

**ELECTROMAGNETIC EMISSIONS  
COMPLIANCE REPORT**

**Applicant:** METROL Co., Ltd.  
1-100 Takamatsu-cho Tachikawa, Tokyo 190-0011 JAPAN

**Manufacturer:** METROL Co., Ltd.  
1-100 Takamatsu-cho Tachikawa, Tokyo 190-0011 JAPAN

**Product Name:** Receiver

**Brand Name:** METROL

**Model No.:** RC-R03-003

**Report Number:** TERF2211002167ER

**FCC ID** AORMETROLRCR0301

**Date of EUT Received:** Nov. 03, 2022

**Date of Test:** Nov. 04, 2022~July 11, 2023

**Issue Date:** July 12, 2023

Approved By

CHUN-CHIEH, CHEN

**Chun Chieh Chen**

**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
TERF2211002167ER	00	Original	May 19, 2023	Yami Kuo	
TERF2211002167ER	01	Revise summary of test results	July 07, 2023	Yami Kuo	*
TERF2211002167ER	02	Update conduction measurement equipment used	July 12, 2023	Yami Kuo	*
TERF2211002167ER	03	Update conduction test data	July 12, 2023	Yami Kuo	*

**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

Product Name:	Receiver
Brand Name:	METROL
Model No.:	RC-R03-003
Hardware Version:	N/A
Firmware Version:	N/A
EUT Series No.:	R03-2
Power Supply:	24Vdc from AC Adapter
Test Software (Name/Version)	Default

### 1.2 RF Specification

Radio Technology:	SRD 2.4G
Frequency Range:	2404 – 2476MHz
Channel number:	37 channels
Modulation type:	GFSK
Transmit Power:	-0.26 dBm

### 1.3 Antenna Designation

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)
Ceramic Patch Antenna	Pulse A YAGEO Company	W3229	2400 – 2500	6.50

**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  
 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.

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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:

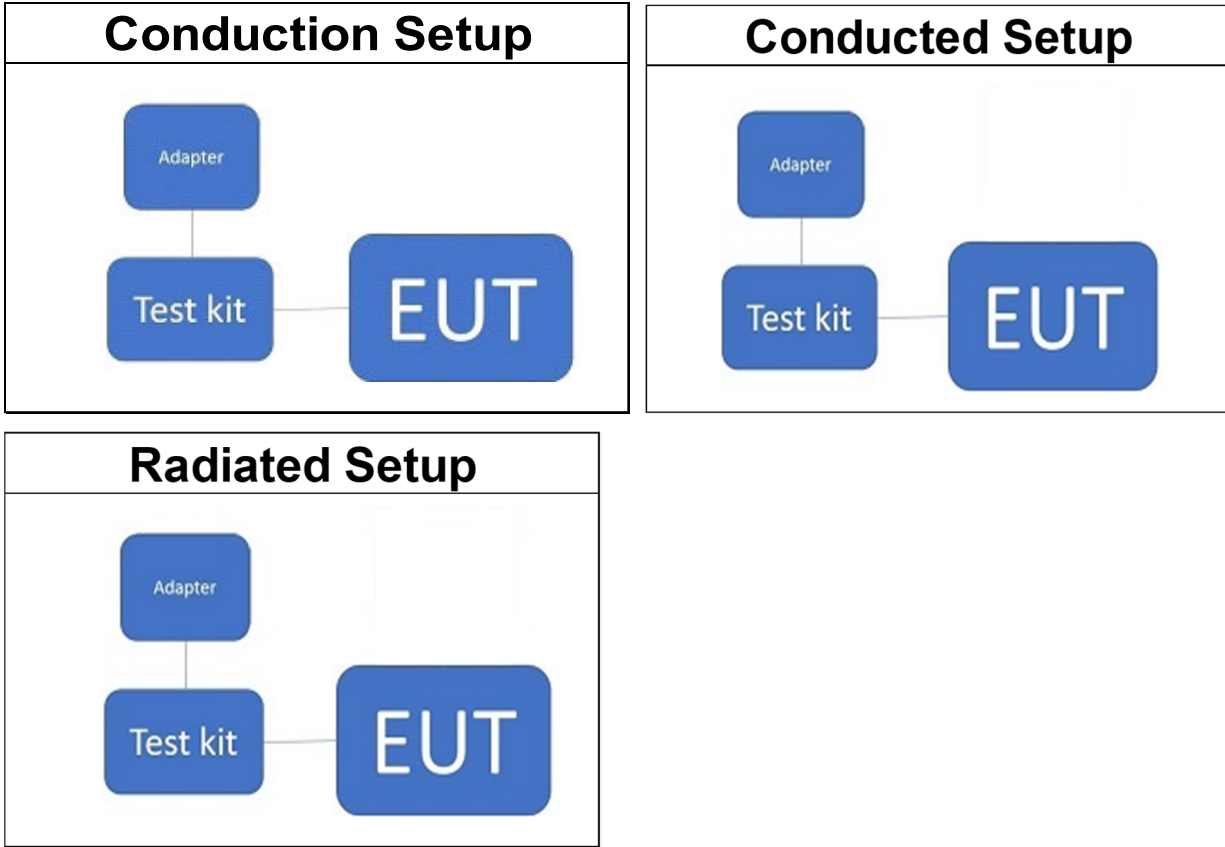
The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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## 2.5 Test Configuration



## 2.6 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Adapter	GF	GF12-US2405	N/A	N/A	N/A
Conducted Emission Test Site: Conducted 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Adapter	GF	GF12-US2405	N/A	N/A	N/A
Radiated Emission Test Site: SAC 3					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Adapter	GF	GF12-US2405	N/A	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
§15.247(d) §15.205 §15.209	Radiated & Conducted Band Edge and Spurious Emission	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

ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY
1	2404 MHz	15	2432 MHz	29	2460 MHz
2	2406 MHz	16	2434 MHz	30	2462 MHz
3	2408 MHz	17	2436 MHz	31	2464 MHz
4	2410 MHz	18	2438 MHz	32	2466 MHz
5	2412 MHz	19	2440 MHz	33	2468 MHz
6	2414 MHz	20	2442 MHz	34	2470 MHz
7	2416MHz	21	2444 MHz	35	2472 MHz
8	2418 MHz	22	2446 MHz	36	2474 MHz
9	2420 MHz	23	2448 MHz	37	2476 MHz
10	2422 MHz	24	2450 MHz		
11	2424 MHz	25	2452 MHz		
12	2426 MHz	26	2454 MHz		
13	2428 MHz	27	2456 MHz		
14	2430 MHz	28	2458 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. The field strength of radiation 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.
4. Investigation has been done on all the possible configurations for searching the worst case.

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CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
SRD	1 to 37	1,19,37	GFSK	1

RADIATED EMISSION TEST (BELOW 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
SRD	1 to 37	19	GFSK	1

RADIATED EMISSION TEST (ABOVE 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
SRD	1 to 37	1,19,37	GFSK	1

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## 5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.32 dB
Output Power measurement	+/- 1 dB
Emission Bandwidth	+/- 1.53 Hz
Undesignable radiated emission measurement	+/- 1.68 dB
Peak Power Density	+/- 2.16 dB
Temperature	+/- 0.7 °C
Humidity	+/- 3 %
DC / AC Power Source	+/- 1 %

Radiated Spurious Emission Measurement Uncertainty				
<b>Polarization: Vertical</b>	+/-	<b>2.8</b>	<b>dB</b>	9kHz~30MHz
	+/-	<b>4.82</b>	<b>dB</b>	30MHz - 1000MHz
	+/-	<b>4.37</b>	<b>dB</b>	1GHz - 18GHz
	+/-	<b>4.21</b>	<b>dB</b>	18GHz - 40GHz
<b>Polarization: Horizontal</b>	+/-	<b>2.8</b>	<b>dB</b>	9kHz~30MHz
	+/-	<b>4.54</b>	<b>dB</b>	30MHz - 1000MHz
	+/-	<b>4.37</b>	<b>dB</b>	1GHz - 18GHz
	+/-	<b>4.21</b>	<b>dB</b>	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

AC Power-Line Conducted Emission Test Site: Conduction 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESR 7	102525	02/18/2023	02/17/2024
Pulse Limiter	SCHWARZBECK	VTSD 9561F-N	793	06/22/2023	06/21/2024
LISN	SCHWARZBECK	NSLK 8127	01040	08/23/2022	08/22/2023
Coaxial Cables	EMC Instruments Corp.	EMCCFD300-BM-BM-3000	161207	06/22/2023	06/21/2024
Test Software	audix	e3	Ver. 9 210322	N.C.R	N.C.R

### 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
Test Software	SGS	Radio Test Software	Ver. 21	N.C.R	N.C.R
Power Meter	Anritsu	ML2496A	1242004	10/26/2022	10/25/2023
Power Sensor	Anritsu	MA2411B	1207365	10/26/2022	10/25/2023
Power Sensor	Anritsu	MA2411B	1207368	10/26/2022	10/25/2023
DC Block	Mini-Circuits	BLK-18-S+	1	12/14/2021	12/13/2022
DC Block	Mini-Circuits	BLK-18-S+	1	12/13/2022	12/12/2023

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### 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	12/30/2022	12/29/2023
Horn Antenna	SCHWARZBECK	BBHA9120D	1441	09/27/2022	09/26/2023
Bi-log Antenna	SCHWARZBECK	VULB9168	378	08/15/2022	08/14/2023
Loop Antenna	ETS.LINDGREN	6502	148045	10/05/2022	10/04/2023
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	EMC Instruments	EMC118A45SEE	980868	12/13/2022	12/12/2023
Pre-Amplifier	EMC Instruments	EMC184045B	980135	10/27/2022	10/26/2023
Pre-Amplifier	HP	8447D	2944A07676	12/13/2022	12/12/2023
Attenuator	Mini-Circuit	BW-S10W2+	4	12/13/2022	12/12/2023
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M1	12/13/2022	12/12/2023
High Pass Filter	WI	WHKX4.0/18G-10SS	22	12/13/2022	12/12/2023
Coaxial Cable	Huber Suhner	SUCOFLEX 104PEA	MY4251/4PEA	12/13/2022	12/12/2023
Coaxial Cable	EMC Instruments	EMC 107-SM-SM-500	221104	12/13/2022	12/12/2023
Coaxial Cable	EMC Instruments	EMC 107-SM-SM-1000	221103	12/13/2022	12/12/2023
Coaxial Cable	EMC Instruments	EMC 107-SM-SM-1500	221110	12/13/2022	12/12/2023
Coaxial Cable	EMC Instruments	EMC 107-SM-SM-8000	221109	12/13/2022	12/12/2023
Site Cal	SGS	SAC 3	N/A	01/01/2023	12/31/2023
Test Software	audix	e3	Ver. 9 210322	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

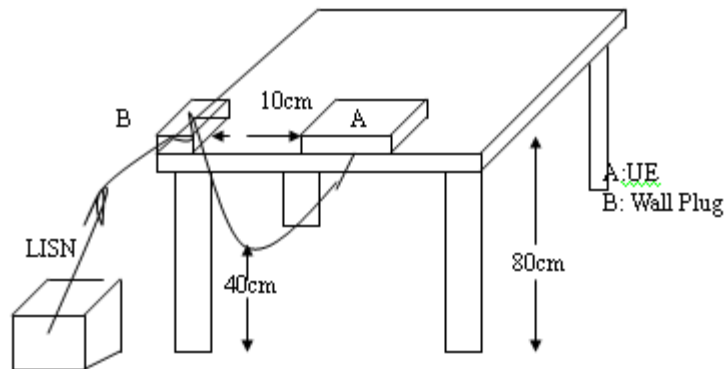
Note

- 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



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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.

