

ISED Test Report

Equipment : 802.11n 2.4GHz + BT5.2 Module
Model No. : Sterling LWB+
Brand Name : Laird Connectivity
Applicant : Laird Connectivity LLC
Address : W66N220 Commerce Court, Cedarburg, WI
53012 United States Of America
Standard : ICES-003 Issue 7, Class B
Received Date : Oct. 04, 2021
Tested Date : Oct. 28 ~ Nov. 01, 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:



Peter Lin / Supervisor

Approved by:



Kent Chen / Assistant Manager



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Release Record

Report No.	Version	Description	Issued Date
CI1O0407	Rev. 01	Initial issue	Dec. 20, 2021

Summary of Test Results

ICES-003 Emission Tests				
Ref. Std. Clause	Test Standard	Test Items	Measured	Result
3.2.1	ICES-003 Issue 7, Class B	Conducted Emissions	Under limit 13.68dB @ 0.375MHz.	Pass
3.2.2	ICES-003 Issue 7, Class B	Radiated Emissions	Under limit 4.33dB @ 3618.20MHz.	Pass

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

The device has 3 configurations as below:

Brand name	Model Name	Product Name	Part Number	Description
Laird Connectivity	Sterling LWB+	802.11n 2.4GHz + BT5.2 Module	453-00085	Chip Antenna
Laird Connectivity	Sterling LWB+	802.11n 2.4GHz + BT5.2 Module	453-00084	MHF4 Connector
Laird Connectivity	Sterling LWB+	802.11n 2.4GHz + BT5.2 Module	453-00083	SIP Module
Note: Part Number: 453-00085 and 453-00084 were selected as a representative one for the final test				

1.1.1 Feature of Equipment under Test (EUT)

Power Supply Type	3.3 Vdc 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)				
Tested Date	Nov. 01, 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
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 19, 2021	Oct. 18, 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)				
Tested Date	Oct. 28, 2021				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101657	Mar. 12, 2021	Mar. 11, 2022
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-523	Dec. 29, 2020	Dec. 28, 2021
Preamplifier	EMC	EMC02325	980194	Sep. 01, 2021	Sep. 02, 2022
LF cable 1M	EMC	EMCCFD400-NM-N M-1000	160501	Oct. 15, 2021	Oct. 14, 2022
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-003	Oct. 15, 2021	Oct. 14, 2022
LF cable 10M	EMC	CFD400-E	CFD400-001	Oct. 15, 2021	Oct. 14, 2022
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)				
Tested Date	Oct. 29, 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. 27, 2021	Sep. 26, 2022
Preamplifier	EMC	EMC12630SE	980322	Jul. 13, 2021	Jul. 12, 2022
RF Cable	EMC	EMC105-SM-SM-8000	180512	Oct. 15, 2021	Oct. 14, 2022
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16018/4	Oct. 15, 2021	Oct. 14, 2022
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:

ICES-003 Issue 7, Class B

ANSI C63.4-2014 amended as per ANSI C63.4a-2017

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	150kHz ~ 30MHz	± 2.92 dB
Radiated Emissions	30MHz ~ 1GHz	± 4.32 dB
	Above 1GHz	± 4.9 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
Address of Test Site	No.3-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)

2.2 The Worst Case Measurement Configuration

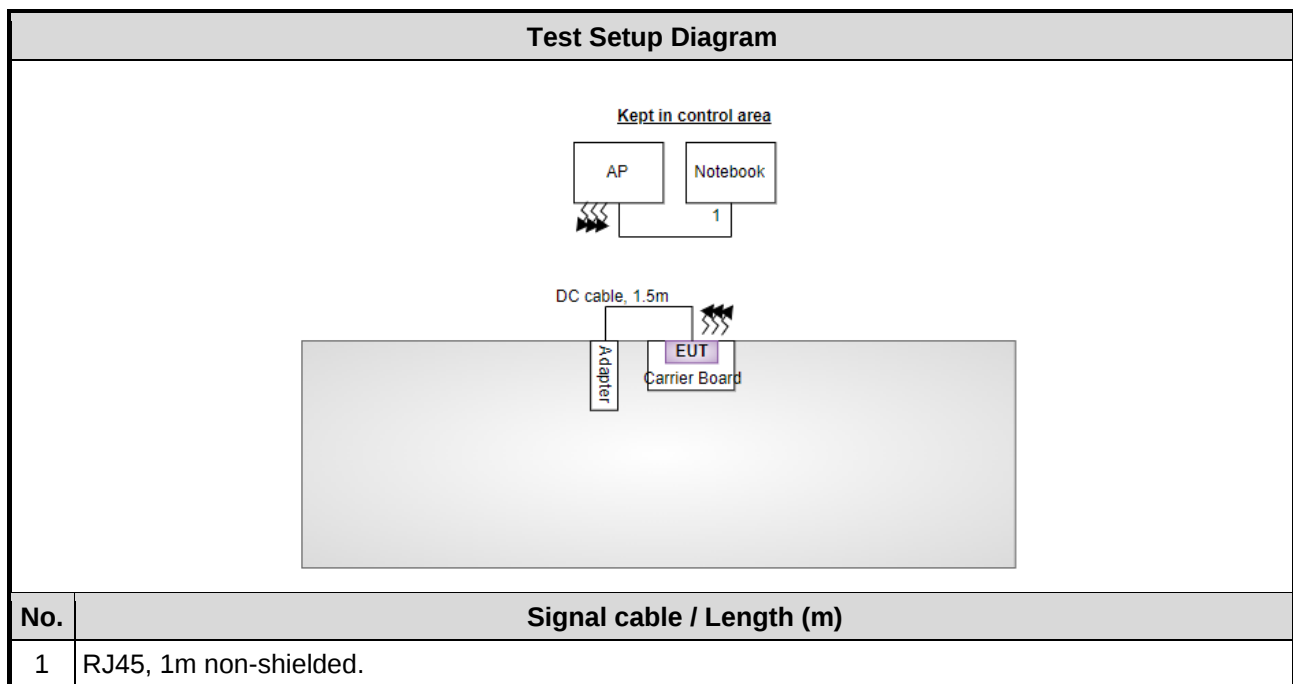
Radiation Pretest Mode	
Pretest Mode	Operating Description
1	Part Number: 453-00084, EUT orientation: Z-axis + Ant.: 001-0001, WiFi 2.4G Link, with adapter
2	Part Number: 453-00084, EUT orientation: Z-axis + Ant.: 001-0022, WiFi 2.4G Link, with adapter
3	Part Number: 453-00084, EUT orientation: Z-axis + Ant.: 001-0023, WiFi 2.4G Link, with adapter
4	Part Number: 453-00084, EUT orientation: Z-axis + Ant.: EFA2400A3S-10MH4, WiFi 2.4G Link, with adapter
5	Part Number: 453-00084, EUT orientation: Z-axis + Ant.: 001-0012, WiFi 2.4G Link, with adapter
6	Part Number: 453-00084, EUT orientation: Z-axis + Ant.: TRAB24003P, WiFi 2.4G Link, with adapter
7	Part Number: 453-00085, EUT orientation: Z-axis + Ant.: AT3216-A2R4PAAT/LF, WiFi 2.4G Link, with adapter
8	Part Number: 453-00084, EUT orientation: Z-axis + Ant.: 001-0001, BT Tx mode, with adapter
9	Part Number: 453-00084, EUT orientation: X-axis + Ant.: 001-0001, BT Rx mode, with adapter
For Pretest Mode 1 is the worst case and only its data was record in this test report.	

