RADIO TEST REPORT
FCC 47 CFR PART 15 SUBPART C

Test Standard	**FCC Part 15.247**
Product name	**802.11b/g/n + BT 5.4 Module**
Brand Name	**USI**
Model No.	**WM-CW-26**
Test Result	**Pass**
Statements of Conformity	**Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.**

The test Result was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were given in ANSI C63.10: 2013 and compliance standards.

The test results of this report relate only to the tested sample (EUT) identified in this report.
The test Report of full or partial shall not copy. Without written approval of Compliance Certification Services Inc.(Wugu Laboratory)

Approved by:

Sehni Hu
Supervisor

Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	June 17, 2024	Initial Issue	ALL	Peggy Tsai
01	July 3, 2024	See the following Note Rev.(01)	P.7, 9, 10, 20, 23,25, 28, 47, 48, A-2, A-3	Peggy Tsai
02	July 10, 2024	See the following Note Rev.(02)	P. A-3-A-5	Peggy Tsai

Note:
Rev.(01)
1. Modify instrument calibration in section 1.6.
2. Modify support and EUT accessories equipment in section 1.7.
3. Modify test set up diagram in section 1.8.
4. Modify test program in section 1.9.
5. Modify test procedure in section 4.2.2.
6. Modify test setup in section 4.2.3, 4.3.3, 4.4.3, 4.5.3.
7. Modify test result in section 4.6.4.
8. Modify test photo in appendix-A.

Rev.(02)
1. Modify test photo in appendix-A.

Table of contents

1. GENERAL INFORMATION

1.1 EUT INFORMATION

Applicant	Universal Global Scientific Industrial Co., Ltd. No. 141, Lane 351, Sec.1, Taiping Road, Tsaotuen, Nantou County, 542007, Taiwan
Manufacturer	Universal Global Scientific Industrial Co., Ltd. No. 141, Lane 351, Sec.1, Taiping Road, Tsaotuen, Nantou County, 542007, Taiwan
Equipment	802.11b/g/n + BT 5.4 Module
Model No.	WM-CW-26
Model Discrepancy	N/A
Trade Name	USI
Received Date	May 3, 2024
Date of Test	May 13 ~ 24, 2024
Power Operation	Powered from Power supply: DC 3.6V
EUT Serial #	850160081201240307000010 32
HW Version	v1.0
FW Version	v7.95.55

Remark:
1. For more details, please refer to the User's manual of the EUT.
2. Disclaimer: Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

1.2 EUT CHANNEL INFORMATION

Frequency Range	2402MHz-2480MHz
Modulation Type	GFSK for BLE 1 Mbps
Number of channel	40 Channels

Remark:
Refer as ANSI C63.10: 2013 clause 5.6.1 Table 4 for test channels

Number of frequencies to be tested		
Frequency range in which device operates	**Number of frequencies**	**Location in frequency range of operation**
☐ 1 MHz or less	1	Middle
☐ 1 MHz to 10 MHz	2	1 near top and 1 near bottom
☒ More than 10 MHz	3	1 near top, 1 near middle, and 1 near bottom

1.3 ANTENNA INFORMATION

Antenna Type	☐ PIFA ☐ PCB ☐ Dipole ☒ Ceramic Chip Antenna
Antenna Gain	Yageo / ANT3216LL11R2400A Gain: 3.68 dBi
Antenna Connector	N/A

Notes:
1.The antenna(s) of the EUT are permanently attached and there are no provisions for connection to an external antenna. So the EUT complies with the requirements of §15.203.

1.4 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
AC Powerline Conducted Emission	± 2.213 dB
Channel Bandwidth	± 2.7 %
RF output power (Power Meter + Power sensor)	± 0.243 dB
Power Spectral density	± 2.739 dB
Conducted Bandedge	± 2.739 dB
Conducted Spurious Emission	± 2.742 dB
Radiated Emission_9kHz-30MHz	± 3.761 dB
Radiated Emission_30MHz-200MHz	± 3.473 dB
Radiated Emission_200MHz-1GHz	± 3.946 dB
Radiated Emission_1GHz-6GHz	± 4.797 dB
Radiated Emission_6GHz-18GHz	± 4.803 dB
Radiated Emission_18GHz-26GHz	± 3.459 dB
Radiated Emission_26GHz-40GHz	± 3.297 dB

Remark:
1.This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2
2. ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report.

1.5 FACILITIES AND TEST LOCATION

All measurement facilities used to collect the measurement data are located at

☒ No.11, Wugong 6th Rd., Wugu Dist., New Taipei City, Taiwan.

CAB identifier: TW1309

Test site	Test Engineer	Remark
AC Conduction Room	Czerny Lin	-
Radiation	Tony Chao、Ray Li	-
RF Conducted	Marco Chan	-

Remark: The lab has been recognized as the FCC accredited lab. under the KDB 974614 D01 and is listed in the FCC pubic Access Link (PAL) database, FCC Registration No. :444940, the FCC Designation No.:TW1309

1.6 INSTRUMENT CALIBRATION

Conducted_FCC/IC/NCC (All)					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Power Sensor	Anritsu	MA2411B	1911387	2023-07-25	2024-07-24
Power Meter	Anritsu	ML2496A	2136002	2023-11-16	2024-11-15
Cable	Woken	WC12	CC003	2023-06-27	2024-06-26
EXA Signal Analyzer	Keysight	N9030B	MY62291089	2023-10-13	2024-10-12
Power Supply	ABM	GPC-3030D	8070184	2023-10-02	2024-10-01
Software	Radio Test Software Ver. 21				

966A_Radiated					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Signal Analyzer	KEYSIGHT	N9010A	MY54200716	2023-10-13	2024-10-12
Thermo-Hygro Meter	WISEWIND	1206	D07	2023-12-08	2024-12-07
Loop Antenna	COM-POWER	AL-130	121051	2023-05-23	2024-05-22
Bi-Log Antenna	Sunol Sciences	JB3	A030105	2023-08-08	2024-08-07
Preamplifier	EMEC	EM330	060609	2024-02-21	2025-02-20
Cable	Huber+Suhner	104PEA	20995+21000+182330	2024-02-21	2025-02-20
Horn Antenna	ETC	MCTD 1209	DRH13M02003	2023-12-28	2024-12-27
Preamplifier	HP	8449B	3008A00965	2023-12-22	2024-12-21
Cable	EMCI	EMC101G	221213+221011+221012	2023-10-17	2024-10-16
Attenuator	Mini-Circuits	BW-S9W5	BWS9W5-09-966A-01	2024-02-07	2025-02-06
High Pass Filters	Titan Microwave	T04H30001800070S01	22011402-4	2023-06-17	2024-06-16
Horn Antenna	SCHWARZBECK	BBHA9170	1047	2023-12-13	2024-12-12
Pre-Amplifier	EMCI	EMC184045SE	980860	2023-12-12	2024-12-11
DC Power Supply	ABM	9603D	D011314	2023-10-02	2024-10-01
Turn Table	CCS	CC-T-1F	N/A	N.C.R	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R	N.C.R
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R	N.C.R
Site Validation	CCS	966A	N/A	2023-07-10	2024-07-09
Software	e3 V9-210616c				

Remark:
1. Each piece of equipment is scheduled for calibration once a year.
2. N.C.R. = No Calibration Required.

AC Mains Conduction					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
EMI Test Receiver	R&S	ESCI	100064	2023-06-07	2024-06-06
LISN	TESEQ	LN2-16N	22012	2024-02-29	2025-02-27
Cable	EMCI	CFD300-NL	CERF	2023-06-27	2024-06-26
Power Supply	GWINISTEK	SPS-3610	GPE880163	2023-10-16	2024-10-15
Software	e3 V6-110812				

Remark:
1. Each piece of equipment is scheduled for calibration once a year.
2. N.C.R. = No Calibration Required.

1.7 SUPPORT AND EUT ACCESSORIES EQUIPMENT

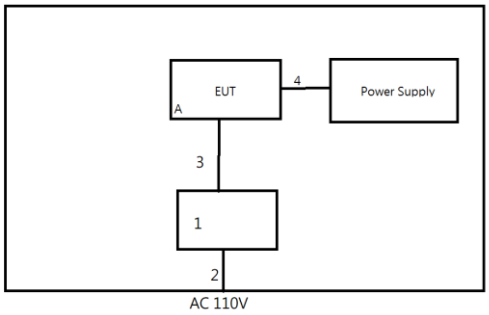
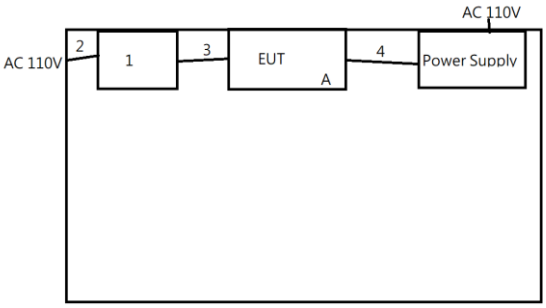
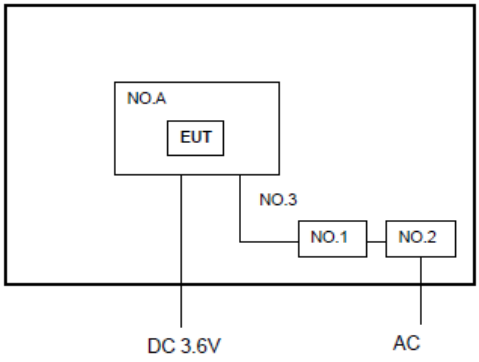
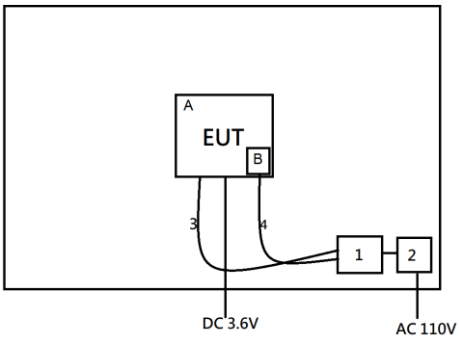
EUT Accessories Equipment						
No.	**Equipment**	**Brand**	**Model**	**Series No.**	**FCC ID**	**IC**
A	Test Kitting	USI	WM-BN-BM-26_A_EVB	N/A	N/A	N/A

Support Equipment (Conducted)					
No.	**Equipment**	**Brand**	**Model**	**Series No.**	**FCC ID**
1	NB(L)	Lenovo	X260	N/A	N/A
2	Adapter	Lenovo	ADLX45DLC3A	N/A	N/A
3	Mini USB	RS Pro	2369084	N/A	N/A
4	DC Cable	MISUMI	MCR3S-RE	N/A	N/A

Support Equipment (RSE, Co-Location)					
No.	**Equipment**	**Brand**	**Model**	**Series No.**	**FCC ID**
1	NB(D)	Lenovo	ThinkPad X260	N/A	N/A
2	Adapter	Lenovo	ADLX45DLC3A	N/A	N/A
3	Mini USB	RS Pro	2369084	N/A	N/A
4	Micro USB	StarTech.	UUSBHAUB3M	N/A	N/A
B	SDIO adapter card	USI	USB TO SDIO CARD	N/A	N/A

Support Equipment (Conduction)					
No.	**Equipment**	**Brand**	**Model**	**Series No.**	**FCC ID**
1	NB(D)	Lenovo	ThinkPad X260	N/A	N/A
2	Adapter	Lenovo	ADLX45DLC3A	N/A	N/A
3	Mini USB	RS Pro	2369084	N/A	N/A
4	DC Cable	MISUMI	MCR3S-RE	N/A	N/A

1.8 TEST SET UP DIAGRAM

Conducted	Conduction
	
RSE	**Co-Location**
	

1.9 TEST PROGRAM

The EUT connection corresponds to the surrounding fixture control board.
This EUT uses the Linux system setup command to set the frequency, modulation, and power to allow the sample to continuously transmit (including frequency hopping mode and Co-Location).

1.10 TEST METHODOLOGY AND APPLIED STANDARDS

The test methodology, setups and results comply with all requirements in accordance with ANSI C63.10:2013, FCC Part 2, FCC Part 15.247, KDB 558074.

2. TEST SUMMERY

FCC Standard Section	Report Section	Test Item	Result
15.203	1.3	Antenna Requirement	Pass
15.207(a)	4.1	AC Conducted Emission	Pass
15.247(a)(2)	4.2	6 dB Bandwidth	Pass
-	4.2	Occupied Bandwidth (99%)	Pass
15.247(b)(3)	4.3	Output Power Measurement	Pass
15.247(e)	4.4	Power Spectral Density	Pass
15.247(d)	4.5	Conducted Band Edge	Pass
15.247(d)	4.5	Conducted Spurious Emission	Pass
15.247(d) 15.205, 15.209	4.6	Radiation Band Edge	Pass
15.247(d) 15.205, 15.209	4.6	Radiation Spurious Emission	Pass

3. DESCRIPTION OF TEST MODES

3.1 THE WORST MODE OF OPERATING CONDITION

Operation mode	BLE Mode (1Mbps)
Test Channel Frequencies	1.Lowest Channel : 2402MHz 2.Middle Channel : 2442MHz 3.Highest Channel : 2480MHz

Remark:
1. EUT pre-scanned data rate of output power for each mode, the worst data rate were recorded in this report.
.

