EMI TEST REPORT

FCC Part 15 Subpart C (§15.247)
Operation within the bands 902-928 MHz, 2400-2483.5 MHz,
and 5725-5850 MHz

RSS-247 Issue 2
Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and
License-Exempt Local Area Network (LE-LAN) Devices

Prepared For:

SafeTrust, Inc.
8112 Mill Creek Rd
Fremont, CA. 94539

Product Name:
BLE Dongle

Model Name :
SL100

FCC ID : 2ANI5SL100
IC: 23133-SL100

Application Purpose :
Original

Prepared by:

EMCE Engineering, Inc.
1726 Ringwood Ave.
San Jose CA 95131 USA

Revision History

Rev.	Issue Date	Description
1	11/03/2017	Initial Issue

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1.0 GENERAL INFORMATION

Test Laboratory:	EMCE Engineering 1726 Ringwood Avenue. San Jose, CA USA Tel : 510-490-4307, Fax : 510-490-3441
	FCC registration number : 743299
	Test Site : FCC : US0125 IC : 3324A
Applicant Name :	SafeTrust, Inc. 8112 Mill Creek Rd Fremont, CA. 94539
	Contact Person: Jack Bubany
Application Purpose :	Original
EUT Description	BLE Dongle
Product Name	BLE Dongle
Model Name :	SL100
Applied Standards :	FCC 47 CFR §15.209, §15.247 IC RSS 247 Issue 2
FCC ID :	2ANI5SL100
IC :	23133-SL100
RF Operating Frequency (ies)	2402 – 2480 MHz
Modulation	GFSK
Emission Designator	2M47F1D
Receipt of EUT :	9/12/17
Date of Testing :	9/12/17 – 9/22/17
Date of Report :	10/09/2017

The tests listed in this report have been completed to demonstrated compliance to CFR 47 Section 15.247, and RSS 247 Issue 2.

Contents approved:

Name: Bob Cole
Title: President

2.0 EUT AND ACCESSORY INFORMATION

EUT	
FCC ID	2ANI5SL100
Product Name	BLE Dongle
Model name	SL100
Frequency Range	TX : 2402 – 2480 MHz RX : 2402 – 2480 MHz
Max. RF Output Power	Peak : -2.49 dBm (0.5636 mW)
Operating Mode	Bluetooth Low Energy (BLE)
Modulation Type	GFSK
Number of Channels	40 Channels
Manufacturer	SafeTrust, Inc.
Power Source	USB
Antenna Specification	Strip Antenna: Gain = -1.0 dB @ 2440 MHz

Support Equipment				
Description	*Model Number*	*Serial Number*	*Manufacturer*	*Power Cable Description*
NONE				

Cable Description				
From	*To*	*Length (Meters)*	*Shielded (Y/N)*	*Ferrite Loaded (Y/N)*
NONE				

3.0 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

15.207	N/A	AC Power Line Conducted Emissions	Antenna Conducted Measurements	N/A
15.247(a)(2)	5.2	6dB Bandwidth		Pass
15.247(6)(3)	5.4 (4)	Conducted Maximum Peak Output Power		Pass
15.247(e)	5.2	Power Spectral Density		Pass
15.247(d)	5.5	Conducted Bandedge (Out of Band Emissions)		Pass
N/A	RSS-GEN 4.6.1	99% Bandwidth		Pass
15.205, 15.209, 15.247	5.5	Radiated Spurious Emissions, Radiated Restricted Bandedge	Radiated Measurements	Pass
Test Document Guidance: ANSI C63.10: 2013 / FCC KDB 558074 D01 DTS Meas Guidance v04 dated 04/05/17 PS: All measurement uncertainties are not taken into consideration for all presented test result.				

PASS The EUT passed the test.
FAIL The EUT failed the test.
N/A Not Applicable – No IC Application

4.0 MODIFICATIONS

There were no modifications.

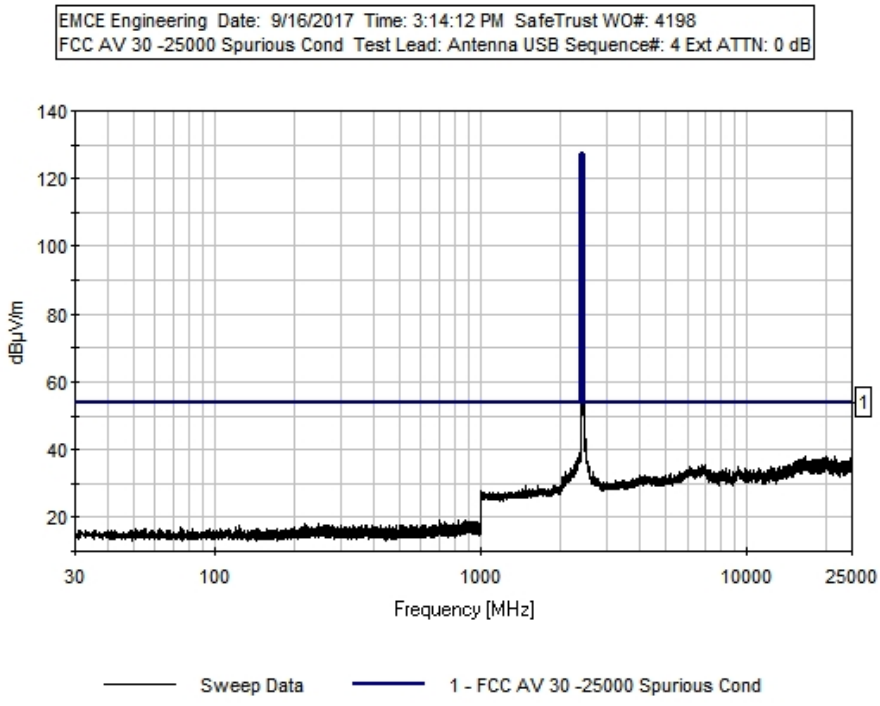
5.0 TEST RESULTS

5.1 CONDUCTED SPURIOUS EMISSIONS

15.247(d) 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

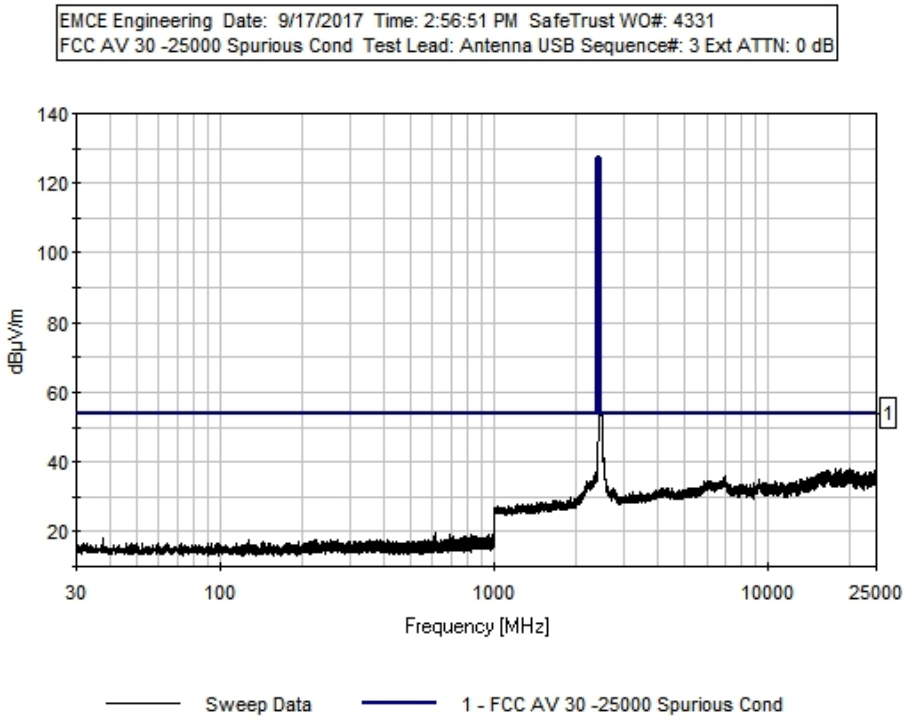
TEST RESULTS – 2402 MHz Xmit Frequency

#	Freq MHz	Rdng dBµV	dB	dB	dB	dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	2491.182M	42.9					+0.0	42.9	54.0	-11.1	Anten
2	2350.301M	39.2					+0.0	39.2	54.0	-14.8	Anten



