ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant:	Murata Manufacturing Co., Ltd. 1-10-1, Higashikotari, Nagaokakyo-shi, Kyoto 617-8555 Japan
Manufacturer:	Murata Manufacturing Co., Ltd. 1-10-1, Higashikotari, Nagaokakyo-shi, Kyoto 617-8555 Japan
Product Name:	Communication Module
Brand Name:	muRata
Model No.:	LBEE5ZZ1XL, LBEE5ZZ2XS
Model Difference:	Refer to section 1.8
Report Number:	TERF2305001164E2
FCC ID	VPYLBEE5ZZ1XL
Date of EUT Received:	N/A, the test results are fully leveraged from test report number: TERF2211002150E2
Date of Test:	N/A, the test results are fully leveraged from test report number: TERF2211002150E2
Issue Date:	May 08, 2023

Approved By _____

Jay Lin

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.

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

Revision History

Report Number	Revision	Description	Issue Date	Revised By	Remark
TERF2305001164E2	00	Initial	May 08, 2023	Yami Kuo	

Note:

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

2、Variant information of model numbers is provided by the applicant, please refer to section 1.8 of this report for details.
Test results of this report are applicable to the sample EUT(s) received and variant models are assessed as electrically identical, no further tests are required for the variant.

Table of Contents

1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Communication Module
Brand Name:	muRata
Model No.:	LBEE5ZZ1XL, LBEE5ZZ2XS
Model Difference:	Refer to section 1.8
Hardware Version:	1
Firmware Version:	1.1.1.1
EUT Series No.:	1XL: Sample. No2
Power Supply:	3.3Vdc, 1.8Vdc
Test Software (Name/Version)	Tera Term V4.105 / Dut labtool v2.0.0.85

1.2 RF Specification

WLAN 2.4GHz

Wi-Fi	Frequency Range	Channels	Rated Power (dBm)		Modulation Technology
			Peak	Avg.	
802.11ax40	2422~2452	7	20.47	10.89	OFDMA
Modulation type:		CCK, DQPSK, DBPSK for DSSS			
		256 QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM			
		1024 QAM, 256 QAM , 64QAM, 16QAM, QPSK, BPSK for OFDMA			
Data Rate:		802.11 b: 1/2/5.5/11 Mbps			
		802.11 g: 6/9/12/18/24/36/48/54 Mbps			
		802.11 n_20MHz:up to 144.4Mbps			
		802.11 n_40MHz:up to 300Mbps			
		802.11 ax_20MHz:up to 286.8Mbps			
		802.11 ax_40MHz:up to 573.6Mbps			

1.3 Antenna Designation

Antenna Type	Freq. (MHz)	Peak Antenna Gain (dBi)	Directional Gain (dBi)
Dipole	2412-2462	3.2	6.21

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.

1.4 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247
FCC KDB 558074 D01 15.247 Meas Guidance v05r02
FCC KDB 662911 D01 Multiple Transmitter Output v02r01
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 2		
		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.

1.8 Model Difference

LBEE5ZZ1XL has a dedicated antenna port for BT.

LBEE5ZZ2XS BT shares same antenna port with WLAN.

Some passive components are different between models as below.

LBEE5ZZ1XL	LBEE5ZZ2XS
C 336 No mounted	C336 mounted
C337 mounted	C337 No mounted
L310 mounted	L310 No mounted

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 a 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. 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 a 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

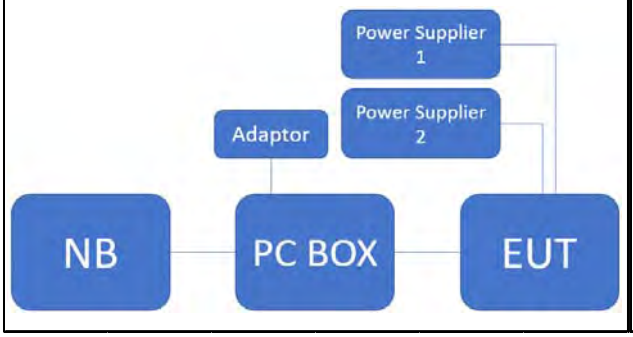
Radiated emission below 30MHz is measured in a 9m*6m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

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

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.

2.5 Test Configuration

Conducted Setup	Radiated Setup
	

2.6 Control Unit(s)

Conducted Emission Test Site: Conducted D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Notebook	Lenovo	T420	S0012599	N/A	N/A
Notebook	Lenovo	L420	S0011721	N/A	N/A

Radiated Emission Test Site: SAC D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LAN Cable	向聯	VPH-02	1500021123	N.C.R	N.C.R
LAN Cable	INVAX	IVX011	N/A	N.C.R	N.C.R
Notebook	Lenovo	T470	P0001293	N/A	N/A
Notebook	Lenovo	T420	S0012599	N/A	N/A
Adapter	APD	NB-65B19	N/A	N/A	N/A
Adapter	FSP	FSP065-REBN2	H6081012364	N.C.R	N.C.R

3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result	Note
§15.247(b) (3)	Peak Output Power	Compliant	
§15.205 §15.209 §15.247(d)	Radiated Band Edge and Spurious Emission	Compliant	

Note

1. *N/S Indicates whether item(s) being newly tested [N] or spot checked [S].*
2. *Items other than newly tested [N] are leveraged from test report TERF2211002150E2.*

4 DESCRIPTION OF TEST MODES

4.1 Operatin Frequencies

Modulation of BW 20MHz		Modulation of BW 40MHz	
CHANNEL	FREQUENCY (MHz)	CHANNEL	FREQUENCY (MHz)
1	2412	3	2422
2	2417	4	2427
3	2422	5	2432
4	2427	6	2437
5	2432	7	2442
6	2437	8	2447
7	2442	9	2452
8	2447		
9	2452		
10	2457		
11	2462		

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.

