

CE EMC Test Report

Equipment : 802.11ac Professional Wi-Fi + BT5.0 Module
Model No. : SU60-SOMC (453-00003),
SU60-SOMC-2G (453-00004)
Brand Name : Laird Connectivity
Applicant : Laird Connectivity, LLC
Address : W66N220 Commerce Court Cedarburg WI
53012 United States Of America (Excluding
The States Of Alaska)
Standard : EN 301 489-1 V2.2.3 (2019-11)
EN 301 489-17 V3.2.4 (2020-09)
Received Date : Apr. 11, 2018
Tested Date : Aug. 01 ~ Oct 28, 2018 (for original test)
Sep. 07 ~ Sep. 30, 2021(for new test)

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:

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Release Record

Report No.	Version	Description	Issued Date
EH841101-05	Rev. 01	Initial issue	Oct. 06, 2021

Draft

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 18.63dB @ 0.402MHz.	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 1.17dB @ 1000.00MHz.	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
N/A means Not Applicable. Note¹: The EUT w/o telecom port. Note²: The EUT consumes DC power, so the test is not required.				

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. “*”: Test method reported herein was performed according to the method specified by applicant.					

Comments and Explanations:

The declared performance criteria of immunity test for EUT presented in the report are provided by manufacturer, and the manufacturer takes all the responsibilities for the judgement of the test result.

1 General Description

1.1 Information

This report is issued as a supplementary report to the original project no. EH841101. The modification is concerned with following:

- ✧ Revised brand name, Applicant and address.
- ✧ Changed U1 to RT5170A for lower suspend mode current.
- ✧ Added C87 for solve the co-location issue with LTE.

Therefore, related test items had been performed and presented in the following sections.

1.1.1 Product Details

The following models are provided to this EUT.

Brand Name	Model Name	Product Name	Description
Laird Connectivity	SU60-SOMC (453-00003)	802.11ac Professional Wi-Fi + BT5.0 Module	2G/1G MCP
	SU60-SOMC-2G (453-00004)		4G/2G MCP

1.1.2 Specification of the Equipment under Test (EUT)

BT	
Operating Frequency	2402 MHz ~ 2480 MHz
Modulation Type	Bluetooth 4.2 LE: GFSK Bluetooth BR(1Mbps): GFSK Bluetooth EDR (2Mbps): $\pi/4$ -DQPSK Bluetooth EDR (3Mbps): 8-DPSK
WIFI	
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)
S/W Version	6.0.0.x

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

Power Supply Type	3.3 Vdc from host
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1.1.4 Accessories

Accessories		
No.	Equipment	Description
1	AC Adapter	Brand Name: I.T.E POWER SUPPLY Model Name: MU12AY120100-A1 Power Rating: I/P: 100-240Vac, 50/60Hz, 0.3A O/P: 12Vdc, 1A Power Line: 1.48m non-shielded cable without core

1.1.5 Antenna Details

Brand	Model	Type	Connector	Operating Frequency (MHz) / Gain (dBi)				
				2400~2483.5	5150~5250	5250~5350	5470~5725	5725~5850
LSR	001-0009	Dipole	IPEX U.FL	2	2			
Laird	NanoBlade-IP04	PCB Dipole	IPEX U.FL	2	3.9	3.9	4	4
Laird	MAF95310 Mini NanoBlade Flex	PCB Dipole	IPEX U.FL	2.79	3.38			
LSR	FlexPIFA 001-0016	PIFA	IPEX U.FL	2.5	3			
Ethertronics	WLAN_1000146	Magnetic Dipole	IPEX U.FL	2.5	3.5			
Laird	MIMO FlexPIFA Antenna	PIFA	IPEX U.FL	2	3			
LSR	001-0009 (with filter)	Dipole	IPEX U.FL	2	2			

1.2 Test Equipment and Calibration Data

For original test

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Tested Date	Aug. 01, 2018				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101657	Jan. 05, 2018	Jan. 04, 2019
LISN	SCHWARZBECK	Schwarzbeck 8127	8127-667	Nov. 13, 2017	Nov. 12, 2018
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-666	Nov. 24, 2017	Nov. 23, 2018
RF Cable-CON	EMC	EMCCFD300-BM-B M-6000	50821	Dec. 18, 2017	Dec. 17, 2018
50 ohm terminal (Support Unit)	NA	50	04	May 22, 2018	May 21, 2019
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	ESD				
Test Site	ESD room 1 / (ES01-WS)				
Tested Date	Aug. 10, 2018				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
ESD Generator	EMTest	Dito	V1248114239	Aug. 16, 2017	Aug. 15, 2018
Note: Calibration Interval of instruments listed above is one year.					

Test Item	ESD				
Test Site	ESD room 1 / (ES01-WS)				
Tested Date	Oct. 11 ~ Oct. 26, 2018				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
ESD Generator	EMTest	Dito	V1248114239	Aug. 23, 2018	Aug. 22, 2019
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)				
Tested Date	Aug. 13 ~ Oct. 11, 2018				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Signal Generator	R&S	SMB100A	103924HA	Oct. 16, 2017	Oct. 15, 2018
Power Sensor	R&S	NRP-Z91	101094-UL	Oct. 16, 2017	Oct. 15, 2018
Power Sensor	R&S	NRP-Z91	101095-KY	Oct. 16, 2017	Oct. 15, 2018
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.					

Test Item	Radiated Immunity (80 MHz - 6 GHz)				
Test Site	RS room 1 / (RS01-WS)				
Tested Date	Aug. 13 ~ Oct. 25, 2018				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Signal Generator	R&S	SMB100A	103924HA	Oct. 23, 2018	Oct. 22, 2019
Power Sensor	R&S	NRP-Z91	101094-UL	Oct. 16, 2018	Oct. 15, 2019
Power Sensor	R&S	NRP-Z91	101095-KY	Oct. 16, 2018	Oct. 15, 2019
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.					

For new test

Test Item	Radiated Emission below 1GHz				
Test Site	966 chamber 2 / (03CH02-WS)				
Test Date	Sep. 07, 2021				
Instrument	Manufacturer	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	Sep. 07, 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
Preamplifier	EMC	EMC12630SE	980322	Jul. 13, 2021	Jul. 12, 2022
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)				
Tested Date	Sep. 23, 2021				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
ESD Generator	EMTest	Dito	V1248114239	Aug. 10, 2021	Aug. 09, 2022
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)				
Tested Date	Sep. 23 ~ Sep. 30, 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	EUT(2Gb FLASH + 1Gb RAM): WiFi 5G & BT Link, EUT orientation: X-axis, Ant: 001-0009, 230V/50Hz
2	EUT(2Gb FLASH + 1Gb RAM): WiFi 2.4G & BT Link, EUT orientation: X-axis, Ant: NanoBlade-IP04, 230V/50Hz
3	EUT(2Gb FLASH + 1Gb RAM): WiFi 5G & BT Link, EUT orientation: X-axis, Ant: MAF95310 Mini NanoBlade Flex, 230V/50Hz
4	EUT(2Gb FLASH + 1Gb RAM): WiFi 2.4G & BT Link, EUT orientation: X-axis, Ant: FlexPIFA 001-0016, 230V/50Hz
5	EUT(2Gb FLASH + 1Gb RAM): WiFi 5G & BT Link, EUT orientation: X-axis, Ant: MIMO FlexPIFA Antenna, 230V/50Hz
6	EUT(2Gb FLASH + 1Gb RAM): WiFi 2.4G & BT Link, EUT orientation: X-axis, Ant: WLAN_1000146, 230V/50Hz
7	EUT(4Gb FLASH + 2Gb RAM): WiFi 5G & BT Link, EUT orientation: X-axis, Ant: 001-0009, 230V/50Hz
8	EUT(2Gb FLASH + 1Gb RAM): WiFi 5G & BT Link, EUT orientation: X-axis, Ant: 001-0009 with filter, 230V/50Hz
9	Link, EUT(4Gb FLASH + 2Gb RAM): WiFi 5G & BT, EUT orientation: X-axis, Ant: 001-0009, 110V/60Hz
10	EUT(4Gb FLASH + 2Gb RAM): EUT orientation: X-axis, Ant: 001-0009, Standby mode, 230V/50Hz
For Pretest Mode 7 is the worst case and only its data was record in this test report.	

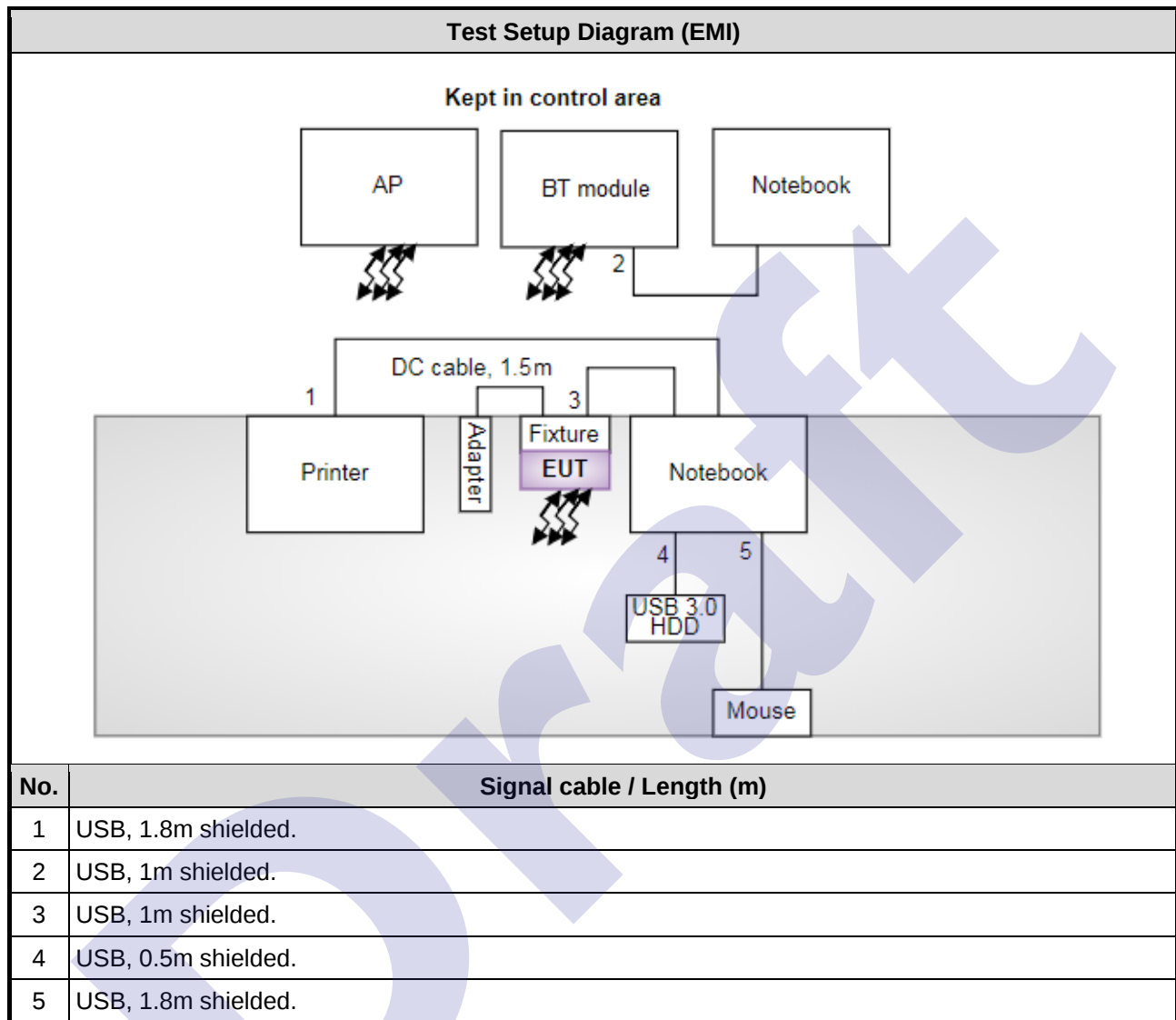
The Worst Test Configurations	
Conducted Emissions from the AC mains power ports	
Test Mode	Operating Description
1	WiFi 5G & BT Link, EUT(4Gb FLASH + 2Gb RAM), EUT orientation: X-axis, Ant: 001-0009, 230V/50Hz
2	WiFi 2.4G & BT Link, EUT(4Gb FLASH + 2Gb RAM), EUT orientation: X-axis, Ant: NanoBlade-IP04, 110V/60Hz
3	WiFi 5G & BT Link, EUT(4Gb FLASH + 2Gb RAM), EUT orientation: X-axis, Ant: MAF95310 Mini NanoBlade Flex, 230V/50Hz
4	WiFi 2.4G & BT Link, EUT(4Gb FLASH + 2Gb RAM), EUT orientation: X-axis, Ant: FlexPIFA 001-0016, 110V/60Hz
5	WiFi 5G & BT Link, EUT(4Gb FLASH + 2Gb RAM), EUT orientation: X-axis, Ant: MIMO FlexPIFA Antenna, 230V/50Hz
6	WiFi 2.4G & BT Link, EUT(4Gb FLASH + 2Gb RAM), EUT orientation: X-axis, Ant: WLAN_1000146 , 110V/60Hz
Radiated Emissions	
Test Mode ≤1GHz	Operating Description
1	EUT(4Gb FLASH + 2Gb RAM): WiFi 5G & BT Link, EUT orientation: X-axis, Ant: LSR/001-0009, 230V/50Hz
Test Mode >1GHz	Operating Description
1	EUT(4Gb FLASH + 2Gb RAM): WiFi 5G & BT Link, EUT orientation: X-axis, Ant: LSR/001-0009, 230V/50Hz
ESD & RS Tests (PER Mode was for RS test only)	
Test Mode	Operating Description
1	WiFi 5G & BT Link, Ant: 001-0009, EUT(4Gb FLASH + 2Gb RAM)
2	WiFi 2.4G & BT Link, Ant: NanoBlade-IP04, EUT(2Gb FLASH + 1Gb RAM)
3	WiFi 5G& BT Link, Ant: MAF95310 Mini NanoBlade Flex, EUT(2Gb FLASH + 1Gb RAM)
4	WiFi 2.4G& BT Link, Ant: FlexPIFA 001-0016, EUT(2Gb FLASH + 1Gb RAM)
5	WiFi 5G& BT Link, Ant: MIMO FlexPIFA Antenna, EUT(2Gb FLASH + 1Gb RAM)
6	WiFi 2.4G & BT Link,BT Link, Ant: WLAN_1000146, EUT(2Gb FLASH + 1Gb RAM)
7	WiFi 5G & BT Link, With Filter, Ant: 001-0009. EUT(4Gb FLASH + 2Gb RAM)
8	WiFi 5G & BT Link, Ant: 001-0009. EUT(4Gb FLASH + 2Gb RAM) (HW changed)
9	BT PER, Ant: 001-0009. EUT(4Gb FLASH + 2Gb RAM)

2.3 Local Support Equipment List

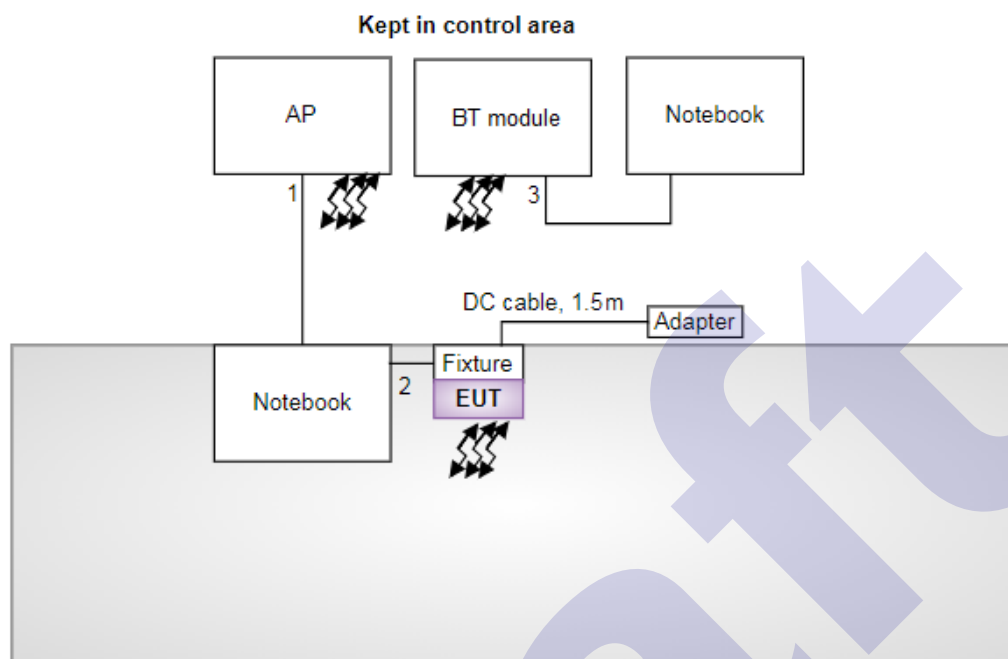
Support Equipment List (EMI)					
No.	Equipment	Brand	Model	S/N	Remarks
1	Notebook	DELL	Latitude E6440	8VXMD12	---
2	Printer	EPSON	XP-30	QSDK002410	---
3	USB 3.0 HDD	WD	WDBKXH5000 ABK	WX31AB210213	---
4	Mouse	DELL	MS111-L	2C3-00MM	---
5	AP	D-LINK	DIR-850L	RZ1Q4G6000263	---
6	Notebook	DELL	Latitude E6440	2PXMD12	---
7	Fixture	---	---	---	Provided by applicant.
8	Adapter	LEADER	MU24AY12020 0-A1	---	Provided by applicant.
9	BT module	---	BL651-SA	---	Provided by applicant.

Support Equipment List (EMS)					
No.	Equipment	Brand	Model	S/N	Remarks
1	Notebook	DELL	Latitude E5430	6R4RWW1	---
2	Notebook	DELL	Latitude E5430	264RWW1	---
3	Wireless AP	D-LINK	DIR-850L	RZ1Q4G6000263	---
4	Fixture	---	---	---	Provided by applicant.
5	Adapter	LEADER	MU24AY12020 0-A1	---	Provided by applicant.
6	BT module	---	BL651-SA	---	Provided by applicant.
7	Wireless connectivity tester	R&S	CMW270	100856	---

2.4 Test Setup Chart

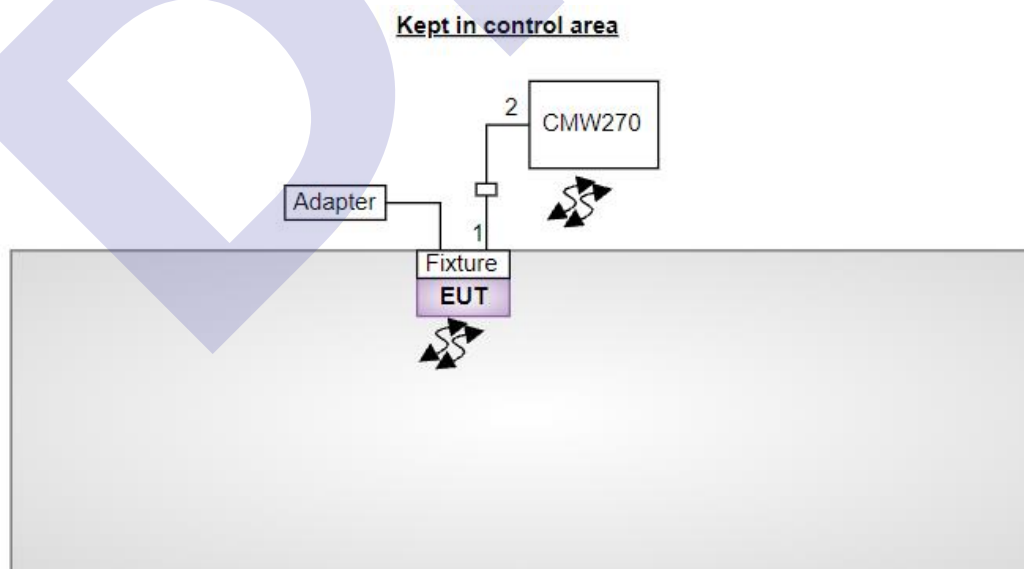


Test Setup Diagram (EMS)



No.	Signal cable / Length (m)
1	RJ45, 2.5m non-shielded.
2	USB, 1m shielded.
3	USB, 1m shielded.

Test Setup Diagram (EMS, BT PER)



No.	Signal cable / Length (m)
1-2	USB, 1.5m shielded.

2.5 Test Software and Operating Condition

EMI

- a. Enabled all function of test system.
- b. The support notebook executed "WinEMC.exe" to send "H" patterns to the printer.
- c. The support notebook executed "WinEMC.exe" to read and wrote data from USB 3.0 HDD.
- d. The notebook executed "KM player.exe" to play colorbar video.
- e. The support notebook executed putty command to link with BT Module via EUT.
- f. The support notebook communicated with the EUT by using ping command through AP to receive and transmit data by WLAN.

EMS

- a. To enable all function of test system.
- b. The support notebook executed putty command to link with BT Module via EUT
- c. The support AP communicated with support notebook via EUT by using ping command over Wireless LAN network.

BT PER

- a. The support notebook executed "putty.exe" to enable bluetooth function of the EUT in packet error mode via USB cable.
- b. The EUT linked with CMW270 to observe packet error rate below 10%.

