

RADIO TEST REPORT

Product : WLAN TRANSCEIVER
Model Name : IP110H
FCC ID : AFJ399510
Test Regulation : FCC 47 CFR Part 15 Subpart C (Section 15.247)
Received Date : 2024/1/26
Test Date : 2024/1/29 ~ 2024/2/1
Issued Date : 2024/5/9

Applicant : Icom Incorporated
1-1-32, Kamiminami, Hirano-Ku, Osaka, 547-0003, Japan

Issued By : Underwriters Laboratories Taiwan Co., Ltd.
Building A, B and E, No. 372-7, Sec. 4, Zhongxing Rd.,
Zhudong Township, Hsinchu County, Taiwan



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Doc No: Form-ULID-004737 (DCS:17-EM-F0876) / 6.1

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1. Attestation of Test Results

APPLICANT: Icom Incorporated
1-1-32, Kamiminami, Hirano-Ku, Osaka, 547-0003, Japan

MANUFACTURER: Icom Incorporated
1-1-32, Kamiminami, Hirano-Ku, Osaka, 547-0003, Japan

EUT DESCRIPTION: WLAN TRANSCEIVER

BRAND: ICOM

MODEL: IP110H

SAMPLE STAGE: Engineering Verification Test sample

DATE of TESTED: 2024/1/29 ~ 2024/2/1

APPLICABLE STANDARDS	
STANDARD	Test Results
FCC 47 CFR PART 15 Subpart C (Section 15.247)	PASS

Underwriters Laboratories Taiwan Co., Ltd. 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 Underwriters Laboratories Taiwan Co., Ltd. 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.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:



Cindy Hsin
Project Handler

Date : 2024/5/9

Approved and Authorized By:



Eric Lee
Senior Laboratory Engineer

Date : 2024/5/9

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2. Summary of Test Results

Summary of Test Results		
FCC Clause	Test Items	Result
15.247(a)(2)	6dB Bandwidth	See Note 1
15.247(b)	Conducted Output Power	See Note 1
15.247(e)	Power Spectral Density	See Note 1
15.247(d)	Antenna Port Emission	See Note 1
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	PASS
15.207	AC Power Conducted Emission	PASS
15.203	Antenna Requirement	See Note 1

Note:

1. This report is as a supplementary report of report no.: 4790590080-US-R0-V1. Except that AC Power Conducted Emission and Radiated Spurious Emission (below 1GHz), others result refer to the original report.

3. Test Methodology and Reference Procedures

The tests documented in this report were performed in accordance with 47 CFR FCC Part 2, KDB 558074 D01 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013.

4. Facilities and Accreditation

Test Location	Underwriters Laboratories Taiwan Co., Ltd.
Address	Building A, B and E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
Accreditation Certificate	Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398.

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5. Measurement Uncertainty

For statement of conformity, simple acceptance (Section 3.1.4 of IEC Guide 115) was applied as decision rule for measurement in this test report.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k=2$.

Determining compliance based on the results of the compliance measurement, not considering measurement instrumentation uncertainty.

Measurement	Frequency	Uncertainty
Conducted disturbance at mains terminals ports	150kHz ~ 30MHz	3.1 dB
RF Conducted	9 kHz - 40GHz	2.3 dB
Radiated disturbance below 30MHz	9 kHz - 30 MHz	3.2 dB
Radiated disturbance below 1 GHz	30MHz ~ 1GHz	6.1 dB
Radiated disturbance above 1 GHz	1GHz ~ 40GHz	5.1 dB

6. Equipment under Test

6.1. Description of EUT

Product	WLAN TRANSCEIVER
Brand Name	ICOM
Model Name	IP110H
Operating Frequency	2412MHz ~ 2462MHz
Modulation	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Transfer Rate	802.11b: up to 11 Mbps 802.11g: up to 54 Mbps 802.11n: up to MCS7
Number of Channel	11 for 802.11b, 802.11g, 802.11n (HT20) 7 for 802.11n (HT40)
Maximum Output Power	802.11b: 15.44 dBm 802.11g: 15.87 dBm 802.11n (HT20): 18.86 dBm 802.11n (HT40): 18.51 dBm
Normal Voltage	5Vdc from host 3.75Vdc for battery
Sample ID	Conducted Test: 6863912 Radiated Test: 6863912
S/N	399543000464

