TEST REPORT

1. Applicant
   - Name : Key Digital Systems Inc.
   - Brand Name : N/A
   - Address : 521 East 3rd Street, Mount vernon, NY10553, USA
   - FCC ID : 2ACQY-KD-ZRC300
2. Products
   - Name : Zigbee Remote Control
   - Model No. : KD-ZRC300
   - Variant Model No. : N/A
   - Manufacturer : Seoby Electronics Co., Ltd.
   - Address : 38-2, Anyang2-Dong, Manan-Gu, Anyang City, Kyungki-Do, Korea
3. Test Standard : FCC CFR 47 Part 15.247 Subpart C
4. Test Method : ANSI C63.10-2009
5. Test Result : PASS
6. Dates of Test : July 07, 2014 to July 09, 2014
7. Date of Issue : July 16, 2014
8. Test Laboratory : Korea Standard Quality Laboratories
   FCC Designation Number : 100384

Tested by	Approved by
KwangMin, Lee	SuWook, Chae
Test Engineer:	Compliance Engineer:

Korea Standard Quality Laboratories
Testing Laboratories for EMC and Safety Compliance
www.ksqlab.com
#102, Jangduk-Dong, Hwasung-City, Kyunggi-Do, KOREA

Revision History

Rev.	Issue Date	Revisions	Revised By
-	2014.07.16	Initial Issue	K.M. Lee
R1	2014.07.29	Add as a test equipment calibration interval.	K.M. Lee

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1. Test Summary

Test	Test Requirement	Result
Antenna Requirement	FCC PART 15 C section 15.247 (c) and Section 15.203	PASS
6 dB Bandwidth	FCC PART 15 C section 15.247 (a)(2)	PASS
Maximum peak power	FCC PART 15 C section 15.247(b)	PASS
Power spectral density	FCC PART 15 C section 15.247(e)	PASS
Conducted spurious emissions & Band edge	FCC PART 15 C section 15.247(d)	PASS
Radiated Spurious Emission & Band edge	FCC PART 15 C section 15.209(a)	PASS
AC Power Line Conducted Emissions	FCC PART 15 C section 15.207	N/A

2. General Information

2.1 Client Information

Applicant	:	Key Digital Systems Inc.
Address of Applicant	:	521 East 3rd Street, Mount vernon, NY10553, USA

2.2 General Description of E.U.T.

Product Name	:	Zigbee Remote Control
Model No.	:	KD-ZRC300

2.3 Details of E.U.T.

Operating Frequency	:	2 405 MHz to 2 480 MHz
Type of Modulation	:	QPSK
Number of Channels	:	16 Channels
Channel Separation	:	5 MHz
Antenna Type	:	Wire Dipole Antenna
Antenna gain	:	-3.77 dBi
Normal Test Voltage	:	DC 3.0 V (AA Alkaline batteries 2 EA)

3. Test Location

#102, Jangduk Dong, Hwasung City, Kyunggi Do, South Korea
(FCC Designation Number : 100384)

This test site is in compliance with ISO/IEC 17025 for general requirements for the competence of testing and calibration laboratories.

4. Equipment Used during Test

No.	Test Equipment	Manufacturer	Model No.	Serial No.	Calibration interval	Next Cal. Data	Used equipment
1	EMI Test Receiver	LIG Nex1	LSA-265	L07098033	1 Year	2014.12.19	■
2	Bi-log Antenna	Schwarzbeck	VULB9160	3311	2 Year	2015.11.21	■
3	Loop ANT.	Com-Power	AL-130	121010	2 Year	2015.04.25	■
4	Spectrum Analyzer	Agilent	E4440A	MY45304715	1 Year	2015.02.13	■
5	Function Generator	Agilent	33120A	US36026465	1 Year	2015.04.29	□
6	Frequency Counter	HP	5350B	3049A05530	1 Year	2015.06.02	□
7	Modulation Analyzer	Agilent	8901B	3438A05099	1 Year	2015.06.02	□
8	Audio Analyaer	Agilent	8903B	3729A18576	1 Year	2015.06.02	□
9	Attenuator	Agilent	8494B	MY41110204	1 Year	2015.06.01	□
10	Attenuator	Agilent	8496B	US40152183	1 Year	2015.06.01	□
11	Attenuator	Agilent	8495B	3308A17660	1 Year	2015.06.01	□
12	Attenuator	TAE SUNG	SMA-2	N/A	1 Year	2015.06.01	□
13	Power Meter	Agilent	E4418B	GB43312894	1 Year	2015.06.01	□
14	Power Sensor	HP	8485A	3316A14708	1 Year	2015.06.27	□
15	Vibration Tester	Gana	GNV-400	C114	1 Year	2015.06.19	□
16	Temp & Humidity Chamber	Seoksan Tech	SE-CT-02	S7400JD5340618	1 Year	2015.06.02	□
17	Signal Generator	Leader Electronics	3220	0137231	1 Year	2015.06.01	■
18	SYNTHESIZED SWEEPER	HP	8340B	2804A00830	1 Year	2015.05.07	■
19	Drop Tester	Self-made	KSQ-01	N/A	N/A	N/A	□
20	Pre Amplifier	GTC	GA-1825A	GT0929/003	1 Year	2015.06.01	■
21	Continuous operation tester	GTC	CT-100	GT0929/001	N/A	N/A	□
22	CW Generator	HP	83711B	US34490158	1 Year	2015.06.01	■
23	POWER DIVIDER	Agilent	11636B	54381	1 Year	2015.06.19	□
24	Power Sensor	Agilent	8482B	N/A	1 Year	2015.06.29	□
25	Attenuator	Winswell	53-30-33	N/A	1 Year	2015.04.17	□
26	Termination	Kwang Yeok	KYTE-NJ-150W	2040004	1 Year	2015.06.01	□
27	Horn ANT.	SCHWARZBECK	BBHA 9120D	831	2 Year	2015.11.28	■
28	Horn ANT.	A.H. SYSTEMS	SAS-572	100284	2 Year	2015.09.07	■
29	DC Power Supply	ALINCO	DM-340MW	F001015	1 Year	2015.06.02	■
30	LISN	ROHDE & SCHWARZ	ENV216	101732	1 Year	2015.03.13	□
31	LISN	Kyoritsu	KNW-407	8-1010-14	1 Year	2015.06.09	□

5. Measurement conditions

5.1 Choice of Equipment for Test Suits

5.1.1 Choice of Operating Frequencies

- The SIZM operates on a total of 16 channels, from channel 11 to channel 26.
- In accordance with ANSI C63.4-2009, section 13.2.1, the choice of operating frequencies selected for the testing detailed in this report was based on the lowest, middle and highest operating frequencies. The frequencies selected were 2405 MHz (Channel 11), 2445 MHz (Channel 19) and 2480 MHz (Channel 26).

5.1.2 Channel Table

Channel	Frequency	Channel	Frequency
11	2 405 MHz	19	2 445 MHz
12	2 410 MHz	20	2 450 MHz
13	2 415 MHz	21	2 455 MHz
14	2 420 MHz	22	2 560 MHz
15	2 425 MHz	23	2 465 MHz
16	2 430 MHz	24	2 470 MHz
17	2 435 MHz	25	2 475 MHz
18	2 440 MHz	26	2 480 MHz

5.2 Description of test modes

- The EUT had been tested under the operating condition.
- There are three channels have been tested as following:
- Channel Low and Channel High with higher data rate were chosen for full testing.

Channel	Frequency (MHz)
Lowest	2 405
Middle	2 440
Highest	2 480

5.3 Setup of equipmet under test

5.3.1 Description of support units

- The EUT has beel tested as an independent unit along with the following necessary accessories or support units, which are adopted to form a representative test configuration.

No.	Equipment	Manufacturer	Model
1	Notebook	ASUS	X501A

6. Test data

6.1 Antenna Requirement

6.1.1 Regulation

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

According to 15.247(c) (1)(i) Systems operating in the 2 400-2 483.5 MHz bands that are used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

6.1.2 EUT Antenna PASS

The transmitter has an Integrated Wire Dipole antenna. The directional gain of the antenna is -3.77 dBi.