3.2 THE WORST MODE OF MEASUREMENT

AC Power Line Conducted Emission	
Test Condition	AC Power line conducted emission for line and neutral
Power supply Mode	Mode 1: EUT Power by DC power Supply
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

AC Power Line Conducted Emission [co-location]	
Test Condition	Radiated Emission [co-location]
Power supply Mode	Mode 1: Wi-Fi 2.4G+ BLE 1M
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

Radiated Emission Measurement Above 1G	
Test Condition	Radiated Emission Above 1G
Power supply Mode	Mode 1: EUT power by Power supply
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4
Worst Position	☐ Placed in fixed position. ☒ Placed in fixed position at X-Plane (E2-Plane) ☐ Placed in fixed position at Y-Plane (E1-Plane) ☐ Placed in fixed position at Z-Plane (H-Plane)

Radiated Emission Measurement Below 1G	
Test Condition	Radiated Emission Below 1G
Power supply Mode	Mode 1: EUT power by Power supply
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

Radiated Emission Measurement [co-location]	
Test Condition	Radiated Emission [co-location]
Power supply Mode	Mode 1: Wi-Fi 2.4G+ BLE 1M
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

Remark:

1. The worst mode was record in this test report.
2. AC power line conducted emission and for below 1G radiation emission were performed the EUT transmit at the highest output power channel as worse case.
3. EUT pre-scanned in three axis ,X,Y, Z and two polarity, for radiated measurement. The worst case(X-Plane) were recorded in this report

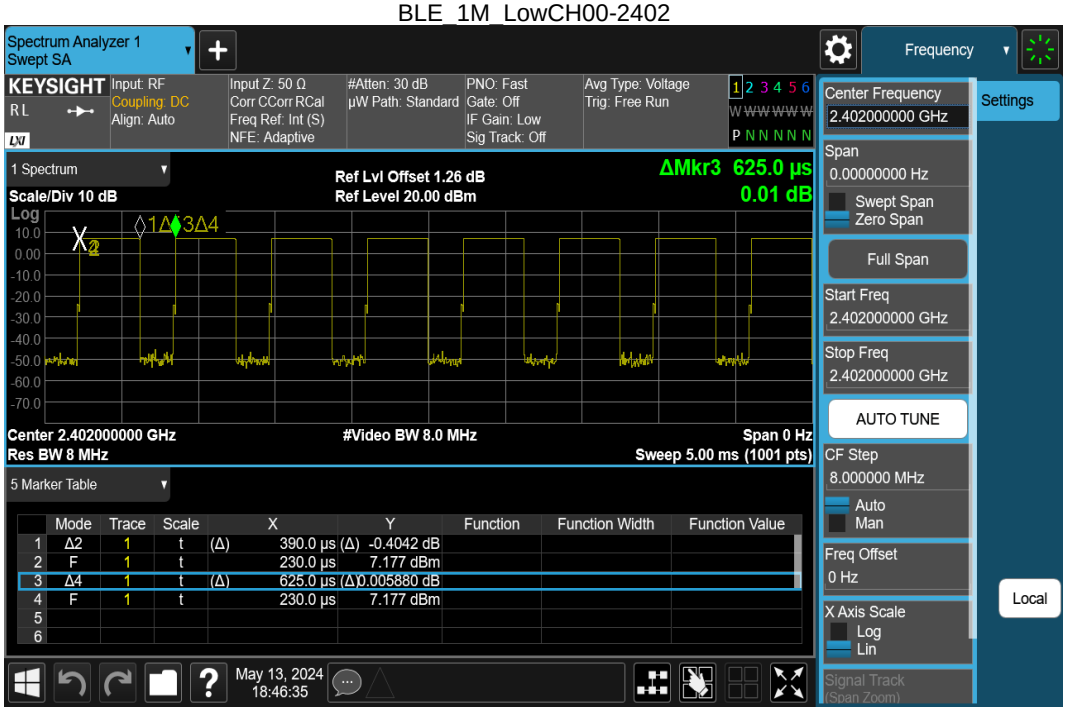
3.3 EUT DUTY CYCLE

Temperature: 23.5℃ **Test date:** May 13, 2024

Humidity: 59% RH **Tested by:** Marco Chan

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
BLE 1M	62.40	2.05	2.56	3.00

BLE_1M_LowCH00-2402



4. TEST RESULT

4.1 AC POWER LINE CONDUCTED EMISSION

4.1.1 Test Limit

According to §15.207(a),

Frequency Range (MHz)	Limits(dBμV)	
	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

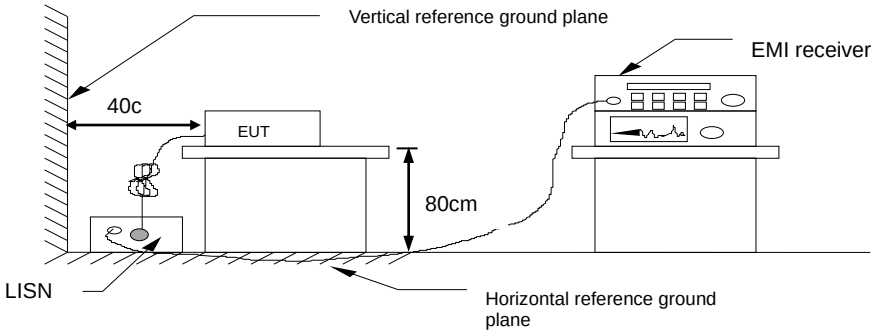
* Decreases with the logarithm of the frequency.

4.1.2 Test Procedure

Test method Refer as ANSI C63.10: 2013 clause 6.2,

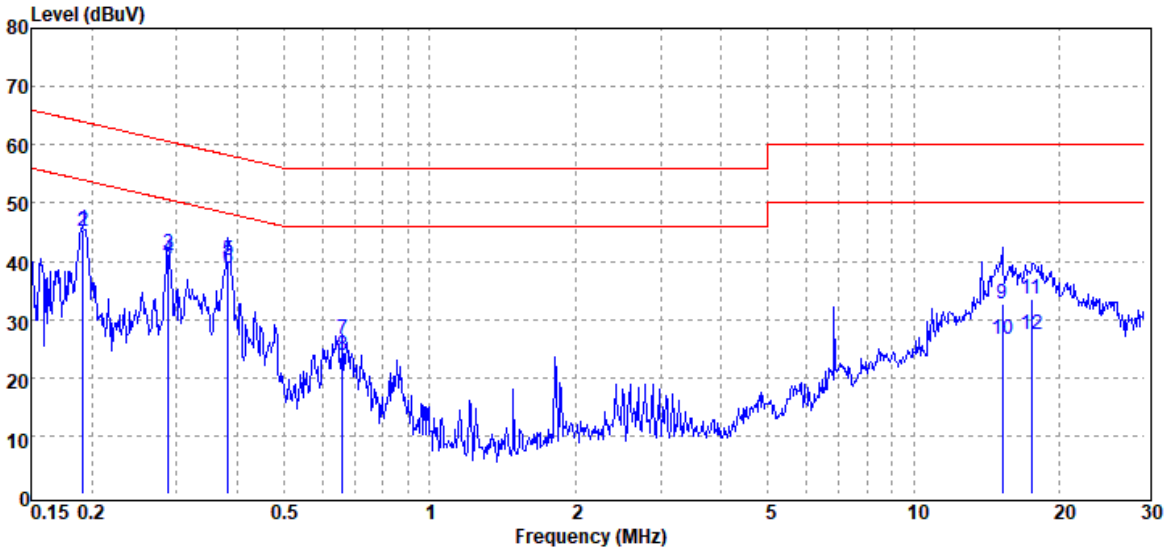
1. The EUT was placed on a non-conducted table, which is 0.8m above horizontal ground plane and 0.4m above vertical ground plane.
2. EUT connected to the line impedance stabilization network (LISN)
3. Receiver set RBW of 9kHz and Detector Peak, and note as quasi-peak and average.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. Recorded Line for Neutral and Line.

4.1.3 Test Setup



4.1.4 Test Result

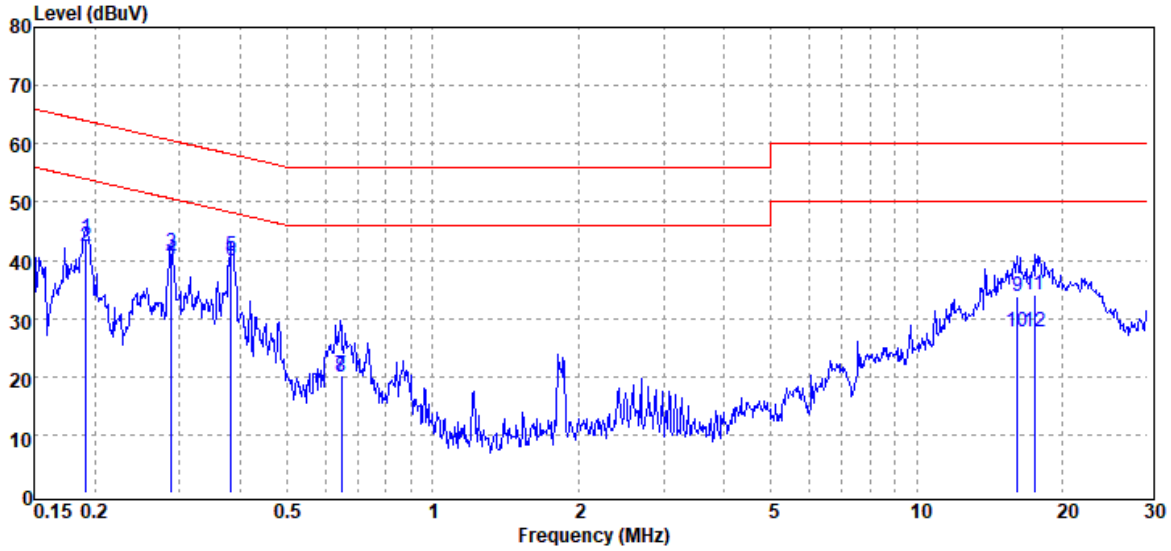
Project No	: TM-2405000018P	Test Date	: 2024-05-24
Operation Mode	: BLE	Temp./Humi.	: 24.1°C / 55%
Test Chamber	: Conduction	Engineer	: Czerny Lin
Probe	: LINE	Test Voltage	: AC 120V/60Hz
Note	:		



Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.192	QP	45.32	0.15	45.47	63.94	-18.47
0.192	Average	44.87	0.15	45.02	53.94	-8.92
0.288	QP	41.08	0.15	41.23	60.57	-19.34
0.288	Average	40.36	0.15	40.51	50.57	-10.06
0.382	QP	39.99	0.15	40.14	58.23	-18.09
0.382	Average	38.67	0.15	38.82	48.23	-9.41
0.661	QP	26.31	0.16	26.47	56.00	-29.53
0.661	Average	23.74	0.16	23.90	46.00	-22.10
15.223	QP	32.11	0.45	32.56	60.00	-27.44
15.223	Average	26.17	0.45	26.62	50.00	-23.38
17.516	QP	32.95	0.48	33.43	60.00	-26.57
17.516	Average	26.81	0.48	27.29	50.00	-22.71

Note: 1. Actual FS= Spectrum Read Level + Factor
Note: 2. Margin= Actual FS - Limit

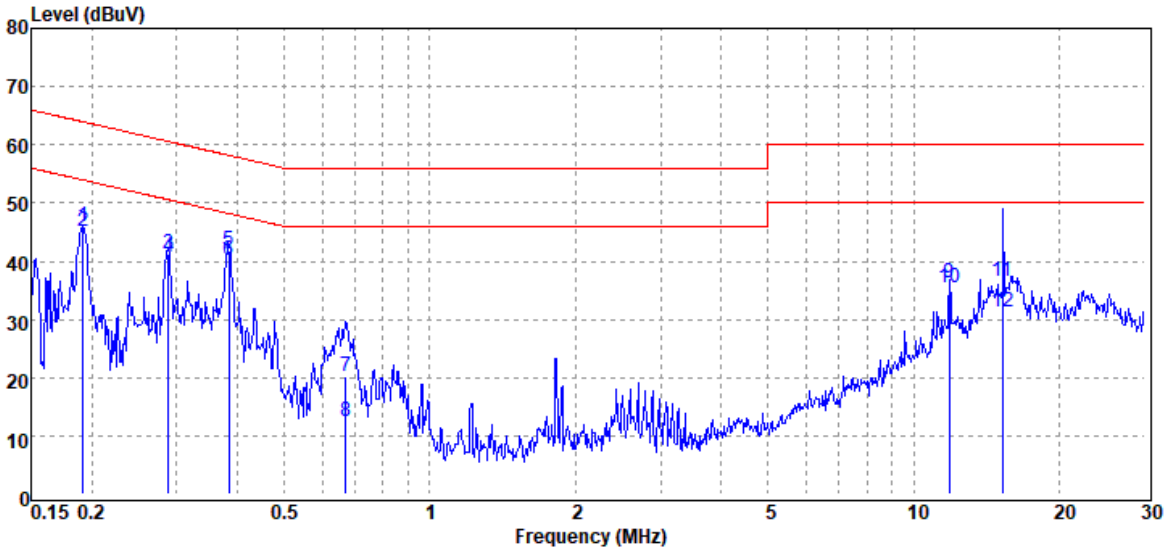
Project No	: TM-2405000018P	Test Date	: 2024-05-24
Operation Mode	: BLE	Temp./Humi.	: 24.1°C / 55%
Test Chamber	: Conduction	Engineer	: Czerny Lin
Probe	: NEUTRAL	Test Voltage	: AC 120V/60Hz
Note	:		



Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.192	QP	43.46	0.19	43.65	63.95	-20.30
0.192	Average	42.18	0.19	42.37	53.95	-11.58
0.289	QP	40.95	0.19	41.14	60.56	-19.42
0.289	Average	39.98	0.19	40.17	50.56	-10.39
0.384	QP	40.59	0.19	40.78	58.20	-17.42
0.384	Average	39.79	0.19	39.98	48.20	-8.22
0.647	QP	20.13	0.21	20.34	56.00	-35.66
0.647	Average	19.67	0.21	19.88	46.00	-26.12
16.181	QP	33.34	0.48	33.82	60.00	-26.18
16.181	Average	27.20	0.48	27.68	50.00	-22.32
17.515	QP	33.64	0.49	34.13	60.00	-25.87
17.515	Average	27.20	0.49	27.69	50.00	-22.31

Note: 1. Actual FS= Spectrum Read Level + Factor
Note: 2. Margin= Actual FS - Limit

