RF Test Report

Applicant	:	Mako Networks
Product Type	:	11ax 2x2 WiFi AP with LTE connectivity
Trade Name	:	Mako Networks
Model Number	:	5600, 5600-LTE US
Applicable Standard	:	FCC 47 CFR PART 22H FCC 47 CFR PART 24E FCC 47 CFR PART 27L 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.
No. 140-1, Changan Street, Bade District,
Taoyuan City 33465, Taiwan (R.O.C.)
Tel：+886-3-2710188 / Fax：+886-3-2710190

Taiwan Accreditation Foundation 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-LTE US
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 27L ANSI C63.26 2015
Test Result	:	Complied
Performing Lab.	:	A Test Lab Techno Corp. No. 140-1, Changan Street, Bade District, Taoyuan City 33465, Taiwan (R.O.C.) Tel：+886-3-2710188 / Fax：+886-3-2710190 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)

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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-LTE US			
Difference description of model number	All models are electrically identical, different model names are for marketing purpose.			
FCC ID	2AVQL-5600			
Mode	Band	UL Frequency (MHz)	DL Frequency (MHz)	Modulation
WCDMA(RMC12.2K)/ HSDPA/ HSUPA	II	1852.4 ~ 1907.6	1932.4 ~ 1987.6	QPSK, BPSK
	V	826.4 ~ 846.6	871.4 ~ 891.6	QPSK, BPSK
	IV	1712.4 ~ 1752.6	2112.4 ~ 2152.6	QPSK, BPSK
Operate Temp. Range	0 ~ 40 °C			

Antenna list:

WCDMA Band	Trade Name: Grand-Tek	
	Type: Dipole Antenna	
	Model Number: 7102A0481000	
	ANT-0	ANT-1
	Max. Gain (dBi)	
Band II	2	---
Band V	-0.2	---
Band IV	0.8	---

1.2. Mode of Operation

In the test report use EUT model: 5600-LTE US to operate testing.

ATL has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
WCDMA Band II Link Mode
WCDMA Band V Link Mode
WCDMA Band IV Link Mode

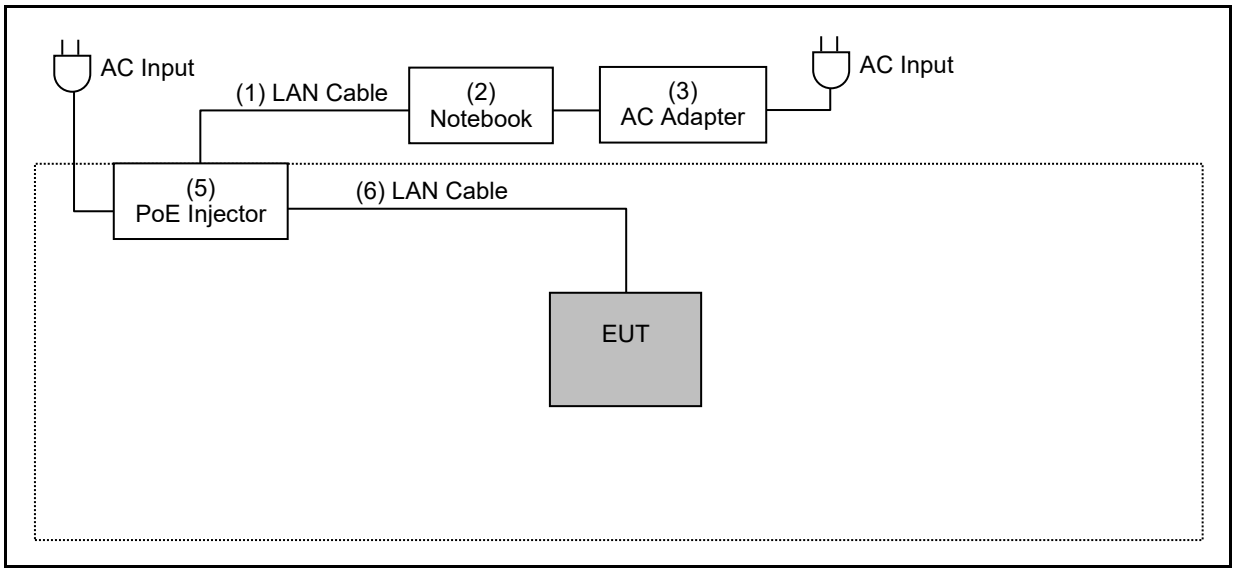
Note: Regards to the frequency band operation: the lowest, middle and highest frequency of channel were selected to perform the test, then shown on this report.

