



FCC RADIO TEST REPORT

FCC ID : 2AEUPBHALP032
Equipment : Video Doorbell Pro 2
Brand Name : Ring
Model Name : 5AT2S2
Applicant : Ring LLC
1523 26th St, Santa Monica, CA 90404, USA
Manufacturer : Goertek Inc.
No.268 Dongfang Road High-Tech Industrial
Development District, Weifang Shandong, China
Standard : FCC Part 15 Subpart C §15.249

The product was received on Mar. 30, 2022 and testing was performed from Apr. 21, 2022 to May 19, 2022. We, Sporton International Inc. Wensan Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.

Approved by: Louis Wu

Sporton International Inc. Wensan Laboratory

No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)



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Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
-	2.1049	99% Occupied Bandwidth	Not Required	-
3.1	15.249(a) 15.249(d)	Field Strength of Fundamental and Radiated Spurious Emission	Pass	3.29 dB under the limit at 72187.000 MHz
3.2	15.207	AC Conducted Emission	Pass	23.63 dB under the limit at 0.422 MHz
-	15.249(b)	Frequency Stability	Not Required	Note
3.3	15.203	Antenna Requirements	Pass	

Note:

1. Only applicable to fixed point to point systems.
2. Not required means after assessing, test items are not necessary to carry out.
3. This is a variant report by changing hardware to remove LoRa PA. All the test cases were performed on original report which can be referred to Sporton Report Number FR093009. Based on the original report, the test cases were verified.

Declaration of Conformity:

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
It's means measurement values may risk exceeding the limit of regulation standards, if measurement uncertainty is include in test results.
2. The measurement uncertainty please refer to report "Uncertainty of Evaluation".

Comments and Explanations:

The product specifications of the EUT presented in the report are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Lewis Ho
Report Producer: Vivian Hsu



1 General Description

1.1 Product Feature of Equipment Under Test

Bluetooth, Wi-Fi 2.4GHz 802.11b/g/n, Wi-Fi 5GHz 802.11a/n/ac, LoRa, and 24G Radar.

Product Feature		
Antenna Type	WLAN: <Ant. 0>: Loop Antenna <Ant. 1>: Loop Antenna	
	Bluetooth: Loop Antenna LoRa: IFA Antenna 24GHz Radar: Patch Antenna	
Antenna information		
24.05 GHz ~ 24.25 GHz	Peak Gain (dBi)	2

Remark: The EUT's information above is declared by manufacturer. Please refer to Comments and Explanations in report summary.

1.2 Modification of EUT

No modifications are made to the EUT during all test items.



1.3 Testing Location

Test Site	Sporton International Inc. EMC & Wireless Communications Laboratory	
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978	
Test Site No.	Sporton Site No.	
	CO05-HY (TAF Code: 1190)	
Test Engineer	Calvin Wang	
Temperature (°C)	23~26	
Relative Humidity (%)	45~55	
Remark	The Conducted Emission test item subcontracted to Sporton International Inc. EMC & Wireless Communications Laboratory.	

Note: The test site complies with ANSI C63.4 2014 requirement.

Test Site	Sporton International Inc. Wensan Laboratory	
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855	
Test Site No.	Sporton Site No.	
	03CH12-HY	03CH18-HY
Test Engineer	Jack Cheng	Eric Cheng
Temperature (°C)	20.8~26.8	22.5~25.3
Relative Humidity (%)	58.0~68.2	55.2~58.5

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW1190 and TW3786

1.4 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC Part 15 Subpart C §15.249
- ♦ ANSI C63.10-2013

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.

2 Test Configuration of Equipment Under Test

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and find Y plane as worst plane.

- b. AC power line Conducted Emission was tested under maximum output power.

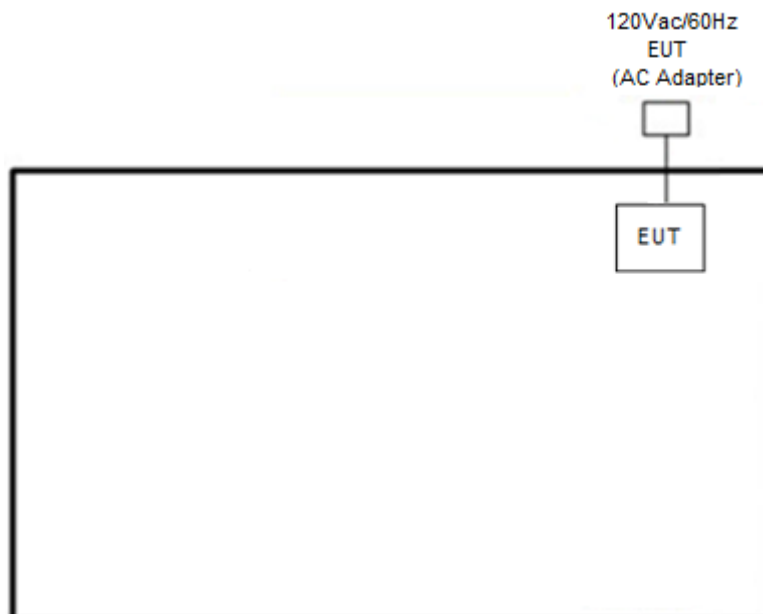
2.1 Carrier Frequency and Test Mode

Frequency Band	Frequency (MHz)	Modulation
24.05-24.25 GHz	24060	CW

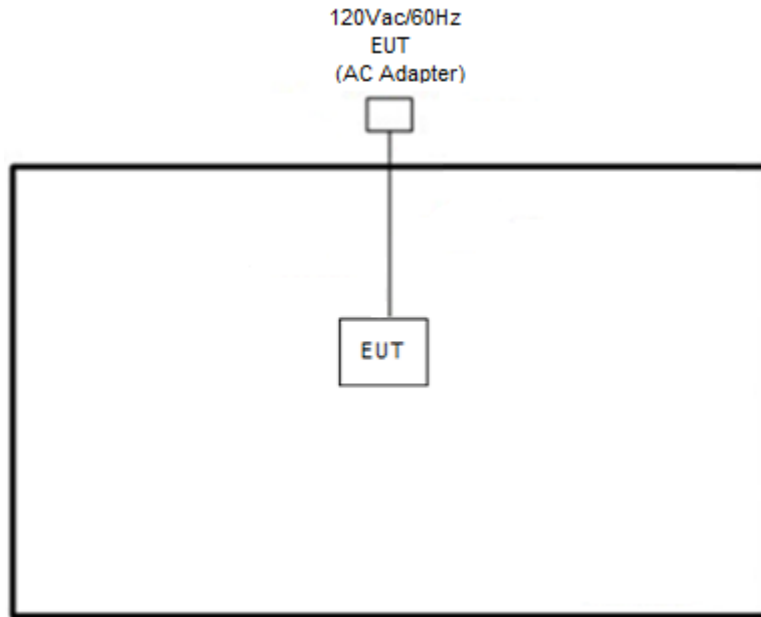
Test Cases	
AC Conducted Emission	Mode 1 :24G Radar TX + AC Adapter

