

RF Test Report

Applicant : Mako Networks
Product Type : 11ax 2x2 WiFi AP with LTE connectivity
Trade Name : Mako Networks
Model Number : 5600, 5600-5G
Applicable Standard : FCC 47 CFR PART 22H
FCC 47 CFR PART 24E
FCC 47 CFR PART 27
ANSI C63.26 2015
Received Date : May 17, 2021
Test Period : Jun. 03 ~ Jul. 30, 2021
Issued Date : Aug. 20, 2021

Issued by

A Test Lab Techno Corp.
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Taiwan Accreditation Eoundation accreditation number: 1330

Frequency Range : 9 kHz to 40 GHz

Test Firm MRA designation number: TW0010

Note:

- 1.The test results are valid only for samples provided by customers and under the test conditions described in this report.
- 2.This report shall not be reproduced except in full, without the written approval of A Test Lab Technology Corporation.
- 3.The relevant information is provided by customers in this test report. According to the correctness, appropriateness or completeness of the information provided by the customer, if there is any doubt or error in the information which affects the validity of the test results, the laboratory does not take the responsibility.



Revision History

Rev.	Issued Date	Revisions	Revised By
00	Aug. 20, 2021	Initial Issue	Tobey Cheng

Verification of Compliance

Applicant : Mako Networks
Product Type : 11ax 2x2 WiFi AP with LTE connectivity
Trade Name : Mako Networks
Model Number : 5600, 5600-5G
FCC ID : 2AVQL-5600
EUT Rated Voltage : DC 12 V, 5 A / DC 54 V, 1.11 A
Test Voltage : 120 Vac / 60 Hz
Applicable Standard : FCC 47 CFR PART 22H
FCC 47 CFR PART 24E
FCC 47 CFR PART 27
ANSI C63.26 2015
Test Result : Complied

Performing Lab. : A Test Lab Techno Corp.
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Taiwan Accreditation Foundation accreditation number: 1330
<http://www.atl-lab.com.tw/e-index.htm>



A Test Lab Techno Corp. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by A Test Lab Techno Corp. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Approved By : Ken Yang
(Manager) (Ken Yang)



TABLE OF CONTENTS

1	General Information	5
1.1.	EUT Description.....	5
1.2.	Mode of Operation	7
1.3.	EUT Test Step.....	12
1.4.	Configuration of Test System Details	12
1.5.	Test Instruments	13
1.6.	Test Site Environment.....	13
1.7.	Measurement Uncertainty	13
1.8.	Summary of Test Result.....	14
2	Measurement Procedure.....	15
2.1.	Radiated Emission Test	15
3	Test Results.....	17
	Radiated Emission	17