6.2 6 dB Bandwidth

6.2.1 Regulation

According to §15.247(a)(2), Systems using digital modulation techniques may operate in the 902-928 MHz, 2 400-2 483.5 MHz, and 5 725-5 850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

6.2.2 Test procedure

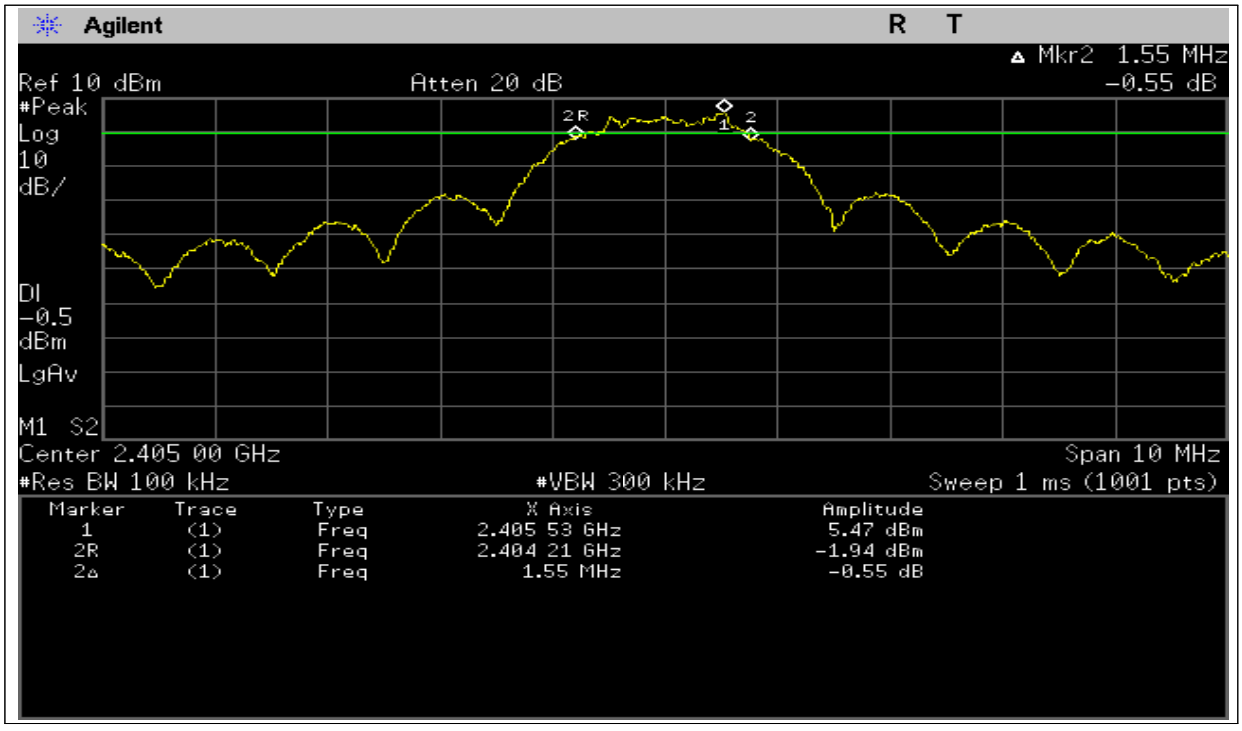
Use the following spectrum analyzer setting

- Center frequency : Lowest, middle and highest channels
- Spen = 10 MHz
- RBW = 100 kHz
- VBW = 300 kHz
- Sweep = 1 s
- Detector function = Peak
- Trace = Max hold

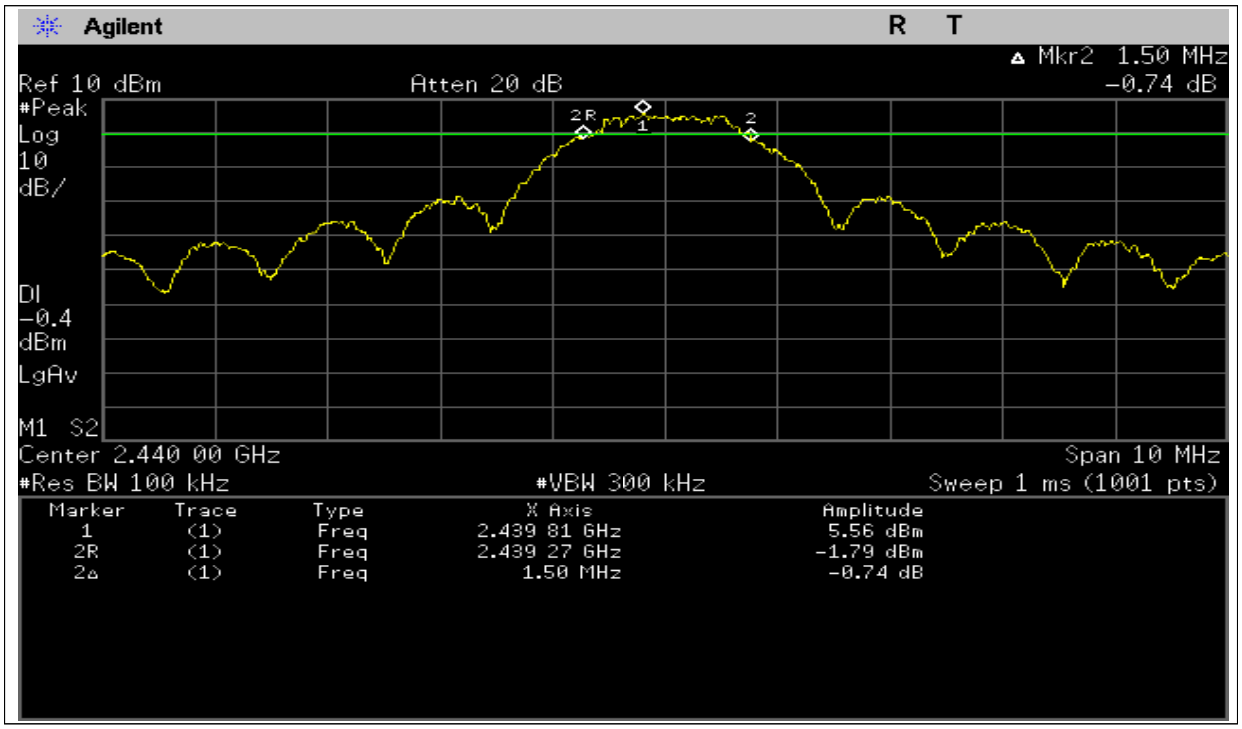
6.2.3 Test Result

Frequency (MHz)	6 dB Bandwidth (kHz)	Limit (kHz)	Verdict
2 405	1 550	> 500	Pass
2 440	1 500	> 500	Pass
2 480	1 520	> 500	Pass

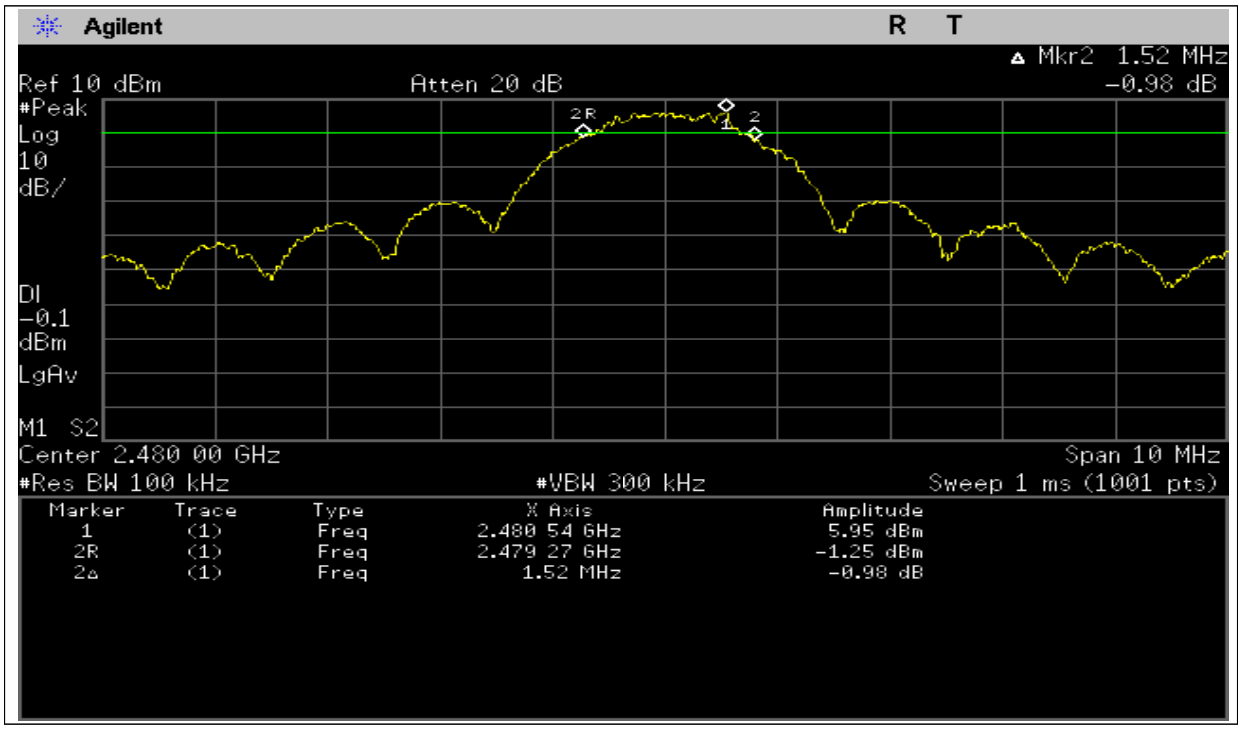
Lowest channel



Middle channel



Highest channel



6.3 Maximum peak power

6.3.1 Regulation

According to §15.247(b), The maximum peak conducted output power of the intentional radiator shall not exceed the following:

§15.247(b)(3), For systems using digital modulation in the 902-928 MHz, 2 400-2 483.5 MHz, and 5 725-5 850 MHz bands: 1 Watt.