WIFI PER

- a. The support notebook executed ping command to monitor the 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

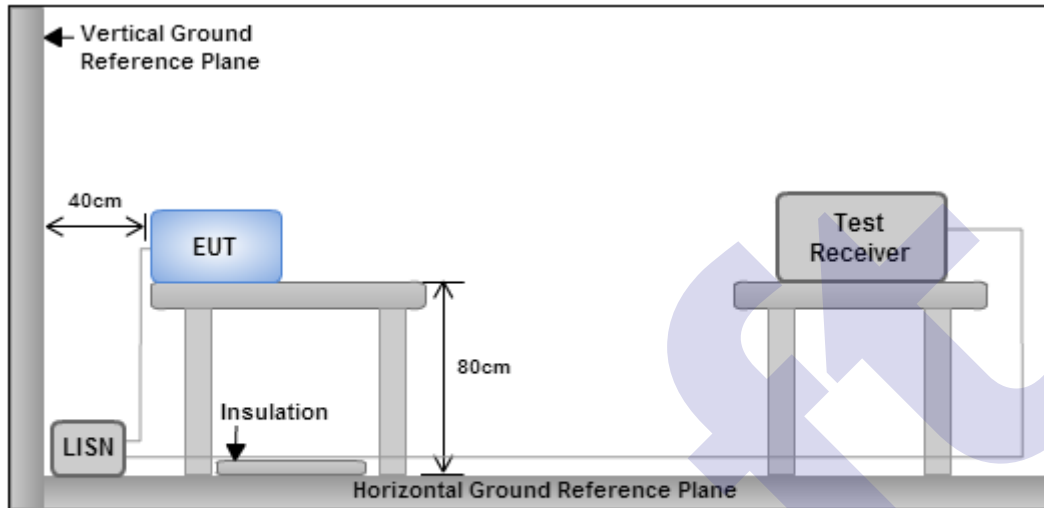
Frequency Range	Limits values (dBμV)			
	Class A		Class B	
	Quasi-Peak	Average	Quasi-Peak	Average
0,15 MHz to 0,5 MHz	79	66	66 to 56 *	56 to 46 *
> 0,5 MHz to 5 MHz	73	60	56	46
> 5 MHz to 30 MHz	73	60	60	50

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

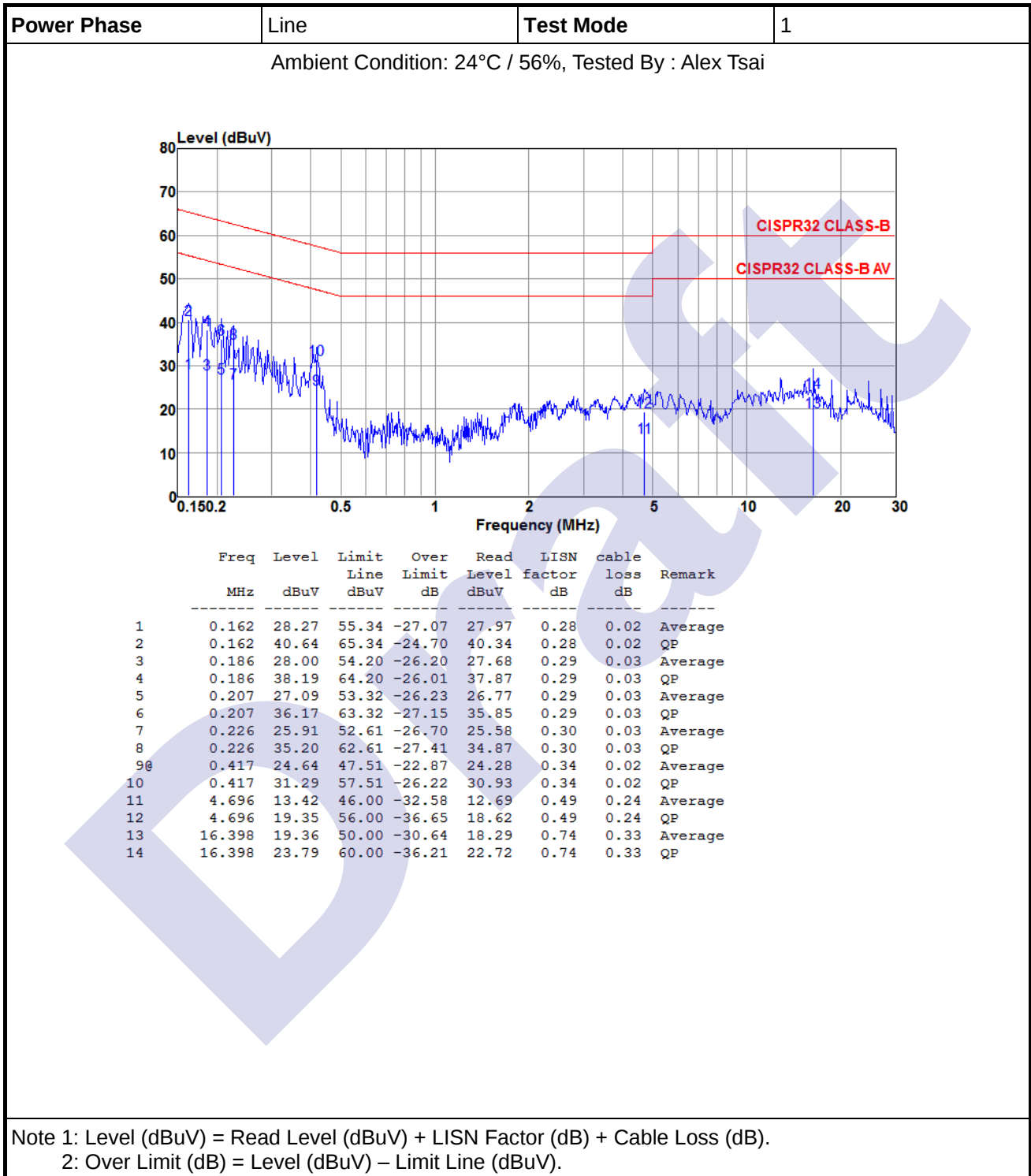
- The EUT was placed on a desk 0.8 meters height from the metal ground plane and 0.4 meter from the conducting wall of the shielding room and it was kept at least 0.8 meters from any other grounded conducting surface.
- A thickness of $\leq 0.15\text{m}$ insulation should be placed between local AE and 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.

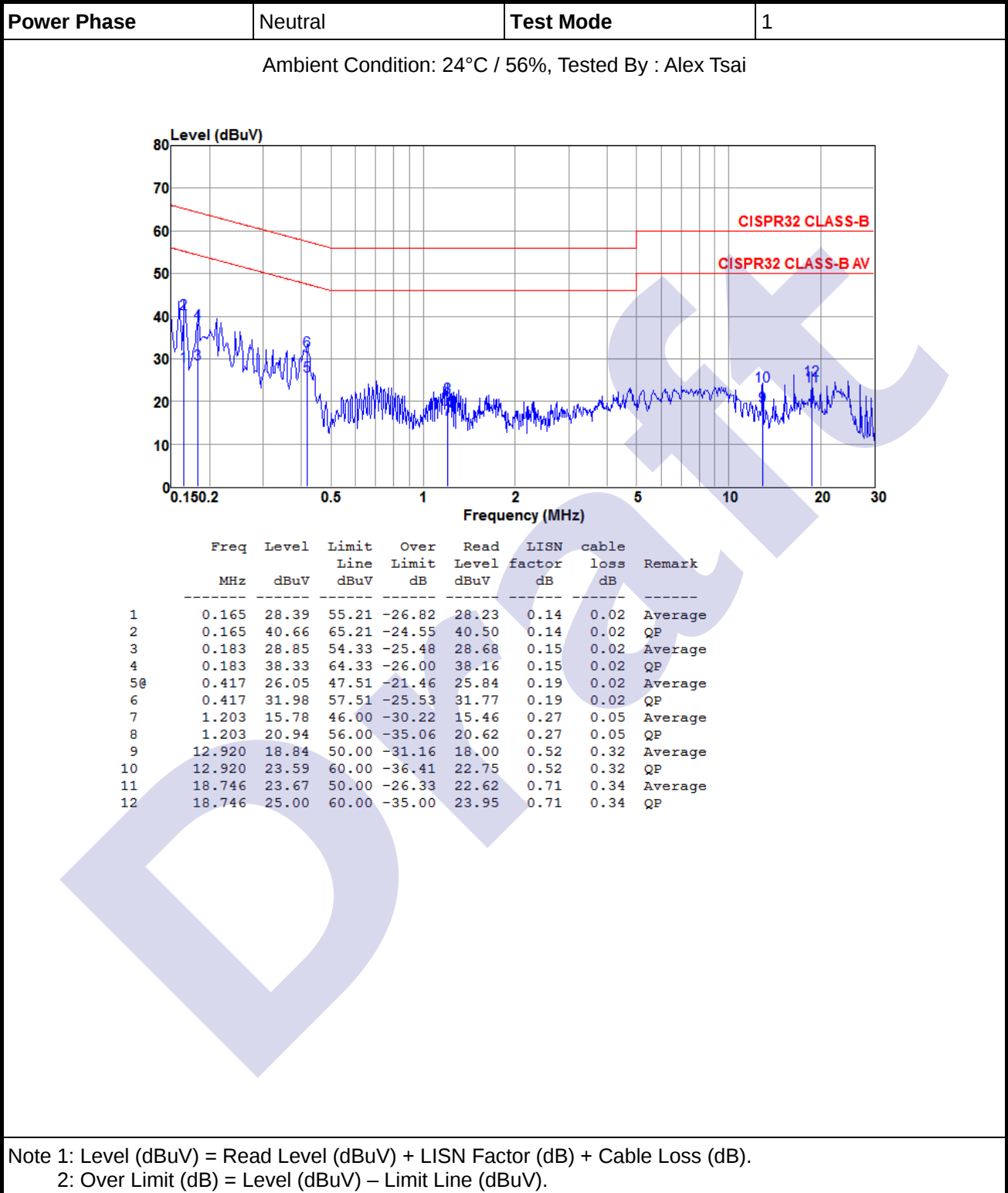
3.1.3 Test Setup

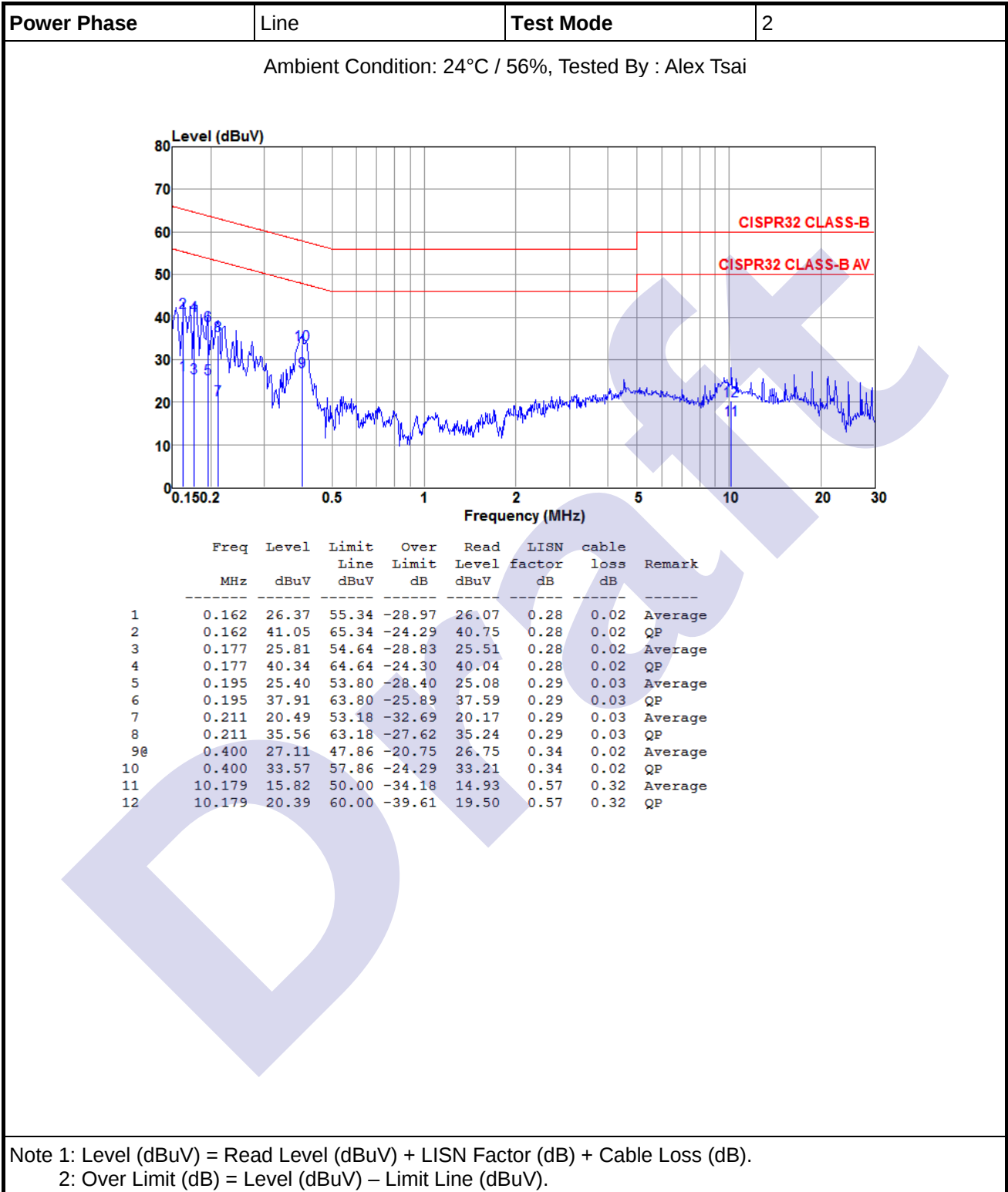


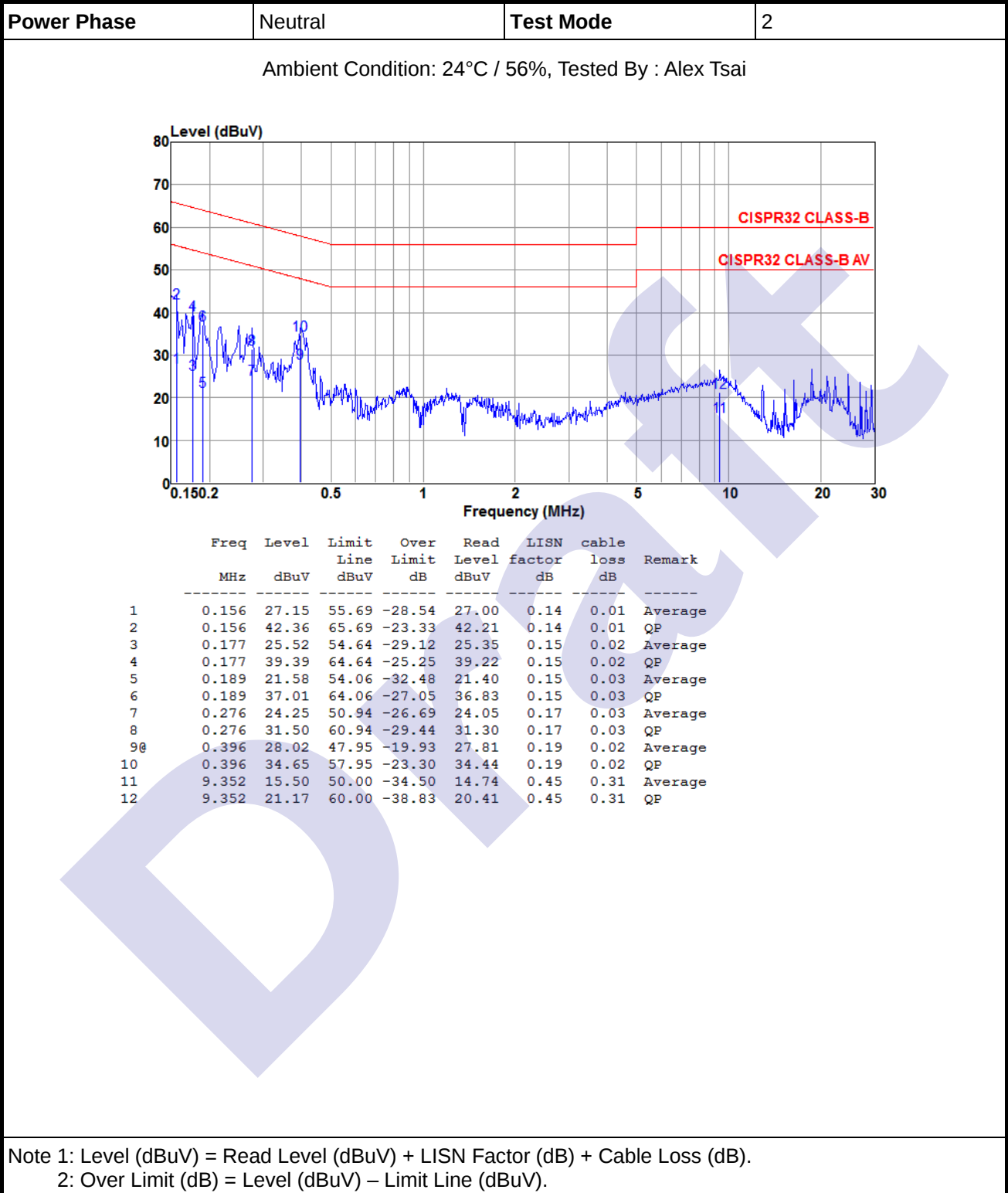
- Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

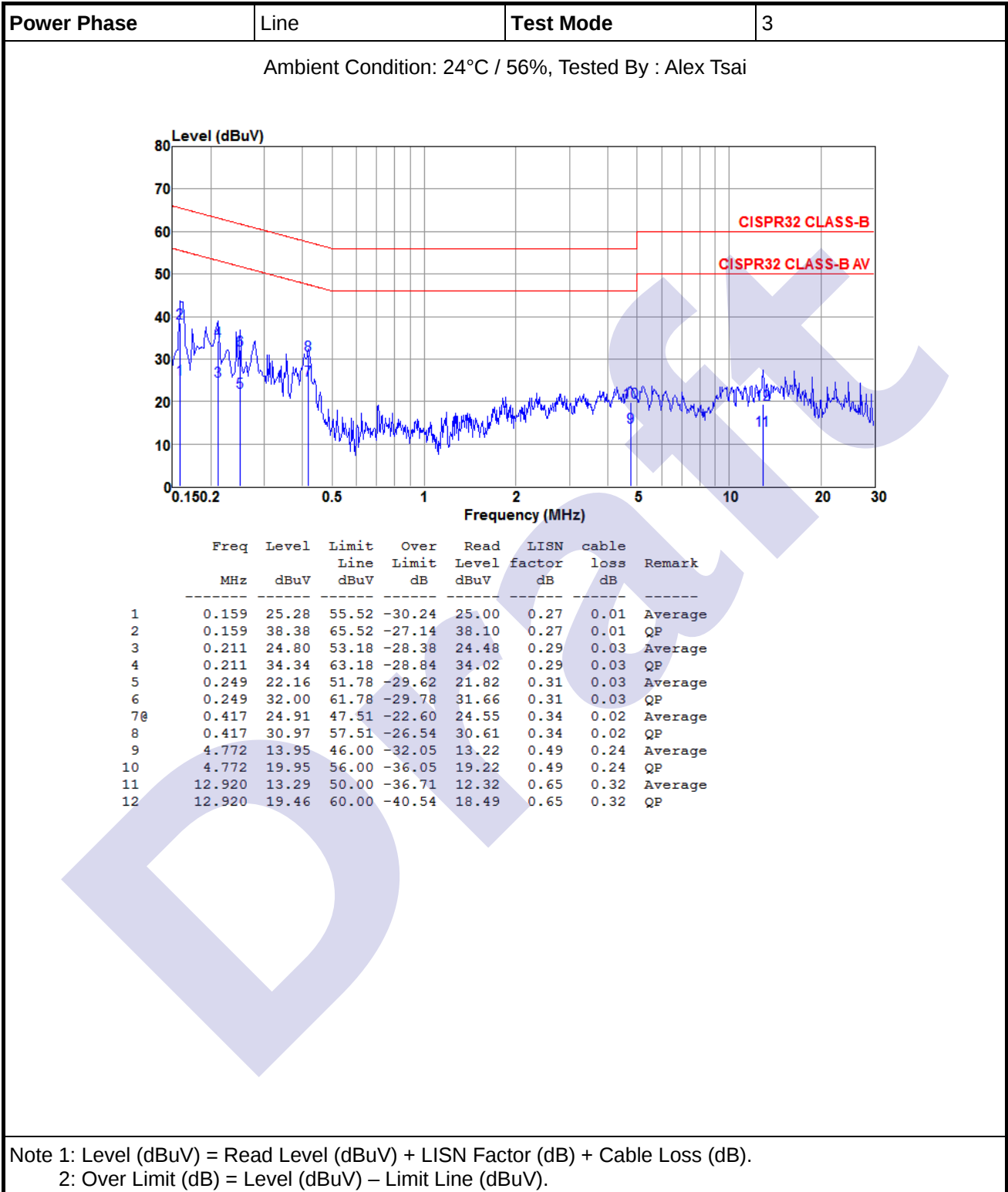
3.1.4 Test Result of Conducted Emissions from the AC mains power ports

