

TEST REPORT

IC ID: 21411-RM9151G

FCC ID: 2AG87RM-915-1G

Product: Prism Wi-Fi [®] Radio Transceiver

Model No.: RM-915-1G

Additional Model: RO-915-1G

Trade Mark: N/A

Report No.: TCT180511E027

Issued Date: May 29, 2018

Issued for:

Doodle Labs (SG) Pte Ltd

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Issued By:

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Appendix A: Photographs of Test Setup

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1. Test Certification

Product:	Prism Wi-Fi® Radio Transceiver
Model No.:	RM-915-1G
Additional Model No.:	RO-915-1G
Trade Mark:	N/A
Applicant:	Doodle Labs (SG) Pte Ltd
Address:	150 Kampong Ampat, KA Center, Suite 05-03 Singapore, 368324 Singapore
Manufacturer:	Doodle Labs (SG) Pte Ltd
Address:	150 Kampong Ampat, KA Center, Suite 05-03 Singapore, 368324 Singapore
Date of Test:	May 10, 2018 – May 29, 2018
Applicable Standards:	IC RSS-Gen(Issue 4, Nov. 2014) IC RSS-247(Issue 2, February 2017) FCC CFR Title 47 Part 15 Subpart C Section 15.247 KDB 558074 D01 DTS Meas Guidance v04

The above equipment has been tested by Shenzhen Tongce Testing Lab. and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Tested By: Jerry Xie
Jerry Xie

Date: May 29, 2018

Reviewed By: Beryl Zhao
Beryl Zhao

Approved By: Tomsin
Tomsin

Date: May 29, 2018

Date: May 29, 2018

2. Test Result Summary

Requirement	CFR 47 Section	Result
Antenna requirement	RSS-247, 5.4(b) §15.203/§15.247 (c)	PASS
AC Power Line Conducted Emission	RSS-GEN, 8.8; §15.207	PASS
Conducted Peak Output Power	RSS-247, 5.4 (b); §15.247 (b)(3) §2.1046	PASS
6dB Emission Bandwidth	RSS-GEN, 6.6; RSS-247, 5.2 (a); §15.247 (a)(2) §2.1049	PASS
99% Bandwidth	RSS-Gen 4.6.1	PASS
Power Spectral Density	RSS-247, 5.2 (b); §15.247 (e)	PASS
Band Edge	RSS-GEN, 8.9; RSS-247, 5.5; §15.247(d) §2.1051, §2.1057	PASS
Spurious Emission	RSS-247, 5.5; §15.205/§15.209 §2.1053, §2.1057	PASS

Note:

1. PASS: Test item meets the requirement.
2. Fail: Test item does not meet the requirement.
3. N/A: Test case does not apply to the test object.
4. The test result judgment is decided by the limit of test standard.

3. EUT Description

Product:	Prism Wi-Fi® Radio Transceiver
Product Type:	WLAN(1TX, 1RX)
Radio Type:	1x1 MIMO
Model No.:	RM-915-1G
Additional Model No.:	RO-915-1G
Trade Mark:	N/A
Hardware Version:	V3
Software Version:	V1.0
Operation Frequency:	905MHz~920MHz
Channel Separation:	5MHz
Number of Channel:	905 MHz, 910 MHz, 915 MHz, 920 MHz,
Modulation Technology:	DSSS, OFDM
Antenna Type:	R-SMA antenna
Antenna Gain:	2dBi
Power Supply:	DC 5V from adapter (voltage range: 5V up to 42V)
Remark:	All models above are identical in interior structure, electrical circuits and components, and just model names are different for the marketing requirement.

Operation Frequency each of channel For DSSS, OFDM.

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	905MHz	2	910MHz	3	915MHz	4	920MHz
Remark: All the channels have been tested.							

4. Genera Information

4.1. Test environment and mode

Operating Environment:

Temperature:	25.0 °C
Humidity:	56 % RH
Atmospheric Pressure:	1010 mbar

Test Mode:

Engineering mode:	Keep the EUT in continuous transmitting by above channel
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The sample was placed (0.8m below 1GHz, 1.5m above 1GHz) above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages. For the full battery state and The output power to the maximum state.

4.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Equipment	Model No.	Serial No.	FCC ID	Trade Name
900MHz Dipole Antenna	001-0002	/	/	LSR
Adapter	EP-TA20CBC	R37HAEY0DT 1RT3	/	SAMSUNG

Note:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.
3. For conducted measurements (Output Power, 6dB Emission Bandwidth, 99% Bandwidth, Power Spectral Density, Spurious Emissions), the antenna of EUT is connected to the test equipment via temporary antenna connector, the antenna connector is soldered on the antenna port of EUT, and the temporary antenna connector is listed in the Test Instruments.

