FCC RF Test Report

APPLICANT	:	**Ness Corporation**
EQUIPMENT	:	**Hub**
BRAND NAME	:	**Mezzo**
MODEL NAME	:	**Mezzo-915**
FCC ID	:	**O2K-MEZZO915LTE**
STANDARD	:	**FCC Part 15 Subpart C §15.247**
CLASSIFICATION	:	**(DSS) Spread Spectrum Transmitter**

The product was received on Dec. 14, 2017 and testing was completed on Feb. 11, 2018. We, Sporton International (Shenzhen) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Shenzhen) Inc., the test report shall not be reproduced except in full.

Eric Shih

Approved by: Eric Shih / Manager

NVLAP®
TESTING
NVLAP LAB CODE 600156-0

Sporton International (Shenzhen) Inc.
1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan Shenzhen City
Guangdong Province 518055 China

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR7D1404A	Rev. 01	Initial issue of report	Feb. 14, 2018

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(1)	Number of Channels	≥ 25Chs	Pass	-
3.2	15.247(a)(1)	Hopping Channel Separation	≥ 25 kHz or the 20 dB bandwidth	Pass	-
3.3	15.247(a)(1)	Dwell Time of Each Channel	≤ 0.4sec in 10sec period	Pass	-
3.4	15.247(a)(1)	20dB Bandwidth	≤ 500KHz	Pass	-
3.4	-	99% Bandwidth	-	Pass	-
3.5	15.247(b)(1)	Peak Output Power	≤ 24dBm	Pass	-
3.6	15.247(d)	Conducted Band Edges	≤ 20dBc	Pass	-
3.7	15.247(d)	Conducted Spurious Emission	≤ 20dBc	Pass	-
3.8	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 7.52 dB at 3708.00 MHz
3.9	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 17.73 dB at 0.41 MHz
3.10	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-

1 General Description

1.1 Applicant

Ness Corporation
4/167 Prospect Hwy, SEVEN HILLS, NSW 2147 AUSTRALIA

1.2 Manufacturer

Ness Corporation
4/167 Prospect Hwy, SEVEN HILLS, NSW 2147 AUSTRALIA

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Hub
Brand Name	Mezzo
Model Name	Mezzo-915
FCC ID	O2K-MEZZO915LTE
EUT supports Radios application	WCDMA/HSDPA/LTE/SRD/Z-wave WLAN 2.4GHz 802.11b/g/n HT20/HT40
IMEI Code	Conducted: 355285080003062 Conduction: N/A Radiation: 355285080002990
HW Version	2
SW Version	00.02.17
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	903 MHz ~ 927 MHz
Number of Channels	25
Carrier Frequency of Each Channel	903+n*1 MHz; n=0~24
Maximum Output Power to Antenna	17.19 dBm (0.0524 W)
Antenna Type / Gain	Fixed Internal Antenna with gain 2.15 dBi
Type of Modulation	GFSK

1.5 Modification of EUT

No modifications are made to the EUT during all test items.

1.6 Testing Location

Sporton International (Shenzhen) Inc. is accredited to ISO 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600156-0) and the FCC designation No are CN5018 and CN5019.

Test Site	Sporton International (Shenzhen) Inc.		
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan Shenzhen City Guangdong Province 518055 China TEL: +86-755-8637-9589 FAX: +86-755-8637-9595		
Test Site No.	**Sporton Site No.**		**FCC Test Firm Registration No.**
	TH01-SZ	CO01-SZ	251365

Test Site	Sporton International (Shenzhen) Inc.	
Test Site Location	No. 3 Bldg the third floor of south, Shahe River west, Fengzeyuan Warehouse, Nanshan District Shenzhen City Guangdong Province 518055 China TEL: +86-755-3320-2398	
Test Site No.	**Sporton Site No.**	**FCC Test Firm Registration No.**
	03CH04-SZ	577730

Note: The test site complies with ANSI C63.4 2014 requirement.

1.7 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

2.1 Descriptions of Test Mode

Preliminary tests were performed in different data rates and recorded the RF output power in the following table:

Channel	Frequency	SRD RF Output Power
CH00	903MHz	**17.19 dBm**
CH12	915MHz	16.34 dBm
CH24	927MHz	15.42 dBm

Remark:

a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction (150 kHz to 30 MHz), radiation (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

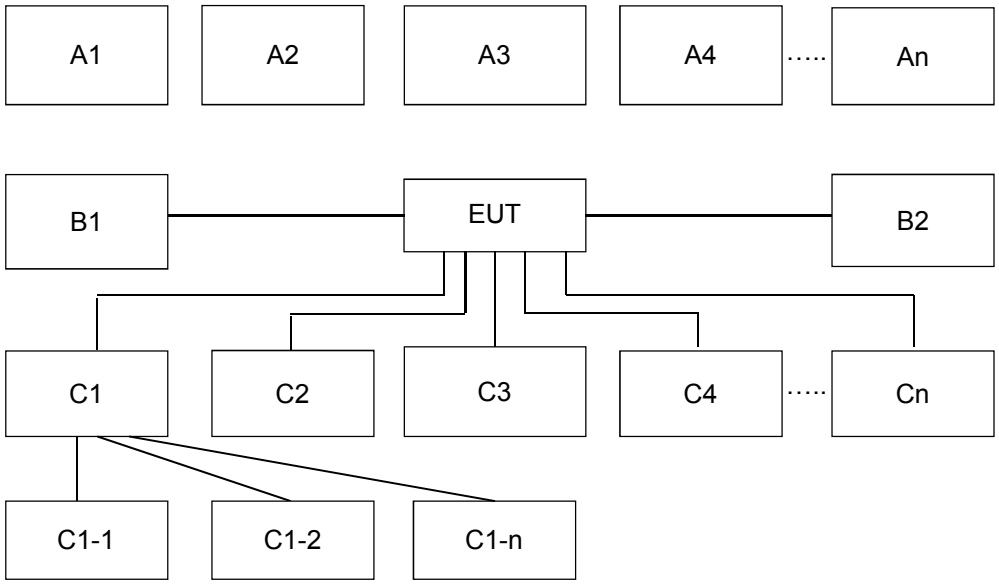
b. AC power line Conducted Emission was tested under maximum output power.

2.2 Test Mode

The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Test Item	**Data Rate**
Conducted Test Cases	Mode 1: CH00_903 MHz Mode 2: CH12_915 MHz Mode 3: CH24_927 MHz
Radiated TCs	Mode 1: CH00_903 MHz Mode 2: CH12_915 MHz Mode 3: CH24_927 MHz
AC Conducted Emission	Mode 1 :WCDMA Band V Idle + SRD Tx + WLAN Link + Adapter
Remark: For Radiated Test Cases, The tests were performance with Adapter.	

2.3 Connection Diagram of Test System



Conduction Test Setup									
No.	Wireless Station	Connection Type	Test Mode							
			1							
A1	System Simulator	GSM/ WCDMA/LTE	X							
A2	AP router	WiFi	X							
A3	Notebook	WiFi	X							
No.	**Power Source**	**Connection Type**	**1**							
B1	AC : 120V/60Hz	AC Power Cable	X							

Radiation Test Setup								
No.	Power Source	Connection Type	Test Mode					
			1	2	3			
B1	AC : 120V/60Hz	AC Power Cable	X	X	X			

2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	System Simulator	Anritsu	MT8820C	N/A	N/A	Unshielded, 1.8 m
2.	WLAN AP	Dlink	DIR-820L	KA2IR820LA1	N/A	Unshielded,1.8m
3.	Notebook	Lenovo	E540	FCC DoC	N/A	Shielded cable DC O/P 1.8 m Unshielded AC I/P cable1.2 m

2.5 EUT Operation Test Setup

For SRD function, The programmed RF utility, “Test Tool” installed in the notebook to make the EUT get into the engineering modes to continuously transmit.

For AC power line conducted emissions, the EUT was set to connect with the WLAN AP under large package sizes transmission.

2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 4.0 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 4.0 + 10 = 14.0 (dB)

3 Test Result

3.1 Number of Channel Measurement

3.1.1 Limits of Number of Hopping Frequency

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.

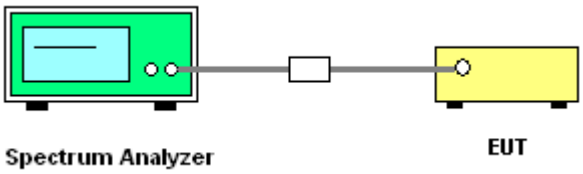
3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedure

1. The testing follows ANSI C63.10-2013 clause 7.8.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = the frequency band of operation; RBW = 300kHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. The number of hopping frequency used is defined as the number of total channel.
7. Record the measurement data derived from spectrum analyzer.

3.1.4 Test Setup

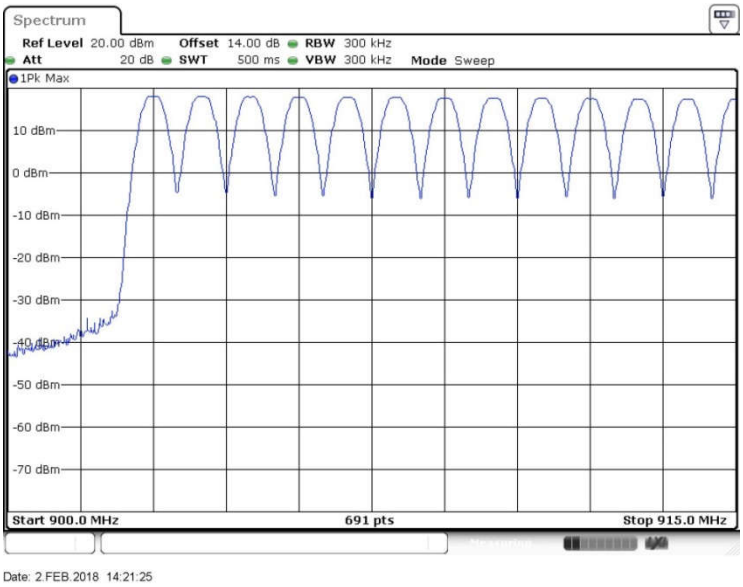


3.1.5 Test Result of Number of Hopping Frequency

Test Mode :	SRD	Temperature :	24~26℃
Test Engineer :	Wilson Chen	Relative Humidity :	50~53%

Number of Hopping (Channel)	Adaptive Frequency Hopping (Channel)	Limits (Channel)	Pass/Fail
25	25	≥25	Pass

Number of Hopping Channel Plot on Channel 00 - 24



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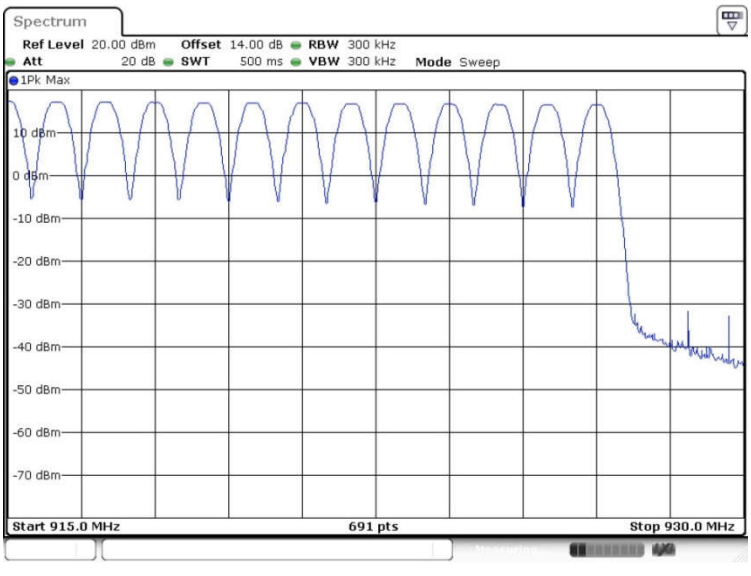

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3.2 Hopping Channel Separation Measurement

3.2.1 Limit of Hopping Channel Separation

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.

