

TEST REPORT

CERTIFICATE OF CONFORMITY

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

Report No.: RMBBUI-WTW-P22100653

Product: 11ax RTL8851BE Combo module

Brand: REALTEK

Model No.: RTL8851BE

Received Date: 2022/10/25

Test Date: 2022/12/24 ~ 2023/1/4

Issued Date: 2023/4/21

Applicant: Realtek Semiconductor Corp.

Address: No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan

Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
Hsin Chu Laboratory

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Approved by:  , **Date:** 2023/4/21
Ken Lu / Manager

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Prepared by : Claire Kuan / Specialist



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Release Control Record

Issue No.	Description	Date Issued
RMBBUI-WTW-P22100653	Original release.	2023/4/21

1 Certificate

Product: 11ax RTL8851BE Combo module
Brand: REALTEK
Test Model: RTL8851BE
Sample Status: Engineering sample
Applicant: Realtek Semiconductor Corp.
Test Date: 2022/12/24 ~ 2023/1/4
Standard: EN 301 489-1 V2.2.3 (2019-11)
EN 301 489-17 V3.2.4 (2020-09)
Measurement procedure: EN 55032: 2015+A11:2020, Class B
EN 61000-4-2: 2009
EN IEC 61000-4-3: 2020

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

2 Summary of Test Results

The test items that the EUT need to perform in accordance with its interfaces, evaluated functions, are as follows:

Standard	Test Item	Result	Remark
EN 55032	Radiated Emissions up to 1 GHz	Pass	Minimum passing Class B margin is -3.17 dB at 129.30 MHz
EN 55032	Radiated Emissions above 1 GHz	Pass	Minimum passing Class B margin is -16.10 dB at 5441.75 MHz
EN 61000-4-2	Electrostatic Discharges (ESD)	Pass	For EN 301 489 -17 Performance Criteria B
EN 61000-4-3 EN IEC 61000-4-3	Radio Frequency Electromagnetic Field (RS)	Pass	For EN 301 489 -17 Performance Criteria A

Note: Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Performance Criteria

General Performance Criteria

For the purpose of the present document two categories of performance criteria apply:

- Performance criteria for **C**ontinuous **P**henomena (**CP**).
- Performance criteria for **T**ransient **P**henomena (**TP**).

NOTE: Normally, the performance criteria depends upon the type of radio equipment and/or its intended application.

Performance criteria for Continuous Phenomena (CP)

During the test, the equipment shall:

- continue to operate as intended;
- not unintentionally transmit;
- not unintentionally change its operating state;
- not unintentionally change critical stored data.

Performance criteria for Transient Phenomena (TP)

For all ports and transient phenomena with the exception described below, the following applies:

- The application of the transient phenomena shall not result in a change of the mode of operation (e.g. unintended transmission) or the loss of critical stored data.
- After application of the transient phenomena, the equipment shall operate as intended.

For surges applied to symmetrically operated wired network ports intended to be connected directly to outdoor lines the following criteria applies:

- For products with only one symmetrical port intended for connection to outdoor lines, loss of function is allowed, provided the function is self-recoverable, or can be otherwise restored. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.
- For products with more than one symmetrical port intended for connection to outdoor lines, loss of function on the port under test is allowed, provided the function is self-recoverable. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

For a 70 % residual voltage dip and voltage interruption tests, the following performance criteria apply:

- in the case where the equipment is fitted with or connected to a battery back-up, the performance criteria for transient phenomena (TP);
- in the case where the equipment is powered solely from the AC mains supply (without the use of a parallel battery back-up) volatile user data may have been lost and if applicable the communication link need not to be maintained and lost functions should be recoverable by user or operator;
- no unintentional responses shall occur at the end of the test, when the voltage is restored to nominal;
- in the event of loss of function(s) or in the event of loss of user stored data, this fact shall be recorded.

Product Specific Performance Criteria

The particular performance criteria which are specified in the relevant part of EN 301 489 series dealing with the particular type of radio equipment, take precedence over the corresponding parts of the general performance criteria.

Where particular performance criteria for specific functions are not given, then the general performance criteria shall apply.

EN 301 489-17, Broadband Data Transmission Systems

The Performance criteria are:

- performance criteria A for immunity tests with phenomena of a continuous nature;
- performance criteria B for immunity tests with phenomena of a transient nature;
- performance criteria C for immunity tests with power interruptions exceeding a certain time.

The equipment shall meet the minimum performance criteria as specified in the following below Table A.

Table A: 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 minimum performance level.

- **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 a FER, the minimum performance level shall be no loss of the wireless transmission function needed for the intended use of the equipment.

- **Performance criteria for Continuous phenomena**

The performance criteria A shall apply.

Where the EUT is a transmitter in standby mode, unintentional transmission shall not occur during the test.

Where the EUT is a transceiver in receive mode, unintentional transmission shall not occur during the test.

- **Performance criteria for Transient phenomena**

The performance criteria B shall apply, except for voltage dips greater than or equal to 100 ms and voltage interruptions of 5 000 ms duration, for which performance criteria C shall apply.

Where the EUT is a transmitter in standby mode, unintentional transmission shall not occur as a result of the application of the test.

Where the EUT is a transceiver in receive mode, unintentional transmission shall not occur as a result of the application of the test.

2.2 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Specification	Expanded Uncertainty (k=2) (±)	Maximum allowable uncertainty (±)
Radiated Emissions up to 1 GHz	30 MHz ~ 1 GHz	5.8 dB	6.3 dB (U_{CISPR})
Radiated Emissions above 1 GHz	1 GHz ~ 6 GHz	4.85 dB	5.2 dB (U_{CISPR})

The other instruments specified are routine verified to remain within the calibrated levels, no measurement uncertainty is required to be calculated.

2.3 Supplementary Information

There is not any deviation from the test standards for the test method, and no modifications required for compliance.

3 General Information

3.1 Description of EUT

Product	11ax RTL8851BE Combo module
Brand	REALTEK
Test Model	RTL8851BE
Sample Status	Engineering sample
Operating Software	NA
Power Supply Rating	3.3Vdc from host equipment
Accessory Device	NA
Data Cable Supplied	NA
Wireless Operating Frequency	For WLAN: 2.4GHz: 2.412 ~ 2.472GHz 5GHz: 5.18 ~ 5.24GHz, 5.26~5.32GHz, 5.5~5.7GHz, 5745~5825GHz For BT-EDR: 2.402GHz ~ 2.480GHz For BT-LE: 2.402GHz ~ 2.480GHz

Note:

1. The EUT has below HW SKU configuration, as below table:

SKU No.	Product name	HW Configuration
1	11ax RTL8851BE Combo module	PCIe + USB interface + dual antenna port
2		PCIe + USB interface + Single antenna port

Note: For spurious emissions: From the above HW SKUs, the worse case was found in **SKU No.: 1**. Therefore only the test data of the SKU was recorded in this report.

2. Simultaneously transmission condition.

Condition	Technology	
1	WLAN (5 GHz)	Bluetooth
2	WLAN (2.4 GHz)	Bluetooth

3.2 Primary Clock Frequencies of Internal Source

The highest frequency generated or used within the EUT or on which the EUT operates or tunes is 6000MHz, provided by Realtek Semiconductor Corp., for detailed internal source, please refer to the manufacturer's specifications.

3.3 Features of EUT

The tests reported herein were performed according to the method specified by Realtek Semiconductor Corp., for detailed feature description, please refer to the manufacturer's specifications or user's manual.

3.4 Operating Modes of EUT and Determination of Worst Case Operating Mode

The EUT has been pre-tested under following test modes.

Test Condition	
Mode	Radiated Emissions up to 1 GHz
1	PCIe + USB interface + dual antenna port+2.4G+BT + Antenna Type(Dipole)
2	PCIe + USB interface + dual antenna port+5G+BT + Antenna Type(Dipole)
3	PCIe + USB interface + dual antenna port+2.4G+BLE + Antenna Type(Dipole)
4	PCIe + USB interface + Single antenna port+2.4G+BT + Antenna Type(Dipole)
5	PCIe + USB interface + dual antenna port+2.4G+BT + Antenna Type(PIFA)
6	PCIe + USB interface + dual antenna port+2.4G+BT + Antenna Type(Monopole)
Note: There are both standby mode and normal mode to be pre-tested then normal mode has the highest emission value.	

Test modes are presented in the report as below.