5. Facilities and Accreditations

5.1. Facilities

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

- FCC - Registration No.: 645098

Shenzhen Tongce Testing Lab

The 3m Semi-anechoic chamber has been registered and fully described in a report with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

- IC - Registration No.: 10668A-1

The 3m Semi-anechoic chamber of Shenzhen TCT Testing Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing

5.2. Location

Shenzhen Tongce Testing Lab

Address: 1B/F., Building 1, Yibaolai Industrial Park, Qiaotou, Fuyong, Baoan District, Shenzhen, Guangdong, China

TEL: +86-755-27673339

5.3. Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

No.	Item	MU
1	Conducted Emission	$\pm 2.56\text{dB}$
2	RF power, conducted	$\pm 0.12\text{dB}$
3	Spurious emissions, conducted	$\pm 0.11\text{dB}$
4	All emissions, radiated(<1G)	$\pm 3.92\text{dB}$
5	All emissions, radiated(>1G)	$\pm 4.28\text{dB}$
6	Temperature	$\pm 0.1^{\circ}\text{C}$
7	Humidity	$\pm 1.0\%$

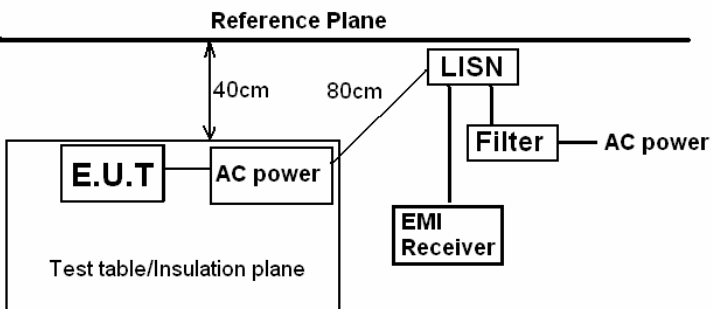
6. Test Results and Measurement Data

6.1. Antenna requirement

Standard requirement:	RSS-247, 5.4 (6) FCC Part15 C Section 15.203 /247(c)
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. 15.247(c) (1)(i) requirement: (i) Systems operating in the 902-928 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi 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 6dBi.	
E.U.T Antenna:	
The EUT has R-SMA antenna which uses a unique coupling to the intentional radiator, and the best case gain of the antenna is 2dBi.	
	

6.2. Conducted Emission

6.2.1. Test Specification

Test Requirement:	RSS-GEN, 8.8 FCC Part15 C Section 15.207		
Test Method:	ANSI C63.10:2013		
Frequency Range:	150 kHz to 30 MHz		
Receiver setup:	RBW=9 kHz, VBW=30 kHz, Sweep time=auto		
Limits:	Frequency range (MHz)	Limit (dBuV)	
		Quasi-peak	Average
	0.15-0.5	66 to 56*	56 to 46*
	0.5-5	56	46
	5-30	60	50
Test Setup:	 <i>Remark</i> E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m		
Test Mode:	Charging + transmitting with modulation		
Test Procedure:	1. The E.U.T is connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement.		
Test Result:	PASS		

6.2.2. Test Instruments

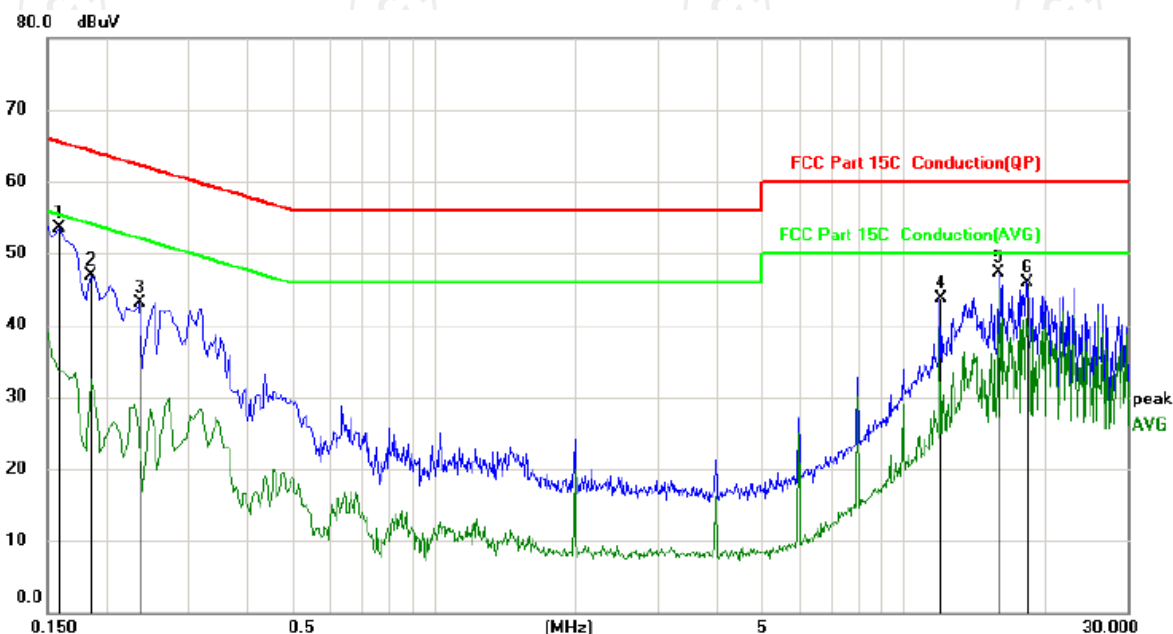
Conducted Emission Shielding Room Test Site (843)				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Test Receiver	R&S	ESPI	101401	Jun. 12, 2018
LISN	Schwarzbeck	NSLK 8126	8126453	Sep. 27, 2018
Coax cable (9KHz-30MHz)	TCT	CE-05	N/A	Sep. 27, 2018
EMI Test Software	Shurple Technology	EZ-EMC	N/A	N/A