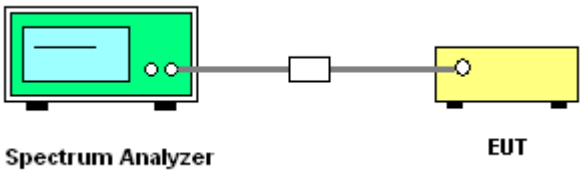
3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.2.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peaks of two adjacent channels;
   RBW = 300kHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

3.2.4 Test Setup

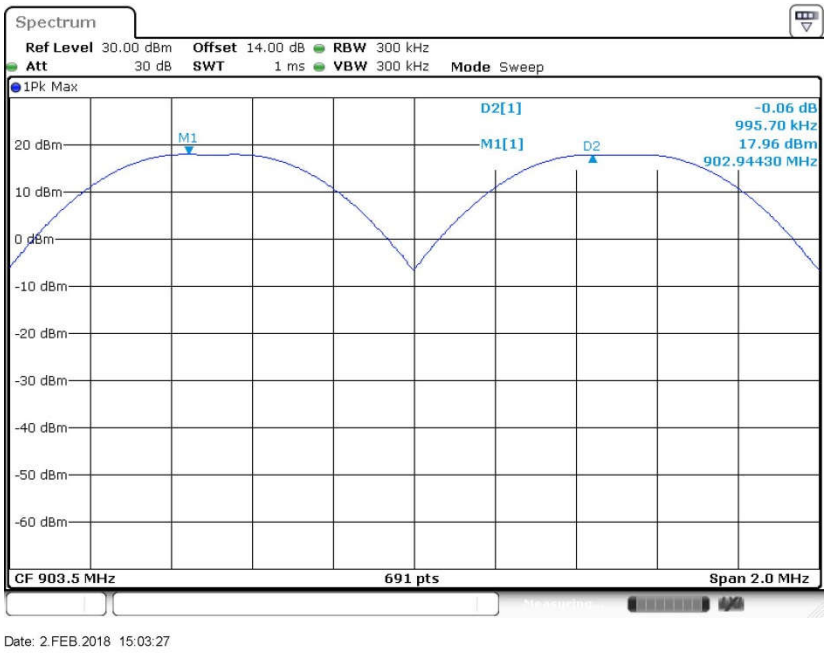


3.2.5 Test Result of Hopping Channel Separation

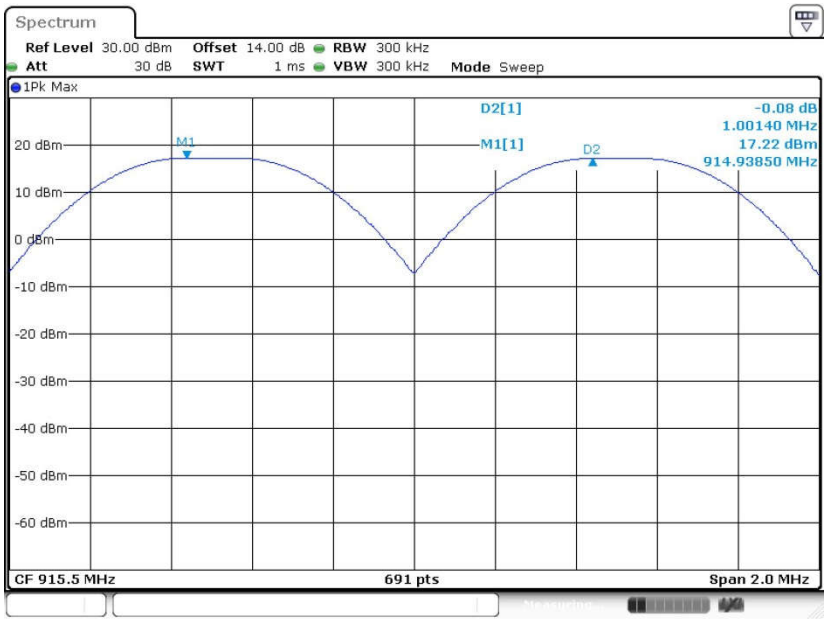
Test Mode :	SRD	Temperature :	24~26℃
Test Engineer :	Wilson Chen	Relative Humidity :	50~53%

Channel	Frequency (MHz)	Frequency Separation (MHz)	(20 dB bandwidth) Limits (MHz)	Pass/Fail
00	903	0.903	0.2770	Pass
12	915	0.915	0.2787	Pass
24	927	0.926	0.2770	Pass

Channel Separation Plot on Channel 00 - 01



Channel Separation Plot on Channel 12 - 13



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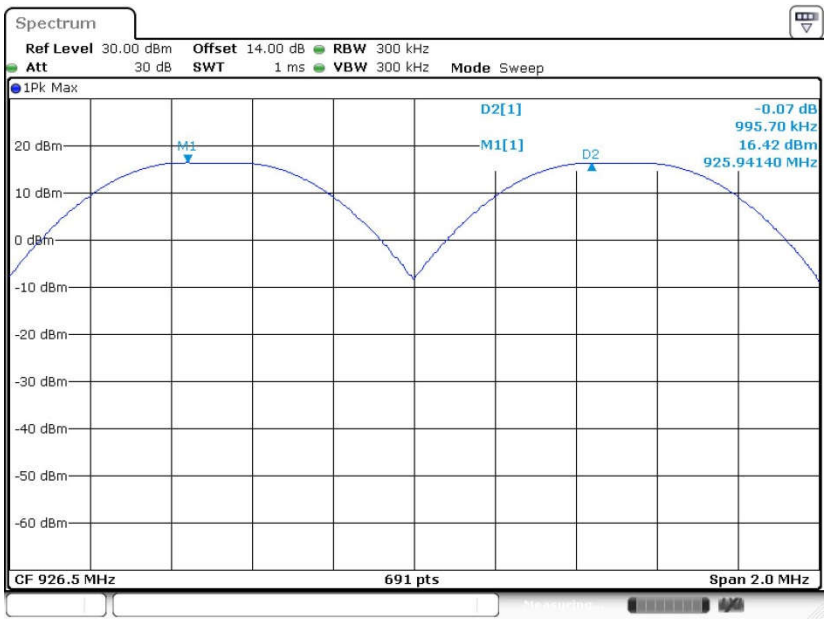
Channel Separation Plot on Channel 23 - 24



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3.3 Dwell Time Measurement

3.3.1 Limit of Dwell Time

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.

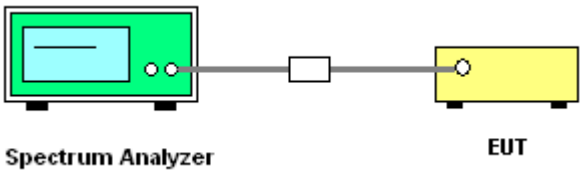
3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.3.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.4.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW = 1 MHz; VBW ≥ RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

3.3.4 Test Setup



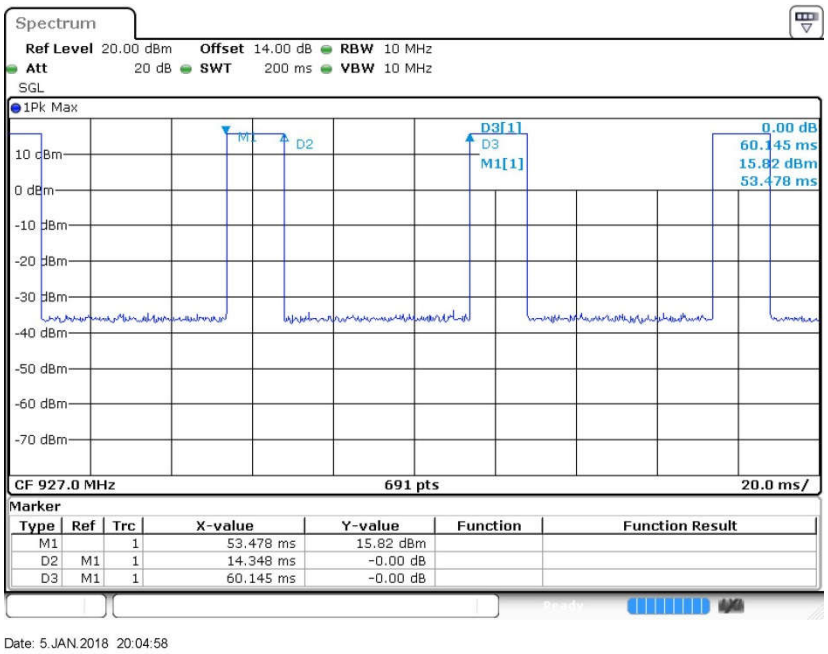
3.3.5 Test Result of Dwell Time

Test Mode :	SRD	Temperature :	24~26℃
Test Engineer :	Wilson Chen	Relative Humidity :	50~53%

Mode	Average Hopping Channel	Package Transfer Time (msec)	Dwell Time (sec)	Limits (sec)	Pass/Fail
SRD	7.00	14.35	0.10	0.4	Pass

Remark: Dwell Time(s) = Average Hopping Channel x Package Transfer Time

Package Transfer Time Plot



3.4 20dB and 99% Bandwidth Measurement

3.4.1 Limit of 20dB and 99% Bandwidth

The maximum allowed 20 dB bandwidth of the hopping channel is 500kHz.