1 General Information

1.1. EUT Description

Applicant	Mako Networks 1355 N. McLean Blvd, Elgin, Illinois 60123, United States		
Manufacturer	Mako Networks 1355 N. McLean Blvd, Elgin, Illinois 60123, United States		
Product Type	11ax 2x2 WiFi AP with LTE connectivity		
Trade Name	Mako Networks		
Model Number	5600, 5600-5G		
Difference description of model number	All models are electrically identical, different model names are for marketing purpose.		
FCC ID	2AVQL-5600		
Operate Band	Frequency Range (MHz)	Modulation	Channel Bandwidth
NR Band 2	UL: 1850 ~ 1910	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	5 MHz, 10 MHz, 15 MHz, 20 MHz
	DL: 1930 ~ 1990	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	
NR Band 5	UL: 824 ~ 849	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	5 MHz, 10 MHz, 15 MHz, 20 MHz
	DL: 869 ~ 894	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	
NR Band 7	UL: 2500 ~ 2570	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	5 MHz, 10 MHz, 15 MHz, 20 MHz
	DL: 2620 ~ 2690	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	
NR Band 12	UL: 699 ~ 716	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	5 MHz, 10 MHz, 15 MHz
	DL: 728 ~ 746	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	
NR Band 25	UL: 1850 ~ 1915	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	5 MHz, 10 MHz, 15 MHz, 20 MHz
	DL: 1930 ~ 1995	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	
NR Band 66	UL: 1710 ~ 1780	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	5 MHz, 10 MHz, 15 MHz, 20 MHz
	DL: 2110 ~ 2200	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	
NR Band 71	UL: 663 ~ 698	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	5 MHz, 10 MHz, 15 MHz, 20 MHz
	DL: 617 ~ 652	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	
NR Band 41	UL/DL: 2496 ~ 2690	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	20 MHz, 30 MHz, 40 MHz, 50 MHz, 60MHz, 80 MHz, 100MHz
NR Band 77	UL/DL: 3700 ~ 3980	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	100 MHz
EN-DC Band	DC_5A_n2A, DC_12A_n2, DC_13A_n2A, DC_2A_n5A DC_30A_n5A, DC_66A_n5A, DC_5A_n7A, DC_12A_n7A DC_2A_n12A, DC_12A_n25A, DC_2A_n41A, DC_25A_n41A DC_26A_n41A, DC_66A_n41A, DC_5A_n66A, DC_12A_n66A DC_13A_n66A, DC_14A_n66A, DC_71A_n66A, DC_2A_n71A DC_7A_n71A, DC_66A_n71A		
HPUE Band	n41, n77		
SCS for NR cell :	FDD Band : 15 kHz ; TDD Band : 30 kHz		



Operate Temp. Range	0 ~ 40 °C
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Antenna list:

NR Band	Trade Name: Grand-Tek			
	Type: Dipole Antenna			
	ANT-0	ANT-1	ANT-2	ANT-3
	Model Number: 7102A0482000	Model Number: 7102A0483000	Model Number: 7102A0484000	Model Number: 7102A0488000
	Max. Gain (dBi)			
NR Band 2	-0.4	---	---	---
NR Band 5	---	-1	---	---
NR Band 7	-0.9	---	---	---
NR Band 12	---	-0.3	---	---
NR Band 25	-0.4	---	---	---
NR Band 41	0.7	---	---	---
NR Band 66	-1.5	---	---	---
NR Band 71	---	-0.3	---	---
NR Band 77	---	---	-4.2	---

1.2. Mode of Operation

In the test report use EUT model: 5600-5G to operate testing.

Three channels had been tested for each channel bandwidth.

NR Band 2				
Channel Bandwidth	5 MHz		10 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	370500	1852.5	371000	1855
Middle CH	376000	1880	376000	1880
High CH	381500	1907.5	381000	1905
Channel Bandwidth	15 MHz		20 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	371500	1857.5	372000	1860
Middle CH	376000	1880	376000	1880
High CH	380500	1902.5	380000	1900

NR Band 5				
Channel Bandwidth	5 MHz		10 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	165300	826.5	165800	829
Middle CH	167300	836.5	167300	836.5
High CH	169300	846.5	168800	844
Channel Bandwidth	15 MHz		20 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	166300	831.5	166800	834
Middle CH	167300	836.5	167300	836.5
High CH	168300	841.5	167800	839

Note: Regards to the frequency band operation: the lowest, middle and highest frequency of channel were selected to perform the test, then shown on this report.

NR Band 7				
Channel Bandwidth	5 MHz		10 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	500500	2502.5	501000	2505
Middle CH	507000	2535	507000	2535
High CH	513500	2567.5	513000	2565
Channel Bandwidth	15 MHz		20 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	501500	2507.5	502000	2510
Middle CH	507000	2535	507000	2535
High CH	512500	2562.5	512000	2560

NR Band 12				
Channel Bandwidth	5 MHz		10 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	140300	701.5	140800	704
Middle CH	141500	707.5	141500	707.5
High CH	142700	713.5	142200	711
Channel Bandwidth	15 MHz		---	
	Channel	Frequency (MHz)	---	---
Low CH	141300	706.5	---	---
Middle CH	141500	707.5	---	---
High CH	141700	708.5	---	---

Note: Regards to the frequency band operation: the lowest, middle and highest frequency of channel were selected to perform the test, then shown on this report.



