EMI Test Report

Equipment	:	**Sentrius™ BT510** **Bluetooth v5 IP67 Multi Sensor**
Model No.	:	**BT510**
Brand Name	:	**Laird**
Applicant	:	**Laird Connectivity**
Address		**W66N220 Commerce Court, Cedarburg, Wisconsin 53012, USA**
Standard	:	**CISPR 32:2015/COR1:2016, Class B** **AS/NZS CISPR 32:2015, Class B**
Received Date	:	**Sep. 16, 2019**
Tested Date	:	**Oct. 07 ~ Oct. 08, 2019**

We, International Certification Corp., 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 **Kent Chen / Assistant Manager**

Testing Laboratory 2732

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Release Record

Report No.	Version	Description	Issued Date
AI991601	Rev. 01	Initial issue	Dec. 10, 2019

Summary of Test Result

Emission Tests				
Ref. Std. Clause	**Test Standard**	**Test Items**	**Measured**	**Result**
A.3	CISPR 32:2015/COR1:2016, Class B AS/NZS CISPR 32:2015, Class B	Conducted Emissions from the AC mains power ports	-12.55dB AV@ 0.363MHz.	Pass
A.3	CISPR 32:2015/COR1:2016, Class B AS/NZS CISPR 32:2015, Class B	Asymmetric Mode Conducted Emissions	Note[1]	N/A
A.2	CISPR 32:2015/COR1:2016, Class B AS/NZS CISPR 32:2015, Class B	Radiated Emissions	-5.47dB PK @ 288.02MHz.	Pass
A.3	CISPR 32:2015/COR1:2016, Class B AS/NZS CISPR 32:2015, Class B	Conducted Differential Voltage Emissions	Note[2]	N/A
N/A means Not Applicable. Note[1]: The EUT w/o telecom port. Note[2]: The EUT w/o tuner port.				

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

1 General Description

1.1 Information

1.1.1 Feature of Equipment under Test (EUT)

Power Supply Type	3Vdc from host
Highest Frequency of the Internal Sources	2.4GHz

1.1.2 Accessories

N/A

1.2 Test Equipment and Calibration Data

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Test Date	Oct. 08, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	R&S	ESR3	101657	Jan. 08, 2019	Jan. 07, 2020
LISN	R&S	ENV216	101579	Mar. 08, 2019	Mar. 07, 2020
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-666	Nov. 29, 2018	Nov. 28, 2019
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 22, 2019	Oct. 21, 2020
50 ohm terminal (Support Unit)	NA	50	04	May 28, 2019	May 27, 2020
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	Oct. 07, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	Agilent	N9038A	MY53290044	Sep. 17, 2019	Sep. 16, 2020
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 09, 2018	Nov. 08, 2019
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-523	Dec. 03, 2018	Dec. 02, 2019
Preamplifier	EMC	EMC02325	980194	Sep. 18, 2019	Sep. 17, 2020
LF cable 1M	EMC	EMCCFD400-NM-NM-1000	160501	Oct. 22, 2018	Oct. 21, 2019
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-003	Oct. 22, 2018	Oct. 21, 2019
LF cable 10M	EMCC	CFD400-E	CFD400-001	Oct. 22, 2018	Oct. 21, 2019
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	Oct. 08, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	Agilent	N9010A	MY53400091	Nov. 07, 2018	Nov. 06, 2019
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1095	Sep. 26, 2019	Sep. 25, 2020
Preamplifier	Agilent	83017A	MY39501309	Sep. 24, 2019	Sep. 23, 2020
RF Cable	EMC	EMC105-SM-SM-8000	180512	Oct. 22, 2018	Oct. 21, 2019
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16018/4	Oct. 22, 2018	Oct. 21, 2019
Measurement Software	AUDIX	e3	6.120210g	NA	NA
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:

CISPR 32:2015/COR1:2016, Class B
AS/NZS CISPR 32:2015, Class B

1.4 Deviation from Test Standard and Measurement Procedure

None

1.5 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. 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	±2.90 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 Condition

Test Item	Test Site	Ambient Condition	Tested By
Conducted Emissions from the AC mains power ports	CO01-WS	23°C / 61%	Alex Tsai
Radiated Emissions	03CH02-WS	23°C / 63-64%	Brad Wu

2.2 The Worst Case Measurement Configuration

The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-axis. The **Z-axis** result was found as the worst case and was shown in this report.

Radiation Pretest Mode	
Pretest Mode	**Operating Description**
1	BT Link, EUT: Z-axis with Notebook, 230V/50Hz
2	BT Link, EUT: Z-axis with Notebook, 110V/60Hz
3	Standby mode, EUT: Z-axis with Notebook, 230V/50Hz
For **Pretest Mode 3** is the worst case and only its data was record in this test report.	

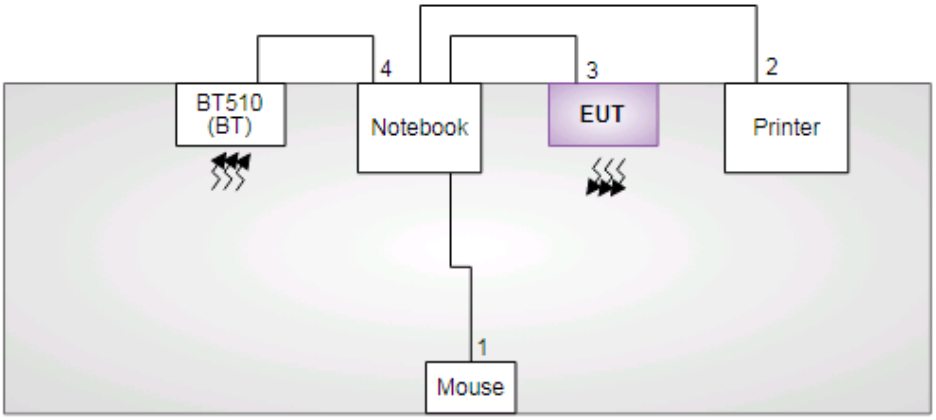
The Worst Test Configurations	
Conducted Emissions from the AC mains power ports	
Test Mode	**Operating Description**
1	BT Link, EUT: X-axis with Notebook, 230V/50Hz
2	BT Link, EUT: X-axis with Notebook, 110V/60Hz
Radiated Emissions	
Test Mode	**Operating Description**
1	BT Link, EUT: Z-axis with Notebook, 230V/50Hz

2.3 Local Support Equipment List

Support Equipment List					
No.	**Equipment**	**Brand**	**Model**	**S/N**	**Remarks**
1	Notebook	DELL	Latitude E6440	8VXMD12	---
2	Printer	EPSON	XP-30	QSDK002410	---
3	Mouse	DELL	MS111-L	2C3-00MM	---
4	Sentrius™ BT510 Bluetooth v5 IP67 Multi Sensor	Laird	BT510	---	Provided by applicant.

