

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

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

Product Name: Voice Remote Control

Brand Name: Sony

FCC Model No.: RMF-TX611U, RMF-TX611B

IC Model No.: RMF-TX611U

Model Difference: Key label differences

Report Number: ER/2019/A0044

FCC ID: MG3-TX611U

IC: 2575A-TX611U

FCC Rule Part: §15.247, Cat: DTS

IC RSS: RSS-247 issue 2 Feb 2017

Issue Date: Nov. 18, 2019

Date of Test: Oct. 14, 2019 ~ Oct. 31, 2019

Date of EUT Received: Oct. 14, 2019

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory. 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 tested as described in this report is in compliance with conducted and radiated emission limits.

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

Approved By: _____

Jay Lin
Jay Lin / Asst. Supervisor



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Revision History

Revision	Description	Issue Date	Remark
Rev.00	Original.	Nov. 13, 2019	Revised By: Karen Huang
Rev.01	Update standard version	Nov. 18, 2019	Revised By: Karen Huang

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Voice Remote Control
Brand Name:	Sony
FCC Model No.:	RMF-TX611U, RMF-TX611B
IC Model No.:	RMF-TX611U
Model Difference:	Key label differences
Hardware Version:	A03
Software Version:	20.01.01.026
Power Supply:	3Vdc from 2 AAA Batteries

Radio Technology:	Zigbee
Frequency Range:	2425 – 2475MHz
Channel number:	3 channels
Modulation type:	O-QPSK
Transmit Power:	7.61 dBm

1.2 Antenna Designation

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)
Chip Antenna	UEI	FY20	2402-2480	0.32

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1.3 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247
FCC KDB 558074 D01 DTS Meas. Guidance v05r01
RSS-247 issue 2 Feb. 2017
RSS-Gen. issue 5 Mar. 2019
ANSI C63.10:2013

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

1.4 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory (TAF code 0513)
No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan
24803

FCC Designation number: TW0001

ISED CAB identifier: TW0513

1.5 Special Accessories

There are no special accessories used while test was conducted.

1.6 Equipment Modifications

There was no modification incorporated into the EUT.

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

Radiated emission below 30MHz is measured in a 9m*9m*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.

1.8 Multiple Model numbers or Trademarks

The variant model numbers are assessed as identical in hardware and software to each other, hence all variants are fully covered by the test results in this test report without further verification test.

1.9 Disclaimer

Variant information between model numbers is provided by the applicant, test results of this report are applicable to the sample EUT received.

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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.

2.4 Measurement Results Explanation Example

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 Configuration of Tested System

Fig. 2-1 Conducted (Antenna Port) Emission Configuration

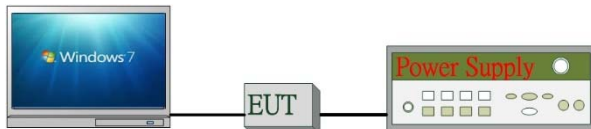


Fig 2-2 Radiated Emission



Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1	Zigbee Test Software	N/A	N/A	N/A	N/A	N/A
2	Notebook	Lenovo	L430	R9-XFG0X	Shielded	Unshielded
3.	DC Power Supply	Agilent	E3640A	MY52410006	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description Of Test	Result
§15.207(a)	RSS-Gen §8.8	AC Power Line Conducted Emission	N/A
§15.247(b) (3)	RSS-247 §5.4(4)	Peak Output Power	Compliant
§15.247(a)(2)	RSS-247 §5.2 (1) RSS-Gen §6.7	6dB & 99% Bandwidth	Compliant
§15.205 §15.209 §15.247(d)	RSS-247 §5.5	Conducted Band Edge and Spurious Emission	Compliant
§15.205 §15.209 §15.247(d)	RSS-247 §5.5	Radiated Band Edge and Spurious Emission	Compliant
§15.247(e)	RSS-247 §5.2(2)	Peak Power Density	Compliant
§15.203 §15.247(b)	N/A	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operated in 2400 ~ 2483.5MHz Band

3 channels are provided for Zigbee

ITEM	FREQUENCY
1	2425 MHz
2	2450 MHz
3	2475 MHz

4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3. Investigation has been done on all the possible configurations for searching the worst case.

MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION
RADIATED EMISSION TEST (BELOW 1 GHz)			
Zigbee	2425 to 2475	2450	O-QPSK
RADIATED EMISSION TEST (ABOVE 1 GHz)			
Zigbee	2425 to 2475	2425,2450,2475	O-QPSK
Note: The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Zigbee Transmitter for channel Low, Mid and High, the worst case H position was reported.			

ANTENNA PORT CONDUCTED MEASUREMENT			
MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION
Zigbee	2425 to 2475	2425,2450,2475	O-QPSK

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 0.84 dB
6dB Bandwidth	+/- 51.33 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 0.84 dB
Peak Power Density	+/- 1.3 dB
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

Radiated Spurious Emission Measurement Uncertainty	
Polarization: Vertical	9kHz~30MHz: +/-2.3dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB
Polarization: Horizontal	9kHz~30MHz: +/-2.3dB
	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

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 CONDUCTED EMISSION TEST

6.1 Standard Applicable:

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

Frequency range MHz	Limits dB(μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Note

- 1.The lower limit shall apply at the transition frequencies
- 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

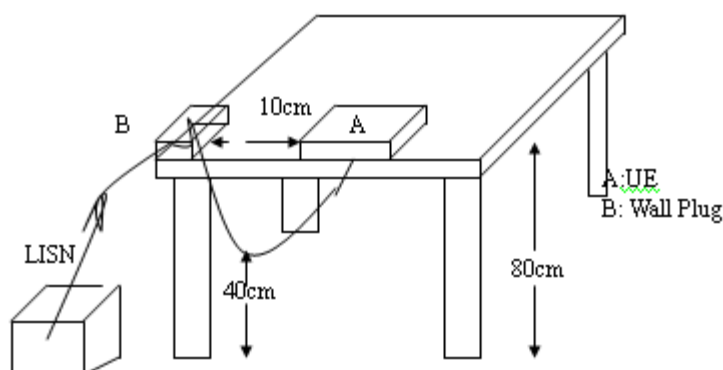
6.2 Measurement Equipment Used:

N/A

6.3 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.

6.4 Test SET-UP (Block Diagram of Configuration)



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6.5 Measurement Procedure:

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

6.6 Measurement Result:

N/A; Powered from 2 AAA batteries.

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7 PEAK OUTPUT POWER MEASUREMENT

7.1 Standard Applicable:

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

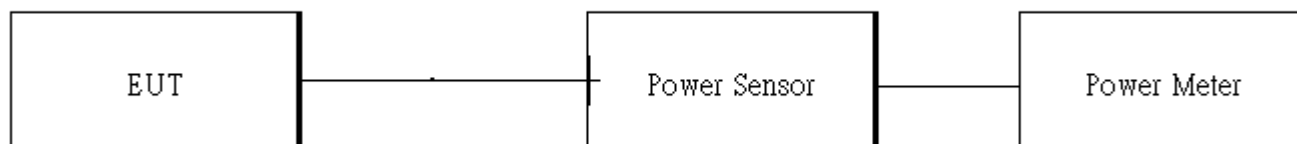
If the transmitting antenna of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

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

7.2 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1804001	02/13/2019	02/12/2020
Power Sensor	Anritsu	MA2411B	1726104	02/13/2019	02/12/2020
Power Sensor	Anritsu	MA2411B	1726107	02/13/2019	02/12/2020
DC Power Supply	Agilent	E3640A	MY52410006	12/04/2018	12/03/2019

7.3 Test Set-up:



7.4 Measurement Procedure:

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

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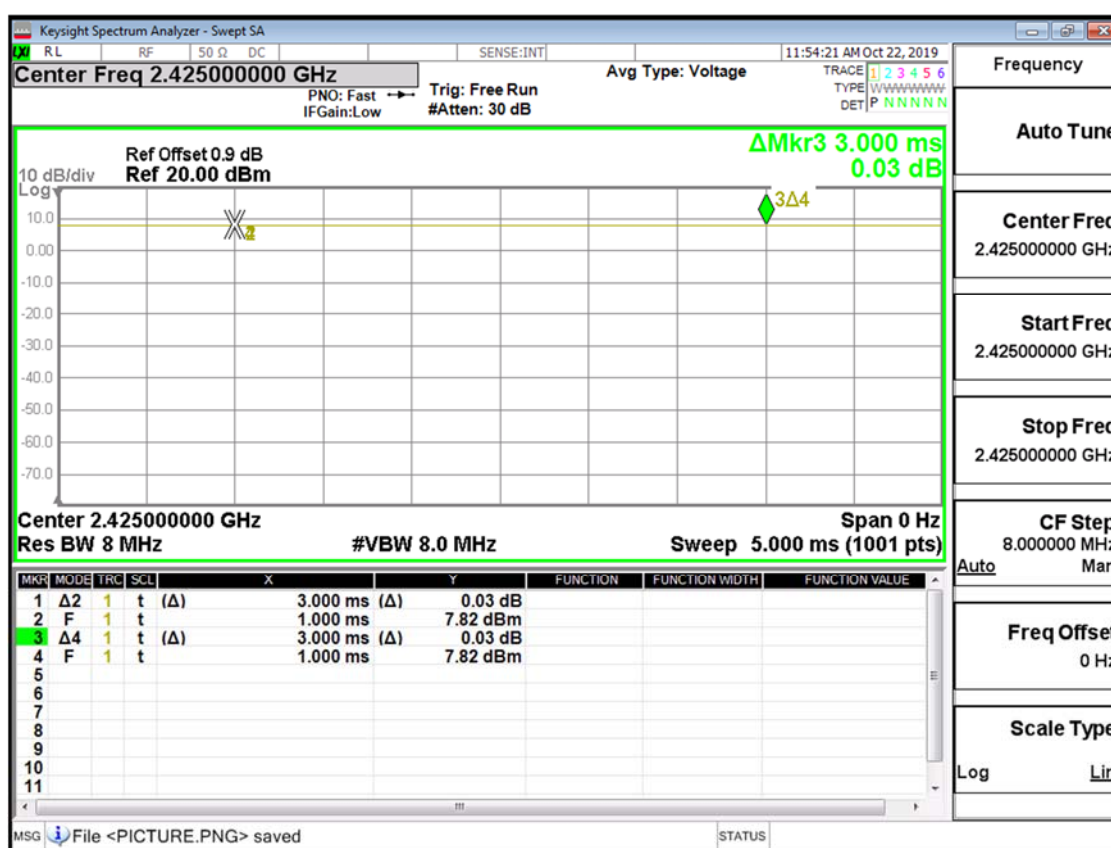
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7.5 Duty Factor:

