

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT



Applicant: FNATIC GEAR LIMITED
2 Ebor St, London, E1 6AW, UK
Manufacturer: FNATIC GEAR LIMITED
2 Ebor St, London, E1 6AW, UK
Product Name: Wireless Dongle
Brand Name: FNATIC
Model No.: C-MS0004
Model Difference: N/A
Report Number: E2/2021/A0031
FCC ID 2A3COC-MS0004
Issue Date: December 29, 2021
Date of Test: October 19, 2021 ~ November 12, 2021
Date of EUT Received: October 7, 2021

Approved By

Arno Hsieh
Arno Hsieh

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 §15.249.

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
E2/2021/A0031	00	Original	December 29, 2021	Ariel Chang

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Wireless Dongle
Brand Name:	FNATIC
Model No.:	C-MS0004
Model Difference:	N/A
Hardware Version:	20210714
Firmware Version:	52820V05
Power Supply:	5Vdc
Power Setting:	default

1.2 RF Specification

Radio Technology:	2.4GHz Short Range Radio
Frequency Range:	2403-2475MHz (2403,2423,2440,2461,2475MHz)
Channel number:	5 channels
Modulation type:	GFSK
Transmit Power:	98.78dBuV/m at 3m

1.3 Antenna Designation

Antenna Type	Freq. (MHz)	Peak Antenna Gain (dBi)
Embedded Antenna	2400~2500	1.21
Note: 1. Antenna information is provided by the applicant.		

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1.4 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.249

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 Conducted Emissions

The EUT is placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. The two LISNs provide 50uH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

2.3.3 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*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.

2.4.2 For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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2.5 Test Configuration

Conduction Setup



Radiated Setup



Conducted Setup



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2.6 Control Unit(s)

Conducted Emission Test Site: Conducted D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
adapter	Fnatic Gear Limited	CA-02	N/A	N.C.R	N.C.R
USB cable	YUE-YANG ELECTRONIC	DP474-Type C-Cable	N/A	N.C.R	N.C.R
Notebook	Lenovo	T420	S0012599	N/A	N/A

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
NB Adaptor	Lenovo	ADLX45NCC3A	N/A	N/A	N/A
Notebook	Lenovo	L440	P0000367	N/A	N/A
USB cable	YUE-YANG ELECTRONIC	DP474-Type C-Cable	N/A	N/A	N/A

Radiated Emission Test Site: SAC C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
adapter	Fnatic Gear Limited	CA-02	N/A	N/A	N/A
USB cable	YUE-YANG ELECTRONIC	DP474-Type C-Cable	N/A	N/A	N/A
Notebook	Lenovo	L440	P0000367	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.249(a)(e) §15.249(a), 15.209	Radiated Emission	Compliant
§15.215(c)	Frequency Stability	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operating Frequencies

Channel	Frequency
0	2403
1	2423
2	2440
3	2461
4	2475

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5 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.

RADIATED EMISSION TEST:

RADIATED EMISSION TEST (BELOW 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED FREQUENCY	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
2.4G	0~4	2440	GFSK	1	MAIN
RADIATED EMISSION TEST (ABOVE 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED FREQUENCY	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
2.4G	0~4	2403, 2440, 2475	GFSK	1	MAIN

CONDUCTED EMISSION TEST:

CONDUCTED EMISSION TEST					
MODE	AVAILABLE CHANNEL	TESTED FREQUENCY	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
2.4G	0~4	2403, 2440, 2475	GFSK	1	MAIN

Note: 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.

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6 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.34 dB
20dB & 99% Bandwidth	+/- 1.53 Hz
100 kHz Bandwidth Of Frequency Band Edges	+/- 1.69 dB
Temperature	+/- 0.4 °C
Humidity	+/- 3.5 %
DC / AC Power Source	+/- 1 %

Radiated Spurious Emission Measurement Uncertainty			
Polarization: Vertical	+/-	2.64 dB	9kHz~30MHz
	+/-	4.93 dB	30MHz - 1000MHz
	+/-	4.81 dB	1GHz - 18GHz
	+/-	4.52 dB	18GHz - 40GHz
Polarization: Horizontal	+/-	2.64 dB	9kHz~30MHz
	+/-	4.45 dB	30MHz - 1000MHz
	+/-	4.81 dB	1GHz - 18GHz
	+/-	4.52 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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7 MEASUREMENT EQUIPMENT USED

7.1 Emission from AC power line

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Software	audix	e3	Ver. 6.11-20180419c	N.C.R	N.C.R
LISN	SCHWARZBECK Mess-Elektronik	NSLK8127	973	03/25/2021	03/24/2022
EMI Test Receiver	R&S	ESCI	101342	04/28/2021	04/27/2022
Coaxial Cable	EC Lab	RF-HY-CAB-250	RF-HY-CAB-250-01	03/27/2021	03/26/2022
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2021	03/26/2022

7.2 Conducted Measurement

Conducted Emission Test Site: Conducted D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071574	06/25/2021	06/25/2022
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R
Attenuator	Marvelous	WATT-218FS-10	RF15	11/19/2020	11/18/2021
DC Block	PASTER-NACK	PE8210	RF158	11/19/2020	11/18/2021
Coaxial Cables	Woken	00100A1F2A196C	RF59	11/19/2020	11/18/2021

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7.3 Radiated Measurement

Radiated Emission Test Site: SAC C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	TESEQ	CBL 6112D	35240	09/10/2021	09/09/2022
Horn Antenna	Schwarzbeck	BBHA9170	184	12/11/2020	12/10/2021
Horn Antenna	Schwarzbeck	BBHA9120D	1187	01/11/2021	01/10/2022
Loop Antenna	ETS.LINDGREN	6502	143303	05/07/2021	05/06/2022
EMI Test Receiver	R&S	ESU 40	100363	04/28/2021	04/27/2022
Pre-Amplifier	EMC Instruments	EMC330	980096	11/19/2020	11/18/2021
Pre-Amplifier	EMC Instruments	EMC0011830	980199	11/19/2020	11/18/2021
Pre-Amplifier	EMC Instruments	EMC184045B	980135	10/27/2021	10/26/2022
Attenuator	Marvelous	WATT-218FS-10	RF20	11/19/2020	11/18/2021
Band Rejection Filter	Micro-Tronics	BRM50701-01	RF201	11/19/2020	11/18/2021
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17388/4	11/19/2020	11/18/2021
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	11/19/2020	11/18/2021
Test Software	audix	e3	20923 sgs Ver.9	N.C.R	N.C.R
High Pass Filter	R&S	F13 HPF 3GHz	RF175	11/19/2020	11/18/2021

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

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8 CONDUCTED EMISSION TEST

8.1 Applicable Standard:

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits (dBuV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

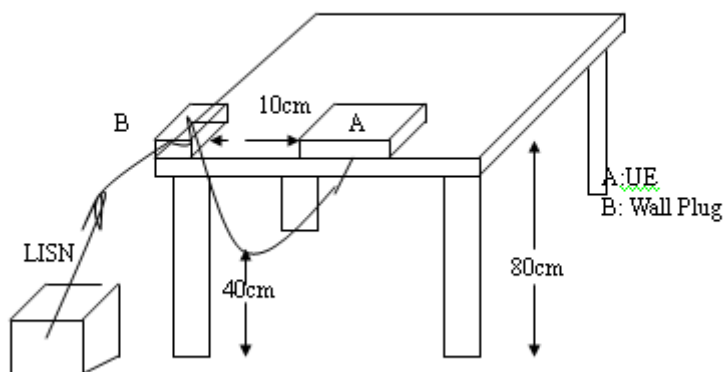
Note

- 1.The lower limit shall apply at the transition frequencies
- 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

8.2 EUT Setup:

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

8.3 Test Setup



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8.4 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

8.5 Measurement Result:

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit.