2.4 Test Setup Chart

Test Setup Diagram



No.	Signal cable / Length (m)
1	USB, 1.8m shielded.
2	USB, 1.8m shielded.
3	USB, 1m shielded.
4	USB, 1m shielded.

2.5 Test Software and Operating Condition

a. To enable all function of test system.
b. The support notebook executed “KM Player” to play colorbar video.
c. The support notebook executed “WinEMC.exe” to send “H” patterns to the printer.
d. The support notebook executed “Uwterminal.exe” to link BT function of EUT via USB cable

3 Emission Tests 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 (MHz)	Limits values (dBµV)			
	Class A		Class B	
	Quasi-peak	Average	Quasi-peak	Average
0.15 to 0,50	79	66	66 to 56 *	56 to 46 *
0,50 to 5	73	60	56	46
5 to 30	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

a. 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.

b. A thickness of ≤ 0.15m insulation should be placed between local AE and associated cabling and the RGP.

c. Connect EUT to the power mains through a line impedance stabilization network (LISN).

d. All the support units are connecting to the other LISN.

e. The LISN provides 50 ohm coupling impedance for the measuring instrument.

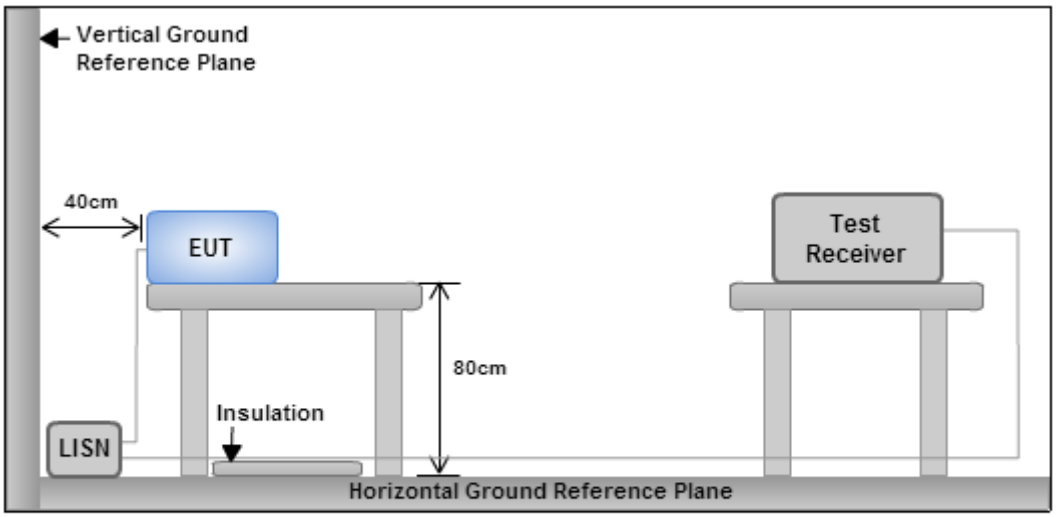
f. The CISPR states that a 50 ohm, 50 microhenry LISN should be used.

g. Both sides of AC line were checked for maximum conducted interference.

h. The frequency range from 150 kHz to 30 MHz was searched.

i. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

3.1.3 Test Setup

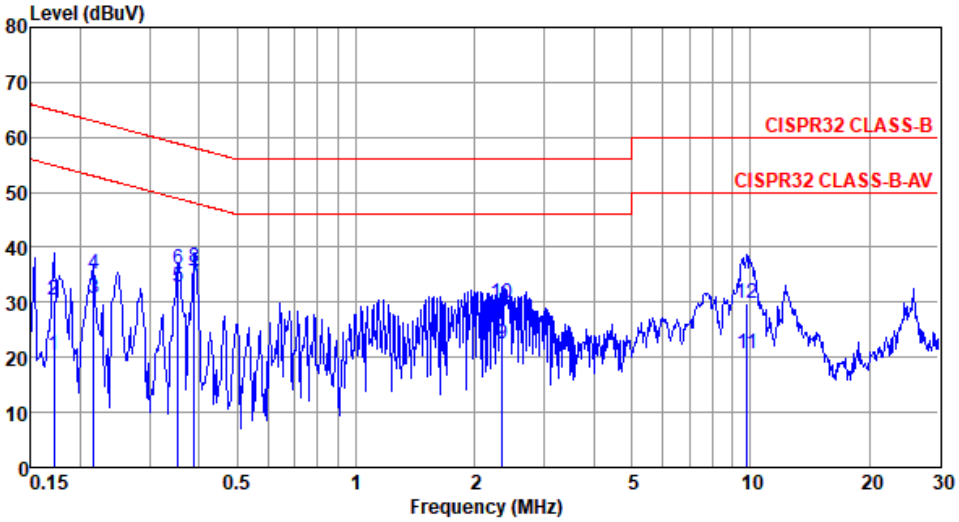


Note: 1. Support units were connected to second LISN.

