ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Applicant:	Targus International LLC 1211 North Miller Street Anaheim, CA 92806 USA
Product Name:	Wireless Receiver
Brand Name:	TARGUS
Model No.:	AMP09BR
Model Difference:	N/A
FCC ID:	OXM000093
Report Number:	E2/2018/90075
FCC Rule Part:	§15.247, Cat: DTS
Issue Date:	Dec. 10, 2018
Date of Test:	Sep. 25, 2018 ~ Oct. 26, 2018
Date of EUT Received:	Sep. 25, 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: Aken Huang

Aken Huang / Engineer

Approved By: Jay Lin

Jay Lin /Asst. Supervisor

ilac-MRA

TAF

Testing Laboratory

0513

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Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
E2/2018/90075	Rev.00	Initial creation of document	All	Dec. 10, 2018	Susan Lin

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Table of Contents

1 GENERAL INFORMATION

1.1 Product Description

General:

Product Name:	Wireless Receiver
Brand Name:	TARGUS
Model No.:	AMP09BR
Model difference:	N/A
Hardware Version:	N/A
Software Version:	N/A
Power Supply:	5Vdc from USB port

2.4GHz:

Channel number:	5 channels
Modulation type:	GFSK
Transmit Power:	-6.32 dBm
Frequency Range:	2417 – 2463MHz

Antenna Designation

Antenna Type	Part Number	Supplier	Peak Gain (dBi)
Printed	AMP09-BR	BTL INC.	-0.13

1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 DTS Meas. Guidance v05.

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.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333 (TAF code 0513)

FCC Registration Number and Designation number are: 735305 / TW0002

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 a 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 according to §15.207. 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 a 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.

2.5 Configuration of Tested System

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

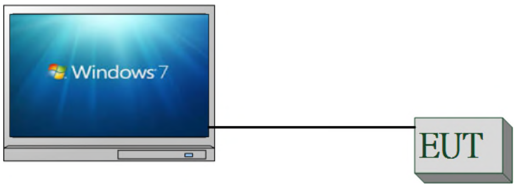

Fig 2-3 Conduction (AC Power Line) Radiated Emission

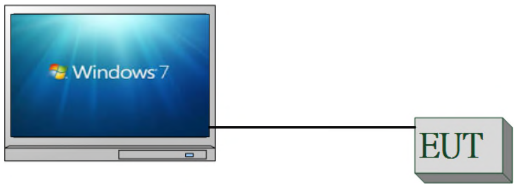

Fig 2-2 Radiated Emission

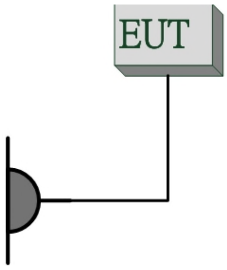

Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	2.4G Test Software	N/A	N/A	N/A	N/A	N/A
2.	Notebook	Lenovo	L430	R9-WR6X4	Shielded	Unshielded

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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)	6dB Bandwidth	Compliant
§15.205 §15.209 §15.247(d)	Conducted Band Edge and Spurious Emission	Compliant
§15.205 §15.209 §15.247(d)	Radiated Band Edge and Spurious Emission	Compliant
§15.247(e)	Peak Power Density	Compliant
§15.203 §15.247(b)	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operated in 2417 ~ 2463MHz Band

5 channels are provided for 2.4GHz

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
1	2417 MHz	2	2431 MHz	3	2443 MHz
4	2451 MHz	5	2463 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)				
2.4GHz	2417 to 2463	2417, 2443, 2463	GFSK	1
RADIATED EMISSION TEST (ABOVE 1 GHz)				
2.4GHz	2417 to 2463	2417, 2443, 2463	GFSK	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 Bluetooth LE Transmitter for channel Low, Mid and High, the worst case E2 position was reported.

ANTENNA PORT CONDUCTED MEASUREMENT:

CONDUCTED TEST				
MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	DATA RATE (Mbps)
2.4GHz	2417 to 2463	2417, 2443, 2463	GFSK	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(μV)	
	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:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LISN	TESEQ	NNB 51	36076	2018/02/14	2019/02/13
EMI Test Receiver	R&S	ESCI	101300	2017/11/02	2018/11/01
Coaxial Cable	EMC Instru-ments Corp	EMC5D-BM-BM-3000	1401004	2018/05/25	2019/05/24
Notebook	Lenovo	T470	P0001293	N/A	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.

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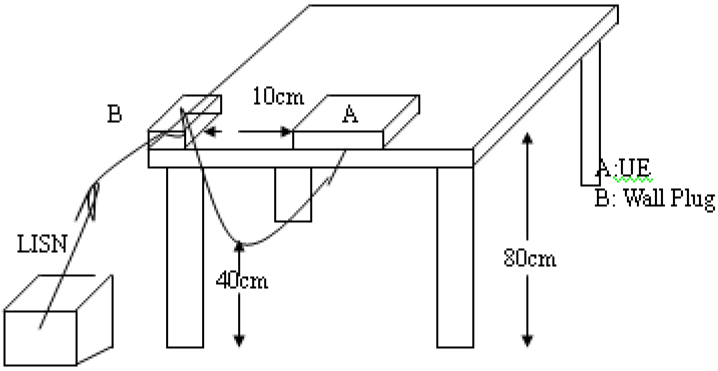
6.4 Test SET-UP (Block Diagram of Configuration)



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:

Note: Refer to next page for measurement data and plots.

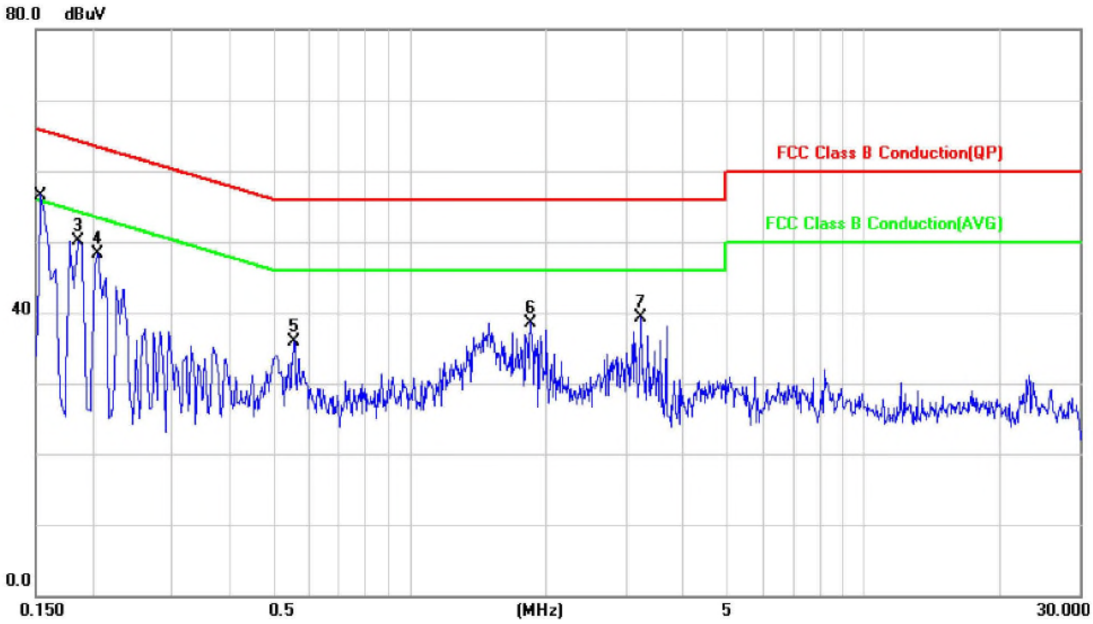
Note2: The * reveals the worst-case results that closet to the limit.

AC POWER LINE CONDUCTED EMISSION TEST DATA

Site : Conduction Room	Phase: L1	Temperature: 23 ℃	
Limit: FCC Class B Conduction(QP)	Power: AC 120V/60Hz	Humidity: 64 %	
Mode:			
Note:			

Conducted Emission

File :Condution   Data :#1119   Date: 2018/10/26   Time: 上午 08:21:11

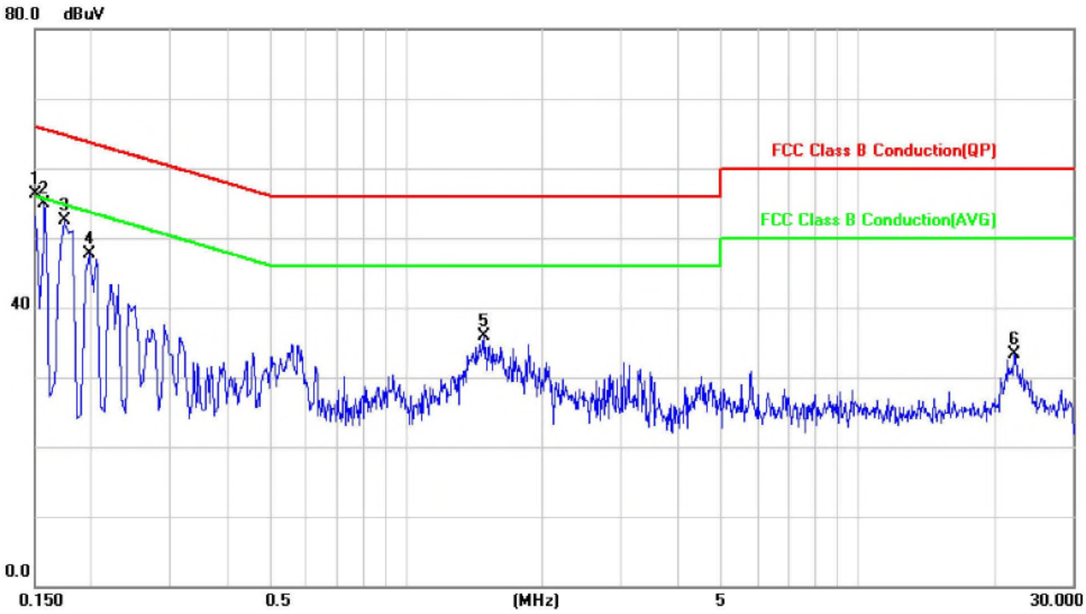


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Detector	Comment
		MHz	dBuV	dB	dBuV	dBuV	dB		
1	*	0.1540	36.90	19.66	56.56	65.78	-9.22	QP	
2		0.1540	19.20	19.66	38.86	55.78	-16.92	AVG	
3		0.1860	30.41	19.71	50.12	64.21	-14.09	peak	
4		0.2060	28.61	19.75	48.36	63.37	-15.01	peak	
5		0.5580	15.80	20.18	35.98	56.00	-20.02	peak	
6		1.8540	18.14	20.46	38.60	56.00	-17.40	peak	
7		3.2380	19.05	20.32	39.37	56.00	-16.63	peak	

Site :	Conduction Room	Phase:	N	Temperature:	23 ℃
Limit:	FCC Class B Conduction(QP)	Power:	AC 120V/60Hz	Humidity:	64 %
Mode:					
Note:					

Conducted Emission

File :Condution　　Data :#1120　　Date: 2018/10/26　　Time: 上午 08:24:25



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1500	36.74	19.64	56.38	66.00	-9.62	peak	
2		0.1580	35.28	19.66	54.94	65.57	-10.63	peak	
3		0.1740	32.85	19.68	52.53	64.77	-12.24	peak	
4		0.1980	28.05	19.72	47.77	63.69	-15.92	peak	
5		1.4860	15.69	20.17	35.86	56.00	-20.14	peak	
6		22.2580	13.26	20.11	33.37	60.00	-26.63	peak	

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.

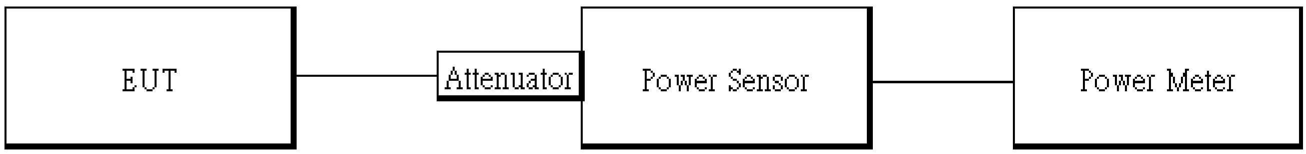
If the transmitting antenna of directional gain greater than 6dBi are used the peak output power form the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

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	1326001	2018/08/09	2019/08/02
Power Sensor	Anritsu	MA2411B	1315048	2018/08/09	2019/08/02
Power Sensor	Anritsu	MA2411B	1315049	2018/08/09	2019/08/02
Splitter	Woken	DOM35LW1A2	RF36	2017/12/26	2018/12/25
Notebook	Lenovo	L420	S0011721	N/A	N/A
Spectrum Analyzer	Agilent	N9010A	MY53400256	2017/10/30	2018/10/29
DC Block	PASTERNACK	PE8210	RF81	2017/12/26	2018/12/25

7.3 Test Set-up:



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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.