Test Condition	
Mode	Radiated Emissions up to 1 GHz
A	PCIe + USB interface + dual antenna port+2.4G+BT + Antenna Type(Dipole)
Mode	Radiated Emissions above 1 GHz
A	PCIe + USB interface + dual antenna port+2.4G+BT + Antenna Type(Dipole)
Mode	Electrostatic Discharges (ESD)
A	PCIe + USB interface + dual antenna port+2.4G+BT + Antenna Type(Dipole)
B	PCIe + USB interface + dual antenna port+5G+BT + Antenna Type(Dipole)
Mode	Radio Frequency Electromagnetic Field (RS)
A	PCIe + USB interface + dual antenna port+2.4G+BT + Antenna Type(Dipole)
B	PCIe + USB interface + dual antenna port+5G+BT + Antenna Type(Dipole)

3.5 Test Program Used and Operation Descriptions

For emission

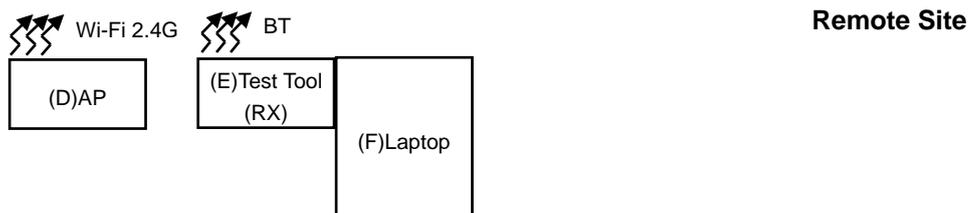
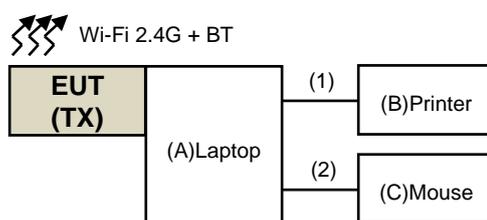
1. Turn on the power of all equipment.
2. Support units A & F (Laptop) run “BTDebugTool.exe” program to communicate with EUT via BT.
3. Support unit A (Laptop) runs “ping.exe” program to communicate with support unit D (AP) via wireless.

For immunity

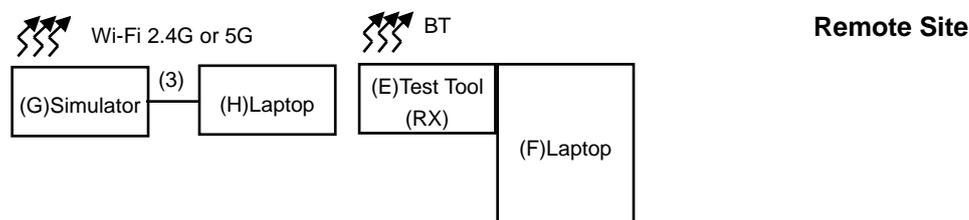
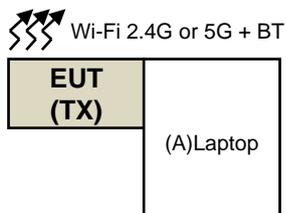
1. Turn on the power of all equipment.
2. Support units A & F (Laptop) run “BTDebugTool.exe” program to communicate with EUT via BT.
3. Support unit A (Laptop) runs “ping.exe” program to communicate with support unit H (Laptop) via wireless.
4. Support unit A (Laptop) links and sends packets to support unit H (Laptop) via wireless, then observe the PER and the minimum performance level shall be less than or equal to 10%.

3.6 Connection Diagram of EUT and Peripheral Devices

For emission



For immunity



3.7 Configuration of Peripheral Devices and Cable Connections

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A	Laptop	DELL	E5420	CHHYLQ1	QDS-BRCM1005-D	Provided by Lab
B	Printer	EPSON	LQ-300+II	G88Y074083	DoC	Provided by Lab
C	Mouse	Logitech	M-U0026	810-002182_002	DoC	Provided by Lab
D	AP	LINKSYS	EA6350	N/A	N/A	Provided by lab
E	Test Tool	N/A	N/A	N/A	N/A	Provided by applicant
F	Laptop	DELL	E5420	FHPH4S1	N/A	Provided by Lab
G	Simulator	Anritsu	MT8860C	1705001	N/A	Provided by Lab
H	Laptop	DELL	E6420	H62T3R1	DoC	Provided by Lab

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1	USB cable	1	1.8	Yes	0	Provided by lab
2	USB cable	1	1.8	Yes	0	Provided by lab
3	Coaxial cable	1	10	No	0	Provided by lab

4 Test Instruments

The calibration interval of the all test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

4.1 Radiated Emissions up to 1 GHz

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Antenna Tower & Turn Table CT	N/A	N/A	N/A	N/A
Fixed attenuator Marvelous Microwave Inc.	MVE2252-05	MVE2252-05-001	2022/9/8	2023/9/7
Pre_Amplifier Mini-Circuits	ZFL-1000VH2B	AMP-ZFL-03	2022/10/17	2023/10/16
RF Coaxial Cable COMMATE/PEWC	8D	CHGCAB-005	2022/9/8	2023/9/7
	8D-FB	CHGCAB-001-2	2022/9/8	2023/9/7
RF Coaxial Cable	RF-141	CHGCAB-004	2022/9/8	2023/9/7
Software BV	ADT_Radiated_V8.7.08	N/A	N/A	N/A
Test Receiver Agilent	N9038A	MY51210105	2022/6/14	2023/6/13
Trilog Broadband Antenna Schwarzbeck	VULB 9168	9168-360	2022/10/21	2023/10/20

Notes:

1. The test was performed in HC - 966 chamber 1. The test site validated date: 2022/9/8 (NSA)
2. The VCCI Site Registration No. is R-20009.
3. Tested Date: 2022/12/24

4.2 Radiated Emissions above 1 GHz

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Antenna Tower & Turn Table CT	N/A	N/A	N/A	N/A
Fix tool for Boresight BV	BAF-01	5	N/A	N/A
Horn Antenna FT-RF	HA-07M18G-NF	0000320091110	2022/11/13	2023/11/12
Pre_Amplifier Agilent	8449B	3008A02578	2022/6/6	2023/6/5
Pre_Amplifier EMCI	EMC118A45SE	980817	2022/7/8	2023/7/7
RF Coaxial Cable EMCI	EMC104-SM-SM-2000	181208	2022/8/15	2023/8/14
	EMC104-SM-SM-6000	181209	2022/8/15	2023/8/14
	EMC104-SM-SM-8500	181211	2022/8/15	2023/8/14
Software BV	ADT_Radiated_V8.7.08	N/A	N/A	N/A
Spectrum Keysight	N9020B	MY60112816	2022/5/20	2023/5/19
Test Receiver Agilent	N9038A	MY51210105	2022/6/14	2023/6/13

Notes:

1. The test was performed in HC - 966 chamber 1. The test site validated date: 2022/8/13 (VSWR)
2. The 3dB beamwidth of the horn antenna is minimum 33 degree (or $w = 1.78m$ at 3 m distance) for 1~6 GHz.
3. The VCCI Site Registration No. is G-10137.
4. Tested Date: 2022/12/24

4.3 Electrostatic Discharges (ESD)

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
ESD Simulator EVERFINE	EMS61000-2A	P185696TJ6401116	2022/10/11	2023/10/10
NOISEKEN ESS-2002 Noiseken	ESS-2002	ESS0625212/244	2022/3/30	2023/3/29

Notes:

1. The test was performed in HC - ESD 1.
2. Tested Date: 2023/1/4

4.4 Radio Frequency Electromagnetic Field (RS)

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
BVADT RS Test Workbench(Software) BV	BVADT_RS_ V7.6.9	N/A	N/A	N/A
Conditioning Amplifier B&K	WH3278	2421896	2022/8/21	2023/8/20
Ear Simulator Telephonometry B&K	4192	3171214	2022/8/19	2023/8/18
High gain horn Antenna ETS-Lindgren	3119	00203652	N/A	N/A
LOG ANTENNA Amplifier Research	AT5080ANT	309740	N/A	N/A
Low Band Power Amplifier ETS-Lindgren	8100-002	00163537	N/A	N/A
High Band Power Amplifier ETS-Lindgren	8100-008	00163547	N/A	N/A
POWER METER KEYSIGHT	N1914A	MY55326005	2022/9/14	2023/9/13
Software BV	ADT_ABMS_ TELE_V7.2.00	N/A	N/A	N/A
	BVABMS_489- 7,24,25_V7.5.2_UPV	N/A	N/A	N/A
Vector Signal Generator KEYSIGHT	N5182B	MY53051971	2022/4/27	2023/4/26

Notes:

1. The test was performed in HC - RS Chamber 1.
2. Tested Date: 2023/1/4

5 Limits of Test Items

5.1 Radiated Emissions up to 1 GHz

Frequency (MHz)	Class A Quasi-peak (dBuV/m)		Class B Quasi-peak (dBuV/m)	
	at 3m	at 10m	at 3m	at 10m
30 - 230	50	40	40	30
230 - 1000	57	47	47	37

- Notes:
1. The lower limit shall apply at the transition frequencies.
 2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
 3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

