

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.: RMCDBM-WTW-P22060902

Model No.: MGM240S22A

Series Model: BGM240S22A

Received Date: 2022/7/6

Test Date: 2022/7/16 ~ 2022/7/28

Issued Date: 2022/8/10

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Approved by: _____, **Date:** 2022/8/10
Ace Wu / Project Engineer

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Prepared by : Anna Lee / Specialist

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Release Control Record

Issue No.	Description	Date Issued
RMCDDBM-WTW-P22060902	Original release.	2022/8/10

1 Certificate

Product: Bluetooth Low Energy and 802.15.4 wireless radio module

Brand: SILICON LABS

Test Model: MGM240S22A

Series Model: BGM240S22A (Refer to item 3.1 for more details)

Sample Status: Engineering sample fully representing the production module

Applicant: Silicon Laboratories Finland Oy

Test Date: 2022/7/16 ~ 2022/7/28

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

Measurement procedure: EN 55032:2015 +A1:2020, Class B
EN 61000-3-2:2014 (Not Applicable)
EN IEC 61000-3-2:2019 +A1:2021 (Not Applicable)
EN 61000-3-3:2013 +A2:2021 (Not Applicable)
EN 61000-4-2:2009
EN 61000-4-3:2006 +A1:2008 +A2:2010
EN IEC 61000-4-3:2020
EN 61000-4-4:2012 (Not Applicable)
EN 61000-4-5:2014 +A1:2017 (Not Applicable)
EN 61000-4-6:2014 +AC:2015 (Not Applicable)
EN 61000-4-11:2004 +A1: 2017 (Not Applicable)
EN IEC 61000-4-11:2020 (Not Applicable)

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	Conducted Emissions from Power Ports	Pass	Minimum passing Class B margin is -17.15 dB at 2.67000 MHz
EN 55032	Radiated Emissions up to 1 GHz	Pass	Minimum passing Class B margin is -3.24 dB at 167.99 MHz
EN 55032	Radiated Emissions above 1 GHz	Pass	Minimum passing Class B margin is -14.95 dB at 5975.58 MHz
EN 61000-4-2	Electrostatic Discharges (ESD)	Pass	For EN 301 489 Performance Criteria A
EN 61000-4-3 EN IEC 61000-4-3	Radio Frequency Electromagnetic Field (RS)	Pass	For EN 301 489 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 (±)
Conducted Emissions from Power Ports	9 kHz ~ 30 MHz	2.79 dB	3.4 dB (U_{CISPR})
Radiated Emissions up to 1 GHz	30 MHz ~ 1 GHz	4.14 dB	6.3 dB (U_{CISPR})
Radiated Emissions above 1 GHz	1 GHz ~ 6 GHz	5.04 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	Bluetooth Low Energy and 802.15.4 wireless radio module
Brand	SILICON LABS
Test Model	MGM240S22A
Series Model	BGM240S22A
Model Difference	Refer to note
Sample Status	Engineering sample fully representing the production module
Operating Software	N/A
Power Supply Rating	1.8V to 3.8V, with nominal supply voltage of 3.0V
Accessory Device	N/A
Data Cable Supplied	N/A

Note:

1. The models difference are as below.

1. The models difference are as below.				
Product Spec.	Model			
	Main Model: MGM240S22A		Series Model: BGM240S22A	
	Power rating: Low-Power Wireless protocols: BLE and 802.15.4		Power rating: Low-Power Wireless protocols: BLE	
Test mode	To be tested as DTS for both 802.15.4 and BLE In the case of BLE, two PHYs to test: 2Mbps and 125Kbps		Testing of the Main Model will cover this Series Model / In fact, the hardware and software are exactly the same, except for one single software-related difference: the 802.15.4 protocol is disabled in the factory for marketing differentiation	
RF nominal max TX output power	10dBm			
Antenna type	Integral antenna	RF pin	Integral antenna	RF pin
Hardware	Hardware-wise, the main model and the first series model are identical. Supply voltage range: 1V8 to 3V8 (nominal 3V0) / Fully internally regulated, including the RF PA. Temperature range: -40C to +105C.			
	The BLE wireless protocol is indential in all the models. The 802.15.4 wireless protocol is made available only for the main model.			
	The module's RF OUT pin exposes the 50Ω-matched RF port of the embedded radio chipset. Conducted measurements are taken at the module's RF OUT pin.			
	The RF OUT pin can be further connected either to the adjacent RF ANT IN pin (using a 0Ω resistor), so that the integral antenna can be used, or directly to an external antenna. All radiated tests are taken both with a sample using the integral antenna, and with a sample where the RF signal from the RF OUT pin is routed instead to an external reference dipole antenna.			

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 2.48 GHz, provided by Silicon Laboratories Finland Oy, 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 Silicon Laboratories Finland Oy, 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	Conducted Emissions from Power Ports
1	EUT + BT link + USB link Notebook
2	EUT + 802.15.4 link + USB link Notebook
Notes:	
1. There are both standby mode and normal mode to be pre-tested then normal mode has the highest emission value.	
2. The worst case is that mode 1 is shown in bold.	
Mode	Radiated Emissions up to 1 GHz
1	EUT + BT link + USB link Notebook
2	EUT + 802.15.4 link + USB link Notebook
Notes:	
1. There are both standby mode and normal mode to be pre-tested then normal mode has the highest emission value.	
2. The worst case is that mode 1 is shown in bold.	

Test modes are presented in the report as below.

Test Condition	
Mode	Conducted Emissions from Power Ports
A	EUT + BT link + USB link Notebook
Mode	Radiated Emissions up to 1 GHz
A	EUT + BT link + USB link Notebook
Mode	Radiated Emissions above 1 GHz
A	EUT + BT link + USB link Notebook
Mode	Electrostatic Discharges (ESD)
A	EUT + BT link + USB link Notebook
B	EUT + 802.15.4 link + USB link Notebook
Mode	Radio Frequency Electromagnetic Field (RS)
A	EUT + BT link + USB link Notebook
B	EUT + 802.15.4 link + USB link Notebook

3.5 Test Program Used and Operation Descriptions

For Emission test

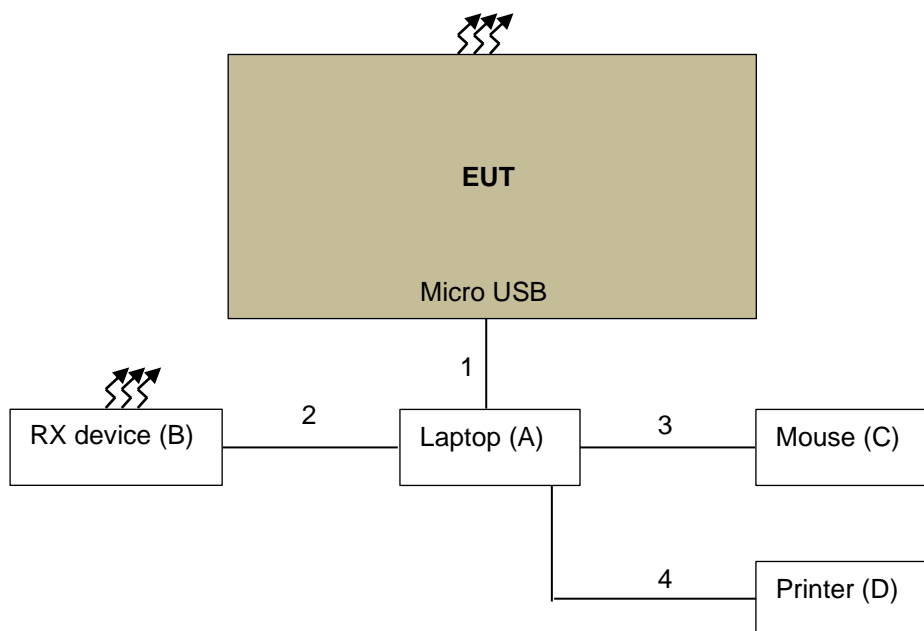
- a. Turned on the power of all equipment.
- b. EUT connects to the laptop via microUSB cable , and laptop runs the test script
- c. EUT connects to RX device via Bluetooth low energy and performs data transmission.