6.3.2 Test procedure

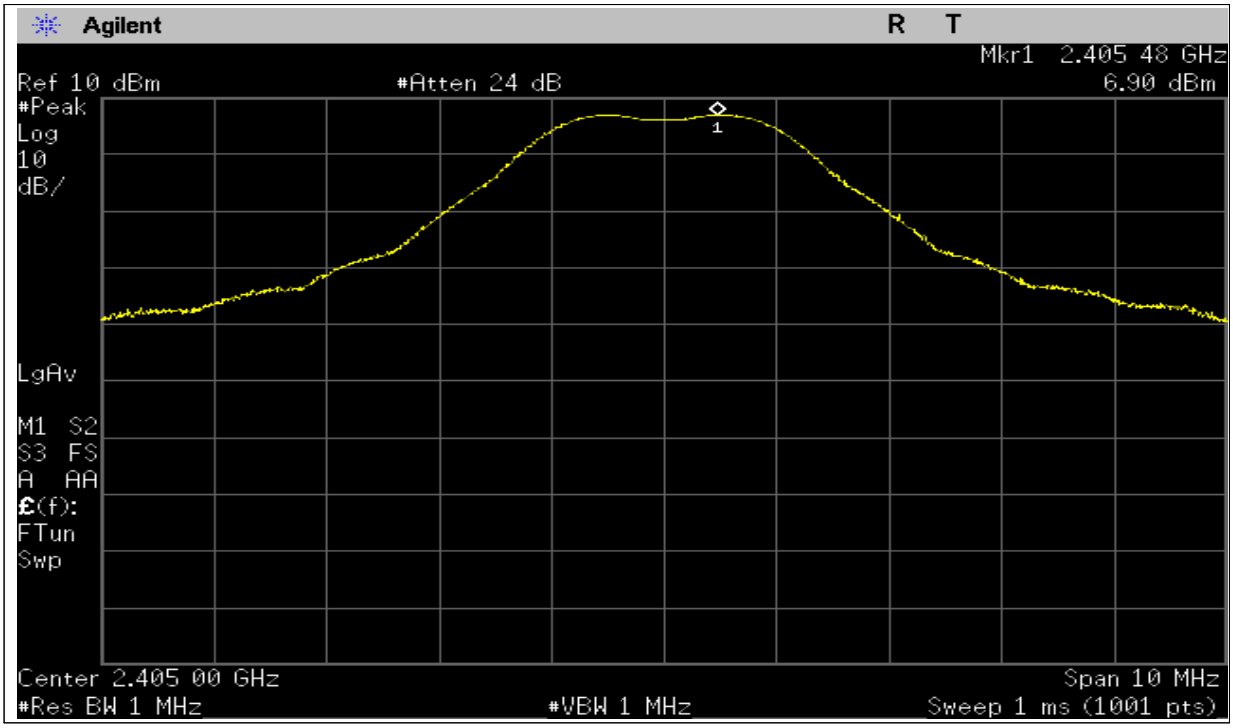
Use the following spectrum analyzer setting

- Center frequency : Lowest, middle and highest channels
- Spen = 10 MHz
- RBW = 1 MHz
- VBW = 1 MHz
- Sweep = 1s
- Detector function = Peak
- Trace = Max hold

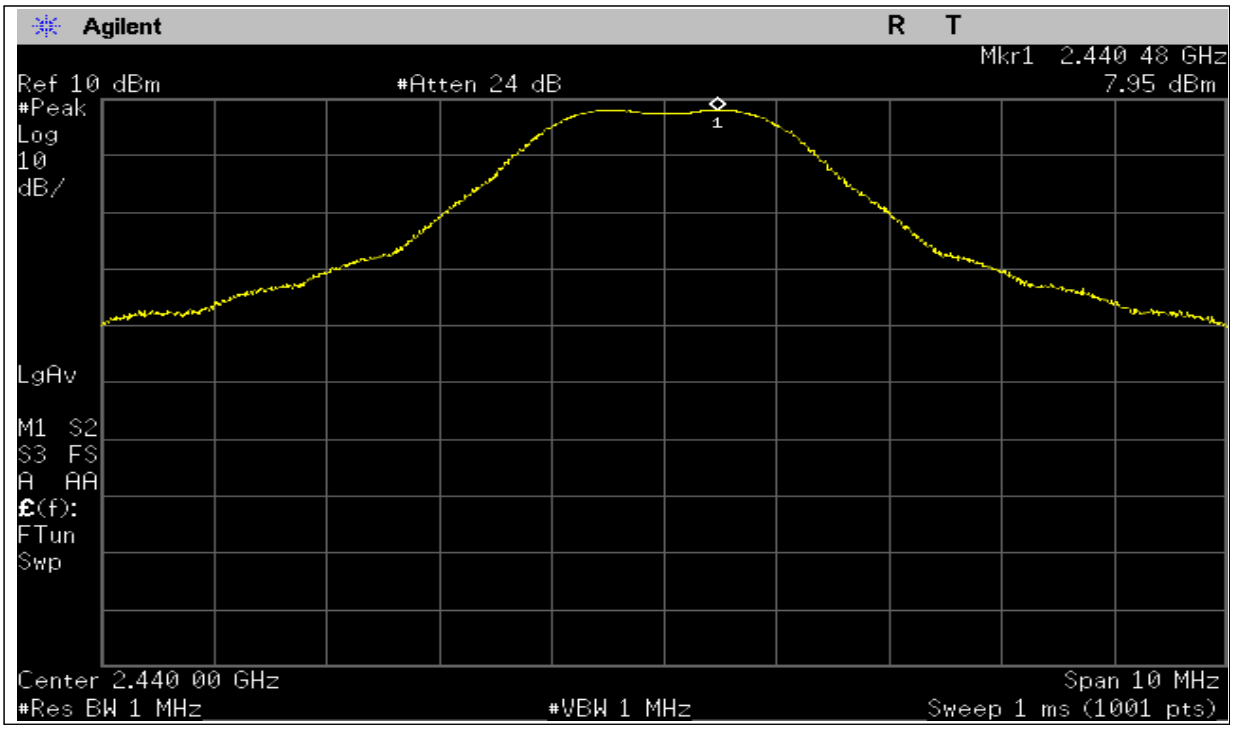
6.3.3 Test Result

Frequency (MHz)	Maximum peak power		Limit (W)	Verdict
	(dBm)	(W)		
2 405	6.90	0.004 9	1	Pass
2 440	7.95	0.006 2	1	Pass
2 480	8.19	0.006 6	1	Pass

