

## ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

**EUT Description**

ESL Base station

**Applicant:**

Opticon sensors Europe B.V.

Opaallaan 35, 2132 XV Hoofddorp, The Netherlands

**Manufacturer:**

Opticon sensors Europe B.V.

Opaallaan 35, 2132 XV Hoofddorp, The Netherlands

**Brand Name:**

Opticon

**Model No.:**

EBS-41

**Report Number:**

TERF2504001481E2

**FCC ID**

Q2Q-EBS41

**Date of EUT Received:** April 22, 2025**Date of Test:** May 5, 2025~May 16, 2025**Issue Date:** June 26, 2025**Approved By****Jay Lin****We hereby certify that:**

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

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

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## Revision History

Report Number	Revision	Description	Issue Date	Revised By	Remark
TERF2504001481E2	00	Original	June 3, 2025	Yuri Tsai	
TERF2504001481E2	01	Update section9.4	June 26, 2025	Yuri Tsai	*

**Note:**

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

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## 1 GENERAL INFORMATION

### 1.1 Product Description

EUT Description	ESL Base station
Brand Name:	Opticon
Model No.:	EBS-41
Hardware Version:	N/A
Firmware Version:	N/A
EUT Series No.:	0006
Power Supply:	12 Vdc
Test Software (Name/Version)	Opticon ESL Server Version 1.0.79.7

### 1.2 RF Specification

Radio Technology:	Zigbee
Frequency Range:	2405 – 2480MHz
Channel number:	16 channels
Modulation type:	DSSS
Transmit Power:	-1.05 dBm

### 1.3 Antenna Designation

Antenna Type	Freq. (MHz)	Peak Antenna Gain (dBi)
Dipole	2.4G	2

**Note:** 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  
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 SAC 2 SAC 3 Conduction 1 Conducted 1 Conducted 2 Conducted 3 Conducted 4 Conducted 5 Conducted 6	TW0027	
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C SAC C SAC D SAC G Conducted A Conducted B Conducted C Conducted D Conducted E Conducted F Conducted G	TW3702 TW0028	

**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.

Temperature:	19~22	°C	Relative Humidity:	62~68	%
Test site	Conducted D		Test Start:	05/06/2025	
Test Engineer:	Charlie		Test Done:	05/08/2025	

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## 1.6 Special Accessories

There are no special accessories used while test was conducted.

## 1.7 Equipment Modifications

There was no modification incorporated into the EUT.

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## 2 SYSTEM TEST CONFIGURATION

### 2.1 EUT Configuration

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

### 2.2 EUT Exercise

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

### 2.3 Test Procedure

#### 2.3.1 Conducted Emissions

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

#### 2.3.2 Conducted Test (RF)

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

#### 2.3.3 Radiated Emissions

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

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## 2.4 Measurement Results Explanation Example

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

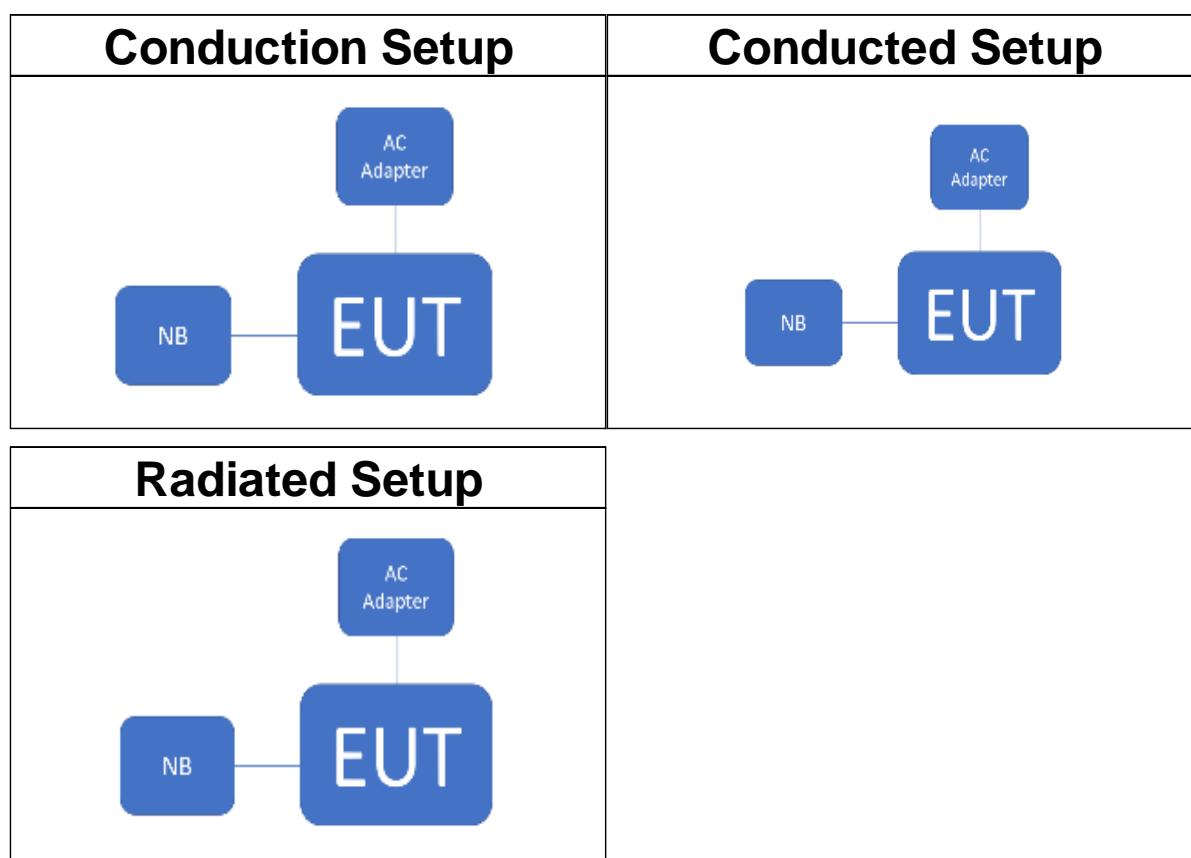
Radiated emission below 30MHz is measured in a 9m\*6m\*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

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

### 2.4.2 For all conducted test items:

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

## 2.5 Test Configuration



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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. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
LAN Cable	AMP	AMP-6e	4.71986E+12	N/A	N/A
AC Adapter	cullpower	icp12-120-1000D	N/A	N/A	N/A
Notebook	HP	HSN-Q35C-4	P0004691	N/A	N/A

Conducted Emission Test Site: Conducted D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
Notebook	Lenovo	T14	P0003332	N/A	N/A
AC Adapter	ULLPOWER	ICP12-120-1000D	N/A	N/A	N/A
LAN Cable	TATUN	E210587	N/A	N/A	N/A

Radiated Emission Test Site: SAC C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
LAN Cable	AMP	AMP-6e	4.72E+12	N/A	N/A
AC Adapter	cullpower	icp12-120-1000D	N/A	N/A	N/A
Notebook	HP	HSN-Q35C-4	P0004691	N/A	N/A

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### 3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	Peak Output Power	Compliant
§15.247(a)(2)	Emission Bandwidth	Compliant
§15.209 §15.247(d)	Conducted Band Edge and Spurious Emission	Compliant
§15.209 §15.247(d)	Radiated Band Edge and Spurious Emission	Compliant
§15.205	Restricted Bands	Compliant
§15.247(e)	Peak Power Density	Compliant
§15.203	Antenna Requirement	Compliant

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## 4 DESCRIPTION OF TEST MODES

### 4.1 Operating Frequencies

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

### 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. This EUT has two output ports: one EE Port and one SE Port. According to the power test, the output port with the worst performance, EE Port, is selected for testing.
4. Investigation has been done on all the possible configurations for searching the worst case.

CONDUCTED TEST			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
Zigbee	11 to 26	11,20,26	DSSS
TRANSMIT RADIATED EMISSION TEST			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
Zigbee	11 to 26	11,20,26	DSSS

**Note:** The field strength of radiated emission was measured as the EUT positioned in different orthogonal planes (E1/E2/H) based on actual usage of the EUT to pre-scan the emissions for determining the worst case scenario.

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## 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
	+/-	4.1	dB
	+/-	3.37	dB
	+/-	3.83	dB
Polarization: Horizontal	+/-	1.89	dB
	+/-	4.1	dB
	+/-	3.37	dB
	+/-	3.83	dB
Radiated Spurious Emission	+/-	2	dB
	+/-	1.59	dB
	+/-	1.71	dB
	+/-	1.64	dB
	+/-	3.84	dB

### 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. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
Coaxial Cable	EC Lab	RF-HY-CAB-250	RF-HY-CAB-250-01	03/27/2025	03/26/2026
EMI Test Receiver	R&S	ESCI	101342	04/23/2025	04/22/2026
LISN	SCHWARZBECK Mess-Elektronik	NSLK8127	974	06/26/2024	06/25/2025
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2025	03/26/2026
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 D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
Attenuator	Marvelous	MVE2213-10	RF08	11/14/2024	11/13/2025
Attenuator	Woken	WATT-218FS-10	RF17	11/14/2024	11/13/2025
DC Block	Marvelous	MVE6114	RF39	11/14/2024	11/13/2025
Power Meter	Anritsu	ML2496A	2138002	08/28/2024	08/27/2025
Power Sensor	Anritsu	MA2411B	1911390	08/28/2024	08/27/2025
Power Sensor	Anritsu	MA2411B	1911398	08/28/2024	08/27/2025
Spectrum Analyzer	KEYSIGHT	N9010A	MY51440113	09/18/2024	09/17/2025
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 C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
3m Site NSA	SGS	966 chamber C	N/A	03/02/2025	03/01/2026
Active Loop Antenna	COM-POWER	AL-130R	10160105	12/11/2024	12/10/2025
Attenuator	Woken	WATT-218FS-10	RF17	11/14/2024	11/13/2025
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-300	11/06/2024	11/05/2025
Coaxial Cable	EMCI+Huber Suhner	RG 214/U+EMC104-SM-SM-6000+EMC105-SM-SM-12000+15	W13.01+150813+23 10002+15	11/14/2024	11/13/2025
EMI Test Receiver	R&S	ESU 40	100363	05/06/2025	05/05/2026
Highpass Filter	R&S	F13 HPF 3GHz	RF167	11/14/2024	11/13/2025
Horn Antenna	Schwarzbeck	BBHA9120D	1187	02/05/2025	02/04/2026
Horn Antenna	Schwarzbeck	BBHA9170	184	12/20/2024	12/19/2025
Lowpass Filter	Woken	EWT-56-0019	RF163	11/14/2024	11/13/2025
Notch Filter	Micro-Tronics	BRM50701-02	RF208	11/14/2024	11/13/2025
Pre-Amplifier	EMC Instruments	EMC118A45SE	980789	11/14/2024	11/13/2025
Pre-Amplifier	EMC Instruments	EMC184045SEE	980881	11/14/2024	11/13/2025
Pre-Amplifier	EMC Instruments	EMC330	980091	11/14/2024	11/13/2025
Spectrum Analyzer	KEYSIGHT	N9010B	MY63440390	02/13/2025	02/12/2026
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 (dB $\mu$ 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