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.

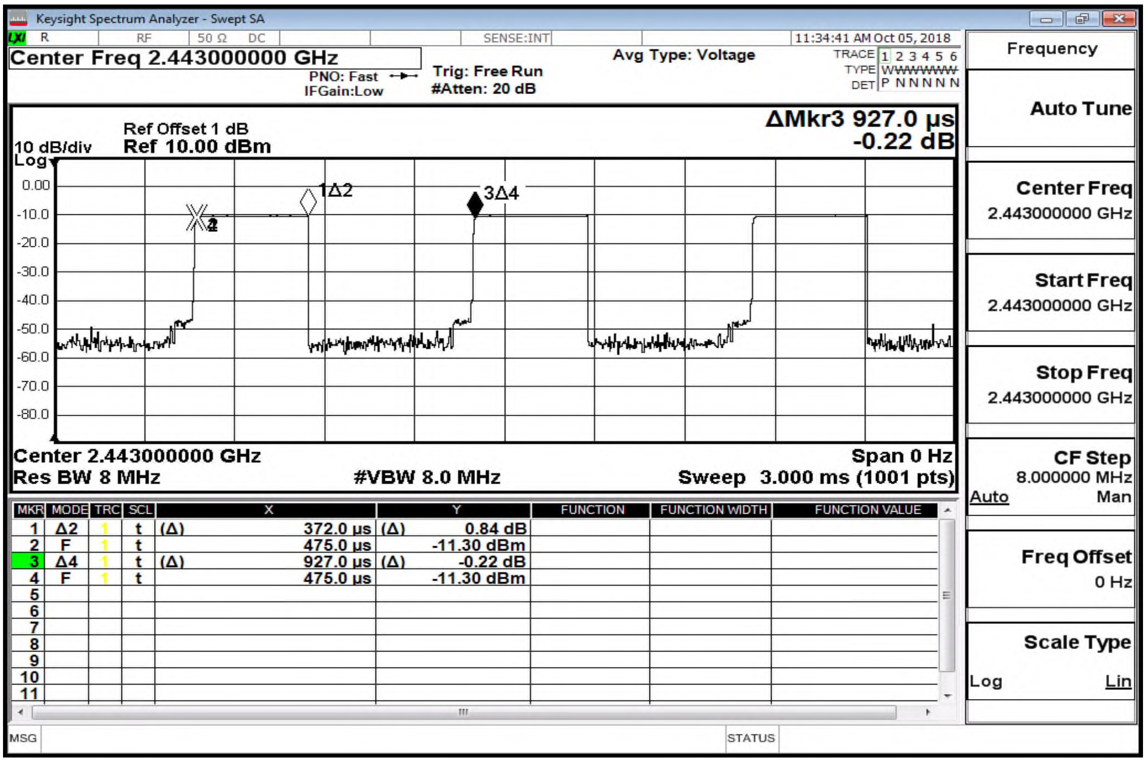
5.Repeat above procedures until all test default channel measured was complete.

Formula:

Duty Cycle = Ton / (Ton+Toff)

Duty Factor:

	Duty Cycle (%)	Duty Factor (dB)	1/T (kHz)	VBW setting (kHz)
2.4G	40.13	3.97	2.69	3.00



Duty Cycle Factor:10*log(1/(40.1294498381877/100))=3.97

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7.5 Measurement Result:

2.4G mode:

CH	Frequency (MHz)	Peak Power Output (dBm)	Required Limit
Low	2417	-6.32	1 Watt = 30 dBm
Mid	2443	-6.58	1 Watt = 30 dBm
High	2463	-6.64	1 Watt = 30 dBm
2.4G mode:			
CH	**Frequency (MHz)**	**Max. Avg. Output include tune up tolerance Power (dBm)**	**Required Limit**
Low	2417	-6.58	1 Watt = 30 dBm
Mid	2443	-6.74	1 Watt = 30 dBm
High	2463	-6.85	1 Watt = 30 dBm

**Note: Measured by power meter, cable loss as 1 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*

8 6DB BANDWIDTH MEASUREMENT

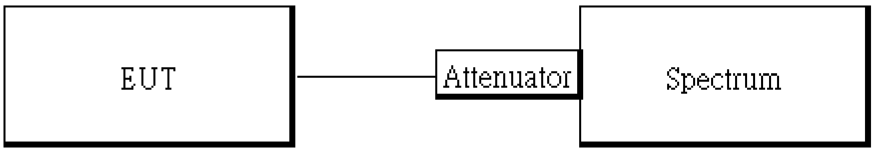
8.1 Standard Applicable

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.
Spectrum Analyzer	Agilent	N9010A	MY53400256	2017/10/30	2018/10/29
DC Block	PASTERNACK	PE8210	RF81	2017/12/26	2018/12/25
Notebook	Lenovo	L420	S0011721	N/A	N/A

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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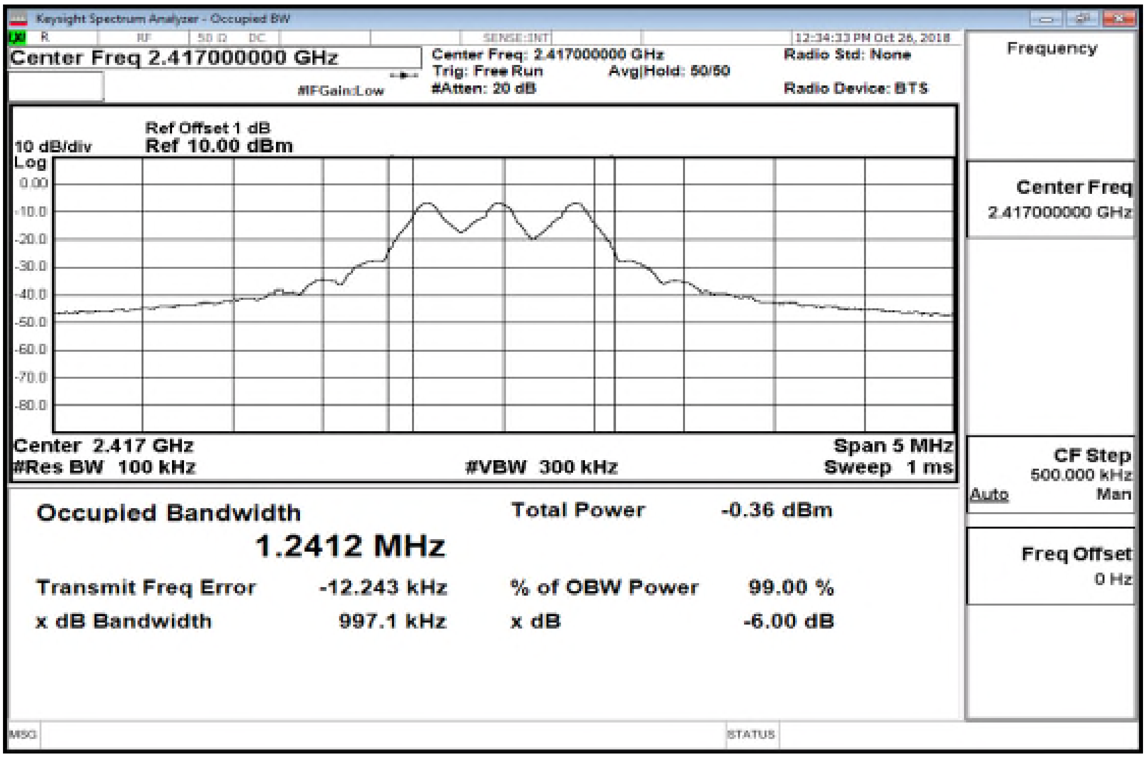
8.5 Measurement Result:

2.4G mode

Frequency (MHz)	6dB BW (MHz)	BW (MHz)	Result
2417	0.9971	> 0.5	PASS
2443	1.022	> 0.5	PASS
2463	1.045	> 0.5	PASS

6dB Band Width Test Data CH-Low



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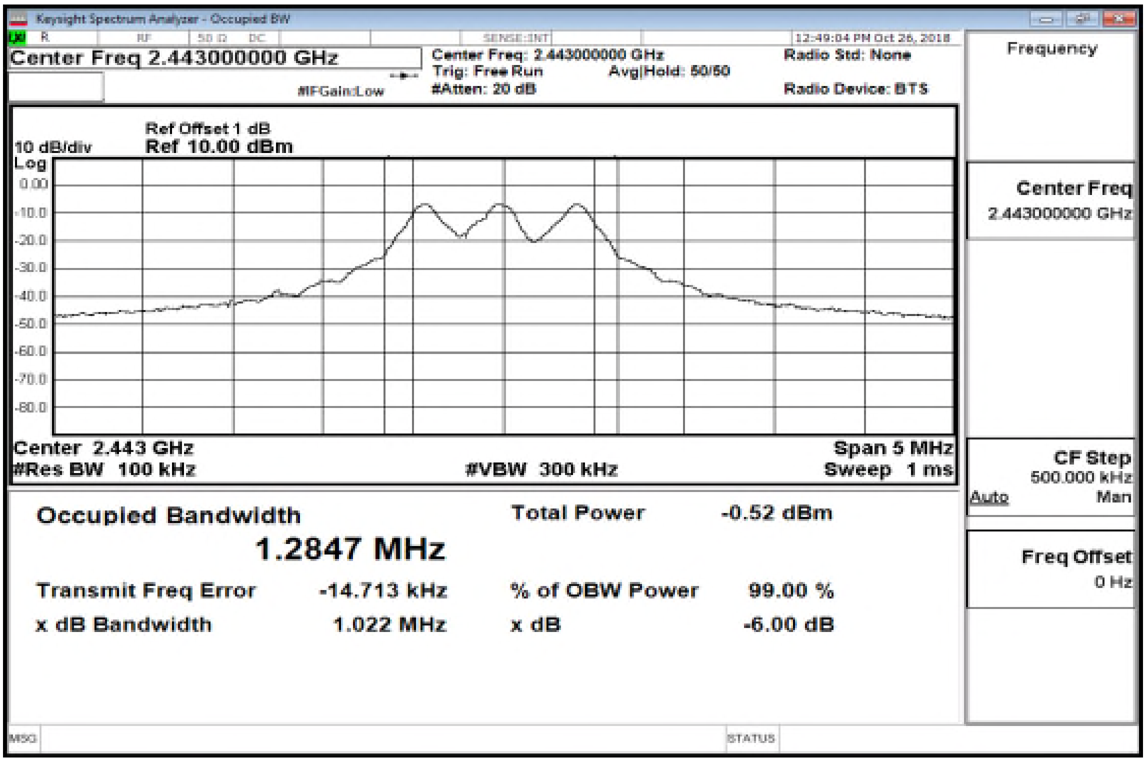
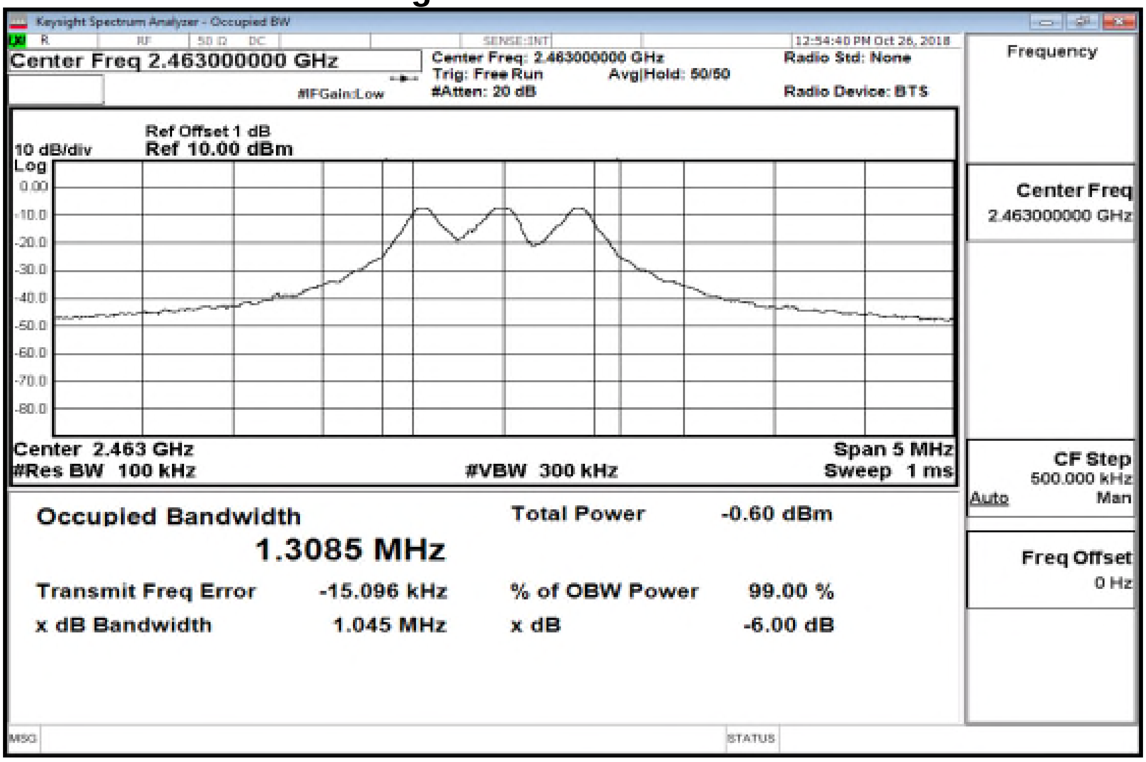
6dB Band Width Test Data CH-Mid