2.2 Connection Diagram of Test System

<AC Conducted Emission Mode>



<WLAN Tx Mode>



2.3 EUT Operation Test Setup

The RF test items, utility "Telnet" was installed in Notebook and connected to the EUT which was programmed in order to make the EUT get into the engineering modes for continuous transmitting signals.



3 Test Result

3.1 Field Strength of Fundamental/Harmonics and Radiated Spurious Emission Measurement

3.1.1 Limit

The field strength measured at 3 meters shall not exceed the limits in the following table:

Rules and specifications	FCC CFR 47 Part 15 section 15.249	
Description	Field strength of fundamental	
24.0~24.25 (GHz)	Field strength of fundamental (millivolts/meter) at 3m	Field strength of fundamental (dBµV/m) at 3m
Average limits	250	107.95
Peak limits	-	127.95
Description	Field strength of harmonics	
24.0~24.25 (GHz)	Field strength of harmonics (microvolts/meter) at 3m	Field strength of harmonics (dBµV/m) at 3m
Average limits	2500	67.95
Peak limits	-	87.95
Note: Above 18GHz, the distance correction factor is used, 18GHz to 90GHz : 20log (1m/3m)= -9.54dB ; 90GHz – 100GHz: 20log (0.5m/3m)= -15.56dB.		

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation

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

3.1.2 Measuring Instruments

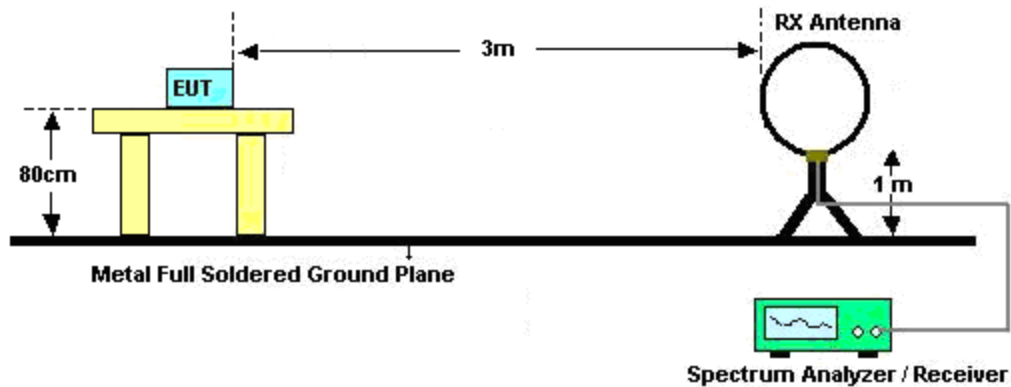
See list of measuring equipment of this test report.

3.1.3 Test Procedures

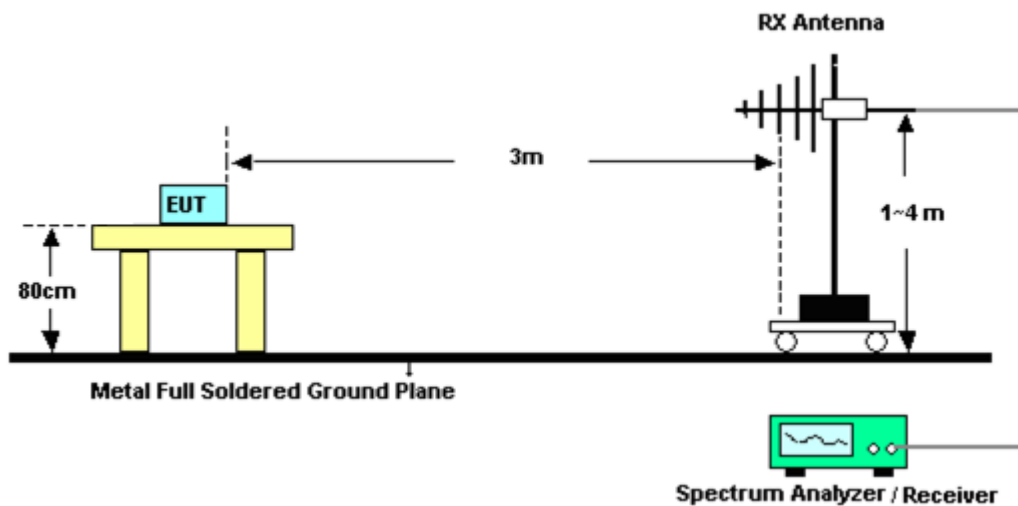
For emissions 9KHz to 40GHz, ANSI C63.10 Section 6.3 Radiated emissions testing follows, and for emissions 40GHz to 100GHz, ANSI C63.10 Section 9.8 and 9.9 radiated measurements follows. The EUT was placed on a turntable with 0.8 meter height for frequency below 1GHz and with 1.5 meter height for frequency above 1GHz, and was arranged test distance as shown in Section 3.4 Test Setup, respectively. For emissions, test results are attenuated more than 20 dB below the permissible value need not be reported in accordance with FCC Part 15.31(O).