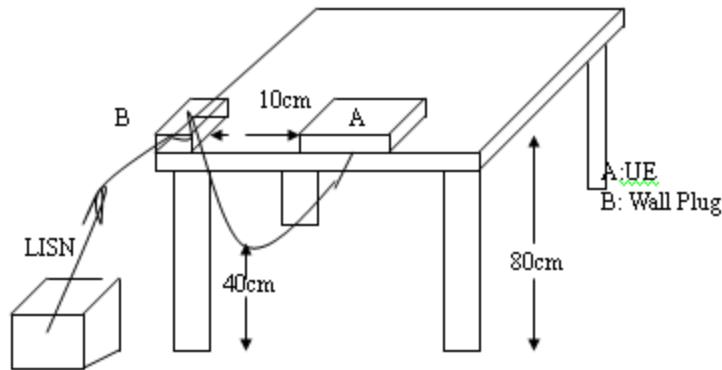
**Note**

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



### 7.4 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.

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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 \* reveals the worst-case results that closest to the limit.

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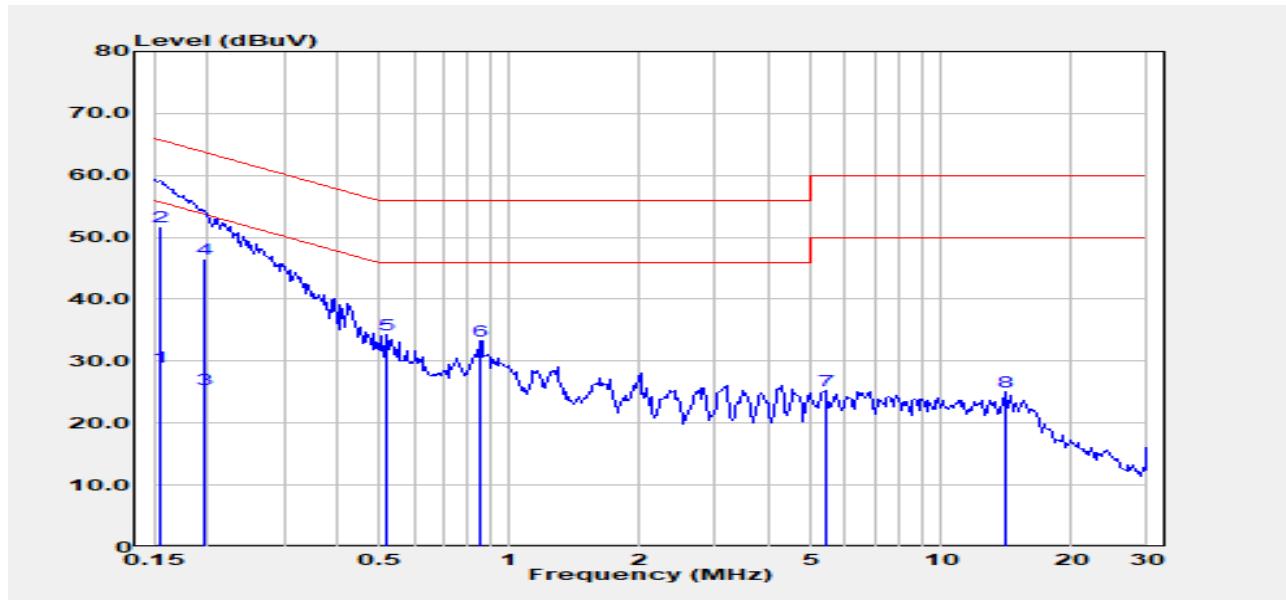
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**AC POWER LINE CONDUCTED EMISSION TEST DATA**

Report Number :TERF2504001481E2  
Test Mode :Zigbee  
Power :120V/60Hz  
Probe :L1

Test Site :Conduction C  
Test Date :2025-05-16  
Temp./Humi. :26.1°C/52%  
Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V	Limit dB $\mu$ V	Margin dB
0.155	Average	18.40	10.65	29.05	55.74	-26.69
0.155	QP	41.10	10.65	51.75	65.74	-13.99
0.198	Average	14.90	10.65	25.55	53.71	-28.16
0.198	QP	35.80	10.65	46.45	63.71	-17.26
0.518	Peak	23.58	10.62	34.20	56.00	-21.80
0.853	Peak	22.63	10.67	33.31	56.00	-22.69
5.390	Peak	14.39	10.95	25.35	60.00	-34.65
14.138	Peak	14.10	11.06	25.16	60.00	-34.84

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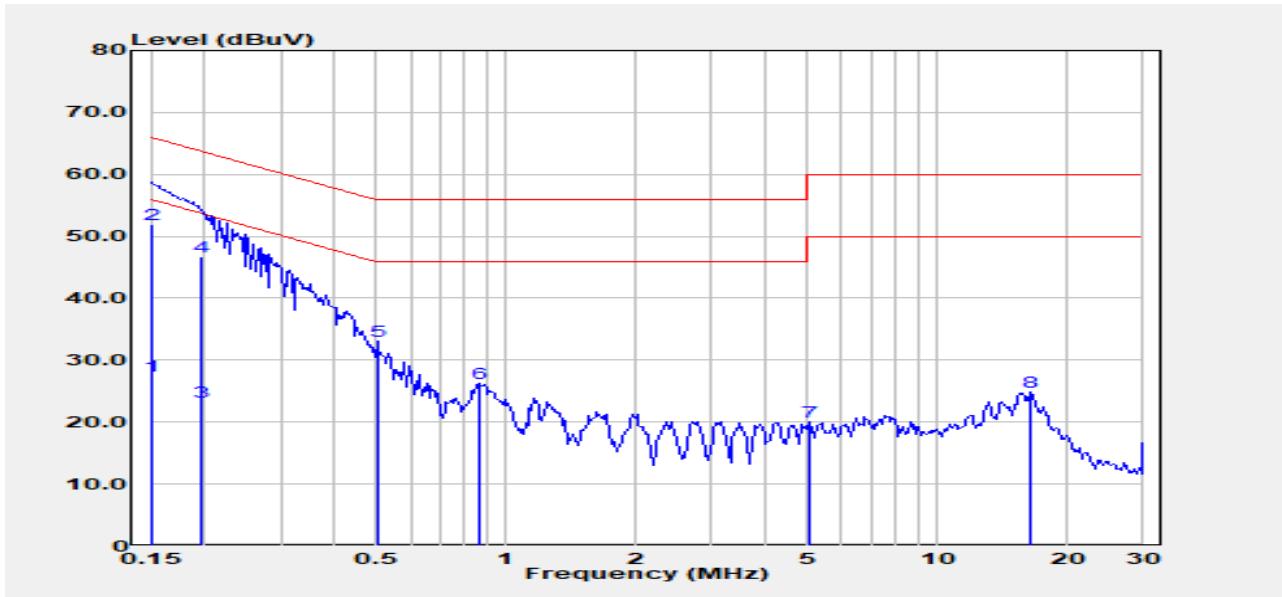
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Report Number :TERF2504001481E2  
Test Mode :Zigbee  
Power :120V/60Hz  
Probe :N

Test Site :Conduction C  
Test Date :2025-05-16  
Temp./Humi. :26.1°C/52%  
Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V	Limit dB $\mu$ V	Margin dB
0.150	Average	16.90	10.66	27.56	56.00	-28.44
0.150	QP	41.20	10.66	51.86	66.00	-14.14
0.195	Average	12.70	10.65	23.35	53.80	-30.45
0.195	QP	36.00	10.65	46.65	63.80	-17.15
0.502	Peak	22.40	10.60	33.00	56.00	-23.00
0.862	Peak	15.56	10.66	26.22	56.00	-29.78
5.058	Peak	9.17	10.94	20.11	60.00	-39.89
16.398	Peak	13.78	11.10	24.88	60.00	-35.12

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## 8 PEAK OUTPUT POWER MEASUREMENT

### 8.1 Standard Applicable:

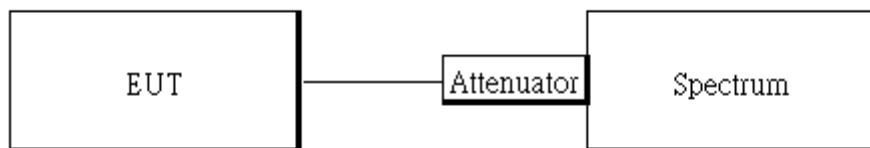
For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt.

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.

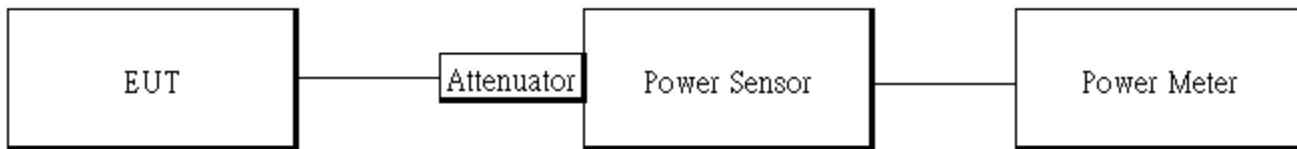
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

### 8.2 Test Setup

#### 8.2.1 Duty Cycle



#### 8.2.2 Output Power



### 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.

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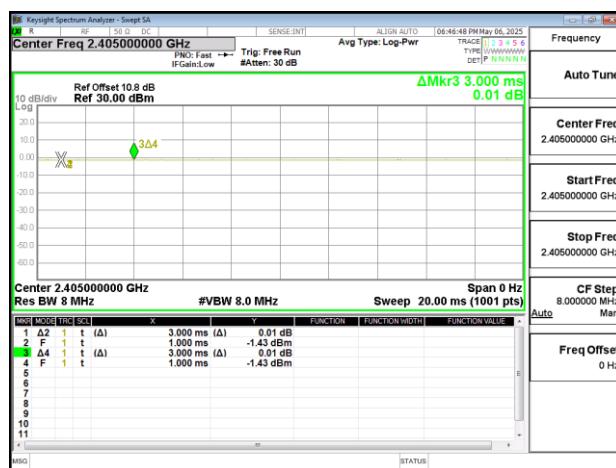
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2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.
4. Record the max. Reading as observed from Power Meter.
5. Repeat above procedures until all test default channel measured was complete.