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AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number :E2/2021/A0031

Test Site :Conduction C

Test Mode :2.4G

Test Date :2021-11-01

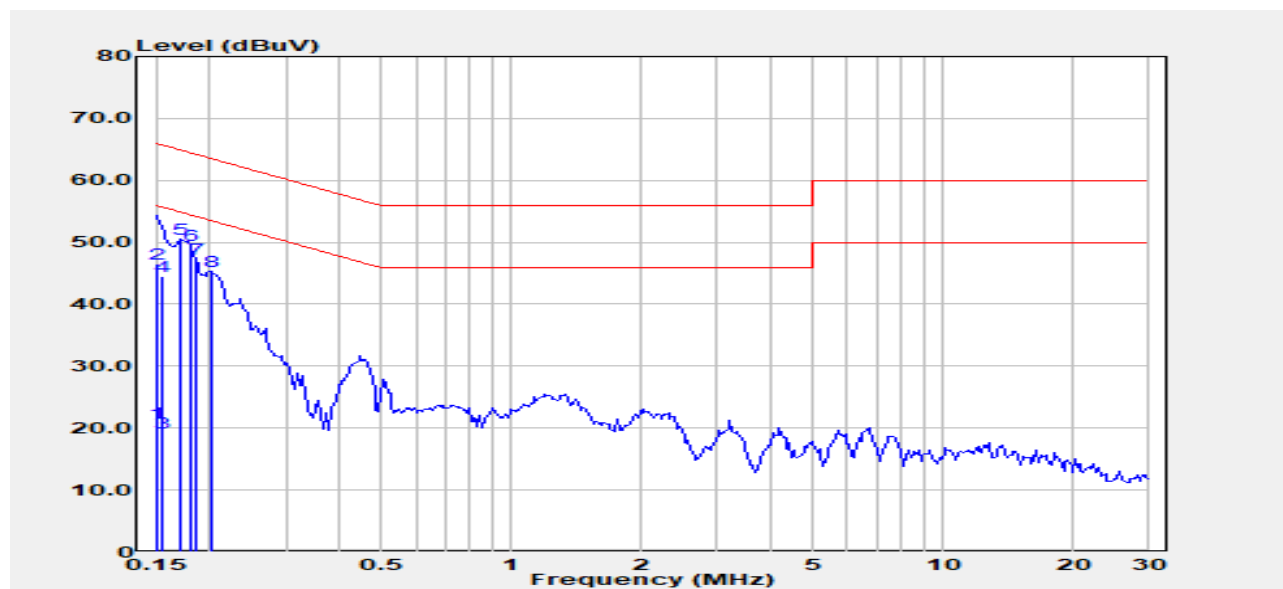
Power :120V/60Hz

Temp./Humi. :21.5/67

Probe :L1

Engineer :Jack Tseng

Note: : Dongle



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.150	Average	10.60	10.30	20.90	56.00	-35.10
0.150	QP	36.30	10.30	46.60	66.00	-19.40
0.155	Average	8.90	10.30	19.20	55.74	-36.54
0.155	QP	34.20	10.30	44.50	65.74	-21.24
0.170	Peak	40.26	10.30	50.56	64.94	-14.39
0.180	Peak	39.24	10.30	49.54	64.50	-14.97
0.185	Peak	37.06	10.30	47.36	64.24	-16.88
0.202	Peak	35.09	10.30	45.39	63.54	-18.14

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Report Number :E2/2021/A0031

Test Site :Conduction C

Test Mode :2.4G

Test Date :2021-11-01

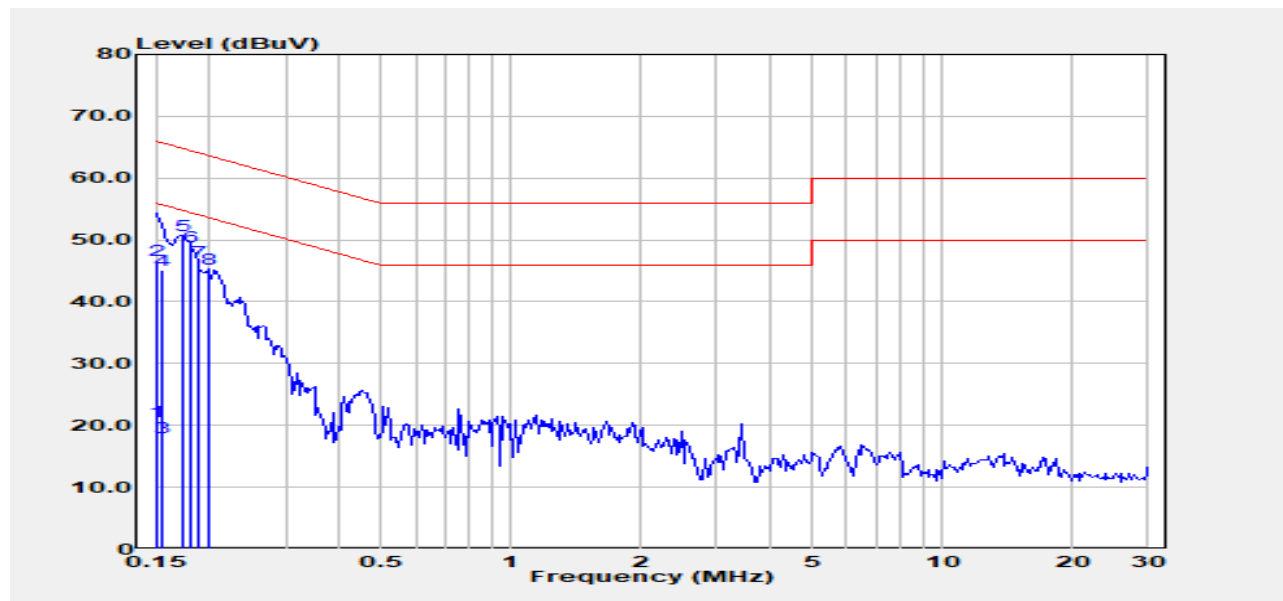
Power :120V/60Hz

Temp./Humi. :21.5/67

Probe :N

Engineer :Jack Tseng

Note: : Dongle



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.150	Average	10.30	10.31	20.61	56.00	-35.39
0.150	QP	36.50	10.31	46.81	66.00	-19.19
0.155	Average	7.80	10.31	18.11	55.74	-37.63
0.155	QP	34.90	10.31	45.21	65.74	-20.53
0.172	Peak	40.45	10.31	50.76	64.86	-14.10
0.182	Peak	38.56	10.30	48.87	64.42	-15.55
0.187	Peak	36.15	10.30	46.45	64.15	-17.70
0.200	Peak	34.96	10.30	45.26	63.62	-18.36

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9 RADIATED EMISSION TEST

9.1 Applicable Standard

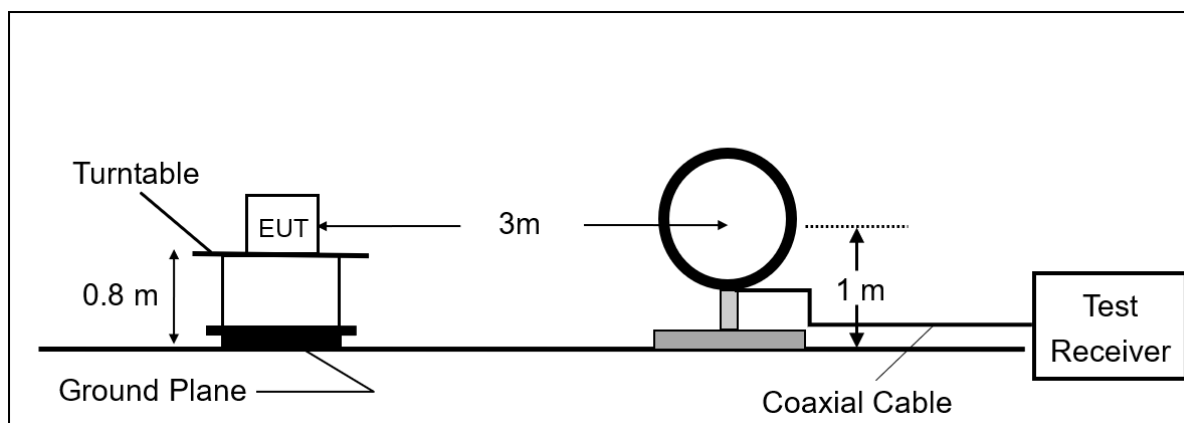
1. Only spurious emissions are permitted in any of the frequency bands listed in §15.205.
2. The field strength of fundamental and harmonic emissions, measured at 3 m, shall not exceed 50 mV/m and 0.5 mV/m respectively.
3. Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in §15.209, whichever is less stringent.

9.2 Measurement Procedure

1. The EUT was placed on a turn table with 0.8m for frequency < 1GHz and 1.5m for frequency > 1GHz above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measured were complete.

