

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT



Applicant: Universal Electronics Inc.
201 East Sandpoint Ave 7th Floor Santa Ana CA 92707 USA

Manufacturer: Gemstar Technology (Qinzhou) Co., Ltd
Hedong Industrial District, Qinzhou, Guangxi Zhuang Autonomous Region, P.R. China

Factory 1 Gemstar Technology (Qinzhou) Co., Ltd
Hedong Industrial District, Qinzhou, Guangxi Zhuang Autonomous Region, P.R. China

Factory 2 UE VIETNAM COMPANY LIMITED
Slot A4, An Phat Complex High-Tech Industrial Park, KM47,
Viet Hoa Ward, Hai Duong City, Vietnam

Product Name: Voice Remote Control

Brand Name: Sony

Model No.: RMF-TX810U, RMF-TX811U

Model Difference: Some key label differences

Report Number: TERF2209001707ER

FCC ID MG3-TX810U

IC: 2575A-TX810U

Date of EUT Received: Sep. 07, 2022

Date of Test: Sep. 14, 2022 ~ Sep. 19, 2022

Issue Date: Oct. 07, 2022

Approved By

Jim Chang

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, ISSED 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
TERF2209001707ER	00	Original.	Oct. 07, 2022	Yami Kuo	

Note:

- 1、The remark "*" indicates modification of the report upon requests from certification body.
- 2、Variant information of model numbers is provided by the applicant, test results of this report are applicable to the sample EUT(s) received.
And are assessed as electrically identical in RF characteristics, therefore, no further assessment required for the variant(s).

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t (886-2) 2299-3279

f (886-2) 2298-0488

www.sgs.com.tw

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Voice Remote Control
Brand Name:	Sony
Model No.:	RMF-TX810U, RMF-TX811U
Model Difference:	Some key label differences
Hardware Version:	60302-2465000 A00
Firmware Version:	23.01.01.009
EUT Series No.:	Q22D5220710
Power Supply:	1.5V AAA battery * 2
Test Software (Name/Version)	RadioControlConsole / 3.1.0.0

1.2 RF Specification

Radio Technology:	Zigbee
Frequency Range:	2425 – 2475MHz
Channel number:	3 channels
Modulation type:	O-QPSK
Transmit Power:	4.52 dBm

1.3 Antenna Designation

Antenna Type	Brand	Antenna Model No.	Freq. (MHz)	Peak Antenna Gain (dBi)
PCB	Universal Electronic Inc.	Sony FY23	2425 – 2475	2.82

Note:

1. Antenna information is provided by the applicant.

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1.4 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

RSS-247 issue 2 Feb. 2017

RSS-Gen, Issue 5 (Amendment 2, February 2021)

ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards.

1.5 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	SAC 1	TW0027	TW3702
		SAC 3		
		Conduction 1		
		Conducted 1		
		Conducted 2		
		Conducted 3		
		Conducted 4		
		Conducted 5		
		Conducted 6		
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C	TW0028	
		SAC C		
		SAC D		
		SAC G		
		Conducted A		
		Conducted B		
		Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
		Conducted G		

Note: Test site name is remarked on the equipment list in each section of this report as an indication where measurements occurred in specific test site and address.

1.6 Special Accessories

There are no special accessories used while test was conducted.

1.7 Equipment Modifications

There was no modification incorporated into the EUT.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Emissions

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

2.3.2 Conducted Test (RF)

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

2.3.3 Radiated Emissions

The EUT is placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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2.4 Measurement Results Explanation Example

2.4.1 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

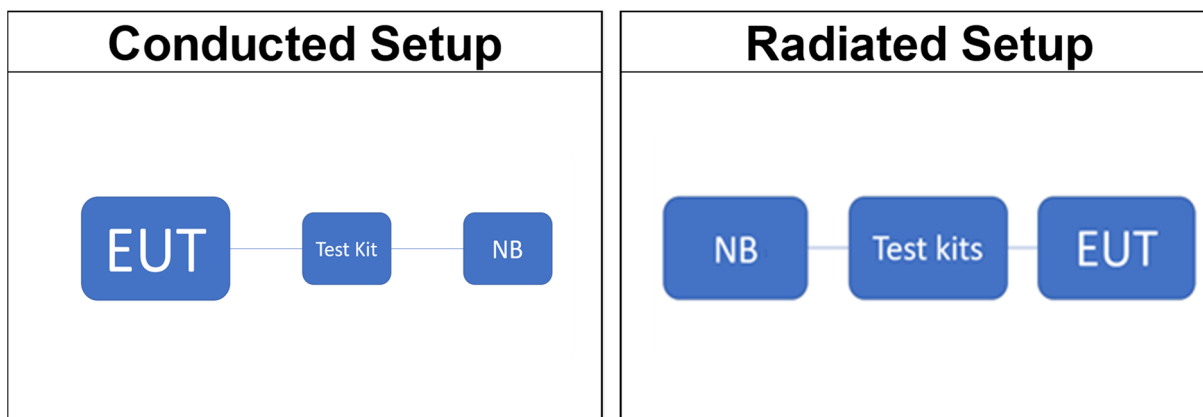
Radiated emission below 30MHz is measured in a 9m*6m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

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

2.4.2 For all conducted test items:

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

2.5 Test Configuration



2.6 Control Unit(s)

Conducted Emission Test Site: Conducted 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Software	SGS	Radio Test Software	Ver. 21	N.C.R	N.C.R
Notebook	Lenovo	T430S	R9-WW5EG 13/0	N/A	N/A

Radiated Emission Test Site: SAC 3					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Software	audix	e3	Ver. 9 210322	N.C.R	N.C.R
Notebook	Lenovo	T430S	R9-WW5EG 13/0	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	N/A
§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
§15.205 §15.209 §15.247(d)	RSS-247 §5.5	Conducted Band Edge and Spurious Emission	Compliant
§15.205 §15.209 §15.247(d)	RSS-247 §5.5	Radiated Band Edge and Spurious Emission	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

ITEM	FREQUENCY
1	2425 MHz
2	2450 MHz
3	2475 MHz

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.

RADIATED EMISSION TEST (BELOW 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (kbps)
Zigbee	15 to 25	20	O-QPSK	250

RADIATED EMISSION TEST (ABOVE 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (kbps)
Zigbee	15 to 25	15,20,25	O-QPSK	250

CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (kbps)
Zigbee	15 to 25	15,20,25	O-QPSK	250

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5 MEASUREMENT UNCERTAINTY

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

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

Note:

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

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6 MEASUREMENT EQUIPMENT USED

6.1 Emission from AC power line

N/A

6.2 Conducted Measurement

Conducted Emission Test Site: Conducted 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	KEYSIGHT	N9010B	MY59071571	05/19/2022	05/18/2023
Power Meter	Anritsu	ML2496A	1242004	11/02/2021	11/01/2022
Power Sensor	Anritsu	MA2411B	1207365	11/02/2021	11/01/2022
Power Sensor	Anritsu	MA2411B	1207368	11/02/2021	11/01/2022
DC Block	Mini-Circuits	BLK-18-S+	1	12/14/2021	12/13/2022

6.3 Radiated Measurement

Radiated Emission Test Site: SAC 3					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Horn Antenna	SCHWARZBECK	BBHA9170	184	12/16/2021	12/15/2022
Horn Antenna	SCHWARZBECK	BBHA9120D	1441	09/27/2021	09/26/2022
Bi-log Antenna	SCHWARZBECK	VULB9168	378	08/15/2022	08/14/2023
Loop Antenna	ETS.LINDGREN	6502	148045	09/29/2021	09/28/2022
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/27/2022	04/26/2023
EMI Test Receiver	R&S	ESCI 7	100759	08/22/2022	08/21/2023
Pre-Amplifier	HP	8449B	3008A00578	12/16/2021	12/15/2022
Pre-Amplifier	EMC Instruments	EMC184045B	980135	10/27/2021	10/26/2022
Pre-Amplifier	HP	8447D	2944A07676	12/16/2021	12/15/2022
Attenuator	Mini-Circuit	BW-S10W2+	4	12/14/2021	12/13/2022
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M1	12/14/2021	12/13/2022
High Pass Filter	WI	WHKX4.0/18G-10SS	22	12/14/2021	12/13/2022
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY2636/2	12/16/2021	12/15/2022
Coaxial Cable	Huber Suhner	SUCOFLEX 104	340057/4	12/16/2021	12/15/2022
Coaxial Cable	Huber Suhner	SUCOFLEX 104PEA	800052/2	12/16/2021	12/15/2022
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY2621/2	12/16/2021	12/15/2022
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY2617/2	12/16/2021	12/15/2022
Site Cal	SGS	SAC 3	N/A	01/01/2022	12/31/2022

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 (dB μ V)	
	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

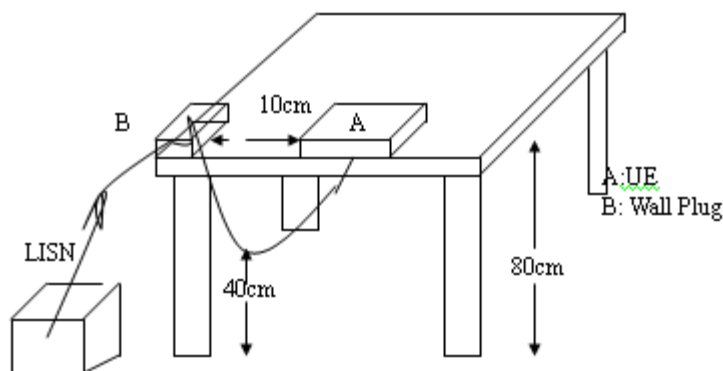
Note

- 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 120Vac/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:

N/A; Powered from AAA battery.