#### 8.4 Duty Factor:

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

Zigbee\_LowCH11-2405



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## 8.5 Output Power:

### 8.5.1 Peak & Avg

#### Zigbee

CH	Frequency (MHz)	Power Setting	Peak Output Power (dBm)	Required Limit (dBm)
11	2405	default	-1.13	30
20	2450	default	-1.05	30
26	2480	default	-3.99	30

CH	Frequency (MHz)	Power Setting	Avg. Output Power (dBm)	Required Limit (dBm)
11	2405	default	-1.79	30
20	2450	default	-1.52	30
26	2480	default	-6.21	30

#### \*Note:

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

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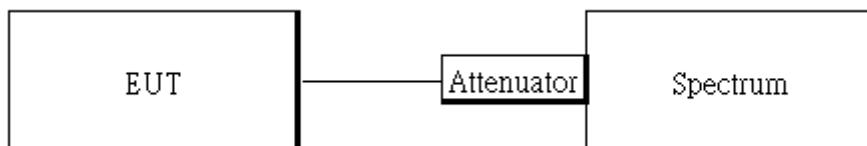
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## 9 EMISSION BANDWIDTH MEASUREMENT

### 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. 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  $\geq$  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:

### Zigbee

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2405	1.632	$\geq 0.5$	PASS
2450	1.616	$\geq 0.5$	PASS
2480	1.631	$\geq 0.5$	PASS

### Zigbee

Frequency (MHz)	99%Bandwidth (MHz)
2405	2.7255
2450	2.6051
2480	2.6319

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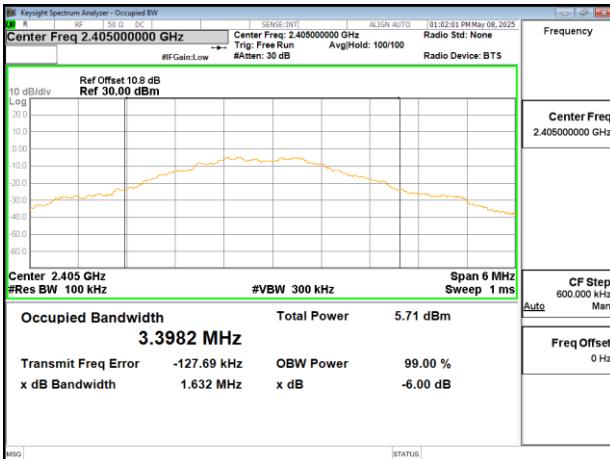
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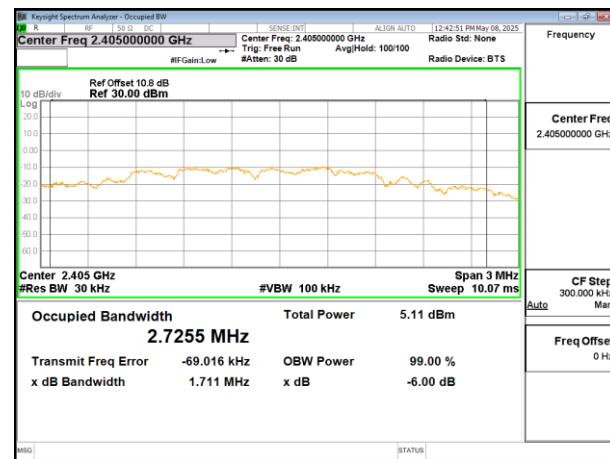
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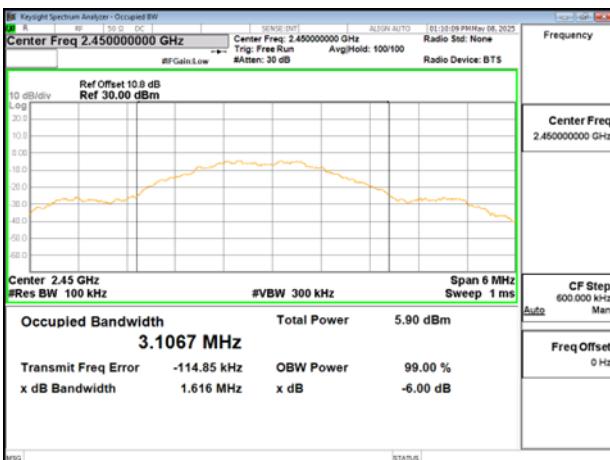
OBW\_Zigbee\_LowCH11-2405MHz



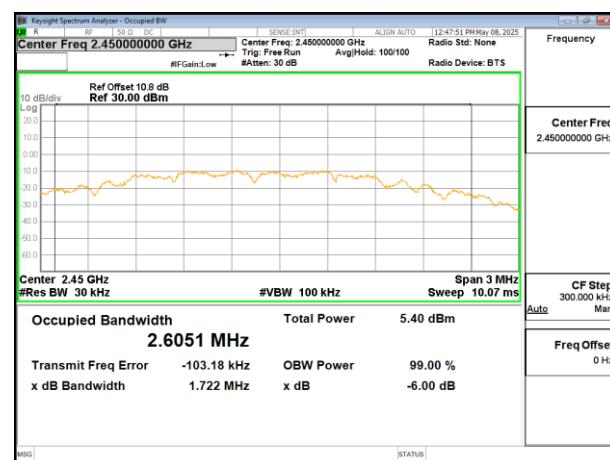
IC OBW\_Zigbee\_LowCH11-2405MHz



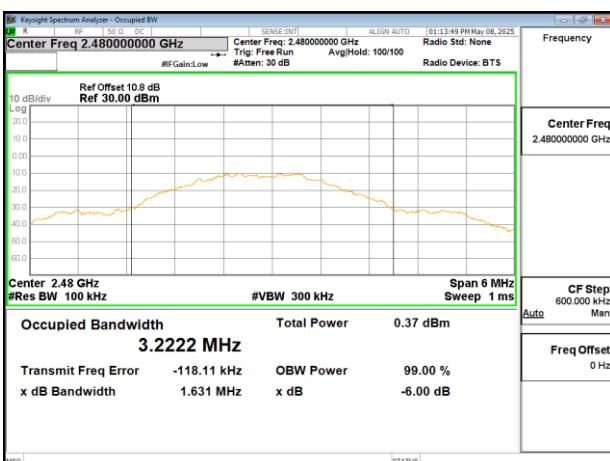
OBW\_Zigbee\_MidCH20-2450MHz



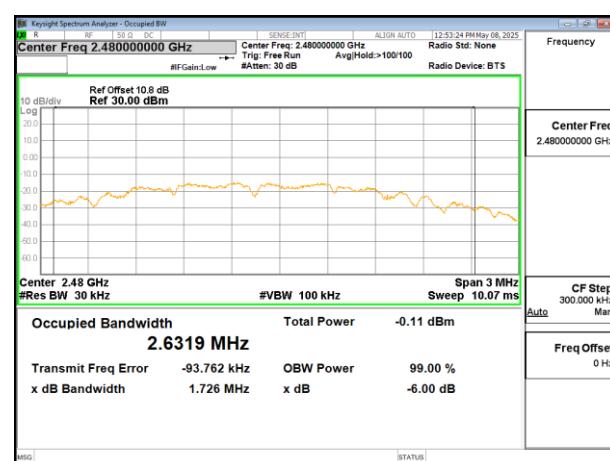
IC OBW\_Zigbee\_MidCH20-2450MHz



OBW\_Zigbee\_HighCH26-2480MHz



IC OBW\_Zigbee\_HighCH26-2480MHz



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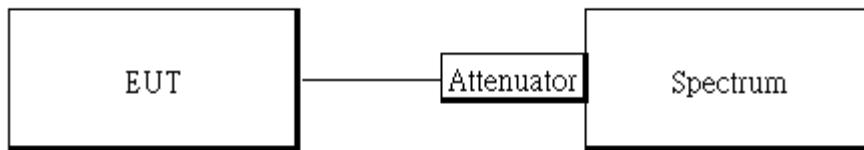
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## 10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

### 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), must also comply with the radiated emission limits specified in §15.209(a).

### 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.

#### 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

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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**

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2405	-5.06	-25.06
2450	-4.76	-24.76
2480	-10.21	-30.21

**\*Note:**

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

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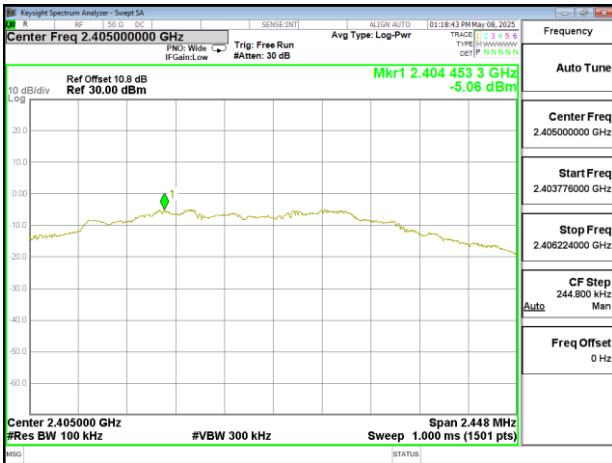
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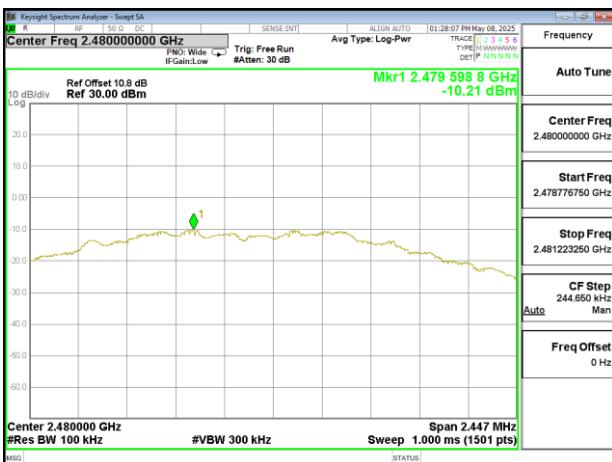
## Reference Level\_Zigbee \_LowCH11-2405MHz