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

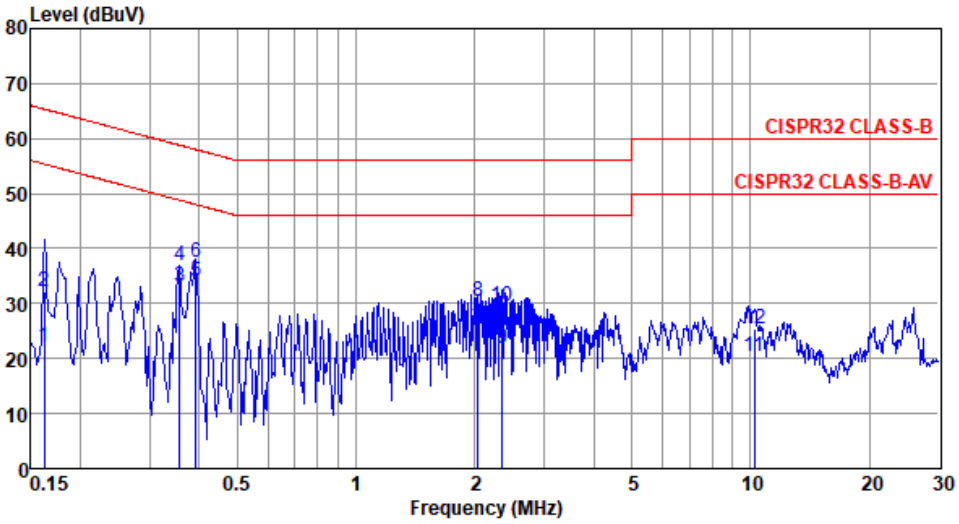
Power Phase	Line	Test Mode	1



	Freq	Level	Limit Line	Over Limit	Read Level	LISN factor	cable loss	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	dB	
1	0.171	20.40	54.90	-34.50	10.81	9.53	0.06	Average
2	0.171	30.51	64.90	-34.39	20.92	9.53	0.06	QP
3	0.216	30.62	52.96	-22.34	21.01	9.54	0.07	Average
4	0.216	35.06	62.96	-27.90	25.45	9.54	0.07	QP
5	0.354	32.74	48.87	-16.13	23.10	9.56	0.08	Average
6	0.354	36.00	58.87	-22.87	26.36	9.56	0.08	QP
7*	0.389	33.32	48.08	-14.76	23.67	9.57	0.08	Average
8	0.389	36.35	58.08	-21.73	26.70	9.57	0.08	QP
9	2.346	22.36	46.00	-23.64	12.57	9.60	0.19	Average
10	2.346	29.91	56.00	-26.09	20.12	9.60	0.19	QP
11	9.809	20.61	50.00	-29.39	10.52	9.65	0.44	Average
12	9.809	29.82	60.00	-30.18	19.73	9.65	0.44	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Limit Line (dBuV) – Level (dBuV).

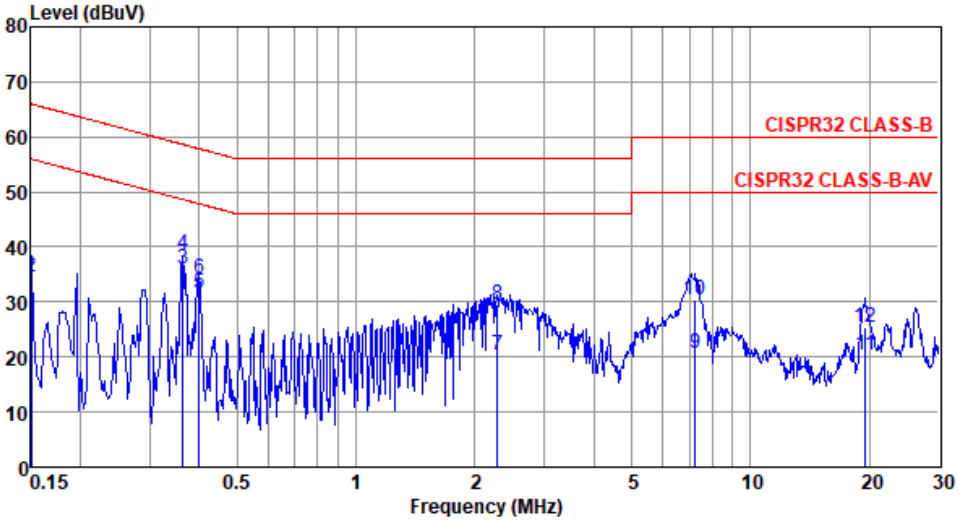
Power Phase	Neutral	Test Mode	1



	Freq	Level	Limit Line	Over Limit	Read Level	LISN factor	cable loss	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	dB	
1	0.162	22.11	55.34	-33.23	12.48	9.57	0.06	Average
2	0.162	32.27	65.34	-33.07	22.64	9.57	0.06	QP
3	0.358	33.06	48.78	-15.72	23.37	9.61	0.08	Average
4	0.358	37.00	58.78	-21.78	27.31	9.61	0.08	QP
5*	0.393	33.87	47.99	-14.12	24.18	9.61	0.08	Average
6	0.393	37.64	57.99	-20.35	27.95	9.61	0.08	QP
7	2.033	25.50	46.00	-20.50	15.69	9.65	0.16	Average
8	2.033	30.39	56.00	-25.61	20.58	9.65	0.16	QP
9	2.346	21.94	46.00	-24.06	12.10	9.65	0.19	Average
10	2.346	29.54	56.00	-26.46	19.70	9.65	0.19	QP
11	10.233	20.28	50.00	-29.72	10.13	9.71	0.44	Average
12	10.233	25.40	60.00	-34.60	15.25	9.71	0.44	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Limit Line (dBuV) – Level (dBuV).