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8 PEAK OUTPUT POWER MEASUREMENT

8.1 Standard Applicable:

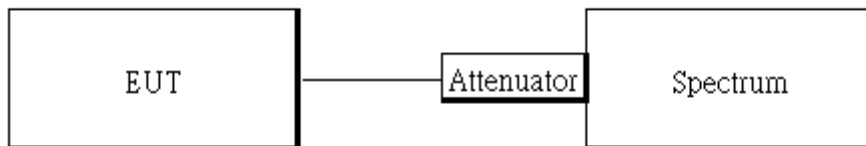
For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt and the e.i.r.p. shall not exceed 4 W.

If the transmitting antenna of directional gain greater than 6dBi are used the peak output power from 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.

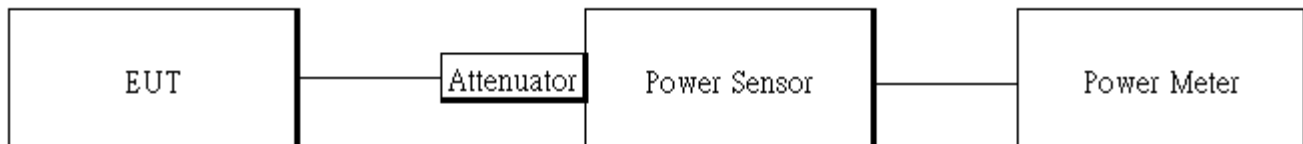
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

8.2 Test Setup

8.2.1 Duty Cycle



8.2.2 Output Power



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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

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.

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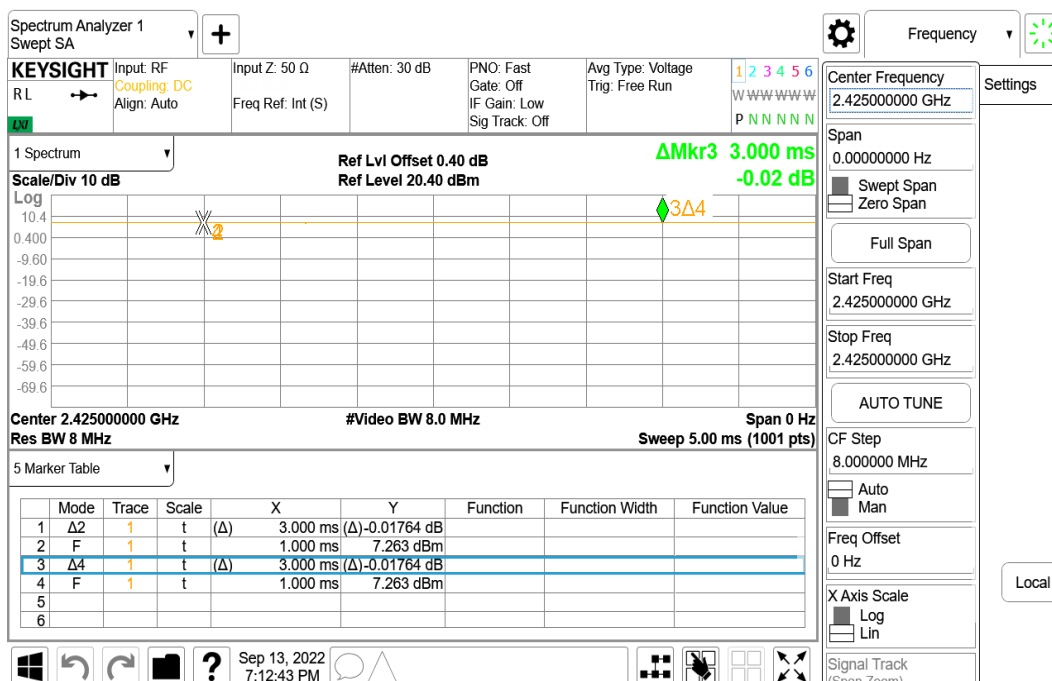
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8.4 Duty Factor:

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
Zigbee	100.00	0.00	0.33	0.01

Zigbee_LowCH15-2425



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8.5 Output Power:

8.5.1 Peak & Avg

Zigbee mode:

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2425	5	4.52	30
Mid	2450	5	4.52	30
High	2475	5	4.49	30
CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit (dBm)
Low	2425	5	4.49	30
Mid	2450	5	4.48	30
High	2475	5	4.45	30

**Note: Measured by power meter, cable loss 0.4 dB + Duty cycle factor has been offsetted to the power meter for Avg. power and cable loss has been offsetted for Peak power measurement.*

8.5.2 EIRP

EIRP Zigbee mode

CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit
Low	2425	5	4.49	2.82	7.31	4W= 36 dBm
Mid	2450	5	4.48	2.82	7.30	4W= 36 dBm
High	2475	5	4.45	2.82	7.27	4W= 36 dBm

** Note: EIRP = Average Power + Gain*

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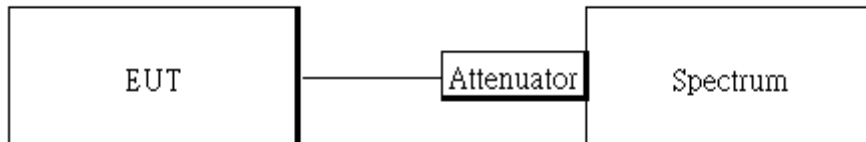
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9 EMISSION BANDWIDTH MEASUREMENT

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. 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 the spectrum analyzer as
RBW= 1 % to 5% of OBW ,
VBW = 3 X RBW,
Span= 2 to 5 times of the OBW,
Sweep=auto,
Detector = Peak, and Max hold for 20dB Bandwidth test.
5. Mark the peak frequency and -20dB (upper and lower) frequency
6. Set the spectrum analyzer as
RBW= 1 % to 5% of 99% Bandwidth ,
VBW $\geq$ 3 X RBW,
Span= large enough to capture all products of the modulation process,
Sweep=auto,
Detector = Peak, and Max hold for 99% Bandwidth test.
7. Mark the peak frequency and 99%dB (upper and lower) frequency.
8. Repeat above procedures until all test default channel is completed

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9.4 Measurement Result:

Zigbee mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2425	1.578	≥ 0.5	PASS
2450	1.58	≥ 0.5	PASS
2475	1.579	≥ 0.5	PASS

Zigbee mode

Frequency (MHz)	99%Bandwidth (MHz)
2425	2.3404
2450	2.3342
2475	2.3374

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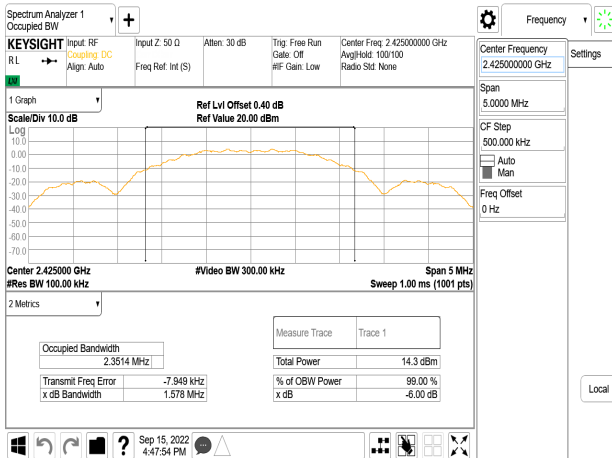
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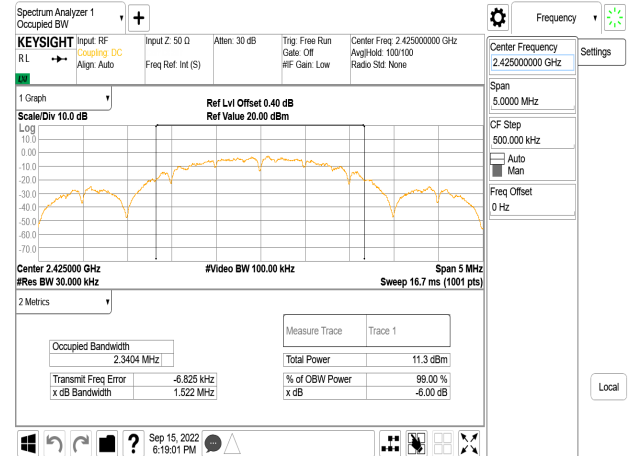
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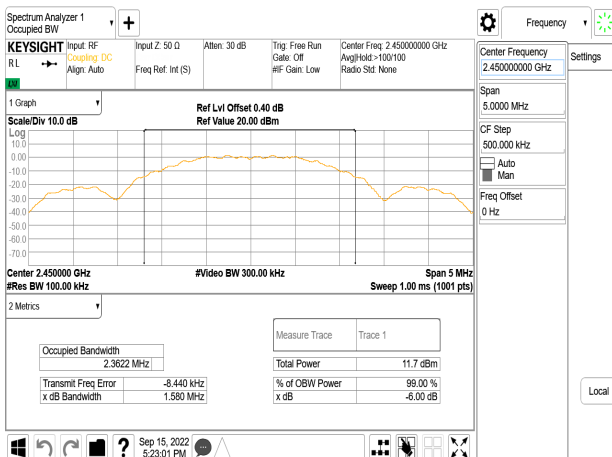
OBW_Zigbee_LowCH15-2425MHz