For Immunity test

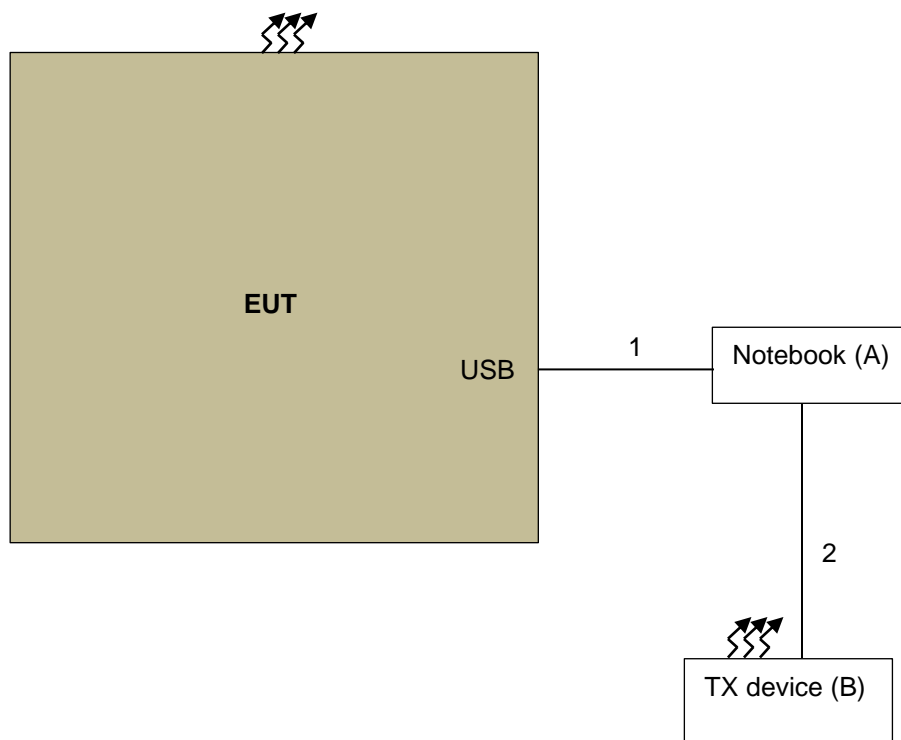
- a. Turned on the power of all equipment.
- b. EUT connects to the laptop via microUSB cable , and laptop runs the test script
- d. The EUT exchange Bluetooth low energy or 802.12.4 data packets with the remote transmission system made of another radio module acting as the wireless communication companion ; PER is monitored at the EUT side for minimum performance level, which is set to have to be below 10 %.

3.6 Connection Diagram of EUT and Peripheral Devices

For Emission test



For Immunity test



3.7 Configuration of Peripheral Devices and Cable Connections

For Emission test

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A	Laptop	Dell	E5420	FHP55S1	N/A	Provided by Lab
B	RX device	Silicon	MGM240S22A	N/A	N/A	Supplied by applicant
C	Mouse	Dell	MOCZUL	CN-049TWY- PRC00-79E-02GB	N/A	Provided by Lab
D	Printer	Epson	T22	MEEZ070220	N/A	Provided by Lab

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1	USB Cable	1	0.9	Yes	0	Supplied by applicant
2	USB Cable	1	0.9	Yes	0	Supplied by applicant
3	USB Cable	1	1.8	Yes	0	Provided by Lab
4	USB Cable	1	1.8	Yes	0	Provided by Lab

For Immunity test

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A	Notebook	Dell	E5420	FHP55S1	N/A	Provided by Lab
B	RX device	Silicon	MGM240S22A	N/A	N/A	Supplied by applicant

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1	USB Cable	1	0.9	Yes	0	Supplied by applicant
2	USB Cable	1	0.9	Yes	0	Supplied by applicant

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 Conducted Emissions from Power Ports

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
DC LISN R&S	ESH3-Z6	100219	2021/7/25	2022/7/24
		844950/018	2021/7/25	2022/7/24
DC-LISN SCHWARZBECK MESS- ELETRONIK	NNBM 8126G	8126G-069	2021/11/10	2022/11/9
LISN R&S	ESH2-Z5	100100	2022/2/17	2023/2/16
	ESH3-Z5	100312	2021/9/17	2022/9/16
RF Coaxial Cable WORKEN	5D-FB	Cable-cond2-01	2021/9/4	2022/9/3
Software BVADT	BVADT_Conf_ V7.3.7.4	N/A	N/A	N/A
Test Receiver R&S	ESR3	102783	2021/12/20	2022/12/19
V-LISN Schwarzbeck	NNBL 8226-2	8226-142	2021/8/20	2022/8/19

Notes:

1. The test was performed in HY - Conduction 2.
2. Tested Date: 2022/7/18

4.2 Radiated Emissions up to 1 GHz

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Antenna Tower (H)	MFA-440	970705	N/A	N/A
Antenna Tower (V)	MFA-440	9707	N/A	N/A
Bi_Log Antenna Schwarzbeck	VULB9168	9168-148	2021/10/19	2022/10/18
		9168-156	2021/10/19	2022/10/18
Controller (H)	MF7802	08093	N/A	N/A
Controller (V)	MF7802	074	N/A	N/A
Pre_Amplifier Sonoma	310N	352924	2022/5/14	2023/5/13
		352923	2022/5/14	2023/5/13
RF Coaxial Cable TIMES	LMR-600(18M)+LMR-400 (7M)	CABLE-CH1(VER)-01	2021/9/4	2022/9/3
	LMR-600(11.8M)+LMR-400 (7M)	CABLE-CH1(HOR)-01	2021/9/4	2022/9/3
Software	ADT_Radiated_V8.7.08	N/A	N/A	N/A
Test Receiver ESR7 R&S	ESR	101240	2021/11/3	2022/11/2
		101264	2022/4/11	2023/4/10
Turn Table	DS430	50303	N/A	N/A

Notes:

1. The test was performed in HY - 10M Chamber. The test site validated date: 2021/8/07 (NSA)
2. Tested Date: 2022/7/21

4.3 Radiated Emissions above 1 GHz

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Antenna Tower BVADT	AT100	AT93021702	N/A	N/A
BandPass Filter MICRO-TRONICS	BRM17690-01	003	2021/9/4	2022/9/3
	BRM50716-01	G011	2021/9/4	2022/9/3
Controller BVADT	SC100	SC93021702	N/A	N/A
Fix tool for Boresight antenna tower BV	BAF-01	2	N/A	N/A
Horn Antenna Schwarzbeck	BBHA 9120D	9120D-405	2021/11/14	2022/11/13
Pre-Amplifier Agilent	8449B	3008A01961	2021/9/4	2022/9/3
RF Coaxial Cable EMCI	EMC102-KM-KM-1000	170820	2022/1/15	2023/1/14
RF Coaxial Cable Rosnol	K1K50-UP0279-K1K50-3000	181129-2	2022/1/15	2023/1/14
RF Coaxial Cable ATK+EMC	EM104-SMSM-600&EM104-SMSM-500	Cable-CH2-02	2022/1/15	2023/1/14
Software BVADT	ADT_Radiated_V8.7.08	N/A	N/A	N/A
Spectrum Analyzer Agilent	E4446A	MY51100039	2021/12/7	2022/12/6
Turn Table BVADT	TT100	TT93021702	N/A	N/A

Notes:

1. The test was performed in HY - 966 chamber 1. The test site validated date: 2022/1/8 (VSWR)
2. Tested Date: 2022/7/16

4.4 Electrostatic Discharges (ESD)

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Electrostatic Analog Tester NoiseKen	ESS-B3011	ESS12Z5082	2021/11/18	2022/11/17
Electrostatic Analog Tester SCHAFFNER	NSG-438	1326	2022/7/8	2023/7/7
Electrostatic Analog Tester TESEQ	NSG 438	1614	2021/8/10	2022/8/9
ESD Generator EM Test	Dito	V0701102114	2021/11/18	2022/11/17
ESD Simulator Noiseken	ESS-B3011A	ESS1694113	2021/8/21	2022/8/20
Radio Communication Analyzer Anritsu	MT8820C	6201010285	2021/8/18	2022/8/17

Notes:

1. The test was performed in HY - ESD 3.
2. Tested Date: 2022/7/27

4.5 Radio Frequency Electromagnetic Field (RS)

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Audio analyzer R&S	UPV	101009	2021/12/23	2022/12/22
Conditioning Amplifier B&K	2690	2790522	2021/10/28	2022/10/27
	Type 2690--0S2	2482371	2022/6/27	2023/6/26
Electric Field Probe ETS-Lindgren	HI-6105	00212757	2021/12/21	2022/12/20
Log.-Per. Antenna Schwarzbeck	STLP 9149	9149-141	N/A	N/A
Log.-Per. Antenna ROHDE&SCHWARZ	HL046E	100114	N/A	N/A
Mouth Simulator B&K	4227	2411656	N/A	N/A
power amplifier BONN Elektronik	BLMA 1060-100/50D	118694	N/A	N/A
power amplifier R&S	BBA100	101011	N/A	N/A
POWER SENSOR R&S	NRP-Z91	101573	2022/5/13	2023/5/12
		101572	2022/5/13	2023/5/12
POWER SENSOR BOONTON	51011-EMC	33107	2022/7/12	2023/7/11
		33105	2022/7/12	2023/7/11
Pressure-field Microphone B&K	4192-L-001	2764583	2021/9/30	2022/9/29
Pressure-field Microphone Brüel&Kjaer	4192	2854670	2022/3/4	2023/3/3
SIGNAL GENERATOR R&S	SMB100A	105801	2021/12/6	2022/12/5
Software R&S	EMC32 Version 8.52.0	N/A	N/A	N/A

Notes:

1. The test was performed in HY - RS Chamber 2.
2. Tested Date: 2022/7/28

5 Limits of Test Items

5.1 Conducted Emissions from Power Ports

For AC mains power input/output Port

Frequency (MHz)	Class A (dB μ V)		Class B (dB μ V)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 - 0.5	79	66	66 - 56	56 - 46
0.50 - 5.0	73	60	56	46
5.0 - 30.0	73	60	60	50

Notes: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases linearly with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.

For DC power input/output ports

Frequency (MHz)	(dB μ V)	
	Quasi-peak	Average
0.15 - 0.5	79	66
0.5 - 30	73	60

Note: The lower limit shall apply at the transition frequencies.

5.2 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.

5.3 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.

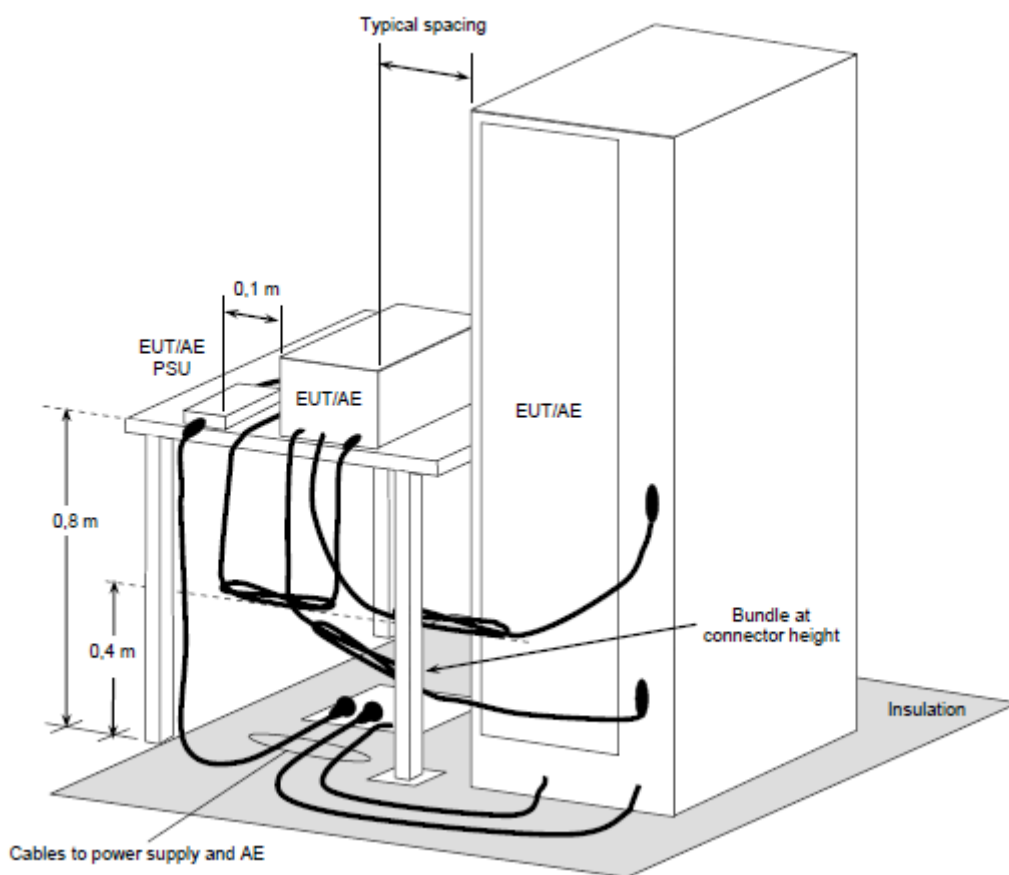
5.4 General immunity requirements

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 location: 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 50Hz) 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, 1.2/50µs line to earth, or shield to ground: ±1 kV, 1.2/50µs 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)

6.2 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 10 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.

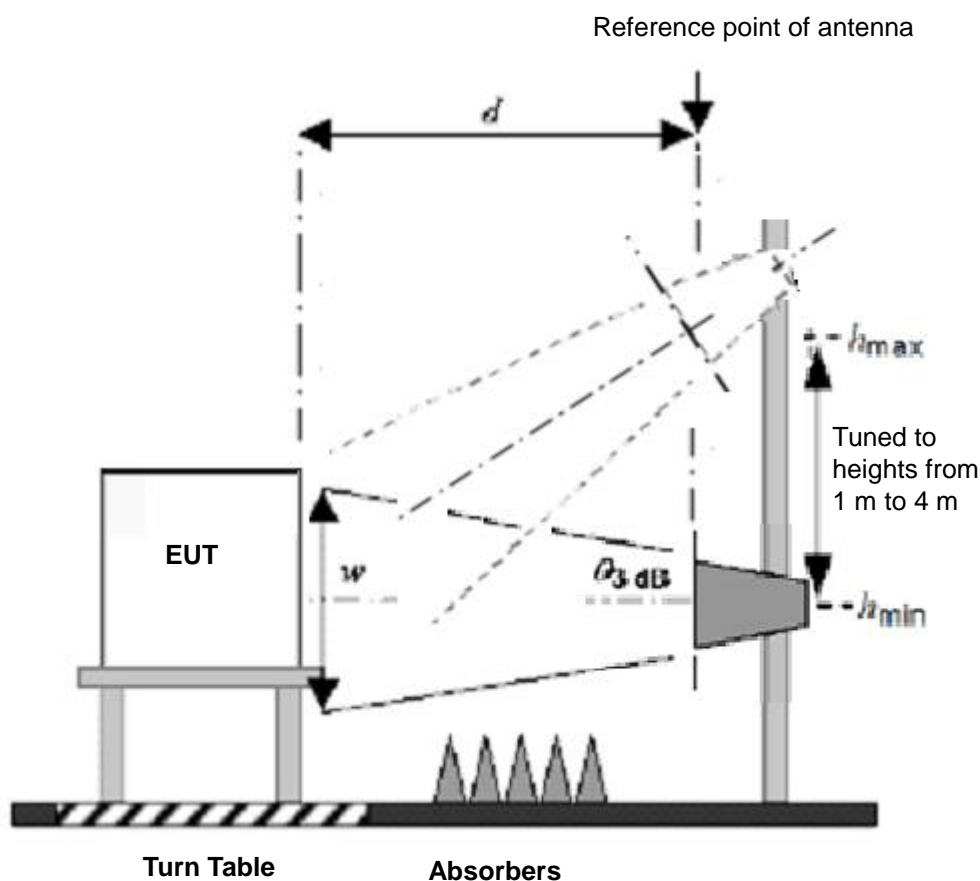


For the actual test configuration, please refer to the related Item – Photographs of the Test Configuration.

6.3 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 12 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.