6dB Band Width Test Data CH-High



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9 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

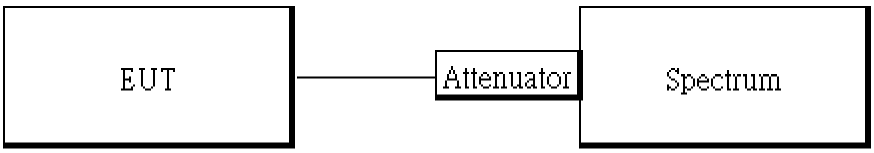
9.1 Standard Applicable

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

9.2 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	N9010A	MY53400256	2017/10/30	2018/10/29
DC Block	PASTERNACK	PE8210	RF81	2017/12/26	2018/12/25
Notebook	Lenovo	L420	S0011721	N/A	N/A

9.3 Test SET-UP:



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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.
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.

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.

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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.

9.5 Measurement Result

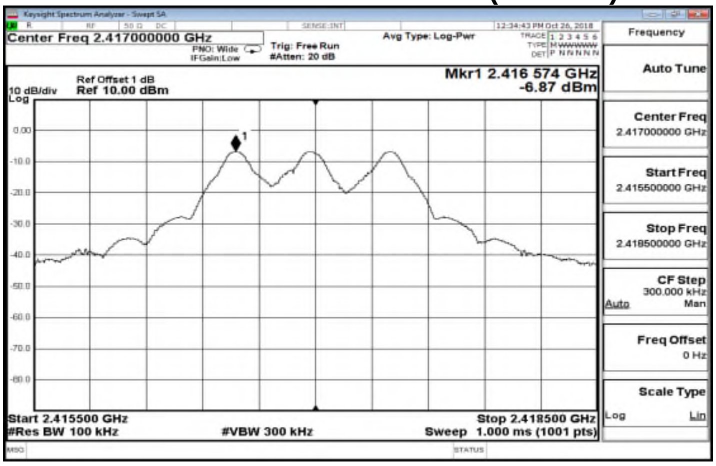
Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2417	-6.87	-26.87
2443	-7.07	-27.07
2463	-7.27	-27.27

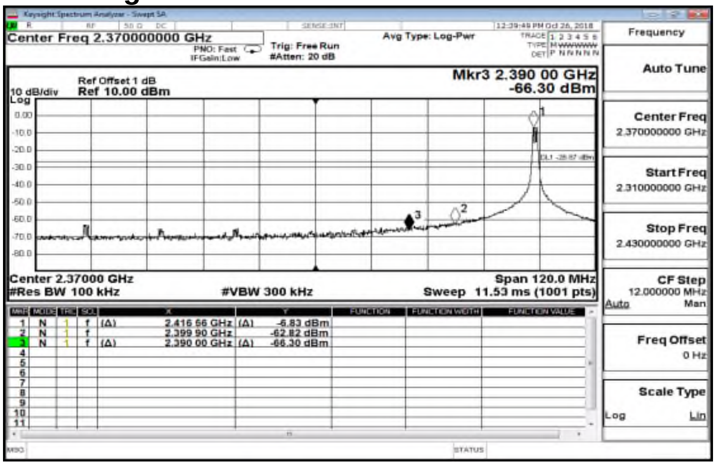
NOTE: cable loss as 1dB that offsets in the spectrum

NOTE: Refer to next page for plots.

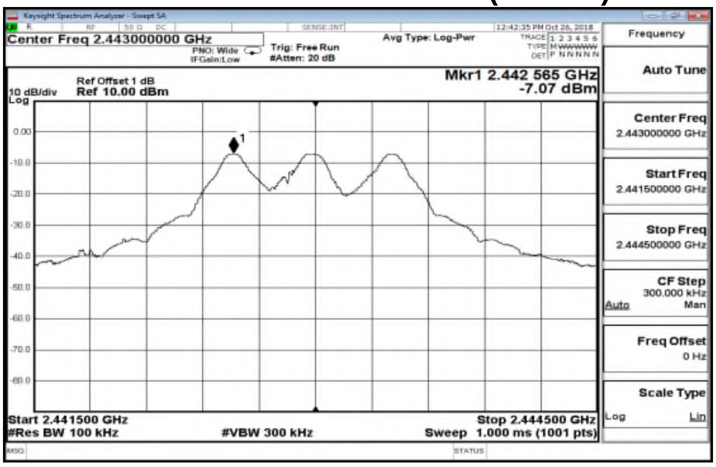
Reference Level of Emission Limit (CH-Low)



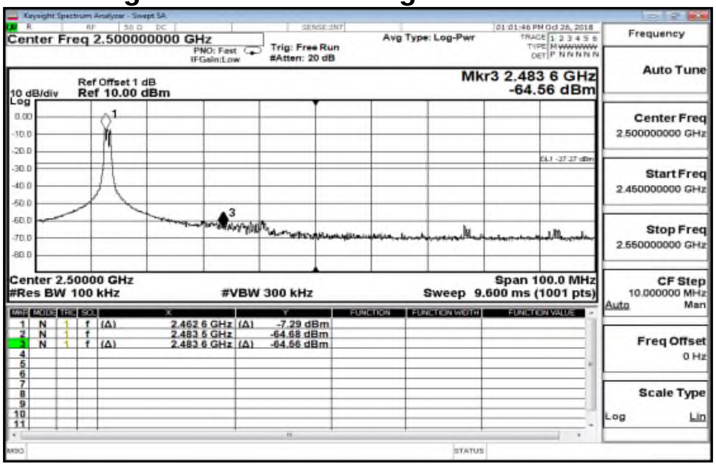
Band Edges Test Data CH-Low



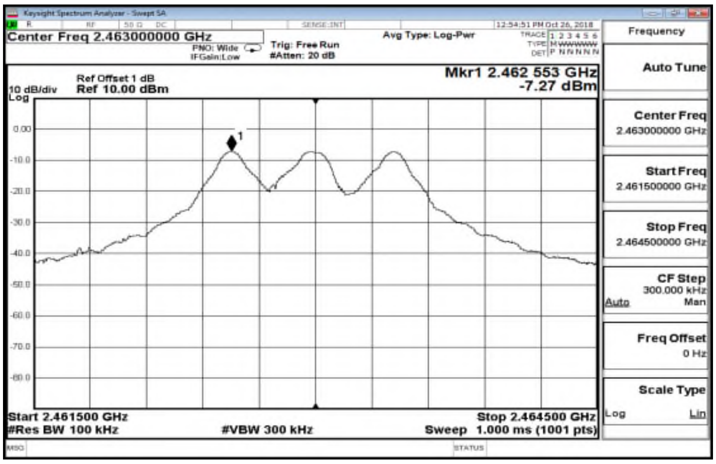
Reference Level of Emission Limit (CH-Mid)



Band Edges Test Data CH-High

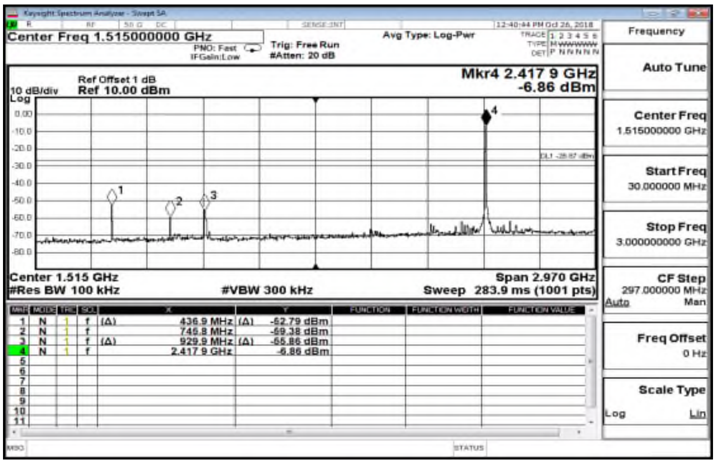


Reference Level of Emission Limit (CH-High)