1.3. EUT Test Step

1	Setup the EUT shown on “Configuration of Test System Details”.
2	Turn on the power of all equipment.

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 Radiated Emissions
Test Period: Jun. 03 ~ Jul. 30, 2021
Testing Engineer: Pink Li, Ida Chuang

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
Universal Radio Communication Tester (824MHz~2170MHz)	R&S	CMU200	109369	11/29/2020	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
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 07/09/2021	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 60068-1)	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 Power	N/A (Note 1)
§22.913(a)(5)	Effective Radiated Power	N/A (Note 1)
§24.232(c) §27. 50(d)(4)	Equivalent Isotropic Radiated Power	N/A (Note 1)
§24.232(d) §27.50 KDB 971168 D01 (5.7.1)	Peak to average ratio	N/A (Note 1)
§2.1049 §22.917(a) §24.238(a) §27.53(g)	Emission Bandwidth & Occupied Bandwidth	N/A (Note 1)
§2.1051 §22.917(a) §24.238(a) §27.53(h)	Band Edge Measurement	N/A (Note 1)
§2.1051 §22.917(a) §24.238(a) §27.53(h)	Conducted Spurious Emission	N/A (Note 1)
§2.1053 §22.917(a) §24.238(a) §27.53(h)	Field Strength of Spurious Radiation	Pass (Note 2)
§2.1055 §22.355 §24.235 §27. 54	Frequency Stability for Temperature & Voltage	N/A (Note 1)

Note 1：C2PC No need for verification, test results could be referred to RF module EM06-A report (HR/2019/3000101).

Note 2：Only verify the worst channel Spurious Radiation.

Decision Rule

■ Uncertainty is not included.

□ Uncertainty is included.