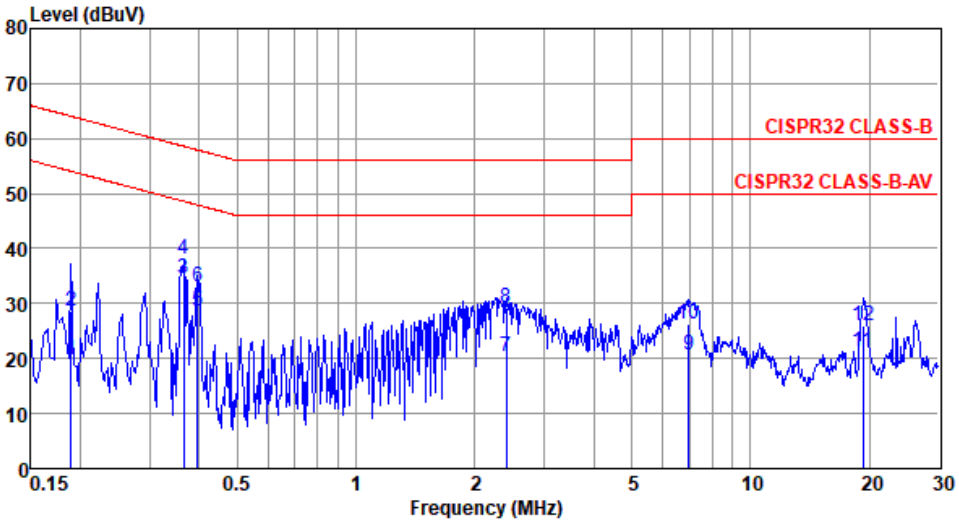
Power Phase	Line	Test Mode	2



	Freq	Level	Limit Line	Over Limit	Read Level	LISN factor	cable loss	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	dB	
1	0.150	23.83	56.00	-32.17	14.25	9.53	0.05	Average
2	0.150	34.55	66.00	-31.45	24.97	9.53	0.05	QP
3*	0.363	36.10	48.65	-12.55	26.45	9.57	0.08	Average
4	0.363	38.63	58.65	-20.02	28.98	9.57	0.08	QP
5	0.400	31.63	47.86	-16.23	21.98	9.57	0.08	Average
6	0.400	34.27	57.86	-23.59	24.62	9.57	0.08	QP
7	2.285	20.26	46.00	-25.74	10.48	9.60	0.18	Average
8	2.285	29.44	56.00	-26.56	19.66	9.60	0.18	QP
9	7.252	20.60	50.00	-29.40	10.58	9.64	0.38	Average
10	7.252	30.41	60.00	-29.59	20.39	9.64	0.38	QP
11	19.532	20.42	50.00	-29.58	10.16	9.66	0.60	Average
12	19.532	25.48	60.00	-34.52	15.22	9.66	0.60	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Limit Line (dBuV) – Level (dBuV).

Power Phase	Neutral	Test Mode	2



	Freq	Level	Limit Line	Over Limit	Read Level	LISN factor	cable loss	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	dB	
1	0.189	19.76	54.06	-34.30	10.11	9.58	0.07	Average
2	0.189	28.71	64.06	-35.35	19.06	9.58	0.07	QP
3*	0.365	34.60	48.61	-14.01	24.91	9.61	0.08	Average
4	0.365	37.98	58.61	-20.63	28.29	9.61	0.08	QP
5	0.396	28.55	47.95	-19.40	18.86	9.61	0.08	Average
6	0.396	33.16	57.95	-24.79	23.47	9.61	0.08	QP
7	2.409	20.42	46.00	-25.58	10.58	9.65	0.19	Average
8	2.409	29.18	56.00	-26.82	19.34	9.65	0.19	QP
9	6.988	20.62	50.00	-29.38	10.55	9.69	0.38	Average
10	6.988	26.35	60.00	-33.65	16.28	9.69	0.38	QP
11	19.326	21.37	50.00	-28.63	10.96	9.81	0.60	Average
12	19.326	26.08	60.00	-33.92	15.67	9.81	0.60	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Limit Line (dBuV) – Level (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 (dBμV/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 (dBμV/m)	Peak limit (dBμV/m)	Average limit (dBμV/m)	Peak limit (dBμV/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 ≤ 0.15m 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.

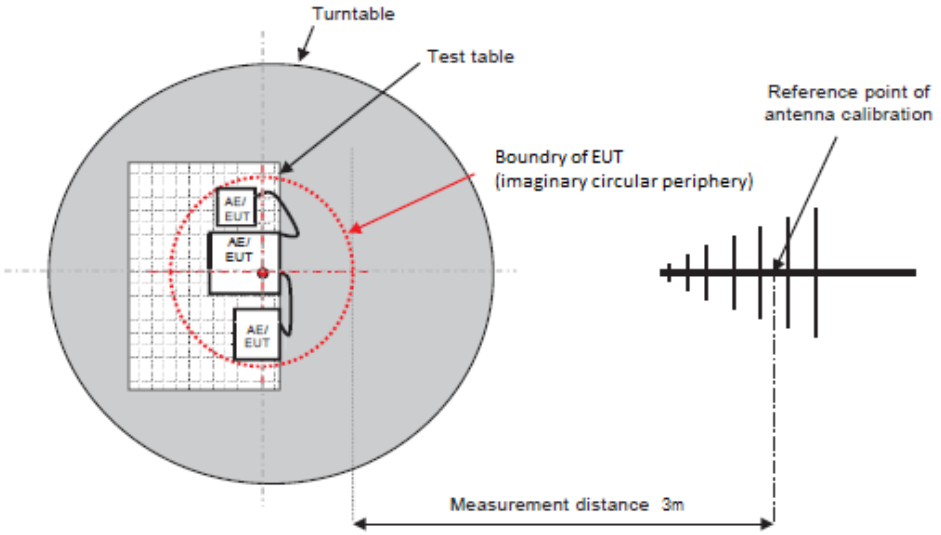
g. For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 to 4 meters) and turn table (from 0 to 360 degrees) to find the maximum reading.

h. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.

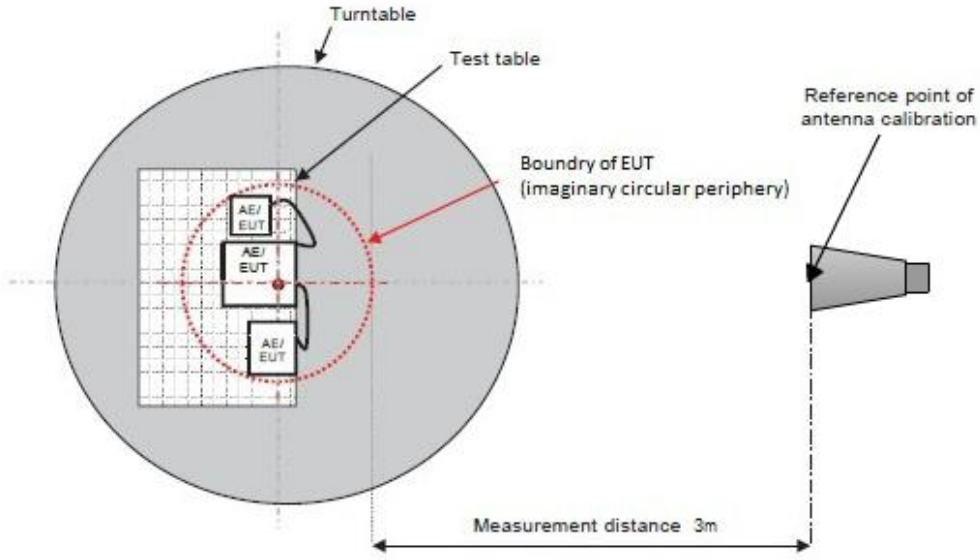
i. If the emission level of the EUT in peak mode was 2 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 2 dB margin will be repeated one by one using the quasi-peak method and reported.