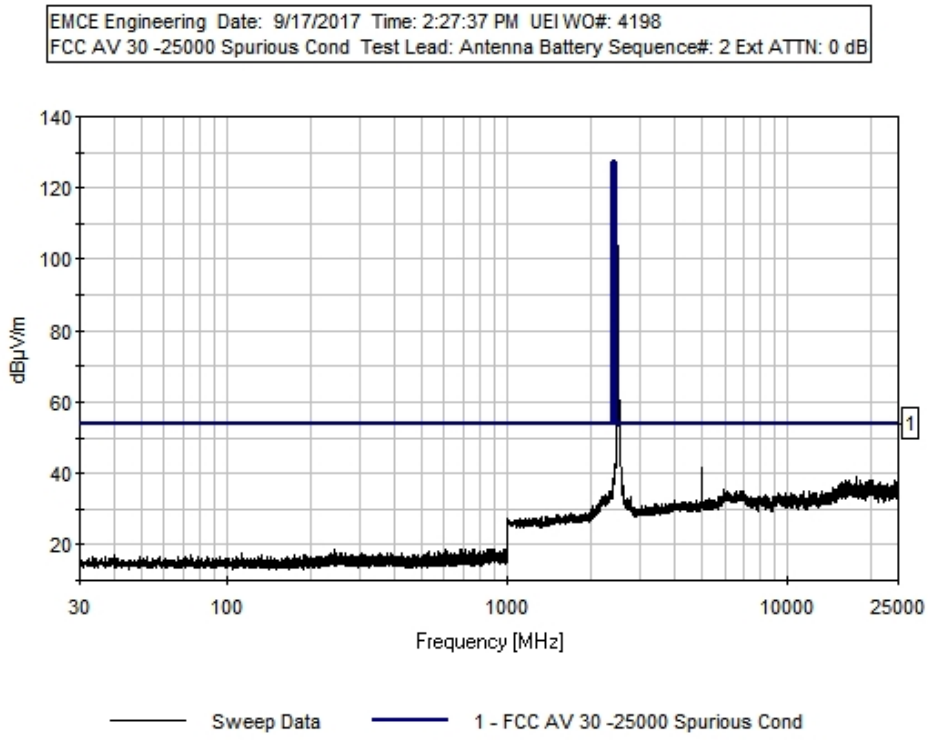
2440 MHz Xmit Frequency

#	Freq MHz	Rdng dBµV	dB	dB	dB	dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	2502.204M	47.7					+0.0	47.7	54.0	-6.3	Anten
2	2345.491M	37.2					+0.0	37.2	54.0	-16.8	Anten



2480 MHz Xmit Frequency

#	Freq MHz	Rdng dBµV	dB	dB	dB	dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	4980.164M	41.8					+0.0	41.8	54.0	-12.2	Anten
2	2480.220M	104.0					+0.0	104.0	127.0	-23.0	Anten



5.2 6 dB BANDWIDTH

LIMIT

§15.247(2)

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

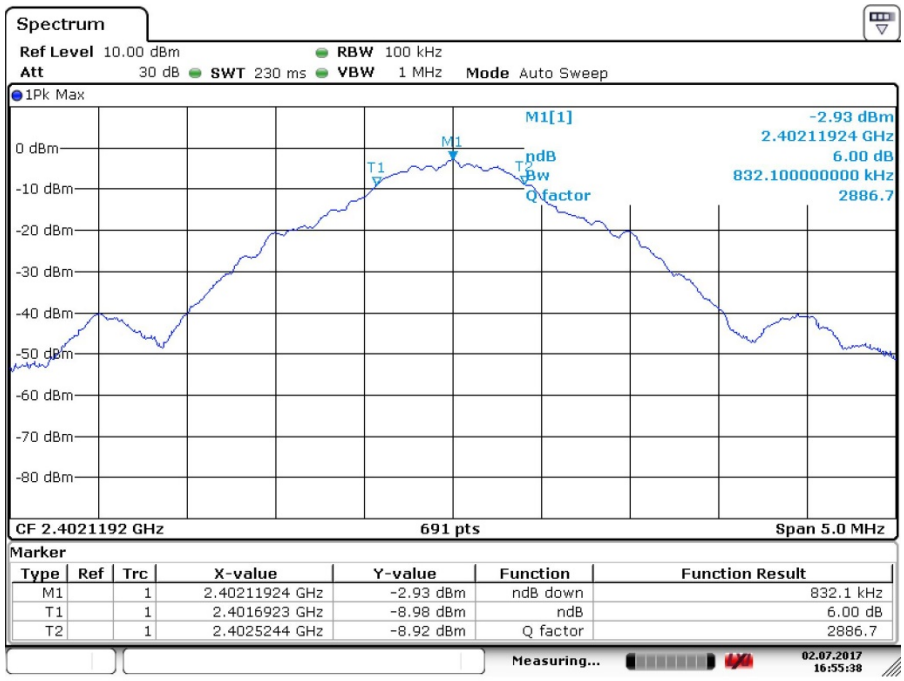
- The transmitter output is connected to the spectrum analyzer
- The RBW is set to 100KHz. The VBW is set to 100KHz. The sweep time is coupled.
- Signal Peak is detected
- Bandwidth is determined at the points 6 dB down from the peak value of the modulated carrier.

RESULTS

NO non-compliance noted.

Operating Frequency (MHz)	6dB Bandwidth (KHz)	Limit (KHz)	Result
2402	832.1	>500	PASS
2440	810.4	>500	PASS
2480	843.6	>500	PASS

2402 MHz



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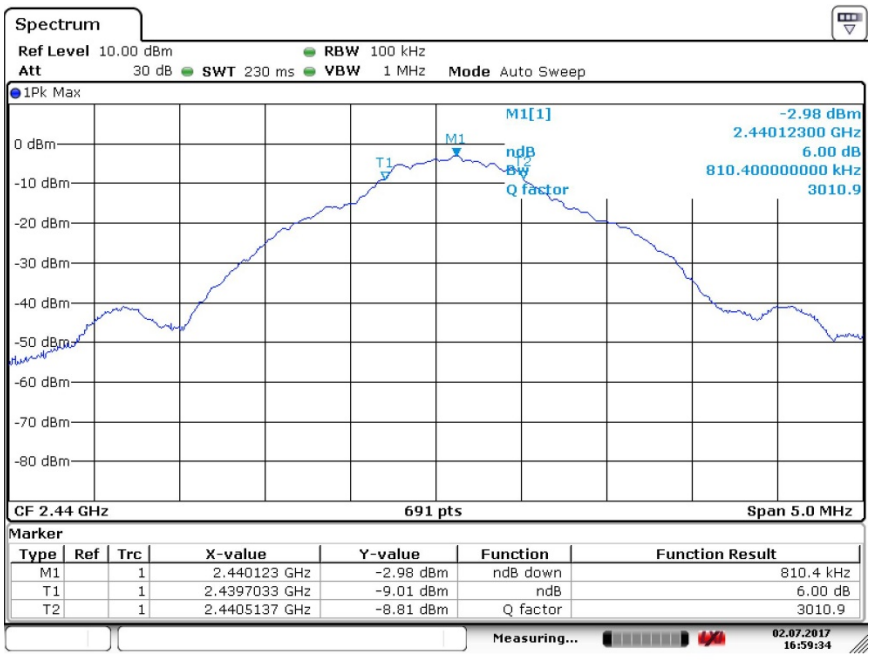
2440 MHz



