SGS-CSTC Standards Technical Services Co., Ltd.
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TEST REPORT

Application No.:	GZEM1412006921CR
Applicant:	GUANGDONG LFF TECHNOLOGY CO., LTD
Manufacturer:	Same as the applicant.
FCC ID:	SY9PLP5101
Product Description:	TIRE PRESSURE MONITORING SYSTEM
Model No.:	LP510
Trade Mark:	SPY
Standards:	CFR 47 FCC PART 15 Subpart C: 2014 section 15.247
Date of Receipt:	2015-01-05
Date of Test:	2015-01-27 to 2015-02-04
Date of Issue:	2015-09-02
Test Result :	**Pass***

* In the configuration tested, the EUT detailed in this report complied with the standards specified above. Please refer to section 3 of this report for further detail.

Authorized Signature:

Jerry Chan
Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government. All test results in this report can be traceable to National or International Standards.

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2 Version

Revision Record				
Version	**Chapter**	**Date**	**Modifier**	**Remark**
00		2015-09-02		Original

Authorized for issue by:				
Tested By		**(Jack Liang) / Project Engineer**		2015-01-27 to 2015-02-04 **Date**
Prepared By		**(June Chen) / Clerk**		2015-03-05 **Date**
Checked By		**(Jerry Chan) / Reviewer**		2015-05-15 **Date**

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3 Test Summary

Test	Test Requirement	Test method	Result
Antenna Requirement	FCC PART 15 C section 15.247 (c) and Section 15.203	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)	ANSI C63.10: Clause 6.9.1	PASS
Maximum Peak Output Power	FCC PART 15 C section 15.247(b)(3)	ANSI C63.10: Clause 8.5	PASS
Peak Power Spectral Density	FCC PART 15 C section 15.247(e)	ANSI C63.10: Clause 6.11.2.3	PASS
Conducted Spurious Emission	FCC PART 15 C section 15.209 &15.247(d)	ANSI C63.10: Clause 6.7	PASS
Radiated Spurious Emission	FCC PART 15 C section 15.209 &15.247(d)	ANSI C63.10: Clause 6.4, 6.5 and 6.6	PASS
Band Edges Measurement	FCC PART 15 C section 15.247 (d) &15.205	ANSI C63.10: Clause 6.10.5.2	PASS

Remark1:
EUT: In this whole report EUT means Equipment Under Test.
N/A: not applicable. Refer to the relative section for the details.
EUT: In this whole report EUT means Equipment Under Test.
Tx: In this whole report Tx (or tx) means Transmitter.
Rx: In this whole report Rx (or rx) means Receiver.
RF: In this whole report RF means Radio Frequency.
ANSI C63.10: the detail version is ANSI C63.10:2009 in the whole report.

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5 General Information

5.1 Client Information

Applicant:	GUANGDONG LFF TECHNOLOGY CO., LTD
Address of Applicant:	NO.9. YONGCHENG NORTH ROAD, XIAOLAN INDUSTRIAL AREA, XIAOLAN TOWN, ZHONGSHAN CITY, GUANGDONG PROVINCE, P.R. CHINA 528416
Manufacturer:	Same as the applicant.
Address of Manufacturer:	Same as the applicant.

5.2 General Description of E.U.T.

Product Description:	TIRE PRESSURE MONITORING SYSTEM
Model No.:	LP510

5.3 Details of E.U.T.

Operating Frequency	2402 MHz to 2480 MHz
Type of Modulation:	GFSK
Equipment types:	DTS
Adaptive function:	Only one adaptive mode is implemented and could not operate in a non-adaptive mode.
Number of Channels	40 Channels
Channel Separation:	2 MHz
Duty Cycle:	Continuous operation possible for testing purposes
Antenna Type	Integral antenna
Antenna gain:	0 dBi
Speciality:	Bluetooth 4.0 Smart (BLE mode)
Function:	BT function to transmit and receive audio signal.
Power Supply:	DC 12V
Normal Test Voltage:	DC 12V
Power cord:	N/A

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5.4 Description of Support Units

The EUT has been tested with DC 12 battery and corresponding accessories as below:

Supplied by SGS:

Description	Manufacturer	Model No.	SN/Certificate NO
NoteBook	IBM	T30	S/N78-3VMLX 06/01
BT test board	SGS EMC	RF 07	RF 07

5.5 Deviation from Standards

Biconical and log periodic antennas were used instead of dipole antennas.

5.6 Abnormalities from Standard Conditions

None.

5.7 Other Information Requested by the Customer

None.

5.8 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou Branch EMC Laboratory,
198 Kezhu Road, Scientech Park, Guangzhou Economic & Technology Development District,
Guangzhou, China 510663
Tel: +86 20 82155555 Fax: +86 20 82075059

No tests were sub-contracted.

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5.9 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **NVLAP (Lab Code: 200611-0)**

  SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou EMC Laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP/NIST). NVLAP Code: 200611-0.

  The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

- **ACMA**

  SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our NVLAP accreditation.

- **SGS UK(Certificate No.: 32), SGS-TUV SAARLAND and SGS-FIMKO**

  Have approved SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory as a supplier of EMC TESTING SERVICES and SAFETY TESTING SERVICES.

- **CNAS (Lab Code: L0167)**

  SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been assessed and in compliance with CNAS-CL01:2006 accreditation criteria for testing laboratories (identical to ISO/IEC 17025:2005 General Requirements) for the Competence of Testing Laboratories.

- **FCC (Registration No.: 282399)**

  SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 282399, May 31, 2002.

- **Industry Canada (Registration No.: 4620B-1)**

  The 3m/10m Alternate Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd., has been registered by Certification and Engineering of Industry Canada for radio equipment testing with Registration No. 4620B-1.

- **VCCI (Registration No.: R-2460, C-2584, G-449 and T-1179)**

  The 10m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services Co. Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-2460, C-2584，G-449 and T-1179 respectively.

- **CBTL (Lab Code: TL129)**

  SGS-CSTC Standards Technical Services Co., Ltd., E&E Laboratory has been assessed and fully comply with the requirements of ISO/IEC 17025:2005, the Basic Rules, IECEE 01:2006-10 and Rules of procedure IECEE 02:2006-10, and the relevant IECEE CB-Scheme Operational documents.

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6 Equipment Used during Test

RE in Chamber						
No.	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. date (YYYY-MM-DD)	Cal.Due date (YYYY-MM-DD)
EMC0525	Compact Semi-Anechoic Chamber	ChangZhou ZhongYu	N/A	N/A	2014-12-5	2015-12-5
EMC0522	EMI Test Receiver	Rohde & Schwarz	ESIB26	100283	2015-03-02	2016-03-02
EMC0056	EMI Test Receiver	Rohde & Schwarz	ESCI	100236	2015-04-07	2016-04-07
EMC0528	RI High frequency Cable	SGS	20 m	N/A	2014-04-19	2016-04-19
EMC2025	Trilog Broadband Antenna 30-1000MHz	SCHWARZBECK MESS-ELEKTRONIK	VULB 9160	9160-3372	2014-07-14	2017-07-14
EMC0524	Bi-log Type Antenna	Schaffner -Chase	CBL6112B	2966	2013-08-31	2016-08-31
EMC0519	Bilog Type Antenna	Schaffner -Chase	CBL6143	5070	2014-05-04	2017-05-04
EMC2026	Horn Antenna 1-18GHz	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	9120D-841	2013-08-31	2016-08-31
EMC0518	Horn Antenna	Rohde & Schwarz	HF906	100096	2012-07-01	2015-07-01
EMC0521	1-26.5 GHz Pre-Amplifier	Agilent	8449B	3008A01649	2015-03-02	2016-03-02
EMC2065	Amplifier	HP	8447F	N/A	2014-08-25	2015-08-25
EMC0075	310N Amplifier	Sonama	310N	272683	2015-03-02	2016-03-02
EMC0523	Active Loop Antenna	EMCO	6502	42963	2014-03-03	2016-03-03
EMC2041	Broad-Band Horn Antenna (14)15-26.5(40)GHz	SCHWARZBECK MESS-ELEKTRONI	BBHA 9170	9170-375	2014-05-26	2017-05-26
EMC2079	High Pass Filter(915MHz)	FSY MICROWAVE	HM1465-9SS	009	2015-03-02	2016-03-02
EMC2069	2.4GHz filter	Micro-Tronics	BRM 50702	149	2015-03-02	2016-03-02
EMC0530	10m Semi-Anechoic Chamber	ETS	N/A	N/A	2014-05-03	2016-05-03

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Conducted Emission						
No.	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. date (YYYY-MM-DD)	Cal.Due date (YYYY-MM-DD)
EMC0306	Shielding Room	Zhong Yu	8 x 3 x 3.8 m^3	N/A	N/A	N/A
EMC0118	Two-line v-netwok	R&S	ENV216	100359	2015-03-02	2016-03-02
EMC0102	LISN	SCHAFFNER CHASE	MN2050D/1	1421	2014-09-14	2015-09-14
EMC0506	EMI Test Receiver	Rohde & Schwarz	ESCS30	100085	2015-03-02	2016-03-02
EMC0107	Coaxial Cable	SGS	2m	N/A	2014-07-25	2016-07-25
EMC0106	Voltage Probe	SGS	N/A	N/A	2014-04-19	2016-04-19
EMC0120	8 Line ISN	Fischer Custom Communications	FCC-TLISN-T8-02	20550	2014-08-30	2015-08-30
EMC0121	4 Line ISN	Fischer Custom Communications	FCC-TLISN-T4-02	20549	2014-08-30	2015-08-30
EMC0122	2 Line ISN	Fischer Custom Communications	FCC-TLISN-T2-02	20548	2014-08-30	2015-08-30
EMC2047	CDN	Elektronik-Feinmechanik	L-801:AF2	2793	2012-09-23	2015-09-23
EMC2048	CDN	Elektronik-Feinmechanik	L-801:M2/M3	2738	2012-09-23	2015-09-23
EMC2062	6dB Attenuator	HP	8491A	24487	2014-04-19	2016-04-19
EMC167	Conical metal housing	SGS-EMC	N/A	N/A	2014-02-16	2016-02-16

General used equipment						
No.	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. date (YYYY-MM-DD)	Cal.Due date (YYYY-MM-DD)
EMC0006	DMM	Fluke	73	70681569	2014-09-15	2015-09-15
EMC0007	DMM	Fluke	73	70671122	2014-09-15	2015-09-15

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7 Test Results

7.1 E.U.T. test conditions

Test Voltage:	DC 12V
Temperature:	20.0 -25.0 °C
Humidity:	38-50 % RH
Atmospheric Pressure:	1000 -1010 mbar
Requirements:	**15.31(e):** For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery. **15.32:** Power supplies and CPU boards used with personal computers and for which separate authorizations are required to be obtained shall be tested as follows: Testing shall be in accordance with the procedures specified in Section 15.31 of this part.
Test frequencies and frequency range:	According to the 15.31(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table: According to the 15.33 (a) For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in the following table:

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Number of fundamental frequencies to be tested in EUT transmit band

Frequency range in which device operates	Number of frequencies	Location in frequency range of operation
1 MHz or less	1	Middle
1 MHz to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

Frequency range of radiated emission measurements

Lowest frequency generated in the device	Upper frequency range of measurement
9 kHz to below 10 GHz	10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower
At or above 10 GHz to below 30 GHz	5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower
At or above 30 GHz	5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified

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EUT channels and frequencies list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	27	2456
1	2404	28	2458
2	2406	29	2460
3	2408	30	2462
4	2410	31	2464
5	2412	32	2466
6	2414	33	2468
7	2416	34	2470
8	2418	35	2472
9	2420	36	2474
10	2422	37	2476
11	2424	38	2478
12	2426	39	2480
13	2428	/	/
14	2430	/	/
15	2432	/	/
16	2434	/	/
17	2436	/	/
18	2438	/	/
19	2440	/	/
20	2442	/	/
21	2444	/	/
22	2446	/	/
23	2448	/	/
24	2450	/	/
25	2452	/	/
26	2454	/	/

Test frequencies are the lowest channel: 0 channel(2402MHz), middle channel: 20 channel(2440 MHz) and highest channel: 39 channel(2480 MHz)

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7.2 Antenna Requirement

Standard requirement

15.203 requirement:

For intentional device. According to 15.203. an intentional radiator shall be designed to

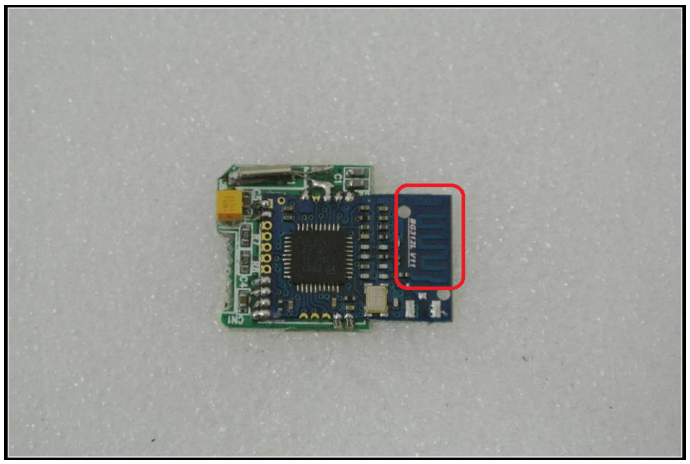
Ensure that no antenna other than that furnished by the responsible party shall be used with the device.

15.247(c) (1)(i) requirement:

(i) Systems operating in the 2400-2483.5 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.

EUT Antenna

The antenna is PCB Layout antenna and no consideration of replacement. The best case gain of the antenna is 0 dBi.