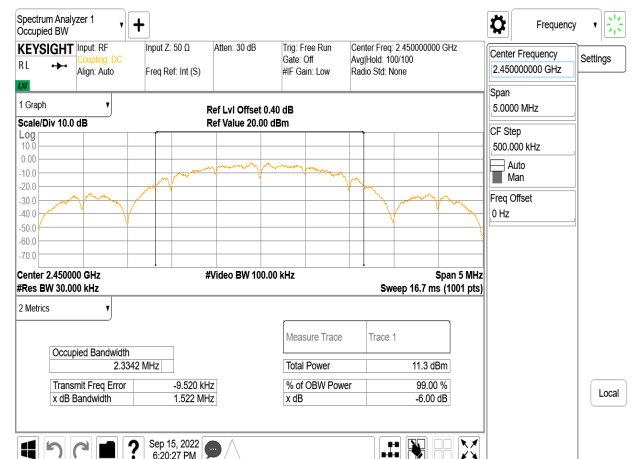
IC OBW_Zigbee_LowCH15-2425MHz



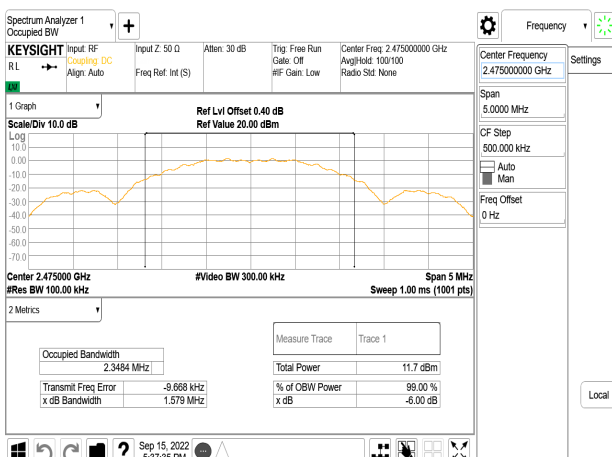
OBW_Zigbee_MidCH20-2450MHz



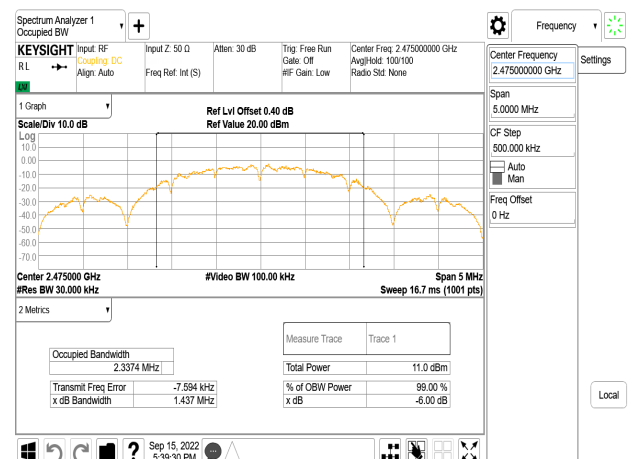
IC OBW_Zigbee_MidCH20-2450MHz



OBW_Zigbee_HighCH25-2475MHz



IC OBW_Zigbee_HighCH25-2475MHz



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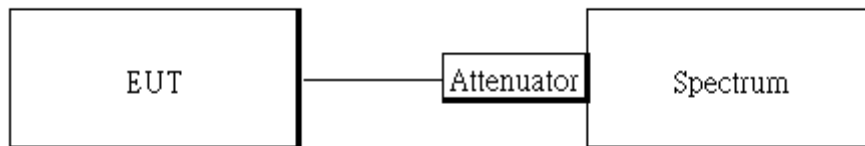
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10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

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

Zigbee_Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2425	4.19	-15.81
2450	1.62	-18.38
2475	1.57	-18.43

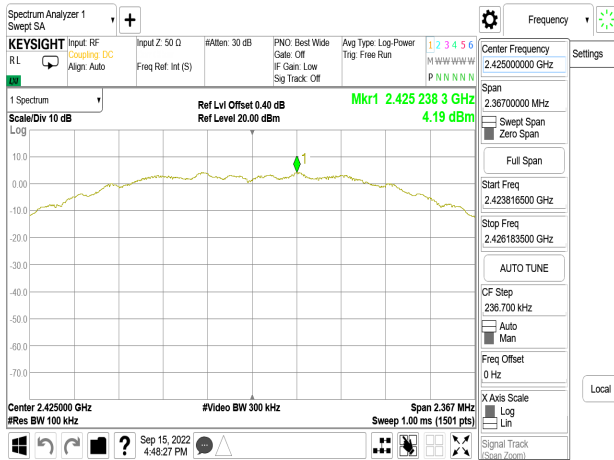
NOTE: cable loss as 0.4dB that offsets in the spectrum

NOTE: Refer to next page for plots.

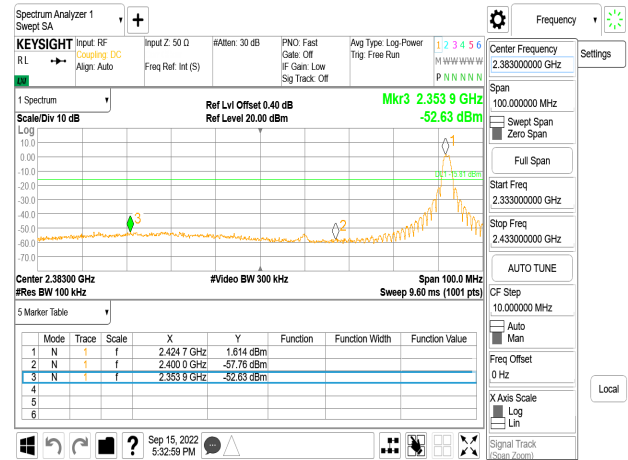
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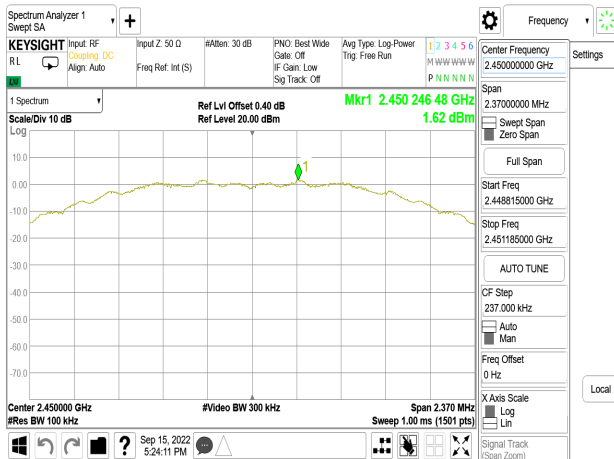
Reference Level_Zigbee_LowCH15-2425MHz



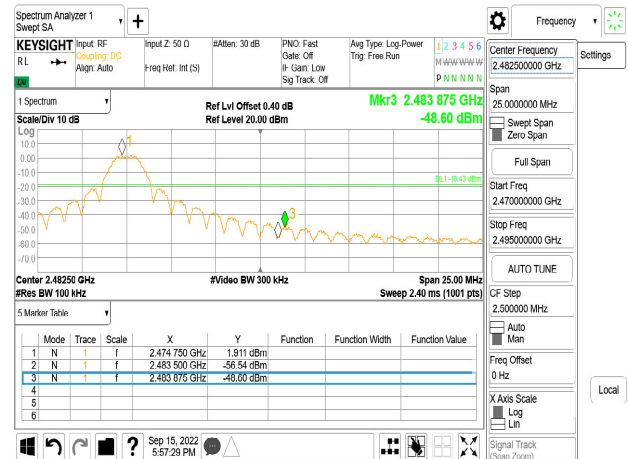
Band Edge_Zigbee_LowCH15-2425MHz



Reference Level_Zigbee_MidCH20-2450MHz



Band Edge_Zigbee_HighCH25-2475MHz



Reference Level_Zigbee_HighCH25_2475MHz

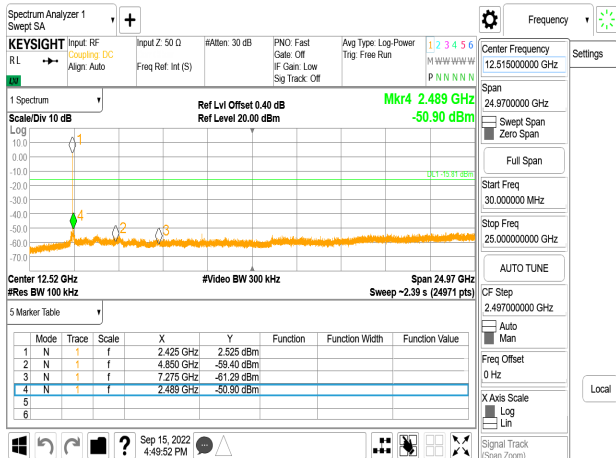


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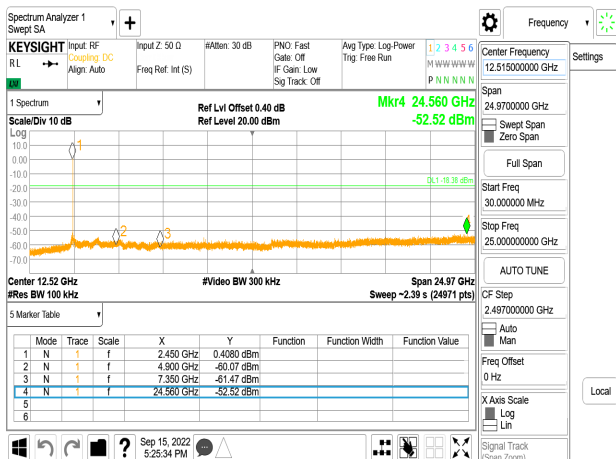
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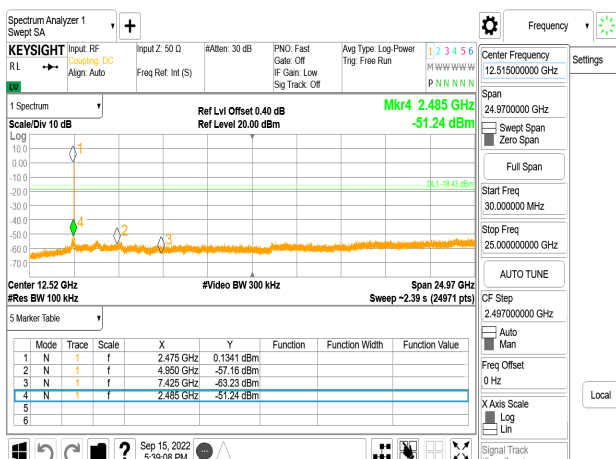
Spurious Emission_Zigbee_LowCH15-2425MHz



Spurious Emission_Zigbee_MidCH20-2450MHz



Spurious Emission_Zigbee_HighCH25-2475MHz



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SGS Taiwan Ltd.

