

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C AND INDUSTRY CANADA RSS 247 REQUIREMENT

OF

Applicant: Universal Electronics Inc.
201 East Sandpointe Ave 8th Floor Santa Ana CA 92707
USA

Product Name: Voice Remote Control

Brand Name: Sony

FCC Model No.: RMF-TX500U, RMF-TX500B

Model Difference: Different printing colors

IC Model No.: RMF-TX500U

Model Difference: N/A

FCC ID: MG3-TX500U

IC: 2575A-TX500U

Report Number: ER/2018/90002

FCC Rule Part: §15.247, Cat: DTS

IC Rule Part: RSS-247 issue 2 Feb 2017

Issue Date: Oct. 05, 2018

Date of Test: Sep. 03, 2018~ Oct. 03, 2018

Date of EUT Received: Sep. 03, 2018

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.

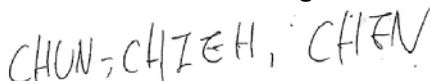
The test results of this report relate only to the tested sample identified in this report.

Tested By:



Louis Chen / Sr. Engineer

Approved By:



Chun Chieh Chen / Asst. Supervisor


Testing Laboratory
0513

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Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
ER/2018/90002	Rev.00	Initial creation of document	All	Oct. 05, 2018	Violetta Tang

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1 GENERAL INFORMATION

1.1 Product Description

General:

Product Name:	Voice Remote Control
Brand Name:	Sony
FCC Model No.:	RMF-TX500U, RMF-TX500B
Model Difference:	Different printing colors
IC Model No.:	RMF-TX500U
Model Difference:	N/A
Product SW/HW version:	V1.01 / A01
Radio SW/HW version:	N/A / N/A
Power Supply:	3Vdc from AAA battery * 2

Zigbee:

Frequency Range:	2425 – 2475MHz
Channel number:	3 channels
Modulation type:	O-QPSK
Transmit Power:	4.82dBm
Antenna Designation:	PCB trace inverted F Antenna, Gain: 3dBi

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1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 DTS Meas. Guidance v05.

RSS-Gen. issue 5 Apr. 2018

RSS-247 issue 2 Feb. 2017

ANSI C63.10:2013

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

1.3 Test Facility

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

(TAF code 0513)

FCC Registration and Designation number are: 509634 / TW0001

Canada Registration Number: 4620A-5

1.4 Special Accessories

There are no special accessories used while test was conducted.

1.5 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 turn table which is 0.8 m above ground plan. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207 & RSS-Gen §8.8. The two LISNs provide 50 ohm/ 50uH 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 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 plan. 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

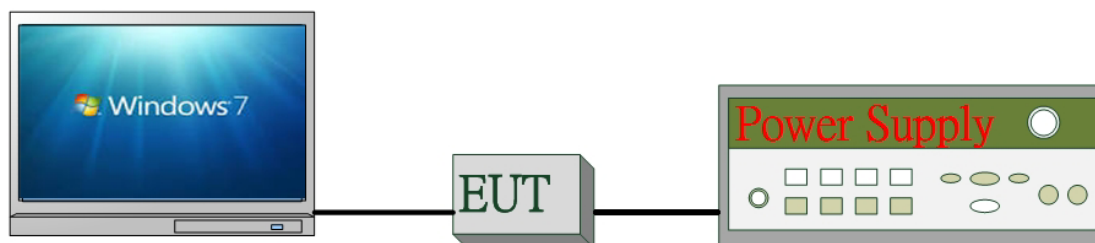


Fig 2-2 Radiated Emission Configuration



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.	DC Power Supply	Agilent	E3640A	KR93300208	N/A	Un-Shielded
3.	Notebook	Lenovo	T440P	P0000564	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	IC 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 §6.6	6dB & 99% Emission Bandwidth	Compliant
§15.247(d)	RSS-247 §5.5	Conducted Band Edge and Spurious Emission	Compliant
§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)	RSS- Gen §6.8	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

CHANNEL	FREQUENCY
15	2425 MHz
20	2450 MHz
25	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.

RADIATED EMISSION TEST:

MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	DATA RATE (Mbps)
RADIATED EMISSION TEST (BELOW 1 GHz)				
Zigbee	2425 to 2475	2450	O-QPSK	1
RADIATED EMISSION TEST (ABOVE 1 GHz)				
Zigbee	2425 to 2475	2425, 2450, 2475	O-QPSK	1
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:

CONDUCTED TEST				
MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	DATA RATE (Mbps)
Zigbee	2425 to 2475	2425, 2450, 2475	O-QPSK	1

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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: +/- 2.87 dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

Measurement uncertainty (Polarization : Horizontal)	9kHz – 30MHz: +/- 2.87 dB
	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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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(uV)	
	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.

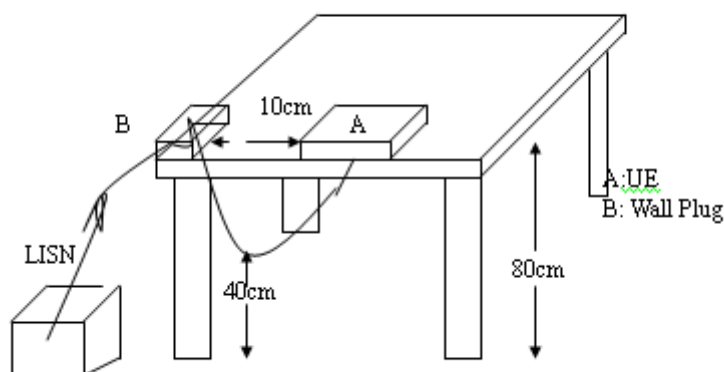
6.2 Measurement Equipment Used:

N/A, the device is powered by 3Vdc AAA battery *2.

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, the device is powered by 3Vdc AAA battery *2.

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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.

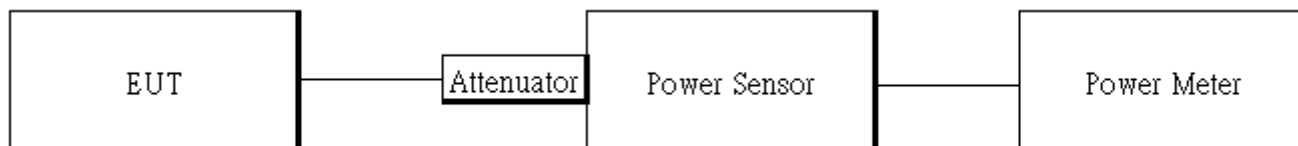
If the transmitting antenna of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

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:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1804001	02/01/2018	01/31/2019
Power Sensor	Anritsu	MA2411B	1726104	02/01/2018	01/31/2019
DC Power Supply	Anritsu	E3640A	KR93300208	08/15/2018	08/14/2019

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 & ANSI C63.10.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.

Power Meter:

It is used as the auxiliary test equipment to conduct the output power measurement.

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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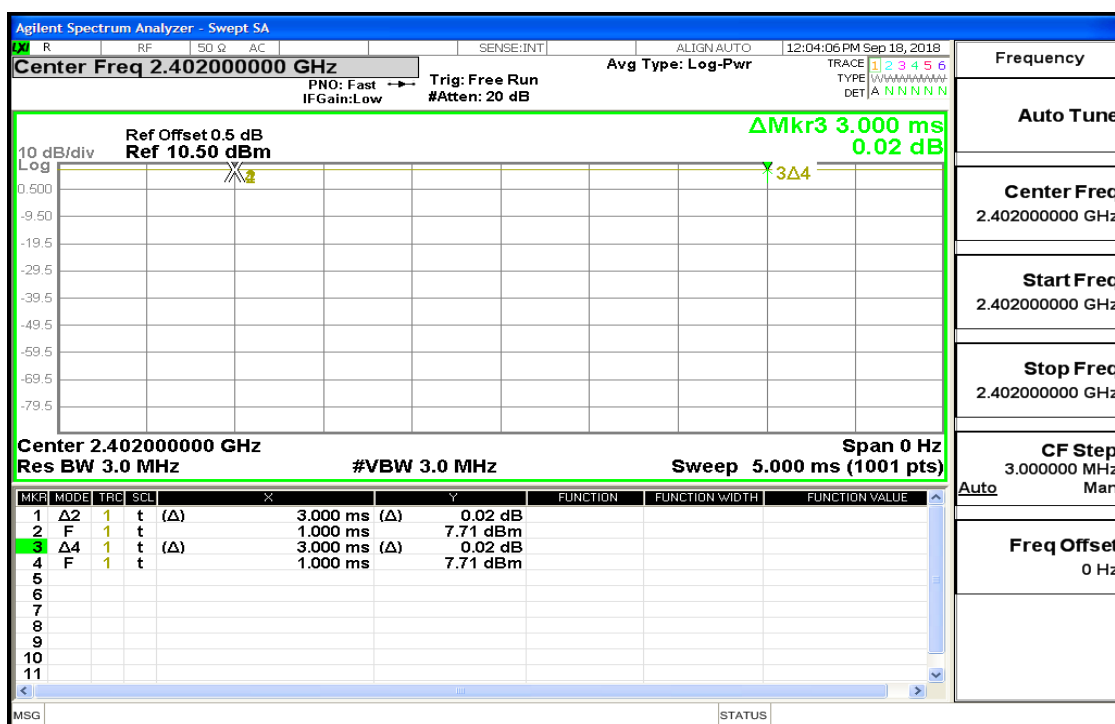
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Formula:

Duty Cycle = Ton / (Ton+Toff)

Duty Factor:

	Duty Cycle (%)	Duty Factor (dB)	1/T (kHz)	VBW setting (kHz)
Zigbee	100.00	0.00	0.33	1.00



Duty Cycle Factor: $10 \cdot \log(1/(100/100))=0$

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7.5 Measurement Result:

Zigbee mode:

CH	Frequency (MHz)	Peak Power Output (dBm)	Required Limit
15	2425	4.82	1 Watt = 30 dBm
20	2450	4.77	1 Watt = 30 dBm
25	2475	4.67	1 Watt = 30 dBm

Zigbee mode:

CH	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit
15	2425	4.78	1 Watt = 30 dBm
20	2450	4.73	1 Watt = 30 dBm
25	2475	4.62	1 Watt = 30 dBm

*Note: Measured by power meter, cable loss as 0.3 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

EIRP

CH	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit		
15	2425	4.78	3.00	7.78	4W=	36	dBm
20	2450	4.73	3.00	7.73	4W=	36	dBm
25	2475	4.62	3.00	7.62	4W=	36	dBm

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

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8 6DB & 99% BANDWIDTH MEASUREMENT

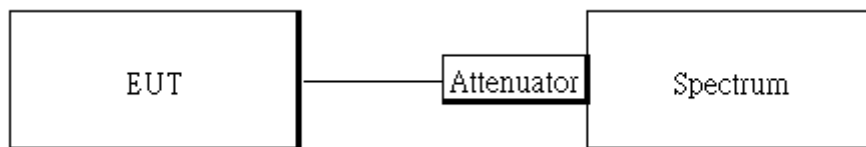
8.1 Standard Applicable

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

8.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9010A	MY57120290	02/14/2018	02/13/2019
DC Power Supply	Anritsu	E3640A	KR93300208	08/15/2018	08/14/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2018	01/01/2019

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 & ANSI C63.10.
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)	BW (MHz)	Result
2425	1.584	> 0.5	PASS
2450	1.543	> 0.5	PASS
2475	1.58	> 0.5	PASS

Zigbee mode

Frequency (MHz)	99%Bandwidth (MHz)
2425	2.3197
2450	2.3108
2475	2.3282

Note: Refer to next page for plots.