Test result: The unit does meet the FCC requirements.

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7.3 6 dB Bandwidth

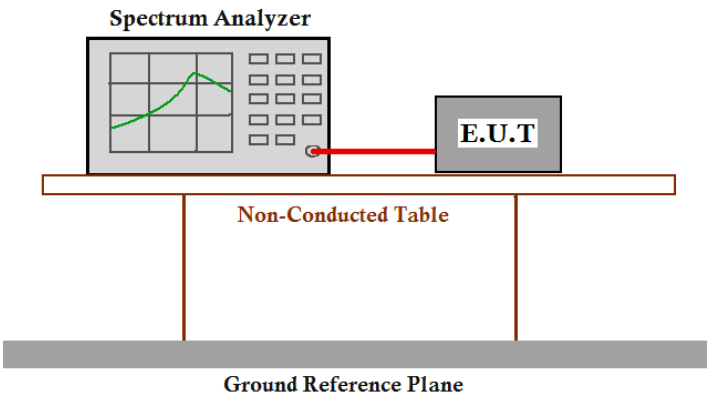
Test Requirement: FCC Part 15 C section 15.247

(a)(2)Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Method: ANSI C63.10: Clause 6.9.1

Test Status: Enter test mode for the product. Test in Channel lowest (2402MHz), middle (2440MHz) and highest (2480MHz), keep in continuously transmitting status.

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low attention attenuation RF cable (cable loss =1.5dB) from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW=100KHz. VBW = 300KHz. Sweep = auto; Detector Function = Peak. Trace = Max Hold, Set span to encompass the entire emission bandwidth of the signal.
3. Mark the peak power frequency and -6dB (upper and lower) power frequency.
4. Repeat until all the test status is investigated.
5. Report the worse case.

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Channel No.	Frequency (MHz)	Mode	Data Rate	Measured 6dB bandwidth (kHz)	Limit	Result
0	2402	GFSK	1 Mbps	721.443	≥500KHz	Pass
20	2440		1 Mbps	721.443		Pass
39	2480		1 Mbps	761.523		Pass

Test result: The unit does meet the FCC requirements.

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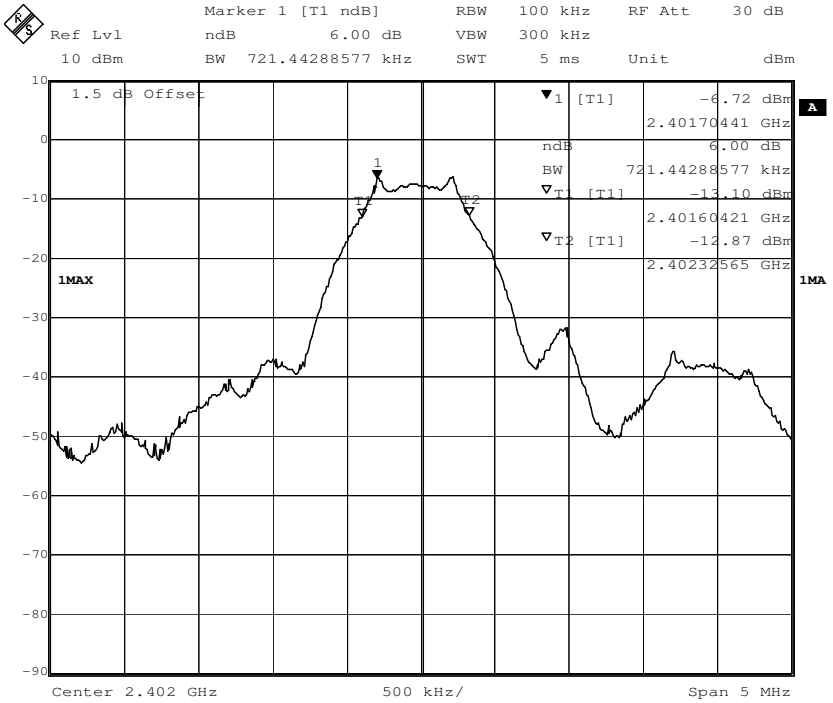
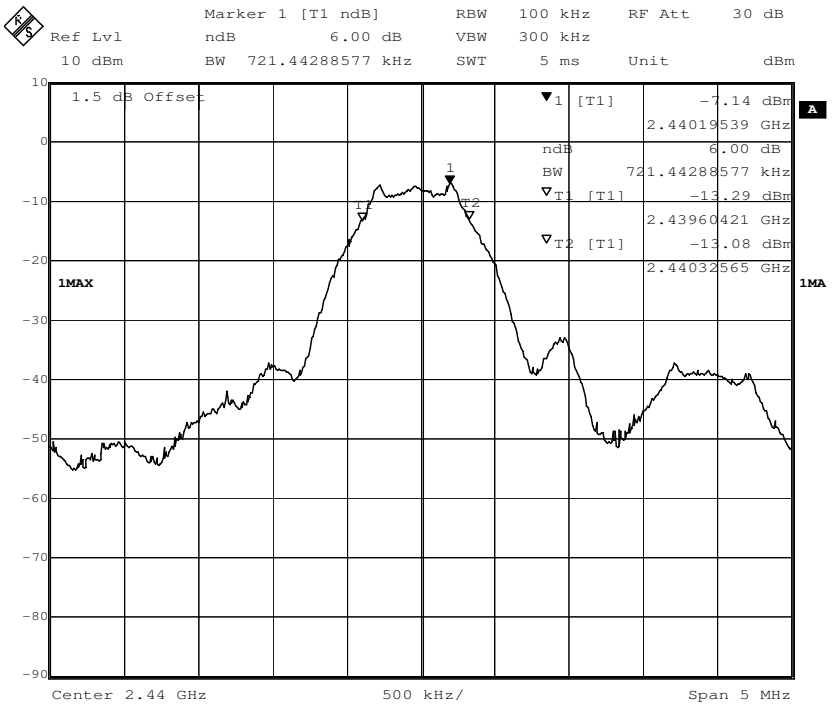
Result plot as follows:

Channel 0:2.402GHz:



Channel 20:2.442GHz:



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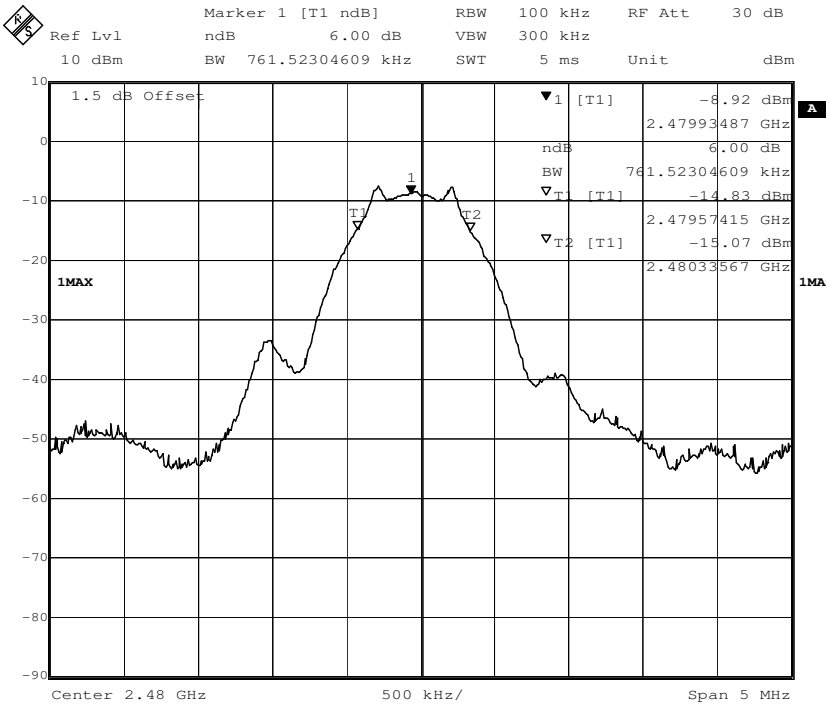
Channel 39:2.480GHz:



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7.4 Maximum Peak Output Power

Test Requirement: FCC Part 15 C section 15.247

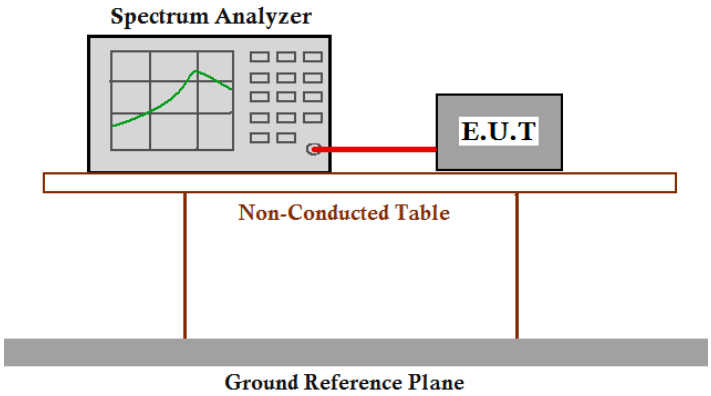
(b)(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b) (1), (b) (2), and (b) (3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test Method: ANSI C63.10: Clause 8.5

Test Status: Enter test mode for the product. Test in Channel lowest (2402MHz), middle (2440MHz) and highest (2480MHz), keep in continuously transmitting status.

Test Configuration:



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Test Procedure:

1. Remove the antenna from the EUT and then connect a low attention attenuation RF cable (Cable loss =1.5dB) from the antenna port to the spectrum.
2. Set the RBW≥DTS bandwidth
3. Set the VBW ≥ 3 x RBW
4. Set the span ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Use peak marker function to determine the peak amplitude level.
9. Report the worse case.

Test result:

Channel No.	Frequency (MHz)	Mode	Data Rate	Measured Channel Power (dBm)	Limit	Result
0	2402	GFSK	1Mbps	-6.22	1W(30dBm)	Pass
20	2440		1Mbps	-6.65		Pass
39	2480		1Mbps	-7.55		Pass

Remark: Level = Read Level + Cable Loss.

The unit does meet the FCC requirements.

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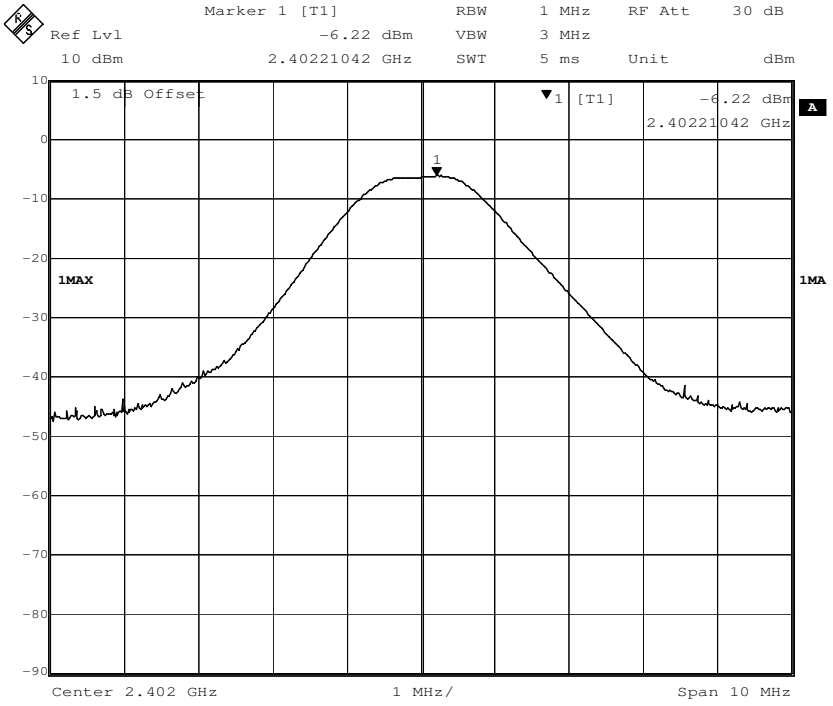
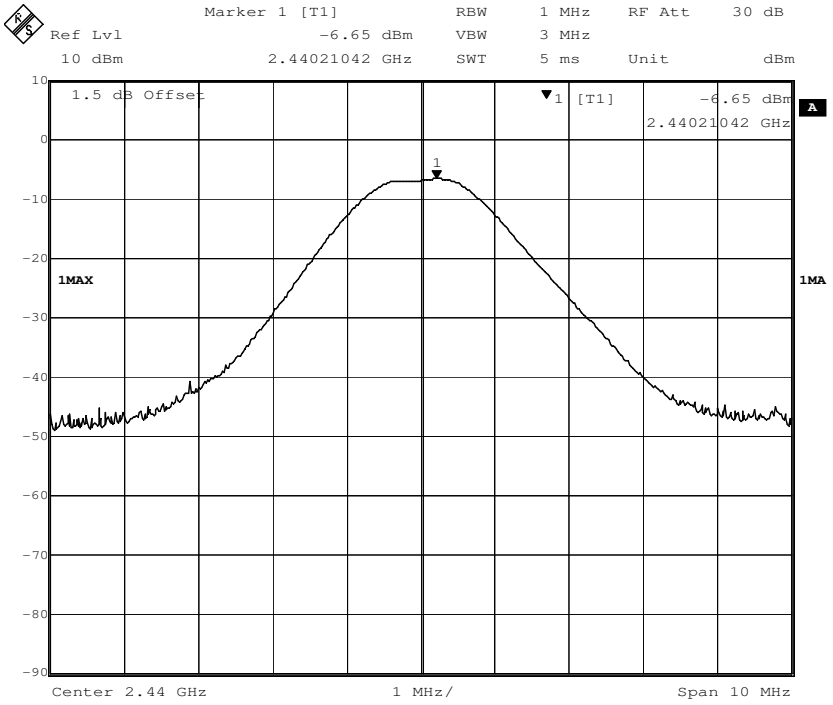
Result plot as follows:

Channel 0:2.402GHz:



Channel 20:2.442GHz:



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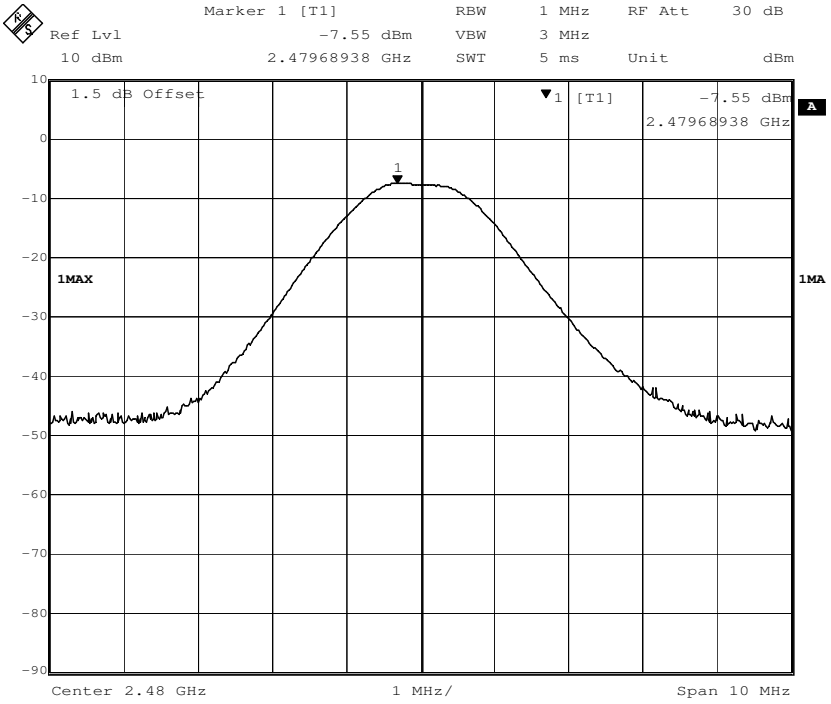
Channel 39:2.480GHz:



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7.5 Peak Power Spectral Density

Test Requirement: FCC Part 15 C section 15.247

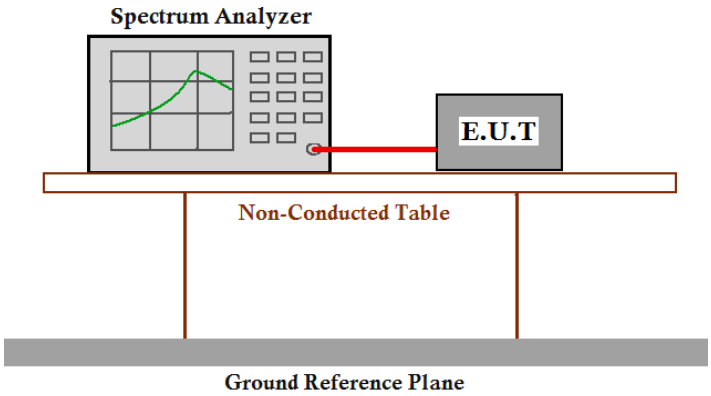
(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

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.

Test Method: ANSI C63.10: Clause 6.11.2.3

Test Status: Enter test mode for the product. Test in lowest Channel 2402MHz, middle Channel 2440MHz and highest Channel 2480MHz, keep in continuously transmitting status.

Test Configuration:



Test Procedure:

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1. Remove the antenna from the EUT and then connect a low attention attenuation RF cable (cable loss =1.5dB) from the antenna port to the spectrum analyzer or power meter.
2. Set the spectrum analyzer:

   a) Set CENTER FREQUENCY = Frequency from Power Spectral Density Test Matrix (see 6.10.2)
   b) Set SPAN = 20 MHz (For devices with a nominal 40 MHz BW, 50 MHz span will be needed)
   c) Set REFERENCE LEVEL = 20 dBm
   d) Set ATTENUATION = 0 dB (add internal attenuation, if necessary)
   e) Set SWEEP TIME = Coupled
   f) Set RBW = 3 kHz
   g) Set VBW = 10 kHz
   h) Set DETECTOR = Peak
   i) Set MKR = Center Frequency
   j) Set TRACE = CLEAR WRITE

   Place the radio in continuous transmit mode. Set the TRACE to MAX HOLD, and after the trace stabilizes, the TRACE to VIEW. Set the marker on the peak of the signal and then adjust the center frequency of the spectrum analyzer to the marker frequency.

   After viewing the EUT waveform on the spectrum analyzer, perform the following spectrum analyzer functions to capture the trace:

   Set SPAN = 300 kHz
   Set SWEEP TIME = 100 s
   Set TRACE = MAX HOLD
   Set MKR = PEAK SEARCH
3. Measure the Power Spectral Density of the test frequency with special test status.
4. Repeat until all the test status is investigated.
5. Report the worse case.

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Channel No.	Frequency (MHz)	Mode	Data Rate	Measured Peak Power Spectral Density (dBm/3KHz)	Limit	Result
0	2402	GFSK	1 Mbps	-18.69	8dBm/3KHz	Pass
20	2440		1 Mbps	-19.14		Pass
39	2480		1 Mbps	-19.58		Pass

Test result: Level = Read Level + Cable Loss.

The unit does meet the FCC requirements.

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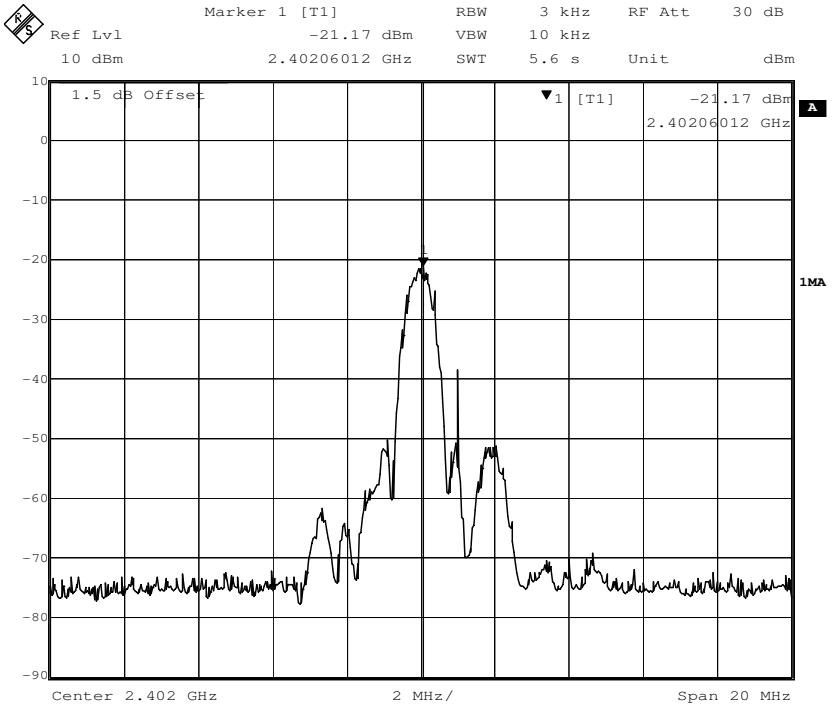
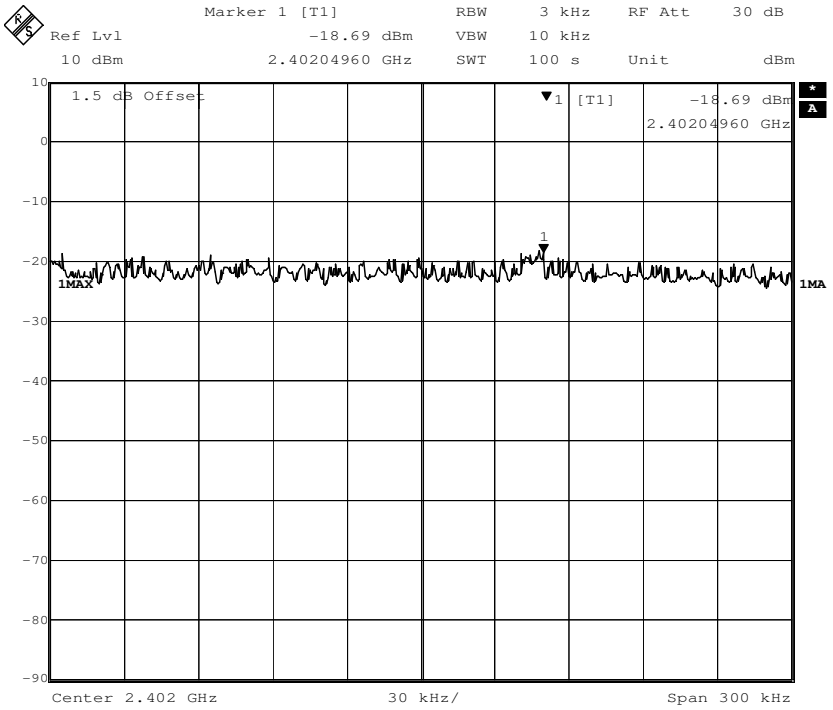
Result plot as follows:

Channel 0:2.402 GHz:





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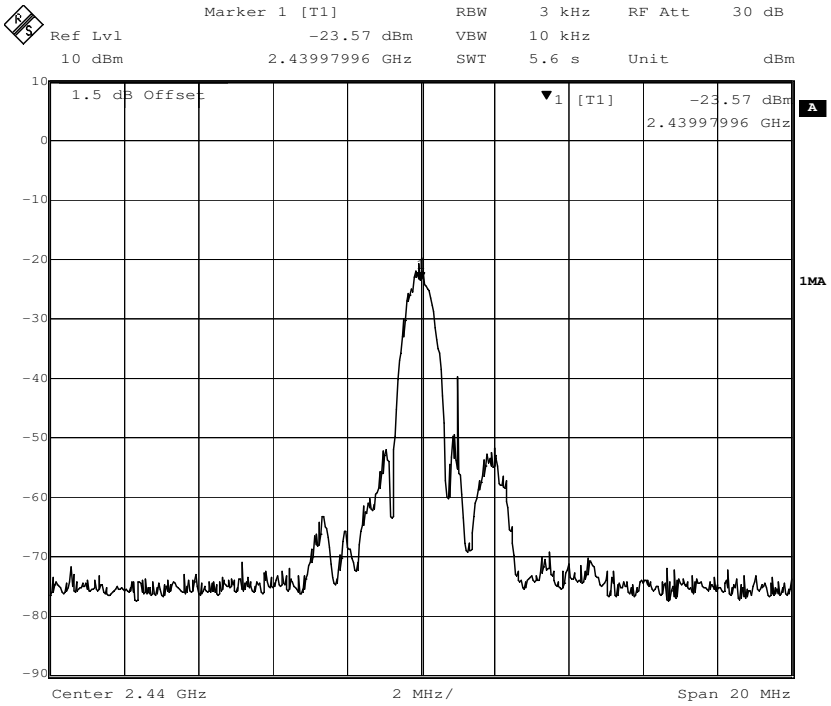
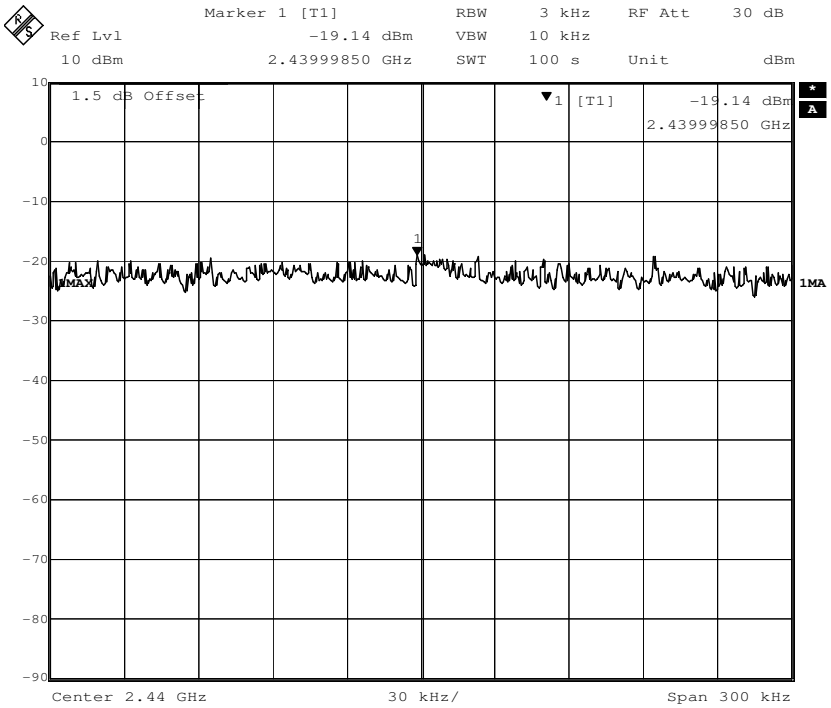
Channel 20:2.442 GHz:





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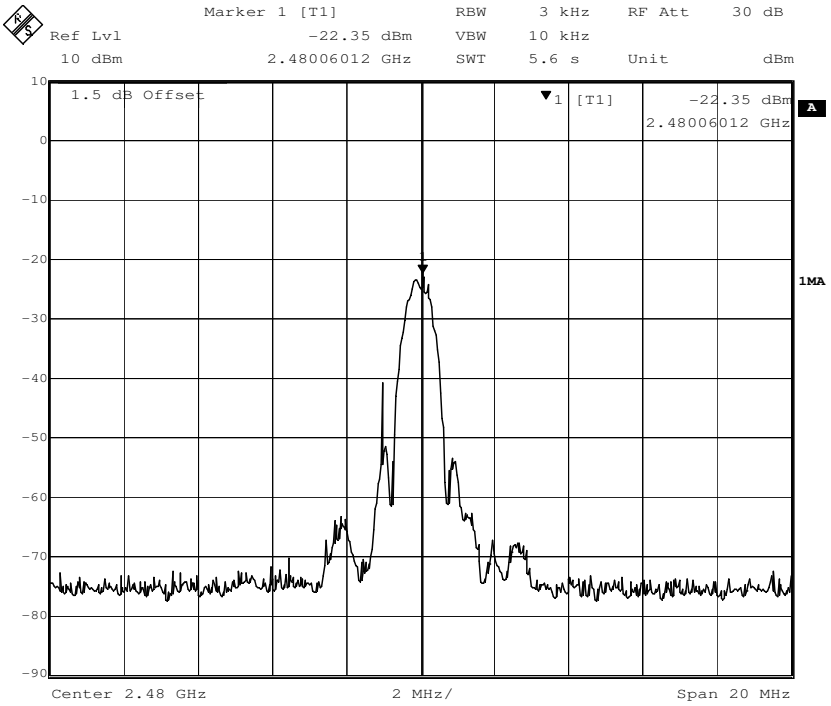
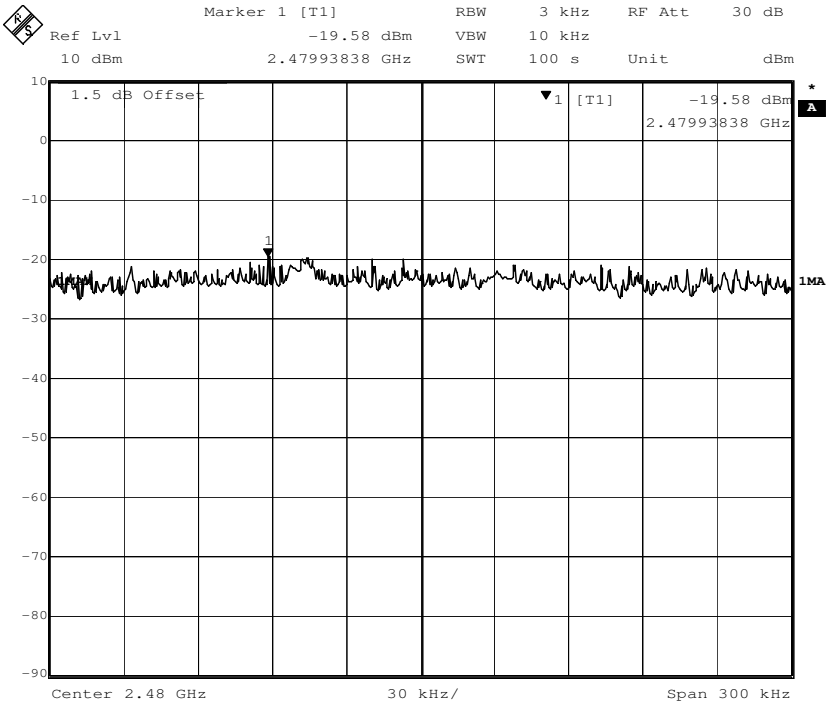
Channel 39:2.480 GHz:





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7.6 Conducted Spurious Emissions

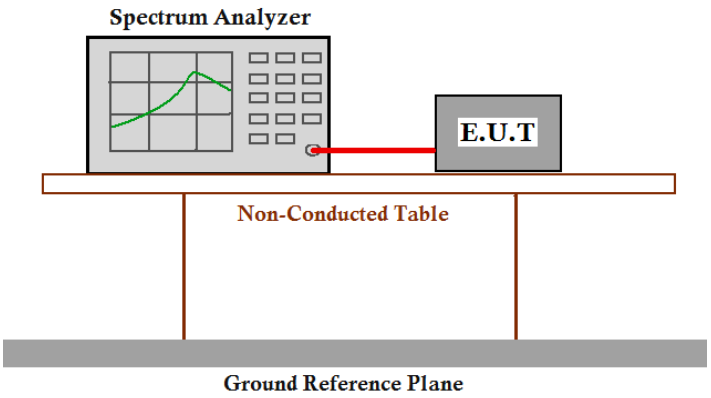
Test Requirement: FCC Part 15 C section 15.247

(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.

Test Method: ANSI C63.10: Clause 6.7

Test Status: Enter test mode for the product. Test in lowest Channel 2402MHz, middle Channel 2440MHz and highest Channel 2480MHz, keep in continuously transmitting status.

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum analyzer or power meter.
2. Set the spectrum analyzer: RBW=100 KHz, VBW = 300KHz. Sweep = auto; Detector Function = Peak. Trace = Max Hold, Scan up through 10th harmonic.
3. Measure the Conducted Spurious Emissions of the test frequency with special test status.
4. Repeat until all the test status is investigated.
5. Report the worse case.

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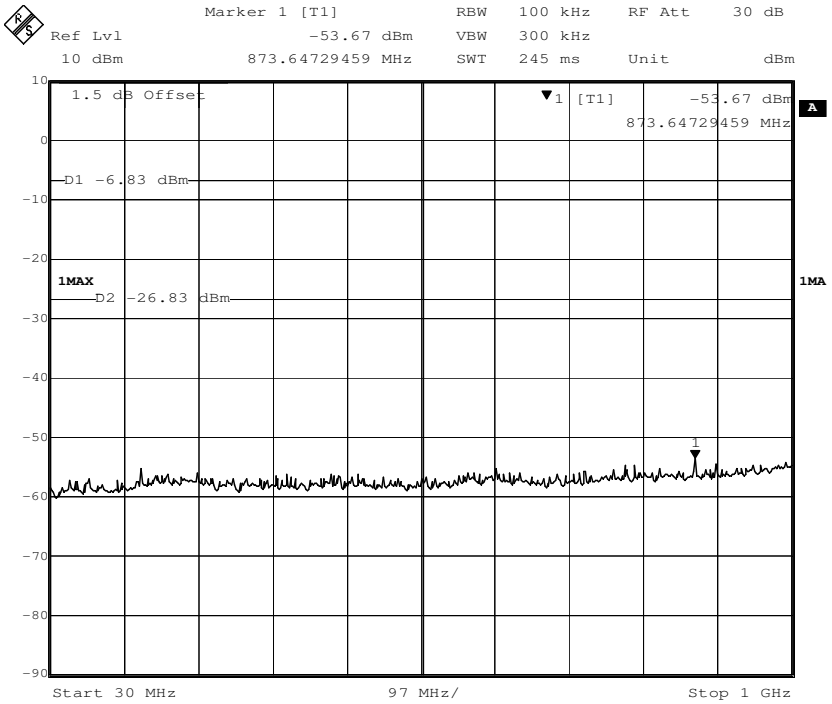
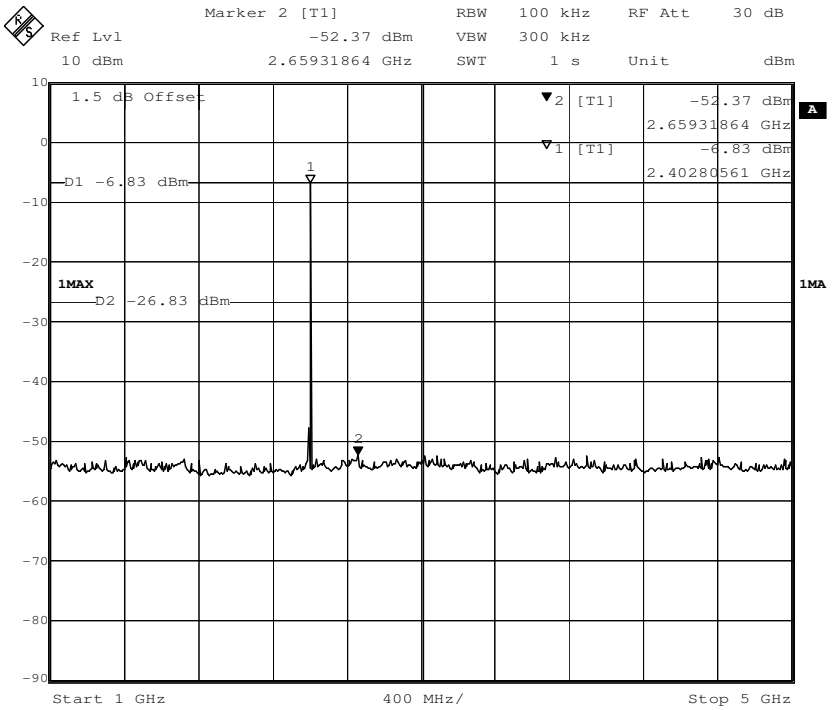
Result plot as follows:

Channel 0: 2.402 GHz

30 MHz to 1GHz



1GHz to 5GHz



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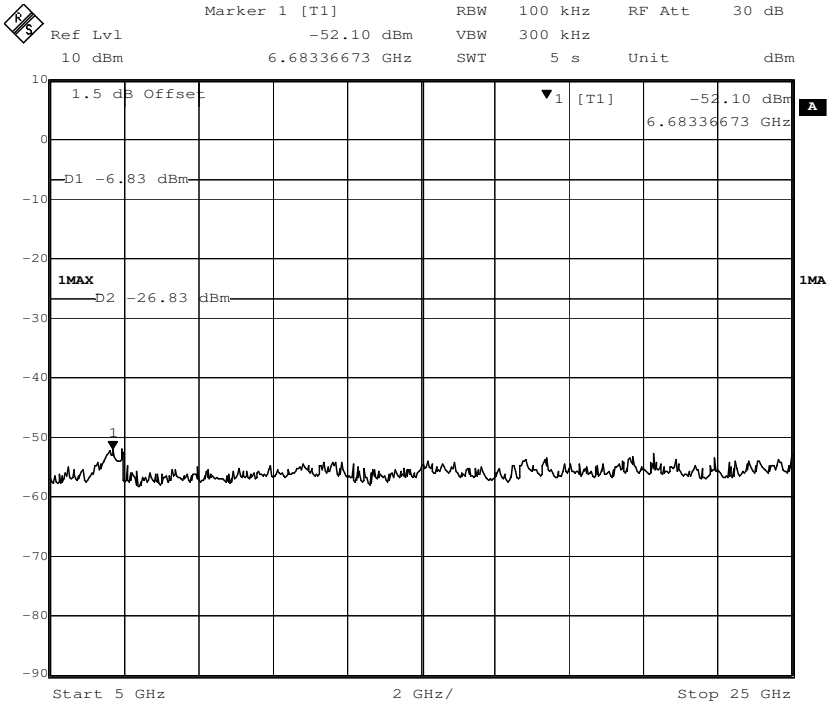
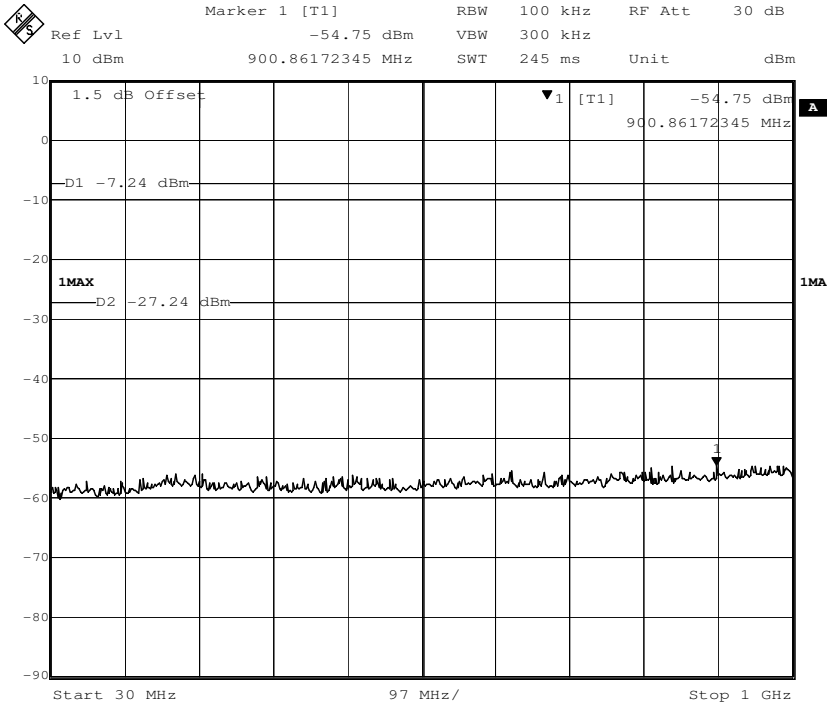
5GHz to 25GHz



