SGS-CSTC Standards Technical Services Ltd.

No. 1 Workshop, M-10, Middle section, Science & Technology Park, Nanshan District, Shenzhen, Guangdong, China 518057

Telephone: +86 (0) 755 2601 2053
Fax: +86 (0) 755 2671 0594
Email: ee.shenzhen@sgs.com

FCC REPORT

Application No:	SZEM1405002742RF
Applicant:	Sherwood Southwest, LLC
Manufacturer:	Sherwood Southwest, LLC
Factory:	Providence Enterprise Limited
Product Name:	MFRM HUB
Model No.(EUT):	E-Hub
FCC ID:	2ADEU065800
Standards:	47 CFR Part 15, Subpart C (2013)
Date of Receipt:	2014-08-07
Date of Test:	2014-10-17 to 2014-11-04
Date of Issue:	2014-11-10
Test Result:	**PASS ***

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:

Jack Zhang
EMC Laboratory 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. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.
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.

2 Version

Revision Record				
Version	**Chapter**	**Date**	**Modifier**	**Remark**
00		2014-11-10		Original

Authorized for issue by:				
Tested By		 **(Jim Huang) /Project Engineer**		2014-11-04 **Date**
Prepared By		 **(Link Liang) /Clerk**		2014-11-10 **Date**
Checked By		 **(Emen Li) /Reviewer**		2014-11-14 **Date**

3 Test Summary

Test Item	Test Requirement	Test method	Result
Antenna Requirement	47 CFR Part 15, Subpart C Section 15.203/15.247 (c)	ANSI C63.10 2009	PASS
AC Power Line Conducted Emission	47 CFR Part 15, Subpart C Section 15.207	ANSI C63.10 2009	PASS
Conducted Peak Output Power	47 CFR Part 15, Subpart C Section 15.247 (b)(3)	KDB558074 D01 v03r02	PASS
6dB Occupied Bandwidth	47 CFR Part 15, Subpart C Section 15.247 (a)(2)	KDB558074 D01 v03r02	PASS
Power Spectral Density	47 CFR Part 15, Subpart C Section 15.247 (e)	KDB558074 D01 v03r02	PASS
Band-edge for RF Conducted Emissions	47 CFR Part 15, Subpart C Section 15.247(d)	KDB558074 D01 v03r02	PASS
RF Conducted Spurious Emissions	47 CFR Part 15, Subpart C Section 15.247(d)	KDB558074 D01 v03r02	PASS
Radiated Spurious Emissions	47 CFR Part 15, Subpart C Section 15.205/15.209	ANSI C63.10 2009	PASS
Restricted bands around fundamental frequency (Radiated Emission)	47 CFR Part 15, Subpart C Section 15.205/15.209	ANSI C63.10 2009	PASS

4 Contents

5 General Information

5.1 Client Information

Applicant:	Sherwood Southwest, LLC
Address of Applicant:	2830 NE 29th Street, Ft. Lauderdale, FL 33306
Manufacturer:	Sherwood Southwest, LLC
Address of Manufacturer:	1825 W. Beltline Road, Suite 100 Carrollton, Texas 75006
Factory:	Providence Enterprise Limited
Address of Factory:	No.5-4 NeiHuan Road, shanxia Community, Pinghu Street, Longgang District, Shenzhen, China

5.2 General Description of EUT

Product Name:	MFRM HUB
Model No.:	E-Hub
Operation Frequency:	2405MHz~2480MHz
Modulation Type:	DSSS(O-QPSK)
Number of Channel:	16
Sample Type:	Fixed production
Antenna Type:	Integral
Antenna Gain:	3.3dBi
AC adapter:	AC/DC adaptor model: YLS0121A-T050200 Input: 100-240V~50/60Hz 0.5A Max Output: 5.0V 2.0A
Test Voltage:	AC 120V 60Hz
AC power cable:	150cm(unshield)

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2405MHz	5	2425MHz	9	2445MHz	13	2465MHz
2	2410MHz	6	2430MHz	10	2450MHz	14	2470MHz
3	2415MHz	7	2435MHz	11	2455MHz	15	2475MHz
4	2420MHz	8	2440MHz	12	2460MHz	16	2480MHz

Note:
In section 15.31(m), regards to the operating frequency range over 10 MHz, the lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The Lowest channel	2405MHz
The Middle channel	2445MHz
The Highest channel	2480MHz

5.3 Test Environment

Operating Environment:	
Temperature:	20.0 °C
Humidity:	50 % RH
Atmospheric Pressure:	995mbar

5.4 Description of Support Units

The EUT has been tested independent unit.

5.5 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen Branch E&E Lab,
No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China. 518057.
Tel: +86 755 2601 2053 Fax: +86 755 2671 0594
No tests were sub-contracted.

5.6 Test Facility

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

- **CNAS (No. CNAS L2929)**

  CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

- **VCCI**

  The 3m Semi-anechoic chamber, Full-anechoic Chamber and Shielded Room (7.5m x 4.0m x 3.0m) of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-2197, G-416, T-1153 and C-2383 respectively.

- **FCC – Registration No.: 556682**

  SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen 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 No.: 556682.

- **Industry Canada (IC)**

  Two 3m Semi-anechoic chambers of SGS-CSTC Standards Technical Services Co., Ltd. have been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1 & 4620C-2.

5.7 Deviation from Standards

None.

5.8 Abnormalities from Standard Conditions

None.

5.9 Other Information Requested by the Customer

None.

5.10 Equipment List

Conducted Emission					
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Due date (yyyy-mm-dd)**
1	Shielding Room	ZhongYu Electron	GB-88	SEL0042	2015-06-10
2	LISN	Rohde & Schwarz	ENV216	SEL0152	2015-10-24
3	LISN	ETS-LINDGREN	3816/2	SEL0021	2015-05-16
4	8 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T8-02	SEL0162	2015-08-30
5	4 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T4-02	SEL0163	2015-08-30
6	2 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T2-02	SEL0164	2015-08-30
7	EMI Test Receiver	Rohde & Schwarz	ESCI	SEL0022	2015-05-16
8	Coaxial Cable	SGS	N/A	SEL0025	2015-05-29
9	DC Power Supply	Zhao Xin	RXN-305D	SEL0117	2015-10-24
10	Humidity/ Temperature Indicator	Shanhai Qixiang	ZJ1-2B	SEL0103	2015-10-24
11	Barometer	Chang Chun	DYM3	SEL0088	2015-05-16

RE in Chamber					
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Due date (yyyy-mm-dd)**
1	3m Semi-Anechoic Chamber	ETS-LINDGREN	N/A	SEL0017	2015-06-10
2	EMI Test Receiver	Agilent Technologies	N9038A	SEL0312	2015-09-16
3	EMI Test software	AUDIX	E3	SEL0050	N/A
4	BiConiLog Antenna (26-3000MHz)	ETS-LINDGREN	3142C	SEL0015	2015-10-24
5	Double-ridged horn (1-18GHz)	ETS-LINDGREN	3117	SEL0006	2015-10-24
6	Horn Antenna (18-26GHz)	ETS-LINDGREN	3160	SEL0076	2015-10-24
7	Pre-amplifier (0.1-1300MHz)	Agilent Technologies	8447D	SEL0053	2015-05-16
8	Pre-Amplifier (0.1-26.5GHz)	Compliance Directions Systems Inc.	PAP-0126	SEL0168	2015-10-24
9	Coaxial cable	SGS	N/A	SEL0027	2015-05-29
10	Coaxial cable	SGS	N/A	SEL0189	2015-05-29
11	Coaxial cable	SGS	N/A	SEL0121	2015-05-29
12	Coaxial cable	SGS	N/A	SEL0178	2015-05-29
13	Band filter	Amindeon	82346	SEL0094	2015-05-16
14	Barometer	Chang Chun	DYM3	SEL0088	2015-05-16
15	DC Power Supply	Zhao Xin	RXN-305D	SEL0117	2015-10-24
16	Humidity/ Temperature Indicator	Shanhai Qixiang	ZJ1-2B	SEL0103	2015-10-24
17	Signal Generator (10M-27GHz)	Rohde & Schwarz	SMR27	SEL0067	2015-05-16
18	Signal Generator	Rohde & Schwarz	SMY01	SEL0155	2015-10-24
19	Loop Antenna	Beijing Daze	ZN30401	SEL0203	2015-06-04

RF connected test					
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Due date (yyyy-mm-dd)**
1	DC Power Supply	Zhao Xin	RXN-305D	SEL0117	2015-10-24
2	Humidity/ Temperature Indicator	HYGRO	ZJ1-2B	SEL0033	2015-10-24
3	Spectrum Analyzer	Rohde & Schwarz	FSP	SEL0154	2015-10-24
4	Coaxial cable	SGS	N/A	SEL0178	2015-05-29
5	Coaxial cable	SGS	N/A	SEL0179	2015-05-29
6	Barometer	ChangChun	DYM3	SEL0088	2015-05-16
7	Signal Generator	Rohde & Schwarz	SML03	SEL0068	2015-05-16
8	Band filter	amideon	82346	SEL0094	2015-05-16
9	POWER METER	R & S	NRVS	SEL0144	2015-10-24
10	Attenuator	Beijin feihang taida	TST-2-6dB	SEL0205	2015-05-16
11	Power Divider(splitter)	Agilent Technologies	11636B	SEL0130	2015-10-24

Note: The calibration interval is one year, all the instruments are valid.

6 Test results and Measurement Data

6.1 Antenna Requirement

Standard requirement:	47 CFR Part 15C Section 15.203 /247(c)

15.203 requirement:

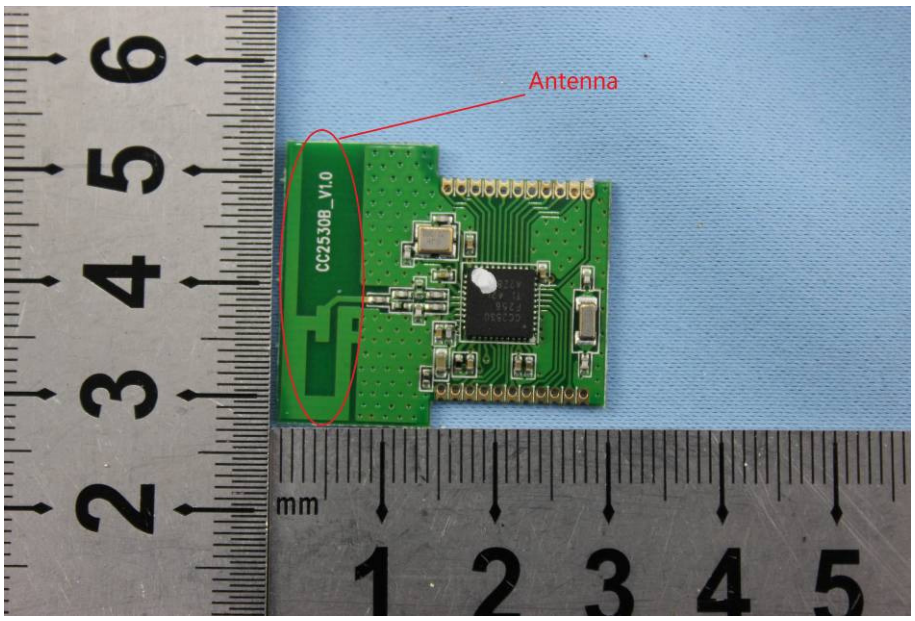
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. 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.

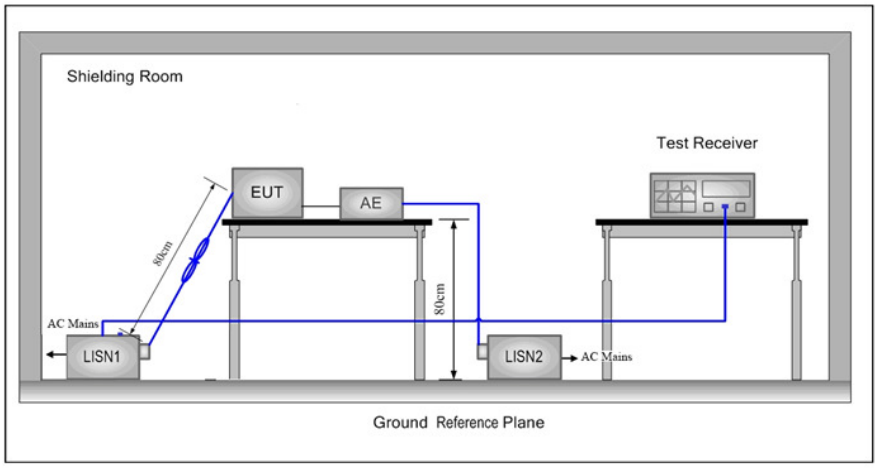
EUT Antenna:	

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 3.3dBi.



6.2 Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.207
Test Method:	ANSI C63.10: 2009
Test Frequency Range:	150kHz to 30MHz
Limit:	Frequency range (MHz) / Limit (dBuV): Quasi-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.
Test Procedure:	1) The mains terminal disturbance voltage test was conducted in a shielded room. 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded. 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2. 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2009 on conducted measurement.