NR Band 25				
Channel Bandwidth	5 MHz		10 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	370500	1852.5	371000	1855
Middle CH	376500	1882.5	376500	1882.5
High CH	382500	1912.5	382000	1910
Channel Bandwidth	15 MHz		20 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	371500	1857.5	372000	1860
Middle CH	376500	1882.5	376500	1882.5
High CH	381500	1907.5	381000	1905

NR Band 66				
Channel Bandwidth	5 MHz		10 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	342500	1712.5	343000	1715
Middle CH	349000	1745	349000	1745
High CH	355500	1777.5	355000	1775
Channel Bandwidth	15 MHz		20 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	343500	1717.5	344000	1720
Middle CH	349000	1745	349000	1745
High CH	354500	1772.5	354000	1770

Note: Regards to the frequency band operation: the lowest, middle and highest frequency of channel were selected to perform the test, then shown on this report.



NR Band 71				
Channel Bandwidth	5 MHz		10 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	133100	665.5	133600	668
Middle CH	136100	680.5	136100	680.5
High CH	139100	695.5	138600	693
Channel Bandwidth	15 MHz		20 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	134100	670.5	134600	673
Middle CH	136100	680.5	136100	680.5
High CH	138100	690.5	137600	688

Note: Regards to the frequency band operation: the lowest, middle and highest frequency of channel were selected to perform the test, then shown on this report.



NR Band 41				
Channel Bandwidth	20 MHz		30 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	591204	2506.02	502200	2511
Middle CH	518958	2592.99	518958	2592.99
High CH	535998	2679.99	534996	2674.98
Channel Bandwidth	40 MHz		50 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	503202	2516.01	504204	2521.02
Middle CH	518958	2592.99	518958	2592.99
High CH	534000	2670	532998	2664.99
Channel Bandwidth	60 MHz		80 MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
Low CH	505200	2526	507204	2536.02
Middle CH	518958	2592.99	518958	2592.99
High CH	531996	2659.98	529998	2649.99
Channel Bandwidth	100 MHz		---	
	Channel	Frequency (MHz)	---	---
Low CH	509202	2546.01	---	---
Middle CH	518958	2592.99	---	---
High CH	528000	2640	---	---

NR Band 77				
Channel Bandwidth	100 MHz		---	
	Channel	Frequency (MHz)	---	---
Low CH	623334	3350.01	---	---
Middle CH	650000	3750	---	---
High CH	676666	4149.99	---	---

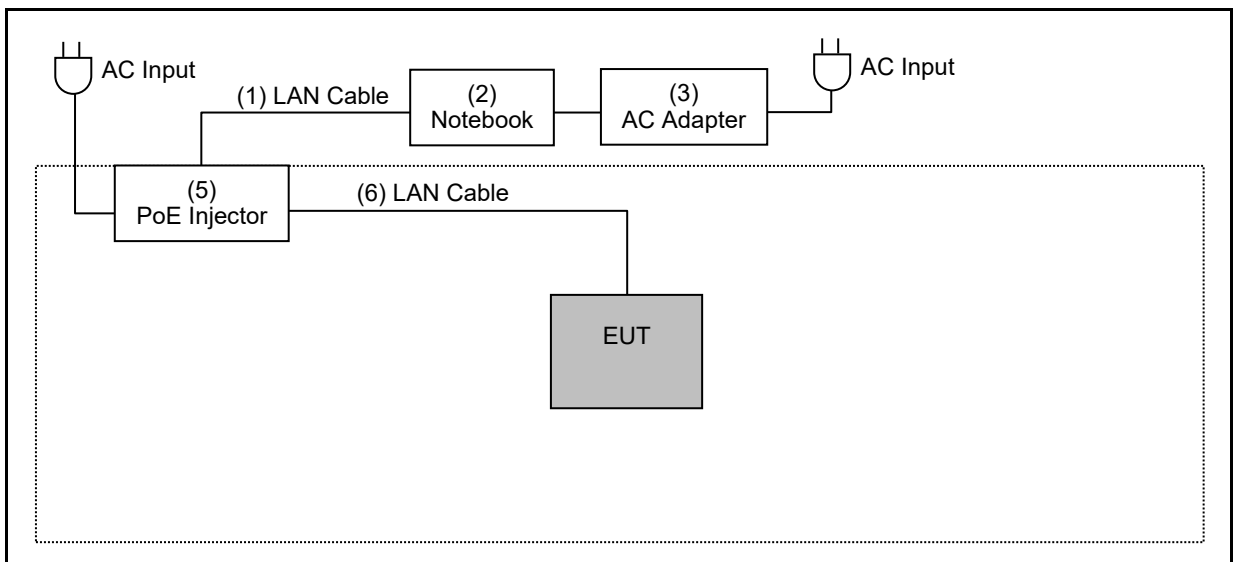
Note: Regards to the frequency band operation: the lowest, middle and highest frequency of channel were selected to perform the test, then shown on this report.

