

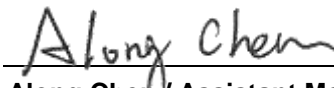
FCC Test Report

FCC ID : SQG-MT320
Equipment : WiFi 6 + Bluetooth 5.4 Module
Model No. : Sona MT320
Brand Name : Laird Connectivity
Applicant : Laird Connectivity LLC
Address : W66N220 Commerce Court, Cedarburg, WI
53012 United States Of America
Standard : 47 CFR FCC Part 15.407
Received Date : Sep. 25, 2023
Tested Date : Oct. 17 ~ Dec. 08, 2023

We, International Certification Corporation, would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:

Approved by:



Along Chen / Assistant Manager



Gary Chang / Manager

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Release Record

Report No.	Version	Description	Issued Date
FR392501AN	Rev. 01	Initial issue	Jan. 23, 2024
FR392501AN	Rev. 02	Product name changed	Feb. 08, 2024

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	AC Power Line Conducted Emissions	[dBuV]: 0.393MHz 33.19 (Margin -14.80dB) - AV	Pass
15.407(b) 15.209	Unwanted Emissions	[dBuV/m at 3m]: 17475.00MHz 60.67 (Margin -7.53dB) - PK	Pass
15.407(a)	Emission Bandwidth	Meet the requirement of limit	Pass
15.407(e)	6dB bandwidth	Meet the requirement of limit	Pass
15.407(a)	Conducted Output Power	Max Power [dBm]: Non-beamforming mode 5150~5250MHz: 20.26 5250~5350MHz: 20.21 5470~5725MHz: 22.56 5725~5850MHz: 22.78 Beamforming mode 5150~5250MHz: 17.07 5250~5350MHz: 17.20 5470~5725MHz: 19.55 5725~5850MHz: 19.77	Pass
15.407(a)	Power Spectral Density	Meet the requirement of limit	Pass
15.407(g)	Frequency Stability	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Information

1.1.1 Product Details

The two configurations of the EUT are shown on the following:

Brand Name	Model Name	Description
Laird Connectivity	Sona MT320	MT320-SC (MHF4 connector on module)
		MT320-ST (RF trace variant)

1.1.2 Specification of the Equipment under Test (EUT)

RF General Information					
Frequency Range (MHz)	IEEE Std. 802.11	Ch. Freq. (MHz)	Channel Number	Transmit Chains (N_{TX})	Data Rate / MCS
5150-5250 5250-5350 5470-5725 5725-5850	a	5180-5240 5260-5320 5500-5720 5745-5825	36-48 [4] 52-64 [4] 100-144 [12] 149-165 [5]	2	6-54 Mbps
5150-5250 5250-5350 5470-5725 5725-5850	n (HT20)	5180-5240 5260-5320 5500-5720 5745-5825	36-48 [4] 52-64 [4] 100-144 [12] 149-165 [5]	2	MCS 0-15
5150-5250 5250-5350 5470-5725 5725-5850	n (HT40)	5190-5230 5270-5310 5510-5710 5755-5795	38-46 [2] 54-62 [2] 102-142 [6] 151-159 [2]	2	MCS 0-15
5150-5250 5250-5350 5470-5725 5725-5850	ac (VHT20)	5180-5240 5260-5320 5500-5720 5745-5825	36-48 [4] 52-64 [4] 100-144 [12] 149-165 [5]	2	MCS 0-9
5150-5250 5250-5350 5470-5725 5725-5850	ac (VHT40)	5190-5230 5270-5310 5510-5710 5755-5795	38-46 [2] 54-62 [2] 102-142 [6] 151-159 [2]	2	MCS 0-9
5150-5250 5250-5350 5470-5725 5725-5850	ac (VHT80)	5210 5290 5530~5690 5775	42 [1] 58 [1] 106-138 [3] 155 [1]	2	MCS 0-9
5150-5250 5250-5350 5470-5725 5725-5850	ax (HE20)	5180-5240 5260-5320 5500-5720 5745-5825	36-48 [4] 52-64 [4] 100-144 [12] 149-165 [5]	2	MCS 0-11
5150-5250 5250-5350 5470-5725 5725-5850	ax (HE40)	5190-5230 5270-5310 5510-5710 5755-5795	38-46 [2] 54-62 [2] 102-142 [6] 151-159 [2]	2	MCS 0-11
5150-5250 5250-5350 5470-5725 5725-5850	ax (HE80)	5210 5290 5530~5690 5775	42 [1] 58 [1] 106-138 [3] 155 [1]	2	MCS 0-11

Note 1: OFDM/OFDMA- BPSK, QPSK, 16QAM, 64QAM, 256QAM and 1024QAM modulation.
Note 2: 802.11ac/an/ax supports beamforming function.
Note 3: 802.11ax supports full RU and partial RU configuration. Test results of full RU configuration are recorded in this report. Refers to report no.: FR392501-1AN for test results of partial RU configuration.