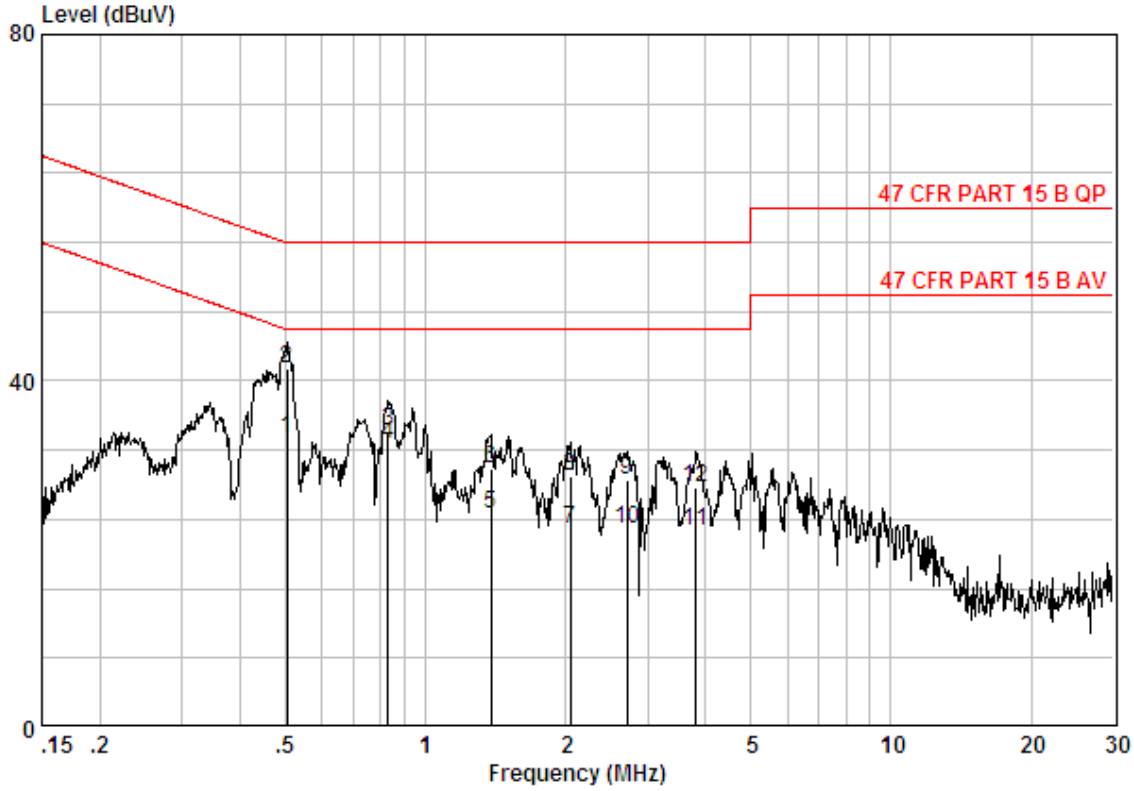
Test Setup:	
Test Mode:	Transmitting mode
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

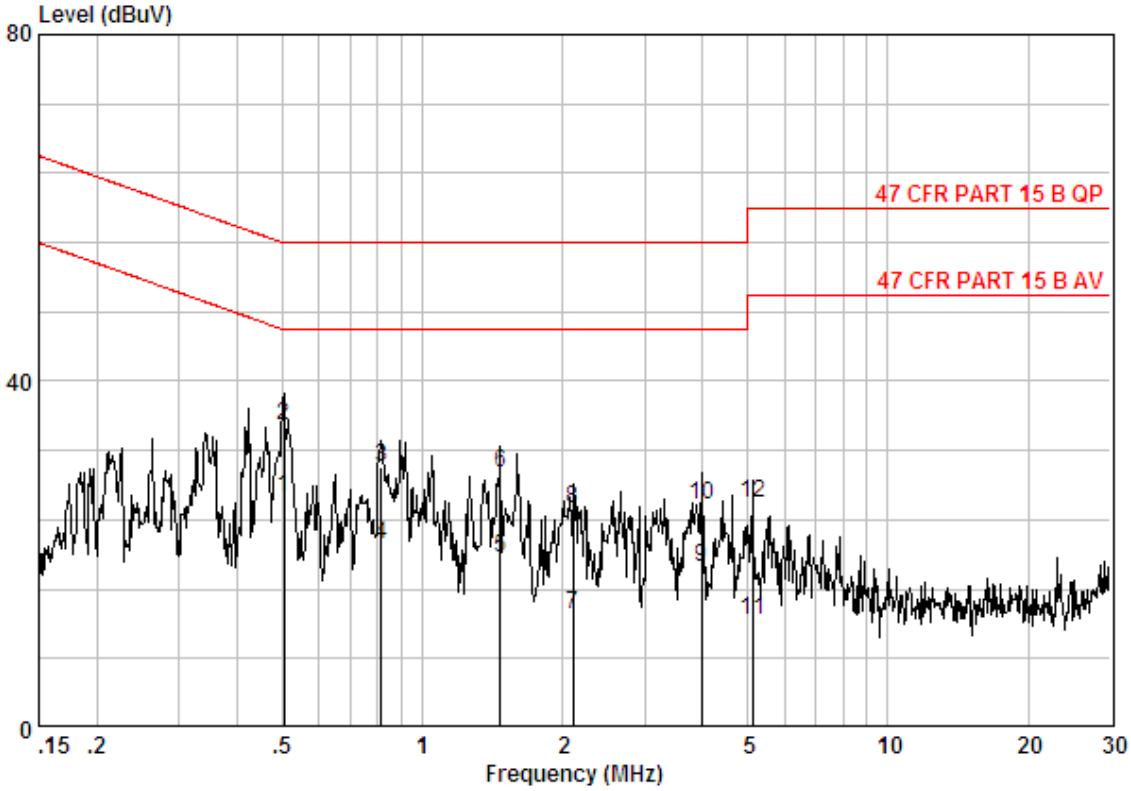
Live line:



Site : Shielding Room
Condition : 47 CFR PART 15 B QP CE LINE
Job.No : 2742RF
Mode : Zigbee mode

	Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1 @	0.50469	0.01	9.80	23.65	33.46	46.00	-12.54	Average
2	0.50469	0.01	9.80	31.68	41.49	56.00	-14.51	QP
3	0.83047	0.02	9.80	24.41	34.23	56.00	-21.77	QP
4	0.83047	0.02	9.80	22.90	32.72	46.00	-13.28	Average
5	1.381	0.02	9.80	14.92	24.74	46.00	-21.26	Average
6	1.381	0.02	9.80	19.98	29.80	56.00	-26.20	QP
7	2.044	0.02	9.80	13.07	22.90	46.00	-23.10	Average
8	2.044	0.02	9.80	19.26	29.08	56.00	-26.92	QP
9	2.707	0.02	9.83	18.67	28.52	56.00	-27.48	QP
10	2.707	0.02	9.83	12.98	22.83	46.00	-23.17	Average
11	3.820	0.02	9.87	12.87	22.75	46.00	-23.25	Average
12	3.820	0.02	9.87	17.82	27.70	56.00	-28.30	QP

Neutral line:



Site : Shielding Room
Condition : 47 CFR PART 15 B QP CE NEUTRAL
Job.No : 2742RF
Mode : Zigbee mode

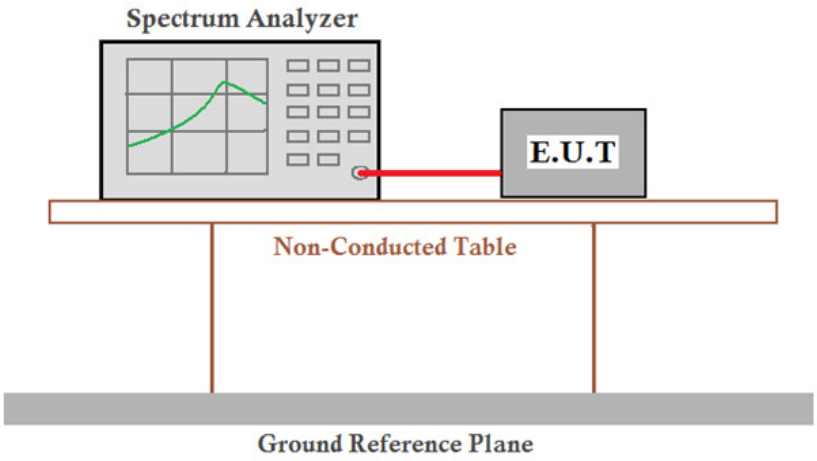
	Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1	0.50469	0.01	9.80	16.86	26.67	46.00	-19.33	Average
2	0.50469	0.01	9.80	25.01	34.82	56.00	-21.18	QP
3	0.81737	0.02	9.80	20.35	30.17	56.00	-25.83	QP
4	0.81737	0.02	9.80	11.38	21.20	46.00	-24.80	Average
5	1.472	0.02	9.80	9.74	19.56	46.00	-26.44	Average
6	1.472	0.02	9.80	19.69	29.51	56.00	-26.49	QP
7	2.110	0.02	9.81	3.29	13.12	46.00	-32.88	Average
8	2.110	0.02	9.81	15.53	25.36	56.00	-30.64	QP
9	3.985	0.02	9.88	8.58	18.47	46.00	-27.53	Average
10	3.985	0.02	9.88	15.84	25.73	56.00	-30.27	QP
11	5.112	0.01	9.91	2.59	12.51	50.00	-37.49	Average
12	5.112	0.01	9.91	15.96	25.88	60.00	-34.12	QP

Notes:

1. The following Quasi-Peak and Average measurements were performed on the EUT:

2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.

6.3 Conducted Peak Output Power

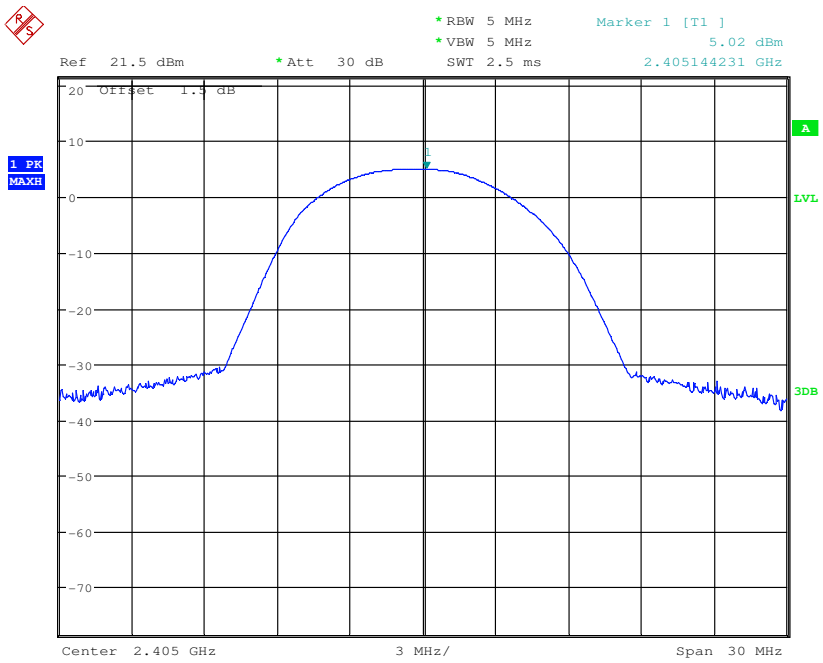
Test Requirement:	47 CFR Part 15C Section 15.247 (b)(1)
Test Method:	KDB558074 D01 v03r02
Test Setup:	 *Remark:* *Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.*
Limit:	30dBm
Test Mode:	transmitting with DSSS(O-QPSK) modulation
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

Measurement Data

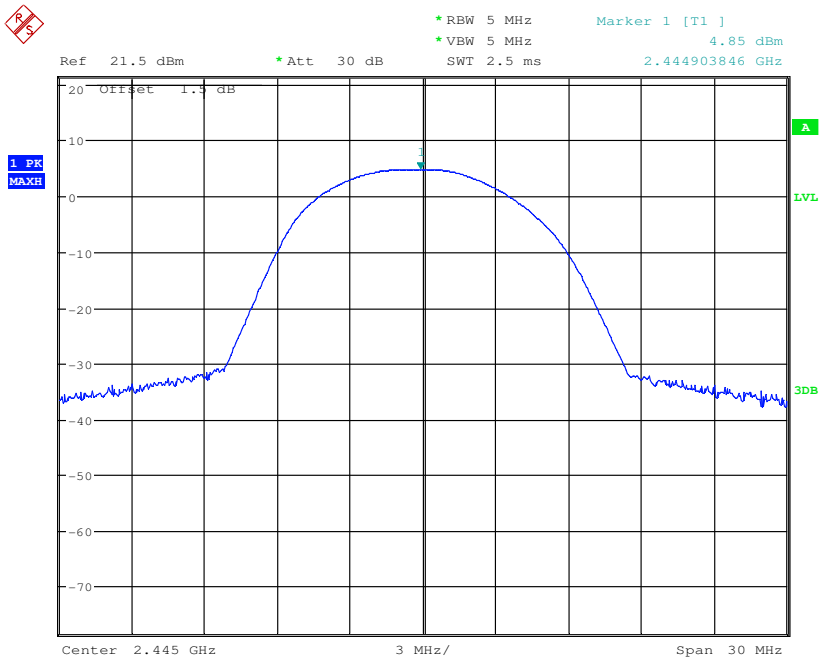
DSSS(O-QPSK) mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	5.02	30.00	Pass
Middle	4.85	30.00	Pass
Highest	4.64	30.00	Pass

Test plot as follows:

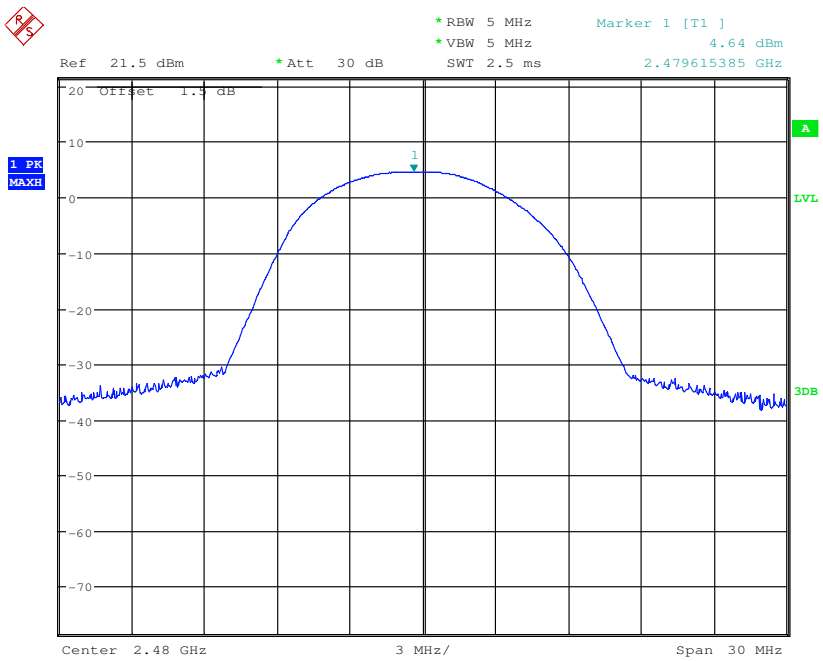
Test mode:	DSSS(O-QPSK)	Test channel:	Lowest