The Determined Worst Case Configurations	
Conducted Emissions	
Test Mode	Operating Description
1	Part Number: 453-00084, EUT orientation: X-axis + Ant.: 001-0001, WiFi 2.4G Link, with adapter
Radiated Emissions	
Test Mode ≤1GHz	Operating Description
1	Part Number: 453-00084, EUT orientation: Z-axis + Ant.: 001-0001, WiFi 2.4G Link, with adapter
Test Mode >1GHz	Operating Description
1	Part Number: 453-00084, EUT orientation: Z-axis + Ant.: 001-0001, WiFi 2.4G Link, with adapter

2.3 Local Support Equipment List

Support Equipment List					
No.	Equipment	Brand	Model	S/N	Remarks
1	Notebook	DELL	Latitude E6440	2PXMD12	---
2	Wireless AP	D-LINK	DIR-850L	RZ1Q4G6000261	---
3	Adapter	I.T.E	MU24AY120200-A1	---	Provided by applicant.
4	Carrier Board	Laird Connectivity	SU60-SOMC	---	Provided by applicant.

2.4 Test Setup Chart



Note: The console is disconnected from EUT and removed from test table after sending command from notebook to control EUT to transmit continuously.

2.5 Test Software and Operating Condition

- To enable all function of test system.
- The support notebook executed "putty.exe" communicated with EUT via support AP by using ping command over Wireless LAN network.
- The support notebook executed "putty.exe" to continue BT TX or RX.

3 Emission Tests Results

3.1 Conducted Emissions

3.1.1 Limit of Conducted Emissions

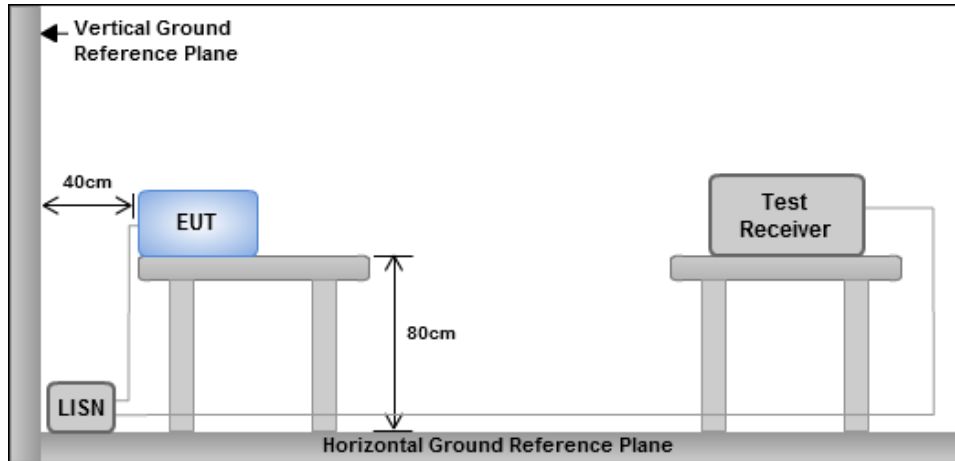
Frequency Range (MHz)	Class A Quasi-Peak (dBuV)	Class A Average (dBuV)	Class B Quasi-Peak (dBuV)	Class B Average (dBuV)
0.15 – 0.5	79	66	66 to 56 ⁱ	56 to 46 ⁱ
0.5 – 5	73	60	56	46
5 – 30	73	60	60	50

Note: The more stringent limit applies at transition frequencies.
i. The limit level in dBuV decreases linearly with the logarithm of frequency.