1.3. EUT Test Step

1	Setup the EUT by "Configuration of Test System Details" shown below.
2	Turn on the power of all equipment.
3	The EUT was programmed to be in continuously transmitting mode.
4	The EUT get into the test mode to provide data rate, channel, bandwidth and power level.

Measurement Software			
No.	Description	Software	Version
1	Radiated Emission	EZ EMC	1.1.4.4

1.4. Configuration of Test System Details



Devices Description					
	Product	Manufacturer	Model Number	Serial Number	Power Cord
(1)	LAN Cable	Tatung	CAT5E	---	---
(2)	Notebook	acer	N19C1	---	---
(3)	AC Adapter	acer	A18-045N2A	---	---
(4)	AC Adapter	Sunny	SYS1649-6012-T2	---	---
(5)	PoE Injector	EnGenius	PNA60BGS-54	---	---
(6)	LAN Cable	Tatung	CAT5E	---	---

Note : The device used (4) AC Adapter and (5) PoE Injector to evaluation, (5) PoE Injector is worst case to perform testing.



1.5. Test Instruments

For Spurious Radiation

Test Period: Jun. 03 ~ Jul. 30, 2021

Testing Engineer: Pink Li, Ida Chuang

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
UXM 5G Wireless Test Platform	Keysight	E7515B	MY59321574	12/04/2019	2 year
Spectrum Analyzer (2 Hz~50 GHz)	Keysight	N9030B	MY57143537	04/19/2021	1 year
Pre Amplifier (1~26.5 GHz)	Titan	T0912E01263025A1F	002	07/23/2020	1 year
				07/26/2021	
Pre Amplifier (1~26.5 GHz)	Agilent	8449B	3008A02237	10/21/2020	1 year
Horn Antenna (1~18 GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA9120D	02207	06/30/2020	1 year
				07/09/2021	
Horn Antenna (18~40 GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA9170	9170-320	08/17/2020	1 year
Loop Antenna	COM-POWER CORPORATION	AL-130	121014	04/06/2021	1 year
Coaxial Cable	Titan	T0710AT327A10A100	J11005	08/13/2020	1 year
Coaxial Cable	Titan	T0710AT327A10A900	J11004	08/13/2020	1 year

Note: N.C.R. = No Calibration Request.

1.6. Test Site Environment

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	20-30
Humidity (%RH)	25-75	45-75

1.7. Measurement Uncertainty

Parameter	Uncertainty
Radiated Emission	5.1 dB



1.8. Summary of Test Result

FCC Rule	Description	Result
§2.1046	Conducted Output Average Power	N/A (Note 1)
§22.913 §24.232 §27.50	Equivalent Isotropic Radiated Power / Equivalent Radiated Power	N/A (Note 1)
§2.1055 §22.355 §24.235 §27.54	Frequency Stability	N/A (Note 1)
§2.1049	Emission Bandwidth & Occupied Bandwidth	N/A (Note 1)
§24.232 §27.50	Peak to average ratio	N/A (Note 1)
§2.1051 §22.917 §24.238 §27.53	Band Edge	N/A (Note 1)
§2.1051 §22.917 §24.238 §27.53	Conducted Spurious Emissions	N/A (Note 1)
§2.1053 §22.917 §24.238 §27.53	Radiated Spurious Emissions	Pass (Note 2)

Note 1 : C2PC No need for verification, test results could be referred to RF module RM502Q-AE report (2010RSU005-U6).