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

Duty Cycle Factor:10*log(1/(100/100))=0

Duty Cycle_Zigbee_LowCH-2425



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7.6 Output Power:

7.6.1 Peak & Avg

CH	Frequency (MHz)	Peak Power Output (dBm)	Required Limit
Low	2425	7.30	1 Watt = 30 dBm
Mid	2450	7.36	1 Watt = 30 dBm
High	2475	7.61	1 Watt = 30 dBm
CH	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit
Low	2425	7.27	1 Watt = 30 dBm
Mid	2450	7.33	1 Watt = 30 dBm
High	2475	7.59	1 Watt = 30 dBm

*Note: Measured by power meter, cable loss as 0.9 dB that offsets on the power meter in Peak

*Note: Measured by power meter, as cable loss+ Duty cycle factor that offsets on the power meter

*Note: Max. Output include tune up tolerance Power is average power

7.6.2 EIRP

CH	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit		
Low	2425	7.27	0.32	7.59	4W=	36	dBm
Mid	2450	7.33	0.32	7.65	4W=	36	dBm
High	2475	7.59	0.32	7.91	4W=	36	dBm

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

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8 6DB & 99% BANDWIDTH MEASUREMENT

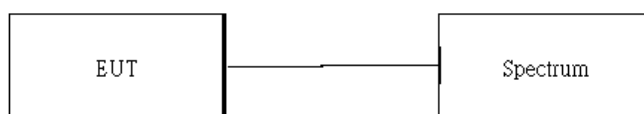
8.1 Standard Applicable

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

8.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1804001	02/13/2019	02/12/2020
Power Sensor	Anritsu	MA2411B	1726104	02/13/2019	02/12/2020
Power Sensor	Anritsu	MA2411B	1726107	02/13/2019	02/12/2020
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	05/02/2019	05/01/2020
DC Power Supply	Agilent	E3640A	MY52410006	12/04/2018	12/03/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2019	01/01/2020

8.3 Test Set-up:



8.4 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. For 6dB Bandwidth:
Set the spectrum analyzer as RBW=100 kHz, VBW= 3*RBW, Span = 5MHz, Detector=Peak, Sweep=auto.
5. Mark the peak frequency and -6dB (upper and lower) frequency.
6. For 99% Bandwidth:
Set the spectrum analyzer as RBW=1%, VBW=3*RBW, Span = 2MHz, Detector=Sample, Sweep=auto.
7. Turn on the 99% bandwidth function, max reading.
8. Repeat above procedures until all test default channel is completed

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8.5 Measurement Result:

Zigbee mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2425	1.581	> 0.5	PASS
2450	1.579	> 0.5	PASS
2475	1.583	> 0.5	PASS

Zigbee mode

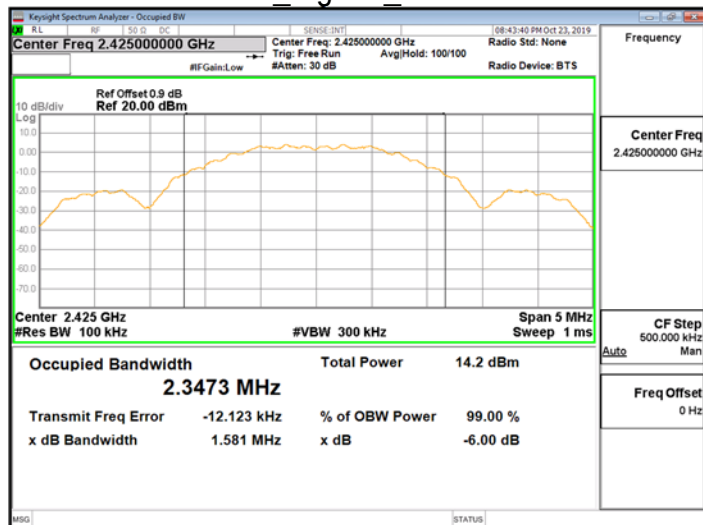
Frequency (MHz)	99%Bandwidth (MHz)
2425	2.3147
2450	2.3195
2475	2.3184

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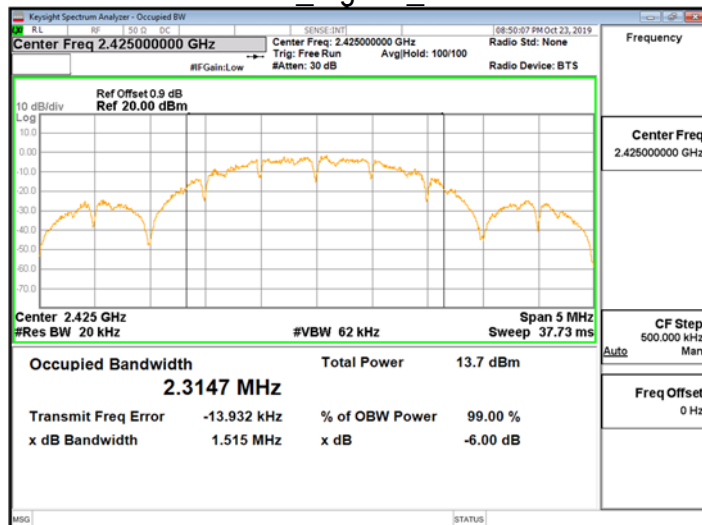
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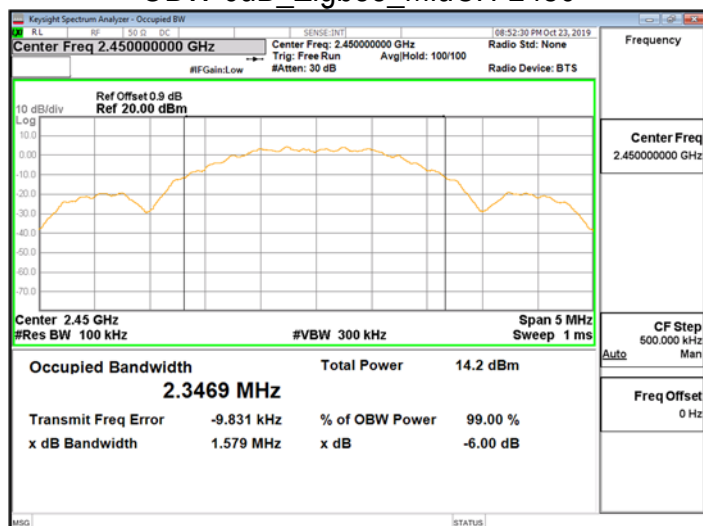
OBW 6dB_Zigbee_LowCH-2425