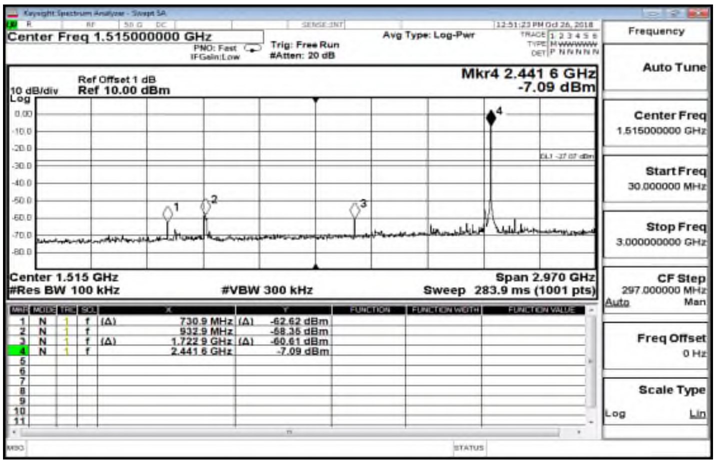


Conducted Spurious Emission Measurement Result

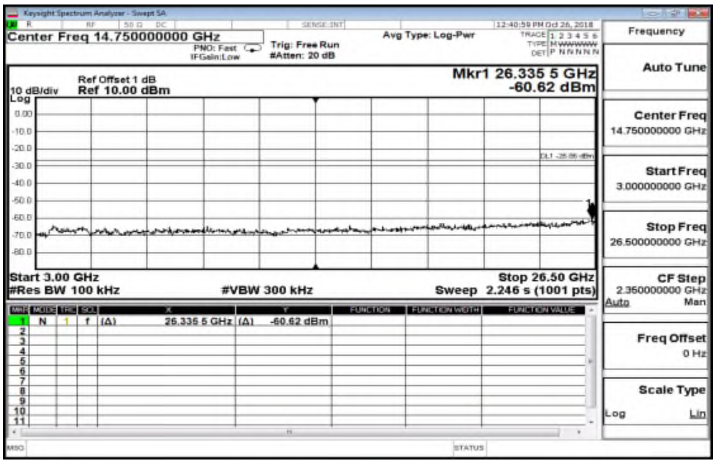
CH-Low 30MHz – 3GHz



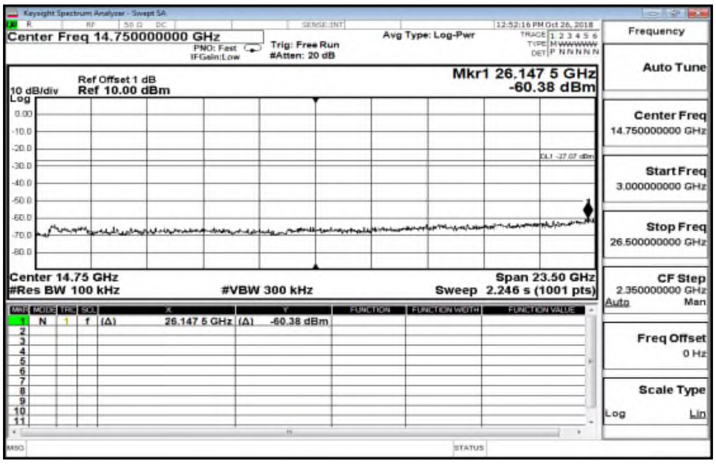
CH-Mid 30MHz – 3GHz



CH-Low 3GHz – 26.5GHz



CH-Mid 3GHz – 26.5GHz



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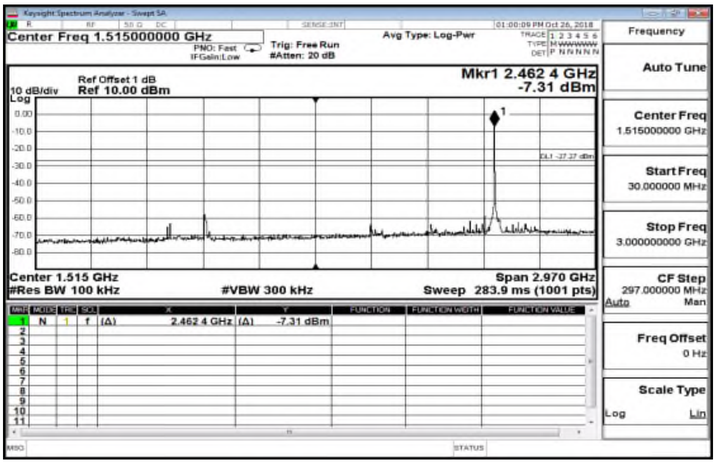
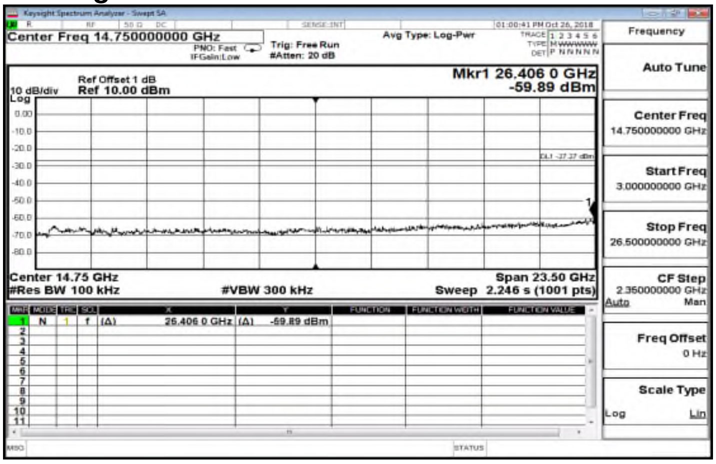
CH-High 30MHz – 3GHz



CH- High 3GHz – 26.5GHz



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 limit as below.

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

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

Note:

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

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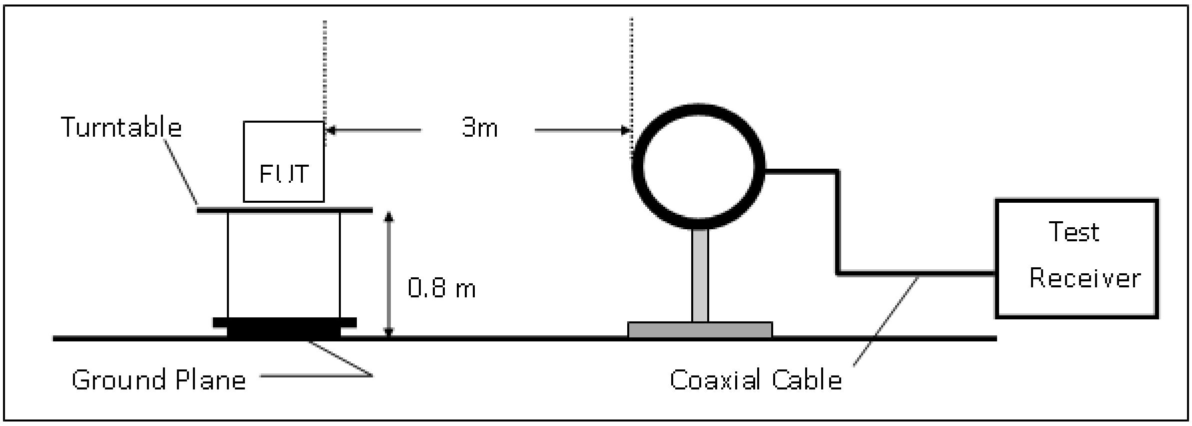
10.2 Measurement Equipment Used

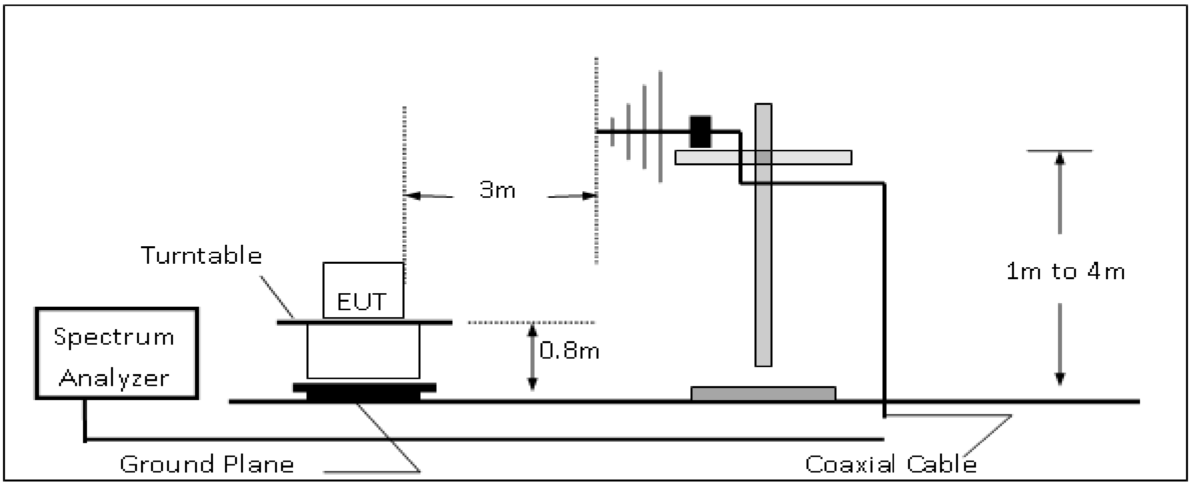
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	TESEQ	CBL 6112D	35243	2017/11/10	2018/11/09
Horn Antenna	Schwarzbeck	BBHA9120D	1187	2018/01/04	2019/01/03
Horn Antenna	SCHWAZBECK	BBHA9170	184	2017/12/12	2018/12/11
Loop Antenna	ETS.LINDGREN	6502	148045	2018/04/19	2019/04/18
EMI Test Receiver	R&S	ESU 40	100363	2018/04/11	2019/04/10
Pre-Amplifier	EMC Instruments	EMC330	980096	2017/12/26	2018/12/25
Pre-Amplifier	EMC Instruments	EMC0011830	980199	2017/12/26	2018/12/25
Pre-Amplifier	EMC Instruments	EMC184045B	980135	2017/10/27	2018/10/26
Attenuator	Marvelous	WATT-218FS-10	RF246	2017/12/26	2018/12/25
Highpass Filter	Micro Tronics	BRM50701-01	G008	2017/12/26	2018/12/25
Coaxial Cable	Huber+Suhner	RG 214/U	W21.01	2017/12/26	2018/12/25
Coaxial Cable	Huber Suhner	EMC106-SM-SM-7200	150703	2017/12/26	2018/12/25
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17388/4	2017/12/26	2018/12/25
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	2017/12/26	2018/12/25
Notebook	Lenovo	T470	P0001293	N/A	N/A

10.3 Test SET-UP

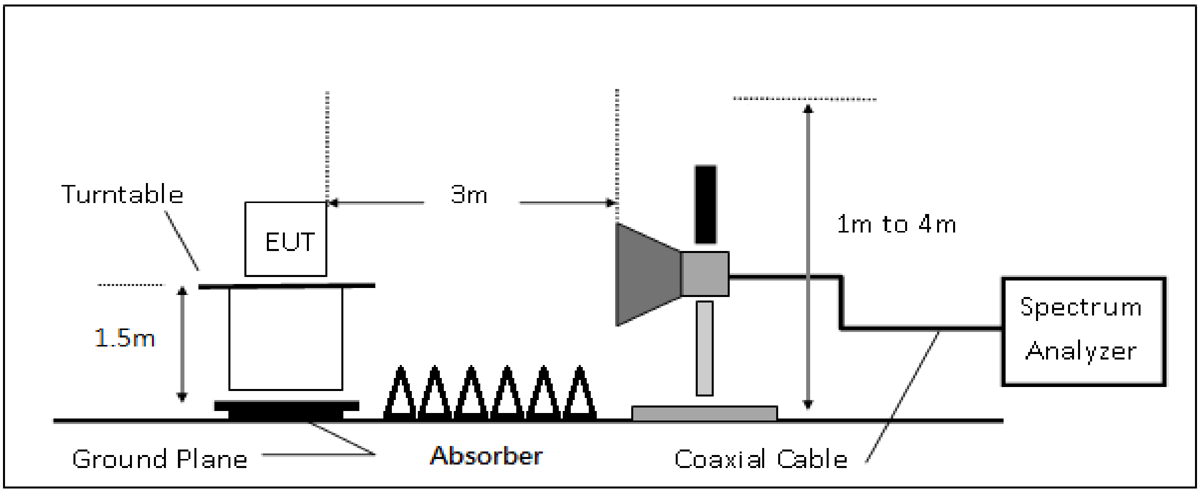
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(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	

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

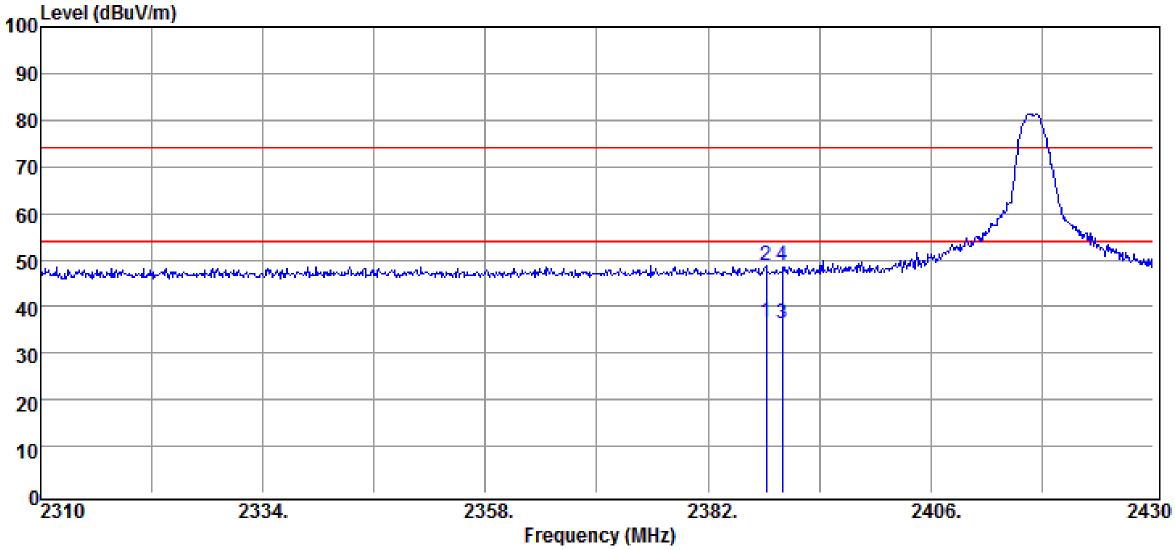
The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