5.2 Radiated Emissions above 1 GHz

Frequency (GHz)	Class A (dBuV/m) (at 3m)		Class B (dBuV/m) (at 3m)	
	Average	Peak	Average	Peak
1 to 3	56	76	50	70
3 to 6	60	80	54	74

- Notes:
1. The lower limit shall apply at the transition frequencies.
 2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
 3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

Frequency Range of Radiated Measurement (For unintentional radiators)

Highest internal frequency (F_x)	Highest measurement frequency (F_M) (GHz)
$F_x \leq 108 \text{ MHz}$	1
$108 \text{ MHz} < F_x \leq 500 \text{ MHz}$	2
$500 \text{ MHz} < F_x \leq 1 \text{ GHz}$	5
$F_x > 1 \text{ GHz}$	$5 \times F_x$ up to a maximum of 6 GHz

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

5.3 General immunity requirements

For EN 301 489-series

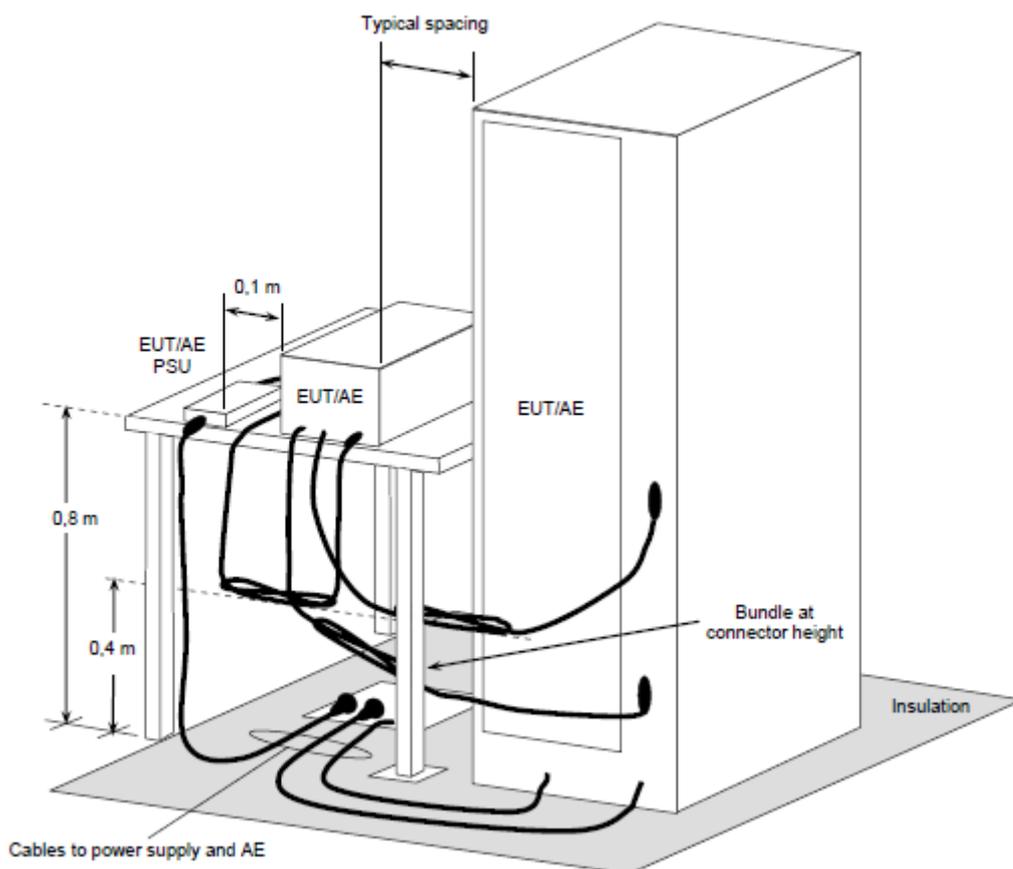
Port	Basic Standard	Test item	Test specification	Performance criteria
Enclosure	EN 61000-4-2	Electrostatic Discharge (ESD)	±4 kV (contact) ±8 kV (Air)	TP (B)
	EN 61000-4-3	Radio Frequency Electromagnetic Field (RS)	80 to 6000(MHz), 3 V/m, 80 % AM (1 kHz)	CP (A)
Power input (AC)	EN 61000-4-4	Fast Transients, Common Mode (EFT)	±1 kV 5/50 ns (Tr/Th) 5 kHz, repetition frequency	TP (B)
	EN 61000-4-5	Surge	In telecom centres: line to line: ±0.5 kV, 1.2/50 µs line to earth: ±1 kV, 1.2/50 µs In others localion: line to line: ±1 kV, 1.2/50 µs line to earth: ±2 kV, 1.2/50 µs	TP (B)
	EN 61000-4-6	Radio Frequency, Common Mode (CS)	0.15 to 80(MHz), 3 V, 80 % AM (1 kHz)	CP (A)
	EN 61000-4-11	Voltage dips and interruptions (DIP)	Voltage Dips: 0% residual voltage, 0.5 cycle 0% residual voltage, 1 cycle 70% residual voltage, 25 cycles (at 50 Hz) EUT with battery back-up EUT without battery back-up Voltage Interruption: 0% residual voltage, 250 cycles (at 50 Hz) EUT with battery back-up EUT without battery back-up	TP (B) TP (B) TP (B) C TP (B) C
DC power/ Wired network and Signal/ Control port	EN 61000-4-4	Fast Transients, Common Mode (EFT)	±0.5 kV 5/50 ns (Tr/Th) 100 kHz, repetition frequency for xDSL port 5 kHz, repetition frequency for other port	TP (B)
	EN 61000-4-5	Surge	Wired network ports (directly connected to outdoor cables): Symmetrically operated: lines to earth: ±1 kV, 10/700 µs Non-symmetrically operated: line to line: ±0.5 kV, 1.2/50 µs line to earth, or shield to ground: ±1 kV, 1.2/50 µs Wired network ports (indoor cables, longer than 30 m): line to earth, or shield to ground: ±0.5 kV, 1.2/50 µs	TP (B)
	EN 61000-4-6	Radio Frequency, Common Mode (CS)	0.15 to 80(MHz), 3 V, 80 % AM (1 kHz)	CP (A)

6 Test Arrangements

6.1 Radiated Emissions up to 1 GHz

- For the table-top EUT is placed on a 0.8 meter to the top of rotating table; for the floor standing EUT shall be insulated (by insulation of maximum thickness of 150 mm) from the horizontal reference ground plane. The rotating table is rotated 360 degrees to determine the position of the highest radiation. If the equipment requires a dedicated ground connection, this shall be provided and bonded to the RGP.
- The EUT is set 3 meters away from the interference-receiving antenna, which is mounted on the top of a variable-height antenna tower.
- The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT is arranged to its worst case and then the antenna is tuned to heights from 1 m to 4 m and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system is set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is up to 1 GHz.

Note: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for quasi-peak detection (QP) at frequency up to 1GHz.

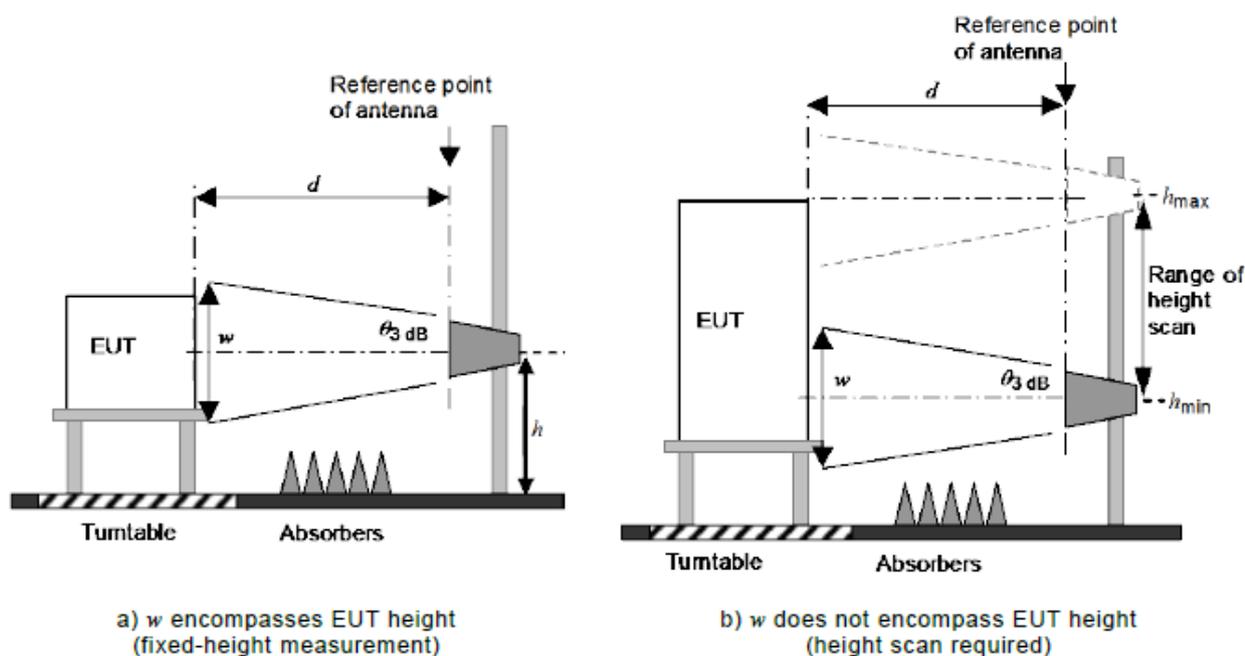


For the actual test configuration, please refer to the related Item – Photographs of the Test Configuration.

