FCC Test Report

FCC ID	:	**SQG-SONAIF513**
Equipment	:	**Sona IF513 802.11ax Wi-Fi 6E Module with Bluetooth 5.4**
Model No.	:	**Sona IF513**
Brand Name	:	**Ezurio**
Applicant	:	**Ezurio LLC**
Address	:	**W66N220 Commerce Court, Cedarburg, WI 53012 United States Of America**
Standard	:	**47 CFR FCC Part 15.407**
Equipment Class / Type	:	☐ **6ID: Indoor access point** ☐ **6PP: Subordinate device** ☒ **6XD: Client device**
Received Date	:	**Jun. 06, 2024**
Tested Date	:	**Aug. 14 ~ Oct. 25, 2024**

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
FR460601AO	Rev. 01	Initial issue	Nov. 25, 2024
FR460601AO	Rev. 02	Modified antenna gain	Dec. 17, 2024
FR460601AO	Rev. 03	Modified antenna gain	Dec. 24, 2024

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	AC Power Line Conducted Emissions	[dBuV]: 0.150MHz 44.57 (Margin -21.43dB) – QP	Pass
15.407(b)(5) 15.209	Unwanted Emission	[dBuV/m at 3m]: 350.1MHz 42.66 (Margin -3.34dB) - QP	Pass
15.407(b)(6)	In-Band Emissions (Mask)	Meet the requirement of limit	Pass
15.407(a)(10)	Emission Bandwidth	Meet the requirement of limit	Pass
15.407(a)(5)	RF Output Power (e.i.r.p)	Max Power [dBm]: 5925-6425MHz: 10.33 6425-6525MHz: 10.42 6525-6875MHz: 10.53 6875-7125MHz: 10.57	Pass
15.407(a)(5)	Power Spectral Density (e.i.r.p)	Meet the requirement of limit	Pass
15.407(d)(6)	Contention Based Protocol	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 four configurations of the EUT are shown on the following:

Model Name	Part No.	Description
Sona IF513	453-00184	Module, Sona IF513, MHF4L
	453-00185	Module, Sona IF513, Trace Pin
	453-00193	Module, Sona IF513, Antenna Diversity, MHF4L
	453-00194	Module, Sona IF513, Antenna Diversity, Trace Pin
	453-00186	Module, Sona IF513, M.2, Key E, SDIO, UART
	453-00195	Module, Sona IF513, Antenna Diversity, M.2, Key E, SDIO, UART
	453-00213	Module, Sona IF513, M.2, Key E, SDIO, UART, Ext. OSC
	453-00214	Module, Sona IF513, Antenna Diversity, M.2, Key E, SDIO, UART, Ext. OSC

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
5925 ~ 7125	11a	5955 ~ 7115	1 ~ 233 [59]	1	6-54 Mbps
5925 ~ 7125	ax (HE20)	5955 ~ 7115	1 ~ 233 [59]	1	MCS 0-11
Note 1: OFDM/OFDMA-BPSK, QPSK, 16QAM, 64QAM, 256QAM and 1024QAM modulation. Note 2: 802.11ax supports full RU and partial RU configuration. Test results of full RU configuration are recorded in this report. Refers to report no.: FR460601-1AO for test results of partial RU configuration.					

1.1.3 Antenna Details

Ant. No.	Manufacturer	Model	Part Number	Type	Connector	Operating Frequencies / Gain (dBi)		
						2.4GHz	5GHz	6GHz
1	Joymax Inc.	TWX-100BRS3B	NA	Dipole	RP-SMA	2	4	4
2	Ezurio	FlexMIMO 6E	EFD2471A3S-10MH4L	PIFA	MHF4L	2.2	3.8	3.3
3	Ezurio	Mini NanoBlade Flex 6 GHz	EMF2471A3S-10MH4L	PCB Dipole	MHF4L	2.4	4.4	5.2
4	Ezurio	FlexPIFA 6E	EFB2471A3S-10MH4L	PIFA	MHF4L	2.2	3.9	3.8

1.1.4 Configuration of Equipment under Test (EUT)

Power Supply Type	3.3Vdc from host	
Beamforming	☐ Support	☒ Not support
RU Configuration	☒ Full RU	☐ Partial RU
Channel Puncturing	☐ Support	☒ Not support

1.1.5 Channel List

802.11a / ax HE20							
Channel	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**
---	---	57	6235	117	6535	177	6835
1	5955	61	6255	121	6555	181	6855
5	5975	65	6275	125	6575	185	6875
9	5995	69	6295	129	6595	189	6895
13	6015	73	6315	133	6615	193	6915
17	6035	77	6335	137	6635	197	6935
21	6055	81	6355	141	6655	201	6955
25	6075	85	6375	145	6675	205	6975
29	6095	89	6395	149	6695	209	6995
33	6115	93	6415	153	6715	213	7015
37	6135	97	6435	157	6735	217	7035
41	6155	101	6455	161	6755	221	7055
45	6175	105	6475	165	6775	225	7075
49	6195	109	6495	169	6795	229	7095
53	6215	113	6515	173	6815	233	7115

1.1.6 Test Tool and Duty Cycle

Test Tool	Tera Term, Version: v4.74		
Duty Cycle and Duty Factor	**Mode**	**Duty Cycle (%)**	**Duty Factor (dB)**
	11a	99.30%	0.03
	ax HE20-OFDMA	98.20%	0.08

