TEST REPORT

Application No.:	HKEM1811000884AV
Applicant:	RFDESIGN PTY LTD
FCC ID:	2ADLE-900X
Product Description:	Modular Radio Modem
Model No.:	900x
Country of Origin:	Taiwan
Country of Destination:	US
Standards:	47 CFR Part 15, Subpart C 15.247
Date of Receipt:	2018-11-01
Date of Test:	2018-11-17 to 2018-11-29
Date of Issue:	2018-12-06
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:

Ivan Toa

2 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
Occupied Bandwidth	FCC PART 15 C section 15.247 (a)(1)	ANSI C63.10: Clause 6.9.1	PASS
Carrier Frequencies Separated	FCC PART 15 C section 15.247(a)(1)	ANSI C63.10: Clause 7.8.2	PASS
Hopping Channel Number	FCC PART 15 C section 15.247(a)(1)(iii)	ANSI C63.10: Clause 7.8.3	PASS
Dwell Time	FCC PART 15 C section 15.247(a)(1)(iii)	ANSI C63.10: Clause 7.8.4	PASS
Pseudorandom Frequency Hopping Sequence	FCC PART 15 C section 15.247(a)(1)	ANSI C63.10: Clause 7.7.5	PASS
Maximum Peak Output Power	FCC PART 15 C section 15.247(b)(1)	ANSI C63.10: Clause 7.8.5	PASS
Conducted Spurious Emission	FCC PART 15 C section 15.247(d)	ANSI C63.10: Clause 7.8.8	PASS
Radiated Spurious Emission	FCC PART 15 C section 15.247(d)	ANSI C63.10: Clause 6.10.4	PASS
Band Edges Measurement	FCC PART 15 C section 15.247 (d) &15.205	ANSI C63.10: clause 7.8.6	PASS

3 Contents

4 General Information

4.1 Client Information

Applicant:	RFDESIGN PTY LTD
Address of Applicant:	7/1 STOCKWELL PLACE, ARCHERFIELD QLD 4108,Australia

4.2 General Description of E.U.T.

Product Name:	RFD 900x
Model No.:	900X

4.3 Details of E.U.T.

Operating Frequency	Band 1: 902.250 – 914.750MHz Band 2: 915.250 – 927.750MHz
Type of Modulation:	GFSK
Number of Channels	Band 1: 51 Channels Band 2: 51 Channels
Channel Separation:	250 kHz
Dwell time	Per channel is less than 0.4s.
Antenna Type	Dipole RPSMA
Antenna gain:	Antenna 1: 3dBi Antenna 2: 3dBi
MIMO:	N/A
Function:	Wireless transmitter
Power Supply:	USB DC 5V VIA USB cable
Adapter:	None.
Power cord:	USB cable

Remark: The device meets the requirements stated within Parts 15.247(g) & (h) in that they were developed under the protocol and operate as a true frequency hopping system. The device does not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

4.4 Modulation configures

None.

4.5 Description of Support Units

The EUT has been tested with computer (Ref no: EMC01) and test software CoolTerm Ver.1.4.4.227 to fixed frequency and air speed(12kBaud / 64kBaud / 125kBaud / 250kBaud) to testing which are provided by lab

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None.

4.8 Other Information Requested by the Customer

None.

4.9 Test Location

All tests were performed at:

SGS IECC Limited (Member of the SGS Group (SGS SA))

No. 16-B, Yip Wo Street, On Lok Tsuen, Fanling, N.T., Hong Kong

Tel: +852 2305 2570 Fax: +852 2756 4480.

No tests were sub-contracted.

4.10 Test Facility

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

- **HOKLAS (Lab Code: 125)**

  SGS IECC Limited has been accepted by HKAS Executive, on the recommendation of the Accreditation Advisory Board, as a HOKLAS Accredited Laboratory, this laboratory meets the requirements of ISO/IEC 17025:2005 an it has been accredited for performing specific test as listed in the scope of accreditation within the test category of Electrical and Electronic Products.

- **FCC Recognized Accredited Test Firm(CAB Registration No.: 446297)**

  SGS IECC Limited has been accredited and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation Number: HK0010, Test Firm Registration Number: 446297.

- **Industry Canada (Registration No.: 5193A-2)**

  The 3m Alternative Semi-anechoic chamber of SGS IECC Limited has been registered by Certification and Engineering of Industry Canada for radio equipment testing with Registration No. **5193A-2**.

4.11 Measurement Uncertainty (95% confidence levels, k=2)

No.	Item	Measurement Uncertainty
1	Radio frequency	7.25×10^{-8}
2	RF power (conducted)	0.75dB
3	Radiated Spurious emission	5.28dB (30MHz-1GHz)
		5.11dB (1GHz-25GHz)
4	Temperature test	1°C
5	Humidity test	3%
6	DC and low frequency voltages test	0.5%

5 Equipment Used during Test

Radiated Emission			
Equipment	**Manufacturer**	**Model / Serial No.**	**Cal. Due Date**
3m Semi-Anechoic Chamber	ChamPro	N/A	2020/09/14
Test Receiver	Rohde & Schwarz	ESCS 30 / 100388	2019/09/26
EMI Test Receiver	Rohde & Schwarz	ESR3	2019/08/15
Signal Generator	Rohde & Schwarz	SMT03 / 832939/017	2019/06/04
Spectrum Analyzer	Rohde & Schwarz	FSP 30 / 101474	2019/05/30
Loop Antenna	Rohde & Schwarz	HFH2-Z2 / 871336/48	2019/01/22
Antenna 30-1000MHz	Schaffner	CBL6111C / 2791	2019/10/26
Antennas (30MHz-300MHz)	Schwarzbeck	BBA9106, VHA9103	2019/11/14
Log-periodic Antennas (300MHz-1000MHz)	Schwarzbeck	UHALP9107	2019/11/14
Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D / 9120D-1070	2019/01/22
Double Ridge Horn Antenna 2-18 GHz	Schwarzbeck	BBHA 9120 C	2020/03/13
Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170 / 9170-492	2019/11/23
Highpass Filter	Wainwright	WHNX3.5/26.5G-6SS / nil	2018/12/18
Band Reject Filter	Wainwright	WRCJV 2400/2500-2100/2800-40/3SS / nil	2018/12/18
Preamplifier 10MHz – 6GHz	Schwarzbeck	BBV9743 / 9743-052	2019/04/18
Preamplifier 1-18GHz	Schwarzbeck	BBV9718 / 9718-223	2019/01/22
Preamplifier 18-26.5GHz	Schwarzbeck	BBV9719 / 9719-019	2019/11/18
Coaxial Cable	--	E167	2019/10/09
RF Cable	HUBER+SUHNER	E207	2019/11/16
Boresight Mast Controller	ChamPro	AM-BS-4500-E / 060860-ABS	--
Turntable with Controller	ChamPro	EM1000 / 60860	--

Conducted Emission			
Equipment	**Manufacturer**	**Model / Serial No.**	**Calibration Due**
Test Receiver	Rohde & Schwarz	ESHS 30 / 839667/002	2019/09/26
Signal Generator	Rohde & Schwarz	SMT03 / 832939/017	2019/06/04
Artificial Mains Network (LISN)	Schwarzbeck	NSLK 8127 / 8127309	2019/09/26
Impulse Limiter	Rohde & Schwarz	ESH-3-Z2 / 357881052	2019/01/22

RF Conducted			
Equipment	**Manufacturer**	**Model / Serial No.**	**Cal. Due Date**
Wireless Conn. Tester (CMW)	Rohde & Schwarz	CMW270	2019/08/12
OSP	Rohde & Schwarz	OSP-B157W8	2019/09/17
FSV40 SIGNAL ANALYZER 40GHz	Rohde & Schwarz	FSV40	2019/08/12
SMBV100A VECTOR SIGNAL GENERATOR	Rohde & Schwarz	SMBV100A	2019/08/12
Cable	Rohde & Schwarz	J12J103539-00-2	2019/08/12

General Use Equipment			
Equipment	**Manufacturer**	**Model / Serial No.**	**Cal. Due Date**
Digital Multimeter	Fluke	189 / 83640020	2019/05/22
Temperature / Humidity meter	-	E159	2019/09/20

6 Test Results

6.1 E.U.T. test conditions

Test Voltage:	DC 5V
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:

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

EUT channels and frequencies list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	**902.25**	21	907.25	41	912.25
2	902.50	22	907.50	42	912.50
3	902.75	23	907.75	43	912.75
4	903.00	24	908.00	44	913.00
5	903.25	25	908.25	45	913.25
6	903.50	26	908.50	46	913.50
7	903.75	27	908.75	47	913.75
8	904.00	28	909.00	48	914.00
9	904.25	29	909.25	49	914.25
10	904.50	30	909.50	50	914.50
11	904.75	31	909.75	51	914.75
12	905.00	32	910.00	**52**	**915.25**
13	905.25	33	910.25	53	915.50
14	905.50	34	910.50	54	915.75
15	905.75	35	910.75	55	916.00
16	906.00	36	911.00	56	916.25
17	906.25	37	911.25	57	916.50
18	906.50	38	911.50	58	916.75
19	906.75	39	911.75	59	917.00
20	907.00	40	912.00	60	917.25

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
61	917.50	81	922.50	101	927.50
62	917.75	82	922.75	**102**	**927.75**
63	918.00	83	923.00		
64	918.25	84	923.25		
65	918.50	85	923.50		
66	918.75	86	923.75		
67	919.00	87	924.00		
68	919.25	88	924.25		
69	919.50	89	924.50		
70	919.75	90	924.75		
71	920.00	91	925.00		
72	920.25	92	925.25		
73	920.50	93	925.50		
74	920.75	94	925.75		
75	921.00	95	926.00		
76	921.25	96	926.25		
77	921.50	97	926.50		
78	921.75	98	926.75		
79	922.00	99	927.00		
80	922.25	100	927.25		

Test frequencies are the lowest channel:1 channel(902.25MHz), middle channel: 52 channel(915.25MHz) and highest channel: 102 channel(927.75MHz)

6.2 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 902-928MHz 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 dedicated antenna with Female RP-SMA unique connector. The maximum gain of the antenna is 3 dBi.

Test result: The unit does meet the FCC requirements.

6.3 Occupied Bandwidth

Test Requirement: FCC Part 15 C section 15.247

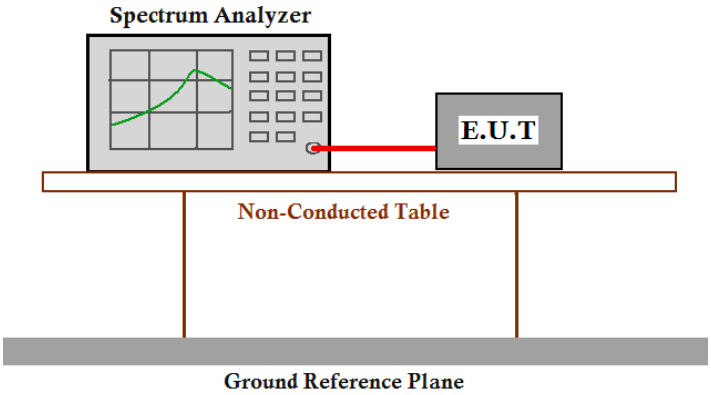
(a)(1)(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies

Test Method: ANSI C63.10: Clause 6.9.1

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (902.250MHz), middle (915.250 MHz) and highest (927.750MHz) channel. to find antenna 1 and air speed 250kBaud is the worst case mode.

Only worst case data is shown on this report

Test Configuration:



Test Procedure:

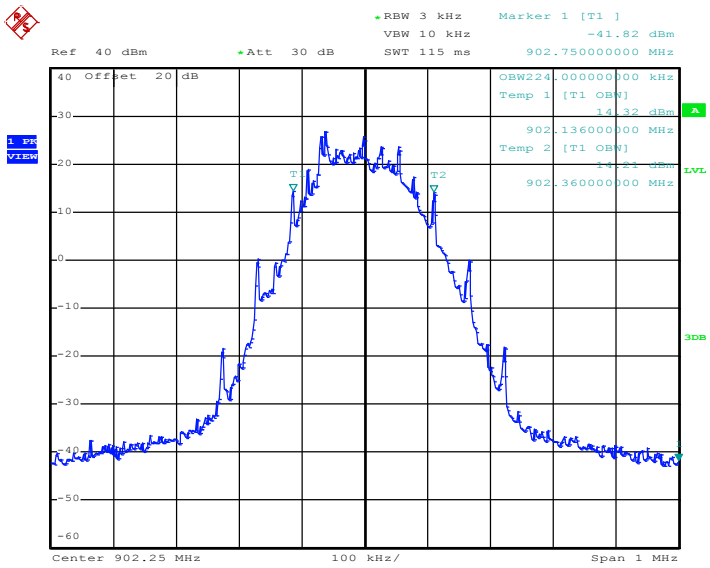
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: Span = approximately 2 to 3 times the 20dB bandwidth, centring on a hopping channel;
3. Set the spectrum analyzer: RBW >= 1% of the 20dB bandwidth VBW >= RBW. Sweep = auto; Detector Function = Peak. Trace = Max Hold.
4. Mark the peak frequency and -20 dB points bandwidth.