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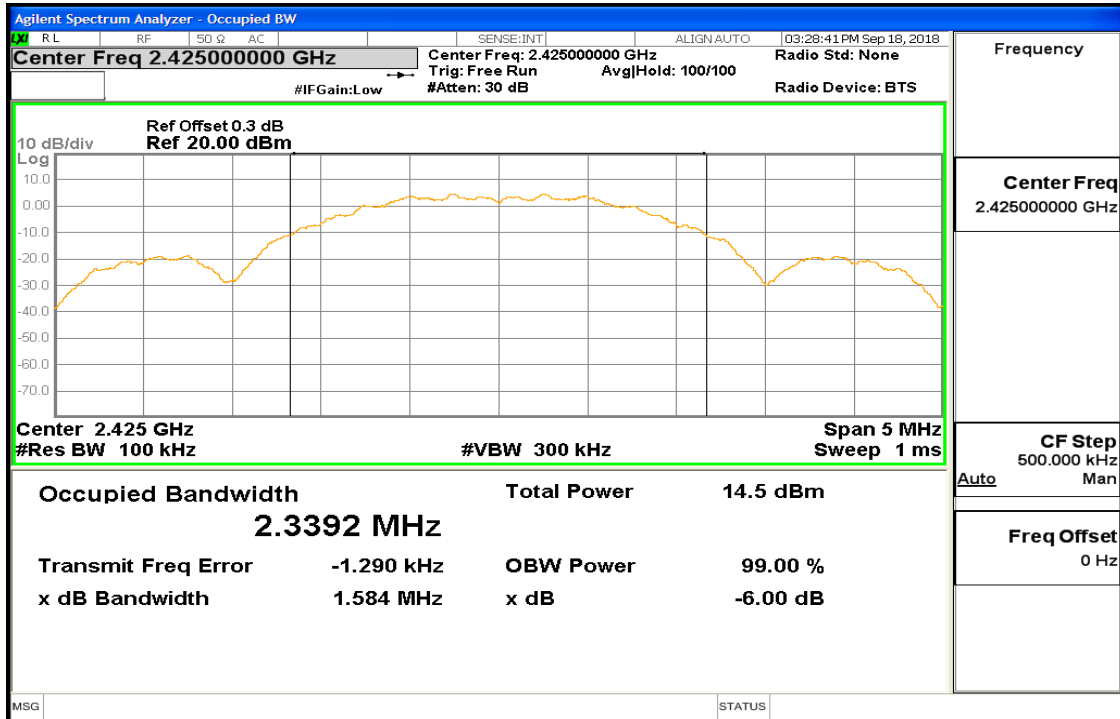
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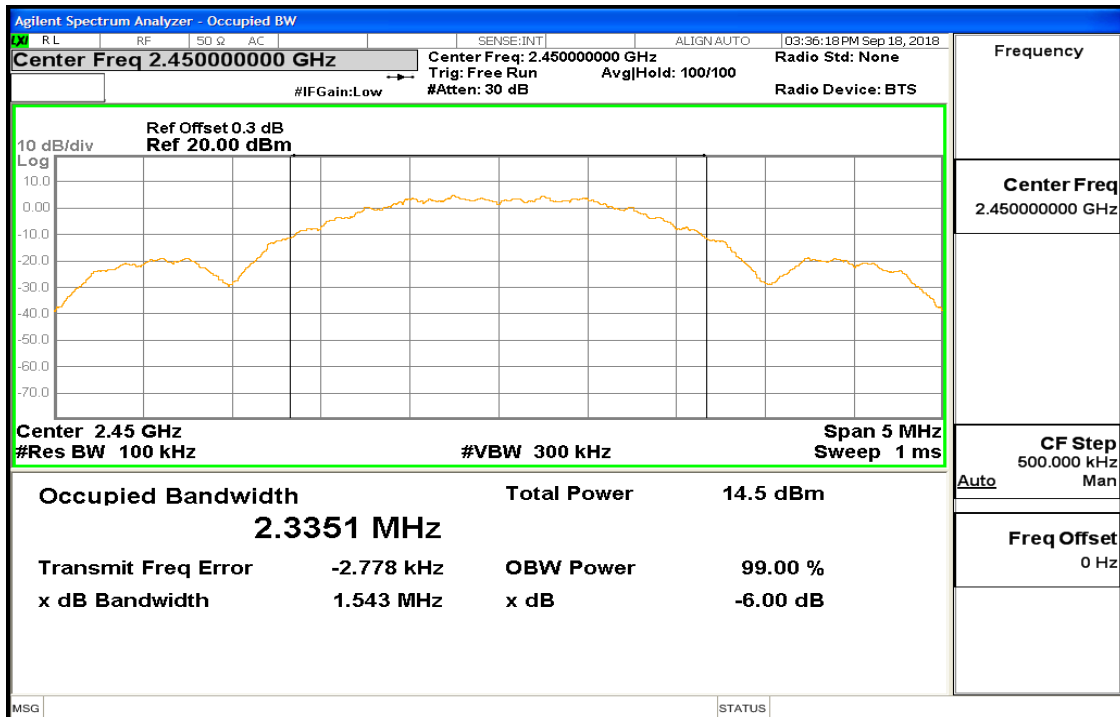
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6dB Band Width Test Data CH-Low



6dB Band Width Test Data CH-Mid



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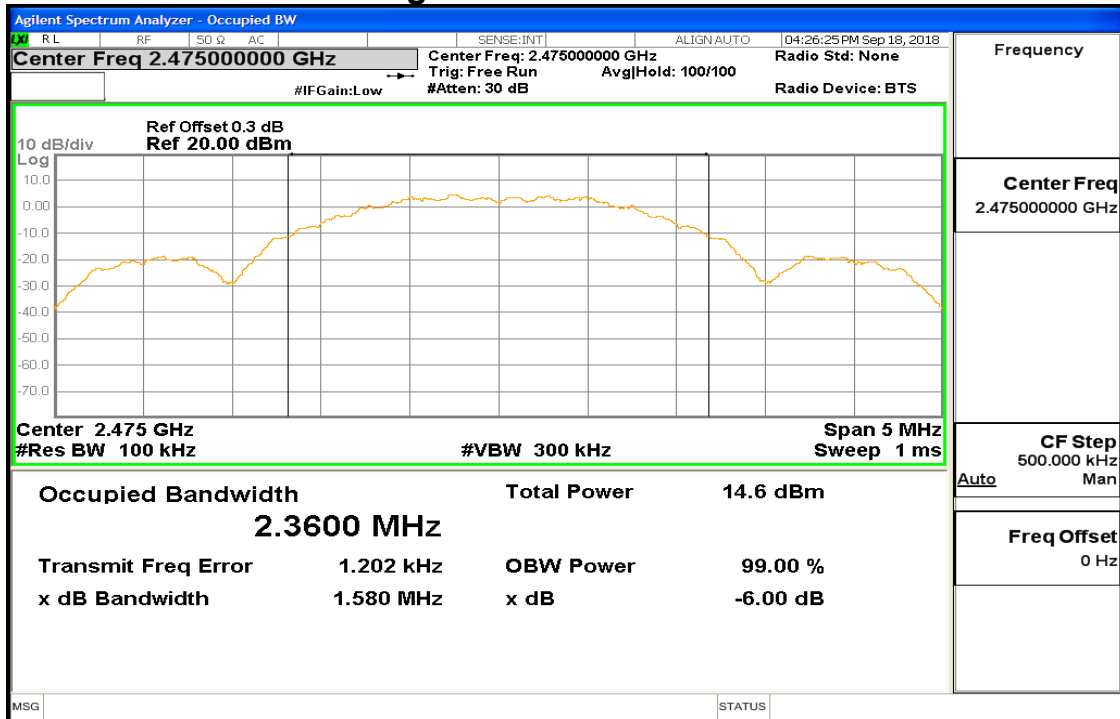
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6dB Band Width Test Data CH-High