1.1.7 Power Index of Test Tool

Part No. 453-00184

Modulation Mode	Test Frequency (MHz)	Power Index
11a	5955	16
11a	6175	18
11a	6415	18
11a	6435	20
11a	6475	20
11a	6515	20
11a	6535	20
11a	6715	20
11a	6855	24
11a	6875	24
11a	6895	24
11a	7015	26
11a	7095	26
11a	7115	20
ax HE20-OFDMA	5955	16
ax HE20-OFDMA	6175	15
ax HE20-OFDMA	6415	18
ax HE20-OFDMA	6435	17
ax HE20-OFDMA	6475	17
ax HE20-OFDMA	6515	17
ax HE20-OFDMA	6535	17
ax HE20-OFDMA	6715	19
ax HE20-OFDMA	6855	21
ax HE20-OFDMA	6875	21
ax HE20-OFDMA	6895	20
ax HE20-OFDMA	7015	22
ax HE20-OFDMA	7095	22
ax HE20-OFDMA	7115	19

Part No. 453-00193

Modulation Mode	Test Frequency (MHz)	Power Index
11a	5955	16
11a	6175	19
11a	6415	16
11a	6435	18
11a	6475	18
11a	6515	17
11a	6535	16
11a	6715	15
11a	6855	16
11a	6875	16
11a	6895	16
11a	7015	18
11a	7095	21
11a	7115	17
ax HE20-OFDMA	5955	19
ax HE20-OFDMA	6175	19
ax HE20-OFDMA	6415	19
ax HE20-OFDMA	6435	19
ax HE20-OFDMA	6475	18
ax HE20-OFDMA	6515	18
ax HE20-OFDMA	6535	17
ax HE20-OFDMA	6715	17
ax HE20-OFDMA	6855	18
ax HE20-OFDMA	6875	18
ax HE20-OFDMA	6895	19
ax HE20-OFDMA	7015	19
ax HE20-OFDMA	7095	20
ax HE20-OFDMA	7115	16

Part No. 453-00213

Modulation Mode	Test Frequency (MHz)	Power Index
11a	5955	16
11a	6175	18
11a	6415	15
11a	6435	17
11a	6475	17
11a	6515	17
11a	6535	14
11a	6715	15
11a	6855	15
11a	6875	16
11a	6895	17
11a	7015	16
11a	7095	18
11a	7115	14
ax HE20-OFDMA	5955	17
ax HE20-OFDMA	6175	17
ax HE20-OFDMA	6415	18
ax HE20-OFDMA	6435	17
ax HE20-OFDMA	6475	18
ax HE20-OFDMA	6515	17
ax HE20-OFDMA	6535	15
ax HE20-OFDMA	6715	16
ax HE20-OFDMA	6855	16
ax HE20-OFDMA	6875	16
ax HE20-OFDMA	6895	16
ax HE20-OFDMA	7015	17
ax HE20-OFDMA	7095	18
ax HE20-OFDMA	7115	12

Part No. 453-00214

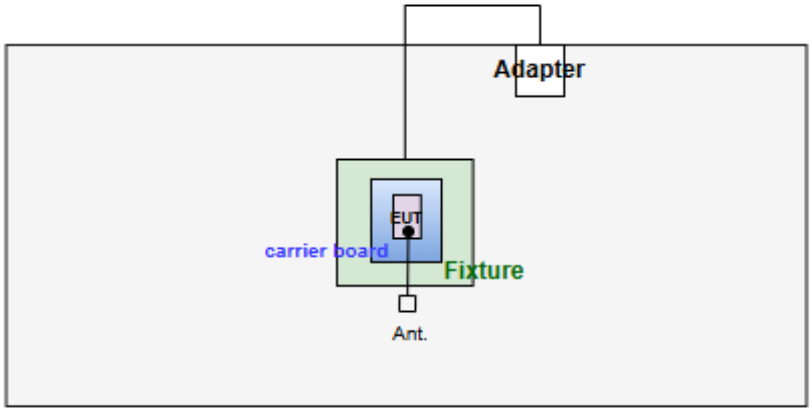
Modulation Mode	Test Frequency (MHz)	Power Index
11a	5955	18
11a	6175	20
11a	6415	20
11a	6435	22
11a	6475	22
11a	6515	22
11a	6535	21
11a	6715	20
11a	6855	21
11a	6875	21
11a	6895	22
11a	7015	20
11a	7095	22
11a	7115	18
ax HE20-OFDMA	5955	20
ax HE20-OFDMA	6175	20
ax HE20-OFDMA	6415	22
ax HE20-OFDMA	6435	22
ax HE20-OFDMA	6475	23
ax HE20-OFDMA	6515	22
ax HE20-OFDMA	6535	22
ax HE20-OFDMA	6715	22
ax HE20-OFDMA	6855	22
ax HE20-OFDMA	6875	22
ax HE20-OFDMA	6895	21
ax HE20-OFDMA	7015	21
ax HE20-OFDMA	7095	21
ax HE20-OFDMA	7115	17

1.2 Local Support Equipment List

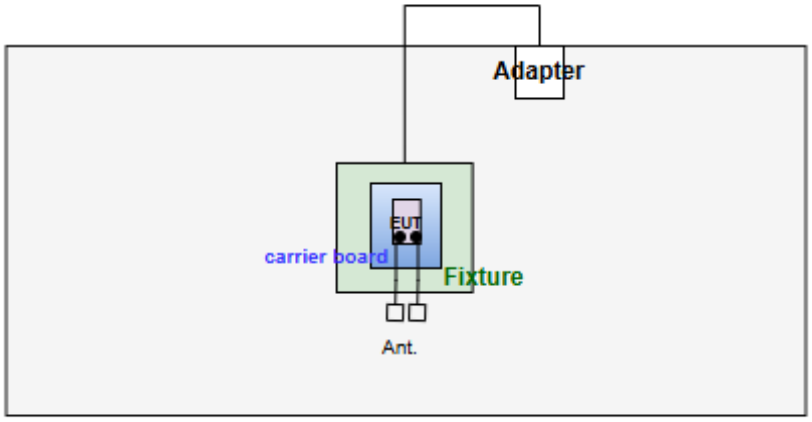
Support Equipment List					
No.	**Equipment**	**Brand**	**Model**	**FCC ID**	**Remarks**
1	Laptop	DELL	Latitude 5400	DoC	---
2	Fixture	Ezurio	750-00001-2-0	---	Provided by applicant.
3	Fixture's adapter	Chenzhou Frecom Electronics Co.	F36L7-120300SPACP	---	Provided by applicant.
4	50Ω terminator	Woken	WTER-18S2	---	---