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.2.3. Test data

Please refer to following diagram for individual

Conducted Emission on Line Terminal of the power line (150 kHz to 30MHz)



Site: Phase: **L1** Temperature: 25
Limit: FCC Part 15C Conduction(QP) Power: AC 120V/60Hz Humidity: 55 %

No.	Mk.	Freq. MHz	Reading Level dBμV	Correct Factor dB	Measure- ment dBμV	Limit dBμV	Over dB	Detector	Comment
1	*	0.1590	42.20	11.39	53.59	65.52	-11.93	peak	
2		0.1860	35.54	11.38	46.92	64.21	-17.29	peak	
3		0.2355	31.73	11.35	43.08	62.25	-19.17	peak	
4		11.9760	32.64	11.01	43.65	60.00	-16.35	peak	
5		15.9675	36.39	10.82	47.21	60.00	-12.79	peak	
6		18.3030	35.81	10.18	45.99	60.00	-14.01	peak	

Note:

Freq. = Emission frequency in MHz

Reading level (dBμV) = Receiver reading

Corr. Factor (dB) = Antenna factor + Cable loss

Measurement (dBμV) = Reading level (dBμV) + Corr. Factor (dB)

Limit (dBμV) = Limit stated in standard

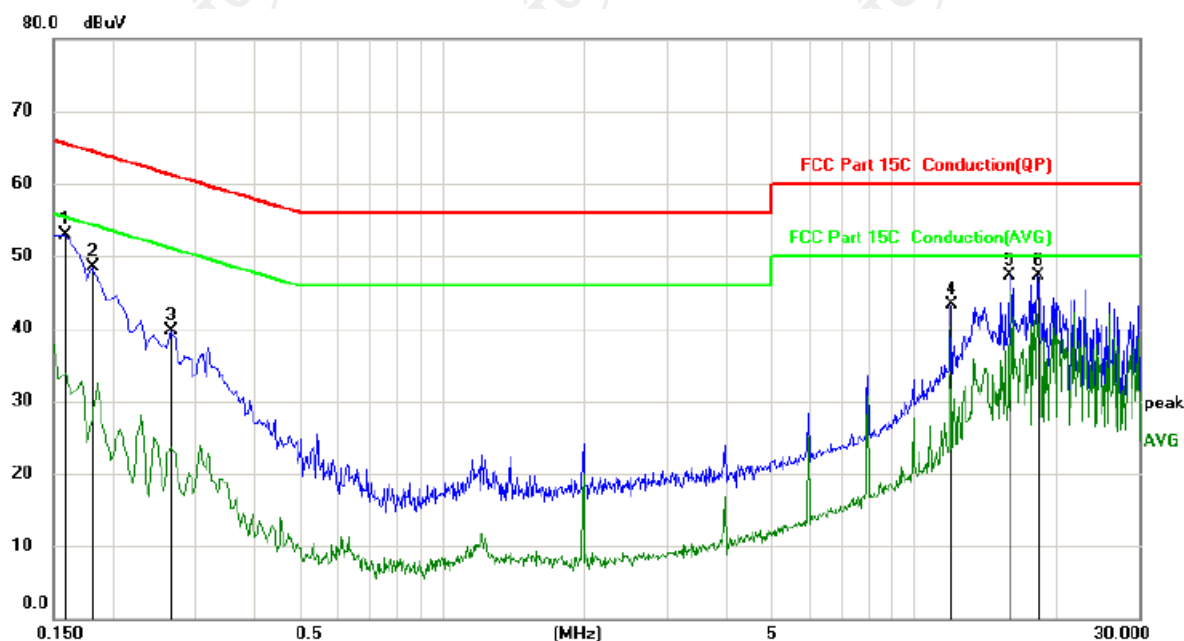
Margin (dB) = Measurement (dBμV) – Limits (dBμV)

Q.P. =Quasi-Peak

AVG =average

* is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.

Conducted Emission on Neutral Terminal of the power line (150 kHz to 30MHz)



Site: Phase: **N** Temperature: 25
 Limit: FCC Part 15C Conduction(QP) Power: AC 120V/60Hz Humidity: 55 %

No.	Mk.	Freq. MHz	Reading Level dBμV	Correct Factor dB	Measure- ment dBμV	Limit dBμV	Over dB	Detector	Comment
1	*	0.1590	41.60	11.39	52.99	65.52	-12.53	peak	
2		0.1815	37.11	11.38	48.49	64.42	-15.93	peak	
3		0.2670	28.31	11.34	39.65	61.21	-21.56	peak	
4		11.9670	32.22	11.01	43.23	60.00	-16.77	peak	
5		15.9585	36.54	10.83	47.37	60.00	-12.63	peak	
6		18.2445	37.19	10.20	47.39	60.00	-12.61	peak	

Note:

Freq. = Emission frequency in MHz

Reading level (dBμV) = Receiver reading

Corr. Factor (dB) = Antenna factor + Cable loss

Measurement (dBμV) = Reading level (dBμV) + Corr. Factor (dB)

Limit (dBμV) = Limit stated in standard

Margin (dB) = Measurement (dBμV) – Limits (dBμV)

Q.P. =Quasi-Peak

AVG =average

* is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.