   The gevin UE is pre-scanned among below modes.

Modulation		Transmission Chain								Single Transmission Spatial		Multi Transmission Spatial	
v	802.11 b	v	Ch0	v	Ch1		Ch2		Ch3		1TX	v	2TX
v	802.11 g	v	Ch0	v	Ch1		Ch2		Ch3		1TX	v	2TX
v	802.11 n	v	Ch0	v	Ch1		Ch2		Ch3		SISO	v	MIMO
v	802.11 ax	v	Ch0	v	Ch1		Ch2		Ch3		SISO	v	MIMO

4. Therefore, below summary is the modes of test configuration that yield the highest reading and generate the highest emission chosen to carry out the relevantly mandatory test items.

5. Observations have been done for 802.11 ax available RU configurations below and found that the lowest, heighest and Full RU results higher emissions.
   Only one RU can be enabled at any given time.

802.11ax	20MHz			
RU type	26-tone RU		52-tone RU	
RU index and subcarrier range	RU0	[-121: -96]	RU37	[-121: -70]
	RU1	[-95: -70]	RU38	[-68: -17]
	RU2	[-68: -43]	RU39	[17: 68]
	RU3	[-42: -17]	RU40	[70: 121]
	RU4	[-16: -4, 4: 16]	RU41	N/A
	RU5	[17: 42]	RU42	N/A
	RU6	[43: 68]	RU43	N/A
	RU7	[70: 95]	RU44	N/A
	RU8	[96: 121]	RU45	N/A
	RU9	N/A	RU46	N/A
	RU10	N/A	RU47	N/A
	RU11	N/A	RU48	N/A
	RU12	N/A	RU49	N/A
	RU13	N/A	RU50	N/A
	RU14	N/A	RU51	N/A
	RU15	N/A	RU52	N/A
	RU16	N/A		
	RU17	N/A	106-tone RU	
	RU18	N/A	RU53	[-122: -17]
	RU19	N/A	RU54	[17: 122]
	RU20	N/A	RU55	N/A
	RU21	N/A	RU56	N/A
	RU22	N/A	RU57	N/A
	RU23	N/A	RU58	N/A
	RU24	N/A	RU59	N/A
	RU25	N/A	RU60	N/A
	RU26	N/A		
	RU27	N/A	242-tone RU	
	RU28	N/A	RU61	[-122: -2, 2:122]
	RU29	N/A	RU62	N/A
	RU30	N/A	RU63	N/A
	RU31	N/A	RU64	N/A
	RU32	N/A		
	RU33	N/A		
	RU34	N/A		
	RU35	N/A		
	RU36	N/A		

802.11ax	40MHz			
RU type	26-tone RU		52-tone RU	
RU index and subcarrier range	RU0	[-243: -218]	RU37	[-243: -192]
	RU1	[-217: -192]	RU38	[-189: -138]
	RU2	[-189: -164]	RU39	[-109: -58]
	RU3	[-163: -138]	RU40	[-55: -4]
	RU4	[-136: -111]	RU41	[4: 55]
	RU5	[-109: -84]	RU42	[58: 109]
	RU6	[-83: -58]	RU43	[138: 189]
	RU7	[-55: -30]	RU44	[192: 243]
	RU8	[-29: -4]	RU45	N/A
	RU9	[4: 29]	RU46	N/A
	RU10	[30: 55]	RU47	N/A
	RU11	[58: 83]	RU48	N/A
	RU12	[84: 109]	RU49	N/A
	RU13	[111: 136]	RU50	N/A
	RU14	[138: 163]	RU51	N/A
	RU15	[164: 189]	RU52	N/A
	RU16	[192: 217]		
	RU17	[218: 243]	106-tone RU	
	RU18	N/A	RU53	[-243: -138]
	RU19	N/A	RU54	[-109: -4]
	RU20	N/A	RU55	[4: 109]
	RU21	N/A	RU56	[138: 243]
	RU22	N/A	RU57	N/A
	RU23	N/A	RU58	N/A
	RU24	N/A	RU59	N/A
	RU25	N/A	RU60	N/A
	RU26	N/A		
	RU27	N/A	242-tone RU	
	RU28	N/A	RU61	[-244: -3]
	RU29	N/A	RU62	[3: 244]
	RU30	N/A	RU63	N/A
	RU31	N/A	RU64	N/A
	RU32	N/A		
	RU33	N/A	484-tone RU	
	RU34	N/A	RU65	[-244: -3, 3: 244]
	RU35	N/A	RU66	N/A
	RU36	N/A		

Conducted					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11ax (HE40)	3 to 9	9	OFDMA	MCS0	2TX

RADIATED EMISSION TEST (ABOVE 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11ax (HE40)	3 to 9	9	OFDMA	MCS0	2TX

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.

5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty		
AC Power Line Conducted Emission	+/-	2.34	dB
Output Power measurement	+/-	1	dB
Emission Bandwidth	+/-	1.53	Hz
Undesignable radiated emission measurement	+/-	1.68	dB
Peak Power Density	+/-	1.62	dB
Temperature	+/-	0.4	°C
Humidity	+/-	3.5	%
DC / AC Power Source	+/-	1	%

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.