Note 2 : Only verify the worst channel Spurious Radiation.

Decision Rule

- Uncertainty is not included.
- Uncertainty is included.

2 Measurement Procedure

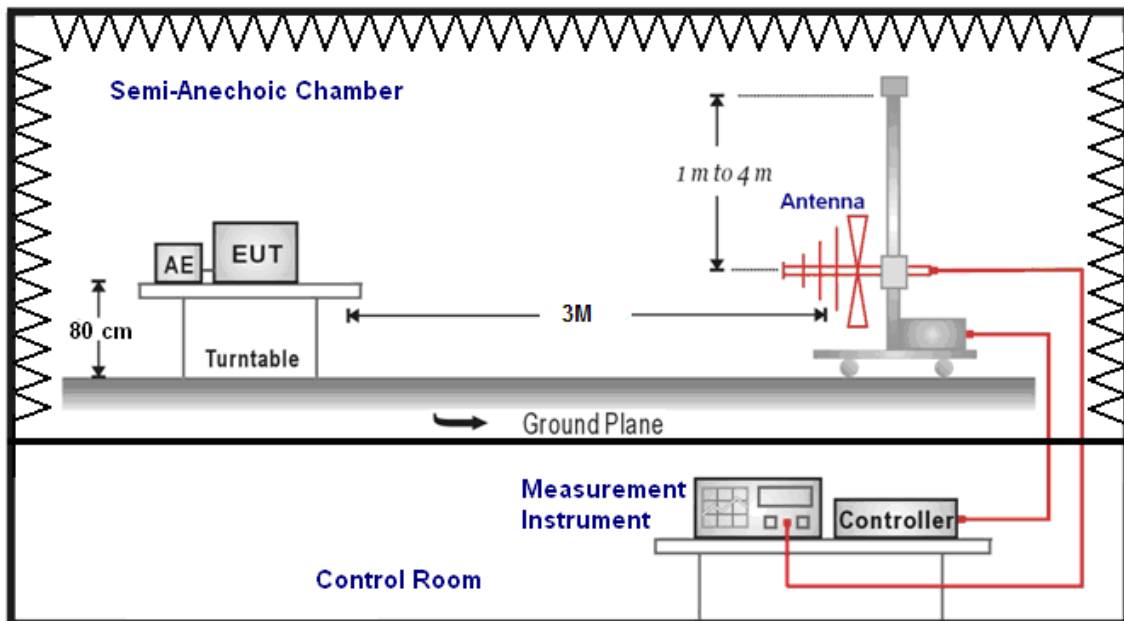
2.1. Radiated Emission Test

■ Limit

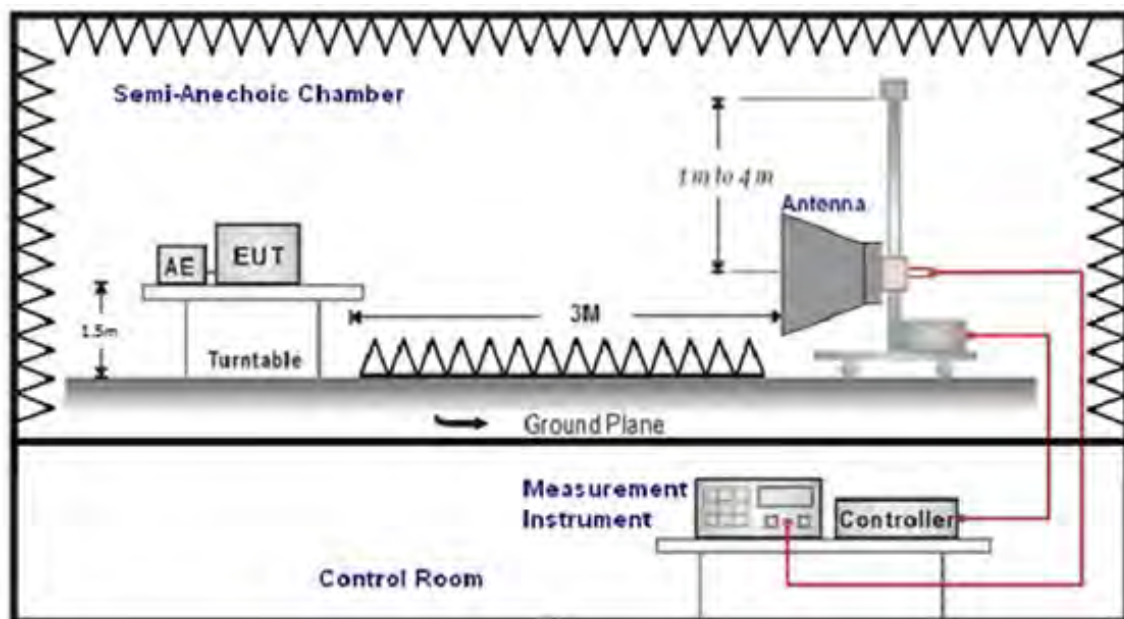
The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least $43 + 10 \log_{10}(P)$ dB. The limit of emission equal to -13 dBm