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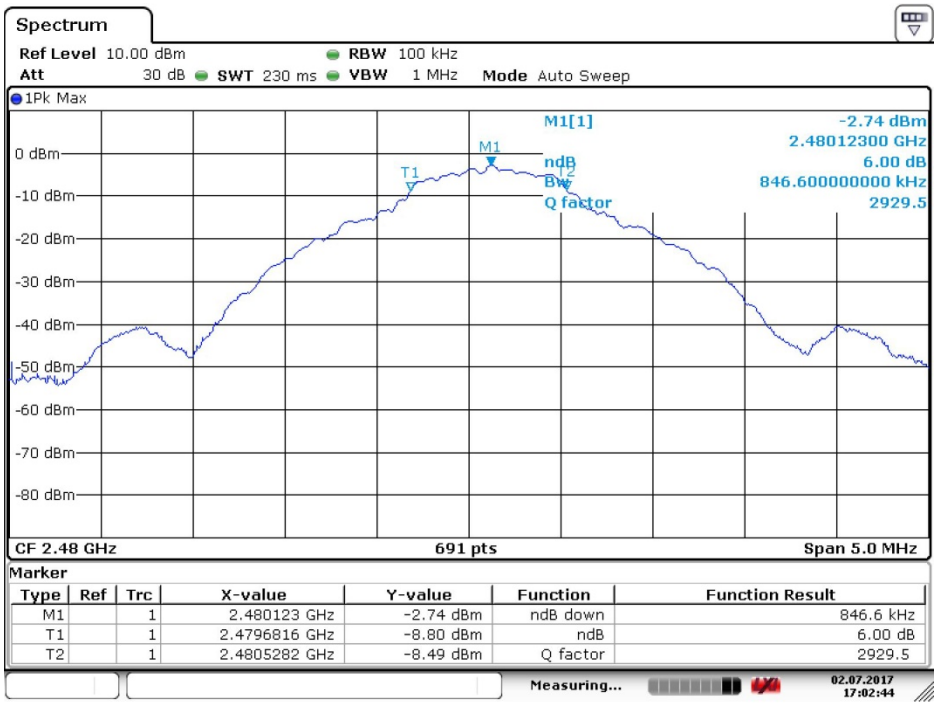
2480 MHz



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5.3 CONDUCTED MAXIMUM PEAK OUTPUT POWER

LIMIT

§15.247(d)

1 Watt / 30dBm

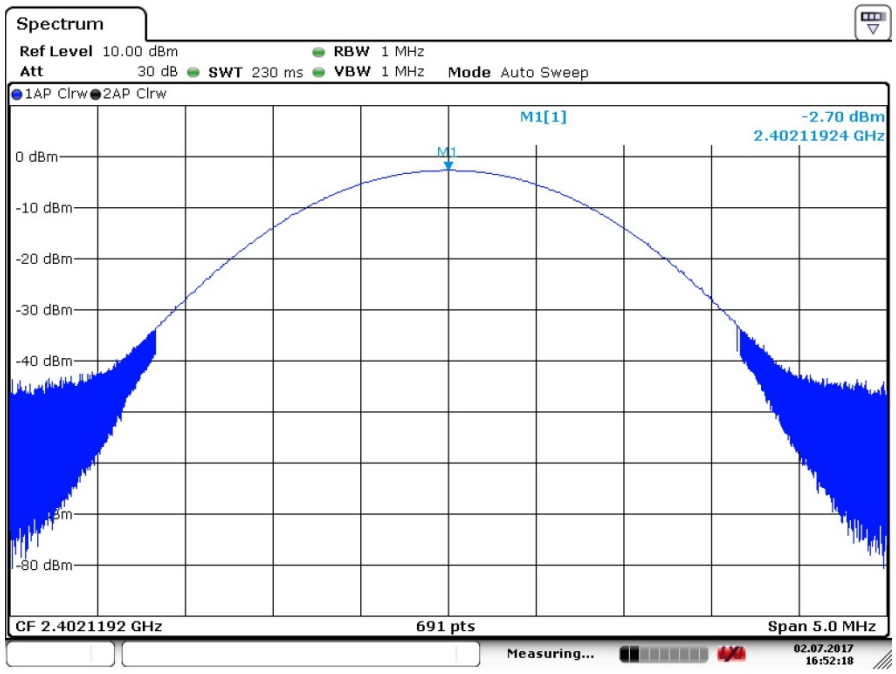
TEST PROCEDURE

The transmitter output to the antenna is connected to a spectrum analyzer. The RBW / VBW is set to 1. The sweep time is coupled and the span is set to 5 MHz.

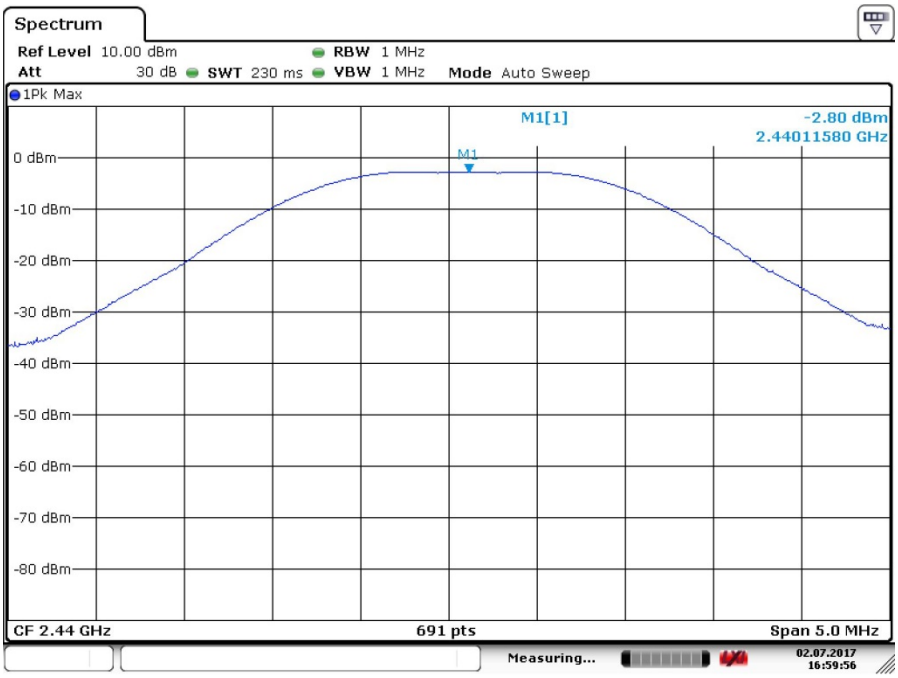
Peak Output Power

Frequency (MHz)	Peak Output Power(dBm)	Limit (dBm)	Results
2402	-2.7	20	PASS
2442	-2.8	20	PASS
2480	-2.49	20	PASS