6.2 Radiated Emissions above 1 GHz

- For the table-top EUT is placed on a 0.8 meter to the top of rotating table; for the floor standing EUT shall be insulated (by insulation of maximum thickness of 150 mm) from the horizontal reference ground plane. The rotating table is rotated 360 degrees to determine the position of the highest radiation. If the equipment requires a dedicated ground connection, this shall be provided and bonded to the RGP.
- The EUT was set $d = 3$ meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The height of antenna can be varied from one meter to four meters, the height of adjustment depends on the EUT height and the antenna 3dB beamwidth both, to detect the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The spectrum analyzer system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.

Note: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection (PK) at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz for Average detection (AV) at frequency above 1GHz.



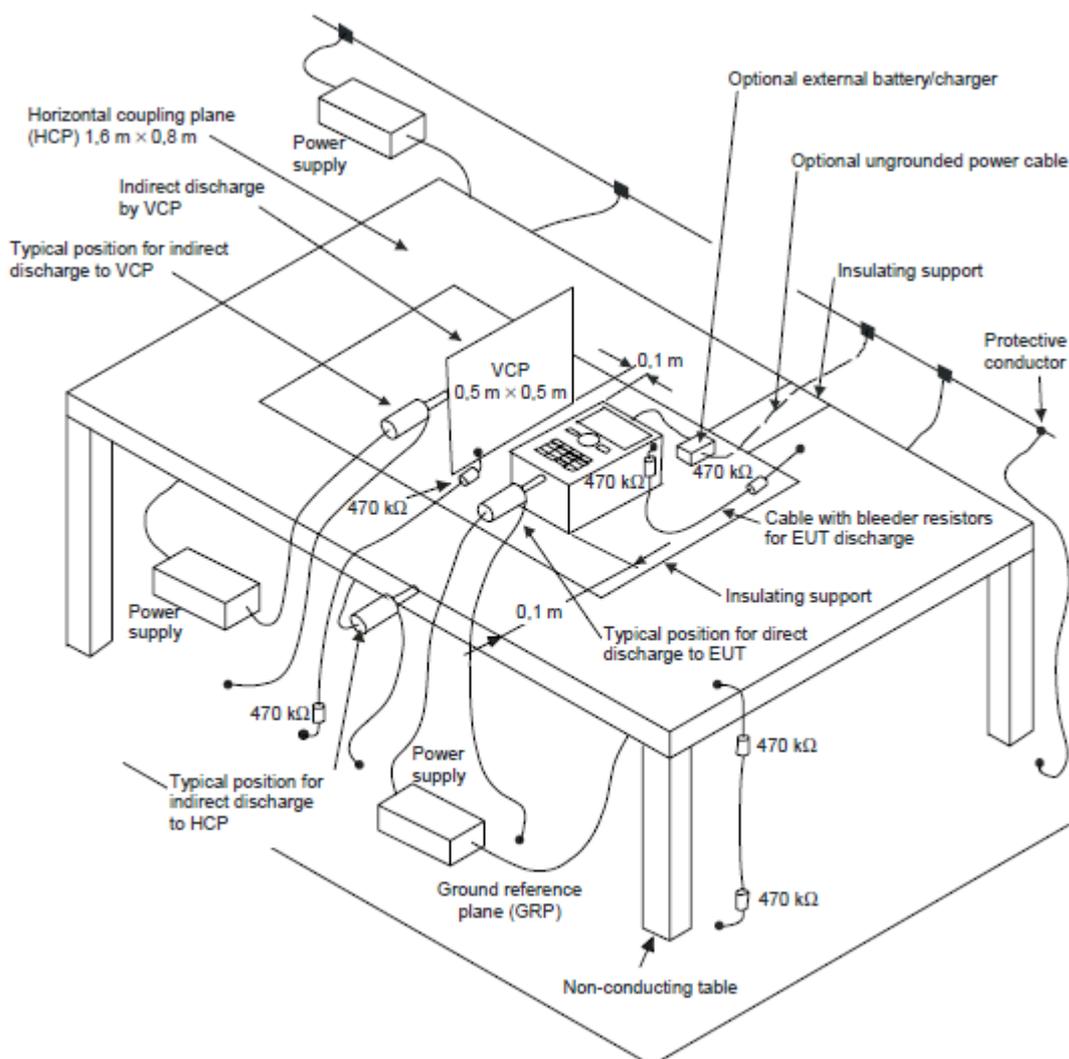
For the actual test configuration, please refer to the related Item – Photographs of the Test Configuration.

6.3 Electrostatic Discharges (ESD)

Discharge Impedance:	330 ohm / 150 pF
Number of Discharge:	Air – Direct: 10 discharges per location (each polarity) Contact – Direct & Indirect: 10 discharges per location (each polarity)
Discharge Period:	1-second minimum

The basic test procedure was in accordance with EN/IEC 61000-4-2:

- a. Electrostatic discharges were applied only to those points and surfaces of the EUT that are accessible to users during normal operation.
- b. The test was performed with at least ten single discharges on the pre-selected points in the most sensitive polarity.
- c. The time interval between two successive single discharges was at least 1 second.
- d. The ESD generator was held perpendicularly to the surface to which the discharge was applied and the return cable was at least 0.2 meters from the EUT.
- e. Contact discharges were applied to the non-insulating coating, with the pointed tip of the generator penetrating the coating and contacting the conducting substrate.
- f. Air discharges were applied with the round discharge tip of the discharge electrode approaching the EUT as fast as possible (without causing mechanical damage) to touch the EUT. After each discharge, the ESD generator was removed from the EUT and re-triggered for a new single discharge. The test was repeated until all discharges were complete.
- g. At least ten single discharges (in the most sensitive polarity) were applied to the **Horizontal Coupling Plane** at points on each side of the EUT. The ESD generator was positioned at a distance of 0.1 meters from the EUT with the discharge electrode touching the **HCP**.
- h. At least ten single discharges (in the most sensitive polarity) were applied to the center of one vertical edge of the **Vertical Coupling Plane** in sufficiently different positions that the four faces of the EUT were completely illuminated. The **VCP** (dimensions 0.5m x 0.5m) was placed vertically to and 0.1 meters from the EUT.



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

NOTE:

TABLE-TOP EQUIPMENT

The configuration consisted of a wooden table 0.8 meters high standing on the **Ground Reference Plane**. The **GRP** consisted of a sheet of aluminum at least 0.25mm thick, and 2.5 meters square connected to the protective grounding system. A **Horizontal Coupling Plane** (1.6m x 0.8m) was placed on the table and attached to the **GRP** by means of a cable with 940kΩ total impedance. The equipment under test, was installed in a representative system as described in section 7 of EN/IEC 61000-4-2, and its cables were placed on the **HCP** and isolated by an insulating support of 0.5mm thickness. A distance of 1-meter minimum was provided between the EUT and the walls of the laboratory and any other metallic structure.