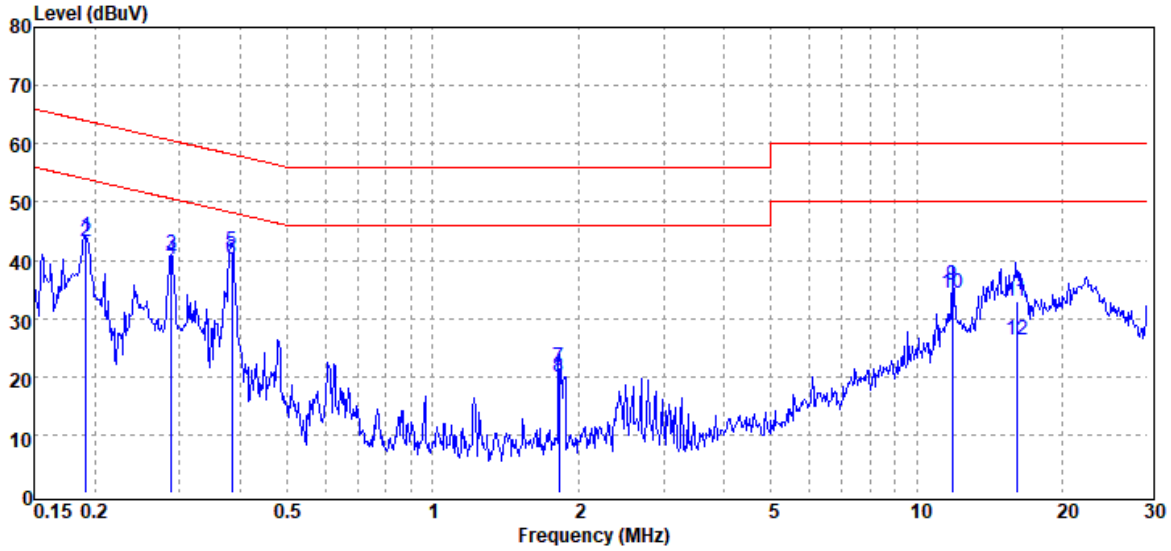
Project No	: TM-2405000018P	Test Date	: 2024-05-24
Operation Mode	: Wi-Fi+BLE Co-Location	Temp./Humi.	: 24.1°C / 55%
Test Chamber	: Conduction	Engineer	: Czerny Lin
Probe	: LINE	Test Voltage	: AC 120V/60Hz
Note	:		



Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.192	QP	45.78	0.15	45.93	63.96	-18.03
0.192	Average	45.04	0.15	45.19	53.96	-8.77
0.288	QP	41.15	0.15	41.30	60.58	-19.28
0.288	Average	40.41	0.15	40.56	50.58	-10.02
0.384	QP	41.62	0.15	41.77	58.20	-16.43
0.384	Average	40.06	0.15	40.21	48.20	-7.99
0.671	QP	20.09	0.16	20.25	56.00	-35.75
0.671	Average	12.36	0.16	12.52	46.00	-33.48
11.824	QP	35.96	0.40	36.36	60.00	-23.64
11.824	Average	34.95	0.40	35.35	50.00	-14.65
15.278	QP	36.01	0.45	36.46	60.00	-23.54
15.278	Average	30.91	0.45	31.36	50.00	-18.64

Note: 1. Actual FS= Spectrum Read Level + Factor
Note: 2. Margin= Actual FS - Limit

Project No	: TM-2405000018P	Test Date	: 2024-05-24
Operation Mode	: Wi-Fi+BLE Co-Location	Temp./Humi.	: 24.1°C / 55%
Test Chamber	: Conduction	Engineer	: Czerny Lin
Probe	: NEUTRAL	Test Voltage	: AC 120V/60Hz
Note	:		



Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.192	QP	43.81	0.19	44.00	63.95	-19.95
0.192	Average	42.98	0.19	43.17	53.95	-10.78
0.288	QP	40.92	0.19	41.11	60.57	-19.46
0.288	Average	40.00	0.19	40.19	50.57	-10.38
0.384	QP	41.31	0.19	41.50	58.19	-16.69
0.384	Average	40.08	0.19	40.27	48.19	-7.92
1.827	QP	21.27	0.25	21.52	56.00	-34.48
1.827	Average	19.75	0.25	20.00	46.00	-26.00
11.825	QP	35.26	0.42	35.68	60.00	-24.32
11.825	Average	33.97	0.42	34.39	50.00	-15.61
16.084	QP	32.53	0.47	33.00	60.00	-27.00
16.084	Average	25.71	0.47	26.18	50.00	-23.82

Note: 1. Actual FS= Spectrum Read Level + Factor
Note: 2. Margin= Actual FS - Limit

4.2 6dB BANDWIDTH AND OCCUPIED BANDWIDTH(99%)

4.2.1 Test Limit

According to §15.247(a)(2),

6 dB Bandwidth ：

Limit	Shall be at least 500kHz

Occupied Bandwidth(99%) ： For reporting purposes only.

4.2.2 Test Procedure

Test method Refer as KDB 558074 D01 and ANSI C63.10: 2013 clause 6.9.2.

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT
3. SA set RBW = 100kHz, VBW = 300kHz and Detector = Peak, to measurement 6 dB Bandwidth.
4. SA set RBW = 1% ~ 5% OBW, VBW = three times the RBW and Detector = Peak, to measurement 99% Bandwidth
5. Measure and record the result of 6 dB Bandwidth and 99% Bandwidth. in the test report.

4.2.3 Test Setup

Refer to section 1.8.

4.2.4 Test Result

Temperature:	23.5℃	**Test date:**	May 13, 2024
Humidity:	59% RH	**Tested by:**	Marco Chan

6dB BANDWIDTH

BLE 1M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.7319	≧ 0.5	PASS
2442	0.7268	≧ 0.5	PASS
2480	0.7265	≧ 0.5	PASS

BANDWIDTH 99%

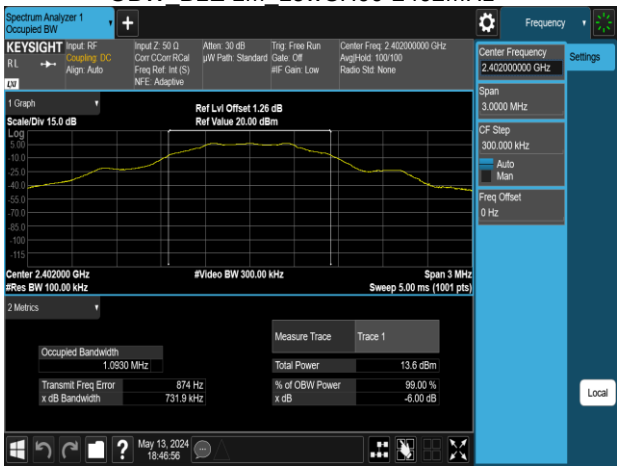
BLE 1M mode

Frequency (MHz)	99%Bandwidth (MHz)
2402	1.0544
2442	1.0548
2480	1.0552

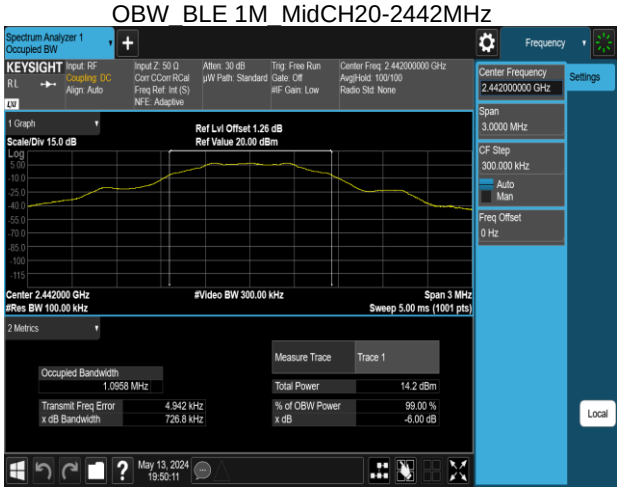
Test Data

6dB BANDWIDTH

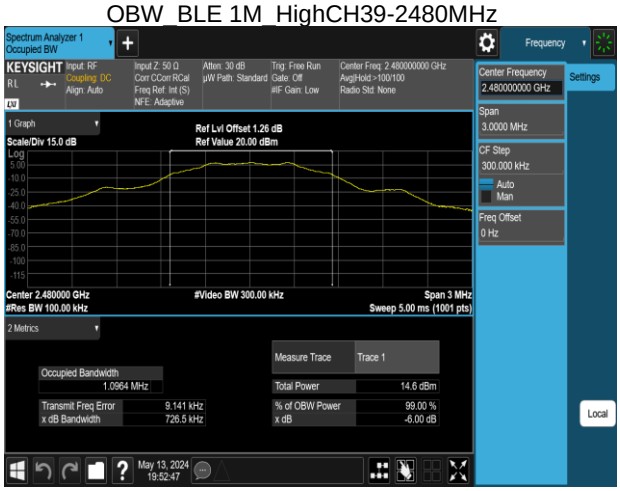
OBW_BLE 1M_LowCH00-2402MHz



OBW_BLE 1M_MidCH20-2442MHz



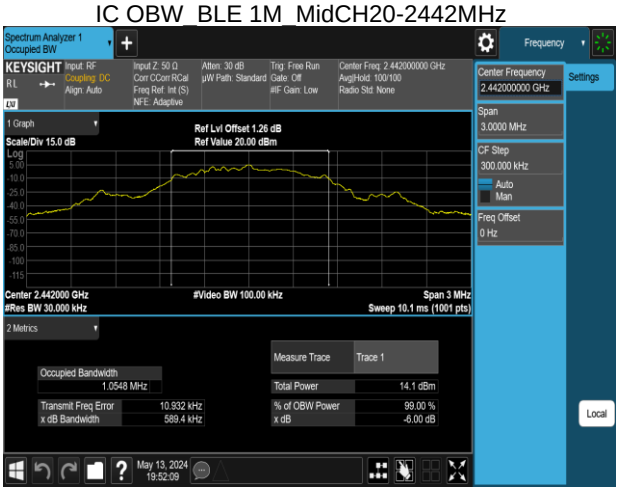
OBW_BLE 1M_HighCH39-2480MHz



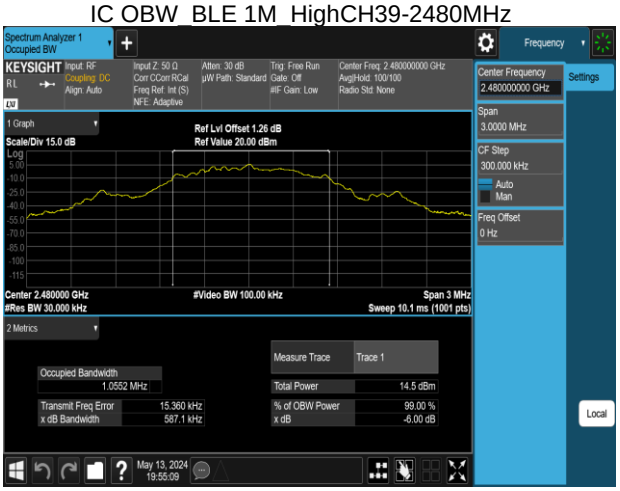
BANDWIDTH 99%

IC OBW_BLE 1M_LowCH00-2402MHz

IC OBW_BLE 1M_MidCH20-2442MHz



IC OBW_BLE 1M_HighCH39-2480MHz



4.3 OUTPUT POWER MEASUREMENT

4.3.1 Test Limit

According to §15.247(b)(3),

Peak output power：

FCC

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

Average output power：For reporting purposes only.

4.3.2 Test Procedure

Test method Refer as KDB 558074 D01

1. The EUT RF output connected to the power meter by RF cable.
2. Setting maximum power transmit of EUT.
3. The path loss was compensated to the results for each measurement.
4. Measure and record the result of Peak output power and Average output power. in the test report.

4.3.3 Test Setup

Refer to section 1.8.

4.3.4 Test Result

Temperature:	23.5℃	**Test date:**	May 13, 2024
Humidity:	59% RH	**Tested by:**	Marco Chan

Peak & Average output power：

BLE 1M mode:

CH	Frequency (MHz)	Power Setting	Peak Output Power (dBm)	Required Limit (dBm)
Low	2402	default	7.28	30
Mid	2442	default	7.94	30
High	2480	default	**8.15**	30
CH	**Frequency (MHz)**	**Power Setting**	**Avg. Output Power (dBm)**	**Required Limit (dBm)**
Low	2402	default	7.21	30
Mid	2442	default	7.76	30
High	2480	default	7.84	30

Note:

1.Measured by power meter, cable loss 1.26 dB + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

4.4 POWER SPECTRAL DENSITY

4.4.1 Test Limit

According to §15.247(e) ,

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Limit	☒ Antenna not exceed 6 dBi：8dBm ☐ Antenna with DG greater than 6 dBi [Limit = 8 – (DG – 6)] ☐ Point-to-point operation：

4.4.2 Test Procedure

Test method Refer as KDB 558074 D01

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT
3. SA set RBW = 3kHz, VBW = 10kHz, Span = 1.5 times DTS Bandwidth (6 dB BW), Detector = Peak, Sweep Time = Auto and Trace = Max hold.
4. The path loss was compensated to the results for each measurement by SA.
5. Mark the maximum level.
6. Measure and record the result of power spectral density. in the test report.

4.4.3 Test Setup

Refer to section 1.8.