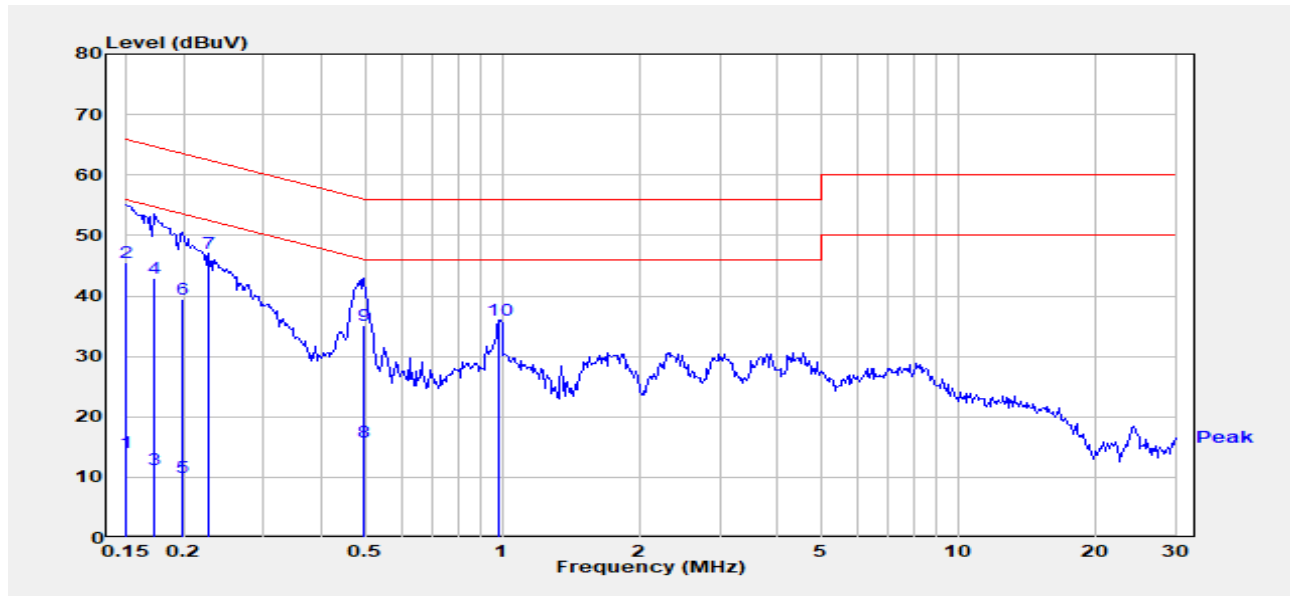
Note2: The \* reveals the worst-case results that closest to the limit.

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### AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number	:TERF2211002167ER	Test Site	:Conduction 1
Test Mode	:SRD Tx (2440MHz)	Test Date	:2023-07-11
Power	:120V/60Hz	Temp./Humi.	:24.4/63
Probe	:L	Engineer	:Ricky Chen
Note:	:		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.150	Average	14.11	0.04	14.15	56.00	-41.85
0.150	QP	45.58	0.04	45.62	66.00	-20.38
0.172	Average	11.22	0.04	11.26	54.85	-43.59
0.172	QP	42.92	0.04	42.96	64.85	-21.89
0.199	Average	10.02	0.04	10.06	53.64	-43.58
0.199	QP	39.44	0.04	39.48	63.64	-24.16
0.227	Peak	46.97	0.04	47.01	62.56	-15.55
0.497	Average	15.89	0.04	15.93	46.05	-30.12
0.497	QP	35.18	0.04	35.22	56.05	-20.83
0.984	Peak	35.95	-0.01	35.94	56.00	-20.06

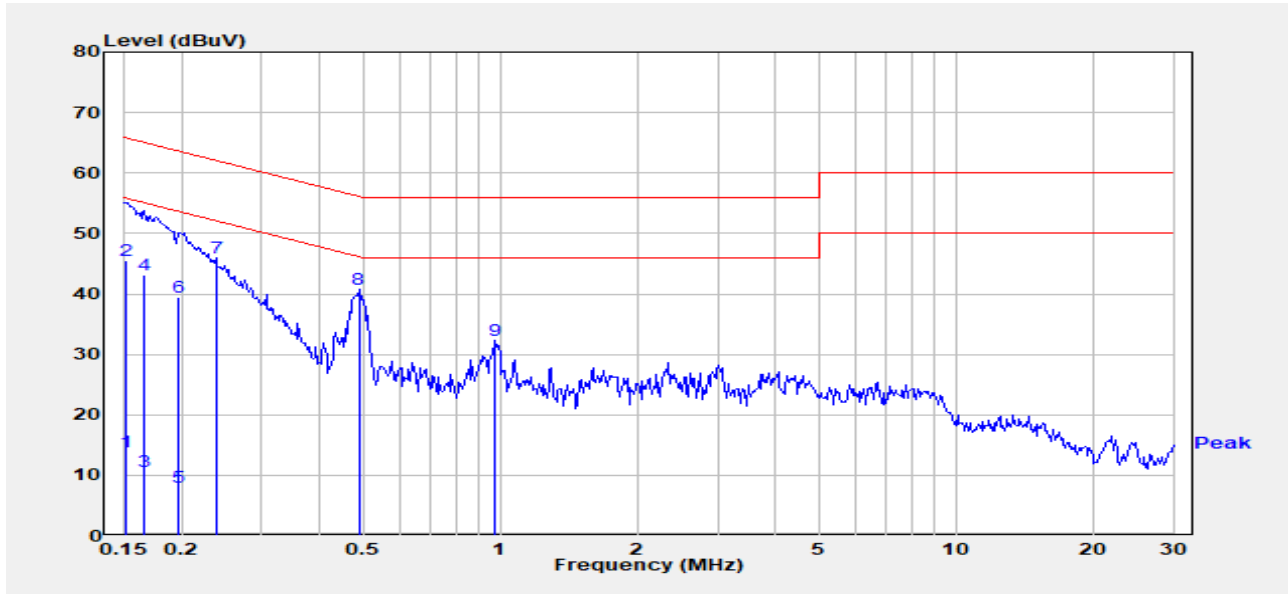
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Report Number :TERF2211002167ER  
 Test Mode :SRD Tx (2440MHz)  
 Power :120V/60Hz  
 Probe :N  
 Note: :

Test Site :Conduction 1  
 Test Date :2023-07-11  
 Temp./Humi. :24.4/63  
 Engineer :Ricky Chen



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
0.151	Average	13.92	0.04	13.96	55.94	-41.98
0.151	QP	45.44	0.04	45.48	65.94	-20.46
0.166	Average	10.51	0.04	10.55	55.17	-44.62
0.166	QP	43.12	0.04	43.16	65.17	-22.01
0.196	Average	7.90	0.04	7.94	53.77	-45.83
0.196	QP	39.44	0.04	39.48	63.77	-24.29
0.238	Peak	46.00	0.04	46.04	62.17	-16.13
0.489	Peak	40.80	0.04	40.84	56.18	-15.33
0.977	Peak	32.34	-0.01	32.33	56.00	-23.67

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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.

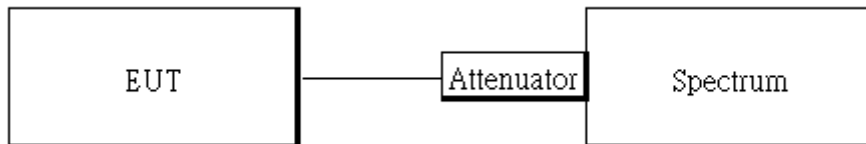
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

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

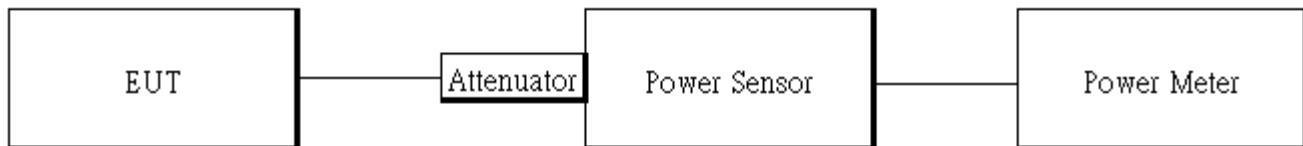
All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

### 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.

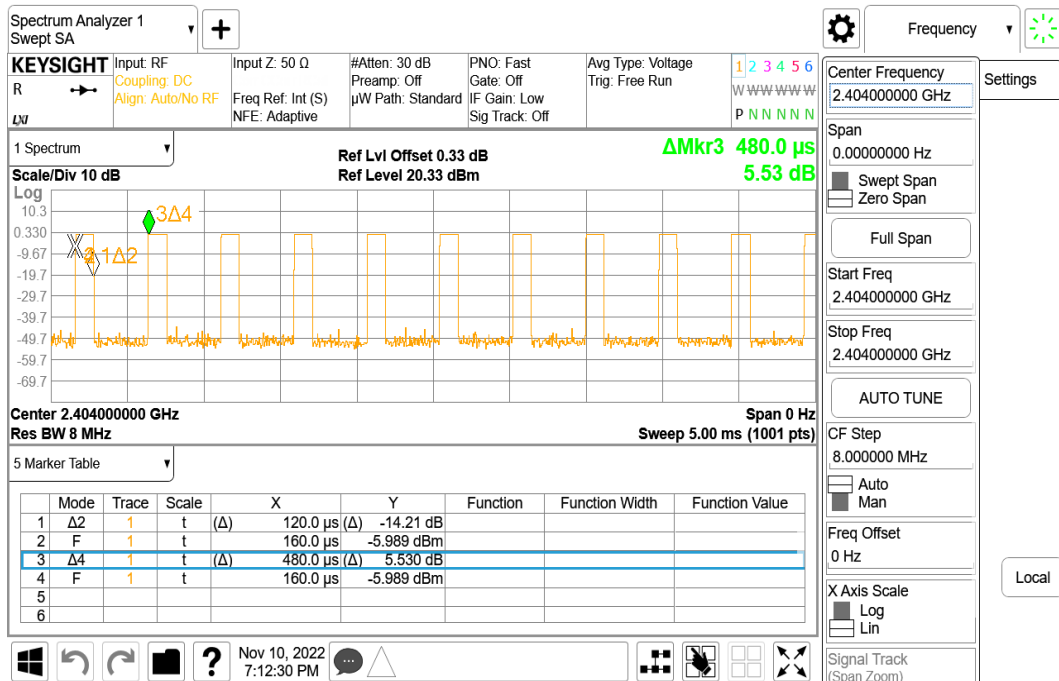
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8.4 Duty Factor:

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log ( 1/Duty Cycle )	1/T (kHz)	VBW setting (kHz)
SRD 1M	25.00	6.02	8.33	9.00

SRD\_1M\_LowCH01-2404



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## 8.5 Output Power:

### 8.5.1 Peak & Avg

SRD 1M mode:

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2404	default	-0.26	29.5
Mid	2440	default	-0.51	29.5
High	2476	default	-0.72	29.5
CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit (dBm)
Low	2404	default	-0.36	29.5
Mid	2440	default	-0.60	29.5
High	2476	default	-0.81	29.5

**\*Note: Measured by power meter, cable loss 0.334 dB + Duty cycle factor has been offsetted to the power meter for Avg. power and cable loss has been offsetted for Peak power measurement.**

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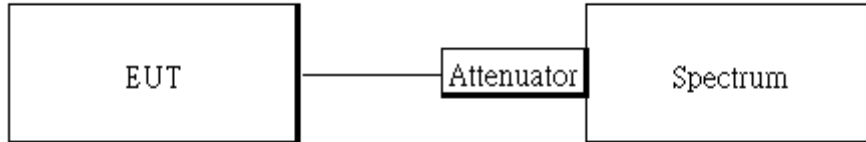
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## 9 EMISSION BANDWIDTH MEASUREMENT

### 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.

### 9.4 Measurement Result:

#### SRD 1M mode

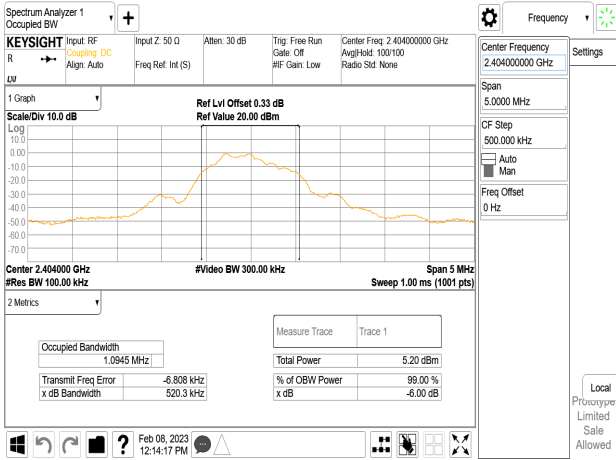
Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2404	0.5203	≥ 0.5	PASS
2440	0.5196	≥ 0.5	PASS
2476	0.5199	≥ 0.5	PASS

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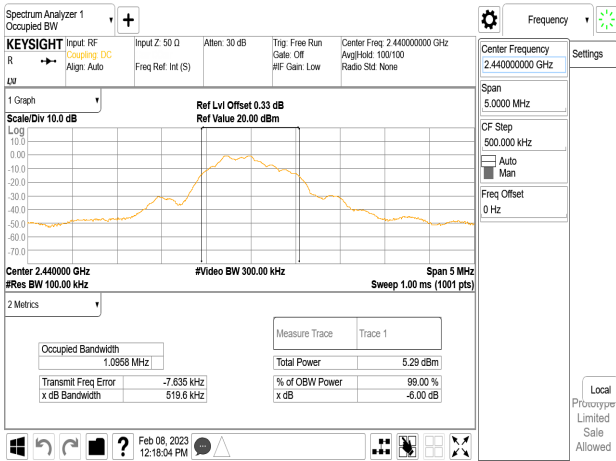
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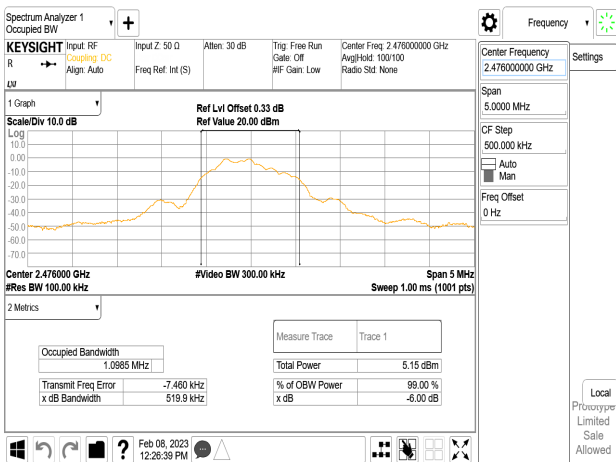
OBW\_SRD 1M\_LowCH01-2404MHz



OBW\_SRD 1M\_MidCH19-2440MHz



OBW\_SRD 1M\_HighCH37-2476MHz



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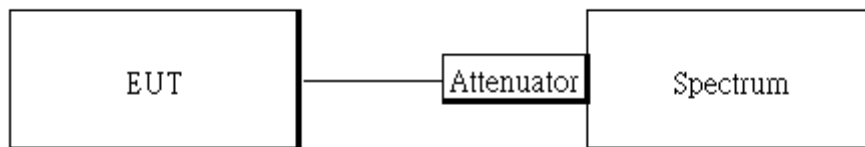
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## 10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

### 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.

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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 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**

**SRD 1M\_Reference Level of Limit**

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2404	-0.65	-20.65
2440	-0.56	-20.56
2476	-0.69	-20.69

**NOTE: cable loss as 0.334dB that offsets in the spectrum**

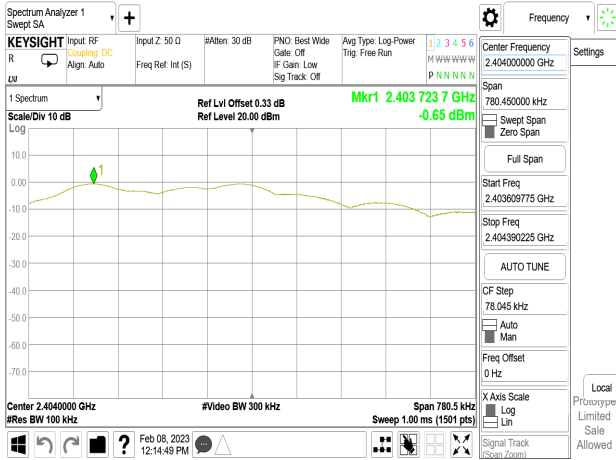
**NOTE: Refer to next page for plots.**

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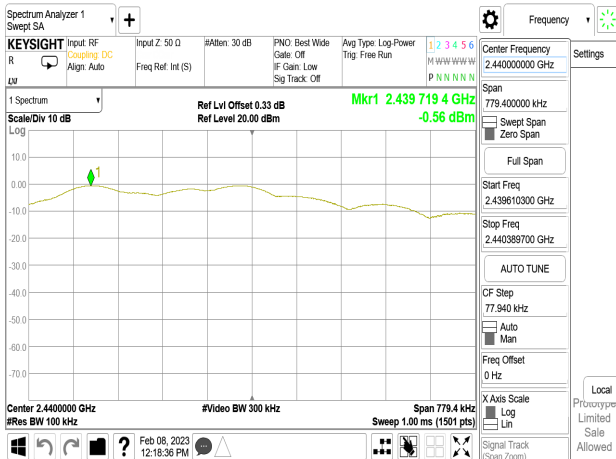
Reference Level\_SRD 1M\_LowCH01-2404MHz



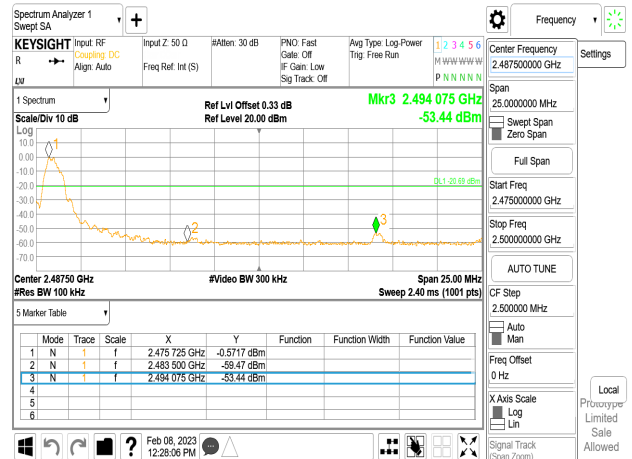
Band Edge\_SRD 1M\_LowCH01-2404MHz



Reference Level\_SRD 1M\_MidCH19-2440MHz



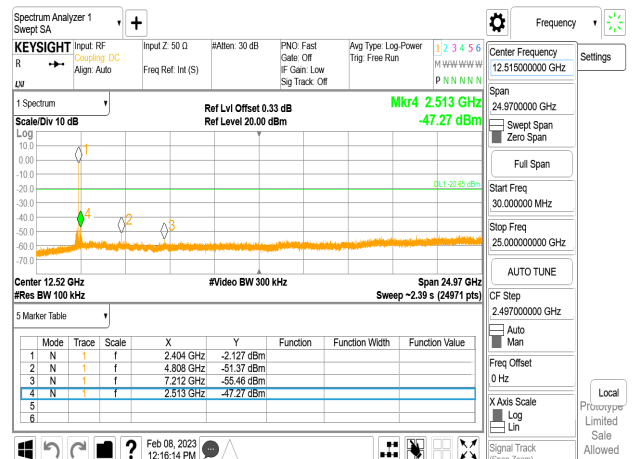
Band Edge\_SRD 1M\_HighCH37-2476MHz



Reference Level\_SRD 1M\_HighCH37-2476MHz



Spurious Emission\_SRD 1M\_LowCH01-2404MHz

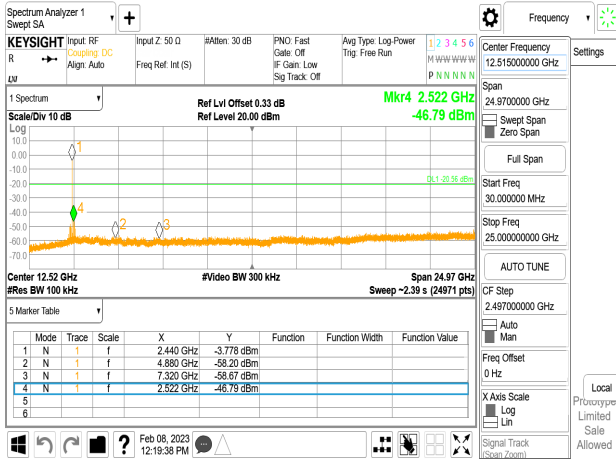


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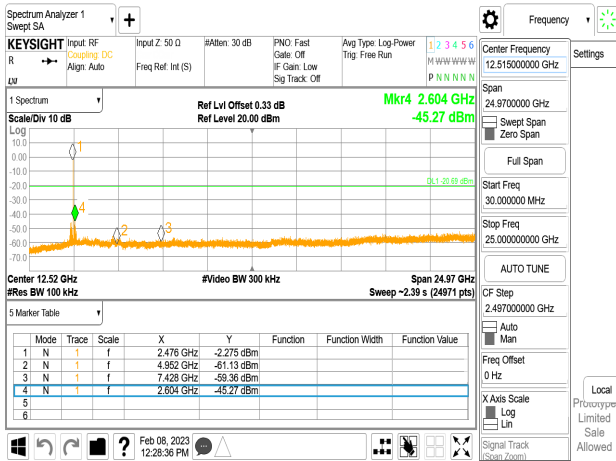
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Spurious Emission\_SRD 1M\_MidCH19-2440MHz



Spurious Emission\_SRD 1M\_HighCH37-2476MHz



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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.