1.1.3 Antenna Details

Ant. No.	Manufacturer	Model	Part Number	Type	Connector	Gain (dBi)	
						2.4GHz	5GHz
1	Laird Connectivity	FlexMIMO 6E	EFD2471A3S-10 MH4L	PIFA	MHF4L	2.2	3.8
2	Laird Connectivity	FlexPIFA 6E	EFB2471A3S-10 MH4L	PIFA	MHF4L	2.2	3.9
3	Laird Connectivity	Mini NanoBlade Flex 6 GHz	EMF2471A3S-10 MH4L	PCB Dipole	MHF4L	2.4	4.4
4	Joymax Electronics	Dipole 6E	TWX-100BRS3B	Dipole	RP-SMA	2	4

1.1.4 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	3.3Vdc from host
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1.1.5 Accessories

N/A

1.1.6 Channel List

802.11a / n HT20 / ac VHT20 / ax HE20		802.11n HT40 / ac VHT40 / ax HE40	
Channel	Frequency(MHz)	Channel	Frequency(MHz)
36	5180	38	5190
40	5200	46	5230
44	5220	54	5270
48	5240	62	5310
52	5260	102	5510
56	5280	110	5550
60	5300	118	5590
64	5320	126	5630
100	5500	134	5670
104	5520	142	5710
108	5540	151	5755
112	5560	159	5795
116	5580	802.11ac VHT80 / ax HE80	
120	5600	42	5210
124	5620	58	5290
128	5640	106	5530
132	5660	122	5610
136	5680	138	5690
140	5700	155	5775
144	5720	---	---
149	5745	---	---
153	5765	---	---
157	5785	---	---
161	5805	---	---
165	5825	---	---

1.1.7 Test Tool and Duty Cycle

Test Tool	QATool, version: 0.0.2.85		
Duty Cycle and Duty Factor	Mode	Duty Cycle (%)	Duty Factor (dB)
	11a	87.67%	0.57
	ax HE20-OFDMA	84.24%	0.74
	ax HE40-OFDMA	73.10%	1.36
	ax HE80-OFDMA	56.35%	2.49

1.1.8 Power Index of Test Tool

SC Module

Modulation Mode	Test Frequency (MHz)	Power Index
11a	5180	8.5
11a	5200	9.5
11a	5240	13
11a	5260	12.5
11a	5300	10.5
11a	5320	9
11a	5500	9.5
11a	5580	13.5
11a	5700	11
11a	5720	13.5
11a	5745	15.5
11a	5785	15.5
11a	5825	15.5
ax HE20-OFDMA	5180	9
ax HE20-OFDMA	5200	11.5
ax HE20-OFDMA	5240	14
ax HE20-OFDMA	5260	14
ax HE20-OFDMA	5300	12
ax HE20-OFDMA	5320	10
ax HE20-OFDMA	5500	11
ax HE20-OFDMA	5580	15.5
ax HE20-OFDMA	5700	11
ax HE20-OFDMA	5720	16
ax HE20-OFDMA	5745	16.5
ax HE20-OFDMA	5785	16.5
ax HE20-OFDMA	5825	16.5

Modulation Mode	Test Frequency (MHz)	Power Index
ax HE40-OFDMA	5190	9
ax HE40-OFDMA	5230	12
ax HE40-OFDMA	5270	12
ax HE40-OFDMA	5310	9.5
ax HE40-OFDMA	5510	11
ax HE40-OFDMA	5590	15.5
ax HE40-OFDMA	5670	13
ax HE40-OFDMA	5710	16.5
ax HE40-OFDMA	5755	15.5
ax HE40-OFDMA	5795	16.5
ax HE80-OFDMA	5210	6.5
ax HE80-OFDMA	5290	7
ax HE80-OFDMA	5530	10
ax HE80-OFDMA	5610	13.5
ax HE80-OFDMA	5690	16.5
ax HE80-OFDMA	5775	14

ST Module

Modulation Mode	Test Frequency (MHz)	Power Index
11a	5180	8.5
11a	5200	9.5
11a	5240	13
11a	5260	12.5
11a	5300	10
11a	5320	9.5
11a	5500	9
11a	5580	13.5
11a	5700	11
11a	5720	13.5
11a	5745	15.5
11a	5785	15.5
11a	5825	15.5
ax HE20-OFDMA	5180	9
ax HE20-OFDMA	5200	11
ax HE20-OFDMA	5240	14
ax HE20-OFDMA	5260	14
ax HE20-OFDMA	5300	11
ax HE20-OFDMA	5320	9
ax HE20-OFDMA	5500	10.5
ax HE20-OFDMA	5580	15
ax HE20-OFDMA	5700	11
ax HE20-OFDMA	5720	15.5
ax HE20-OFDMA	5745	16.5
ax HE20-OFDMA	5785	16.5
ax HE20-OFDMA	5825	16.5