3.2.3 Test Setup

Radiated Emissions below 1 GHz

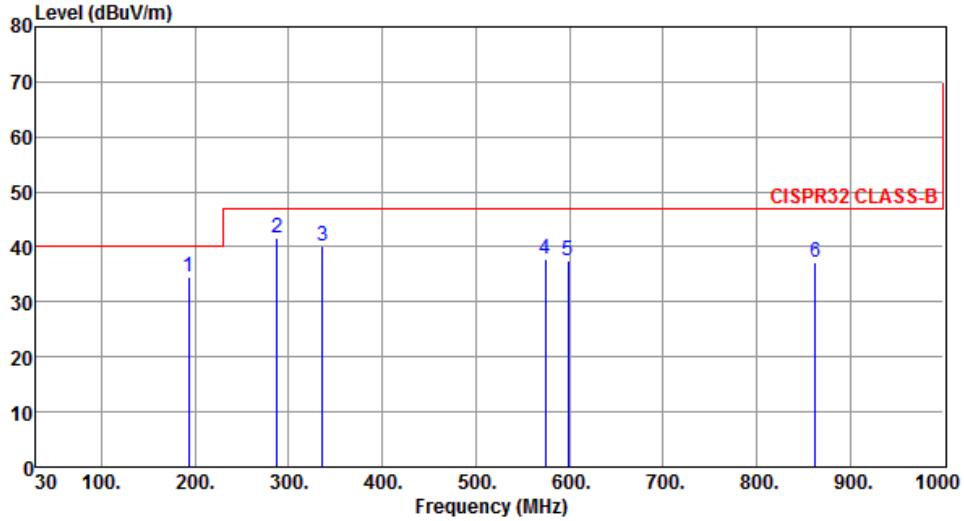


Radiated Emissions above 1 GHz



3.2.4 Radiated Emissions (Below 1GHz)

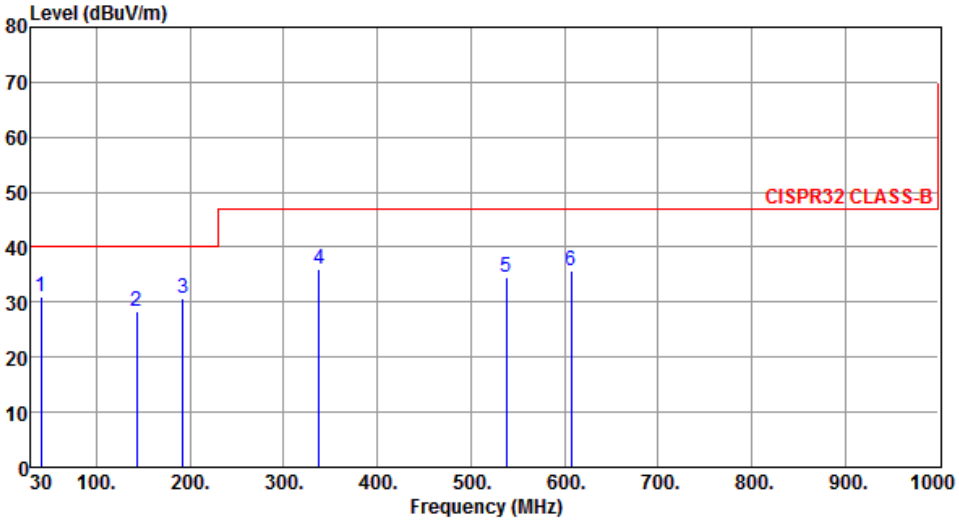
Polarization	Horizontal	Test Mode	1



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	192.96	34.41	40.00	-5.59	43.91	-9.50	Peak	---	---
2	288.02	41.53	47.00	-5.47	48.90	-7.37	Peak	---	---
3	335.70	40.17	47.00	-6.83	46.21	-6.04	QP	100	174
4	574.17	37.92	47.00	-9.08	38.55	-0.63	Peak	---	---
5	598.42	37.49	47.00	-9.51	37.43	0.06	Peak	---	---
6	863.23	37.06	47.00	-9.94	32.52	4.54	Peak	---	---

Note 1: Emission level (dBuV/m) = SA reading (dBuV) + Factor (dB).
2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Polarization	Vertical	Test Mode	1

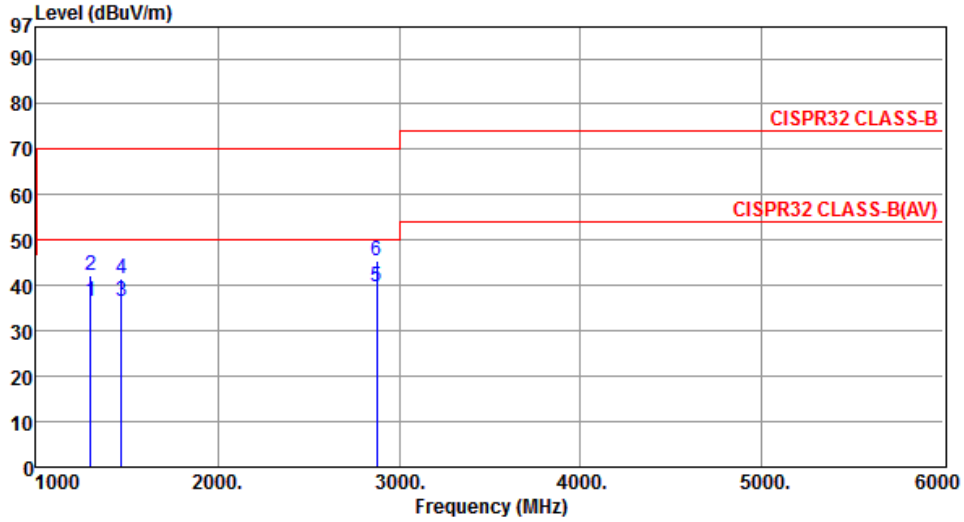


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	40.67	31.06	40.00	-8.94	39.09	-8.03	Peak	---	---
2	142.52	28.27	40.00	-11.73	36.30	-8.03	Peak	---	---
3	191.99	30.83	40.00	-9.17	40.33	-9.50	Peak	---	---
4	337.49	36.11	47.00	-10.89	42.11	-6.00	Peak	---	---
5	538.28	34.50	47.00	-12.50	35.89	-1.39	Peak	---	---
6	607.15	35.73	47.00	-11.27	35.36	0.37	Peak	---	---