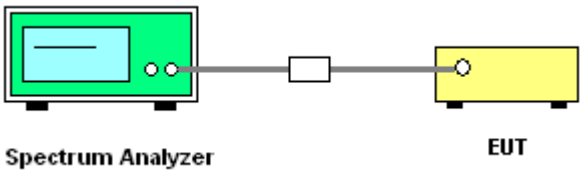
3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.4.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 6.9.2 and 6.9.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.
   Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel;
   RBW ≥ 1% of the 20 dB bandwidth; VBW ≥ RBW; Sweep = auto; Detector function = peak;
   Trace = max hold.
5. Use the following spectrum analyzer settings for 99 % Bandwidth measurement.
   Span = approximately 1.5 to 5 times the 99% bandwidth, centered on a hopping channel;
   RBW ≥ 1% of the 99% bandwidth; VBW ≥ RBW; Sweep = auto; Detector function = peak;
   Trace = max hold.
6. Measure and record the results in the test report.

3.4.4 Test Setup

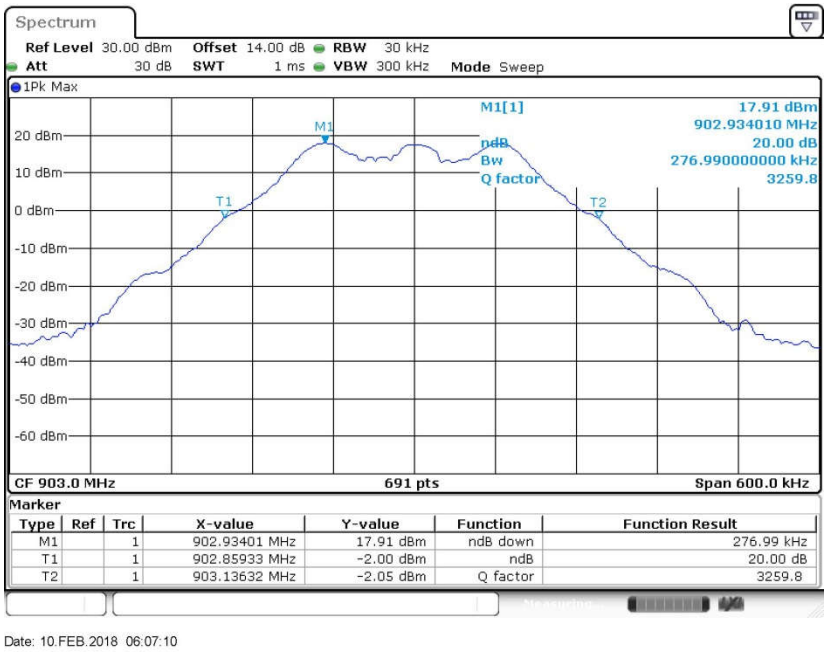


3.4.5 Test Result of 20dB Bandwidth

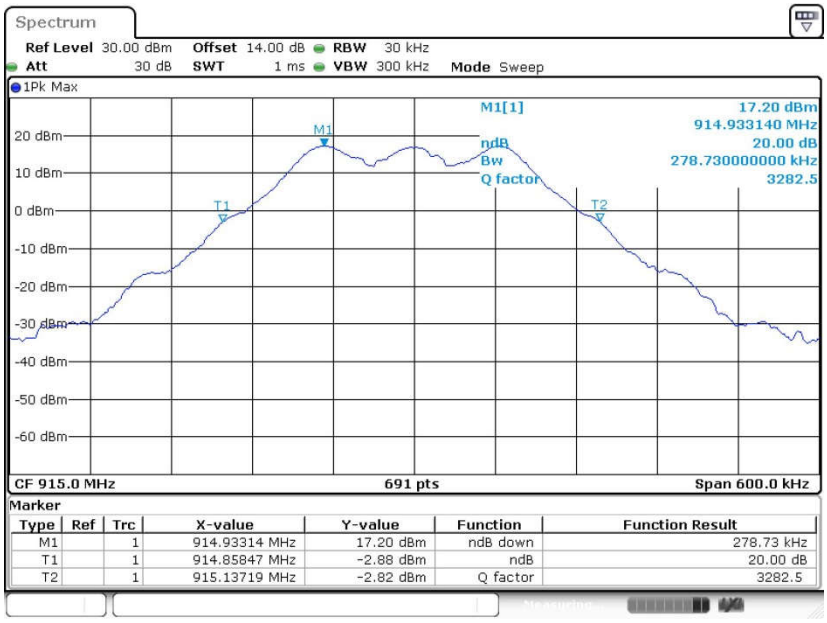
Test Mode :	SRD	Temperature :	24~26℃
Test Engineer :	Wilson Chen	Relative Humidity :	50~53%

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Limit (MHz)
00	903	0.277	0.5
12	915	0.279	0.5
24	927	0.277	0.5

20 dB Bandwidth Plot on Channel 00



20 dB Bandwidth Plot on Channel 12



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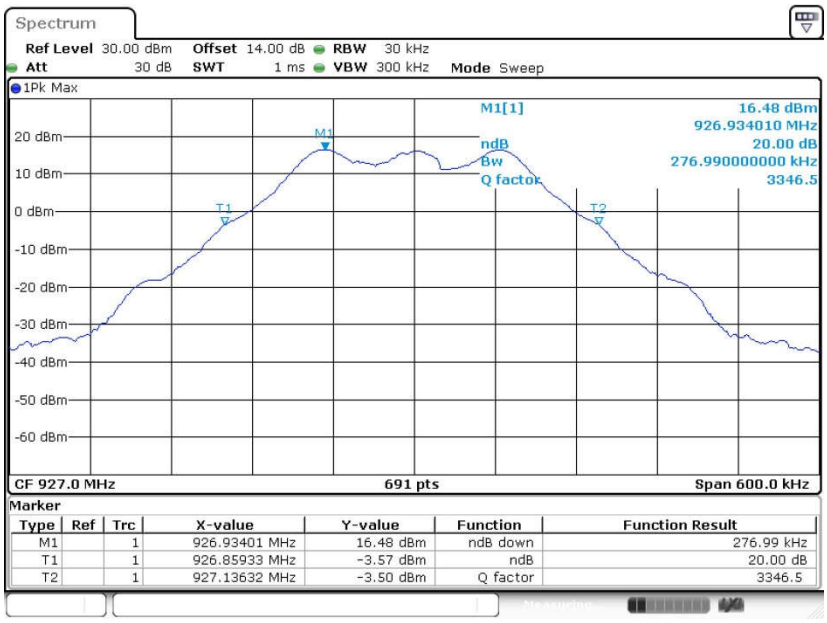
20 dB Bandwidth Plot on Channel 24



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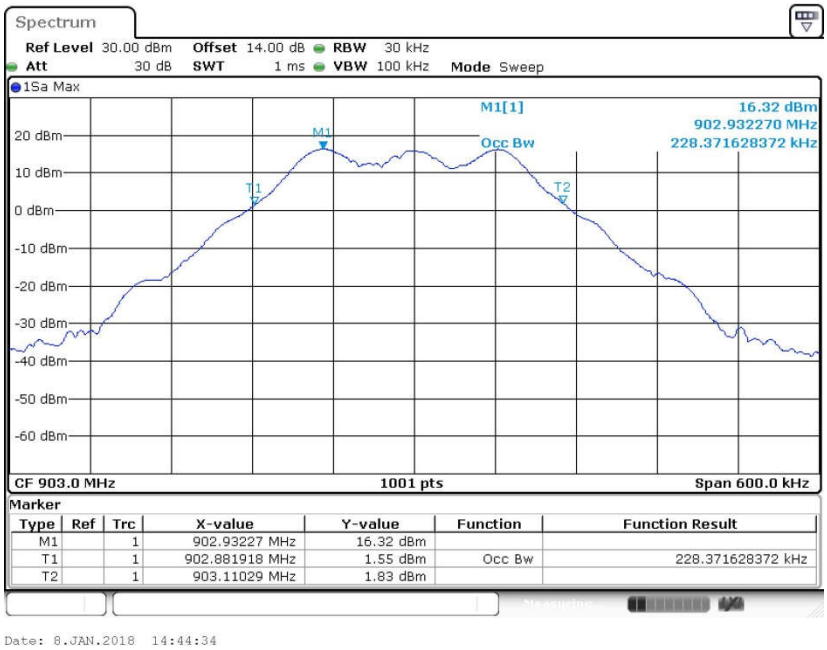
3.4.6 Test Result of 99% Occupied Bandwidth

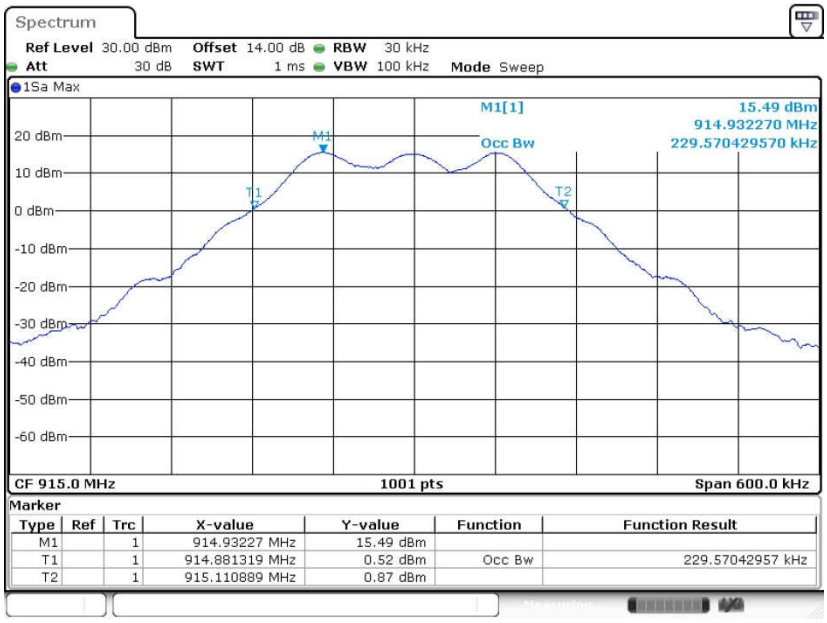
Test Mode :	SRD	Temperature :	24~26℃
Test Engineer :	Wilson Chen	Relative Humidity :	50~53%

Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
00	903	0.228
12	915	0.230
24	927	0.228