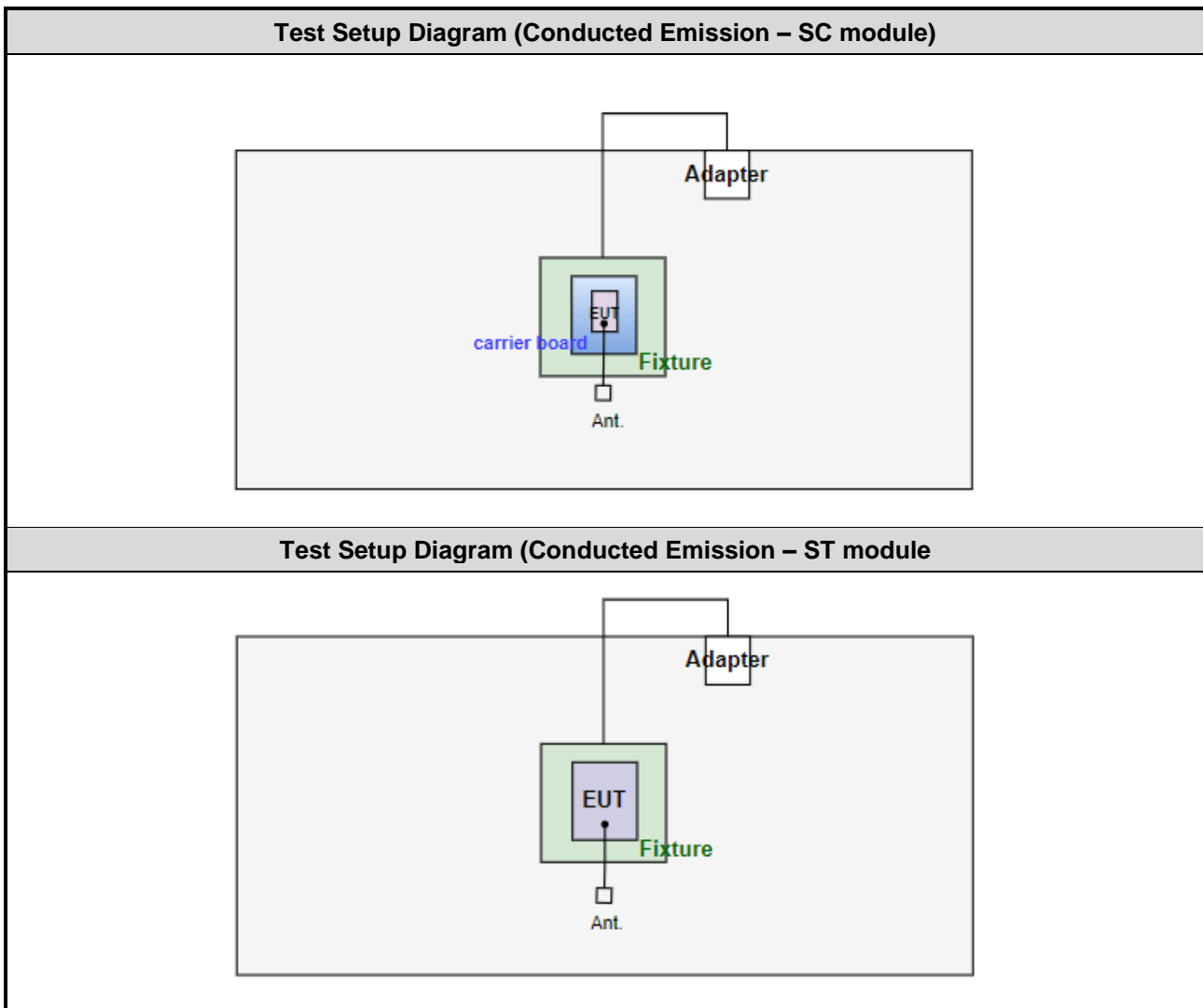
Modulation Mode	Test Frequency (MHz)	Power Index
ax HE40-OFDMA	5190	9
ax HE40-OFDMA	5230	12
ax HE40-OFDMA	5270	12
ax HE40-OFDMA	5310	9
ax HE40-OFDMA	5510	10.5
ax HE40-OFDMA	5590	15.5
ax HE40-OFDMA	5670	13
ax HE40-OFDMA	5710	16.5
ax HE40-OFDMA	5755	15.5
ax HE40-OFDMA	5795	16.5
ax HE80-OFDMA	5210	6.5
ax HE80-OFDMA	5290	7
ax HE80-OFDMA	5530	9.5
ax HE80-OFDMA	5610	13.5
ax HE80-OFDMA	5690	16
ax HE80-OFDMA	5775	14

1.2 Local Support Equipment List

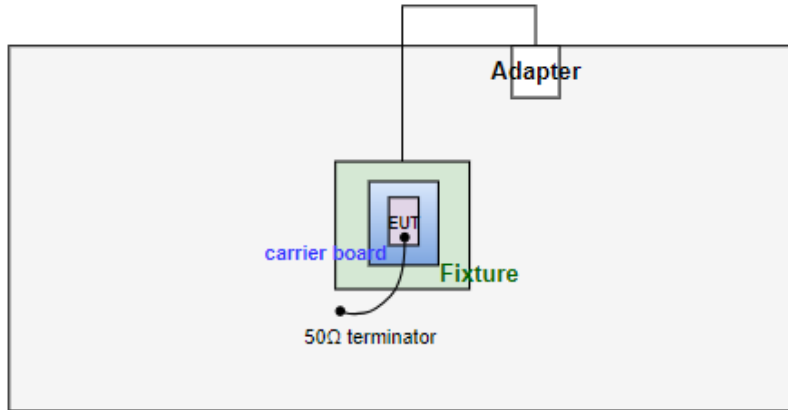
Support Equipment List					
No.	Equipment	Brand	Model	FCC ID	Remarks
1	Laptop	DELL	Latitude 5400	DoC	---
2	Fixture	---	---	---	Provided by applicant.
3	Fixture's adapter	---	---	---	Provided by applicant. I/P: 100-240Vac, 1.5A, 50-60Hz O/P: 5.0V 3.0A
4	Carrier board	---	---	---	Provided by applicant.
5	50Ω terminator	---	---	---	---

Note: The support laptop was disconnected from EUT and was removed from testing table after sending command to EUT to transmit continuously.

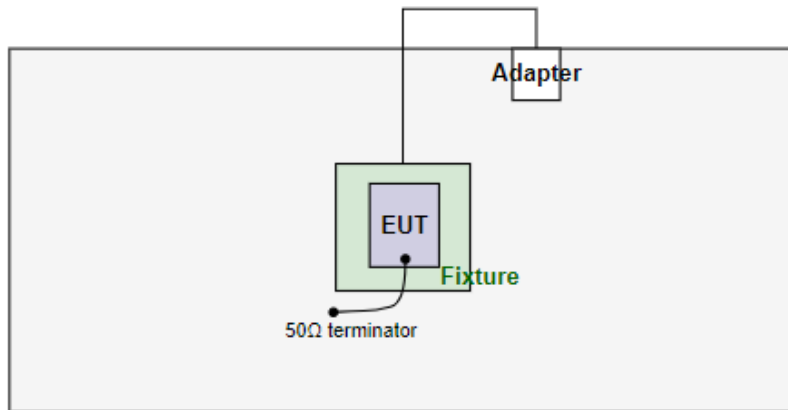
1.3 Test Setup Chart



Test Setup Diagram (Radiated Emission – SC module)