6.3. Maximum Conducted (Average) Output Power

6.3.1. Test Specification

Test Requirement:	RSS-247, 5.4 (b) FCC Part15 C Section 15.247 (b)(3)
Test Method:	KDB 558074
Limit:	30dBm
Test Setup:	 Spectrum Analyzer EUT
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows the Measurement Procedure of FCC KDB No. 558074 DTS D01 Meas. Guidance v04. 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. Measure the conducted output power and record the results in the test report.
Test Result:	PASS

6.3.2. Test Instruments

Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100060	Sep. 27, 2018
RF Cable (9KHz-26.5GHz)	TCT	RE-06	N/A	Sep. 27, 2018
Antenna Connector	TCT	RFC-01	N/A	Sep. 27, 2018

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

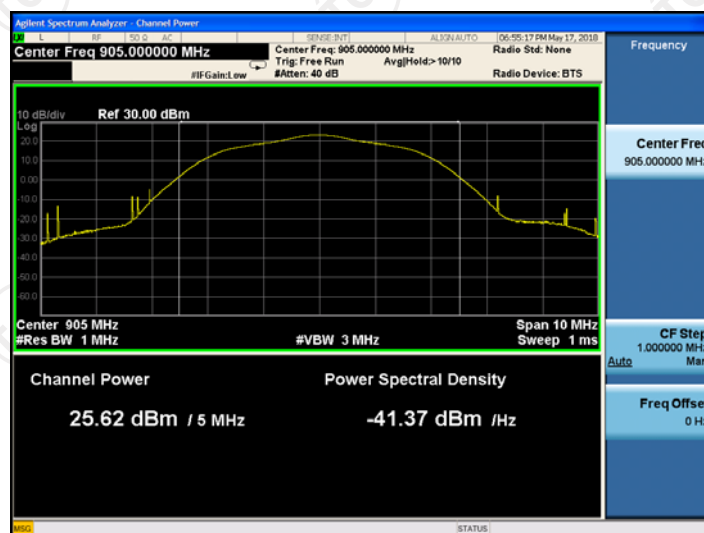
6.3.3. Test Data

For DSSS			
Test channel	Maximum Conducted Output Power (dBm)	Limit (dBm)	Result
905MHz	25.62	30.00	PASS
910MHz	26.08	30.00	PASS
915MHz	25.24	30.00	PASS
920MHz	25.22	30.00	PASS

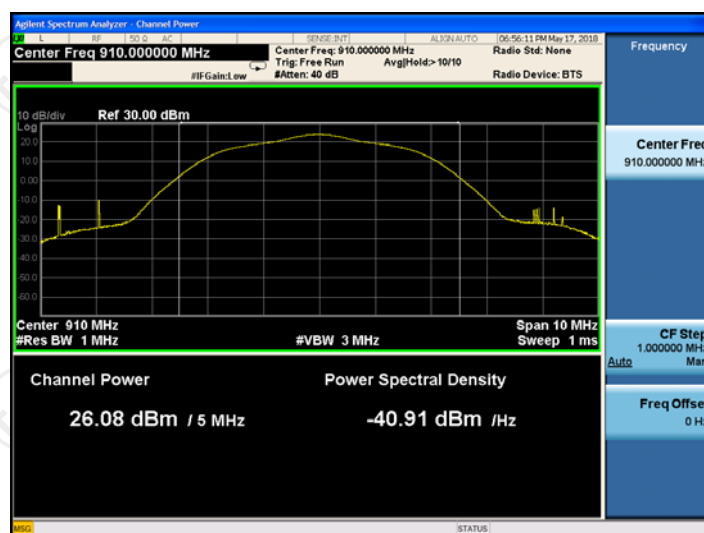
For OFDM			
Test channel	Maximum Conducted Output Power (dBm)	Limit (dBm)	Result
905MHz	29.10	30.00	PASS
910MHz	28.70	30.00	PASS
915MHz	28.01	30.00	PASS
920MHz	27.73	30.00	PASS