1.3 Test Setup Chart

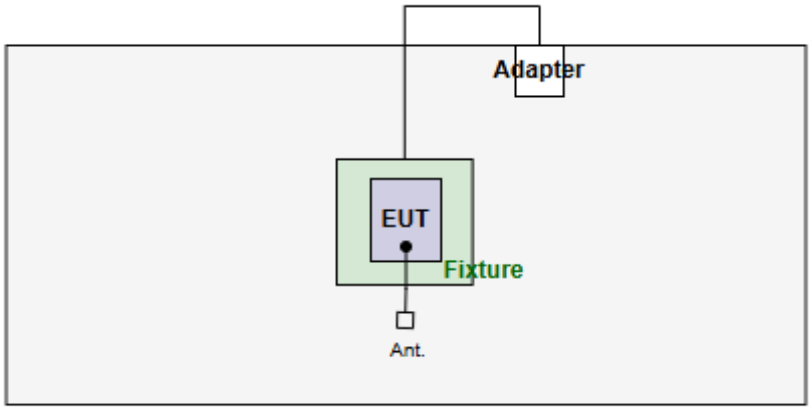
Test Setup Diagram (Conducted Emission –Laird part number: 453-00184)



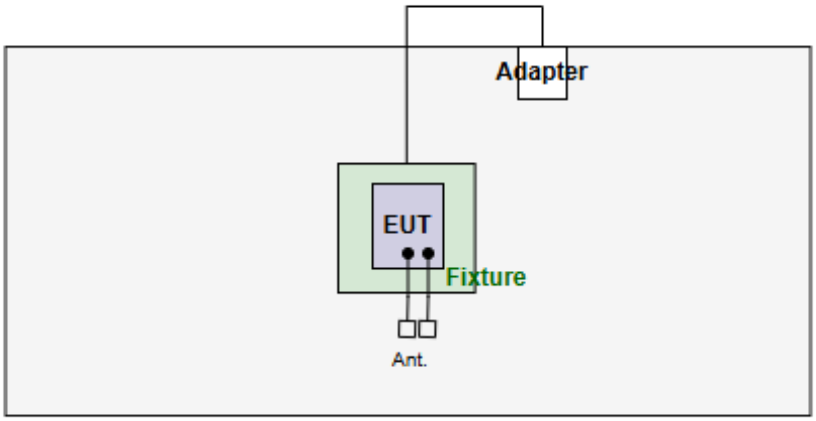
Test Setup Diagram (Conducted Emission –Laird part number: 453-00193)



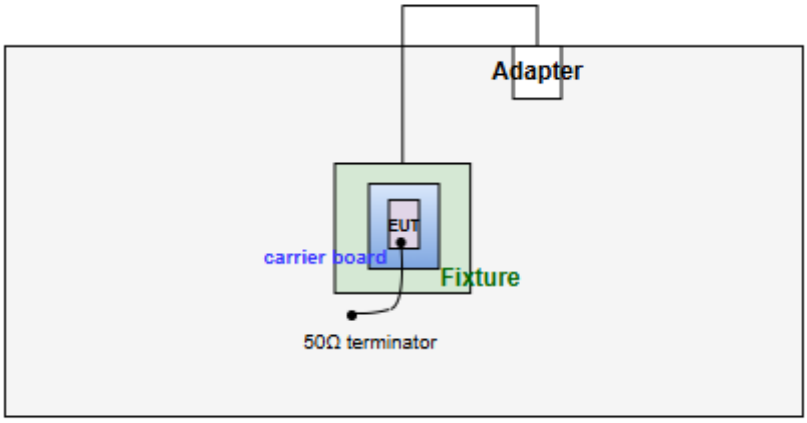
Test Setup Diagram (Conducted Emission –Laird part number: 453-00213)



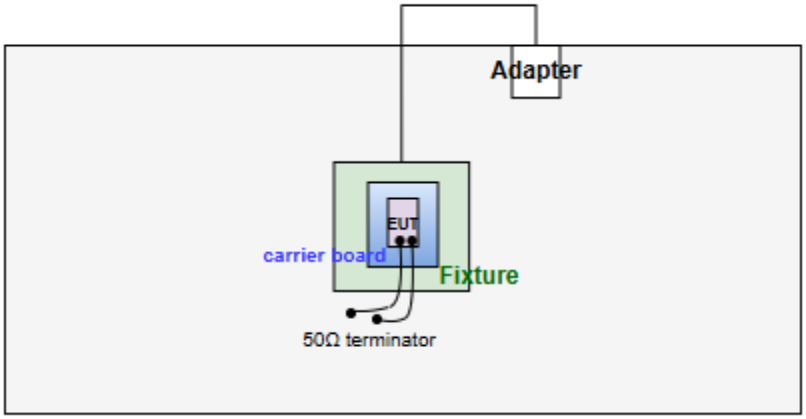
Test Setup Diagram (Conducted Emission – Laird part number: 453-00214)