Test Setup Diagram (Radiated Emission – ST module)



1.4 The Equipment List

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Tested Date	Dec. 08, 2023				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101658	Feb. 17, 2023	Feb. 16, 2024
LISN	R&S	ENV216	101579	May. 09, 2023	May. 08, 2024
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127667	Jan. 03, 2023	Jan. 02, 2024
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 11, 2023	Oct. 10, 2024
50 ohm terminal (Support Unit)	NA	50	01	Jun. 14, 2023	Jun. 13, 2024
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Tested Date	Oct. 20 ~ Oct. 25, 2023				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101657	Mar. 03, 2023	Mar. 02, 2024
Spectrum Analyzer	R&S	FSV40	101498	Nov. 21, 2022	Nov. 20, 2023
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 01, 2022	Oct. 31, 2023
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Jul. 31, 2023	Jul. 30, 2024
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Nov. 25, 2022	Nov. 24, 2023
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Oct. 27, 2022	Oct. 26, 2023
Preamplifier	EMC	EMC02325	980225	Jun. 28, 2023	Jun. 27, 2024
Preamplifier	EMC	EMC118A45SE	980898	Jul. 14, 2023	Jul. 13, 2024
Preamplifier	EMC	EMC184045SE	980903	Jul. 17, 2023	Jul. 16, 2024
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 03, 2023	Oct. 02, 2024
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Oct. 03, 2023	Oct. 02, 2024
LF cable 11M	EMC	EMCCFD400-NW-NW-1 1000	200801	Oct. 03, 2023	Oct. 02, 2024
LF cable 1M	EMC	EMCCFD400-NM-NM-1 000	160502	Oct. 03, 2023	Oct. 02, 2024
RF Cable	EMC	EMC104-35M-35M-8000	210920	Oct. 03, 2023	Oct. 02, 2024
RF Cable	EMC	EMC104-35M-35M-3000	210922	Oct. 03, 2023	Oct. 02, 2024
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Tested Date	Oct. 17 ~ Nov. 28, 2023				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101910	Apr. 14, 2023	Apr. 13, 2024
Power Meter	Anritsu	ML2495A	1241001	Jan. 11, 2023	Jan. 10, 2024
Power Sensor	Anritsu	MA2411B	1911228	Jan. 11, 2023	Jan. 10, 2024
TEMP&HUMIDITY CHAMBER	GIANT FORCE	GCT-225-40-SP-SD	MAF1212-002	Jun. 21, 2023	Jun. 20, 2024
AC POWER SOURCE	APC	AFC-500W	F312060012	Dec. 09, 2022	Dec. 08, 2023
Attenuator	Pasternack	PE7005-10	10-2	Oct. 05, 2023	Oct. 04, 2024
HIGHPASS FILTER 7-18G	K&L	11SH10-7000/T18000-O/OP	18	Oct. 05, 2023	Oct. 04, 2024
LOWPASS FILTER	WI	WLKS1100-12SS	2	Oct. 05, 2023	Oct. 04, 2024
LOWPASS FILTER	WI	WLKS5000-12SS	1	Oct. 05, 2023	Oct. 04, 2024
Measurement Software	Sporton	SENSE-15407_NII	V5.11	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.5 Test Standards

47 CFR FCC Part 15.407
ANSI C63.10-2013

1.6 Reference Guidance

FCC KDB 412172 D01 Determining ERP and EIRP v01r01
FCC KDB 662911 D01 Multiple Transmitter Output v02r01
FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01

1.7 Deviation from Test Standard and Measurement Procedure

None

1.8 Measurement Uncertainty

The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)).

Measurement Uncertainty	
Parameters	Uncertainty
Bandwidth	±34.130 Hz
Conducted power	±0.808 dB
Frequency error	±1×10 ⁻⁹
Power density	±0.583 dB
Conducted emission	±2.715 dB
AC conducted emission	±2.92 dB
Unwanted Emission ≤ 1GHz	±3.41 dB
Unwanted Emission > 1GHz	±4.59 dB
Time	±0.1%
Temperature	±0.4 °C

2 Test Configuration

2.1 Testing Facility

Test Laboratory	International Certification Corporation
Test Site	CO01-WS, 03CH01-WS, TH01-WS
Address of Test Site	No.3-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)

- FCC Designation No.: TW2732
- FCC site registration No.: 181692
- ISED#: 10807A
- CAB identifier: TW2732