10.7 Measurement Result:

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

Radiated Band Edge Measurement Result

Operation Mode	:2.4G	Test Date	:2018-10-05
Test Mode	:BE CH LOW	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2417 MHz	Engineer	:Ashton



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2388.24	Average	33.14	3.38	36.52	54.00	-17.48
2388.24	Peak	45.41	3.38	48.79	74.00	-25.21
2390.00	Average	33.04	3.39	36.43	54.00	-17.57
2390.00	Peak	45.40	3.39	48.79	74.00	-25.21

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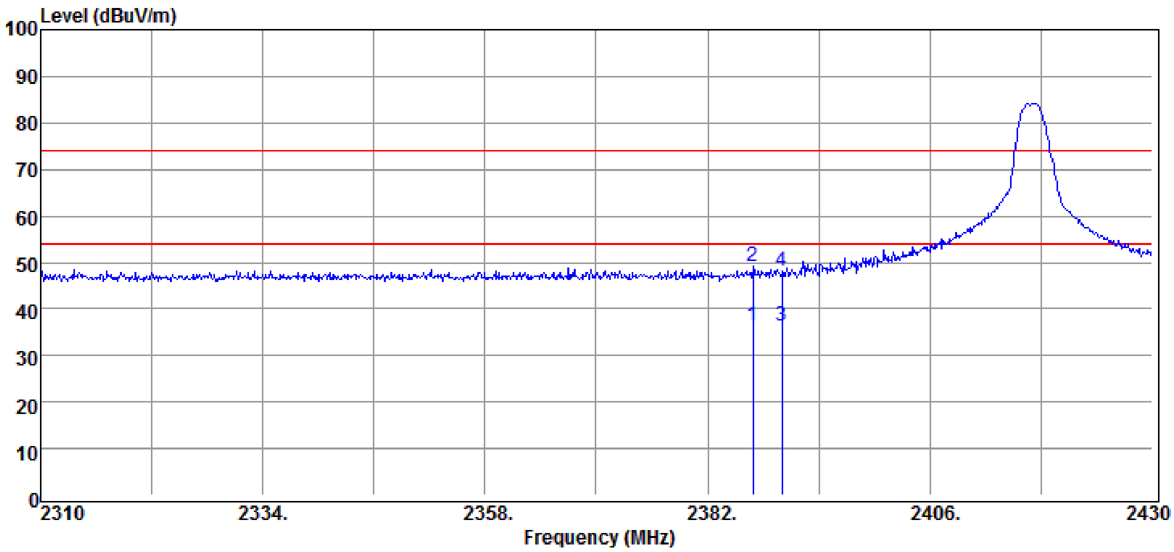
Operation Mode	:2.4G	Test Date	:2018-10-05
Test Mode	:BE CH LOW	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2417 MHz	Engineer	:Ashton



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2386.92	Average	32.82	3.38	36.20	54.00	-17.80
2386.92	Peak	45.75	3.38	49.13	74.00	-24.87
2390.00	Average	32.86	3.39	36.25	54.00	-17.75
2390.00	Peak	44.54	3.39	47.93	74.00	-26.07

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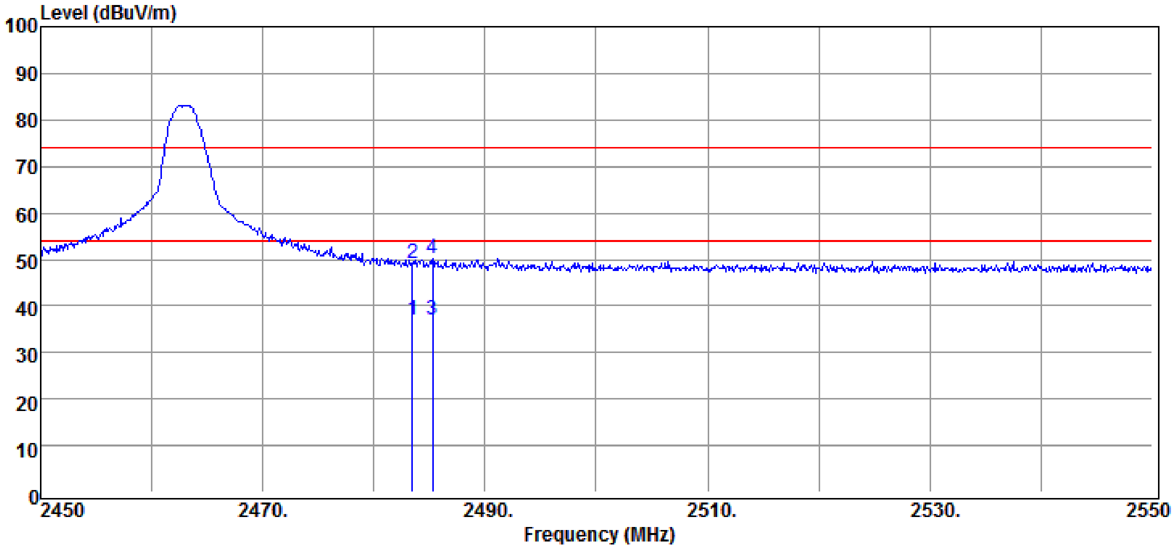
Operation Mode	:2.4G	Test Date	:2018-10-05
Test Mode	:BE CH HIGH	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2463 MHz	Engineer	:Ashton



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	33.12	3.96	37.08	54.00	-16.92
2483.50	Peak	45.03	3.96	48.99	74.00	-25.01
2485.30	Average	33.04	3.98	37.02	54.00	-16.98
2485.30	Peak	46.12	3.98	50.10	74.00	-23.90

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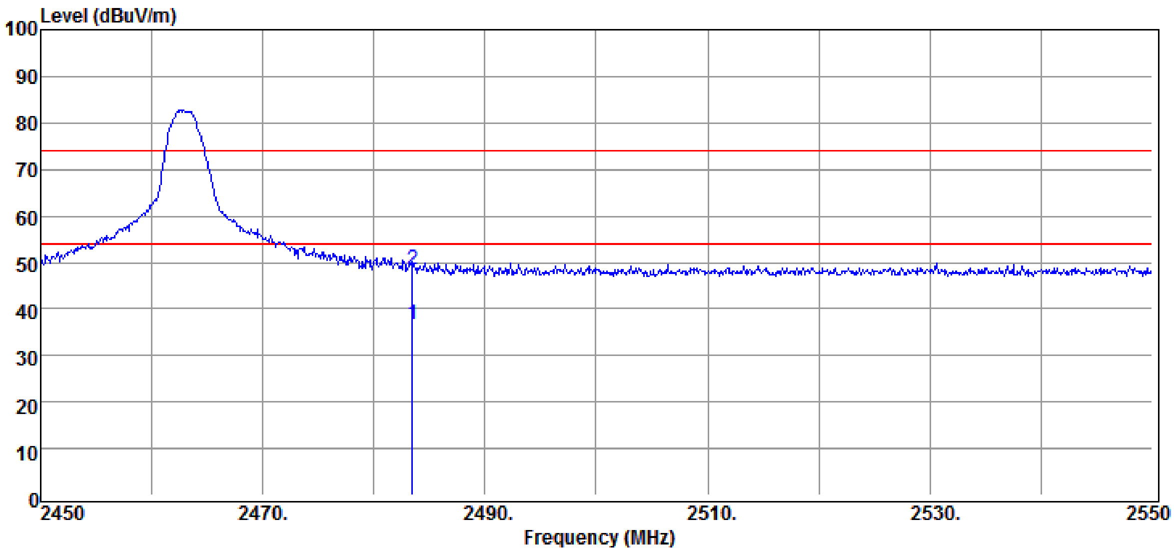
Operation Mode	:2.4G	Test Date	:2018-10-05
Test Mode	:BE CH HIGH	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2463 MHz	Engineer	:Ashton



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	32.82	3.96	36.78	54.00	-17.22
2483.50	Peak	44.51	3.96	48.47	74.00	-25.53

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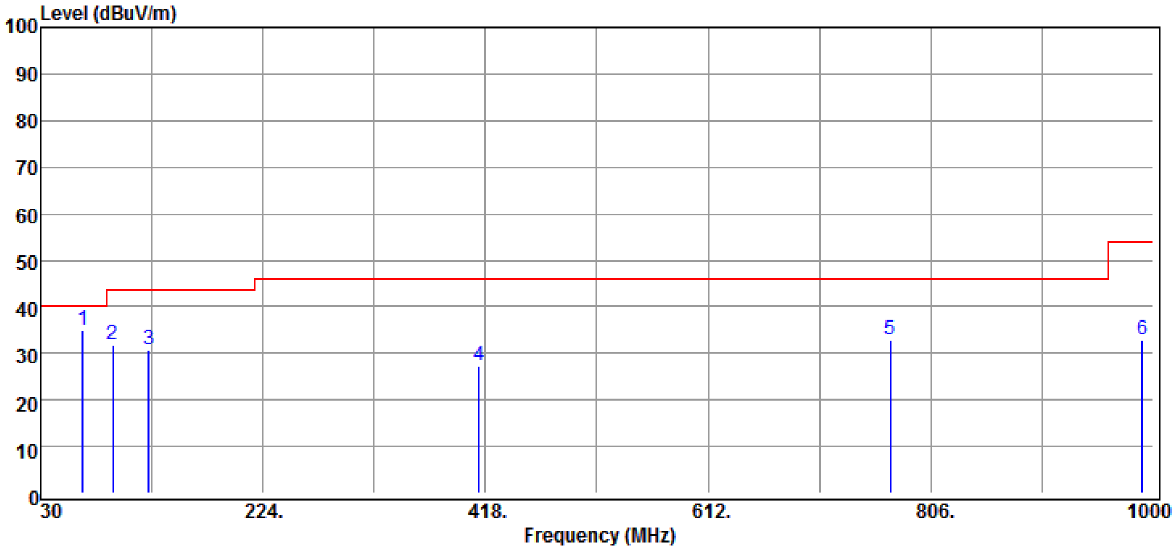
Radiated Spurious Emission Measurement Result
For Frequency form 30MHz to 1000MHz

Operation Mode	:2.4G	Test Date	:2018-10-03
Test Mode	:TX CH LOW	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2417 MHz	Engineer	:Enzo



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
66.86	Peak	53.40	-18.45	34.95	40.00	-5.05
93.05	Peak	47.69	-15.88	31.81	43.50	-11.69
124.09	Peak	42.63	-11.84	30.79	43.50	-12.71
412.18	Peak	33.26	-5.91	27.35	46.00	-18.65
771.08	Peak	33.71	-0.93	32.78	46.00	-13.22
990.30	Peak	29.83	3.07	32.90	54.00	-21.10

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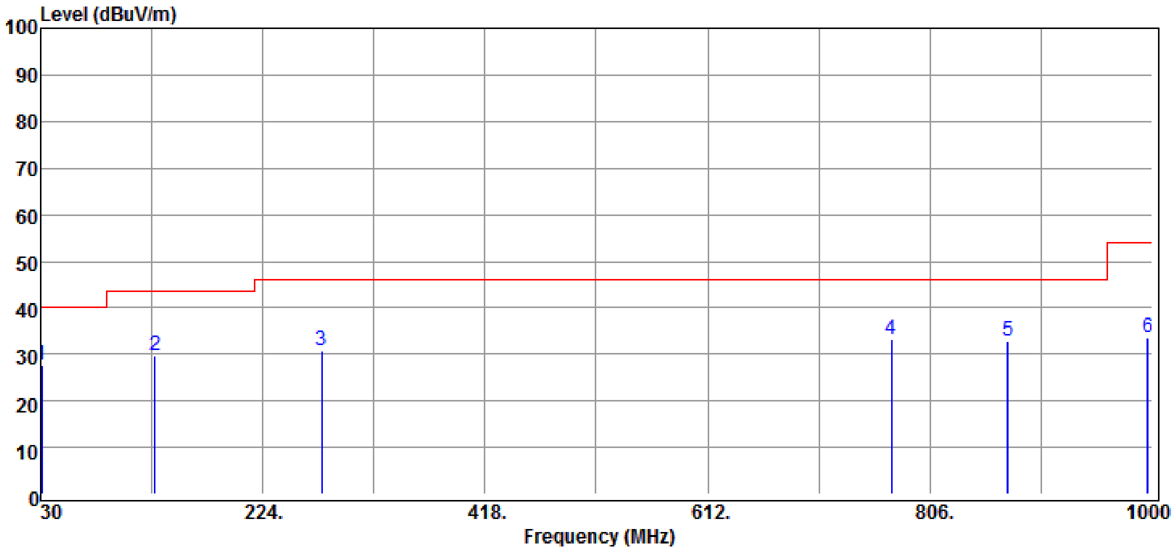
Operation Mode	:2.4G	Test Date	:2018-10-03
Test Mode	:TX CH LOW	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2417 MHz	Engineer	:Enzo