4.4.4 Test Result

Temperature:	23.5℃	**Test date:**	May 13, 2024
Humidity:	59% RH	**Tested by:**	Marco Chan

BLE 1M mode

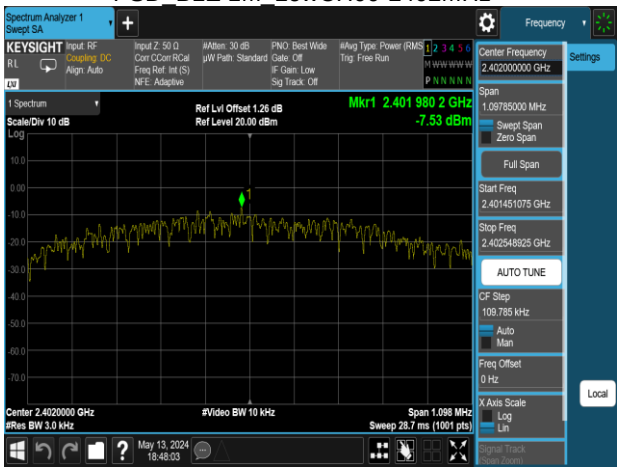
Frequency (MHz)	RF Power Density (dBm/3kHz)	Maximum Limit (dBm/3kHz)	Result
2402	-7.53	8	PASS
2442	-6.99	8	PASS
2480	-6.65	8	PASS

Note:

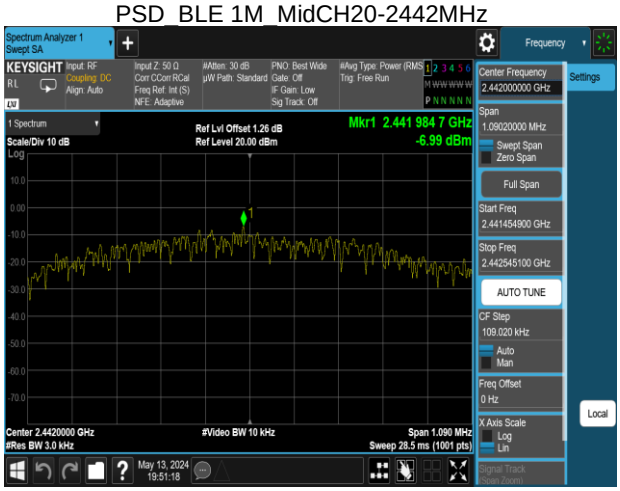
1.cable loss as 1.26dB that offsets in the spectrum

Test Data

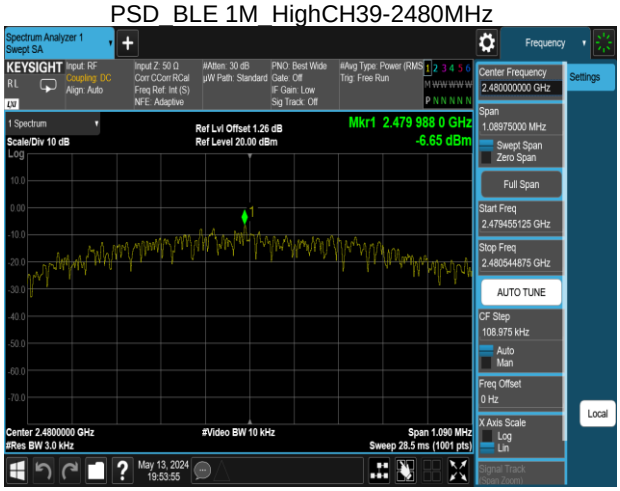
PSD_BLE 1M_LowCH00-2402MHz



PSD_BLE 1M_MidCH20-2442MHz



PSD_BLE 1M_HighCH39-2480MHz



4.5 CONDUCTED BAND EDGE AND SPURIOUS EMISSION

4.5.1 Test Limit

According to §15.247(d),

FCC: In any 100 kHz bandwidth outside the authorized frequency band,

Non-restricted bands shall be attenuated at least 20 dB/30 dB relative to the maximum PSD level in 100 kHz by RF conducted or a radiated measurement which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

4.5.2 Test Procedure

Test method Refer as KDB 558074 D01

1. EUT RF output port connected to the SA by RF cable, and the path loss was compensated to result.

2. SA setting, RBW=100kHz, VBW=300kHz, Detector=Peak, Trace mode = max hold, SWT = Auto.

3. In any 100 kHz bandwidth outside the authorized frequency band, shall be attenuated at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when conducted power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

4.5.3 Test Setup

Refer to section 1.8.

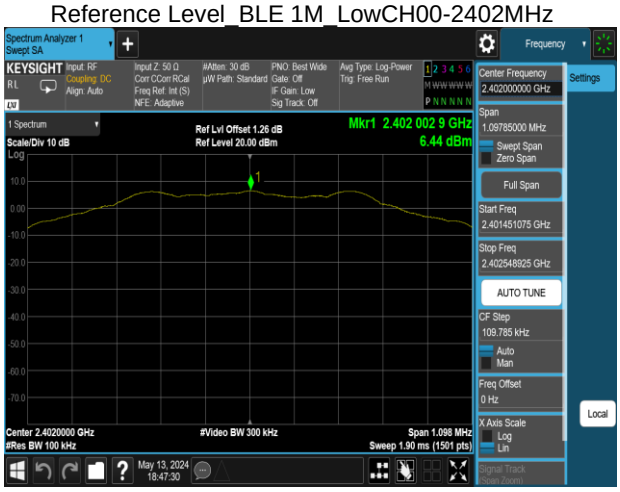
4.5.4 Test Result

Temperature:	23.5℃	**Test date:**	May 13, 2024
Humidity:	59% RH	**Tested by:**	Marco Chan

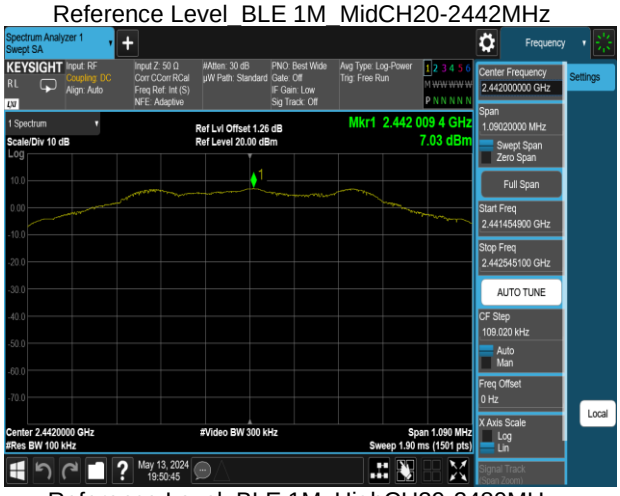
Test Data

Reference Level

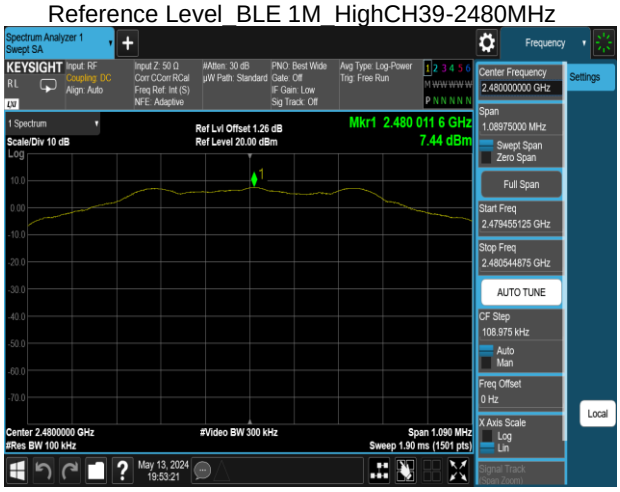
Reference Level_BLE 1M_LowCH00-2402MHz



Reference Level_BLE 1M_MidCH20-2442MHz

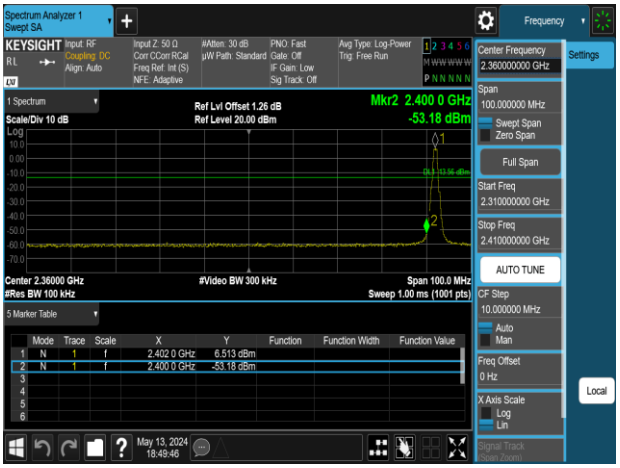


Reference Level_BLE 1M_HighCH39-2480MHz

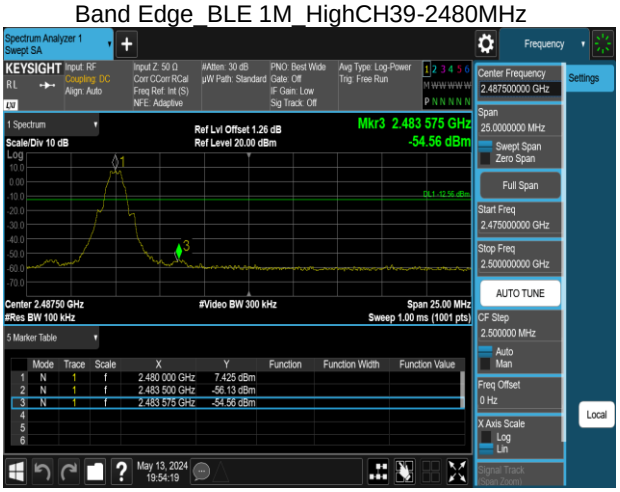


Band Edge

Band Edge_BLE 1M_LowCH00-2402MHz

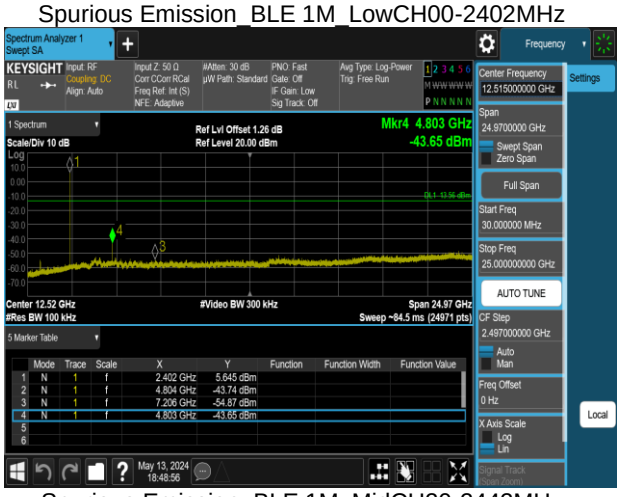


Band Edge_BLE 1M_HighCH39-2480MHz

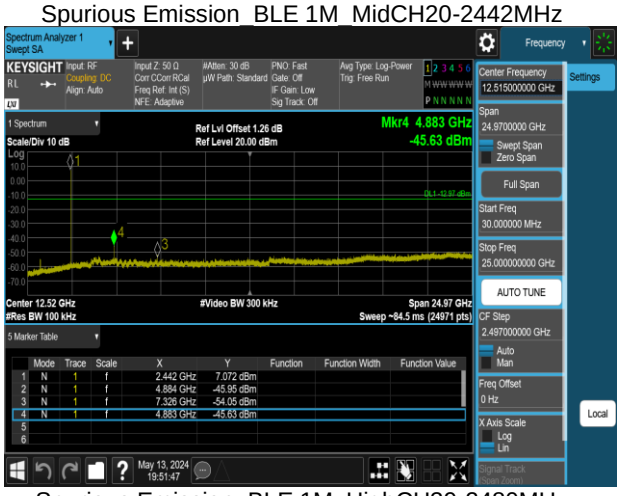


Spurious Emission

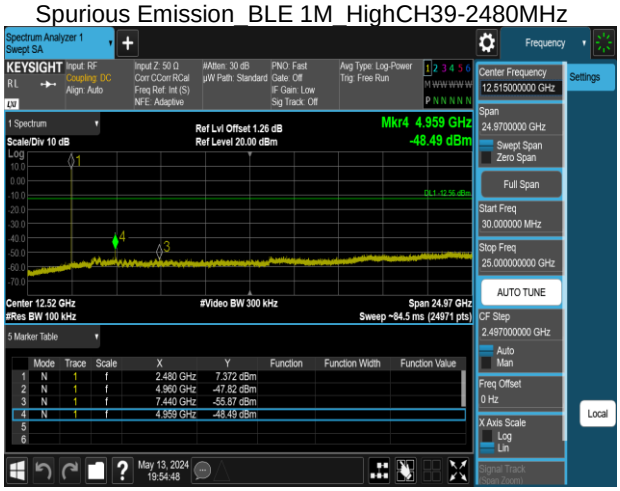
Spurious Emission_BLE 1M_LowCH00-2402MHz



Spurious Emission_BLE 1M_MidCH20-2442MHz



Spurious Emission_BLE 1M_HighCH39-2480MHz



4.6 RADIATION BANDEDGE AND SPURIOUS EMISSION

4.6.1 Test Limit

FCC according to §15.247(d), §15.209 and §15.205,

In any 100 kHz bandwidth outside the authorized frequency band, all harmonic and spurious must be least 20 dB below the highest emission level with the authorized frequency band. Radiation emission which fall in the restricted bands must also follow the FCC section 15.209 as below limit in table.

Below 30 MHz

Frequency	Field Strength (microvolts/m)	Magnetic H-Field (microamperes/m)	Measurement Distance (metres)
9-490 kHz	2,400/F (F in kHz)	2,400/F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/F (F in kHz)	30
1.705-30 MHz	30	N/A	30

Above 30 MHz

Frequency (MHz)	Field Strength microvolts/m at 3 metres (watts, e.i.r.p.)	
	Transmitters	Receivers
30-88	100 (3 nW)	100 (3 nW)
88-216	150 (6.8 nW)	150 (6.8 nW)
216-960	200 (12 nW)	200 (12 nW)
Above 960	500 (75 nW)	500 (75 nW)

Remark:
Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

4.6.2 Test Procedure

1. The EUT is placed on a turntable, Above 1 GHz is 1.5m and below 1 GHz is 0.8m above ground plane. The EUT Configured un accordance with ANSI C63.10: 2013, and the EUT set in a continuous mode.

2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level. And EUT is set 3m away from the receiving antenna, which is scanned from 1m to 4m above the ground plane to find out the highest emissions. Measurement are made polarized in both the vertical and the horizontal positions with antenna.

3. Span shall wide enough to full capture the emission measured. The SA from 9KHz to 26.5GHz set to the low, Mid and High channels with the EUT transmit.

4. No emission found between lowest internal used/generated frequency to 30MHz (9KHz~30MHz).

Radiated emission below 30MHz is measured in a 9m*6m*6m semi-ane choic 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.