Test plots as follows:
For DSSS

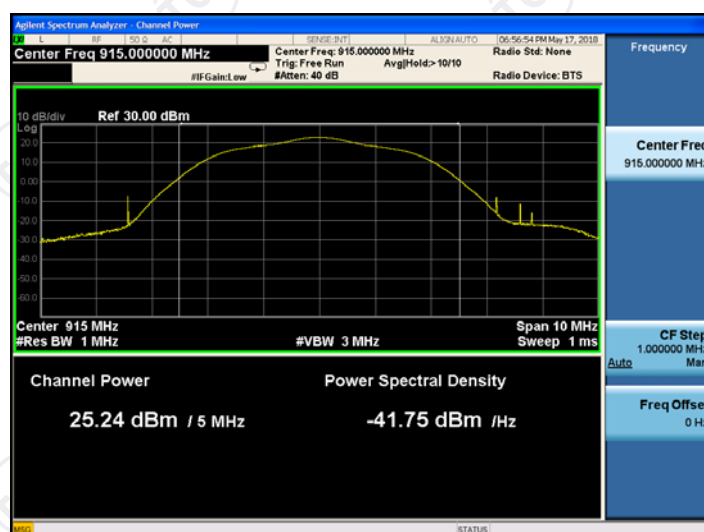
905MHz



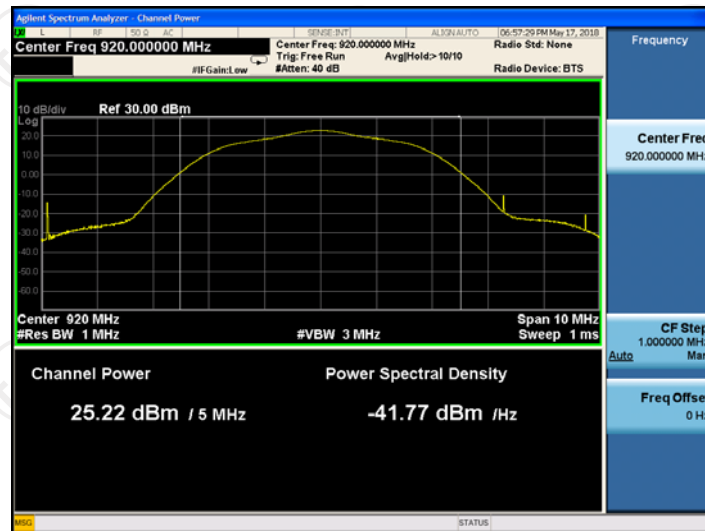
910MHz



915MHz

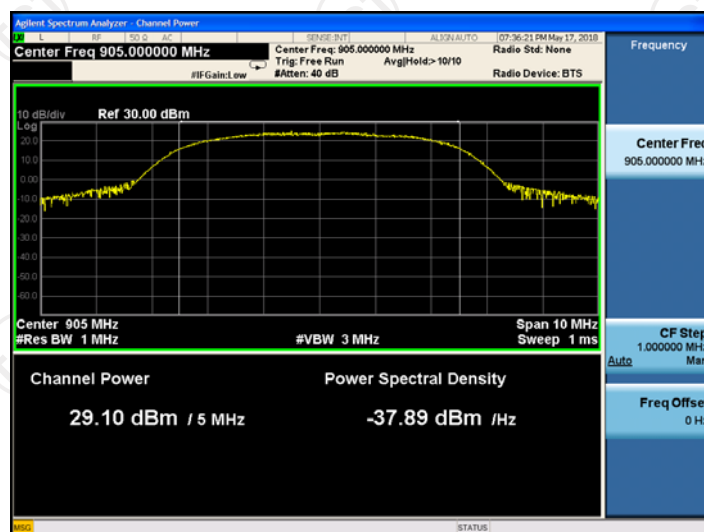


920MHz

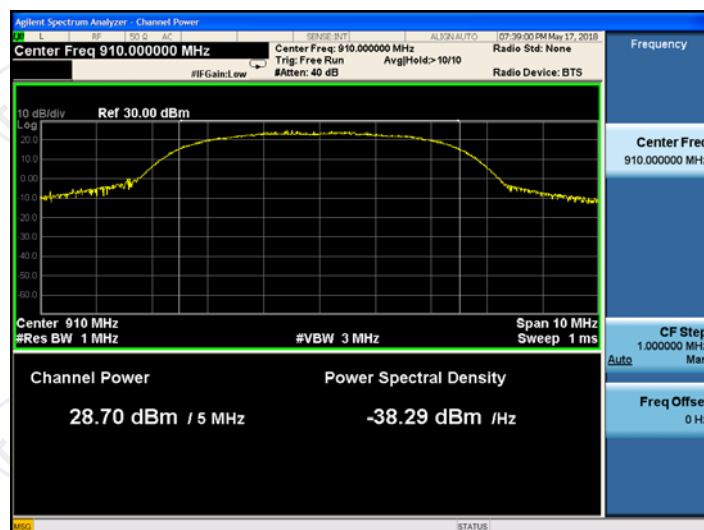


For OFDM

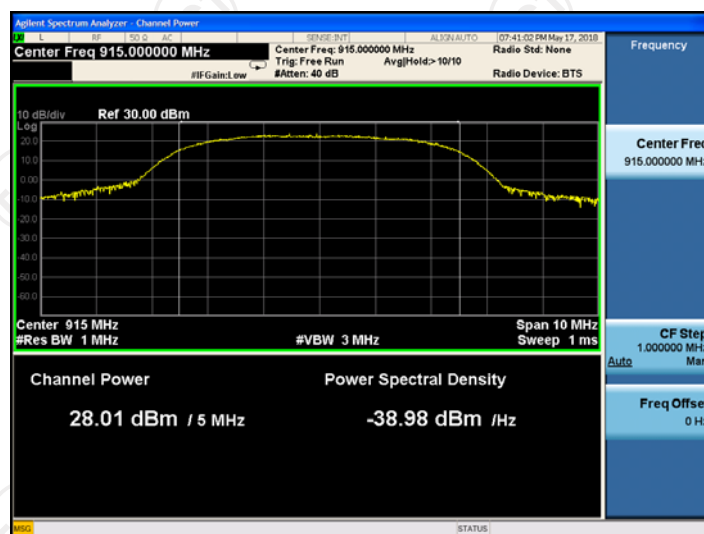
905MHz



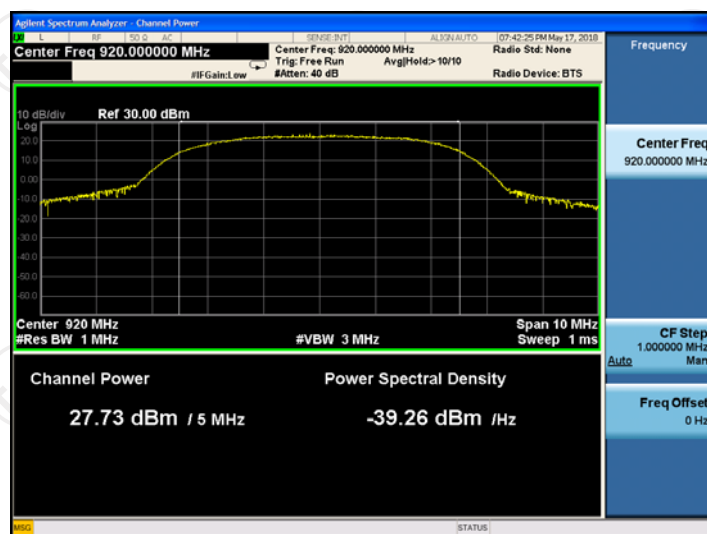
910MHz



915MHz



920MHz



6.4. Emission Bandwidth

6.4.1. Test Specification

Test Requirement:	RSS-GEN, 6.6; RSS-247, 5.2(a) FCC Part15 C Section 15.247 (a)(2)
Test Method:	KDB 558074
Limit:	>500kHz
Test Setup:	 Spectrum Analyzer EUT
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows FCC KDB Publication No. 558074 DTS D01 Meas. Guidance v04. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6dB bandwidth must be greater than 500 kHz. 4. Measure and record the results in the test report.