3.1.2 Test Procedures

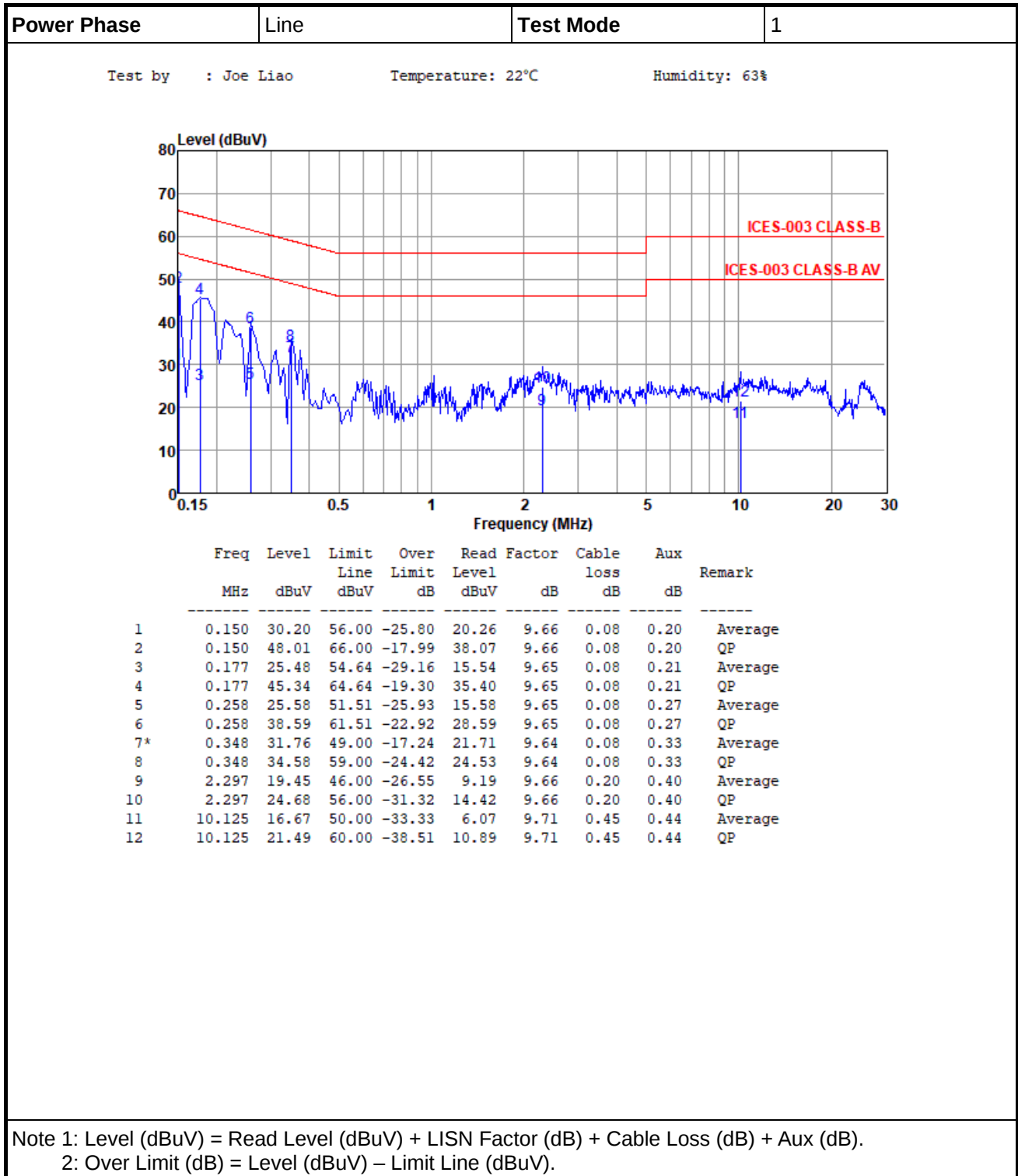
- The EUT was placed on a table with a height of 0.8 meters from the metal ground plane and 0.4 meters from the conducting wall of the shielding room and it was kept at least 0.8 meters from any other grounded conducting surface.
- The test equipment EUT installed received DC power through a Line Impedance Stabilization Network (LISN), which supplied power source and was grounded to the ground plane.
- All the support units were connected 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 measurement frequency range extends from 150 kHz to 30 MHz.
- Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