Note:

1. This report is as a supplementary report of report no.: 4790590080-US-R0-V1. The differences were as below:

- Changed BT module, new model name is HRM1086.
- Add one adapter table as below:

Newly			
Product	Brand	Model	Description
AC Adapter 2	ICOM	BC-258A	Input: 100-240V, 50/60Hz, 0.45A, Output: 5.0V, 2A
Original			
Product	Brand	Model	Description
AC Adapter 1	ICOM	BC-258	Input: 100-240V, 50/60Hz, 0.45A, Output: 5.0V, 2A
USB Cable	ICOM	OPC-2480	Length: 1m
Charger Cradle	ICOM	BC-257	-
AC Adapter (for Cradle)	ICOM	BC-228	-

2. The BT module in this project adopts the Contain ID method, so all conducted output power has been verified. Due to the addition of a new adapter, the worst case of AC Power Conducted Emission and Radiated Spurious Emission (below 1GHz) need to be performed, other test results are referred to the original report.

3. The EUT incorporates a SISO function. Physically, the EUT provides one completed transmitters and one receivers.

Modulation Mode	Tx,Rx Function
802.11b	1TX,1RX
802.11g	1TX,1RX
802.11n (HT20)	1TX,1RX
802.11n (HT40)	1TX,1RX

4. The EUT contains following accessory devices:

Product	Brand	Model	Description
AC Adapter 1	ICOM	BC-258	Input: 100-240V, 50/60Hz, 0.45A, Output: 5.0V, 2A
AC Adapter 2	ICOM	BC-258A	Input: 100-240V, 50/60Hz, 0.45A, Output: 5.0V, 2A
USB Cable	ICOM	OPC-2480	Length: 1m
Charger Cradle	ICOM	BC-257	-
AC Adapter (for Cradle)	ICOM	BC-228	-

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5. The EUT could be supplied with rechargeable battery as the following table:

Brand Name	Model	Description
ICOM	RB-LB1081	3.75V, 3200mAh 12Wh

6. The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual, the laboratory shall not be held responsible.

6.2. Channel List

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437	-	-

7 channels are provided for 802.11n (HT40):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
3	2422	7	2442
4	2427	8	2447
5	2432	9	2452
6	2437	-	-

6.3. Test Condition

Test Item	Test Site No.	Environmental Condition	Input Power	Test Date	Tested by
Radiated Spurious Emission	966-3	22~26°C/ 62~68%RH	5Vdc from host	2024/01/29	Eric Peng
AC power Line Conducted Emission	SR1	23~26°C/ 60~66%RH	120Vac/ 60Hz	2024/02/01	Eric Peng

FCC Test Firm Registration Number: 498077

Sample Calculation:

Radiated Spurious Emission:

- Where relevant, the follow sample calculation is provided:
Result Value (dBuV/m) = Reading Value (dBuV) + Correction Factor (dB/m).
Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB) - Preamp Factor (dB).
Example: Result Value (34.5dBuV/m) = Reading Value (40.1dBuV) + Antenna Factor (18.7dB/m) + Cable Loss (4.2dB) - Preamp Factor (28.5dB).

AC power Line Conducted Emission:

- Where relevant, the follow sample calculation is provided:
Result Value (dBuV) = Reading Value (dBuV) + Correction Factor (dB).
Correction Factor (dB) = Insertion loss(dB) + Cable loss(dB).
Example: Result Value (53.7dBuV) = Reading Value (35.1dBuV) + Insertion loss(18.1dB) + Cable loss(0.5dB).

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6.4. Description of Available Antennas

Ant. No.	Brand Name	Model Name	Ant. Type	Maximum Gain (dBi)
1	Japan Aviation Electronics Industry, Limited	AN01DL25C00R3200	Split ring	2.4GHz: 1.15 5.18~5.32GHz: 0.15 5.50~5.82GHz:0.62

Note: The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual, the laboratory shall not be held responsible.

6.5. Test Mode Applicability and Tested Channel Detail

- This report is as a supplementary report of report no.: 4790590080-US-R0-V1. The differences were as below:
 - Add one adapter, model name is BC-258A.
- According to the changed above, used the normal operation of radiated spurious emission (below 1GHz) and AC power line conduction emission needs to be performed only.