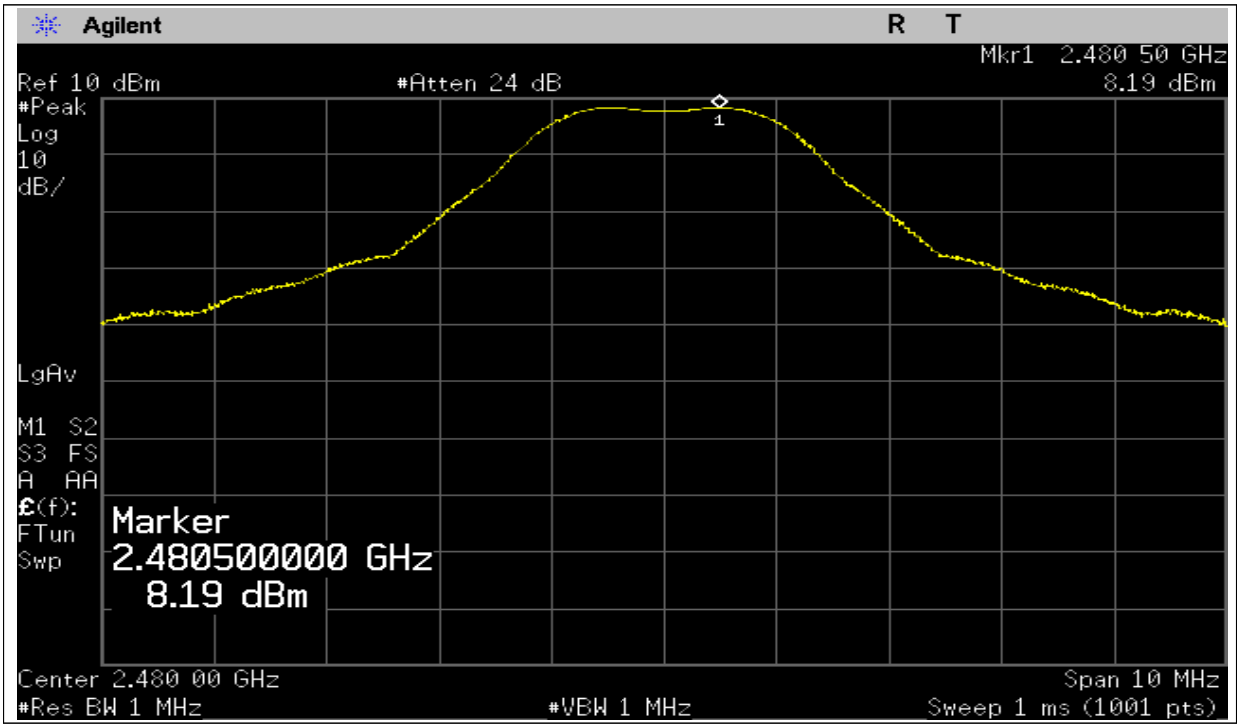
Lowest channel



Middle channel



Highest channel



6.4 Power spectral density

6.4.1 Regulation

According to §15.247(e), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

6.4.2 Test procedure

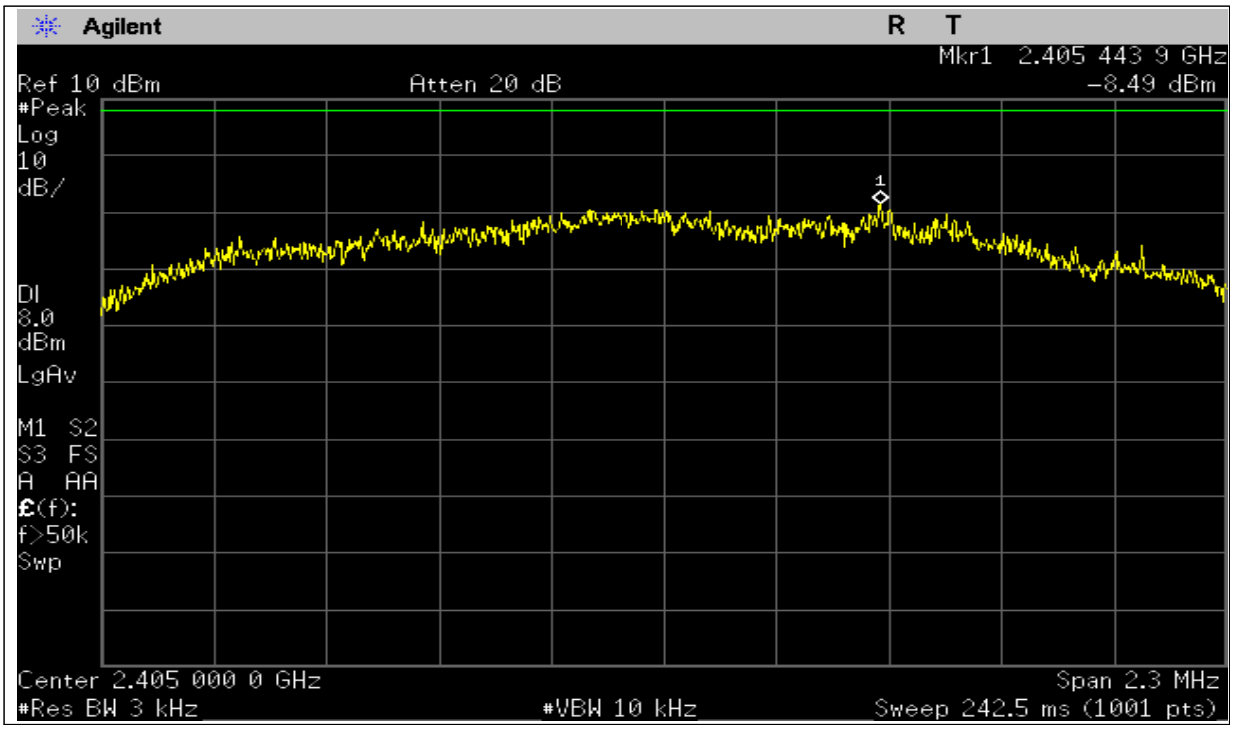
Use the following spectrum analyzer setting

- Center frequency : Lowest, middle and highest channels
- Spen = 2.3 MHz
- RBW = 3 kHz
- VBW = 10 kHz
- Sweep = Auto
- Detector function = Peak
- Trace = Max hold

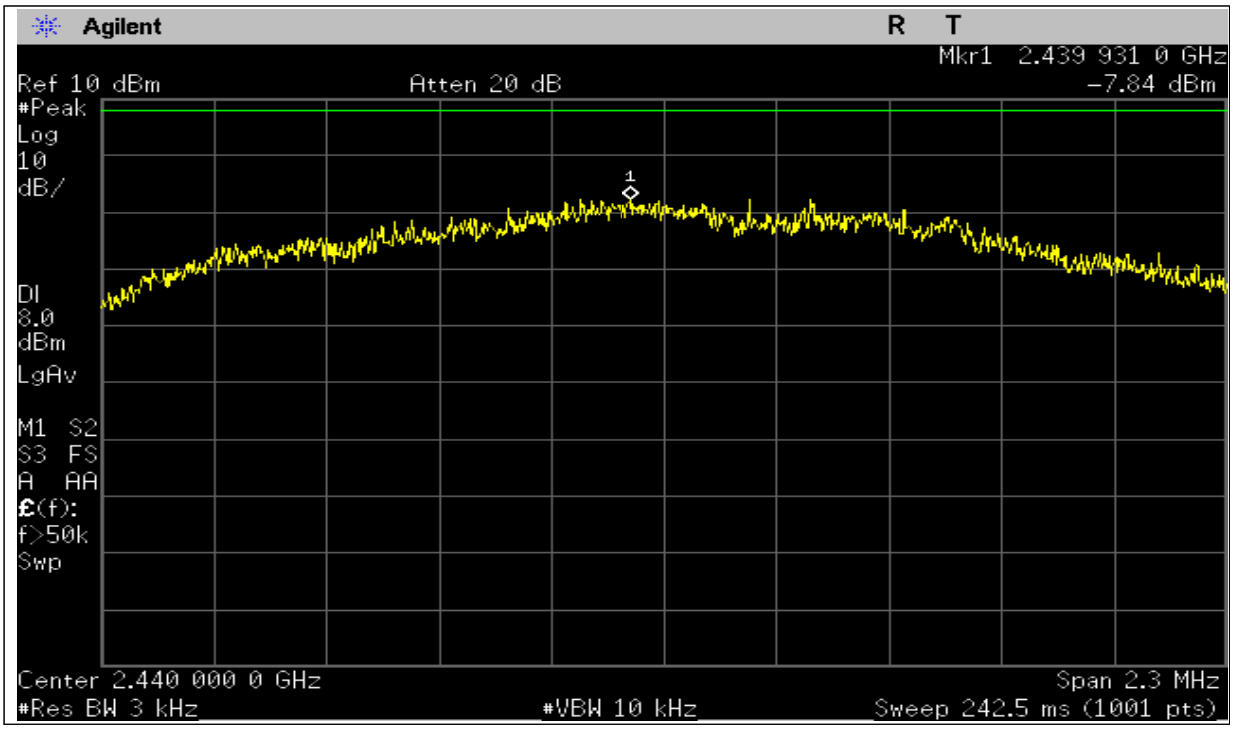
6.4.3 Test Result

Frequency (MHz)	Power spectral density (dBm)	Limit (dBm)	Verdict
2 405	-8.49	8	Pass
2 440	-7.84	8	Pass
2 480	-6.65	8	Pass

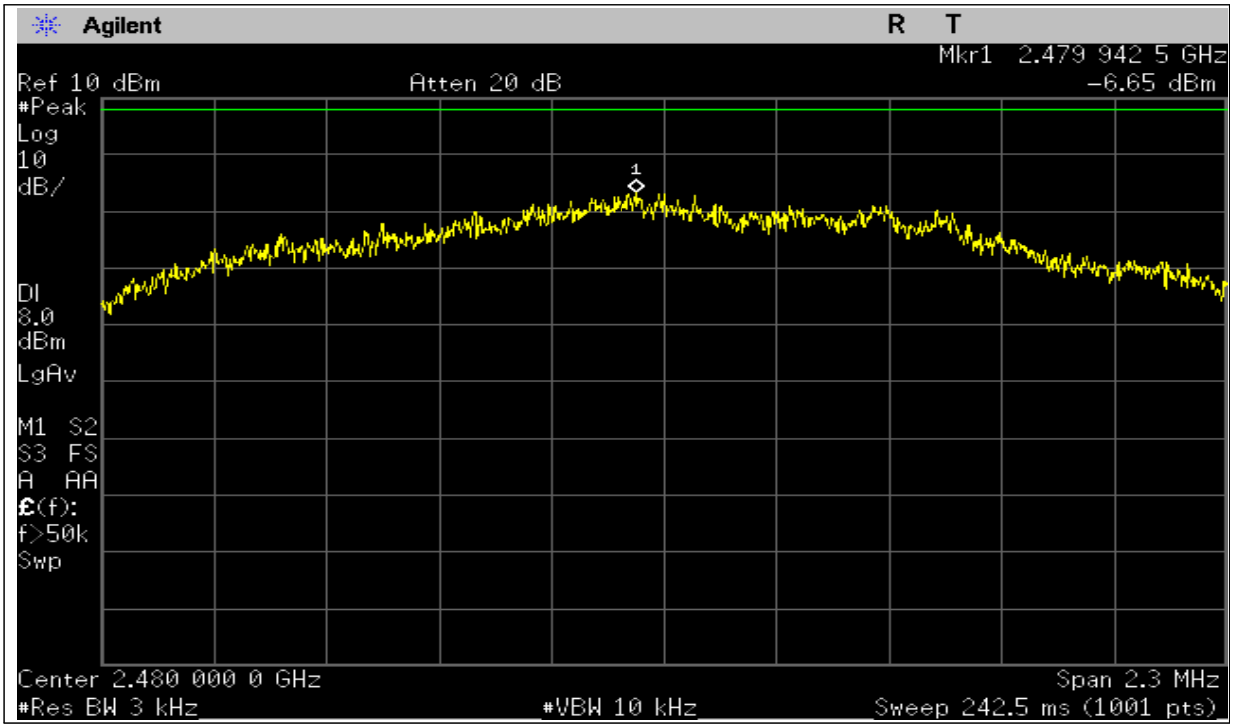
Lowest channel



Middle channel



Highest channel



6.5 Conducted spurious emissions & Band edge

6.5.1 Regulation

According to §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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