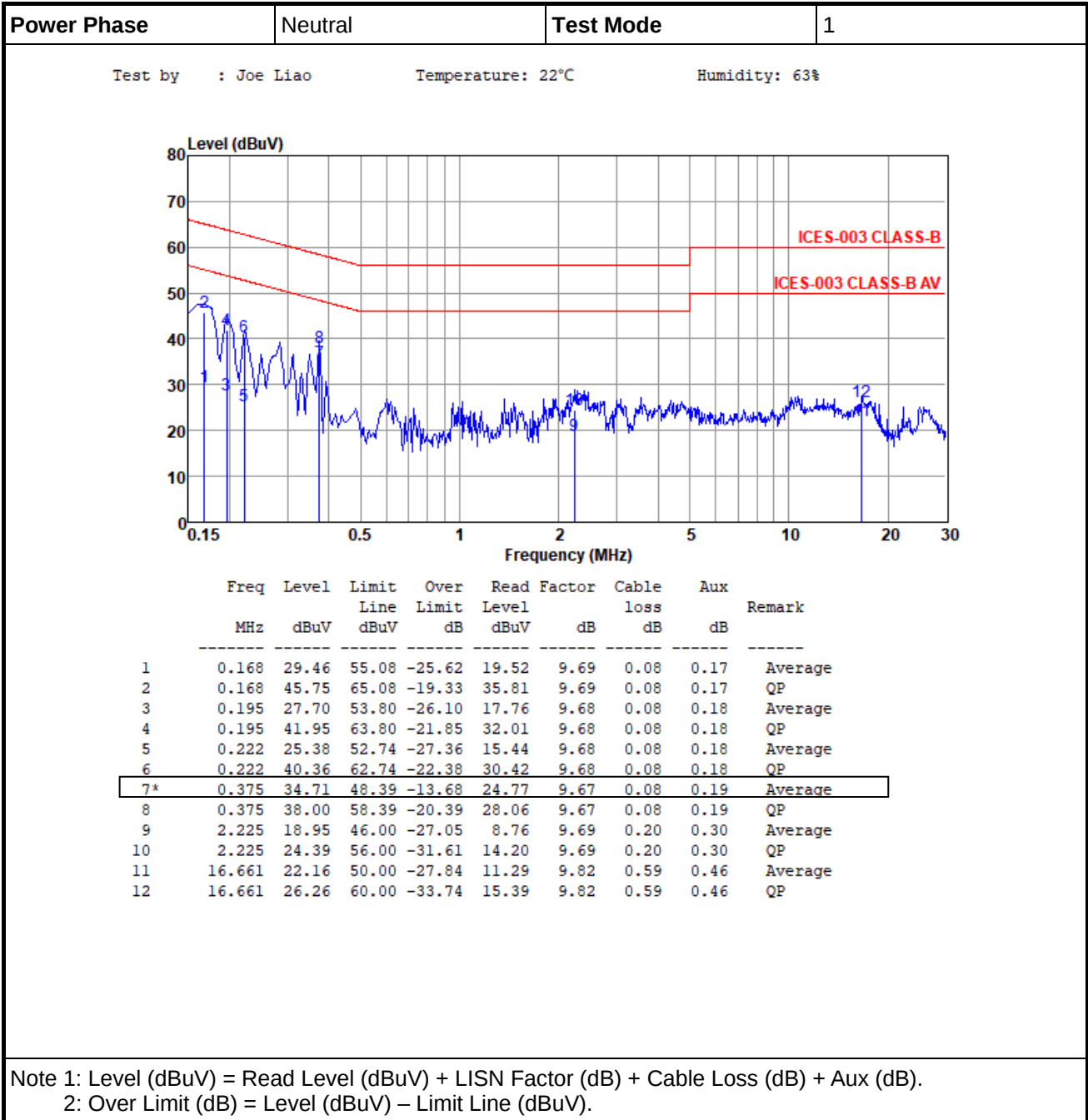
3.1.3 Test Setup



- 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





3.2 Radiated Emissions

3.2.1 Limit of Radiated Emissions

Radiated emissions limits (30 MHz to 1 GHz) at 3 m distance

Frequency range (MHz)	Class A Quasi-peak (dBuV/m)	Class B Quasi-peak (dBuV/m)
30 – 88	50.0	40.0
88 – 216	54.0	43.5
216 – 230	56.9	46.0
230 – 960	57.0	47.0
960 – 1000	60.0	54.0

Note: The more stringent limit applies at transition frequencies.

Required emission limits at 3 m distance (at and above 1 GHz)

Frequency range (GHz) ⁱ	Class A Average dB(μV/m)	Class A Peak dB(μV/m)	Class B Average dB(μV/m)	Class B Peak dB(μV/m)
1 – F _M	60	80	54	74

i. The highest measurement frequency, F_M in GHz, shall be determined as per table above.

Required highest measurement frequency for radiated emissions:

Highest internal frequency (F _x) ⁱ	Highest measurement frequency (F _M)
F _x ≤ 108 MHz	1 GHz
108 MHz < F _x ≤ 500 MHz	2 GHz
500 MHz < F _x ≤ 1 GHz	5 GHz
F _x > 1 GHz	5 x F _x up to maximum of 40GHz

i. F_x is the highest fundamental frequency generated and/or used in the ITE or digital apparatus under test.

3.2.2 Test Procedures

Measuring below 1 GHz:

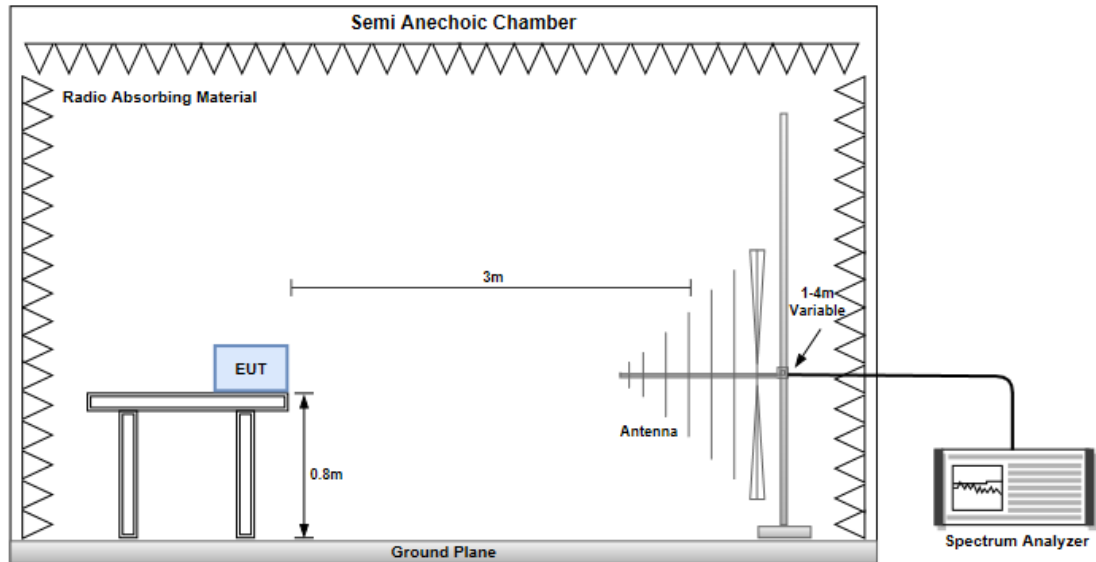
- a. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at a height of 0.8 m test table above the ground plane.
- b. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
- c. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Measuring above 1 GHz:

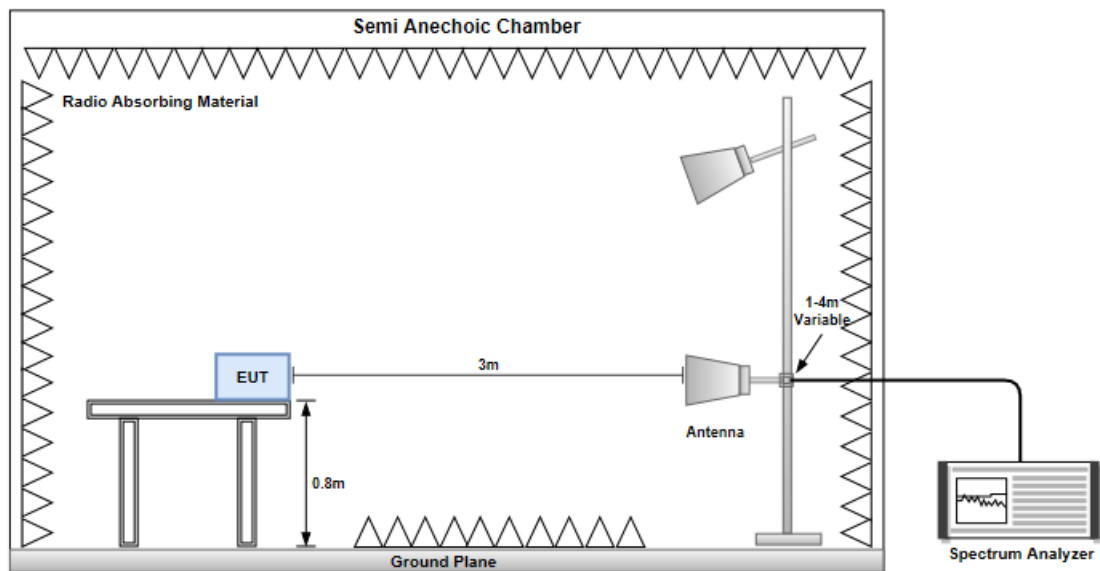
- a. Same test set up as below 1GHz radiated testing.
- b. The EUT was set 3 meters from the interference-receiving antenna which was mounted on the top of a variable height antenna tower.
- c. There should be absorber placed between the EUT and Antenna and its located size should let the test site meet CISPR16-1-4 requirement.
- d. The table was rotated 360 degrees to determine the position of the highest radiation.
- e. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.
- f. Set the Horn Antenna at 1m height, then run the turn table to get the maximum noise reading from Horizontal and Vertical polarity separately.
- g. When EUT locating on the turn-table, the Horn Antenna must be raised up and descended down, then turning around the turn-table to get the maximum noise reading of the Horizontal and Vertical polarity separately. Note the maximum raise up height is same as the top of EUT.
- h. If emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again 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
Test By :Joe Liao Temperature(°C):22 Humidity(%):58			
Level (dBuV/m) <			

Polarization	Vertical	Test Mode	1
Test By :Joe Liao Temperature(°C):22 Humidity(%):58			
Level (dBuV/m)			

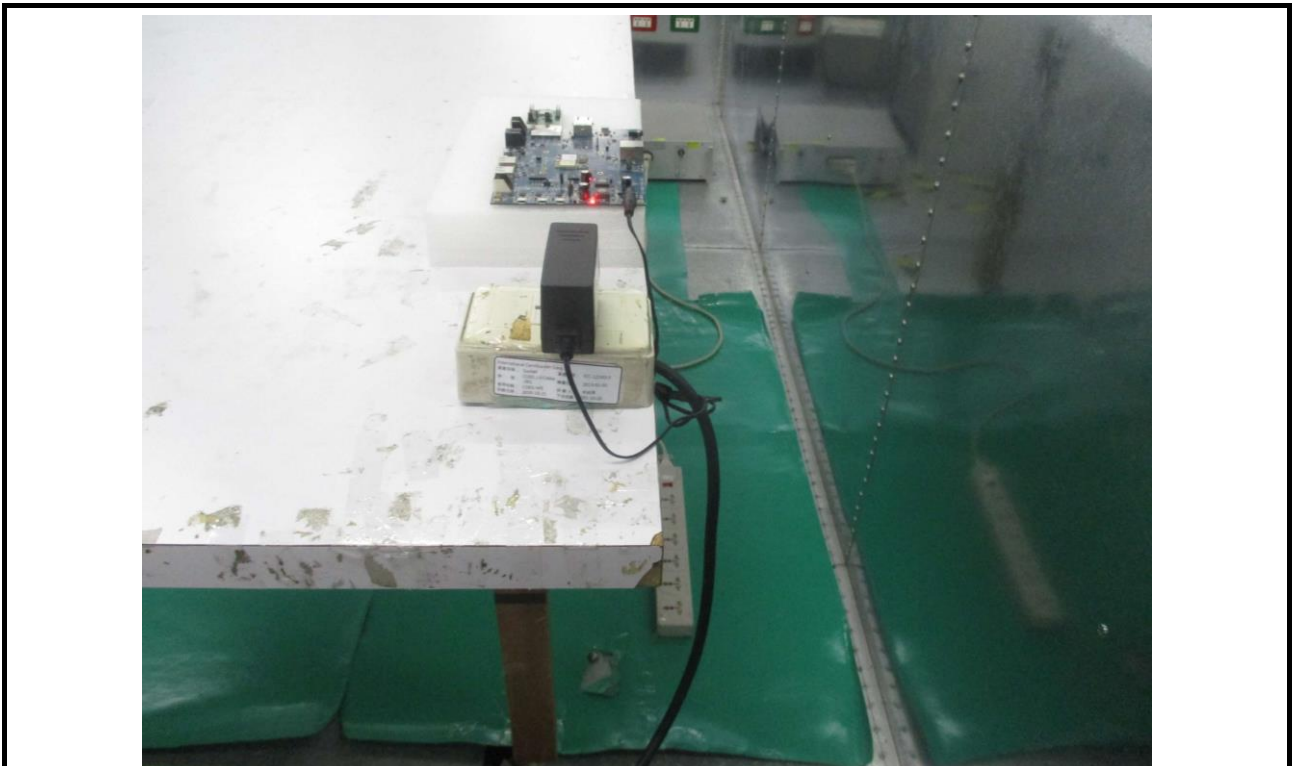
3.2.5 Radiated Emissions (Above 1GHz)