FLOOR-STANDING EQUIPMENT

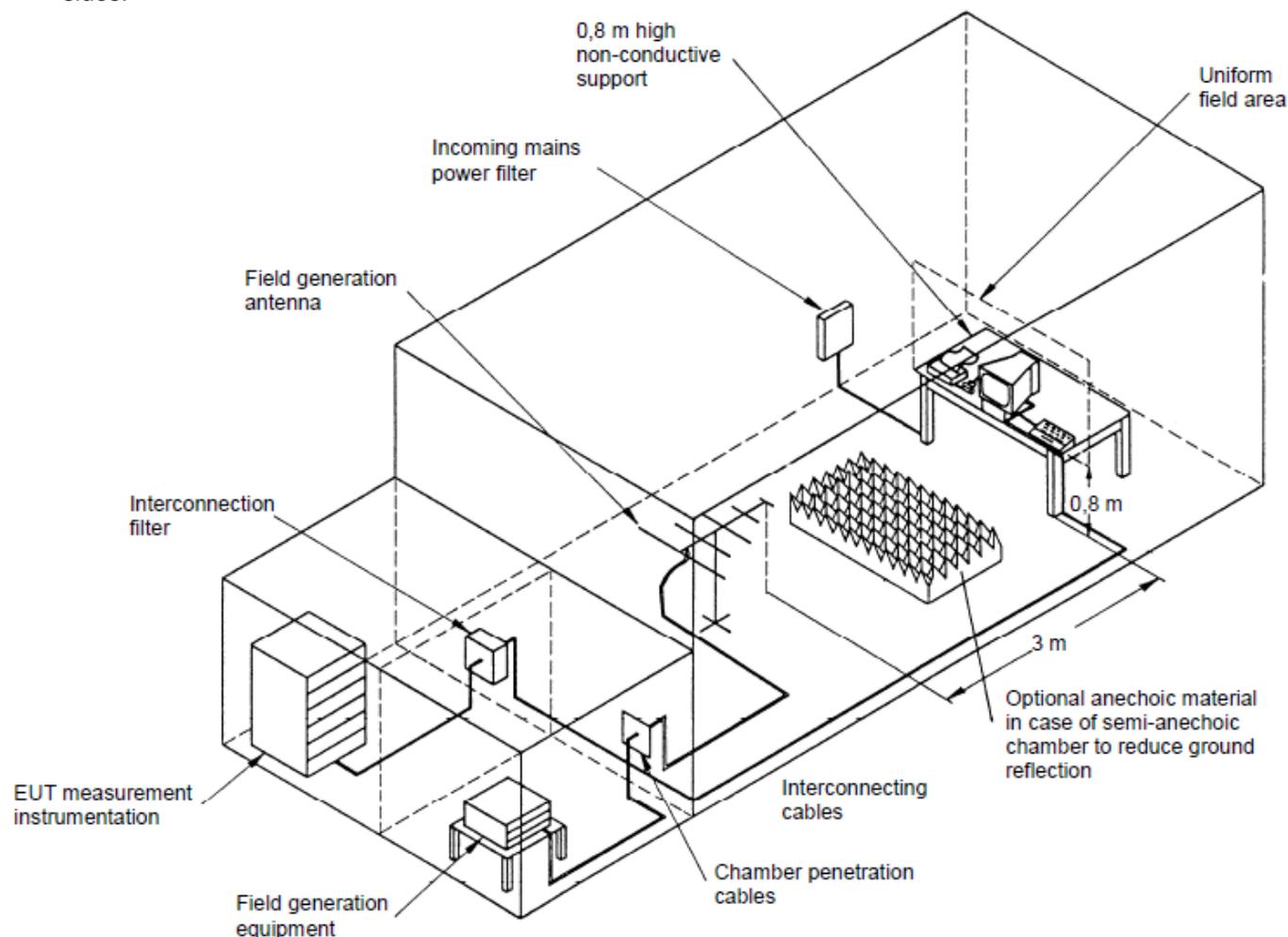
The equipment under test was installed in a representative system as described in section 7 of IEC 61000-4-2, and its cables were isolated from the Ground Reference Plane by an insulating support of 0.1-meter thickness. The **GRP** consisted of a sheet of aluminum that is at least 0.25mm thick, and 2.5 meters square connected to the protective grounding system and extended at least 0.5 m.

6.4 Radio Frequency Electromagnetic Field (RS)

Modulation:	1kHz Sine Wave, 80%, AM Modulation
Frequency Step:	1 % of preceding frequency value
Dwell Time:	3 seconds

The test procedure was in accordance with EN/IEC 61000-4-3.

- The testing was performed in a modified semi-anechoic chamber.
- The frequency range shall be swept, with the signal 80% amplitude modulated with a 1kHz sine wave.
- The test was performed with the EUT exposed to both vertically and horizontally polarized fields on each of the four sides.



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

NOTE:

TABLETOP EQUIPMENT

The EUT installed in a representative system as described in section 7 of EN/IEC 61000-4-3 was placed on a non-conductive table 0.8 meters in height. The system under test was connected to the power and signal wire according to relevant installation instructions.

FLOOR STANDING EQUIPMENT

The EUT installed in a representative system as described in section 7 of EN/IEC 61000-4-3 was placed on a non-conductive wood support 0.1 meters in height. The system under test was connected to the power and signal wire according to relevant installation instructions.

7 Test Results of Test Item

7.1 Radiated Emissions up to 1 GHz

Mode A

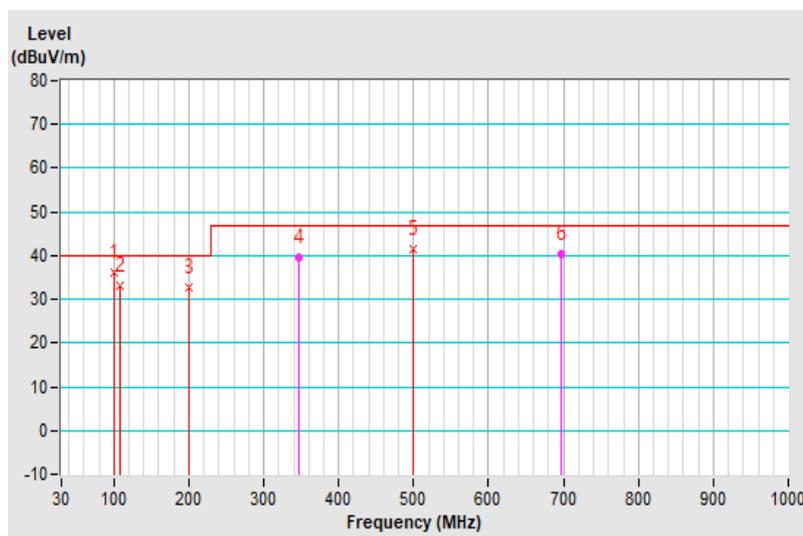
Frequency Range	30 MHz ~ 1 GHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP), 120 kHz
Input Power	3.3 Vdc from host	Environmental Conditions	14°C, 57% RH
Tested By	Gillian Peng		

Antenna Polarity & Test Distance : Horizontal at 3 m

No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	99.77	36.14 QP	40.00	-3.86	2.94 H	92	48.65	-12.51
2	108.86	32.96 QP	40.00	-7.04	3.00 H	179	43.93	-10.97
3	199.53	32.84 QP	40.00	-7.16	2.00 H	264	43.92	-11.08
4	346.24	39.46 QP	47.00	-7.54	1.00 H	251	45.53	-6.07
5	498.87	41.61 QP	47.00	-5.39	2.00 H	265	43.69	-2.08
6	697.02	40.24 QP	47.00	-6.76	1.00 H	222	38.41	1.83

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
– Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

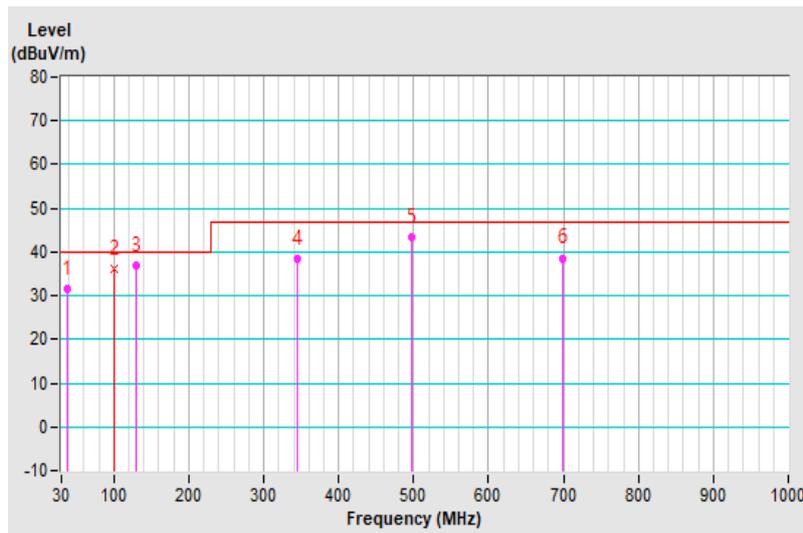


Frequency Range	30 MHz ~ 1 GHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP), 120 kHz
Input Power	3.3 Vdc from host	Environmental Conditions	14°C, 57% RH
Tested By	Gillian Peng		

Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	37.64	31.70 QP	40.00	-8.30	2.00 V	273	40.53	-8.83
2	99.77	36.09 QP	40.00	-3.91	4.00 V	249	48.60	-12.51
3	129.30	36.83 QP	40.00	-3.17	1.07 V	284	46.02	-9.19
4	344.93	38.24 QP	47.00	-8.76	2.00 V	359	44.33	-6.09
5	497.88	43.22 QP	47.00	-3.78	1.00 V	43	45.32	-2.10
6	698.45	38.60 QP	47.00	-8.40	1.00 V	163	36.74	1.86

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
– Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value



