

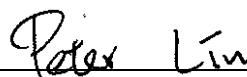
CE EMC Test Report

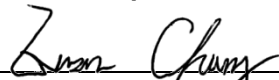
Equipment : Sterling-LWB5+ WiFi 5 + Bluetooth 5.2 USB Adapter
Model No. : Sterling LWB5+
Brand Name : Laird Connectivity
Applicant : Laird Connectivity, LLC.
Address : W66N220 Commerce Court, Cedarburg, Wisconsin 53012, USA
Standard : EN 301 489-1 V2.2.3 (2019-11)
EN 301 489-17 V3.2.4 (2020-09)
Received Date : Jun. 01, 2021
Tested Date : Jun. 09 ~ Jun. 21, 2021

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. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:

Approved by:


Peter Lin / Supervisor


Eason Chang / Assistant Manager


Kent Chen / Assistant Manager



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Release Record

Report No.	Version	Description	Issued Date
EH061103-02	Rev. 01	Initial issue	Aug. 17, 2021

Summary of Test Results

EN 301 489-1 Emission Tests				
Ref. Std. Clause	Test Standard	Test Items	Measured	Result
8.3/8.4	EN 55032:2015/A11:2020, Class B	Conducted Emissions from the AC mains power ports	Under limit 18.31dB @ 0.322MHz.	Pass
8.7	EN 55032:2015/A11:2020, Class B	Asymmetric Mode Conducted Emissions	Note ¹	N/A
8.2	EN 55032:2015/A11:2020, Class B	Radiated Emissions	Under limit 6.15dB @ 933.07MHz.	Pass
8.5	EN 61000-3-2:2014, Class A	Harmonic Current Emissions	Note ²	N/A
8.6	EN 61000-3-3:2013+A1:2019	Voltage Fluctuations and Flicker	Note ²	N/A
<p>N/A means Not Applicable. Note¹: The EUT w/o telecom port. Note²: The EUT consumes DC power, so the test is not required.</p>				

Declaration of Conformity:

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

EN 301 489-1 Immunity Tests					
Ref. Std. Clause	Test Standard	Description of Test		Pass Criterion	Result
9.3	EN 61000-4-2:2009	Electrostatic Discharge (ESD)		A	Pass
9.2	EN 61000-4-3:2006/A1:2008/A2:2010	Radio Frequency Electromagnetic Field (RS)		A	Pass
9.4	EN 61000-4-4:2012	Electrical Fast Transient/Burst (EFT)		Note ¹	N/A
9.8	EN 61000-4-5:2014+A1:2017	Surge		Note ²	N/A
9.5	EN 61000-4-6:2014	Conducted Disturbances (CS)		Note ¹	N/A
9.7	EN 61000-4-11:2004+A1:2017	Voltage Dips	0% residual for 0.5 cycle	Note ²	N/A
			0% residual for 1 cycle	Note ²	N/A
			70% residual for 25 cycle	Note ²	N/A
		Voltage Interruption	0% residual for 250 cycle	Note ²	N/A
N/A means Not Applicable.					
Note ¹ : The EUT consumes DC power, and it is not intended to be used with cables longer than 3m. So this test is not carried out.					
Note ² : The EUT consumes DC power, so the test is not required.					

Comments and Explanations:
None.

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

S/W Version	N/A
BT	
Operating Frequency	2402 MHz ~ 2480 MHz
Modulation Type	Bluetooth BR(1Mbps): GFSK Bluetooth EDR (2Mbps): $\pi/4$ -DQPSK Bluetooth EDR (3Mbps): 8-DPSK
Antenna Type	Chip Antenna
WLAN	
Operating Frequency	802.11b/g/n: 2412 MHz ~ 2472 MHz 802.11a/n/ac: 5180 MHz ~ 5240 MHz; 5260 MHz ~ 5320 MHz; 5500 MHz ~ 5700 MHz
Modulation Type	802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11a/g/n/ac: OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)
Antenna Type	Chip Antenna

1.1.2 Power Supply Type of the Equipment under Test (EUT)

Power Supply Type	5Vdc from host
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1.1.3 Accessories

N/A

1.2 Test Equipment and Calibration Data

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Test Date	Jun. 21, 2021				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101658	Feb. 08, 2021	Feb. 07, 2022
LISN	R&S	ENV216	101579	Mar. 17, 2021	Mar. 16, 2022
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-666	Dec. 29, 2020	Dec. 28, 2021
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 21, 2020	Oct. 20, 2021
50 ohm terminal (Support Unit)	NA	50	04	May 25, 2021	May 24, 2022
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission below 1GHz				
Test Site	966 chamber 2 / (03CH02-WS)				
Test Date	Jun. 18, 2021				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	Agilent	N9038A	MY53290044	Sep. 15, 2020	Sep. 14, 2021
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-523	Dec. 29, 2020	Dec. 28, 2021
Preamplifier	EMC	EMC02325	980194	Sep. 16, 2020	Sep. 15, 2021
LF cable 1M	EMC	EMCCFD400-NM-N M-1000	160501	Oct. 17, 2020	Oct. 16, 2021
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-003	Oct. 17, 2020	Oct. 16, 2021
LF cable 10M	EMC	CFD400-E	CFD400-001	Oct. 17, 2020	Oct. 16, 2021
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission above 1GHz				
Test Site	966 chamber 2 / (03CH02-WS)				
Test Date	Jun. 18, 2021				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	Agilent	N9010A	MY53400091	Nov. 17, 2020	Nov. 16, 2021
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1095	Sep. 25, 2020	Sep. 24, 2021
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 06, 2020	Nov. 05, 2021
Preamplifier	EMC	EMC184045B	980192	Jul. 21, 2020	Jul. 20, 2021
Preamplifier	EMC	EMC12630SE	980322	Jul. 10, 2020	Jul. 09, 2021
RF Cable	EMC	EMC105-SM-SM-8000	180512	Oct. 17, 2020	Oct. 16, 2021
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16018/4	Oct. 17, 2020	Oct. 16, 2021
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	ESD				
Test Site	ESD room 1 / (ES01-WS)				
Test Date	Jun. 15, 2021				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
ESD Generator	EMTest	Dito	V1248114239	Aug. 13, 2020	Aug. 12, 2021
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Immunity (80 MHz - 6 GHz)				
Test Site	RS room 1 / (RS01-WS)				
Test Date	Jun. 09, 2021				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Signal Generator	R&S	SMB100A	103924HA	Oct. 14, 2020	Oct. 13, 2021
Power Sensor	R&S	NRP-Z91	101094-UL	Oct. 18, 2020	Oct. 17, 2021
Power Sensor	R&S	NRP-Z91	101095-KY	Oct. 18, 2020	Oct. 17, 2021
Power Amplifier	BONN	BLWA 0810-160/100D	107972A	N/A	N/A
Power Amplifier	BONN	BLMA 1060-100D	107972B	N/A	N/A
Antenna	SCHWARZBECK MESS-ELEKTRONIK	STLP 9149	9149-073	N/A	N/A
Antenna	R&S	HL046E	100076-Cd	N/A	N/A
Note: Calibration Interval of instruments listed above is one year.					

1.3 Testing Applied Standards

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

EN 301 489-1 V2.2.3 (2019-11)
EN 301 489-17 V3.2.4 (2020-09)

1.4 Deviation from Test Standard and Measurement Procedure

None

1.5 Measurement Uncertainty

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

Measurement Uncertainty		
Test Item	Frequency	Uncertainty
Conducted Emissions from the AC mains power ports	150kHz ~ 30MHz	± 2.92 dB
Radiated Emissions	30MHz ~ 1GHz	± 4.32 dB
	Above 1GHz	± 4.57 dB

Note: The results of measurements of emissions shall reference the measurement uncertainty considerations contained in CISPR 16-4-2.

2 Test Configuration

2.1 Testing Facility

Test Laboratory	International Certification Corporation
Test Site	CO01-WS, 03CH02-WS, RS01-WS
Address of Test Site	No.3-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)
Test Site	ES01-WS
Address of Test Site	No.2-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)

2.2 The Worst Case Measurement Configuration

Radiation Pretested Mode	
Pretest Mode	Operating Description
1	Ping WiFi 5G, EUT: X-axis, with Carrier Board + Adapter 230V/50Hz
2	Ping WiFi 5G, EUT: Y-axis, with Carrier Board + Adapter 230V/50Hz
3	Ping WiFi 5G, EUT: Z-axis, with Carrier Board + Adapter 230V/50Hz
4	Ping WiFi 5G, EUT: X-axis, with Carrier Board + Adapter 110V/60Hz
5	Ping WiFi 2.4G, EUT: X-axis, with Carrier Board + Adapter 230V/50Hz
6	BT Link, EUT: X-axis, with Carrier Board + Adapter 230V/50Hz
7	Standby mode, EUT: X-axis, with Carrier Board + Adapter 230V/50Hz
For Pretest Mode 1 is the worst case and only its data was record in this test report.	

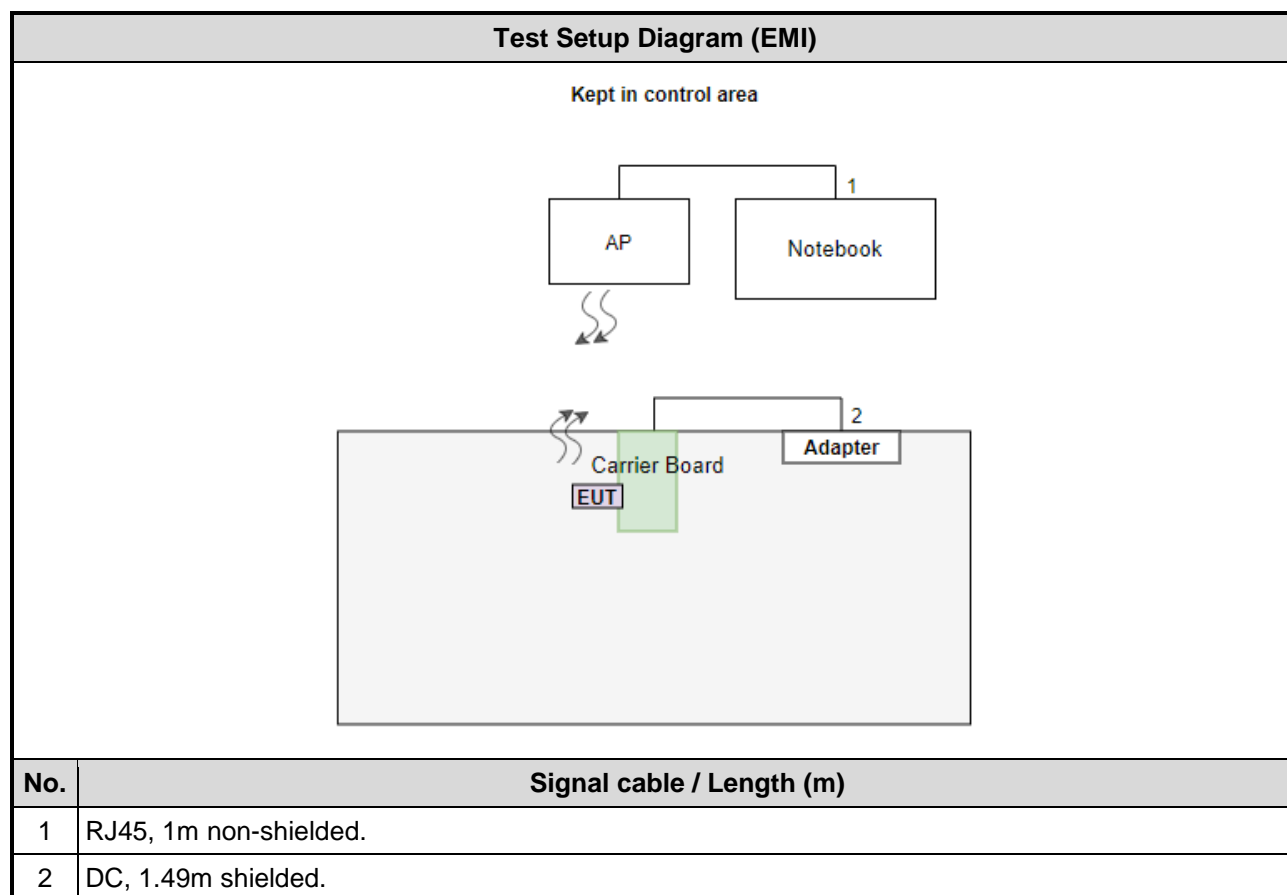
The Worst Test Configurations	
Conducted Emissions from the AC mains power ports	
Test Mode	Operating Description
1	Ping WiFi 5G, EUT: X-axis, with Carrier Board + Adapter 230V/50Hz
2	Ping WiFi 5G, EUT: X-axis, with Carrier Board + Adapter 110V/60Hz
Radiated Emissions	
Test Mode $\leq 1\text{GHz}$	Operating Description
1	Ping WiFi 5G, EUT: X-axis, with Carrier Board + Adapter 230V/50Hz
Test Mode $>1\text{GHz}$	Operating Description
1	Ping WiFi 5G, EUT: X-axis, with Carrier Board + Adapter 230V/50Hz
ESD & RS Tests	
Test Mode	Operating Description
1	Wi-Fi 2.4G ping test.
2	Wi-Fi 5G ping test.
3	BT PER.