Polarization	Horizontal	Test Mode	1
Test By :Joe Liao Temperature(°C):23 Humidity(%):61			
Level (dBuV/m) </			

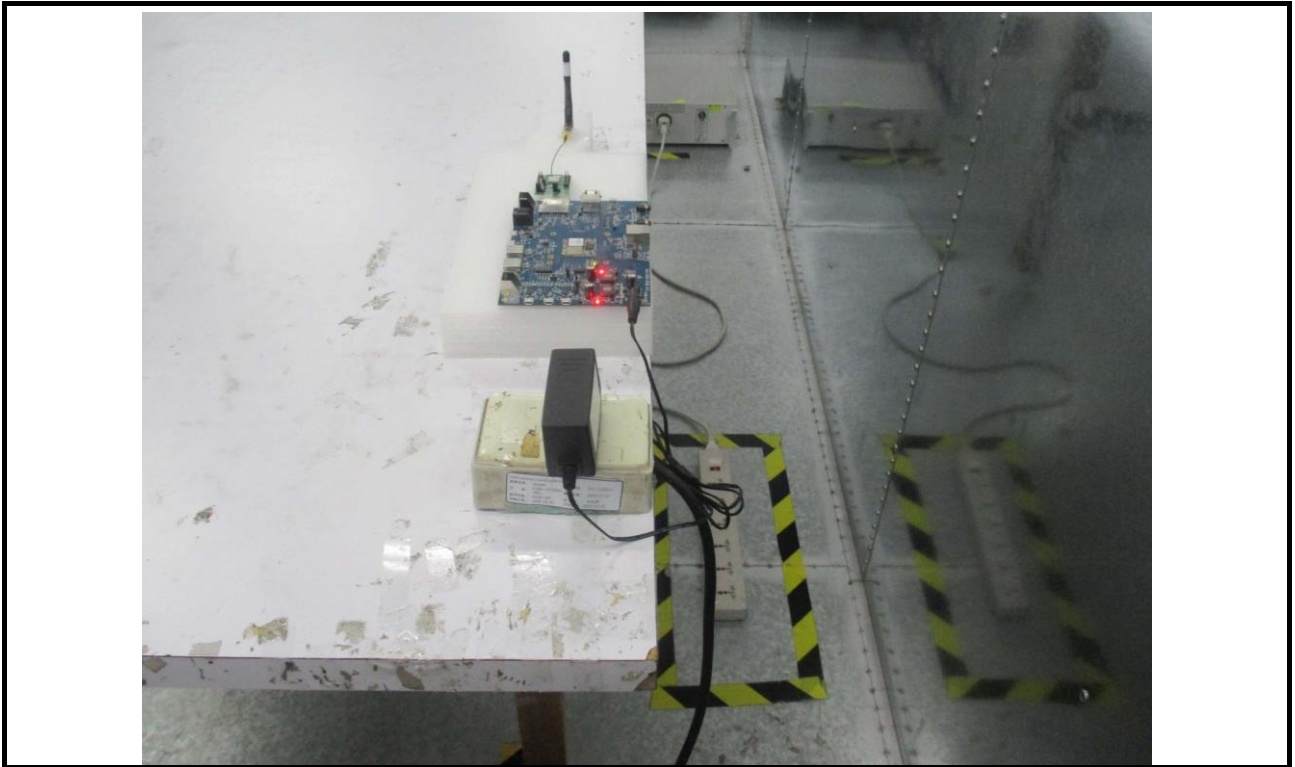
Polarization	Vertical	Test Mode	1
Test By	:Joe Liao	Temperature(°C):23	Humidity(%):61
Level (dBuV/m) </			