9.3 Test Setup

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

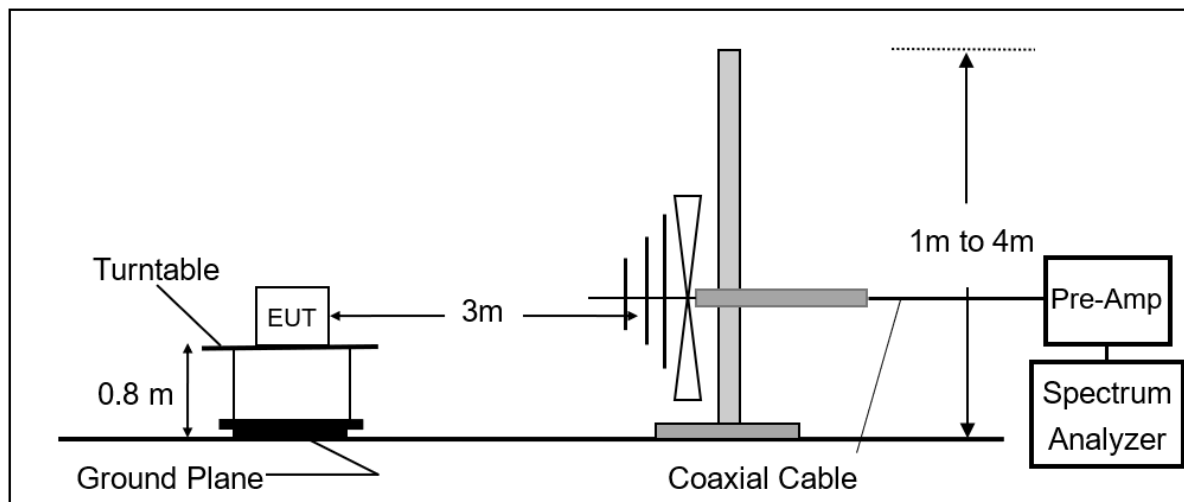


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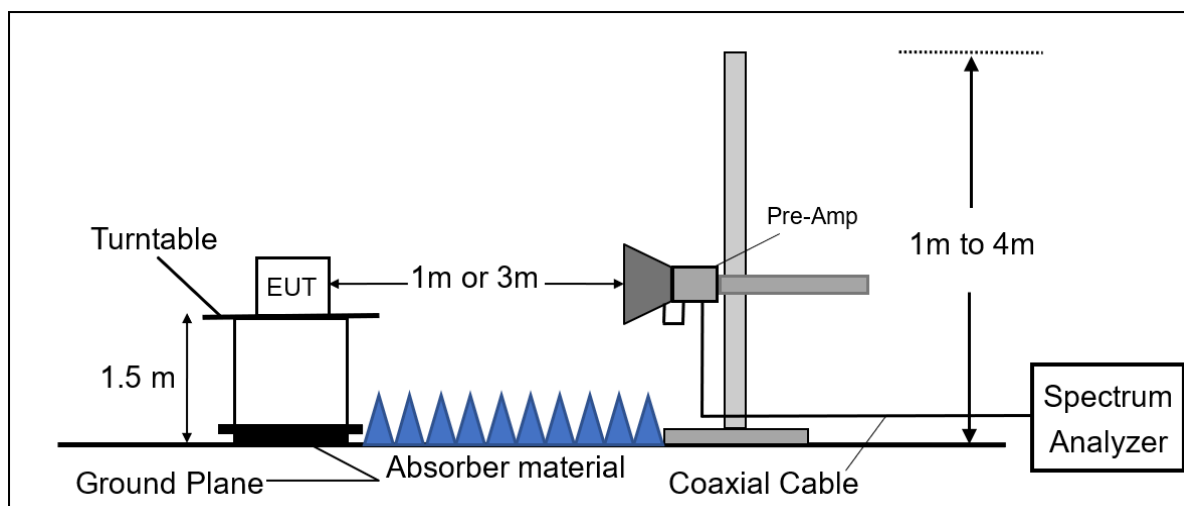
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(B) Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz.



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



9.4 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	

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

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

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9.5 Measurement Result

9.5.1 Field Strength of the Fundamental Signal

Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2403 MHz

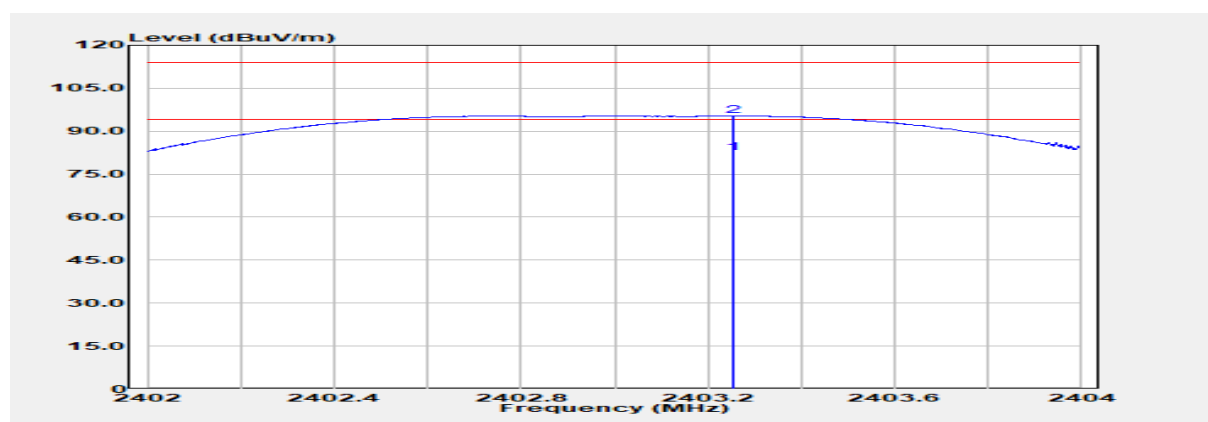
Temp./Humi. :19.1/55

Test Mode :Main

Antenna Pol. :Vertical

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2403.253	Average	77.50	4.77	82.27	94.00	-11.73
2403.253	Peak	90.50	4.77	95.28	114.00	-18.72

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Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2403 MHz

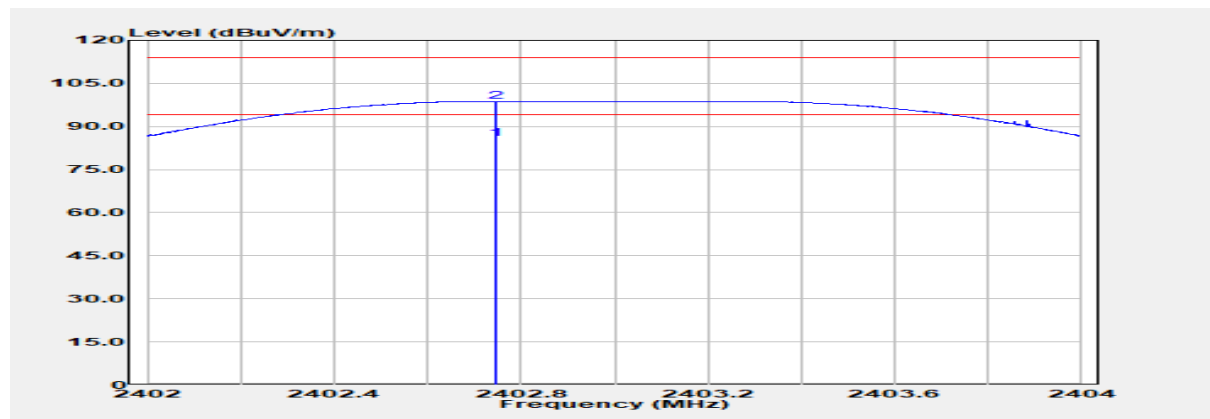
Temp./Humi. :19.1/55

Test Mode :Main

Antenna Pol. :Horizontal

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2402.747	Average	80.99	4.79	85.78	94.00	-8.22
2402.747	Peak	93.99	4.79	98.78	114.00	-15.22

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Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2440 MHz

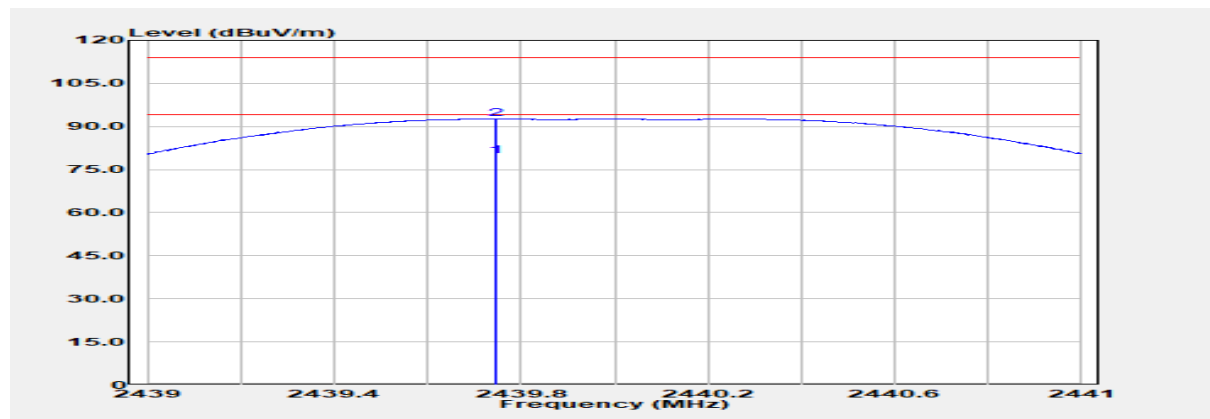
Temp./Humi. :19.1/55

Test Mode :Main

Antenna Pol. :Vertical

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2439.744	Average	75.43	4.15	79.58	94.00	-14.42
2439.744	Peak	88.43	4.15	92.58	114.00	-21.42