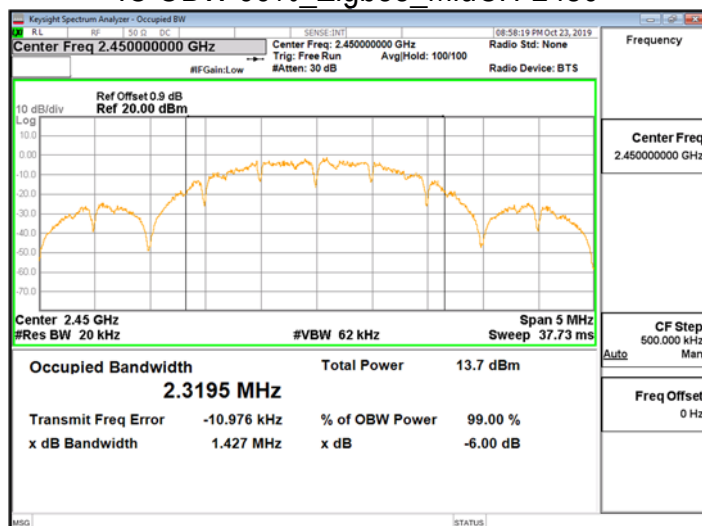
IC OBW 99%_Zigbee_LowCH-2425



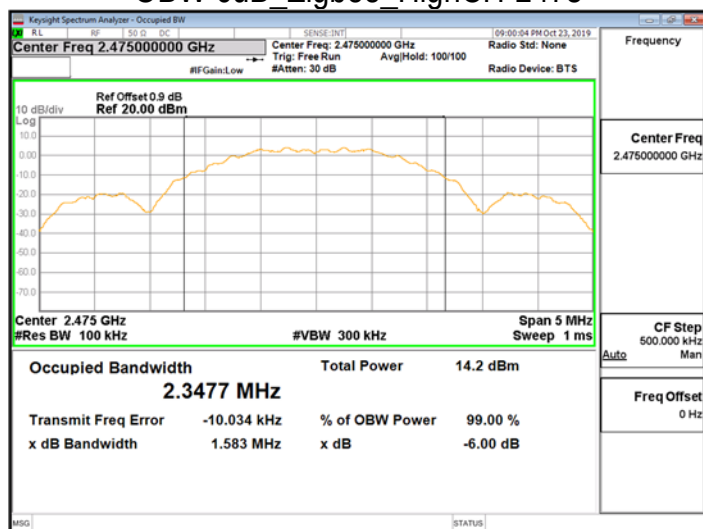
OBW 6dB_Zigbee_MidCH-2450



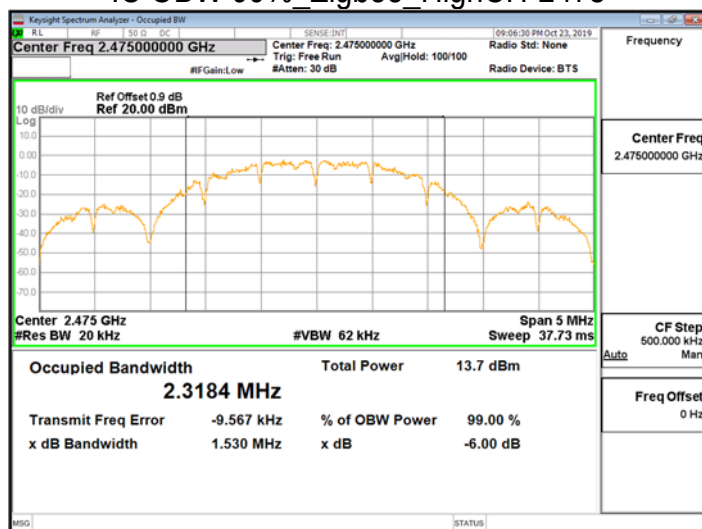
IC OBW 99%_Zigbee_MidCH-2450



OBW 6dB_Zigbee_HighCH-2475



IC OBW 99%_Zigbee_HighCH-2475



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9 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

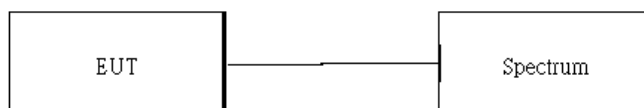
9.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a) & RSS-Gen §8.10, must also comply with the radiated emission limits specified in §15.209(a) & RSS-Gen §8.9.

9.2 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1804001	02/13/2019	02/12/2020
Power Sensor	Anritsu	MA2411B	1726104	02/13/2019	02/12/2020
Power Sensor	Anritsu	MA2411B	1726107	02/13/2019	02/12/2020
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	05/02/2019	05/01/2020
DC Power Supply	Agilent	E3640A	MY52410006	12/04/2018	12/03/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2019	01/01/2020

9.3 Test SET-UP:



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9.4 Measurement Procedure

9.4.1 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.

9.4.2 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. Mark the highest reading of the emission as the reference level measurement.
7. Marker on frequency, 2.3999GHz and 2.4836GHz, and examine shall 100 kHz immediately outside the authorized (2400~2483.5MHz) be attenuated by 20dB at least relative to the maximum emission of power.
8. Repeat above procedures until all default test channel (low, middle, and high) was complete.

9.4.3 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.

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9.5 Measurement Result

Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2425	4.04	-15.96
2450	4.12	-15.88
2475	4.09	-15.91

NOTE: cable loss as 0.9dB that offsets in the spectrum

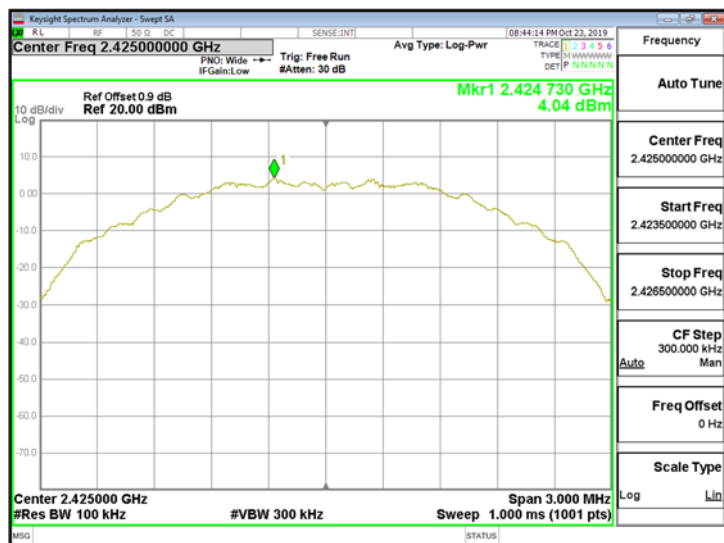
NOTE: Refer to next page for plots.

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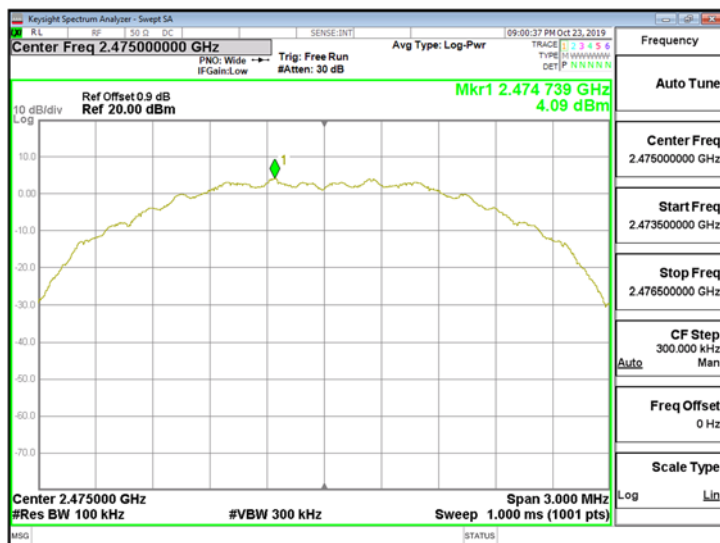
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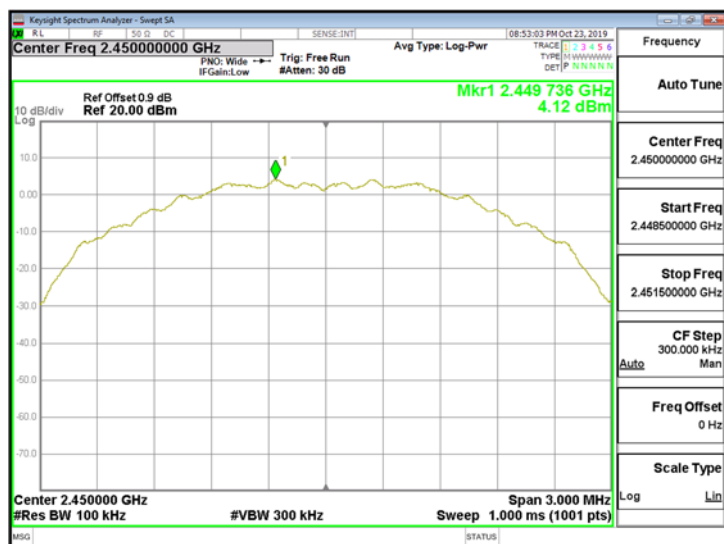
Reference Level_Zigbee_LowCH-2425



Reference Level_Zigbee_HighCH-2475



Reference Level_Zigbee_MidCH-2450

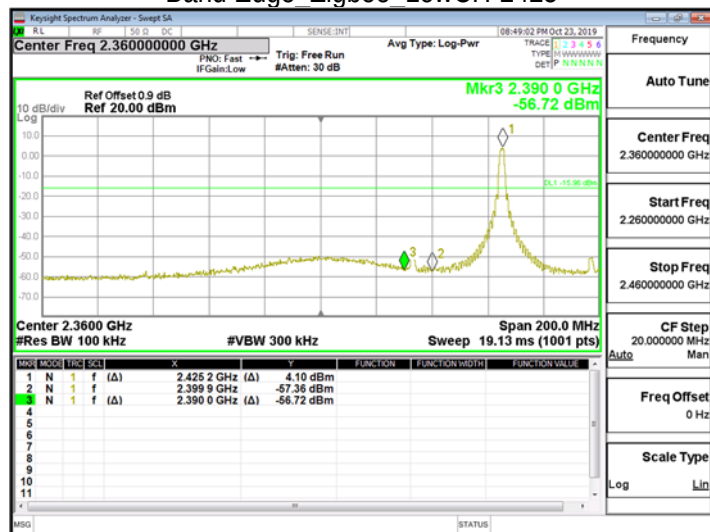


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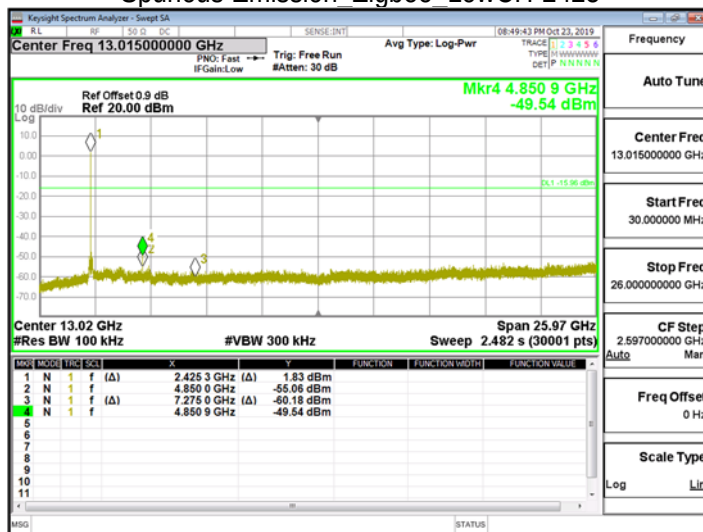
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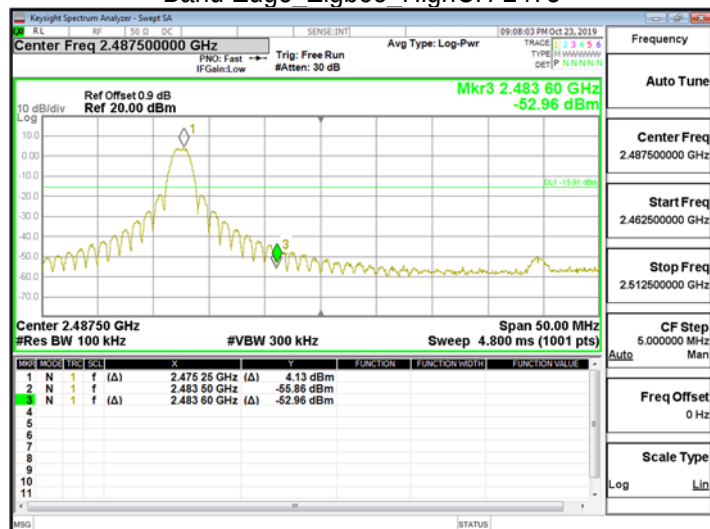
Band Edge Zigbee LowCH-2425