6 MEASUREMENT EQUIPMENT USED

6.1 Condcuted Measurement

Conducted Emission Test Site: Conducted D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071574	06/20/2022	06/19/2023
Power Meter	Anritsu	ML2496A	1512003	07/26/2022	07/25/2023
Power Sensor	Anritsu	MA2411B	1339378	07/26/2022	07/25/2023
Power Sensor	Anritsu	MA2411B	1339379	07/26/2022	07/25/2023
DC Power Supply	Agilent	E3640A	MY53130054	09/29/2022	09/28/2023
DC Power Supply	Agilent	E3640A	MY53140006	05/16/2022	05/15/2023
DC Power Supply	HOLA	DP-3003	D7070035	06/09/2022	06/08/2023
DC Power Supply	Gwinstek	SPS-3610	GEV856767	09/29/2022	09/28/2023
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R
Attenuator	Marvelous	MVE2213-10	RF13	11/16/2022	11/15/2023
Attenuator	Woken	WATT-218FS-10	RF15	11/16/2022	11/15/2023
Attenuator	KEYSIGHT	11716C	8494B TH60075424+8496B TH6075262	11/16/2022	11/15/2023
Coupler	MIDISCO52335	MDC2044-20	RF36	11/16/2022	11/15/2023
DC Block	PASTERNACK	PE8210	RF158	11/16/2022	11/15/2023
Splitter	Marvelous	MVE8576	RF256	11/16/2022	11/15/2023
Switch E-Channel	E-Channel	ETF-1801 RF Switch	EC2100175	11/16/2022	11/15/2023
Coaxial Cables	Woken	00100A1F2A196C	RF62	11/16/2022	11/15/2023
Coaxial Cables	Woken	00100A1F2A196C	RF64	11/16/2022	11/15/2023
Coaxial Cables	Woken	00100A1F1A185C	RF71	11/16/2022	11/15/2023

6.2 Radiated Measurement

Radiated Emission Test Site: SAC D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-300	11/11/2022	11/10/2023
Horn Antenna	Schwarzbeck	BBHA9170	185	08/22/2022	08/21/2023
Horn Antenna	Schwarzbeck	BBHA9120D	1341	05/31/2022	05/30/2023
Loop Antenna	ETS.LINDGREN	6502	143303	05/14/2022	05/13/2023
3m Site NSA	SGS	966 chamber D	N/A	04/30/2022	04/29/2023
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/24/2022	03/23/2023
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R
DC Power Supply	Agilent	E3640A	MY53130054	09/29/2022	09/28/2023
DC Power Supply	Agilent	E3640A	MY53140006	05/16/2022	05/15/2023
DC Power Supply	Gwinstek	SPS-3610	GEV856769	09/29/2022	09/28/2023
DC Power Supply	Gwinstek	SPS-3610	GEV856767	09/29/2022	09/28/2023
Pre-Amplifier	EMC Instruments	EM26400	971576	10/02/2022	10/01/2023
Pre-Amplifier	EMC Instruments	EMC9135	980234	11/16/2022	11/15/2023
Pre-Amplifier	EMC Instruments	EMC12630SE	980273	11/16/2022	11/15/2023
Attenuator	Woken	WATT-218FS-10	RF17	11/16/2022	11/15/2023
Coaxial Cable	Huber+Suhner	RG 214/U	W21.01	11/16/2022	11/15/2023
Coaxial Cable	Huber Suhner	EMC106-SM-SM-7200	150703	11/16/2022	11/15/2023
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17413/4	11/16/2022	11/15/2023

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

7 PEAK OUTPUT POWER MEASUREMENT

7.1 Standard Applicable

7.2 Duty Cycle

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle.

All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

7.3 Output Power

For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt and the e.i.r.p. shall not exceed 4 W.

If the transmitting antenna of directional gain greater than 6dBi are used the peak output power form the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

Note:

As per section F. 2). e). (ii) of FCC KDB 662911 D01

If antenna gains are not equal and each transmit antenna is driven by only one spatial stream, directional gain may be calculated by either of the following formulas.

- $$DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{SS}}\left\{\sum_{k=1}^{N_{ANT}} g_{j,k}\right\}^2}{N_{ANT}}\right]$$

where

Each antenna is driven by no more than one spatial stream;

NSS = the number of independent spatial streams of data;

NANT = the total number of antennas

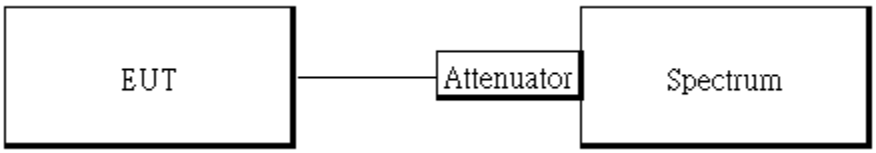
$g_{j,k} = 10^{Gk/20}$ if the kth antenna is being fed by spatial stream j, or zero if it is not;

G_k is the gain in dBi of the kth antenna.

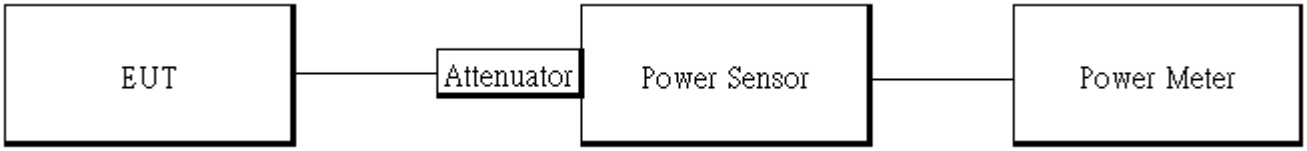
The antenna gain is grater than 6 dBi, therefore the power limit autenuation has been applied in the test results.