No.134,Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan/新北市五股區新北產業園區五工路 134 號

台灣檢驗科技股份有限公司

t (886-2) 2299-3279

f (886-2) 2298-0488

www.sgs.com.tw

Member of SGS Group

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.

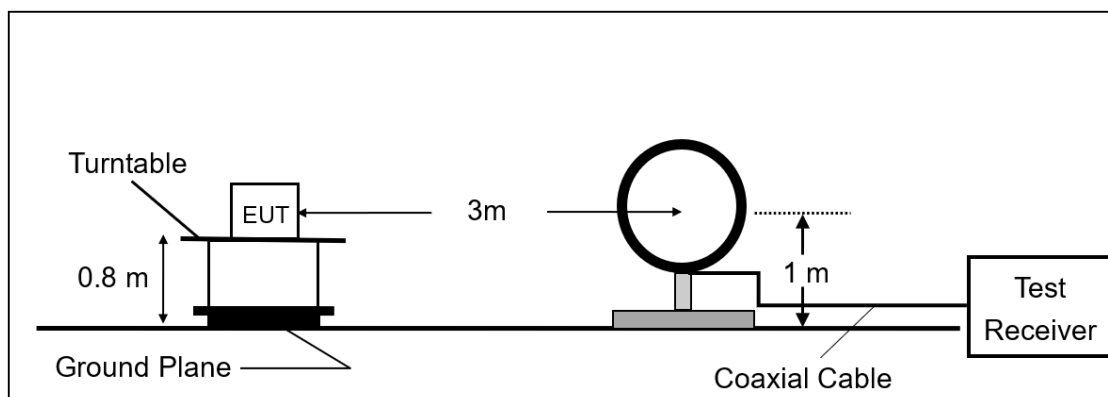
Frequency (MHz)	Field strength (microvolts/meter)	Distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

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

11.2 Test Setup

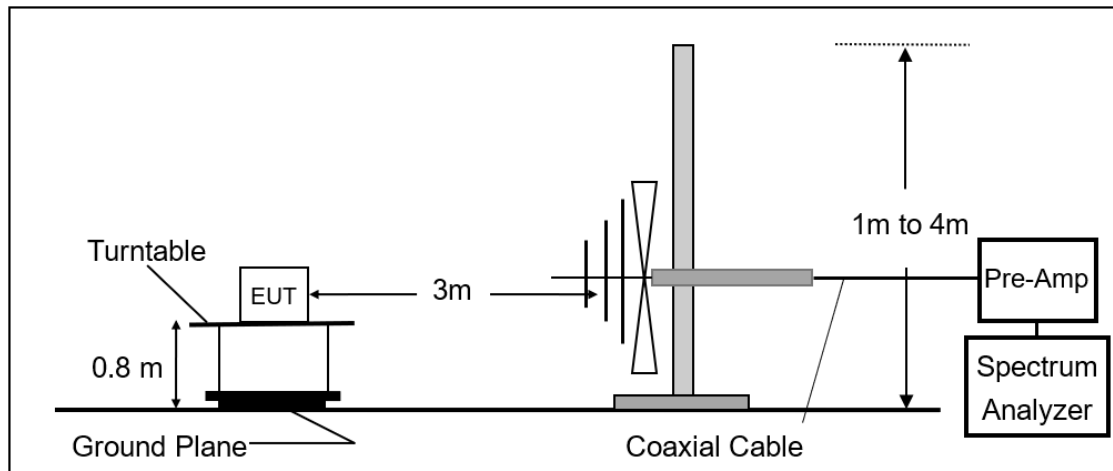
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz.



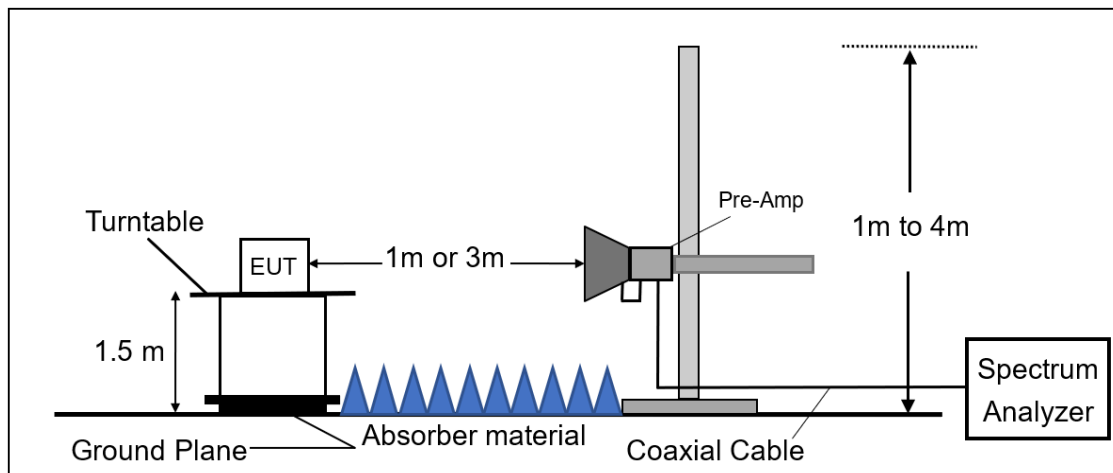
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(B) Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz.



(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

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

The limit of the emission level is expressed in dBuV/m, which converts $20 \cdot \log(uV/m)$

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

Factor(dB) = Antenna Factor(dBuV/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.

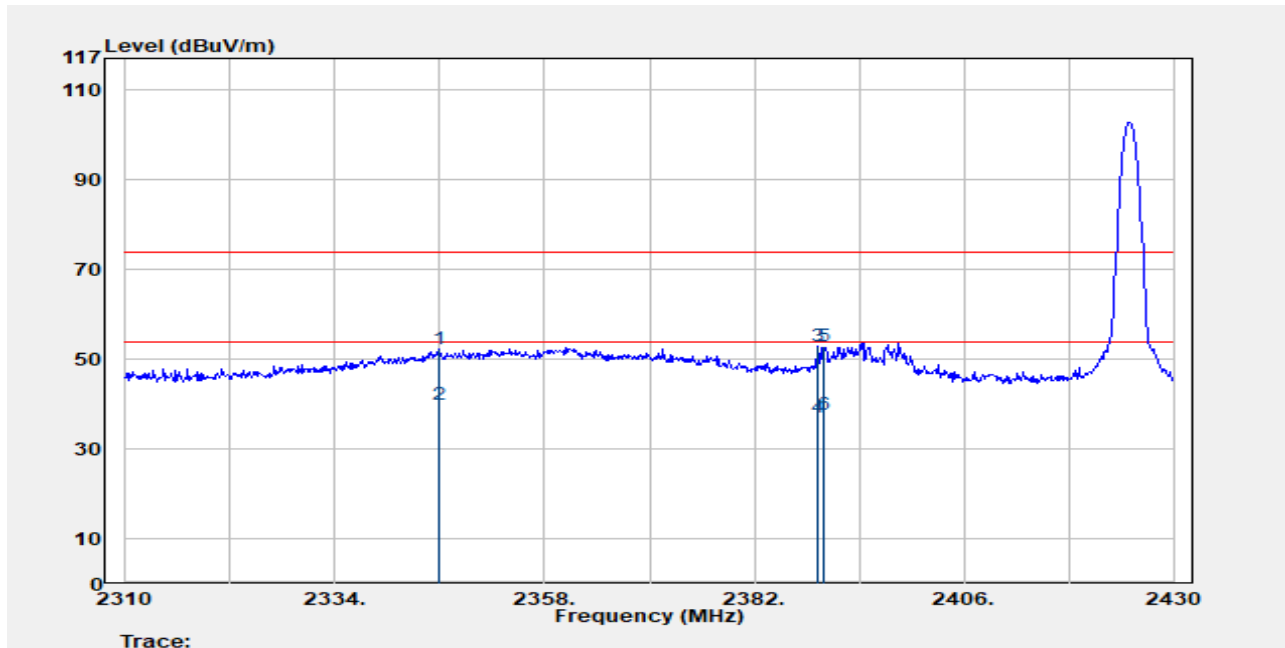
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11.6.1 Radiated Band Edge Measurement Result

Report Number :TERF2209001707ER
 Operation Mode :ZigBee
 Test Frequency :2425 MHz
 Test Mode :Bandedge
 EUT Pol :E1 Plane

Test Site :SAC 3
 Test Date :2022-09-19
 Temp./Humi. :24.6/67
 Antenna Pol. :VERTICAL
 Engineer :Nick Lin



