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 Manufacturing Co., Ltd.
Model No.: /ISED HVIN:	LBES0ZZ2LL
Family Model No.: / Family ISED HVIN:	LBEE0ZZ2KL
Model Difference:	Different functions: LBES0ZZ2LL includes IEEE802.15.4. functionality.
ISED PMN:	LBES0ZZ2LL, LBEE0ZZ2KL
Report Number:	TERF2410002916E2
FCC ID	VPYLBES0ZZ2LL
IC:	772C-LBES0ZZ2LL
Date of EUT Received:	September 24, 2024
Date of Test:	October 4, 2024～November 19, 2024
Issue Date:	December 18, 2024

Aken Huang

Approved By _____
Aken Huang

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT comply with FCC rule part §15.247, ISED RSS-247.

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

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Revision History

Report Number	Revision	Description	Issue Date	Revised By	Remark
TERF2410002916E2	00	Original	Dec. 6, 2024	Candice Li	
TERF2410002916E2	01	Modify FVIN of section 1.1	Dec. 18, 2024	Candice Li	*
TERF2410002916E2	02	Modify Frequency Range	Dec. 24, 2024	Candice Li	

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, test results of this report are applicable to the sample EUT(s) received.
Only the main model LBES0ZZ2LL has IEEE802.15.4. functionality and has been independently tested for this feature. The variants are assessed as electrically identical in RF characteristics, therefore, no further assessment required for the variant(s).

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Communication Module
Brand Name:	Murata Manufacturing Co., Ltd.
Model No.: /ISED HVIN:	LBES0ZZ2LL
Family Model No.: / Family ISED HVIN:	LBEE0ZZ2KL
Model Difference:	Different functions: LBES0ZZ2LL includes IEEE802.15.4. functionality.
Hardware Version:	1.0
Firmware Version:	1.1.1.1
EUT Series No.:	2LL #116 (Conducted, Conduction, Radiated) 2LL #106 (Radiated)
Power Supply:	3.3 Vdc, 1.8 Vdc
Test Software (Name/Version)	DUT Labtool Version 2.0.0.17

1.2 RF Specification

Radio Technology:	IEEE802.15.4
Frequency Range:	2405 – 2480MHz
Channel number:	16 channels
Modulation type:	GFSK
Transmit Power:	14.89 dBm

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1.3 Antenna Designation

External Antenna

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)
Dipole	Molex	146187	2400-2500	3.2
	Molex	145153	2400-2500	3.2
	Molex	219611	2400-2500	2.67
	Unictron	WT32D1-KX	2400-2500	3
	Unictron	AA258	2400-2500	0.9
	Taoglas	FXP830.07.0100C	2400-2500	2.5
	Antenova	SRF2W012	2400-2500	3
	Sansei	STDANTEMD-013	2400-2500	1.9
	Laird	EMF2471A3S	2400-2500	2.2
	Kyocera AVX (KAVX)	1001932FT	2400-2500	2.5
	Kyocera AVX (KAVX)	1001932PT	2400-2500	2.03
	Kyocera AVX (KAVX)	W3P35x8W04	2400-2500	2.3
	Inventek	W2.4-5P-U	2400-2500	**3.73**

Internal Antenna

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)
Monopole	Murata	Type2LL _Antenna	2400-2500	3.6

Note:

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

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1.4 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247
FCC KDB 558074 D01 15.247 Meas Guidance v05r0
RSS-247 issue 3 Aug. 2023
RSS-Gen, Issue 5 April 2018, Amendment 2 (February 2021)
ANSI C63.10:2013

1.5 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	SAC 1	TW0027	TW3702
		SAC 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.

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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 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.

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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

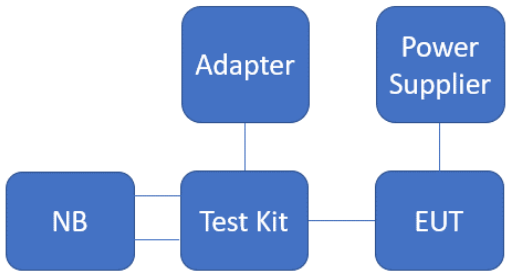
Radiated emission below 30MHz is measured in a 9m*6m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.
There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

2.4.2 For all conducted test items:

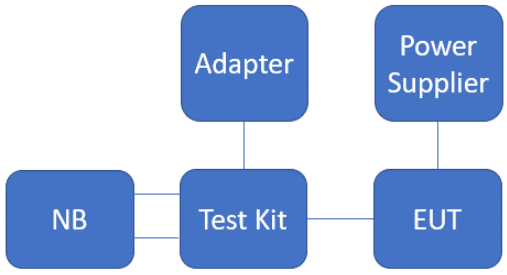
The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

2.5 Test Configuration

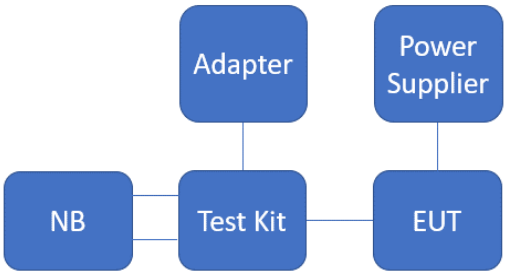
Conduction Setup



Conducted Setup



Radiated Setup



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2.6 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LAN Cable	BUFFALO	BSLS6NU30BL	N/A	N/A	N/A
USB cable	ZHUANG SHAN	2725	N/A	N/A	N/A
USB cable	ANKER	A8852011	N/A	N/A	N/A
Adapter	ANKER	A2664	N/A	N/A	N/A
Notebook	Lenovo	T470	P0001293	N/A	N/A

Conducted Emission Test Site: Conducted C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Adapter	ANKER	A2664	N/A	N/A	N/A
LAN Cable	TATUNG	IMG_5283	N/A	N/A	N/A
USB cable	ANKER	A8852011	N/A	N/A	N/A
USB cable	ZHUANG SHAN CHUAN	2725	N/A	N/A	N/A
Notebook	Lenovo	T14	P0003332	N/A	N/A

Radiated Emission Test Site: SAC G					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LAN Cable	AMP	AMP-6e	4719862256612	N/A	N/A
USB cable	ZHUANG SHAN CHUAN	2725	N/A	N/A	N/A
USB cable	ANKER	A8852011	N/A	N/A	N/A
Adapter	ANKER	A2664	N/A	N/A	N/A
Notebook	Lenovo	T470	P0001293	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description Of Test	Result
§15.207(a)	RSS-Gen §8.8	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	RSS-247 §5.4 d	Peak Output Power	Compliant
§15.247(a)(2)	RSS-247 §5.2 a RSS-Gen §6.7	Emission Bandwidth	Compliant
§15.209 §15.247(d)	RSS-247 §5.5	Conducted Band Edge and Spurious Emission	Compliant
§15.209 §15.247(d)	RSS-247 §5.5	Radiated Band Edge and Spurious Emission	Compliant
§15.205	RSS-Gen § 8.10	Restricted Bands	Compliant
§15.247(e)	RSS-247 §5.2 b	Peak Power Density	Compliant
§15.203	N/A	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operating Frequencies

2400~2483.5 MHz			
CH	Freq. (MHz)	CH	Freq. (MHz)
11	2405	21	2455
12	2410	22	2460
13	2415	23	2465
14	2420	24	2470
15	2425	25	2475
16	2430	26	2480
17	2435		
18	2440		
19	2445		
20	2450		

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.

CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
IEEE802.15.4.	11 to 26	11,18,25,26	GFSK	1

TRANSMIT RADIATED EMISSION TEST (BELOW 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
IEEE802.15.4	11 to 26	18	GFSK	1	ch0

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TRANSMIT RADIATED EMISSION TEST (ABOVE 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
IEEE802.15.4	11 to 26	11,18,25,26	GFSK	1	ch0

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty		
AC Power Line Conducted Emission	+/-	1.54	dB
Output Power measurement	+/-	0.97	dB
Emission Bandwidth	+/-	1.38	Hz
Conducted emission measurement	+/-	0.77	dB
Peak Power Density	+/-	0.61	dB
Temperature	+/-	0.6	°C
Humidity	+/-	3	%
DC / AC Power Source	+/-	1	%

Radiated Spurious Emission Measurement Uncertainty				
Polarization: Vertical	**+/-**	**1.89**	**dB**	9kHz~30MHz
	+/-	**4.15**	**dB**	30MHz - 1000MHz
	+/-	**3.43**	**dB**	1GHz - 18GHz
	+/-	**3.86**	**dB**	18GHz - 40GHz
Polarization: Horizontal	**+/-**	**1.89**	**dB**	9kHz~30MHz
	+/-	**4.02**	**dB**	30MHz - 1000MHz
	+/-	**3.43**	**dB**	1GHz - 18GHz
	+/-	**3.86**	**dB**	18GHz - 40GHz
Radiated Spurious Emission	**+/-**	**2**	**dB**	33GHz-50GHz
	+/-	**1.59**	**dB**	50GHz-60GHz
	+/-	**1.7**	**dB**	60GHz-90GHz
	+/-	**1.64**	**dB**	90GHz-140GHz
	+/-	**3.83**	**dB**	140GHz-220GHz

Note:

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

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6 MEASUREMENT EQUIPMENT USED

6.1 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.
Coaxial Cable	EC Lab	RF-HY-CAB-250	RF-HY-CAB-250-01	03/27/2024	03/26/2025
EMI Test Receiver	R&S	ESCI	101342	04/29/2024	04/28/2025
LISN	SCHWARZBECK Mess-Elektronik	NSLK8127	973	04/22/2024	04/21/2025
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2024	03/26/2025
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R

6.2 Conducted Measurement

Conducted Emission Test Site: Conducted C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Attenuator	Woken	WATT-218FS-10	RF18	11/15/2023	11/14/2024
Attenuator	Woken	WATT-218FS-10	RF19	11/15/2023	11/14/2024
DC Block	PASTERNACK	PE8210	RF155	11/15/2023	11/14/2024
DC Power Supply	HOLA	DP-3003	D7070035	06/14/2024	06/13/2025
Power Meter	Anritsu	ML2496A	2138005	09/25/2024	09/24/2025
Power Sensor	Anritsu	MA2411B	1911395	09/25/2024	09/24/2025
Power Sensor	Anritsu	MA2411B	1911396	09/25/2024	09/24/2025
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071573	05/24/2024	05/23/2025
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R

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6.3 Radiated Measurement

Radiated Emission Test Site: SAC G					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
3m Site NSA	SGS	966 chamber G	N/A	03/30/2024	03/29/2025
Active Loop Antenna	COM-POWER	AL-130R	10160105	12/04/2023	12/03/2024
Broadband Antenna	SCHWARZBECK	VULB 9168	1208	07/17/2024	07/16/2025
Coaxial Cable	EMC Instruments	EMC104-SM-SM-8000-5000-5000	210219、210220、210221	03/13/2024	03/12/2025
Coaxial Cable	EMC Instruments	EMCCFD400-NM-NM-8000-5000-2000	210216、210217、210218	03/13/2024	03/12/2025
DC Power Supply	Agilent	E3640A	MY53140006	05/17/2024	05/16/2025
High Pass Filter	WI	WHKX10-2624-3200-18000-80SS	RF210	11/15/2023	11/14/2024
High Pass Filter	WI	WHKX10-2624-3200-18000-80SS	RF210	11/14/2024	11/13/2025
Horn Antenna	RF SPIN	DRH18-E	210105A18E	04/12/2024	04/11/2025
Horn Antenna	Schwarzbeck	BBHA9170	184	12/28/2023	12/27/2024
Lowpass Filter	Woken	EWT-56-0019	RF173	11/15/2023	11/14/2024
Lowpass Filter	Woken	EWT-56-0019	RF173	11/14/2024	11/13/2025
Pre-Amplifier	EMC Instruments	EMC118A45SE	980815	05/08/2024	05/07/2025
Pre-Amplifier	EMC Instruments	EMC184045SEE	980881	11/15/2023	11/14/2024
Pre-Amplifier	EMC Instruments	EMC184045SEE	980881	11/14/2024	11/13/2025
Pre-Amplifier	EMC Instruments	EMC330N	980781	03/13/2024	03/12/2025
Spectrum Analyzer	KEYSIGHT	N9010B	MY63440390	02/16/2024	02/15/2025
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R

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

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7 CONDUCTED EMISSION TEST

7.1 Standard Applicable:

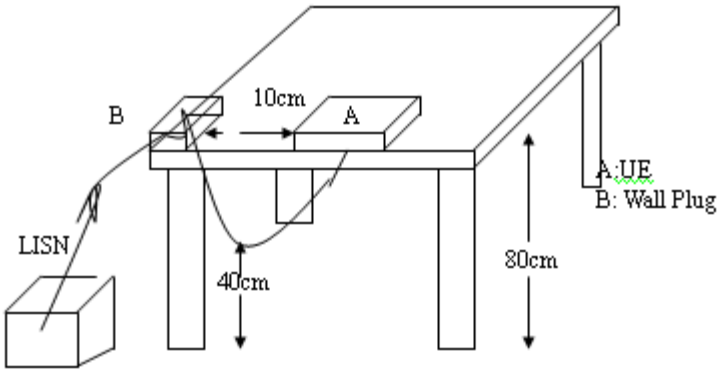
Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

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
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.		

7.2 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 120-240Vac/60Hz power source.

7.3 Test Setup



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7.4 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

7.5 Measurement Result:

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

Note2: The test date reveals the worst-case results that closest to the limit.