3.1.4 Test Setup

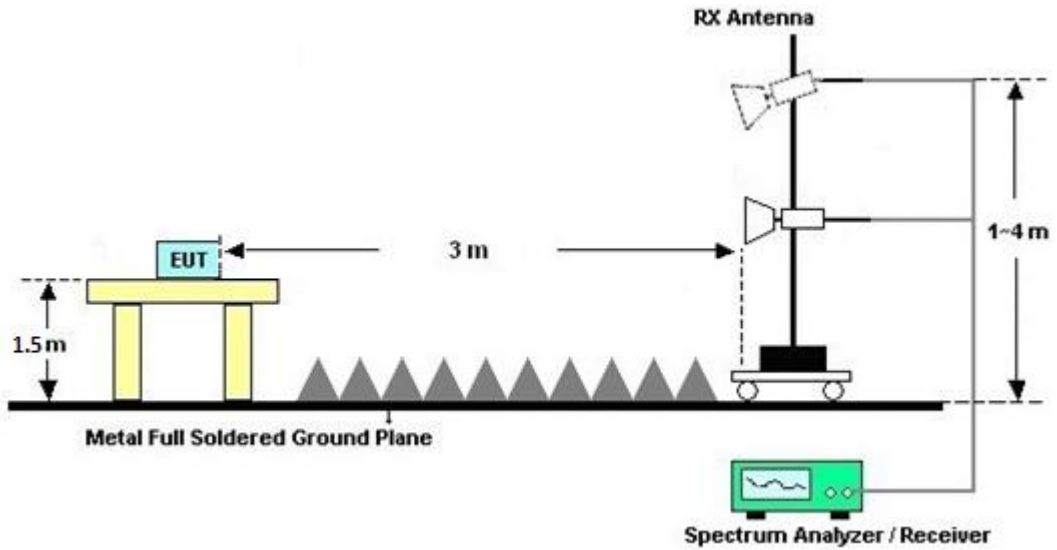
<For radiated emissions below 30MHz>



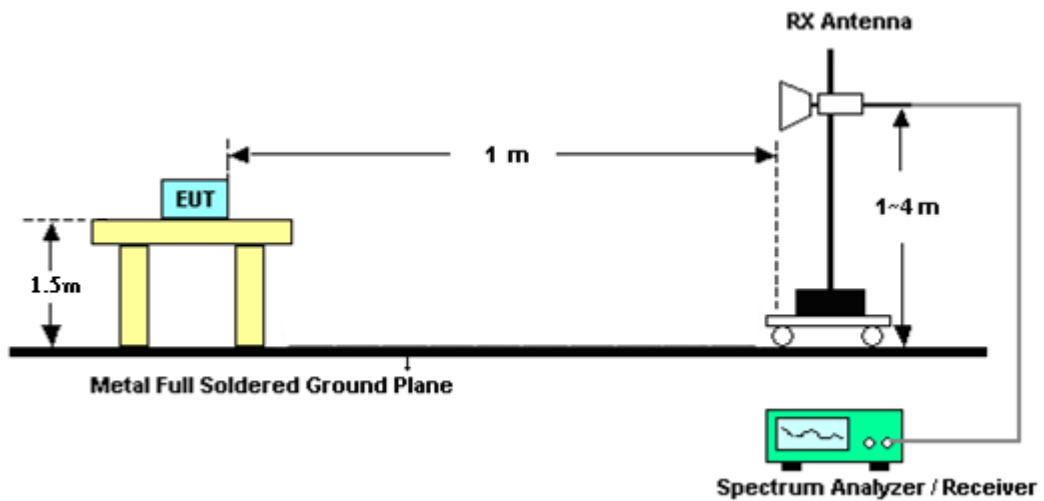
<For radiated emissions from 30MHz ~ 1GHz>



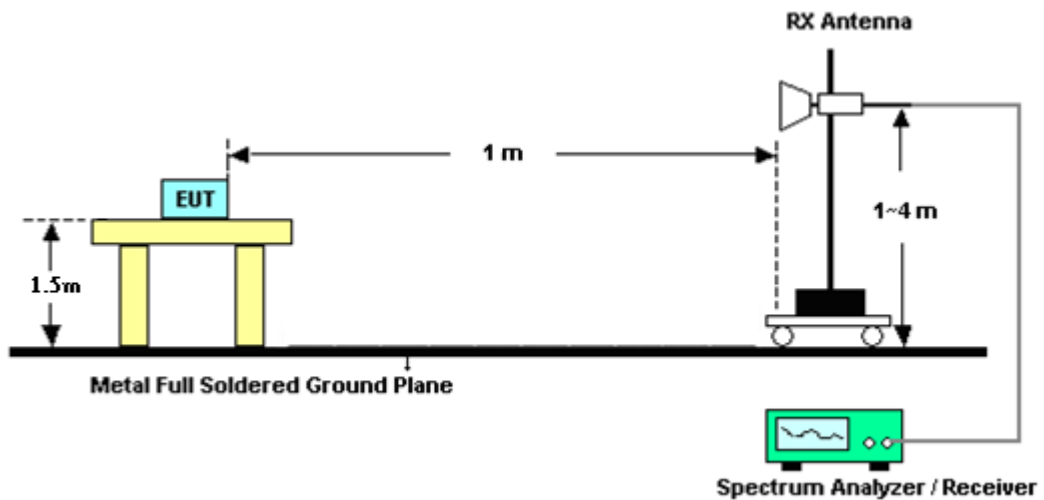
<For radiated emissions from 1 ~ 18GHz>



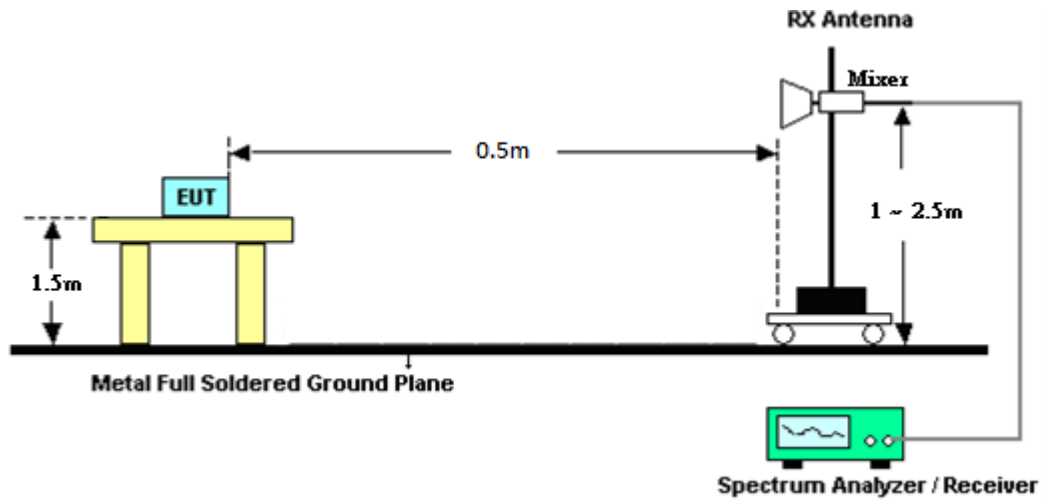
<For radiated emissions from 18 ~ 40GHz>