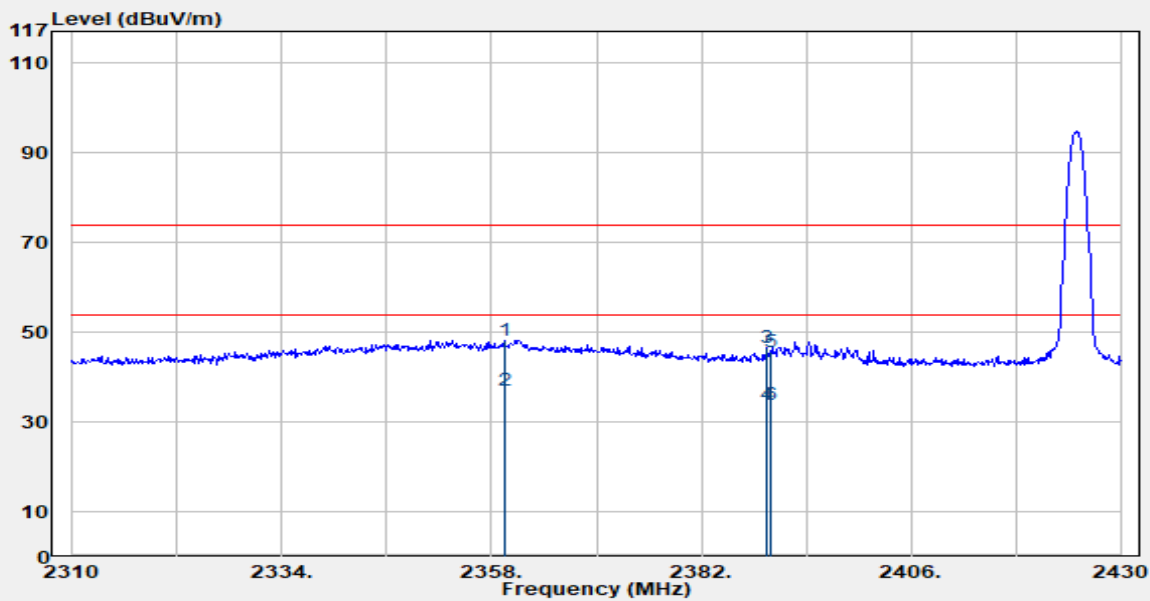
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2346.000	Peak	51.28	1.15	52.44	74.00	-21.56
2346.000	Average	38.91	1.15	40.06	54.00	-13.94
2389.320	Peak	51.71	1.18	52.89	74.00	-21.11
2389.320	Average	35.98	1.18	37.16	54.00	-16.84
2390.000	Peak	51.75	1.18	52.93	74.00	-21.07
2390.000	Average	36.48	1.18	37.66	54.00	-16.34

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Report Number :TERF2209001707ER
 Operation Mode :ZigBee
 Test Frequency :2425 MHz
 Test Mode :Bandedge
 EUT Pol :E1 Plane

Test Site :SAC 3
 Test Date :2022-09-19
 Temp./Humi. :24.6/67
 Antenna Pol. :Horizontal
 Engineer :Nick Lin



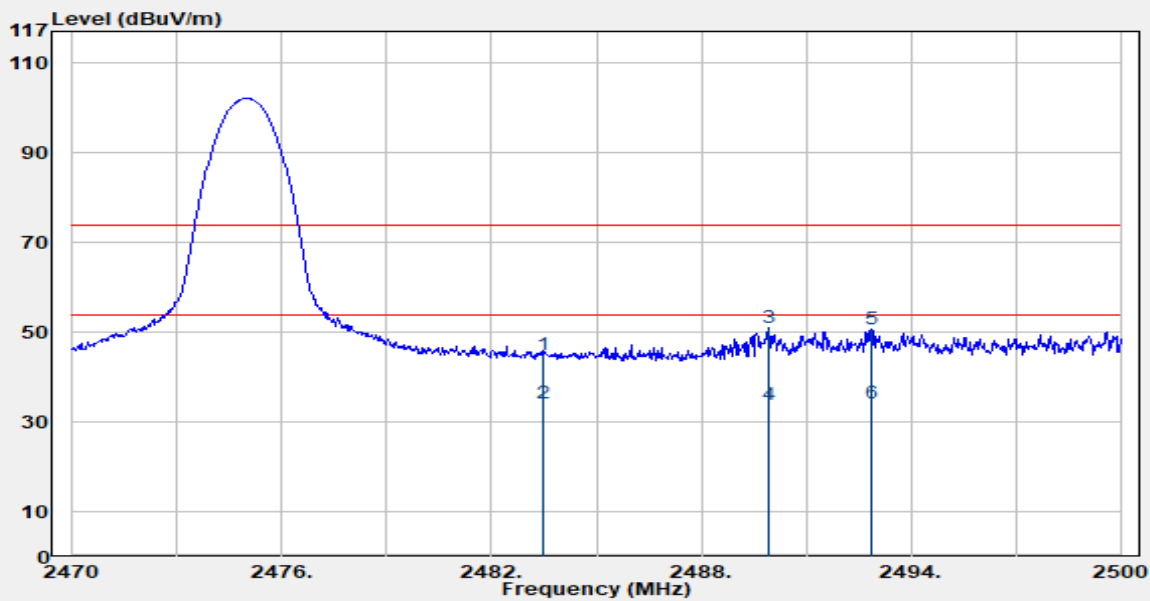
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2359.440	Peak	47.13	1.18	48.30	74.00	-25.70
2359.440	Average	35.97	1.18	37.15	54.00	-16.85
2389.560	Peak	45.41	1.18	46.60	74.00	-27.40
2389.560	Average	32.75	1.18	33.93	54.00	-20.07
2390.000	Peak	44.52	1.18	45.70	74.00	-28.30
2390.000	Average	32.88	1.18	34.06	54.00	-19.94

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Report Number :TERF2209001707ER
 Operation Mode :ZigBee
 Test Frequency :2475 MHz
 Test Mode :Bandedge
 EUT Pol :E1 Plane

Test Site :SAC 3
 Test Date :2022-09-19
 Temp./Humi. :24.6/67
 Antenna Pol. :Vertical
 Engineer :Nick Lin



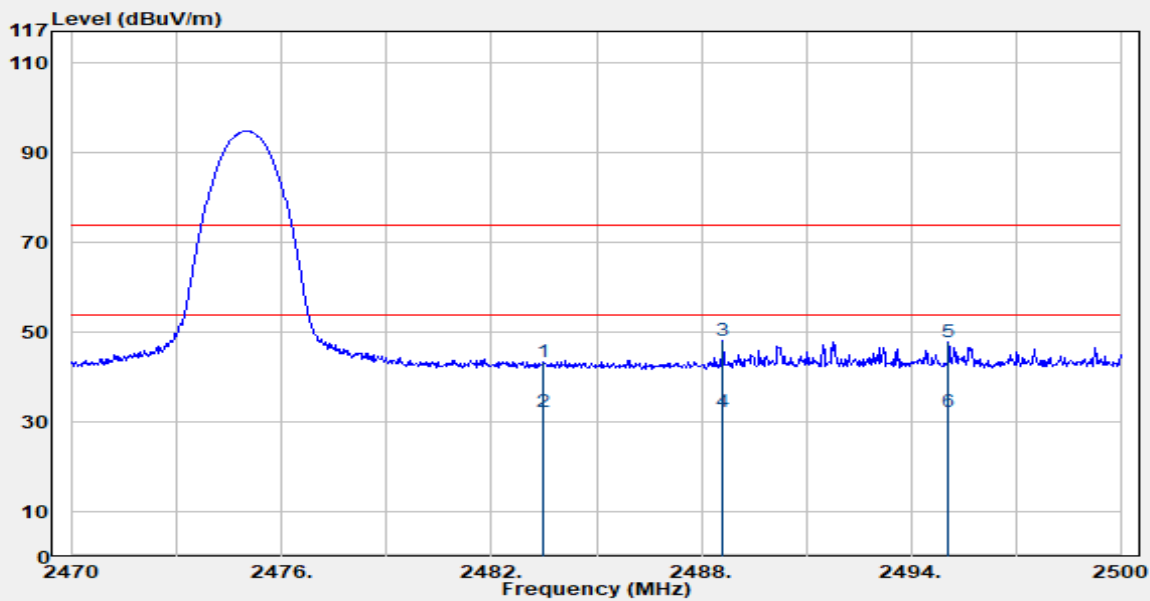
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBUV	Factor dB	Actual FS dBUV/m	Limit @3m dBUV/m	Margin dB
2483.500	Peak	43.89	1.09	44.98	74.00	-29.02
2483.500	Average	33.11	1.09	34.20	54.00	-19.80
2489.950	Peak	50.08	1.13	51.21	74.00	-22.79
2489.950	Average	32.93	1.13	34.06	54.00	-19.94
2492.890	Peak	49.65	1.14	50.79	74.00	-23.21
2492.890	Average	33.07	1.14	34.21	54.00	-19.79

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Report Number :TERF2209001707ER
 Operation Mode :ZigBee
 Test Frequency :2475 MHz
 Test Mode :Bandedge
 EUT Pol :E1 Plane

Test Site :SAC 3
 Test Date :2022-09-19
 Temp./Humi. :24.6/67
 Antenna Pol. :Horizontal
 Engineer :Nick Lin



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	Peak	42.33	1.09	43.42	74.00	-30.58
2483.500	Average	31.26	1.09	32.35	54.00	-21.65
2488.630	Peak	46.94	1.12	48.06	74.00	-25.94
2488.630	Average	31.16	1.12	32.28	54.00	-21.72
2495.080	Peak	46.60	1.15	47.75	74.00	-26.25
2495.080	Average	31.31	1.15	32.46	54.00	-21.54