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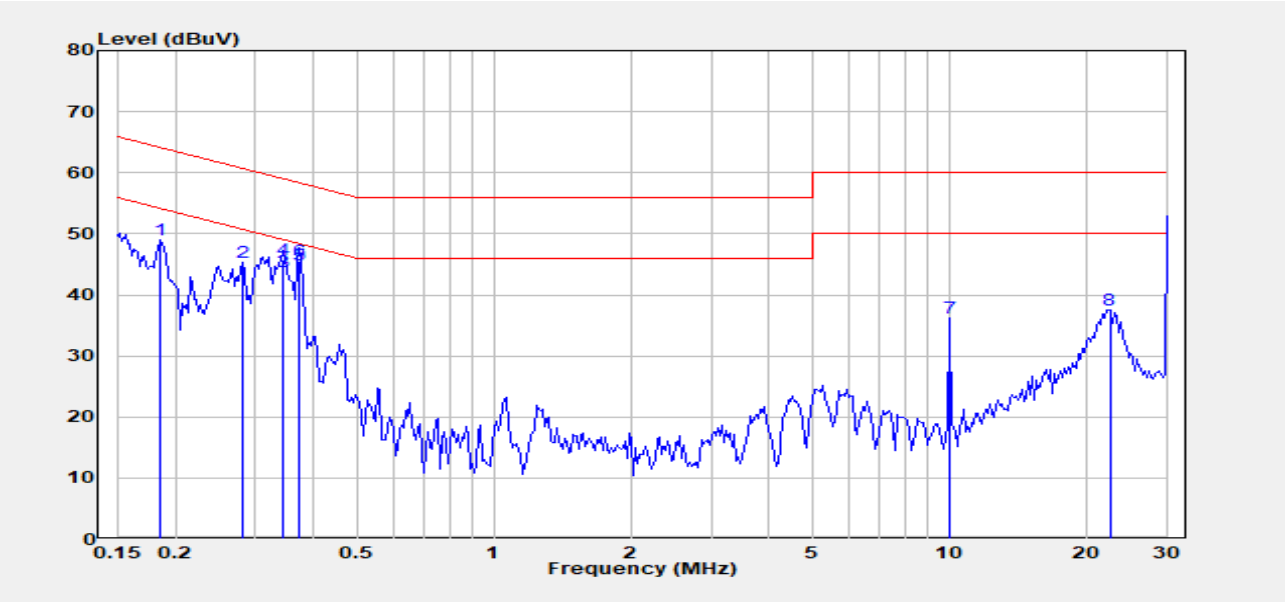
AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number	:TERF2410002916E2	Test Site	:Conduction C
Test Mode	: IEEE802.15.4.	Test Date	:2024-11-18
Power	:120V/60Hz	Temp./Humi	:23.6℃/58%
Probe	:L1	Engineer	:Howard Huang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.185	Peak	38.43	10.65	49.08	64.24	-15.16
0.280	Peak	34.62	10.64	45.25	60.81	-15.56
0.343	Average	33.20	10.63	43.83	49.13	-5.31
0.343	QP	35.10	10.63	45.73	59.13	-13.41
0.373	Average	34.20	10.62	44.82	48.43	-3.61
0.373	QP	34.80	10.62	45.42	58.43	-13.01
10.072	Peak	25.17	10.96	36.14	60.00	-23.86
22.535	Peak	26.32	11.22	37.54	60.00	-22.46

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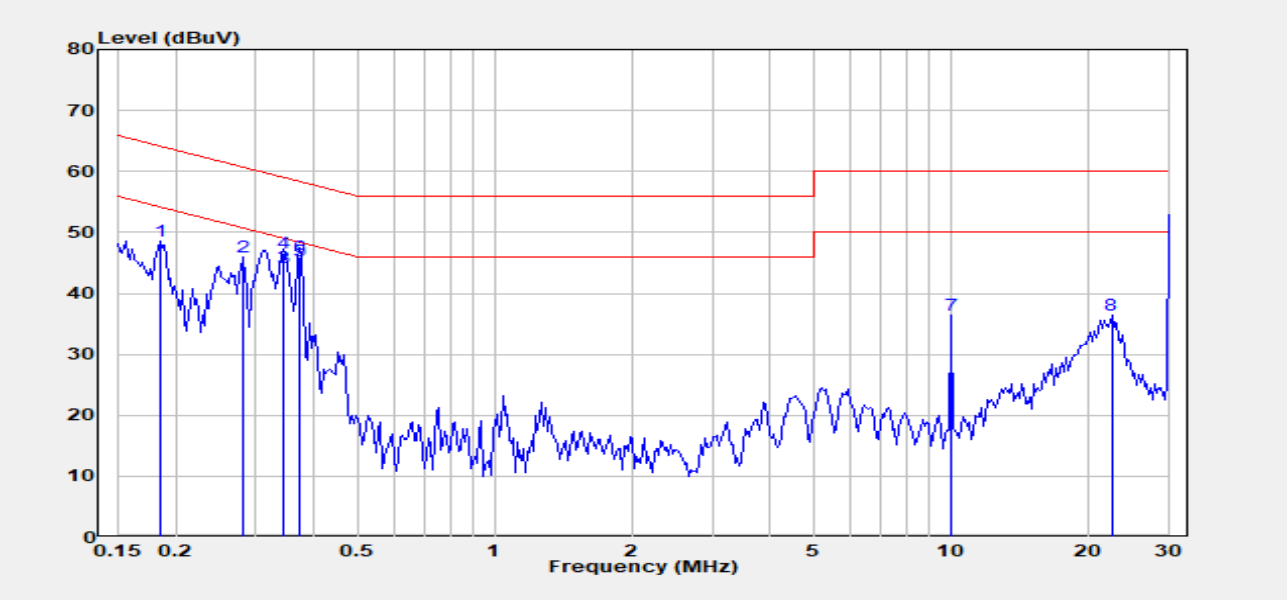
Report Number	:TERF2410002916E2	Test Site	:Conduction C
Test Mode	: IEEE802.15.4.	Test Date	:2024-11-18
Power	:120V/60Hz	Temp./Humi	:23.6℃/58%
Probe	:N	Engineer	:Howard Huang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.185	Peak	37.85	10.65	48.50	64.24	-15.74
0.280	Peak	35.32	10.63	45.95	60.81	-14.85
0.343	Average	33.50	10.62	44.12	49.13	-5.01
0.343	QP	36.00	10.62	46.62	59.13	-12.51
0.373	Average	34.60	10.62	45.22	48.43	-3.21
0.373	QP	35.30	10.62	45.92	58.43	-12.51
10.072	Peak	25.50	10.95	36.45	60.00	-23.55
22.535	Peak	25.21	11.23	36.44	60.00	-23.56

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8 PEAK OUTPUT POWER MEASUREMENT

8.1 Standard Applicable:

8.1.1 ISED

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.

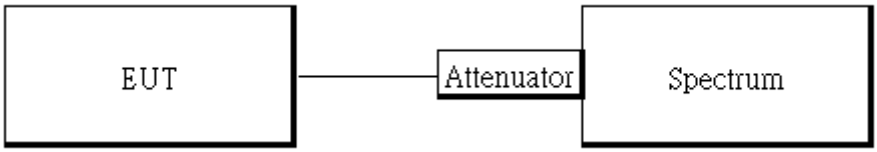
8.1.2 FCC

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.

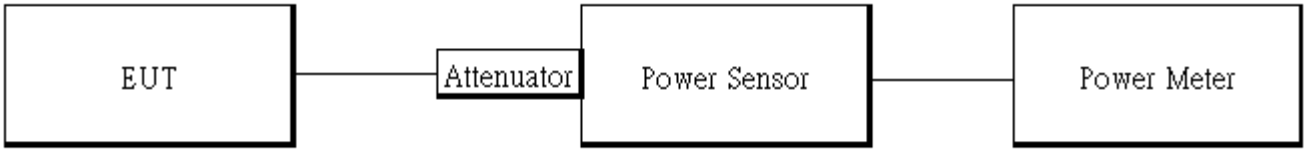
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

8.2 Test Setup

8.2.1 Duty Cycle



8.2.2 Output Power



8.3 Measurement Procedure:

8.3.1 Duty Cycle

1. Place the EUT on the table and set it in transmitting mode.
2. Set span = Zero
3. RBW = 8MHz, VBW = 8MHz,
4. Detector = Peak

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8.3.2 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.
4. Record the max. Reading as observed from Power Meter.
5. Repeat above procedures until all test default channel measured was complete.

8.4 Duty Factor:

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
IEEE802.15.4.	26.60	5.75	0.38	1.00

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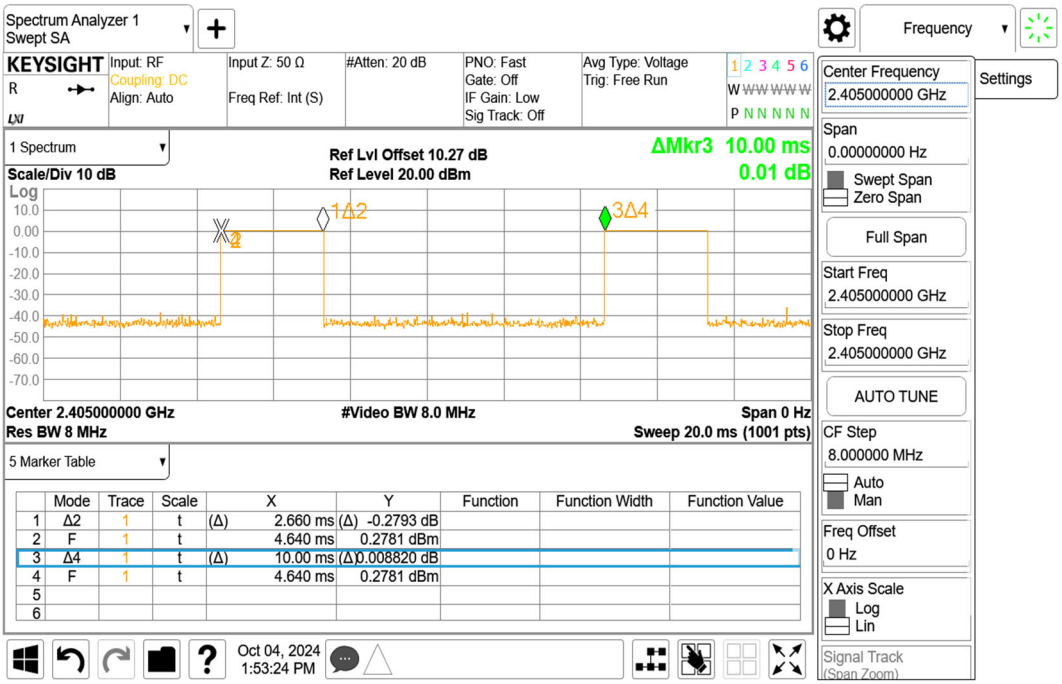
IEEE802.15.4_LowCH11-2405



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8.5 Output Power:

8.5.1 Peak & Avg

IEEE802.15.4. mode:

CH	Frequency (MHz)	Power Setting	Peak Output Power (dBm)	Required Limit (dBm)
11	2405	11	14.76	30
18	2440	11	**14.89**	30
25	2475	11	14.69	30
26	2480	0	1.32	30
CH	**Frequency (MHz)**	**Power Setting**	**Avg. Output Power (dBm)**	**Required Limit (dBm)**
11	2405	11	12.88	30
18	2440	11	12.90	30
25	2475	11	12.98	30
26	2480	0	0.79	30

Note:

1.Measured by power meter, cable loss 10.8 dB + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

8.5.2 EIRP

IEEE802.15.4. mode

CH	Frequency (MHz)	Power Setting	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit		
11	2405	11	12.88	3.73	16.61	4W=	36	dBm
18	2440	11	12.90	3.73	16.63	4W=	36	dBm
25	2475	11	12.98	3.73	16.71	4W=	36	dBm
26	2480	0	0.79	3.73	4.52	4W=	36	dBm

* ***Note:*** EIRP = Average Power + Gain

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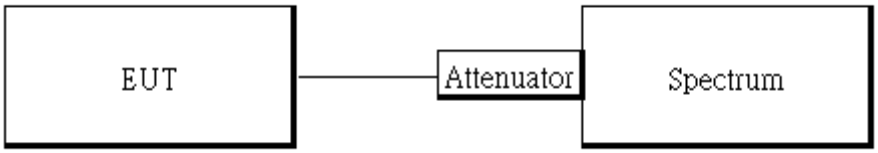
9 EMISSION BANDWIDTH MEASUREMENT

9.1 Standard Applicable

The minimum 6 dB bandwidth shall be at least 500 kHz .

9.2 Test Setup



9.3 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.

9.3.1 FCC measurements

1. The testing follows the Measurement Procedure of the KDB 558074 D01.
2. Set the spectrum analyzer as
   RBW= 100 kHz ,
   VBW = 3 X RBW,
   Span= 2 to 5 times of the OBW,
   Sweep=auto, Detector = Peak, and Max hold.
3. Mark the upper and lower frequencies of -6dB.
4. Repeat above procedures until all test default channel is completed.

9.3.2 ISED measurements

1. The testing follows the Measurement Procedure of the RSS-Gen section 6.7.
2. Set the spectrum analyzer as
   RBW= 1 % to 5% of 99% and -6dB Bandwidth ,
   VBW ≥ 3 X RBW,
   Span= large enough to capture all products of the modulation process
   Sweep=auto, Detector = Peak, and Max hold.
3. Mark the upper and lower frequencies of 99% and -6dB.
4. Repeat above procedures until all test default channel is completed.

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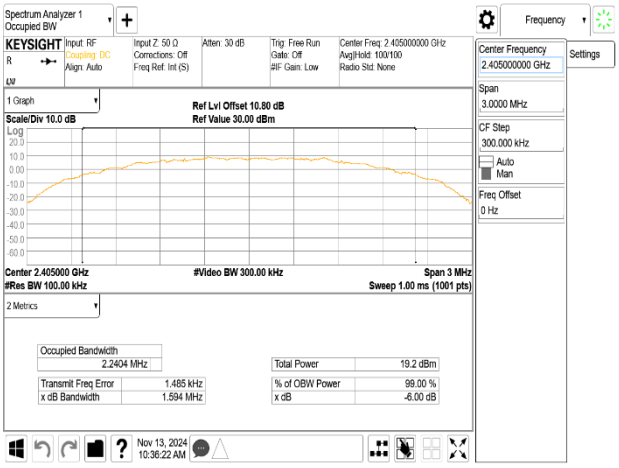
9.4 Measurement Result:

9.4.1 6dB BW measurements

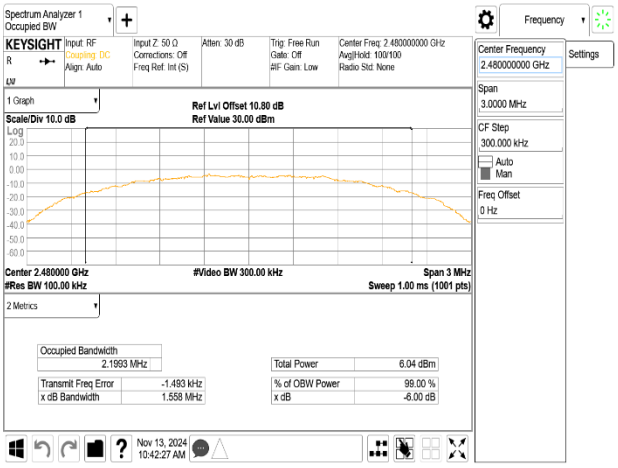
IEEE802.15.4. mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2405	1.594	≧ 0.5	PASS
2440	1.571	≧ 0.5	PASS
2480	1.558	≧ 0.5	PASS