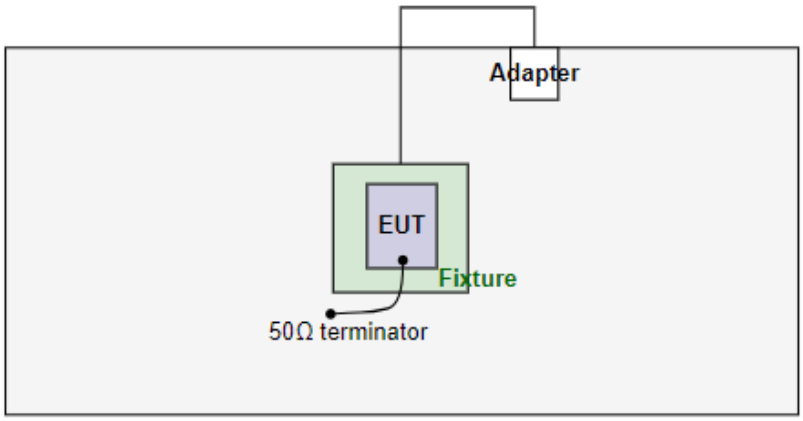
Test Setup Diagram (Radiated Emission – Laird part number: 453-00184)



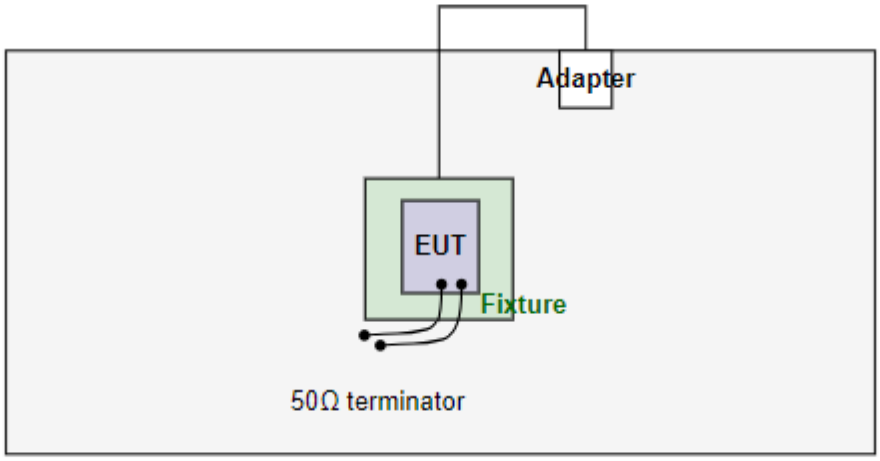
Test Setup Diagram (Radiated Emission –Laird part number: 453-00193)



Test Setup Diagram (Radiated Emission – Laird part number: 453-00213)



Test Setup Diagram (Radiated Emission –Laird part number: 453-00214)



1.4 The Equipment List

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Tested Date	Oct. 21, 2024				
Instrument	**Brand**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	R&S	ESR3	101658	Feb. 23, 2024	Feb. 22, 2025
LISN	R&S	ENV216	101579	May 09, 2024	May 08, 2025
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127667	Jan. 10, 2024	Jan. 09, 2025
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 07, 2024	Oct. 08, 2025
50 ohm terminal	NA	50	01	Jun. 19, 2024	Jun. 18, 2025
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Tested Date	Oct. 04 ~ Oct. 25, 2024				
Instrument	**Brand**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101910	Apr. 18, 2024	Apr. 17, 2025
Power Meter	Anritsu	ML2495A	1241002	Nov. 21, 2023	Nov. 20, 2024
Power Sensor	Anritsu	MA2411B	1207366	Nov. 21, 2023	Nov. 20, 2024
Attenuator	Pasternack	PE7005-10	10-2	Oct. 04, 2024	Oct. 03, 2025
HIGHPASS FILTER 3.1-18G	WHK	WHK3.1/18G-10SS	39	Oct. 02, 2024	Oct. 01, 2025
LOWPASS FILTER	WI	WLKS1100-12SS	2	Oct. 02, 2024	Oct. 01, 2025
Measurement Software	Sporton	SENSE-15247_DTS	V5.11	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. 09 ~ Oct. 14, 2024				
Instrument	**Brand**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	R&S	ESR3	101657	Mar. 05, 2024	Mar. 04, 2025
Spectrum Analyzer	R&S	FSV40	101498	Nov. 23, 2023	Nov. 22, 2024
Loop Antenna	R&S	HFH2-Z2	100330	Oct. 31, 2023	Oct. 30, 2024
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Aug. 09, 2024	Aug. 08, 2025
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Nov. 27, 2023	Nov. 26, 2024
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Oct. 30, 2023	Oct. 29, 2024
Preamplifier	EMC	EMC02325	980225	Jun. 17, 2024	Jun. 16, 2025
Preamplifier	EMC	EMC118A45SE	980898	Jul. 05, 2024	Jul. 04, 2025
Preamplifier	EMC	EMC184045SE	980903	Jul. 30, 2024	Jul. 29, 2025
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 02, 2024	Oct. 01, 2025
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Oct. 02, 2024	Oct. 01, 2025
LF cable 11M	EMC	EMCCFD400-NW-NW-11000	200801	Oct. 02, 2024	Oct. 01, 2025
LF cable 1M	EMC	EMCCFD400-NM-NM-1000	160502	Oct. 02, 2024	Oct. 01, 2025
RF Cable	EMC	EMC104-35M-35M-8000	210920	Oct. 02, 2024	Oct. 01, 2025
RF Cable	EMC	EMC104-35M-35M-3000	210922	Oct. 02, 2024	Oct. 01, 2025
Attenuator	Pasternack	PE7005-10	10-1	Oct. 02, 2024	Oct. 01, 2025
HIGHPASS FILTER 3.1-18G	WHK	WHK3.1/18G-10SS	39	Oct. 02, 2024	Oct. 01, 2025
Measurement Software	Sporton	SENSE-15247_DTS	V5.11	NA	NA
Measurement Software	Sporton	SENSE-EMI	V5.11	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	CBP (Contention Based Protocol)				
Test Site	(TH01-WS)				
Tested Date	Aug. 14, 2024				
Instrument	**Brand**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101063	Dec. 21, 2023	Dec. 20, 2024
AWGN Signal Gemerator	R&S	SMW200A	109619	Jul. 27, 2024	Jul. 26, 2025
Splitter	woken	0120A02201801O	DOM2AEW1A23	Oct. 13, 2023	Oct. 12, 2024
Directional Coupler	KRYTAR	180120	146890	Oct. 13, 2023	Oct. 12, 2024
RF Cable	WOKEN	woken-S05	S05-141231-110	Aug. 30, 2023	Aug. 29, 2024
RF Cable	EMC	EMC105SFF-SM-SM-2000	210816	Aug. 30, 2023	Aug. 29, 2024
RF Cable	EMC	EMC104-SM-SM-8000	181106	Aug. 30, 2023	Aug. 29, 2024
Attenuator	woken	PE7013-10	10-1	Oct. 13, 2023	Oct. 12, 2024
Attenuator	woken	PE7013-20	20-1	Oct. 13, 2023	Oct. 12, 2024
Measurement Software	NA	NA	NA	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 987594 D02 U-NII 6 GHz EMC Measurement v03
FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01
FCC KDB 412172 D01 Determining ERP and EIRP v01r01
FCC KDB 662911 D01 Multiple Transmitter Output 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	$\pm 1 \times 10^{-9}$
Power density	±0.583 dB
Conducted emission	±2.715 dB
AC conducted emission	±2.92 dB
Radiated emission ≤ 1GHz	±3.41 dB
Radiated emission > 1GHz	±4.59 dB
Time	±0.1%
Temperature	±0.4 °C