<For radiated emissions above 40 ~ 90GHz>



<For radiated emissions above 90 ~ 100GHz>



3.1.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

3.1.6 Test Result of Field Strength of Fundamental and Radiated Spurious Emission

Please refer to Appendix A and B.



3.2 AC Conducted Emission Measurement

3.2.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-Peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

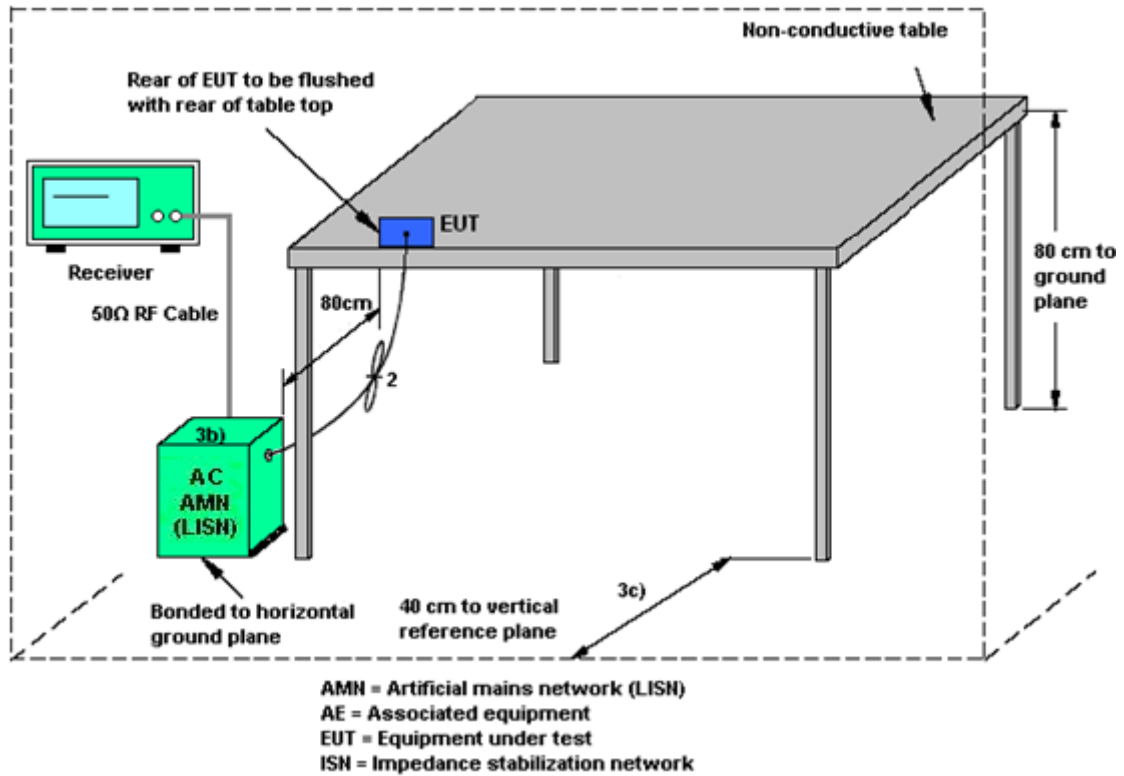
3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

3.2.3 Test Procedures

1. Connect EUT to the power mains through a line impedance stabilization network (LISN).
2. All the support units are connecting to the other LISN.
3. The LISN provides 50 ohm coupling impedance for the measuring instrument.
4. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
5. Both sides of AC line were checked for maximum conducted interference.
6. The frequency range from 150 kHz to 30 MHz was searched.
7. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF bandwidth = 9kHz) with Maximum Hold Mode.

3.2.4 Test Setup



3.2.5 Test Result of AC Conducted Emission

Please refer to Appendix A.



3.3 Antenna Requirements

3.3.1 Limit

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.

3.3.2 Antenna Connector Construction

Embedded in Antenna.



