SGS-CSTC Standards Technical Services Co., Ltd.
Shenzhen Branch

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

FCC REPORT

Application No.:	SZEM1607006185CR
Applicant:	Eureka Technology Partners, LLC
Manufacturer:	EREX LTD.
Factory:	Erex(ShenZhen) Limited
Product Name:	Tracking Tag
Model No.(EUT):	ETP-TAG-02
Trade Mark:	Marco Polo
FCC ID:	A8QMPT-201
Standards:	47 CFR Part 15, Subpart C (2015)
Date of Receipt:	2016-09-01
Date of Test:	2016-09-06 to 2016-10-18
Date of Issue:	2016-10-20
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.

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2 Version

Revision Record				
Version	***Chapter***	***Date***	***Modifier***	***Remark***
00		*2016-10-20*		*Original*

Authorized for issue by:				
Tested By		Peter Geng **(Peter Geng) /Project Engineer**		2016-10-18 **Date**
Checked By		Eric Fu **(Eric Fu) /Reviewer**		2016-10-20 **Date**

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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 (2013)	PASS
AC Power Line Conducted Emission	47 CFR Part 15, Subpart C Section 15.207	ANSI C63.10 (2013)	PASS
Conducted Peak Output Power	47 CFR Part 15, Subpart C Section 15.247 (b)(1)	ANSI C63.10 (2013)	PASS
20dB Occupied Bandwidth	47 CFR Part 15, Subpart C Section 15.247 (a)(1)	ANSI C63.10 (2013)	PASS
Carrier Frequencies Separation	47 CFR Part 15, Subpart C Section 15.247 (a)(1)	ANSI C63.10 (2013)	PASS
Hopping Channel Number	47 CFR Part 15, Subpart C Section 15.247 (a)(1)	ANSI C63.10 (2013)	PASS
Dwell Time	47 CFR Part 15, Subpart C Section 15.247 (a)(1)	ANSI C63.10 (2013)	PASS
Pseudorandom Frequency Hopping Sequence	47 CFR Part 15, Subpart C Section 15.247(b)(4)&TCB Exclusion List (7 July 2002)	ANSI C63.10 (2013)	PASS
Band-edge for RF Conducted Emissions	47 CFR Part 15, Subpart C Section 15.247(d)	ANSI C63.10 (2013)	PASS
RF Conducted Spurious Emissions	47 CFR Part 15, Subpart C Section 15.247(d)	ANSI C63.10 (2013)	PASS
Radiated Spurious emissions	47 CFR Part 15, Subpart C Section 15.205/15.209	ANSI C63.10 (2013)	PASS

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5 General Information

5.1 Client Information

Applicant:	Eureka Technology Partners, LLC
Address of Applicant:	5519 Paseo Gilberto, Yorba Linda, CA, USA 92886
Manufacturer:	EREX LTD.
Address of Manufacturer:	FLAT5 16/F TOWER 1 METROPOLIS RESIDENCE 8 METROPOLIS DRIVE, HUNG HOM KLN H.K
Factory:	Erex(ShenZhen) Limited
Address of Factory:	2FL Block30, BaoTian Industrial Estate, Xixiang, Baoan, Shenzhen City, Guangdong, China

5.2 General Description of EUT

Product Name:	Tracking Tag
Model No.:	ETP-TAG-02
Trade Mark:	Marco Polo
Operation Frequency:	902.673767MHz ~906.569958MHz
Channel number:	53
Channel separation:	75kHz
Modulation Type:	FHSS
Antenna Type:	Monopole antenna
Antenna Gain:	2dBi
Power Supply:	DC 3.7V rechargeable battery which charged by adapter of AC 120V/60Hz
Test Voltage:	AC 120V/60Hz

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Operation Frequency each of channel

Channel	Frequency
The Lowest channel	902.673767MHz
The Middle channel	904.622863MHz
The Highest channel	906.569958MHz

5.3 Test Environment

Operating Environment:	
Temperature:	25.0 °C
Humidity:	55 % RH
Atmospheric Pressure:	1005 mbar

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
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.

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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.

• **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• **VCCI**

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.: G-823, R-4188, 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 and the 10m Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab have been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1, 4620C-2, 4620C-3.

5.7 Deviation from Standards

None.

5.8 Abnormalities from Standard Conditions

None.

5.9 Other Information Requested by the Customer

None.

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5.10 Equipment List

Conducted Emission						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal. date (yyyy-mm-dd)**	**Cal.Due date (yyyy-mm-dd)**
1	Shielding Room	ZhongYu Electron	GB-88	SEM001-06	2016-05-13	2017-05-13
2	LISN	Rohde & Schwarz	ENV216	SEM007-01	2016-10-09	2017-10-09
3	LISN	ETS-LINDGREN	3816/2	SEM007-02	2016-04-25	2017-04-25
4	8 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T8-02	EMC0120	2016-09-28	2017-09-28
5	4 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T4-02	EMC0121	2016-09-28	2017-09-28
6	2 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T2-02	EMC0122	2016-09-28	2017-09-28
7	EMI Test Receiver	Rohde & Schwarz	ESCI	SEM004-02	2016-04-25	2017-04-25
8	DC Power Supply	Zhao Xin	RXN-305D	SEM011-02	2016-10-09	2017-10-09

RF connected test						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal. date (yyyy-mm-dd)**	**Cal.Due date (yyyy-mm-dd)**
1	DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
2	Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
3	Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
4	Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09

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RE in Chamber						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal. date (yyyy-mm-dd)**	**Cal.Due date (yyyy-mm-dd)**
1	3m Semi-Anechoic Chamber	ETS-LINDGREN	N/A	SEM001-01	2016-05-13	2017-05-13
2	EMI Test Receiver	Agilent Technologies	N9038A	SEM004-05	2016-10-09	2017-10-09
3	BiConiLog Antenna (26-3000MHz)	ETS-LINDGREN	3142C	SEM003-01	2014-11-01	2017-11-01
4	Double-ridged horn (1-18GHz)	ETS-LINDGREN	3117	SEM003-11	2015-10-17	2018-10-17
5	Horn Antenna (18-26GHz)	ETS-LINDGREN	3160	SEM003-12	2014-11-24	2017-11-24
6	Pre-amplifier (0.1-1300MHz)	Agilent Technologies	8447D	SEM005-01	2016-04-25	2017-04-25
7	Band filter	Amindeon	Asi 3314	SEM023-01	N/A	N/A
8	DC Power Supply	Zhao Xin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
9	Loop Antenna	Beijing Daze	ZN30401	SEM003-09	2015-05-13	2018-05-13

RE in Chamber						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal. date (yyyy-mm-dd)**	**Cal.Due date (yyyy-mm-dd)**
1	3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2016-05-13	2017-05-13
2	EMI Test Receiver	Rohde & Schwarz	ESIB26	SEM004-04	2016-04-25	2017-04-25
3	BiConiLog Antenna (26-3000MHz)	ETS-Lindgren	3142C	SEM003-02	2014-11-15	2017-11-15
4	Amplifier (0.1-1300MHz)	HP	8447D	SEM005-02	2016-10-09	2017-10-09
5	Horn Antenna (1-18GHz)	Rohde & Schwarz	HF907	SEM003-07	2015-06-14	2018-06-14
6	Horn Antenna (18-26GHz)	ETS-Lindgren	3160	SEM003-12	2014-11-24	2017-11-24
7	Horn Antenna (26GHz-40GHz)	A.H.Systems, inc.	SAS-573	SEM003-13	2015-02-12	2018-02-12
8	Low Noise Amplifier	Black Diamond Series	BDLNA-0118-352810	SEM005-05	2016-10-09	2017-10-09
9	Band filter	Amindeon	Asi 3314	SEM023-01	N/A	N/A

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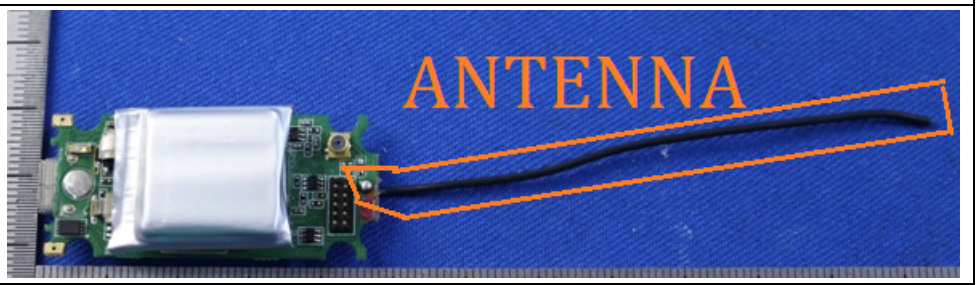
6 Test results and Measurement Data

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 2dBi.	

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6.2 Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.207
Test Method:	ANSI C63.10: 2013
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: 2013 on conducted measurement.

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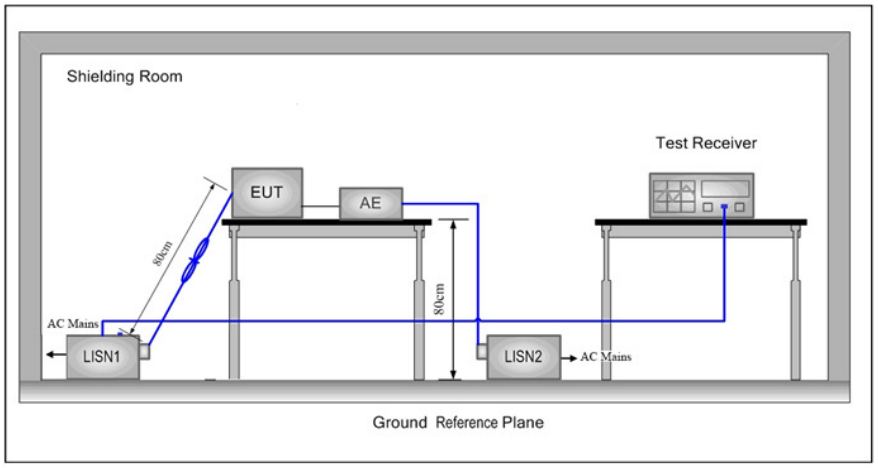
Test Setup:	
Exploratory Test Mode:	Non-hopping transmitting mode at the lowest, middle, high channel. Charge + Transmitting mode.
Final Test Mode:	Charge + Transmitting mode
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