6.5.2 Test procedure

1) Test procedure for band edge

Use the following spectrum analyzer setting

- Center frequency : Lowest and highest channels
- Spen = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
- RBW = 100 kHz
- VBW = 300 kHz
- Sweep = Auto
- Detector function = Peak
- Trace = Max hold
- Allow the trace to stabilize. Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
- Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

2) Test procedure for spurious emission

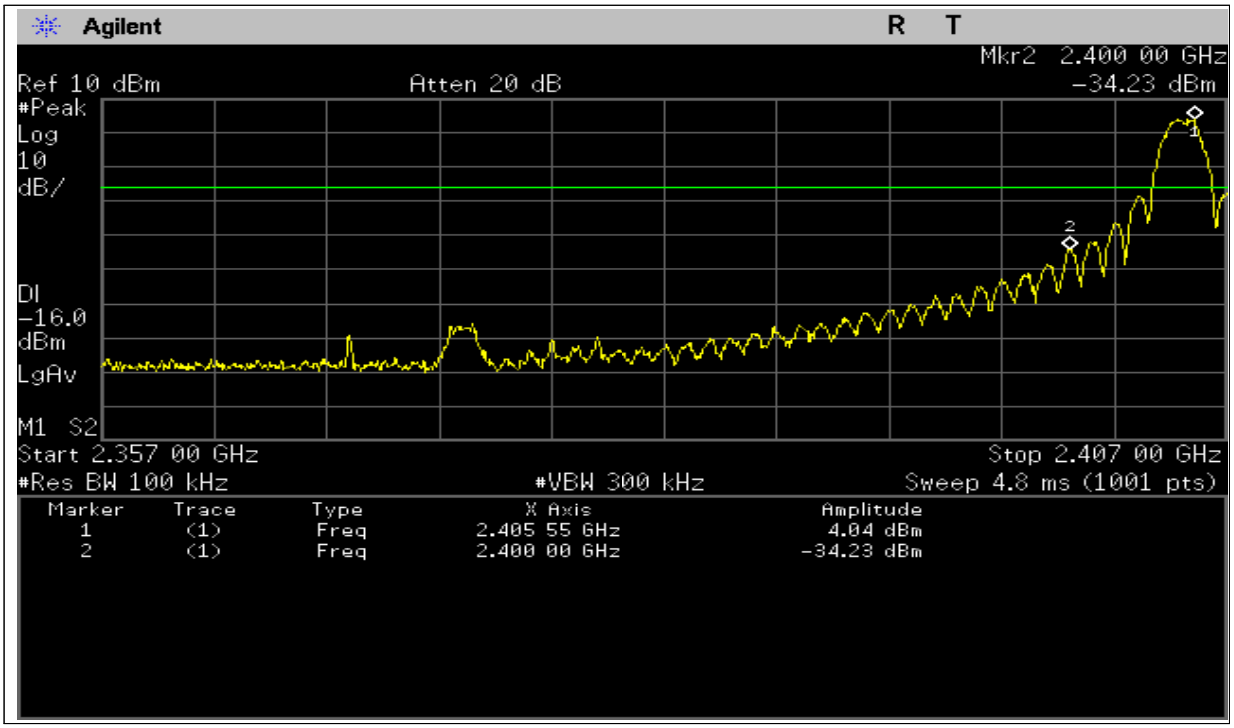
Use the following spectrum analyzer setting

- Center frequency : Lowest, middle and highest channels
- Spen = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
- RBW = 100 kHz
- VBW = 300 kHz
- Sweep = Auto
- Detector function = Peak
- Trace = Max hold
- Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.