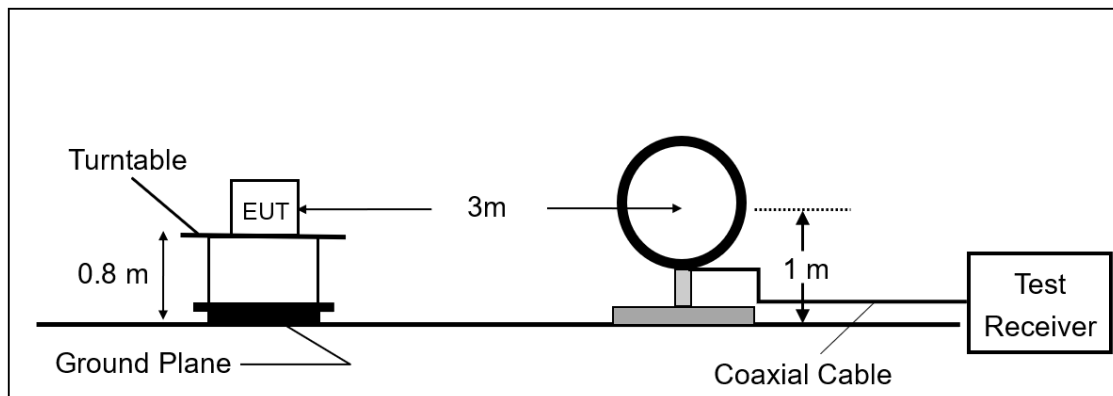
And according to §15.33(a) (1) for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

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

### 11.2 Test Setup

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

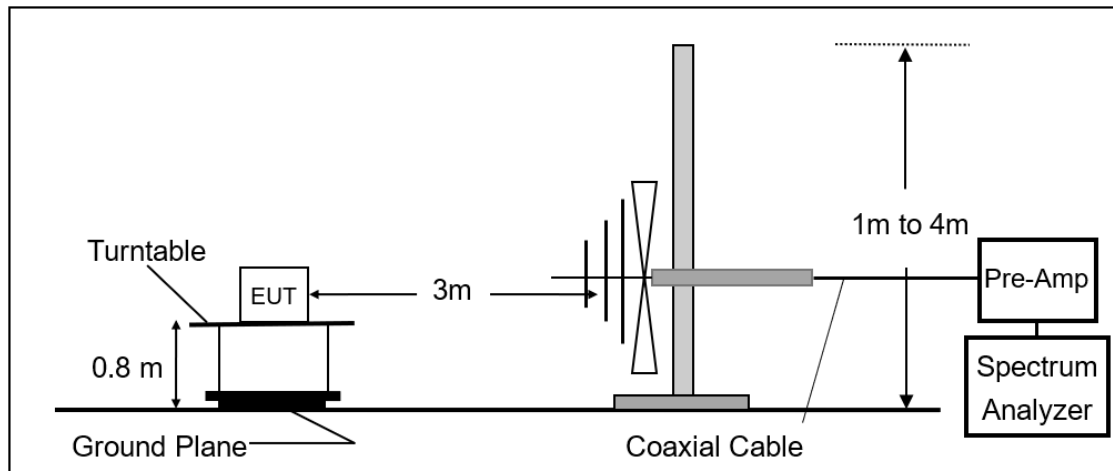


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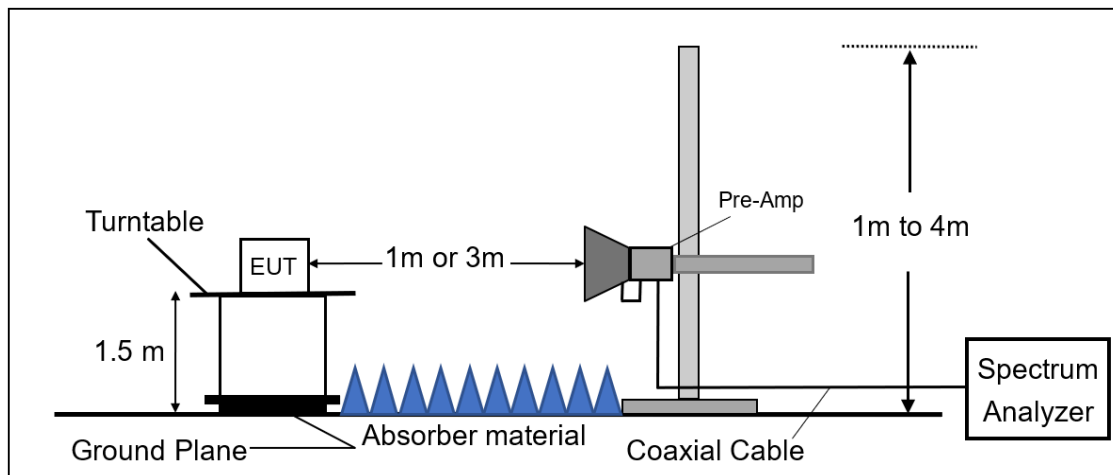
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(B) Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz.



(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 and 1 GHz.

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7. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Maximum Emission Measurements at frequency above 1 GHz.
8. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Emission Measurements at frequency above 1 GHz.
9. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
10. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
11. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
12. Repeat above procedures until all default test channel measured were complete.

#### 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\*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.

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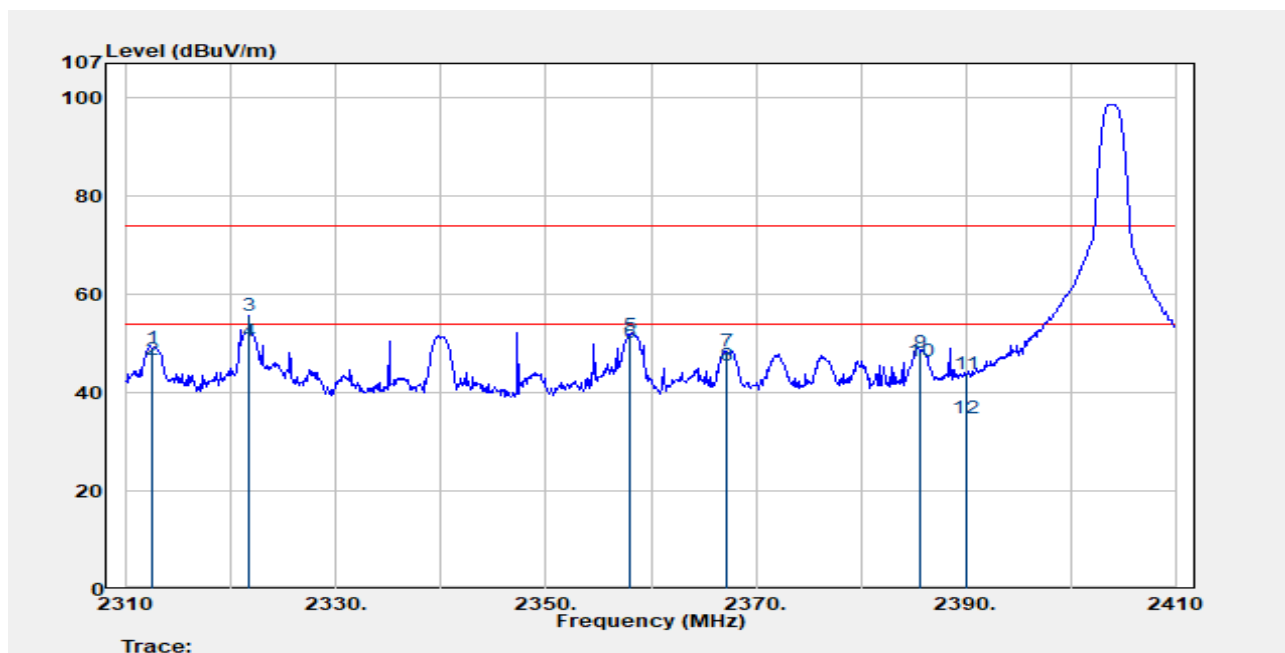
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### 11.6 Measurement Result:

#### 11.6.1 Radiated Band Edge Measurement Result

Report Number	:TERF2211002167ER	Test Site	:SAC 3
Operation Mode	:SRD BW 1M	Test Date	:2023-02-13
Test Frequency	:2404 MHz	Temp./Humi.	:23.5/62
Test Mode	:Bandedge	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2312.400	Peak	53.43	-4.39	49.03	74.00	-24.97
2312.400	Average	51.06	-4.39	46.67	54.00	-7.33
2321.700	Peak	60.09	-4.43	55.65	74.00	-18.35
2321.700	Average	54.98	-4.43	50.55	54.00	-3.45
2358.000	Peak	56.23	-4.49	51.74	74.00	-22.26
2358.000	Average	54.72	-4.49	50.23	54.00	-3.77
2367.200	Peak	52.92	-4.42	48.50	74.00	-25.50
2367.200	Average	49.98	-4.42	45.56	54.00	-8.44
2385.700	Peak	52.49	-4.29	48.21	74.00	-25.79
2385.700	Average	50.63	-4.29	46.34	54.00	-7.66
2390.000	Peak	48.05	-4.25	43.79	74.00	-30.21
2390.000	Average	39.06	-4.25	34.81	54.00	-19.19