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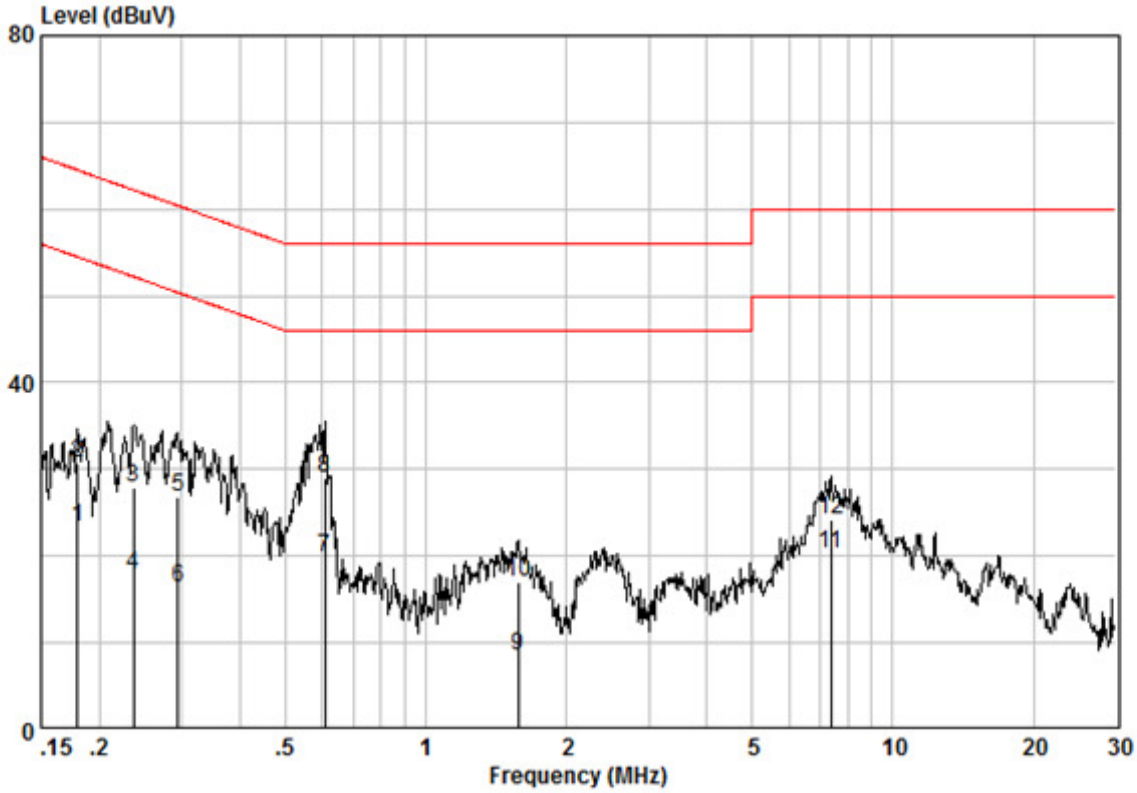
Measurement Data

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 : CE LINE
Job No. : 6185CR
Test Mode : Charging + TX

	Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1	0.17961	0.02	9.60	13.73	23.35	54.50	-31.16	AVERAGE
2	0.17961	0.02	9.60	21.15	30.77	64.50	-33.74	QP
3	0.23658	0.02	9.60	18.19	27.81	62.22	-34.40	QP
4	0.23658	0.02	9.60	8.24	17.86	52.22	-34.36	AVERAGE
5	0.29398	0.02	9.59	17.09	26.70	60.41	-33.71	QP
6	0.29398	0.02	9.59	6.79	16.41	50.41	-34.01	AVERAGE
7	0.60752	0.02	9.61	10.18	19.81	46.00	-26.19	AVERAGE
8	0.60752	0.02	9.61	19.46	29.10	56.00	-26.90	QP
9	1.577	0.03	9.59	-1.02	8.60	46.00	-37.40	AVERAGE
10	1.577	0.03	9.59	7.38	17.00	56.00	-39.00	QP
11	7.368	0.09	9.68	10.40	20.17	50.00	-29.83	AVERAGE
12	7.368	0.09	9.68	14.40	24.17	60.00	-35.83	QP

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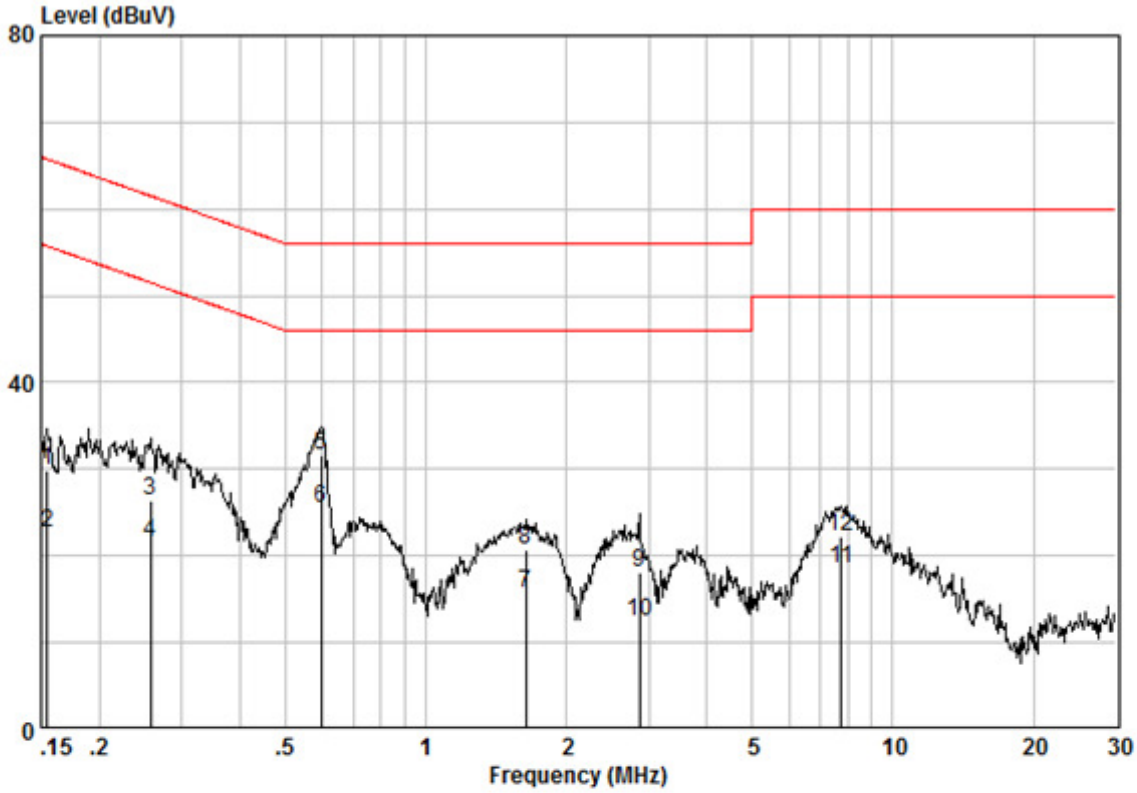
Neutral line:



Site : Shielding Room
Condition : CE NEUTRAL
Job No. : 6185CR
Test Mode : Charging +TX

		Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
		MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1		0.15485	0.02	9.61	20.15	29.79	65.74	-35.95	QP
2		0.15485	0.02	9.61	12.99	22.63	55.74	-33.11	AVERAGE
3		0.25751	0.02	9.61	16.72	26.35	61.51	-35.16	QP
4		0.25751	0.02	9.61	11.86	21.50	51.51	-30.02	AVERAGE
5		0.59794	0.02	9.63	21.88	31.53	56.00	-24.47	QP
6	@	0.59794	0.02	9.63	15.80	25.46	46.00	-20.54	AVERAGE
7		1.636	0.03	9.65	5.92	15.60	46.00	-30.40	AVERAGE
8		1.636	0.03	9.65	11.12	20.80	56.00	-35.20	QP
9		2.869	0.03	9.67	8.48	18.18	56.00	-37.82	QP
10		2.869	0.03	9.67	2.69	12.39	46.00	-33.61	AVERAGE
11		7.769	0.10	9.75	8.77	18.62	50.00	-31.38	AVERAGE
12		7.769	0.10	9.75	12.29	22.14	60.00	-37.86	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.

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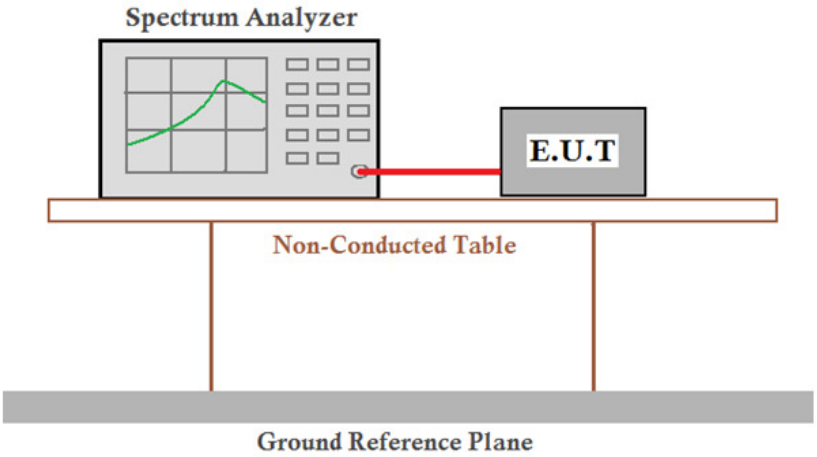
6.3 Conducted Peak Output Power

Test Requirement:	47 CFR Part 15C Section 15.247 (b)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.5
Test Setup:	 *Remark:* *Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.*
Limit:	30dBm
Exploratory Test Mode:	Non-hopping transmitting with modulation
Final Test Mode:	Non-hopping transmitting with modulation
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

Measurement Data

Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	19.86	30.00	Pass
Middle	19.82	30.00	Pass
Highest	19.89	30.00	Pass