Test Item	Mode
Radiated Emissions (Below 1GHz)	Normal Operation
AC Power Line Conducted Emission	Normal Operation

7. Test Equipment

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Expired date
Radiated Spurious Emission					
Spectrum Analyzer	Keysight	N9010A	MY56070827	2023/4/7	2024/4/6
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	2023/11/22	2024/11/21
Loop Antenna	ETS lindgren	6502	00213440	2023/12/13	2024/12/12
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck & EMCI	VULB 9168 & N-6-05	774 & AT-N0538	2024/1/5	2025/1/4
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	2023/12/8	2024/12/7
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	781	2023/12/27	2024/12/26
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	2023/6/7	2024/6/6
Preamplifier (1-18 GHz)	EMCI	EMC051835BE	980406	2023/2/17	2024/2/16
Preamplifier (18-40GHz)	EMCI	EMC184040SEE	980426	2023/5/9	2024/5/8
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-4 & 170425-2	2023/11/29	2024/11/28
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-1 & 170214-2	2023/11/29	2024/11/28

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Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Expired date
AC power Line Conducted Emission					
EMI Test Receiver	Rohde & Schwarz	ESR7	101753	2023/10/23	2024/10/22
Two-Line V-Network	Rohde & Schwarz	ENV216	102136	2023/5/24	2024/5/23
Impuls-Begrenzer Pulse Limiter	Rohde & Schwarz	ESH3-Z2	102219-Qt	2023/9/7	2024/9/6
Cables	TITAN	CFD200	T0732ACFD200 20A300-2	2023/5/23	2024/5/22

UL Software		
Description	Name	Version
Radiated measurement	e3	6.191211 (V6)
AC power Line Conducted Emission	EZ_EMG	UL-3A1.2

8. Description of Test Setup

Support Equipment

ID	Equipment	Brand Name	Model Name	S/N	Remark
A	AC Adapter	ICOM	BC-258A	NA	Supplied by Client
B	Microphone	ICOM	HM179PI	NA	Supplied by Client

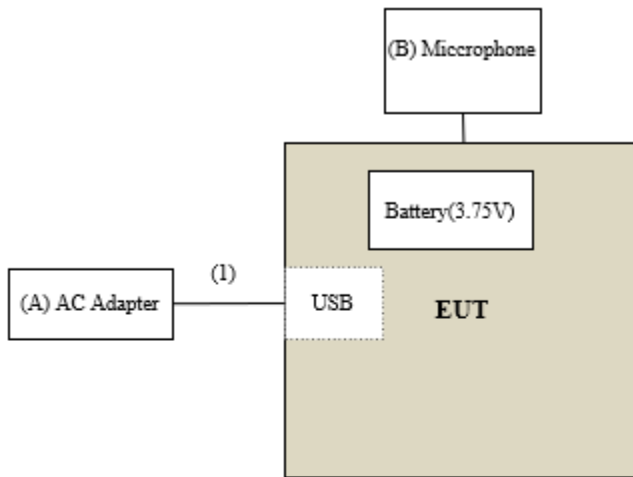
I/O Cables

ID	Equipment	Brand Name	Model Name	Length (m)	Remark
1	USB cable (typeA-typeC)	ICOM	OPC-2480	1	Supplied by Client

Test Setup

Controlled using a bespoke application (MFG Tool) on a test Notebook. The application was used to enable a continuous transmission mode and to select the test channels, data rates, modulation schemes and power setting as required.

Setup Diagram for Test



Under Table

Remote Site

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9. Test Results

9.1. Radiated Spurious Emission

Requirements

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

Frequency(MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

Test Procedures

[For 9 kHz ~ 30 MHz]

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. For measurement below 30MHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

[For above 30 MHz]

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
- f. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

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Note:

- a. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
- b. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
- c. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.

Configuration	Average	
	RBW	VBW
802.11b	1MHz	Duty cycle refer to original report.
802.11g		
802.11n (HT20)		
802.11n (HT40)		

- d. All modes of operation were investigated (includes all external accessories) and the worst-case emissions are reported, the other emission levels were low against the limit.
- e. Test data of Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
- f. Test data of Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
- g. Test data of Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB) - Preamp Factor (dB).
- h. Test data of Notation "@" = Fundamental Frequency
- i. Test data of Notation "*" = The peak result under 20 dB above and complies with AVG limit, AVG result is deemed to comply with AVG limit.