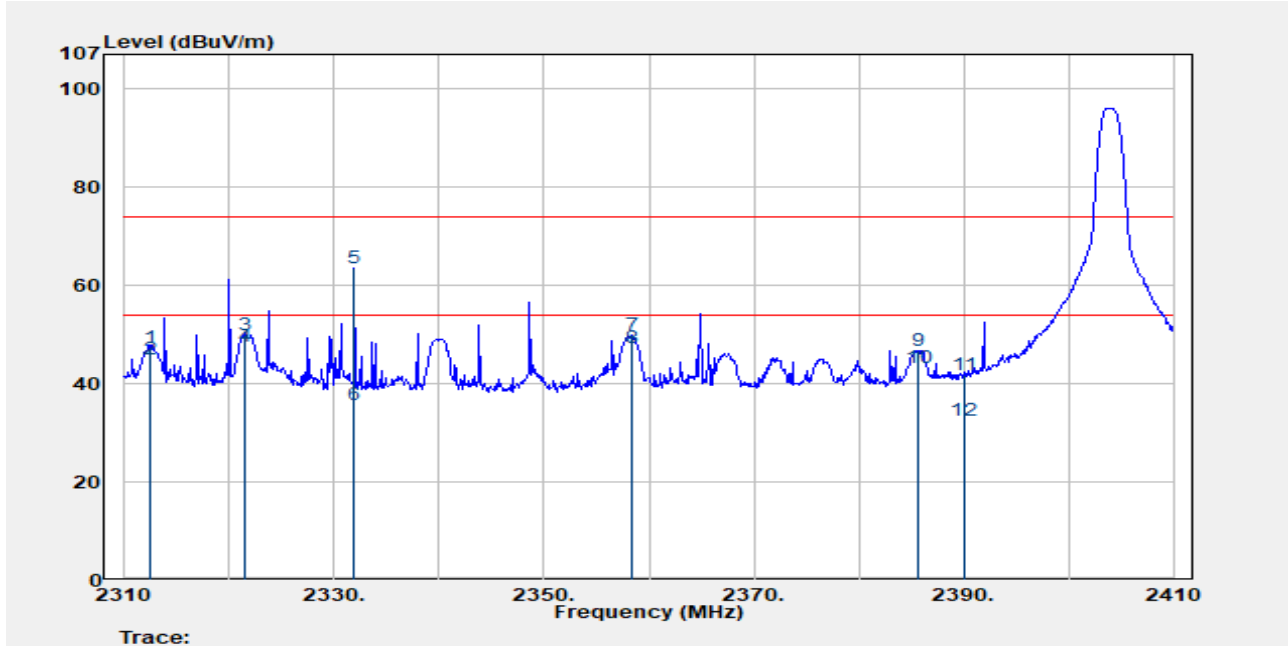
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Report Number :TERF2211002167ER  
 Operation Mode :SRD BW 1M  
 Test Frequency :2404 MHz  
 Test Mode :Bandedge  
 EUT Pol :E2 Plane

Test Site :SAC 3  
 Test Date :2023-02-13  
 Temp./Humi. :23.5/62  
 Antenna Pol. :Horizontal  
 Engineer :Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level d $\mu$ V	Factor dB	Actual FS d $\mu$ V/m	Limit @3m d $\mu$ V/m	Margin dB
2312.400	Peak	51.79	-4.39	47.40	74.00	-26.60
2312.400	Average	49.28	-4.39	44.89	54.00	-9.11
2321.500	Peak	54.23	-4.43	49.80	74.00	-24.20
2321.500	Average	52.08	-4.43	47.65	54.00	-6.35
2331.900	Peak	67.89	-4.47	63.42	74.00	-10.58
2331.900	Average	40.08	-4.47	35.61	54.00	-18.39
2358.300	Peak	54.23	-4.49	49.75	74.00	-24.25
2358.300	Average	51.76	-4.49	47.27	54.00	-6.73
2385.600	Peak	50.88	-4.29	46.59	74.00	-27.41
2385.600	Average	47.39	-4.29	43.10	54.00	-10.90
2390.000	Peak	46.14	-4.25	41.89	74.00	-32.11
2390.000	Average	36.63	-4.25	32.38	54.00	-21.62

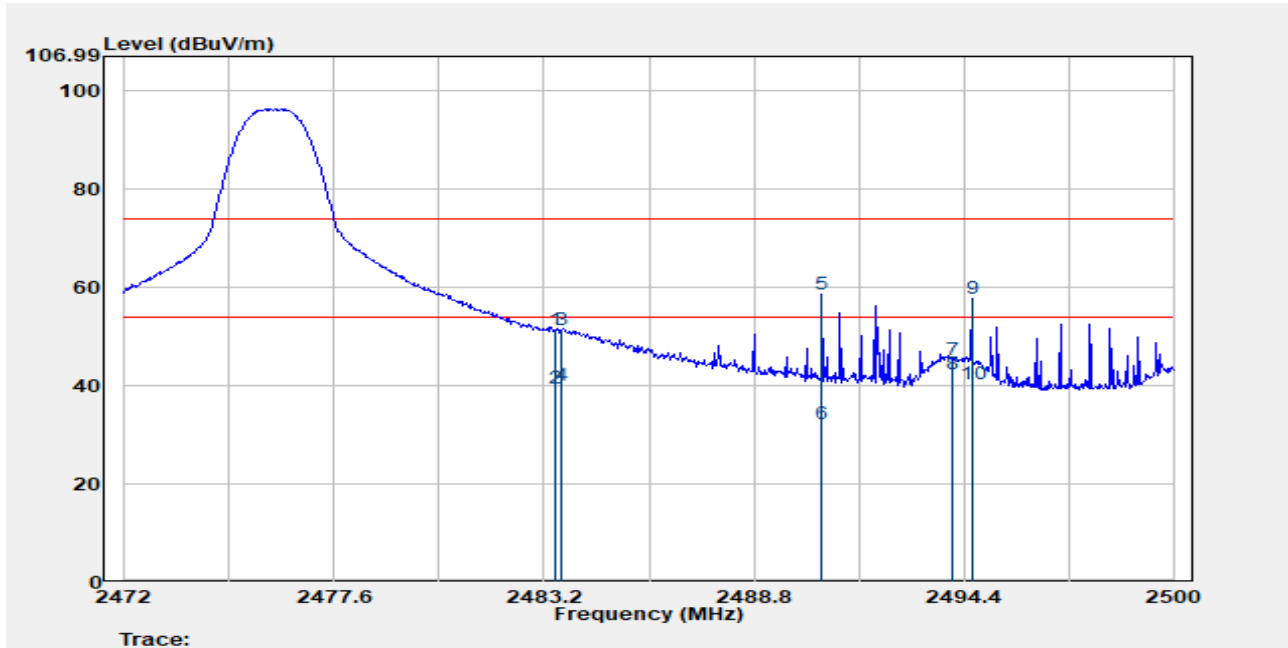
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Report Number :TERF2211002167ER  
 Operation Mode :SRD BW 1M  
 Test Frequency :2476 MHz  
 Test Mode :Bandedge  
 EUT Pol :E2 Plane

Test Site :SAC 3  
 Test Date :2023-02-13  
 Temp./Humi. :23.5/62  
 Antenna Pol. :Vertical  
 Engineer :Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level d $\mu$ V	Factor dB	Actual FS d $\mu$ V/m	Limit @3m d $\mu$ V/m	Margin dB
2483.500	Peak	55.91	-4.64	51.27	74.00	-22.73
2483.500	Average	43.98	-4.64	39.34	54.00	-14.66
2483.650	Peak	55.87	-4.64	51.23	74.00	-22.77
2483.650	Average	44.58	-4.64	39.94	54.00	-14.06
2490.610	Peak	63.18	-4.62	58.56	74.00	-15.44
2490.610	Average	36.75	-4.62	32.13	54.00	-21.87
2494.090	Peak	49.83	-4.61	45.22	74.00	-28.78
2494.090	Average	46.82	-4.61	42.21	54.00	-11.79
2494.630	Peak	62.39	-4.61	57.78	74.00	-16.22
2494.630	Average	44.81	-4.61	40.20	54.00	-13.80

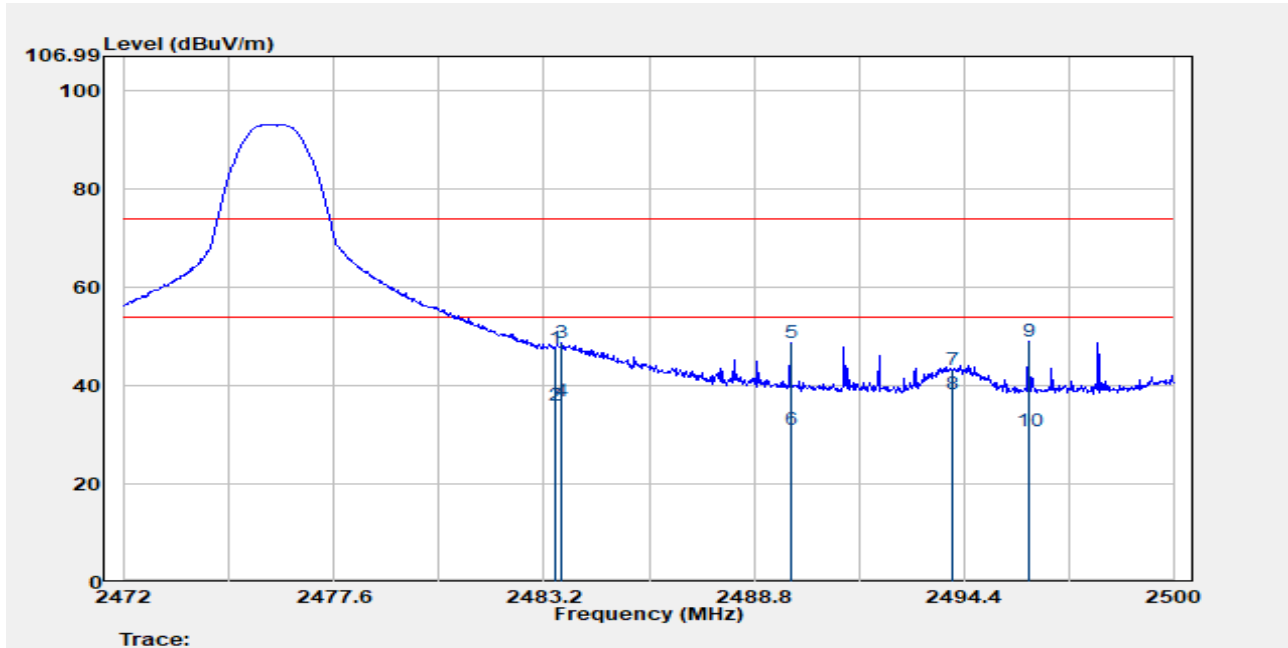
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Report Number :TERF2211002167ER  
 Operation Mode :SRD BW 1M  
 Test Frequency :2476 MHz  
 Test Mode :Bandedge  
 EUT Pol :E2 Plane