2402 MHz



2442 MHz



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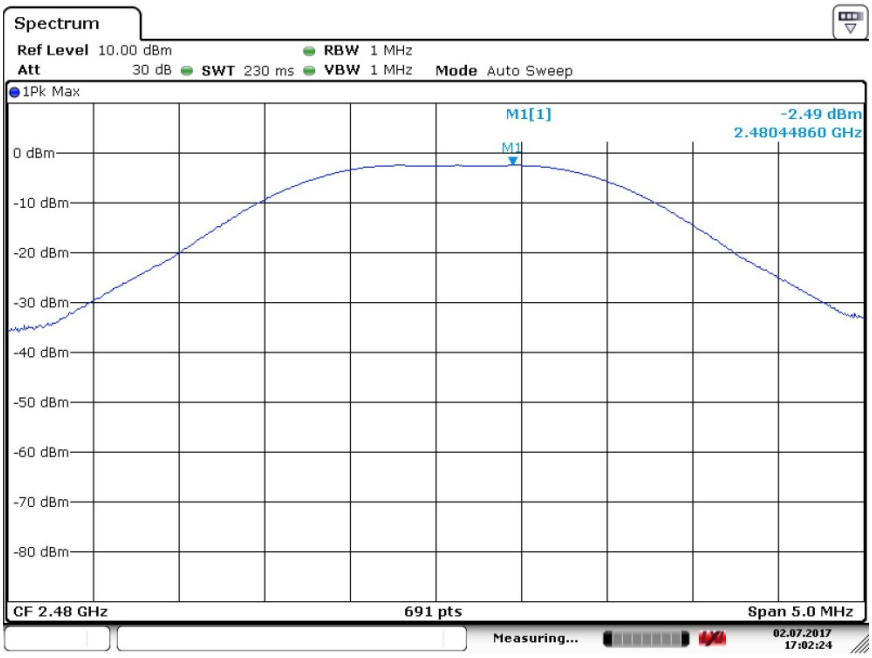
2480 MHz



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5.4 POWER SPECTRAL DENSITY

LIMIT

§15.247 (e)

8 dBm

TEST PROCEDURE

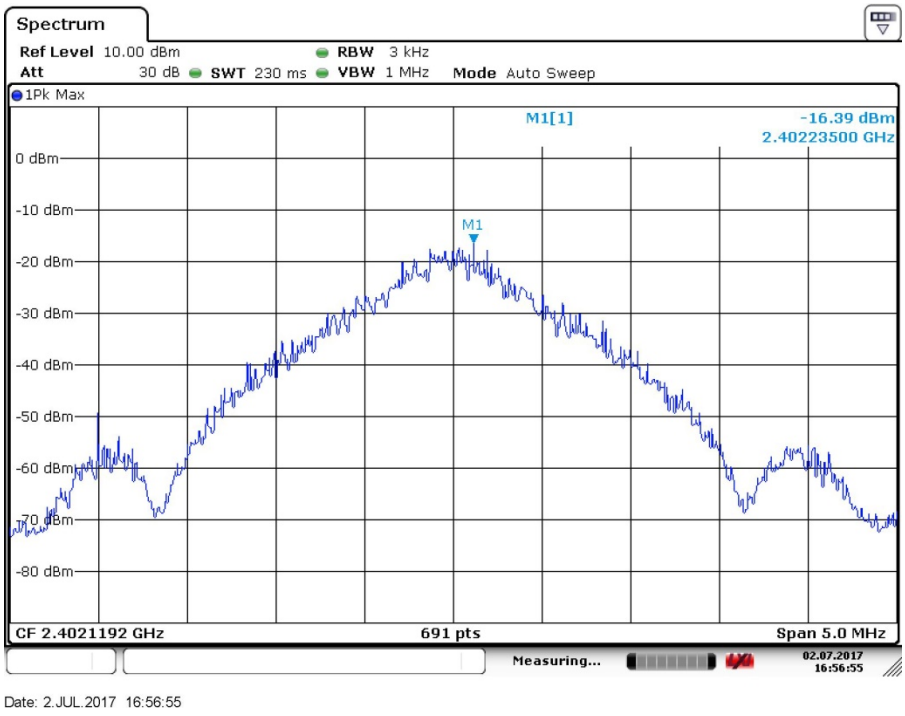
The transmitter antenna output is connected to a spectrum analyzer. The RBW is set to 3 KHz and the VBW is set to >3 * RBW .

RESULTS

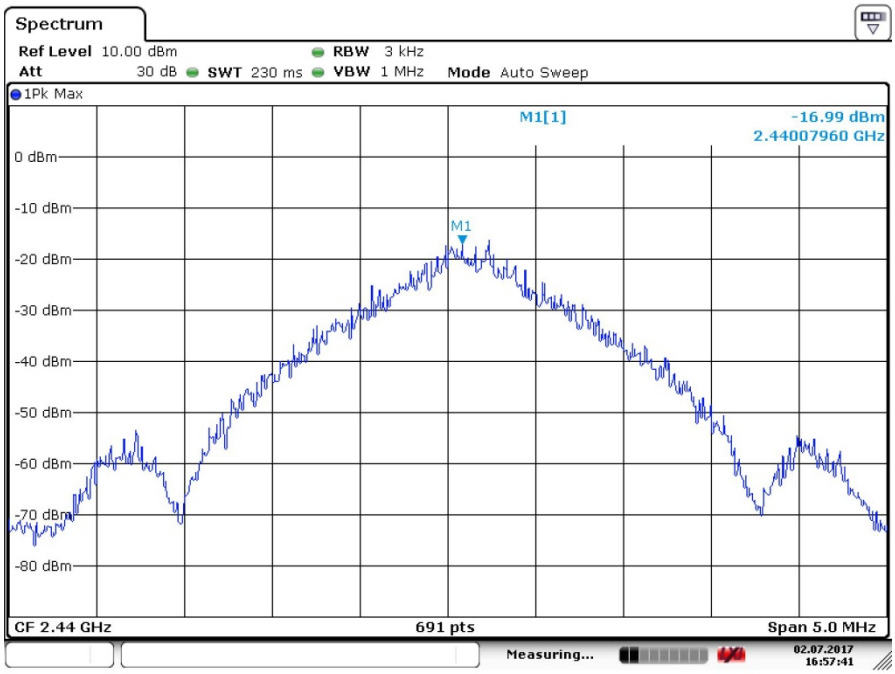
NO non-compliance noted.

Frequency (MHz)	PSD (dBm)	Limit (dBm)	Result
2402	-16.39	8.0	PASS
2442	-16.99	8.0	PASS
2480	-17.01	8.0	PASS

2402 MHz



2440 MHz



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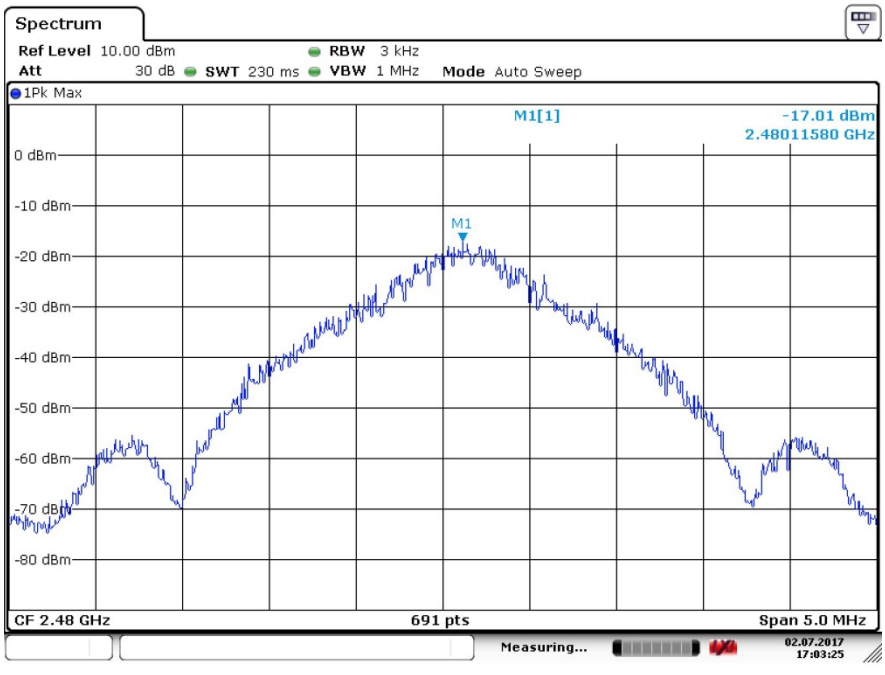
2480 MHz