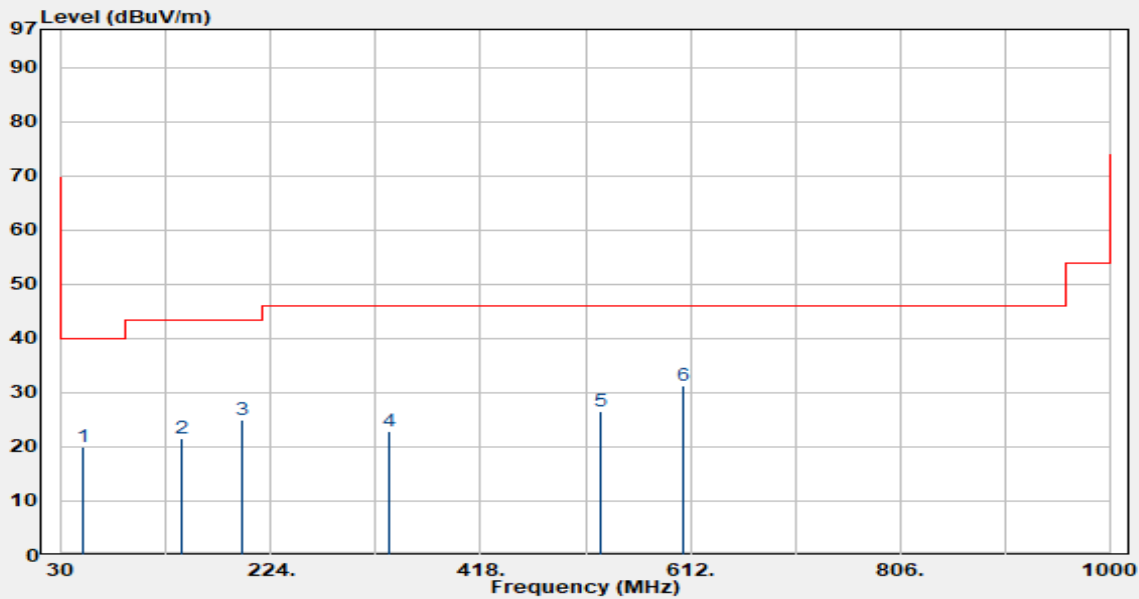
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11.6.2 Radiated Spurious Emission

Report Number :TERF2209001707ER
 Operation Mode :ZigBee
 Test Frequency :2450 MHz
 Test Mode :Tx
 EUT Pol :E1 Plane

Test Site :SAC 3
 Test Date :2022-09-19
 Temp./Humi. :24.6/67
 Antenna Pol. :Vertical
 Engineer :Nick Lin



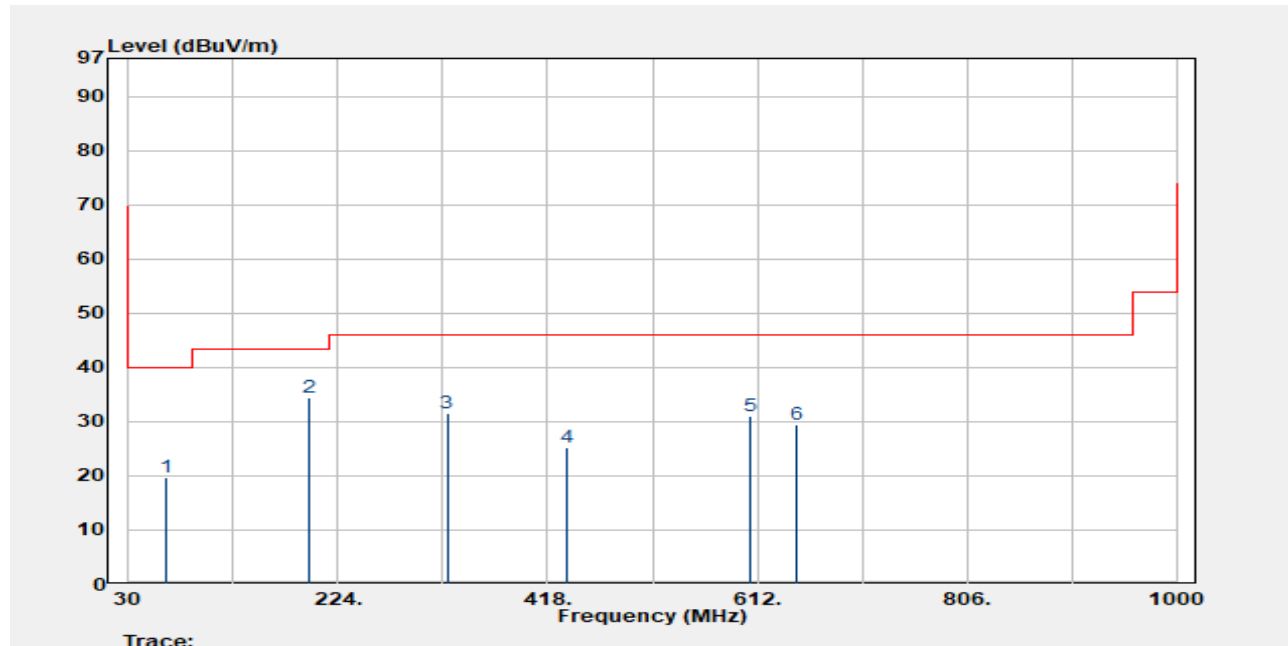
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
49.400	Peak	28.38	-8.53	19.85	40.00	-20.15
141.550	Peak	29.88	-8.25	21.62	43.50	-21.88
196.840	Peak	35.62	-10.62	25.00	43.50	-18.50
332.640	Peak	28.47	-5.54	22.94	46.00	-23.06
529.550	Peak	28.40	-1.79	26.61	46.00	-19.39
605.210	Peak	31.12	0.10	31.22	46.00	-14.78

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Report Number :TERF2209001707ER
 Operation Mode :ZigBee
 Test Frequency :2450 MHz
 Test Mode :Tx
 EUT Pol :E1 Plane

Test Site :SAC 3
 Test Date :2022-09-19
 Temp./Humi. :24.6/67
 Antenna Pol. :Horizontal
 Engineer :Nick Lin



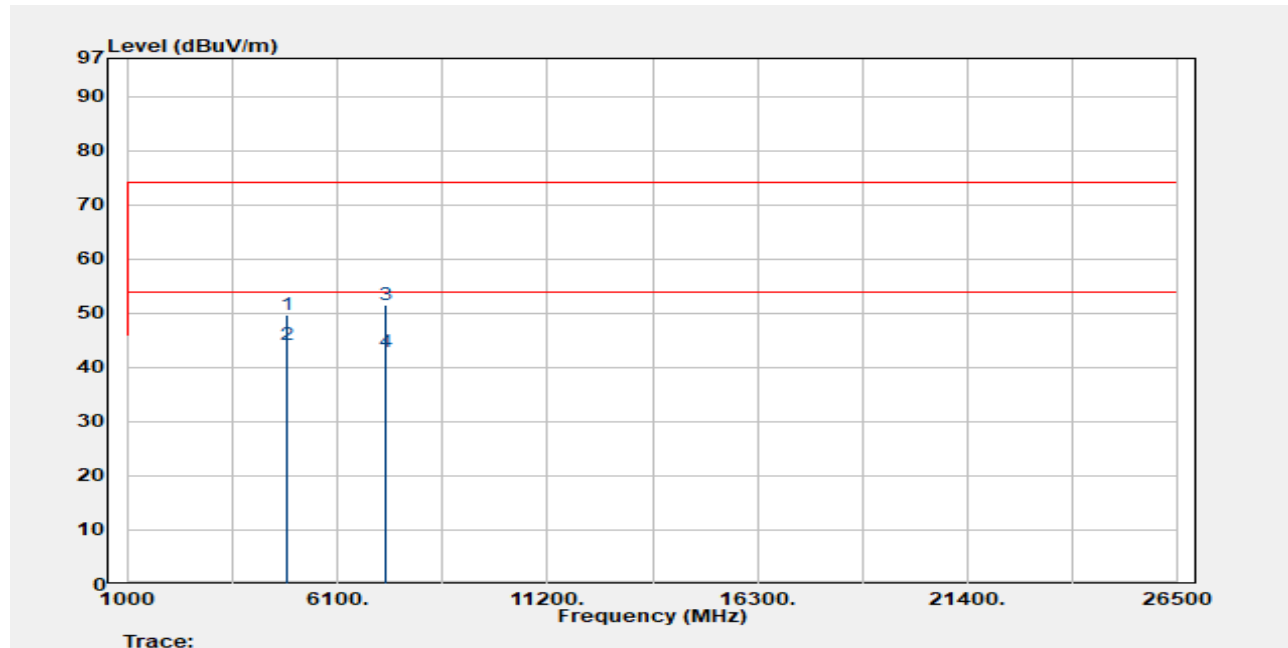
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
64.920	Peak	29.57	-9.81	19.76	40.00	-20.24
196.840	Peak	45.07	-10.62	34.46	43.50	-9.04
324.880	Peak	37.37	-5.77	31.60	46.00	-14.40
435.460	Peak	29.12	-3.77	25.35	46.00	-20.65
605.210	Peak	30.92	0.10	31.02	46.00	-14.98
648.860	Peak	29.45	-0.11	29.34	46.00	-16.66

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Report Number :TERF2209001707ER
 Operation Mode :ZigBee
 Test Frequency :2425 MHz
 Test Mode :Tx
 EUT Pol :E1 Plane

Test Site :SAC 3
 Test Date :2022-09-19
 Temp./Humi. :24.6/67
 Antenna Pol. :Vertical
 Engineer :Nick Lin