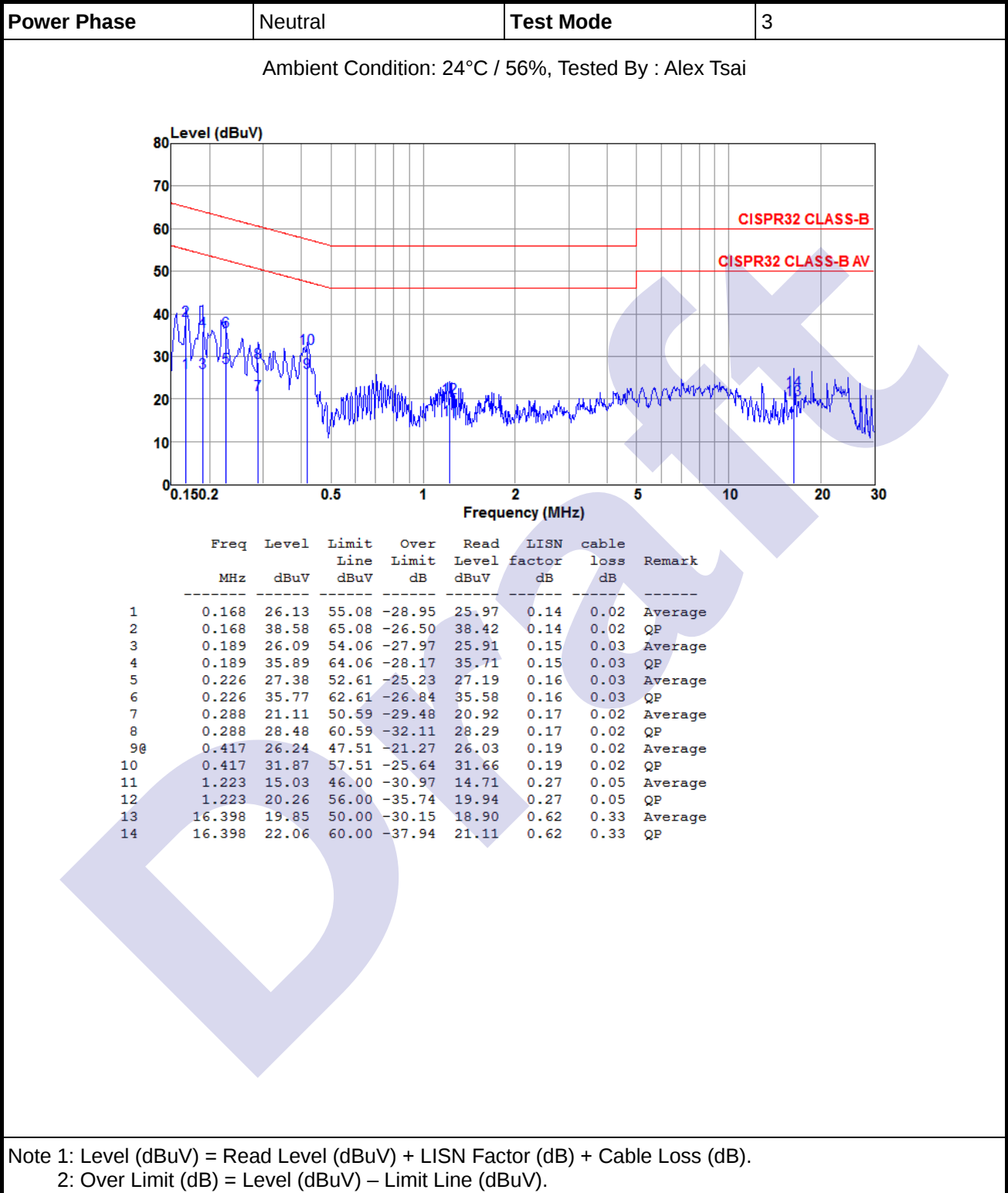


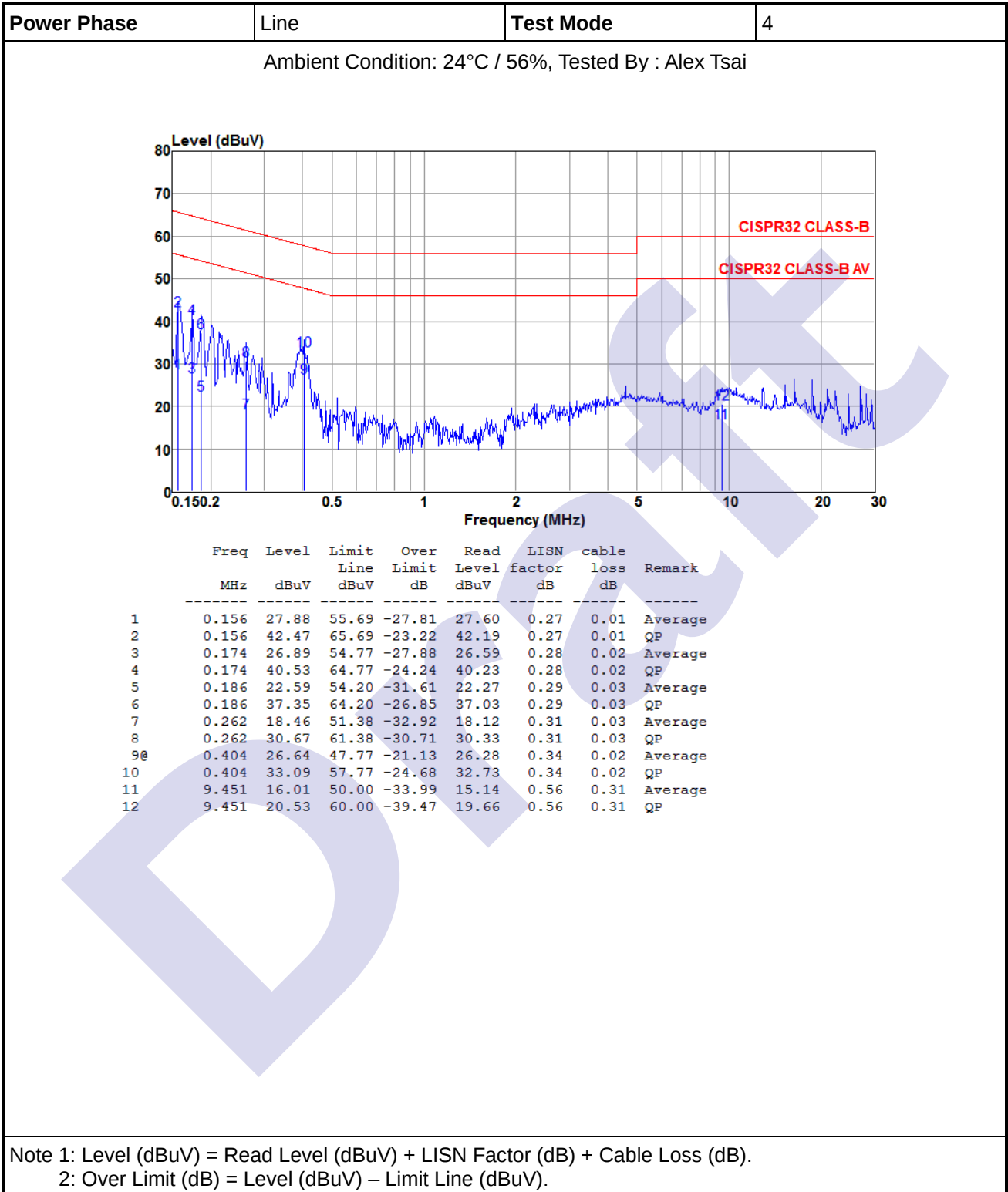


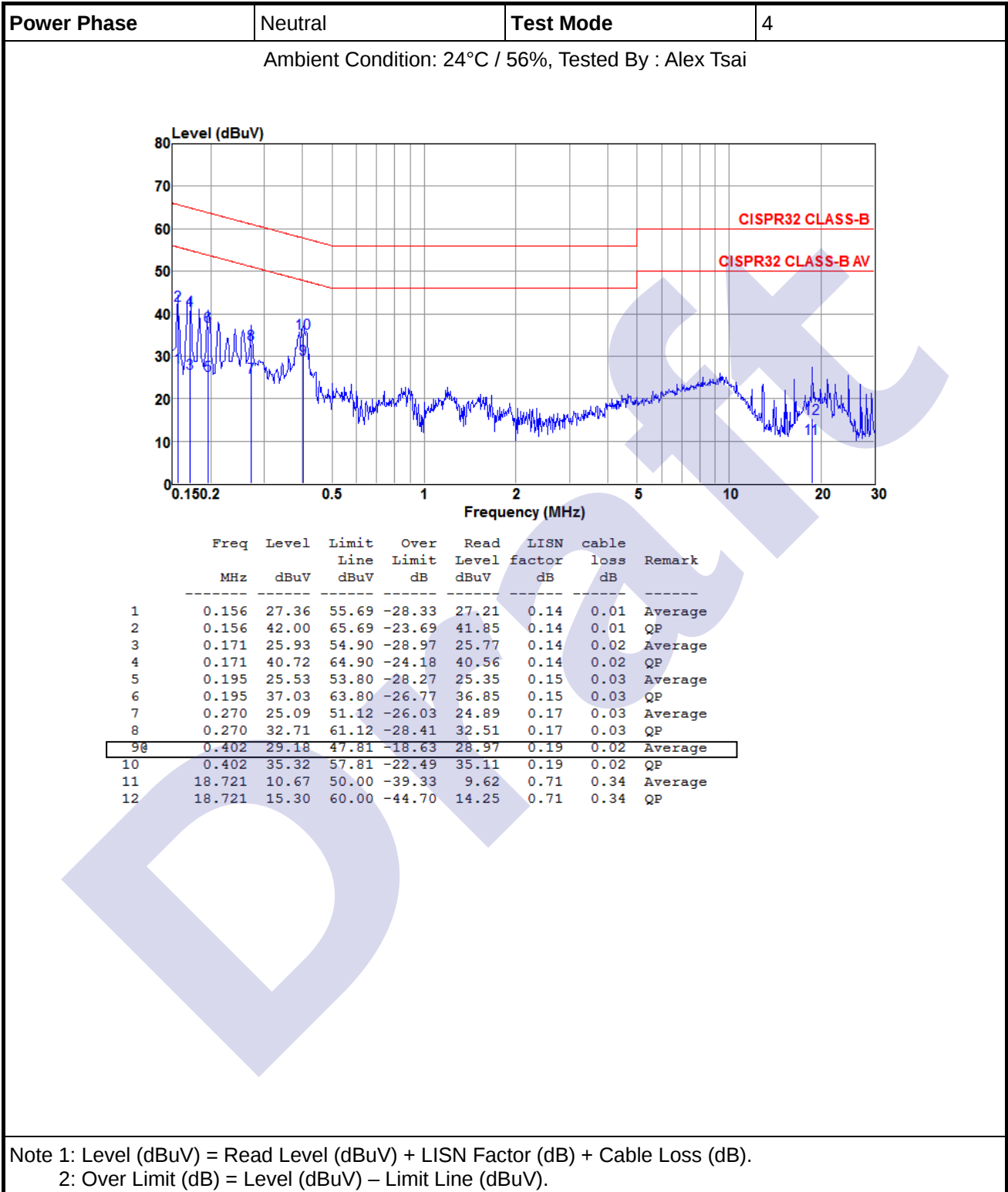


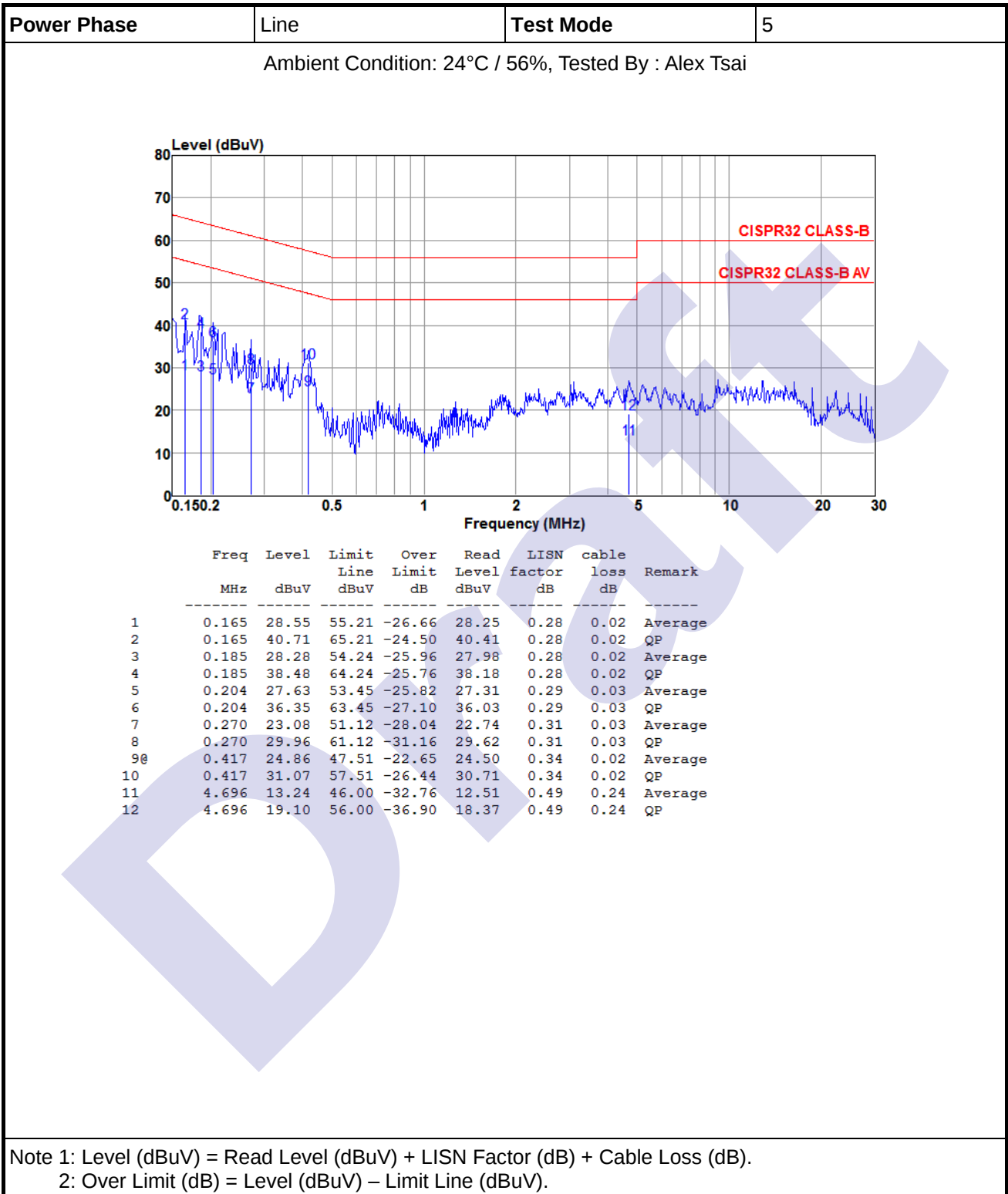


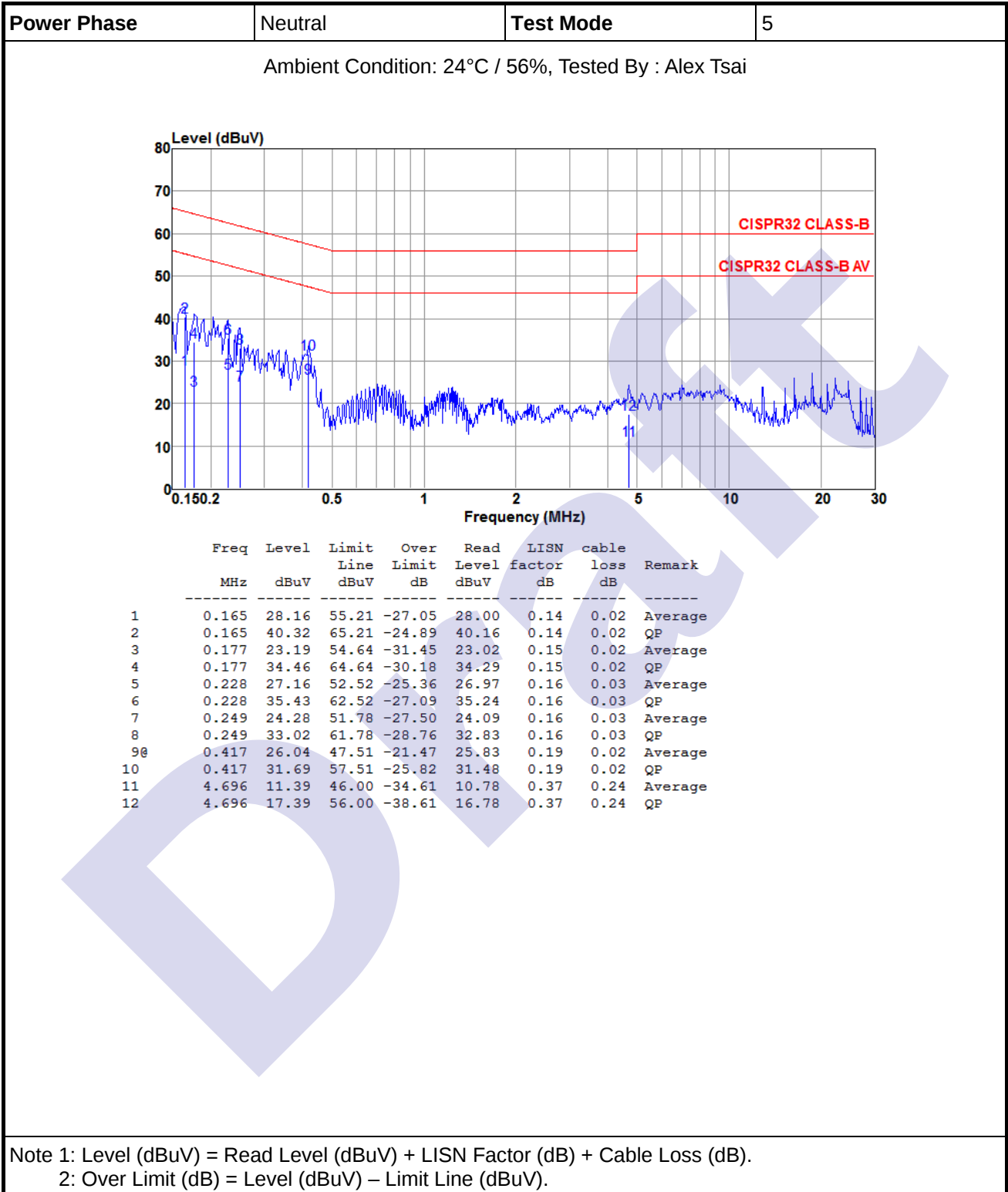


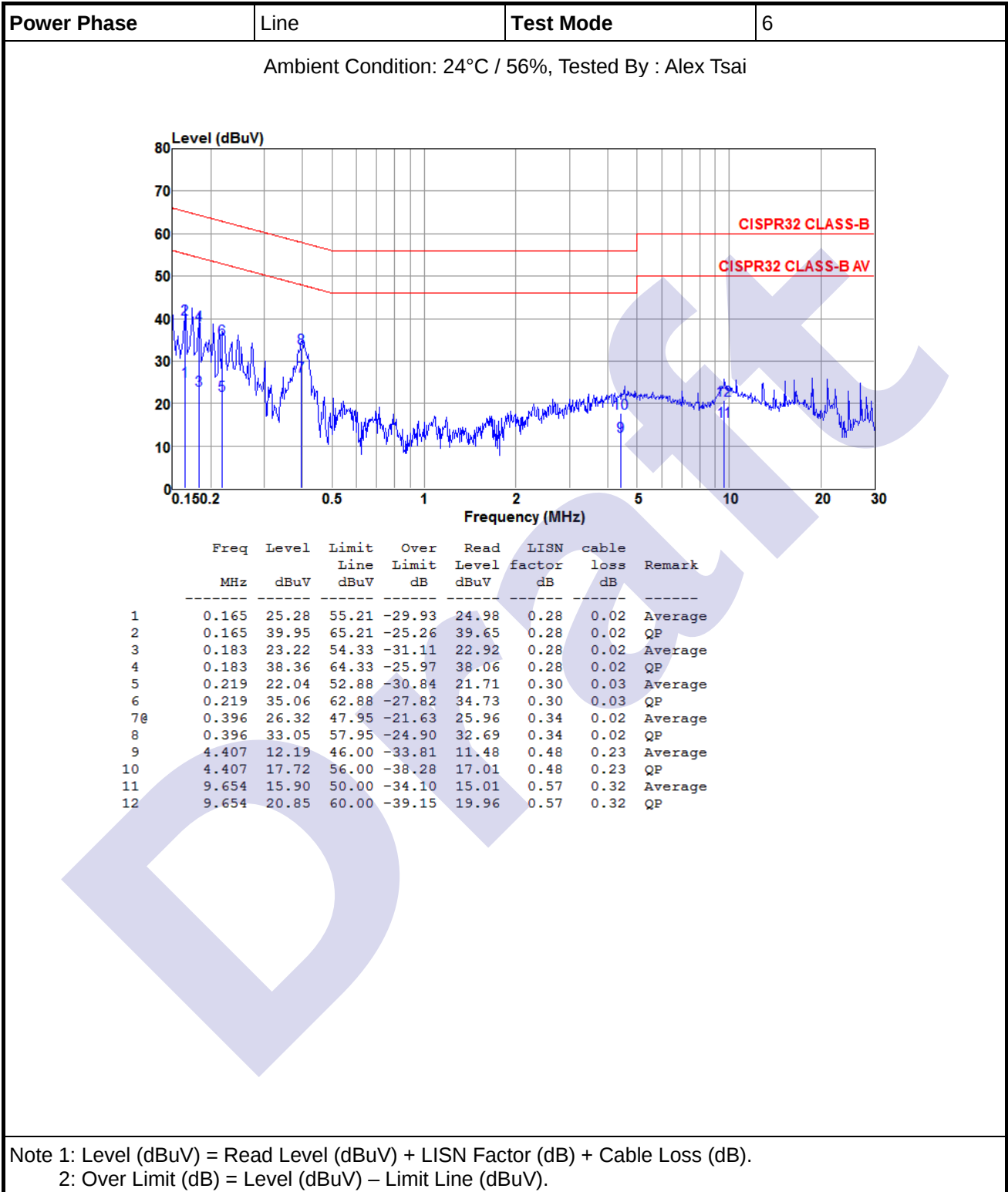






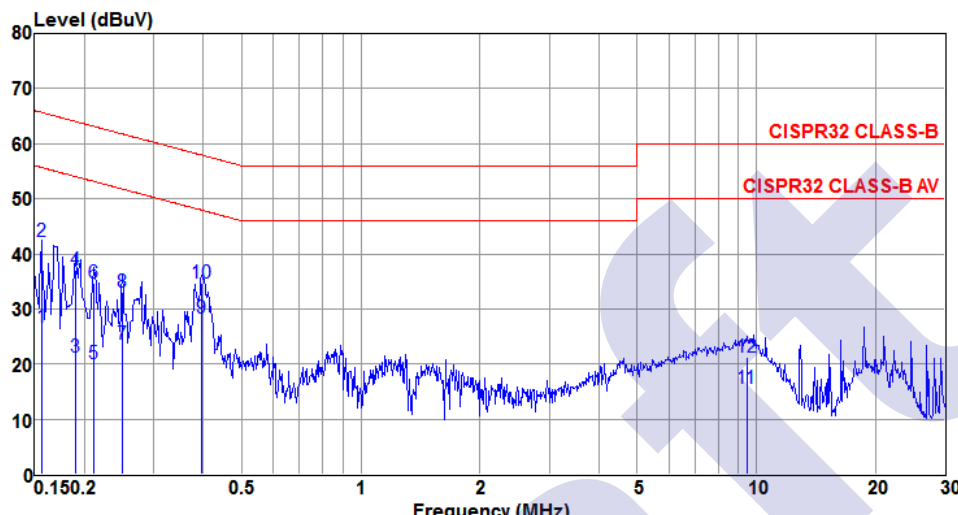






Power Phase	Neutral	Test Mode	6
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Ambient Condition: 24°C / 56%, Tested By : Alex Tsai



	Freq	Level	Limit	Over	Read	LISN	cable	Remark
	MHz	dBuV	dBuV	dB	dBuV	factor	loss	
1	0.156	26.63	55.69	-29.06	26.48	0.14	0.01	Average
2	0.156	42.18	65.69	-23.51	42.03	0.14	0.01	QP
3	0.189	21.21	54.06	-32.85	21.03	0.15	0.03	Average
4	0.189	36.96	64.06	-27.10	36.78	0.15	0.03	QP
5	0.211	19.99	53.18	-33.19	19.81	0.15	0.03	Average
6	0.211	34.75	63.18	-28.43	34.57	0.15	0.03	QP
7	0.249	23.63	51.78	-28.15	23.44	0.16	0.03	Average
8	0.249	33.15	61.78	-28.63	32.96	0.16	0.03	QP
9	0.396	28.38	47.95	-19.57	28.17	0.19	0.02	Average
10	0.396	34.65	57.95	-23.30	34.44	0.19	0.02	QP
11	9.451	15.50	50.00	-34.50	14.74	0.45	0.31	Average
12	9.451	21.28	60.00	-38.72	20.52	0.45	0.31	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.