4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 07, 2021	Apr. 21, 2022	Sep. 06, 2022	Radiation (03CH12-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N-06	37059 & 01	30MHz~1GHz	Oct. 09, 2021	Apr. 21, 2022	Oct. 08, 2022	Radiation (03CH12-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1328	1GHz~18GHz	Dec. 03, 2021	Apr. 21, 2022	Dec. 02, 2022	Radiation (03CH12-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	00993	18GHz~40GHz	Nov. 30, 2021	Apr. 21, 2022	Nov. 29, 2022	Radiation (03CH12-HY)
Preamplifier	COM-POWER	PA-103	161075	10MHz~1GHz	Mar. 23, 2022	Apr. 21, 2022	Mar. 22, 2023	Radiation (03CH12-HY)
Preamplifier	Aglient	8449B	3008A02375	1GHz~26.5GHz	May 25, 2021	Apr. 21, 2022	May 24, 2022	Radiation (03CH12-HY)
Preamplifier	E-INSTRUMENT TECH LTD.	ERA-100M-18G-56-01-A70	EC1900249	1GHz-18GHz	Dec. 22, 2021	Apr. 21, 2022	Dec. 21, 2022	Radiation (03CH12-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz~40GHz	Dec. 24, 2021	Apr. 21, 2022	Dec. 23, 2022	Radiation (03CH12-HY)
Spectrum Analyzer	Keysight	N9010A	MY53470118	10Hz~44GHz	Jan. 12, 2022	Apr. 21, 2022	Jan. 11, 2023	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4PE	9kHz~30MHz	Mar. 10, 2022	Apr. 21, 2022	Mar. 09, 2023	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126E	0058/126E	30MHz~18GHz	Dec. 10, 2021	Apr. 21, 2022	Dec. 09, 2022	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	505134/2	30MHz~40GHz	Feb. 21, 2022	Apr. 21, 2022	Feb. 20, 2023	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	803953/2	30MHz~40GHz	Mar. 08, 2022	Apr. 21, 2022	Mar. 07, 2023	Radiation (03CH12-HY)
Filter	Wainwright	WLKS1200-12SS	SN2	1.2GHz Low Pass Filter	Mar. 16, 2022	Apr. 21, 2022	Mar. 15, 2023	Radiation (03CH12-HY)
Hygrometer	TECPEL	DTM-303B	TP140349	N/A	Sep. 30, 2021	Apr. 21, 2022	Sep. 29, 2022	Radiation (03CH12-HY)
Controller	EMEC	EM1000	N/A	Control Turn table & Ant Mast	N/A	Apr. 21, 2022	N/A	Radiation (03CH12-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1m~4m	N/A	Apr. 21, 2022	N/A	Radiation (03CH12-HY)
Turn Table	EMEC	TT2000	N/A	0~360 Degree	N/A	Apr. 21, 2022	N/A	Radiation (03CH12-HY)
Software	Audix	E3 6.2009-8-24	RK-000989	N/A	N/A	Apr. 21, 2022	N/A	Radiation (03CH12-HY)
Spectrum Analyzer	Rohde & Schwarz	FSV30	103738	9kHz to 30GHz	May 19, 2021	Apr. 25, 2022	May 18, 2022	Radiation (03CH18-HY)
Harmonic Mixer	Rohde & Schwarz	RPG FS-Z60	100986	40GHz to 60GHz	Apr. 09, 2021	Apr. 25, 2022	Apr. 08, 2024	Radiation (03CH18-HY)
Harmonic Mixer	Rohde & Schwarz	FSZ-90	101811	60GHz to 90GHz	Nov. 16, 2021	Apr. 25, 2022	Nov. 15, 2024	Radiation (03CH18-HY)
Harmonic Mixer	Rohde & Schwarz	RPG FS-Z140	101128	90GHz to 140GHz	Oct. 26, 2020	Apr. 25, 2022	Oct. 25, 2023	Radiation (03CH18-HY)



Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Antenna	Quinstar	QWH-UPRR00	QWH-UPRR00-01	40-60 GHz	Jul. 06, 2021	Apr. 25, 2022	Jul. 05, 2024	Radiation (03CH18-HY)
Antenna	Quinstar	QWH-VPRR00	1371800009	50-75 GHz	Jul. 06, 2021	Apr. 25, 2022	Jul. 05, 2024	Radiation (03CH18-HY)
Antenna	Quinstar	QWH-EPRR00	1372000000	60-90 GHz	Jul. 06, 2021	Apr. 25, 2022	Jul. 05, 2024	Radiation (03CH18-HY)
Antenna	Quinstar	QWH-FPRR00	1011500008	90-140 GHz	Jul. 06, 2021	Apr. 25, 2022	Jul. 05, 2024	Radiation (03CH18-HY)
Solid State Amplifier	Quinstar	QLW-50754530-I2	953600006	50-75 GHz	Jul. 06, 2021	Apr. 25, 2022	Jul. 05, 2024	Radiation (03CH18-HY)
Solid State Amplifier	Quinstar	QLW-40605030-00	953500005	40-60 GHz	Jul. 06, 2021	Apr. 25, 2022	Jul. 05, 2024	Radiation (03CH18-HY)
Solid State Amplifier	Quinstar	QLW-70905030-I2	953700007	70-90 GHz	Jul. 06, 2021	Apr. 25, 2022	Jul. 05, 2024	Radiation (03CH18-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	May 19, 2022	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102388	9kHz~3.6GHz	Dec. 01, 2021	May 19, 2022	Nov. 30, 2022	Conduction (CO05-HY)
Hygrometer	Testo	608-H1	34913912	N/A	Nov. 17, 2021	May 19, 2022	Nov. 16, 2022	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz~30MHz	Dec. 03, 2021	May 19, 2022	Dec. 02, 2022	Conduction (CO05-HY)
Software	Rohde & Schwarz	EMC32	N/A	N/A	N/A	May 19, 2022	N/A	Conduction (CO05-HY)
Pulse Limiter	SCHWARZBECK	VTSD 9561-FN	00691	N/A	Jul. 28, 2021	May 19, 2022	Jul. 27, 2022	Conduction (CO05-HY)
LISN Cable	MVE	RG-400	260260	N/A	Dec. 30, 2021	May 19, 2022	Dec. 29, 2022	Conduction (CO05-HY)