2.3 Local Support Equipment List

Support Equipment List (EMI)					
No.	Equipment	Brand	Model	S/N	Remarks
1	Adapter	I.T.E POWER SUPPLY	MU12AY12010 0-A1	---	Provided by applicant.
2	Notebook	DELL	Latitude E6440	8VXMD12	---
3	Wireless AP	D-LINK	DIR-850L	RZ1Q4G6000261	---
4	Carrier Board	Laird	DVK-LWB5+	---	Provided by applicant.

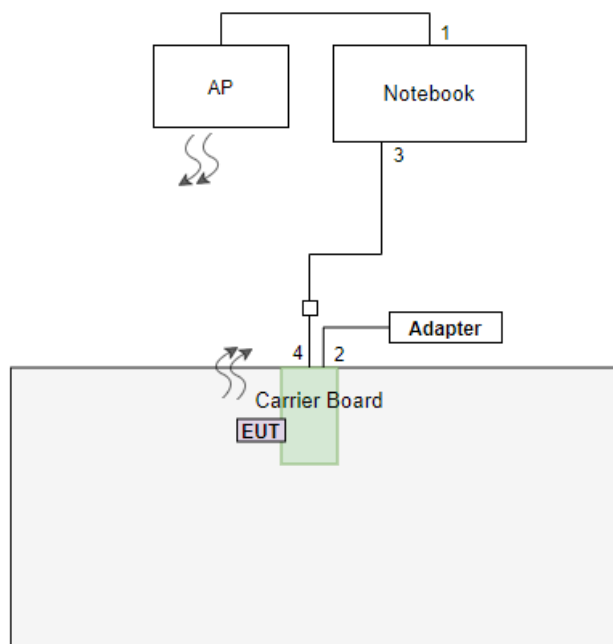
Support Equipment List (EMS)					
No.	Equipment	Brand	Model	S/N	Remarks
1	Adapter	I.T.E POWER SUPPLY	MU12AY12010 0-A1	---	Provided by applicant.
2	Carrier Board	Laird	DVK-LWB5+	---	Provided by applicant.
3	Note Book	DELL	Latitude E5430	6R4RWW1	---
4	Wireless AP	D-LINK	DIR-850L	RZ1Q4G6000262	---
5	Wireless Connectivity Tester	ROHDE&SCHW ARZ	CMW270	100856	---

2.4 Test Setup Chart



Test Setup Diagram (EMS _ESD_ Mode 1, 2)

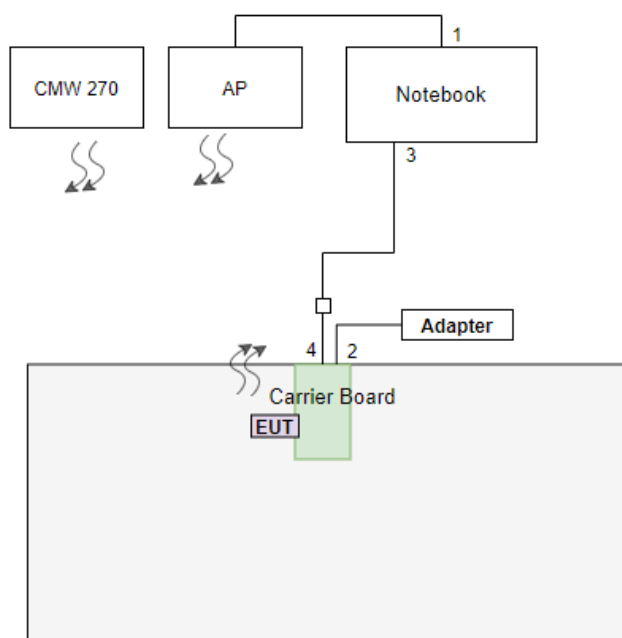
Kept in control area



No.	Signal cable / Length (m)
1	RJ45, 3m non-shielded.
2	DC, 1.49m shielded.
3	USB, 1.5m shielded.
4	Type A to USB, 1.5m shielded.

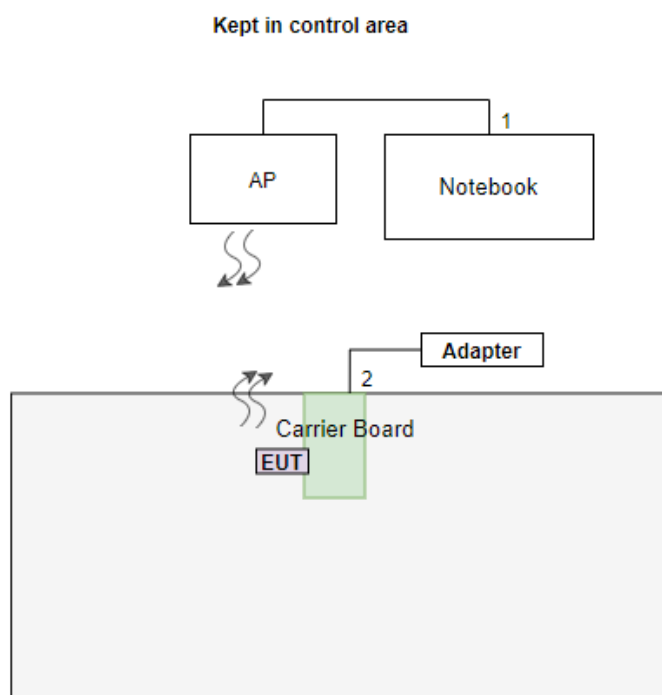
Test Setup Diagram (EMS _ESD_ Mode 3)

Kept in control area



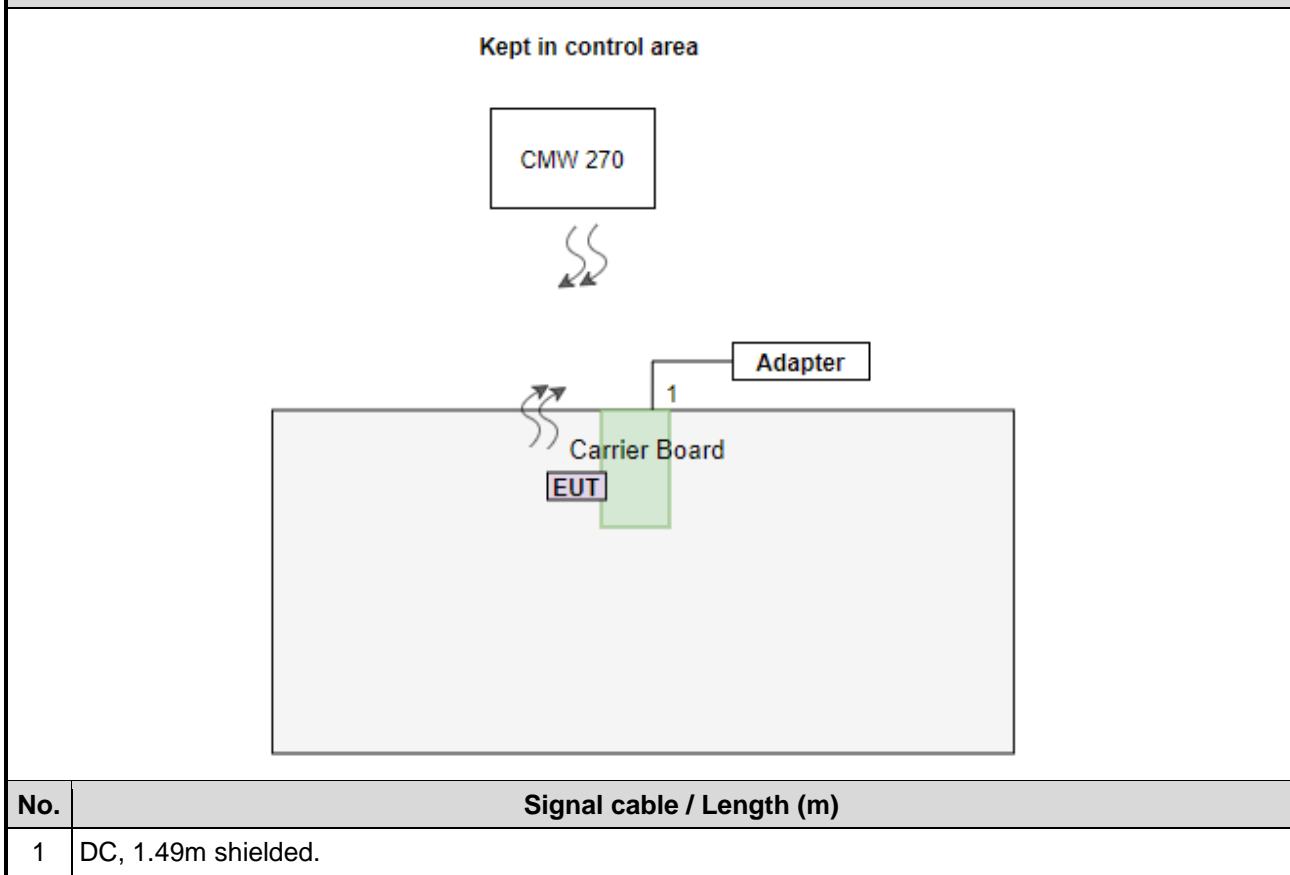
No.	Signal cable / Length (m)
1	RJ45, 3m non-shielded.
2	DC, 1.49m shielded.
3	USB, 1.5m shielded.
4	Type A to USB, 1.5m shielded.