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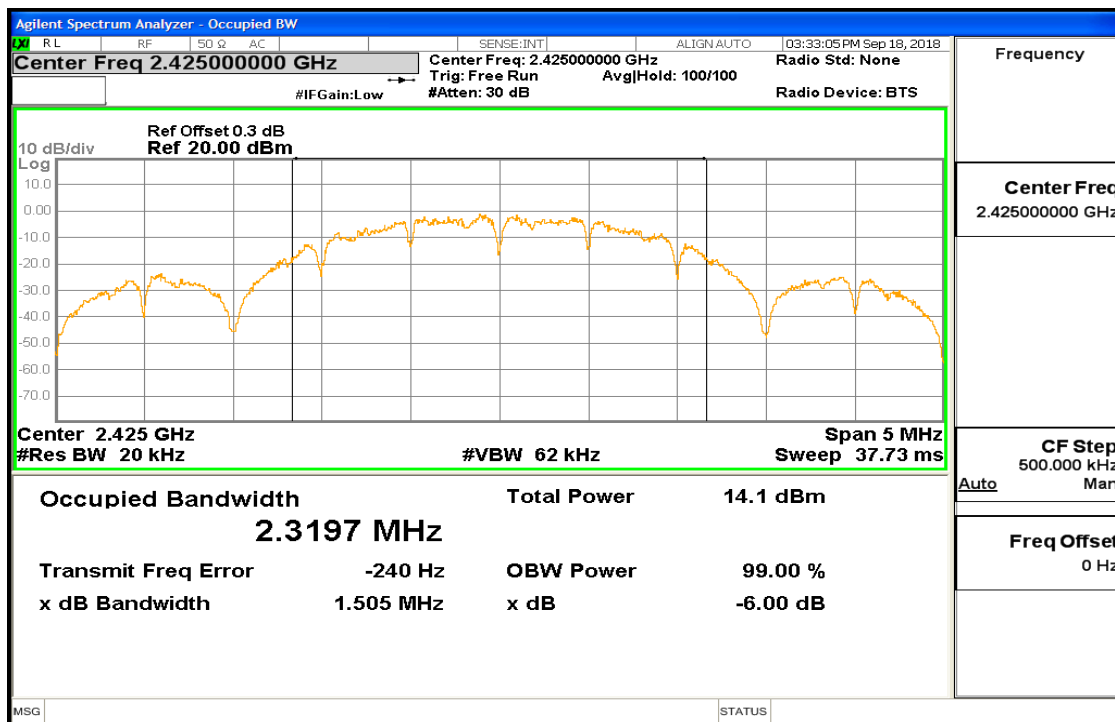
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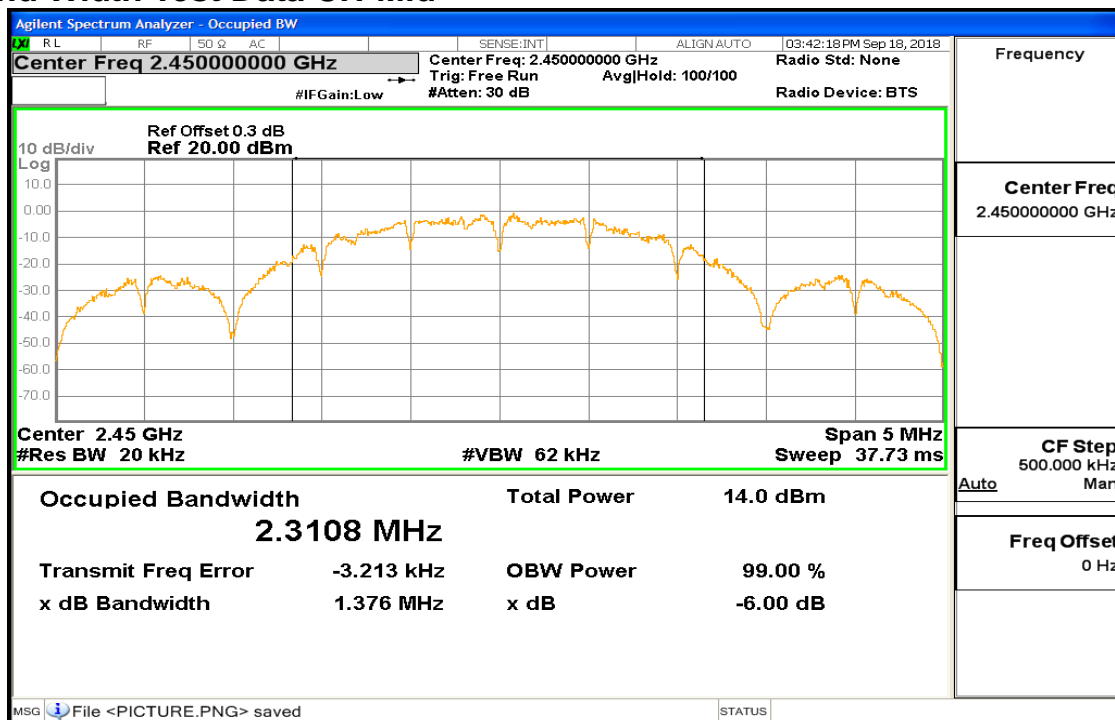
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99% Band Width Test Data CH-Low



99% Band Width Test Data CH-Mid



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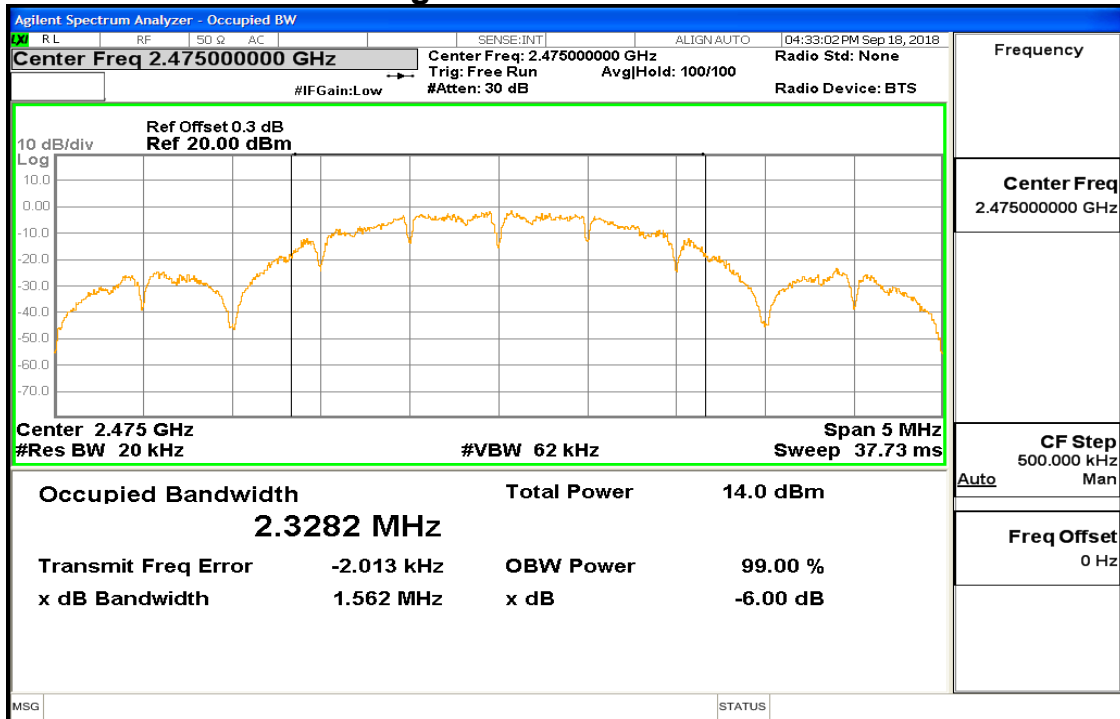
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9 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

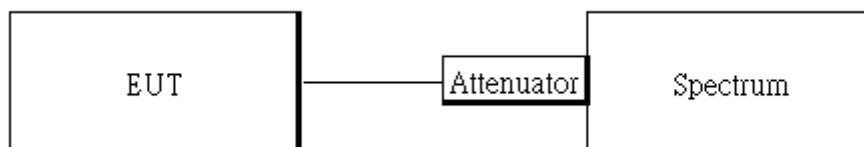
9.1 Standard Applicable

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 §8.8.

9.2 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9010A	MY57120290	02/14/2018	02/13/2019
DC Power Supply	Anritsu	E3640A	KR93300208	08/15/2018	08/14/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2018	01/01/2019

9.3 Test SET-UP:



9.4 Measurement Procedure

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 & ANSI C63.10.
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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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 & ANSI C63.10.
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 (2400~2483.5) 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.

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 & ANSI C63.10.
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.

9.5 Measurement Result**Reference Level of Limit**

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2425	1.45	-18.55
2450	1.46	-18.54
2475	1.37	-18.63

NOTE: cable loss as 0.3dB that offsets in the spectrum

NOTE: Refer to next page for plots.

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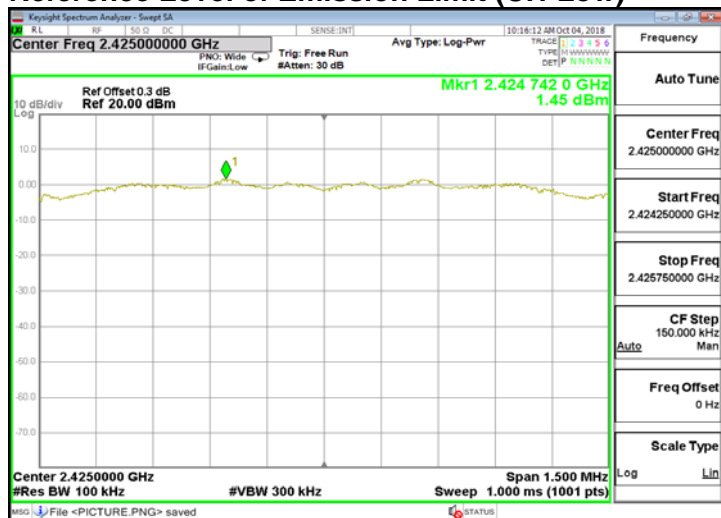
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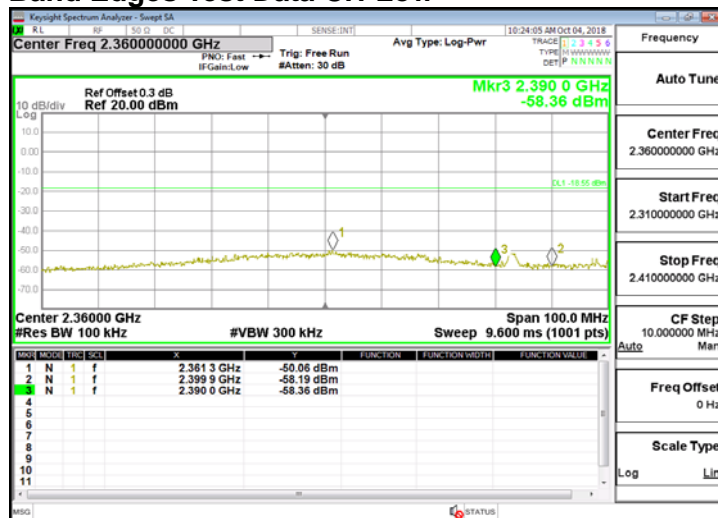
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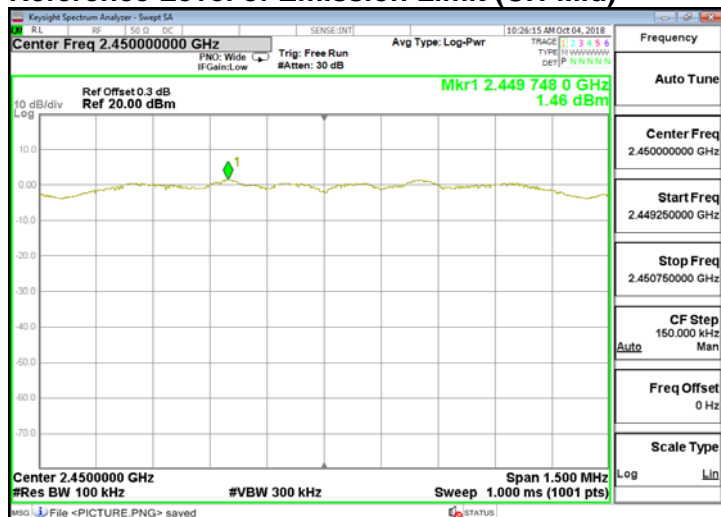
Reference Level of Emission Limit (CH-Low)