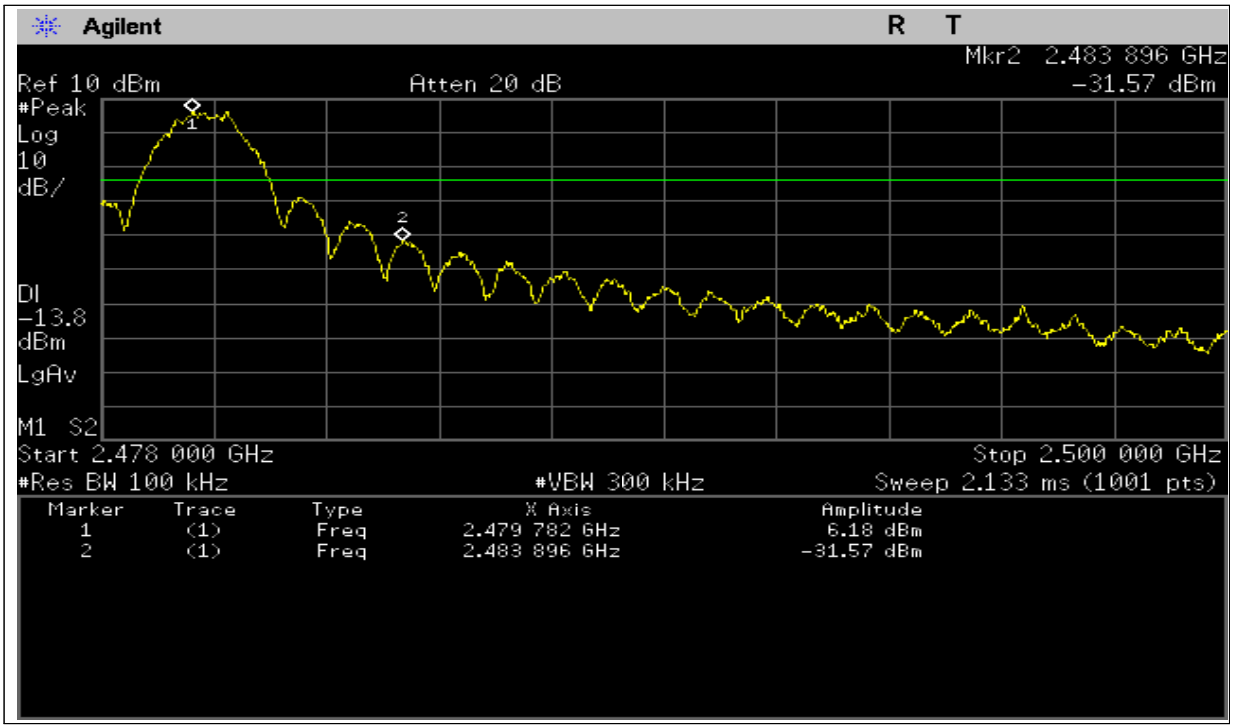
6.5.3 Test Result

1) band edge

Lowest channel

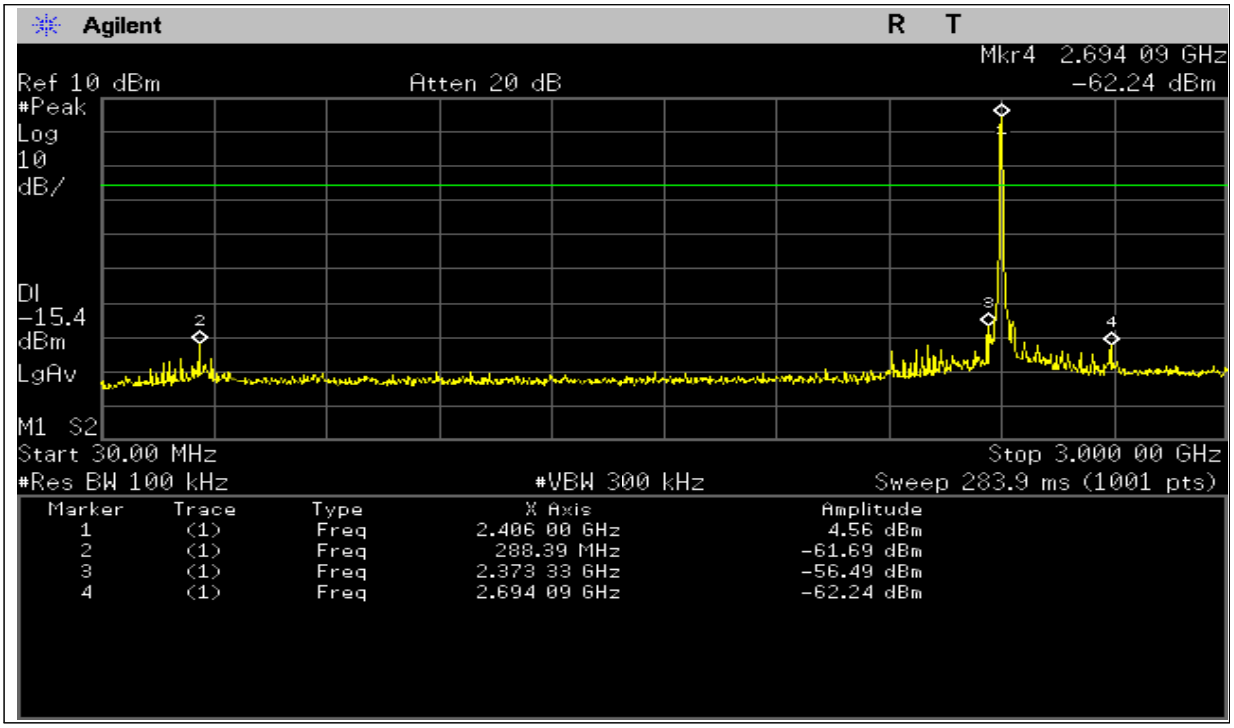


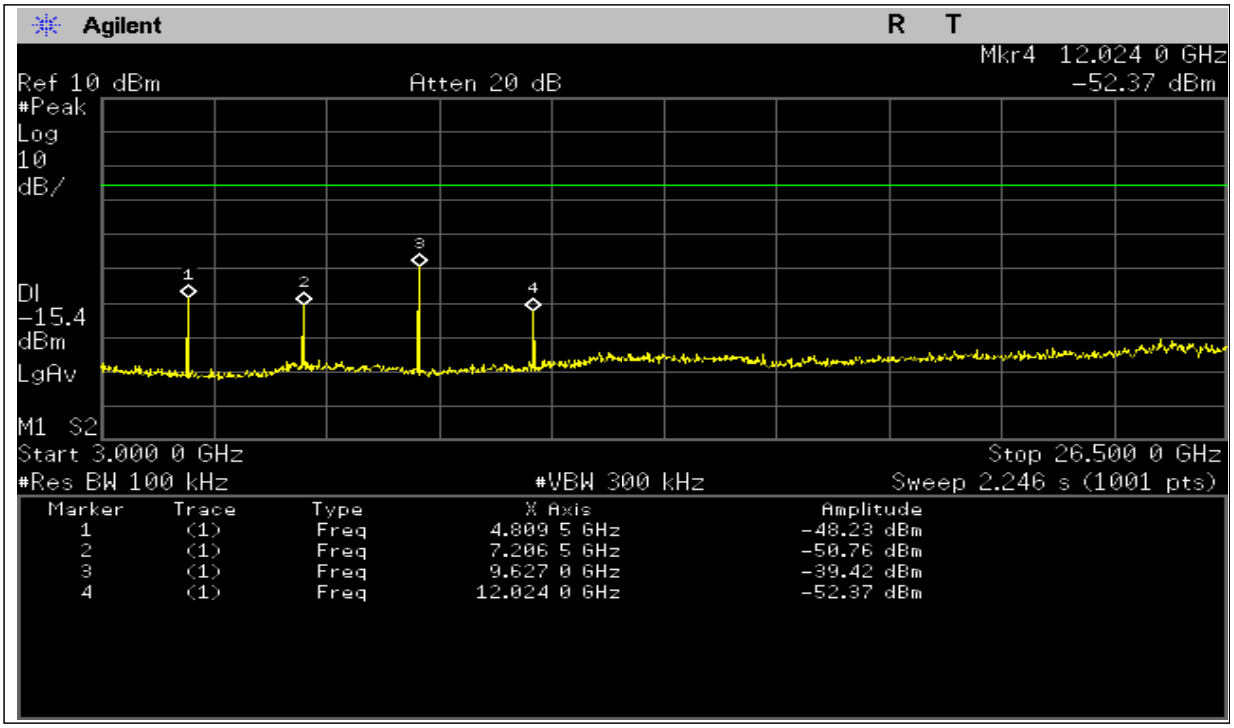
Highest channel



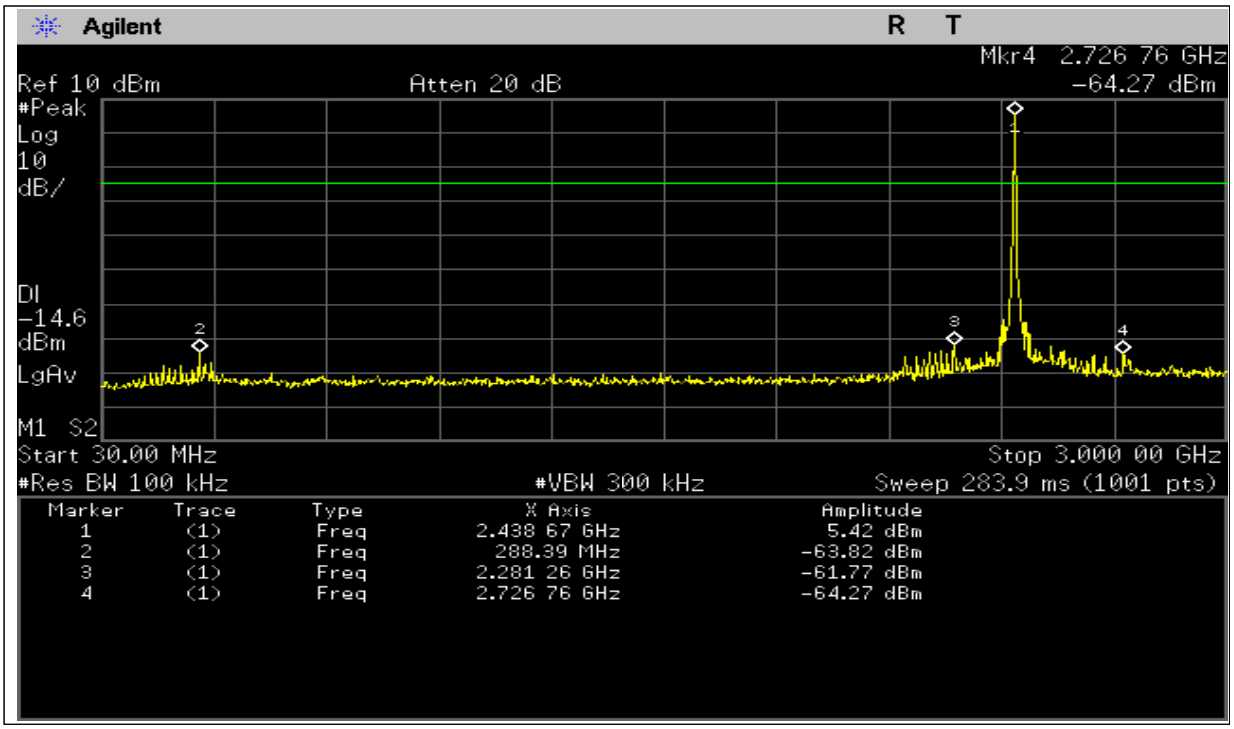
2) spurious emission

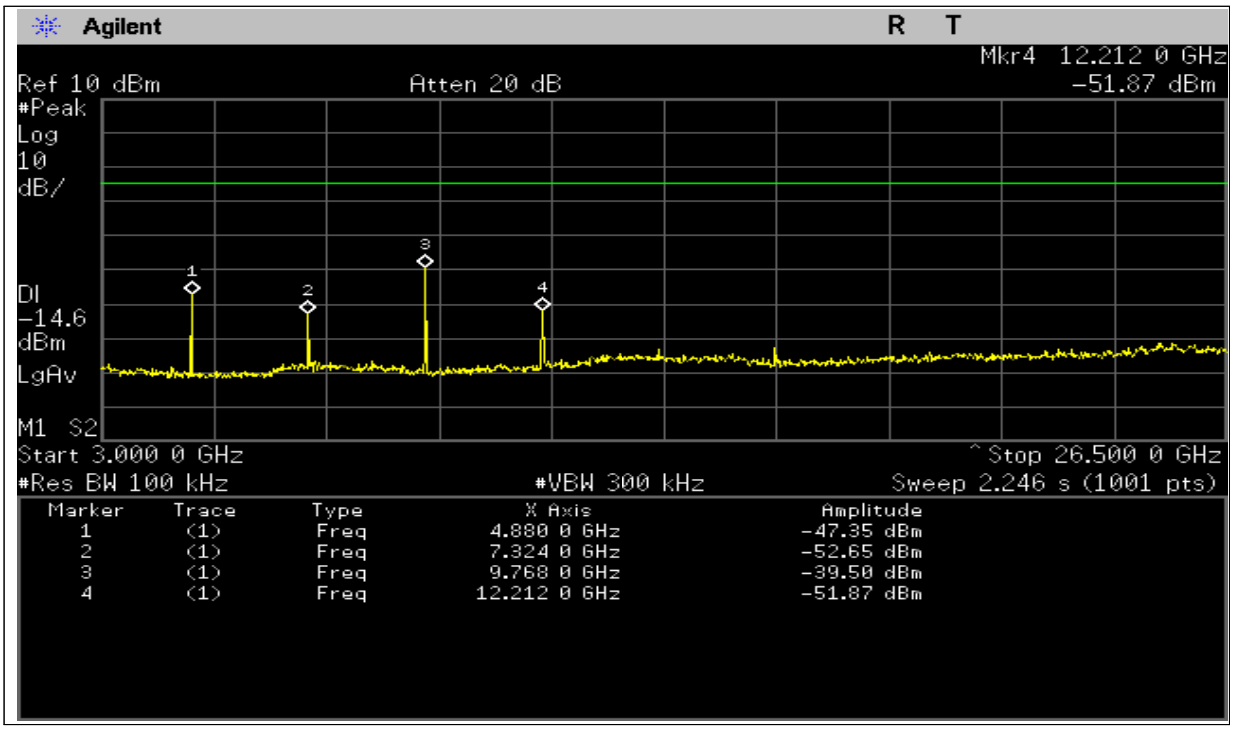
Lowest channel



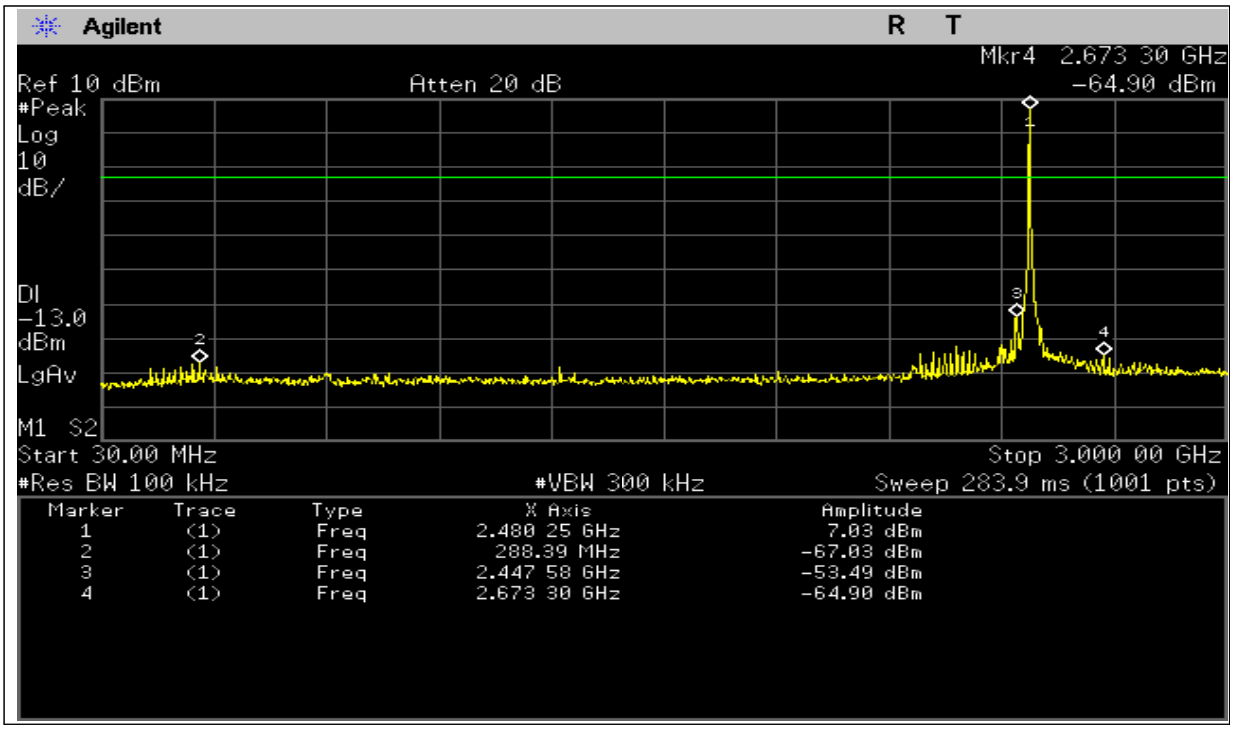


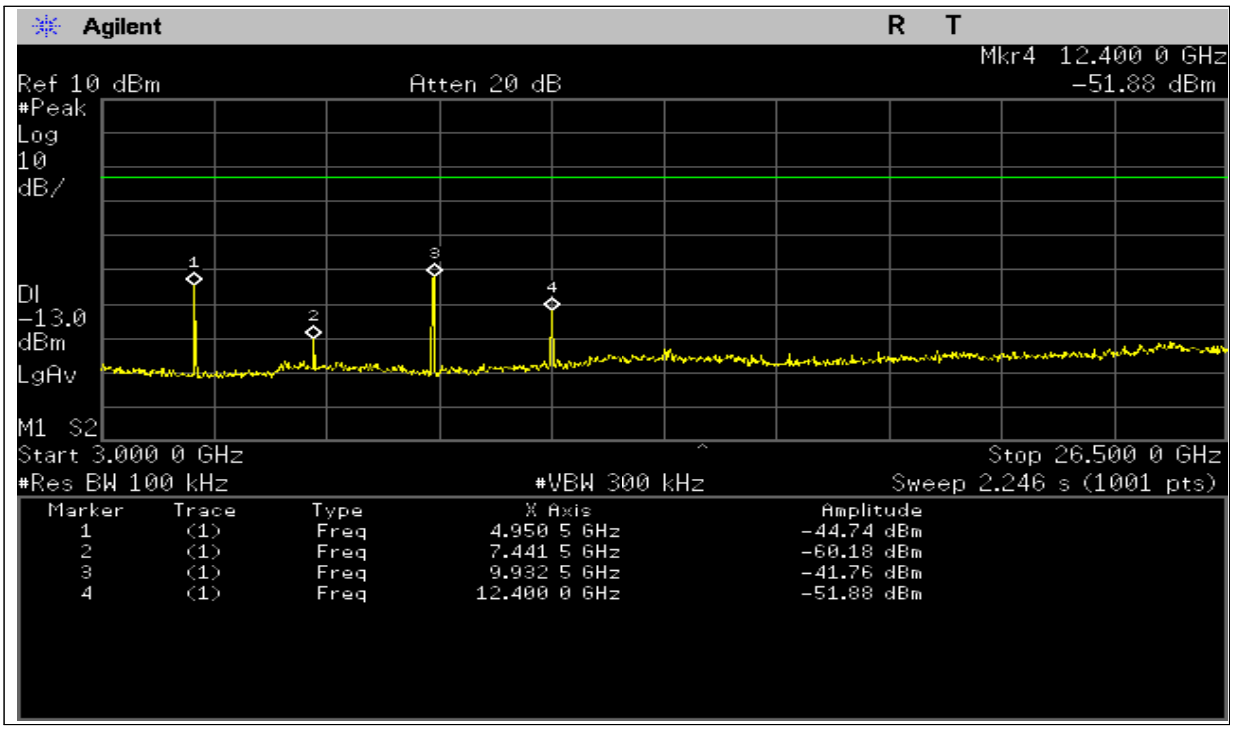