5. The SA setting following：

(1) Below 30MHz：

(1.1) 9KHz-490KHz：RBW=200Hz / VBW=1kHz / Sweep=AUTO

(1.2) 490KHz-30MHz：RBW=10kHz / VBW=30kHz / Sweep=AUTO

(2) 30MHz to 1GHz：RBW = 100kHz, VBW ≥ 3*RBW, Sweep = Auto,

Detector = Peak, Trace = Max hold.

(3) Above 1GHz：

(3.1) For Peak measurement：RBW = 1MHz, VBW ≥ 3 RBW, Sweep = Auto, Detector = Peak, Trace = Max hold.

(3.2) For Average measurement：RBW = 1MHz, VBW

˙If Duty Cycle ≥ 98%, VBW=10Hz.

˙If Duty Cycle < 98%, VBW=1/T.

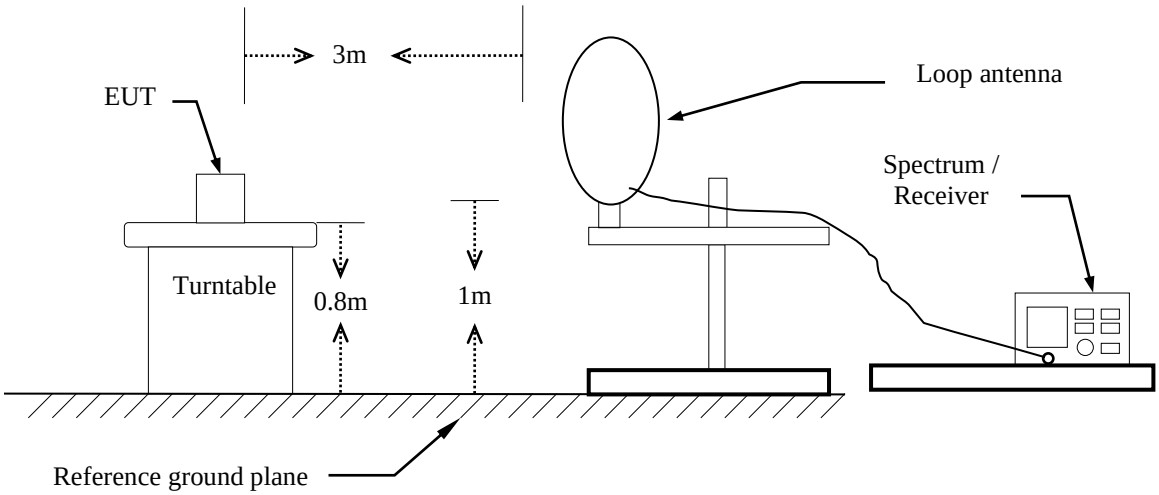
6. Data result：

Actual FS=Spectrum Reading Level + Factor

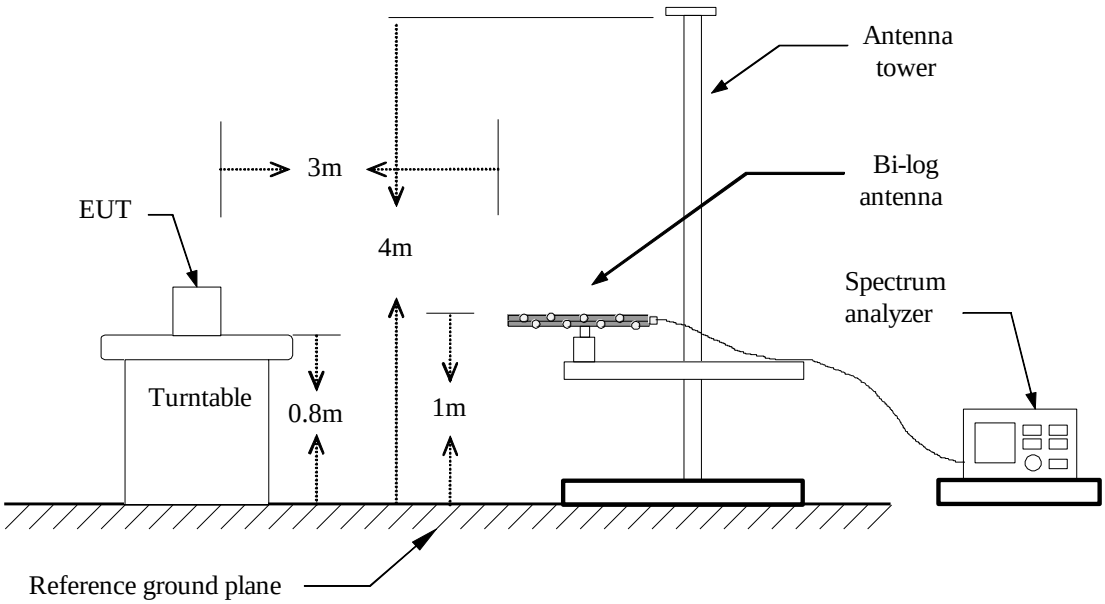
Margin=Actual FS- Limit

4.6.3 Test Setup

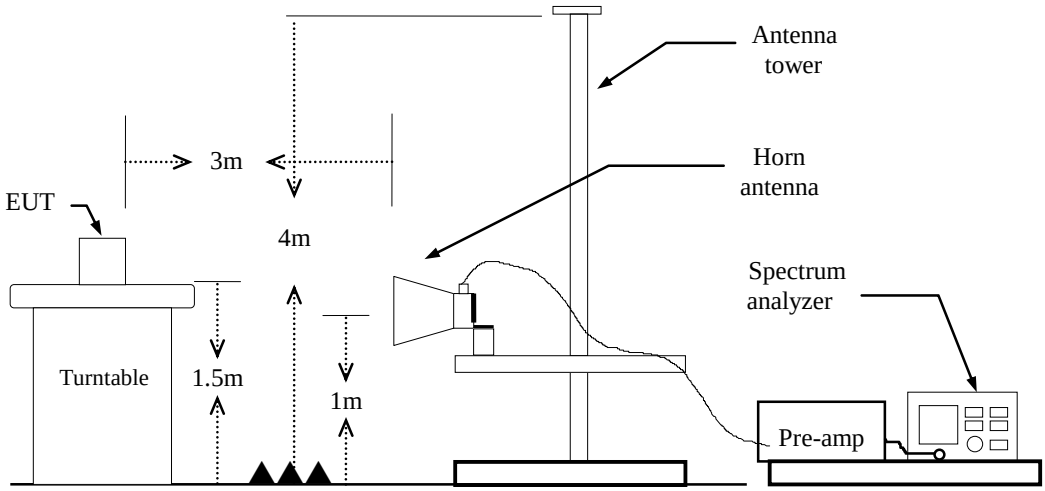
9kHz ~ 30MHz



30MHz ~ 1GHz



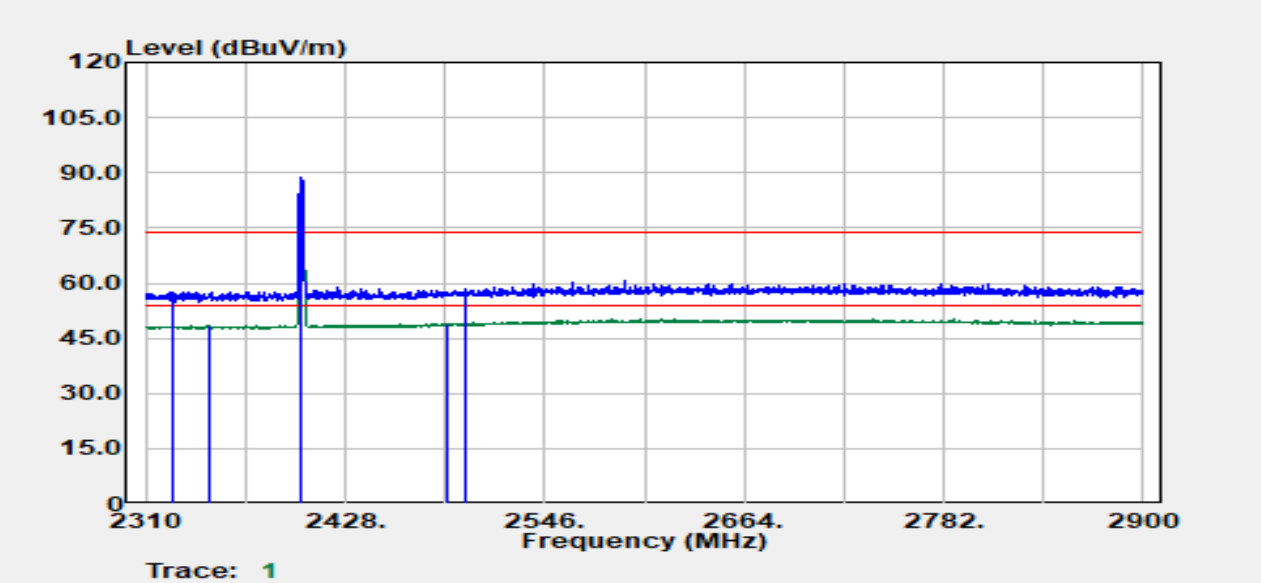
Above 1 GHz



4.6.4 Test Result

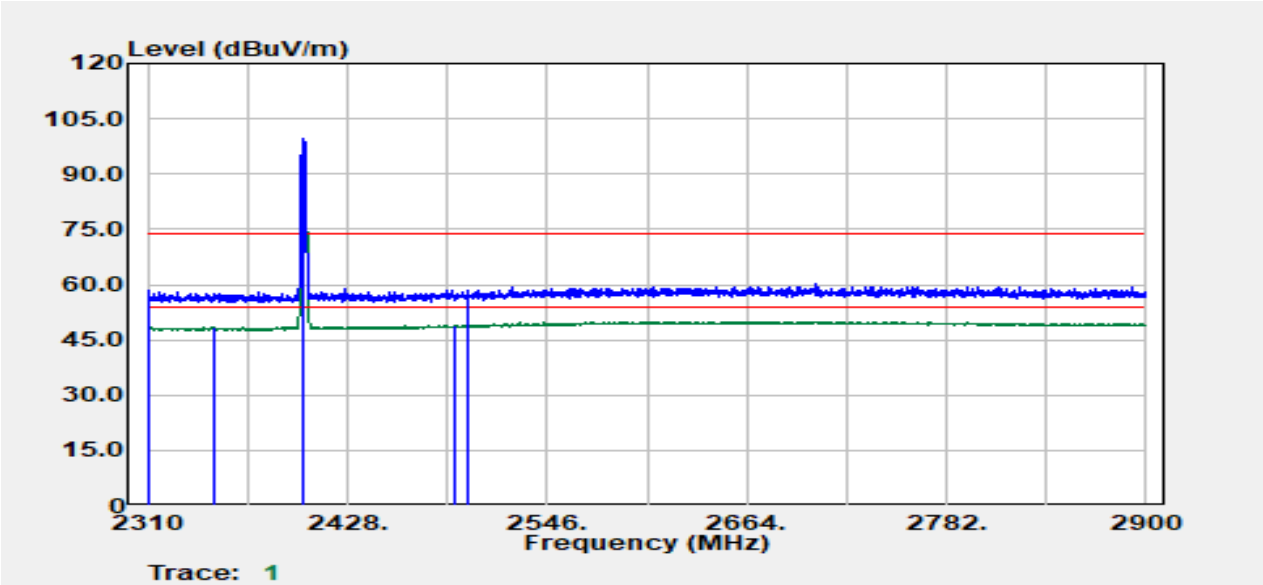
Band Edge Test Data

Project No	:TM-2405000018P	Test Date	:2024-05-16
Operation Band	:BLE 1M	Temp./Humi.	:24.6/57
Frequency	:2402 MHz	Antenna Pol.	:Vertical
Operation Mode	:Bandedge	Engineer	:Tony Chao
EUT Pol	:E2	Test Chamber	: 966A
Setting	:		



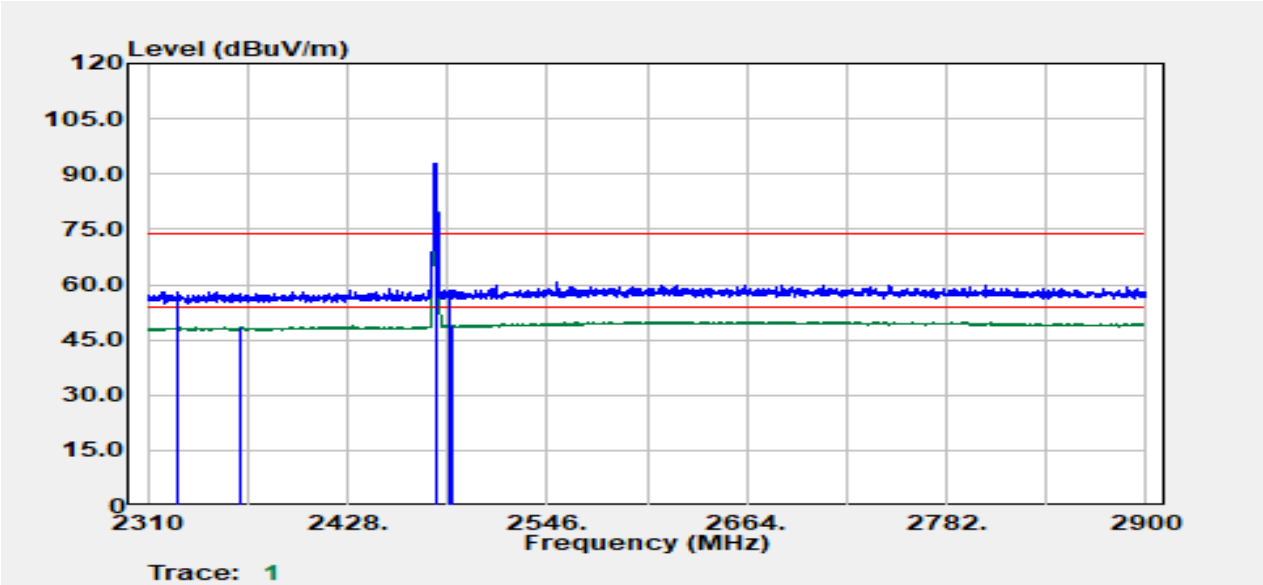
Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2326.23	Peak	25.63	32.05	57.67	74.00	-16.33
2347.45	Average	16.32	32.04	48.37	54.00	-5.63
2402.00	Peak	56.69	32.12	88.82	- -	- -
2402.00	Average	56.30	32.12	88.42	- -	- -
2488.77	Average	16.56	32.49	49.05	54.00	-4.95
2499.76	Peak	25.70	32.51	58.21	74.00	-15.79