Test result:

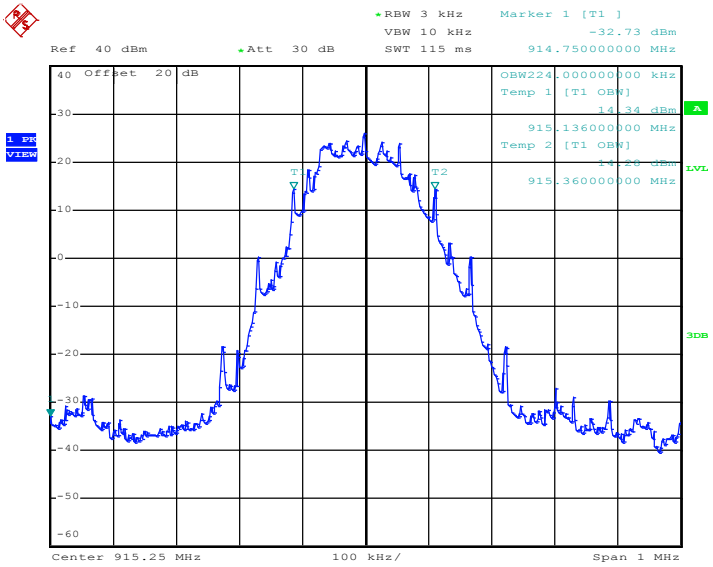
Test Channel	Bandwidth(kHz)	limit (kHz)
Lowest	240	Less than 250kHz
Middle	240	Less than 250kHz
Highest	240	Less than 250kHz

Result plot as follows:

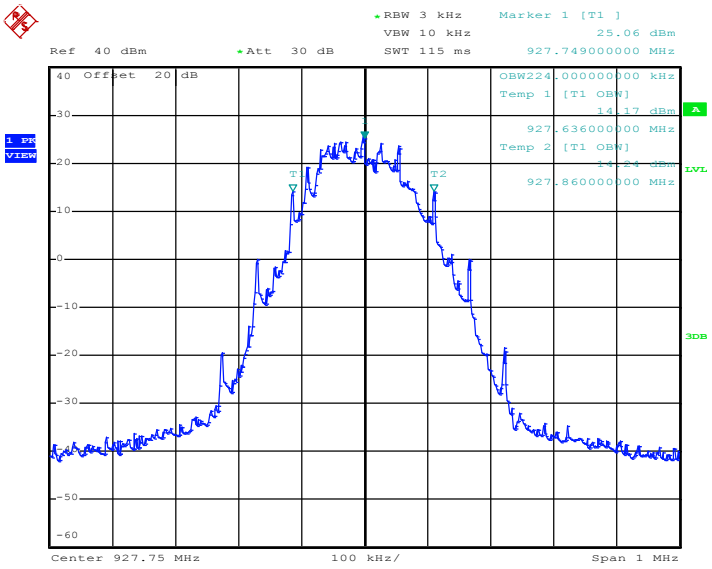
Lowest Channel



Middle Channel



Highest Channel



6.4 Carrier Frequencies Separated

Test Requirement: FCC Part 15 C section 15.247

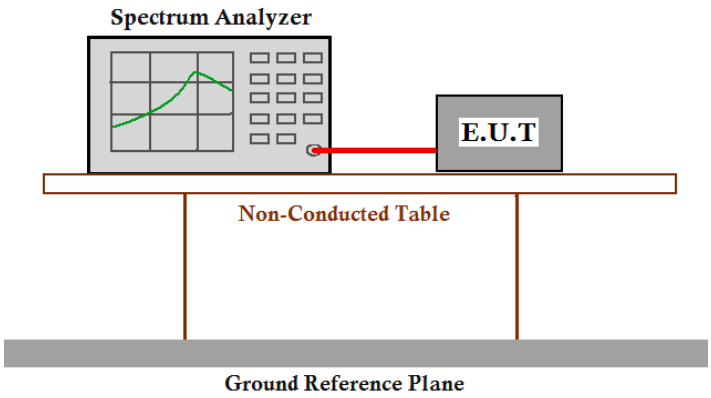
(a)(1)(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies

Test Method: ANSI C63.10: Clause 7.7.2

Test Status: Pre-test the EUT in hopping mode.to find antenna 1 and air speed 250kBaud is the worst case mode.

Only worst case data is shown on this report

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW >= 1% of the span, VBW >= RBW. Sweep = auto; Detector Function = Peak. Trace = Max, hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

Test result:

Test Channel	Carrier Frequencies Separated (kHz)	Limit①(kHz)	Pass/Fail
Lower Channels (channel 1 and channel 2)	250	Larger than 240KHz	Pass
Middle Channels (channel 52 and channel 53)	250	Larger than 240KHz	Pass
Upper Channels (channel 101 and channel 102)	250	Larger than 240KHz	Pass

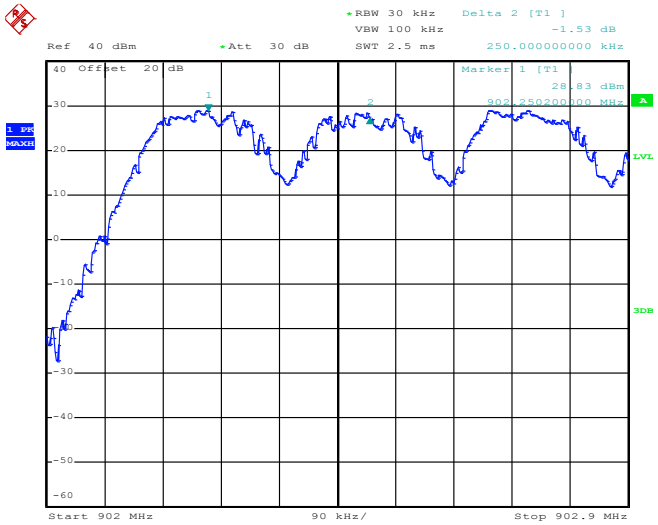
Remark:

① The limit is 20 dB bandwidth

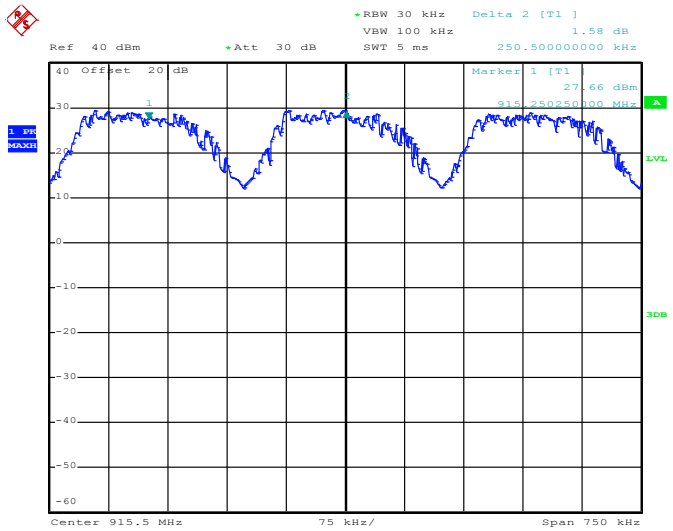
② channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater

Result plot as follows:

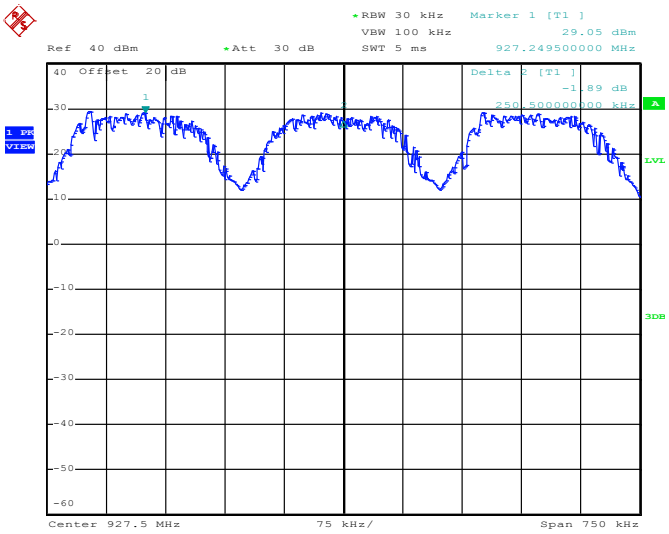
Lowest Channels: **Carrier Frequencies Separated**



Middle Channels: **Carrier Frequencies Separated**



Highest Channels: **Carrier Frequencies Separated**



Test result: The unit does meet the FCC requirements.

6.5 Hopping Channel Number

Test Requirement: FCC Part15 C section 15.247

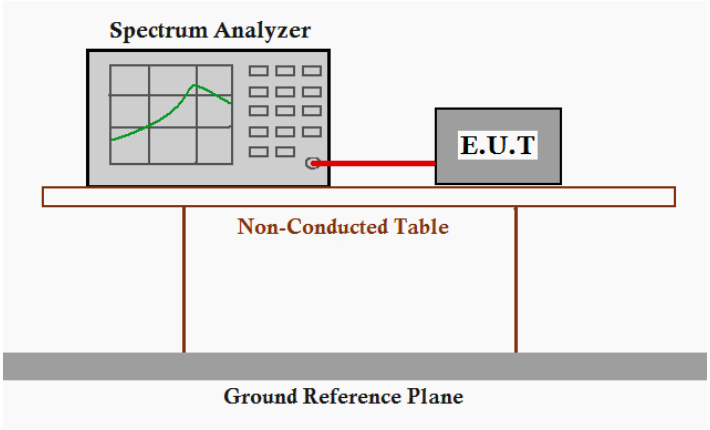
(b)(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of section 15.247.

Test Method: ANSI C63.10: Clause 7.7.3

Test Status: Pre-test the EUT in hopping mode to find antenna 1 and air speed 250kBaud is the worst case mode.

Only worst case data is shown on this report

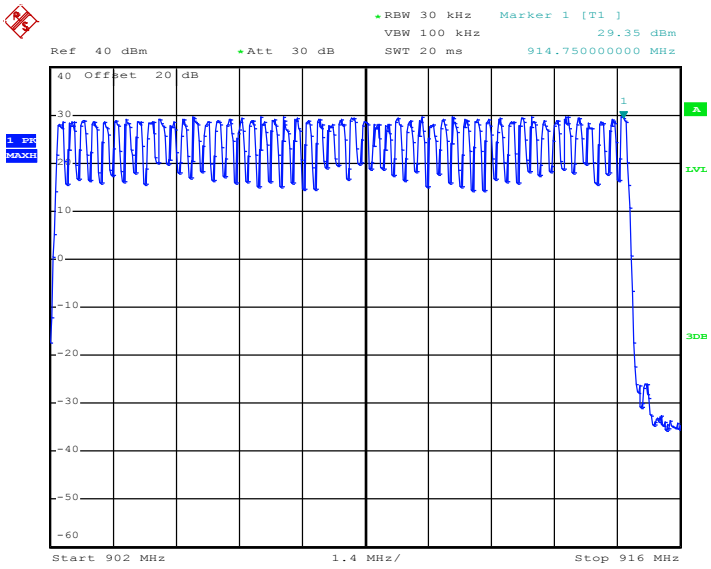
Test Configuration:



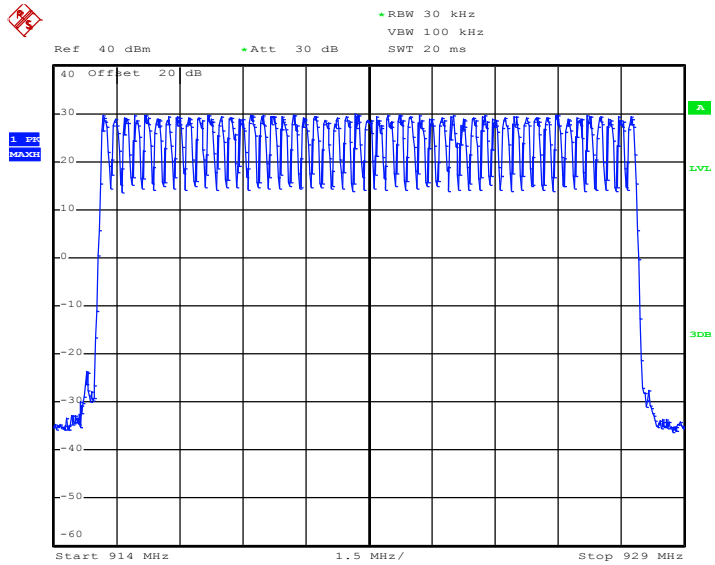
Test Procedure:

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 10 kHz. VBW = 10 kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: start frequency = 901 MHz. stop frequency = 929 MHz. Submit the test result graph.