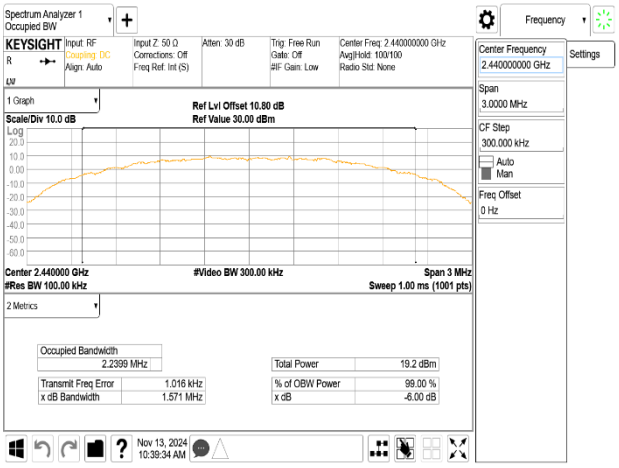
OBW_IEEE802.15.4_LowCH11-2405MHz



OBW_IEEE802.15.4_HighCH26-2480MHz



OBW_IEEE802.15.4_MidCH18-2440MHz



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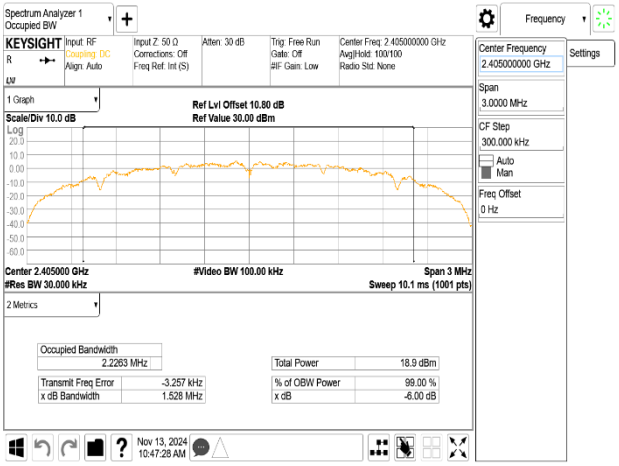
9.4.1 99% Bandwidth

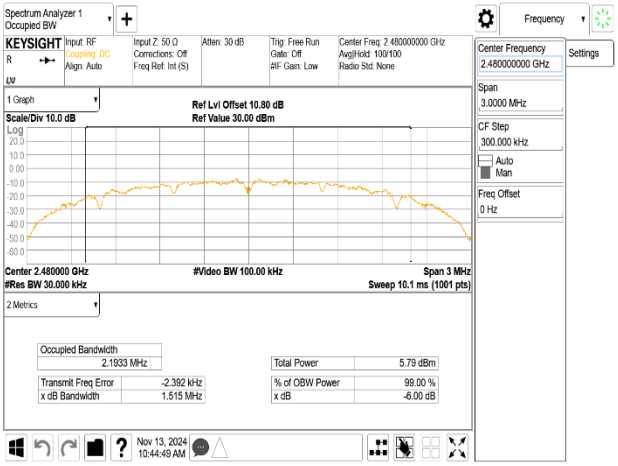
IEEE802.15.4. mode

Frequency (MHz)	99%Bandwidth (MHz)
2405	2.2263
2440	2.2319
2480	2.1933

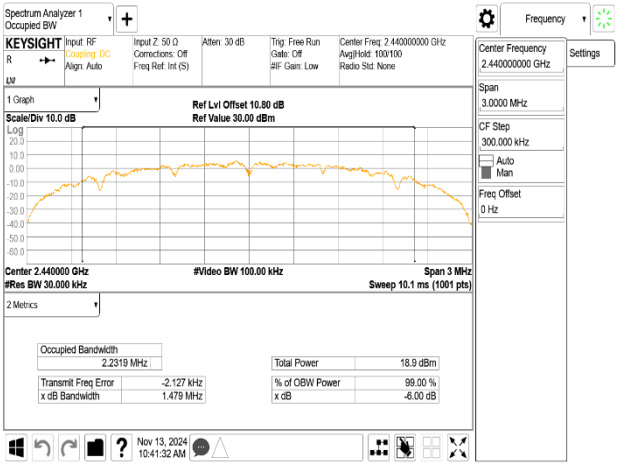
IC OBW_IEEE802.15.4_LowCH11-2405MHz



IC OBW_IEEE802.15.4_HighCH26-2480MHz



IC OBW_IEEE802.15.4_MidCH18-2440MHz



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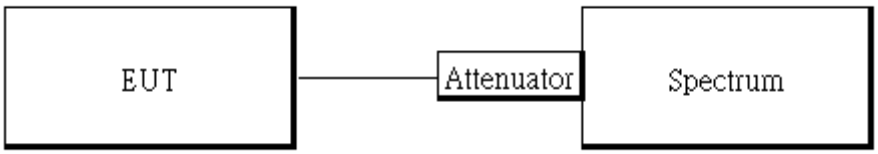
10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

10.1 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, as defined in §15.205(a) & RSS-Gen §8.10, must also comply with the radiated emission limits specified in §15.209(a) & RSS-Gen §8.9.

10.2 Test Setup



10.3 Measurement Procedure

10.3.1 Reference Level of Emission Limit:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 100kHz & VBW = 300 kHz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.

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10.3.2 Conducted Band Edge:

1. To connect Antenna Port of EUT to Spectrum.
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 spectrum analyzer.
4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Detector = Peak, Sweep = auto
6. Set DL as the limit = reading on marker of reference level measurement – 20dBm
7. Mark the highest readings of the emissions outside of 2400MHz~2483.5MHz.
8. Repeat above procedures until all default test channel (low, middle, and high) was complete.

10.3.3 Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set RBW = 100 kHz & VBW=300 kHz, Detector =Peak, Sweep = Auto
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Repeat above procedures until all default test channel measured were complete.

10.4 Measurement Result

IEEE802.15.4._Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2405	9.15	-10.85
2440	8.85	-11.15
2480	-3.43	-23.43

Note:

1.cable loss as 10.8dB that offsets in the spectrum
2.Refer to next page for plots.

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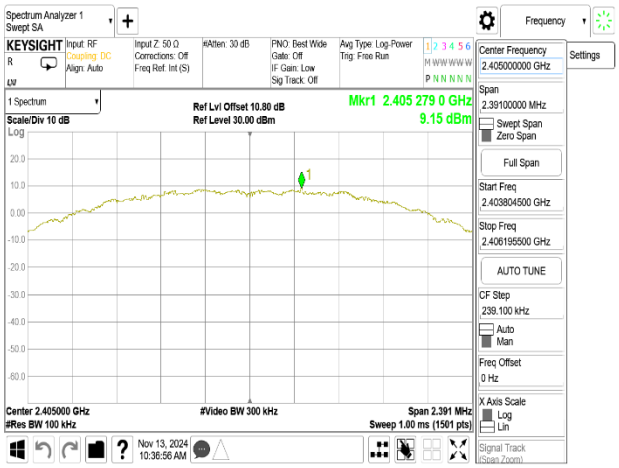
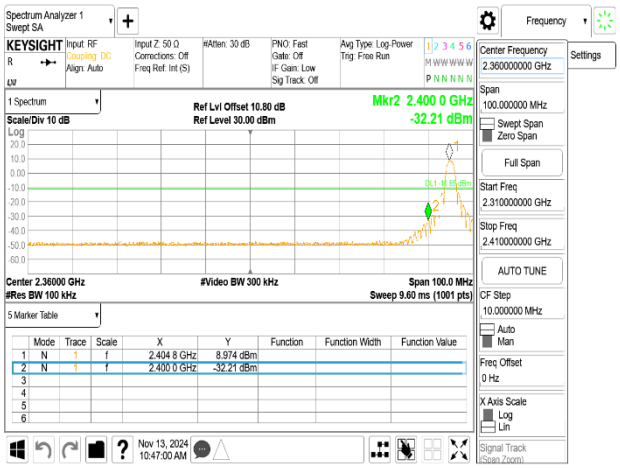
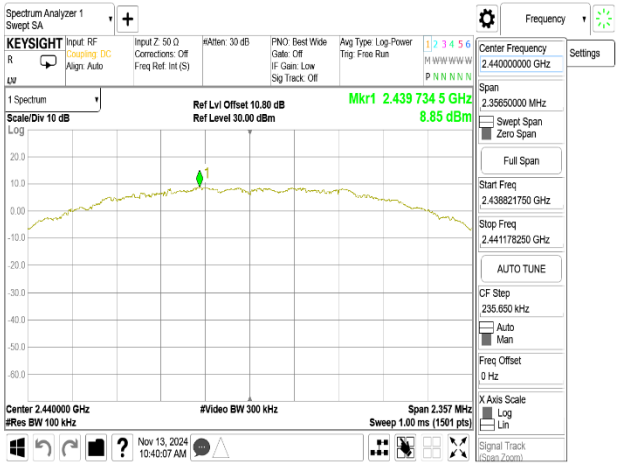
Reference Level_IEEE802.15.4_LowCH11-2405MHz



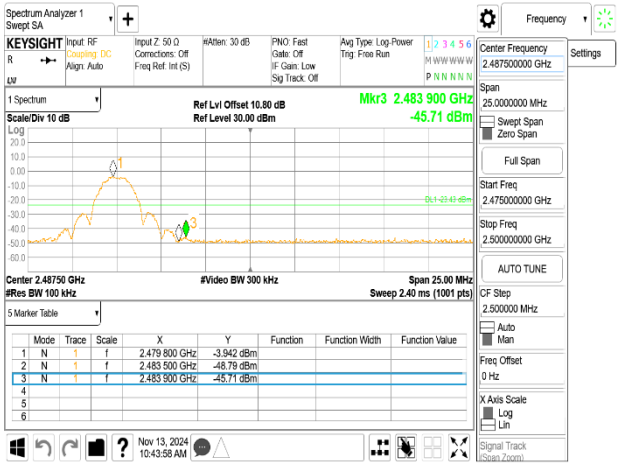
Band Edge_IEEE802.15.4_LowCH11-2405MHz



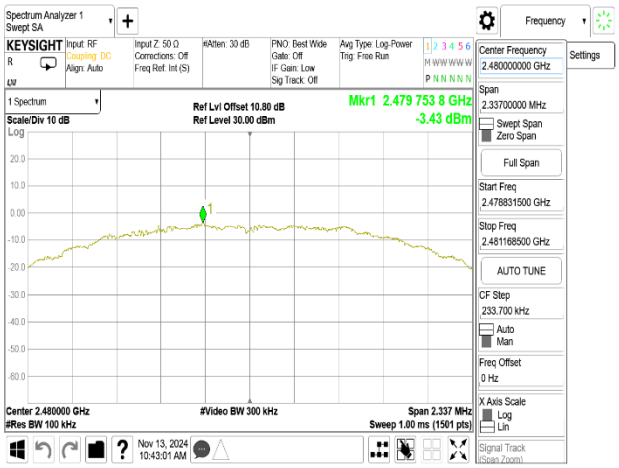
Reference Level_IEEE802.15.4_MidCH18-2440MHz



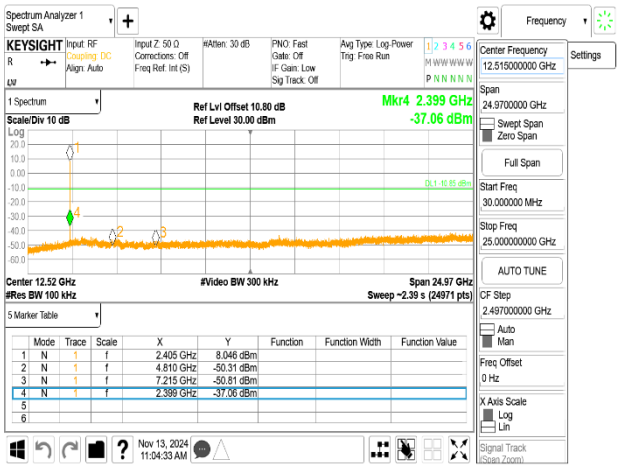
Band Edge_IEEE802.15.4_HighCH26-2480MHz



Reference Level_IEEE802.15.4_HighCH26-2480MHz



Spurious Emission_IEEE802.15.4_LowCH11-2405MHz



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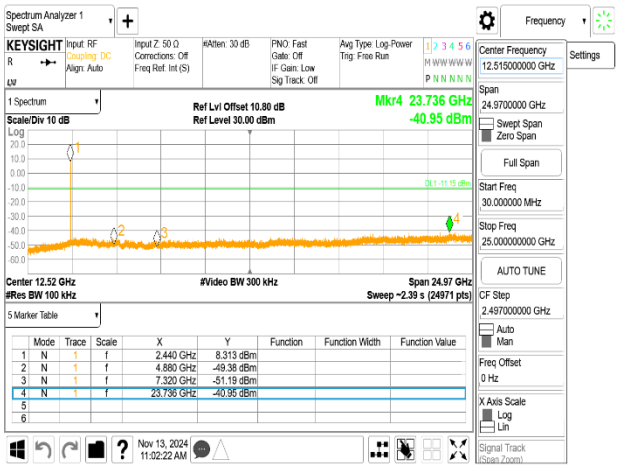
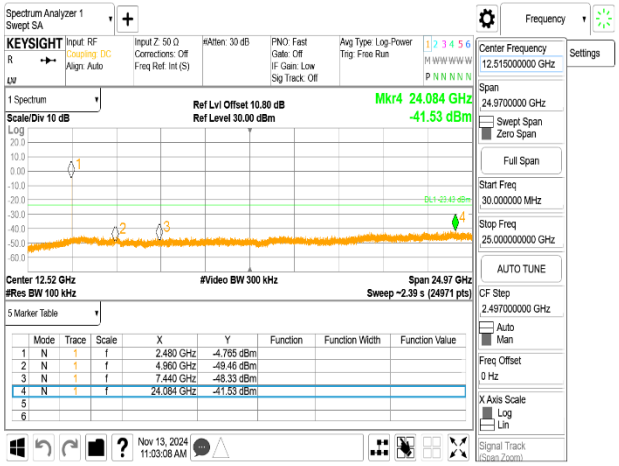
Spurious Emission_IEEE802.15.4_MidCH18-2440MHz



Spurious Emission_IEEE802.15.4_HighCH26-2480MHz



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11 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

11.1 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: The lower limit shall apply at the transition frequencies.