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Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2440 MHz

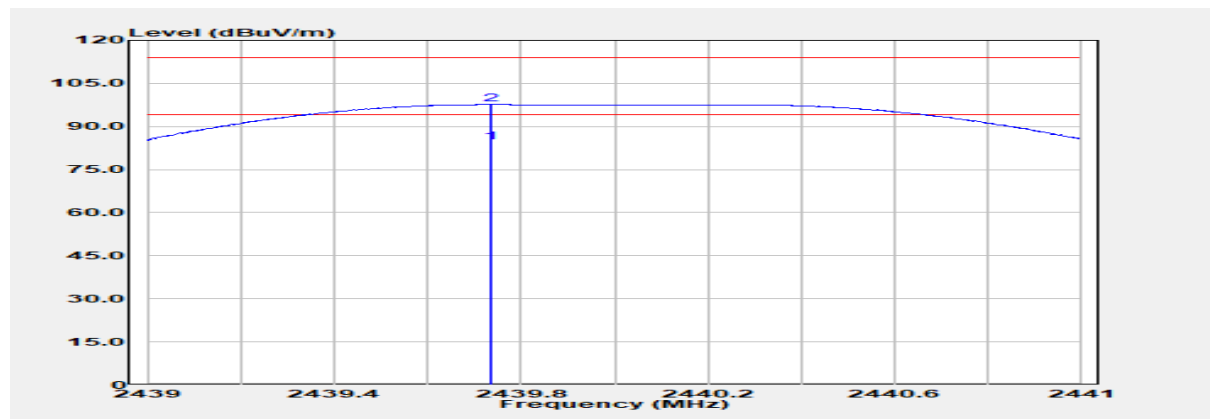
Temp./Humi. :20.5/52

Test Mode :Main

Antenna Pol. :Horizontal

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2439.737	Average	80.47	4.15	84.62	94.00	-9.38
2439.737	Peak	93.47	4.15	97.62	114.00	-16.38

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Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2475 MHz

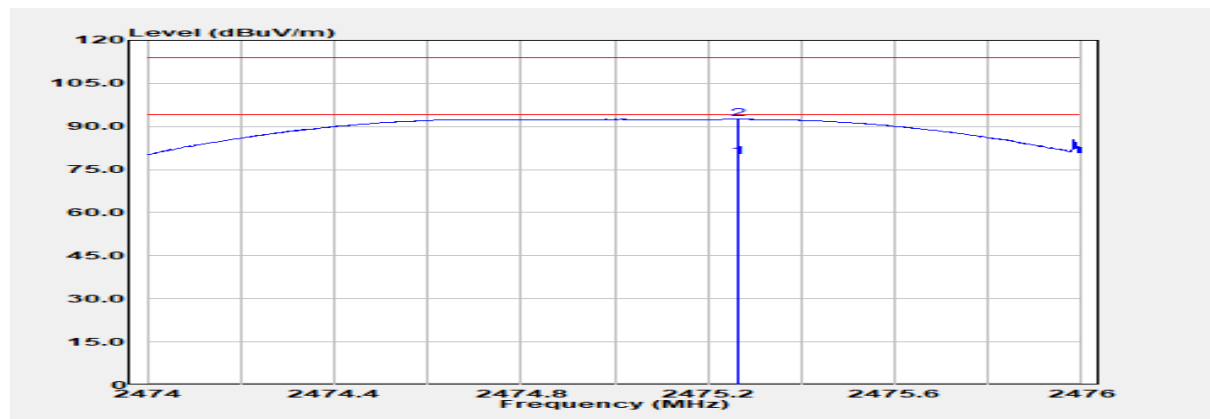
Temp./Humi. :19.1/55

Test Mode :Main

Antenna Pol. :Vertical

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2475.266	Average	75.63	3.88	79.51	94.00	-14.49
2475.266	Peak	88.63	3.88	92.50	114.00	-21.50

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Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2475 MHz

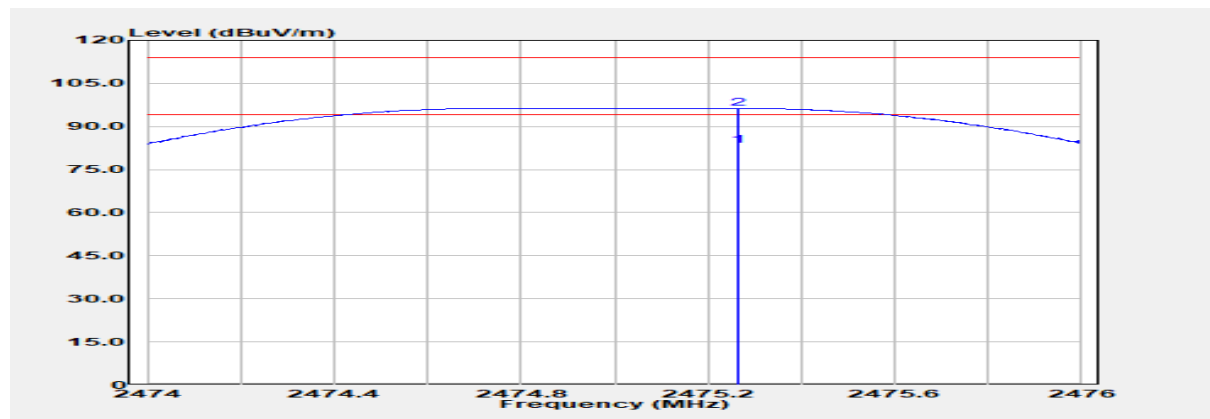
Temp./Humi. :19.1/55

Test Mode :Main

Antenna Pol. :Horizontal

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2475.266	Average	79.42	3.88	83.30	94.00	-10.70
2475.266	Peak	92.42	3.88	96.30	114.00	-17.70

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9.5.2 Restricted bands around fundamental frequency

Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2403 MHz

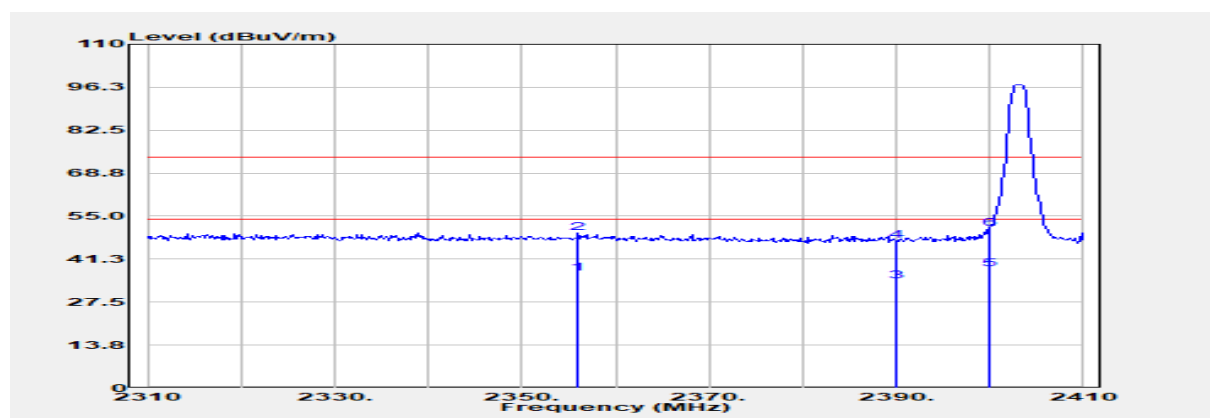
Temp./Humi. :23.3/58

Test Mode :BE CH LOW

Antenna Pol. :Vertical

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2355.994	Average	31.12	5.43	36.55	54.00	-17.45
2355.994	Peak	44.12	5.43	49.55	74.00	-24.45
2390.000	Average	28.87	5.18	34.05	54.00	-19.95
2390.000	Peak	41.87	5.18	47.05	74.00	-26.95
2400.000	Average	33.10	4.90	38.00	54.00	-16.00
2400.000	Peak	46.10	4.90	51.00	74.00	-23.00

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Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2403 MHz