Test result (channel 1 to channel 51): Total channels are 51 channels.



Test result(channel 51 to 102): Total channels are 51 channels.



Test result: The unit does meet the FCC requirements.

6.6 Dwell Time

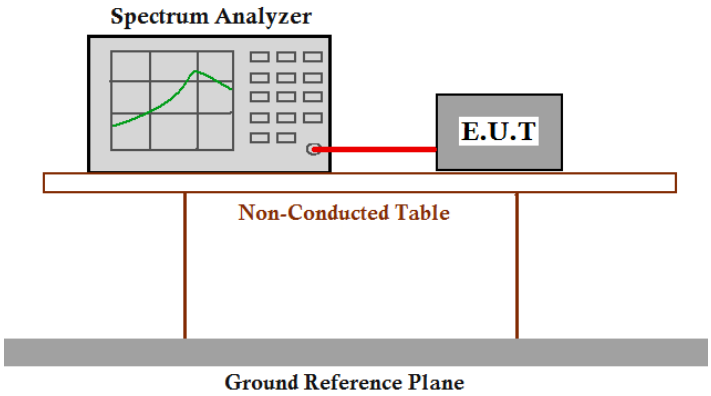
Test Requirement: FCC Part 15 C section 15.247

(a)(1)(iii) Frequency hopping systems in the 902-928 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Method: ANSI C63.10: Clause 7.7.4

Test Status: Test the EUT in hopping mode at the lowest (902.250 MHz), middle (915.2500 MHz) and highest (927.750 MHz) channel at antenna 1 and air speed 250kBaud as the worst case mode.
Only worst case data is shown on this report

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0. centered on a hopping channel;
3. Set RBW = 100 kHz and VBW = 100 kHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Detector Function = Peak. Trace = Max hold;
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g. data rate. modulation format. etc.). Repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s). An oscilloscope may be used instead of a spectrum analyzer.

Test Result:

The test period: T= 20 s

1. Channel 1: 902.250 MHz										
time slot	=	58	(ms)	*	2		=	116.0	ms	
2. Channel 52: 915.250 MHz										
time slot	=	59.2	(ms)	*	2	*	=	118.4	ms	
3. Channel 102: 927.750 MHz										
time slot	=	62.4	(ms)	*	2	*	=	124.8	ms	

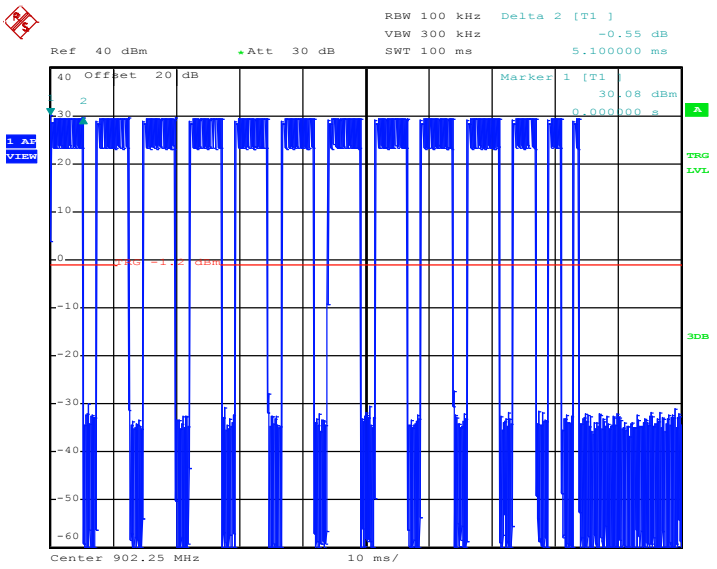
The results are not greater than 0.4 seconds.

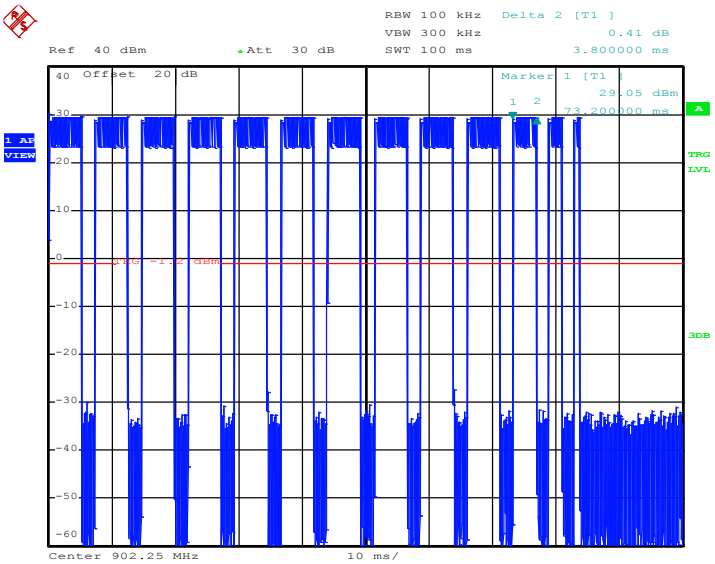
The unit does meet the FCC requirements.

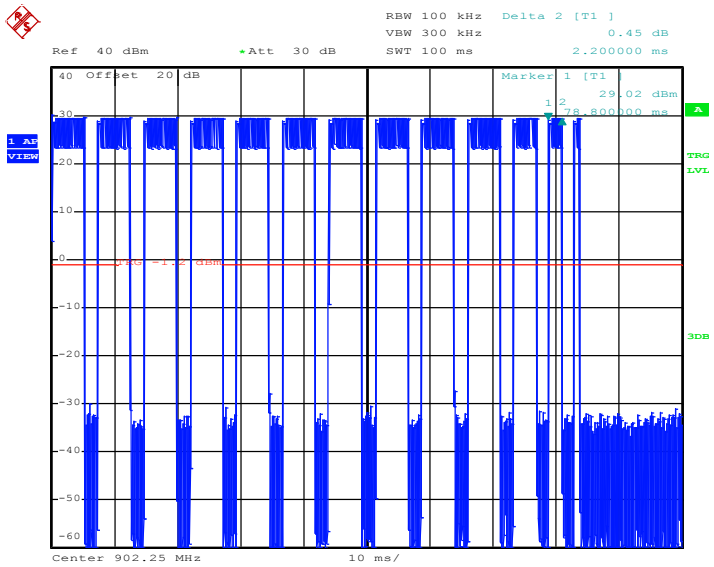
Result plot as follows:

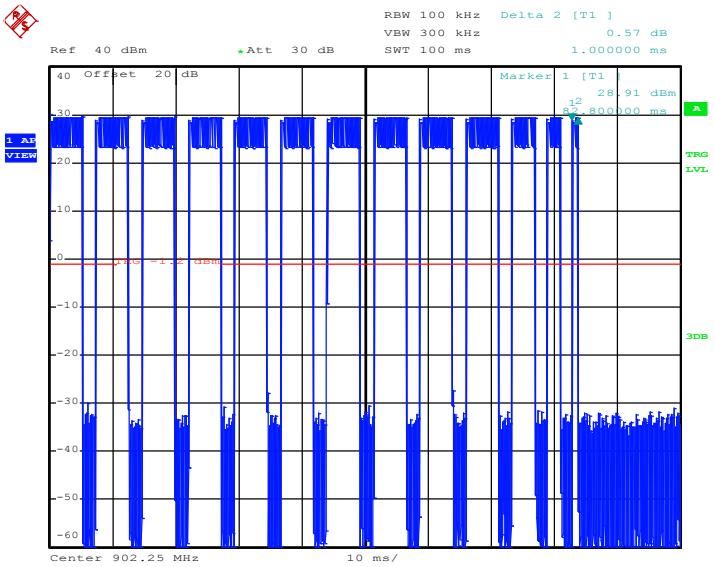
1. Lowest channel (902.250 MHz):

Pulse Width:

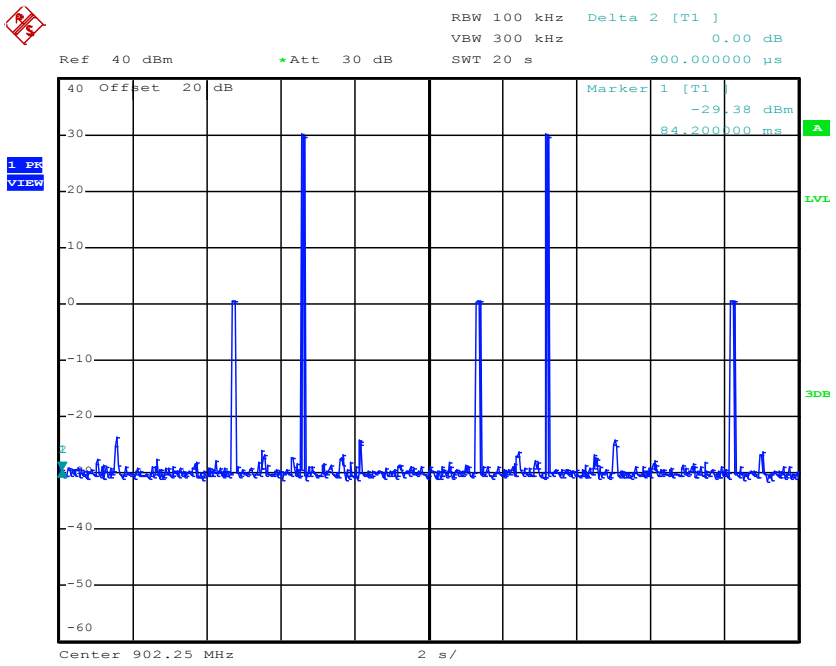






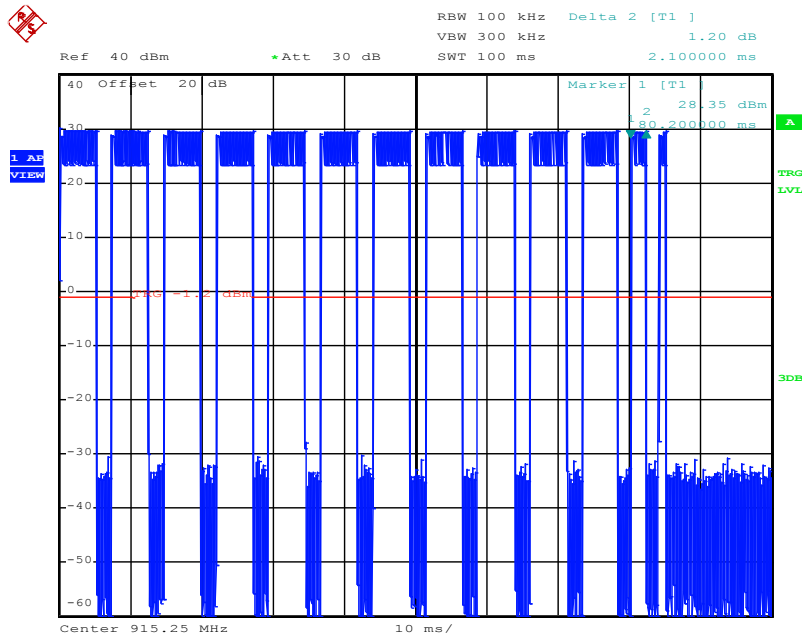


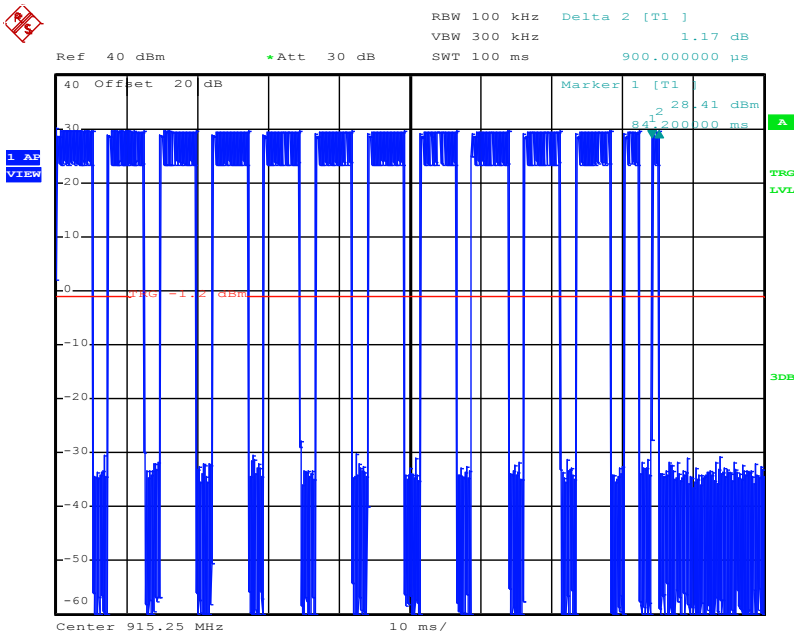
Number of Pulses in 20s observation period:

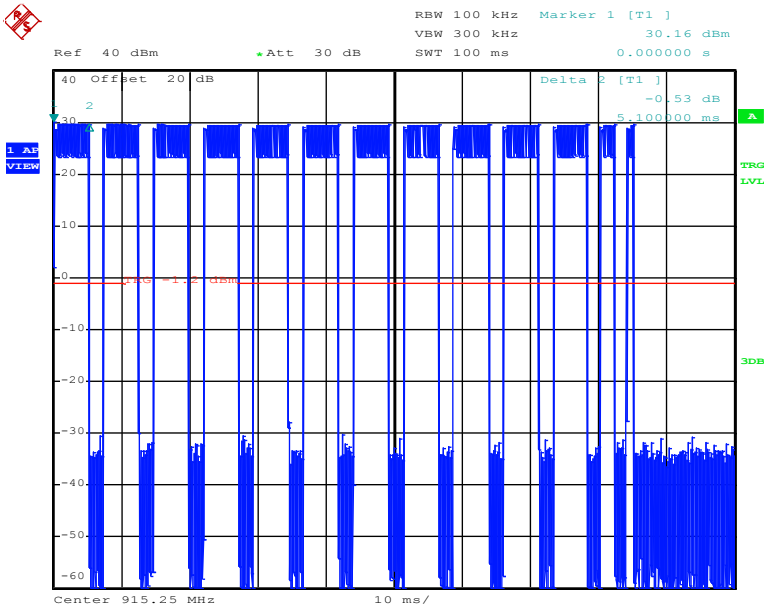


2. Middle Channel (915.250 MHz):

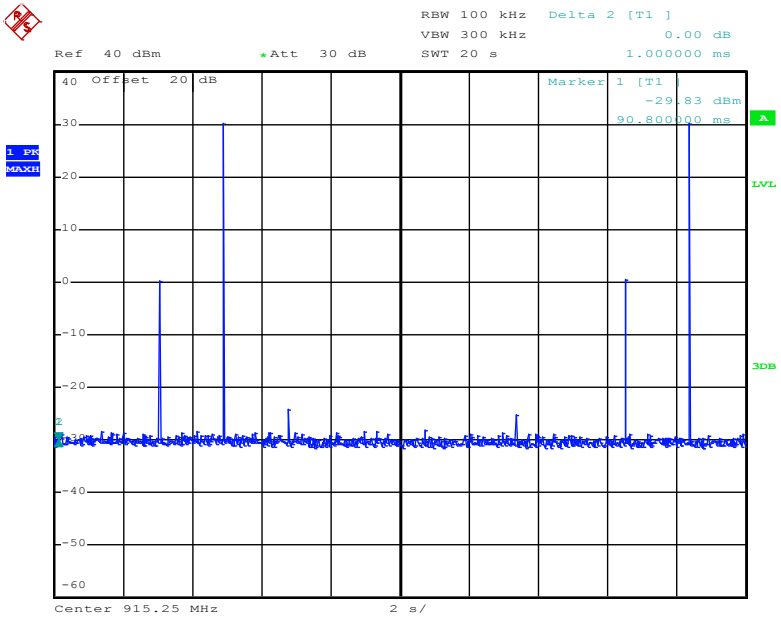
Pulse Width:





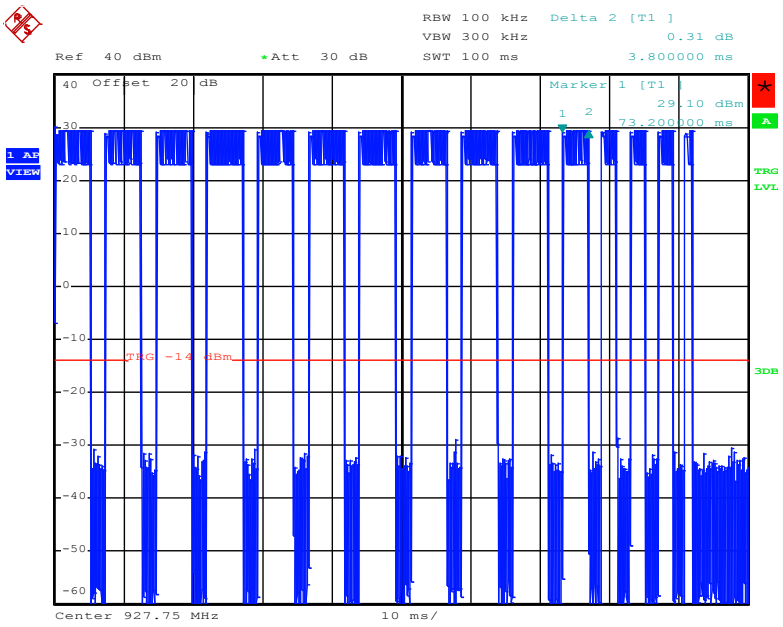


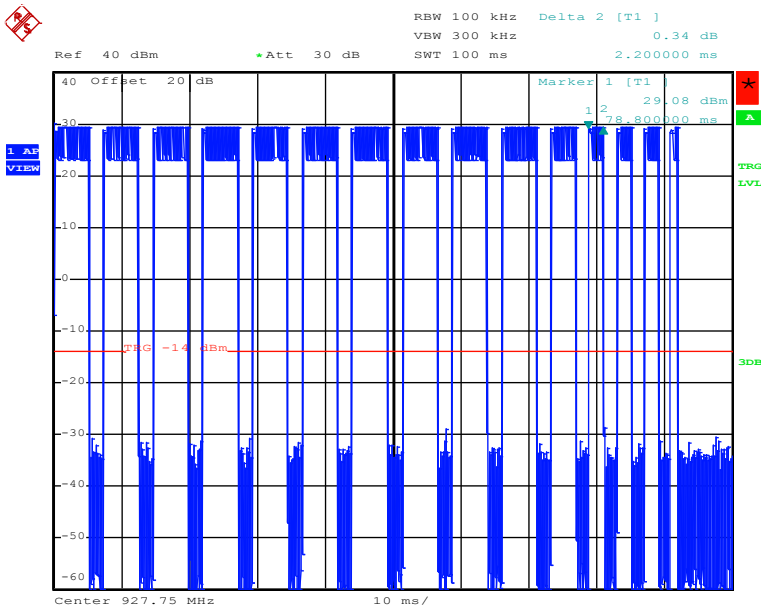
Number of Pulses in 20s observation period:

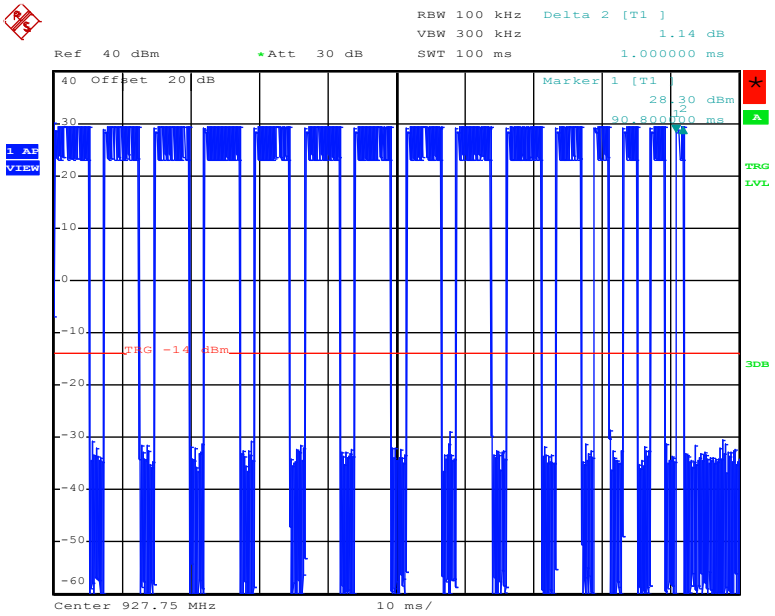


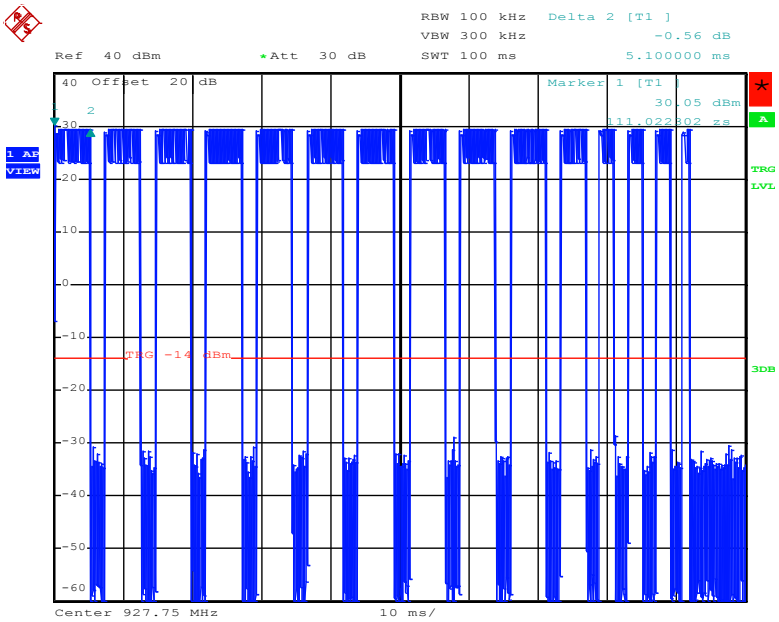
2. Highest Channel (927.750 MHz):

Pulse Width:

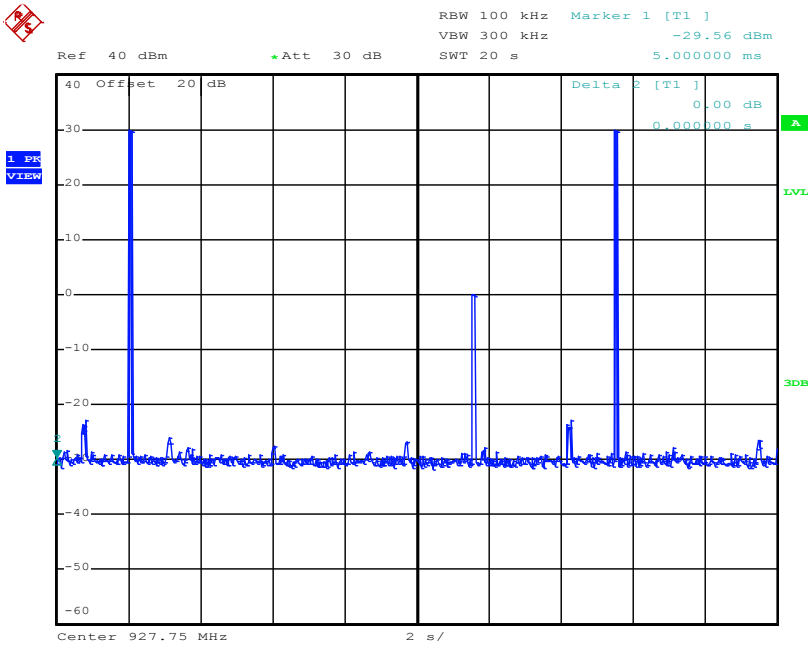








Number of Pulses in 20s observation period:



6.7 Pseudorandom Frequency Hopping Sequence

6.7.1 Standard requirement

15.247(a)(1) requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

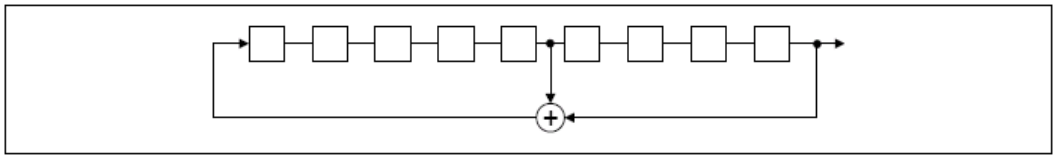
6.7.2 EUT Pseudorandom Frequency Hopping Sequence

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

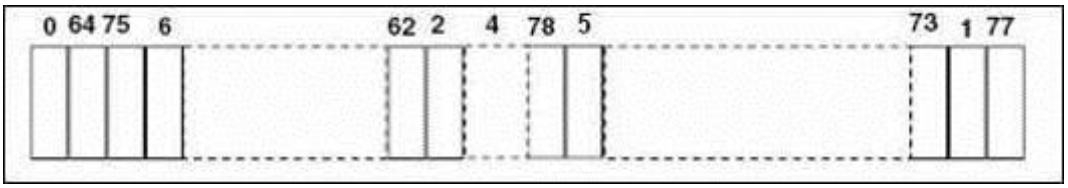
• Length of pseudo-random sequence: 2^9 -1 = 511 bits

• 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:



Each frequency used equally on the average by each transmitter.