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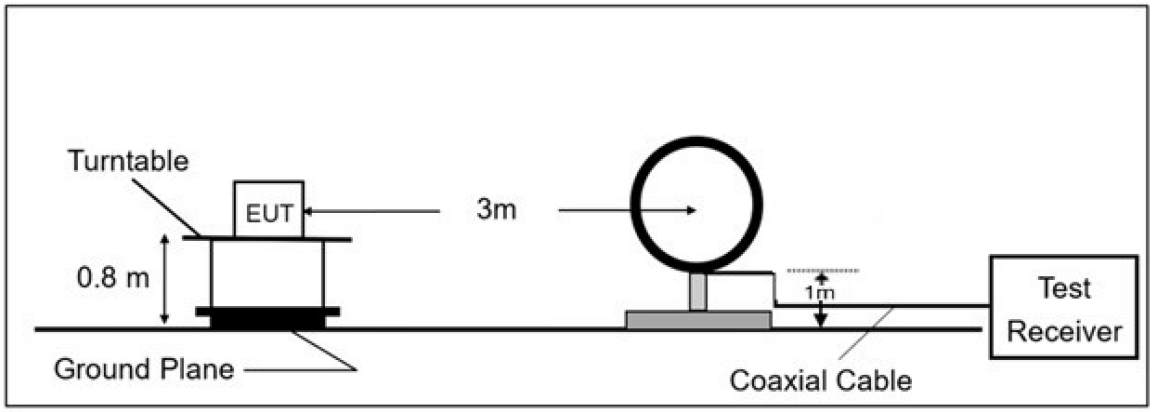
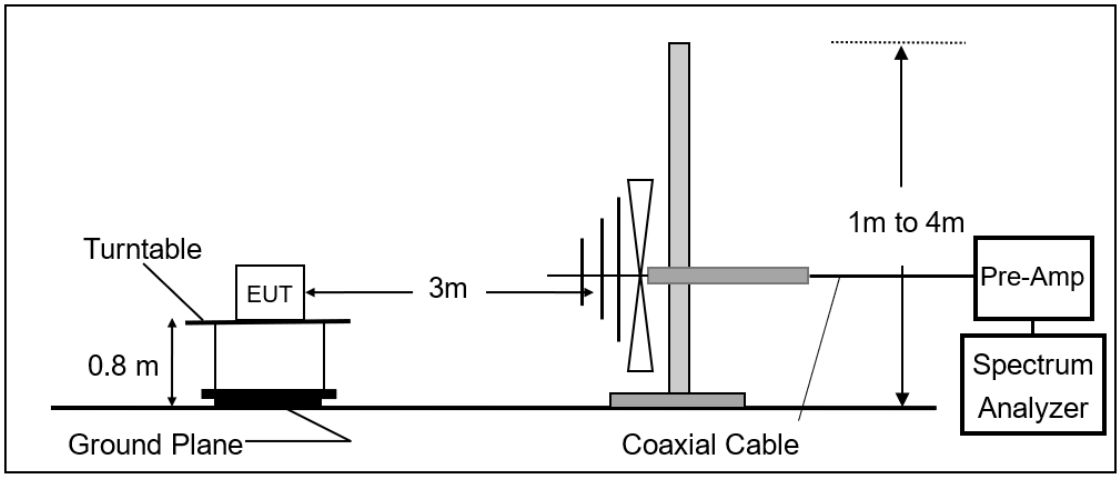
11.2 Test Setup

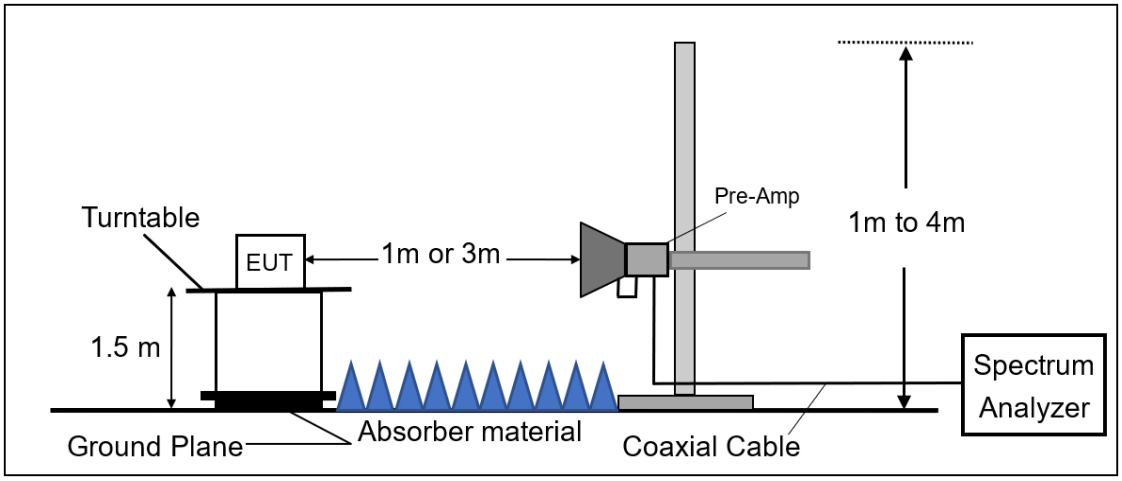
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz.



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



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



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11.3 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. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
12. Repeat above procedures until all default test channel measured were complete.

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11.4 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*
RA = Reading Amplitude
AF = Antenna Factor
CL = Cable Attenuation Factor (Cable Loss)
AG = Amplifier Gain

*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)

11.5 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) was not reported.

11.6 Measurement Result:

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

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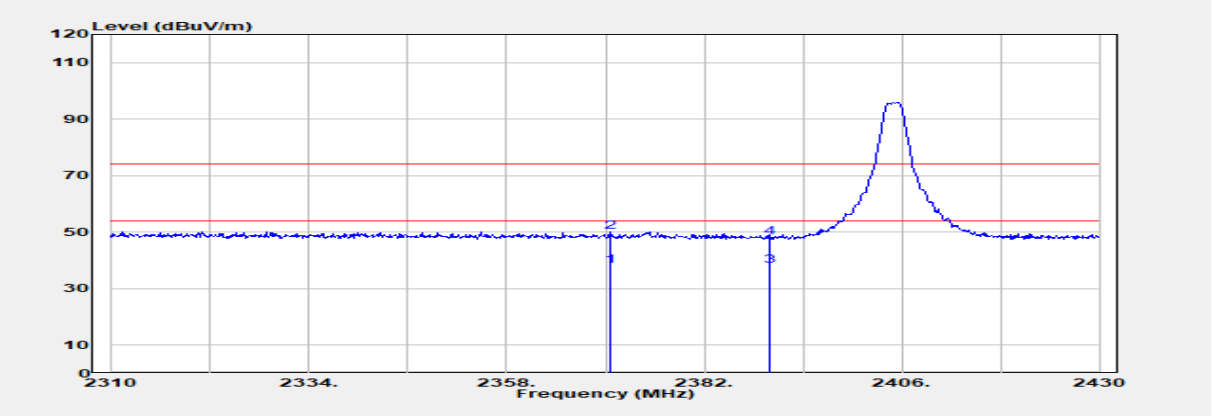
11.6.1 Radiated Band Edge Measurement Result

External Antenna

Report Number	:TERF2410002916E2	Test Site	:SAC C
Operation Mode	:SRD 2.4G	Test Date	:2024-10-25
Test Frequency	:2405 MHz	Temp./Humi.	:22.9℃/58%
Test Mode	:Bandedge	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2370.480	Average	42.14	-4.09	38.06	54.00	-15.94
2370.480	Peak	54.26	-4.09	50.17	74.00	-23.83
2390.000	Average	42.30	-4.25	38.05	54.00	-15.95
2390.000	Peak	52.54	-4.25	48.29	74.00	-25.71

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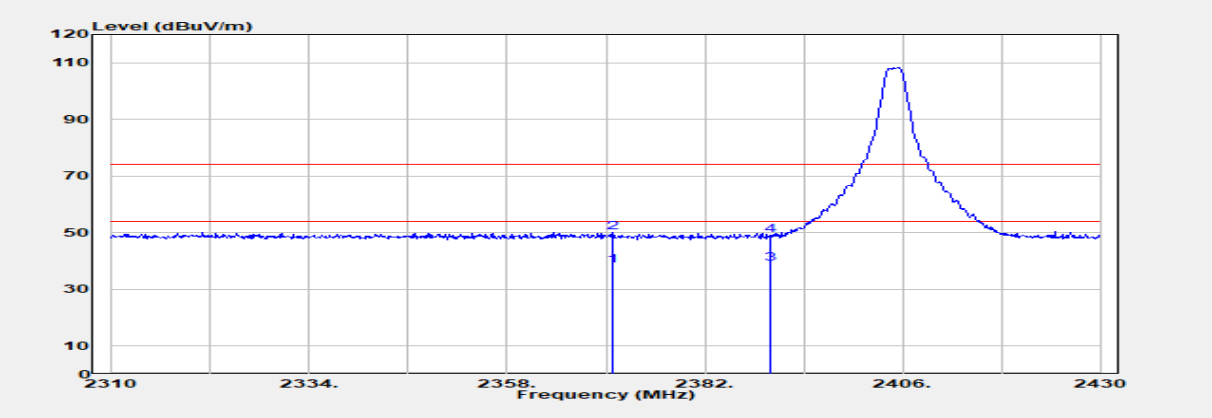
Report Number	:TERF2410002916E2	Test Site	:SAC C
Operation Mode	:SRD 2.4G	Test Date	:2024-10-25
Test Frequency	:2405 MHz	Temp./Humi.	:22.9℃/58%
Test Mode	:Bandedge	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2370.840	Average	42.60	-4.09	38.51	54.00	-15.49
2370.840	Peak	54.29	-4.09	50.19	74.00	-23.81
2390.000	Average	43.19	-4.25	38.94	54.00	-15.06
2390.000	Peak	53.25	-4.25	49.00	74.00	-25.00

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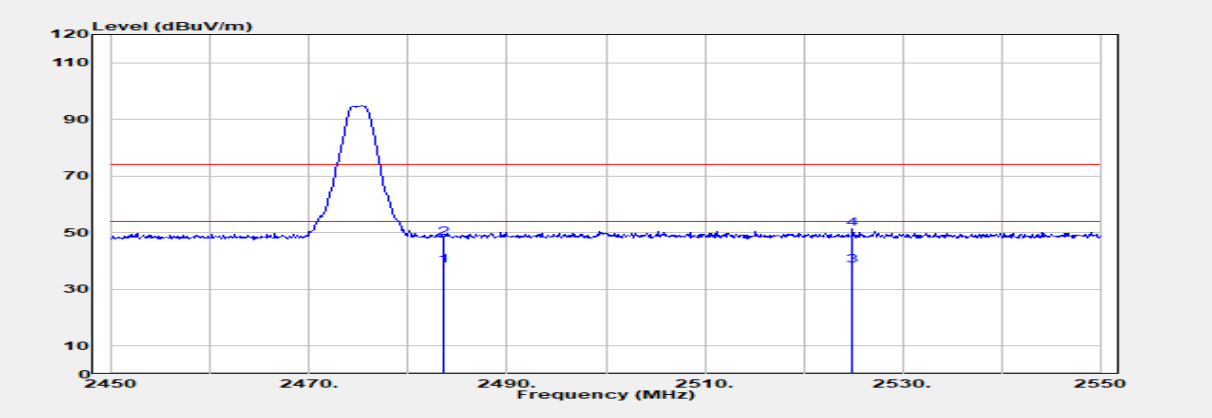
Report Number	:TERF2410002916E2	Test Site	:SAC C
Operation Mode	:SRD 2.4G	Test Date	:2024-10-25
Test Frequency	:2475 MHz	Temp./Humi.	:22.9℃/58%
Test Mode	:Bandedge	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



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	42.14	-3.82	38.32	54.00	-15.68
2483.500	Peak	52.05	-3.82	48.23	74.00	-25.77
2524.900	Average	42.07	-3.64	38.43	54.00	-15.57
2524.900	Peak	55.00	-3.64	51.36	74.00	-22.64

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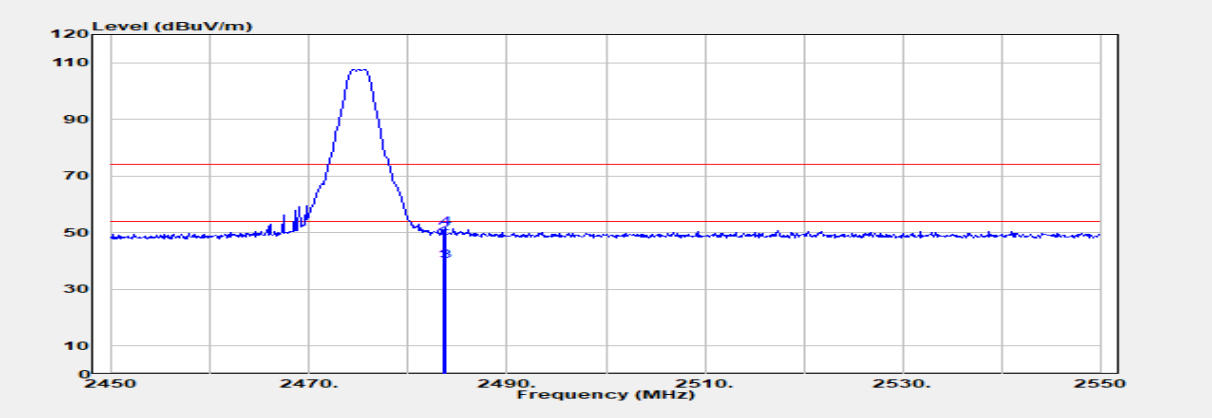
Report Number	:TERF2410002916E2	Test Site	:SAC C
Operation Mode	:SRD 2.4G	Test Date	:2024-10-25
Test Frequency	:2475 MHz	Temp./Humi.	:22.9℃/58%
Test Mode	:Bandedge	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Alex Li



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	43.66	-3.82	39.84	54.00	-14.16
2483.500	Peak	53.46	-3.82	49.64	74.00	-24.36
2483.700	Average	43.70	-3.82	39.88	54.00	-14.12
2483.700	Peak	55.44	-3.82	51.62	74.00	-22.38

