



ISED EMI TEST REPORT

IC : 451H-CC2652RSIP
Equipment : CC2652RSIPMOT
Brand Name : Texas Instruments Incorporated
HVIN : CC2652RSIPMOT
PMN : CC2652RSIP SimpleLink™ Multiprotocol
2.4-GHz Wireless System-in-Package
Applicant : Texas Instruments
12500 TI BLVD., Dallas, Texas, 75243
Manufacturer : Texas Instruments
12500 TI BLVD., Dallas, Texas, 75243
Standard : ISED ICES-003 Issue 7 Class B

The product was received on Nov. 09, 2021 and testing was performed from Nov. 25, 2021 to Dec. 13, 2021. We, Sporton International Inc. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures given in ANSI C63.4a-2017 and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval from Sporton International Inc. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

Sporton International Inc. EMC & Wireless Communications Laboratory
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)

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History of this test report

Report No.	Version	Description	Issue Date
CI1N0955	01	Initial issue of report	Mar. 03, 2022

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	ICES003 Section 6.1	AC Conducted Emission	Pass	7.01 dB under the limit at 0.152 MHz
3.2	ICES003 Section 6.2	Radiated Emission	Pass	9.62 dB under the limit at 233.850 MHz for Quasi-Peak

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 this 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: Danny Lee

Report Producer: Amy Chen

1. General Description

1.1. Product Feature of Equipment Under Test

Bluetooth - LE, and Zigbee.

	Brand	Antenna type	Model	2.4 GHz Gain
1	Texas Instruments	Inverted F - PCB	Custom Antenna	3.3dBi
2			Custom Antenna	5.3dBi
3	Ethertronics	Dipole	1000423	-0.6dBi
4	LSR	Rubber Whip / Dipole	001-0012	2dBi
5			080-0013	2dBi
6			080-0014	2dBi
7		PIFA	001-0016	2.5dBi
8			001-0021	2.5dBi
9	Laird	PCB	CAF94504	2dBi
10			CAF9405	2dBi
11	Pulse	Ceramic Chip	W3006	3.2dBi
12	ACX	Multilayer Chip	AT3216-BR2R7HAA	0.5dBi
13			AT312-T2R4PAA	1.5dBi
14	TDK	Multilayer Ceramic Chip Antenna	ANT016008LCD2442MA1	1.6dBi
15			ANT016008LCD2442MA2	2.5dBi
16	Mitsubishi Material	Chip Antenna	AM03DP-ST01	1.6dBi
17		Antenna Unit	UB18CP-100ST01	-1.0dBi
18	Taiyo Yuden	Chip Antenna / Helical Monopole	AF216M245001	1.5dBi
19		Chip Antenna / Monopole Type	AH212M245001	1.3dBi
20			AH316M245001	1.9dBi
21	Antenna Technology	Dipole	AA2402SPU	2.0dBi
22			AA2402RSPU	2.0dBi
23			AA2402A-UFLLP	2.0dBi
24			AA2402AU-UFLLP	2.0dBi
25	Staf	Mono-pole	1019-016	2.14dBi
26			1019-017	2.14dBi
27			1019-018	2.14dBi
28			1019-019	2.14dBi

	Brand	Antenna type	Model	2.4 GHz Gain
29	Map Electronics	Rubber Whip	MEIWX-2411SAXX-2400	2.0dBi
30			MEIWX-2411RSXX-2400	2.0dBi
31			MEIWX-1511RSXX-2400	5.0dBi
32			MEIWX-151XSAXX-2400	5.0dBi
33			MEIWX-1451RSXX-2400	4.0dBi
34			MEIWX-282XSAXX-2400	2.0dBi
35			MEIWX-282XRSXX-2400	2.0dBi
36			MEIWF-HP01RS2X-2400	2.0dBi
37	Yageo	Chip	ANT3216A063R2400A	1.69dBi
38	Mag Layers Scientific	Chip	LTA-3216-2G4S3-A1	1dBi
39			LTA-3216-2G4S3-A3	2dBi
40	Advantech	Rubber Whip / Dipole	AN2450-5706RS	2.38dBi
41			AN2450-5010BRS	5.03dBi
42			AN2450-92K01BRS	5.03dBi
43			R-AN2400-5701RS	3.3dBi

Remark:

1. The EUT uses the PCB antenna from Texas Instruments (Antenna #1)
2. 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 made to the EUT during the testing.

1.3. Test 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, 03CH06-HY

FCC designation No.: TW1093

ISED Registration No.: 4086B



1.4. Applicable Standards

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

- ♦ ISED ICES-003 Issue 7 Class B
- ♦ ISED RSS-Gen Issue 5
- ♦ ANSI C63.4a-2017

Remark:

1. All the test items were validated and recorded in accordance with the standards without any modification during the testing.
2. The test results for FCC compliance, indicating that these results are deemed satisfactory evidence of compliance with Industry Canada Interference-Causing Equipment Standard ICES-003.