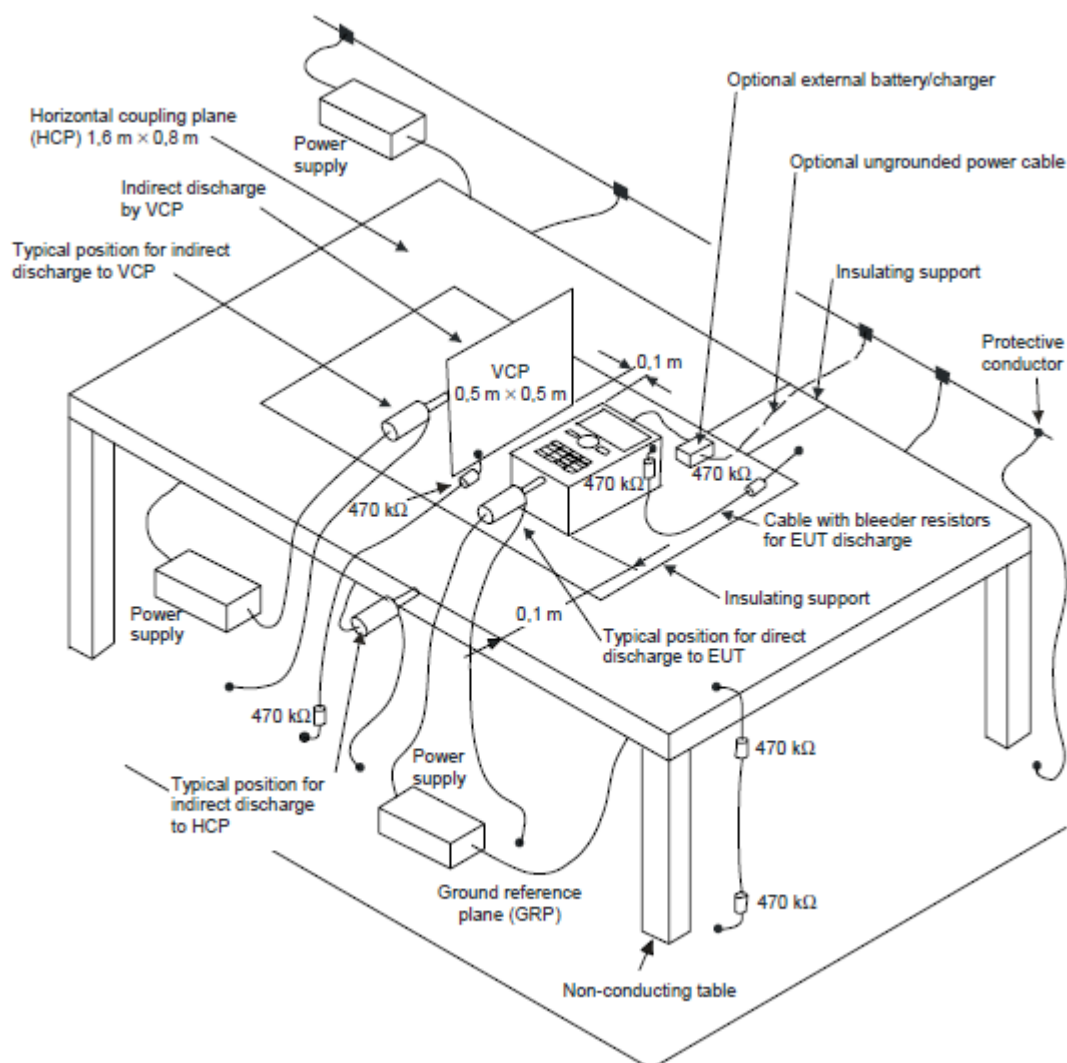
For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

6.4 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:

- Electrostatic discharges were applied only to those points and surfaces of the EUT that are accessible to users during normal operation.
- The test was performed with at least ten single discharges on the pre-selected points in the most sensitive polarity.
- The time interval between two successive single discharges was at least 1 second.
- 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.
- Contact discharges were applied to the non-insulating coating, with the pointed tip of the generator penetrating the coating and contacting the conducting substrate.
- 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.
- 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**.
- 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

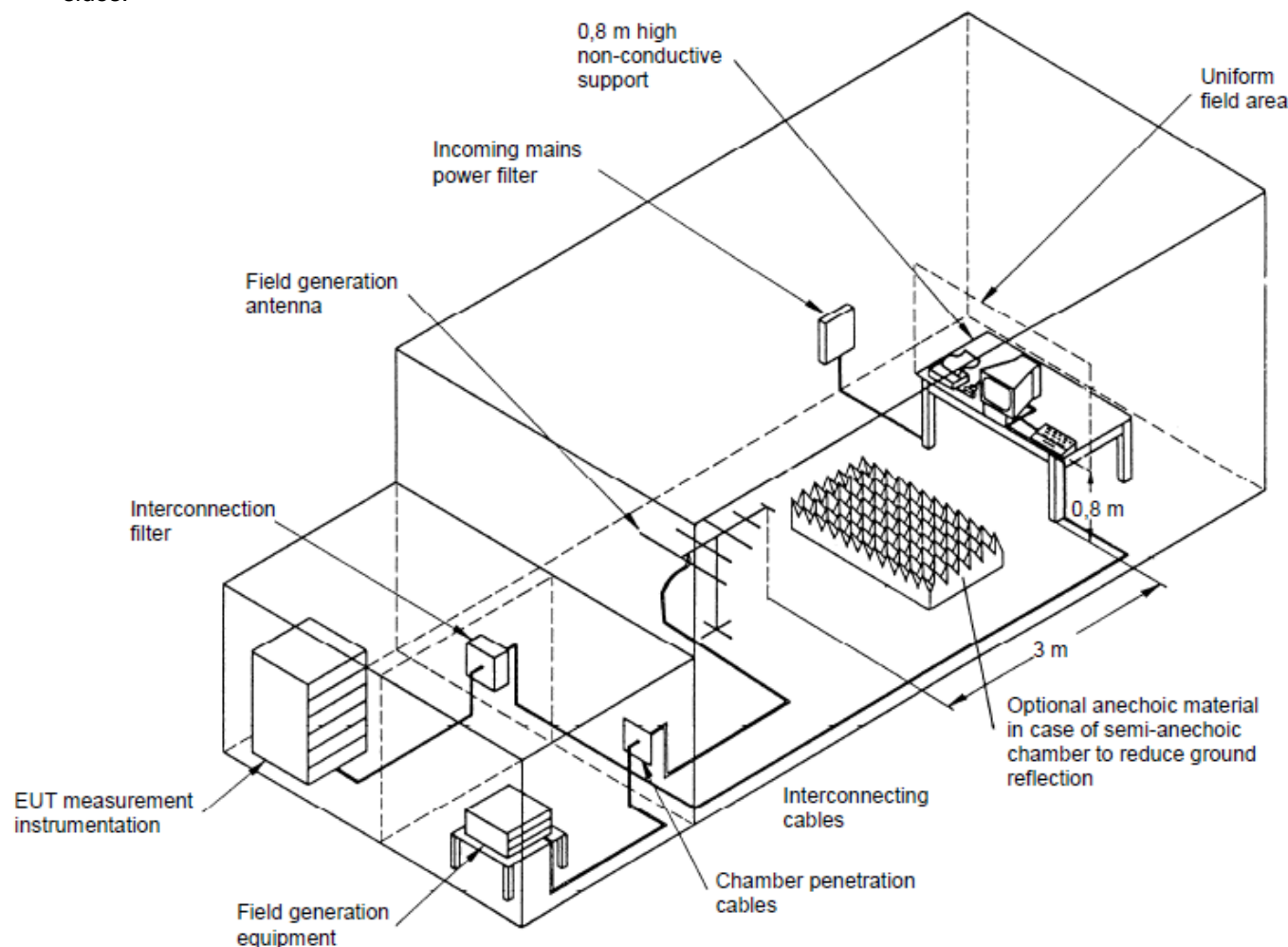
The equipment under test was installed in a representative system as described in section 7 of IEC 61000-4-2, and its cables were isolated from the Ground Reference Plane by an insulating support of 0.1-meter thickness. The GRP consisted of a sheet of aluminum that is at least 0.25mm thick, and 2.5 meters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

6.5 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 Conducted Emissions from Power Ports