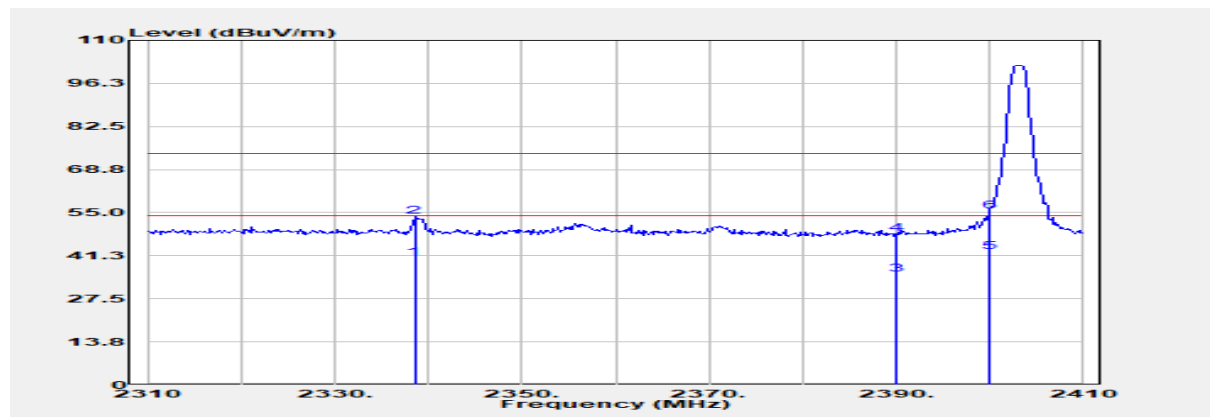
Temp./Humi. :23.3/58

Test Mode :BE CH LOW

Antenna Pol. :Horizontal

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
2338.526	Average	35.35	5.31	40.66	54.00	-13.34
2338.526	Peak	48.34	5.31	53.66	74.00	-20.34
2390.000	Average	30.10	5.18	35.28	54.00	-18.72
2390.000	Peak	43.10	5.18	48.28	74.00	-25.72
2400.000	Average	37.47	4.90	42.37	54.00	-11.63
2400.000	Peak	50.46	4.90	55.37	74.00	-18.63

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Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2475 MHz

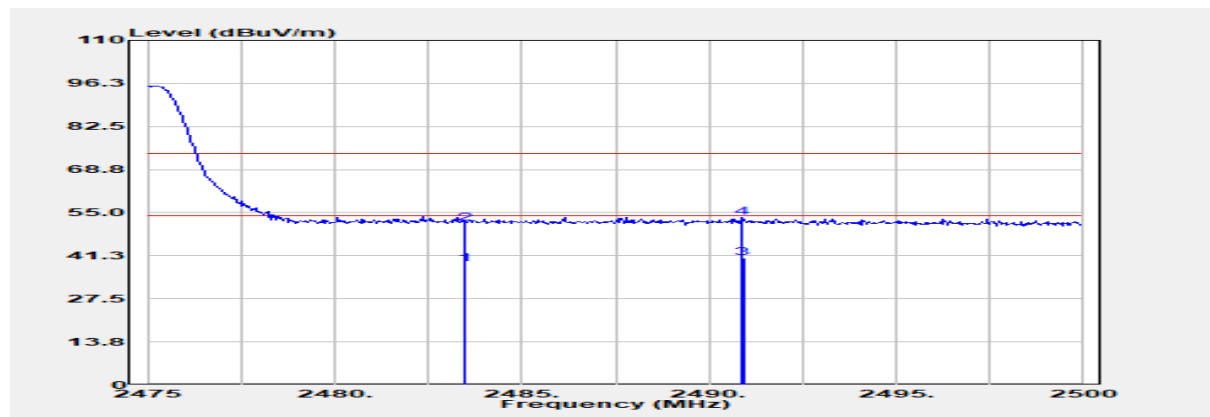
Temp./Humi. :23.3/58

Test Mode :BE CH HIGH

Antenna Pol. :Vertical

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.500	Average	34.45	4.04	38.49	54.00	-15.51
2483.500	Peak	47.45	4.04	51.49	74.00	-22.51
2490.906	Average	36.63	3.92	40.55	54.00	-13.45
2490.906	Peak	49.63	3.92	53.55	74.00	-20.45

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Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2475 MHz

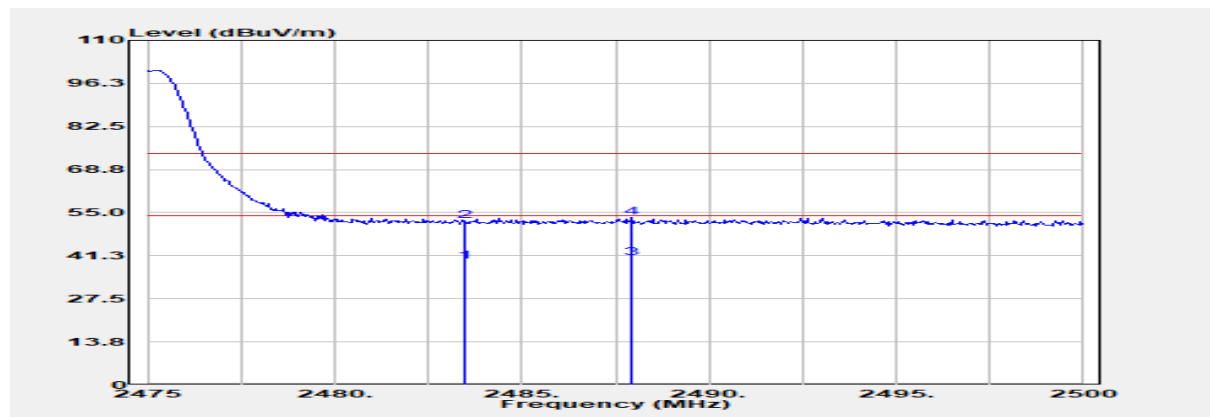
Temp./Humi. :23.3/58

Test Mode :BE CH HIGH

Antenna Pol. :Horizontal

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.500	Average	35.28	4.04	39.32	54.00	-14.68
2483.500	Peak	48.28	4.04	52.32	74.00	-21.68
2487.941	Average	36.48	3.99	40.47	54.00	-13.53
2487.941	Peak	49.49	3.99	53.48	74.00	-20.52

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9.5.3 Radiated Spurious Emission Measurement Result

Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-12

Test Frequency :2440 MHz

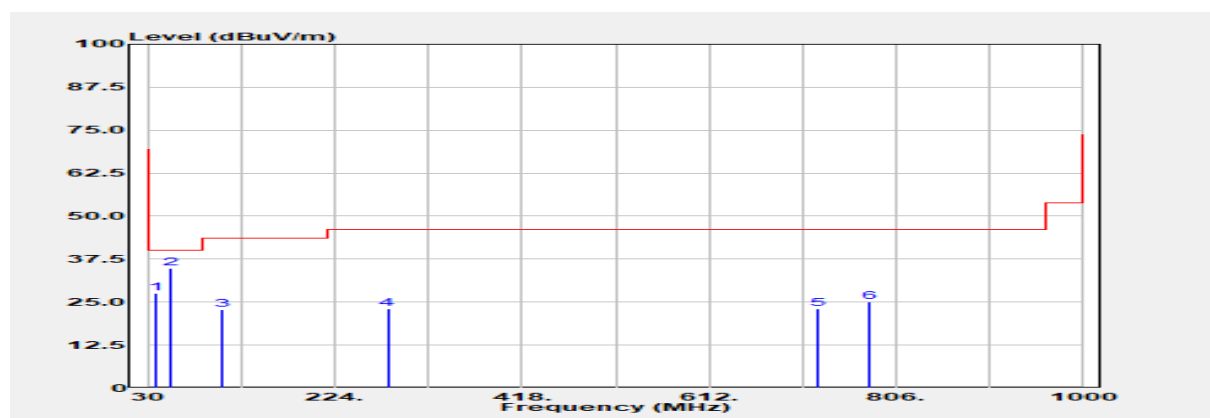
Temp./Humi. :22.1/60

Test Mode :TX CH MID

Antenna Pol. :VERTICAL

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
37.772	Peak	38.40	-10.79	27.61	40.00	-12.39
53.317	Peak	57.11	-22.16	34.95	40.00	-5.05
106.170	Peak	41.39	-18.69	22.70	43.50	-20.80
278.718	Peak	38.75	-15.69	23.06	46.00	-22.94
724.856	Peak	30.74	-7.64	23.10	46.00	-22.90
777.708	Peak	32.05	-7.01	25.04	46.00	-20.96

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Report Number :E2/2021/A0031