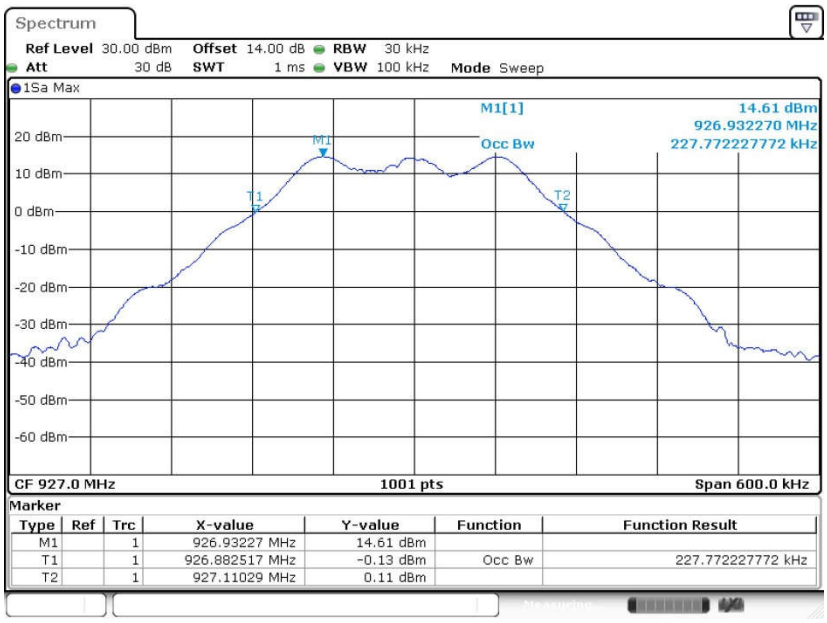
99% Occupied Bandwidth Plot on Channel 00



99% Occupied Bandwidth Plot on Channel 12



99% Occupied Bandwidth Plot on Channel 24



3.5 Peak Output Power Measurement

3.5.1 Limit of Peak Output Power

For systems using digital modulation in the 903-927MHz, the limit for peak output power is 24dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

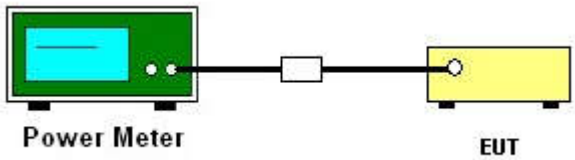
3.5.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.5.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.5.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power with cable loss and record the results in the test report.
5. Measure and record the results in the test report.

3.5.4 Test Setup



3.5.5 Test Result of Peak Output Power

Test Mode :	SRD	Temperature :	24~26℃
Test Engineer :	Wilson Chen	Relative Humidity :	50~53%

Channel	Frequency (MHz)	RF Power (dBm)		
		SRD	Max. Limits (dBm)	Pass/Fail
00	903	17.19	24.00	Pass
12	915	16.34	24.00	Pass
24	927	15.42	24.00	Pass

3.6 Conducted Band Edges Measurement

3.6.1 Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

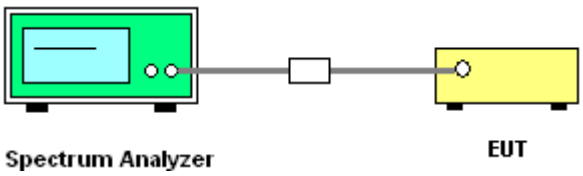
3.6.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.6.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.6.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100kHz, VBW = 300kHz. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
4. Enable hopping function of the EUT and then repeat step 2. and 3.
5. Measure and record the results in the test report.

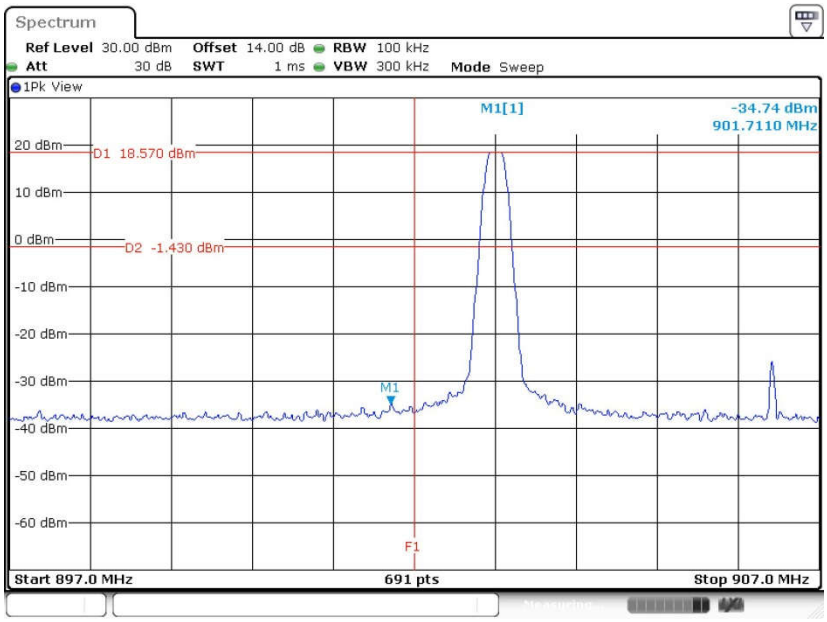
3.6.4 Test Setup



3.6.5 Test Result of Conducted Band Edges

Test Mode :	SRD	Temperature :	24~26℃
Test Channel :	00 and 24	Relative Humidity :	50~53%
		Test Engineer :	Wilson Chen

Low Band Edge Plot on Channel 00



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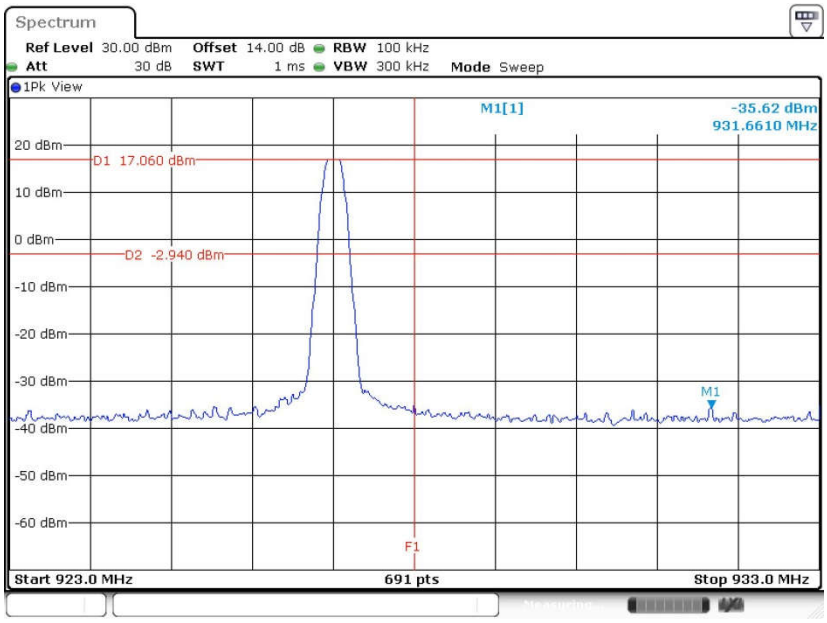
High Band Edge Plot on Channel 24



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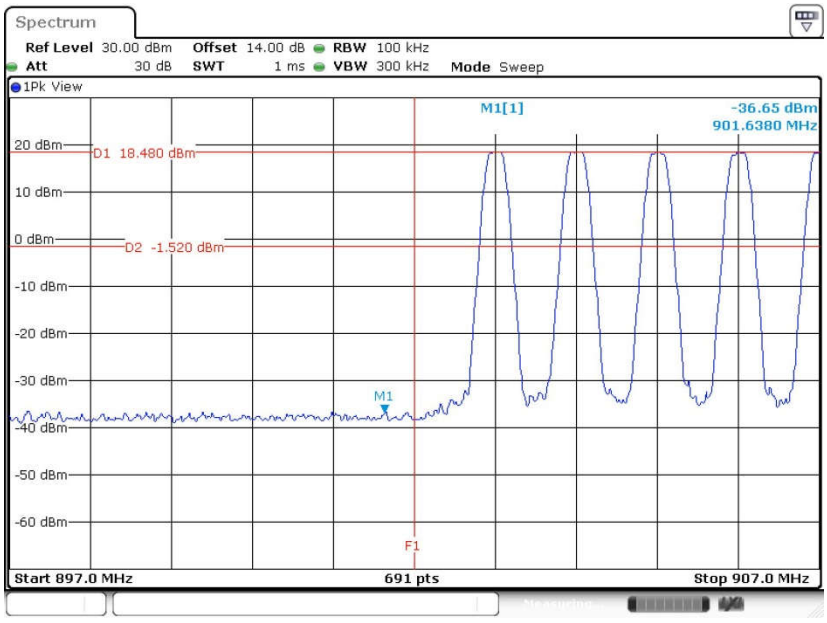
3.6.6 Test Result of Conducted Hopping Mode Band Edges

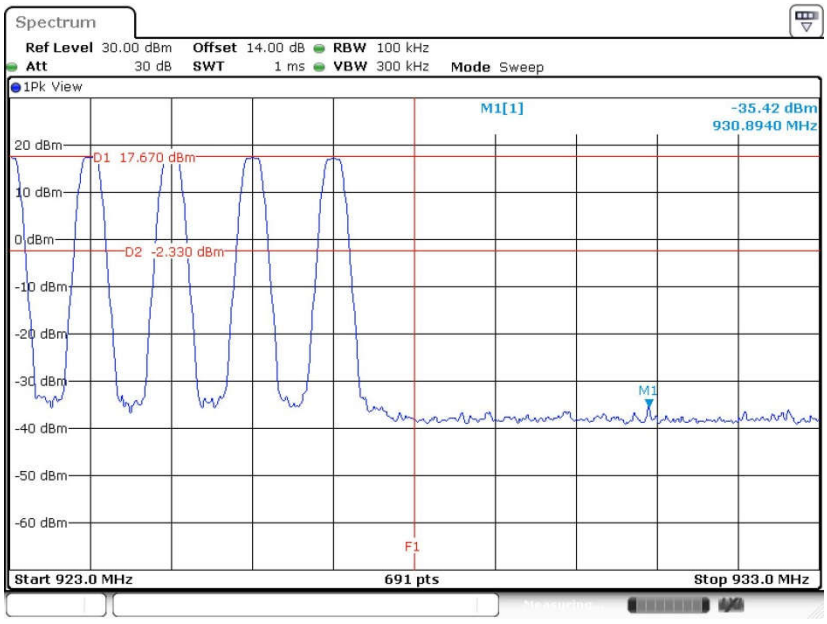
Test Mode :	SRD	Temperature :	24~26℃
Test Engineer :	Wilson Chen	Relative Humidity :	50~53%

Hopping Mode Low Band Edge Plot



Date: 10.FEB.2018 06:46:29

Hopping Mode High Band Edge Plot



Date: 10.FEB.2018 06:50:11

3.7 Conducted Spurious Emission Measurement

3.7.1 Limit of Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

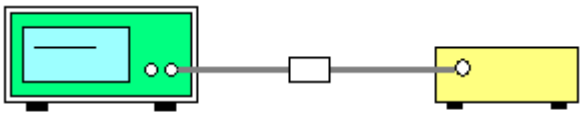
3.7.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.7.3 Test Procedure