2 Measurement Procedure

2.1. Field Strength of Spurious Radiation Test

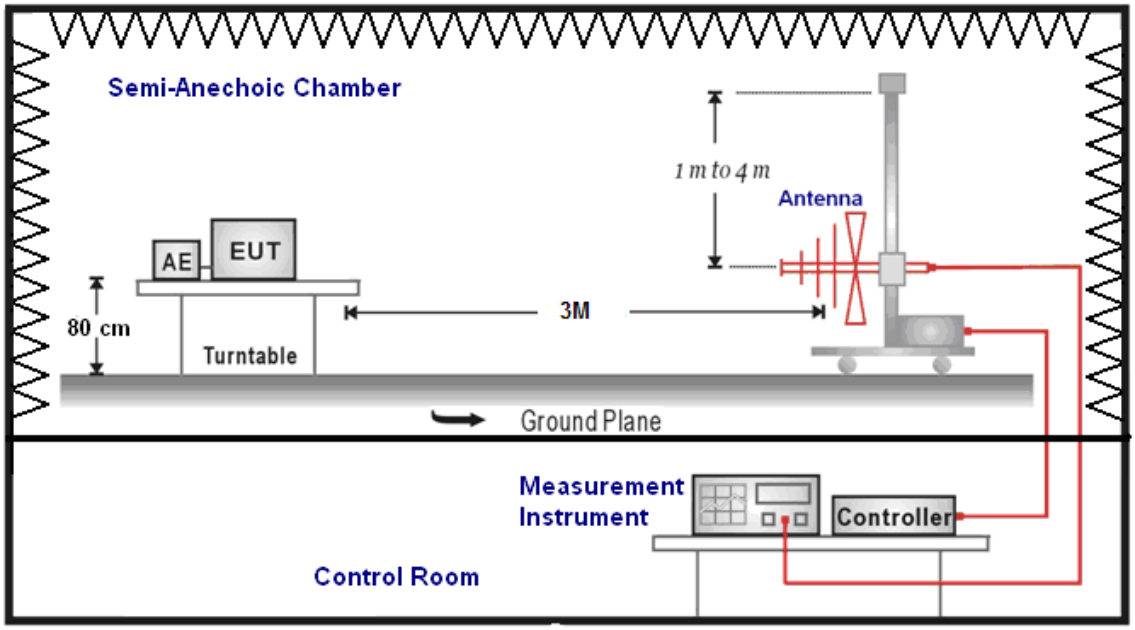
■ Limit

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

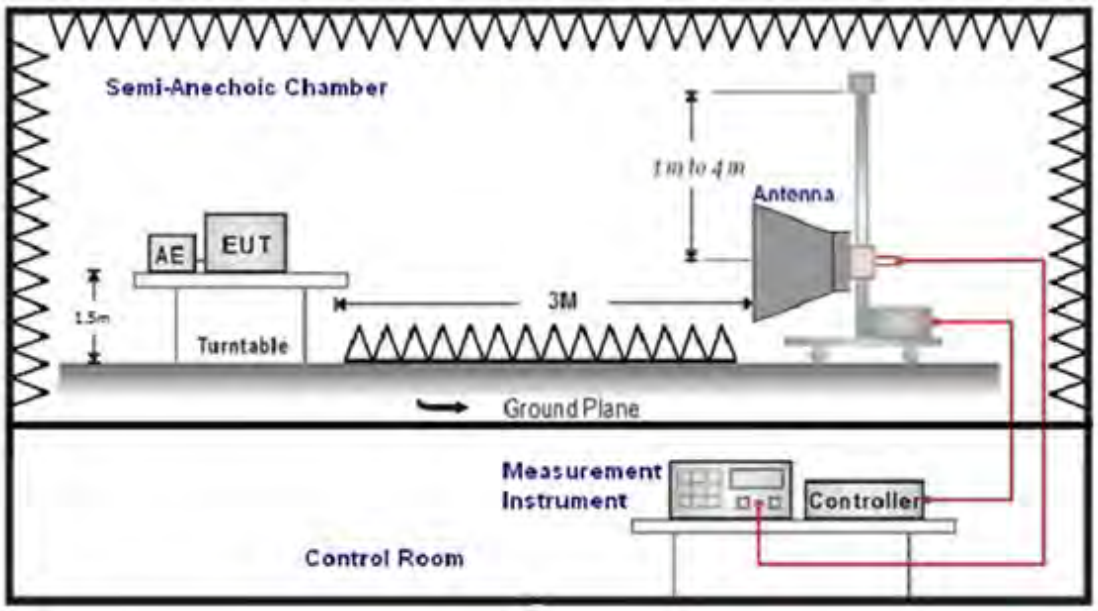
It is measured by means of a calibrated spectrum analyzer and scanned from 30 MHz up to a frequency including its 10th harmonic.

■ Setup

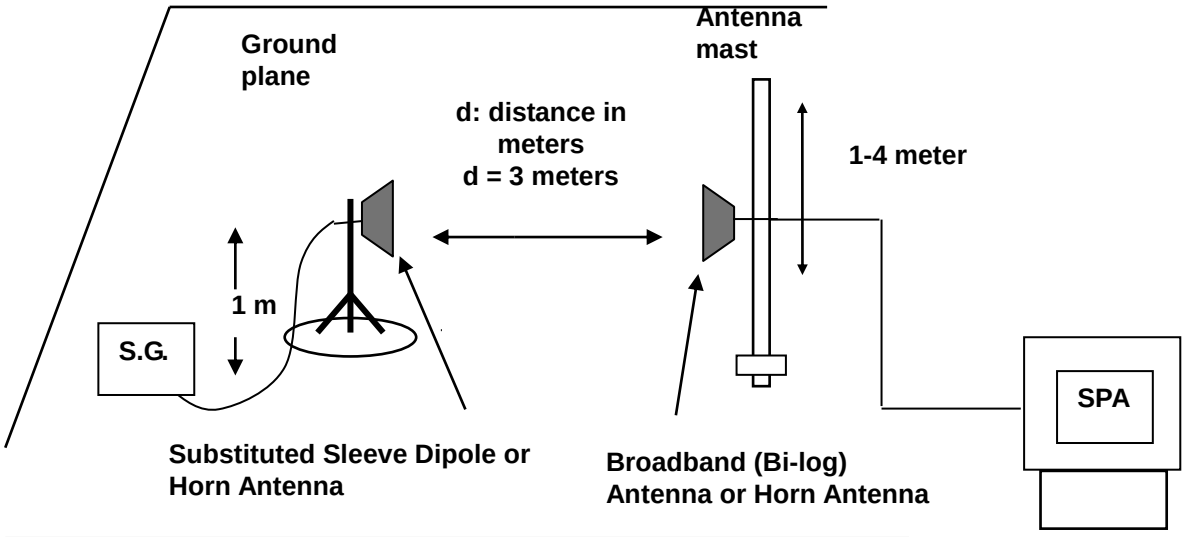
Below 1 GHz



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. E.I.R.P power 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 Antenna