5 Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	3.1 dB
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Uncertainty of Radiated Emission Measurement (30 MHz ~ 1 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.8 dB
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Uncertainty of Radiated Emission Measurement (1GHz ~ 18GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.4 dB
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Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.9 dB
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Uncertainty of Radiated Emission Measurement (40 GHz ~ 140 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.9 dB
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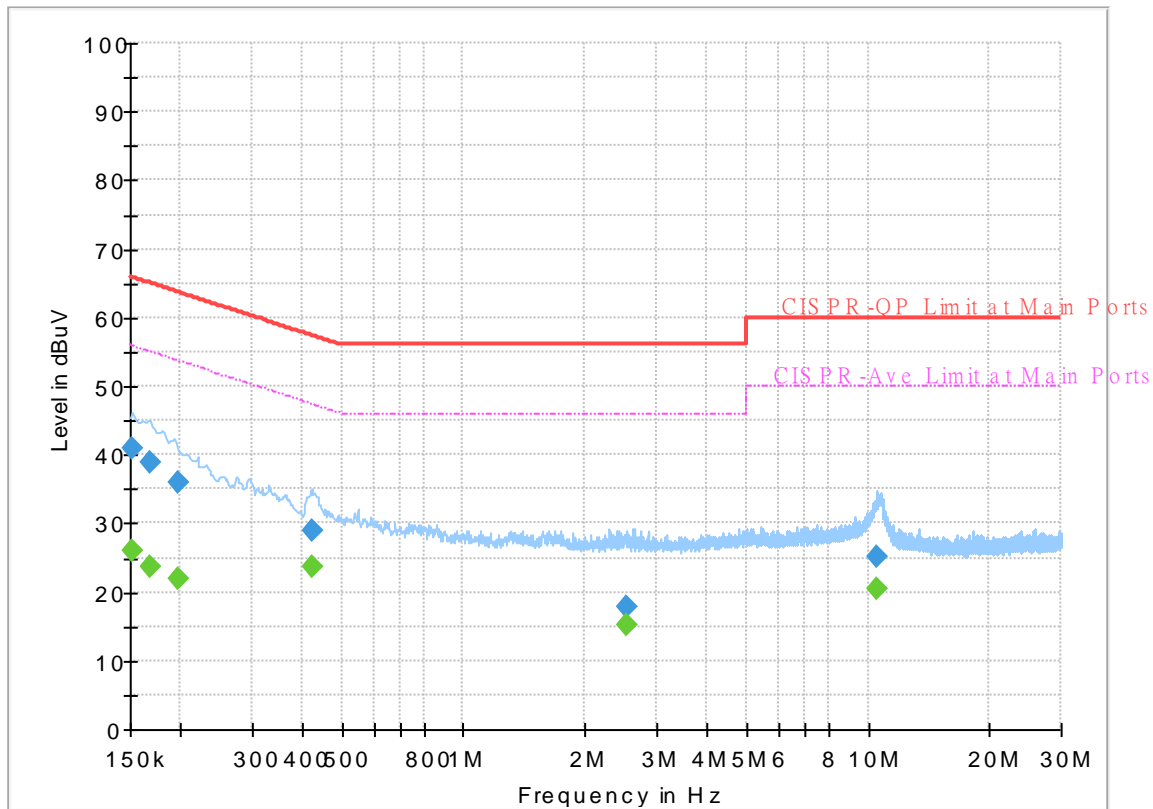


Appendix A. AC Conducted Emission Test Results

EUT Information

Report NO : 093009-01
 Test Mode : Mode 1
 Test Voltage : 120Vac/60Hz
 Phase : Line

Full Spectrum



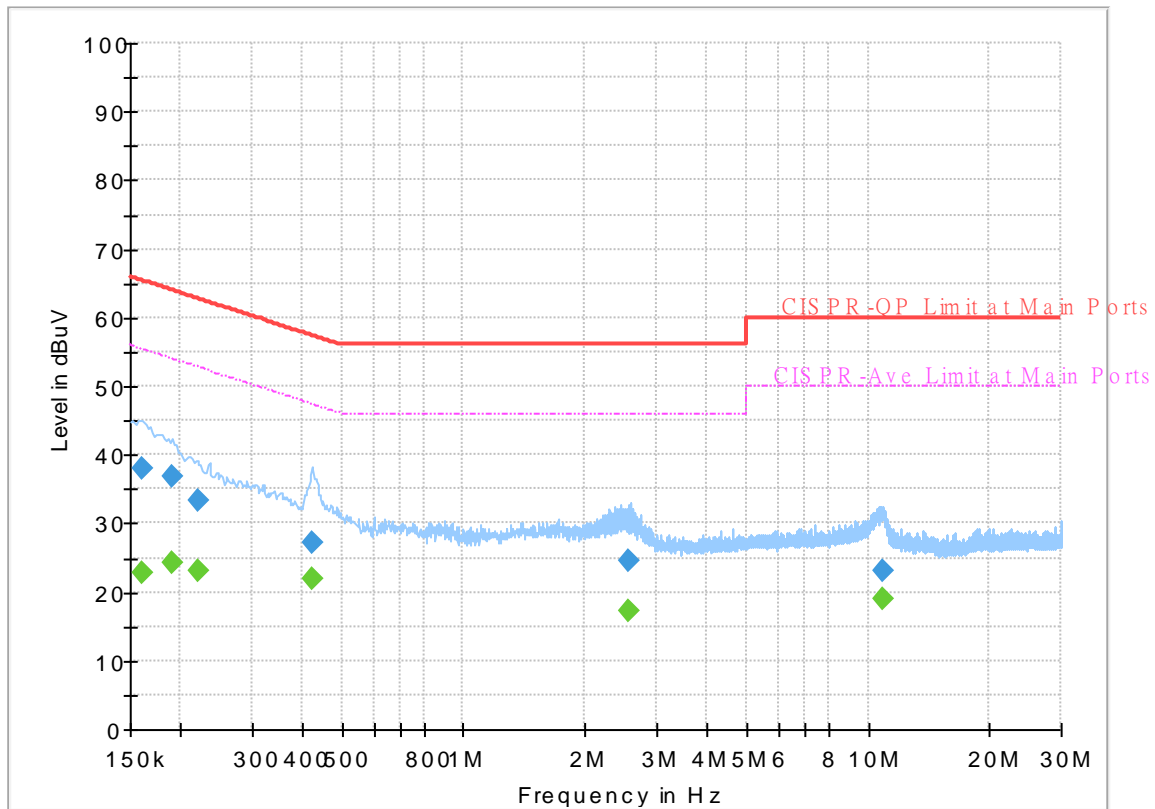
Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.152250	---	25.89	55.88	29.99	L1	OFF	19.6
0.152250	40.79	---	65.88	25.09	L1	OFF	19.6
0.168000	---	23.77	55.06	31.29	L1	OFF	19.6
0.168000	38.97	---	65.06	26.09	L1	OFF	19.6
0.197250	---	22.00	53.73	31.73	L1	OFF	19.6
0.197250	36.09	---	63.73	27.64	L1	OFF	19.6
0.422250	---	23.77	47.40	23.63	L1	OFF	19.6
0.422250	29.06	---	57.40	28.34	L1	OFF	19.6
2.530500	---	15.21	46.00	30.79	L1	OFF	19.6
2.530500	17.91	---	56.00	38.09	L1	OFF	19.6
10.551750	---	20.46	50.00	29.54	L1	OFF	19.8
10.551750	25.25	---	60.00	34.75	L1	OFF	19.8