1. The testing follows ANSI C63.10-2013 clause 7.8.8.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

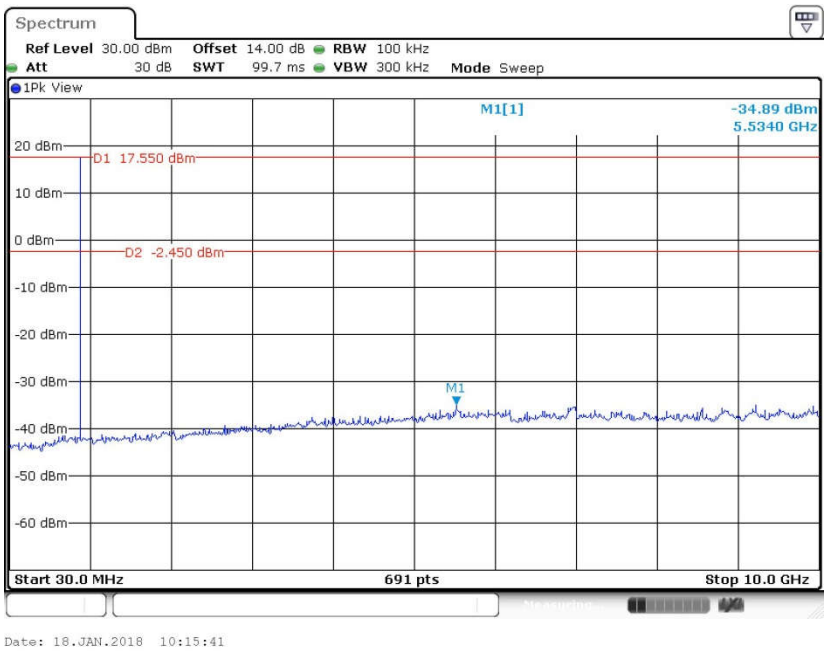
3.7.4 Test Setup



3.7.5 Test Result of Conducted Spurious Emission

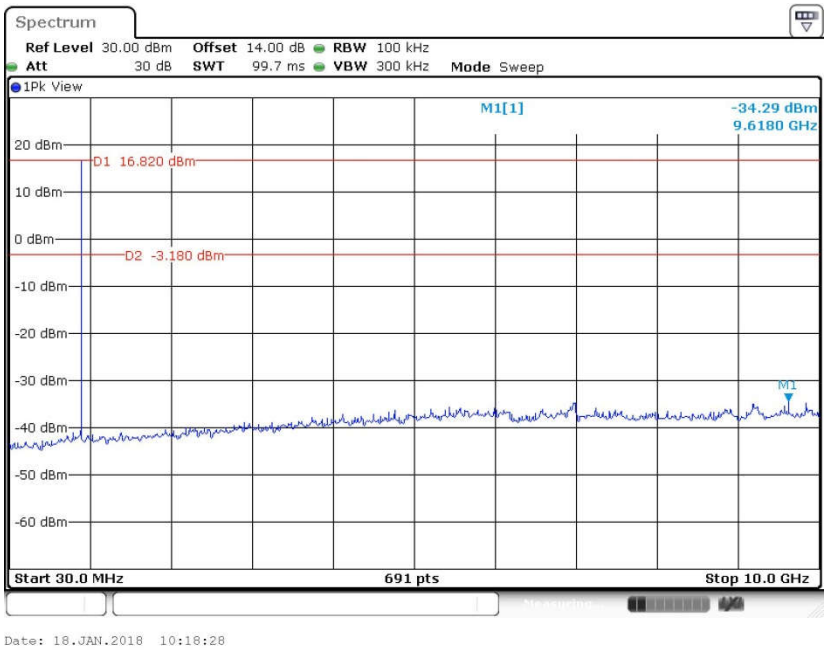
Test Mode :	SRD	Temperature :	24~26℃
Test Channel :	00	Relative Humidity :	50~53%
		Test Engineer :	Wilson Chen

CSE Plot on Ch 00 between 30MHz ~ 10 GHz



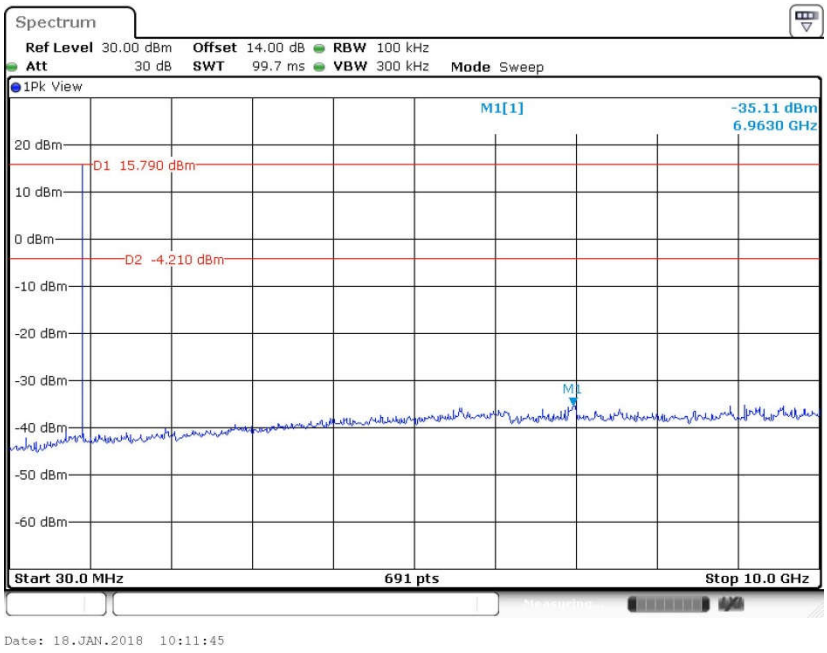
Test Mode :	SRD	Temperature :	24~26℃
Test Channel :	12	Relative Humidity :	50~53%
		Test Engineer :	Wilson Chen

CSE Plot on Ch 12 between 30MHz ~ 10 GHz



Test Mode :	SRD	Temperature :	24~26℃
Test Channel :	24	Relative Humidity :	50~53%
		Test Engineer :	Wilson Chen

CSE Plot on Ch 24 between 30MHz ~ 10 GHz



3.8 Radiated Band Edges and Spurious Emission Measurement

3.8.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.8.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

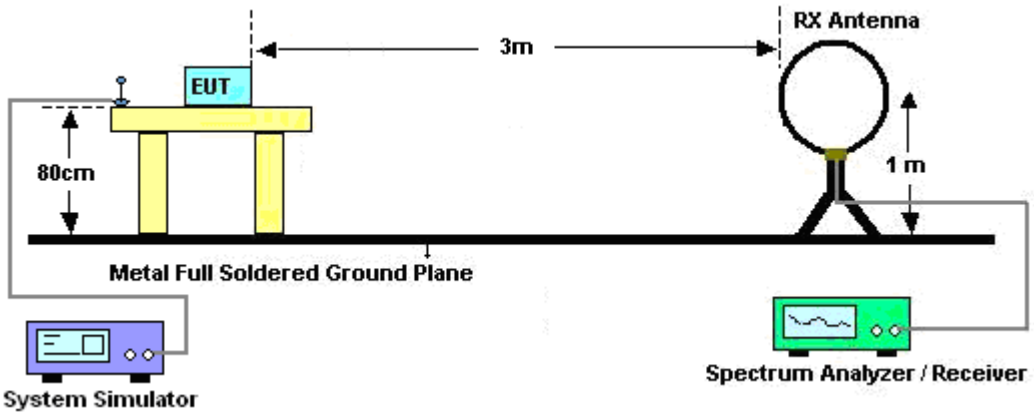
3.8.3 Test Procedures

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
   (3) For average measurement: use duty cycle correction factor method per 15.35(c).
   Duty cycle = On time/100 milliseconds
   On time = $N_1*L_1+N_2*L_2+...+N_{n-1}*LN_{n-1}+N_n*L_n$
   Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.
   Average Emission Level = Peak Emission Level + 20*log(Duty cycle)
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

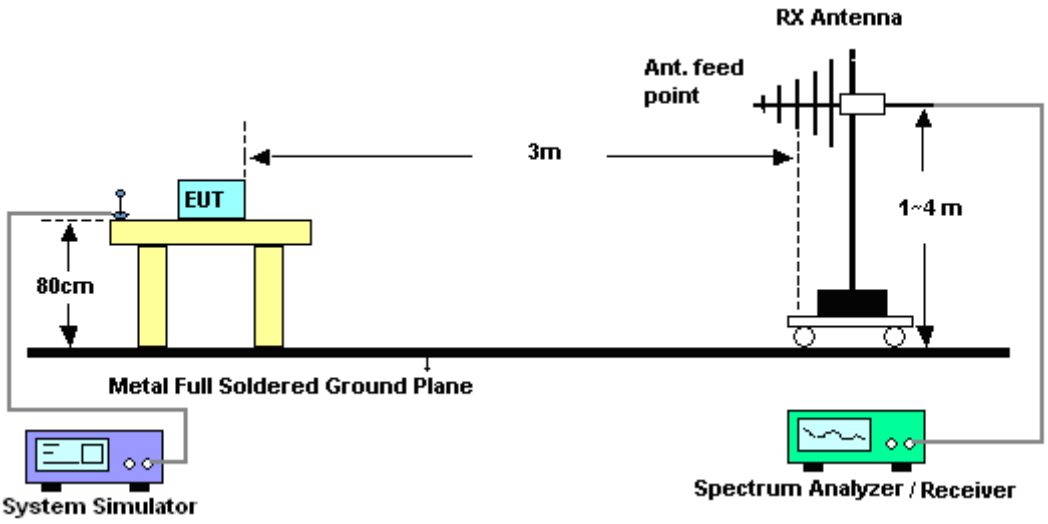
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-10.93dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