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
30.97	Peak	32.01	-4.16	27.85	40.00	-12.15
129.91	Peak	41.17	-11.44	29.73	43.50	-13.77
275.41	Peak	40.96	-10.27	30.69	46.00	-15.31
772.05	Peak	34.12	-0.90	33.22	46.00	-12.78
873.90	Peak	32.00	0.95	32.95	46.00	-13.05
996.12	Peak	30.31	3.20	33.51	54.00	-20.49

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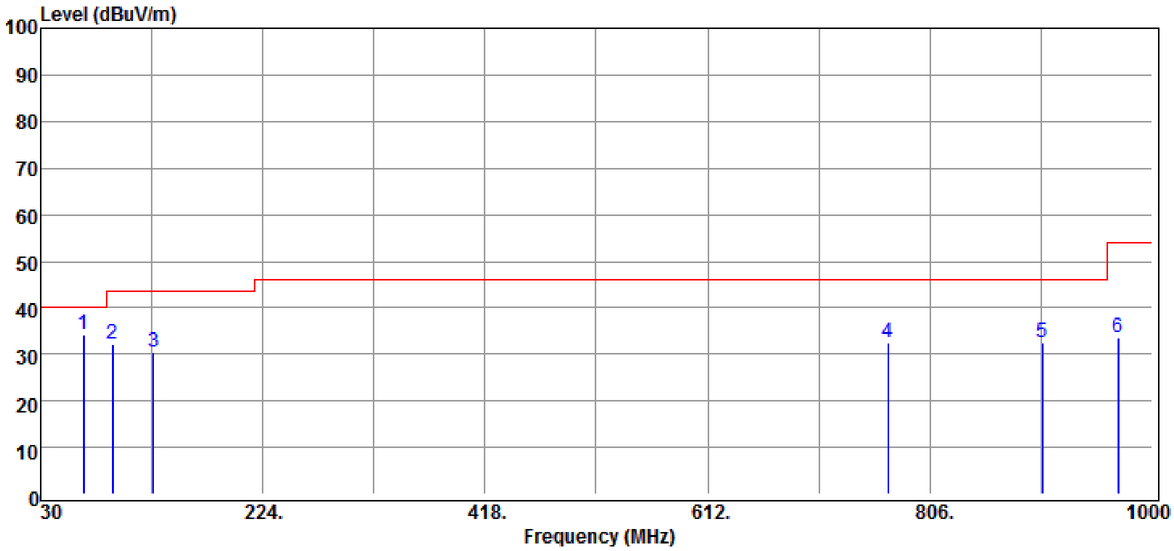
Operation Mode	:2.4G	Test Date	:2018-10-03
Test Mode	:TX CH MID	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2443 MHz	Engineer	:Enzo



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
67.83	Peak	52.40	-18.28	34.12	40.00	-5.88
93.05	Peak	48.03	-15.88	32.15	43.50	-11.35
128.94	Peak	41.98	-11.51	30.47	43.50	-13.03
769.14	Peak	33.58	-0.96	32.62	46.00	-13.38
903.97	Peak	31.16	1.25	32.41	46.00	-13.59
969.93	Peak	30.90	2.55	33.45	54.00	-20.55

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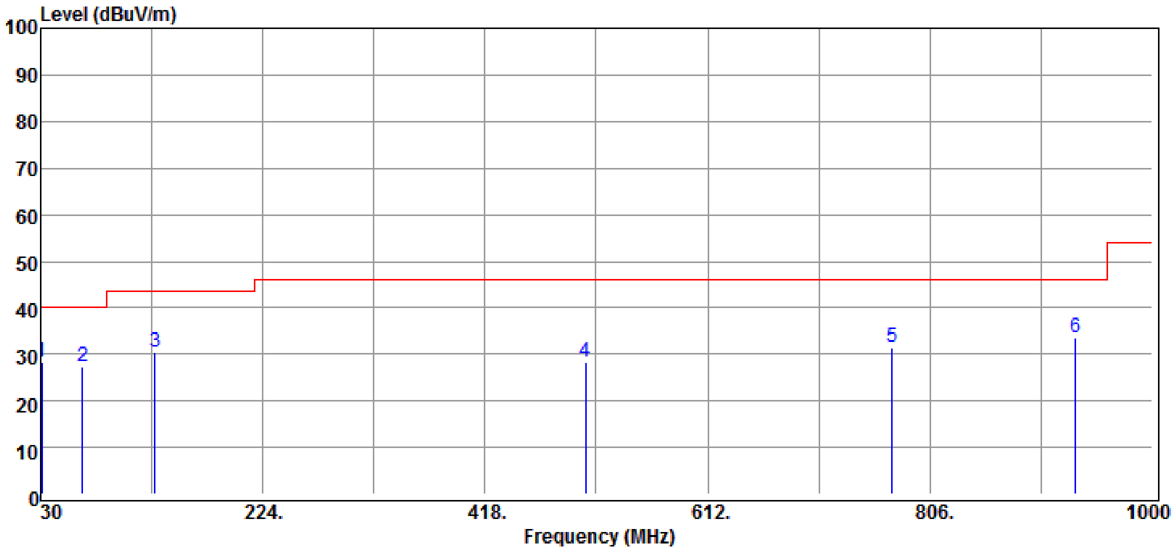
Operation Mode	:2.4G	Test Date	:2018-10-03
Test Mode	:TX CH MID	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2443 MHz	Engineer	:Enzo



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
30.97	Peak	32.43	-4.16	28.27	40.00	-11.73
66.86	Peak	45.68	-18.45	27.23	40.00	-12.77
129.91	Peak	41.83	-11.44	30.39	43.50	-13.11
505.30	Peak	32.44	-4.10	28.34	46.00	-17.66
773.02	Peak	32.43	-0.88	31.55	46.00	-14.45
933.07	Peak	31.85	1.76	33.61	46.00	-12.39

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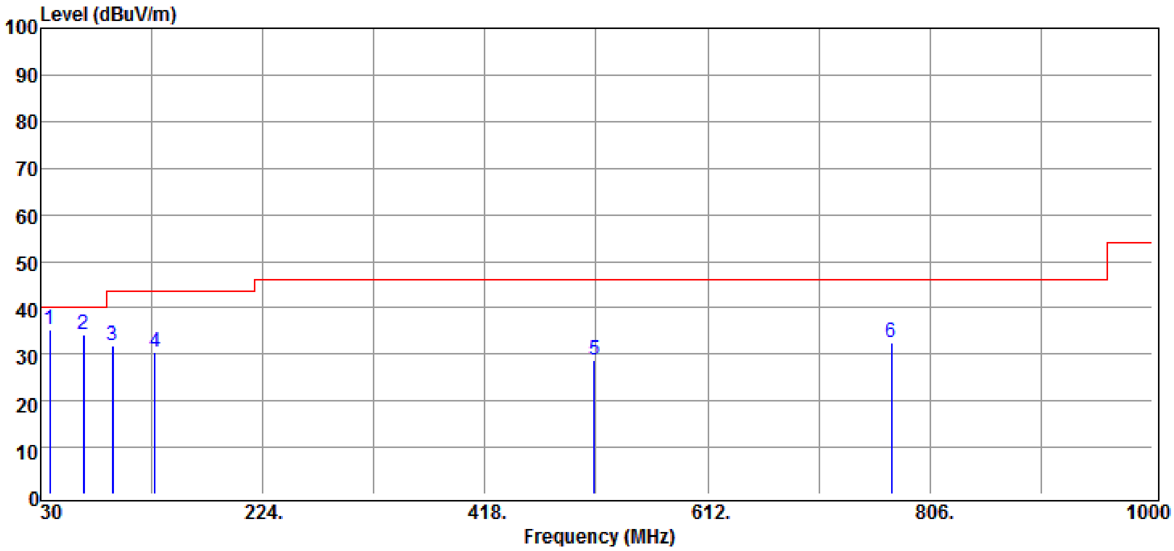
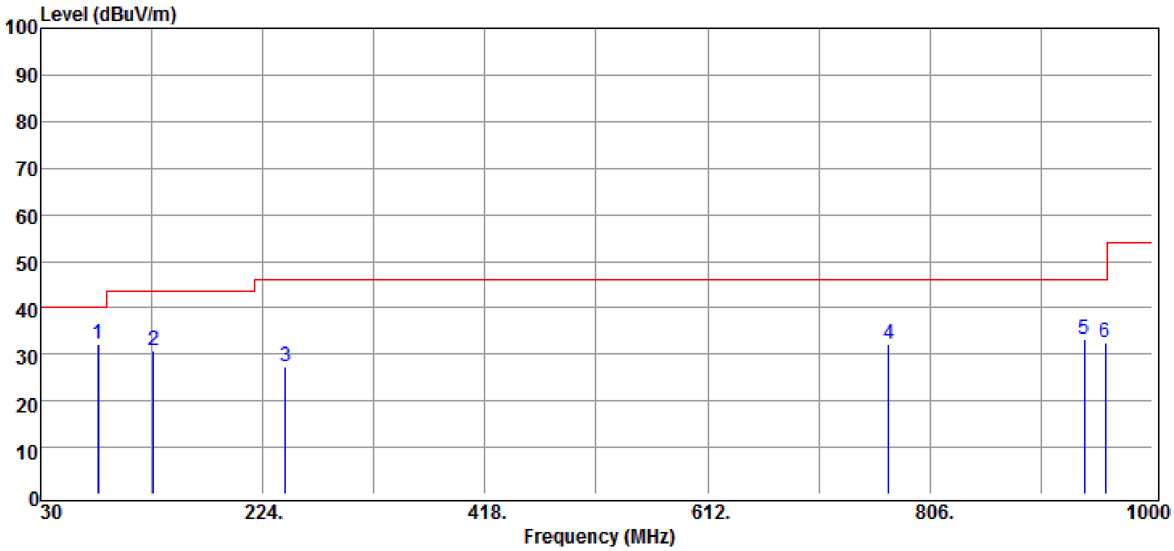
Operation Mode	:2.4G	Test Date	:2018-10-03
Test Mode	:TX CH HIGH	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2463 MHz	Engineer	:Enzo



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
37.76	Peak	42.76	-7.62	35.14	40.00	-4.86
67.83	Peak	52.70	-18.28	34.42	40.00	-5.58
93.05	Peak	47.76	-15.88	31.88	43.50	-11.62
129.91	Peak	42.02	-11.44	30.58	43.50	-12.92
513.06	Peak	32.55	-3.92	28.63	46.00	-17.37
772.05	Peak	33.37	-0.90	32.47	46.00	-13.53

Operation Mode	:2.4G	Test Date	:2018-10-03
Test Mode	:TX CH HIGH	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2463 MHz	Engineer	:Enzo



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
80.44	Peak	48.99	-16.84	32.15	40.00	-7.85
128.94	Peak	42.34	-11.51	30.83	43.50	-12.67
243.40	Peak	38.68	-11.32	27.36	46.00	-18.64
770.11	Peak	33.21	-0.95	32.26	46.00	-13.74
940.83	Peak	31.20	1.89	33.09	46.00	-12.91
959.26	Peak	30.34	2.28	32.62	46.00	-13.38