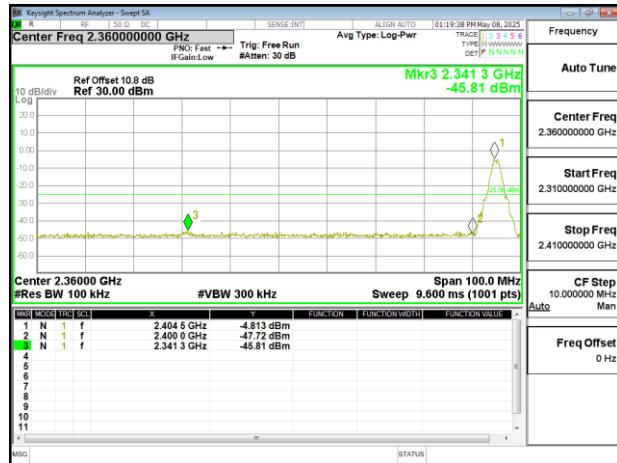
Reference Level\_Zigbee \_MidCH20-2450MHz



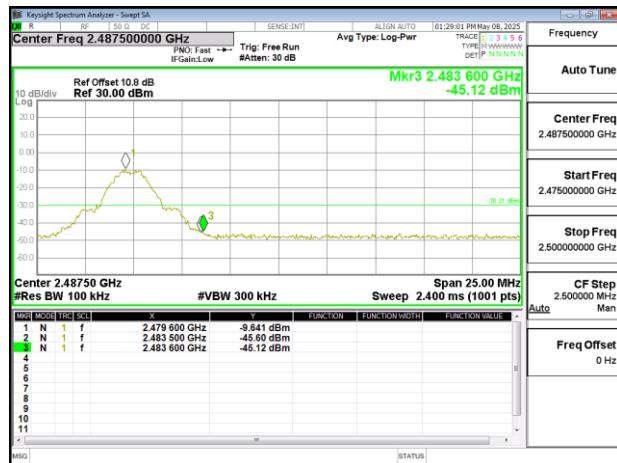
Reference Level\_Zigbee \_HighCH26-2480MHz



## Band Edge\_Zigbee\_LowCH11-2405MHz



## Band Edge\_Zigbee\_HighCH26-2480MHz

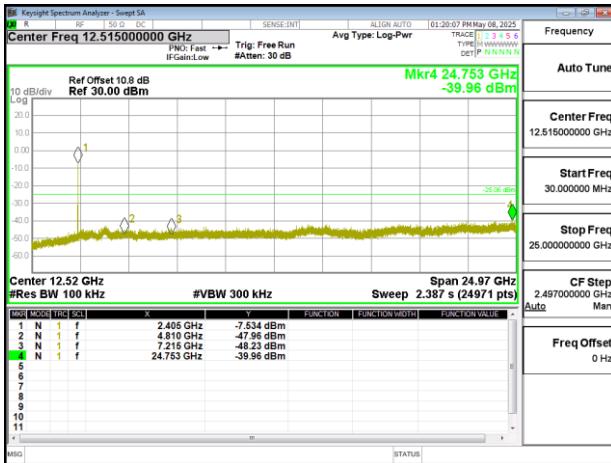


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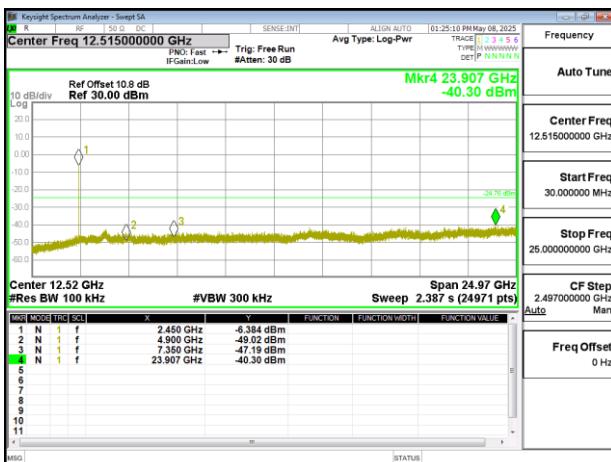
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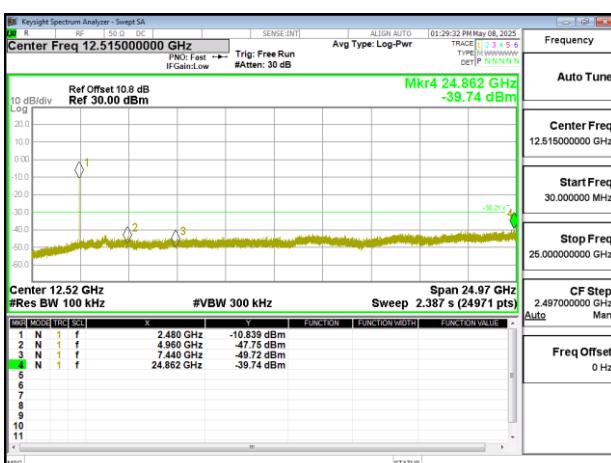
Spurious Emission\_Zigbee\_MidCH11-2405MHz



Spurious Emission\_Zigbee\_MidCH20-2450MHz



Spurious Emission\_Zigbee\_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 limit as below.

And according to §15.33(a) (1) 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.

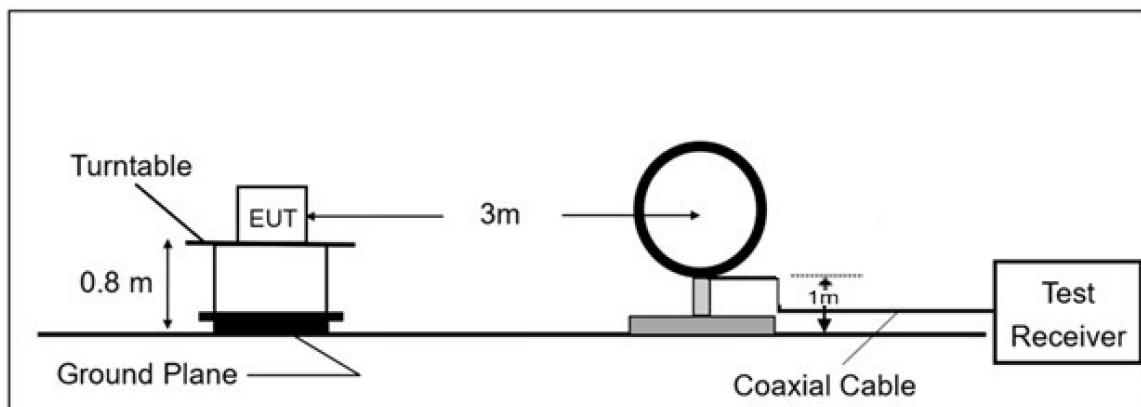
Frequency (MHz)	Field strength (microvolts/meter)	Distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

**Note:**

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

### 11.2 Test Setup

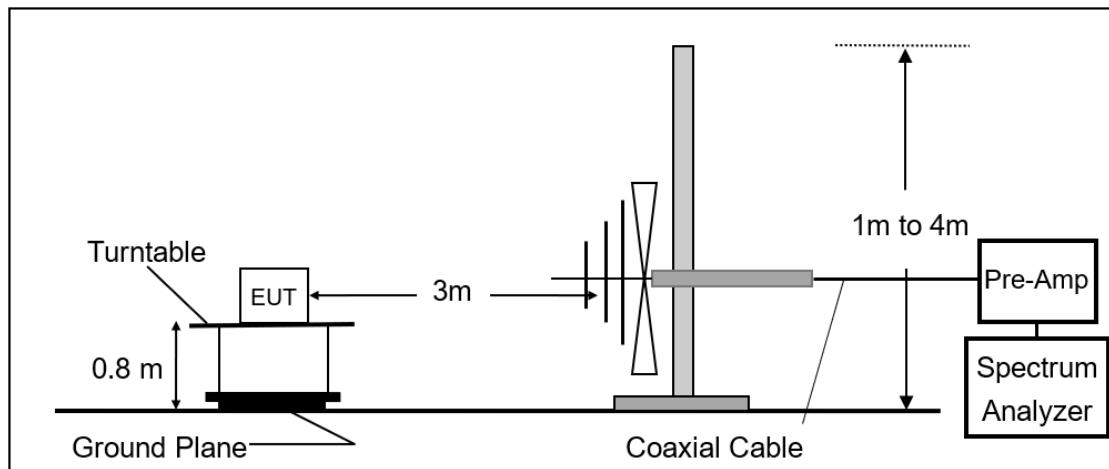
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz.



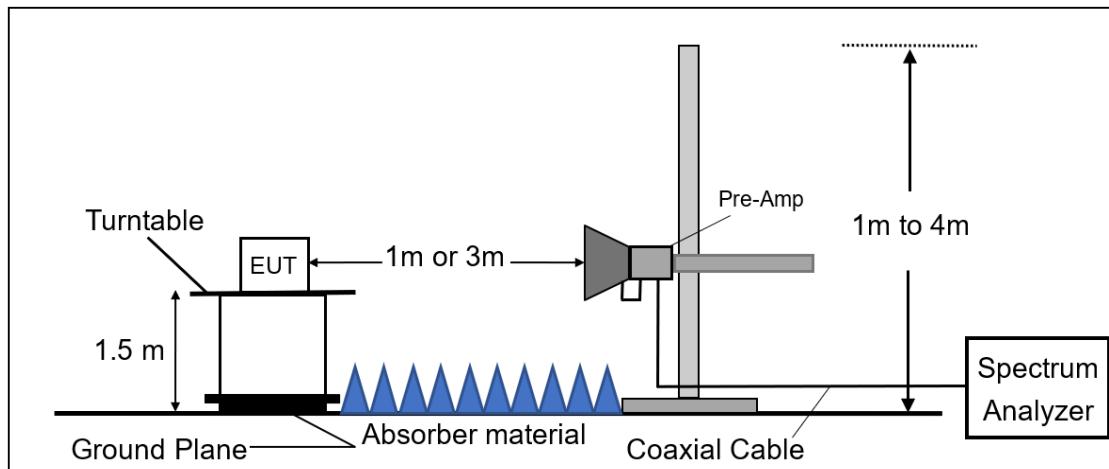
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(B) Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz.