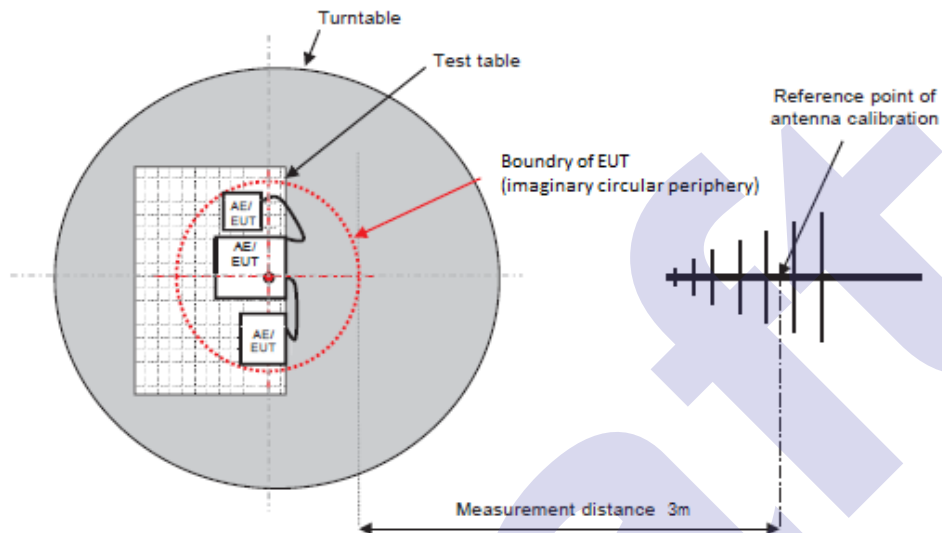
The highest internal source of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes.	Upper frequency of measurement range
Below 108 MHz	1 GHz
108 MHz to 500 MHz	2 GHz
500 MHz to 1 GHz	5 GHz
Above 1 GHz	5 times the highest frequency or 6 GHz,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

3.2.2 Test Procedures

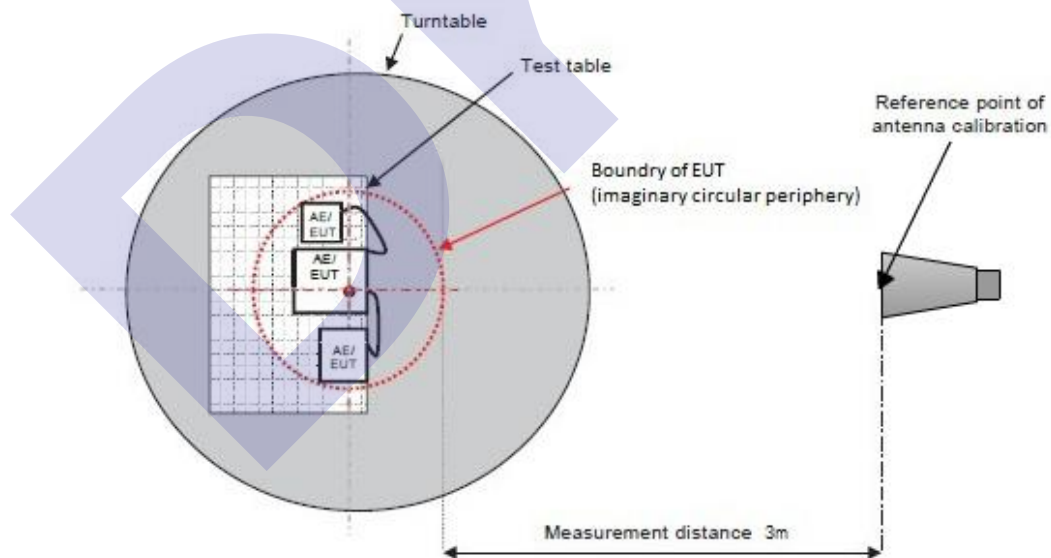
- a. The EUT was placed on a rotatable table top with a height of 0.8 meters which is placed on the ground plane.
- b. A thickness of $\leq 0.15\text{m}$ insulation should be placed between local AE and associated cabling and the RGP.
- c. The EUT received DC power source from the outlet socket under 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

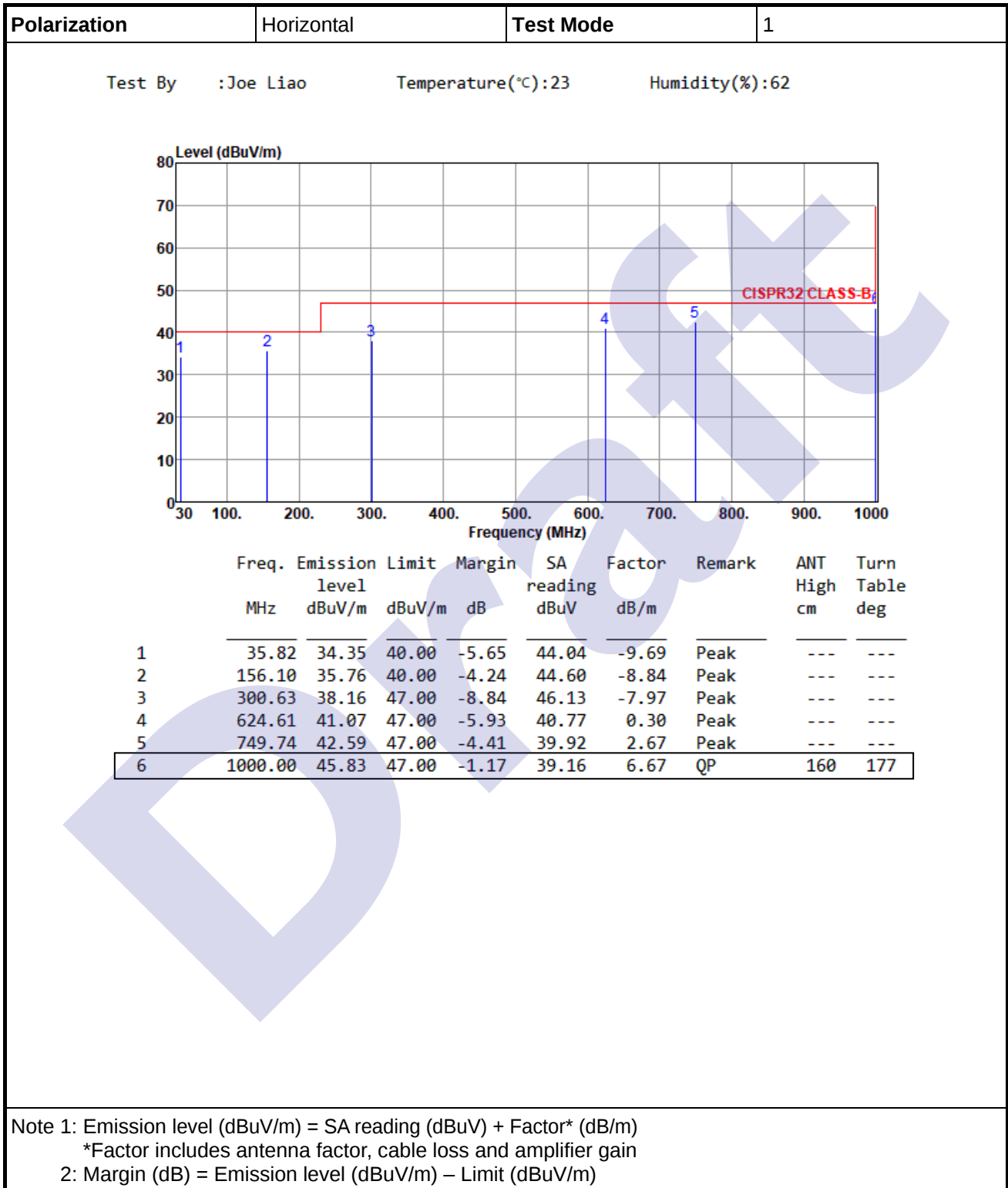
Radiated Emissions below 1GHz



Radiated Emissions above 1GHz



3.2.4 Radiated Emissions (Below 1GHz)

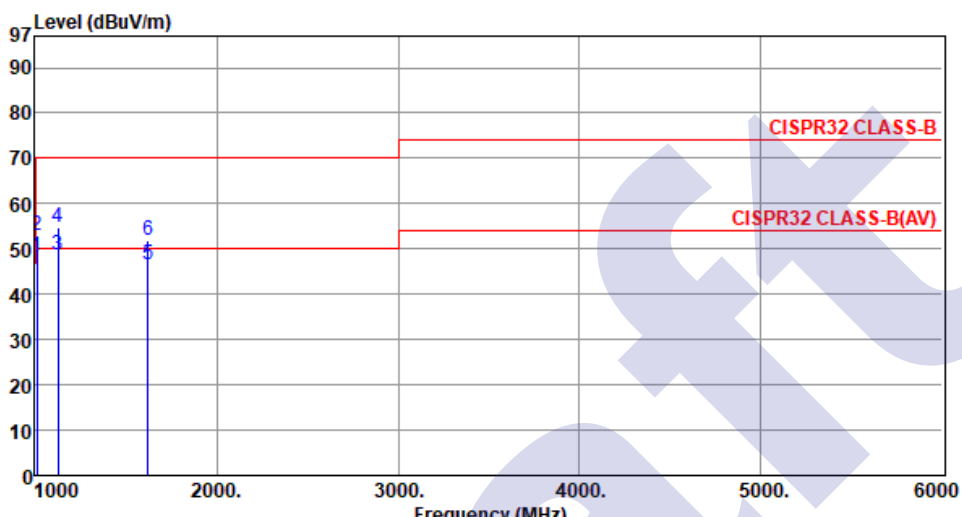


Polarization	Vertical	Test Mode	1
Test By :Joe Liao Temperature(°C):23 Humidity(%):62			
Level (dBuV/m) </			

3.2.5 Radiated Emissions (Above 1GHz)

Polarization	Horizontal	Test Mode	1
Test By	:Joe Liao	Temperature(°C):23	Humidity(%):62

Level (dBuV/m)



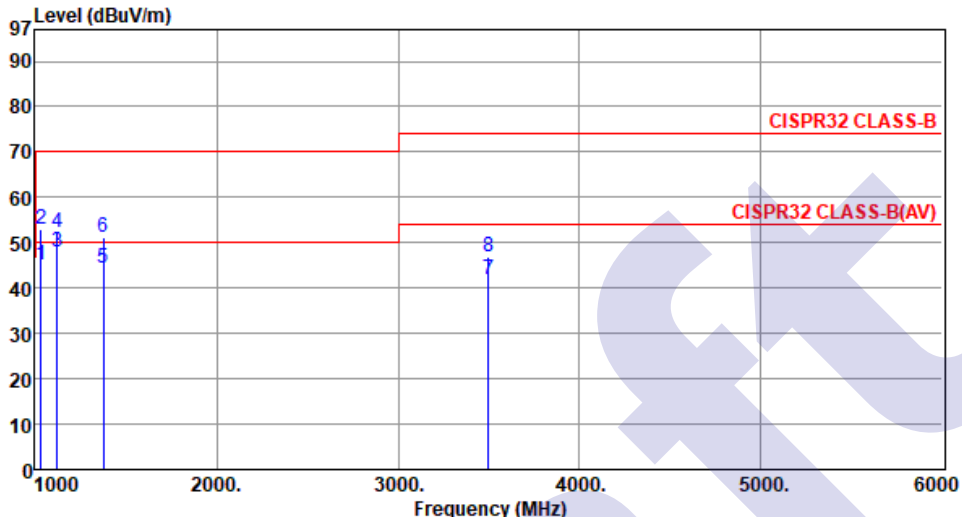
Frequency (MHz)

	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	1011.60	48.28	50.00	-1.72	57.20	-8.92	Average	100	221
2	1011.60	53.08	70.00	-16.92	62.00	-8.92	Peak	100	221
3	1124.60	48.72	50.00	-1.28	56.79	-8.07	Average	100	91
4	1124.60	54.72	70.00	-15.28	62.79	-8.07	Peak	100	91
5	1624.30	46.46	50.00	-3.54	53.67	-7.21	Average	160	345
6	1624.30	51.93	70.00	-18.07	59.14	-7.21	Peak	160	345

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	:Joe Liao	Temperature(°C):23	Humidity(%):62

Level (dBUV/m)



Frequency (MHz)

	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	1033.40	45.03	50.00	-4.97	53.76	-8.73	Average	152	77
2	1033.40	53.09	70.00	-16.91	61.82	-8.73	Peak	152	77
3	1124.20	48.08	50.00	-1.92	56.15	-8.07	Average	100	231
4	1124.20	52.29	70.00	-17.71	60.36	-8.07	Peak	100	231
5	1374.60	44.32	50.00	-5.68	50.86	-6.54	Average	126	180
6	1374.60	51.24	70.00	-18.76	57.78	-6.54	Peak	126	180
7	3498.60	41.71	54.00	-12.29	42.97	-1.26	Average	100	88
8	3498.60	46.74	74.00	-27.26	48.00	-1.26	Peak	100	88

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)

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.

Note: Operate as intended during the test allows a level of degradation in accordance with clause 6.2.2.

Clause 6.2.2 Minimum performance level
For equipment that supports a PER or FER, the minimum performance level shall be a PER or FER less than or equal to 10%.
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.

4.3 Electrostatic Discharge (ESD)

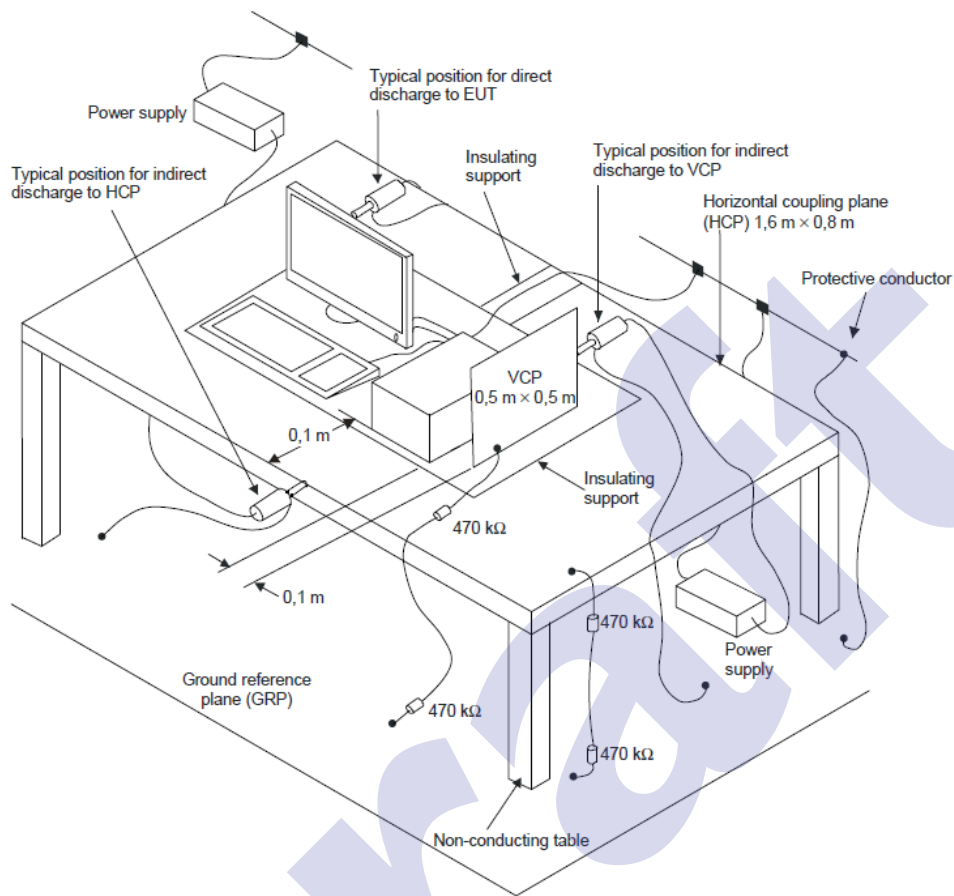
4.3.1 Test Specification of Electrostatic Discharge (ESD)

Basic Standard	EN 61000-4-2
Discharge Voltage	Contact Discharge: ± 2 kV / ± 4 kV / ± 8 kV Air Discharge: ± 2 kV / ± 4 kV / ± 8 kV / ± 15 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.

4.3.3 Test Setup



The test setup shall consist of a non-conductive table, (0.8 ± 0.08) m high, standing on the ground reference plane.

A horizontal coupling plane (HCP), (1.6 ± 0.02) m $\times$ (0.8 ± 0.02) m, shall be placed on the table. The EUT and its cables shall be isolated from the coupling plane by an insulating support (0.5 ± 0.05) mm in thickness.

4.3.4 Test Result of Electrostatic Discharge (ESD)

Test Site	ES01-WS	Ambient Condition	25°C/50%/100kPa
Tested By	JN Chen		

Test Mode	1, 7				
Direct Application					
Test Voltage (kV)	Polarity	Test Point	Contact Discharge	Air Discharge	Performance Criteria
2, 4, 8, 15	+/-	1	N/A	Note*	A
2, 4, 8	+/-	2	Note*	N/A	A
Indirect Application					
Test Voltage (kV)	Polarity	Test Point	Horizontal Coupling Plane (HCP)	Vertical Coupling Plane (VCP)	Performance Criteria
2, 4, 8	+/-	At front, rear, left and right side	Note*	Note*	A

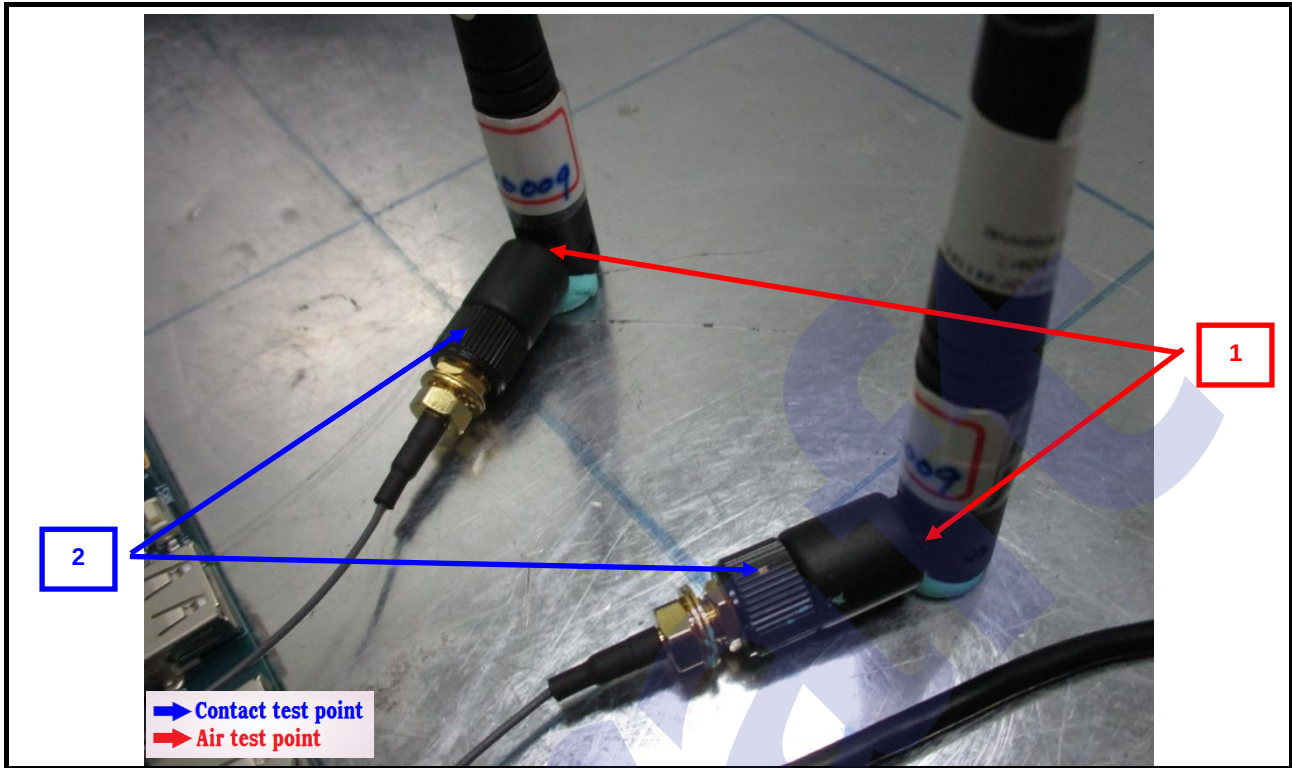
Note: There was no abnormal situation during the test compared with initial operation.

“*”: Test method reported herein was performed according to the method specified by applicant.

Test Mode	2 ~ 6				
Indirect Application					
Test Voltage (kV)	Polarity	Test Point	Horizontal Coupling Plane (HCP)	Vertical Coupling Plane (VCP)	Performance Criteria
2, 4, 8	+/-	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



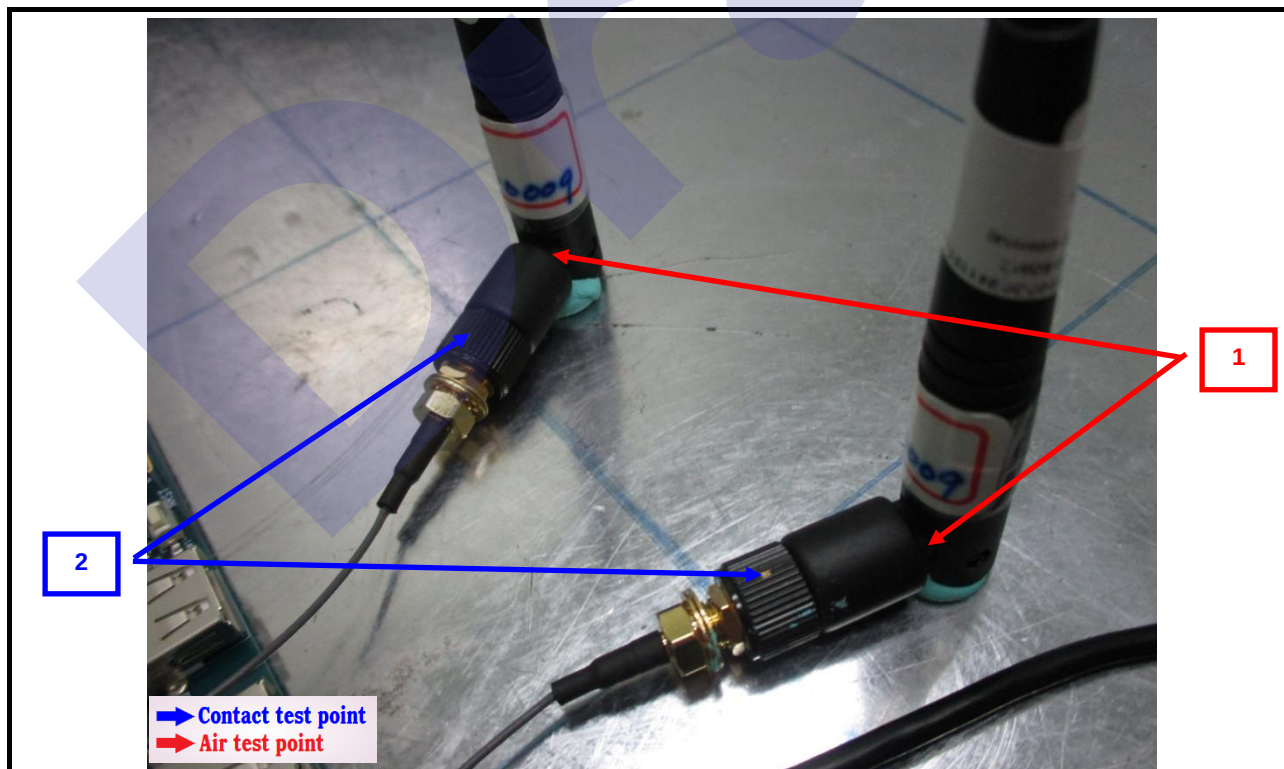
Test Site	ES01-WS	Ambient Condition	24°C/51%/101kPa
Tested By	JN Chen		

Test Mode	8				
Direct Application					
Test Voltage (kV)	Polarity	Test Point	Contact Discharge	Air Discharge	Performance Criteria
2, 4, 8, 15	+/-	1	N/A	Note*	A
2, 4, 8	+/-	2	Note*	N/A	A
Indirect Application					
Test Voltage (kV)	Polarity	Test Point	Horizontal Coupling Plane (HCP)	Vertical Coupling Plane (VCP)	Performance Criteria
2, 4, 8	+/-	At front, rear, left and right side	Note*	Note*	A

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

“*”: Test method reported herein was performed according to the method specified by applicant.

4.3.6 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:

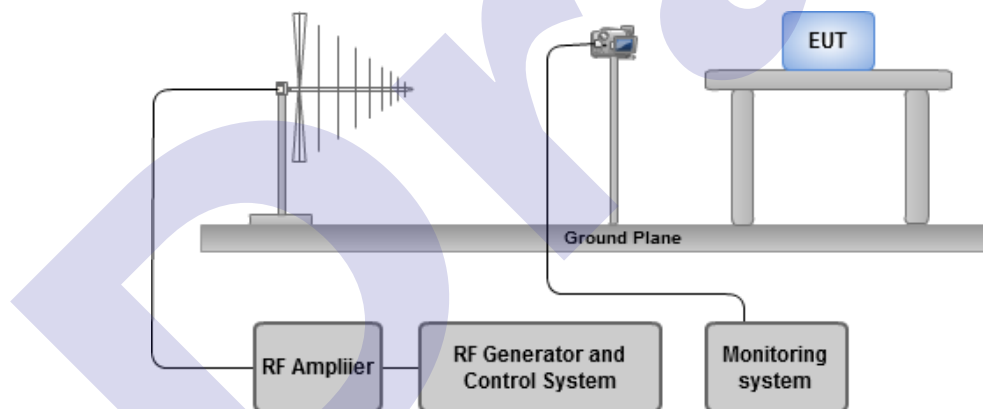
- lower limit of exclusion band = lowest allocated band edge frequency -270 MHz, i.e. 4 880 MHz;
- upper limit of exclusion band = highest allocated band edge frequency +270 MHz, i.e. 5 995 MHz.

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	26°C/60%/100kPa
Tested By	JN Chen		

Test Mode	1 ~ 7				
Frequency Range (MHz)	Azimuth	Polarity	Test Field Strength (V/m)	Observation	Performance Criteria
80 – 6000	0	V&H	3	Note	A
80 – 6000	90	V&H	3	Note	A
80 – 6000	180	V&H	3	Note	A
80 – 6000	270	V&H	3	Note	A

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

Test Site	RS01-WS	Ambient Condition	24°C/61%/101kPa
Tested By	JN Chen		

Test Mode	8				
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 WiFi PER shall be less than or equal to 10%.