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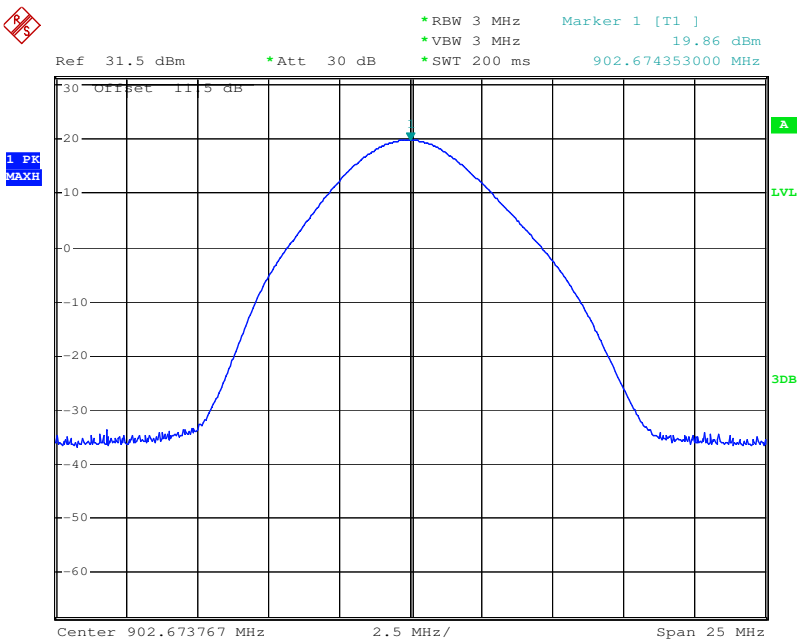
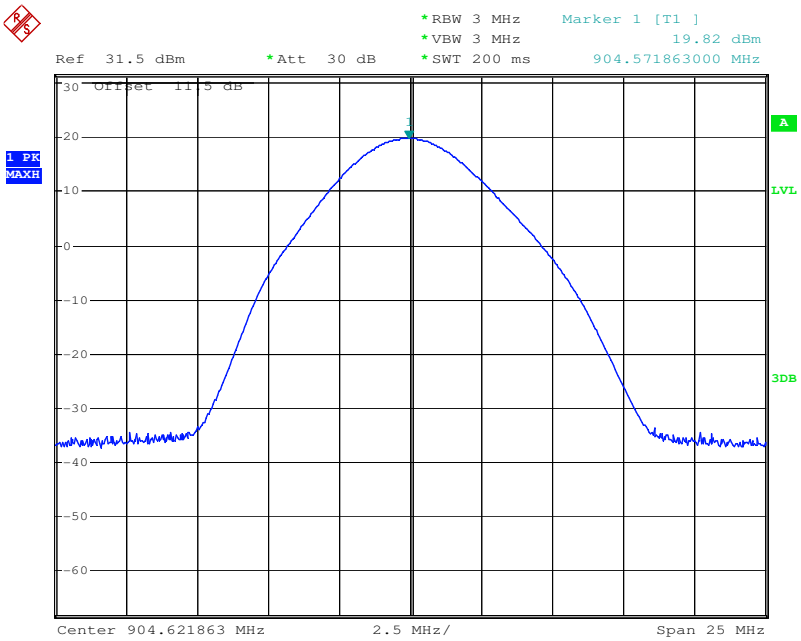
Test plot as follows:

Test mode:	Modulation	Test channel:	Lowest



Test mode:	Modulation	Test channel:	Middle



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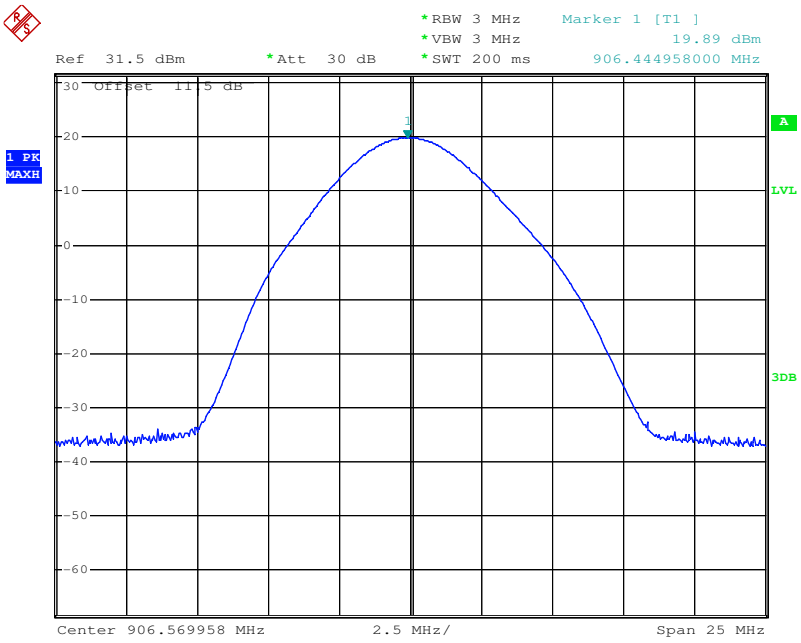
Test mode:	Modulation	Test channel:	Highest



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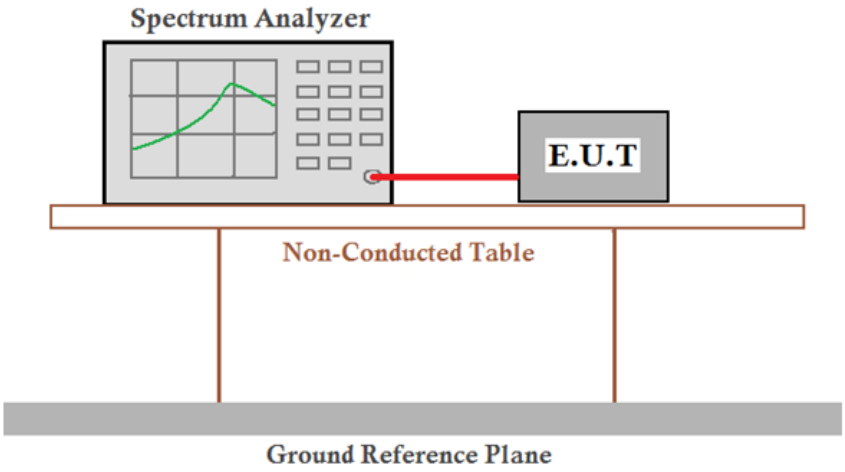
6.4 20dB Occupy Bandwidth

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.7
Test Setup:	
Limit:	250kHz
Exploratory Test Mode:	Non-hopping transmitting with modulation
Final Test Mode:	Non-hopping transmitting with modulation
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

Measurement Data

Test channel	20dB Occupy Bandwidth (kHz)	Limit(kHz)	Result
Lowest	41.90	250	Pass
Middle	41.90	250	Pass
Highest	42.00	250	Pass

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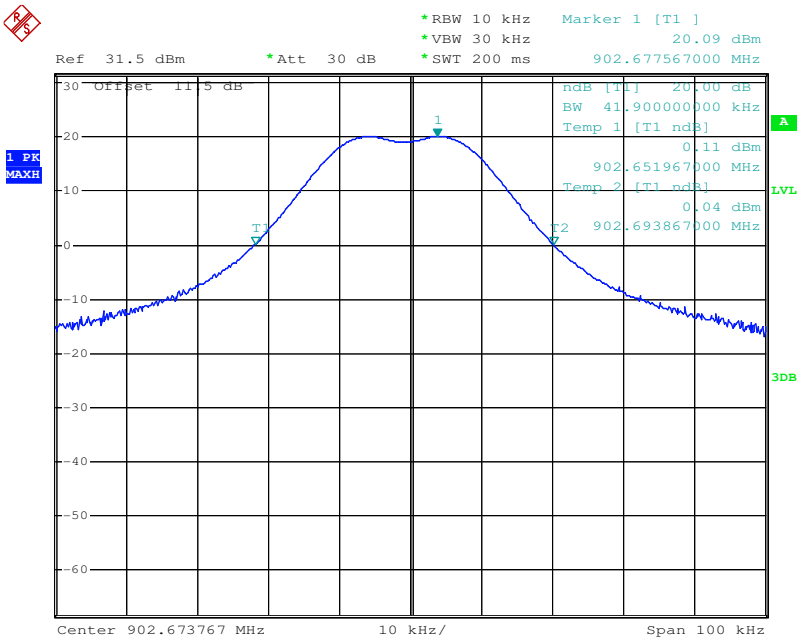
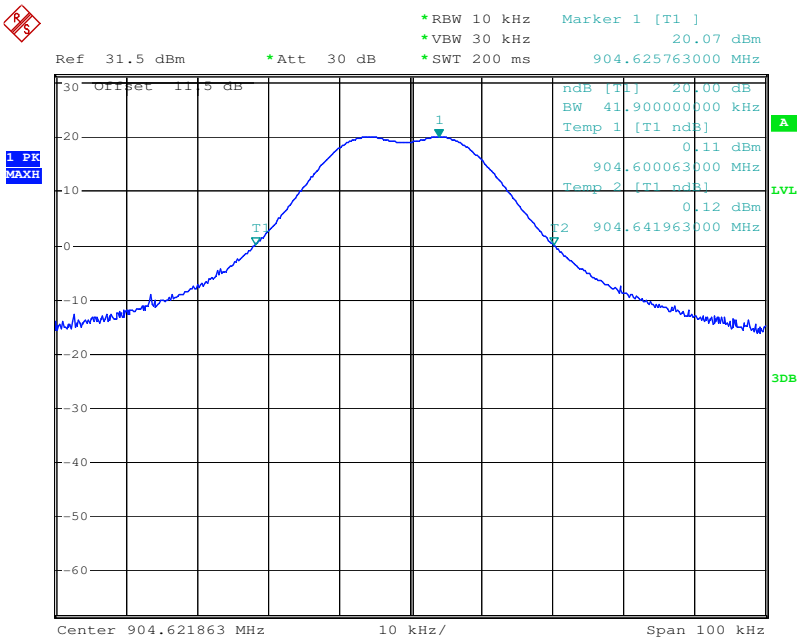
Test plot as follows:

Test mode:	modulation	Test channel:	Lowest



Test mode:	modulation	Test channel:	Middle



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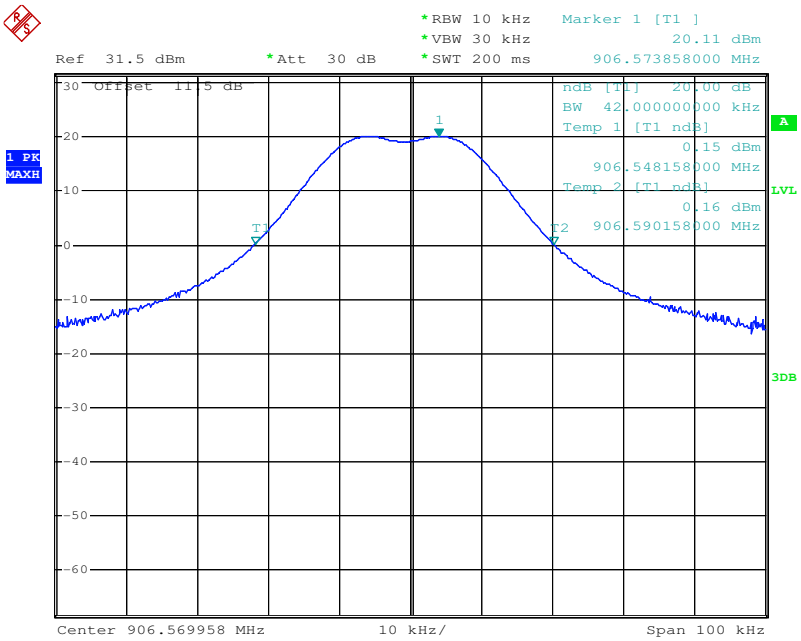
Test mode:	modulation	Test channel:	Highest