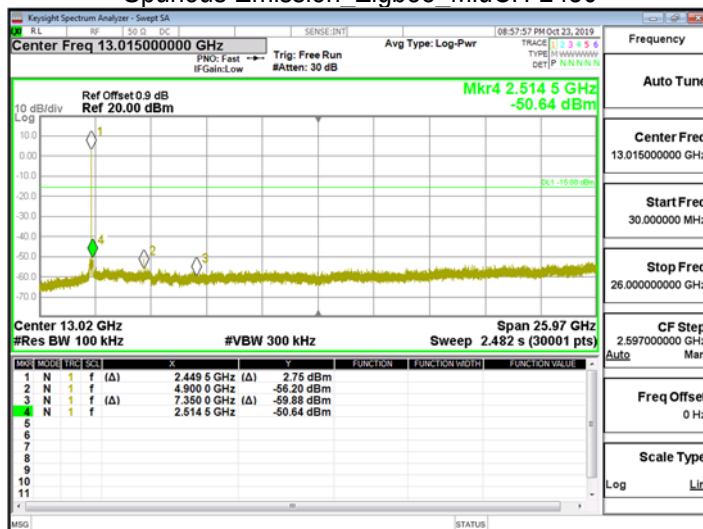
Spurious Emission Zigbee LowCH-2425



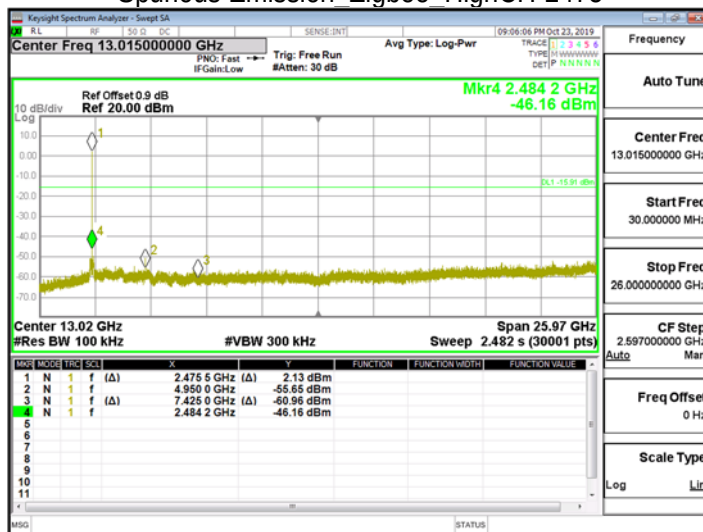
Band Edge Zigbee HighCH-2475



Spurious Emission Zigbee MidCH-2450



Spurious Emission Zigbee HighCH-2475



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10 RADIATED BANDEDGE 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 must also comply with the §15.209 and RSS-Gen §8.9 Table 5 and 6 limit as below.

And according to §15.33(a) (1) & RSS-Gen §6.13.2.a for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

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

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (dBμV/m)

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10.2 Measurement Equipment Used

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Bi-log Antenna	TESEO	CBL 6112D	35242 & AT-N0555	01/10/2019	01/09/2020
Horn Antenna	Schwarzbeck	BBHA9170	07/02/1900	12/27/2018	12/26/2019
Horn Antenna	Schwarzbeck	BBHA9120D	D803	12/24/2018	12/23/2019
Loop Antenna	ETS.LINDGREN	6502	148045	10/15/2019	10/14/2020
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/22/2019	04/21/2020
EMI Test Receiver	R&S	ESCI 3	100335	02/12/2019	02/11/2020
Pre-Amplifier	EMC Instruments	EMC184045B	980135	01/02/2019	01/01/2020
Pre-Amplifier	EMC Instruments	EMC051825	980152	01/02/2019	01/01/2020
Pre-Amplifier	HP	8447D	2944A09469	01/02/2019	01/01/2020
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M1	01/02/2019	01/01/2020
High Pass Filter	WI	WHKX4.0/18G-10SS	22	01/02/2019	01/01/2020
Coaxial Cable	Huber Suhner	succoflex 102	MY2622/2	01/02/2019	01/01/2020
Coaxial Cable	Huber Suhner	succoflex 104A	800086/4a	01/02/2019	01/01/2020
Coaxial Cable	Huber Suhner	EMC 104-SM-SM-2000	160123	01/02/2019	01/01/2020
Software	e3 V6.11-20180413				

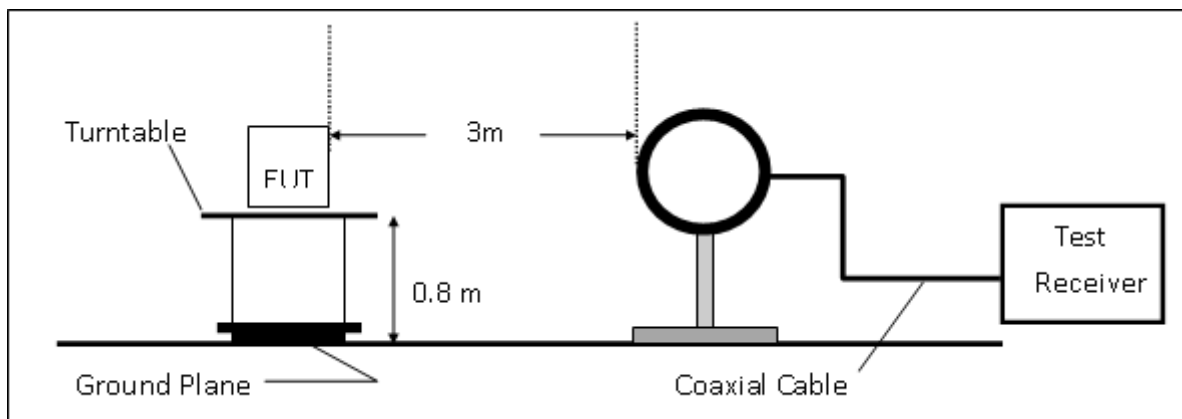
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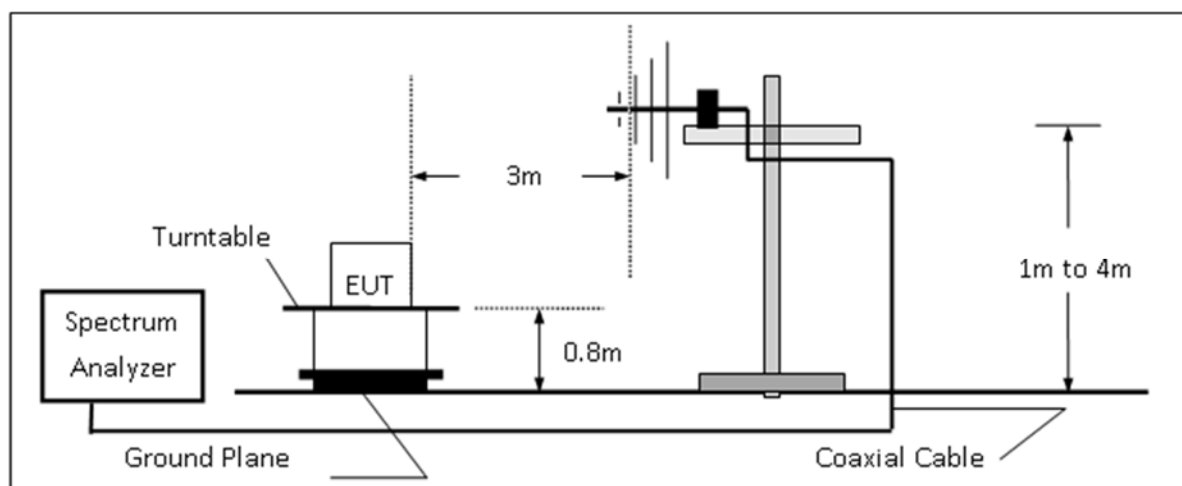
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10.3 Test SET-UP