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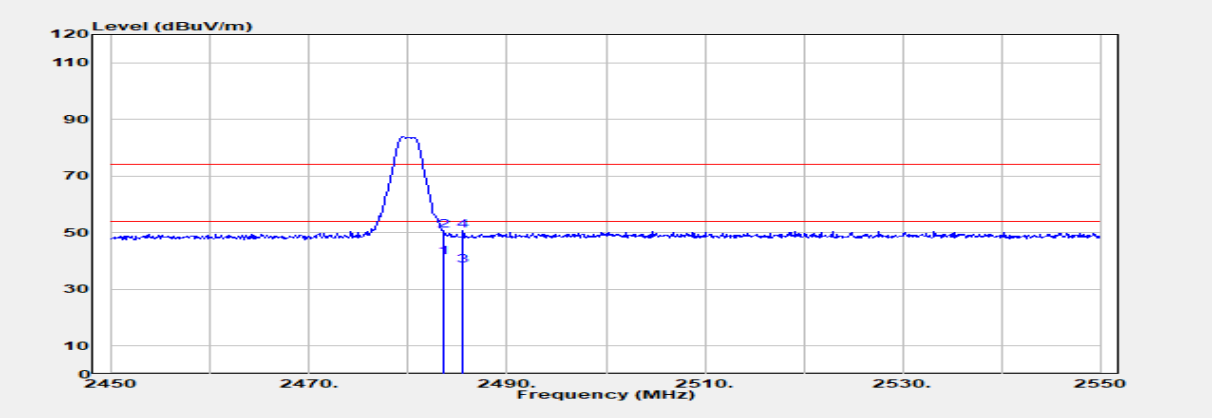
Report Number	:TERF2410002916E2	Test Site	:SAC C
Operation Mode	:SRD 2.4G	Test Date	:2024-10-25
Test Frequency	:2480 MHz	Temp./Humi.	:22.9℃/58%
Test Mode	:Bandedge	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



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	45.16	-3.82	41.34	54.00	-12.66
2483.500	Peak	54.69	-3.82	50.87	74.00	-23.13
2485.500	Average	42.19	-3.80	38.39	54.00	-15.61
2485.500	Peak	54.44	-3.80	50.64	74.00	-23.36

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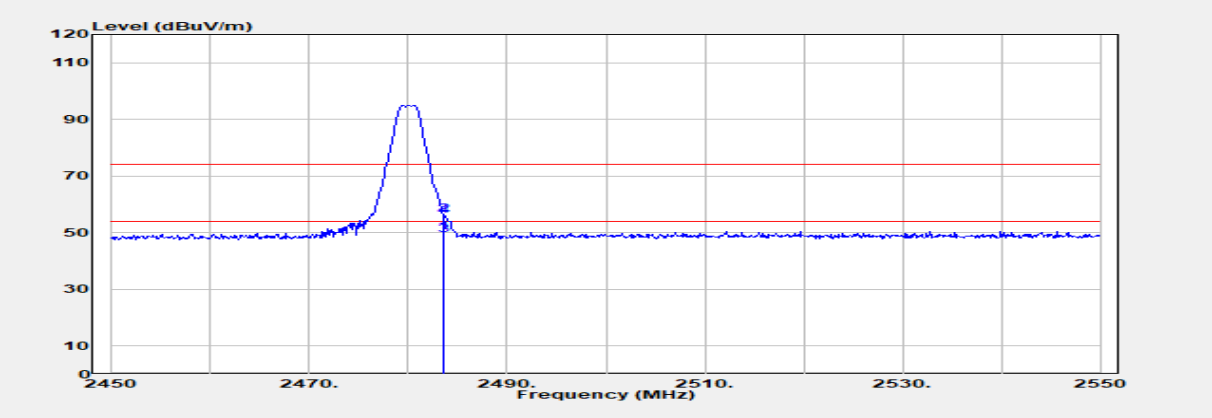
Report Number	:TERF2410002916E2	Test Site	:SAC C
Operation Mode	:SRD 2.4G	Test Date	:2024-10-25
Test Frequency	:2480 MHz	Temp./Humi.	:22.9℃/58%
Test Mode	:Bandedge	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Alex Li



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	53.85	-3.82	50.03	54.00	-3.97
2483.500	Peak	60.15	-3.82	56.33	74.00	-17.67
2483.600	Average	52.86	-3.82	49.04	54.00	-4.96
2483.600	Peak	59.90	-3.82	56.08	74.00	-17.92

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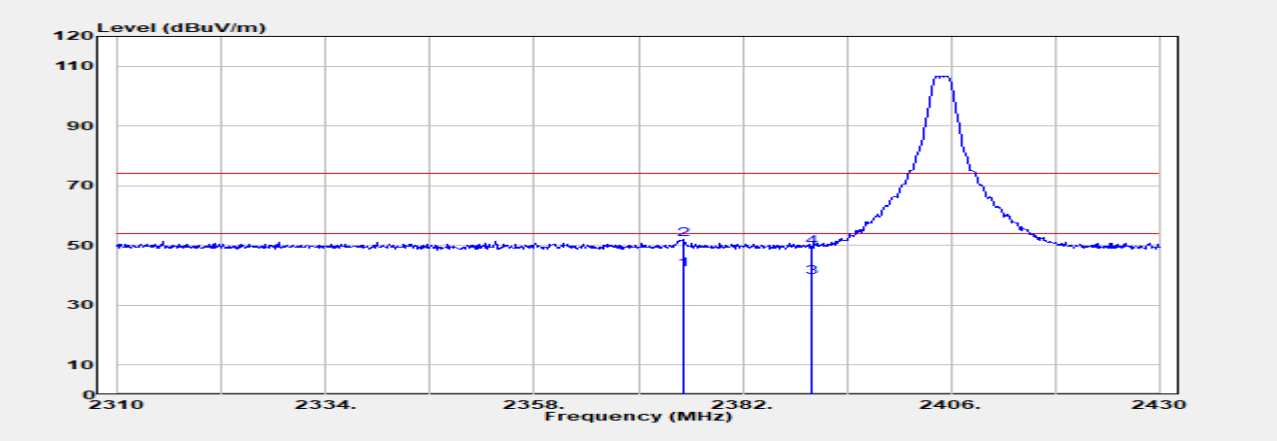
Internal Antenna

Report Number	:TERF2410002916E2	Test Site	:SAC G Chamber
Operation Mode	:SRD 2.4G	Test Date	:2024-11-19
Test Frequency	:2405 MHz	Temp./Humi.	:22.3℃/64%
Test Mode	:Bandedge	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2375.160	Average	45.06	-3.25	41.81	54.00	-12.19
2375.160	Peak	55.38	-3.25	52.13	74.00	-21.87
2390.000	Average	42.76	-3.28	39.48	54.00	-14.52
2390.000	Peak	52.80	-3.28	49.52	74.00	-24.48

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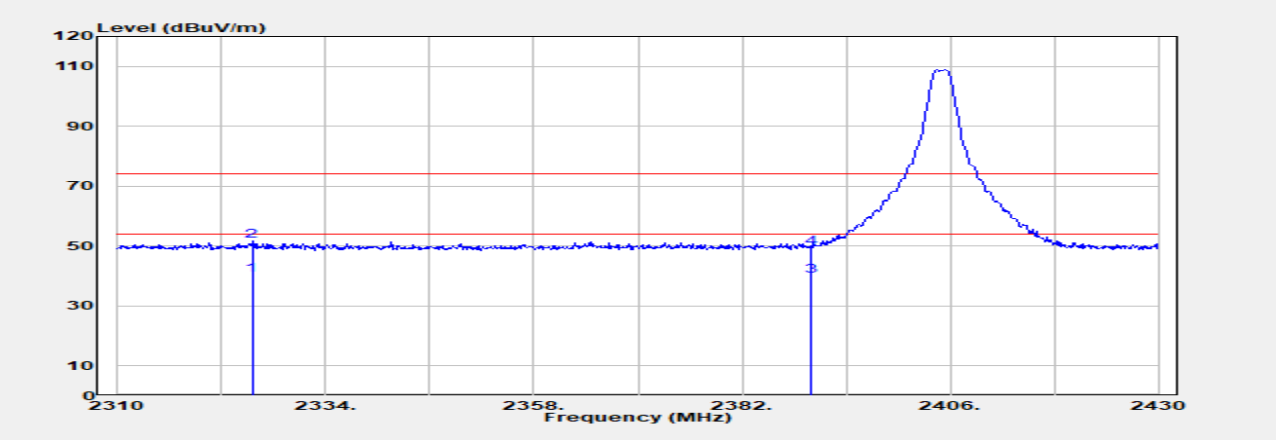
Report Number	:TERF2410002916E2	Test Site	:SAC G Chamber
Operation Mode	:SRD 2.4G	Test Date	:2024-11-19
Test Frequency	:2405 MHz	Temp./Humi.	:22.3℃/64%
Test Mode	:Bandedge	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2325.480	Average	43.48	-3.18	40.30	54.00	-13.70
2325.480	Peak	54.74	-3.18	51.56	74.00	-22.44
2390.000	Average	43.35	-3.28	40.08	54.00	-13.92
2390.000	Peak	52.69	-3.28	49.41	74.00	-24.59

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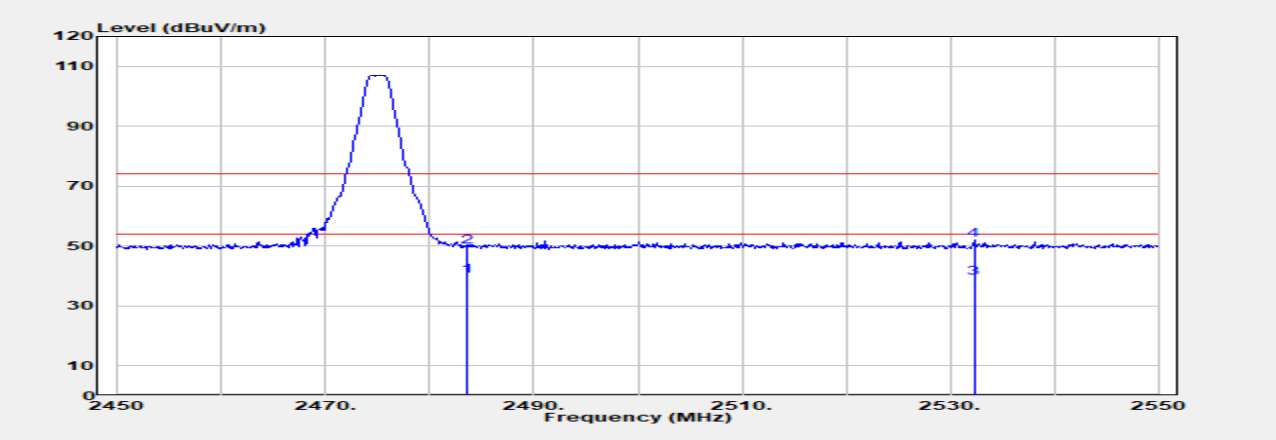
Report Number	:TERF2410002916E2	Test Site	:SAC G Chamber
Operation Mode	:SRD 2.4G	Test Date	:2024-11-19
Test Frequency	:2475 MHz	Temp./Humi.	:22.3℃/64%
Test Mode	:Bandedge	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.500	Average	43.31	-3.31	40.00	54.00	-14.00
2483.500	Peak	52.97	-3.31	49.66	74.00	-24.34
2532.300	Average	42.60	-3.13	39.47	54.00	-14.53
2532.300	Peak	55.13	-3.13	51.99	74.00	-22.01

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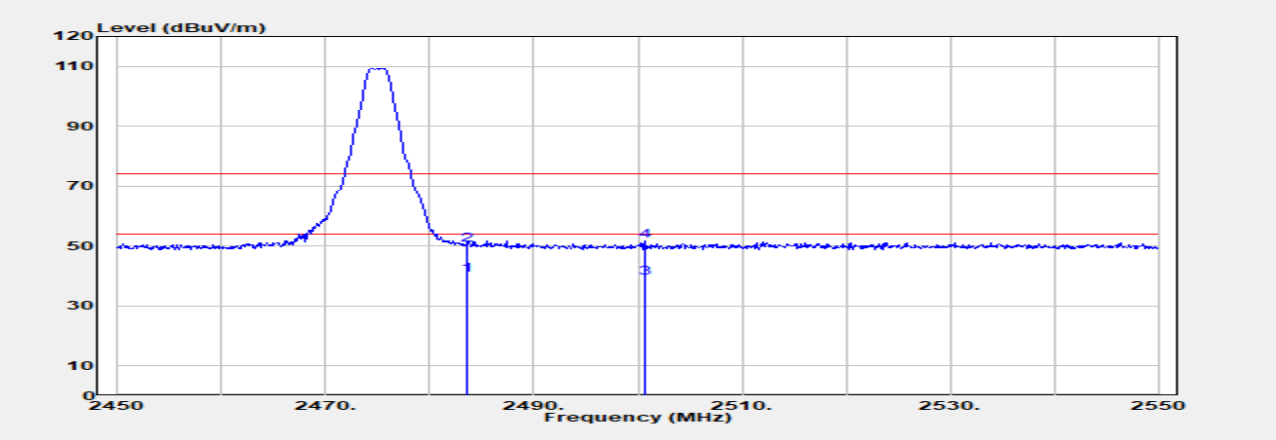
Report Number	:TERF2410002916E2	Test Site	:SAC G Chamber
Operation Mode	:SRD 2.4G	Test Date	:2024-11-19
Test Frequency	:2475 MHz	Temp./Humi.	:22.3℃/64%
Test Mode	:Bandedge	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.500	Average	43.67	-3.31	40.36	54.00	-13.64
2483.500	Peak	53.60	-3.31	50.29	74.00	-23.71
2500.700	Average	42.55	-3.26	39.30	54.00	-14.70
2500.700	Peak	55.12	-3.26	51.87	74.00	-22.13

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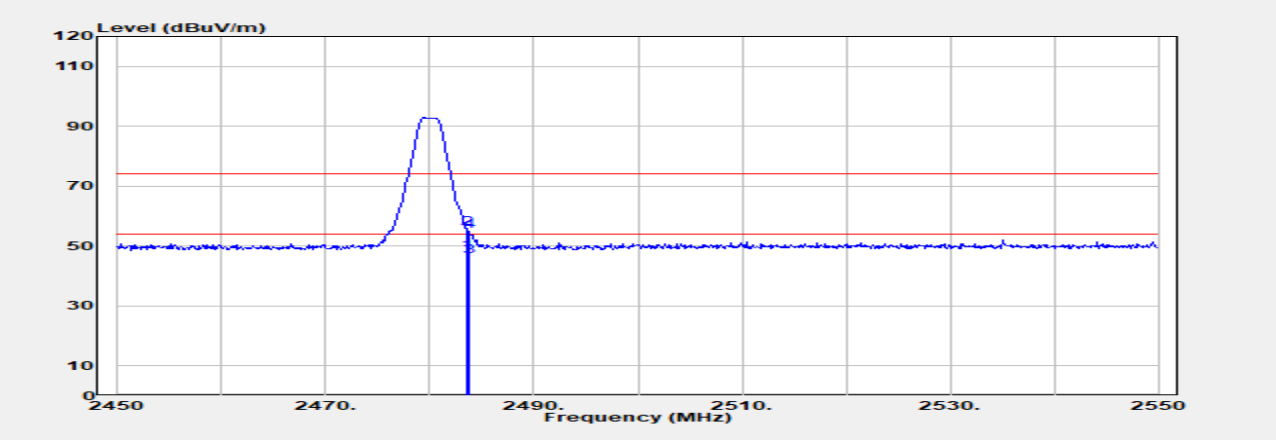
Report Number	:TERF2410002916E2	Test Site	:SAC G Chamber
Operation Mode	:SRD 2.4G	Test Date	:2024-11-19
Test Frequency	:2480 MHz	Temp./Humi.	:22.3℃/64%
Test Mode	:Bandedge	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.500	Average	51.54	-3.31	48.23	54.00	-5.77
2483.500	Peak	59.18	-3.31	55.87	74.00	-18.13
2483.700	Average	49.71	-3.31	46.40	54.00	-7.60
2483.700	Peak	58.31	-3.31	55.00	74.00	-19.00