3.8.4 Test Setup

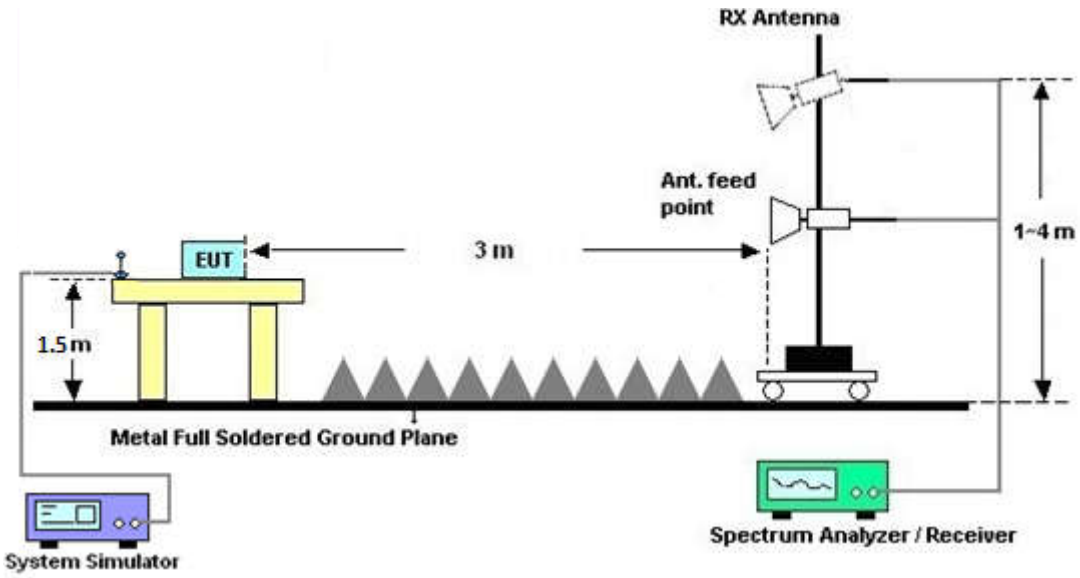
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz

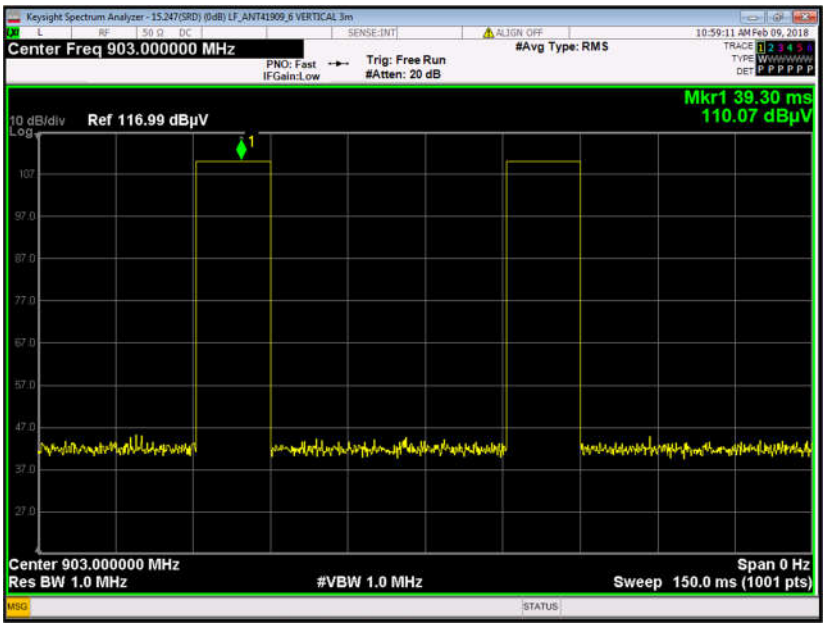


3.8.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

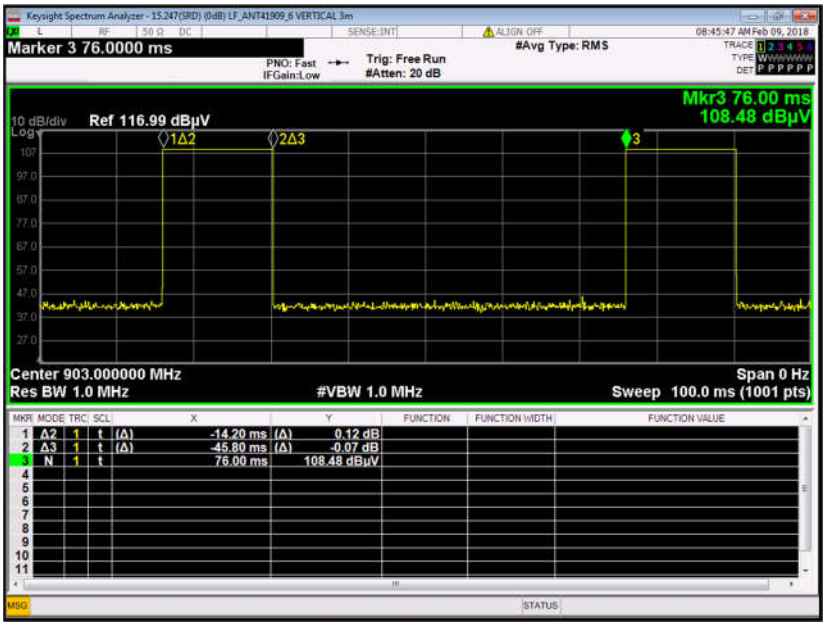
The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

3.8.6 Duty cycle correction factor for average measurement

903MHz: on time (One Pulse) Plot on Channel 00



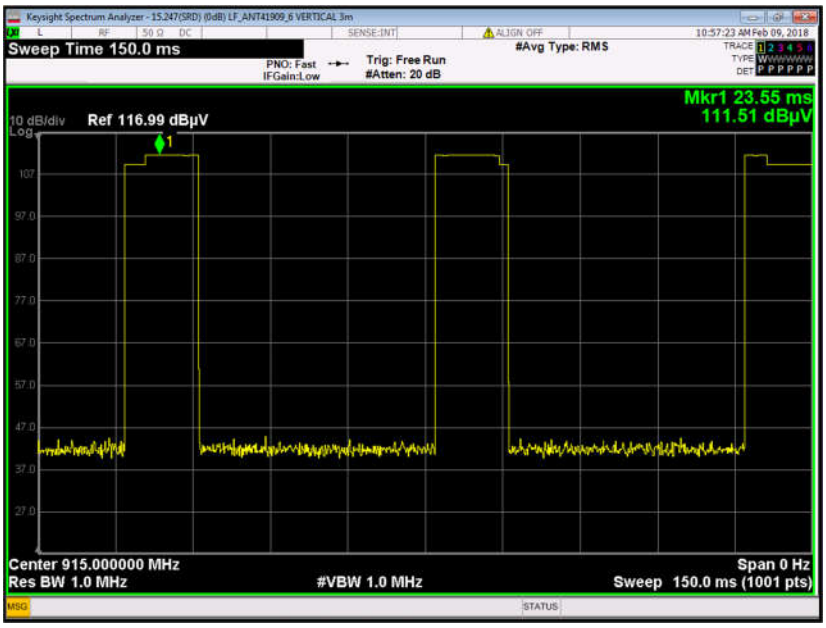
903MHz: on time (Count Pulses) Plot on Channel 00



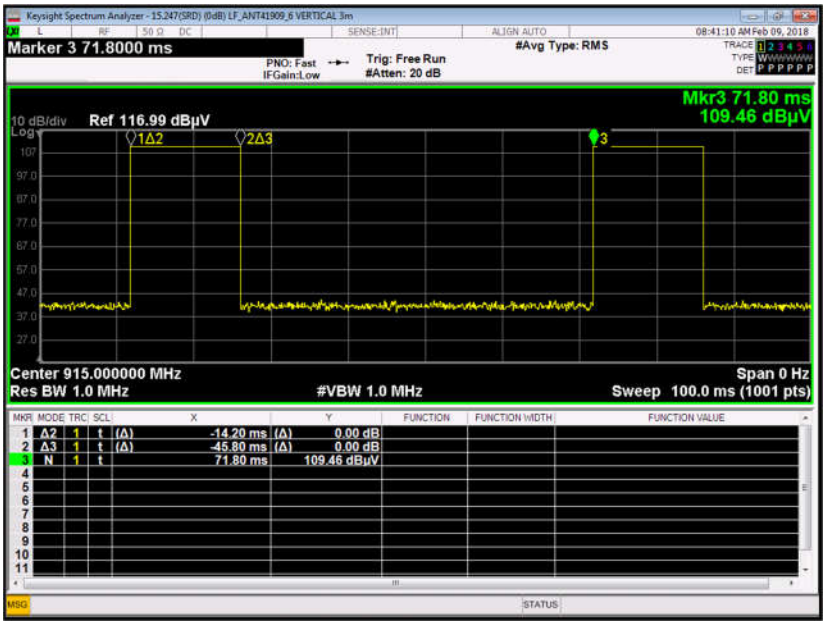
Note:

1. Duty cycle = on time/100 milliseconds = 2 * 14.2 / 100 = 28.40 %
2. Duty cycle correction factor = 20*log(Duty cycle) = -10.93 dB

915MHz: on time (One Pulse) Plot on Channel 12



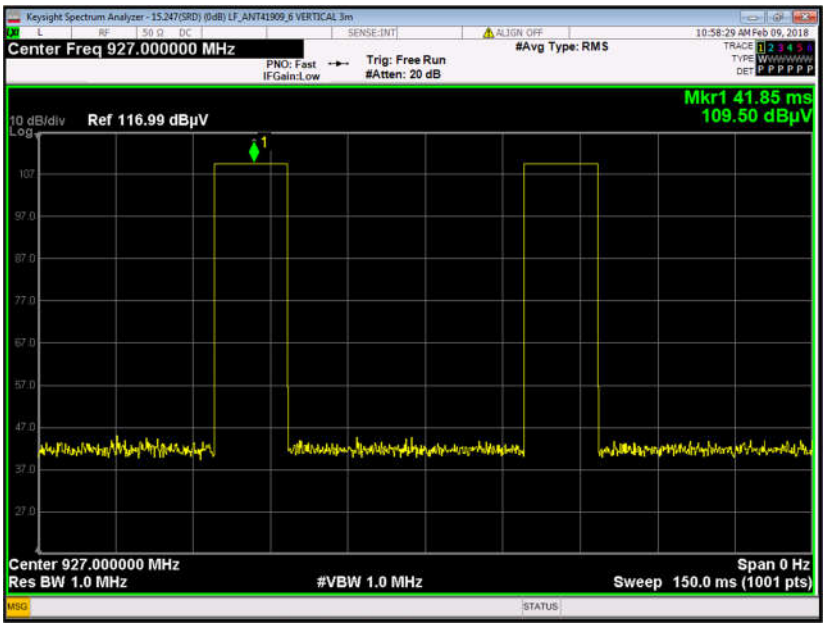
915MHz: on time (Count Pulses) Plot on Channel 12