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



### 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

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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  $VBW \geq 1/T$  (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  $VBW = 10$ Hz if average reading is measured.
12. Repeat above procedures until all default test channel measured were complete.

#### 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  $dB\mu V/m$ , which converts  $20 * \log(uV/m)$

Actual  $FS(dB\mu V/m) = SPA$ . Reading level( $dB\mu V$ ) + Factor( $dB$ )

Factor( $dB$ ) = Antenna Factor( $dB/m$ ) + 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.

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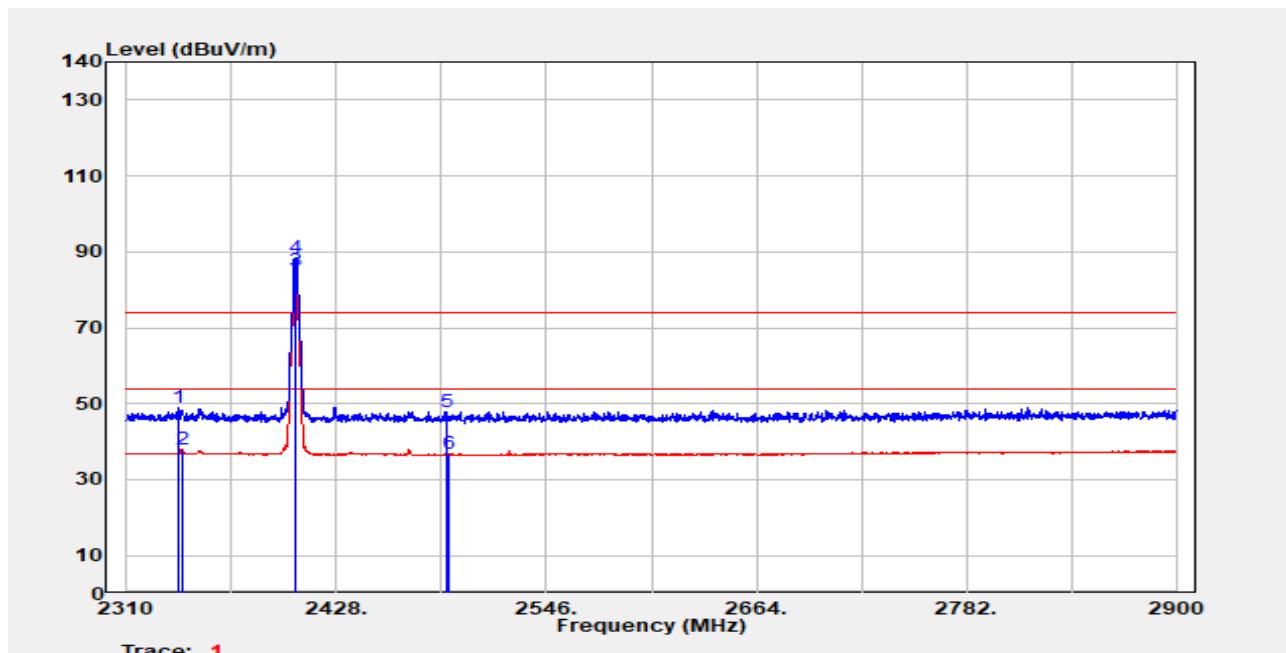
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## 11.6 Measurement Result:

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

### 11.6.1 Radiated Band Edge Measurement Result

Report Number	:TERF2504001481E2	Test Site	:SAC C
Operation Mode	:Zigbee	Test Date	:2025-05-16
Test Frequency	:2405 MHz	Temp./Humi.	:25.3°C/51%
Test Mode	:Bandedge	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2339.51	Peak	52.83	-3.77	49.06	74.00	-24.94
2341.08	Average	41.85	-3.78	38.07	54.00	-15.93
2405.00	Average	88.98	-4.02	84.96	-	-
2405.00	Peak	92.30	-4.02	88.28	-	-
2489.42	Peak	51.77	-4.07	47.70	74.00	-26.30
2490.80	Average	40.79	-4.07	36.72	54.00	-17.28

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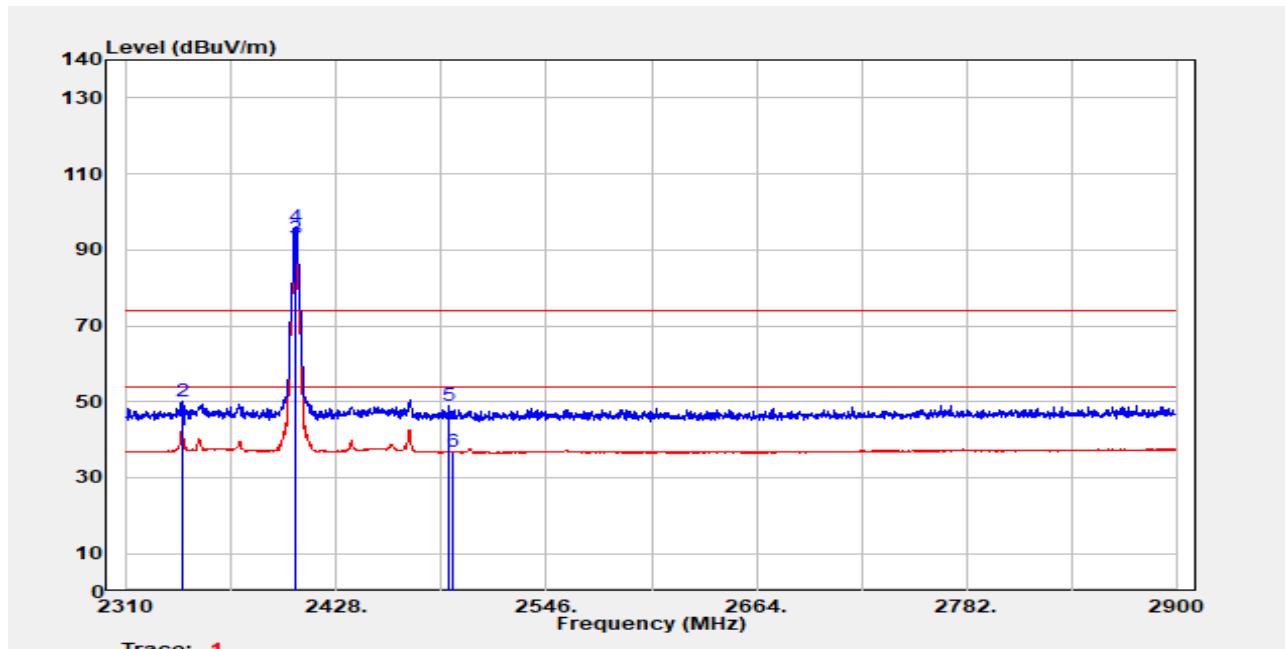
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Report Number :TERF2504001481E2 Test Site :SAC C  
Operation Mode :Zigbee Test Date :2025-05-16  
Test Frequency :2405 MHz Temp./Humi. :25.3°C/51%  
Test Mode :Bandedge Antenna Pol. :Horizontal  
EUT Pol :E2 Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2341.08	Average	46.12	-3.78	42.34	54.00	-11.66
2341.28	Peak	53.98	-3.78	50.20	74.00	-23.80
2405.00	Average	96.80	-4.02	92.78	-	-
2405.00	Peak	100.02	-4.02	96.00	-	-
2490.80	Peak	53.06	-4.07	48.99	74.00	-25.01
2492.96	Average	41.02	-4.09	36.93	54.00	-17.07

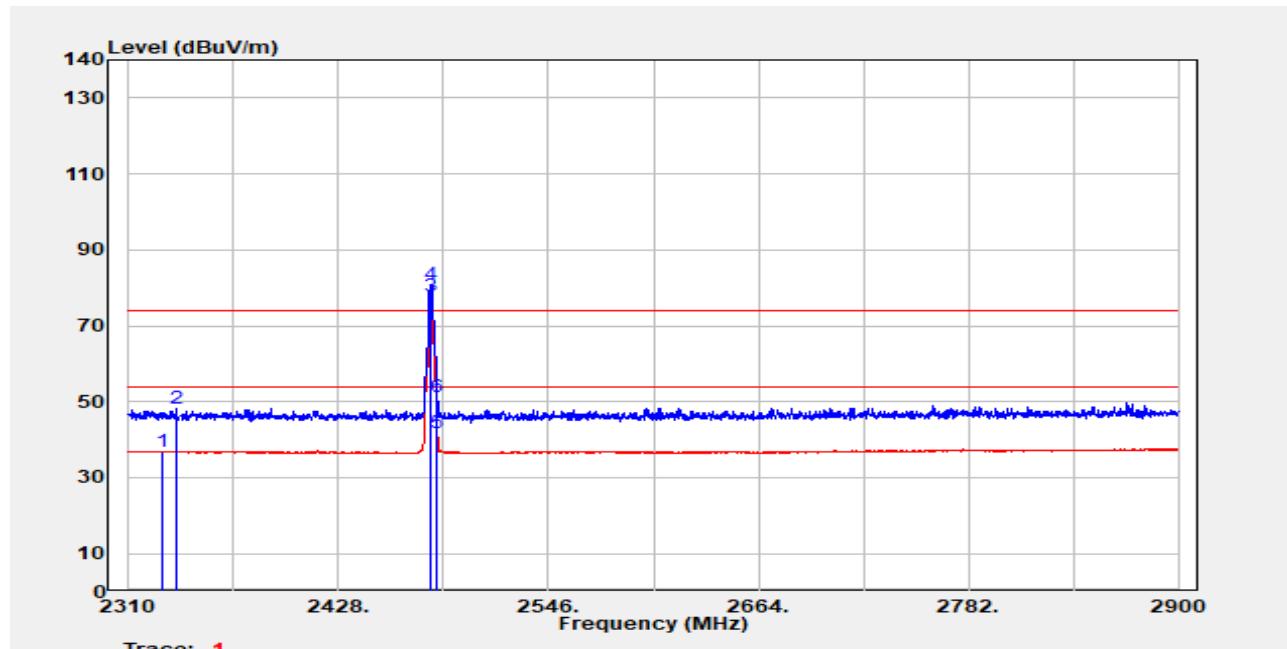
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Report Number :TERF2504001481E2 Test Site :SAC C  
Operation Mode :Zigbee Test Date :2025-05-16  
Test Frequency :2480 MHz Temp./Humi. :25.3°C/51%  
Test Mode :Bandedge Antenna Pol. :Vertical  
EUT Pol :E2 Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2328.69	Average	40.64	-3.77	36.87	54.00	-17.13
2336.76	Peak	51.79	-3.77	48.02	74.00	-25.98
2480.00	Average	81.87	-4.15	77.72	-	-
2480.00	Peak	85.14	-4.15	80.99	-	-
2483.50	Average	45.96	-4.12	41.84	54.00	-12.16
2483.50	Peak	55.47	-4.12	51.35	74.00	-22.65