EUT Information

Report NO : 093009-01
 Test Mode : Mode 1
 Test Voltage : 120Vac/60Hz
 Phase : Neutral

Full Spectrum



Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.161250	---	22.77	55.40	32.63	N	OFF	19.6
0.161250	38.00	---	65.40	27.40	N	OFF	19.6
0.190500	---	24.15	54.02	29.87	N	OFF	19.6
0.190500	36.92	---	64.02	27.10	N	OFF	19.6
0.219750	---	23.11	52.83	29.72	N	OFF	19.6
0.219750	33.29	---	62.83	29.54	N	OFF	19.6
0.422250	---	21.82	47.40	25.58	N	OFF	19.6
0.422250	27.30	---	57.40	30.10	N	OFF	19.6
2.553000	---	17.38	46.00	28.62	N	OFF	19.6
2.553000	24.54	---	56.00	31.46	N	OFF	19.6
10.941000	---	19.04	50.00	30.96	N	OFF	19.8
10.941000	23.14	---	60.00	36.86	N	OFF	19.8



Appendix B. Radiated Spurious Emission

Test Engineer :	Jack Cheng	Temperature :	20.8~26.8°C
		Relative Humidity :	58~68.2%

24GHz 24000~24250MHz

(Field strength of fundamental @ 3m)

24GHz	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
24.06GHz		23999.5	42.74	-31.26	74	44.35	38.8	22.33	53.2	150	141	P	H
	*	24060	97.1	-30.85	127.95	98.65	38.82	22.37	53.2	150	141	P	H
	*	24060	97.11	-10.89	108	98.66	38.82	22.37	53.2	150	141	A	H
		24832	42.41	-31.59	74	43.25	39.07	22.83	53.2	150	141	P	H
		23659	43.69	-30.31	74	45.48	38.8	22.22	53.27	150	171	P	V
	*	24060	86.21	-41.74	127.95	87.76	38.82	22.37	53.2	150	171	P	V
	*	24060	86.42	-21.58	108	87.97	38.82	22.37	53.2	150	171	A	V
		24976	44.01	-29.99	74	44.65	39.18	22.92	53.2	150	171	P	V
Remark	<ol style="list-style-type: none"> No other spurious found. All results are Pass against Peak and Average limit line. The general radiated emission limits in §15.209 is lesser attenuation as limit. The maximized peak level complies with the average limit, unnecessary to perform an average measurement 												



24GHz 24000~24250MHz
(Radiated Spurious Emission @ 3m)

24GHz	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
24.06GHz		18000	61.51	-12.49	74	59.5	50	21.29	69.28	100	0	P	H
		18000	50.67	-3.33	54	48.66	50	21.29	69.28	100	0	A	H
		39972	58.52	-15.48	74	48.08	44.5	29.42	53.94	150	0	P	H
		39972	48.21	-5.79	54	37.77	44.5	29.42	53.94	150	0	A	H
		18000	61.27	-12.73	74	59.26	50	21.29	69.28	100	0	P	V
		18000	50.58	-3.42	54	48.57	50	21.29	69.28	100	0	A	V
		39510	57.42	-16.58	74	47.47	44.69	29.39	54.59	150	0	P	V
		39510	47.77	-6.23	54	37.82	44.69	29.39	54.59	150	0	A	V
Remark	<ol style="list-style-type: none"> No other spurious found. All results are Pass against Peak and Average limit line. The general radiated emission limits in §15.209 is lesser attenuation as limit. The maximized peak level complies with the average limit, unnecessary to perform an average measurement 												



24GHz 24000~24250MHz

(Radiated Spurious Emission& Harmonic @ 3m)

24GHz	Note	Frequency (MHz)	Level (dB μ V/m)	Over Limit (dB)	Limit Line (dB μ V/m)	Peak Avg. (P/A)	Pol. (H/V)
24.06GHz		48298	-45.98	-38.69	87.95	P	H
		48298	-53.72	-26.43	67.95	A	H
		72187	-29.44	-22.15	87.95	P	H
		72187	-35.31	-8.02	67.95	A	H
		96240	-31.22	-29.95	87.95	P	H
		96240	-39.96	-18.69	67.95	A	H
		48298	-39.93	-32.64	87.95	P	V
		48298	-44.55	-17.26	67.95	A	V
		72187	-23.53	-16.24	87.95	P	V
		72187	-30.58	-3.29	67.95	A	V
		96240	-30.03	-28.76	87.95	P	V
		96240	-39.82	-18.55	67.95	A	V
Remark	1. No other spurious found. 2. All results are Pass against Peak and Average limit line.						



Emission below 1GHz
24GHz (LF)

24GHz	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
24.06GHz LF		30	23.55	-16.45	40	27.75	24.67	0.77	29.64	-	-	P	H
		180.35	28.19	-15.31	43.5	40.95	14.86	1.92	29.54	-	-	P	H
		299.66	31.95	-14.05	46	39.54	19.21	2.49	29.29	-	-	P	H
		471.35	39.2	-6.8	46	41.52	23.58	3.15	29.05	-	-	P	H
		912.7	35.07	-10.93	46	29.53	29.21	4.51	28.18	-	-	P	H
		974.78	35.86	-18.14	54	28.7	30.6	4.64	28.08	-	-	P	H
		33.88	29.22	-10.78	40	35.57	22.49	0.82	29.66	-	-	P	V
		161.92	32.77	-10.73	43.5	44.34	16.22	1.76	29.55	-	-	P	V
		279.29	29.02	-16.98	46	37.21	18.78	2.37	29.34	-	-	P	V
		472.32	36.7	-9.3	46	39.01	23.59	3.15	29.05	-	-	P	V
		833.16	34.15	-11.85	46	29.69	28.65	4.23	28.42	-	-	P	V
		971.87	36.01	-17.99	54	28.82	30.64	4.64	28.09	-	-	P	V
Remark	<ol style="list-style-type: none"> No other spurious found. All results are PASS against limit line. The general radiated emission limits in §15.209 is lesser attenuation as limit. The emission position marked as “-” means no suspected emission found and emission level has at least 6dB margin against limit or emission is noise floor only. 												