Test Result:	PASS

6.4.2. Test Instruments

RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100060	Sep. 27, 2018
RF Cable (9KHz-26.5GHz)	TCT	RE-06	N/A	Sep. 27, 2018
Antenna Connector	TCT	RFC-01	N/A	Sep. 27, 2018

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.4.3. Test data

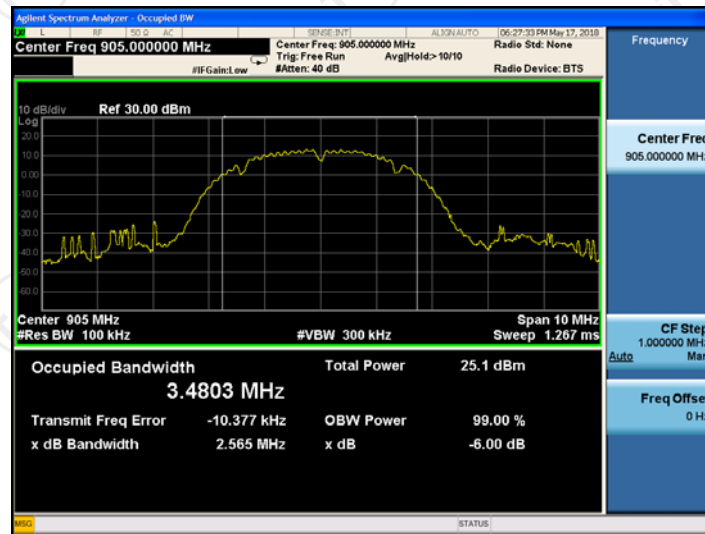
Test channel	6dB Emission Bandwidth (MHz)	
	For DSSS	For OFDM
905MHz	2.565	4.278
910MHz	2.562	4.188
915MHz	2.564	4.264
920MHz	2.555	4.182
Limit:	>500k	
Test Result:	PASS	

Test channel	99% Emission Bandwidth (MHz)	
	For DSSS	For OFDM
905MHz	3.480	4.410
910MHz	3.458	4.410
915MHz	3.487	4.406
920MHz	3.435	4.390
Limit:	>500k	
Test Result:	PASS	

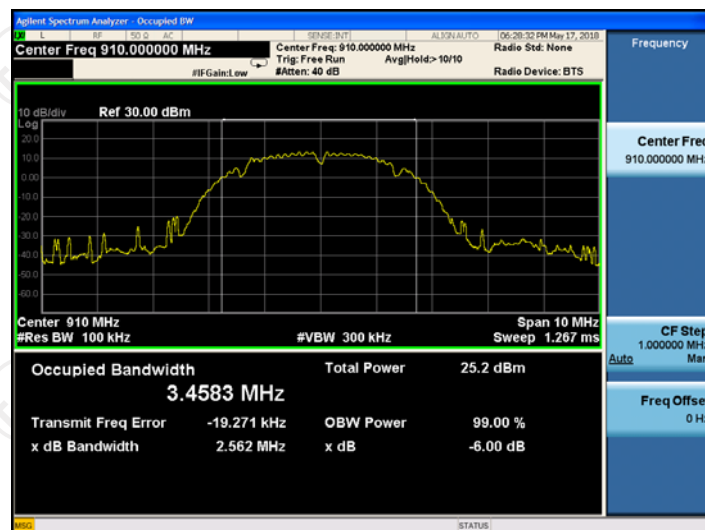
Test plots as follows:

99%& 6dB Emission Bandwidth:
For DSSS

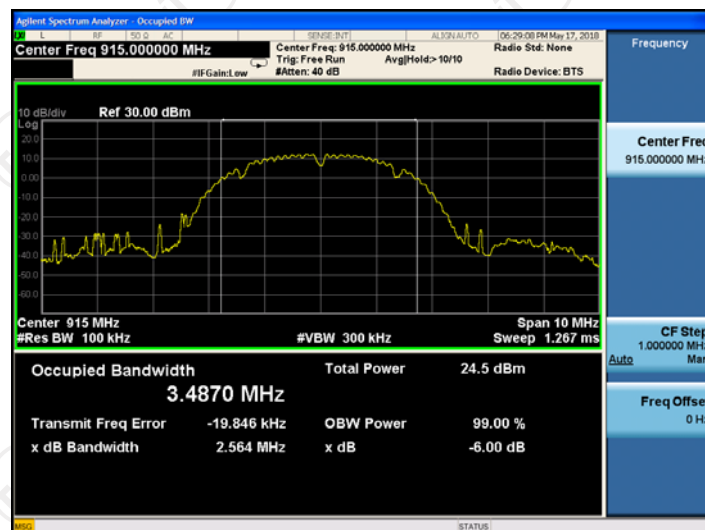
905MHz



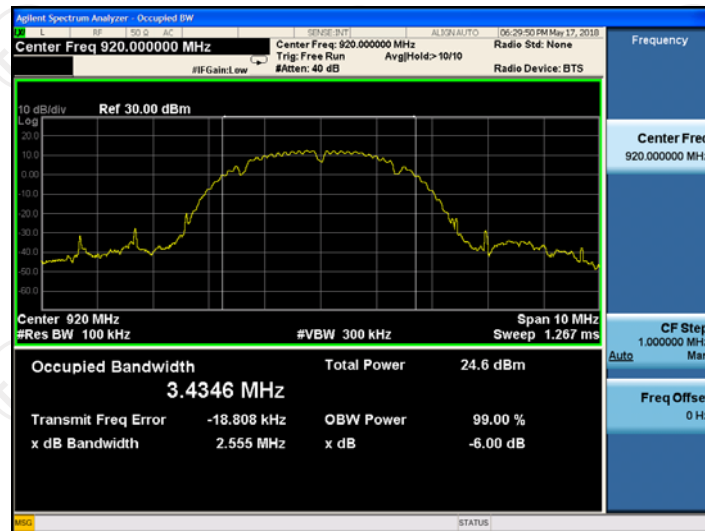
910MHz



915MHz

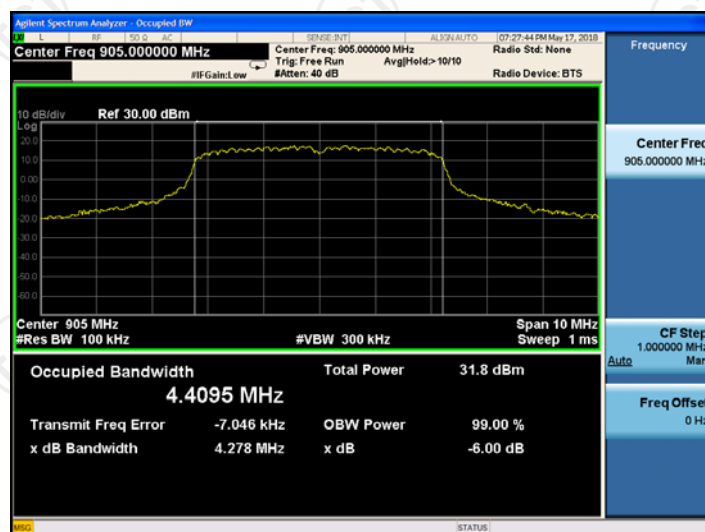


920MHz

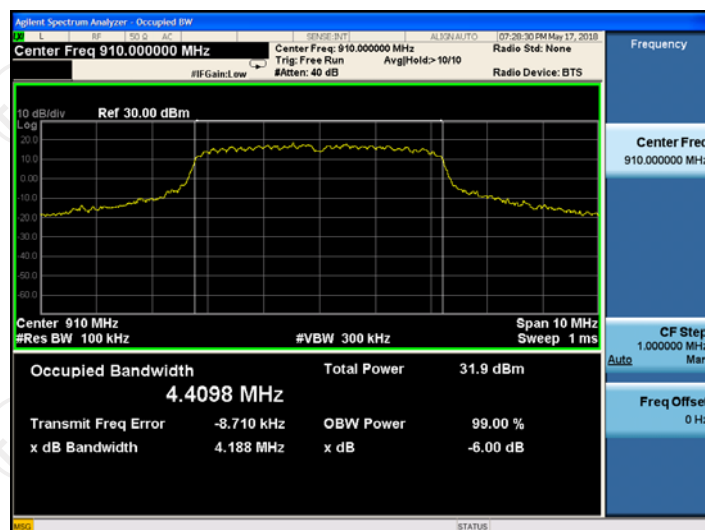


For OFDM

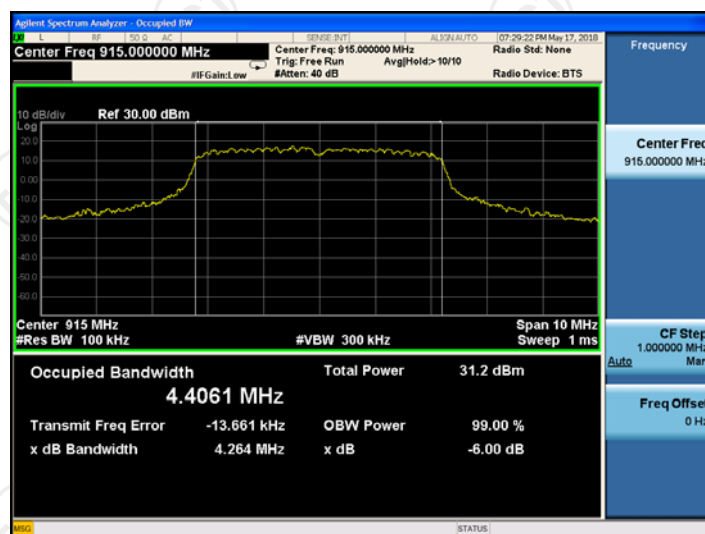
905MHz



910MHz



915MHz



920MHz



6.5. Power Spectral Density

6.5.1. Test Specification

Test Requirement:	RSS-247, 5.2(b) FCC Part15 C Section 15.247 (e)
Test Method:	KDB 558074
Limit:	The average power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.
Test Setup:	 Spectrum Analyzer EUT
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows Measurement Procedure 10.3 Method AVGPSP of FCC KDB Publication No.558074 D01 DTS Meas. Guidance v04 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. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW): $3\text{ kHz} \leq \text{RBW} \leq 100\text{ kHz}$. Video bandwidth VBW $\geq 3 \times \text{RBW}$. Set the span to at least 1.5 times the OBW. 5. Detector = RMS, Sweep time = auto couple. 