The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

6.8 Maximum Peak Output Power

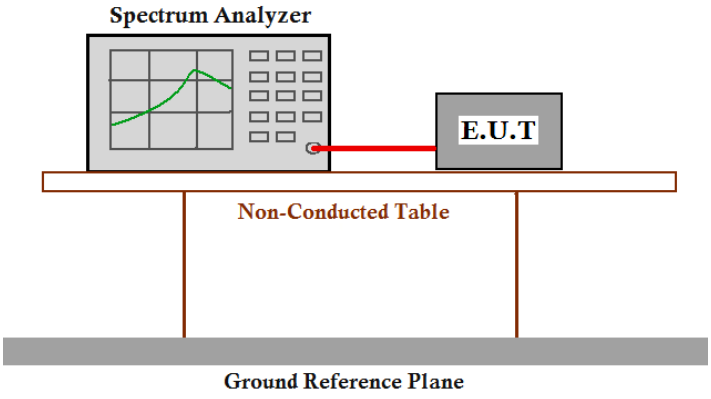
Test Requirement: FCC Part 15 C section 15.247
(b)(1)For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels.
Refer to the result "Hopping channel number" of this document. The 1 watt (30.0 dBm) limit applies.

Test Method: ANSI C63.10: Clause 6.10.1

Test Limit:

Test mode: Pre-test the EUT in continuous transmitting mode at the lowest (902.250 MHz), middle (915.750 MHz) and highest (927.750 MHz) channel to find antenna 1 and air speed 250kBaud is the worst case mode.
Only worst case data is shown on this report

Test Configuration:



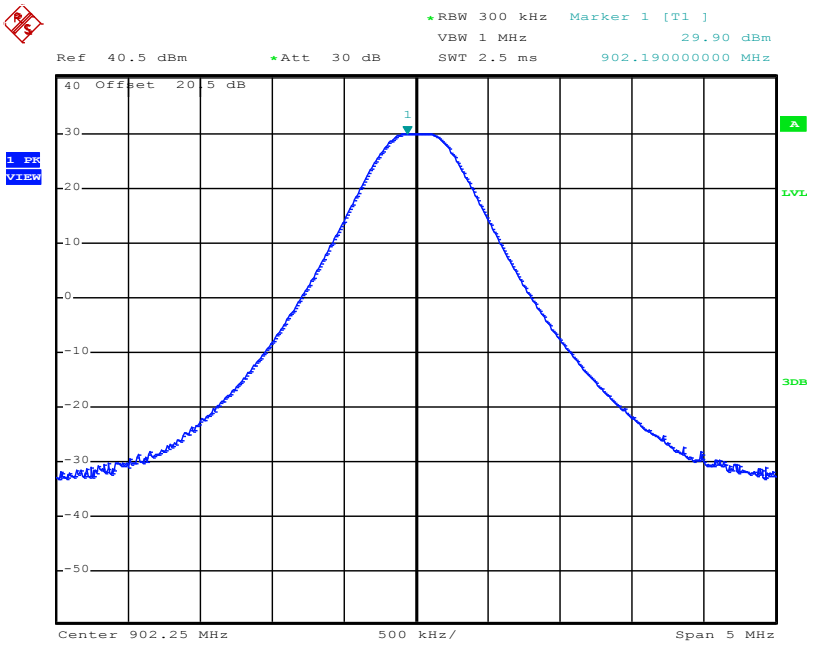
Test Procedure:

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 300 kHz. VBW = 300 kHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

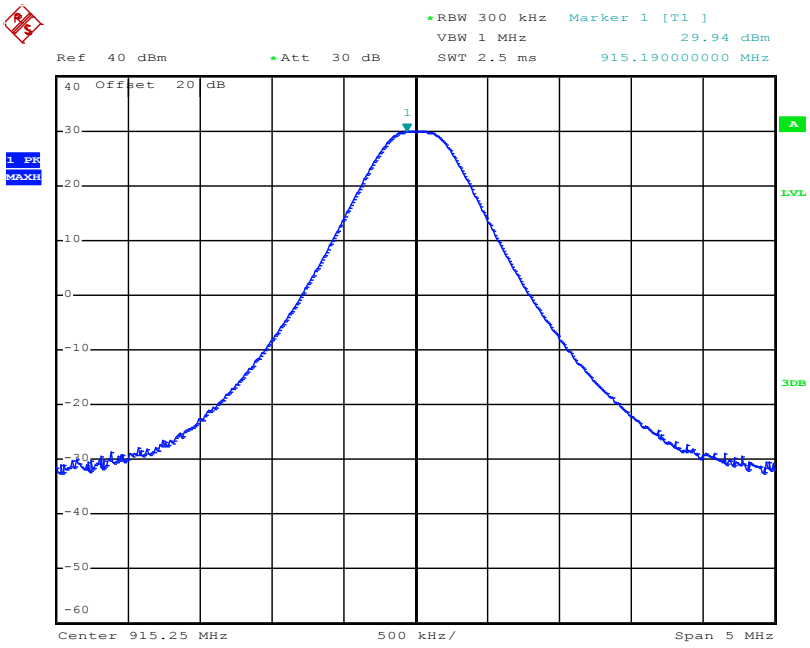
Test Result:				
Test Channel	**Fundamental Frequency (MHz)**	**Output Power (dBm)**	**Limit (dBm)**	**Result**
Lowest	902.250	29.90	30.0	Pass
Middle	915.250	**29.94**	30.0	Pass
Highest	927.750	29.85	30.0	Pass
Remark: cable loss=20.5 dB				
Test result: The unit does meet the FCC requirements.				

Result plot as follows:

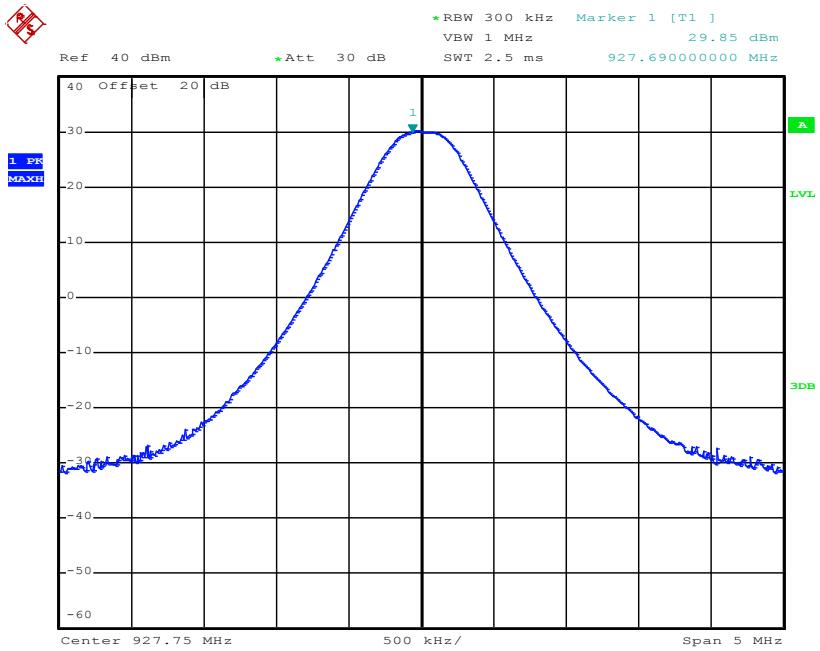
Lowest Channel (902.250 MHz):



Middle Channel (915.250 MHz):



Highest Channel (927.750 MHz):



6.9 Conducted Spurious Emissions

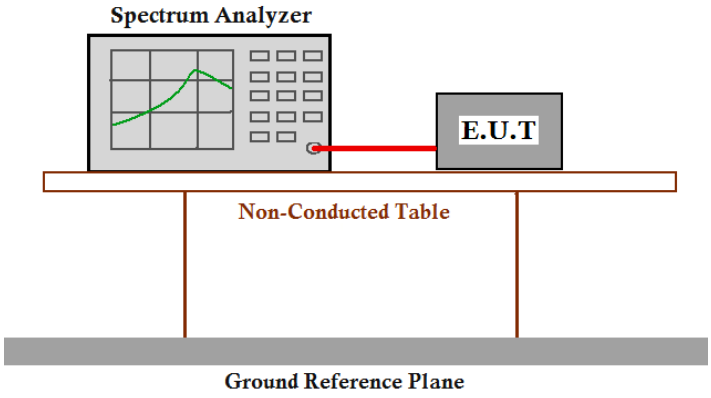
Test Requirement: FCC Part15 C section 15.247

(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: Pre-test the EUT in continuous transmitting mode at the lowest (902.250 MHz), middle (915.250 MHz) and highest (927.750 MHz) channel to find antenna 1 and air speed 250kBaud is the worst case mode.
Only worst case data is shown on this report

Test Configuration:



Test Procedure:

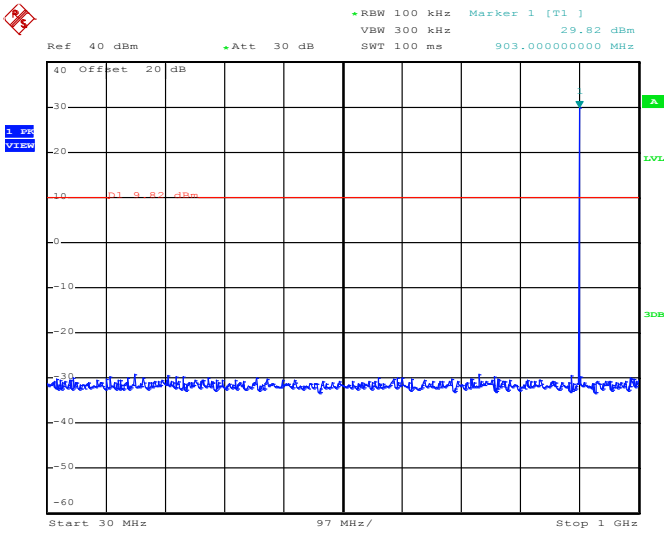
1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 100 kHz. VBW >= RBW. Sweep = auto; Detector Function = Peak (Max. hold).