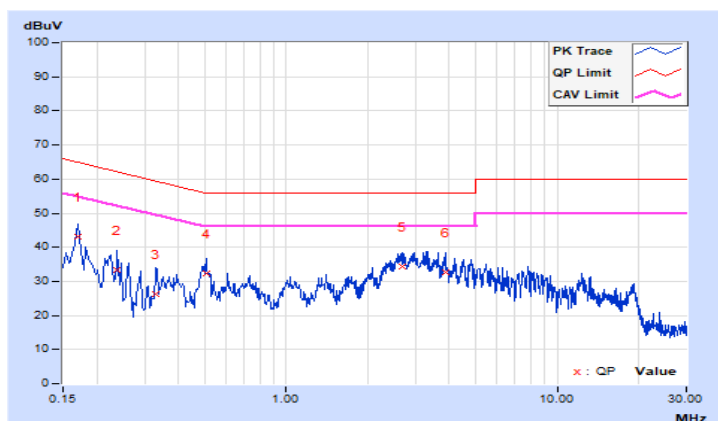
Mode A

Frequency Range	150 kHz ~ 30 MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	230 Vac, 50 Hz	Environmental Conditions	26°C, 71% RH
Tested by	Daniel Lin		

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.17000	10.13	32.96	21.57	43.09	31.70	64.96	54.96	-21.87	-23.26
2	0.23800	10.14	23.11	11.52	33.25	21.66	62.17	52.17	-28.92	-30.51
3	0.33000	10.15	16.28	7.35	26.43	17.50	59.45	49.45	-33.02	-31.95
4	0.50600	10.17	22.14	15.72	32.31	25.89	56.00	46.00	-23.69	-20.11
5	2.67000	10.23	24.24	18.62	34.47	28.85	56.00	46.00	-21.53	-17.15
6	3.86600	10.25	22.48	15.83	32.73	26.08	56.00	46.00	-23.27	-19.92

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

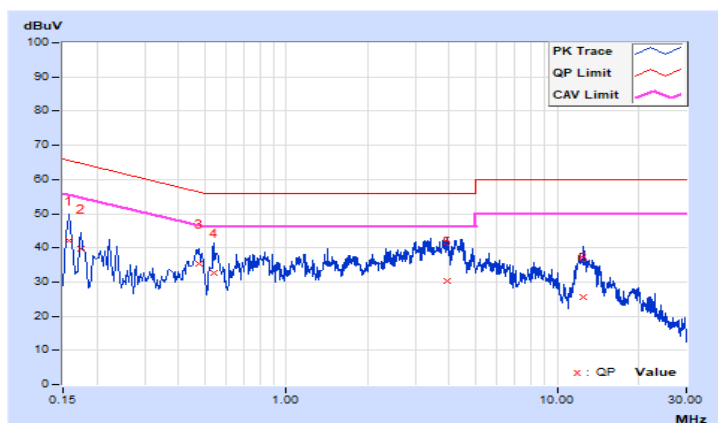


Frequency Range	150 kHz ~ 30 MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	230 Vac, 50 Hz	Environmental Conditions	26°C, 71% RH
Tested by	Daniel Lin		

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15800	10.14	31.82	19.29	41.96	29.43	65.57	55.57	-23.61	-26.14
2	0.17400	10.14	29.70	17.78	39.84	27.92	64.77	54.77	-24.93	-26.85
3	0.47434	10.17	25.18	17.99	35.35	28.16	56.44	46.44	-21.09	-18.28
4	0.53800	10.18	22.63	15.81	32.81	25.99	56.00	46.00	-23.19	-20.01
5	3.92200	10.27	20.15	14.02	30.42	24.29	56.00	46.00	-25.58	-21.71
6	12.55000	10.39	15.17	7.81	25.56	18.20	60.00	50.00	-34.44	-31.80

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value



7.2 Radiated Emissions up to 1 GHz

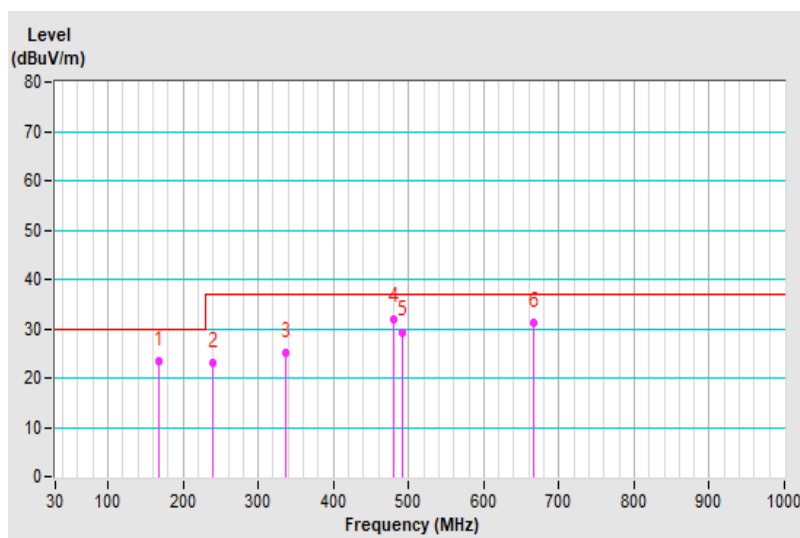
Mode A

Frequency Range	30 MHz ~ 1 GHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP), 120 kHz
Input Power	230 Vac, 50 Hz	Environmental Conditions	24°C, 67% RH
Tested By	Mick Chou		

Antenna Polarity & Test Distance : Horizontal at 10 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	167.99	23.26 QP	30.00	-6.74	4.00 H	220	36.94	-13.68
2	239.97	22.93 QP	37.00	-14.07	3.00 H	126	37.50	-14.57
3	336.00	24.95 QP	37.00	-12.05	3.50 H	18	36.30	-11.35
4	480.01	31.93 QP	37.00	-5.07	2.50 H	110	39.88	-7.95
5	491.99	29.28 QP	37.00	-7.72	2.50 H	110	36.95	-7.67
6	666.45	31.04 QP	37.00	-5.96	1.50 H	84	35.38	-4.34

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

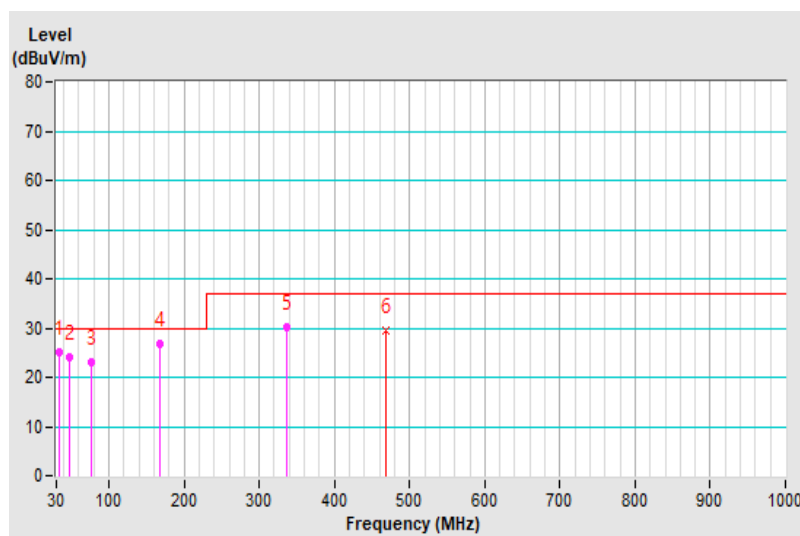


Frequency Range	30 MHz ~ 1 GHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP), 120 kHz
Input Power	230 Vac, 50 Hz	Environmental Conditions	24°C, 67% RH
Tested By	Mick Chou		

Antenna Polarity & Test Distance : Vertical at 10 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	33.30	25.06 QP	30.00	-4.94	1.50 V	202	40.22	-15.16
2	47.99	24.21 QP	30.00	-5.79	1.00 V	355	37.43	-13.22
3	76.08	23.06 QP	30.00	-6.94	2.50 V	251	40.07	-17.01
4	167.99	26.76 QP	30.00	-3.24	1.00 V	157	40.35	-13.59
5	336.00	30.29 QP	37.00	-6.71	1.00 V	336	41.22	-10.93
6	467.98	29.44 QP	37.00	-7.56	1.00 V	127	37.03	-7.59

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 Radiated Emissions above 1 GHz