Operation Mode :2.4G

Test Frequency :2440 MHz

Test Mode :TX CH MID

EUT Pol :E2 Plane

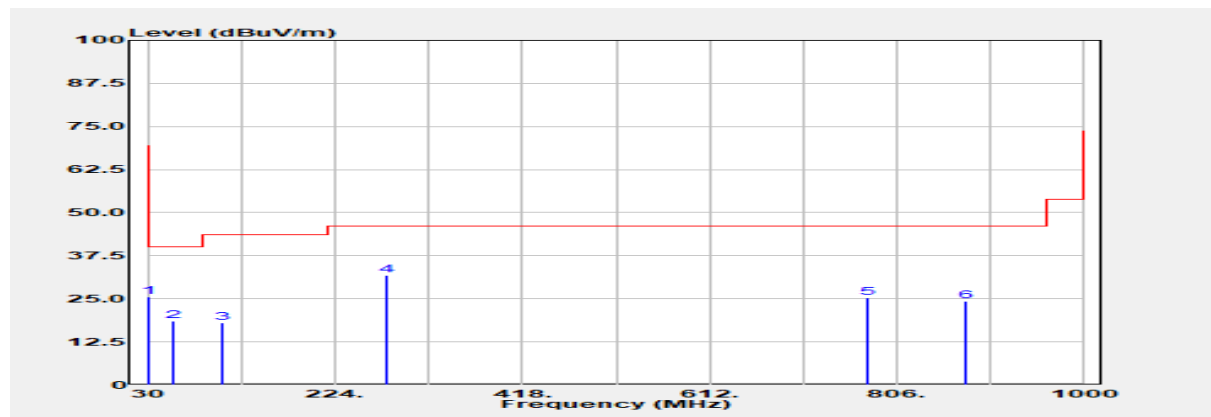
Test Site :SAC C

Test Date :2021-11-12

Temp./Humi. :22.1/60

Antenna Pol. :HORIZONTAL

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
30.000	Peak	31.93	-6.45	25.48	40.00	-14.52
56.426	Peak	42.34	-23.67	18.67	40.00	-21.33
106.170	Peak	36.71	-18.69	18.02	43.50	-25.48
277.164	Peak	47.60	-15.70	31.90	46.00	-14.10
774.599	Peak	32.42	-7.17	25.26	46.00	-20.74
877.196	Peak	30.85	-6.51	24.34	46.00	-21.66

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Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2403 MHz

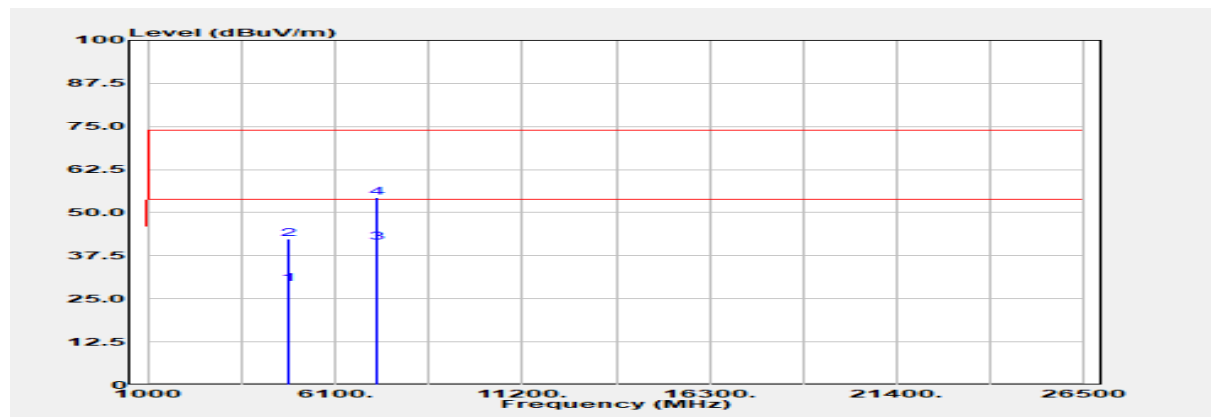
Temp./Humi. :19.1/55

Test Mode :TX CH LOW

Antenna Pol. :Vertical

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4806.000	Average	18.50	10.92	29.42	54.00	-24.58
4806.000	Peak	31.49	10.92	42.41	74.00	-31.59
7209.000	Average	24.29	17.07	41.36	54.00	-12.64
7209.000	Peak	37.29	17.07	54.36	74.00	-19.64

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Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2403 MHz

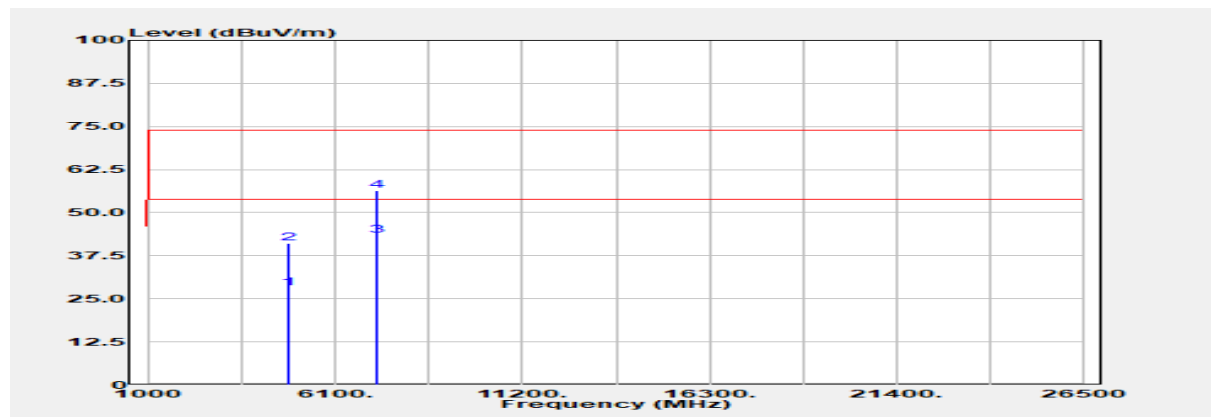
Temp./Humi. :19.1/55

Test Mode :TX CH LOW

Antenna Pol. :Horizontal

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4806.000	Average	17.17	10.92	28.09	54.00	-25.91
4806.000	Peak	30.16	10.92	41.08	74.00	-32.92
7209.000	Average	26.20	17.07	43.27	54.00	-10.73
7209.000	Peak	39.19	17.07	56.27	74.00	-17.73

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Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2440 MHz

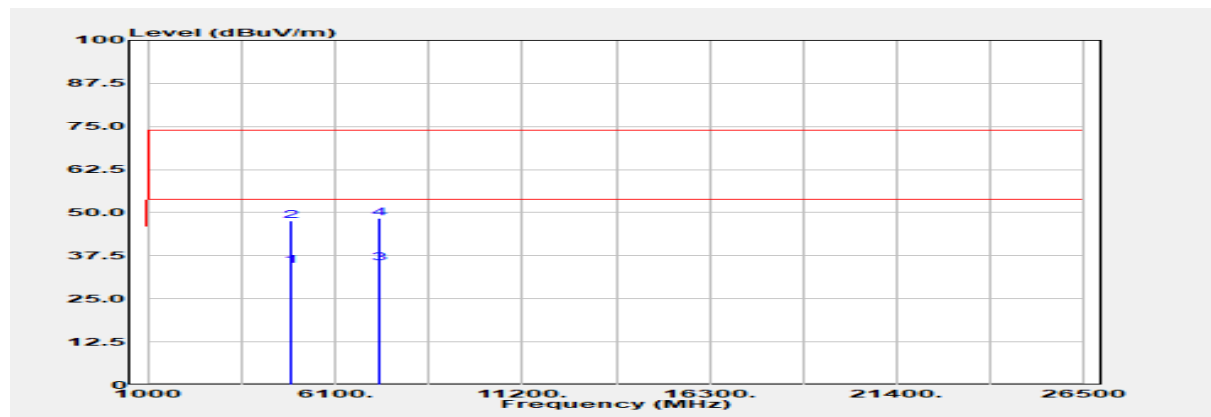
Temp./Humi. :19.1/55

Test Mode :TX CH MID

Antenna Pol. :Vertical

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4880.000	Average	24.53	10.07	34.60	54.00	-19.40
4880.000	Peak	37.53	10.07	47.60	74.00	-26.40
7320.000	Average	16.60	18.77	35.37	54.00	-18.63
7320.000	Peak	29.59	18.77	48.37	74.00	-25.63

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Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2440 MHz