Project No	:TM-2405000018P	Test Date	:2024-05-16
Operation Band	:BLE 1M	Temp./Humi.	:24.6/57
Frequency	:2402 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Bandedge	Engineer	:Tony Chao
EUT Pol	:E2	Test Chamber	: 966A
Setting	:		



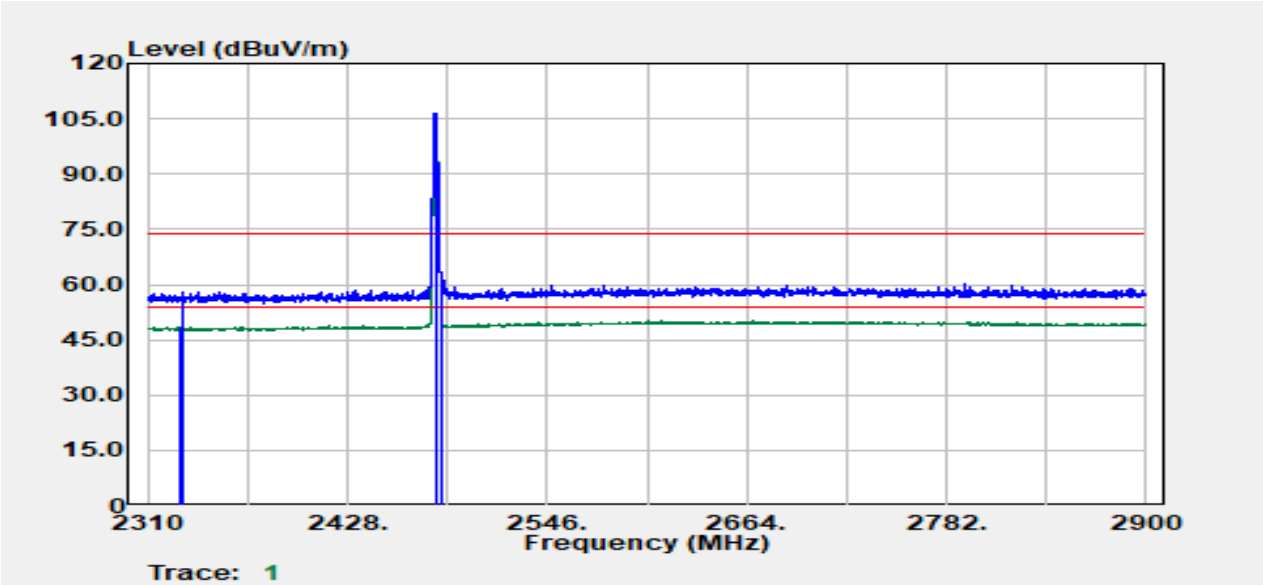
Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2310.25	Peak	26.20	32.03	58.23	74.00	-15.77
2348.95	Average	16.44	32.06	48.50	54.00	-5.50
2402.00	Peak	67.63	32.12	99.75	- -	- -
2402.00	Average	67.33	32.12	99.45	- -	- -
2490.77	Average	16.40	32.50	48.90	54.00	-5.10
2499.51	Peak	26.10	32.51	58.61	74.00	-15.39

Project No	:TM-2405000018P	Test Date	:2024-05-16
Operation Band	:BLE 1M	Temp./Humi.	:24.6/57
Frequency	:2480 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Bandedge	Engineer	:Tony Chao
EUT Pol	:E2	Test Chamber	: 966A
Setting	:		



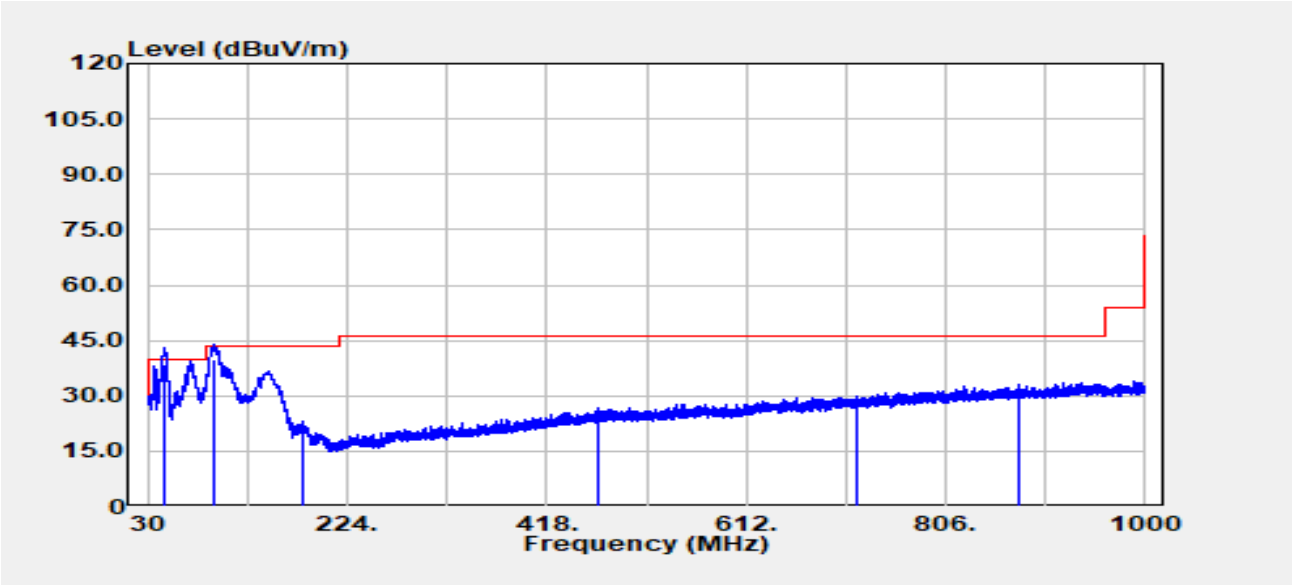
Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2327.48	Peak	26.09	32.05	58.14	74.00	-15.86
2365.18	Average	16.43	32.03	48.46	54.00	-5.54
2480.00	Peak	60.55	32.39	92.94	- -	- -
2480.00	Average	60.23	32.39	92.62	- -	- -
2488.02	Peak	26.06	32.48	58.54	74.00	-15.46
2490.27	Average	16.47	32.50	48.98	54.00	-5.02

Project No	:TM-2405000018P	Test Date	:2024-05-16
Operation Band	:BLE 1M	Temp./Humi.	:24.6/57
Frequency	:2480 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Bandedge	Engineer	:Tony Chao
EUT Pol	:E2	Test Chamber	: 966A
Setting	:		



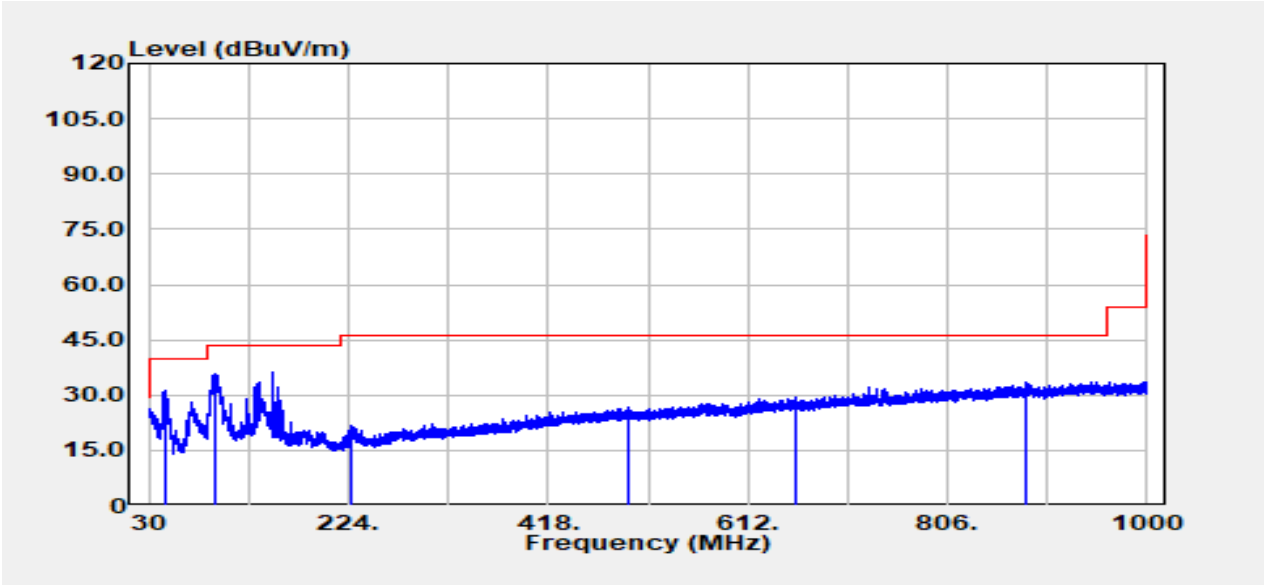
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
2328.98	Average	16.36	32.05	48.41	54.00	-5.59
2330.22	Peak	25.98	32.05	58.03	74.00	-15.97
2480.00	Peak	74.13	32.39	106.52	- -	- -
2480.00	Average	73.82	32.39	106.21	- -	- -
2483.53	Average	20.21	32.43	52.64	54.00	-1.36
2483.78	Peak	29.22	32.43	61.66	74.00	-12.34

Project No	:TM-2405000018P	Test Date	:2024-05-20
Operation Band	:BLE 1M	Temp./Humi.	:24.6/57
Frequency	:2480 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:TX	Engineer	:Ray Li
EUT Pol	:E2	Test Chamber	: 966A
Setting	:		



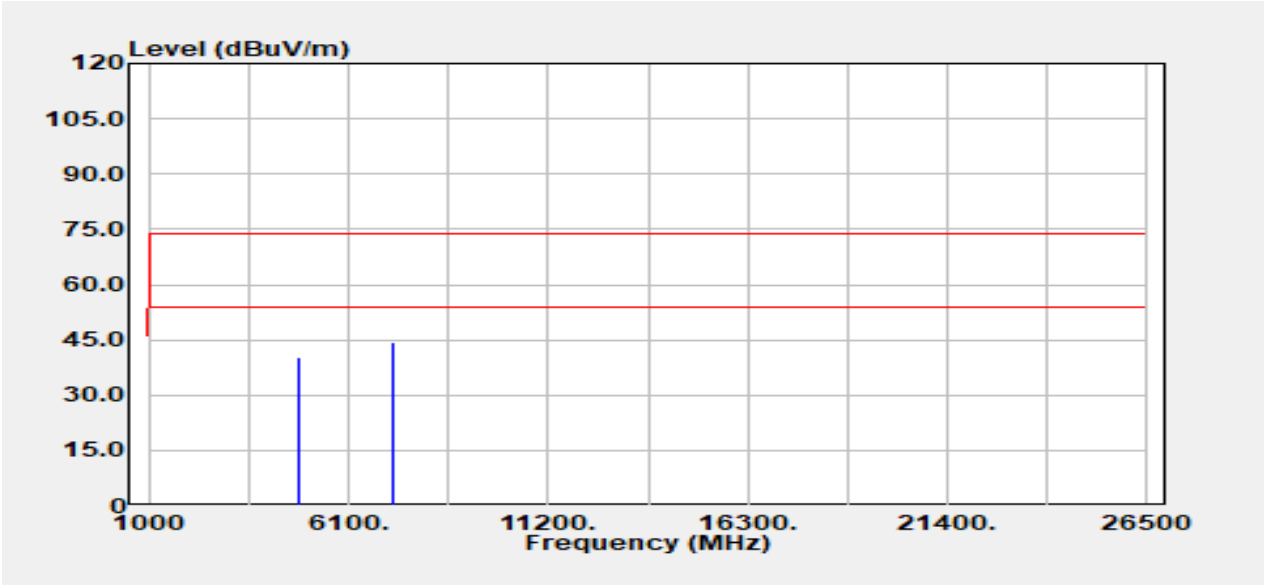
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
46.01	QP	51.74	-13.27	38.47	40.00	-1.53
93.50	QP	54.41	-14.43	39.98	43.50	-3.52
179.99	Peak	34.65	-11.40	23.25	43.50	-20.25
467.23	Peak	30.77	-3.90	26.87	46.00	-19.13
720.16	Peak	29.38	0.36	29.74	46.00	-16.26
878.02	Peak	30.62	2.56	33.17	46.00	-12.83

Project No	:TM-2405000018P	Test Date	:2024-05-20
Operation Band	:BLE 1M	Temp./Humi.	:24.6/57
Frequency	:2480 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:TX	Engineer	:Ray Li
EUT Pol	:E2	Test Chamber	: 966A
Setting	:		