■ Setup

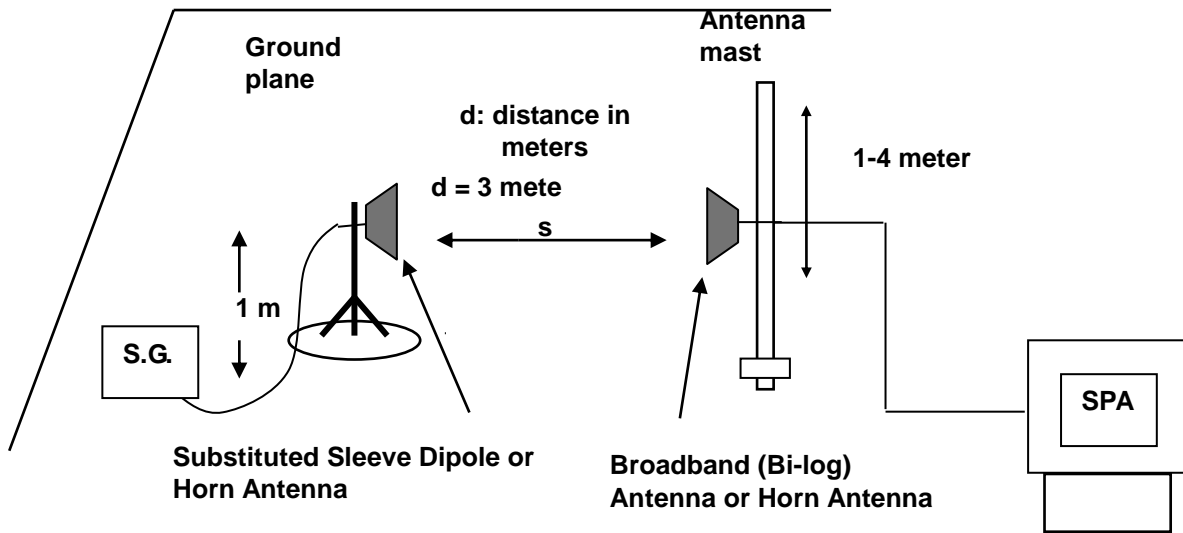
Below 1 GHz



Above 1 GHz



For Substituted Method Test Set-UP



■ Test Procedure

- a. The EUT was set up for the maximum power with wwan link data modulation. The power was measured with Spectrum Analyzer. All measurements were done at 3 channels (low, middle and high operational frequency range).
- b. Radiation Emission measurement. In the semi-anechoic chamber, EUT placed on the 0.8 m (1.5 m for above 1 GHz) height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1 m to 4 m to find the maximum polar radiated power. The "Read Value" is the spectrum reading the maximum power value.
- c. The substitution antenna (Note:1 & 2) is substituted for EUT at the same position and signals generator export the CW signal to the substitution antenna via a TX cable. Rotated the Turn Table and moved receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a Value of spectrum reading equal to "Read Value" of step a. Record the power level of S.G.
- d. E.I.R.P. = Output power level of S.G - TX cable loss + Antenna gain of substitution horn
- e. E.R.P. = E.I.R.P- 2.15 dB
- f. Measurement range 9 kHz - 10 th Harmonic

Note: 1. Below 1 GHz Substituted Method Test : Sleeve dipole antenna to Bi-Log Antenna

2. Above 1 GHz Substituted Method Test : Horn antenna to Horn Antenn



3 Test Results

Radiated Emission

Standard:	FCC Part 22H/24E/27	Test Distance:	3 m
Test item:	Harmonic		
Mode:	Simultaneous Transmitting		
Ant.Polar.:	Horizontal		
Description:	NR B41 + WLAN 2.4 GHz + 5 GHz		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2724.000	41.45	-6.35	35.10	70.30	-35.20	peak
2	4723.000	40.48	-1.53	38.95	70.30	-31.35	peak
3	7290.000	37.00	6.03	43.03	70.30	-27.27	peak

Standard:	FCC Part 22H/24E/27	Test Distance:	3 m