7.2 Radiated Emissions above 1 GHz

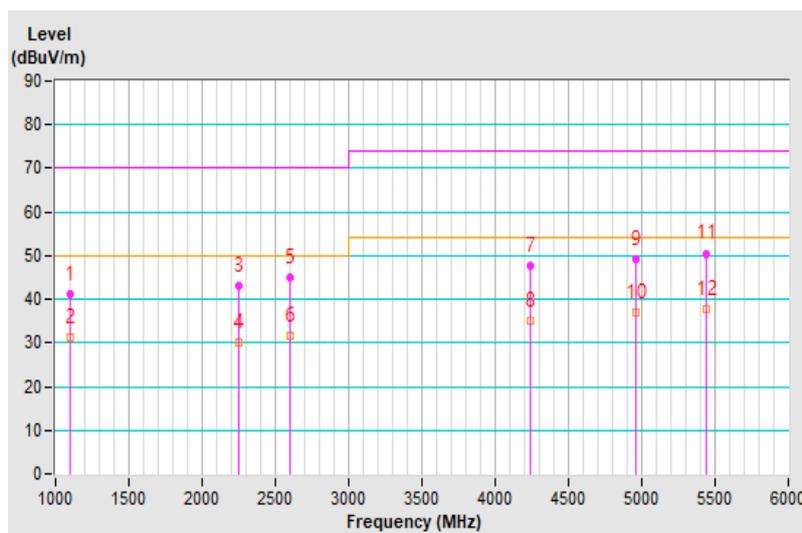
Mode A

Frequency Range	1GHz ~ 6GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Input Power	3.3 Vdc from host	Environmental Conditions	14°C, 57% RH
Tested By	Gillian Peng		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1096.25	41.11 PK	70.00	-28.89	1.00 H	136	47.53	-6.42
2	1096.25	31.30 AV	50.00	-18.70	1.00 H	145	37.72	-6.42
3	2249.50	42.98 PK	70.00	-27.02	1.00 H	157	40.59	2.39
4	2249.50	30.13 AV	50.00	-19.87	1.00 H	214	27.74	2.39
5	2603.50	44.82 PK	70.00	-25.18	1.00 H	290	41.02	3.80
6	2603.50	31.71 AV	50.00	-18.29	1.00 H	251	27.91	3.80
7	4242.50	47.73 PK	74.00	-26.27	1.00 H	131	37.96	9.77
8	4242.50	35.20 AV	54.00	-18.80	1.00 H	90	25.43	9.77
9	4964.50	49.10 PK	74.00	-24.90	1.00 H	225	37.25	11.85
10	4964.50	36.86 AV	54.00	-17.14	1.00 H	239	25.01	11.85
11	5442.25	50.52 PK	74.00	-23.48	1.00 H	342	37.06	13.46
12	5442.25	37.84 AV	54.00	-16.16	1.00 H	360	24.38	13.46

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
– Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

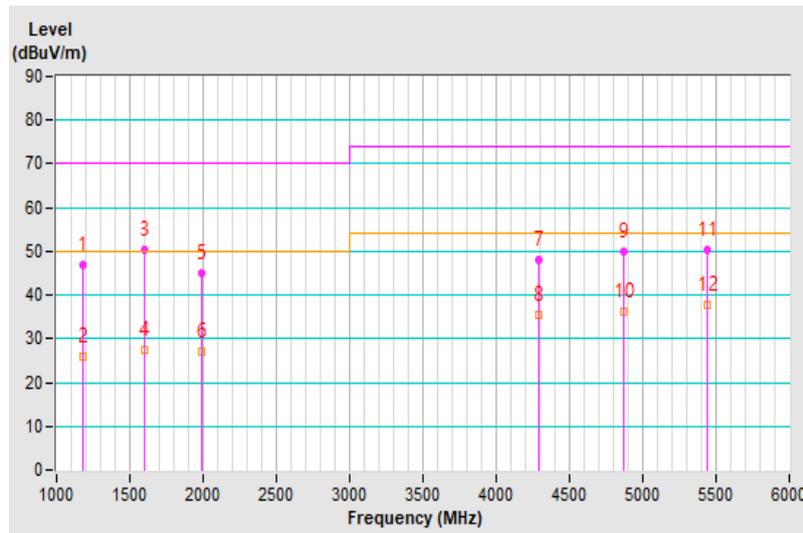


Frequency Range	1GHz ~ 6GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Input Power	3.3 Vdc from host	Environmental Conditions	14°C, 57% RH
Tested By	Gillian Peng		

Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1184.25	46.74 PK	70.00	-23.26	1.00 V	157	52.32	-5.58
2	1184.25	25.83 AV	50.00	-24.17	1.00 V	175	31.41	-5.58
3	1596.25	50.32 PK	70.00	-19.68	1.00 V	161	53.10	-2.78
4	1596.25	27.57 AV	50.00	-22.43	1.00 V	158	30.35	-2.78
5	1985.00	44.94 PK	70.00	-25.06	1.00 V	165	45.10	-0.16
6	1985.00	27.02 AV	50.00	-22.98	1.00 V	180	27.18	-0.16
7	4287.50	48.04 PK	74.00	-25.96	1.00 V	352	38.09	9.95
8	4287.50	35.45 AV	54.00	-18.55	1.00 V	294	25.50	9.95
9	4865.75	49.92 PK	74.00	-24.08	1.00 V	211	38.51	11.41
10	4865.75	36.35 AV	54.00	-17.65	1.00 V	173	24.94	11.41
11	5441.75	50.41 PK	74.00	-23.59	1.00 V	156	36.95	13.46
12	5441.75	37.90 AV	54.00	-16.10	1.00 V	360	24.44	13.46

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value



7.3 Electrostatic Discharges (ESD)

Mode A

For EN 301 489 -17

Input Power	3.3 Vdc from host	Environmental conditions	22 °C, 45 % RH 1024 mbar
Tested by	Bear Lee		

There is not direct discharge point from the EUT therefore no description of test points of direct application.

Test Results of Indirect Application					
Discharge Level (kV)	Polarity (+/-)	Test Point	Horizontal Coupling Plane	Vertical Coupling Plane	Performance Criteria
2, 4	+/-	Four Side	Note	Note	B

Description of test points of indirect application:

1. Front side
2. Rear side
3. Right side
4. Left side

Note: The EUT is appears "packet loss" message during the test, but it can be self-recoverable after the test.

Mode B

For EN 301 489 -17

Input Power	3.3 Vdc from host	Environmental conditions	22 °C, 45 % RH 1024 mbar
Tested by	Bear Lee		

There is not direct discharge point from the EUT therefore no description of test points of direct application.

Test Results of Indirect Application					
Discharge Level (kV)	Polarity (+/-)	Test Point	Horizontal Coupling Plane	Vertical Coupling Plane	Performance Criteria
2, 4	+/-	Four Side	Note	Note	B

Description of test points of indirect application:

1. Front side

2. Rear side

3. Right side

4. Left side

Note: The EUT is appears "packet loss" message during the test, but it can be self-recoverable after the test.

7.4 Radio Frequency Electromagnetic Field (RS)

Mode A

For EN 301 489 -17

Input Power	3.3 Vdc from host	Environmental conditions	22 °C, 65 % RH
Tested by	Bear Lee		

Frequency (MHz)	Polarity	Azimuth(°)	Applied Field Strength		Observation	Performance Criteria
			(V/m)	Modulation		
80~6000	V&H	0, 90, 180, 270	3	80% AM (1kHz)	Note*	A

Note: The EUT is operated normal during the test.

* : EUT has function lost during 2280 MHz to 2603.5 MHz at "WIFI 2.4G". But this band is exclusion band in EN 301489-17, under this condition (the function lost) that is acceptable.