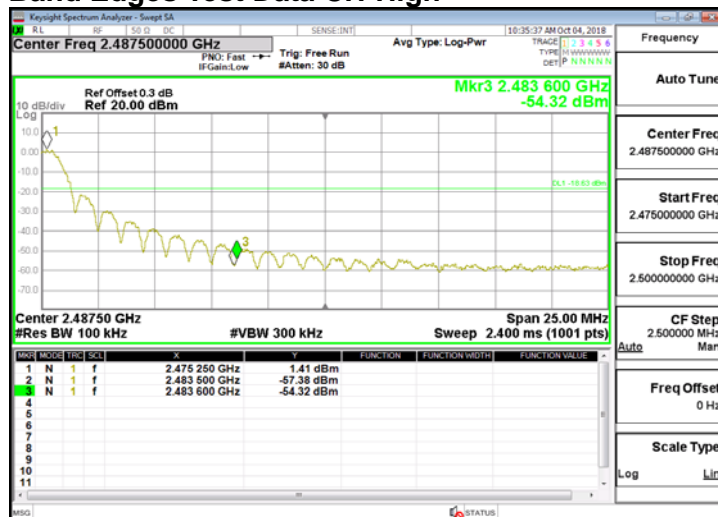
Band Edges Test Data CH-Low



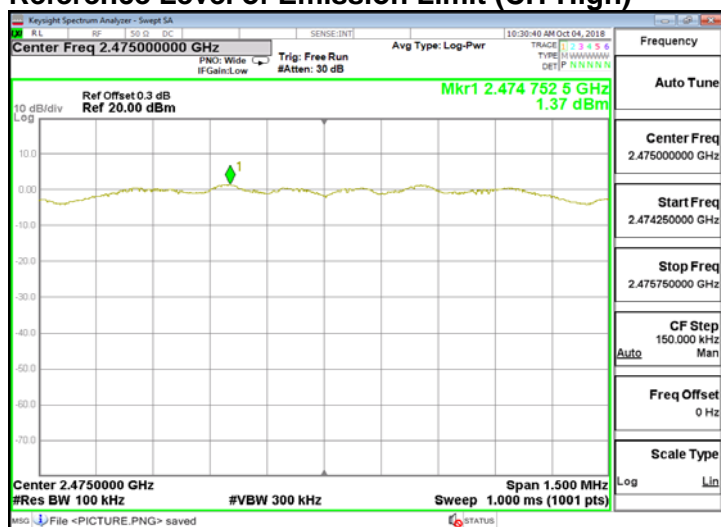
Reference Level of Emission Limit (CH-Mid)



Band Edges Test Data CH-High



Reference Level of Emission Limit (CH-High)

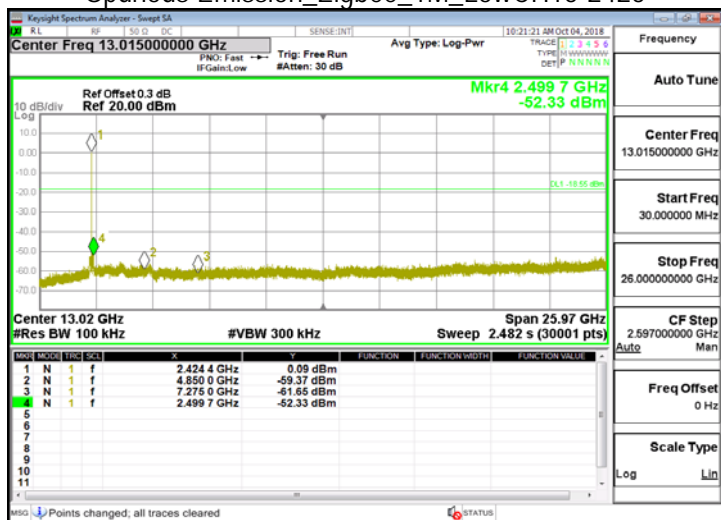


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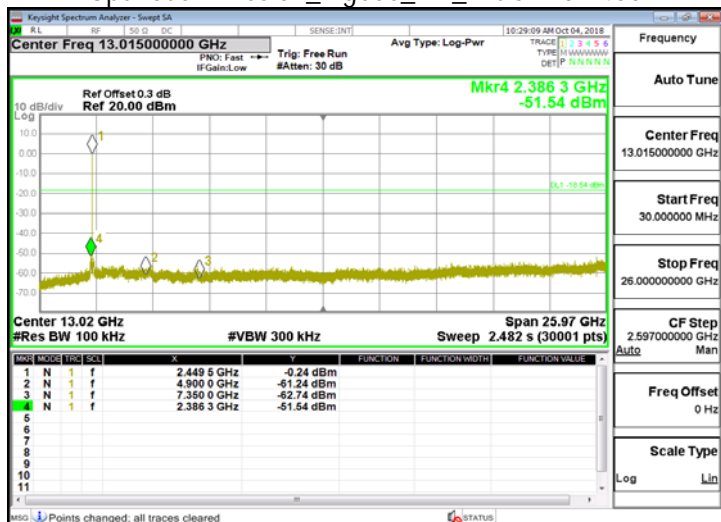
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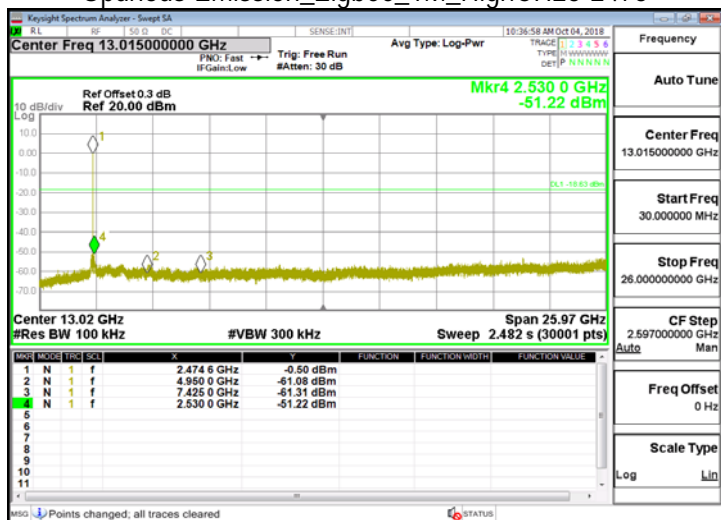
Spurious Emission_Zigbee_1M_LowCH15-2425



Spurious Emission_Zigbee_1M_MidCH20-2450



Spurious Emission_Zigbee_1M_HighCH25-2475



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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 & RSS-Gen §8.8, 8.9 limit as below.

And according to §15.33(a) (1) & RSS-Gen §6.13(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

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Bi-log Antenna	SCHWAZBECK	VULB9168	378	12/29/2017	12/28/2018
Horn Antenna	Schwarzbeck	BBHA9120D	1441	08/16/2018	08/15/2019
Horn Antenna	Schwarzbeck	BBHA9170	184	12/12/2017	12/11/2018
Loop Antenna	ETS.LINDGREN	6502	148045	09/26/2017	09/25/2018
3m Site NSA	SGS	966 chamber	N/A	01/02/2018	01/01/2019
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/15/2018	05/14/2019
EMI Test Receiver	R&S	ESCI7	100335	02/02/2018	02/01/2019
Pre-Amplifier	HP	8449B	3008A00578	01/02/2018	01/01/2019
Pre-Amplifier	HP	8447D	2944A07676	01/02/2018	01/01/2019
Pre-Amplifier	EMC Instruments	EMC184045B	980135	10/27/2017	10/26/2018
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2018	01/01/2019
2GHz High Pass Filter	Micro-Tronics	HPM50110	36	01/02/2018	01/01/2019
Filter 5150-5350 MHz	Micro-Tronics	BRM50703	1	01/02/2018	01/01/2019
Low Loss Cable	Huber Suhner	966_RX	9	01/02/2018	01/01/2019
Notebook	Lenovo	T440P	P0000564	N/A	N/A

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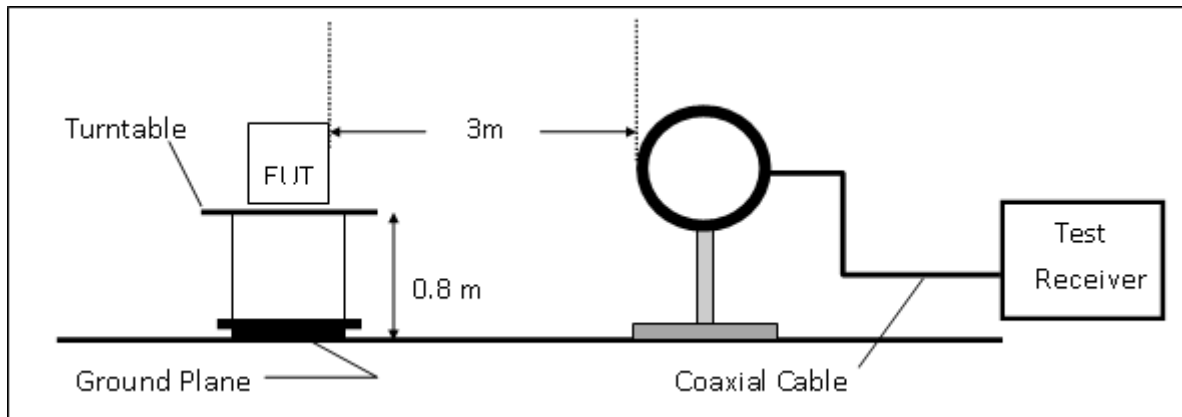
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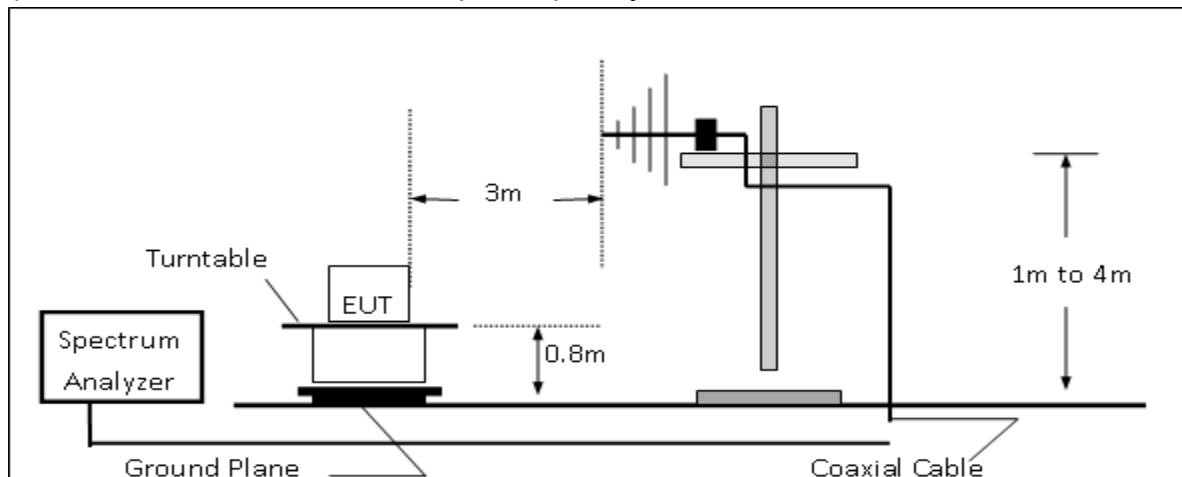
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10.3 Test SET-UP