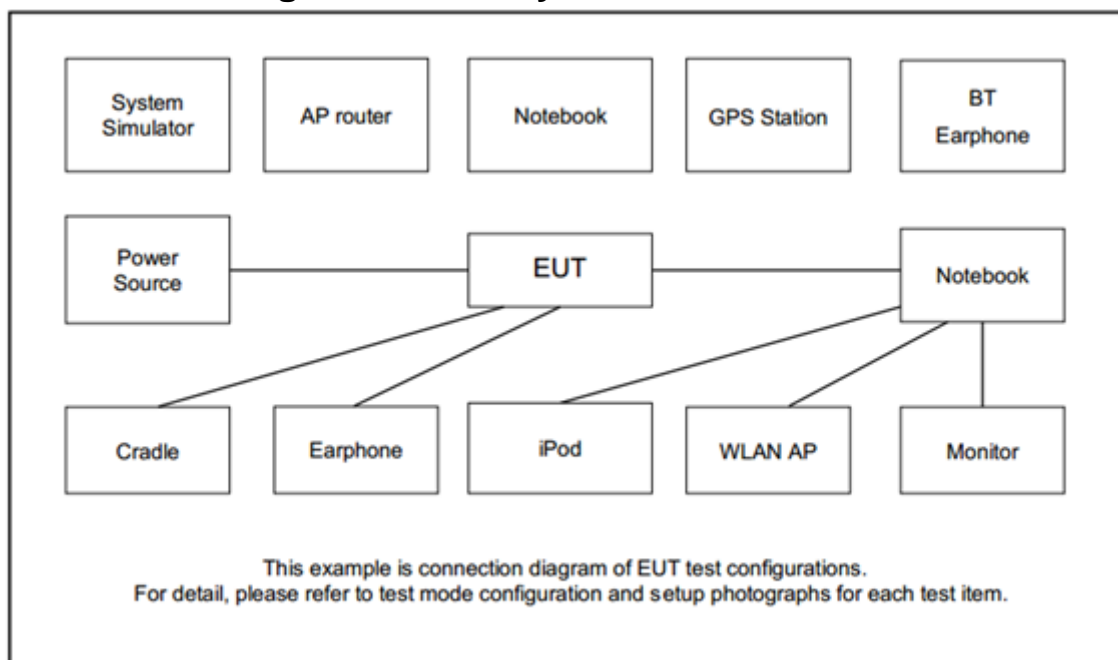
2. Test Configuration of Equipment Under Test

2.1. Test Mode

The EUT is tested along with the peripherals, operating under possible configurations in compliant with normal operation. The maximum emissions can be identified by a pre-scan carried out in different orientations of placement pursuant to ANSI C63.4a-2017. Frequency range covered: Conduction Emission (150 kHz to 30 MHz), Radiation Emission (30 MHz to the 5th harmonics of the highest fundamental frequency or to 40 GHz, whichever is lower).

Test Items	Functions Enabled
AC Conducted Emission	Mode 1: Bluetooth - LE RX + USB Cable (Charging from Notebook) Mode 2: Zigbee RX + USB Cable (Charging from Notebook)
Radiated Emissions	Mode 1: Bluetooth - LE RX + USB Cable (Charging from Notebook) Mode 2: Zigbee RX + USB Cable (Charging from Notebook)
Remark: 1. The worst case of AC is mode 1; only the test data of this mode was reported. 2. The worst case of RE is mode 2; only the test data of this mode was reported.	

2.2. Connection Diagram of Test System



2.3. Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	ASUS	RT-AC66U	MSQ-RTAC66U	N/A	Unshielded, 1.8 m
2.	iPod	Apple	A1285	FCC DoC	Shielded, 1.0 m	N/A
3.	Notebook	DELL	Latitude 3400	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m

2.4. EUT Operation Test Setup

The EUT was installed in the notebook to continuous receiving signals from Bluetooth - LE and Zigbee function.

3. Test Result

3.1. Test of AC Conducted Emission Measurement

3.1.1. Limits 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.

<Class B>

Frequency of emission (MHz)	Conducted limit (dBuV)	
	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.

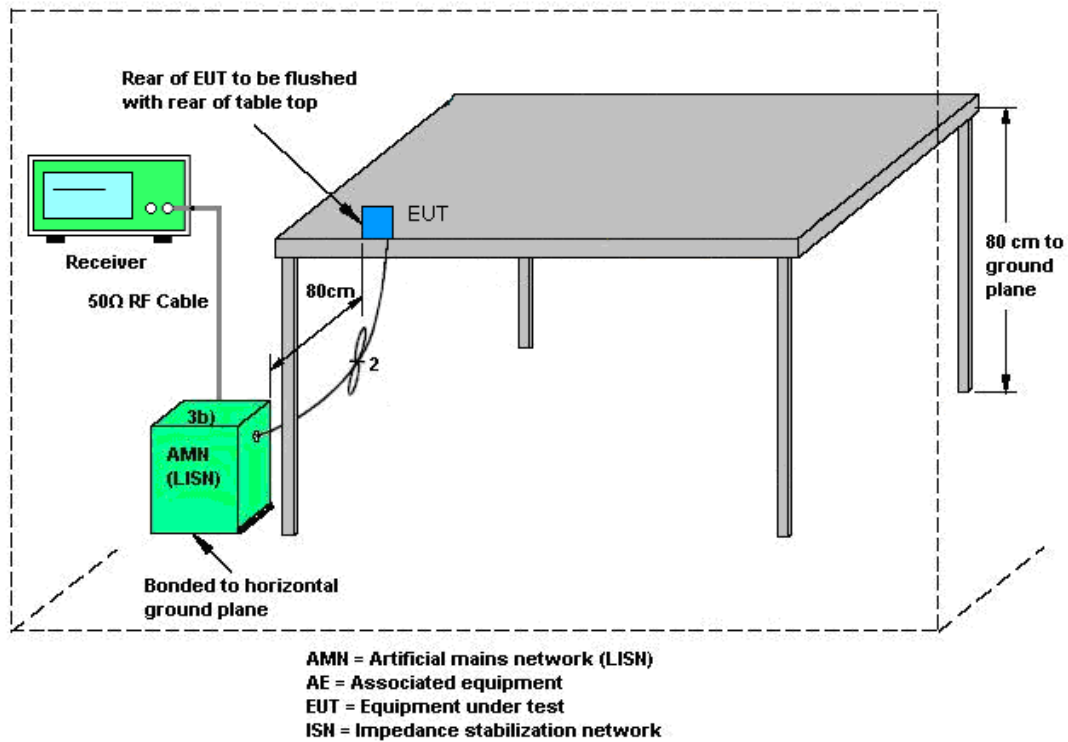
3.1.2. Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.1.3. Test Procedure

1. The EUT is placed 0.4 meter away from the conducting wall of the shielding room, and is kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN shall be used.
6. Both Line and Neutral shall be tested in order to find out the maximum conducted emission.
7. The frequency range from 150 kHz to 30 MHz is scanned.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (If Bandwidth = 9 kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.1.4. Test Setup



3.1.5. Test Result of AC Conducted Emission

Please refer to Appendix A.