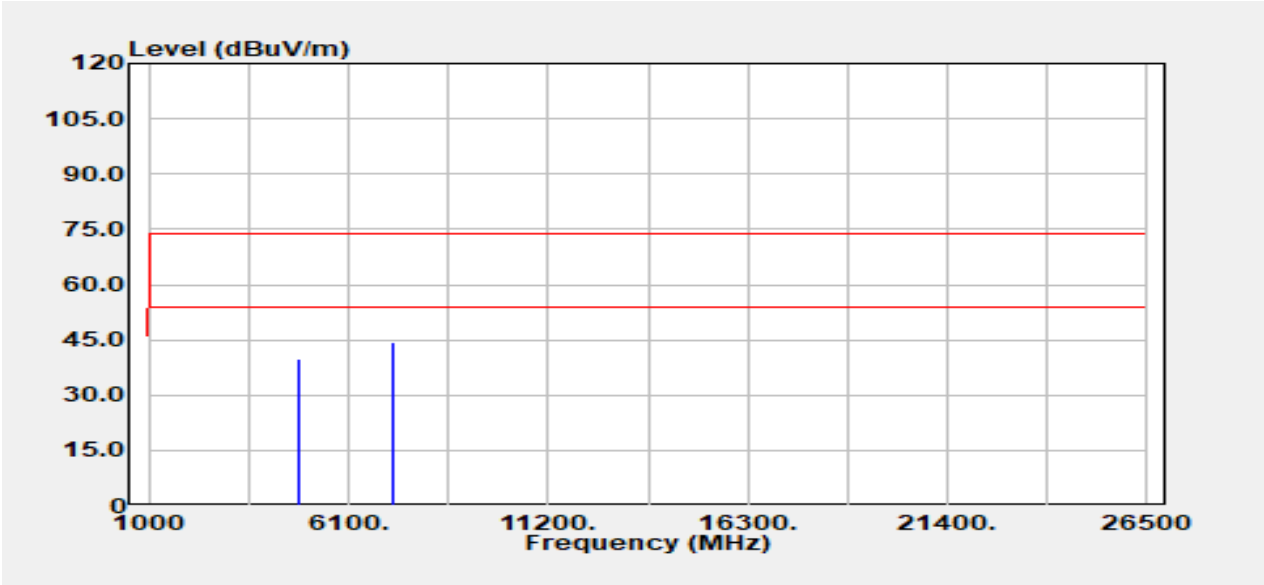
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
45.16	Peak	44.14	-12.94	31.20	40.00	-8.80
93.66	Peak	50.34	-14.44	35.89	43.50	-7.61
226.30	Peak	33.33	-11.51	21.82	46.00	-24.18
496.45	Peak	30.32	-3.43	26.89	46.00	-19.11
657.71	Peak	30.01	-0.60	29.41	46.00	-16.59
881.18	Peak	30.92	2.57	33.49	46.00	-12.51

Project No	:TM-2405000018P	Test Date	:2024-05-16
Operation Band	:BLE 1M	Temp./Humi.	:24.6/57
Frequency	:2402 MHz	Antenna Pol.	:Vertical
Operation Mode	:TX	Engineer	:Ray Li
EUT Pol	:E2	Test Chamber	: 966A
Setting	:		



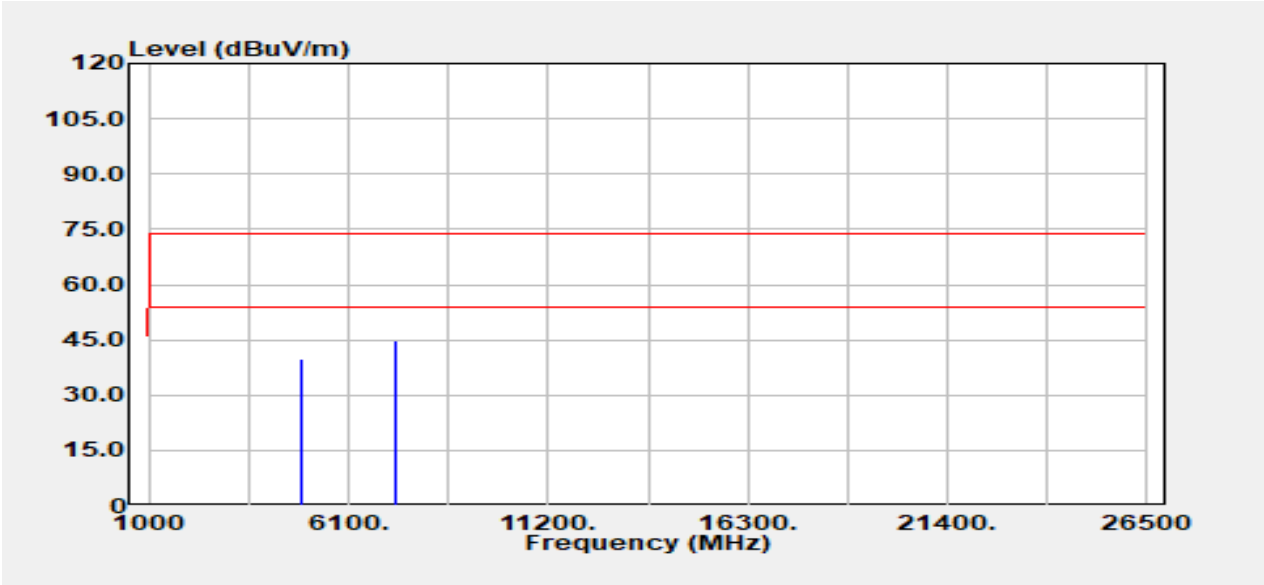
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
4804.00	Peak	37.87	2.23	40.09	74.00	-33.91
4804.00	Average	30.15	2.23	32.38	54.00	-21.62
7206.00	Peak	35.50	9.01	44.51	74.00	-29.49
7206.00	Average	26.92	9.01	35.93	54.00	-18.07

Project No	:TM-2405000018P	Test Date	:2024-05-16
Operation Band	:BLE 1M	Temp./Humi.	:24.6/57
Frequency	:2402 MHz	Antenna Pol.	:Horizontal
Operation Mode	:TX	Engineer	:Ray Li
EUT Pol	:E2	Test Chamber	: 966A
Setting	:		



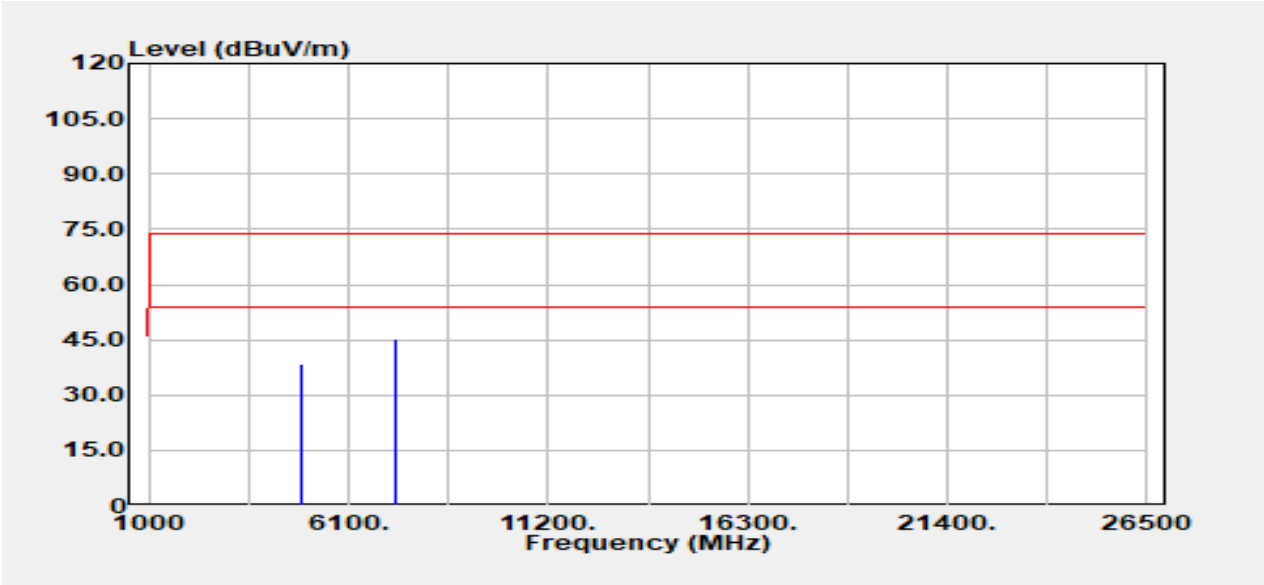
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
4804.00	Peak	37.64	2.23	39.87	74.00	-34.13
4804.00	Average	29.06	2.23	31.28	54.00	-22.72
7206.00	Peak	35.37	9.01	44.38	74.00	-29.62
7206.00	Average	27.10	9.01	36.11	54.00	-17.89

Project No	:TM-2405000018P	Test Date	:2024-05-16
Operation Band	:BLE 1M	Temp./Humi.	:24.6/57
Frequency	:2442 MHz	Antenna Pol.	:Vertical
Operation Mode	:TX	Engineer	:Ray Li
EUT Pol	:E2	Test Chamber	: 966A
Setting	:		



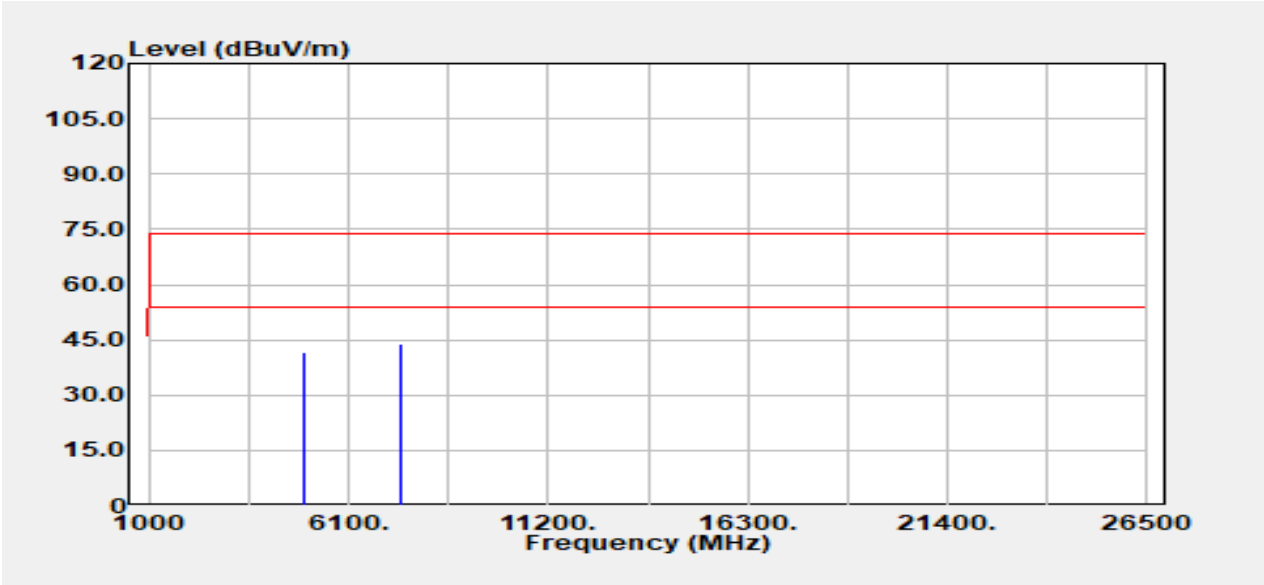
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
4884.00	Peak	37.31	2.58	39.90	74.00	-34.10
4884.00	Average	27.85	2.58	30.43	54.00	-23.57
7326.00	Peak	36.10	8.95	45.06	74.00	-28.94
7326.00	Average	27.07	8.95	36.03	54.00	-17.97

Project No	:TM-2405000018P	Test Date	:2024-05-16
Operation Band	:BLE 1M	Temp./Humi.	:24.6/57
Frequency	:2442 MHz	Antenna Pol.	:Horizontal
Operation Mode	:TX	Engineer	:Ray Li
EUT Pol	:E2	Test Chamber	: 966A
Setting	:		



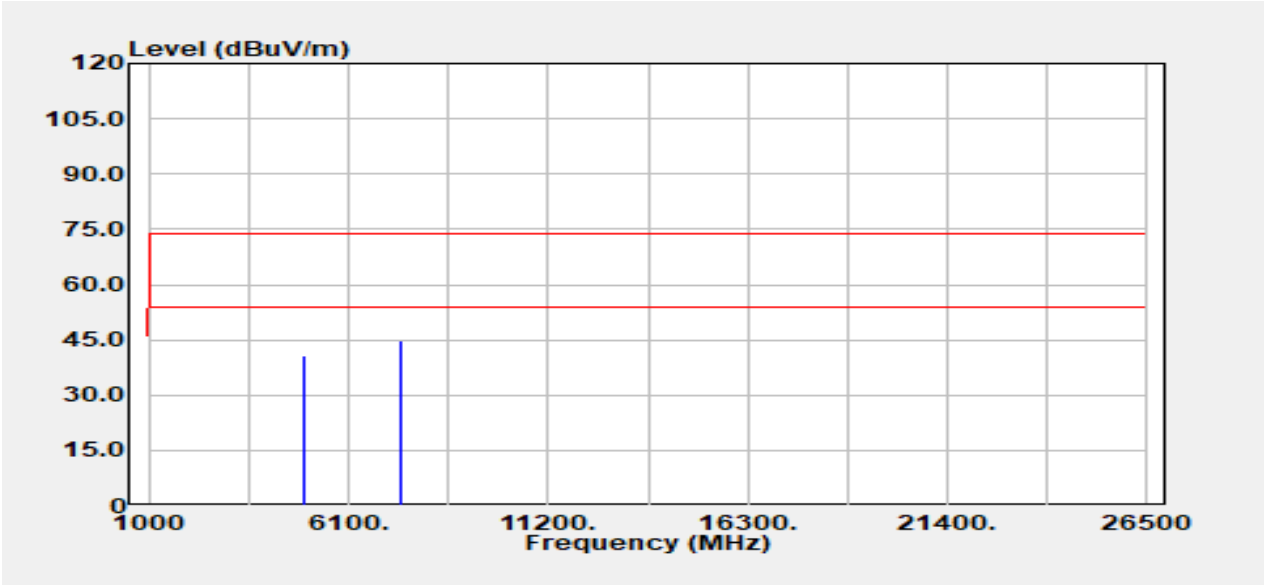
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
4884.00	Peak	35.77	2.58	38.35	74.00	-35.65
4884.00	Average	27.84	2.58	30.43	54.00	-23.57
7326.00	Peak	36.27	8.95	45.23	74.00	-28.77
7326.00	Average	27.17	8.95	36.13	54.00	-17.87

Project No	:TM-2405000018P	Test Date	:2024-05-16
Operation Band	:BLE 1M	Temp./Humi.	:24.6/57
Frequency	:2480 MHz	Antenna Pol.	:Vertical
Operation Mode	:TX	Engineer	:Ray Li
EUT Pol	:E2	Test Chamber	: 966A
Setting	:		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
4960.00	Peak	38.39	3.21	41.60	74.00	-32.40
4960.00	Average	28.33	3.21	31.54	54.00	-22.46
7440.00	Peak	34.80	8.92	43.72	74.00	-30.28
7440.00	Average	27.17	8.92	36.09	54.00	-17.91