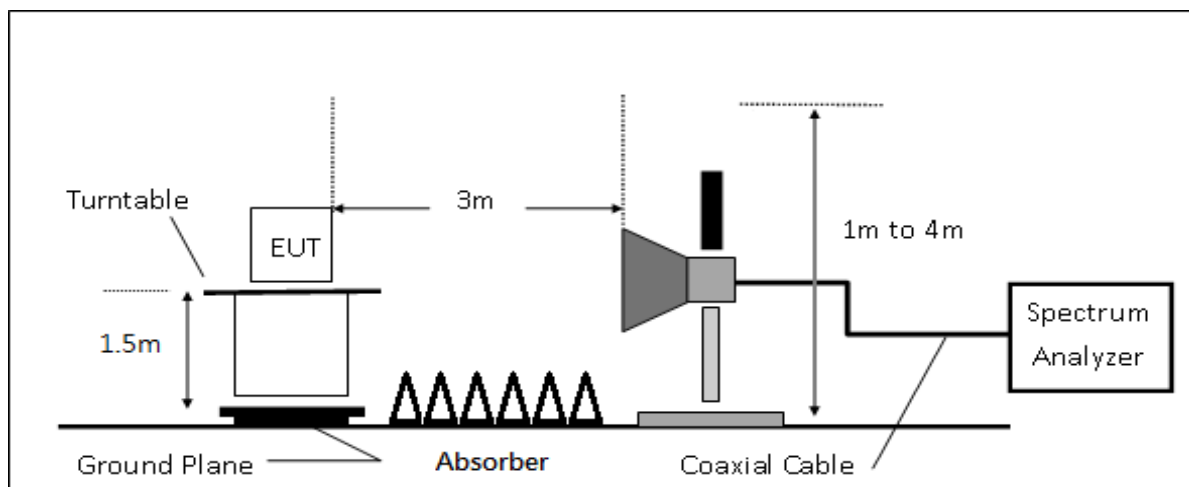
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(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 & ANSI C63.10.
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.

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	

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

$$\text{Factor(dB)} = \text{Antenna Factor(dB}\mu\text{V/m)} + \text{Cable Loss(dB)} - \text{Pre_Amplifier Gain(dB)}$$

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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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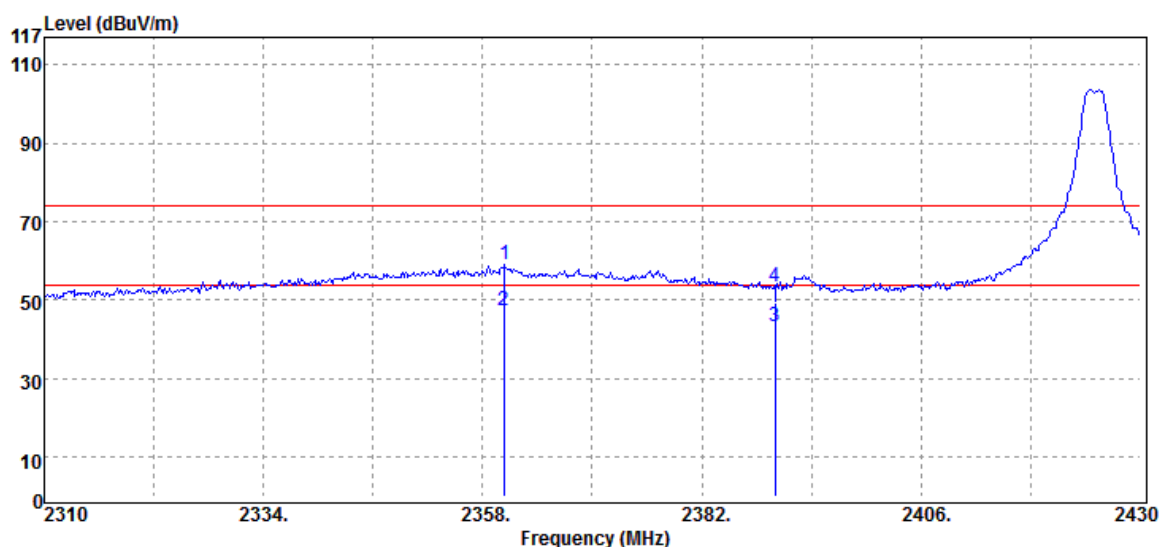
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Radiated Band Edge Measurement Result:

Operation Band : Zigbee
Fundamental Frequency : 2425 MHz
Operation Mode : Bandedge CH LOW
EUT Pol. : H Plane

Test Date : 2018-09-21
Temp./Humi. : 21 deg_C / 62 RH
Engineer : Tin
Measurement Antenna Pol. : VERTICAL



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
2360.40	Average	40.69	0.12	40.81	54.00	-13.19
2360.40	Peak	59.09	0.12	59.21	74.00	-14.79
2390.00	Average	35.39	0.20	35.59	54.00	-18.41
2390.00	Peak	53.18	0.20	53.38	74.00	-20.62

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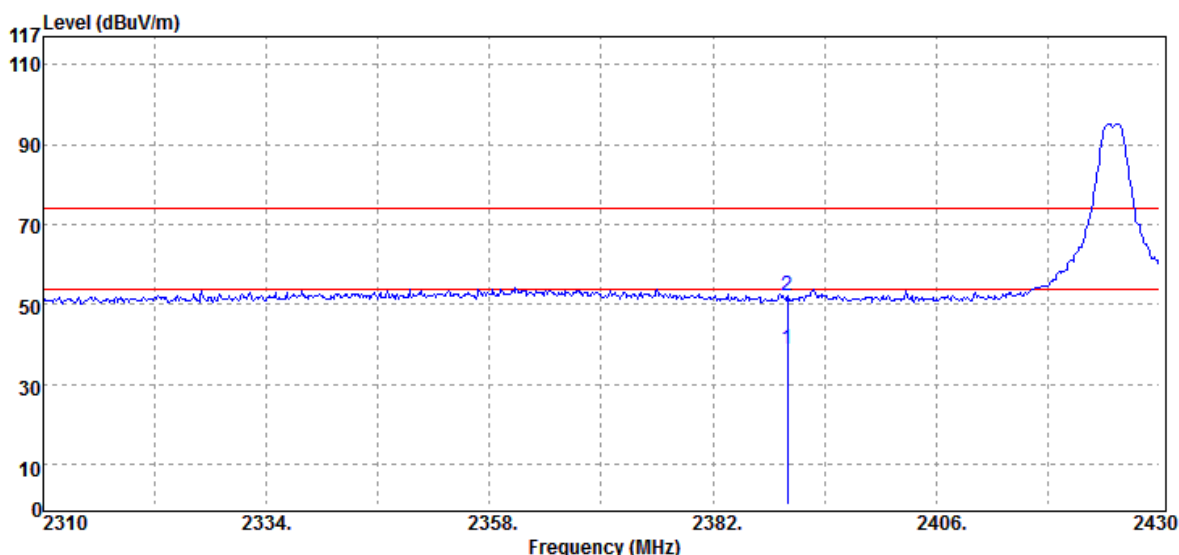
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Operation Band : Zigbee
 Fundamental Frequency : 2425 MHz
 Operation Mode : Bandedge CH LOW
 EUT Pol. : H Plane

Test Date : 2018-09-21
 Temp./Humi. : 21 deg_C / 62 RH
 Engineer : Tin
 Measurement Antenna Pol. : HORIZONTAL



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
2390.00	Average	38.75	0.20	38.95	54.00	-15.05
2390.00	Peak	52.12	0.20	52.32	74.00	-21.68

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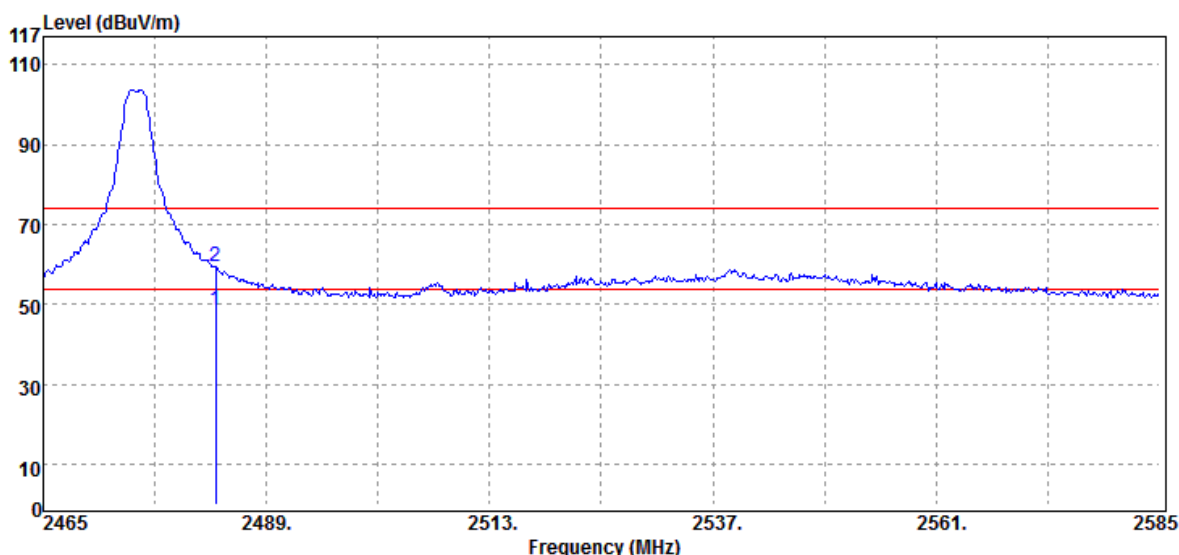
f (886-2) 2298-0488

www.tw.sgs.com

Member of SGS Group

Operation Band : Zigbee
Fundamental Frequency : 2475 MHz
Operation Mode : Bandedge CH HIGH
EUT Pol. : H Plane

Test Date : 2018-09-21
Temp./Humi. : 21 deg_C / 62 RH
Engineer : Tin
Measurement Antenna Pol. : VERTICAL



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
2483.50	Average	48.13	0.53	48.66	54.00	-5.34
2483.50	Peak	59.09	0.53	59.62	74.00	-14.38