2.2 The Worst Test Modes and Channel Details

Frequency band 5150~5350 MHz / 5470~5725 MHz							
Test item	Modulation Mode	Test Frequency (MHz)	Data Rate	Test method	Mode	Test Configuration	Note
<i>Non-beamforming mode</i>							
AC Power Line Conducted Emissions	ax HE40-OFDMA	5710	MCS 0	Conducted	TX	1	-
Unwanted Emissions ≤1GHz	ax HE40-OFDMA	5710	MCS 0	Radiated	TX	1, 2	Note 2
Unwanted Emissions >1GHz	11a	5180 / 5200 / 5240 / 5260 / 5300 / 5320 / 5500 / 5580 / 5700 / 5720	6 Mbps	Radiated	TX	1	Note 2
	ax HE20-OFDMA	5180 / 5200 / 5240 / 5260 / 5300 / 5320 / 5500 / 5580 / 5700 / 5720	MCS 0				
	ax HE40-OFDMA	5190 / 5230 / 5270 / 5310 / 5510 / 5590 / 5670 / 5710	MCS 0				
	ax HE80-OFDMA	5210 / 5290 / 5530 / 5610 / 5690	MCS 0				
	ax HE80-OFDMA ax HE40-OFDMA ax HE80-OFDMA	5210 5270 5610	MCS 0	Radiated	TX	2	Note 2
Unwanted Emissions ≤1GHz	ax HE40-OFDMA	5710	MCS 0	Conducted	TX	1, 2	-
Unwanted Emissions >1GHz	11a	5180 / 5200 / 5240 / 5260 / 5300 / 5320 / 5500 / 5580 / 5700 / 5720	6 Mbps	Conducted	TX	1	-
	ax HE20-OFDMA	5180 / 5200 / 5240 / 5260 / 5300 / 5320 / 5500 / 5580 / 5700 / 5720	MCS 0				
	ax HE40-OFDMA	5190 / 5230 / 5270 / 5310 / 5510 / 5590 / 5670 / 5710	MCS 0				
	ax HE80-OFDMA	5210 / 5290 / 5530 / 5610 / 5690	MCS 0				
	11a ax HE80-OFDMA	5200 / 5700 5290	MCS 0	Conducted	TX	2	-

Frequency band 5150~5350 MHz / 5470~5725 MHz							
Test item	Modulation Mode	Test Frequency (MHz)	Data Rate	Test method	Mode	Test Configuration	Note
Conducted Output Power	11a	5180 / 5200 / 5240 / 5260 / 5300 / 5320 / 5500 / 5580 / 5700 / 5720	6 Mbps	Conducted	TX	1, 2	-
	ax HE20-OFDMA	5180 / 5200 / 5240 / 5260 / 5300 / 5320 / 5500 / 5580 / 5700 / 5720	MCS 0				
	ax HE40-OFDMA	5190 / 5230/ 5270 / 5310 / 5510 / 5590 / 5670 / 5710	MCS 0				
	ax HE80-OFDMA	5210 / 5290 / 5530 / 5610 / 5690	MCS 0				
Emission Bandwidth Power Spectral Density	11a	5180 / 5200 / 5240 / 5260 / 5300 / 5320 / 5500 / 5580 / 5700 / 5720	6 Mbps	Conducted	TX	1	-
	ax HE20-OFDMA	5180 / 5200 / 5240 / 5260 / 5300 / 5320 / 5500 / 5580 / 5700 / 5720	MCS 0				
	ax HE40-OFDMA	5190 / 5230/ 5270 / 5310 / 5510 / 5590 / 5670 / 5710	MCS 0				
	ax HE80-OFDMA	5210 / 5290 / 5530 / 5610 / 5690	MCS 0				
Frequency Stability	Un-modulation	5300	---	Conducted	TX	1	-
Beamforming mode							
Conducted Output Power	ax HE20-OFDMA	5180 / 5200 / 5240 / 5260 / 5300 / 5320 / 5500 / 5580 / 5700 / 5720	MCS 0	Conducted	TX	1, 2	-
	ax HE40-OFDMA	5190 / 5230/ 5270 / 5310 / 5510 / 5590 / 5670 / 5710	MCS 0				
	ax HE80-OFDMA	5210 / 5290 / 5530 / 5610 / 5690	MCS 0				
NOTE:							
<ol style="list-style-type: none"> The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The Y-plane result was found as the worst case and was shown in this report. The 50Ω terminator is connected to antenna port of EUT for radiated emission measurement. Beamforming mode is calculated not measured. The calculation method is conducted power of non-beamforming – 3.01 dB. Test configurations are listed as below: Configuration 1: SC Module Configuration 2: ST Module 							

Frequency band 5725-5850 MHz							
Test item	Modulation Mode	Test Frequency (MHz)	Data Rate	Test method	Mode	Test Configuration	Note
Non-beamforming mode							
AC Power Line Conducted Emission	ax HE20-OFDMA	5825	MCS 0	Conducted	TX	1	-
Unwanted Emissions ≤ 1GHz	ax HE20-OFDMA	5825	MCS 0	Radiated	TX	1, 2	Note 2
Unwanted Emissions >1GHz	11a ax HE20-OFDMA ax HE40-OFDMA ax HE80-OFDMA	5745 / 5785 / 5825 5745 / 5785 / 5825 5755 / 5795 5775	6 Mbps MCS 0 MCS 0 MCS 0	Radiated	TX	1	Note 2
	11a	5825	6 Mbps	Radiated	TX	2	Note 2
Unwanted Emissions ≤ 1GHz	ax HE20-OFDMA	5825	MCS 0	Conducted	TX	1, 2	-
Unwanted Emissions >1GHz	11a ax HE20-OFDMA ax HE40-OFDMA ax HE80-OFDMA	5745 / 5785 / 5825 5745 / 5785 / 5825 5755 / 5795 5775	6 Mbps MCS 0 MCS 0 MCS 0	Conducted	TX	1	-
	ax HE80-OFDMA	5775	MCS 0	Conducted	TX	2	-
Conducted Output Power	11a ax HE20-OFDMA ax HE40-OFDMA ax HE80-OFDMA	5745 / 5785 / 5825 5745 / 5785 / 5825 5755 / 5795 5775	6 Mbps MCS 0 MCS 0 MCS 0	Conducted	TX	1, 2	-
6dB bandwidth Power spectral density	11a ax HE20-OFDMA ax HE40-OFDMA ax HE80-OFDMA	5745 / 5785 / 5825 5745 / 5785 / 5825 5755 / 5795 5775	6 Mbps MCS 0 MCS 0 MCS 0	Conducted	TX	1	-
Frequency Stability	Un-modulation	5785	-	Conducted	TX	1	-
Beamforming mode							
Conducted Output Power	ax HE20-OFDMA ax HE40-OFDMA ax HE80-OFDMA	5745 / 5785 / 5825 5755 / 5795 5775	MCS 0 MCS 0 MCS 0	Conducted	TX	1, 2	-
NOTE:							
<ol style="list-style-type: none"> The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The Y-plane result was found as the worst case and was shown in this report. The 50Ω terminator is connected to antenna port of EUT for radiated emission measurement. Beamforming mode is calculated not measured. The calculation method is conducted power of non-beamforming – 3.01 dB. Test configurations are listed as below: Configuration 1: SC Module Configuration 2: ST Module 							