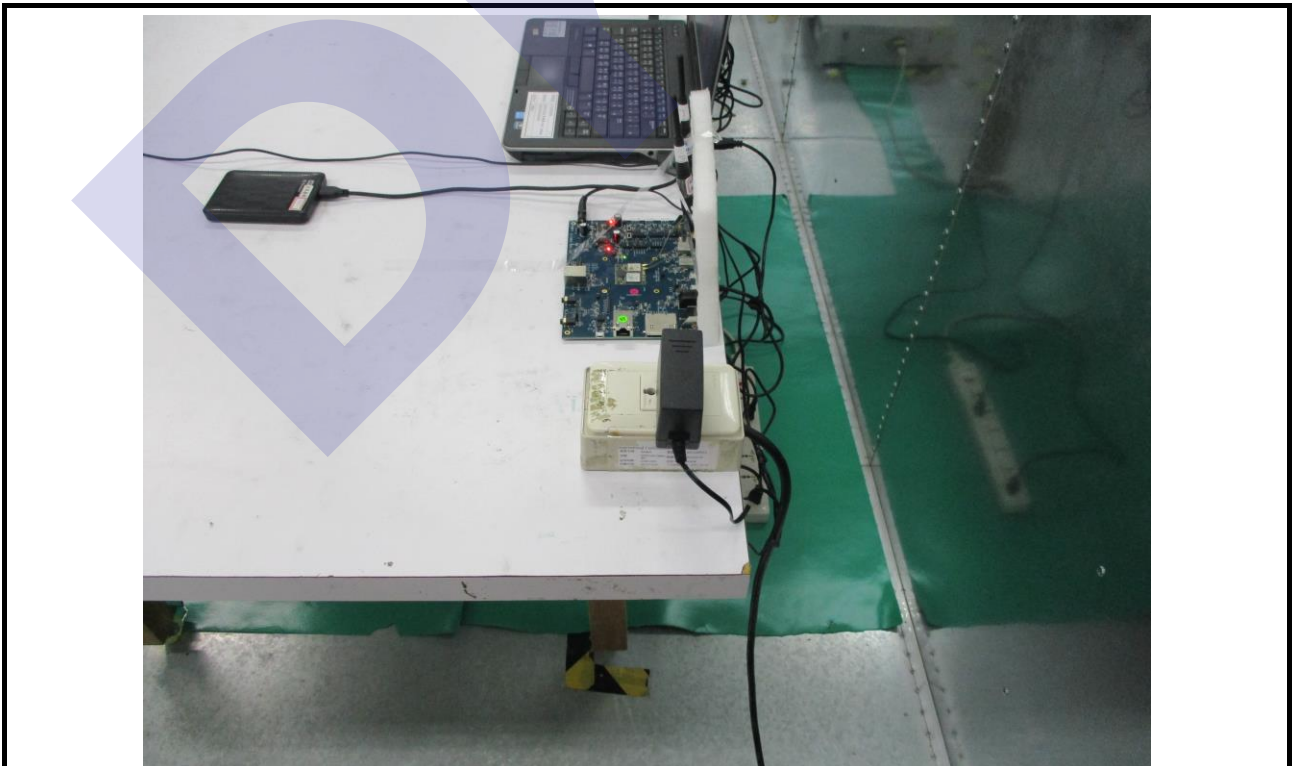
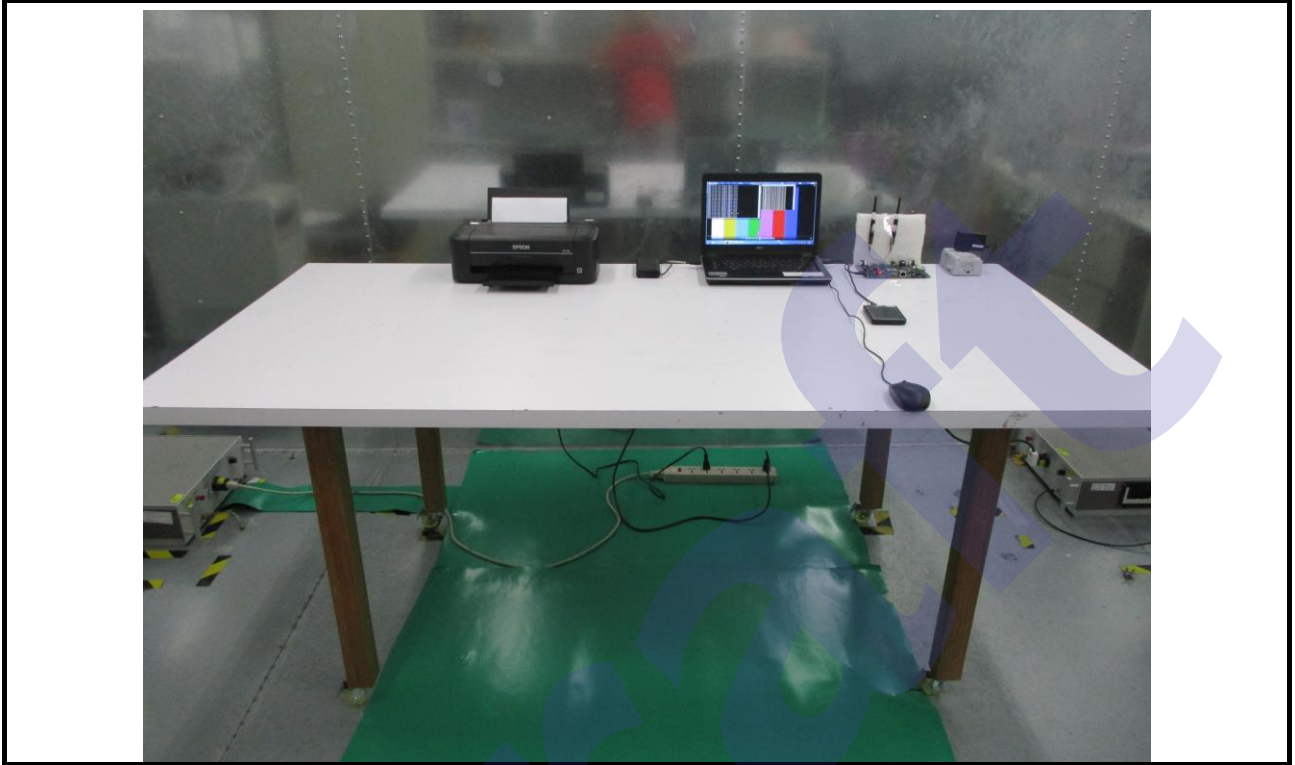
Test Mode	9				
Frequency Range (MHz)	Azimuth	Polarity	Test Field Strength (V/m)	Observation	Performance Criteria
80 - 6000	0	V&H	3	Note 1, 2	A
80 - 6000	90	V&H	3	Note 1, 2	A
80 - 6000	180	V&H	3	Note 1, 2	A
80 - 6000	270	V&H	3	Note 1, 2	A

Note:

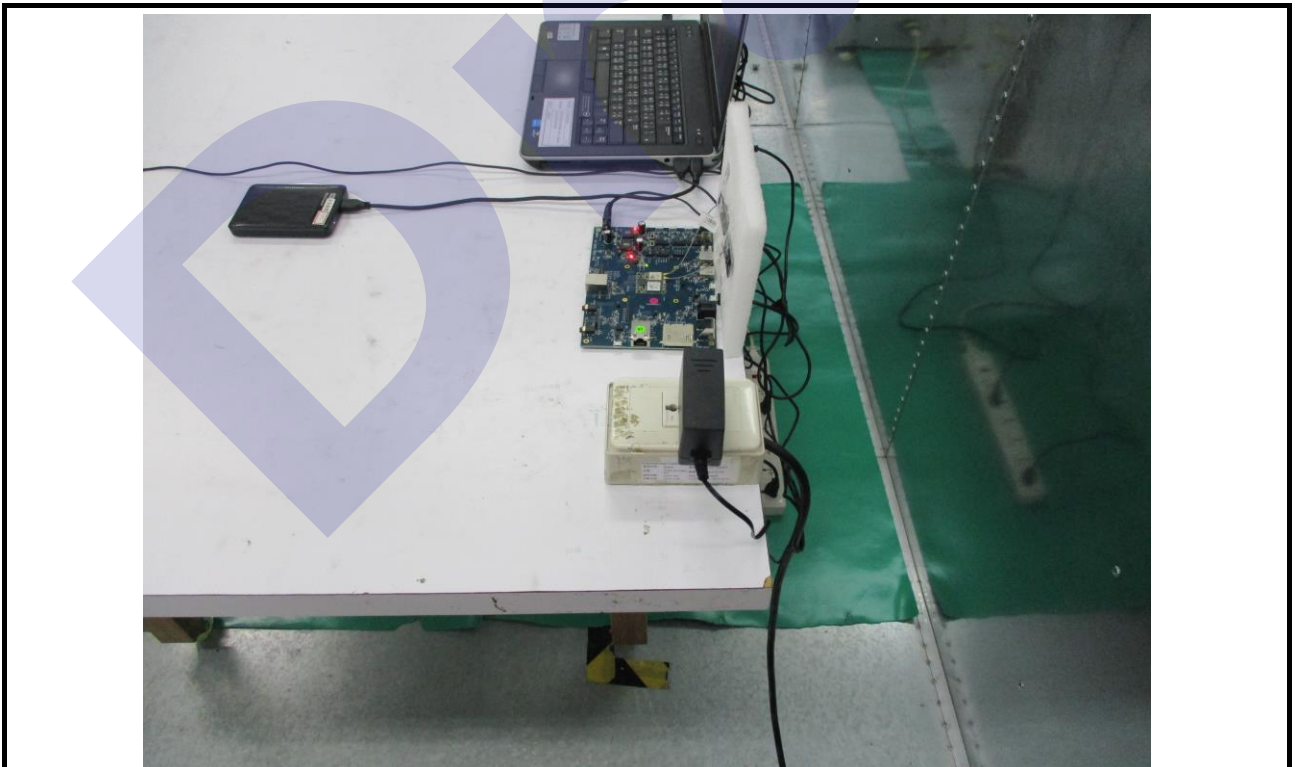
- 1) There was no abnormal situation during the test compared with initial operation.
- 2) The BT PER shall be less than or equal to 10%.

5 Photographs of the Test Configuration

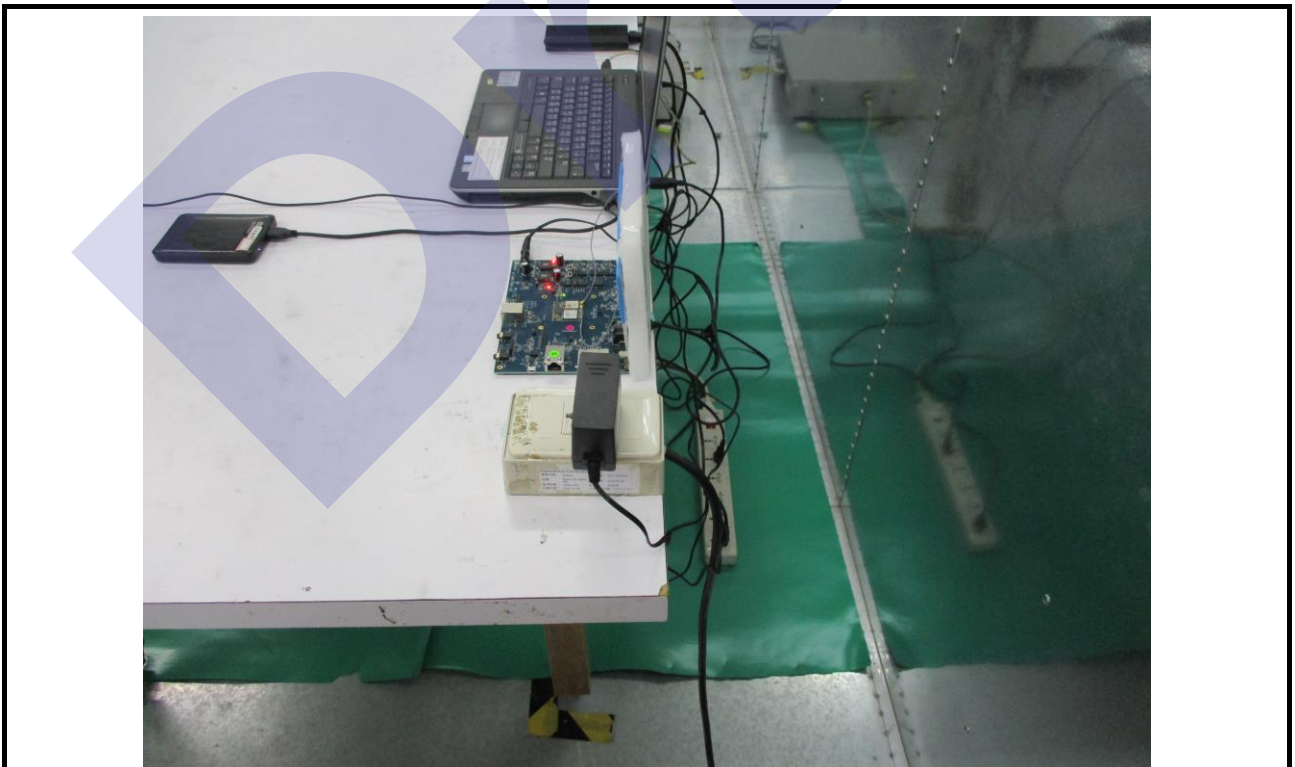
Conducted Emissions from the AC mains power ports (Antenna: 001-0009) (Test Mode 1)



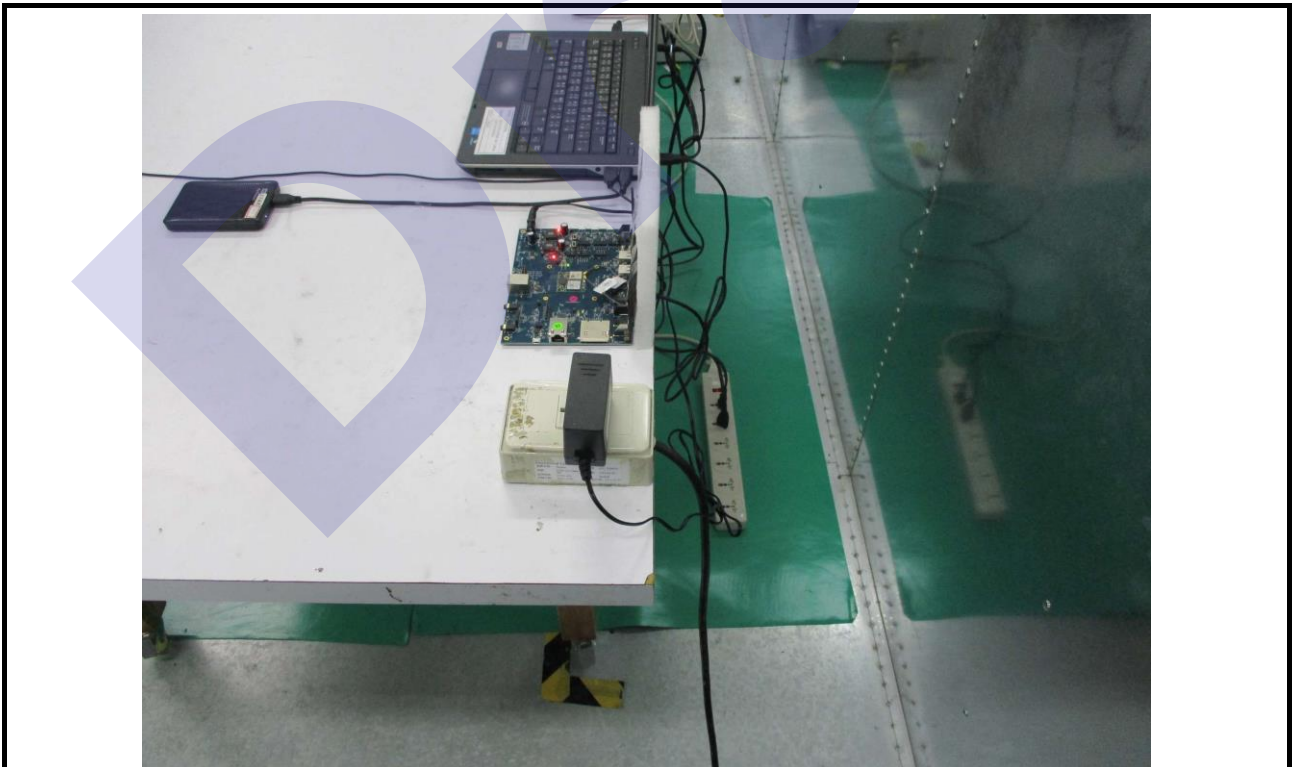
Conducted Emissions from the AC mains power ports (Antenna: NanoBlade-IP04) (Test Mode 2)



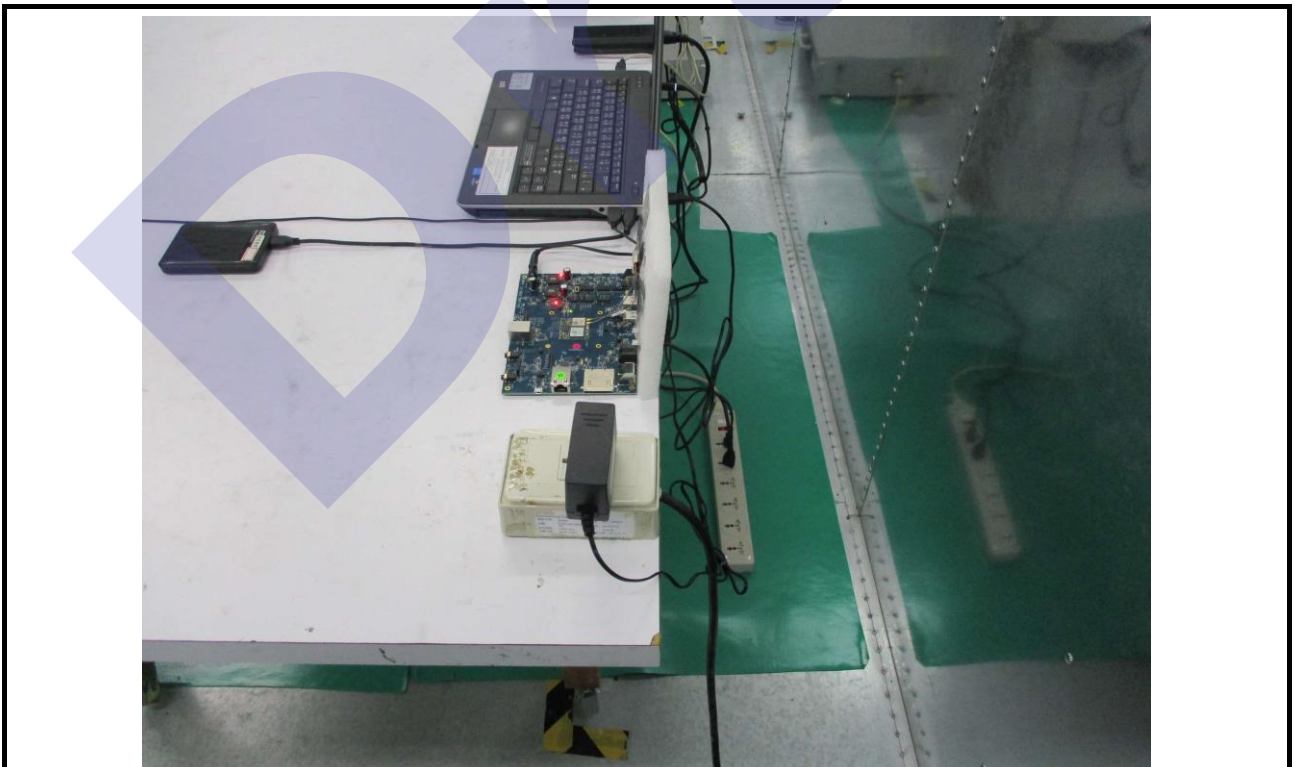
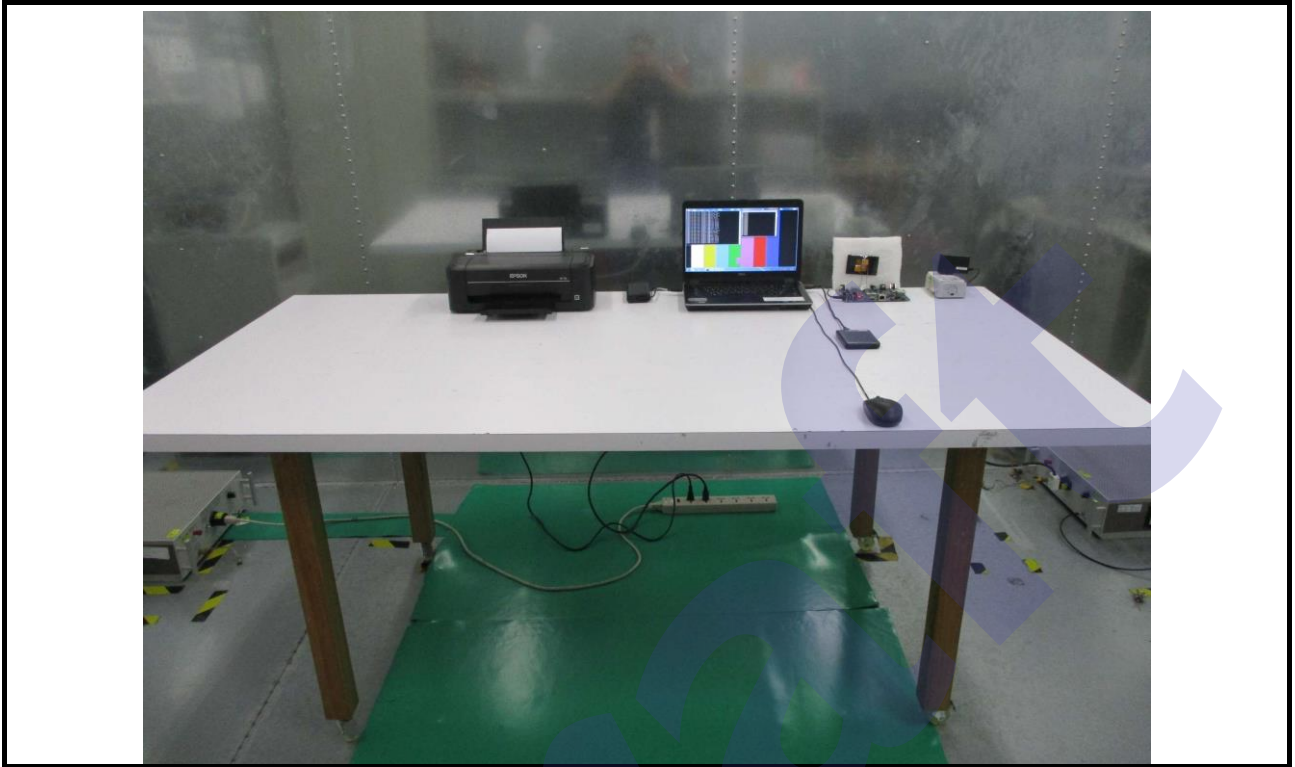
**Conducted Emissions from the AC mains power ports (Antenna: MAF95310 Mini NanoBlade Flex)
(Test Mode 3)**