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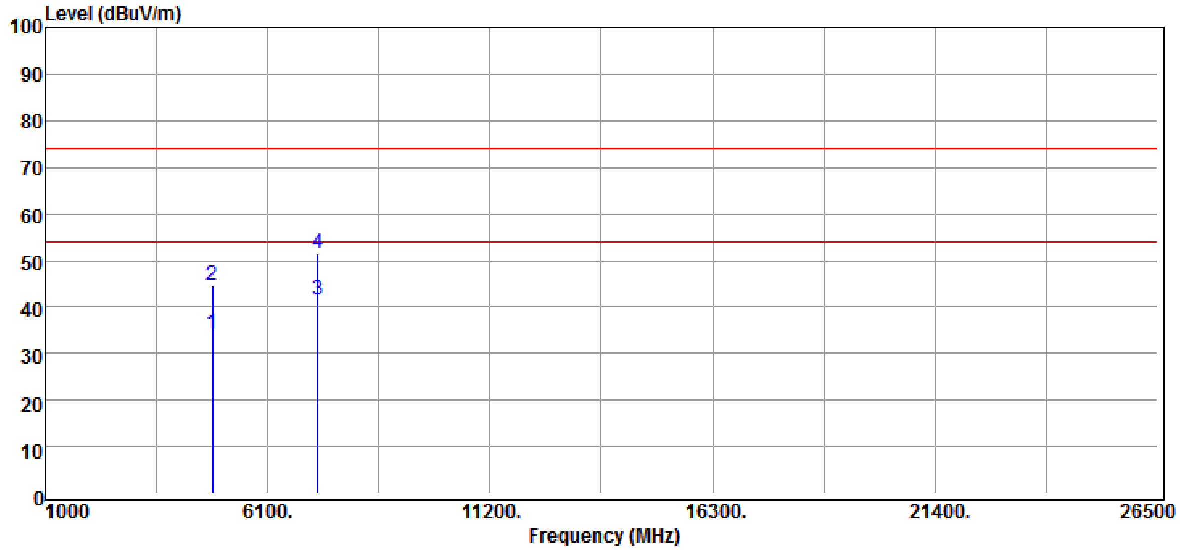
Radiated Spurious Emission Measurement Result
For Frequency above 1GHz

Operation Mode	:2.4G	Test Date	:2018-10-05
Test Mode	:TX CH LOW	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2417 MHz	Engineer	:Ashton



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
4834.00	Average	21.82	12.42	34.24	54.00	-19.76
4834.00	Peak	32.39	12.42	44.81	74.00	-29.19
7251.00	Average	21.33	20.04	41.37	54.00	-12.63
7251.00	Peak	31.61	20.04	51.65	74.00	-22.35

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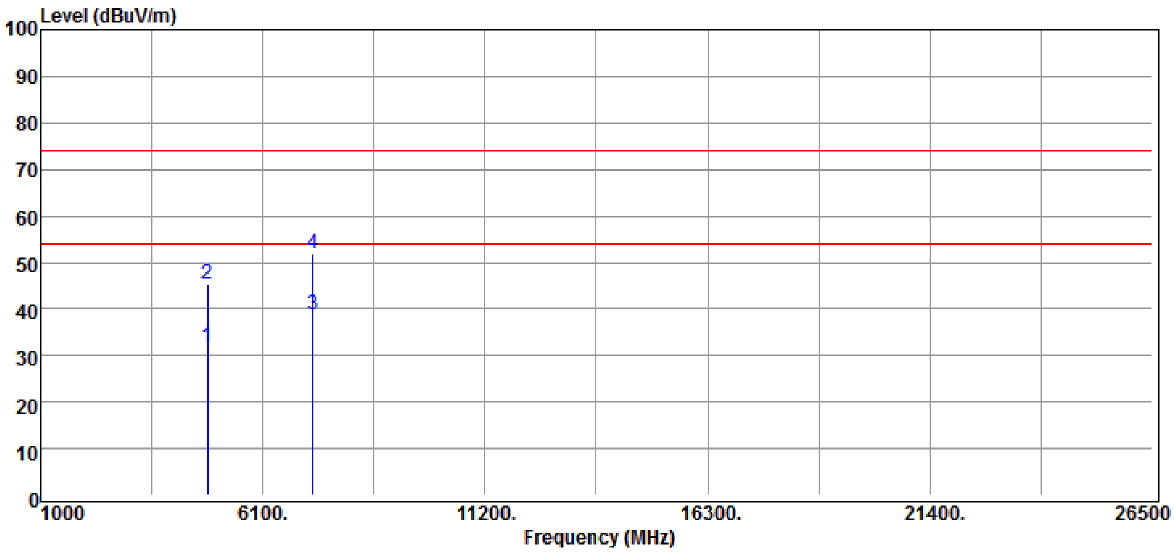
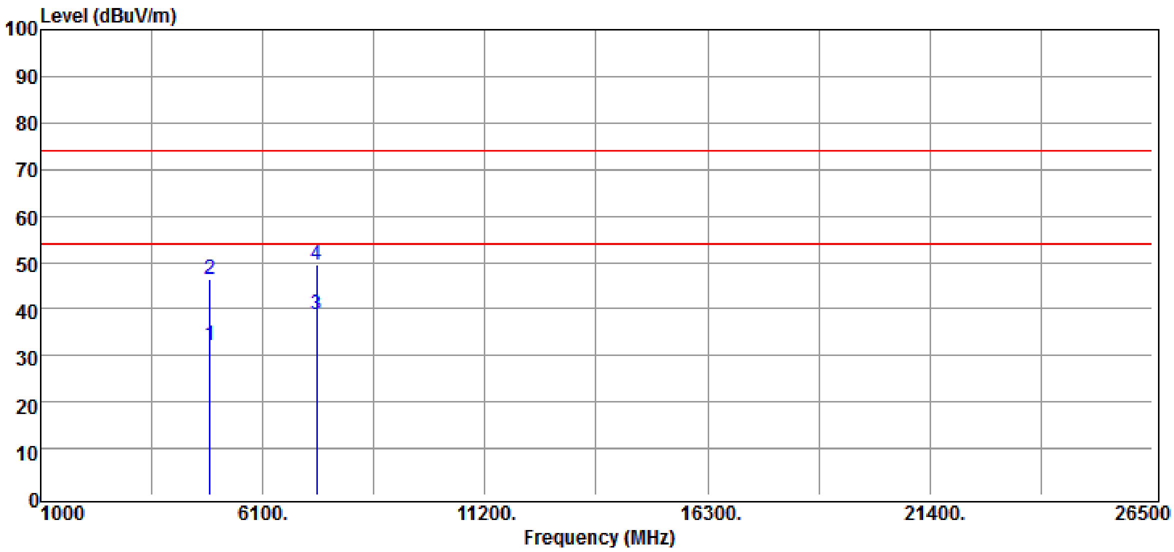
Operation Mode	:2.4G	Test Date	:2018-10-05
Test Mode	:TX CH LOW	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2417 MHz	Engineer	:Ashton



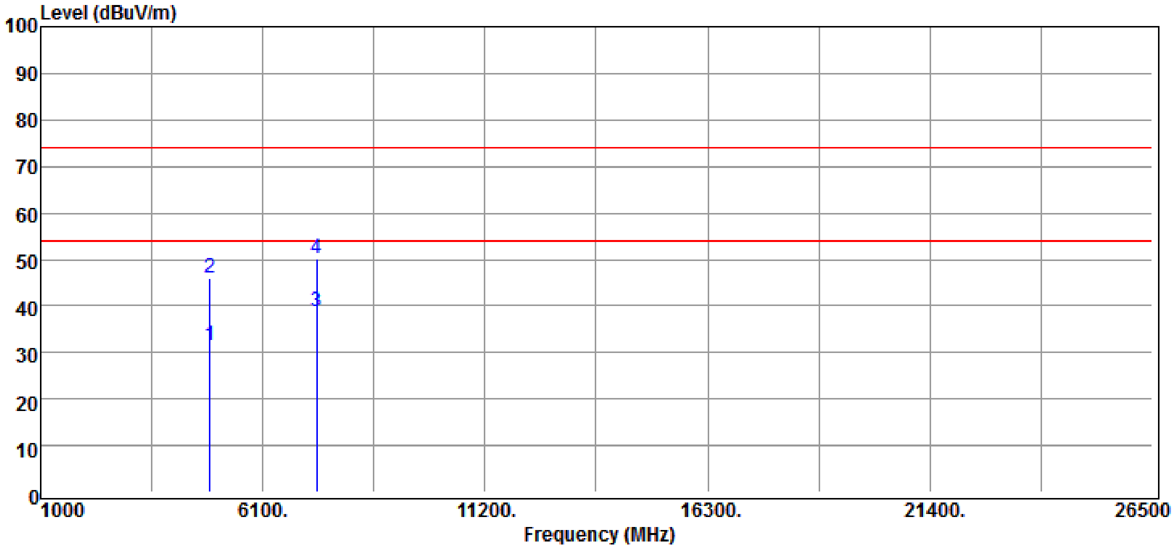
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4834.00	Average	19.24	12.42	31.66	54.00	-22.34
4834.00	Peak	33.01	12.42	45.43	74.00	-28.57
7251.00	Average	18.78	20.04	38.82	54.00	-15.18
7251.00	Peak	31.83	20.04	51.87	74.00	-22.13

Operation Mode	:2.4G	Test Date	:2018-10-05
Test Mode	:TX CH MID	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2443 MHz	Engineer	:Ashton



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
4886.00	Average	19.62	12.64	32.26	54.00	-21.74
4886.00	Peak	33.78	12.64	46.42	74.00	-27.58
7329.00	Average	18.64	20.08	38.72	54.00	-15.28
7329.00	Peak	29.49	20.08	49.57	74.00	-24.43

Operation Mode	:2.4G	Test Date	:2018-10-05
Test Mode	:TX CH MID	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2443 MHz	Engineer	:Ashton



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
4886.00	Average	18.82	12.64	31.46	54.00	-22.54
4886.00	Peak	33.32	12.64	45.96	74.00	-28.04
7329.00	Average	18.64	20.08	38.72	54.00	-15.28
7329.00	Peak	30.01	20.08	50.09	74.00	-23.91

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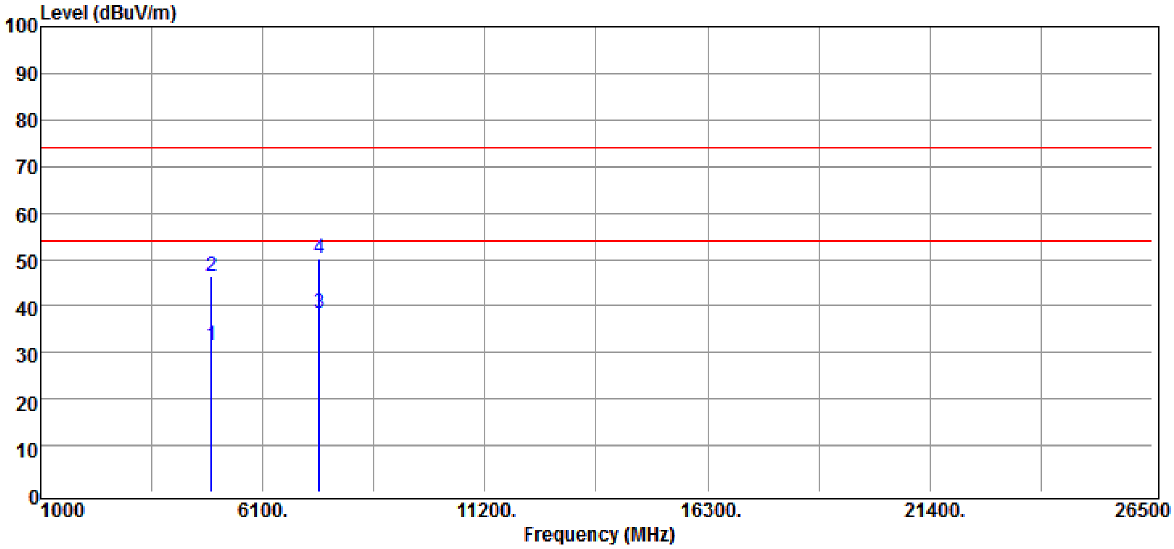
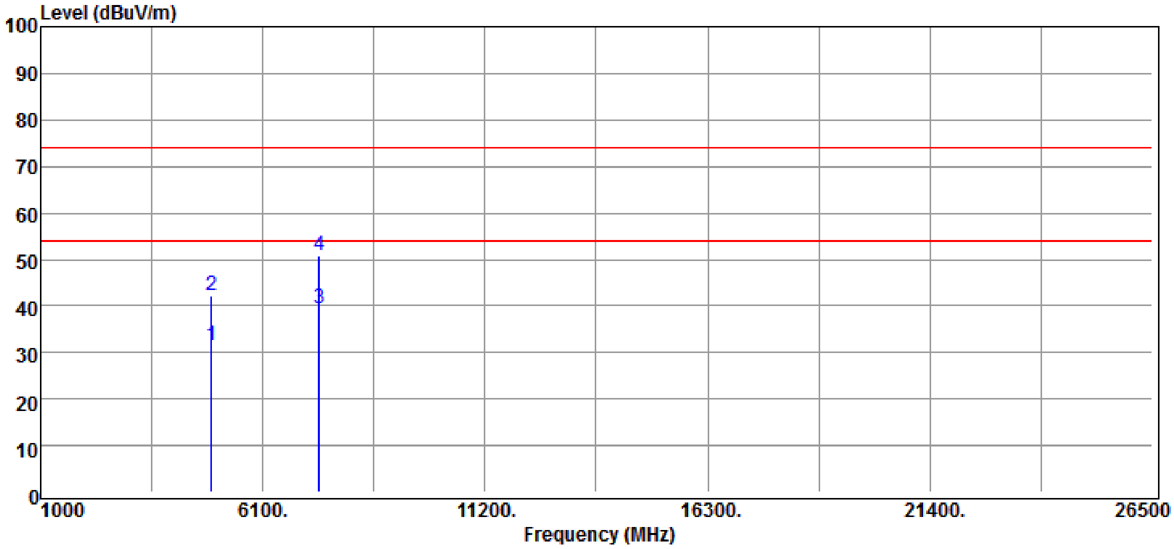
Operation Mode	:2.4G	Test Date	:2018-10-05
Test Mode	:TX CH HIGH	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2463 MHz	Engineer	:Ashton