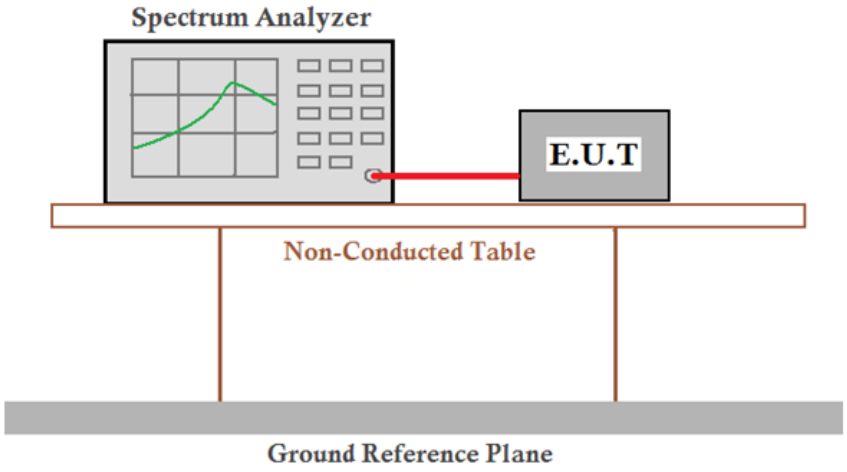
Test mode:	DSSS(O-QPSK)	Test channel:	Middle



Test mode:	DSSS(O-QPSK)	Test channel:	Highest



6.4 6dB Occupy Bandwidth

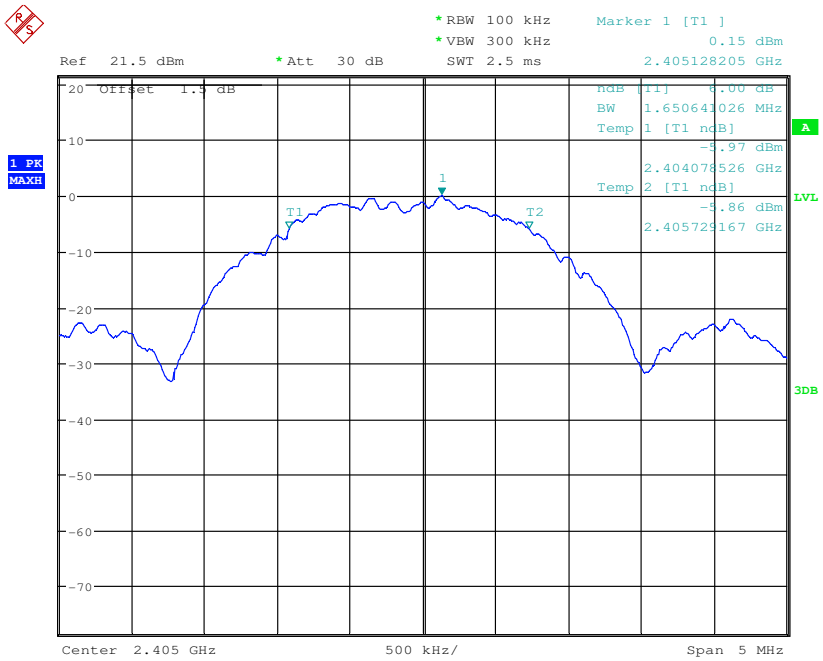
Test Requirement:	47 CFR Part 15C Section 15.247 (a)(2)
Test Method:	KDB558074 D01 v03r02
Test Setup:	
Limit:	≥ 500 kHz
Test Mode:	transmitting with DSSS(O-QPSK) modulation
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

Measurement Data

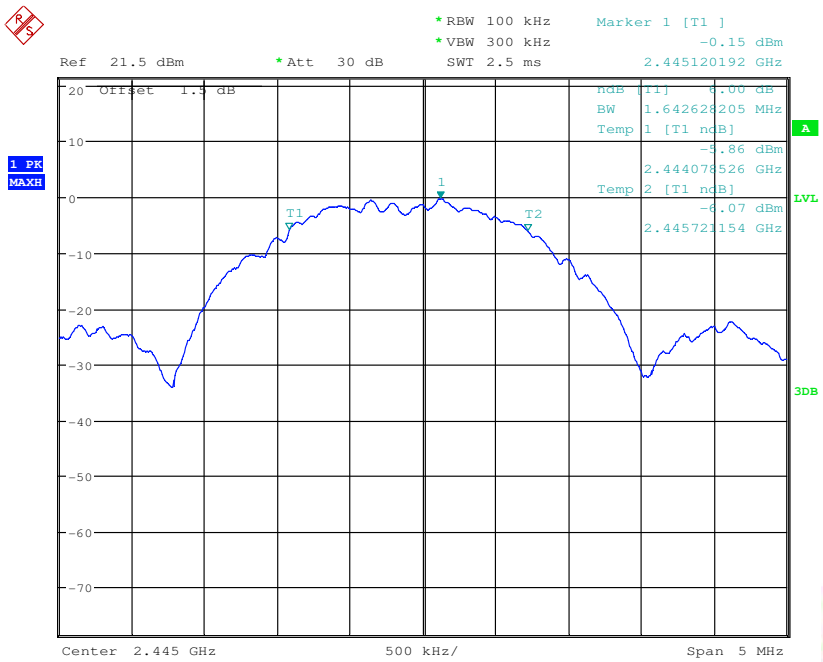
Test channel	6dB Occupy Bandwidth (MHz)	Limit (kHz)	Result
Lowest	1.651	≥500	Pass
Middle	1.643	≥500	Pass
Highest	1.651	≥500	Pass

Test plot as follows:

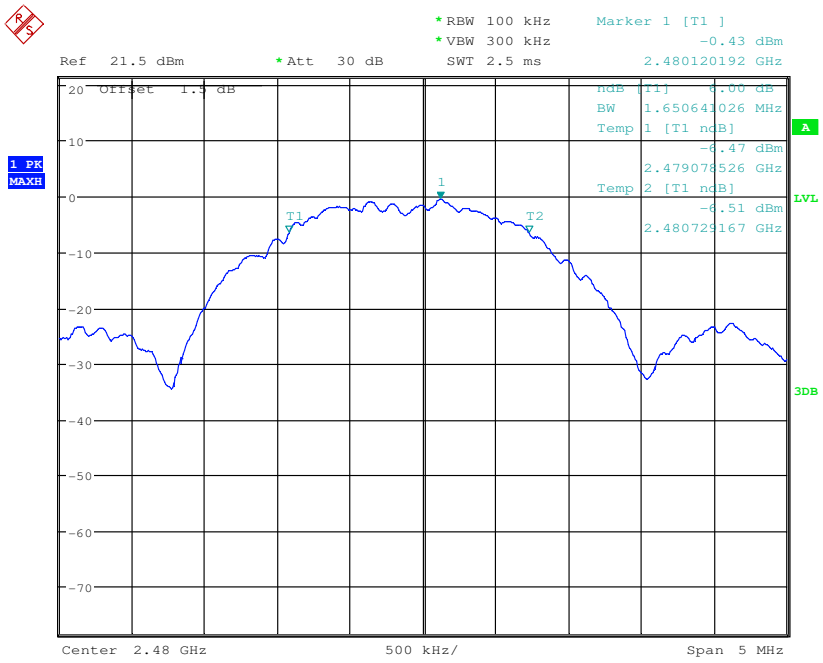
Test mode:	DSSS(O-QPSK)	Test channel:	Lowest



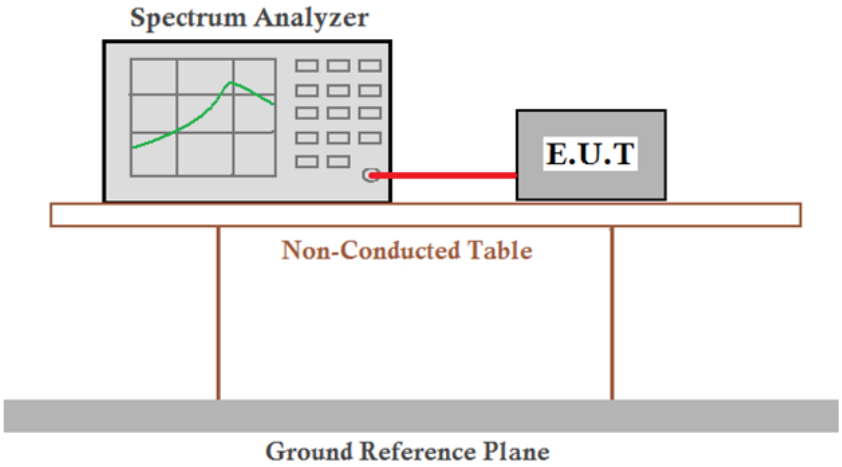
Test mode:	DSSS(O-QPSK)	Test channel:	Middle



Test mode:	DSSS(O-QPSK)	Test channel:	Highest



6.5 Power Spectral Density

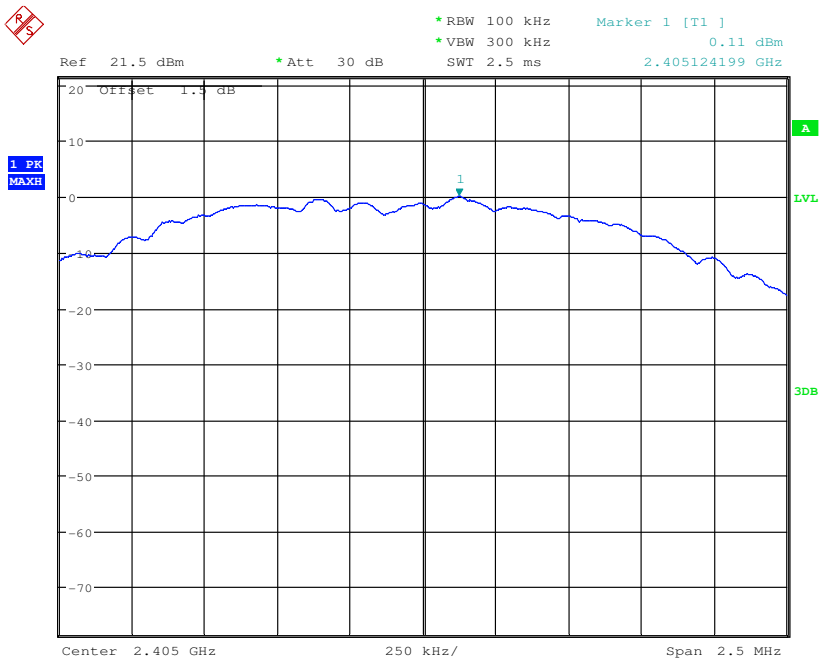
Test Requirement:	47 CFR Part 15C Section 15.247 (e)
Test Method:	KDB558074 D01 v03r02
Test Setup:	
Limit:	≤8.00dBm
Exploratory Test Mode:	transmitting with DSSS(O-QPSK) modulation
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

Measurement Data

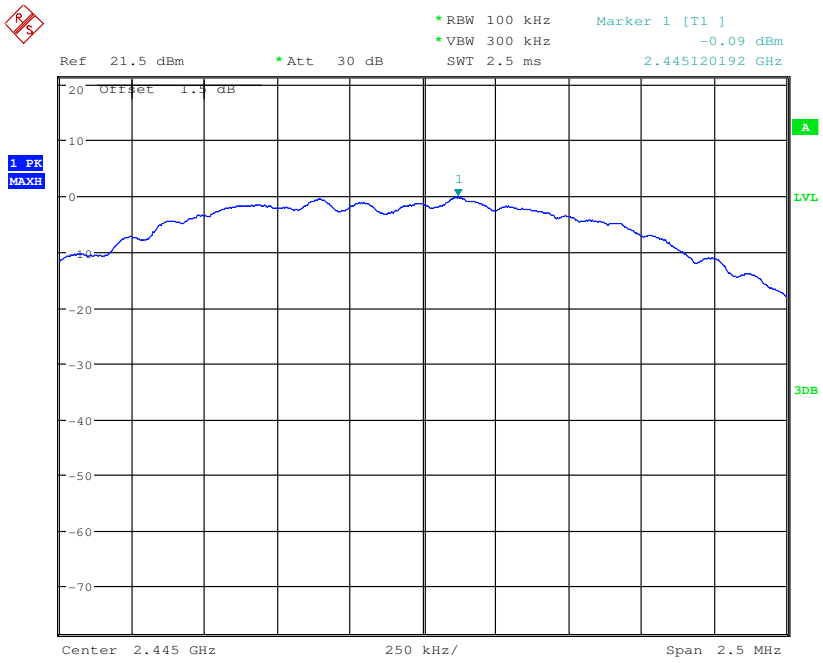
DSSS(O-QPSK) mode			
Test channel	Power Spectral Density (dBm)	Limit (dBm)	Result
Lowest	0.11	≤8.00	Pass
Middle	-0.09	≤8.00	Pass
Highest	-0.43	≤8.00	Pass

Test plot as follows:

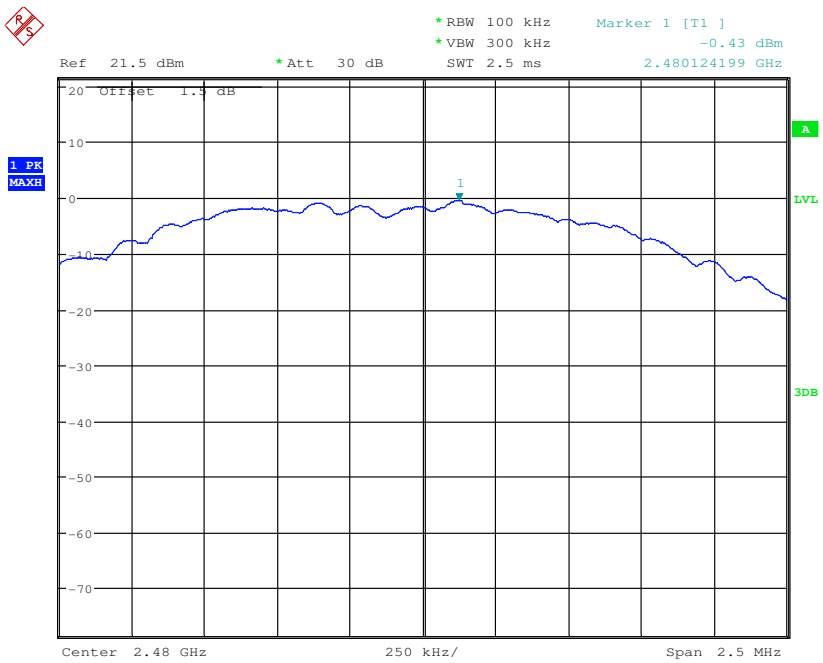
Test mode:	DSSS(O-QPSK)	Test channel:	Lowest



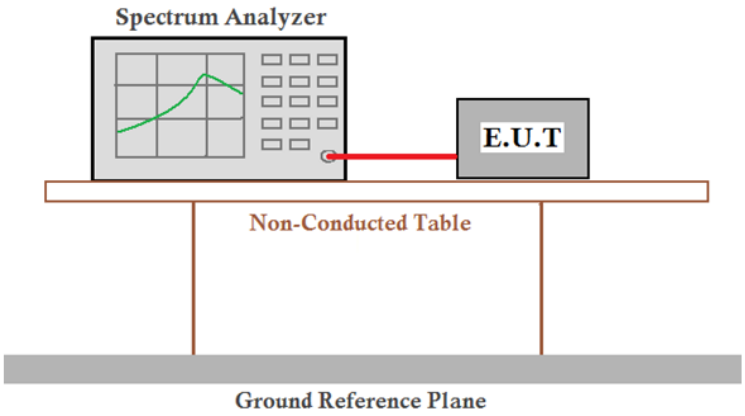
Test mode:	DSSS(O-QPSK)	Test channel:	Middle



Test mode:	DSSS(O-QPSK)	Test channel:	Highest

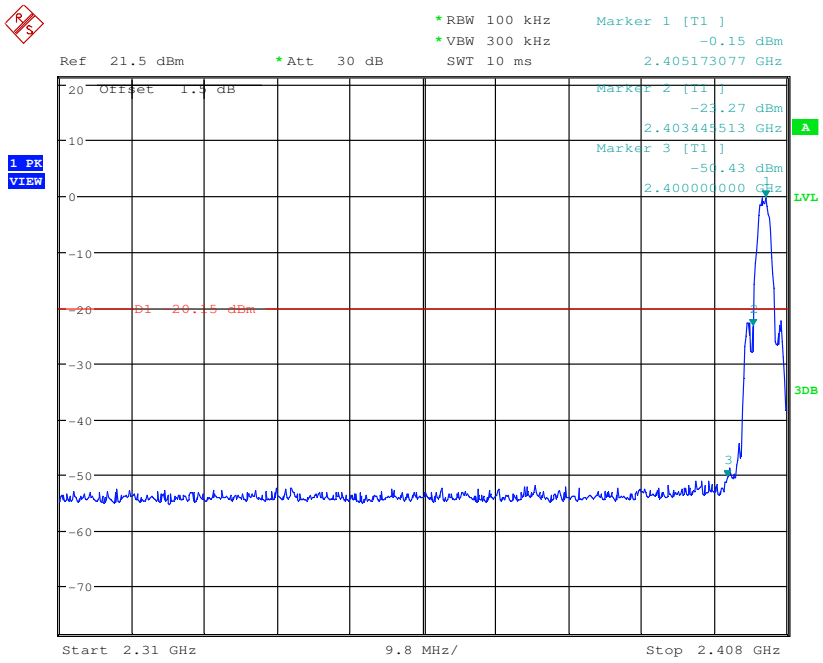


6.6 Band-edge for RF Conducted Emissions

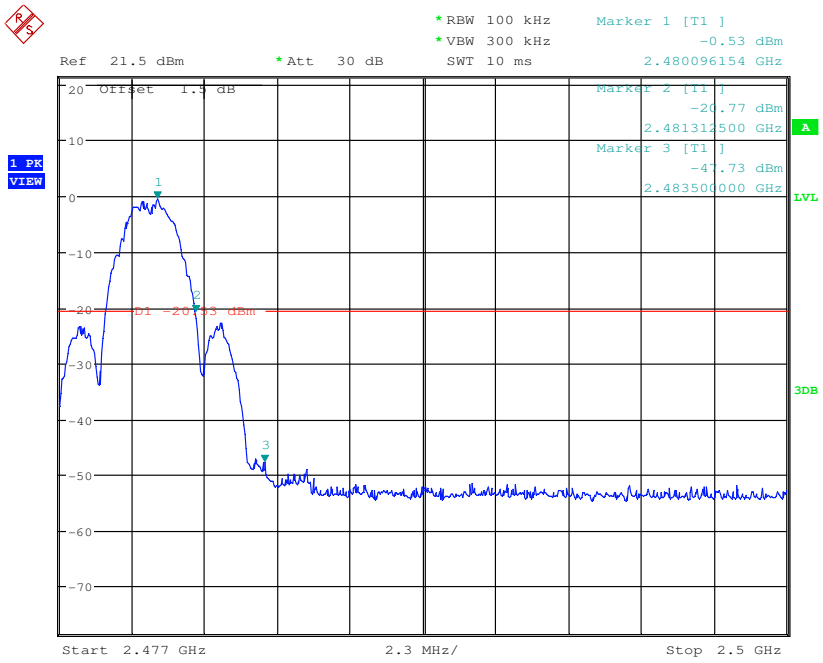
Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	KDB558074 D01 v03r02
Test Setup:	 Remark: Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the 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 Mode:	transmitting with DSSS(O-QPSK) modulation
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

Test plot as follows:

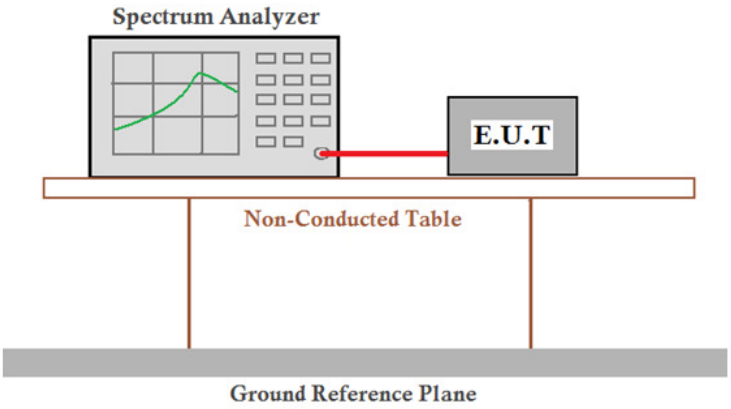
Test mode:	DSSS(O-QPSK)	Test channel:	Lowest



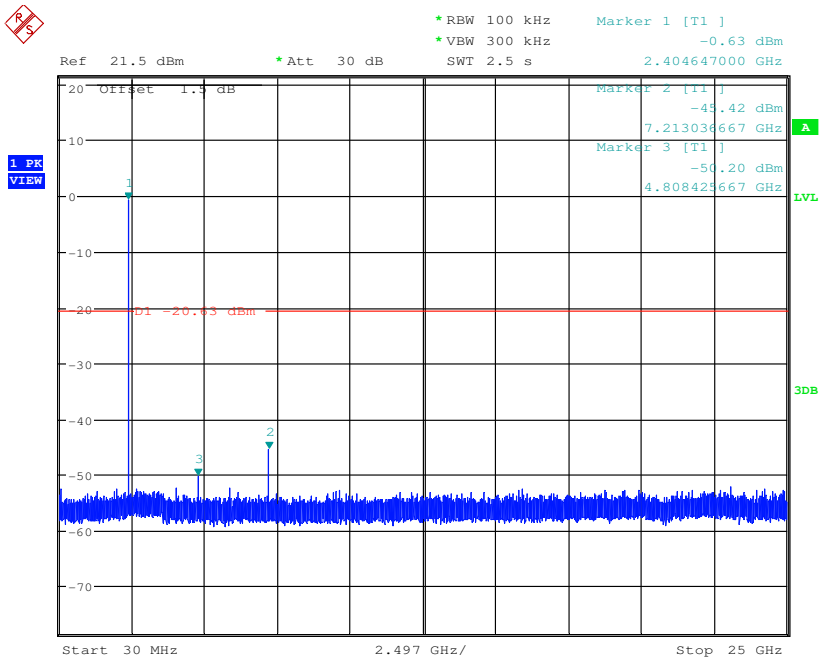
Test mode:	DSSS(O-QPSK)	Test channel:	Highest

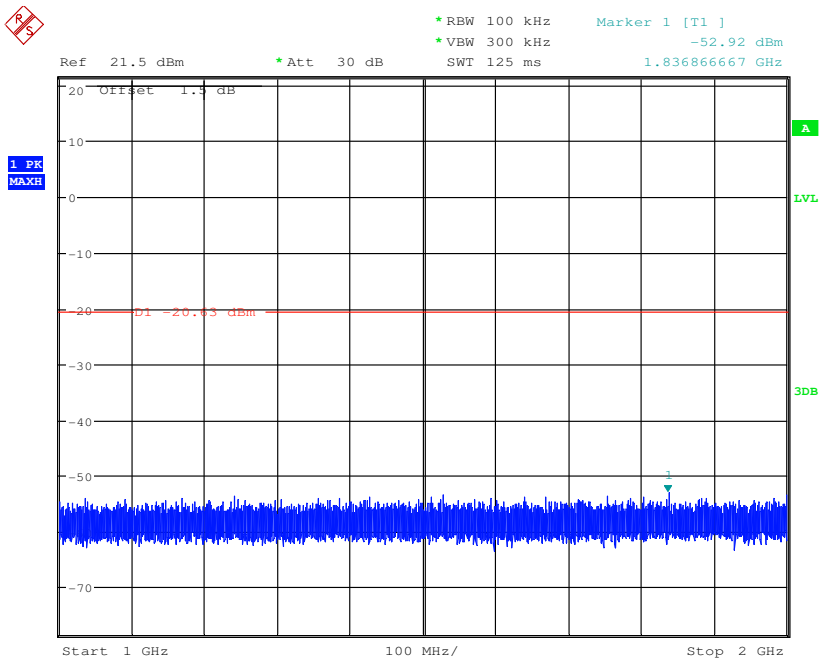


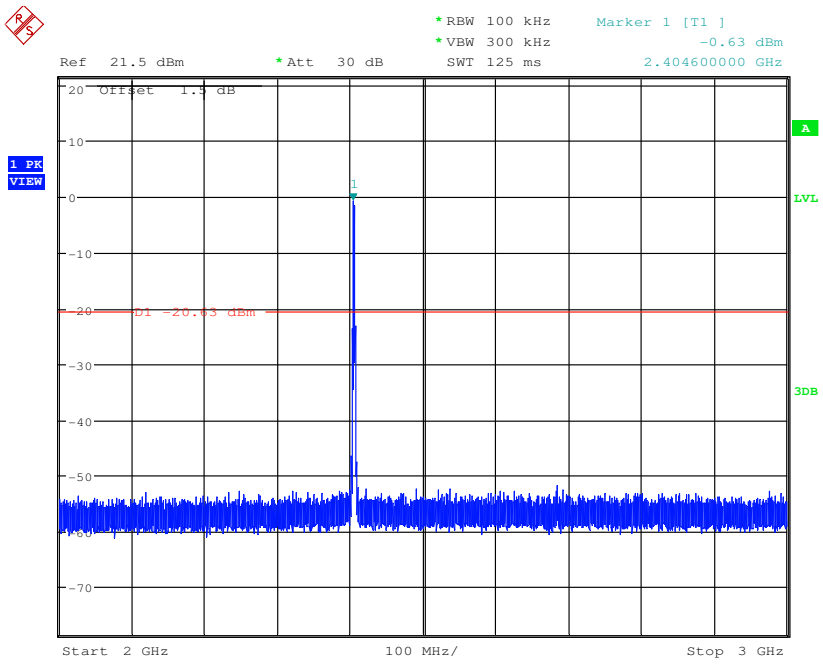
6.7 Spurious RF Conducted Emissions

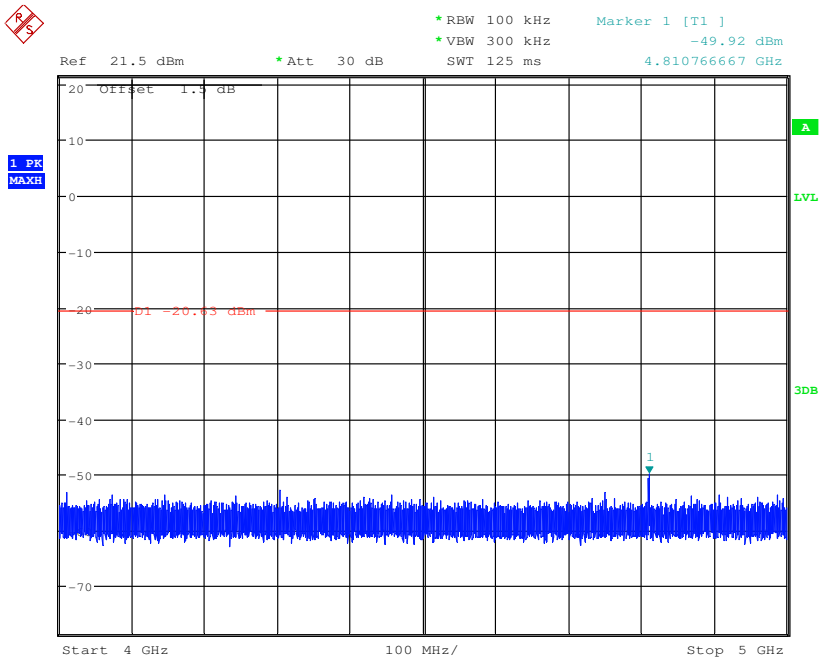
Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	KDB558074 D01 v03r02
Test Setup:	 Remark: Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the 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 Mode:	transmitting with DSSS(O-QPSK) modulation
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