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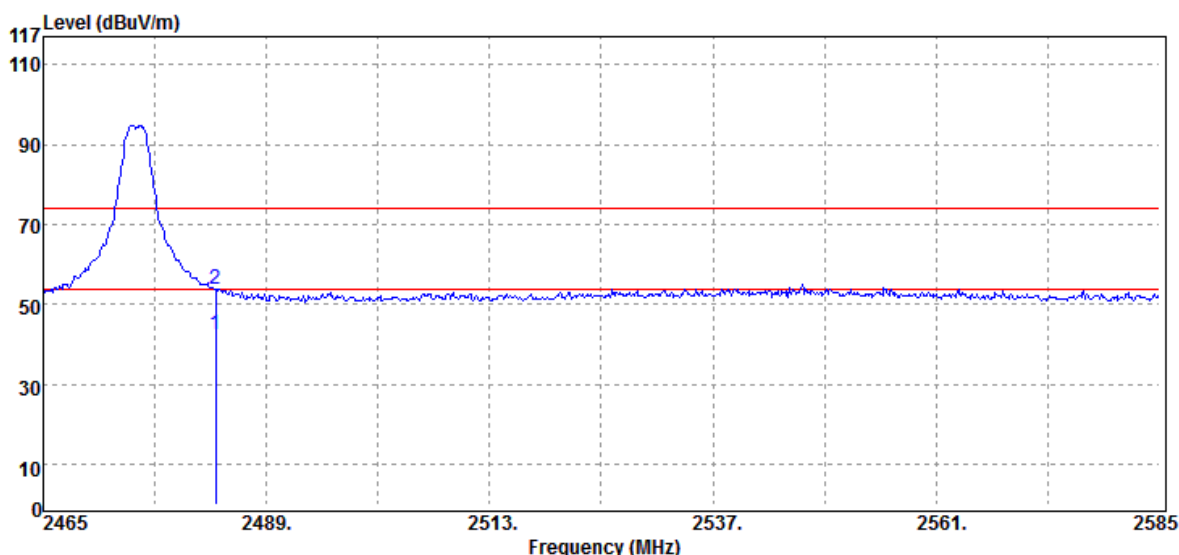
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Member of SGS Group

Operation Band :Zigbee
Fundamental Frequency :2475 MHz
Operation Mode :Bandedge CH HIGH
EUT Pol. :H Plane

Test Date :2018-09-21
Temp./Humi. :21 deg_C / 62 RH
Engineer :Tin
Measurement Antenna Pol. :HORIZONTAL



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
2483.50	Average	41.89	0.53	42.42	54.00	-11.58
2483.50	Peak	53.25	0.53	53.78	74.00	-20.22

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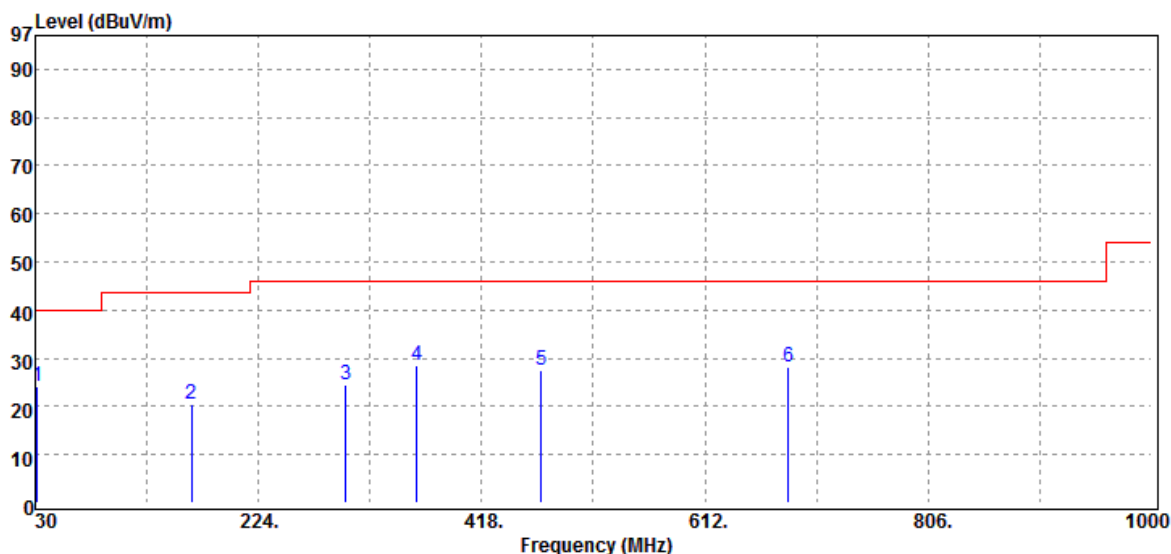
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Radiated Spurious Emission Measurement Result:

For Frequency from 30MHz to 1000MHz

Operation Band : Zigbee
Fundamental Frequency : 2450 MHz
Operation Mode : Tx CH MID
EUT Pol. : H Plane

Test Date : 2018-09-21
Temp./Humi. : 21 deg_C / 62 RH
Engineer : Tin
Measurement Antenna Pol. : VERTICAL



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
31.94	Peak	32.89	-8.88	24.01	40.00	-15.99
165.80	Peak	27.85	-7.32	20.53	43.50	-22.97
299.66	Peak	30.05	-5.52	24.53	46.00	-21.47
361.74	Peak	32.58	-4.19	28.39	46.00	-17.61
469.41	Peak	29.74	-2.14	27.60	46.00	-18.40
684.75	Peak	26.74	1.58	28.32	46.00	-17.68

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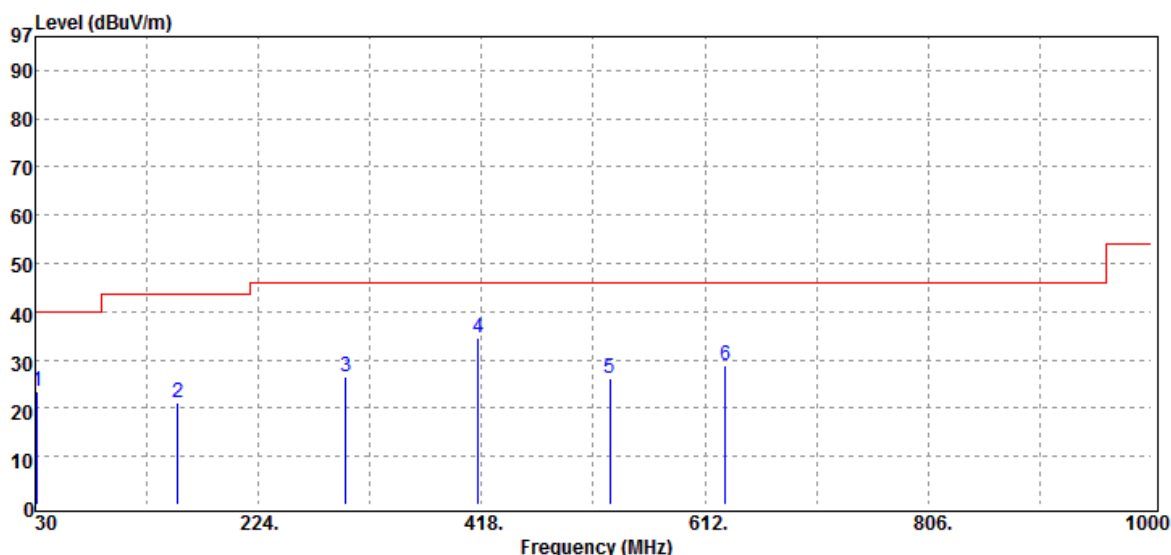
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Operation Band :Zigbee
Fundamental Frequency :2450 MHz
Operation Mode :Tx CH MID
EUT Pol. :H Plane

Test Date :2018-09-21
Temp./Humi. :21 deg_C / 62 RH
Engineer :Tin
Measurement Antenna Pol. :HORIZONTAL



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
31.94	Peak	32.51	-8.88	23.63	40.00	-16.37
154.16	Peak	28.60	-7.30	21.30	43.50	-22.20
299.66	Peak	31.88	-5.52	26.36	46.00	-19.64
415.09	Peak	37.67	-2.95	34.72	46.00	-11.28
529.55	Peak	27.48	-1.18	26.30	46.00	-19.70
629.46	Peak	28.11	0.85	28.96	46.00	-17.04

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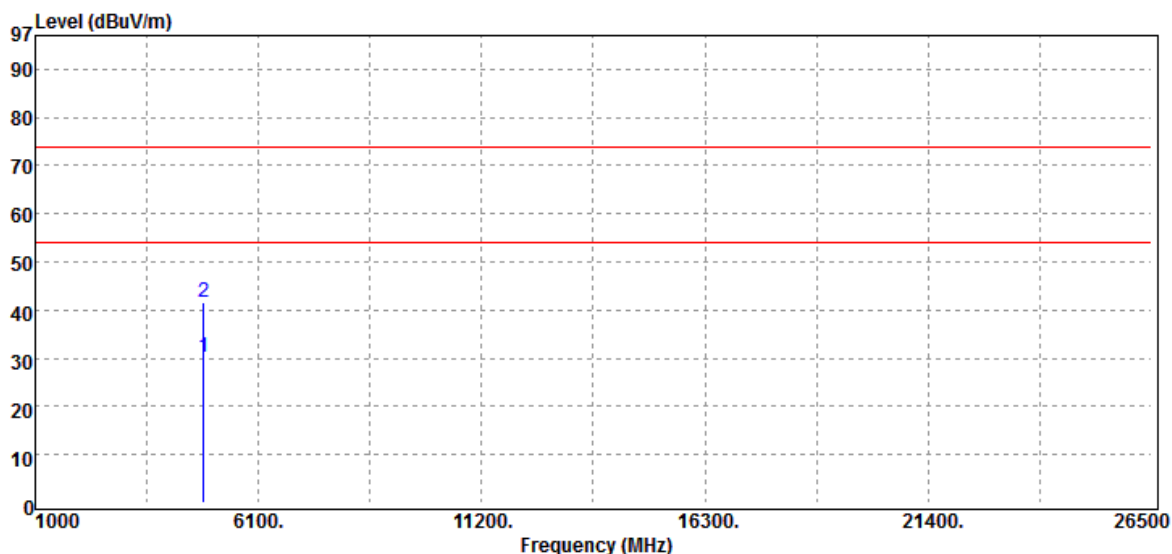
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Radiated Spurious Emission Measurement Result:

For Frequency above 1GHz

Operation Band : Zigbee
Fundamental Frequency : 2425 MHz
Operation Mode : Tx CH LOW
EUT Pol. : H Plane

Test Date : 2018-09-21
Temp./Humi. : 21 deg_C / 62 RH
Engineer : Tin
Measurement Antenna Pol. : VERTICAL



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	24.55	5.66	30.21	54.00	-23.79
4850.00	Peak	36.00	5.66	41.66	74.00	-32.34