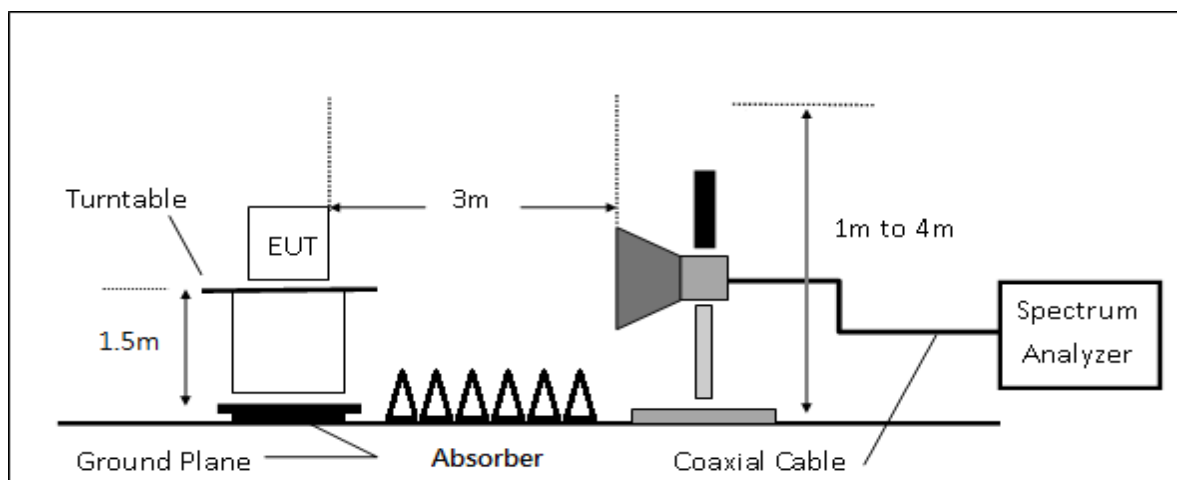
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



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



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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10.4 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 plan.
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=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
6. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
7. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
8. 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.
9. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
10. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
11. Repeat above procedures until all default test channel measured were complete.

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10.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where *FS* = Field Strength *CL* = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude *AG* = Amplifier Gain
AF = Antenna Factor

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

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

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

10.6 Test Results of Radiated Spurious Emissions form 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.

10.7 Measurement Result:

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

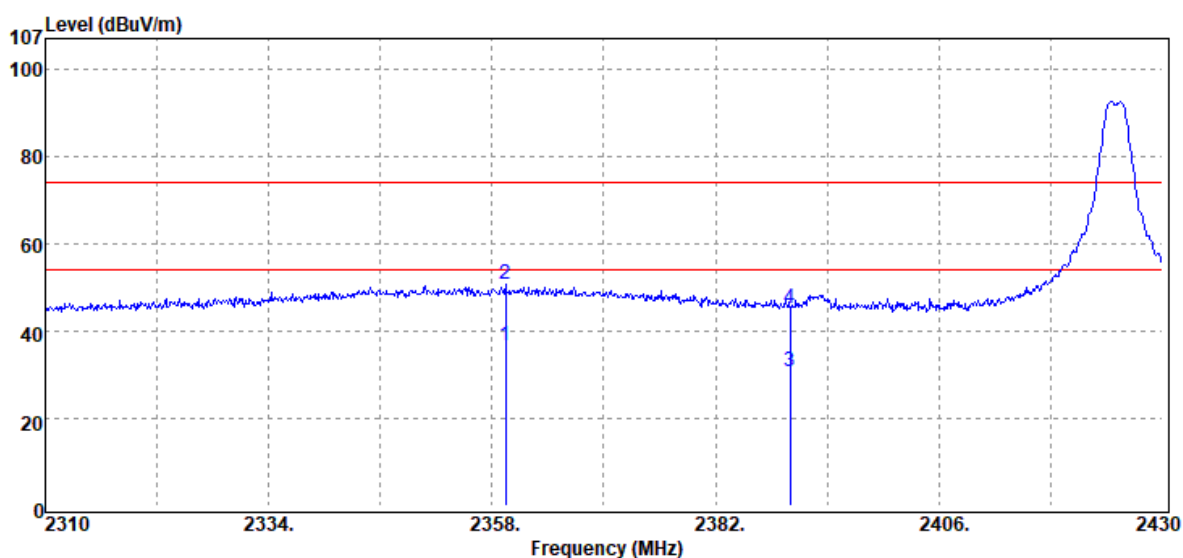
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10.7.1 Radiated Band Edge Measurement Result

Report Number	:ER-2019-A0044	Test Date	:2019-10-23
Operation Mode	:Zigbee	Temp./Humi.	:23.1/69
Test Channel	:2425 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH Low	Engineer	:Nick
EUT Pol	:H Plane		



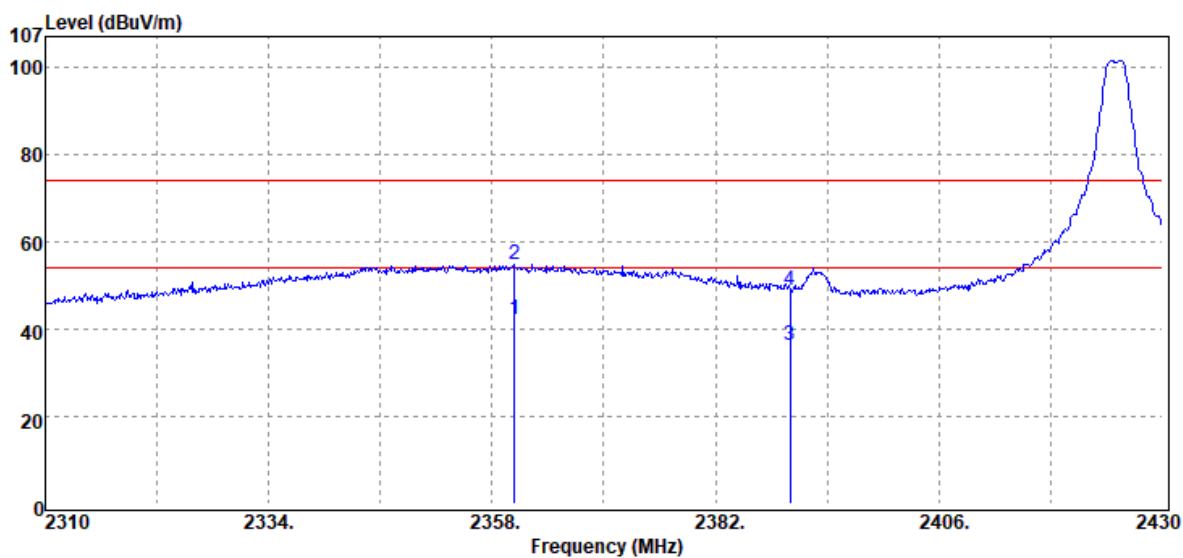
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
2359.44	Average	29.07	7.66	36.73	54.00	-17.27
2359.44	Peak	42.93	7.66	50.59	74.00	-23.41
2390.00	Average	23.34	7.57	30.91	54.00	-23.09
2390.00	Peak	37.78	7.57	45.35	74.00	-28.65

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Report Number	:ER-2019-A0044	Test Date	:2019-10-23
Operation Mode	:Zigbee	Temp./Humi.	:23.1/69
Test Channel	:2425 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH Low	Engineer	:Nick
EUT Pol	:H Plane		



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2360.40	Average	34.41	7.67	42.08	54.00	-11.92
2360.40	Peak	47.15	7.67	54.82	74.00	-19.18
2390.00	Average	28.82	7.57	36.39	54.00	-17.61
2390.00	Peak	41.19	7.57	48.76	74.00	-25.24

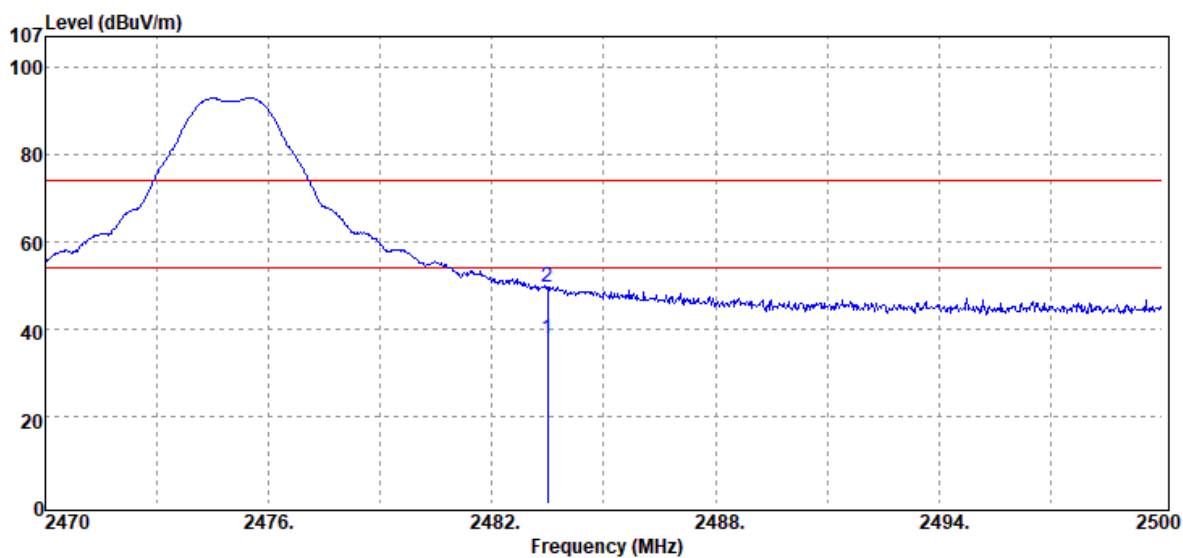
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Report Number :ER-2019-A0044
Operation Mode :Zigbee
Test Channel :2475 MHz
Test Mode :Bandedge CH Mid
EUT Pol :H Plane