6. Employ trace averaging (RMS) mode over a minimum of 100 traces. Use the peak marker function to determine the maximum power level. 6. Measure and record the results in the test report.
Test Result:	PASS

6.5.2. Test Instruments

RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100060	Sep. 27, 2018
RF Cable (9KHz-26.5GHz)	TCT	RE-06	N/A	Sep. 27, 2018
Antenna Connector	TCT	RFC-01	N/A	Sep. 27, 2018

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to

international system unit (SI).

6.5.3. Test data

Test channel	AVG Power Spectral Density (dBm/3kHz)	
	For DSSS	For OFDM
905MHz	2.997	-3.801
910MHz	2.367	-2.883
915MHz	2.724	-4.504
920MHz	3.393	-3.653
Limit:	8dBm/3kHz	
Test Result:	PASS	

Test plots as follows:

For DSSS

905MHz



910MHz



915MHz

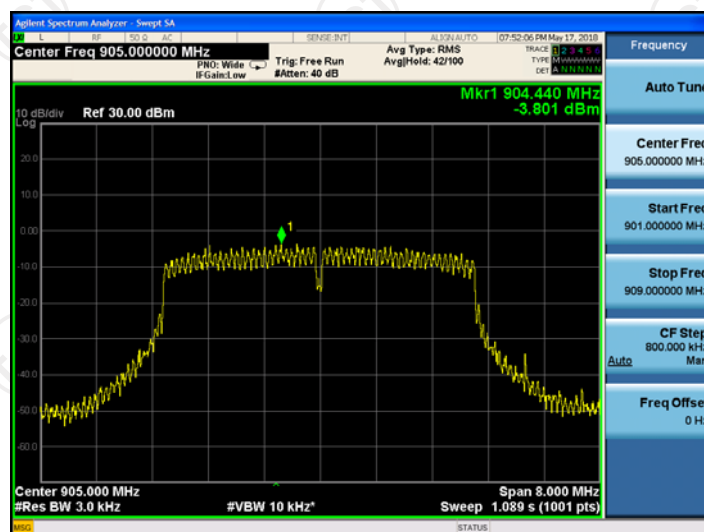


920MHz

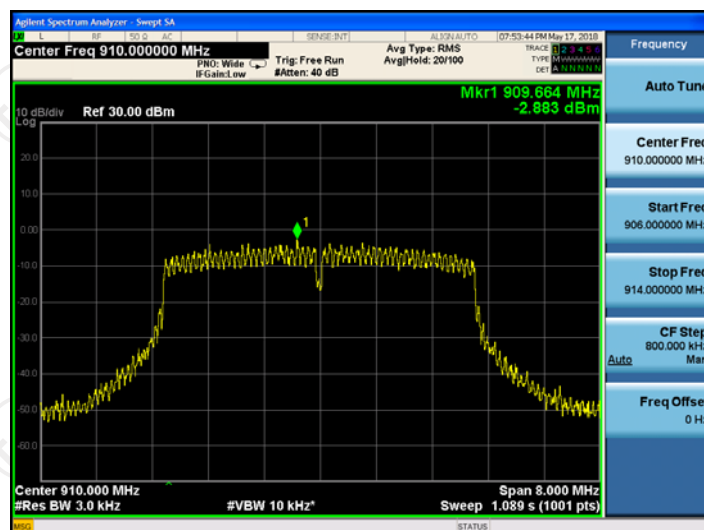


For OFDM

905MHz



910MHz



915MHz