Note 1: Emission level (dBuV/m) = SA reading (dBuV) + Factor (dB).
2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.2.5 Radiated Emissions (Above 1GHz)

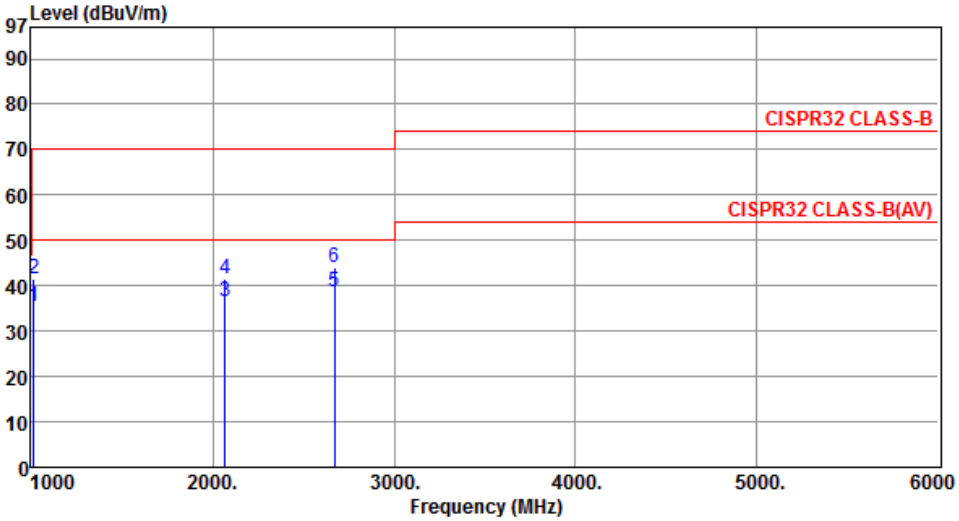
Polarization	Horizontal	Test Mode	1



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1300.54	36.63	50.00	-13.37	43.59	-6.96	Average	100	114
2	1300.54	42.26	70.00	-27.74	49.22	-6.96	Peak	100	114
3	1472.20	36.45	50.00	-13.55	42.67	-6.22	Average	100	74
4	1472.20	41.68	70.00	-28.32	47.90	-6.22	Peak	100	74
5	2878.76	39.86	50.00	-10.14	40.68	-0.82	Average	100	308
6	2878.76	45.40	70.00	-24.60	46.22	-0.82	Peak	100	308

Note 1: Emission level (dBuV/m) = SA reading (dBuV) + Factor (dB).
2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Polarization	Vertical	Test Mode	1