Test Date :2019-10-23
Temp./Humi. :23.1/69
Antenna Pol. :VERTICAL
Engineer :Nick



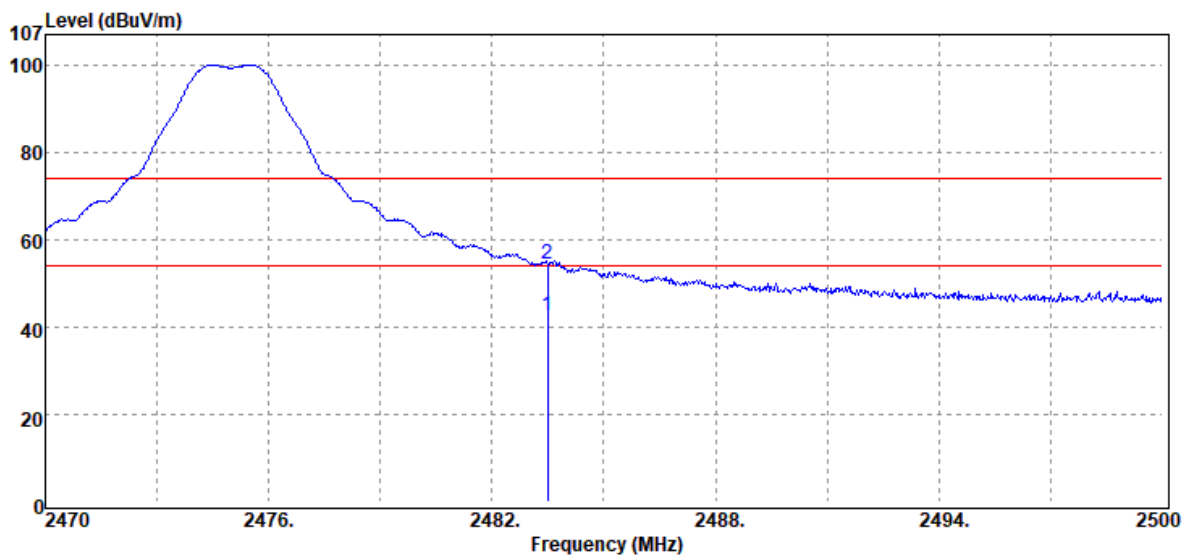
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Average	30.64	6.94	37.58	54.00	-16.42
2483.50	Peak	42.69	6.94	49.63	74.00	-24.37

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Report Number	:ER-2019-A0044	Test Date	:2019-10-23
Operation Mode	:Zigbee	Temp./Humi.	:23.1/69
Test Channel	:2475 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH Mid	Engineer	:Nick
EUT Pol	:H Plane		



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	Average	35.53	6.94	42.47	54.00	-11.53
2483.50	Peak	47.55	6.94	54.49	74.00	-19.51

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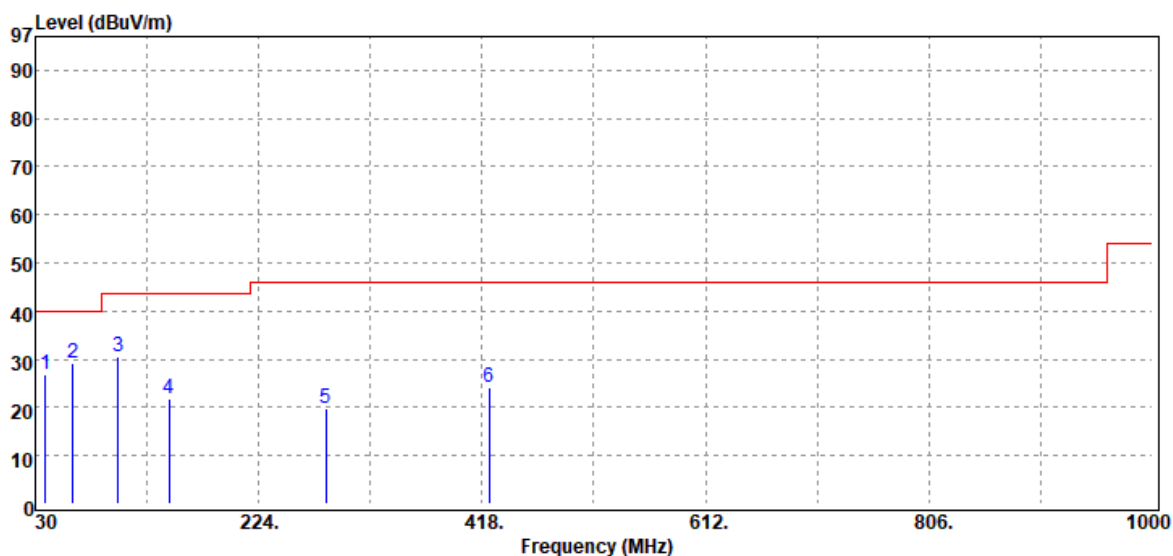
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10.7.2 Radiated Spurious Emission from 30MHz to 1000MHz (Worst Case)

Report Number :ER-2019-A0044
Operation Mode :Zigbee
Test Channel :2450 MHz
Test Mode :Tx CH Mid
EUT Pol :H Plane

Test Date :2019-10-23
Temp./Humi. :23.1/69
Antenna Pol. :VERTICAL
Engineer :Nick



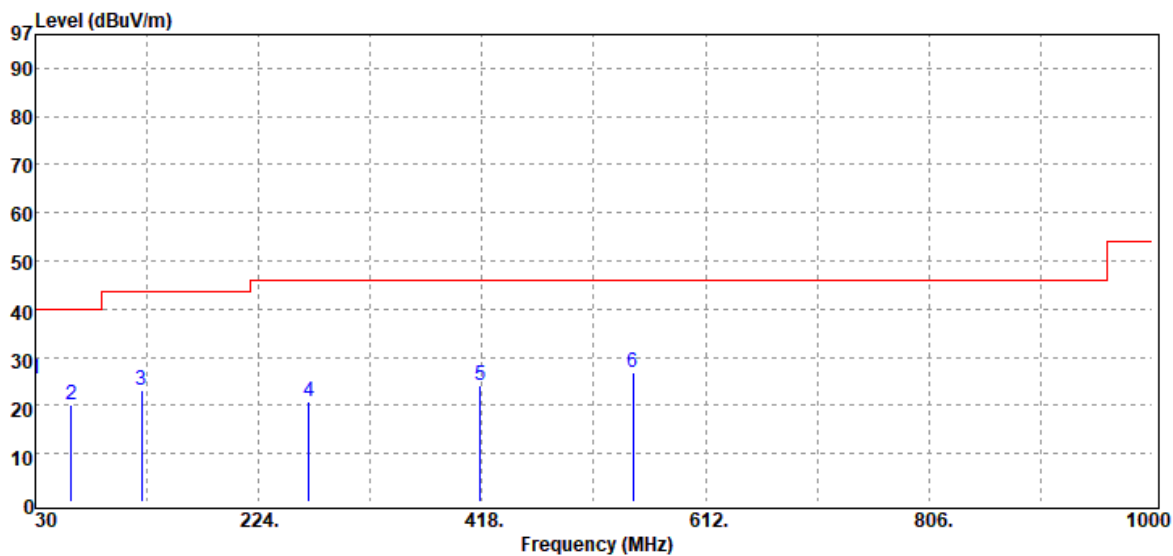
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
38.73	Peak	35.61	-8.90	26.71	40.00	-13.29
62.98	Peak	46.69	-17.42	29.27	40.00	-10.73
101.78	Peak	42.91	-12.25	30.66	43.50	-12.84
146.40	Peak	33.70	-12.04	21.66	43.50	-21.84
282.20	Peak	28.77	-8.89	19.88	46.00	-26.12
423.82	Peak	29.19	-4.97	24.22	46.00	-21.78

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Report Number	:ER-2019-A0044	Test Date	:2019-10-23
Operation Mode	:Zigbee	Temp./Humi.	:23.1/69
Test Channel	:2450 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Mid	Engineer	:Nick
EUT Pol	:H Plane		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
30.00	Peak	29.66	-4.05	25.61	40.00	-14.39
61.04	Peak	37.35	-17.31	20.04	40.00	-19.96
122.15	Peak	34.48	-11.20	23.28	43.50	-20.22
267.65	Peak	29.50	-8.70	20.80	46.00	-25.20
416.06	Peak	29.25	-4.99	24.26	46.00	-21.74
548.95	Peak	31.20	-4.42	26.78	46.00	-19.22

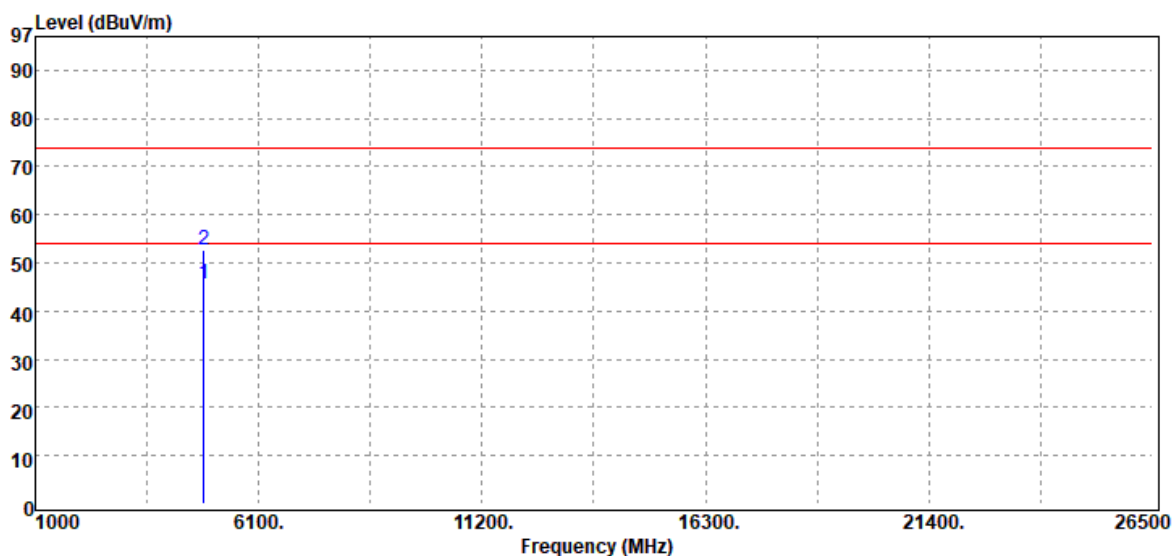
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10.7.3 Radiated Spurious Emission above 1GHz