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5.5 CONDUCTED BANDEDGE

LIMIT

15.247(d) 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

TEST PROCEDURE

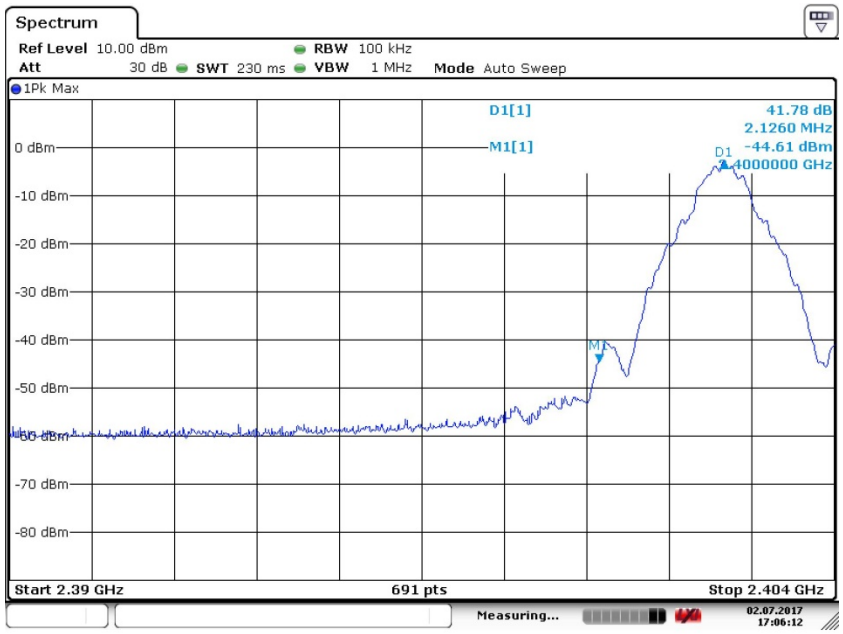
Transmitter antenna output connected to spectrum analyzer. Analyzer span is set to show Peak in band, as well as out of band peaks.

RESULTS

NO non-compliance noted.

Frequency (MHz)	PSD (dBm)	Limit [Delta] (dBm)	Result
2402	41.39	>20.0	PASS
2483.5	51.29	?20.0	PASS

2400 MHz Bandedge



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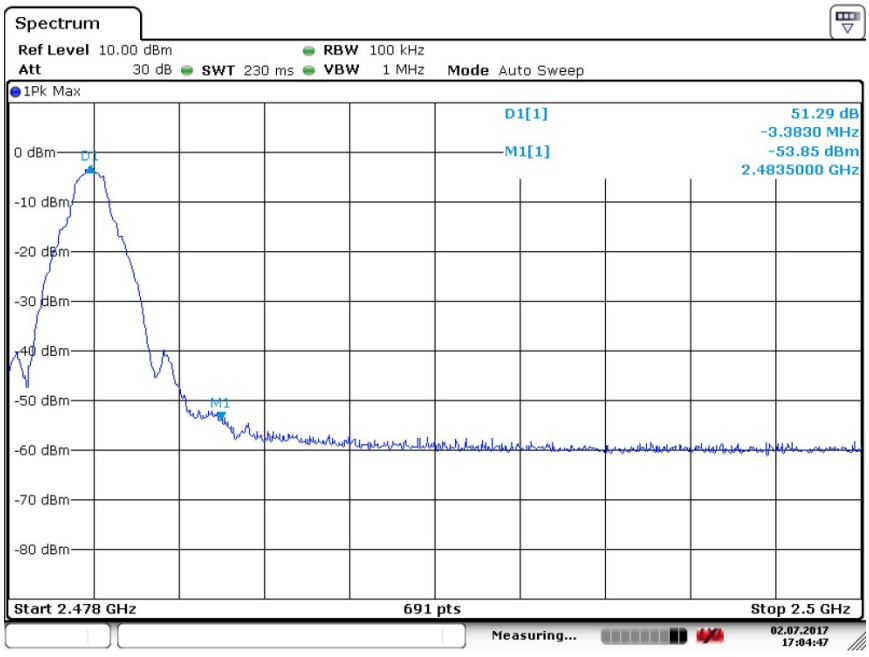
2483.5 MHz Bandedge



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5.6 RADIATED SPURIOUS EMISSIONS – BANDEDGE

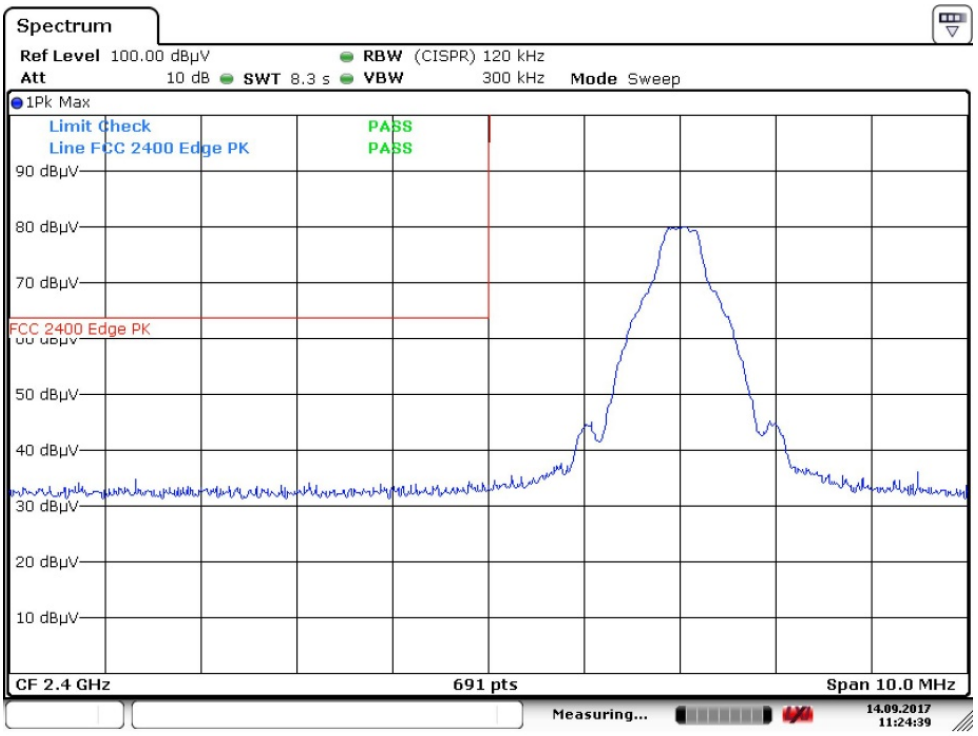
15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 db. Attenuation below the general limits specified in §15.209(a) is not required. **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) (see §15.205(c)).**

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	**2310-2390**	15.35-16.2
8.362-8.366	156.52475-156.52525	**2483.5-2500**	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

RESULTS

Bandedge Frequency(MHz)	Measured(dBc)	Limit (dBc)	Result
2402 PEAK	**>20**	**>20**	**Pass**
2480 PEAK	**>20**	**>20**	**Pass**
2483.5 AVE	**>20**	**>20**	**Pass**
2483.5 AVE	**>20**	**>20**	**Pass**