Test Setup Diagram (EMS_RS_Mode 1, 2)



No.	Signal cable / Length (m)
1	RJ45, 3m non-shielded.
2	DC, 1.49m shielded.

Test Setup Diagram (EMS_RS_Mode 3)



2.5 Test Software and Operating Condition

- To enable all function of test system.
- The support notebook executed "teraterm" program to enable WLAN function of EUT.
- The EUT linked to support AP by WiFi.
- The support notebook executed ping command to monitor the packet error rate below 10%.

BT PER

- The EUT linked with CMW270 to observe packet error rate below 10%.

3 Emission Test Results

3.1 Conducted Emissions from the AC mains power ports

3.1.1 Limits of Conducted Emissions from the AC mains power ports

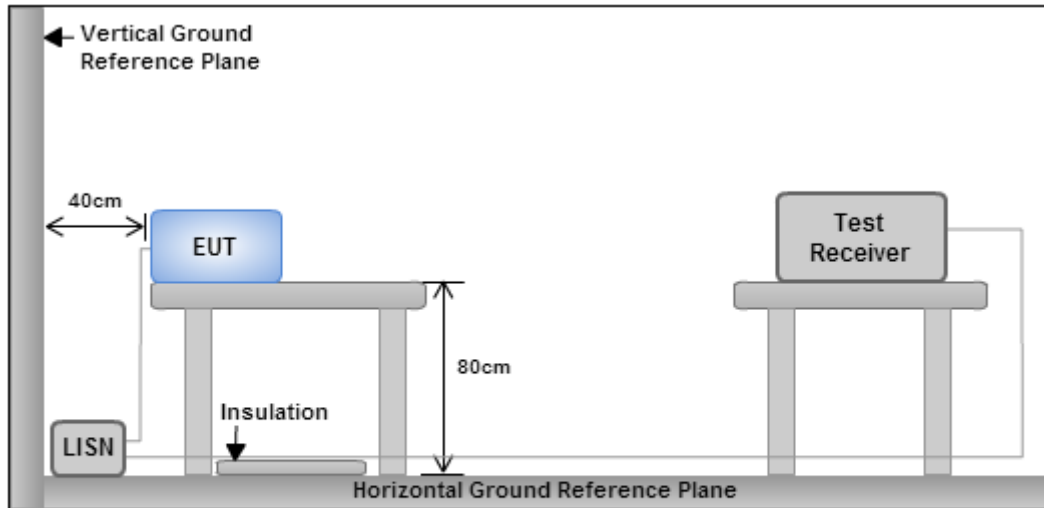
Frequency Range	Limits values (dB μ V)			
	Class A		Class B	
	Quasi-Peak	Average	Quasi-Peak	Average
0,15 MHz to 0,5 MHz	79	66	66 to 56 *	56 to 46 *
> 0,5 MHz to 5 MHz	73	60	56	46
> 5 MHz to 30 MHz	73	60	60	50

Note 1: “*” Decreasing linearly with the logarithm of the frequency.
 Note 2: If the limits for the average detector are met when using the quasi-peak detector, then the limits for the measurements with the average detector are considered to be met.
 Note 3: The higher value measured with and without the outer conductor screen of the antenna terminal connected to earth is considered.

3.1.2 Test Procedures

- The EUT was placed on a desk 0.8 meters height from the metal ground plane and 0.4 meter from the conducting wall of the shielding room and it was kept at least 0.8 meters from any other grounded conducting surface.
- A thickness of ≤ 0.15 m insulation should be placed between local AE and associated cabling and the RGP.
- Connect EUT to the power mains through a line impedance stabilization network (LISN).
- All the support units are connecting to the other LISN.
- The LISN provides 50 ohm coupling impedance for the measuring instrument.
- The CISPR states that a 50 ohm, 50 microhenry LISN should be used.
- Both sides of AC line were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched.
- Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