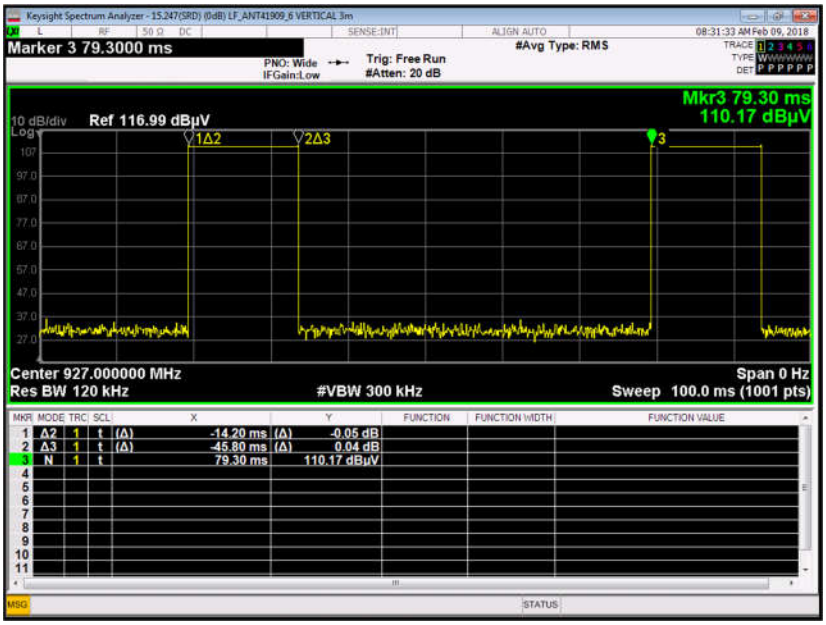
Note:

1. Duty cycle = on time/100 milliseconds = 2 * 14.2 / 100 = 28.40 %
2. Duty cycle correction factor = 20*log(Duty cycle) = -10.93 dB

927MHz: on time (One Pulse) Plot on Channel 24



927MHz: on time (Count Pulses) Plot on Channel 24



Note:

1. Duty cycle = on time/100 milliseconds = 2 * 14.2 / 100 = 28.40 %
2. Duty cycle correction factor = 20*log(Duty cycle) = -10.93 dB

Duty Cycle Correction Factor Consideration:

In 903MHz, 915MHz, 927MHz, the minimum hopping frequencies are 20, to get the longest dwell time packet is observed; the period to have packet completing one hopping sequence is

14.2 ms x 20 channels = 28.40 ms

There cannot be 2 complete hopping sequences within 100ms period, considering the random hopping behavior, maximum 2 hops can be possibly observed within the period. [100ms / 57.6ms] = 2 hops

Thus, the maximum possible ON time:

2.840 ms x 2 = 5.68 ms

Worst case Duty Cycle Correction factor, which is derived from the maximum possible ON time,

20 x log(5.68 ms/100ms) = -10.93 dB

3.8.7 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B.

3.8.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix B.

3.9 AC Conducted Emission Measurement

3.9.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	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.

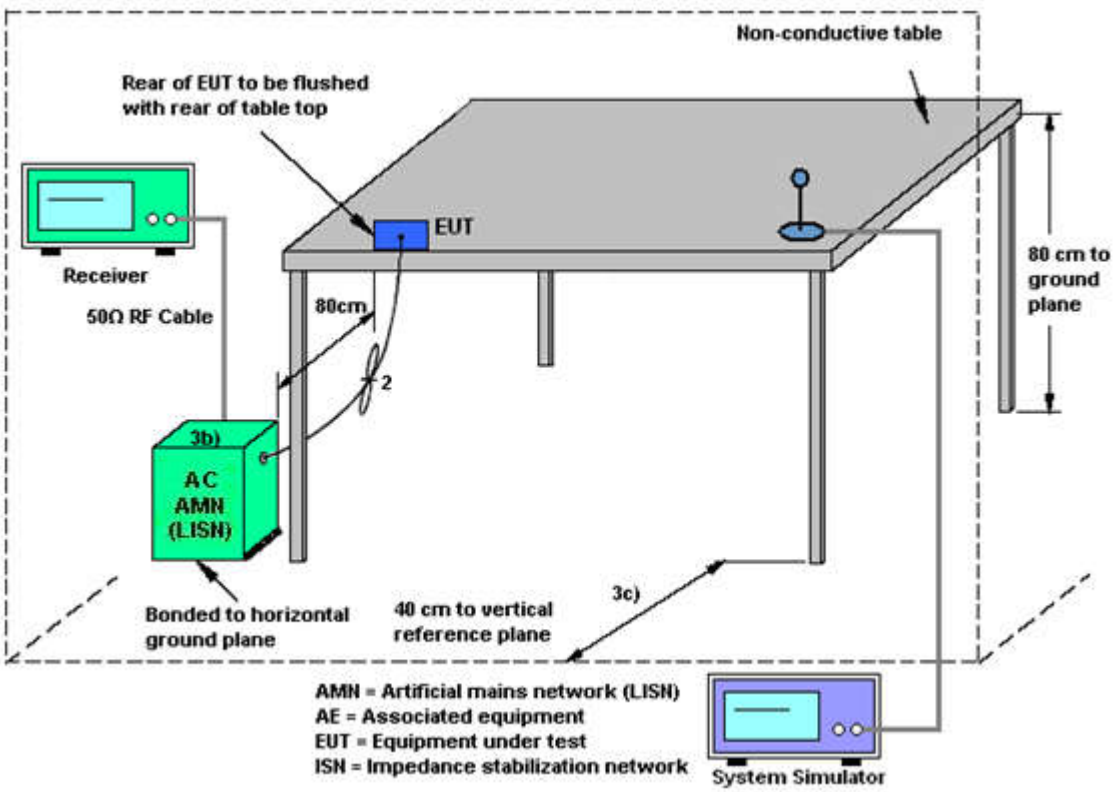
3.9.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.9.3 Test Procedures

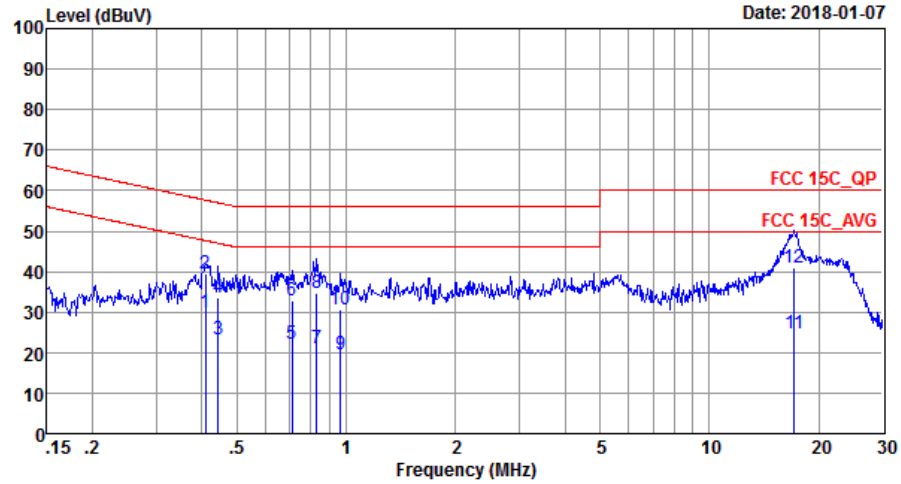
1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.9.4 Test Setup



3.9.5 Test Result of AC Conducted Emission

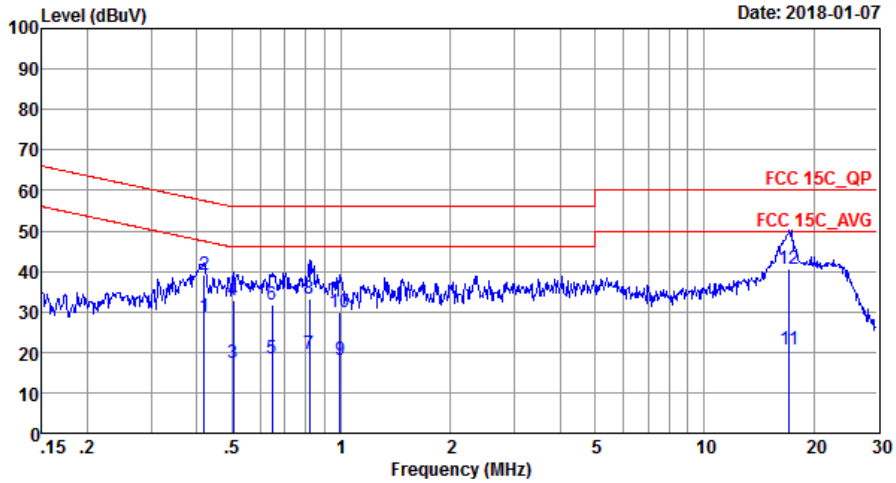
Test Mode :	Mode 1	**Temperature :**	22~25℃
Test Engineer :	Peng Wang	**Relative Humidity :**	50~55%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line
Function Type :	WCDMA Band V Idle + SRD Tx + WLAN Link + Adapter		



Site : CO01-SZ
Condition: FCC 15C_QP LISN_20170907_L LINE

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	*	0.41	29.91	-17.73	47.64	19.80	0.03	10.08	Average
2		0.41	39.51	-18.13	57.64	29.40	0.03	10.08	QP
3		0.44	23.11	-23.87	46.98	13.00	0.03	10.08	Average
4		0.44	33.51	-23.47	56.98	23.40	0.03	10.08	QP
5		0.71	22.30	-23.70	46.00	12.20	0.02	10.08	Average
6		0.71	32.90	-23.10	56.00	22.80	0.02	10.08	QP
7		0.83	21.13	-24.87	46.00	11.00	0.04	10.09	Average
8		0.83	34.63	-21.37	56.00	24.50	0.04	10.09	QP
9		0.96	19.45	-26.55	46.00	9.30	0.06	10.09	Average
10		0.96	30.55	-25.45	56.00	20.40	0.06	10.09	QP
11		17.11	24.66	-25.34	50.00	13.40	0.88	10.38	Average
12		17.11	40.96	-19.04	60.00	29.70	0.88	10.38	QP

Test Mode :	Mode 1	Temperature :	22~25℃
Test Engineer :	Peng Wang	Relative Humidity :	50~55%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	WCDMA Band V Idle + SRD Tx + WLAN Link + Adapter		



Site : CO01-SZ
Condition: FCC 15C_QP LISN_20170907_N NEUTRAL

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.42	28.80	-18.66	47.46	18.70	0.02	10.08	Average
2	*	0.42	39.20	-18.26	57.46	29.10	0.02	10.08	QP
3		0.50	17.30	-28.70	46.00	7.20	0.02	10.08	Average
4		0.50	32.70	-23.30	56.00	22.60	0.02	10.08	QP
5		0.64	18.40	-27.60	46.00	8.30	0.02	10.08	Average
6		0.64	31.70	-24.30	56.00	21.60	0.02	10.08	QP
7		0.82	19.62	-26.38	46.00	9.51	0.03	10.08	Average
8		0.82	33.32	-22.68	56.00	23.21	0.03	10.08	QP
9		0.99	18.04	-27.96	46.00	7.90	0.05	10.09	Average
10		0.99	29.84	-26.16	56.00	19.70	0.05	10.09	QP
11		17.11	20.73	-29.27	50.00	9.91	0.44	10.38	Average
12		17.11	40.63	-19.37	60.00	29.81	0.44	10.38	QP