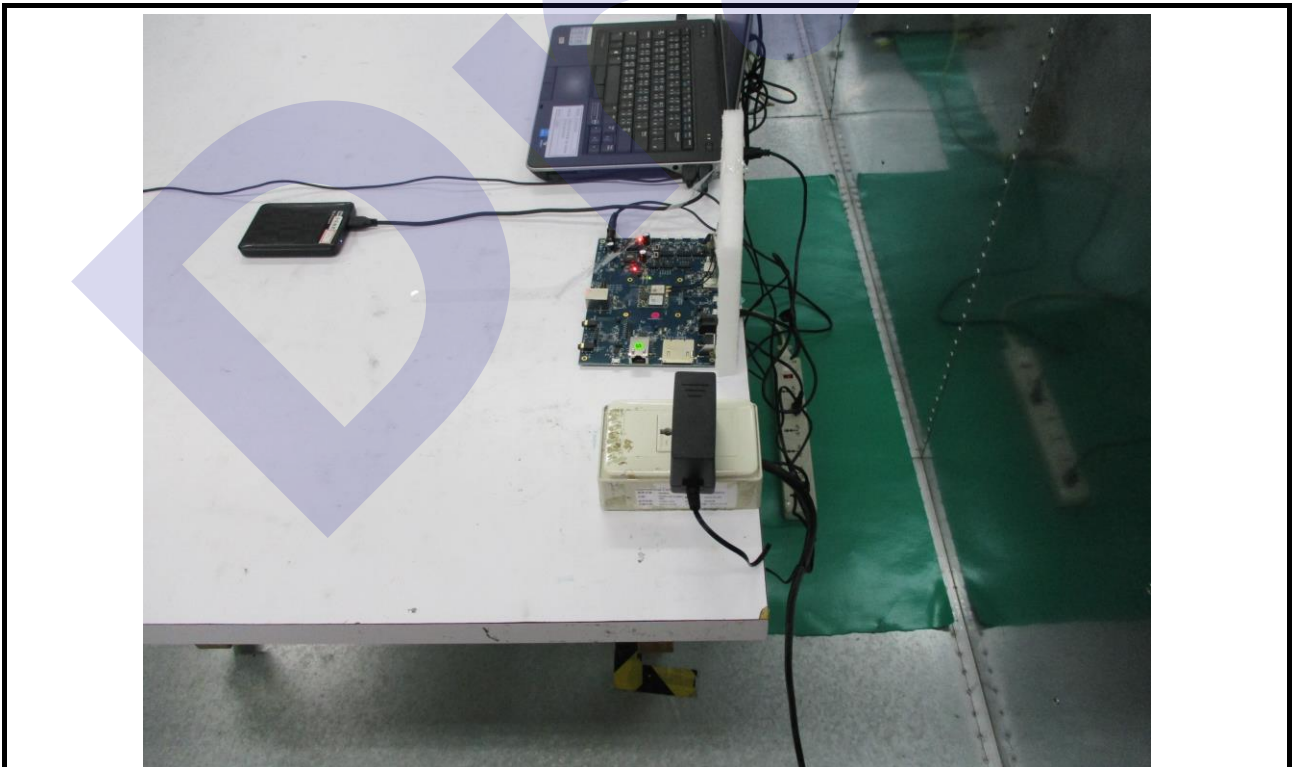
Conducted Emissions from the AC mains power ports (Antenna: FlexPIFA 001-0016) (Test Mode 4)



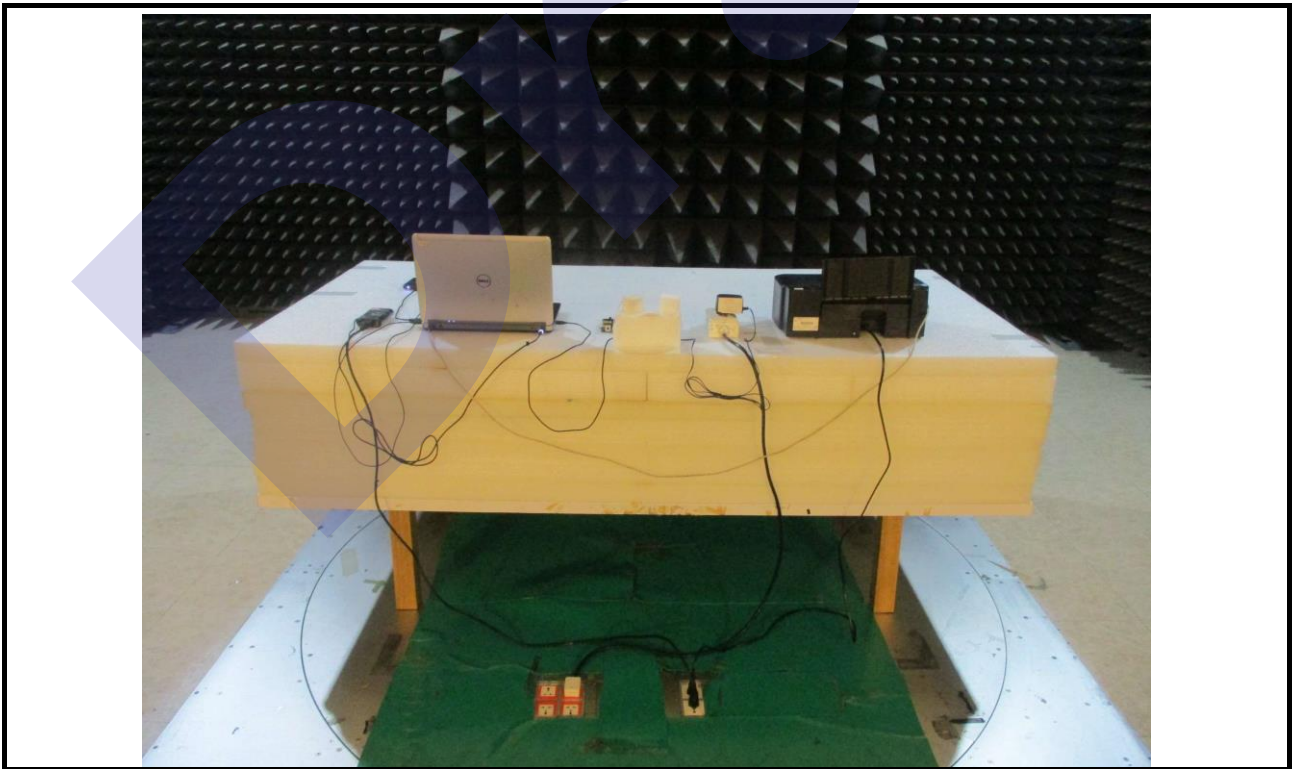
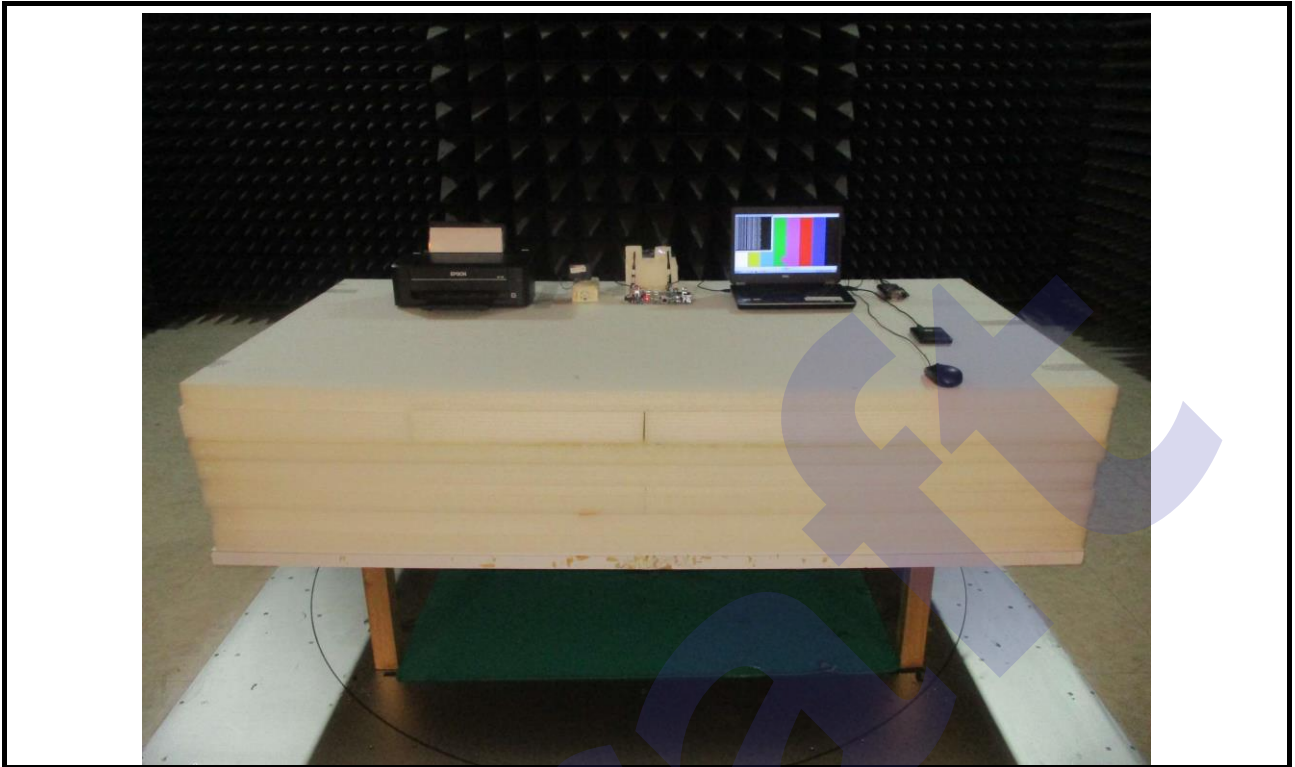
**Conducted Emissions from the AC mains power ports (Antenna: MIMO FlexPIFA Antenna)
(Test Mode 5)**



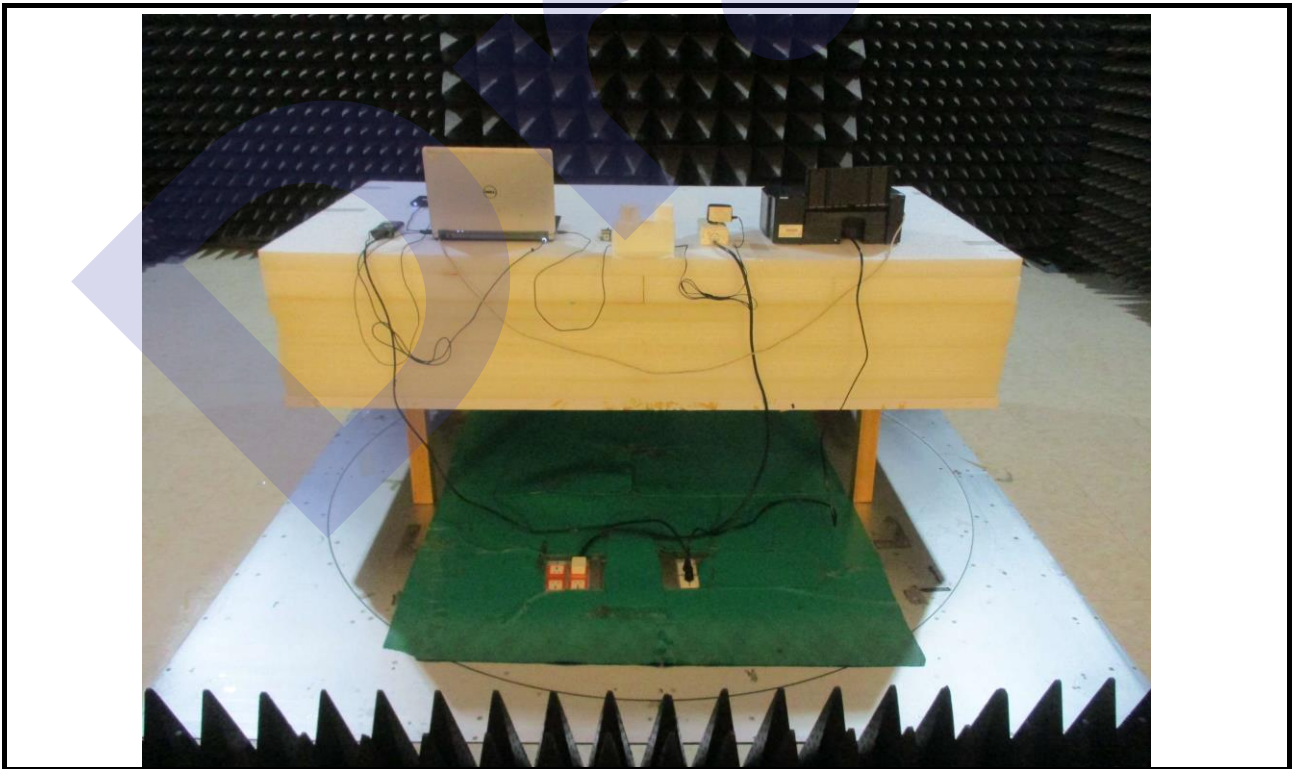
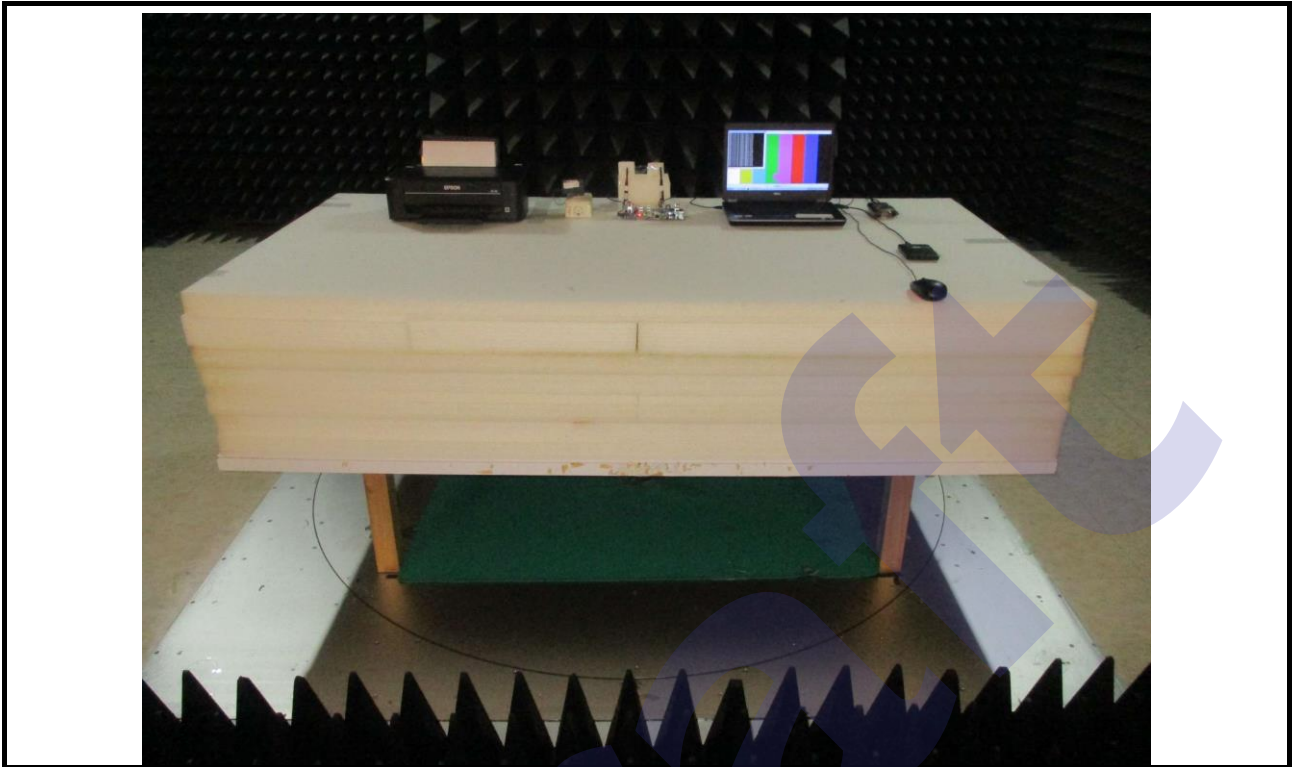
Conducted Emissions from the AC mains power ports (Antenna: WLAN_1000146) (Test Mode 6)



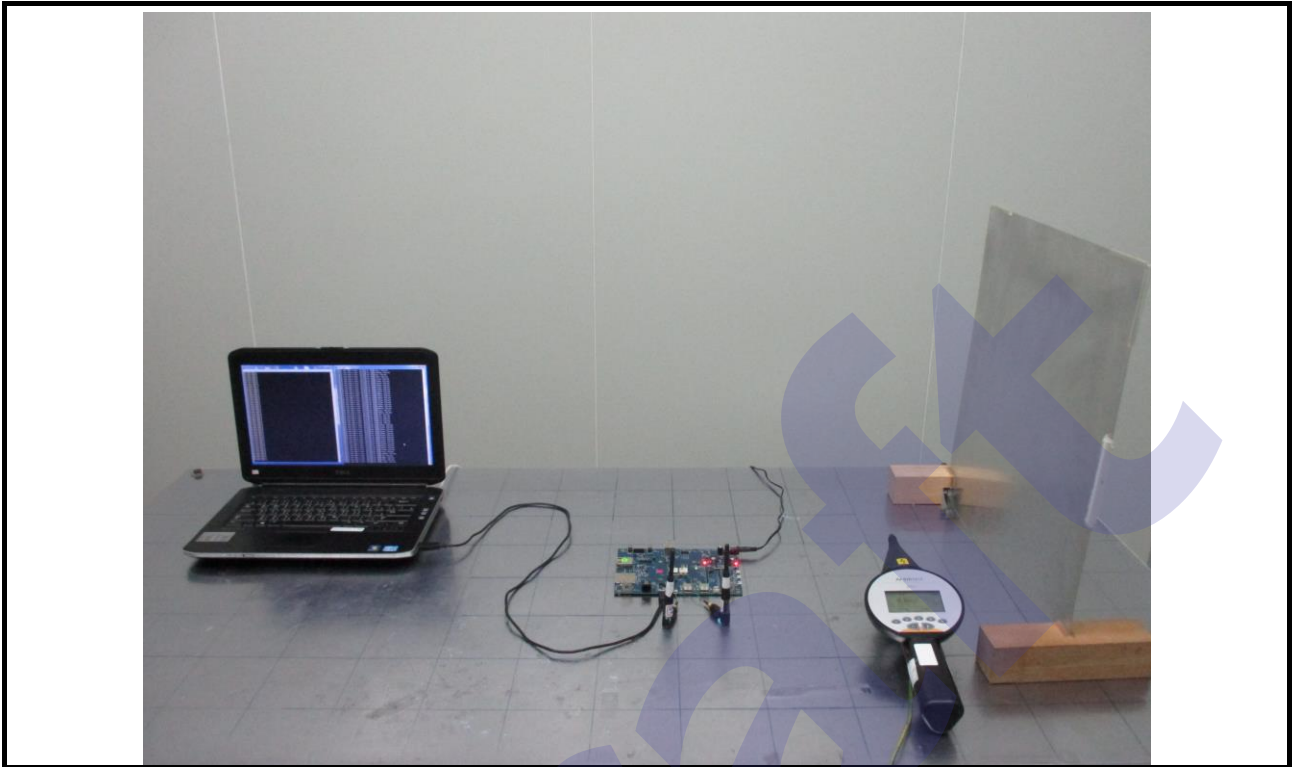
Radiated Emissions below 1GHz test



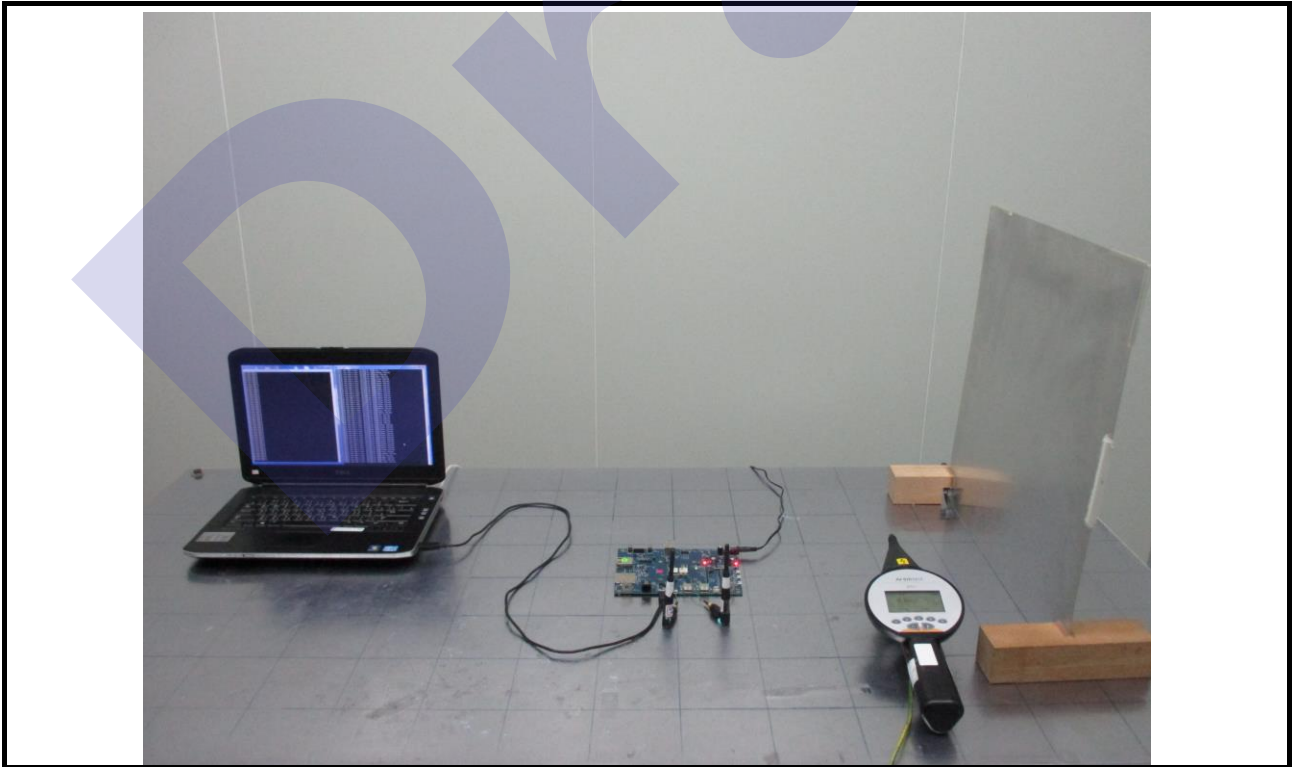
Radiated Emissions above 1GHz test



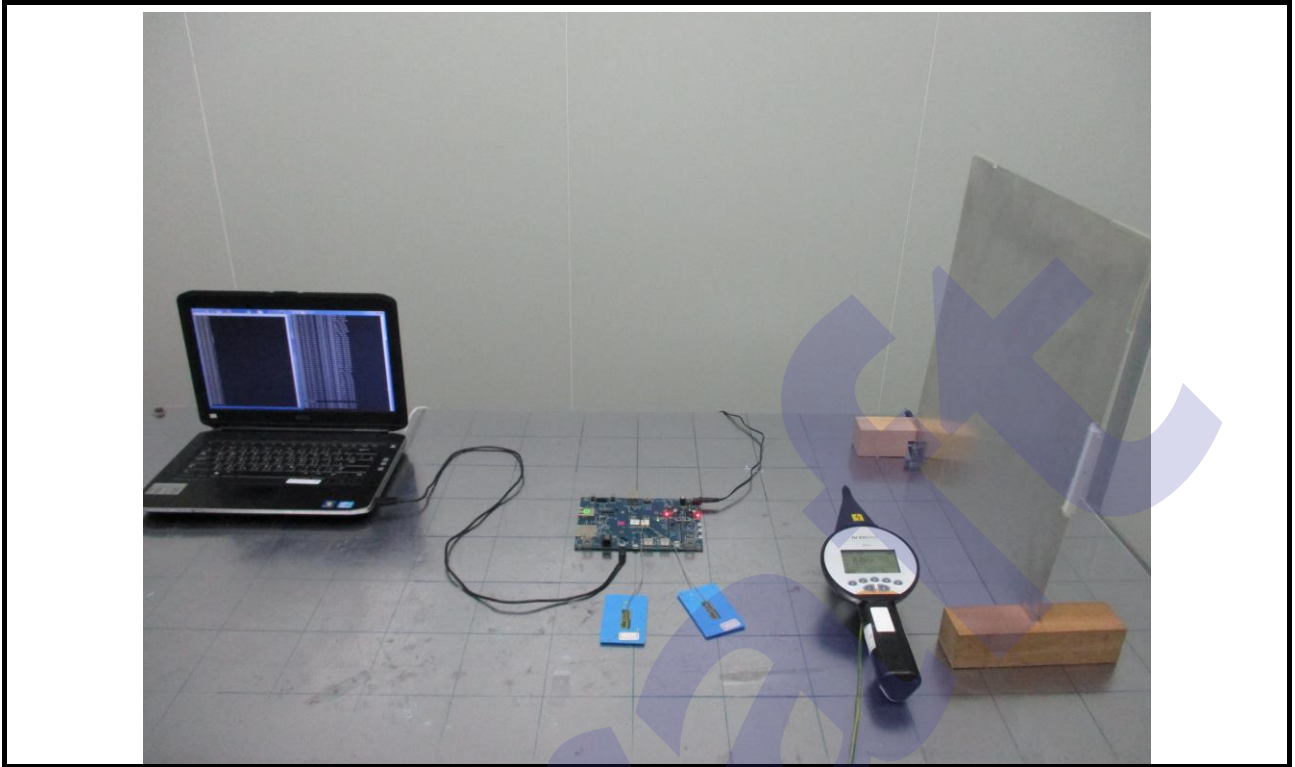
ESD Test (Antenna: 001-0009) (Test Mode 1)