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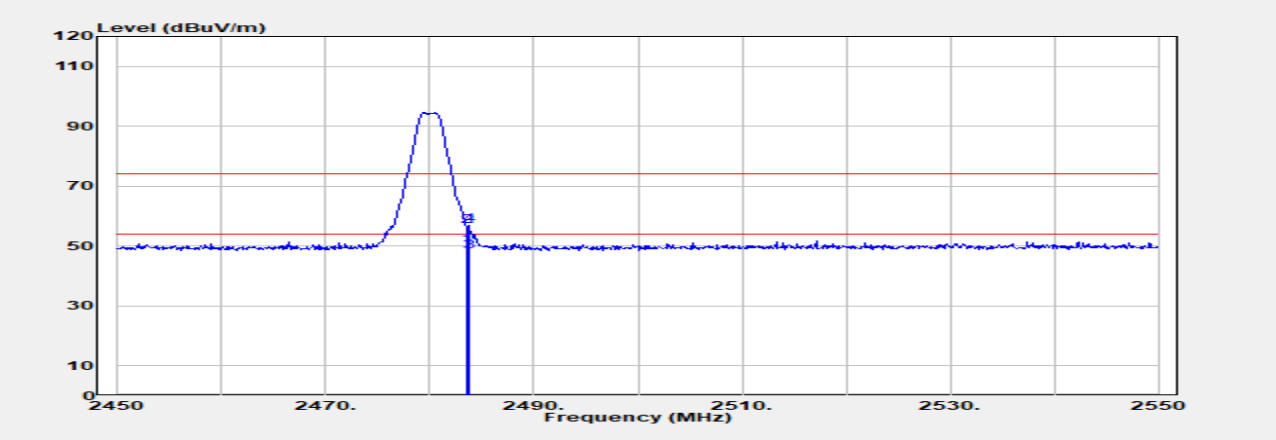
Report Number	:TERF2410002916E2	Test Site	:SAC G Chamber
Operation Mode	:SRD 2.4G	Test Date	:2024-11-19
Test Frequency	:2480 MHz	Temp./Humi.	:22.3℃/64%
Test Mode	:Bandedge	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.500	Average	53.27	-3.31	49.96	54.00	-4.04
2483.500	Peak	59.82	-3.31	56.51	74.00	-17.49
2483.700	Average	51.37	-3.31	48.06	54.00	-5.94
2483.700	Peak	60.07	-3.31	56.75	74.00	-17.25

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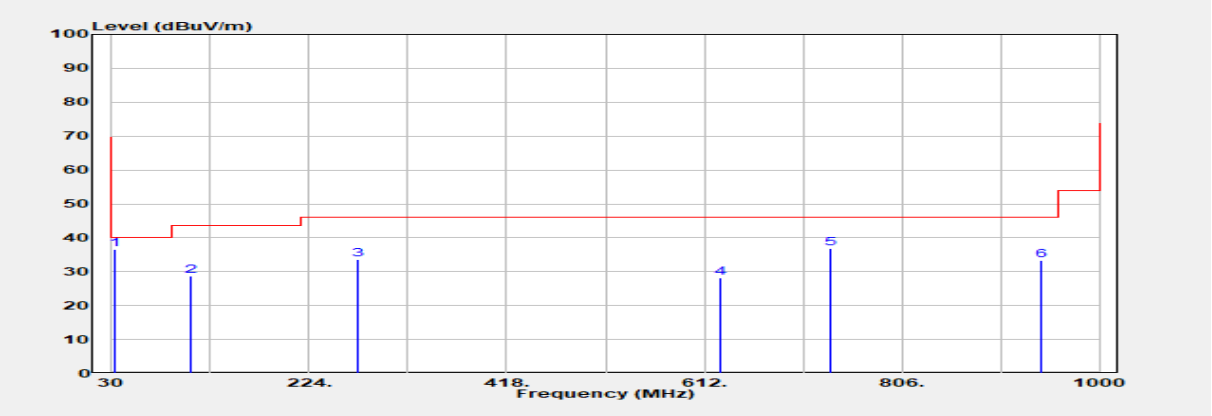
11.6.2 Radiated Spurious Emission

External Antenna

Report Number	:TERF2410002916E2	Test Site	:SAC C
Operation Mode	:SRD 2.4G	Test Date	:2024-10-25
Test Frequency	:2440 MHz	Temp./Humi.	:22.9℃/58%
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
33.880	QP	49.50	-12.93	36.57	40.00	-3.43
107.600	Peak	43.70	-15.09	28.61	43.50	-14.89
272.500	Peak	44.90	-11.34	33.57	46.00	-12.43
628.490	Peak	30.64	-2.34	28.30	46.00	-17.70
736.160	Peak	37.63	-0.83	36.80	46.00	-9.20
943.740	Peak	31.27	1.98	33.24	46.00	-12.76

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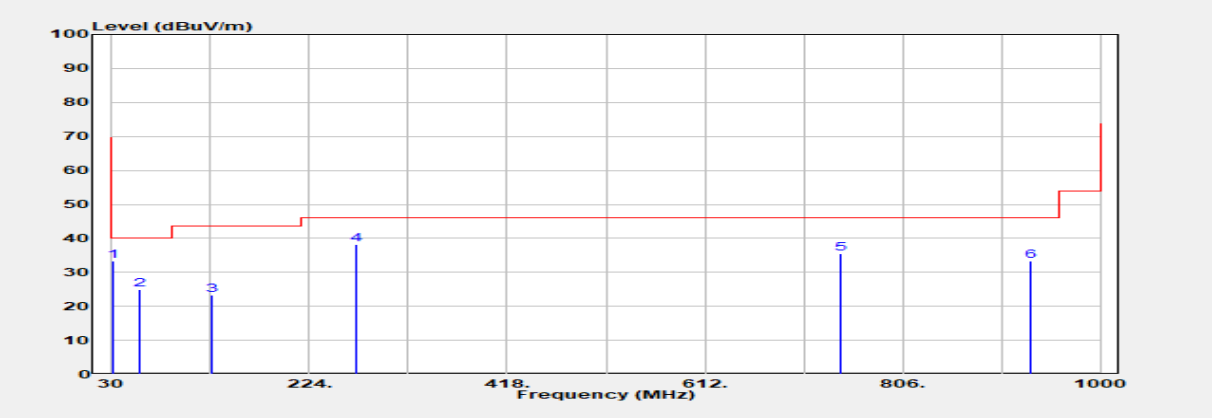
Report Number	:TERF2410002916E2	Test Site	:SAC C
Operation Mode	:SRD 2.4G	Test Date	:2024-10-25
Test Frequency	:2440 MHz	Temp./Humi.	:22.9℃/58%
Test Mode	:Tx	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
31.940	QP	46.20	-13.00	33.20	40.00	-6.80
57.160	Peak	36.61	-11.72	24.89	40.00	-15.11
127.970	Peak	36.45	-13.24	23.20	43.50	-20.30
269.590	Peak	49.57	-11.49	38.08	46.00	-7.92
744.890	Peak	36.13	-0.51	35.62	46.00	-10.38
932.100	Peak	31.14	2.12	33.26	46.00	-12.74

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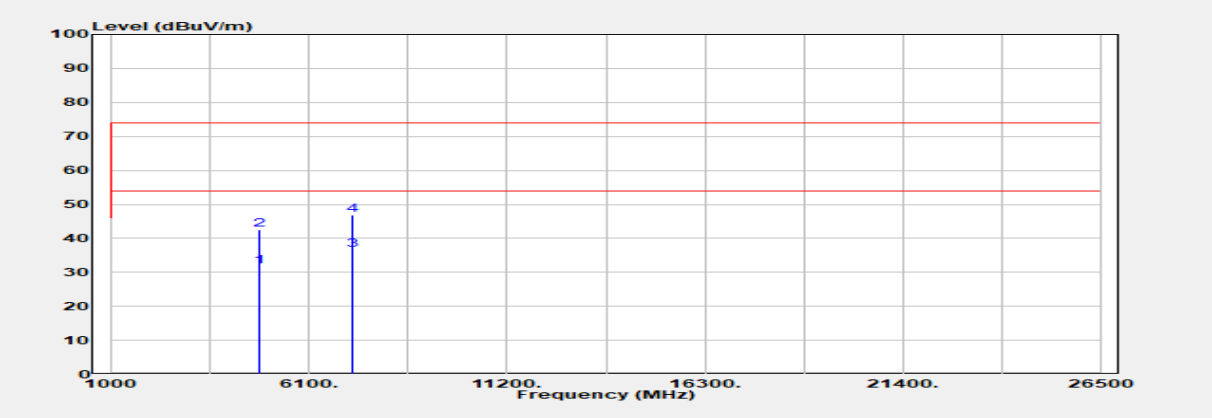
Report Number	:TERF2410002916E2	Test Site	:SAC C
Operation Mode	:SRD 2.4G	Test Date	:2024-10-25
Test Frequency	:2405 MHz	Temp./Humi.	:22.9℃/58%
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4810.000	Average	31.00	0.64	31.64	54.00	-22.36
4810.000	Peak	41.91	0.64	42.55	74.00	-31.45
7215.000	Average	29.72	6.85	36.57	54.00	-17.43
7215.000	Peak	40.06	6.85	46.92	74.00	-27.08

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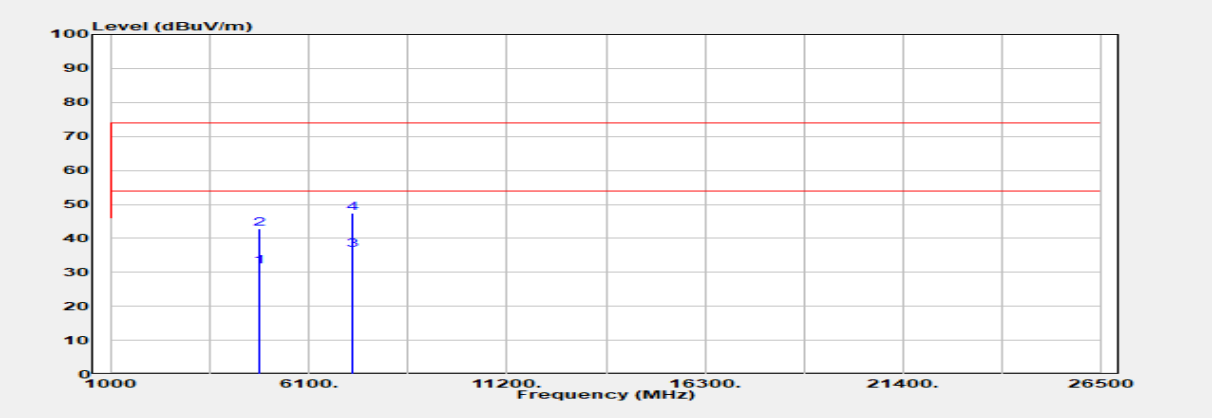
Report Number	:TERF2410002916E2	Test Site	:SAC C
Operation Mode	:SRD 2.4G	Test Date	:2024-10-25
Test Frequency	:2405 MHz	Temp./Humi.	:22.9℃/58%
Test Mode	:Tx	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4810.000	Average	31.00	0.64	31.64	54.00	-22.36
4810.000	Peak	42.13	0.64	42.77	74.00	-31.23
7215.000	Average	29.71	6.85	36.56	54.00	-17.44
7215.000	Peak	40.65	6.85	47.51	74.00	-26.49

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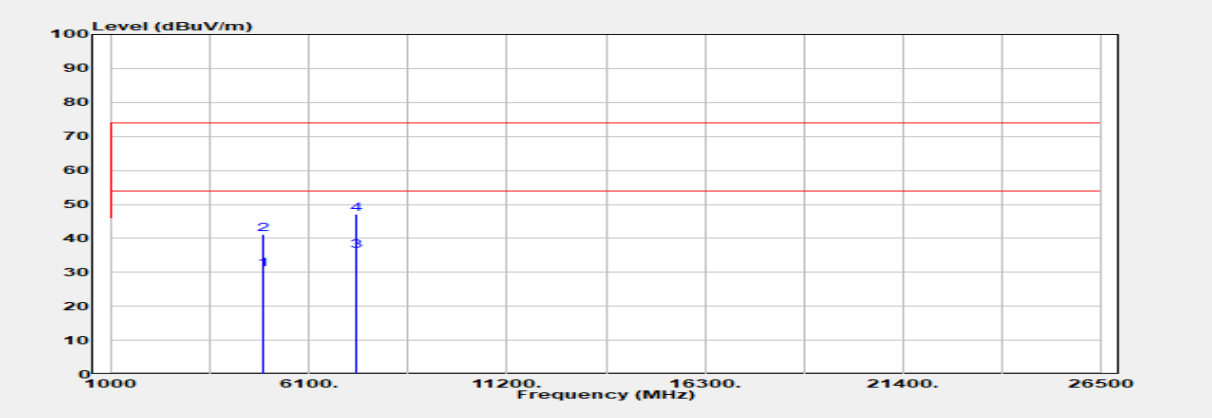
Report Number	:TERF2410002916E2	Test Site	:SAC C
Operation Mode	:SRD 2.4G	Test Date	:2024-10-25
Test Frequency	:2440 MHz	Temp./Humi.	:22.9℃/58%
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



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	30.48	0.42	30.91	54.00	-23.09
4880.000	Peak	40.81	0.42	41.23	74.00	-32.77
7320.000	Average	29.78	6.42	36.20	54.00	-17.80
7320.000	Peak	40.65	6.42	47.07	74.00	-26.93