7.4 Test Setup

7.4.1 Duty Cycle



7.4.2 Output Power:



7.5 Measurement Procedure

7.5.1 Duty Cycle:

1. Set span = Zero
2. RBW = 8MHz
3. VBW = 8MHz,
4. Detector = Peak

7.5.2 Output Power

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.
   Power Meter:
   It is used as the auxiliary test equipment to conduct the output power measurement.
4. Record the max. Reading as observed from Spectrum or Power Meter.
5. MIMO mode: offset is set with “measure and add 10 Log (N)” to measurement for MIMO mode. Offset = cable loss + 10 log (N), where N is number of transmitting antenna, cable loss is specified below.

**** Note: The duty cycle factor** and below **is compensated to obtain the maximum value of measurement in average.***

7.6 Measurement Result

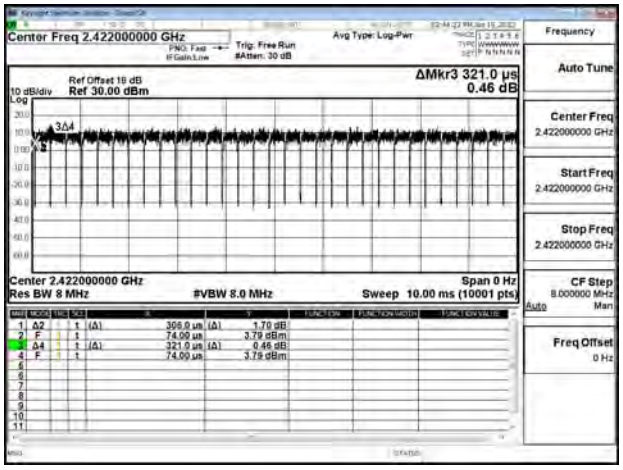
7.6.1 Duty Cycle:

Duty Cycle

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
802.11ax_40	95.33	0.21	3.27	4.00

7.6.2 Duty Cycle test plots

802.11ax_40MHz_Chain0_2422MHz



7.6.3 Output Power

802.11ax_HE_40M Ch0							
CH	Freq. (MHz)	Data Rate	RU Config	Power set	Peak Output Power (dBm)	Limit (dBm)	RESULT
9	2452	MCS0	242/62	10	17.46	30.00	PASS
802.11ax_HE_40M Ch0							
CH	Freq. (MHz)	Data Rate	RU Config	Power set	Avg. Output Power (dBm)	Limit (dBm)	RESULT
9	2452	MCS0	242/62	10	7.82	30.00	PASS
802.11ax_HE_40M Ch1							
CH	Freq. (MHz)	Data Rate	RU Config	Power set	Peak Output Power (dBm)	Limit (dBm)	RESULT
9	2452	MCS0	242/62	10	17.39	30.00	PASS
802.11ax_HE_40M Ch1							
CH	Freq. (MHz)	Data Rate	RU Config	Power set	Avg. Output Power (dBm)	Limit (dBm)	RESULT
9	2452	MCS0	242/62	10	7.74	30.00	PASS

802.11ax_HE_40M_2TX									
CH	Freq. (MHz)	Data Rate	RU Config	Power set	Peak Output Power		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
					Ch0	Ch1			
9	2452	MCS0	242/6	11	17.57	17.35	20.47	29.79	PASS
802.11ax_HE_40M_2TX									
CH	Freq. (MHz)	Data Rate	RU Config	Power set	Avg. Output Power		Total Avg. Output Power (dBm)	Limit (dBm)	RESULT
					Ch0	Ch1			
9	2452	MCS0	242/6	11	8.03	7.73	10.89	29.79	PASS

8 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

8.1 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.

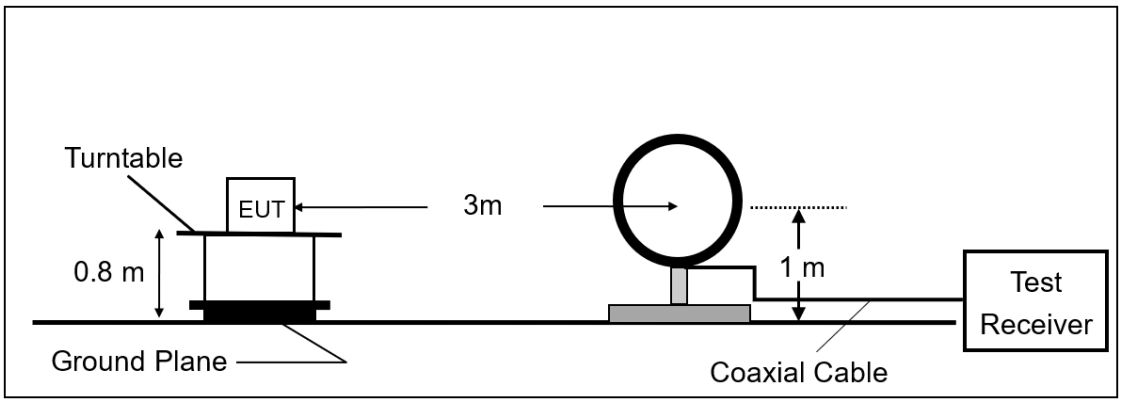
Frequency (MHz)	Field strength (microvolts/meter)	Distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