Test Site :SAC 3  
 Test Date :2023-02-13  
 Temp./Humi. :23.5/62  
 Antenna Pol. :Horizontal  
 Engineer :Ricky Chen



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	52.24	-4.64	47.59	74.00	-26.41
2483.500	Average	40.72	-4.64	36.08	54.00	-17.92
2483.676	Peak	53.26	-4.64	48.62	74.00	-25.38
2483.676	Average	41.48	-4.64	36.84	54.00	-17.16
2489.780	Peak	53.22	-4.62	48.60	74.00	-25.40
2489.780	Average	35.76	-4.62	31.14	54.00	-22.86
2494.090	Peak	47.83	-4.61	43.22	74.00	-30.78
2494.090	Average	42.89	-4.61	38.28	54.00	-15.72
2496.136	Peak	53.51	-4.60	48.90	74.00	-25.10
2496.136	Average	35.28	-4.60	30.68	54.00	-23.32

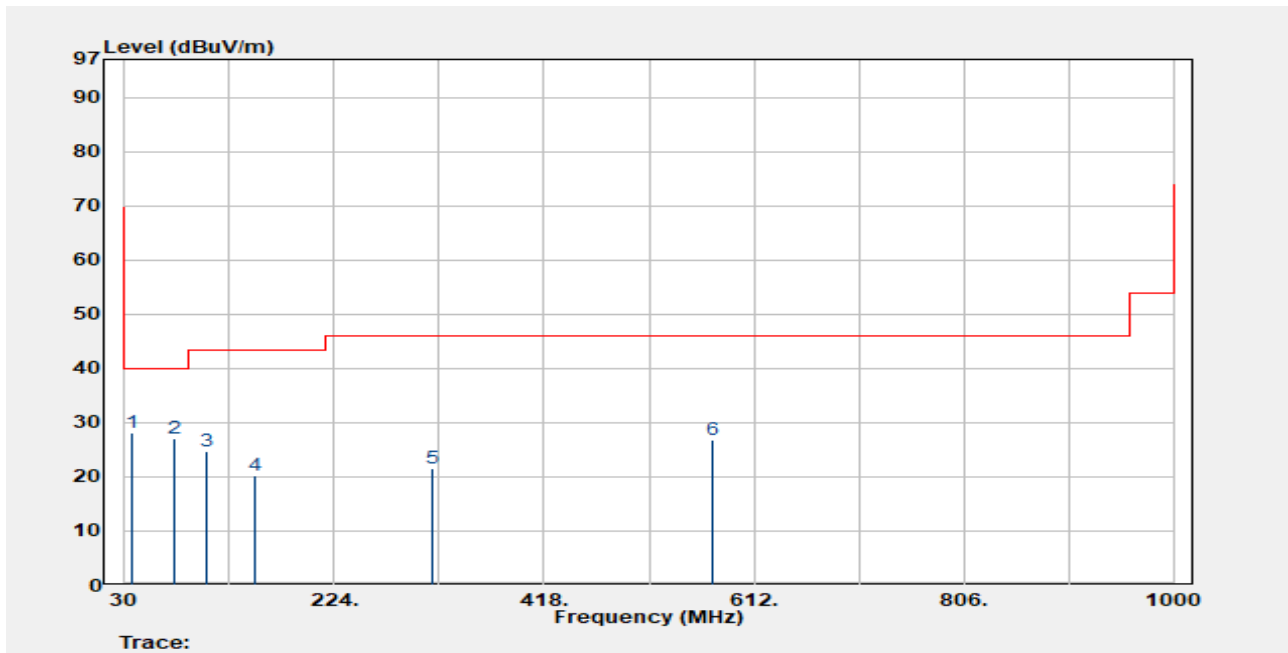
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### 11.6.2 Radiated Spurious Emission

Report Number	:TERF2211002167ER	Test Site	:SAC 3
Operation Mode	:SRD BW 1M	Test Date	:2023-02-13
Test Frequency	:2440 MHz	Temp./Humi.	:23.5/62
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Ricky Chen



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
36.790	Peak	37.48	-9.46	28.02	40.00	-11.98
75.590	Peak	38.99	-11.98	27.01	40.00	-12.99
106.630	Peak	36.50	-11.78	24.72	43.50	-18.78
150.280	Peak	28.46	-8.15	20.31	43.50	-23.19
315.180	Peak	27.91	-6.35	21.56	46.00	-24.44
573.200	Peak	29.28	-2.41	26.86	46.00	-19.14

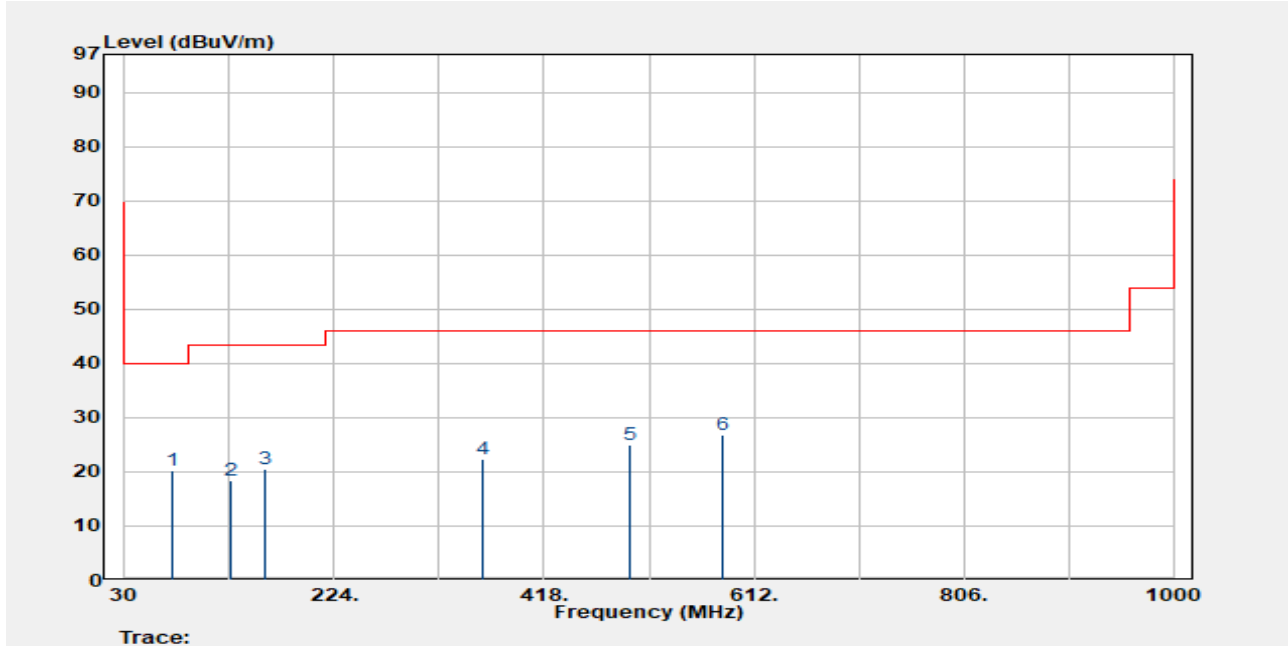
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Report Number :TERF2211002167ER  
 Operation Mode :SRD BW 1M  
 Test Frequency :2440 MHz  
 Test Mode :Tx  
 EUT Pol :E2 Plane

Test Site :SAC 3  
 Test Date :2023-02-13  
 Temp./Humi. :23.5/62  
 Antenna Pol. :Horizontal  
 Engineer :Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
74.620	Peak	31.95	-11.79	20.17	40.00	-19.83
127.970	Peak	28.26	-9.92	18.34	43.50	-25.16
159.010	Peak	28.67	-8.18	20.50	43.50	-23.00
361.740	Peak	28.41	-6.06	22.35	46.00	-23.65
496.570	Peak	28.73	-3.63	25.10	46.00	-20.90
582.900	Peak	28.95	-2.03	26.92	46.00	-19.08

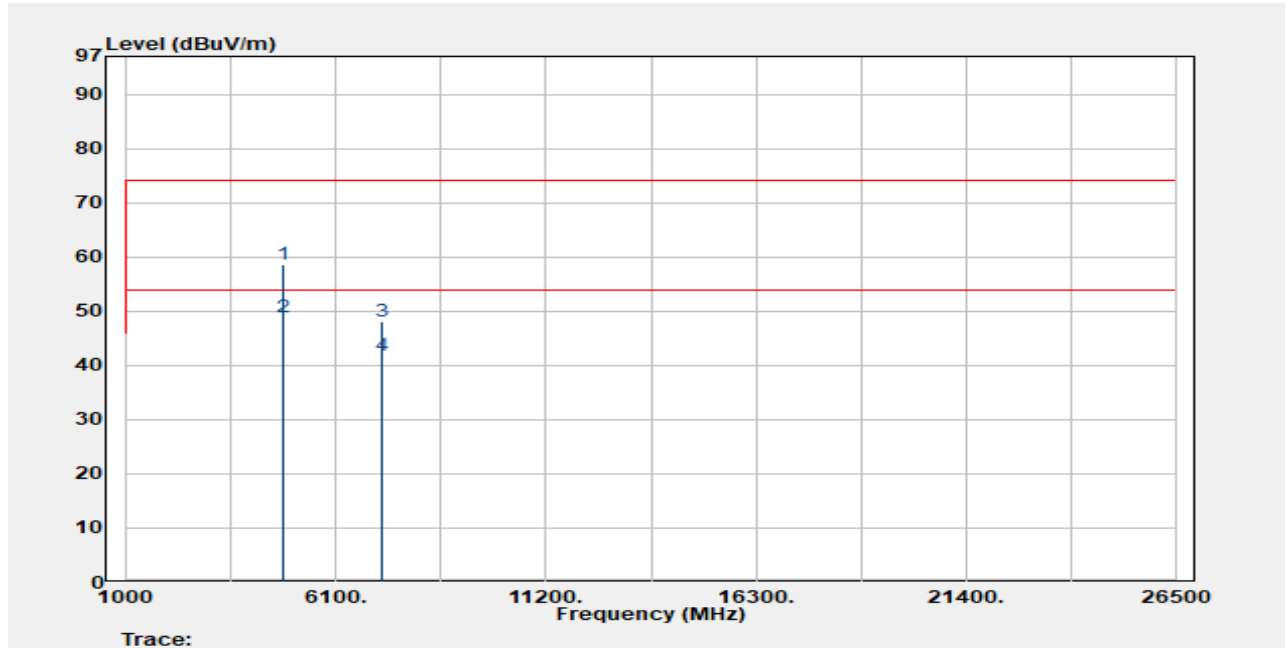
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Report Number :TERF2211002167ER  
 Operation Mode :SRD BW 1M  
 Test Frequency :2404 MHz  
 Test Mode :Tx  
 EUT Pol :E2 Plane