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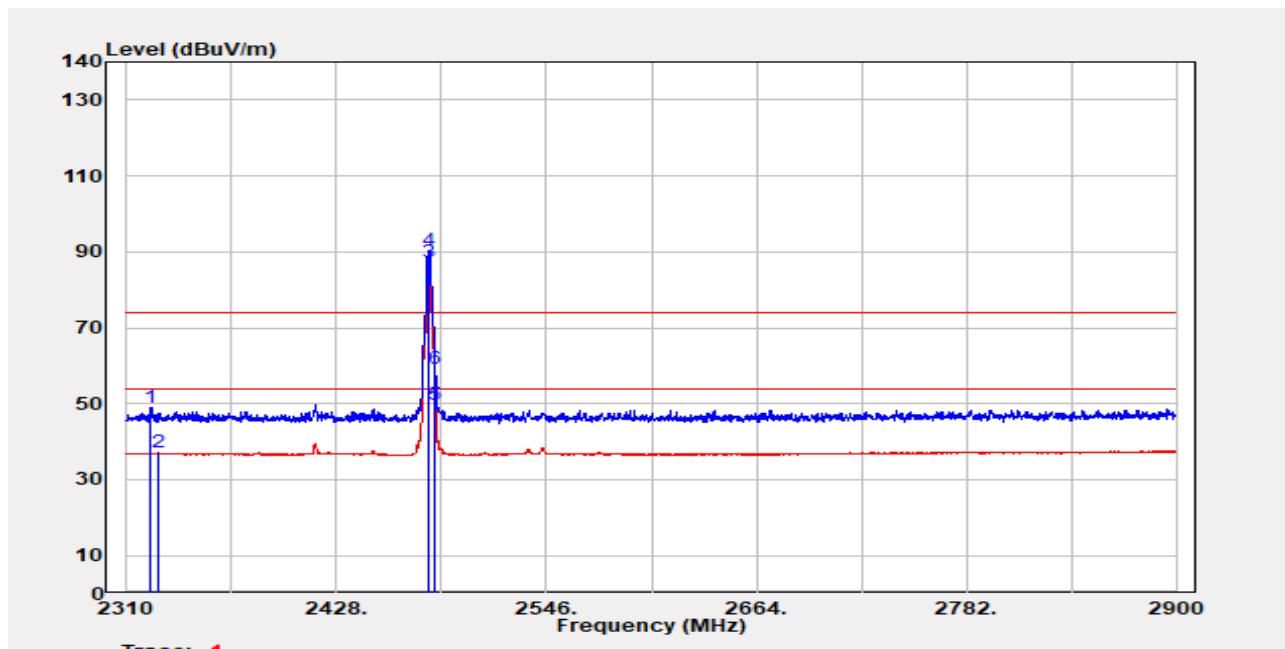
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Report Number :TERF2504001481E2 Test Site :SAC C  
Operation Mode :Zigbee Test Date :2025-05-16  
Test Frequency :2480 MHz Temp./Humi. :25.3°C/51%  
Test Mode :Bandedge Antenna Pol. :Horizontal  
EUT Pol :E2 Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2323.57	Peak	52.80	-3.73	49.07	74.00	-24.93
2328.10	Average	40.78	-3.76	37.02	54.00	-16.98
2480.00	Average	91.29	-4.15	87.14	-	-
2480.00	Peak	94.50	-4.15	90.35	-	-
2483.50	Average	53.88	-4.12	49.76	54.00	-4.24
2483.50	Peak	63.38	-4.12	59.26	74.00	-14.74

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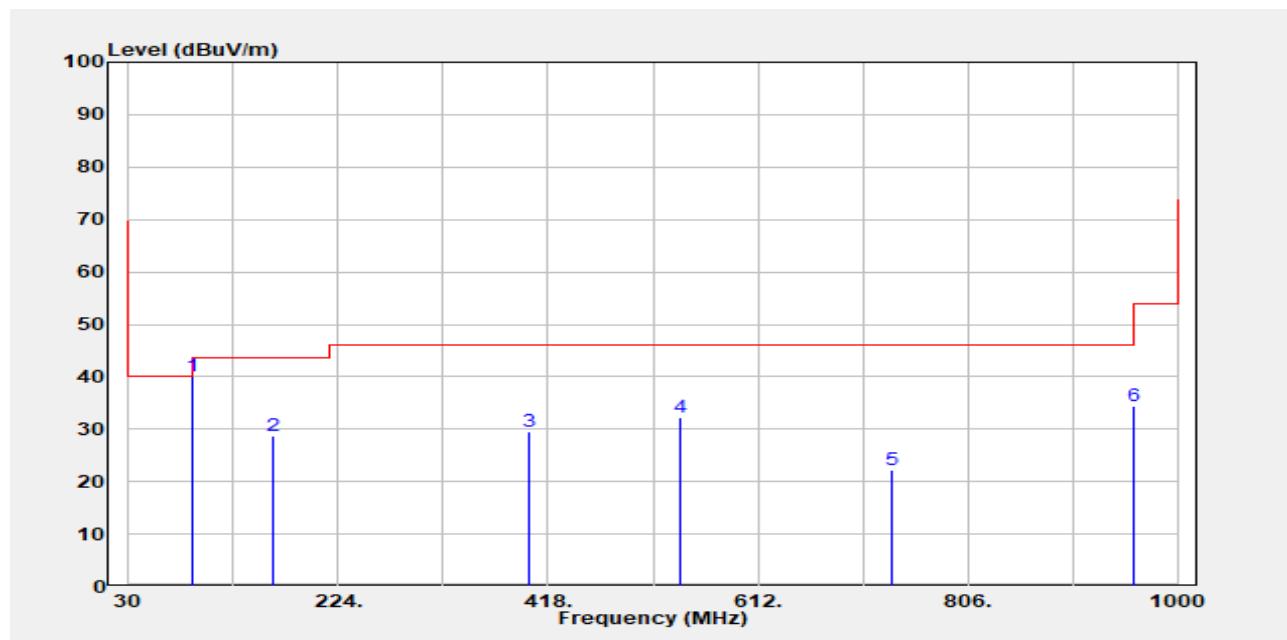
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## 11.6.2 Radiated Spurious Emission

Report Number	:TERF2504001481E2	Test Site	:SAC C
Operation Mode	:Zigbee	Test Date	:2025-05-16
Test Frequency	:2450 MHz	Temp./Humi.	:25.3°C/51%
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
89.17	QP	58.30	-18.16	40.14	43.50	-3.36
162.89	Peak	40.65	-11.93	28.72	43.50	-14.78
399.57	Peak	37.92	-8.34	29.58	46.00	-16.42
540.22	Peak	37.55	-5.35	32.20	46.00	-13.80
736.16	Peak	23.60	-1.45	22.15	46.00	-23.85
960.23	Peak	33.06	1.45	34.51	54.00	-19.49

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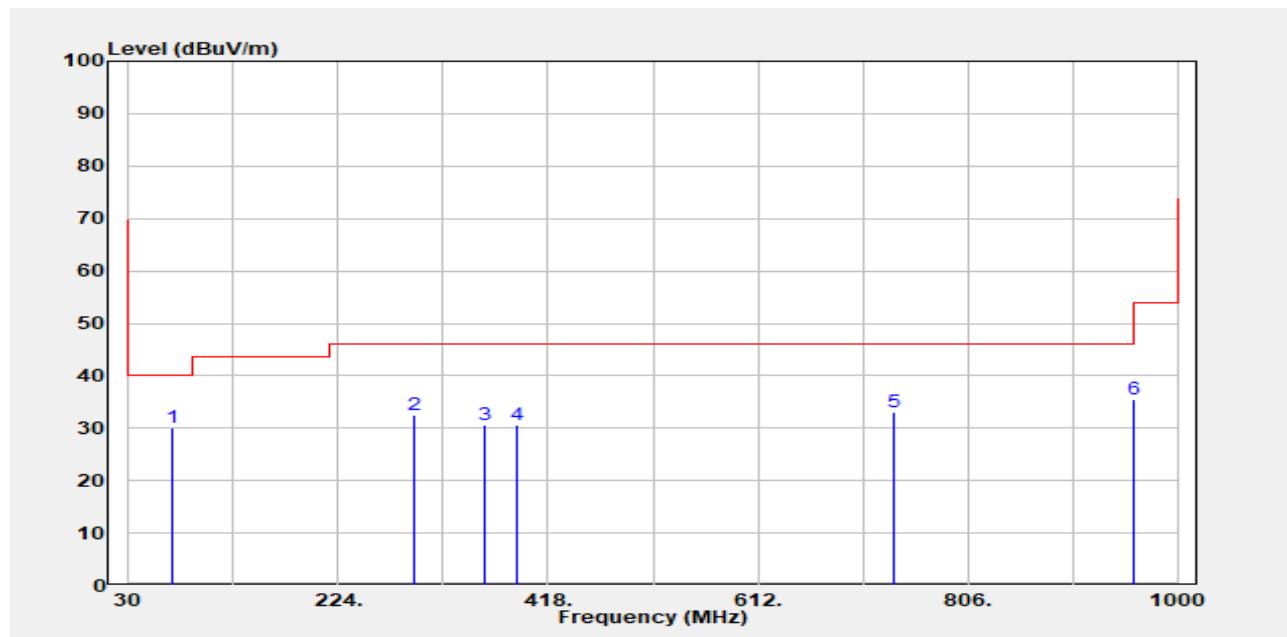
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Report Number :TERF2504001481E2 Test Site :SAC C  
Operation Mode :Zigbee Test Date :2025-05-16  
Test Frequency :2450 MHz Temp./Humi. :25.3°C/51%  
Test Mode :Tx Antenna Pol. :Horizontal  
EUT Pol :E2 Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
69.77	Peak	44.67	-14.50	30.17	40.00	-9.83
294.81	Peak	43.60	-11.10	32.50	46.00	-13.50
359.80	Peak	40.21	-9.59	30.62	46.00	-15.38
389.87	Peak	39.02	-8.48	30.54	46.00	-15.46
738.10	Peak	34.50	-1.37	33.13	46.00	-12.87
960.23	Peak	34.18	1.45	35.63	54.00	-18.37