Middle channel





Highest channel





6.6 Radiated spurious emissions & Band edge

6.5.1 Regulation

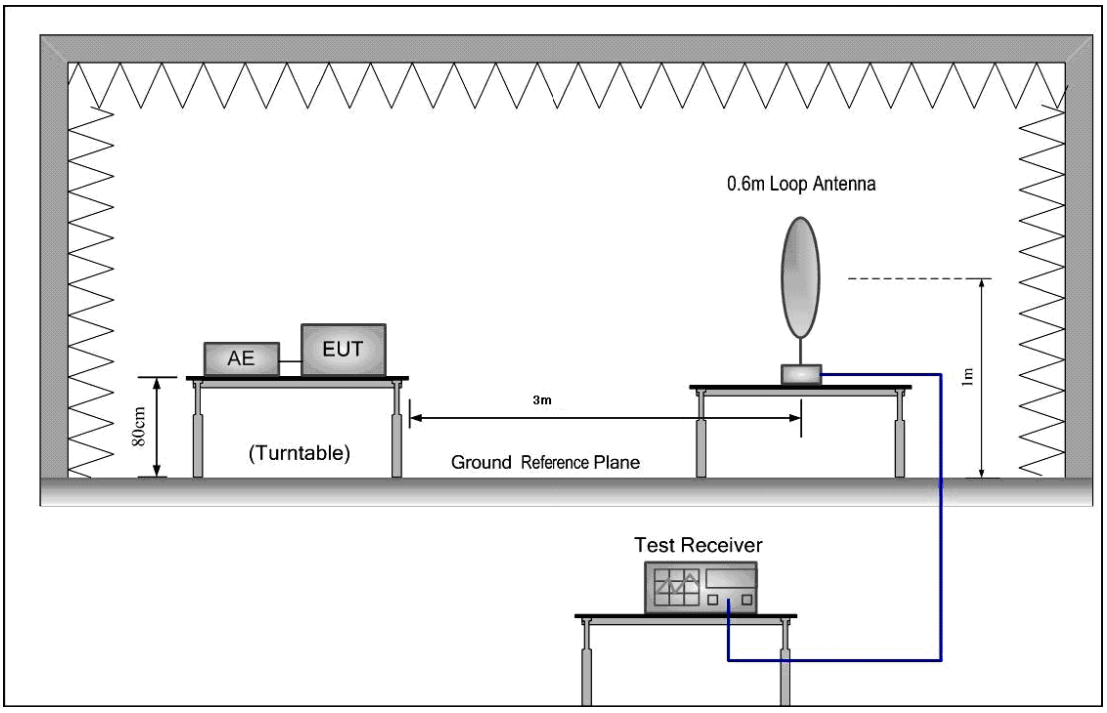
According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (meters)
0.009-0.490	2 400/F (kHz)	-	300
0.490-1.705	24 000/F (kHz)	-	30
1.705-30	30	29.5	30
30–88	100**	40.0	3
88–216	150**	43.5	3
216–960	200**	46.0	3
Above 960	300	54.0	3