Test item:	Harmonic		
Mode:	Simultaneous Transmitting		
Ant.Polar.:	Vertical		
Description:	NR B41 + WLAN 2.4 GHz + 5 GHz		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2769.000	41.89	-6.18	35.71	70.30	-34.59	peak
2	4774.000	39.59	-1.40	38.19	70.30	-32.11	peak
3	7511.000	37.79	6.79	44.58	70.30	-25.72	peak



Standard:	FCC Part 22H/24E/27	Test Distance:	3 m
Test item:	Harmonic		
Mode:	Simultaneous Transmitting		
Ant.Polar.:	Horizontal		
Description:	NR B66 + WLAN 2.4 GHz + 5 GHz		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2754.000	41.72	-6.24	35.48	82.30	-46.82	peak
2	4774.000	39.80	-1.40	38.40	82.30	-43.90	peak
3	7324.000	37.56	6.16	43.72	82.30	-38.58	peak

Standard:	FCC Part 22H/24E/27	Test Distance:	3 m
Test item:	Harmonic		
Mode:	Simultaneous Transmitting		
Ant.Polar.:	Vertical		
Description:	NR B66 + WLAN 2.4 GHz + 5 GHz		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2792.000	41.96	-6.08	35.88	82.30	-46.42	peak
2	4723.000	40.71	-1.53	39.18	82.30	-43.12	peak
3	7477.000	36.85	6.70	43.55	82.30	-38.75	peak



Standard:	FCC Part 22H/24E/27	Test Distance:	3 m
Test item:	Harmonic		
Mode:	Simultaneous Transmitting		
Ant.Polar.:	Horizontal		
Description:	NR B71 + WLAN 2.4 GHz + 5 GHz		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2743.000	42.08	-6.29	35.79	82.30	-46.51	peak
2	4842.000	40.04	-1.20	38.84	82.30	-43.46	peak
3	7290.000	37.45	6.03	43.48	82.30	-38.82	peak

Standard:	FCC Part 22H/24E/27	Test Distance:	3 m
Test item:	Harmonic		
Mode:	Simultaneous Transmitting		
Ant.Polar.:	Vertical		
Description:	NR B71 + WLAN 2.4 GHz + 5 GHz		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2732.000	42.09	-6.33	35.76	82.30	-46.54	peak
2	4689.000	40.18	-1.63	38.55	82.30	-43.75	peak
3	7528.000	37.16	6.81	43.97	82.30	-38.33	peak

---END---