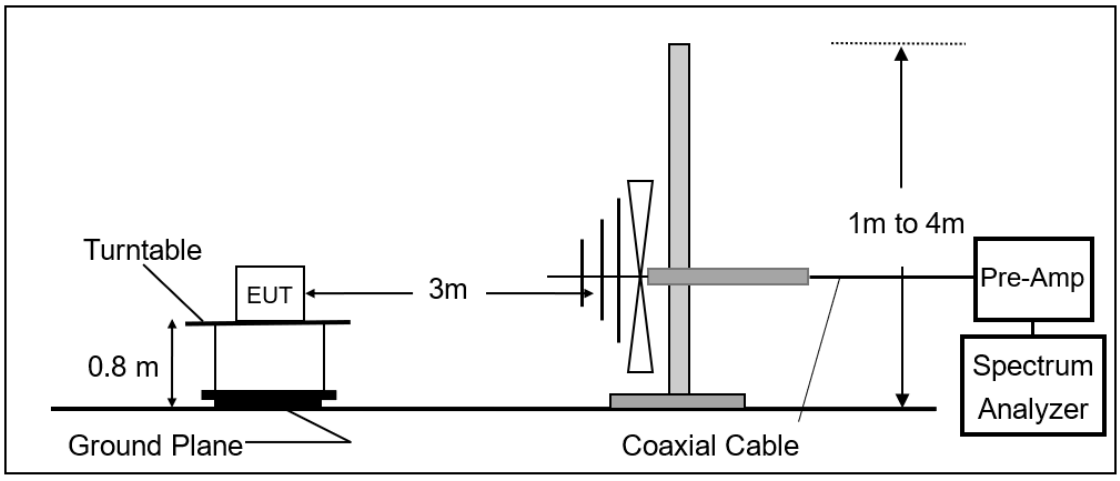
1. The lower limit shall apply at the transition frequencies.

8.2 Test Setup

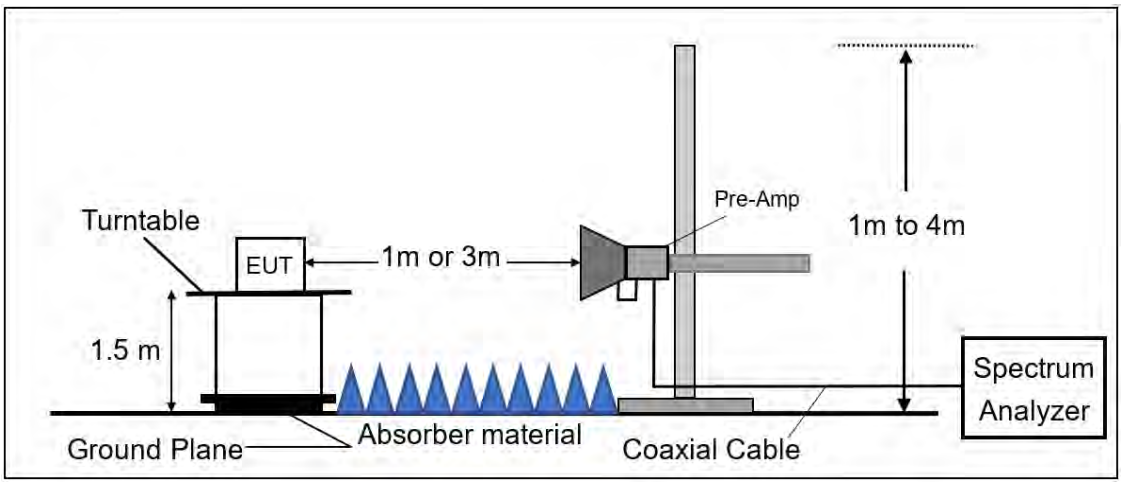
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz.



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



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



8.3 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 Maximum Emission Measurements 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 Emission Measurements 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.
12. Repeat above procedures until all default test channel measured were complete.

8.4 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

*The limit of the emission level is expressed in dBuV/m, which converts 20*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)

8.5 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.

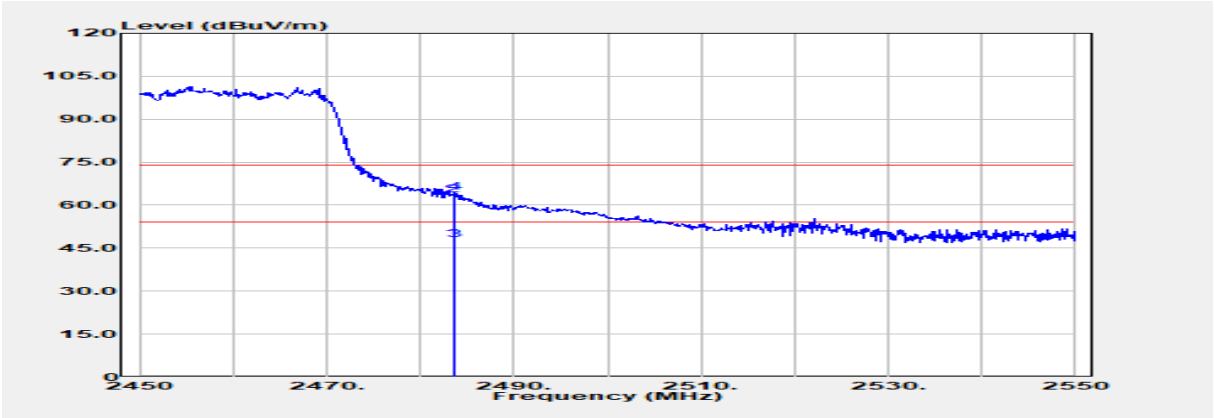
8.6 Measurement Result

Note:

1. *Refer to next page spectrum analyzer data chart and tabular data sheets.*
2. *Measurements are completed at peak and average level, the mark of average is the highest emission in restricted bands*

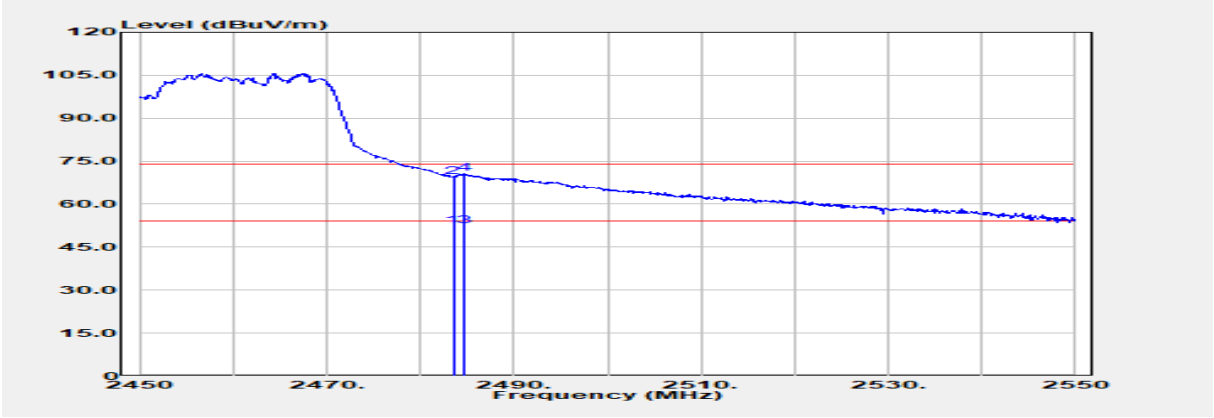
8.6.1 Radiated Band Edge Measurement Result

Report Number	:TERF2211002150E2	Test Site	:SAC D
Operation Mode	:802.11ax40	Test Date	:2022-11-24
Test Frequency	:2452 MHz	Temp./Humi.	:22.5/60
Test Mode	:Bandedge RU 242/62	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Howard Huang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.500	Average	54.08	-5.91	48.18	54.00	-5.82
2483.500	Peak	69.45	-5.91	63.54	74.00	-10.46
2483.700	Average	53.81	-5.91	47.91	54.00	-6.09
2483.700	Peak	70.28	-5.91	64.37	74.00	-9.63

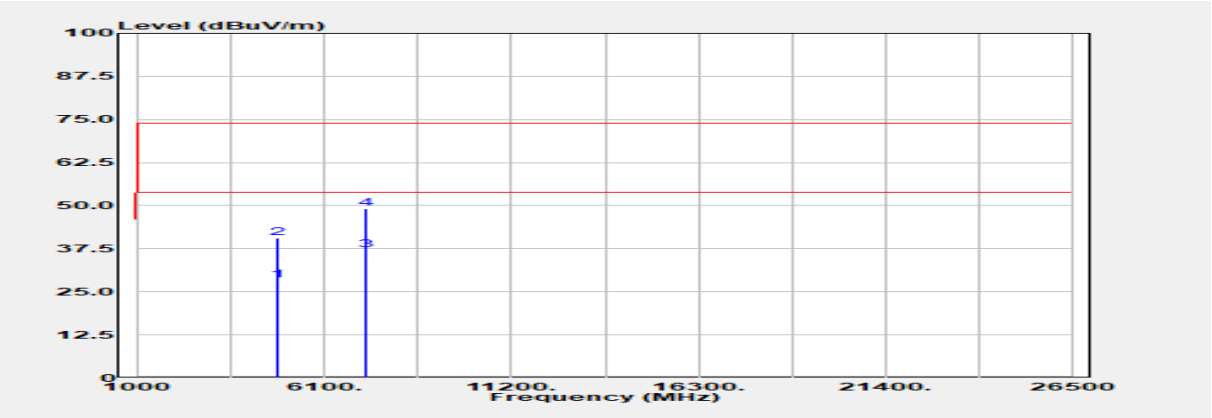
Report Number	:TERF2211002150E2	Test Site	:SAC D
Operation Mode	:802.11ax40	Test Date	:2022-11-24
Test Frequency	:2452 MHz	Temp./Humi.	:22.5/60
Test Mode	:Bandedge RU 242/62	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Howard Huang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.500	Average	58.11	-5.91	52.20	54.00	-1.80
2483.500	Peak	75.47	-5.91	69.56	74.00	-4.44
2484.600	Average	58.25	-5.91	52.33	54.00	-1.67
2484.600	Peak	76.56	-5.91	70.65	74.00	-3.35