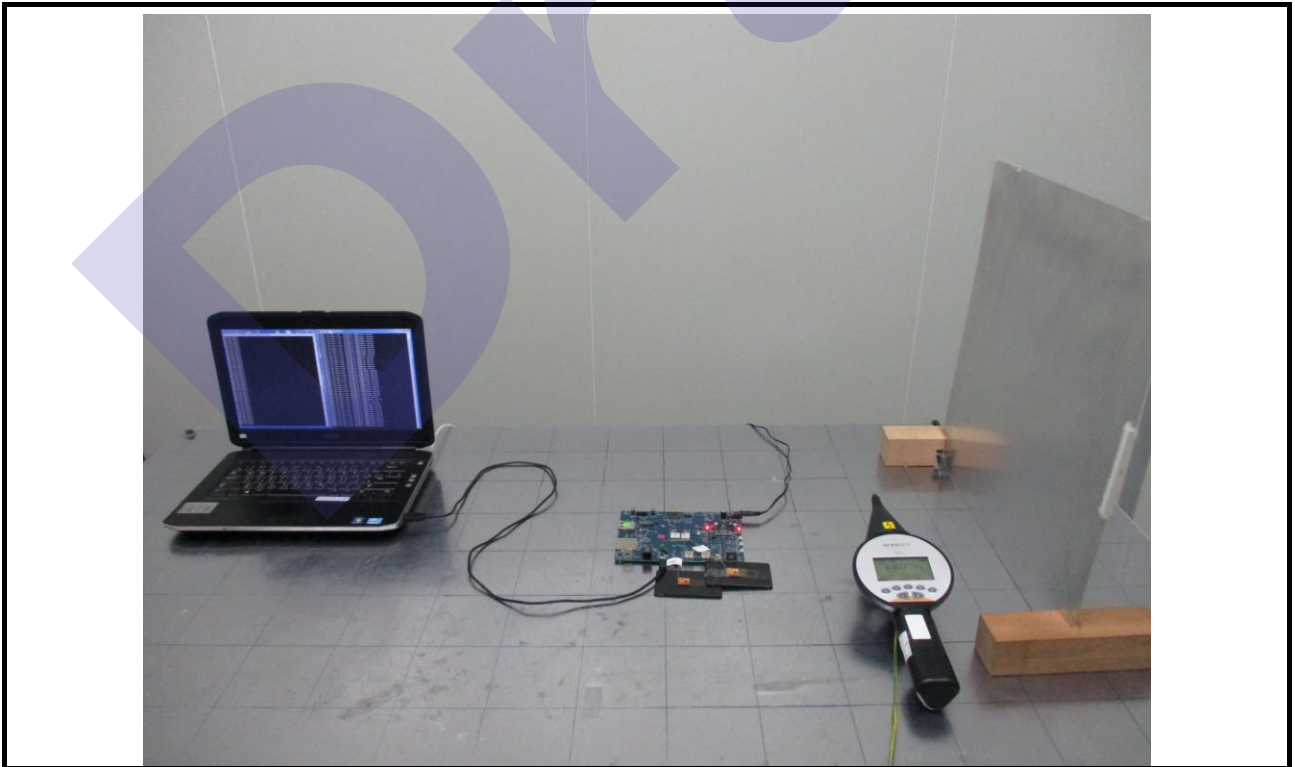
ESD Test (Antenna: NanoBlade-IP04) (Test Mode 2)



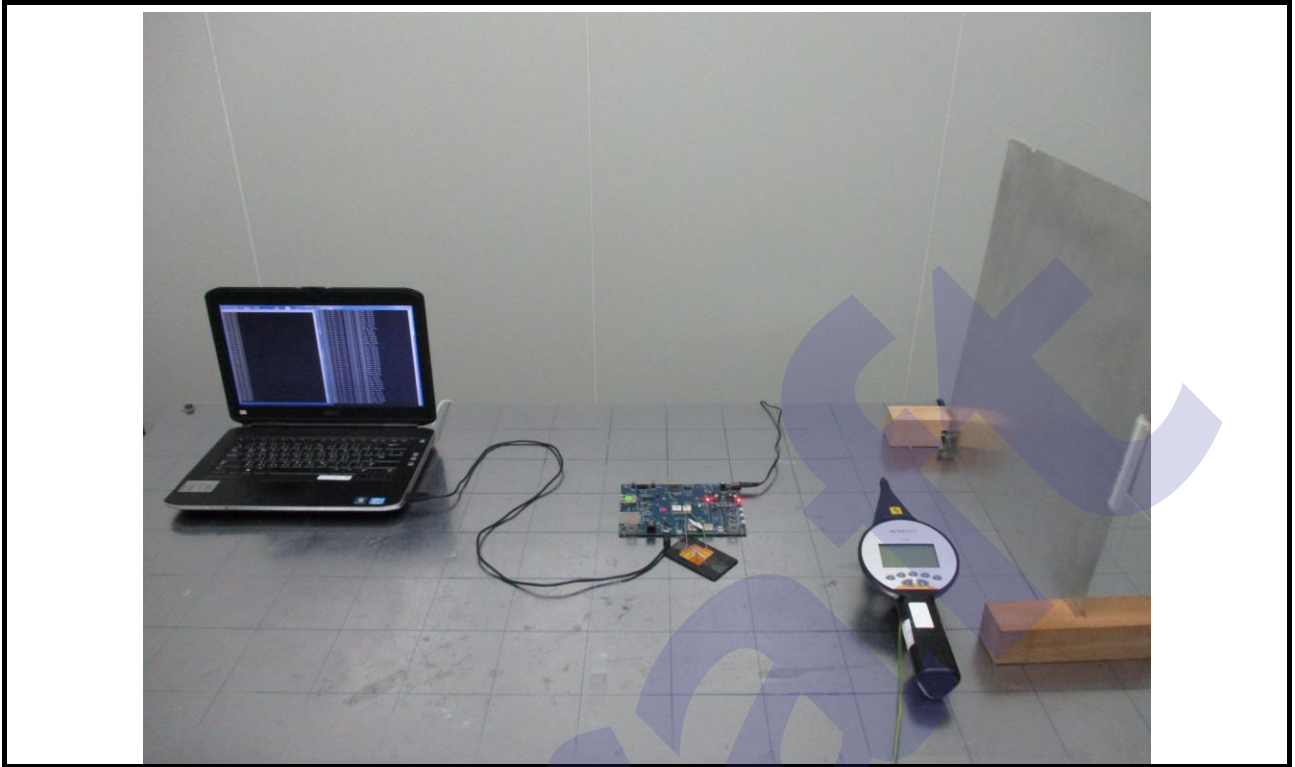
ESD Test (Antenna: MAF95310 Mini NanoBlade Flex) (Test Mode 3)



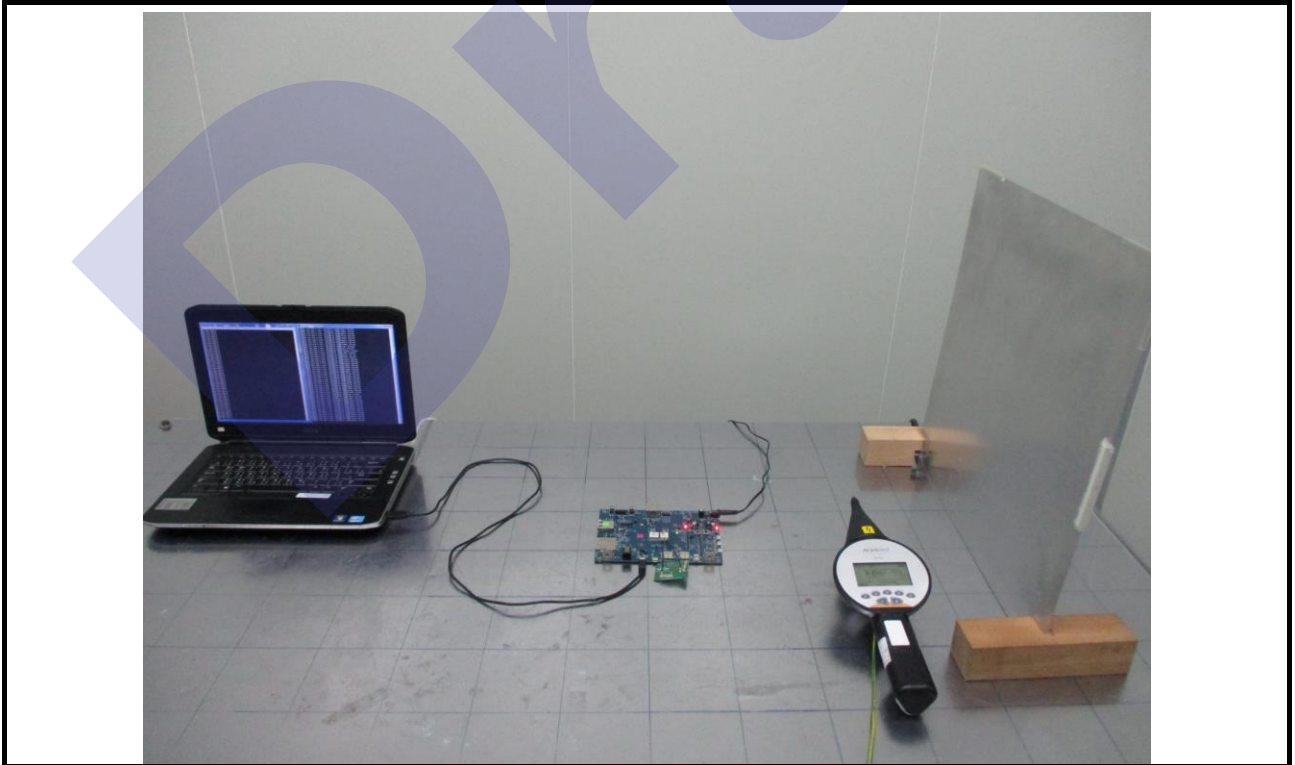
ESD Test (Antenna: FlexPIFA 001-0016) (Test Mode 4)



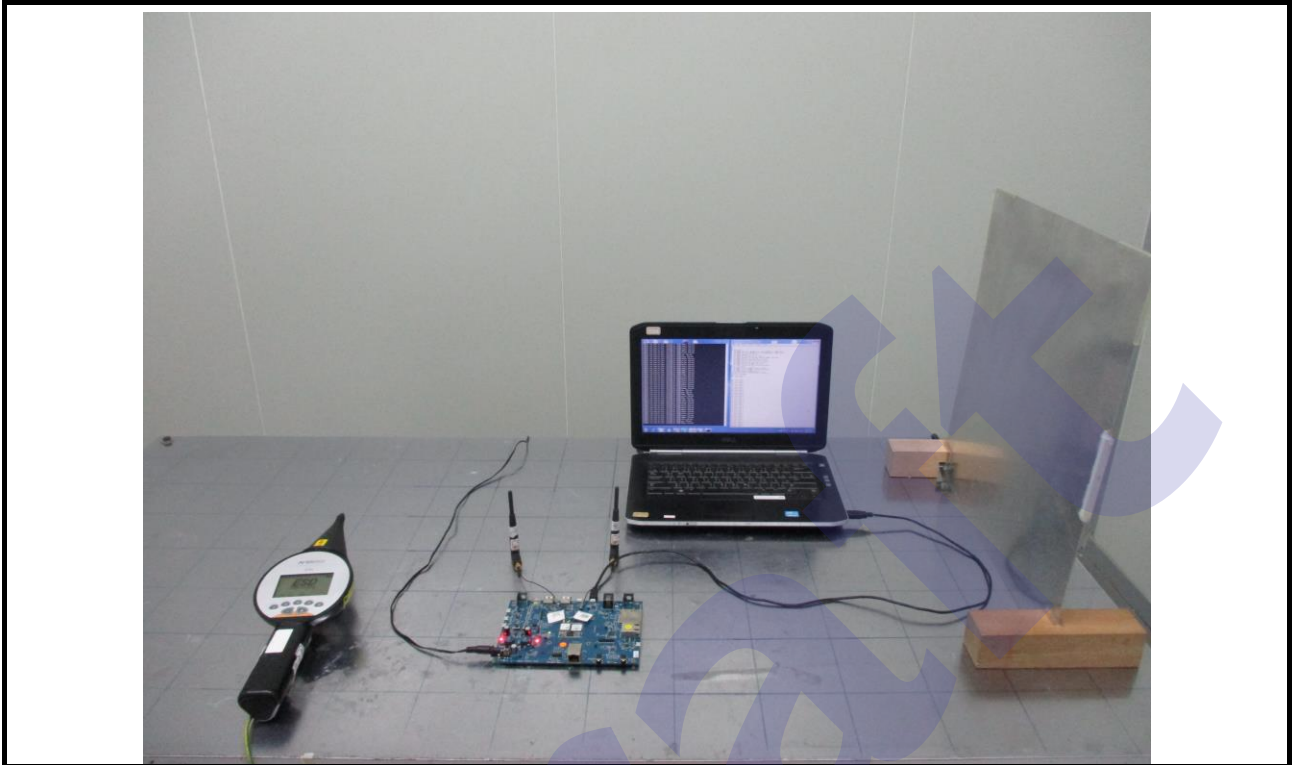
ESD Test (Antenna: MIMO FlexPIFA Antenna) (Test Mode 5)



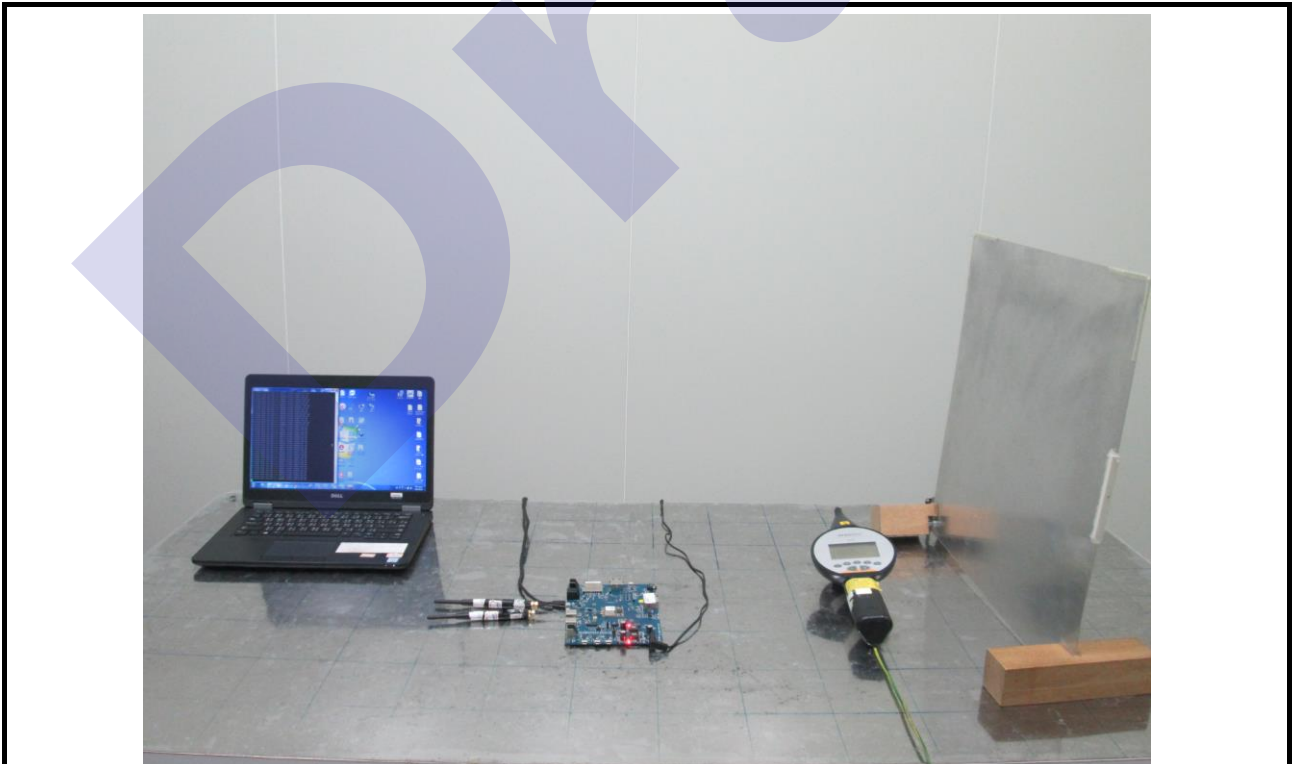
ESD Test (Antenna: WLAN_1000146) (Test Mode 6)



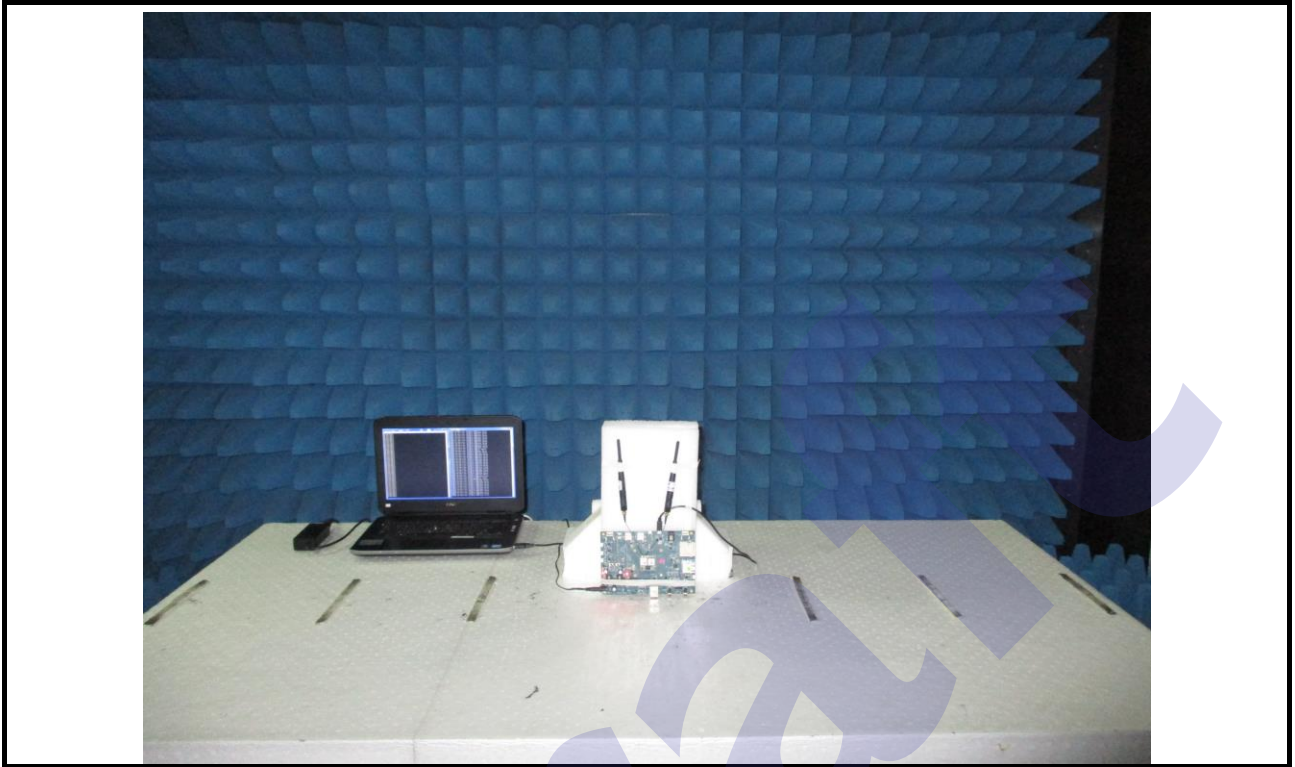
ESD Test (Antenna: 001-0009 (with filter)) (Test Mode 7)



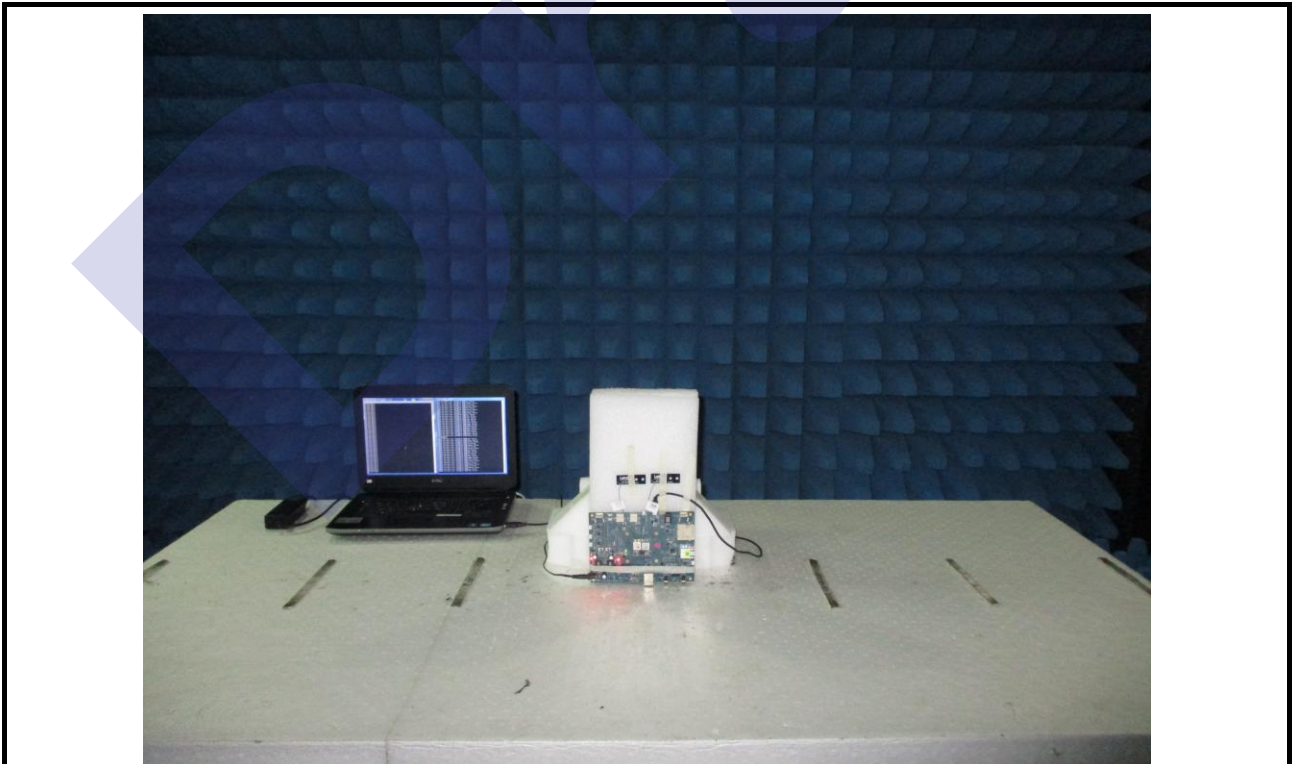
ESD Test (Antenna: 001-0009) (Test Mode 8)