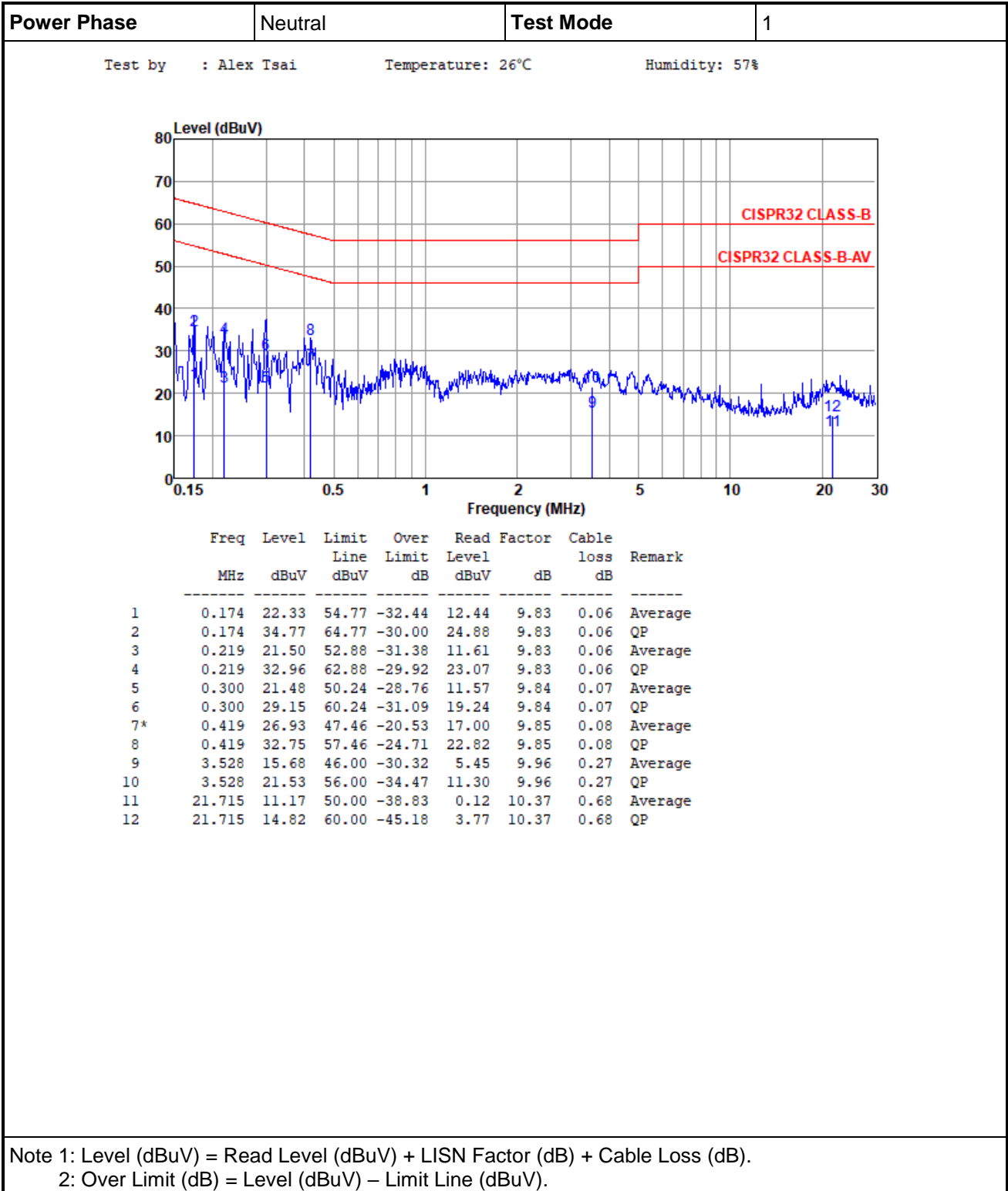
3.1.3 Test Setup

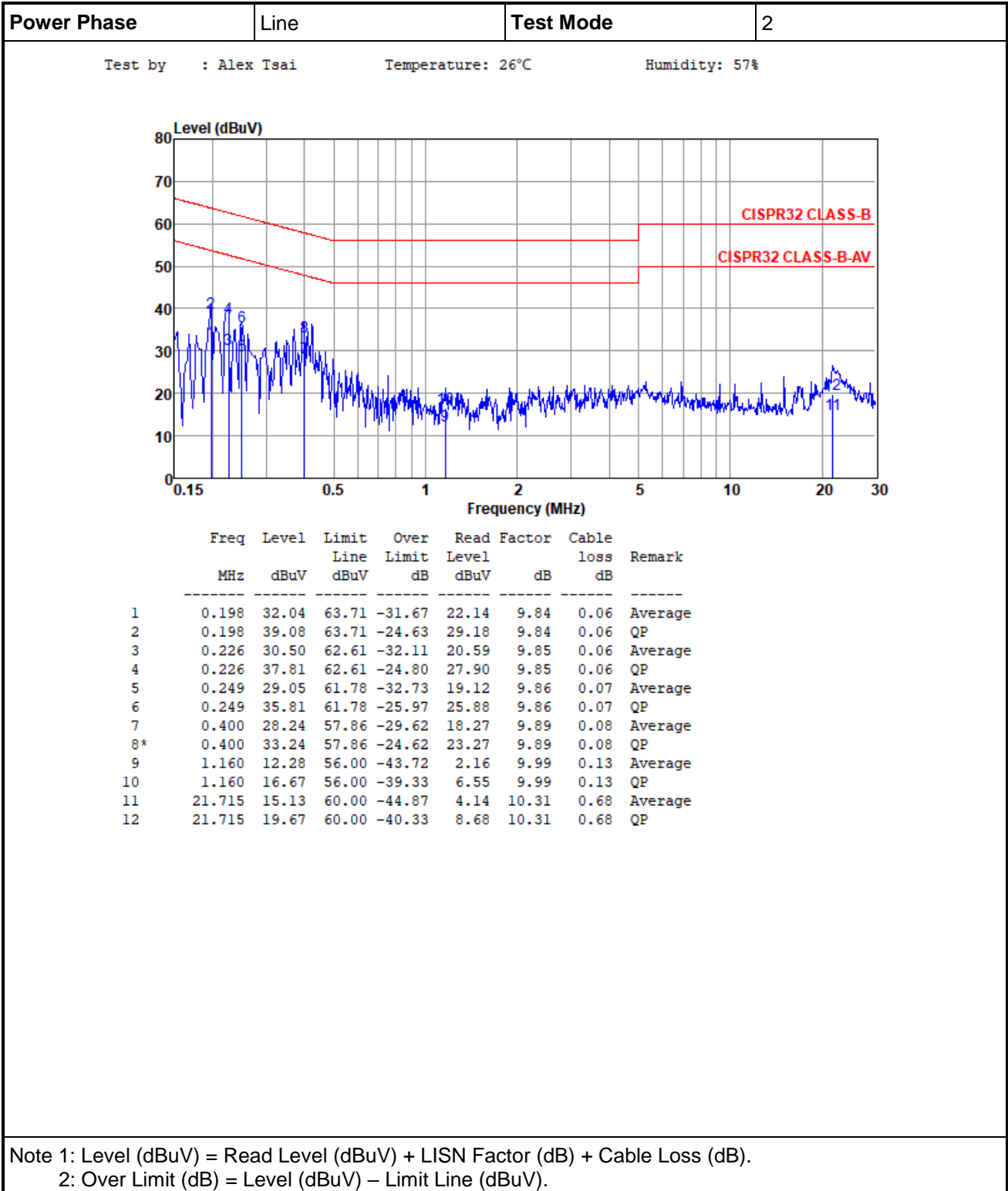


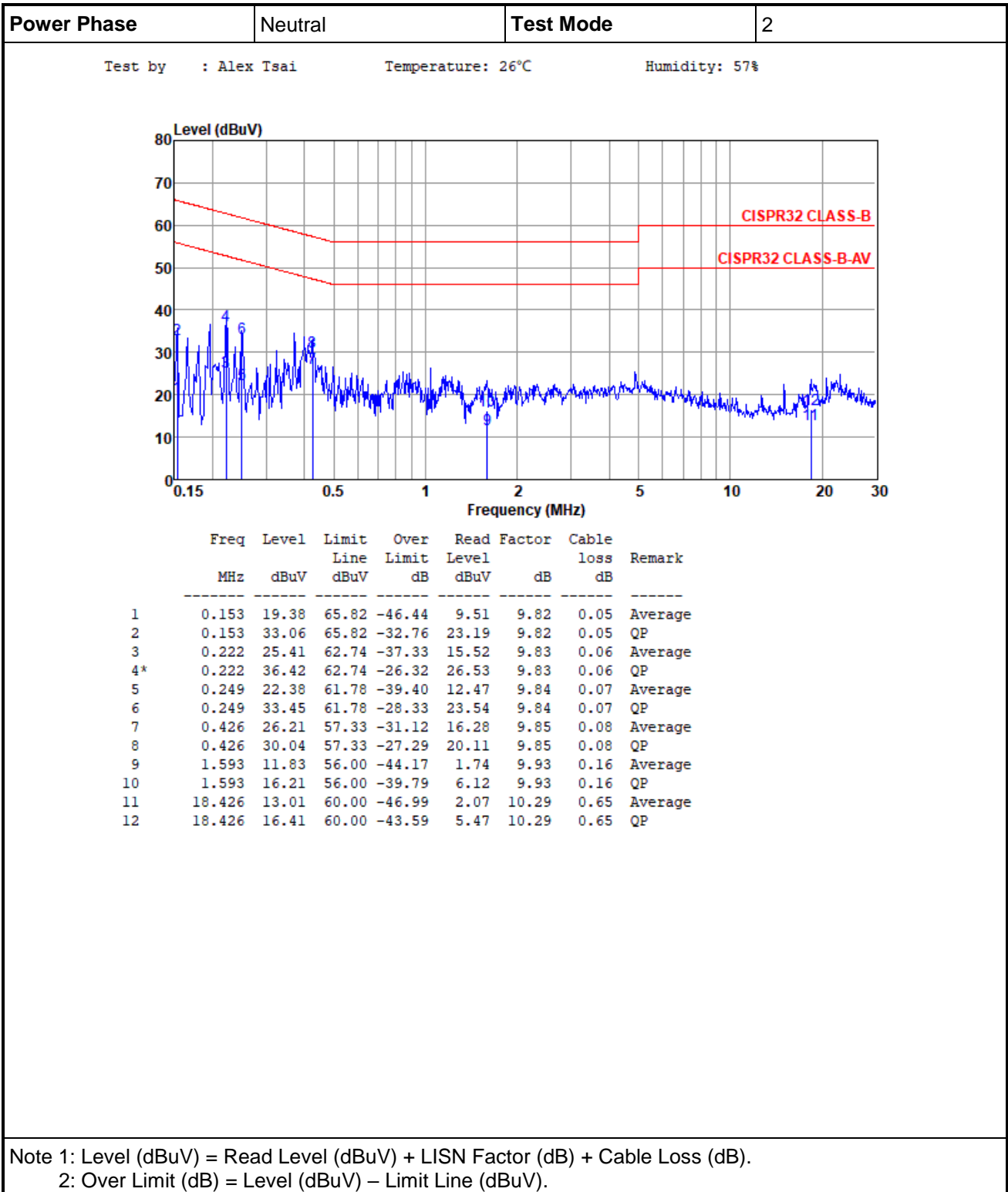
- Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

3.1.4 Test Result of Conducted Emissions from the AC mains power ports

Power Phase	Line	Test Mode	1																																																																																																																					
Test by : Alex Tsai Temperature: 26°C Humidity: 57%																																																																																																																								
<div><div><div>Level (dBuV)</div><div></div></div><table><thead><tr><th></th><th>Freq MHz</th><th>Level dBuV</th><th>Limit Line dBuV</th><th>Over Limit dB</th><th>Read Level dBuV</th><th>Factor dB</th><th>Cable loss dB</th><th>Remark</th></tr></thead><tbody><tr><td>1</td><td>0.174</td><td>28.53</td><td>54.77</td><td>-26.24</td><td>18.63</td><td>9.84</td><td>0.06</td><td>Average</td></tr><tr><td>2</td><td>0.174</td><td>37.64</td><td>64.77</td><td>-27.13</td><td>27.74</td><td>9.84</td><td>0.06</td><td>QP</td></tr><tr><td>3</td><td>0.222</td><td>32.32</td><td>52.74</td><td>-20.42</td><td>22.41</td><td>9.85</td><td>0.06</td><td>Average</td></tr><tr><td>4</td><td>0.222</td><td>41.13</td><td>62.74</td><td>-21.61</td><td>31.22</td><td>9.85</td><td>0.06</td><td>QP</td></tr><tr><td>5*</td><td>0.322</td><td>31.35</td><td>49.66</td><td>-18.31</td><td>21.41</td><td>9.87</td><td>0.07</td><td>Average</td></tr><tr><td>6</td><td>0.322</td><td>38.32</td><td>59.66</td><td>-21.34</td><td>28.38</td><td>9.87</td><td>0.07</td><td>QP</td></tr><tr><td>7</td><td>0.419</td><td>29.06</td><td>47.46</td><td>-18.40</td><td>19.08</td><td>9.90</td><td>0.08</td><td>Average</td></tr><tr><td>8</td><td>0.419</td><td>37.07</td><td>57.46</td><td>-20.39</td><td>27.09</td><td>9.90</td><td>0.08</td><td>QP</td></tr><tr><td>9</td><td>3.509</td><td>11.41</td><td>46.00</td><td>-34.59</td><td>1.11</td><td>10.03</td><td>0.27</td><td>Average</td></tr><tr><td>10</td><td>3.509</td><td>17.92</td><td>56.00</td><td>-38.08</td><td>7.62</td><td>10.03</td><td>0.27</td><td>QP</td></tr><tr><td>11</td><td>21.373</td><td>16.21</td><td>50.00</td><td>-33.79</td><td>5.23</td><td>10.30</td><td>0.68</td><td>Average</td></tr><tr><td>12</td><td>21.373</td><td>22.25</td><td>60.00</td><td>-37.75</td><td>11.27</td><td>10.30</td><td>0.68</td><td>QP</td></tr></tbody></table></div>					Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	Factor dB	Cable loss dB	Remark	1	0.174	28.53	54.77	-26.24	18.63	9.84	0.06	Average	2	0.174	37.64	64.77	-27.13	27.74	9.84	0.06	QP	3	0.222	32.32	52.74	-20.42	22.41	9.85	0.06	Average	4	0.222	41.13	62.74	-21.61	31.22	9.85	0.06	QP	5*	0.322	31.35	49.66	-18.31	21.41	9.87	0.07	Average	6	0.322	38.32	59.66	-21.34	28.38	9.87	0.07	QP	7	0.419	29.06	47.46	-18.40	19.08	9.90	0.08	Average	8	0.419	37.07	57.46	-20.39	27.09	9.90	0.08	QP	9	3.509	11.41	46.00	-34.59	1.11	10.03	0.27	Average	10	3.509	17.92	56.00	-38.08	7.62	10.03	0.27	QP	11	21.373	16.21	50.00	-33.79	5.23	10.30	0.68	Average	12	21.373	22.25	60.00	-37.75	11.27	10.30	0.68	QP
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12	21.373	22.25	60.00	-37.75	11.27	10.30	0.68	QP																																																																																																																
Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB). 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).																																																																																																																								







3.2 Radiated Emissions

3.2.1 Limit of Radiated Emissions

Frequency Range (MHz)	Class A		Class B	
	10m	3m	10m	3m
	Quasi-peak limits (dB μ V/m)			
30 to 230	40	50	30	40
230 to 1000	47	57	37	47

Note 1: The lower limit shall apply at the transition frequency.
Note 2: Additional provisions may be required for cases where interference occurs.

Frequency range (GHz)	Class A (3 m)		Class B (3 m)	
	Average limit (dB μ V/m)	Peak limit (dB μ V/m)	Average limit (dB μ V/m)	Peak limit (dB μ V/m)
1 to 3	56	76	50	70
3 to 6	60	80	54	74

Note 1: The lower limit shall apply at the transition frequency.
Note 2: Additional provisions may be required for cases where interference occurs.

For an unintentional radiator is shown in the table below.

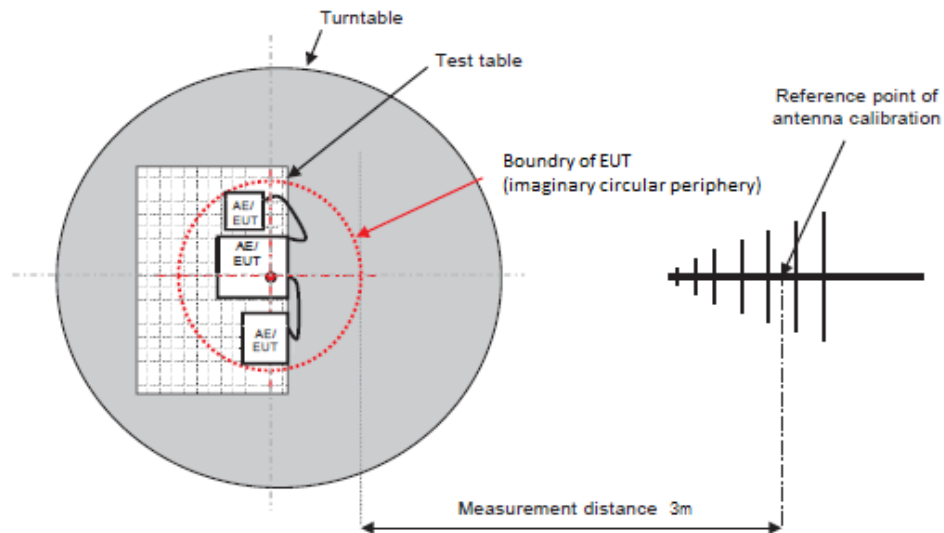
The highest internal source of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes.	Upper frequency of measurement range
Below 108 MHz	1 GHz
108 MHz to 500 MHz	2 GHz
500 MHz to 1 GHz	5 GHz
Above 1 GHz	5 times the highest frequency or 6 GHz, whichever is less.