4 Photographs of the Test Configuration

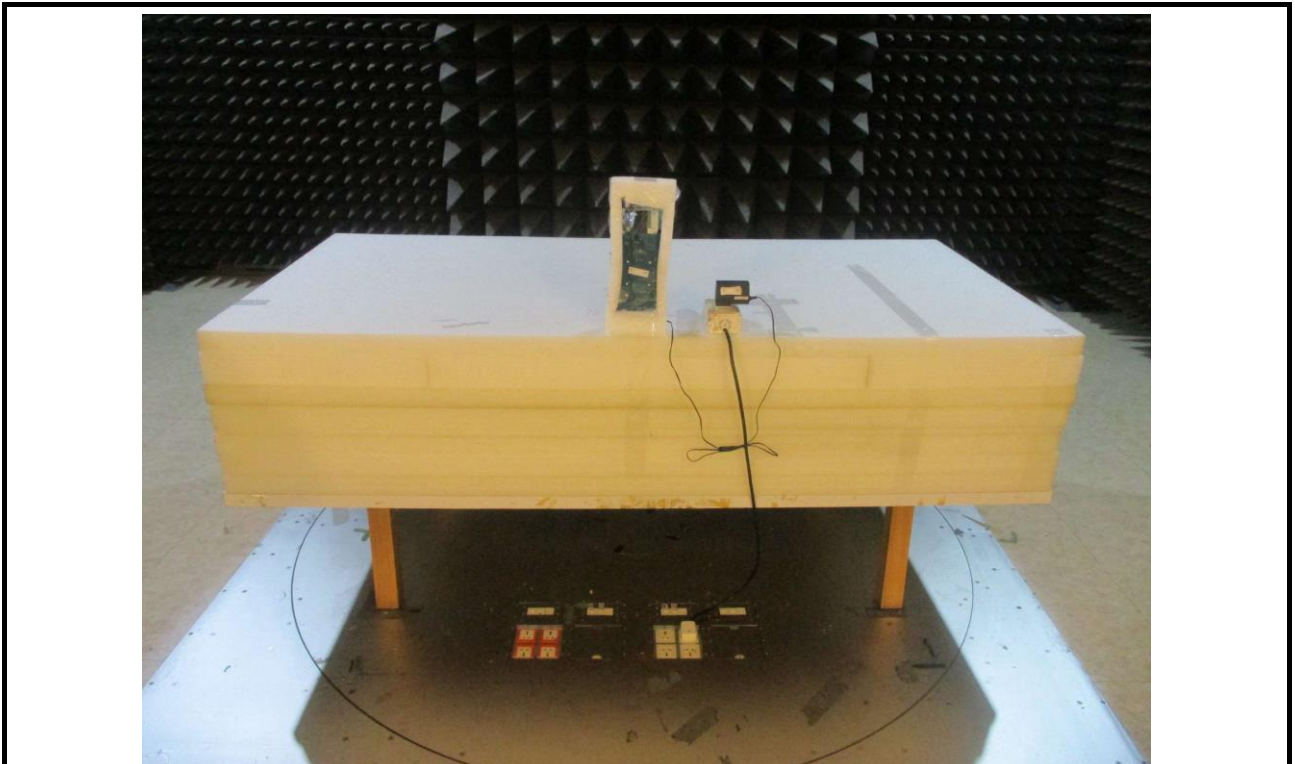
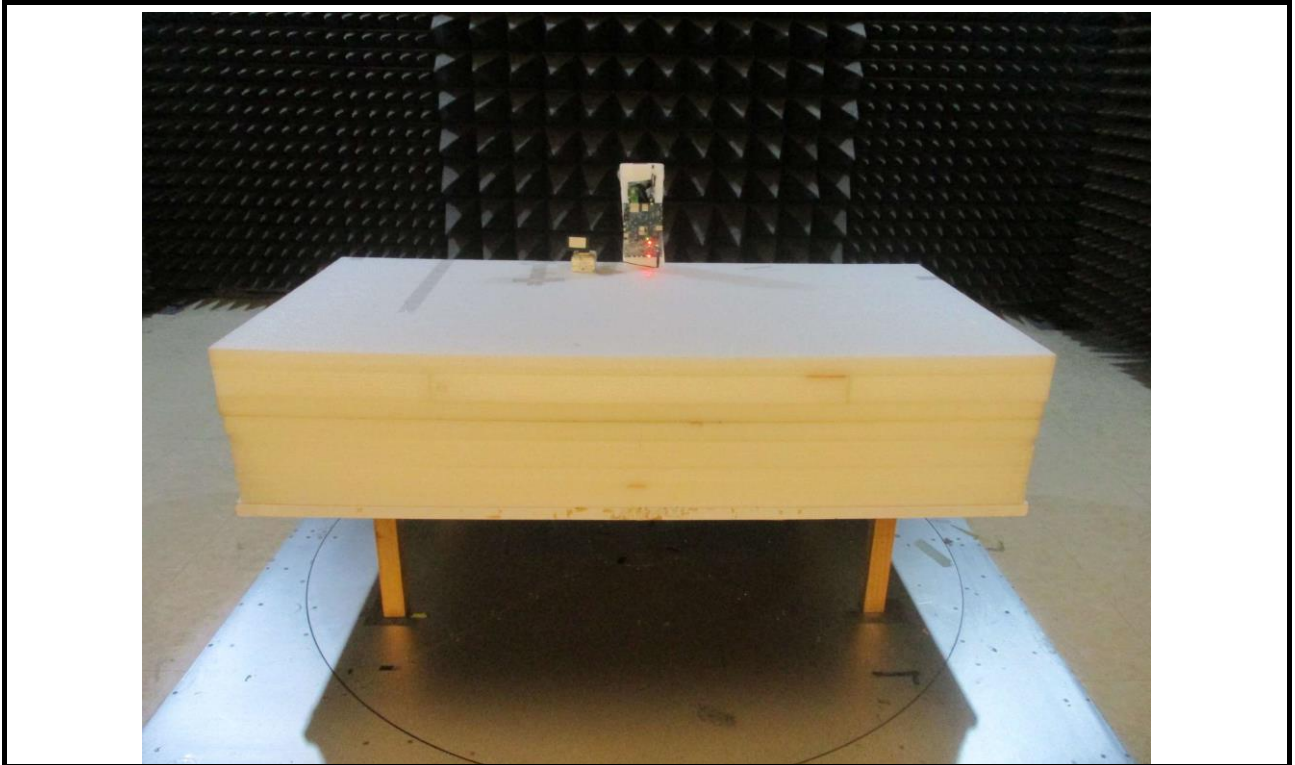
Conducted Emission Test (Part Number: 453-00085)