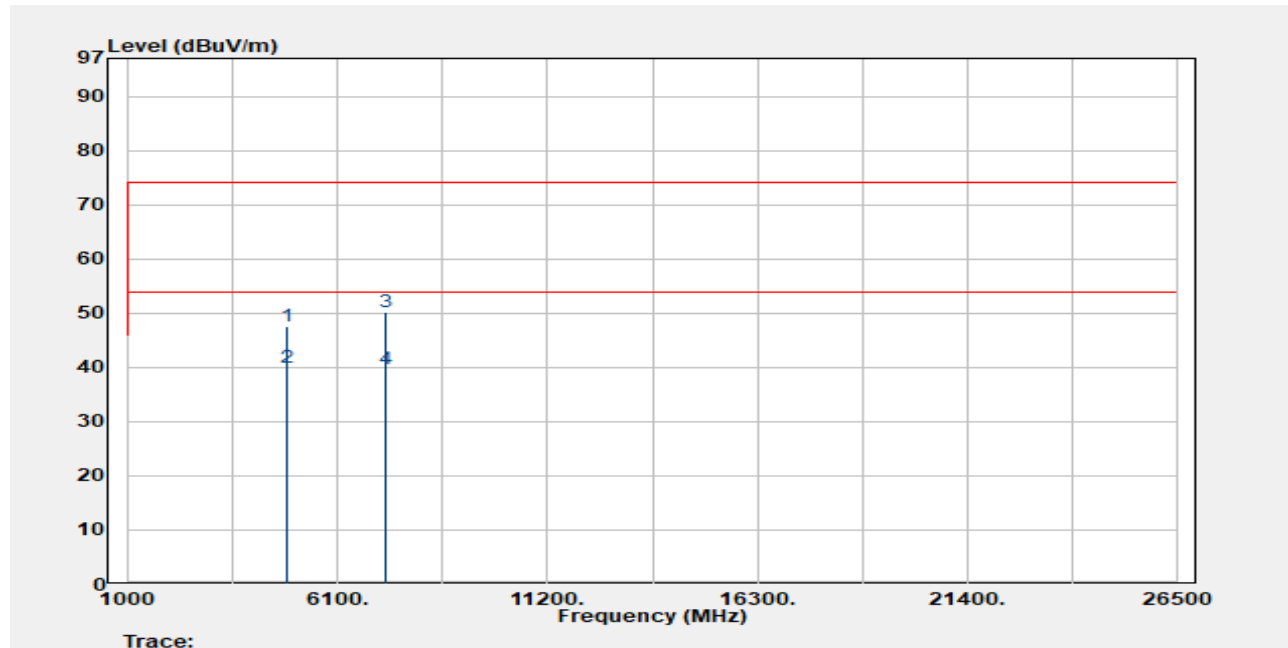
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4850.000	Peak	41.31	8.36	49.67	74.00	-24.33
4850.000	Average	35.93	8.36	44.29	54.00	-9.71
7275.000	Peak	36.56	15.00	51.56	74.00	-22.44
7275.000	Average	27.83	15.00	42.83	54.00	-11.17

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Report Number :TERF2209001707ER
 Operation Mode :ZigBee
 Test Frequency :2425 MHz
 Test Mode :Tx
 EUT Pol :E1 Plane

Test Site :SAC 3
 Test Date :2022-09-19
 Temp./Humi. :24.6/67
 Antenna Pol. :Horizontal
 Engineer :Nick Lin



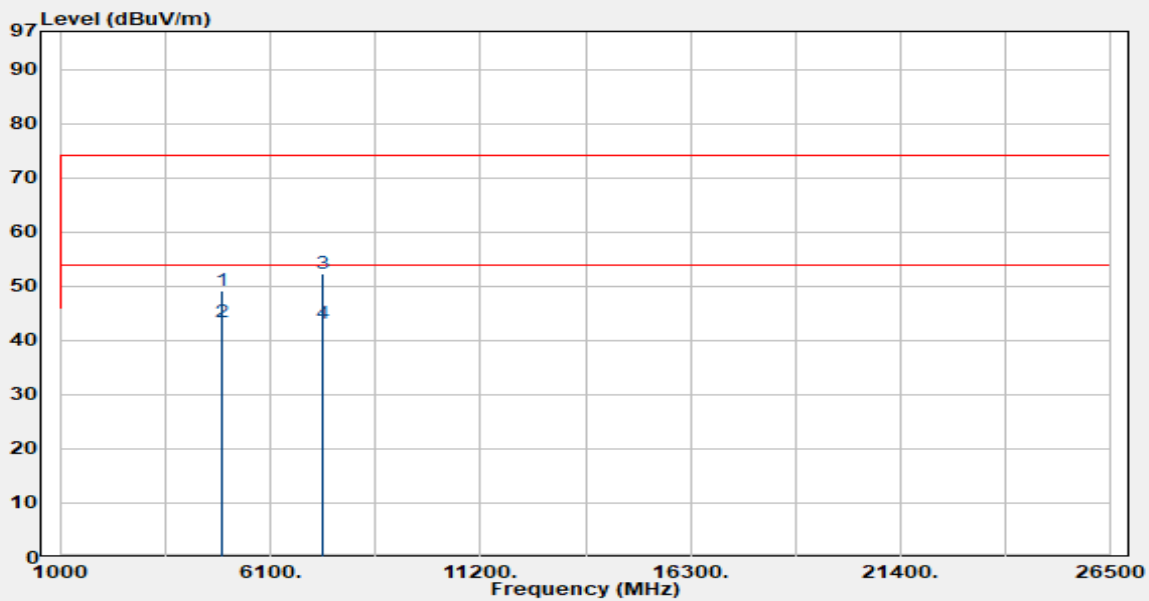
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
4850.000	Peak	39.30	8.36	47.66	74.00	-26.34
4850.000	Average	31.71	8.36	40.07	54.00	-13.93
7275.000	Peak	35.27	15.00	50.26	74.00	-23.74
7275.000	Average	24.68	15.00	39.68	54.00	-14.32

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Report Number :TERF2209001707ER
 Operation Mode :ZigBee
 Test Frequency :2450 MHz
 Test Mode :Tx
 EUT Pol :E1 Plane

Test Site :SAC 3
 Test Date :2022-09-19
 Temp./Humi. :24.6/67
 Antenna Pol. :Vertical
 Engineer :Nick Lin



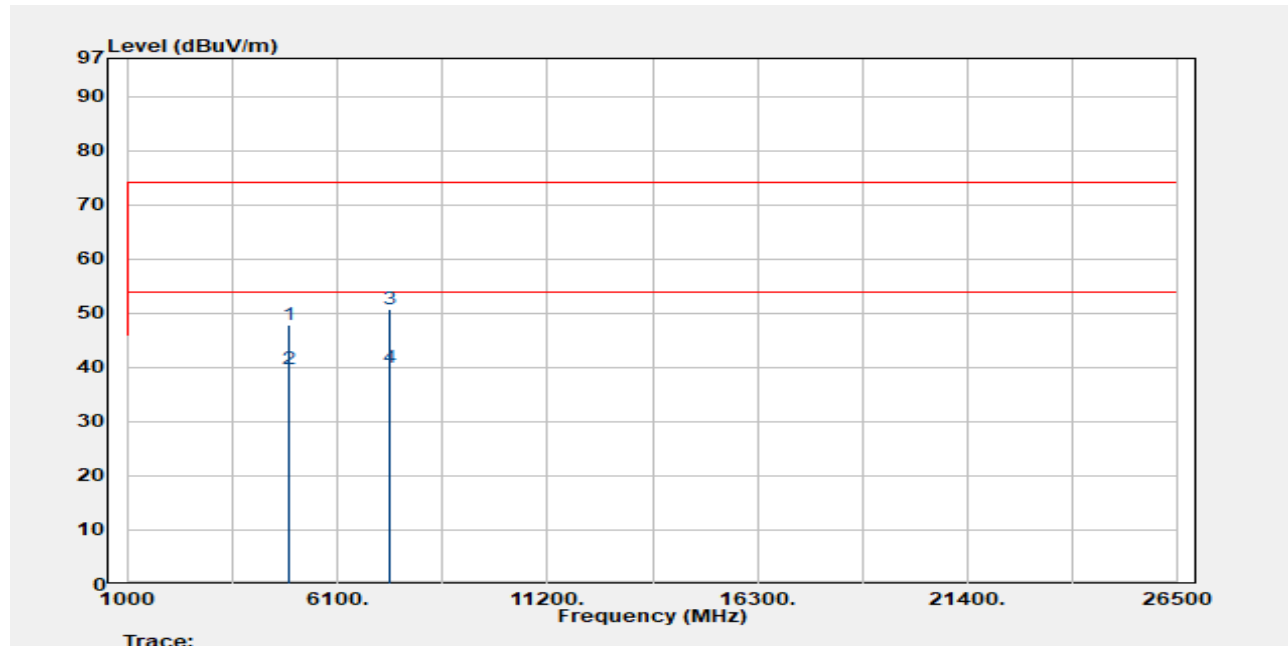
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4900.000	Peak	40.94	8.09	49.04	74.00	-24.96
4900.000	Average	35.38	8.09	43.47	54.00	-10.53
7350.000	Peak	37.51	14.93	52.44	74.00	-21.56
7350.000	Average	28.08	14.93	43.01	54.00	-10.99

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Report Number :TERF2209001707ER
 Operation Mode :ZigBee
 Test Frequency :2450 MHz
 Test Mode :Tx
 EUT Pol :E1 Plane

Test Site :SAC 3
 Test Date :2022-09-19
 Temp./Humi. :24.6/67
 Antenna Pol. :Horizontal
 Engineer :Nick Lin