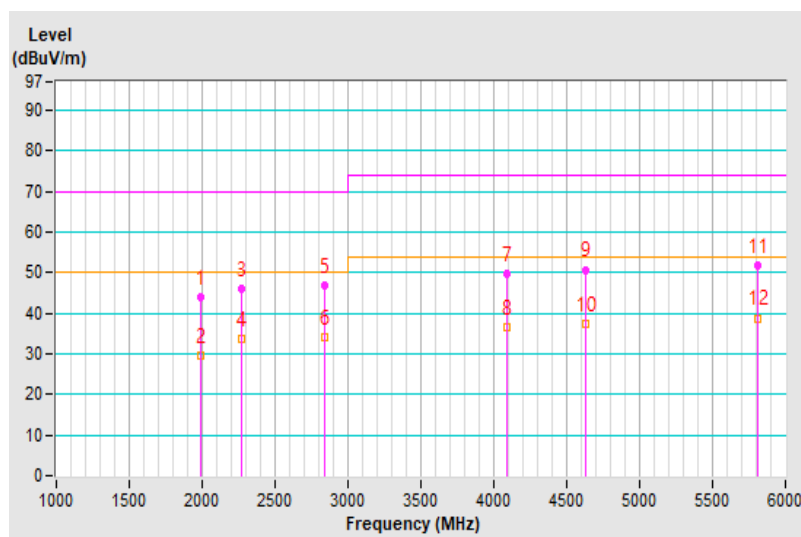
Mode A

Frequency Range	1GHz ~ 6GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Input Power	230 Vac, 50 Hz	Environmental Conditions	25°C, 74% RH
Tested By	Slash Huang		

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	1994.38	43.92 PK	70.00	-26.08	1.75 H	360	42.98	0.94
2	1994.38	29.58 AV	50.00	-20.42	1.75 H	360	28.64	0.94
3	2266.02	46.03 PK	70.00	-23.97	1.00 H	269	42.75	3.28
4	2266.02	33.54 AV	50.00	-16.46	1.00 H	269	30.26	3.28
5	2840.43	46.81 PK	70.00	-23.19	1.00 H	346	42.19	4.62
6	2840.43	33.91 AV	50.00	-16.09	1.00 H	346	29.29	4.62
7	4088.15	49.59 PK	74.00	-24.41	1.75 H	360	41.70	7.89
8	4088.15	36.40 AV	54.00	-17.60	1.75 H	360	28.51	7.89
9	4632.65	50.71 PK	74.00	-23.29	2.00 H	1	41.21	9.50
10	4632.65	37.50 AV	54.00	-16.50	2.00 H	1	28.00	9.50
11	5806.49	51.64 PK	74.00	-22.36	1.75 H	360	39.09	12.55
12	5806.49	38.78 AV	54.00	-15.22	1.75 H	360	26.23	12.55

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

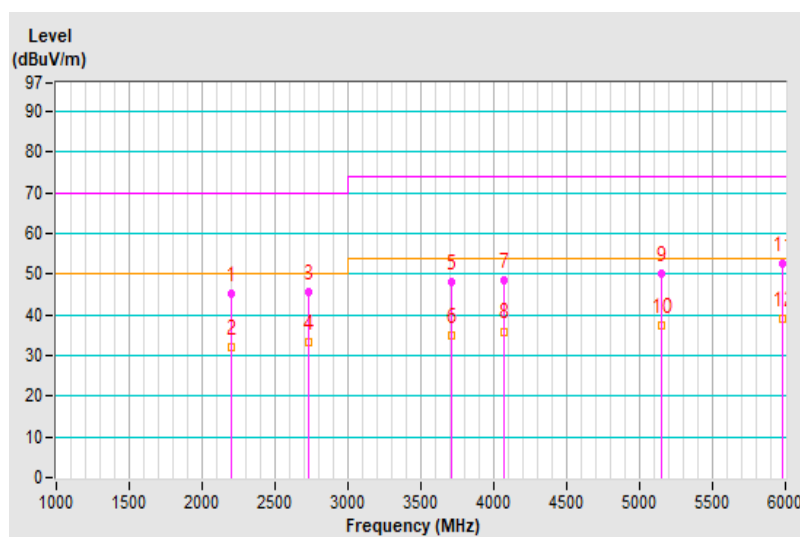


Frequency Range	1GHz ~ 6GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Input Power	230 Vac, 50 Hz	Environmental Conditions	25°C, 74% RH
Tested By	Slash Huang		

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	2197.66	45.33 PK	70.00	-24.67	1.25 V	9	41.13	4.20
2	2197.66	31.96 AV	50.00	-18.04	1.25 V	9	27.76	4.20
3	2734.22	45.76 PK	70.00	-24.24	1.75 V	80	42.32	3.44
4	2734.22	33.42 AV	50.00	-16.58	1.75 V	80	29.98	3.44
5	3711.51	48.05 PK	74.00	-25.95	1.50 V	167	41.32	6.73
6	3711.51	35.02 AV	54.00	-18.98	1.50 V	167	28.29	6.73
7	4073.50	48.63 PK	74.00	-25.37	1.00 V	340	40.80	7.83
8	4073.50	35.92 AV	54.00	-18.08	1.00 V	340	28.09	7.83
9	5146.01	50.13 PK	74.00	-23.87	1.75 V	137	38.85	11.28
10	5146.01	37.37 AV	54.00	-16.63	1.75 V	137	26.09	11.28
11	5975.58	52.45 PK	74.00	-21.55	1.75 V	43	39.28	13.17
12	5975.58	39.05 AV	54.00	-14.95	1.75 V	43	25.88	13.17

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



7.4 Electrostatic Discharges (ESD)

Mode A

For EN 301 489

Input Power	DC 5V	Environmental conditions	23 °C, 42 % RH 999 mbar
Tested by	Water Su		

Note: No conductive surfaces, therefore no contact discharge was executed.

Description of test points of direct application: Please refer to following page for representative mark only.

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

Description of test points of indirect application:

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

Note: The EUT is operated normal during the test.

Mode B

For EN 301 489

Input Power	DC 5V	Environmental conditions	23 °C, 42 % RH 999 mbar
Tested by	Water Su		

Note: No conductive surfaces, therefore no contact discharge was executed.

Description of test points of direct application: Please refer to following page for representative mark only.

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

Description of test points of indirect application:

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

Note: The EUT is operated normal during the test.

7.5 Radio Frequency Electromagnetic Field (RS)

Mode A

For EN 301 489

Input Power	DC 5V	Environmental conditions	24 °C, 55 % RH 982 mbar
Tested by	Koei Chang		

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.

* The exclusion band for the transmitter and / or receiver part of the BT function under test shall extend from 2280MHz to 2603.5MHz.

*Establish the required communication link between EUT and remote device, reduce remote device power to point of link failure then increase by 30 dB.

Mode B

For EN 301 489

Input Power	DC 5V	Environmental conditions	24 °C, 55 % RH 982 mbar
Tested by	Andy Chang		

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.

* The exclusion band for the transmitter and / or receiver part of the ZigBee function under test shall extend from 2280MHz to 2520MHz.