2402 MHz – Peak Measurement



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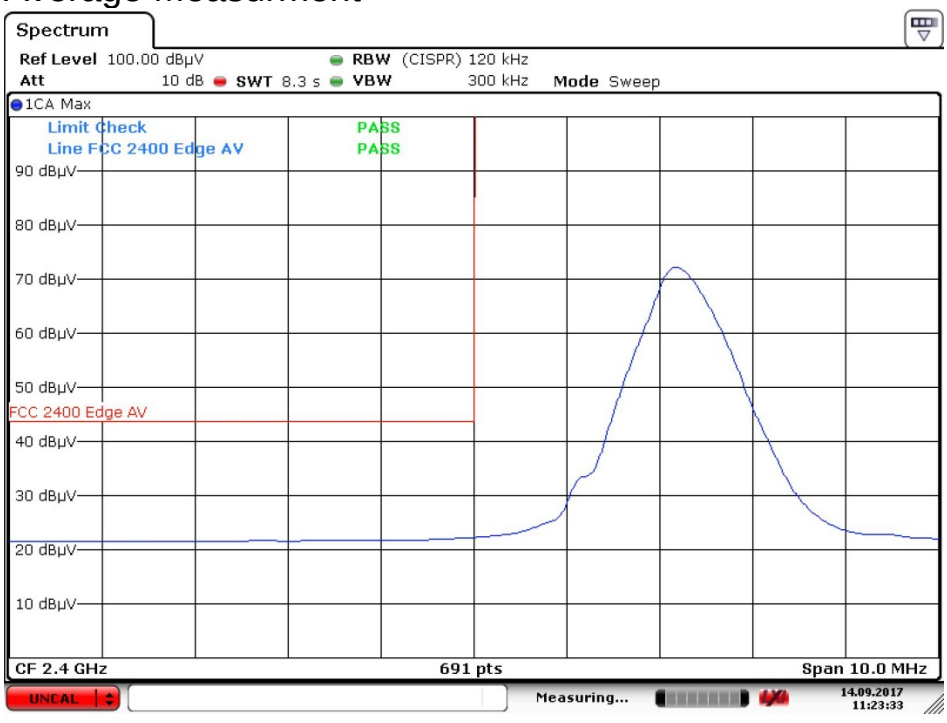
2402 MHz – Average Measurment



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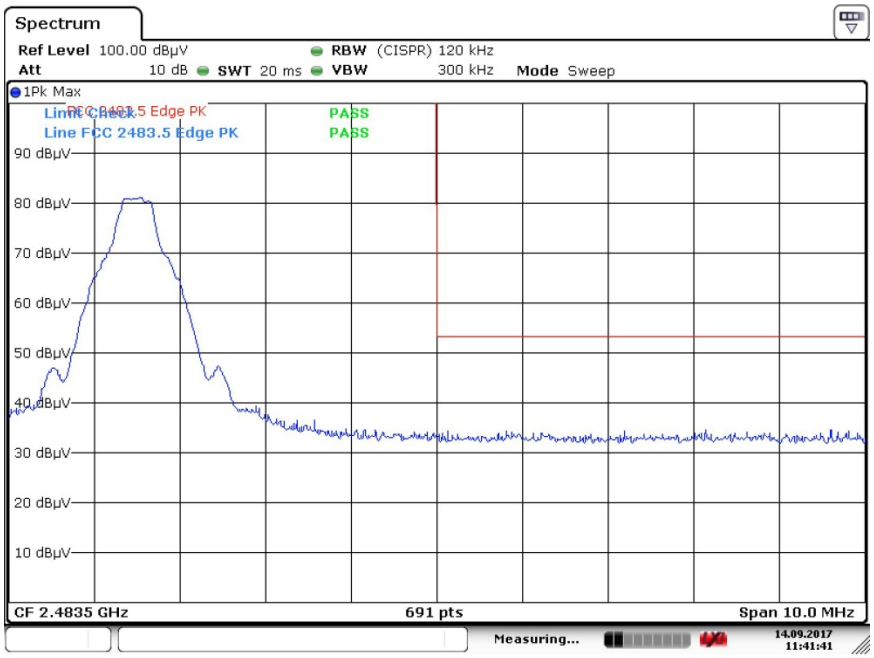
2483.5 MHz – Peak Measurement



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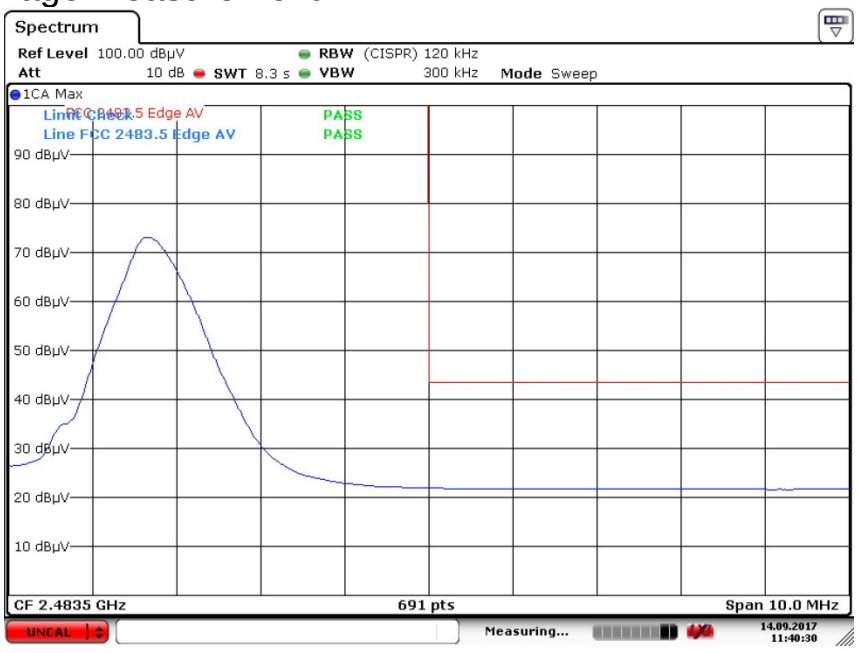
2483.5 MHz – Average Measurement



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5.7 TRANSMITTER RADIATED SPURIOUS EMISSIONS

LIMITS

§15.247 (d) 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 db. Attenuation below the general limits specified in §15.209(a) is not required. 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) (see §15.205(c)).

§15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.
(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

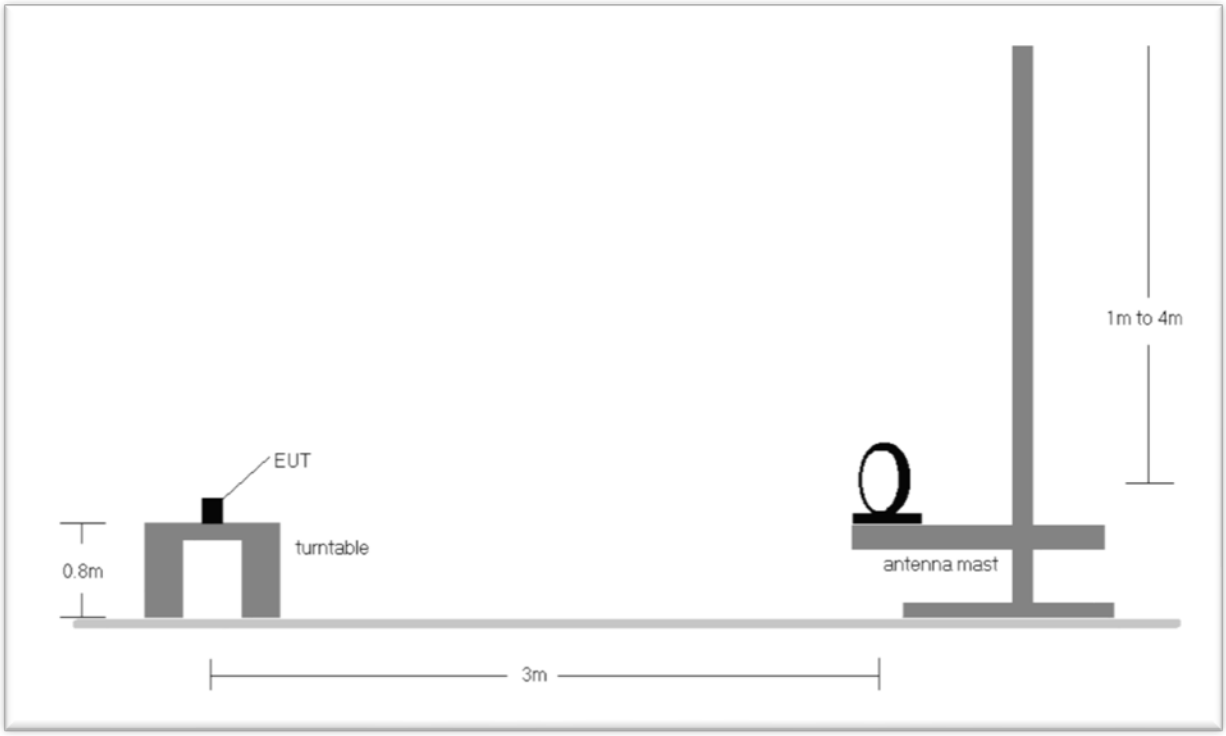
§15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table ;