3.2. Test of Radiated Emission Measurement

3.2.1. Limit of Radiated Emission

The emissions from an unintentional radiator shall not exceed the field strength levels specified in the following table:

<Class B>

Frequency range (MHz)	Class A (3m) Quasi-peak (dB μ V/m)	Class A (10m) Quasi-peak (dB μ V/m)	Class B (3m) Quasi-peak (dB μ V/m)	Class B (10m) Quasi-peak (dB μ V/m)
30-88	50.0	40.0	40.0	30.0
88-216	54.0	43.5	43.5	33.1
216-230	56.9	46.4	46.0	35.6
230-960	57.0	47.0	47.0	37.0
960-1000	60.0	49.5	54.0	43.5

Note: The more stringent limit applies at transition frequencies.

Frequency range (GHz)	Class A (3m) Average (dB μ V/m)	Class A (3m) Peak (dB μ V/m)	Class B (3m) Average (dB μ V/m)	Class B (3m) Peak (dB μ V/m)
1 – F_M	60	80	54	74

Note: The highest measurement frequency (F_M).

3.2.2. Measuring Instruments

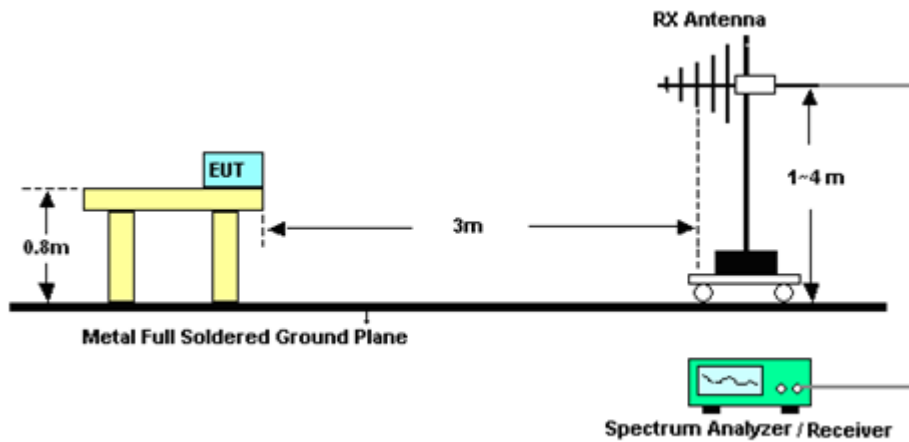
Please refer to the measuring equipment list in this test report.

3.2.3. Test Procedures

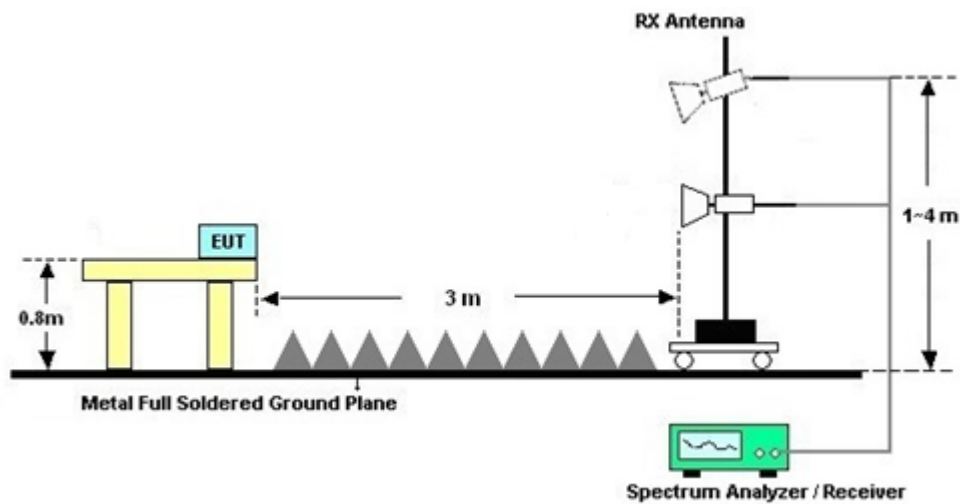
1. The EUT is placed on a turntable with 0.8 meter above ground.
2. The EUT is set 3 meters from the interference receiving antenna, which is mounted on the top of a variable height antenna tower.
3. The table is rotated 360 degrees to determine the position of the highest radiation.
4. The antenna is a Bi-Log antenna and its height is adjusted between one to four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT is arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode (RBW=120 kHz/VBW=300 kHz for frequency below 1 GHz; RBW=1 MHz VBW=3 MHz (Peak), RBW=1 MHz/VBW=10 Hz (Average) for frequency above 1 GHz).
7. If the emission level of the EUT in peak mode is 3 dB lower than the limit specified, peak values of EUT will be reported. Otherwise, the emission will be repeated by using the quasi-peak method and reported.
8. Emission level (dB μ V/m) = 20 log Emission level (μ V/m)
9. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

3.2.4. Test Setup of Radiated Emission

For Radiated Emissions from 30 MHz to 1 GHz



For Radiated Emissions above 1 GHz



3.2.5. Test Result of Radiated Emission

Please refer to Appendix B.