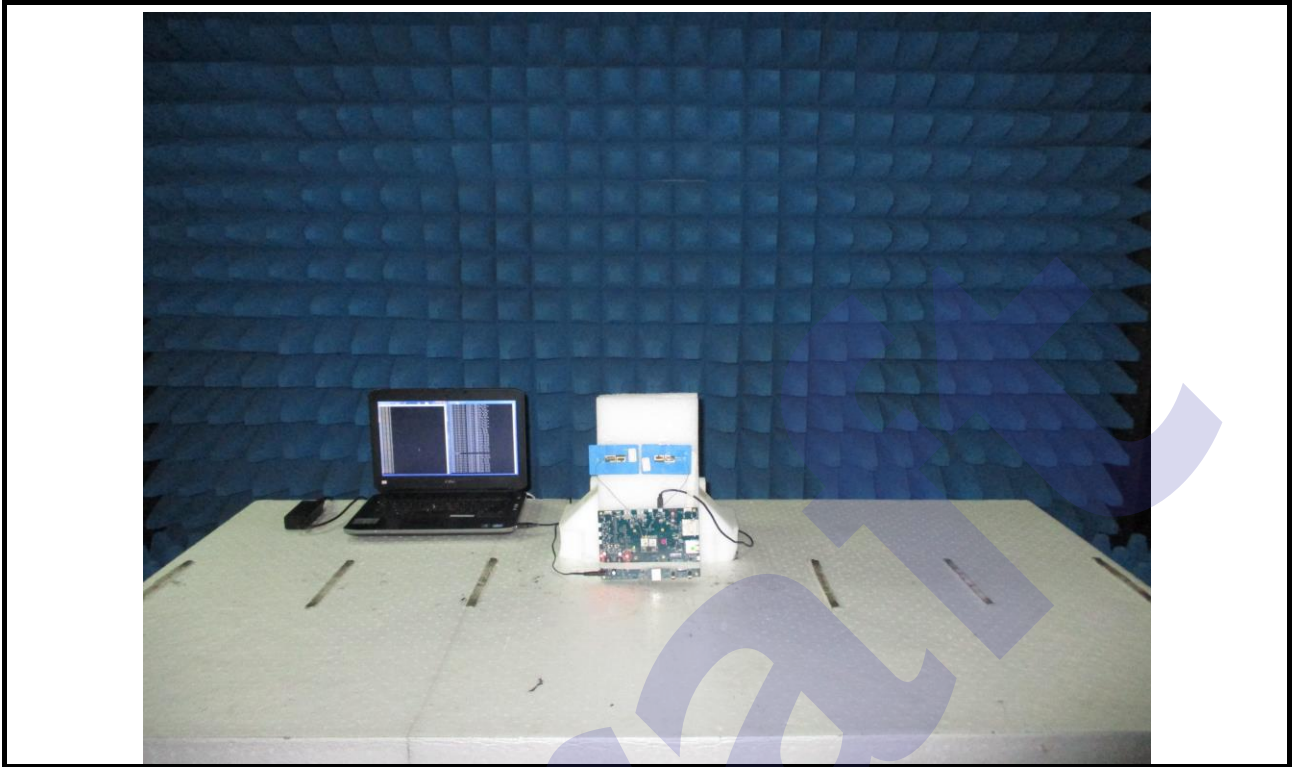
RS Test (Antenna: 001-0009) (Test Mode1)



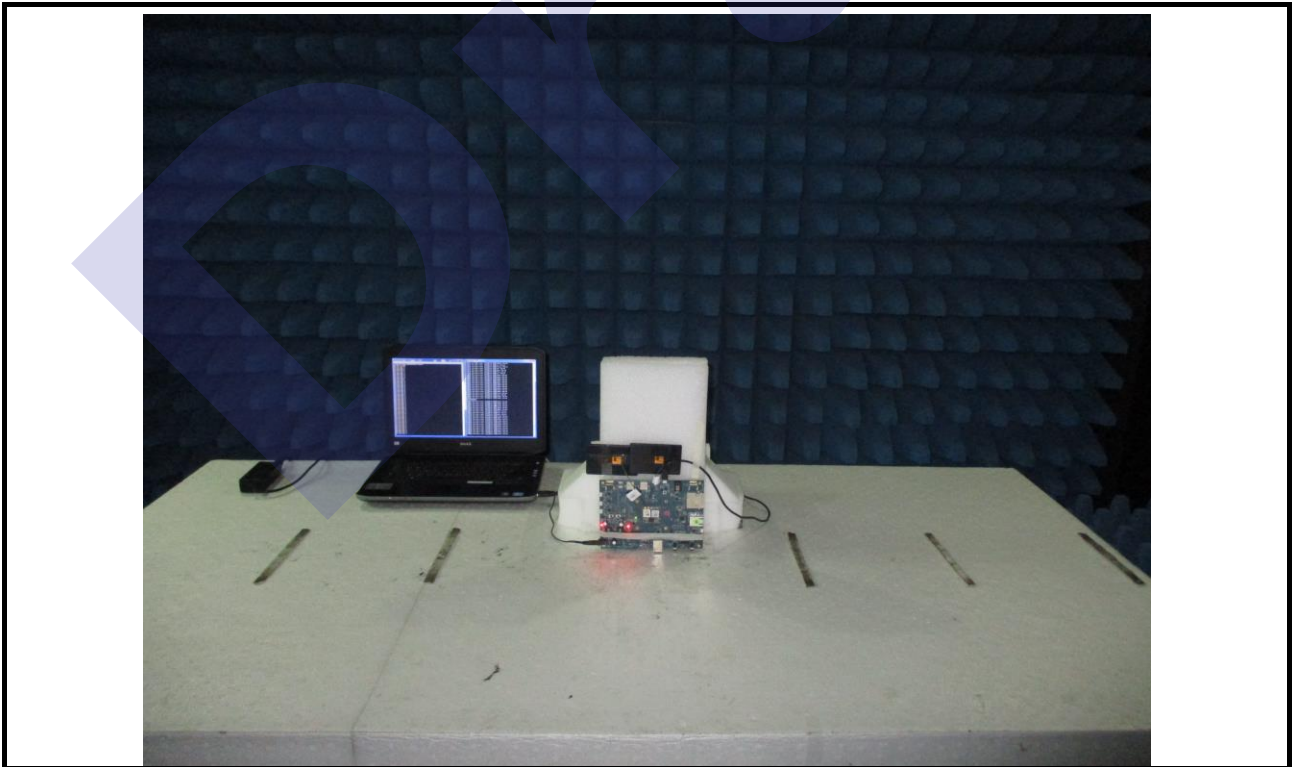
RS Test (Antenna: NanoBlade-IP04) (Test Mode2)



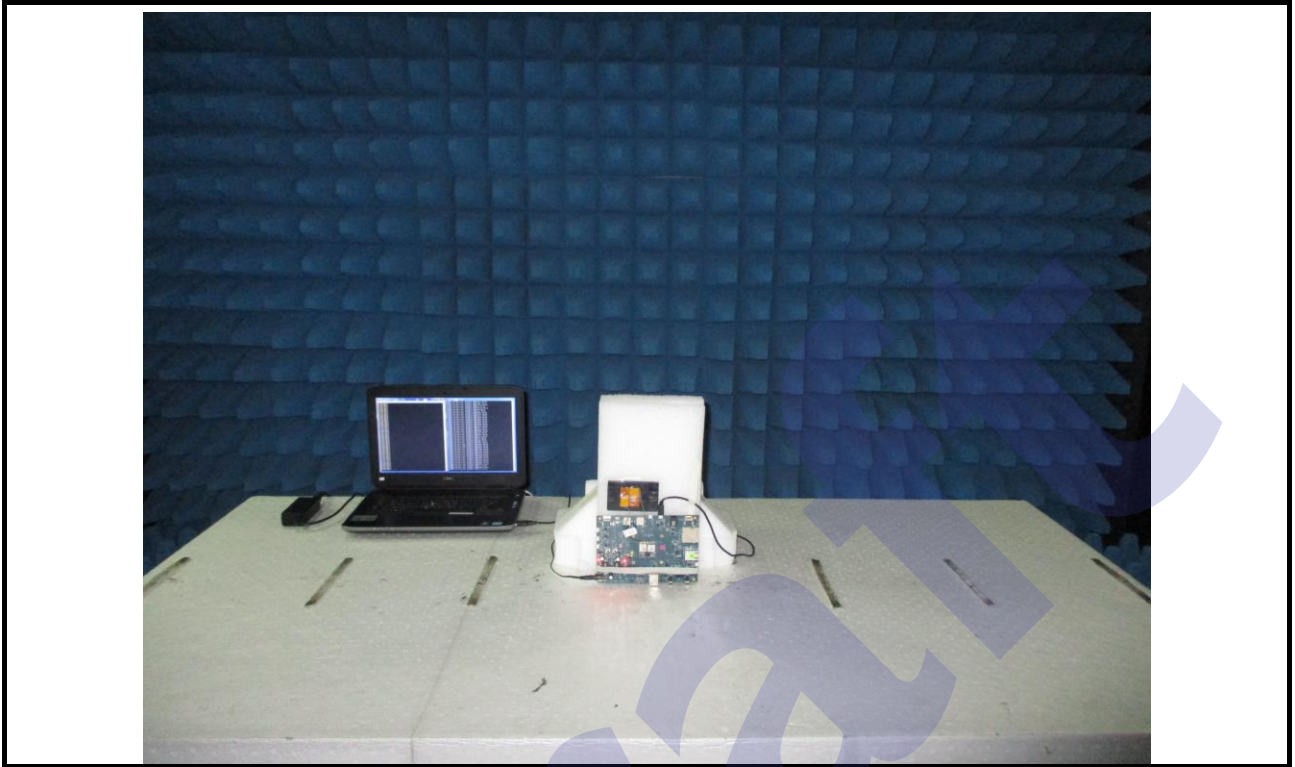
RS Test (Antenna: MAF95310 Mini NanoBlade Flex) (Test Mode3)



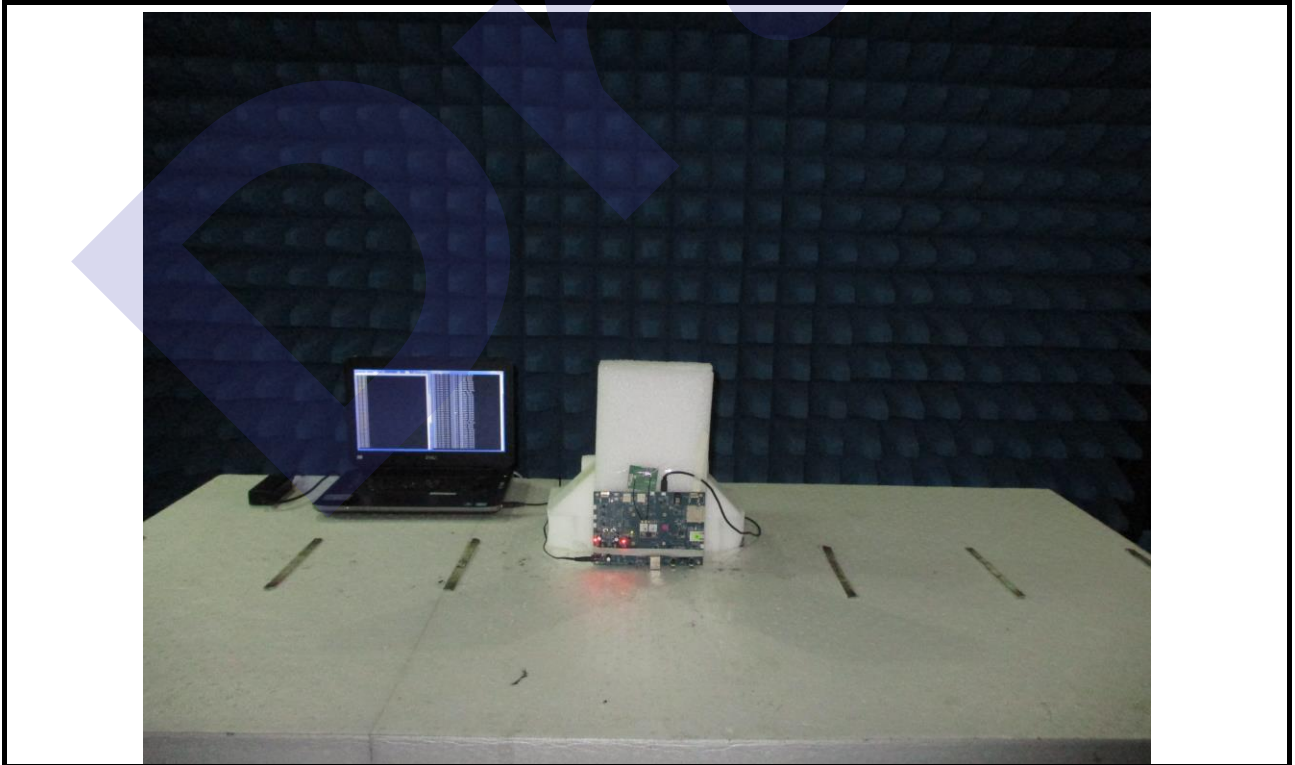
RS Test (Antenna: FlexPIFA 001-0016) (Test Mode4)



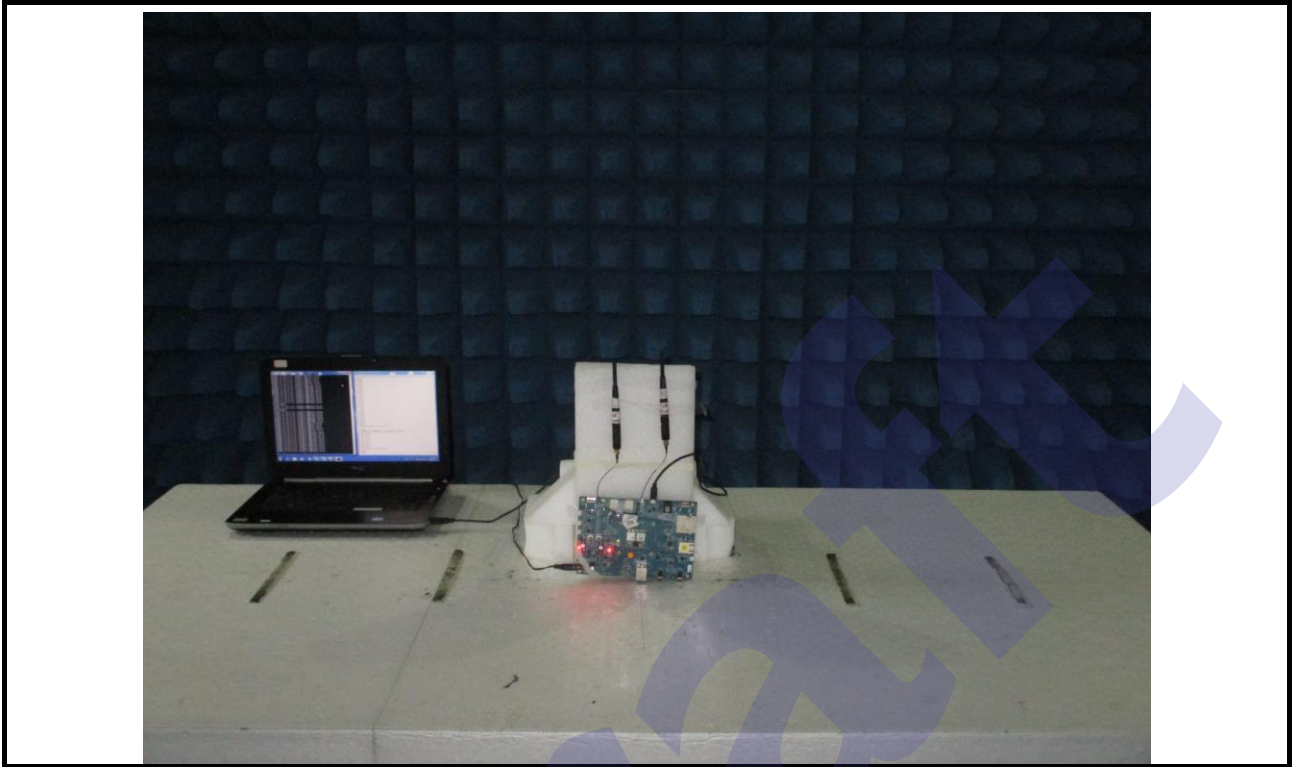
RS Test (Antenna: MIMO FlexPIFA Antenna) (Test Mode5)



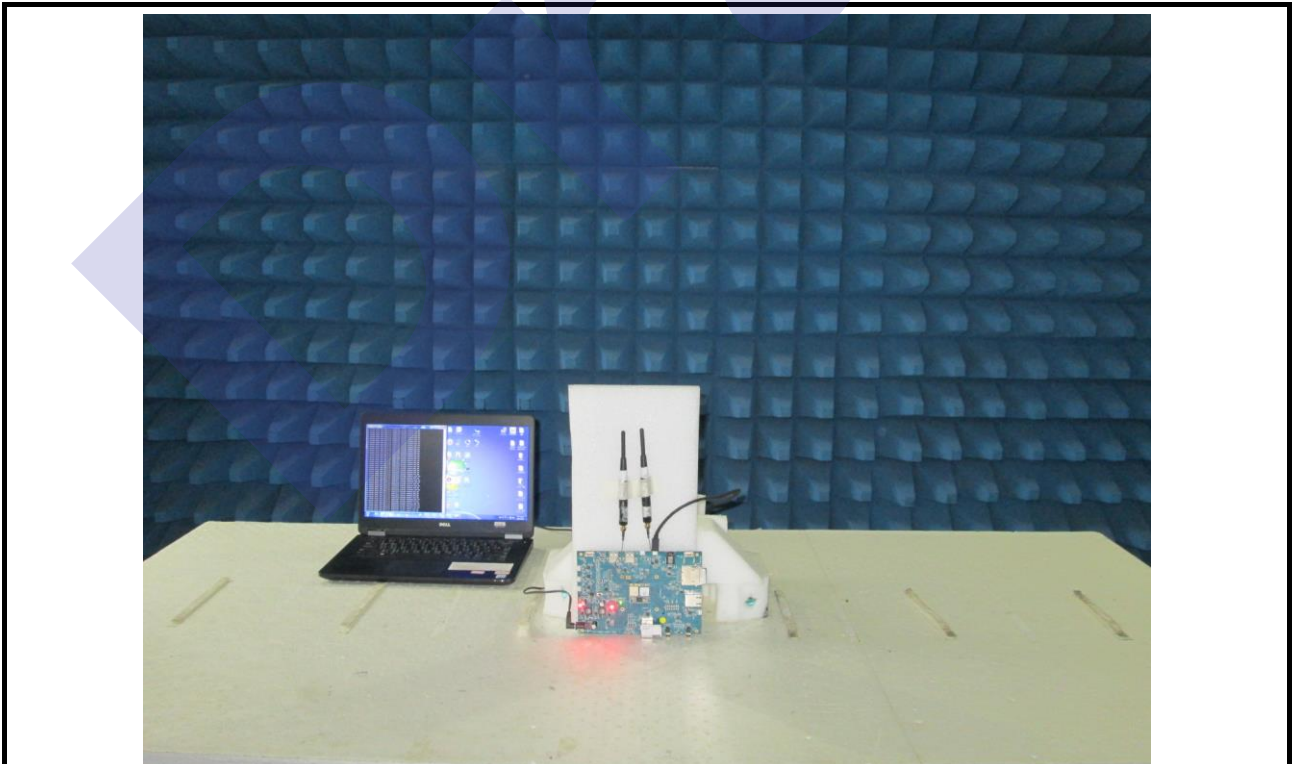
RS Test (Antenna: WLAN_1000146) (Test Mode6)



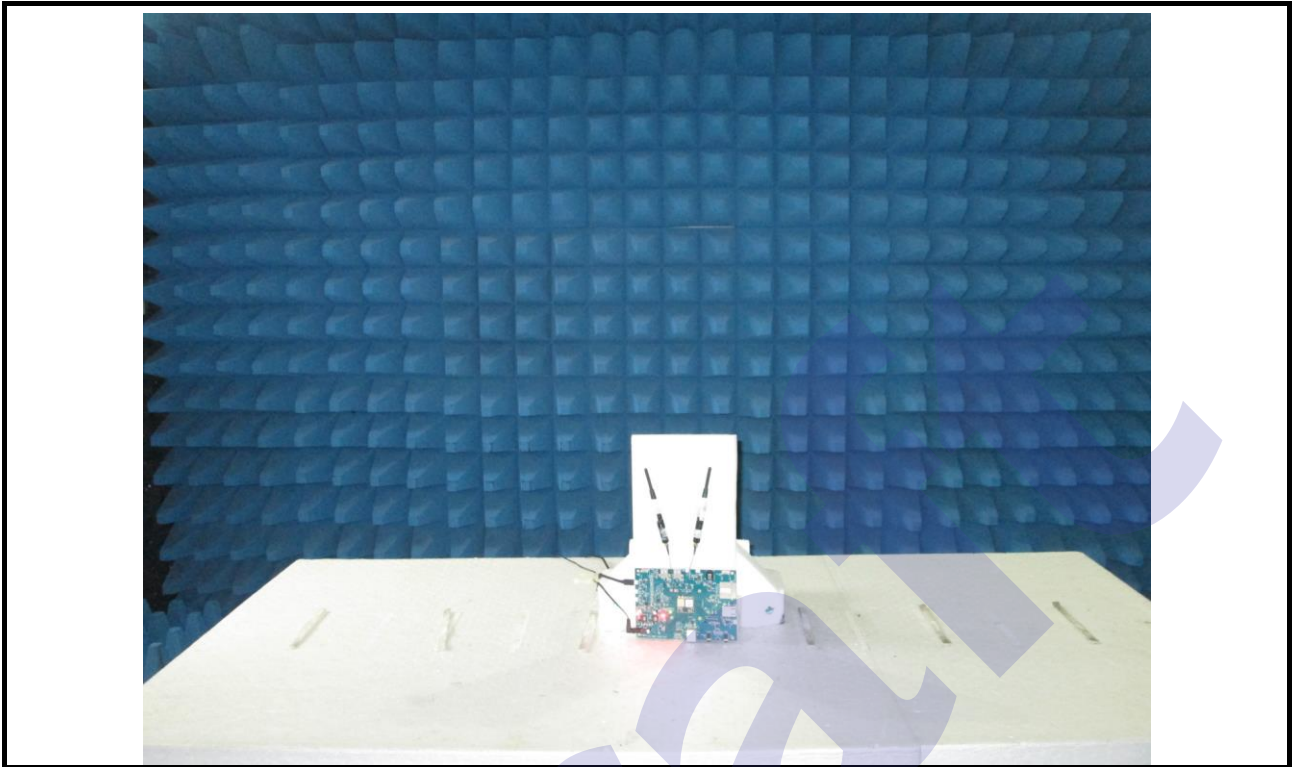
RS Test (Antenna: 001-0009(with filter)) (Test Mode7)



RS Test (Antenna: 001-0009) (Test Mode 8)



RS Test (Antenna: 001-0009) (Test Mode 9)



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

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St., Kwei Shan Dist., Tao Yuan
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Kwei Shan Site II

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St., Kwei Shan Dist., Tao Yuan
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If you have any suggestion, please feel free to contact us as below information.

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