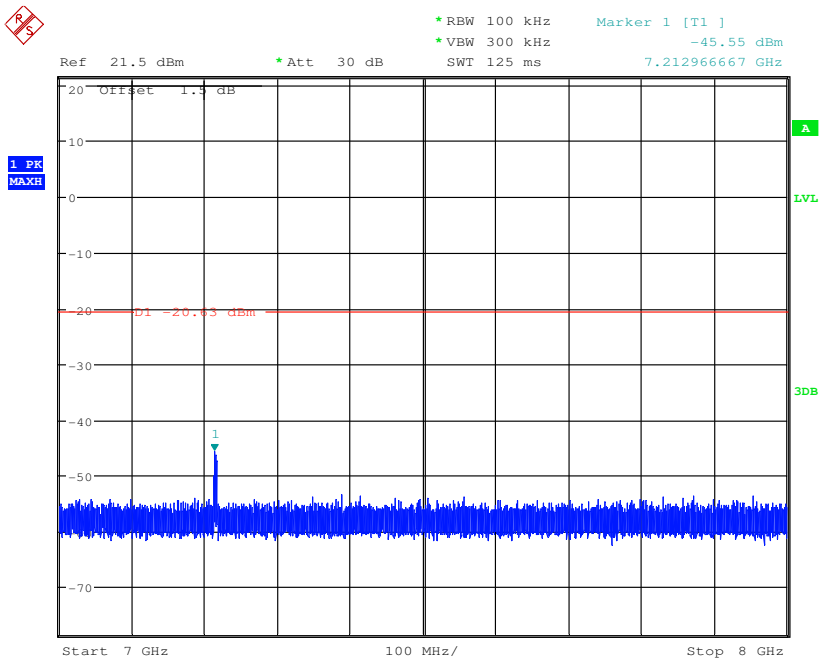
Test mode:	DSSS(O-QPSK)	Test channel:	Lowest

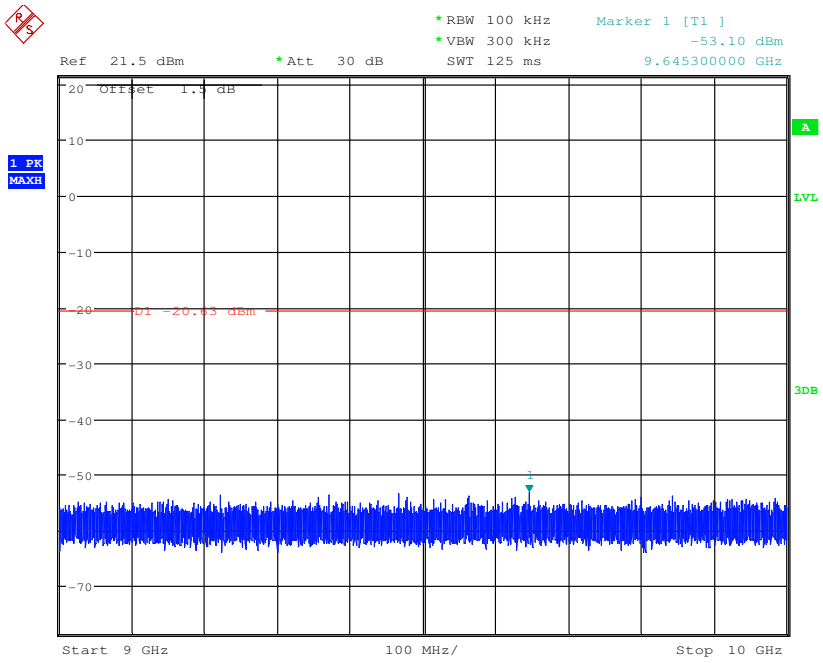




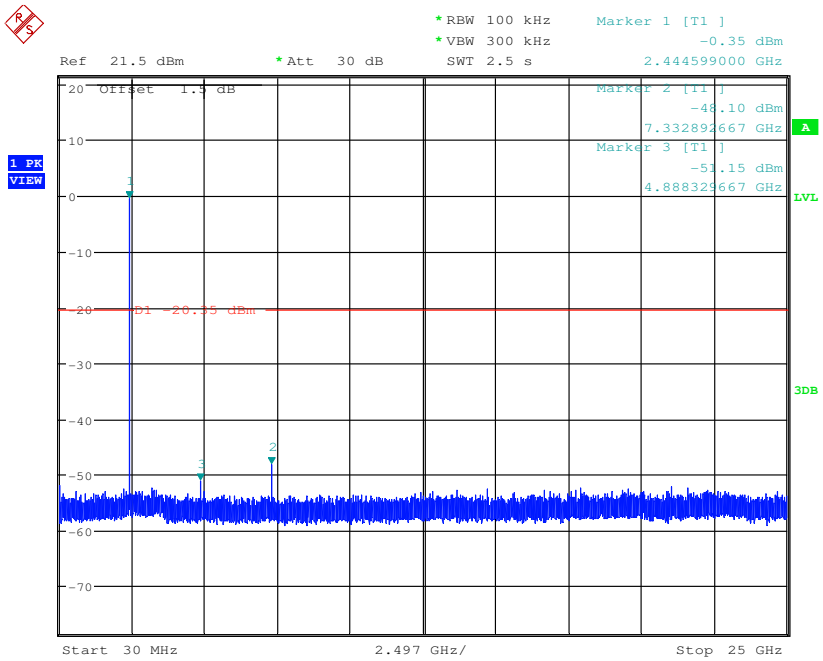


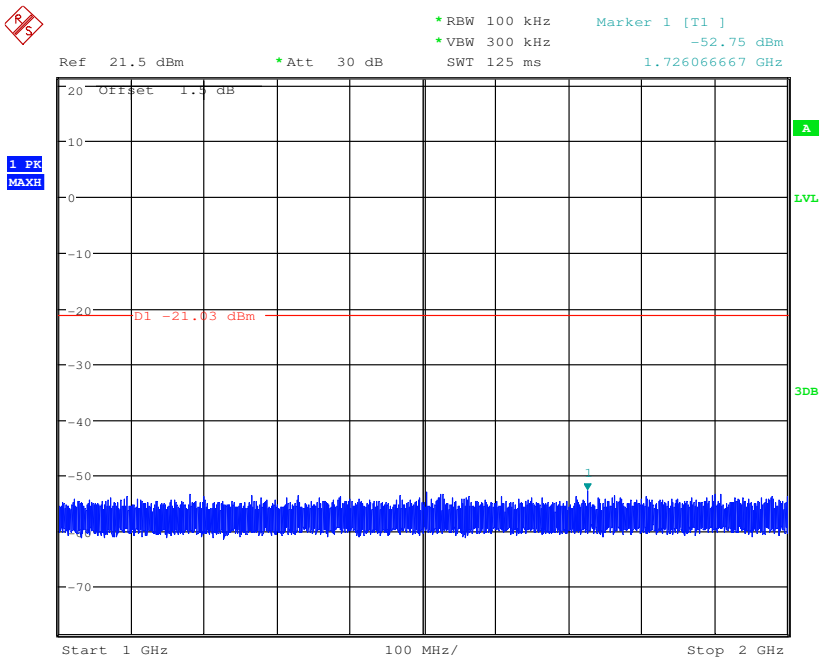


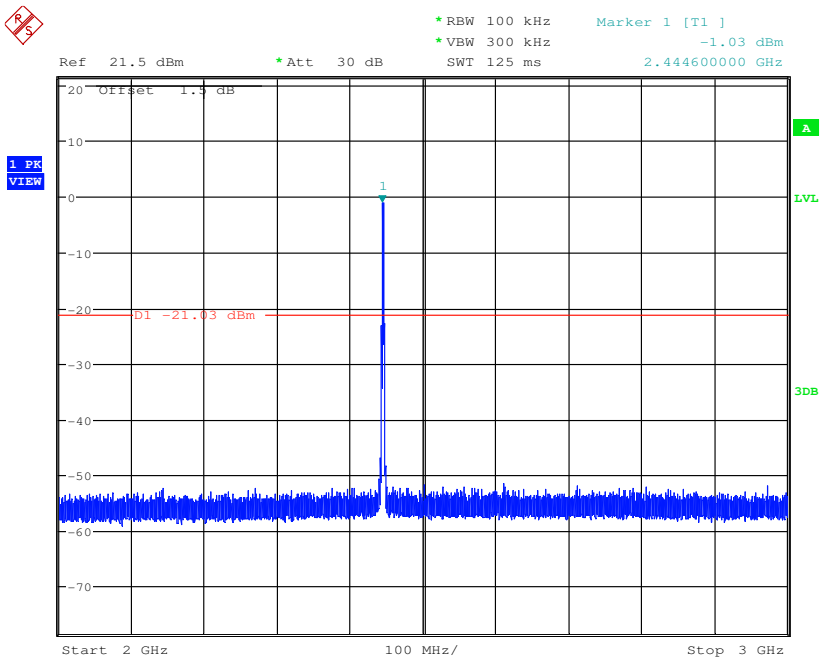


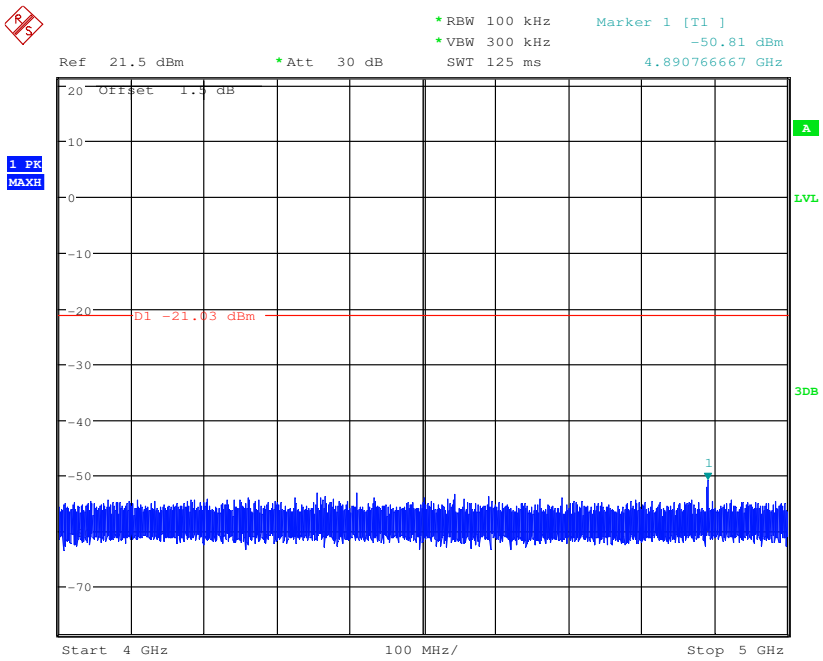


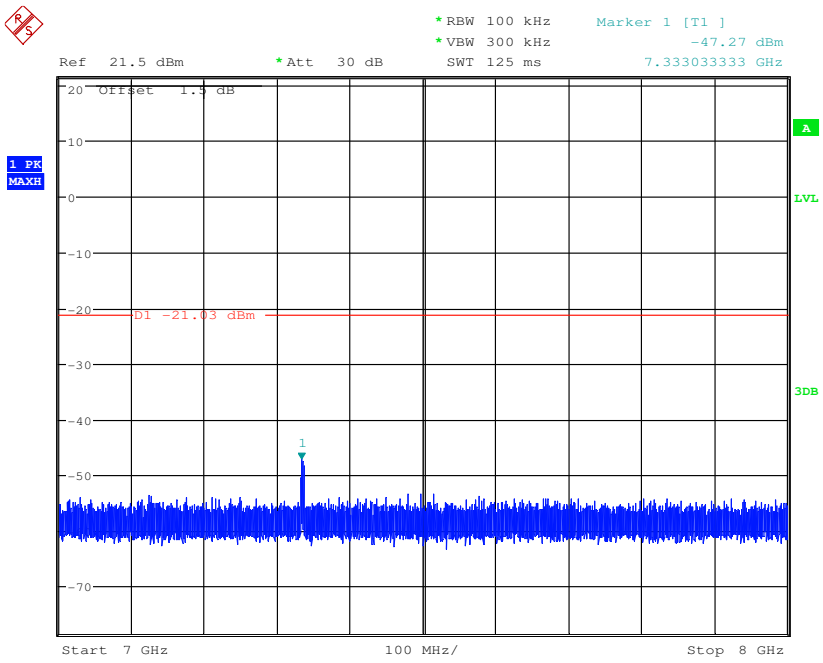
Test mode:	DSSS(O-QPSK)	Test channel:	Middle