Mode B

For EN 301 489 -17

Input Power	3.3 Vdc from host	Environmental conditions	22 °C, 65 % RH
Tested by	Bear Lee		

Frequency (MHz)	Polarity	Azimuth(°)	Applied Field Strength		Observation	Performance Criteria
			(V/m)	Modulation		
80~6000	V&H	0, 90, 180, 270	3	80% AM (1kHz)	Note*	A

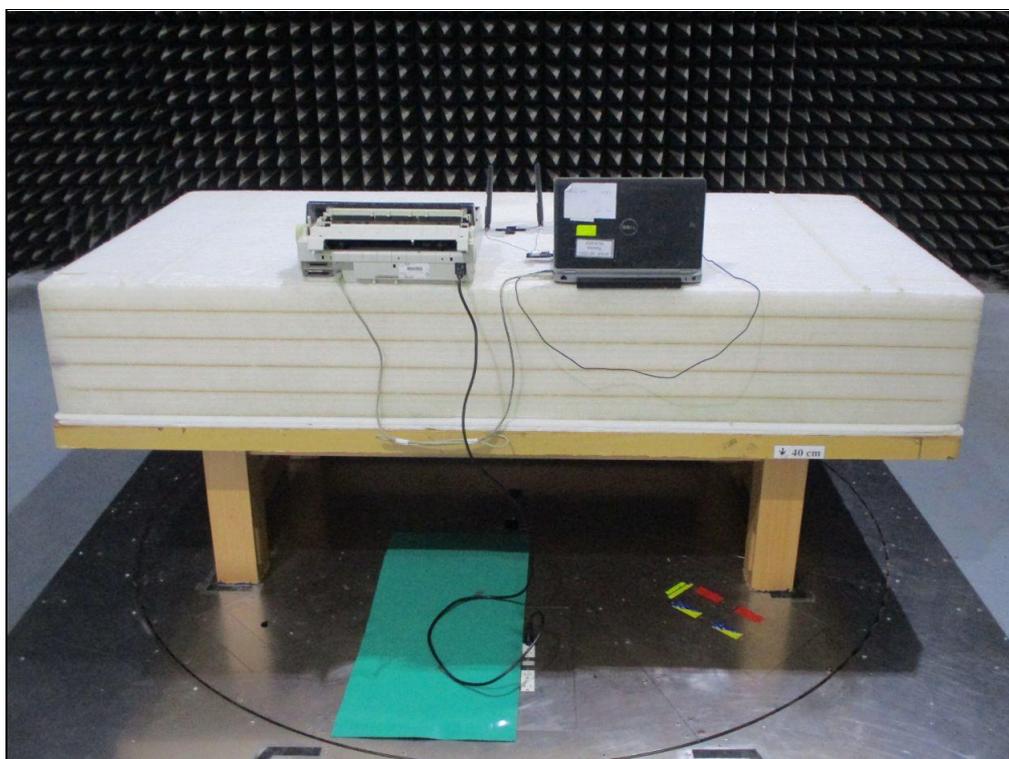
Note: The EUT is operated normal during the test.

* : EUT has function lost during 4880 MHz to 5995 MHz at "WIFI 5G". But this band is exclusion band in EN301489-17, under this condition (the function lost) that is acceptable.

8 Pictures of Test Arrangements

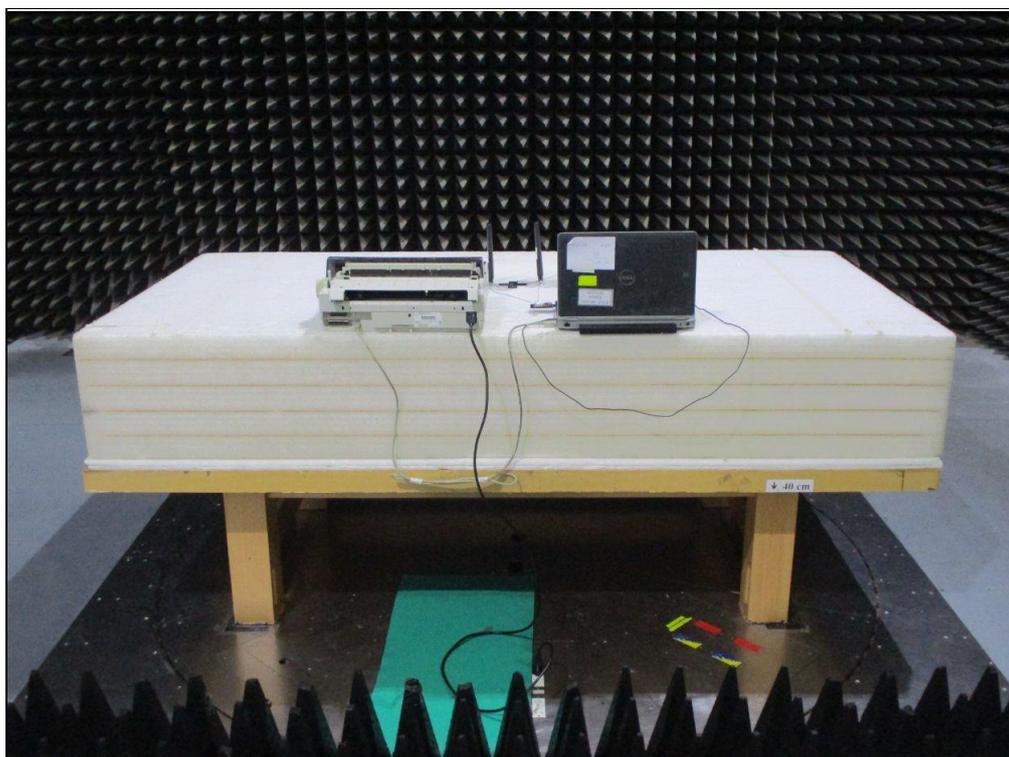
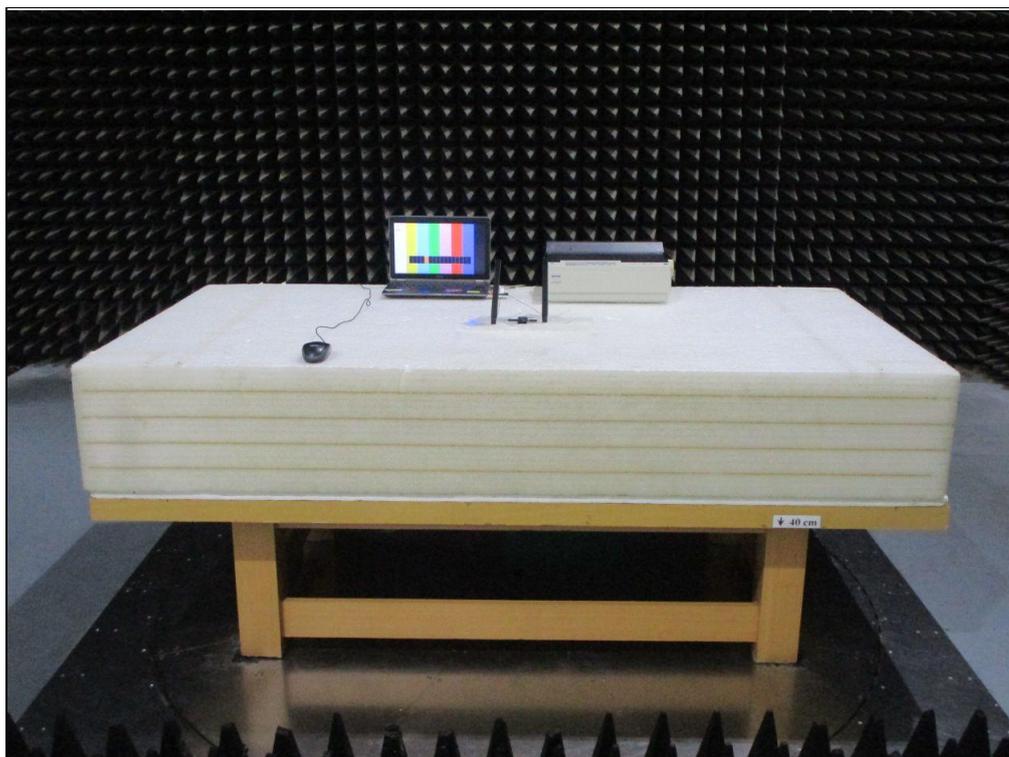
8.1 Radiated Emissions up to 1 GHz