4. List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
EMI Test Receiver	Rohde & Schwarz	ESU26	100472	20Hz~26.5GHz	Feb. 03, 2021	Nov. 25, 2021	Feb. 02, 2022	Radiation (03CH06-HY)
Bilog Antenna	Schaffner	CBL 6111C & N-6-06	2725 & AT-N0601	30MHz~1GHz	Nov. 11, 2021	Nov. 25, 2021	Nov. 10, 2022	Radiation (03CH06-HY)
Horn Antenna	SCHWARZB ECK	BBHA 9120 D	9120D-1156	1GHz~18GHz	Sep. 27, 2021	Nov. 25, 2021	Sep. 26, 2022	Radiation (03CH06-HY)
Amplifier	SONOMA	310N	186713	9kHz~1GHz	Apr. 29, 2021	Nov. 25, 2021	Apr. 28, 2022	Radiation (03CH06-HY)
Preamplifier	Jet-Power	JPA00101800-3 0-10P	1601180001	1GHz~18GHz	Jul. 19, 2021	Nov. 25, 2021	Jul. 18, 2022	Radiation (03CH06-HY)
RF Cable	HUBER + SUHNER	SF102_7000mm	532299/2	30MHz to 40GHz	Jul. 05, 2021	Nov. 25, 2021	Jul. 04, 2022	Radiation (03CH06-HY)
RF Cable	HUBER + SUHNER	SF102_3000mm	532422/2	30MHz to 40GHz	Jul. 05, 2021	Nov. 25, 2021	Jul. 04, 2022	Radiation (03CH06-HY)
RF Cable	HUBER + SUHNER	SF102_2000mm	532421/2	30MHz to 40GHz	Jul. 05, 2021	Nov. 25, 2021	Jul. 04, 2022	Radiation (03CH06-HY)
RF Cable	HUBER + SUHNER	SF104	802433/4	30Mhz to 18Ghz	Aug. 19, 2021	Nov. 25, 2021	Aug. 18, 2022	Radiation (03CH06-HY)
Antenna Mast	MF	MF-7802	MF780208212	1m~4m	N/A	Nov. 25, 2021	N/A	Radiation (03CH06-HY)
Turn Table	INN-CO	DS2000	420/650/00	0-360 degree	N/A	Nov. 25, 2021	N/A	Radiation (03CH06-HY)
Software	Audix	E3 6.2009-8-24 (k5)	N/A	N/A	N/A	Nov. 25, 2021	N/A	Radiation (03CH06-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Dec. 13, 2021	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102388	9kHz~3.6GHz	Dec. 01, 2021	Dec. 13, 2021	Nov. 30, 2022	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz~30MHz	Dec. 03, 2021	Dec. 13, 2021	Dec. 02, 2022	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Nov. 16, 2021	Dec. 13, 2021	Nov. 15, 2022	Conduction (CO05-HY)
Software	Rohde & Schwarz	EMC32	N/A	N/A	N/A	Dec. 13, 2021	N/A	Conduction (CO05-HY)
Pulse Limiter	SCHWARZB ECK	VTSD 9561-F N	00691	N/A	Jul. 28, 2021	Dec. 13, 2021	Jul. 27, 2022	Conduction (CO05-HY)
LISN Cable	MVE	RG-400	260260	N/A	Dec. 31, 2020	Dec. 13, 2021	Dec. 30, 2021	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 ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.2 dB
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.4 dB
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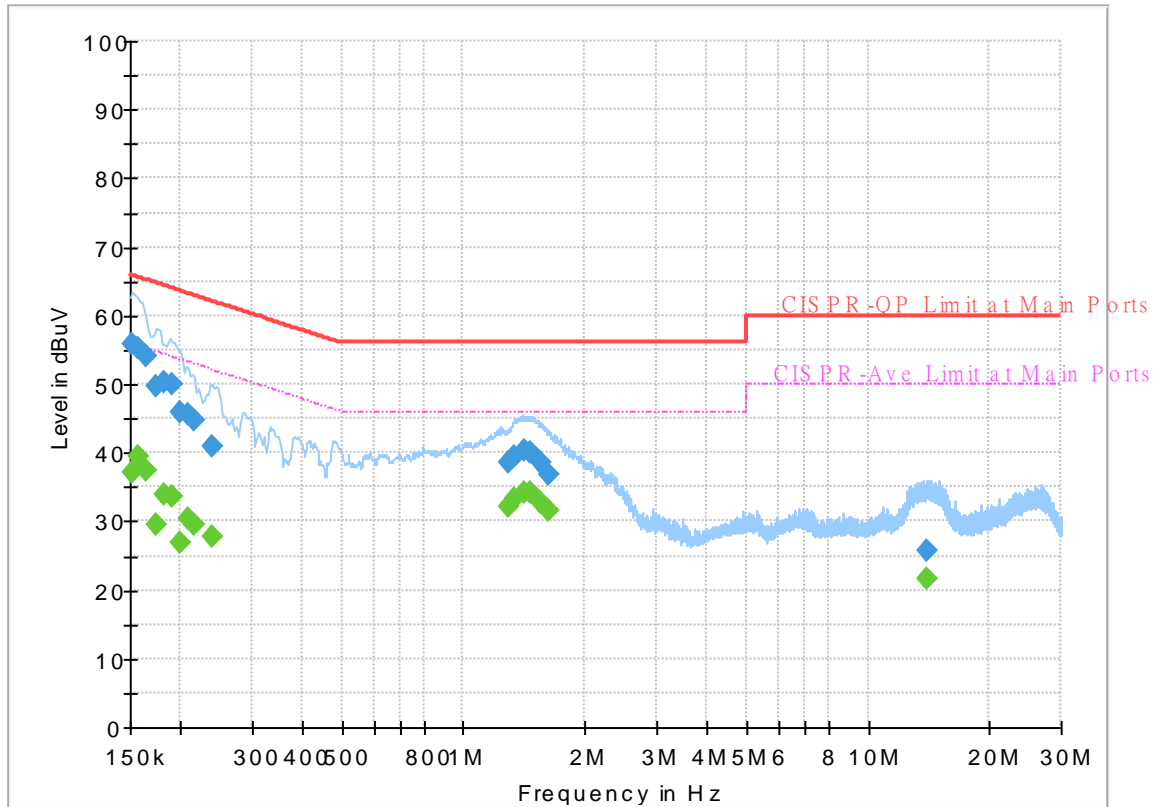
Appendix A. AC Conducted Emission Test Results

Test Engineer :	Calvin Wang	Temperature :	23~26°C
		Relative Humidity :	45~55%

EUT Information

Report NO : 1N0955
Test Mode : Mode 1
Test Voltage : Power From System
Phase : Line