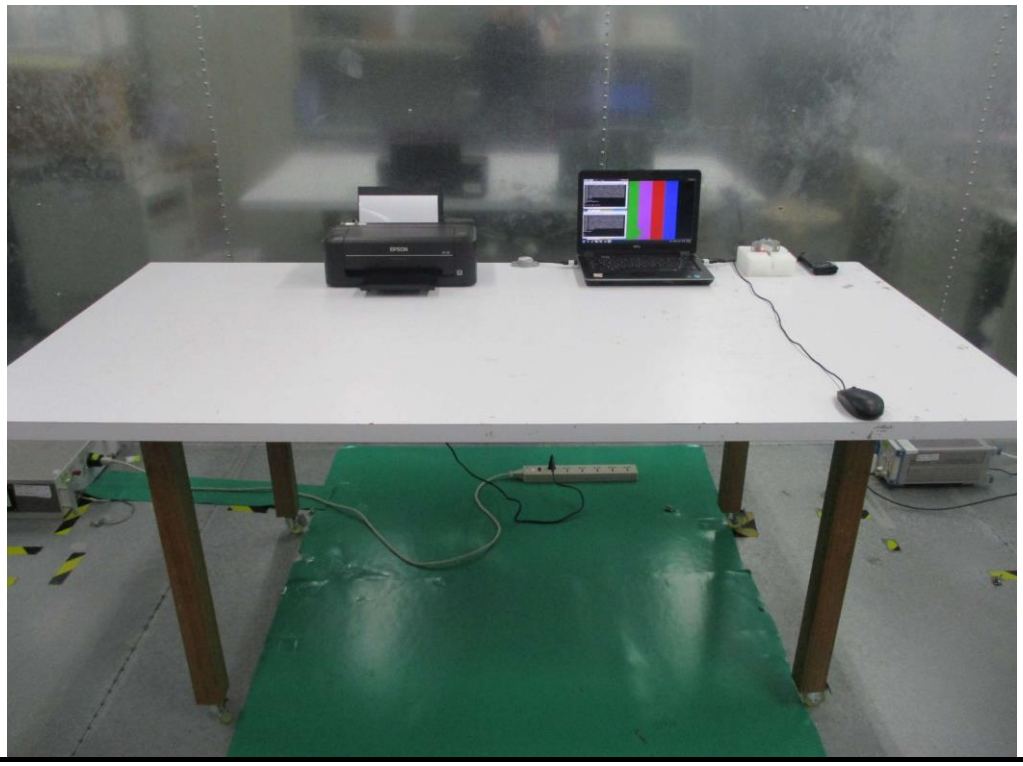


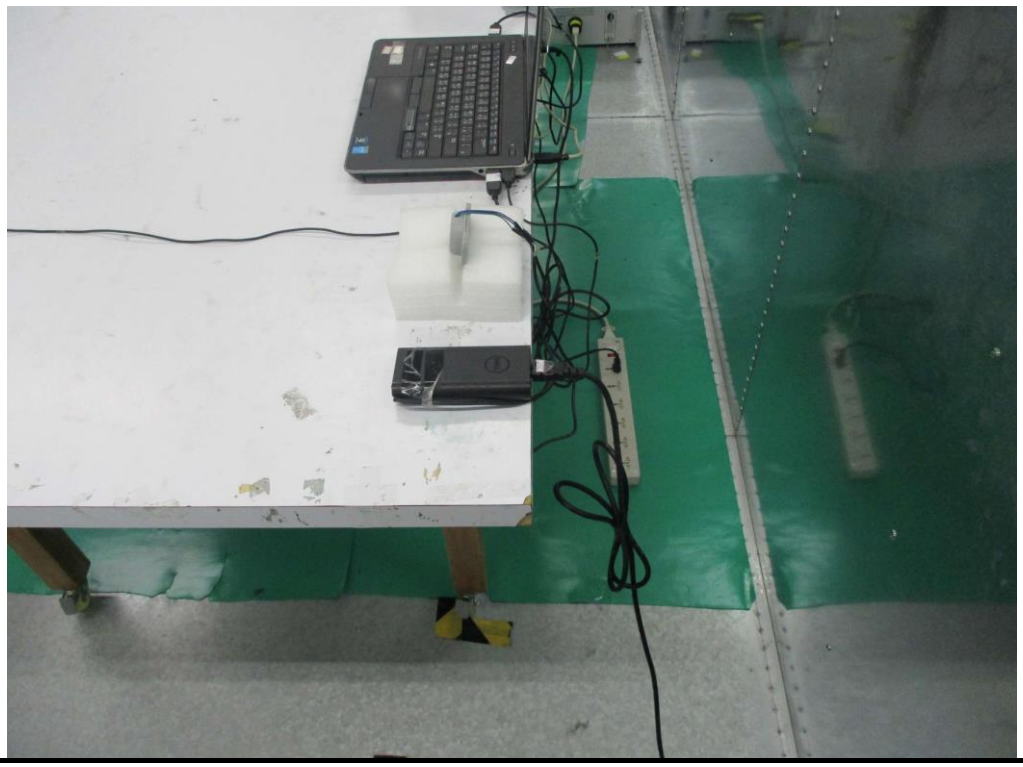
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1016.67	35.53	50.00	-14.47	45.29	-9.76	Average	100	69
2	1016.67	41.44	70.00	-28.56	51.20	-9.76	Peak	100	69
3	2069.12	36.33	50.00	-13.67	40.10	-3.77	Average	100	225
4	2069.12	41.39	70.00	-28.61	45.16	-3.77	Peak	100	225
5	2672.02	38.83	50.00	-11.17	40.55	-1.72	Average	100	142
6	2672.02	43.97	70.00	-26.03	45.69	-1.72	Peak	100	142

Note 1: Emission level (dBuV/m) = SA reading (dBuV) + Factor (dB).
2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

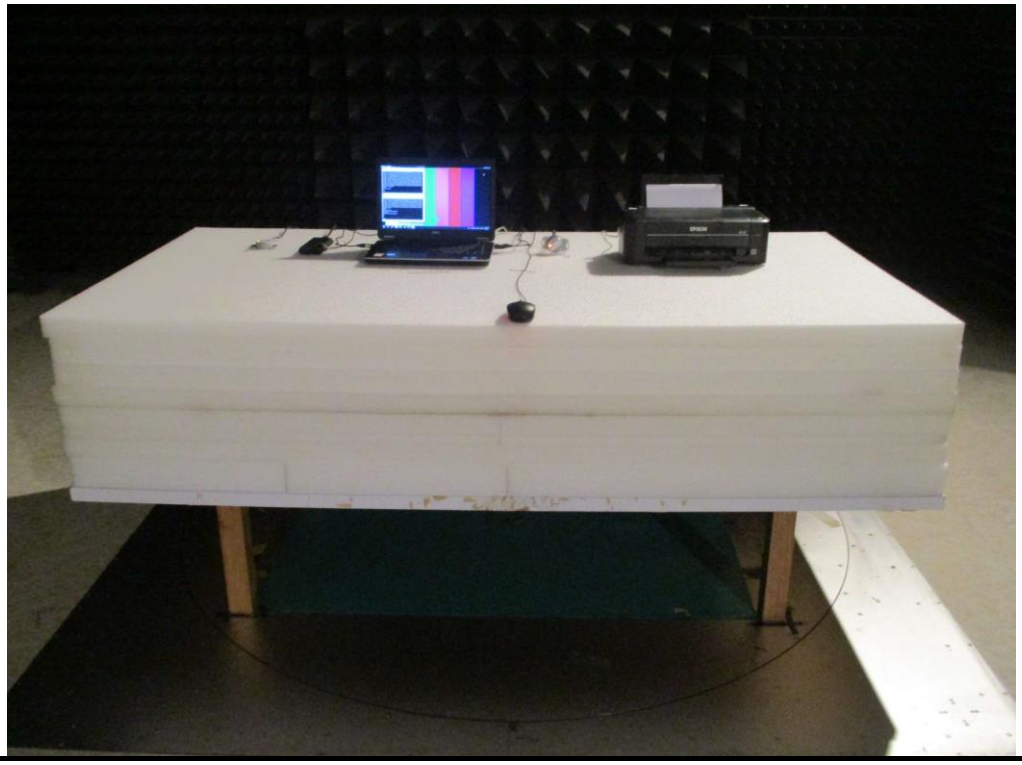
4 Photographs of the Test Configuration

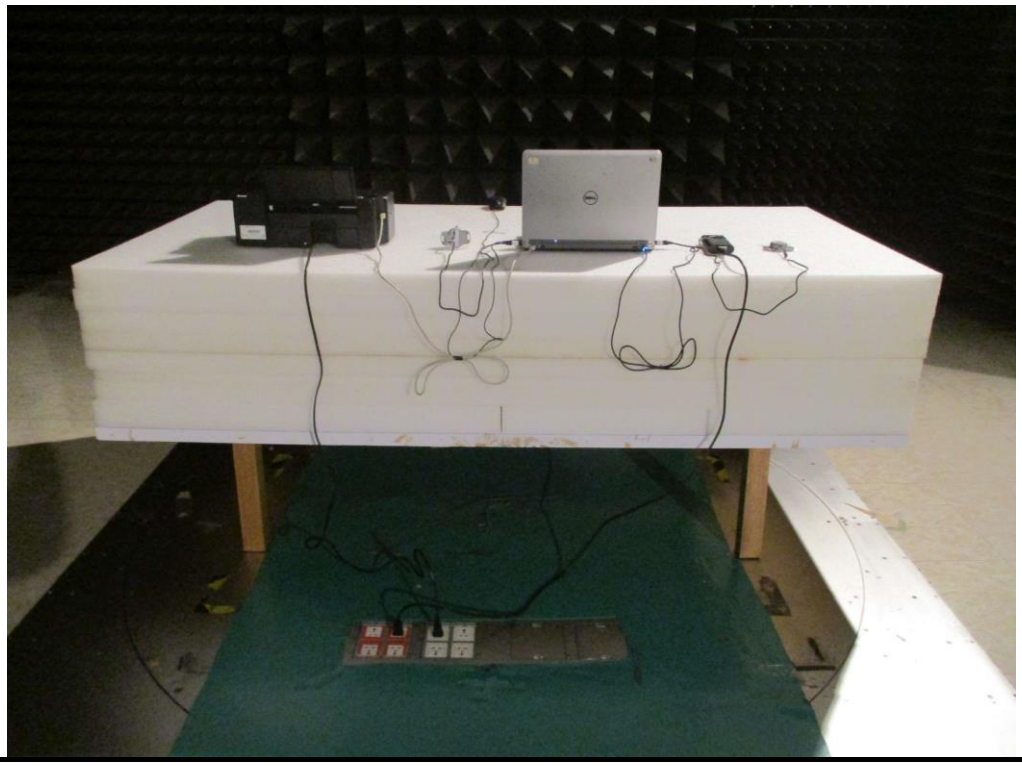
Conducted Emissions from the AC mains power ports