Frequency (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
Above 960	500	54.0

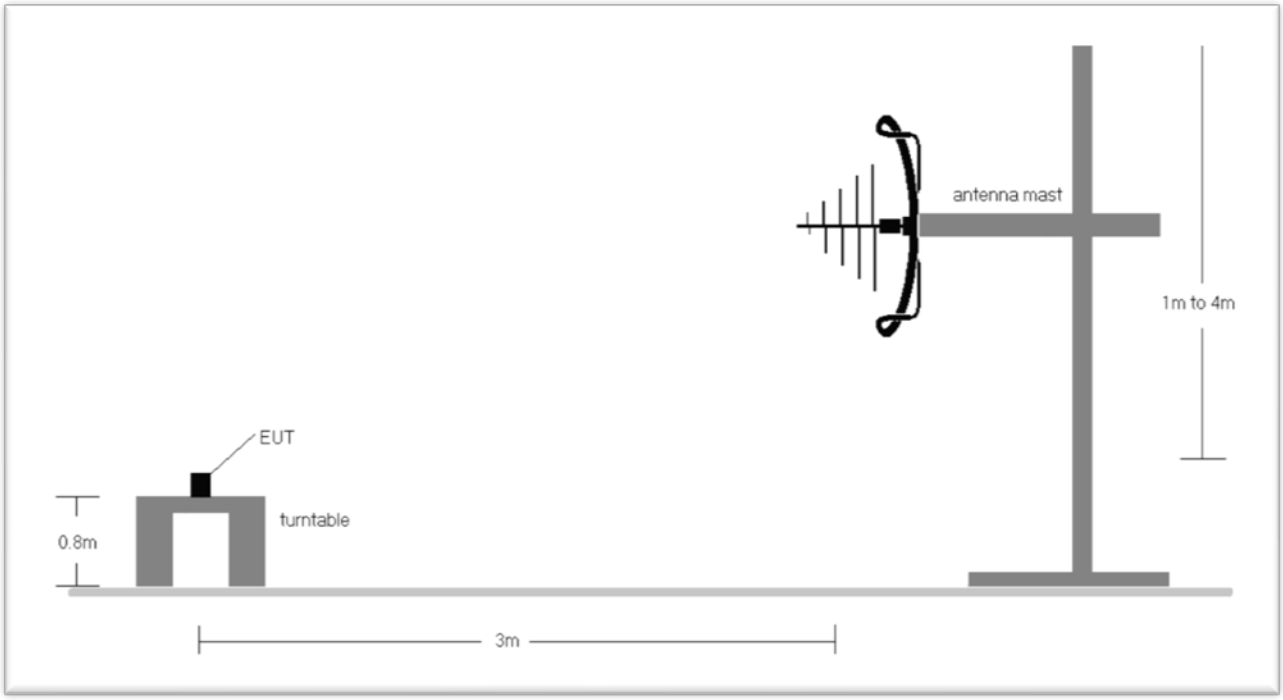
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz However, operation within these frequency bands is permitted under other sections of this part, e.g., Sections 15.231 and 15.241

Test Configuration

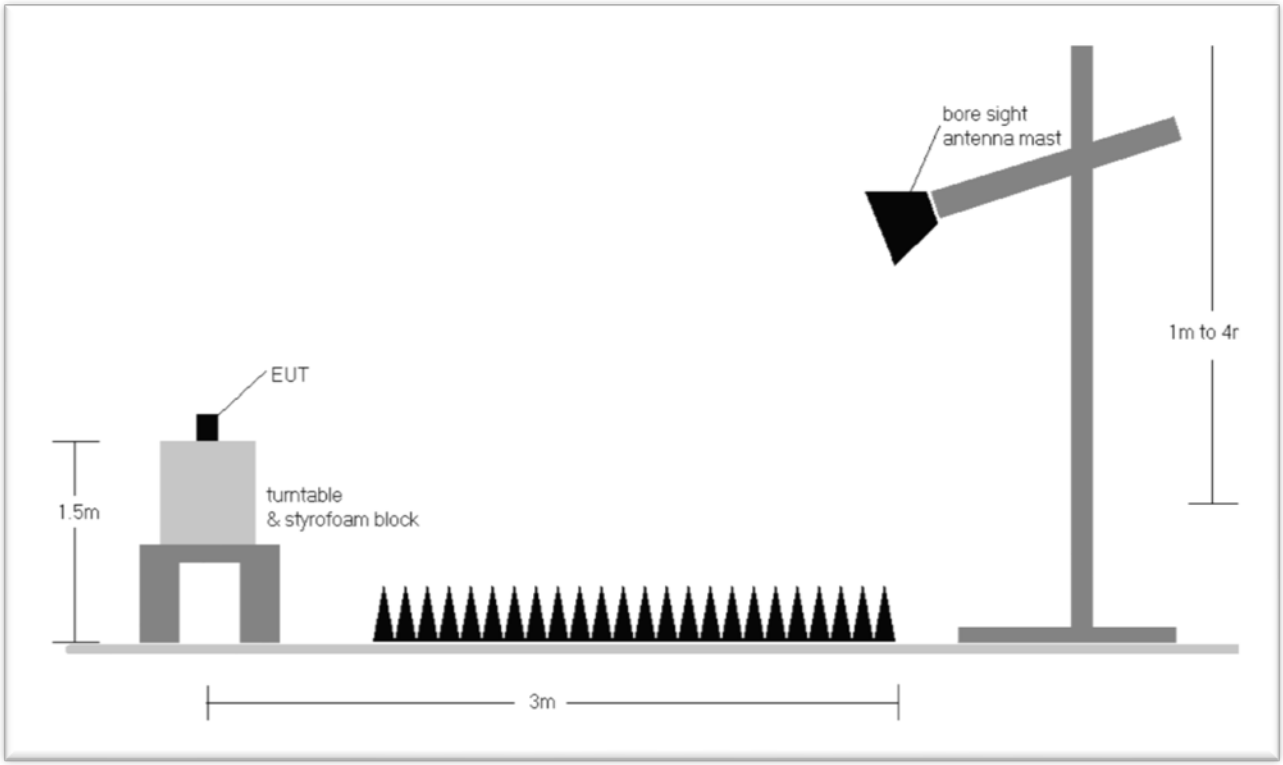
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



TEST PROCEDURE

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. Each emission is to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. Spectrum Setting
    a. Peak Setting **1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 MHz**
    b. AV Setting **1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 kHz ≥ 1/τ Hz, where τ = pulse width in seconds.**

RESULTS:

NO non-compliance noted.

Note

1. The antenna is manipulated through typical positions, polarity and length during the testing
2. The frequency range was scanned from 30 MHz to 1 GHz and the worst-case emissions are reported.
3. There is detected level above reference noise floor spectrum analyzer.

FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor.
The basic equation with a sample calculation is as follows:

FS = RA + AF + CF

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

Assume a receiver reading of 21.5 dBuV is obtained. The Antenna Factor of 7.4 dB/m and a Cable Factor of 1.1 dB is added. The 30 dBuV/m value is mathematically converted to its corresponding level in uV/m.