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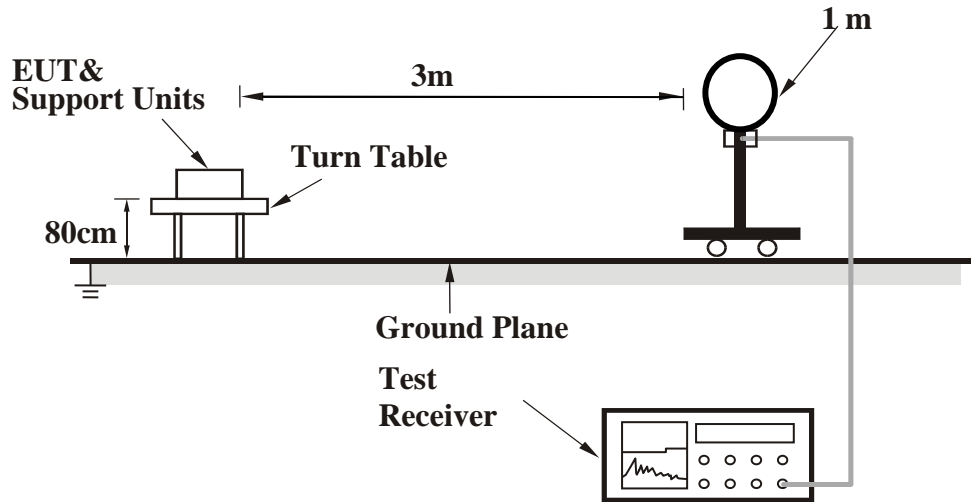
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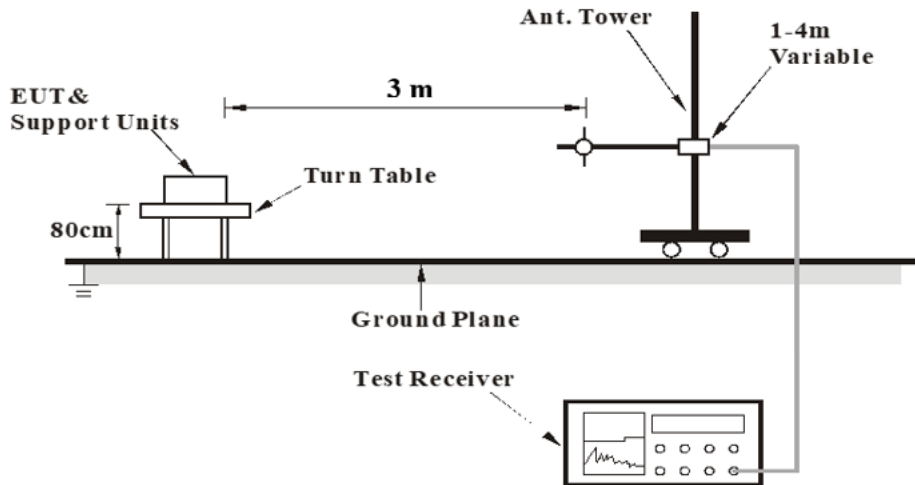
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Test Setup