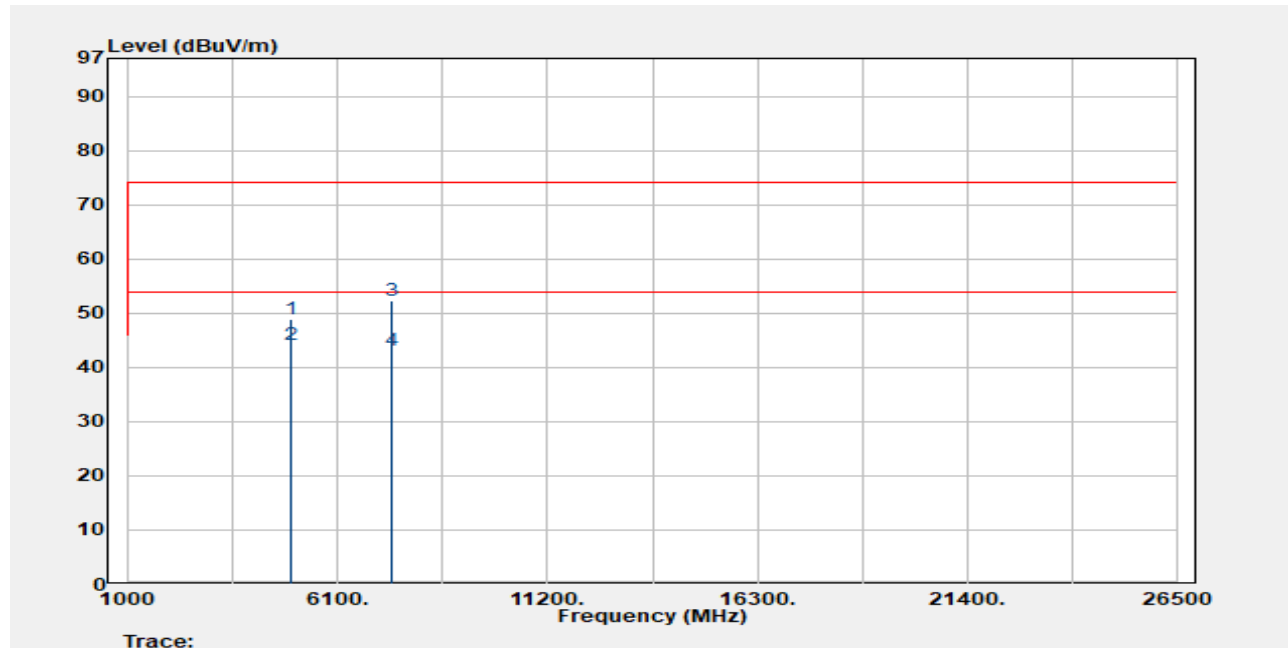
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4900.000	Peak	39.77	8.09	47.86	74.00	-26.14
4900.000	Average	31.55	8.09	39.64	54.00	-14.36
7350.000	Peak	35.69	14.93	50.62	74.00	-23.38
7350.000	Average	24.98	14.93	39.91	54.00	-14.09

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Report Number :TERF2209001707ER
 Operation Mode :ZigBee
 Test Frequency :2475 MHz
 Test Mode :Tx
 EUT Pol :E1 Plane

Test Site :SAC 3
 Test Date :2022-09-19
 Temp./Humi. :24.6/67
 Antenna Pol. :Vertical
 Engineer :Nick Lin



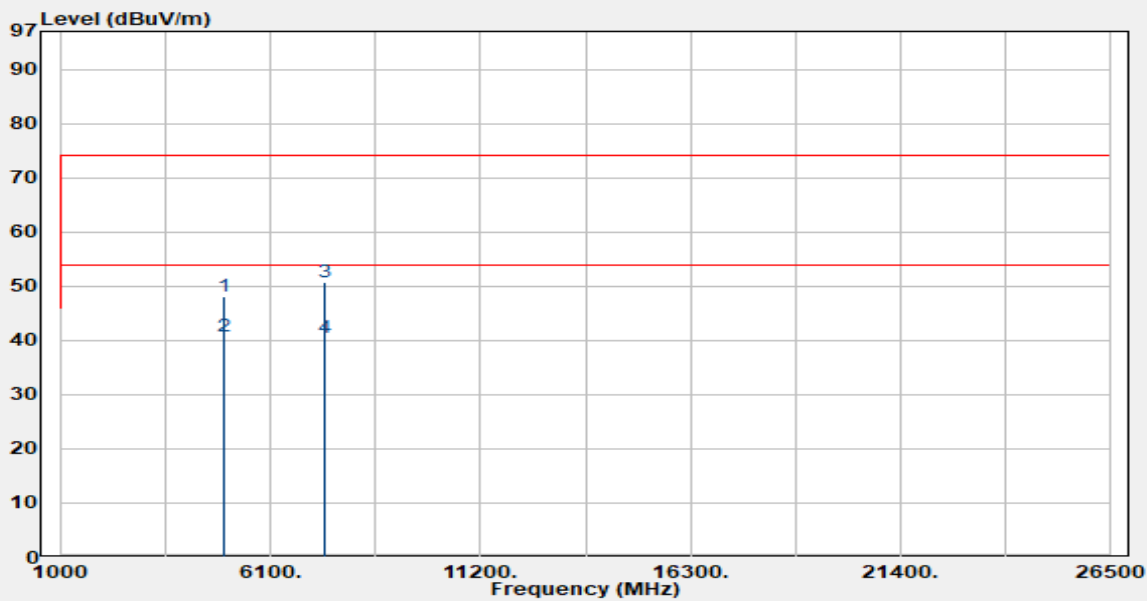
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4950.000	Peak	40.53	8.47	49.00	74.00	-25.00
4950.000	Average	35.69	8.47	44.16	54.00	-9.84
7425.000	Peak	36.71	15.47	52.18	74.00	-21.82
7425.000	Average	27.62	15.47	43.09	54.00	-10.91

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Report Number :TERF2209001707ER
 Operation Mode :ZigBee
 Test Frequency :2475 MHz
 Test Mode :Tx
 EUT Pol :E1 Plane

Test Site :SAC 3
 Test Date :2022-09-19
 Temp./Humi. :24.6/67
 Antenna Pol. :Horizontal
 Engineer :Nick Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4950.000	Peak	39.67	8.47	48.14	74.00	-25.86
4950.000	Average	32.35	8.47	40.82	54.00	-13.18
7425.000	Peak	35.17	15.47	50.64	74.00	-23.36
7425.000	Average	24.91	15.47	40.38	54.00	-13.62

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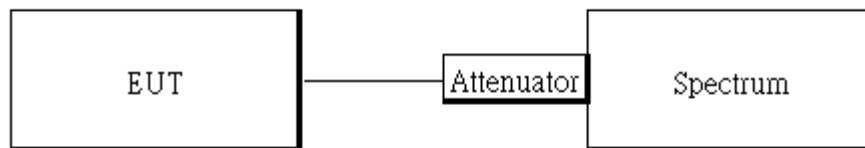
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12 POWER SPECTRAL DENSITY

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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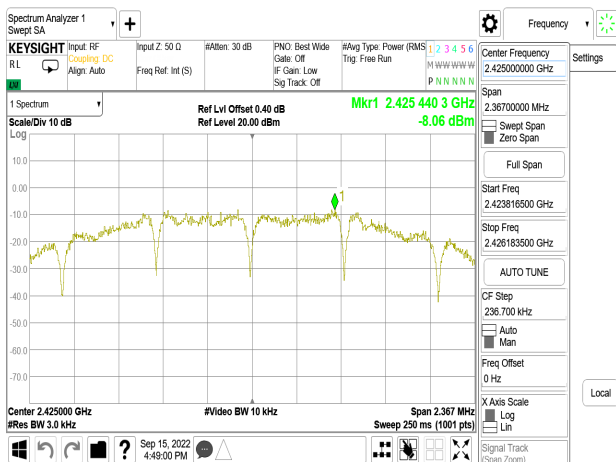
12.4 Measurement Result:

Zigbee mode

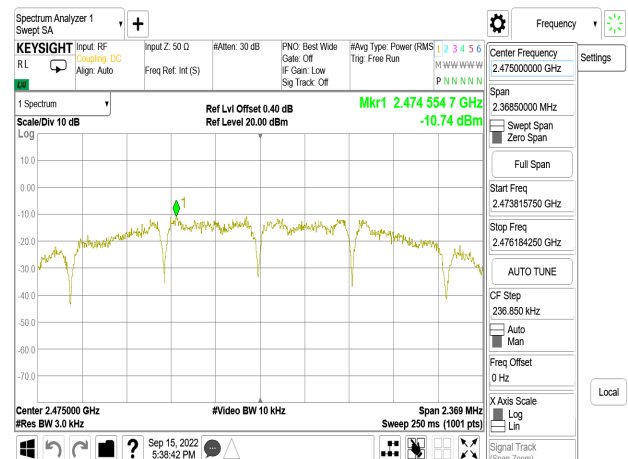
Frequency (MHz)	RF Power Density (dBm/3kHz)	Maximum Limit (dBm/3kHz)	Result
2425	-8.060	8	PASS
2450	-10.060	8	PASS
2475	-10.740	8	PASS

NOTE: cable loss as 0.4dB that offsets in the spectrum

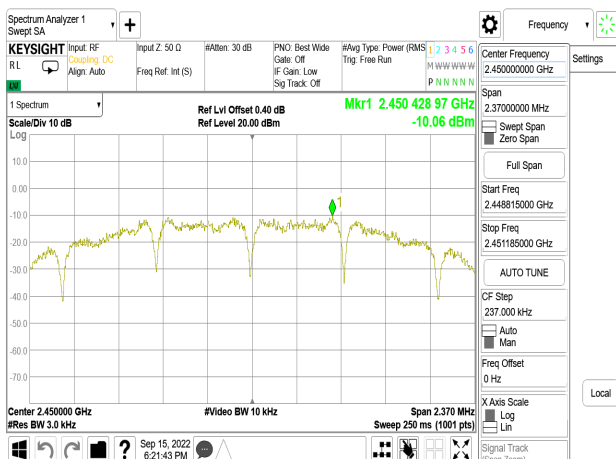
PSD_Zigbee_LowCH15-2425MHz



PSD_Zigbee_HighCH25-2475MHz



PSD_Zigbee_MidCH20-2450MHz



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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 ~

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No.134,Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan/新北市五股區新北產業園區五工路 134 號

t (886-2) 2299-3279

f (886-2) 2298-0488

www.sgs.com.tw

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