Full Spectrum



Final_Result

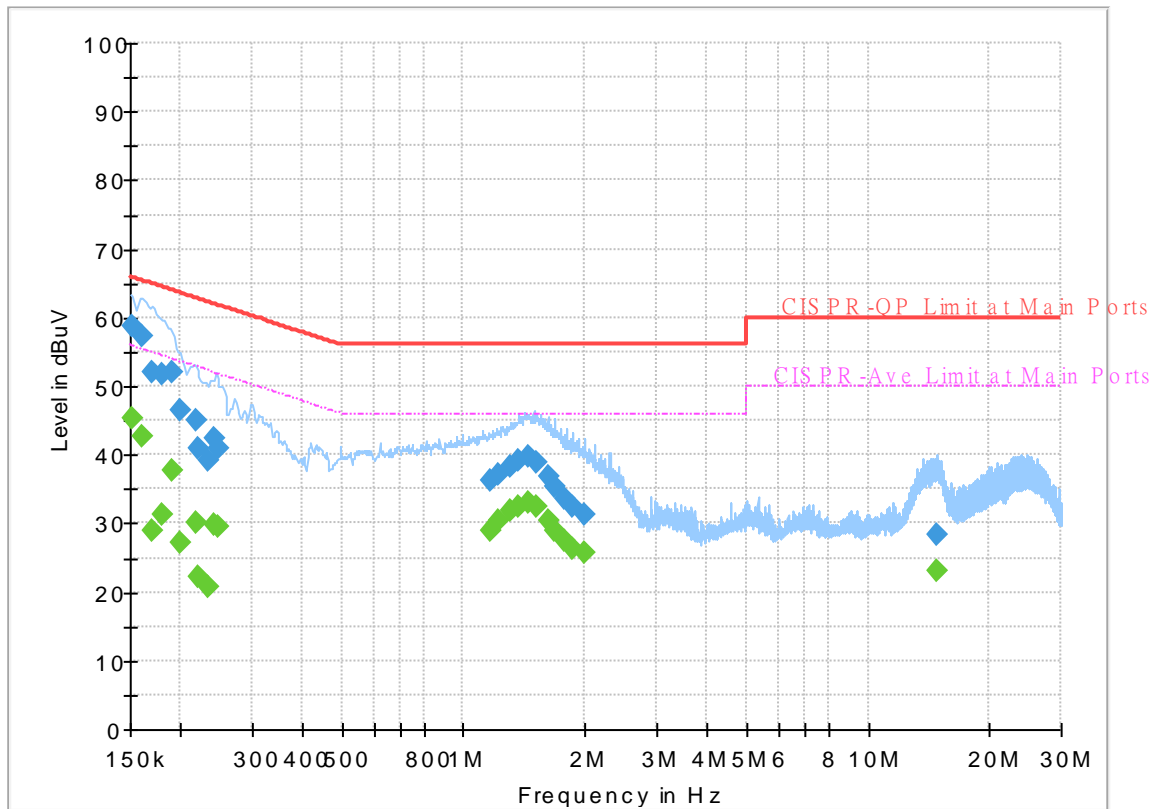
Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.152250	55.94	---	65.88	9.94	L1	OFF	19.6
0.152250	---	37.26	55.88	18.62	L1	OFF	19.6
0.156750	55.14	---	65.63	10.49	L1	OFF	19.6
0.156750	---	39.34	55.63	16.29	L1	OFF	19.6
0.163500	54.02	---	65.28	11.26	L1	OFF	19.6
0.163500	---	37.32	55.28	17.96	L1	OFF	19.6
0.174750	49.65	---	64.73	15.08	L1	OFF	19.6
0.174750	---	29.40	54.73	25.33	L1	OFF	19.6
0.181500	50.32	---	64.42	14.10	L1	OFF	19.6
0.181500	---	33.93	54.42	20.49	L1	OFF	19.6
0.190500	50.12	---	64.02	13.90	L1	OFF	19.6
0.190500	---	33.74	54.02	20.28	L1	OFF	19.6
0.199500	45.81	---	63.63	17.82	L1	OFF	19.6
0.199500	---	27.03	53.63	26.60	L1	OFF	19.6
0.208500	45.73	---	63.27	17.54	L1	OFF	19.6
0.208500	---	30.33	53.27	22.94	L1	OFF	19.6
0.215250	44.63	---	63.00	18.37	L1	OFF	19.6
0.215250	---	29.65	53.00	23.35	L1	OFF	19.6
0.240000	40.88	---	62.10	21.22	L1	OFF	19.6
0.240000	---	27.92	52.10	24.18	L1	OFF	19.6
1.290750	38.65	---	56.00	17.35	L1	OFF	20.1

1.290750	---	32.28	46.00	13.72	L1	OFF	20.1
1.344750	39.50	---	56.00	16.50	L1	OFF	20.1
1.344750	---	33.38	46.00	12.62	L1	OFF	20.1
1.416750	40.21	---	56.00	15.79	L1	OFF	20.1
1.416750	---	34.34	46.00	11.66	L1	OFF	20.1
1.466250	39.98	---	56.00	16.02	L1	OFF	20.1
1.466250	---	34.33	46.00	11.67	L1	OFF	20.1
1.551750	38.53	---	56.00	17.47	L1	OFF	20.1
1.551750	---	32.68	46.00	13.32	L1	OFF	20.1
1.619250	36.86	---	56.00	19.14	L1	OFF	20.0
1.619250	---	31.45	46.00	14.55	L1	OFF	20.0
14.030250	25.87	---	60.00	34.13	L1	OFF	19.9
14.030250	---	21.51	50.00	28.49	L1	OFF	19.9

EUT Information

Report NO : 1N0955
Test Mode : Mode 1
Test Voltage : Power From System
Phase : Neutral