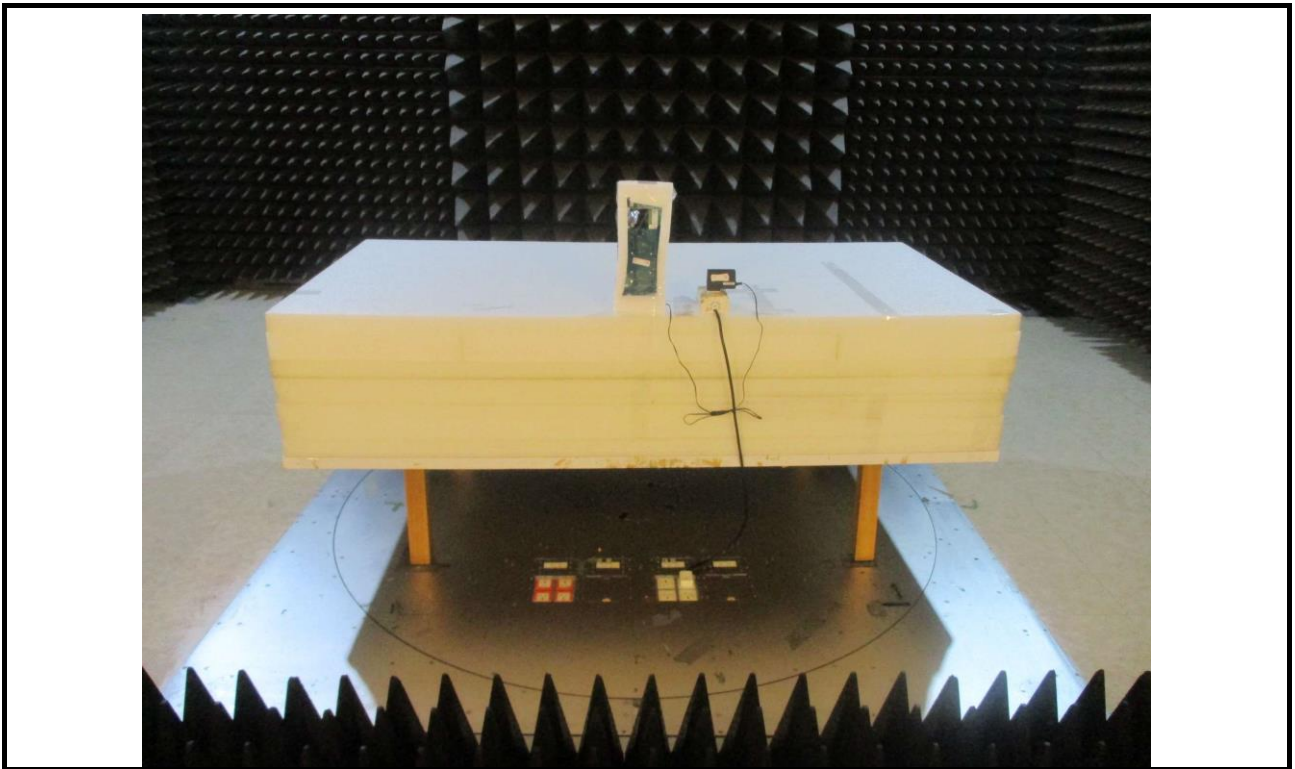
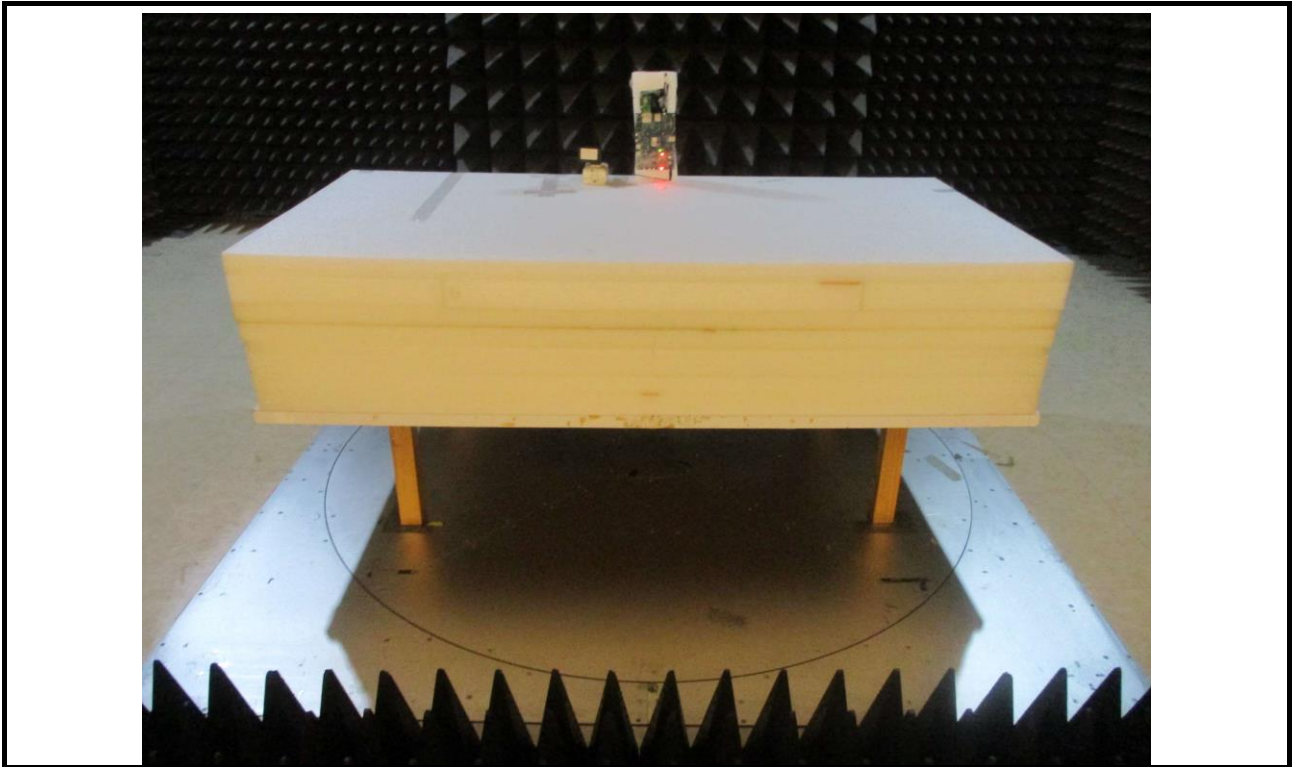
Conducted Emission Test (Part Number: 453-00084)



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 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>.

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Kwei Shan Site II

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