Note symbol

*	Fundamental Frequency which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is over limit line.
P/A	Peak or Average
H/V	Horizontal or Vertical



A calculation example for radiated spurious emission is shown as below:

Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBμV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is “PASS”.



Appendix C. Radiated Spurious Emission Plots

Test Engineer :	Jack Cheng	Temperature :	20.8~26.8°C
		Relative Humidity :	58~68.2%

24GHz 24000~24250MHz

Field strength of fundamental@ 3m

24GHz	Field strength of fundamental	
	24.06GHz	
	Horizontal	Vertical
Peak	<p>Site : 03CH2-HY Condition : 15.249_Peak 1m SHF HORN BBH49170993 HORIZONTAL : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto</p>	<p>Site : 03CH2-HY Condition : 15.249_Peak 1m SHF HORN BBH49170993 VERTICAL : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto</p>
Avg.	<p>Site : 03CH2-HY Condition : AVG_54 1m SHF HORN BBH49170993 HORIZONTAL : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto</p>	<p>Site : 03CH2-HY Condition : AVG_54 1m SHF HORN BBH49170993 VERTICAL : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto</p>



**24GHz 24000~24250MHz
(Radiated Spurious Emission & Harmonic @ 3m)**

24GHz	24.06GHz	
	1-18GHz	
	Horizontal	Vertical
Peak	<p>Site : 03CH12-HY Condition : PEAK_74 3m HORN_91200_1328 HORIZONTAL</p>	<p>Site : 03CH12-HY Condition : PEAK_74 3m HORN_91200_1328 VERTICAL</p>
24GHz	1-18GHz	
	Horizontal	Vertical
Avg.	<p>Site : 03CH12-HY Condition : AVG_54 3m HORN_91200_1328 HORIZONTAL</p>	<p>Site : 03CH12-HY Condition : AVG_54 3m HORN_91200_1328 VERTICAL</p>



24GHz	24.06GHz	
18-40GHz		
	Horizontal	Vertical
Peak	<p>Site : 03CH12-HY Condition : 15.249_Peak Im SHF HORN BBH49170993 HORIZONTAL</p>	<p>Site : 03CH12-HY Condition : 15.249_Peak Im SHF HORN BBH49170993 VERTICAL</p>
24GHz	18-40GHz	
	Horizontal	Vertical
Avg.	<p>Site : 03CH12-HY Condition : AVG_54 Im SHF HORN BBH49170993 HORIZONTAL</p>	<p>Site : 03CH12-HY Condition : AVG_54 Im SHF HORN BBH49170993 VERTICAL</p>



24GHz	24.06GHz	
	40-60GHz	
	Horizontal	Vertical
Peak.		
24GHz	40-60GHz	
	Horizontal	Vertical
Avg		



24GHz	24.06GHz	
60-90GHz		
Horizontal		Vertical
Peak	<p>Spectrum Ref Level 0.11 dBm Offset 21.11 dB RBW 1 MHz SWF 60 ms VBW 3 MHz Mode Sweep E-15Mz E</p> <p>UPR Max AutoID</p> <p>M1 [1] -35.37 dBm 73.908300 GHz M2 [1] -23.44 dBm 72.187100 GHz</p> <p>Start 70.0 GHz 20001 pts Stop 90.0 GHz</p> <p>Date: 27 APR 2022 14:22:38</p>	<p>Spectrum Ref Level 0.11 dBm Offset 21.11 dB RBW 1 MHz SWF 60 ms VBW 3 MHz Mode Sweep E-15Mz E</p> <p>UPR Max AutoID</p> <p>M1 [1] -39.74 dBm 73.908300 GHz M2 [1] -23.53 dBm 72.187100 GHz</p> <p>Start 70.0 GHz 20001 pts Stop 90.0 GHz</p> <p>Date: 27 APR 2022 14:23:07</p>
24GHz	60-90GHz	
Horizontal		Vertical
Avg.	<p>Spectrum Ref Level 0.11 dBm Offset 21.11 dB RBW 1 MHz SWF 60 ms VBW 3 MHz Mode Sweep E-15Mz E</p> <p>SQL Count 100/100</p> <p>LRm AvgPer AutoID</p> <p>M1 [1] -38.21 dBm 73.908300 GHz M2 [1] -35.31 dBm 72.187100 GHz</p> <p>Start 70.0 GHz 20001 pts Stop 90.0 GHz</p> <p>Date: 27 APR 2022 14:21:48</p>	<p>Spectrum Ref Level 0.11 dBm Offset 21.11 dB RBW 1 MHz SWF 60 ms VBW 3 MHz Mode Sweep E-15Mz E</p> <p>SQL Count 100/100</p> <p>LRm AvgPer AutoID</p> <p>M1 [1] -46.94 dBm 73.908300 GHz M2 [1] -39.58 dBm 72.187100 GHz</p> <p>Start 70.0 GHz 20001 pts Stop 90.0 GHz</p> <p>Date: 27 APR 2022 14:21:00</p>

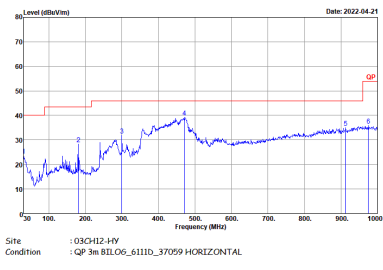
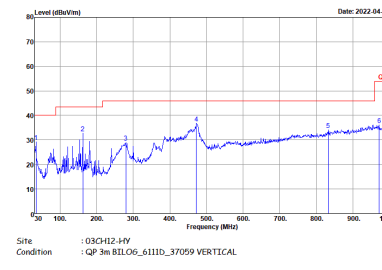


24GHz	24.06GHz	
	90-100GHz	
	Horizontal	Vertical
Peak		
24GHz	90-100GHz	
	Horizontal	Vertical
Avg.		



Emission below 1GHz

24GHz

24GHz	24GHz	
	24.06GHz_LF	
	Horizontal	Vertical
QP / Peak	 <p>Site : 03CH12-HY Condition : QP 3m BIL06_6111D_37059 HORIZONTAL</p>	 <p>Site : 03CH12-HY Condition : QP 3m BIL06_6111D_37059 VERTICAL</p>