3.2.2 Test Procedures

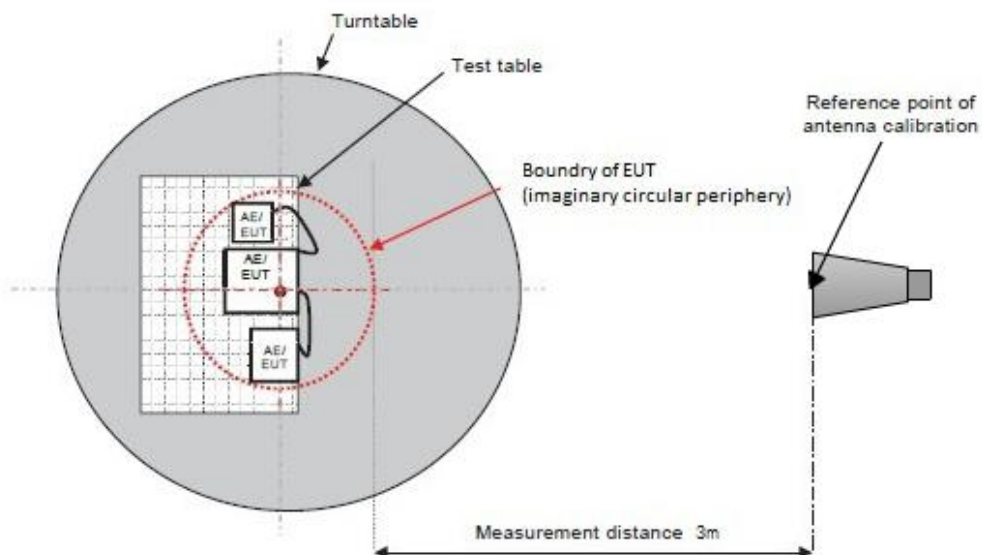
- a. The EUT was placed on a rotatable table top with a height of 0.8 meters which is placed on the ground plane.
- b. A thickness of $\leq 0.15\text{m}$ insulation should be placed between local AE and associated cabling and the RGP.
- c. The EUT received DC power source from the outlet socket under the turntable. All support equipment power received from another socket under the turntable.
- d. The EUT and local AE shall be arranged in the most compact practical arrangement within the test volume. The central point of the arrangement shall be positioned at the centre of the turntable. The measurement distance is the shortest horizontal distance between an imaginary circular periphery just encompassing this arrangement and calibration point of the antenna.
- e. The table was rotated 360 degrees to determine the position of the highest radiation.
- f. The antenna is a half wave dipole and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.
- g. For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 to 4 meters) and turn table (from 0 to 360 degrees) to find the maximum reading.
- h. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.
- i. If the emission level of the EUT in peak mode was 2 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 2 dB margin will be repeated one by one using the quasi-peak method and reported.

3.2.3 Test Setup

Radiated Emissions below 1GHz



Radiated Emissions above 1GHz



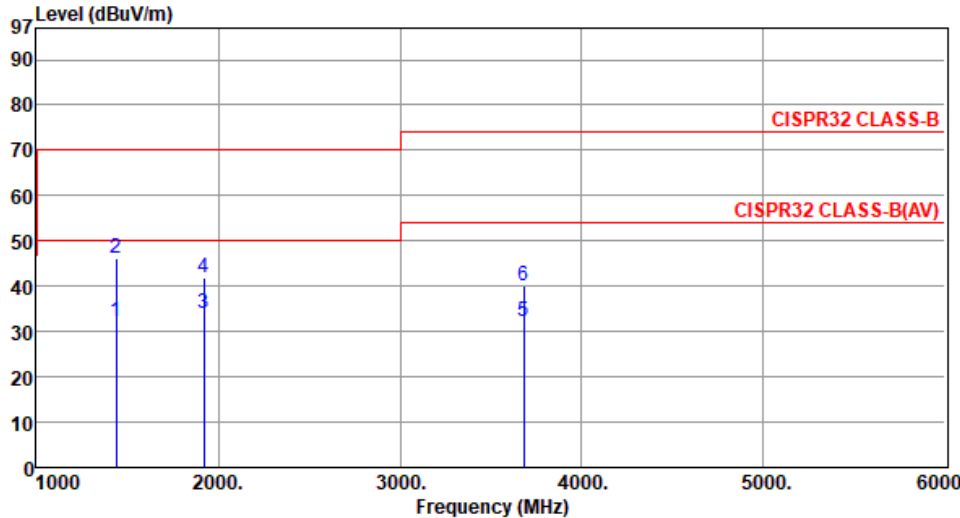
3.2.4 Radiated Emissions (Below 1GHz)

Polarization	Horizontal		Test Mode		1				
Test By	:Alex Tsai		Temperature(°C):22		Humidity(%):60				
<div><div><div>Level (dBuV/m)</div><div><div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div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Polarization	Vertical	Test Mode	1
Test By :Alex Tsai Temperature(°C):22 Humidity(%):60			
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3.2.5 Radiated Emissions (Above 1GHz)

Polarization		Horizontal		Test Mode		1	
Test By		:Alex Tsai		Temperature(°C):22		Humidity(%):60	



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	1440.01	32.38	50.00	-17.62	39.07	-6.69	Average	110	360
2	1440.01	46.05	70.00	-23.95	52.74	-6.69	Peak	110	360
3	1920.02	34.13	50.00	-15.87	40.47	-6.34	Average	144	202
4	1920.02	42.01	70.00	-27.99	48.35	-6.34	Peak	144	202
5	3681.55	32.25	54.00	-21.75	32.83	-0.58	Average	125	300
6	3681.55	40.11	74.00	-33.89	40.69	-0.58	Peak	125	300

Note 1: Emission level (dBuV/m) = SA reading (dBuV) + Factor* (dB/m)
 *Factor includes antenna factor, cable loss and amplifier gain
 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m)

Polarization	Vertical	Test Mode	1
Test By	:Alex Tsai	Temperature(°C):22	Humidity(%):60
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4 Immunity Tests

4.1 General Description

Product Standard: EN 301 489-1 , EN 301 489-17		
Basic Standard	Spec. Requirement	Performance Criteria
EN 61000-4-2 (ESD)	Contact Discharge: ± 4 kV Air Discharge: ± 8 kV	B
EN 61000-4-3 (RS)	80 MHz to 6000 MHz 3 V/m, 1 kHz Sine Wave 80%, AM Modulation	A

4.2 Performance Criteria Description

EN 301 489-17 Performance Criteria		
Criteria	During test	After test (i.e. as a result of the application of the test)
A	Shall operate as intended. (see note). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance Shall be no loss of function. Shall be no loss of critical stored data.
B	May be loss of function.	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no loss of critical stored data.
C	May be loss of function.	Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no loss of critical stored data.
<p>Note: Operate as intended during the test allows a level of degradation in accordance with clause 6.2.2.</p> <p>Clause 6.2.2 Minimum performance level</p> <p>For equipment that supports a PER or FER, the minimum performance level shall be a PER or FER less than or equal to 10%.</p> <p>For equipment that does not support a PER or FER, the minimum performance level shall be no loss of wireless transmission function needed for the intended use of the equipment.</p>		

4.3 Electrostatic Discharge (ESD)

4.3.1 Test Specification of Electrostatic Discharge (ESD)

Basic Standard	EN 61000-4-2
Discharge Voltage	Contact Discharge: ± 2 kV / ± 4 kV Air Discharge: ± 2 kV / ± 4 kV / ± 8 kV
Discharge Impedance	330 ohm / 150 pF
Number of Discharge	Air Discharge: minimum 20 times at each test point Contact Discharge: minimum 20 times at each test point
Discharge Mode	Single Discharge
Discharge Period	1 second minimum

4.3.2 Test Procedures

- a. In the case of air discharge testing the climatic conditions shall be within the following ranges:
 - ambient temperature: 15°C to 35°C;
 - relative humidity : 30% to 60%;
 - atmospheric pressure : 86 kPa (860 mbar) to 106 kPa (1060 mbar).
- b. Test programs and software shall be chosen so as to exercise all normal modes of operation of the EUT. The use of special exercising software is encouraged, but permitted only where it can be shown that the EUT is being comprehensively exercised.
- c. The test voltage shall be increased from the minimum to the selected test severity level, in order to determine any threshold of failure. The final severity level should not exceed the product specification value in order to avoid damage to the equipment.
- d. The test shall be performed with both air discharge and contact discharge. On preselected points at least 10 single discharges (in the most sensitive polarity) shall be applied on air discharge. On preselected points at least 10 single discharges (in the most sensitive polarity) shall be applied on contact discharge.
- e. For the time interval between successive single discharges an initial value of one second is recommended. Longer intervals may be determined whether a system failure has occurred.
- f. In the case of contact discharges, the tip of the discharge electrode shall touch the EUT before the discharge switch is operated.
- g. In the case of painted surface covering a conducting substrate, the following procedure shall be adopted:
 - If the coating is not declared to be an insulating coating by the equipment manufacturer, then the pointed tip of the generator shall penetrate the coating so as to make contact with the conducting substrate.
 - Coating declared as insulating by the manufacturer shall only be submitted to the air discharge.
 - The contact discharge test shall not be applied to such surfaces.
- h. In the case of air discharges, the round discharge tip of the discharge electrode shall be approached as fast as possible (without causing mechanical damage) to touch the EUT. After each discharge, the ESD generator (discharge electrode) shall be removed from the EUT. The generator is then retriggered for a new single discharge. This procedure shall be repeated until the discharges are completed. In the case of an air discharge test, the discharge switch, which is used for contact discharge, shall be closed.