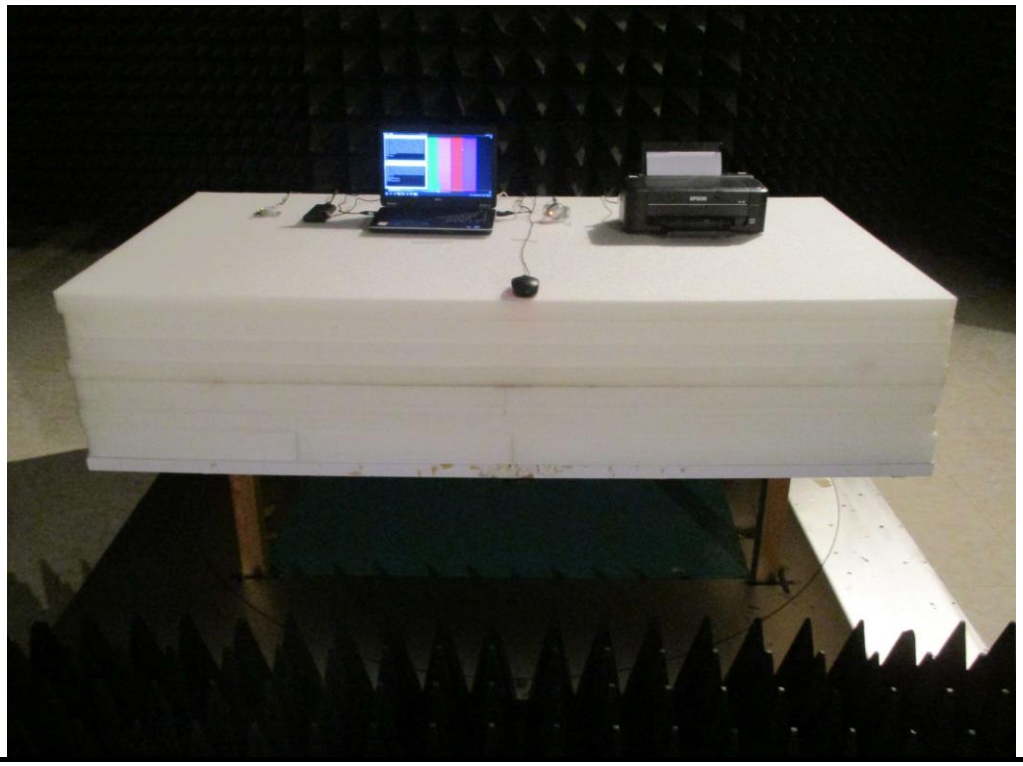


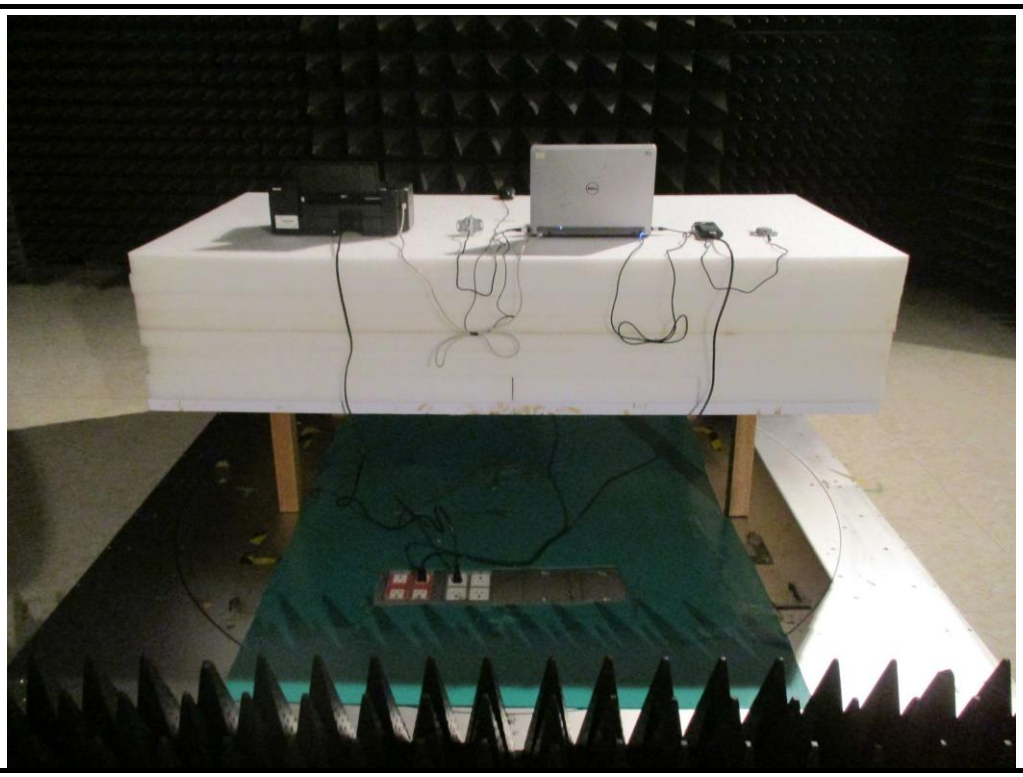
Radiated Emission Below 1GHz Test





Radiated Emission Above 1GHz Test





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

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

Linkou	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.	No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information

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