2.3 Directional gain

Directional gain is calculated by following formula from FCC KDB 662911 D01 section F)2)f)(i)

Directional gain = G_{ANT} + Array Gain;

For Power measurement (Non-Beamforming)

Array gain = 0 dB for $N_{ANT} \leq 4$;

For Power spectral density / out of band emission (conducted measurement) / Power measurement (Beamforming)

Array gain = $10 \cdot \log(N_{ANT}/N_{SS})$ dB;

Directional gain is calculated as below

Test item	G_{ANT} (dBi)	Array gain (dB)	Directional gain (dBi)
Output power (Non-Beamforming)	4.4	0	4.4
Output power (Beamforming)	4.4	3.01	7.41
Power spectral density	4.4	3.01	7.41
Out of band emission(conducted measurement)	4.4	3.01	7.41

3 Transmitter Test Results

3.1 Emission Bandwidth

3.1.1 Limit of Emission Bandwidth

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

3.1.2 Test Procedures

26dB Bandwidth

1. Set RBW = approximately 1% of the emission bandwidth.
2. Set the VBW > RBW, Detector = Peak.
3. Trace mode = max hold.
4. Measure the maximum width of the emission that is 26 dB down from the peak of the emission.

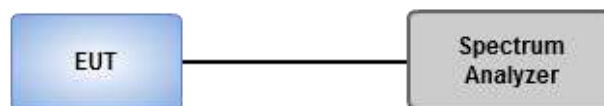
Occupied Bandwidth

1. Set RBW = 1 % to 5 % of the OBW.
2. Set VBW \geq 3 RBW.
3. Sample detection and single sweep mode shall be used.
4. Use the 99 % power bandwidth function of the instrument.

6dB Bandwidth

1. Set RBW = 100kHz, VBW = 300kHz.
2. Detector = Peak, Trace mode = max hold.
3. Allow the trace to stabilize.
4. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

3.1.3 Test Setup



3.1.4 Test Results

Ambient Condition	22-23°C / 65-67%	Tested By	Akun Chung
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Refer to Appendix A.

3.2 Conducted Output Power

3.2.1 Limit of Conducted Output Power

Frequency band 5150-5250 MHz	
Operating Mode	Limit
<input type="checkbox"/> Outdoor access point	Conducted Power: 1 W The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm)
<input type="checkbox"/> Indoor access point	Conducted Power: 1 W
<input type="checkbox"/> Fixed point-to-point access points	Conducted Power: 1 W
<input checked="" type="checkbox"/> Client devices	Conducted Power: 250 mW

Frequency Band (MHz)	Limit
<input checked="" type="checkbox"/> 5250 ~ 5350	Conducted Power: 250mW or 11dBm+10 log B
<input checked="" type="checkbox"/> 5470 ~ 5725	Conducted Power: 250mW or 11dBm+10 log B
<input checked="" type="checkbox"/> 5725 ~ 5850	Conducted Power: 1 W

Note: "B" is the 26dB emission bandwidth in MHz.

3.2.2 Test Procedures

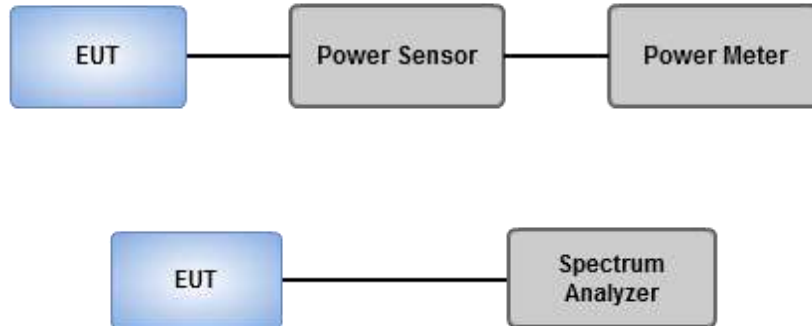
Method PM-G (Measurement using a gated RF average power meter)

Measurements is performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

Spectrum analyzer (For channel that extends across the 5.725 GHz boundary)

1. Set RBW = 1MHz, VBW = 3MHz, Sweep time = Auto, Detector = RMS.
2. Trace average at least 100 traces in power averaging mode.
3. Compute power by integrating the spectrum across the 26 dB EBW.
4. Add $10 \log(1/X)$, X:duty cycle) if duty cycle is <98%).

3.2.3 Test Setup



3.2.4 Test Results

Ambient Condition	22-23°C / 65-67%	Tested By	Akun Chung
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Refer to Appendix B.