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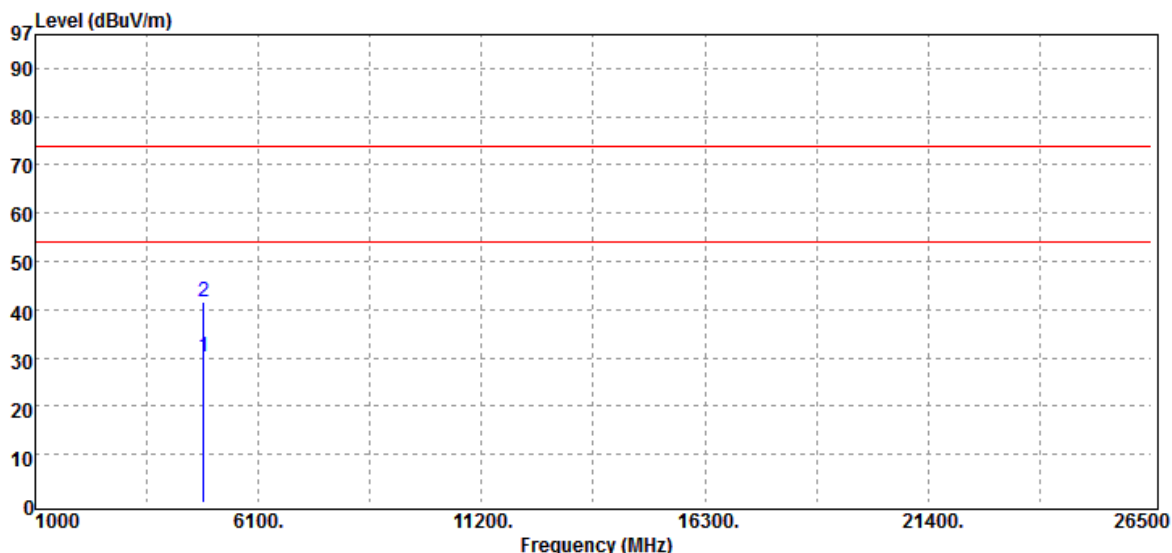
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Operation Band :Zigbee
Fundamental Frequency :2425 MHz
Operation Mode :Tx CH LOW
EUT Pol. :H Plane

Test Date :2018-09-21
Temp./Humi. :21 deg_C / 62 RH
Engineer :Tin
Measurement Antenna Pol. :HORIZONTAL



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
4850.00	Average	24.69	5.66	30.35	54.00	-23.65
4850.00	Peak	35.87	5.66	41.53	74.00	-32.47

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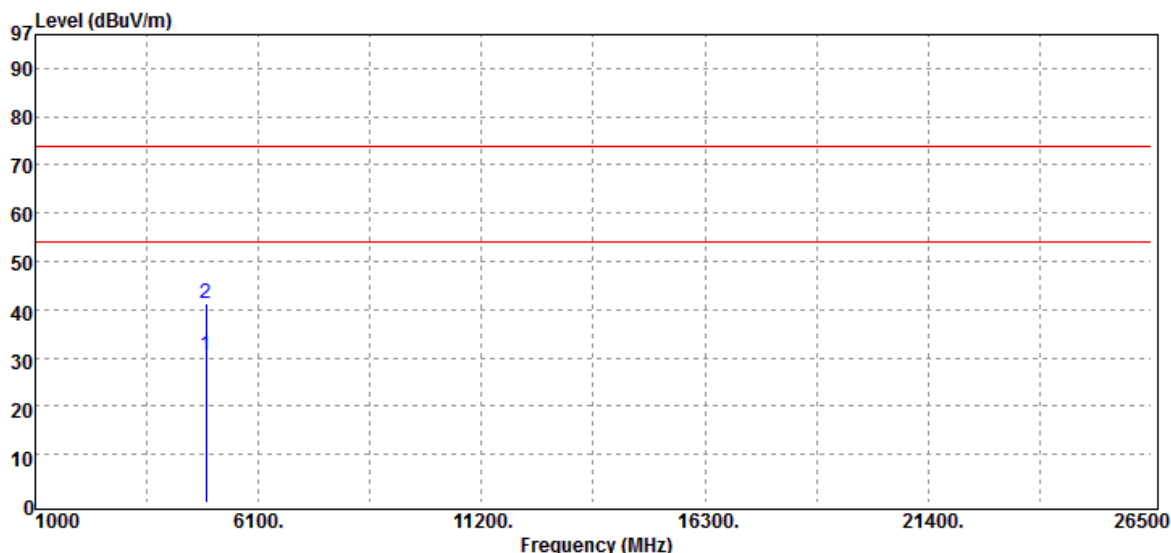
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Operation Band :Zigbee
Fundamental Frequency :2450 MHz
Operation Mode :Tx CH MID
EUT Pol. :H Plane

Test Date :2018-09-21
Temp./Humi. :21 deg_C / 62 RH
Engineer :Tin
Measurement Antenna Pol. :VERTICAL



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	24.73	5.88	30.61	54.00	-23.39
4900.00	Peak	35.34	5.88	41.22	74.00	-32.78

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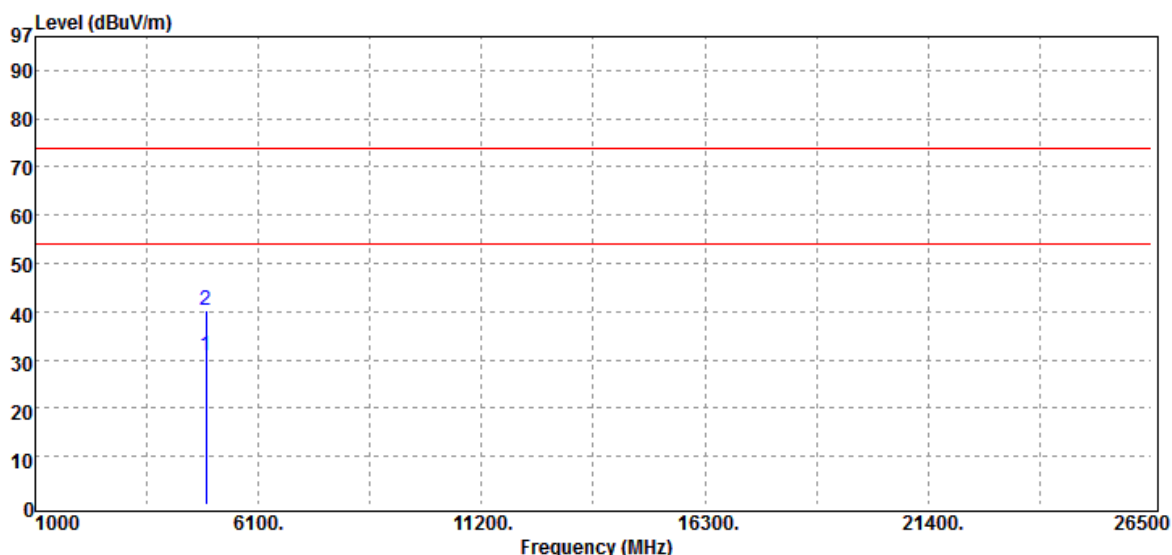
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Operation Band :Zigbee
Fundamental Frequency :2450 MHz
Operation Mode :Tx CH MID
EUT Pol. :H Plane

Test Date :2018-09-21
Temp./Humi. :21 deg_C / 62 RH
Engineer :Tin
Measurement Antenna Pol. :HORIZONTAL



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	24.87	5.88	30.75	54.00	-23.25
4900.00	Peak	34.38	5.88	40.26	74.00	-33.74

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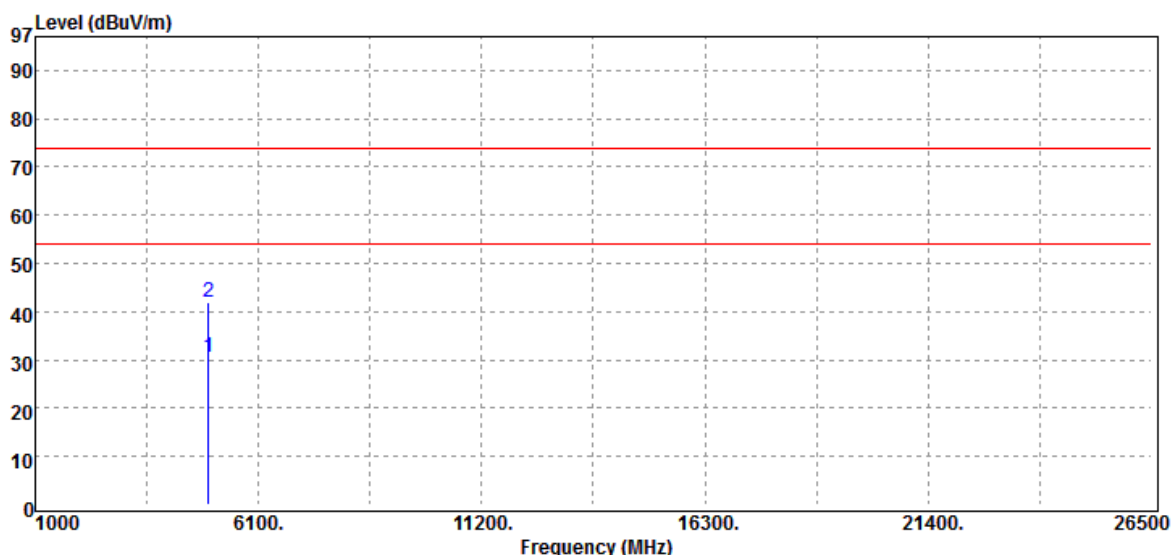
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Operation Band :Zigbee
Fundamental Frequency :2475 MHz
Operation Mode :Tx CH HIGH
EUT Pol. :H Plane

Test Date :2018-09-21
Temp./Humi. :21 deg_C / 62 RH
Engineer :Tin
Measurement Antenna Pol. :VERTICAL



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
4950.00	Average	24.69	5.97	30.66	54.00	-23.34
4950.00	Peak	35.82	5.97	41.79	74.00	-32.21