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
4926.00	Average	18.77	12.81	31.58	54.00	-22.42
4926.00	Peak	33.69	12.81	46.50	74.00	-27.50
7389.00	Average	18.45	20.10	38.55	54.00	-15.45
7389.00	Peak	30.20	20.10	50.30	74.00	-23.70

Operation Mode	:2.4G	Test Date	:2018-10-05
Test Mode	:TX CH HIGH	Temp./Humi.	:24/60
EUT Pol	:E2 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2463 MHz	Engineer	:Ashton



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
4926.00	Average	18.64	12.81	31.45	54.00	-22.55
4926.00	Peak	29.41	12.81	42.22	74.00	-31.78
7389.00	Average	19.24	20.10	39.34	54.00	-14.66
7389.00	Peak	30.90	20.10	51.00	74.00	-23.00

11 POWER SPECTRAL DENSITY

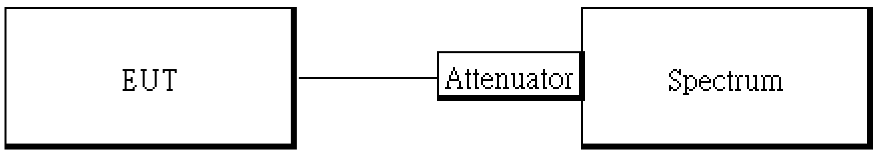
11.1 Standard Applicable:

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:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1326001	2018/08/09	2019/08/02
Power Sensor	Anritsu	MA2411B	1315048	2018/08/09	2019/08/02
Power Sensor	Anritsu	MA2411B	1315049	2018/08/09	2019/08/02
Splitter	Woken	DOM35LW1A2	RF36	2017/12/26	2018/12/25
Notebook	Lenovo	L420	S0011721	N/A	N/A
Spectrum Analyzer	Agilent	N9010A	MY53400256	2017/10/30	2018/10/29
DC Block	PASTERNACK	PE8210	RF81	2017/12/26	2018/12/25

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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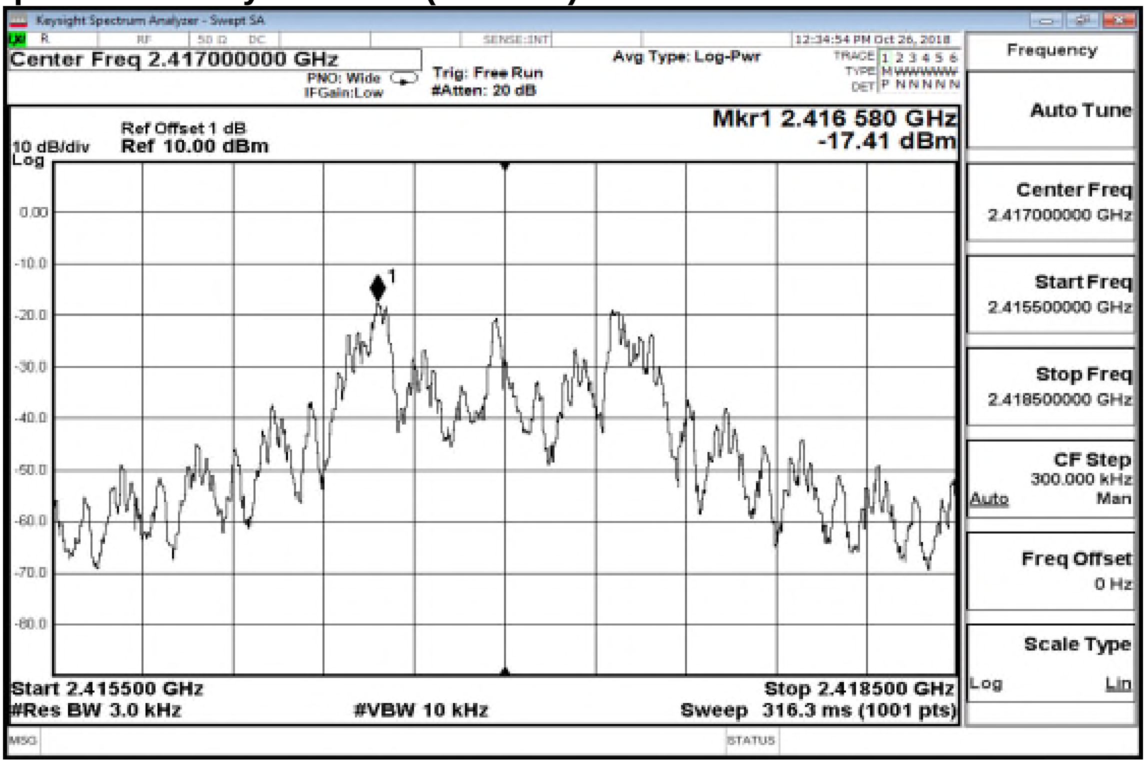
11.5 Measurement Result:

2.4G mode

Frequency (MHz)	RF Power Density (dBm)	Maximum Limit (dBm)	Result
2417	-17.41	8	PASS
2443	-18.18	8	PASS
2463	-19.48	8	PASS

NOTE: cable loss as 1dB that offsets in the spectrum

2.4GHz mode
Power Spectral Density Test Plot (CH-Low)



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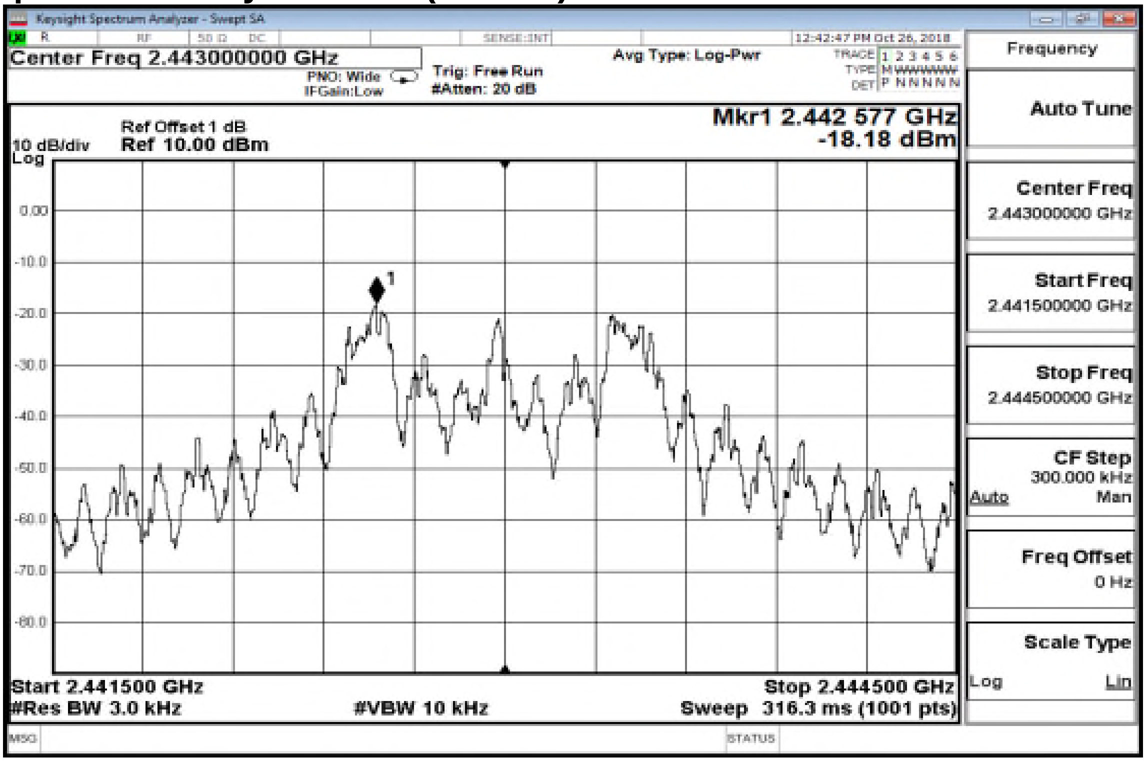
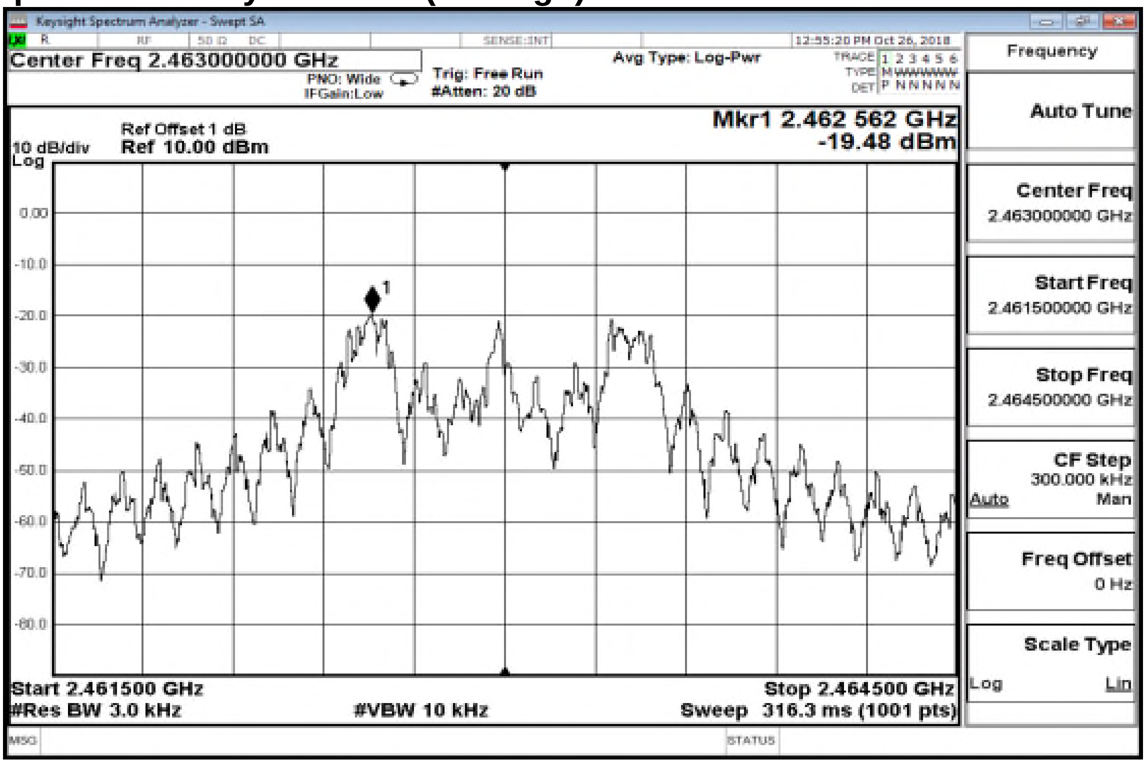
Power Spectral Density Test Plot (CH-Mid)



Power Spectral Density Test Plot (CH-High)



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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