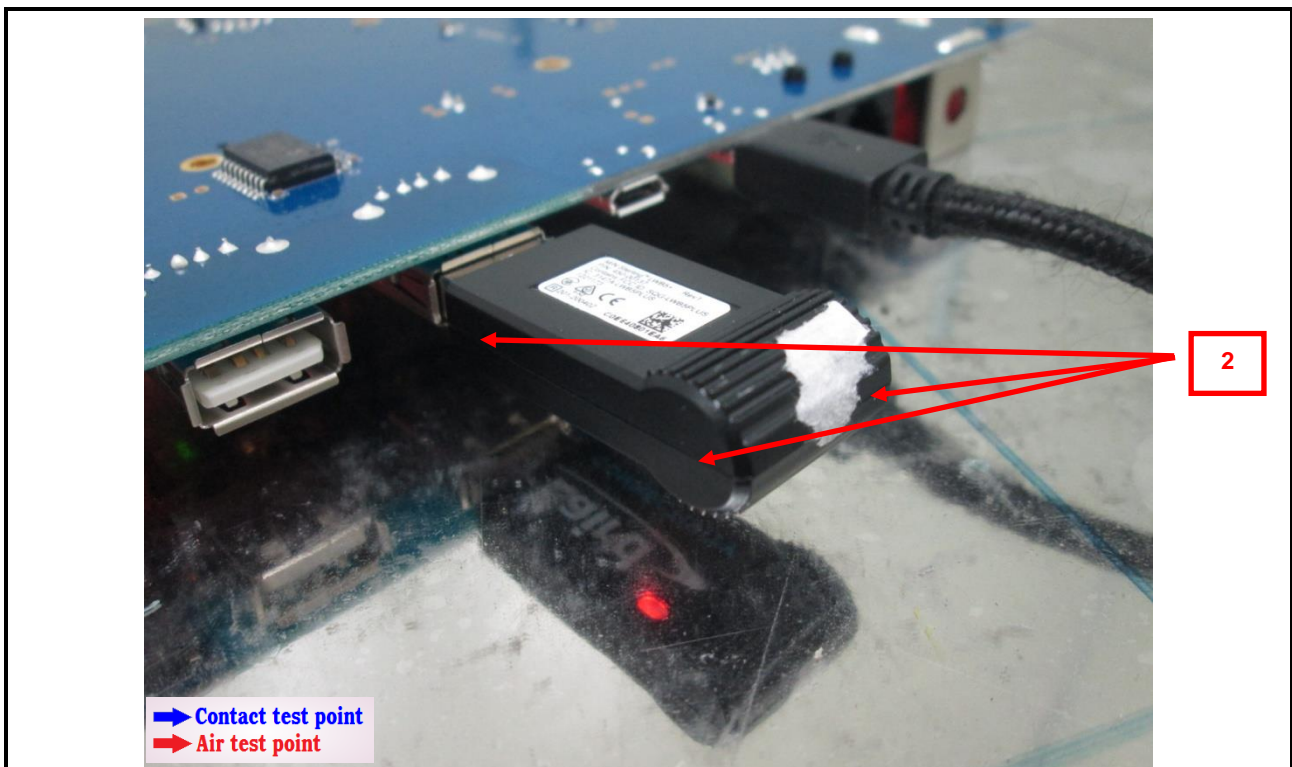
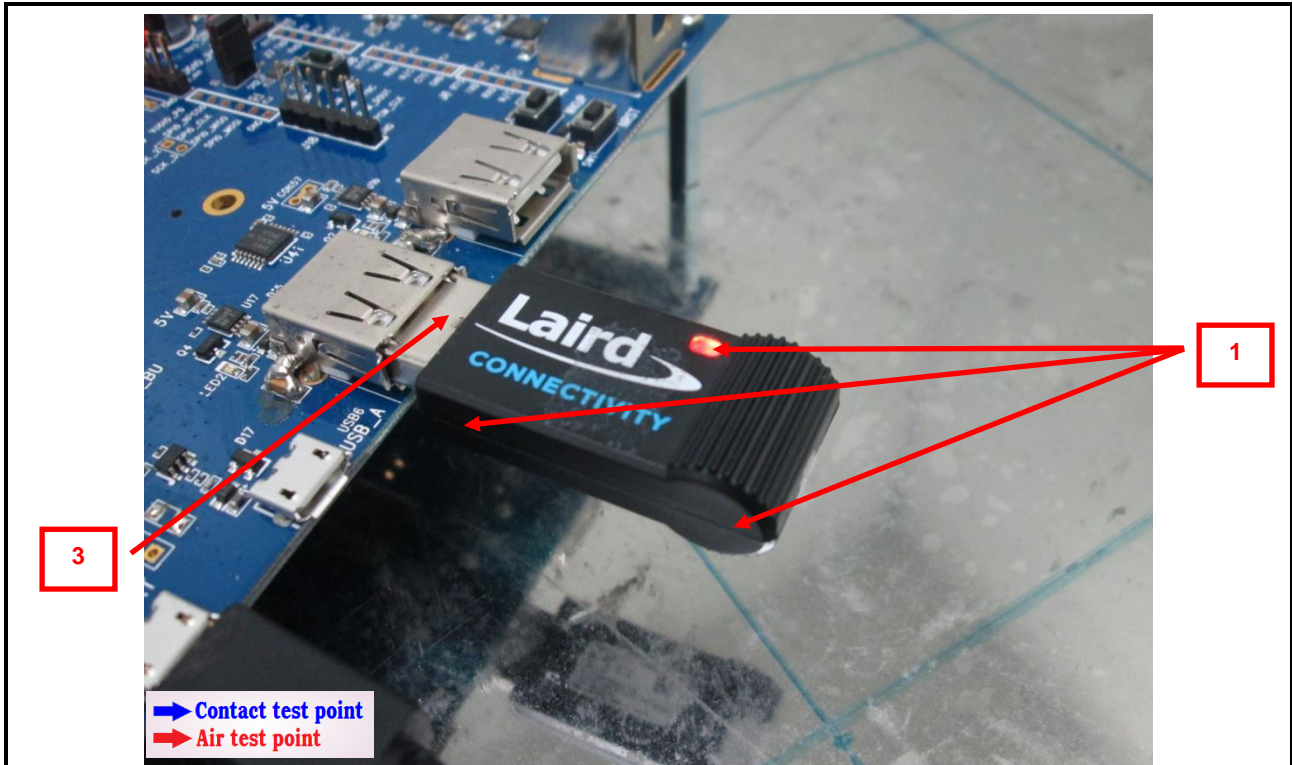
4.3.4 Test Result of Electrostatic Discharge (ESD)

Test Site	ES01-WS	Ambient Condition	22°C/45%/99kPa
Tested By	Zoe Yu		

Test Mode	1, 2, 3				
Direct Application					
Test Voltage (kV)	Polarity	Test Point	Contact Discharge	Air Discharge	Performance Criteria
2, 4, 8	+/-	1 ~ 3	N/A	Note	A
Indirect Application					
Test Voltage (kV)	Polarity	Test Point	Horizontal Coupling Plane (HCP)	Vertical Coupling Plane (VCP)	Performance Criteria
2, 4	+/-	At front, rear, left and right side	Note	Note	A

Note: There was no abnormal situation during the test compared with initial operation.

4.3.5 Test Point Photo



4.4 Radio Frequency Electromagnetic Field (RS)

4.4.1 Test Specification of Radio Frequency Electromagnetic Field (RS)

Basic Standard	EN 61000-4-3
Frequency Range	80 MHz ~ 6000 MHz
Field Strength	3 V/m
Modulation	1 kHz Sine Wave, 80%, AM Modulation
Frequency Step	1 % of preceding frequency value
Polarity of Antenna	Horizontal and Vertical
Antenna Height	1.5 m
Antenna Distance	80 MHz ~ 1000 MHz: 3 m 1000 MHz ~ 6000 MHz: 1 m
Dwell Time	3 seconds

4.4.2 Test Procedures

- The test level shall be 3 V/m (measured unmodulated). The test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1000 Hz. If the wanted signal is modulated at 1000 Hz, then an audio signal of 400 Hz shall be used.
- The test shall be performed over the frequency range 80 MHz to 6000 MHz with the exception of the exclusion band for transmitters, receivers and duplex transceivers, as appropriate.
- For receivers and transmitters the stepped frequency increments shall be 1 % frequency increment of the momentary used frequency, unless specified otherwise in the part of EN 301 489 series [i.13] dealing with the relevant type of radio equipment.
- Further product related spot frequency tests may be specified in the relevant part of EN 301 489 series [i.13] dealing with the particular type of radio equipment.
- Responses on receivers occurring at discrete frequencies, which are narrow band responses, shall be disregarded from the test.
- The frequencies selected and used during the test shall be recorded in the test report.
- When testing at frequencies above 1 GHz, the test distance shall be 1 m when using the independent windows method. Compliance with the field uniformity requirement shall be verified for the selected test distance.
- The alternative method for frequencies above 1 GHz divides the calibration area into a suitable array of 0,5 m × 0,5 m windows such that the whole area to be occupied by the face of the EUT is covered. The field uniformity shall be independently calibrated over each window.
- During the test, at each frequency the forward power shall be applied to the field-generating antenna. The test shall be repeated with the field-generating antenna repositioned to illuminate each of the required windows in turn.

4.4.3 Exclusion bands

The frequencies on which the transmitter part of the EUT is intended to operate shall be excluded from radiated emission measurements when performed in transmit mode of operation.

There shall be no frequency exclusion band applied to emission measurements of the receiver part of transceivers or the stand alone receiver under test, and/or associated ancillary equipment.

The exclusion band for immunity testing of equipment operating in the 2,4 GHz band shall be:

- lower limit of exclusion band = lowest allocated band edge frequency -120 MHz, i.e. 2 280 MHz;
- upper limit of exclusion band = highest allocated band edge frequency +120 MHz, i.e. 2 603,5MHz.

The exclusion band for immunity testing of equipment operating in the 5 GHz Wi-Fi band shall be:

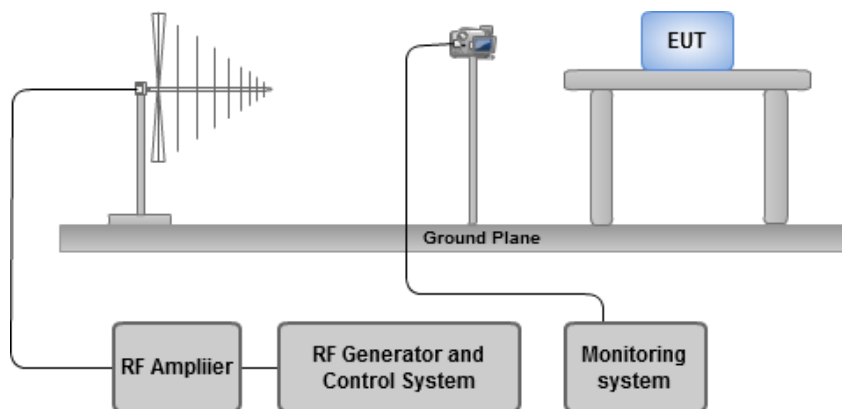
- lower limit of exclusion band = lowest allocated band edge frequency -270 MHz, i.e. 4 880 MHz;
- upper limit of exclusion band = highest allocated band edge frequency +270 MHz, i.e. 5 995 MHz.

The exclusion band for immunity testing of equipment operating in the 5,8 GHz band shall be:

- lower limit of exclusion band = lowest allocated band edge frequency -270 MHz, i.e. 5 455 MHz;
- as the immunity requirements have an upper frequency range of 6 GHz and any upper edge exclusion band would be greater than this for the 5,8 GHz band. The above frequency shall also be regarded as the upper end of the test range.

NOTE: These receiver exclusion band ranges align with the relevant blocking test ranges.

4.4.4 Test Setup



Note: The procedure defined in this part requires the generation of electromagnetic fields within which the test sample is placed and its operation observed. To generate fields that are useful for simulation of actual (field) conditions may require significant antenna drive power and the resultant high field strength levels. To comply with local regulations and to prevent biological hazards to the testing personnel, it is recommended that these tests be carried out in a shielded enclosure or semi-anechoic chamber.

4.4.5 Test Result of Radio Frequency Electromagnetic Field (RS)

Test Site	RS01-WS	Ambient Condition	23°C/56%/99kPa
Tested By	Zoe Yu		

Test Mode	1, 2, 3				
Frequency Range (MHz)	Azimuth	Polarity	Test Field Strength (V/m)	Observation	Performance Criteria
80 - 6000	0	V&H	3	Note 1, 2	A
80 - 6000	90	V&H	3	Note 1, 2	A
80 - 6000	180	V&H	3	Note 1, 2	A
80 - 6000	270	V&H	3	Note 1, 2	A

Note:

- 1) There was no abnormal situation during the test compared with initial operation.
- 2) The PER shall be less than or equal to 10%.