8 Pictures of Test Arrangements

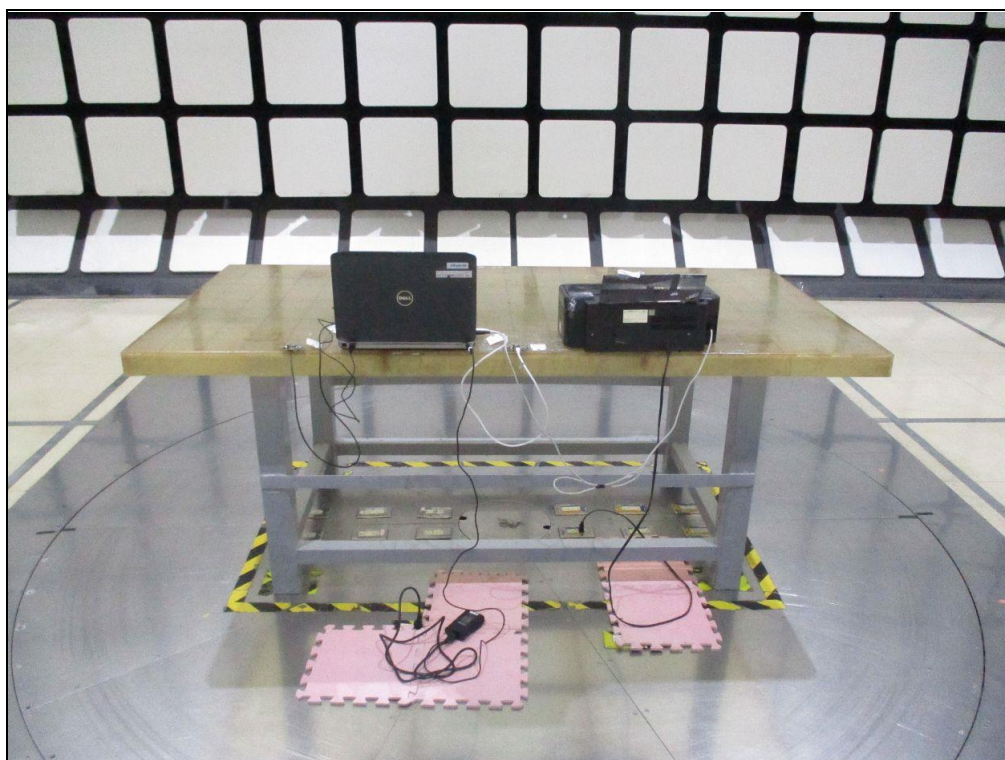
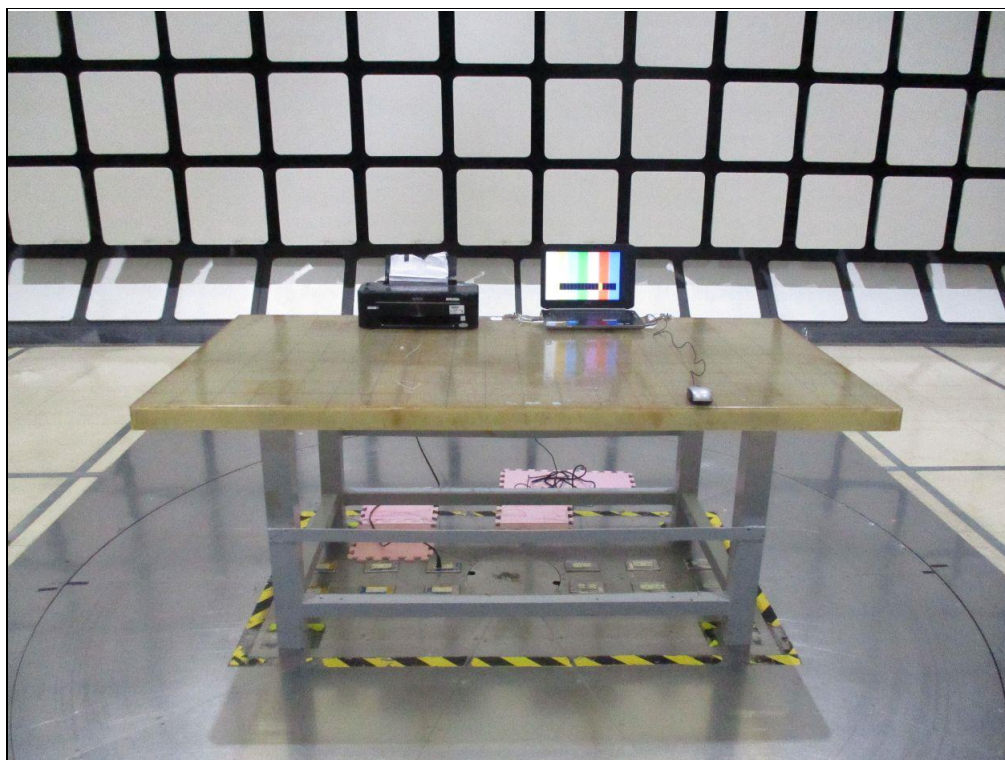
8.1 Conducted Emissions from Power Ports