Full Spectrum

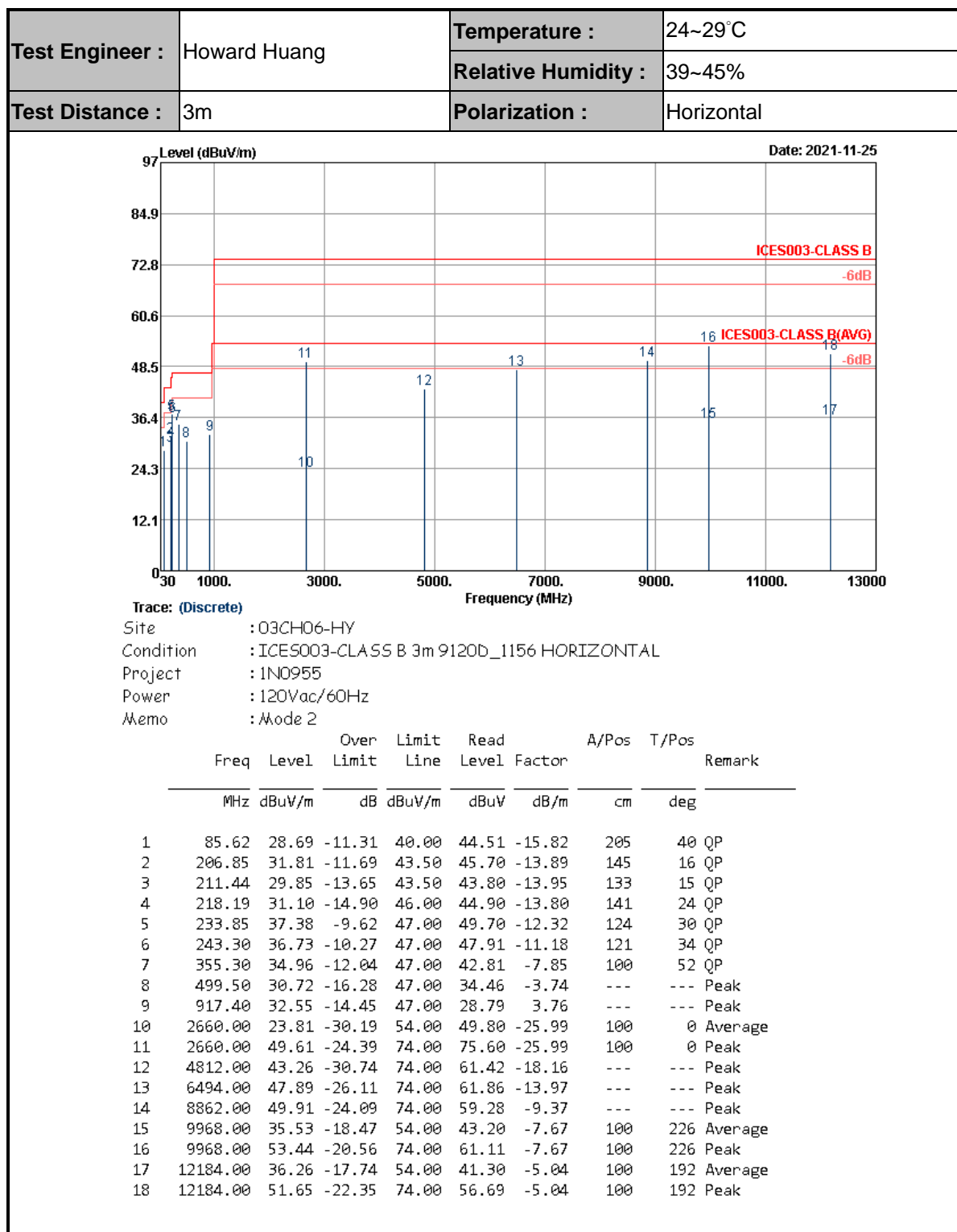


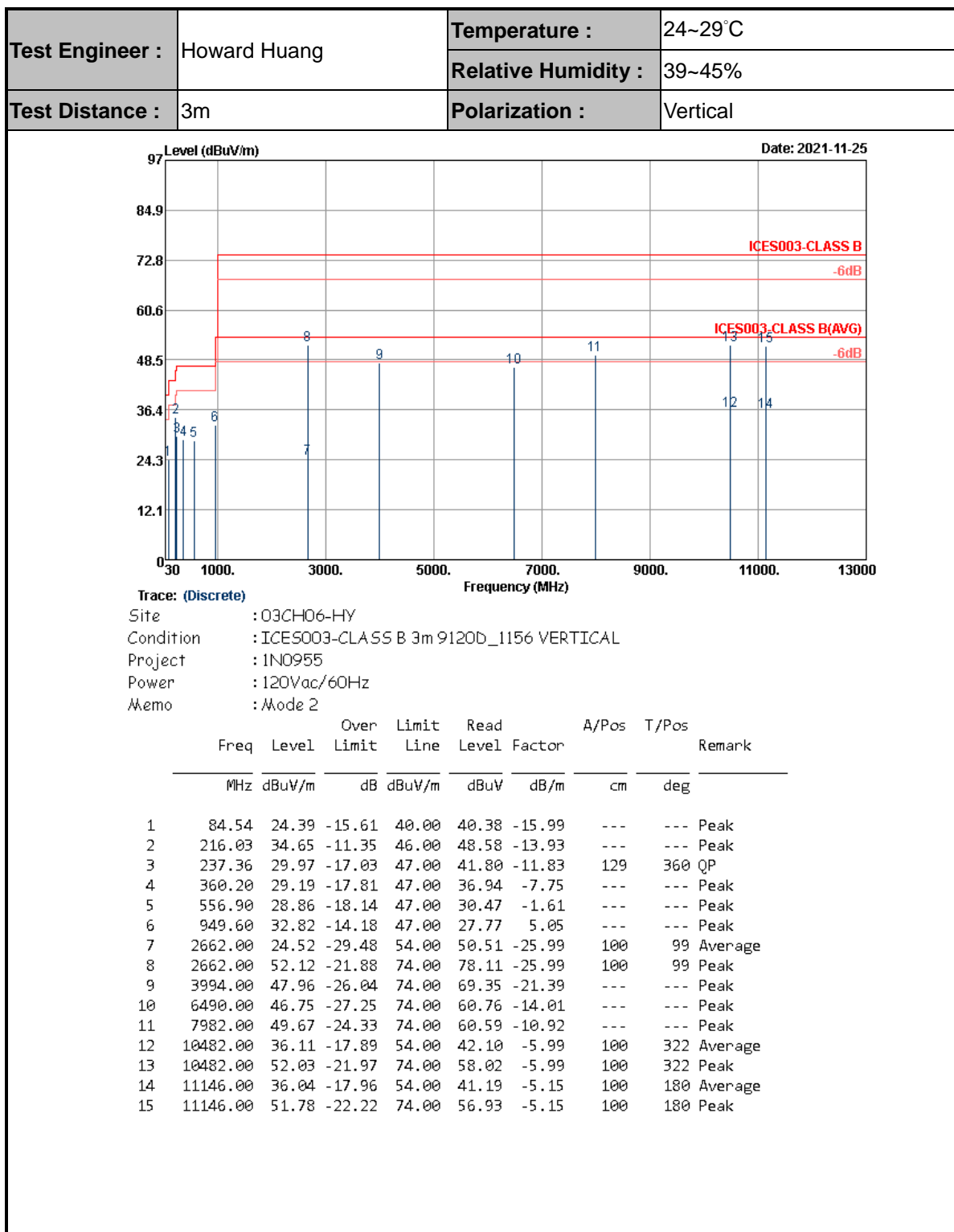
Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.152250	---	45.44	55.88	10.44	N	OFF	19.6
0.152250	58.87	---	65.88	7.01	N	OFF	19.6
0.161250	---	42.59	55.40	12.81	N	OFF	19.6
0.161250	57.35	---	65.40	8.05	N	OFF	19.6
0.170250	---	28.91	54.95	26.04	N	OFF	19.6
0.170250	51.91	---	64.95	13.04	N	OFF	19.6
0.179250	---	31.24	54.52	23.28	N	OFF	19.6
0.179250	51.88	---	64.52	12.64	N	OFF	19.6
0.190500	---	37.60	54.02	16.42	N	OFF	19.6
0.190500	52.06	---	64.02	11.96	N	OFF	19.6
0.199500	---	27.34	53.63	26.29	N	OFF	19.6
0.199500	46.44	---	63.63	17.19	N	OFF	19.6
0.217500	---	30.04	52.91	22.87	N	OFF	19.6
0.217500	44.91	---	62.91	18.00	N	OFF	19.6
0.222000	---	22.36	52.74	30.38	N	OFF	19.6
0.222000	40.81	---	62.74	21.93	N	OFF	19.6
0.233250	---	20.78	52.33	31.55	N	OFF	19.6
0.233250	39.09	---	62.33	23.24	N	OFF	19.6
0.242250	---	29.70	52.02	22.32	N	OFF	19.6
0.242250	42.39	---	62.02	19.63	N	OFF	19.6
0.249000	---	29.58	51.79	22.21	N	OFF	19.6