FS = 21.5 + 7.4 + 1.1 = 30 dBuV/m

MEASUREMENT UNCERTAINTY

Measurement Uncertainty Budget
Radiated Emissions @ 10 Meters
Per CISRP 16-4-2

Input Quantity	Uncertainty of x_i		U(x) dB	C_i	C_i u (x_i) dB
	dB	Probability Distribution Function			
Receiver Reading	+/- 0.1	K = 1	0.1	1	0.1
Attenuation, Antenna - receiver	+/- 0.1	K = 2	0.05	1	0.05
Antenna Factor	+/- 2.0	K = 2	1.0	1	1.0
Receiver Corrections					
Sine Wave Voltage	+/- 1.0	K = 1	0.5	1	0.5
Pulse Amplitude Response	+/- 1.5	Rectangular	0.87	1	0.87
Pulse Rep Rate Response	+/- 1.5	Rectangular	0.87	1	0.87
Noise Floor Proximity	+/- 0.5	K = 2	0.25	1	0.25
Mismatch Antenna – Receiver	+/- 0.9	U shaped	0.67	1	0.67
Antenna Corrections					
AF Freq Interpolation	+/- 0.3	Rectangular	0.17	1	0.17
AF Height Deviations	+/- 0.5	Rectangular	0.29	1	0.29
Balance	+/- 0.3	Rectangular	0.17	1	0.17
Site Corrections					
Site Imperfections	+/- 3.0	Rectangular	1.22	1	0.82
Separation distance	+/- 0.1	Rectangular	0.06	1	0.06
Table Height	+/- 0.1	K = 2	0.05	1	0.05
Total Measurement Uncertainty - Radiated Emissions @ 10 Meters $2U_c(E) = 4.89$					4.89

Transmit Frequencies 2402 / 2440 / 2480 MHz were examined and maximized. Worst case data is presented:

9 kHz – 30MHz

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
No Signals Detected Within 10 dB of Limit											

Notes:
1. Measuring frequencies from 9 kHz to the 30MHz.
2. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
3. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
4. Limit line = specific Limits (dBuV) + Distance extrapolation factor
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

30MHz - 1 GHz

Operation Mode: Normal Mode

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	573.325M QP	38.7	+0.5	+27.0	+18.5		-10.0 298	20.7	37.0	-16.3	Vert 146
2	373.382M QP	39.9	+0.3	+26.9	+14.9		-10.0 81	18.2	37.0	-18.8	Vert 128
3	53.382M QP	39.6	+0.1	+26.8	+7.9		-10.0 172	10.8	30.0	-19.2	Horiz 120
4	196.897M QP	33.1	+0.1	+26.9	+12.2		-10.0 180	8.5	30.0	-21.5	Horiz 125

Notes:
1. Measuring frequencies from 30 MHz to the 1 GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

1 – 18 GHz

#	Freq MHz	Rdng dBµV	T1 dB	-T2 dB	dB	dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	7440.402M	33.8	+36.9	+30.9			+0.0 225	39.8	54.0	-14.2	Horiz 190
2	1009.671M	40.6	+27.5	+29.3			+0.0 311	38.8	54.0	-15.2	Horiz 154
3	2399.223M	44.4	+29.2	+30.1			+0.0 188	43.5	74.0	-30.5	Horiz 175
4	2512.954M	43.2	+29.3	+30.2			+0.0 156	42.3	74.0	-31.7	Horiz 277
5	5182.365M	37.6	+35.1	+30.4			+0.0 74	42.3	74.0	-31.7	Horiz 208
6	1801.603M	43.6	+28.3	+29.8			+0.0 109	42.1	74.0	-31.9	Horiz 275

18 - 26 GHz

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
No Signals Detected Within 10 dB of Limit											

Notes:

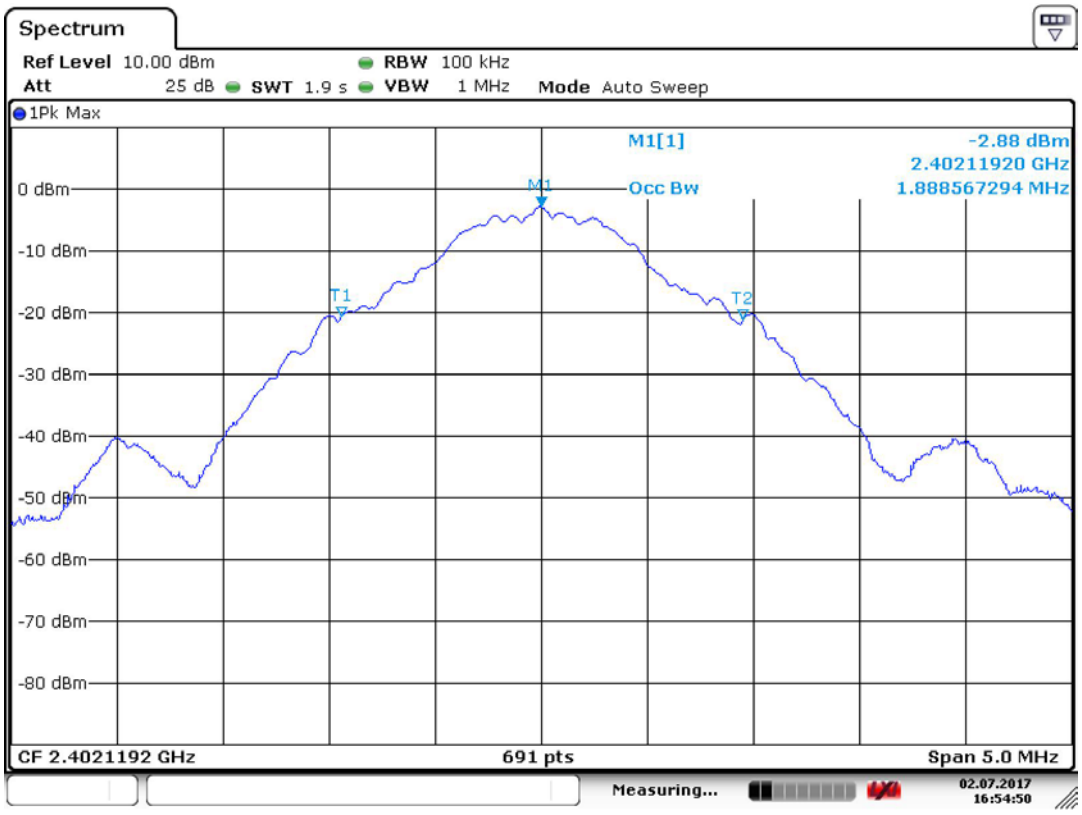
1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain
5. Worst case data is the lowest data of each mode.
6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

5.7 99% BANDWIDTH

LIMITS

None – For information purposes only

Frequency (MHz)	99% BW (MHz)	Limit (MHz)	Result
2440	1.888	N/A	PASS



Date: 2.JUL.2017 16:54:51

6.0 TEST EQUIPMENT

Equipment	Serial Number	Last Calibration Date	Calibration Due Date
Omega-IBTHXBP	14490199	7/8/2016	7/8/2018
Schaffner-NSG435	5892	7/8/2016	7/8/2018
Fluke-87	64920001	6/28/2016	6/28/2018
Sunol Sciences-JB1	A061416	6/12/2017	6/12/2018
EMCO-3816-2	9809-1089	8/12/2016	8/12/2018
Sunol Sciences-JB6	101424	6/20/2016	6/20/2018
Sunol Sciences-JB6	A042610	6/12/2017	6/12/2018
A. H. Systems-SAS- 571	236	6/13/2016	6/13/2018
Com-Power-C50E	561034	2/22/2016	2/22/2018
Com-Power-M225E	511107	2/22/2016	2/22/2018
Com-Power-T8SE	511402	2/22/2016	2/22/2018