2 Test Configuration

2.1 Testing Facility

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

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

2.2 Test Modes and Channel Details

Test item	Modulation Mode	Test Frequency (MHz)	Data Rate	Test method	Mode	Test Configuration	Note
AC Power Line Conducted Emissions	ax HE20-OFDMA	7015	MCS 0	Conducted	TX	1	---
Unwanted Emissions ≤1GHz	ax HE20-OFDMA	7015	MCS 0	Radiated	TX	1, 2, 3, 4	Note 2
Unwanted Emissions >1GHz	11a ax HE20-OFDMA	5955 / 6175 / 6415 / 6435 6475 / 6515 / 6535 / 6715 / 6855 6875 / 6895 / 7015 / 7095 / 7115	6 Mbps MCS 0	Radiated	TX	1	Note 2
	11a	7095	6 Mbps	Radiated	TX	2, 3, 4	Note 2
	ax HE20-OFDMA	5955 / 6475 / 6875	MCS 0	Radiated	TX	2, 3, 4	Note 2
Unwanted Emissions ≤1GHz	ax HE20-OFDMA	7015	MCS 0	Conducted	TX	1, 2, 3, 4	---
Unwanted Emissions >1GHz	ax HE20-OFDMA	5955 / 6175 / 6415 / 6435 6475 / 6515 / 6535 / 6715 / 6855 6875 / 6895 / 7015 / 7095 / 7115	MCS 0	Conducted	TX	1	---
	11a	6875 / 7115	6 Mbps	Conducted	TX	2, 3, 4	---
	ax HE20-OFDMA	5955 / 6475	MCS 0	Conducted	TX	2, 3, 4	---
RF Output Power	11a ax HE20-OFDMA	5955 / 6175 / 6415 / 6435 6475 / 6515 / 6535 / 6715 / 6855 6875 / 6895 /	6 Mbps MCS 0	Conducted	TX	1, 2, 3, 4	---

		7015 / 7095 / 7115					
Emission Bandwidth In-Band Emissions	11a ax HE20-OFDMA	5955 / 6175 / 6415 / 6435 6475 / 6515 / 6535 / 6715 / 6855 6875 / 6895 / 7015 / 7095 / 7115	6 Mbps MCS 0	Conducted	TX	1	---
Power Spectral Density	11a ax HE20-OFDM	5955 / 6175 / 6415 / 6435 6475 / 6515 / 6535 / 6715 / 6855 6875 / 6895 / 7015 / 7095 / 7115	6 Mbps MCS 0	Conducted	TX	1	---
Contention Based Protocol	ax HE20-OFDMA	6215 / 6455 / 6695 / 7015	MCS 0	Conducted	TX	1	---
Frequency Stability	Un-modulation	6475 / 7015	---	Conducted	TX	1	---

NOTE:

1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Z-plane** result was found as the worst case and was shown in this report.
2. The 50Ω terminator is connected to antenna port of EUT for radiated emission measurement.
3. Test configurations are listed as below:

   Configuration 1: Laird part number: 453-00184

   Configuration 2: Laird part number: 453-00193

   Configuration 3: Laird part number: 453-00213

   Configuration 4: Laird part number: 453-00214

3 Transmitter Test Results

3.1 Emission Bandwidth

3.1.1 Limit

The maximum transmitter channel bandwidth for U-NII devices in the 5.925-7.125 GHz band is 320 megahertz.

3.1.2 Test Procedures

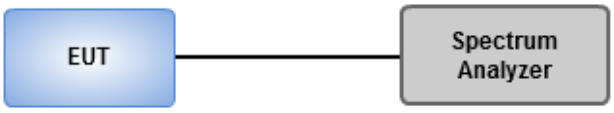
26dB Bandwidth

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 ≥ 3 RBW.
3. Sample detection and single sweep mode shall be used.
4. Use the 99 % power bandwidth function of the instrument.

3.1.3 Test Setup



3.1.4 Test Result

Ambient Condition	24-25°C / 61-62%	Tested By	Roger Lu

Refer to Appendix A.