Channel 20:2.440GHz

30 MHz to 1GHz



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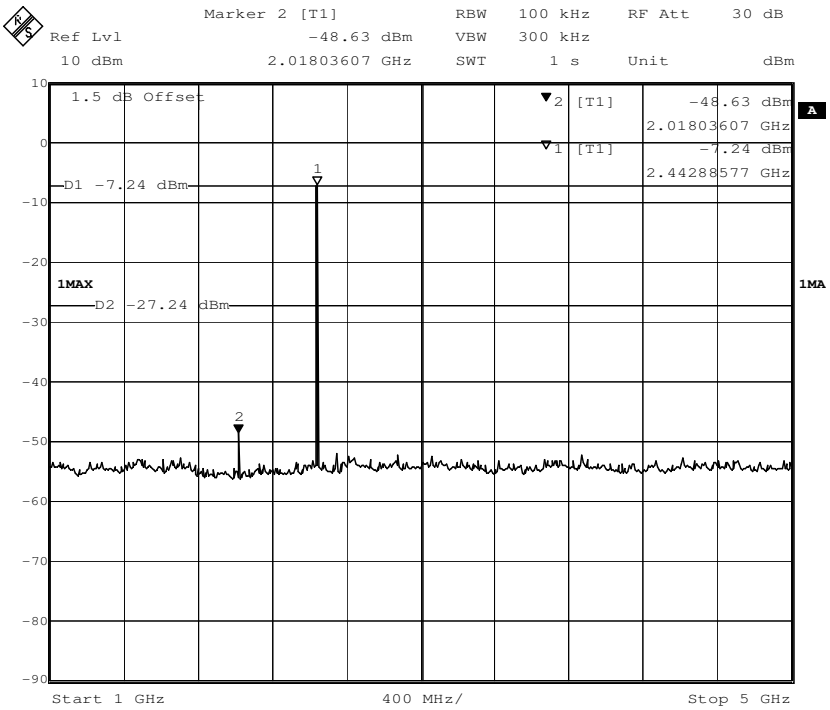
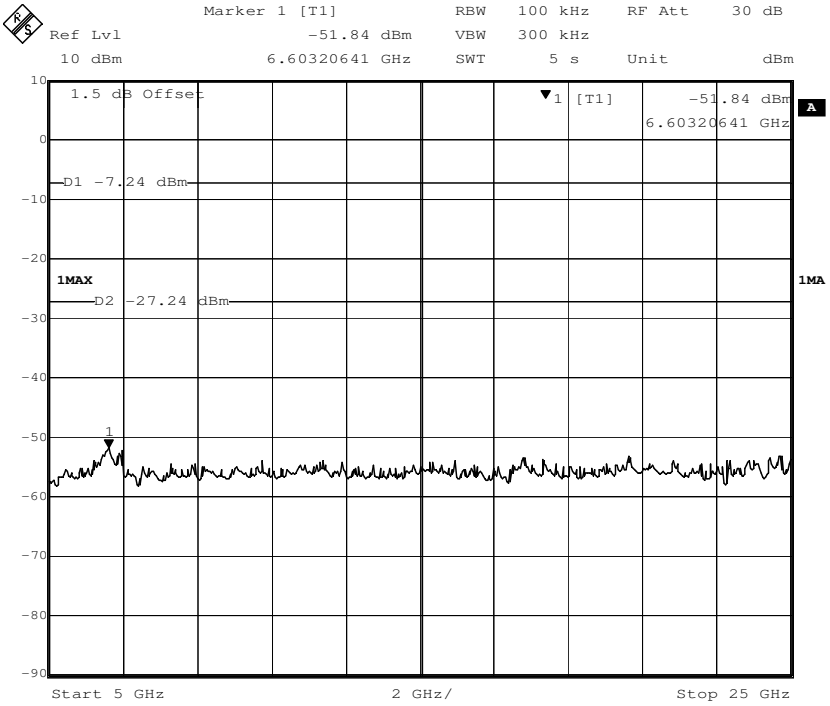
1GHz to 5GHz



5GHz to 25GHz



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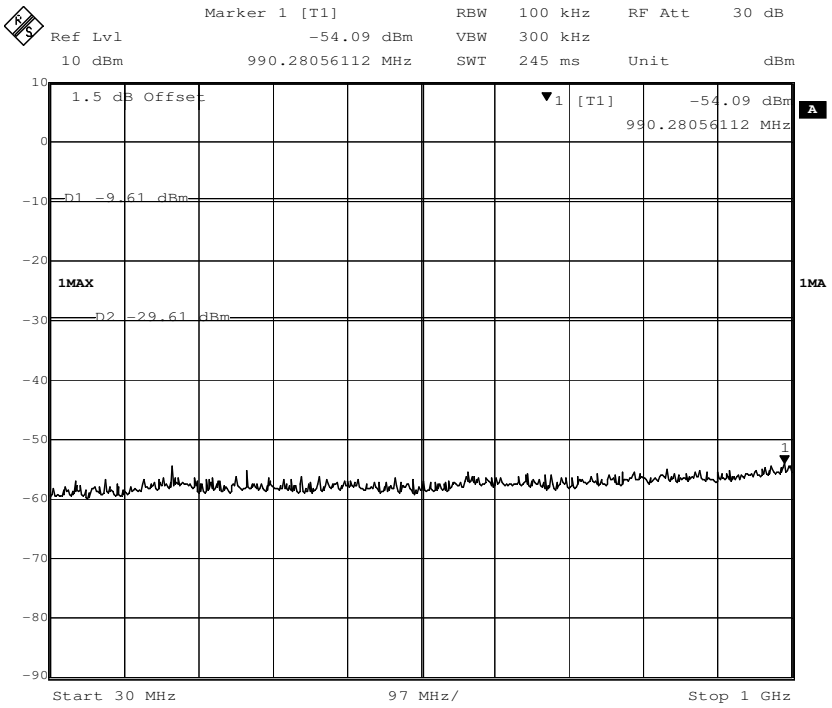
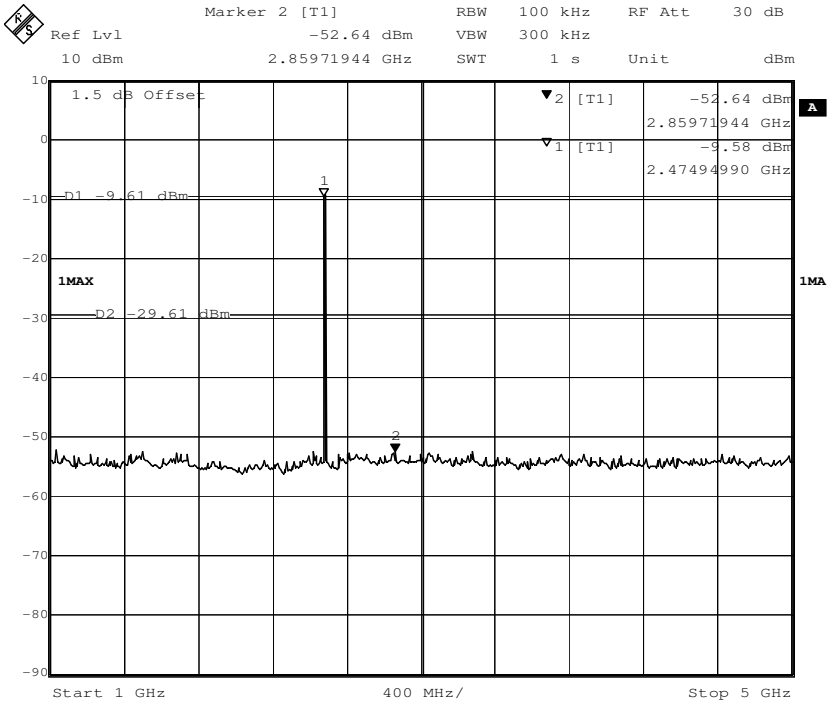
Channel 39:2.480GHz

30 MHz to 1GHz



1GHz to 5GHz



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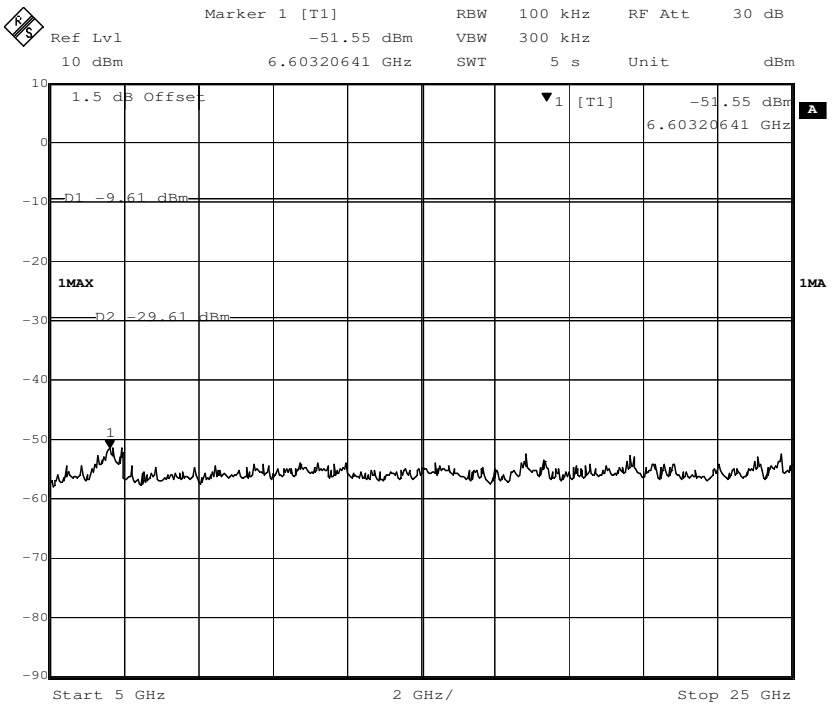
5GHz to 25GHz



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7.7 Radiated Spurious Emissions

Test Requirement:	FCC Part 15 C section 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, and provided the transmitter demonstrates compliance with the peak conducted power limits.
Test Method:	ANSI C63.10: Clause 6.4, 6.5 and 6.6
Test Status:	Enter test mode for the product. Test in lowest channel 2402 MHz and highest channel 2480 MHz, keep in continuously transmitting status with GFSK modulation.
Detector:	For PK value: RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold For AV value: RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz VBW =10Hz Sweep = auto Detector function = peak Trace = max hold
15.209 Limit:	40.0 dBμV/m between 30MHz & 88MHz 43.5 dBμV/m between 88MHz & 216MHz 46.0 dBμV/m between 216MHz & 960MHz 54.0 dBμV/m above 960MHz

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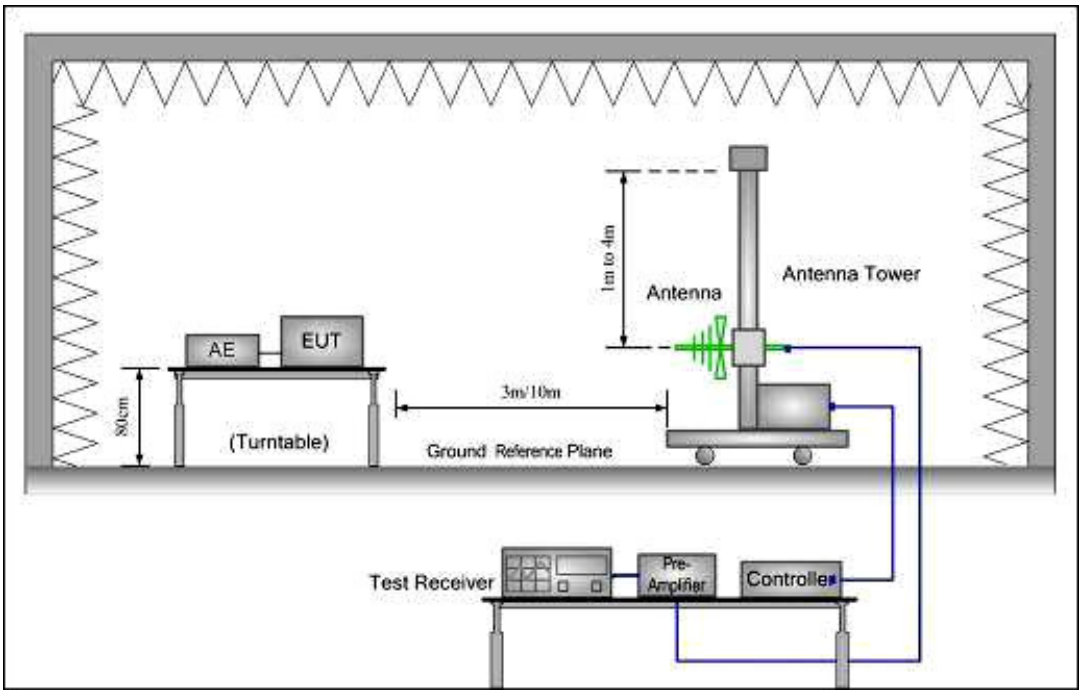
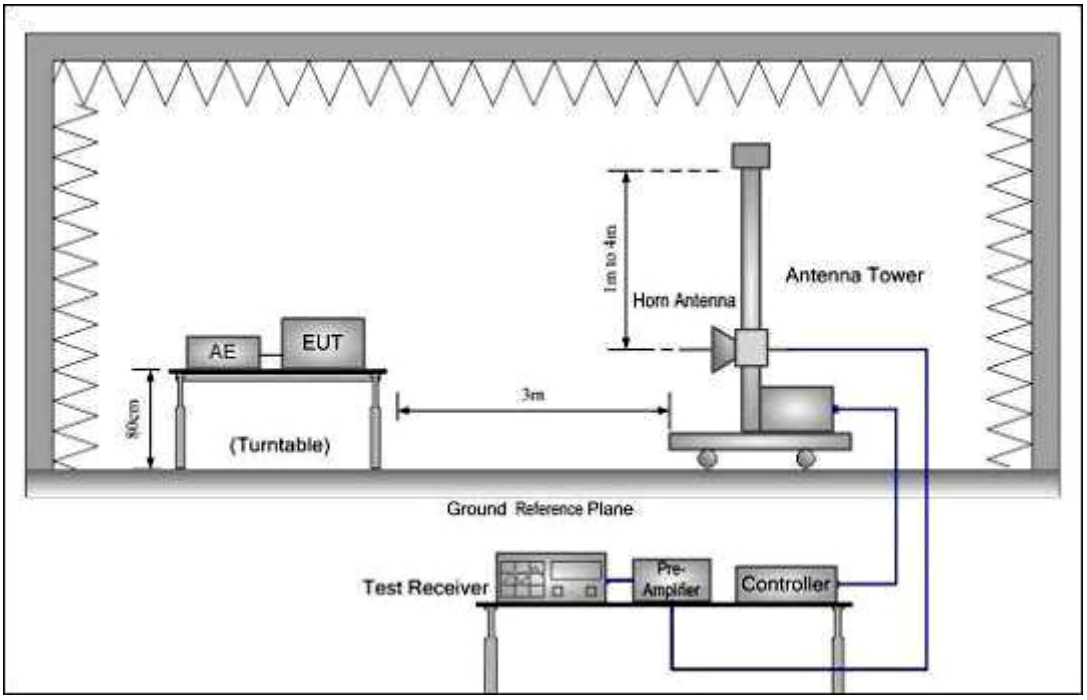
Test Configuration:

1) 30 MHz to 1 GHz emissions:



2) 1 GHz to 40 GHz emissions:



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Test Procedure:

Test site with RF absorbing material covering the ground plane that met the site validation criterion called out in CISPR 16-1-4:2007 was used to perform radiated emission test above 1 GHz.