<Frequency Range 9 kHz ~ 30 MHz>



<Frequency Range 30 MHz ~ 1 GHz >



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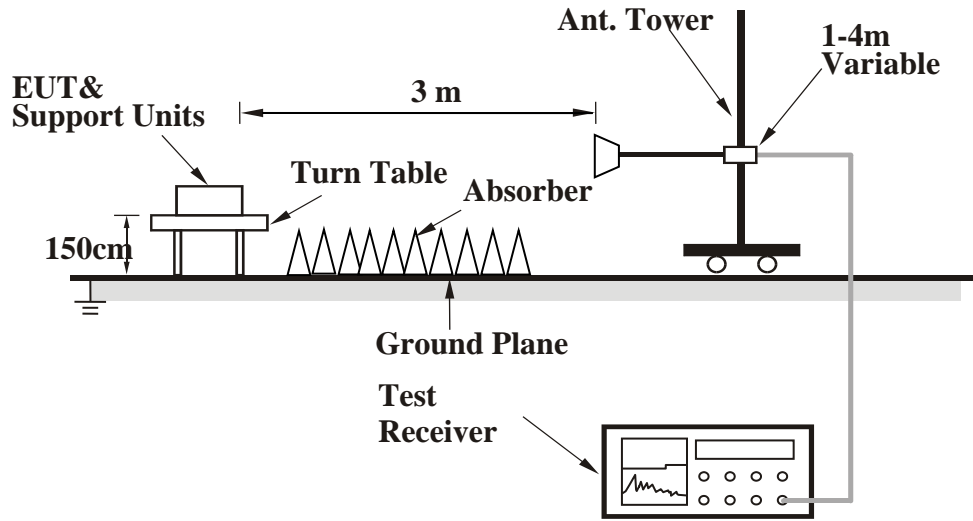
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<Frequency Range above 1 GHz>



For the actual test configuration, please refer to the Setup Configurations.

Test Data

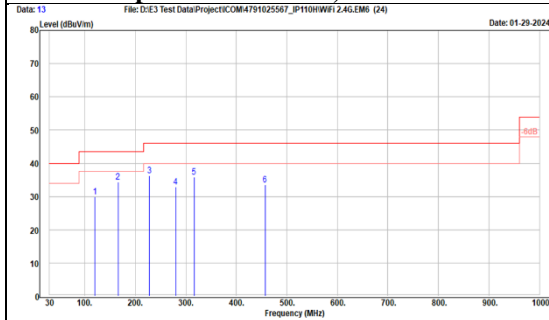
Below 1 GHz

Mode	Normal operation	Channel	N/A
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Polarization	Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
		(MHz)	(dBuV)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
Horizontal		120.21	42.72	-12.83	29.89	43.5	-13.61	PK
		165.8	44.94	-10.67	34.27	43.5	-9.23	PK
		227.88	49.73	-13.44	36.29	46	-9.71	PK
		280.26	43.11	-10.32	32.79	46	-13.21	PK
		316.15	44.99	-9.15	35.84	46	-10.16	PK
		456.8	38.71	-5.24	33.47	46	-12.53	PK
Vertical		165.8	34.53	-10.67	23.86	43.5	-19.64	PK
		228.85	49.25	-13.31	35.94	46	-10.06	PK
		299.66	36.36	-9.76	26.6	46	-19.4	PK
		370.47	37.26	-7.82	29.44	46	-16.56	PK
		458.74	33.52	-5.19	28.33	46	-17.67	PK
		534.4	32.83	-3.66	29.17	46	-16.83	PK

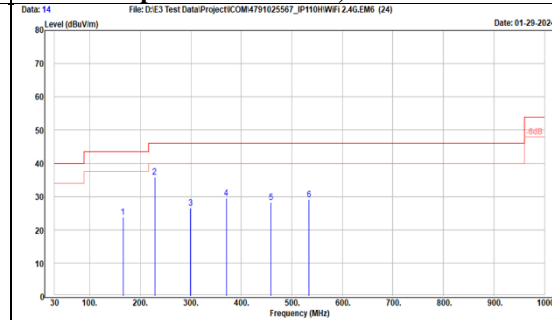
TX, Normal operation (N/A)

Radiated Spurious Emission, Horizontal



TX, Normal operation (N/A)

Radiated Spurious Emission, Vertical



9 kHz ~ 30 MHz Data:

For 9 kHz to 30 MHz radiated emission have performed all modes of operation were investigated. The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

No non-compliance noted:

KDB 414788 D01 OATS and Chamber Correlation Justification

- Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

- OATs and chamber correlation testing had been performed and chamber measured test results is the worst case test result.

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30m open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

9.2. AC Power Line Conducted Emission

Requirements

Frequency (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50

Note:

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

Test Procedures

- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.
2. All modes of operation were investigated (includes all external accessories) and the worst-case emissions are reported, the other emission levels were low against the limit.
3. Test data of Result value (dB μ V) = Reading value (dB μ V) + Correction Factor (dB).
4. Test data of Margin(dB) = Result value (dB μ V) - Limit value (dB μ V).
5. Test data of Correction Factor (dB) = Insertion loss(dB) + Cable loss(dB).

