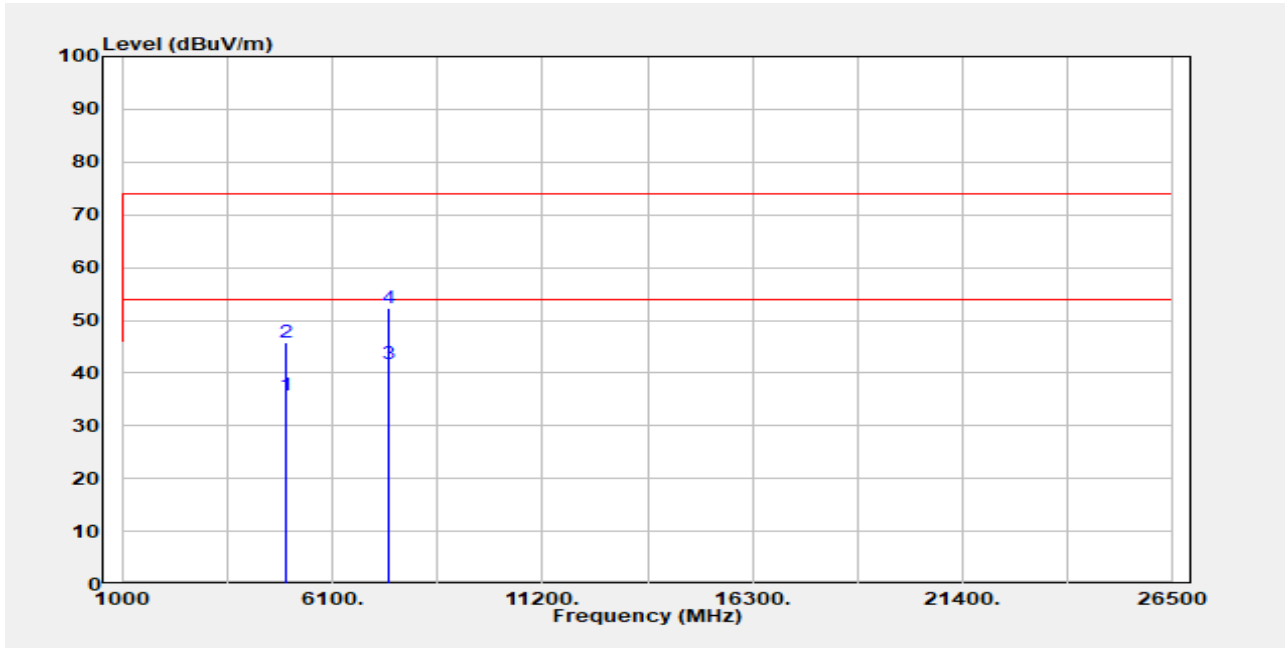
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Report Number :TERF2207001060ER
 Operation Mode :BLE 1M
 Test Frequency :2480 MHz
 Test Mode :Tx
 EUT Pol :NB Plane

Test Site :SAC 1
 Test Date :2022-07-21
 Temp./Humi. :24.3/63
 Antenna Pol. :Vertical
 Engineer :Jack Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
4960.00	Average	27.38	8.51	35.89	54.00	-18.11
4960.00	Peak	37.19	8.51	45.70	74.00	-28.30
7440.00	Average	26.57	15.09	41.66	54.00	-12.34
7440.00	Peak	37.18	15.09	52.27	74.00	-21.73

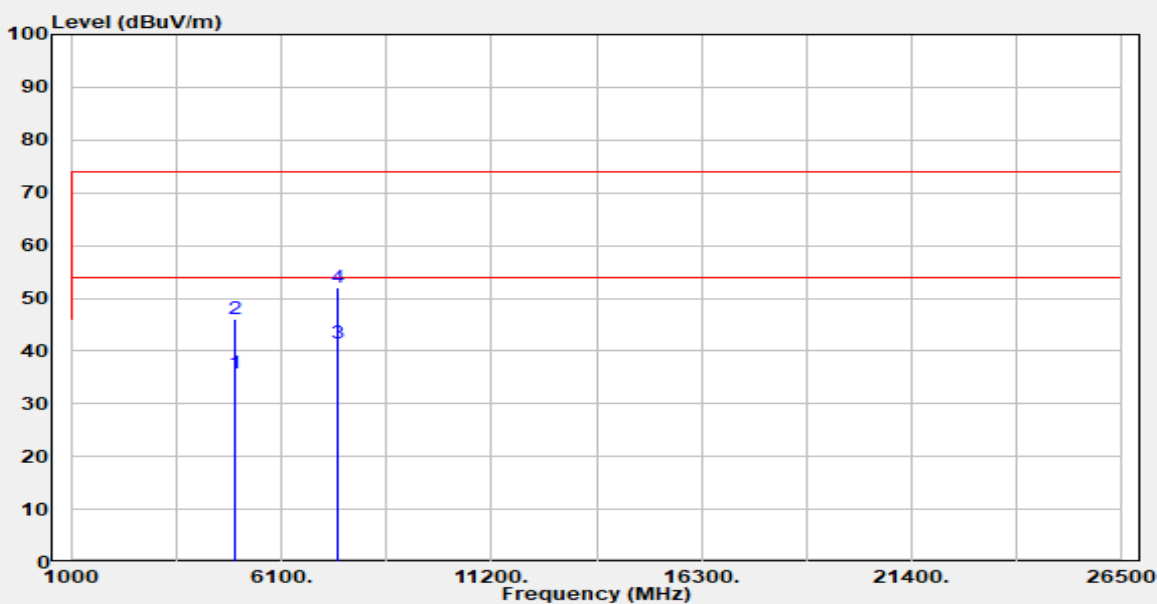
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Report Number :TERF2207001060ER
 Operation Mode :BLE 1M
 Test Frequency :2480 MHz
 Test Mode :Tx
 EUT Pol :NB Plane

Test Site :SAC 1
 Test Date :2022-07-21
 Temp./Humi. :24.3/63
 Antenna Pol. :Horizontal
 Engineer :Jack Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
4960.00	Average	27.23	8.51	35.74	54.00	-18.26
4960.00	Peak	37.46	8.51	45.97	74.00	-28.03
7440.00	Average	26.45	15.09	41.54	54.00	-12.46
7440.00	Peak	37.01	15.09	52.10	74.00	-21.90

~ End of Report ~

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