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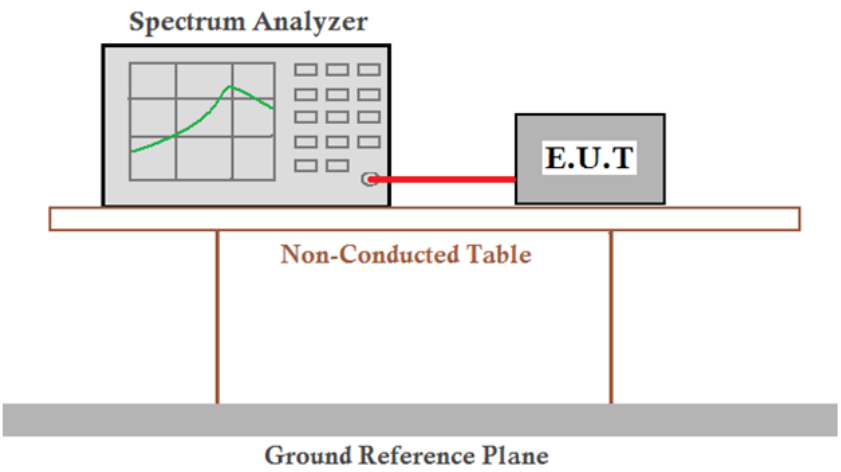
6.5 Carrier Frequencies Separation

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.2
Test Setup:	
Limit:	25kHz or 20 dB bandwidth, which is greater
Exploratory Test Mode:	Hopping transmitting with modulation
Final Test Mode:	Hopping transmitting with modulation
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

Measurement Data

Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Lowest	74.80	42.00	Pass
Middle	75.20	42.00	Pass
Highest	75.20	42.00	Pass

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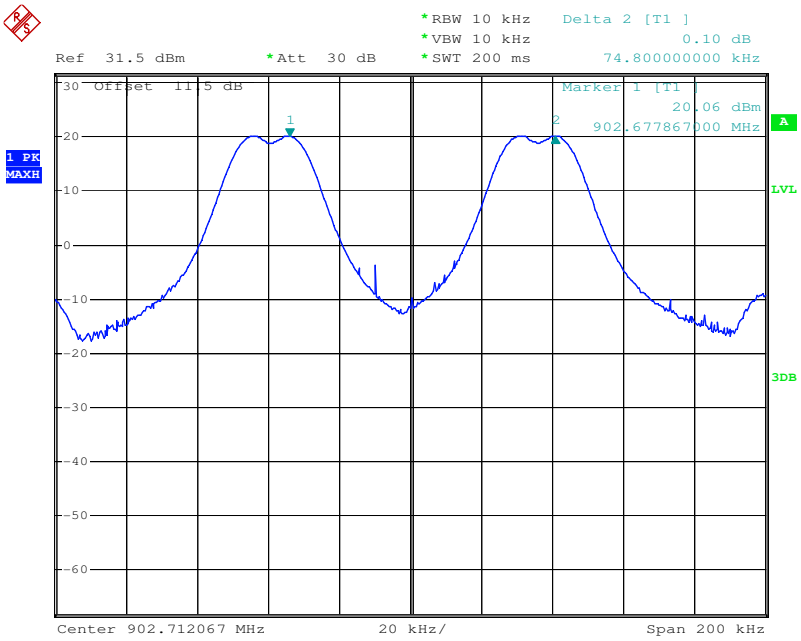
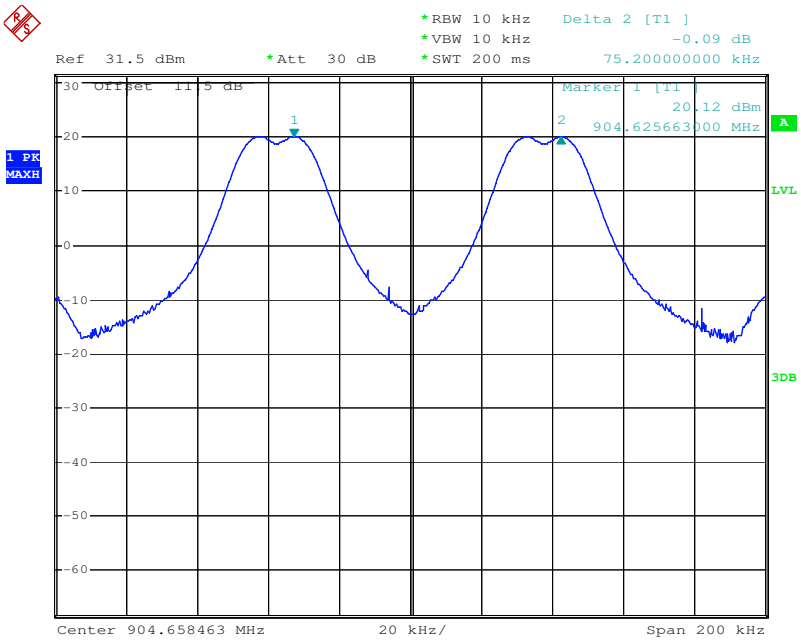
Test plot as follows:

Test mode:	modulation	Test channel:	Lowest



Test mode:	modulation	Test channel:	Middle



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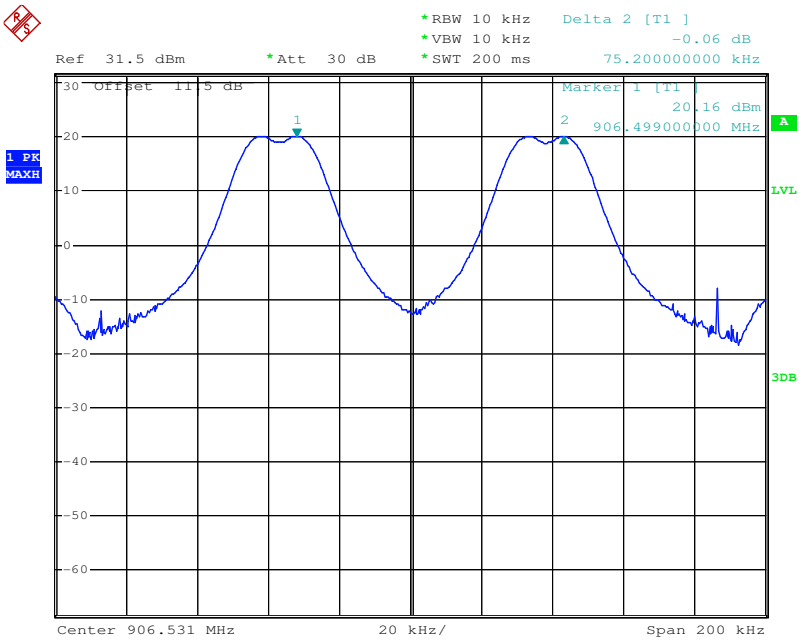
Test mode:	modulation	Test channel:	Highest



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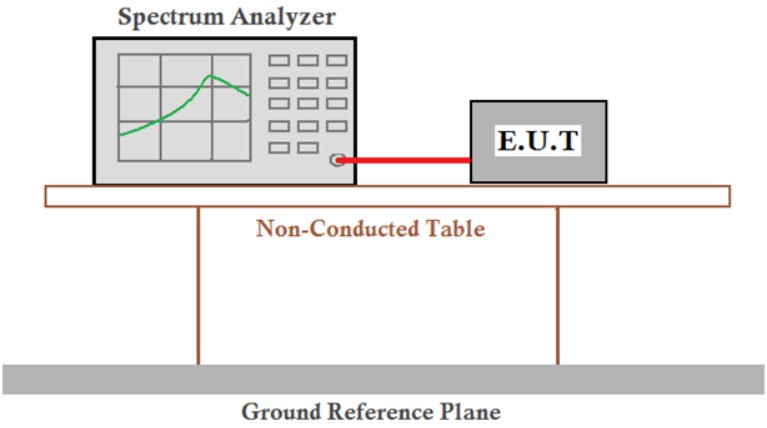
6.6 Hopping Channel Number

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.3
Test Setup:	
Limit:	At least 50channels
Test Mode:	Hopping transmitting with modulation
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

Measurement Data

Mode	Hopping channel numbers	Limit
FHSS	53	≥50

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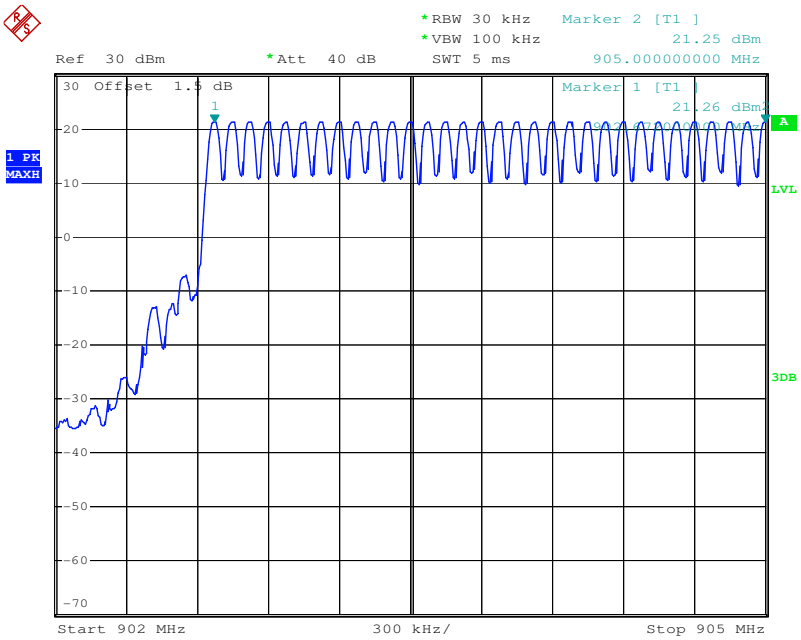
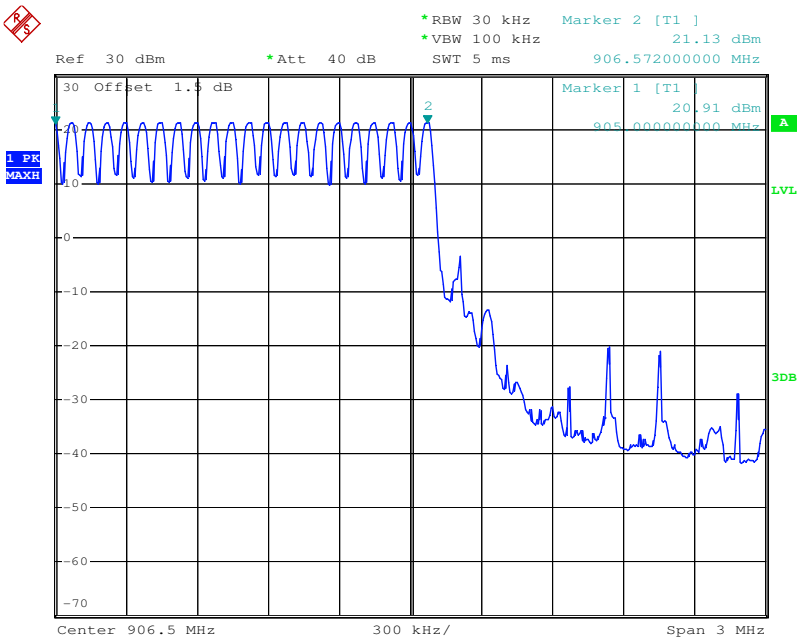
Test plot as follows