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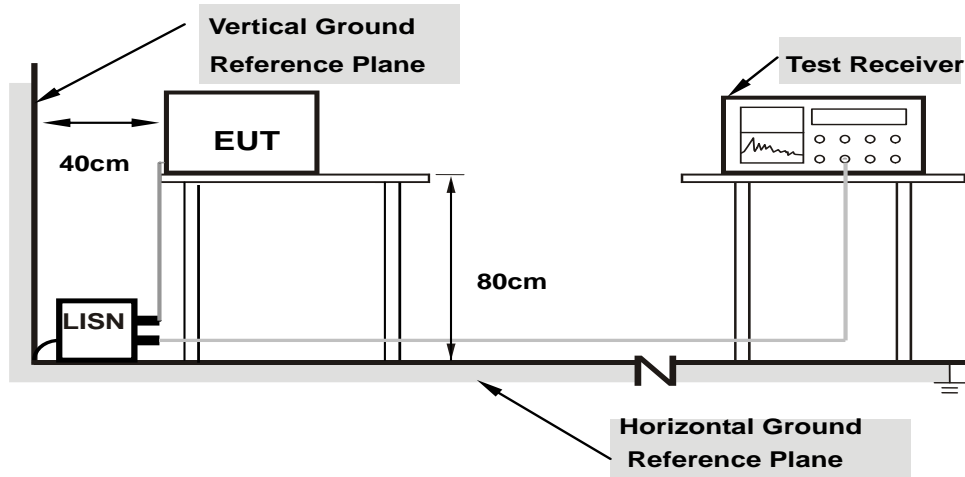
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Test Setup

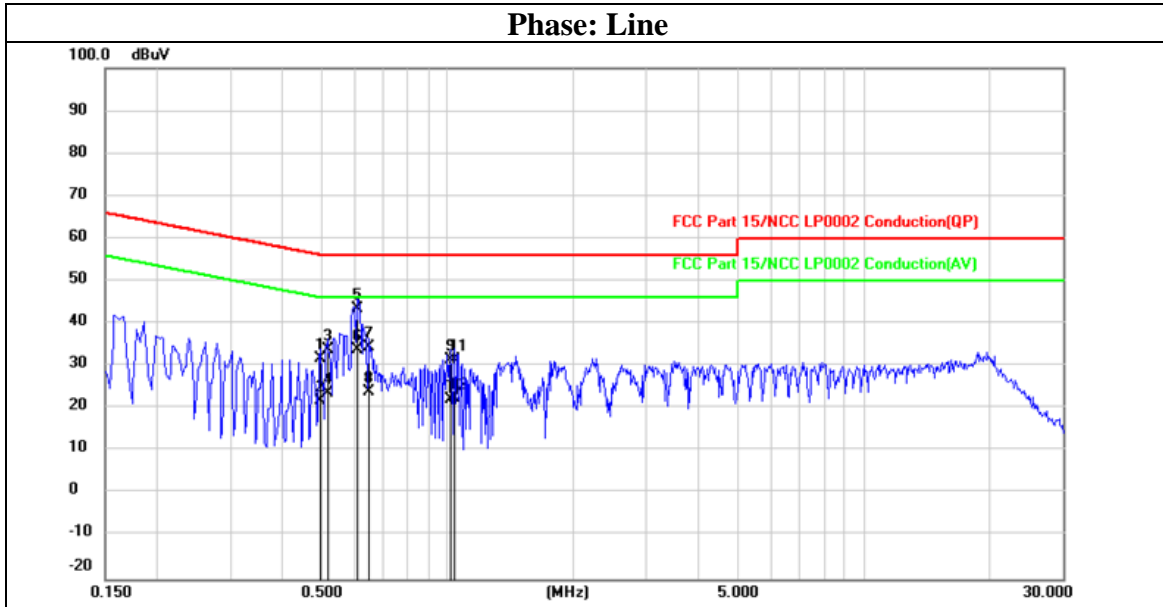


Note: 1.Support units were connected to second LISN.

For the actual test configuration, please refer to the Setup Configurations.