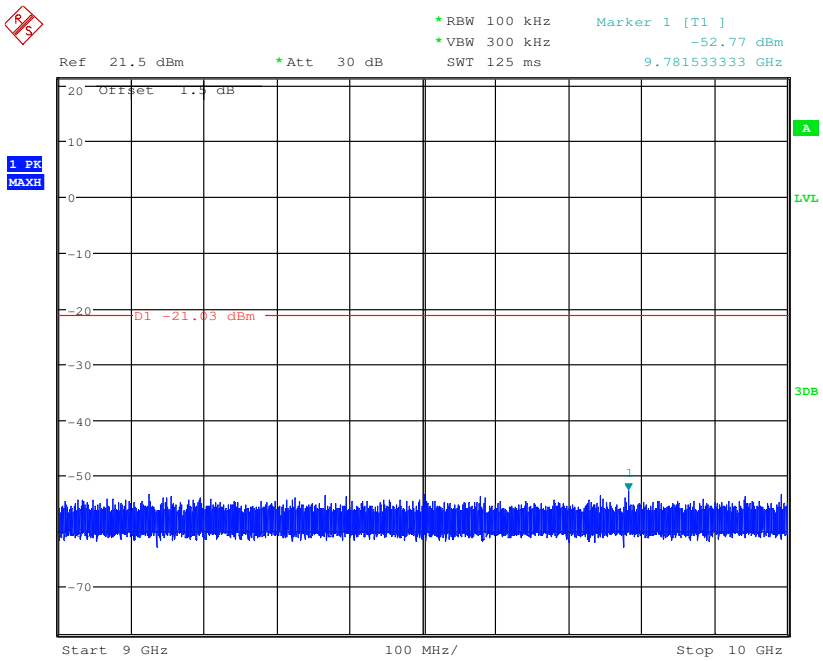


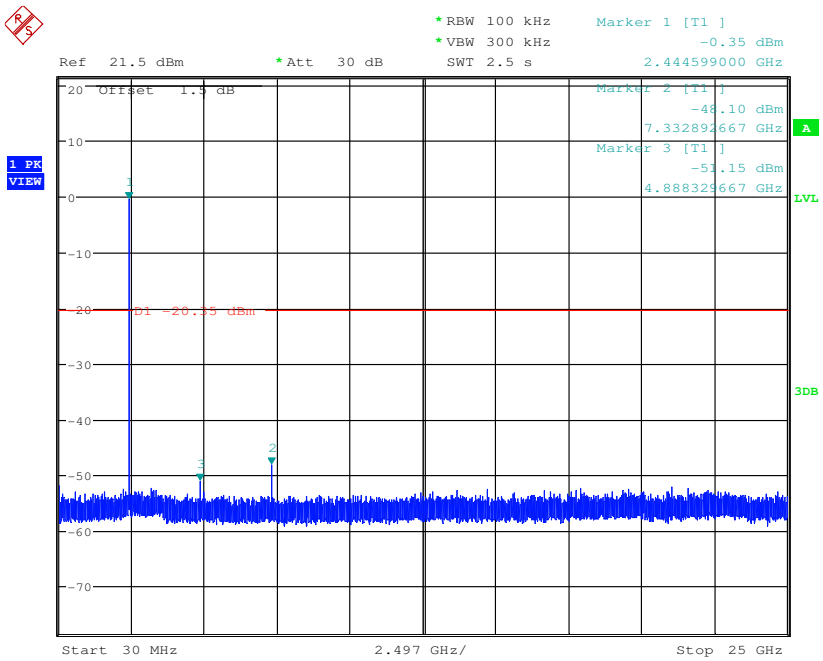




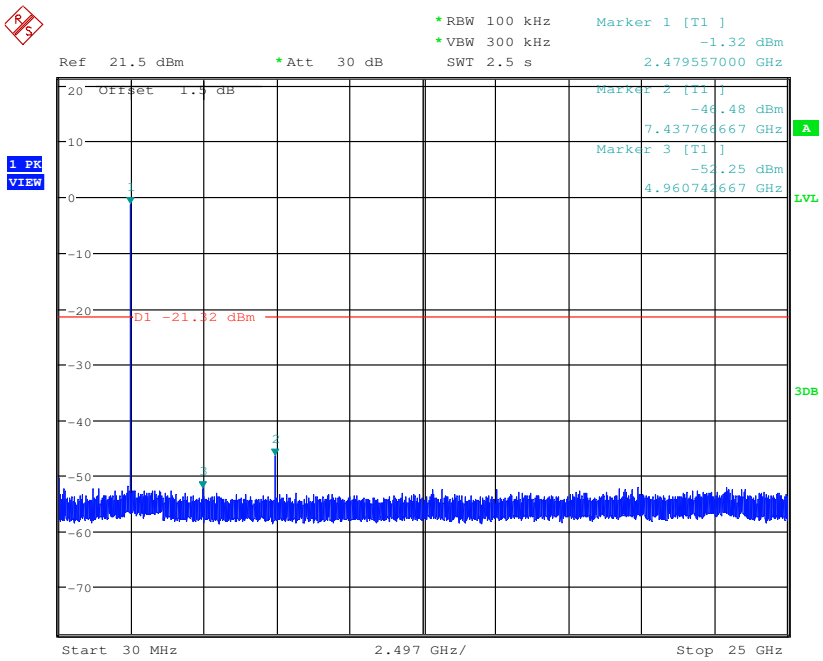


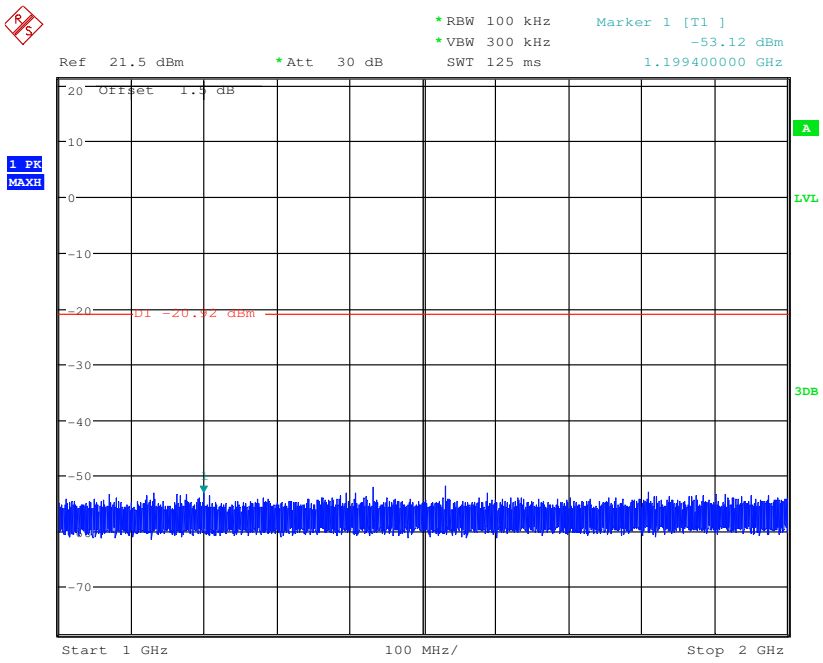


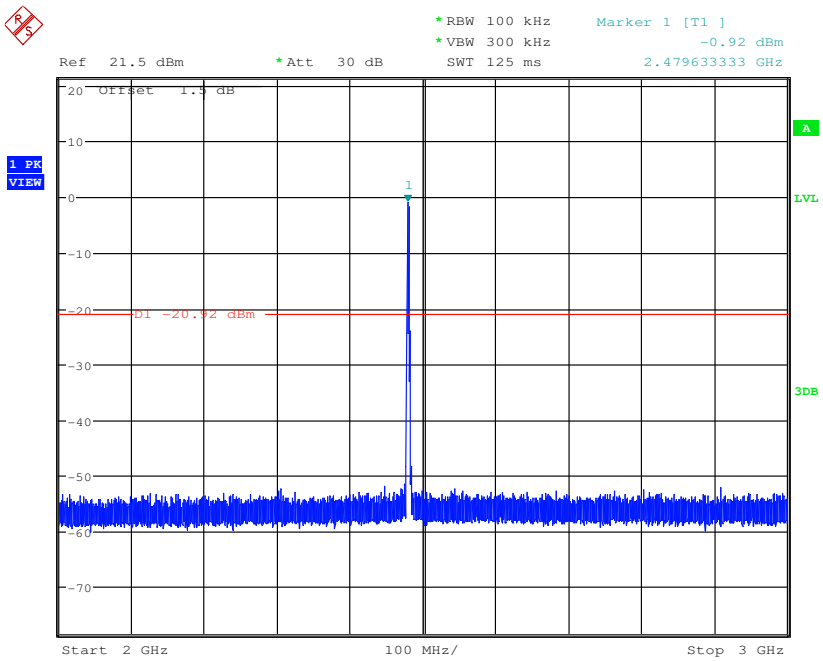


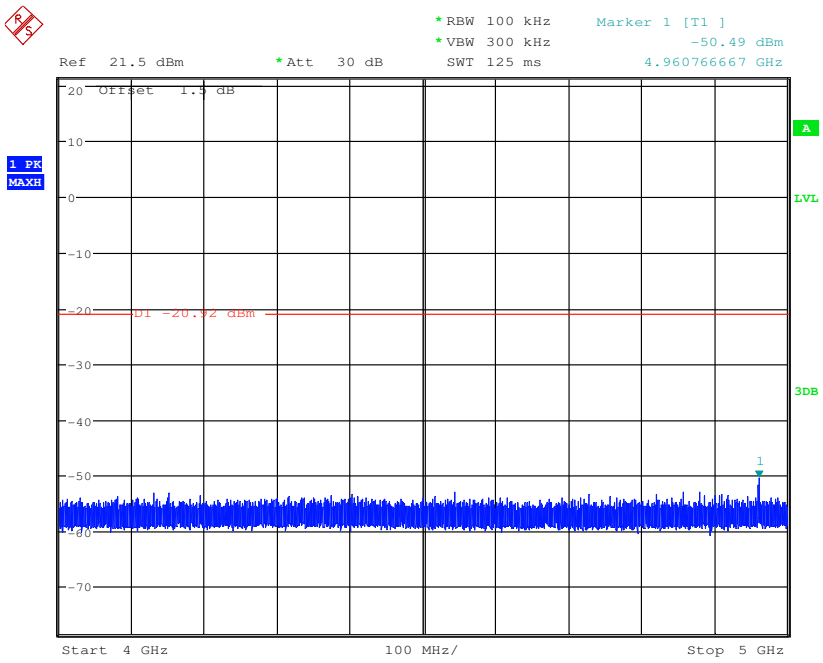


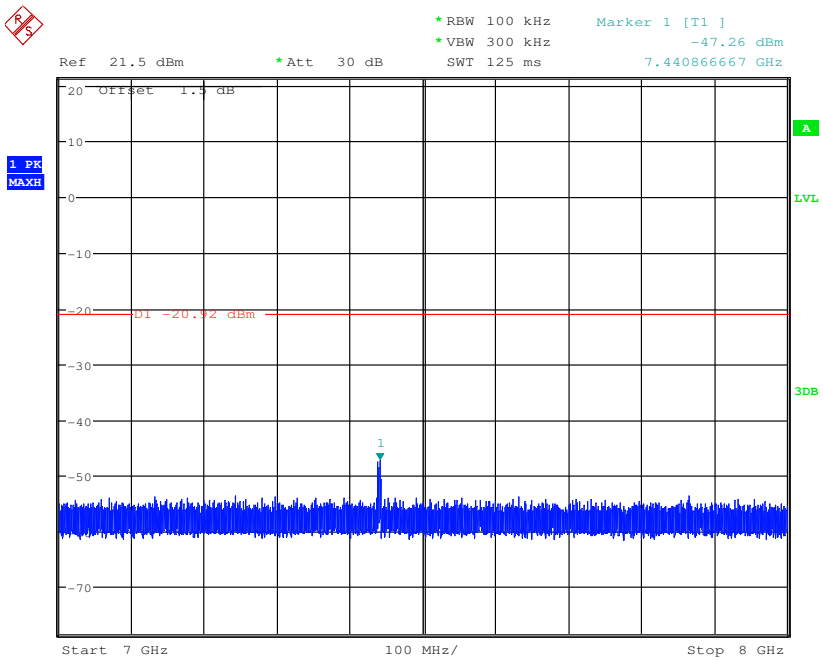
Test mode:	DSSS(O-QPSK)	Test channel:	Highest

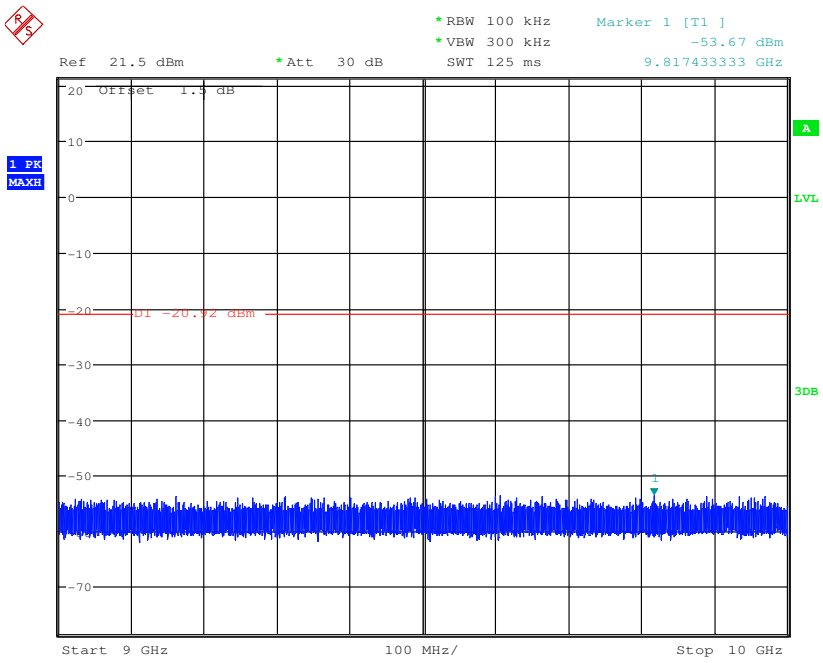












Remark:

Pretest 9kHz to 25GHz, find the highest point when testing, so only the worst data were shown in the test report. Per FCC Part 15.33 (a) and 15.31 (o) ,The amplitude of spurious emissions from intentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

6.8 Radiated Spurious Emission

6.8.1 Spurious Emissions

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205
Test Method:	ANSI C63.10 2009
Test Site:	Measurement Distance: 3m (Semi-Anechoic Chamber)

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
30MHz-1GHz	Quasi-peak	100 kHz	300kHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

Limit:

Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
1.705MHz-30MHz	30	-	-	30
30MHz-88MHz	100	40.0	Quasi-peak	3
88MHz-216MHz	150	43.5	Quasi-peak	3
216MHz-960MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1GHz	500	54.0	Average	3

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

Test Setup:

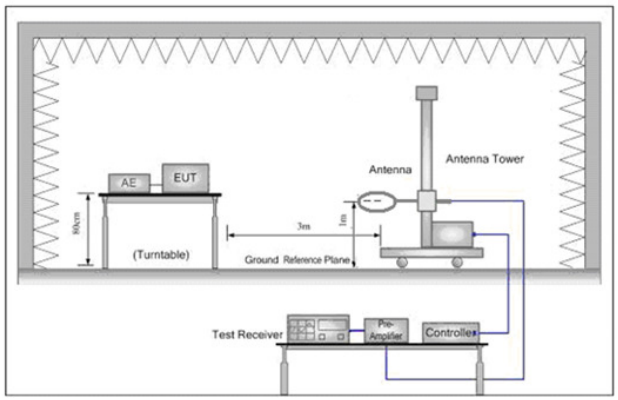


Figure 1. Below 30MHz

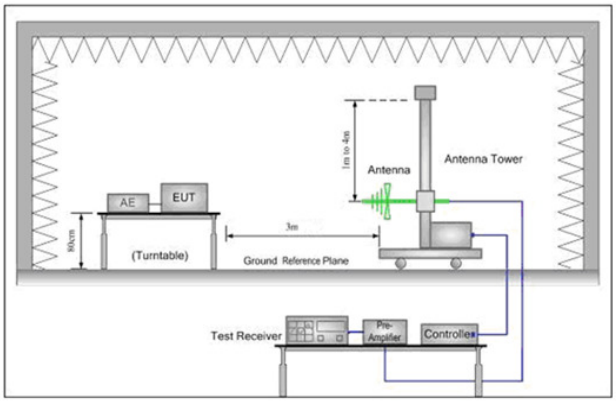


Figure 2. 30MHz to 1GHz

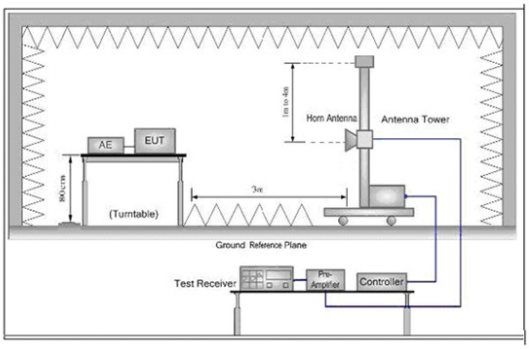
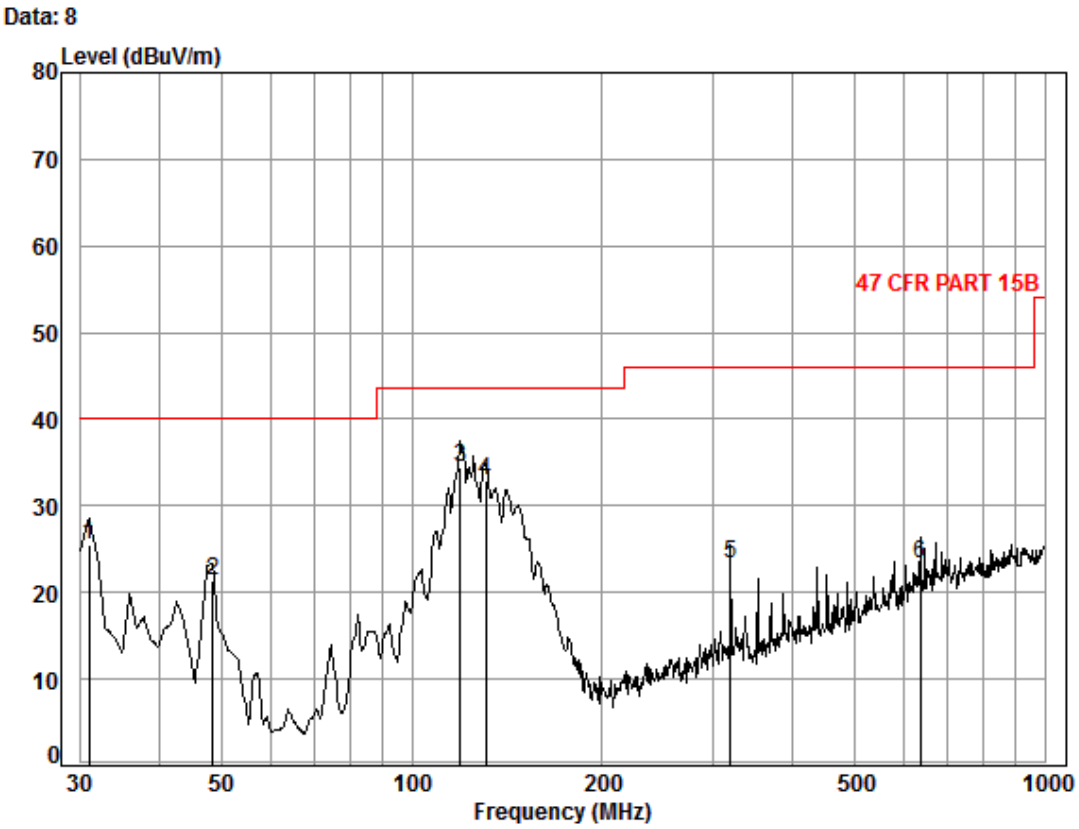


Figure 3. Above 1 GHz

Test Procedure:	a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. g. Test the EUT in the lowest channel (2405MHz),the middle channel (2445MHz),the Highest channel (2480MHz) h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode,And found the X axis positioning which it is worse

	case. i. Repeat above procedures until all frequencies measured was complete.
Test Mode:	Transmitting mode
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

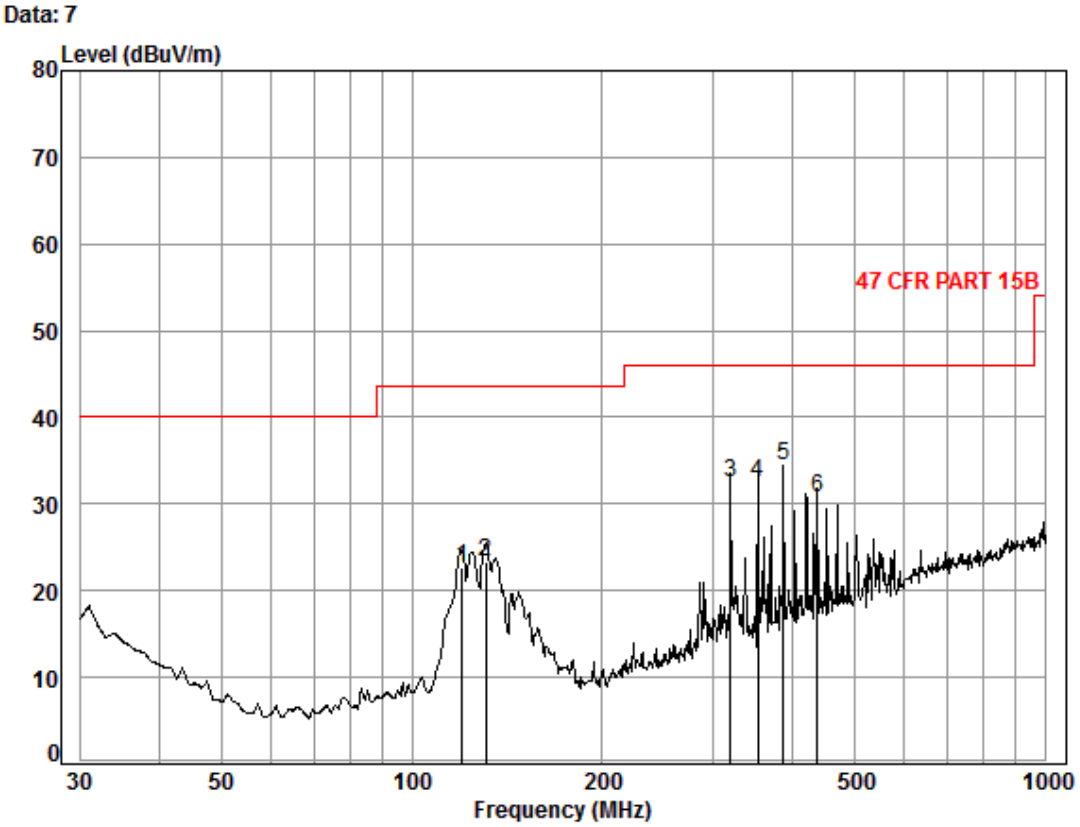
Radiated Emission below 1GHz		
30MHz~1GHz (QP)		
Test mode:	Transmitting	Vertical



Condition: 47 CFR PART 15B 3m 3142C Vertical
Job No. : 2742RF
Mode : TX mode
: Zigbee

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	30.96	0.60	18.16	27.35	34.15	25.56	40.00	-14.44	
2	48.50	0.77	9.36	27.29	38.57	21.41	40.00	-18.59	
3	119.44	1.25	7.94	27.07	52.30	34.42	43.50	-9.08	
4	130.84	1.28	7.73	27.01	50.89	32.89	43.50	-10.61	
5	318.82	1.96	14.58	26.54	33.40	23.40	46.00	-22.60	
6	636.13	2.78	20.54	27.49	27.49	23.32	46.00	-22.68	

Test mode:	Transmitting	Horizontal



Condition: 47 CFR PART 15B 3m 3142C Horizontal
Job No. : 2742RF
Mode : TX mode
: Zigbee

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	120.28	1.25	7.89	27.07	40.58	22.65	43.50	-20.85	
2	130.84	1.28	7.73	27.01	41.41	23.41	43.50	-20.09	
3	318.82	1.96	14.58	26.54	42.58	32.58	46.00	-13.42	
4	351.71	2.06	14.05	26.81	43.27	32.57	46.00	-13.43	
5	386.63	2.16	16.14	27.05	43.12	34.37	46.00	-11.63	
6	437.12	2.36	16.65	27.35	39.15	30.81	46.00	-15.19	

Transmitter Emission above 1GHz								
Test mode:	Transmitting		Test channel:		Lowest		Remark:	Peak
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1672.296	2.76	29.54	38.39	45.99	39.90	74	-34.10	Vertical
3738.129	4.04	33.10	38.84	46.21	44.51	74	-29.49	Vertical
4810.000	4.30	34.71	39.24	45.13	44.90	74	-29.10	Vertical
7215.000	5.30	35.62	39.07	42.01	43.86	74	-30.14	Vertical
9620.000	6.52	37.36	37.93	41.13	47.08	74	-26.92	Vertical
11515.680	7.62	38.24	38.47	43.70	51.09	74	-22.91	Vertical
1672.296	2.76	29.54	38.39	46.82	40.73	74	-33.27	Horizontal
3579.815	4.13	32.98	38.78	45.48	43.81	74	-30.19	Horizontal
4810.000	4.30	34.71	39.24	45.49	45.26	74	-28.74	Horizontal
7215.000	5.30	35.62	39.07	42.39	44.24	74	-29.76	Horizontal
9620.000	6.52	37.36	37.93	41.80	47.75	74	-26.25	Horizontal
11341.140	7.73	38.14	38.39	43.63	51.11	74	-22.89	Horizontal

Test mode:	Transmitting		Test channel:		Middle		Remark:	Peak
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1938.352	2.97	31.22	38.42	46.75	42.52	74	-31.48	Vertical
3786.010	3.99	33.14	38.86	45.16	43.43	74	-30.57	Vertical
4880.000	4.36	34.78	39.26	45.03	44.91	74	-29.09	Vertical
7320.000	5.21	35.51	39.06	44.68	46.34	74	-27.66	Vertical
9760.000	6.49	37.80	37.84	44.62	51.07	74	-22.93	Vertical
11428.080	7.80	38.17	38.43	44.40	51.94	74	-22.06	Vertical
1880.038	2.93	30.76	38.41	48.51	43.79	74	-30.21	Horizontal
3616.451	4.15	33.01	38.79	45.73	44.10	74	-29.90	Horizontal
4880.000	4.36	34.78	39.26	45.34	45.22	74	-28.78	Horizontal
7320.000	5.21	35.51	39.06	44.39	46.05	74	-27.95	Horizontal
9760.000	6.49	37.80	37.84	39.43	45.88	74	-28.12	Horizontal
11872.880	7.29	38.57	38.64	44.31	51.53	74	-22.47	Horizontal

Test mode:		Transmitting		Test channel:	Highest		Remark:	Peak
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1498.912	2.65	28.56	38.37	46.16	39.00	74	-35.00	Vertical
3662.775	4.11	33.05	38.81	45.50	43.85	74	-30.15	Vertical
4960.000	4.43	34.86	39.29	45.17	45.17	74	-28.83	Vertical
7440.000	5.15	35.43	39.05	45.12	46.65	74	-27.35	Vertical
9920.000	6.83	38.27	37.75	41.83	49.18	74	-24.82	Vertical
11903.140	7.27	38.60	38.66	44.17	51.38	74	-22.62	Vertical
1889.633	2.94	30.84	38.42	47.71	43.07	74	-30.93	Horizontal
3747.656	4.03	33.11	38.85	46.59	44.88	74	-29.12	Horizontal
4960.000	4.43	34.86	39.29	47.20	47.20	74	-26.80	Horizontal
7440.000	5.15	35.43	39.05	45.26	46.79	74	-27.21	Horizontal
9920.000	6.83	38.27	37.75	42.52	49.87	74	-24.13	Horizontal
11933.470	7.25	38.63	38.67	45.38	52.59	74	-21.41	Horizontal

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 Factor – Preamplifier Factor
2) Scan from 9kHz to 25GHz,The disturbance above 13GHz and below 30MHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported .
3) As shown in this section, for frequencies above 1GHz, the 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. So, only the peak measurements were shown in the report.