Mode A



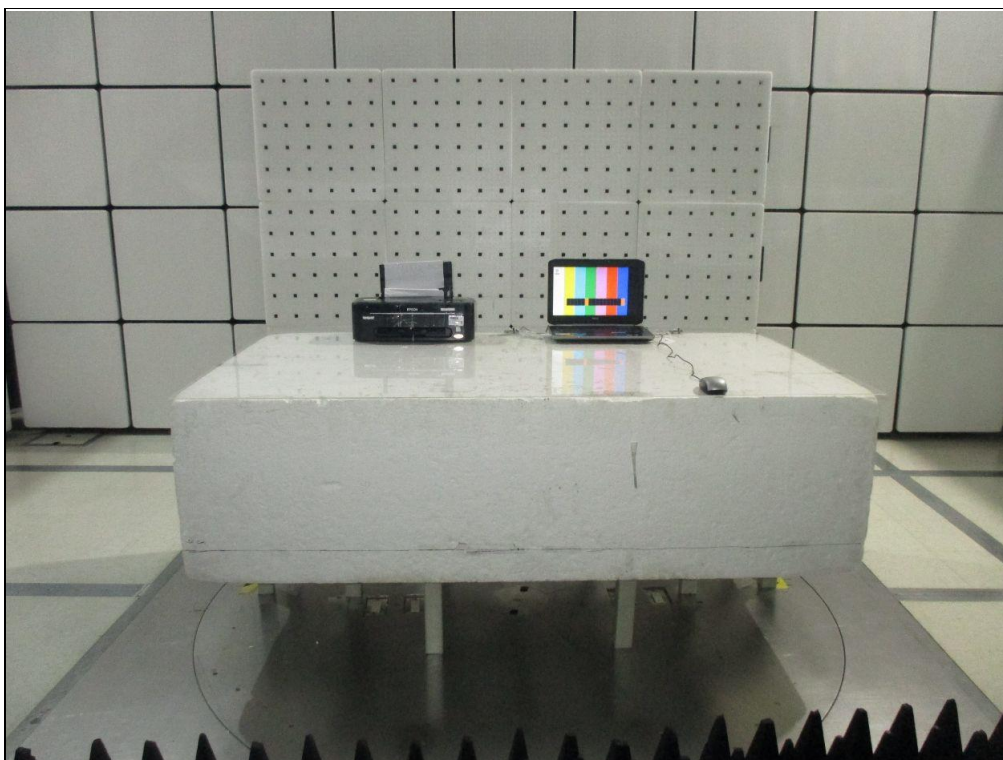
8.2 Radiated Emissions up to 1 GHz

Mode A



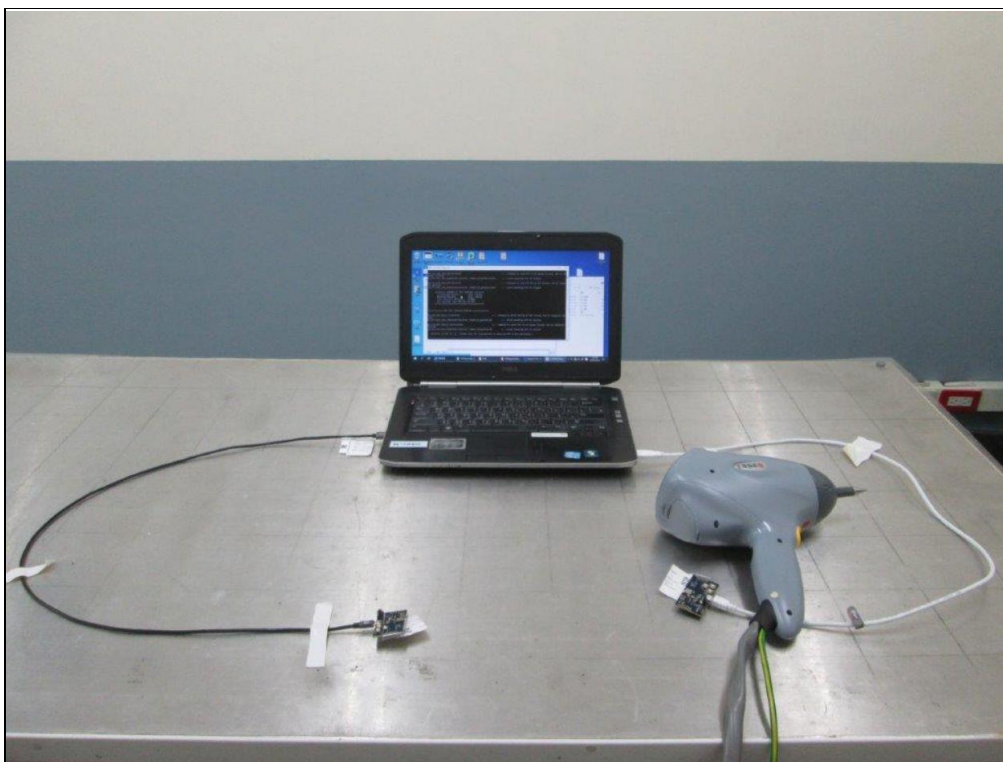
8.3 Radiated Emissions above 1 GHz

Mode A

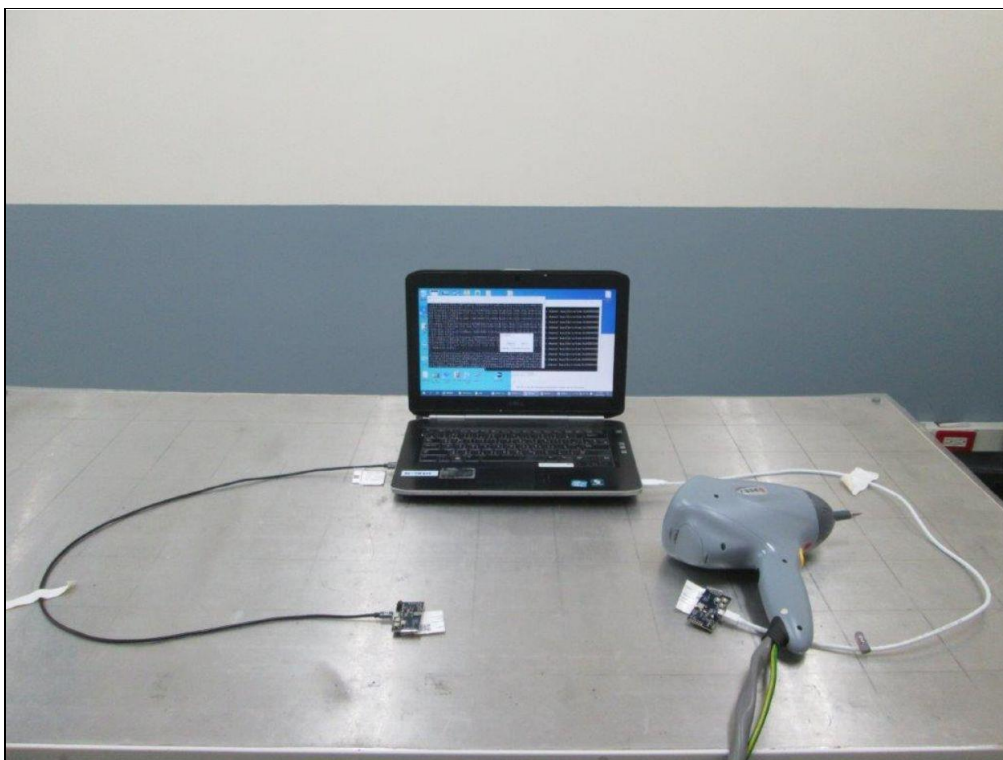


8.4 Electrostatic Discharges (ESD)

Mode A

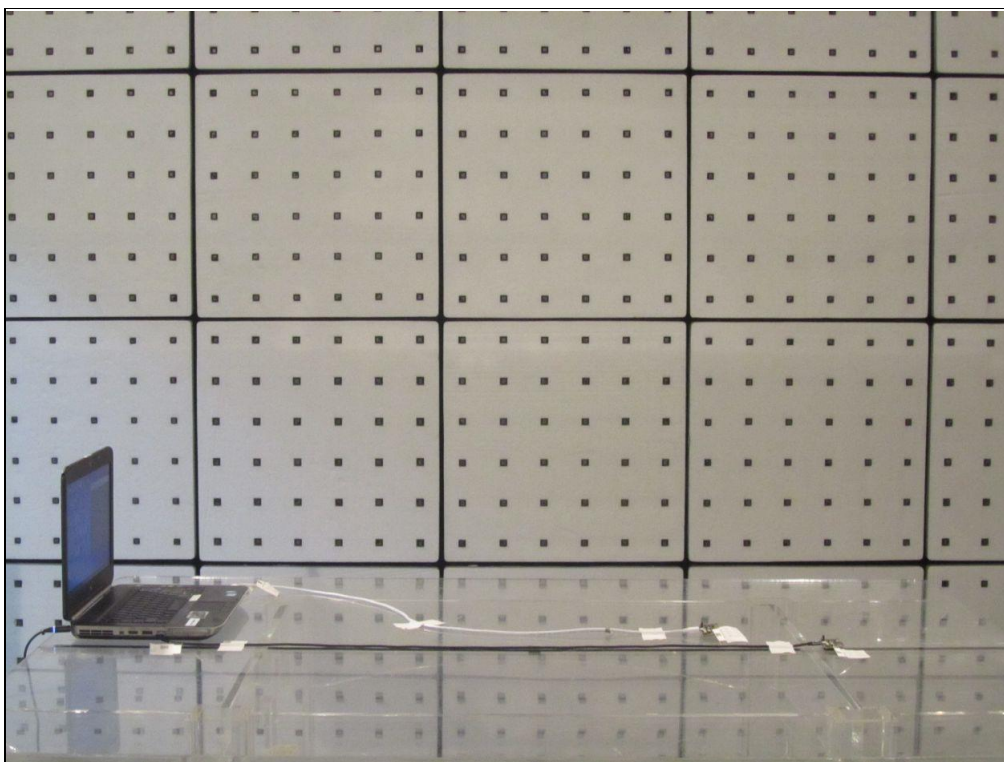


Mode B

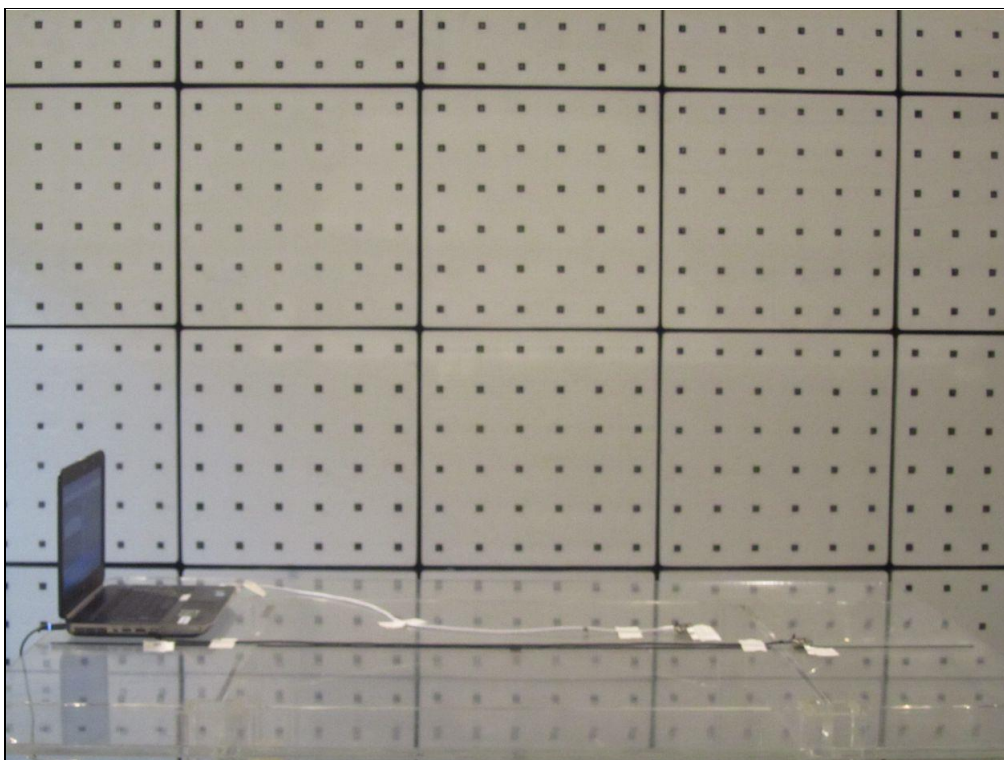


8.5 Radio Frequency Electromagnetic Field (RS)

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

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