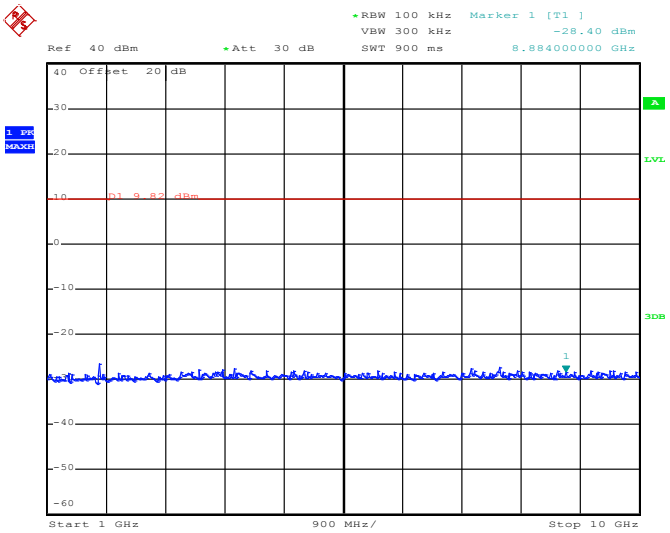
Result plot as follows:

Lowest Channel:

Lowest Channel: 30 MHz to 1 GHz

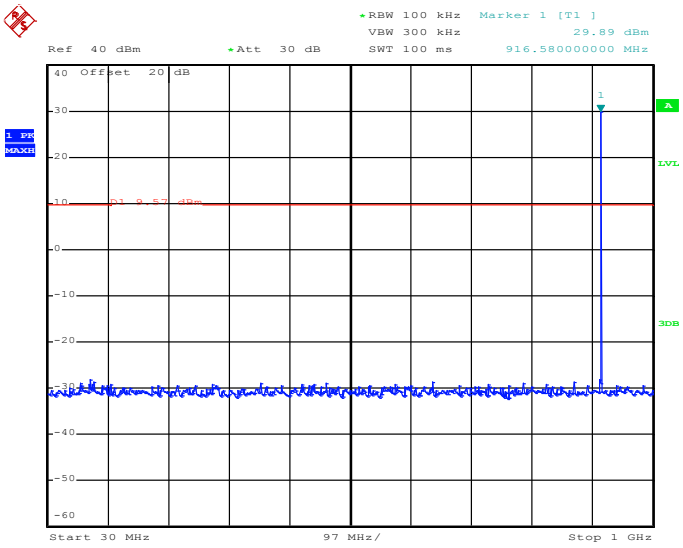


Lowest Channel: 1 GHz to 10 GHz

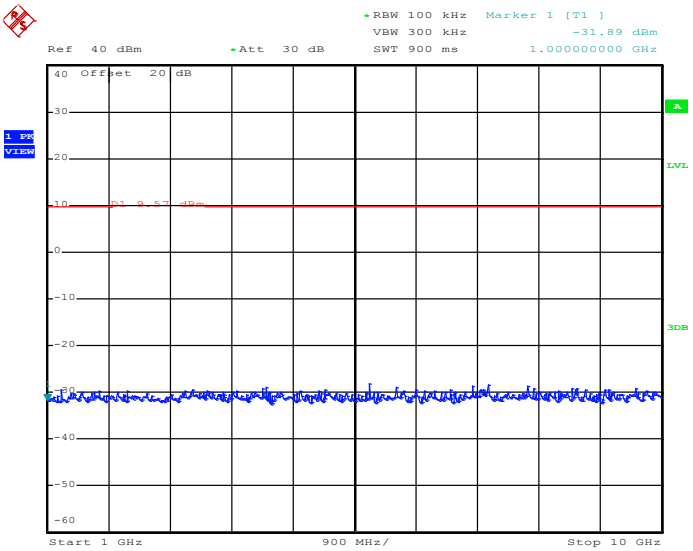


Middle Channel:

Middle Channel: 30 MHz to 1 GHz

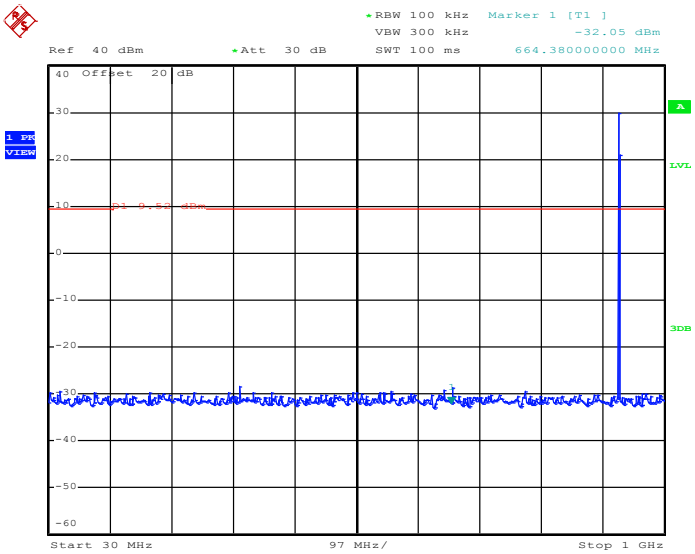


Middle Channel: 1 GHz to 10 GHz

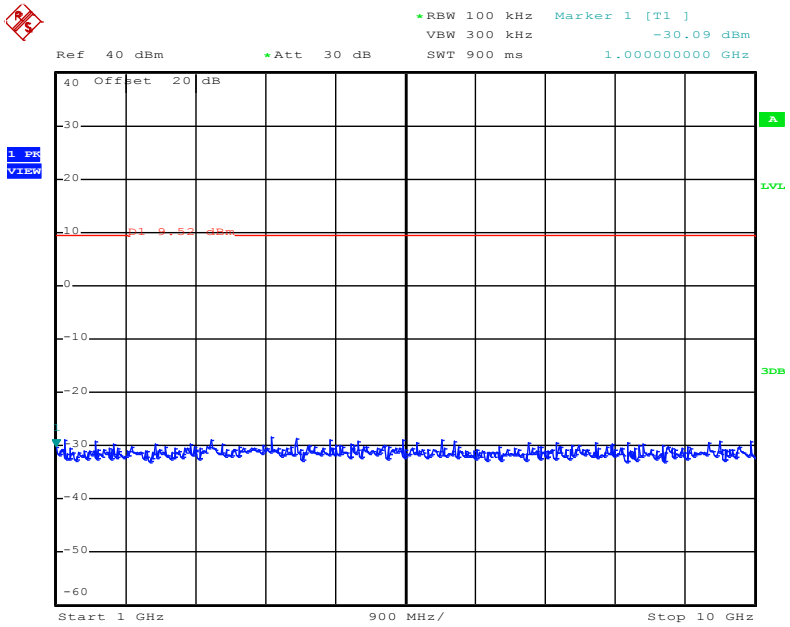


Highest Channel:

Highest Channel: 30 MHz to 1 GHz



Highest Channel: 1 GHz to 10 GHz

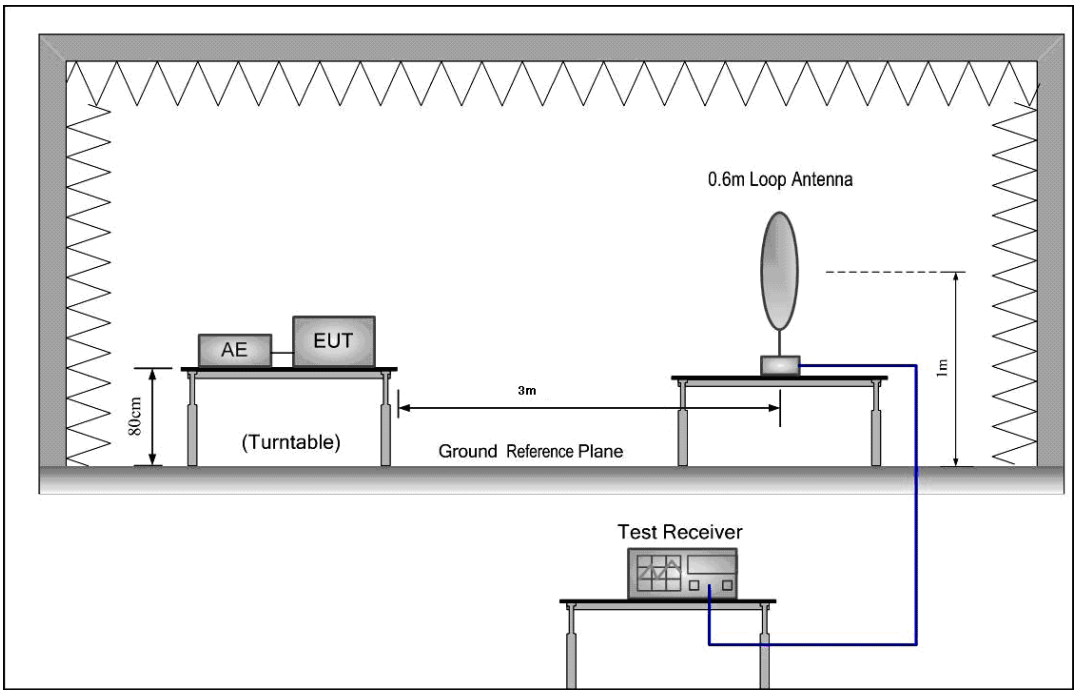


6.10 Radiated Spurious Emissions

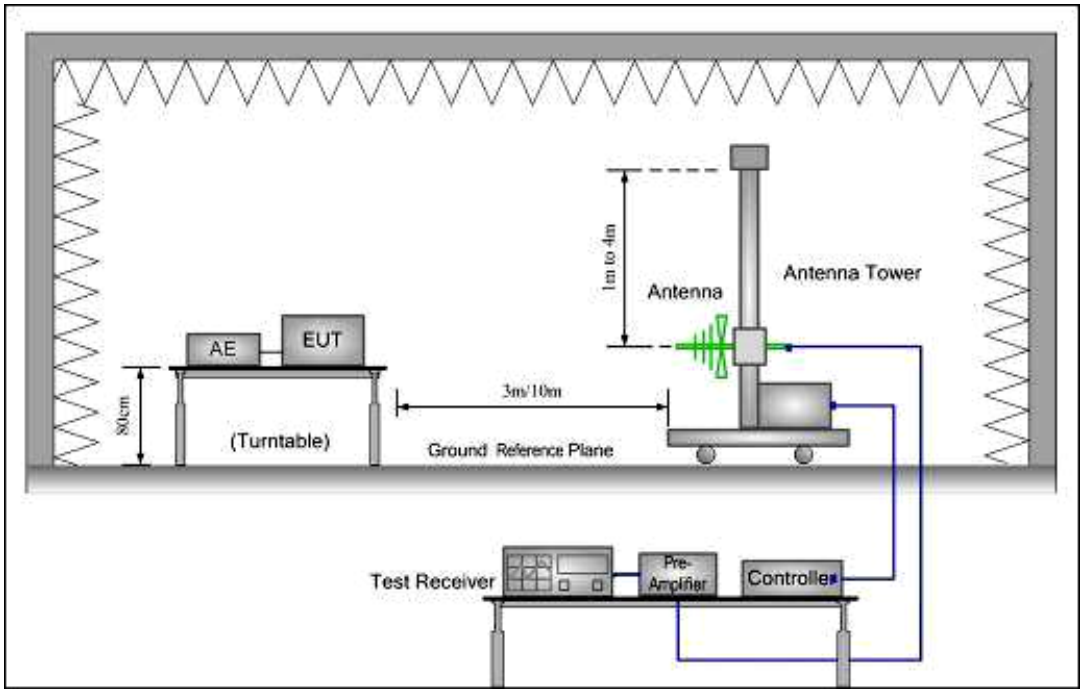
Test Requirement:	FCC Part15 C section 15.247
	(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating. The radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 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:	Pre-test the EUT in continuous transmitting mode at the lowest (902.250 MHz), middle (915.250 MHz) and highest (927.750 MHz) channel to find antenna 1 and air speed 250kBaud is the worst case mode. Only worst case data is shown on this report
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, VBW =10 Hz 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

Test Configuration:

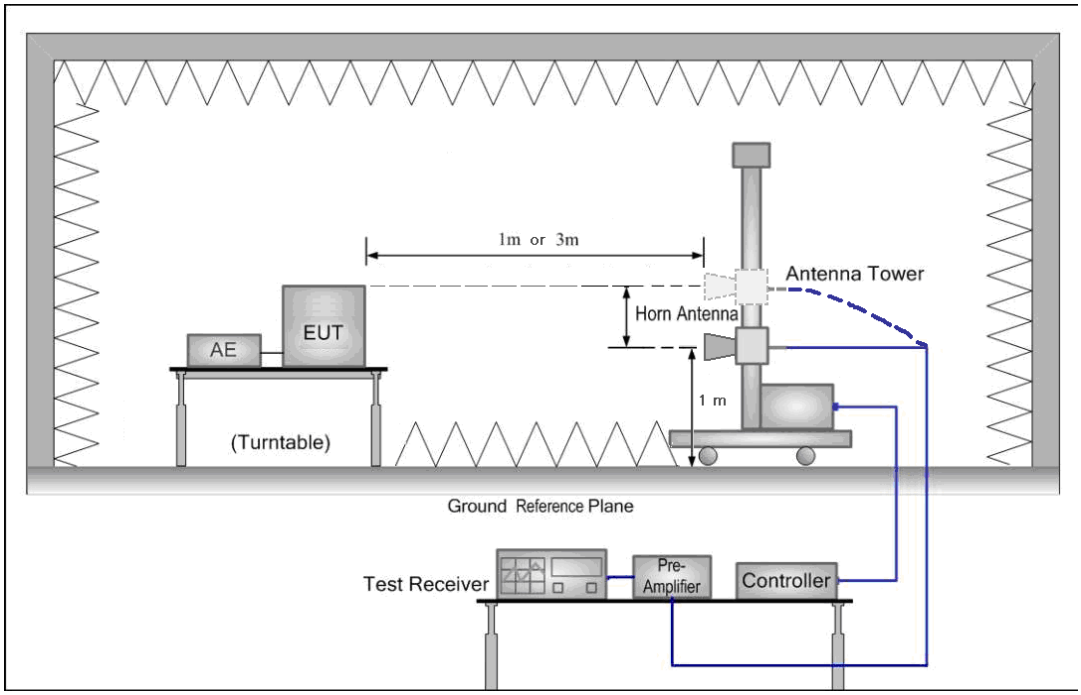
1) 9 kHz to 30 MHz emissions:



2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 40 GHz emissions:



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 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.