3.2 RF Output Power

3.2.1 Limit

Frequency Band	Operating Mode	Maximum EIRP Limit
5925 ~ 7125 MHz	☐ Indoor access point	30 dBm
	☐ Subordinate device	30 dBm
	☒ Client devices	24 dBm

3.2.2 Test Procedures

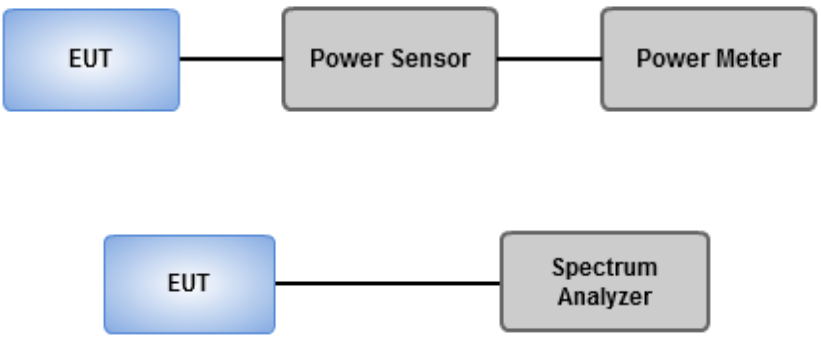
Method PM-G (Measurement using a gated RF average power meter)

1. 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.
2. EIRP = Measured conducted power + Antenna gain

Spectrum analyzer (For channel that extends across the 6.525 / 6.875 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%).
5. EIRP = Measured conducted power + Antenna gain

3.2.3 Test Setup



3.2.4 Test Result

Ambient Condition	24-25°C / 61-62%	Tested By	Roger Lu

Refer to Appendix B.

3.3 Power Spectral Density

3.3.1 Limit

Frequency Band	Operating Mode	Limit
5925 ~ 7125 MHz	☐ Indoor access point	EIRP: 5 dBm / 1 MHz
	☐ Subordinate device	EIRP: 5 dBm / 1 MHz
	☒ Client devices	EIRP: -1 dBm / 1 MHz

3.3.2 Test Procedures

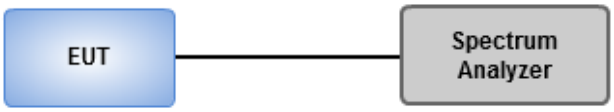
Duty cycle ≥ 98 %

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.
4. EIRP PSD = Measured conducted power density + Antenna gain

Duty cycle < 98 %

1. Set RBW = 1 MHz, VBW = 3 MHz, Detector = RMS.
2. Set sweep time ≥ 10 * (number of points in sweep) * (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.
6. EIRP PSD = Measured conducted power density + Antenna gain

3.3.3 Test Setup



3.3.4 Test Result

Ambient Condition	24-25°C / 61-62%	Tested By	Roger Lu

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	**PK Limit**	**AV Limit**
5.925 – 7.125 GHz	e.i.r.p. -7 dBm [88.2 dBuV/m@3m]	e.i.r.p. -27 dBm [68.2 dBuV/m@3m]

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

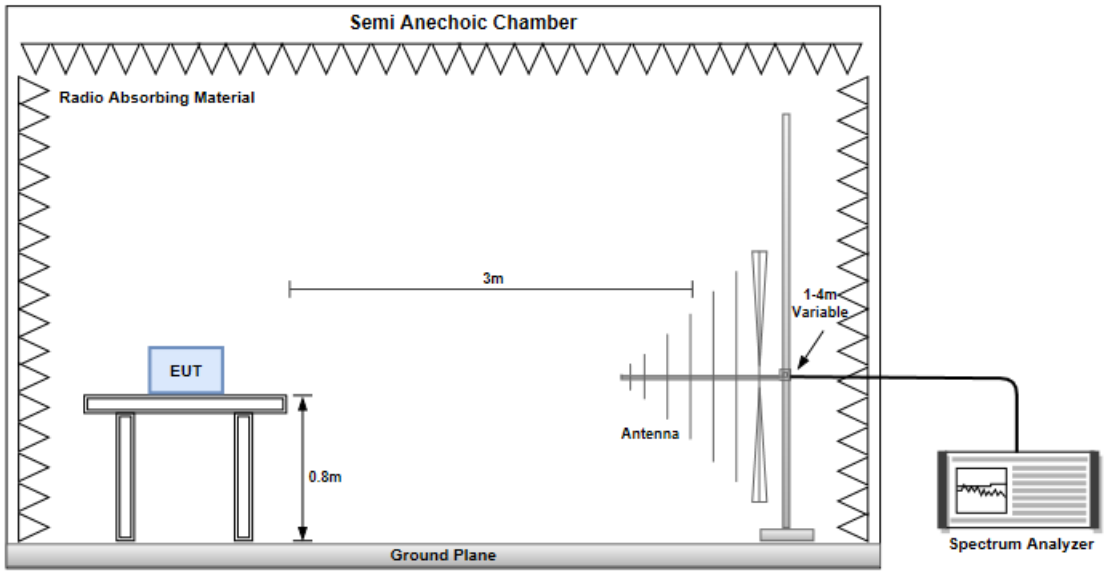
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission 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:

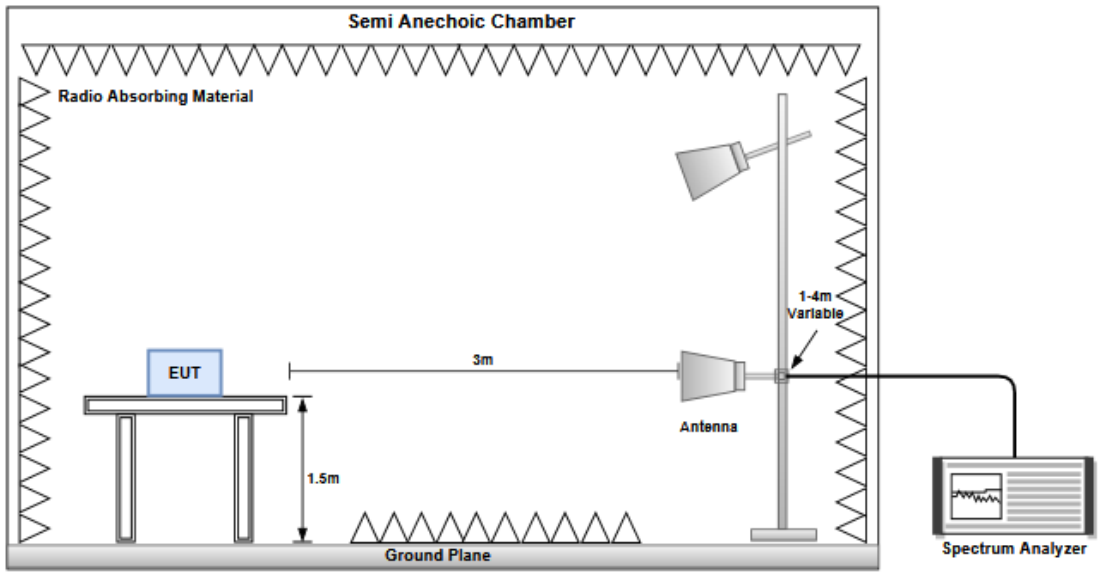
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above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

3.4.3 Test Setup

Radiated Emissions below 1 GHz



Radiated Emissions above 1 GHz



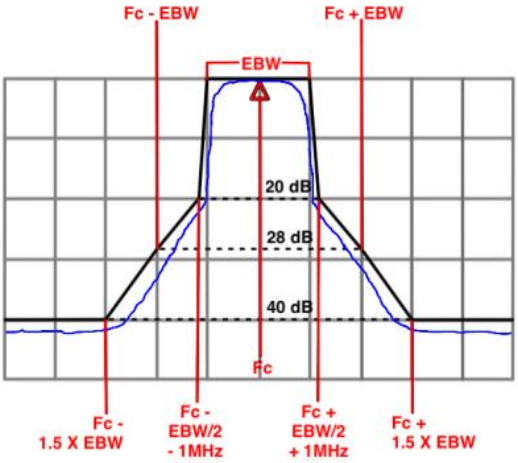
3.4.4 Test Results

Refer to Appendix D.

3.5 In-Band Emissions

3.5.1 Limit

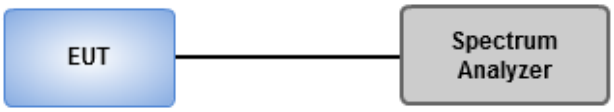
Power spectral density must be suppressed by 20 dB at 1 MHz outside of channel edge, by 28 dB at one channel bandwidth from the channel center, and by 40 dB at one- and one-half times the channel bandwidth away from channel center. At frequencies between one megahertz outside an unlicensed device's channel edge and one channel bandwidth from the center of the channel, the limits must be linearly interpolated between 20 dB and 28 dB suppression,and at frequencies between one and one- and one-half times an unlicensed device's channel bandwidth, the limits must be linearly interpolated between 28 dB and 40 dB suppression. Emissions removed from the channel center by more than one- and one-half times the channel bandwidth must be suppressed by at least 40 dB.



3.5.2 Test Procedures

1. Connect output of the antenna port to a spectrum analyzer
2. Set the reference level of the measuring equipment
3. Measure the 26 dB EBW
4. Measure the power spectral density (which will be used for emissions mask reference) using the following procedure:
   a) Set the span to encompass the entire 26 dB EBW of the signal.
   b) Set RBW = same RBW used for 26 dB EBW measurement.
   c) Set VBW ≥ 3 X RBW
   d) Number of points in sweep ≥ [2 X span / RBW].
   e) Sweep time = auto.
   f) Detector = RMS (i.e., power averaging)
   g) Trace average at least 100 traces in power averaging (rms) mode.
   h) Use the peak search function on the instrument to find the peak of the spectrum.
5. For the purposes of developing the emission mask, the channel bandwidth is defined as the 26 dB EBW
6. Using the measuring equipment limit line function, develop the emissions mask based on the following requirements. The emissions power spectral density must be reduced below the peak power spectral density (in dB) as follows
   a. Suppressed by 20 dB at 1 MHz outside of the channel edge. (The channel edge is defined as the 26-dB point on either side of the carrier center frequency.)
   b. Suppressed by 28 dB at one channel bandwidth from the channel center.
   c. Suppressed by 40 dB at one- and one-half times the channel bandwidth from the channel center.
7. Adjust the span to encompass the entire mask as necessary
8. Clear trace.
9. Trace average at least 100 traces in power averaging (rms) mode.
10. Adjust the reference level as necessary so that the crest of the channel touches the top of the emission mask

3.5.3 Test Setup



3.5.4 Test Results

Ambient Condition	24-25°C / 61-62%	Tested By	Roger Lu

Refer to Appendix E.

3.6 Frequency Stability

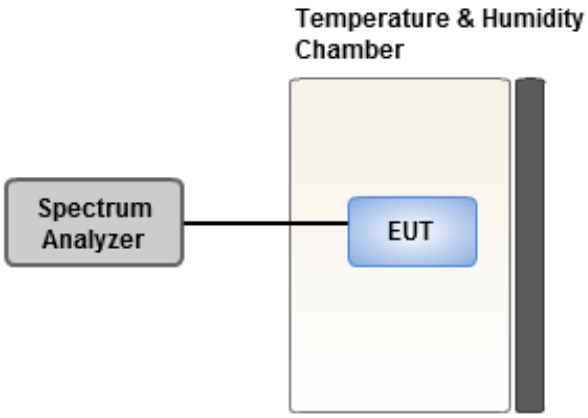
3.6.1 Limit of Frequency Stability

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.

3.6.2 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.

3.6.3 Test Setup



3.6.4 Test Result of Frequency Stability

Ambient Condition	24-25°C / 61-62%	Tested By	Roger Lu

Refer to Appendix F.