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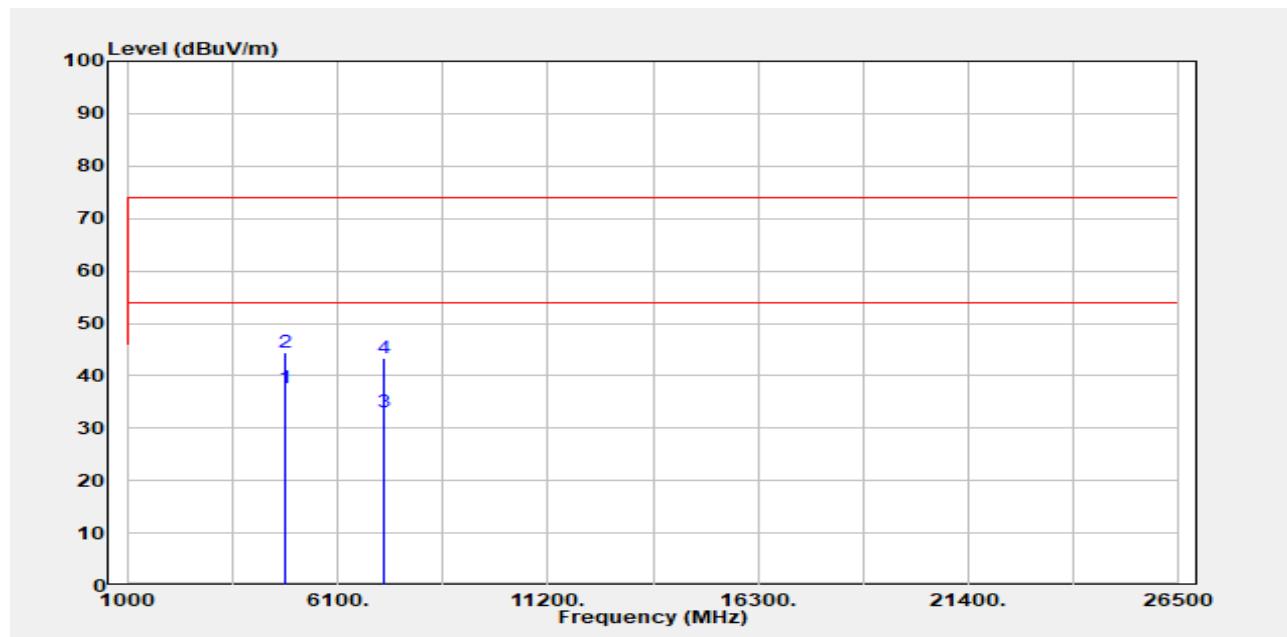
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Report Number :TERF2504001481E2 Test Site :SAC C  
Operation Mode :Zigbee Test Date :2025-05-16  
Test Frequency :2405 MHz Temp./Humi. :25.3°C/51%  
Test Mode :Tx Antenna Pol. :Vertical  
EUT Pol :E2 Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4810.00	Average	37.50	0.11	37.61	54.00	-16.39
4810.00	Peak	44.22	0.11	44.33	74.00	-29.67
7215.00	Average	26.74	6.29	33.03	54.00	-20.97
7215.00	Peak	37.06	6.29	43.35	74.00	-30.65

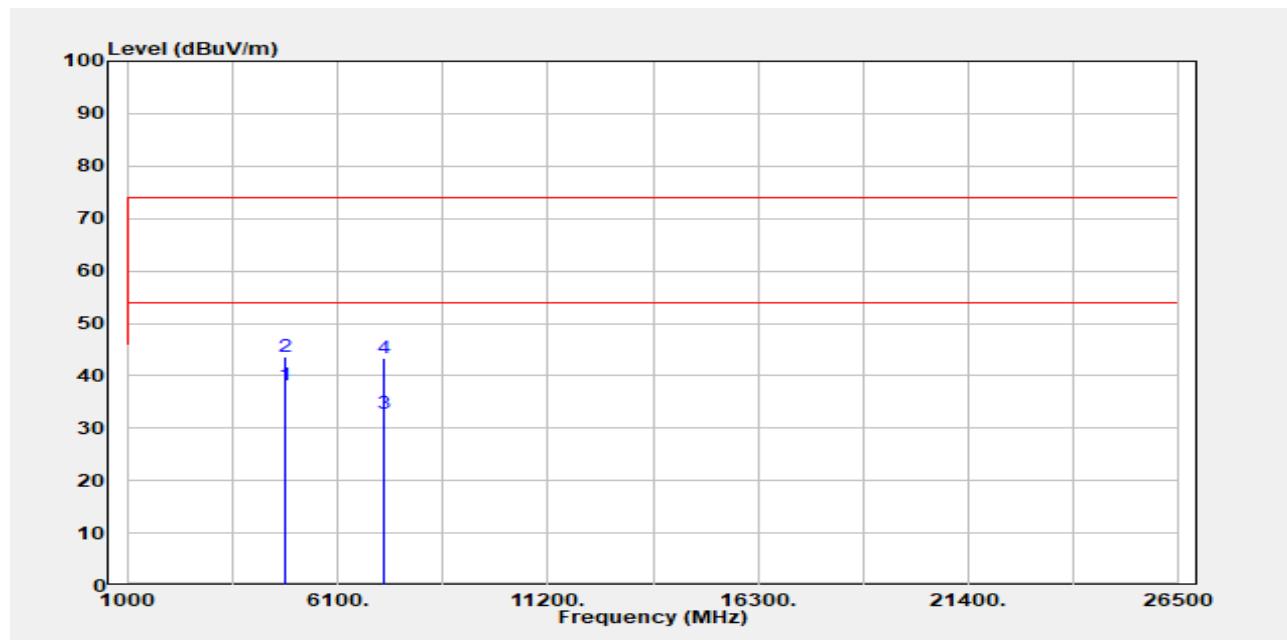
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Report Number :TERF2504001481E2 Test Site :SAC C  
Operation Mode :Zigbee Test Date :2025-05-16  
Test Frequency :2405 MHz Temp./Humi. :25.3°C/51%  
Test Mode :Tx Antenna Pol. :Horizontal  
EUT Pol :E2 Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4810.00	Average	38.14	0.11	38.25	54.00	-15.75
4810.00	Peak	43.59	0.11	43.70	74.00	-30.30
7215.00	Average	26.56	6.29	32.85	54.00	-21.15
7215.00	Peak	37.08	6.29	43.37	74.00	-30.63

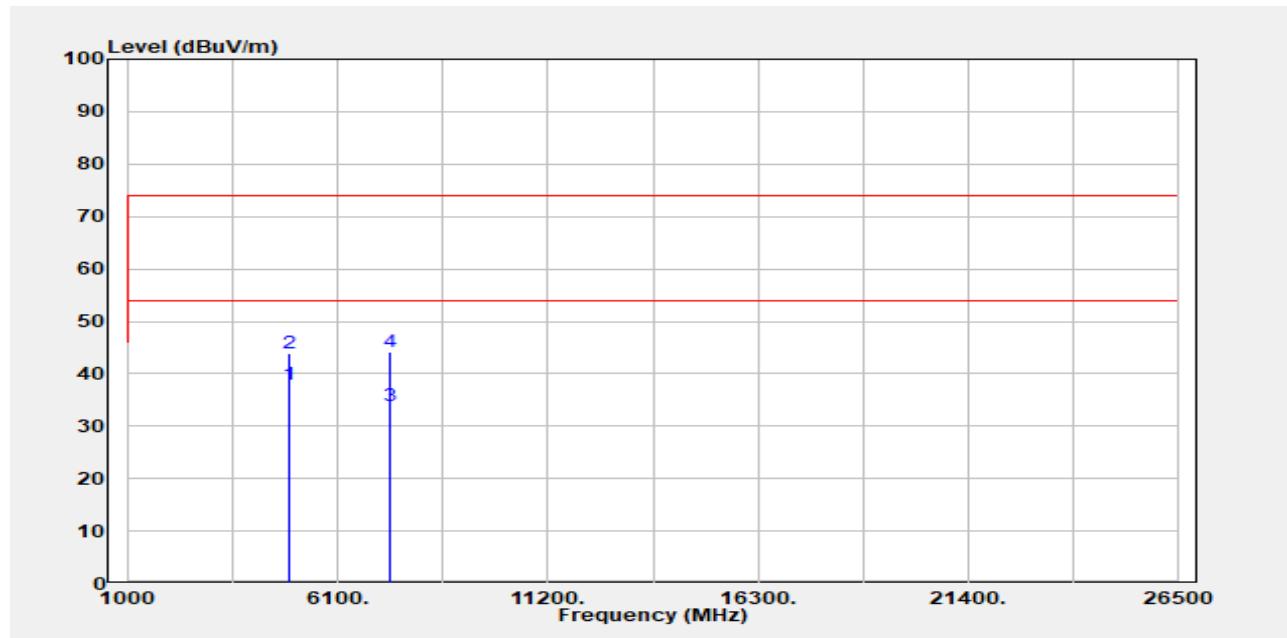
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Report Number :TERF2504001481E2 Test Site :SAC C  
Operation Mode :Zigbee Test Date :2025-05-16  
Test Frequency :2450 MHz Temp./Humi. :25.3°C/51%  
Test Mode :Tx Antenna Pol. :Vertical  
EUT Pol :E2 Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4900.00	Average	37.75	0.32	38.07	54.00	-15.93
4900.00	Peak	43.50	0.32	43.82	74.00	-30.18
7350.00	Average	27.28	6.57	33.85	54.00	-20.15
7350.00	Peak	37.51	6.57	44.08	74.00	-29.92