3.3 Power Spectral Density

3.3.1 Limit of Power Spectral Density

Frequency band 5150-5250 MHz		
Operating Mode		Limit
<input type="checkbox"/>	Outdoor access point	17 dBm / MHz
<input type="checkbox"/>	Indoor access point	17 dBm / MHz
<input type="checkbox"/>	Fixed point-to-point access points	17 dBm / MHz
<input checked="" type="checkbox"/>	Client devices	11 dBm / MHz

Frequency Band (MHz)		Limit
<input checked="" type="checkbox"/>	5250 ~ 5350	11 dBm / MHz
<input checked="" type="checkbox"/>	5470 ~ 5725	11 dBm / MHz
<input checked="" type="checkbox"/>	5725 ~ 5850	30 dBm /500 kHz

3.3.2 Test Procedures

For 5150 ~ 5250 MHz / 5250 ~ 5350 MHz / 5470 ~ 5725 MHz

Duty cycle \geq 98 %

1. Set RBW = 1 MHz, VBW = 3 MHz, Sweep time = auto, Detector = RMS.
2. Trace average 100 traces.
3. Use the peak marker function to determine the maximum amplitude level.

Duty cycle < 98 %

1. Set RBW = 1 MHz, VBW = 3 MHz, Detector = RMS.
2. Set sweep time $\geq 10 * (\text{number of points in sweep}) * (\text{total on/off period of the transmitted signal})$.
3. Perform a single sweep.
4. Use the peak marker function to determine the maximum amplitude level.
5. Add $10 \log(1/x)$, where x is the duty cycle.

For 5725 ~ 5850 MHz

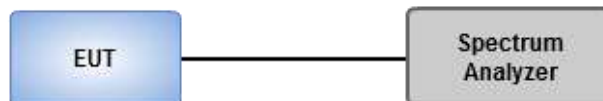
Duty cycle \geq 98 %

1. Set RBW = 500 kHz, VBW = 3 MHz, Sweep time = auto, Detector = RMS.
2. Trace average 100 traces.
3. Use the peak marker function to determine the maximum amplitude level.

Duty cycle < 98 %

1. Set RBW = 500 kHz, VBW = 3 MHz, Detector = RMS.
2. Set sweep time $\geq 10 * (\text{number of points in sweep}) * (\text{total on/off period of the transmitted signal})$.
3. Perform a single sweep.
4. Use the peak marker function to determine the maximum amplitude level.
5. Add $10 \log(1/x)$, where x is the duty cycle.

3.3.3 Test Setup



3.3.4 Test Results

Ambient Condition	22-23°C / 65-67%	Tested By	Akun Chung
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Refer to Appendix C.

3.4 Unwanted Emissions

3.4.1 Limit of Unwanted Emissions

Restricted Band Emissions Limit			
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit

Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

Un-restricted band emissions above 1GHz Limit	
Operating Band	Limit
5.15 - 5.25 GHz	e.i.r.p. -27 dBm [68.2 dBuV/m@3m]
5.25 - 5.35 GHz	e.i.r.p. -27 dBm [68.2 dBuV/m@3m]
5.47 - 5.725 GHz	e.i.r.p. -27 dBm [68.2 dBuV/m@3m]
5.725 - 5.850 GHz	All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