Test Mode WiFi 2.4G PER mode

命令提示字元

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回覆自 192.168.1.146: 位元組=32 時間=3ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=1ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=1ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=3ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
```

192.168.1.146 的 Ping 統計資料:
封包: 已傳送 = 1000, 已收到 = 1000, 已遺失 = 0 (0% 遺失),
大約的來回時間 (毫秒):
最小值 = 1ms, 最大值 = 206ms, 平均 = 2ms

C:\Users\aaabcc>

Test Mode WiFi 5G PER mode

命令提示字元


```
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
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回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=1ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
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回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=184ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=89ms TTL=64
回覆自 192.168.1.146: 位元組=32 時間=2ms TTL=64
```

192.168.1.146 的 Ping 統計資料:

封包: 已傳送 = 1000, 已收到 = 999, 已遺失 = 1 (0% 遺失),
大約的來回時間 (毫秒):

最小值 = 1ms, 最大值 = 264ms, 平均 = 6ms

C:\Users\aaabbcc>

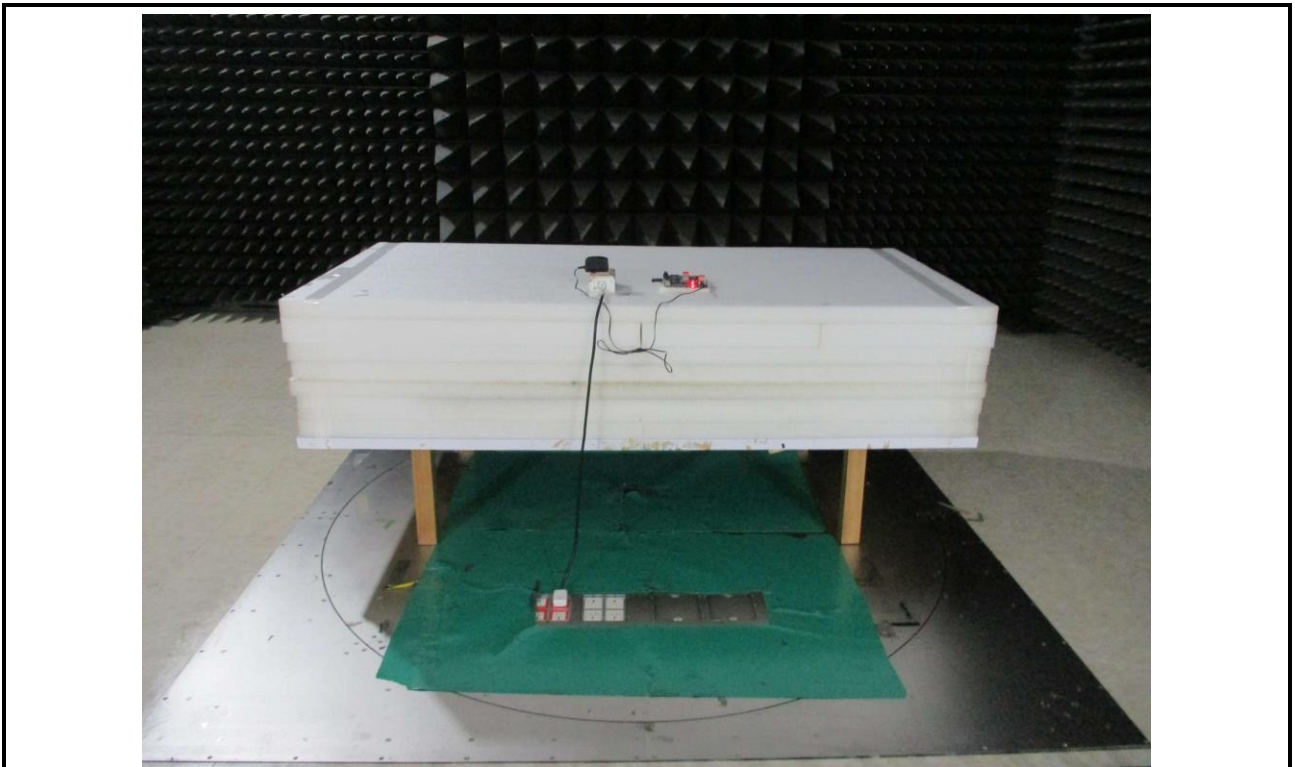
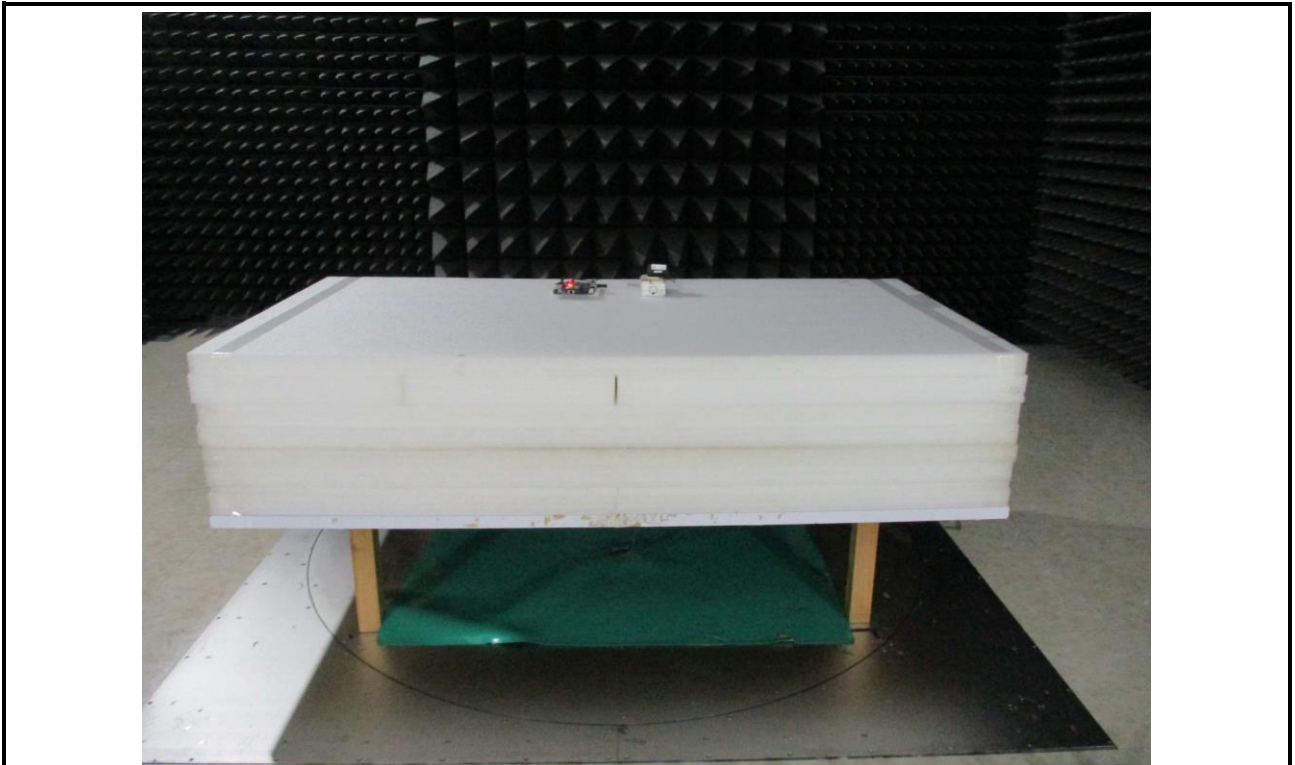
Test Mode		BT PER mode	
CMW 270 V 3.7.10 - Bluetooth Signaling V3.7.10 - RX Measurement			
BER <input checked="" type="radio"/> BER Search <input type="radio"/>		Bluetooth	
Bit Errors BER [%] 0.09861 Bit Errors 639		Rx Quality RUN	
NAK NAK Rate [%] 4.77		RF Settings	
Packet Errors PER [%] 3.11 Missing Packets Rate [%] 1.92 HEC Error Rate [%] 0.00 CRC Error Rate [%] 0.67 Wrong Packet Type [%] 0.03 Wrong Payload Length [%] 0.48		Dirty Tx	