3 Test Results

Appendix A: Field Strength of Spurious Radiation

Standard:	FCC Part 22H/24E/27	Test Distance:	3 m
Test item:	Harmonic		
Mode:	Simultaneous Transmitting		
Ant.Polar.:	Horizontal		
Description:	WCDMA B2 + WLAN 2.4 GHz + 5 GHz		

No.	Frequency (MHz)	Reading (dBm)	Correct Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	2188.000	-64.31	3.23	-61.08	-13.00	-48.08	peak
2	3484.000	-65.90	6.97	-58.93	-13.00	-45.93	peak
3	4768.000	-65.68	10.46	-55.22	-13.00	-42.22	peak

Standard:	FCC Part 22H/24E/27	Test Distance:	3 m
Test item:	Harmonic		
Mode:	Simultaneous Transmitting		
Ant.Polar.:	Vertical		
Description:	WCDMA B2 + WLAN 2.4 GHz + 5 GHz		

No.	Frequency (MHz)	Reading (dBm)	Correct Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	2224.000	-64.83	3.39	-61.44	-13.00	-48.44	peak
2	3292.000	-66.11	6.84	-59.27	-13.00	-46.27	peak
3	4624.000	-67.89	10.03	-57.86	-13.00	-44.86	peak

Standard:	FCC Part 22H/24E/27	Test Distance:	3 m
Test item:	Harmonic		
Mode:	Simultaneous Transmitting		
Ant.Polar.:	Horizontal		
Description:	WCDMA B4 + WLAN 2.4 GHz + 5 GHz		

No.	Frequency (MHz)	Reading (dBm)	Correct Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	2032.000	-64.22	2.57	-61.65	-13.00	-48.65	peak
2	2464.000	-64.42	4.38	-60.04	-13.00	-47.04	peak
3	3676.000	-66.75	7.48	-59.27	-13.00	-46.27	peak

Standard:	FCC Part 22H/24E/27	Test Distance:	3 m
Test item:	Harmonic		
Mode:	Simultaneous Transmitting		
Ant.Polar.:	Vertical		
Description:	WCDMA B4 + WLAN 2.4 GHz + 5 GHz		

No.	Frequency (MHz)	Reading (dBm)	Correct Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	2380.000	-63.83	4.03	-59.80	-13.00	-46.80	peak
2	3616.000	-64.93	7.31	-57.62	-13.00	-44.62	peak
3	5044.000	-67.28	11.23	-56.05	-13.00	-43.05	peak

Standard:	FCC Part 22H/24E/27	Test Distance:	3 m
Test item:	Harmonic		
Mode:	Simultaneous Transmitting		
Ant.Polar.:	Horizontal		
Description:	WCDMA B5 + WLAN 2.4 GHz + 5 GHz		

No.	Frequency (MHz)	Reading (dBm)	Correct Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	2416.000	-64.33	4.18	-60.15	-13.00	-47.15	peak
2	3664.000	-66.78	7.45	-59.33	-13.00	-46.33	peak
3	4852.000	-67.47	10.71	-56.76	-13.00	-43.76	peak

Standard:	FCC Part 22H/24E/27	Test Distance:	3 m
Test item:	Harmonic		
Mode:	Simultaneous Transmitting		
Ant.Polar.:	Vertical		
Description:	WCDMA B5 + WLAN 2.4 GHz + 5 GHz		

No.	Frequency (MHz)	Reading (dBm)	Correct Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	2356.000	-64.63	3.93	-60.70	-13.00	-47.70	peak
2	3292.000	-64.99	6.84	-58.15	-13.00	-45.15	peak
3	4540.000	-67.61	9.78	-57.83	-13.00	-44.83	peak

---END---