Test Data

Mode	Normal operation	Channel	N/A
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No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dB)	
1	0.4940	21.70	9.95	31.65	56.10	-24.45	QP
2	0.4940	11.85	9.95	21.80	46.10	-24.30	AVG
3	0.5140	23.84	9.95	33.79	56.00	-22.21	QP
4	0.5140	13.64	9.95	23.59	46.00	-22.41	AVG
5	0.6060	33.52	9.96	43.48	56.00	-12.52	QP
6	0.6060	23.79	9.96	33.75	46.00	-12.25	AVG
7	0.6460	24.36	9.96	34.32	56.00	-21.68	QP
8	0.6460	13.91	9.96	23.87	46.00	-22.13	AVG
9	1.0140	21.39	9.98	31.37	56.00	-24.63	QP
10	1.0140	12.12	9.98	22.10	46.00	-23.90	AVG
11	1.0339	21.56	9.98	31.54	56.00	-24.46	QP
12	1.0339	12.35	9.98	22.33	46.00	-23.67	AVG

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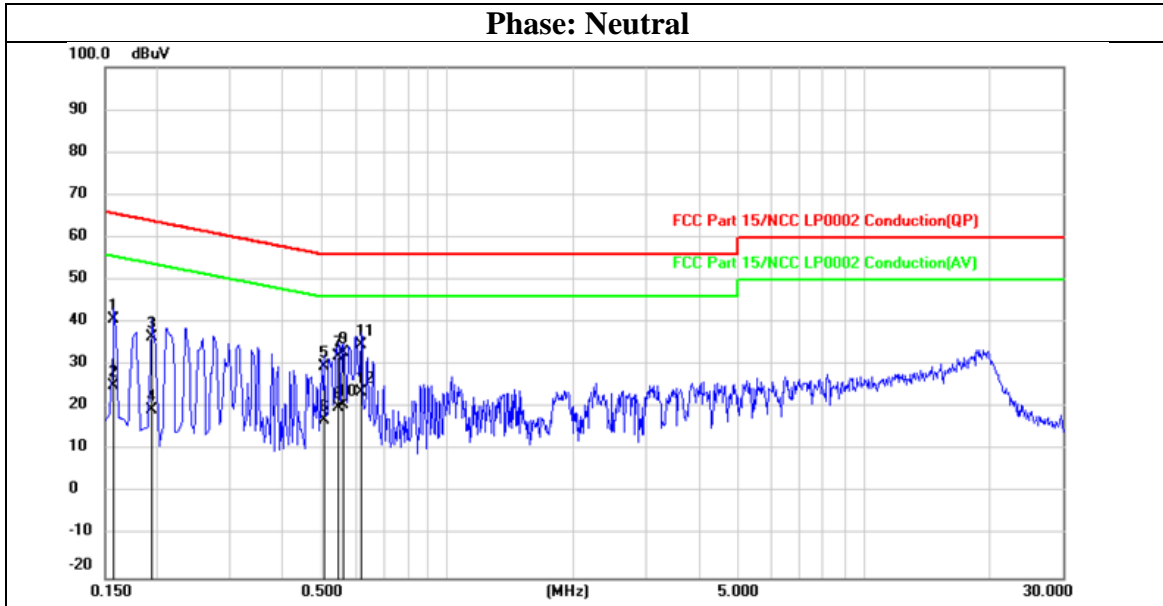
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Mode	Normal operation	Channel	N/A
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1580	30.77	9.95	40.72	65.57	-24.85	QP
2	0.1580	15.13	9.95	25.08	55.57	-30.49	AVG
3	0.1940	26.66	9.94	36.60	63.86	-27.26	QP
4	0.1940	9.65	9.94	19.59	53.86	-34.27	AVG
5	0.5060	19.67	9.95	29.62	56.00	-26.38	QP
6	0.5060	7.19	9.95	17.14	46.00	-28.86	AVG
7	0.5460	22.17	9.95	32.12	56.00	-23.88	QP
8	0.5460	9.97	9.95	19.92	46.00	-26.08	AVG
9	0.5620	22.89	9.95	32.84	56.00	-23.16	QP
10	0.5620	10.77	9.95	20.72	46.00	-25.28	AVG
11	0.6180	24.81	9.95	34.76	56.00	-21.24	QP
12	0.6180	13.74	9.95	23.69	46.00	-22.31	AVG

END OF REPORT

Underwriters Laboratories Taiwan Co., Ltd.

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