Mode A



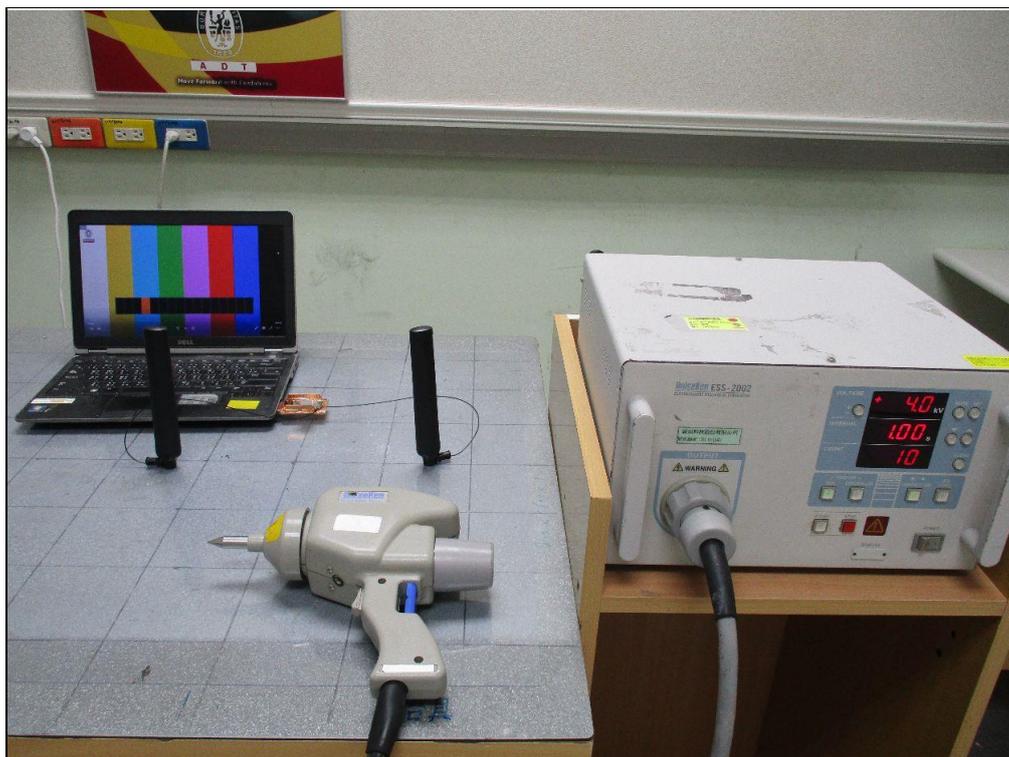
8.2 Radiated Emissions above 1 GHz

Mode A

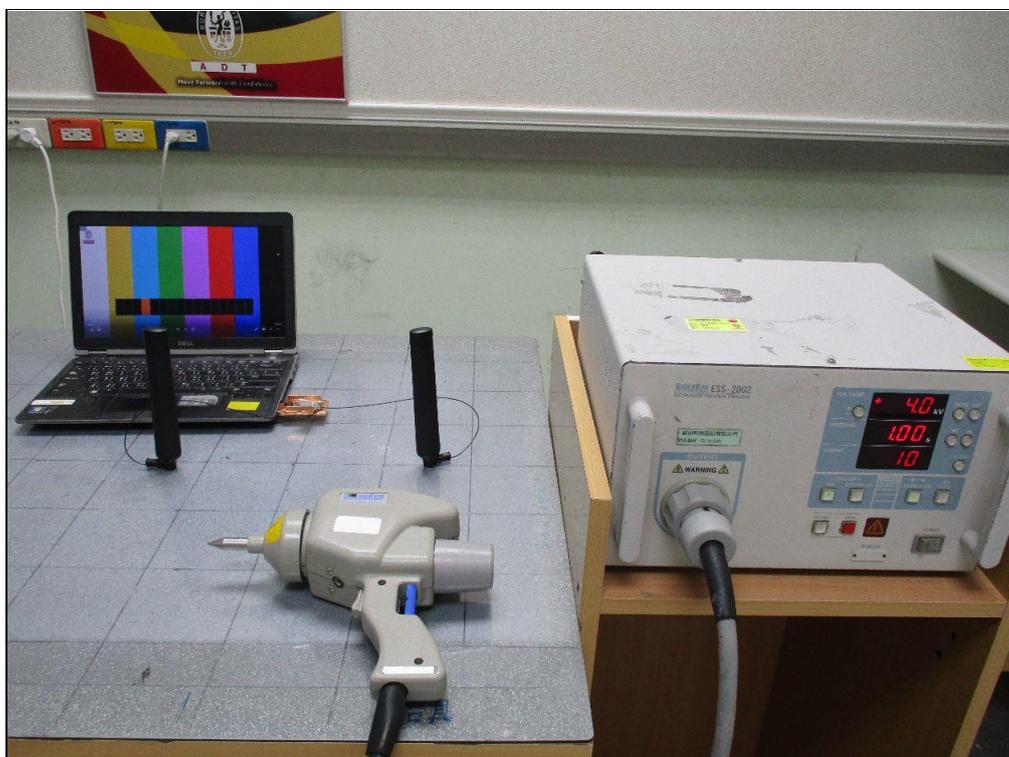


8.3 Electrostatic Discharges (ESD)

Mode A

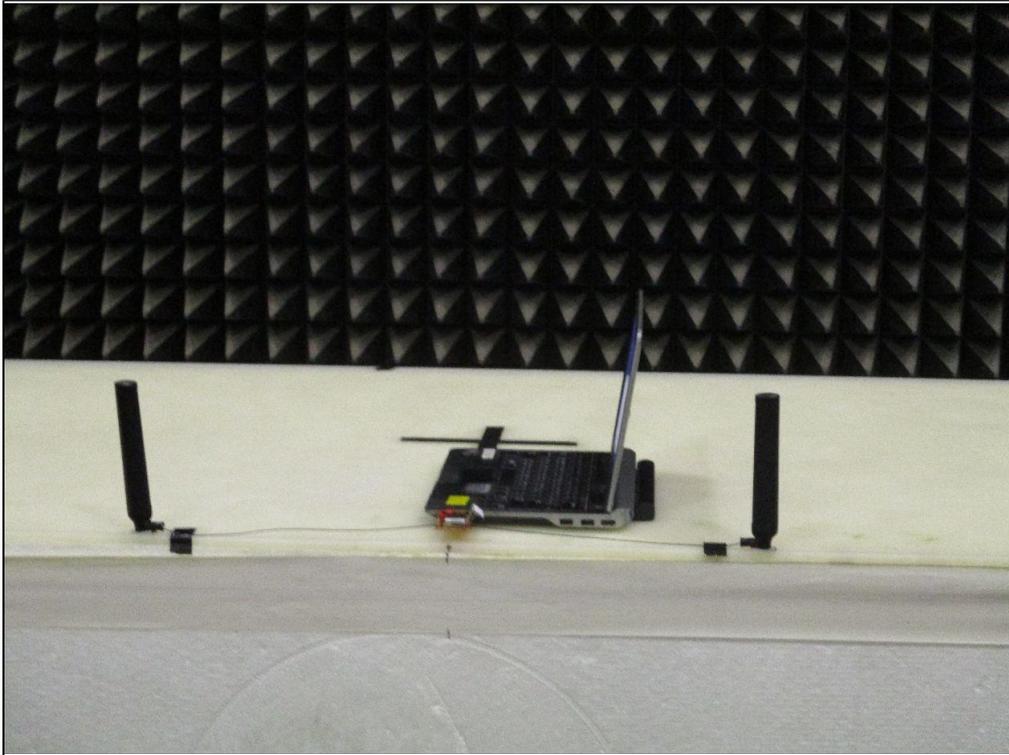


Mode B

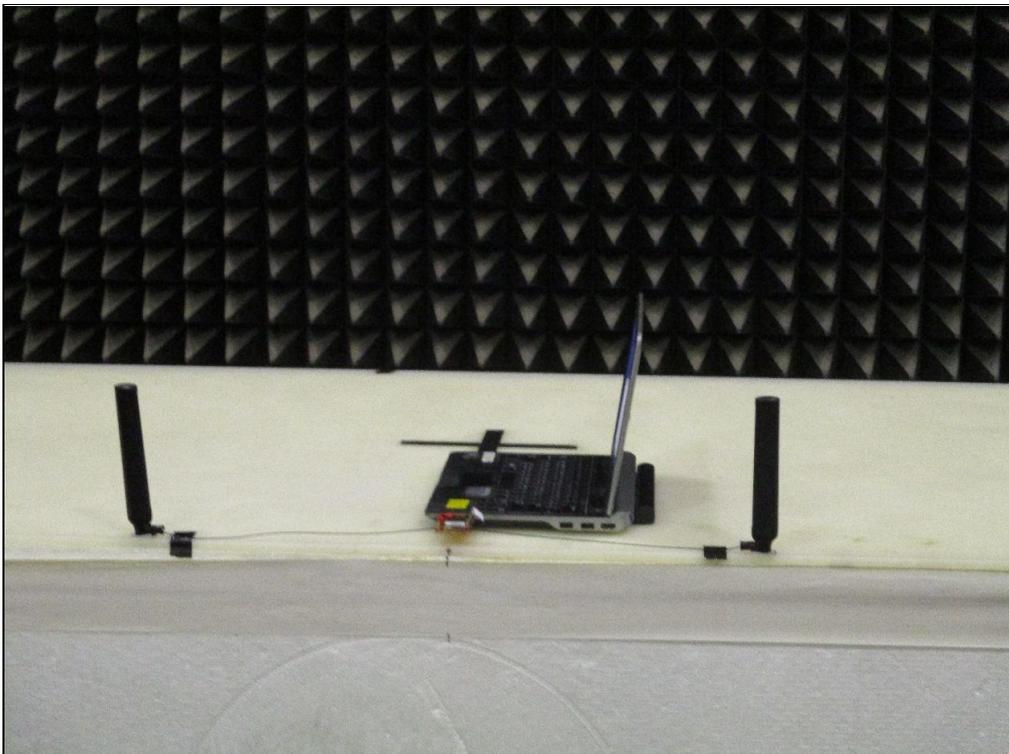


8.4 Radio Frequency Electromagnetic Field (RS)

Mode A



Mode B



9 Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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Fax: 886-2-26051924

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The address and road map of all our labs can be found in our web site also.

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