Test mode:	FHSS





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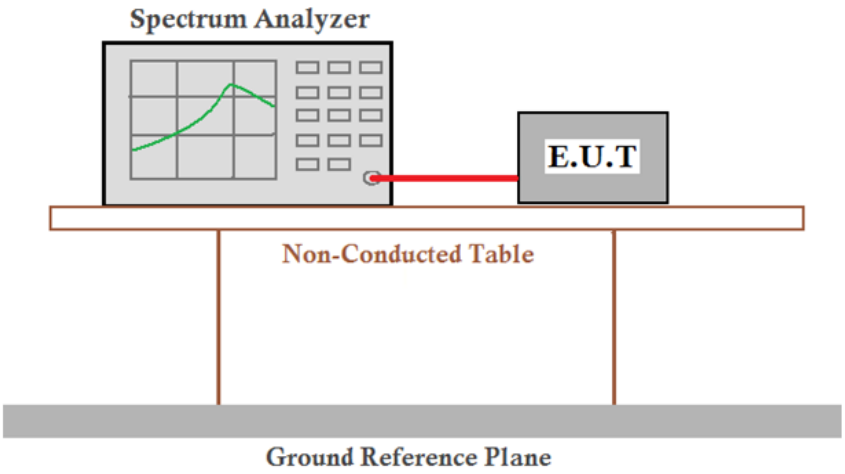
6.7 Dwell Time

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.4
Test Setup:	
Instruments Used:	Refer to section 5.10 for details
Test Mode:	Hopping transmitting with modulation
Limit:	0.4 Second
Test Results:	Pass

Measurement Data

Dwell time (second)	Limit (second)
0.192	≤0.4

Remark:

The test period: T= 20 s

On (ms)*total number=dwell time (ms)

Time slot=T1+T2=28ms+20ms

Total number: 4 in observe time 20s

Time slot=48 (ms)*total number=192 (ms)

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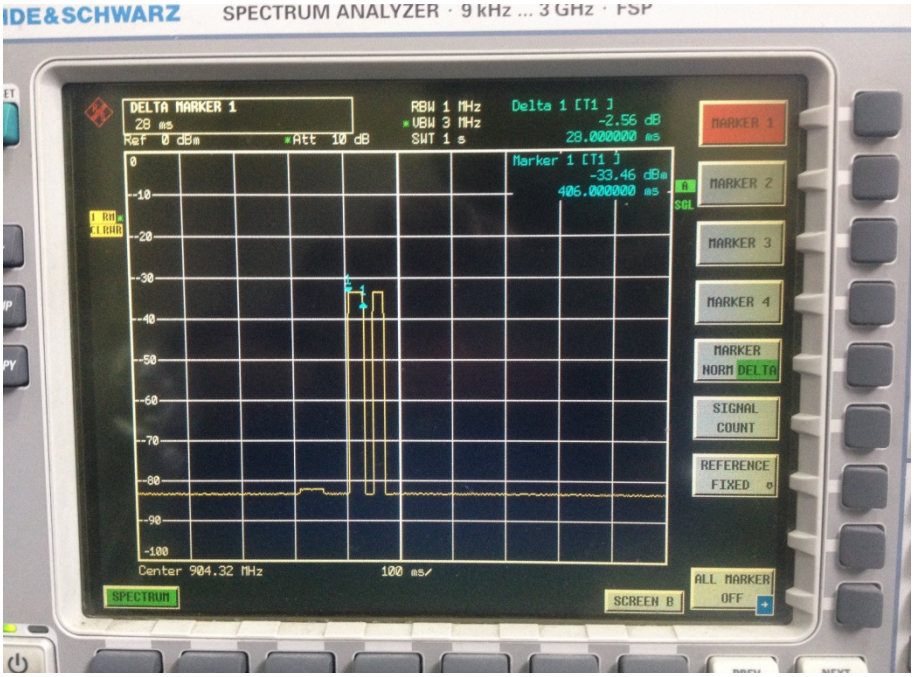
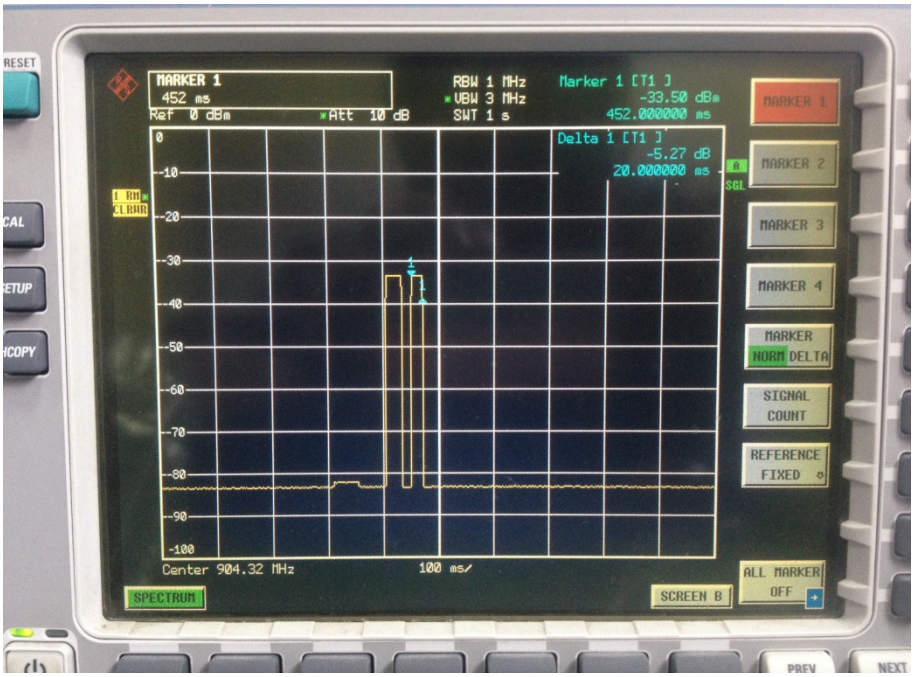
Test plot as follows:

Test Packet:	DH1





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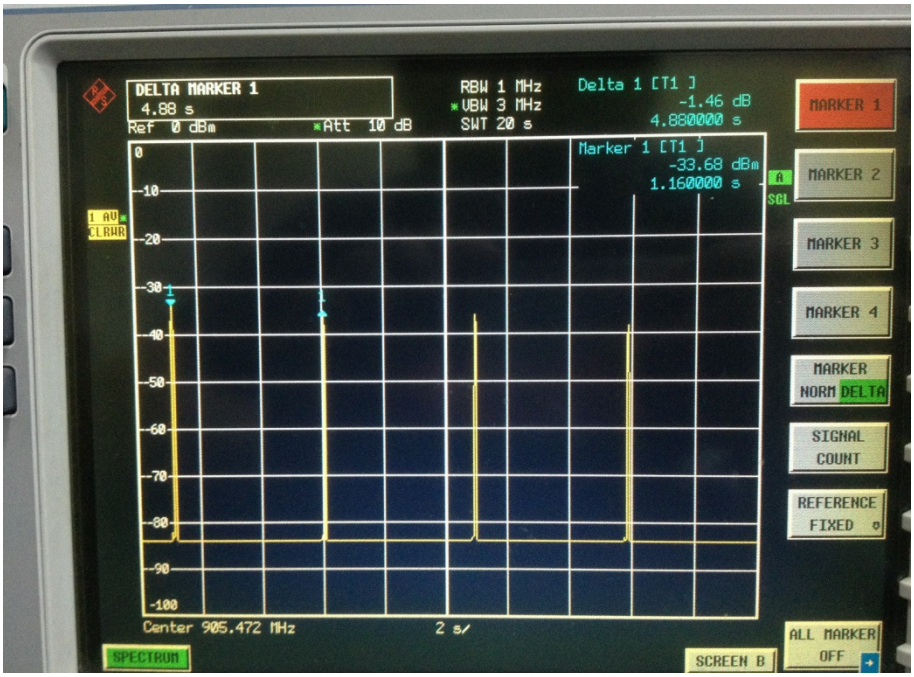

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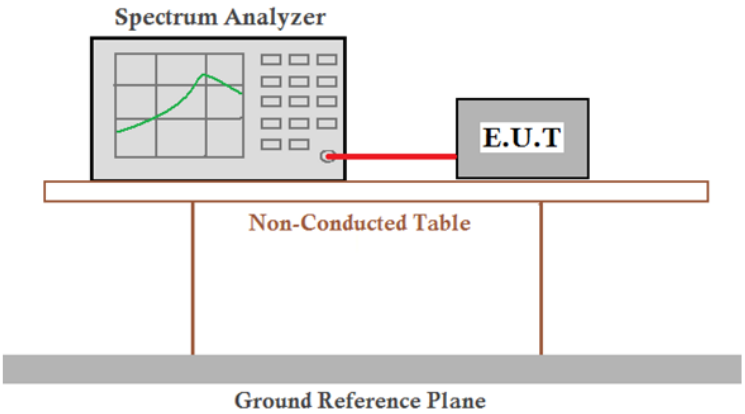
6.8 Band-edge for RF Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10:2013 Section 7.8.6
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.
Exploratory Test Mode:	Hopping and Non-hopping transmitting with modulation
Final Test Mode:	Hopping and Non-hopping transmitting with modulation
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

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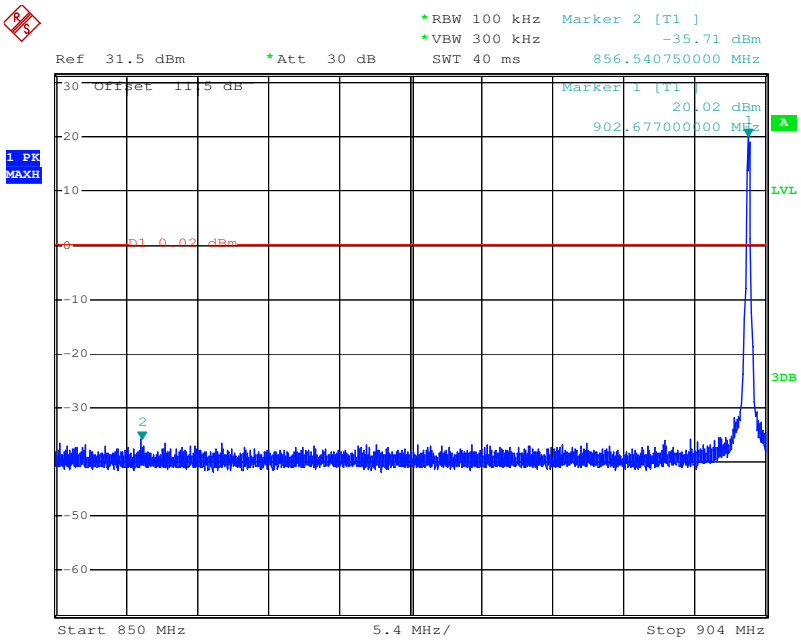
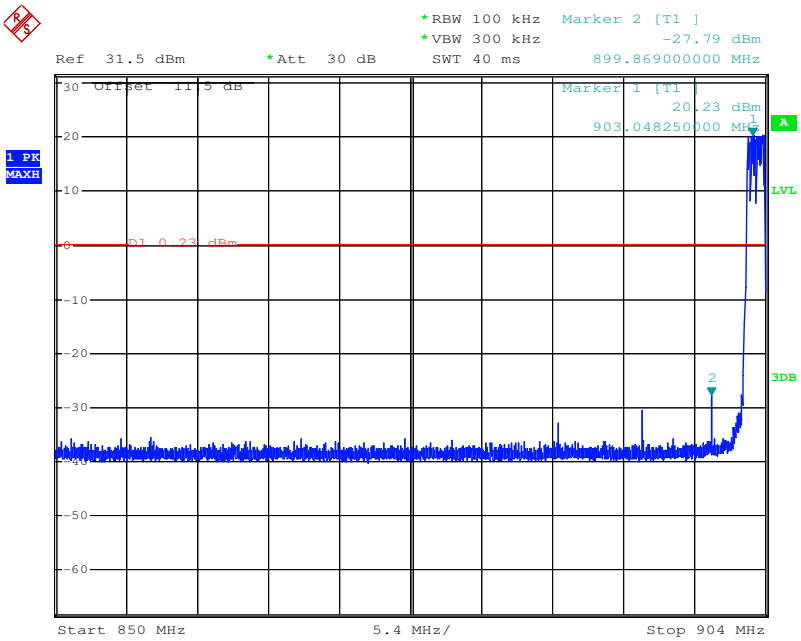
Test plot as follows:

Test mode:	Modulation	Test channel:	Lowest





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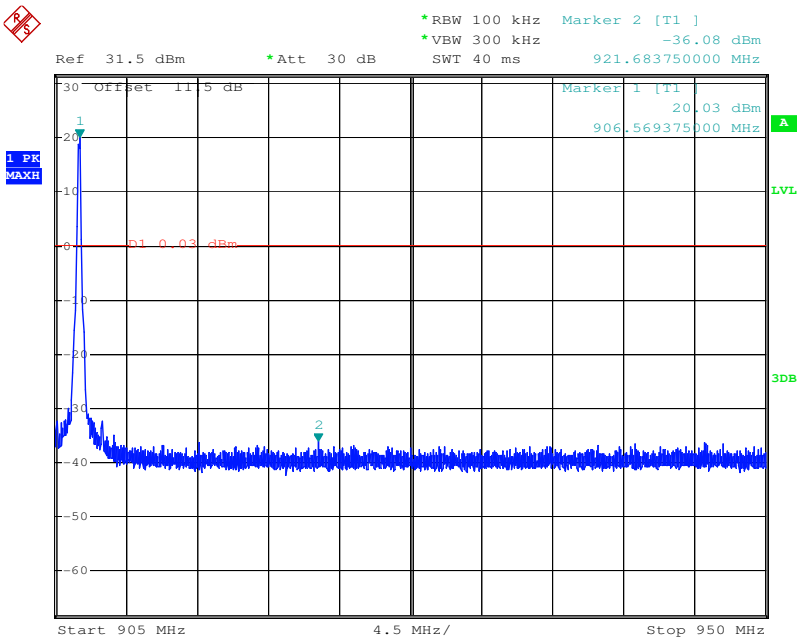
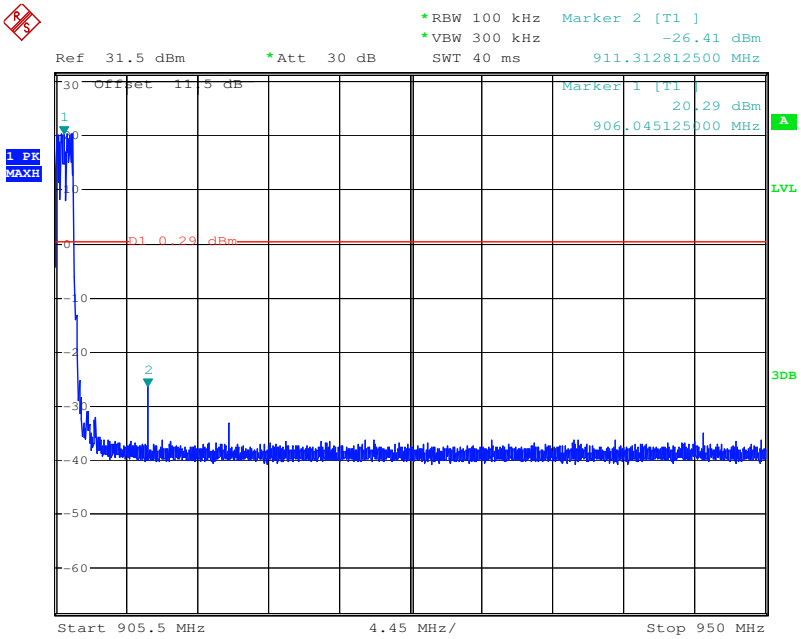
Test mode:	Modulation	Test channel:	Highest





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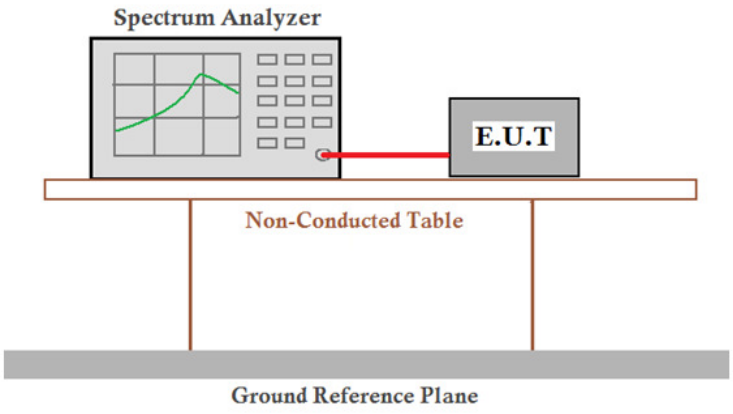
6.9 Spurious RF Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10:2013 Section 7.8.8
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.
Exploratory Test Mode:	Non-hopping transmitting with modulation
Final Test Mode:	Non-hopping transmitting with modulation
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

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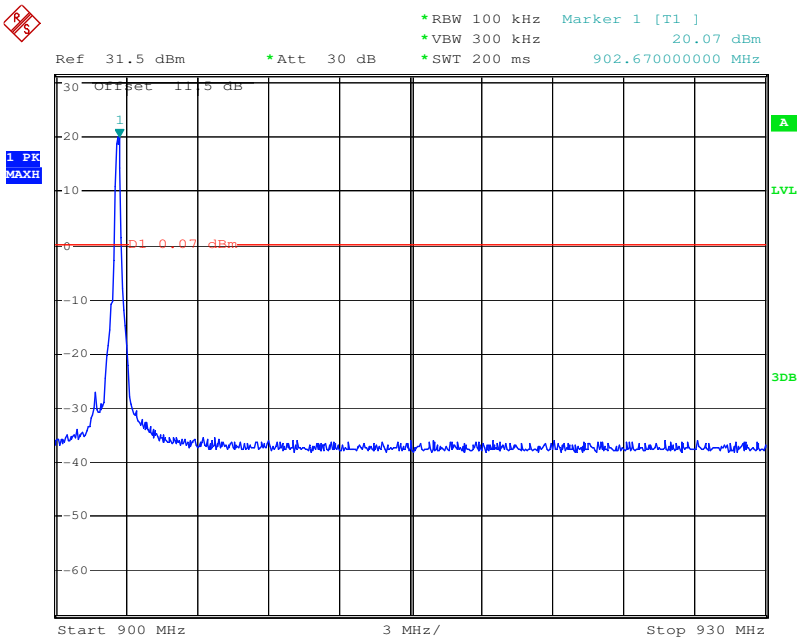
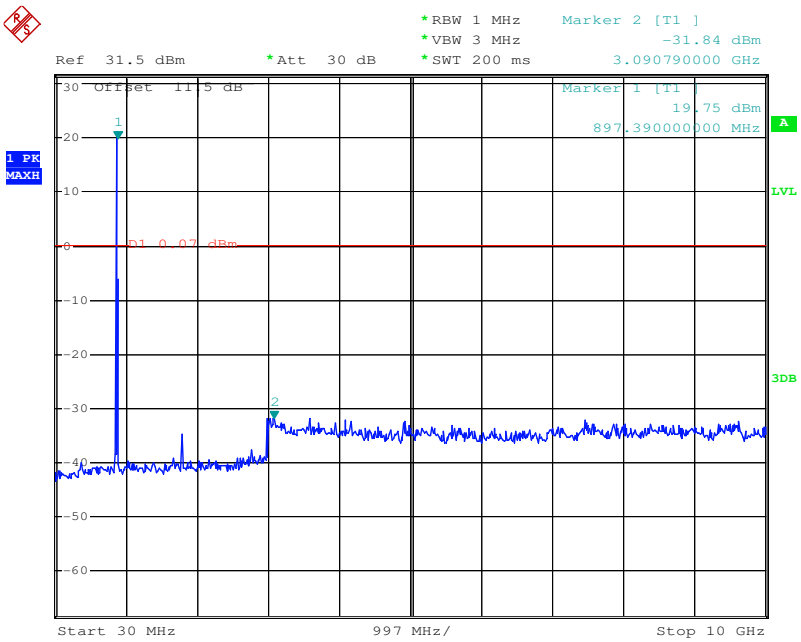
Test plot as follows:

Test mode:	Modulation	Test channel:	Lowest





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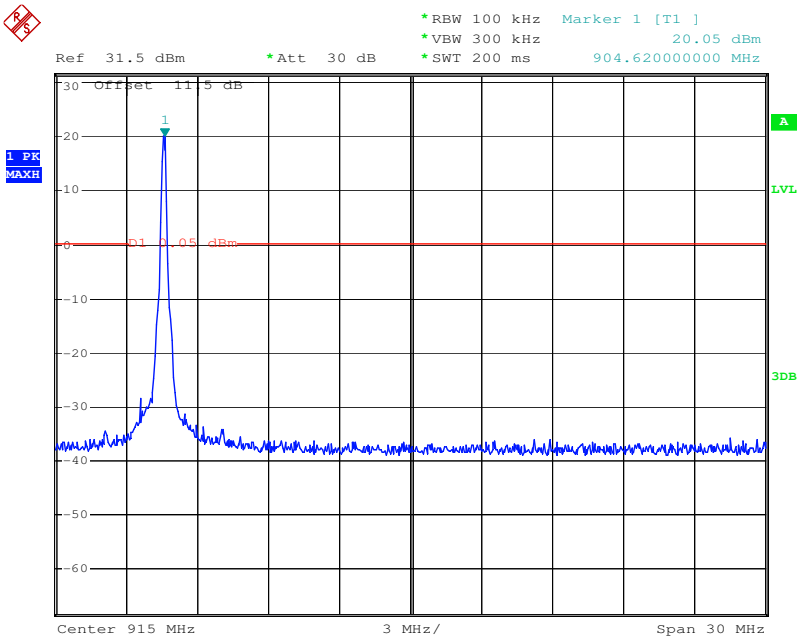
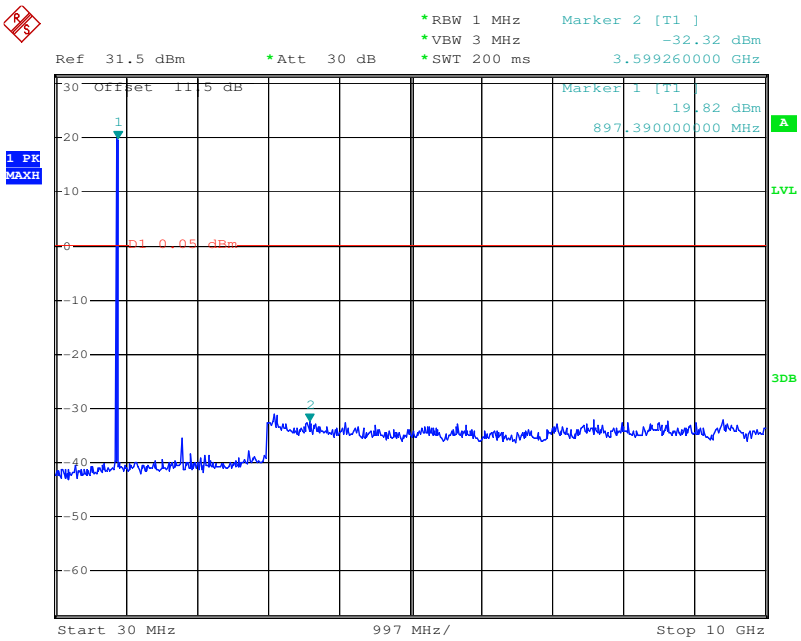
Test mode:	Modulation	Test channel:	Middle





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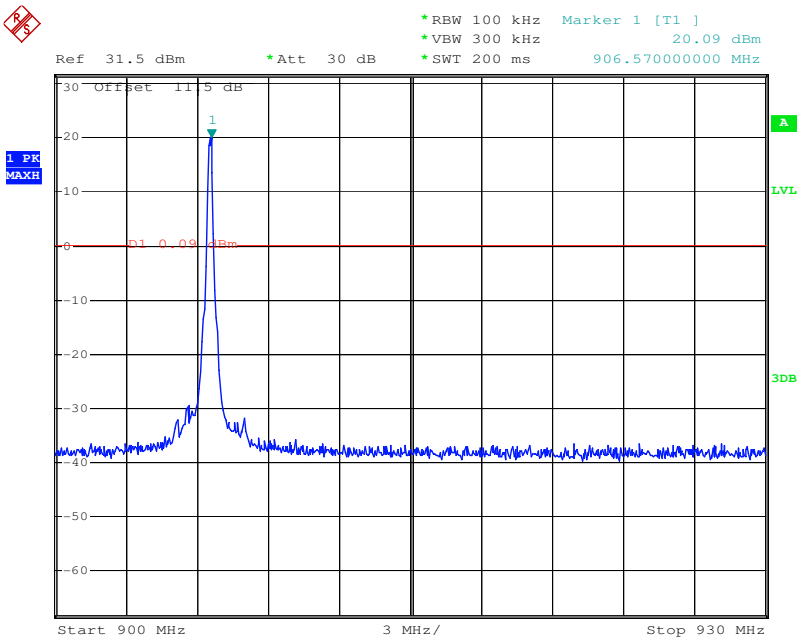
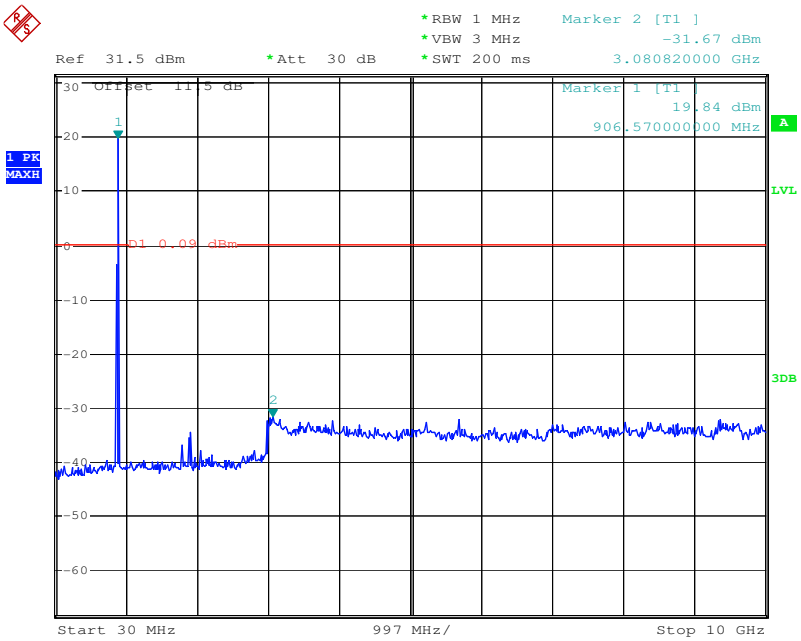
Test mode:	Modulation	Test channel:	Highest





Remark:

Use 100kHz RBW to determine the relative limit in the band 900MHz to 930MHz, and Use 1MHz RBW to measure spurious emissions in the band 30MHz to 10GHz. The sweep points set to 30001.

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6.10 Other requirements Frequency Hopping Spread Spectrum System

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1), (h) requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

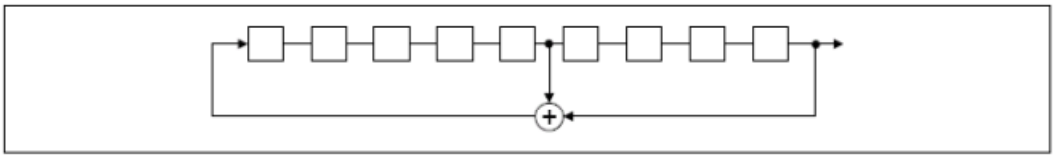
Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Compliance for section 15.247(a)(1)

According to Hopping RF chip Specification, the pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage
outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones.

- Number of shift register stages: 9
- Length of pseudo-random sequence: 2^9 -1 = 511 bits
- Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:
2,5,7,12,43,23,37,9
Each frequency used equally on the average by each transmitter.

Compliance for section 15.247(g)

According to Hopping RF chip Specification, the hopping system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the hopping system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

Compliance for section 15.247(h)

According to Hopping RF chip specification, the Hopping system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to

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avoid hopping on the occupied channels.

According to the Hopping RF chip specification, the Hopping system is designed not have the ability to coordinated with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.

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6.11 Radiated Spurious Emission and Restricted band

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205
Test Method:	ANSI C63.10: 2013
Test Site:	Below 1GHz: Measurement Distance: 3m (Semi-Anechoic Chamber) Above 1GHz: Measurement Distance: 3m (Full-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.

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Test Setup:	

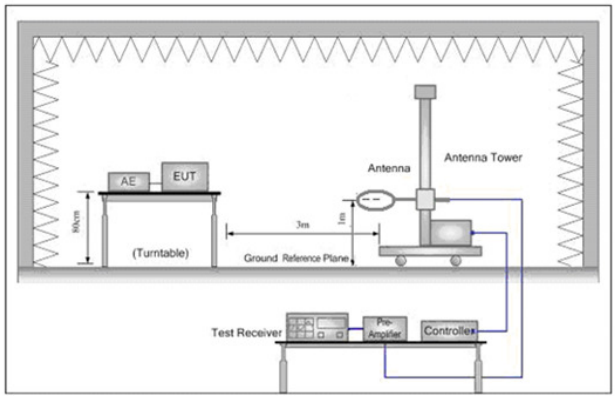

Figure 1. Below 30MHz

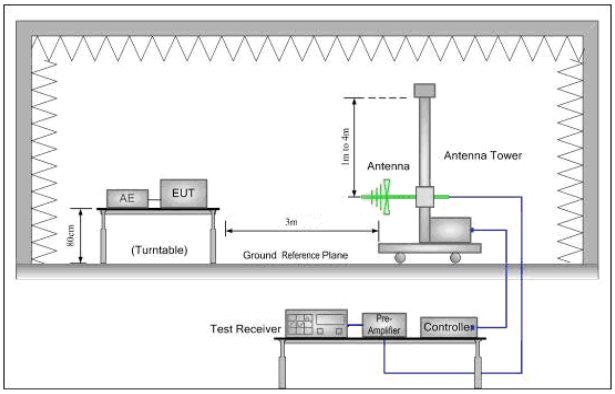

Figure 2. 30MHz to 1GHz

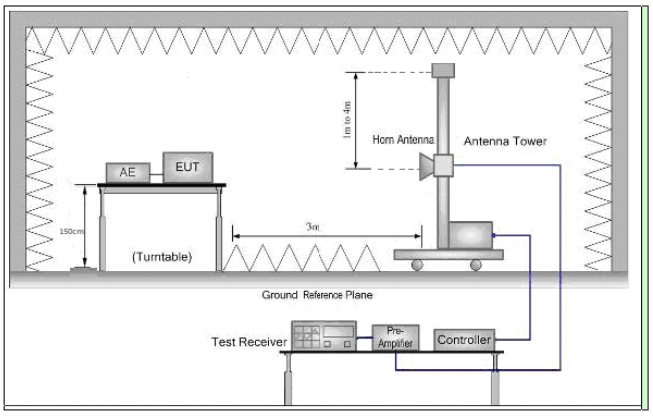

Figure 3. Above 1 GHz

Test Procedure:	
	a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter full-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. c. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. d. 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. e. 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. f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. g. 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

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	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. h. Test the EUT in the lowest channel (2402MHz),the middle channel (2441MHz),the Highest channel (2480MHz) i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case. j. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Non-hopping transmitting mode with modulation Transmitting mode, Charge + Transmitting mode.
Final Test Mode:	Pretest the EUT at Transmitting mode and Charge + Transmitting mode, found the Transmitting mode which it is worse case For below 1GHz part, through pre-scan, the worst case is the lowest channel. Only the worst case is recorded in the report.
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