Packets Received 3000 / 3000 * Packets to be received by CMW 3000 Payload bits to be received 648000		General Setup Operating Mode RF Test Burst Type Basic Rate Test Mode Loopback Test RF Setup Channel Rx (EUT) 78 Tx (EUT) 0 Frequency 2480.0 MHz 2402.0 MHz Hopping <input type="checkbox"/> Tx Level (CMW) -60.00 dBm Exp. Nom. Power 10.00 dBm Auto Ranging <input type="checkbox"/> Dirty Tx <input type="checkbox"/> Signal Characteristics Packet Type DH1 Payload Length 27 byte(s) Pattern Type PRBS9 Whitening <input type="checkbox"/>	
CMW (Master)  Signaling		EUT for Paging C0EE40801EA7	
Repetition ...		Packets...	
		Bluetooth Signaling ON	
		Config ...	

5 Photographs of the Test Configuration

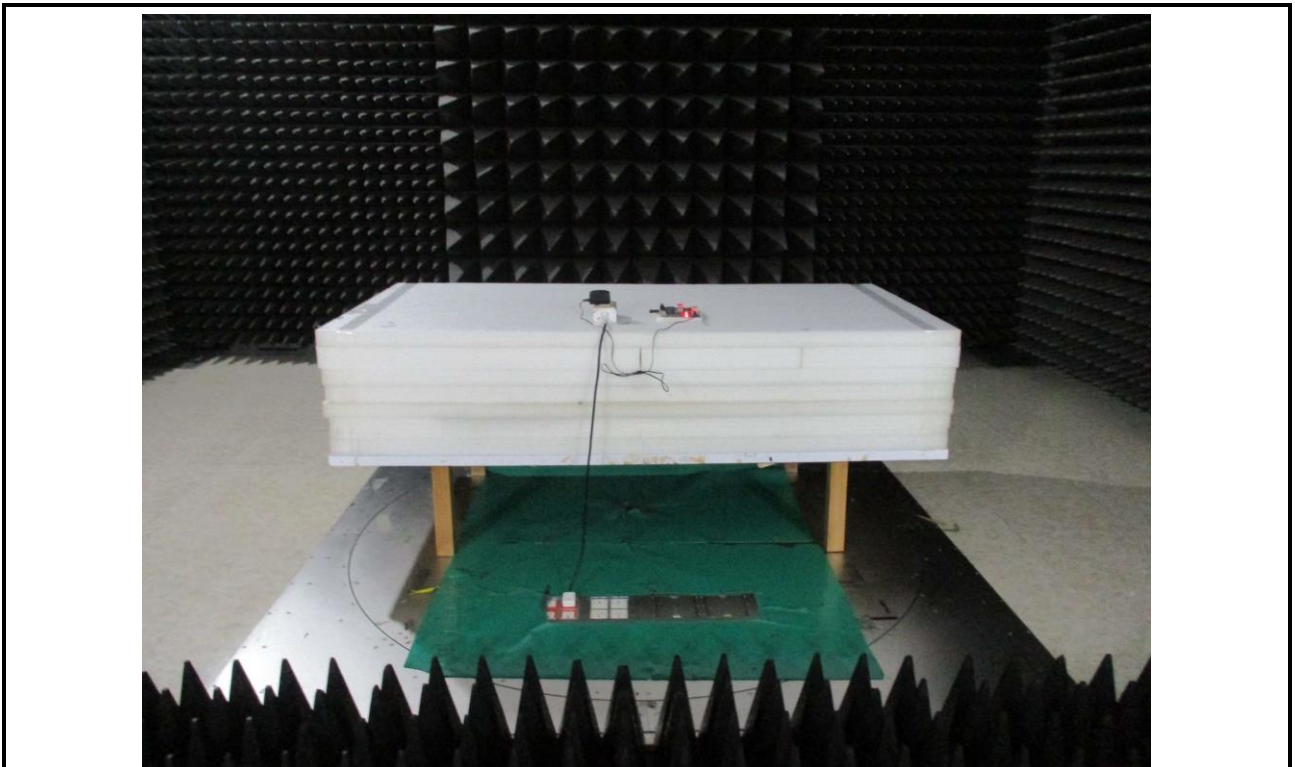
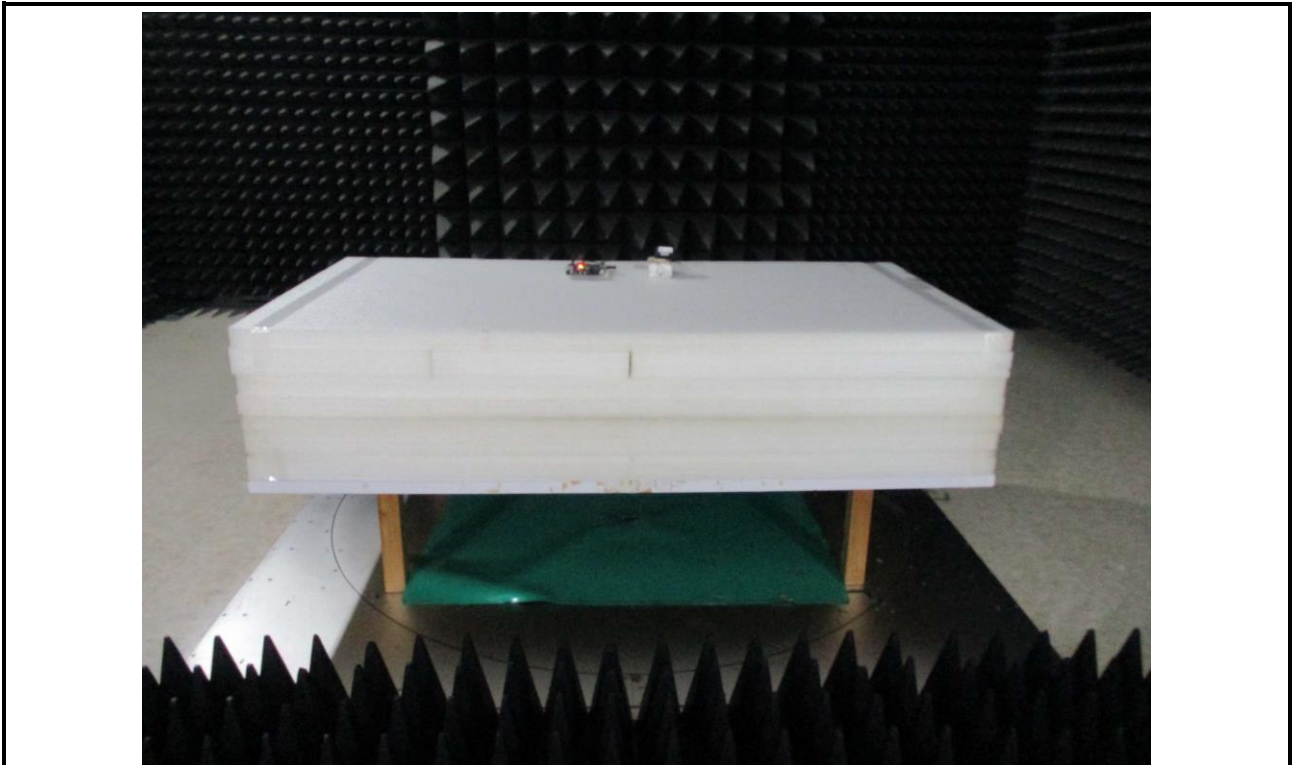
Conducted Emissions from the AC mains power ports



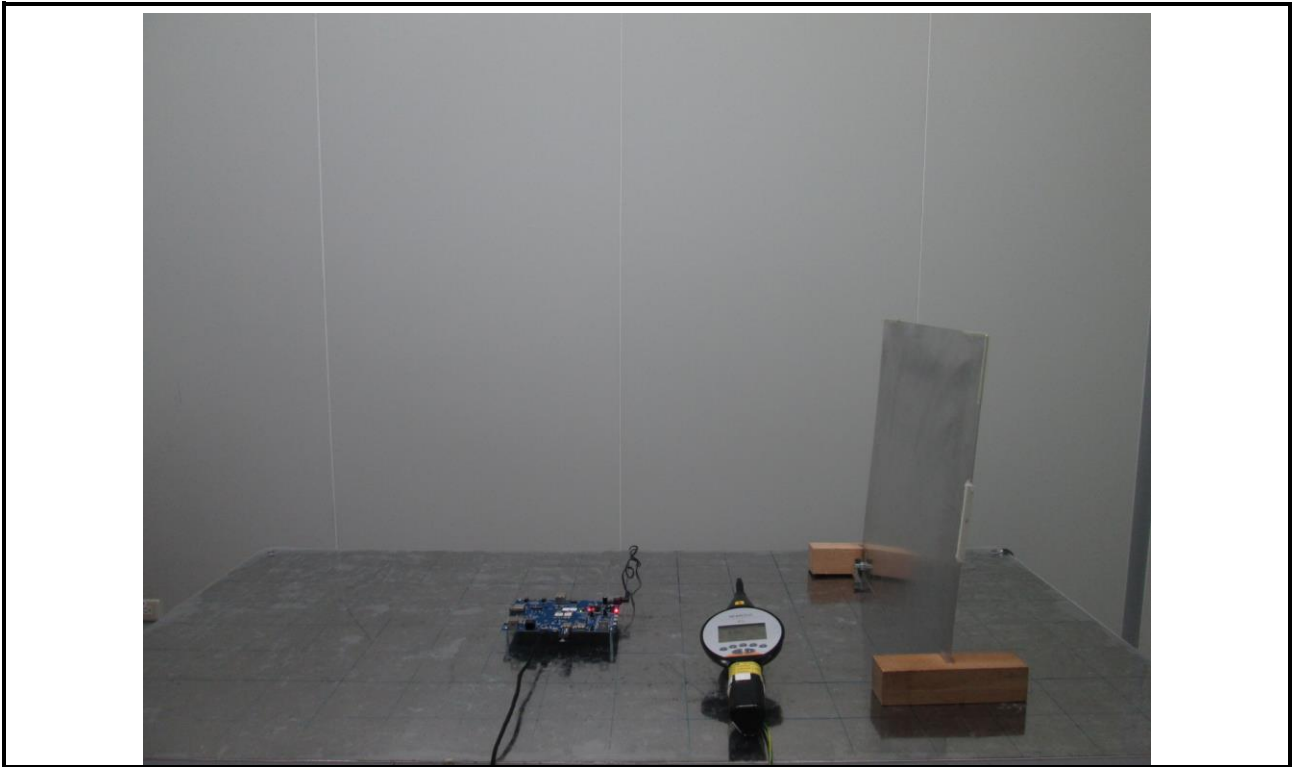
Radiated Emissions below 1GHz test



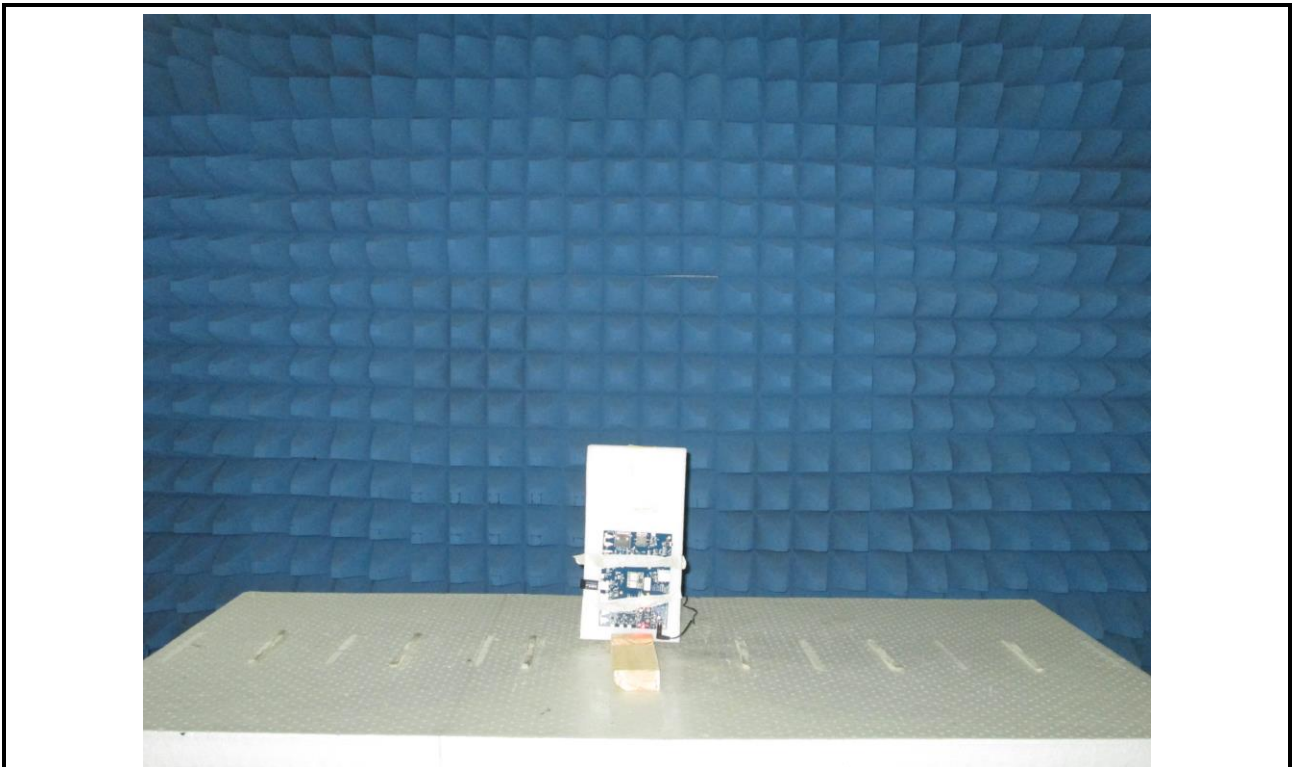
Radiated Emissions above 1GHz test



ESD Test



RS Test



6 Test laboratory information

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

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

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

Linkou

Tel: 886-2-2601-1640

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

Kwei Shan

Tel: 886-3-271-8666

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

Kwei Shan Site II

Tel: 886-3-271-8640

No.14-1, Lane 19, Wen San 3rd
St., Kwei Shan Dist., Tao Yuan
City 333, 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

==END==