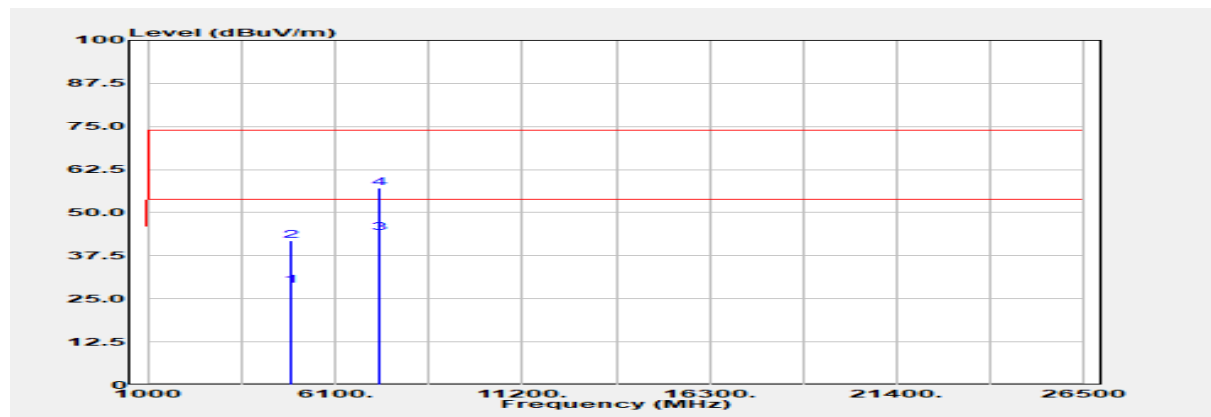
Temp./Humi. :19.1/55

Test Mode :TX CH MID

Antenna Pol. :Horizontal

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4880.000	Average	18.70	10.07	28.77	54.00	-25.23
4880.000	Peak	31.70	10.07	41.77	74.00	-32.23
7320.000	Average	25.28	18.77	44.05	54.00	-9.95
7320.000	Peak	38.28	18.77	57.05	74.00	-16.95

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Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2475 MHz

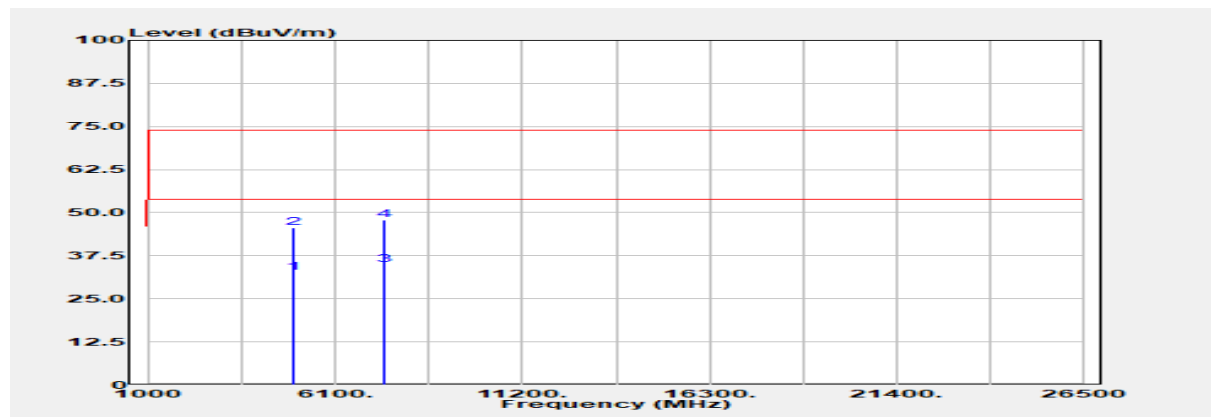
Temp./Humi. :19.1/55

Test Mode :TX CH HIGH

Antenna Pol. :Vertical

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4950.000	Average	22.76	9.75	32.51	54.00	-21.49
4950.000	Peak	35.76	9.75	45.51	74.00	-28.49
7425.000	Average	17.27	17.58	34.85	54.00	-19.15
7425.000	Peak	30.28	17.58	47.85	74.00	-26.15

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Report Number :E2/2021/A0031

Test Site :SAC C

Operation Mode :2.4G

Test Date :2021-11-11

Test Frequency :2475 MHz

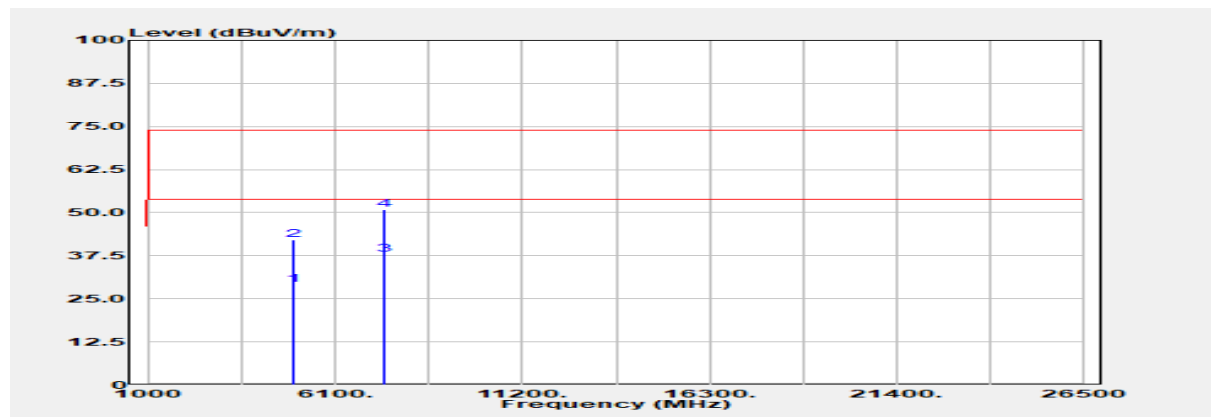
Temp./Humi. :19.1/55

Test Mode :TX CH HIGH

Antenna Pol. :Horizontal

EUT Pol :E2 Plane

Engineer :Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4950.000	Average	19.29	9.75	29.04	54.00	-24.96
4950.000	Peak	32.29	9.75	42.04	74.00	-31.96
7425.000	Average	20.26	17.58	37.84	54.00	-16.16
7425.000	Peak	33.27	17.58	50.84	74.00	-23.16

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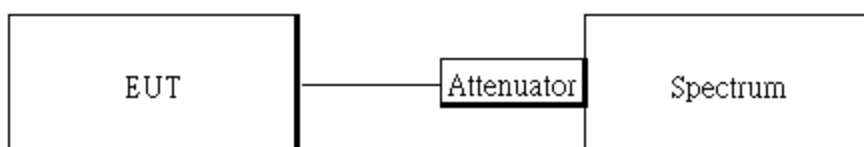
10 EMISSION BANDWIDTH

10.1 Applicable Standard

§2.1049 (h) & 15.215(c)

- (c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

10.1 Test Setup



10.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW=1% of the approximate emission bandwidth, VBW = 3 times RBW, Span= approximately 20dB below the peak level. Sweep=auto
4. Turn on the 99% bandwidth function, max reading.

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10.3 Measurement Results:

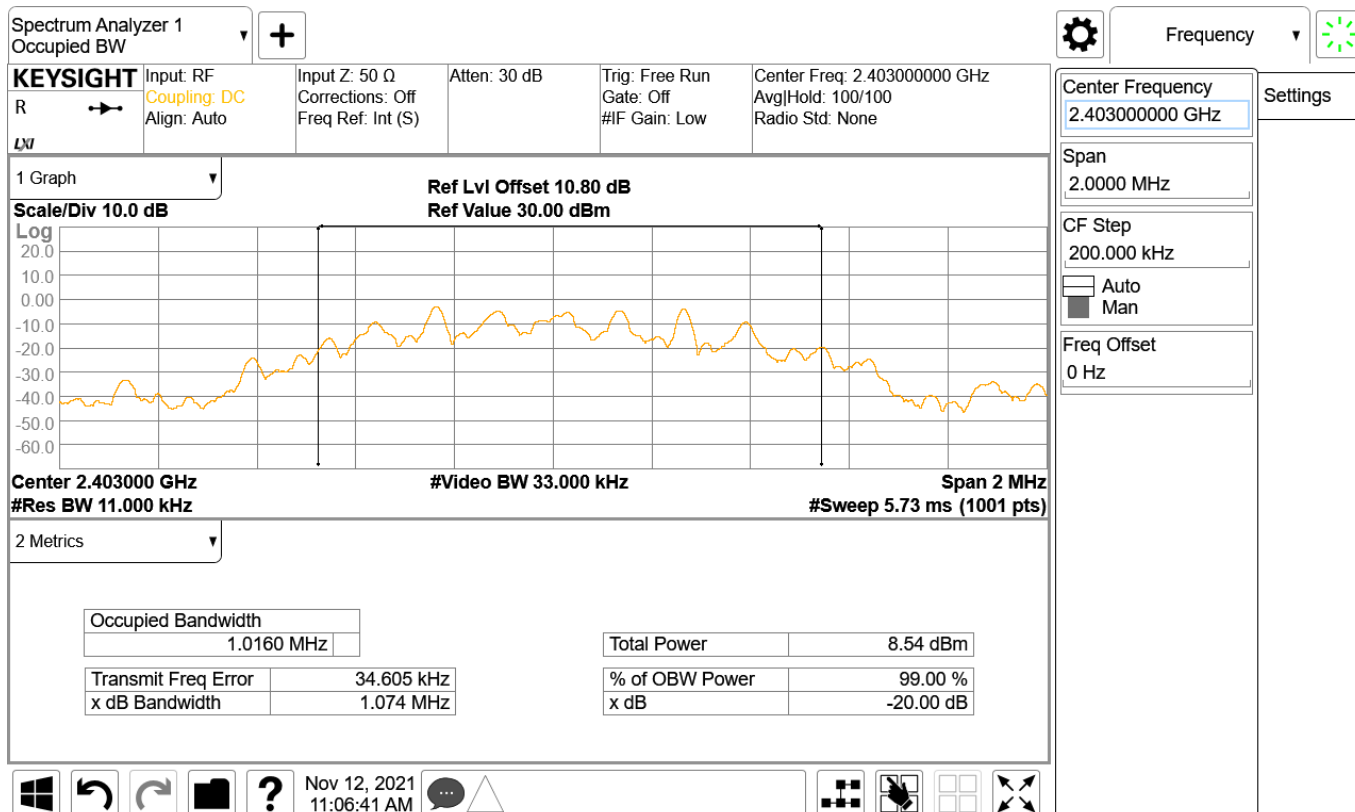
Frequency (MHz)	20dB Bandwidth (MHz)
2403	1.074
2440	1.076
2475	1.076