Now set the VBW to 10 Hz, 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 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.

Submit this data.

6.10.1 Harmonic and other spurious emissions

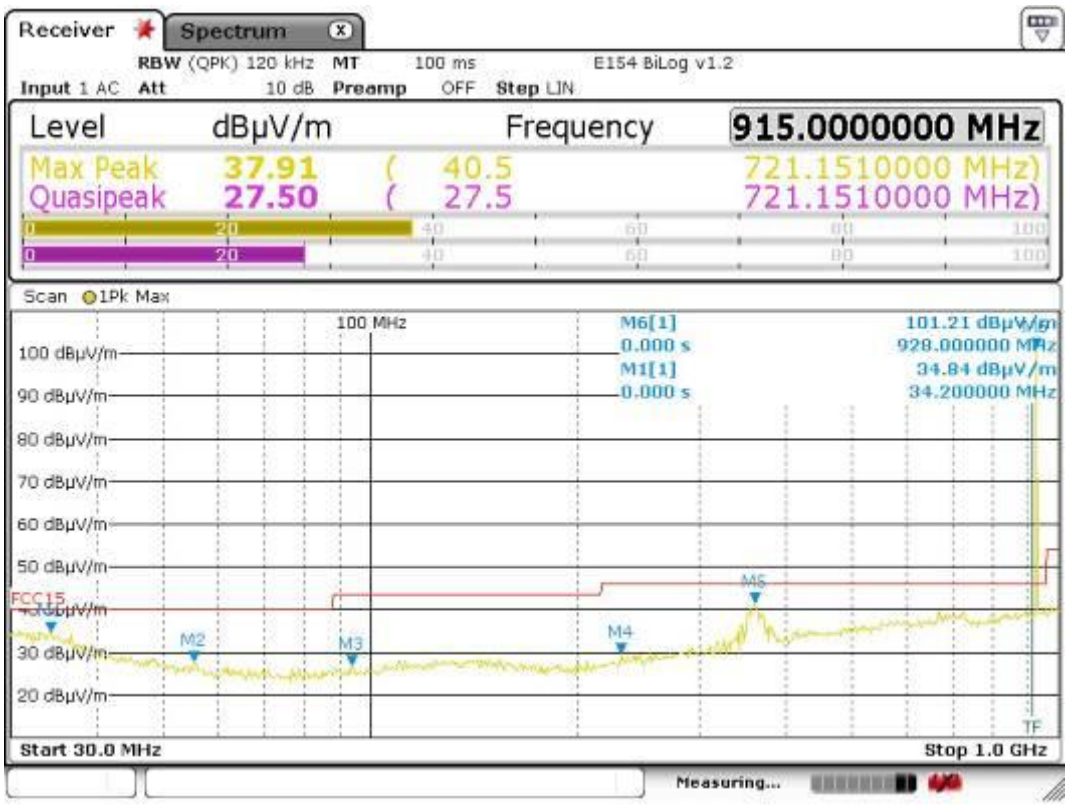
6.10.1.1 Test the lowest Channel in transmitting status

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

Quasi-peak measurement:



Frequency (MHz)	Antenna Polarization	Correction Factor (dB/m)	Receiver QP Reading (dBµV)	Emission Level (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)
33.160	V	17.5	8.5	26.0	40	-14.0
52.640	V	11.1	6.2	17.3	40	-22.7
124.840	V	10.9	7.0	17.9	43.5	-25.6
223.510	V	9.8	7.7	17.5	46	-28.5
371.200	H	14.1	24.5	38.6	46	-7.4
715.500	H	19.6	7.8	27.4	46	-18.6

1. All readings are Quasi-Peak values.

2. Correction Factor = Antenna Factor + Cable Loss.

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

Frequency (MHz)	Antenna Polarization	Emission Level (dBμV/m)		Limit (dBμV/m)		Remark
		Peak	Average	Peak	Average	
1804	H	58.66	48.79	74	54	Pass
2706	V	57.65	47.33	74	54	Pass
3608	V	49.37	35.62	74	54	Pass
4512	V	63.09	53.11	74	54	Pass
5414	V	46	--	74	54	Pass
6316	V	48	--	74	54	Pass

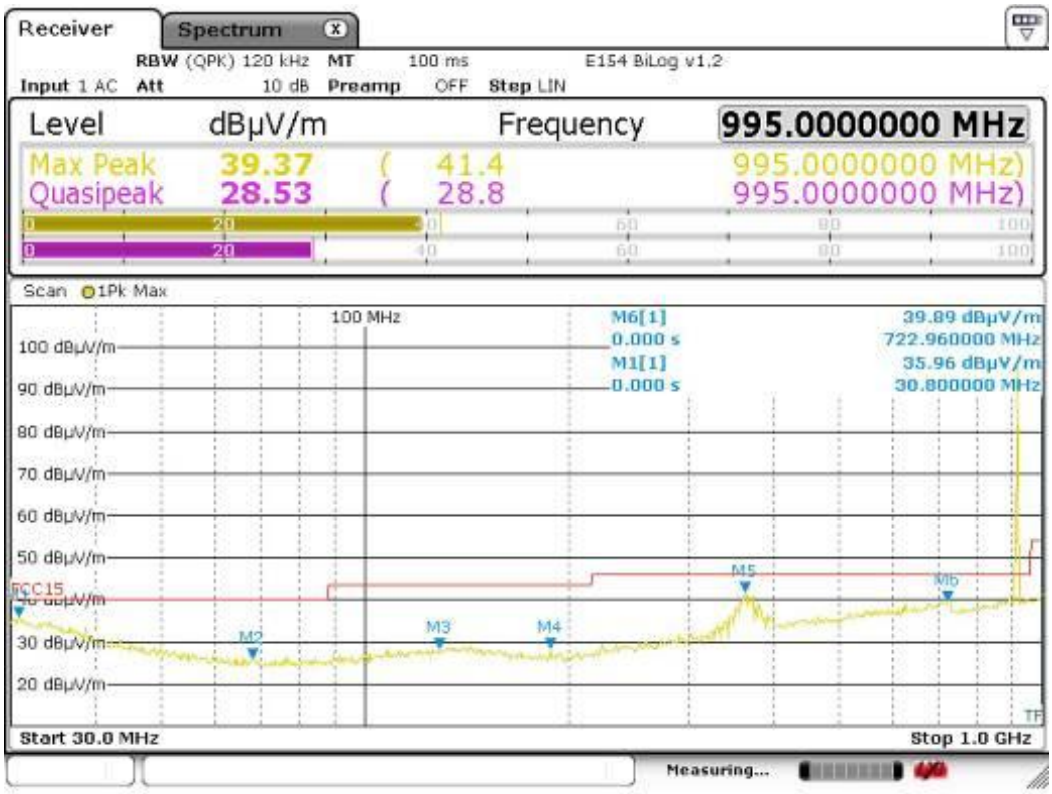
6.10.1.2 Test the middle Channel in transmitting status

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

Quasi-peak measurement:



Frequency (MHz)	Antenna Polarization	Correction Factor (dB/m)	Receiver QP Reading (dBµV)	Emission Level (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)
30.840	H	18.6	7.1	25.7	40	-14.3
66.570	V	9.1	8.4	17.5	40	-22.5
130.550	V	11.0	7.1	18.1	43.5	-25.4
186.450	H	8.7	7.5	16.2	43.5	-27.3
366.960	H	13.8	29.6	43.4	46	-2.6
721.150	H	19.6	7.8	27.4	46	-18.6

1. All readings are Quasi-Peak values.

2. Correction Factor = Antenna Factor + Cable Loss.

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

Frequency (MHz)	Antenna Polarization	Emission Level (dBμV/m)		Limit (dBμV/m)		Remark
		Peak	Average	Peak	Average	
1831	V	59.23	49.22	74	54	Pass
2746.5	V	58.66	47.21	74	54	Pass
3662	V	49.55	35.90	74	54	Pass
4577.5	V	62.98	52.99	74	54	Pass
5493	V	46.50	--	74	54	Pass
6408.5	V	48.10	--	74	54	Pass

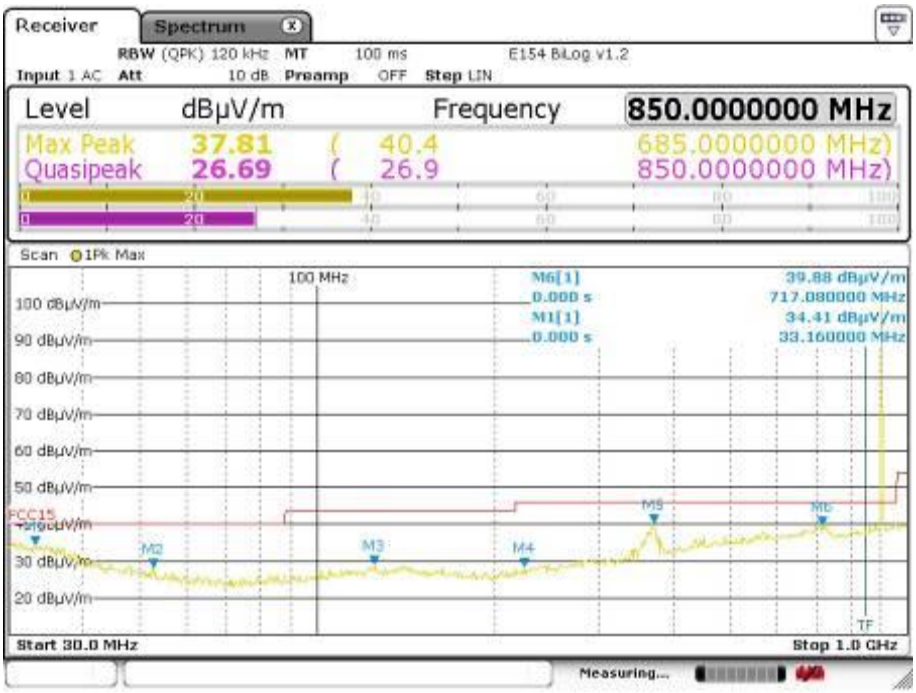
6.10.1.3 Test the highest Channel in transmitting status

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

Quasi-peak measurement:



Frequency (MHz)	Antenna Polarization	Correction Factor (dB/m)	Receiver QP Reading (dBµV)	Emission Level (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)
30.310	V	18.8	7.2	26.0	40	-14.0
52.890	V	11.0	6.4	17.4	40	-22.6
94.330	V	9.2	7.0	16.2	43.5	-27.3
231.040	H	10.2	7.8	18.0	46	-28.0
362.240	H	13.4	26.4	39.8	46	-6.2
724.360	H	19.6	7.9	27.5	46	-18.5

1. All readings are Quasi-Peak values.

2. Correction Factor = Antenna Factor + Cable Loss.

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

Frequency (MHz)	Antenna Polarization	Emission Level (dBμV/m)		Limit (dBμV/m)		Remark
		Peak	Average	Peak	Average	
1855.5	V	56.55	47.50	74	54	Pass
2771	V	55.46	46.89	74	54	Pass
3686.5	V	47.52	34.79	74	54	Pass
4602	V	62.11	51.84	74	54	Pass
5517.5	V	46.10	--	74	54	Pass
6433	V	48.32	--	74	54	Pass

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.