Note 1: Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

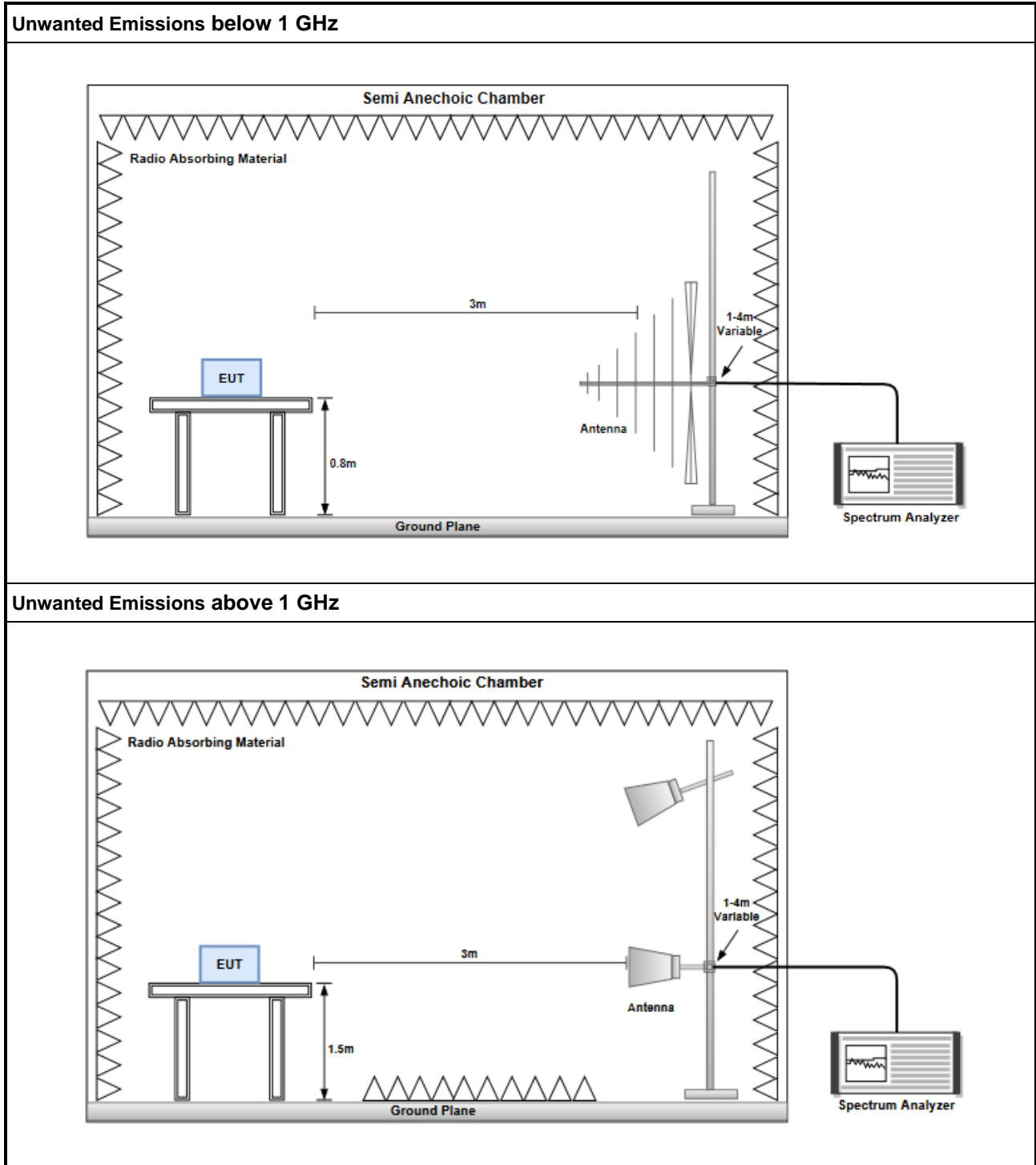
3.4.2 Test Procedures

1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above 1GHz.

3.4.3 Test Setup



3.4.4 Test Results

Refer to Appendix D.

3.5 Frequency Stability

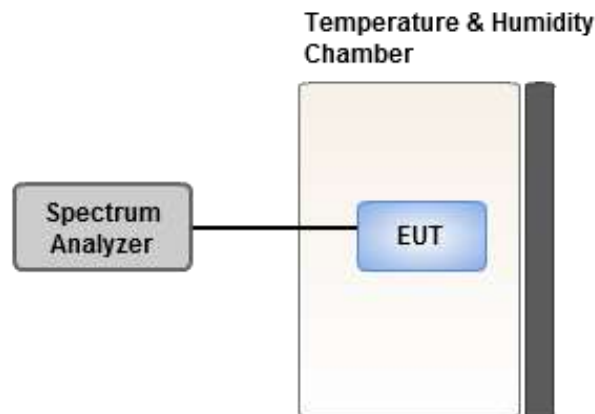
3.5.1 Limit of Frequency Stability

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

3.5.2 Test Procedures

1. The EUT is installed in an environment test chamber with external power source.
2. Set the chamber to operate at 20 centigrade and external power source to output at nominal voltage of EUT.
3. A sufficient stabilization period at each temperature is used prior to each frequency measurement.
4. When temperature is stabled, measure the frequency stability.
5. The test shall be performed under normal and extreme condition for temperature and voltage.

3.5.3 Test Setup



3.5.4 Test Results

Ambient Condition	22-23°C / 65-67%	Tested By	Akun Chung
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Refer to Appendix E.

3.6 AC Power Line Conducted Emissions

3.6.1 Limit of AC Power Line Conducted Emissions

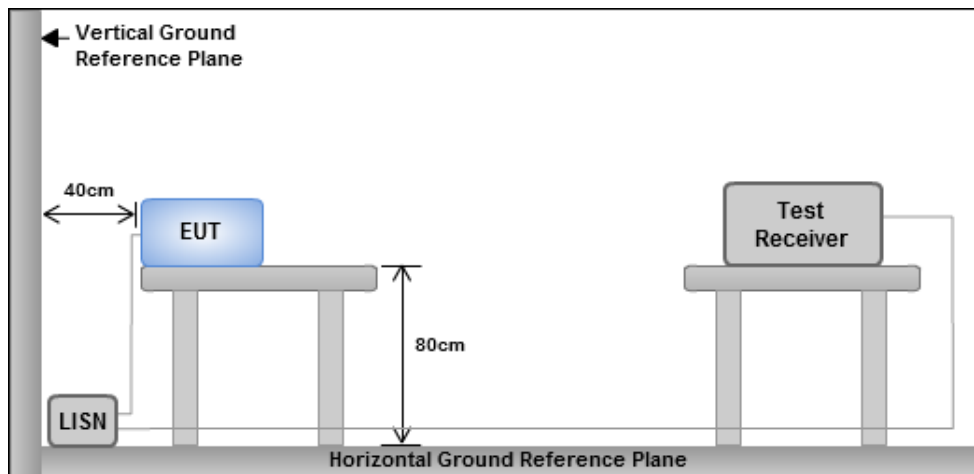
Conducted Emissions Limit		
Frequency Emission (MHz)	Quasi-Peak	Average
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50

Note 1: * Decreases with the logarithm of the frequency.

3.6.2 Test Procedures

1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
4. This measurement was performed with AC 120V/60Hz

3.6.3 Test Setup



- Note: 1. Support units were connected to second LISN.
 2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

3.6.4 Test Results

Refer to Appendix F.

4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corporation (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website <http://www.icertifi.com.tw>.

Linkou

Tel: 886-2-2601-1640

No.30-2, Ding Fwu Tsuen, Lin Kou
District, New Taipei City, Taiwan
(R.O.C.)

Kwei Shan

Tel: 886-3-271-8666

No.3-1, Lane 6, Wen San 3rd
St., Kwei Shan Dist., Tao Yuan
City 33381, Taiwan (R.O.C.)
No.2-1, Lane 6, Wen San 3rd
St., Kwei Shan Dist., Tao Yuan
City 33381, Taiwan (R.O.C.)

Kwei Shan Site II

Tel: 886-3-271-8640

No.14-1, Lane 19, Wen San 3rd
St., Kwei Shan Dist., Tao Yuan
City 33381, Taiwan (R.O.C.)

If you have any suggestion, please feel free to contact us as below information.

Tel: 886-3-271-8666

Fax: 886-3-318-0345

Email: ICC_Service@icertifi.com.tw

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