The receiver scanned from the lowest frequency generated within the EUT to 25GHz.When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. The worst case emissions were reported.

From 30MHz to 1GHz, read the Quasi-Peak field strength of the emissions with receiver QP detector RBW=120KHz.

Above 1GHz, read the Peak field strength and Average field strength.

Read the Peak field strength through RBW=1MHz,VBW=3MHz in spectrum analyzer setting;

Read the Average field strength through RBW=1MHz,VBW=10Hz in spectrum analyzer setting;

While maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the average field strength reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit.

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7.7.1 Harmonic and other spurious emissions

Test at Channel 0 (2.402 GHz) in transmitting status

9 kHz~30 MHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement

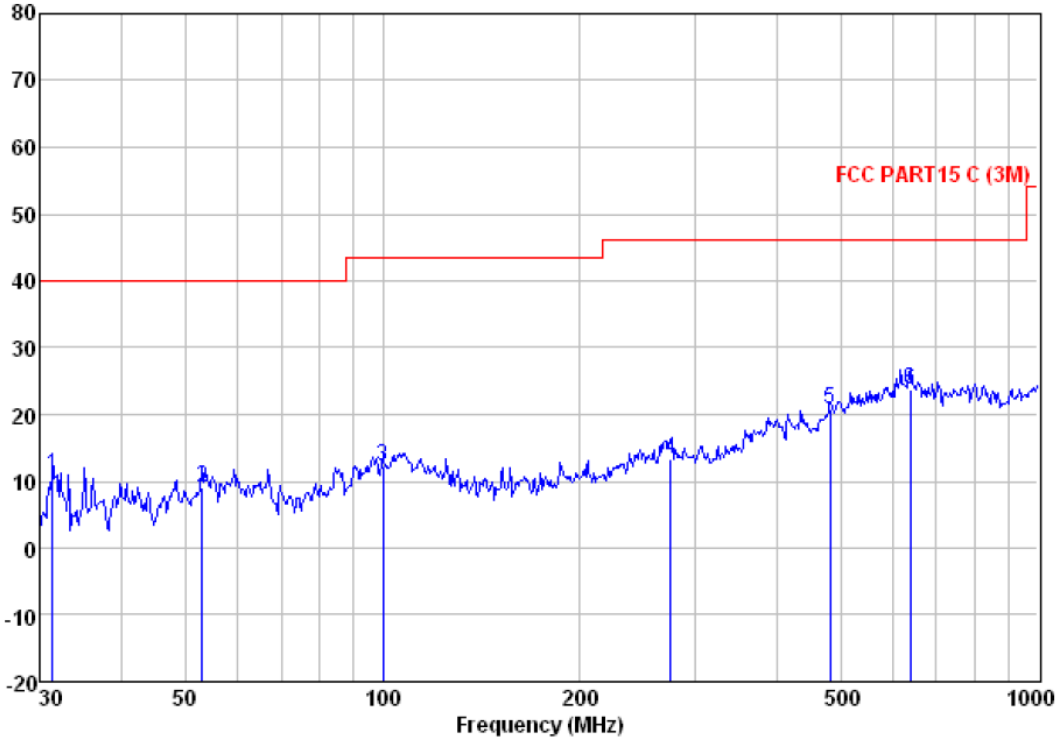
The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Vertical:

Peak scan

Level (dBµV/m)



Quasi-peak measurement

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Correct Factor	Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dB	dBuV/m	dBuV/m	dB	
31.29	29.49	12.32	0.84	31.60	-18.44	11.05	40.00	-28.95	QP
52.95	26.53	13.11	1.04	31.60	-17.45	9.08	40.00	-30.92	QP
99.88	29.20	13.16	1.43	31.60	-17.01	12.19	43.50	-31.31	QP
275.16	29.72	12.55	2.25	31.30	-16.50	13.22	46.00	-32.78	QP
482.22	32.94	16.13	3.04	31.19	-12.02	20.92	46.00	-25.08	QP
638.37	32.99	18.59	3.41	31.26	-9.26	23.73	46.00	-22.27	QP

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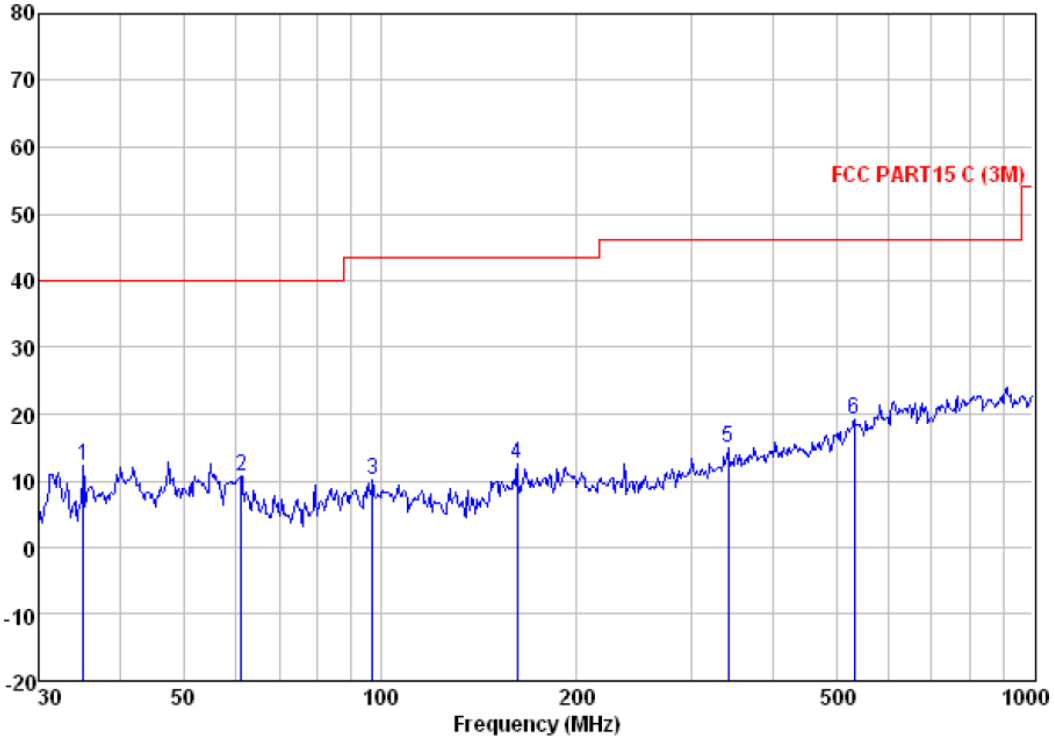
Horizontal:

Peak scan

Level (dBµV/m)



Quasi-peak measurement

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Correct Factor	Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dB	dBuV/m	dBuV/m	dB	
35.00	30.81	12.30	0.88	31.60	-18.42	12.39	40.00	-27.61	QP
61.13	28.79	12.29	1.13	31.60	-18.18	10.61	40.00	-29.39	QP
97.11	27.42	12.97	1.40	31.60	-17.23	10.19	43.50	-33.31	QP
162.04	33.51	8.72	1.76	31.37	-20.89	12.62	43.50	-30.88	QP
340.78	29.35	14.15	2.52	31.21	-14.54	14.81	46.00	-31.19	QP
531.96	30.10	17.20	3.09	31.23	-10.94	19.16	46.00	-26.84	QP

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1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4804.00	31.53	11.11	38.57	39.90	43.97	74.00	V
7206.00	36.47	12.90	38.84	41.95	52.48	74.00	V
9608.00	38.08	15.16	39.70	42.11	55.65	74.00	V
4804.00	31.53	11.11	38.57	43.68	47.75	74.00	H
7206.00	36.47	12.90	38.84	39.19	49.72	74.00	H
9608.00	38.08	15.16	39.70	41.81	55.35	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4804.00	31.53	11.11	38.57	28.73	32.80	54.00	V
7206.00	36.47	12.90	38.84	30.92	41.45	54.00	V
9608.00	38.08	15.16	39.70	30.51	44.05	54.00	V
4804.00	31.53	11.11	38.57	35.63	39.70	54.00	H
7206.00	36.47	12.90	38.84	31.03	41.56	54.00	H
9608.00	38.08	15.16	39.70	33.02	46.56	54.00	H

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Test at Channel20 (2.440 GHz) in transmitting status

9 kHz~30 MHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement

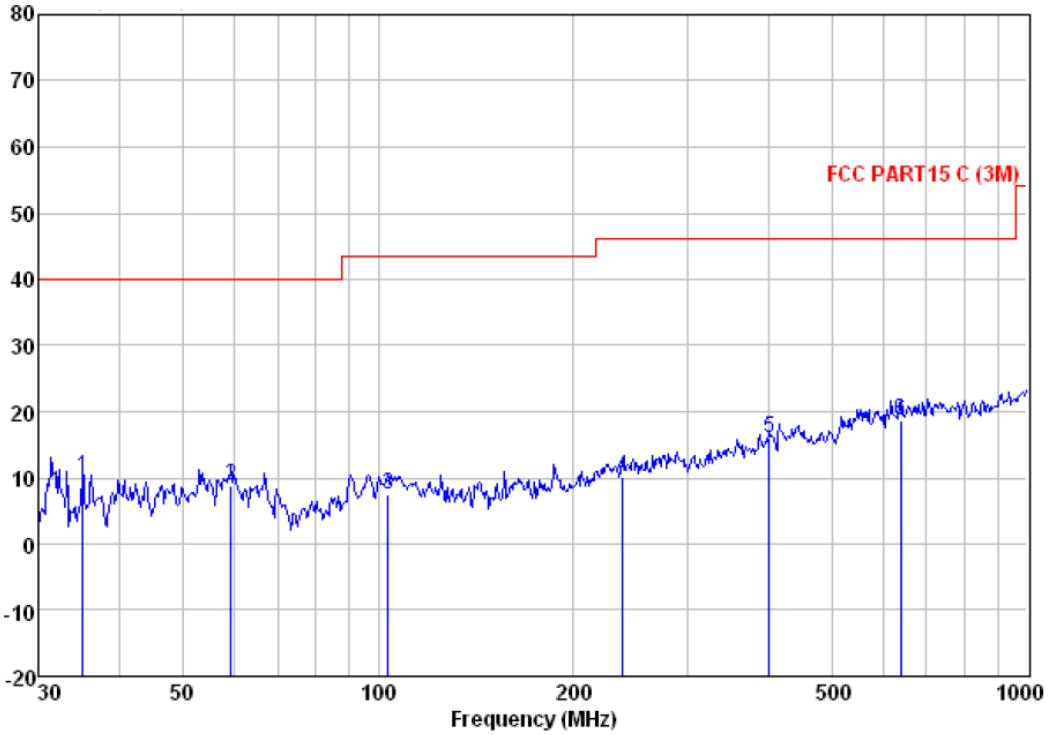
The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Vertical:

Peak scan

Level (dBµV/m)



Quasi-peak measurement

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Correct Factor	Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dB	dBuV/m	dBuV/m	dB	
35.00	28.51	12.30	0.88	31.60	-18.42	10.09	40.00	-29.91	QP
59.23	26.59	12.74	1.11	31.60	-17.75	8.84	40.00	-31.16	QP
103.44	24.92	12.82	1.45	31.59	-17.32	7.60	43.50	-35.90	QP
238.31	27.31	11.99	2.09	31.30	-17.22	10.09	46.00	-35.91	QP
400.43	29.32	15.10	2.71	31.10	-13.29	16.03	46.00	-29.97	QP
638.37	27.99	18.59	3.41	31.26	-9.26	18.73	46.00	-27.27	QP