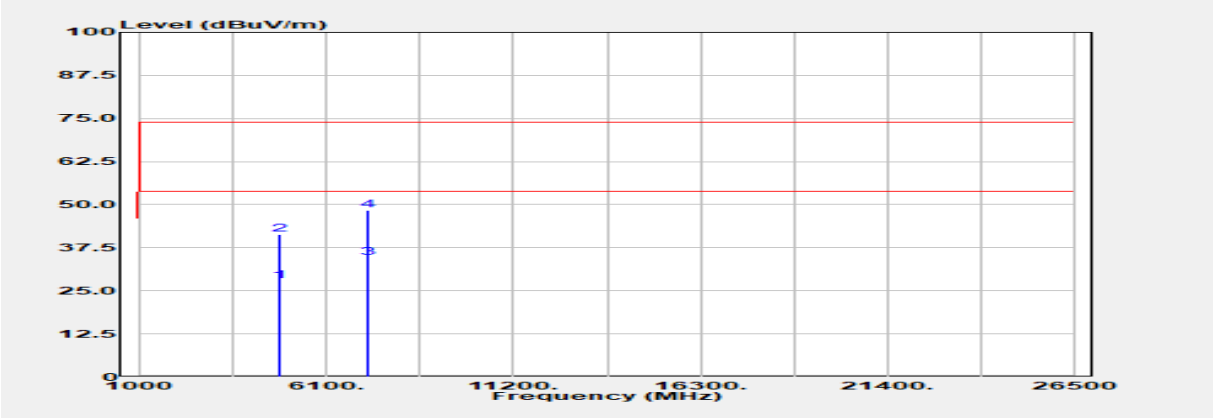
8.6.1 Spurious Emission:

Report Number	:E2/2022/10038	Test Site	:SAC D
Operation Mode	:802.11ax40	Test Date	:2022-03-07
Test Frequency	:2422 MHz	Temp./Humi.	:18.8/64
Test Mode	:TX CH LOW FULL RU	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Jack Tseng



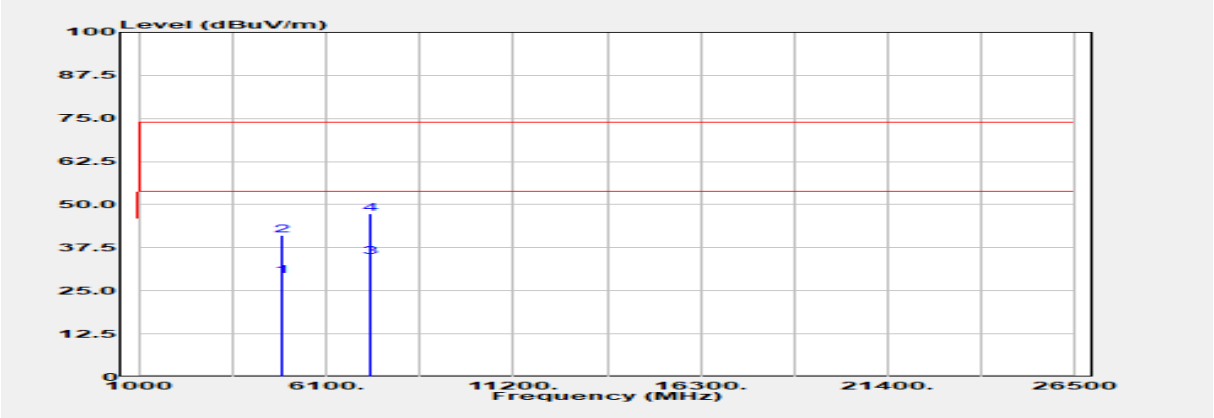
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4844.000	Average	28.26	0.08	28.34	54.00	-25.66
4844.000	Peak	40.56	0.08	40.65	74.00	-33.35
7266.000	Average	29.45	7.53	36.98	54.00	-17.02
7266.000	Peak	41.67	7.53	49.20	74.00	-24.80

Report Number	:E2/2022/10038	Test Site	:SAC D
Operation Mode	:802.11ax40	Test Date	:2022-03-07
Test Frequency	:2422 MHz	Temp./Humi.	:18.8/64
Test Mode	:TX CH LOW FULL RU	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Jack Tseng



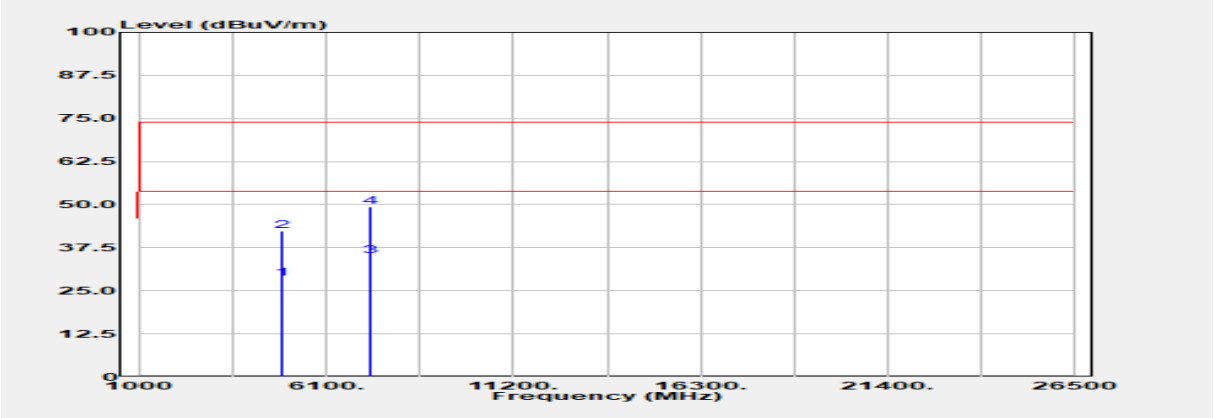
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4844.000	Average	27.85	0.08	27.93	54.00	-26.07
4844.000	Peak	41.18	0.08	41.27	74.00	-32.73
7266.000	Average	26.98	7.53	34.51	54.00	-19.49
7266.000	Peak	40.83	7.53	48.36	74.00	-25.64

Report Number	:E2/2022/10038	Test Site	:SAC D
Operation Mode	:802.11ax40	Test Date	:2022-03-07
Test Frequency	:2437 MHz	Temp./Humi.	:18.8/64
Test Mode	:TX CH MID FULL RU	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Jack Tseng