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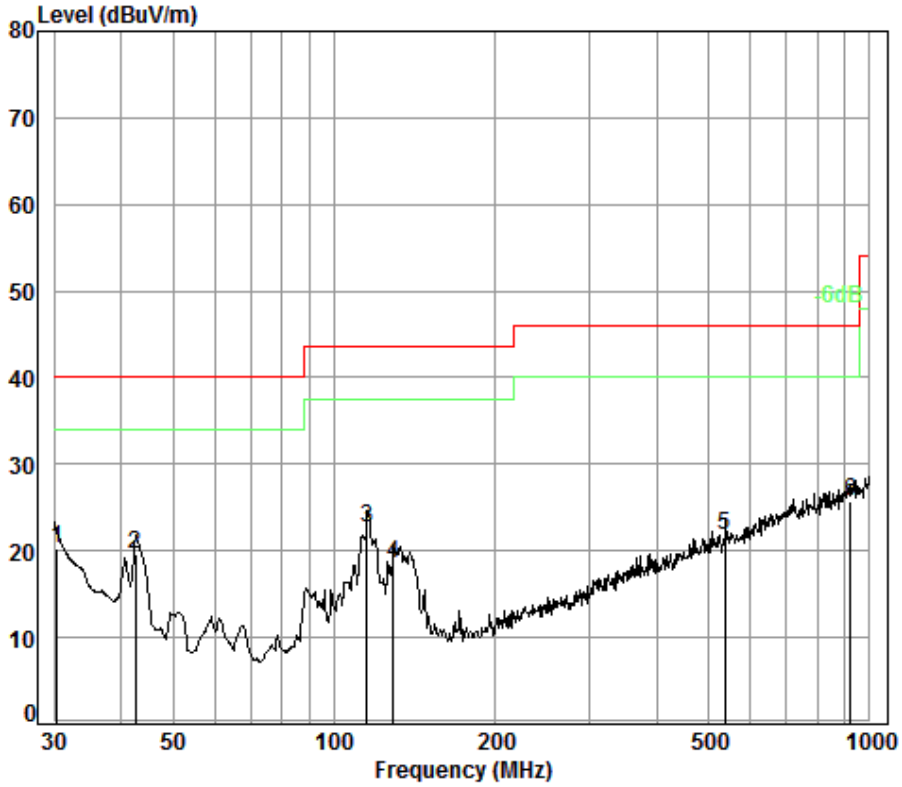
6.11.1 Radiated Emission below 1GHz

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



Condition: 3m Vertical
Job No. : 6185CR
Test mode: TX

	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	30.42	0.60	18.72	27.40	28.26	20.18	40.00	-19.82
2	42.60	0.66	11.99	27.37	34.43	19.71	40.00	-20.29
3	115.32	1.24	8.37	27.21	40.17	22.57	43.50	-20.93
4	129.01	1.27	7.92	27.14	36.56	18.61	43.50	-24.89
5	537.59	2.64	18.71	27.61	28.01	21.75	46.00	-24.25
6	922.52	3.62	23.38	26.83	25.50	25.67	46.00	-20.33

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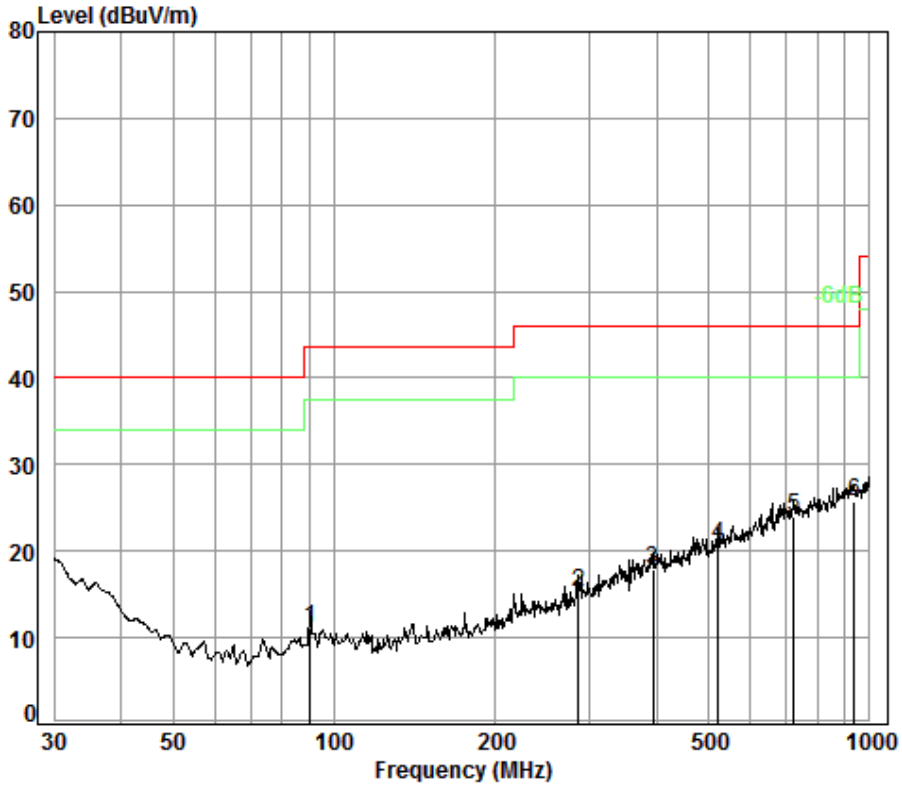
Test mode:	Transmitting	Horizontal



Condition: 3m Horizontal
Job No. : 6185CR
Test mode: TX

	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	90.22	1.10	8.81	27.31	28.53	11.13	43.50	-32.37
2	285.98	1.84	13.10	26.63	26.98	15.29	46.00	-30.71
3	393.47	2.18	16.27	27.07	26.48	17.86	46.00	-28.14
4	522.72	2.62	18.33	27.56	27.22	20.61	46.00	-25.39
5	721.73	2.97	21.61	27.54	27.00	24.04	46.00	-21.96
6 pp	935.55	3.64	23.31	26.77	25.61	25.79	46.00	-20.21

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6.11.2 Transmitter Emission above 1GHz

Test mode:	Transmitting		Test channel:	Lowest		Remark:	Peak
Frequency (MHz)	Antenna factors (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1805.005	27.09	4.82	38.09	66.73	60.55	74.00	-13.45	Vertical
2705.543	30.22	5.64	38.17	55.54	53.23	74.00	-20.77	Vertical
4512.966	33.62	7.30	38.92	54.19	56.19	74.00	-17.81	Vertical
1805.005	27.09	4.82	38.09	69.16	62.98	74.00	-11.02	Horizontal
2705.543	30.22	5.64	38.17	52.89	50.58	74.00	-23.42	Horizontal
4455.890	33.60	7.23	38.89	46.99	48.93	74.00	-25.07	Horizontal

Test mode:	Transmitting		Test channel:	Lowest		Remark:	Average
Frequency (MHz)	Antenna factors (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1805.005	27.09	4.82	38.09	53.31	47.13	54.00	-6.87	Vertical
4512.966	33.62	7.3	38.92	42.26	44.26	54.00	-9.74	Vertical
1805.005	27.09	4.82	38.09	54.24	48.06	54.00	-5.94	Horizontal

Test mode:	Transmitting		Test channel:	Middle		Remark:	Peak
Frequency (MHz)	Antenna factors (dB/m)	Cable Loss (dB)	Cable Loss (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Over limit (dB)	Polarization
1809.605	27.10	4.82	38.09	71.77	65.60	74.00	-8.40	Vertical
2712.439	30.25	5.65	38.18	57.52	55.24	74.00	-18.76	Vertical
4524.468	33.65	7.32	38.92	49.00	51.05	74.00	-22.95	Vertical
1809.605	27.10	4.82	38.09	68.50	62.33	74.00	-11.67	Horizontal
2712.439	30.25	5.65	38.18	56.60	54.32	74.00	-19.68	Horizontal
4524.468	33.65	7.32	38.92	45.85	47.90	74.00	-26.10	Horizontal

Test mode:	Transmitting		Test channel:	Middle		Remark:	Average
Frequency (MHz)	Antenna factors (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1809.605	27.1	4.82	38.09	55.63	49.46	54.00	-4.54	Vertical
2712.439	30.25	5.65	38.18	47.53	45.25	54.00	-8.75	Vertical
1809.605	27.1	4.82	38.09	53.46	47.29	54.00	-6.71	Horizontal
2712.439	30.25	5.65	38.18	48.79	46.51	54.00	-7.49	Horizontal

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Test mode:	Transmitting	Test channel:	Highest	Remark:	Peak

Frequency (MHz)	Antenna factors (dB/m)	Cable Loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Over limit (dB)	Polarization
1814.218	27.12	4.83	38.09	61.96	55.82	74.00	-18.18	Vertical
2719.353	30.28	5.66	38.18	60.45	58.21	74.00	-15.79	Vertical
4536.000	33.67	7.33	38.93	63.02	65.09	74.00	-8.91	Vertical
1814.218	27.12	4.83	38.09	57.90	51.76	74.00	-22.24	Horizontal
2719.353	30.28	5.66	38.18	53.14	50.90	74.00	-23.10	Horizontal
4536.000	33.67	7.33	38.93	54.26	56.33	74.00	-17.67	Horizontal

Test mode:	Transmitting	Test channel:	Highest	Remark:	Average

Frequency (MHz)	Antenna factors (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1814.218	27.12	4.83	38.09	52.16	46.02	54.00	-7.98	Vertical
2719.353	30.28	5.66	38.18	45.57	43.33	54.00	-10.67	Vertical
4536.000	33.67	7.33	38.93	45.6	47.67	54.00	-6.33	Vertical
4536.000	33.67	7.33	38.93	46.24	48.31	54.00	-5.69	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 10GHz, the disturbance above 5GHz 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.

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7 Photographs - EUT Test Setup

Test Model No.: ETP-TAG-02

7.1 Conducted Emission

7.2 Radiated Emission

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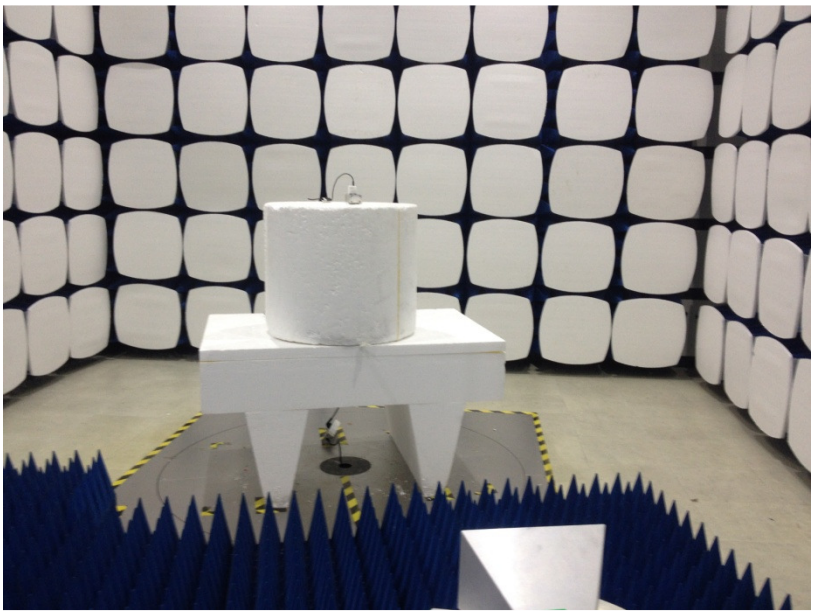
7.3 Radiated Spurious Emission



8 Photographs - EUT Constructional Details

Refer to Appendix A - Photographs of EUT Constructional Details for SZEM1607006185CR.

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