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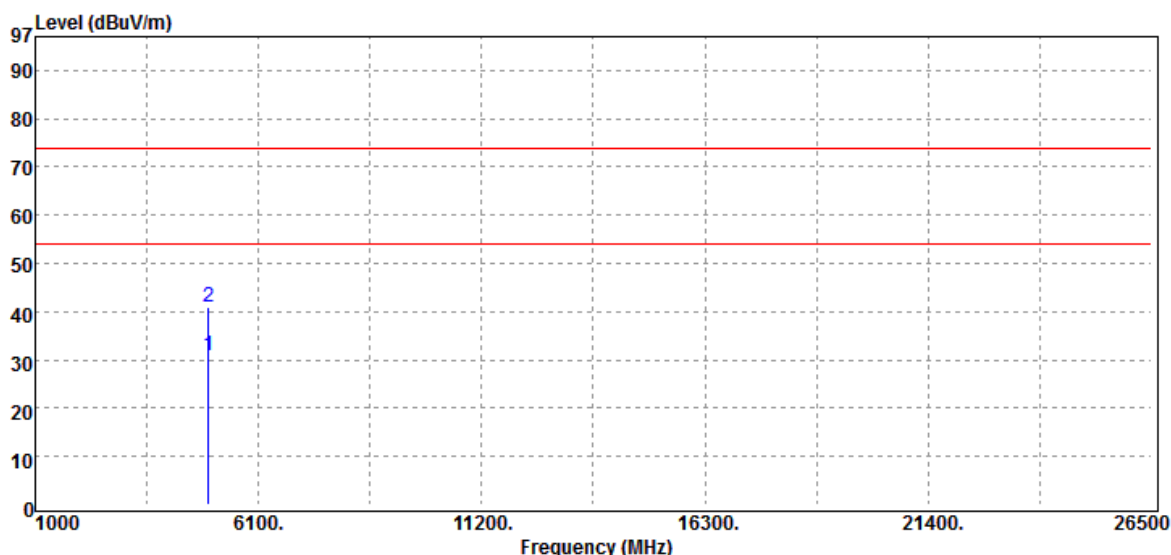
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Operation Band :Zigbee
Fundamental Frequency :2475 MHz
Operation Mode :Tx CH HIGH
EUT Pol. :H Plane

Test Date :2018-09-21
Temp./Humi. :21 deg_C / 62 RH
Engineer :Tin
Measurement Antenna Pol. :HORIZONTAL



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
4950.00	Average	25.03	5.97	31.00	54.00	-23.00
4950.00	Peak	34.93	5.97	40.90	74.00	-33.10

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11 PEAK POWER SPECTRAL DENSITY

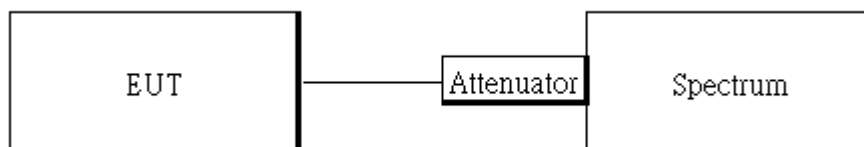
11.1 Standard Applicable:

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:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1804001	02/01/2018	01/31/2019
Power Sensor	Anritsu	MA2411B	1726104	02/01/2018	01/31/2019
DC Power Supply	Anritsu	E3640A	KR93300208	08/15/2018	08/14/2019

11.3 Test Set-up:



11.4 Measurement Procedure:

- Set analyzer center frequency to DTS channel center frequency.
- The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance & ANSI C63.10.
- Set the span to 1.5 times the DTS channel bandwidth.
- Set the RBW = 3 kHz. & the VBW = 10 kHz
- For defining Restricted Band Edge Limit:
Set the RBW = 100kHz & VBW = 300 kHz.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.

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11.5 Measurement Result:

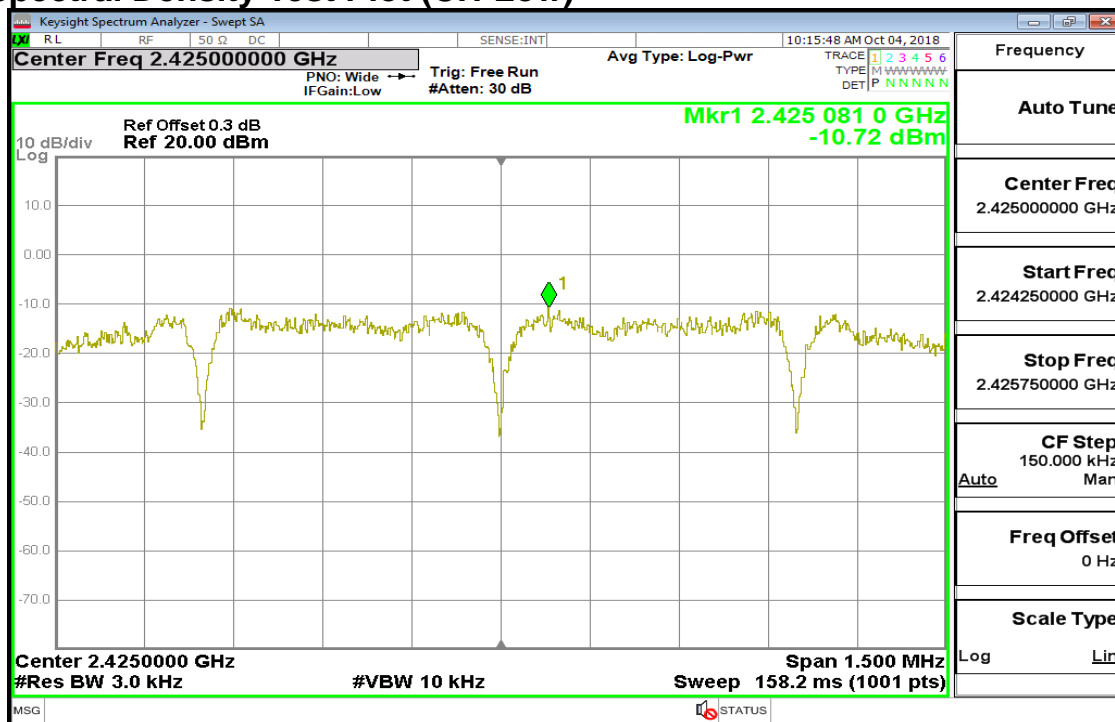
Zigbee mode

Frequency (MHz)	RF Power Density (dBm)	Maximum Limit (dBm)	Result
2425	-10.72	8	PASS
2450	-10.56	8	PASS
2475	-11.21	8	PASS

NOTE: cable loss as 0.3dB that offsets in the spectrum

Zigbee mode

Power Spectral Density Test Plot (CH-Low)



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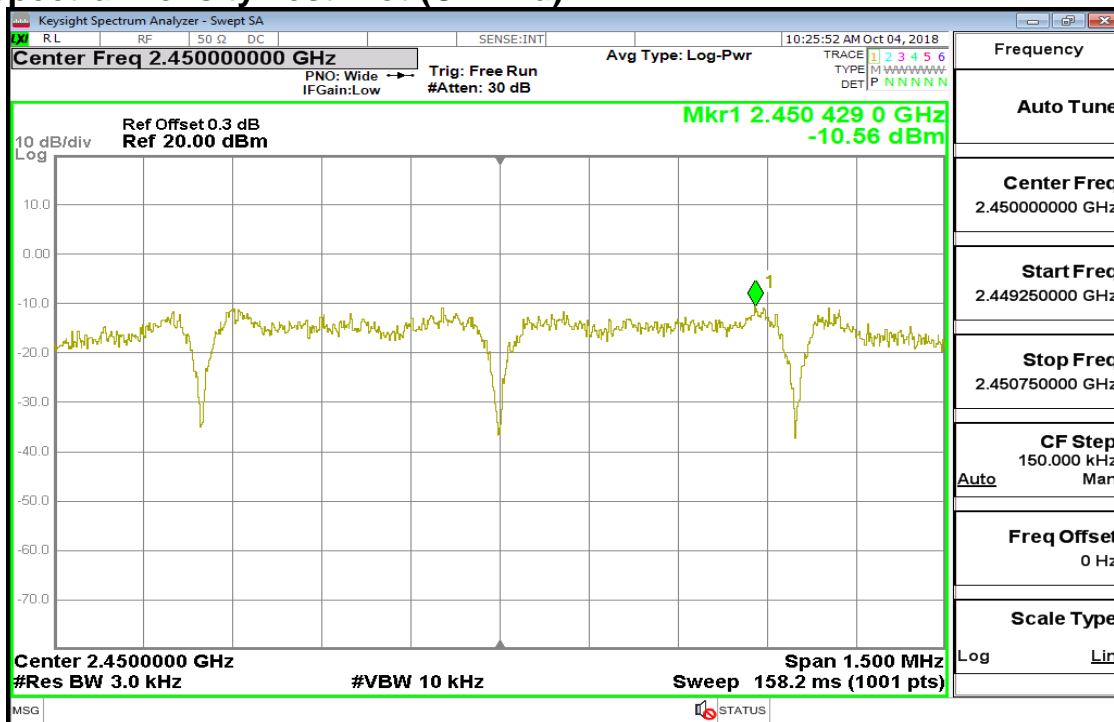
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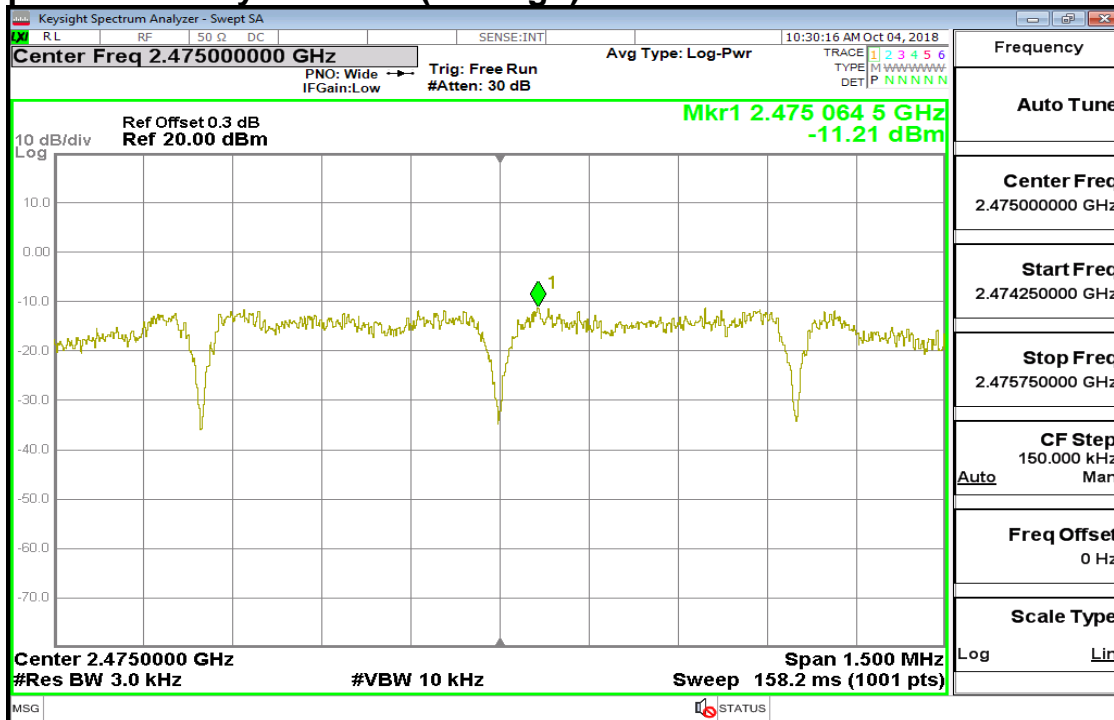
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Power Spectral Density Test Plot (CH-Mid)



Power Spectral Density Test Plot (CH-High)



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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.

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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