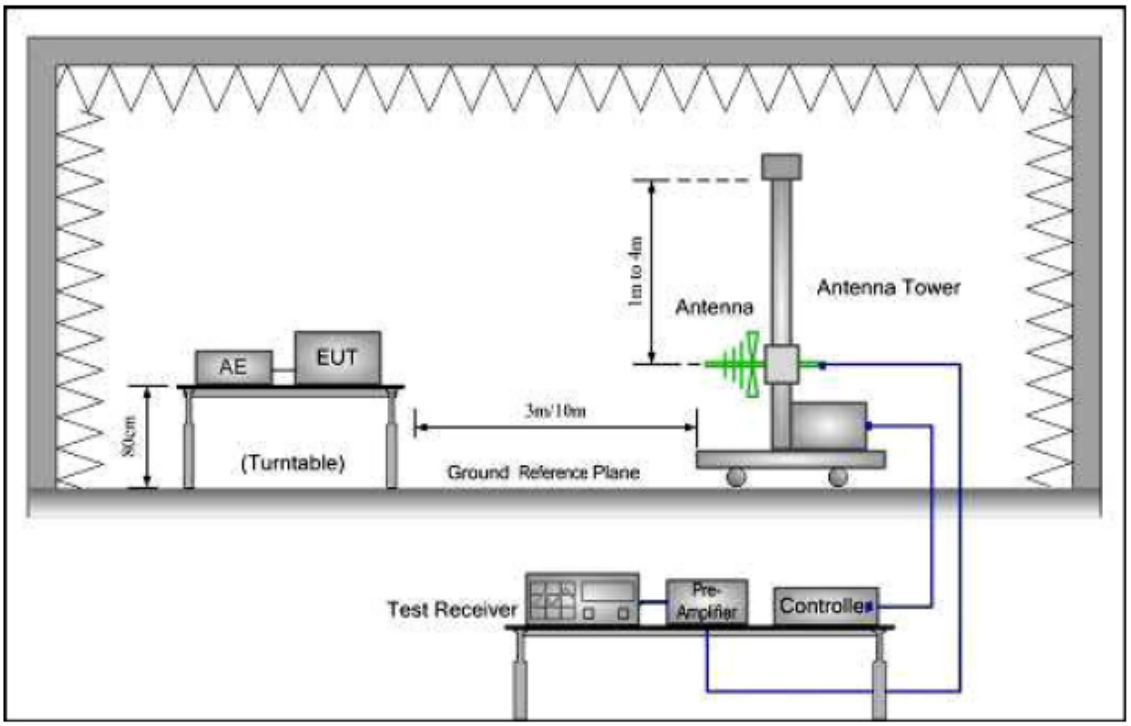
**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permlttted under other sections of this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

6.5.2 Test Setup Layout

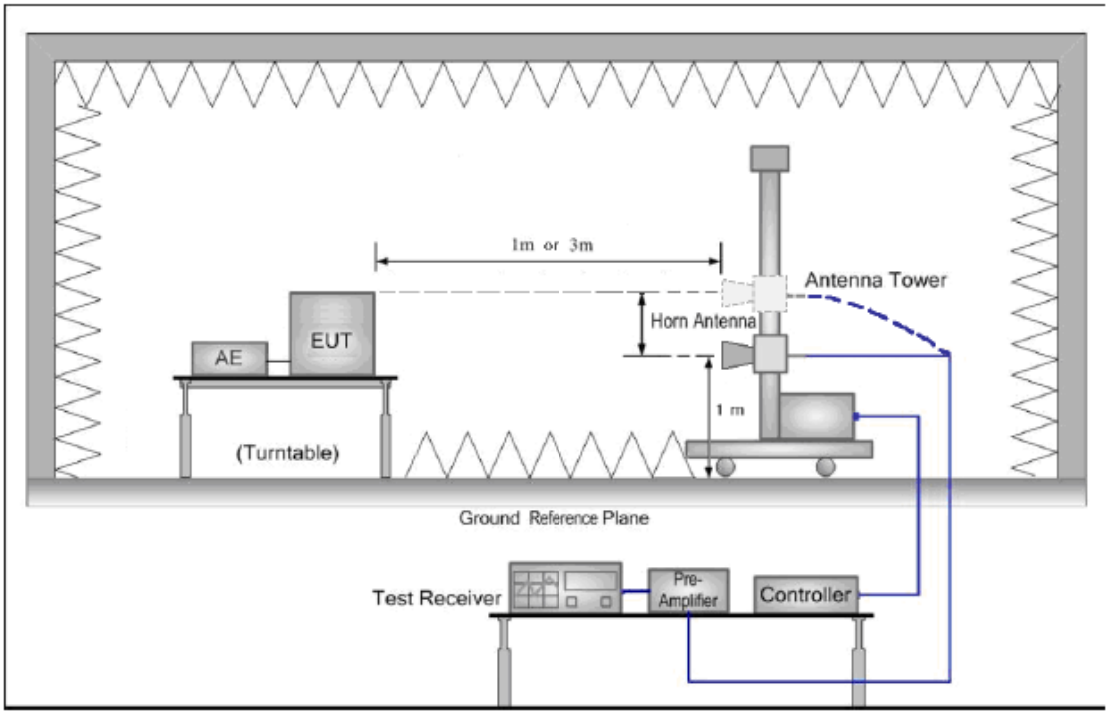
6.5.2.1 Radiated Emission Test Set-Up, Frequency Below 30 MHz



6.5.2.1 Radiated Emission Test Set-Up, Frequency Below 1 000 MHz



6.5.2.2 Radiated Emission Test Set-UP Frequency Over 1 000 MHz



6.5.3 Test procedure

6.5.3.1 Spurious Radiated Emissions:

1) The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters for above 30 MHz, and at 1 meter distance for below 30 MHz.
2) The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
3) The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, from 30 to 1000 MHz using the Trilog broadband antenna, and from 1 GHz to tenth harmonic of the highest fundamental frequency using the horn antenna.
4) To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5) Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6) The EUT is situated in three orthogonal planes (if appropriate)
7) The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.
8) If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative “arker-delta”method may be employed.

6.5.3.2 Marker-Delta Method at the edge of the authorized band of operation:

1) Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function as the above Spurious Radiated Emissions test procedure.
2) Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band-edge relative to the highest fundamental emission level.
3) Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by Section 15.205.
4) The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band-edge measurements in the restricted band that begins at 2483.5 MHz, C63.4 specifies a measurement bandwidth of at least 1 MHz. Therefore you may use the "delta" technique for measuring emissions up to 2 MHz removed from the band-edge. Radiated emissions that are removed by more than two “tandard” bandwidths must be measured as the above Spurious Radiated Emissions test procedure.

6.5.4 Test Result

6.5.4.1 band edge

Frequency (MHz)		Detect Mode	Emission Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 405	2 400	Peak	52.89	74	21.11
	2 400	Average	47.13	54	6.87
2 480	2 483.5	Peak	55.62	74	18.38
	2 483.5	Average	50.05	54	3.95

6.5.4.2 spurious emission

Frequency (MHz)		Detect Mode	Polarization (V/H)	Emission Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 405	395.10	Quasi-Peak	V	36.28	46.00	9.72
	640.59	Quasi-Peak	H	36.00	46.00	10.00
	830.89	Quasi-Peak	V	39.16	46.00	6.84
	900.525	Quasi-Peak	V	40.38	46.00	5.62
	4 811.00	Peak	V	48.72	74.00	25.28
	4 811.00	Average	V	45.30	54.00	8.70
	7 212.50	Peak	V	53.52	74.00	20.48
	7 212.50	Average	V	49.62	54.00	4.38
2 440	43.74	Quasi-Peak	V	30.91	40.00	9.09
	322.98	Quasi-Peak	V	31.75	46.00	14.25
	451.82	Quasi-Peak	V	31.75	46.00	14.25
	595.71	Quasi-Peak	H	35.61	46.00	10.39
	900.52	Quasi-Peak	V	39.26	46.00	6.74
	4 881.00	Peak	V	50.11	74.00	23.89
	4 881.00	Average	V	47.57	54.00	6.43
	7 317.50	Peak	H	51.76	74.00	22.24
	7 317.50	Average	H	49.03	54.00	4.97
2 480	146.41	Quasi-Peak	V	31.82	43.50	11.68
	261.04	Quasi-Peak	H	33.73	46.00	12.27
	322.98	Quasi-Peak	H	33.93	46.00	12.07
	580.07	Quasi-Peak	V	33.55	46.00	12.45
	800.22	Quasi-Peak	H	36.28	46.00	9.72
	900.524	Quasi-Peak	V	40.83	46.00	5.17
	4 961.00	Peak	V	48.88	74.00	25.12
	4 961.00	Average	V	45.83	54.00	8.17
	7 440.50	Peak	H	51.37	74.00	22.63
	7 440.50	Average	H	49.13	54.00	4.87

6.6. AC Power Line Conducted Emissions

6.6.1. Regulation

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 Ω line impedance stabilization network (LISN).

Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Qausi-peak	Average
0.15 −0.5	66 to 56 *	56 to 46 *
0.5 −5	56	46
5 −30	60	50

* Decreases with the logarithm of the frequency.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

6.6.2. Test Procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5 m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50 Ω / 50 μH LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5. The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 kHz or to QUASI-PEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

6.6.3 Test Result

Frequency (MHz)	Detect Mode	Hot/Neutral (H/N)	Measured Value (dBμV)	Correction Factor (dB)	Cable Loss (dB)	Emission Level (dBμV)	Limit (dBμV)	Margin (dB)

EUT is using the battery, so the test is not conducted.

1. Margin (dB) = Limit −Emission Level
2. Emission Level = Measured Value + CF + CL

6.4.4. Graph of the AC Power Line Conducted Emissions

HOT LINE

N/A

NEUTRAL LINE

N/A

APPENDIX

1. EUT photo