Test Site :SAC 3  
 Test Date :2023-02-13  
 Temp./Humi. :23.5/62  
 Antenna Pol. :Vertical  
 Engineer :Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4808.000	Peak	58.97	-0.36	58.61	74.00	-15.39
4808.000	Average	49.24	-0.36	48.88	54.00	-5.12
7212.000	Peak	42.17	5.97	48.14	74.00	-25.86
7212.000	Average	35.78	5.97	41.75	54.00	-12.25

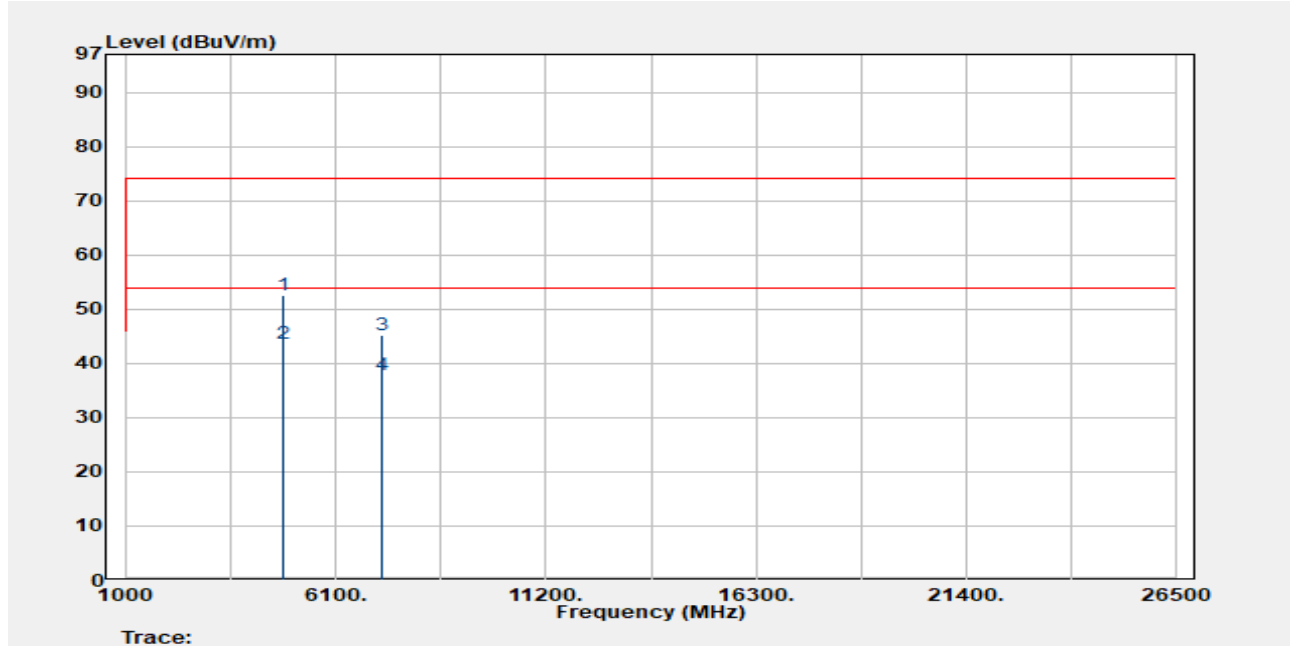
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Report Number :TERF2211002167ER  
 Operation Mode :SRD BW 1M  
 Test Frequency :2404 MHz  
 Test Mode :Tx  
 EUT Pol :E2 Plane

Test Site :SAC 3  
 Test Date :2023-02-13  
 Temp./Humi. :23.5/62  
 Antenna Pol. :Horizontal  
 Engineer :Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4808.000	Peak	53.04	-0.36	52.68	74.00	-21.32
4808.000	Average	43.93	-0.36	43.57	54.00	-10.43
7212.000	Peak	39.18	5.97	45.15	74.00	-28.85
7212.000	Average	31.92	5.97	37.89	54.00	-16.11

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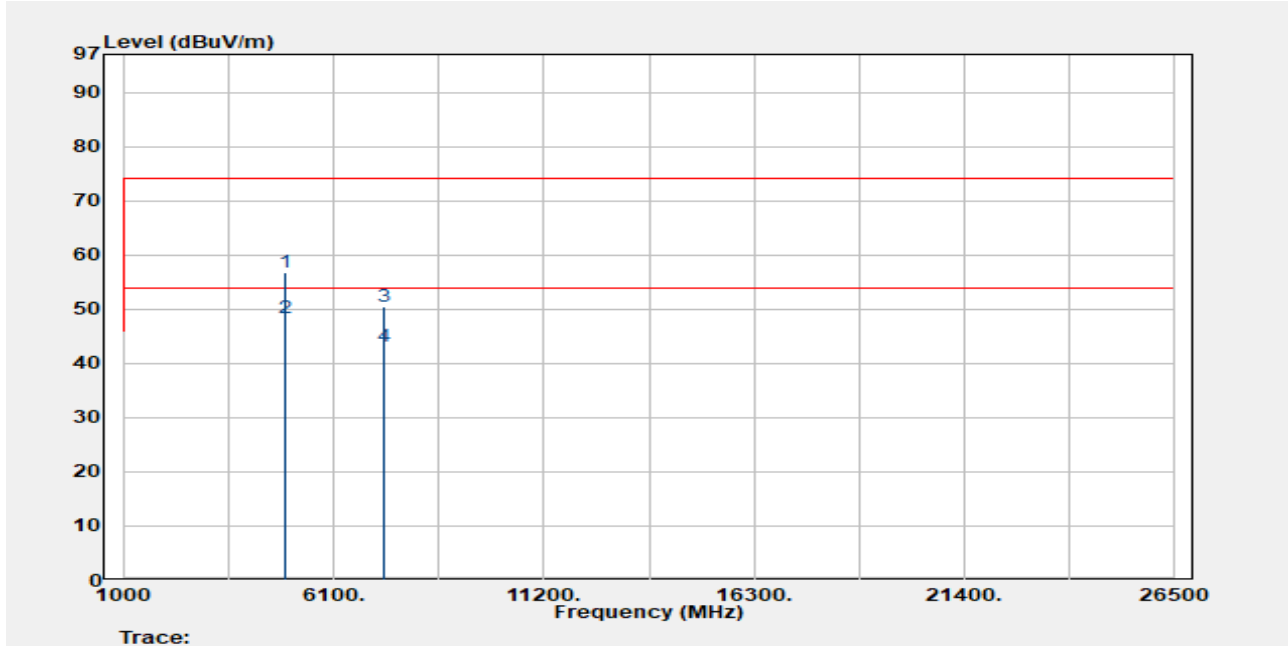
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Report Number :TERF2211002167ER  
 Operation Mode :SRD BW 1M  
 Test Frequency :2440 MHz  
 Test Mode :Tx  
 EUT Pol :E2 Plane

Test Site :SAC 3  
 Test Date :2023-02-13  
 Temp./Humi. :23.5/62  
 Antenna Pol. :Vertical  
 Engineer :Ricky Chen



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	Peak	57.17	-0.29	56.88	74.00	-17.12
4880.000	Average	48.59	-0.29	48.30	54.00	-5.70
7320.000	Peak	44.68	5.83	50.51	74.00	-23.49
7320.000	Average	37.16	5.83	42.99	54.00	-11.01

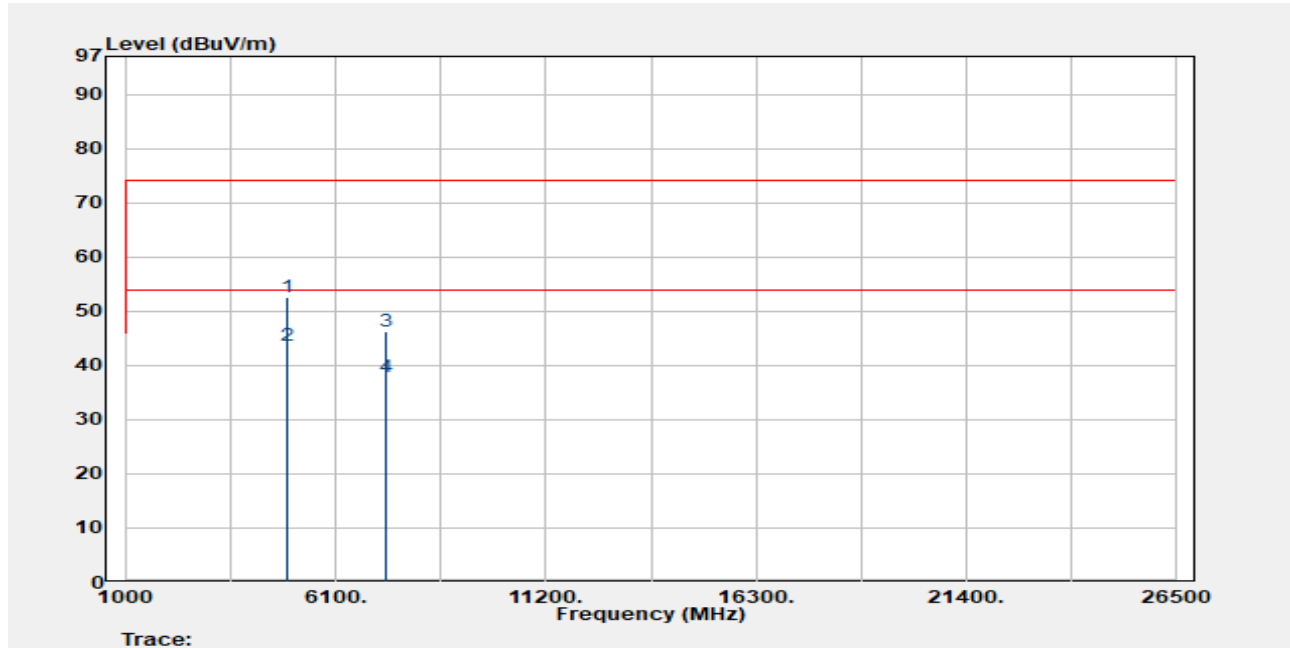
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Report Number :TERF2211002167ER  
 Operation Mode :SRD BW 1M  
 Test Frequency :2440 MHz  
 Test Mode :Tx  
 EUT Pol :E2 Plane

Test Site :SAC 3  
 Test Date :2023-02-13  
 Temp./Humi. :23.5/62  
 Antenna Pol. :Horizontal  
 Engineer :Ricky Chen