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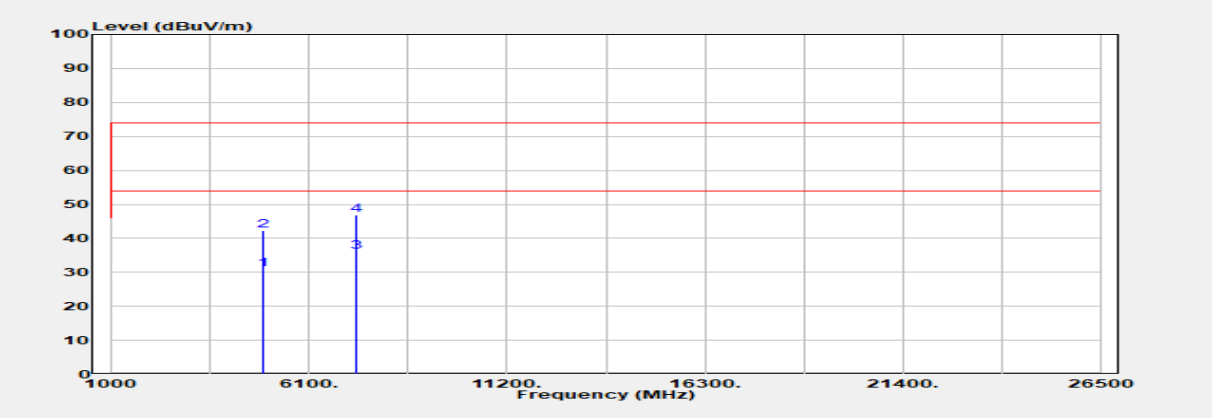
Report Number	:TERF2410002916E2	Test Site	:SAC C
Operation Mode	:SRD 2.4G	Test Date	:2024-10-25
Test Frequency	:2440 MHz	Temp./Humi.	:22.9℃/58%
Test Mode	:Tx	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Alex Li



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	30.42	0.42	30.84	54.00	-23.16
4880.000	Peak	41.86	0.42	42.28	74.00	-31.72
7320.000	Average	29.72	6.42	36.14	54.00	-17.86
7320.000	Peak	40.41	6.42	46.83	74.00	-27.17

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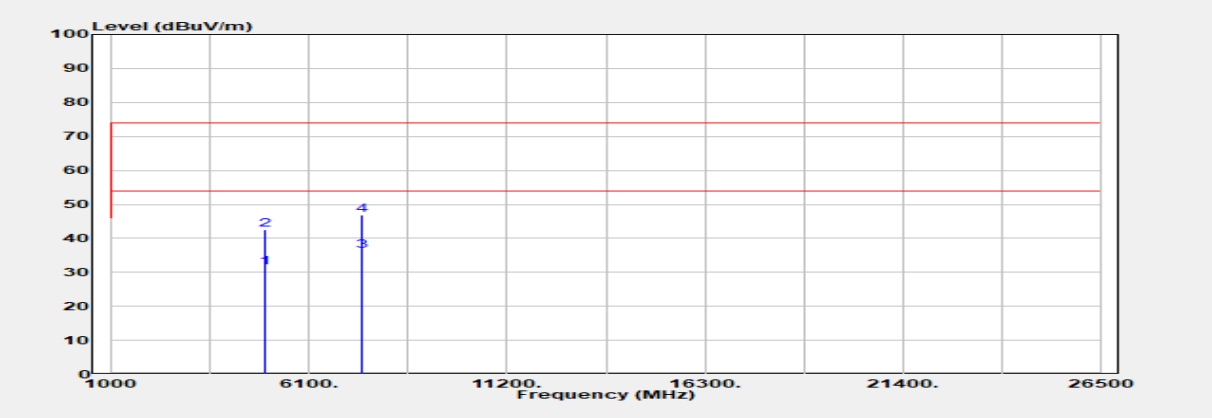
Report Number	:TERF2410002916E2	Test Site	:SAC C
Operation Mode	:SRD 2.4G	Test Date	:2024-10-25
Test Frequency	:2480 MHz	Temp./Humi.	:22.9℃/58%
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.000	Average	30.66	0.70	31.36	54.00	-22.64
4960.000	Peak	41.89	0.70	42.58	74.00	-31.42
7440.000	Average	29.75	6.52	36.27	54.00	-17.73
7440.000	Peak	40.31	6.52	46.83	74.00	-27.17

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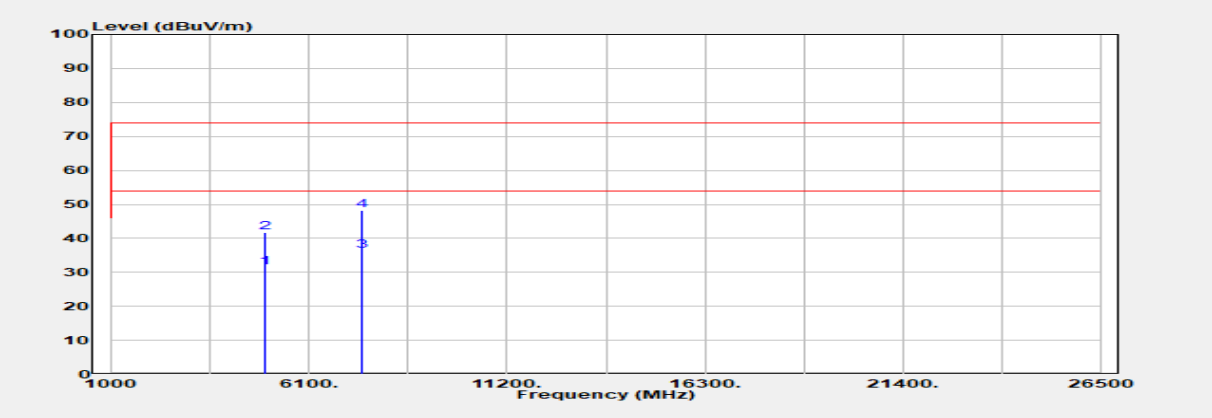
Operation Mode	:SRD 2.4G	Test Date	:2024-10-25
Test Frequency	:2480 MHz	Temp./Humi.	:22.9℃/58%
Test Mode	:Tx	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.000	Average	30.67	0.70	31.36	54.00	-22.64
4960.000	Peak	41.16	0.70	41.86	74.00	-32.14
7440.000	Average	29.78	6.52	36.30	54.00	-17.70
7440.000	Peak	41.64	6.52	48.15	74.00	-25.85

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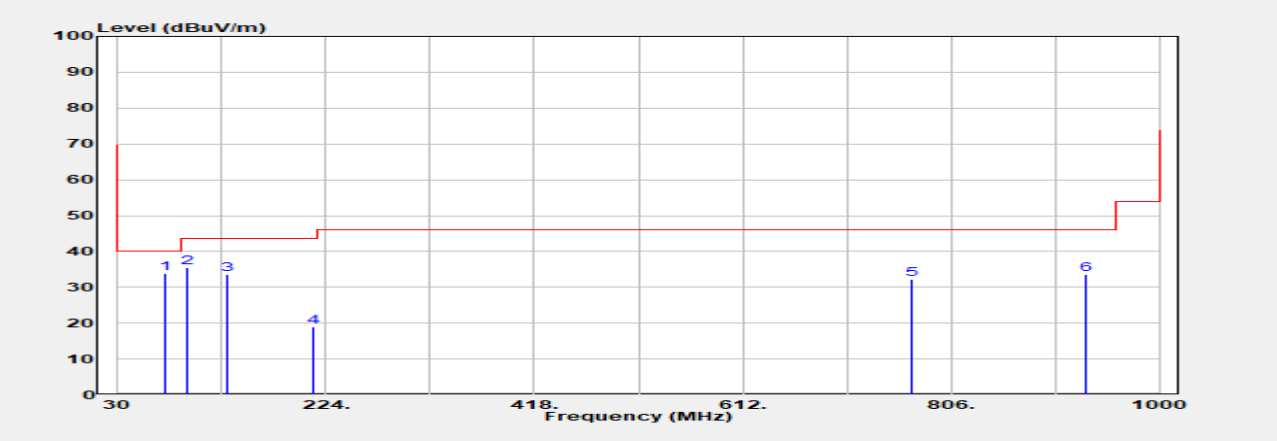
Internal Antenna

Report Number	:TERF2410002916E2	Test Site	:SAC G Chamber
Operation Mode	:SRD 2.4G	Test Date	:2024-11-19
Test Frequency	:2440 MHz	Temp./Humi.	:22.3℃/64%
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
73.650	Peak	49.66	-15.80	33.86	40.00	-6.14
94.990	Peak	53.87	-18.25	35.62	43.50	-7.88
131.850	Peak	48.23	-14.49	33.73	43.50	-9.77
212.360	Peak	35.05	-16.03	19.02	43.50	-24.48
770.110	Peak	33.90	-1.56	32.34	46.00	-13.66
931.130	Peak	33.74	-0.25	33.48	46.00	-12.52

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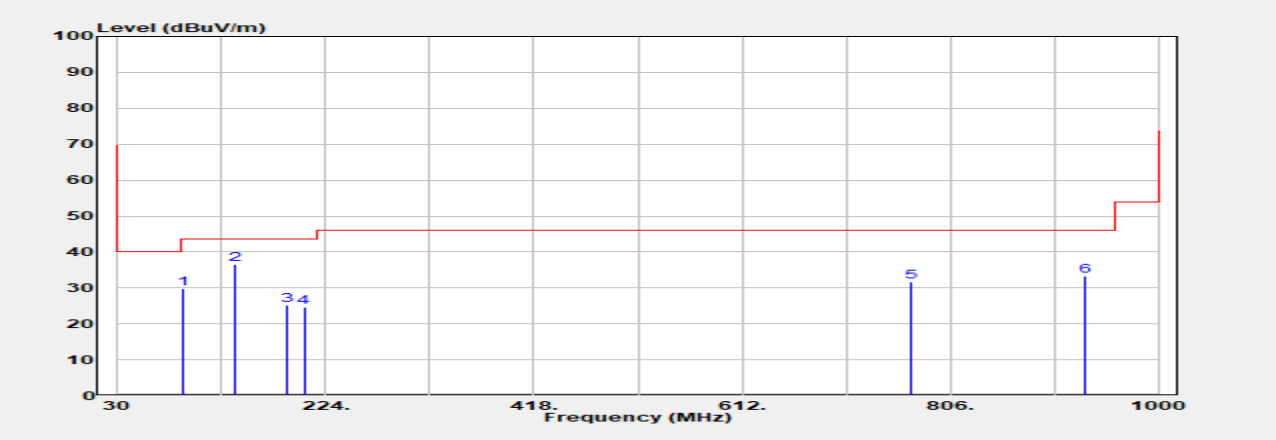
Operation Mode	:SRD 2.4G	Test Date	:2024-11-19
Test Frequency	:2440 MHz	Temp./Humi.	:22.3℃/64%
Test Mode	:Tx	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
91.110	Peak	48.36	-18.55	29.81	43.50	-13.69
139.610	Peak	50.15	-13.59	36.56	43.50	-6.94
188.110	Peak	40.29	-15.06	25.23	43.50	-18.27
203.630	Peak	40.61	-16.02	24.59	43.50	-18.91
770.110	Peak	33.23	-1.56	31.67	46.00	-14.33
931.130	Peak	33.59	-0.25	33.34	46.00	-12.66

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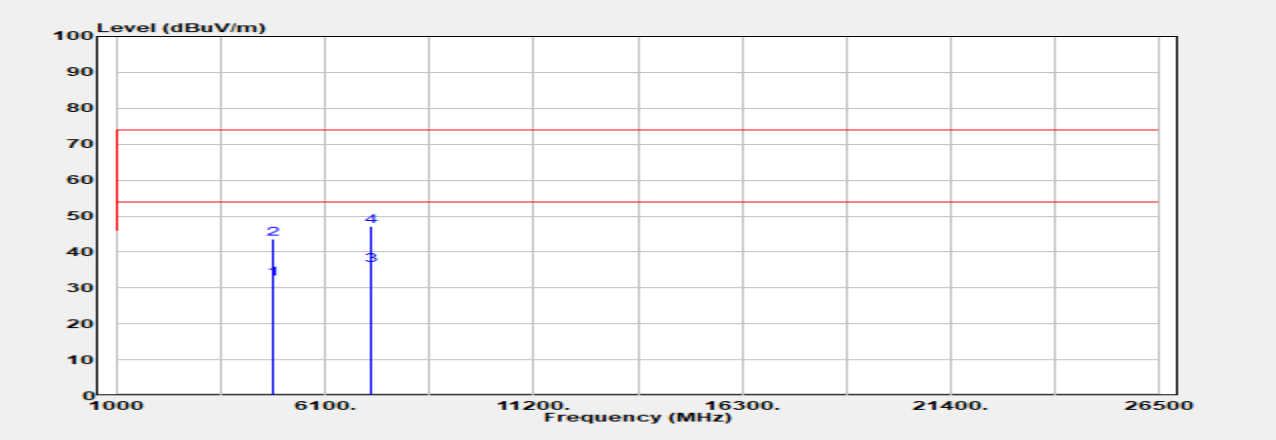
Report Number	:TERF2410002916E2	Test Site	:SAC G Chamber
Operation Mode	:SRD 2.4G	Test Date	:2024-11-19
Test Frequency	:2405 MHz	Temp./Humi.	:22.3℃/64%
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4810.000	Average	29.21	3.34	32.55	54.00	-21.45
4810.000	Peak	40.40	3.34	43.74	74.00	-30.26
7215.000	Average	27.11	9.23	36.34	54.00	-17.66
7215.000	Peak	37.82	9.23	47.06	74.00	-26.94

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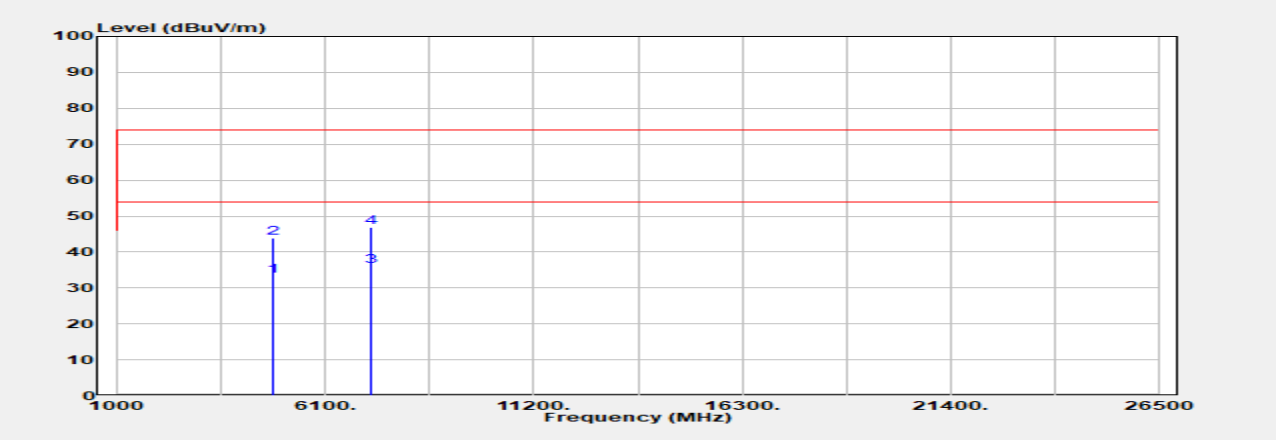
Report Number	:TERF2410002916E2	Test Site	:SAC G Chamber
Operation Mode	:SRD 2.4G	Test Date	:2024-11-19
Test Frequency	:2405 MHz	Temp./Humi.	:22.3℃/64%
Test Mode	:Tx	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4810.000	Average	30.02	3.34	33.35	54.00	-20.65
4810.000	Peak	40.65	3.34	43.99	74.00	-30.01
7215.000	Average	26.90	9.23	36.14	54.00	-17.86
7215.000	Peak	37.76	9.23	47.00	74.00	-27.00