6.9 Restricted bands around fundamental frequency

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205
Test Method:	ANSI C63.10 2009
Test Site:	Measurement Distance: 3m (Semi-Anechoic Chamber)
Limit:	

Frequency	Limit (dBuV/m @3m)	Remark
30MHz-88MHz	40.0	Quasi-peak Value
88MHz-216MHz	43.5	Quasi-peak Value
216MHz-960MHz	46.0	Quasi-peak Value
960MHz-1GHz	54.0	Quasi-peak Value
Above 1GHz	54.0	Average Value
	74.0	Peak Value

Test Setup:

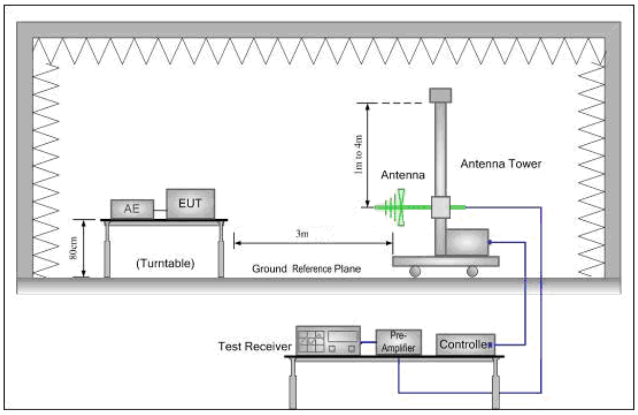


Figure 1. 30MHz to 1GHz

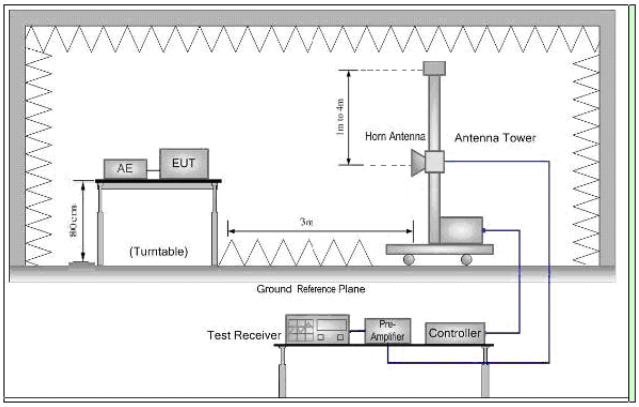


Figure 2. Above 1 GHz

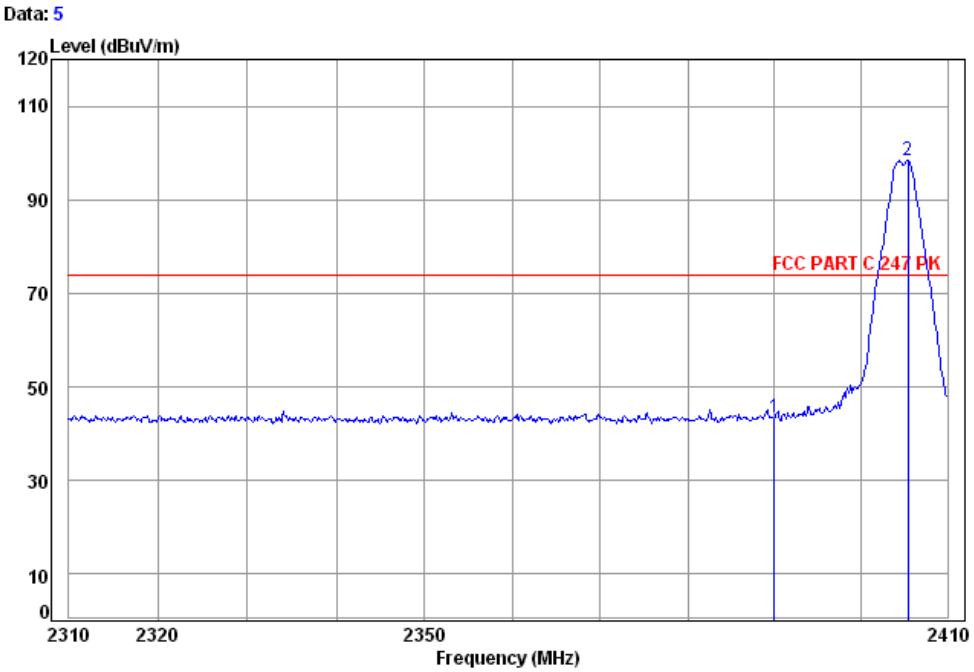
Test Procedure:

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel

	g. Test the EUT in the lowest channel , the Highest channel h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode,And found the X axis positioning which it is worse case. i. Repeat above procedures until all frequencies measured was complete.
Test Mode:	Transmitting mode
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

Test plot as follows:

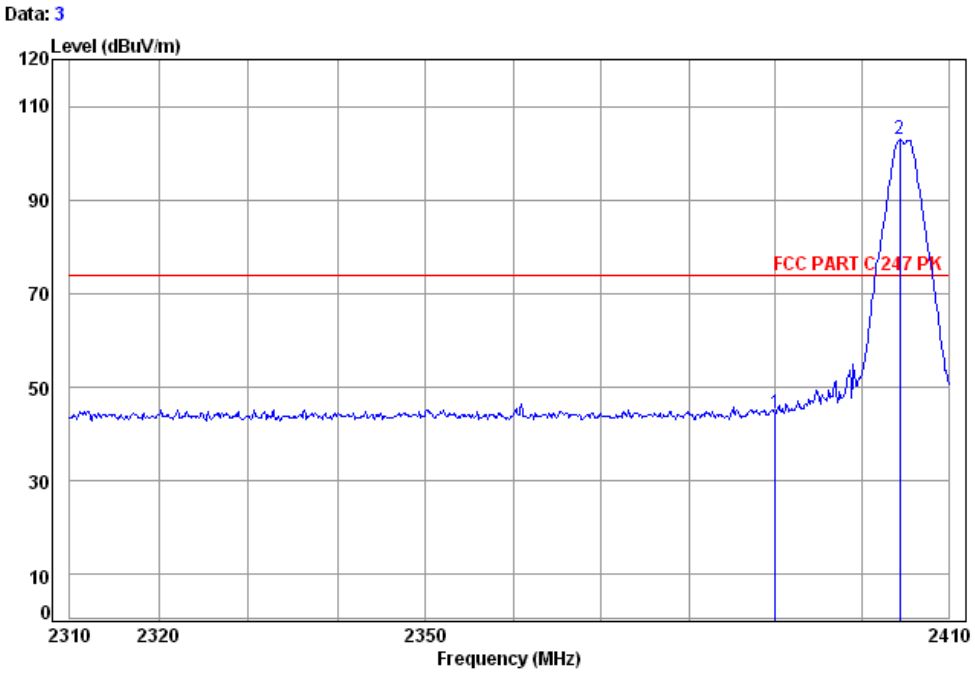
Restricted bands around fundamental frequency						
Test mode:	Transmitting	Test channel:	Lowest	Remark:	Peak	Vertical



Site : chamber
Condition: FCC PART C 247 PK 3m Vertical
Job No: : 2742RF
Mode: : 2405 Band edge

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2390.00	3.36	32.35	38.46	46.32	43.57	74.00	-30.43
2 pp	2405.41	3.38	32.41	38.46	101.11	98.44	74.00	24.44

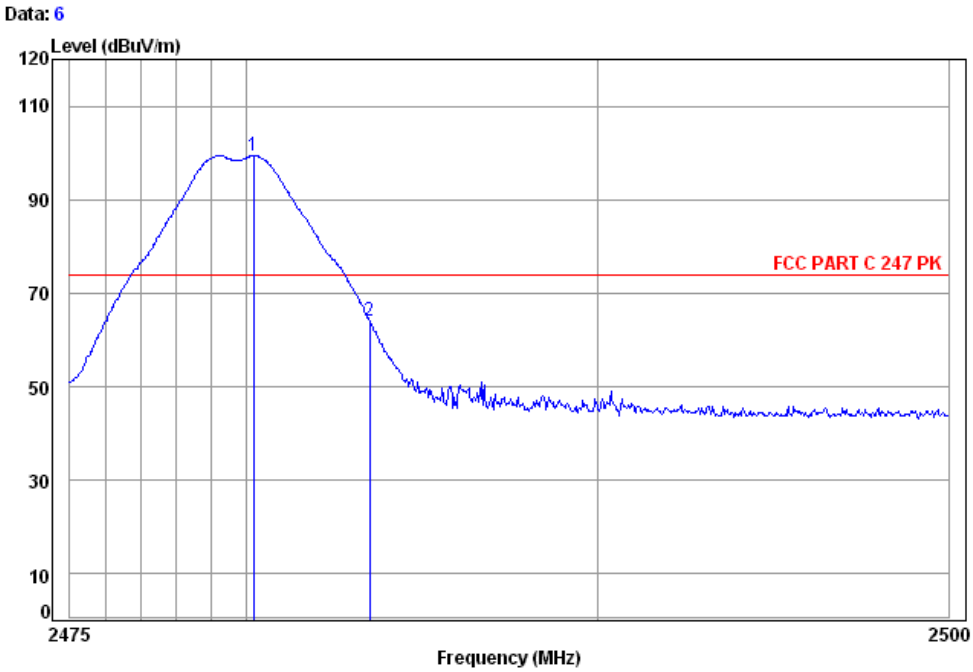
Test mode:	Transmitting	Test channel:	Lowest	Remark:	Peak	Horizontal



Site : chamber
Condition: FCC PART C 247 PK 3m Horizontal
Job No: : 2742RF
Mode: : 2405 Band edge

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2390.00	3.36	32.35	38.46	47.35	44.60	74.00	-29.40
2 pp	2404.39	3.38	32.41	38.46	105.58	102.91	74.00	28.91

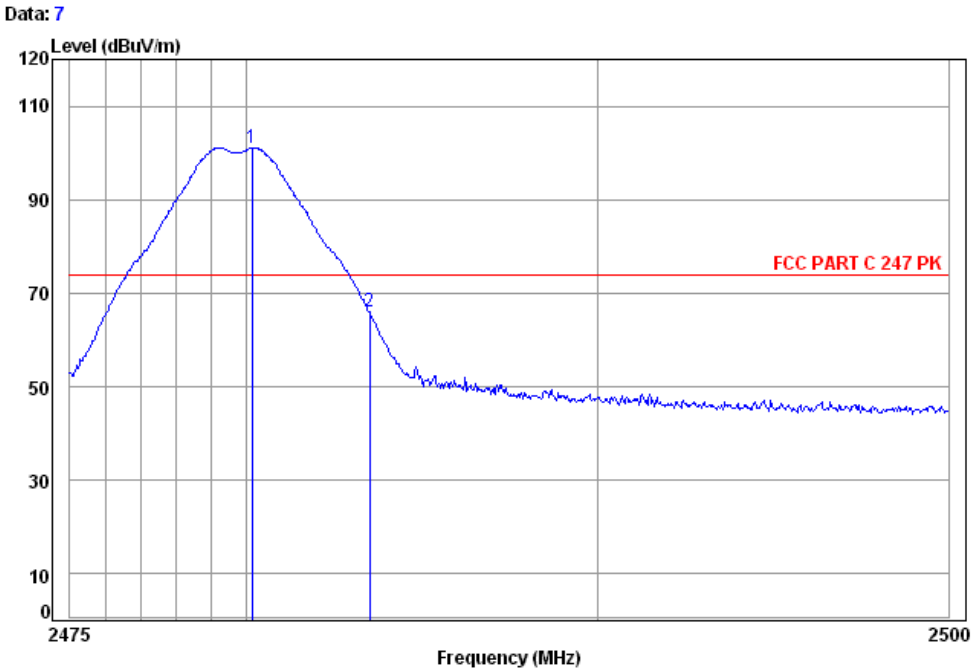
Test mode:	Transmitting	Test channel:	Highest	Remark:	Peak	Vertical



Site : chamber
Condition: FCC PART C 247 PK 3m Vertical
Job No: : 2742RF
Mode: : 2480 Band edge

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1 pp	2480.20	3.46	32.44	38.47	102.04	99.47	74.00	25.47
2	2483.50	3.47	32.44	38.47	66.68	64.12	74.00	-9.88

Test mode:	Transmitting	Test channel:	Highest	Remark:	Average	Vertical



Site : chamber
Condition: FCC PART C 247 PK 3m Horizontal
Job No: : 2742RF
Mode: : 2480 Band edge

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1 pp	2480.15	3.46	32.44	38.47	103.65	101.08	74.00	27.08
2	2483.50	3.47	32.44	38.47	68.51	65.95	74.00	-8.05

Note:
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 Factor – Preamplifier Factor

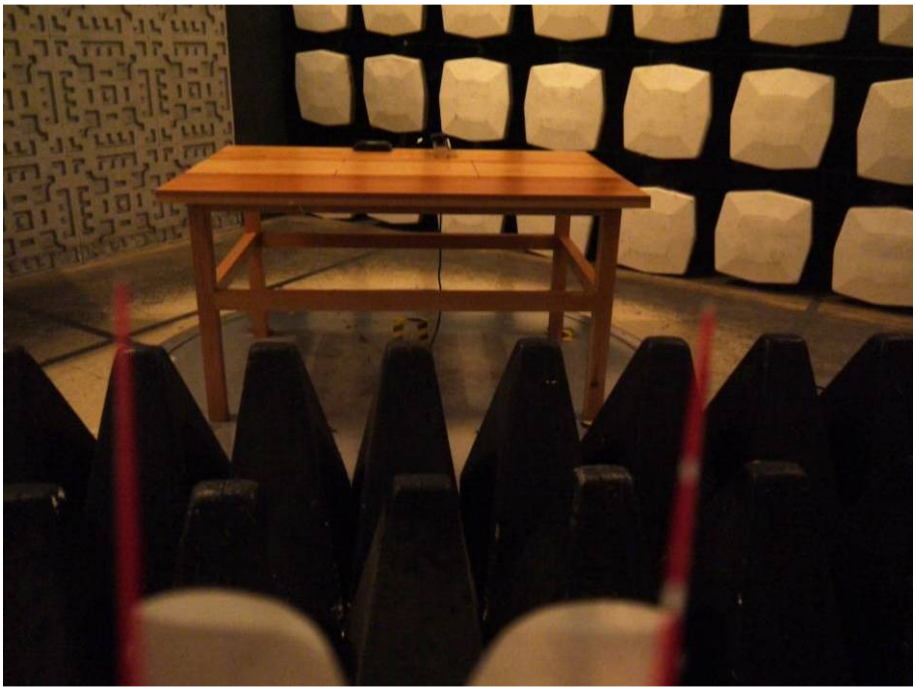
7 Photographs - EUT Test Setup

Test model No.:E-Hub

7.1 Conducted Emission

7.2 Radiated Emission

7.3 Radiated Spurious Emission



8 Photographs - EUT Constructional Details

Refer to Report No. SZEM140500274201 for EUT external and internal photos.