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	Peak	52.92	-0.29	52.63	74.00	-21.37
4880.000	Average	44.02	-0.29	43.73	54.00	-10.27
7320.000	Peak	40.47	5.83	46.30	74.00	-27.70
7320.000	Average	32.13	5.83	37.96	54.00	-16.04

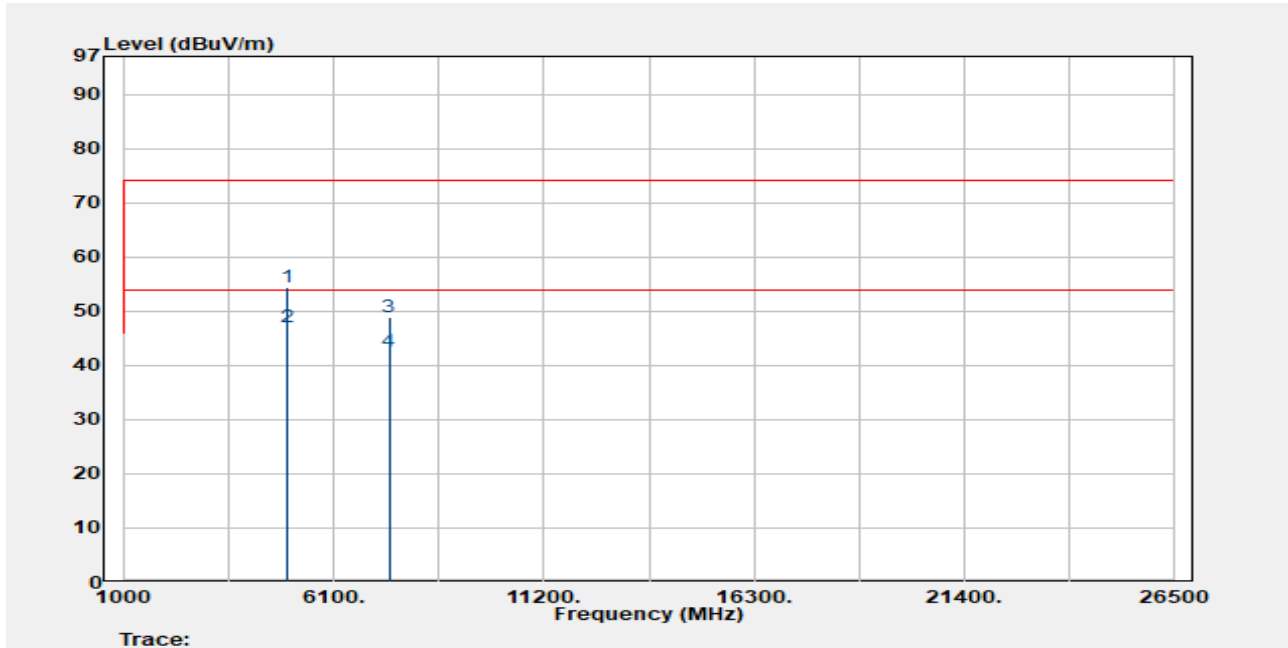
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 Operation Mode :SRD BW 1M  
 Test Frequency :2476 MHz  
 Test Mode :Tx  
 EUT Pol :E2 Plane

Test Site :SAC 3  
 Test Date :2023-02-13  
 Temp./Humi. :23.5/62  
 Antenna Pol. :Vertical  
 Engineer :Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4952.000	Peak	54.69	-0.28	54.41	74.00	-19.59
4952.000	Average	47.29	-0.28	47.01	54.00	-6.99
7428.000	Peak	42.45	6.47	48.92	74.00	-25.08
7428.000	Average	36.15	6.47	42.62	54.00	-11.38

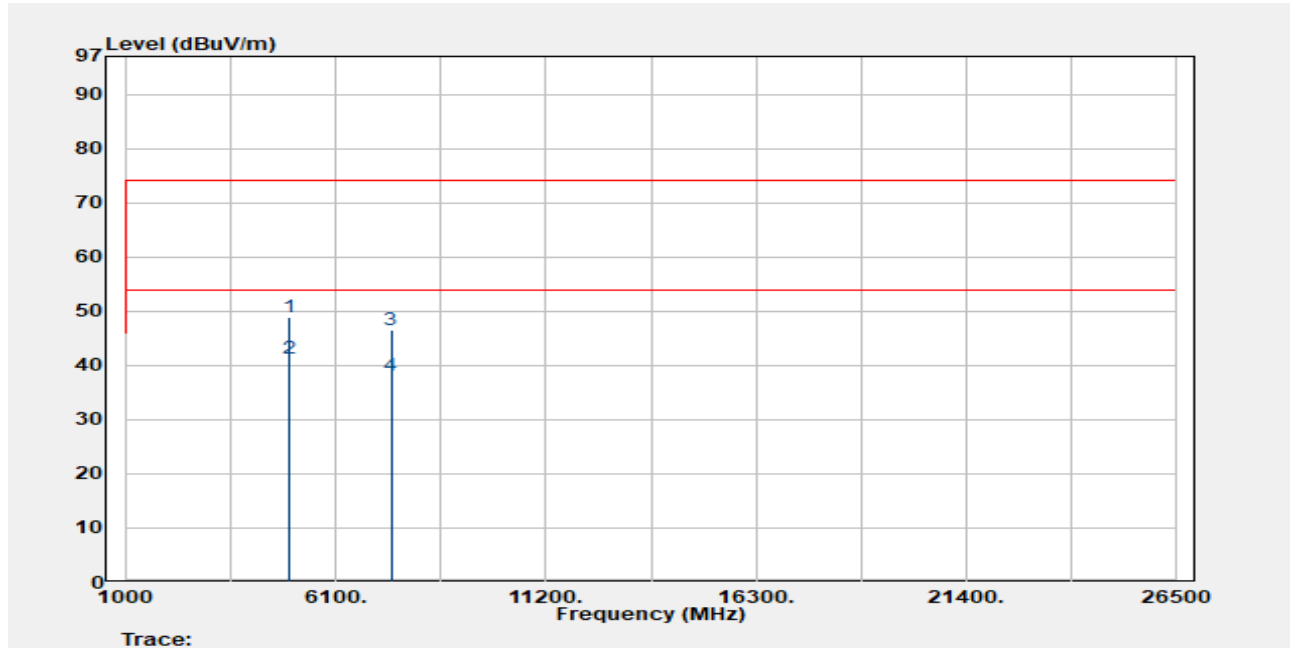
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 Operation Mode :SRD BW 1M  
 Test Frequency :2476 MHz  
 Test Mode :Tx  
 EUT Pol :E2 Plane

Test Site :SAC 3  
 Test Date :2023-02-13  
 Temp./Humi. :23.5/62  
 Antenna Pol. :Horizontal  
 Engineer :Ricky Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4952.000	Peak	49.27	-0.28	48.98	74.00	-25.02
4952.000	Average	41.62	-0.28	41.34	54.00	-12.66
7428.000	Peak	40.04	6.47	46.51	74.00	-27.49
7428.000	Average	31.69	6.47	38.16	54.00	-15.84

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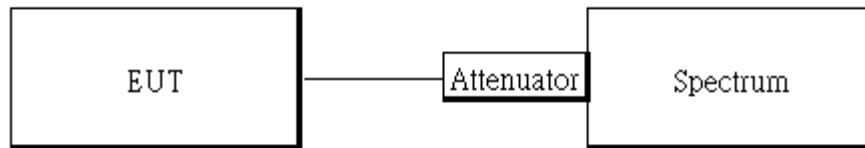
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## 12 POWER SPECTRAL DENSITY

### 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. 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.

### 12.4 Measurement Result:

#### SRD 1M mode

Frequency (MHz)	RF Power Density (dBm/3kHz)	Maximum Limit (dBm/3kHz)	Result
2404	-16.47	7.5	PASS
2440	-16.35	7.5	PASS
2476	-16.48	7.5	PASS

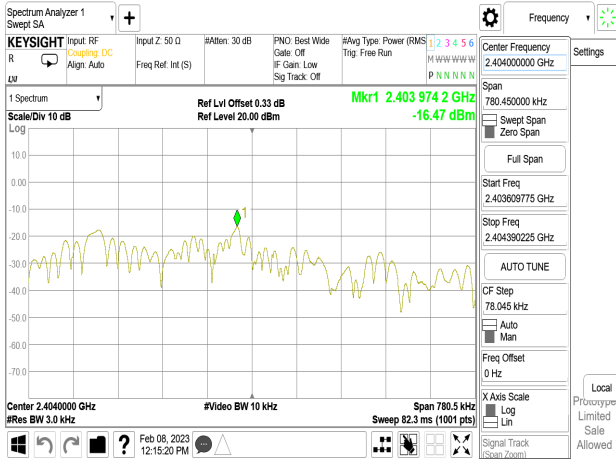
**NOTE: cable loss as 0.334dB that offsets in the spectrum**

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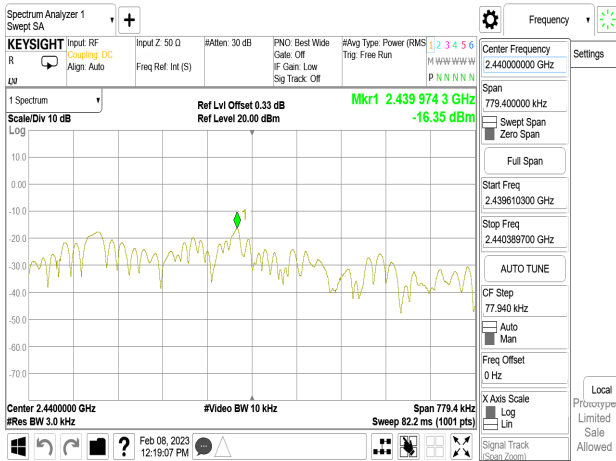
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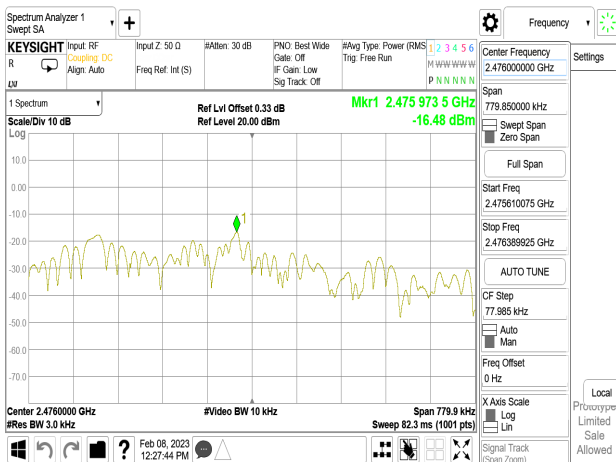
PSD\_SRD 1M\_LowCH01-2404MHz



PSD\_SRD 1M\_MidCH19-2440MHz



PSD\_SRD 1M\_HighCH37-2476MHz



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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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