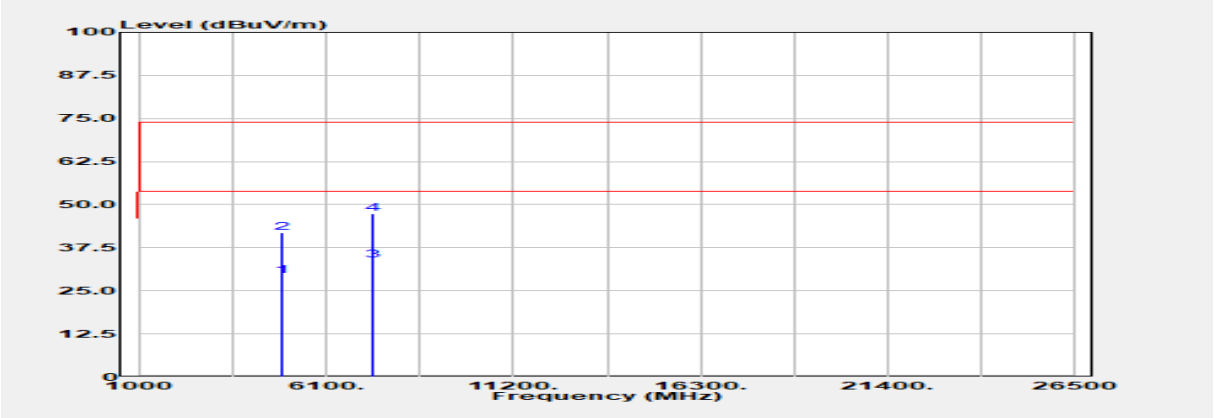
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4874.000	Average	29.53	-0.26	29.27	54.00	-24.73
4874.000	Peak	41.38	-0.26	41.11	74.00	-32.89
7311.000	Average	28.13	6.68	34.81	54.00	-19.19
7311.000	Peak	40.63	6.68	47.31	74.00	-26.69

Report Number	:E2/2022/10038	Test Site	:SAC D
Operation Mode	:802.11ax40	Test Date	:2022-03-07
Test Frequency	:2437 MHz	Temp./Humi.	:18.8/64
Test Mode	:TX CH MID FULL RU	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Jack Tseng



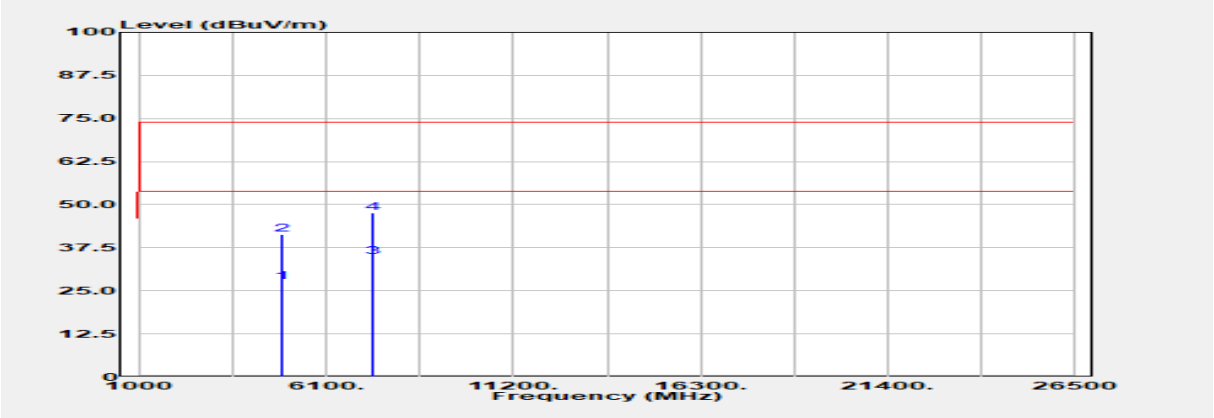
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4874.000	Average	28.75	-0.26	28.49	54.00	-25.51
4874.000	Peak	42.54	-0.26	42.27	74.00	-31.73
7311.000	Average	28.37	6.68	35.05	54.00	-18.95
7311.000	Peak	42.66	6.68	49.34	74.00	-24.66

Report Number	:E2/2022/10038	Test Site	:SAC D
Operation Mode	:802.11ax40	Test Date	:2022-03-07
Test Frequency	:2452 MHz	Temp./Humi.	:18.8/64
Test Mode	:TX CH HIGH FULL RU	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Jack Tseng



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4904.000	Average	29.82	-0.60	29.21	54.00	-24.79
4904.000	Peak	42.54	-0.60	41.93	74.00	-32.07
7356.000	Average	26.28	7.53	33.81	54.00	-20.19
7356.000	Peak	39.94	7.53	47.46	74.00	-26.54

Report Number	:E2/2022/10038	Test Site	:SAC D
Operation Mode	:802.11ax40	Test Date	:2022-03-07
Test Frequency	:2452 MHz	Temp./Humi.	:18.8/64
Test Mode	:TX CH HIGH FULL RU	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Jack Tseng



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4904.000	Average	28.19	-0.60	27.59	54.00	-26.41
4904.000	Peak	42.02	-0.60	41.42	74.00	-32.58
7356.000	Average	27.22	7.53	34.75	54.00	-19.25
7356.000	Peak	40.07	7.53	47.59	74.00	-26.41

~ End of Report ~