Report Number	:ER-2019-A0044	Test Date	:2019-10-23
Operation Mode	:Zigbee	Temp./Humi.	:23.1/69
Test Channel	:2425 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH Low	Engineer	:Nick
EUT Pol	:H Plane		



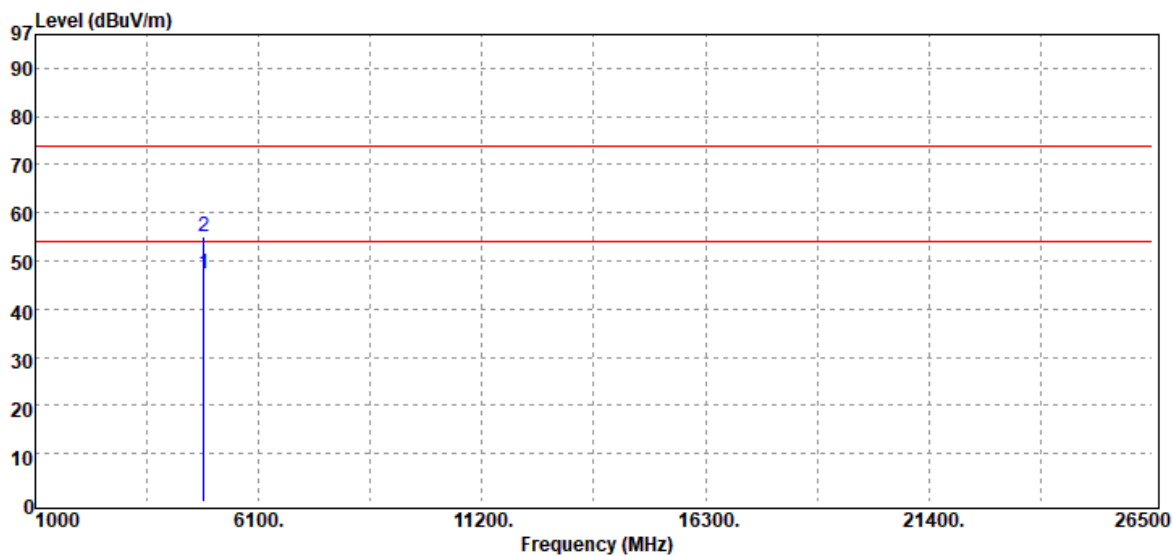
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4850.00	Average	30.64	14.89	45.53	54.00	-8.47
4850.00	Peak	37.87	14.89	52.76	74.00	-21.24

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Report Number	:ER-2019-A0044	Test Date	:2019-10-23
Operation Mode	:Zigbee	Temp./Humi.	:23.1/69
Test Channel	:2425 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Low	Engineer	:Nick
EUT Pol	:H Plane		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBUV/m	Limit @3m dBUV/m	Margin dB
4850.00	Average	32.48	14.89	47.37	54.00	-6.63
4850.00	Peak	40.18	14.89	55.07	74.00	-18.93

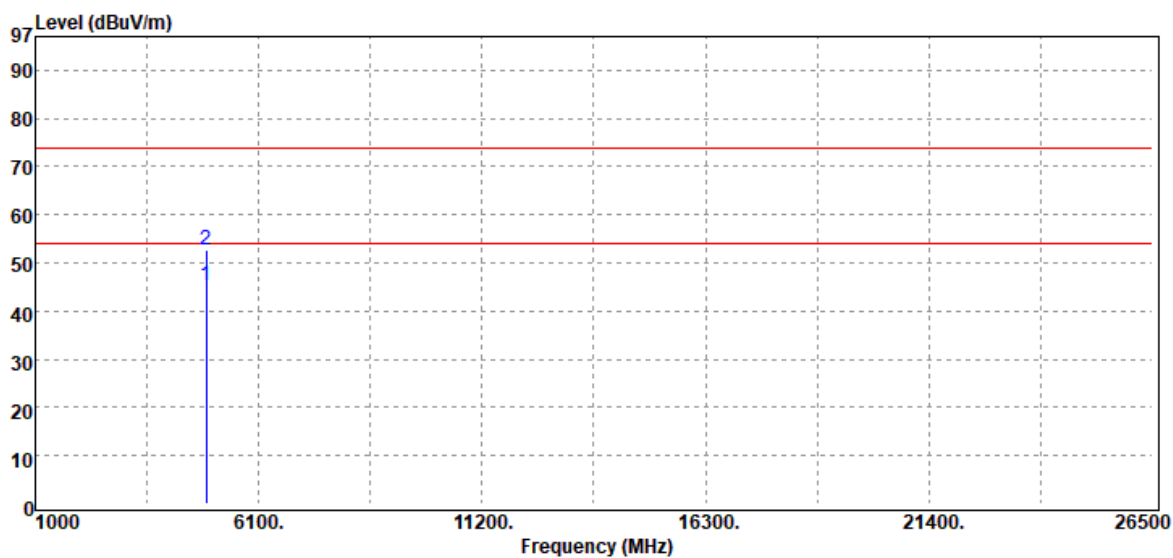
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Report Number :ER-2019-A0044
Operation Mode :Zigbee
Test Channel :2450 MHz
Test Mode :Tx CH Mid
EUT Pol :H Plane

Test Date :2019-10-23
Temp./Humi. :23.1/69
Antenna Pol. :VERTICAL
Engineer :Nick



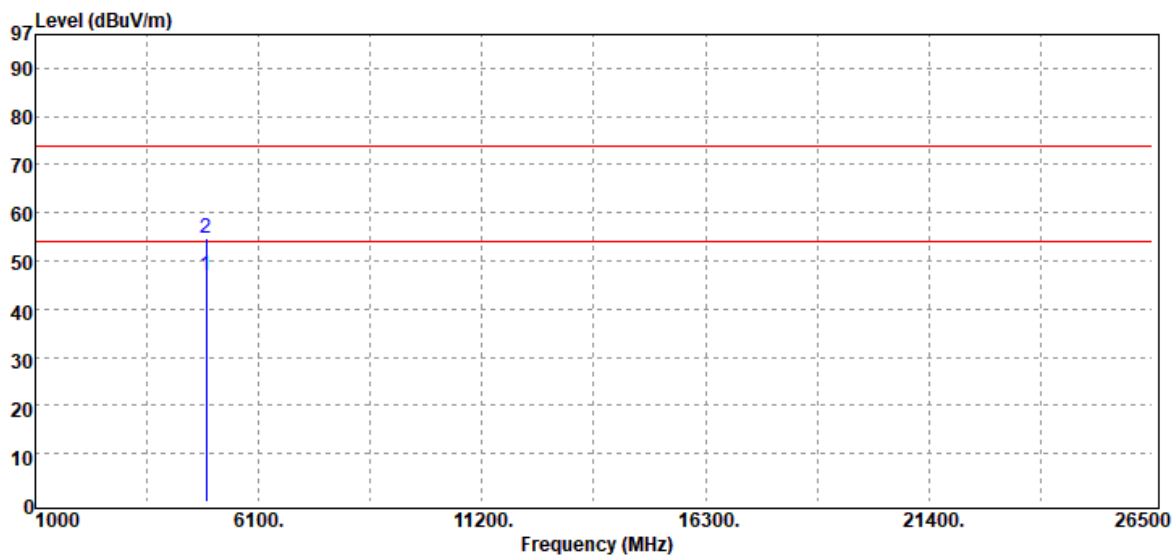
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBUV/m	Limit @3m dBUV/m	Margin dB
4900.00	Average	30.30	15.18	45.48	54.00	-8.52
4900.00	Peak	37.52	15.18	52.70	74.00	-21.30

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Report Number	:ER-2019-A0044	Test Date	:2019-10-23
Operation Mode	:Zigbee	Temp./Humi.	:23.1/69
Test Channel	:2450 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Mid	Engineer	:Nick
EUT Pol	:H Plane		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
4900.00	Average	31.68	15.18	46.86	54.00	-7.14
4900.00	Peak	39.37	15.18	54.55	74.00	-19.45