6.10.2 Radiated Emissions which fall in the restricted bands

Test Requirement:	FCC Part15 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:	Pre-test the EUT in continuous transmitting mode at the lowest (902.250 MHz) and highest (927.750 MHz) channel to find antenna 1 and air speed 250kBaud is the worst case mode. Only worst case data is shown on this report
Measurement Distance:	3m (Semi-Anechoic Chamber)
Limit:	Section 15.209(a) 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, VBW =10 Hz Sweep = auto Detector function = peak Trace = max hold

Test Result:

Test at lowest Channel (902.250 MHz) in transmitting status

Frequency (MHz)	Antenna Polarization	Emission Level (dBμV/m)		Limit (dBμV/m)		Remark
		Peak	Average	Peak	Average	
1804	H	58.66	48.79	74	54	Pass
2706	V	57.65	47.33	74	54	Pass
3608	V	49.37	35.62	74	54	Pass
4512	V	63.09	53.11	74	54	Pass
5414	V	46	--	74	54	Pass

Test at highest Channel (927.750 MHz) in transmitting status

Frequency (MHz)	Antenna Polarization	Emission Level (dBμV/m)		Limit (dBμV/m)		Remark
		Peak	Average	Peak	Average	
1855.5	V	56.55	47.50	74	54	Pass
2771	V	55.46	46.89	74	54	Pass
3686.5	V	47.52	34.79	74	54	Pass
4602	V	62.11	51.84	74	54	Pass
5517.5	V	46.10	--	74	54	Pass

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

Test result: The unit does meet the FCC requirements.

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

6.11 Band Edges Requirement

Test Requirement: FCC Part15 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

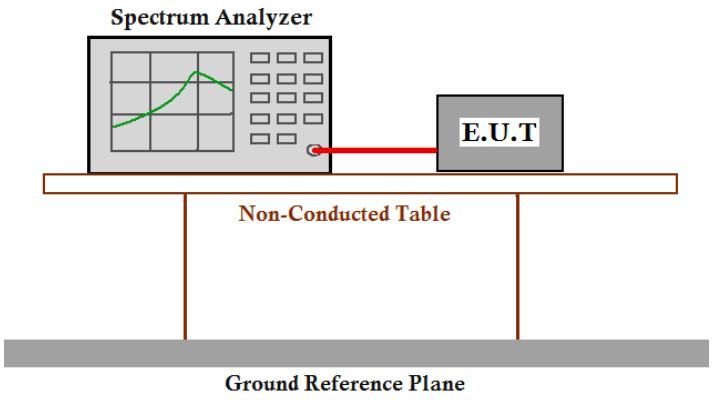
Frequency Band: 902 MHz to 928 MHz

Test Method: ANSI C63.10 (2013) Section 7.8.6

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (902.250 MHz) and highest (927.750 MHz) channel to find antenna 1 and air speed 250kBaud is the worst case mode.

Only worst case data is shown on this report

Test Configuration:



Test Procedure: Use the following spectrum analyzer settings:

Span = 10MHz (wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation.)

RBW = 100 kHz (1% of the span) and VBW = 300 kHz

Sweep = auto

Detector function = peak

Trace = max hold

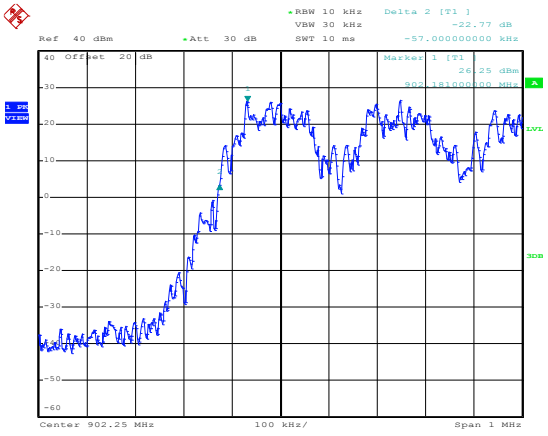
Test Result:

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

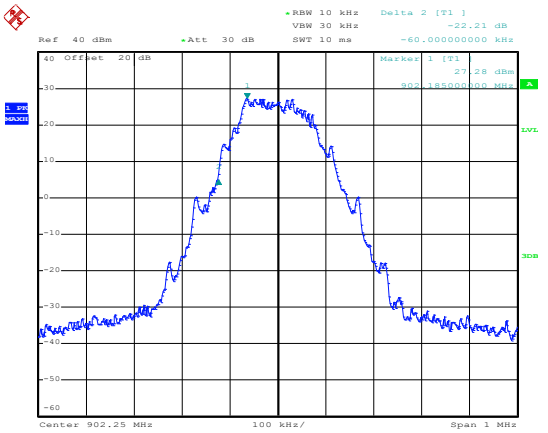
Compare with the output power of the highest frequency, the Upper Edges attenuated more than 20dB.

Lowest channel(902.250 MHz):

Hopping On:



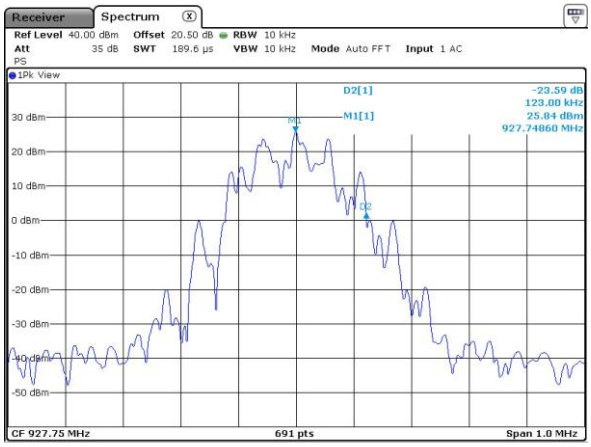
Hopping Off:



Highest Channel(927.750 MHz):

Hopping On:

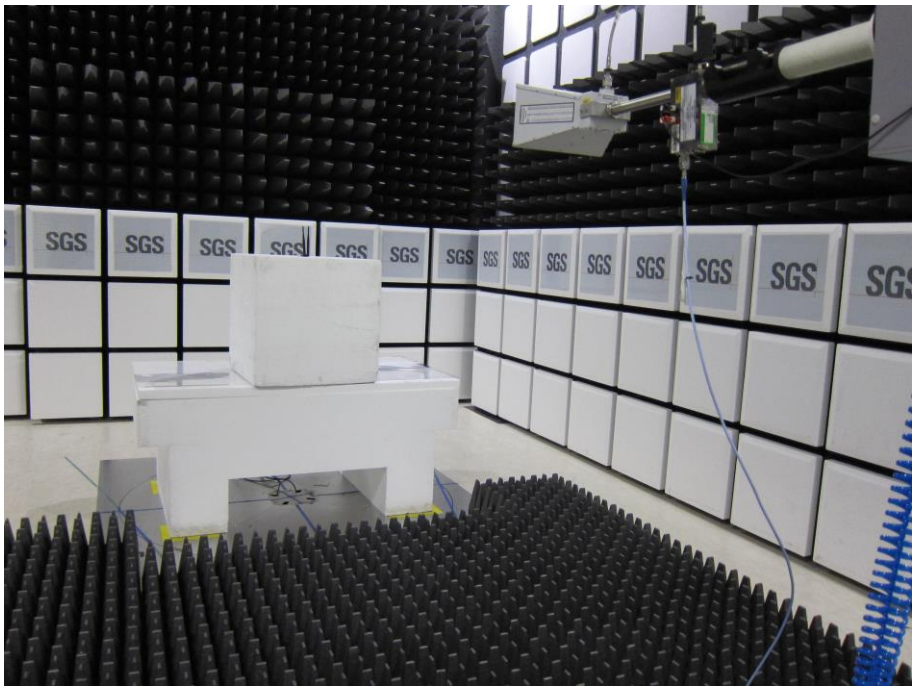
Hopping Off:



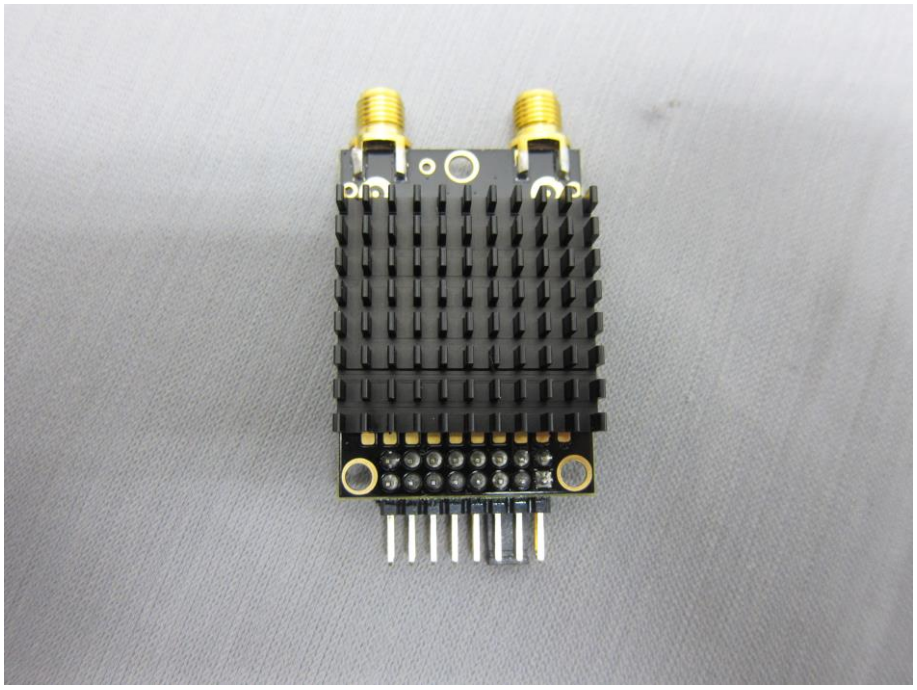
Test result: The unit does meet the FCC requirements.

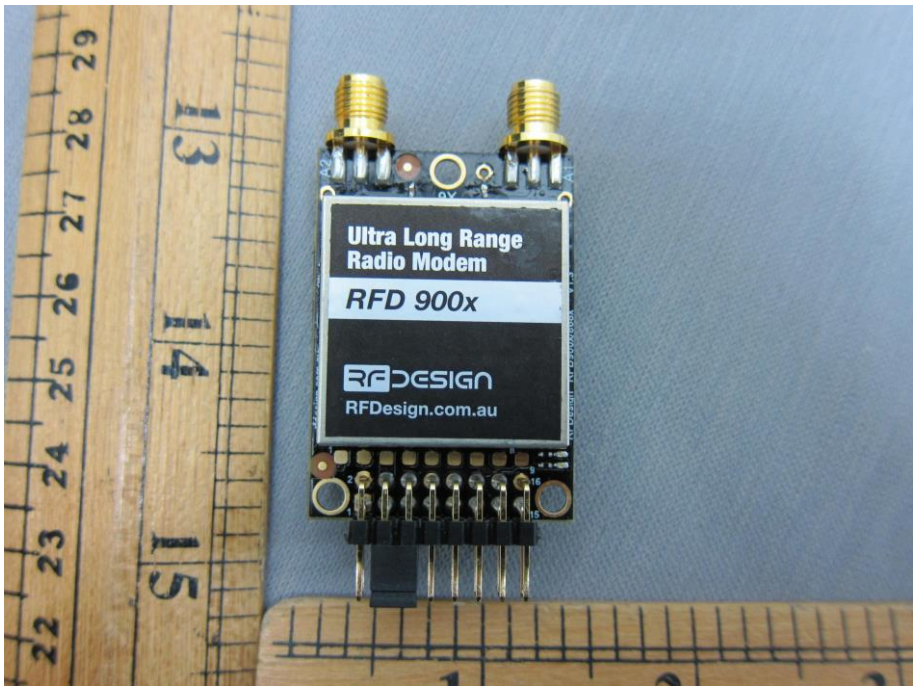
7 Photographs

7.1 Radiated Spurious Emission Test Setup



8 EUT Constructional Details





--End of Report--