0.249000	40.89	---	61.79	20.90	N	OFF	19.6
1.162500	---	29.03	46.00	16.97	N	OFF	20.1
1.162500	36.39	---	56.00	19.61	N	OFF	20.1
1.223250	---	30.29	46.00	15.71	N	OFF	20.1
1.223250	37.18	---	56.00	18.82	N	OFF	20.1
1.304250	---	31.82	46.00	14.18	N	OFF	20.1
1.304250	38.16	---	56.00	17.84	N	OFF	20.1
1.371750	---	32.50	46.00	13.50	N	OFF	20.1
1.371750	39.22	---	56.00	16.78	N	OFF	20.1
1.446000	---	33.00	46.00	13.00	N	OFF	20.1
1.446000	39.63	---	56.00	16.37	N	OFF	20.1
1.511250	---	32.36	46.00	13.64	N	OFF	20.0
1.511250	38.77	---	56.00	17.23	N	OFF	20.0
1.614750	---	30.50	46.00	15.50	N	OFF	20.0
1.614750	36.89	---	56.00	19.11	N	OFF	20.0
1.677750	---	28.99	46.00	17.01	N	OFF	20.0
1.677750	35.25	---	56.00	20.75	N	OFF	20.0
1.774500	---	27.44	46.00	18.56	N	OFF	20.0
1.774500	33.76	---	56.00	22.24	N	OFF	20.0
1.862250	---	26.46	46.00	19.54	N	OFF	20.0
1.862250	32.52	---	56.00	23.48	N	OFF	20.0
1.988250	---	25.68	46.00	20.32	N	OFF	20.0
1.988250	31.37	---	56.00	24.63	N	OFF	20.0
14.739000	---	23.24	50.00	26.76	N	OFF	19.9
14.739000	28.39	---	60.00	31.61	N	OFF	19.9