3.10 Antenna Requirements

3.10.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.10.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.10.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101078	9kHz~40GHz	Apr. 20, 2017	Jan. 05, 2018~ Feb. 10, 2018	Apr. 19, 2018	Conducted (TH01-SZ)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 19, 2017	Jan. 05, 2018~ Feb. 10, 2018	Jan. 19, 2018	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 18, 2018		Jan. 17, 2019	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 19, 2017	Jan. 05, 2018~ Feb. 10, 2018	Jan. 19, 2018	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 18, 2018		Jan. 17, 2019	Conducted (TH01-KS)
EMI Test Receiver	R&S	ESR7	101404	9kHz~7GHz	Apr. 20, 2017	Feb. 09, 2018~ Feb. 11, 2018	Apr. 19, 2018	Radiation (03CH04-SZ)
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY55150213	10Hz~44GHz	Apr. 20, 2017	Feb. 09, 2018~ Feb. 11, 2018	Apr. 19, 2018	Radiation (03CH04-SZ)
Loop Antenna	R&S	HFH2-Z2	100354	9kHz~30MHz	May 14, 2017	Feb. 09, 2018~ Feb. 11, 2018	May 13, 2018	Radiation (03CH04-SZ)
Bilog Antenna	TeseQ	CBL6111D	41909	30MHz~1GHz	May 16, 2017	Feb. 09, 2018~ Feb. 11, 2018	May 15, 2018	Radiation (03CH04-SZ)
Double Ridge Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-1285	1GHz~18GHz	Dec. 13, 2017	Feb. 09, 2018~ Feb. 11, 2018	Dec. 12, 2018	Radiation (03CH04-SZ)
Amplifier	Burgeon	BPA-530	102211	0.01Hz ~3000MHz	Oct. 19, 2017	Feb. 09, 2018~ Feb. 11, 2018	Oct. 18, 2018	Radiation (03CH04-SZ)
HF Amplifier	MITEQ	AMF-7D-00101800-30-10P-R	1989346	1GHz~18GHz	Jul. 27, 2017	Feb. 09, 2018~ Feb. 11, 2018	Jul. 26, 2018	Radiation (03CH04-SZ)
Amplifier	Agilent Technologies	83017A	MY53270156	500MHz~26.5GHz	Apr. 20, 2017	Feb. 09, 2018~ Feb. 11, 2018	Apr. 19, 2018	Radiation (03CH04-SZ)
AC Power Source	Chroma	61601	N/A	N/A	NCR	Feb. 09, 2018~ Feb. 11, 2018	NCR	Radiation (03CH04-SZ)
Turn Table	EM	EM1000	N/A	0~360 degree	NCR	Feb. 09, 2018~ Feb. 11, 2018	NCR	Radiation (03CH04-SZ)
Antenna Mast	EM	EM1000	N/A	1 m~4 m	NCR	Feb. 09, 2018~ Feb. 11, 2018	NCR	Radiation (03CH04-SZ)
EMI Receiver	R&S	ESR7	101630	9kHz~7GHz;	Dec. 26, 2017	Jan. 07, 2018	Dec. 25, 2018	Conduction (CO01-SZ)
AC LISN	EMCO	3816/2SH	00103912	9kHz~30MHz	Dec. 26, 2017	Jan. 07, 2018	Dec. 25, 2018	Conduction (CO01-SZ)
AC LISN (for auxiliary equipment)	MessTec	3816/2SH	00103892	9kHz~30MHz	Nov. 01, 2017	Jan. 07, 2018	Oct. 31, 2018	Conduction (CO01-SZ)
AC Power Source	Chroma	61602	616020000891	100Vac~250Vac	Jul. 19, 2017	Jan. 07, 2018	Jul. 18, 2018	Conduction (CO01-SZ)

NCR: No Calibration Required

5 Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.6dB**

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.1dB**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.8dB**

Appendix A. conducted test results

SRD

Test Engineer:	Wilson Chen	Temperature:	21~25	°C
Test Date:	2018/2/2 ~ 2018/2/10	Relative Humidity:	51~54	%

TEST RESULTS DATA
20dB and 99% Occupied Bandwidth and Hopping Channel Separation

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	20db BW (MHz)	99% Bandwidth (MHz)	Hopping Channel Separation Measurement (MHz)	20db BW Limit (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
SRD	128 kbps	1	0	903	0.277	0.228	0.903	0.5000	0.2770	Pass
SRD	128 kbps	1	12	915	0.279	0.230	0.915	0.5000	0.2787	Pass
SRD	128 kbps	1	24	927	0.277	0.228	0.926	0.5000	0.2770	Pass

TEST RESULTS DATA
Dwell Time

Mod.	Average Hopping Channel	Package Transfer Time(ms)	Dwell Time (sec)	Limits (sec)	Pass/Fail
SRD	7	14.35	0.10	0.4	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
SRD	0	1	**17.19**	24.00	Pass
	12	1	16.34	24.00	Pass
	24	1	15.42	24.00	Pass

TEST RESULTS DATA
Number of Hopping Frequency

Number of Hopping (Channel)	Adaptive Frequency Hopping (Channel)	Limits (Channel)	Pass/Fail
25	25	⩾25	Pass

Appendix B. Radiated Spurious Emission

SRD (Band Edge @ 3m)

SRD	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
SRD CH00 903MHz		901.72	56.61	-36.71	93.32	55.07	29.32	3.39	31.17	147	339	P	H
	*	903	113.32	-	-	111.77	29.33	3.39	31.17	147	339	P	H
		901.9	54.1	-37.74	91.84	52.56	29.32	3.39	31.17	116	191	P	V
	*	903	111.84	-	-	110.29	29.33	3.39	31.17	116	191	P	V
SRD CH12 915MHz	*	915	110.81	-	-	109.14	29.47	3.41	31.21	144	341	P	H
	*	915	112.6	-	-	110.93	29.47	3.41	31.21	135	190	P	V
SRD CH24 927MHz	*	927	113.37	-	-	111.57	29.63	3.43	31.26	148	340	P	H
		928.12	54.85	-38.52	93.37	53.03	29.64	3.44	31.26	148	340	P	H
	*	927	112.99	-	-	111.19	29.63	3.43	31.26	116	191	P	V
		928.03	55.17	-37.82	92.99	53.35	29.64	3.44	31.26	116	191	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

SRD Hopping (Band Edge @ 3m)

SRD	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
SRD CH00 Hopping 903MHz		901.99	55.68	-37.78	93.46	54.14	29.32	3.39	31.17	147	340	P	H
	*	910.96	113.46	-	-	111.82	29.43	3.41	31.2	147	340	P	H
		901.99	52.81	-39.42	92.23	51.27	29.32	3.39	31.17	116	191	P	V
	*	910.06	112.23	-	-	110.59	29.42	3.41	31.19	116	191	P	V
SRD CH24 Hopping 927MHz	*	927	114.06	-	-	112.29	29.58	3.43	31.24	147	340	P	H
		928.28	53.26	-40.8	94.06	51.44	29.64	3.44	31.26	147	340	P	H
	*	927	113.24	-	-	111.46	29.59	3.43	31.24	116	191	P	V
		928.04	54.62	-38.62	93.24	52.8	29.64	3.44	31.26	116	191	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

SRD (Harmonic @ 3m)

SRD	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
SRD CH 00 903MHz		2709	47.58	-26.42	74	71.97	28.1	5.1	57.59	189	238	P	H
		2709	36.65	-17.35	54	-	-	-	-	-	-	A	H
		3612	52.94	-21.06	74	77.8	28.99	4.88	58.73	150	200	P	H
		3612	42.01	-11.99	54	-	-	-	-	-	-	A	H
		2709	50.8	-23.2	74	75.19	28.1	5.1	57.59	189	238	P	V
		2709	39.87	-14.13	54	-	-	-	-	-	-	A	V
		3612	48.27	-25.73	74	73.13	28.99	4.88	58.73	155	205	P	V
		3612	37.34	-16.66	54	-	-	-	-	-	-	A	V
SRD CH 12 915MHz		2745	48.39	-25.61	74	72.65	28.15	5.14	57.55	180	230	P	H
		2745	37.46	-16.54	54	-	-	-	-	-	-	A	H
		3660	56.44	-17.56	74	81.27	29.07	4.91	58.81	161	360	P	H
		3660	45.51	-8.49	54	-	-	-	-	-	-	A	H
		2745	50.8	-23.2	74	75.06	28.15	5.14	57.55	180	230	P	V
		2745	39.87	-14.13	54	-	-	-	-	-	-	A	V
		3660	50.69	-23.31	74	75.52	29.07	4.91	58.81	161	360	P	V
		3660	39.76	-14.24	54	-	-	-	-	-	-	A	V
SRD CH 24 927MHz		2781	49.62	-24.38	74	73.75	28.2	5.19	57.52	189	238	P	H
		2781	38.69	-15.31	54	-	-	-	-	-	-	A	H
		3708	57.41	-16.59	74	82.19	29.2	4.95	58.93	158	360	P	H
		3708	46.48	-7.52	54	-	-	-	-	-	-	A	H
		2781	50.23	-23.77	74	74.36	28.2	5.19	57.52	158	360	P	V
		2781	39.3	-14.7	54	-	-	-	-	-	-	A	V
		3708	51.38	-22.62	74	76.16	29.2	4.95	58.93	158	360	P	V
		3708	40.45	-13.55	54	-	-	-	-	-	-	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

SRD (LF)

SRD	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
SRD LF		106.63	27.92	-15.58	43.5	41.83	16.7	1.09	31.7	-	-	P	H
		259.89	37.76	-8.24	46	46.86	20.4	1.74	31.24	100	14	P	H
		286.08	33.96	-12.04	46	44.26	19.12	1.81	31.23	-	-	P	H
		485.9	25.13	-20.87	46	30.28	23.7	2.39	31.24	-	-	P	H
		603.27	28.09	-17.91	46	30.82	25.83	2.71	31.27	-	-	P	H
		769.14	30.59	-15.41	46	30.76	27.94	3.08	31.19	-	-	P	H
		42.61	30.38	-9.62	40	43.24	18.65	0.46	31.97	100	214	P	V
		73.65	29.73	-10.27	40	47.76	13.03	0.8	31.86	-	-	P	V
		105.66	30.48	-13.02	43.5	44.47	16.64	1.08	31.71	-	-	P	V
		259.89	30.52	-15.48	46	39.62	20.4	1.74	31.24	-	-	P	V
		550.89	26.97	-19.03	46	30.75	24.91	2.56	31.25	-	-	P	V
		819.58	32.04	-13.96	46	31.35	28.66	3.2	31.17	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI Ant. 1+2	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBμV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is "PASS".