3.7 Contention Based Protocol

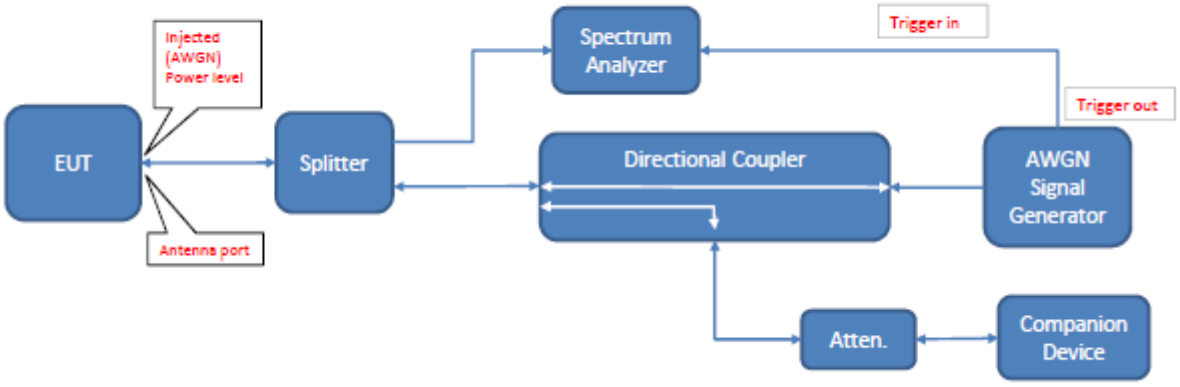
3.7.1 Limit

Unlicensed low-power indoor devices must detect co-channel radio frequency power that is at least -62 dBm or lower. The -62 dBm (or lower) threshold is referenced to a 0 dBi antenna gain. Additionally, low-power indoor devices must detect co-channel energy with 90% or greater certainty

3.7.2 Test Procedure

1. Configure the EUT to transmit with a constant duty cycle
2. Set the operating parameters of the EUT including power level, operating frequency, modulation and bandwidth
3. Set the signal analyzer center frequency to the nominal EEUT channel center frequency. The span range of the signal analyzer shall be between two times and five times the OBW of the EUT. Connect the output port of the EUT to the signal analyzer 2, as shown in Figure 2. Ensure that the attenuator 2 provides enough attenuation to not overload the signal analyzer 2 receiver.
4. Monitoring the signal analyzer 2, verify the EUT is operating and transmitting with the parameters set at step two.
5. Using an AWGN signal source, generate (but do not transmit, i.e., RF OFF) a 10 MHz-wide AWGN signal. Use Table 1 to determine the center frequency of the 10 MHz AWGN signal relative to the EUT's channel bandwidth and center frequency.
6. Set the AWGN signal power to an extremely low level (more than 20 dB below the -62 dBm threshold). Connect the AWGN signal source, via a 3-dB splitter, to the signal analyzer 1 and the EUT as shown in Figure 2
7. Transmit the AWGN signal (RF ON) and verify its characteristics on the signal analyzer 1.
8. Monitor the signal analyzer 2 to verify if the AWGN signal has been detected and the EUT has ceased transmission. If the EUT continues to transmit, then incrementally increase the AWGN signal power level until the EUT stops transmitting.
9. (Including all losses in the RF paths) Determine and record the AWGN signal power level (at the EUT's antenna port) at which the EUT ceased transmission. Repeat the procedure at least 10 times to verify the EUT can detect an AWGN signal with 90% (or better) level of certainty.
10. Refer to Table 1 to determine number of times the detection threshold testing needs to be repeated. If testing is required more than once, then go back to step 5, choose a different center frequency for the AWGN signal and repeat the process.

3.7.3 Test Setup



3.7.4 Test Result

Ambient Condition	23°C / 65%	Tested By	Aska Huang
EUT FW version	config_sdio_prod_v28.10.301.trxse		

Refer to Appendix G.

3.8 AC Power Line Conducted Emissions

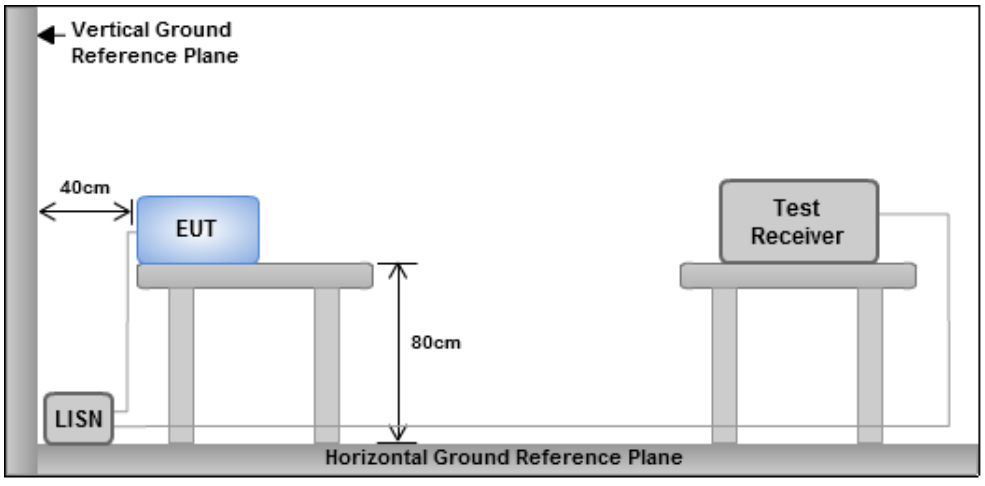
3.8.1 Limit of AC Power Line Conducted Emissions

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.		

3.8.2 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

3.8.3 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

3.8.4 Test Result

Refer to Appendix H.

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	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No.30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan (R.O.C.)	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.)	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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