Appendix B. Radiated Emission Test Result



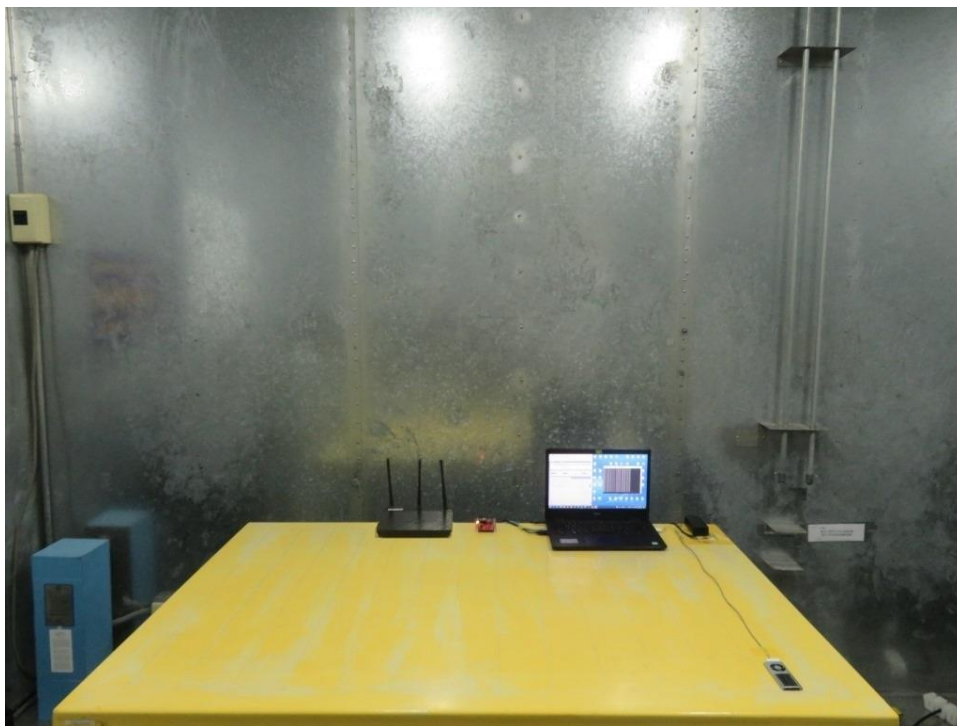


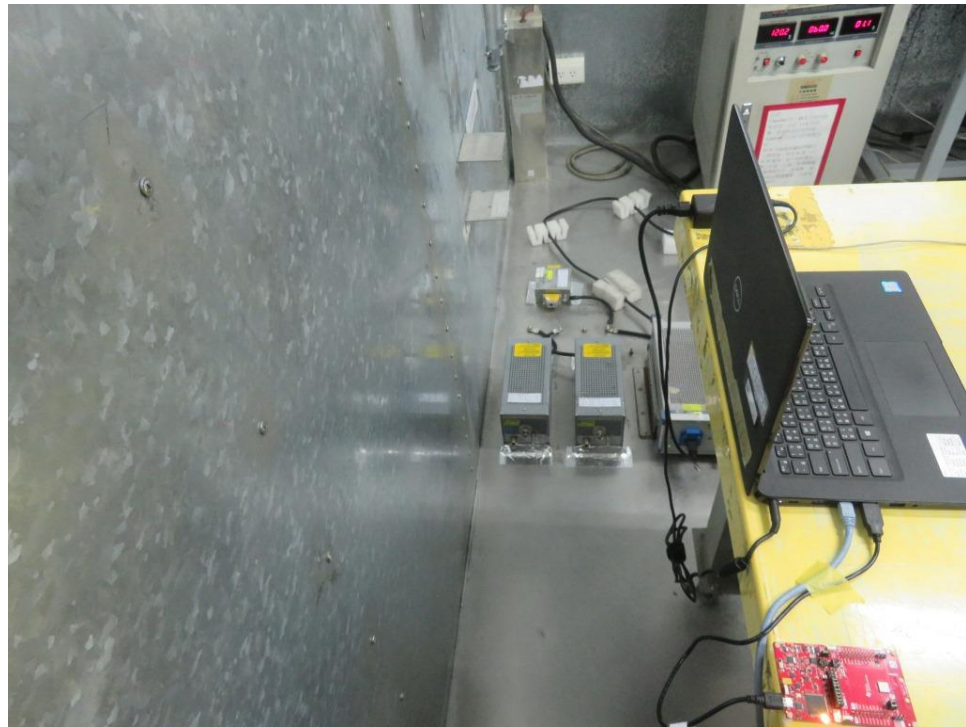
Appendix C. Setup Photographs

<Conducted Emission>

Mode 1

Remote View





Rear View



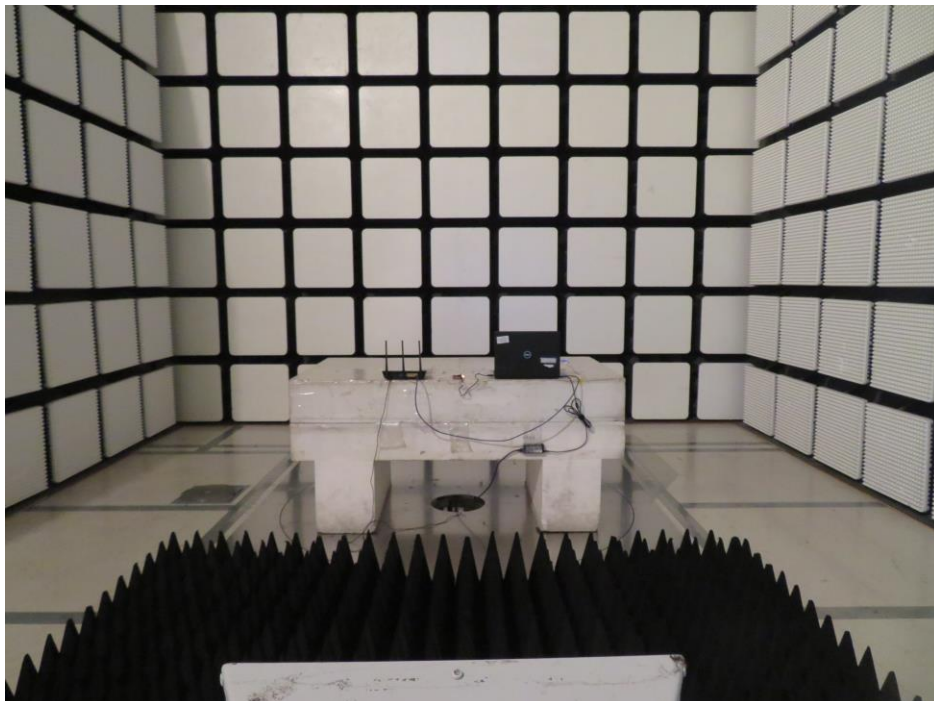
<Radiated Emission>

Mode 2

LF



HF



——THE END——