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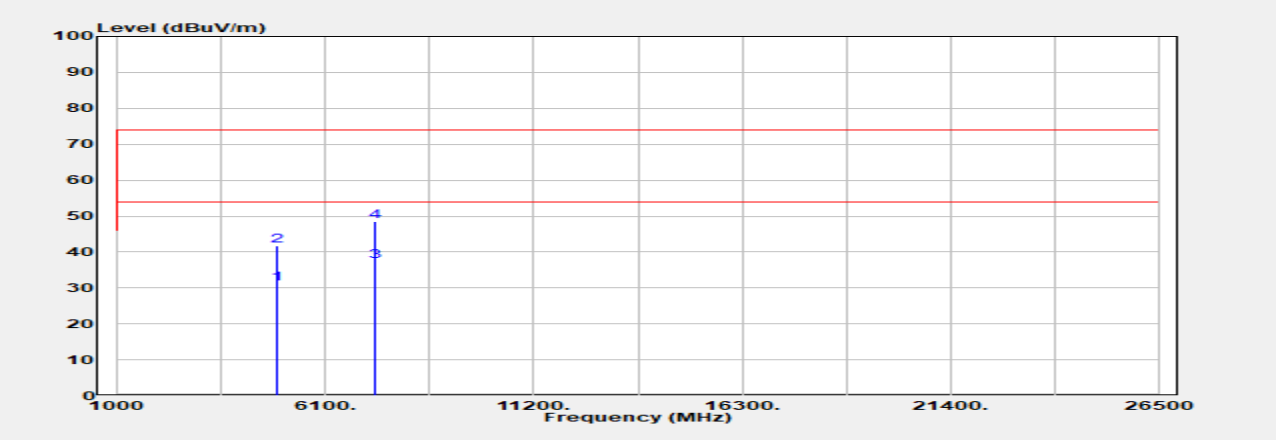
Report Number	:TERF2410002916E2	Test Site	:SAC G Chamber
Operation Mode	:SRD 2.4G	Test Date	:2024-11-19
Test Frequency	:2440 MHz	Temp./Humi.	:22.3℃/64%
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4880.000	Average	27.54	3.51	31.06	54.00	-22.94
4880.000	Peak	38.19	3.51	41.70	74.00	-32.30
7320.000	Average	27.64	9.79	37.42	54.00	-16.58
7320.000	Peak	38.64	9.79	48.43	74.00	-25.57

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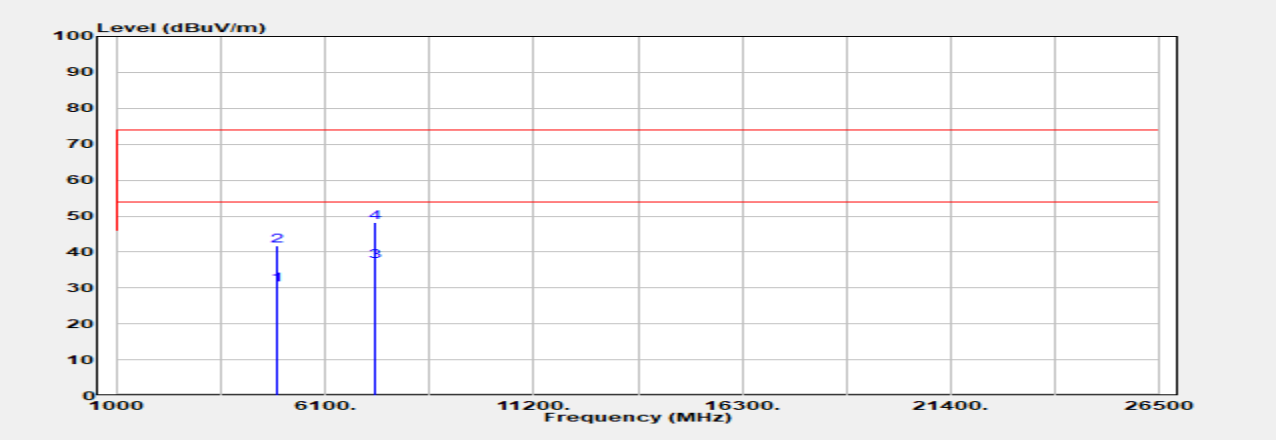
Report Number	:TERF2410002916E2	Test Site	:SAC G Chamber
Operation Mode	:SRD 2.4G	Test Date	:2024-11-19
Test Frequency	:2440 MHz	Temp./Humi.	:22.3℃/64%
Test Mode	:Tx	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4880.000	Average	27.45	3.51	30.97	54.00	-23.03
4880.000	Peak	38.21	3.51	41.72	74.00	-32.28
7320.000	Average	27.52	9.79	37.31	54.00	-16.69
7320.000	Peak	38.58	9.79	48.37	74.00	-25.63

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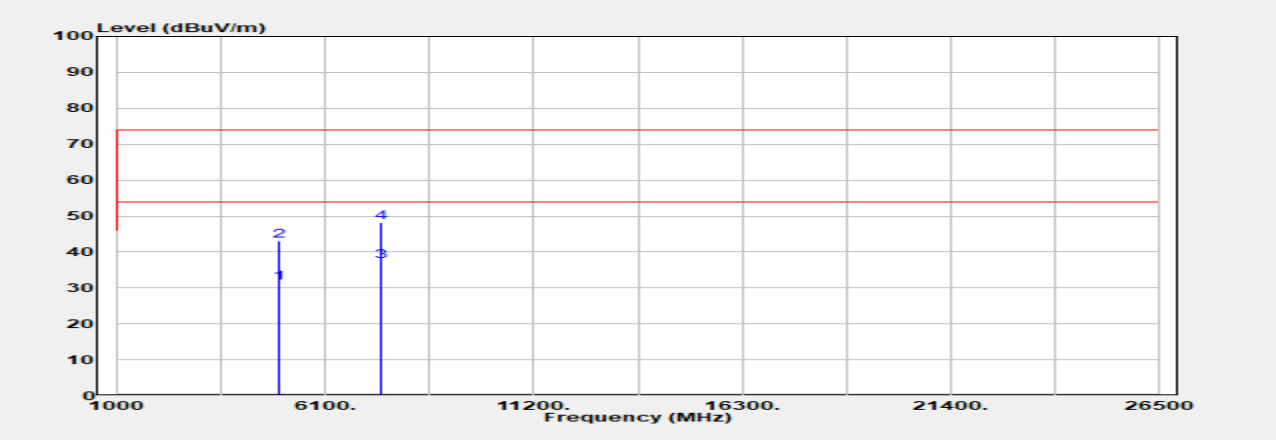
Report Number	:TERF2410002916E2	Test Site	:SAC G Chamber
Operation Mode	:SRD 2.4G	Test Date	:2024-11-19
Test Frequency	:2480 MHz	Temp./Humi.	:22.3℃/64%
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.000	Average	27.68	3.86	31.54	54.00	-22.46
4960.000	Peak	39.14	3.86	43.00	74.00	-31.00
7440.000	Average	27.18	10.14	37.32	54.00	-16.68
7440.000	Peak	38.13	10.14	48.27	74.00	-25.73

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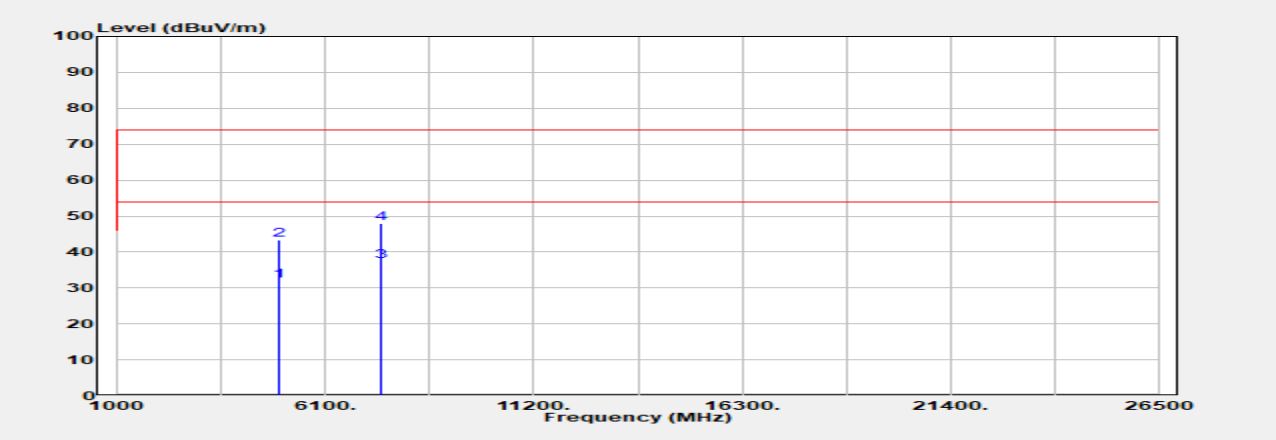
Operation Mode	:SRD 2.4G	Test Date	:2024-11-19
Test Frequency	:2480 MHz	Temp./Humi.	:22.3℃/64%
Test Mode	:Tx	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.000	Average	28.00	3.86	31.85	54.00	-22.15
4960.000	Peak	39.43	3.86	43.29	74.00	-30.71
7440.000	Average	27.19	10.14	37.32	54.00	-16.68
7440.000	Peak	37.82	10.14	47.96	74.00	-26.04

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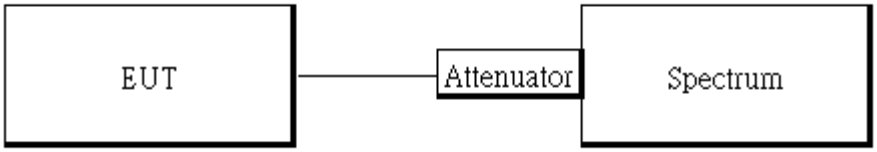
12 POWER SPECTRAL DENSITY

12.1 Standard Applicable:

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

12.2 Test Setup



12.3 Measurement Procedure:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 3 kHz. & the VBW = 10 kHz
5. For defining Restricted Band Edge Limit:
   Set the RBW = 100kHz & VBW = 300 kHz.
6. Detector = peak.
7. Sweep time = auto couple.
8. Trace mode = max hold.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum amplitude level.

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12.4 Measurement Result:

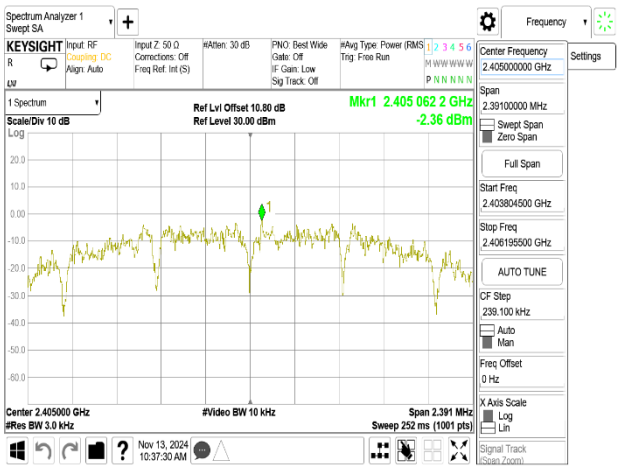
IEEE802.15.4. mode

Frequency (MHz)	RF Power Density (dBm/3kHz)	Maximum Limit (dBm/3kHz)	Result
2405	-2.36	8	PASS
2440	-2.47	8	PASS
2480	-15.65	8	PASS

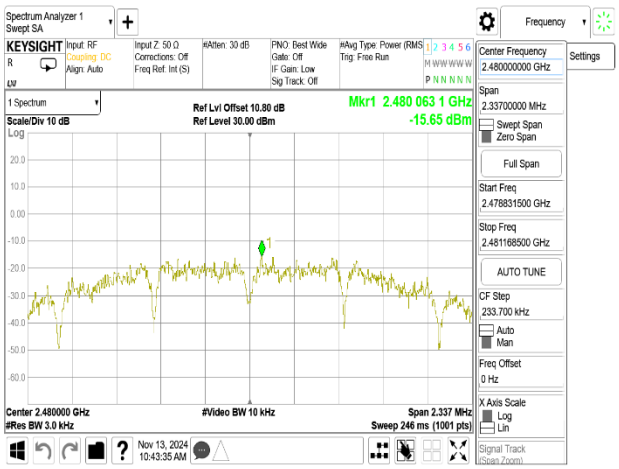
***Note:**

1.cable loss as 10.8 dB that offsets in the spectrum

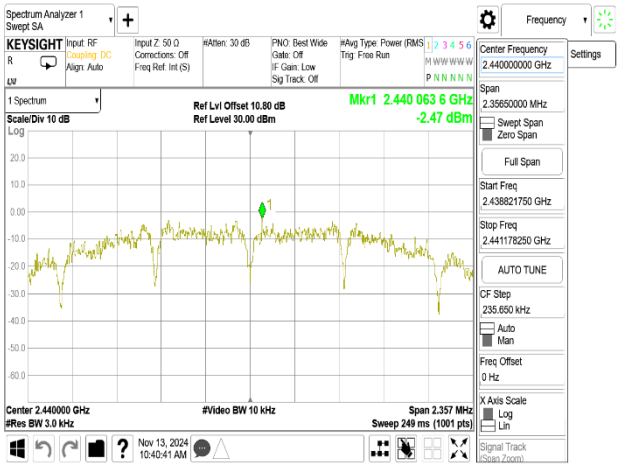
PSD_IEEE802.15.4_LowCH11-2405MHz



PSD_IEEE802.15.4_HighCH26-2480MHz



PSD_IEEE802.15.4_MidCH18-2440MHz



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13 ANTENNA REQUIREMENT

13.1 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.

13.2 Antenna Connected Construction:

The antenna complies with this requirement and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.
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