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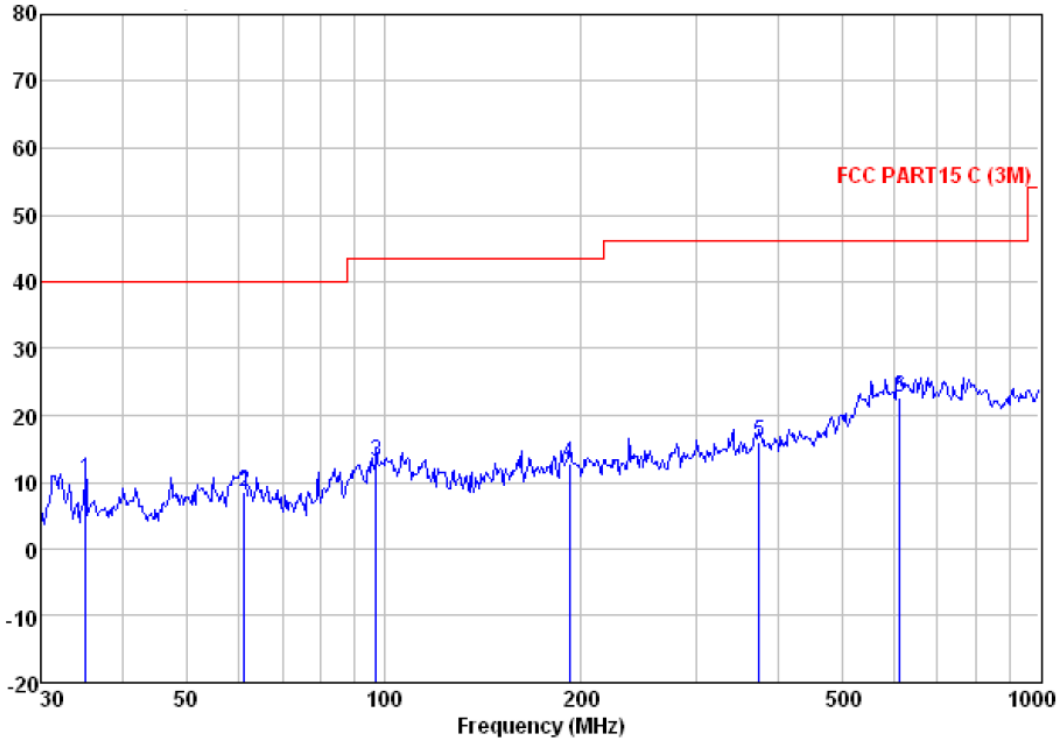
Horizontal:

Peak scan

Level (dBµV/m)



Quasi-peak measurement

Freq	Read Level	Anterna Factor	Cable Loss	Preamp Factor	Correct Factor	Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dB	dBuV/m	dBuV/m	dB	
35.00	28.81	12.30	0.88	31.60	-18.42	10.39	40.00	-29.61	QP
61.13	26.79	12.29	1.13	31.60	-18.18	8.61	40.00	-31.39	QP
97.11	30.42	12.97	1.40	31.60	-17.23	13.19	43.50	-30.31	QP
191.75	31.80	10.56	1.86	31.31	-18.89	12.91	43.50	-30.59	QP
373.31	29.88	14.54	2.63	31.14	-13.97	15.91	46.00	-30.09	QP
612.06	32.25	18.50	3.32	31.29	-9.47	22.78	46.00	-23.22	QP

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1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4880.00	31.58	11.26	38.56	44.08	48.36	74.00	V
7320.00	36.50	13.28	38.88	38.98	49.88	74.00	V
9760.00	38.46	15.05	39.75	40.91	54.67	74.00	V
4880.00	31.58	11.26	38.56	43.80	48.08	74.00	H
7320.00	36.50	13.28	38.88	38.87	49.77	74.00	H
9760.00	38.46	15.05	39.75	40.66	54.42	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4880.00	31.58	11.26	38.56	37.12	41.40	54.00	V
7320.00	36.50	13.28	38.88	32.25	43.15	54.00	V
9760.00	38.46	15.05	39.75	32.67	46.43	54.00	V
4880.00	31.58	11.26	38.56	34.63	38.91	54.00	H
7320.00	36.50	13.28	38.88	30.28	41.18	54.00	H
9760.00	38.46	15.05	39.75	30.44	44.20	54.00	H

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Test at Channel39 (2.480 GHz) in transmitting status

9 kHz~30 MHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement

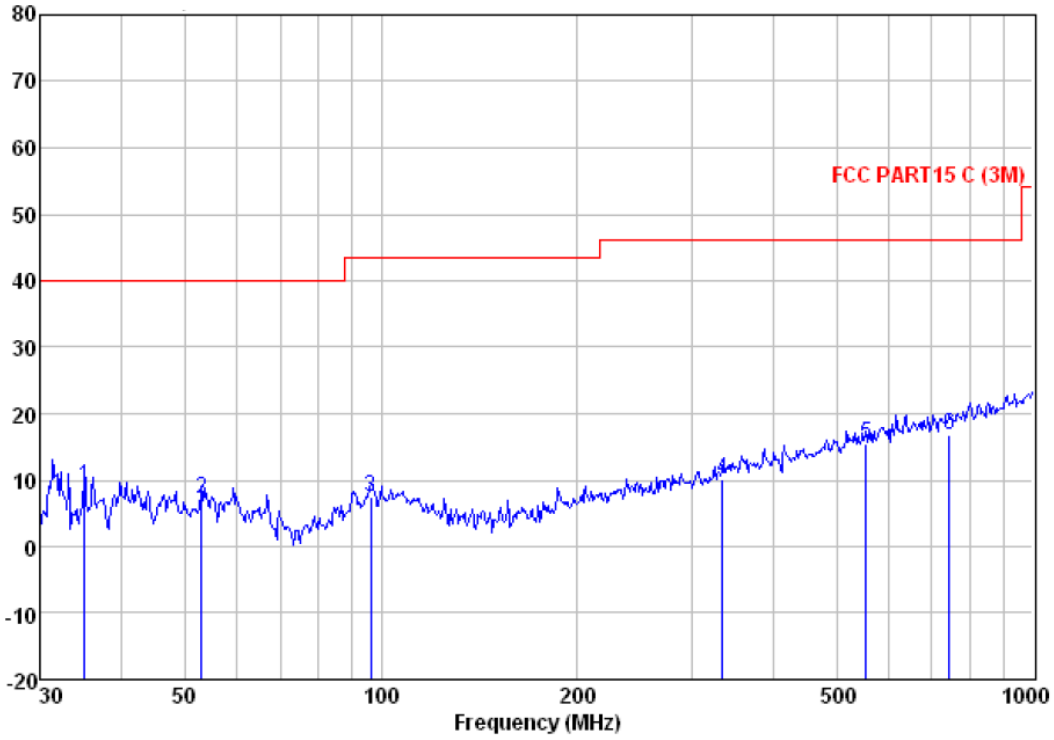
The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Vertical:

Peak scan

Level (dBµV/m)



Quasi-peak measurement

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Correct Factor	Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dB	dBuV/m	dBuV/m	dB	
35.00	27.51	12.30	0.88	31.60	-18.42	9.09	40.00	-30.91	QP
52.95	24.53	13.11	1.04	31.60	-17.45	7.08	40.00	-32.92	QP
96.44	24.77	12.94	1.40	31.60	-17.26	7.51	43.50	-35.99	QP
333.69	24.98	13.92	2.49	31.22	-14.81	10.17	46.00	-35.83	QP
554.83	25.82	17.67	3.11	31.26	-10.48	15.34	46.00	-30.66	QP
744.87	24.98	19.39	3.69	31.20	-8.12	16.86	46.00	-29.14	QP

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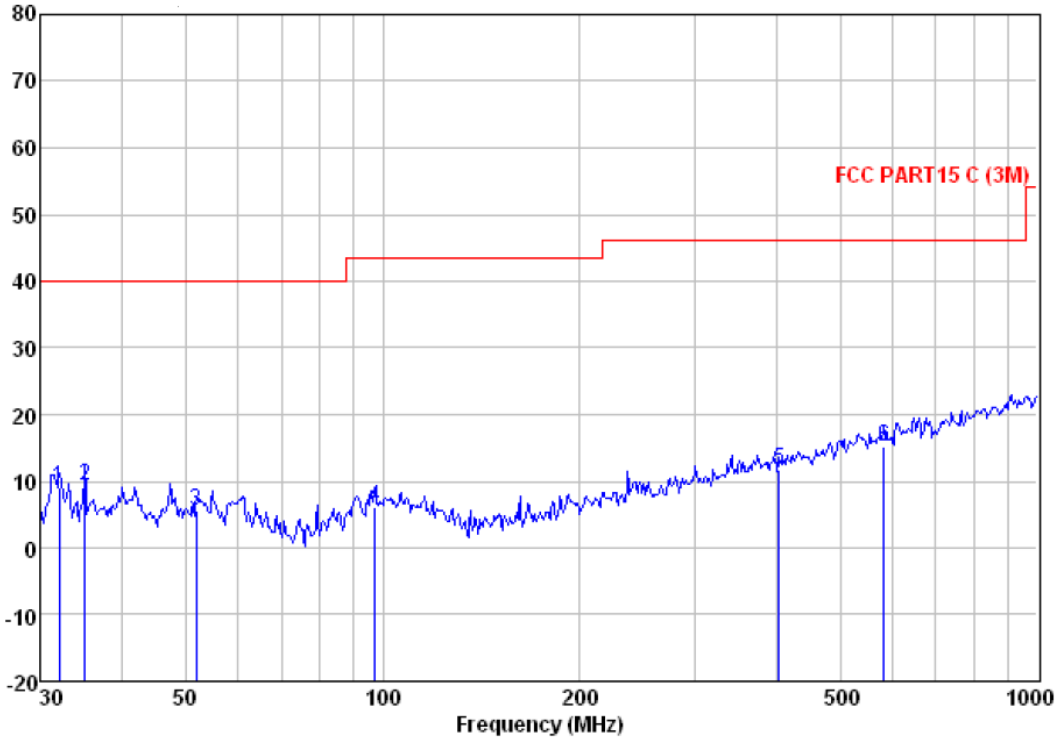
Horizontal:

Peak scan

Level (dBµV/m)



Quasi-peak measurement

Freq	Read Level	Anterna Factor	Cable Loss	Preamp Factor	Correct Factor	Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dB	dBuV/m	dBuV/m	dB	
31.95	27.56	12.32	0.85	31.60	-18.43	9.13	40.00	-30.87	QP
35.00	27.81	12.30	0.88	31.60	-18.42	9.39	40.00	-30.61	QP
51.84	23.10	13.16	1.02	31.60	-17.42	5.68	40.00	-34.32	QP
97.11	23.42	12.97	1.40	31.60	-17.23	6.19	43.50	-37.31	QP
403.25	24.94	15.14	2.72	31.10	-13.24	11.70	46.00	-34.30	QP
582.74	25.22	18.14	3.22	31.29	-9.93	15.29	46.00	-30.71	QP

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1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4960.00	31.70	11.39	38.56	44.56	49.09	74.00	V
7440.00	36.60	13.60	38.91	40.41	51.70	74.00	V
9920.00	38.65	14.92	39.78	42.34	56.13	74.00	V
4960.00	31.70	11.39	38.56	38.16	42.69	74.00	H
7440.00	36.60	13.60	38.91	33.61	44.90	74.00	H
9920.00	38.65	14.92	39.78	40.97	54.76	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4960.00	31.70	11.39	38.56	37.28	41.81	54.00	V
7440.00	36.60	13.60	38.91	34.22	45.51	54.00	V
9920.00	38.65	14.92	39.78	32.85	46.64	54.00	V
4960.00	31.70	11.39	38.56	28.03	32.56	54.00	H
7440.00	36.60	13.60	38.91	24.63	35.92	54.00	H
9920.00	38.65	14.92	39.78	33.24	47.03	54.00	H

Remark:

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

Final Test Level =Receiver Reading + Antenna Factor + Cable Loss –Preamplifier Factor.

2). As shown in Section, for frequencies above 1000 MHz. the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

3). The test only perform the EUT in transmitting status since the test frequencies were over 1GHz only required transmitting status.

Test result: The unit does meet the FCC requirements.

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7.7.2 Radiated Emissions which fall in the restricted bands

Test Requirement:	FCC Part 15 C section 15.247 (d) 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)).
Test Method:	ANSI C63.10: Clause 6.4, 6.5 and 6.6
Test Status:	Enter test mode for the product. Test in lowest channel 2402 MHz and highest channel 2480 MHz, keep in continuously transmitting status with GFSK modulation.
Test site:	Measurement Distance: 3m (Semi-Anechoic Chamber)
Limit:	40.0 dBμV/m between 30MHz & 88MHz; 43.5 dBμV/m between 88MHz & 216MHz; 46.0 dBμV/m between 216MHz & 960MHz; 54.0 dBμV/m above 960MHz.
Detector:	For PK value: RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold For AV value: RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz VBW =10Hz Sweep = auto Detector function = peak Trace = max hold

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Section 15.205 Restricted bands of operation.