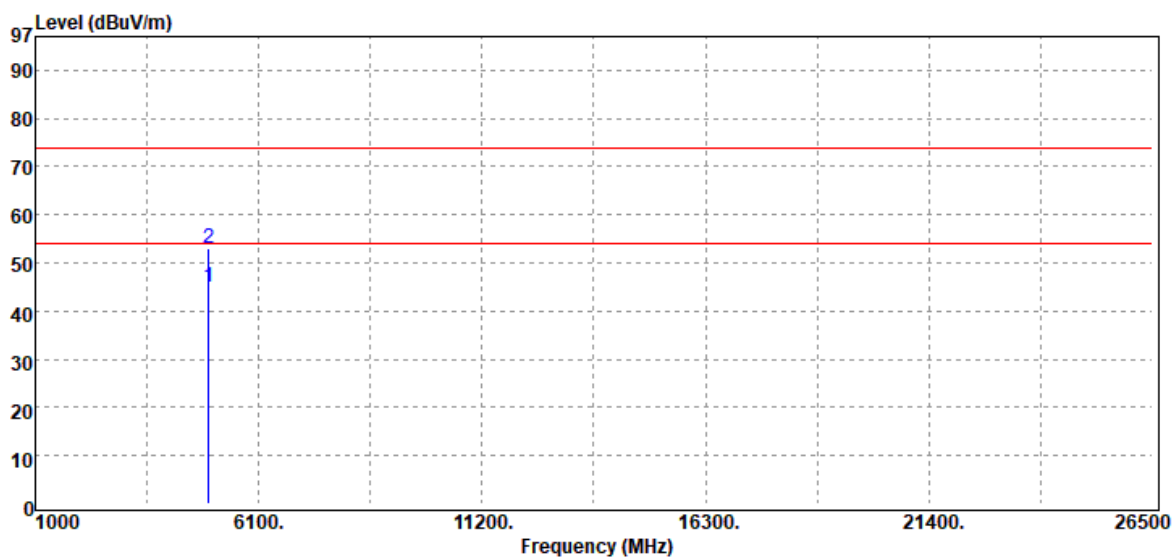
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Report Number :ER-2019-A0044
Operation Mode :Zigbee
Test Channel :2475 MHz
Test Mode :Tx CH High
EUT Pol :H Plane

Test Date :2019-10-23
Temp./Humi. :23.1/69
Antenna Pol. :VERTICAL
Engineer :Nick



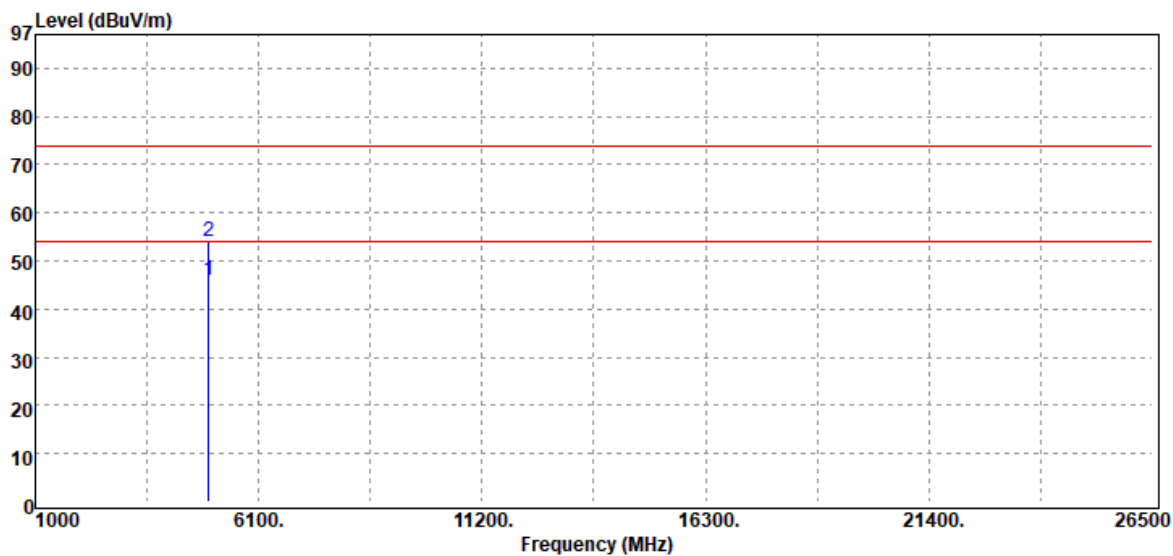
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBUV/m	Limit @3m dBUV/m	Margin dB
4950.00	Average	29.82	15.17	44.99	54.00	-9.01
4950.00	Peak	37.97	15.17	53.14	74.00	-20.86

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Report Number	:ER-2019-A0044	Test Date	:2019-10-23
Operation Mode	:Zigbee	Temp./Humi.	:23.1/69
Test Channel	:2475 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH High	Engineer	:Nick
EUT Pol	:H Plane		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBUV/m	Limit @3m dBUV/m	Margin dB
4950.00	Average	30.65	15.17	45.82	54.00	-8.18
4950.00	Peak	38.98	15.17	54.15	74.00	-19.85

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11 POWER SPECTRAL DENSITY

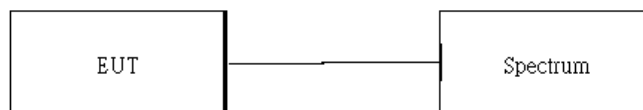
11.1 Standard Applicable:

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.

11.2 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1804001	02/13/2019	02/12/2020
Power Sensor	Anritsu	MA2411B	1726104	02/13/2019	02/12/2020
Power Sensor	Anritsu	MA2411B	1726107	02/13/2019	02/12/2020
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	05/02/2019	05/01/2020
DC Power Supply	Agilent	E3640A	MY52410006	12/04/2018	12/03/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2019	01/01/2020

11.3 Test Set-up:



11.4 Measurement Procedure:

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

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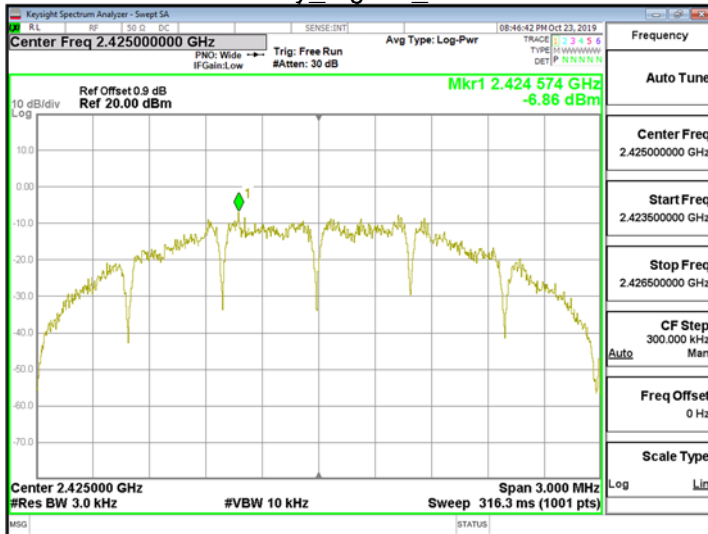
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11.5 Measurement Result:

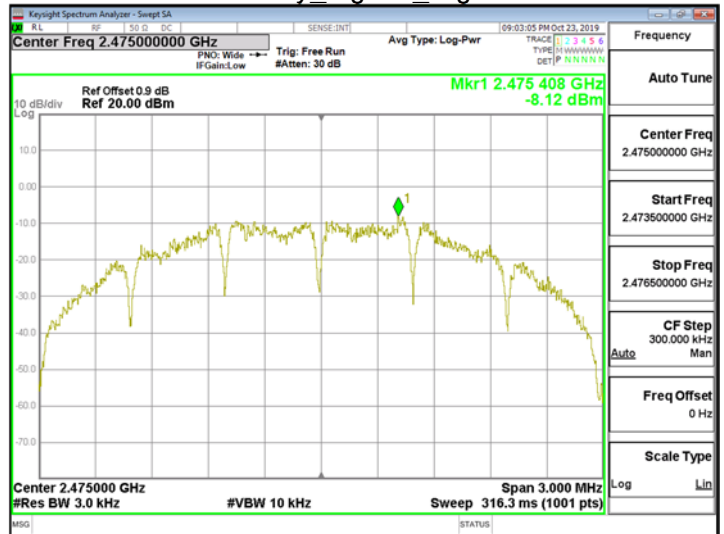
Frequency (MHz)	RF Power Density (dBm)	Maximum Limit (dBm)	Result
2425	-6.86	8	PASS
2450	-8.24	8	PASS
2475	-8.12	8	PASS

NOTE: cable loss as 0.9dB that offsets in the spectrum

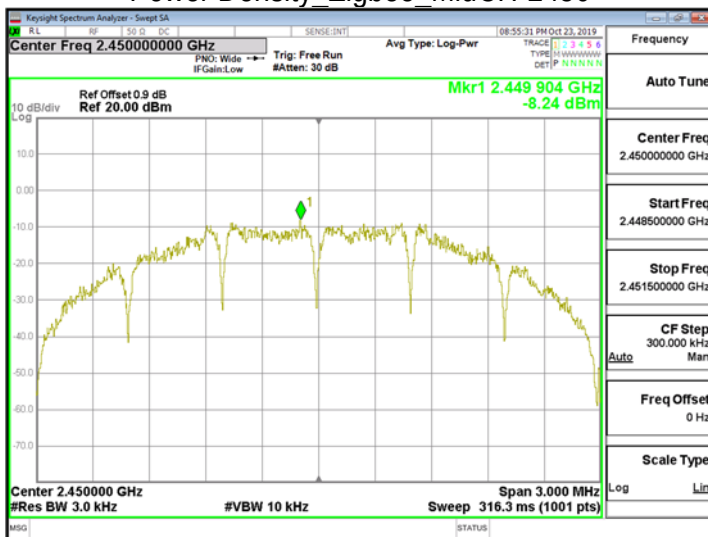
Power Density_Zigbee_LowCH-2425



Power Density_Zigbee_HighCH-2475



Power Density_Zigbee_MidCH-2450



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12 ANTENNA REQUIREMENT

12.1 Standard Applicable:

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

In case of point-to-point operation, the power shall be reduced by the one dB for every 3 dB that the directional gain of antenna exceeds 6dBi.

12.2 Antenna Connected Construction:

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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