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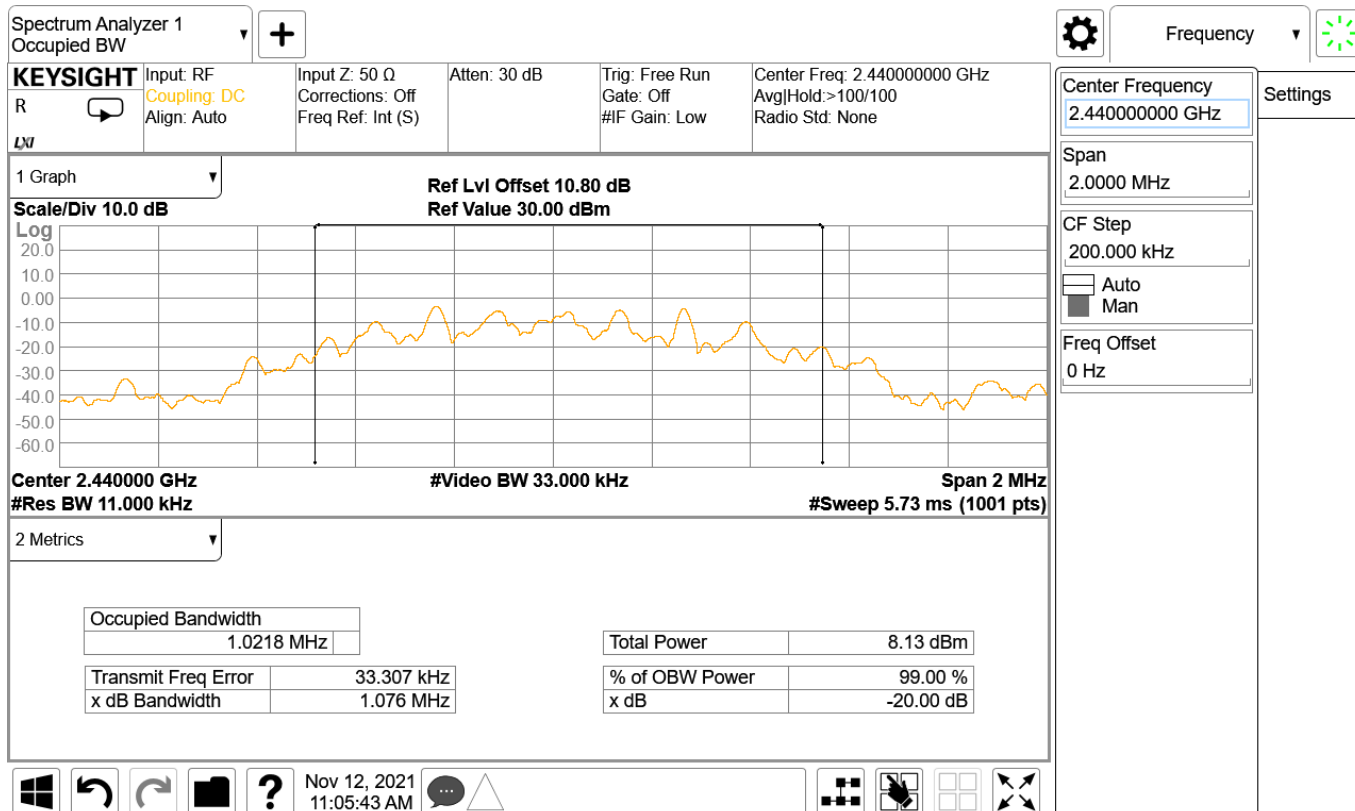
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CH Low



CH Mid

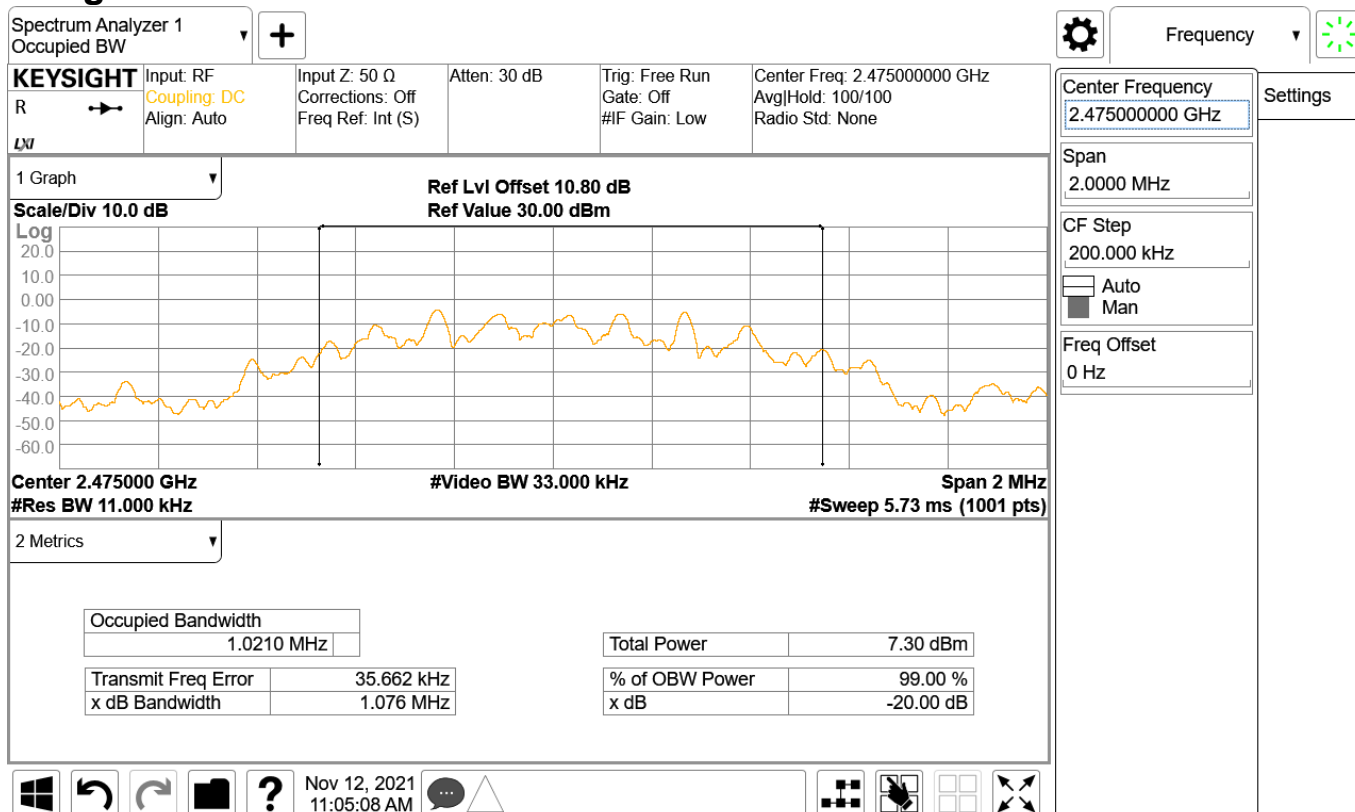


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CH High



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11 ANTENNA REQUIREMENT

1.1 Standard Applicable:

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 shall be considered sufficient to comply with the provisions of this section. 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

1.2 Antenna Connected Construction:

The antenna is designed with as permanently attached and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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