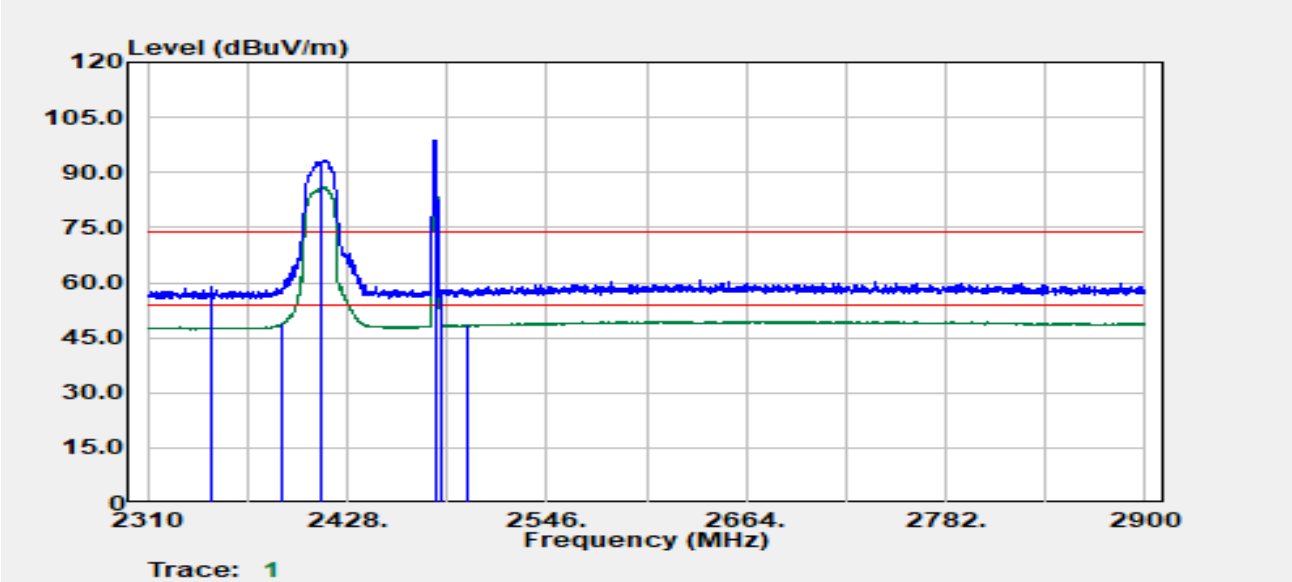
Project No	:TM-2405000018P	Test Date	:2024-05-16
Operation Band	:BLE 1M	Temp./Humi.	:24.6/57
Frequency	:2480 MHz	Antenna Pol.	:Horizontal
Operation Mode	:TX	Engineer	:Ray Li
EUT Pol	:E2	Test Chamber	: 966A
Setting	:		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
4960.00	Peak	37.57	3.21	40.79	74.00	-33.21
4960.00	Average	28.70	3.21	31.91	54.00	-22.09
7440.00	Peak	36.01	8.92	44.93	74.00	-29.07
7440.00	Average	27.37	8.92	36.29	54.00	-17.71

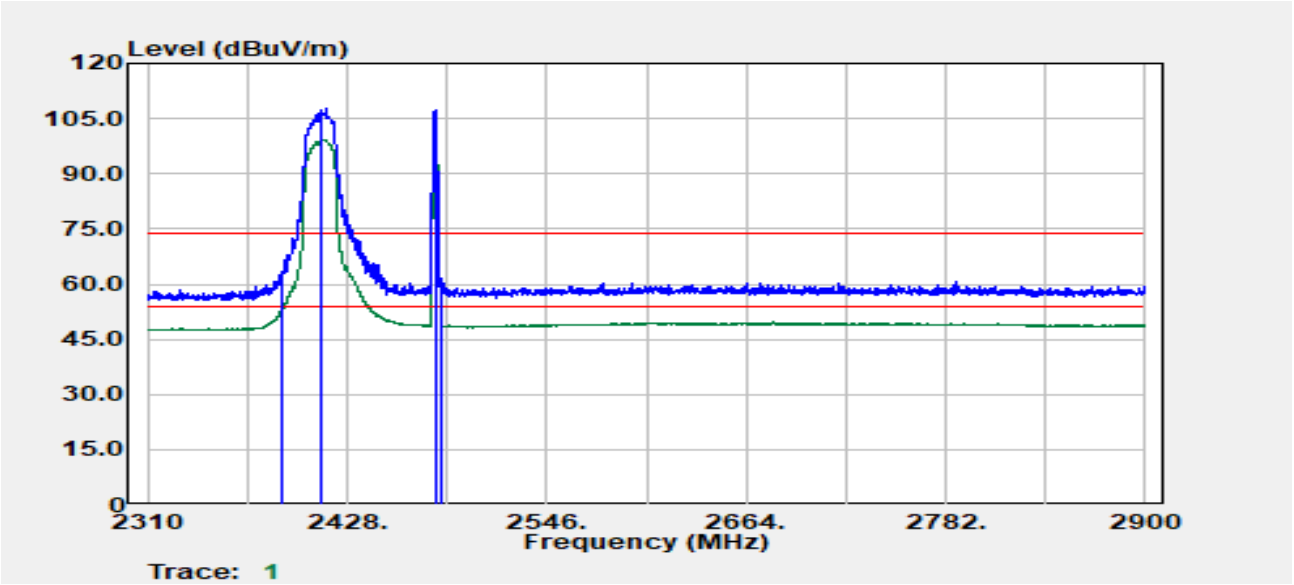
Co-location

Project No	:TM-2405000018P	Test Date	:2024-05-20
Operation Band	:802.11n20_BLE 1M	Temp./Humi.	:24.5/57
Frequency	:2412_2480 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Bandedge	Engineer	:Tony Chao
EUT Pol	:E2	Test Chamber	: 966A
Setting	:15_default		



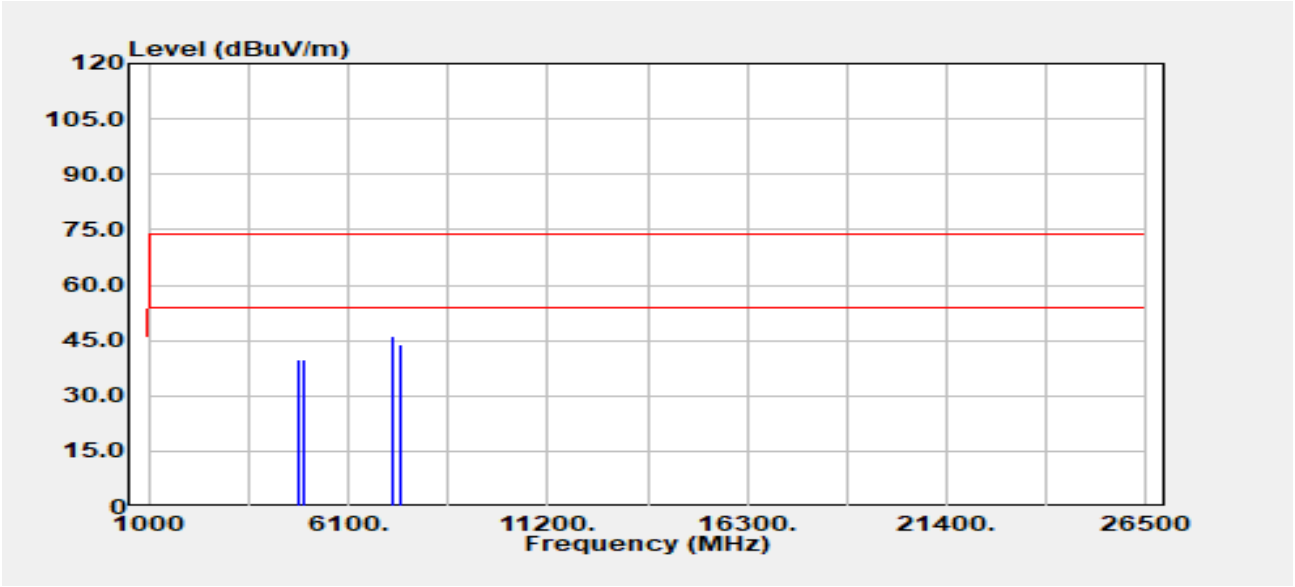
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
2347.41	Peak	52.57	6.21	58.78	74.00	-15.22
2389.77	Average	42.48	6.28	48.75	54.00	-5.25
2412.00	Peak	90.09	6.31	96.39	- -	- -
2412.00	Average	82.63	6.31	88.94	- -	- -
2480.00	Peak	91.83	6.67	98.50	- -	- -
2480.00	Average	91.48	6.67	98.14	- -	- -
2483.50	Peak	51.69	6.71	58.40	74.00	-15.60
2499.27	Average	41.51	6.84	48.35	54.00	-5.65

Project No	:TM-2405000018P	Test Date	:2024-05-20
Operation Band	:802.11n20_BLE 1M	Temp./Humi.	:24.5/57
Frequency	:2412_2480 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Bandedge	Engineer	:Tony Chao
EUT Pol	:E2	Test Chamber	: 966A
Setting	:15_default		



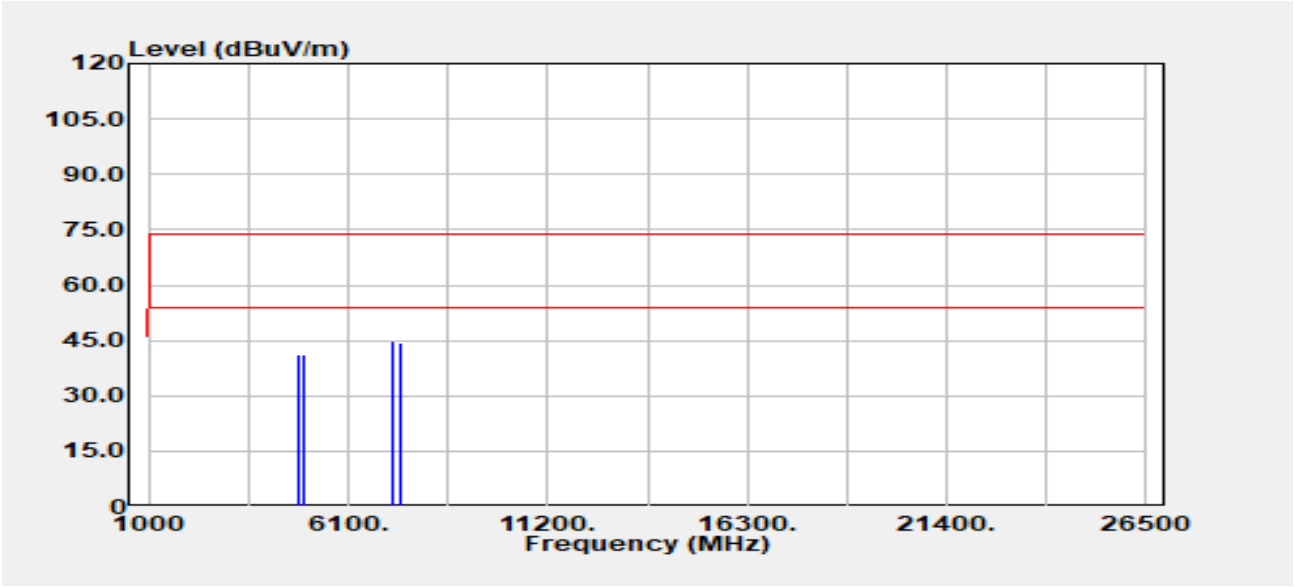
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
2390.00	Peak	57.22	6.28	63.50	74.00	-10.50
2390.00	Average	47.19	6.28	53.47	54.00	-0.53
2412.00	Peak	101.58	6.31	107.88	- -	- -
2412.00	Average	92.84	6.31	99.15	- -	- -
2480.00	Peak	101.22	6.67	107.88	- -	- -
2480.00	Average	99.39	6.67	106.06	- -	- -
2483.50	Peak	55.08	6.71	61.80	74.00	-12.20
2483.50	Average	43.39	6.71	50.11	54.00	-3.89

Project No	:TM-2405000018P	Test Date	:2024-05-20
Operation Band	:802.11n20_BLE 1M	Temp./Humi.	:24.5/57
Frequency	:2412_2480 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:TX	Engineer	:Tony Chao
EUT Pol	:E2	Test Chamber	: 966A
Setting	:15_default		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
4824.00	Peak	37.80	2.25	40.05	74.00	-33.95
4824.00	Average	28.19	2.25	30.44	54.00	-23.56
4960.00	Peak	36.76	3.21	39.97	74.00	-34.03
4960.00	Average	27.59	3.21	30.80	54.00	-23.20
7236.00	Peak	37.20	9.17	46.36	74.00	-27.64
7236.00	Average	26.47	9.17	35.64	54.00	-18.36
7440.00	Peak	34.85	8.92	43.77	74.00	-30.23
7440.00	Average	28.26	8.92	37.18	54.00	-16.82

Project No	:TM-2405000018P	Test Date	:2024-05-20
Operation Band	:802.11n20_BLE 1M	Temp./Humi.	:24.5/57
Frequency	:2412_2480 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:TX	Engineer	:Tony Chao
EUT Pol	:E2	Test Chamber	: 966A
Setting	:15_default		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
4824.00	Peak	38.83	2.25	41.08	74.00	-32.92
4824.00	Average	28.72	2.25	30.97	54.00	-23.03
4960.00	Peak	38.04	3.21	41.26	74.00	-32.74
4960.00	Average	28.37	3.21	31.58	54.00	-22.42
7236.00	Peak	35.87	9.17	45.03	74.00	-28.97
7236.00	Average	27.54	9.17	36.71	54.00	-17.29
7440.00	Peak	35.61	8.92	44.53	74.00	-29.47
7440.00	Average	28.63	8.92	37.55	54.00	-16.45

- End of Test Report -