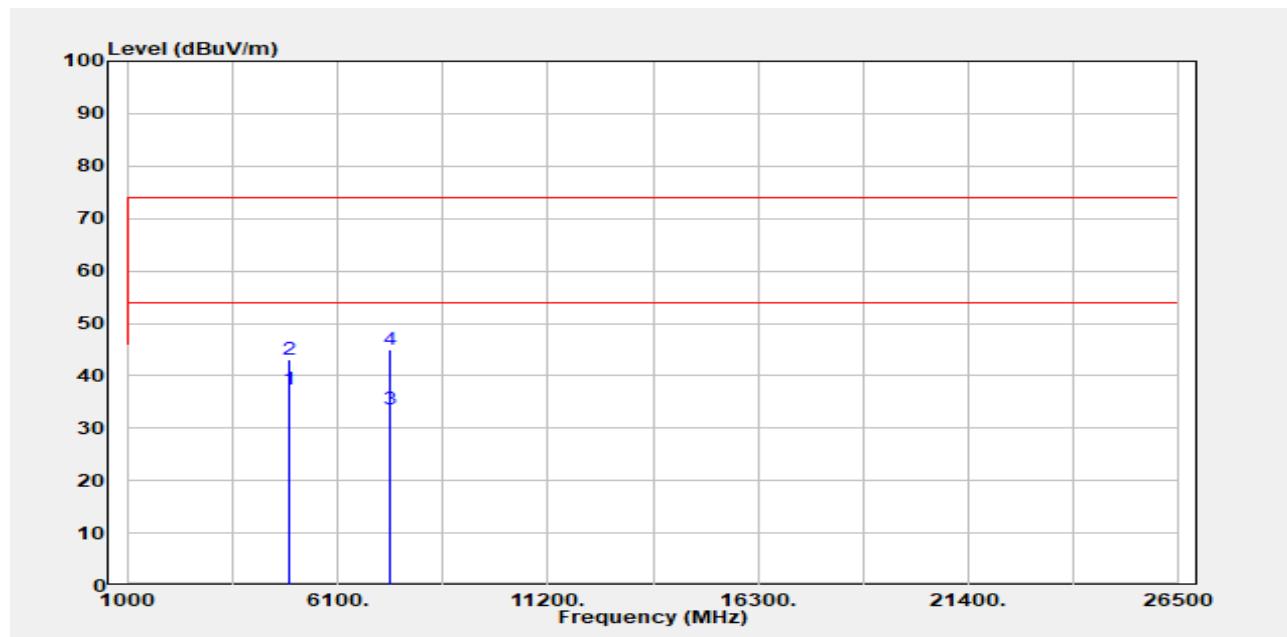
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Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4900.00	Average	37.21	0.32	37.53	54.00	-16.47
4900.00	Peak	42.71	0.32	43.03	74.00	-30.97
7350.00	Average	26.97	6.57	33.54	54.00	-20.46
7350.00	Peak	38.36	6.57	44.93	74.00	-29.07

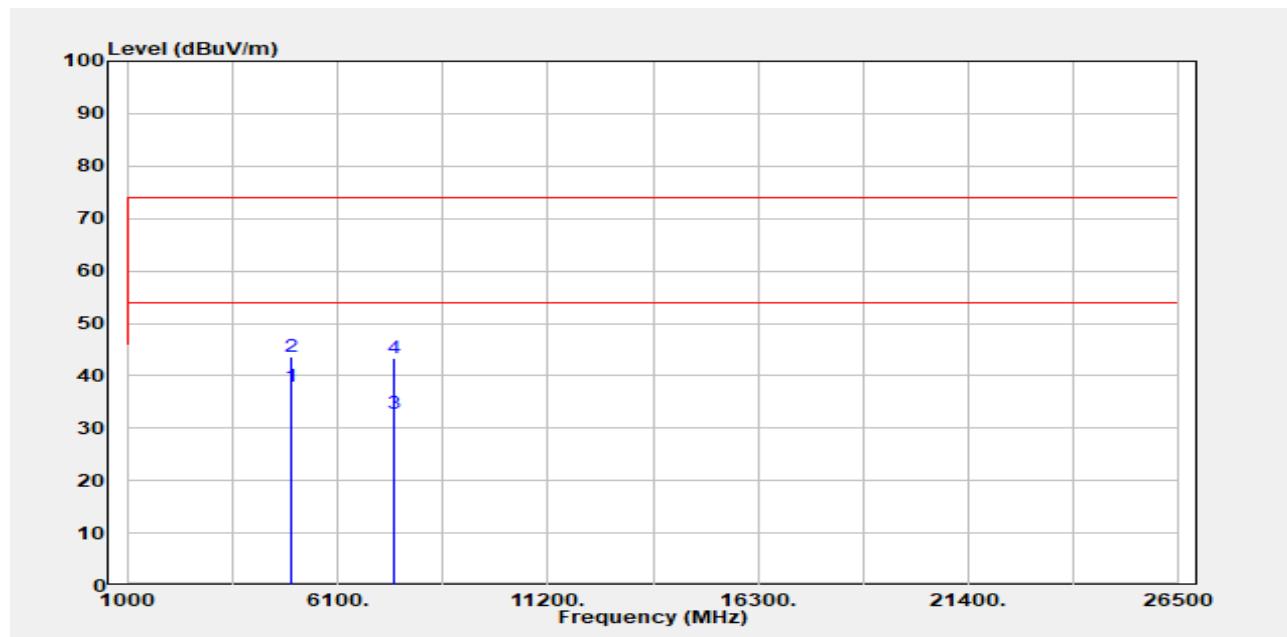
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Report Number :TERF2504001481E2 Test Site :SAC C  
Operation Mode :Zigbee Test Date :2025-05-16  
Test Frequency :2480 MHz Temp./Humi. :25.3°C/51%  
Test Mode :Tx Antenna Pol. :Vertical  
EUT Pol :E2 Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4960.00	Average	37.37	0.49	37.86	54.00	-16.14
4960.00	Peak	43.20	0.49	43.69	74.00	-30.31
7440.00	Average	26.61	6.25	32.86	54.00	-21.14
7440.00	Peak	37.23	6.25	43.48	74.00	-30.52

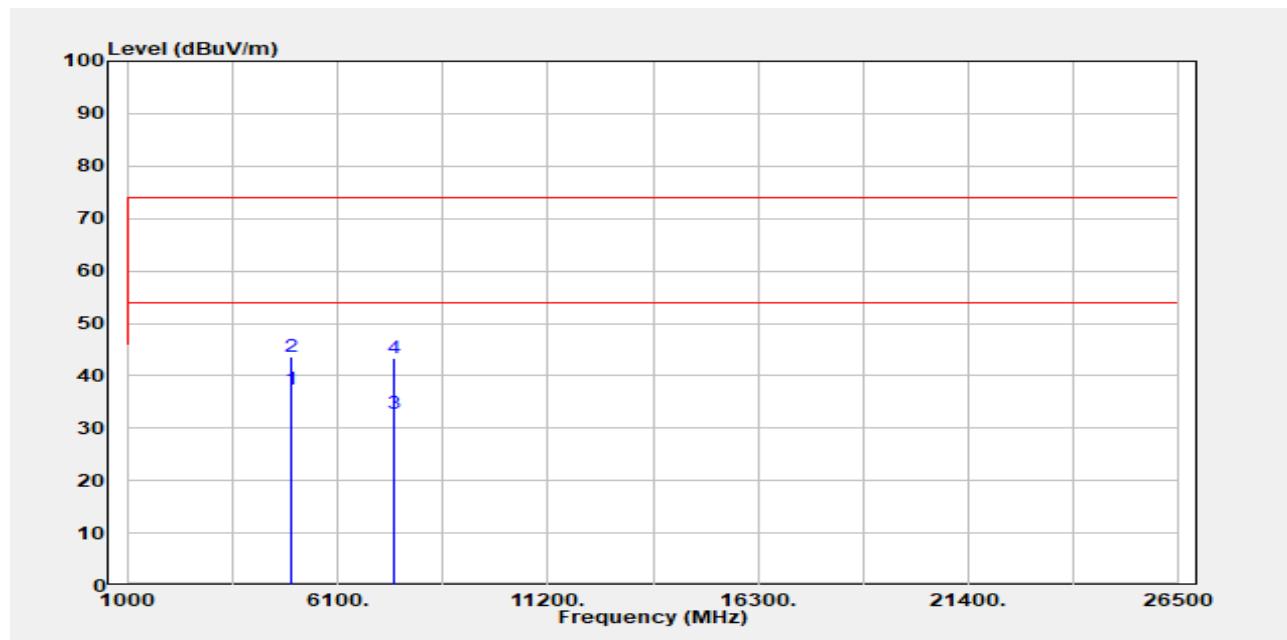
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Report Number :TERF2504001481E2 Test Site :SAC C  
Operation Mode :Zigbee Test Date :2025-05-16  
Test Frequency :2480 MHz Temp./Humi. :25.3°C/51%  
Test Mode :Tx Antenna Pol. :Horizontal  
EUT Pol :E2 Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4960.00	Average	36.97	0.49	37.46	54.00	-16.54
4960.00	Peak	43.04	0.49	43.53	74.00	-30.47
7440.00	Average	26.58	6.25	32.83	54.00	-21.17
7440.00	Peak	37.06	6.25	43.31	74.00	-30.69

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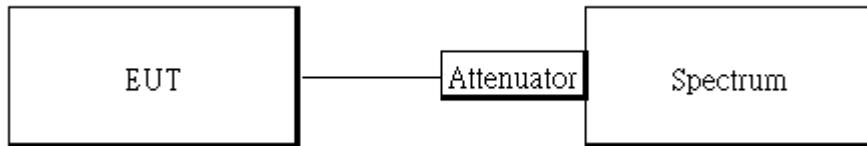
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## 12 POWER SPECTRAL DENSITY

### 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.

### 12.4 Measurement Result:

Zigbee			
Frequency (MHz)	RF Power Density (dBm/3kHz)	Maximum Limit (dBm/3kHz)	Result
2405	-16.66	8	PASS
2450	-16.27	8	PASS
2480	-21.00	8	PASS

\*Note:

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

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PSD\_Zigbee\_LowCH11-2405MHz



PSD\_Zigbee\_MidCH20-2450MHz



PSD\_Zigbee\_HighCH26-2480MHz



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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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