(a) Except as shown in paragraph (d) of this section. only spurious emissions are permitted in any of the frequency bands listed below:

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 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	
13.36 - 13.41	322 - 335.4		

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Test Result:

Test at lowest Channel (2.402 GHz) in transmitting status

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
2310.00	27.93	6.52	38.23	45.98	42.20	74.00	Vertical
2390.00	27.63	6.55	38.25	47.98	43.91	74.00	V
2483.50	27.55	6.99	38.26	47.07	43.35	74.00	V
2500.00	27.55	7.02	38.26	48.03	44.34	74.00	V
2310.00	27.93	6.52	38.23	43.50	39.72	74.00	Horizontal
2390.00	27.63	6.55	38.25	45.76	41.69	74.00	H
2483.50	27.55	6.99	38.26	46.60	42.88	74.00	H
2500.00	27.55	7.02	38.26	47.29	43.60	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
2310.00	27.93	6.52	38.23	37.41	33.63	54.00	Vertical
2390.00	27.63	6.55	38.25	38.09	34.02	54.00	V
2483.50	27.55	6.99	38.26	38.32	34.60	54.00	V
2500.00	27.55	7.02	38.26	38.05	34.36	54.00	V
2310.00	27.93	6.52	38.23	39.44	35.66	54.00	Horizontal
2390.00	27.63	6.55	38.25	40.32	36.25	54.00	H
2483.50	27.55	6.99	38.26	42.29	38.57	54.00	H
2500.00	27.55	7.02	38.26	40.39	36.70	54.00	H

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Test at middle Channel(2.440 GHz) in transmitting status

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
2310.00	27.93	6.52	38.23	44.75	40.97	74.00	Vertical
2390.00	27.63	6.55	38.25	45.90	41.83	74.00	V
2483.50	27.55	6.99	38.26	48.21	44.49	74.00	V
2500.00	27.55	7.02	38.26	48.86	45.17	74.00	V
2310.00	27.93	6.52	38.23	44.69	40.91	74.00	Horizontal
2390.00	27.63	6.55	38.25	45.73	41.66	74.00	H
2483.50	27.55	6.99	38.26	46.70	42.98	74.00	H
2500.00	27.55	7.02	38.26	48.37	44.68	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
2310.00	27.93	6.52	38.23	38.38	34.60	54.00	Vertical
2390.00	27.63	6.55	38.25	38.31	34.24	54.00	V
2483.50	27.55	6.99	38.26	39.86	36.14	54.00	V
2500.00	27.55	7.02	38.26	39.96	36.27	54.00	V
2310.00	27.93	6.52	38.23	38.20	34.42	54.00	Horizontal
2390.00	27.63	6.55	38.25	40.63	36.56	54.00	H
2483.50	27.55	6.99	38.26	40.47	36.75	54.00	H
2500.00	27.55	7.02	38.26	41.20	37.51	54.00	H

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Test at highest Channel (2.480 GHz) in transmitting status

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
2310.00	27.93	6.52	38.23	45.68	41.90	74.00	Vertical
2390.00	27.63	6.55	38.25	46.52	42.45	74.00	V
2483.50	27.55	6.99	38.26	48.05	44.33	74.00	V
2500.00	27.55	7.02	38.26	47.95	44.26	74.00	V
2310.00	27.93	6.52	38.23	44.74	40.96	74.00	Horizontal
2390.00	27.63	6.55	38.25	47.38	43.31	74.00	H
2483.50	27.55	6.99	38.26	53.16	49.44	74.00	H
2500.00	27.55	7.02	38.26	51.40	47.71	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
2310.00	27.93	6.52	38.23	38.00	34.22	54.00	Vertical
2390.00	27.63	6.55	38.25	39.28	35.21	54.00	V
2483.50	27.55	6.99	38.26	38.15	34.43	54.00	V
2500.00	27.55	7.02	38.26	40.49	36.80	54.00	V
2310.00	27.93	6.52	38.23	40.88	37.10	54.00	Horizontal
2390.00	27.63	6.55	38.25	40.72	36.65	54.00	H
2483.50	27.55	6.99	38.26	38.25	34.53	54.00	H
2500.00	27.55	7.02	38.26	37.53	33.84	54.00	H

Remark: above table only record the worse data of emissions in restricted frequency bands.

Test result: The unit does meet the FCC requirements.

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7.8 Band Edges Requirement

Test Requirement: FCC Part 15 C section 15.247

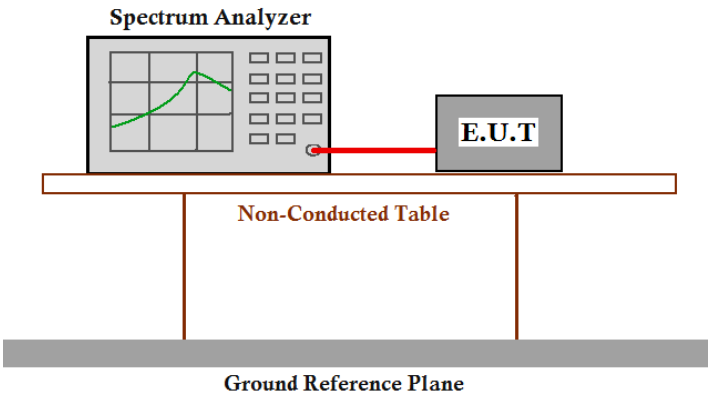
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating. The radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains 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.

Frequency Band: 2400 MHz to 2483.5 MHz

Test Method: ANSI C63.10: Clause 6.10.5.2

Test Status: Enter test mode for the product. Test in lowest channel 2402 MHz and highest channel 2480 MHz, keep in continuously transmitting status with GFSK modulation.

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum analyzer or power meter.
2. Set instrument center frequency to the frequency of the emission to be measured(must be within 2MHz of the authorized band edge).
3. Set span to 2MHz,
4. RBW=100kHz,
5. VBW≥3×RBW
6. Detector=peak
7. Sweep time =auto,

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8. Trace mode=max hold.
9. Allow sweep to continue until the trace stabilizes(required measurement time may increase for low duty cycle applications)
10. Compute the power by integrating the spectrum over 1MHz using the analyzer's band power measurement function with band limits set equal to the emission frequency($f_{emission}$)±0.5MHz.If the instrument does not have a band power function,the sum the amplitude levels(in power units) at 100kHz intervals extending across the 1MHz spectrum defined by femission±0.5MHz.

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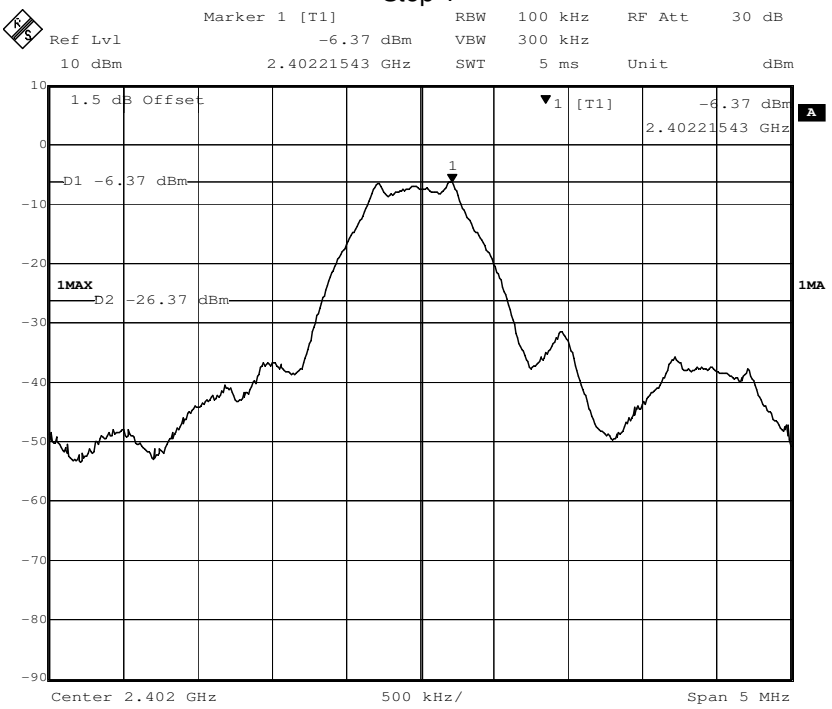
Test result with plots as follows:

Compare with the output power of the lowest frequency, the Lower Edges attenuated more than 20dB
Compare with the output power of the highest frequency, the Upper Edges attenuated more than 20dB.

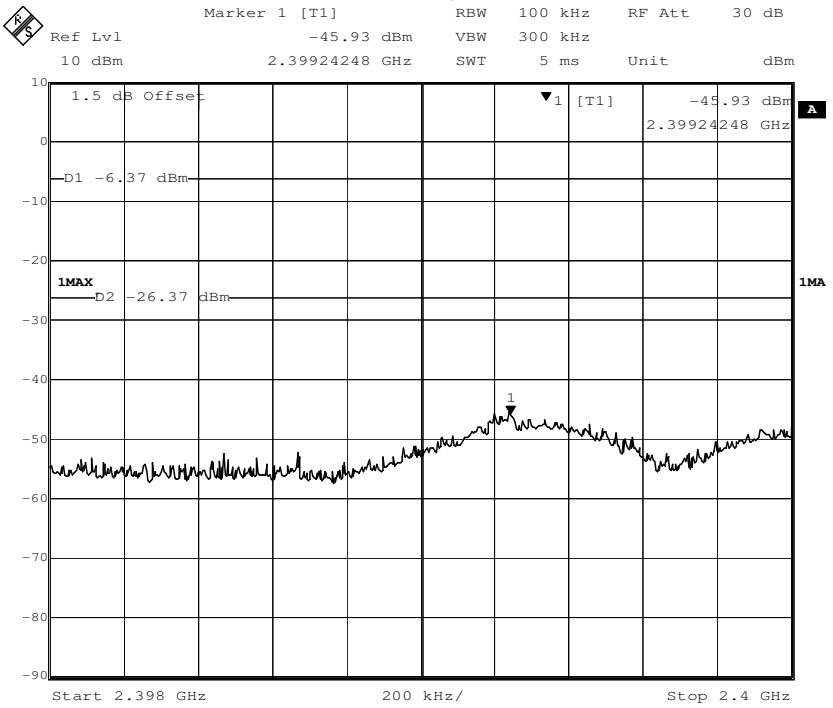
Result plot as follows:

Channel 0: 2.402 GHz

Step 1



Step 2



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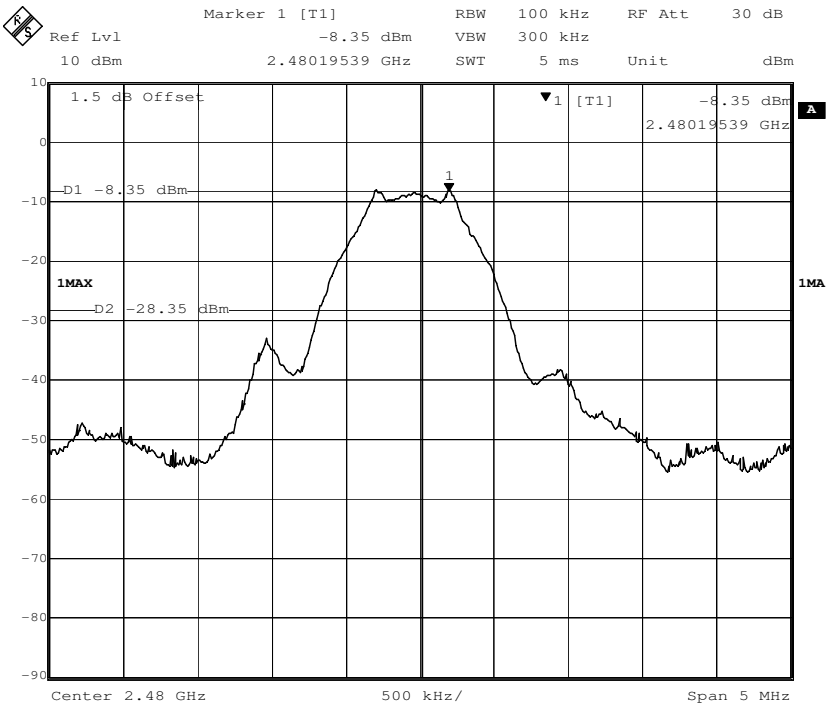
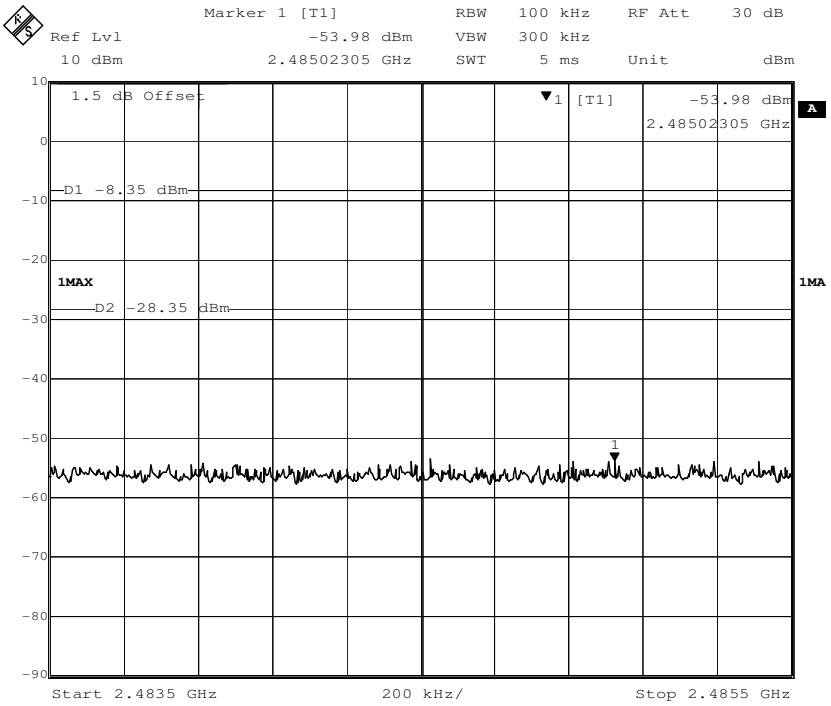
Channel 39: 2.480GHz

Step 1



Step 2



--End of Report--

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